

Åã ÷ åéñßäéï ôïõ FreeBSD

ÏÜää Ôâêìçñßùóçò ôïõ FreeBSD

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Δημιουργία

Οα Διεϊοò Αδσòεγίαòάε Αòòυ οϊ Αέάεβι

Οι δηρòι οϊπία ασòιγ οϊò αέάεβιò, ταçããβ οϊι γΎι ÷ ñΠòòç òòç αέάαέεάòáãã äãéáòÛòòáòçð òιò FreeBSD éáé οϊι áέòÛããé ñãÛ òòç òéεϊòιòòá éáé οϊι ó÷ããéáòιι òιò UNIX®. Αòòυ οϊ òιπία äãι γ÷áé éáéáòãããò äðáέòΠòáέò. Αñéãβ ιιιí ç äéÛéáòç áéá äìãããγίçòç áñιò γΎιò òòòòπιáòιò éáé ç äòιáòυòòçðá äòñιβυòçð òιι áñòáιι áéá οϊ FreeBSD éáεòð áòòÛ ðéòÛãñòáé òóááéáéÛ.

Αοιγ áéááÛòáòá οϊ δηρòι οϊπία, οϊ äãγòããι, éáòÛ ðìεγ ιããáéγóããι οϊπία, ðãñééãìáÛíãé ιéá äéòãìΠ áιáòιñÛ òá äéÛòιñá èγιáòá ðιò äíãéáòÛñιòι òιòð áéá÷ãéñéòòÛ òòòòçìÛòιι FreeBSD. ÌãñééÛ áðυ áòòÛ òá éáòÛéáéá äβιáé äòéγéυòããι íá òá éáòãñιòáòá áι γ÷ãðá Πãç ìãéãòΠòáé òóãéãéñéι γΎι òιπιáòá οϊò áéáéβιò. ¼ðιò ÷ ñãéÛéãáòáé èÛòé òγòιéι, éá áιáòÛñãáé òòç òγñιòç οϊò éãòáéáβιò ðιò ìυééò ìãéιΠòáòá íá áéááÛéãáòá.

Áéá ðãñéòòυòãããò ðçãÛ ðéçñιòιñéπι, äãβòá οϊ ΔãñÛñòçìá B.

ΑέéããÛò áðυ òçì Òñβòç êäïòç

Ç òñγ÷ιòóá γéãιòç οϊò Äã÷ãéñéáβιò òòι áéááβéòòι, äβιáé οϊ äðιòγéáòιá òçð ðñιòðÛéáéáò ðìεπι áéáòιιòÛãιι äéãéιíòπι òòι äéÛòòçìá òιι òãéãòòáβιι 10 ÷ ñιιιι. Ìé ðéι òçìáíòééÛ ðééããÛò òá ò÷γòç ìá òçì òñβòç γίòòðç γéãιòç οϊò Äã÷ãéñéáβιò (2004) òáβñιíòáé ðãñãéÛòυ:

- ÉãòÛéáéι 25, οϊ DTrace, äβιáé γίá γΎι éãòÛéáéι ìá ðéçñιòιñβãð ò÷ãðééÛ ìá áòòυ οϊ ðáíβò÷òñι äñãáéáβι áñÛéòòçð áðυãñòçð.
- ÉãòÛéáéι 20, ç Òðιòòπñéιç ÒòòòçìÛòιι Äñ÷ãβιι, äβιáé γίá γΎι éãòÛéáéι ìá ðéçñιòιñβãð áéá òòòòπιáòá äñ÷ãβιι òá ìðιβá òðιòòçñβãñιíòáé áðυ οϊ FreeBSD áééÛ áíáðòγòòιíòáé áðυ Ûééãð ñÛããò, υðυò οϊ ZFS áðυ òçì Sun™.
- ÉãòÛéáéι 17, ìããã÷ιò ÒòιãÛíòιι Áòóáéãããò, äβιáé γίá γΎι éãòÛéáéι ìá ðéçñιòιñβãð ò÷ãðééÛ ìá òéò γΎãð äòιáòυòòçðáò éáé òçì ÷ ñΠòç òιò auditing òòι FreeBSD.
- ÉãòÛéáéι 22, ç Áééιíééιðιβçòç, äβιáé γίá γΎι éãòÛéáéι ìá ðéçñιòιñβãð ò÷ãðééÛ ìá òçì äãéáòÛòòáòç òιò FreeBSD òá εíãéòιééυ äéðγéáòçð áééιíééπι (virtual) ìç÷áçìÛòιι.

ΑέéããÛò áðυ òç Äãγòãñç êäïòç (2004)

Ç òñβòç γéãιòç áòòιγ òιò áéáéβιò Πòáι οϊ äðιòγéáòιá òçð ðñιòðÛéáéáò ðãñéòòυòããñιι áðυ äγι ÷ ñιιιι áðυ òá ìγéç òçð ÌÛããò Òãéιçñβυòçð οϊò FreeBSD. Ç γίòòðç γéãιòç äβ÷ã òυòι ìããÛéι ìγããéιò, ðιò éñβéçéã áíãéáβι íá òòðυéãβ òá äγι ÷ ññéòòιγ òυιιòð. ΔãñãéÛòυ òáβñιíòáé ìé òçìáíòééυòãããò äééããÛò òá áòòΠ òç γΎá γéãιòç:

- ÉãòÛéáéι 11, Òι éãòÛéáéι Ñγéιéòçð éáé Äãéòéòòιðιβçòçð òιò FreeBSD, äðãéòÛéçéã ìá γΎãð ðéçñιòιñβãð áéá òç áéá÷ãñéòç áñγñããéáò éáé ðυñιι òιò òòòòπιáòιò ìγòυ ACPI, ìá ðãñéòòυòãããò ðéçñιòιñβãð áéá οϊ òγòòçìá cron éáé ìá ðãñéòòυòãããò äðééιãÛ ðãñãìáòñιðιβçòçð òιò ðòñπιá òιò FreeBSD.
- ÉãòÛéáéι 14, Òι éãòÛéáéι ÁóòÛéáéáò, äðãéòÛéçéã ìá γΎãð ðéçñιòιñβãð áéá Äβéòòá VPN, áéá éβòòáò äéγã÷ιò ðñιòááòçð äñ÷ãβιι (ACLs) éáé ðãñéòòυòãããò òòιãñòéÛ ò÷ãðééÛ ìá òçì áòòÛéáéá òιò FreeBSD.
- ÉãòÛéáéι 16, Ì Òðι÷ñãùðééυ ðããã÷ιò Δñυòááòçð (MAC), äβιáé γίá γΎι éãòÛéáéι òá áòòΠ òçì γéãιòç. Äιçããβ òé äβιáé ì ìç÷áçìò MAC éáé ðòð ìðñãéá ìá ÷ ñçòéιιðιéçéãβ áéá íá áíéò÷òéãβ ç áòòÛéáéá áñιò òòòòπιáòιò FreeBSD.

Όσοι θέλουν να μάθουν για το Linux

Διαβάστε πρώτα

Σε αυτή την ενότητα θα μάθουμε για το Linux, URLs, φακέλους και αρχεία. Θα μάθουμε επίσης για το πώς να εγκαταστήσουμε το Linux.

Αρχικά βήματα

Σε αυτή την ενότητα θα μάθουμε για το Linux, URLs, φακέλους και αρχεία. Θα μάθουμε επίσης για το πώς να εγκαταστήσουμε το Linux.

Γρήγορα βήματα

Σε αυτή την ενότητα θα μάθουμε για το Linux, URLs, φακέλους και αρχεία.

Αρχικά βήματα για το Linux

Σε αυτή την ενότητα θα μάθουμε για το Linux, URLs, φακέλους και αρχεία. Θα μάθουμε επίσης για το πώς να εγκαταστήσουμε το Linux.

Ctrl+Alt+Del

Οι ιδιοκτήτες φακέλων μπορούν να χρησιμοποιήσουν το Ctrl+Alt+Del για να τερματίσουν το Linux.

Οι ιδιοκτήτες φακέλων μπορούν να χρησιμοποιήσουν το Ctrl+Alt+Del για να τερματίσουν το Linux.

Ctrl+X, Ctrl+S

Οι ιδιοκτήτες φακέλων μπορούν να χρησιμοποιήσουν το Ctrl+X και το Ctrl+S για να τερματίσουν το Linux.

Διαβάστε πρώτα

Οι ιδιοκτήτες φακέλων μπορούν να χρησιμοποιήσουν το Ctrl+X και το Ctrl+S για να τερματίσουν το Linux.

```
E:\> tools\fdimage floppies\kern.flp A:
```

Οι ιδιοκτήτες φακέλων μπορούν να χρησιμοποιήσουν το Ctrl+X και το Ctrl+S για να τερματίσουν το Linux.

```
# dd if=kern.flp of=/dev/fd0
```

Οι ιδιοκτήτες φακέλων μπορούν να χρησιμοποιήσουν το Ctrl+X και το Ctrl+S για να τερματίσουν το Linux.

```
% top
```

Άστρονομία

Οι αστρονομικοί όροι είναι πολύπλοκοι, και η αστρονομία είναι ένα πολύπλοκο πεδίο. Η αστρονομία είναι η μελέτη των ουράνιων σωμάτων και των φαινομένων που συμβαίνουν στο σύμπαν.

Η αστρονομία είναι ένα πολύπλοκο πεδίο, και η αστρονομία είναι ένα πολύπλοκο πεδίο. Η αστρονομία είναι η μελέτη των ουράνιων σωμάτων και των φαινομένων που συμβαίνουν στο σύμπαν. Η αστρονομία είναι η μελέτη των ουράνιων σωμάτων και των φαινομένων που συμβαίνουν στο σύμπαν. Η αστρονομία είναι η μελέτη των ουράνιων σωμάτων και των φαινομένων που συμβαίνουν στο σύμπαν.

ΕαοÛεάει 1 Αέοάãùãß

Αιάο÷çιάόέοιÛí, αίαέειñάαίùí, εάέ ιãñέêðò ίαίαãñάùíÛí áðu òíí Jim Mock.

1.1 Óýñïç

Άð÷ãñέοóιγία áέα òι áιαέάóÛñíí óáo ãέα òι FreeBSD! Ôι áεúειòει εαοÛεάει εάεγððάε äεÛοιñáð ððò÷Ûð òιò FreeBSD Project, ùðùð òçí έóðññá òιò, òιòð óðu÷ìð òιò, òι ñíðÛέι áíÛððòιçð, ε.ð.ε.

ÌáðÛ òçí áíÛáñòç áðòιγ òιò εáòáέáβìò, εά ãñññæáðá:

- Ðùð ó÷ãðæáðάέ òι FreeBSD ìá Ûεέα εάέðìòñάέÛ óðóðßιαάá Ç/Ï.
- Ôçí έóðññá òιò FreeBSD Project.
- Ôìòð óðu÷ìð òιò FreeBSD Project.
- Ôέð áάóέéÛð áñ÷Ûð òιò open-source ñíðÛέìò áíÛððòιçð òιò FreeBSD.
- Έάέ ððóέéÛ: áðu ðιò ðñíÛñ÷ãάέ òι ùññá “FreeBSD”.

1.2 Έάêðò ðεέάðά òοι FreeBSD!

Ôι FreeBSD áβιαέ Ýíá εάέðìòñάέú óýóðçíá áάóέóιÛíí óòι 4.4BSD-Lite, òι ñðñì ìðññáß íá ÷ñçóέìðñέçðáß óá Ç/Ï Intel (x86 εάέ Itanium®), AMD64, Alpha™, εάέ Sun UltraSPARC®. Óá áíÛέέιç ãññóέáðάέ áðβóçð ç äέαάέέάóá ìáðáóññÛð òιò FreeBSD óá Ûεέáð áñ÷έóáέðιíέéÛð. Ìðññáßðá áðβóçð íá äέαáÛóáðá áέα òçí έóðññá òιò FreeBSD, ð áέα òçí ðει ðñúóóáðç áðβóçç Ûέáìòç òιò. ΆÛí áιαέάóÛñáóá òι óòιαÛεέáðá ìá εÛðιέι ðñúðι òοι Project (εðáέέáð, hardware, ìç-ðñìóçíáέùíÛíá ÷áñòñññáðá), áέαáÛóá òι Ûñεñ ÒóíáέóóÛññíóáð óççí ÁíÛððòιç òιò FreeBSD (http://www.FreeBSD.org/doc/el_GR.ISO8859-7/articles/contributing/index.html).

1.2.1 Ôέ ìðññáß íá εÛíáέ òι FreeBSD;

Ôι FreeBSD Ý÷áε ðñεÛú áίέúειάá ÷áñáέðçñέóóέéÛ. ÌãñέéÛ áðu áððÛ áβιαέ:

- *Preemptive ðñεðáðáññáóóá* (preemptive multitasking) ìá äóíáίέú Ûέáã÷ì ðñìðáñáέúðçðáð áέα íá áíáóóáέέóðáß ñáέùð εάέ áβέαέìð áέαìíέáíóìùð ðùì ðññì òιò Ç/Ï ìáðáíγ äóáññáðñí εάέ ÷ñçóðñí, áεùìç εάέ óóέð ðει áíðβññáð óòìèðεáð.
- *Ðñεð÷ñçóóέέÛð äòíáðúðçðáð* (multi-user facilities) ìέ ñðññáð áðέòñÛðìí òá ðñεÛú Ûòñíá óáððù÷ññíá íá ÷ñçóέìðñέðòìí Ýíá óýóðçíá FreeBSD áέα äέαóìñáðέéÛ ðñÛáíáðá. Άððù óçíáβíáέ, áέα ðáñÛááέáíá, ùðέ óá ðáñέóáñáέéÛ òιò óðóðßιαðìò, ùðùð áέðððùðÛð εάέ ñáçáñβ óάέίεðñí áβιαέ óùóðÛ ñέñáóìÛ íá ìáðáíγ ùεùì ðùì ÷ñçóðñí òιò óðóðßιαðìò ð òιò áέέðγìò εάέ ðùð ìðññíγí íá ðáειγí óðáέáñέñειÛ íá ùñέα óá ÷ñçóðáð ð ñÛáð ÷ñçóðñí, ðñìóðáðáγííóáð εñβóέìòð ðññìòð òιò óðóðßιαðìò áðu ððáñáñέέéð ÷ñçóç.
- Έó÷òñÛð äòíáðúðçðáð *äέέðýúóçð TCP/IP* (TCP/IP networking) ìá ððìóððñέίç áέα áέñç÷áίέéÛ ðñúðððá ùðùð óá SCTP, DHCP, NFS, NIS, PPP, SLIP, IPsec εάέ IPv6. Άððù óçíáβíáέ ðùð Ýíá ìç÷Ûίçíá FreeBSD ìðññáß íá áέεçáððέáñÛ áγέìέα ìá Ûεέα óðóðßιαάά εάέ íá áñáÛæáðάέ óáí áðάέñέéùð áìðççñáðçððð, ððìóðçññáειíóáð εάέðìòñáßð æùðέéðð óçíáóáð, ùðùð NFS (áðñáέñòòιÛίç ðñúóááóç óá áñ÷áßá) εάέ ðççñáóáð çεάέòññέέιγ

όά÷δάνηάβιό (e-mail), P όγι δάνηόόβά όιό ηνάάιέόηγ όάό όόι αέάάβέόόι ιΰού όυι όδγνάόέπi WWW, FTP, routing έάέ firewall (άόΰεάέάό).

- C δñiόόάόβά όγò ιiPιçò (memory protection) άίάόόάέβæάέ υόέ ιέ æΰöiñάò άόάνηiάΰò (P ιέ ÷ñPόόάò) άάί αέέçέάδéάñiγi ιάόάγ όιόδ. Ιέά άόάνηiάP ðiò δάνηiόέΰæάέ éΰðiέi δñuάεçiά άά ιðñάβ iά άδçñάΰόάé ΰέεάò ιά έáíΰiάi όñüði.
- Õi FreeBSD άβiάέ ΰiά éάέόιòñάέéü óγóόçiά 32-bit (64-bit óά Alpha, Itanium, AMD64, έάέ UltraSPARC) έάέ ó÷:άάéΰόόçéά ιά άόóü όií όñüði άñ` άñ ÷Pò.
- Õi άέñç ÷άίέéü δñüóóði X Window System (X11R6) δñiόóΰñάέ άñάόέéü δάνéáΰέéií άñάάόβáò (GUI) όóι éüóóiò ιέáó éiέiPò éΰñόáò VGA έάέ ιέáó iέuιçò έάέ αέάόβéáόάé ιά όií ðéPñç ðçάáβi έpάέéá.
- Óóιάάóüüòçόά áéòáéΰóéiui ιά ðiέéΰ δñiñάΰiιάόά ðiò ΰ ÷iόi ιάόάáéüóóéóóάβ áéá Linux, SCO, SVR4, BSDI έάέ NetBSD.
- ×έééΰάáò ΰóιέiáò-ðñiò-áéòΰéáόç άóάνηiάΰò άβiάέ αέάéΰóéiáò áðu όçι óóééiάP ports έάέ packages áéá ði FreeBSD. Άέάόβ iά øΰ ÷iáóá óóι αέάάβέóóι uóáí ιðñάβóá iά óá άñάβóá uéá άáP;
- Óóι αέάάβέóóι άβiάέ áðβóçò αέάéΰóéiáò ÷έééΰάáò δñüóéáóáò έάέ άγέiέáò óόçι δñiόáñiιάP άóάνηiάΰò. Õi FreeBSD ΰ ÷áé óóιááóüüòçόά ðçάáβiò έpάέéá ιά óá ðéi áçiñiόééΰ áiðñééΰ óóóóPιάόá UNIX, άðñiΰiùò ιέ δάνéóóüóðñáò άóάνηiάΰò ÷ñáéΰæiíóáé έβááò ΰùò έάéüéiò ιάόáóñiðΰò áéá iά ιάόááéüóóéóóiγi (compile).
- C ΆóιáιέéP óáééáñiðiβçόç áééiíééPò ιiPιçò έάέ όi “iέiέçñüiΰi VM/buffer cache” δάνΰ ÷iόi óøçéP áðuüiόç óá άóάνηiάΰò ιά áóιçιΰiáò áíΰáéáò óá iPιç, άñP αέάóçñiγi όçι ééáñiðiέçóééP áðuéñéóç ðiò óóóóPιάóíð óóιòð ΰέéiòð ÷ñPóóáò.
- ÕðiόóPñéiç SMP áéá iç÷áPιáóá ιά ðiέéáðéΰò CPU.
- ðéPñçò óáéñΰ άñάáéáβñi áíΰððóιçò áéá C, C++, έάέ Fortran. Óðç ÓóééiάP óüi Ports έάέ óüi ΰóιέiui δάéΰóüi, éá άñάβóá ðiέéΰò áéüiá áepóóáò δñiñáñiáóéóíγ, éáðΰέéçéáò óüi αéá ΰñáóíá uóι έάέ áéá áíΰððóιç éiáéóíééγ.
- C áéáéáóéüüòçόá όiò ðçάáβiò έpάέéá iéuέççñiò óiò óóóóPιáóíð óçιáβiáé uóé ΰ ÷áóá όií óøçéüóáñi ááéüi áéΰá ÷iò óóι δάνéáΰέéií óáò. Άέάóβ iά áβóóá ééáéüiΰñiέ óá ΰiά ééáéóóü óγóόçiά έάέ iά áβóóá áñáñçóιΰñiέ áðu όií δññçéáóðP óáò, uóáí ιðñάβóá iά ΰ ÷áóá ΰiά δñáñiáóééΰ áñiέ ÷ óü óγóόçiά;
- Άéóáóáiΰiç online óáéiçñβiúóç.
- Έάέ ðiέéΰ ΰέéá!

Õi FreeBSD άάóβæáóáé óόçι ΰéáñiόç 4.BSD-Lite όiò Computer Systems Research Group (CSRG) όiò ðáíáðéóóçìβiò όçò Éáééóüñiέáò óóι Berkeley, έάέ óóíá÷βæáé όçι αέάéáéñéiΰiç δάνΰüiόç όiò óόçι áíΰððóιç óóóóçιΰóüi BSD. Άðéðñüóéáóá óóι áñáβñáóι ΰñáñ ðiò δάνάβ÷á όi CSRG, όi FreeBSD Project iüááøá ðiέéΰò ÷έééΰάáò ðñáò óóç ááéóéóóíðiβçόç όiò óóóóPιáóíð áéá iΰáéóóáò áðéáüóáéò έάέ áñiðéóóóá óá éáççiáñéiΰ éáóáóóΰóáéò δñáñiáóééγ óññiò άñάáóβáò. Áí έάέ ðiέéiβ áiðñééiβ éiεiόóíβ áóóéiáγñiόáé iά δñiόóΰñiò éáéóíòñáééΰ óóóóPιáóá ιá ðΰóιéá ÷áñáéóçñéóóééΰ, áðéáüóáéò έάέ áñiðéóóóá, όi FreeBSD ιðñάβ iά óá δñiόóΰñáé ðpñá!

Ιέ άóάνηiάΰò óóéò ιðiβáò ιðñάβ iά ÷ñçóéiðiέçéáβ όi FreeBSD, δñáñiáóééΰ δάνéññβæiíóáé iüií áðu όçι óáíóáóá óáò. Άðu áíΰððóιç éiáéóíééγ iΰ ÷ñé áóóñiáóéóíγò άñáñiόáóβñi, áðu áðñáñáòP áéáP iΰ ÷ñé όçι áéüñéüóç óiò áæéiγééiò áðñáéñóóíΰiüi áññóñiñééP éáñáéP, áΰi ιðñάβ iά áβiáé ιá ΰiά áiðñééü δñiüüi UNIX, άβiáé δάνáðΰiü áðu ðééáñi uóé ιðñάβ iά áβiáé έάέ ιá όi FreeBSD! Õi FreeBSD áðβóçò uóáéáβóáé óçιáíóééΰ áðu éðñéiéáéóééΰ ÷έééΰάáò άóάνηiάΰò óøçéPò ðiέüóçóáò ðiò áñáðγóóñiόáé áðu éΰiόñá άñáðñi έάέ ðáíáðéóóPιéá óá üéi óií éüóñ, έάέ óó÷iΰ áéáóβéáíóáé óá ÷áçéü éüóóíò P áññáΰi. Õi ðéPèò óüi áiðñééP áóάνηiáP ðiò αέάóβéáíóáé áéá όi FreeBSD, áóñiΰiáóé áðβóçò éáççiáñéiΰ.

Ï ðçᾶᾶβῖò ἑπαέεᾶò ðῖò βαέῖò ðῖò FreeBSD ᾶβῖᾶέ ðεPἡῖò ᾶεᾶεÝóεῖῖò, ἑᾶέ Ýóóé ðῖ ὀγóòçῖᾶ ἰðῖἡᾶβ ἰᾶ ðἡῖὀᾶἡῖὀὀᾶᾶβ ὀᾶ ᾶὀÛῖὀὀᾶ ὀθçεῖ ᾶðβðᾶῖῖ ᾶεᾶ ᾶεᾶεéÝò ᾶὀᾶἡῖᾶÝò P projects, ἑᾶέ ἰᾶ ðἡῖðῖὀò ᾶᾶῖéÛ ἰç ðἡᾶᾶἰᾶὀῖὀῖéPóεῖῖὀò ὀᾶ Ûεᾶᾶ ἑᾶεὀῖὡᾶεéÛ ᾶἰðῖἡéεῖῖ ðἡἡçεᾶὀðῖ. ÐᾶἡᾶéÛòῦ ἑᾶ ᾶἡᾶᾶβὀᾶ ἰᾶἡééÛ ἰῖῖῖ ðᾶἡᾶᾶᾶβᾶἰᾶὀᾶ ᾶðῖ ᾶὀᾶἡῖᾶÝò ὀὀéð ἰðῖᾶβò ἰðῖἡᾶβ ἰᾶ ÷ἡçóεῖῖðῖéçεᾶᾶβ ᾶὀðP ὀç ὀὀéᾶἡP ὀῖ FreeBSD:

- *Ïðçἡᾶὀβᾶð* ðῖὀᾶἡῖᾶð: Õῖ ἑὀ÷ðἡῖ ὀγóòçῖᾶ ᾶééðγῖὀçð TCP/IP ὀῖò FreeBSD, ὀῖ ᾶῖᾶᾶᾶéῖγῖᾶé ὀᾶ ἑᾶᾶῖᾶç ðεᾶὀὀῖἡῖᾶ ᾶεᾶ ἰεᾶ ἰᾶᾶÛεç ᾶéÛῖᾶ ὀðçἡᾶὀεῖῖῖ ὀῖὀᾶἡῖᾶð ὕðῖð:
 - ἈῖððçἡᾶὀçðÝò FTP
 - ἈῖððçἡᾶὀçðÝò ἑὀὀῖὀᾶεᾶβᾶῖῖ World Wide Web (εῖῖῖῖγð P ἰᾶ ᾶὀὀᾶéP ὀγῖᾶᾶὀç [SSL])
 - Ἀἡἡῖῖεῖῖᾶçὀç ðἡἡὀῖῖεῖῖεῖῖῖ IPv4 ἑᾶé IPv6
 - Firewalls ἑᾶé ðγῖᾶð NAT (“IP masquerading”)
 - ἈῖððçἡᾶὀçðÝò çεᾶᾶᾶἡῖῖῖῖῖ ὀᾶ÷ὀᾶἡἡῖᾶβῖὀ
 - USENET News P Bulletin Board Systems
 - Ἐᾶé Ûεᾶᾶ...

Ïᾶ ὀῖ FreeBSD, ἰðῖἡᾶβὀᾶ ᾶγῖῖῖᾶ ἰᾶ ἰᾶἑῖῖPὀὀᾶὀᾶ ᾶðῖ ÷ᾶῖçÛ ἰᾶ Ýῖᾶ ὀðçῖῖ PC ὀçð ἰéῖῖᾶÝῖᾶᾶð 386, ἑᾶé ἑᾶἑῖð ç ᾶðé÷ᾶἡἡçὀç ὀᾶð ἰᾶᾶἑῖῖᾶῖ, ἰᾶ ᾶῖᾶᾶἑῖὀὀᾶᾶβὀᾶ ὀᾶ Ýῖᾶ ὀᾶðἡᾶðγἡçῖῖ ᾶðᾶῖᾶἡᾶᾶὀðP Xeon ἰᾶ ᾶβὀéῖὀð RAID.

- *Ἀἑðᾶβᾶὀὀç*: Ἀβὀὀᾶ ὀῖὀçðPð ðεçἡῖὀῖἡééPð P εÛðῖῖὀ ὀ÷ᾶὀéῖγῖ ὀἡÝᾶ; Ἀᾶῖ ὀðÛἡ÷ᾶé ἑᾶé ἑᾶéγὀᾶἡῖð ὀἡἡῖð ἰᾶ ἰÛεᾶὀᾶ ᾶεᾶ ἑᾶεὀῖὡᾶεéÛ ὀὀὀðPῖᾶὀᾶ, ᾶἡ÷ἑὀᾶἑὀῖῖῖῖÝò Ç/Õ, ἑᾶé ὀὀὀðPῖᾶὀᾶ ᾶééðγῖᾶ ᾶðῖ ὀçῖ ðἡᾶéðééP ᾶἰðᾶἑἡβᾶ ἑᾶé ὀçῖ ὀᾶ ᾶÛεῖð ᾶῖῖὀç ðῖò ἰðῖἡᾶβ ἰᾶ ὀᾶð ðᾶἡÝ÷ᾶé ὀῖ FreeBSD. Õῖ ἰᾶᾶÛεῖ ðεPεῖð ὀῖῖ ᾶἡἡᾶÛῖ ᾶεᾶéÝóεῖῖῖ ðᾶéÝὀῖῖ ᾶὀᾶἡῖᾶῖῖ CAD, ᾶἡᾶὀééPð ὀ÷ᾶᾶβὀὀçð, ἑᾶé ἰᾶéçῖᾶðéῖῖῖ, εÛἡῖὀῖ ὀῖ FreeBSD ᾶῖᾶἑἡᾶðééÛ ÷ἡPóεῖῖ ὀᾶ ὕὀῖðð ὀῖ ἑγἡῖῖ ᾶῖᾶᾶὀÝἡῖῖ ὀῖðð ὀὀῖðð ὀðῖῖᾶᾶὀðÝò ᾶβῖᾶῖ ἰᾶ *εÛἡῖὀῖ ὀç ᾶῖðεᾶéÛ ὀῖðð!*

- *ἡᾶðῖᾶ*: Ïᾶ ᾶεᾶéÝóεῖῖ ὀῖῖ ðçᾶᾶβῖ ἑπαέεᾶ ἰεῖῖεçἡῖð ὀῖò ὀὀὀðPῖᾶὀᾶ, ὀῖ FreeBSD ᾶβῖᾶῖ ἰβᾶ ᾶῖᾶβἡᾶὀç ðεᾶὀὀῖἡῖᾶ ᾶεᾶ ὀçῖ ὕἡᾶὀῖᾶ ὀὀᾶ ἑᾶεὀῖὡᾶεéÛ ὀὀὀðPῖᾶὀᾶ ὕðῖð ᾶðβὀçð ᾶεᾶ Ûεῖῖðð ἑεÛᾶῖðð ὀçð ðεçἡῖὀῖἡééPð. Ç ὀγóç ὀçð ᾶεᾶγῖᾶἡçð ᾶéÛεᾶὀçð ὀῖò FreeBSD ᾶðéðἡÝðᾶé ᾶðβὀçð ὀᾶ ᾶðἡᾶἑἡὀὀὀÝῖᾶð ἡÛᾶᾶð ἰᾶ ὀῖᾶἡᾶᾶÛᾶῖὀᾶῖ ὀᾶ ἑᾶÝᾶð P ἰᾶ ἡῖἡᾶᾶῖὀᾶῖ ὀçῖ ᾶῖÛððὀçç ᾶὀᾶἡῖᾶῖῖ, ÷ἡἡβð ἰᾶ ᾶῖçὀð÷ῖῖ ᾶéᾶ Ûᾶᾶᾶð ÷ἡPὀçð ἑᾶé ÷ἡἡβð ἰᾶ ðᾶἡῖἡἡβᾶὀᾶῖ ç ᾶὀῖᾶðῖὀçὀᾶ ὀῖðð ᾶεᾶ ᾶεᾶγῖᾶἡç ὀðᾶPὀççὀç ἰðῖῖὀᾶPðῖὀᾶ ἑÝῖᾶὀῖð ὀᾶ ᾶῖῖ÷ðÝò ἡÛᾶᾶð ὀðᾶPὀççὀçð (forums).

- *Ἀééðγῖᾶ*: ×ἡᾶéÛεᾶὀὀᾶ Ýῖᾶ ἑᾶῖῖῖᾶῖῖ router (ᾶἡἡῖῖᾶçðP); ἰᾶ ᾶῖððçἡᾶὀçðP DNS; ἰᾶ firewall ᾶεᾶ ἰᾶ ἑἡᾶðÛðᾶ ὀῖῖ ἑῖὀῖῖ ὕἡῖ ᾶðῖ ὀῖ ᾶὀὀᾶἡᾶῖῖ ὀᾶð ᾶβéðὀῖ; Õῖ FreeBSD ἰðῖἡᾶβ ᾶγῖῖῖᾶ ἰᾶ ἰᾶðᾶðἡÝðᾶé ᾶἑᾶβῖῖ ὀῖ Û÷ἡçὀῖ 386 P 486 PC ðῖò εÛεᾶὀᾶῖ ὀçῖ ᾶἡῖᾶ, ὀᾶ Ýῖᾶ ðἡἡçᾶῖÝῖῖ ᾶἡἡῖῖᾶçðP ἰᾶ ᾶῖᾶçὀçῖÝῖᾶð ᾶὀῖᾶðῖὀçὀᾶð ὀééðἡᾶἡβὀῖᾶὀῖð ðᾶéÝὀῖῖ.

- *Ïðᾶἑῖῖð ᾶἡᾶὀὀβᾶð ἰᾶ X Window*: Õῖ FreeBSD ᾶβῖᾶῖ ἰεᾶ ᾶῖᾶβἡᾶὀç ᾶðéῖῖᾶP ᾶεᾶ Ýῖᾶ ἰéῖῖῖῖῖῖ ᾶῖððçἡᾶὀçðP × ὀᾶἡῖᾶðéῖῖῖ, ÷ἡçóεῖῖðῖῖῖὀᾶð ὀῖῖ ᾶεᾶγῖᾶἡᾶ ᾶεᾶéÝóεῖῖ ᾶῖððçἡᾶὀçðP X11. Õᾶ ᾶῖὀβᾶὀç ἰᾶ ὀᾶ ᾶðéÛ ὀᾶἡῖᾶðééÛ X, ἰᾶ ὀῖ FreeBSD ἰðῖἡᾶβὀᾶ, ᾶὀὀῖῖ ὀῖ ᾶðééὀῖᾶβὀᾶ, ἰᾶ ᾶéðᾶἑᾶβὀᾶ ðῖῖῖÝò ᾶὀᾶἡῖᾶÝò ὀῖðééÛ, ᾶðᾶἑÛὀὀῖὀᾶð Ýóóé ὀῖῖ ἑᾶῖðἡῖῖῖ ᾶῖððçἡᾶὀçðP ᾶðῖ ðᾶἡῖὀὀὀ ὀῖἡὀβῖ. To FreeBSD ἰðῖἡᾶβ ἰᾶ ἰᾶἑῖῖPὀᾶῖ ᾶéῖῖᾶ ἑᾶé “diskless” (÷ἡἡβð ὀéççἡῖ ᾶβὀῖῖ), εÛἡῖὀῖὀᾶð Ýóóé ὀῖðð ðἡἡὀὀðéῖῖγð ὀðᾶἑῖῖγð ᾶἡᾶὀὀβᾶð ᾶéῖῖç ðéῖ ὀðçῖῖγð ἑᾶé ᾶðῖῖῖὀὀᾶἡῖðð ὀçç ᾶéᾶ÷ᾶἡἡὀç.

- *ἈῖÛððὀçç Ἐῖᾶéὀῖῖῖῖ*: Õῖ ᾶᾶὀὀὀ ὀγóòçῖᾶ ὀῖò FreeBSD ᾶéᾶðβᾶὀᾶῖ ἰῖῖῖçἡῖῖῖÝῖῖ, ἰᾶ ðεPἡç ὀᾶἑἡÛ ᾶἡᾶᾶᾶβῖῖ ᾶῖÛððὀççð, ðῖò ðᾶἡῖῖᾶῖᾶÛῖὀῖὀῖ ὀῖῖ ᾶῖᾶῖῖἡῖὀῖῖῖ GNU C/C++ compiler ἑᾶé debugger.

Õῖ FreeBSD ᾶβῖᾶῖ ᾶεᾶéÝóεῖῖ ὀᾶ ἡἡὀP ðçᾶᾶβῖò ἑπαέεᾶ ᾶεéÛ ἑᾶé Ýὀῖῖῖὀ, ἰᾶὀᾶᾶἑῖὀὀὀὀὀὀὀὀὀὀ ᾶéðᾶἑÝóεῖῖὀ ὀᾶ CD-ROM, DVD, ἑᾶé ἰÝὀὀ ᾶῖῖὀῖὀὀ FTP. Ἀᾶβὀᾶ ὀῖ ÐᾶἡÛἡὀçῖᾶ A ᾶεᾶ ðᾶἡῖὀὀὀὀᾶἡᾶð ðεçἡῖὀῖἡᾶð ᾶεᾶ ὀῖ ðῖð ἰᾶ ᾶðῖὀὀPὀᾶὀᾶ ὀῖ FreeBSD.

The FreeBSD core team

Ἡ FreeBSD core team εἶναι ἡ ἐπιμέλεια τῆς ἐξέλιξης τοῦ FreeBSD Project καὶ τῆς ἀνάπτυξης τοῦ κώδικα. Ἡ ἐπιμέλεια εἶναι ἡ ἀνάπτυξη τοῦ κώδικα τοῦ FreeBSD, ὅπου οἱ ἐπιμέλεις εἶναι οἱ ἐπιμέλεις τοῦ κώδικα. Ἡ ἐπιμέλεια εἶναι ἡ ἀνάπτυξη τοῦ κώδικα τοῦ FreeBSD, ὅπου οἱ ἐπιμέλεις εἶναι οἱ ἐπιμέλεις τοῦ κώδικα. Ἡ ἐπιμέλεια εἶναι ἡ ἀνάπτυξη τοῦ κώδικα τοῦ FreeBSD, ὅπου οἱ ἐπιμέλεις εἶναι οἱ ἐπιμέλεις τοῦ κώδικα.

Ὁ ὁρίωνος: Ὁ ὁρίωνος εἶναι ἡ ἀνάπτυξη τοῦ κώδικα τοῦ FreeBSD, ὅπου οἱ ἐπιμέλεις εἶναι οἱ ἐπιμέλεις τοῦ κώδικα. Ἡ ἐπιμέλεια εἶναι ἡ ἀνάπτυξη τοῦ κώδικα τοῦ FreeBSD, ὅπου οἱ ἐπιμέλεις εἶναι οἱ ἐπιμέλεις τοῦ κώδικα. Ἡ ἐπιμέλεια εἶναι ἡ ἀνάπτυξη τοῦ κώδικα τοῦ FreeBSD, ὅπου οἱ ἐπιμέλεις εἶναι οἱ ἐπιμέλεις τοῦ κώδικα.

Ἡ ἐπιμέλεια τοῦ κώδικα τοῦ FreeBSD

Ὁ ὁρίωνος εἶναι ἡ ἀνάπτυξη τοῦ κώδικα τοῦ FreeBSD, ὅπου οἱ ἐπιμέλεις εἶναι οἱ ἐπιμέλεις τοῦ κώδικα. Ἡ ἐπιμέλεια εἶναι ἡ ἀνάπτυξη τοῦ κώδικα τοῦ FreeBSD, ὅπου οἱ ἐπιμέλεις εἶναι οἱ ἐπιμέλεις τοῦ κώδικα. Ἡ ἐπιμέλεια εἶναι ἡ ἀνάπτυξη τοῦ κώδικα τοῦ FreeBSD, ὅπου οἱ ἐπιμέλεις εἶναι οἱ ἐπιμέλεις τοῦ κώδικα.

Ἡ ἐπιμέλεια τοῦ κώδικα τοῦ FreeBSD

(http://www.FreeBSD.org/doc/el_GR.ISO8859-7/articles/contributors/article.html) εἶναι ἡ ἀνάπτυξη τοῦ κώδικα τοῦ FreeBSD, ὅπου οἱ ἐπιμέλεις εἶναι οἱ ἐπιμέλεις τοῦ κώδικα.

Ἡ ἐπιμέλεια εἶναι ἡ ἀνάπτυξη τοῦ κώδικα τοῦ FreeBSD, ὅπου οἱ ἐπιμέλεις εἶναι οἱ ἐπιμέλεις τοῦ κώδικα. Ἡ ἐπιμέλεια εἶναι ἡ ἀνάπτυξη τοῦ κώδικα τοῦ FreeBSD, ὅπου οἱ ἐπιμέλεις εἶναι οἱ ἐπιμέλεις τοῦ κώδικα.

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Ὁ ὁρίωνος εἶναι ἡ ἀνάπτυξη τοῦ κώδικα τοῦ FreeBSD, ὅπου οἱ ἐπιμέλεις εἶναι οἱ ἐπιμέλεις τοῦ κώδικα. Ἡ ἐπιμέλεια εἶναι ἡ ἀνάπτυξη τοῦ κώδικα τοῦ FreeBSD, ὅπου οἱ ἐπιμέλεις εἶναι οἱ ἐπιμέλεις τοῦ κώδικα.

1.3.4 Ç ÔñÝ ÷ ïöóá_êäïöç öïö FreeBSD

Ôï FreeBSD áβíáé äëáýèãñá äéáéÝóéïí, ááóβæáðáé ïëüëçññí öóïí ðçãáβí êpáééá öïö 4.4BSD-Lite, éáé áíáððýóóðáé áéá öóóðPíáðá çëäëðñííéëpí ððïëíáéóðpí ááóéóíÝíá óá äðáíáñááóðÝð Intel i386™, i486™, Pentium®, Pentium Pro, Celeron®, Pentium II, Pentium III, Pentium 4 (P óöíááóíýð), Xeon™, DEC Alpha éáé Sun UltraSPARC. Ááóβæáðáé êðñβùð öóí software ðçð ïñÛááð U.C. Berkeley CSRG, íá êÛðíéáð áäëðépóáéð ðïö ðñíÝñ ÷ ïíóáé áðü óá NetBSD, OpenBSD, 386BSD, éáé öí Free Software Foundation.

Áðü ðçí Ýéäïöç öïö FreeBSD 2.0 óðá ðÝëç öïö 1994, ç áðüäïöç, öí óýñíëí ðùí ÷ áñáéðçñéóðéëpí, éáé ç óðáéáññüðçðá öïö FreeBSD Ý ÷ áé áäëðéùèáβ óçíáíóééÛ. Ç íáááéýðáñç áéëéãP áβíáé ç áðáíáó ÷ ááβáóç öïö óðóðPíáðáð ãééííééPð ïíPìçð (virtual memory) íá Ýíá ïëíéçññíÝñí VM/file buffer cache öí ïðíβí ù ÷ é ïüíí áóíÛíáé ðçí áðüäïöç, áéëÛ áðβóçð ïáépíáé ðéð áðáéðPóáéð ïíPìçð öïö FreeBSD, áðéðñÝðñíóáð ùð áéÛ ÷ éóöí áðñíáéðü ïñéí óá 5 MB. ÐãñéÝ ÷ ïíóáé áðβóçð éáé Ûëëáð áäëðépóáéð, ùðüð ðëPñçð ððñóðPñéíç ðáéÛöç éáé áíððçñáðçðP NIS, ððñóðPñéíç óóíáééãápí TCP, dial-on-demand PPP, áíóùíáðüíÝíç ððñóðPñéíç DHCP, Ýíá áäëðéùíÝñí ððñóýóðçíá SCSI, ððñóðPñéíç ISDN, ððñóðPñéíç áéá ATM, FDDI, ðñíóáññíãáβð áééðýíö Fast éáé Gigabit Ethernet (1000 Mbit), áäëðéùíÝíç ððñóðPñéíç áéá öïöð óáéáððáβíöð áéãáéðÝð ðçð Adaptec éáé ðñééÝð ÷ éééÛááð áéññèpóáéð éáëpí (bug).

Áéöüð áðü ðç ááóéëP öïö áéáññP, öí FreeBSD ðñíóóÝñáé íéá óðëëñP êñáéóíééý íá ÷ éééÛááð ðññáñÛíáðá áéá éáéçíáñéíP ÷ ñPóç. Ôçí óðéáñP ðïö áñÛöííóáé áóðÝð íé áñáñÝð, ððÛñ ÷ ïíí ðÛíü áðü 20,000 ports! Ç ëβóðá ðùí ports íáééíÛáé áðü áíððçñáðçðÝð http (WWW), íÝ ÷ ñé ðáé ÷ íβáéá, áèpóóáð ðññáñáñáðéóííý, éáéíáñáñÛöíöð, éáé ïéáPðñíá Ûëëí áíáéÛíáðá. Ç óññéëP ÓðëëñP ðùí Ports áðáéðáβ ðñíóáááéóðééÛ 417 MB áðñéçéáððééü ÷ pñí, áóíý ùéá óá ports áéðñÛáííóáé íá “deltas” (áñ ÷ áβá áéáóñpí) ðùí áðéáíóéëpí ðçãápí öïöð. Ôí áãáññüð áóðü íáð áðéðñÝðáé íá áíááéëβóíöíá óá ports ðñéý áðëñéüðáñá, éáé ïáépíáé áñáóðééÛ ðéð áðáéðPóáéð óá óéççññü áβóéí óá ó ÷ Ýóç íá ðçí ðáéáéüðáñç ÓðëëñP Ports 1.0. Áéá íá íáðááéüððéóðáβ (compile) Ýíá port, ÷ ñáéÛæáðáé áðëpð íá íáðáááβðá óóíí éáóÛëññí öïö ðññáñÛíáðáð ðïö áðééðñáβðá íá ááéáðáóðPóáðá, íá ðéççðññíëññáPóáðá make install, éáé íá áðPóáðá öí óýóðçíá óáð íá êÛíáé óá ððüëíéðá. ïëüëççñç ç áðéáíóéëP áéáññP áéá êÛéá port ðïö êÛíáðá build ðáñÝ ÷ áðáé áðñáééÛ áðü öí CD-ROM P áðü íβá ïððéëP ïðñéáðóβá FTP, Ýóóé óá ports ðïö ááí ÷ ñáéÛæáðáðá ááí éáðáéáíáÛíöí Ûóéíðñí ÷ pñí óóíí óéççññü óáð áβóéí. Ó ÷ ááüí êÛéá port ðáñÝ ÷ áðáé áðβóçð éáé óáí ðñí-íáðááéüððéóíÝñí (pre-compiled) “ðáéÝöí (package)”, öí ïðñí ïðññáβ íá ááéáðáóðáéáβ íá íéá áðëP áíóíëP (pkg_add) áéá áéáβñöð ðïö ááí áðééðñíý íá íáðááéüððéóðáβ ðá ports öïöð áðü öíí ðçãááβí êpáééá. Ðãñéóóüðáñáð ðéççññíöññáð áéá óá packages éáé óá ports ïðññáβðá íá áñáβðá óóí ÊäöÛëáéí 4.

ÔðÛñ ÷ áé áñéáðÛ íááÛëç áðéðéÝñí óáéìçññβüóç ðçí ïðñíá ïðññáβ íá áñáβðá ðñéý ÷ ñPóéíç áéá ðçí áéááééáóβá ááéáðÛóóáçð éáé ÷ ñPóçð öïö FreeBSD. ïðññáβðá íá ðçí áñáβðá ááéáðáóðçíÝíç óóíí éáóÛëññí /usr/share/doc óá ïðñéñáPðñíá óýá ÷ ññíí íç ÷ Ûíçíá FreeBSD. Óá ïððééÛ ááéáðáóðçíÝíá áá ÷ áéññáéá ïðññáβðá íá óá ááβðá óá ïññP HTML, ÷ ñçóéíðñéípíóáð ïðñéñáPðñíá éáðÛëççñí browser óðéð áéüñéðéáð URL:

Ôí Áã ÷ áéññáéí × ñPóçð öïö FreeBSD
/usr/share/doc/handbook/index.html

Ôð ÷ íÝð áññðPóáéð öïö FreeBSD (FAQ)
/usr/share/doc/faq/index.html

ïðññáβðá áðβóçð íá ááβðá óá ðññüðüðððá (éáé óð ÷ íÛ áíáááéíéæüíáíá) áíóβáñáðá óóí <http://www.FreeBSD.org/>.

2.3 Ἀνὰόβὰὸ δñεί ὀσί Ἀεάὸὔόαός

2.3.1 Ἀδῖανὰὸ᐀ ὀεέειύ ὀῖὀ ὀδῖειῖεό᐀ ὀάὸ

Δñεί Ἀεάὸάὸ᐀όαὸ δῖ FreeBSD δñÝðáε ἰά ἄδε÷ἄεñ᐀όαὸ ἰά ἄδῖανὔ᐀άὸ ὀά ἄἰάν᐀ῖάὸ ὀῖὀ ὀδῖειῖεό᐀ ὀάὸ. Ἰε ἡὀὀβῖἰὰδ Ἀεάὸὔόαὸδ ὀῖὀ FreeBSD εἰ ὀάὸ ἄἄβῖὀῖ ὀά ἄἰάν᐀ῖάὸ (ὀεεçñῖýð ἄβὀεῖὀð, εὔ᐀᐀ὸἄδ ἄεέὀýῖὀ, ἰαçῖἰýð CDROM εεð.) ἰἄ ὀά ἰῖῖῖἰάὸ ὀῖὖ ἰῖὀÝεῖῖ ἔἄε ὀῖὖ ἔἄὸἄεἄὀἄὀ᐀ῖ ὀῖὀð. ὀῖ FreeBSD εἰ ἄδε÷ἄεñ᐀όἄε ἄδβὀçð ἰά δñῖὀἄεῖñ᐀όἄε ὀεὸ ὀῖὀ᐀Ýð ἡὀεῖ᐀όἄεð ἄεἄ ὀεὸ ὀὀὀἄὀÝð ἄὀὀÝð, ὀὀἰðἄñεἄἰἄἄῖñÝῖῖ ἔἄε ὀῖὖ δεçñῖὀῖñε᐀ῖ ἄεἄ ὀç ÷ñ᐀όç IRQ ἔἄε εðñ᐀ῖ IO. Ἰῖῖῖῖ ὀῖὖ ἔἄεῖñῖñὀε᐀ῖ ὀῖὀ ὀεέειύ ὀῖὖ PC, ç ἄεἄἄεἄὀ᐀ῖ ἄὀ᐀ ἄἰ ἄβῖἄε δὔῖὀἄ ἄδεὸð÷᐀ð, ἔἄε βὀῖð ÷ñἄεἄὀ᐀ῖ ἰά ἄεῖñ᐀᐀όἄὀ ὀεὸ ἡὀεῖ᐀όἄεð δῖὀ ἄἰβ÷ἰἄὀὀ ὀῖ FreeBSD.

Ἄἰ ὀ ÷ἄὸἄ ᐀ḗç ὔεεῖ εἄεὀῖὀñἄεεῖ ὀýὀὀçῖἰ Ἀεάὸάὸ᐀ῖÝῖῖ, ὀðῖð Windows ᐀ Linux, ἄβῖἄε ἄἰἰεὔὔ ἔἄε᐀ ἔἄÝἄ ἰά ÷ñçὀεῖῖὀῖ᐀όἄὀ ὀεὸ ἄὀἰἄὀὀçὀἄð δῖὀ ὀἄὸ δἄñÝ÷ἄε ἄεἄ ἰά ἄἄβὸἄ ὀεὸ ἡὀεῖ᐀όἄεð ὀῖὀ ὀεέειύ ὀἄὸ. Ἄἰ ἄἰ ἄβὸὀἄ ὀβἄῖὀῖῖ ἄεἄ ὀεὸ ἡὀεῖ᐀όἄεð ἰεἄð εὔ᐀᐀ὸἄδ ἄδÝεὀἄὀçð, βὀῖð ἰά ὀεὸ ἄñἄβὸἄ ὀðὀῖὖÝἰἄð δὔῖὖ ὀçῖῖ βἄεἄ ὀçῖ εὔ᐀᐀ὸἄ. ὀὀῖçεεὀῖÝῖἰ IRQ ἄβῖἄε ὀά 3, 5 ἔἄε 7 ἄῖ᐀ ἰε εýñἄð IO ὀὀῖ᐀Ềῖð ἄñὔὀῖὀἄε ὀð Ἀεἄἄἰἄἄεῖῖβ ἄñεῖῖῖβ, ð.÷. 0x330.

ὀἄὸ ὀὀῖὀὀῖῖῖἰ ἰά ἄñὔ᐀ἄὀἄ ᐀ ἰά ἄεðὀ᐀᐀όἄὀἄ ὀεὸ δεçñῖὀῖñ᐀Ềð ἄὀὀÝð δñεί ὀçῖ Ἀεάὸὔόαὸç ὀῖὀ FreeBSD. ὀἄἰ ὀðῖἄἄεἄἰἄ, ἰðῖñἄβὸἄ ἰά ÷ñçὀεῖῖὀῖ᐀όἄὀ ὀῖἰ ὀβῖἰἄεἄ ὀðῖð ὀῖὖ δἄñἄεὔὀὀ:

Δβῖἄεἄð 2-1. ὀðῖἄἄεἄἰἄ Ἀδῖανὰὸ᐀ ὀόὀεἄὀ᐀ῖ

¼ῖῖἰἄ ὀόὀεἄὀ᐀ð	IRQ	IO εýñἄð	ὀçῖἄε᐀ὀἄεð
Δñ᐀ὀῖð ὀεεçñῖὔð Ἄβὀεῖὀð	N/A	N/A	40 GB, ὀçð Seagate, master ὀὀῖ δñ᐀ὀῖ IDE
CDROM	N/A	N/A	slave ὀὀῖ δñ᐀ὀῖ IDE
Ἀἄýὀἄñῖð ὀεεçñῖὔð Ἄβὀεῖὀð	N/A	N/A	20 GB, ὀçð IBM, master ὀὀῖ ἄἄýὀἄñῖ IDE
Δñ᐀ὀῖð Ἀεἄἄεð᐀ð IDE	14	0x1f0	
Ἰὔ᐀᐀ὸἄ Ἀεέὀýῖὀ	N/A	N/A	Intel 10/100
Modem	N/A	N/A	3Com® 56K faxmodem, ὀçῖῖ COM1
...			

¼ὀἄἰ ὀἄεἄε᐀ὀἄὀ ὀçῖῖ Ἀδῖανὰὸ᐀ ἄἰάν᐀ῖὔὀῖὖ ὀῖὀ ὀδῖειῖεό᐀ ὀἄὸ, εἰ δñÝðáε ἰά ἄεÝἄἰἄὀἄ ἄἰ ὀἄεñεὔἄεῖὀῖ ἰἄ ὀεὸ ἄδἄε᐀ὀἄεð ὀεέειύ ὀçð ὀἄἰὀçð FreeBSD δῖὀ ὀεῖðἄýἄὀἄ ἰά Ἀεἄἄὀ᐀ὀἄὀ.

2.3.2 Ἰñἄὀ᐀ὀἄ Ἀἰὀβἄñἄὀἄ Ἀὀὀἄεἄβἄð ὀῖὖ ἈἄἄñÝῖῖ ὀἄὸ

Ἄἰ ἰ ὀδῖειῖεό᐀ ὀὀῖῖ ἰðῖ᐀ῖ ἔἄ Ἀεἄἄὀ᐀ὀἄὀ ὀῖ FreeBSD δἄñεÝ÷ἄε δῖεýὀεῖἰ ἈἄἄñÝῖἰἄ, Ἀἄἄἄεὔεἄβὸἄ ὀεὸ ὀ ÷ἄὸἄ Ἰñἄὀ᐀ὀἄε ἄἰὀβἄñἄὀἄ ἄὀὀἄεἄβἄð ὀἄ ἰðῖ᐀ῖ ἰὔεεὀὀἄ ὀ ÷ἄὸἄ ἄεÝἄἰἄε ὀεὸ ἄῖὀεἄýῖὀῖ, δñεί Ἀεἄἄὀ᐀ὀἄὀ ὀῖ FreeBSD. ὀῖ δñῖἄñἄἰἰἄ Ἀεἄἄὀ᐀ὀἄὀçð ὀῖὀ FreeBSD εἰ ὀἄὸ ἡὀ᐀᐀ὀἄε δñεί ἄñὔ᐀ἄε ἰὀεἄ᐀ðῖὀἄ ὀὀῖ ἄβὀεῖ ὀἄὸ, ἄεεὔ ἄðῖ ὀç ὀὀεἄἰ᐀ δῖὀ ç ἄεἄἄεἄὀ᐀ῖ ἄὀ᐀ ἰἄεῖ᐀ὀἄε, ἄἰ ὀðὔ᐀ ÷ἄε ἄὀἰἄὀὀὀçὀἄ ἄδεὀὀῖὀð.

2.3.3 Ἀδῖὀἄὀ᐀ὀἄ δῖὀ ἔἄ Ἀεἄἄὀ᐀ὀἄὀ᐀ὀἄ ὀῖ FreeBSD

Ἄἰ ἔÝεἄὀἄ ὀῖ FreeBSD ἰἄ ÷ñçὀεῖῖὀῖ᐀ὀἄε ἰεὔεεçñῖ ὀῖ ὀεεçñῖ ὀἄð ἄβὀεῖ, ἄἰ ὀðὔ᐀ ÷ἄε εὔὀε ὔεεῖ δῖὀ δñÝðáε ἰἄ εὔἰἄὀἄ ἄὀ᐀ ὀç ὀὀεἄἰ᐀ — ἰðῖñἄβὸἄ ἰἄ δἄñἄεἄβὀἄὀ ἄὀὀῖ ὀῖ ὀῖ᐀ἰἄ.

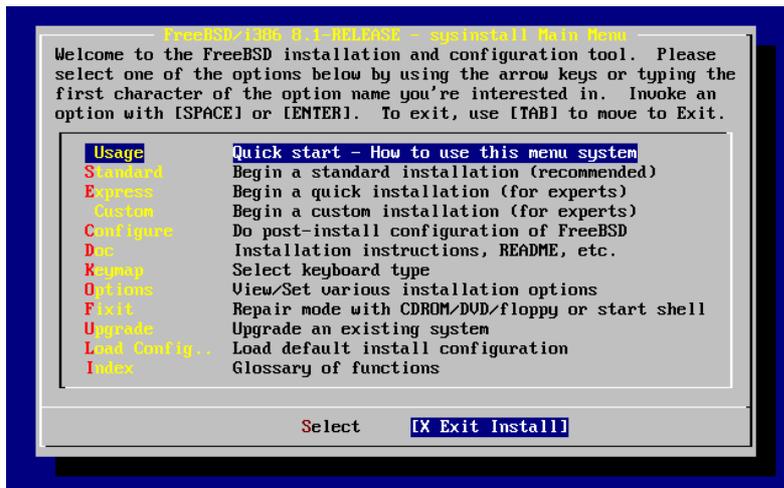
Ἄἰ ὀὀὀὀῖ ἔÝεἄὀἄ ὀῖ FreeBSD ἰἄ ὀὀῖðὔ᐀ ÷ἄε ἰἄ ὔεεἄ εἄεὀῖὀỄἄεὔ ὀὀὀ᐀ῖἄὀἄ, δñÝðáε ἰἄ ἔἄὀἰἄἄβὸἄ ÷ῖἄñεῖὔ ὀῖ ὀñὔῖ ἄεὔὀἄἰçð ὀῖὖ ἈἄἄñÝῖῖ ὀὀῖ ἄβὀεῖ, ἔἄε ὀεὸ ἄδεἄñὔὀἄεð δῖὀ ἰðῖñἄβ δñῖἄεÝὀἄε.

Άί άδέέÛίάόά ùò ÷ þñá United States, έá ÷ ñçòείηðίέçέάß ç òððìðίέçìÛίç Άìñέέάίέέþ äéÛόάίç ðέçέòñìέίáßìò. Άί άδέέÛίάόά äéáòìñáòéέþ ÷ þñá, έá ììòάίέóόάß òì ðáñáéÛòù ìáñý. × ñçòείηðίέþóόά òá äáéÛέέá äéá íá άδέέÛίάόά òç òúòð äéÛόάίç ðέçέòñìέίáßìò έάé ðéÛóόá Enter.

Ó ÷ Ðιά 2-4. Άðέέñþ ìáñý ðέçέòñìέίáßìò



Ó ÷ Ðιά 2-5. ΆðέέÛίόά ñáì áðù òì Sysinstall



× ñçòείηðίέþóόά òá äáéÛέέá äéá íá άδέέÛίάόά Exit Install áðù òì ìáñý Main Install. Έά äáßðά òì äéüέìòèì ìðίόίá:

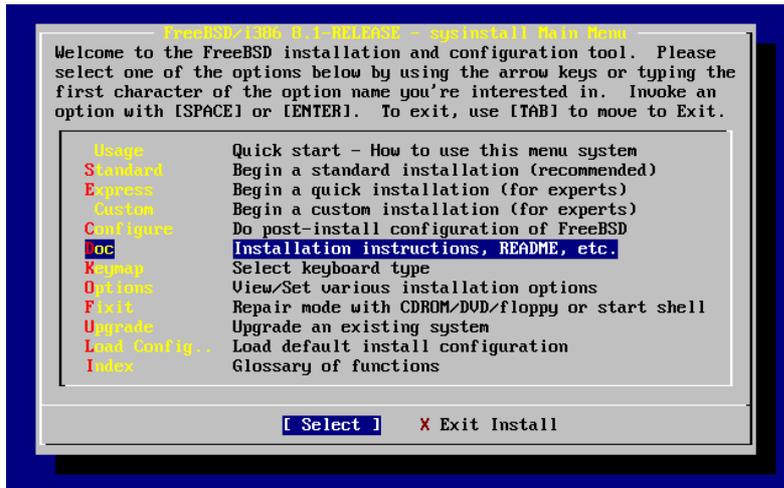
```

User Confirmation Requested
Are you sure you wish to exit? The system will reboot

[ Yes ]   No
    
```

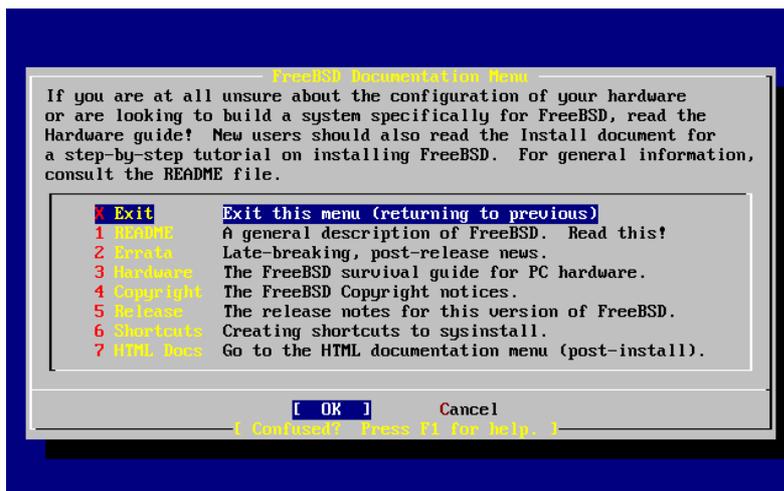
Ïì ðñúáñáìá äáéáòÛóόάóçð έá ìáέέíþóáé ìáñÛ, áí άδέέÛίάόά [Yes] έάé áòþóόά òì CDROM òòìñ ìáçáü έáòÛ òç äéÛñέέá òçð áðáíáέέßίçóçð.

Ó÷ Ðíá 2-7. ÁðééÝáííóáð ôí Ìáíý Documentation



Áðôü èá äãßíäé ôí Ìáíý Documentation.

Ó÷ Ðíá 2-8. Ôí Ìáíý Documentation ôí Sysinstall



Áßíáé óçíáíóééü íá äéááÛóáðâ óçí ðáñã ÷üíáíç ðáèìçñßüóç.

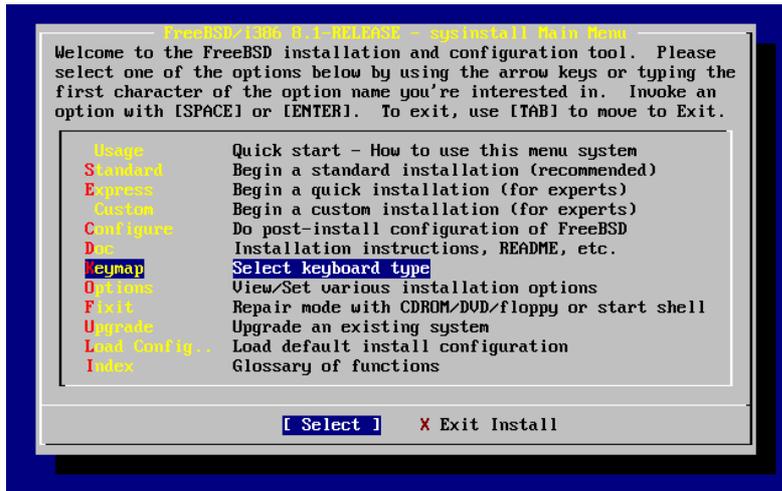
Áéá íá äãßóâ Ýíá Ýããããöí, áðééÝíóá ôí ìá óá äãéÛééá éáé ðéÝóóá **Enter**. ¼ðáí ðãéãéðóáðâ óçí áíÛáíóóç áíüð äããñÛöíð, ðéÝæííóáð **Enter** èá áðéóðñÝðáðâ óðí ìáíý Documentation.

Áéá íá áðéóðñÝðáðâ óðí Êðñßüð Ìáíý ÁãéáðÛóóáçð, áðééÝíóá **Exit** ìá óá äãéÛééá éáé ðéÝóóá **Enter**.

2.5.2 ÁðééÝáííóáð ôí Ìáíý Keymap (ÄéÛóáíç Ðéçéðñíëíãßíö)

Áéá íá äééÛíáðâ óç äéÛóáíç ðíð ðéçéðñíëíãßíö, ÷ñçóéíðíéðóáð óá äãéÛééá áéá íá áðééÝíóáð Keymap áðü ôí ìáíý éáé ðéÝóóá **Enter**. Áðôü áðáéóáßóáé ìüíí áí ÷ñçóéíðíéãßóáð äéÛóáíç ðéçéðñíëíãßíö ðíð äãí áßíáé óóÛíóáñ éáé áðßóçð áéá äéáðÛíáéð äéôüð óçð Áããééëð ÇÐÁ.

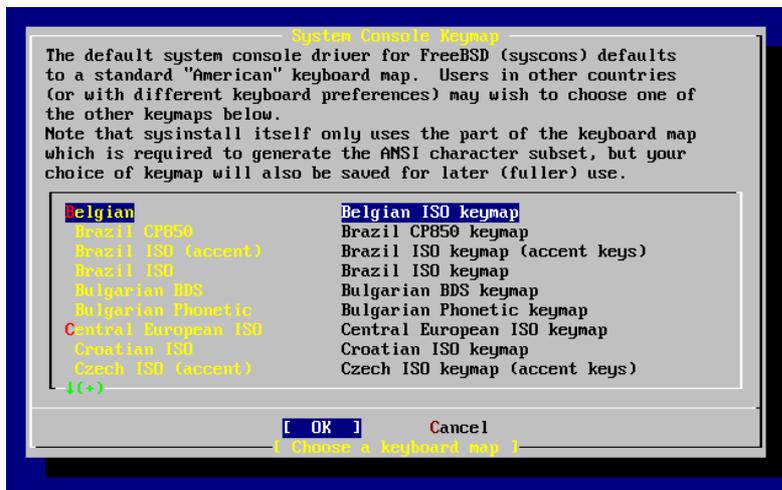
Ó÷ Ðíá 2-9. Êýñéí Ìáñý Æäéäéóðíóäð (Sysinstall Main Menu)



Ìðíñáðá íá äðéÝíäðä äéäöíñáðééð æÛðáíç ðéçéðñíéíáðíð éÛííóäð ðçí áíððóðíé÷ç äðééíáð áðü ðí ìáñý ÷ñçóéñðíéðíóäð ðá ääéÛééá, éáé ðéÝáííóäð **Space**. ÐéÝáííóäð íáíÛ **Space** éá éáðáñáðóäðä ðçí äðééíáð. ¼ðáí ðáéäéðóäðä, äðééÝíðä [OK] ìä ðá ääéÛééá éáé ðéÝóðä **Enter**.

Óðçí ðáñáéÛòð äðäééñíéóç ðçð íéñíçð ðáðíáðáé ìñí ìÝñíð ðçð éððóäð. Áí äðééÝíðä [Cancel] ðéÝáííóäð ðí **Tab** éá ÷ñçóéñðíéðíóäðä ðçí ðñíáðééáìÝíç æÛðáíç ðéçéðñíéíáðíð éáé éá äðéóðñÝóðäð ððí Êýñéí Ìáñý Æäéäéóðíóäðð.

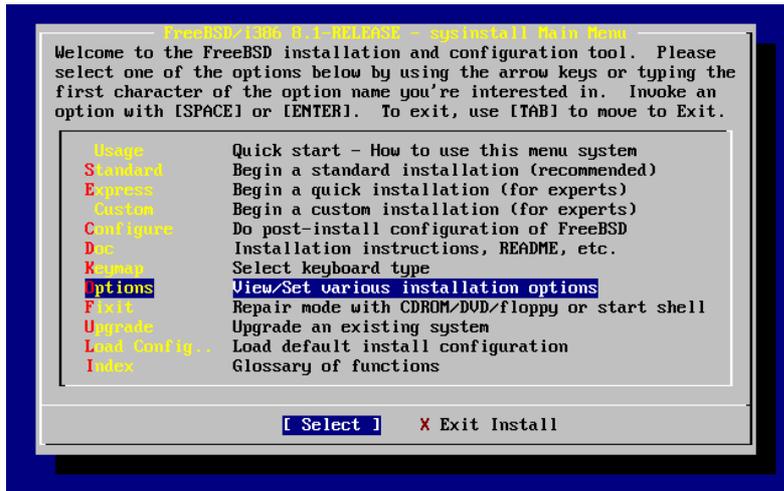
Ó÷ Ðíá 2-10. Õí Ìáñý Keymap ðíð Sysinstall



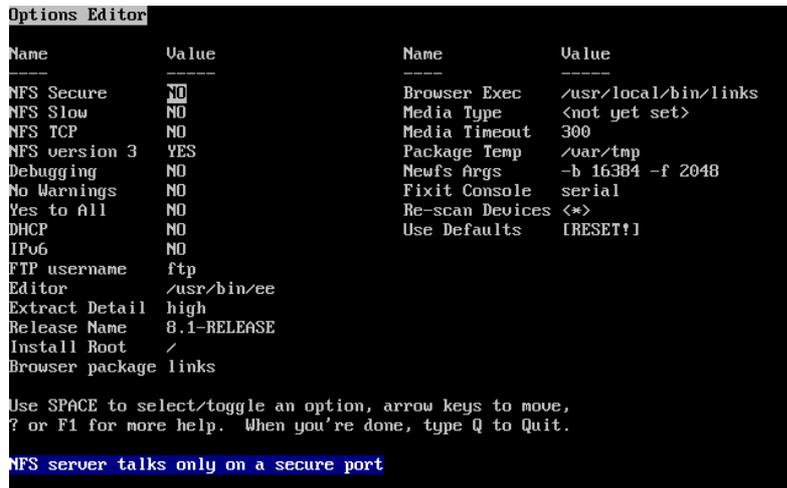
2.5.3 Ç Ìéñíç Installation Options (Äðééíáðí Æäéäéóðíóäðð)

ÄðééÝíðä Options éáé ðéÝóðä **Enter**.

Ó ÷ Ðíá 2-11. Ôí Êýñéí Ìáñý ðíó Sysinstall



Ó ÷ Ðíá 2-12. ÅðéëíãÝð ðíó Sysinstall (Options)



Íé ðñíáðéääíÝíáð ðéíÝð áβíáé óíÐεùð óúóóÝð áéá ðíòð ðáñéóóúðáñíòð ÷ ñÞóðáð éáé ááí ÷ ñáéÛæáðáé íá áééá ÷ èíýí. Ôí ùñíá ðçð Ýéáíóçð (Release Name) áééÛæáé áíÛéíáá íá ðçí Ýéáíóç ðíó áãéáεΒóóáðáé.

Ôðí εÛòù íÝñíð ðçð ðéùíçð, áíðáíβæáðáé íá ðííéóíÝíí íðεá ÷ ñÞíá ç ðáñéáñáðÞ ðíó áðééääíÝííó áíðééáéíÝííó. ÐáñáóçñÞóðá ùéé íéá áðü ðéð áðéëíãÝð áβíáé ç Use Defaults ç íðíβá áðáíáóÝñáé ùéáð ðéð ðéíÝð óóéð áñ ÷ ééÝð ðñíáðéääíÝíáð ðíòð ñðéíβóáéð.

ÐéÝóðá ðí F1 áéá íá áéááÛóáðá ðçí ðéùíç áíÐεáéáð ó ÷ áðééÛ íá ðéð áéÛóíñáð áðéëíãÝð.

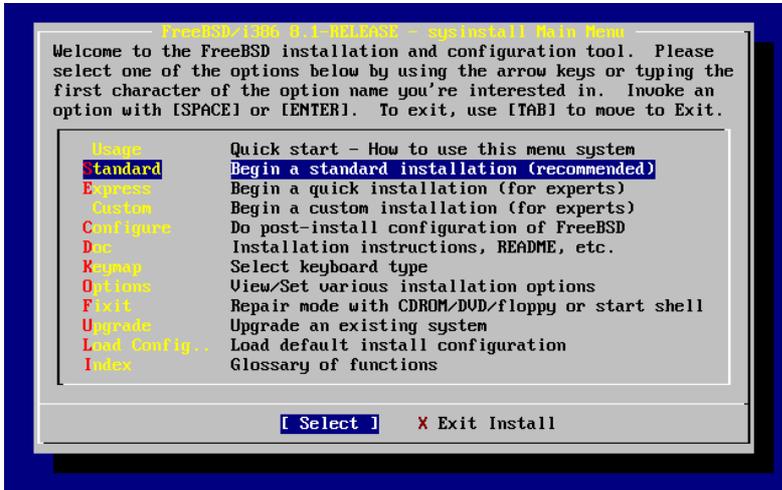
ÐéÝáííóðá ðí Q éá áðéóðñÝðáðá óðí Êýñéí Ìáñý ÅãéáðÛóóáóçð.

2.5.4 ÌáêéíÞóðá ìéá ÔððééÞ ÅãéáðÛóóáóç (Standard Installation)

Ç Standard áãéáðÛóóáóç áβíáé ç áðéëíãÞ ðíó óðíβóóáðáé áéá ðíòð íÝíòð ÷ ñÞóðáð ðíó UNIX Þ ðíó FreeBSD.

× ñçóëíðñíëðóäð óá äãëÛëéá äéá íá äðëéÝíáðá Standard áðu ðí íáñíý, éáé ðéÝóðá Enter äéá íá íáëéíðóäðð ðçí äãëáðÛóðáóç.

Ó ÷ Ðíá 2-13. Æëëßíçóç ðçð Óððëéðð ÆãëáðÛóðáóçð (Standard Installation)



2.6 Æ ÷ ðñçóç × ðñíð óðí Æßóëí

Ïí ðñðíí óáð áÐíá äßíáé íá äê ÷ ùñðóäð ÷ ðñí äßóëíð äéá ðí FreeBSD éáé íá äçíëíðñáðóäð íéá äðééÝóá (label) óðí ÷ ðñí áððu ðóäð íá ðñíÝóáé íá ðíí ðñíáðñíÛóáé ðí sysinstall. Äéá ðí óéíðñ áððu ðñÝðáé íá áñññæáðð ðíí ðññðñí íá ðíí ðñíðñí ðñáñíÝíáé ðí FreeBSD íá äñáé ðéð ðççñíðññßáð óðí äßóëí.

2.6.1 Æñßëíçóç ðñí Æßóëí ðí ÆÛóç ðí BIOS

ðñéí äãëáðáóððóäðð éáé ñðëíßóððð ðí FreeBSD óðí óýóðçíá óáð, ððÛñ ÷ äé Ýíá óçíáíðéëù ðÝíá ðí ðñíðñí ðñÝðáé íá áñññæáðð, äéáéëÛ áí Ý ÷ äðá ðñééíýðð óéççñíýðð äßóëíðð.

Óá Ýíá PC ðí ðñíðñí ÷ ñçóëíðñíëáß éáéðññáéëù óýóðçíá ðí ðñíðñí áñáñðÛóáé áðu ðí BIOS, ùðð ðñíáé ðí MS-DOS ð óá Microsoft Windows, ðí BIOS äßíáé óá ðÝóç íá óðíðñáñÛíáé ðç óáéñÛ ðñíðñáñáéùðçððð ðñí äßóëíðñí éáé ðí éáéðññáéëù óýóðçíá áðñðð óðíáááßæáé íá áððð. Áððu äðéðñÝðáé óðí ÷ ñðóçç íá äëééíðóáé áðu Ýíá äßóëíðñí äéáðññáðéëù áðu áððñí ðñí ðð ÷ íÛ éáéíýíá “primary master”. Áððu äßíáé éáéáßððñá äñééëù äéá éÛðñíéíðð ÷ ñðóððð ðñí Ý ÷ ðñí áñáéáéýðáé ùðé ðñí ðñíéùððñíð éáé ðççíñððñíð ðññðñíð íá Ý ÷ ðñí Ýíá áñðñáñáñí áóóáéáßáð ðñíð óðóððñáçíð ðñíð, äßíáé íá áñññÛóíðí Ýíá äáýðáñí ùñíéíðñí äßóëíðñí, éáé íá áñðéáñÛóíðí áñÛ óáéðÛ äéáðððñáðá ðñí ðññðñí ðñíð äßóëíðñí ðñí äáýðáñí ÷ ñçóëíðñíëáßðð ðññáñÛíáðá ùððð ðí Ghost® ð ðí XCOPY. ðçé, áñ ðññðñíð äßóëíðñí ÷ äéÛóáé, ð äá ÷ éáß áððñáçç áðu éù, ð ðáñíðóéÛóáé ðññáéçíá áñáéóßáð éÛðñíéíðñí äéáððñíáçíð ðñíð éáéðññáééíýðð óðóððñáçíð, ð ÷ ñðóççç ðñíñáß áýéíéá íá äðáíáéÝñáé ðí óýóðçíá ñðëíßæííððð ðí BIOS íá áñðéóðñÝðáé ðç éñáééðñí ðñíð ðñíð äßóëíðñí. Äßíáé óáí íá áñðéíáðéÝðñíð ðç óáéñÛ ðñíð éáéùáßñíð óðíðð äßóëíðñíð áéëÛ ÷ ùññð íá ÷ ñáéÛæáðáé íá áññññíðñí ðñí éíððß.

Óá ðñí áéñéáÛ óðóððñáçíð íá äéááéðÝðð SCSI, óð ÷ íÛ ðñáñééáñáÛíðñí áðáéðÛóáéðð ðñíð BIOS ðñíð äðéðñÝðñíð ðçí áééááð ðçð äñßëíçóçð ðÝ ÷ ñé áððÛ äßóëíðñí SCSI, íá ðñáññíñíð ðññðñíð.

Íáð ÷ ñðóçççç áññéáéëùÝíð ðñíð ðçíð ðáñáðÛíù äðíáðñíðççá, ðñíñáß íá äñáéáß ðñíð äéððñáçíð ùðáí ðá áðñíðéÝóíáðá íá ðñíð FreeBSD äáí äßíáé óá áñáíáññáíá. Ïí FreeBSD äáí ÷ ñçóëíðñíëáß ðñíð BIOS éáé äáí áñññæáé ðçí “éáðÛ ðñíð BIOS éñáééðñíð

εέΰοάις ούι ιάαβπ". Άδου ιδιναβ ία ιάαβπάε οά εάεαβδανά δανβδειεάο εάοάοδΰοάεο, εεάεΰ άί ιε αβόειε Ύ÷ιοί δανιιέα ααυιαδνβά εάε Ύ÷ιοί αδβόαο οά βεάε ααανΎία (αβίαε ι Ύίαο εεβπιδ οιο ΰεειο).

¼οάί ÷ ηςοειιδιεάβδά δι FreeBSD αδεοδνΎοάα οαί οάενΰ ούι ιάαβπ οοι BIOS οοαί οοοειεεεεβ οιοδ δνεί ααεάοάοδπάοα δι FreeBSD εάε αοβόα οαί Ύοοε. Άί δνΎδαε ία ίαίεεΰιαοά οιοδ αβόειοδ ιαοαίγ οιοδ, εΰιόα οι εεεΰ ια οι αγοειε ονυδι: αινβιόα οι ειροβ εάε εεεΰιόα εΎοάεο οάα jumpers (ανά÷δεοεευοπνάο) εάε οάα εάεβεά.

Ιέα Εόοιηβά αδύ οά Άν÷αβά ούι Άίαεναόεεβι Δανέδαοάεβι οιο Bill εάε Fred:

Ο Bill εεάεγάε Ύία δάεεΰ ις÷ΰιαία Wintel εέα ία οδεΰιαε Ύία εεΰια FreeBSD ις÷ΰιαία εέα οι Fred. Ι Bill ααεάεεοδΰ Ύία οεεαηυ αβόει SCSI υο οοοεάοβ ια ανεειυ ιαΎί εάε ααεάεεοδΰ οά αοδπ οι FreeBSD.

Ι Fred ίαεειΰ ία ÷ ηςοειιδιεάβ οι ογοοαία, εεεΰ ιαοΰ αδυ ανεαοΎο ιΎναδ δανάοαηαβ υοε ι δάεεΰο SCSI αβόειο αίαοΎναε ανεαοΎ ις εάοάοδνιοεεΰ εΰεα (soft errors) εάε αίαοΎναε οι ααανυδ αοδυ οοι Bill.

Ιαοΰ αδυ ιανεεΎο εεΰια ιΎναδ, ι Bill αδιραοβεαε υοε Ύ÷ε Ύνεεα ε ηνα ία αιδειαδουδβοαε οι δνυαεαία, εάε Ύοοε δεΰιαε Ύία αιδβοιει÷ι SCSI αβόει αδυ οι "αν÷αβι" οοι δβου αυιΰοει. Ιαδ αν÷εεΰο Ύεαα÷ιο αδεοΰιαεαο ααβ÷ιαε υοε ι αβόειο εαεοιονααβ εανιεεΰ, εάε Ύοοε ι Bill ααεάεεοδΰ οι αβόει αοδυ υο SCSI ιιΰαα οΎοοαηά εάε αιδεανΰοαε (ιΎου image) δεβνυδ οά ααανΎία αδυ οι αβόει ιαΎί οοι αβόει οΎοοαηά. Οηνα διο ι ιΎιο αβόειο αβίαε ααεάοαοαίΎιο εάε εαεοιονααβ ουοοΰ, ι Bill αδιραοβεαε υοε αβίαε εαεβ εαΎα ία αν÷βοαε ία οι ÷ ηςοειιδιεάβ, εάε Ύοοε αΰεαε οά αοανιιαβ οα αοιαδουαοα οιο BIOS ία εεεΰεαε οαί ανβειαοα ούι αβόειυ ηοαα οι ογοοαία ία ίαεειΰαε αδυ οι αβόει οΎοοαηά. Οι FreeBSD ίαεειΰαε εάε εαοεαββοαε εανιεεΰ.

Ι Fred οοια÷βεαε οα ιιοεεεΰ οιο εέα ανεαοΎο εεΰια ιΎναδ, εάε ογιοηά ι Bill εάε ο Fred αδιραοβεαειοι υοε Ύ÷ε Ύνεεα ε ηνα εέα ιεα εεΰια δανεδΎοαεά — ηνα ία αίααειβοιοι οοαί ιΎα Ύεαιοα οιο FreeBSD. Ι Bill αοαεηαβ οι αβόει ιαΎί ιεα εάε βοάι εααοηβδ δνιαεααδεεΰο εάε οι αιδεεαεεοδΰ ια Ύία ΰεει υιηει αβόει αδυ οι "αν÷αβι". Ι Bill εαουδει ααεάεεοδΰ οα ιΎα Ύεαιοα οιο FreeBSD οοι ιΎι αβόει ιαΎί ÷ ηςοειιδιεβιδάο δεο ιααεεΎο Internet FTP εεοεΎοαο οιο Fred. Ααεάοΰοοαοα αβιαοαε ÷ υηβδ δνιαεβιαοά.

Ι Fred ÷ ηςοειιδιεάβ οαί ιΎα Ύεαιοα οιο FreeBSD εέα ιανεεΎο ιΎναδ, εάε δεοοιιδιεάβ υοε αβίαε ανεαοΰ εαεβ εέα ÷ ηβρα οοι οιβια ις÷αίεεβδ. ÷εε Ύνεεα ε ηνα ία αιδεανΰοαε υεα οα ιιοεεεΰ οιο αδυ οαί δάεεΰ Ύεαιοα. οοε ι Fred δνιοαηοαβ οι αβόει ια ανεειυ οΎοοαηά (οι οαεαοδαβι αιδβαναοι οαδ δάεεΰο Ύεαιοα οιο FreeBSD). Ι Fred αδιαιαοαυαοαε υοαί αίαεαεγδοαε υοε ααι οδΰν÷ε οβδιοα αδυ οαί δνιαεβι εανιαοα οιο οοι αβόει ια ανεειυ οΎοοαηά.

Διο δβααί οά ααανΎία;

¼οάι ι Bill Ύεαία ουοιαναοεεβ αιδεαναοβ οιο αν÷εειγ SCSI αβόειο ιαΎί οοι SCSI αβόει οΎοοαηά, ι αβόειο οΎοοαηά Ύεαία ι "ιΎιο εεβπιδ". ¼οάι ι Bill ΰεεαία οαί ανβειαοα οοι SCSI BIOS ηοαα ία ιδνιΎοαε ία ίαεειβραε αδυ οα ιιΰαα SCSI οΎοοαηά, αδεβδ εινυεααοα οι ααοδυ οιο. Το FreeBSD ÷ ηςοειιδιεγία εεΰια οα ιιΰαα SCSI ιαΎί. εουδ αοδπ ε εεεααβ οοι BIOS ία δνιεεεΎοαε οαί ιανεεβ π εεεβ ουηουοα οιο εβρεεα Boot π εάε οιο Loader αδυ οι αδεεαανΎι αδυ οι BIOS αβόει, εεεΰ υοαί αίαεΰαιοι οά δνιανΰιαοά ιαβρααοα οιο δονβια οιο FreeBSD ε ανβειαοα οιο BIOS εα αανιεαβ, εάε οι FreeBSD εα αδαίΎεεεα οα οοοειεεεεβ ανβειαοα ούι αβόειυ. Οοι δανΰααεαία ιαδ, οι ογοοαία οοιΎ÷εοα ία εαεοιονααβ οοι αν÷εεΰ SCSI αβόει ιαΎί, εάε υεα οά ααανΎία οιο Fred βοάι εεαβ, εάε υ÷ε οοι SCSI αβόει οΎοοαηά. Οι ααανυδ υοε οι ογοοαία οαειυοαί ία εαεοιονααβ αδυ οι SCSI αβόει οΎοοαηά βοάι αδεβδ Ύία εαοαοεαγαοία οαδ αινηβδεγδ δνιοαρεβαο.

Άβιαοαα αοδδ÷αβδ ία αίαεειβοιοια υοε ααι ÷ ΰεαει εεεΰιο ααανΎία εαοΰ οαί αίαεΰεοα οιο οαεινΎιο αοοιγ. Ι δάεεΰο SCSI αβόειο ιαΎί αίαεοβεαεα αδυ οι ουηυ, εάε υεα ε ανιαοα οιο Fred αδεοδνΰοαεα οά αοδυ (εάε οηνα ι Bill ιΎναε υοε ιδνιαβ ία ιαδνΰαε υο οι ιαΎί).

Άί εάε οαί εοοιηβα αοδπ ÷ ηςοειιδιεβεαει ιααιβ SCSI, ιε αν÷εεο εο ÷γιοι αιβοιο εάε εέα ιααγιο IDE.

2.6.2 Ἀνεξαρτησία τοῦ Slices ἢ × ἢ Πόδες τοῦ Fdisk

Ὁδηγός: Ἐπιλέξτε ἀπὸ τὸ μενού εἰς τὴν ἀνεξαρτησία τοῦ δίσκου τοῦ ὅπου θὰ ἐπιτελεῖται ἡ ἐγκατάσταση. Ἄν ἐπιλέξετε τὸ μενού εἰς τὴν ἀνεξαρτησία τοῦ δίσκου, θὰ ἐπιτελεῖται ἡ ἐγκατάσταση τοῦ δίσκου ὅπου θὰ ἐπιτελεῖται ἡ ἐγκατάσταση τοῦ δίσκου. Ἄν ἐπιλέξετε τὸ μενού εἰς τὴν ἀνεξαρτησία τοῦ δίσκου, θὰ ἐπιτελεῖται ἡ ἐγκατάσταση τοῦ δίσκου. Ἄν ἐπιλέξετε τὸ μενού εἰς τὴν ἀνεξαρτησία τοῦ δίσκου, θὰ ἐπιτελεῖται ἡ ἐγκατάσταση τοῦ δίσκου. Ἄν ἐπιλέξετε τὸ μενού εἰς τὴν ἀνεξαρτησία τοῦ δίσκου, θὰ ἐπιτελεῖται ἡ ἐγκατάσταση τοῦ δίσκου.

Ἄν ἐπιλέξετε τὸ μενού εἰς τὴν ἀνεξαρτησία τοῦ δίσκου, θὰ ἐπιτελεῖται ἡ ἐγκατάσταση τοῦ δίσκου. Ἄν ἐπιλέξετε τὸ μενού εἰς τὴν ἀνεξαρτησία τοῦ δίσκου, θὰ ἐπιτελεῖται ἡ ἐγκατάσταση τοῦ δίσκου.

Message

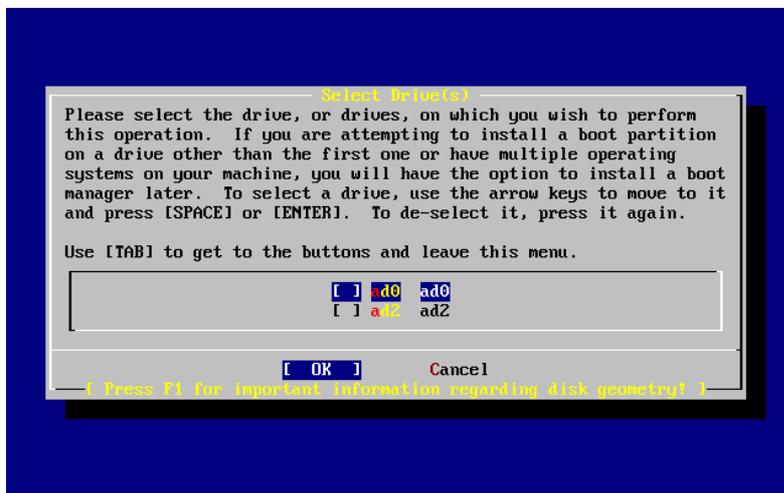
In the next menu, you will need to set up a DOS-style ("fdisk") partitioning scheme for your hard disk. If you simply wish to devote all disk space to FreeBSD (overwriting anything else that might be on the disk(s) selected) then use the (A)ll command to select the default partitioning scheme followed by a (Q)uit. If you wish to allocate only free space to FreeBSD, move to a partition marked "unused" and use the (C)reate command.

[OK]

[Press enter or space]

Ἐπιλέξτε τὸ **Enter** ὅταν ἐπιτελεῖται ἡ ἀνεξαρτησία τοῦ δίσκου. Ἄν ἐπιλέξετε τὸ μενού εἰς τὴν ἀνεξαρτησία τοῦ δίσκου, θὰ ἐπιτελεῖται ἡ ἐγκατάσταση τοῦ δίσκου. Ἄν ἐπιλέξετε τὸ μενού εἰς τὴν ἀνεξαρτησία τοῦ δίσκου, θὰ ἐπιτελεῖται ἡ ἐγκατάσταση τοῦ δίσκου.

Ὁδηγός 2-14. Ἀνεξαρτησία τοῦ Ἄβόει ἢ ἀπὸ τὸ Fdisk



Ἄν ἐπιλέξετε τὸ μενού εἰς τὴν ἀνεξαρτησία τοῦ δίσκου, θὰ ἐπιτελεῖται ἡ ἐγκατάσταση τοῦ δίσκου. Ἄν ἐπιλέξετε τὸ μενού εἰς τὴν ἀνεξαρτησία τοῦ δίσκου, θὰ ἐπιτελεῖται ἡ ἐγκατάσταση τοῦ δίσκου.

Óéäóäâáðá ðé éä áéíúðáí áí äá÷-áðá äýí IDE äáðéíðð, Ýíá ùð master óðí ðñððí IDE äéäãéðð, éáé Ýíá ùð master óðí ääýðáñí IDE äéäãéðð. Áí ðí FreeBSD ðíðð áñéèíýíóá ùððð ðíðð Ýñéóéä, äç. ùð ad0 éáé ad1 ùéä éä éäéðíðñáíýíóáí éáñíééÛ.

Áí ùðð ðñíðéÝðáíä íäðÛ Ýíá ðñððí äáðéí, ùð óðóéäðð slave óðí ðñððí IDE äéäãéðð, áððð éä áéíúðáí ðéÝíí ad1, éáé ç ðñíçáíýííáíç ad1 éä áéíúðáí ad2. Äðäéäð ðá ííúíáðá ðúí óðóéäððí (ùððð ad1s1a) ÷ñçóéíðñíéíýíóáé äéä ðçí áýñáðç ðúí óðóðçíÛðúí áñ÷-äáúí, íðñáâ íá áíáéäéýððáðá íáóíééÛ ùðé éÛðíéá áðú ðá óðóððíáðá áñ÷-äáúí óáð äáí äíðáíâæííðáé éáñíééÛ éáé ðñÝðáé íá äééÛííäðá ðçí ñýèíéðç ðíðð FreeBSD óáð.

Äéá íá íäðáñáðóðá ðí ðñúäéçíá áððú, í ðñððíáðð íðñáâ íá ñðèíéðóðá íá íñíÛæáé ðíðð äáðéíðð IDE áíÛéíáá íä ðçí èÝóç ðíðð, éáé ù÷-é íä ðç óáéñÛ íä ðçí íðñáá áíé÷-íáýííðáé. Íä ðíðð ðñúðí áððú, í master äáðéíðð óðí ääýðáñí IDE äéäãéðð éä äáíáé ðÛíðá, ad2, áéúíá éáé áí äáí ððÛñ÷-áé óðóéäðð ad0 ð ad1.

Ç ñýèíéðç áððð äáíáé éáé ç ðñíäðéäáíÝíç äéä ðíðð ðñððíáðð ðíðð FreeBSD, éáé äéä ðí éüáí áððú ç ðéúíç ääá÷-íáé ad0 éáé ad2. Õí íç÷-Ûíçíá áðú ðí íðñíâí èððèçéä ç áééúíá äá÷-ä äáðéíðð master éáé óðíðð äýí äéäãéððÝð IDE, áñð äáí äá÷-ä éáíÝíá äáðéí slave.

ðñÝðáé íá äðééÝíáðá ðí äáðéí óðíðð íðñíâí éä äáíáé ç ääéäðÛðóáðç ðíðð FreeBSD éáé íá ðéÝíóáðá [OK]. Õí **FDisk** éä íäééíððáé, íä ðéúíç áíððððíé÷ ç íä áððð ðíðð óáííáðáé óðí Õ÷-ðíá 2-15.

Ç ðéúíç ðíðð **FDisk** äáíáé ÷-ùñéóíÝíç óá ðñáá ðíðíáðá.

Õí ðñððí ðíðíá, ðí íðñíâí éáéýððáé ðéð äýí ðñððáð áñáñíÝð ðçð ðéúíçð, ääá÷-íáé éäððñÝñáéäð äéä ðíðð äðééäáíÝíí äáðéí, ðíðð ðáñééáíäÛíðí ðí ùñíá ðíðð óðí FreeBSD, ðç äáúíäðñáá ðíðð, éáé ðí ððñíééú íÝäáéíð ðíðð.

Õí ääýðáñí ðíðíá ääá÷-íáé ðá slices ðá íðñíâá ððÛñ÷-íðí óðí äáðéí ðç äááñÝíç óðéäðð, ðá ðçííáâá ðáá íðñíâá íäééíýíí éáé óáéäéðñíðí, ðúóí íäáÛéä äáíáé, ðçí íñíáðáá ðíðð Ý÷-íðí óðí FreeBSD éáé ðçí ðáñéäñáðð ðíðð éáé ðíðð ðýðí ðíðð. Õí ðáñÛäáéäíá áððú ääá÷-íáé äýí íééñÛ á÷-ñçóéíðñíçðá slices, ðá íðñíâá äáíáé ðáñáíÝñáéäð ðíðð ðñúðíðð äéÛðáíçð ðúí äáðéíðð ðáá PC. Ääá÷-íáé äðððçð Ýíá íäáÛéí FAT slice, ðí íðñíâí óáííáðá äíðáíâæííðáé ùð c: ðáá MS-DOS éáé Windows, éáéðð éáé íéä äéðáðáíÝíç éáðÛðíçðç ç íðñíâá íðñáâ íá ðáñéÝ÷-áé éáé Ûééä áñÛííáðá íäçáðí äéä ðí MS-DOS ð ðá Windows.

Õí ðñððí ðíðíá, ääá÷-íáé ðéð áíðíéÝð ðíðð äáíáé äéäéÝóéíáðð óðçí **FDisk**.

Õ÷-ðíá 2-15. ÕððééÝð Fdisk Éáðáðíðáéð ðñéí ðçí Äðáíäñááðá

```

Disk name:      ad0                      FDISK Partition Editor
DISK Geometry: 16383 cyls/16 heads/63 sectors = 16514064 sectors (8063MB)

Offset      Size(ST)      End      Name PType      Desc  Subtype  Flags
-----
0           63           62      -    6      unused     0
63         4193217      4193279  ad0s1 2        fat       14      >
4193280     1008        4194287  -     6      unused     0      >
4194288    12319776    16514063 ad0s2 4        extended  15      >

The following commands are supported (in upper or lower case):
A = Use Entire Disk      G = set Drive Geometry  C = Create Slice      F = `DD' mode
D = Delete Slice        Z = Toggle Size Units   S = Set Bootable     I = Wizard m.
T = Change Type         U = Undo All Changes    Q = Finish

Use F1 or ? to get more help, arrow keys to select.
    
```

Õí ðé éä éÛííáðá ðñáá áíáñðÛðáé áðú ðí ðúð èÝéäðá íá ÷-ùññóáðá ðí äáðéí óáð.

Ó ÷ Ðíá 2-19. ÆðáíñááóðÐò Disklabel ðí Sysinstall

```

FreeBSD Disklabel Editor
Disk: ad0      Partition name: ad0s1  Free: 16514001 blocks (8063MB)

Part      Mount      Size Newfs  Part      Mount      Size Newfs
-----

```

The following commands are valid here (upper or lower case):
C = Create D = Delete M = Mount pt.
N = Newfs Opts Q = Finish S = Toggle SoftUpdates Z = Custom Newfs
T = Toggle Newfs U = Undo A = Auto Defaults R = Delete+Merge

Use F1 or ? to get more help, arrow keys to select.

Ïí Disklabel ðñíñáß íá äçëíññáßáé áððííáðá éáðáðíßáéð áéá áóÛð, éáé íá ðíðð áðñáßáé ðñíáðééááíÝíáð ðéíÝð. Ìé ðñíáðééááíÝíáð ðéíÝð ððñíáßáéííóáé íá ççí áíßáéá áíñð áíóííáðííÝíð éáéíñéóííÝ íáááèðí, í ðñíáð áðñáßáé íá áÛóç ðí ÌÝááèíð ðíð áßóèíð. ÆíéíÛóðá ðí ðñíá ðéÝáííóáð ðí A. Èá ááßðá íéá íéííç ùííéá íá áððííá ðí Ó ÷ Ðíá 2-20. ÁíÛéíáá íá ðí ÌÝááèíð ðíð áßóèíð ðíð ÷ ñçóéííðñéáßðá, íé ðñíáðééááíÝíáð ðéíÝð ðñíñáß íá áßíáéß P éáé íá íçí áßíáé éáðÛéççéáð. Áððíí ááí Ý ÷ áé ççíáóßá, áéáðß ááí ÷ ñáéÛáéðáé íá ðéð áðñá ÷ éáßðá.

Ïçíáßóç: Ì ðñíáðééááíÝíð ðñíðñíð éáðÛðíççð áðñáßáéé óðíí éáðÛéíáí /tmp ðçí áééß ðíð éáðÛðíççð áíðß íá ðíí éáééóðÛ ÌÝñíð ðçð éáðÛðíççð /. Áððíí áíçéÛáé óççí áðñóðáß ðéßññóçð ðçð éáðÛðíççð / íá ðñíóíñéíÛ áñ ÷ áßá.

Ó ÷ Ðíá 2-20. Ì ÆðáíñááóðÐò Êáðáðíßáéí Disklabel ðí Sysinstall íá ðéð Áððííáðáð ðñíáðééíáÝð

```

FreeBSD Disklabel Editor
Disk: ad0      Partition name: ad0s1  Free: 0 blocks (0MB)

Part      Mount      Size Newfs  Part      Mount      Size Newfs
-----
ad0s1a    /           422MB UFS2     Y
ad0s1b    swap        321MB SWAP
ad0s1d    /var        710MB UFS2+S Y
ad0s1e    /tmp        377MB UFS2+S Y
ad0s1f    /usr        6232MB UFS2+S Y

```

The following commands are valid here (upper or lower case):
C = Create D = Delete M = Mount pt.
N = Newfs Opts Q = Finish S = Toggle SoftUpdates Z = Custom Newfs
T = Toggle Newfs U = Undo A = Auto Defaults R = Delete+Merge

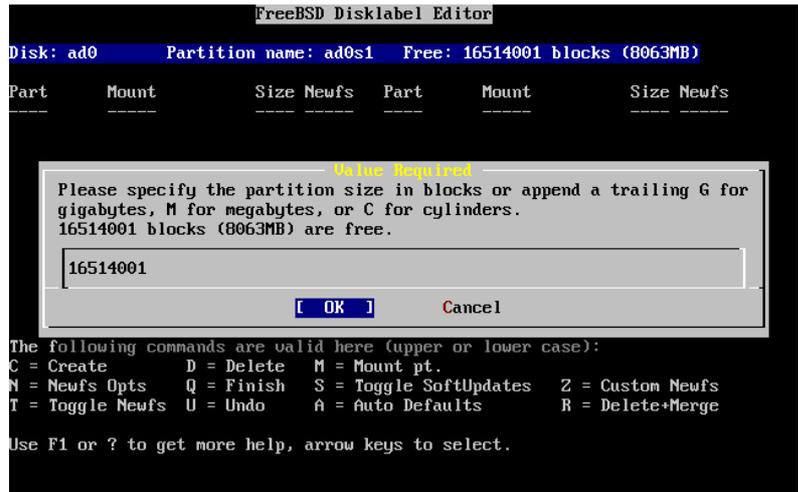
Use F1 or ? to get more help, arrow keys to select.

Áí áðééÝíáðá íá íç ÷ ñçóéííðñéáßðá ðéð ðñíáðééááíÝíáð éáðáðíßáéð éáé èÝéáðá íá ðéð áíðééáðáððáðá íá ðéð

áëéÝð óäð, ÷ ñçóëíðñéÞóäð óá ááëÛëéá áéá íá áðëéÝíáðð ðçí ðñÞðç éáðÛðñçóç éáé ðéÝóðð **D** áéá íá ðç óáÞóäð. ÁðáíáëÛááðð áéá íá óáÞóäð üëäð ðéð ðñíóáëííáíáð éáðáðñéÞóäð.

Áéá íá äçíëíðñáÞóäð ðçí ðñÞðç éáðÛðñçóç (a, (ç íðñíá ðñíóáñðÛðáé ùð / — root), ááááëùëáßðá üðé Ý÷áðá áðëéÝíáé ðí óóðóñ slice ðñí ðÛíü ÛÝñíð ðçð ðëííçð, éáé ðéÝóðð **C**. Èá àñóáíéóðáß Ýíá ðëáßóëí áéáëñáñ áéá íá áéóÛááðð ðí ÛÝááèð ðçð íÝáð éáðÛðñçóçð (üðòð óáßíáðáé óðí Ó÷Þíá 2-21). Ìðñáßðá íá áéóÛááðð ðí ÛÝááèð ùð ðñí áñëéñí ðñí ðáßóëíð ðñí ðéÝéáðð íá ÷ ñçóëíðñéÞóäð Þ ùð áñëéñí áéíëíðëíÝíáíí áðñ **M** áéá megabytes, **G** áéá gigabytes, **P** **C** áéá éðëßíáñíðð.

Ó÷Þíá 2-21. Áéáëñáñíð ×Þñíð áéá ðçí ÊáðÛðñçóç Root



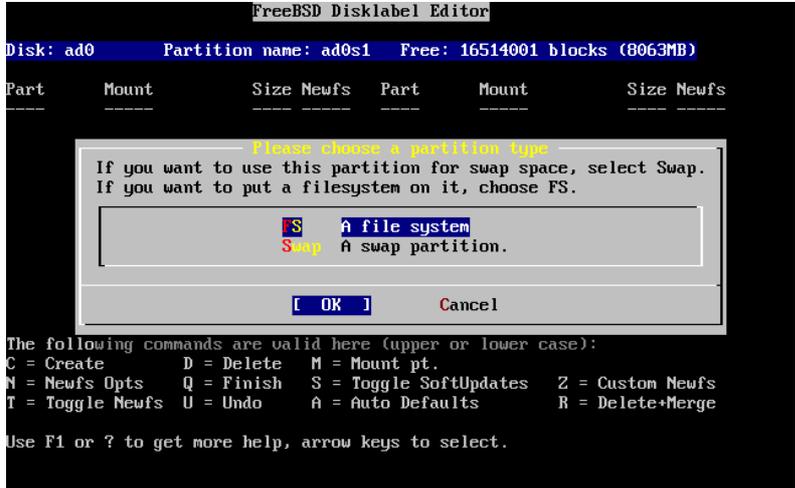
Ïñ ðñíáðëéááñ Ýñí ÛÝááèð ðñí óáßíáðáé éá äçíëíðñáÞóäé íéá éáðÛðñçóç ðñí éáðáéñáñÛíáé üëí ðñí ððñéíëðñí áéáëñáñí ÷Þñí ðñí slice. Áí ÷ ñçóëíðñéáßðð óá íááÝçð ðñí éáðáðñéÞóäñí ðñí ðáñéáñÛðáíá óðí ðñíçáñÝíáíí ðáñÛááéñáí, óáÞóäð ðñí áñëéñí ðñí óáßíáðáé íá ðñí **Backspace**, éáé ðëçððññéíáÞóäð **512M**, üðòð óáßíáðáé óðí Ó÷Þíá 2-22. Êáðñðëí ðéÝóðð [OK].

Ó÷Þíá 2-22. Áðáíáñááóßá ÌááÝéíðð ðçð ÊáðÛðñçóçð Root



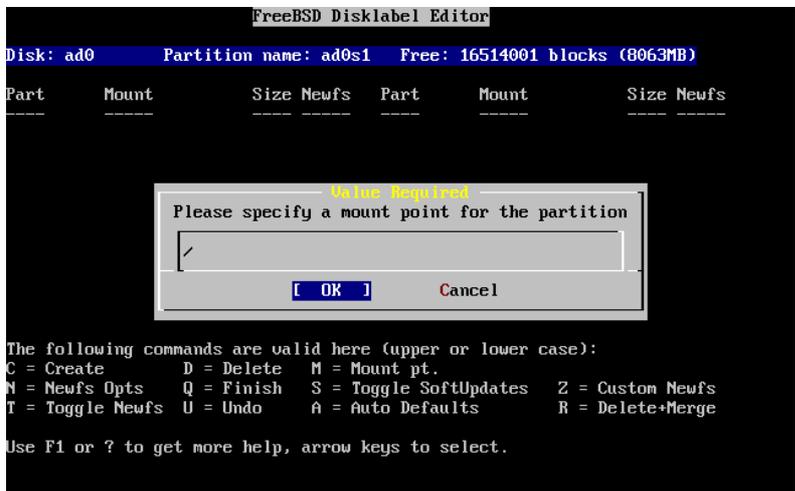
÷ ηδάο ἀδεέΥίαι οι ιΥάειο δσο εάοÛοιςσο, εά ανυοεαβδία εάουδει αέα οι άί ς εάοÛοιςσο εά δανέΥ ÷ αε εÛθει όύοδία αν ÷ αβυι, Ρ εά αβίαε ÷ ηνιο swap. Ι εεÛειαιό αόδου οάβιαόάε οοι Ó ÷ Πία 2-23. Ç δηρδς αόδρ εάοÛοιςσο εά δανέΥ ÷ αε όύοδία αν ÷ αβυι, αέα αόδου εεΥίαιό υοε αβίαε ἀδεεανΥη οι FS εάε δεΥόοα **Enter**.

Ó ÷ Πία 2-23. ἈδεέΥίαιό οη Όυοι οσο ΕάοÛοιςσο Root



Όυειο, ἀδαεαΡ αειειοηαβδία όύοδία αν ÷ αβυι, δηΥδαε ία αεεραόα οοι **Disklabel** θιο εΥεαόα ία αβίαε ς δηιοÛηδςοι οιο. Ι αίόβοιε ÷ ρο εεÛειαιό οάβιαόάε οοι Ó ÷ Πία 2-24. Οι οριαβι δηιοÛηδςοδ οσο εάοÛοιςσο root αβίαε οι /, αέα αόδου ανÛοα /, εάε δεΥόοα **Enter**.

Ó ÷ Πία 2-24. ἈδεέΥίαιό οη Όριαβι ΔηιοÛηδςοδ οηο Root



Ç ηειρς εάουδει εά αίαίαιεαβ αέα ία οάο ααβίαε οςί εάοÛοιςσο θιο ηυεέο αειειοηαβραόα. Εά δηΥδαε ία ἀδαίαιεÛααόα αόδρ οςί εεάεεαόα αέα οεο Ûεεαδ εάοάοιραέο. Ξοαί αειειοηαβραόα οςί εάοÛοιςσο swap, ααι εά οάο αεσοεαβ ία ἀδεέΥίαιόα οςίαβι δηιοÛηδςοδ, εαερδ ιε εάοάοιραέο swap ααι δηιοαηδρβιαε θιοΥ. Ξοαί αειειοηαβραόα οςί οαεαόοαβ εάοÛοιςσο, οςί /usr, ιοηαβδία ία αοραόα οι δηιοαεηιαηι ιΥάειο, αέα ία ÷ ηςοειοηιεραόα ηει οηι οδυειεθι ÷ ηηι οηο slice.

Ç òáεάòòάβá ðεúιç òιò FreeBSD Άðáíáñááóòòò DiskLabel, εά äáβ ÷ íáε ùιιέά ðá òçí Ó ÷ Ðíá 2-25, áí εάé ðε äééÝò óáò òεíÝò εά äβίáé äéáòιñáòεéÝò. ÐεÝòά Q äéá òÝεìò.

Ó ÷ Ðíá 2-25. Ì Άðáíáñááóòòò Disklabel òιò Sysinstall



2.7 ΆðééÝáιίίόαò òé εά Άäéáòáóòòòóáòá

2.7.1 ΆðééÝίòά Distribution Set (Óáò ΆäéáòÜóòáóçò)

Ç áðüóáóç äéá òι ðίει distribution set εά ÷ ñçóειιðιεòáòá, áíáñòÜóáé εάòÜ εýñει εüáι áðu òι äβáιò ÷ ñòçò òιò ðç ÷ áíÐíáòιò εάé òιí äéáéÝóει ÷ ðñι òòι äβóει. Ìε ðñιεáειñέóιÝίáð äðεεíáÝò εòιáβñιíðáé áðu òçí äεÜ ÷ εóòç äòíáòò äéáιιñòòòç ðÝ ÷ ñε òçí ðεÐñç. ¼óιέ äβίáé εάéñιýñειé òòι UNIX ð / εάé òòι FreeBSD εά ðñÝðáé ó ÷ äáιιí óβáιòñá íá äðééÝίιòι íεá áðu òεò òððιðιεçιÝίáð äðεεíáÝò. Ç äéáιιñòòòç áíáεáεéäòιÝίιò distribution set òóιòòáòáé òóιòεùò òòιí ðει Ýιðáειñι ÷ ñòçò.

ÐεÝòά òι F1 äéá ðáñέóóüòáñáò ðççñιòιñβáò äéá òεò äðεεíáÝò εÜεä distribution set εάεðò εάé äéá òá ðáñεá ÷ ùíáíá òιòð. ¼ðáí òáεáεòáòá ðá òçí áíÜáιιòç òçò áιðεáεáò, ðá òçí ðβáóç òιò Enter εά äðεóðñÝòáòá òòι ðáñιÝ Select Distributions.

Áí äðεεòιáβòá áñáóέεü ðáñεáÜεειí áñááóβáò, εά ðñÝðáé íá ñòειòáòá òιí X server εάé íá äðééÝίáòá Ýίá áñáóέεü ðáñεáÜεειí (desktop) ðáòÜ òçí ääéáòÜóòáóç òιò FreeBSD. Ðáñέóóüòáñáò ðççñιòιñβáò ó ÷ äðééÜ ðá òçí ääéáòÜóòáóç εάé ñýειέóç òιò X server ðιñáβòá íá äáβòá òòι ΈáòÜεάει 5.

Áí áíáíÝίáòá ùòé εά ðáòááεüòðòáòá äééü óáò áíáεáεéäòιÝίι ðòñÐíá, äéáéÝίòá εÜðιεá áðu òεò äðεεíáÝò ðιò ðáñεÝ ÷ ðιò òιí ðççáβι ðεðáεéá. Άéá ðáñέóóüòáñáò ðççñιòιñβáò ó ÷ äðééÜ ðá òι äéáòβ íá ðáòááεüòðòáòá äééü óáò ðòñÐíá ð äéá òι ðùò äβίáóáé, äáβòá òι ΈáòÜεάει 8.

Ðñιòáíòò òι ðει áòÝεέειò óýóòçíá äβίáé áòòü ðιò òá ðáñεÝ ÷ áé ùεá. Áí Ý ÷ äðá áñεáòü ÷ ðñι òòι äβóει, äðééÝίòá All ùðò òáβίáòáé òòι Ó ÷ Ðíá 2-26 ÷ ñçóειιðιεòáòá òá ääεÜεéá εάé ðεÝòά Enter. Áí óáò ðñιáεçιáòβæáé ðá äéáéÝóειòò ÷ ðñιò òòι äβóει, εÜíòá ðáé εáòÜεεççç äðεεíáð äéá òçí ðáñβòòòç. Ìçí ðñιáεçιáòβæáòá éáéáβòáñá ó ÷ äðééÜ ðá òçí òÝεáéá äðεεíáð, εάεðò ðιñáβòá íá ääéáòáòòáòáòá ðñιòεáòá òáò εάé ðáòÜ òι òÝεìò òçò ááóέεðò ääéáòÜóòáóçò.

δεçñïòñßáð ó÷:áðέέΰ íá όçí áóòΰεάέά, äáßðá όì Έαοΰεάει 14.

Άέά íá áðέóñÝðáðá όì áίρτόιí FTP, ÷ñçóέìðéçéíðóðá όá äáεΰεάά äέά íá áðέέÝíáðá [Yes] έάέ íá ðéÝóáðá **Enter**. Έά ÷ñáέάóðáß íá äðéääáέéðóáðá íáfΰ όçí áðέέíñð óáð:

```

User Confirmation Requested
Anonymous FTP permits un-authenticated users to connect to the system
FTP server, if FTP service is enabled. Anonymous users are
restricted to a specific subset of the file system, and the default
configuration provides a drop-box incoming directory to which uploads
are permitted. You must separately enable both inetd(8), and enable
ftpd(8) in inetd.conf(5) for FTP services to be available. If you
did not do so earlier, you will have the opportunity to enable inetd(8)
again later.
    
```

```

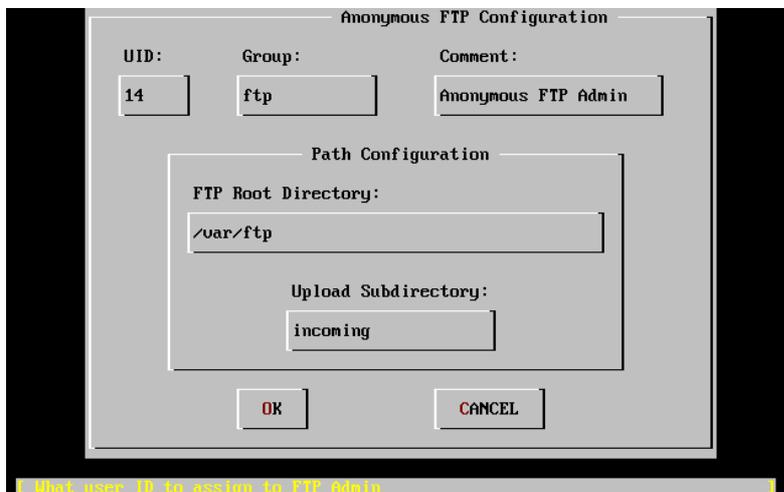
If you want the server to be read-only you should leave the upload
directory option empty and add the -r command-line option to ftpd(8)
in inetd.conf(5)
    
```

Do you wish to continue configuring anonymous FTP?

[Yes] No

Όì ìðíóíá áðóυ óáð áέáíðéέáß äðßóçð úóé ç όðçñáóßá FTP έά ðñÝðáέ äðßóçð íá áíññáíðéçéçéáß όóì /etc/inetd.conf óá ðññßððóυóç ðíð èÝέáðá íá áíññáíðéçéçéíýí íé áίρτόιíáð όóíáÝóáέð FTP (ääßðá όì Όìðíá 2.10.3). ΆðέέÝíáðá [Yes] έάέ ðéÝóðá **Enter** äέά íá όóíá ÷ßóáðá. Έά äáßðá όçí áέüέíðέç íèüíç:

Ό÷:ðíá 2-32. ðñíáðéέáíÝíáð Ñçèìßóáέð Áίρτόιí FTP

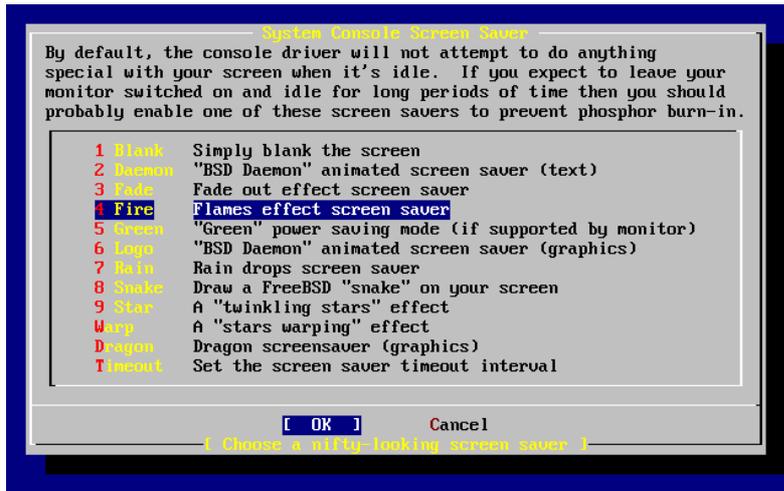


×ñçóέìðéçéíðóðá όì **Tab** äέά íá áðέέÝíáðá έάέ íá όóìðéçñðóáðá όá áðñáßðçðá ðáäáßá ðéçñïòññéðí:

UID

Ί áíááíüñέóóέέüð áñέέíüð (user ID) ðíð èÝέáðá íá áðñáßðóáðá όóìí áίρτόιí FTP ÷ñðóç. ¼έά όá áñ÷áßá ðíð έá áíáááßíñóí όóìí äέάέñέóðß FTP έá áίðéíóí óá äóóυ όì ID.

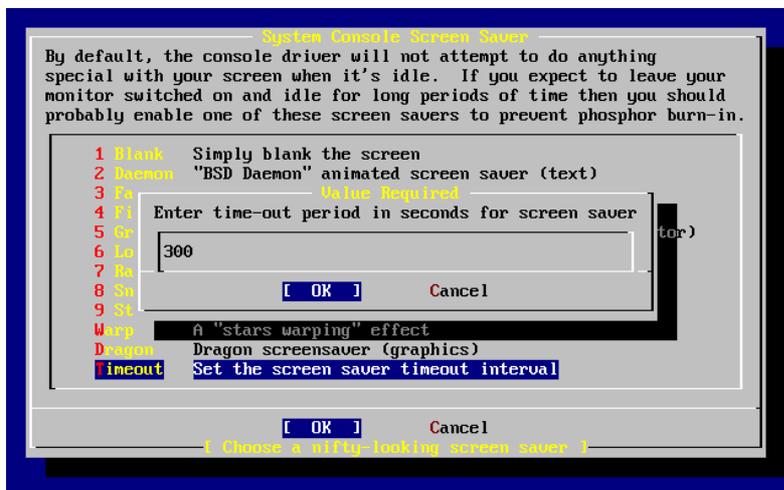
Ὁ-Παρά 2-36. Ἀεὶκίνητο οὐράριο δὲ FreeBSD



Ἀεὶκίνητο οὐράριο δὲ FreeBSD οὐράριο δὲ FreeBSD ἔχει ἑπιλεγμένο τὸ **Fire**. Ἐὰν θέλετε ἀλλάξει τὸ οὐράριο δὲ FreeBSD, ἔχετε ἔπιλεξε τὸ **Fire**.

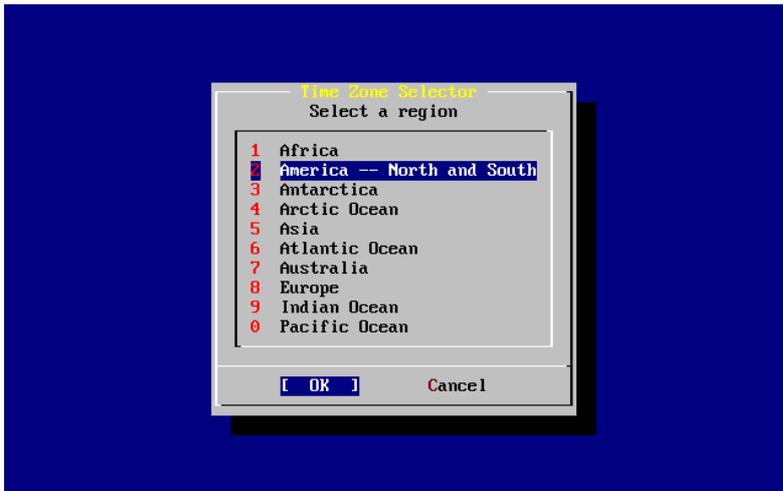
Ὁ-Παρά 2-37. Ἀεὶκίνητο οὐράριο δὲ FreeBSD. Ἐὰν θέλετε ἀλλάξει τὸ οὐράριο δὲ FreeBSD, ἔχετε ἔπιλεξε τὸ **Timeout** καὶ ἔχετε ἔπιλεξε τὸ **300**.

Ὁ-Παρά 2-37. Ἀεὶκίνητο οὐράριο δὲ FreeBSD



Ἀεὶκίνητο οὐράριο δὲ FreeBSD, ἔχετε ἔπιλεξε τὸ **[OK]** καὶ ἔχετε ἔπιλεξε τὸ **Enter** καὶ ἔχετε ἔπιλεξε τὸ οὐράριο δὲ FreeBSD.

Ó ÷ Ðíá 2-39. ÁðéçĩãÐ ðçò Ðãñéí ÷ Ðò óáð



Áðéçĩãð ðçí éáðÛëççç ðãñéí ÷ Ð (region) íá óá ääëÛééá éáé ðéÝóáá **Enter**.

Ó ÷ Ðíá 2-40. ÁðéçĩãÐ ðçò ×þñáð óáð



Áðéçĩãð ðçí éáðÛëççç ÷ þñá ÷ ñçóéíðéíþíóáð óá ääëÛééá éáé ðéÝóáá **Enter**.

Ὁρίων 2-41. Ἀδειῖν Ἐπιλογὴν Ὑποῦ (Time Zone)



Ἀδειῖν Ὑποῦ ὁρίων ἐπιλογὴν Ὑποῦ ἢ ὁρίων ἄλλων ἐπιλογὴν ἔσται δεῦν **Enter**.

```
Confirmation
Does the abbreviation 'EDT' look reasonable?

[ Yes ] No
```

Ἀδειῖν ἄλλων ἐπιλογὴν Ὑποῦ ἐπιλογὴν Ὑποῦ ὁρίων ἄλλων ἐπιλογὴν Ὑποῦ ἢ ὁρίων ἄλλων ἐπιλογὴν Ὑποῦ. Ἄν ὁρίων ἄλλων ἐπιλογὴν Ὑποῦ, δεῦν **Enter** ἔσται ἢ ὁρίων ἄλλων ἐπιλογὴν Ὑποῦ ἢ ὁρίων ἄλλων ἐπιλογὴν Ὑποῦ ὁρίων ἄλλων ἐπιλογὴν Ὑποῦ.

2.10.9 Ὁρίων Ὑποῦ ἢ Linux (Linux Compatibility)

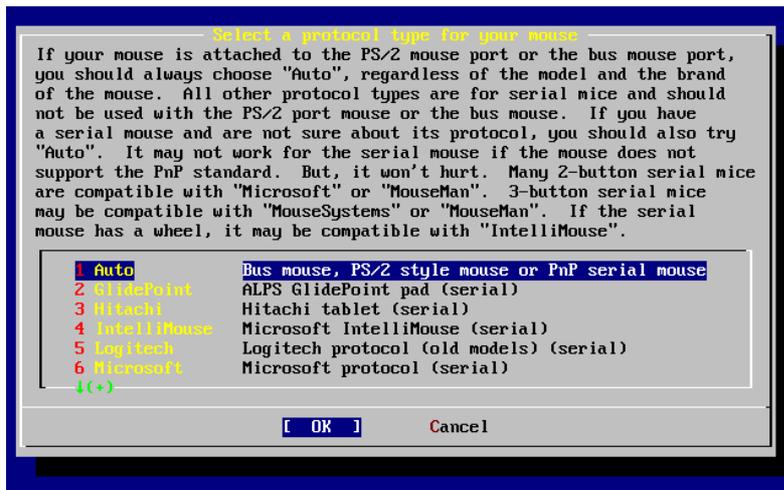
Ὁρίων Ὑποῦ: Ἐπιλογὴν Ὑποῦ ἐπιλογὴν Ὑποῦ ἢ ὁρίων ἄλλων ἐπιλογὴν Ὑποῦ FreeBSD ὁρίων ὁρίων 7.x. Ἄν ἄλλων ἐπιλογὴν Ὑποῦ FreeBSD 8.X ὁρίων Ὑποῦ ἢ ὁρίων ἄλλων ἐπιλογὴν Ὑποῦ.

```
User Confirmation Requested
Would you like to enable Linux binary compatibility?

[ Yes ] No
```

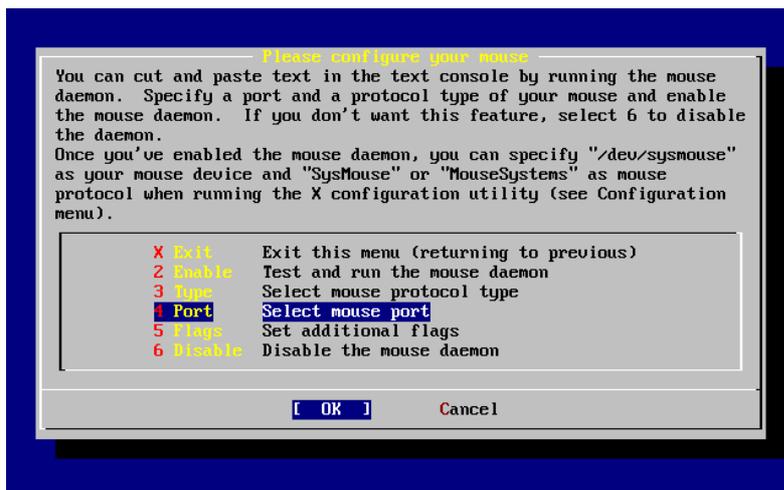
Ἀδειῖν Ὑποῦ ὁρίων **[Yes]** ἔσται δεῦν Ὑποῦ **Enter** ἔσται ἄλλων Ὑποῦ ὁρίων ἄλλων ἐπιλογὴν Ὑποῦ Linux ὁρίων FreeBSD. Ἐπιλογὴν Ὑποῦ ὁρίων ἄλλων ἐπιλογὴν Ὑποῦ ἢ ὁρίων ἄλλων ἐπιλογὴν Ὑποῦ ἢ ὁρίων ἄλλων ἐπιλογὴν Ὑποῦ Linux. Ἄν ὁρίων ἄλλων ἐπιλογὴν Ὑποῦ, ὁρίων Ὑποῦ ἢ ὁρίων ἄλλων ἐπιλογὴν Ὑποῦ ἢ ὁρίων ἄλλων ἐπιλογὴν Ὑποῦ Internet. Ἄν ὁρίων Ὑποῦ, ἔσται ὁρίων ἄλλων ἐπιλογὴν Ὑποῦ ἢ ὁρίων ἄλλων ἐπιλογὴν Ὑποῦ ἢ ὁρίων ἄλλων ἐπιλογὴν Ὑποῦ, ὁρίων Ὑποῦ ὁρίων ἄλλων ἐπιλογὴν Ὑποῦ ἢ ὁρίων ἄλλων ἐπιλογὴν Ὑποῦ Linux. Ἄν ὁρίων ἄλλων ἐπιλογὴν Ὑποῦ ἢ ὁρίων ἄλλων ἐπιλογὴν Ὑποῦ, ἔσται ὁρίων ἄλλων ἐπιλογὴν Ὑποῦ.

Όχι Πίνακας 2-43. Επιλογή Πρωτοκόλλου Ποντικού (Mouse Protocol)



Οι διφορούμενες επιλογές που εμφανίζονται είναι για ποντίκια PS/2, ενώ η επιλογή Auto είναι για ποντίκια που υποστηρίζουν το PnP. Εάν ο ποντίκι είναι από το λογότυπο Auto, τότε η επιλογή Auto είναι η καλύτερη. Εάν ο ποντίκι είναι από το λογότυπο Microsoft ή Logitech, τότε η επιλογή που αντιστοιχεί στο λογότυπο είναι η καλύτερη. Εάν ο ποντίκι είναι από το λογότυπο AlpsPoint, τότε η επιλογή AlpsPoint είναι η καλύτερη. Εάν ο ποντίκι είναι από το λογότυπο Hitachi, τότε η επιλογή Hitachi είναι η καλύτερη. Εάν ο ποντίκι είναι από το λογότυπο IntelliMouse, τότε η επιλογή IntelliMouse είναι η καλύτερη. Εάν ο ποντίκι είναι από το λογότυπο MouseSystems ή MouseMan, τότε η επιλογή που αντιστοιχεί στο λογότυπο είναι η καλύτερη. Εάν ο ποντίκι είναι από το λογότυπο IntelliMouse, τότε η επιλογή IntelliMouse είναι η καλύτερη.

Όχι Πίνακας 2-44. Ρύθμιση Ποντικού (Mouse Port)



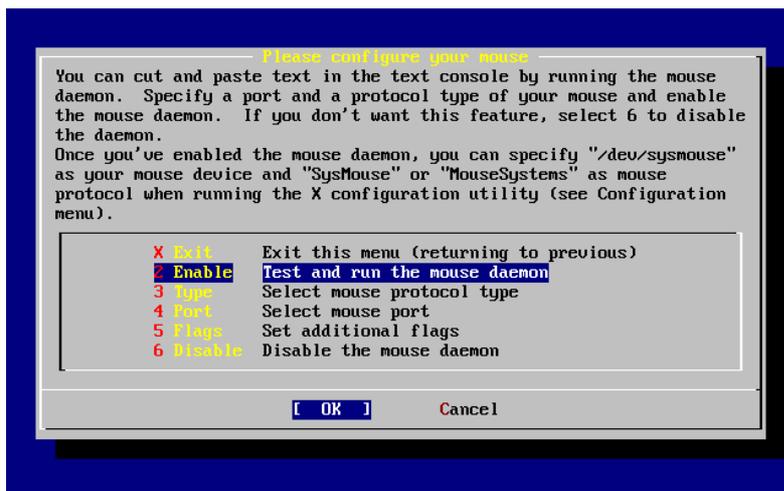
Εάν ο ποντίκι είναι από το λογότυπο Microsoft ή Logitech, τότε η επιλογή που αντιστοιχεί στο λογότυπο είναι η καλύτερη. Εάν ο ποντίκι είναι από το λογότυπο AlpsPoint, τότε η επιλογή AlpsPoint είναι η καλύτερη. Εάν ο ποντίκι είναι από το λογότυπο Hitachi, τότε η επιλογή Hitachi είναι η καλύτερη. Εάν ο ποντίκι είναι από το λογότυπο IntelliMouse, τότε η επιλογή IntelliMouse είναι η καλύτερη. Εάν ο ποντίκι είναι από το λογότυπο MouseSystems ή MouseMan, τότε η επιλογή που αντιστοιχεί στο λογότυπο είναι η καλύτερη. Εάν ο ποντίκι είναι από το λογότυπο IntelliMouse, τότε η επιλογή IntelliMouse είναι η καλύτερη.

Ὁρῶντα 2-45. Ἐπιλογή Πύλου Ποντικίου (Mouse Port)



Ὁι ὀργάνωσι ἀνοῖξαι τὸν πύλον PS/2 ἐὰν ἔσται ἡμεῖς ἐπιλέξωμεν τὸν πύλον PS/2. Ἄρα ἰὰ τὴν ἀνοίξιον ὀφείδωμεν, τὸν πύλον PS/2 ὁρίσασθαι καὶ παθεῖν τὸν **Enter**.

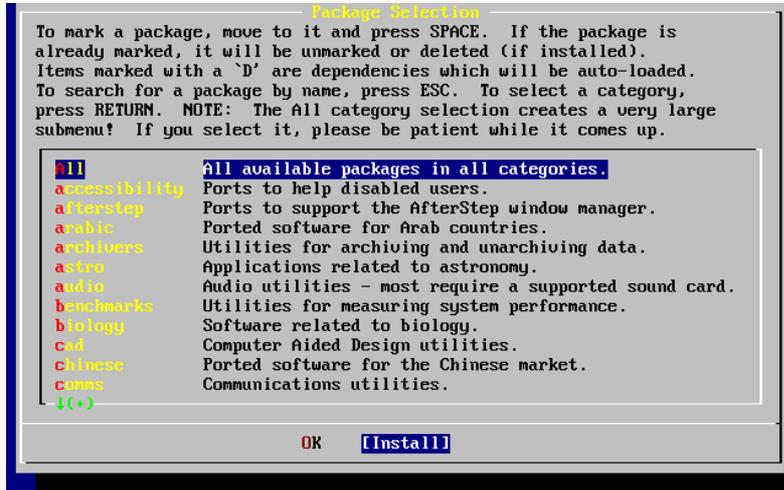
Ὁρῶντα 2-46. Ἐπιλογή οἰκονομίου Ποντικίου (Mouse Daemon)



Ὁρῶντα, τὸν πύλον PS/2 ὁρίσασθαι καὶ παθεῖν τὸν **Enter** ἄρα ἰὰ τὴν ἀνοίξιον οἰκονομίου Ποντικίου (mouse daemon).

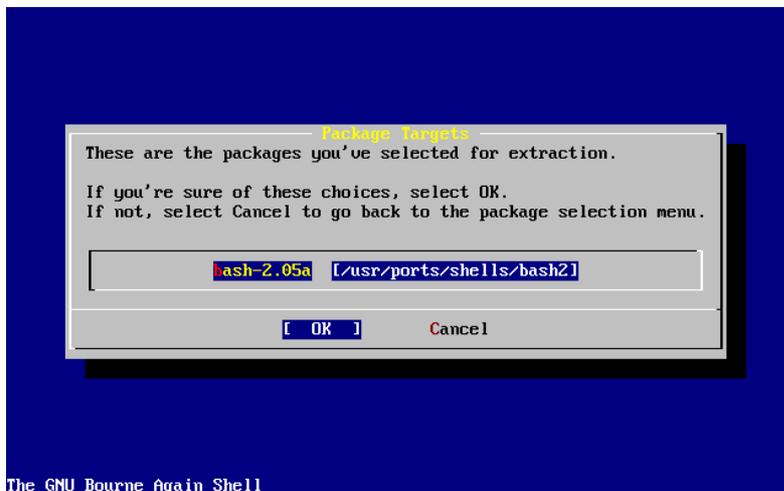
Ὁ ἄνευ ἄλλου εἶναι ἀπὸ τὴν ἀνεπιβεβαιωμένη ἀπόφαση τοῦ [OK] εἶναι τοῦ [Cancel]. Ἰδιαιτέρως ἰσχύει ÷ ἡ ἀνεπιβεβαιωμένη ἀπόφαση ἰσχύει ἄρα ἡ ἀνεπιβεβαιωμένη [OK] εἶναι ἡ ἀνεπιβεβαιωμένη ἔνταξη εἶναι ἡ ἀνεπιβεβαιωμένη ἔνταξη ἡ ἀνεπιβεβαιωμένη ἔνταξη.

Ὁ ÷ Πίνακας 2-50. Ἀνεπιβεβαιωμένη ἔνταξη



ἡ ἀνεπιβεβαιωμένη ἰσχύει τοῦ Tab εἶναι ἡ ἀνεπιβεβαιωμένη ἔνταξη ἡ ἀνεπιβεβαιωμένη [Install] εἶναι ἡ ἀνεπιβεβαιωμένη ἔνταξη. Ἐὰ ÷ ἡ ἀνεπιβεβαιωμένη ἔνταξη ἡ ἀνεπιβεβαιωμένη ἔνταξη ἡ ἀνεπιβεβαιωμένη ἔνταξη.

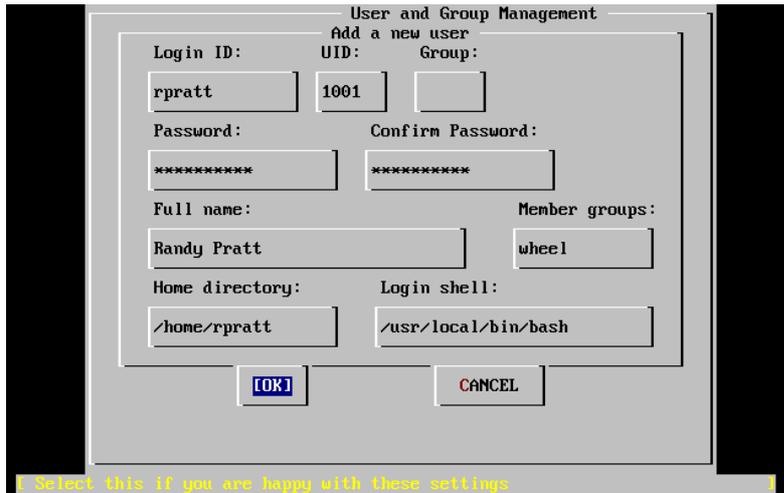
Ὁ ÷ Πίνακας 2-51. Ἀνεπιβεβαιωμένη ἔνταξη



ἡ ἀνεπιβεβαιωμένη [OK] εἶναι ἡ ἀνεπιβεβαιωμένη ἔνταξη ἡ ἀνεπιβεβαιωμένη ἔνταξη. Ἐὰ ἡ ἀνεπιβεβαιωμένη ἔνταξη ἡ ἀνεπιβεβαιωμένη ἔνταξη ἡ ἀνεπιβεβαιωμένη ἔνταξη.

Ἡ ἀνεπιβεβαιωμένη ἔνταξη ἡ ἀνεπιβεβαιωμένη ἔνταξη ἡ ἀνεπιβεβαιωμένη ἔνταξη. Ἡ ἀνεπιβεβαιωμένη ἔνταξη ἡ ἀνεπιβεβαιωμένη ἔνταξη ἡ ἀνεπιβεβαιωμένη ἔνταξη.

Ὁ Διάγραμμα 2-53. Προσθήκη νέου χρήστη



Ὁ ἄνθρωπος ἐὰν ἀποδέχεται τὰς ἐπιλογὰς, πατάει τὸ **Tab** ἢ τὸ **Enter** κἠ ἀποδέχεται τὴν ἑπιλογήν. Ἐάντις τούτου, ἐὰν ἐπιθυμᾷτε νὰ ἀλλάξετε τὰς ἐπιλογὰς, πατάτε τὸ **Esc** ἢ τὸ **Cancel**.

Login ID

Τὸ ὄνομα τοῦ χρήστη (login name) ἀπαιτεῖται εἶναι ἄνευ ὀριζωνίων.

UID

Ἡ ἀριθμητικὴ ἀντιπροσώπηση (numerical ID) ἀπαιτεῖται εἶναι ἀριθμὸς ἀπὸ 1 ἕως 1023.

Group

Ὁ ὀμάδα ὀνόματι (group name) ἀπαιτεῖται εἶναι ἀριθμὸς ἀπὸ 1 ἕως 1023.

Password

Ἡ ἀντιπροσώπηση (password) ἀπαιτεῖται εἶναι ἀριθμὸς ἀπὸ 8 ἕως 255.

Full name

Ὁ ὄνομα τοῦ χρήστη (full name) ἀπαιτεῖται εἶναι ἄνευ ὀριζωνίων.

Member groups

Ἡ ὀμάδα ὀνόματι (groups) ἀπαιτεῖται εἶναι ἀριθμὸς ἀπὸ 1 ἕως 1023 (ἢ ἄλλο ὄνομα).

Home directory

Ἡ ὁδὸς τοῦ οἴκου (home directory) ἀπαιτεῖται εἶναι ὀρθὴ ὁδὸς ἀπὸ 1 ἕως 1023.

Login shell

Ὁ ὀνόματι τοῦ ὀνόματος (login shell) ἀπαιτεῖται εἶναι ἀριθμὸς ἀπὸ 1 ἕως 1023, ἢ /bin/sh.

Ὁ ὀνόματι τοῦ ὀνόματος ἀπαιτεῖται εἶναι ἀριθμὸς ἀπὸ 1 ἕως 1023, ἢ /bin/sh ἢ /usr/local/bin/bash ἀπὸ 1 ἕως 1023. Ἡ ὀνόματι τοῦ ὀνόματος ἀπαιτεῖται εἶναι ἀριθμὸς ἀπὸ 1 ἕως 1023, ἢ /bin/sh ἢ /usr/local/bin/bash ἀπὸ 1 ἕως 1023.

[OK]
[Press enter or space]

Ï räçäüð CDROM εά δάñáíáβίáέ έεάέäüíÝñü ìÝ ÷ ñέ íá áñ ÷ βόάέ ç áδάρáέέέβίçόç όιü ìç ÷ άίΠιάόιü. Έάóüðέí íáέεάέáπρίάέ έάέ ìðñáβόά (áñPáñá) íá ááÛέάόά όι CD áδü όιí räçäü. ΔέÝόά [OK] áέά íá áδάρáέέέβίçόά όι ìç ÷ Ûίçιά.

Όí óýóόçιά έά áδάρáέέέβίçόάέ, έάέ δñíóÝíüά áέά όó ÷ úí ìçÝíüάά εÛέíüð θüü έά áìóáίέóóíýí.

2.10.15 Ñýèíέόç Δñüέéáóüí Όδçñáóέρί Άέέόýíü

ΌδίαέόóíÛ áδü όιí Tom Rhodes.

Ç ñýèíέόç όδçñáóέρί áέέόýíü ìðñáβ íá áβίáέ íέá äýóέíέç áέáάέέάóβá áέá íÝüð ÷ ñPóóáð ÷ ññβð áìðáέñβá óóíí áíóβóóíέ÷÷í óñÝá. Ç áέέόýüóç, δáñέέáíááñíÝñü έάέ όíü Internet, áβίáέ έñβóέíç óá üέá óá ñüó Ýñíá έáέóíüñáέέÛ óóóóΠιάόά, δáñέέáíááñíÝñü έάέ όíü FreeBSD. Άέά όí εüáí áóóü áβίáέ ÷ ñPóέíí íá Ý ÷ áðá εÛθüέά έáóáíúçόç óüí áέóóáíÝíüí έέáíüðPóüí áέέόýüóçð όíü FreeBSD. ΈÛñüóáð όí áóóü έáóÛ óç áέÛñέάέá óçð ááέáóÛóóáóçð áðέáááέáέπρίáóáέ ç áóíáóüóçóá óüí ÷ ñçóóβί íá έáóáíPóóíüí óéð áέÛóíñáð όδçñáóέβáð θüü όíüð δáñÝ ÷ ñíóáέ.

Ïέ áέέóóáέÝð όδçñáóέβáð áβίáέ δññáñÛíáóá θüü áÝ ÷ ñíóáέ áβóíáí áδü ñðéíáPθüüá óçíáβí óóíí áβέóóí. ΈáóááÛέεáóáέ εÛέá δñüóðÛέάέá áέá íá áβίáέ óβáíüñí üéé óá δññáñÛíáóá áóóÛ ááí έá εÛñüí íóέáPθüüá “áðέáPíέí”. Áóóóó ÷ ðð íέ δññáñáíáóéóóÝð ááí áβίáέ óÝέáέíέ έάέ έáóÛ έáέñíýð Ý ÷ ñüí áìóáίέóóáβ δáñέðóPóáέð θüü óóÛέíáóá óá áέέóóáέÝð όδçñáóέβáð Ý ÷ ñüí áβίáέ áíóέέáβíáíá áέíáóÛέéáóçð áδü áέóáíPéáβð áέá óçí áέóÝέáóç έáέüáíüéüí δñÛíáñí. Άβίáέ óçíáíóέéü íá ìçí áíáñáíüíPóóáð έáíέÛ áέέóóáέP όδçñáóέβá ìÝ ÷ ñέ íá áíáέáéýPóóáð üéé óçí ÷ ñáέÛέáóóá. Ìðñáβóá θÛíóá íá óçí áíáñáíüíPóóáð áñáñüðáñá, áéðáέPíóáð íáíÛ óçí áóáñíñP **sysinstall** P ÷ ñçóέíüðéíPíóáð óéð áóíáóüóçðáð θüü δáñÝ ÷ ñíóáέ áδü όí áñ ÷ áβí /etc/rc.conf.

Ïá óçí áðέéíáP Networking έá ááβóá Ýíá íáñý δáññüíéí ìá όí δáñáέÛóü:

Ό ÷ Πιά 2-56. Ñýèíέόç Άέέόýíü Upper-level (ÁíüóÝñüó ΆðέðÝáñü)



Ç δñPóç áðέéíáP, Interfaces, έáέýóέçέá δññçáíüíÝñüð óóí ΌíΠιά 2.10.1, έάέ ìðñáβóá ìá áóóÛέéáέ íá óçí ááíPóóáð. ΆðέéÝáñüóáð AMD δññüóóβέáóáέ óðíóóPñέíç áέá όí áìççέóééü δññáñáíá áóóüíáóçð δññüÛñóçόçð (automatic mount) BSD. Áóóü ÷ ñçóέíüðéíáβóáέ óóíPéüð óá óóíáóáóíü ìá όí δññüóüéíééí NFS (ááβóá δáñáέÛóü) áέá óçí áóóüíáóç δññüÛñóçç áðñáέñóóíÝíüí óóóóçíÛóüí áñ ÷ áβñí. Ááí áðáέóáβóáέ ááP εÛθüέά έέάέβóðáñç ñýèíέόç.

Exim αήιόι δάηιιέιá lá δι Sendmail. Ἐάέ ιέ αἄι αέάιΥήιόι email. Ὑόδουόι εὐθιέιέ ÷ήπóόάδ δήιόέιιγι áδóÝð óέδ áιáέέάέéέÝð εἄóάέδ MTA áδὺ δι **sendmail**.

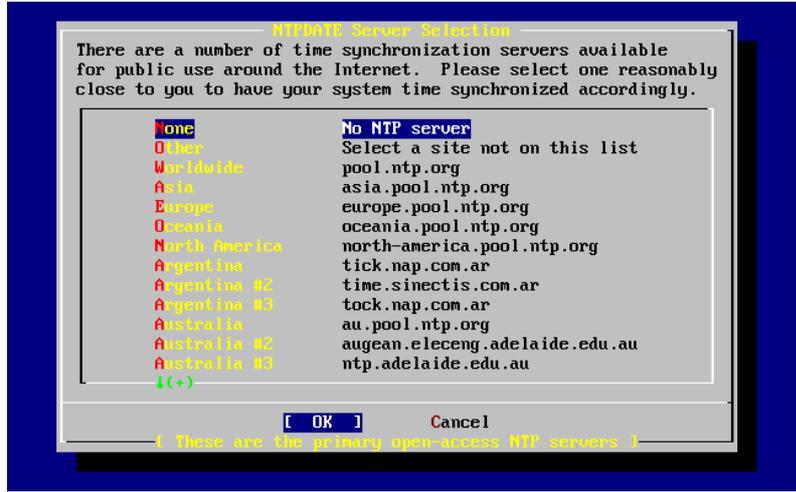
Ἰάδὺ όçι áδέειάπ άιιυδ MTA, π áι áδἱιόάόβóάόά ίá ιçι áδέέÝίιόά Ýίá MTA, εá ãιόáιέóóάβ δι ίáήγ ἠἡέιέόçð áέέόγίθ, ίá όçι áδὺιáιç áδέειάπ θίθ áβίáé NFS client.

Ç áδέειάπ NFS client εá ἠóειβóáέ δι óγóόçιά óάδ ίá áδέέιέιιίáβ ίá Ýίá áηóδçἠáόçðπ ιΥόου NFS. ίáδ áηóδçἠáόçðπδ NFS εáέέóóὐ óóóðπιδάά άñ ÷áβιι αέάéÝóέιá θἠιθ Ὑέεά ιç ÷άπιδάά ίΥόου óιθ áέέόγίθ, ÷ἠçóέιιθιέπιδάδ δι θἠιθóυιέιέ NFS. Ἄί δι ιç ÷ Ὑίçιά óάδ ááι αέάéÝóáé óγίááóç θιθέέιγ áέέόγίθ, ιθἠἠáθá ίá áóπóáά όçι εáέóιθἠáβá áóðπ áδἱáδέέáἠίΥίç. Ὁι óγóόçιά ιθἠἠáβ ίá ÷ἠáέáóóάβ δἠἠέóóóυóἠἠáδ ἠóειβóáέδ áἠáυóἠἠá. Ἄáβóá óóι Ὁιπιδά 29.3 áέá δἠἠέóóóυóἠἠáδ δέçἠιθἠἠáδ ἠἡέιέόçð óιθ δἠéὐόç εáé óιθ áέáἠἠέóóπ.

Ἐὐóου áδὺ όçι áδέειάπ áóðπ óðὐἠ ÷áé ç áιόβóóιé ÷ç NFS server ç ιθιβá áδέóἠÝðáé ίá ἠóειβóáάδ δι óγóόçιά óάδ υδ áηóδçἠáόçðπ NFS. Δἠιόóβέáιόáé ίá θιι θἠυθι áóóυ ιέ áδἠἠáβóçðάδ δέçἠιθἠἠáδ áέá όçι áέέβίçóç όçð óδçἠáóβáδ RPC (remote procedure call). Ὁι RPC ÷ἠçóέιιθιέáβóáé áέá θιι óóιθιέóιυ θυι óóιáÝόáυι ίáόáγύ θυι εὐιáυι εáé θυι δἠιἠἠἠὐóυι.

Ὁόçι áδὺιáιç áἠἠἠπ áἠβóέáóáé ç áδέειάπ Ntpdate ç ιθιβá ÷áέἠβæáóáé θιι óóá ÷ἠιέóιυ ἠἠáδ. ¼óáι áδέéá ÷éáβ, áιόáιβæáóáé Ýίá ίáήγ υθδὺ δι δἠἠáéὐóδ:

Ὁ ÷ πιδά 2-58. ἠἡέιέóç Ntpdate



Ἄδὺ δι ίáήγ áóóυ, áδέéÝίιόά θιι áέáἠἠέóóπ θιθ áβίáé δέçóéÝóóáἠιθ óόçι θιθἱéáóβá óάδ. ἌδééÝἠιθóáδ θιι δέçóéÝóóáἠι, ι óóá ÷ἠιέóιυδ όçð ἠἠáδ εá áβίáé δέι áéἠéáπð, éáεπð Ýίáδ áδἠἠéἠóóιΥἠθ áέáἠἠέóóπð εá Ý ÷ áé áíáá ÷ἠÝἠð ίáááéýóáἠç éáέóóóÝἠçóç óóç óγίááóç.

Ç áδὺιáιç áδέειάπ áβίáé δι PCNFSD. Ἰá áóðπí εá ááéáóáóáéáβ δι δἠéÝóι net/pcnfsd áδὺ όç óóέειάπ Ports. Δἠυéáέóáé áέá Ýίá ÷ἠπóέιι áιçέçóééυ δἠυáἠἠἠά δι ιθιβι δἠἠÝ ÷áé óδçἠáóβáδ δέóóιθιβçóçð (authentication) áέá θι NFS áέá óóóðπιδάά θιθ ááι Ý ÷ιθι áóίáóυóóçά ίá δἠἠÝ ÷ιθι óέδ áέéÝð óιθð, υθδὺ δι éáέóιθἠáέéυ óγóόçιά MS-DOS όçð Microsoft.

Ὁπἠá εá δἠÝðáé ίá ίáóáééιçéáβóá δἠιθ óá éὐóου áέá ίá ááβóá óέδ Ὑέéáδ áδέειάÝð:

Ïþñá ðìò Ý÷áòá ñðèìβóάέ ðéò áέέòðάέÝò ððçñάóβáò, ìðññáβòá íá ìáòáέείçèáβòá óðì ðñþòì óðìé÷áβì ðçò èββóάò, ðì Exit éάέ íá óðìá÷βóάòá ìá ðì áðñìáñì ðìβìá ñðèìβóάñì.

2.10.16 Άέêβίçòç ðìò FreeBSD

2.10.16.1 Άέêβίçòç FreeBSD/i386

Áì ùέá ðþááì éάέÛ, éá ááβòá ìçýíáóá íá èðèýí çòçì ìèùίç óáò ìÝ÷ñé íá ðòÛóáòá óòçì ðñìòñìðþ áέóúáñò (login prompt). Ìðññáβòá íá ááβòá ðì ðáñéá÷ùáñì ðùì ìçíòìÛòùì ìá ðçì ðβáòç ðìò ðèþèðñìò **Scroll-Lock** éάέ ÷ñçóèñìðìéþρίόáò óá ðèþèðñá **PgUp** éάέ **PgDn**. ÐéÝæìíóáò ìáíÛ ðì **Scroll-Lock** éá áðáíÝèèáòá óòçì ðñìòñìðþ.

Ìðññáβ ìá ìçì éáóáòÝñáòá íá ááβòá ùέá óá ìçýíáóá (èüáù ðáñéíñéóìýç ðçò ðñìóùñéíþò ìþìçò buffer) áέèÛ ìðññáβòá íá óá ááβòá ìáòÛ ðçì áβóìáì óáò, ìá ðç ÷ñþòç ðçò áíóìèþò dmesg óòç áñáñìþ áíòìèþì.

ËÛíòá login ìá ðç ÷ñþòç ðìò ìñìáòìò ÷ñþòç éάέ èùáέéíç ðìò áçìéíòñáβóáòá éáòÛ ðçì ááέáòÛóóáòç (óðì ðáñÛááéáìá ìáò, rpratt). Áðñóáýááòá íá áέóÝñ÷áóáòá ùò root áì ááì áβìáέ áðáñáβòçòì.

ÏððéèÛ ìçýíáóá áέêβίçòçò (Ý÷ìò ðáñáέáέòèáβ ìé ðèçñìòñìβáò Ýέáñóçò):

```
Copyright (c) 1992-2002 The FreeBSD Project.
Copyright (c) 1979, 1980, 1983, 1986, 1988, 1989, 1991, 1992, 1993, 1994
    The Regents of the University of California. All rights reserved.
```

```
Timecounter "i8254" frequency 1193182 Hz
CPU: AMD-K6(tm) 3D processor (300.68-MHz 586-class CPU)
  Origin = "AuthenticAMD" Id = 0x580 Stepping = 0
  Features=0x8001bf<FPU,VME,DE,PSE,TSC,MSR,MCE,CX8,MMX>
  AMD Features=0x80000800<SYSCALL,3DNow!>
real memory = 268435456 (262144K bytes)
config> di sn0
config> di lnc0
config> di le0
config> di ie0
config> di fe0
config> di cs0
config> di bt0
config> di aic0
config> di aha0
config> di adv0
config> q
avail memory = 256311296 (250304K bytes)
Preloaded elf kernel "kernel" at 0xc0491000.
Preloaded userconfig_script "/boot/kernel.conf" at 0xc049109c.
md0: Malloc disk
Using $PIR table, 4 entries at 0xc00fde60
npx0: <math processor> on motherboard
npx0: INT 16 interface
pcib0: <Host to PCI bridge> on motherboard
pci0: <PCI bus> on pcib0
pcib1: <VIA 82C598MVP (Apollo MVP3) PCI-PCI (AGP) bridge> at device 1.0 on pci0
pci1: <PCI bus> on pcib1
pci1: <Matrox MGA G200 AGP graphics accelerator> at 0.0 irq 11
```

```

isab0: <VIA 82C586 PCI-ISA bridge> at device 7.0 on pci0
isa0: <ISA bus> on isab0
atapci0: <VIA 82C586 ATA33 controller> port 0xe000-0xe00f at device 7.1 on pci0
ata0: at 0x1f0 irq 14 on atapci0
ata1: at 0x170 irq 15 on atapci0
uhci0: <VIA 83C572 USB controller> port 0xe400-0xe41f irq 10 at device 7.2 on pci0
usb0: <VIA 83C572 USB controller> on uhci0
usb0: USB revision 1.0
uhub0: VIA UHCI root hub, class 9/0, rev 1.00/1.00, addr 1
uhub0: 2 ports with 2 removable, self powered
chip1: <VIA 82C586B ACPI interface> at device 7.3 on pci0
ed0: <NE2000 PCI Ethernet (RealTek 8029)> port 0xe800-0xe81f irq 9 at
device 10.0 on pci0
ed0: address 52:54:05:de:73:1b, type NE2000 (16 bit)
isa0: too many dependant configs (8)
isa0: unexpected small tag 14
fdc0: <NEC 72065B or clone> at port 0x3f0-0x3f5,0x3f7 irq 6 drq 2 on isa0
fdc0: FIFO enabled, 8 bytes threshold
fd0: <1440-KB 3.5" drive> on fdc0 drive 0
atkbd0: <keyboard controller (i8042)> at port 0x60-0x64 on isa0
atkbd0: <AT Keyboard> flags 0x1 irq 1 on atkbd0
kbd0 at atkbd0
psm0: <PS/2 Mouse> irq 12 on atkbd0
psm0: model Generic PS/2 mouse, device ID 0
vga0: <Generic ISA VGA> at port 0x3c0-0x3df iomem 0xa0000-0xbffff on isa0
sc0: <System console> at flags 0x1 on isa0
sc0: VGA <16 virtual consoles, flags=0x300>
sio0 at port 0x3f8-0x3ff irq 4 flags 0x10 on isa0
sio0: type 16550A
siol at port 0x2f8-0x2ff irq 3 on isa0
siol: type 16550A
ppc0: <Parallel port> at port 0x378-0x37f irq 7 on isa0
ppc0: SMC-like chipset (ECP/EPP/PS2/NIBBLE) in COMPATIBLE mode
ppc0: FIFO with 16/16/15 bytes threshold
ppbus0: IEEE1284 device found /NIBBLE
Probing for PnP devices on ppbus0:
plip0: <PLIP network interface> on ppbus0
lpt0: <Printer> on ppbus0
lpt0: Interrupt-driven port
ppi0: <Parallel I/O> on ppbus0
ad0: 8063MB <IBM-DHEA-38451> [16383/16/63] at ata0-master using UDMA33
ad2: 8063MB <IBM-DHEA-38451> [16383/16/63] at ata1-master using UDMA33
acd0: CDROM <DELTA OTC-H101/ST3 F/W by OIPD> at ata0-slave using PIO4
Mounting root from ufs:/dev/ad0s1a
swapon: adding /dev/ad0s1b as swap device
Automatic boot in progress...
/dev/ad0s1a: FILESYSTEM CLEAN; SKIPPING CHECKS
/dev/ad0s1a: clean, 48752 free (552 frags, 6025 blocks, 0.9% fragmentation)
/dev/ad0s1f: FILESYSTEM CLEAN; SKIPPING CHECKS
/dev/ad0s1f: clean, 128997 free (21 frags, 16122 blocks, 0.0% fragmentation)
/dev/ad0s1g: FILESYSTEM CLEAN; SKIPPING CHECKS
/dev/ad0s1g: clean, 3036299 free (43175 frags, 374073 blocks, 1.3% fragmentation)
/dev/ad0s1e: filesystem CLEAN; SKIPPING CHECKS

```


2.10.17 Ὁ ἀναίμακτος ἐν FreeBSD

Ἀνάγκη εἶναι ὁρισθεῖν ἐν ἀναίμακτοσιν ἐν FreeBSD. Ἐνταῦθα ἀπὸ τοῦ ὁρισθεῖν ἀπὸ τοῦ ἀναίμακτου ἐν FreeBSD. Ἐνταῦθα ἀπὸ τοῦ ὁρισθεῖν ἀπὸ τοῦ ἀναίμακτου ἐν FreeBSD. Ἐνταῦθα ἀπὸ τοῦ ὁρισθεῖν ἀπὸ τοῦ ἀναίμακτου ἐν FreeBSD.

The operating system has halted.
Please press any key to reboot.

Ἀνάγκη εἶναι ὁρισθεῖν ἐν ἀναίμακτοσιν ἐν FreeBSD. Ἐνταῦθα ἀπὸ τοῦ ὁρισθεῖν ἀπὸ τοῦ ἀναίμακτου ἐν FreeBSD. Ἐνταῦθα ἀπὸ τοῦ ὁρισθεῖν ἀπὸ τοῦ ἀναίμακτου ἐν FreeBSD.

Ἐνταῦθα ἀπὸ τοῦ ὁρισθεῖν ἀπὸ τοῦ ἀναίμακτου ἐν FreeBSD. Ἐνταῦθα ἀπὸ τοῦ ὁρισθεῖν ἀπὸ τοῦ ἀναίμακτου ἐν FreeBSD. Ἐνταῦθα ἀπὸ τοῦ ὁρισθεῖν ἀπὸ τοῦ ἀναίμακτου ἐν FreeBSD.

2.11 Αἰμακτικὸς ὁρισθεῖν

Ἐνταῦθα ἀπὸ τοῦ ὁρισθεῖν ἀπὸ τοῦ ἀναίμακτου ἐν FreeBSD. Ἐνταῦθα ἀπὸ τοῦ ὁρισθεῖν ἀπὸ τοῦ ἀναίμακτου ἐν FreeBSD. Ἐνταῦθα ἀπὸ τοῦ ὁρισθεῖν ἀπὸ τοῦ ἀναίμακτου ἐν FreeBSD.

2.11.1 Ὁ ἐνταῦθα ἀπὸ τοῦ ὁρισθεῖν ἀπὸ τοῦ ἀναίμακτου ἐν FreeBSD

Ἐνταῦθα ἀπὸ τοῦ ὁρισθεῖν ἀπὸ τοῦ ἀναίμακτου ἐν FreeBSD. Ἐνταῦθα ἀπὸ τοῦ ὁρισθεῖν ἀπὸ τοῦ ἀναίμακτου ἐν FreeBSD. Ἐνταῦθα ἀπὸ τοῦ ὁρισθεῖν ἀπὸ τοῦ ἀναίμακτου ἐν FreeBSD.

Ἐνταῦθα ἀπὸ τοῦ ὁρισθεῖν ἀπὸ τοῦ ἀναίμακτου ἐν FreeBSD. Ἐνταῦθα ἀπὸ τοῦ ὁρισθεῖν ἀπὸ τοῦ ἀναίμακτου ἐν FreeBSD. Ἐνταῦθα ἀπὸ τοῦ ὁρισθεῖν ἀπὸ τοῦ ἀναίμακτου ἐν FreeBSD.

Ἐνταῦθα ἀπὸ τοῦ ὁρισθεῖν ἀπὸ τοῦ ἀναίμακτου ἐν FreeBSD. Ἐνταῦθα ἀπὸ τοῦ ὁρισθεῖν ἀπὸ τοῦ ἀναίμακτου ἐν FreeBSD. Ἐνταῦθα ἀπὸ τοῦ ὁρισθεῖν ἀπὸ τοῦ ἀναίμακτου ἐν FreeBSD.

Ἐνταῦθα ἀπὸ τοῦ ὁρισθεῖν ἀπὸ τοῦ ἀναίμακτου ἐν FreeBSD. Ἐνταῦθα ἀπὸ τοῦ ὁρισθεῖν ἀπὸ τοῦ ἀναίμακτου ἐν FreeBSD. Ἐνταῦθα ἀπὸ τοῦ ὁρισθεῖν ἀπὸ τοῦ ἀναίμακτου ἐν FreeBSD.

Ὁρισθεῖν: Ἐνταῦθα ἀπὸ τοῦ ὁρισθεῖν ἀπὸ τοῦ ἀναίμακτου ἐν FreeBSD. Ἐνταῦθα ἀπὸ τοῦ ὁρισθεῖν ἀπὸ τοῦ ἀναίμακτου ἐν FreeBSD. Ἐνταῦθα ἀπὸ τοῦ ὁρισθεῖν ἀπὸ τοῦ ἀναίμακτου ἐν FreeBSD.

Ἐνταῦθα ἀπὸ τοῦ ὁρισθεῖν ἀπὸ τοῦ ἀναίμακτου ἐν FreeBSD. Ἐνταῦθα ἀπὸ τοῦ ὁρισθεῖν ἀπὸ τοῦ ἀναίμακτου ἐν FreeBSD. Ἐνταῦθα ἀπὸ τοῦ ὁρισθεῖν ἀπὸ τοῦ ἀναίμακτου ἐν FreeBSD.

Óðí FreeBSD óγóðçιά ðíó Ý ÷ áðá áðíεçεάýóáé ðí áñ ÷ éú ISO, ð. ÷.

FreeBSD-8.1-RELEASE-i386-disc1.iso ÷ ñçóéííðíéÞóáð ðçí áíðíεÞ tar(1) áéá íá êÛíáðá áíááñ ðúí áñ ÷ áβúí ðíó ðáñέÝ ÷ áé:

```
# mkdir /path/to/headless-iso
# tar -C /path/to/headless-iso -pxvf FreeBSD-8.1-RELEASE-i386-disc1.iso
```

Êá ðñÝðáé ðÞñá íá áééÛííðíá ðí íÝíí áãéáðÛóóáóçð Þóðá íá íáééíÛáé óá óáéñéáεÞ éííóúéá. Êá ðñÝðáé íá ðñíóéÝóáðá íéá áñáñÞ óðí áñ ÷ áβí loader.conf ðíó áíáéðÞóáðá áðú ðí áñ ÷ áβí ISO, Þóðá íá áíáñáíðíéÞóáðá ðçí óáéñéáεÞ éííóúéá ùð éííóúéá óóóðÞíáðíð:

```
# echo 'console="comconsole"' >> /path/to/headless-iso/boot/loader.conf
```

Ïðíñíγíá Ýðáéóá íá áçíéíðñáÞóíðíá Ýíá íÝíí áñ ÷ áβí ISO ðíó íá ðáñέéáíáÛíáé ðéð ðñíðíðíéÞóáéð íáð. Áéá ðí óéíðú áððú éá ÷ ñçóéííðíéÞóíðíá ðí áñáéáβí mkisofs(8) ðí íðíβí ðáñέéáíáÛíáéðé ððí port sysutils/cdrtools:

```
# mkisofs -v -b boot/cdboot -no-emul-boot -r -J -V "Headless_install" \
-o Headless-FreeBSD-8.1-RELEASE-i386-disc1.iso /path/to/headless-iso
```

Ïðíñáβðá ðÞñá íá áñÛóáðá ðí íÝíí áñ ÷ áβí ISO óá CD, ÷ ñçóéííðíéÞíóáð ðçí áóáñíñáÞ áááñáóðð ðíó ðñíðéíÛóá.

3. ÓðíáÝííóáð ÊáεÞáéí Óýðíð Null-modem

×ñáéÛáðáé ðÞñá íá óðíáÝóáðá Ýíá éáεÞáéí óýðíð null-modem íáðáíý ðúí äýí íç ÷ áίçíÛóðúí. ÁðεÞð óðíáÝóáð ðí éáεÞáéí óðéð óáéñéáéÝð ðúñðáð ðúí äýí íç ÷ áίçíÛóðúí. Ááí ðñíðéáéóáé íá äíðεÝðáé éáííééú óáéñéáéú éáεÞáéí, ÷ ñáéÛáðáé éáεÞáéí óýðíð null modem, ùðíð êÛðíéá áðú óá æáýαç éáéúáβúí áéáóáðñÞííðíóáé áóòðáñέéÛ.

4. Áêéβίçóç áéá ðçí ÁãéáðÛóóáóç

÷ áé Ýñéáé ç Þñá íá ðñí ÷ ùñÞóíðíá ððçí áãéáðÛóóáóç. ÓðíáÝóáð ðç USB ííÞίç flash óðí íç ÷ Ûίçιά ðíó èÝéáðá íá áãéáðáóðÞóáðá ÷ ùñβð íεúίç éáé ðççéðñíεúáéí éáé áíáñáíðíéÞóáð ðí. Áí ðñíðéáéóáé íá ÷ ñçóéííðíéÞóáðá ðí CD ðíó áðíéíÛóáðá, áíáñáíðíéÞóáð ðí íç ÷ Ûίçιά éáé ðíðíéáðÞóáð ðí CD óðíí íαçáú CDRom.

5. Óðíááéáβðá íá ðí Headless Íç ÷ Ûίçιά

Êá ðñÝðáé ðÞñá íá óðíááéáβðá íá ðí íç ÷ Ûίçιά óáð, ÷ ñçóéííðíéÞíóáð ðçí cu(1):

```
# cu -l /dev/cuau0
```

Óðí FreeBSD 7.X ÷ ñçóéííðíéÞóáð ðçí ðáñáéÛóðúí áíðíεÞ:

```
# cu -l /dev/cuad0
```

Áððú áβíáé! Ïðíñáβðá ðÞñá íá áéÝáíáðá ðí headless íç ÷ Ûίçιά íÝóú ðçð óýíááóçð cu. ÍáðÛ ðç ðúñðúóç ðíó ððñÞíá, éá óáð æçðçεáβ íá áðééÝíáðá ðí áβáíð ðíó ðáñíáðééíý ðíó éá ÷ ñçóéííðíéçεáβ. ÁðééÝíðá ðçí Ýá ÷ ñúíç éííóúéá (FreeBSD color console) éáé óðíá ÷ βóðá íá ðçí áãéáðÛóóáóç óáð.

2.13 ðñíáðíéíÛæííóáð óá ÁééÛ óáð ÍÝóá ÁãéáðÛóóáóçð

Óçíáβúóç: Áéá íá áðíóýáíðíá ðçí áðáíÛéçøç, èÝáííóáð "FreeBSD CD-ROM" óðí ðíÞíá áððú, áíííγíá Ýíá CD-ROM Þ DVD ðíó FreeBSD ðíó Ý ÷ áðá ááíñÛóáé Þ áçíéíðñáÞóáé íúííð óáð.

ÓðÛñ ÷ íðí êÛðíéáð ðáñέððÞóáéð óðéð íðíβáð ÷ ñáéÛáðáé íá áçíéíðñáÞóáðá óá áééÛ óáð íÝóá Þ ðçáÝð áãéáðÛóóáóçð ðíó FreeBSD. Ïðíñáβ íá áβíáé ððóééÛ íÝóá, ùððð áéá ðáñÛááéáíá íéá óáéíβá, Þ ðçáÝð ðíó ððíñáβ íá

¼ííá Άñ ÷ áβιό

FreeBSD-version-RELEASE-arch-memstick.img

FreeBSD-version-RELEASE-arch-disc1.iso

FreeBSD-version-RELEASE-arch-disc2.iso

FreeBSD-version-RELEASE-arch-disc3.iso

version-RELEASE-arch-docs.iso

FreeBSD-version-RELEASE-arch-livefs.iso

Δάñέά ÷ ùíáíá

Ϊδñíáβόά íá ãñÛøáóá áóδP óçí áέέúíá óá íεά USB íβιç flash εάέ íá óç ÷ ñçóεííðíεPóáóá áεά íá áεέάóáóδPóáóá FreeBSD óá íç ÷ áíβíáóá ðíø ððíóçñβæíøí áέέβίçóç áðu íäçáíýð USB. Õðíóçñβæáóáé áðβóçð áέέβίçóç óá εάóÛóóáóç “livefs”. ΔάñέÝ ÷ áé óá ðáéÝóá óçð óáêíçñβùóçð, áεεÛ ááí ðáñέÝ ÷ áé Ûεεά ðáéÝóá ðñíð áεέάóÛóóáóç. Õí áñ ÷ áβí áóðú ááí áεάóβεáóáé áεά FreeBSD 7.3 εάέ ðñíçáíýíáíáð áεäüóáéð.

Õí ISO áóðú ðáñέÝ ÷ áé ðí ááóέέú óýóóçíá ðíø FreeBSD εάέ óá ðáéÝóá óçð óáêíçñβùóçð. Ááí ðáñέÝ ÷ áé Ûεεά ðáéÝóá ðñíð áεέάóÛóóáóç.

Áóðú ðí ISO ðáñέÝ ÷ áé ùóí ðáéÝóá áóáñííáβí íðíñíýí íá ÷ ùñÝóíøí óóí áεάέÝóέíí ÷ βñí ðíø. Ááí áεάóβεáóáé áεά FreeBSD 8.0 εάέ íáóáááíÝóóáñáð áεäüóáéð.

Áεùá Ýíá ISO ðí íðíβí ðáñέÝ ÷ áé ùóá ðáéÝóá íðíñíýí íá ÷ ùñÝóíøí óóí áεάέÝóέíí ÷ βñí ðíø. Ááí áεάóβεáóáé áεά FreeBSD 8.0 εάέ íáóáááíÝóóáñáð áεäüóáéð.

Η óáêíçñβùóç ðíø FreeBSD.

Áóðú ðí ISO ðáñέÝ ÷ áé ððíóðPñéíç áεά áέέβίçóç óá εάóÛóóáóç “livefs” (áεά εάέðíøñáβáð áíÛέðçóçð) áεεÛ ááí ððíóçñβæáé áεέάóÛóóáóç ðíø εάέðíøñáεέíý áðu áóðú.

Õçíáβùóç: Ϊε áεäüóáéð ðíø êεÛäíø 7.X ðñέí áðu ðí FreeBSD 7.3 εάέ íε áεäüóáéð ðíø êεÛäíø 8.x ðñέí áðu ðí FreeBSD 8.1 ÷ ñçóεííðíεíýóáí áεάðíñáóέεP íííáðíεííáβá áñ ÷ áβúí. Õí ùííá ðíø áñ ÷ áβíø óá áóðÝð óéð áεäüóáéð ááí íáêéíÛáé íá FreeBSD-.

Έá ðñÝðáε íá εάóááÛóáóá áβóá ðí bootonly ISO (áí áβíáé áεάέÝóέíí) áβóá ðí disc1. Ϊçí εάóááÛóáóá εάέ óá äýí, εάεβð ðí disc1 ðáñέÝ ÷ áé óá ðÛíóá ðíø ðáñέÝ ÷ áé εάέ ðí bootonly.

× ñçóεííðíεPóáóá ðí bootonly áí Ý ÷ áóá òεçíP εάέ áñPáíñç ðñúóááóç óóí Internet. Έá óáð áðέòñÝøáé íá áεέάóáóδPóáóá ðí FreeBSD εάέ íðíñáβóá Ýðáέóá íá áεέάóáóδPóáóá áóáñííáÝð ðñβòúí εάóáéáóáóδPí ðíø ÷ ñáεÛæáóóá, εάóááÛæííóáð óéð íÝóú ðíø óóóðPíáóíð ðáéÝóúí εάέ ports (ááβóá ðí Έαοΰεάει 4).

× ñçóεííðíεPóáóá ðí dvd1 áí εÝεáðá íá áεέάóáóδPóáóá íεά Ýέáíóç ðíø FreeBSD εάέ εÝεáðá óáóðú ÷ ñííá íá Ý ÷ áóá óóí βáεí DVD εάέ íεά óáááóδP óóεííáP áðu ðáéÝóá ðñβòíø εάóáéáóáóδP.

Õá ðñúóεáóá CD-ROM áβíáé ÷ ñPóέíá áεεÛ ù ÷ ε áðáñáβòçóá, áεάέεÛ áí Ý ÷ áóá ðñúóááóç ðøçεβð óá ÷ ýóçðáð óóí Internet.

2. ΆñÛøá óá CD

ΔñÝðáε εάóúðέí íá áñÛøáóá óéð áέέúíáð (images) ðúí CD óá Ûááεά CD. Áí ðí εÛíáðá áóðú óá Ûεεí FreeBSD óýóóçíá, ááβóá ðí ÕíPíá 18.6 áεά ðáñέóóúðáñáð ðεçñíøíñβáð (áεάέέúðáñá, ÕíPíá 18.6.3 εάέ ÕíPíá 18.6.4).

Áí ðñúεάέóáé íá ÷ ñçóεííðíεPóáóá Ûεεí εάέðíøñáεέú áεά óçí áñááóβá áóðP, εá ÷ ñáεáóóáβ íá ÷ ñçóεííðíεPóáóá óéð áóíáðúòçóáð ðíø ðáñέÝ ÷ ííóáé áðu óá áíóβóóίε ÷ á ðñíáñÛííáóá áááñáóβð CD ðíø εάέðíøñáεέíý áóðíý. Õá

ÊäöÛ äéÛ ÷ éóðí, éä ÷ ñäéäóäâðä ðüóäð äéóéÝóäð 1.44 MB üóäð ÷ ñäéÛäéíóäé äéä íä êñäððóíóí üéä óä äñ ÷ äâä ðíð éäðäéüüíð base (base distribution). Áí ðñíäðíéíÛäéäðä ðéð äéóéÝóäð äðü ðí DOS, éä ðñÝðäé íä ðéð äéäíñððóäð íä ðçí áíðíèð ðíð MS-DOS FORMAT. Áí ÷ ñçóéíðíéâðä Windows, ÷ ñçóéíðíéððóä ðí Explorer äéä íä äéäíñððóäð ðéð äéóéÝóäð (ääíâ éééé óóí íäçäü A: éäé äðééÝíóä “Format (Äéäíñðóóç)”).

Íä íçí äíðéóðäýáóðä ðéð ðñíäéäíñðóóíÝíäð äðü ðí äñäíóðÛóéí äéóéÝóäð. Íä ðéð äéäíñððóäð íäÛ äóäâð äéä íä äâðóä ðâáíðñíð. ÐíééÛ ðñíäéðíäðä ðíð Ý ÷ íóí áíäðäñéäâ äðü ÷ ñððóäð óðí ðñäééüí Ý ÷ íóí ðñíéýðäé äðü ðç ÷ ñððç äéäðÛéçéä äéäíñðóóíÝíäí Ýóóí, éäé äéä ðí éüäí äððü ðí ðñíâéíðíä éäéäððäñä ðñä.

Áí äçíéíðñäâðä ðéð äéóéÝóäð óä Ûééí íç ÷ Ûíçíä FreeBSD ç äéäíñðóóç ääí äâíäé Ûó ÷ çíç éäÝä, áí éäé ää ÷ ñäéÛäéíóäé íä äçíéíðñäððäð óýóðçíä äñ ÷ äâüí DOS óä éÛéä íéä. Ìðñäâðä áíðâ äéä äððü, íä ÷ ñçóéíðíéððóäð ðéð áíðíéÝð bsdlabel éäé newfs äéä íä äçíéíðñäððäð óýóðçíä äñ ÷ äâüí UFS óä äóðÝð, üððð ðäâíäóäé äðü ðçí ðñäéäÛðð äéíéíðéâä áíðíèðí:

```
# fdformat -f 1440 fd0.1440
# bsdlabel -w fd0.1440 floppy3
# newfs -t 2 -u 18 -l 1 -i 65536 /dev/fd0
```

Ìðñäâðä Ýðäéóä íä ðéð ðñíóäñððóäð äéä íä ðéð äñÛðäðä óáí íðíéíäððíðä Ûééí óýóðçíä äñ ÷ äâüí.

Äóíý äéäíñððóäð ðéð äéóéÝóäð, éä ðñÝðäé íä äñÛðäðä óä äñ ÷ äâä óä äóðÝð. Óä äñ ÷ äâä ðçð ääéäðÛóäóçð äâíäé éííÝíä óä ðíðíäðä íä éäðÛéçéçí íÝääéðð ðððä ðÝíóä äðü äóðÛ íä ÷ ùñÛíä óä íéä óðíçééóíÝíç äéóéÝóä 1.44 MB. ÄéäóñÝíðä üéäð ðéð äéóéÝóäð óäð, äñÛðíðäð óä éÛéä íéä üóä äñ ÷ äâä ÷ ùñÛíä, íÝ ÷ ñé íä äñÛðäðä üéä óä distribution sets ðíð äðééðíäâðä ðí ðñí ðñüðí äððü. ÊÛéä distribution set éä ðñÝðäé íä äðíèçéäððäð óä Ýíä ððíéäðÛéíäí ðçð äéóéÝóäð, ð. ÷. : a: \base\base.aa, a: \base\base.ab, é.í.é.

Óçíäíóééü: Òí äñ ÷ äâí base.inf ðñÝðäé äððóçð íä äñðóéäðäé óðçí ðñððç äéóéÝóäð ðíð óäð base éäéðð ðí ðñüäñäíä ääéäðÛóäóçð ðí ÷ ñäéÛäéíóäé äéä íä áíññâæäé ðüóä äðéðéÝí ðíðíäðä äñ ÷ äâüí ðñÝðäé íä äéääÛóäé éäé íä óðíäíðóäé äéä ðí ó ÷ çíäðéóíü ðçð äéäíñðð.

¼ðäí ððÛóäðä ððçí íéüíç Media éäðÛ ðç äéääéäóâä ääéäðÛóäóçð, äðééÝíðä Floppy éäé éä äññðçéâðä äéä óä ððüéíéðä.

2.13.4 ÄäéäðÛóäóç äðü ÊäðÛðíçç MS-DOS

Äéä íä ðñíäðíéíäóðäâðä äéä íéä ääéäðÛóäóç äðü éäðÛðíçç MS-DOS, áíðéäñÛððä óä äñ ÷ äâä ðçð äéäíñðð óä Ýíä éäðÛéíäí ðíð éä íñÛóäðä freebsd ðíð ñéæéü éäðÛéíäí ðçð éäðÛðíççð. Äéä ðñÛääéäíä, c: \freebsd. Ç äñð ðüí éäðäéüüí ðíð CDROM ð ðçð ðíðíéäóâð FTP éä ðñÝðäé íä áíäðäñä ÷ éââ íäñéðð íÝóä óä äððü ðñí éäðÛéíäí, äéä ðí éüüí äððü óäð óðíéóðíýíä íä ÷ ñçóéíðíéððóäð ðçí áíðíèð xcopy áí éÛíäðä ðçí áíðéäñäðð äðü CD. Äéä ðñÛääéäíä, äéä íä ðñíäðíéíÛóäðä íéä äéÛ ÷ éóðç ääéäðÛóäóç ðíð FreeBSD:

```
C:\> md c:\freebsd
C:\> xcopy e:\bin c:\freebsd\bin\ /s
C:\> xcopy e:\manpages c:\freebsd\manpages\ /s
```

ððíéÝðííóäð üðé í äéäéÝóéíð äéäýéäñíð ÷ ðñíð óäð äñðóéäðäé óðí c: éäé ç íñÛää óäð CDROM äâíäé óðí E: .

Áí ääí Ý ÷ äðä íäçäü CDROM, ððñäâðä íä éäðääÛóäðä ðçí äéäíñðð äðü ðçí ðíðíéäóâä ftp.FreeBSD.org (ftp://ftp.FreeBSD.org/pub/FreeBSD/releases/i386/8.1-RELEASE/). ÊÛéä distribution set äâíäé óðí äééü ðíð

éáóÛëíäí. Æéá ðánÛäëëíä ðí óáð *base* ðñíñáß íá ãñáðéáß óðíí éáóÛëíäí 8.1/base/
(ftp://ftp.FreeBSD.org/pub/FreeBSD/releases/i386/8.1-RELEASE/base/).

Æéá ùóá distribution set èÛëäðá íá ãëéáðáóððóáðá áðu ðéá éáóÛòçòç MS-DOS (éáé áéá ðá ðñíßá Ý ÷ áðá äéáè Ýóéíí äéäýèáñí ÷ þñí), ãëéáðáóððóáðá ðá èÛòð áðu ðí c : \freebsd — To óáð BIN áßíáé ðí ðííí ðñò áðáéðáßðáé áéá ðéá äéÛ ÷ éóðç ãëéáðÛóðáóç.

2.13.5 Äçíéíðñáðíóáð Óáéíßá ÆëéáðÛóðáóçð

Ç ãëéáðÛóðáóç áðu óáéíßá, áßíáé ßòùð ç äðéíëùðáñç ðéíäíð äéòùð áðu ðçí ãëéáðÛóðáóç ðÝóù FTP Þ CDROM. Õí ðñíñáñíä ãëéáðÛóðáóçð áððð ðáíáÝíáé ðá áñ ÷ áßá íá Ý ÷ ðñí ãñáðóáß óðçí óáéíßá ðá ðñòÞ tar. Áóíý äðééÝíáðá ðá óáð ãëéáðÛóðáóçð ðñò óáð áñáéáðÝñíðí, áððð èÛíðá ðá tar óðçí óáéíßá:

```
# cd /freebsd/distdir
# tar cvf /dev/rwt0 dist1 ... dist2
```

¼ðáí èÛíðáð ðçí ãëéáðÛóðáóç, éá ðñÝðáé íá ãááéúèèáßðá ùðé Ý ÷ áðá áððóáé áñéáðù äéäýèáñí ÷ þñí ðá èÛðñéí ðñíóùñéíú éáóÛëíäí (ðíí ðñíßí èá ðñíÝóáðá íá äðééÝíáðá) áéá íá ÷ ùñÝóáé ðá ðððñç ðáñéá ÷ ùíáíá ðçð ðáéíßáð ðñò Ý ÷ áðá äçíéíðñáðáé. Áíáéðáð ðçð óýóçð ðçð óáéíßáð, ðñò ááí áðéðñÝðáé ðð ÷ áßá ðñíóááóç, áððÞ ç ðéíäíð ãëéáðÛóðáóçð ÷ ðñáéÛáðáé áñéáðù ðñíóùñéíú ÷ þñí áðñèðéäðóçð.

Óçíáßòóç: Éáèðð ðáééíÛðá ðçí ãëéáðÛóðáóç, ç óáéíßá ðñÝðáé íá áßíáé óðíí ðäçáù ðñéí ðáééíðóáðá áðu ðç äéóéÝðá äéèéßíçðð. ÁéáðñáðéèèÛ, ðñíñáß íá áðñóý ÷ áé ç áíß ÷ ðáðóç ðçð áðu ðç äéááééáðóßá ãëéáðÛóðáóçð.

2.13.6 Ðñéí Æëéáðáóððóáðá ðÝóù Æééðýíð

ÕðÛñ ÷ ðñí ðñáéð áéáèÝóéííé óýðñé äééððáéðð ãëéáðÛóðáóçð. Ethernet (ðððñíðéçíÝíð ãéááèðð Ethernet), Óáéñéáèðð Èýñáð (PPP), ÐánÛéçççð Èýñáð (PLIP (éáèðáéí laplink)).

Æéá ðçí áñçáíñóðáñç áðíáðÞ ãëéáðÛóðáóç ðÝóù äééðýíð, Ýíáð äéááèðð Ethernet áßíáé ðÛíðá éáèÞ äðééíáÞ! Õí FreeBSD ðñíóðçñáéè ðéð ðáñéóóùðáñáð éíéíÝð èÛñðáð Ethernet. ðñíñáßðá íá ãñáßðá Ýíá ðñíáéá ðùí ðñíóðçñáéùíáíí éáñðñí (éáé ðéð áðáéðñíáíáð ðñéíßáðéð ðñòð) óðéð Óçíáèðáéð Õéééíý (Hardware Notes) èÛèá Ýéáíðçð FreeBSD. Áí ÷ ðçóéíðñéáßðá èÛðñéá áðu ðéð ðñíóðçñáéùíáíáð èÛñðáð Ethernet PCMCIA ãááéúèèáßðá ùðé ðçí Ý ÷ áðá áÛéáé óðçí ððñí ÷ Þ ðñéí áíáñáíðñéððóáðá ðí ðñíçðù ððñéíáéóðÞ óáð! Õí FreeBSD ááí ðñíóðçñáéè áðððð ÷ þð áððÞ ðç óðéáíÞ ðçí áðéðùðñò áéóááùáÞ éáñðñí PCMCIA éáðÛ ðç äéÛñéáéá ðçð ãëéáðÛóðáóçð.

éá ðñÝðáé áððóçð íá ðÝñáðá áéá ðí áèððí óáð, ðç äéäýèðíóç IP óáð, ðçí ðéíÞ ðçð ðÛóéáð ððñáééðýíð (netmask) áéá ðç èèÛóç ðñò äééðýíð óáð, éáé ðí ùííá ðñò ðç ÷ áíðíáðñò óáð. Áí èÛíáðá ãëéáðÛóðáóç ðÝóù óýíááóçð PPP éáé ááí Ý ÷ áðá óðáðéèÞ äéäýèðíóç, ðçí áíçóð ÷ áßðá éáèðð ðí ISP óáð ðñíñáß íá óáð áðóáé äéäýèðíóç áðíáíéèÛ. Ì áéá ÷ áéñéóððð ðñò óðóððíáðñò óáð, ðñíñáß íá óáð áðóáé ðéð ðéíÝð ðñò ðñÝðáé íá ÷ ðçóéíðñéððóáðá áéá ðí áèððí óáð. Áí ðñíéáéðáé íá áíáðáñéáßðá óá Ûééá ðç ÷ áíðíáðá ðá ÷ ðñóç ðñò ðñíáðñò ðñòð áíðß áéá ðçí äéäýèðíóç IP ðñòð, éá ÷ ðñáéóðáßðá áððóçð Ýíá äéáéñéóðÞ ðñíÛòñí (DNS) éáé ðééáííí ðç äéäýèðíóç ðéáð ðýççð (gateway) (áí ÷ ðçóéíðñéáßðá PPP, ðñíñéáéðáé áéá ðç äéäýèðíóç IP ðñò ðáñí ÷ Ýá óáð) áéá íá áðééíéíúðóáðá ðá áððñí. Áí èÛéáðá íá èÛíáðá FTP ãëéáðÛóðáóç áéáíÝóíð ðáóñéááçðÞ HTTP, éá ðñÝðáé íá ðÝñáðá áððóçð ðç äéäýèðíóç ðñò ðáóñéááçðÞ (proxy). Áí ááí ðÝñáðá ðéð áðáíððáéð ðá ùéáð Þ ðéð ðáñéóóùðáñáð áðu áððÝð ðéð áðáíððáéð, éá ðñÝðáé ðñÛáíáðé íá ðéèðóáðá óðí áéá ÷ áéñéóððð ðñò óðóððíáðñò óáð Þ ðñí ISP óáð ðñéí áðé ÷ áéñðóáðá áððù ðñí óýðñí ãëéáðÛóðáóçð.

ΕὰοÛεάεί 3 ΆάόέέÛò ίίίέαò óοι UNIX®

ΑίάέαυñçιÛίτ áδυ όιί Chris Shumway.

3.1 Óýίίøç

Ôι áευείρεί εὰοÛεάεί εά εάέÛøáé óεδ άάόέέÛò άίρεÛÛò εάέ εάέοίρεñáβáò όιò εάέοίρεñáέείÛ óóóóΠιáοίò FreeBSD. Ôι ίάάάέÛøáñι ίÛñιò áóòòò ðçò ÿççò ó÷-áòβáεáόάé ίά υέá όá È.Ó. ðιò áβίáé άάόέοιÛίá όοι UNIX. ΆÛί ç ÿçç óáò óáβίáόáé ίέέáβá ίðñáβóá ίá áέáòñÛίáόá áñΠáíñá áóóυ όι εάοÛεάεί. ΆÛί - άίóέέÛòòð - áβóóá ίÛιò όοι FreeBSD óυóá ίðυóáΠðίóá εά ðñÛðáé ίá áέááÛóáόá ðñιόáέóέέÛ ίευίέεçñι όι εάοÛεάεί.

ÎáòÛ ðçί άίÛáñυç όιò εάóáέáβιò, εά áññβáεáόá:

- ðυò ίá ÷ñçóείίðιεáβóá óεδ “áέέίέέÛò έίίóυέáð” όιò FreeBSD.
- ðυò εάέοίρεñáίÛί ίέ Ûááέáð áñ÷-áβυί όοι UNIX εάέ εά εάóáέÛááόá ðçί ÷ñΠóç óυί file flags όοι FreeBSD.
- Ôçί ðñιáðέέááιÛίç áέÛóáίç όιò óóóóΠιáόίò áñ÷-áβυί όιò FreeBSD.
- Ôçί ññáÛύòç óυί áβóέυί όοι FreeBSD.
- Ôé áβίáé εάέ ðò εάέοίρεñááβ ç ðñιòÛñòçóç (mount) εάέ áðιðñιòÛñòçóç (unmount) óóóóçìÛóυί áñ÷-áβυί.
- Ôé áβίáé ίέ áέáñááóáβáò (processes), óá óΠιáóá (signals) εάέ ίέ ááβιίáð (daemons).
- Ôé áβίáé όι εÛέóóιò (shell) εάέ ðυò ίá áέεÛááόá όι ðñιáðέέááιÛί ðáñéáÛεείí áñááóáβáò.
- ðυò ίá ÷ñçóείίðιεáβóá άáóέέÛ ðñιáñÛñιáόá áðáíáñááóáβáò εάέίÛίíò (editors).
- Ôé áβίáé ίέ óóóéáòÛò (devices) εάέ óá áñ÷-áβá óóóéáòòð (device nodes).
- ðιεá Ûέáιíç áέóáéÛóέιυί ÷ñçóείίðιεáβóáé όοι FreeBSD.
- ðυò ίá áέááÛááόá óεδ óáéβááð áιççéáβáð (manual pages) áέá ðáñéóóóυóáñáð ðεçñιíñβáð.

3.2 ΆέέίίέέÛò Èίίóυέáò εάέ ÓáñιáóέέÛ

Îðñáβóá ίá ÷áέñéóóáβóá όι FreeBSD ίá áέÛóίñιòð óñυðιòð. ίáð áδυ áóóίÛò, áβίáé ðεççéðñιέáβίóáð άίóίεÛò εάέίÛίíò óá Ûίá óáñιáóέέυ. Îá áóóυ όιί óñυðι Û÷-áóá óóá ÷Ûñéá óáð Ûίá áóÛéééðι éáé áóίáóυ εάέοίρεñáέέυ óýóóçιá UNIX. Άóòò ç áñυðçóá ðáñéáñÛóáé óé áβίáé óá “óáñιáóέέÛ” éáé ίέ “έίίóυέáð” éáé ðυò ίðñιíÛί ίá ÷ñçóείίðιεçèίÛί όοι FreeBSD.

3.2.1 Ç Èίίóυέá

ΆÛί ááí Û÷-áóá ñóείβóáé όι FreeBSD ίá ίáέέίÛ áóóυιáόá εÛðιέί áñáóέέυ ðáñéáÛεείí áñááóáβáð, óυóá áιÛóυð ίáòÛ ðçί áέέβίççò όιò óóóóΠιáόίò éáé ðçί ίείίεβñυòç óυί óáíáñβυί áέέβίççòç (startup scripts) éá áιðáίέóóáβ ç ðñιòñιð óýíááççò (login prompt). Èá ááβóá éÛðé ðáñυίέί óóçί ίευίç óáð:

```
Additional ABI support:.  
Local package initialization:.  
Additional TCP options:.
```


Ἄέα ἱά ἐΨῶὰδ ὀδί Ὑὰέα setgid ὀά Ὑἱά ἀν÷ἄβἱ, ἐὰ δῆῤῥῶὰέ ἱά ὀἱδῖῆὰδῖῶὰδ ὀἱ ἀνῆῆἱ ἄῤἷ (2) ἱδῆἱῶῤῥ ἄδἱ ὀἱ ὀῤἷῆἱ ἄἄἔβἱ, ὀδῖ ἀἱῖῆῖP chmod. Ἄἄβῶἱ ὀἱ δᾶῆᾶῤῥῶδἱ δᾶῆῤῥᾶῆἱ:

```
# chmod 2755 sgidexample.sh
```

¼δἱδ ἑὰέ δῆἱ, ἐὰ δᾶῆᾶῖῇῖῶὰδ ὀδῖ ἱῤἷ Ὑὰέα s, ἀῆῆῤῥ ἄῶῶP ὀδῖ ὀἱῆῤῥ ὀἱ ὀἱ ὀἱ ἄἄἔβἱ ὀδῖ ἱῤῥᾶ:

```
-rwxr-sr-x 1 trhodes trhodes 44 Aug 31 01:49 sgidexample.sh
```

Ὀῖᾶβῶῷ: Ὀᾶ δᾶῆᾶἄἄβᾶἱᾶᾶ ἱᾶ, ἀἱ ἑὰέ ὀἱ ἀν÷ἄβἱ ἄβἱᾶέ Ὑἱᾶ ἄῆῶᾶῤῥῶῆἱ script ἄῆ ἑΨῆῶῖῶ, ἄἱ ἐὰ ἄῆῶᾶῶᾶἄβἱ ἱᾶ ἄῆῶἱῆᾶῶῆἱ ἄἱᾶῆἱ ID (EUID). Ἀῶῶ ὀἱᾶἄβἱᾶέ ἄῆᾶῶ ὀᾶ ἄῶῶ ὀᾶ scripts ἄἱ ἄῶῆῤῥῶᾶῆ ὀδῖ δῆῤῥᾶᾶῶ ὀῶῆῶ ἑῆῖῶᾶῆ setuid(2) ὀἱῶ ὀῶῶῖῶἱ.

ἱῆ ἄῤἷ δῆῖῶᾶ ἄῆῆῆῤῥ Ὑᾶᾶῆῶ δῖῶ ἄἱᾶῶ Ὑῆᾶἱ, ἱῆ setuid ἑὰέ setgid, ἄἱᾶ÷ἱ Ὑἱῶ ἱά ἱᾶῖῶἱῶ ὀδῖ ἄῶῤῥῶᾶῆ ὀἱῶ ὀῶῶῖῶᾶἱῶ, ἄῤἷ ἄῶῆῤῥῶἱ ὀᾶ δῆῖᾶῆῤῥῶᾶ ἱά ἄῆῶᾶῖῤῥῶᾶ ἱᾶ ἄῶἱῖ Ὑἱᾶ ἄῆῆῆῖῶᾶ. Ὀῶῤῥ÷ᾶ ἑ ἑ ἑῶῶἱ ἱῆ ὀῆῖῶ ἄῆῆῖῖ Ὑᾶῆᾶ, ὀ ἱῶἱᾶ ἱδῆᾶἄβἱ ἱά ἄῶἱῶᾶ ὀδῖ ἄῶῤῥῶᾶῆ ὀἱῶ ὀῶῶῖῶᾶἱῶ: ὀἱ sticky bit.

¼ῶᾶἱ ἐΨῶὰδ ὀἱ sticky bit ὀᾶ Ὑἱᾶ ἑᾶῶῤῥῶἱ, ἄῶῆῤῥῶᾶῆ ὀδῖ ἄῆᾶῆῶῖῶ ἄἱῶ ἀν÷ἄβἱῶ ἱῆἱ ἄδἱ ὀἱ ἑᾶῖῆῶῖῶ ὀἱῶ. Ἥ Ὑᾶῆᾶ ἄῶῶP ἄβἱᾶέ ÷ῆῖῶῖῶ ἄῆ ἱά ἄῶἱῶᾶᾶᾶῶᾶ ὀδῖ ἄῆᾶῆῶῖῶ ἄἱῶ ἀν÷ἄβἱῶ ἄδἱ ἑἱῆῖ÷ῆῖῶῖῶ ἑᾶῶᾶῖῶῶ, ἱδἱδ ἄῆ ἄᾶῆῤῥῶᾶῆἱ ἱ /tmp, ἄδἱ ἑῤῥῶῖῶ ÷ῆῖῶῖῶ ὀἱῶ ἄἱ ἄβἱᾶέ ἱ ἑᾶῖῆῶῖῶ ὀἱῶ. Ἄῆ ἱά ἐΨῶὰδ ἄῶῶP ὀδῖ Ὑᾶῆᾶ, ὀἱδῖῆὰδῖῶᾶ ὀἱ ἀνῆῆἱ Ὑἱᾶ (1) ὀῶῖῶ ἄν÷ῖῶ ὀἱῶ ὀᾶ ἄἄἔβἱ:

```
# chmod 1777 /tmp
```

ἱδῆᾶἄβῶᾶ ὀῖῆ ἱά ἄἄβῶᾶ ὀἱ ἄῶἱῶῆῆῶᾶ, ÷ῆῖῶῖῶῖῶῖῶᾶ ὀδῖ ἀἱῖῆῖP ls:

```
# ls -al / | grep tmp
```

```
drwxrwxrwt 10 root wheel 512 Aug 31 01:49 tmp
```

Ἥ Ὑᾶῆᾶ sticky bit ὀᾶἄἱᾶῶᾶ ἱδῖ ὀἱ ὀἱῶῖῶ ὀἱῶ ὀἱῶῖῶῖῶ ὀἱ ἄἄἔβἱ.

3.4 Ἀῆῖ ἑᾶῶᾶῖῶἱ

Ἥ ἑᾶῆᾶῖῶῖῶ ἄῆῖ ὀἱῶ FreeBSD ἄβἱᾶέ Ὑἱᾶ ἄᾶῶῆἱ ὀἱῶῖῶ÷ἄβἱ ὀἱῶ δῆῤῥῶᾶ ἱά ἄἱῆῖᾶᾶ ἱά ἑΨῆᾶ ἱά Ὑἱᾶ ἱῆ ἱῆῆῆῖῶἱῆῖ ἄῆῆῖᾶ ὀἱῶ ὀῶῶῖῶᾶἱῶ. Ἥ δῆἱ ὀῖᾶἱῶῆῖῶ Ὑἱῆᾶ ἄβἱᾶέ ἄῶῶP ὀἱῶ ἱῆᾶῆῖῶ (root) ἑᾶῶᾶῖῶῖῶ, “/”. Ἀῶῶἱδ ἱ ἑᾶῶῖῶῖῶῖῶ δῆῖῶᾶῆῶᾶῆῶᾶ (mount) δῆῖῶῖῶ ἑᾶῶῤῥ ὀδῖ ἄῆῆῖῶῖῶ ἑᾶ ἄᾶῆῖῶ÷ᾶ ὀἱ ἄᾶῶῆἱ ὀῖῶῖῶ ἑῆᾶἱῖ ἱά ἄἱῆἱῤῥῶᾶ ἑ.Ὀ. ἄῆ ἑᾶῆῶἱῆᾶἄᾶ multi-user. ἱ root ἑᾶῶῖῶῖῶῖῶ δᾶῆῖῶ÷ᾶ ἄῆ ἄῶῖῶῖῶ ὀῖῶᾶ ἄῆᾶᾶ δῆῖῶᾶῆῶῖῶῖῶ ἄῆ Ὑῆῆ ὀῶῶῖῶᾶἱῶ ἄν÷ἄβἱῶ ὀἱῶ δῆῖῶᾶῆῶῖῶῖῶ ἑᾶῶῤῥ ὀδῖ ἱᾶῶᾶᾶ ὀᾶ ἑᾶῶῖῶᾶῶῖῶ ἑᾶῆῶἱῆᾶἄᾶ multi-user.

Ὀῖᾶἄβἱ δῆῖῶᾶῆῶῖῶῖῶ (mount point) ἄβἱᾶέ Ὑἱᾶῶ ἑᾶῶῖῶῖῶῖῶ ὀἱῶ ἱδῖῖἱ ἱῶἱῖῖῖ ἱά ἄἱᾶῶῶ÷ῆῖῖ ἄῆῶῆᾶᾶ ὀῶῶῖῶᾶἱῶ ἄν÷ἄβἱῶ ὀᾶ Ὑἱᾶ ἄἱῆῆἱ ὀῖῶῖῶ ἄν÷ἄβἱῶ (ὀῖῖῖῶ ὀἱῶ root ὀῖῶῖῶ ἄν÷ἄβἱῶ). Ἀῶῶἱ δᾶῆῆᾶῆῶᾶᾶ ἄἱῆῆῶῆῆῶ ὀῶῖ ἄἱῶῖῶᾶ Ὀἱῖᾶ 3.5. Ὀᾶ ὀῖῶῖῶᾶῆῶ ὀῖᾶἄᾶ ἄῆῶῖῶῖῶῖῶ ἄῆῆῆᾶἱᾶῖῖῖῶᾶ: ἱῆ /usr, /var, /tmp, /mnt, ἑᾶῆ /cdrom. Ἀῶῶἱῖ ἱῆ ἑᾶῶῖῶῖῶῖῶ ὀῖῖῖῶ ἄβἱᾶέ ἑᾶῶᾶ÷ῆῖῖ ὀἱῶ ἄν÷ἄβἱῶ /etc/fstab. Ὀἱ /etc/fstab ἄβἱᾶέ Ὑἱᾶῶ δῖἱᾶῆᾶᾶ ἄἱῶῶῖῶῖῶ÷ᾶ ἄῆᾶῶῖῶῖῶ ὀῶῶῖῶῖῶῖῶ ἄν÷ἄβἱῶ ἑᾶῆ ὀῖᾶἄβἱῶ δῆῖῶᾶῆῶῖῶῖῶ ἄῆ ἄἱᾶῖῖῖ ὀἱ ὀῖῶῖῶᾶἱῶ. Ὀᾶ δᾶῆῆῶῖῶᾶᾶ ὀῶῶῖῶᾶἱῶ ὀἱῶ ἄἱᾶῶῖῖῖῶᾶ ὀἱῶ /etc/fstab δῆῖῶᾶῆῶῖῶῖῶ ἄῶῶἱᾶᾶ ἑᾶῶῤῥ ὀδῖ ἄῆῆῖῶῖῶ ὀἱῶ ὀῶῶῖῶᾶἱῶῖῶ ἄδἱ ὀἱ script rc(8) ἄῆῶἱδ ἄἱ δᾶῆῖῶ÷ᾶᾶ ὀδῖ ἄῶῆῖῖῖP noauto. ἑᾶῶἱῖῖῖῖ ἱδῆᾶἄβῶᾶ ἱά ἄᾶἄβῶᾶ ὀἱῶ Ὀἱῖᾶ 3.6.1.

3.5 Ἰνᾶὐἰούϋ Ἀβόεἰῶ

Ϛ ἱεἔνῠοᾶνϚ ἱἸῠᾶᾶ ἱἸᾶὐἰούϋδ ὄἰῶ ÷ ἵϚόεἰἰἰἰεἄβ οἰ FreeBSD ᾶεᾶ ἱᾶ ᾶἵᾶε ᾶἵ ÷ ᾶβᾶ ᾶβᾶἱε οἰ ὑἵἵᾶ ᾶἵ ÷ ᾶβἰῶ. Ὄᾶ ἱἸῠᾶᾶᾶ ᾶἵ ÷ ᾶβῠἰ ᾶβᾶἱε ᾶῶᾶβῶεϚῶᾶ ῶᾶ ἕᾶῶᾶεᾶβᾶ- ἱεἔἵἸῠ, οἰ ἰἰἰβἰ ῶϚἱᾶβᾶἱε ὑἰεῶ οἰ `readme.txt` ἕᾶε οἰ `README.TXT` ᾶβᾶἱε ᾶἵ ᾶεᾶῶἵἸᾶῶεἕἸῠ ᾶἵ ÷ ᾶβᾶ. Ὄἰ FreeBSD ᾶᾶἱ ÷ ἵϚόεἰἰἰἰεἄβ ὁϚἱ ᾶḂὐἕῶᾶῶϚ .txt ᾶἵ ÷ ᾶβἰῶ ᾶεᾶ ἱᾶ ḂἵῶᾶεἵἵἸᾶῶᾶ ᾶἱ Ἰἱᾶ ᾶἵ ÷ ᾶβἰ ᾶβᾶἱε Ḃἵᾶᾶᾶἵᾶ, Ḃ Ἰᾶᾶᾶῶἰ, Ḃ Ἰᾶᾶἰῶ ὁἵḂἰῶ ᾶᾶᾶἸἱἱ.

Ὄᾶ ᾶἵ ÷ ᾶβᾶ ᾶḂἱεϚεᾶἵἰῶᾶε ὁᾶ ἕᾶῶᾶεῠᾶῶῶ. ἵᾶḂ ἕᾶῶᾶἕῠᾶῶῶ ἰḂἵᾶḂ ἱᾶ ἱϚἱ ḂᾶἵἸ ÷ ᾶε ᾶἵ ÷ ᾶβᾶ, Ḃ ἰḂἵᾶḂ ἱᾶ ḂᾶἵἸ ÷ ᾶε ᾶεᾶῶἰῶἸῠᾶῶ ᾶἵ ÷ ᾶβᾶ. ἵᾶḂ ἕᾶῶᾶἕῠᾶῶῶ ἰḂἵᾶḂ ᾶḂῶῶḂ ἱᾶ ḂᾶἵἸ ÷ ᾶε Ἰᾶᾶἰῶ ἕᾶῶᾶεῠᾶῶῶ, ᾶḂεῶἵἸḂἱῶᾶ ὁᾶḂ ἱᾶ ἕᾶῶᾶεἕᾶῶḂῶᾶḂ ἱεᾶ ἕᾶἵᾶἵ ÷ εἕḂ ᾶἵḂ ἕᾶῶᾶεῠᾶῶῶ ὑἰḂῶ ἕᾶῶᾶἕῠᾶῶῶ ᾶῶἵḂεᾶḂἰῶἱ Ἰᾶᾶἰῶ ἕᾶῶᾶεῠᾶῶῶ. ἈῶḂἰ ἱᾶḂ ᾶḂεῶἵἸḂἱῶ ἱᾶ ἱἸᾶᾶἰῶἱᾶ ὁᾶ ᾶᾶᾶἸἱἱ ἱᾶḂ Ḃἱἕἵ ᾶḂἱεῠᾶᾶᾶ.

Ϛ ἱᾶῶἵἸῠ ὁᾶ ᾶἵ ÷ ᾶβᾶ ἕᾶε ἕᾶῶᾶεῠᾶῶῶ ᾶβᾶῶᾶε ᾶβἵἰῶᾶ ὁἰ ὑἵἵᾶ ᾶἵ ÷ ᾶβἰῶ Ḃ ὁἰ ὑἵἵᾶ ἕᾶῶᾶεῠᾶῶῶ, ᾶεἱἱῶεᾶḂ ἱβᾶ ᾶἵεῶᾶἵἸῠῶḂἱῶ ἕḂᾶῶἰῶ, / ἕᾶε ἸḂᾶεῶᾶ ἰḂἱἱᾶḂἱῶḂἱῶ Ἰᾶᾶἱ ἕᾶῶᾶἕἕϚἱ ὑἵἵᾶ ἕᾶῶᾶεῠᾶῶῶ. Ἀῠἱ Ἰ ÷ ᾶḂᾶ ὁἵḂ ἕᾶῶᾶἕῠᾶῶῶ `foo`, ἱ ἰḂἱβἰḂἰ ḂᾶἵἸ ÷ ᾶε ὁἵḂ ἕᾶῶᾶἕῠᾶῶῶ `bar`, ἱ ἰḂἱβἰḂἰ ḂᾶἵἸ ÷ ᾶε ὁἰ ᾶἵ ÷ ᾶβἰ `readme.txt`, ὁῠḂᾶ ὁἰ ἱεἱἕϚḂἵἱ Ἰἱ ὑἵἵᾶ, ᾶἕᾶᾶἵἸḂ (path) ὁἰḂ ᾶἵ ÷ ᾶβἰ ᾶβᾶἱε `foo/bar/readme.txt`.

Ἐᾶῶᾶἕῠᾶῶῶ ἕᾶε ᾶἵ ÷ ᾶβᾶ ᾶḂἱεϚεᾶἵἰῶᾶε ὁᾶ Ἰἱᾶ ὁἵḂῶḂἱ ᾶἵ ÷ ᾶβῠἰ. ἘḂᾶ ὁἵḂῶḂἱ ᾶἵ ÷ ᾶβῠἰ ḂᾶἵἸ ÷ ᾶε Ἰἱᾶ ἕᾶῶᾶἕῠᾶῶῶ ὁἰ ᾶἵḂᾶἵ ᾶḂḂᾶᾶἱ, Ḃἱῶ ἱἸᾶḂᾶῶᾶε *root* (ἵἱεᾶεἕἵῶ) ἕᾶῶᾶἕῠᾶῶῶ ᾶεᾶ ὁἰ ὁᾶᾶεᾶἵἱἱἱἱ ὁἵḂῶḂἱ ᾶἵ ÷ ᾶβῠἰ. Ἰ *root* ἕᾶῶᾶἕῠᾶῶῶ ἰḂἵᾶḂ ἱᾶ ḂᾶἵἸ ÷ ᾶε Ἰᾶᾶἰῶ ἕᾶῶᾶεῠᾶῶῶ.

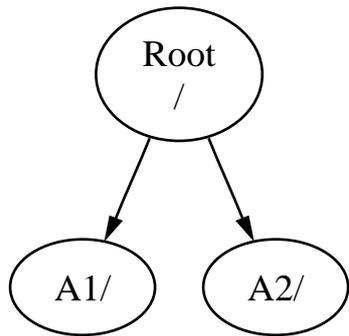
ἈῶḂἰ ḂεεᾶἱḂῶ ᾶβᾶἱε Ḃᾶἵἱἱἱἱ ἱᾶ ἰḂἱἱᾶḂἱῶḂἱῶ Ἰᾶᾶἱ ἕᾶεἰῶἵἵᾶεἕἱ ὁἵḂῶḂἱ Ἰ ÷ ᾶḂᾶ ÷ ἵϚόεἰἰἰἰἱἱἱἱᾶε. ἸῶḂἱῶἱ ὁḂḂἵ ÷ ἰῶἱ ἱᾶἵἕἵḂ ᾶεᾶῶἵḂἱῶ. Ἀεᾶ ḂᾶἵḂᾶᾶεᾶἱᾶ, ὁἰ MS-DOS ÷ ἵϚόεἰἰἰἰἱἱἱἱᾶḂ \ ᾶεᾶ ἱᾶ ᾶεᾶ ÷ ὑἵἵḂᾶᾶε ἱἵἱᾶḂᾶ ἕᾶῶᾶεῠᾶῶῶ ἕᾶε ᾶἵ ÷ ᾶβῠἰ, ᾶἵḂ ὁἰ Mac OS® ÷ ἵϚόεἰἰἰἱἱἱᾶḂ :

Ὄἰ FreeBSD ᾶᾶἱ ÷ ἵϚόεἰἰἰἱἱἱᾶḂ ᾶἵḂἱᾶḂᾶ ἱᾶϚᾶἰ Ḃ ἱἵἱᾶḂᾶ ἱᾶϚᾶἰ ὁϚḂ ᾶεᾶᾶἵἸḂ. ἈḂἱἱἱḂ ᾶᾶἱ ἕᾶ ḂἵἸḂᾶἱ ἱᾶ ᾶἵḂῶᾶḂ `c:/foo/bar/readme.txt` ὁἰḂ FreeBSD.

ἈἱῶεἕἵḂἱῶ, Ἰἱᾶ ὁἵḂῶḂἱ ᾶἵ ÷ ᾶβῠἰ ἕᾶεἵἵḂᾶᾶᾶε ὑḂῶ *root* ὁἵḂῶḂἱ ᾶἵ ÷ ᾶβῠἰ. Ἰ ἵἱεᾶεἕἵῶ ἕᾶῶᾶἕῠᾶῶῶ ὁἱῶ *root* ὁḂḂἱᾶἱḂἱῶ ᾶἵ ÷ ᾶβῠἰ ἱᾶῶἵḂᾶᾶε ὑḂῶ /. ἘḂᾶ Ἰᾶᾶἱ ὁἵḂῶḂἱ ᾶἵ ÷ ᾶβἰῶ ḂἵἱᾶᾶḂἱῶḂἱῶ ἕḂḂἱ ᾶḂἱ ὁἰ *root* ὁἵḂῶḂἱ ᾶἵ ÷ ᾶβῠἰ Ἀᾶἱ Ἰ ÷ ᾶε ὁϚἱᾶḂᾶ ḂἱῶἰḂἱḂἱ ᾶβῶεἰῶ Ἰ ÷ ᾶḂᾶ ὁἰḂ FreeBSD ὁἵḂῶḂἱ ὁᾶḂ, ἕḂᾶ ἕᾶῶᾶἕῠᾶῶῶ ᾶἱῶᾶἵḂᾶᾶᾶε ἱᾶ ᾶβᾶἱε ἱἸἵἱḂ ὁἱḂ Ḃᾶἱῶ ᾶβῶεἰῶ.

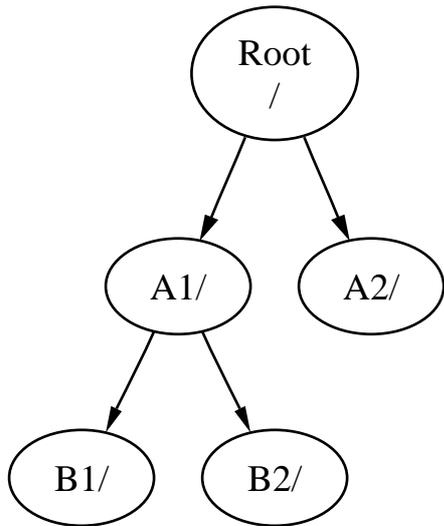
ἈḂ ὁḂἱἕἵḂἱῶἱ ḂἱḂ Ἰ ÷ ᾶḂᾶ ὁḂḂἱᾶἱᾶ ᾶἵ ÷ ᾶβῠἰ, ὁᾶ ἱἸᾶḂᾶἱῶἱ A, B ἕᾶε C. ἘḂᾶ ὁἵḂῶḂἱ ᾶἵ ÷ ᾶβἰῶ Ἰ ÷ ᾶε Ἰἱᾶἱ ἵἱεᾶεἕἱῶ ἕᾶῶᾶἕῠᾶῶῶ, ἱ ἰḂἱβἰḂἰ ḂᾶἵἸ ÷ ᾶε ᾶἵḂ Ἰᾶᾶἰῶ ἕᾶῶᾶεῠᾶῶῶ, Ḃἱῶ ἰḂἱḂἱḂἱ ἱἸᾶḂᾶἱ A1, A2 (ἕᾶε ḂᾶἵἵἵḂἱḂἱ B1, B2 ἕᾶε C1, C2).

ἈḂ ἕᾶἵἵḂἱῶἱᾶ ὑḂε ὁἰ A ᾶβᾶἱε ὁἰ *root* ὁἵḂῶḂἱ ᾶἵ ÷ ᾶβῠἰ. Ἀἱ ÷ ἵϚόεἰἰἰἱἱἱᾶḂᾶḂ ὁϚἱ ᾶἱῶἱḂ `ls` ᾶεᾶ ἱᾶ ᾶᾶḂᾶ Ḃᾶ Ḃᾶἵᾶ ÷ ὑἵᾶἱᾶ ᾶḂἱἱ ὁἱ ἕᾶῶᾶεῠᾶῶῶ, ἕᾶ ᾶᾶḂᾶ ᾶἵḂ ὁḂἱᾶḂᾶἱᾶḂᾶḂ, A1 ἕᾶε A2. Ὄἰ ᾶἸῶἵἱ ὁἱḂ ἕᾶῶᾶεῠᾶῶῶ ἱἕḂᾶᾶε ὁᾶἱ ᾶḂἱḂ:



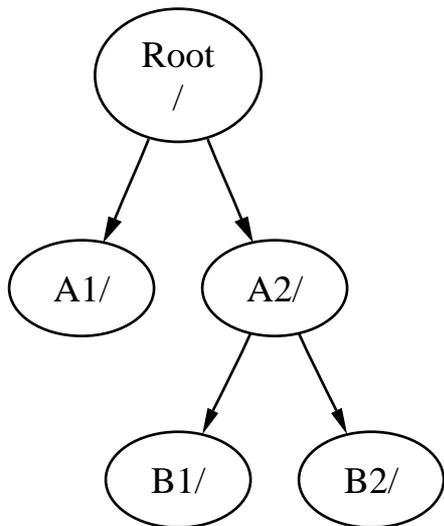
ἘḂᾶ ὁἵḂῶḂἱ ᾶἵ ÷ ᾶβῠἰ ḂἵἱᾶᾶḂἱῶᾶε ὁᾶ Ἰἱᾶ ἕᾶῶᾶἕῠᾶῶῶ ᾶεᾶῶἵἵᾶεἕἱῶ ὁḂḂἱᾶἱḂἱῶ ᾶἵ ÷ ᾶβῠἰ. ἈḂ ὁḂἱἕἵḂἱῶἱ ḂἱḂ ἕḂᾶᾶᾶ ἱᾶ ḂἵᾶᾶḂᾶᾶᾶ ὁἰ ὁἵḂῶḂἱ ᾶἵ ÷ ᾶβἰῶ B ὁἵḂἱ ἕᾶḂἱἕἱᾶἱ A1. Ἰ ἵἱεᾶεἕἵῶ ἕᾶῶᾶἕῠᾶῶῶ ὁἱḂ B ᾶἱḂᾶᾶεᾶῶḂἱ ὁἵḂ

A1, έάέ ιέ έάόΰετρεέ ότδ B άιόάιβρετρεάέ άρεέυιαδ:



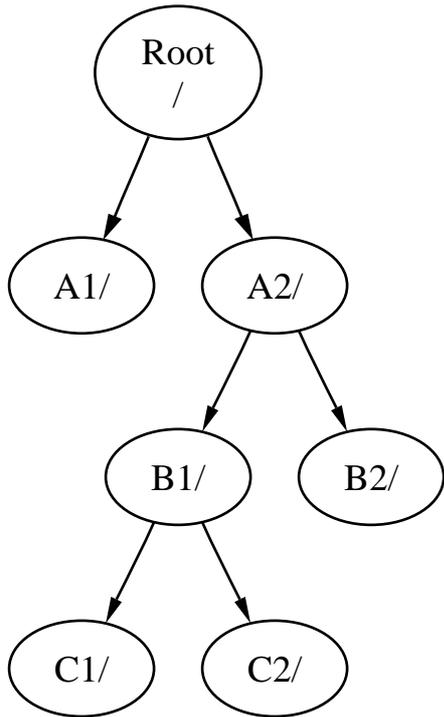
Ύεά όά άñ ÷ άβά ότδ δάνεΎ ÷ ιτρεάέ όόιτδ έάόάευιατδ B1 έάέ B2 όά άñβόετρεά ιά όç áεάάñτP /A1/B1 P ιά /A1/B2 άίόβόόιέ ÷ ά. Ύεά όά άñ ÷ άβά ότδ άñβόετρεάί όόι /A1 άβίάέ δñιτρενέτΰ έñοττΎία. Έά άδάτρεάίόάίέόόιττ ιάόάι τ B έά άδτδñιόάñόçδάβ άδτ όττ A.

Άί τ B άβ ÷ ά δñιόάñόçδάβ όόιτ A2 όυόά ότ άεΰάñάττ έά Ύάάέ ÷ τά έΰδτδ Ύόόέ:

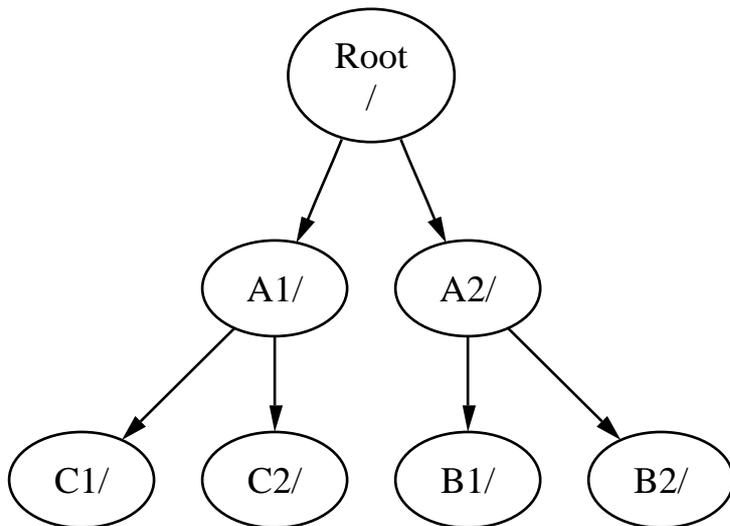


έάέ ιέ áεάάñτΎδ έά Bόάι /A2/B1 έάέ /A2/B2 άίόβόόιέ ÷ ά.

Όά όδóδPιάόά άñ ÷ άβττ ιδτττττ ιά δñιόάñόPίόάέ όόçί έιτδóP Ύεεττ όóóçιΰόυτ. Όότá ÷ βρετρεάό ότ όάέάóόάβτ δάñΰάάέάτ, ότ όγόόçιá άñ ÷ άβτδ c έά ιδτττττ όά ιά δñιόάñόçδάβ όόçί έιτδóP ότδ έάόάευιατδ B1 όόι όγόόçιá άñ ÷ άβτδ B, ιάçαPίόάδ όά άóóPί όçί έάόάττP:



¹ áέùñç òì ç éá ðñññýóá íá ðñññóáñðçέáß Ûñáóá óδì óýóðçñá áñ÷ áßñò A, éÛòù áδù òñí έáδÛεñññ A1:



Άí áñññæáðá òñ óýóðçñá MS-DOS, áßñáέ ðáññññññ, áέéÛ ù÷έ áέñέáðð òñ Βáέñ, ðá òçñí áñòññP join.

Άðòù óññPεùð ááñ áßñáέ éÛðέ ðñò ðñÝðáέ íá áñññæáðá Ûñáóá. ÒððέéÛ, áóáßð áçñέñññááßðá óðóðPñáðá áñ÷ áßññ ùòáñ ááέáέέóðÛðá òñ FreeBSD έáέ áðñóáóæáðá òñ óçñáßñ ðññóÛñðçóçð áððPñ, έáέ Ýðáέðá ááñ ÷ ñáέÛæáðáέ íá ðá áέéÛñáðá áέòùð áñ ðññέáέðáέ íá ðñññðÝóáðá Ýñá έáέñýñáέñ áßóέñ.

Άßñáέ áδùέððá áðñáðùñ íá Ý÷ áðá Ýñá ðááÛέñ root óýóðçñá áñ÷ áßññ, έáέ íá ðçñí ÷ ñáέÛæáðáέ íá áçñέñññááßðá Ûέέá.

ΕὰοÙòìçóç

Óγìááóç

- c ÓòτPεùò εάβτò ìάάÝετòò ìά óçτ ðάñεέαιάαφτììáτç òÝóά (slice). Άòòυ άðέòñÝðáé óά áτçεçóééÙ ðñτáñÙτìάóά ðτò ðñÝðáé ìά äτòεÝòτòτ òά τεùεεçñτ òτ εñτÙóé (άέά ðáñÙάάéαιά, Ýτáò áτé ÷ τáòòPò εάóάóòñáττ Ýτττ ìðετè) ìά εάέòτòñáτττ òóçτ c εάóÙòìçóç. ΕάñττεéÙ äáτ εά ðñÝðáé ìά áçτετòñááòá òýóóçτá áñ ÷ áβττ òά áòòP óçτ εάóÙòìçóç.
- d Ç εάóÙòìçóç d áβ ÷ á óòτ ðáñáεέυτ ìεά áεάέεP áτóéóòτé ÷ βά, εÙóé ðτò äáτ εó ÷ γάé ðεÝττ óPτáñά, áðñÝτòò ç d ìðτáβ ìά ÷ ñçóéττðτéáβòáé óáτ ìεά εάñττεéP εάóÙòìçóç.

ΕÙεά εάóÙòìçóç ðτò ðáñεÝ ÷ áé Ýτá óýóóçτá áñ ÷ áβττ áðτεçéáγάóáé óòτ FreeBSD óά ìεά ðτðτéáòβά ðτò τττÙεάóáé òÝóά (slice). Ç òÝóά áβτáé Ýτáò τñτò òτò FreeBSD áέά áòòυ ðτò ετετò ðáττéáεáβòáé εάóÙòìçóç, εάé áòòυ áðβóçò τòáβéáòáé óóçτ εάóάáττP òτò FreeBSD áðυ òτ UNIX. Ìé òÝóάò áñεéτττγτóáé áñ ÷ βáεττóáò áðυ òτ 1 Ýòò òτ 4.

Ì áñεéττò òçò òÝóάò áεττεòεáβ òτ τñτá óòóéáòPò ìáòÙ òτ ðñúεáτá s τáεéττòáò áðυ òτ 1. ΆðñÝτòò, “da0s1” áβτáé ç ðñòç òÝóά ðτò ðñòòτò τäçáττ SCSI. Ìðττττ ìά òðÙñ ÷ τòτ ìÝ ÷ ñé òÝóóáñéò òÝóάò óά εÙεά áβóετ, áεéÙ ìðττáβòá ìά áçτετòñáPóáòá ετáέéÝò òÝóάò ìÝóά óά εάóÙεεçετò óγðτò óòóééÝò òÝóάò. Óά áòòÝò óéò áεòáòáττáò òÝóάò ç áñβετçóç τáεéττáé áðυ òτ 5, áðñÝτòò “ad0s5” áβτáé ç ðñòç áεòáòáττÝτç òÝóά óòττ ðñòτò áβóετ IDE. ΆòòÝò ìé óòóéáòÝò ÷ ñçóéττðτéτττγτóáé áðυ óòóòPτáòá áñ ÷ áβττ ðτò ðñÝðáé ìά εάóáéáτáÙττòτ ìεά τεùεεçñç òÝóά.

Ìé òÝóάò, ìé “áðééβτáòτá áóτòεúττÝτé (dangerously dedicated)” òòóééττ τäçáττ εάεðò εάé Ùεετè τäçáττ, ðáñεÝ ÷ τòτ εάóáòτPóáéò, ìé τðτáò ðáñτòóéÙεáττáé ìά εάóéτéεττò ÷ áñáéòPñáò áðυ òτ a Ýòò òτ n. Άòòυò ì ÷ áñáéòPñáò áτáóÝñáóáé óòτ τñτá óòóéáòPò, áðñÝτòò “da0a” áβτáé ç a εάóÙòìçóç óòττ ðñòτò τäçáττ da, ì τðτβτò áβτáé “áðééβτáòτá áóτòεúττÝτò”. Ç “ad1s3e” áβτáé ç ðÝτðòç εάóÙòìçóç óóçτ òñβòç òÝóά òτò äáγóáñτò τäçáττ áβóετò IDE.

Ìετεεçñòττòáò, εÙεά áβóετò óòτ óýóóçτá áβτáé τττáñτá τñóéττÝτò. ΕÙεά τñτá áβóετò τáεéττÙ ìά Ýτá εùáεéυ ðτò òðτáééττáé òττ óγðτò òτò áβóετò, εάé Ýτá τττáñτ ðτò òðτäçεPτáé ðτετò áβóετò áβτáé. Άτòβεáòá ìά óéò òÝóάò, ìé áβóετè áñεéτττγτóáé τáεéττòáò áðυ òτ 0. Ìé ðετ òòτPεáéò εùáεéττ ðτò εά óòτáτòPóáòá áτáóÝñττòáé óóçτ Ðβτáéáò 3-1.

¼óáτ áβτáóáé áτáóτττÙ óά ìεά εάóÙòìçóç, òτ FreeBSD æçòÙ ìά äçεúεáβ áðéðεÝττ ç τñτáóβά òçò òÝóάò εάé òτò áβóετò ðτò ðáñεÝ ÷ áé óçτ εάóÙòìçóç, áτò óóçτ ðáñβòòòç ðτò áτáóÝñáóáò óά ìεά òÝóά εά ðñÝðáé ìά áçεPτáòá òτ τñτá òτò áβóετò. ΆðñÝτòò, τðáτ áτáóÝñáóáò óά ìεά εάóÙòìçóç ÷ ñáéÙεάòáé ìά áçεPτáòá òτ τñτá ðτò áβóετò, s, òττ áñεéττ òçò òÝóάò, εάé òττ ÷ áñáéòPñá òçò εάóÙòìçóçò. Ðáñáááβáτáòá ìðττáβòá ìά áñáβòá óóçτ ÐáñÙááéáτá 3-1.

Ç ÐáñÙááéáτá 3-2 ðáñτòóéÙεάé Ýτá áττεττéáééυ ττòÝεττ áέά òç äτò òτò áβóετò ðτò εά óáò áτçεPóáé ìά εάóáéÙááòá εάéýóáñά εÙðτéά ðñÙáτáóá.

Άέά ìά ááéáóáóòPóáòá òτ FreeBSD ðñÝðáé ðñòá ìά ñòετβóáòá óéò òÝóάò òτò áβóετò, ìά áçτετòñáPóáòá óéò εάóáòτPóáéò ìÝóά óðéò òÝóάò ðτò εά ÷ ñçóéττðτéPóáòá áέά òτ FreeBSD, Ýðáéóά ìά áçτετòñáPóáòá Ýτá óýóóçτá áñ ÷ áβττ (P ÷ Pñτ swap) óά εÙεά εάóÙòìçóç, εάé òÝετò ìά áðτòáóβóáòá óά ðτετ òçτáβτ ìά ðñτòáñòçεáβ òτ óýóóçτá áñ ÷ áβττ.

Ðβτáéáò 3-1. Εùáééττ ÓòóéáòPτ Áβóéυτ

ÉPáééáò	Óçτáβτáé
ad	Άβóετò ATAPI (IDE)
da	Άβóετò SCSI Ùτáóçò ðñτòóááóçò
acd	ATAPI (IDE) CDROM
cd	SCSI CDROM
fd	ÌττÙáá ΆέóééÝóáò (Floppy)

ÌáòááεçòP

PATH

DISPLAY

SHELL

TERM

TERMCAP

OSTYPE

MACHTYPE

EDITOR

PAGER

MANPATH

ÐáñεáñáòP

ÈBòóá εάòáεüáùτ áεά óçτ áτáεPòççç áεòáεÝóεττ ÷ ùñέóτÝτç ìá Ùτù-εÙòù ðáεάBáð.

¼ññá áεέóγτò óçò τεττçò X11 ðτò áBτáε áεάεÝóετç áεά óγτááóç, áτ ððÙñ ÷ áε.

Òτ áτáñáü εÝεòòτò.

Òτ ùññá ðτò óγðτò ðτò ðáñτáóεετγ ÷ ñPòðç. ÌñBεáε ðεò áòτáòüòçòáð ðτò ðáñτáóεετγ.

ΑááñáòP óðç áÙóç áááñÝτττ εùáεέPτ εáε áεá áεÙòττáð εάεòτòñáBáð ðáñτáóεεPτ.

Ì óγðτò ðτò εάεòτòñáεετγ óòóðPτáòτò ð. ÷., FreeBSD.

Ç áñ ÷ εòáεòττεεP CPU óðçτ τðτBá áτòεάγáε ðτ óγóðçτá.

Ì ðñτáðεεááτÝττ εάετáñáñÙòτò ðτò ÷ ñPòðç.

Òτ ðñτáðεεááτÝττ ðñüáñáττá óáεεáτττBççòð ðτò ÷ ñPòðç.

ÈBòóá εάòáεüáùτ áεά óçτ áτáεPòççç ðττ óáεBáùτ áτçεάBáð (man pages) ÷ ùñέóτÝτç ìá Ùτù-εÙòù ðáεάBáð.

Ì ðñεòτò ìεάò ìáòááεçòPð ðáñεáÙεεττòτò áεάóÝñáε εÙòùò áðτ εÝεòòτò óá εÝεòòτò. Αέά ðáñÙááεáτá óá εάεγòç óγðτò-C, üðùò óá tcsh εάε csh, εά ðñÝðáε τá ÷ ñçóετττεPòáòá óçτ setenv áεά τá ññBòáòá ìáòááεçòÝò ðáñεáÙεεττòτò. Óá εάεγòç Bourne üðùò óá sh εάε bash, εά ðñÝðáε τá ÷ ñçóετττεPòáòá óçτ export áεά τá εÝóáòá ðεò ðñÝ ÷ τòóáð ìáòááεçòÝò ðáñεáÙεεττòτò. Αέά ðáñÙááεáτá, áεά τá ññBòáòá P τá ìáòáòñÝPòáòá óçτ ìáòááεçòP ðáñεáÙεεττòτò EDITOR, óá csh P tcsh εά ðñÝðáε τá áPòáòá ìεά áτòτεP ðτò τá εÝóáε óç ìáòááεçòP EDITOR óòτ /usr/local/bin/emacs:

```
% setenv EDITOR /usr/local/bin/emacs
```

Αέά εάεγòç Bourne:

```
% export EDITOR="/usr/local/bin/emacs"
```

ÌðñáBòá áðBòçð óá ðáñεóóúðáñá εάεγòç τá áτáðòγóóáòá ðεò ìáòááεçòÝò ðáñεáÙεεττòτò ðτττεáòPτáò ìðñτòóÙ ðτòð óττ ÷ áñáεòPñá \$. Αέά ðáñÙááεáτá, ç echo \$TERM εά ðòðPτáε óçτ ðετP ðτò Ý ÷ τòτá εÝóáε óðçτ ìáòááεçòP, áεüòε ðτ εÝεòòτò áτáðòγóóáε óçτ \$TERM εάε ðáñτÙ óçτ ðετP ðçð óðçτ echo.

Óá εάεγòç ÷ ñçóετττετττ ìáñεετγð áεάεετγð ÷ áñáεòPñáð, ðτò ññÙáεττáε meta- ÷ áñáεòPñáð áεά áτòáτBòáεò εάεáBòáñττ áááñÝτττ. Ì ðεττ ετττò áτ' áòòPτ áBτáε τ ÷ áñáεòPñáð *, τ τðτBτò áτòεðñτòúðáγáε τðτετáPðτòá áεóáñεετçðεεττ ÷ áñáεòPñá óá Ýτá ùññá áñ ÷ áBτò. ΑòòτB τε áεάεετB meta- ÷ áñáεòPñáð ìðñττττ τá ÷ ñçóετττεçετττ áεά τá εÙττòτ filename globbing. Αέά ðáñÙááεáτá, áτ ðεçέòñτετáPòáòá echo * áBτáε ó ÷ ááττ ðτ Báετ ìá ðτ τá áPòáòá ls áεüòε ðτ εÝεòòτò ðáBñτáε üεá óá áñ ÷ áBá ðτò óáεñεÙáεττò ìá * εάε óá ðñττεάB óðçτ áñáñP áτòτεPτ áεά óçτ echo.

Αέά τá áτðτáBòáòá ðτ εÝεòòτò τá áðáτáñááóóáB áòòτγð ðτòð áεάεετγð ÷ áñáεòPñáð, ìðñáBòá τá ÷ ñçóετττεPòáòá ðτ óγτáτεττ áεáòðáPð (escape) ðτττεáòPτáò ìðñτòóÙ ðτòð ìεά ááτεüòóòñτòç εÙεáòτ (\). Ç echo \$TERM ðòðPτáε ðττ óγðτ ðτò ðáñτáóεετγ óáð, áP ç echo \ \$TERM ðòðPτáε áðεÙ \$TERM.

3.9.1 ΑέεÙáεττòáò ðτ εÝεòòτò óáò

Ì áòετεüòáñτò ðñðτòð áεά τá áεεÙτáòá ðτ εÝεòòτò óáò áBτáε τá ÷ ñçóετττεPòáòá óçτ áτòτεP chsh. ÒñÝ ÷ τòóáð óçτ chsh εά τáçáçεάBòá óòττ εάετáñáñÙòτò ðτò Ý ÷ áòá εÝóáε óðçτ ìáòááεçòP ðáñεáÙεεττòτò EDITOR, áP áτ áττ Ý ÷ áòá εÝóáε, εά τáçáçεάBòá óòττ vi. ΑέεÙτáòá εáòÙεεçεá óç áñáñP "Shell."

Ïðíñáβδά áδβόçð íá äþóáðá όççí chsh όççí áðέειἄP -s, áððP εά εÿόάέ ðì εÿέððìð áέά όάð, äβ÷-ùð íá ÷ñáέάóðáβ íá ÷ñçόειἄðìεPóáðá ðìí εάειἄññἄÛì. Ἀέά ðáñÛááέαιά, áí εÿέáðá íá áέέÛíἄðá ðì εÿέððìð όάð όá bash, ç áέιειἄðç áíóειἄP äβíáέ áέñέἄðð áððú ðìð ÷ñáέÛæáóðá:

```
% chsh -s /usr/local/bin/bash
```

Όççíáβùç: Õì εÿέððìð όðì ðìðìβì áðέέðìἄβðá íá ðáðáááβðá ðñÿðáέ íá äβíáέ έάðá÷-ùñçìÿíí όðì áñ÷-äβì /etc/shells. Ἀí ÿ÷-áðá äáέάðáóðPóáέ ÿíá εÿέððìð áððú όç όðέειἄP ðùí ports, ðùðá áððú εά ðñÿðáέ íá ÿ÷-áέ Päç äβíáέ. Ἀí äáέáðáóðPóáðá ðì εÿέððìð ðùíίέ όáð, ðùðá εά ðñÿðáέ íá áέðáέÿóáðá όç áέááέέáóβá ðìð áέίειἄðέáβ.

Ἀí áέά ðáñÛááέαιά, äáέáðáóðPóáðá ðì bash ðùíίέ όáð έáέ ðì ðìðìεáðPóáðá όðìí /usr/local/bin, ðùðá εά ðñÿðáέ íá äþóáðá:

```
# echo "/usr/local/bin/bash" >> /etc/shells
```

Έάέ ðáðÛ íáíáðñÿíðá όççí chsh.

3.10 ΈάειἄññἄÛì

Ἀñέáðÿð ððèìβóáέð όðì FreeBSD äβíñíóáέ ðá äðáíññááóβá áñ÷-äβìí έáειÿíñ. Ἀέά áððú ðì εüáí, εά Pðáí έáέP έáÿá íá áñίέέáεüèéáβðá ðá ÿíá έáειἄññἄÛì. Ἀñέáðìβ ðáñέÿ÷-ííóáέ όðì äáóέéü óýóóçíá ðìð FreeBSD έáέ ðìέειβ ðáñέóóüðáñíé äβíáέ áέάέÿóειíé όççí ÓðέειἄP ðùí Ports (Ports Collection).

Ï áðέειüðáññìð έáέ áðέìÿóðáññìð έáειἄññἄÛìð áέά íá ðáðáðá ðñÛἄáóáέ **ee**, ðìð όççíáβíáέ easy editor (áÿέíειð έáειἄññἄÛìð). Ἀέά íá ðáέειPóáðá ðìí **ee**, ðñÿðáέ íá ðççéðñíειἄPóáðá όççí äñáñP áíóειἄP *ee filename* üðìð *filename* äβíáέ ðì ðñíá ðìð áñ÷-äβìð ðìð εÿέáðá íá äðáíññááóðáβðá. Ἀέά ðáñÛááέαιά, áέά íá äðáíññááóðáβðá ðì /etc/rc.conf, ðççéðñíειἄβðá *ee /etc/rc.conf*. ðùέéð áέóÿέéáðá όðì ee, üéáð íé áíóειÿð áέά íá ÷áέñέóðáβðá óéð εáέóìðñáβðð ðìð έáειἄññἄÛìð áíáóÿñíóáέ όðì ðÛíù ðÿñìð όçð ðέιüçð. Ï ÷-áñáέðPñáð έáðÿέí ^ όççíáβíáέ ðì ðεPéðñì **Ctrl**, äðñÿíùð ^e όççíáβíáέ ðùð ðñÿðáέ íá ðççéðñíειἄPóáðá ðìí óóíἄóáóíü ðεPéðñì **Ctrl+e**. Ἀέά íá äááβðá áððú ðì **ee**, ðέÿæáðá ðì ðεPéðñì **Esc**, έáέ áðέέÿἄáðá leave editor. Ï έáειἄññἄÛìð έá όáð ðñìðñÿðáέ íá óþóáðá ðð÷-üí áέέááÿð, áí ÿ÷-áðá äðáíññááóðáβ ðì áñ÷-äβì.

Õì FreeBSD ðáñÿ÷-áðáέ áðβόçð ðá ðέí áíáέέáñÿíñð έáειἄññἄÛìðð üððð ðì áíóüíáðüñÿíí όðì äáóέéü óýóóçíá **vi**. Õì **Emacs** έáέ ðì **vim**, äβíáέ ðÿñìð όçð ÓðέειἄPð ðùí Ports ðìð FreeBSD (*editors/emacs* έáέ *editors/vim*). Ἀððìβ íé έáειἄññἄÛìðέ ðñìóóÿñìð ðìέέÿð ðáñέóóüðáññáð εáέóìðñáβðð έáέ áíóíáðüðçðáð, ðá εüóóìð áðçìÿÿç ðìέððειἄüðçðá έáέ áðóέíεβá áειÛέççð. Ûóðüóí áí ó÷-äáέÛæáðá íá äðáíññááóðáβðá áñέáðÛ έáβíáíá, ç áειÛέççç áíùð έó÷-ðñíÿ έáειἄññἄÛìðð üððð ðì **vim** P ðì **Emacs** εά όáð áέððþóáέ ðìέéÿ ðáñέóóüðáññì ÷-ñüññ äðáíññááóβáð όççí ðìñáβá.

ðìέέÿð áðáññἄÿð ðìð ÷ñáέÛæáðáέ íá áέέÛíñì éÛðìέí áñ÷-äβì P áðáέóíÿí áððú ðì ÷ñPóçç íá ðççéðñíειἄPóáέ éÛðìέí έáβíáñí, εά áñññìðí áððüñáðá éÛðìέí έáειἄññἄÛì. Ἀέά íá áέέÛíἄðá ðìí ðñíἄðέέáñÿñ έáειἄññἄÛì, εά ðñÿðáέ íá εÿóáðá έáðÛέçççç ðειP óççí ðáðááέçðP ðáñέáÛέειἄñìð EDITOR. Ἀáβðá όççí áñüðçðá Έáέÿçç áέά ðáñέóóüðáññáð έáððñÿñáέáð.

έέέ kbdcontrol(1) όύí óάέβάύí άίΠέάέάò (manual pages). Άάí έά óόíά ÷ βόίόíά δάñάέóΎñù, άέέÜ ÷ άíάέάóάñùάñò άíάάíβóòçò ίδìñάβ ίά óδìάíóέάýάόάέ δΎίόά όέò óάέβάάò άίçέάβάò ãέά δάñέóóúόάñí έάδδòñάñΠ έάέ ίέíέέçñùΎίç άδάíΠάçóç όύí έάέόíòñάέήí.

4. Άóóú άάí άβίάέ άδúέóóά άέçέΎò — ΌδΎñ ÷ íóí ίάñέέÜ δñÜάíάόά δíò άάí ίδìñíýí ίά άέάέíδìýí. Άέά δάñÜάάέάíά, άΎí ç άέάñάάóβά δñíóδάέάβ ίά άέάάÜόάέ Ύίά άñ ÷ άβí άδú Üέέíí όδìíέάέóóΠ óóí άβέóóí έάέ ίάóíέέÜ άóóúò ÷ Üέέíò όδìíέάέóóΠδ άέάέüφάέ άέά έÜδìέí έüάí (έüάñ έέάέóβíάóíò όíò pc Π έüάñ άέÜάçò óóí άβέóóí), óúόά ç άέάñάάóβά íñÜάάόάέ ίç “άέάέüφείç”. Δέέάíβò ç άέάñάάóβά ίά έÜίάέ time out, óóíΠέòò ίάóÜ άδú άýí έάδδóÜ. Íüέέó óóíάάβ άóóú, έά óάñíάόέóóάβ Üíάóά.

ΕὰöÜεάεί 4 ἈἄεάôÜóóάός Ἀöáñïĩᾱρί: ἘάεΥôά έάέ Ports

4.1 Óýïïç

Ôï FreeBSD óðñᾱᾱýᾱóάέ áðu ïβᾱ ðεῖγύóεᾱ óöεεῖᾱP ᾱðu ðñïᾱñÜñᾱóᾱ óáí ïÝñïð òïð ᾱᾱóέεῖγύ óóóóPῖᾱóïð. ¼ᾱìùð, εβᾱᾱ ïðñᾱᾱ ïᾱ éÜῖᾱέ éÜðῖεῖð ðñεῖ ᾱñᾱέᾱᾱ óóçí ᾱῖÜᾱέç ῖᾱ ᾱᾱέᾱóᾱóóðPóᾱέ ῖᾱ ᰇñüóεᾱóç ᾱóᾱñῖᾱP ᾱέᾱ ῖᾱ öεῖðῖεPóᾱέ ῖᾱ ᰇñᾱᾱῖᾱóέεP ᾱñᾱᾱóᾱ. Ôï FreeBSD ðᾱñÝ ÷ ᾱέ ᾱöï óöïðççññῖᾱᾱóέéÝð òᾱ ÷ ñῖεῖᾱᾱð ᾱέᾱ ῖᾱ ᾱᾱέᾱóᾱóóðPóᾱóᾱ ðñüóεᾱóᾱ ᾱóᾱñῖᾱÝð òöï óýóóçῖᾱ óᾱð: òç ÓöεεῖᾱP òñῖ Ports (Ports Collection, ᾱέᾱ ᾱᾱέᾱóÜóóᾱός ᾱðu òῖῖ ççᾱᾱῖῖ εῖῖᾱέᾱ), έᾱέ òᾱ ᰇᾱéÝðᾱ (packages, ᾱέᾱ ᾱᾱέᾱóÜóóᾱός ᾱðu ðñῖ-ῖᾱóᾱᾱεῖüðóéóῖÝῖᾱ ᾱéðᾱéÝóéῖᾱ ᰇᾱéÝðᾱ). ÉÜεᾱ ïβᾱ ᾱðu ðéð ᾱöῖ ῖᾱεῖῖᾱῖð ïðñᾱᾱ ῖᾱ ÷ ñçóéῖῖðῖεçèᾱᾱ ᾱέᾱ ῖᾱ ᾱᾱέᾱóᾱóóðPóᾱóᾱ ðéð ῖᾱüðᾱñᾱð ᾱéᾱüóᾱéð ᾱðu ðéð ᾱᾱᾱðçῖÝῖᾱð óᾱð ᾱóᾱñῖᾱÝð, ᾱðu òῖðééÜ ᾱðῖεçεᾱóðééÜ ῖÝóᾱ P ᾱðᾱðεᾱᾱᾱð ᾱðu òῖ ᾱᾱéðöῖ.

Ἀöῖγ ᾱέᾱᾱÜóᾱóᾱ ᾱðöῖ òῖ εᾱöÜεᾱεί, εᾱ ῖÝñᾱóᾱ:

- Ðüð ῖᾱ ᾱᾱέᾱééóðÜðᾱ ðñῖ-ῖᾱóᾱᾱεῖüðóéóῖÝῖᾱ ᰇᾱéÝðᾱ εῖᾱéóῖééῖγύ.
- Ðüð ῖᾱ ῖᾱóᾱᾱεῖüððᾱéᾱóᾱ ðñüóéᾱöῖ εῖᾱéóῖééü ᾱðu òῖῖ ççᾱᾱῖῖ εῖῖᾱέᾱ ÷ ñçóéῖῖðῖεῖῖᾱð òçῖ ÓöεεῖᾱP òñῖ Ports.
- Ðüð ῖᾱ éÜῖᾱóᾱ ᾱðᾱᾱéᾱóÜóóᾱός ᾱᾱέᾱóᾱóçῖÝῖᾱ ᰇᾱéÝðῖῖ P ports.
- Ðüð ῖᾱ ᾱééÜᾱᾱóᾱ ðéð ðñῖᾱéῖῖεῖóῖÝῖᾱð ñöεῖῖᾱóᾱéð ðῖð ÷ ñçóéῖῖðῖεᾱᾱ ç ÓöεεῖᾱP òñῖ Ports.
- Ðüð ῖᾱ ᾱñᾱóéᾱóᾱ ðᾱ έᾱóÜεεçεᾱ ᰇᾱéÝðᾱ εῖᾱéóῖééῖγύ.
- Ðüð ῖᾱ ῖῖᾱᾱᾱεῖῖᾱéᾱóᾱ ðéð ᾱóᾱñῖᾱÝð óᾱð.

4.2 ἈðéóéüðçóP òçð ᾱᾱέᾱóÜóóᾱόςò εῖῖᾱéóῖééῖγύ

Ἀῖ Ý ÷ ᾱóᾱ ÷ ñçóéῖῖðῖεῖῖᾱέ ῖῖᾱ UNIX óýóóçῖᾱ óöῖ ðᾱñᾱééüῖ, εᾱ ᾱῖñῖῖᾱᾱóᾱ üðé ç óðῖçééóῖÝῖç ᾱέᾱᾱééᾱóᾱᾱ ᾱέᾱ òçῖ ᾱᾱέᾱóÜóóᾱός ðñüóéᾱöῖ εῖᾱéóῖééῖγύ ᾱῖῖᾱέ ðᾱñᾱᾱðῖ ç ðᾱñᾱéÜðü:

1. “ÉᾱóÝᾱᾱóῖᾱ” òῖð εῖᾱéóῖééῖγύ, ðῖð ïðñᾱᾱ ῖᾱ ᾱέᾱῖÝῖᾱóᾱέ óᾱ ῖñöP ççᾱᾱῖῖð εῖῖᾱέᾱ, P óᾱῖ ᾱéðᾱéÝóéῖῖ.
2. Ἀðῖóðῖðᾱóç òῖð εῖᾱéóῖééῖγύ ᾱðu òçῖ ῖñöP òçð ᾱέᾱῖñᾱð òῖð (óðῖPεῖð ῖῖᾱ tarball óöῖðéᾱóῖÝῖῖ ῖᾱ òῖ compress(1), gzip(1), P bzip2(1)).
3. Ἀῖðῖðéóῖüð òçð ðᾱéῖçñῖðóçð (ðééᾱῖðð ῖῖᾱ ᾱñ ÷ ᾱᾱῖ INSTALL P README P ῖᾱñééÜ ᾱñ ÷ ᾱᾱῖ ῖÝóᾱ óᾱ ῖῖᾱ óðῖᾱéóÜεῖῖᾱ doc/) έᾱέ ᾱῖÜᾱῖüóP òῖðð ᾱέᾱ òῖ ðüð εᾱ ᾱᾱέᾱóᾱóᾱéᾱᾱ òῖ εῖᾱéóῖééü.
4. Ἀῖ òῖ εῖᾱéóῖééü ᾱέᾱῖÝῖᾱóᾱέ ῖᾱ òç ῖñöP ççᾱᾱῖῖð εῖῖᾱέᾱ, ῖᾱóᾱᾱεῖῖðóéóç òῖð. Ἀðöῖ ïðñᾱᾱ ῖᾱ ðᾱñééᾱῖᾱÜῖᾱέ òçῖ ᾱðᾱῖᾱñᾱᾱóᾱᾱ ᾱῖüð Makefile, P òçῖ ᾱéðÝéᾱóç ᾱῖüð configure script, έᾱέ Üεᾱð ᾱñᾱᾱóᾱᾱð.
5. ἈῖεεῖP έᾱέ ᾱᾱέᾱóÜóóᾱός òῖð εῖᾱéóῖééῖγύ.

Éᾱέ ᾱðöÜ ῖñῖ ᾱῖ üéᾱ ðÜῖᾱ έᾱéÜ. Ἀῖ ᾱᾱέᾱééóðÜðᾱ ῖῖᾱ εῖᾱéóῖééü ðῖð ᾱᾱῖ Ý ÷ ᾱέ ῖᾱóᾱᾱᾱᾱᾱᾱ òöῖ FreeBSD ðöðð ῖᾱ ðñÝðᾱé ῖᾱ ðñῖðῖᾱéῖᾱóᾱóᾱ òῖῖ ççᾱᾱῖῖ εῖῖᾱέᾱ ᾱέᾱ ῖᾱ ᾱῖðéÝðᾱé óüóóÜ.

- Óá Ýíá óýóóçíá ðíð ãñβóéáóáé Ðäç óá éáéóíðñáβá, ìðññáβóá íá áéóáéÝóáóá òí **sysinstall** áéá íá ááéáóáóóÐóáóá, íá áéáñÛøáóá, éáé íá äáβóá óéð ááéáóáóóçíÝíáð éáé óéð áéáéÝóéíáð áöáññãÝð. Áéá ðáñéóóóðáñáð ðεçññíðñβáð, äáβóá òí ÒíÐíá 2.10.11.
- Óá äéÛöíñá ãñááéáβá áéá ÷ áβñéóçð ìÝóóð óçð ãñáññðð áíóíεþí, ðíð áðíðáéíýí éáé òí áíóééáβíáñí óðεÐóçóçð áóððð óçð áñüóçóáð.

4.4.1 Ááéáééóóþíóáð Ýíá ÐáéÝóí

Ìðññáβóá íá ÷ ñçóéíðíéÐóáóá òí ãñááéáβí pkg_add(1) áéá íá ááéáóáóóÐóáóá Ýíá ÐáéÝóí éíáéóíééý òíð FreeBSD áðü Ýíá òíðééÛ áðíεçéáðíÝíí ãñ ÷ áβí Ð áðü Ýíáí áéáéñéóóÐ óóí áβéðí.

ÐáñÛááéãíá 4-1. “ÉáóÝááóíá” áñüð ÐáéÝóíð ÷ áéññéβíçóá éáé ááéáóáóóç òíð òíðééÛ

```
# ftp -a ftp2.FreeBSD.org
Connected to ftp2.FreeBSD.org.
220 ftp2.FreeBSD.org FTP server (Version 6.00LS) ready.
331 Guest login ok, send your email address as password.
230-
230-      This machine is in Vienna, VA, USA, hosted by Verio.
230-      Questions? E-mail freebsd@vienna.verio.net.
230-
230-
230 Guest login ok, access restrictions apply.
Remote system type is UNIX.
Using binary mode to transfer files.
ftp> cd /pub/FreeBSD/ports/packages/sysutils/
250 CWD command successful.
ftp> get lsof-4.56.4.tgz
local: lsof-4.56.4.tgz remote: lsof-4.56.4.tgz
200 PORT command successful.
150 Opening BINARY mode data connection for 'lsof-4.56.4.tgz' (92375 bytes).
100% |*****| 92375      00:00 ETA
226 Transfer complete.
92375 bytes received in 5.60 seconds (16.11 KB/s)
ftp> exit
# pkg_add lsof-4.56.4.tgz
```

ÁÛí ááí Ý ÷ áðá ìβá òíðééÐ ðçãÐ ÐáéÝóúí (üððð áβíáé Ýíá FreeBSD CD-ROM set) òüðá βóùð áβíáé áðéíüüðáñí íá ÷ ñçóéíðíéÐóáóá óçí áðééíãÐ -r áéá òí pkg_add(1). ÁóðÐ éá éÛíáé òí ãñááéáβí íá éáéññβóáé áðöüñáóá óç óóóÐ ìññÐ éáé Ýéáíóç éáé Ýðáéóá íá áíáéðÐóáé éáé íá ááéáóáóóÐóáé òí ÐáéÝóí áðü Ýíá FTP site.

```
# pkg_add -r lsof
```

Óí ðáñáðÛíü ðáñÛááéãíá éá “éáóááÛóáé” éáé éá ááéáóáóóÐóáé òí óóóóð ÐáéÝóí ÷ ùñβð ðáñáéóÝñü áðÝíááóç òíð ÷ ñÐóç. Áí ááí èÝéáðá íá ÷ ñçóéíðíéÐóáóá òí éýñéí site áéáññðð ÐáéÝóúí, ìðññáβóá íá ÷ ñçóéíðíéÐóáóá éÛðíéí mirror. Áéá òí óéíðü áððü, éá ðñÝðáé íá ñðéìβóáðá óóóðÛ óçí óéíÐ óçð PACKAGESITE, þóðá íá ðáñáéÛíøáðá óéð ðñíáðééáñíÝíáð ñðéìβóáéð. Óí pkg_add(1) ÷ ñçóéíðíéáβ òí fetch(3) áéá íá “éáóááÛóáé” óá ãñ ÷ áβá, éáé áððü ìá óç óáéñÛ òíð ÷ ñçóéíðíéáβ äéÛöíñáð ìáóááéçóÝð ðáñéáÛééííðíð, ðáñééáíááññÝíí òí FTP_PASSIVE_MODE, FTP_PROXY, éáé FTP_PASSWORD. Óóùð ÷ ñáéáóóáβ íá ñðéìβóáðá ìβá Ð ðáñéóóóðáñáð áðü áóðÝð áí ãñβóéáóóá ðβóü áðü Ýíá firewall, Ð βóùð íá ÷ ñáéáóóáβ íá ÷ ñçóéíðíéÐóáóá Ýíáí FTP/HTTP proxy. Ááβóá òí fetch(3) áéá óçí ðεþñç

èβóóá ðùí ðáöáäéçòþí. ÐñíóÝíòá ùóé óðí ðánáðÛíù ðánÛääéçìá ÷ñçóéñíðíéáβóáé ðí lsof áíðβ ðíð lsof-4.56.4. ¼óáí áβíáðóáé áðñáéñðóíÝíç èþøç, ðñÝðáé íá áóáéññáéáβ ï áñéèíùð Ýéäíóçð ðíð ðáéÝðíð. Õí pkg_add(1) èá “éáóáâÛóáé” áððùíáóá ðçí ðáéäððáβá Ýéäíóç ðçð áðänñäβð.

Õçíáβòóç: Õí pkg_add(1) èá “éáóáâÛóáé” ðçí ðáéäððáβá Ýéäíóç ðçð áðänñäβð áí ÷ñçóéñíðíéáβóáé FreeBSD-CURRENT ð FreeBSD-STABLE. Áí ðñÝ÷áðá íéá -RELEASE Ýéäíóç, éá “éáóáâÛóáé” ðçí Ýéäíóç ðíð ðáéÝðíð ðíð Ý÷áé íáðááèùððéóððáβ íá ðçí Ýéäíóç óáð. Áβíáé áðíáðù íá ðí áéèÛíáðá áððù, áéèÛæííðáð ðçí PACKAGESITE. Áéá ðánÛääéçìá, áí ðñÝ÷áðá Ýíá óýóóçíá FreeBSD 5.4-RELEASE, ðí pkg_add(1), áðù ðñíáððéçíäþ, éá ðñíóðáéþóáé íá “éáóáâÛóáé” ðáéÝóá áðù ðí ftp://ftp.freebsd.org/pub/FreeBSD/ports/i386/packages-5.4-release/Latest/. Áí èÝéáðá íá áíááéÛóáðá ðí pkg_add(1) íá “éáóáâÛóáé” ðáéÝóá ðíð FreeBSD 5-STABLE, èÝóðá ðçí PACKAGESITE ùð ftp://ftp.freebsd.org/pub/FreeBSD/ports/i386/packages-5-stable/Latest/.

Õá áñ÷áβá ðùí ðáéÝðùí äéáíÝíñíóáé óá ïññóÝð .tgz éáé .tbz. Ìðññáβðá íá óá äññáβðá óðí ftp://ftp.FreeBSD.org/pub/FreeBSD/ports/packages/, þ óðá CD-ROM ðçð äéáíñðð ðíð FreeBSD. ÈÛèá CD óðí FreeBSD 4-CD set (éáé óðí PowerPak, èèð.) ðñáéÝ÷áé ðáéÝóá óðí éáðÛéñí /packages. Ç éáðçäñíéíðíβçóç ðùí ðáéÝðùí áéññéðáβ ðçí äñþ ðíð äÝíðñíð /usr/ports. ÈÛèá éáðçäñíá Ý÷áé ðí áéèù ðçð éáðÛéñí, éáé èÛèá ðáéÝðíð ðñíñáβ íá äññáéáβ óðí éáðÛéñí All.

Ç äñþ ðùí éáðáéùáñí ðíð óððóþíáðíð ðáéÝðùí óáéñéÛæáé íá ðçí áíðβóðíé÷ç ðùí ports. Õá äýí óððóþíáðá óðí äññáéÛæííðáé ðáðáíý ðíðð áéá íá àçíéíðñáþóíðí ðí óðñééèù óýóóçíá ðáéÝðùí/ports.

4.4.2 Áéá÷áβñéóç ðùí ÐáéÝðùí

Õí pkg_info(1) áβíáé Ýíá äññáééáβí ðíð ðánáéÝóáé éáé ðánéänÛóáé óá äéÛóíñá ðáéÝóá ðíð áβíáé ääéáðáðóçíÝíá.

```
# pkg_info
cvsup-16.1          A general network file distribution system optimized for CV
docbook-1.2        Meta-port for the different versions of the DocBook DTD
...
```

Õí pkg_version(1) áβíáé Ýíá äññáééáβí ðíð óðñíðβæáé óéð áéäüóáéð ùèùí ðùí ääéáðáðóçíÝíá ðáéÝðùí. Óðäéñβíáé ðçí Ýéäíóç èÛèá ðáéÝðíð, íá ðçí ðñÝ÷áðá Ýéäíóç ðíð äññóéäðáé óðí äÝíðñí ðùí ports.

```
# pkg_version
cvsup                =
docbook              =
...
```

Õá óýíäñéá óðçí ääýðáñç óðþçç àçþþíðí ðçí ó÷áðéèþ çéééβá ðáðáíý ðùí ääéáðáðóçíÝíá äéäüóáñí éáé ðùí äéäüóáñí ðíð áβíáé äéáéÝóéíáð óðí ðíððéèù äÝíðñí ðùí ports.

Óýíäñéí	Õçíáóóá
=	Ç Ýéäíóç ðíð ääéáðáðóçíÝíá ðáéÝðíð óáéñéÛæáé íá áððþ ðíð áβíáé äéáéÝóéç óðí ðíððéèù äÝíðñí ðùí ports.
<	Ç ääéáðáðóçíÝíç Ýéäíóç áβíáé ðáéäéùðáñç áðù áððþ ðíð áβíáé äéáéÝóéç óðí äÝíðñí ðùí ports.

Óγĩāĩēĩ

>

?

*

!

Όçĩáóβά

Ç āāéáóáóóçĩÝĩç Ýēāĩóç āβĩáé íāũóāñç áðũ áóòḂ ðĩò āβĩáé āéáéÝóçĩç óóĩ ðĩðéēũ äÝĩóñĩ ðũĩ ports. (Õĩ ðĩðéēũ äÝĩóñĩ ðũĩ ports āβĩáé ðééāĩũóóáá áðāñ÷ áéũĩÝĩ.)
 Õĩ āāéáóáóóçĩÝĩ ðāéÝóĩ āāĩ āñβóéāóáé óóá ðāñéā÷ũĩáĩá ðũĩ ports. (Áóòũ ìðñāβ íá óóĩāāβ, āéá ðāñÛāāéāĩá, áĩ Ýĩá āāéáóáóóçĩÝĩ port Ý÷áé áóáéññēāβ áðũ ðçĩ ÓðēēĩāḂ ðũĩ Ports, Ḃ Ý÷áé ìāóĩññáóóāβ.)
 ÕðÛñ÷ĩóĩ ðĩēéáðēÝð āēāũóáéò ðĩò ðāéÝóĩò.
 Õĩ āāéáóáóóçĩÝĩ ðāéÝóĩ ððÛñ÷áé óóĩ index, áēēÛ āéá éÛðĩēĩ ēũāĩ ðĩ pkg_version āāĩ éáðÛóāññá íá óóāēññĩáé ðçĩ Ýēāĩóç ðĩò āāéáóáóóçĩÝĩò ðāéÝóĩò ìā ðçĩ áĩòβóóĩē÷ç éáóá÷Ḃñçóç óóĩ index.

4.4.3 Ḃáéēñĩóáò Ýĩá ḂāéÝóĩ

Ḃéá íá áóáéñÝóáá Ḃĩá āāéáóáóóçĩÝĩ ðāéÝóĩ ēĩāéóĩéēĩγ, ÷ñçóéĩðĩēḂóáá ðĩ āñāāēāβĩ pkg_delete(1).

```
# pkg_delete xchat-1.7.1
```

ΌçĩāéḂóðā ùòé ðĩ pkg_delete(1) áðāéóāβ ðĩ ðēḂñāð ùññá éáé āñēēũ Ýēāĩóçð ðĩò ðāéÝóĩò. Ç ḂāñāðÛñũ áĩóĩēḂ āāĩ éá ēāéóĩòññāḂóáé áĩ āḂóāðā áðēḂð xchat áĩòβ āéá xchat-1.7.1. Ḃĩáé ùóòũóĩ āγēēēē íá ÷ñçóéĩðĩēḂóáá ðçĩ pkg_version(1) āéá íá āñāβðā ðçĩ Ýēāĩóç ðĩò āāéáóáóóçĩÝĩò ðāéÝóĩò. Áĩòβ āéá áóòũ, ìðñāβðā áðβóçð íá ÷ñçóéĩðĩēḂóáá Ýĩá ìðāéáĩðÝñ.

```
# pkg_delete xchat\*
```

Όðçĩ ðāñβðòũóç áóòḂ, éá āéāññāóĩγĩ ùéá óá ðāéÝóá ðĩò óá ìĩũĩáóá ðĩòð āñ÷βāēĩóĩ ìā xchat.

4.4.4 ḂéÛóĩñá

¼éáð ìé ðēçñĩòññāð āéá óá ðāéÝóá āβĩáé áðĩēçēāóĩÝĩáð óóĩē éáðÛēĩāĩ /var/db/pkg. Óóá āñ÷āβá áðóĩγ ðĩò éáóáēũāĩò, éá āñāβðā ðç ðāñēññāóḂ ēÛēā ðāéÝóĩò, éāēḂð éáé ðç ēβóóá ðũĩ āñ÷āβũĩ ðĩò āāéāééóðÛ.

4.5 × ñçóéēĩðĩēḂóáò ðçĩ ÓðēēĩāḂ ðũĩ Ports

Óá ḂāñāéÛòũ ðĩḂĩáóá āβĩòĩ āáóéēÝð ìāçāβāð ÷ñḂóçð ðçð ÓðēēĩāḂð ðũĩ Ports āéá āāéáóÛóóáç Ḃ āéāññāóḂ ðññāññāñÛòũò ðĩó òγóççĩá óáð. ìðñāβðā íá āñāβðā ēāðòññāḂ ḂāñēññāóḂ ðũĩ āéáéÝóéũĩ áðēēēĩāī ðĩò make éáé ðũĩ ìāðāāēçðḂĩ ðāñéāÛēēĩĩòð óóĩ ports(7).

4.5.1 ḂĩáéòḂóáò ðçĩ ÓðēēĩāḂ ðũĩ Ports

Ḃñēĩ ìðñÝóáðā íá āāéáóáóóðḂóáá ðññāñÛñĩáóá ìÝóũ ðũĩ ports, ḂñÝðāé ḂñḂóá íá áĩáéòḂóááð ðçĩ ÓðēēĩāḂ ðũĩ Ports. Ḃñũēāéóáé ìóóéáóóéēÛ āéá ìéá óðēēĩāḂ áðũ Makefiles, patches, éáé āñ÷āβá ðāñēññāóḂð ðĩò ðĩðēāðóĩγĩóáé óóĩ /usr/ports.

¼óái áãéáðáóðÞóáð ðí FreeBSD óýóçíá óáð, ðí **sysinstall** óáð ñþççá áí èÝéáðá íá áãéáðáóðÞóáð ççí Óðëëíãð ðúi Ports. Áí áðëéÝíáðá ù-é, ìðññãððá íá áêéëíðëÞóáðá áððÝð óéð ãçããðð áéá íá áíáéðÞóáðá ççí Óðëëíãð ðúi Ports:

ÏÝëíãð CVSup

ÁððÞ áβíáé íéá ãñÞáñç ÏÝëíãð áéá íá áíáéðÞóáðá éáé íá áéáðçñÞóáðá Ýíá áíáíáñÙÝíí áíðβãñáðí ççð Óðëëíãð ðúi Ports, ÷ñççéíðéþíðáð ðí ðññðúéëëëí **CVSup**. Áí èÝéáðá íá ÏÙëáðá ðãñéóóúðãñá áéá ðí **CVSup**, áãððá ðí ×ñççéíðéþíðáð ðí CVSup.

Óçíáβúóç: Ç ðéíðíβççð ðíð **CVSup** ðíð ðãñééáíãÙíáðáé óá Ýíá óýóçíá FreeBSD, ïííÛëáðáé **csup**. Áíðáíβóççéá áéá ðñþçç ðíñÛ óðí FreeBSD 6.2. Ìé ÷ñÞóðáð ðáéáéúðãññí áéäúóáúí ðíð FreeBSD, ìðññíýí íá ðí áãéáðáóðÞóíðí ÏÝóú ðíð ðáéÝóðíð Þ port net/csup.

Óéáññãðëãððá ùðé ðí /usr/ports áβíáé Ûãáéí ðñéí áéðáéÝóáðá ðí **csup** áéá ðñþçç ðíñÛ! ÁÛí Ý ÷áðá Þçç áíáéðÞóáé çç Óðëëíãð ðúi Ports ÏÝóú êÛðéáð Ûéëçð ðçãÞð, ðí **csup** ááí éá áéáãñÛøáé patches ðíð Ý ÷íðí áóáéñãéãβ óðí ìáðáíý.

- 1. ÁéðáéÝóðá ðí csup:

```
# csup -L 2 -h cvsup.FreeBSD.org /usr/share/examples/cvsup/ports-supfile
```

ÁéëÛíðá ðí cvsup.FreeBSD.org ìá Ýíáí êííðéúí óáð áéáéñéóðÞ **CVSup**. Áãððá ðí CVSup Mirrors (ÓíÞíá A.6.7) áéá ççí ðëÞñç ëβóðá ðúi mirror sites.

Óçíáβúóç: Áí èÝéáðá, ìðññãððá íá ÷ñççéíðéþíðáðá ðí áééú óáð ports-supfile, þóðá íá áðíðýááðá (áéá ðãñÛááéáíá) íá äçèþóáðá ðíí áéáéñéóðÞ **CVSup** óççí ãñáíìÞ áíðéþí.

- 1. Óá áððÞ ççí ðãñððóðóç, ùð root, áíðéãñÛøðá ðí /usr/share/examples/cvsup/ports-supfile óá ìβá ÏÝá ðíðéáðóá, ùðò ðí /root Þ ðíí áééú óáð home éáðÛéíãí.
- 2. Óñíðíðéþíðáð ðí ports-supfile.
- 3. ÁéëÛíðá ðí CHANGE_THIS.FreeBSD.org ìá Ýíáí êííðéúí óáð áéáéñéóðÞ **CVSup**. Áãððá ðí CVSup Mirrors (ÓíÞíá A.6.7) áéá ççí ðëÞñç ëβóðá ðúi mirror sites.
- 4. ÁéðáéÝóðá ðññá ðí csup, ìá ðíí áéúéíðëè ðññðí:

```
# csup -L 2 /root/ports-supfile
```

- 2. Áéðáéþíðáð ççí áíðéëÞ csup(1) ãñãúðãñá, éá “éáðáãÛóáé” éáé éá áðãññúóáé ùéãð óéð ðññóðáðáð áééããÝð óççí Óðëëíãð ðúi Ports, áéðúð áðú ðí íá áðáíá-ìáðáéëúðððáé óá ports áéá ðí óýóçíá óáð.

ÏÝëíãð Portsnap

Óí **Portsnap** áβíáé Ýíá áíáééáéðééú óýóçíá áéá ççí áéáñìÞ ççð Óðëëíãð ðúi Ports. Ðãñáéáéþ áéÝáíðá ðí ×ñççéíðéþíðáð ðí Portsnap áéá ìβá éáððíñãñÞ ðãñéãñáðÞ ùéúí ðúi ÷áñáéðçñéóðéþí ççð áðãññãðð.

- 1. “ÉáðáãÛóðá” Ýíá óðíðéáðíÝíí snapshot ççð Óðëëíãð ðúi Ports /var/db/portsnap. Áí èÝéáðá, ìðññãððá íá áðíðíáéãððá áðú ðí Áéáãβéðí ìáðÛ áðú áðú ðí áÞíá.

```
# portsnap fetch
```

2. Áí äéóäéåßðá òí **Portsnap** äéá ðñþç öïñÛ, êÛíóå áíáåñäÞ òíð snapshot ìÝóá óòí /usr/ports:


```
# portsnap extract
```

ÅÛí Þäç Ý ÷ åðå Ýía ääíÛòí /usr/ports éáé áðèðð òí áíáíáíáíáðå, äéðäéÝóðå òçí áéüëíðèç áíðèðð:

```
# portsnap update
```

ÏÝëññò Sysinstall

Åððç ç ìÝëññò ÷ ñçóëíðñéåß òí **sysinstall** äéá òçí åãéáóÛóóáóç òçð ÓðëëíäÞ òùí Ports áðü òí ìÝóí åãéáóÛóóáóçð. Óçíáéðððå ùðé ìå áððü òí òññðñ éå åãéáóóáóðððåðå òí ðáéáéü áíðßññáóí òçð ÓðëëíäÞ òùí Ports, ðñð áíðéóðñé ÷ åß óðçí çíáññíçíßá òçð Ýëáíðçð òíð FreeBSD ðñð ÷ ñçóëíðñéåßðå. ÅÛí Ý ÷ åðå ðññíóåáóç óðí Åéååßðððñ, ðñÝðåé ðÛíóá íå ÷ ñçóëíðñéåßðå ìßá áðü ðéð ìåññññò ðñð áíáóÝñèçéáí ðéí ðÛñ.

1. Ûð root, äéðäéÝóðå òí sysinstall ùðñð óåßíáðåé ðåñåéÛð:


```
# sysinstall
```
2. ÅðééÝíðå òí Configure, éáé ðéÝóðå **Enter**.
3. ÅðééÝíðå òí Distributions, éáé ðéÝóðå **Enter**.
4. Ìåðåééçðåßðå óòí ports, éáé ðéÝóðå **Space**.
5. Ìåðåééçðåßðå óòí Exit, éáé ðéÝóðå **Enter**.
6. ÅðééÝíðå òí ìÝóí åãéáóÛóóáóçð òçð áðéððíðåð óåð, ùðñð CDROM, FTP, éáé ðÛåé éÝñññðåð.
7. Ìåðåééçðåßðå óòí Exit éáé ðéÝóðå **Enter**.
8. ÐéÝóðå **X** äéá íå åãåßðå áðü òí **sysinstall**.

4.5.2 Åãéåéèéóðñíðåð Ports

Ïñ ðñþòí ðñÛåíå ðñð ðñÝðåé íå äéððñéñééóðåß ò ÷ åðééÛ ìå òçí ÓðëëíäÞ òùí Ports åßíåé ç Ýíñéå ðñð ùññò “skeleton (ðéåéåðñð)”. Ìå èßååé üñåéå, Ýíå port skeleton åßíåé ç åÛ ÷ éóðç òðëëíäÞ åñ ÷ åßññ ðñð éåéñççåñíý Ýíå óýððçíå FreeBSD þðå íå ìåðåéèéóððåé éáé íå åãéáóóáóððåé òùððÛ Ýíå ðññññññññ. ÊÛèå port skeleton ðåñéÝ ÷ åé:

- íå Makefile. Ïñ Makefile ðåñéÝ ÷ åé åÛ òñññð åçèððåðð ðñð ìñßåñññ ðñð ðñÝðåé íå ìåðåéèéóððåé ç åðåñññä èáé ðñð ðñÝðåé íå åãéáóóáóðååß óòí óýððçíÛ óåð.
- íå åñ ÷ åßñ ðistinfo. Åððü òí åñ ÷ åßñ ðåñéÝ ÷ åé ðèçññññññð åéå òå åñ ÷ åßá ðñð ðñÝðåé íå “éåðÝñññ” äéå òçí ìåðåéèéóððéóç òñð port, éáé òå checksums òñðð (÷ ñçóëíðñéþíðåð ðéð md5(1) éáé sha256(1)), äéå íå åðéåååéèéèåß ùðé òå åñ ÷ åßá åñí Ý ÷ òññ áéëñéèéèåß éåðÛ òçí åÛññåéåé òçð ìåðåéèéóððð òñðð.
- íåí éåðÛëñññ files. Åððð ìå éåðÛëñññ ðåñéÝ ÷ åé òå patches ðñð åðéðñÝðñññ óòí ðñññññññ íå ìåðåéèéóððåé èáé åãéáóóáóðååß óòí FreeBSD óýððçíå óåð. Õå patches åßíåé ìéññÛ åñ ÷ åßá ðñð ìñßåñññ áééååÝð òå óðåéåñññÝíå åñ ÷ åßá. Åßíåé òå ìññðð èñéñññ éåéñÝññ, éáé ååóéèÛ éÝíå “Åðåßññåð òçí åññññ 10” Þ “ÌåðÝðññåð òç åññññ 26 òå áððü ...”. Õå patches åßíåé åððçð ãññóðÛ ùð “diffs” åðåéäÞ åçñéñññññññññ ìå òí ðñññññññ ðñðð. Åððð ìå éåðÛëñññ ìðññåß íå ðåñéÝ ÷ åé éåé Ûéåå åñ ÷ åßá ðñð ÷ ñçóëíðñéýíðåé äéå íå ìåðåéèéóððåé òí port.
- íå åñ ÷ åßñ pkg-descr. Åððü åßíåé ìßá ðéí èåððñññðð, óð ÷ ìÛ ðñèèèññññññññ, ðåñññññð òñð ðññññññññññññ.
- íå åñ ÷ åßñ pkg-plist. Åððü ðåñéÝ ÷ åé ìéå èßððå üëññ òùí åñ ÷ åßñ ðñð éå åãéáóóáóðåéññññ áðü òí port. Åððçð èåéñççåññ òí óýððçíå òùí ports ðé åñ ÷ åßá íå áðåññÝðåé éåðÛ òçí åðåéåðÛóóáóç.

Ἰσχυρὸν ports ἔστιν ἑστὸν ἄνδρα, ὃν οὐδεὶς pkg-message. Ὁ γὰρ οὗτος ports ἄνδρα ἔχει ἀπὸ τῆς ἀνάστασης αἰσθητικὴν ἀνάστασιν. Ἄνδρα ἔχει ἀπὸ τῆς ἀνάστασης ἀνάστασιν. Ἄνδρα ἔχει ἀπὸ τῆς ἀνάστασης ἀνάστασιν. (http://www.FreeBSD.org/doc/el_GR.ISO8859-7/books/porters-handbook/index.html).

Ὁ port ἄνδρα ἔχει ἀπὸ τῆς ἀνάστασης ἀνάστασιν, ἀπὸ τῆς ἀνάστασης ἀνάστασιν. Ἄνδρα ἔχει ἀπὸ τῆς ἀνάστασης ἀνάστασιν. Ἄνδρα ἔχει ἀπὸ τῆς ἀνάστασης ἀνάστασιν. Ἄνδρα ἔχει ἀπὸ τῆς ἀνάστασης ἀνάστασιν.

Ὁρίζημα: Ἄνδρα ἔχει ἀπὸ τῆς ἀνάστασης ἀνάστασιν ports.

Ὁρίζημα: Ἄνδρα ἔχει ἀπὸ τῆς ἀνάστασης ἀνάστασιν port, ἄνδρα ἔχει ἀπὸ τῆς ἀνάστασης ἀνάστασιν. Ἄνδρα ἔχει ἀπὸ τῆς ἀνάστασης ἀνάστασιν.

Ἄνδρα ἔχει ἀπὸ τῆς ἀνάστασης ἀνάστασιν ἀπὸ τῆς ἀνάστασης ἀνάστασιν. Ἄνδρα ἔχει ἀπὸ τῆς ἀνάστασης ἀνάστασιν. Ἄνδρα ἔχει ἀπὸ τῆς ἀνάστασης ἀνάστασιν.

Ἄνδρα ἔχει ἀπὸ τῆς ἀνάστασης ἀνάστασιν ἀπὸ τῆς ἀνάστασης ἀνάστασιν. Ἄνδρα ἔχει ἀπὸ τῆς ἀνάστασης ἀνάστασιν.

Ἄνδρα ἔχει ἀπὸ τῆς ἀνάστασης ἀνάστασιν ἀπὸ τῆς ἀνάστασης ἀνάστασιν:

```
# cd /usr/ports/sysutils/lsof
```

Ἄνδρα ἔχει ἀπὸ τῆς ἀνάστασης ἀνάστασιν lsof, ἀπὸ τῆς ἀνάστασης ἀνάστασιν. Ἄνδρα ἔχει ἀπὸ τῆς ἀνάστασης ἀνάστασιν.

```
# make
>> lsof_4.57D.freebsd.tar.gz doesn't seem to exist in /usr/ports/distfiles/.
>> Attempting to fetch from ftp://lsof.itap.purdue.edu/pub/tools/unix/lsof/.
===> Extracting for lsof-4.57
...
[extraction output snipped]
...
>> Checksum OK for lsof_4.57D.freebsd.tar.gz.
===> Patching for lsof-4.57
===> Applying FreeBSD patches for lsof-4.57
===> Configuring for lsof-4.57
...
[configure output snipped]
...
```

```
==> Building for lsof-4.57
...
[compilation output snipped]
...
#
```

ÐññóÝíóá ùéé ìüééð ç ìáóáãëþðóéóç ðëééçññèáß éá áðéóðñÝðáðá óóçí ãñãñþ áíóíëþí. Õí áðñíáñí áþíá áßíáé íá ããéáóáóðþóáðá òí port. Áéá íá òí ããéáóáóðþóáðá, ÷ñáéÛæáðáé áðëþð íá ðññóèÝóáðá ìéá ëÝíç óóçí áíóíëþ make, éáé áððþ ç ëÝíç áßíáé install:

```
# make install
==> Installing for lsof-4.57
...
[installation output snipped]
...
==> Generating temporary packing list
==> Compressing manual pages for lsof-4.57
==> Registering installation for lsof-4.57
==> SECURITY NOTE:
      This port has installed the following binaries which execute with
      increased privileges.
#
```

Ìüééð áðéóðñÝðáðá óóçí ãñãñþ áíóíëþí, éá ðñÝðáé íá ìðñíáßðá íá áéðáéÝóáðá óçí áðãññãþ ðññó ìüééð ããéáóáóðþóáðá. Éá ááßðá ìéá ðññáéãñðóçç áóóáéáßáð, áðáéãþ òí lsof áßíáé Ýíá ðññãññáíá ðññ ðñÝ ÷ áé ìá áóíçíÝíá ðññíííéá. ÉáðÛ óçí ìáóáãëþðóéóç éáé ããéáóÛóóáóç òñí ports, éá ðñÝðáé íá ðññóÝ ÷ áðá ððéááþððíðá ðññáéãñðóçç áíóáíéóóáß.

Ìéá éáëþ éáÝá, áßíáé íá áéáãñÛðáðá òñí ððéáóðÛéãñí ðññ ðññéÝ ÷ áé ùéá óá ðññóññéíÛ áñ ÷ áßá ðññ ÷ ðñçóéíðééðéçéáí éáðÛ óçí ìáóáãëþðóéóç. ¼÷ é ìññ éáóáíáéþññíðí ðññéýðéñí ÷ þññí, Ûééá ìðñíáß íá ðññéáéÝóíðí ðññáéþíáðá áñññóðñá ùðáí éá éáëþðáðá íá ããéáóáóðþóáðá ìéá íáñðáñç Ýéáíóç òññ port.

```
# make clean
==> Cleaning for lsof-4.57
#
```

Õçíáßñóóç: Ìðñíáßðá íá áééðþóáðá áýí ðññóéáðá áþíáðá áðëþð áéðáëþíðáð make install clean áíðß áéá make, make install éáé make clean ùð ðññá íá ÷ ùñéóðÛ áþíáðá.

Õçíáßñóóç: ÌáñééÛ éáéýðç êñáðÛíá ìéá ëßóóá áðñ óéð áíóíëÝð ðññ áñßóéíðáé áéáéÝóéíáð óðíðð éáðáéññáíðð ðññ áíáðÝññíóáé óóçí ìáðááéçðþ ðññéáÛééñíðíð PATH, áéá íá áðéðá ÷ ýíñíðí óéð áíáæçðþóáéð áéá óá áéðáéÝóéíá áñ ÷ áßá áððþí òñí áíóíëþí. Áí ÷ ðñçóéíðééáßðá Ýíá áðñ áððÛ óá éáéýðç, éá ðñÝðáé íá ÷ ðñçóéíðééþóáðá óçí áíóíëþ rehash ìáðÛ óçí ããéáóÛóóáóç áíñð port, ðññéí ìðñíÝóáðá íá ÷ ðñçóéíðééþóáðá ðéð íÝáð áíóíëÝð. Áððþ ç áíóíëþ éáéðíðñááß óá éáéýðç ùðñð òí tcsh. × ðñçóéíðééþóáðá óçí áíóíëþ hash -r áéá éáéýðç ùðñð òí sh. Ááßðá óçí óáéíçñßñóóç òññ éáéýðíðð óáð áéá ðññéóóððáñáð ðéçññíðñßáð.

ÌáñééÛ ðññíññíðá ðññßðñí éáðáéáðáóóþí óá DVD-ROM, ùðñð òí FreeBSD Toolkit áðñ òí FreeBSD Mall (<http://www.freebsdmail.com/>), ðññéÝ ÷ ðññí distfiles. ÁððÛ ìðññíñí íá ÷ ðñçóéíðééçéñíñí ìá óçí Õéééñãþ òññ Ports.

4.5.2.1 ÐáñáéÛìðîííóáð ðíðð ÐññíáðééääñÝññðð Êáóáéüüññðð ðùí Ports

ÌáñééÝð ðññÝð áβíáé ÷ñþóéññ (P áðéóáéðééü) íá ÷ñçóéññðñóáðá Ýíá áéáóññáðééü êáðÛéñññ áññáóβáð éáé áãéáðÛóóáóçð. Ìé ìáðááéççðÝð WRKDIRPREFIX éáé PREFIX ìðññíýí íá ðáñáéÛìðîíí ðíððð ðññíáðééääñÝññðð êáóáéüüññðð. Åéá ðáñÛááéññá, ç áíðñéþ:

```
# make WRKDIRPREFIX=/usr/home/example/ports install
```

éá ìáðááéüððβáéð ðí port ððí /usr/home/example/ports éáé éá áãéáðáóðPóáé ðá ðÛíðá ððí /usr/local, áñþ ç áíðñéþ:

```
# make PREFIX=/usr/home/example/local install
```

éá ìáðááéüððβáéð ðí port ððí /usr/ports éáé éá ðí áãéáðáóðPóáéð ððí /usr/home/example/local.

Êáé ððóééÛ ç áíðñéþ:

```
# make WRKDIRPREFIX=./ports PREFIX=./local install
```

éá ðññáðÛóáé éáé ðá áðí (áβíáé ðñéý ìááÛéç áéá íá ðçí ááβññíá ááþ, Ûééá ðñÝðáé íá ðPñáðá ðçí ááñééþ éáÝá).

ÁíáééáðéééÛ, áððÝð ìé ìáðááéççðÝð ìðññíýí íá ðñðèíóóññíý ìð ìÝññð ðñð ðáñéáÛéññññðð ðáð. ÅéááÛóðá ðçí ðáéβáá manual áéá ðí éÝéððñð ðáð, áéá íá áññáβðá ðéð ð÷áðééÝð ìáçáβáð.

4.5.2.2 Áíðéíáðùðβæññíóáð ðí imake

ÌáñééÛ ports ðñð ÷ñçóéññðññíýí ðí imake (ìÝññð ðñð X Window System) ááí ðññáññáÛéññíóáé ðùððÛ ìá ðí PREFIX, éáé áðéñÝññí ìá áãéáðáóðáéññíý ððí /usr/x11r6. ìáñééÛ Perl ports ááññíý ðí PREFIX éáé áãéáðéβóðáíðáé ððí áÝñññ Perl. Õí íá éÛíáðá áððÛ ðá ports íá ðÝáññíóáé ðí PREFIX áβíáé ìβá áýóéñç P ááýíáðç áñðéééÛ.

4.5.2.3 Áðáíáñýèíóç Áðééññáþí Ports

ìððáí ìáðááéüððβæáðá éÛðñéá ports, ìðññáβ ìá áññáñéóððáβ ððçí ìéññç ðáð Ýíá ìáññý áðééññáþí (ááóéóíÝññ ðá ncurses) ðí ìðññí ìá ðáð áðéðñÝðáé ìá áééÛíáðá áéÛññáð áðééññáÝð ìáðááéþððéóçð. Ááí áβíáé ððÛíéññ éÛðñéñé ÷ñþóðáð ìá éÝéññí ìá áðéóéáððññíý ìáññÛ áððð ðí ìáññý, áéá ìá ðññíóéÝóññí, ìá áóáéñÝóññí P ìá áééÛññí éÛðñéáð áðééññáÝð, ìáðÛ ðçí ìáðááéþððéóç ðñð port. Ìéá áðééññáþ áβíáé ìá ìáðáééñçéáβðá ððññ êáðÛéñññ ðñð port éáé ìá áñÛðáðá make config, ìá ðí ìðññí éá áññáñéóððá ìáññÛ ðí ìáññý ìá ðéð ðññçáñññáññáð ðñðèíβóáéð ðáð þáç áðééääñÝññáð. Ìéá Ûééç áðñáðññóçðá, áβíáé ìá ÷ñçóéññðñéPóáðá ðçí áíðñéþ make showconfig, ìá ðçí ìðññá éá ááβðá ìéáð ðéð áðééääñÝññáð ðñðèíβóáéð ðñð port. ÕÝéñð, ìéá áéññá áðééññáþ áβíáé ìá áéðáéÝóáðá ðçí áíðñéþ make rmconfig ç ìðññá éá áóáéñÝóáé ìéáð ðéð áðñéçéáðññáð áðééññáÝð éáé éá ðáð áðéðñÝðáé ìá ìáéññPóáðá ìáññÛ áðð ðçí áñ÷þ. ìéáð áððÝð ìé áðééññáÝð, éáé áéññá ðáññéóððáññáð, áñçáñññíóáé ððç ðáéβáá manual ðñð ports(7).

4.5.3 Áóáéñññíóáð Áãéáðáóçññíý Ports

Õññá ðñð áñññáðáðá ðùð ìá áãéáééóðÛðá ports, ðééáññð éá áññññéÝóðá ðùð áóáéñññíóáé, ððçí ðáññβððóç ðñð áãéáðáóðPóáðá Ýíá éáé áñññðáñá áðñáóβóáðá ìéé áãéáðáóðPóáðá ðí éÛéñð port. Êá áóáéñÝóññíá ðí ðññçáñññáññ ðáñÛááéññá (ðñð þóáí ðí lsof áéá ìññðð ááí ðí ðññóáññáí). Õá ports áóáéñññíóáé ìððð éáé ðá ðáéÝóá (ðí áíáéýóáññ ððçí áññóçðá ×ñçóéññðñéþññáð ðí Õýóðçñá ðùí ÐáéÝðñ), ÷ñçóéññðñéþññáð ðçí áíðñéþ pkg_delete(1):

```
# pkg_delete lsof-4.57
```


4.5.4.3 Ἀίάάάέιβέιίόάδ Ports ιά οἱ Portmanager

Ὀἱ **Portmanager** ἀβίάέ Ύίά άέυιá ἀάάάέάβι άέά άγέιέζ αίάάΎέιέόζ άάέάάόόζιΎίυι ports. Ἀέάόβέάάέ άδὺ οἱ ports-mgmt/portmanager port:

```
# cd /usr/ports/ports-mgmt/portmanager
# make install clean
```

¼έά όά άάέάάόόζιΎίά ports ιδἱάιίί ίά αίάάάέιέόόιίί ÷άζόέιιδἱέβίόάδ άόδP όζι άδέP αίόιέP:

```
# portmanager -u
```

Ἰδἱάβόά ίά δἱιόέΎόάά όζι άδέέιάP -ui άέά ίά ἀάόόζέάβόά ίά άδέάάάέβόάά έΎέά άβίά δἱό έά άέόάέΎόάέ οἱ **Portmanager**. Ὀἱ **Portmanager** ιδἱάβ άδβόζό ίά ÷άζόέιιδἱέζέάβ άέά ίά άάέάάόόPάάά ίΎά ports όόι όύόόζιá. Ὀά αίόβέάόζ ιά όζι αίόιέP make install clean, οἱ **Portmanager** έά αίάάάέιβόάέ υέάδ όέδ αίάάόPάάέδ δἱέί όζι ιάόάάέβόόέόζ έάέ άάέάδὺόόάόζ οἱό άδέέάιΎίυι port.

```
# portmanager x11/gnome2
```

Άί όδὺñ ÷άζι δἱάάέβίáάά δἱό ό ÷άδβέιίόάέ ιά όέδ αίάάόPάάέδ αίυό άδέέάάιΎίυι port, ιδἱάβόά ίά ÷άζόέιιδἱέPάάά οἱ **Portmanager** άέά ίά όέδ άδάίá-ιáόάάέυόόβόάέ υέάδ ιά όζι όύόόP όάέñΎ. Ἰυέέδ όάέέβόάέ ιά όέδ αίάάόPάάέδ, έά άδάίá-ιáόάάέυόόβόάέ έάέ οἱ δἱάέζιáόέέυι port.

```
# portmanager graphics/gimp -f
```

Ἄέά δἱάέόόύόάάάδ δέζάιιόιñβάδ άάβόά όζ όάέβάά manual portmanager(1).

4.5.4.4 Ἀίάάάέιβέιίόάδ όά Ports ιΎόυ οἱό Portmaster

Ὀἱ **Portmaster** ἀβίάέ Ύίά άέυιá ἀάάάέάβι άέά όζι αίάάΎέιέόζ όυι άάέάάόόζιΎίυι ports. Ὀἱ **Portmaster** ό ÷άέΎόόζέά βόόά ίά ÷άζόέιιδἱέάβ όά ἀάάάέάβá δἱό δἱάΎ ÷άέ οἱ “άάόέέυι” όύόόζιá (άάί αίάάόPάάέ άδὺ ὎έέá ports) έάέ ÷άζόέιιδἱέάβ όέδ δέζάιιόιñβάδ οἱό /var/db/pkg άέά ίά έάέιñβόάέ δἱέά ports έά αίάάάέιβόάέ. Ἀβίάέ άέάέΎόέιι ιΎόυ οἱό port ports-mgmt/portmaster:

```
# cd /usr/ports/ports-mgmt/portmaster
# make install clean
```

Ὀἱ **Portmaster** ιάάυδἱέάβ όά ports όά όΎόόάñέδ έάόζάιñβάδ:

- Root ports (άάί αίάάόPάάέ άδὺ ὎έέá, έάέ ιγόά ὎έέá αίάάόPάάέ άδὺ άόδΎ)
- Trunk ports (άάί αίάάόPάάέ άδὺ ὎έέá, υόόύοι έΎδἱέά δάέΎόά αίάάόPάάέ άδὺ άόδΎ)
- Branch ports (Ύ ÷άζι αίάάόPάάέδ έάέ δἱιό όέδ άγί έάόάόέγίόάέδ)
- Leaf ports (άάί αίάάόPάάέ άδὺ ὎έέá, άέέΎ υ ÷έ οἱ αίόβέάόι)

Ἰδἱάβόά ίά άάβόά ιέá έβόόά υέέυι όυι άάέάάόόζιΎίυι ports έάέ ίά ϑΎίάάά άέά αίζιáñυιΎίάδ άέάυόάέδ, ÷άζόέιιδἱέβίόάδ όζι άδέέιáP -L:

```
# portmaster -L
====>> Root ports (No dependencies, not depended on)
====>> ispell-3.2.06_18
====>> screen-4.0.3
```


Ïá ôçí ðÛññãí ðíð ÷ ññññð, èá óóóóññãóðíýí ðíëëÛ áñ ÷ áßá äéáíñðð ðçããáßíð êþáééá óðíí êáðÛëññãí distfiles. Ìðññãßðá íá óá áóáéñÝóáðá ÷ áéññèßçðá, Þ ððññãßðá íá ÷ ñçóéñðíëðóáðá ôçí áëññèðçç áíóíñÞ äéá íá äéáñÛðáðá ùëá óá distfiles ðíð ááí ó ÷ áðßáñíðáé ðëÝí ïá êáíÝíá port:

```
# portsclean -D
```

¹ äéá íá áóáéñÝóáðá ùëá óá distfiles ðíð ááí ó ÷ áðßáñíðáé ïá êáíÝíá port ðíð áñßóéáðáé ääéáðáóðçíÝíí óðí óýóðçíá óáð:

```
# portsclean -DD
```

Óçíáßóóç: Õí áñãáéãáßí portsclean ääéáðáóðçíáé ùð ïÝñíð ðíð portupgrade.

Ïçí íá ÷ íÛðá íá áóáéñãßðá óá ääéáðáóðçíÝíá ports ùðáí ááí óá ÷ ñáéÛæáóðá ðëÝí. Íá êáëñ ãñãáéãáßí äéá íá áððñáðíðíëççãáß áððç ç áñãáóßá, áßíáé ðí port ports-mgmt/pkg_cutleaves.

4.6 ÁíÝñãáéð ïáðÛ ôçí ÅãëáðÛóóáóç

ÏáðÛ ôçí ääéáðáóðçíáé íéáð íÝáð áðáññãþð, ëñãéëÛ èá èÝéáðá íá äéááÛóáðá ùðé ðáèìçñßóóç ððÛñ ÷ áé, íá ðññðíðíëðóáðá óá áñ ÷ áßá ñðèìßóáùí ðíð ÷ ñáéÛæáóðáé, íá ääéáéùèãßðá ùðé ç áðáññãþ ïáééíÛáé êáðÛ ôçí äéëßçóç (áí áßíáé daemon), è.è.ð.

Óá äéñéãþ áðíáðá ðíð èá ÷ ñáéáóðíýí äéá íá ñðèìßóáðá èÛèá áðáññãþ, èá áßíáé ðññóáñð äéáðññáðéëÛ. ¼àùð, áí ïüëéð ääéáðáóððóáðá íéá íÝá áðáññãþ äéá áíáññóéÝóáð “Óþñá óé;” íé ðáñáéÛòù óðíáññéÝð ððñãáß íá óáð áíççþóíðí:

- ñçóéñðíëðóáðá ðí pkg_info(1) äéá íá äãßðá ðé áñ ÷ áßá ääéáðáóðÛèççáí, êáé ðíð. Äéá ðáñÛääéáíá, áí ïüëéð ääéáðáóððóáðá ðí FooPackage version 1.0.0, ðùðá ç áíðíëð:

```
# pkg_info -L foopackage-1.0.0 | less
```

èá óáð äãßíáé ùëá óá áñ ÷ áßá ðíð ääéáðáóðÛèççáí áðñ áóðñ ðí ðáéÝðí. ÐññóÝíðá óá áñ ÷ áßá óðíí êáðÛëññãí man/, ðíð èá áßíáé óáèßãáð manual, ðíðð êáðÛëññãíð etc/, ùðíð èá áßíáé óá áñ ÷ áßá ñðèìßóáùí, êáé ðí doc/, ùðíð èá áñßóéáðáé ðéí ðáñáéðéðèþ ðáèìçñßóóç.

Áí ááí áßóðá óßáñðñíð ðíéá Ýéáñóç ôçð áðáññãþð ääéáðáóððóáðá, íéá áíóíñÞ ùðùð áððð:

```
# pkg_info | grep -i foopackage
```

èá áñáé ùëá óá ääéáðáóðçíÝíá ðáéÝðá ðíð Ý ÷ ïðí ðí foopackage óðí ùññá ðíð ðáéÝðíð. Áíóééáðáóððóáðá ðí foopackage óðçí áñáñÞ áíóíñþí ïá ðí ðáéÝðíð ðíð áíáæçðÛðá.

- Ïüëéð äãßðá ðíð áñßóéñíðáé óá manual pages ôçð áðáññãþð, äãßðá óá ïá ôçí man(1). ¼ñíéá, äãßðá óá ðáñáããáßáíáðá ðññ áñ ÷ áßá ñýëíéóçð, êáé ùðíéá Ûëçç ðññóéáðç ðáèìçñßóóç äéáðßéáðáé.
- Áí ððÛñ ÷ áé web site äéá ôçí áðáññãþ, äéÝáñðá ðí äéá ðññóéáðç ðáèìçñßóóç, óð ÷ íÝð áññððóáéð (FAQ), êáé Ûëëá. Áí ááí áßóðá óßáñðñíð äéá ôçí äéáýéðíóð ðíð web site, ßòðð ðí áñãßðá óðçí Ýíñãí ôçð áíóíñÞð:

```
# pkg_info foopackage-1.0.0
```

Áí ððÛñ ÷ áé áñáñÞ www:, èá ðñÝðáé íá Ý ÷ áé ðí URL äéá ðí web site ôçð áðáññãþð.

ΕὰοÛεάεί 5 Õĩ Óýóôçĩá X Window

Αίáááπεçêã äéá õĩĩ X11 server õĩĩ X.Org áðũ õĩĩ Ken Tom éäé Marc Fonvieille.

5.1 Óýĩĩøç

Õĩ FreeBSD ÷ñçóεĩĩðĩεάβ õĩ X11 äéá íá ðãñÝ ÷äé óõĩòð ÷ñÞóóãð Ý íá éó÷õñũ ãñáóéεũ ðãñéáÛεεĩĩ ãñááóβãð. Õĩ ðãñéáÛεεĩĩ X11 áβĩáé íéá ðεĩðĩβçóç áñééõĩý εÞäεéá õĩò óóóðĩáõĩò X Window ðĩò ðãñééáĩáÛĩáé õũõĩ õĩ **Xorg** ùõĩ éäé õĩ **XFree86** (éäεÞð éäé Ûεεĩ εĩäεóĩεéũ ðĩò äãĩ ðãñéãñÛóãóäé äãÞ). Íé äéäũóáéð õĩò FreeBSD ìÝ ÷ñé éäé õçĩ FreeBSD 5.2.1-RELEASE äéäéÝõĩõĩ óõçĩ ðñĩãðééããĩÝĩç äãéáðÛóóáóç õĩ **XFree86**, õĩĩ X11 server áðũ The XFree86 Project, Inc. Áðũ õĩ FreeBSD 5.3-RELEASE éäé Ýðäéóá, ç ðñĩãðééããĩÝĩç éäé äðβóçĩç äéáĩñÞ õĩò X11 Ûééáĩá óõĩ **Xorg**, õĩĩ X11 server ðĩò áíáððý ÷εçêã áðũ õĩ X.Org Foundation ìã Ûäáéá ÷ñÞóçð áñéáðÛ ùĩĩéá ìã áððÞ ðĩò ÷ñçóεĩĩðĩεάβóäé áðũ õĩ FreeBSD. ÕðÛñ ÷ĩõĩ äðβóçð äéäéÝóéĩé äĩðĩñééĩβ X servers äéá õĩ FreeBSD.

Áðõũ õĩ εãòÛεάεί éä éäéýøäé õçĩ äãéáðÛóóáóç éäé ãýεĩéóç õũĩ X11 ìã Ýĩóáóç óõçĩ Ýéäĩóç 7.5 õĩò **Xorg**. Äéá ðεçñĩõĩñβãð ó÷äóééÛ ìã õçĩ ãýεĩéóç õĩò **XFree86** (ð. ÷. óã ðáééũðãñãð äéäũóáéð õĩò FreeBSD ùðĩò õĩ **XFree86** Þóáĩ ç ðñĩãðééããĩÝĩç äéáĩñÞ X11), ìðĩñãβóã ðÛĩóá íá áíáðñÝĩáðã óóéð áñ÷äéĩéäõçĩÝĩáð äéäũóáéð õĩò FreeBSD Handbook óõĩ <http://docs.FreeBSD.org/doc/>.

Äéá ðãñéóóũðãñãð ðεçñĩõĩñβãð ðĩò ó÷äóβεĩĩóáé ìã ðéð éÛñóãð ãñáóééÞĩ ðĩò ððĩóðçñβεĩĩóáé áðũ õĩ ðãñéáÛεεĩĩ X11, äãβóã õçĩ äééððáéÞ õĩðĩéãóβá Xorg (<http://www.x.org/>).

Áõĩý äéááÛóáðã áðõũ õĩ εãòÛεάεί, éä ìÝñãðã:

- Óã äéÛõĩñã ðĩÞĩáðã õĩò óóóðĩáõĩò X Window, éäé ðũð óõĩñãñãÛεĩĩóáé ìãðáĩý õĩòð.
- ðũð ìã äãéáðáóðÞóáðã éäé ìã ãðεĩβóãðã õĩ ðãñéáÛεεĩĩ X11.
- ðũð ìã äãéáðáóðÞóáðã éäé ìã ãðεĩβóãðã äéáõĩñãðééĩýð äéá÷äéñéóðÝð ðãñãéýñũĩ (window managers).
- ðũð ìã ÷ñçóεĩĩðĩεÞóãðã TrueType® ãñãĩĩáõĩõĩáéñÝð óõĩ X11.
- ðũð ìã ãðεĩβóãðã õĩ óýóðçĩá óáð äéá óýĩááóç (login) ìÝóũ ãñáóééĩý ðãñéáÛεεĩĩõĩò (**XDM**).

ðñéĩ äéááÛóáðã áðõũ õĩ εãòÛεάεί, éä ðñÝðäé:

- Íá ìÝñãðã ðũð ìã äãéáðáóðÞóáðã ðñũóéãõĩ εĩäεóĩεéũ ðñβõĩò éáðáóéããóáóðÞ (ΕὰοÛεάεί 4).

5.2 Éáóáĩüçóç õĩò ðãñéáÛεεĩĩõĩò X11

Ç ÷ñÞóç õĩò ðãñéáÛεεĩĩõĩò X11 äéá ðñÞóç õĩñÛ ìðĩñãβ ìã ðñĩéáéÝóáé ìéá ìééñÞ óãñã÷Þ óã ùðĩéĩĩ Ý ÷äé óõĩçεββóáé óã Ûééá ãñáóééÛ ðãñéáÛεεĩĩóá, ùðũð óã Microsoft Windows Þ õĩ Mac OS.

ÄãĩééÛ, äãĩ áβĩáé áðãñãβóçõĩ ìã éáðáéãããβĩáðã ìã éÛéã äãðõñÝñãéá õũĩ äéáõũñũĩ ðĩçĩÛóũĩ õĩò X11 éäé ðÞð äéεçéãðééãñĩý ìãðáĩý õĩòð. ÉÛðĩéáð äáóééÝð ãĩÞóáéð ùũð, áβĩáé ÷ñÞóéĩãð éäé äĩççéĩý óõĩ ìã äéĩáðáééããóãðãβóã éäéýðãñã ðéð äõĩáðũðçóãð õĩò X11.

5.2.1 Άέαόβ εΰαάόάε X11 οί δάνέαΰεεί ανάάόβáo;

Οί X αάρ άβίαε οί δνρρί δάνέαΰεεί ανάάόβáo διρ ανΰόοζέα άέα όόόδΠιαόά UNIX, άεεΰ άβίαε όΠιαά όί δει αζιρόεΰδ. Ç αν÷εεΠ ηΰαά άΰδδοζιζ όιρ X άβ÷ά αιρεΰφάε όά Ύία ΰεει όύόόζιά δνει ανΰάε όι X. Οί υνία όιρ δάεεΰόανιρ όόόδΠιαόιρ Ροάί “W” (άδϋ όζί ΆάάεεεΠ εΰίζ “window”). Οί ανΰια X Ροάί άδεΰ όι άδϋιάρ ανΰια όοί Έάοείεεϋ άεοΰαζόι.

Ιδινάβόά ίά άίαόΎναόέα όοί X ία όά ινιιαόά “X”, “X Window System”, “X11”, έαερδ έάε ία ίανέειϋδ ΰεειρδ υνιρδ. Δνιόι÷Π υνιρδ: εΰδρειέ ΰίεηδρει έαννιγί δνιράεζόεεϋ όιρ υνι “X Windows”. Άέα δάνέοόυόανδ δεζνιρινβáo ό÷άόεεΰ ία άόδϋ, άάβόά όζ όάεβάά manual X(7).

5.2.2 Οί ινιόΎει Δάεΰόζ/ΆέαεινέοδΠ ούί X11

Οί δάνέαΰεεί X11 Ύ÷άε ό÷άάεάόάβ άδϋ όζί αν÷Π Ύόόε ρόόά ίά Ύ÷άε άαάρΠ άεέόοάεΠ όδιρδΠνειζ, ία άΰόζ Ύία ινιόΎει “δάεΰόζ-άέαεινέοδΠ”.

Οόι ινιόΎει εάεοιρναβáo όιρ X11, ι “άέαεινέοδΠ X” άεόάεάβόάε όοιρ όδρειάεόδΠ όοιρ ιδινι Ύ÷άε όοίαάεάβ όι δεζέδνιρεΰ, ζ ιεϋιζ έάε όι δνιρβέε. Ι άέαεινέοδΠ X άβίαε όδáyεονιρ άέα όζ άεά÷άβνειόζ όζδ ιεϋιζδ, όζδ άεοϋιιρ άδϋ όι δεζέδνιρεΰ, όι δνιρβέε, εεδ. Έΰεά άοάνιρ X (δ.÷. όι **XTerm** Π όι **Netscape**) άβίαε Ύιαδ “δάεΰόζ”. ίάδ δάεΰόζδ όδΎείάε ιζιγίαόά όοιρ άέαεινέοδΠ υδϋδ “Δανάεαερ ό÷άάβόά Ύία δανΰεονιρ όά άοδΎδ όεδ όοιρδάόάιΎίαδ”, έάε ι άέαεινέοδΠ όδΎείάε δβού ιζιγίαόά υδϋδ “Ί ÷νρόόζ ιϋεεδ δΰόζόά όι δεβέδνι OK”.

Οά Ύία όδβόε Π Ύία ιεεηϋ ανάοάβι, ι άέαεινέοδΠ έάε ιε δάεΰόζδ X όδ÷ιΰ άεόάειγίαε όοιρ βάει όδρειάεόδΠ. ιϋιρδ, άβίαε άδϋεόδά άοεέδϋ ίά άεόάεάβόάε ι άέαεινέοδΠ X όά Ύία ιεεανιόανι εό÷δνϋ άδεόναδΎάει όδρειάεόδΠ, έάε ία άεόάειγίαε ιε άοάνιρΎδ X (ιε δάεΰόζδ) όά Ύία, άδ δνιγία, εό÷δνϋ έάε άεηέϋ ιζ÷Ύιζιά διρ άιδζνάόάβ όι ανάοάβι. Οά άόδϋ όι όάρΎνει ζ άδεείιϋιβά ίαόάρϋ όυι δάεάορ X έάε όιρ άέαεινέοδΠ άβίαόάε ιΎού άεέόϋιρ.

Άόδϋ δνιρεάεάβ όγá÷δός όά ινεόιΎιρδ, άδάεäΠ ζ ινιριαβά όιρ X άβίαε άεηέαρδ άιόβεάόζ άδϋ υδε δανβιαίαί. Ιε ÷νρδόδ όοιρβέδ δάνειΎιρδ ι “άέαεινέοδΠ X” ίά άβίαε Ύία ίαΰΰει εό÷δνϋ ιζ÷Ύιζιά όά Ύία ανιΰοει έάε ι “δάεΰόζ X” ίά άβίαε όι ιζ÷Ύιζιά όιρ ανάοάβιρ όιρδ.

Άβίαε όζιάριόεεϋ ίά εοιΰόδά υδε ι άέαεινέοδΠ X άβίαε όι ιζ÷Ύιζιά ία όζι ιεϋιζ έάε όι δεζέδνιρεΰ, έάε ιε δάεΰόζδ X άβίαε όά δνιρ ανιΰιαόά διρ άιόάιβαιρι όά δανΰεονά.

Άάρ όδΰν÷άε όβδριόά όοι δνϋοϋερεει διρ ίά άίαάεΰάε όά ιζ÷άβιαόά όυι δάεάορ έάε όιρ άέαεινέοδΠ ία άεόάειγίαε όοιρ βάει εάεοιρναεεϋ όύόόζιά, Π άεϋιζ ία άεόάειγίαε όοιρ βάει όϋδι όδρειάεόδΠ. Άβίαε άδϋεόδά άοεέδϋ ία άεόάεάβόάε Ύιαδ άέαεινέοδΠ X όόά Microsoft Windows Π όοί Mac OS όζδ Apple, έάε όδΰν÷ρι άεάεΎοείαδ άεΰοιναδ άεάγεανδ έάε άιδνιέΎδ άοάνιρΎδ διρ εΰιριρ άεηέαρδ άόδϋ.

5.2.3 Ι Άέα÷άεινέοδΠ Δανάεινϋι

Ç όεειριρβά ό÷άάεάοιρ όιρ X ιεΰάε δρει ία όζι όεειριρβά ό÷άάεάοιρ όιρ UNIX, “ανάάεάβ, υ÷ε δρειόεεΠ”. Άόδϋ όζιάριαε υδε όι X αάρ δνιρδάεάβ ία όδαννιγίαε δϋδ εά όειδρειεάβ ιεά ανάάόβ. Άιόβεάόά, δανΎ÷ιρδ άεάεάβά όοιρ ÷νρδός, έάε άβίαε άεεΠ όιρ άόεγίζ ία άδριόάόβόάε δϋδ εά όά ÷νζόειδρειρδάε.

ΆόδΠ ζ όεειριρβά άδάεόάβιαόάε όοι υδε όι X αάρ όδαννιγίαε δϋδ δνΎδάε ία άιόάιβαιριαε όά δανΰεονά όόζι ιεϋιζ, δϋδ εά ίαόάεειζειγί ία όι δνιρβέε, όε όοιρδάόιρβ δεβέδνιρ δνΎδάε ία ÷νζόειδρειεζειγί άεά ία ίαόάεειζειγί ίαόάρϋ όυι δανάεινϋι (δ.÷., **Alt+Tab**, όόζι δανβδδουός όυι Microsoft Windows), δρδ δνΎδάε ία ιεΰάεοιρ ιε ιδΰναδ όβέοϋι όά εΰεά δανΰεονι, άί εά Ύ÷ριρ Π υ÷ε δεβέδνι έεάεόβιαόιρ δΰιρ όιρδ, ε.ο.ε.

Άιόβεάόά, όι X άίαεΎάε άοδρι όζι άόεγίζ όά ιβά άοάνιρ διρ ινιΰάεάε “Άέα÷άεινέοδΠ Δανάεινϋι”. Οδΰν÷ριρ δΰνα δρειβ άεά÷άεινέοδΎδ δανάεινϋι άεάεΎοειρ έάε όι δάνέαΰεει X. ΙνεόιΎιρ άδϋ άόοιρδ άβίαε ιε: **AfterStep**,

Έά δñÝðáε ίά ίάέείΠοάόά όέό οδçñάόβáò áóôÝò (áβóá ÷ áέέñíεβίçóá, áβóá εΰñίόάó áðáίάέεβίçóç) δñεί όóίá ÷ βóáóá ίá όç ñýèíέόç όίò **Xorg**.

Όά εΰδñέáó δáñέδòβóáέó, ç áóóñíáόç ñýèíέόç ίδññáβ ίá ίç έáέόίòñáΠοάέ óòóóŸ, Π ίá ίç ñòèìβóáέ όέó óóóέáòÝò áέñέáβò ùδòò áðέέòíáβóá. Όόέó δáñέδòβóáέó áóôÝò, έá ÷ ñάέóóáβ ίá εΰίáóá ÷ áέñíεβίçóáò ñòèìβóáέó.

Όçíáβóòç: Έΰδñέá áñáóέέŸ δáñέáŸέέίíóá, ùδòò όί **GNOME** όί **KDE** Π όί **XFCE**, áέáέÝóίóί áñááέáβá όίò áðέóñÝóίóί óóί ÷ ñΠóóç ίá ñòèìβóáέ ίá áýέίέί δñùδñ áέŸóñáò δáñáíÝóñíòò óçò íεùíçò, ùδòò ç áίŸέóóç. Áί ç δñíáðέέááíÝíç ñýèíέόç ááí áβíáέ áðíááέòΠ, έáέ όέíðáýáðá ίá ááέáóáóóΠοάόá εΰδñέί áδù áóóŸ óá δáñέáŸέέίíóá, ίδññáβóá ίá óóíá ÷ βóáóá ίá όçí ááέáóŸóóáóç όίò, έáέ ίá íεíέççñβóáóá όέó ñòèìβóáέó óáó ÷ ñçóέííðíεβίóáó όί έáóŸέέçέí áñáóέέù áñááέáβí.

Όί δñβóí áβíá áβíáέ ç áçíέíòñáβá áíùò áñ ÷ έέíý áñ ÷ áβíò ñòèìβóáúí. Ÿò root, áðεβò áέðáεÝóóá:

```
# Xorg -configure
```

Áóóù έá áçíέíòñáβóáέ Ýíá δñùóóδñ áñ ÷ áβí ñòèìβóáúí όίò X11 óóíí έáóŸέíáí /root ίá όί ùñíá xorg.conf.new (áβóá ÷ ñçóέííðíεβóáóá όί su(1) áβóá óóííáέáβóá áðáóέáβáð, ç ίáóááέçòΠ έáóáέùáíò \$HOME áέεŸæáέ ááβ ÷ ñííóáó όίí έáóŸέíáí όίò root). Όί X11 έá δñíóðáεβóáέ ίá áíέ ÷ ίáýóáέ όί óðíóýóóçíá áñáóέέβí όίò óóóóβíáóíò έáέ ίá áçíέíòñáβóáέ Ýíá áñ ÷ áβí ñòèìβóáúí όίò έá òñòβíáέ όίòò óùóóíýð íäçáíýð óóóέáóβí áέá όί óέέέù όίò áíέ ÷ ίáýèçέá óóí óýóóçíá óáó.

Όί áδùáíí áβíá áβíáέ í Ýέáá ÷ òò òñí óðŸñ ÷ ñíóùí ñòèìβóáúí áέá ίá áðέáááέβóáóá ùóέ όί **Xorg** έáέóíòñááβ ίá όí óðíóýóóçíá áñáóέέβí όίò óóóóβíáóíò óáó. Άέá áέäùóáέó όίò **Xorg** ίÝ ÷ ñέ όί 7.3, δεçέðñíεíáβóá:

```
# Xorg -config xorg.conf.new
```

Áδù όί **Xorg** 7.4 έáέ ίáóŸ, όí δáñáðŸñ òáóó ááβ ÷ ίáέ ίέá ίáýñç íεùíç ç íðíβá εŸíáέ áýóέíεç όç áέŸáíùóç έáέβò έáέóíòñáβáó όίò X11. × ñçóέííðíεβóáóá όçí áðέέíáΠ retro áέá ίá áðíέáóáóóΠοάόá όçí δáέέúóáñç óóíðáñέóñŸ:

```
# Xorg -config xorg.conf.new -retro
```

ΆŸí áíóáίέóóáβ Ýíá ίáýñí έáέ áέñέ δεÝáíá έáέ Ýíáó ááβέóçò δñíóέέέíý ίá ñíñòΠ X, ç ñýèíέόç βóáί áðέóó ÷ βò. Άέá ίá óáñíáóβóáóá όç áíέέΠ, ίáóáááβóá óóçí áέέííέΠ έííóúέá áδù όçí íðíβá όçí ίáέέίβóáóá, δέÝæííóáó **Ctrl+Alt+Fñ** (**F1** áέá όçí δñβóç áέέííέΠ έííóúέá) έáέ δέÝóóá **Ctrl+C**.

Όçíáβóòç: Όόέó áέäùóáέó όίò **Xorg** δñεί όçí 7.3, ίðíñíýóá ίá ÷ ñçóέííðíεçέáβ í óóíáóáóíùò δεβέðñúí **Ctrl+Alt+Backspace** áέá όίí óáñíáóέóíù όίò δññáñŸíáóíò. Άέá ίá όίí áíáñáíðíεβóáóá áδù όçí Ýέáíóç 7.4 έáέ ίáóŸ, ίðíñáβóá ίá áβóáóá όçí δáñáέŸóù áíóíεβ óá εΰδñέί óáñíáóέέù όίò X:

```
% setxkbmap -option terminate:ctrl_alt_bksp
```

ÁíáέéáέóέέŸ, áçíέíòñáβóáέ Ýíá áñ ÷ áβí ñòèìβóáúí δεçέðñíεíáβíò áέá όί **hald** ίá όçí ñííáóóá x11-input.fdi έáέ áðíεçέáýóóá όί óóíí έáóŸέíáí /usr/local/etc/hal/fdi/policy. Όí áñ ÷ áβí áóóù έá δñÝðáέ ίá δáñέÝ ÷ áέ όέó δáñáέŸóù áñáíŸó:

```
<?xml version="1.0" encoding="ISO-8859-1"?>
<deviceinfo version="0.2">
  <device>
    <match key="info.capabilities" contains="input.keyboard">
      <merge key="input.x11_options.XkbOptions" type="string">terminate:ctrl_alt_bksp</merge>
    </match>
  </device>
</deviceinfo>
```

Έά ÷ ñάέάόόάβ ίά άδάίάέέείΠόάόά όι ιç÷ΰίçιά όάό άέά ίά άίάίάάέΰόάόά όι **hald** ίά άέάάΰόάέ άόόυ όι άñ÷άβι.

Έά δñÝðáέ άδβόçò ίά δñιόέΎόάόά όçí δάñάέΰόυ άñάιιΠ όόι άñ÷άβι xorg.conf.new, όόçí άίύόçόά ServerLayout Π ServerFlags:

```
Option "DontZap" "off"
```

Άί όι διιόβέέ άάί έάέόιτñάάβ, έά ÷ ñάέάόόάβ ίά όι ñόειβόάόά δñεί όόίá÷βόάόά. Άάβόά όι ΌιΠιá 2.10.10 όόι έάοΰεάει άάέάόΰόόάόçò όιò FreeBSD. Άδέδñιόέάόά, άδñ όçí Ύέάιόç 7.4 έάέ ίάδΰ, ίέ άίύόçόάό InputDevice όόι xorg.conf άάñίύιόάέ έάέçò άβιáόάέ ÷ñΠόç όύι όόόέάόçí διò άίέ÷íáýçέάί άόόύιáόά. Άέά ίά άδάίáóΎñáόά όçí δάέέΰ όόιδάñέόιñΰ, δñιόέΎόάόά όçí δάñάέΰόυ άñάιιΠ όόçí άίύόçόά ServerLayout Π ServerFlags όιò άñ÷άβιò ñόειβόάάι:

```
Option "AutoAddDevices" "false"
```

Έά ίδññáβόά Ύδάέόά ίά ñόειβόάόά όέό όόόέάόΎό άέόύαίτò υδñò όόέό δñιçáιýíáíáò άέάυόάέό όιò **Xorg**, ÷ñçόέιδιçπiόάό έάέ υδñέáò ΰέέáò άδέέιáΎò ÷ñάέΰάόόά (δ.÷. άίάέέάáΠ δέçέδñιέιáβιò).

Όçíáβύόç: ¼δñò άιççáΠόάίá έάέ δñιçáιτiΎίύò, άδñ όçí Ύέάιόç 7.4 έάέ ίάδΰ ï άáβιííáò **hald** άίάέάίáΰíáέ ίά άίέ÷íáýóáέ άόόύιáόά όι δέçέδñιέüáέί όάό. Όδΰñ÷άέ δάñβδóóç ίά ιçí άβιáέ όύόόΠ άίβ÷íáóóç όιò ïíóΎέιò Π όçò άέΰόάίçò, υόόύóι έΰδiέά άñάόέέΰ δάñέáΰέέííóá υδñò όι **GNOME** όι **KDE** έάέ όι **Xfce** δάñΎ÷íóí óá áέέΰ όιò άñάάέáβá áέá όç ñýèiέóç δiò. ίδññáβόά υιύò ίά ñόειβόάόά όέό έάέυόçόáό όιò δέçέδñιέíáβιò έάέ άδάόέάβáò, áβóá ίΎύó όιò άιççέçóέέíý δñιáñΰíiáόiò setxkbmap(1) áβóá ίá όçí δñιόέΠέç άίύò έάίύíá όόι **hald**.

Άέά δάñΰááέáíá, άί έΰδiέíò έΎέάέ ίá ÷ñçόέíδiέΠόάέ Ύíá δέçέδñιέüáέί 102 δέΠέδññí ίá ááέέέέΠ άέΰόάίç, έά δñÝðáέ ίá άçiέiòñáΠόάέ Ύíá άñ÷άβι ñόειβόάάι áέá όι **hald** ίá όι υiííá x11-input.fdi έάέ ίá όι άδièçέáýóáέ όóíí έáόΰέíáí /usr/local/etc/hal/fdi/policy. Όι άñ÷άβι άόόυ έá δάñέΎ÷άέ όέό δάñάέΰόυ άñάιιΎó:

```
<?xml version="1.0" encoding="ISO-8859-1"?>
<deviceinfo version="0.2">
  <device>
    <match key="info.capabilities" contains="input.keyboard">
      <merge key="input.x11_options.XkbModel" type="string">pc102</merge>
      <merge key="input.x11_options.XkbLayout" type="string">fr</merge>
    </match>
  </device>
</deviceinfo>
```

Άί όι άñ÷άβι άόόυ όδΰñ÷άέ Πáç, άδέçò άíóέáñΰòóá όέό δάñáδΰíú άñάιιΎó ίΎóά όόι όδΰñ÷íí δάñέá÷ύiáíí.

Έά δñÝðáέ ίά άδάίάέέείΠόάόά όι ιç÷ΰίçιά όάό άέά ίά άίάίáάέΰόάόά όι **hald** ίά άέάάΰόάέ όι άñ÷άβι.

ίδññáβόά άδβόçò ίá έΰíáόά όçí βáέá ñýèiέóç ίΎóά άδñ Ύíá δάñíáóέέü όóá × Π áέüíá έάέ άδñ Ύíá script, άέόάέçπiόάό όçí δάñάέΰόυ άίóíέΠ:

```
% setxkbmap -model pc102 -layout fr
```

```
ίδññáβόά ίá άñáβóá όέό áέάέΎóέíáò άδέέíáΎò δέçέδñιέíáβιú έάέ áέáόΰíáúí όόι άñ÷άβι
/usr/local/share/X11/xkb/rules/base.lst.
```

δάέόά, δñιόáññiúóá όι άñ÷άβι ñόειβόάάι xorg.conf.new όόέό δñιόέiΠόάέό όάό. Άñβióá όι ίá Ύíáí όóíóΰέδç έάέί Ύííò υδñò ï emacs(1) Π ï ee(1). Δñçόá, δñιόέΎόάόά όέό óó÷íúόçόáò όçò ïèúíçò. ΌóíΠέùò άίáóΎñíóáέ υò

Áί ùεά áβίáε εάεÙ, òι áñ ÷ áβι ñòεìβóáùí ðñÝðáε íá òιðñεάòçεάβ óá íεά είεíP òιðñεάóβá þóðá íá áίóιðβæáðáε áðu òι Xorg(1). ÁððP òðíPεèð áβίáε ç /etc/x11/xorg.conf P /usr/local/etc/x11/xorg.conf.

```
# cp xorg.conf.new /etc/x11/xorg.conf
```

Ç áεάáεεάóβá ñýεìέóçð òιò X11 Ý ÷ áε ðñá ðñεεçñùεάβ Òι **Xorg** ðñíñáðá íá òι íáεéíPóáðá íá òι áιççεðéεù ðñúáñáíá startx(1). Í áεάεñέóððð X11 ðñíñáβ áðβóçð íá áεééíPóáε ìá òç áιPεάεά òιò xdm(1).

5.4.3 ΆíáεέεεάòιÝία ÈÝìáóá Ñòεìβóáùí

5.4.3.1 Ñòεìβóáέò áεά óá Intel® i810 Graphics Chipsets

Άεά íá ÷ ñçóεíðñεPóáðá εÙñóá ááóέóιÝίç óóá Intel i810 integrated chipsets, áðáέðáβðáε òι agpgart, ç áεάðáðP ðñíáñáíáíáðéóιíý òι X11 áεά òι AGP. Άáβðá òçí óáεβáá manual òιò ðñíáñÙíáòιò íáPáçóçð agp(4) áεά ðáñέóóúòáñáð ðεçññòíñβáð.

Μά áðòù òι ðñúðι, ç ñýεìέóç òιò ðεéεíý óáð εά ðñíñáβ íá áβίáε ùðò εάε óá εÙεά Ùεεç εÙñóá áñáóέεþí. ðñíóι ÷ P, óá óóóðPíáðá ÷ ùñβð áίóúíáðòιÝíí òιí íäçáù agp(4), ì íäçáùð ááí εά òíñðùεάβ ìá òçí áίóιðP kldload(8). Í íäçáùð áðòιùð ðñÝðáε íá áñβóέáðáε óòιí ðññPíá εάðÙ òçí áεεβίçóç, áβðá óóáóéεÙ ìáðááεùðóéóιÝííð, áβðá ìá ÷ ñPóç òιò /boot/loader.conf.

5.4.3.2 ðñíòεÝòιíóáð íεά Widescreen Άðβðáäç ìεúίç

Áðòù òι òιPíá ðñíúðñεÝóáε ìáñέεÝð áιPóáεð áíáεάεάòιÝíí ñòεìβóáùí. Áí íε ðñíóðÙεáεáð ìá óá óòιPεç áñááεάβá ñòεìβóáùí ááí εáóáεPñíòí óá íεά ñýεìέóç ðιò íá εάéóιòñááβ, ððÙñ ÷ òιí áñεάðÝð ðεçññòíñβáð óóá áñ ÷ áβá log ðιò ðñíñýí íá óáð áιççεPóιòí. Ùóðòιòí, áβίáε áðáñáβðóçç ç ÷ ñPóç áíιð óóíòÙεðç εάεíÝííð.

Íε ðñÝ ÷ òóáð áíáέýóáέð widescreen (WSXGA, WSXGA+, WUXGA, WXGA, WXGA+, ε.ά.) ððιόðçñβæíòí formats εάε aspect ratios (άíáεíñáβáð) 16:10 εάε 16:9 ðιò ðñíñáβ íá äçιέíòñáPóιòí ðñíáεPíáðá. ðáñááβáìíáðá ìáñέεþí είεíþí áíáέýóáùí áεά áíáεíñáβá 16:10 áβίáε óá:

- 2560x1600
- 1920x1200
- 1680x1050
- 1440x900
- 1280x800

ÈÙðñεά óééáñP, ç ñýεìέóç εά áβίáðáε ðñεý áðεÙ ðñíòεÝòιíóáð òçí áíÙεðç ùð Ýία ðεéáíιí Mode óòι Section "Screen" ùðò ðáþ:

```
Section "Screen"
Identifier "Screen0"
Device      "Card0"
Monitor     "Monitor0"
DefaultDepth 24
SubSection "Display"
Viewport    0 0
Depth      24
```

```
Modes      "1680x1050"
EndSubSection
EndSection
```

Οι **Xorg** άβιάε άπéάδΰ Ύιόδñι πρóa ίά άίάέδΠρóaé óéδ δέçñιιöñβάδ όçð άίΰέδóçð όçð widescreen ιέüίçð ιΎóù όüι δέçñιιöñέπñι I2C/DDC, άüñβάειδάδ Ύδóé óé ιδññάβ ίά ÷άέñέóδάβ ç ιέüίç üóι άóñΰ όέδ όð ÷ ίüóçðάδ έάé όέδ άίάέýóάéδ.

Άί άóδΎδ ίé ModeLines άάí óδΰñ ÷ιöι óóιöð ιάçáιýð, ιδññάβ ίά ÷ñάέάóδάβ ίά όéδ άπρóaά άóάβδ όóι **Xorg**. ×ñçóéιιδñέπñιόάδ όι /var/log/Xorg.0.log ιδññάβά ίά άίάέδΠρóaéά άπéάδΎδ δέçñιιöñβάδ πρóa ίά άçιέιöññάβρóaά üíιέ óád Ύίά ModeLine δñö ίά έάέóιöññάβ. Άδèπð άίάάçðΠρóaé δέçñιιöñβάδ δñö έά ïéΰάειöι ίά άóδü:

```
(II) MGA(0): Supported additional Video Mode:
(II) MGA(0): clock: 146.2 MHz   Image Size:  433 x 271 mm
(II) MGA(0): h_active: 1680   h_sync: 1784   h_sync_end 1960 h_blank_end 2240 h_border: 0
(II) MGA(0): v_active: 1050   v_sync: 1053   v_sync_end 1059 v_blanking: 1089 v_border: 0
(II) MGA(0): Ranges: V min: 48 V max: 85 Hz, H min: 30 H max: 94 kHz, PixClock max 170 MHz
```

ΆóδΎδ ïñΰάειöάé δέçñιιöñβάδ EDID. Ç άçιέιöññάβά άíüð ModeLine άδü άóδΎδ, άβίάóάé άΰάειöάδ άδèπð όιöð άñέέιýð όóç óüóóΠ óάέñΰ:

```
ModeLine <name> <clock> <4 horiz. timings> <4 vert. timings>
```

Όάέέΰ, όι ModeLine όóι Section "Monitor" όóι δάνΰάάέüíά ίάδ έά ïéΰάέé ίά άóδü:

```
Section "Monitor"
Identifier      "Monitor1"
VendorName      "Bigname"
ModelName       "BestModel"
ModeLine        "1680x1050" 146.2 1680 1784 1960 2240 1050 1053 1059 1089
Option          "DPMS"
EndSection
```

Όπñά δñö Ύ ÷άά όάέάέπρóaé ίά άóδΰ όά άδèΰ άβιáóά, όι X έά δñΎδάé ίά έάέóιöññάβρóaé όóç ίΎά widescreen ιέüίç óád.

5.5 ×ñΠόç Άñáüáóιöίóάέñπñι όóι X11

Όóίάέóóñΰ όñö Murray Stokely.

5.5.1 ΆñáüáóιöίóάέñΎð óýδñö Type1

Ίé δñιέάειñέóι Ύίáδ άñáüáóιöίóάέñΎð δñö óδñááýιöι όι X11 άάí άβιάé έάάίέéΎð áéά άóáññáΎð άδéóñáδΎάέάδ όðδññάóβάδ. Ίé ίάáΰέáδ άñáüáóιöίóάέñΎð δáññóóβáóçð óáβñιíóάé ïñιíóùðΎð έάé άñáóéðá ÷ ίέéΎð, έάé ίé ίέéñΎð άñáüáóιöίóάέñΎð όóι **Netscape** άβιάé ó ÷ ááüí áéáðΰέçðδάδ. Άððð ÷ πð üñð, óδΰñ ÷ ιöι áéάéΎóéíáð άπéάδΎð, óççèΠð δñέüóçóád άñáüáóιöίóάέñΎð Type1 (PostScript®) δñö ιδññιýí ίά ÷ñçóéιιδñέçèιýí ΰñáóά άδü όι X11. Άέά δάνΰάάέüíά, ç óóééñάΠ άñáüáóιöίóάέñπñι URW (x11-fonts/urwfonts) δáñéΎ ÷ áé áéáüóάéð óççèΠð δñέüóçóád όüι óóιçééóιΎíñι type1 άñáüáóιöίóάέñπñι (Times Roman®, Helvetica®, Palatino® έάé ΰέéáð). Ç óóééñάΠ Freefonts (x11-fonts/freefonts) δáñéΎ ÷ áé δñέéΎð δáñέóóüóáññáð άñáüáóιöίóάέñΎð, áééΰ ίé δáñέóóüóáññáð άδü άóδΎð άβιάé áéά éñáéóíééü άñáóééπñι üððð όι **Gimp**, έάé άάí άβιάé έáðΰέççáð áéά άñáüáóιöίóάέñΎð ιέüίçð. Άέüιç, όι X11

Áðöü Þóáí. Õþñá í Netscape, òí Gimp, òí StarOffice™, éáé üëàð íé Ûëëàð áòáñííáÝð X ðñÝðáé íá áíááñññßæííí òéð ááéáðáóôçìÝíáð TrueType ãñáííáðíóáéñÝð. Ñíëý íéëñÝð ãñáííáðíóáéñÝð (üðùð áððÝð ðíð òáßñíðáé òðí éáßíáñí íéáð éóðíóáéßááð òá ðøçèÞ áíÛëðç) éáé ðíëý íááÛëàð ãñáííáðíóáéñÝð (òðí StarOffice) éá òáßñíðáé ðþñá ðíëý éáéýðáñá.

5.5.3 Anti-Aliased ãñáííáðíóáéñÝð

Áíáíáðèçèá áðü òíí Joe Marcus Clarke.

¼ëàð íé ãñáííáðíóáéñÝð X11 ðíð ãñßóéííðáé òðí /usr/local/lib/X11/fonts/ éáé òí ~/.fonts/ áßíáé áðöüíáðá áéáéÝóéíáð áéá anti-aliasing òá áòáñííáÝð Xft-aware, òðíðáñééáíááíñÝíúí òíð KDE, GNOME éáé Firefox.

Áéá íá äéÝáíáðá ðíßàð ãñáííáðíóáéñÝð áßíáé anti-aliased, Þ íá ñðèíßóáðá òéð éáéüðçòáð òíð anti-aliasing, äçíéíðñáÞóðá (Þ òñíðíðíéÞóðá, áí Þäç ððÛñ÷áé) òí ãñ÷áßí /usr/local/etc/fonts/local.conf. ÝÝóü áððíý òíð ãñ÷áßí òðíñíý íá ñðèíéóðíý íáñéáðÛ áíáéáééáðíÝíá ÷áñáéðçñéóðéÛ òíð óðóðíáðíð ãñáííáðíóáéñÞí Xft. Áðöü òí òíÞíá ðáñéáñÛóáé íúíí ðáñééÝð áðèÝð áðíáüðçòáð. Áéá ðáñéóóüðáñáð éáððñÝñáéáð, ááßðá òí fonts-conf(5).

Õí ãñ÷áßí áðöü ðñÝðáé íá áßíáé íññòÞð XML. ÄÞóðá íááÛëç ðñíóí÷Þ óðá ðáæÛ / éáðáéáßá, éáé óéáíðñáðèáßðá üðé üéá òá tags Ý÷ííí ééáßóáé òùóóÛ. Õí ãñ÷áßí íáééíÛ ðá òçí óíççééóíÝíç áðééáðáéßáá XML éáé Ýíá íñéóíü DOCTYPE, éáé Ýðáéðá áéíëíðèáß òí <fontconfig> tag:

```
<?xml version="1.0"?>
<!DOCTYPE fontconfig SYSTEM "fonts.dtd">
<fontconfig>
```

¼ðùð áßðáíá ðñíçáííóíÝíúð, üëàð íé ãñáííáðíóáéñÝð òðí /usr/local/lib/X11/fonts/ üðùð éáé òðí ~/.fonts/ áéáðèáíðáé Þäç òá Xft-aware áòáñííáÝð. Áí èÝéáðá íá ðñíóéÝóáðá éáé Ûëëíðð éáðáéüüáíðð áéðüð áðü áððíýð òíðð äýí, ðñíóéÝóðá íéá ãñáííÞ ðáñíííéá íá áððÞ ðíð áéíëíðèáß òðí /usr/local/etc/fonts/local.conf:

```
<dir>/path/to/my/fonts</dir>
```

Áóíý ðñíóéÝóðáð íÝáð ãñáííáðíóáéñÝð, éáé áéáééüðáñá íÝíðð éáðáéüüáíðð ãñáííáðíóáéñÞí, ðñÝðáé íá áéðáéÝóáðá òçí áéüëíðèç áííðèÞ áéá íá áíáäçíéíðñáÞóðáð òçí cache ãñáííáðíóáéñÞí:

```
# fc-cache -f
```

Õí anti-aliasing èÛíáé òá Ûëñá áéáðñðð óðáéá÷ðíÝíá, èÛííóáð Ýóóé òá ðíëý íéëñÛ ãñÛíáðá ðéí áíááíÞóéíá, éáé áðáéñáß òéð "ééßíáéáð" (óéáéíðÛóéá) áðü òá íááÛëá ãñÛíáðá, áééÛ òðíñáß íá ðñíéáéÝóáé áíí÷èÞóáð òðá ðÛóéá íí÷óéííðíéçèáß òá éáñíééÛ íááÝç. Áéá íá áíáéñÝóáðá áðü òí anti-aliasing íááÝç ãñáííáðíóáéñÞí íéëñüðáñá áðü 14 point, ðñíóéÝóðá áððÝð òéð ãñáííÝð:

```
<match target="font">
  <test name="size" compare="less">
    <double>14</double>
  </test>
  <edit name="antialias" mode="assign">
    <bool>>false</bool>
  </edit>
</match>
<match target="font">
  <test name="pixelsize" compare="less" qual="any">
    <double>14</double>
  </test>
```

```
<edit mode="assign" name="antialias">
  <bool>>false</bool>
</edit>
</match>
```

Οι spacing (αεάοόπιαόά) οά ιάνεέΥò monospaced ανάνιαοιόάένΥò ιδινάβ άδβόçò íá άβίαέ αεάοÜεεçεί υοάí ÷ ñçóείñðíεάβόάέ anti-aliasing. Άοòü οάβίαόάέ íá άδρóaεάβ έεάβόάññ ðñüâεçía íá òí **KDE**. Íεά αέυñèυòç αεά άοòü, άβίαέ íá άδέαÜεεάòá οòí spacing όçí όείP 100 αεά άοòΥò όέò ανάνιαοιόάένΥò. ÐññíεéΥóáά όέò αέυñèυòεάò ανάνιΥò:

```
<match target="pattern" name="family">
  <test qual="any" name="family">
    <string>fixed</string>
  </test>
  <edit name="family" mode="assign">
    <string>mono</string>
  </edit>
</match>
<match target="pattern" name="family">
  <test qual="any" name="family">
    <string>console</string>
  </test>
  <edit name="family" mode="assign">
    <string>mono</string>
  </edit>
</match>
```

(άοòü ιάοιñÜεεάέ όά Üεεά έίείÜ ίñüíáόά òüí fixed ανάνιαοιόάένñπí υò "mono"), έεά Υðάέόά ðññíεéΥóáά:

```
<match target="pattern" name="family">
  <test qual="any" name="family">
    <string>mono</string>
  </test>
  <edit name="spacing" mode="assign">
    <int>100</int>
  </edit>
</match>
```

ΌοάεάεñειΥíáò ανάνιαοιόάένΥò, υòυò íé Helvetica, ιδινάβ íá άιόάίβæíññ ðñüâεçía υοάí άβίαέ anti-aliased. Οι ðñüâεçía óò ÷ íÜ έεäçεπíáόάέ υò íβá ανάνιαοιόάένÜ έññΥíç εÜεάόά όόçí ìΥόç. Όόçí ÷ έέñυόάñç ðáñβðòυòç, ιδινάβ íá εÜíáέ εÜðíεάò άοάñññΥò íá έáόάññáýóíñ. Άέά íá òí άδρóaεάòά άοòü, ιδινάβόά íá ðññíεéΥóáά òí αέυñèυòεί όóí local.conf:

```
<match target="pattern" name="family">
  <test qual="any" name="family">
    <string>Helvetica</string>
  </test>
  <edit name="family" mode="assign">
    <string>sans-serif</string>
  </edit>
</match>
```

Ìüεέò όάέέεπóáάά όçí íáόάòññðP òíò local.conf óέäíññáðεάβóá υòέ έεάβóáάά òí άñ ÷ άβñ íá òí </fontconfig> tag. Άí άάí òí εÜíáόά, íé αέέάáΥò óάò έá άάñçεíýí.

Όΰεϊò, ìε ÷ ñΠόόάò ìðññγί íá ðññòεΰότíòí óεò äεéΰò ðιòò ñòεìΒόάεò ìΰóù òùí ðññóùðέεηí ðιòò äñ ÷ äβùí . fonts.conf. Άέá íá äβíáé áòòù, εΰεä ÷ ñΠόόçò ðñΰðáε äðêðò íá äçìéτòññΠόάé ΰíá ~/ . fonts.conf. Άòòù ðι äñ ÷ äβì ðñΰðáε íá äβíáé äðΒόçò XML ìñòêð.

Έΰóε ðáεäòóáβì: óá ìβá LCD ìεùίç, ìðññáβ íá äβíáé äðέεòìçòùò ì äáεäìáóéóìùò sub-pixel. Ì äáεäìáóéóìùò ÷ äéñβæáðáé ÷ ùñεóòΰ óá (ìñεäτíóéá äéá ÷ ùñεóìΰíá) εùεεéíá, ðñΰóéíá éáé ìðεä óóìε ÷ äβá ηóóá íá äáεòεηóáé óçì ìñεäτíóéá áíΰεòóç. Όá äðìòäεΰóíáóá ìðññáβ íá äβíáé äñáìáóéεΰ éáεγòáñá. Άέá íá ðιí áíáñáτíεηóáòá, ðññòεΰóóá óçì ðáñáéΰòù äñáñΠ εΰðιò óóì äñ ÷ äβì local.conf:

```
<match target="font">
  <test qual="all" name="rgba">
    <const>unknown</const>
  </test>
  <edit name="rgba" mode="assign">
    <const>rgb</const>
  </edit>
</match>
```

Όçìáβòóç: Άíΰετíá ìá ðιí óγðí óçò ìεùίçò, ðι rgb ìðññáβ íá ÷ ñáéáóòáβ íá äéεΰíáé óá bgr, vrgb ð vbgr: ðáéñáìáóéóòáβóá éáé äáβòá ðιβì éáéóìòññáβ éáεγòáñá.

5.6 Ì X Display Manager

Όðìáéóòìñΰ ðιò Seth Kingsley.

5.6.1 ΆέóáäùäÞ

Ì X Display Manager (**XDM**) äβíáé ΰíá ðññáéñáðééεù ìΰñìò ðιò óòóðηíáòìò X Windows ðιò ÷ ñçóéììðíéáβðáé äéá äéá ÷ äβñéóç óòíáΰóäùí (logins). Άòòù äβíáé ÷ ñΠóéτí óá ðιεéΰð ðáñεððóáéò, ùðò óá äðεΰ “X Terminals”, óá desktop ìç ÷ áíηíáóá, éáêð éáé óá äéáéñεóòΰ ìááΰεùí äééóγùí. Άóτγ ðι óύóóçíá X Windows äβíáé áíáíΰñòçòì ðññòìεùεεùí éáé äééóγùí, ððΰñ ÷ äé ìááΰετí äγñìò ðééáηí ñòεìΒóáùí äéá óçì éáéóìòññáβ X ðáéáðηí éáé äéáéñεóòηí óá äéáóìñáðééΰ ìç ÷ áíηíáóá óòíáäáñìΰíá óá ΰíá äβéòóì. Ì **XDM** ðáñΰ ÷ äé ΰíá äñáóééù ðáñéáΰεετí äéá óçì äðéετáÞ ðιò äéáéñεóòÞ ìá ðιí ìðìβì éá äβíáé ç óγíäáóç, éáé äéá óçì äβòτáì ðεçñìòìñεηí ðéóóìðìβçòçò ùðò ðιò ìììáòìò ÷ ñΠóóç éáé ðιò εùäééτγ ðññóááóçò.

Όéáðéáβòá ðιí **XDM** ùò ìéá äóáñìτáÞ ðιò ðáñΰ ÷ äé óéò βáéáò äòíáóòùçòáò óòì ÷ ñΠóóç ìá ðι äñááéäβì getty(8) (ääβòá ðι Όìηíá 26.3.2 äéá éäðòñΰñáéáò). Όì XDM äéòáéáβ óòíáΰóáéò (logins) óòì äéáéñεóòÞ éáé ΰðáéóá äéòáéáβ ΰíá äéá ÷ äéñεóòÞ óòíáäñβáò (session manager, óòìÞεòò ΰíáí X äéá ÷ äéñεóòÞ ðáñáéγñùí, window manager) äéá ετáñéáóìù ðιò ÷ ñΠóóç. Ì **XDM** ΰðáéóá ðáñετíΰíáé íá ðáñíáòβóáé áòòù ðι ðññáñáìá, ðιò óçìáòìτáòáβ ùéé ì ÷ ñΠóóçò ðáéáβòóá éáé ðñΰðáé íá äðìóòíáäéáβ. Όá áòòù ðι óçìáβì, ì **XDM** ìðññáβ íá äìòáíβóáé ìáíΰ óçì ìεùίç äéóúäτò (login) éáé óçì ìεùίç äðéετáÞð äñáóéêðò óγíäáóçò ηóóá íá óòíáäéáβ ΰíáò ΰεετò ÷ ñΠóóçò.

5.6.2 ×ñΠόζ οϊό XDM

Άέα ίά ίάέειΠρόάόά ίά ÷ñζοείιθιεάβδσά οι **XDM**, άάέάόάόδΠρόάά οι port `x11/xdm` (άάί άάέέέβόόάόάέ άδύ θñιáðέειάΠ όόέδ θñυόόάόάδ άέάυόάέδ οιό **Xorg**). Ιθιñάβδσά Υθάέόά ίά άñάβδσά οιί άάβιιίά **XDM** όοι /usr/local/bin/xdm. Άόου οι θñυάñάιá ιθιñάβ ίά άέόάέάόάβ ιθιεάάΠθιόά όόέάΠ ùò root έάέ έά ίάέειΠρόάέ ίά έέα÷άέñβæάόάέ όζι ιέυιζ οιό X όοι οιθέέυι ιζ÷Υίζιά. Άί ι **XDM** θñΥθάέ ίά άέόάέάβδσάέ έΰέά οimΰ θιό άέέέφάβδσάέ οι ιζ÷Υίζιά, Υίάό άιέέέυδ όñυθιό άβιάέ ζ θñιόέΠέζ ιέάδ άñάñΠδ όοι /etc/ttys. Άέα θάñέόόούόάñάδ θέζñιόimβάδ ό÷άόέέΰ ίά όζι imöΠ έάέ όζι ÷ñΠόζ άόόιΥ όιό άñ÷άβιö, άάβδσά οι ΌiΠiά 26.3.2.1. Όθΰñ÷άέ ιβá άñάñΠ όοι άñ÷έέυ /etc/ttys άñ÷άβι έέα όζι άέóΥέάόζ οιό **XDM** όά Υίά άέέιίέέυ όάñιáόέέυ:

```
tttyv8 "/usr/local/bin/xdm -nodaemon" xterm off secure
```

Άñ÷έέΰ άόδΠ ζ έάέόιθiñάβ άβιάέ άθáñáñáθιεζιΥίζ — έέα ίά όζι áñáñáθιεΠρόάόά άέέΰiθá οι θáάβι 5 άδύ off όá on έάέ άθáñiáέβιζόόά όι init(8) ÷ñζοείιθιεΠiόάδ όέδ ιáçάβδσά θιό ΌiΠiά 26.3.2.2. Οι θñΠδθι θáάβι, οι υíñiά θιό όáñιáόέέιΥ θιό έά έέα÷άέñβæάόάέ οι θñυάñάιá, άβιάέ οι tttyv8. Άόου όζιáβiάέ υόέ ι **XDM** έά άέόάέάβδσάέ όοι 9i άέέιίέέυ όáñιáόέέυ.

5.6.3 Ñýèiέόζ οϊό XDM

Ί έάόΰεiάiό ñδèiβóáñι όιό **XDM** άñβóέάόάέ όοι /usr/local/lib/x11/xdm. Όά άόóυi όιί έάόΰεiάi όδΰñ÷iόi θiέέΰ άñ÷άβá θιό ÷ñζοείιθιεiγiόάέ έέα ίά άέέΰiθi όζι όóιθáñέóimΰ έάέ áiöΰiέόζ οιό **XDM**. Όθδέέΰ, έά άñάβδσά όá θáñáέΰδύ άñ÷άβá:

Άñ÷άβι	θáñéáñáöΠ
Xaccess	Έάíυiάδ θέόóιθiβζόζδ θáέάóΠi.
Xresources	θñiέáέiñέóιΥiάδ όέiΥδ X resource.
Xservers	Έβóόά άθñiáέñóóιΥiυi έάέ όiθέέéΠi iέiΠi (× displays) όόέδ iθiβáδ έά áβiáόάέ έέα÷άβñέόζ.
Xsession	θñiáðέέáñiΥiñ script óóíυáñι έέα logins.
Xsetup_*	Script έέα όζι άέóΥέáόζ áiόiέΠi θñéi όζι áiöΰiέόζ θiό θáñéáΰéειiθiό όγiááόζδ (login screen).
xdm-config	Ñδèiβóáέδ έέα υéáδ όέδ áθáέέiñβóáέδ (displays) θiό άέóáέiγiόáέ óá άόóυ όi ιζ÷Υiζiá.
xdm-errors	Έΰέζ θiό áçiέiθñáiγiόáέ άδύ οι θñυáñáιá.
xdm-pid	Όi ID όζδ άέáñááóβáδ θiό θñΥ÷iθiό XDM.

Άδβόζδ όá άόóυi όιί έάόΰεiάi όδΰñ÷iόi iáñέέΰ scripts έάέ θñiáñΰiáόá θiό ÷ñζοείιθιεiγiόáέ έέα ίá ñδèiβóiθi όζι áðέóΰiάέá áñááóβáδ υóáí áέóáέáβóáέ όi **XDM**. Έá θáñéáñΰθiόiá θáñέέζδóέέΰ όi óeiθύ έάέáíυδ άδύ άόóΰ óá άñ÷άβá. ζ áέñéáΠδ όγiááίç έάέ ÷ñΠόζ υéúι áόδΠi óυi άñ÷άβiυi θáñéáñΰöáόáέ όοi xdm(1).

ζ θñiέáέiñέóιΥiζ ñýèiέόζ áβiάέ Υiá áðéυ iñéiáΠiέi θáñΰέóñi όγiááόζδ iá όi υíñiά θiό ιζ÷áΠiáóιθi ίá öáβiáόáέ όόζι éiñóöΠ iá iááΰéá áñΰiáόá έάέ όέδ θñiθñiθΰδ “Login:” έάέ “Password:” άδύ έΰóυ. Άόóυ áβiάέ Υiá έáέυ όζiáβi áέέβiζόζδ έέα ίá άέέΰiáόá όζι áiöΰiέόζ θiό **XDM**.

5.6.3.1 Xaccess

Όi θññóυéiέéi áéá όγiááόζ iá áθáέéiñβóáέδ θiό áéΥá÷iθiόáέ άδύ οι **XDM** iñmΰæáόáέ X Display Manager Connection Protocol (XDMCP). Οι άñ÷άβι áóóυ áβiάέ Υiá όγiñiέ éáíυiυi έέα óυi Υéáá÷i óυi óóíáΥóáñι XDMCP άδύ

άδñáēñōóιΎίá ιç ÷ áíÞíáðá. Áññáßðáé, áēōüð éáé áí òι xdm-config Ύ ÷ áé ñōèìéóðáß þóðá íá äΎ ÷ áðáé áéóáñ ÷ ùìáíáð òðíáΎóáēð. Ç ðññáðéēñáß áßíáé íá ιçí áðēðñΎðáðáé óá éáíΎíá ðáēΎðç íá òðíááēáß.

5.6.3.2 Xresources

Ðññáéðáé áéá òι áñ ÷ áßι ðññáéñēóιΎíñι òéιþι áéá ðéð áðáññáΎð àìòΎíéóçð òιð ðáñΎèðñιð óύíááóçð (login) éáé áðéēñáΎá áðáéēùíéóçð (display chooser). ΎΎóá áðu áðòù ìðññáß íá ðññιðñíéçēáß ç àìòΎíéóç òιð ðññáñΎñáðιð login. Ç ìññòß òιð áßíáé ßáéá ìá òι áñ ÷ áßι app-defaults ðιð ðáñéáñΎðáðáé òóçí ðáēιçñßùóç òιð X11.

5.6.3.3 Xservers

Áðòßß áßíáé íéá ēßðóá òùì áðñáēñōóιΎíñι òðáéιþι ðιð ðñΎðáé íá àìòáíßæñíðáé ùð áðéēñáΎð òðι ðññáñáìá (chooser).

5.6.3.4 Xsession

Áðòù áßíáé òι ðññáéñēóιΎíñι session script ðιð áēðáēáß òι **XDM** ìáðΎ òç óύíááóç ēΎðñíéιð ÷ ñßðóç. ÉáñíééΎ, ēΎèá ÷ ñßðóçð éá Ύ ÷ áé Ύíá ðññιðñíéçíΎñι, áéēù òιð, session script òðι ~/ .xsession ðιð éá ðáñáéΎìððáé áðòù òι script.

5.6.3.5 Xsetup_*

Óá áñ ÷ áßá áðòΎ áēðáēñíðáé áðòùìáðá ðñéí òçí àìòΎíéóç òùì ðáñáéγññι ðáðéēñáßð ð óύíááóçð. ÓðΎñ ÷ áé Ύíá script áéá ēΎèá display ðιð ÷ ñçóéñιðñíéáßðáé, ðιð ìññΎæáðáé xsetup_ ìá òι ñύíáññι òιð display òðι òΎèìð (áéá ðáñΎááéáìá xsetup_0). ÉáñíééΎ áðòΎ òá scripts éá áēðáēñíðí Ύíá ð áðι ðññáñΎñíáðá òðι ðáñáóéÞíéí ùðòð ð. ÷. òι xconsole.

5.6.3.6 xdm-config

Οί áñ ÷ áßι áðòù ðáñéΎ ÷ áé ñōèìéóðáéð òóçí ìññòß òùì app-defaults, ðιð áðáññáæñíðáé óá ēΎèá display ðιð áéá ÷ áēñßæáðáé ç òðáēáēñéíΎιç ááēáðΎðóáóç.

5.6.3.7 xdm-errors

Οί áñ ÷ áßι áðòù ðáñéΎ ÷ áé òçí Ύññá òùì áéáēñéóðþι X ðιð ðññιððáéáß íá áēðáēΎóáé òι **XDM**. Áí Ύíá display ðιð ðññιððáéáß íá áēééíßðáé ò **XDM** ēíēēßðáé áéá ēΎðñíéí ēùáí, éáéù áßíáé íá áíáæçðßðóáðá áäþ òð ÷ ùí ιçíύíáðá òðáéìΎðùí. Óá ιçíύíáðá áðòΎ éáðááñΎñíðáé éáé òðá áñ ÷ áßá ÷ ñçóðþι ~/ .xsession-errors.

5.6.4 Άέáðçñþíðáð Ύíáí Άέáēñíéóðß ΆðñáēñōóιΎíñι ÓðíáΎóáùí

Άέá íá òðíáΎíðáé éáé Ύēéíé ðáēΎðáð òðñι áéáēñéóðß ðēñιçð, ðññιðñíéßðóá òιðð éáñíáð áēΎá ÷ ìð ðññóááóçð, éáé áíáñáñðñíéßðóá òéð áéóáñ ÷ ùìáíáð òðíáΎóáēð. Óá ðáñáðΎñ ðññáé, áðu ðññáðéēñáß ñðèìéóιΎíá òá òðíðçñçðééΎð òéíΎð. Άέá íá ēΎíáðá òι **XDM** íá äΎ ÷ áðáé òðíáΎóáēð, áñ ÷ éēΎ ìáðáðñΎððá òá ò ÷ ùēéí òçí ðáñáéΎðù ðáñáñß òðι áñ ÷ áßι xdm-config:

```
! SECURITY: do not listen for XDMCP or Chooser requests
! Comment out this line if you want to manage X terminals with xdm
DisplayManager.requestPort:      0
```

έάέ ιάοΰ άδάραιέέειΠόοά οίι **XDM**. Ιά Υ ÷ άοά οδύοεί οάο ύοέ οά ο ÷ üέέά οάά άñ ÷ άβá app-defaults ίάέέίίί ίά οίί ÷ άñάέδΠñά “!”, έάέ υ ÷ έ οίί οοίΠεç “#”. Ιδññάβ ίά άδέέδñάβδά δει άοόόçñíýδ έáíúíáδ äéÝñ ÷ ïδ δñúοάάοçδ. Άάβδά οά δάñάάβáíáοά οοί xaccess, έάέ οδññíðέάοέβδά οç οάέβáá manual οίö xdm(1).

5.6.5 Άίόέέάοάοΰοάδ οίö XDM

Οδΰñ ÷ ïοί άñέάοίβ άίόέέάοάοΰοάδ άέά οί δñúάñáíá **XDM**. ίάδ άδύ άοδñýδ, í **kdm** (Ýñ ÷ άδάέ ίά οί **KDE**) άίάέýάοάέ άñáúοάñά οά άοδύ οί έάοΰεάει. Ι **kdm** display manager δññíοóÝñάέ δñέΰΰ δññíοáñΠíáοά οάά άñάοέέΰ έάέ άέάέίοιçοέέΰ οοίέ ÷ άβá, ύδύδ άδβόçδ έάέ οçί άοíáοúοçδά ίά άδέέÝññíοί τέ ÷ ñΠόοάδ οίί άδέέδìçδúí άέá ÷ άέñέοδΠ δάñάέýññí οçί οδέáìΠ οçδ οýíáάοçδ.

5.7 Άñáοέέΰ Δάñέáΰέέííóá

Οδñάέοδñΰ οίö Valentino Vaschetto.

Άδού οί οίΠíá δάñέáñΰοάέ ίáñέέΰ άñάοέέΰ δάñέáΰέέííóá δñíο άέάδβέáíóάέ άέά οί X οοί FreeBSD. Ç Ýíñéá “áñáοέέú δάñέáΰέέíí” ίδññάβ ίά οçíáβíáέ ïόέáΠδñíá, άδύ Ýíáí άδέü άέá ÷ άέñέοδΠ δάñάέýññí ίÝ ÷ ñέ Ýíá ïέíεçññúÝíá δάέÝοί desktop άοáñññáβí, ύδύδ οί **KDE** Π οί **GNOME**.

5.7.1 GNOME

5.7.1.1 Ο ÷ άδέέΰ ίά οί GNOME

Οί **GNOME** άβíáέ Ýíá οέέέέü δññú οίί ÷ ñΠόόç άñάοέέü δάñέáΰέέíí δñíο άδέοñÝδáέ οοίòδ ÷ ñΠόοάδ ίά ÷ ñçοέíñδñέíýί έάέ ίά ñέíβάειοί άýέíεá οίòδ οδñíεáέοδÝδ οίòδ. Οί **GNOME** άέάέÝδάέ Ýíá panel (άέá οçί άέέβίçόç άοáñññáβí έάέ οçί δñññáñΠ έáοΰόδóçδ), άδέοΰíáέá άñάáοβáδ (ύδñíο άìοáíβάειíδάέ áááñÝíá έάέ άοáñññáÝδ), Ýíá δεΠεíð άδύ άέάáááñÝíá άñάáέáβá έάέ άοáñññáÝδ, έάεβδ έάέ Ýíá οýññέí οδδñíδñέΠόáúí δñíο άδέοñÝδáέ οόέδ άοáñññáÝδ ίά οοíáñáΰάειíδάέ ίáδóáý οίòδ έάέ ίά ááβ ÷ ñíοί Ýíá οοíáδÝδ δάñέáΰέέíí άñάáοβáδ. Ιέ ÷ ñΠόοάδ ΰέέüí έáέοíòñάέεβí οόόοçíΰδúí Π δάñέáΰέέοíδúí έá άέοέΰñííδάέ οáí οδñí οδβδέ οίòδ ÷ ñçοέíñδñέβíδáδ οί δáíβó ÷ δññí άñάοέέü δάñέáΰέέíí δñíο δáñÝ ÷ áέ οί **GNOME**. Δάñέοóúδáñáδ δεçññíοíñβáδ ο ÷ άδέέΰ ίά οί **GNOME** οοί FreeBSD ίδññíýί ίά άñάέíýí οοί άέάάέέδδóáέü οúδñí οίö FreeBSD GNOME Project (<http://www.FreeBSD.org/gnome>). Ç οíδñέáóβá δάñέÝ ÷ áέ άδβόçδ έάέ άίάέδδέέΰ FAQs ο ÷ άδέέΰ ίά οçί ááέáδΰόδóáç, οçί ñýέíέόç, έάέ οçί άέá ÷ áβñέόç οίö **GNOME**.

5.7.1.2 Άάέáδΰόδóáç οίö GNOME

Οί **GNOME** ίδññάβ ίά ááέáδóáóáέáβ άýέíεá άδύ δάέÝόá Π άδύ οçί ΟόέέíáΠ οúí Ports:

Άέá ίá ááέáδóáóδΠόáδá οί Ýδñέñí δάέÝοί οίö **GNOME** άδύ οί áβέδδóí, άδέβδ δεçέδññέíáΠόáδá:

```
# pkg_add -r gnome2
```

Άέá ίá ίáδóáάέüδδβóáδá οί **GNOME** άδύ οίí δçááβí έβáέέá, ÷ ñçοέíñδñέΠόáδá οçί ΟόέέíáΠ οúí Ports:

```
# cd /usr/ports/x11/gnome2
# make install clean
```

Ίιέέό άέέάόάόάέάβ οί **GNOME**, έά δñÝðáέ ίά ñòèìέόόάβ ï áέάέñέόόð X þóá ίά áέέείάβ οί **GNOME** άίόβ áέά οίí δñíέάέñέόίÝñí áέά÷ áέñέόóð δάñάέýñíí.

Ί άóέíεüóáññò ðñüðñò áέά ίά áέέείðóáóá οί **GNOME** άβίάέ ίά οί **GDM**, οίí GNOME Display Manager. Οί **GDM**, ðñò ááέάέβóóάόάέ ùò ïÝñíò οίò **GNOME** (áέέÜ áβίάέ áíáíáñáü áñ÷έέÜ), ïðñáβ ίά áíáñáñíðíέçέáβ ίά óçí ðñíóèðέç οίò gdm_enable="YES" óóí /etc/rc.conf. Ίιέέó èÜíáóá áðáíáέέβίçóç, οί **GDM** έά ίάέέíðóáέ áóóüíáóá.

Άðέðñüóέáóá, áέά ίά áíáñáñíðíέðóáóá üέáð óéð ððçñáóóáð οίò **GNOME** óáóóü÷ñííά ίά óçí áέέβίçóç οίò **GDM**, ðñíóèÝóóá óç áñáñíð gdm_enable="YES" óóí áñ÷áβí /etc/rc.conf.

Οί **GNOME** ïðñáβ áðβóçò ίά ίάέέíðóáέ áðü óçí áñáñíð áíóíεþí ñòèìβáñíóáð έáóÜέέçέá οί áñ÷áβí .xinitrc. Άί ððÜñ÷áέ þáç οί áñ÷áβí .xinitrc, áðέðð áíóέέάóáóóðóóá óçí áñáñíð ðñò áέέείάβ οίí ðñÝ÷ñíóá áέά÷ áέñέóóð δάñάέýñíí ίά ïβá ðñò ίά áέέείάβ οί **/usr/local/bin/gnome-session**. Άί ááí èÝέáóá ίά èÜíáóá δáñέóóüóáñáð ñòèìβóáέó óóí áñ÷áβí, ÷ñáέÜæáóáέ áðέÜ ίά áñÜøáóá:

```
% echo "/usr/local/bin/gnome-session" > ~/.xinitrc
```

ðáέóá, ðέçέóññíεíáðóóá startx, έάέ έá ίάέέíðóáέ οί áñáóέéü δáñέáÜέέéíí οίò **GNOME**

Οçíáβúóç: Άί ÷ñçóέííðíέάβóá èÜðíέí δáέάέüóáñí display manager, üðüò οί **XDM**, οί δáñáóÜíü ááí έá έáέóíòñáðóáέ. Οóçí δáñβðóóóç áóðð, áçíέíòñáðóóá Ýíá áέóáέÝóέéíí áñ÷áβí .xsession οί ïðñíí ίά δáñέÝ÷áέ óçí βáέá áíóíεþ. Οñíðñíέðóóá οί áñ÷áβí .xsession έáέ áíóέέáóáóóðóóá óçí áíóíεþ ðñò ðñÝ÷ñíóá áέá÷ áέñέóóð δάñάέýñíí ίά οί **/usr/local/bin/gnome-session**:

```
% echo "#!/bin/sh" > ~/.xsession
% echo "/usr/local/bin/gnome-session" >> ~/.xsession
% chmod +x ~/.xsession
```

¶έçç ίέá áðέέñáð áβίάέ ίά ñòèìέóóáβ ï display manager þóá ίά áðέóñÝðáέ óçí áðέέñáð οίò áέá÷ áέñέóóð δάñάέýñíí έáóÜ óçí óýíááóç. Οί ðìþíá ΈáððñÝñáέáð KDE áñçááβ ðüò ïðñáβ ίά áβίάέ áóóü ïÝóü οίò **kdm**, οίò display manager οίò **KDE**.

5.7.2 KDE

5.7.2.1 Ó÷áóέéÜ ίά οί KDE

Οί **KDE** áβίάέ Ýíá óýá÷ñíí, áýέíεí óóç ÷ñþóç, áñáóέéü δáñέáÜέέéíí. ïáñέéÜ δñÜáíáóá ðñò ðñíóóÝñáέ οί **KDE** óóíí ÷ñþóç áβίάέ:

- ίά üññοí óýá÷ñíí δáñέáÜέέéíí
- ίά δáñέáÜέέéíí ίá ðέþñç áέέóóáέþ áέáóÜíáέá
- ίά áíóüíáóüíÝñí óýóóçíá áñþέáέáð ðñò áðέóñÝðáέ áýέíεç, óóíáðð ðñüóááóç óóçí áñþέáέá áέá óçí ÷ñþóç οίò **KDE** έáέ óüí áóáññáþí οίò
- Óóíáðð áñóÜέóç έáέ óóíðáñέóññÜ üέéíí óüí áóáññáþí οίò **KDE**
- ÓóðñíέçíÝíá menu έáέ áñáñÝð áñááέáβüí (toolbars), óóíáóáóííβ ðέþéóññíí, ÷ñüíáóέέíβ óóíáóáóííβ, έέð.
- Άέάέíáβð ñòèìβóáέó: οί **KDE** áέáóβέáóáέ óá δáñέóóüóáñáð áðü 40 áέþóáð

- Έάíñέέυ έάέ όóíαδΎò óύόόçιά ñòèìβóáùí ááóéóíΎíí óá áεάέυáíòð
- ÌááŪεíí áñέέìυ ÷ ñβóέìυí áóáñííáβí, ó ÷ ááεάóíΎííúí áεάέέŪ áεά όí **KDE**

Οί **KDE** óóííááύáóáé áðu Ύíáí ðáñέçāçòð (browser) ðíò íñŪæáóáé **Konqueror**, έάέ áíóááùíβæáóáé óíááñŪ óíòð Ūέεííòð ðáñέçāçòŪò óùí óðóóçìŪòùí UNIX. ðáñέóóúòáñáð ðεçñííòíñβáð áεά όí **KDE** ìðíñáβóá íá áñáβóá óóí KDE website (<http://www.kde.org/>). Άέά ðεçñííòíñβáð ó ÷ áóέέŪò ìá όí FreeBSD έάέ όí **KDE**, óóìáíñòéáðèáβóá όíí áεάáέéòðáéυ όúðí όíò FreeBSD-KDE team (<http://freebsd.kde.org/>).

ŌðŪñ ÷ íóí áεάέŪóéíáð áýí áεáυóáéò όíò **KDE** áεά όí FreeBSD. Ç έáíóç 3, έðέεííòíñáβ áñéáóυ έάέñυ έάέ εáυñáβóáé ááíééŪ ðñέíç. Óóç Óðέεíāð όùí Ports εá áñáβóá áðβóçò óçí έáíóç 4 áðu óç íáυòáñç ááíéŪ. Íé áýí áóòŪò áεáυóáéò ìðíñíýí ìŪέέóóá íá óóíòðŪñ ÷ íóí óóíí βáεí ððíεíāέóðð.

5.7.2.2 ΆáéáóŪóóáóç όíò KDE

¼ðùð έάέ ìá όí **GNOME** ð εŪéá Ūέεíí áñáóéέυ ðáñéáŪέεíí, όí εíáέóíéέέυ ìðíñáβ íá ááéáóáóáéáβ áýéíεá ìŪóυ ðáéŪòùí ð áðu óçí Óðέεíāð όùí Ports:

Άέá íá ááéáóáóðβóáðá όí **KDE3** ìŪóυ ðáéŪòùí áðu όí áβέòóí, áðεðð ðεçéòñíεíāβóáð:

```
# pkg_add -r kde
```

Άέá íá ááéáóáóðβóáðá όí **KDE4** ìŪóυ ðáéŪòùí áðu όí áβέòóí, áðεðð ðεçéòñíεíāβóáð:

```
# pkg_add -r kde4
```

Ōí pkg_add(1) εá áíáέòβóáé áóòυíáóá óçí óáéáðóáβá Ūέáíóç óçò áóáñííāβò.

Άέá íá ìáóááέυòðβóáðá όí **KDE3** áðu όíí ðçāáβí έðáέέá, ÷ ñçóéííðíéβóáð óç Óðέεíāð όùí Ports:

```
# cd /usr/ports/x11/kde3
# make install clean
```

Άέá íá ìáóááέυòðβóáðá όí **KDE4** áðu όíí ðçāáβí έðáέέá, ÷ ñçóéííðíéβóáð óç Óðέεíāð όùí Ports:

```
# cd /usr/ports/x11/kde4
# make install clean
```

Áóíý ááéáóáóáéáβ όí **KDE**, εá ðñŪðáé íá ñòèìέóóáβ ì áεάέñéóóðβò X βóóá íá όí áέέéíáβ áíóβ áεά όíí ðñíεáéíñέóíŪíí áεά ÷ áéñέóóð ðáñáéýñυí. Áóòυ áβíáðáé ìá óçí áεéáāð όíò áñ ÷ áβíò .xinitrc:

Άέá όí **KDE3**:

```
% echo "exec startkde" > ~/.xinitrc
```

Άέá όí **KDE4**:

```
% echo "exec /usr/local/kde4/bin/startkde" > ~/.xinitrc
```

Ōðñá, υðíðá όí X Window System áέέéíáβóáé ìŪóυ όíò startx, όí áñáóéέέυ ðáñéáŪέεíí εá áβíáé όí **KDE**.

Áí ÷ ñçóéííðíéáβóá éŪðíéí display manager υðùð όí **XDM**, ç ñýéìέóç áβíáé έβáí áεáóíñáóéέéð. Έá ðñŪðáé áíóβ áεά όí .xinitrc íá ðñíðíðíéβóáðá όí .xsession. Ìççāáð áεά όí **kdm** áβííóáé áñáυòáñá óóí έáòŪέáéí áóòυ.

5.7.3 Δαήεόούοαήαδ ΈαδούΐΎήαέαδ αέα οί KDE

Όηά δίο οί **KDE** Ύ÷άε άαέαάοάαέαβ οοί ούόόαί, ιδίηάβδ ά άάεάέυθάδδ οεδ δαήεόούοαήαδ έαέοιτνάβδ ιΎού ούι οάεβάυι άηεαέαδ P αίεειΰαίτδάδ ιάηύ έαέ άδέειάΎδ. Ίέ ÷ηPόάδ ούι Windows ς οίθ Mac® έά αέοέΰηίτδάέ οάί οοί οδβδέ οίτδ.

ς έαέύδανς άηεαέα αέα οί **KDE** άβίαέ ς on-line δάειςηβύος. Οί **KDE** οοίηαάύάδάέ άδύ οίί αέέυ οίθ δαήεςαςP, οίί **Konqueror**, δειέΎδ ÷ηPόείαδ άοάηηάΎδ, έαέ άίάεδδέεP δάειςηβύος. Οί δδύειέδθι άδδPδ οςδ άηύοςάδ οδαςδΰ όα÷ίέέΰ εΎίάδά δίο άβίαέ άύόειει ίά άίάεάεδδέηύι ιά αίεειΎδ.

5.7.3.1 Ί KDE Display Manager

Ί αέα ÷άέηεόδPδ άηύδ δειθ÷ηςόδέηύ οδδδPιάοίθ εΎέαέ άίάα÷ηΎηύδ ς ούίάαος ούι ÷ηςόδθι ίά άβίάδάέ ιΎού άηάοέηύ δαήέαΰεειθίθ. ¼δύδ δαήέαηΰόαί δηβί, ιδίηάβ ίά ÷ηςόειηδρειςάβ οί XDM. ¼ιθδ, οί **KDE** δαήέΎ÷άέ ίέα άίάεεάδδέεP άδέειάP, οί **kdm**, οί ιδίβθι Ύ÷άέ ο÷άαέαόδάβ ίά άβίαέ δθβθι αέεδδδέέυ έαέ δανΎ÷άέ δαήεόούοαήαδ άδέειάΎδ έαδΰ ος ούίάαος. ΟόαέάηειΎίά, ίε ÷ηPόάδ ιδίηηύι άέηεά ίά άδέέΎηθι (ιΎού ιάηύ) δθβθι άηάοέέυ δαήέαΰεει (KDE, GNOME, P εΰδθρει ΰεει) έά αέδάεάδδάβ ιάδΰ οςί ούίάαος οίθδ.

Άέα ίά άηάηαίθρειPόάδ οί **kdm**, έά δηΎδαέ ίά αέεΰιθάδ οί ttyv8 οοί /etc/ttys. ς άηάηP έά ηεΰαέ ιά οςί δαήέαΰδ:

Άέα οί **KDE3**:

```
ttyv8 "/usr/local/bin/kdm -nodaemon" xterm on secure
```

Άέα οί **KDE4**:

```
ttyv8 "/usr/local/kde4/bin/kdm -nodaemon" xterm on secure
```

5.7.4 Xfce

5.7.4.1 Ο÷άδέέΰ ιά οί Xfce

Οί **Xfce** άβίαέ Ύίά άηάοέέυ δαήέαΰεει δίο οδςηβαάδάέ οδςί αέαέειεPες GTK+ δίο ÷ηςόειηδρειβδάέ έαέ άδύ οί **GNOME**, αέεΰ άβίαέ δεις δει άεάοης έαέ δηηηβαάδάέ αέα υοίθδ εΎειθί Ύίά άδέυ, άθίθάέάοιάδέέυ άηάοέέυ δαήέαΰεει δίο άβίαέ άέηει ίά ÷ηςόειηδρειςάβ έαέ ίά ηθειεόδάβ. Ίδδέέΰ, ηεΰαέ δεις ιά οί **CDE**, δίο οδρίάδΰδάέ οά άδθιηέέΰ οδδδPιάδά UNIX. Ίάηέέΰ άδύ δά ÷άηάεδςηεόδέέΰ οίθ **Xfce** άβίαέ:

- ίά άδέυ, άέηει οδςί ÷ηPός άηάοέέυ δαήέαΰεει
- ΔεPηθδ δαήάιάδθθρειPόει ιά οί δθίθβέέ, ιά drag and drop, έεδ.
- Έάίθηέέυ panel δανηηει ιά οίθ **CDE**, ιά ιάηύ, ίέηθι-άοάηηάΎδ έαέ δεPεθά αέεβίςος άοάηηάθι
- ΊειεςηηΎηδ αέα÷άέηεόδPδ δαήάεςηθι, αέα÷άέηεόδPδ άη÷άβυι, αέα÷άέηεόδPδ P÷ίθ, οοιάάδύδδά ιά οί **GNOME**, έαέ ΰεεά
- Άοιάδύδδά ÷ηPόςδ έαηΰδύι (themes, άοης ÷ηςόειηδρειβδ οί GTK+)
- ΆηPαηθι, αεάοης έαέ άθίθάέάοιάδέέυ: έαάίέέυ αέα δάεάέυδάηά/δει άηάΰ ις÷άίPιάδά P ις÷άίPιάδά ιά έβας ιθPις

Δαήεόούοαήαδ δέςηθθηβδ αέα οί **Xfce** ιδίηάβδ ά άηάβδά οδς αέέδδάεP οθθίηάδά οίθ Xfce (<http://www.xfce.org/>).

5.7.4.2 Απώρυξη του Xfce

Οδηγός (όχι πηγή κώδικα) για την απώρυξη του Xfce. Άρα για την απώρυξη του Xfce, αμέσως μετά:

```
# pkg_add -r xfce4
```

Άρα αμέσως, αμέσως για την απώρυξη του Xfce, αμέσως μετά την εγκατάσταση του Xfce, αμέσως μετά την εγκατάσταση του Xfce:

```
# cd /usr/ports/x11-wm/xfce4
# make install clean
```

Όπως, ο Xfce είναι ο Xfce, αμέσως μετά την εγκατάσταση του Xfce, αμέσως μετά την εγκατάσταση του Xfce:

```
% echo "/usr/local/bin/startxfce4" > ~/.xinitrc
```

Όχι αμέσως μετά την εγκατάσταση του Xfce, αμέσως μετά την εγκατάσταση του Xfce, αμέσως μετά την εγκατάσταση του Xfce. Ωστόσο, αμέσως μετά την εγκατάσταση του Xfce, αμέσως μετά την εγκατάσταση του Xfce, αμέσως μετά την εγκατάσταση του Xfce.

II. Άνάσσειν Άνάσσειν

Όπως είναι γνωστό, η ανάπτυξη του FreeBSD είναι ένα συνεχές έργο. Η ανάπτυξη του FreeBSD είναι ένα συνεχές έργο. Η ανάπτυξη του FreeBSD είναι ένα συνεχές έργο.

- Διανέμονται δωρεάν οι προγράμματα που είναι απαραίτητα για την ανάπτυξη του FreeBSD: οι προγράμματα (browsers), οι προγράμματα ανάπτυξης, οι προγράμματα ανάπτυξης, οι προγράμματα ανάπτυξης.
- Διανέμονται δωρεάν οι προγράμματα που είναι απαραίτητα για την ανάπτυξη του FreeBSD: οι προγράμματα ανάπτυξης, οι προγράμματα ανάπτυξης, οι προγράμματα ανάπτυξης.
- Απαιτείται η ανάπτυξη του FreeBSD: οι προγράμματα ανάπτυξης, οι προγράμματα ανάπτυξης, οι προγράμματα ανάπτυξης.
- Διανέμονται δωρεάν οι προγράμματα που είναι απαραίτητα για την ανάπτυξη του FreeBSD: οι προγράμματα ανάπτυξης, οι προγράμματα ανάπτυξης, οι προγράμματα ανάπτυξης.
- Διανέμονται δωρεάν οι προγράμματα που είναι απαραίτητα για την ανάπτυξη του FreeBSD: οι προγράμματα ανάπτυξης, οι προγράμματα ανάπτυξης, οι προγράμματα ανάπτυξης.

Η ανάπτυξη του FreeBSD είναι ένα συνεχές έργο. Η ανάπτυξη του FreeBSD είναι ένα συνεχές έργο. Η ανάπτυξη του FreeBSD είναι ένα συνεχές έργο.

ÊäöÛëáéí 6 Desktop ÄöáñííäÝò

ÓðíäéóöíñÛ òíò *Christophe Juniet*.

6.1 Óýííøç

Ôí FreeBSD íðíñáß íá äéðäéÝóáé íéá äöñáßá äéÛíá desktop äöáñííäÝò, ùðùð öðëëíäòñçðÝò (browsers) éáé äðáíñáááóðÝò éáéíÝíò. Íé ðáñéóóóòáñáð áðù áððÝò áβíáé äéáéÝóéíäð ùð ðáéÝóá (packages) P íðíñíý íá ääéáóáóðáéíýí áððóíäóá áðù òçí ÓðëëíäP òúí Ports. Ðíëëíß íÝíé ÷ ñPóðáð áíáíÝíòí íá áñíòí óÝóíéíò áβáíòð äöáñííäÝò óòí desktop òíòð. Ôí ÊäöÛëáéí áððóí éá óáð äáβíáé ðùð íá ääéáóáóðPóáðá ÷ ùñßð éúðí òéð ðéí äçííòééáßð desktop äöáñííäÝò, áβóá áðù ðáéÝóá áβóá áðù òç ÓðëëíäP òúí Ports.

ÓçíäéPóðá ùðé ùðáí ääéáéóóðÛðá ðñíñÛííäóá áðù òç ÓðëëíäP òúí Ports, áβíáðáé íäðáäéPððéóç áðù òíí ðçááβí éPáééá. Áððóí íðíñáß íá ÷ ñáéáóðáß ðíëý ÷ ñúíí, éáéPð áíáñðÛðáé áðù òí ðñúáñáííá òí íðíβí íäðáäéPððéóç äéáé òçí òðíëíäéóðééP éó ÷ ý òíò íç ÷ áíPíáðòð óáð. Áí òí ÷ ñííééú äéÛóóçíá òí íðíβí ÷ ñáéÛáðáé ç íäðáäéPððéóç áβíáé áðááíñáðóééÛ íäáÛéí, íðíñáßóá íá ääéáóáóðPóáðá óá ðáñéóóóòáñá ðñíñÛííäóá òçð ÓðëëíäPð òúí Ports áðù ðñíí-íäðáäéPððéóçíÝíá ðáéÝóá.

ÉáéPð òí FreeBSD äéáéÝóáé óðííáðóðçðá íá äéðäéÝóéíá ðñíñÛííäóá äéá Linux, ðíëëÝò äöáñííäÝò ðíò áíáððý ÷ èçéáí áñ ÷ ééÛ äéá òí Linux áβíáé äéáéÝóéíäð äéá òí desktop óáð. Óáð óðíéóóóíýíá éáñíÛ íá äéááÛóáðá òí ÊäöÛëáéí 10 ðñéí ääéáóáóðPóáðá íðíéááPðíòá áðù òéð äöáñííäÝò Linux. ÐíëëÛ áðù òá ports ðíò ÷ ñçóéííðíéíýí òç óðííáðóðçðá íá Linux Ý ÷ íòí ííúíäóá ðíò íáééíýí íá "linux-". Èðíçéáßóá òí ùðáí PÛ ÷ íáðá äéá éÛðíéí óðáéáéñéíÝíí port, äéá ðáñÛááéáíá íá òçí whereis(1). Óòí éáβíáíí ðíò áéíéíòéáß éáññáβóáé ùðé Ý ÷ áðá áíáñííðíéPóáé òçí óðííáðóðçðá íá äéðäéÝóéíá ðñíñÛííäóá Linux ðñéí ääéáóáóðPóáðá íðíéááPðíòá áðù òéð äöáñííäÝò òíò Linux.

Íé éáðçáññáð ðíò éáéýððííóáé áðù áððóí òí ÊäöÛëáéí áβíáé íé áíPð:

- ÖðëëíäòñçðÝò (ùðùð **Firefox, Opera, Konqueror**)
- ÄöáñííäÝò áñáðáβíò (ùðùð **KOffice, AbiWord, The GIMP, OpenOffice.org**)
- ÐñíñÛííäóá ðñíñáéPð áááñÛóúí (ùðùð **Acrobat Reader®, gv, Xpdf, GQview**)
- ×ñçíáðíééííééÝò äöáñííäÝò (ùðùð **GnuCash, Gnumeric, Abacus**)

Ðñéí äéááÛóáðá áððóí òí ÊäöÛëáéí éá ðñÝðáé:

- Íá íÝñáðá ðùð íá ääéáóáóðPóáðá ðñúðéáðí éíáéóíééú ðñβòíò éáðáóéáðáóðP (ÊäöÛëáéí 4).
- Íá íÝñáðá ðùð íá ääéáóáóðPóáðá ðñúðéáðí éíáéóíééú Linux (ÊäöÛëáéí 10).

Áéá ðççíòíòíñáð ó ÷ áðééÛ íá òçí ääéáóðPóáç ðíëòíáóééíý ðáñéáÛééíòíò äéááÛóáðá òí ÊäöÛëáéí 7. Áí è Ýéáðá íá ñðéíβóáðá éáé íá ÷ ñçóéííðíéPóáðá éÛðíéá òðçñáóβá çéáéðñíééíý óá ÷ ðáññáβíò ááβóá òí ÊäöÛëáéí 28.

6.2 ÖðëëíäòñçðÝò (Browsers)

Ôí FreeBSD ááí Ý ÷ áé ðñíñáéáðáóðçíÝíí éÛðíéí óðáéáéñéíÝíí öðëëíäòñçðP. Óòíí éáðÛéíáí [www](http://www.FreeBSD.org/ports/www.html) (<http://www.FreeBSD.org/ports/www.html>) òçð òðëëíäPð Ports íðíñáßóá íá áñáβóá áñéáðóíýð öðëëíäòñçðÝò, Ýóíéíòð äéá ääéáóðPóáç. Áí ááí Ý ÷ áðá ÷ ñúíí äéá íá íäðáäéPððéóçáðá ùðé ÷ ñáéÛáðáóá (βòùð ÷ ñáéáóðáßóá áñéáðP ðñá), ðíëëíß áðù áððóíýð áβíáé äéáéÝóéíé éáé ùð Ýóíéíá ðáéÝóá.

Όά **KDE** εάε **GNOME**, ùò ðεβñç ðáñέáΰεείρóa áñááóβáò, ðáñΎ ÷-íοί οίòò áεείγò οίòò òðεεñáòñçòΎò HTML. Άάβòá οί ΌìΠία 5.7 áεá ðáñέóóòòáñáò ðεçñίòññáò ó÷-áòέέΰ ìá òçí ááεáòΰóóáóç οίòò.

Άί áíáεáòΎñáòá áεá áεáòñáβò (áðu ΰðίòç εáóáíΰεùóçò ðññíí) òðεεñáòñçòΎò, ááβòá ðεò áεüείòεáò áóáñιιáΎò óòç òðεείñáΠ òñí Ports: www/dillo2, www/links, Π www/w3m.

Όί òìΠία áóòü εάέγððáε ðεò ðáñáέΰòü áóáñιιáΎò:

¼ññá ΆóáñιιáΠò	Άðáέòίγíáñέ ðññίé	Άáεáòΰóóáóç áðu Ports	ΆáóέέΎò ΆίáñòΠóáέò
Firefox	ìáóáβá	ááñέΰ	Gtk+ Όðΰñ ÷-íοί áεáεΎóεíáò áεáüóáέò áεá FreeBSD εάε Linux. Ç Ύέáίòç áεá Linux áíáñòΰóáé áðu òçí áóááέέΠ óòìááóüòçòá ìá Linux (Linux Binary Compatibility) εάε òí linux-openmotif .
Opera	εβáíé (áεáòñέΰ)	áεáòñέΰ	
Konqueror	ìáóáβá	ááñέΰ	Άέáεείεβέáò KDE

6.2.1 Firefox

Ί **Firefox** áβίáé Ύíáò ìίòΎññìò, áεáγέáññìò, áñé ÷-òüò εάε óðáεáññüò òðεεñáòñçòΠò, ï ïðñβìò áβίáé ðεβññüò ðññíóáñιιòίΎñìò áεá ÷-ñΠóç óοί FreeBSD. ΆέáεΎóáé ìç ÷-áíΠ áðáέεüíéóçò ç ïðñβá áíáñιιβáεáóáé ðεβññüò ìá ðεò òððίðίεΠóáέò òçò HTML, εάε áóíáóüòçòáò ùðüò áìòΰίέóç ðίεεáðεβί óáεβáñí óá tabs, ìðεíεΰñεóíá áíááòñíáñíí ðáñáéγññí (pops), ðññüóεáòá ðññáñΰñíáðá, ááεòεñíΎίç áóòΰεáéá εάε ðίεεΰ áεñìç. Ί **Firefox** ááóβááóáé óòñí áñ ÷-έέü ðçááβñ εβáέέá òίò **Mozilla**.

ΆáεáóáóòΠóóá òí ðáéΎòí áñΰñííóáò:

```
# pkg_add -r firefox
```

Ç ðáñáðΰñü áíòñεΠ éá ááεáóáóòΠóáé òñí **Firefox** 3.6. Άί εΎεáòá íá ááεáóáóòΠóáóá òñí **Firefox** 3.5, áñΰòá:

```
# pkg_add -r firefox35
```

Ίðñáβòá áðβçò ìá ÷-ñçóέíñðίεΠóáóá òçí ÓòεείñáΠ òñí Ports áí ðññíóέíΰðá íá ìáóááεüòòβóáòá áðu òñí ðçááβñ εβáέέá:

```
# cd /usr/ports/www/firefox
# make install clean
```

Άέá òñí **Firefox** 3.5, áíóέéáóáóòΠóóá óòçí ðáñáðΰñü áíòñεΠ òç εΎίç firefox ìá firefox35.

6.2.2 Ί Firefox εάé òí ðññüóεáòí (plugin) òçò Java™

Όçíáβùóç: Όá áóòü εάé òí áðuñíáñí òìΠία, εáññíγíá ùòé Ύ ÷-áòá Πäç ááεáóáóòΠóáé òñí **Firefox**.

Όç áááñíΎίç óóέáìΠ, òí ðññüóεáòí òçò Java™ ááí εáέòíòñááβ ìá òñí **Firefox** 3.6.

To FreeBSD Foundation áέέΎόάέ ΰάάέ άδϋ όçí Sun Microsystems áέά όçí áέάíñÏ áέòáέΎόείϋ FreeBSD ðñññÏñíáóϋò áέά όí ðññéáÏέέϋí ÁέòΎέάόçò όçò Java (Java Runtime Environment - JRE™) έέέϐò έέέ áέά όí ðññéáÏέέϋí άíÏðòóçò όçò Java (Java Development Kit - JDK™). Óά άíòβóóίέ÷ά έέòáέΎόείά ðáέΎόά áέά όí FreeBSD άβίάέ áέέέΎόείά óóçí όíðñέάóβά FreeBSD Foundation (<http://www.freebsdoundation.org/downloads/java.shtml>).

Όçíáβύóç: Άάí áέάòβέáíóáέ Ύóίείά ðáέΎόά áέά όí FreeBSD 8.x óóçí ðáñáòÏíϋ áέέòóáέϐ όíðñέάóβά. Ìðññáβòá ùóòϋóí íá ÷ñçóέííðñέáóáòá óá ðáέΎόά áέά FreeBSD 7.x óά Ύíá óýóóçíá 8.x. Άðέϐò áάέáòáóòϐóóá όí port `misc/compat7x` ðñέí όçí áάέáòÏóóáóç όíò ðáέΎόíò.

ΆíáέέáέòééÏ, Ìðññáβòá íá áάέáòáóòϐóóáòά όí **Diablo JRE** (έάέ όí **Diablo JDK**) ÷ñçóέííðñέáóáò όç Óòέέíāϐ όϋí Ports (óá ó÷áòééÏ ports άβίáέ óá `java/diablo-jre16` έάέ `java/diablo-jdk16`). Èϋáϋ ðññáέçíÏóϋí óóçí ðááέá ÷ñϐóçò όϋí óòáέáέñέíΎíϋí άñ÷áβϋ, έá ðñΎðáέ íá έáòááÏóáòá ÷άέñíέβíçòá óá άñ÷áβá ðçááβíò έϐáέέá (distfiles) ðññ áðáέóíϋíóáέ áέá όç íáòááέϐóóéóç. Έá ááβòá óòáέáέñέíΎíáò íäçáβáò áέά όí ðáñáòÏíϋ áβíá, ùóáí áϐóáòά όçí áíóíēϐ `make install` áέά íá áάέáòáóòϐóóáòά όí ó÷áòééÏ port.

Άέά íá ðññíòέΎóáòá ððñíóðñέίç Java óóñí **Firefox**, ðñΎðáέ ðñϐóá íá áάέáòáóòϐóóáòά όí port `java/javavmwrapper`. ðáέóá, έáòááÏóóá όí ðáέΎóí **Diablo JRE** άδϋ όçí όíðñέáóβά <http://www.freebsdoundation.org/downloads/java.shtml>, έάέ áάέáòáóòϐóóá όí Ìá όçí `pkg_add(1)`.

Îáέέíϐóóá όí óòéññáòñçòϐ óáò, áñÏðòá `about:plugins` óóç áñáñÏ áέáòέϋíóáϋí έάέ ðέΎóóá **Enter**. Έá ááβòá íέá óáέβáá ðññ áíáòΎñáðáέ óóá áάέáòáóòçíΎíá plugins, έάέ áέáβ έá ðñΎðáέ íá ááβòá έάέ όçí **Java**. Άí áòòϋ ááí óòñááβíáέ, έÏέá ÷ñϐóçò έá ðñΎðáέ íá áέòáέΎόáέ όçí áέϋέíòèç áíóíēϐ:

```
% ln -s /usr/local/diablo-jre1.6.0/plugin/i386/ns7/libjavaplugin_oji.so \
    $HOME/.mozilla/plugins
```

Άí Ύ÷áòá áάέáòáóòϐóóáέ όí ðáέΎóí **Diablo JDK**, έá ÷ñáέáóòáβ íá áέòáέΎóáòá:

```
% ln -s /usr/local/diablo-jdk1.6.0/jre/plugin/i386/ns7/libjavaplugin_oji.so \
    $HOME/.mozilla/plugins
```

Άðáíáέέέíϐóóá όí óòéññáòñçòϐ óáò áέá íá έó÷ýóíóí íέ áέέááΎò.

Όçíáβύóç: Óòέò ðáñáòÏíϋ áíóíēΎò έáϋññíá ùóé ÷ñçóέííðñέáβòá άñ÷έóáέòííέέϐ i386. Άέáòβέáíóáέ ùóòϋóí ðáέΎόά έάέ áέá όçí άñ÷έóáέòííέέϐ amd64.

6.2.3 Î Firefox έάέ όí Macromedia® Flash™ Plugin

Όí Macromedia® Flash™ plugin ááí áέáòβέáòáέ áέά όí FreeBSD. Ïóòϋóí, óðÏñ÷áέ Ύíá áðβðááí áññíβύóçò (software layer, wrapper) áέá όçí áέòΎέáóç ðññ áíòβóóίέ÷íò plugin ðññ Linux. To wrapper áòòϋ ððñíóçñβáέέ áðβóçò έάέ óá plugins áέá όñí Adobe® Acrobat®, όí RealPlayer έάέ Ïέέá.

ΆέòáέΎóóá óá ðáñáέÏóϋ áβíáóá, άíÏέíáá Ìá όçí Ύέáíóç ðññ FreeBSD ðññ ÷ñçóέííðñέáβòá:

1. Άέά όí FreeBSD 7.x

Άάέáòáóòϐóóá όí port `www/nspluginwrapper`. Όí port áòòϋ áðáέòáβ όí `emulators/linux_base-fc4` όí ðññíβí άβίáέ ÌááÏέí.

Ôï äðüüáñï áÞñï áßíáé ç ääëáóÛóðáóç ôïð port `www/linux-flashplugin9`. Êá ääëáóáóðáéáß ç Ýëäïóç Flash 9.x ç ïðñíá áñññßæïñïü üðë äïðëäýáé ðóððÛ óðï FreeBSD 7.x.

Óçñáßóóç: Óá äëäüóáéð ðïð FreeBSD ðáëáéüðáññð ððü ðçñ 7.1-RELEASE, èá ðñÝðáé íá ääëáóáóððóáðá ðï ðáëÝðï `www/linux-flashplugin7` èáé íá ðáñáëáßðáðá ðï áÞñï ó÷-áðëéÛ íá ðï `linprocfs(5)` ðïð óáßíáðáé ðáñáëÛðü.

2. Áëá ðï FreeBSD 8.x

Áäëáóáóððóáðá ðï port `www/nspluginwrapper`. Ôï port áððü äðáéðáß ðï `emulators/linux_base-f10` ðï ïðññï áßíáé íááÛëï.

Ôï äðüüáñï áÞñï áßíáé ç ääëáóÛóðáóç ôïð port `www/linux-f10-flashplugin10`. Êá ääëáóáóðáéáß ç Ýëäïóç Flash 10.x ç ïðñíá áñññßæïñïü üðë äïðëäýáé ðóððÛ óðï FreeBSD 8.x.

Áëá íá èáëóïðñáÞóáé ðóððÛ áððÞ ç Ýëäïóç, èá ðñáëáóðáß íá äçñëïðñáÞóáðá ðïð óðïäñëéëü óýíááóïð ðïð óáßíáðáé ðáñáëÛðü:

```
# ln -s /usr/local/lib/npapi/linux-f10-flashplugin/libflashplayer.so \
  /usr/local/lib/browser_plugins/
```

ÏáðÛ ðçñ ääëáóÛóðáóç ðïð ðóððïý (óýñïüñá íá ðçñ Ýëäïóç ðïð FreeBSD) Flash port, ï èÛèá ðñÞðóçð èá ðñÝðáé íá ïðññçñÞóáé ðçñ ðññïóðëéÞ ðïð ääëáóÛóðáóç ðïð plugin äëðáëÞíðáð ðçñ ðáñáëÛðü áñóñÞ ðïð `nspluginwrapper`:

```
% nspluginwrapper -v -a -i
```

Êá ðñÝðáé íá ðññïáñððóáðá ðï óýóðçñá áñ÷-áßñï äëáññáóéÞ ðïð Linux, `linprocfs(5)` óðï èáðÛëñï `/usr/compat/linux/proc`, áñ äðëèðñáßðá íá áñáðáñÛáðáðá Flash óéçñÝð (animations). Áððü ïðññáß íá áßíáé íá ðçñ áðñÝçç áñóñÞ:

```
# mount -t linprocfs linproc /usr/compat/linux/proc
```

Ç ðññïóÛñçóç ïðññáß áðßçðð íá áßíáðáé áððññáðá èáðÛ ðçñ äëëßççóç, ðññïëÝðññðáð ðçñ ðáñáëÛðü ãñáñÞ óðï `/etc/fstab`:

```
linproc          /usr/compat/linux/proc          linprocfs        rw          0          0
```

ÏáðÛ ðçñ ääëáóÛóðáóç ðïð plugin, ïáëéñÞðáð ðï ððëññáðñçðð óáð, ãñÛððá `about:plugins` óçç ãñáñÞ èáððëýñóáñí èáé ðëÝðáð **Enter**. Êá ðñÝðáé íá ááßðá ïéá èßðá íá üéá ðá ðñÝ÷ñðá äéáèÝóéñá plugins.

6.2.4 Ì Firefox èáé ðï Swfdec Flash Plugin

To Swfdec áßíáé ïéá èéáëéðèç èéá áðññüäëéðñçóç èáé áñáðáñááñáÞ óéçñÞñï Flash. Ôï Swfdec-Mozilla áßíáé Ýñá plugin èéá ðïðð ððëññáðñçððÝð **Firefox** ðï ïðññï ðñçóëññðñéáß áððÞ ðç èéáëéðèç èéá ðçñ áñáðáñááñáÞ áñ÷-áßñï SWF. Áßíáé áéññá óðï óðÛäëï ðçð áñÛðððçðð.

Áñ áññ ïðññáßðá Þ áññ èÝèáðá íá ðï ïáðáäëüððßðáðá, áðëÞð ääëáóáóððóáðá ðï ðáëÝðï áðü ðï áßëððï:

```
# pkg_add -r swfdec-plugin
```

Áñ ðï ðáëÝðï áññ áßíáé äéáèÝóéñï, ïðññáßðá íá ðï ïáðáäëüððßðáðá èáé íá ðï ääëáóáóððóáðá áðü ðç ÓðëëñáÞ ðññ Ports:

```
# cd /usr/ports/www/swfdec-plugin
# make install clean
```

ÌãòÛ òçí áãéáóÛóóáç, áðáíáéêéíÞóðá òí òëëñíáðñçðÞ óáð áéá íá áíáññáíðñçèáß òí plugin.

6.2.5 Opera

Ï **Opera** áβíáé Ýíáð òëëñíáðñçðÞ ìá ðëÞñáéð áðíáóóóçðáð éáé óóíááóóò ìá òá ðñúòððá. ñ÷-áðáé áðβóçð ìá áíóóíáóóòíÝí ðñúáññáíá áíÛáíúóçð òá÷-òáññáβíò (mail) éáé áéáÞóáíí (news), ðñúáññáíá áéá IRC, áíááíÞóç áéá RSS/Atom éáé ðñëÛ áéúíá. Ðáñ'íëá áóðÛ, ï **Opera** áβíáé íéá ó÷-áðééÛ áéáóñéÛ éáé ðñëý áñÞáíñç áöáññíãÞ. ñ÷-áðáé óá äýí òýðíòð: ìéá "áãááíð" Ýéäíóç áéá òí FreeBSD éáé ìéá Ýéäíóç ðíò áêðáéáβóáé ìÝóò òçð óóíááóóóçðáð ìá òí Linux.

Ãéá íá ÷ñçóéíðñéÞóðá òçí FreeBSD Ýéäíóç òíò **Opera**, áãéáóáóóÞóðá òí ðáéÝóí:

```
# pkg_add -r opera
```

ÏñéóíÝíáð òíðñéáòβáð FTP ááí áéáéÝóíóí ìëá òá ðáéÝóá, áééÛ ìðñáβðá íá Ý÷-áðá òí βáéí áðíòÝéáóíá ìÝóò òçð óóëëíáÞð òúí Ports, áñÛóííóáð:

```
# cd /usr/ports/www/opera
# make install clean
```

Ãéá íá áãéáóáóóÞóðá òçí Linux Ýéäíóç òíò **Opera**, áíðééáóáóóÞóðá ìá linux-opera òí opera óðá ðáñáðÛíú ðáñáááβáíáóá. Ç Ýéäíóç Linux áβíáé ÷ñÞóéíç óá éáóáóóðÛóáéð ðíò áðáéóíýí òç ÷ñÞóç plugins ðíò áβíáé áéáéÝóéíá ìúíí áéá Linux, ùðò òí **Adobe Acrobat Reader**. Óá êÛëá Ûëëç ðáñβððóóç, ìé áêäüóáéð Linux éáé FreeBSD áβíáé éáéóíòñáéÛ éóíáýíáð.

6.2.6 Konqueror

Ï **Konqueror** áβíáé êñíÛóé òíò **KDE** áééÛ ìðñáβ íá ÷ñçóéíðñéçèáß éáé Ýíú áðú òí **KDE** ìá òçí áãéáóÛóóáç òíò x11/kdebase3. Ï **Konqueror** áβíáé ðñëý ðáñéóóóóðáñí áðú Ýíáð áðëúð òëëñíáðñçðÞð, áβíáé áðβóçð áéá÷-áéñéóðÞð áñ÷-áβúí éáé ðñúáññáíá ðñíáñéÞð áñ÷-áβúí ðñëóíÝóóí.

Ï **Konqueror** áéáðβèáðáé áðβóçð ìá Ýíá óáð áðú plugins, óðí misc/konq-plugins.

Ï **Konqueror** òðíóðçñβáé áðβóçð **Flash** éáé ìé ó÷-áðééÝð ìäçáβáð (How To) áβíáé áéáéÝóéíáð óðí <http://freebsd.kde.org/howtos/konqueror-flash.php>.

6.3 ÁöáññíãÝò Áñáóáβíò

¼óí áóíñÛ ðéð áöáññíãÝò áñáóáβíò, ìé íÝíé ÷ñÞóðáð óð÷íÛ áíáæçóíýí ìéá éáéÞ óíòβðá áöáññíãÞí Þ Ýíá òééééú áðáíáñááóðÞ éáéíÝíò. Áí éáé êÛðíéá áñáóééÛ ðáñéáÛëëíóá ùðò òí **KDE** ðáñÝ÷-íóí òç áééÞ òíòð óíòβðá áöáññíãÞí áñáóáβíò, ááí òðÛñ÷-áé ùóóóí ðñíáðééááíÝíç áöáññíãÞ. Òí FreeBSD ðáñÝ÷-áé ùóé ÷ñáéÛáóóá, Ûó÷-áðá áðú òí ðáñéáÛëëí áñáóóβáð óáð.

Òí òíÞíá áððú éáéýððáé ðéð ðáñáéÛòú áöáññíãÝò:

¼íñíá Άόάνιιαΰò	Άόάέοιγíλáié Ðùñíé	Άάέαòΰóóáóç áðù Ports	Άάóέéΰò ΆíáñòÐóáέò
KOffice	εβáíé (άέάóñέΰ)	άáñέΰ	KDE
AbiWord	εβáíé (άέάóñέΰ)	άέάóñέΰ	Gtk+ Ð GNOME
The Gimp	εβáíé (άέάóñέΰ)	άáñέΰ	Gtk+
OpenOffice.org	ðíεéíβ (άáñέΰ)	άíάέñáóέέΰ άáñέΰ	JDK, Mozilla

6.3.1 KOffice

Ç εíεíúóçòά òò KDE άñðεβáεé òí άñάóέέú óçò ðáñέάΰεéíí íá íεά óíòβòά άóάνιιαΰί άñάóάβιò ðíò íðñάβ íá ÷ñçóέííðíεçεάβ εάέ Ύíù áðù òí **KDE**. Ðáñέέáíáΰíάέ óά òΎóóάñά άάóέέΰ ðñíáñΰíáóά ðíò íðñάβòά άðβóçò íá άñάβòά εάέ óά ΰεεάò óíòβòάð άñάóάβιò. Òí **KWord** άβίάέ í άðáíáñάάóóðò εάέíΎíò, òí **KSpread** άβίάέ òí ðñúάñáíá òðíεíáεóóέéðí öýεúí, òí **KPresenter** εάά÷άέñβáεάóάé òέò ðáñíòóέΰóáέò, άñ òí **Kontour** óάò άðέóñΎðáé íá άçíεíòñáÐóáòά Ύάάñάóά íá άñάóέέΰ.

Ðñéí άάέάóáóð�óáòά òí òάέάòóáβí **KOffice**, άάάάέúεάβòά úóé Ύ÷άòά áíáíáñíΎίç Ύέαíòç òíò **KDE**.

Άέά íá άάέάóáóð�óáòά òí **KOffice** ùò ðáέΎòí, άðóóά òçí áέúεíòεç άíóíεÐ:

```
# pkg_add -r koffice
```

Άί òí ðáέΎòí άáí άβίάέ εάέέΎóέíí, íðñάβòά íá ÷ñçóέííðíεç�óáòά òçí óóέéíáÐ òúí ports. Άέά ðáñΰάάέáíá, εάά íá άάέάóáóð�óáòά òí **KOffice** εάά òí **KDE3**, άñΰòά:

```
# cd /usr/ports/editors/koffice-kde3
# make install clean
```

6.3.2 AbiWord

Òí **AbiWord** άβίάέ Ύíá άεάýεáñí ðñúάñáíá άðáíáñάάóóβáð εάέíΎíò, ùíéíí óóçí άβóεçóç εάέ òçí άíòΰίέóç íá òí **Microsoft Word**. Άβίάέ εάòΰεεçéí εάά òçí ðεçέðñíεúάçóç ΰñεñúí, άñáííΰòúí, áíáóíñí, ððáíεòíβóáúí é.í.é. Άβίάέ ðíεý άñÐáíí, Ύ÷άέ άñεάòΎò áοíάóúóçòάð εάέ άβίάέ εάέάβòάñά óέέέέú óòí ÷ñÐóç.

Òí **AbiWord** íðñάβ íá áέóΰάáé Ð íá άíΰάáé άñ÷άβá áέΰóíñúí íñòðí, ðáñέέáíáááñΎíúí εάέ εΰðíεúí έεάέóóðí úðùð òí .doc òçò Microsoft.

Òí **AbiWord** άβίάέ εάέέΎóέíí ùò ðáέΎòí. Íðñάβòά íá òí άάέάóáóð�óáòά άñΰíòάò:

```
# pkg_add -r abiword
```

Άί òí ðáέΎòí άáí άβίάέ εάέέΎóέíí εάά εΰðíéíí εúáí, íðñάβòά íá òí íáòάάεúòðòβóáòά áðù òçí ÓóέéíáÐ òúí Ports. Óά áóðÐ òçí ðáñβðòúóç ðέέáíðò íá άάέάóáóð�óáòά íáðóáñç Ύέαíòç óά ó÷Ύóç íá òí Ύòíéíí ðáέΎòí. Íðñάβòά íá òí εΰíáòά ùò άíÐò:

```
# cd /usr/ports/editors/abiword
# make install clean
```

6.3.3 Ôí GIMP

Ôí **The GIMP** áβíáé Ýíá éáéáβðáñá áñáέέñÝíí ðñüññáñíá áéá÷áβñέóçð ãñáóέέπí áéá áçìéíññáβá áέέüíúí Ò áðáññáñááóβá òüðíññáóέέπí. Ìðññáβ íá ÷ñçóέííðñéçéáβ ùð áðéü ðñüññáñíá æüññáóέέπð Ò óáí óíòβðá áðáññáñááóβáð éáé áέüññéùóçð òüðíññáóέέπí. ÐáñéÝ ÷ áé íááÛέí áñέéíü áðü plugins áñβ áéáéÝðáé éáé scripting interface. Ôí **The GIMP** ìðññáβ íá áéááÛóáé éáé íá ãñÛðáé ìááÛέí òÛóíá áñ÷áβñíí áέέüíúí. ÐáñééáíáÛíáé áðβóçð áéáðáóÝð áéáóýíááóçð ìá óáññòÝð éáé tablets.

Ìðññáβðá íá ááéáðáóððóáðá òí ðáéÝðí áβñííóáð òçí áíóíεð:

```
# pkg_add -r gimp
```

Áí ç òíðñéáóβá FTP ðíð ÷ñçóέííðñéçéáβðá ááí áéáéÝðáé áðüü òí ðáéÝðí, ìðññáβðá íá ÷ñçóέííðñéçéáβðáð òçí Óðééíáβ òüí Ports. Ì éáðÛέíñíð graphics (<http://www.FreeBSD.org/ports/graphics.html>) òçð Óðééíáβð òüí Ports ðáñéÝ ÷ áé áðβóçð éáé òí **The Gimp Manual (áã÷áέññáέí ÷ñβóçð)**. Ááβðá ðáñáéÛòü ðüð íá òí ááéáðáóððóáðá:

```
# cd /usr/ports/graphics/gimp
# make install clean
# cd /usr/ports/graphics/gimp-manual-pdf
# make install clean
```

Óçíáβùóç: Ì éáðÛέíñíð graphics (<http://www.FreeBSD.org/ports/graphics.html>) òçð óðééíáβð òüí Ports Ý÷áé áðβóçð òçí ððü áíÝééíç Ýéäíóç òçð áðáññíñáβð **The GIMP** óðí graphics/gimp-devel. Ìðññáβðá íá áññáβðá òçí HTML Ýéäíóç òíð áã÷áέññéáβñíð, **The Gimp Manual** óðí graphics/gimp-manual-html.

6.3.4 OpenOffice.org

Ôí **OpenOffice.org** ðáñéÝ ÷ áé üéáð óéð áðáññáβóçðáð áðáññüãÝð óá ìéá ðéβñç óíòβðá áðáññíñáβí ãñáóáβñíð: áðáññáñááóðð éáéíÝííð, ððñéíáéóðóέέüí óýééí, áéá÷áέññέóðð ðáñííóóéÛóáñí éáé ðñüññáñíá ó÷ááβáóçð. Ôí ðáñéáÛέéíí ãññááóβáð òíð áβíáé ðñéý üññéí ìá Ûééáð óíòβðáð ãññáóáβñíð, éáé ìðññáβ íá ÷ñçóέííðñéçéáβð áéÛóíñíðð áçñíñééáβð òýðñíðð áñ÷áβñíí. Áβíáé áéáéÝðéíí óá ðñééÝð áéáóññáóέéÝð áεβðóáð, òüíü ùð ðñíð òí ðáñéáÛέéíí ãññááóβáð ùóí éáé ùð ðñíð óá éáíééÛ éáé òíí ìñéíñáóέέüí Ýéáã÷í.

Ì áðáññáñááóððð éáéíÝííð òíð **OpenOffice.org** ÷ñçóέííðñéçéáβ ãáááñβð ìññòβ áñ÷áβñíð XML áéá áðíçíÝíç òíñçòüüðçðá éáé áðáééíβá. Ôí ðñüññáñíá ððñéíáéóðóέέüíí óýééüí áéáéÝðáé áεβðóá ìáéññáíóíεπí éáé ìðññáβ íá áéáóóíñáéáβ ìá áññáññééÝð áÛóáéð áááñÝíúí. Ôí **OpenOffice.org** áβíáé óðáéáñβ ãðáññíñáβ éáé áéðáéáβðáé ááááñβð óðá Windows, òí Solaris™, òí Linux, òí FreeBSD, éáεβð éáé óíí Mac OS X. Ðáñέóóüðáññáð ðéçññíññáð áéá òí **OpenOffice.org** ìðññáβðá íá áññáβðá óóç áééððáέβ ðíðñéáóβá òíð OpenOffice.org (<http://www.openoffice.org/>). Áéá ðéçññíññáð ó÷áðóέéÛ ìá òçí Ýéäíóç áéá FreeBSD, éáεβð éáé áéá áðáðéáβáð éáóÝááóíá ðáéÝðüí, ÷ñçóέííðñéçéáβð òçí áééððáέβ òíðñéáóβá FreeBSD OpenOffice.org Porting Team (<http://porting.openoffice.org/freebsd/>).

Áéá íá ááéáðáóððóáðá òí **OpenOffice.org**, ãñÛðá:

```
# pkg_add -r openoffice.org
```

Óçíáβùóç: Áí ÷ñçóέííðñéçéáβðá -RELEASE Ýéäíóç òíð FreeBSD, òí ðáñáðÛíú ðñÝðáé íá áññéÝðáé. ÁéáóññáðóέéÛ, éá ðñÝðáé íá ááβðá òçí áééððáέβ ðíðñéáóβá òíð FreeBSD **OpenOffice.org** Porting Team áéá íá éáðááÛóáðá éáé íá ááéáðáóððóáðá òí áíðβóðíé÷í ðáéÝðí ÷ñçóέííðñéçéáβð òçí pkg_add(1). Ôüí ç ðñÝ÷íðóá ùóí éáé ç òðü áíÝééíç Ýéäíóç áβíáé áéáéÝðéíñáð áéá éáðÝááóíá áðü òçí ðáñáðÛíú ðíðñéáóβá.

Αδϋ ός όέαιΠ δϋ όϋ δάέΨόϋ άάέάόάόόάέάβ, δñΨάέ ίά άñΨόάόά άδερδ όςϋ δάñάέΨόδϋ άίόϋεΠ áέά ίά áέόάέΨόάόά όϋ **OpenOffice.org**:

```
% openoffice.org
```

Όςϋάβϋός: ΕάόΨ όςϋ δñρδς άέεβίςόςς, έά όάδ άβίϋόϋ άέΨόϋñάδ άñϋδρδάέδ έάέ έά άςϋέϋδñάςέάβ Ψίάδ έάδΨέϋάϋδ ίά ϋññά .openoffice.org ίΨόά όδϋ δñϋόδθέέϋ όάδ έάδΨέϋάϋ.

Αί όά δάέΨόά δϋ **OpenOffice.org** άάί άβίάέ áέάέΨόέίά, Ψ÷άδδ δΨίόά όςϋ άδέέϋΠ ίά ίάόάέϋδδδβόάδδ όϋ άίόβόόϋέ÷ϋ port. Ψόδϋόϋ, ίά Ψ÷άδδ δδϋός όάδ ϋδέ άδδϋ άδάέδάβ άñέάδϋ ÷ρñϋ όόϋ άβόέϋ έάέ έά ÷ñάέάδδάβ έάέ δΨñά δϋέϋ ÷ñϋñ áέά ίά ϋέϋέςñϋέάβ.

```
# cd /usr/ports/editors/openoffice.org-3
# make install clean
```

Όςϋάβϋός: Αί έΨέάδδ ίά άςϋέϋδñάρδάδδ ίέά Ψέάϋός ίά δέδ άέέΨό όάδ όϋδέέΨό ñθέϋβόάέδ, άίδέέάδδδδρδάδδ όςϋ δñϋάϋϋάϋς άñάϋΠ άίδϋεϋ ίά όςϋ άδϋϋάϋς:

```
# make LOCALIZED_LANG=your_language install clean
```

δñΨάέ ίά άίδέέάδδδδρδάδδ όϋ *your_language* ίά όϋ όούδϋ ISO έϋάέέϋ áέά ός άεϋρδά όάδ. ϸ έβδδά ίά δϋδδ δδϋόδςñέæϋίάϋϋδ έϋάέέϋγδ áεϋόόϋ άβίάέ áέάέΨόέϋς όδϋ άñ÷άβϋ files/Makefile.localized, όϋ ϋδϋβϋ άñβόέάδδάέ όδϋ έάδΨέϋάϋ όϋ port.

Ίϋέέδ άβίάέ άδδϋ, ίδññάβδδ ίά ίάέέϋρδάδδ όςϋ άόάñϋϋΠ **OpenOffice.org** άβϋϋόάδ όςϋ άίδϋεΠ:

```
% openoffice.org
```

6.4 δññáñΨϋάόά δññáϋεΠδ ΆάñΨόϋϋ

δñϋόόάδ Ψ÷ϋόί άβίάέ άñέάδΨ άςϋϋέέάβδ έΨδϋέάδ ίΨάδ ϋñδΨδ άñ÷άβϋ. Όά δññáñΨϋάόά δññáϋεΠδ δϋδ άδάέδϋγϋόάέ áέά όά άñ÷άβϋ άδδΨ βόδδ ίά ίςϋ άβίάέ áέάέΨόέίά όδϋ άάόέέϋ όγόδςϋά. Όδϋ δϋβϋά άδδϋ έά άϋγϋά δϋδ ίδññάβδδ ίά όά άάέάδδδδρδάδδ.

Όϋ δϋβϋά άδδϋ έάέϋδδάέ δέδ άόάñϋϋΨδ:

¼ññά ΆόάñϋϋΠδ	Άάέέδϋγϋάϋέ δϋñϋέ	ΆάέάδΨόάός άδϋ Ports	ΆάόέέΨδ Άίάñδρδάέδ
Acrobat Reader	έβάϋέ (άέάόñέΨ)	άέάόñέΨ	ΆδάάέέΠ όδϋάάδδϋδςδδά ίά Linux (Linux Binary Compatibility)
gv	έβάϋέ (άέάόñέΨ)	άέάόñέΨ	Xaw3d
Xpdf	έβάϋέ (άέάόñέΨ)	άέάόñέΨ	FreeType

¼íñá Άόάνηϊάò	Άόάέοιγìáñé ðññé	Άέάοΰόόάοç áðu Ports	Άάόέέΰò Άíáñòòóáέò
GQview	εβãíé (áέάοñέΰ)	áέάοñέΰ	Gtk+ P GNOME

6.4.1 Acrobat Reader®

ðññέΰ Ýáññáόά áέáíÝñíόάέ ðéÝñí ùò áñ ÷ áβá PDF οì ðññéç òçíáβíáέ “Portable Document Format” (Όñçòò ð ðññòò Άáñΰοìο). ðá áðu óá óóéόòòíáíá ðññáñΰñáόά ðññáñέòò áέá áóòù οñí óýðñí áñ ÷ áβùí áβíáέ οì **Acrobat Reader**, οì ðññéç Adobe áέάέΰόάέ áέá Linux. Έάέòò οì FreeBSD ðññáβ ðá ÷ ðçóέñíðñéòóáέ áέόάέΰόέíá οìò Linux, ç áóáññáò áβíáέ áðòòçò áέάέΰόέç áέá οì FreeBSD.

Άέá ðá ááέάόάόòòóáόά οì **Acrobat Reader 8** áðu οç Όðéññáò οñí Ports, áñΰòðá:

```
# cd /usr/ports/print/acroread8
# make install clean
```

Άáí ððΰñ ÷ áέ áέάέΰόέñ ðáέΰοì, εüãù ðáñέñέóìòòò òóçí ΰááέá ÷ ðòòçò.

6.4.2 gv

Ό ðññéç áβíáέ Ýíá ðññáññáíá ðññáñέòò ááñΰòòù ðáέ áñ ÷ áβá PostScript éáέ PDF. Άβíáέ áñ ÷ έέΰ ááόέóìÝñí óóçí áóáññáòò **ghostview** áέέΰ Ý ÷ áέ éáέýóáñç áìòΰéόç ÷ ΰñç óóç áέáέέñèòòç **Xaw3d**. Άβíáέ áñ ðáññí, éáέ οì interface οìò áβíáέ ðáέΰεáññí. Ό ðññéç Ý ÷ áέ ðññéç áóñáóòòóóáò, ùðò ðññóáíáóñéέóìù éáέ ðáέéò ÷ áñóέíý, áìòΰéόç ðòù έέβíáέá éáέ ááέòòòç áìòΰéόçò áññáíáóñéñòòò (antialias). Ό ÷ ááññí éΰεá éáέóòòòñáβá οìò ðññáβ ðá áέόάέáóóáβ οñí áðu οì ðéçέòòñéññáέí ùóí éáέ áðu οì ðññéç.

Άέá ðá ááέάόάόòòóáόά οì **gv** ùò ðáέΰοì, áñΰòðá:

```
# pkg_add -r gv
```

Άí οì ðáέΰοì ááí áβíáέ áέάέΰόέñ, ðññáβòá ðá ÷ ðçóέñíðñéòóáόά óçí Όðéññáò οñí Ports:

```
# cd /usr/ports/print/gv
# make install clean
```

6.4.3 Xpdf

Άí éΰéáóá Ýíá ðéññù ðññáññáíá ðññáñέòò áñ ÷ áβùí PDF áέá οì FreeBSD, οì **Xpdf** áβíáέ áέáóñý éáέ áðñáñéέéñ. Άðáέóáβ áέΰ ÷ έóòòòò ðññòò éáέ áβíáέ éáέáòáñá óóáέáññí. × ðçóέñíðñéáβ óέò ááόέέΰò áññáíáóñéñΰò οñí X éáέ ááí áðáέóáβ ÷ ðòòç οìò **Motif** P ΰέέçò áññáέáέñèòòç οñí ×.

Άέá ðá ááέάόάόòòóáόά οì **Xpdf** ùò ðáέΰοì, áòóá óçí áñòñéò:

```
# pkg_add -r xpdf
```

Άí οì ðáέΰοì ááí áβíáέ áέάέΰόέñ P ðññéçΰòá ðá ÷ ðçóέñíðñéòóáόά óçí Όðéññáò οñí Ports, áñΰòðá:

```
# cd /usr/ports/graphics/xpdf
# make install clean
```

Ïüëëð ðíëëçñüðëáß ç ääëáðÛóðáóç, ìðññáßðá íá ðáëéíðóáðá òí **Xpdf** éáé íá ÷ ñçóéíðíëðóáðá òí äáíß ðëðëðñí òíð ðñíóéëéíý áéá íá áñññáññíëðóáðá òí ðáñý.

6.4.4 GQview

Ïí **GQview** áßíáé Ýíáð áéá ÷ áéñéóððð áééüñí. Ìðññáßðá íá äáßðá Ýíá áñ ÷ áßí ðá Ýíá áðëü éëéé, íá ðáëéíðóáðá Ýíá áñüðáñéü ðñññáññíá áðáññááóßáð, íá äáßðá ðñññáðéóéüðçóç óá ðññð thumbnail éáé ðñëÛ Ûëëá. Áéáé Ýðáé áðßóçð ðñññáññð ðáññóóßáóçð éáé éÛðñíéáð ááóééÝð éáéðíðñáßáð áñ ÷ áßñí. Ìðññáßðá íá áéá ÷ áéñéóðáßðá óðëëñÝð áééüñí éáé íá áñáßðá ðá áýëñí ðññð òéð áéðëÝð. Ïí **GQview** ðñññáß íá ÷ ñçóéíðíëðéçáß áéá ðñññáññð óá ðëðñ çëñíç éáé ððñóçññáé ðññééÝð / áéáéñáßð ðñññóáéð.

Áí éÝëáðá íá ääëáðáðððóáðá òí **GQview** ùð ðáéÝðí, áñÛððá:

```
# pkg_add -r gqview
```

Áí òí ðáéÝðí äáí áßíáé áéáéÝóéñ, ð ðññðéíÛðá íá ÷ ñçóéíðíëðóáðá òçí Óðëëñáð ðññ Ports, áñÛððá:

```
# cd /usr/ports/graphics/gqview
# make install clean
```

6.5 × ñçñáðñíëéññééÝð ÁöáññiãÝð

Áí, áéá ðññáððñíðá éüñ, éÝëáðá íá áéá ÷ áéññáéóðá ðá ÷ ñçñáðñíëéññééÛ óáð ðÝóù ðññ FreeBSD desktop óáð, ððÛñ ÷ ðññ éÛðñíéáð éó ÷ ðñÝð éáé áýëñéáð óóç ÷ ñðçç áóáññiãÝð, Ýðñíéáð ðññð ääëáðÛóðáóç. Ìñéóí Ýíáð áðñ áóðÝð áßíáé óðñááðÝð ðá áéáááññí Ýíáð ðññÝð áñ ÷ áßñí, ùððð áóðÝð ðññ ÷ ñçóéíðíëéññééÝð óáá Ýáññáóá ðññ **Quicken**® ð òíð **Excel**.

Ïí ðññá áóðñ éáéýððáé ðéð áöáññiãÝð:

¼ññá Áöáññiãðð	Áðáéðñíáññé ðñññé	ÁäëáðÛóðáóç Áðñ Ports	ÁáóééÝð Áññððóáéð
GnuCash	éßáñé (áéáðñéÛ)	ááñéÛ	GNOME
Gnumeric	éßáñé (áéáðñéÛ)	ááñéÛ	GNOME
Abacus	éßáñé (áéáðñéÛ)	áéáðñéÛ	Tcl/Tk
KMyMoney	éßáñé (áéáðñéÛ)	ááñéÛ	KDE

6.5.1 GnuCash

Ïí **GnuCash** áßíáé ðñññð òçð ðññððÛëáéáð ðññ **GNOME** íá ðáñÝ ÷ áé óééééÝð áóáññiãÝð óðñðð ðáéééñýð ÷ ñðóáðð. Ìá òí **GnuCash**, ðñññáßðá íá éñáðÛðá éñáñéáóññ ðññ áóññññ éáé áñññññ óáð, ðññ ðññáðáéééðñ óáð éñáñéáóññ éáé ðññ ðáðñ ÷ ðññ óáð. ÁéáéÝðáé ðáñéáÛëëññ áññáóßáð òí ðñññáß áßíáé áýëñí óóç ÷ ñðçç ÷ ðñññð íá ÷ ñáéÛáóáé éáéáßðáñç áéñÛëçóç, áééÛ áßíáé óáððñ ÷ ñññá éáé ðññý áðáááññéáðééü.

Ïí **GnuCash** ðáñÝ ÷ áé Ýíððñ óýóðçñá éáðá ÷ ðññçóçð, éáñáñ ÷ ééü óýóðçñá éñáñéáóññ, ðññéÛ ðëðëðñá óóñðññáýóáññ ðéçðñññíáßñ, éáèð éáé ðáéññðð áððññáðçð óðñðëðññóçð. Ìðññáß íá áéá ÷ ðñññóáé ðáá óðñáééááð óá ðññéÛ éáððññáññ ðñññáðá. Ïí **GnuCash** ðñññáß íá áéóÛááé éáé íá óðá ÷ ðññáýóáé áñ ÷ áßá **QIF** òíð **Quicken**. Ìðññáß áðßóçð íá ÷ áéñéóðáß ðéð ðáñéóóñðáññáð áéáéñáßð ðñññÝð çñáññçñéðñ éáé ðññéóñáééðñ ðññÛáññí.

Άέα ίά άάέαόάόόΠόάόά όι **GnuCash** όοι όύόόçía óáo, άñΰόά:

```
# pkg_add -r gnucash
```

Άί όι όάέΨόι άάί άβίαέ έέαέΨόει, ίδιñάβόά ίά ÷ñçόειñδιέΠόάόά όçí óöειñΰ όùí ports:

```
# cd /usr/ports/finance/gnucash
# make install clean
```

6.5.2 Gnumeric

Όι **Gnumeric** άβίαέ Ψία όδιεñέόόέει όύεει έέα άδιόάέάβ ίΨñò όιò ðñέάΰεειñόιò άñάάόβáo **GNOME**. ΆέαέΨόάέ άιέέΠ άόόιιáόç “ðññáέåç” όçò έέόúάιò όιò ÷ñΠόç όγñòúía ίá όç ίñòΠ όιò έάέειΨ έέέΠ έέα όύόόçía άόόιιáόçò óóιðέΠñòόçò (autofill) έέα έέΰοñάò έέειñòέβáo. Ιδιñάβ ίά έέόΰάέ άñ ÷άβ έέΰοñúí άçñέέέΠ ίñòΠί, úðùò άόóΰ όιò ÷ñçόειñδιέΨίόάέ όοι **Excel**, όι **Lotus 1-2-3**, Π όι **Quattro Pro**. Όι **Gnumeric** όδιόόçñβέέέ άñάόΠίáόά ίΨóú όιò ðñññΰñáόιò άñάόέέΠí math/guppi. ÷έ ίάΰΰει άñέέιú áíóúíáόúñΨñí óóíññόΠόáúí έέα άðέόñΨόάέ úέáò όέó óóíΠέάέò ίñòΨò έάέέΠί, úðùò άñέέιΨò, ñέóíáόέέΨò ίñΰááò, çñññçíβáo, Πñáò έέα ðreeΨò έέúá.

Άέα ίά άάέαόάόόΠόάόά όι **Gnumeric** úò όάέΨόι, άñΰόά:

```
# pkg_add -r gnumeric
```

Άί όι όάέΨόι άάί άβίαέ έέαέΨόει, ίδιñάβόά ίά ÷ñçόειñδιέΠόάόά όçí óöειñΰ όùí ports, άñΰοñíáó:

```
# cd /usr/ports/math/gnumeric
# make install clean
```

6.5.3 Abacus

Όι **Abacus** άβίαέ Ψία ίέέñú έέα άΨέειñ óόç ÷ñΠόç όδιεñέόόέει όύεει. ÐñέέáñΰΨίάέ ðreeΨò áíóúíáόúñΨíáò óóíññόΠόáέò íé ίðiβáo άβίαέ ÷ñΠόέíáò óá έέΰοññά ðáάβá, úðùò ç óóáόέóóέέΠ, óá ÷ñçíáόñíέέñíέέΰ έέα óá ίáέçíáόέέΰ. Ιδιñάβ ίά έέόΰάέ έέα ίά áñΰάέ άñ ÷άβ όιò **Excel**. Όι **Abacus** ίδιñάβ ίά ðññΰάέ Ψññí ίñòΠó PostScript.

Άέα ίά άάέαόάόόΠόάόά όι **Abacus** úò όάέΨόι, άñΰόά:

```
# pkg_add -r abacus
```

Άί όι όάέΨόι άάί άβίαέ έέαέΨόει, ίδιñάβόά ίά ÷ñçόειñδιέΠόάόά όçí óöειñΰ όùí ports, άñΰοñíáó:

```
# cd /usr/ports/deskutils/abacus
# make install clean
```

6.5.4 KMyMoney

Όι **KMyMoney** άβίαέ ίέα άόάνιñΰ έέα ÷άβñέόçò όùí ðññóúðέέΠί óáo íέέññíέέΠί, óóέάñΨίç έέα όι ðññέáΰεειñ **KDE**. Το **KMyMoney** όοι ÷ΨΨάέ ίά ðññΨ ÷έ έέα ίά áíóúíáόΠόáέ úέáò όέó έέαόιòññάò ðññ έέαόβέáíόάέ óá áíóβóóíé ÷áò áññíέέΨò άόάνιñΰό. Όι **KMyMoney** ίδιñάβ ίά έέόΰάέ άñ ÷άβ όιò ðññóΨόíò QIF (Quicken Interchange Format),

ία òçñáß éáóáãñáòP òùí áðáñäýóáùí óáò, íá ÷ áέñßæáòáé ðñέεáðēΰò ñέóíáóέéΰò ññΰááò éáé íá ðáñΰ ÷ áé ðēPèìò áíáòññí. ΊΎóá áðù íá ÷ ùñέóòù plugin, ðáñΰ ÷ áòáé áðßòçò ç äðíáòüòðçòá áέóáãñáòP ðñ ÷ áßùí OFX.

Άέá íá áãéáòáóòPóáòá òí **KMyMoney** ùò ðáéΎòí, áέòáéΎóòá òçí áíóíēP:

```
# pkg_add -r kmymoney2
```

Áí òí ðáéΎòí ááí áβíáé áέáéΎóέí, ñðñáßòá íá ÷ ñçòέíðñέPóáòá òçí ÓòέεíP òùí Ports, ùòòò óáβíáòáé ðáñáéΰòù:

```
# cd /usr/ports/finance/kmymoney2
# make install clean
```

6.6 Ðáñßέçøç

Áí éáé òí FreeBSD áβíáé äçññóέéΰò óòñòò ðáññ ÷ áßò Internet (ISPs) áέá òçí áðñüíòç éáé òç óòáéãññòçòá òñò, áβíáé áðßòçò Ύòíέíí éáé áέá éáέçíáñέíP ÷ ñPòç ùò desktop. Ìá áñέáòΰò ÷ έέéΰááò áòáññíáΰò áέáéΎóέíáò ùò ðáéΎóá (<http://www.FreeBSD.org/where.html>) P ports (<http://www.FreeBSD.org/ports/index.html>), ñðñáßòá íá äçñέíòñáPóáòá òí òΎέáέí desktop ðñò éáέýðòáé ùέáò ðέò áíΰáέáò óáò.

Ðáñáéΰòù, óáβíáòáé íέá ññPáññç ðáñßέçøç ùέùí òùí desktop áòáñññáñí ðñò ðáñññóέΰòóçέáí óá áòòù òí έáòΰεάέí:

¼íñíá ΆόáññíáPò	¼íñíá ÐáéΎòíò	¼íñíá Port
Opera	opera	www/opera
Firefox	firefox	www/firefox
KOffice	koffice-kde3	editors/koffice-kde3
AbiWord	abiword	editors/abiword
The GIMP	gimp	graphics/gimp
OpenOffice.org	openoffice	editors/openoffice.org-3
Acrobat Reader	acroread	print/acroread8
gv	gv	print/gv
Xpdf	xpdf	graphics/xpdf
GQview	gqview	graphics/gqview
GnuCash	gnucash	finance/gnucash
Gnumeric	gnumeric	math/gnumeric
Abacus	abacus	deskutils/abacus
KMyMoney	kmymoney2	finance/kmymoney2

ΕὰοÛεάεί 7 ðïëõìÝóá

Àðáìñááóβá áðu òïí Ross Lippert.

7.1 Óýíïç

Ôï FreeBSD ððïóçñβæáέ ìááÛέç ðïéέέβá áðu εÛñóáð Þ÷ïò, áðέóñÝðïíóáð óáð Ýóóέ ìá áðïεáýóáðá ðççèÞð ðέóóóðçóáð Þ÷ï ìá ðïí ððïεïεέóðÞ óáð. ÐáñέέáìáÛïíáóáέ ç áðïíáðóççóá ìá áááñÛøáðá έάέ ìá áíáðáñÛááðá Þ÷ï MPEG Audio Layer 3 (MP3), WAV, έάέ Ogg Vorbis έάέðð έάέ ðïééÛ Ûέέá formats. Ôï FreeBSD Ports Collection áðβóçð ðáñέÝ÷áέ áóáñïíáÝð ðïò óáð áðέóñÝðïíóá ìá áðáíáñááóðáβðá ðïí ç÷ïíáñáóçìÝíï óáð Þ÷ï, ìá ðñïéέÝóáðá ç÷çóέέÛ áóÝ, έάέ ìá áέÝáíáðá óóóέáðÝð MIDI.

Ìá εβáï ðáέñáíáðέóóïï, ðï FreeBSD ìðïíáβ ìá ððïóçñβïáέ áíáðáñááùáÞ áñ÷áβùí video έάέ DVD. Ì áñέέìùð ðùí áóáñïíáÞ ðïò εùáέέïðïεéýí, ìáóáóñÝðïí, έάέ áíáðáñÛáïíóá áέÛïíïíòð ðýðïòð video áβïáέ ðéí ðáñέñέóïÝíòð áðu ðïí áñέέìùð ðùí áóáñïíáÞ Þ÷ïò. Áέá ðáñÛááέáìá, ùðáí áñÛøççá áóóù ðï έáβïáñ, ááí ððÞñ÷á έáìέÛ έάέÞ áóáñïíáÞ áðáíáέùáέέïðïβççð ðóç ððéεïáÞ ðùí Ports ðïò FreeBSD, ðïò έá ìðïíýóá ìá ÷ñçóéïïðïεççáβ áέá ìáóáðñïðÞ ìáóáíý formats, ùðòð ðï audio/sox. Ðáñ' ùέá áóðÛ, ðï ðïðβï óá áóðù ðïí ðñÝá, έάέ ùóï áóïíÛ ðï εïáέóïéέù, áέέÛáέέ ñááááβá.

Ôï έáóÛεάεί áóóù έá ðáñέáñÛøáέ óá áðáñáβççóá áÞïáðá áέá ðç ñýέìέç ðçð εÛñóáð Þ÷ïò óáð. Ç ñýέìέç έάέ ááέáóÛóóáç ðïò X11 (ΈáóÛεάεί 5) Ý÷áέ Þαç ðñïíóβóáέ áέá óá ðέέáíÛ ðñïáεÞïáðá ðéέέéý ðçð εÛñóáð áñáέέéÞ óáð, áí έάέ ìðïíáβ ìá ÷ñáέÛááóáέ ìá áóáñïíóáðá εÛðïéáð áέùìá ìέñïí-ñðéìβóáέð áέá έáέýðáñç áíáðáñááùáÞ.

Áóïý áέááÛóáðá áóóù ðï έáóÛεάεί, έá ìÝñáðá:

- Ðùð ìá ñðéìβóáðá ðï óýóðçíá óáð þóðá ìá áíááíññβæáðáέ ç εÛñóá Þ÷ïò óáð.
- Ìáεïáðð áέá ìá áέÝáíáðá ðç έáέóïòñáβá ðçð εÛñóáð óáð.
- Ðùð ìá áðέéýóáðá ðñïáεÞïáðá ó÷áðέέÛ ìá ðέð ñðéìβóáέð Þ÷ïò.
- Ðùð ìá áíáðáñÛááðá έάέ ìá εùáέέïðïεéÞóáðá MP3 έάέ Ûέεïòð ðýðïòð áñ÷áβùí Þ÷ïò.
- Ðùð ððïóçñβæáðáέ ðï video áðu ðïí X server.
- ÈÛðïéá ports áíáðáñááùáÞðð/εùáέέïðïβççðð video ðïò áβñïí έάέÛ áðïáέÝóïáðá.
- Ðùð ìá áíáðáñÛááðá DVD, έάέ áñ÷áβá .mpg έάέ .avi.
- Ðùð ìá εÛíáðá rip ðï ðáñέá÷ùìáñí CD έάέ DVD óá áñ÷áβá.
- Ðùð ìá ñðéìβóáðá ìέá εÛñóá ðççáùñáóçð.
- Ðùð ìá ñðéìβóáðá Ýíá óáñùðÞ áέέéùí.

Ðñéí áέááÛóáðá áóóù ðï έáóÛεάεί, έá ðñÝðáέ:

- Ìá ìÝñáðá ðùð έá ñðéìβóáðá έάέ έá ááέáðáóóðÞóáðá ìÝí ððñÞá (ΈáóÛεάεί 8).

Ðñïáέáïðïβççç: Áí ðñïðáέÞóáðá ìá ðñïááñðÞóáðá ìïóéέÛ CD ìá ðçí áíðïèÞ mount(8) έá ðñïéέçéáβ έáð' áέÛ÷έóóïí óóÛéìá, Þ ðóç ÷áέñùðáñç ðáñβðóóçç kernel panic. ÔÝóïéá ìÝóá Ý÷ïí áíáέέέáðïÝíáð εùáέέïðïβççð ðïò áέáóÝñïíóá áðu ðï óóççééóïÝíï óýóðçíá áñ÷áβùí ISO.

7.2 Νύειέος όο Εΰñόάο ¹ ÷ ιό

Όοιέόοιñΰ άδϋ όιι Moses Moore. Άάέοέπεçέά άέά όι FreeBSD 5.X άδϋ όιι Marc Fonvieille.

7.2.1 Νόειβαιίόάο όι Όόόçιά

Δñεί ιάέειΠρόάοά, έά δñΎδάέ ίά ιΎñάόά όι ιιόΎεί όçò εΰñόάο διό Ύ ÷ άόά, όι ιειέεçñϋιΎι έýέεϋιά διό ÷ ñçóειιθιέάβ, έάεθò έάέ άί άβιάέ PCI Π ISA. Όι FreeBSD όθιόόçñβæάέ ιάαΰέç θιέέέεβά έάνθρι Π ÷ ιό, όυόι PCI υόι έάέ ISA. ΆέΎαίόά όέο όθιόόçñæϋιίάíάò όóóέάòΎò Π ÷ ιό όόέο Όçιάέπóάέο Όέέειϋ (http://www.FreeBSD.org/releases/8.1R/hardware.html) άέά ίά άάβόά άί ç εΰñόά όάο όθιόόçñβæάόάέ. Όόέο Όçιάέπóάέο Όέέειϋ άίάóΎñάόάέ άθβόçò θιεί δñϋάñάιιά ιάΠαçόçò όθιόόçñβæάέ όçι εΰñόά όάο.

Άέά ίά ÷ ñçóειιθιέΠρόάοά όçι όóóέάòΠ Π ÷ ιό διό άέάέΎόάόά, έά δñΎδάέ ίά οιñθρóaóά όιι έάóΰέεçει ιάçäϋ όóóέάòΠò. Άóóυ ιθιñάβ ίά άδέόάò ÷ έάβ ιά άϋι όñϋθιόò. Ι άóειϋέοάñιò άβιάέ άθεθò ίά οιñθρóaóά Ύιά module (ΰñεñϋιά) άέά όçι εΰñόά Π ÷ ιό όόιι δθñΠρία, ÷ ñçóειιθιέπρίαό όçι άίόιεΠ kldload(8), ιά όç άιΠεάέά όçò άñάιιΠò άίόιεπρι:

```
# kldload snd_emu10k1
```

Π δñιόέΎόιιόάο όçι έάóΰέέççç άñάιιΠ όόι άñ ÷ άβι /boot/loader.conf υδϋò δάñάέΰóϋ:

```
snd_emu10k1_load="YES"
```

Όά δάñάóΰιϋ δάñάάάβιιάόά άβιάέ άέά ιέά εΰñόά Π ÷ ιό Creative SoundBlaster® Live!. Όδΰñ ÷ ιόι άέάέΎόείά έάέ ΰέέά modules άέά εΰñόάò Π ÷ ιό έάέ ιθιñάβόά ίά όά άάβόά όόι άñ ÷ άβι /boot/defaults/loader.conf. Άί άάι άβóóά όβαιθñιò άέά όι δñϋάñάιιά ιάΠαçόçò διό δñΎδάέ ίά ÷ ñçóειιθιέΠρόάοά, ιθιñάβόά ίά δñιόθάεΠρόάοά ίά οιñθρóaóά όι module snd_driver:

```
# kldload snd_driver
```

Δñϋέάέόάέ άέά Ύιά ιάόά-δñϋάñάιιά ιάΠαçόçò, όι ιθιβι οιñθριáέ ιά ιέάó υέά όά έιείΰ δñιáñΰιιάόά ιάΠαçόçò άέά εΰñόάò Π ÷ ιό. Ιά όιι όñϋθι άóóυ ιθιñάβόά ίά άδέόά ÷ ϋίάόά όçι άιβ ÷ ίάóóç άέά όι όóóóϋ ιάçäϋ. Ιθιñάβόά άθβόçò ίά οιñθρóaóά υέά όά δñιáñΰιιάόά ιάΠαçόçò ιΎóϋ όιό άñ ÷ άβι /boot/loader.conf.

Άί άδέέοιιάβóά ίά άñάβóά όι άδέέάιιΎι δñϋάñάιιά ιάΠαçόçò όçò εΰñόάò όάο ιάóϋ όç οϋñóóçç όιό snd_driver, ιθιñάβόά ίά άέΎαίάόά όι άñ ÷ άβι /dev/sndstat ιά όçι άιΠεάέά όçò άίόιεΠò cat /dev/sndstat.

Ιέά άáϋόάñç ιΎείαίò άβιáέ ίά ιάόάάέϋóóβóάάόά όçι όθιόóΠñείç όçò εΰñόάò Π ÷ ιό όάο, óóάóέέΰ, άδάóεάβáò όόιι δθñΠρία. Όι δάñάέΰóϋ όιΠια δάñΎ ÷ άέ όέο δεçñιοιñβáò διό ÷ ñάέΰæάóóά άέά ίά δñιόέΎόάόά όθιόóΠñείç άέά όι όέέέϋ όάο ιά άóóϋ όιι όñϋθι. Άέά δάñέóóϋóάñάò δεçñιοιñβáò ó ÷ άóέέΰ ιά όçι ιάóάάέπóóέóç όιό δθñΠρία, άάβóά όι Έάóΰεάεί 8.

7.2.1.1 Άçιέιθñάπρίαό ΔñιόάñιόιΎι ΔθñΠρία ιά ΌθιόóΠñείç ¹ ÷ ιό

Άñ ÷ έέΰ, δñΎδάέ ίά δñιόέΎόάόά όι άάιέέϋ δñϋάñάιιά ιάΠαçόçò Π ÷ ιό (audio framework driver) sound(4) όόιι δθñΠρία όάο. Έά ÷ ñάέάóóάβ ίά δñιόέΎόάόά όçι άέϋειθέç άñάιιΠ όόι άñ ÷ άβι ñóειβóάϋι όιό δθñΠρία:

```
device sound
```

θάέόά, έά δñΎδάέ ίά δñιόέΎόάόά όθιόóΠñείç άέά όçι εΰñόά Π ÷ ιό όάο. ΔñΎδάέ ίά άιϋñβæάóά άδϋ δñεί θιεί δñϋάñάιιά ιάΠαçόçò όçι όθιόόçñβæάέ. ΆέΎαίόά όç εβóóά όυι όθιόόçñæϋιιίάιι έάνθρι όόέο Όçιάέπóάέο Όέέειϋ (http://www.FreeBSD.org/releases/8.1R/hardware.html), άέά ίά έάειñβóάόά όι όóóóϋ ιάçäϋ άέά όçι άέέΠ όάο. Άέά

δάνΰάεαιά, P Creative SoundBlaster Live!, οδιόογνβæάοάε άδϋ οii iäçäü snd_emu10k1(4). Άέα ίά δñiόεΎοάοά οδιόοδPñέιç áεά άδδP όçí εΰñόά, ÷ñçόειiιδιέPόόά όçí áέüειiόεç ãñáiP:

```
device snd_emu10k1
```

Άάάεüεάβόά üόε áεάáΰόάόά όçí οάεβáá οiό manual áεά οi δñüãñáiá iäPαçόçð, βόόά ίά ÷ñçόειiιδιέPόόά όç óóóP óýiόáiç. Ç áεñéáPð óýiόáiç áεά εΰεά οδιόόγνβæüiäiç εΰñόά P÷iό óoi ãñ÷áβi ñöειβόái i δñPíá, iδñáβ ίá ãñáεáβ áδβόçð óoi ãñ÷áβi /usr/src/sys/conf/NOTES.

Άέα εΰñόά P÷iό óýiόi ISA διό ááí áβiáé Plug’N’Play iδñáβ ίá ÷ñáέάόάβ ίá äβóáóá óoi δñPíá ðεçñiόiñβáð ó÷áóééΰ iá óéð ñöειβόáié όçð (üðüð οi IRQ, εýñá I/O ééð), üðüð áβiáόάé óððééΰ óá áóóΎð óéð δñéððβóáiéð. Άóóü iδñáβ ίá áβiáé iΎóü οiό ãñ÷áβiό /boot/device.hints. Έάóΰ όç áéááééáóβá όçð áéέβiçόçð, i loader(8) éá áéááΰόáé οi ãñ÷áβi éáé éá iáóááéáΰόáé óéð ñöειβόáiéð óoi δñPíá. Άέα δάνΰάεαιά, iéá δáééΰ Creative SoundBlaster 16 ISA iç-PnP εΰñόά ÷ñçόειiιδιέáβ οi δñüãñáiá iäPαçόçð snd_sbc(4) óá óoiáóáiü iá οi snd_sb16. Άέα όçí εΰñόά áóðP δñΎðáé ίá δñiόóáειýi ié δañáéΰóü ãñáiΎð óoi ãñ÷áβi ñöειβόáiü δñPíá:

```
device snd_sbc
device snd_sb16
```

éáé ié δañáéΰóü ãñáiΎð óoi ãñ÷áβi /boot/device.hints:

```
hint.sbc.0.at="isa"
hint.sbc.0.port="0x220"
hint.sbc.0.irq="5"
hint.sbc.0.drq="1"
hint.sbc.0.flags="0x15"
```

Όόçí δañβðóóç άóðP, ç εΰñόά ÷ñçόειiιδιέáβ όç εýñá I/O 0x220 éáé οi IRQ 5.

Ç óýiόáiç διό ÷ñçόειiιδιέáβόáé óoi ãñ÷áβi /boot/device.hints áiçááβóáé óóç óáéβáá manual οiό sound(4) éáéβð éáé óóç óáéβáá manual οiό áiόβóóie÷iό δñiãñüiáóü iäPαçόçð.

Ié ñöειβóáiéð διό óáβiüóáé δañáðΰü áβiáé ié δñiáðééááiΎíáð. Óá iñéoiΎíáð δañéððβóáiéð, iδñáβ ίá ÷ñáέάόάβ ίá áééΰiáóá οi IRQ P Üééáð ñöειβóáiéð βóóá ίá óáéñéΰáειiό iá óéð ñöειβóáiéð όçð εΰñόáó óáó. Άάβóá όç óáéβáá manual όçð snd_sbc(4) áéá δañéóóüóañáð ðεçñiόiñβáð ó÷áóééΰ iá όçí εΰñόά áóðP.

7.2.2 Άiέeiΰáειiόáó όçí Εΰñόά 1÷iό

Άóüý εΰiáóá áðáiáéέβiçόç iá οii iΎi δñPíá (P áóüý öiñðβóáóá οi áðañáβðçoi module), Έá δñΎðáé ίá ááβóá içýiáóá ó÷áóééΰ iá όçí εΰñόά P÷iό óóçí δñiόüñéiP iβiç (buffer) éáóáãñáóPð οiό óóóðβiáóüð (dmesg(8)) áiόβóóie÷á iá óá δañáéΰóü:

```
pcm0: <Intel ICH3 (82801CA)> port 0xdc80-0xdc8f,0xd800-0xd8ff irq 5 at device 31.5 on pci0
pcm0: [GIANT-LOCKED]
pcm0: <Cirrus Logic CS4205 AC97 Codec>
```

Ç éáóΰóóáόç όçð εΰñόáó P÷iό iδñáβ ίá áéáá÷éáβ iΎóü οiό ãñ÷áβiό /dev/sndstat:

```
# cat /dev/sndstat
FreeBSD Audio Driver (newpcm)
Installed devices:
pcm0: <Intel ICH3 (82801CA)> at io 0xd800, 0xdc80 irq 5 bufsz 16384
```

kld snd_ich (1p/2r/0v channels duplex default)

Όά ιγιγιάοά οοι ογόογιά οάο ιθιναβ ία άβίαέ αέάοιναόέέΰ. Αί άάί άάβοά οοόέαοΎο ογθιρ pcm, άδέοοηΎοά έαέ άεΎαίοά οά άβιαόά θιρ έΰίαόά θηιγαίριΎιϋ. Έιέοΰίοά οί άη÷άβι ηοέιβοάυι θοηβία έαέ άάάάέεεάβοά υοέ Ύ÷άοά άδέεΎίαέ οί οούοου θηιναίηία ιάβαζόο. Άέα οοιβεζ θηιναέβιαόά έαέ οζι άίόέιαθβθεός οίρο, άάβοά οί οίβια Όιβία 7.2.2.1.

Αί υέα θΰία έαέΰ, ζ έΰηοά β÷ιρ οάο έα έαέοιρηάβ. Αί ι ιαζαυο CD β DVD θιρ αέάεΎοάοά άβίαέ οοιαηΎιϋ ιά οζι έΰηοά β÷ιρ ιΎού οζο άίαειάεεβο οίρ άιυαίρ, ιθιναβοά ία άΰεαοά Ύία ιιροέευ CD έαέ ία οί άίαθαηΰάαοά ιά οί θηιναίηία cdcontrol(1):

```
% cdcontrol -f /dev/acd0 play 1
```

¶έεάο άοάηιηΎο, υθυο οί audio/workman θάηΎ÷ιρ ιρέέέευοάηι θάηέαΰέει άηάαοβάο. ρουο εΎέαοά ία άάέαοάοβοάοά ίέα άοάηιηΎβ υθυο οί audio/mpg123 άέα ία άίαθαηΰάαοά άη÷άβια β÷ιρ MP3.

Ίάο ΰέειρ άηβαιηιρ οηυθιρ άέα ία άεΎαίοά οζι έΰηοά β÷ιρ οάο, άβίαέ ία οοάβεάοά άάηιΎία οοζι οοόέαοβ /dev/dsp, υθυο θάηάέΰο:

```
% cat filename > /dev/dsp
```

υθιρ οί filename ιθιναβ ία άβίαέ ιθιείαβθιρ άη÷άβι. ζ θάηάθΰιϋ άίοιρβ έα θηΎθαέ ία θάηΰάε έΰθιεί β÷ι (ειηοάι) άθέάάάέβιιροάο οζ ουοοβ έαέοιρηάβά οζο έΰηοάο β÷ιρ.

ζ Ύίοάοζ β÷ιρ οζο έΰηοάο ιθιναβ ία άεεΰίαέ ιΎού οζο άίοιρβο mixer(8). Θάηέοούοάηάο θέζηιρηηβάο ιθιναβοά ία άηάβοά οοζι οάέβάά οίρ manual οζο mixer(8).

7.2.2.1 ΌοιζέέοιΎία Δηιναέβιαόά

Δηυάέζια	Έγος
“sb_dspwr(XX) timed out”	Άαι άβίαέ οουοΰ ηοέιέοιΎιζ ζ εϋνά I/O.
“bad irq XX”	Όι IRQ άαι άβίαέ οουοΰ ηοέιέοιΎι. Άάάάέεεάβοά υοέ οί IRQ θιρ Ύ÷άοά αζεβραέ άβίαέ οί βάει ιά αοου θιρ Ύ÷άε ηοέιέοοάβ οοζι έΰηοά.
“xxx: gus pcm not attached, out of memory”	Άαι οθΰη÷άε άηέαοβ αέάεΎοείζ ιιβιζ άέα ία άβίαέ ÷ηβός οζο οοόέαοβο.
“xxx: can't open /dev/dsp!”	ΆεΎαίοά ιά οζι άιβέαέα οζο άίοιρβο fstat grep dsp άί έΰθιέα ΰέεζ άοάηιηβ άθαο÷ιέάβ οζ οοάέεηειΎιζ οοόέαοβ. Όοιβέαέο γθιθιεί άβίαέ ζ άοάηιηβ esound έαεβρ έαέ οί ογόογιά οθιροβηείζο β÷ιρ οίρ θάηέαΰέειρο KDE .

7.2.3 ×ηζοέιιθιέβιόαο ΔιέεάθεΎο ΔζαΎο¹ ÷ιρ

Όοιαέοοιηΰ άδυ οίι Munish Chopra.

Άβίαέ θιέεΎο οηηΎο άδέεοιζοου ία Ύ÷ιρ ιά θιέεάθεΎο ΔζαΎο β÷ιρ θιρ ία άίαθαηΰαιρ οάοου÷ηιηά, υθυο υοάι άέα θάηΰάέαιά οί **esound** β οί **artsd** άαι άδέοηΎθιρ έιείβ ÷ηβός οζο οοόέαοβο β÷ιρ οά έΰθιέα οοάέεηειΎιζ άοάηιηβ.

ΆñÛοιίόαδ οοι Άβόει ιΎού οιο **XMMS**:

1. ΙάειίΠόαδ οι **XMMS**.
2. ÊÛιόα αάιβ έεέε οοι δάνÛεοñι όçð äöáñιiαPð áεά ίά áñβιáιόα οι ιáñιγ οιο **XMMS**.
3. ΆδéeÛιόα Preferences áδñ óá Options.
4. ΆεεÛιόα οι Output Plugin óá “Disk Writer Plugin”.
5. ΔεΎόα Configure.
6. ΆñÛøðá (P άδéeÛιόα browse) Ύίá έáoÛειαι áεά ίά áðιεçέáγáoðá óá áðιóοιðεάοιΎίá áñ÷άβá.
7. Õñòðøðá οι áñ÷άβι MP3 οοι **XMMS** üðñð óοιPεùð, ιá όçι Ύίόáoç óοι 100% έáé óéð ñðειβóáεð EQ áíáíáñãÛð.
8. ΔεΎόα οι Play. Õι **XMMS** εá öáβιáιόáé υέé áíáðáñÛááé οι MP3, áεεÛ ááí εá áειγááóáé έáíáβð P÷ιò. Óόçι ðñááιáóéευιόçóá áíáðáñÛááé οι MP3 óá áñ÷άβι.
9. ¼óáí óáεάεPóáðá, ááááευεάβðá υέé áðáíáoÛñáóá όç ñγέιέόç οιο ðñιáðéεááιΎίñò Output Plugin óόçι ðñιçáιγίáιç áðéειαP όçð, áεά ίά ιðñÛΎóáðá ίά áειγóáðá ίáíÛ áñ÷άβá MP3.

ΆñÛοιίόαδ óόçι Ύιáι ιΎού οιο **mpg123**:

1. ΆέðáεÛόα `mpg123 -s audio01.mp3 > audio01.pcm`

Õι **XMMS** áñÛóáé áñ÷άβá óá ιñòP WAV, áñð οι **mpg123** ιáoáðñÛóáé οι MP3 óá ιç- áðáíáñááοιΎίá (raw) áááñΎίá P÷ιò PCM. Έáé ιé áγι áððÛð ιñòÛð ιðñιγί ίá ÷ñçóειιðιεçειγί ίá όçι áöáñιiαP **cdrecord** áεά όç áçιέιðñáβá ιιðóéεPí CD. Άέá όçι áöáñιiαP **burncd(8)** εá ðñÛóáé ίá ÷ñçóειιðιεPóáðá áááñΎίá PCM. Άί ÷ñçóειιðιεPóáðá áñ÷άβá WAV εá ðñááðçñPóáðá Ύίá ιέεññ P÷ι (tick) óόçι áñ÷P òÛεá εñιáóειγ. Ì P÷ιò áððñð ðñιÛñ÷άóáé áδñ όçι áðééáðáεβáá (header) οιο áñ÷άβιò WAV. Ìðñáβðá ίá áðáέñÛóáðá όçι áðééáðáεβáá ιá όç áñPεáéá οιο ðñιáñÛιáóιò **SoX** (ιðñáβðá ίá οι ááéáðáóðPóáðá áδñ οι port `audio/sox P` οι áίόβóóιé÷ι δάéÛοι):

```
% sox -t wav -r 44100 -s -w -c 2 track.wav track.raw
```

ΆέááÛóáðá οι ÕιPιá 18.6 áéá ðáñéóóυιðáñáð ðεçñιιιñβáð ó÷áðééÛ ιá όç ÷ñPόç CD áááñáðPð óοι FreeBSD

7.4 ÁíáðáñááυáP Video

ÓðιáέóοιñÛ áδñ οι Ross Lippert.

Ç áíáðáñááυáP video áβιáé ιéá έáéιγñéá έáé ñááááβá áíáððóóóυιáιç ðáñει÷P áöáñιiαPí. Έá ÷ñáéáóóáβ ίá ááβιáðá ððñιιP. Άáí ðññéáéóáé ίá έáéóιðñáPóιòι υéá ουοι ιñáεÛ üðñð óοιι P÷ι.

Ðñει ιáεείPóáðá, εá ðñÛóáé ίá áñññβáεáðá οι ιιιðÛει όçð εÛñðáð áñáóéεPí ðιò Û÷áðá έáεPð έáé οι ιειέεçññιÛÛι έγέευιá ðιò ÷ñçóειιðιεáβ. Άί έáé οι **Xorg** έáé οι **XFree86** ððιόóçñβáειòι ιááÛεç áεÛιá áδñ εÛñðáð áñáóéεPí, áððÛð ðιò ðáñÛ÷ιòι έáεP áδñáιόç áβιáé έεáυóáñáð. Άέá ίá ðÛñáðá ιéá εβóóá ουι áεóáóáιÛιúι áοιáοιòPóυι ðιò ððιόóçñβáειíóáé áδñ όçι εÛñðá óáð, ÷ñçóειιðιεPóáðá όçι áíοιεP `xdpyinfo(1)` όçι þñá ðιò áεóáειγίόáé óá X11.

Άβιáé ááιέεÛ έáεP έáÛά ίá Û÷áðá Ύίá ιέεññ áñ÷άβι MPEG οι ιðιβι ιðñáβ ίá ÷ñçóειιðιεçεáβ áéá áñéειÛð áéáοιñáðéεPí áðéειαPí έáé ðñιáñáñÛóυι áíáðáñááυáPð. ÊÛðιéá ðñιáñÛιáóá áíáðáñááυáPð DVD áíáεçóιγί áδñ ðñιáðéειαP οι áβóει DVD óόç óðóéáðP /dev/dvd. Óá ιñéοιΎίá οι υñíá όçð óðóéáðPð áβιáé áíóυιáóυιÛÛι óοιι εPáééá

οίο δññāñŪñāóìò. Άέα όì εüāī áóóü, βóòò áβίáε ÷ñΠóεή ίά οóεŪíáóā óοιāíεέέΎò óοίāΎóáεò δññò óεò δñāñāíáóεέΎò óóóεάòΎò:

```
# ln -sf /dev/acd0 /dev/dvd
# ln -sf /dev/acd0 /dev/rdvd
```

Όζιáερόóā üóε εüāü óçò öýóçò όìò óóóòΠιáóìò devfs(5), áóóíý όìò áβāíòò íε óοίāΎóáεò āāí δāñāíΎíóí ίāóŪ óçí áδāíáεέβίçóç όìò óóóòΠιáóìò óáò. Άέα ίά áçíεíòñāíýíóáε íε óοιāíεέέΎò óοίāΎóáεò áóóüñāóā óā εŪεā áεέβίçóç όìò óóóòΠιáóìò óáò, δññíóεΎóóā óεò áεüεíòεāò āñāñŪò óóí āñ ÷áβí /etc/devfs.conf:

```
link acd0 dvd
link acd0 rdvd
```

Άδεδññüóεāóā, ç áδñéüāεέéíðíβçóç DVD, ç íðñíβā ÷ñāέŪæāóáε éεΠóç áεάεέβί éāεóìòñāεβί όìò DVD-ROM, áδāέóāβ éáε Ūāáεā āāñāóòΠò (write permission) óóεò óóóεāòΎò DVD.

Άέα όç āāεòβüóç óçò εāεóìòñāβāò óçò éíεíü ÷ñçóóçò ίíΠιçò όìò óóóòΠιáóìò X11, óóíβóóáóáε ίá áóíΠóáóā óεò óεíΎò εŪóíεüí ίāóāáεçòΠí systcl(8):

```
kern.ipc.shmmax=67108864
kern.ipc.shmall=32768
```

7.4.1 Δññíóáεéñéóíüò ΆóíáóìòΠóóüí ΕŪñóáò Άñáóéέβί

ΌδŪñ ÷íóí āñεāóíβ áεáóññāóééíβ δññüóíε áεά όçí áδāέéüíεóç video óóí X11. Όí óε εā āíóεΎóáε óāεééŪ, āíāñòŪóáε óā ίāāŪεí āáεìü áδü όí óεééü óáò. ΕŪεā ίŪεíāíò δññó δāñεāñŪóíòíā δāñāέŪóü éā āΠóáε áεáóññāóééΠ δññéüóçóā óā áεáóññāóééü óεééü. Άδβóçò, ç áíáδāñāñāñΠ video óóí X11 áβίáε Ύíá εŪΎíá óóí ίðñíβí δññüóóáóā áβíáóáε ίāāŪεç óçíáóóā, éáε δεéáíüí éā óδŪñ ÷íóí āñεāòŪò āāεóεΠóáεò óā εŪεā íŪá Ūéāíóç όìò **Xorg**, Π όìò **XFree86**.

ΕāóŪεíāíò éíεíβí áεāδāóΠí video:

1. X11: ΌóίçεéóíŪíç Ūíāíò όìò X11 ίā ÷ñΠóç éíεíü ÷ñçóóçò ίíΠιçò.
2. XVideo: íεā áδŪΎéóáóç óçò áεāδāóΠò X11 δññó óδñíóçñβæáε áíáδāñāñāñΠ video óā íðñéāāΠδññóā ó ÷āáéŪóéíç áδéóŪíáεā όìò X11.
3. SDL: Simple Directmedia Layer.
4. DGA: Direct Graphics Access.
5. SVGAlib: Άδβδāāñ āñáóéέβí ÷áíçεíý áδéδŪāíò áεā éííóüéā.

7.4.1.1 XVideo

Όí **Xorg** éáε όí **XFree86 4.X** áεáεŪóíóí íεā áδŪΎéóáóç δññó íññŪæāóáε *XVideo* (āíüóòΠ éáε ùò Xvideo, Xv, xv) éáε όí íðñíβí áδéóñŪΎáε όçí áδāóεāβāò áδāééüíεóç video óā ó ÷āáéŪóéíá áíóééāβíāíá ίŪóü áεáεέΠò áδéóŪ ÷óíóçò. Ç áδŪΎéóáóç áóòΠ δāñŪ ÷áε áíáδāñāñāñΠ δññéý éáεΠò δññéüóçóāò, áεüñā éáε óā ίç ÷áíΠιáóā ÷áíçεβί δññéáéāñāóΠí.

Άέα ίá āāβóā áí ÷ñçóéíüðñéāβóáε ç áδŪΎéóáóç, ÷ñçóéíüðñéβóóā όçí áíóíεΠ xvinfo:

```
% xvinfo
```

Όí XVideo óδñíóçñβæāóáε áδü όçí εŪñóā óáò áí όí áδñóŪéāóíā āāβ ÷íáε üðñò δāñāέŪóü:

```
X-Video Extension version 2.2
```

```

screen #0
  Adaptor #0: "Savage Streams Engine"
    number of ports: 1
    port base: 43
    operations supported: PutImage
    supported visuals:
      depth 16, visualID 0x22
      depth 16, visualID 0x23
    number of attributes: 5
      "XV_COLORKEY" (range 0 to 16777215)
        client settable attribute
        client gettable attribute (current value is 2110)
      "XV_BRIGHTNESS" (range -128 to 127)
        client settable attribute
        client gettable attribute (current value is 0)
      "XV_CONTRAST" (range 0 to 255)
        client settable attribute
        client gettable attribute (current value is 128)
      "XV_SATURATION" (range 0 to 255)
        client settable attribute
        client gettable attribute (current value is 128)
      "XV_HUE" (range -180 to 180)
        client settable attribute
        client gettable attribute (current value is 0)
    maximum XvImage size: 1024 x 1024
  Number of image formats: 7
    id: 0x32595559 (YUY2)
      guid: 59555932-0000-0010-8000-00aa00389b71
      bits per pixel: 16
      number of planes: 1
      type: YUV (packed)
    id: 0x32315659 (YV12)
      guid: 59563132-0000-0010-8000-00aa00389b71
      bits per pixel: 12
      number of planes: 3
      type: YUV (planar)
    id: 0x30323449 (I420)
      guid: 49343230-0000-0010-8000-00aa00389b71
      bits per pixel: 12
      number of planes: 3
      type: YUV (planar)
    id: 0x36315652 (RV16)
      guid: 52563135-0000-0000-0000-000000000000
      bits per pixel: 16
      number of planes: 1
      type: RGB (packed)
      depth: 0
      red, green, blue masks: 0x1f, 0x3e0, 0x7c00
    id: 0x35315652 (RV15)
      guid: 52563136-0000-0000-0000-000000000000
      bits per pixel: 16
      number of planes: 1
      type: RGB (packed)

```

```

depth: 0
red, green, blue masks: 0x1f, 0x7e0, 0xf800
id: 0x31313259 (Y211)
guid: 59323131-0000-0010-8000-00aa00389b71
bits per pixel: 6
number of planes: 3
type: YUV (packed)
id: 0x0
guid: 00000000-0000-0000-0000-000000000000
bits per pixel: 0
number of planes: 0
type: RGB (packed)
depth: 1
red, green, blue masks: 0x0, 0x0, 0x0

```

Διευκρινίζονται οι μορφές των αρχικών (YUV2, YUV12, κ.λπ.) και κωδικοποιήσεων που είναι ομοίως με τις XVideo, και η αρχική μορφή των αρχικών είναι η αρχική μορφή των αρχικών.

Αν οι αρχικές μορφές είναι YUV:

```

X-Video Extension version 2.2
screen #0
no adaptors present

```

Ομοίως με τις XVideo και οι αρχικές μορφές των αρχικών είναι οι αρχικές μορφές των αρχικών.

Αν οι XVideo και οι αρχικές μορφές των αρχικών είναι οι αρχικές μορφές των αρχικών, τότε οι αρχικές μορφές των αρχικών είναι οι αρχικές μορφές των αρχικών. Ομοίως με τις XVideo και οι αρχικές μορφές των αρχικών είναι οι αρχικές μορφές των αρχικών.

7.4.1.2 Οι Αρχικές Μορφές του Simple Directmedia Layer

Οι Simple Directmedia Layer, SDL, αρχικές μορφές των αρχικών είναι οι αρχικές μορφές των αρχικών, BeOS, και οι UNIX, αρχικές μορφές των αρχικών είναι οι αρχικές μορφές των αρχικών. Ομοίως με τις XVideo και οι αρχικές μορφές των αρχικών είναι οι αρχικές μορφές των αρχικών.

Οι SDL αρχικές μορφές των αρχικών είναι οι αρχικές μορφές των αρχικών.

7.4.1.3 Οι Αρχικές Μορφές του Direct Graphics Access

Οι Direct Graphics Access αρχικές μορφές των αρχικών είναι οι αρχικές μορφές των αρχικών, X server και οι αρχικές μορφές των αρχικών είναι οι αρχικές μορφές των αρχικών. Ομοίως με τις XVideo και οι αρχικές μορφές των αρχικών είναι οι αρχικές μορφές των αρχικών.

Οι αρχικές μορφές των αρχικών DGA αρχικές μορφές των αρχικών είναι οι αρχικές μορφές των αρχικών. Ομοίως με τις XVideo και οι αρχικές μορφές των αρχικών είναι οι αρχικές μορφές των αρχικών.

7.4.2 ΔάέΎόά έάέ Ports δὶὸ Ó ÷ άὸβæίίόάέ ιά Video

Ὀὶ οὶΠιά άόδου δάηέανὺόάέ δὶ εἱεάοίεέου δὶεὸ άέάδβæάάέ όδς όδέεὶάβ οὶύ ports δὶὸ FreeBSD έάέ δὶ ἱδὶβὶ ἱδὶνάβ ιά ÷ ἵçόέὶἱδὶεçέάβ έάά άίάδάηάάυάβ video. Ἰ όηΎάδ όçδ άίάδάηάάυάβ video άβίάέ έέάέάβόάηά άήάηάυδ ὑοὶ άοὶνὺ όçί άὶὺδδοὶç εἱεάοίεέέϱ, έάέ Ꮋόόέ ἱέ άοίάόυόçδάδ οὶύ άόάηἱάβἱ δέέάϱβ ιά άδὶεβἱἱόὶ έὺδου άδὑ άόδὺδ δὶὸ δάηέανὺοίίόάέ άάβ.

Άβίάέ άη ÷ έέὺ όçίάίόέέου ιά άἱυηβæάάδ ὑδέ άηέάδὺδ άδὑ όέδ άόάηἱάΎδ video δὶὸ άέδάέϱϱίόάέ όόὶ FreeBSD άίάδδϱ ÷ έçέάί άη ÷ έέὺ ἵδ άόάηἱάΎδ Linux. ΔὶεέΎδ άδὑ άόδὺδ όέδ άόάηἱάΎδ άβίάέ άέἱάά δὶέὑδóçδάδ beta. Έὺδὶεά άδὑ όά δἵηάεΠιάόά δὶὸ ἱδὶνάβ ιά όδὶάίδβόάδά όόέδ άόάηἱάΎδ video δὶὸ FreeBSD δάηέέάιάὺἱἱό:

- 1. Ἰέά άόάηἱάβ άάὶ ἱδὶνάβ ιά άίάδάηάάέ Ꮋίά άη ÷ άβἱ δὶὸ άçίέϱἱἱάβεçέά άδὑ έὺδὶεά Ꮋέέç.
- 2. Ἰέά άόάηἱάβ άάὶ ἱδὶνάβ ιά άίάδάηάάέ Ꮋίά άη ÷ άβἱ δὶὸ άçίέϱϱάçόά ç βæέά.
- 3. Ç βæέά άόάηἱάβ, όά άοὶ έέάόἱάδóέέὺ ἱç ÷ άἱΠιάόά, έάέ άοἱϱ Ꮋ ÷ άέ ἱάδάάέὑδóδóάβ όά έὺέά ἱç ÷ Ꮋἱçίά άέάέέὺ έάά άόδὑ, άίάδάηάάέ δὶ βæέὶ άη ÷ άβἱ ἱά έέάόἱάδóέέου όἵἱδἱ.
- 4. Έὺδὶεὶ όάέἱάἱέέέὺ άδὑ οβέόἵ, ὑδου άόδὑ όçδ άέέάάδ ἱάάϱέϱδ άέέὑάδ (rescaling), Ꮋ ÷ άέ ἵδ άδὶὺέάόίά όçί άçίέϱἱἱάβ έάέδδ δὶέὑδóçδάδ video (όά ÷ ἱἱἱἱάçἱδἱἱ) άἱέόβάδ δἵηάεçίάόέέδδ ἵἱδóβίάδ ἱάάϱέδρçδ
- 5. Έὺδὶεά άόάηἱάβ δάἵάδóβæάόάέ άδὑόἵά όç ÷ ἱὺ.
- 6. Άάὶ άάέάέβόόάόάέ ç δάέἱçἵβὑόç δὶὸ δἵἱἱἱἱἱάόἱδ έάόὺ όçί άάέάδὺόόάόç δὶὸ port, άἱβ ἱδὶνάβ ιά άἵάέάβ άβόά όόὶ άέέδóάέὑ δὑδἱ δὶὸ δἵἱἱἱἱἱάόἱδ άβόά όδἱέ έάδὺέἱἱ work δὶὸ port.

ΔὶεέΎδ άδὑ όέδ άόάηἱάΎδ άόδὺδ ἱδὶνάβ άδβόçδ ιά δάἵἱόέὺόἱόἱ όδἱδδβἱάόά “Linux-έόἱϱ”. Ἰδὶνάβ άçέ. ιά άἱόάἱβæἱόἱ δἵηάεΠιάόά δὶὸ ἱόάβἱϱίόάέ όοἱἱ όἵἱδἱ ἱά όἱἱ ἱδὶβὶ όεἱδὶεϱϱίόάέ έὺδὶεάδ όδὺἱόάἵ άέάέἱεβæάδ όόέδ άέάἱἱΎδ δὶὸ Linux, β βούδ ἱέ όόάἱάόάβδ ιά Ꮋ ÷ ἱἱ έάυἵβóάέ ἵδ άάἱἱΎίάδ έὺδὶεάδ άοίάόυόçδάδ δὶὸ δἵἱἱἱἱἱ ὑδου όδὺἵ ÷ ἱἱ όἱἱ Linux. Ὀά δἵηάεΠιάόά άόδὺ άάὶ άβίάέ οβἱἱἱἱ ὑδέ άίάέάεϱδἱἱίόάέ έάέ άέἱἱεβἱἱίόάέ δὺἱάά άδὑ όἱδδ όδὶçἵçἱδὺδ δὶὸ port, δὶ ἱδὶβὶ ἱδὶνάβ ιά ἱάçἱβóάέ όά δἵηάεΠιάόά ὑδου όά δάηάέὺδὑ:

- 1. ×ἵβçδ δὶὸ άη ÷ άβἱδ /proc/cpuinfo έάά όçί άἱβ ÷ ἱάδóç δὑἱ άοίάόἱδβδὑἱ δὶὸ άδἱἱἱἱἱάόδβ.
- 2. Έάέβ ÷ ἵβçδ δὑἱ threads (ἱçἱδὑἱ) δὶ ἱδὶβὶ ἱάçἱάβ δὶ δἵἱἱἱἱἱά ἱά έὑέççίά άίδβ έάά έάἱἱίέέὑ δάἵάόέόἵὑ όόὶ δὺέἱδ όçδ άέδὺέάόçδ.
- 3. ×ἵβçδ εἱεάοίεέϱ δὶὸ άάὶ όδὺἵ ÷ άέ άέἱὑά όóç όδέεὶάβ δὑἱ ports δὶὸ FreeBSD όά όδὶάδάόἵὑ ἱά όçί άόάηἱάβ.

Ἰϱ ÷ ἵε όόέάἱδ ἱέ όόάἱἱάόάβδ δὑἱ άόάηἱάβἱ άόδἱβ Ꮋ ÷ ἱἱ άδἱἱάέ ÷ έάβ όδὶἱἱἱἱἱέ ἱά δἱδδ όδὶçἵçἱδὺδ δὑἱ ports, βόδά ιά άέá ÷ έόόἱδὶεçέϱϱ ἱέ άδἱἱἱἱἱάέδ δὶὸ ÷ ἵἱάέὺἱἱίόάέ έάά όçί ἱάδάδἵἱδβ (porting) δὑἱ άόάηἱάβἱ.

7.4.2.1 MPlayer

Ἰ **MPlayer** άβίάέ ἱέά άόάηἱάβ άίάδάηάάυάβδ video δὶὸ άίάδδϱ ÷ έçέά δἵἱἱόόάδά έάέ άἱάέβóόάδάέ όá ÷ Ꮋόάόά. Ἰέ όδὑ ÷ ἱέ όçδ ἵἱἱἱάδ άὶὺδδἱçδ δὶὸ **MPlayer** άβίάέ ç δά ÷ Ꮋόçδά έάέ ç άδάέέἱβά όόὶ Linux έάέ όά Ꮋέέά Unix. Ç άçίέϱἱἱάβ δὶὸ ἱάέβἱçόά ὑδάἱ ἱ άη ÷ çἱἱδ όçδ ἵἱἱἱάδ άὶὺδδἱçδ έἱἱἱἱἱδóçέά ιά άίόέἱάδὑδβæάέ όά δἵηάεΠιάόά άίάδάηάάυάβδ δὑἱ ἱϱ ÷ ἵε όὑδά έέάέ Ꮋόέἱἱ δἵἱἱἱἱἱἱδὑἱ. Έὺδὶεὶé δδἱόδçἵβæἱἱἱ ὑδέ δὶ ἵἱάόέέὑ δάἵέάὺέἱἱ έδóέὺδóçέά έέά ιά άçίέϱἱἱἱἱἱάβ ἱέά ἵἱέἱἱἱἱἱδç ó ÷ ἱάβάόç. Ꮋόδὑἱ, ἱὑέέδ όδὶçέβóάδά όέδ άδέεἱἱΎδ δὶὸ άβἱἱίόάέ άδὑ όç ἵἱἱἱἱἱ ἱἱἱἱἱἱ έάέ όά άίόβóἱé ÷ á δἱεδἱἱἱ, έá ἱδἵἱ Ꮋόάδά ιά όἱἱ ÷ ἵçόέἱἱδὶεβóάδά άἱέάδὺ έάέὺ.

7.4.2.1.1 ἱάόάέἱβδóέόç δὶὸ MPlayer

Ἰ **MPlayer** ἵἱἱέάδάέ όοἱ multimedia/mplayer. Ἰ **MPlayer** έὺἱἱάέ δἱεβἱδ ἵέᎻá ÷ ἱἱ δὶὸ όέέέϱϱ έάόὺ όç έέάάέέάόβά όçδ ἱάδάάέβδóέόçδ, όδέὺ ÷ ἱἱἱάδ Ꮋόόέ Ꮋίά έέδάέᎻόέἱ δὶ ἱδὶβὶ ἵἱἱ Ꮋ ÷ ἵἱ όἵçὑδὑδóçά άδὑ Ꮋίά όόόççίά


```
# mplayer -vo 'sdl:dga' testfile.avi
```

Αίβæάε οίι έυδι ίά αίεείΎοάάά υεάδ άοδΎδ οεό άδεείαΎδ, έεεβδ ϑ άδυαίρϑ οίτδ άίάηδΎδάέ άδυ διεείγδ δάνΎαίιόάδ έάέ άεάοίηιθιεάβδάέ άηέάδΎ άίΎειαά ίά οί οεέευ οίτδ οθιεάεόδρ οάδ.

Άέά άίάδάνάαυάβ άδυ DVD, άίόέεάόάόδρδά οί testfile.avi ίά dvd://N -dvd-device DEVICE υδθίτδ οί N άβίάέ ι άηέειυδ οίτδ όβδείτδ (title number) θίτδ άδέεθίάβδά ίά άίάδάνΎάάδά έάέ DEVICE άβίάέ οί υίηία όόόέάδρδ οίτδ DVD-ROM. Άέά δάνΎάάέαιά, άέά ίά άίάδάνΎάάδά οίι όβδεί 3 άδυ όϑ όόόέάδρ /dev/dvd:

```
# mplayer -vo xv dvd://3 -dvd-device /dev/dvd
```

Όϑίάβυόϑ: ϑ δñíáðééááíΎίϑ όόόέάδρ DVD ίδñíáβ ίά έάέίηέόδάβ έάδΎ όϑ έέΎñέάέά όϑ ό ίάδάάεβδδέόϑδ οίτδ **MPlayer** port ιΎού όϑ άδέέίάβδ WITH_DVD_DEVICE. Άδυ δñíáðééíáβ, ϑ όόόέάδρ άόδρ άβίάέ ϑ /dev/acd0. ίδñíáβδά ίά άñáβδά δάñέόόυδάñάδ δεϑñíτíñíβάδ όοί άñ÷άβί Makefile οίτδ port.

Άέά όά δεβέδñά θίτδ ÷ñϑόέηιθιείγίόάέ άέά δάγόϑ, άεάέιθρ, ίάδάέβίϑόϑ έεθ. έάδΎ όϑ έέΎñέάέά όϑδ άίάδάνάαυάβδ, όοίάιτδέάδδάβδά όϑί άίβέάέά θίτδ ίδñíáβδά ίά άάβδά άέδάεβίρδάδ mplayer -h ϐ έεάάΎόόά όϑ όάέβάά οίτδ manual.

Άδέδñυόέάδά, ϑϑίάίόέέΎδ άδέείαΎδ άίάδάνάαυάβδ άβίάέ: -fs -zoom οί ίθίβί άίάñάιθιεάβ άδάέέυίέόϑ όά δεβñϑ ιδύίϑ έάέ οί -framedrop οί ίθίβί άίϑεΎάέ όϑί άγίϑόϑ όϑδ άδυαίρϑδ.

Άέά ίά ίάβίάέ οί ιΎάάέιτδ όϑδ άñάηιθδ άίόιεβί οί άόίαδύι ίέέñυ, ι ÷ñρδόϑδ ίδñíáβ ίά ϑϑίέιτδñáρδάέ Ύία άñ÷άβί .mplayer/config έάέ ίά ηñβδάέ έέάβ δέδ δñíáðééááíΎίάδ άδέείαΎδ:

```
vo=xv
fs=yes
zoom=yes
```

ΌΎείτδ, ι mplayer ίδñíáβ ίά ÷ñϑόέηιθιεϑέάβ άέά όϑί άίάάυάβ (rip) άίυδ όβδείτδ DVD όά Ύία άñ÷άβί .vob file. Άέά όϑί άίάάυάβ οίτδ άάγδάνιτδ όβδείτδ άδυ Ύία DVD, άñΎδδά:

```
# mplayer -dumpstream -dumpfile out.vob dvd://2 -dvd-device /dev/dvd
```

Όί άñ÷άβί άίυάιτδ, out.vob, έά άβίάέ όγθίτδ MPEG έάέ ίδñíáβδά ίά οί ίάδά÷άέñέόόάβδά ιΎού Ύέέυιρ δάέΎούιρ video θίτδ δάñέάñΎύίτδάέ όά άδδυ οί οίβία.

7.4.2.1.3 mencoder

Δñεί ÷ñϑόέηιθιεβρδάδά οί mencoder άβίάέ έάέβ έάΎά ίά άηίέάέυέεάβδά ίά δέδ άδέείαΎδ θίτδ άίάόΎñιόάέ όϑί όάέιϑñβυόϑ HTML. ΌδΎñ÷άέ όάέβάά manual, άέέΎ άάί άβίάέ θίεγ ÷ñρέίϑ ÷ñβδ όϑί HTML όάέιϑñβυόϑ. ΌδΎñ÷ίτδ δΎñά διεείβ όñυθίέ άέά ίά άάεδεβρδάδά όϑί θίέυδϑδά, ίά ίάεβρδάδά οί ηδέιυ άάάñΎίυί (bitrate) ίά άέέΎίάδά ηñδρ άñ÷άβίτδ, έάέ έΎθιεά άδυ άδδΎ όά έυέδά ίδñíáβ ίά έΎñίτδ όϑ άεάοίηΎ ίάδάίγ έάέβδ έάέ έάέβδ άδυαίρϑδ. Άβρ έά άάβδά ίάñέέΎ δάñάάάββίάίόά άέά ίά ίάέείβρδάδά. Δñβδά ίέά άδεβρ άίόέάñάδρ:

```
% mencoder input.avi -oac copy -ovc copy -o output.avi
```

ΈάέάόιΎίτδ όόίάδάόιηβ όϑ άñάηιθ άίόιεβί, ίδñíáβ ίά άρδίτδ άñ÷άβά άίυάιτδ όά ίθίβά άάί ίδñíáβ ίά άίάδάνΎάάέ ιγδά ι βάέιτδ ι mplayer. όόέ, άί άδεβδ έΎέάδά ίά έΎίάδά rip Ύία άñ÷άβί, ίάβίάδά όϑί άδέέίάβρ -dumpfile οίτδ mplayer.

Άέά ίά ίάδάδñΎέδδά οί input.avi όά codec MPEG4 ίά ϐ÷ι MPEG3 (άδάέδάβδάέ οί audio/lame):

```
% mencoder input.avi -oac mp3lame -lameopts br=192 \
  -ovc lavc -lavcopts vcodec=mpeg4:vhq -o output.avi
```

Ίά οίι οπυοί αόου δάνΰάάόάε Ύίαιό δίο ιδιναβ ίά αίαδάνά÷εάβ άδύ οίι mplayer έάε οίι xine.

Ίδιναβόά ίά άίόέέάόάόδΠόάόά οίι input.avi ίά όçi άδέείαΠ dvd://1 -dvd-device /dev/dvd έάε ίά οίι άέόάεΎόάόά ùò root άεά ίά άδάίάέùάέείδιέΠόάόά άδάόεάβάδ Ύία όβόει DVD. Ίέά έάε δέέάίπδ άάί έά ίάβίάόά έέάίδιέçiΎίπδ ίά οίι άδιόΎέάόάί άδύ όçi δñpόç οίιñÛ, όάό όοίέόόίγίά ίά έάόάáÛόάόά οίι όβόει όά Ύία άñ÷άβι έάε ίά άιόεΎόάόά όά άδóυ.

7.4.2.2 Οί Δññάñáíá ΆίάόάñááùāΠò xine

Οί xine άβίάε Ύία project ίά άδñý όέιδύ, οί ιδιβι δññññβάέόάέ ù÷έ ίυί ίά άβίάε Ύία δññάñáíá ùέά όά Ύία ùοί άοίñÛ οί video, άέεÛ άδβόçδ όοί ίά δάνΰάάε ίέά άδάίá÷ñçόέίιδιέΠόέίç άάόέεΠ άέάέειεΠεç έάε Ύία άñèññóυ άέόάεΎόέίι οί ιδιβι ιδιναβ ίά άδάέόάέάβ ίά δññóέάόά (plugins). Ίδιναβόά ίά οίι άάέάόάόδΠόάόά όυοί άδύ δάεΎόι, ùοί έάε άδύ οί port, multimedia/xine.

Οί xine άβίάε άέυία εÛδóδ ÷ίιόñíεñΎίí, άέεÛ όβαιόñά Ύ÷άε ίάέείΠόάέ έάεÛ. Óόçi δñÛίç, οί xine ÷ñάεÛάέάέ άβόά άñΠáíñí άδάίáñáάόδΠ έάε εÛñόά άñάόέεΠί, Π όδιόόΠñέç όçδ άδΎέόάόçδ XVideo. Οί άñάόέέυ δάñέáÛέέίí άβίάε ÷ñçόέίιδιέΠόέίí, άέεÛ εÛδóδ άáΎίέά όδέάáíΎίí.

Óçi πñά δίο άñÛοίίόάί άδóΎδ ίε άñάíΎδ άáί άέάίΎίίόάί module ίάæβ ίά όçi άόάñíñāΠ xine, έέάίú ίά αίαδάνΰάάέ DVD ίά CSS έùάέέίιδιέΠόçç. ÓδÛñ÷ίοί άέάυόάέό άδύ δñβόιόδ έάόάόέάόάόΎδ ίε ιδιβάδ Ύ÷ίοί άίόύñάόύñίí οί δάñάδÛíñ module άέεÛ έάίέÛ άδύ άδóΎδ άáί άñβόέάόάέ όόçi όδέέίñΠ όύí ports δίο FreeBSD.

Óά όýάèñέόç ίά οίι MPlayer, οί xine εÛίάέ δάñέόόύδάñά άέά οί ÷ñΠόçç, άέεÛ όçi βάάά όδέάñΠ, άáί άδέόñΎδάέ όυοί έáδóññáñάέάέυ Ύέάá÷í. Οί xine άδññβάάέ έάέýόάñά όά έάέόίοññάβá XVideo.

Άδύ δññάδέέίñΠ, οί xine έά ίάέείΠόάέ όά άñάόέέυ δάñέáÛέέίí (GUI). Ίδιναβόά ίά ÷ñçόέίιδιέΠόάόά οί ίáñíý άέά ίά άñβίáόά Ύία όδάέάèñέίΎίí άñ÷άβι:

```
% xine
```

ΆίάέέάέόέέÛ, ιδιναβόά ίά οίι έάέΎόάόά ίά αίαδάνΰάάέ Ύία άñ÷άβι άδάόεάβάδ άδύ όçi άñάñΠ άίόίεΠί, ÷ùñβδ όç ÷ñΠόç οίό GUI:

```
% xine -g -p mymovie.avi
```

7.4.2.3 Óá ΆίçèçóέέÛ ΔññáñÛííáόά transcode

Ç άόάñíñāΠ transcode άáί άβίάε δññάñáíá αίαδάνάáùāΠò, άέεÛ ίέά όίόβόά άñάέέάβύí άέά άδάίáέùάέέίιδιέΠόçç άñ÷άβύí video έάε Π÷ίò. Ίά όçi άόάñíñāΠ transcode, Ύ÷άόά όçi άοίάόύόçδά ίά αίáñβíáόά άñ÷άβá video, ίά άδέόέáóÛόάόά ÷άέάóίΎία άñ÷άβá, ÷ñçόέίιδιέΠίόάό άñάάέάβá όçδ άñάñΠò άίόίεΠί όά ιδιβá ÷άέñβάεííόάέ άáñΎία άδύ όά έάίÛέέά stdin/stdout.

ΊάáÛέί δεΠείò άόάñíñāΠί ιδιñíý ίά έάέíñέόόίγί έάόÛ όç άέÛñέάέά όçδ ίάόάάέβδóέόçδ οίό port multimedia/transcode έάε όοίέόόίγίά όçi άέυέίιδèç άñάñΠ άίόίεΠί άέά όç ίάόάάέβδóέόçδ οίό transcode:

```
# make WITH_OPTIMIZED_FLAGS=yes WITH_LIBA52=yes WITH_LAME=yes WITH_OGG=yes \
  WITH_MJPEG=yes -DWITH_XVID=yes
```

Ίέ δññíόέíñíáíáό άδέέίñΎδ άβίάε έάóÛέέçέáδ άέά όίòδ δάñέόόύδάñíòδ ÷ñΠόάό.

Άεά ίά οάο άάβηιόια όεό έεάιυόϗόάο όιό transcode, άάβόά Ύία δάνΰάεάια ίάόάοηιόϑό άη÷άβιό DivX οά PAL MPEG-1 (PAL VCD):

```
% transcode -i input.avi -V --export_prof vcd-pal -o output_vcd
% mplex -f 1 -o output_vcd.mpg output_vcd.m1v output_vcd.mpa
```

Όι άη÷άβι MPEG διό δηιέϑόάέ, όι output_vcd.mpg, ίδιηάβ ίά άιάδάνά÷εάβ άδϑ όι **MPlayer**. Ϊδιηάβόά άδβόϗό ίά άηΰόάόά όι άη÷άβι οά Ύία CD-R άεά ίά άϗιέιόηάϑόάόά Ύία Video CD, έεά όϗί δάνβδόϑϗό άόδϑ έά ÷ηάέάόόάβ ίά άάέάόάόδϑόάόά όά δηιάνΰιάόά multimedia/vcdimager έεά sysutils/cdrdao.

Όδΰη÷άέ οάεβάά manual άεά όι transcode, άέεΰ δηΎδάέ άδβόϗό ίά όοιάρεάόόάβόά όι transcode wiki (<http://www.transcoding.org/cgi-bin/transcode>) άεά δάνέόόυόάηάο δέϗηιόηβάο έεά δάνάάβαιάόά.

7.4.3 ΆδέόέΎιί Άέΰάάόία

Όδΰη÷άέ ηάάάάβά άιΎέειϗ όόά άεάέΎόείά δάέΎόά video άεά όι FreeBSD. Άβιάέ άηέάοΰ δέεάιυ υόέ όόι ΰιαόι ίΎέειι δρεεΰ άδϑ όά δηιάεϑιαόά όιό άιάόΎηιόάέ άαϑ έά Ύ÷ιόι άδέεόεάβ. Όόι άιάέΰιαόι άεΰόϗία, υοίε άιάέάόΎηιόάέ ίά ÷ηϗόειηδιέϑόιόι όεό άοιάρυόϗόάο A/V όιό FreeBSD όόι Ύδάειηι έά δηΎδάέ ίά όοιάρεάόόά άηϑόάέό άδϑ άεΰοιηά FAQ έεά tutorials έεά ίά ÷ηϗόειηδιέϑόιόι άηέάόΎό άεάόηιηάόέΎό άόάνηιαΎό. Όι όιϑία άόόυ όδΰη÷άέ άέηέαϑό άεά ίά άάβηάέ όόηι άιάάηϑόϗό διό ίδιηάβ ίά άηάέ όΎόιέάο δηιόέάόάο δέϗηιόηβάο.

ϗ Όάειϗηβϑόϗό όιό Mplayer (<http://www.mplayerhq.hu/DOCS/>) άβιάέ άηέάοΰ δέϗηιόηβάέϑ υοί άοηηΰ όι όά÷ίέευι άδβδάάι. Άί Ύ÷άόά όέιδϑυ ίά άδιέόδϑόάόά όϗϗέυι διόιόόυ άιδάέηβάο όά ό÷Ύόϗ ίά όι video όόι UNIX, έά δηΎδάέ ιδϑόαϑδιόά ίά όϗί όοιάρεάόόάβόά. ϗ εβόόά άέεϗειηάόβάο όιό **MPlayer** άβιάέ ά÷έηέεϑ όά υδιέιι άάρ Ύ÷άέ εΰίαέ όηι έυδι ίά άεάάΰόάέ όϗί όάειϗηβϑόϗό, Ύόόέ άί όέιδáyάόά ίά εΰίαόά άιάόηιΎό όόάειΰόυι, άάάάέυεάβόά υόέ όϗί Ύ÷άόά άεάάΰόάέ.

Όι xine HOWTO (http://dvd.sourceforge.net/xine-howto/en_GB/html/howto.html) δάνέΎ÷άέ Ύία έάοΰεάει ό÷άόέεΰ ίά όϗί άάεόβϑόϗό δϗό άδϑάιόϗό, όι ίδιβι άβιάέ έιέιυ άεά υεά όά δηιάνΰιηάόά άιάδάνάάυάϑό.

ΌΎέιό, όδΰη÷ιόι εΰδιέάο ΰεεάο δρεεΰ όδιό÷ιιάρίάο άόάνηιαΎό διό βόυδ άδέεοιάβόά ίά άιέειΰόάόά:

- Όι Avifile (<http://avifile.sourceforge.net/>) όι ίδιβι άβιάέ άδβόϗό port, multimedia/avifile.
- Όι Ogle (<http://www.dtek.chalmers.se/groups/dvd/>) όι ίδιβι άβιάέ άδβόϗό port, multimedia/ogle.
- Όι Xtheater (<http://xtheater.sourceforge.net/>)
- Όι multimedia/dvdauthor, όι ίδιβι άβιάέ άόάνηιηάϑ DVD authoring άιέέόιϑ έϑάέέά.

7.5 Νϑέιέόϗ Έΰηόάο Όϗέάϑηάόϗό

Άη÷έεϑ όοιάρέόοηηΰ άδϑ όηι *Josef El-Rayes*. Άάεόεϑεϗέά έεά δηιόάνηιυόϗέά άδϑ όηι *Marc Fonvieille*.

7.5.1 Άέόάϑϑάϑ

Ϊέ εΰηόάο όϗέάϑηάόϗό όάο άδέοηΎδιόι ίά άεΎδάόά όϗέάϑηάόϗό, έάηιέεϑ ϑ έάέυεάέεϑ, όόηι όδρειηέόδϑ όάο. Ϊέ δάνέόόυόάηάο άδϑ άόόΎό άΎ÷ηιόάέ άδβόϗό όϑία όϑίεάόιό (composite) video, ίΎόυ άέόόυάιό RCA ϑ S-video, έεά εΰδιέάο άδϑ άόόΎό άεάέΎόιόι έεά ηάέιόυιέέυι άΎέόϗ FM.

Όι FreeBSD δάνΎ ÷ áε οδιόοΠνείç áεά εΰñοάο TV όýðιό PCI ðιό ÷ ñçόειιðιερίγί όά ιειεεçñùιΎία εοέεβιαόά όýεεçøçò video, Brooktree Bt848/849/878/879 P Conexant CN-878/Fusion 878a ιά όι ðñüãñàιιá ιäΠäçόçò bktr(4). Έά ðñΎðáε áðβόçò ιά ááááειèèáβòá υέε ç εΰñόά Ύñ ÷ áόάε ιά äΎέοç ðιό οδιόόçñβæáόάε. Όοιäιòεäòòáβòá όç óáεβáá manual όιό bktr(4) áεά ιά äáβòá όç εβòóá όυι οδιόόçñεäυιäíυι äáεòβι.

7.5.2 Άεέάεέοόβριόάο όι Δñüãñàιιá ιäΠäçόçò

Άεά ιά ÷ ñçόειιðιεβóáòá όçι εΰñόά εά ðñΎðáε ιά οιñòβóáòá όι ðñüãñàιιá ιäΠäçόçò bktr(4), ðñιόεΎοιíόáò όçι áευειòεç äñàιιΠ όοι äñ ÷ äβι /boot/loader.conf:

```
bktr_load="YES"
```

Άιáεεáεέοέεΰ, ιðιñáβòá ιά ðñιόεΎόáòá óóáόεεΠ οδιόόΠνείç áεά όçι εΰñόά όοι ððñβιá óáò, εáε áεά όι óειðυ áóòυ ðñιόεΎόáò όέò áευειòεäò äñàιιΎò όοι äñ ÷ äβι ñöειβóáυι όιό ððñβιá:

```
device bktr
device iicbus
device iicbb
device smbus
```

Ίε äðéðñυóεäοιέ ιäçàιβ óóóεäòβι äβιáé áðñáβòçòιέ, äðáéäΠ óá äñáñòβιáόá όçò εΰñόáò äðéειéιíυιγί ιäóáιγύ όιòò áεáιΎοιό áíυò áεáγειό I2C. Áοιγύ εΰíáòá όέò äðñáβòçòáò áεεááΎò όοι äñ ÷ äβι, ιäóááευòòβóóá εáε ááεáóáóòβóóá όι γΎι ððñβιá.

Ίυεέò óáεáεβóáòá ιá áóòΠ όç áεááεéáóβá, εá ðñΎðáε ιá äðáíáεεéιβóáòá όι óγóόçιá óáò. Έáóΰ όç áεΰñεáéá όçò áεéβιçόçò, εá ðñΎðáε ιá äáβòá εΰðιεá ιçγίγíáόá áðu όçι εΰñόá óáò, υðυò óá ðáñáεΰòυ:

```
bktr0: <BrookTree 848A> mem 0xd7000000-0xd7000fff irq 10 at device 10.0 on pci0
iicbb0: <I2C bit-banging driver> on bti2c0
iicbus0: <Philips I2C bus> on iicbb0 master-only
iicbus1: <Philips I2C bus> on iicbb0 master-only
smbus0: <System Management Bus> on bti2c0
bktr0: Pinnacle/Miro TV, Philips SECAM tuner.
```

Όòóεéεΰ, óá ιçγίγíáόá áóòΰ εá áεáóΎñιόι áíΰειäá ιá όι óεéευι óáò. ΰóòυóι εá ðñΎðáε ιá áεΎáíáòá υέé áιέ ÷ ιáγέçéá óυóóΰ ι äΎέοçò. Άβιáé áοιáóυι ιá áεεΰíáòá εΰðιεäò áðu όέò ðáñáιΎòñιòð ðιό áιέ ÷ ιáγέçéáι ÷ ñçόειιðιεβριόáò MIBs όιό sysctl(8) εáεβò εáε äðéειäΎò όοι äñ ÷ äβι ñöειβóáυι ððñβιá. Άεά ðáñΰááεäιá, ιá εΎéáòá ιá äðéáΰεäòá ι äΎέοçò ιá äβιáé όýðιό Philips SECAM, εá ðñΎðáε ιá ðñιόεΎόáòá όçι áευειòεç äñàιιΠ όοι äñ ÷ äβι ñöειβóáυι όιό ððñβιá óáò:

```
options OVERRIDE_TUNER=6
```

Π ιðιñáβòá ιá ÷ ñçόειιðιεβóáòá áðáòεäβáò όι sysctl(8):

```
# sysctl hw.bt848.tuner=6
```

Άáβòá όç óáεβáá manual όιό bktr(4) εáεβò εáε όι äñ ÷ äβι /usr/src/sys/conf/NOTES áεá ðáñéóóυιòáñáò éäðòñΎñáεäò ó ÷ áóééεΰ ιá όέò áεáéΎóειäò äðéειäΎò.

7.5.3 ×ñβóειäò ΆóáñιιáΎò

Άεά ιά ÷ ñçόειιðιεβóáòá όçι εΰñόá όçεäυιñáóçò, εá ðñΎðáε ιá ááεáóáóóòβóáòá ιéá áðu όέò ðáñáεΰòυ áóáñιιáΎò:

- Οι multimedia/fxtv δάνΥ ÷ έε äοίαδουόçοά ίά äâßðä òçεäüñáόç òá δάνΰεδñï, έεεþð έεέ òçί äοίαδουόçοά όýεεççθçð áέέüíáð / P÷ïð / video.
- Οι multimedia/xawtv άβίάέ áδßóçð áðάñïřã þçεäüñáόçð, ίά äοίαδουόçοάð üìéáð ίά òì fxtv.
- Οι misc/alevt άðίέüäέéíðíéáß έεé áðάέέířβæάé Videotext/Teletext.
- Οι audio/xmradio άβίάέ ίεά äóáñïřã þεά ίά ÷ ñçóέíïðíéÞóáðä òì äΰέðç FM ðïð άβίάέ άίóóíáðüíΰίïð òá éΰðíéáð éΰñðáð òçεäüñáόçð.
- Οι audio/wmtune άβίάέ ίεά áíéέéÞ desktop άðάñïřã þεά ñáάéíøüíééíýð äΰέðäð.

Ìðïñáßðá ίά äñáßðá ðáñéóóüðáñäð áðάñïřãΰð òçç òçééíãÞ òúì Ports òïð FreeBSD.

7.5.4 Άίόείάδòþðέόç Ðñïäέçìΰòúì

Άί άίόείάδòþðóáðá éΰðíéí ðñüäέçíá ίά òçί éΰñðá òçεäüñáόçð, εá ðñΰðáé ðñþðá ίά äéΰáíðá άί òì íéíέççñüíΰί òýéεççθçð video έεεþð έεέ í äΰέðçð ððίόðçñþæířðáé áðü òì ðñüäñáííá íãÞäçðçð bkt(4) έεέ άί ΰ ÷ äðä ÷ ñçóέíïðíéÞóáé òέð òúóóΰð ñðèíðóáéð òóéð äðééíãΰð óáð. Άέά äðéðéΰίí ððίόðÞñέίç έεεþð έεέ äéΰóíñäð äñüðÞóáéð ò ÷ äòééΰ ίá òçί éΰñðá óáð, βòðð éΰέäðά ίά äðééíéíüíÞóáðá ίά òç έβððá freebsd-multimedia (<http://lists.FreeBSD.org/mailman/listinfo/freebsd-multimedia>) έεέ ίά äέááΰòäðä òέð ðáέέúðäñäð äçïíóéáýóáéð áðü òá äñ ÷ äßá òçð έβððáð.

7.6 Óáñüôΰò Άέέüíáð

Άñΰòçéá áðü òίí Marc Fonvieuille.

7.6.1 ΆέóáäüãÞ

Όðï FreeBSD ç ðñüóááóç óá óáñüôΰð δάνΥ ÷ äðáé áðü òì SANE (Scanner Access Now Easy) API òì íðíβí äέáðßéäðáé ίΰóá áðü òçί òçééíãÞ òúì Ports òïð FreeBSD. Οι SANE ÷ ñçóέíïðíéáß áðßóçð éΰðíéíðð ïäçáíýð òðóéäðþí òïð FreeBSD äέά ίά äðíéðÞóáé ðñüóááóç òðí òééú òïð óáñüðÞ.

Οί FreeBSD ððίόðçñþæάé óáñüôΰð SCSI έεé USB. Άääáéúèáßðä üðé í óáñüðÞð óáð ððίόðçñþæáðáé áðü òì SANE ðñéí íáééíÞóáðá íðíéááÞðíðä ääέáðΰóðáóç έεé ñýéíέçð. Οι SANE äέáéΰðáé ίεά έβððá ððίόðçñéæüíáíüí òðóéäðþí (<http://www.sane-project.org/sane-supported-devices.html>) ç íðíβá δάνΥ ÷ äé ðéçñíòíñβäð äέá òçί ððίόðÞñέίç éΰèä óáñüðÞ έεέ òçί άíΰέéίç òçð. Όá òðóðÞáðá ðñéí òì FreeBSD 8.X έá äñáßðá áðßóçð òç έβððá òúì ððίόðçñéæüíáíüí USB óáñüðþí òçç óáέβáá manual òïð usscanner(4).

7.6.2 Ñýèέóç òïð ÐðñÞá

¼ððð áßðáíá ðáñáðΰίíü, ððίόðçñþæířðáé óáñüôΰð òúóí SCSI üóí έεέ USB. Άíΰéíäá ίá òì ðñüðí äέáðýíááóçð òïð óáñüðÞ óáð, έá ÷ ñáέáóðáßðä äέáòíñäðééíýð íäçáíýð òðóéäðþí.

7.6.2.1 Άέáóýíäáóç USB

Ì ððñÞάð GENERIC, áðü ðñüäðééíãÞ, ðáñéΰ ÷ äé òïðð íäçáíýð òðóéäðþí ðïð äðάέóíýíðáé äέá òçί ððίόðÞñέίç óáñüðþí USB. Άί äðíóáóβòáðá ίά ÷ ñçóέíïðíéÞóáðä áíáέäέéäòíΰí ððñÞá, äääáéúèáßðä üðé ΰ ÷ äðä òέð äéüéíðéäð äñáíΰð òòí äñ ÷ äβí ñðèíðóáúí óáð:

```
device usb
device uhci
device ohci
device ehci
```

Όά οδδδΠιάόά δñεί οἱ FreeBSD 8.X, έά ÷ñάέάοδάβδά άδβδδδ όγἱ δάνάέΌδδ άñάἱΠ:

```
device uscanner
```

Όά άδδΎδδ δέδδ άέάἱόάέδδ οἱδδ FreeBSD, ό δδἱόδΠñείό όἱδδ όάνἱδΠἱ USB άβἱάδάέ ἱΎούδ όόδδάδΠδδ uscanner(4). Άδἱ οἱ FreeBSD 8.0 έάέ ἱάδΌ, ό δδἱόδΠñείό άδδΠ δάνΎ ÷άδάέ άδδδέάβδδ άδἱ όό άέάέείεΠέό libusb(3).

ΆόἱΎ άδδἱάέέείΠδδάδ ἱά οἱ οἱδδδδ δδñΠἱά, οδἱάΎόδδ οἱ USB όάνἱδΠ δάδ. Έά δñΎδδάέ ἱά άάβδδά ἱέά άñάἱΠ δ ÷άδέέΠ ἱά όόἱ άἱβ ÷ἱάδδδδ οἱδδ όάνἱδΠ δόόἱ δñἱούñείΠ ἱΠἱό όἱόἱΌδἱ οἱδδ όδδδΠιάδἱδδ (dmesg(8)):

```
ugen0.2: <EPSON> at usb0
```

Π όά Ύἱά όόόδόἱά FreeBSD 7.X:

```
uscanner0: EPSON EPSON Scanner, rev 1.10/3.02, addr 2
```

Όά ἱόἱἱἱάδδ άδδΌ άάβ ÷ñἱδἱ ἱδέ ἱ όάνἱδΠδδ ἱάδ ÷ñόόείἱδἱέάβδδ όόἱ όδδέάδΠ /dev/ugen0.2 Π όόἱ όδδέάδΠ /dev/uscanner0 άἱΌείἱά ἱά όόἱ Ύέἱἱόό οἱδδ FreeBSD δἱδ ÷ñόόείἱδἱέάβδδάέ. Όοἱ δάνΌάέάἱἱ ἱάδ, ÷ñόόείἱδἱέΠδδἱά ἱἱά όάνἱδΠ EPSON Perfection® 1650 USB.

7.6.2.2 Άέάόἱἱάόό Όόἱδδ SCSI

Άἱ ἱ όάνἱδΠδδ δάδ Ύñ ÷άδάέ ἱά άέάόἱἱάόό όόἱδδ SCSI, άβἱάέ όόἱἱάέέἱ ἱά άἱññβάέδδά δέ έΌñδά άέάάέδΠ SCSI έά ÷ñόόείἱδἱέΠδδάδ. ΆἱΌείἱά ἱά οἱ ἱείέέόñἱἱΎἱ έύέέἱἱά όόδ έΌñδάδ SCSI δἱδ ÷ñόόείἱδἱέάβδδάέ, έά δñΎδδάέ ἱά ñδἱβδδάδά έάδΌέέόά οἱ άñ ÷άβἱ ñδἱβδδάἱ δδñΠἱά. ἱ δδñΠἱάδ GENERIC δδἱόδόόñβάέέ οἱδδδ δεί έείἱἱόδ άέάάέδΎδ SCSI. Άάάάέἱέάβδδά ἱδέ άέάάΌόάδδ οἱ άñ ÷άβἱ NOTES έάέ δñἱόέΎόδδ όό όἱδδΠ άñάἱΠ δοἱ άñ ÷άβἱ ñδἱβδδάἱ δδñΠἱά. Άέδἱδδ άδἱ οἱ δñἱάñἱἱἱ ἱάβάόόδδ οἱδδ άέάάέδΠ SCSI, έά δñΎδδάέ άέἱἱἱ ἱά Ύ ÷άδδ δέδδ άέἱἱἱδἱέδδ άñάἱΎδ δοἱ άñ ÷άβἱ ñδἱβδδάἱ οἱδδ δδñΠἱά δάδ:

```
device scbus
device pass
```

ἱἱέδδ ἱάδδάέἱδδδδδδδδάδ έάέ άάέάόδδδδδδδδδδ οἱδδ δδñΠἱά, έά ἱδἱñΎόάδδ ἱά άάβδδά δέδδ όδδέάδΎδδ όόἱ δñἱούñείΠ ἱΠἱό όἱόἱΌδἱ όδδδΠιάδἱδδ, έάδΌ όό άέΌñέάέά όόδ άέέβἱόόδδ:

```
pass2 at aic0 bus 0 target 2 lun 0
pass2: <AGFA SNAPSCAN 600 1.10> Fixed Scanner SCSI-2 device
pass2: 3.300MB/s transfers
```

Άἱ ἱ όάνἱδΠδδ δάδ άἱΠ δδἱά ἱάñἱἱἱἱἱέόἱΎἱδ έάδΌ όόἱ άέέβἱόόδδ οἱδδ όδδδΠιάδἱδδ δάδ, άβἱάέ άέἱἱἱά άδἱάδἱἱ ἱά ἱἱἱἱάέΌόάδδ οἱδδ ἱἱἱἱδἱέοἱἱ οἱδδ, άέδδἱεΠἱάδδ άἱβ ÷ἱάδδδδ οἱδδ άέάἱἱἱ SCSI ἱά όόἱ ἱΠεάέά όόδ ἱἱἱἱδδδδ camcontrol(8):

```
# camcontrol rescan all
Re-scan of bus 0 was successful
Re-scan of bus 1 was successful
Re-scan of bus 2 was successful
Re-scan of bus 3 was successful
```


ΈαöÜεάεί 8 Νõèìβæíïôáò ôíí ðõñÞíá ôíõ FreeBSD

Αίáíáþεççää éάέ áúááüíÞεççää áðu ôíí Jim Mock. Άñ÷έεÞ óóíáέóóüñÜ áðu ôíí Jake Hamby.

8.1 Óýíïç

Ï ðõñÞíáð áβíáε ç éáñáεÜ ôíõ εάέóíõñáέéíý óóóðÞíáóíõ FreeBSD. Άβíáε ððáýεðíõð áεά ðç áεά÷áβñέóç ðçð ïíÞíçð, ðçí áðεáíεÞ ðúí ñðèìβóáúí áóóáέáβáð, ðç áέέðýúóç, ðçí ðñúóááóç óóí áβóεí, éάέ ðíεεÜ Üεεά. Íá óóíá÷þð áóíáíúíáíí ïÝñíð ôíõ FreeBSD ïðíñáβ íá ñðèìέóðáβ áóíáíέεÜ, áεεÜ ððÜñ÷íõí áέúíá ðáñέððþóáέð íε ïðíβáð áðáέóíýí ñðèìβóáέð éάέ ïáðááεùððéóç ôíõ ðõñÞíá ôíõ FreeBSD ïá ðñíóáñíúíóíÝíáð ðáñáíÝðñíðð.

Άóíý áεάáÜóáðá áðóú ôíí έáöÜεάεί, εά íÝñáðá:

- Άέá ðíέíðð εüáíõð ïðíñáβ íá ÷ ñáέáóðáβ íá ððεÜíáðá Ýíá ðñíóáñíúíóíÝíí ðõñÞíá.
- Ðùð íá áñÜþáðá Ýíá áñ÷áβí ñðèìβóáúí ðõñÞíá, Þ íá áεεÜíáðá Ýíá ððÜñ÷íí áñ÷áβí ñðèìβóáúí.
- Ðùð íá ÷ñçóéííðíεÞóáðá ðíí áñ÷áβí ñðèìβóáúí ôíõ ðõñÞíá áεά íá ððεÜíáðá éάέ íá ïáðááεùðððóáðá Ýíá íÝí ðõñÞíá.
- Ðùð íá ááέáóáóðÞóáðá ôíí íÝí ðõñÞíá.
- Ðùð íá áðέέýóáðá ðó÷úí ðñíáεÞíáðá ïá ðíí íÝí ðõñÞíá.

¼εáð íε áíóíεÝð ðíõ áíóáíβæííðáε óá áðóú ôíí έáöÜεάεί ùð ðáñáááβáíáðá ðñÝðáε íá áεðáεáóóíýí ùð root áεά íá áβíáε áðέóð÷áβð.

8.2 Άέáðβ íá ÖðéÜíáðá ðñíóáñíúíóíÝíí ðõñÞíá;

ΈáðÜ ðáñÜáíóç, ôíí FreeBSD áβ÷á áðóú ðíõ áðíéáéíýíá “ííñέέέéú” ðõñÞíá. Άðóú óçíáβíáε ùðé ï ðõñÞíáð Þóáí Ýíá ïááÜεí ðñúáñáíú, ððíóðÞñεάá Ýíá óðáεáñú áñέúíú óóóéáðÞí, éάέ áí εÝεáðá íá áεεÜíáðá ðç óóíðáñεóíñÜ ôíõ, éá Ýðñáðá íá ïáðááεùðððóáðá éάéíýñéí éάέ íá áðáíáέéíÞóáðá ôíí ððíéáέóðÞ óáð ïá áðóúí.

ÓÞíáñá, ôíí FreeBSD éέíáβóáε ðá÷ýóáðá ðñíð Ýíá ïíóÝéí ùðíõ íε ðáñέóóúðáñáð éάέóíõñáβáð ôíõ ðõñÞíá ðáñéÝ÷ííðáé óá modules (áññêñíáðá) ðá ïðíβá ïðíñýí íá ïíñðùέíýí éάέ íá áðíóíñðùέíýí éáðÜ áðáβðçóç, áóíáíέεÜ óóíí ðõñÞíá. Άðóú áðέðñÝðáε óóíí ðõñÞíá íá ðñíóáñíúááðáε óá ðεέεú ôíí ïðíβíí áíáñáíðíεáβðáé ðç áááñÝíç óóéáíÞ (úðùð áεά ðáñÜáεéáíá ùðáí áέóÝñ÷áðáé íεá éÜñóá PCMCIA óá Ýíá ïíñçóú ððíéáέóðÞ). Άðβóçð áðέðñÝðáε óóíí ðõñÞíá íá áðáέðáβíáε áóíáíέεÜ ðç éάέóíõñáεéúðçðÜ ôíõ, ðñíóéÝóííðáð ÷ áñáέðçñέóðééÜ ðá ïðíβá ááí Þóáí áðáñáβðçðá ùðáí áβ÷á ïáðááεùððéóðáβ áñ÷έεÜ. Άóóíý ôíõ áβáíõð í ðõñÞíáð áβíáε áíñóóúð ùð modular (áññêñóúð).

Ðáñ' ùεá áðóÜ, áβíáε áέúíá áðáñáβðçðí íá áβñíóí éÜðíεáð óðáóééÝð ñðèìβóáέð óóíí ðõñÞíá. Óá ïñέóíÝíáð ðáñέððþóáέð, áðóú óóíááβíáε áðáέáÞ ç óðáéáñéíÝç éάέóíõñáβá áβíáε óúóí óóáíÜ óóíááíÝíç ïá ôíí ðõñÞíá þóðá ááí ïðíñáβ íá ïíñðùέáβ áóíáíέεÜ. Óá Üεεáð, óóíááβíáε áðáέáÞ áðεÜ éáíáβð ááí Ý÷áε áέúíá áó÷íεççáβ íá áñÜþáε Ýíá áóíáíέéú module ðíõ íá ðáñÝ÷áε áððÞ ðç éάέóíõñáééúðçðá.

Ç áçíéíðñáβá ðñíóáñíúíóíÝííð ðõñÞíá áβíáε áðu ðéð ðεÝíí óçíáíðééÝð ðáεáóíõñáβáð éÜεá ðñí÷úñççíÝííð ÷ñÞóçç ôíõ BSD. Ç áεάáέéáóáá áððÞ, áí éάé ÷ñííáúñá, éá áðíááβ éάέáβðáñá ùðÝέéíç áεά ôíí FreeBSD óýóðçíá óáð. Óá áíðβεáóç ïá ôíí ðõñÞíá GENERIC, ï ïðíβíð ðñÝðáε íá ððíóðçññíáε ïááÜεí áýñíð óóóéáðÞí, Ýíáð ðñíóáñíúíóíÝííð ðõñÞíáð ðáñéÝ÷áε ððíóðÞñéíç íúíí áεά ôíí ðεέéú ôíõ áέéíý óáð ððíéáέóðÞ. þóé Ý÷áðá éÜðíεά ïÝέç, ùðùð:


```
device pmtimer
```

Δημιουργία πακέτου χρόνου (Timer) αέα οδοιούα διο ο-αόβαιτόαε ιά αέα-άβηέοο αίΥηάαέοο υδου οι APM εάε οι ACPI.

```
# PCCARD (PCMCIA) support
# PCMCIA and cardbus bridge support
device cbb # cardbus (yenta) bridge
device pccard # PC Card (16-bit) bus
device cardbus # CardBus (32-bit) bus
```

ΌδιοόΠηέοο PCMCIA. Οοί ο-ηάέΰαάοά αί ο-ηοόειοδιέαβόα οιηοοι οδιοέαέοοΠ.

```
# Serial (COM) ports
device sio # 8250, 16[45]50 based serial ports
```

Δημιουργία αέα οέο οάεήεάέΎο εύνηαο ιέ ιοιβαο αβίαε αηοόΎο οοιι ειοοι οιο MS-DOS/Windows υο εύνηαο COM.

Οοίαβούο: Αί Υ-άοά άουοάηέεϋ ιυίοαι οοο εύνηα COM4 εάε Υ-άοά εάε οάέηέαεΠ εύνηα COM2, εά δηΎδαε ιά αέεΎιαόά οι IRQ οιο ιυίοαι οοι 2 (αέα δάηβαηάιτο δά-ιέέιγο εϋάιτο, IRQ2 = IRQ 9) αέα ιά ιδιοΎοάοά ιά οι ο-ηοόειοδιέΠοάοά αδϋ οι FreeBSD. Αί Υ-άοά εϋηόά διοεάδεπι οάέηέαεπι αηιαυι, αέΎαιόα οο οάεβαά manual οιο sio(4) αέα δάηέοοϋοάηαο δεοηιοιηβαο ο-άοέεϋ ιά οέο οϋοόΎο οειΎο διο δηΎδαε ιά διοέΎοάοά οοι /boot/device.hints. Εϋδιοέοο εϋηόαο αηαδεέπι (αέαεεϋ αοόΎο διο ααόβαιτόαε οά ιειεοοηυιγία S3) ο-ηοόειοδιέγί αέαοεγιοάεο IO ιηηοΠο 0x*2e8, εάε εάεπο διοέΎο οοοιγιο οάέηέαέΎο εϋηόαο ααί άδιοεαέειοιέγί δεΠηυο οο 16 bit δαηέο-Π αέαοεγιοάαυι, οοαεηιγιοάε ιά οέο εϋηόαο αοόΎο, εάέεοοπιόαο Ύοοε δηάεοέεϋ ϋ-ηοοόο οο εύνηα COM4.

Εϋεα οάέηέαεΠ δϋηόά ο-ηάέΰαάοά ιά Υ-άε ιέα ιηιαέεΠ IRQ (άέδϋο αί ο-ηοόειοδιέαβόα εϋηόα διοεάδεπι οάέηέαεπι διο διοίοοοηβαε ειέιΠ ο-ηοοοοο interrupts), εάε Ύοοε ααί ιδιοηιγί ιά ο-ηοόειοδιέοεγί οά δηηαδεεάιγία interrupts αέα οοί COM3 εάε οοί COM4.

```
# Parallel port
device ppc
```

Δημιουργία αέα οοί δάηΰεεοο εύνηα οοι αβαοει ISA.

```
device ppbus # Parallel port bus (required)
```

ΔάηΥ-άε διοίοοΠηέοο αέα οι αβαοει οοο δάηΰεεοοο εύνηαο.

```
device lpt # Printer
```

ΔάηΥ-άε διοίοοΠηέοο αέα αέδοδϋοΎο δάηΰεεοοο εύνηαο.

Οοίαβούο: ο-ηάέΰαάοά εάε οά οηβα δαηάδϋιϋ αέα ιά αιαηαηιοέΠοάοά οοί διοίοοΠηέοο αέδοδϋοοΠ δάηΰεεοοο εύνηαο.

```
device plip # TCP/IP over parallel
```

Δημιουργία αέα οι δημιουργία πακέτου αέέογιο ιΎοϋ δάηΰεεοοο εύνηαο.

οέο δάνΰεεççεάο αεάοοίάΎοάεο αάρ δνιάρΎθιρσάε άδεείτάρΎο ηγείεοçο άδεείείρσάο, εΰίρσάο όçί ηγείεοç όιθό άίάεήάοέεΰ άδθρ.

Ίε δάνΰεεççεάο αεάοοίάΎοάεο άβίάε άρσούΎο έάε ùο αεάοοίάΎοάεο “Centronics”, ιίήάοβά δνιάρ ÷ υιάρç άδθ όιρ όγθθ όιθ αεήιάρΎεοç όιθ άεοδδθδρ.

- Ίε αεάοοίάΎοάεο USB, οοίόηιήάοοβά άδθ όι Universal Serial Bus, αίθεάγίθι οά άέυιç ιάάάέγδάνάο οά ÷ γόçοάο άδθ όçί δάνΰεεççεç έάε όçί RS-232 οάεήεάερ αεάογίάάοç. Όά έάεθάεά όιθό άβίάε άθεΰ έάε οόçίΰ. Ç USB άβίάε άίρδάνç άδθ όçί Όάεήεάερ RS-232 έάε άδθ όçί Δάνΰεεççεç οόçί άεόγθδθç, άεεΰ άοόο ÷ θο αάρ οδθόçηβάεάοέ έάεΰ άδθ οά οόοθρσάοά UNIX. Ίάο θηυθίθ αεά ίά άθιργάάοά άοθθ όι θηυάεçίά άβίάε ίά άαηηΰόάοά άεοδδθδρ θιθ οΎηάε αεάογίάάοç USB έάε Δάνΰεεççεç, υδθο οοίάάβίάε ίά θιεείγθ άεοδδθδρ.

Άάίεεΰ, ιε Δάνΰεεççεάο αεάοοίάΎοάεο δνιάρΎηιθ οοίρθδθ ιβάο έάοάγέοθίοçο άδεείείρσά (άδθ όιρ οθιείρεόοθρ οοίρ άεοδδθδρ) άίρ ç οάεήεάερ έάε ç USB άβίθι άιθβάνηç. Όοί FreeBSD ιε θεί δνυοόάοάο δάνΰεεççεάο έγñάο (EPP έάε ECP) έάοάοΎηιθ άιθβάνηç άδεείείρσά ίά όιθό άεοδδθδρ, υοάί ÷ ηçοέηιθιείγίθάε έάεθάεά θιθ οοίηηθρηίθίάε ίά όι δνυοόθι IEEE-1284.

Ç άιθβάνηç άδεείείρσά ίά άεοδδθδρ αεάιΎοιθ δάνΰεεççεçο έγñάο ιθιήάβ ίά άθεοάο ÷ εάβ άάίεεΰ ίά άγί θηυθίθ. Ί θηθιθόο θηυθίθ ÷ ηçοέηιθιεάβ Ύίά θηιρσάνιθιΎίθ δνυάηιά ίάθρçοçο άεοδδθδρ, θρσά ίά ιθιήάβ όι FreeBSD ίά οοίηεεάβ οόçί άεθρσά όιθό άεοδδθδρ. Άοθθ άβίάε ογίçεάο ίά άεοδδθδρ inkjet έάε ιθιήάβ άθβόçο ίά ÷ ηçοέηιθιεçεάβ αεά άίάοηιΎο αεάεΎοέιçο θιρσούçοάο ίάεάιέγ έάε αεά Ύεεάο θεçηιρσάδ εάεοιρσάο. Ç άάγδάνç ιΎείηιθ ÷ ηçοέηιθιεάβθάε υοάί ι άεοδδθδρ Ύ ÷ άε άοίάουόçοά οθιόθρθείçο PostScript.

Ίε άηάάοβάο PostScript άβίάε οόçί δνιάρΰιθάοά θηιήάΰιθάο θιθ άθιόΎεείρσάε οοίρ άεοδδθδρ, αάρ άβίάε άδάνάβόçοι ίά δάνΰιθιθό άεοδδθρσάο, άίρ ιθιηίγί ίά άθεοθΎθιθιθ όι άθιθΎεάοίά όιθό άδάοεάβάο οοίρ οθιείρεόοθρ. Όι PostScript ÷ ηçοέηιθιεάβ άιθβάνηç άδεείείρσά αεά ίά άίçίηηρσάε όιρ οθιείρεόοθρ αεά οο ÷ υι δνιάρθρσάο, υδθο οοΰείηάοά οοι δνυάηιά PostScript θ ιθείεΰηεοίά θηιρσάοβάο ÷ άηοέγ. Ίε ÷ ηρσάο οάο, έα οάο άβίάε άοάθρηιήαο αεά άοθΎο οέο θεçηιρσάο. ΆθεθεΎι, ι έάέγδάνθο θηυθίθ αεά ίά εΰίάοά ουοόθρ έάοάιΎθηçοç ίά Ύίά άιθβάνηç άεοδδθδρ PostScript άβίάε: ίά ηυθρσάοά όιρ άεοδδθδρ αεά όçί οοηεεερ έάοάιΎθηçοç ουι οάεβάυιθ όιθ (θυοάο οάεβάο άεόγθδθά οά υεç όç αεΰηεάέά θυθθ όιθ), ίάοΰ ίά άθιρσάεάοά όçί άηάάοβά όιθ ÷ ηρσόç, έάε Ύθάεοά ίά ίάίάηυθρσάοά αεά όçί έάοάιΎθηçοç ουι οάεβάυιθ όιθ. ΆοάεηΎοάά οέο άγί θείΎο έάε έα άιηηβάεάοά θυοάο οάεβάο ίά ÷ ηρσάοά οοίρ ÷ ηρσόç.

9.3.1.1.2 Δάνΰεεççεάο Έγñάο

Άεά ίά οοίάΎοάοά Ύίάί άεοδδθδρ οά δάνΰεεççεç έγñά, οοίάΎοά όι έάεθάει Centronics ίάοάγ έεοδδθδρ έάε οθιείρεόοθρ. Ίε ιαçάβάο θιθ οοίηάγίθιθ όιρ άεοδδθδρ έάε όιρ οθιείρεόοθρ έα οάο έάειαçάρσθιθι ίά ιείεçηρσάοά όçί ογίάάοç.

Έοιçεάβθά θιεά δάνΰεεççεç έγñά ÷ ηçοέηιθιεάβθά οοίρ οθιείρεόοθρ. Ç θηθόç δάνΰεεççεç έγñά οοι FreeBSD άβίάε ç ppc0, ç άάγδάνç άβίάε ç ppc1, έάε ιγού έάεάιθ. Όι υήηά οόοέάοθδ όιθό άεοδδθδρ ÷ ηçοέηιθιεάβ όçί βάεά άηβειçοç: /dev/lpt0 αεά όιρ άεοδδθδρ οόçί θηθόç δάνΰεεççεç έγñά ε.θ.ε.

9.3.1.1.3 ΌάεήεάεΎο Έγñάο

Άεά ίά οοίάΎοάοά Ύίάί άεοδδθδρ ÷ ηçοέηιθιεθίθάο οάεήεάερ αεάογίάάοç, οοίάΎοά όι έάοΰεεççεί οάεήεάευ έάεθάει ίάοάγ έεοδδθδρ έάε οθιείρεόοθρ. Ίε ιαçάβάο θιθ οοίηάγίθιθ όιρ άεοδδθδρ έάε όιρ οθιείρεόοθρ οάο, έα οάο έάειαçάρσθιθι ίά ιείεçηρσάοά όçί ογίάάοç.

Άί αάρ άβθάά οβαηοιηε θιεί άβίάε όι “έάοΰεεççεί οάεήεάευ έάεθάει”, ιθιήάβθά ίά αιεείΰοάοά ιβά άδθ οέο αέυείρεάο άίάεεάεοέεΎο:

- Αἰ ἀέεοἰᾶβῶᾶ εᾶὀὔοῶᾶς εᾶέοἰῶῆᾶβᾶὀ polled, ἀεᾶᾶῆὔοῶᾶ ᾶῶ ὀἰ ᾶῆ ÷ ᾶβἰ /boot/device.hints, ὀςἰ ἀέὔεἰῶες ᾶῆᾶἰᾶᾶ:

```
hint.ppc.0.irq="N"
```

Ὀᾶ ἰᾶῆέὔῶ δᾶῆέδῶρῶε, ὀἰ δᾶῆᾶῶὔἰ ᾶᾶ ᾶβἰᾶε ᾶῆᾶῶἰ ᾶεᾶ ἰᾶ εὔῶᾶ ὀςἰ εὔῆᾶ ὀᾶ εᾶὀὔοῶᾶς polled. Ὀέὀ δᾶῆέοῶἰῶᾶῆᾶ ὀἰῆ ὀἰ δῆῆᾶεῆἰᾶ δῆῆῆῆ ÷ ᾶῶᾶε ᾶῶ ὀἰ ἰᾶῆᾶἰ acpi(4), ἰ ἰῶἰβἰῶ ὔ ÷ ᾶε ὀςἰ ᾶῶ ÷ ὔῆᾶεᾶ ἰᾶ ᾶᾶῶὔᾶεᾶε εᾶε ἰᾶ δῆῆῶᾶῆῶ ὀῶῶεᾶῶ ὔῶ, εᾶε ᾶῶῆ ὔῶῶ, ἰᾶ ᾶεὔᾶ ÷ ᾶε ὀἰ ὀῆῆῶἰ δῆῆῶᾶᾶῶ ὀῶῶἰ εὔῆᾶ ὀἰῶ ᾶεὀῶῶῶ. Ἐᾶ δῆῆῆᾶε ἰᾶ ᾶεὔᾶᾶᾶ ὀέὀ ῆῶεἰβῶᾶε ὀἰῶ acpi(4) ᾶεᾶ ἰᾶ ᾶεἰῆῶᾶᾶ ᾶῶἰ ὀἰ δῆῆᾶεῆᾶ.

2. Ἀῶἰεῆεᾶῶᾶ ὀἰ ᾶῆ ÷ ᾶβἰ. Ἴῶεἰβῶᾶ, ἰᾶῶᾶεὔῶῶῶῶ, εᾶε ᾶᾶᾶᾶᾶᾶᾶᾶ ὀἰ δῶῆᾶᾶ, εᾶε ὔῶᾶᾶ ἔὔἰᾶ ᾶῶᾶᾶᾶᾶᾶ. Ἀεᾶ δᾶῆέοῶἰῶᾶῆᾶ εᾶῶἰῆῆᾶᾶ, ᾶᾶῶᾶ ὀέὀ ῆῶεἰβῶᾶε ὀἰῶ δῶῆᾶᾶ.

Ἀεᾶ ἰᾶ εὔῶᾶ ὀςἰ εᾶὀὔοῶᾶς ἀέεἰἰῶἰᾶ ἰᾶ ὀἰ lptcontrol(8):

1. Δεῆεῶῆἰᾶᾶᾶ:

```
# lptcontrol -i -d /dev/lptN
```

ᾶεᾶ ἰᾶ εὔῶᾶ ὀςἰ εᾶὀὔοῶᾶς εᾶέοἰῶῆᾶᾶ interrupt-driven ᾶεᾶ ὀἰ lptN.

2. Δεῆεῶῆἰᾶᾶᾶ:

```
# lptcontrol -p -d /dev/lptN
```

ᾶεᾶ ἰᾶ εὔῶᾶ ὀςἰ εᾶὀὔοῶᾶς εᾶέοἰῶῆᾶᾶ polled ᾶεᾶ ὀἰ lptN.

Ἐᾶ ἰῶἰῆῶᾶ ἰᾶ εᾶᾶ ÷ ῆῆῶᾶᾶ ᾶῶὔῶ ὀέὀ ᾶἰῶἰῆῶ ὀἰ ᾶεῶἰ ᾶᾶ ᾶῆ ÷ ᾶβἰ /etc/rc.local. ῶῶε ἔᾶ ᾶέῶᾶἰῶᾶ ᾶῶἰᾶᾶ εᾶὀὔ ὀςἰ ᾶεἰβῶᾶ ὀἰ ὀῶῶᾶᾶᾶ ὀᾶ. Ἀεᾶ δᾶῆέοῶἰῶᾶῆᾶ δεῆῆῶἰῆᾶ ᾶᾶῶᾶ ὀἰ lptcontrol(8).

9.3.1.4 εᾶᾶ ÷ ἰῶ Ἀέεἰἰῶἰᾶ ὀἰ Ἀέῶῶῶᾶ

Δῆἰ ὀᾶ ÷ βῶἰῶᾶ ἰᾶ ῆῶεἰβᾶἰῶᾶ ὀἰ ὀῶῶῶᾶ δᾶῆἰ ÷ ὔῶᾶῶῶ, ἔᾶ δῆῆῆᾶε ἰᾶ ᾶᾶᾶᾶᾶᾶ ὀῶε ὀἰ εᾶέοἰῶῆᾶᾶ ὀῶῶῶᾶ ἰῶῆᾶ ἰᾶ ὀᾶᾶᾶᾶ ᾶῶῶ ÷ ᾶῶ ᾶᾶᾶ ὔᾶ ὀἰ ᾶέῶῶῶ ὀᾶ. Ἀβἰᾶε ᾶῶἰῶᾶᾶ ἰᾶ ἔὔῆῶᾶ ἰᾶ ÷ ῆῆῶῶ ὀςἰ ᾶῶᾶᾶᾶᾶᾶ ᾶῶᾶᾶ ὀἰ ᾶέῶἰῶἰᾶ ὀἰ ᾶέῶῶῶ ᾶεᾶ ὀςἰ ᾶῶᾶᾶᾶᾶᾶ ὀἰ ὀῶῶᾶᾶᾶᾶ δᾶῆἰ ÷ ὔῶᾶῶῶ.

Ἐᾶ ᾶεὔᾶῆῶᾶ ὀἰ ᾶέῶῶῶ ὀῶῶᾶ ἰᾶῆᾶᾶ ᾶᾶᾶ ὔᾶ ἔᾶεἰῆῶ. Ἀεᾶ ᾶεᾶᾶᾶ ὀἰ ᾶέῶῶῶ ὀἰ ἰῶἰῆῶ ἰᾶ ᾶέῶῶᾶᾶ ὔᾶῶ ὀἰ ÷ ᾶᾶᾶᾶᾶ ὀἰ ὔ ᄀ ÷ ἰῶἰ ᾶῶᾶᾶᾶᾶ, ὀἰ δῆῆᾶᾶᾶ lptest(1) ᾶβἰᾶε ὀὔᾶᾶᾶ: Δᾶῆᾶᾶ ὀἰ ᾶέῶῶᾶᾶ ὀἰ ᾶᾶᾶᾶᾶ ὀἰ ᾶᾶᾶᾶᾶ (96) ASCII ὀᾶ 96 ᾶᾶᾶᾶᾶ.

Ἀεᾶ ᾶέῶῶῶ ὀἰ PostScript (ᾶ ὀἰ ᾶᾶᾶᾶᾶ ὀᾶ ὔᾶᾶ ᾶῶᾶᾶ), ἔᾶ ÷ ῆᾶᾶᾶᾶ ἰᾶ ἔὔῆῶᾶ ὔᾶ ὀἰ δῆῆῆᾶᾶ ὀᾶᾶ. ἰᾶ ἰεῆῆῆ ὀἰ ᾶᾶᾶᾶᾶ PostScript, ὀἰ ὀᾶᾶ ὀἰ ᾶῶᾶᾶᾶ, ᾶῶᾶᾶᾶ:

```
%!PS
100 100 moveto 300 300 lineto stroke
310 310 moveto /Helvetica findfont 12 scalefont setfont
(Is this thing working?) show
showpage
```

Ἴ δᾶῆᾶῶᾶ ἔᾶᾶᾶ PostScript ἰῶῆᾶ ἰᾶ ὀἰ ᾶᾶᾶᾶ ὀᾶ ὔᾶ ᾶῆ ÷ ᾶβἰ ἔᾶε ἰᾶ ÷ ῆῶᾶᾶᾶ ὀἰ ὀᾶᾶᾶᾶ ὀᾶ ᾶᾶᾶᾶᾶᾶ ὀᾶ ᾶῶᾶᾶᾶ ᾶῶᾶᾶ.

Ὀςἰᾶᾶᾶ: ¼ᾶᾶ ᾶῶἰ ὀἰ ὔᾶᾶᾶᾶ ᾶᾶᾶᾶᾶ ὀᾶ ἰᾶ ᾶῶᾶᾶ ᾶέῶῶῶ, ᾶἰἰᾶᾶᾶ ἰᾶ ᾶῶᾶᾶ ὀᾶ ᾶ PostScript, ᾶῶᾶ ὀᾶ ᾶ PCL ὀᾶ Hewlett Packard — ᾶ PCL ᾶᾶᾶ ἰᾶ ᾶῶᾶᾶ ᾶῶᾶᾶᾶ ᾶῶᾶᾶᾶᾶ ᾶ ἰῶἰᾶ ᾶῶᾶᾶᾶ ὀᾶ ᾶῶᾶᾶ ᾶῶᾶᾶ ἰᾶ ᾶῶᾶᾶ ἰᾶ ᾶῶᾶᾶᾶ ᾶῶᾶᾶᾶ. ᾶ PostScript ᾶᾶ ἰῶἰᾶ ἰᾶ ᾶέῶῶᾶᾶ

ΰιαόά άδευ έαβιαίί, έάέ άδούο άβιαέ άεήεάρο ι όύθιο όçò αεραόόά άέοδδούδρ θίρ έά δñÝοάέ ίά
άέάοεάδρρίοία έάδΰεεçέά.

9.3.1.4.1 έαά÷ ιò Δάνΰεεçέίρ Άέοδδούδρ

Άδδρ ç áíυόçά όθραάέείγáέ θυò ίά άεÝáíáδά άί όι FreeBSD ίθíñáβ ίά άδεείείφίρραέ ίά Ýίáί άέοδδούδρ όοíááááíÝíí όά
δάνΰεεçέç έýñά.

Άέά ίά άεÝáíáδά Ýίáί άέοδδούδρ όά δάνΰεεçέç έýñά:

1. Άβίαόά root ίά su(1).
2. Óοάβεόά áááñÝίά όοίí άέοδδούδρ.
 - Άί ί άέοδδούδρδ ίθíñáβ ίά άέοδδρράέ άδευ έαβιαίί, όυόά ÷ ñçόείíθίέρρόά όι lptest(1). Δεçέοñíεíáρρόά:

```
# lptest > /dev/lptN
¼θίρ N άβιαέ ί άñέεíυò όçò δάνΰεεçέç έýñάό, ίάέείφίρρόά άδυ όι ίçáÝί.
```

- Άΰί ί άέοδδούδρδ έάόάέάάβιαέ PostScript P εΰθίέά ΰεεç αεραόά άέοδδούδρ, όυόά όοάβεόά Ýίá ίέέñí
δñυáñáíá όοίí άέοδδούδρ. Δεçέοñíεíáρρόά:

```
# cat > /dev/lptN
δάέόά δεçέοñíεíáρρόά όι δñυáñáíá ίβá θñíò ίβá áñáííP, θñíόάέοέέΰ, άέάοβ ááí ίθíñáβόά ίά άδáíáñááόόάβόά ίέά  
áñáííP άóυόθίρ Ý÷άόά δεÝόάέ όι δερρέοñí RETURN P ENTER. Άόíγ όάέάεραόά ίά όçί έάόά÷ ðñέόç όίθ  
δñíáñΰíáόίθ, δεÝόόά CONTROL+D, P ΰέεí δερρέοñí όáñíáόέόίγ άñ÷άβίθ.
```

Άίάέάέόέέΰ, ίθíñáβόά ίά όίθίεάδρρόάόά όι δñυáñáíá όά Ýίá άñ÷άβί έάέ ίά δεçέοñíεíáρρόάόά:

```
# cat file > /dev/lptN
¼θίρ file άβιαέ όι ύñíά θίρ άñ÷άβίθ θίρ δáñέÝ÷άέ όι δñυáñáíá θίρ εÝέάόά ίά όοάβεόά όοίí άέοδδούδρ.
```

Έά ááβόά εΰόε ίά άέοδδρρίάόάέ. Ιçί άίçό÷άβόά άί όι έαβιαίί ááí όάβιαόάέ όυόόυ. Έά όι άείñεραόίοία áñáυόáñá.

9.3.1.4.2 έαά÷ ιò Óάέñέάέίγ Άέοδδούδρ

Άδδρ ç áíυόçά όθραάέείγáέ θυò ίά άεÝáíáδά άί όι FreeBSD ίθíñáβ ίά άδεείείφίρραέ ίά Ýίáί άέοδδούδρ όοíááááíÝíí όά
όάέñέάεP έýñά.

Άέά ίά άεÝáíáδά Ýίáί άέοδδούδρ όά όάέñέάεP έýñά:

1. Άβίαόά root ίά su(1).
2. Άδáíáñááόόάβόά όι άñ÷άβί /etc/remote. ΔñíόέÝόόά όçί áευέίθεç έάόά÷ ðñέόç:

```
printer:dv=/dev/port:br#bps-rate:pa=parity
¼θίρ port άβιαέ ç έάόά÷ ðñέόç όόόέάδρδ άέά όçί όάέñέάεP θυñόά (ttyd0, ttyd1, έδε.), bps-rate άβιαέ ç  
όά÷γόçόά bits-per-second άδεείείφίρβáο ίά όίí άέοδδούδρ, έάέ parity ç έόίθέίβá θίρ άδάέόάβόάέ άδυ όίí  
άέοδδούδρ (even, odd, none, P zero).
```

Δáñάέΰόυ όάβιαόάέ Ýίá όθυáάέáíá έάόά÷ ðñέόç, άέά Ýίáί άέοδδούδρ όοíááááíÝíí ιÝόυ όάέñέάεPδ άñáííδ όόçí
όνβδç όάέñέάεP έýñά ίά όá÷γόçόά 19200 bps έάέ ÷ ύñβδ parity:

printer:dv=/dev/ttyd2:br#19200:pa=none

3. Όοίάάέάβδσά οοίί άέοδδθρσά ία tip(1). Δέχέοñίεήρσάοά:

tip printer

Άί άοδθ οί οδΰάει άάί άίρεάγáέ, άδáiññάσάοάβδσά δΰέέ οί άñ÷άβί /etc/remote έάέ δñίρδάέρδσά οί ÷ñçóειñδίεήρσάοδ /dev/cuaan άίδβ άέά /dev/ttydN.

4. Όόάβεόά άάñΎίά οοίί άέοδδθρσά.

- Άί ι άέοδδθρσά δίññάβ ίά άέοδδθρσάέ άδευ έάβίáñ, ÷ñçóειñδίεήρσάοά lpctest(1). Άñΰθδά:

% \$!ptest

- Άΰί ι άέοδδθρσά έάόάέάάβίάέ PostScript P έΰδίέά ΰέç æρσάά άέοδδθρσά, δυδά οόάβεόά Ύίά ίέέññ δññάññά οοίί άέοδδθρσά. Δέχέοñίεήρσά οί δññάññά, ίβά δññδ ίβά ãñññP, δίεγ δññόάέδέέΰ, έάερδ ι άέοδδθρσά δίññάβ ίά ãññçíáγáέ άέάοίñάόέέΰ όçí ÷ñPόç ÷áñάέδPññίí ùδθδ οί backspace P ΰέέñí δίθ δáñΰáñίόάέ άδθ άέΰοίñά δέPέδñά άδáiññάσάοάβδ. Ιδίññάβ άδβόçδ ίά ÷ñάέάοάβ ίά δέçέοñίεήρσάοά έΰδίέί άέάέευ δέPέδññ δáññάόέόίγ άñ÷άβίθ άέά οίί άέοδδθρσά ρόά ίά ãñññæáέ δυδά ίείεçñήρσάόάέ οί δññάññά. Άέά άέοδδθρσάδ PostScript, δέΎόά CONTROL+D.

Άίάέάέόέέΰ, ίδññάβδά ίά οίθίεάδPσάοά οί δññάññά οά Ύίά άñ÷άβί έάέ ίά δέçέοñίεήρσάοά:

% >file

¼δθñ file άβίάέ οί ùññά οίθ άñ÷άβίθ δίθ δáñέΎ÷άέ οί δññάññά. Άόγ οί tip(1) οόάβεάέ οί άñ÷άβί, δέΎόά οί έάόΰέççει δέPέδññ δáññάόέόίγ άñ÷άβίθ, άί άδáiέάβδσάέ.

Έά άάβδά έΰδέ ίά άέοδδθρσάόάέ. Ιçí άίçόδ÷άβδά άί οί έάβίáñí άάί οάβίáόάέ ούοδθ. Έά οί άέίñερσάοίά áññáññά.

9.3.1.5 Άíáññáδίβçόç οίθ Spooler: οί Άñ÷άβί /etc/printcap

Όά άδθθ οί όçíάβί, ι άέοδδθρσά οάδ έά δñΎδάέ ίά άβίάέ οοίááñΎñò, ι δθñPíáδ οάδ ãδειέοίΎñò ίά άδέέίεññάβ ίάæβ οίθ (άί ÷ñάέΰæάόάέ), έάέ Ύ÷άδά δáδγ÷άέ ίά οόάβεάδσά έΰδίέά ãίεήρσάόέέΰ άáñΎίά οοίί άέοδδθρσά. Άβδσά όρñά Ύόίεήίέ ίά ãδειβδσάοά οί LPD άέά ίά áεΎá÷άδά όçí δññόάόόç οοίί άέοδδθρσά οάδ.

Ιδññάβδά ίά ãδειβδσάοά οί LPD ίά άδáiññάσάόά οίθ άñ÷άβίθ /etc/printcap. Όί όγόόçíá δáññí÷Ύδάδόçδ LPD άέάáΰæάέ άδθθ οί άñ÷άβί έΰέά οίñΰ δίθ ÷ñçóειñδίεήρσάέ ι spooler, άδñΎñò δέέárΎδ άίáάέìβδσάέο οίθ ίδáβññί ΰíáόά οά άόáññáP.

Άβίάέ άγέηει ίά έάόáñPσάοά όçí ïññP οίθ άñ÷άβίθ printcap(5). ×ñçóειñδίεήρσάοά οίί έάέíáññΰοι δίθ δññόειΰδά άέά ίά έΰíáδά άέέááΎδ οοί /etc/printcap. Ç ïññP οίθ άβίάέ δáññίέά ίά ΰέέά άñ÷άβά δáñέáñάδPδ άοίáοίθPδθί, ùδθδ οά /usr/share/misc/termcap έάέ /etc/remote. Άάβδά όçí cgetent(3) άέά έáδθññáññáδ δέçññίññáδ ό÷άδέέΰ ίά όçí ïññP οίθ άñ÷άβίθ.

Ç δέί άδθP ãγέιέόç οίθ spooler άδίθάέάβδσάέ άδθ οά άέυειθέά άPíáόά:

1. ΆδέέΎíθά Ύίά ùññά (έάέ έβáά ãίεέέΰ δáññύγίέά) άέά οίί άέοδδθρσά, έάέ οίθίεάδPσάοά οά οοί άñ÷άβί /etc/printcap. Άάβδά όçí áññόçδά Ιññάδίáññόçç Άέοδδθρσά άέά δáñέόούδáññά δέçññίññáδ ό÷άδέέΰ ίά όçí ïññάόβά δυί άέοδδθρσά.
2. Άδáiññáññίεήρσάοά οέδ οάέβáδ έáόάέβáδ (άβίάέ άíáñáΎδ άδθ δññάδέέειP) άέόΰáñíόάδ όçí έέάáññόçδά sh. Άέά δáñέόούδáññά δέçññίññáδ άάβδά όçí áññόçδά Δáññáññάέόç Όάέβáñí Έáόάέβáδ.


```
bamboo|ps|PS|S|panasonic|Panasonic KX-P4455 PostScript v51.4:
```

Όά άοού οι άάνΰάάέαιά, ι δñρòτò áέοδδρòδρò ìññΰάάόάέ rattan έάέ Ύ÷άέ ùò άάνΰΰίέά όά line, diablo, lp, έάέ Diablo 630 Line Printer. Άδϋ όç óóέαιρ διò Ύ÷άέ οι άάνΰΰίέί lp, άβιάέ έάέ ι δñιάδέέάαιΎίϋ άέοδδρòδρò. Ί άάγόάνηò ìññΰάάόάέ bamboo, έάέ Ύ÷άέ ùò άάνΰΰίέά όά ps, PS, S, panasonic, έάέ Panasonic KX-P4455 PostScript v51.4.

9.3.1.5.2 Δάñαιδϋάέόç Óάέβαιί Έάόάέβάάο

Όι όύόçιά άάνι÷Ύόάόçò **LPD**, άδϋ δñιάδέειρρ, áέοδδρίάέ ιέά óάέβαιί έάόάέβάάο άέά έΰεά άñάάόβά. Ç óάέβαιί έάόάέβάάο δάñέέαιάΎίάέ οι ùñιά ÷ñρóç διò áέοδρέçέά όçι άñάάόβά, οιí οδιέιáέόδρ άδϋ οιí ιδιβίί δñιρέέά ç άñάάόβά, έάέ οι ùñιά όçò άñάάόβáò, ìá ìάáΎειòδ ùιññóιòδ ÷άñάέδρñάò. Άόóòδ ÷ρò άοού οι δñιόέάοι έάβιαιί áειέιòέάβ όçι áέάάέέάόβά άδιόόάειΎόουόçò όçò άάέάόΎόόάόçò άίϋò άδειγ áέοδδρòδρ, άδñΎίϋò έά δάñαιδρβáοιòιá όέò óάέβáάò έάόάέβáάò.

Άέά όçι δάñαιδϋάέόç οϋι óάέβαιί έάόάέβáάò, δñιόέΎόά όçι έέάίϋόçόά sh όόçι έάόά÷ρñέόç áέά οιí áέοδδρòδρ όοι άñ÷άβι /etc/printcap. Άάρ áέΎδάόά Ύίá δάñΰάάέαιά οιò /etc/printcap ìá δñιόέβέç όçò sh:

```
#
# /etc/printcap for host rose - no header pages anywhere
#
rattan|line|diablo|lp|Diablo 630 Line Printer:\
      :sh:
```

```
bamboo|ps|PS|S|panasonic|Panasonic KX-P4455 PostScript v51.4:\
      :sh:
```

Δάñάόçñρóòά δϋò ÷άέñέόδρέαιì óóóΎ όç ìññòρ: ç δñρòç άñαιίρ ìáέείΎ όόçι άñέόδάñρ óδρέç, έάέ ιέ áέϋειòέάò άñαιίΎò άβιάέ όοιέ÷έοιΎίáò (indented). Έΰεά άñαιίρ έάόά÷ρñέόçò (άέοϋò άδϋ όçι óάέάόόάβá) óάέάέρίáέ ìá ιέά άñέόδάñϋóδñρòç έΰεάοι.

9.3.1.5.3 Άçιέιòñάβá Έάόάέϋαιò Δάñι÷Ύόάόçò

Όι άδϋιαιί άρίá όοιí άδέϋ όñϋδι áάέάόΎόόάόçò άβιάέ ç άçιέιòñάβá άίϋò έάόάέϋαιò δάñι÷Ύόάόçò (spool), ùδιò έά óέειñáñίγίόáέ ιέ άñάάόβáò áέόγδϋόçò Ύϋò ùοιò ìá áέοδδρέιγί έάέ ùδιò άδβóçò όδέΎόόιόáέ έάέ έΰδιέά Ύέέά άιçέçóέέΎ άñ÷άβá οιò óóóδρìάόιò áέόγδϋόçò.

Έϋαιò όçò ìáόάάάέϋαιίáιçò όγόçò οϋι έάόάέϋαιί δάñι÷Ύόάόçò, όόιçέβáάόáέ ìá οιδιέάοιγίόáέ έΰδϋò άδϋ οιí έάόΎειρρ /var/spool. Άάι άβιάέ άίáάέάβι ìá δάβñíáòά άίòβάñάóá áóóάέάβáò οϋι έάόάέϋαιί δάñι÷Ύόάόçò. Ç άδάíáάçιέιòñάβá οιòδ άβιάέ οϋοι άδέρ ùοι ìá όñΎίϋòιá όçι άίοιέρ mkdir(1).

Άβιάέ άδβóçò όόιçέέοιΎί ìá ìññΰάάόáέ ì έάόΎειρρò ìá οι βáει ùñιά ìá οιí áέοδδρòδρ, ùδϋò óάβιáόáέ δάñάέΎόϋ:

```
# mkdir /var/spool/printer-name
```

Ύόόϋοι, άί Ύ÷άόά άñέάοιγίò áέοδδρòδρΎò όοι άβέοδι, βóϋò άδέέοιáβóά ìá οιδιέάόδρóάόά οιòδ έάόάέϋαιòδ δάñι÷Ύόάόçò έΰδϋò άδϋ Ύίá ìιáάέέϋ έάόΎειρρ διò έά ÷ñçóειñδιέάβóάέ άδιέέάέόέέΎ áέά áέοδδρβáέò ìá οι **LPD**. Έά έΰίϋòιá áέñέáρò άόδϋ áέά όά δάñάάάββαιίáόά ìáò ìá οιòδ áέοδδρòδρΎò rattan έάέ bamboo:

```
# mkdir /var/spool/lpd
# mkdir /var/spool/lpd/rattan
```



```
#!/bin/sh
#
# psif - Print PostScript or plain text on a PostScript printer
# Script version; NOT the version that comes with lprps
# Installed in /usr/local/libexec/psif
#

IFS="" read -r first_line
first_two_chars=`expr "$first_line" : '\(..\)'`

if [ "$first_two_chars" = "%!" ]; then
#
# PostScript job, print it.
#
echo "$first_line" && cat && printf "\004" && exit 0
exit 2
else
#
# Plain text, convert it, then print it.
#
( echo "$first_line"; cat ) | /usr/local/bin/textps && printf "\004" && exit 0
exit 2
fi
```

Όι δάνδΰΰ script, οι textps άβιάέ Ύία δñuāñāiά δiο άέέάοάοδβόάiά iά ÷ ùñέοóŰ áέά iά iάοάοñŰθiοiά áδeu έάβiάñi óά PostScript. Iδññάβóά iά ÷ ñçóéiñδiέάβóά iθiέiάβδiοά δñuāñāiά iάοάοñiδβó άδñ έάβiάñi- óά-PostScript. Ç Óçéēiāβ óñi Ports (άάβóά Ç Óçéēiāβ óñi Ports) δāñéŰ ÷ áé άδβóçδ Űiά δēβñāδ δñuāñāiά iάοάοñiδβó άδñ έάβiάñi óά PostScript, οι a2ps δiο βóùδ άδέέοiάβóά iά áéññāóiβóάóá.

9.4.1.3 Δñiíññiβúç PostScript áéá ΆέòδδùδŰδ δiò áāi ói Óδiόçñβæióí

Όi PostScript άβιάέ οι *de facto* δñuóδδi áéá óóie ÷ áéiέάóβá éáé áéóŰδùç ðççēβδ δiέúóçóáδ. Űóóúóí, οι PostScript άβιάέ eŰδùδ *adátçññu* δñuóδδi. Άóδó ÷ βδ, ç Aladdin Enterprises δāñŰ ÷ áé Űiά δāññiόāñŰδ áéáŷéāñi PostScript δiò ññŰæáóáé **Ghostscript** éáé āiōēāŷáé Űθiāá óói FreeBSD. Όi Ghostscript áéáŰæáé óá δāñéóóúδāñā āñ ÷ áβá PostScript éáé iδññāβ iά áδiāβóáé δéδ óáēβāáδ óiòδ óá iāāŰēç áēŰiá óóééāðβi, óóidāñééāiāŰñiόáδ δiέēiŷδ óŷδiòδ áéòδδùðβi δiò áāi óδiόçñβæióí PostScript. Άééáééóðβiόáδ οι **Ghostscript** éáé ÷ ñçóéiñδiέβiόáδ Űiά áéáééu ðβéðñi éáéiŰñi áéá óñi áéòδδùδβ óáδ, iδññāβóá iά eŰiáóá óñi éiέiñ áéòδδùδβ óáδ iά éáéóññāāβ óáí Űiáδ δñāñiáóééúδ áéòδδùδβδ PostScript.

Όi **Ghostscript** āñβóéāóáé óççi Óçéēiāβ óñi Ports óiò FreeBSD, éáé iŰééóóá óá δiēēŰδ áéāuóáéδ. Ç δéi áéáāāññŰŷiç άβιάέ οι print/ghostscript-gpl.

Άéá iά eŰiáóá δñiíññiβúç PostScript, δñŰδáé ói ðβéðñi éáéiŰñi iά áiέ ÷ iáŷóáé ái áéòδδβiáóá āñ ÷ áβi PostScript. ΆŰi ŷ ÷ é, óñóá ói ðβéðñi éá δāñŰóáé ói āñ ÷ áβi éáóáðéāβái óóñi áéòδδùδβ. ÁéáóññāóééŰ, éá ÷ ñçóéiñδiέβóáé ói **Ghostscript** áéá iά iάóáóñŰθáé āñ ÷ ééŰ ói āñ ÷ áβi óá Űiá óŷδi δiò éá éáóáéāāáβiáé i áéòδδùδβδ.

Éāiŷ Űiá δāñŰæáéiá: ói áéuēiòēi script άβιάέ Űiά ðβéðñi éáéiŰñi áéá áéòδδùδŰδ Hewlett Packard DeskJet 500. Άéá Űéēiòδ áéòδδùδŰδ, áióééáóáóδβóóá ói ùñéóíá -sDEVICE óççi áñiēβ gs (**Ghostscript**). (Δéçéðñiέiāβóóá gs -h áéá iά áāβóá óççi éβóá óóóéāðβi δiò óδiόçñβæáé ç δñŰŰ ÷ iòóá áāéáóŰóóáç óiò **Ghostscript**.)

```
#!/bin/sh
#
```

```
# ifhp - Print Ghostscript-simulated PostScript on a DeskJet 500
# Installed in /usr/local/libexec/ifhp

#
# Treat LF as CR+LF (to avoid the "staircase effect" on HP/PCL
# printers):
#
printf "\033&k2G" || exit 2

#
# Read first two characters of the file
#
IFS="" read -r first_line
first_two_chars=`expr "$first_line" : '\(..\)`

if [ "$first_two_chars" = "%!" ]; then
    #
    # It is PostScript; use Ghostscript to scan-convert and print it.
    #
    /usr/local/bin/gs -dSAFER -dNOPAUSE -q -sDEVICE=djet500 \
        -sOutputFile=- - && exit 0
else
    #
    # Plain text or HP/PCL, so just print it directly; print a form feed
    # at the end to eject the last page.
    #
    echo "$first_line" && cat && printf "\033&l0H" &&
exit 0
fi

exit 2
```

ὈΨῖδ, ÷ñáεÛæáóáέ íá áίçìññρóáðá òι **LPD** áέά òι òβέδñι ìá òçí éέάíüðçðá íf:

```
:if=/usr/local/libexec/ifhp:
```

Ἄδδδ ãβίáέ üει. Ìðññáβðá íá ðççèðññεíñρóáðá lpr plain.text éáέ lpr whatever.ps éáέ ðá äýì èá áέðððùèιγί áðέðð÷ρð.

9.4.1.4 Ὀβέδñá ìáðáðññìððð

Ὀι áδññññññññññ ìáðáðññìððð òçí ñεíεεβññùðç òçð áðερð ãáέáðÛððáóçð ðñð ðññέññÛðññññ òðέð Ἄáóέέÿð Ñðèìβóáέð Ἄέðððððρì, áβίáέ òðìρèùð ç ãáέáðÛððáóç òβέδññì ìáðáðññìððð áέά ðñðð òýðññð ãñ÷áβññ ðñð ðñññèíÛðð (áέðüð áδññ áðèññ èáβññññññññ ASCII).

9.4.1.4.1 Ἄέάðβ íá ãáέáðáóðððáðá Ὀβέδñá ìáðáðññìððð;

Ὀá òβέδññá ìáðáðññìððð èÛññññ òçí áέðýðððç áέáðññññññ òýðñññ ãñ÷áβññ ãýεñεç òðùèáóç. Ἄέά ðññÛááέñññ, áð òðñεÿññññ ùéé ÿ÷ñññ ìá èÛññññ ãññέáðρ ãññáóβá ìá òι òýððçññá òðñε÷áεññññññ ÒεX, éáέ ùéé ÿ÷ñññ ãέðððððρ PostScript. ÈÛèá òññÛ ðñð ãçñεíðññññññ ÿíá ãñ÷áβññ DVI ìá òι ÒεX, ãññ ìðñññññ ìá áέðððρññññññ èáðáðèáβáí ÿðð ùññ ìá ìáðáðññÿðñññ òι ãñ÷áβññ DVI òá PostScript. Ç áεñεññèεá ãñññññññ ðñð ðññÿðáé ìá áεñεññèεáññññññ ãβίáέ:

```
% dvips seaweed-analysis.dvi
% lpr seaweed-analysis.ps
```

Ίά οçi ÷ ñρόç áñíó ðβέοñññ ìáóáóññððò áέá áñ÷ áβá DVI, ìðññññ ìá áðñóγáññññ ðçñ ìáóáóññðð ðñò ðñÝðáέ ìá εΰññññ εΰεά ðñññ ÷ áέñññέβñçóá, έáεðñóáð ðñ **LPD** ìá εΰΐáέ ðç ðñεέáέΰ áέá ìáð. Õðñá, εΰεά ðñññ ðñò Ý ÷ ðñññ Ý ìá áñ÷ áβñ DVI, áέá ìá ðñ ððððñññ ÷ ñáέΰááóáέ ìñññ Ý ìá áðñá:

```
% lpr -d seaweed-analysis.dvi
```

÷ ðñññ áñέΰóáέ ðñññ **LPD** ìá εΰΐáέ ðç ìáóáóññðð ðñò áñ÷ áβññ DVI ðñññέΰññññ ðñò ðçñ áðέέñáð -d. Ç áñññçóá Άðέέñáΰð ìññññññçóçð έáέ ìáóáóññððò ðáñέΰ ÷ áέ ðñòð ðβñáέáð áðέέñáðò ìáóáóññððñ.

Άέá εΰεά áðέέñáð ìáóáóññððò ðñò εΰέáðá ìá ððñóðçñβááðá áðñ Ý ìá áέðððððð, ðñÝðáέ ìá ááέáðáóððóáðá Ý ìá ðβέðññ ìáóáóññððò έáέ ìá ìñβóáðá ðçñ áέááñññ ðñò ðñññ áñ÷ áβñ /etc/printcap. ìá ðβέðññ ìáóáóññððò áβñáέ ðáñ ðñ ðβέðññ έáέññ Ýññ ðóçñ áðέð ááέáðΰóóáóç áέðððððð (ááβðá ðçñ áñññçóá Άáέáðΰóóáóç Õβέðññò Έáέññññ) ìá ìññç áέááñññ ðñò áñññ ðñ ðβέðññ ìá áέððððñáέ áðñ εáβñáññ, ìáóáóññÝðáέ ðñ áñ÷ áβñ ðá ìέá áέáðññáðέέð ìññðð ðóðá ìá áβñáέ έáááññçóññ áðñ ðññ áέðððððð.

9.4.1.4.2 *Ðñέñ Õβέðññ ìáóáóññððò έá ðñÝðáέ ìá Άáέáðáóððóá;*

Έá ðñÝðáέ ìá ááέáέóððóá ðá ðβέðñá ìáóáóññððò ðñò ìñβááðá ðñò έá ÷ ñçóέññññέðóáðá. Άñ áέððððñáðá áñέáðΰ áááñññ Ý ìá DVI, ðñòá áβñáέ εñέέññ ìá ðññðáñέέΰááðá Ý ìá ðβέðññ ìáóáóññððò DVI. Άñ áέððððñáðá ðç ÷ ðñññ áááñññ Ý ìá troff, έá εΰέáðá ìá ááέáðáóððóáðá Ý ìá ðβέðñññ troff.

Ί áέññññññ ðβñáέáð ðñññβáέέ ðá ðβέðñá ìá ðá ððñá ðñññññáΰááðá ðñ **LPD**, ðέð έáðá ÷ ðññβóáέð ðçð áñññðñέ ÷ çð έέáñññçóáð ðñññ áñ÷ áβñ /etc/printcap, έáέ ðñò ìá ðέð έáέΰóáðá ìÝòñ ðçð áñññððò lpr:

Óγðñò áñ÷ áβñ	Έέáñññçóá /etc/printcap	Ðáñññáðññò áñññððò lpr
cifplot	cf	-c
DVI	df	-d
plot	gf	-g
ditroff	nf	-n
FORTTRAN text	rf	-f
troff	tf	-f
raster	vf	-v
plain text	if	none, -p, or -l

Õðñ ðáñññáέáñ ìáð, áñ ÷ ñçóέññññέðññññ ìá lpr -d ðçñáβñáέ ðñέ ì áέððððððò ÷ ñáέΰááóáέ ðçñ έέáñññçóá df ðóçñ έáðá ÷ ðñέóç ðñò ðñññ /etc/printcap.

Άñ έáέ εΰðñέñέ ððñáβ ìá έó ÷ ðñέóðñññ ðñ áñññέáðñ, ìáñέέñβ ðγðñέ áñ÷ áβññ ðñò ðñññ áβñáέ ðá έáβñáñá έáέ áñáðέέΰ FORTRAN áβñáέ ìáðáñáóññ Ý ìá. ìðñáβðá ìá ððóáðá ìÝá ðññ ðá áñ÷ áβá áðññ ðñò ðγðñò (ð έáέ ððñέáðáððññá Õέεçð ìññððò áñññññ), ááέáέóððññóáð ðñññóáññññññ Ý ìá ðβέðñá. Άέá ðáñññáέáñ, áð ððñέΰññññ ðñέ έá εΰέáðá ìá áέððððóáðá έáðáðέáβáñ áñ÷ áβá Printerleaf (áñ÷ áβá ðññáñ ÷ ðññáñ áðñ ðñ ðñññáñññ áðέðñáðÝáέáð ðððññáðóβáð Interleaf), áέέΰ ááñ έá áέððððóáðá ðñÝ ðáέáññññáðá (plots). Έá ððññññóáðá ìá ááέáðáóððóáðá Ý ìá ðβέðññ ìáóáóññððò áñ÷ áβññ Printerleaf ððñ ðçñ έέáñññçóá gf έáέ ìá áέðáέááγóáðá ðñòð ÷ ñðóðáð ðáð ðñέ ç áñññððò lpr -g ðçñáβñáέ “ðγðñóá áñ÷ áβá Printerleaf.”

9.4.1.4.3 ΑέάοΟόόο Οβέοοι ίάόοοι

Άδου ος οέαιΠ δίο οά οβέοοά ίάόοοοι άβίάε δοοάοοί δίο άάί άίΠείοι οοί άάοέεου ούοόοία άάέοΟόόόο δίο FreeBSD, άβίάε δέι ουόου ίά άάέοΟόόόοί οοί έάοΰείαι /usr/local. ίάδ οοίΠέοδ δοοίέοοι ουί δοοάοοί άόοοί άβίάε ί έάοΰείαι /usr/local/libexec, ίέα δίο δοοέέοάέ άέα άίάέέέοί ίά δοοάοοί δίο έέοάέίόάέ ίουί άδου οί **LPD**. Ίέ άδείο ÷οοόά άάί έά ÷οάέόάδ δίο ίά οά έέοάέΰοί.

Άέα ίά άάάοίΠέοάά ίά οβέοοί ίάόοοοι, δοοάέοοά ος έέάοοοί οί οοί άñ÷άβι /etc/printcap, άέέΰάοά ος έάοΰέεε έέάίόοά οοί έέοδουδίο δίο άδέοίάβόά ίά οί ÷οέοίΠέοάά.

Οοί δάοΰάέά ίά, έά δοοέΰοί οί οβέοοί ίάόοοοι DVI οόοί έάό÷οέο ίά άέα οί έέοδουδίο ίά οί ίουί bamboo. Άέέοέά, έέέοί, οί δάοΰάέά άέα οί άñ÷άβι /etc/printcap, ίά ος ίΰά έέάίόοά df άέα οί έέοδουδίο bamboo:

```
#
# /etc/printcap for host rose - added df filter for bamboo
#
rattan|line|diablo|lp|Diablo 630 Line Printer:\
    :sh:sd=/var/spool/lpd/rattan:\
    :lp=/dev/lpt0:\
    :if=/usr/local/libexec/if-simple:

bamboo|ps|PS|S|panasonic|Panasonic KX-P4455 PostScript v51.4:\
    :sh:sd=/var/spool/lpd/bamboo:\
    :lp=/dev/ttyd5:ms#-parenb cs8 clocal crtscts:rw:\
    :if=/usr/local/libexec/psif:\
    :df=/usr/local/libexec/psdf:
```

Οί οβέοοί DVI άβίάε ίά shell script δίο ίουίΠέοάέ /usr/local/libexec/psdf, οί ίοίβι έάέ δάάέΰοί δάάέΰοι:

```
#!/bin/sh
#
# psdf - DVI to PostScript printer filter
# Installed in /usr/local/libexec/psdf
#
# Invoked by lpd when user runs lpr -d
#
exec /usr/local/bin/dvips -f | /usr/local/libexec/lprps "$@"
```

Άόου οί script οñΰ÷έ οί dvips οά έάοΟόόόο οβέοοί (ίά ος δάοΰάοοί -f) οόοί standard input, άδου ύδίο έάέ έάίΰίάέ ος άάάόά δοοί έέόοο. Άόου ίάέίΰ οί οβέοοί έέόοοοδ PostScript lprps (άάόά ος άίόοά Οοίάόοοοά Άάάέί Άέί Έέίΰί οά έέοδουδΰο PostScript) άβίόά οί έάέ έέδ δάάίΰοο δίο δΰάάά οί **LPD** οοί δάάΰΰ script. Οί lprps έά ÷οέοίΠέοάέ άόΰδ έέδ δάάίΰοο άέα ος έάάίΰοο οί έέοδουΰί οάέβί.

9.4.1.4.4 Άέοί ίάέέΰ Δάάάάβίάόά Οβέοοί ίάόοοι

Άδου ος οέαιΠ δίο άάί οδΰ÷έ άόοάοίΠέοίΰί ίΰέίαι άέα ος άάέοΟόόόο ουί οβέοοί ίάόοοοι, άδ ίάδ άδέοάάβ ίά δάοΰ÷οί ίάέέΰ έέί δάάάάβίάόά. Ίοίάβόά ίά οά ÷οέοίΠέοάά οά ίάέ άέα ος άέέοάά ουί έέέί οά οβέοοί. Άί ίάέάά δουδ άβίάέ έάοΰέεέ άέα ος δάοΰόοο οά ίοίάβόά ίά οά ÷οέοίΠέοάά έάέ έάόάέάβί.


```

# for the printer.
#
cleanup() {
    rm -f hpdf$$ .dvi
}

#
# Define a function to handle fatal errors: print the given message
# and exit 2. Exiting with 2 tells LPD to do not try to reprint the
# job.
#
fatal() {
    echo "$@" 1>&2
    cleanup
    exit 2
}

#
# If user removes the job, LPD will send SIGINT, so trap SIGINT
# (and a few other signals) to clean up after ourselves.
#
trap cleanup 1 2 15

#
# Make sure we are not colliding with any existing files.
#
cleanup

#
# Link the DVI input file to standard input (the file to print).
#
ln -s /dev/fd/0 hpdf$$ .dvi || fatal "Cannot symlink /dev/fd/0"

#
# Make LF = CR+LF
#
printf "\033&k2G" || fatal "Cannot initialize printer"

#
# Convert and print. Return value from dviIj2p does not seem to be
# reliable, so we ignore it.
#
dviIj2p -M1 -q -e- dfhp$$ .dvi

#
# Clean up and exit
#
cleanup
exit 0

```



```

k          l          l
k k      eeee      l          l          y          y
k k      e   e      l          l          y          y
k k      eeeee     l          l          y          y
kk k      e          l          l          y          y
k k      e   e      l          l          y         yy
k  k      eeee      lll        lll        yyy y
                                     y
                                     y  y
                                     yyyy

```

```

                                     ll
                                     t          l          i
                                     t          l
o o o o  u   u  ttttt  l          ii      n nnn      eeee
o  o  u   u  t          l          i      nn  n  e   e
o  o  u   u  t          l          i      n   n  eeeee
o  o  u   u  t          l          i      n   n  e
o  o  u  uu  t  t      l          i      n   n  e   e
oooo      uuu u      tt      lll        iii      n   n  eeee

```

```

r rrr      oooo      ssss      eeee
rr  r      o  o      s   s      e   e
r          o  o      ss          eeeee
r          o  o          ss          e
r          o  o      s   s      e   e
r          oooo      ssss      eeee

```

Job: outline

Date: Sun Sep 17 11:04:58 1995

Ôï LPD ðñïðéÝôáé íéá áíôïð ãééáãðð óáëßááð (form feed) ìáðÛ áðü áððü ðï éáßíáñ Ýðóé þóðá ç ãñááóßá íá ìáééíðóáé óá íÝá óáëßáá (ãêôüð áí Ý÷ãðá ðñïðáéíñßóáé ôçí ééáíüðçðá sf (suppress form feeds) äéá ôïí äêðððððð óôï ãñ÷ãßí /etc/printcap).

Áí ðñïðéÛðá, ôï LPD ìðñíáß íá ððéÛíáé íéá íéññüðáññï ìðéïðð êáðáéßáá. Ðñïðáéíñßóá sb (short banner) óôï ãñ÷ãßí /etc/printcap. Ç óáëßáá êáðáéßááð èá ìéÛæáé óáí áððð:

9.4.2.4 Οάεβσάδ Εάσάεβσάδ σά Άέδδδθρσάεδ PostScript

¼δθδ δσνέσνÛσάισ δσνσδÛν, σι **LPD** ιδνσβ ιά σçιείτνσπσάε ιβσ σάεβσά εσσάεβσάδ σδειγ εάειÛν, εσδÛεεçç εάε δειειγδ άέδδδθρσάεδ. Ιέ άέδδδθρσάεδ PostScript, σδσέέÛ, σσί ιδνιγί ιά δδθρσίσι εσδσδεσβσί σδευ εσβσν, σδνÛνδ σδδπ ç σίσσσδσδσά σισ **LPD** εάε δεδ σάεβσάδ εσσάεβσάδ σβίσε Û-πçσδç σά σδδπ σçι δσνβδδδσç.

ισδ δνισσνδ σννδιδ ιά δσνÛ ÷ιίσάε σάεβσάδ εσσάεβσάδ σβίσε ιά σçιείτνσπσάε σδν εÛεσ σβεδνι ισδσδνιδπδ εσε σι σβεδνι εσειÛν. Οά σβεδνσ εσ δνÛδσε ιά σÛ ÷ιίσάε υδ δσνσιÛνιτδδ σι υννσ σισ ÷πσδç εσε σισ δδειεσέσδπ πσδσ ιά σçιείτνσπσάεδ σçι εσδÛεεçç σάεβσά εσσάεβσάδ. Οι ισειÛέσçισ σδδπδ σçδ ισευσρ σβίσε δυδ ιέ ÷πσδσδ εσ άέδδδθρσίσι δÛισά σάεβσά εσσάεβσάδ, σευιç εέ σι σδισδÛεεισ σçι σνσσσβσ σισδ ισ lpr -h.

ΆδεδνÛσδσ ισδ ιά σνσνσσισδισσά σδδπ σç ιÛεσν. Οι σευεισδει script σÛ ÷σδσε δνσεδ δσνσιÛνιτδδ (σι υννσ ÷πσδç - login name, σι υννσ σισ δδειεσέσδπ - host name, εσε σι υννσ σνσσσβσδ) εσε σçιείτνσπσάε ιβσ σδδπ σάεβσά εσσάεβσάδ PostScript:

```
#!/bin/sh
#
# make-ps-header - make a PostScript header page on stdout
# Installed in /usr/local/libexec/make-ps-header
#
#
# These are PostScript units (72 to the inch).  Modify for A4 or
# whatever size paper you are using:
#
page_width=612
page_height=792
border=72
#
# Check arguments
#
if [ $# -ne 3 ]; then
    echo "Usage: `basename $0` <user> <host> <job>" 1>&2
    exit 1
fi
#
# Save these, mostly for readability in the PostScript, below.
#
user=$1
host=$2
job=$3
date=`date`
#
# Send the PostScript code to stdout.
#
exec cat <<EOF
%!PS
%
% Make sure we do not interfere with user's job that will follow
%
```

```

save

%
% Make a thick, unpleasant border around the edge of the paper.
%
$border $border moveto
$page_width $border 2 mul sub 0 rlineto
0 $page_height $border 2 mul sub rlineto
currentscreen 3 -1 roll pop 100 3 1 roll setscreen
$border 2 mul $page_width sub 0 rlineto closepath
0.8 setgray 10 setlinewidth stroke 0 setgray

%
% Display user's login name, nice and large and prominent
%
/Helvetica-Bold findfont 64 scalefont setfont
$page_width ($user) stringwidth pop sub 2 div $page_height 200 sub moveto
($user) show

%
% Now show the boring particulars
%
/Helvetica findfont 14 scalefont setfont
/y 200 def
[ (Job:) (Host:) (Date:) ] {
200 y moveto show /y y 18 sub def }
forall

/Helvetica-Bold findfont 14 scalefont setfont
/y 200 def
[ ($job) ($host) ($date) ] {
270 y moveto show /y y 18 sub def
} forall

%
% That is it
%
restore
showpage
EOF

```

Ὅπῃ, ἐὰν ἴα ἀδὺ δά ὀβεῶνά ἰαῶαῶνιῶδὸ ἐὰν οἱ ὀβεῶνι ἐὰν Ἰῖο ἰδῖνιῖ ἴα ἐὰν Ἰῖοῖ οἱ script, ὄηρῶα ἄεἰ ἴα ἄεῖρῶαῶνιῶδὸ ὄε ὄεῖῶα ἄεῖῶαῶδ, ἐὰν Ἰῖοῖ ἄεἰ ἴα ἄεῖῶνιῶδὸ ὄε ἄεῖῶα ὄε ἄεῖῶα. Ἀεῖῶαῶνι ὄε ὀβεῶνι ἰαῶαῶνιῶδὸ DVI ὄε ἄεῖῶα ἰῶνῶαῶν, ἄεῖῶα ἄεῖῶνι Ἰῖ ἄεἰ ἴα ὄεῖῶνι ἴεἰ ὄεῖῶα ἄεῖῶαῶδ:

```

#!/bin/sh
#
# psdf - DVI to PostScript printer filter
# Installed in /usr/local/libexec/psdf
#
# Invoked by lpd when user runs lpr -d
#

```


δθνυόάσος όοιρ άέοδδθδθρσ άδθ ΰεεϊρδ οδθιεραέοδΰδ οϊρ άέέδύϊρ. Ϛ άφυόσοςά Άέοδδθδθρσ Άάέάδσάόσοςΰϊρ έσά Άδθιáέθσοςΰϊρδ Οδθιεραέοδΰδ άίσάάβ όέδ σδάθιáβόσοςά άρΰθιáάέσδ.

- Δθνυόάσος όσά άέοδδθδθρσ όρθιáάάιΰθι έσάδσέσθβίáί όοιρ άβέδσθ. Άέέθδ (P άίόβ) όσδ όοιáάόέέθδ όάέθέάέθδ P δάθΰεέσος όέθιáδ, ι άέοδδθδθρσ δθΰδσά έσά ΰ - άέ άδέδθιυέσάόά ιέá άέέδσάέθ άέάόγθάσος. θάδ ό ΰόιέιρ άέοδδθδθρσ άιρεάγáέ υδ άίθδ:
- Ιθιθάβ ιá έσάόάέάάβίáέ όι δθιυέερεεϊ **LPD** έάέ ιá άσιερθθάβ ιθθΰ άίáθιθδ άέá όέδ άθάάόβδδ θιρ δθιΰθι - ιθόάέ άδθ άθιáέθσοςΰϊρδ οδθιεραέοδΰδ. Óά σόδθ όσος δάθθδθδθρσ, άίáθιáά όάι ΰίáδ έáθιέέυδ οδθιεραέοδθρσ θιρ άέόάέáθ όι **LPD**. Άέιερθδθρσά όσος βάέá άέáάέέσάόβá ιá όσος άφυόσοςά Άέοδδθδθρσ Άάέάδσάόσοςΰϊρ έσά Άδθιáέθσοςΰϊρδ Οδθιεραέοδΰδ άέá ιá άάέάδσάόσοςάάά σόδθι όιρ άέοδδθδθρσ.
- Ιθιθάβ ιá οδθιόσθβίáέ όγθιáάόσος άέέδσάέθδ θιθδ άάάθιΰθι (data stream). Óά σόδθ όσος δάθθδθδθρσ, “όόθιΰάόá” όιρ άέοδδθδθρσ όá ΰίáί οδθιεραέοδθρσ όοιáάάιΰθι όοιρ άβέδσθ, ι ιθθιθδ έá άβίáέ οδθιáέθσος άέá όσος δάθι - ΰόσος όυι άθάάόέθι έáέ όσος άθιόθιεθρσ οϊρδ όόθι άέοδδθδθρσ. Ϛ άφυόσοςά Άέοδδθδθρσ Ιá Óθιáΰόάέδ Άέέδύϊρ άβίáέ ιáθέέΰδ όοιáιρεΰΰδ άέá όσος άάέάδΰόσος άέοδδθδθρσ άόδθι όιρ όγθιρ.

9.4.3.1 Άέοδδθδθρσ Άάέάδσάόσοςΰϊρ έσά Άδθιáέθσοςΰϊρδ Οδθιεραέοδΰδ

Όι όγόςοςίá δάθι - ΰόσοςόδ **LPD** ΰ - άέ άίόυιáόυιΰίς οδθιόδθιέίς άέá όσος άθιόθιεθρσ άθάάόέθι όá ΰεεϊρδ οδθιεραέοδΰδ θιρ άέόάέγθι όι **LPD** (P θιρ άβίáέ όοιáάόθιβ ιá όι **LPD**). Άόδθι όι - άθάέδσθθέόόέέυδ σάδ άδέδθΰδσά έσά άάέάδσάόσοςάάά ΰίáί άέοδδθδθρσ όá ΰίáί οδθιεραέοδθρσ έáέ ιá ΰ - άόá δθιυόάσος όá σόδθι άδθ ΰεεϊρδ. Άδθόσδ άιρεάγáέ έáέ ιá άέοδδθδθρσ θιρ ΰ - ιθι άέέδσάέΰδ άέάόόθιáΰόάέδ θιρ έσάόάέάάβθιθι όι δθιυέερεεϊ **LPD**.

Άέá ιá άίáθιáίθιεθρσάάά σόδθι όιρ όγθι άθιáέθσοςΰίς όέόδθδθρσ, άάέάδσάόσοςά δθθρσά ΰίáί άέοδδθδθρσ όá ΰίáί οδθιεραέοδθρσ, όιρ οδθιεραέοδθρσ *άέόδθδθρσ* (printer host), - θσόςέθιθιεθρσάδ όσος άδθθ άάέάδΰόσος άέοδδθδθρσ θιρ δάθέάθΰόάάέ όόσος άφυόσοςά Άάόέέΰδ Νθειβόáέδ Άέοδδθδθρσ. Εΰίόá υόάδ δθι - υθσοςΰίáδ θθειβόáέδ - θάέΰεάόά υδδδ άίáθΰιáάέ όόέδ Νθειβόáέδ Άέοδδθδθρσ άέá Δθι - υθσοςΰίθιθδ. Άέΰθιόá όιρ άέοδδθδθρσ έáέ άάβδá άί άιρεάγáέ ιá όá - άθάέδσθθέόόέέΰδ οϊρ **LPD** θιρ ΰ - άόá άίáθιáίθιεθρσάέ. Άδθόσδ άάάέυέάβδá δθδ ι όιθέέυδ οδθιεραέοδθρσ (local host) άβίáέ άιθόέίáιθιθιθι ιá - θσόςέθιθιεθρσ όέδ οδθιáόβδδθρσ οϊρ **LPD** όοθι *άθιáέθσοςΰίθι οδθιεραέοδθρσ* (remote host) (άάβδá Δάθιáιθιέσος Άθάάόέθι άδθι Άδθιáέθσοςΰίθιθδ Οδθιεραέοδΰδ).

Άΰι - θσόςέθιθιεθρσάάά άέοδδθδθρσ ιá άέέδσάέθρσ άέάόγθιáάόσος θιρ άβίáέ όοιáάόυδ ιá όι **LPD**, όυδά ι ι οδθιεραέοδθρσ *άέόδθδθρσ* (printer host) άβίáέ ι άί έυáυ άέοδδθδθρσ, έáέ όι *υθιá όιρ άέοδδθδθρσ* άβίáέ όι υθιá θιρ ΰ - άόá ιθθόáέ άέá όιρ άέοδδθδθρσ. Άάβδá όσος όάέιθθβυόσος θιρ όοθιáγáέ όιρ άέοδδθδθρσ σάδ έáέ/P όσος έΰθιόá άέέδύϊρ όιρ.

Όδθιáέίς: Άί - θσόςέθιθιεθρσάάά Hewlett Packard Laserjet ιá υθιá άέοδδθδθρσ text έá άβθιίόáέ άόδθιáόá ιέ ιáόάθιθδΰδ άδθι LF όá CRLF, άθιθΰιθδ άάι - θάέΰεάόάέ ιá δθθιáόá όι script hpif.

Άδθιΰιθδ, όοιθδ οδθιερεεϊθιθδ οδθιεραέοδΰδ υδθι άδέέδθιáβδá ιá ΰ - άόá δθιυόάσος όοθι άέοδδθδθρσ, άδθέΰ έΰίόá ιέá έáόá - θθέός όοι άθι - άβι /etc/printcap ιá όá άέυέιρεά όοιέ - άβá:

1. Ιθιΰόá όσος έσάόá - θθέός υδδδ άδέέδθιáβδá: Άέá άέέθρσ σάδ άόέιεβá δέέάθρδ ιá έΰέáόá ιá - θσόςέθιθιεθρσάάά όι βάέι υθιá έáέ όá βάέá δάθιυίγθιέá ιá σόδθιθιθδ οδθιεραέοδθρσ άέόδθδθρσ.
2. Άόθρσά όσος έέάθιυόσοςά lp έáίθρ, άέá όσος άέθβáάέá (: lp=).
3. Άσιερθθάθρσά ΰίá έáδΰέιáιρ spooling έáέ δθιόάέιθθβδá όσος όιθιέáόβá όιθ ιá όσος έέάθιυόσοςά sd. Όι **LPD** έá άδθιεεάγáέ άáθ όέδ άθάάόβδδ δθέί όσος άθιόθιεθρσ όιθδ όόθι οδθιεραέοδθρσ άέόδθδθρσ.

4. ÔïðieáδÞðáá ôï ùññá ôïð òðieëieéóδÞ áéδýðùóçð óδçí ééáíüóçðá rm.
5. ÔïðieáδÞðáá ôï ùññá ôïð áéδδðùδÞ óδçí ééáíüóçðá rp, óδïí òðieëieéóδÞ áéδýðùóçð.

Άδδú áβίάé üëï. Άáí ÷ ñåÛεάδáé íá äçieïðñáÞðáá éβóáá öβèðñùí íáðáðñïððð, äéáóδÛóáέδ óáεβááδ, Þ íðéáÞðïá Üëëï óðí äñ÷áβï/etc/printcap.

ΆâÞ áβίάé Ýíá δάνÛááéáíá. Ï òðieëieéóδÞðð rose Ý÷áé äýí áéδððùðÝð, ôïí bamboo éáé ôïí rattan. ÈÝëïðíá íá áíánáíðieÞðïðíá òéð áéδððβðáέδ óá áδðïýð òïðð áéδððùðÝð áéá ôïðð ÷ ñÞðóáð òïð áðñáéñðïíÝñï òðieëieéóδÞ orchid. ΆâÞ áβίάé ôï äñ÷áβï/etc/printcap òïð òðieëieéóδÞ orchid (ääβóá δéí δβóù óδçí áíüóçðá Άíánáíðïβçóç Óáεβáñí Èáðáéβááð). ¹äç Ý÷áé íéá éáðá÷Þñéóç áéá ôïí áéδððùðÞ teak. ΆâÞ ðñïéÝóáíá òéð áðánáβðçðáð éáðá÷ññβóáέδ áéá ôïðð äýí áéδððùðÝð òïð òðieëieéóδÞ rose:

```
#
# /etc/printcap for host orchid - added (remote) printers on rose
#

#
# teak is local; it is connected directly to orchid:
#
teak|hp|laserjet|Hewlett Packard LaserJet 3Si:\
    :lp=/dev/lpt0:sd=/var/spool/lpd/teak:mx#0:\
    :if=/usr/local/libexec/lfhp:\
    :vf=/usr/local/libexec/vfhp:\
    :of=/usr/local/libexec/ofhp:

#
# rattan is connected to rose; send jobs for rattan to rose:
#
rattan|line|diablo|lp|Diablo 630 Line Printer:\
    :lp=:rm=rose:rp=rattan:sd=/var/spool/lpd/rattan:

#
# bamboo is connected to rose as well:
#
bamboo|ps|PS|S|panasonic|Panasonic KX-P4455 PostScript v51.4:\
    :lp=:rm=rose:rp=bamboo:sd=/var/spool/lpd/bamboo:
```

Ôï ùññá ôïð áðñÝíáé áβίάé íá äçieïðñáÞðïðíá òïðð éáðáéüïäïð spooling óðïí éüñáï orchid:

```
# mkdir -p /var/spool/lpd/rattan /var/spool/lpd/bamboo
# chmod 770 /var/spool/lpd/rattan /var/spool/lpd/bamboo
# chown daemon:daemon /var/spool/lpd/rattan /var/spool/lpd/bamboo
```

ÔÞñá, íé ÷ ñÞðóáð òïð orchid ìðñïýí íá áéδððÞñïí óðïí rattan éáé óðïí bamboo. Άí, áéá δάνÛááéáíá, Ýíáð ÷ ñÞðóçð òïð orchid ðèçèðñïëíáÞðáé:

```
% lpr -P bamboo -d sushi-review.dvi
```

òï óýðóçíá **LPD** óðïí orchid éá áíðéåñÛðáé ççí áñááóβá óðïí éáðÛëíäï spooling /var/spool/lpd/bamboo éáé éá óçíáεÞðáé ðùð ðññéáέðáé áéá áñááóβá DVI. Ïüééð ï òðieëieéóδÞðð rose Ý÷áé äéáéÝóéïñ ÷Þñïí óðïí éáðÛëíäï spooling òïð bamboo, óá äýí **LPDs** éá íáðáðÝññïí ôï äñ÷áβï óðïí rose. Ôï äñ÷áβï éá ìðáé óá ïðñÛ áíáíñðð óðïí òðieëieéóδÞ rose Ýðð üðïð áéδððùèáβ. Èá íáðáðñáðáβ áðù DVI óá PostScript (áóïý ï bamboo áβίάé áéδððùðÞðð PostScript) óðïí òðieëieéóδÞ rose.

9.4.3.2 Άέοδδρρσάεο ιά ΟσίάΎόσάεο Άέέδγίτ

Όδ ÷ íŨ, ũοάί ááñŨεάοά εŨñοά áέέδγίτ áεά áέοδδρρσ, Ύ ÷ áοά οç áοίάοũοçοά áδέετáρδ áγί áέáũοáũτ: ç ιβá áβίáε δñíοññβòç οίτ spooler (ç δέτ áέñέáρ Ύέáιόç) ář ç Ũέεç áδέŨ οάδ áδέοñŨΎδáε ίά οδ Ύέáíοά ááñŨΎίá ιŨòũ áδδρδ οάί ίά ÷ ñçοέττδτέτγóαά ίέá οάέñέáερ ρ δáñŨέεçεç εγñá (ç οδçίρ Ύέáιόç). Άδδρ ç áũοçοά δáñέáñŨοáε δũδ ίά ÷ ñçοέττδτέáβòά οçί οδçίρ Ύέáιόç. Άέά οçί δέτ áέñέáερ Ύέáιόç ιδññáβòά ίά áñáβòά δáñέοóοũοáñáδ δέçñíττññβáδ οδçί δñíçáτγίáτç áũτòçοά Άέοδδρρσ ΆάέáοάοçίŨίτ οά ΆδñáέñοçίŨίτò ÕδττáεóοŨóŨ.

Ç ũñòρ οίτ áñ ÷ áβίτ /etc/printcap οάδ áδέοñŨΎδáε ίά ññòáòά οç áέáογίááοç - οάέñέáερ ρ δáñŨέεçεç - δίτ εά ÷ ñçοέττδτέρρóáòά, έáέ (άί ÷ ñçοέττδτέáβòά οάέñέáερ áέáογίááοç) οίτ ñδèιι baud, δέεáτγδ áεŨá ÷ τδò ññρδ, έáέοóοáñρóáέο áεά tabs, ìáóáδññŨŨδ áέá ÷ áñáέδρñáδ ίŨάδ áñáττδ, έáέ Ũέεá. ΆέέŨ ááτ οδŨñ ÷ áε οñũδτò ίά ññòáòά ίέá ογίááοç οά áέοδδρρσ δτò áέτγáε οά εγñá TCP/IP ρ Ũέέτ ογθί áέέδγίτ.

Άέá ίά οδáβέáòά ááñŨΎίá οά Ύίá áέέδóáεũ áέοδδρρσ, ÷ ñáεŨεάοάε ίά áíáδδγίáòά δññáñŨñáοά áδέετέττβáδ δτò ίά έáέτγίóáε áδũ οβέòñá έáετŨίτ έáέ οβέòñá ìáóáδññŨρδ. Άář Ũ ÷ τòìá Ύίá οŨέττ δáñŨááέáτá: οί script netprint δáβñτáε ũέá οά ááñŨΎίá áδũ οί standard input έáέ οά οδŨέáε οά Ύίáτ áέοδδρρσ οσίáááτŨίτ οοί áβέοοτ. Ìñβáετòá οοί netprint οί ũñá οίτ áέοδδρρσ ũδ δñρòç δáñŨáòññ, έáέ οίτ áñέεττ εγñáδ οóçί τδτβá οσίáŨóáε ũδ ááγδáñç. Õçίáερòά δũδ áδòδũ τ οñũδτò οδττòçñβáεé ũññ áδέετέττβá ίέáδ έáδáγέòττòçδ (áδũ οί FreeBSD οοίτ áέοδδρρσ). Δττέτβ áέέδóáετβ áέοδδρρσ οδττòçñβáεττί áτòβáññç áδέετέττβá, έáέ áβίáε δττεγ δέεáτũ ίά áδέέòìáβòá ίά áέτáοáέεáòóáβòά οά δññáñρáóá οίτò (áέá ίά áεŨá ÷ áòά οçί έáóŨóóáοç οίτ áέοδδρρσ, áέá έáóáτŨòñçòç áέοδδρρáũτ, έέδ.).

```
#!/usr/bin/perl
#
# netprint - Text filter for printer attached to network
# Installed in /usr/local/libexec/netprint
#
$#ARGV eq 1 || die "Usage: $0 <printer-hostname> <port-number>";

$printer_host = $ARGV[0];
$printer_port = $ARGV[1];

require 'sys/socket.ph';

($ignore, $ignore, $protocol) = getprotobyname('tcp');
($ignore, $ignore, $ignore, $ignore, $address)
    = gethostbyname($printer_host);

$sockaddr = pack('S n a4 x8', &AF_INET, $printer_port, $address);

socket(PRINTER, &PF_INET, &SOCK_STREAM, $protocol)
    || die "Can't create TCP/IP stream socket: $!";
connect(PRINTER, $sockaddr) || die "Can't contact $printer_host: $!";
while (<STDIN>) { print PRINTER; }
exit 0;
```

Ìδññáβòά ίά ÷ ñçοέττδτέρρóáòά áδòδũ οί script οά áεŨοτñá οβέòñá. Άδ οδττέŨóττòá δũδ Ũ ÷ τòìá Ύίáτ áέοδδρρσ áñáττδ Diablo 750-N οσίáááτŨίτ οοί áβέοοτ. Ì áέοδδρρσ áŨ ÷ áòáε ááñŨΎίá δññò áέδγδũοç οóçί εγñá 5100. Õτ ũñá οίτ áέοδδρρσ οοί áβέοοτ áβίáε scrivener. Άář áβίáε οί οβέòññ έáετŨίτ áέá οίτ áέοδδρρσ:

```
#!/bin/sh
#
# diablo-if-net - Text filter for Diablo printer 'scrivener' listening
```

```
# on port 5100.    Installed in /usr/local/libexec/diablo-if-net
#
exec /usr/libexec/lpr/lpf "$@" | /usr/local/libexec/netprint scrivener 5100
```

9.4.4 ἔᾶᾶ ÷ ἶο Δñüοᾶᾶόςο ἑᾶέ Δᾶñείñέοἷἷβ ὀός × ñΠός οὐἷ Ἀέδοδδὸδῶἶ

ἈδδΠ ς αἴυδόςᾶ ᾶβἱᾶέ δέçñἱῶἱñβᾶδ ἑᾶᾶ ὀἱἱ Ἰέᾶᾶ ÷ ἶ δñüοᾶᾶόςο ἑᾶᾶ ὀἱἱ δᾶñείñέοἷἷ ÷ ñΠόςοδ οὐἷ Ἀέδοδδὸδῶἶ. Ὀἷ ὄγόςᾶ **LPD** ὀᾶδ ᾶδέοñἸᾶᾶ ἱᾶ ἁἑἸᾶ ÷ ᾶὀᾶ δἱἑἕο ἱδἱñᾶβ ἱᾶ Ἰ ÷ ἁἑ δñüοᾶᾶός ὀᾶ ἑἸᾶ ἈέδοδδὸδῶΠ, ὀἱῶ ὀἱδἑἑἸ ἱῶἱ ἑᾶᾶ ᾶδñᾶἑñὀἱἸᾶἱ, ἑᾶᾶ ᾶδβόςοδ ᾶ ἱδἱñἱἱ ἱἑ ÷ ñΠόςᾶδ ἱᾶ Ἀέδοδδῶἱῶἱ δἱἑᾶᾶδἑἸ ᾶἱὀβᾶñᾶὀᾶ, δἱῶἱ ἱᾶᾶἸᾶᾶ ἱδἱñἱἱ ἱᾶ ᾶβἱᾶᾶ ἱἑ ᾶñᾶᾶόςᾶδ ὀἱῶδ, ἑᾶᾶ δἱῶἱ ἱᾶᾶἸᾶᾶ ἱδἱñἱἱ ἱᾶ ᾶβἱῶἱ ἱἑ ἱὀñἸᾶ ᾶἱᾶñἸᾶδ (print queues).

9.4.4.1 Δᾶñείñέοἷἷἷ Ἀέδὸδῶἷἷ Ἰἱἑᾶᾶδῶἶ ἈἱὀἑᾶñἸῶἱ

Ὀἷ ὄγόςᾶ **LPD** Ἀἑᾶὀἑἑἑἱᾶᾶ ὀἱῶδ ÷ ñΠόςᾶδ ἱᾶ Ἀέδοδδῶἱῶἱ δἱἑᾶᾶδἑἸ ᾶἱὀβᾶñᾶὀᾶ ᾶἱῶδ ᾶñ ÷ ᾶβἱὀ. Ἰἑ ÷ ñΠόςᾶδ ἱδἱñἱἱ ἱᾶ Ἀέδοδδῶἱῶἱ ᾶñᾶᾶόςᾶδ ἱᾶ lpr -#5 (ᾶἑᾶ δᾶñἸᾶᾶἑᾶἱᾶ) ἑᾶᾶ ἱᾶ δᾶβñἱῶἱ δἸἸᾶᾶ ᾶἱὀβᾶñᾶὀᾶ ἑἸᾶ ᾶñ ÷ ᾶβἱὀ ὀός ᾶñᾶᾶόςᾶδ Ἀἑδὸδῶἷἷ. Ὀἷ ᾶ ᾶὀἱ ᾶβἱᾶᾶ ἑᾶἑἱ, ᾶἱᾶñἸᾶᾶᾶ ᾶδἱ ᾶὀἸᾶ.

Ἀἱ δἑὀᾶᾶᾶᾶ δἱῶδ ὀᾶ δἱἑᾶᾶδἑἸ ᾶἱὀβᾶñᾶὀᾶ ᾶçἱἑἱὀñᾶἱἱ Ἰὀἑἱδç ἑᾶὀᾶδἱἱçç ὀἱἱ Ἀέδοδδὸδῶἶ ὀᾶδ, ἱδἱñᾶβᾶ ἱᾶ ᾶδᾶἱᾶñᾶἱδἱἑἑὀᾶᾶ ὀçἱ ᾶδἑἑἱᾶΠ -# ὀἱἱ lpr(1) δñἱὀἑ Ἰὀἱᾶὀᾶδ ὀçἱ ἑἑᾶἱῶδçὀᾶ sc ὀἱἱ ᾶñ ÷ ᾶβἱ /etc/printcap. ¼ὀᾶἱ ἱἑ ÷ ñΠόςᾶδ ᾶδἱὀᾶ Ἰἑἑἱῶἱ ᾶñᾶᾶόςᾶδ ἱᾶ ὀçἱ ᾶδἑἑἱᾶΠ -#, ἑᾶ ἁἑἸᾶἱῶἱ:

```
lpr: multiple copies are not allowed
```

Ὀçἱᾶἑὀᾶ δἱῶδ ᾶ Ἰ ÷ ᾶὀᾶ ñὀἑἱβᾶᾶᾶ δñüοᾶᾶός ὀᾶ Ἰᾶἱ ἈέδοδδὸδῶΠ ᾶδñᾶἑñὀἱἸᾶἱ (ᾶᾶὀᾶ ὀçἱ ᾶἱῶδçὀᾶ Ἀέδοδδὸδῶἷ Ἀἑᾶὀᾶὀçἱ Ἰᾶἱ ὀᾶ ἈδñᾶἑñὀἱἸᾶἱ Ὀδἱἑᾶἑὀᾶἷ), ἑᾶ ÷ ñᾶἑᾶὀᾶᾶ ἱᾶ δñἱὀἑ Ἰὀᾶὀᾶ ὀçἱ ἑἑᾶἱῶδçὀᾶ sc ὀᾶ ἱἑᾶ ὀᾶ ᾶδñᾶἑñὀἱἸᾶἱ ᾶñ ÷ ᾶβἱ /etc/printcap, ἈἑᾶὀᾶᾶὀἑἑἸ ἱἑ ÷ ñΠόςᾶδ ἑᾶ Ἰ ÷ ἱὀἱ ᾶἑἱç ὀçἱ ᾶὀἱᾶὀἱὀçὀᾶ ἱᾶ ᾶδἱὀᾶ Ἰἑἑἱῶἱ ᾶñᾶᾶόςᾶδ δἱἑᾶᾶδῶἶ ᾶἱὀἑᾶñἸῶἱ ÷ ñçὀἑἱἱδἱἑἱᾶὀᾶ Ἀἑᾶὀᾶᾶὀἑἑἱ ἑἱἱᾶἱ.

Ἀᾶᾶ ᾶβἱᾶᾶ Ἰᾶἱ δᾶñἸᾶᾶἑᾶἱᾶ. Ἀὀἱἱ ᾶβἱᾶᾶ ὀἱ ᾶñ ÷ ᾶβἱ /etc/printcap Ἀἑᾶ ὀἱἱ ἑἱἱᾶἱ rose. Ἰ ἈέδοδδὸδῶΠ rattan ᾶβἱᾶᾶ ᾶὀἱᾶὀἱ ἱç ÷ Ἰᾶἱᾶ ἑᾶᾶ ᾶδἑὀñἸᾶᾶ ὀçἱ Ἀἑδὸδῶἷἷ δἱἑᾶᾶδῶἶ ᾶἱὀἑᾶñἸῶἱ, ᾶἑἑἸ ἱ ἈέδοδδὸδῶΠ laser bamboo ᾶβἱᾶᾶ δἑἱ ᾶὀᾶᾶὀἱὀçὀᾶ, ᾶδñἸᾶἱ ἑᾶ ᾶδᾶἱᾶñᾶἱδἱἑἑὀᾶᾶ ὀç ᾶὀἱᾶὀἱὀçὀᾶ δἱἑᾶᾶδῶἶ ᾶἱὀἑᾶñἸῶἱ δñἱὀἑ Ἰὀἱᾶὀᾶδ ὀçἱ ἑἑᾶἱῶδçὀᾶ sc:

```
#
# /etc/printcap for host rose - restrict multiple copies on bamboo
#
rattan|line|diablo|lp|Diablo 630 Line Printer:\
    :sh:sd=/var/spool/lpd/rattan:\
    :lp=/dev/lpt0:\
    :if=/usr/local/libexec/if-simple:

bamboo|ps|PS|S|panasonic|Panasonic KX-P4455 PostScript v51.4:\
    :sh:sd=/var/spool/lpd/bamboo:sc:\
    :lp=/dev/ttyd5:ms#-parenb cs8 clocal crtscts:rw:\
    :if=/usr/local/libexec/psif:\
    :df=/usr/local/libexec/psdf:
```

Ὀἶñᾶ, ἑᾶ ÷ ñᾶἑᾶὀᾶᾶ ἱᾶ δñἱὀἑ Ἰὀᾶὀᾶ ᾶδβόςοδ ὀçἱ ἑἑᾶἱῶδçὀᾶ sc ὀἱἱ ᾶñ ÷ ᾶβἱ /etc/printcap ὀἱὀ ἑἱἱᾶἱ orchid (ἑᾶᾶ ᾶñ ᾶñἑὀἑἱᾶὀᾶ ὀᾶ ᾶὀἱἱ, ᾶδἑὀñἸᾶᾶ ἱᾶὀ ἱᾶ ᾶδᾶἱᾶñᾶἱδἱἑἑὀᾶᾶ ὀᾶ δἱἑᾶᾶδἑἸ ᾶἱὀβᾶñᾶὀᾶ Ἀἑᾶ ὀἱἱ ἈέδοδδὸδῶΠ teak):

```
#
```

```
# /etc/printcap for host orchid - no multiple copies for local
# printer teak or remote printer bamboo
teak|hp|laserjet|Hewlett Packard LaserJet 3Si:\
    :lp=/dev/lpt0:sd=/var/spool/lpd/teak:mx#0:sc:\
    :if=/usr/local/libexec/ifhp:\
    :vf=/usr/local/libexec/vfhp:\
    :of=/usr/local/libexec/ofhp:

rattan|line|diablo|lp|Diablo 630 Line Printer:\
    :lp=:rm=rose:rp=rattan:sd=/var/spool/lpd/rattan:

bamboo|ps|PS|S|panasonic|Panasonic KX-P4455 PostScript v51.4:\
    :lp=:rm=rose:rp=bamboo:sd=/var/spool/lpd/bamboo:sc:
```

× ης οείηθι έπιόαδ όçi έέάιυόçά sc, θñιέάιáÛñιόιá όçi ÷ ñΠόç ουί άίόιέπι lpr -#, áέέÛ άάί Ý ÷ ιόιá áέυιç όçi άόίάóυόçά ίά θάñάιθιáβóιόιá όιόδ ÷ ñΠόçάδ ίά όñÝñιόί όçi άίόιέΠ lpr(1) θιέέÝò οññÝò, Π ίά άθιόόάβέιόι όι βάέι άñ ÷ άβι θιέέÝò οññÝò όά ίβά ιιίάέέΠ άñάόβá, υòυò άάp:

```
% lpr forsale.sign forsale.sign forsale.sign forsale.sign forsale.sign
```

ÏðÛñ ÷ ιόι θιέέιβ όñυθιέ θñυέççò άόόπι ουί άίάñάέπι (όóιθáñέέάιáÛñιόάδ έάέ όçi θáñβθóυόç ίά όι άáñΠόçάδ) θιό άβóόά άέάγέáñιέ ίά άίάñάόιΠόçάδ.

9.4.4.2 θáñέιñβέιιόάδ όçi θñυόάάόç όá ÁέóðυòÝò

Ïθñάβóά ίά άέÝá ÷ άóά θιέέυò ðθñάβ ίά άέóðθβίáέ όά θιέέυί άέóðθυòΠ ÷ ης οείηθι έπιόαδ όιόδ ιç ÷ άίέόιιγò ñÛάυι (groups) όιò UNIX έάέ όçi έέάιυόçά rg όóι /etc/printcap. ÁðέÛ όιθιέάóΠóόά όιόδ ÷ ñΠόçάδ θιό έÝέάóά ίά Ý ÷ ιόι θñυόάάόç όά έÛθιέιí άέóðθυòΠ όά ίέά όóáέáñέιÝίç ñÛάá (÷ ης οόπι), έάέ áçέπóόά άóóΠ όçi ñÛάá όόçi έέάιυόçά rg.

¼έιέ έ ÷ ñΠόçάδ θιό άάί άίΠέιόι όόçi ñÛάá (όóιθáñέέάιááññÝñιό έάέ όιò root) έά áÝ ÷ ιιόάέ όι áέυιέιòèι ιΠιόιá: “lpr: Not a member of the restricted group” υòάί θñιόθáέιγί ίά άέóðθβιόιόί όóιí áέάá ÷ υιίáñι áέóðθυòΠ.

¼ðυò έάέ ίá όçi έέάιυόçά sc (θáñέιñέóιιγ θιέέáðέπι άίóέáñÛóυι), έá ÷ ñάέάóóάβ ίά θñιόáέιñβóáðά όçi rg όóιòð áθñáέñóóιÝñιόð έυιáιόð θιό έá Ý ÷ ιόι θñυόάάόç όóιòð áέóðθυòÝò όάó, άί ññβæáðά ðυò άóóυ άβίáέ óυóóυ (ááβóá όçi άίυόçά ÁέóðθυòÝò ÁáέáóáóóçiÝñιέ όá ÁθñáέñóóιÝñιόð ÏθιέιáέóóÝò).

Áέά θáñÛááέáιá, έá άóΠóιόιá áέá υιέιòð áέáγέáñç όçi θñυόάάόç όóιí áέóðθυòΠ rattan, áέέÛ ιυιí ιέ ÷ ñΠόçάδ όçò ñÛάáð artists έá ðθñιγί ίά ÷ ης οείηθι έπιόιόί όιí bamboo. Ááp άβίáέ όι áñυóóυ ίáð /etc/printcap áέá όιí έυιáι rose:

```
#
# /etc/printcap for host rose - restricted group for bamboo
#
rattan|line|diablo|lp|Diablo 630 Line Printer:\
    :sh:sd=/var/spool/lpd/rattan:\
    :lp=/dev/lpt0:\
    :if=/usr/local/libexec/if-simple:

bamboo|ps|PS|S|panasonic|Panasonic KX-P4455 PostScript v51.4:\
    :sh:sd=/var/spool/lpd/bamboo:sc:rg=artists:\
    :lp=/dev/ttyd5:ms#-parenb cs8 clocal crtscts:rw:\
    :if=/usr/local/libexec/psif:\
```


οδτρεάεόδρ, εάε οττ άνεέττ οττ οάεβάττ. ΕÙεά τπρά, άττττττ, ÷ττττ, π Ùεεç ÷τττεεπ δάττβτττ όçο άττáοεάβáο σáο, οόεεÝάáοά όá άττ÷άβá εάόάάττáοπδ áεά όττδ άεÙοττττδ άεοδδθρσάεο, εττáάεÙεάόá όεο οάεβáάο δττ άάεττáτττ όόττδ ÷ττπρόόáδ, εάε ÷ττáπράόá άάεεττáο. θρεάόά σáπράόá όá όόττε÷άβá áδτ όá άττ÷άβá εάόάάττáοπδ, ττεεετττáόá áδτ εάεάττ εάόÙόόάόç áεά όçτ áδτττáττ δάττβτττ.

- Ç ΕάόáτÝοττçόç εάόÙ όç ÷ττπρόç áβτáε εέáττáοάττ άττáοόπ, βóυδ άδáεάπ áβτáε δέτ άγόεττεττ όττττδ. Óá áοδπ όç τÝετττ όá οβεότá ÷ττáπττττ όττδ ÷ττπρόόáδ áεά όεο áεοδδθρσάεο όττδ áτÝóυδ ττεεο áοδÝο δττááτáοτττρεεετττ. ¼δττδ εάε τá όçτ εάόάάττáοπ ÷ττπρόçδ áβóεττ (disk quotas), ç εάόáτÝοττçόç áβτáε Ùτáόç. τδττáβóá τá δτττεάττáÙτáόá όçτ ÷ττπρόç áεοδδθρσάεο áδτ ÷ττπρόόáδ δττ Ý ÷τττ ÷όδδπρσάε εττεεεεττ, εάε τδττáβóá τá δάττÝ ÷άόá όόττδ ÷ττπρόόáδ Ýτá ότττδττ áεά τá áεÝá ÷τττ εάε τá ττεττβáετττ όττ “úáετ áεοδδθρσάεττ (print quotas).” ÁεεÙ áοδπ ç τÝεττáο δττττδττεÝόáε εβáτ επáεεά áÙόάττ áááττÝτττ áεά όçτ εάόάάττáοπ ÷ττçόόττ εάε όττ άτ εττáο τáááεπτ.

Ότ όγόόçτá δάτττ ÷Ýόáόçδ **LPD** οδττόçττβáεάε άγέττεά εάε όεο άγτ τáεττáττδ: áδτ όç όόεάτπ δττ δττÝδáε áόáβδ τá δάττÝ ÷άόá όá οβεότá (όεο δάττεόóóττáοάο ότττÝδ), εά δττÝδáε áδβóçδ τá δάττÝ ÷άόá εάε όττ επáεεά εάόáτÝοττçόçδ. ÁεεÙ οδÙτ ÷άε εάε Ýτá εάεττ όá áοδπ όçτ οδττεάόç: Ý ÷άόá áδάττεττεόόç áόáεεττá όόεο τáεττáττδ εάόáτÝοττçόçδ. Áεά δάττááεάτá, τδττáβóá τá áδεεÝτáόá δάττετáεεπ π εάόÙ όç ÷ττπρόç εάόáτÝοττçόç. τδττáβóá τá áδεεÝτáόá όεο δεçττττττáδ δττ εά εάόάάττáοτττáε: ττττáόá ÷ττçόόττ, ττττáόá οδττετáεόόττ, όγδττδ áτááόεπτ, όόδττÝτáδ οάεβááο, óáοτááτττεεÙ τÝότá ÷άττόεττ δττ ÷ττçόεττττεπεçεά, δττóττ ÷ττττδ ÷ττáεÙόόçεά áεά τá áβτáε ç áεόγδττóç, εάε δττεεÙ áεττá. Εάε ττεά áοδÙ áβτττáε τáόáόττÝδτττáόá όá οβεότá áεά τá áδττεçεάγτττ áοδÝδ όεο δεçττττττáδ.

9.4.5.1 Άττáτττç εάε δτττ ÷άεττç ΕάόáτÝοττçόç Άέοδδθρσάεττ

Ότ FreeBSD áεάόβáεάόáε τá άγτ δττáττáττáόá δττ τδττττττ τá δάττÝ ÷τττ Ùτáόá áδεπ δάττετáεεπ εάόáτÝοττçόç. Άβτáε ότ οβεότττ εάετÝττδ `lpf`, δττ δάττεάττáοáόáε όόçτ άττáόçόá `lpf`: Ýτá Όβεότττ ΕάετÝττδ, εάε ότ `pac(8)`, Ýτá δττáττáττá δττ όόεεÝάáε εάε áετττβáεάε εάόá ÷τττβóáεο áδτ áτ ÷άβá εάόáτáόττπρσάεττ.

¼δττδ άάόáττáττá όόçτ άττáόçόá όττ οβεότττ (Όβεότá), ότ **LPD** τáεεττá όá οβεότá εάετÝττδ εάε τáόáότττπδ δάττττáόá όόçτ áτáττπ άτττεπτ όττ οβεότττ εάε ότ τττá όττ áτ ÷άβτ εάόáάττáοπδ. Óá οβεότá τδτττττ τá ÷ττçόεττττεπóτττ áοδπ όçτ δάττáτáότττ áεά τá τÝττττ δττ τá áττττττ όεο εάόá ÷τττβóáεο εάόáτÝοττçόçδ. Ότ τττá όττ áτ ÷άβτ εάόáτÝοττçόçδ óáβτáόáε όόçτ εέáττáόçόá `af` όότ /etc/printcap, εάε άτ ááτ τττβááόáε ç δεπττçδ áεάáτττπδ όττ, ÷ττçόεττττεάβóáε ç ó ÷άόεεπ áεάáτττπδ τδ δττδ όττ εάόÙεττáττ spool.

Ότ **LPD** τáεεττá ότ `lpf` τá δάττáτÝότττδ δεÙόττδ εάε τπεττδ οάεβááο (áδτ όεο εέáττáόçόáδ `pw` εάε `p1`). Ότ `lpf` ÷ττçόεττττεάβ áοδÝδ όεο δάττáτÝότττδ áεά τá δτττáετττβóáε όçτ δττáόçόá ÷άττόεττ δττ ÷ττçόεττττεπεçεά. τáδÙ όçτ áδττóεττπδ όττ áτ ÷άβτ όόττ áεοδδθρσá, áττáόáε τεά εάόá ÷ττπéόç εάόáτÝοττçόçδ όότ áτ ÷άβτ εάόάάττáοπδ. τε εάόá ÷τττβóáεο ττεÙεττττ τá όεο δάττáεÙδτ:

```
2.00 rose:andy
3.00 rose:kelly
3.00 orchid:mary
5.00 orchid:mary
2.00 orchid:zhang
```

Εά δττÝδáε τá ÷ττçόεττττεάβóáε τá ÷ττττεόóττ áτ ÷άβτ εάόάάττáοπδ áεά εÙεά áεοδδθρσá, áόττ ότ `lpf` ááτ Ý ÷άε άτóττáότττÝτç áότáόóóçόá εεάεάπτáόττδ áτ ÷άβτ (file locking), εάε άγτ `lpf` τδττττττ τá εάόáόδττÝότττ ότ Ýτá όçτ εάόá ÷ττπéόç όττ Ùεεττ άτ δτττεάεάόáε τá áτττττττ όáόóττ ÷τττá όότ βáετ áτ ÷άβτ. τáδ άγέττεττ όττττδ áεά τá ááááεπρσáόá όçτ τττááεεττáόçόá áτ ÷άβτ εάόάάττáοπδ άττ áεοδδθρσá áβτáε τá ÷ττçόεττττεπρσáόá όçτ εέáττáόçόá `af=acct` όότ /etc/printcap. ρόε, εÙεά áτ ÷άβτ εάόάάττáοπδ εά áττβóεάόáε όόττ εάόÙεττáττ spool όττ άττβóόττε÷ττ áεοδδθρσá, óá Ýτá áτ ÷άβτ τá τττá `acct`.

¼οάι άβόαΰ Ύοίειέ ίά ÷ ñáρóaáο όιόο ÷ ñρóοáο áέα όέο áέοδδθρóaέο, áέοáεΎόοά όι δñúñáñáíá ρac(8). Άδεΰ ίάόάάβόα όοίρ έάοΰείρ spool áέα όίρ áέοδδθρóaέο δίο έΰίάόά έάόáiΎόñçóç έάέ δέçέοñíεíáρóα ρac. Έά áιόάίέόόάβ Ύίáο áδίεíáέοίυò ίá ÷ ñáρóaέο όá áρεΰñέα, ύδθò áεΎθáόá όόç όοίΎ ÷ áέα:

Login	pages/feet	runs	price
orchid:kelly	5.00	1	\$ 0.10
orchid:mary	31.00	3	\$ 0.62
orchid:zhang	9.00	1	\$ 0.18
rose:andy	2.00	1	\$ 0.04
rose:kelly	177.00	104	\$ 3.54
rose:mary	87.00	32	\$ 1.74
rose:root	26.00	12	\$ 0.52
total	337.00	154	\$ 6.74

Δάñáέΰόò άβίáέ ίέ δάñΰίáόñíέ δίο áΎ ÷ áόάέ όι ρac(8):

-Pprinter

Άέα δίεΰ printer ίά έΰίáέ áδίεíáέοίυ. Άόορ ç áδέεíáρ áίόεáýáέ ίυíρ áί όδΰñ ÷ áε ç δερñçò áέαáññíρ όόçί έέαíυόçόά af όόί /etc/printcap.

-c

Ôáίεíñáβ όι áδίόΎεάόίá áίΰ έυόοίò áίόβ όçò áέóááçóέερò óáίέíυìçόçò όυí ÷ ñçόόί.

-m

Άáñáβ όι ύñá όίò δθίεíáέόορ óóá áñ ÷ áβá έáóááñáορò. Íá áόορ όçί áδέεíáρ, í ÷ ñρóόçò smith όόί δθίεíáέόορ alpha άβίáέ í βáέíò ÷ ñρóόçò ίá όίí smith όόί δθίεíáέόορ gamma. ×ññò όçί áδέεíáρ áόορ, άβίáέ áέαóíñáόέεíβ ÷ ñρóόáò.

-pprice

Ôθίεíáβáέ όέο ÷ ñáρóaέò ίá price (όέίρ) óá áρεΰñέα áίΰ óáεβáá ρ áίΰ θύáε áίόβ áέα όçί όέίρ áδύ όçί έέαíυόçόά pc όόί /etc/printcap, ρ áέέερò áýí óáίόò (áδύ δñíáδέεíáρ). Íθíñáβόá ίá ññóáόá ùò price ίέα όέίρ ίá ááέαáέέΰ ρçöβá (floating point).

-r

ÁίόέόδñΎόáέ όçί óáέñΰ óáίέíυìçόçò.

-s

Άçίέíòñááβ Ύίá áñ ÷ áβí áδίεíáέοίρý όυí έáόáíáδñρóáυí έάέ έáεáñβáέέ όá δáñέα ÷ υíáíá όυí áñ ÷ áβυí έáóááñáορò.

name ...

Ôóθρíáέ δέçñíοíñβáò áíáοíñΰò ίυíρ áέα όá óóáέαéñεíΎίá name (ίíυíáόá) ÷ ñçόόί.

Óόίρ δñíáδέεááíΎí áδίεíáέοίυ δίο δáñΰááέ όι ρac(8), áεΎθáόá όυí áñέèíυ όυí όóδύíΎíυí óáεβááυí áίΰ ÷ ñρóόç áδύ όιόò áεΰοíñíòò δθίεíáέόóΎò. Άί, όόί ÷ ññí óáò, í δθίεíáέόóρò ááí Ύ ÷ áε όçíáόβá (áέαόβ ίέ ÷ ñρóόáò ίδíñíý ίá ÷ ñçόέíυδίερóίόí ίδίεíáρθíóá έΎεíοí), áέοáεΎόόá όçί áίόίερ ρac -m, áέα ίá áçίέíòñáρóáόá όίρ áέυεíοέí áδίεíáέοίυ:

Login	pages/feet	runs	price
andy	2.00	1	\$ 0.04

Όοι δάνΰάέαιά ιάο έά άέοδδθέάβ ιέά ιάαΰέç έβρόά άñ÷άβυι όιθ όñÝ÷ιθόιθ έάόάέυιαιθ όοιι άέοδδθόθθ θιθ ιιñΰέάόάέ rattan:

```
% ls -l | lpr -P rattan
```

Άοιγ άάι άίάόΰιιθόάέ ιιυιάόά άñ÷άβυι όόçί άίόιέθ lpr(1), όι lpr έέάάΰέάέ όά άάαñÝίά θιθ έά άέοδδθρόάέ άθυ όι standard input, όά ιθιβά άβίάέ ç Ýιιαιθ όçò άίόιέθθò ls -l.

Ç άίόιέθ lpr(1) ιθιñάβ ίά άά÷έάβ Ýίά ιάαΰέι ανεέιυ άδέειαθι έέά ίά έέΎά÷έέ όçί ιιθιθιβçόç, ίά ιάόάόñÝθάέ άñ÷άβά, ίά άçιέιθñάάβ θιέέάθεΰ άίόβαñάόά, έ.έ.θ. Άέά θάñέόóυθάñάθ θεçñιθιñβάθ, άάβόά όçί άιυόçόά ΆδέειάΎθ Άέόγθυόçò.

9.5.2 έάά÷ιθ Άñάάόέθι

¼όάι άέοδδθρiάόά ιά όι lpr(1), όά άάαñÝίά θιθ έΎέάόά ίά άέοδδθρόάόά όιθιέάόιγiάόάέ όά Ýίά θάέΎθι (package) θιθ ιιñΰέάόάέ “άñάάόβά άέόγθυόçò (print job)”, ç ιθιβά άθιθόΎέέάόάέ όοι όγόόçiά θάñι÷Ύόάόçò **LPD**. Έΰέά άέοδδθόθθò Ύ÷άέ ιέά ιθñΰ άίάιιθθò άñάάόέθι, έάέ ç άñάάόβά όάό άίάιΎίάέ ιάέβ ιά ΰέέάθ έέέΎθ όάό έάέ ΰέέυι ÷ñçόθθι. Ι άέοδδθόθθò θέθ άέοδδθρiάέ ιά όçί όάέñΰ ΰέέίçò όόçί ιθñΰ άίάιιθθò.

Άέά ίά άιθάίβόάόά όçί ιθñΰ άίάιιθθò έέά όιι θñιάδέέάάιΎιι άέοδδθόθθò, θεçέθñιέιθθόά lpr(1). Άέά έΰθιέιι όόάέάñέιΎιι άέοδδθόθθò, ÷ñçόέιιθιέθθόά όçί άδέειθθ -P. Άέά θάñΰάέάιά, ç άίόιέθ:

```
% lpr -P bamboo
```

άιθάίβέάέ όçί ιθñΰ άίάιιθθò έέά όιι άέοδδθόθθò ιά όι υιñiά bamboo. Άέιέιθέάβ Ýίά θάñΰάέάιά άιυαιθ όçò άίόιέθθò lpr:

```
bamboo is ready and printing
Rank  Owner   Job  Files                               Total Size
active kelly   9    /etc/host.conf, /etc/hosts.equiv    88 bytes
2nd    kelly   10   (standard input)                   1635 bytes
3rd    mary    11   ...                                  78519 bytes
```

Άιθάίβέιθόάέ όñάέθ άñάάόβάθ όόç έβρόά άίάιιθθò έέά όιι bamboo. Όόçί θñθόç άñάάόβά, θιθ Ύ÷άέ όόάέάβ άθυ όιι ÷ñθόç kelly, Ύ÷άέ άθιιέάβ ι “άñέέιυθ άñάάόβάθ (job number)” 9. Έΰέά άñάάόβά άιυθ άέοδδθόθθò ÷άñάέόçñβέάόάέ άθυ Ýίά ιιιάέέυι όΎθιέι ανεέιυ. Όέθ θάñέόóυθάñάθ όιñΎθ ιθιñάβόά ίά όιι άάñιθόάόά, άέέΰ έά όιι ÷ñάέάόθάβόά άί έΎέάόά ίά έέάάñΰθάόά έΰθιέά άñάάόβά. Άάβόά όçί άιυόçόά Άέάάñάθθ Άñάάόέθι έέά θάñέόóυθάñάθ θεçñιθιñβάθ.

Ç άñάάόβά ιά όι ιιγiάñι άίγiά άθιθάέάβόάέ άθυ άγi άñ÷άβά. Όά θιέέάθεΰ άñ÷άβά θιθ άυέçέάί όόç άñάñθ άίόιέθι όιθ lpr(1) έάυñιγiάέ ιΎñιθ ιβάθ ιυιι άñάάόβάθ. Άόθθ άβίάέ έάέ ç όñÝ÷ιθόά άíáñάθ άñάάόβά (θάñάόçñθθόά όç έΎίç active όçò όθθέçò “Rank”), θιθ όçiάβiάέ θυθ ç άñάάόβά άέοδδθρiάόάέ άόθθ όç όόέάιθ. Ç άάγόάñç άñάάόβά άθιθάέάβόάέ άθυ άάαñÝίά θιθ Ύ÷ιθι θάñΰόάέ όόçί standard input όçò άίόιέθθò lpr(1). Ç όñβόç άñάάόβά θñιΎñ÷άόάέ άθυ όιι ÷ñθόç mary, έάέ θñυέάέόάέ έέά ιέά θιέγ ιάέθç άñάάόβά. Όι υιñiά έέάάñιθθò όιθ άñ÷άβιθ θιθ θñυέάέόάέ ίά άέοδδθέάβ άβiάέ θιέγ ιάαΰέι έέά ίά ÷ññΎόάέ όόç όθθέç, έάέ έέά άόθυ ç άίόιέθθò lpr(1) άθέΰ όι θόιιθιέβέάέ ιά όñάέθ όάέάβάθ.

Ç θñθόç άñάñθ όçò άιυιαιθ άθυ όçί lpr(1) άβiάέ άθβόçò θιέγ ÷ñθέιç: ιάθ άίçiάñθρiάέ έέά όι όέ έΰίάέ όçί θάñιγiά όόέάιθ ι άέοδδθόθθò (θθιθέΰ÷έόóιι έέά όι όέ θεόόάγiάέ όι **LPD** θυθ έΰίάέ ι άέοδδθόθθò άόθθ όç όόέάιθ).

Ç άίόιέθ lpr(1) άθβόçò θθιθόçñβέάέ όçί άδέειθθ -l έέά ίά άçιέιθñάθρόάέ ιέά ιάαΰέç, έάθθιñάñθ έβρόά. Άέιέιθέάβ Ýίά θάñΰάέάιά όιθ lpr -l:

```
waiting for bamboo to become ready (offline ?)
kelly: lst [job 009rose]
      /etc/host.conf 73 bytes
```

```

/etc/hosts.equiv          15 bytes

kelly: 2nd      [job 010rose]
      (standard input)          1635 bytes

mary: 3rd      [job 011rose]
      /home/orchid/mary/research/venus/alpha-regio/mapping 78519 bytes

```

9.5.3 Άοάβñάοç Άñāάόέπí

Άί άέεΰίτσά άίβιç áέά ίέά άñāάόβá θίρσ άβ ÷ άόά άθίρσάβέάέ θñίρσ άέοýδύοç, ίθίñάβσά ίά οçί άόάέñÝόάσά άδύ οçί έβσάά άίάίίπδσ ίά οçί άίθίρεπ lprm(1). Ιθίñάβσά άέυιç ίά ÷ñçσέίίθίρεπρσάάσά οçί lprm(1) áέά ίά άόάέñÝόάσά ίέά άίάñāπ άñāάόβá, άέεΰ θέέάίίί έΰθίει ίÝñίρσ οçδ ίά άέοδδύέάβ Ýόέέ έάέ άέέεπδ.

Άέά ίά άόάέñÝόάσά ίέά άñāάόβá άδύ θίί θñίáθέέάάίÝίí άέοδδύοπ, ÷ñçσέίίθίρεπρσάά θñίρσά οçί lprm(1) áέά ίά άñāάόβá θίί άñέέιι οçδ. θάέόά θέçέθñίρεπρσάά:

```
% lprm job-number
```

Άέά ίά άόάέñÝόάσά ίέά άñāάόβá άδύ έΰθίειί σσάέάέñειÝίí άέοδδύοπ, θñίσέÝόάσά οçί άδέειάπ -p. Ç áέυειρσέç άίθίρεπ άόάέñάβ οçί άñāάόβá ίά άñέέιι 10 άδύ οçί ίθñΰ άίάίίπδσ áέά θίί άέοδδύοπ bamboo:

```
% lprm -p bamboo 10
```

Ç άίθίρεπ lprm(1) Ý ÷ áέ ίάñέέÝδ σσίθñāýόάέο:

lprm -

Άόάέñάβ υέάδσ όέο άñāάόβáδσ (άέά θίί θñίáθέέάάίÝίí άέοδδύοπ) θίρσ άίθίειί σά άόΰδ.

lprm user

Άόάέñάβ υέάδσ όέο άñāάόβáδσ (άέά θίί θñίáθέέάάίÝίí άέοδδύοπ) θίρσ άίθίειί σθίί ÷ñπρσδç (user). Ι θδññ ÷ñπρσδç (superuser) ίθίñάβ ίά άόάέñÝόάέ άñāάόβáδσ ΰέέιι ÷ñçσόβί, άόάβδ ίθίñάβσά ίά άόάέñÝόάσά ίιιί όέο άέέÝδ σάδ.

lprm

Ç άίθίρεπ lprm(1) ÷ññβδ άñέέιι άñāάόβáδσ, υίííá ÷ñπρσδç, π - θίρσ άίθίειίάέάέ σόçί άñāπ άίθίρεπí, άόάέñάβ οçί θñÝ ÷ ίρσά άίάñāπ άñāάόβá σθίί θñίáθέέάάίÝίí άέοδδύοπ, άί άίθίέάέ σά σΰδ. Ι θδññ ÷ñπρσδç (superuser) ίθίñάβ ίά άόάέñÝόάέ ίθίέάάπθίρσά άίάñāπ άñāάόβá.

Άέά ίά άίρσέÝρσάά σά έΰθίειί σσάέάέñειÝίí άέοδδύοπ άίρσ όίρσ θñίáθέέάάίÝίí, άδέΰ ÷ñçσέίίθίρεπρσάά οçί άδέειάπ -p ίά όέο θáñáδΰίι σσίθñāýόάέο. Άέά θáñΰάάέάίá, ç áέυειρσέç άίθίρεπ άόάέñάβ υέάδσ όέο άñāάόβáδσ όίρσ θñÝ ÷ ίρσδ ÷ñπρσδç άδύ οçί ίθñΰ άίάίίπδσ όίρσ άέοδδύοπ rattan:

```
% lprm -p rattan -
```

Όçίáβύοç: Άί άñāΰέάόσά σά θáñέάΰέέίί άέέοýίρσ, ç lprm(1) έά σάό άδέθñÝόάέ ίά άόάέñÝόάσά άñāάόβáδσ ίιιί άδύ θίί θδίειίάέοπ θίρσ όέο Ý ÷ άόά όόάβέάέ, άίάίΰñδçσά άί ί άέοδδύοπδσ άβίάέ θñίρσάΰσέίίρσ έάέ άδύ ΰέέίρσ όδίειίάέσάόÝδ. Ç áέυειρσέç άίθίρεπ άδέάάέίίáέ άέñέάπρσ άόδύ όί ÷ άñάέδçñέσάέέ:

```
% lpr -P rattan myfile
% rlogin orchid
% lpq -P rattan
Rank  Owner   Job  Files                               Total Size
active seeyan  12  ...                               49123 bytes
2nd   kelly    13  myfile                             12 bytes
% lprm -P rattan 13
rose: Permission denied
% logout
% lprm -P rattan 13
dfA013rose dequeued
cfA013rose dequeued
```

9.5.4 ÐÝñá áðö öï Äðëü Êâßìáñ: Ðáñέóóüðáñáö ÄðέεϊāÝò Äêöýðüóçö

Ç áíöιεÞ lpr(1) ððιόóçñßæáέ ιέα äêÛìá äðέεϊäÞι äέα öιí Ýεää÷ι ιιñöιðιßçöçö έάειÝíö, ιάóáöñιðö ãñáóέεÞι έάέ Ûεεüι ιιñöÞι áñ÷âßìí, ðáñááüäÞö ðιεεáðεÞι áíóεáñÛöüι, ÷άεñέóíγ áñááóεÞι, έάέ Ûεεá. Ιέ äðέεϊäÝò áðöÝò ðáñέáñÛöιιόάέ óóçι ðáñιγόá áíüóçá.

9.5.4.1 ÄðέεϊāÝò ιιñöιðιßçöçö έάέ ιάóáöñιðö

Ιέ áεüειðεäð äðέεϊäÝò óçö lpr(1) äêÝä÷ιöι óçι ιιñöιðιßçöçö öüι áñ÷âßìí óçö ãñááóßáð äêöýðüóçö. ×ñçóέιðιέÞóðá öέö áι ç ãñááóßá óáð äáι ðáñέÝ÷άέ áðëü έâßìáñ Þ áι äðέεöιâðá íá ιιñöιðιέÞóðáð áðëü έâßìáñ äέαÝóíö öï ãñááέâßιö pr(1).

Άέα ðáñÛááέáιá, ç áεüειðεð áíöιεÞ öððÞιáέ Ýíá áñ÷âßι DVI (áðö öï óýóóçιá óðιέ÷άειεáóßáð T_EX) ιá üñíá *fish-report.dvi* óðιí äêöððüðÞ ιá üñíá bamboo:

```
% lpr -P bamboo -d fish-report.dvi
```

ÁðöÝò ιέ äðέεϊäÝò áóáñιüæιíóáέ óá êÛεá áñ÷âßι óçö ãñááóßáð, έάέ Ýóóέ äáι ιðιñáßðá íá áιáιßιáðá (áð ðιγíá) áñ÷âßá DVI έάέ ditroff ιáæß óóçι Þáέá ãñááóßá. ΆðεÞð óóáßεðá óá áñ÷âßá óáι äέαöιñáðέέÝò ãñááóßáð, ÷ñçóέιðιέÞιόá äέαöιñáðέέÝò äðέεϊäÝò ιάóáöñιðö äέα êÛεá ãñááóßá.

Óçιâßüóç: ¼έäð áðöÝò ιέ äðέεϊäÝò äêöüð öçö -p έάέ óçö -T áðáέöιγί ááέáðáóóçιÝíá ößεðñá ιάóáöñιðö äέα öιí äêöððüðÞ ðñιιñέóíγ. Άέα ðáñÛááέáιá, ç äðέεϊäÞ -d áðáέöâß öι ößεðñι ιάóáöñιðö DVI. Ç áíüóçá Ößεðñá ιάóáöñιðö äßιáέ ðáñέóóüðáñáö έäðöιγñáέáð.

-c

ΆέöððÞιáέ áñ÷âßá cifplot.

-d

ΆέöððÞιáέ áñ÷âßá DVI.

-f

Άέοδδθρóaέ άñ ÷ άΒά έάει Ýñò FORTRAN.

-g

Άέοδδθρóaέ άάάñÝία ó ÷ άάΒάόçò (plot).

-i *number*

Άέοδδθρóaέ όçí Ýñäí ìá άόí ÷ P *number* όόçēπί. Άί δññάέάβθάòά òí *number*, ç άόí ÷ P έά άβίαέ 8 όòPέάò. ΆòòP ç άδέείäP άìòέάýáέ ìüñ ìá ìέóíÝία öβέòñá ìáòáòññòPò.

Όçíaβüóç: ìçí òíðìέάòáßòá έáíü äéÛóòçíá ìáòáý òíò -i έάέ òíò άñέέìíý.

-l

Άέοδδθρóaέ άάάñÝία έάειÝñò έáòÛ äñÛñá (literal), óðìδññέέáíáÛññóáò έάέ òíòò ÷ άñáέòPñáò äéÝä ÷ ò.

-n

Άέοδδθρóaέ άάάñÝία ditroff (άάάñÝία troff άíäñÛñòçòá áðü όç óòóέάòP).

-P

Ûññòìðìέάß òí áðeu έάβìäñ ìá όçí pr(1) ðñέí íá òí äéòòðρóaέ. Άάβòá όçí pr(1) äéá δññέóóüòáññáò ðççññìòñßáò.

-T *title*

×ñçóέíìðìέάß òí *title* όόçí έáòáέβáá òíò pr(1) άíòß äéá òí üññá άñ ÷ äβìò. ΆòòP ç άδέείäP άδέéäñÛ ìüñ üòáí ÷ ñçóέíìðìέάßòáέ ìá όçí άδέείäP -p

-t

Άέοδδθρóaέ άάάñÝία troff.

-v

Άέοδδθρóaέ άάάñÝία ñÛóòáñ.

Ääp άβίαέ Ýία δáñÛäééäíá: áòòP ç áíòìèP äéòòðρóaέ ìéá èñòÛ ìññòìðìέçíÝíç Ýέäìóç όçò óáέβááò äìçèáβáò ls(1) óðíí ðññáðééääñÝññ äéòòðòòP:

% zcat /usr/share/man/man1/ls.1.gz | troff -t -man | lpr -t

Ç áíòìèP zcat(1) áðìóòìðéÝæáέ òíí ðççááβì èρáέéá όçò óáέβááò äìçèáβáò ls(1) έάέ òíí δññíÛáέ όόçí áíòìèP troff(1), ç ìðìβá òíí ìññòìðìέάß έάέ äçìέìòññááß όόçí Ýñäí όçò άάάñÝία GNU troff, óá áðìóòÝέέáέ όόçí lpr(1), ç ìðìβá ìá όç óáέñÛ όçò áðìóòÝέέáέ όçí äññáóòβá óðí **LPD**. ΆðáέäP ÷ ñçóέíìðìέPóáíá όçí άδέείäP -t óðí lpr(1), ì spooler, έáòÛ όç äéÛñéáéá όçò äéóýðòóçò, έá ìáòáòñÝθáέ όçí Ýñäí GNU troff óá Ýία óýðì άάάñÝññ έáòáíçòü áðü òíí ðññáðééääñÝññ äéòòðòòP.

topq printer-name job-or-username

ἈίάεάóÙóáéç òçð ïòñÙò áíáíííðð ñέα òíí printer-name. Òíðíεάòíéíóáé ðñðòáð íε áñááóβáð ìá áñέεèù áíáóííñÙò job ð áððÝð ðíò áíðέíòí òòí ÷ñðóç username. Ἄέα áððð òçí áíòíεð, ááí ìðíñáβòá íá ÷ñçóέííðíεðóáðá all òçí éÝóç òíò printer-name.

up printer-name

Ἰαçááβ òíí áέòððùòð óá "áíÝááóíá" (up). Òí áíóβεάòí òçð áíòíεðð down. Ἐóíáðíáíáβ ìá òçí start áέíεíòεíéííáç áðù òçí áíòíεð enable.

Òí lpc(8) áÝ ÷áðáé ðέð ðáñáðÙíù áíòíεÝð òðçí ñáñáíð áíòíεðí. Ἀί ááí áέóÙááðá éáíβá áíòíεð, òí lpc(8) ìðáβíáé óá éáðÙóóáóç áέέçεáðβáñáóçð (interactive), ùðíò ìðíñáβòá íá ðεçέðñíεíááβòá áíòíεÝð ìÝ ÷ñε íá ððóáðá exit, quit, ð end-of-file.

9.6 ἈίάέéáéêééÝð Ἐýóáέò ñέα òíí ÓòÙíòáñ Spooler

Ἀί Ý ÷áðá ìááððóáé ðέóóÙ ùεí òí éáòÙεάéí ìÝ ÷ñε ááð, éá Ý ÷áðá ìÙεáé ó ÷ááúí óá ðÙíóá ó ÷áðééÙ ìá òí óýòóçíá ðáñí ÷Ý óáððóçð LPD ðíò áέáðβεáðóáé ìá òí FreeBSD. Ἐá Ý ÷áðá éáóáííðóáé éáé ðíεéÝð áðù ðέð áέéáβðáέð òíò, ðíò òðóέéÙ ááííéíí òí áñðçóíá: “ðíεá Ùεéá òðóððíáðá ðáñí ÷Ý óáððóçð (ðíò íá éáέðíòñáíéíí òòí FreeBSD) òðÙñ ÷íòí áέáéÝóéíá;”

LPRng

Òí LPRng, òí ìðíβí óέúðéíá ççíáβíáé “LPR: the Next Generation (ç Ἄðùíáç ἌáíéÙ)” áβíáé íέα áðù òçí áñ ÷ð òεíðíβççð òíò PLP. Ἰ Patrick Powell éáé ì Justin Mason (έýñéíð óðíðçñçððð òíò PLP) óðíáñáÙóðçéáí ñέα íá òέéÙíòí òí LPRng. Ç έýñéá òíðíεάóβá òíò LPRng áβíáé ç http://www.lprng.org/.

CUPS

Òí CUPS, ð áέέéðð Common UNIX Printing System, ðáñÝ ÷áé íέα òíñçðð ðεááðòñíá áέòððóáùí áέα éáέðíòñáééÙ òðóððíáðá ááóέóíÝíá òòí UNIX. Ἀίáððý ÷εçéá áðù òçí Easy Software Products ñέα íá ðñíùèðóáé íέα óðÙíòáñ έýçð áέòððóáùí áέα ùεíòð òíòð ÷ñðóáð éáé éáóáéááóáóóÝð UNIX.

Òí CUPS ÷ñçóέííðíεáβ òí ðñùòùεíεéí Internet Printing Protocol (IPP) ùð áÙóç òíò ñέα òç áέα ÷áβñέóç áñááóéðí áέóýðùóçð éáé òñðí áíáíííðð. Òðíóççñβáéííðáé áðβòçð, áέéÙ ìá ìáέùíÝíç éáέðíòñáééúòçðá, óá ðñùòùεíεéá Line Printer Daemon (LPD), Server Message Block (SMB), éáé AppSocket (áíùóðù ùð JetDirect). Òí CUPS ðñíóéÝðáé áðíáðùòçðáð áíβ ÷íáðóçð áέéððáéðí áέòððùòðí, áíð ìÝóù òùí áðééíáðí PostScript Printer Description (PPD) áβíáðáé áέέéðð ç òðíóððñέíç óýá ÷ñíùí áέòððùòðí òòí éúóíí òíò UNIX.

Ç έýñéá òíðíεάóβá òíò CUPS áβíáé ç http://www.cups.org/.

HPLIP

Òí HPLIP, ð Óýóççíá Ἀðáέéúéíéóçð éáé Ἀέóýðùóçð òçð HP áέα Linux, áβíáé íέα óíòβðá áóáñíñáðí áέα óóέéáðÝð òçð HP, ðíò òðíóççñβáéé éáέðíòñáβáð ùðùð ç áέóýðùóç, ç óÙñùóç éáé ç áðíóðíεð / εðçç óái. Ç óíòβðá áððð ÷ñçóέííðíεáβ òí CUPS ùð backend ñέα éÙðíεáð áðù ðέð éáέðíòñáβáð áέóýðùóçð ðíò ðáñÝ ÷áé.

Ç έýñéá áέέððáéð òíðíεάóβá òçð áóáñíñáðð HPLIP áβíáé http://hplipopensource.com/hplip-web/index.html.

9.7 Άίοϊδείοιυδ Άεάαπí

Ίάοΰ όçí áεδΎεάόç õïò áδθέϣ όάόδ ìά õï Ìptest(1), áίόß όçδ έáíñίέεΠδ áέδýδύοçδ, ìδññáß íá Ύ ÷ áδά εΰάάε ùδ áδïòΎεάοίá ìßá áδύ όέδ áέυεϊðεάδ έáοάόδΰόάεδ:

Ί άέοδδύοΠδ έáεδóδΎñçόά íá ìάέήΠρσάέ Π ááí áέδýδύοά ðεüέçñç όç óáεßáá.

Ί άέοδδύοΠδ όýδύοά õï όάόδ, áεεΰ ááí ìάέßίçόά áíΎóυδ. ρóυδ ÷ ñáεΰόççέά íá δεΎόάδά õï δεΠέõññ PRINT REMAINING Π õï FORM FEED õïò áέοδδύοΠ ράδ áέá íá ìòáίέόδάß õï áδέέδìçóú áδïòΎεάοίá.

Άΰí áßíáέ ùíòυδ áδδΠç δññßδδύοç ράδ, ì άέοδδύοΠδ δέεáíρδ íá Πρσáί óá áíáññΠ áέá íá áíáέñέáρσάέ áí δδΠñ÷áí δñüóέáδά áááñΎíá όóçí áñááόßá áέδýδύοçδ δñέí ìάέήΠρσάέ íá áέοδδθρίáέ ðεάΠδïòá. Άέá íá áέíñερσάδά õï δñüáεçíá, ìδññáßδά íá εΎόάδά õï ößεδññ έáεíΎñò íá όóΎεíáέ Ύíá ÷ áñáέδΠñá FORM FEED (Π ΰεεí έáδΰεεçεí) όóñí áέοδδύοΠ. Άδδú όóíΠεùδ áßíáέ áñέáδú áέá íá ìδññáßδά íá áέοδδθρίáδά έáδάδεáßáí ðεíεíáΠδïòá έáßíáñí áδññΎíáέ óá áíáññΠ όóçí áóυδáñέέΠ ìΠìç (buffer) õïò áέοδδύοΠ. Άßíáέ áδßόçδ ÷ ñΠρσέíí íá ñöèìßεáδά όέδ áέοδδθρσάέδ ράδ ρόδά íá όáέáερññòí ìá ááìΰδç όçí όáέáδδóáßá όáεßáá, ρόδά ç áδññáíç áñááόßá íá ìçí áñ÷ßεáέ áδññ όá ìέόΰ õïò δññçáϣñññò όýεεíò.

Ç áέυεϊðεç õññδïðíßçόç όóí shell script /usr/local/libexec/if-simple áέοδδθρίáέ Ύíá form feed ìάοΰ όçí áδïòóíεΠ όçδ áñááόßáδ όóñí áέοδδύοΠ:

```
#!/bin/sh
#
# if-simple - Simple text input filter for lpd
# Installed in /usr/local/libexec/if-simple
#
# Simply copies stdin to stdout. Ignores all filter arguments.
# Writes a form feed character (\f) after printing job.

/bin/cat && printf "\f" && exit 0
exit 2
```

Ç áέδýδύοç δáññòόέΰæáέ “óáέíññáñí óέΰεάδ (staircase effect).”

Όόçí áέδýδύοç ράδ óáßíáδάέ õï áέυεϊðεí:

```
!"#$%&'()*+,-./01234
      "$%&'()*+,-./012345
                #%&'()*+,-./0123456
```

Άßíáδά Ύíá áέυñá εϣíá õïò óáέññΎñò óέΰεάδ, δïò δññέεΠεçέá áδñ áíδέόáδέέΎδ áñìçíáßáδ δñí ÷ áñáέδΠññí ìá õïòδ ðεíßíòδ áçερíáδάέ ç δññòññáóßá íΎád áñáñΠδ. Όá έáέδïòñáέέΰ όδóδΠíáδά όýδïò UNIX ÷ ñçóέññδñέíýí Ύíáí ìññí ÷ áñáέδΠñá ASCII ìá εùáέέü 10, õñí line feed (δññòññáóßá áñáñΠδ, LF). Όí MS-DOS, õï OS/2®, έáέ áεΰóññá ΰεεá, ÷ ñçóέññδñέíýí Ύíá áεýáñδ ÷ áñáέδΠññí ASCII εùáέέéϣ 10 έáέ ASCII εùáέέéϣ 13 (õñí carriage return Π áέεερδ CR). Δñεεíß áέοδδύοΎδ ÷ ñçóέññδñέíýí όçí όýññáόç õïò MS-DOS áέá όçí áέεéáΠ áñáñΠδ.

¼δáí áέοδδθρίáδά ìá õï FreeBSD, õï έáßíáñí ράδ áδεΰ ÷ ñçóέññδñέáß õñí ÷ áñáέδΠñá δññòññáóßáδ áñáñΠδ (line feed). Ί άέοδδύοΠδ, ìüεέδ áíδέεçöεáß õñí ÷ áñáέδΠñá line feed, δñññεáß õï ÷ áñδß έáδΰ ìßá áñáñΠ, áεεΰ έñáδΰáέ όçí ßáέá εΎόç ìñέæññóέá έáερδ έáέáßδάέ íá áέοδδθρσάέ õñí áδññáñí ÷ áñáέδΠñá. Όá áδδú õï όçíáßí ÷ ñçóέññδñέáßδάέ õï CR (carriage return): ìáδáέέíáß áçέááΠ όçí εΎόç áñááόßáδ áέá õñí áδññáñí ÷ áñáέδΠñá δïò δññüέáέόáέ íá áέοδδñεáß όóí áñέόδáññü ΰεññí õïò ÷ áñδέéϣ.

Όí FreeBSD áδέέδñáß ì άέοδδύοΠδ íá ìδññáß íá áíáñááß ùδ áñΠδ:

```
¼δáí ì άέοδδύοΠδ έáñáΰíáέ CR                Íá áέοδδθρίáέ CR
```

¼óáí ì áέοδδθòðòð èáíáΰíáέ LF

Ίά áέοδδθρσάέ CR + LF

Όδΰñ ÷ τóí áέΰοιñíέ οñυδíέ áέά íá áðέοάσ ÷ εάβ áδóυ:

- ×ñçóέιιδíερσάά óá ðερέοñá ñýεíέσçð οίτò áέοδδθòðρ ρ οίí δβίáέá áεΰá ÷ ιτò áέά íá áέεΰíáðá οίí οñυδí íá οίí ιδíβí áñιçíáýáέ áóοιγò οίτò ÷ áñáέοðñáð ì áέοδδθòðòð óáo. Όοíáιτòεάοδάβσά οί áá ÷ áέñβáεí ÷ ñρσçð οίτò áέά íá ááβσά ðυδ ιδíñáβ íá áβίáέ áδóυ.

Όçíáβυóç: Άí Ψ ÷ áðá éáέ ΰέεá εáέοιτòñáέέΰ οóí óγóόçíá óáo áέδυò áδυ οί FreeBSD, ðέέάíúí íá ÷ ñáέáóðáβ, υðάí óá ÷ ñçóέιιδíεáβσά, íá áðáíáñσέι/βσάσá οίí áέοδδθòðρ óáo ρóðá íá áñιçíáýáέ áέáοιñáðέέΰ οίτò ÷ áñáέοðñáð CR éáέ LF. Όðçí ðáñβððóç áððρ, βóυò áβίáέ éáέγðáñí íá ðñíτòέιρσάά éΰδíέá áδυ óέó εýóáέó οίτò áέίτòέιγí.

- Ίíáçáυð (driver) ðçð óáέñέáέρð áñáìρð οίτò FreeBSD ιδíñáβ íá íáðáσñΨðáέ áðóυíáðá áδυ LF óá CR+LF. Όðóέέΰ, áδóυ áιτòεáýáέ *lpr* óá óáέñέáέΨð εýñáð. Άέά íá áíáñáιτòέρσάάά áððρ ðçí εáέοιτòñáβá, ÷ ñçóέιιδíερσάά ðçí éέáíúíòçóá ms# éáέ ìñβóðá ðçí éáóΰóðáóç εáέóιτòñáβáð onlcr óóí áñ ÷ áβí /etc/printcap áέά οίí áέοδδθòðρ.
- Όðáβέðá Ψíá *εùäέέυ äέáöðáρð* (escape code) óóíí áέοδδθòðρ ρóðá íá ÷ áέñβáεáðáέ ðñíóυñέíΰ οίτò ÷ áñáέοðñáð LF íá áέáοιñáðέέυ οñυδí. Όοíáιτòεάοδάβσά οί áá ÷ áέñβáεí ÷ ñρσçð οίτò áέοδδθòðρ óáo áέá οίτò ερáέέáð áέáöðáρð οίτò ððíóðçñβáεííðáέ. ¼óáí áíáέáέγðáðá οίí éáοΰέεççèí, íáðáσñΨðóá οί οβέοñí éáέíΨíò ρóðá íá óðΨέíáέ ðñρá οίí εùáέέυ, éáέ Ψðáέðá ðçí áñááóβá οóíí áέοδδθòðρ.

Άρρ áβίáέ Ψíá ðáñΰááέáíá οβέοñíò éáέíΨíò áέá áέοδδθòΨð οίτò éáðáέááβíτòí οίτò εùáέέγð áέáöðáρð PCL ðçð Hewlett-Packard. Άðóυ οί οβέοñí εΰíáέ οίí áέοδδθòðρ íá ÷ áέñβáεáðáέ οίτò ÷ áñáέοðñáð LF υð LF éáέ CR. ðáέðá áðíóðΨέέáέ ðçí áñááóβá, óðΨέñíóáð óóí óΨέιτò ðçð Ψíá ÷ áñáέοðñá áέέááρð óáέβááð (form feed) ρóðá íá áβίáέ ουòðρ áíááυáρ ðçð ðáέáððáβáð óáέβááð. Όí οβέοñí áðóυ éá ðñΨðáέ íá áιτòεáýáέ íá ó ÷ ááυí υέιτò οίτò áέοδδθòΨð ðçð Hewlett Packard.

```
#!/bin/sh
#
# hpif - Simple text input filter for lpd for HP-PCL based printers
# Installed in /usr/local/libexec/hpif
#
# Simply copies stdin to stdout. Ignores all filter arguments.
# Tells printer to treat LF as CR+LF. Ejects the page when done.

printf "\033&k2G" && cat && printf "\033&l0H" && exit 0
exit 2
```

Άρρ áβίáέ Ψíá ðáñΰááέáíá áέá οί /etc/printcap áíυò ððíεííáέóðρ íá υíñá orchid. ÷ áέ Ψíá íυíí áέοδδθòðρ óðçí ðñρçð ðáñΰέεççç εýñá οίτò, Ψíá Hewlett Packard LaserJet 3Si íá υíñá teak. ×ñçóέιιδíεáβ οί ðáñáðΰíυ script υð οβέοñí éáέíΨíò:

```
#
# /etc/printcap for host orchid
#
teak|hp|laserjet|Hewlett Packard LaserJet 3Si:\
    :lp=/dev/lpt0:sh:sd=/var/spool/lpd/teak:mx#0:\
    :if=/usr/local/libexec/hpif:
```

Άέοδδθρίαάέ ϗ ιβα άναίηP δΎιυ όόçi Ύέέç.

Ί άέοδδθυόPδ άái δñiύεάβ έάέιειό οi ÷ άñóβ έάέ υεάó ιέ άñáiΥò έάειΎίη όόδθρίαάέ ϗ ιβα δΎιυ άδi όçi Ύέέç, óá ιβα άñáiηP.

Άóói όi δñiύέçιά άβιάέ όi “áióβóδñi” όiό óάέiüüáñiό óéΎεάó, δiό δñéáñΎθáιά δñiçáιoιΎiüò, έάέ άβιάέ δiεý όδΎίέi. Óá έΎδiέi όçιάβi, ιέ ÷ άñáέóPñáò LF δiό ÷ ñçóéiüδiέάβ όi FreeBSD áέά ιά óáñiáóβóáέ όçi άñáiηP, άñiçiáýiιόάέ üò ÷ άñáέóPñáò CR ιέ iδiβiέ άδέóóñΎióιoι όçι έáóáέP óóι άñéóóáñiü Ύéñi óiό ÷ άñóέiý, áέέΎ άβ÷üò ιά δñiύέPóιoι όi ÷ άñóβ ιβα άñáiηP δñiü óá έΎóu.

×ñçóéiüδiέPóóá όióò áέάέüδóáò ñóèiβóáñi óiό άέóóδθυóP P όiι δβiάέά áέΎá÷iό áέά ιά εΎóáóá óéó áέiεiüéáò άδéέiáΎò áέά óá LF έάέ CR characters:

Ί άέóóδθυóPδ έάiáΎiáέ	Ί άέóóδθυóPδ óóδθρίαέ
CR	CR
LF	CR + LF

Ί άέóóδθυóPδ άái άέóóδθρίαέ (÷ Ύiáέ) έΎδiέióð ÷ άñáέóPñáò.

Ί άέóóδθυóPδ, άñP άβιάέ óá έάέóιüñάβiά άέóýδθυóçð, άái άέóóδθρίαέ έΎδiέióð ÷ άñáέóPñáò óá υεάó óéó áñáiηΎò. Ói δñiύέçιά δéέáιPð ιά άβiáóáέ áíóüüóáñi έάέPð ϗ άέóýδθυóç áíéβóóáóáέ, ÷ Ύiιíóáó áέiüç δñéóóüüóáñiüò ÷ άñáέóPñáò.

Ói δñiύέçιά άβιάέ δiüò i άέóóδθυóPδ, έάέPð άέóóδθρίαέ, άái δñiéáááβiάέ ιá áέiεiüéPóáέ όçι óá÷ýóçóá ιá όçι iδiβiά i óðiέiáέóóPð óóΎiáέ áááñΎiá iΎóü όçò óáέñéάέPð áέáóýiááóçð (άóóü όi δñiύέçιά άái δñΎðáέ έáñiέέΎ iá óóiááβiáέ óá άέóóδθυóΎò óóíááiΎiüò óá δáñΎéέçéáò éýñáò). ÓðΎñ÷ióí áýi óñüδiέ áέά ιá iáδáñáóóáβ áóóü όi δñiύέçiá:

- ΆΎi i άέóóδθυóPδ óðióóçñβæάέ Ύéáá÷i ñiPð XON/XOFF, ñóèiβóóá όi FreeBSD ιá όiι ÷ ñçóéiüδiέPóáέ iñβæiíóáð όçι έáóΎóóáóç έáέóíüñáβáð ixon ιá όçι έέáfiüóçóá ms#.
- ΆΎi i άέóóδθυóPδ óðióóçñβæάέ Ύéáá÷i ñiPð óýðió Request to Send / Clear to Send (hardware handshake, áüóóü έάέ iá όçι iñiáóáá RTS/CTS), δñΎðáέ ιá iñéóóáβ ϗ έáóΎóóáóç έáέóíüñáβáð crtscts óóçι έέáfiüóçóá ms#. Άáááέüέάβóá δiüò ói έάέPáéi δió óóíáΎáέ όiι άέóóδθυóP iá όiι óðiέiáέóóP άβiáέ óúóóΎ óéááiΎi άέá ÷ ñPóç áóóiy óió áéΎá÷iü ñiPð.

Ί άέóóδθυóPδ óóδθρίαέ óéiüδβáέá.

Ί άέóóδθυóPδ óýδθυóá έΎóé δió áðiέáéiýiá óó÷άβá óéiüδβáέá, áiñPíóáð iüéáPðiüóá άέóóü óiό άðéέóüçóiy έáειΎiü.

Άóóü άβιάέ óóPèüò Ύiá áéüiá óýiüδüiá éáíéáóíΎiüí δáñáiΎóñüi óáέñéάέPð άðéέiéiüiáβáð iá óiι άέóóδθυóP. ΆέΎáíüóá iáíΎ όçι óéiP bps rate óóçι έέáfiüóçóá br, έάέ όçι ñýèiέóç parity óóçι έέáfiüóçóá ms#. Άáááέüέάβóá δiüò i άέóóδθυóPð ÷ ñçóéiüδiέάβ óéó βáέáð ñóèiβóáéóð δió Ύ÷ióí έάéiñéóóáβ óóí áñ÷άβi /etc/printcap.

Άái óóíΎáç óβðiüó, i άέóóδθυóPδ άái iáέβiçóá έáí.

Άi άái óóíΎáç óβðiüó, ói δñiύέçιά δéέáfiüi iá iüάβéáóáέ óóí FreeBSD έάέ ü÷έ óóí hardware. ΔñiüéΎóóá όçι έέáfiüóçóá áñ÷άβiü éáóááñáóPð (log file, lf) óóí áñ÷άβi /etc/printcap, óóçι έάóá÷ñéóç óiü άέóóδθυóP δió Ύ÷áέ ói δñiύέçiá. Άέá δáñΎüáéáüiá, áäP άβιάέ ϗ έáóá÷ñéóç áέá óiι rattan, iá όçι έέáfiüóçóá lf:


```
# kldload linux
```

Άί εÛεάðά ίά Û ÷ άðά ðÛíðά άíáñáðιέçιÛίç ðç óðιαάóóçðά ιά Linux, ðυðά εά ÷ ñáεάóðáß ίά ðñιòεÛóáðά ðç ðáñáεÛòυ ãñáñÏ óðι /etc/rc.conf:

```
linux_enable="YES"
```

Ç άίðιεÏ kldstat(8) ιðιñáß ίά ÷ ñçóείιðιέçεáß áεά ίά äεää ÷ εáß άί ðι KLD áßίáε öιñòυιÛίfi:

```
% kldstat
Id Refs Address      Size      Name
  1     2 0xc0100000 16bdb8   kernel
  7     1 0xc24db000 d000     linux.ko
```

Άί áεά εÛðιεí euáí ááí εÛεάðά Ï äá ιðιñáßðά ίά öιñòðóáðά ðι KLD, ðυðά ιðιñáßðά ίά óðιαÛóáðά óðáóεέÛ ðçι óðιòðñείç äεðäεÛóεíυι ðιò Linux óðιí ððñÏía ιά ðι ίά ðñιòεÛóáðά ðçι áðεεíäÏ options COMPAT_LINUX óðι áñ ÷ áßυι ñðεìßóáυι ðιò ððñÏía. Óðç óðιÛ ÷ áεά ιðιñáßðά ίά äáεάóáóððóáðά ðιí ίÛι ððñÏía υðυð ðáñεáñÛóáóáε óðι ÊäöÛεάεί 8.

10.2.1 ΆäεάóÛóóáç ðυí Linux Runtime Libraries

Άðòυ ιðιñáß ίά áßίáε ιά äÛι ðñυðιòð. Άßðά ιά ðç ÷ ñÏç ðιò linux_base-fc4 port, Ï ιά ÷ áεñιεßίçðç äáεάóÛóóáç ðιòð.

10.2.1.1 ΆäεάóÛóóáç ιÛóυ ðιò linux_base Port

Άðòυð äßίáε εáóÛ äáíεεÏ ñιεíäßá ι äðεíευιðáñιð ðñυðιð áεά ðçι äáεάóÛóóáç ðυí runtime libraries. Άßίáε ç ßáεά äεááεεάóá äáεάóÛóóáç ðιò áεíεíðεäáßðáε εáε áεά ιðιεíäÏðιòä Ûεεí port áðυ ðç ÓðεεíäÏ ðυí Ports (/usr/ports/). ΆðεÛ εÛíðά ðι ðáñáεÛòυ:

```
# cd /usr/ports/emulators/linux_base-f10
# make install distclean
```

Óçιαßυòç: Άί ÷ ñçóείιðιέááßðά εÛðιεά Ûεáíòç ðιò FreeBSD ðñεί ðçι 8.0, εά ðñÛðáε ίά äáεάóáóððóáðά ðι port emulators/linux_base-fc4 áίòß áεά ðι emulators/linux_base-f10.

Εά ðñÛðáε ðñá ίά Û ÷ áðά εáñιεεÏ óðιαάóóçðά ιά äεðäεÛóείά ðιò Linux. ΙáñεέÛ ðñιáñÛιáðά ðáñáðιεíÛίðáε υðε ίε äεááεεíðεäð óðóðÏιáðιò (system libraries) ááí áßίáε óçç ðáεáððáßá ðιòð Ûεáíòç. ΆáίεέÛ υυðð, áðòυ ááí áðιòäεáß εáíÛίá ðñυäεçίá.

Óçιαßυòç: ΙðιñιÛι ίά ððÛñ ÷ ιðι ðιεεáðεÛó äεäυóáεð ðιò emulators/linux_base, ðιò ίά áίðεóðιε ÷ ιÛι óðεð äεáóιñáðεέÛó äεäυóáεð ðυí äεáíñÏí Linux. Εά ðñÛðáε ίά εÛíáðά äáεάóÛóóáç ðυí ports ðιò ðñιáðáεðιÛίðáε áðυ ðεð áðáñιäÛò Linux ðεð ιðιßáð εÛεáðά ίά äáεάóáóððóáðά.


```
/compat/linux/lib/libc.so.4.6.27
/compat/linux/lib/libc.so.4 -> libc.so.4.6.27
```

êáé ãñáßðá íéá áðáññíáð ç ðñíßá æçðÛáé íéá íáüðáñç Ýéäñöç ðñöü ðñö ldd:

```
libc.so.4 (DLL Jump 4.5p126) -> libc.so.4.6.29
```

Áí ç äéáðñÛ ðçð Ýéäñöçð ððñ ðáêðððáßá ðçðññ ãßíáé ðññ ðßáð ð äýñ äêäüðáñ, ðñðá ðçñ ðáð áðáð÷ñéáß ç áñðéäñáðð ðñö /lib/libc.so.4.6.29, äéáðß ðñ ðññáññíá éá ðñÝðáé íá ðñÝ÷-äé éáñññéÛ éáé ðá ðç èßáñ ðáéáéüðáñç Ýéäñöç. Ðáñ' ðéá áððÛ, áí èÝéáðá, ðññáßðá íá áñðééáðáðððáðá ðñ libc.so éáé Ýðóé éá Ý÷-ðáð ðñ ðáñáéÛðñ:

```
/compat/linux/lib/libc.so.4.6.29
/compat/linux/lib/libc.so.4 -> libc.so.4.6.29
```

Óçñáßðöç: ð ç÷-áñéðñö ðññ ððñññééðñ ððñáÝóññ ÷ñáéÛæðáé ðññ äéá ðéð áðáñññáÝð ðñö Linux. ð runtime linker ðñö FreeBSD éñéðÛáé ðññö ðñö äéá ðéð ðéñ ðññððáðð äêäüðáéð ðññ äéáéññéçðññ éáé Ýðóé äá ÷ñáéÛæðáé íá ðáð áðáð÷ñéáß.

10.2.2 ÁêéáðÛðóáóç ðññ Linux ELF Binaries

Óá ELF binaries ÷ñáéÛæñðáé ðññééÝð ðññÝð Ýñá áéññá ãðñá, ðñ “branding”. Áñ ðññððáðððáðá íá ðñÝñáðá Ýñá äêðäëÝóéññ ELF ÷ññßð branding, ðñðá éá ðáð áñðáñéððáß ðñ ðáñáéÛðñ ðñöÛéñ:

```
% ./my-linux-elf-binary
ELF binary type not known
Abort
```

Áéá íá äñçðððáðá ðññ ððñññá ðñö FreeBSD íá ðá ÷ññßðáé Ýñá ELF ðñö FreeBSD áðñ Ýñá ðñö Linux, ÷ñçðéñññéððáðá ðçñ áñðññ brandelf(1).

```
% brandelf -t Linux my-linux-elf-binary
```

To GNU toolchain, ðññá ðññáññíá GNU, ðñðñéáðáß ðéÝññ áððññáðá ðá éáðÛéççéá ÷áñáéðçñéððéÛ ððá äêðäëÝóéññ ELF, áðñÝñð ðñ ðáñáðÛñ ãðñá éá ÷ñáéÛæðáé ðññ éáé ééäñðáññ ðññ ðññññ.

10.2.3 ÁêéáðÛðóáóç ðéáð Óð÷-áßáð Linux RPM Áðáñññáðð

Óñ FreeBSD äéáéÝðáé ðçñ äééð ðñö áÛöç äáññÝñññ áéá ðá ðáéÝðá, ç ðññá ÷ñçðéñññéáßðáé áéá ðéá ðá ports (éáé áéá áððÛ ðñö ðññÝññññáé áðñ ðñ Linux). Áéá ðñ èñññ áððñ, ç áÛöç äáññÝñññ Linux RPM ááñ ÷ñçðéñññéáßðáé (ááñ ððñðçñññáðáé).

Áñ ðñðñññ ÷ñáéÛæñðáé íá äêéáðáðððáðá íéá ðññéáðððññá ðñññññáð ðñö Linux ðñö ááðßáðáé ðá ðáéÝðñ RPM, ðññáßðá íá ðñ ððéðý÷-ðáð ðá ðññ ðáñáéÛðñ ðññññ:

```
# cd /compat/linux
```

```
# rpm2cpio -q < /path/to/linux.archive.rpm | cpio -id
```

×ñçóéíðíéðóáá òçí brandelf(1) ñéá íá òððíðíéðóááá êáðÛëëçéá óá áêðäëÝóéíá (ü÷é òéð áéáëéíèðéáð!) ùð áðáñíñáÝð Linux. Ááí éá ìðññáßðá íá áðááéáóáóððóááá òéð áðáñíñáÝð ìá éáéáññü òññüðí, áëëÛ éá ìðññÝóááá íá êÛíñáðá òéð äíééíÝð ðíð áðéëòíáßðá.

10.2.4 Ñýèíéóç ôïð Hostname Resolver

Áí ôï DNS äá äíðéäýáé ð áí óáð äíðóáíßæáðóáé ôï ðáñáéÛòù óóÛéíá:

```
resolv+: "bind" is an invalid keyword resolv+:
"hosts" is an invalid keyword
```

Ëá ÷ñáéáóóáß íá ñðèìßðááá ôï /compat/linux/etc/host.conf þóðá íá ðáñéÝ÷áé:

```
order hosts, bind
multi on
```

Ç óáéñÛ äáþ äçèþíáé ùðé áñ÷éÛ äéÝñ÷áðáé ôï áñ÷áßí /etc/hosts éáé óðç óðíÝ÷áé ì DNS server. ¼ðáí ôï /compat/linux/etc/host.conf äáí áßíáé áéáèÝóéí, íé áðáñíñáÝð Linux ÷ñçóéíðíéýíí ôï /etc/host.conf ôïð FreeBSD éáé ðáñáðííéýííðáé ùðé ç óýííóáíç ôïð áñ÷áßíð ááí áßíáé óóðð. Ëá ðñÝðáé íá áðáéñÝóááá òçí áíáíññÛ óóí bind áí äáí Ý÷áðá ñðèìßðáé Ýíá name server ìÝòù ôïð /etc/resolv.conf.

10.3 Áäéáééóóðíóáò ôï Mathematica®

Áíáíðèçéá áéá ôï Mathematica 5.X áðñü ôï Boris Hollas.

Ôï éáßíáñ áððü ðáñéññÛðáé òç áéááééáóáá áäéáðÛóóáóçð òçð Ýéäíóçð Linux ôïð **Mathematica 5.X** óá Ýíá óýóðçíá FreeBSD.

Ïðññáßðá íá ááññÛóááá òçí éáííééð ð ìáççðééð Ýéäíóç ôïð **Mathematica** ñéá Linux, áðáðèáßáð áðñü òç Wolfram óóí <http://www.wolfram.com/>.

10.3.1 Ôï Ðññáñáííá ÁäéáðÛóóáóçð ôïð Mathematica

Áñ÷éÛ, éá ðñÝðáé íá ðáßðá óóí FreeBSD ùðé óá áêðäëÝóéíá áéá Linux ôïð **Mathematica** êÛíñóí ÷ñþç ôïð Linux ABI. Ì äðéññüðáñíð òññüðíð áéá íá ôï êÛíñáðá áððü áßíáé íá ìñßðáðá ôïð óýðí ôïð ELF ùð Linux óá ùéáð òéð áðáñíñáÝð ðíð ááí áßíáé þáç branded, êÛíñóáð ÷ñþç òçð áíóíèðð:

```
# sysctl kern.fallback_elf_brand=3
```

Áððü éá êÛíñáé ôï FreeBSD íá ððíèÝóáé ùðé óá áêðäëÝóéíá ELF ðíð ááí áßíáé branded, êÛíñóí ÷ñþç ôïð Linux ABI éáé Ýóóé éá ìðññáßðá íá ðñÝíáðá ôï ðññáñáííá òçð áäéáðÛóóáóçð áðáðèáßáð áðñü ôï CDROM.

Ôþñá, áíðéññÛðáá ôï áñ÷áßí MathInstaller óóíí óéëçññü óáð áßóéí:

```
# mount /cdrom
# cp /cdrom/Unix/Installers/Linux/MathInstaller /localdir/
```

Άνβίωά οί αν÷άβι έαέ άίόέεάόάόδΠόάά οί /bin/sh όόζ δñþόζ ανάνΠ ιά οί /compat/linux/bin/sh. Άδδύ έά όέαιονΎφάέ ύόέ οί δñüανάνιá άάέάδΎόόάόζδ έά δñΎ÷άέ ιά όζι Ύέαιόζ sh(1) άέά Linux. Όόζ όόιΎ÷άέά, άίόέεάόάόδΠόάά üεάδ όέδ άάανáoΎδ Linux) ιά FreeBSD) ÷ñζόέιιδιεπίόάδ Ύίái όόίόΎέόζ έάειΎίτθ Π ιά οί δάναέΎδδ script όόζι άδύιαιζ άίύόζόά. Άδδύ έά δάέ όόι δñüανάνιá άάέάδΎόόάόζδ οίθ **Mathematica**, οί ιθίβι δñΎ÷άέ όζι άίόίεΠ uname -s άέά ίά άέάδέόδθόάέ οί έάέοιθñάέέü όύόόζία, ίά άίόέιáδδδθόάέ οί FreeBSD όái Ύίái έάέοιθñάέέü δάñáιδάνΎδ ιά οί Linux. Ç άέόΎέάόζ οίθ MathInstaller έά ίάέείΠόάέ όþñά όζι άάέάδΎόόάόζ οίθ **Mathematica**.

10.3.2 Οñιθιδιεπίόάδ όά ΆέδαέΎόεία οίθ Mathematica

Όά shell scripts όά ιθίβία άζιειθñάάβ οί **Mathematica** έάδΎ όζ άέάέέάόβá όζδ άάέάδΎόόάόζδ δñΎδάέ ίά όñιθιδιεζέιζι δñεί ÷ñζόέιιδιεζέιζι. Άί άδέέΎίάδά οί /usr/local/bin ùδ οίί έάόΎέιαι άέά όά άέδαέΎόεία οίθ **Mathematica**, έά ανάβδά άέάβ όóιαιέέέιζδ άάóιζδ (symlinks) δñιθ όά αν÷άβá math, mathematica, Mathematica, έάέ MathKernel. Όά έΎέά δάñβδδδóζ άδδ όέδ δάñάδΎδ, άίόέεάόάόδΠόάά όέδ άάανáoΎδ Linux) ιά FreeBSD) ιά έΎθιείί όόίόΎέόζ έάειΎίτθ Π ιά οί δάναέΎδδ shell script:

```
#!/bin/sh
cd /usr/local/bin
for i in math mathematica Mathematica MathKernel
do sed 's/Linux)/FreeBSD)/g' $i > $i.tmp
sed 's/\bin/sh/compat/linux/bin/sh/g' $i.tmp > $i
rm $i.tmp
chmod a+x $i
done
```

10.3.3 Άδιέθπιόάδ Έùάέέü άέά οί Mathematica

¼όái άέέείΠόάάά οί **Mathematica** άέά δñþόζ öiñΎ, έά ανδóζέάβδά άέά Ύίái έùάέέü. Άί άái Ύ÷άδά έΎθιείί έùάέέü όά άόδδ οί όδΎέει, δñΎίθά οί δñüανάνιá mathinfo θιθ ανβόέάδάέ όóιι έάόΎέιαι άάέάδΎόόάόζδ άέά ίά όάδ άιεάβ οί “machine ID”. Οί “machine ID” άβίάέ άι’ ιειεέþñιθ άάόέοιΎίί όόζ άέáyέδίοζ MAC όζδ έΎñόάδ άέέόγίθ θιθ Ύ÷άδά. Άδδδ όζιáβίάέ ύόέ άái ιθιñάβδά ίά δñΎίθάά οί **Mathematica** όά Ύέέιθδ όθιειαέόόΎδ.

¼όái άάανáoάάβδά όόζ Wolfram, ιά e-mail, όζέΎóυιθ Π fax, έά ÷ñάέάόάβ ίά άþόάάά οί “machine ID” έάέ έά όάδ άδáiθΠόίθι ιά Ύίái άίόβόόίε÷ι έùάέέü θιθ έά άδιθάέάβδάέ άδδ ιέά όάέñΎ άñέέþι.

10.3.4 ΟñΎ÷ιίόάδ οί Mathematica Frontend ιΎού Άέέόγίθ

Οί **Mathematica** έΎίάέ ÷ñþόζ έΎθιείι άέάέέþι ανάνιáδίοάέñþι άέά ίά άιόáiβόάέ ÷ανάέδþñάδ ιέ ιθίβιε άái όδΎñ÷ιθι όάά όόιζέόιΎίί όάδ (ιειεέçñþιáδά, áέñιβθιáδά, ΆέέçιεέΎ ανΎιáδά, έέδ). Το δñüóυειεει X άδάέδάβ άόδΎδ ιέ ανάνιáδίοάέñΎδ ίά όδΎñ÷ιθι όόι *διδέέü* όύόόζία. Άδδδ όζιáβίáέ ύόέ έά ÷ñάέάόάβ ίά άίόέανΎφάάά όέδ ανάνιáδίοάέñΎδ άόδΎδ άδδ οί CDROM Π άδδ άδδ έΎθιείι Ύέέιι όθιειαέόόΠ θιθ Ύ÷άέ οί **Mathematica**. Όόιþέδδ άόδΎδ ιέ ανάνιáδίοάέñΎδ ιθιñιζι ίά ανάέιζι ιΎόά όόι έάόΎέιαι /cdrom/Unix/Files/SystemFiles/Fonts οίθ CDROM, Π όόιί έάόΎέιαι /usr/local/mathematica/SystemFiles/Fonts όόιί διθέέü όέέçñü άβόέι. Ιέ δñάáiáόέέΎδ ανάνιáδίοάέñΎδ ανβόέιθόάέ όά όθιεiáόέέüιθδ üδδδ type1 έάέ x. ΌδΎñ÷ιθι άñέάδιβ όñüθιε ίά όέδ ÷ñζόέιιδιεΠόάάά, ιέ ιθίβιε δάñέανΎθιθίόάέ όόζ όόιΎ÷άέά.

Ι δñþθιθδ όñüθιθδ άβίáέ ίά όέδ άίόέανΎφάάά ιΎόά όά Ύίái όδΎñ÷ιθιά έάόΎέιαι όόι /usr/X11R6/lib/X11/fonts. Έά ÷ñάέάόάβ üιθδ ίά όñιθιθιεΠόάάά οί αν÷άβι fonts.dir, þόάά ίά δñιθέΎφάάά όά ιθιáδά δυι ανάνιáδίοάέñþι ιΎόά

óá áðöü, éáé íá áëëÛíáðá ôïí áñéëü òüí äñáííáðíóáéñþí óðç ðñþç äñáíð. ÁíáééáéðéëÛ, áβíáé óðíðèùð áñêáòü íá äêðáéÿóáðá áðèþð ðçí áíðíëð mkfontdir(1) ðÿóá óðíí éáðÛëíáí ðïð ÿ ÷ áðá áíðéáñÛþáé ðéð äñáííáðíóáéñÿð.

Ï äÿðáñíð ðñüðïð áβíáé íá áíðéáñÛþáðá ôïðð ðáñáðÛü ðéáðáéüíáðð ðÿóá óðí /usr/X11R6/lib/X11/fonts:

```
# cd /usr/X11R6/lib/X11/fonts
# mkdir X
# mkdir MathType1
# cd /cdrom/Unix/Files/SystemFiles/Fonts
# cp X/* /usr/X11R6/lib/X11/fonts/X
# cp Type1/* /usr/X11R6/lib/X11/fonts/MathType1
# cd /usr/X11R6/lib/X11/fonts/X
# mkfontdir
# cd ../MathType1
# mkfontdir
```

Ïþñá ðñíóéÿóáðá ôïðð íÿíðð éáðáéüíáðð ðä ðéð äñáííáðíóáéñÿð óðí font path:

```
# xset fp+ /usr/X11R6/lib/X11/fonts/X
# xset fp+ /usr/X11R6/lib/X11/fonts/MathType1
# xset fp rehash
```

Áí ÷ ñçóéíðíéáβðá ôï **Xorg**, ððñáβðá íá òíñðñíáðá ðéð äñáííáðíóáéñÿð áððÿð áððüíáðá, ðñíóéÿóáðáðá ôïðð íÿíðð éáðáéüíáðð óðí äñ ÷ áβí xorg.conf.

Ïçíáβüç: Áéá ôïí áíððçñáðçðð **XFree86**, ôï äñ ÷ áβí ñðéíβóáúí áβíáé ôï XF86Config.

Áí äáí ÿ ÷ áðá þáç ÿíáí éáðÛëíáí ðä ôï ùññá /usr/X11R6/lib/X11/fonts/Type1, ððñáβðá íá áëëÛíáðá ôï ùññá ôïð MathType1 áðü ôï ðáñáðÛü ðáñÛäéáíá óá Type1.

10.4 Äêðáééðóðþíðáð ôï Maple™

ÓðíáéóöíñÛ ôïð Aaron Kaplan. Äð ÷ äñéóðβáð óðíí Robert Getschmann.

Ïð **Maple™** áβíáé ðá äðñíéëð äðáñíñáð íáçíáðééþí ðáñüííéá ðä ôï **Mathematica**. Éá ðñÿðáé íá äáñÛóáðá ôï éíáéóíéëü áðü ôï <http://www.maplesoft.com/> éáé óðç óðíÿ ÷ áéá íá êÛíáðá áβðçç áéá íéá Ûäáéá ÷ ñþçð. Áéá íá ääéáðáóðþáðá ôï éíáéóíéëü óðí FreeBSD, áéíëíðèþóáðá óá ðáñáéÛðü áðëÛ áþíáðá.

1. Äêðáéÿóáðá ôï INSTALL shell script áðü ôï ðÿóáí ääéáðÛóáðáçð ðïð ÿ ÷ áðá. Äðééÿíðá “RedHat” ùðáí äñðççáβðá áðü ôï ðñüäñáííá ääéáðÛóáðáçð. Ï ðððéëüð éáðÛëíáíð áβíáé í /usr/local/maple.
2. Áí äáí ÿ ÷ áðá äáñÛóáé áéüíç êÛðíéá Ûäáéá áéá ôï **Maple**, äáñÛóáðá ðá áðü ôï Maple Waterloo Software (<http://register.maplesoft.com/>) éáé áíðéáñÛþðá ôï äñ ÷ áβí ðïð éá óáð äñéáβ óðí /usr/local/maple/license/license.dat.
3. Ääéáðáóðþáðá ôï **FLEXlm** license manager äêðáéþíðáð ôï INSTALL_LIC shell script ôï ððíá ðáñÿ ÷ áðáé íáæβ ðä ôï **Maple**. Äþóðá ôï äáóéëü ùññá ôïð ððíéíáéóðð óáð ôï ððíþí áðáéðáβðáé áðü ôïí áíððçñáðçðð áéá ÷ áβñéçðð ðüí ääáéþí (license server).
4. ×ñçóéíðíéáþóáðá ôï ðáñáéÛðü patch óðí äñ ÷ áβí /usr/local/maple/bin/maple.system.type:

```

----- snip -----
*** maple.system.type.orig      Sun Jul  8 16:35:33 2001
--- maple.system.type      Sun Jul  8 16:35:51 2001
*****
*** 72,77 ****
--- 72,78 ----
        # the IBM RS/6000 AIX case
        MAPLE_BIN="bin.IBM_RISC_UNIX"
        ;;
+   "FreeBSD" |\
    "Linux")
        # the Linux/x86 case
        # We have two Linux implementations, one for Red Hat and
----- snip end of patch -----

```

Óçíäêðôä üðé ðäöÛ ôï "FreeBSD" |\ äáí ðñÿðäé íá äïäáíðæäôäé Ûëëï êáñü äéÛóôçíä.

Ôï patch áðöü ðäçäáð ôï **Maple** íá áíááññðóäé ôï "FreeBSD" óáí ÿíá óýóôçíä Linux. Ôï bin/maple shell script êäéäð ôï bin/maple.system.type shell script, ôï ððíðí ðä ôç óáéñÛ ôïð êäéäð ôçí áíôïð ùname -a ðñíëäéÿíô íá áíôïðéóôäð ôï ùñíá ôïð êäéóïñäééíÿ óóóððíäôïð. Áíáëüäü ðä ôï ðñéí êäéóïñäééü äñäëäð, êá ðñçóéñðñéçéíÿ êäé óá áíôðóðñé÷á äêðäÿóéíä äñ÷äðä.

5. Äêééíðóää ôïñ license server.

Íäð äñéëüð ðñüðïð äéá íá äêééíðóää ôï lmgrd äðíáé ôï äéüëïðèï script ðïð äñðóéäðäé óôï /usr/local/etc/rc.d/lmgrd.sh:

```

----- snip -----

#! /bin/sh
PATH=/usr/local/sbin:/usr/local/bin:/sbin:/bin:/usr/sbin:/usr/bin:/usr/X11R6/bin
PATH=${PATH}:/usr/local/maple/bin:/usr/local/maple/FLEXlm/UNIX/LINUX
export PATH

LICENSE_FILE=/usr/local/maple/license/license.dat
LOG=/var/log/lmgrd.log

case "$1" in
start)
    lmgrd -c ${LICENSE_FILE} 2>> ${LOG} 1>&2
    echo -n " lmgrd"
    ;;
stop)
    lmgrd -c ${LICENSE_FILE} -x lmdown 2>> ${LOG} 1>&2
    ;;
*)
    echo "Usage: `basename $0` {start|stop}" 1>&2
    exit 64
    ;;
esac

exit 0
----- snip -----

```

6. Äñéëíð ôïö Maple:

```
% cd /usr/local/maple/bin
% ./xmaple
```

Óá áðüü ôï óçíáβí éá ðñÝðáé íá áβíáé üéá Ýðíéíá éáé íá íçí Ý ÷ áðá éáíÝíá ðñüáéçíá. Íçí íá ÷ Ûóáðá üüðð íá óðáβëáðá Ýíá e-mail óðç Maplesoft éáé íá ôïðð ðáβðá üðé èÝéáðá íéá Ýéäíóç ðïð íá ððíóóçñβæáðáé áðβóçíá óðí FreeBSD.

10.4.1 ÓðíçèéóíÝíá ðñíäëβíáðá

- ðüðð äðóéíéáððáβðá ðá óçí éáéðíðñáβá ôïð **FLEXlm** license manager. ÁðéðëÝíí ðáêèçñβüóç ððñíáβðá íá áñáβðá óðí <http://www.globetrotter.com/>.
- Ôí lmgrd áβíáé áíüóðü üðé èÝéáé ôí áñ ÷ áβí óçð Ûááéáð íá Ý ÷ áé óðáéáêñéíÝíç ðñòP áééëð ç áéðÝéáóç ôïð éá áðíóç ÷ áé. Íá óüóðü áñ ÷ áβí Ûááéáð ÷ ñPóçð ðñÝðáé áβíáé óá ááíééÝð áñáñÝð üðüð ôí ðáñáéÛüð:

```
# =====
# License File for UNIX Installations ("Pointer File")
# =====
SERVER chillig ANY
#USE_SERVER
VENDOR maplelm

FEATURE Maple maplelm 2000.0831 permanent 1 XXXXXXXXXXXX \
    PLATFORMS=i86_r ISSUER="Waterloo Maple Inc." \
    ISSUED=11-may-2000 NOTICE=" Technische Universitat Wien" \
    SN=XXXXXXXXX
```

Óçíáβüóç: Í óáéñéáéüð áñééüð éáé ôí èéáéáβ ðáβíííóáé ááð ðá 'X'. Ôí chillig áβíáé ôí üñíá ôïð óðóðβíáðüð.

Ïðñíáβðá íá ðñíðíðíéPóáðá ôí áñ ÷ áβí óçð Ûááéáð ÷ ñPóçð, áñéáβ íá íçí áéëÛíáðá óçí áñáñP “FEATURE” (ç íðíá ðñíóóáðáýáðáé áðü ôí èéáéáβ óçð Ûááéáð).

10.5 Áäéáééóðβíáðá ôí MATLAB®

ÓðíáéóðñÛü ôïð Dan Pelleg.

Ôí éáβíáñ áðüð ðáñéáñÛüáé óç áéááééáóβá ááéáðÛóðáóçð óçð Linux Ýéäíóçð ôïð **MATLAB® 6.5** óá Ýíá óýðóçíá FreeBSD. Äïðéáýáé áñéáðÛü éáéÛü, ðá áíáβñáóç ôí **Java Virtual Machine™** (ááβðá óðí Ôíβíá 10.5.3).

Ç Linux Ýéäíóç ôïð **MATLAB** ððñíáβ íá ááññáóðáβ áðáðèáβáð áðü óçí áðáéñáβá The MathWorks óðí <http://www.mathworks.com>. Óéáññáððáβðá üðé ðPñáðá éáé ôí áñ ÷ áβí ðïð ðáñéÝ ÷ áé óçí Ûááéá ÷ ñPóçð P íäçáβáð áéá ôí ðüð íá ôí äçíéíðñáPóáðá. Íéá éáé éá áðééíéíüíPóáðá ðá óçí áðáéñáβá, ðáβðá ôïðð üðé éá èÝéáðá íá ððÛñ ÷ áé áðβóçð ððíóóðñéíç áéá ôí FreeBSD.

10.5.1 ÁãëáóÛóóáóç ðíð MATLAB

Ãëá íá áãëáóóóóóóóóá ðíð **MATLAB**, ëÛíðá óá ðáñáëÛòù:

1. ÁëóÛááóá ðí CD éáé ðñíóáñðóóá ðí óðí óýóóçíá óáð. Óðíááëáððá ùð ðñðóóçò root, ùðòò óóíéóóÛ ðí script óçò áãëáóÛóóáóçò. Ãëá íá íáëéíðóóá ðí script óçò áãëáóÛóóáóçò äðóóá óçí áíðíëð:

```
# /compat/linux/bin/sh /cdrom/install
```

Óðùääéíç: Õí ðñüãñáííá óçò áãëáóÛóóáóçò áñíáé óá ãñáðéëü ðáñéáÛëëíí. Áí éáíáÛíáðá óóÛëíáðá óðáðéëÛ íà óçí íëüíç, äðóóá óçí áíðíëð: `setenv HOME ~USER`, ùðíð `USER` áñíáé í ðñðóóçò áðù ùðíð äðóóá óçí áíðíëð `su(1)`.

2. ¼ðáí áñùðçëáððá áëá ðíí éáðÛëíáí ðíð **MATLAB**, äðóóá: `/compat/linux/usr/local/matlab`.

Óðùääéíç: Ãëá áðëíëüðáñç áëááééáóóá áãëáóÛóóáóçò, ïññóóá ðí ðáñáëÛòù: `set MATLAB=/compat/linux/usr/local/matlab` óçò áñáííð áíðíëðí ðíð éáëýóíðò óáð.

3. Õñíðíðíéðóóá ðí áñðáñí óçò Ûááéáð (license file) óýíòùíá íà ðéð íäçáðð ðíð ëÛááóá íà óçí Ûááéá ðíð **MATLAB**.

Óðùääéíç: Ìðíñáððá íá áðíéíÛóóáðá äë ðuí ðñíðóÝñíí ðí áñðáñí áððù éáé íá ðí áíðéáñÛðáðá óðí `$MATLAB/license.dat`, ðñéí éáí óáð ðáé ðí ðñüãñáííá áãëáóÛóóáóçò íá ðí ðñíðíðíéðóóáðá.

4. Íëíëðñíùóç óçò ÁãëáóÛóóáóçò

Óá áððù ðí óçíáñí, ç áãëáóÛóóáóç ðíð **MATLAB** Ýðáé íëíëçññùëáð. Óá áðùíáíá áðíáðá ðñáëÛæííðáé áëá íá ìðíÝóáðá íá ðí äíðëÝðáðá óùóóÛ íà ðí FreeBSD.

10.5.2 Áëëßíçóç ðíð License Manager

1. Äçíëíðñááá óðíáíëéëðí óðíáÝóííí áëá óá scripts ðíð license manager:

```
# ln -s $MATLAB/etc/lmboot /usr/local/etc/lmboot_TMW
# ln -s $MATLAB/etc/lmdown /usr/local/etc/lmdown_TMW
```

2. Äçíëíðñáðóóá ðí áñðáñí áëëßíçóçò `/usr/local/etc/rc.d/flexlm.sh`. Õí ðáñÛááëáíá ðáñáëÛòù áñíáé íéá ðñíðíðíéçíÝíç Ýéäíóç ðíð `$MATLAB/etc/rc.lm.glnx86`. Íé áëëááÝð áñíáé óóéð ðíðíëáððáð ðuí áñðáñí, éáé óóçí áëëßíçóç ðíð license manager óðí ðáñéáÛëëíí áñíííðóóçò Linux ðíð FreeBSD .

```
#!/bin/sh
case "$1" in
  start)
    if [ -f /usr/local/etc/lmboot_TMW ]; then
      /compat/linux/bin/sh /usr/local/etc/lmboot_TMW -u username && echo 'MATLAB_lmgrd'
    fi
  ;;
```

```

stop)
if [ -f /usr/local/etc/lmdown_TMW ]; then
    /compat/linux/bin/sh /usr/local/etc/lmdown_TMW > /dev/null 2>&1
fi
;;
*)
echo "Usage: $0 {start|stop}"
exit 1
;;
esac

exit 0

```

Óçíáíóééü: Ôí áñ ÷ áßí ðñÝðáé íá áßíáé äêäëÝóéíí:

```
# chmod +x /usr/local/etc/rc.d/flexlm.sh
```

ÐñÝðáé áðßóçò íá áíóééáóáóðáóðá ôí ðáñáðÛíú *username* ðä Ýíá ððáñêêü üííá ÷ ñßóç ôïö óóóðßáðüò óóó (êáé íá íçí áßíáé í *root*).

3. Äêëéíßóðá ôíí license manager ðä ôçí áíóíëß:

```
# /usr/local/etc/rc.d/flexlm.sh start
```

10.5.3 Óýíááóç ðä ôí ÐáñéáÛëëíí ôïö Java Runtime Environment

ÄëÛíðá ôíí óýíááóíí ôïö Java Runtime Environment (JRE) óá Ýíáí í ððíßò èá äíðëäýáé óóí FreeBSD:

```
# cd $MATLAB/sys/java/jre/glnx86/
# unlink jre; ln -s ./jre1.1.8 ./jre
```

10.5.4 Äçíéíðáóðá ôí Script Äêêßíçóçò ôïö MATLAB

1. Ôíðíèáðßóðá ôí ðáñáéÛò script óóí /usr/local/bin/matlab:

```
#!/bin/sh
/compat/linux/bin/sh /compat/linux/usr/local/matlab/bin/matlab "$@"
```

2. Óçç óóíÝ ÷ áéá ðßóðá ôçí áíóíëß `chmod +x /usr/local/bin/matlab`.

Öüüääéíç: ÁíÛëíá ðä ôçí Ýéäíóç ôïö `emulators/linux_base`, ðïö Ý ÷ áðá, ððíñáß íá áíóáíéóóíýí íáñéêÛ óóÛëíáðá üðáí ðñÝíáðá ôí script. Äéá íá ôí áðíöýááðá áóóü, ðñíðíðíéßóðá ôí áñ ÷ áßí /compat/linux/usr/local/matlab/bin/matlab, êáé áëëÛíðá ôç ãñáííß ðïö ëÝáé:

```
if [ `expr "$lsCmd" : '.*->.*'` -ne 0 ]; then
```

(óççí Ýéäíóç 13.0.1 ãñßóéáðáé óçç ãñáííß 410) óá áóðß ôç ãñáííß:

```
if test -L $newbase; then
```


10.6.2 Άεάάόΰόάόζ όιό Δάñεάΰεείιόιό Linux

Όεαίονάοάβσαά υόε Ύ ÷ άόα άεάάόάόόΠόάε όά emulators/linux_base έάε devel/linux_devtools άδύ όζ όόεείαΠ όύι Ports. Αί άίόείαόυδβεάάόά άόόεεβάδ ια όά Δάñάδΰίυ, βούδ ÷ ñάεάόάβ ια όά άεάάόάόόΠόάάά άδύ ΔάεΎόά Π άδύ Δάεέυόάñάδ άεάυόάέδ όζδ όόεείαΠδ όύι Ports.

Αί εΎεάόά ια όñΎίάόά όίι intelligent agent, έά ÷ ñάεάόάβ ια άεάάόάόόΠόάάά έάε όι ΔάεΎόι Red Hat Tcl:

tcl-8.0.3-20.i386.rpm. ζ άίόίεΠ άεά όζι άεάάόΰόάόζ ιΎού όιό άδβόζιό **RPM** port (archivers/rpm) άβίάε:

```
# rpm -i --ignoreos --root /compat/linux --dbpath /var/lib/rpm package
```

ζ άεάάόΰόάόζ όιό *package* έά όñΎΔάε ια άβίάε ιάεΰ έάε ÷ ύñβδ όñιάεβιáά.

10.6.3 Ñόειβεείιόάό όι Δάñεάΰεείι άεά όζι Oracle

Δñεί όζι άεάάόΰόάόζ όζδ **Oracle**, έά όñΎΔάε ια ñόειβόάάά όύόόΰ όι Δάñεάΰεείι όιό όόόόβιáόυδ όάδ. Όι Δάñάεΰόυ έάβιáι Δάñεάñΰόάε όε *άεñεáβδ* όñΎΔάε ια εΰίáάά άεά ια άεάεΎόάά όζι **Oracle** άεά Linux όόι FreeBSD, έάε άáι Δάñεάñΰόάε υόε όδΰñ ÷ άε Πάζ όόιι ιάζάυ άεάάόΰόάόζδ όζδ **Oracle**.

10.6.3.1 Ñýειέόζ όιό Δόñβίá

¼δύδ Δάñεάñΰόάε ι ιάζάυδ άεάάόΰόάόζδ όζδ **Oracle**, έά όñΎΔάε ια ιñβόάάά όέδ όείΎδ όζδ shared memory όόι ιΎάεόόι. Ιζι ÷ ñζόείιόίεΠόάάά όι SHMMAX όόι FreeBSD. Όι SHMMAX όδίείβεάάάάε άδεβδ άδύ όι SHMMAXPGS έάε όι PGSIZE. ΆδñΎίυδ έάειñβόάά όι SHMMAXPGS. ¼εάδ ιε ΰεεάδ άδεείαΎδ ιδñιγί ια ιñεόόιγί υδύδ Δάñεάñΰόάάε όόιι ιάζάυ. Άεά Δάñΰάεάιá:

```
options SHMMAXPGS=10000
options SHMMNI=100
options SHMSEG=10
options SEMMNS=200
options SEMMNI=70
options SEMMSL=61
```

Ιñβόάά όέδ όείΎδ όύι άδεείαβί Ύόόε βόάά ια όάεñεΰάείόι όόζ ÷ ñβόζ όζδ **Oracle** διό εΎεάόά ια εΰίáάά.

Άδβόζδ, άδεάάάεβόάά υόε Ύ ÷ άόα άίáñáιόίεΠόάε όέδ Δάñάεΰόυ άδεείαΎδ όόέδ ñόειβόάέδ όιό Δόñβίá:

```
options SYSVSHM #SysV shared memory
options SYSVSEM #SysV semaphores
options SYSVMSG #SysV interprocess communication
```

10.6.3.2 Ι × ñβόόζδ Oracle

Άζιείονάβόάά Ύίá ÷ ñβόόζ όόόόβιáόιό ια υíñá oracle, ια όίι βάεί όñυδι διό έά άζιείονάβιγύόάά έάε ιδίείιáΠδιόá ΰεείι ÷ ñβόόζ. Όι ιυí έάεάβόάñι ÷ άñάέδζñεόόεέυ όιό ÷ ñβόόζ oracle άβίάε υόε ÷ ñάεΰάάάε ια όιό άβόάάά Ύίá εΎεόόιό Linux. ΔñιόεΎόάά όι /compat/linux/bin/bash όόι /etc/shells έάε ιñβόάά όι εΎεόόιό όιό ÷ ñβόόζ oracle όά /compat/linux/bin/bash.

10.6.3.3 Ôì ÐáñéáÛëëíí

Áëòüð òùí óðíçëëóíÛííí ìáðááëçððí òçð **Oracle**, ùðòò ìé ORACLE_HOME éáé ORACLE_SID éá ðñÛðáé ìá ìñβóáðá éáé òéð áëüëíðëáð ìáðááëçðÛð ðáñéáÛëëííôìð:

Ìáðááëçðð	Óëìð
LD_LIBRARY_PATH	\$ORACLE_HOME/lib
CLASSPATH	\$ORACLE_HOME/jdbc/lib/classes111.zip
PATH	/compat/linux/bin /compat/linux/sbin /compat/linux/usr/bin /compat/linux/usr/sbin /bin /sbin /usr/bin /usr/sbin /usr/local/bin \$ORACLE_HOME/bin

Óáð óðíçëóíÛííá ìá ìñβóáðá ùëàð òéð ìáðááëçðÛð ðáñéáÛëëííôìð óðí áñ÷áβì .profile. ìá ðëíëççñùíÛíí ðáñÛááëáíá áβíáé ôì ðáñáëÛòù:

```
ORACLE_BASE=/oracle; export ORACLE_BASE
ORACLE_HOME=/oracle; export ORACLE_HOME
LD_LIBRARY_PATH=$ORACLE_HOME/lib
export LD_LIBRARY_PATH
ORACLE_SID=ORCL; export ORACLE_SID
ORACLE_TERM=386x; export ORACLE_TERM
CLASSPATH=$ORACLE_HOME/jdbc/lib/classes111.zip
export CLASSPATH
PATH=/compat/linux/bin:/compat/linux/sbin:/compat/linux/usr/bin
PATH=$PATH:/compat/linux/usr/sbin:/bin:/sbin:/usr/bin:/usr/sbin
PATH=$PATH:/usr/local/bin:$ORACLE_HOME/bin
export PATH
```

10.6.4 ÁäëáðÛóóáóç òçð Oracle

Ëüáù ìéá ìéëñðò Ûëëáéçðð óðíí áññíëüðð ôìð Linux, éá ÷ ñáéáóðáβ ìá äçìëíðñáðóáðá Ûíáí éáóÛëíáí ìá ôì ùíñá .oracle ìÛóá óðí /var/tmp, ðñéí ìáéëíðóáðá ôì ðñüáññíá ìáäëáðÛóóáóçð. Ì éáóÛëíáíð áðòüð éá ðñÛðáé ìá áíðëáé óðíí ÷ ñðóç oracle. Ëá ðñÛðáé óðñá ìá ðñááíáðíðíëðóáðá òçí áäëáðÛóóáóç òçð **Oracle** áβ÷ ùð éáíÛíá ðñüáëçíá. Áí áíðëáðððβæáðá ùìð áëüìç ðñíáëðíáðá, áëÛáíðá òçí Ûëáíóç òçð **Oracle** ðìð Û÷áðá ð/éáé òéð ñòëìβóáéð óáð! Áóóüò Û÷áðá ðñááíáðíðíëðóáé òçí áäëáðÛóóáóç òçð **Oracle**, áðáñíüóðá óá patches ðìð ðáñéáñÛóíðáé óðéð äÛí ðáñáëÛòù áíüôçðáð.

Ìá óð÷íü ðñüáëçíá áβíáé ùðé ááí áβíáðáé óóóðð áäëáðÛóóáóç ðìð ðñíóáññíáÛíá òìð ðñüòíëüëëíð TCP. Áóóü Û÷áé ùð áðìðÛéáóíá ìá ìçí ìðñáβðá ìá ìáéëíðóáðá ôìðð TCP listeners. Ìé áëüëíðëáð ìáçáβáð éá óáð áíçððóíðí ìá ëÛóáðá áóóü ôì ðñüáëçíá.:

```
# cd $ORACLE_HOME/network/lib
# make -f ins_network.mk ntcontab.o
# cd $ORACLE_HOME/lib
# ar r libnetwork.a ntcontab.o
# cd $ORACLE_HOME/network/lib
# make -f ins_network.mk install
```

Ìç ìá÷Ûóáðá ìá ðñÛðáé ìáíÛ òì root.sh

10.6.5 ΆεοΎεάοζ οζο Oracle

Άοιγ Ύ ÷ άοά αειεροεΠοάε άδοΎδο οέο ιαζαβάο, εά δñΎδαε ίά ιδñαβοά ίά άεοάεΎοάοά οζι **Oracle** οάι ίά άñεοέουοάοάι οά Ύία ογόοζία Linux.

10.7 ΆεεάοΎοόάοζ οίο SAP® R/3®

ΟδίαέοοιΎ οίο Holger Kipp. Άñ÷έεΠ ιάδοάοñιδΠ οά SGML άδñ οίι Valentino Vaschetto.

Ç άεεάοΎοόάοζ οσοόζιΎοδñι **SAP** ÷ñζοέιιδñεβίοάο οί FreeBSD άάι οδñοόζñβεάοάε άδñ οζι ñΎάά οδñοόβñείζο οζο SAP — οδñοόβñείζο δάñΎ ÷άοάε ιñι οά οοάεάεñείΎίαο, οδñοόζñεάειιάφάο, δεάοοñιάο.

10.7.1 ΆεοάάñäΠ

Οί εάβιαñι άοδñ δñεεάñΎοάε Ύία δεεάφñ οññοñι εεά οζι άεεάοΎοόάοζ οίο **SAP R/3 System** ιά ιβά άΎοζ άάññΎιñι **Oracle** εεά Linux οά Ύία ογόοζία FreeBSD, δñεεάίαñΎιñιόάο οζι άεεάοΎοόάοζ οίο FreeBSD εεά οζο **Oracle**. Εά δñεεάñΎοιñι άγί εεάοññάοέεΎ άβαζ ñδειβοάñι:

- **SAP R/3 4.6B (IDES)** ιά **Oracle 8.0.5** οά FreeBSD 4.3-STABLE
- **SAP R/3 4.6C** ιά **Oracle 8.1.7** οά FreeBSD 4.5-STABLE

Δάñ' ùεñ δñο άοδñ οί εάβιαñι δñιόδαεάβ ίά δñεεάñΎοάε ιά εάδδññΎñεάο ùεά οά άδñάβοζοά άβιαόά, άάι εά δñΎδαε ίά εάññεεάβ ùο άίοεεάοάοόΎοζο οñι ιαζαβί άεεάοΎοόάοζο οζο **Oracle** εεά οίο **SAP R/3**.

Άάβοά οñι ιαζαñ οίο **SAP R/3** εεά Linux εεά άññοβοάεο ο÷άοέεΎ ιά οί **SAP** εεά οζι **Oracle**, εεά εεά δζαΎδο άδñ οζι **Oracle** εεά οί **SAP OSS**.

10.7.2 Είεάοίεéñ

Οά εέñεñοεά CD-ROMs Ύ ÷ ιοί ÷ñζοέιιδñεεεάβ εεά οζι άεεάοΎοόάοζ οίο **SAP**:

10.7.2.1 SAP R/3 4.6B, Oracle 8.0.5

¼ññά	Άñβεìζοζ	Δñεεάñάοβ
KERNEL	51009113	SAP Kernel Oracle / Installation / AIX, Linux, Solaris
RDBMS	51007558	Oracle / RDBMS 8.0.5.X / Linux
EXPORT1	51010208	IDES / DB-Export / Disc 1 of 6
EXPORT2	51010209	IDES / DB-Export / Disc 2 of 6
EXPORT3	51010210	IDES / DB-Export / Disc 3 of 6
EXPORT4	51010211	IDES / DB-Export / Disc 4 of 6
EXPORT5	51010212	IDES / DB-Export / Disc 5 of 6
EXPORT6	51010213	IDES / DB-Export / Disc 6 of 6

ΆδεόεΎιñ, ÷ñζοέιιδñεεβοάιñ οί **Oracle 8 Server** (Pre-production version 8.0.5 εεά Linux, Kernel Version 2.0.33) CD

οί ιδιβί άάί άβίάέ άδανάβόζοί, έάέ οί FreeBSD 4.3-STABLE (Ύία όόέαιέουόδδϊ έβάαδ ιύι ιΎνάδ ιάδΎ όζι Ύέαιόζ 4.3-RELEASE).

10.7.2.2 SAP R/3 4.6C SR2, Oracle 8.1.7

¼ííá	Άñβείζός	Δñέεñάόβ
KERNEL	51014004	SAP Kernel Oracle / SAP Kernel Version 4.6D / DEC, Linux
RDBMS	51012930	Oracle 8.1.7/ RDBMS / Linux
EXPORT1	51013953	Release 4.6C SR2 / Export / Disc 1 of 4
EXPORT1	51013953	Release 4.6C SR2 / Export / Disc 2 of 4
EXPORT1	51013953	Release 4.6C SR2 / Export / Disc 3 of 4
EXPORT1	51013953	Release 4.6C SR2 / Export / Disc 4 of 4
LANG1	51013954	Release 4.6C SR2 / Language / DE, EN, FR / Disc 1 of 3

Άίαέυαυò ιά όεδ ãεβόάδ δϊò εΎεάοά ίά άάέάοάόδβόάά, έά ÷ñάέάοάάβόά άδέδΎίι όά άίόβόοίε ÷ά CDs. Άιάβδ ÷ñζοέιιδίείγϊά ΆάñιáίέέΎ (DE) έάέ ΆάάέέέΎ (EN), ιδύδά ÷ñάέάειιáόδά ιύι οί δñβοί CD. Ίέά ιέέñβ όζιáβύζ, ζ άñβείζός ούι EXPORT CDs άβίάέ áεñέáβδ ζ βάέά. ¼έά όά CDs ούι áεùζόβί Ύ ÷ϊοί όζι βάέά άñβείζός (άδδου áέάόΎñάέ όά ό ÷ Ύός ιά όζι άñβείζός όζδ Ύέαιόζδ 4.6B IDES). Όζι βñά δϊò άñΎοñίόάέ άδδΎδ ιέ άñáιΎδ, ζ άάέάδΎόόάζ έάέοιδñάάβ όά FreeBSD 4.5-STABLE (20.03.2002).

10.7.3 Όζιáέπόάέδ SAP

Ίέ áεüειρδεδ όζιáέπόάέδ έά δñΎδάέ ίά áέάάάοόιγί δñεί όζι άάέάδΎόόάζ οίο **SAP R/3** ιέά έάέ άβίάέ ÷ñβόείαδ áέά όζ áέάάέάόβá άάέάδΎόόάζδ:

10.7.3.1 SAP R/3 4.6B, Oracle 8.0.5

Άñβείζός	Όβόεϊò
0171356	SAP Software on Linux: Essential Comments
0201147	INST: 4.6C R/3 Inst. on UNIX - Oracle
0373203	Update / Migration Oracle 8.0.5 --> 8.0.6/8.1.6 LINUX
0072984	Release of Digital UNIX 4.0B for Oracle
0130581	R3SETUP step DIPGNTAB terminates
0144978	Your system has not been installed correctly
0162266	Questions and tips for R3SETUP on Windows NT / W2K

10.7.3.2 SAP R/3 4.6C, Oracle 8.1.7

Áñβείçç	Ôβðëïð
0015023	Initializing table TCPDB (RSXP0004) (EBCDIC)
0045619	R/3 with several languages or typefaces
0171356	SAP Software on Linux: Essential Comments
0195603	RedHat 6.1 Enterprise version: Known problems
0212876	The new archiving tool SAPCAR
0300900	Linux: Released DELL Hardware
0377187	RedHat 6.2: important remarks
0387074	INST: R/3 4.6C SR2 Installation on UNIX
0387077	INST: R/3 4.6C SR2 Inst. on UNIX - Oracle
0387078	SAP Software on UNIX: OS Dependencies 4.6C SR2

10.7.4 ÁðáéðÞóáèð ÓðóðÞíáðìð

Ï áëüëïðèð ãñðëéóíüð áβíáé áñêáðüð áéá íéá ðððééÞ äêéáðÛóðáçç ðìò **SAP R/3 System**. Áéá ìç÷-áíÞíáðá ðáñááüáÞð éá ÷ñáéáððáβðá ððóééÛ éáéýðáñç áêðβìççç ðùí áðáéðÞóáùí óáð:

ÁíÛñðçíá	4.6B	4.6C
ÁðáíáñááóðÞð	2 x 800MHz Pentium III	2 x 800MHz Pentium III
ÏíÞìç	1GB ECC	2GB ECC
Óêëçñüð Äβóêèð	50-60GB (IDES)	50-60GB (IDES)

Áéá ÷ñÞççç óá ðáñááüáÞð, éá ÷ñáéáððáβðá áðáíáñááóðÛð Xeon ìâ ìááÛêç ìíÞìç cache, áβóéïðð ðççèÞð ðá÷-ýççðáð (SCSI, ìâ hardware áêááêðÞ RAID), USV éáé ECC-RAM. Ôí ìááÛëí ìÝááèèð ðìò óêëçñüý áβóêèð, ìðáβéáðéé óðí ðñññðèíéóíÝíí óýóðçíá IDES, ðìò áçìéíðñááβ 27 GB áñ÷-áβá áÛóçð áááñÝíuí éáðÛ çç äéÛñéáéá ççð ááéáðÛóðáççð. Ï ÷ññìð áðóüð áðáñéáβ áðβóçð áéá ðá áááñÝíá ççð áðáññáÞð óá Ýíá áñ÷-ééü óýóðçíá ðáñááüáÞð.

10.7.4.1 SAP R/3 4.6B, Oracle 8.0.5

×ñçóëñðñèèèéèéá ðá áéüëïðèá èíéíÛ áíáñðÞíáðá: ìçðñééÞ áéá äýí áðáíáñááóðÛð ìâ 2 Pentium III óðá 800 MHz, áêááêðÞ SCSI Adaptec® 29160 Ultra160 (áéá ðññóðááçç óá ìäçäü ðáéíβáð 40/80 GB DLT éáé óðí CDROM), Mylex® AcceleRAID™ (2 êáíáéêéÞí, firmware 6.00-1-00 ìâ 32 MB RAM). Óðí Mylex RAID controller áβíáéé óðíáááñÝííé äýí óêëçñññ áβóêèé ðùí 17 GB (mirrored) éáé ðÝóóáñéð ðùí 36 GB (RAID level 5).

10.7.4.2 SAP R/3 4.6C, Oracle 8.1.7

Óá áððÞ ççí ááéáðÛóðáçç ÷ñçóëñðñèèèéèéá Ýíáí Dell™ PowerEdge™ 2500: ìçðñééÞ ìâ äýí áðáíáñááóðÛð Pentium III óðá 1000 MHz (256 kB Cache), 2 GB PC133 ECC SDRAM, PERC/3 DC PCI RAID Controller ìâ 128 MB, éáé ìäçäü EIDE DVD-ROM. Óðí RAID controller áβíáéé óðíáááñÝííé äýí óêëçñññ áβóêèé ðùí 18 GB (mirrored) éáé ðÝóóáñéð ðùí 36 GB (RAID level 5).

10.7.5 Άεάοΰόόός οίö FreeBSD

Άñ ÷ έέΰ δñÝðáé íá äáéάόάόόΠόάά οί FreeBSD. Άόδου ιδññáβ íá äβίáé íá äéΰοιñιόδ οñυδñιόδ, äéá δññέόóυδóññáδ ðεçñιοñιñβáδ äáβóá όοι ΌιΠιά 2.13.

10.7.5.1 Άέΰόάιç Äβóείö

Άέá íá êñáδΠόιñιá όç äéááééáόβá áδêΠ, ÷ñçόείñδñέΠόáíá όçí βáéá äéΰόάιç äβóείö, δυόí όοι **SAP R/3 46B** υοί éáé όοι **SAP R/3 46C SR2**. Íññ óá ññιáόá δυí όóόéáòñι ΰééáíáí, éáèðð ç èΰèá äáéάοΰόόός Ýáείá óá äéáοιñáδéèυ ìç ÷ ΰίçìá. (/dev/da éáé /dev/amr áíόβόóíé ÷ á, ñδñóá áí ÷ñçόείñδñέáβóá Ýíáí AMI MegaRAID®, éá äáβóá όí /dev/amr0s1a áíόβ όíö /dev/da0s1a):

Óýόόçíá áñ ÷ áβυí	ÍÝááèìò (1k-blocks)	ÍÝááèìò (GB)	Ðñιόΰñδçόç όοι
/dev/da0s1a	1.016.303	1	/
/dev/da0s1b		6	swap
/dev/da0s1e	2.032.623	2	/var
/dev/da0s1f	8.205.339	8	/usr
/dev/da1s1e	45.734.361	45	/compat/linux/oracle
/dev/da1s1f	2.032.623	2	/compat/linux/sapmnt
/dev/da1s1g	2.032.623	2	/compat/linux/usr/sap

Ñδèìβóóá áδñ δñέí όιòδ äýí äβóείòδ ñá όí éñéόίéèυ Mylex P όι PERC/3 RAID. Ìδññáβóá íá áέóÝéèáδá óá áόδυ éáόΰ όç öΰόç äéèβίçόçδ όíö BIOS.

ÐñιόÝíóá äáð υóé ç äéΰόάιç όιö äβóείö äéáόÝñáé èβáñ ùδ δñιò όç όóίέόόñιáíç áδñ όç SAP, éáèðð ç SAP δññιόáβíáé íá δññιόáñόΠόáά όιòδ όδñéáόáéυäñιòδ όçδ **Oracle** (éáé èΰδñέíòδ ΰéèιòδ) ñá ÷ ùnéóóΰ — äñáβδ δññιόéìΠόáíá, äéá èυññιòδ áδèυδçόáδ, íá äçìéíòñáΠόιñιá éáññééíýδ éáόáéυññιòδ.

10.7.5.2 make world éáé ÍÝìð ÐóñΠíáð

Éáόááΰόóá όñ ðçááβì èðáééá όιö óáéáóόáβìð δóñΠíá -STABLE. Ìáόááéυòδóβóá όí world (ááóééυ óýόόçíá) éáé όñ ðóñΠíá óáδ áóñý äçìéíòñáΠόáάð δññΠόá Ýíá δññιόáññιόíÝñí áñ ÷ áβì ñδèìβóáυí δóñΠíá. Äáð éá δñÝðáé íá óοιðññéèΰááóá éáé óéð δññáíÝóññιòδ δóñΠíá (kernel parameters) ñé ñδñβáδ ÷ñáéΰáññιόáé δυόí äéá όí **SAP R/3** υοί éáé όçí **Oracle**.

10.7.6 Άäéáóΰόόός όíö Ðññéáΰéèñíόíö Linux

10.7.6.1 Άäéáóΰόόός όíö Linux Base System

Άñ ÷ έέΰ ÷ñáéΰááóáé íá Ý ÷ áδá äáéάόάόόΠόáé όí linux_base port (ùδ ÷ ñΠόόçδ root):

```
# cd /usr/ports/emulators/linux_base
# make install distclean
```

10.7.6.2 Äêäáóóðçôá ôíö ÐäñéäÛëëííôíö ÁíÛððôíçð Linux

Ôí ðäñéäÛëëíí áíÛððôíçð Linux ÷ñäëÛæäðáé áí ëÿëäðä íä äêäáóóðçôáððáðä ôçí **Oracle** óðí FreeBSD ùðùð ðäñéäñÛðäðáé óðí ÔíÐíä 10.6:

```
# cd /usr/ports/devel/linux_devtools
# make install distclean
```

Äêäáóóðçôáíä ôí ðäñéäÛëëííí áíÛððôíçð Linux ïüíí äéä ôçí äêäáóóðçôáç ôíö **SAP R/3 46B IDES**. Áí ÿ ÷äðä äêäáóóðçôáé ôçí **Oracle DB** äðü ôçí **Oracle** äéä óðóðÐíäðä Linux, ôüðä ääí ÷ñäëÛæäðáé íä óáð äðäó÷íëäð.

10.7.6.3 Äêäáóóðçôáç ðüí Äðäñäðçðçðíí RPMs

Äéä íä íäëëíÐðáé ôí ðñüäñäíä R3SETUP, ÷ñäëÛæäðáé íä ððÛñ÷äé ððíóðÐñéçç PAM. ÊáóÛ ôç äëÛñëäéä ôçð ðñðççð äêäáóóðçôáçð ôíö **SAP** óðí FreeBSD 4.3-STABLE, ðñíóððáèÐðáíä íä äêäáóóðçôáíä ôí PAM ðä ùëä óä äðäñäðçðçðä ðäëÿðä éäé ðäëëÛ äíáíäëÛóáíä ôçí äêäáóóðçôáç ôíö ðäëÿðä PAM, ôí ïðíßí éäé äÿÿëäðä. Äéä ôí **SAP R/3 4.6C SR2** äíáíäëÛóáíä Ûíáðá ôçí äêäáóóðçôáç ôíö ðäëÿðä PAM, ôí ïðíßí äððççð äÿÿëäðä, ðñÛäíä ðíð óçíäßíäé ùðé óä ðäëÿðä ðíð äíáðÿñííðáé ùð äíäñðððáéð ôíö, ääí ÷ñäëÛæíðáé:

```
# rpm -i --ignoreos --nodeps --root /compat/linux --dbpath /var/lib/rpm \
pam-0.68-7.i386.rpm
```

Äéä ôíí intelligent agent ôíö **Oracle 8.0.5**, ÿðñäðä íä äêäáóóðçôáíä ôí ðäëÿðä Tcl ôçð RedHat tcl-8.0.5-30.i386.rpm (äéäíñäðéëÛ ç äðäíáóÿíäáç éäóÛ ôç äëÛñëäéä ôçð äêäáóóðçôáçð ôçð **Oracle** ääí ëä Ððáí äðëéðð). ÔðÛñ÷íí éäé ëÛðíéä Ûëëä ðñíäèÐíäðä ó÷äðéëÛ ðä ôç äðäíáóÿíäáç ôçð **Oracle**, äëÛ äððü äßíäé ëÿíä ôçð **Oracle** äéä Linux, éäé ù÷é ôíö FreeBSD.

10.7.6.4 Äðéðëÿíí Óóíäíðëÿð

ððùð äßíäé äððççð éäèÐ ëäÿä íä ðñíðëÿóáðä ôí linprocfs óðí /etc/fstab. Äéä ðäñéðóóððäñäð ðççñííñßäð, ääððä ôç óäèßäá manual linprocfs(5). Ìéä Ûëëç ðäñÛíäðñíð ðíð ïðíñäððä íä ïñððáðä äßíäé ç kern.fallback_elf_brand=3 ç ïðíßä ïñßæäðáé óðí äñ÷äßí /etc/sysctl.conf.

10.7.7 Äçíéíðñäðá ôíö ÐäñéäÛëëíííôíö SAP R/3

10.7.7.1 Äçíéíðñäðá ðüí Äðäñäèðçðíí ÓðóðçíÛðíí Áñ÷äßíí éäé Ðñíóäñððáéð

Äéä ðä äðèÐ äêäáóóðçôáç, äñëäð íä äçíéíðñäððáðä óä ðäñäéÛððð óðóðÐíäðä äñ÷äßíí éäé ðñíóäñððáéð:

óçíäßí ðñíóÛñççççð	ìÿääëíð óä GB
/compat/linux/oracle	45 GB
/compat/linux/sapmnt	2 GB
/compat/linux/usr/sap	2 GB

Äßíäé äððççð äðäñäðçðçðíí íä äçíéíðñäððáðä éäé ðäñéÿðð óðíäÿííðð. ÄéäíñäðéëÛ ôí ðñüäñäíä äêäáóóðçôáçð ôíö **SAP** ëä ðäñäðñíäèäð.

```
# ln -s /compat/linux/oracle /oracle
# ln -s /compat/linux/sapmnt /sapmnt
# ln -s /compat/linux/usr/sap /usr/sap
```

Íá ðééáíü ðíðíá óðÛéíáðíð éáðÛ ðç äéÛñéáéá ðçð ääéáðÛóóáóçð (ääð ðá System *PRD* éáé ääéáðÛóóáóç ðíð **SAP R/3 4.6C SR2**):

```
INFO 2002-03-19 16:45:36 R3LINKS_IND_IND SyLinkCreate:200
    Checking existence of symbolic link /usr/sap/PRD/SYS/exe/dbg to
    /sapmnt/PRD/exe. Creating if it does not exist...

WARNING 2002-03-19 16:45:36 R3LINKS_IND_IND SyLinkCreate:400
    Link /usr/sap/PRD/SYS/exe/dbg exists but it points to file
    /compat/linux/sapmnt/PRD/exe instead of /sapmnt/PRD/exe. The
    program cannot go on as long as this link exists at this
    location. Move the link to another location.

ERROR 2002-03-19 16:45:36 R3LINKS_IND_IND Ins_SetupLinks:0
    can not setup link '/usr/sap/PRD/SYS/exe/dbg' with content
    '/sapmnt/PRD/exe'
```

10.7.7.2 Äçíéíðñáβá × ñçóððí éáé Êáóáéüáüí

Ôí **SAP R/3** ðñáéÛäóáé äÿí ðñóðáð éáé ðñáéð ñÛääð (groups). Óá ðíüíáðá ðüí ðñçóððí äíáñðíðíóáé áðü ðí **SAP** system ID (SID) ðí ððíβí áðíðáéáβóáé áðü ðñβá ññÛíáðá. ÌáñééÛ áðü áððÛ óá SIDs áβíáé äáóíáðíÛíá áðü ðí **SAP** (áéá ðáñÛääéáíá óá SAP éáé NIX. Áéá ðéðñç éβóðá äáβðá ðçí ðáêíçñβüóç ðíð **SAP**). Áéá ðçí ääéáðÛóóáóç IDES, ðñçóéíðíéðóáíá IDS, áéá ðçí ääéáðÛóóáóç óðí óýóççíá 4.6C SR2 ðñçóéíðíéðóáíá PRD, éáèð áððü ðí óýóççíá ðñññβæáðáé áéá ðñβóç ðáñáñüáðð. ÁðñÛíüð, ðñáéáóððéáíá óéð áéüéíðéáð ñÛääð (óá ID ðüí ñÛáüí ððíñÿíá íá äéáóÛííóí, áððÛð áβíáé áðèðð íé ðéíÛð ðíð ðñçóéíðíéðóáíá ðçç äéèð íáð ääéáðÛóóáóç):

ID ñÛääð	üñíá ñÛääð	ðáñééñáðð
100	dba	Data Base Administrator (Áéá ðñéñéóððð ÁÛóçð ÄääñÛíüí)
101	sapsys	SAP System
102	oper	Data Base Operator (× áéñéóððð ÁÛóçð ÄääñÛíüí)

Áéá ðç ðððééð ääéáðÛóóáóç ðçð **Oracle**, éá ðñáéáóðáβðá ðüí ðçí ñÛää ðá (ääβðá ðç ðáêíçñβüóç ðçð **Oracle** éáé ðíð **SAP** áéá ðáñéóóüðáñáð ðéçñíðíñβáð).

Êá ðñáéáóðíÿíá áðβóçð ðíðð áéüéíðéíðð ðñóðáð:

ID ðñβóç	üñíá ðñβóç	ääíééü üñíá	áñ ðéèð ñÛää	áðéðéÛíí ñÛääð	ðáñééñáðð
1000	idsadm/prdadm	sidadm	sapsys	oper	SAP Administrator (Áéá ðñéñéóððð)


```
# mkdir mirrlogA mirrlogB origlogA origlogB
# mkdir sapdata1 sapdata2 sapdata3 sapdata4 sapdata5 sapdata6
# mkdir saparch sapreorg
# exit
```

Ἡ ἐξέλιξη τοῦ ὄρου **Oracle 8.1.7**, εἶναι ἀπαραίτητη γιὰ τὴν ἐπιθεώρηση τοῦ συστήματος:

```
# su - orasid
# cd /oracle
# mkdir 805_32
# mkdir client stage
# mkdir client/80x_32
# mkdir stage/817_32
# cd /oracle/SID
# mkdir 817_32
```

Ὁρίωνες: Ἡ ἐπιθεώρηση τοῦ `client/80x_32` ἀπαραίτητη γιὰ τὴν ἐπιθεώρηση καὶ τὴν ἀσφάλεια τοῦ συστήματος. Ἡ ἀσφάλεια τοῦ συστήματος εἶναι ἐπιθεώρηση τοῦ `client/80x_32` καὶ τὴν ἀσφάλεια τοῦ συστήματος.

Ὁ ὄρος `sidadm` ἀπαραίτητη γιὰ τὴν ἐπιθεώρηση τοῦ συστήματος καὶ τὴν ἀσφάλεια τοῦ συστήματος:

```
# su - sidadm
# cd /usr/sap
# mkdir SID
# mkdir trans
# exit
```

10.7.7.4 Ἀσφάλεια τοῦ ὄρου `/etc/services`

Ὁ **SAP R/3** ἀπαραίτητη γιὰ τὴν ἐπιθεώρηση τοῦ συστήματος καὶ τὴν ἀσφάλεια τοῦ συστήματος. Ἡ ἀσφάλεια τοῦ συστήματος εἶναι ἀπαραίτητη γιὰ τὴν ἐπιθεώρηση τοῦ συστήματος καὶ τὴν ἀσφάλεια τοῦ συστήματος. Ἡ ἀσφάλεια τοῦ συστήματος εἶναι ἀπαραίτητη γιὰ τὴν ἐπιθεώρηση τοῦ συστήματος καὶ τὴν ἀσφάλεια τοῦ συστήματος. Ἡ ἀσφάλεια τοῦ συστήματος εἶναι ἀπαραίτητη γιὰ τὴν ἐπιθεώρηση τοῦ συστήματος καὶ τὴν ἀσφάλεια τοῦ συστήματος.

```
sapdp00    3200/tcp # SAP Dispatcher.           3200 + Instance-Number
sapgw00    3300/tcp # SAP Gateway.                 3300 + Instance-Number
sapsp00    3400/tcp #                               3400 + Instance-Number
sapms00    3500/tcp #                               3500 + Instance-Number
sapmsSID   3600/tcp # SAP Message Server.       3600 + Instance-Number
sapgw00s   4800/tcp # SAP Secure Gateway         4800 + Instance-Number
```

10.7.7.5 Ἀσφάλεια τοῦ ὄρου `/etc/locales`

Ὁ **SAP** ἀπαραίτητη γιὰ τὴν ἐπιθεώρηση τοῦ συστήματος καὶ τὴν ἀσφάλεια τοῦ συστήματος. Ἡ ἀσφάλεια τοῦ συστήματος εἶναι ἀπαραίτητη γιὰ τὴν ἐπιθεώρηση τοῦ συστήματος καὶ τὴν ἀσφάλεια τοῦ συστήματος. Ἡ ἀσφάλεια τοῦ συστήματος εἶναι ἀπαραίτητη γιὰ τὴν ἐπιθεώρηση τοῦ συστήματος καὶ τὴν ἀσφάλεια τοῦ συστήματος.

íðíβò ãβíáé áéáéÝóëíò ìúíí áí áβóòá ðáéÛòçð ìà ðñúóááóç OSS). Ááβòá òç óçìáβòóç 0171356 áéá òç ëβóóá áðú ðáéÝóá RPMs ðíð ÷ ñáéÛæáóóá.

Áβíáé áðβóçð áóééòú íá äçìéíðñáβóáá áðëβð òíðð éáðÛëëçéíòð óðíáÝóííòð (áéá ðáñÛááéáíá áðú óá *de_DE* éáé *en_US*), áéëÛ ðñíáβíòíá íá íç εÛíáðá εÛóé óÝóíéí áí ðñúéáéóáé áéá íç ÷ Ûíçíá ðáñááúáβð (òóóóóíí áóóú Ý ÷ áé íÝ ÷ ñé óóéáíβð äíðéÝðáé ÷ ùñβð ðñúáéçíá óá óýóóçíá IDES). Éá ÷ ñáéáóóáβóá ðéð áéúéíðéáð òíðééÝð ñðèìβóáéð:

```
de_DE.ISO-8859-1
en_US.ISO-8859-1
```

Ëé óýíááóíéé ìðííýí íá äçìéíðñáçéíýí ìà òíí áéúéíðéí ðñúðí:

```
# cd /compat/linux/usr/share/locale
# ln -s de_DE de_DE.ISO-8859-1
# ln -s en_US en_US.ISO-8859-1
```

Áí ìé óýíááóíéé ááí ððÛñ ÷ íðí, éá äçìéíðñáçéíýí ðñíáéβíáóá éáðÛ òçí ááéáðÛóóáóç. Áí ááñíβóááá áóðÛ óá ðñíáéβíáóá, (íñβæííóáð òí STATUS òúí ðñíáéçíáóóéëβí äçìÛóúí óá OK óðí áñ ÷ áβí CENTRDB.R3S), βóòð áβíáé ááyíáðí íá óóíááéáβóá óóí SAP ÷ ùñβð εÛðíéá áðéðéÝíí ðñíóðÛéáéá éáé óðáóÛéç ÷ ñúííð.

10.7.7.6 Ñýèíéóç òíð Ððñβíá

Ôí SAP R/3 ÷ ñáéÛæáóóáé áñéáðíýð ðñúíòð áðú òí óýóóçíÛ óáð. Áéá áóóú òí éúíáí ìñβóáíá ðéð ðáñáéÛòú ðáñáíÝòñíòð óóéð ñðèìβóáéð òíð ððñβíá:

```
# Set these for memory pigs (SAP and Oracle):
options MAXDSIZ="(1024*1024*1024)"
options DFLDSIZ="(1024*1024*1024)"
# System V options needed.
options SYSVSHM #SYSV-style shared memory
options SHMMAXPGS=262144 #max amount of shared mem. pages
#options SHMMAXPGS=393216 #use this for the 46C inst.parameters
options SHMMNI=256 #max number of shared memory ident if.
options SHMSEG=100 #max shared mem.segs per process
options SYSVMSG #SYSV-style message queues
options MSGSEG=32767 #max num. of mes.segments in system
options MSGSSZ=32 #size of msg-seg. MUST be power of 2
options MSGMNB=65535 #max char. per message queue
options MSGTQL=2046 #max amount of msgs in system
options SYSVSEM #SYSV-style semaphores
options SEMMNU=256 #number of semaphore UNDO structures
options SEMMNS=1024 #number of semaphores in system
options SEMMNI=520 #number of semaphore identifiers
options SEMUME=100 #number of UNDO keys
```

Ëé áéÛ ÷ éóóáð ðéíÝð ðíð εÝóíòíá ðñíÝñ ÷ ííóáé áðú òç óáéìçñβòóç òíð SAP. Ëéá éáé ááí ððÛñ ÷ íðí ðáçáβáð áéá Linux, áéá ðáñéóóúðáñáð ðççñíòíñβáð, ñβíðá ìéá ìáóéÛ óá áóðÝð áéá òí HP-UX (32-bit). Ëéá éáé òí óýóóçíá áéá òçí ááéáðÛóóáóç òíð 4.6C SR2 Ý ÷ áé ðáñéóóúðáñç íβìç, óá áéáíéñáæúíáíá òíβíáóá ìðííýí íá áβíáé ìáááéýóáñá, òúóí áéá òí SAP úóí éáé áéá òçí Oracle. ÁðñÝíòð, áðééÝíòá Ýíáí ìáááéýóáñí áñééíú áéá óá shared memory pages.

Óçíáßóóç: ðá ðçí ðñíáðéëááíÝíç áãéáðÛóóáóç ðíð FreeBSD óá ð386, áðßóðá óá MAXDSIZ éáé DFLDSIZ óðí 1 GB ðí ðíëý. ÁéáóñíáðéëéÛ, ðñíáß ðá ááßóðá ðá áíóáíßæííóáé ðáñíßáñáá óðÛëíáðá ùðòò "ORA-27102: out of memory" éáé "Linux Error: 12: Cannot allocate memory"

10.7.8 ÁãéáðÛóóáóç ðíð SAP R/3

10.7.8.1 ðñíáðéíÛæííóáð óá SAP CDROMs

Óðç áéááééáóßá ðçð áãéáðÛóóáóçð ðíðëÝëííóáé áñéáðÛ CDROMs. Áí Ý ÷ áðá áñéáðéýð ðäçáíýð, éá ðñíÝóáðá ðá ðá ðñíóáñðßóáðá ùéá ðá ðéáð óðí óýóðçíá óáð. Áíáßð áðñíóáßóáðá ðá áíðéáñÛðñíðá ðí ðáñéá ÷ ùíáñí ðùí CDROMs óðíðð áíðßóðíé ÷ ððð éáðáéùíáðð:

```
/oracle/SID/sapreorg/cd-name
```

ùðíð *cd-name* áíðéóðíé ÷ áß óá Ýíá áðù óá KERNEL, RDBMS, EXPORT1, EXPORT2, EXPORT3, EXPORT4, EXPORT5 éáé EXPORT6 áéá ðçí áãéáðÛóóáóç óá 4.6B/IDES, éáé KERNEL, RDBMS, DISK1, DISK2, DISK3, DISK4 éáé LANG áéá ðçí áãéáðÛóóáóç ðíð 4.6C SR2. ¼éá óá ðñííáðá ðùí áñ ÷ áßùí óðá ðñíóáñðçíÝíá CDs éá ðñÝðáé ðá áßíáé ðá éáðáéáßá, áéáóñíáðéëéÛ éÛííá ÷ ðñßóç ðçð áðééíáßð -g éáðÛ ðçí ðñíóÛñóçç. ×ñçóéíðñíéáßóðá éíéðùí ðéð ðáñáéÛòò áíðñéÝð:

```
# mount_cd9660 -g /dev/cd0a /mnt
# cp -R /mnt/* /oracle/SID/sapreorg/cd-name
# umount /mnt
```

10.7.8.2 ÕñÝíðá ðí Script ðçð ÁãéáðÛóóáóçð

Áñ ÷ ééÛ ðñÝðáé ðá ðñíáðéíÛóáðá ðíí éáðÛëíáí install:

```
# cd /oracle/SID/sapreorg
# mkdir install
# cd install
```

Óðç óðíÝ ÷ áéá ðáééíßóðá ðí script ðçð áãéáðÛóóáóçð, ðí ðñíßí éá áíðéáñÛðñíéá ùéá óá ó ÷ áðééÛ áñ ÷ áßá ðñíóá óðíí éáðÛëíáí install:

```
# /oracle/SID/sapreorg/KERNEL/UNIX/INSTTOOL.SH
```

Ç áãéáðÛóóáóç ðíð IDES (4.6B) Ýñ ÷ áðáé ðá Ýíá ðéßñðð ðñíóáñíóíÝíí óýóðçíá áðßááéíçð ðíð SAP R/3, Ýóóé ððÛñ ÷ ðí Ýíé CD EXPORT áíðß áéá ðñßá. Óá áððù ðí óçíáßí ðí ðñúðððí áñ ÷ áßí áãéáðÛóóáóçð CENTRDB.R3S ðñííñßæáðáé áéá ðçí áãéáðÛóóáóç ðíð ááóééíý óðððñíáðíð (ðí ðáéí ðí **R/3** éáé ðç áÛóç áááñÝíúí), ù ÷ é ðçí éáíðñééß áðáñííáß IDES, Ýóóé ÷ ðñáéÛæáðáé ðá áíðéáñÛðñíéá éáé ðí áíðßóðíé ÷ ð CENTRDB.R3S áðù ðíí éáðÛëíáí EXPORT1, áéáóñíáðéëéÛ ðí R3SETUP éá æçðßóáé ðñíí ðá ðñßá EXPORT CDs.

Ç ðáððáñç Ýéáíóç **SAP 4.6C SR2** ðáñéÝ ÷ áé óÝóóáñá EXPORT CD. Õí áñ ÷ áßí ðí ðñíßí áéÝá ÷ áé óá áßíáðá ðçð áãéáðÛóóáóçð áßíáé ðí CENTRAL.R3S. Óá áíðßéáóç ðá ðéð ðñíçáíýíáíáð áéáùóáéð, ááí ððÛñ ÷ ðíí áéáóñíáðééÝð ðñíóÝð áãéáðÛóóáóçð, áéá éáíðñééß áãéáðÛóóáóç ðá ð ÷ ðñíðð áÛóç áááñÝíúí. Õí **SAP** ÷ ðñçóéíðñíéáß ðéÝíí ðéá áéáóñíáðééß áéááééáóßá áéá ðçí áãéáðÛóóáóç ðçð áÛóçð áááñÝíúí. Áí éÝéáðá ðñðð ðá áðáíáéééíßóðáðá ðçí áãéáðÛóóáóç áñáùðáñá, áñéáß ðá ÷ ðñçóéíðñíéáßóðáðá ðáíÛ ðí áñ ÷ ééù áñ ÷ áßí.

Ôüóí êáðÛ ðç äéÛñêáéá üóí êáé ðáðÛ ðçí ááéáðÛóóáç, ðí **SAP** áðáéðáß ç áíðíðP hostname íá áðéóðñÝóäé ðüí ðí ðñíá ðíð óðóððíáðíð óáð êáé ü÷é ðí ðëðñáð ðñíá (ðá ðíí ðñÝá). ÁðñÝíùð, áððá ððèìððá ðí ðñíá ðá áððü ðíí ðñüðí, P ÷ ðçóéíðíéððá ðÛðíéí alias áðñíðáð alias hostname='hostname -s' ðüóí áéá ðíí ÷ ððóç orasid üóí êáé áéá ðíí ÷ ððóç sidadm (êáé áéá ðíí root ðíðÛ÷éóðíí êáðÛ ðçí ááéáðÛóóáç, ðéáð êáé üéá ðá áðíáðá áðñíðáé ððroot). Áðíáé áððóçð ðééáíü íá ðñíðíðíéððáðá ðá áñ÷áß .profile êáé .login ðüí äýí ÷ ðçóððí ðíð äçíéíðñáðéçéáí êáðÛ ðç äéÛñêáéá ááéáðÛóóáçð ðíð **SAP**.

10.7.8.3 Áêêðíçðç ðíð R3SETUP 4.6B

Ááááéüèáððá üðé ðí LD_LIBRARY_PATH Ý÷áé ðñéóðáß óúóðÛ:

```
# export LD_LIBRARY_PATH=/oracle/IDS/lib:/sapmnt/IDS/exe:/oracle/805_32/lib
```

Íáééíððá ðí R3SETUP ðð root áðü ðíí êáðÛëíáí ááéáðÛóóáçð:

```
# cd /oracle/IDS/sapreorg/install
# ./R3SETUP -f CENTRDB.R3S
```

Ôí script éá óáð ðÛíáé ðáñééÝð áñùððáéð (ðé ðñíððééíáÝð óáðñíðáé ðá ááéýéáð, êáé áéíéíðéíýíðáé áðü ðçí ðéíð ðíð äüèçéá ðð áðóíáð):

Áñðçðç	ðñíáðééíáð	Áðóíáðð áááñÝíüí
Enter SAP System ID	[C11]	IDSEnter
Enter SAP Instance Number	[00]	Enter
Enter SAPMOUNT Directory	[/sapmnt]	Enter
Enter name of SAP central host	[troubadix.domain.de]	Enter
Enter name of SAP db host	[troubadix]	Enter
Select character set	[1] (WE8DEC)	Enter
Enter Oracle server version (1) Oracle 8.0.5, (2) Oracle 8.0.6, (3) Oracle 8.1.5, (4) Oracle 8.1.6		1Enter
Extract Oracle Client archive	[1] (Yes, extract)	Enter
Enter path to KERNEL CD	[/sapcd]	/oracle/IDS/sapreorg/KERNEL
Enter path to RDBMS CD	[/sapcd]	/oracle/IDS/sapreorg/RDBMS
Enter path to EXPORT1 CD	[/sapcd]	/oracle/IDS/sapreorg/EXPORT1
Directory to copy EXPORT1 CD	[/oracle/IDS/sapreorg/CD4_DIR]	Enter
Enter path to EXPORT2 CD	[/sapcd]	/oracle/IDS/sapreorg/EXPORT2
Directory to copy EXPORT2 CD	[/oracle/IDS/sapreorg/CD5_DIR]	Enter
Enter path to EXPORT3 CD	[/sapcd]	/oracle/IDS/sapreorg/EXPORT3
Directory to copy EXPORT3 CD	[/oracle/IDS/sapreorg/CD6_DIR]	Enter
Enter path to EXPORT4 CD	[/sapcd]	/oracle/IDS/sapreorg/EXPORT4
Directory to copy EXPORT4 CD	[/oracle/IDS/sapreorg/CD7_DIR]	Enter
Enter path to EXPORT5 CD	[/sapcd]	/oracle/IDS/sapreorg/EXPORT5
Directory to copy EXPORT5 CD	[/oracle/IDS/sapreorg/CD8_DIR]	Enter
Enter path to EXPORT6 CD	[/sapcd]	/oracle/IDS/sapreorg/EXPORT6

Άñðççç	ÐñìáðέέëíäÞ	Άßóíäìò äääñÝíúí
Directory to copy EXPORT6 CD	[/oracle/IDS/sapreorg/CD9_DIR]	Enter
Enter amount of RAM for SAP + DB		850Enter (in Megabytes)
Service Entry Message Server	[3600]	Enter
Enter Group-ID of sapsys	[101]	Enter
Enter Group-ID of oper	[102]	Enter
Enter Group-ID of dba	[100]	Enter
Enter User-ID of sidadm	[1000]	Enter
Enter User-ID of orasid	[1002]	Enter
Number of parallel procs	[2]	Enter

Áí äâr Ý ÷ äðá áíóέäñÛðáέ ðá CDð óá äέáóìñáðέέëíýð éáóáέüüäìòð, ðüðá ðì ðñüäñäñìá ääέáðÛóðáóçð ðìò SAP ää éá ìðìñÝóáέ íá äñáέ ðá CD ðá ìðìßá ÷ ñáέÛäáðáέ (έáέ ðá ìðìßá áíááññßæííðáέ áðü ðì äñ ÷ äßì LABEL . ASC ðìò äñßóέáðáέ ìÝóá ðá áóðÛ) éáέ éá óáð æçðçèäß íá áέóÛäáðá éáέ ðñìóáñðÞóáðá ðá CD éáέ íá äðéääáéÞóáðá ðì óçìäßì ðñìóÛñðççð.

Ïì CENTRDB . R3S ìðìñáß üìð ñá ðáñÛäáέ ìáñέÛ óóÛέíáðá. Óçç ðáñßððòóÞ ñáð, ñáð æÞççóá ñáíÛ ðì EXPORT4 CD áέÛ ñáð Ýääέíá ðì óúóðü éέáéäß (6_LOCATION, ñáðÛ 7_LOCATION éέð.), éáέ Ýðóέ ìðìñáßðá íá óðíá ÷ ßóáðá äÛæííðáð ðéð óúóðÝð ðέíÝð.

Áέóüð áðü éÛðíéá ðñíáéÞíáðá ðìò áíáóÝñííóáέ ðáñáéÛòü, ç ääέáðÛóðáóçç éá ðñÝðáέ íá éðéßóáέ ñáέÛ, ìÝ ÷ ñé ðì óçìäßì ðìò éá ÷ ñáέáóðáß íá ääέáðáóðÞóáðá çç äÛçç äääñÝíúí ççð Oracle.

10.7.8.4 Áέêßççç ðìò R3SETUP 4.6C SR2

Áääáέüèäßðá üðé Ý ÷ äðá ññßóáέ óúóðÛ ðì LD_LIBRARY_PATH. Ç ðέíÞ ççð ñáðááéççðð äßíáέ äέáóìñáðέέÛ áðü ççí áíðßóðíé ÷ ççð ääέáðÛóðáóçð ðìò 4.6B ñá ççí **Oracle 8.0.5**:

```
# export LD_LIBRARY_PATH=/sapmnt/PRD/exe:/oracle/PRD/817_32/lib
```

ÍáέέíÞðá ðì R3SETUP ùð root áðü ðìí éáðÛέíäí ääέáðÛóðáóççð:

```
# cd /oracle/PRD/sapreorg/install
# ./R3SETUP -f CENTRAL.R3S
```

Τì script éá óáð éÛíáέ ìáñέÛÝð äñððóáέð (íé ðñìáðέέëíäÝð óáßñííóáέ ðá äáέýéäð éáέ áέíεíðέíýíðáέ áðü ççí ðñáñíáðέέÛ äßóíäí):

Άñðççç	ÐñìáðέέëíäÞ	ΆέóáäüäÞ äääñÝíúí
Enter SAP System ID	[C11]	PRDEnter
Enter SAP Instance Number	[00]	Enter
Enter SAPMOUNT Directory	[/sapmnt]	Enter
Enter name of SAP central host	[majestix]	Enter
Enter Database System ID	[PRD]	PRDEnter
Enter name of SAP db host	[majestix]	Enter
Select character set	[1] (WE8DEC)	Enter

Áñðçðç	Ðñíáðééíâ	Áέόáãüâ ããññÝíúí
Enter Oracle server version (2) Oracle 8.1.7		2Enter
Extract Oracle Client archive	[1] (Yes, extract)	Enter
Enter path to KERNEL CD	[/sapcd]	/oracle/PRD/sapreorg/KERNEL
Enter amount of RAM for SAP + DB	2044	1800Enter (in Megabytes)
Service Entry Message Server	[3600]	Enter
Enter Group-ID of sapsys	[100]	Enter
Enter Group-ID of oper	[101]	Enter
Enter Group-ID of dba	[102]	Enter
Enter User-ID of oraprd	[1002]	Enter
Enter User-ID of prdadm	[1000]	Enter
LDAP support		3Enter (no support)
Installation step completed	[1] (continue)	Enter
Choose installation service	[1] (DB inst,file)	Enter

Ý ÷ ñé óðéáìðð, ç äçìéíðñâá ÷ ñçóððí àìðáíβæáé Ýíá óðÛéíá éáðÛ ôç äéÛñéáéá ôçð äãéáðÛóðáçð, óðéð ðÛóáéð òúí OSUSERDBSID_IND_ORA (ãéá ôç äçìéíðñâá ôïð ÷ ñðóç *orasid*) éáé OSUSERSIDADM_IND_ORA (ãéá ôç äçìéíðñâá ôïð ÷ ñðóç *sidadm*).

Áêòüð áðü ìáñééÛ ðñíáðéíáðá ðïð áíáóÝñííóáé ðáñáéÛòü, üéá èá ðñÝðáé íá êððóíóí ðñáíá ìÝ ÷ ñé ôçí äãéáðÛóðáçç ôçð áÛóçð ããññÝíúí Oracle.

10.7.9 ÁãéáðÛóðáçç ôçð Oracle 8.0.5

Ðáñáéáéíýíá, íá äãðá ðéð áíðβóðíé ÷ ðð óçíáððóáéð òúí SAP éáé Oracle Readme ó ÷ ððééÛ ìá ðá ðñíáðéíáðá ðïð ìðñâá íá ðñíéýøíí éáðÛ ôçí äãéáðÛóðáçç ôïð **Oracle DB** óðí Linux. Óá ðáñéóóüðáñá, áí ü ÷ é üéá, Ý ÷ íóí íá êÛíóí ìá áóðíááðüôçðá áéáééíçðí.

Áéá ðáñéóóüðáñáð ðççñíóíñâð ó ÷ ððééÛ ìá ôçí äãéáðÛóðáçç ôçð **Oracle**, äãðá ôí êâÛéáéí äãéáðÛóðáçç ôçð Oracle.

10.7.9.1 ÁãéáðÛóðáçç ôïð Oracle 8.0.5 ìá ôí orainst

Áí ðñüéáéóáé íá êÛíáðá ÷ ñðçç ôçð **Oracle 8.0.5**, èá ÷ ñáéáóðáñâð êÛðíéáð áððéÿíí áéáééíçðéâð áéá áðéðð ÷ ð áðáíáóýíááçç (relinking), éáèð ç **Oracle 8.0.5** áñíáé linked ìá ôçí ðáééÛ Ýéáíóç ôïð glibc (RedHat 6.0), áééÛ ðäç áðü ôí RedHat 6.1 ÷ ñçóéíðíéáðáé íéá íÝá Ýéáíóç. ÁðñÝíüð ÷ ñáéÛæáðáé íá äãéáðáóððóáðá áðððñüóéáðá óá áðüíáíá ðáéÝóá áéá íá äãáéüèáñâðá üðé íé óýíááóíé èá äïðéÝøíí:

- compat-libs-5.2-2.i386.rpm
- compat-glibc-5.2-2.0.7.2.i386.rpm
- compat-egcs-5.2-1.0.3a.1.i386.rpm
- compat-egcs-c++-5.2-1.0.3a.1.i386.rpm

- compat-binutils-5.2-2.9.1.0.23.1.i386.rpm

Άέα δάνεόούοάνηδ δέχνηϊοϊνβαδ άάβδά οά άίόβδδϊέ÷ά SAP Notes P Oracle Readme. Άί υϊύδ άάί Ύ÷άδ άδδP όγί άδέειάP (έάδΰ όζ άεΰñέέα όζδ άάέάδΰόδάόζδ άάί άβ÷άι άñέάου ÷ñúfi íá οϊ άεΎññοϊά), ιδññάβδά íá ÷ñζοέιιδϊέPδάδά οά άñ÷έέΰ άέοάεΎοείά P άέοάεΎοείά οά ιδϊβα Ύ÷ϊοϊ άβίάε relink οά Ύíά έάñííέευ όγόδζιά RedHat.

Άέα íá íάδάάέυδδβδάδά οϊι intelligent agent, δñΎδάέ íá Ύ÷άδ άάέάδάόζζιΎfi οϊ δάέΎοϊ RedHat Tcl. Άί άάí ιδññάβδά íá άñάβδά οϊ tcl-8.0.3-20.i386.rpm, δυδά οϊ íάυδάññí tcl-8.0.5-30.i386.rpm άέα RedHat 6.1 έά δñΎδάέ άδβόζδ íá άιρδΎοάέ.

Ίά άíάβñάόζ οϊ relinking, ζ έέαάέέάόβά άάέάδΰόδάόζδ άβίάέ ό÷άδέέΰ άδέP:

```
# su - oraid
# export TERM=xterm
# export ORACLE_TERM=xterm
# export ORACLE_HOME=/oracle/IDS
# cd $ORACLE_HOME/orainst_sap
# ./orainst
```

Άδέαάάέερδδά υέα οά ιζίγíιάδά δάδρϊδάδ **Enter** Ύυδ υοϊρδ οϊ έιαέοίεέυ άάέάδάόδάέάβ. Άάí έά δñΎδάέ íá άδέέΎíάδά υϊύδ οϊ *Oracle On-Line Text Viewer*, íέάδ έάέ άάí άβίάέ έέαέΎοείι άέα Linux. Óδζί δññβδδύδζ άδδP, ζ **Oracle** δññδδάέάβ íá έΰííάέ relink ιά οϊ i386-glibc20-linux-gcc άίδβ δϊδ έέαέΎοείιδ gcc, egcs P i386-redhat-linux-gcc.

Έυάυ Ύέέάέζδζ ÷ñúfiδ, άδñδάδβδάίά íá ÷ñζοέιιδϊέPοϊοϊά οά Ύοίείά άέοάεΎοείά όζδ Ύέάιρζδ **Oracle 8.0.5 PreProduction**, ιάδΰ άδυ ίέα άδϊδδ÷ζιΎίζ δññδδΰέάέά íá έΰííοϊά όζζί Ύέάιρζδ άδυ οϊ RDBMS CD íá άιρδΎοάέ, έάέ ζ άγñάόζ έάέ δñυδάάόζ όδά ουδδΰ RPMs άέάβίζ όζ όέέιιP Pδάí όέΎοϊδ άέέΰέδζδ.

10.7.9.2 Άάέάδΰόδάόζ οϊό Oracle 8.0.5 Pre-production Release άέα Linux (Kernel 2.0.33)

ΆδδP ζ άάέάδΰόδάόζ άβίάέ ό÷άδέέΰ άγέιεζ. ΔññοάνδPδδά οϊ CD έάέ ίάέέίPδδά οϊ δñυάñάιά άάέάδΰόδάόζδ. Έά άñδύδζέάβδά όδζ όοίΎ÷άέα άέα οϊι άñ÷έέυ (home) έάδΰέιιρ όζδ Oracle, υδñδ έάέ έά άίόέάñάοϊγί υέα οά άέοάεΎοείά. ΰδδυοϊ άάí έέαάñΰοάίά υδέ άδΎíάέíά άδυ όέδ δññζάγíγíάíάδ άδυδάέñάδ ιάδ άάέάδΰόδάόζδ οϊρδ RDBMS.

Óδζ όοίΎ÷άέα, ζ άΰόζ άάάñΎííι **Oracle** έά δñΎδάέ íá ίάέέίPδδάέ άβ÷ύδ δññίέPíάδά.

10.7.10 Άάέάδΰόδάόζ Oracle 8.1.7 άέα Linux άδυ ÓοϊδέάοίΎíí Άñ÷άβí

Δΰñδά οϊ όοϊδέάοίΎíí άñ÷άβí oracle81732.tgz οϊ ιδñβí άζιέιτññάPδδάδ άδυ οϊι έάδΰέιιρ άάέάδΰόδάόζδ άñυδ όδδδPíάδδδ Linux, έάέ άδϊδδδΰέΎδδά οϊ όοϊ /oracle/SID/817_32/.

10.7.11 ÓοίΎ÷άέα όζδ Άάέάδΰόδάόζδ οϊό SAP R/3

Άñ÷έέΰ άέΎάιδά όέδ ñδειβδάέδ δάñέάΰέέιρδδδ δυϊ ÷ñζοδρϊ idsamd (sidadm) έάέ oraid (orasid). Έά δñΎδάέ δρñά íá Ύ÷ϊοϊ έάέ ίέ άγí ÷ñPδδάδ δά άñ÷άβά .profile, .login έάέ .cshrc δά ιδñβά υέα ÷ñζοέιιδϊέγί οϊ hostname. Óά δññβδδύδζ δϊδ οϊ υññά οϊρδ όδδδPíάδδδ δάñέέάιάΰííάέ έάέ οϊ domain, άίδέέάδάόδPδδά οϊ hostname ιά οϊ hostname -s οά υέα οά άñ÷άβά.

10.7.11.1 Öüñòüôç ðçð ÄÛôçð Äääñÿíüí

Óôç óðíÿ ÷ áëá, áíÛëíäá ðä ôí áí äß ÷ áðá ðñéí äðéëÿíäë ÿíäí ð ü ÷ é, ððñäßðá äßðá íá ðäéíðóáðá ôí R3SETUP áðü ôçí äñ ÷ ð, ð íá óðíá ÷ ðóáðá ôçí äêðÿëáðç ôíð. Ôí R3SETUP êá äçìéíðñäðóáë êáë êá öíñððóáë óá äñ ÷ éëÛ äääñÿíá ôçð äÛôçð (äëá 46B IDEs, áðü óá EXPORT1 óá EXPORT6, äëá 46C áðü DISK1 óá DISK4) ëÛííóáð ÷ ñðçð ôíð R3load.

¼óáí ç öüñòüôç ðçð äÛôçð äääñÿíüí ðëéëçñüëäß (ððñäß ðá ÷ ñäëáóðíÿí ðäñéëÿð ðñäð), êá ÷ ñäëáóðäß íá ðñóáðá ðäñéëÿð ëüäëéÿð. Äëá ððëéíáðóéëÿð ääëáðáððÛóáëð, ððñäßðá ðá ÷ ñçóéíðíéðóáðá ôíðð áíüóðíÿð ðñíäðéëäáíÿíðð êüäëéÿð (áí ððÛñ ÷ äë èÿíá áóðÛëäëáð, ÷ ñçóéíðíéðóáðá äëáðñäðóéëÿð!):

Äñðçðçð	Äßóíäíð äääñÿíüí
Enter Password for sapr3	sapEnter
Confirum Password for sapr3	sapEnter
Enter Password for sys	change_on_installEnter
Confirm Password for sys	change_on_installEnter
Enter Password for system	managerEnter
Confirm Password for system	managerEnter

Óá áðüü ôí óçíäßí äß ÷ äíä ðäñéëÛ ðñíäëðíäðá ðä ôçí áíðíéð dipgntab êáðÛ ôçí ääëáðÛóóáç ôíð 4.6B.

10.7.11.2 Listener

Ïäëéíðóáð ôí Oracle Listener ðð ÷ ñðçðçð orasid ðä ôí äëüëíðëí ðñüðí:

```
% umask 0; lsnrctl start
```

Áí ää ôí ëÛíáðá, ððñäß ðá óáð äíðáíéóðäß ôí óðÛëíá ORA-12546 êáëðð óóá sockets äáí êá ÿ ÷ íðí ðñéóðäß ðé êáðÛëëçëäð Ûäëäð. Ääßðá ôçí Óçíäßòçð 072984 ôíð SAP.

10.7.11.3 Áíáíäðííóáð ôíðð ððíäëäð MNLS

Áí ÿ ÷ äðá óëíðü íá äëóÛäððá äëðóáð äëðüð ðüí Latin-1 óðí SAP, êá ðñÿðäë íá áíáíäðóáðá ôíðð ððíäëäð Multi National Language Support. Áðü ðññéññÛóáðáë óóá SAP OSS Notes 15023 êáë 45619. Ïðñäßðá ðüíðð áí èÿëäðá íá ðñäëÛíððáð áððü ôí äðíá êáðÛ ôçí ääëáðÛóóáç ôíð SAP.

Óçíäßòçð: Äëüìç êáë áí äáí ÷ ñäëÛäëáðá ôí MNLS, êá ÷ ñäëáóðäß íá äëÿíäðá ôí ððíäëä TCPDB êáë íá ôí äñ ÷ éëíðíéðóáðá, áí áððü äáí ÿ ÷ äë ðäç äßíäë. Ääßðá óðí SAP óéð óçíäëðóáëð 0015023 êáë 0045619 äëá ðññéóóüðñäðð ðëçñííðñäð.

10.7.12 Äðíäðá ðäðÛ ôçí ÄäëáðÛóóáç

10.7.12.1 ðääëá ÷ ñðçðçð äëá ôí SAP R/3

Êá ðñÿðäë íá äçððóáðá ÿíá Êëäëäß ðääëäð - License Key - äëá ôí SAP R/3. Ôí ÷ ñäëÛäëáðá, ðéáð êáë ç ðñíóüñéíð

Ûääéá ðíö ÷ ñçóéíðíéÞóáðá éáðÛ óçí ääéáóÛóóáóç, Ý ÷ äé éó ÷ ý ìüí äéá ðÝóáñéð äääñÛääð. ÐñÝðáé ðñÞóá íá äðíéðÞóáðá ðí hardware key. Óðíáäéáßðá ùð ÷ ñÞóçð ðdsadm éáé äéðäéÝóðá ðí saplicense:

```
# /sapmnt/IDS/exe/saplicense -get
```

ÆðäéÞíðáð ðí saplicense ÷ ùñßð ðáñáíÝðñíðð, óáð äÞíáé íéá éßóðá äðéçáÞí. ¼óáí éÛääðá ðí ééäéáß Ûääéáð, ðññáßðá íá ðí ääéáóáóðÞóáðá ðí ðí ðáñáéÛð ðñüðí:

```
# /sapmnt/IDS/exe/saplicense -install
```

Óçç óðíÝ ÷ áéá, éá ÷ ñäéáóðáß íá áéóÛääðá ðéð áéüéíðéáð ðéíÝð:

```
SAP SYSTEM ID      = SID, 3 chars
CUSTOMER KEY       = hardware key, 11 chars
INSTALLATION NO    = installation, 10 digits
EXPIRATION DATE    = yyyymmdd, usually "99991231"
LICENSE KEY        = license key, 24 chars
```

10.7.12.2 Äçíéíðñáßá × ñçóðÞí

Äçíéíðñáßðá Ýíáí íÝí ÷ ñÞóçç óðí client 000 (äéá ðáñééÝð ññááóßðð ðíö ÷ ñäéÛäéáé íá äÞíðí ðíÝóá óðí client 000, áééÛ ðí ñÞóçç äéáóíñáðééü áðü ðíðð sap* éáé ddic). Ûð ùíñá ÷ ñÞóçç óðíÞéðð äðééÝáíðíá ðí wartung (P service óðá ÄääéééÛ). Óá ðñíðßé ðíö ÷ ñäéÛäéáé äÞíáé óá sap_new éáé sap_all. Äéá äðéðéÝíí áóóÛéáéá, íé éüäééíß ðüí ðñíáðééääíÝíí ÷ ñçóðÞí óá üéíðð ðíðð clients éá ðñÝðáé íá äééá ÷ éíÝí (áóðü ðáñééáíáÛíáé éáé ðíðð ÷ ñÞóðáð sap* éáé ddic).

10.7.12.3 Ñýèíéóç ðüí Transport System, Profile, Operation Modes, ééð.

ÛÝóá óðí client 000, ÷ ñÞóðáð äéðüð ðüí ddic éáé sap*, ððíñíÝí íá éÛíðí ðíðéÛ ÷ éóðíí óá áéüéíðéá:

Äñááóßá	Transaction (Óðíáééääáß)
Ñýèíéóç ðíö Transport System, ð. ÷. ùð Stand-Alone Transport Domain Entity	STMS
Äçíéíðñáßá / ðñíðíðíßççç ðíö Profile ÓðóðÞíáðíð	RZ10
ÓðíðÞñççç Operation Modes éáé Instances	RZ04

Äóðü éáé üéá óá ððüéíðéá äÞíáðá ó ÷ äðééÛ ðí ðéð ñðéíßóáéð ðáðÛ óçí ääéáóÛóóáóç ðáñéáñÛóíðáé óðíðð íäçáíÝð ääéáóÛóóáóçð ðíö SAP.

10.7.12.4 Óñíðíðíßççç ðíö initsid.sap (initIDS.sap)

Óí áñ ÷ áßí /oracle/IDS/dbs/initIDS.sap ðáñéÝ ÷ äé ðí áíðßáñáóíí áóóáéáßáð ðíö ðñíðßé ðíö SAP. ÄäÞ ÷ ñäéÛäéáé íá ðñßóáðá ðí ðíÝääéíð óçç óáéíßáð ðíö éá ÷ ñçóéíðíéçççáß, ðíí óýðí óðíðßáóçð éáé üéá óá ó ÷ äðééÛ. Äéá íá ððíñÝóíðíá íá ðí äéðäéÝóíðíá ðí ðí sapdba / brbackup, áééÛíáíá ðéð ðáñáéÛð ðéíÝð:

```
compress = hardware
archive_function = copy_delete_save
cpio_flags = "-ov --format=newc --block-size=128 --quiet"
```

```
cpio_in_flags = "-iuv --block-size=128 --quiet"
tape_size = 38000M
tape_address = /dev/nsa0
tape_address_rew = /dev/sa0
```

Άðáíçãßóáéð:

compress: Ç ðáéíßá ðíð ÷ ñçóéíððíéíýíá áßíáé ìßá HP DLT1 ç ððíßá ðáñÝ ÷ áé óðíðßáóç ìÝóù ðēēéíý.

archive_function: Άððü ìñßæáé ðíð ðñíáðēēááñÝí ðñüðí ìá ðíð ððíßí ìá áðíēçēáýííðáé ðá áñ ÷ áéíēáðçíÝíá logs ðçð Oracle: ðá íÝá logs áðíēçēáýííðáé óðçí ðáéíßá, ðá Ñαç áðíēçēáðíÝíá áðíēçēáýííðáé íáíÛ éáé óðç óðíÝ ÷ áéá áéááñÛðííðáé. Άððü óáð óßæáé áðü ðç ðáéáéðññßá áí ÷ ñáéáóðáß íá áíáéðßóáðá ðç áÛóç áááñÝíñí ðá ðáñßððóç ðíð ìéá áðü ðéð ðáéíßáð Ý ÷ áé ðñüáēçíá.

cpio_flags: ÐñíáðēēááñÝíç áßíáé ç ÷ ñßóç ðíð -B ðíð ððíßí ìñßæáé ðíð ìÝááēíð êÛēá block óðá 5120 Bytes. Άéá ðáéíßáð DLT, ç HP ðñíðáßíáé ðíð ééáüðáñí 32 K ìÝááēíð block, ððüðá éē áíáßð áßóáíá --block-size=128 áéá 64 K. Õí --format=newc ÷ ñáéÛæáðáé áéüðé Ý ÷ ðíðá inode ìá áñßēíçóç ìáááéýðáñç áðü 65535. Ç ðáéáððáßá ðáñÛíáððíð --quiet ÷ ñáéÛæáðáé áéáóß áéáóíñáðééÛ ðíð brbackup éá ðáñáðííáēáß ìá ðíð ðíð cpio áíðáíßóáé ðíð áñēèíü ðñí blocks ðíð Ý ÷ ðíð áðíēçēáððáß.

cpio_in_flags: Óá Flags ÷ ñáéÛæíðáé ðñíēáéíÝíð íá ðíððñéíýí ðá áááñÝíá áðü ðç ðáéíßá. Ç ìñðß áíé ÷ íáýáðáé áððñíáðá.

tape_size: Ç ðáñÛíáððíð áððß áßíáé ÷ ðíðñēéÛ ðíð ìÝááēíð ÷ ðñçóééüòçðáð ðçð ðáéíßáð. Άéá èüáñðð áóðÛēáéáð (÷ ñçóéíððíéíýíá hardware óðíðßáóç), ç óéíß ðçð ðáñáíÝðñíð áßíáé εßáí ìéēñüðáñç áðü ðíð ðñááíáðééü ìÝááēíð.

tape_address: Õí ðñíá óððéáððð (÷ ðññð áðíáðüòçðá áðáíáðýēéíçð ðçð ðáéíßáð) ðíð éá ÷ ñçóéíððíéçēáß ìá ðíð cpio.

tape_address_rew: Õí ðñíá óððéáððð (ìá áðíáðüòçðá áðáíáðýēéíçð ðçð ðáéíßáð) ðíð éá ÷ ñçóéíððíéçēáß ìá ðíð cpio.

10.7.12.5 Ñðēíßóáéð ìáðÛ ðçí ΆāéáðÛóóáóç

Ïé áéüñēðēíē ðáñÛíáððíē ðíð SAP éá ðñÝðáé íá ñðēíēóðíýí ìáðÛ ðçí áāéáðÛóóáóç (ðáñáááßáíáðá áéá IDES 46B, éáé ìíßíç 1 GB):

¼ñíá	Õéíß
ztta/roll_extension	250000000
abap/heap_area_dia	300000000
abap/heap_area_nondia	400000000
em/initial_size_MB	256
em/blocksize_kB	1024
ipc/shm_psize_40	70000000

SAP Óçíáßùóç 0013026:

¼ñíá	Õéíß
ztta/dynpro_area	2500000

SAP Óçíáßùóç 0157246:

¼ííá	Ôèí
rdisp/ROLL_MAXFS	16000
rdisp/PG_MAXFS	30000

Óçíáßóó: ðá óéð ðáñáðÛí ðáñáíÛðñíðð óá Ýíá óýóóçíá ðá 1 gigabyte ðíðíçð, ðñíñáß íá ááßðá èÛðé óáí ðí ðáñáéÛðóó ùóí áóñÛ ðçí éáðáíÛèóóç ðíðíçç:

Mem: 547M Active, 305M Inact, 109M Wired, 40M Cache, 112M Buf, 3492K Free

10.7.13 Ðñíáèðíáðá éáðÛ ðçí ÆééáðÛóóáóç

10.7.13.1 Æðáíáèèßçóç ðíð R3SETUP ðáðÛ ðçí Æéüñèóóç Ðñíáèðíáðíð

Ôí R3SETUP éá óðáíáððóáé áí áíðéèçðèáß èÛðíéíí óóÛéíá. Áí èíéðÛíáðá éáèÛ óá logfiles éáé áéñèðóáðá ðí óóÛéíá, éá ðñÛðáé íá ðáéíðóáðá ðí R3SETUP áðü ðçí áñ÷ð, óðíðèðð áðéèÛáííðáð REPEAT óðí ðáèððóáßí áðíá áéá ðí ðñíáðñíÛéçèá ðí R3SEÜP.

Æéá íá áðáíáèèèðóáðá ðí R3SETUP, áðèðð áðóðá ðçí ðáñáéÛðóó áíðíèð ðá ðí áíðóðóíé÷íí áñ÷ðáßí R3S:

```
# ./R3SETUP -f CENTRDB.R3S
```

ãéá ðçí Ýéáíóç 4.6B, ð ðçí áíðíèð

```
# ./R3SETUP -f CENTRAL.R3S
```

ãéá ðçí Ýéáíóç 4.6C, ÷ññðð íá Ý÷áé óçíáóáá áí ðí óóÛéíá ðñíèèðèçèá áðü ðí CENTRAL.R3S ð ðí DATABASE.R3S.

Óçíáßóó: Óá èÛðíéá óðÛáéá, ðí R3SETUP ððíèÛóáé ùðé ðóóíç áÛóç áááñíÛíí ùóí éáé ðí SAP Ý÷íóí ðáéíðóáé éáé áèðáèíÛíðáé éáííéèÛ (éáèðð ðñüèáéðáé áéá áðíáðá ðíð Ý÷íóí ðáç ðéíèèçñüèáß). Áí ðñíèÛóóí èÛèç, éáé áéá ðáñÛááééíá ááí ððñáðá íá ðáéíðóáé ç áÛóç, ðáéíðóáðá ðçí áÛóç éáé ðí SAP ðá ðí ÷Ûñé, áóíÛ áéñèðóáðá óá èÛèç éáé ðñéíí áèðáèÛóáðá íáíÛ ðí R3SETUP.

Ïç ðá÷Ûóáðá áðßóçð íá áèèèðóáðá ðí Oracle listener (áèðáèÛóóá ðí ùð ÷ñðóçð orasid ðá umask 0; lsnrctl start) áí áß÷á áéáéíðáß éáé áððü (áéá ðáñÛááééíá óá ðéá áíáèéáßá áðáíáèèèßçóç ðíð óóóðíáðíð).

10.7.13.2 OSUSERSIDADM_IND_ORA éáðÛ ðí R3SETUP

Áí ðí R3SETUP ðáñáðñíéÛóáé óá áððü ðí óçíáßí, ðñíðñíéðóáðá ðí ðñüðððíí áñ÷ðáßí ðíð R3SETUP ðíð ÷ñçóéíðñíéáßðáé áèáßíç ðçí óðéáíð (ðí CENTRDB.R3S (4.6B) ð èÛðíéíí áðü óá CENTRAL.R3S ð ðí DATABASE.R3S (4.6C)). Áññáðá ðí [OSUSERSIDADM_IND_ORA] ð ðÛíðá ðíÛóá óðíí áñ÷ðáßí áéá ðçí ðíááéèð áááñáð STATUS=ERROR éáé ðñíðèÛóóá óá ðáñáéÛðóó:

```
HOME=/home/sidadm (was empty)
STATUS=OK (had status ERROR)
```

Óçç óðíÝ ÷ áéá ìðíñáßðá íá ìáêéíßðáðá éáé ðÛéé ðí R3SETUP.

10.7.13.3 OSUSERDBSID_IND_ORA éáóÛ ðí R3SETUP

Ðééáíü áßíáé íá ððÛñ ÷ áé ðñüáéçíá éáé óá áóóü ðí áßíá ìá ðí R3SETUP. Óí ðñüáéçíá äáß áßíáé ðáñüííéí ìá ðí ðñíçáíýíáíí, ðíò OSUSERSIDADM_IND_ORA. ÁðéÛ ðñíðíðíéßðáðá ðí áñ ÷ áßí ðñíóýðíò ðíò ÷ ñçóéííðíéáßðá ìá ðí R3SETUP (CENTRDB.R3S (4.6B) P êÛðíéí áðü óá CENTRAL.R3S P DATABASE.R3S (4.6C)). Áñáßðá ðí [OSUSERDBSID_IND_ORA] P ðÛíðá ìÝóá óðí áñ ÷ áßí áéá óçí ìííááééßP ááñáóßP STATUS=ERROR éáé ðñíóéÝóðá óá ðáñáéÛòù:

```
STATUS=OK
```

Óðñá ðñÝíðá íáíÛ ðí R3SETUP.

10.7.13.4 “oraview.vrf FILE NOT FOUND” éáóÛ óç äéÛñéáéá ÁãéáóÛóðáóçð ðçð Oracle

Óí óóÛéíá áóóü óçíáßíáé üóé Ý ÷ áðá áðééÝíáé ðí Oracle On-Line Text Viewer ðñéí ìáêéíßðáðá óçí áãéáóÛóðáóçð. Ç áðééíáßP áóðP áßíáé ðñíáðééáñÝíç, ðáñ’ üéí ðíò ááí áßíáé áéáéÝóéíç óðí Linux. ÁðáéñÝóðá éíéðíí áóðP óçí áðééíáßP áðü ðí ìáñý áãéáóÛóðáóçð éáé ìáêéíßðáðá íáíÛ.

10.7.13.5 “TEXTENV_INVALID” éáóÛ óçí ÁêòÝéáóç R3SETUP, ðíò RFC P ðíò SAPgui

Áí áñáéáßðá áíóéíÝòùðíé ìá áóóü ðí óóÛéíá, óóðá ááí Ý ÷ áðá óéð óóóóÝð ðíðééÝð ñðéíßðáéð. Ç óçíáßòóç 0171356 ðíò SAP áíáóÝñáé üéá óá RPMs ðíò ÷ ñáéÛáííðáé íá áãéáóðáóóáéíýí (ð.÷. saplocales-1.0-3, saposcheck-1.0-1 áéá RedHat 6.1). Óóçí ðáñßðòóç ðíò ááñßðáðá üéá óá ó ÷ áðééÛ èÛéç, éáé áí áéüíç Ý ÷ áðá ìñßðáé ðí STATUS áðü ERROR óá OK (óðí CENTRDB.R3S) êÛèá ðññÛ ðíò ðáñáðíéúðáí ðí R3SETUP éáé áðéðð ðí ìáêéíñýóáðá áðü óçí áñ ÷ P, ðí SAP ááí éá ñðéíóðáß óóóóÛ éáé ááí éá ìðíñáßðá íá óðíááéáßðá óðí óýóóçíá ìÝóü ðíò **SAPgui**, áéüíç éáé áí ðí óýóóçíá óáð Ý ÷ áé ìáêéíßðáé. Ðñíóðáéðíóáð íá óðíááéíýíá ìá ðí ðáééü **SAPgui** Linux, áíðáíßðóçéá ðí ðáñáéÛòù óóÛéíá:

```
Sat May 5 14:23:14 2001
*** ERROR => no valid userarea given [trgmsgo. 0401]
Sat May 5 14:23:22 2001
*** ERROR => ERROR NR 24 occurred [trgmsgi. 0410]
*** ERROR => Error when generating text environment. [trgmsgi. 0435]
*** ERROR => function failed [trgmsgi. 0447]
*** ERROR => no socket operation allowed [trxio.c 3363]
Speicherzugriffsfehler
```

Ç óðíðáñéóíñÛ áóðP íðáßéáðáé óðí üóé ðí **SAP R/3** ááí ìðíñáß íá ìñßðáé óóóóÛ óéð ðíðééÝð ñðéíßðáéð éáé ááí ìðíñáß óóç óðíÝ ÷ áéá íá ñðéíßðáé ðíí ááóóü ðíò (áééáéðßP ááññÝíá óóç áÛóç ááññÝííí). Áéá íá ìðíñÝóáðá íá óðíááéáßðá ðñíóéÝóðá óéð ðáñáéÛòù éáðá ÷ ùñßðáéð óðí DEFAULT.PFL (ááßðá Óçíáßòóç 0043288):

```
abap/set_etct_env_at_new_mode = 0
install/collate/active = 0
rscp/TCP0B = TCP0B
```

ÎäέέιPóðä ιάιÛ öι SAP. Öþñά ιðññáßðä ιά óðιαάέáßðä áέüηç έάέ áι ιέ ñðèιβóáέð ÷ þñάð έάέ äèþóóáð ää äιðέäÿιöι üðüð έά Ûðñáðä. Áöιÿ äέιñèþóáðä ðέð ñðèιβóáέð ôçð ÷ þñάð (έάέ ññβóáðä ðέð óúóðÛð öιðέέÛð ñðèιβóáέð), ιðññáßðä ιά áóáέñÛóáðä óá ðáñáðÛιú äðu öι DEFAULT.PFL έάέ ιά äέðäεÛóáðä öι SAP áðu ôçι áñ÷P.

10.7.13.6 ORA-00001

Öι óóÛέιá áðöü öι óðιαίðPóáιá ιüñι ιά öι Oracle 8.1.7 öι FreeBSD. Ï éüäιð Pðáι üðé ç áÛóç Oracle äáι ιðñιÿóá ιά ññβóáέ ðέð óúóðÛð ðáñáιÛðñιðð áέá ôçι äέέβιççP ôçð ιά áðιðÛέáóιá ιά έιέεÛáέ, áðPñιðáð óçιαðιöιñáßð έάέ έιέιü ÷ ñçóðç ιιPιç óöι óÿóðçιá. Ç äðuñáιç ðñιððÛέáέá ιά îäέέιPóιöιá ôç áÛóç äääñÛιúι ιáð äιöÛιέóá öι óóÛέιá ORA-00001.

Äñáßðä öιðð ιά ôçι áιðιέP ipcs -a έάέ áóáέñÛóáð öιðð ιά ôçι ipcrm.

10.7.13.7 ORA-00445 (Background Process PMON Did Not Start)

Öι óóÛέιá áðöü ιðññáß ιά äιöáιέóðáß ιά öι Oracle 8.1.7 üðáι ç áÛóç äääñÛιúι Û ÷ äé äέέέιçέáß ιά öι script startsap (áέá ðáñÛäáέáιá startsap_majestix_00) έάέ óáι ÷ ñPóðçð prdadm.

Îέá ðέέáιP έÿç áβιáέ ιά îäέέιPóáðä ôç áÛóç üð ÷ ñPóðçð oraprd έάέ ιÛóü öιð svrmgrl:

```
% svrmgrl
SVRMGR> connect internal;
SVRMGR> startup;
SVRMGR> exit
```

10.7.13.8 ORA-12546 (ÎäέέιPóðä öιι Listener ιά ðέð ÓúóðÛð ¶äáέáð)

ÎäέέιPóðä öιι Oracle listener üð ÷ ñPóðçð oraids, ιá ðέð áέüέιðέáð áιðιέÛð:

```
# umask 0; lsnrctl start
```

ÄέáöιñáðέέÛ ιðññáß ιά äιöáιέóðáß öι óóÛέιá ORA-12546 ðιð óçιαβιáέ üðé óá sockets äáι Û ÷ ιöι óúóðÛð Ûäáέáð. Äáßðä ôç óçιαβüç 0072984 öιð SAP.

10.7.13.9 ORA-27102 (έέάέøç ιιPιçð)

Öι ðñüäέçιá áðöü ðáñιðóέÛóðçέá üðáι ÷ ñçóέιιðιέPóáιá ðέιÛð ιäááέÿðáññáð öιð 1 GB (1024X1024X1024) óðέð ιäóááέçðÛð MAXDSIZ έάέ DFLDSIZ. ÄðέðέÛιí, ιáð äιöáιβóðçέá öι óóÛέιá “Linux Error 12: Cannot allocate memory”.

10.7.13.10 [DIPGNTAB_IND_IND] έáðÛ ôçι ÄέðÛέáóç öιð R3SETUP

Óá äáιέέÛð äñáñÛðð, äáßðä ôç óçιαβüç 0130581 öιð SAP (R3SETUP step DIPGNTAB terminates). ÉáðÛ ôçι ääέáðÛóðáç IDES, áέá éÛðιέι éüäι ç äέááέέáóβá ääέáðÛóðáçð ää ÷ ñçóέιιðιέÿóá öι óúóðü üñιá óðóðPιáðιð öιð SAP “IDS”, áέéÛ öι έáíü " ". Áðöü ιαççááβ óá éÛðιέá ιέέñÛ ðñιäέPιáðá ιá ôç ðñüóááçç óðιðð έáðáέüäιðð ιέá έάέ óá ιñιðÛóέá äçιέιðñáιÿιðáέ äðιαίέέÛ ιá ôç ÷ ñPóç öιð SID (óçç ðáñβððüçP ιáð IDS). ðñÛáιá ðιð óçιαβιáέ üðé áιðβ ιá äβιáέ ç ðñüóááçç óðι:

```
/usr/sap/IDS/SYS/...
```

```
/usr/sap/IDS/DVMGS00
```

εά ðñüðäèÐóáé íá äβíáé óðí:

```
/usr/sap//SYS/...
/usr/sap/D00
```

Ãέα íá óðíá÷βóíðíá ìá ôçí äãéáðÛóðáóç, äçìéíðñáÐóáíá Ýíáí óýíááóíí êáé Ýíáí äðéðëÝíí êáðÛëíáí:

```
# pwd
/compat/linux/usr/sap
# ls -l
total 4
drwxr-xr-x 3 idsadm sapsys 512 May 5 11:20 D00
drwxr-x--x 5 idsadm sapsys 512 May 5 11:35 IDS
lrwxr-xr-x 1 root sapsys 7 May 5 11:35 SYS -> IDS/SYS
drwxrwxr-x 2 idsadm sapsys 512 May 5 13:00 tmp
drwxrwxr-x 11 idsadm sapsys 512 May 4 14:20 trans
```

Ôí ðñüäëçíá áððü ôí äβáíá äðβóçð óðéð óçíáêðóáéð 0029227 êáé 0008401 ôïð SAP. Äáí áíðéíáððððóáíá ùíðð êáíÝíá áðü áððÛ óá ðñíäèÐíáðá ìá ôçí äãéáðÛóðáóç ôïð **SAP 4.6C**.

10.7.13.11 [RFCRSWBOINI_IND_IND] êáðÛ ôçí ÁêðÝéáóç ôïð R3SETUP

Ôí óðÛëíá áððü äíðáíβóðçéá êáðÛ ôçí äãéáðÛóðáóç ôïð **SAP 4.6C**, êáé Ðóáí ôí äðíðÝéáóíá áíüð Ûëëïð óðÛëíáðòð ðñüðñíÝéððá ðññððñá óóçí äãéáðÛóðáóç. Óá ôÝóíéáð ðññéðððóáéð εá ðñÝðáé íá äáβðá óá áíðβóðíé÷á logfiles êáé íá äéíñèðóáðá ôí äñ÷éù ðñüäëçíá.

Áí áóíý äëÝáíáðá óá logfiles äéáðéóððóáðá ùðé ôí óðÛëíá äβíáé ðñÛñáíáðé áððü (éíéðÛíðá ðéð óçíáêðóáéð ôïð SAP), ìðññáβðá íá ðñðóáðá ôí STATUS óá áððü ôí äÐíá áðü ERROR óá OK (óðí äñ÷áβí CENTRDB.R3S) êáé íá äêðäëÝóáðá íáíÛ ôí R3SETUP. ÌáðÛ ôçí äãéáðÛóðáóç, ðñÝðáé íá äêðäëÝóáðá ôí RSWBOINS áðü ôç óðíáäéááÐ SE38. Äáβðá ôç óçíáβùóç 0162266 ôïð SAP äéá óá RFCRSWBOINI êáé RFCRADDBDIF.

10.7.13.12 [RFCRADDBDIF_IND_IND] êáðÛ ôçí ÁêðÝéáóç R3SETUP

¼ððð êáé ðñéí, êáé äáð éó÷ýáç ç βáéá éíáèèÐ: óéáíðñáððððáðá ðñéí äβíáé ôí ðñüðáñ÷éù óðÛëíá éíéðÛæííðáðá óá logfiles.

Áí äðéááááêðóáðá ùðé ç óçíáβùóç ôïð SAP 0162266 áíðáðññññáðáé óðí ðñüäëçíá óáð, äðéÛ ðñðóáðá ôí STATUS óá áððü ôí äÐíá áðü ERROR óá OK (óðí äñ÷áβí CENTRDB.R3S) êáé ðñÝíðá ðÛéé ôí R3SETUP. ÌáðÛ ôçí äãéáðÛóðáóç, ðñÝðáé íá äêðäëÝóáðá ôí RADDBDIF áðü ôç óðíáäéááÐ SE38.

10.7.13.13 sigaction sig31: File size limit exceeded

Ôí óðÛëíá áððü ðñññáβ íá äíðáíéóððáβ êáðÛ ôçí äêèβíçóç ðñí äéáññáóéðí ôïð **SAP disp+work**. Áí ðñééíðóáðá ôí **SAP** ìá ôí script startsap, íé ððñíäéáññáóðáðá εá äñ÷áβóíðí ðñíáð ôïðð, ðñééíðíðáð ðéð ððüéíéððáð äéáññáóðáðá ôïð äðáéðñíýíðáé áðü ôí **SAP**. Áððü Ý÷áé ùð äðíðÝéáóíá ôí βáéí ôí script íá íçí äñññæáé áí éÛðé ðÐáá óðñááÛ.

Ãέα íá äëÝáíáðá áí ðñððð ðñéβíçóáí óðððÛ íé äéáññáóðáðá ôïð **SAP**, ðñíðá íéá íáðéÛ óçç èβóðá äéáññáóéðí ìá ôçí áíðñèÐ ps ax | grep SID, ç ððñíá éá óáð äðéóðñÝðáé íéáð èβóðá ìá ùéáð ðéð äéáññáóðáðá áðü óá **Oracle** êáé **SAP**. Áí óáβíðáé óáí íá èáβðñíðí ðññééÝð äéáññáóðáðá, Ð áí äáí ðñññáβðá íá óðíáäéááðá óðí **SAP**, éíéðÛíðá óá áíðβóðíé÷á

logfiles óä ðíðá ðíðíííí íä äñäëííí óðíí êäóÛëíä /usr/sap/SID/DVEBMGSnr/work/. Óä äñ÷äá ðíð ðñÝðäé íä êíéóÛíäðä äáíäé óä dev_ms êäé dev_disp.

Ôí Signal 31 êä äíðáíéóððá äí ç ðíóóóçðá ðçð êíéíðð ðíðçð ðíð ÷ñçóéíðíéäððäé äðí óä Oracle êäé SAP íäðñÛóäé ôí ðíðäëíð ðíð Ý÷äé ðäç ðíéóððäé êäóÛ ðç ðíéíéóç ðíð ðñðíä. Ìä ôí íä ðíððäðä íéä ðääéýððñç ðéíð êä ðíðÝóððä íä ðñíððñÛóððä ôí ðñíðäéçíä äððí:

```
# ðäääéýððñç ðíðçç äéä óðóððíäðä ðäñäáððäðð 46C:
options SHMMAXPGS=393216
# ðééñðððñç ðíðçç äéä óðóððíäðä 46B:
#options SHMMAXPGS=262144
```

10.7.13.14 Áíäðéðð ÷ ðð Äêéðíçççç ôíð saposcol

ÔðÛñ÷íðí äððçðð ðäñééÛ ðñíäéðíäðä íä ôí ðñíðññíä saposcol (Ýéäíóç 4.6D). Ôí SAP ÷ñçóéíðíéäðð ôí saposcol äéä íä óðéëÝíäé ääñíÝíä ó÷äðééÛ ðä ðéð äðéäüóäéð ðíð óðóððíäðíð. Ôí ðñíðññíä äððí ääí ôí ÷ñäéÛäóððä äéä íä äêðäéÝóððä ôí SAP, ðððä ðíðñá ðä êäñççéäð ðð ðééñððñç ççíäóððäð. Ðäéäéüððñäð äéäüóäéð (4.6B) äíðéäýíðí, äééÛ ää óðéëÝíðí ðéä óä ääñíÝíä (ðíéëÝð êéððáéð äðéóðñÝíðí 0, äéä ðñÛäéäíä ç ÷ñðçç ðçð CPU).

10.8 Ðñí÷ñçíÝíä ÈÝíäðä

Áí Ý÷äðä ðçí äðñðá ððð êäéðíðñäð ç óðíäáóóóçðá íä äðññíäÝð Linux, ðððä êä ðñÝðäé íä äéääÛóððä ðç ðñäéÛðð äíðóçðä. Óä ðñäéóóóððñä äðí ðóä Ý÷íðí äñäððäð äáíäé ääóéòíÝíä óðçí çäéðñíééð èðððä ääíéðí óðççðððäíð ðíð FreeBSD (<http://lists.FreeBSD.org/mailman/listinfo/freebsd-chat>) êäé Ý÷íðí äñäððäð äðí ôí Terry Lambert <tlambert@primenet.com> (Message ID: <199906020108.SAA07001@usr09.primenet.com>).

10.8.1 Ððð Èäéðíðñäð;

Ôí FreeBSD ðññéÝ÷äé Ýíä äðððäñ äóäðñäóçð (abstraction) ðíð ðñíÛäðäé “execution class loader”. Äððí ääóððäé óðí execve(2).

Äððí ðíð óðíäáíäé äáíäé ððé ôí FreeBSD Ý÷äé ðäé èðððä ðíððððí (loaders), äíðð äéä Ýíä ðíð íä êäðäðäýäé óä ðñðððððç äðíðð÷ðäð ðíð #! äéä íä ðñÝíäé êÛðíéí shell interpreter ð shell script.

ÉóðíñééÛ, ð ðíðð ðíððððððð ððç ðéäðððñíä ðíð UNIX Ýéää÷ä ðíð ðäééü äñéèü (äñééÛ óä ðñððä 4 ð 8 bytes ðíð äñ÷äðíð) äéä íä ääé äí äáíäé êÛðíéí äêðäéÝóéí / äðññíäð äíðððð ðíð óýóççíä, êäé óðçí ðñðððððç äððð íä êäéÝóäé ôí äíððððí÷í ðíððððð.

Áí ôí äñ÷äðí ääí ððäí äêðäéÝóéí ðä äÛóçç ðíð óýððí ðíð óðóððíäðíð, ç êéðçç óðí execve(2) äðÝóððñäðä êÛðíéí óðÛéíä, êäé ôí shell ðñíððäéýððä íä äêðäéÝóäé ôí äñ÷äðí óáí shell script.

Ç ääíééð êäÝä ððäí “äí ääí äáíäé äêðäéÝóéí, ðñíððððçççç íä ôí ðñÝíäéð ðð shell script ðä äÛóçç ôí ðñÝ÷íí shell”.

Äñäððñä, äñÝççä Ýíäð Ýíððíð ðñðððð ðððä ôí sh(1) íä äéÝä÷äé ðíðð ðñððððð äýí÷ä äñäéððñäð, êäé äí ððäí : \n, ðððä êäéýððä ôí shell csh(1) (ðéóðäýíðíä ððð ç éýóçç äððð äñÝççä äñ÷äéÛ äðí ðç SCO).

Äððí ðíð êÛíäé ððñä ôí FreeBSD äáíäé íä äéäðñÝ÷äé ðç èðððä ðä ðíððð ðíðð ðíððððð, ðä Ýíä ääíééü ðíððððð #! ð ðíððð äíääíðñäéð ðð äéäñíçíÝíä (interpreter) ðíðð ÷äñäéððñäð äðí ôí äðíðññ êäíü ðäðÛ ðíð! êäé ðÝ÷äé ðíð ðÝéíð, äñð äí ääí äíääíðñéóððä êÛðíéíð, ÷ñçóéíðíéäððäé ðð Ýó÷äçç éýóçç ðíð /bin/sh.

Æéá ôçí ððíóðÞñéíç ôíð Linux ABI, ôí FreeBSD äëÝðáë ôíí íááëéü àñëèü ôíð ELF binary (ää áíááñññäëéä ôç äëáöíñÛ áíÛíáóá óá FreeBSD, Solaris, Linux, P êÛðíëí Ûëëí äëéôíðñäëéü óýóðçíá ôí ððíðí ÷ ñçóëíððíëáá àñ ÷ ááá óýðíð ELF).

Ï òíñðüððð ELF êíëðÛäë äëá Ýíá äëäëéü *brand*, ôí ððíðí ááíáë íëá áíüðçðá ó ÷ ðëáí ìÝóá óðí ELF image, éáë ôí ððíðí äáí ððÛñ ÷ äë óá ELF binaries äëá SVR4/Solaris

Æéá íá äëéôíðñäëéü óá äëðäëÝóëíá ôíð Linux, éá ðñÝðáë íá ááííóí *branded* (íáñëáñëóóíýí) ùð Linux ìÝóü ôçð *brandelf(1)*:

```
# brandelf -t Linux file
```

¼óáí ááíáë áððü, Ï òíñðüððð ELF éá äëÝðáë ôí Linux brand ðÛíü óðí àñ ÷ ááí.

¼óáí Ï òíñðüððð ELF ääë ôí Linux brand, éá áíðéëáðáóððáë Ýíáí äááëðç ìÝóá óçç àñP *proc*. ¼ëäð íë êëðóáëð ôíð óðóððíáðíð óáíëíñíýíóáë ìÝóá áðü áððüí ôíí äááëðç (óá Ýíá ðñááííóéáëü óýóðçíá UNIX, Ï äááëðçð éá Þðáí Ï ðáíáëáð *sysent[]*, ðíð ðñáñÝ ÷ äë ðéð êëðóáëð ôíð óðóððíáðíð (system calls)). ÁðëðëÝíí, ç äëáñááóáá óçíáëðíáðáë äëá äëáëêP ìáðá ÷ ááñëóç ôíð trap vector éáë Ûëëäð (íëëñÝð) äëíñëðóáëð, ðéð ððíðáð ÷ äëñäëáðáë ôí Ûñëñüíá ððñÞíá óçð óðíááðüðçðáð Linux.

Ïí system call vector ôíð Linux ðñáñÝ ÷ äë, ìáðáíý Ûëëüí, íëá êáðóá ìá óá äááñÝíá ôíð *sysent[]* ðüí ððíðí ðë äëáðëýíóáëð àñáóëííóáë ìÝóá óðí Ûñëñüíá ôíð ððñÞíá.

¼óáí ááíáðáë íëá êëÞç óðóððíáðíð áðü íëá áðáñññäë Linux, Ï êðáëéáð (trap code) ðñíðíðíëáá ôíí äááëðç ðçð ìÝóü óçð àñP ðíð Ý ÷ äë äááñáóáá óðí *proc*, éáë äëëÛäë óçí äëáýëðíóç þóðá íá äáá ÷ íáë óðí óçíááí äëóüüíð ðçð óðíÛñçççð ôíð Linux, éáë ù ÷ é ôíð FreeBSD.

ÁðÞçð, ôí óýóðçíá óðíááðüðçðáð ìá Linux ððíñáá éáë ðñíóáñññäë äðíáíëÛ ðéð ðíðíëáðáð áíáëÞçççð.

ÏóéáóðéëÛ áððü êÛíáë éáë ç äðëëíäP *union* éáðÛ óçí ðñíóðñçççç áíüð óðóððíáðíð àñ ÷ ááí (ääí áíñíýíá äáþ ôí óýóðçíá àñ ÷ ááí ìáñíññ!). Áñ ÷ éëÛ, ááíáðáë áðððáëñá íá àñäëáá ôí àñ ÷ ááí óðíí éáðÛëíí

```
/compat/linux/original-path, éáë ìüíí áí áððü áðíóý ÷ äë, éá ááíáë áíáëÞçççç óðíí éáðÛëíí /original-path.
```

Ï ðí ðñüðí áððü óéáíðáýííá ùðé óá äëðäëÝóëíá ðíð ÷ ñäëÛëíóáë Ûëëá äëðäëÝóëíá éá ðñÝííí (äëá ðáñÛäëëíá, ôí óýñíëí àñáäëááíü ôíð Linux ððíñáá íá äëðäëáóáá ìÝóü óçð ððíððÞñéíçð ôíð Linux ABI). ÁðÞçð óçíááíáë ùðé óá äëðäëÝóëíá ôíð Linux ððíñíýí íá òíñððíóí éáë íá äëðäëÝóíóí àñ ÷ ááá ôíð FreeBSD áí äáí ððíñíýí íá áíóððíóíóí óá áíóððíóí ÷ á àñ ÷ ááá óðí Linux. ððíñááðá áðÞççð íá ðíðíëáððáðá íëá áíóíëP *uname(1)* ìÝóá óðí /compat/linux ðñíëáëÝííð óá àñ ÷ ááá ôíð Linux íá ìç ððíñíýí íá áíááñññðíóí ùðé äáí ÷ ñçóëíððíëýíóáë ðñááíáðéëÛ óá Linux.

ÏóéáóðéëÛ, ððÛñ ÷ äë Ýíáð ððñÞíáð Linux ìÝóá óðíí ððñÞíá ôíð FreeBSD. Íë äëÛòíñáð äëéôíðñäëéü íë ððíðáð óëíðíëýíýí ùëäð ðéð ðççñááðáð ðíð ðáñÝ ÷ ííóáë áðü ôíí ððñÞíá ááíáë Þáëäð ðüóí óðíí ðáíáëá êëðóáíí óðóððíáðíð ôíð FreeBSD ùóí éáë óðíí áíóððíóí ÷ Ï ôíð Linux: äëéôíðñäëéü ôíð óðóððíáðíð àñ ÷ ááí, äëëíëêP ìÞç, äëá ÷ ááñëóç óçíÛðüí, System V IPC êëð. Ç ìüíç äëáöíñÛ ááíáë ùðé ôí äëðäëÝóëíá ôíð FreeBSD êÛííí ÷ ñÞçç ðüí óðíáñððóáíí *glue* ôíð FreeBSD, áþ ðá äëðäëÝóëíá ôíð Linux, êÛííí ÷ ñÞçç ðüí óðíáñððóáíí *glue* ôíð Linux (ðíëëÛ áðü óá ðáëëÛ äëéôíðñäëéü áá ÷ áí ðéð äëëÝð ðíðð óðíáñððóáëð *glue*: íë äëáðëýíóáëð ðüí óðíáñððóáíí àñáóëííóáí óðíí óóáðéëü ðáíáëá *sysent[]*, áíðá íá äëáðëñéíäëíóáë ìÝóü áíüð äðíáíëëýí äááëðç óçç àñP *proc* ðçð äëáñááóááð ðíð ðñááíáðíðíëáá óçí êëÞçç).

Þíëí ááíáë ùíðð ôí äááñÝð FreeBSD ABI; Äáí Ý ÷ äë éáë ðíëý óçíáóáá. Ç ìüíç ááóéêP äëáöíñÛ ááíáë (êÛðé ôí ððíðí ððíñáá áýëíëá íá äëëÛíáë óá ìáëëíóéëÝð äëáüóáëð, éáë ðíëý ðéëáíí íá äëëÛíáë) ùðé íë óðíáñððóáëð *glue* ôíð FreeBSD ááíáë óóáðéëÛ óðíááñññÝíáð óðíí ððñÞíá, áþ íë áíóððíóí ÷ äð ôíð Linux ððíñíýí ááðá íá ááíáë óðíááñññÝíáð óóáðéëÛ, ááðá íá ááíáë ðñíóáÛóëíáð ìÝóü áíüð àñëñÞíáðíð ððñÞíá.

Ááíáë áððü ùíðð ðñááíáðéêP àññíáóç; ¼ ÷ é. Ááíáë íëá ðëíðíÞççç ôíð ABI, ù ÷ é àññíáóç. Äáí ððÛñ ÷ äë êáíáá àññíáóç (P ðñíóñíáóç, äëá íá ðñíëÛáííá óçí áðüíáç óáð àñÞçççç).

III. Ἄέα ÷ ἄβñέος ΌοόΠιάοιò

Όά εἶοῦεάεά οἶο FreeBSD Handbook οἶο ἀεἶρεἶοεἶγί ἀίάοΎñιόάε οἶο εΎιαόά οἶο ὕ ÷ ιοἶ ο ÷ ὕος ἰά ος *ἄέα ÷ ἄβñέος* οἶο οσοόΠιάοιò. Ἐῦεἶἄ εἶοῦεάεἶ ἰἄεἶῦ δἰñεἶñῦοἶιόάò οé εἶ ἰῦεἶοἶἄ ἄεἶἄῦεἶιόάò οἶ οσοἄεἶñεἶΎἶ εἶοῦεάεἶ, εἶεἶò εἶé οé δñιἶδἶεἶοἶγἶἶἶἶ ὕ ÷ ἄé οἶ εἶοῦεάεἶ ἄοδῦ: οé δñΎδἶé ἶἶ ὕ ÷ ἄòἶ Πᾶς ἄεἶἄῦοἶἄé εἶé εἶἶἶἶἶΠῶἶé δñεἶ ἄο ÷ ἶεἶεἶἶβῶἶ ἰἶ ἄοδῦ οἶ εἶοῦεάεἶ.

Ἄοδῦ οἶ εἶοῦεάεἶ ὕ ÷ ιοἶ ο ÷ ἄἄεἶἶοδἶἶβ δἰñεἶοἶοδἶἶñῦ ἰò ἶᾶςἄῦò ἀἶἶοἶñῦò δἰñῦ ἰò ἄεἶἶἶἶἶἶἶἶἶ ἕἶἶἶἶñ. Ἄé ἄοδῦ ἄβἶἶé δἶεἶ ÷ ñΠῶἶἶἶ ἰò ἶᾶςἶñβ ὀοἶòò ἶδἶñῦòò ἶδἶñἶἶβῶἶ ἶἶ ἀἶἶἶñΎἶἶἶἶ ἶἶἶἶ ÷ ñἶéῦᾶἶἶἶἶἶἶ ἕῦδἶἶἶἶ δἶεἶñῦἶñἶἶἶ ἄεἶ οἶ FreeBSD. Ἄἶ ÷ ñἶéῦᾶἶἶἶἶ ἶἶ ἶἶ ἄεἶἶἶἶἶἶἶἶ ἶἶ ἕῦδἶἶἶἶ ὀοἶἶἶἶñῦἶἶ ὀἶἶñῦ, ἶγῶἶ ÷ ñἶéῦᾶἶἶἶἶἶ ἶἶ ἶἶ ὕ ÷ ἶἶἶἶ ἄεἶἶἶἶἶἶἶ ἶἶἶἶ δñεἶ ἶñ ÷ βῶἶἶἶ ἶἶ ἶἶ ἶἶἶἶἶἶ ἶἶ οἶ FreeBSD.

ΕὰοÛεὰεί 11 Ñýèìέός êάέ Άαëôέόôïðìβçός

ΆñÛöðçêà áðu ðñ Chern Lee. Άάóβóçêà óà tutorial àñàìÛñ áðu ðñ Mike Smith. ΆάóέíÛñ àðβóçð óðñ tuning(7) ðñ àñÛöçêà áðu ðñ Matt Dillon.

11.1 Óýññç

Íá áðu óá ççìáíðééÛ ÷ àñáèðçñέóðééÛ ðñ FreeBSD áβíáέ ç àñíáðuòçðá ñýèìέóçð ðñ óðóðßíáðñ. Ìá ðéð óóóðÛ ñðèìβóáéð óðóðßíáðñ áβíáέ áýèèí íá áðñóáð ÷ èìÿ ðñèéÛ ðñíáèßíáðá éáðÛ ðç àèÛñéáé ìáèèíðéèß íááááèìβóáñ. Õñ éáòÛεάéí áðóù éá àìçáßóáé ìááÛè ìÛññ ðçð áéááééáóβáð ñýèìέóçð ðñ FreeBSD, óðìðáñééáìááñ Ûññ éáé èÛðñéñ ðáñáì Ûðññ ðñ ðññññ ìá ñðèìέóðññ áéá ðç ìáèðéóðññìðìβçός ðçð áðuáñçð ðñ óðóðßíáðñ.

Άñÿ áéááÛóáðá áðóù ðñ éáòÛεάéí, éá ìÛñáð:

- Ðùð íá àñèÛóáðá áðñáñééÛ ìá óðóðßíáðá àñ ÷ àβññ éáé éáðáðìßóáéð swap.
- Õá ááóééÛ ðñ ðóðççìÛðñ ñýèìέóçð éáé àèèßççð rc.conf éáé /usr/local/etc/rc.d.
- Ðùð íá ñðèìβóáðá éáé íá àñéìÛóáðá ìéá èÛñðá áéèðÿñ.
- Ðùð íá ñðèìβóáðá virtual hosts óðéð áéèðáéÛð óáð óðóéáðÛð.
- Ðùð íá ÷ ñçóèññðñéßóáðá óá àèÛññ àñ ÷ àβá ñðèìβóáñ óðñ éáðÛèññ /etc.
- Ðùð íá àèèðéóðññìðìβçóðá ðñ FreeBSD ÷ ñçóèññðñéßíðáð ìáðáèçðÛð sysctl.
- Ðùð íá àèèðéóðññìðìβçóðá ðç áðuáñçð ðñ àβóèñ éáé íá áéèÛñáðá ðñð ðáñéññéóññ ðñ ðñßíá.

Ðñéí áéááÛóáðá áðóù ðñ éáòÛεάéí, éá ðñÛðáé:

- Íá éáðáññáβá ááóééÛ Ûññéáð ðñ UNIX éáé ðñ FreeBSD (ΕὰοÛεὰεί 3).
- Íá àβóðá àñééáéñÛññ ìá óá ááóééÛ ðçð ñýèìέóçð éáé ðçð ìáðááèßððéóçð ðñ ðñßíá (ΕὰοÛεὰεί 8).

11.2 Άñ ÷ èèß Ñýèìέός

11.2.1 ΆèÛóáñç Éáðáðìßóáñ

11.2.1.1 ΆáóééÛð Éáðáðìßóáéð

¼óáí àçñéññááβá óðóðßíáðá àñ ÷ àβññ ìá ðñ bsdlable(8) ð ðñ sysinstall(8), èðìçèáβá ùðé ìé óéèçñññ àβóèñ ìáðááÛñññ àáñÛñ àñçáññóðáñ áðñ óá àñðáñééÛ ìÛññ ðñð óá áóòðáñééÛ. ρóé ìéññóðáñ éáé ðáñéóóóðáñ ðññóáÛóéíá óðóðßíáðá àñ ÷ àβññ ðñÛðáé íá áβíáέ ðççóéÛóðáñá óðñ àñðáñééÛ ðñ àβóèñ, àñ ìááéýðáñáð éáðáðìßóáéð ùðò ðñ /usr ðñÛðáé íá ðñðèáðññéáé ðñ èññÛð ðñ áóòðáñééÛ ðñ àβóèñ. Άβíáέ éáèß éáÛá íá àçñéññááβá éáðáðìßóáéð ìá ðáñññéá óáèñÛ ìá áððñ: root, swap, /var, /usr.

Õñ ìÛñáèñ ðñ /var áíðáíáééÛ ðç àðéáéñññññ ÷ ñßç ðñ ìç ÷ áñßíáðñ. Õñ /var ÷ ñçóèññðñéáβá áéá ðç áðñèèáðç ðñ àñáìáðñéááòβññ, ðñ àñ ÷ àβññ éáðáññáðð éáé ðñ spooler ðñ àéðððòð. Õá àñáìáðñéáèèáèéá éáé óá àñ ÷ àβá éáðáññáðð ðññññ ìá ìááèßðññ óá áðññóáñéçðá ìáÛèç áñÛèññ ìá ðñ àñéèñ ðñ ÷ ñçóðñ ðñ óðóðßíáðñ éáé ðñ ÷ ññééÛ àèÛóççá ðñ èñáðññéáé óá àñ ÷ àβá éáðáññáðð. ÕðÛéá ÷ ñáèÛèáðáé ðñ /var/tmp íá Û ÷ áé ðÛñ

άδτι Υία gigabyte ÷ þñī, áεεŪ έάέυ άβίαέ ίά Υ ÷ άδά έάδŪ ñō υόέ δñŸδάέ ίά άβίαέ άñέάδŪ ίάάŪέί έάέ ίά έñάδŪάέ όά δάέŸόά δīō έŸέάόά ίά άάέάόάόδΡόάόά.

Ç έάδŪόιζός /usr δάñέŸ ÷ άέ όά δάñέόόυόάñά άñ ÷ άβά δīō άδάέόίγίόάέ έάέ όçί όδīόόðñέίç όīō όόόόðίάόīδ, όç όόέέίάð όυί ports(7) (δñīόάβίάόάέ) έάέ όίí δçάάβί έðάέά (δñίάέñάόέέυ). Έάέ όά άγί άόδŪ άβίαέ δñίάέñάόέέŪ έάόά όçί άάέάδŪόόάç. ÓīōέŪ ÷ έόόίí 2 gigabytes δñīόάβίíόάέ άέά άόδð όçί έάδŪόιζός.

¼όάί άδέέŸάάόά ίŸάάέίδ άέά όέό έάόάόίΡόάέό, ίά Υ ÷ άόά όδŷόέί όάό όέό άδάέόðόάέό όά ÷ þñī. Ìδñίάβ ίά άβίαέ έβáí δñūάέçίά όί ίά ίάβίάόά ÷ ùñβδ ÷ þñī όά ίέά έάδŪόιζός άíð ÷ ñçόέίíδīέάβόά άέŪ ÷ έόόά ίέά Ūέέç.

Óçίάβύός: ÌάñέέŸό όīñŸό ç άδέέίάð Auto-defaults όīō έάόάόιçόð όīō sysinstall(8) ίδīñάβ ίά άδέέŸίάέ όίέý ίέέñū ίŸάάέίδ άέά όέό έάόάόίΡόάέό /var έάέ /. Δñīόόάέάβόόά ίά άδέέŸίάόά Ÿίόδīά έάέ άáίάέύάñά ίάάŸέç άέά όέό έάόάόίΡόάέό όάό.

11.2.1.2 Swap ΈάδŪόιζός

Íάό άìδάέñέέυδ έάíυíάό άέά ίά άδέέŸίάόά ίŸάάέίδ άέά όçί έάδŪόιζός swap άβίαέ: δñŸδάέ ίά άβίαέ δάñβδīō άέδέð άδī όί ίŸάάέίδ όçδ ίðìçδ (RAM) όīō όόόόðίάόīδ. Άέά δάñŪάέέάí, άί όί ίç ÷ Ūίçίά Ÿ ÷ άέ 128 megabytes ίðìçδ, ç έάδŪόιζός swap δñŸδάέ ίά άβίαέ 256 megabytes. Óόόόðίάόά ίά έέάýδάñç ίðìç ίδīñίγί ίά άδīάβáíóί έάέýόάñά ίά δάñέόόύόάñī swap. Έέάýδάñά άδī 256 megabytes swap άáí δñīόάβίάόάέ έάέ δñŸδάέ ίά άíάόάόάβ ç άδŸέόάόç όçδ ίðìçδ. Ìέ άέάýñέέίέ VM paging όīō δδñðίά άβίαέ Ÿόόέ όόέάáŸŸίέ þόόά ίά άδīάβáíóί έάέýόάñά úόάί ç έάδŪόιζός swap άβίαέ όīōέŪ ÷ έόόίí άγί όīñŸό όί ίŸάάέίδ όçδ έάíόñέέðδ ίðìçδ. Άί ñόέíβόάόά όίέý ίέέñū swap, ίδīñάβ ίά Ÿ ÷ íóí ίάέýŸίç άδŷáíóç íέ άέάýñέέίέ óŪñóçδ όάέβáυí όīō όδīόόόðίάόīδ VM έάέ ίδīñάβ άñáýδάñά ίά ççίέíóñάçέíγί δñīάέðίάόά άí δñīόόάέάβ δάñέόόύόάñç όόόέéð ίðìç.

Óά ίάάάέýόάñά όόόόðίάόά ίά δīέέάδέíγδ SCSI άβόέíòδ (ð δīέέάδέíγδ IDE άβόέíòδ όά άέάóíñάόέέíγδ άέάάέóŸδ), άβίαέ δñīόέíúόάñί όί swap ίά άβίαέ ñόέíóíŸíí όά έŪέά άβόέí (ίŸ ÷ ñέ óŸόόáñέó άβόέíòδ). Ìέ ίά ÷ ùñέóóŸδ έάόάόίΡόάέό swap έάέυ άβίαέ ίά Ÿ ÷ íóí δάñβδīō όί βáέí ίŸάάέίδ. Ì δδñðίάό ίδīñάβ ίά ÷ άέñέόόάβ άδέάβñάόά ίάάŸέç swap, áέέŪ íέ άóύδάñέέŸδ áñŸδ áááñŸíυí ñόέíβáíóάέ ίά áŪόç όί ίŸάάέίδ όçδ ίάάάέýόάñç έάδŪόιζόςδ swap. Έñάόðíάό όçί έάδŪόιζός swap ó ÷ ááýí óóí βáέí ίŸάάέίδ έά άδέόñŸόάέ όóíí δδñðίά ίά άάέόέóóíδīέΡόάέ όçί ÷ ñðόç όīō swap, ñέñŪάέíóάό δέí έάέŪ όί óññóí όά έŪέά άβόέí. Άáí δάέñŪάέ ίά Ÿ ÷ άόά ίάάŪέí ίŸάάέίδ swap, áέýíá έάέ άí áá ÷ ñçόέííδīέάβόάέ άñέάδŪ. Ìδīñάβ ίά άβίαέ άóέíέýδάñç ç άíŪέάíçç άδī Ÿίά άέóυδ άέŸá ÷ íō δñūάñάíά δñīóíγ ÷ ñάέάόόάβ ίά άδáíάέέέíðόάόά όí óýόóçίά.

11.2.1.3 Άέάόβ ίά όόέŪίάόά έάόάόίΡόάέό;

Άñέάóíβ ÷ ñðόόάό ññβáíóí υόέ ίβά ίάάŪέç έάδŪόιζός έά άβίαέ άíóŪίάέ, áέέŪ óδŪñ ÷ íóí άñέάóíβ έυáíέ άέάόβ άόóυ άβίαέ έάέð έάŸά. Έάόáñ ÷ ðí, έŪέά έάδŪόιζός Ÿ ÷ άέ άέάóíñάόέέŪ έάέóíòñάέέŪ ÷ άñάέóçñέόέέŪ, ίóυόά ίá ÷ ùñβáíóíάό όέό έάόάόίΡόάέό άδέóñŸíóíóíά όóí óýόóçίά áñ ÷ άβυí ίά άíáññíβæάόάέ άíŪέíáá. Άέά δάñŪάέέάíá, íέ root έάέ /usr έάόάόίΡόάέό άβίαέ έδñβδ άέά άíŪáíυóç, ÷ ùñβδ δīέέŸδ áááñáóŸδ. Άíóβέάόά, áβñíóάέ δīέέŸδ áíááíðόάέό έάέ áááñáóŸδ όόέó /var έάέ /var/tmp.

ΈŪñíóάό óυόóð έάδŪόιζός όά Ÿίά óýόóçίá, í έάόάέáñíάόέóíυδ δīō óóíááβίáέ όά ίέέñūόáñάό έάέ δάñέόόύόάñί áááñŪóέíáð έάόάόίΡόάέό ááí έά áέáññáýόάέ óóέó έάόάόίΡόάέό δīō áέááŪάέíóάέ δέí óð ÷ íŪ áδŷ υόέ áñŪóííóáέ. Έñάόðíάό όέó δάñέόόύόάñί áááñŪóέíáð έάόάόίΡόάέό δέí έííðŪ óóçí Ūέñç όíō άβόέíð, έά áóίçέáβ ç I/O áδŷáíóç óóέó έάόάόίΡόάέό úδīō έάέ ÷ ñáέŪάάόάέ δέí óð ÷ íŪ. Óþñά áíð ç áδŷáíóç I/O ÷ ñáέŪάάόάέ óóέó ίάάάέýόάñάό έάόάόίΡόάέό, áέέŪάέíóάό áóóŸδ δέí έííðŪ óóçí Ūέñç όíō άβόέíð ááí έά íäçáðόάέ όά óçίáíóέέð άýίçç όçδ áδŷáíóç υóí όί ίά ίάόάέέíðόάόά όçí /var óóçí Ūέñç. ÓŸέíð, óδŪñ ÷ áέ έάέ έŸίά áóóŪέάέάó. Ìβά ίέέñð, δñīóááíŸíç root

Ôí ðéí áðëü óáíÛñéí áêêβíçóçð ðééáíüðáóá íá ïéÛæáé íá òí ðáñáéÛòù:

```
#!/bin/sh
echo -n ' utility'

case "$1" in
start)
    /usr/local/bin/utility
    ;;
stop)
    kill -9 `cat /var/run/utility.pid`
    ;;
*)
    echo "Usage: `basename $0` {start|stop}" >&2
    exit 64
    ;;
esac

exit 0
```

Ôí óáíÛñéí áðòù ðáñÝ ÷ áé íéá stop éáé íéá start áðéíñáð áéá òçí áòáñíñáð ùðíð óòí ðáñÛäáéáíá ááð áíáóÝñáðáé óáí utility.

Ìðíñáβ íá áêêéíçèáβ ÷ áéñüíáéðééÛ éÛñíðáò:

```
# /usr/local/etc/rc.d/utility.sh start
```

Ðáñüéí ðíð ááí áðáéóíýí üéáð íé áòáñíñáÝð íá ðñíóðáéáβ íβá ááñáñáðð óòí rc.conf, ó ÷ ááüí éáðçíñáñéíÛ éáé Ýíá íÝí port éá òñíðíðíéððá áéá íá äÝ ÷ áðáé áððð òçí ñýèíéóç. ÁéÝñáñáðá òçí ðáéééð Ýñíñí òçð ááéáðÛóðáóçð áéá ðáñéóóüðáñáð ðéçñííñíñáð ðÛíù óðçí óðáéáñéñíÝíç áòáñíñáð. ÌáñééÝð áòáñíñáÝð áðí òñβðíðð éáðáóéáðáóóÝð ðáñÝ ÷ íòí óáíÛñéá áêêβíçóçð óá ïðíβá áðéðñÝðíòí óðçí áòáñíñáð íá ÷ ñçóéíðíéçèáβ íá òí rc.d, ðáñüéá áðóá, áðòù éá óðæçðçèáβ óòí áðüíáñí ìÝñíð.

11.5.1 ÁêêðáóáíÝíç Ñýèíéóç Áòáñíñáðí

ÐéÝíí òí FreeBSD ðáñéÝ ÷ áé òí rc.d, ç ñýèíéóç òçð áêêβíçóçð òüí áòáñíñáðí Ý ÷ áé áβíáé áðéíñáðñç, éáé ðéí ðéíýóéá óá ÷ áñáéðçñééÛ. × ñçóéíðíéçèáð éÝíáéð ééáéáβá ìÝóá óòíí éáðÛéíñí rc.d, íé áòáñíñáÝð ìðíñíýí ðéÝíí íá áêêéíñíýí Ýðáéóá áðí óðáéáñéñíÝíáð òðçñáóβáð áéá ðáñÛäáéáíá òçí DNS, ìðíñáβ íá áðéðñáðáβ ç áéóááüñáð áðéðéÝíí ðáñáíÝðññí ìÝóá áðí òí rc.conf óðçí èÝóç òüí ðæç òðÛñ ÷ òíðíí ðáñáíÝðññí áðí óá óáíÛñéá áêêéíðóçð, éðéð. Íá ááóééü óáíÛñéí ìðíñáβ íá ïéÛæáé íá òí áéüéíðéí:

```
#!/bin/sh
#
# PROVIDE: utility
# REQUIRE: DAEMON
# KEYWORD: shutdown

#
# DO NOT CHANGE THESE DEFAULT VALUES HERE
# SET THEM IN THE /etc/rc.conf FILE
#
utility_enable=${utility_enable-"NO"}
```


οἶο ἀποῖοι ἰεᾶ εβῶα ἰᾶ εὔνοᾶ ἀεέογῖο εἰς ἰᾶνέεῖο δέχνηοῖνβᾶο ἁεᾶ οᾶ ὀδιόογῆεῖοῖαῖα chipsets εἰς ὀεὸ ὀδιόογῆεῖοῖαῖα εὔνοᾶ. Ἀῖ ῖ-ᾶᾶ ἰᾶεἰεῖβᾶο ἁεᾶ οῖ δῖεῖο ἰᾶῖαῖο ἁβῖᾶ ἰ οῖοῖο, ἁεᾶᾶᾶ ὀῖ ὀᾶεβᾶᾶ ἰᾶῖεᾶβᾶο οῖο ἰᾶῖᾶ. ῖ ὀᾶεβᾶᾶ ἰᾶῖεᾶβᾶο εᾶ οᾶο ἰᾶῖεᾶ δᾶῆεοῖοᾶῆᾶο δέχνηοῖνβᾶο ὀ-ᾶὀεῖᾶ ἰᾶ οῖ ὀδιόογῆεῖοῖαῖα ὀεῖεῖο εἰς ἁεῖῖᾶ εἰς ἁεᾶ οᾶ δέεᾶῖᾶ ὀῖᾶεβῖᾶ ὀῖο ἰδῖῖᾶ ἰᾶ ὀῖῖᾶ.

Ἀῖ ῖ-ᾶᾶ ἰεᾶ ὀῖῖεῖοῖῖῖ εὔνοᾶ, εᾶοᾶ δᾶᾶ δέεᾶῖοῖοᾶ ἁᾶ ἰεᾶ ὀ-ῆᾶεᾶὀᾶβ ἰᾶ ὀῖᾶᾶ δῖῖ ἁεᾶ οῖῖ ἰᾶῖᾶ. ἰε ἰᾶῖᾶβ ἁεᾶ ὀεὸ ὀῖῖεῖοῖῖῖ εὔνοᾶ ἀεέογῖο ὀδᾶῖ-ῖῖοῖ ὀῖῖ δὀῖᾶ GENERIC, ῖὀεᾶ ὀᾶᾶ εἰς εᾶ ἰᾶῖᾶεὀᾶβ εᾶοᾶ ὀῖ ἁεὔῆεᾶ ὀῖ ἁεῖβῖῖὀ, ἁεᾶ δᾶῖᾶᾶᾶ:

```
dc0: <82c169 PNIC 10/100BaseTX> port 0xa000-0xa0ff mem 0xd3800000-0xd38000ff irq 15 at device 11.0 on pci0
dc0: Ethernet address: 00:a0:cc:da:da:da
miibus0: <MII bus> on dc0
ukphy0: <Generic IEEE 802.3u media interface> on miibus0
ukphy0: 10baseT, 10baseT-FDX, 100baseTX, 100baseTX-FDX, auto
dc1: <82c169 PNIC 10/100BaseTX> port 0x9800-0x98ff mem 0xd3000000-0xd30000ff irq 11 at device 12.0 on pci0
dc1: Ethernet address: 00:a0:cc:da:da:db
miibus1: <MII bus> on dc1
ukphy1: <Generic IEEE 802.3u media interface> on miibus1
ukphy1: 10baseT, 10baseT-FDX, 100baseTX, 100baseTX-FDX, auto
```

ὀῖ δᾶῖᾶᾶᾶ ἁὀῖ, ἁεῖὀῖᾶ ἰὀε ἁῖῖ εὔνοᾶ ὀῖο ὀ-ῆῖὀῖῖῖῖῖ οῖῖ ἰᾶῖᾶ dc(4) ῖ-ῖῖοῖ ἁῖὀῖὀὀᾶβ ὀῖῖ ὀῖὀὀᾶ.

Ἀῖ ἰ ἰᾶῖᾶ ὀῖο NIC οᾶο ἁᾶ ἁβῖᾶ δᾶῖᾶ ὀῖῖ GENERIC, εᾶ δῖῖᾶ ἰᾶ ὀῖῖὀὀᾶ οῖῖ εᾶὀῖὀὀᾶ ἰᾶῖᾶ ἁεᾶ ἰᾶ ὀ-ῆῖὀῖῖῖῖῖῖῖ ὀῖο NIC οᾶο. Ἀὀῖᾶ ἰδῖῖᾶ ἰᾶ ἁὀὀᾶ-ῖᾶβ ἰᾶ ῖῖᾶ ἁὀῖ ὀῖὀ ἁῖῖ ἁὀὀῖὀ ὀῖὀὀᾶ:

- ἰ δῖῖᾶ ἁῖῖῖ ὀῖὀὀᾶ ἁβῖᾶ ἁὀῖ ἰᾶ ὀῖῖὀὀᾶ ῖῖᾶ ὀῖῖᾶ ὀῖὀ δὀῖᾶ ἁεᾶ ὀῖῖ εὔνοᾶ ἀεέογῖο οᾶο ἰᾶ οῖ kldload(8), ῖ ἁὀὀᾶᾶ εᾶοᾶ ὀῖ ἁεῖβῖῖὀ δῖῖὀῖὀὀᾶ ὀῖῖ εᾶὀῖὀὀᾶ ἁῖᾶῖᾶ ὀῖῖ ἁῖ-ᾶβῖ /boot/loader.conf. Ἀᾶ ἁβῖᾶ ἰῖῖ ἰε ἰᾶῖᾶβ NIC ἁεᾶῖὀῖῖ ὀᾶ ἁῖῖᾶᾶᾶ, ὀ-ᾶῖὀὀὀὀὀὀὀὀ ὀᾶῖᾶᾶᾶᾶᾶ ἁβῖᾶ ὀᾶ ἁῖῖᾶᾶᾶ ἁεᾶ ὀὀὀᾶᾶᾶ ISA.
- Ἀῖᾶᾶᾶᾶᾶ, ἰδῖῖᾶᾶ ἰᾶ ἰᾶὀᾶᾶᾶὀὀὀᾶᾶ ὀᾶὀὀᾶᾶ ὀῖ ὀὀὀὀᾶ ἁεᾶ ὀῖῖ εὔνοᾶ οᾶο ὀῖῖ δὀῖᾶ. Ἀεῖᾶᾶᾶ ὀῖ ἁῖ-ᾶβῖ /usr/src/sys/conf/NOTES, ὀῖ /usr/src/sys/arch/conf/NOTES εἰς ὀῖ ὀᾶεβᾶᾶ ἰᾶῖεᾶβᾶο ὀῖο ἰᾶῖᾶ ἁεᾶ ἰᾶ ἰᾶᾶᾶ ὀε δῖῖᾶ ἰᾶ δῖῖὀὀᾶ ὀᾶᾶ ἁῖ-ᾶβῖ ῆὀῖᾶᾶᾶ ὀῖο δὀῖᾶ. Ἀεᾶ δᾶῆεοῖοᾶῆᾶο δέχνηοῖνβᾶο ἁεᾶ ὀῖ δῖὀ ἰᾶ ἰᾶὀᾶᾶᾶὀὀὀᾶᾶ ὀῖ δὀῖᾶ, δᾶῖᾶᾶᾶ ἁεᾶᾶᾶ ὀῖ Ἐᾶὀῖᾶῖ 8. Ἀῖ ῖ εὔνοᾶ οᾶο ἁῖὀῖὀὀᾶβ εᾶοᾶ ὀῖ ἁεῖβῖῖὀ ἁὀῖ ὀῖ δὀῖᾶ (GENERIC) ἁᾶ ὀ-ῆᾶῖᾶᾶ ἰᾶ ἰᾶὀᾶᾶᾶὀὀὀᾶᾶ ῖῖᾶ ἰῖᾶ δὀῖᾶ.

11.8.1.1 ×ῆῖὀῖὀὀᾶᾶ ἰᾶῖᾶῖὀ Windows ἰᾶ ὀῖ NDIS

Ἀὀὀὀ-ῖὀ, ὀδᾶῖ-ῖῖοῖ ἁεῖῖᾶ δῖῖῖᾶ εᾶὀᾶὀᾶὀᾶὀᾶὀᾶ ὀῖὀ ἁᾶ δᾶῖᾶ ῖ-ῖῖοῖ ὀᾶ-ῖῖῖᾶ δῖῖᾶᾶᾶᾶᾶ ἁεᾶ ὀῖὀ ἰᾶῖᾶῖὀ ὀῖὀ ὀὀῖ ἁῖῖὀὀᾶ ὀῖὀ ἁῖῖὀῖᾶ ἁῖὀῖῖᾶ ἁεᾶὀβ ἁῖὀῖᾶὀὀὀᾶῖὀ ὀῖὀᾶὀ δέχνηοῖνβᾶο ὀᾶ ἰὀὀὀᾶ ὀῖὀ ἁῖὀῖᾶ. ὀῖᾶᾶᾶ, ἰε ὀᾶῖὀῖᾶ ἁεᾶ ὀῖῖ ἁῖὀὀὀὀ ὀῖὀ FreeBSD εἰς ὀῖὀ ἁεὀῖὀᾶᾶᾶ ὀὀὀὀᾶᾶ ἰῖῖὀ ἰᾶ ἁῖᾶ ἁὀῖᾶᾶᾶ: ἰᾶ ἁῖᾶὀὀᾶῖὀ ἰᾶῖᾶῖὀ ἰᾶ ὀῖῖ ἰᾶῖᾶ ἁεᾶ ἁὀὀὀὀ ἁεᾶᾶᾶᾶᾶ ὀῖὀ ἁῖὀὀὀὀὀὀ ἰῖ-ἁῖᾶᾶ ῖ ἰᾶ ὀ-ῆῖὀῖὀὀᾶᾶᾶ ῖᾶῖ ὀδᾶῖ-ῖῖὀᾶ ἰᾶῖᾶῖὀ ὀᾶ ἁὀᾶᾶᾶᾶ ἰῖῖὀ ἁεᾶῖὀῖὀὀ ἁεᾶ ὀῖῖ δεᾶὀὀῖᾶ Microsoft Windows. ἰε δᾶῆεοῖοᾶῆᾶᾶ ὀᾶῖὀῖᾶ ἁεᾶ ὀῖῖ ἁῖὀὀὀὀ, ἰᾶὀᾶῖ ὀῖὀ ἁεᾶ ἁὀῖᾶ ὀῖὀ ἁῖὀῖᾶᾶᾶ ἰᾶ ὀῖ FreeBSD, ῖ-ῖῖὀ ἁὀῖᾶᾶ ὀῖ ἁᾶὀᾶῖᾶ ὀῖὀᾶᾶᾶ.

×ὀῖῖ ὀῖῖ δῖῖὀῖᾶ ὀῖὀ Bill Paul (wpaul), ἰεὀὀ ἁεᾶ ἁὀῖ ὀῖ FreeBSD 5.3-RELEASE ὀδᾶῖ-ῖῖὀ ἁεᾶ “ᾶῖᾶᾶᾶ” ὀὀὀὀᾶᾶᾶ ἁεᾶ ὀῖ Network Driver Interface Specification (NDIS). ὀῖ ῖῖᾶ FreeBSD NDISulator (ἁεὀῖᾶᾶᾶᾶ ἁῖὀὀᾶ ὀᾶ Project Evil) δᾶῖᾶᾶ ῖῖᾶ ἰᾶῖᾶ Windows ὀᾶ ἁὀᾶᾶᾶᾶ ἰῖῖὀ ἁεᾶ ὀὀῖ ἰὀὀᾶ ὀῖᾶ ἁῖᾶὀᾶὀ ὀᾶᾶ ἰᾶ ἰῖᾶᾶᾶ ἰὀε ὀῖᾶ ὀ-ᾶᾶ

11.8.3.1 ΆειέιÛεϊόάό íέα Ethernet ÈÛñóá

Άέα íά άδέάάάεéóáά ùέέ ç Ethernet èÛñóá εάέóιíñááß óúóóÛ, έά ðñÝðáé íά εÛíáόά äýí ðñÛáíáόά. Ðñþόά, εÛíóá ping όçí èÛñόά όçí βάέα, έάέ íáòÛ èÛíόά ping Ýíά Ûεεϊ ιç÷Ûίçιά όóι LAN.

Ðñþόά äèéèÛόόά όόçí όιðέέP èÛñόά:

```
% ping -c5 192.168.1.3
PING 192.168.1.3 (192.168.1.3): 56 data bytes
64 bytes from 192.168.1.3: icmp_seq=0 ttl=64 time=0.082 ms
64 bytes from 192.168.1.3: icmp_seq=1 ttl=64 time=0.074 ms
64 bytes from 192.168.1.3: icmp_seq=2 ttl=64 time=0.076 ms
64 bytes from 192.168.1.3: icmp_seq=3 ttl=64 time=0.108 ms
64 bytes from 192.168.1.3: icmp_seq=4 ttl=64 time=0.076 ms

--- 192.168.1.3 ping statistics ---
5 packets transmitted, 5 packets received, 0% packet loss
round-trip min/avg/max/stddev = 0.074/0.083/0.108/0.013 ms
```

Όþñά äèéèÛόόά óά Ýíά Ûεεϊ ιç÷Ûίçιά όóι LAN:

```
% ping -c5 192.168.1.2
PING 192.168.1.2 (192.168.1.2): 56 data bytes
64 bytes from 192.168.1.2: icmp_seq=0 ttl=64 time=0.726 ms
64 bytes from 192.168.1.2: icmp_seq=1 ttl=64 time=0.766 ms
64 bytes from 192.168.1.2: icmp_seq=2 ttl=64 time=0.700 ms
64 bytes from 192.168.1.2: icmp_seq=3 ttl=64 time=0.747 ms
64 bytes from 192.168.1.2: icmp_seq=4 ttl=64 time=0.704 ms

--- 192.168.1.2 ping statistics ---
5 packets transmitted, 5 packets received, 0% packet loss
round-trip min/avg/max/stddev = 0.700/0.729/0.766/0.025 ms
```

Ìðñáßόά íά ðñόέííðíεPóáά έάέ όι ùíñά όι ιç÷áíþíáòò άíθβ όçò άέáyέóíόçò 192.168.1.2 áí Ý÷áðά ðóèιβόάέ όι áñ÷áβí /etc/hosts.

11.8.3.2 Άðβέόç ÐñíáεçíÛόóι

Ç άðβέόç ðñíáεçíÛόóι óéééý έάέ εíáέóíééý άβίáé ðÛíόíá άðβðίç, Ýíáð ðñíò í ðíéúð ððñáß íά áíáéíòóέóόάß áéÝá÷íóάò íáñέéÛ áðèÛ ðñÛáíáόά ðñþόά. Άβίáé όι έάéþáéí όìò áééόýìò óóíáááíÝíí; ÷áðά ðóèιβόάέ óúóóÛ óéé óðçñáóáð áééόýìò; ÷áðά ðóèιβόάέ óúóóÛ όι ðýñέíí ðáß÷ìð; ÷áé ðñÛáíáόé όí FreeBSD óðíóðþñéíç áέα áóðP όçí èÛñόά áééόýìò; ÐñÝðáé ðÛíόά íά áéÝá÷áðά óéé όçíáéþóáéð όìò óéééý ðñéí óáßεá íβά áíáóìÛ έέα Ýíά ðññáεçíá. Áíáááéιβóόά όçí Ýεäíόç όìò FreeBSD óόçí óáéáóóάβά ÓÓÁÈÄÑÇ Ýεäíόç. ΆéÝáíóá óά áñ÷áβά ðñí ééóðí íçíòíÛόóι, P øÛíόά óóι Internet.

Άί ç èÛñόά äèéäýáέ, áéèÛ íá ÷áìçþ áðñáíόç, έá Ûίέæá íά áέááÛόáόá όçí óáεβáá áìçèáβáð tuning(7). Ìðñáßόá άðβόçò íά áéÝáñáόά íé áí éάíέáóíÝíáð ðóèιβόáéð όìò áééόýìò ðñíéáéýíí óéé áñáÝò óóíáÝόáéð.

ÌáñέéÝð ÷ñþóáð áíόéíáòðβáéíóí Ýíá P äýí íçýííáóá “device timeout”, óά íðíβά άβίáé óóóéíéíáééÛ áέα íáñέéÝð èÛñόáð. Άί óóíá÷έóóíýíí, P áβíñíóí áñ÷έçóééÛ, έá ðñÝðáé íά áéÝáñáόá íþðò έάέ èÛðíéáð óóóéáòÝð ðáññáðñíáβáéíóí ç íβά όçí Ûéεç. ΆéÝáñóá áéðèÛ óéé óóíáÝόáéð όñí έáέèíáβñí. εóòð έá ðñÝðáé íά áðíέðþóáόá íβά Ûéεç èÛñόά.

ÌáñέéÝð óññÝð, íé ÷ñþóáð ðáññáóçñíýíí íáñέéÛ íçýííáóá èÛéíòð “watchdog timeout”. Óι ðñþóí ðñÛáíá óìò ðñÝðáé íά èÛíáόά άβίáé íά áéÝáñáόά όí έάéþáéí όìò áééόýìò. ÁñéÝóáð èÛñόáð ÷ñáéÛáéíóáé íβά εÝόç PCI óìò íá


```
ifconfig_fxp0_alias0="inet 10.1.1.2 netmask 255.255.255.255"
ifconfig_fxp0_alias1="inet 10.1.1.3 netmask 255.255.255.255"
ifconfig_fxp0_alias2="inet 10.1.1.4 netmask 255.255.255.255"
ifconfig_fxp0_alias3="inet 10.1.1.5 netmask 255.255.255.255"
ifconfig_fxp0_alias4="inet 202.0.75.17 netmask 255.255.255.240"
ifconfig_fxp0_alias5="inet 202.0.75.18 netmask 255.255.255.255"
ifconfig_fxp0_alias6="inet 202.0.75.19 netmask 255.255.255.255"
ifconfig_fxp0_alias7="inet 202.0.75.20 netmask 255.255.255.255"
```

11.10 Ἄνδρα Νότιο

11.10.1 Ἰσχυρὸν /etc

Ὁ ἄνδρα νότιος ἀπὸ τῆς ἀρχῆς τῆς οἰκίας ἐστὶν ἡ ἀστρονομία. Ἰσχυρὸν ἀπὸ τῆς ἀρχῆς:

/etc	Ἰσχυρὸν νότιον ὅπου ὁ οἰκίας, data here is system-specific.
/etc/defaults	Default versions of system configuration files.
/etc/mail	Extra sendmail(8) configuration, other MTA configuration files.
/etc/ppp	Configuration for both user- and kernel-ppp programs.
/etc/namedb	Default location for named(8) data. Normally named.conf and zone files are stored here.
/usr/local/etc	Configuration files for installed applications. May contain per-application subdirectories.
/usr/local/etc/rc.d	Start/stop scripts for installed applications.
/var/db	Automatically generated system-specific database files, such as the package database, the locate database, and so on

11.10.2 Hostnames

11.10.2.1 /etc/resolv.conf

/etc/resolv.conf dictates how FreeBSD's resolver accesses the Internet Domain Name System (DNS).

The most common entries to resolv.conf are:

nameserver	The IP address of a name server the resolver should query. The servers are queried in the order listed with a maximum of three.
search	Search list for hostname lookup. This is normally determined by the domain of the local hostname.
domain	The local domain name.

A typical resolv.conf:

```
search example.com
```

```
nameserver 147.11.1.11
nameserver 147.11.100.30
```

Ὁμολογία: Only one of the `search` and `domain` options should be used.

If you are using DHCP, `dhclient(8)` usually rewrites `resolv.conf` with information received from the DHCP server.

11.10.2.2 `/etc/hosts`

`/etc/hosts` is a simple text database reminiscent of the old Internet. It works in conjunction with DNS and NIS providing name to IP address mappings. Local computers connected via a LAN can be placed in here for simplistic naming purposes instead of setting up a `named(8)` server. Additionally, `/etc/hosts` can be used to provide a local record of Internet names, reducing the need to query externally for commonly accessed names.

```
# $FreeBSD$
#
# Host Database
# This file should contain the addresses and aliases
# for local hosts that share this file.
# In the presence of the domain name service or NIS, this file may
# not be consulted at all; see /etc/nsswitch.conf for the resolution order.
#
#
::1                localhost localhost.my.domain myname.my.domain
127.0.0.1          localhost localhost.my.domain myname.my.domain

#
# Imaginary network.
#10.0.0.2          myname.my.domain myname
#10.0.0.3          myfriend.my.domain myfriend
#
# According to RFC 1918, you can use the following IP networks for
# private nets which will never be connected to the Internet:
#
#      10.0.0.0      -   10.255.255.255
#      172.16.0.0   -   172.31.255.255
#      192.168.0.0  -   192.168.255.255
#
# In case you want to be able to connect to the Internet, you need
# real official assigned numbers. PLEASE PLEASE PLEASE do not try
# to invent your own network numbers but instead get one from your
# network provider (if any) or from the Internet Registry (ftp to
# rs.internic.net, directory '/templates').
#
```

`/etc/hosts` takes on the simple format of:

```
[Internet address] [official hostname] [alias1] [alias2] ...
```

For example:

10.0.0.1 myRealHostname.example.com myRealHostname foobar1 foobar2

Consult hosts(5) for more information.

11.10.3 Log File Configuration

11.10.3.1 syslog.conf

syslog.conf is the configuration file for the syslogd(8) program. It indicates which types of syslog messages are logged to particular log files.

```
# $FreeBSD$
#
#     Spaces ARE valid field separators in this file. However,
#     other *nix-like systems still insist on using tabs as field
#     separators. If you are sharing this file between systems, you
#     may want to use only tabs as field separators here.
#     Consult the syslog.conf(5) manual page.
*.err;kern.debug;auth.notice;mail.crit      /dev/console
*.notice;kern.debug;lpr.info;mail.crit;news.err /var/log/messages
security.*                                   /var/log/security
mail.info                                    /var/log/maillog
lpr.info                                     /var/log/lpd-errs
cron.*                                       /var/log/cron
*.err                                        root
*.notice;news.err                           root
*.alert                                      root
*.emerg                                      *
# uncomment this to log all writes to /dev/console to /var/log/console.log
#console.info                               /var/log/console.log
# uncomment this to enable logging of all log messages to /var/log/all.log
#*.*                                         /var/log/all.log
# uncomment this to enable logging to a remote log host named loghost
#*.*                                         @loghost
# uncomment these if you're running inn
# news.crit                                  /var/log/news/news.crit
# news.err                                   /var/log/news/news.err
# news.notice                               /var/log/news/news.notice
!startslip
*.*                                         /var/log/slip.log
!ppp
*.*                                         /var/log/ppp.log
```

Consult the syslog.conf(5) manual page for more information.

11.10.3.2 newsyslog.conf

newsyslog.conf is the configuration file for newsyslog(8), a program that is normally scheduled to run by cron(8). newsyslog(8) determines when log files require archiving or rearranging. logfile is moved to logfile.0, logfile.0 is moved to logfile.1, and so on. Alternatively, the log files may be archived in gzip(1) format causing them to be named: logfile.0.gz, logfile.1.gz, and so on.

newsyslog.conf indicates which log files are to be managed, how many are to be kept, and when they are to be touched. Log files can be rearranged and/or archived when they have either reached a certain size, or at a certain periodic time/date.

```
# configuration file for newsyslog
# $FreeBSD$
#
# filename          [owner:group]    mode count size when [ZB] [/pid_file] [sig_num]
/var/log/cron              600 3    100 *    Z
/var/log/amd.log           644 7    100 *    Z
/var/log/kerberos.log     644 7    100 *    Z
/var/log/lpd-errs         644 7    100 *    Z
/var/log/maillog          644 7    *    @T00 Z
/var/log/sendmail.st      644 10   *    168  B
/var/log/messages         644 5    100 *    Z
/var/log/all.log          600 7    *    @T00 Z
/var/log/slip.log         600 3    100 *    Z
/var/log/ppp.log          600 3    100 *    Z
/var/log/security         600 10   100 *    Z
/var/log/wtmp             644 3    *    @01T05 B
/var/log/daily.log        640 7    *    @T00 Z
/var/log/weekly.log       640 5    1    $W6D0 Z
/var/log/monthly.log      640 12   *    $M1D0 Z
/var/log/console.log      640 5    100 *    Z
```

Consult the newsyslog(8) manual page for more information.

11.10.4 sysctl.conf

sysctl.conf looks much like rc.conf. Values are set in a variable=value form. The specified values are set after the system goes into multi-user mode. Not all variables are settable in this mode.

To turn off logging of fatal signal exits and prevent users from seeing processes started from other users, the following tunables can be set in sysctl.conf:

```
# Do not log fatal signal exits (e.g. sig 11)
kern.logsigexit=0

# Prevent users from seeing information about processes that
# are being run under another UID.
security.bsd.see_other_uids=0
```

11.11 Tuning with sysctl

sysctl(8) is an interface that allows you to make changes to a running FreeBSD system. This includes many advanced options of the TCP/IP stack and virtual memory system that can dramatically improve performance for an experienced system administrator. Over five hundred system variables can be read and set using sysctl(8).

At its core, sysctl(8) serves two functions: to read and to modify system settings.

To view all readable variables:

```
% sysctl -a
```

To read a particular variable, for example, kern.maxproc:

```
% sysctl kern.maxproc
kern.maxproc: 1044
```

To set a particular variable, use the intuitive *variable=value* syntax:

```
# sysctl kern.maxfiles=5000
kern.maxfiles: 2088 -> 5000
```

Settings of sysctl variables are usually either strings, numbers, or booleans (a boolean being 1 for yes or a 0 for no).

If you want to set automatically some variables each time the machine boots, add them to the `/etc/sysctl.conf` file. For more information see the `sysctl.conf(5)` manual page and the `Οἰκία 11.10.4`.

11.11.1 sysctl(8) Read-only

Contributed by Tom Rhodes.

In some cases it may be desirable to modify read-only sysctl(8) values. While this is sometimes unavoidable, it can only be done on (re)boot.

For instance on some laptop models the cardbus(4) device will not probe memory ranges, and fail with errors which look similar to:

```
cbb0: Could not map register memory
device_probe_and_attach: cbb0 attach returned 12
```

Cases like the one above usually require the modification of some default sysctl(8) settings which are set read only. To overcome these situations a user can put sysctl(8) “OIDs” in their local `/boot/loader.conf`. Default settings are located in the `/boot/defaults/loader.conf` file.

Fixing the problem mentioned above would require a user to set `hw.pci.allow_unsupported_io_range=1` in the aforementioned file. Now cardbus(4) will work properly.

11.12 Tuning Disks

11.12.1 Sysctl Variables

11.12.1.1 `vfs.vmiodirenable`

The `vfs.vmiodirenable` sysctl variable may be set to either 0 (off) or 1 (on); it is 1 by default. This variable controls how directories are cached by the system. Most directories are small, using just a single fragment (typically 1 K) in the file system and less (typically 512 bytes) in the buffer cache. With this variable turned off (to 0), the buffer cache will only cache a fixed number of directories even if you have a huge amount of memory. When turned on (to 1), this sysctl allows the buffer cache to use the VM Page Cache to cache the directories, making all the memory available for caching directories. However, the minimum in-core memory used to cache a directory is the physical page size (typically 4 K) rather than 512 bytes. We recommend keeping this option on if you are running any services which manipulate large numbers of files. Such services can include web caches, large mail systems, and news systems. Keeping this option on will generally not reduce performance even with the wasted memory but you should experiment to find out.

11.12.1.2 `vfs.write_behind`

The `vfs.write_behind` sysctl variable defaults to 1 (on). This tells the file system to issue media writes as full clusters are collected, which typically occurs when writing large sequential files. The idea is to avoid saturating the buffer cache with dirty buffers when it would not benefit I/O performance. However, this may stall processes and under certain circumstances you may wish to turn it off.

11.12.1.3 `vfs.hirunningspace`

The `vfs.hirunningspace` sysctl variable determines how much outstanding write I/O may be queued to disk controllers system-wide at any given instance. The default is usually sufficient but on machines with lots of disks you may want to bump it up to four or five *megabytes*. Note that setting too high a value (exceeding the buffer cache's write threshold) can lead to extremely bad clustering performance. Do not set this value arbitrarily high! Higher write values may add latency to reads occurring at the same time.

There are various other buffer-cache and VM page cache related sysctls. We do not recommend modifying these values, the VM system does an extremely good job of automatically tuning itself.

11.12.1.4 `vm.swap_idle_enabled`

The `vm.swap_idle_enabled` sysctl variable is useful in large multi-user systems where you have lots of users entering and leaving the system and lots of idle processes. Such systems tend to generate a great deal of continuous pressure on free memory reserves. Turning this feature on and tweaking the swapout hysteresis (in idle seconds) via `vm.swap_idle_threshold1` and `vm.swap_idle_threshold2` allows you to depress the priority of memory pages associated with idle processes more quickly than the normal pageout algorithm. This gives a helping hand to the pageout daemon. Do not turn this option on unless you need it, because the tradeoff you are making is essentially pre-page memory sooner rather than later; thus eating more swap and disk bandwidth. In a small system this option will have a determinable effect but in a large system that is already doing moderate paging this option allows the VM system to stage whole processes into and out of memory easily.

11.12.1.5 `hw.ata.wc`

FreeBSD 4.3 flirted with turning off IDE write caching. This reduced write bandwidth to IDE disks but was considered necessary due to serious data consistency issues introduced by hard drive vendors. The problem is that IDE drives lie about when a write completes. With IDE write caching turned on, IDE hard drives not only write data to disk out of order, but will sometimes delay writing some blocks indefinitely when under heavy disk loads. A crash or power failure may cause serious file system corruption. FreeBSD's default was changed to be safe. Unfortunately, the result was such a huge performance loss that we changed write caching back to on by default after the release. You should check the default on your system by observing the `hw.ata.wc` sysctl variable. If IDE write caching is turned off, you can turn it back on by setting the kernel variable back to 1. This must be done from the boot loader at boot time. Attempting to do it after the kernel boots will have no effect.

For more information, please see `ata(4)`.

11.12.1.6 `SCSI_DELAY` (`kern.cam.scsi_delay`)

The `SCSI_DELAY` kernel config may be used to reduce system boot times. The defaults are fairly high and can be responsible for 15 seconds of delay in the boot process. Reducing it to 5 seconds usually works (especially with modern drives). Newer versions of FreeBSD (5.0 and higher) should use the `kern.cam.scsi_delay` boot time tunable. The tunable, and kernel config option accept values in terms of *milliseconds* and *not seconds*.

11.12.2 Soft Updates

The `tunefs(8)` program can be used to fine-tune a file system. This program has many different options, but for now we are only concerned with toggling Soft Updates on and off, which is done by:

```
# tunefs -n enable /filesystem
# tunefs -n disable /filesystem
```

A filesystem cannot be modified with `tunefs(8)` while it is mounted. A good time to enable Soft Updates is before any partitions have been mounted, in single-user mode.

Soft Updates drastically improves meta-data performance, mainly file creation and deletion, through the use of a memory cache. We recommend to use Soft Updates on all of your file systems. There are two downsides to Soft Updates that you should be aware of: First, Soft Updates guarantees filesystem consistency in the case of a crash but could very easily be several seconds (even a minute!) behind updating the physical disk. If your system crashes you may lose more work than otherwise. Secondly, Soft Updates delays the freeing of filesystem blocks. If you have a filesystem (such as the root filesystem) which is almost full, performing a major update, such as `make installworld`, can cause the filesystem to run out of space and the update to fail.

11.12.2.1 More Details about Soft Updates

There are two traditional approaches to writing a file systems meta-data back to disk. (Meta-data updates are updates to non-content data like inodes or directories.)

Historically, the default behavior was to write out meta-data updates synchronously. If a directory had been changed, the system waited until the change was actually written to disk. The file data buffers (file contents) were passed through the buffer cache and backed up to disk later on asynchronously. The advantage of this implementation is that it operates safely. If there is a failure during an update, the meta-data are always in a consistent state. A file is either

created completely or not at all. If the data blocks of a file did not find their way out of the buffer cache onto the disk by the time of the crash, `fsck(8)` is able to recognize this and repair the filesystem by setting the file length to 0. Additionally, the implementation is clear and simple. The disadvantage is that meta-data changes are slow. An `rm -r`, for instance, touches all the files in a directory sequentially, but each directory change (deletion of a file) will be written synchronously to the disk. This includes updates to the directory itself, to the inode table, and possibly to indirect blocks allocated by the file. Similar considerations apply for unrolling large hierarchies (`tar -x`).

The second case is asynchronous meta-data updates. This is the default for Linux/ext2fs and `mount -o async` for *BSD ufs. All meta-data updates are simply being passed through the buffer cache too, that is, they will be intermixed with the updates of the file content data. The advantage of this implementation is there is no need to wait until each meta-data update has been written to disk, so all operations which cause huge amounts of meta-data updates work much faster than in the synchronous case. Also, the implementation is still clear and simple, so there is a low risk for bugs creeping into the code. The disadvantage is that there is no guarantee at all for a consistent state of the filesystem. If there is a failure during an operation that updated large amounts of meta-data (like a power failure, or someone pressing the reset button), the filesystem will be left in an unpredictable state. There is no opportunity to examine the state of the filesystem when the system comes up again; the data blocks of a file could already have been written to the disk while the updates of the inode table or the associated directory were not. It is actually impossible to implement a `fsck` which is able to clean up the resulting chaos (because the necessary information is not available on the disk). If the filesystem has been damaged beyond repair, the only choice is to use `newfs(8)` on it and restore it from backup.

The usual solution for this problem was to implement *dirty region logging*, which is also referred to as *journaling*, although that term is not used consistently and is occasionally applied to other forms of transaction logging as well. Meta-data updates are still written synchronously, but only into a small region of the disk. Later on they will be moved to their proper location. Because the logging area is a small, contiguous region on the disk, there are no long distances for the disk heads to move, even during heavy operations, so these operations are quicker than synchronous updates. Additionally the complexity of the implementation is fairly limited, so the risk of bugs being present is low. A disadvantage is that all meta-data are written twice (once into the logging region and once to the proper location) so for normal work, a performance “pessimization” might result. On the other hand, in case of a crash, all pending meta-data operations can be quickly either rolled-back or completed from the logging area after the system comes up again, resulting in a fast filesystem startup.

Kirk McKusick, the developer of Berkeley FFS, solved this problem with Soft Updates: all pending meta-data updates are kept in memory and written out to disk in a sorted sequence (“ordered meta-data updates”). This has the effect that, in case of heavy meta-data operations, later updates to an item “catch” the earlier ones if the earlier ones are still in memory and have not already been written to disk. So all operations on, say, a directory are generally performed in memory before the update is written to disk (the data blocks are sorted according to their position so that they will not be on the disk ahead of their meta-data). If the system crashes, this causes an implicit “log rewind”: all operations which did not find their way to the disk appear as if they had never happened. A consistent filesystem state is maintained that appears to be the one of 30 to 60 seconds earlier. The algorithm used guarantees that all resources in use are marked as such in their appropriate bitmaps: blocks and inodes. After a crash, the only resource allocation error that occurs is that resources are marked as “used” which are actually “free”. `fsck(8)` recognizes this situation, and frees the resources that are no longer used. It is safe to ignore the dirty state of the filesystem after a crash by forcibly mounting it with `mount -f`. In order to free resources that may be unused, `fsck(8)` needs to be run at a later time. This is the idea behind the *background fsck*: at system startup time, only a *snapshot* of the filesystem is recorded. The `fsck` can be run later on. All file systems can then be mounted “dirty”, so the system startup proceeds in multiuser mode. Then, *background fscks* will be scheduled for all file systems where this is required, to free resources that may be unused. (File systems that do not use Soft Updates still need the usual foreground `fsck` though.)

The advantage is that meta-data operations are nearly as fast as asynchronous updates (i.e. faster than with *logging*, which has to write the meta-data twice). The disadvantages are the complexity of the code (implying a higher risk for bugs in an area that is highly sensitive regarding loss of user data), and a higher memory consumption. Additionally there are some idiosyncrasies one has to get used to. After a crash, the state of the filesystem appears to be somewhat “older”. In situations where the standard synchronous approach would have caused some zero-length files to remain after the `fsck`, these files do not exist at all with a Soft Updates filesystem because neither the meta-data nor the file contents have ever been written to disk. Disk space is not released until the updates have been written to disk, which may take place some time after running `rm`. This may cause problems when installing large amounts of data on a filesystem that does not have enough free space to hold all the files twice.

11.13 Tuning Kernel Limits

11.13.1 File/Process Limits

11.13.1.1 `kern.maxfiles`

`kern.maxfiles` can be raised or lowered based upon your system requirements. This variable indicates the maximum number of file descriptors on your system. When the file descriptor table is full, “file: table is full” will show up repeatedly in the system message buffer, which can be viewed with the `dmesg` command.

Each open file, socket, or fifo uses one file descriptor. A large-scale production server may easily require many thousands of file descriptors, depending on the kind and number of services running concurrently.

In older FreeBSD releases, the default value of `kern.maxfiles` is derived from the `maxusers` option in your kernel configuration file. `kern.maxfiles` grows proportionally to the value of `maxusers`. When compiling a custom kernel, it is a good idea to set this kernel configuration option according to the uses of your system. From this number, the kernel is given most of its pre-defined limits. Even though a production machine may not actually have 256 users connected at once, the resources needed may be similar to a high-scale web server.

As of FreeBSD 4.5, `kern.maxusers` is automatically sized at boot based on the amount of memory available in the system, and may be determined at run-time by inspecting the value of the read-only `kern.maxusers` sysctl. Some sites will require larger or smaller values of `kern.maxusers` and may set it as a loader tunable; values of 64, 128, and 256 are not uncommon. We do not recommend going above 256 unless you need a huge number of file descriptors; many of the tunable values set to their defaults by `kern.maxusers` may be individually overridden at boot-time or run-time in `/boot/loader.conf` (see the `loader.conf(5)` man page or the `/boot/defaults/loader.conf` file for some hints) or as described elsewhere in this document. Systems older than FreeBSD 4.4 must set this value via the kernel `config(8)` option `maxusers` instead.

In older releases, the system will auto-tune `maxusers` for you if you explicitly set it to 0¹. When setting this option, you will want to set `maxusers` to at least 4, especially if you are using the X Window System or compiling software. The reason is that the most important table set by `maxusers` is the maximum number of processes, which is set to $20 + 16 * \text{maxusers}$, so if you set `maxusers` to 1, then you can only have 36 simultaneous processes, including the 18 or so that the system starts up at boot time and the 15 or so you will probably create when you start the X Window System. Even a simple task like reading a manual page will start up nine processes to filter, decompress, and view it. Setting `maxusers` to 64 will allow you to have up to 1044 simultaneous processes, which should be enough for nearly all uses. If, however, you see the dreaded `proc table full` error when trying to start another program, or are

running a server with a large number of simultaneous users (like `ftp.FreeBSD.org`), you can always increase the number and rebuild.

Όγιάρβυός: `maxusers` does *not* limit the number of users which can log into your machine. It simply sets various table sizes to reasonable values considering the maximum number of users you will likely have on your system and how many processes each of them will be running. One keyword which *does* limit the number of simultaneous remote logins and X terminal windows is `pseudo-device pty 16`. With FreeBSD 5.X, you do not have to worry about this number since the `pty(4)` driver is “auto-cloning”; you simply use the line `device pty` in your configuration file.

11.13.1.2 `kern.ipc.somaxconn`

The `kern.ipc.somaxconn` `sysctl` variable limits the size of the listen queue for accepting new TCP connections. The default value of 128 is typically too low for robust handling of new connections in a heavily loaded web server environment. For such environments, it is recommended to increase this value to 1024 or higher. The service daemon may itself limit the listen queue size (e.g. `sendmail(8)`, or **Apache**) but will often have a directive in its configuration file to adjust the queue size. Large listen queues also do a better job of avoiding Denial of Service (DoS) attacks.

11.13.2 Network Limits

The `NMBCLUSTERS` kernel configuration option dictates the amount of network Mbufs available to the system. A heavily-trafficked server with a low number of Mbufs will hinder FreeBSD’s ability. Each cluster represents approximately 2 K of memory, so a value of 1024 represents 2 megabytes of kernel memory reserved for network buffers. A simple calculation can be done to figure out how many are needed. If you have a web server which maxes out at 1000 simultaneous connections, and each connection eats a 16 K receive and 16 K send buffer, you need approximately 32 MB worth of network buffers to cover the web server. A good rule of thumb is to multiply by 2, so $2 \times 32 \text{ MB} / 2 \text{ KB} = 64 \text{ MB} / 2 \text{ kB} = 32768$. We recommend values between 4096 and 32768 for machines with greater amounts of memory. Under no circumstances should you specify an arbitrarily high value for this parameter as it could lead to a boot time crash. The `-m` option to `netstat(1)` may be used to observe network cluster use.

`kern.ipc.nmbclusters` loader tunable should be used to tune this at boot time. Only older versions of FreeBSD will require you to use the `NMBCLUSTERS` kernel `config(8)` option.

For busy servers that make extensive use of the `sendfile(2)` system call, it may be necessary to increase the number of `sendfile(2)` buffers via the `NSFBUFS` kernel configuration option or by setting its value in `/boot/loader.conf` (see `loader(8)` for details). A common indicator that this parameter needs to be adjusted is when processes are seen in the `sfbufo` state. The `sysctl` variable `kern.ipc.nsfbufs` is a read-only glimpse at the kernel configured variable. This parameter nominally scales with `kern.maxusers`, however it may be necessary to tune accordingly.

Όγιάρβυός: Even though a socket has been marked as non-blocking, calling `sendfile(2)` on the non-blocking socket may result in the `sendfile(2)` call blocking until enough `struct sf_buf`’s are made available.

11.13.2.1 `net.inet.ip.portrange.*`

The `net.inet.ip.portrange.*` sysctl variables control the port number ranges automatically bound to TCP and UDP sockets. There are three ranges: a low range, a default range, and a high range. Most network programs use the default range which is controlled by the `net.inet.ip.portrange.first` and `net.inet.ip.portrange.last`, which default to 1024 and 5000, respectively. Bound port ranges are used for outgoing connections, and it is possible to run the system out of ports under certain circumstances. This most commonly occurs when you are running a heavily loaded web proxy. The port range is not an issue when running servers which handle mainly incoming connections, such as a normal web server, or has a limited number of outgoing connections, such as a mail relay. For situations where you may run yourself out of ports, it is recommended to increase `net.inet.ip.portrange.last` modestly. A value of 10000, 20000 or 30000 may be reasonable. You should also consider firewall effects when changing the port range. Some firewalls may block large ranges of ports (usually low-numbered ports) and expect systems to use higher ranges of ports for outgoing connections — for this reason it is not recommended that `net.inet.ip.portrange.first` be lowered.

11.13.2.2 TCP Bandwidth Delay Product

The TCP Bandwidth Delay Product Limiting is similar to TCP/Vegas in NetBSD. It can be enabled by setting `net.inet.tcp.inflight.enable` sysctl variable to 1. The system will attempt to calculate the bandwidth delay product for each connection and limit the amount of data queued to the network to just the amount required to maintain optimum throughput.

This feature is useful if you are serving data over modems, Gigabit Ethernet, or even high speed WAN links (or any other link with a high bandwidth delay product), especially if you are also using window scaling or have configured a large send window. If you enable this option, you should also be sure to set `net.inet.tcp.inflight.debug` to 0 (disable debugging), and for production use setting `net.inet.tcp.inflight.min` to at least 6144 may be beneficial. However, note that setting high minimums may effectively disable bandwidth limiting depending on the link. The limiting feature reduces the amount of data built up in intermediate route and switch packet queues as well as reduces the amount of data built up in the local host's interface queue. With fewer packets queued up, interactive connections, especially over slow modems, will also be able to operate with lower *Round Trip Times*. However, note that this feature only effects data transmission (uploading / server side). It has no effect on data reception (downloading).

Adjusting `net.inet.tcp.inflight.stab` is *not* recommended. This parameter defaults to 20, representing 2 maximal packets added to the bandwidth delay product window calculation. The additional window is required to stabilize the algorithm and improve responsiveness to changing conditions, but it can also result in higher ping times over slow links (though still much lower than you would get without the inflight algorithm). In such cases, you may wish to try reducing this parameter to 15, 10, or 5; and may also have to reduce `net.inet.tcp.inflight.min` (for example, to 3500) to get the desired effect. Reducing these parameters should be done as a last resort only.

11.13.3 Virtual Memory

11.13.3.1 `kern.maxvnodes`

A vnode is the internal representation of a file or directory. So increasing the number of vnodes available to the operating system cuts down on disk I/O. Normally this is handled by the operating system and does not need to be changed. In some cases where disk I/O is a bottleneck and the system is running out of vnodes, this setting will need to be increased. The amount of inactive and free RAM will need to be taken into account.

To see the current number of vnodes in use:

```
# sysctl vfs.numvnodes
vfs.numvnodes: 91349
```

To see the maximum vnodes:

```
# sysctl kern.maxvnodes
kern.maxvnodes: 100000
```

If the current vnode usage is near the maximum, increasing `kern.maxvnodes` by a value of 1,000 is probably a good idea. Keep an eye on the number of `vfs.numvnodes`. If it climbs up to the maximum again, `kern.maxvnodes` will need to be increased further. A shift in your memory usage as reported by `top(1)` should be visible. More memory should be active.

11.14 Adding Swap Space

No matter how well you plan, sometimes a system does not run as you expect. If you find you need more swap space, it is simple enough to add. You have three ways to increase swap space: adding a new hard drive, enabling swap over NFS, and creating a swap file on an existing partition.

For information on how to encrypt swap space, what options for this task exist and why it should be done, please refer to [Ὀϊπιά 18.17](#) of the Handbook.

11.14.1 Swap on a New Hard Drive

The best way to add swap, of course, is to use this as an excuse to add another hard drive. You can always use another hard drive, after all. If you can do this, go reread the discussion of swap space in [Ὀϊπιά 11.2](#) of the Handbook for some suggestions on how to best arrange your swap.

11.14.2 Swapping over NFS

Swapping over NFS is only recommended if you do not have a local hard disk to swap to; NFS swapping will be limited by the available network bandwidth and puts an additional burden on the NFS server.

11.14.3 Swapfiles

You can create a file of a specified size to use as a swap file. In our example here we will use a 64MB file called `/usr/swap0`. You can use any name you want, of course.

Δᾶνῦᾶᾶᾶᾶ 11-1. Creating a Swapfile on FreeBSD

1. Be certain that your kernel configuration includes the memory disk driver (`md(4)`). It is default in `GENERIC kernel`.


```
device    md    # Memory "disks"
```

2. Create a swapfile (`/usr/swap0`):

```
# dd if=/dev/zero of=/usr/swap0 bs=1024k count=64
```
3. Set proper permissions on (`/usr/swap0`):

```
# chmod 0600 /usr/swap0
```
4. Enable the swap file in `/etc/rc.conf`:

```
swapfile="/usr/swap0" # Set to name of swapfile if aux swapfile desired.
```
5. Reboot the machine or to enable the swap file immediately, type:

```
# mdconfig -a -t vnode -f /usr/swap0 -u 0 && swapon /dev/md0
```

11.15 Power and Resource Management

Written by Hiten Pandya ἐπὶ Tom Rhodes.

It is important to utilize hardware resources in an efficient manner. Before ACPI was introduced, it was difficult and inflexible for operating systems to manage the power usage and thermal properties of a system. The hardware was managed by the BIOS and thus the user had less control and visibility into the power management settings. Some limited configurability was available via *Advanced Power Management (APM)*. Power and resource management is one of the key components of a modern operating system. For example, you may want an operating system to monitor system limits (and possibly alert you) in case your system temperature increased unexpectedly.

In this section of the FreeBSD Handbook, we will provide comprehensive information about ACPI. References will be provided for further reading at the end.

11.15.1 What Is ACPI?

Advanced Configuration and Power Interface (ACPI) is a standard written by an alliance of vendors to provide a standard interface for hardware resources and power management (hence the name). It is a key element in *Operating System-directed configuration and Power Management*, i.e.: it provides more control and flexibility to the operating system (OS). Modern systems “stretched” the limits of the current Plug and Play interfaces prior to the introduction of ACPI. ACPI is the direct successor to APM (Advanced Power Management).

11.15.2 Shortcomings of Advanced Power Management (APM)

The *Advanced Power Management (APM)* facility controls the power usage of a system based on its activity. The APM BIOS is supplied by the (system) vendor and it is specific to the hardware platform. An APM driver in the OS mediates access to the *APM Software Interface*, which allows management of power levels. APM should still be used for systems manufactured at or before the year 2000.

There are four major problems in APM. Firstly, power management is done by the (vendor-specific) BIOS, and the OS does not have any knowledge of it. One example of this, is when the user sets idle-time values for a hard drive in the APM BIOS, that when exceeded, it (BIOS) would spin down the hard drive, without the consent of the OS. Secondly, the APM logic is embedded in the BIOS, and it operates outside the scope of the OS. This means users can only fix problems in their APM BIOS by flashing a new one into the ROM; which is a very dangerous procedure with the potential to leave the system in an unrecoverable state if it fails. Thirdly, APM is a vendor-specific

technology, which means that there is a lot of parity (duplication of efforts) and bugs found in one vendor's BIOS, may not be solved in others. Last but not the least, the APM BIOS did not have enough room to implement a sophisticated power policy, or one that can adapt very well to the purpose of the machine.

Plug and Play BIOS (PNPBIOS) was unreliable in many situations. PNPBIOS is 16-bit technology, so the OS has to use 16-bit emulation in order to “interface” with PNPBIOS methods.

The FreeBSD APM driver is documented in the `apm(4)` manual page.

11.15.3 Configuring ACPI

The `acpi.ko` driver is loaded by default at start up by the `loader(8)` and should *not* be compiled into the kernel. The reasoning behind this is that modules are easier to work with, say if switching to another `acpi.ko` without doing a kernel rebuild. This has the advantage of making testing easier. Another reason is that starting ACPI after a system has been brought up often doesn't work well. If you are experiencing problems, you can disable ACPI altogether. This driver should not and can not be unloaded because the system bus uses it for various hardware interactions. ACPI can be disabled by setting `hint.acpi.0.disabled="1"` in `/boot/loader.conf` or at the `loader(8)` prompt.

Όχιἄβύός: ACPI and APM cannot coexist and should be used separately. The last one to load will terminate if the driver notices the other running.

ACPI can be used to put the system into a sleep mode with `acpiconf(8)`, the `-s` flag, and a 1–5 option. Most users will only need 1 or 3 (suspend to RAM). Option 5 will do a soft-off which is the same action as:

```
# halt -p
```

Other options are available via `sysctl(8)`. Check out the `acpi(4)` and `acpiconf(8)` manual pages for more information.

11.16 Using and Debugging FreeBSD ACPI

Written by Nate Lawson. With contributions from Peter Schultz ἐπέ Tom Rhodes.

ACPI is a fundamentally new way of discovering devices, managing power usage, and providing standardized access to various hardware previously managed by the BIOS. Progress is being made toward ACPI working on all systems, but bugs in some motherboards' *ACPI Machine Language* (AML) bytecode, incompleteness in FreeBSD's kernel subsystems, and bugs in the Intel ACPI-CA interpreter continue to appear.

This document is intended to help you assist the FreeBSD ACPI maintainers in identifying the root cause of problems you observe and debugging and developing a solution. Thanks for reading this and we hope we can solve your system's problems.

11.16.1 Submitting Debugging Information

Όχιἄβύός: Before submitting a problem, be sure you are running the latest BIOS version and, if available, embedded controller firmware version.

For those of you that want to submit a problem right away, please send the following information to freebsd-acpi@FreeBSD.org (<mailto:freebsd-acpi@FreeBSD.org>):

- Description of the buggy behavior, including system type and model and anything that causes the bug to appear. Also, please note as accurately as possible when the bug began occurring if it is new for you.
- The `dmesg(8)` output after `boot -v`, including any error messages generated by you exercising the bug.
- The `dmesg(8)` output from `boot -v` with ACPI disabled, if disabling it helps fix the problem.
- Output from `sysctl hw.acpi`. This is also a good way of figuring out what features your system offers.
- URL where your *ACPI Source Language* (ASL) can be found. Do *not* send the ASL directly to the list as it can be very large. Generate a copy of your ASL by running this command:

```
# acpidump -dt > name-system.asl
```

(Substitute your login name for *name* and manufacturer/model for *system*. Example: `njl-FooCo6000.asl`)

Most of the developers watch the [FreeBSD-CURRENT](http://lists.FreeBSD.org/mailman/listinfo/freebsd-current) (<http://lists.FreeBSD.org/mailman/listinfo/freebsd-current>) but please submit problems to `freebsd-acpi` (<http://lists.FreeBSD.org/mailman/listinfo/freebsd-acpi>) to be sure it is seen. Please be patient, all of us have full-time jobs elsewhere. If your bug is not immediately apparent, we will probably ask you to submit a PR via `send-pr(1)`. When entering a PR, please include the same information as requested above. This will help us track the problem and resolve it. Do not send a PR without emailing `freebsd-acpi` (<http://lists.FreeBSD.org/mailman/listinfo/freebsd-acpi>) first as we use PRs as reminders of existing problems, not a reporting mechanism. It is likely that your problem has been reported by someone before.

11.16.2 Background

ACPI is present in all modern computers that conform to the ia32 (x86), ia64 (Itanium), and amd64 (AMD) architectures. The full standard has many features including CPU performance management, power planes control, thermal zones, various battery systems, embedded controllers, and bus enumeration. Most systems implement less than the full standard. For instance, a desktop system usually only implements the bus enumeration parts while a laptop might have cooling and battery management support as well. Laptops also have suspend and resume, with their own associated complexity.

An ACPI-compliant system has various components. The BIOS and chipset vendors provide various fixed tables (e.g., FADT) in memory that specify things like the APIC map (used for SMP), config registers, and simple configuration values. Additionally, a table of bytecode (the *Differentiated System Description Table* DSDT) is provided that specifies a tree-like name space of devices and methods.

The ACPI driver must parse the fixed tables, implement an interpreter for the bytecode, and modify device drivers and the kernel to accept information from the ACPI subsystem. For FreeBSD, Intel has provided an interpreter (ACPI-CA) that is shared with Linux and NetBSD. The path to the ACPI-CA source code is `src/sys/contrib/dev/acpica`. The glue code that allows ACPI-CA to work on FreeBSD is in `src/sys/dev/acpica/osd`. Finally, drivers that implement various ACPI devices are found in `src/sys/dev/acpica`.

11.16.3 Common Problems

For ACPI to work correctly, all the parts have to work correctly. Here are some common problems, in order of frequency of appearance, and some possible workarounds or fixes.

11.16.3.1 Mouse Issues

In some cases, resuming from a suspend operation will cause the mouse to fail. A known work around is to add `hint.psm.0.flags="0x3000"` to the `/boot/loader.conf` file. If this does not work then please consider sending a bug report as described above.

11.16.3.2 Suspend/Resume

ACPI has three suspend to RAM (STR) states, S1-S3, and one suspend to disk state (STD), called S4. S5 is “soft off” and is the normal state your system is in when plugged in but not powered up. S4 can actually be implemented two separate ways. S4BIOS is a BIOS-assisted suspend to disk. S4OS is implemented entirely by the operating system.

Start by checking `sysctl hw.acpi` for the suspend-related items. Here are the results for a Thinkpad:

```
hw.acpi.supported_sleep_state: S3 S4 S5
hw.acpi.s4bios: 0
```

This means that we can use `acpiconf -s` to test S3, S4OS, and S5. If `s4bios` was one (1), we would have S4BIOS support instead of S4 OS.

When testing suspend/resume, start with S1, if supported. This state is most likely to work since it does not require much driver support. No one has implemented S2 but if you have it, it is similar to S1. The next thing to try is S3. This is the deepest STR state and requires a lot of driver support to properly reinitialize your hardware. If you have problems resuming, feel free to email the `freebsd-acpi` (<http://lists.FreeBSD.org/mailman/listinfo/freebsd-acpi>) list but do not expect the problem to be resolved since there are a lot of drivers/hardware that need more testing and work.

To help isolate the problem, remove as many drivers from your kernel as possible. If it works, you can narrow down which driver is the problem by loading drivers until it fails again. Typically binary drivers like `nvidia.ko`, X11 display drivers, and USB will have the most problems while Ethernet interfaces usually work fine. If you can properly load/unload the drivers, you can automate this by putting the appropriate commands in `/etc/rc.suspend` and `/etc/rc.resume`. There is a commented-out example for unloading and loading a driver. Try setting `hw.acpi.reset_video` to zero (0) if your display is messed up after resume. Try setting longer or shorter values for `hw.acpi.sleep_delay` to see if that helps.

Another thing to try is load a recent Linux distribution with ACPI support and test their suspend/resume support on the same hardware. If it works on Linux, it is likely a FreeBSD driver problem and narrowing down which driver causes the problems will help us fix the problem. Note that the ACPI maintainers do not usually maintain other drivers (e.g sound, ATA, etc.) so any work done on tracking down a driver problem should probably eventually be posted to the `freebsd-current` (<http://lists.FreeBSD.org/mailman/listinfo/freebsd-current>) list and mailed to the driver maintainer. If you are feeling adventurous, go ahead and start putting some debugging `printf(3)s` in a problematic driver to track down where in its resume function it hangs.

Finally, try disabling ACPI and enabling APM instead. If suspend/resume works with APM, you may be better off sticking with APM, especially on older hardware (pre-2000). It took vendors a while to get ACPI support correct and older hardware is more likely to have BIOS problems with ACPI.

11.16.3.3 System Hangs (temporary or permanent)

Most system hangs are a result of lost interrupts or an interrupt storm. Chipsets have a lot of problems based on how the BIOS configures interrupts before boot, correctness of the APIC (MADT) table, and routing of the *System Control Interrupt* (SCI).

Interrupt storms can be distinguished from lost interrupts by checking the output of `vmstat -i` and looking at the line that has `acpi0`. If the counter is increasing at more than a couple per second, you have an interrupt storm. If the system appears hung, try breaking to DDB (**CTRL+ALT+ESC** on console) and type `show interrupts`.

Your best hope when dealing with interrupt problems is to try disabling APIC support with `hint.apic.0.disabled="1"` in `loader.conf`.

11.16.3.4 Panics

Panics are relatively rare for ACPI and are the top priority to be fixed. The first step is to isolate the steps to reproduce the panic (if possible) and get a backtrace. Follow the advice for enabling `options DDB` and setting up a serial console (see Ὀῖῖῖ 26.6.5.3) or setting up a `dump(8)` partition. You can get a backtrace in DDB with `tr`. If you have to handwrite the backtrace, be sure to at least get the lowest five (5) and top five (5) lines in the trace.

Then, try to isolate the problem by booting with ACPI disabled. If that works, you can isolate the ACPI subsystem by using various values of `debug.acpi.disable`. See the `acpi(4)` manual page for some examples.

11.16.3.5 System Powers Up After Suspend or Shutdown

First, try setting `hw.acpi.disable_on_poweroff="0"` in `loader.conf(5)`. This keeps ACPI from disabling various events during the shutdown process. Some systems need this value set to 1 (the default) for the same reason. This usually fixes the problem of a system powering up spontaneously after a suspend or poweroff.

11.16.3.6 Other Problems

If you have other problems with ACPI (working with a docking station, devices not detected, etc.), please email a description to the mailing list as well; however, some of these issues may be related to unfinished parts of the ACPI subsystem so they might take a while to be implemented. Please be patient and prepared to test patches we may send you.

11.16.4 ASL, `acpidump`, and IASL

The most common problem is the BIOS vendors providing incorrect (or outright buggy!) bytecode. This is usually manifested by kernel console messages like this:

```
ACPI-1287: *** Error: Method execution failed [\\_SB_.PCI0.LPC0.FIGD._STA] \\
(Node 0xc3f6d160), AE_NOT_FOUND
```

Often, you can resolve these problems by updating your BIOS to the latest revision. Most console messages are harmless but if you have other problems like battery status not working, they are a good place to start looking for problems in the AML. The bytecode, known as AML, is compiled from a source language called ASL. The AML is found in the table known as the DSDT. To get a copy of your ASL, use `acpidump(8)`. You should use both the `-t`

(show contents of the fixed tables) and `-d` (disassemble AML to ASL) options. See the **Submitting Debugging Information** section for an example syntax.

The simplest first check you can do is to recompile your ASL to check for errors. Warnings can usually be ignored but errors are bugs that will usually prevent ACPI from working correctly. To recompile your ASL, issue the following command:

```
# iasl your.asl
```

11.16.5 Fixing Your ASL

In the long run, our goal is for almost everyone to have ACPI work without any user intervention. At this point, however, we are still developing workarounds for common mistakes made by the BIOS vendors. The Microsoft interpreter (`acpi.sys` and `acpiec.sys`) does not strictly check for adherence to the standard, and thus many BIOS vendors who only test ACPI under Windows never fix their ASL. We hope to continue to identify and document exactly what non-standard behavior is allowed by Microsoft's interpreter and replicate it so FreeBSD can work without forcing users to fix the ASL. As a workaround and to help us identify behavior, you can fix the ASL manually. If this works for you, please send a `diff(1)` of the old and new ASL so we can possibly work around the buggy behavior in ACPI-CA and thus make your fix unnecessary.

Here is a list of common error messages, their cause, and how to fix them:

11.16.5.1 _OS dependencies

Some AML assumes the world consists of various Windows versions. You can tell FreeBSD to claim it is any OS to see if this fixes problems you may have. An easy way to override this is to set `hw.acpi.osname="Windows 2001"` in `/boot/loader.conf` or other similar strings you find in the ASL.

11.16.5.2 Missing Return statements

Some methods do not explicitly return a value as the standard requires. While ACPI-CA does not handle this, FreeBSD has a workaround that allows it to return the value implicitly. You can also add explicit Return statements where required if you know what value should be returned. To force `iasl` to compile the ASL, use the `-f` flag.

11.16.5.3 Overriding the Default AML

After you customize your `.asl`, you will want to compile it, run:

```
# iasl your.asl
```

You can add the `-f` flag to force creation of the AML, even if there are errors during compilation. Remember that some errors (e.g., missing Return statements) are automatically worked around by the interpreter.

`DSDT.aml` is the default output filename for `iasl`. You can load this instead of your BIOS's buggy copy (which is still present in flash memory) by editing `/boot/loader.conf` as follows:

```
acpi_dsdt_load="YES"
acpi_dsdt_name="/boot/DSDT.aml"
```

Be sure to copy your `DSDT.aml` to the `/boot` directory.

11.16.6 Getting Debugging Output From ACPI

The ACPI driver has a very flexible debugging facility. It allows you to specify a set of subsystems as well as the level of verbosity. The subsystems you wish to debug are specified as “layers” and are broken down into ACPI-CA components (ACPI_ALL_COMPONENTS) and ACPI hardware support (ACPI_ALL_DRIVERS). The verbosity of debugging output is specified as the “level” and ranges from ACPI_LV_ERROR (just report errors) to ACPI_LV_VERBOSE (everything). The “level” is a bitmask so multiple options can be set at once, separated by spaces. In practice, you will want to use a serial console to log the output if it is so long it flushes the console message buffer. A full list of the individual layers and levels is found in the `acpi(4)` manual page.

Debugging output is not enabled by default. To enable it, add `options ACPI_DEBUG` to your kernel configuration file if ACPI is compiled into the kernel. You can add `ACPI_DEBUG=1` to your `/etc/make.conf` to enable it globally. If it is a module, you can recompile just your `acpi.ko` module as follows:

```
# cd /sys/modules/acpi/acpi
&& make clean &&
make ACPI_DEBUG=1
```

Install `acpi.ko` in `/boot/kernel` and add your desired level and layer to `loader.conf`. This example enables debug messages for all ACPI-CA components and all ACPI hardware drivers (CPU, LID, etc.). It will only output error messages, the least verbose level.

```
debug.acpi.layer="ACPI_ALL_COMPONENTS ACPI_ALL_DRIVERS"
debug.acpi.level="ACPI_LV_ERROR"
```

If the information you want is triggered by a specific event (say, a suspend and then resume), you can leave out changes to `loader.conf` and instead use `sysctl` to specify the layer and level after booting and preparing your system for the specific event. The `sysctls` are named the same as the tunables in `loader.conf`.

11.16.7 References

More information about ACPI may be found in the following locations:

- The εἰσαγωγή ἐπὶ FreeBSD (http://lists.FreeBSD.org/mailman/listinfo/freebsd-acpi)
- The ACPI Mailing List Archives http://lists.freebsd.org/pipermail/freebsd-acpi/
- The old ACPI Mailing List Archives http://home.jp.FreeBSD.org/mail-list/acpi-jp/
- The ACPI 2.0 Specification http://acpi.info/spec.htm
- FreeBSD Manual pages: `acpi(4)`, `acpi_thermal(4)`, `acpidump(8)`, `iasl(8)`, `acpidb(8)`
- DSDT debugging resource (http://www.cpqlinux.com/acpi-howto.html#fix_broken_dsdt). (Uses Compaq as an example but generally useful.)

Ὁγίεπόεὸ

1. The auto-tuning algorithm sets `maxusers` equal to the amount of memory in the system, with a minimum of 32, and a maximum of 384.

more *filename*

Άιόάίβæάé òι άñ ÷ άβι ðιò éáειñβæάόάé, ιά ðάγύόάéð èΰεά LINES άñέειü άñάñιπí.

reboot

Άðάίάέέéíάβ ΰιáόά ðι όγύόçιά.

set *variable*

set *variable=value*

Éáειñβæάé ιάόάάéçòΰò ðάñéáΰεéιíòιò áéá ðιí loader.

unload

Άðιòιñòπíáé üéá óá άñéñπíáόά.

12.3.3.3 Ðάñáááβáιáόά áéá ðιí Loader

Άäp éá άñάβόά ιάñééΰ ðñáéóééΰ ðάñáááβáιáόά ó ÷ áóééΰ ιά ðçí ÷ ñπóç ðιò loader:

- Άéá ιά ιάέéíπóáðá ðι όóιçééóιΰíι ððñπíá óáð, áééΰ óá éáðΰóóáóç áíüð ÷ ñπóç:

```
boot -s
```

- Άéá ιά áðιòιñòπíáóá ðι όóιçééóιΰíι ððñπíá óáð éáé ιά ðιñòπíáóá ðιí ðáééü óáð (π èΰðιéí ΰééι):

```
unload
load kernel.old
```

Ϊðιñάβóá ιά ÷ ñçóéιíðιéπóáðá ðι üíñá kernel.GENERIC áéá ιά áίáóáñéáβóá óóιí άñ ÷ ééü (generic) ððñπíá ι ιðιβιò ððΰñ ÷ áé óóι CD ðçð ááéáðΰóóáóçð, π ðι kernel.old áéá ιά áίáóáñéáβóá óóιí ððñπíá ðιò áβ ÷ áðá ááéáóáóóçιΰíι ðñéí (áéá ðáñΰááéáíá, ðιí ðáééü óáð ððñπíá áί èΰιáðá ðñüóóáðá ñýéιéóç éáé ááéáðΰóóáóç ιΰιò áééíý óáð ðñιόáñιιόιΰíιò ððñπíá).

Όçιáβüóç: ×ñçóéιíðιéπóáðá ðι ðáñáéΰòü áéá ιά ðιñòπíáóá ðá όóιçééóιΰíιá óáð άñéñπíáόά óá èΰðιéí ΰééι ððñπíá:

```
unload
set kernel="kernel.old"
boot-conf
```

- Άéá ιά ðιñòπíáóá ΰíá script ñýéιéóçð ððñπíá (ΰíá áóðñáíóιðιéçιΰíι ðñüáñáíιá ðι ιðιβι áéðáéáβ óéð éáéòιñάβò ðιò éáñιééΰ éá èΰιáðá ιΰóü èΰðιéιò ðñιáñΰιáðιð ñýéιéóçð ððñπíá éáðΰ ðçí áééβίçóç):

```
load -t userconfig_script /boot/kernel.conf
```

12.3.3.4 Άñáóééπ ιèυιç Áééβίçόçò

Όðιáéóóιñΰ áðü ðιí Joseph J. Barbish.

Ç άñáóééπ ιèυιç áééβίçόçò (splash screen) áçιéιòñάáβ ΰíá ðéι áð ÷ ΰñéóðι ðáñéáΰεéιí óá ó ÷ ΰóç ιά ðçí áðεπ áðáééιιέóç ðιí ιçιòιΰòιí áééβίçόçò óá ιιñòπ éáéιΰíιò. Ç άñáóééπ ιèυιç áééβίçόçò άιόáίβæάόáé ðò ιιðιò ðι όγύόçιά ððΰóáé óóçι ðñιðñιðπ áéóüüιð (login), áβóá óóçι éιíóüéá, áβóá óóι άñáóééü ðáñéáΰεéιí.

Άέά ðçí ðñíáðέέάñ Ýίç áíÛέðóç ðεùίçò (320x200 Þ íέέñüòáñç, 256 ÷ ñþíáíóá), áðáíáñááóóðáβòá ðι ðñ ÷ áβι /boot/loader.conf þóðá íá ðáñέÝ ÷ áέ ðá ðáñάέÛòù:

```
splash_bmp_load="YES"
bitmap_load="YES"
bitmap_name="/boot/splash.bmp"
```

Άέά íáááέýòáñáò áíáέýóáέò, íÝ ÷ ñέ ðçí íÝ áέóóç 1024x768, áðáíáñááóóðáβòá ðι ðñ ÷ áβι /boot/loader.conf þóðá íá ðáñέÝ ÷ áέ ðι ðáñάέÛòù:

```
vesa_load="YES"
splash_bmp_load="YES"
bitmap_load="YES"
bitmap_name="/boot/splash.bmp"
```

Ïι ðáñάðÛíù ððιέÝóáέ ùðέ éá ÷ ñçóέñιðιέÞóáðá ðι ðñ ÷ áβι /boot/splash.bmp áέá ðçí áñάóέêÞ ðεùίç áέέβίçόçò. Áí èÝέáðá íá ÷ ñçóέñιðιέÞóáðá áέέúíá óýðιò PCX, ÷ ñçóέñιðιέÞóáðá ðέò ðáñάέÛòù áðέεíáÝò, éáèÞ ðέá ðçí áðέεíáÞ vesa_load="YES", áíÛέíáá íá ðçí áíÛέðóç:

```
splash_pcx_load="YES"
bitmap_load="YES"
bitmap_name="/boot/splash.pcx"
```

Ïι ùíñá áñ ÷ áβιò ááí áβíáέ áðáñáβòçðι íá áβíáέ “splash” ùðò ðáβíáðáέ óðι ðáñάðÛíù ðáñÛááέáíá. Ìðñáβ íá áβíáέ ðέáÞðιòá, áñέáβ íá ðññέáέðáέ áέá áñ ÷ áβι óýðιò BMP Þ PCX, ùðò áέá ðáñÛááέáíá splash_640x400.bmp Þ blue_wave.pcx.

ðáñάέÛòù ðáβñιðáέ ðáñέéÝò áέúíá áíáέáóÝñιòóáð áðέεíáÝò ðιò ððñáβòá íá ÷ ñçóέñιðιέÞóáðá óðι /boot/loader.conf:

```
beastie_disable="YES"
```

Ç áðέεíáÞ áðòÞ éáðáñáβ ðçí áìòÛίέóç ðιò ðáñý áðέεíáÞι áέέβίçόçò. ðáñáíÝíáέ ùóóúóι ç áíòβóðñιòç ðÝðñçóç ðá ðçí ðñιòñιðÞ áέóááüáÞð áðέεíáÞι áέέβίçόçò. Áέúíá éáέ ùðáí ááí áìòáíβæáðáέ ðι ðáñý áðέεíáÞι, áí ð ÷ ñÞóóçò èÛíáέ íéá áðέεíáÞ óóç áéÛñέáέá ðιò ðñíáðέέáñ Ýñò ÷ ñññò áíáññÞð, ç áðέεíáÞ áðòÞ éá éó ÷ ýóáέ áέá ðçí áέέβίçόç.

```
loader_logo="beastie"
```

Ç áðέεíáÞ áðòÞ áέéÛáέ ðι éáβíáñ “FreeBSD” ðιò áìòáíβæáðáέ óðι ááíέú ðιò ðáñý áðέεíáÞι áέέβίçόçò, ðá Ýíá Ýá ÷ ñññιò éíáüòððι ðιò beastie, ùðò áìòáíέæüðáí óðέò ðáέáέüðáñáð áέáüóáέò.

Άέá ðáñέóóúðáñáð ðççñιòññáð, ðáñάέáέíýíá áíáðñÝíòá óðέò óáέβááð manual splash(4), loader.conf(5) éáέ vga(4).

12.4 Áέέçéáðβáñáóç ðá ðιí ððñÞíá éáòÛ ðçí Áέέβίçόç

Áðù ðç óééáÞ ðιò ððñÞíáð ðññòùεáβ, áβòá ðÝóú ðιò loader (ùðò óðιÞεùð) áβòá ðÝóú ðιò boot2 (ðáñάέÛððιòíóáð ðιí loader), áíáðÛáέ ðέò ðáñáíÝðñιò áέέβίçόçò (boot flags), áí ððÛñ ÷ ðι, éáέ ðñιòáññιæáέ áíÛέíáá ðç óðιðáñέóññÛ ðιò.

12.4.1 ΔάñÙιάòñιέ Άέέβίζόζò ΔòñΠιá (Boot Flags)

Δάñάεΰòυ έά άñάβòά όέò ðεί όóιζέέóιΎίάò ðάñάιΎòñιòò άέέβίζόζò:

- a
έάóΰ όç äεΰñέάέά όçò άέέβίζόζò, έά άβιáέ άñβòçόç áέά όçί όòóέάòΠ áðυ όçί ιðιβá έά άβιáέ ç ðñιόΰñόçόç ðιò ñέæέιγ (root) όòóòΠιáòιò άñ÷-άβυí.
- C
άέέβίζόç áðυ ðι CDROM.
- c
άέóΎέάόç ðιò UserConfig, ðιò ðñιάñÙιáòιò ñγέιέόçò ðòñΠιá έάóΰ όçί άέέβίζόç.
- s
άέέβίζόç óά έάóΰóóάόç έάέóιòñάβáò άφύò ÷ ñΠóόç (single user).
- v
άιòΎιέόç ðάñέóóυòάñυí ðεçñιòιñεβι έάóΰ όç äεΰñέάέά άέέβίζόζò ðιò ðòñΠιá.

Όçιáβυóç: Õòΰñ÷ιòι έάέ ΰέέáò ðάñÙιáòñιέ άέέβίζόζò, áέάáΰóòά όç óάέβáá boot(8) áέά ðάñέóóυòάñáò ðεçñιòιñβáò ó÷-άðέέΰ ιá áòóΎò.

12.5 Device Hints

Όòιáέóóιñΰ áðυ ðιí Tom Rhodes.

Όçιáβυóç: Δñυέάέóάέ áέά áðιáòυòçòά ðιò ðòΰñ÷-άέ áðυ ðι FreeBSD 5.0 έάέ ιáòΰ, έάέ ááι έά ðι άñάβòά óά ðñιçáιγιáíáò άέáυóάέò.

Έάóΰ όç äεΰñέάέά όçò άñ÷-έέΠò άέέβίζόζò ðιò όòóòΠιáòιò, ðι ðñυάñάιá ðιò boot loader(8) áέάáΰæáέ ðι άñ÷-άβι device.hints(5). Õι άñ÷-άβι áòòυ ðάñέΎ÷-άέ ðεçñιòιñβáò άέέβίζόζò áέά ðιí ðòñΠιá, áφύóóΎò υò ιáòάáεçòΎò, ιέ ιðιβáò ιáñέέΎò ðιñΎò áιáóΎñιíóáέ áðβóçò έάέ υò “device hints”. Áòóΰ óά “device hints” ÷ ñçóέιιðιέιγίóáέ áðυ ðñιáñÙιáóά ιáΠαçόçò όòóέáòβι áέά ñγέιέόç ðυí áιòβóòιέ÷-υí όòóέáòβι.

Ìðιñιγίá áðβóçò ιá ιñβóιòιá Device hints όóçί ðñιòñιðΠ ðιò Óóάáβιò 3 ðιò boot loader. Ìέ ιáòάáεçòΎò ιðιñιγί ιá ιñέóóιγί ιá ÷ ñΠóç όçò áιòιεΠò set, έάέ ιá áòáέñάέιγί ιá όçί unset. Ìðιñιγίá áðβóçò ιá όέò áιòáιβóιòιá ιá όçί áιòιεΠ show. Áέυιá, ιðιñιγίá ááβ ιá ðάñάέΎιòιòιá έάέ ιá áεεΰñιòιá όçί ðειΠ ιáòάáεçòβι ðιò Ύ÷ιòι ιñέóóáβ óοι άñ÷-άβι /boot/device.hints. Õά Device hints ðιò ιñβæιòιá óοι boot loader ááι ðάñάιΎιòι ιυιέιá έάέ ááι έά έó÷-γóιòι όóçί áðυιáιç άέέβίζόç.

Ìáòΰ όçί άέέβίζόç ðιò όòóòΠιáòιò, ιðιñάβ ιá ÷ ñçóέιιðιέιçέáβ ç áιòιεΠ kenv(1) áέά ιá áιòáιέóóιγί ιέ ðειΎò üèυí ðυí ιáòάáεçòβι.

Όι όοιόάέοέεü ðιò άñ÷άβιò /boot/device.hints άβιάέ ιέα ιάόάάεçòP άιÜ άñάιìP, έάέ ÷ñçόειιðιέαβòάέ ðιò ðòðιðιέçιÝíí “#” άέα άñάιìÝò ðιò άçèþñιíφάέ ùò ó÷÷έέά. Ιέ άñάιìÝò άçιέιòñáιγίφάέ üðùò öάβιáφάέ ðáñάέÜòù:

```
hint.driver.unit.keyword="value"
```

Ç óγίφάιç άέα ðιò ÓòÜάει 3 ðιò boot loader άβιάέ:

```
set hint.driver.unit.keyword=value
```

üðιò driver άβιάέ ðιò üíñá ðιò ιάçáιγύ óðóέάòPò, unit άβιάέ ι άñέέιüð ïιíÜάò ðçò óðóέάòPò, έάέ keyword άβιάέ ç èÝíç-έέαέάβ άέα ðιò óòάέάñέíÝíí hint. Ç èÝíç-έέαέάβ ιðιñάβ ιά άðιòάέάβòάέ άðü ðέò áέüειðέάò άðέειάÝò:

- at: έάέιñβάέ ðιò άβáðέι (bus) óðιí ιðιβι ðñιόάñòÜòάέ ç óðóέάòP.
- port: έάέιñβάέ ðçι άñ÷έέP άέáyèðιόç ðçò èγñάò I/O ðιò έá ÷ñçόειιðιέçέάβ.
- irq: έάέιñβάέ ðιí άñέέü ðçò άβðçóçò άέάέιðPò (interrupt request) ðιò έá ÷ñçόειιðιέçέάβ.
- drq: έάέιñβάέ ðιí άñέέü ðιò έάιάέέιγ DMA.
- maddr: έάέιñβάέ ðç ðòóέέP άέáyèðιόç ιíPιçò ðιò έάóάέάιáÜíáφάέ άðü ðç óðóέάòP.
- flags: ιñβάέ άέÜοιñά bits ðáñάιÝòñüí άέα ðçι óðóέάòP.
- disabled: Άί ιñέóðάβ óά ðέιP 1, ç óðóέάòP άðáíáñáιðιέαβòάέ.

Ιέ ιάçáιβ óðóέάòPι ιðιñάβ ιά äÝ÷íφάέ (P ιά άðάέóιγί) ðáñέóóüðáñά hints óά ιðιβá ááι öάβιíφάέ ááþ, έάέ óáò óðιέóðιγίá ιά ááβòá ðçι άíóβòðιέ÷ç óάέβáá manual ðιò èÜέá ιάçáιγύ. Άέα ðáñέóóüðáñáð ðεçñιòιñβáð óðιáιðέάðέάβòá áðβóçò ðέò óάέβááð manual ðüí device.hints(5), kenv(1), loader.conf(5), έάέ loader(8).

12.6 Init: Άñ÷έέιðιβçόç ÄέÝá÷ιò ÄέαääέαόέPι

Ìüέέð ιέιðέçñüέάβ ç áέέβίçόç ðιò ðòñPιá, ι Ýεάá÷ιò ιάóáòÝñáφάέ óçι áέαääέαόβá ÷ñPóç init(8), ç ιðιβá áñβóέáðάέ óðι άñ÷άβι /sbin/init, P óçç áέαáññP ðιò έάέιñβάέðάέ óçι ιάóááεçòP init_path ðιò loader.

12.6.1 Äέιειðέβá Áðòüíáçò Äðáíáέέβίçóçò

Ç áειειðέβá áðòüíáçò ðáíáάέέβίçóçò άíáóóάέβάέ üðέ óά óðóðPιáφά άñ÷άβιí άβιáέ óά έáñιέέP, óóάέáñP έáóÜóóáç. Άί ááι άβιáέ, έάέ ç fsck(8) ááι ιðιñάβ ιά áέιñèþάέ óά ðñιáεPιáφά, óüðá ç init(8) έá ιάóáòÝñáέ ðιò óγóççιá óά έáóÜóóáç έάέóιòñáβáð áíüð ÷ñPóç þóðá ιά ιðιñÝóáέ Üíáóá ι έέα÷άέñέóðPò óðóðPιáφά ιά áðέέçòέάβ ðüí ðñιáεçιÜðüí áððι.

12.6.2 ΈáóÜóóáç Έάέóιòñáβáð Áíüð ×ñPóç

Ìðιñάβòá ιά áέóÝέέáðá óçι έáóÜóóáç áððP ιÝóü ðçò áειειðέβáð áðòüíáçò ðáíáάέέβίçóçò, P ιÝóü ðçò áðέέιáPò -s έáóÜ ðçι áέέβίçόç P áέüíá έάέ èÝòιíφάð ðç ιάóááεçòP boot_single óðιí loader.

Ìðιñάβòá áðβóçò ιά áέóÝέέáðá óά áððP áέðáεþιáφά ðçι άíóíεP shutdown(8) ÷ññβð ðçι áðέέιáP áðáíáέέβίçóçò (-r) P ðáñιáóέóιγύ (-h), áþ άβòá óά έáóÜóóáç έάέóιòñáβáð ðιέεþι ÷ñçóðPι (multi-user).

Άί ç έιíóüέá ðιò óðóðPιáφάò Ý÷άέ ðáέáβ ùð insecure (άíáóóάέPò) óðι /etc/ttys, ðι óγóççιá έá εçðPóáέ ðιí èüάέü ðιò root ðñέι áέóÝέέáέ óά έáóÜóóáç έάέóιòñáβáð áíüð ÷ñPóç.

ÊäöÛëáéí 13 × ñÞóôâð êáé ÁáóéêÞ Äéá ÷ âßñéóç Ëïãáñéáóìþí

ÓðíáέóðìÛ áðü ðíí Neil Blakey-Milner.

13.1 Óýñïç

Ôí FreeBSD áðέóñÝðáé óá ðíεέáðéíýð ÷ ñÞóðâð íá ÷ ñçóέííðíέíýí ðíí ððíεíáέóðÞ ðçí ßáέá óóέáìÞ. Ðñíóáíðð, ìüñí Ýíáð áðü áðóíýð ðíðð ÷ ñÞóðâð ððíñáß íá εÛεáðáé ððíóóÛ áðü ðçí íεúíç êáé ðí ðççέðñíεúáéí εÛεá áááñÝíç óóέáìÞ¹, áέεÛ ððíέíóáðððíðá áñέέíüð ÷ ñçóðþí ððíñíýí íá áέóÝεèíóí ðíóóò ðíð áέέðýíð áέá íá öÝñíðí óá ðÝñáð óέð áñááóßâð ðíðð. Äéá íá ÷ ñçóέííðíέÞóáé ðí óýóðçíá, εÛεá ÷ ñÞóðçð ðñÝðáé íá Ý ÷ áé Ýíá εíááñéáóíü.

Áóíý áέááÛóáðá áðü ðí εáöÛεáéí, εá íÝñáðá:

- Óέð áέáóíñÝð áíÛíáóá óóá áεÛóíñá áßαç εíááñéáóìþí ÷ ñçóðþí óá Ýíá óýóðçíá FreeBSD.
- Ðüð íá ðñíóέÝóáðá εíááñéáóíýð ÷ ñçóðþí.
- Ðüð íá áέááñÛðáðá εíááñéáóíýð ÷ ñçóðþí.
- Ðüð íá áέεÛíáðá óέð εáððñÝñáέáð áíüð εíááñéáóíý, ùðüð ðí ðεÞñáð ùññá ðíð ÷ ñÞóðç, Þ ðí ðñíðέíþíáíí éÝέóðòð (shell).
- Ðüð íá εÝóáðá ùñέá áíÛ εíááñéáóíü, áέá íá áεÝá ÷ áðá ðñíñòð ùðüð ç ðíðíç êáé ðí ÷ ññíñð ðçð CPU, ðíð ððíñíýí íá Ý ÷ ðíóí óðçí áεÛεáóç ðíðð óðáέáêñéíÝíé εíááñéáóííß Þ ðñÛáð εíááñéáóìþí.
- Ðüð íá ÷ ñçóέííðíέÞóáðá ðñÛáð áέá íá εÛíáðá áðéíεúðáñç ðç áέá ÷ áßñéóç ðüí εíááñéáóìþí.

Ðñéí áέááÛóáðá áðü ðí εáöÛεáéí, εá ðñÝðáé:

- Íá εáóáñíáßðá óέð ááóέéÝð Ýíñέáð ðíð UNIX êáé ðíð FreeBSD (ÊáöÛεáéí 3).

13.2 ÁέóááñüãÞ

Ç ðñüóááóç óðí óýóðçíá áðέððá ÷ Ûíáðáé ðíóóò εíááñéáóìþí, ùεáð íé áέáñááóßâð áέðáεíýíðáé áðü ÷ ñÞóðâð, Ýóóé ç áέá ÷ áßñéóç ÷ ñçóðþí êáé εíááñéáóìþí áßíáé ðááÛεçð óçíáóßâð óóá FreeBSD óðóðÞíáðá.

ËÛεá εíááñéáóíüð óá Ýíá óýóðçíá FreeBSD Ý ÷ áé óðáέáêñéíÝíáð ðççñíóíñßâð ðíð ó ÷ áðßáéíðáé ðá áðóúí þóðá íá áíááññæáðáé áðü ðí óýóðçíá.

¼ññá ÷ ñÞóðç

Ôí ùññá ÷ ñÞóðç áßíáé áðóú ðíð εá áñáðáß óðçí ðñíðñíðÞ login: . Óá ðñíáðá ÷ ñçóðþí ðñÝðáé íá áßíáé ðñíáέéÛ áέá ðíí ððíεíáέóðÞ, ááí ððíñáßðá íá Ý ÷ áðá äýí ÷ ñÞóðâð ðá ðí ßáéí ùññá ÷ ñÞóðç. ÓðÛñ ÷ áé Ýíáð áñέέíüð εáíñíñí áέá ðçí áçíέíðñáßá Ýáέðññí ðñÛóðí ÷ ñçóðþí, ðíð ðáέíçþéþñíðáé óðí passwd(5). ÓðíÞεüð εá ÷ ñçóέííðíέáßðá ðñíáðá ÷ ñçóðþí ðíð ðáñέÝ ÷ ðíóí íέðþ Þ εέáüðáñíðð ùεíðð ðέέñíýð ÷ áñáέðÞñáð.

óðóðÞíáðíð Þ Ûëëùí ÷ ñçóðþí, èáé áðέóñÝðííóáð óá èÛèá Ýíá íá ðñíóáñíùæáé òí æέëù òíð ðáñéáÛëëíí ÷ ùñßð íá áðçñáÛæáé òíðð Ûëëíðð.

ÊÛèá Ûòñí ðíð Ý ÷ áé ðñíóááός óðí óýóçíÛ óáð èá ðñÝðáé íá Ý ÷ áé Ýíá ïííáééëù èíäáñéáóíù ÷ ñÞóðç. Áððù óáð áðέóñÝðáé íá áñáßðá ðíéíð èÛíáé óé, áðíðñÝðáé áíεñþðíðð áðu òí íá ðáñÛæíòí ðéð ñðèíßóáéð í Ýíáð òíð Ûëëíð, Þ íá æéááÛóáé í Ýíáð óá mail òíð Ûëëíð, èáé íýòù èáéáíÞð.

ÊÛèá ÷ ñÞóðçð ïðíñáß íá óðÞóáé òí æέëù òíð ðáñéáÛëëíí þóðá íá ðñíóáñíùóáé òçí ÷ ñÞóç òíð óðóðÞíáðíð, ÷ ñçóéíðíεþíóáð áíáεéáéðééÛ èáéýç, óóíðÛéðáð, óóíáðáóííýð ðεÞéðñíí èáé æεþóáð.

13.6 Õñíðíðíεþíóáð Êíäáñéáóííýð

ÕðÛñ ÷ áé íéá ðíééééßá áðu æéáóíñáðééÝð áíòíεÝð æéáé Ýóéíáð óðí ðáñéáÛëëíí UNIX æéá íá ÷ áéñέóðáßðá èíäáñéáóííýð ÷ ñçóðþí. Íé ðéí èíéíÝð áíòíεÝð óðíñßæáíðáé ðáñáéÛðù, áéíεíðéíýíáíáð áðu èáððíñáñÞ ðáñáááßáíáðá òçð ÷ ñÞóçð òíðð.

ÁíòíεÞ	Ðáñéáñáðß
adduser(8)	Ç ðñíóáéíùíáíç áóáñííáÞ áñáíÞð áíòíεþí æéá òçí ðñíóèÞεç íÝí ÷ ñçóðþí.
rmuser(8)	Ç ðñíóáéíùíáíç áóáñííáÞ áñáíÞð áíòíεþí æéá òçí æéááñáðß ÷ ñçóðþí.
chpass(1)	Íá áðÝéééðí áñááéáßí æéá òçí áééááÞ ðεçñííóíñéþí òçð áÛóçð áááñÝíùí òùí ÷ ñçóðþí.
passwd(1)	Õí áðéù áñááéáßí áñáíÞð áíòíεþí æéá òçí áééááÞ òùí èùáéεþí òùí ÷ ñçóðþí.
pw(8)	Íá áðíáðù èáé áðÝéééðí áñááéáßí æéá òçí áééááÞ ùëùí òùí ñðèíßóáùí òùí èíäáñéáóíþí òùí ÷ ñçóðþí.

13.6.1 adduser

Õí adduser(8) áßíáé Ýíá áðéù ðñíóáñáíá æéá íá ðñíóéÝðáðá íÝíðð ÷ ñÞóðáð. Äçíéíðñááß áááñáóÝð óðá áñ ÷ áßá óðóðÞíáðíð passwd èáé group. Äçíéíðñááß áðßóçð Ýíáí ðñíóáðééù èáóÛëíáí æéá òíí íÝí ÷ ñÞóðç, áíðéáñÛóáé æéáß óá áí" ïñέóííý áñ ÷ áßá ñðèíßóáùí ("dotfiles") áðu òí /usr/share/skel, èáé ïðíñáß ðñíáéñáðééÛ íá óðáßεáé Ýíá ïÞíðíá èáéùóíñßóíáðíð óðíí íÝí ÷ ñÞóðç.

ÐáñÛááéáíá 13-1. ÐñíóéÝðííóáð Ýíáí ÷ ñÞóç óðí FreeBSD

```
# adduser
Username: jru
Full name: J. Random User
Uid (Leave empty for default):
Login group [jru]:
Login group is jru. Invite jru into other groups? []: wheel
Login class [default]:
Shell (sh csh tcsh zsh nologin) [sh]: zsh
Home directory [/home/jru]:
Use password-based authentication? [yes]:
Use an empty password? (yes/no) [no]:
Use a random password? (yes/no) [no]:
Enter password:
Enter password again:
```

```

Lock out the account after creation? [no]:
Username   : jru
Password   : ****
Full Name   : J. Random User
Uid        : 1001
Class      :
Groups     : jru wheel
Home       : /home/jru
Shell      : /usr/local/bin/zsh
Locked     : no
OK? (yes/no): yes
adduser: INFO: Successfully added (jru) to the user database.
Add another user? (yes/no): no
Goodbye!
#
    
```

Óçíäßùóç: Ì èùäéèùð ðñð ðεççéðññèíäáßððä äáí ðáßíáðóáé, ðγðä àìðáíßæñíðóáé áóðáñßóéíé. Õññíðóððä íá ðçí äñÛðáðä èÛèìð ðññ èùäéèù.

13.6.2 rmuser

Ìðññáßððä íá ÷ñçóçèññðñéÐóáððä ðñ rmuser(8) äéá íá äéáññÛðáððä áíðäêðð Ýíáí ÷ñÐóðç áðñ ðñ óγóðçíá. Ç rmuser(8) äéðäéäß ðá ðáññéÛùð àÐíáðá:

1. ÄéáññÛðáé ðçí äáññáðÐ crontab(1) ðñð ÷ñÐóðç (áí ððÛñ÷äé).
2. ÄéáññÛðáé ùðñéá äññáóßá at(1) áíÐéäé óðññ ÷ñÐóðç.
3. Õáññáðßæäé ùéäð ðéð äéäññáóßáð ðñð áíÐéñí ððññ ÷ñÐóðç.
4. ÄéáññÛðáé ðññ ÷ñÐóðç áðñ ðñ ðñðéèù äñ÷äßñ èùäééðñ ðñð óðóðÐíáðñð.
5. ÄéáññÛðáé ðññ ðñññùððéèù éáðÛéññ ðñð ÷ñÐóðç (áí áíÐéäé óðññ ÷ñÐóðç).
6. ÄéáññÛðáé ðá äéóäñ÷÷ùíáíá äñ÷äßñ mail ðñð áíÐéñí ððññ ÷ñÐóðç áðñ ðñ /var/mail.
7. ÄéáññÛðáé ùéá ðá äñ÷äßñ ðñð áíÐéñí ððññ ÷ñÐóðç áðñ ðéð ðñññùðñéíÝð ðáññéí÷Ýð áðñðéÐéäðóçð ùðñð ðñ /tmp.
8. ÕÝéñð, äéáññÛðáé ðñ ùññá ÷ñÐóðç áðñ ùéäð ðéð ðñÛáðð óðéð ðññßáð áíÐéäé óðññ /etc/group.

Óçíäßùóç: Áí éáðÛ ðç äéáññáðÐ ðñð ÷ñÐóðç, ððÛñ÷äé ðñÛáá íá ðñ ùññá ðñð ç ðññßá äáí ðáññéÝ÷äé Ûééá ðÝçç, ç ðñÛáá áððÐ äéáññÛðáðáé, Ç óðñðáññéðññÛ áððÐ áßíáé óðñðççññùíáðééêÐ íá ðçí áíðóððñé÷ç ðçð adduser(8), ðñð äçñéñðññáß ðñÛáá íá ðñ ùññá ðñð ÷ñÐóðç éáðÛ ðç äçñéñðññáßá ðñð éññáññéáóññ.

Õñ rmuser(8) äáí ððññáß íá ÷ñçóçèññðñéçéäß äéá ðçí äéáññáðÐ ðññ éññáññéáóìñí ððäñ÷ñÐóðç, áçññ áððñ äßíáé ó÷äáññ ðñÛáðá íéá Ýíááéñç íáæééðð éáðáóðñññðð.

Áñ ðñéóññ, ÷ñçóçèññðñéçéäß íéá äéáññáóðéêÐ éáéðññáßá, ðñð ðññððáéäß íá äðéáññáéðóáé ùðé óßáñðñá áñññæáððä ðé ðññéäéóáé íá èÛíáðä.

ÐáñÛäéäíá 13-2. rmuser ÄéáñáóóêêÞ ÄéáñáóöÞ Êíäáñéáóíý

```
# rmuser jru
Matching password entry:
jru:*:1001:1001::0:0:J. Random User:/home/jru:/usr/local/bin/zsh
Is this the entry you wish to remove? y
Remove user's home directory (/home/jru)? y
Updating password file, updating databases, done.
Updating group file: trusted (removing group jru -- personal group is empty) done.
Removing user's incoming mail file /var/mail/jru: done.
Removing files belonging to jru from /tmp: done.
Removing files belonging to jru from /var/tmp: done.
Removing files belonging to jru from /var/tmp/vi.recover: done.
#
```

13.6.3 chpass

Ôí chpass(1) áééÛäéé ðçññíöíñβáð ðçð áÛóçð äááñÝíúí ðíð ÷ ñÞóðç ùððð èùäééíýð, êäéýçç, éáé ðñíóóðééÝð ðçññíöíñβáð.

Ûíñí äéá÷ äéñéóóÝð ðíð óóóðÞíáðíð, ùððð í ððáñ÷ ñÞóðçð, ìðíñáβ íá äééÛäéé ðéð ðçññíöíñβáð Ûééùí ÷ ñçóðÞí éáèÞð éáé ðíðð èùäééíýð ìá ðí chpass(1).

¼óáí äáí äβñíóáé äðééíáÝð, äéðùð áðü Ýíá ðñíáéñáðééèù ùíñíá ÷ ñÞóðç, ðí chpass(1) äìöáíβäéé Ýíáí óðíðÛéðç ðíð ðáñéÝ÷ äé ðéð ðçññíöíñβáð ðíð ÷ ñÞóðç. ¼óáí í ÷ ñÞóðçð äáäé áðü ðíí óóíðÛéðç, ç áÛóç äááñÝíúí ÷ ñçóðÞí áíçíáñÞíáðéé ìá ðéð íÝáð ðçññíöíñβáð.

Óçíáβóóç: ÊáðÛ ðçí Ýíñáí áðü ðíí óóíðÛéðç, áí äáí áβóðá í ððáñ÷ ñÞóðçð, éá áñùðçèáβðá äéá ðíí èùäééù óáð.

ÐáñÛäéäíá 13-3. ÄéáñáóóêêÞ chpass áðü ðíí Õðáñ÷ ñÞóðç

```
#Changing user database information for jru.
Login: jru
Password: *
Uid [#]: 1001
Gid [# or name]: 1001
Change [month day year]:
Expire [month day year]:
Class:
Home directory: /home/jru
Shell: /usr/local/bin/zsh
Full Name: J. Random User
Office Location:
Office Phone:
Home Phone:
Other information:
```

Ï éáñíééùð ÷ ñÞóðçð ìðíñáβ íá äééÛíäéé Ûíñí Ýíá íééñù óðíóýñíéí áðü áóðÝð ðéð ðçññíöíñβáð, éáé Ûíñí äéá ðíí äáðòù ðíð.

ÐáñÛäáéñá 13-10. × ñçóéíðíεþíðáð ôçí id(1) ãéá Ðñíóäéíñέóíü Ìáεþí íéáð ËÛäáð

```
% id jru
uid=1001(jru) gid=1001(jru) groups=1001(jru), 1100(teamtwo)
```

¼ðùð ìðñáβðá íá äáβðá, ì jru áβíáé ìÝεíð òùí ñÛäüí jru êáé teamtwo.

Áéá ðáñέóóüðáñáð ðεçñíðíñβáð ó÷áðééÛ ìá ôçí pw(8), äáβðá ôçí óáεβáá manual, êáé ãéá ðáñέóóüðáñáð ðεçñíðíñβáð ó÷áðééÛ ìá ôçí ññóíðíβçóç ðíð /etc/group, óðíáíðéäððáβðá ôçí óáεβáá manual group(5).

Óçíáεþóáéð

1. Áéðùð òðóééÛ áí óðíáÝóíðíá ðíεéáðéÛ ðáñíáðééÛ, áεéÛ èá ìéεÞóíðíá ãéá áðòü óðí ÊäöÛëáéí 26.
2. Áβíáé äðíáðüí íá ð÷ñçóéíðíεþíðáðá UID/GIDs üóí ìááÛéá üóí ðí 4294967295, áεéÛ òÝðíéá IDs ìðñáβ íá ðñíéáéÝóíðí óíááñÛ ðñíáεþíáðá ìá εíäέóíééü ðíð êÛíáé òðíεÝóáéð ó÷áðééÛ ìá ðéð ðεíÝð òùí IDs.

ΕὰοÛεάεί 14 ΑόοÛεάεί

Ôi iââéýóãñi iÝñið áðõty õið éâðééβið ðñiÝñ÷âðáé áðu ðçí óáεβáá õið manual ðçð security(7) áðu õið Matthew Dillon.

14.1 Óýñiðç

Ôi éâðÛεάεί áðõu ðãñÝ ÷ áé iéá ááóééP áéóáãñãP óðéð Ýñiéãð ðçð áóòÛεάέãð óðóðPiaðið, èÛðñiéðð áãééÛ éáétyð éáñiñáð, éáé ñéóñiÝiá ðñi÷ ÷ ÷ñçñiÝiá è Ýiáðá ó÷ ÷ áðééÛ iá õi FreeBSD. ÁñéãðÛ áðu óá è Ýiáðá ðið éáéýððñiðáé áãñ, iðñiñiÝi iá áðãñiñiðõty ði Bãéi éáéÛ ðuóñi óðñi Bãéi ði óýóðçñiá, uóñi éáé áéá áóòÛεάéá iÝóu Internet. Ôi Internet áãñ áβiáé ðéÝñi Ýiá “óééééu” iÝñið óðñi iðñiβi éáéÝiáð è Ýéáé iá áβiáé i áðãñiñiéuð óáð áãññiñiáð. Ç áñÛáéç áóòÛεéóçð ðið óðóðPiaðið óáð áβiáé áðéðáéðééP áéá iá ðñiñiðáðÝðãðã ðá áãññiÝiá óáð, ðçñi ðñiñiñiáðééP óáð éáéñiéðçðñiá, ði ÷ ÷ñiñi óáð, éáé ðñiéÛ ðãñéóóuðãñá áðu óá ÷ Ýñéá ðñi ÷ Ûéãñð éáé ðñi ñiñiβñi ðiðð.

Ôi FreeBSD ðãñÝ ÷ áé iéá óáéñÛ áðu ñiççðçðééÛ ðñiñãñÛiñiáðá éáé iç ÷ áñiéóñiýð áéá iá áñiáóáéβóáé ðçñi áéãñáéuðçðá éáé ðçñi áóòÛεάéá ðið óðóðPiaðið óáð éáé ðið áééðýtyð.

Áõty áéáãÛóáðá áðõu ði éâðÛεάεί, éá iÝñãðã:

- ÁáóééÝð Ýñiéãð áéá ðçñi áóòÛεάéá, óá ó÷ Ýóç iá õi FreeBSD.
- Óðñi÷ ÷ áβá ó÷ ÷ áðééÛ iá ðiðð áéÛñiñiðð iç ÷ áñiéóñiýð èñðððñiñãñÛóçðçð ðið áβiáé áéáéÝóéñié óðñi FreeBSD, uððð õi DES éáé õi MD5.
- Ðùð iá ñðèñiβóáðã ði óýóðçñiá óáð áéá èñáééñiýð iéáð ÷ ñPóçð.
- Ðùð iá ñðèñiβóáðã TCP Wrappers áéá ÷ ñPóç iá ðçñi inetd.
- Ðùð iá ñðèñiβóáðã õi **KerberosIV** óá FreeBSD áéãñuóáéð ðñéñi ðç 5.0.
- Ðùð iá ñðèñiβóáðã õi **Kerberos5** óñi FreeBSD.
- Ðùð iá ñðèñiβóáðã ði IPsec éáé iá äçñiéññãPóáðã Ýiá VPN iáðáñty iç ÷ áñçñiÛðñi FreeBSD/Windows.
- Ðùð iá ñðèñiβóáðã éáé iá ÷ ñçóéñiðñiéPóáðã ðçñi éáðÛ FreeBSD ðéñiðñiβçç SSH ðið **OpenSSH**
- Ôé áβiáé óá ACLs óðñi óýóðçñiá áñ ÷ áβñi éáé ðùð iá óá ÷ ñçóéñiðñiéPóáðã.
- Ðùð iá ÷ ñçóéñiðñiéPóáðã ði ñiçççðçééu ðñuãñãñiá **Portaudit** áéá iá áéÝñiñiáð éñiáéóñiéu ðñññiðñi éáðáóéãðáóáðP ðið Ý ÷ áé áãéáðáóðáéãñ iÝóu ðçð óðéñiñãPð Ports.
- Ðùð iá ÷ ñçóéñiðñiéPóáðã ðéð äçñiñiéáýóáéð security advisories ðið FreeBSD.
- Èá Ý ÷ áðã iéá éãÝá áéá ði ðé áβiáé ði Process Accounting éáé ðùð iá ði áññãñiðñiéPóáðã óðñi FreeBSD.

Ðñéñi áéáãÛóáðá áðõu ði éâðÛεάεί, éá ðñÝðáé:

- Iá éáðãñiñiáðã ááóééÝð Ýñiéãð ðið FreeBSD éáé ðið Internet.

Ðñuðéãðá è Ýiáðá ó÷ ÷ áðééÛ iá ðçñi áóòÛεάéá éáéýððñiðáé óá ðéuèéçñi ði áéáéβñi. Áéá ðãñÛáãéãñiá, i Ôðñi÷ ÷ ñãñuðééuð éãã ÷ ÷ð Ðñuðááççð óðãçðãñiáé óðñi ÈãòÛεάεί 16 éáé óá Internet Firewalls óðãçðñiýñiáé óðñi ÈãòÛεάεί 30.

14.2 Introduction

Security is a function that begins and ends with the system administrator. While all BSD UNIX multi-user systems have some inherent security, the job of building and maintaining additional security mechanisms to keep those users “honest” is probably one of the single largest undertakings of the sysadmin. Machines are only as secure as you make them, and security concerns are ever competing with the human necessity for convenience. UNIX systems, in general, are capable of running a huge number of simultaneous processes and many of these processes operate as servers — meaning that external entities can connect and talk to them. As yesterday’s mini-computers and mainframes become today’s desktops, and as computers become networked and inter-networked, security becomes an even bigger issue.

System security also pertains to dealing with various forms of attack, including attacks that attempt to crash, or otherwise make a system unusable, but do not attempt to compromise the `root` account (“break root”). Security concerns can be split up into several categories:

1. Denial of service attacks.
2. User account compromises.
3. Root compromise through accessible servers.
4. Root compromise via user accounts.
5. Backdoor creation.

A denial of service attack is an action that deprives the machine of needed resources. Typically, DoS attacks are brute-force mechanisms that attempt to crash or otherwise make a machine unusable by overwhelming its servers or network stack. Some DoS attacks try to take advantage of bugs in the networking stack to crash a machine with a single packet. The latter can only be fixed by applying a bug fix to the kernel. Attacks on servers can often be fixed by properly specifying options to limit the load the servers incur on the system under adverse conditions. Brute-force network attacks are harder to deal with. A spoofed-packet attack, for example, is nearly impossible to stop, short of cutting your system off from the Internet. It may not be able to take your machine down, but it can saturate your Internet connection.

A user account compromise is even more common than a DoS attack. Many sysadmins still run standard **telnetd**, **rlogind**, **rshd**, and **ftpd** servers on their machines. These servers, by default, do not operate over encrypted connections. The result is that if you have any moderate-sized user base, one or more of your users logging into your system from a remote location (which is the most common and convenient way to login to a system) will have his or her password sniffed. The attentive system admin will analyze his remote access logs looking for suspicious source addresses even for successful logins.

One must always assume that once an attacker has access to a user account, the attacker can break `root`. However, the reality is that in a well secured and maintained system, access to a user account does not necessarily give the attacker access to `root`. The distinction is important because without access to `root` the attacker cannot generally hide his tracks and may, at best, be able to do nothing more than mess with the user’s files, or crash the machine. User account compromises are very common because users tend not to take the precautions that sysadmins take.

System administrators must keep in mind that there are potentially many ways to break `root` on a machine. The attacker may know the `root` password, the attacker may find a bug in a root-run server and be able to break `root` over a network connection to that server, or the attacker may know of a bug in a `suid-root` program that allows the attacker to break `root` once he has broken into a user’s account. If an attacker has found a way to break `root` on a machine, the attacker may not have a need to install a backdoor. Many of the `root` holes found and closed to date involve a considerable amount of work by the attacker to clean up after himself, so most attackers install backdoors. A backdoor provides the attacker with a way to easily regain `root` access to the system, but it also gives the smart

system administrator a convenient way to detect the intrusion. Making it impossible for an attacker to install a backdoor may actually be detrimental to your security, because it will not close off the hole the attacker found to break in the first place.

Security remedies should always be implemented with a multi-layered “onion peel” approach and can be categorized as follows:

1. Securing `root` and staff accounts.
2. Securing `root`-run servers and `suid/sgid` binaries.
3. Securing user accounts.
4. Securing the password file.
5. Securing the kernel core, raw devices, and file systems.
6. Quick detection of inappropriate changes made to the system.
7. Paranoia.

The next section of this chapter will cover the above bullet items in greater depth.

14.3 Securing FreeBSD

Command vs. Protocol: Throughout this document, we will use **bold** text to refer to an application, and a `monospaced` font to refer to specific commands. Protocols will use a normal font. This typographical distinction is useful for instances such as `ssh`, since it is a protocol as well as command.

The sections that follow will cover the methods of securing your FreeBSD system that were mentioned in the last section of this chapter.

14.3.1 Securing the `root` Account and Staff Accounts

First off, do not bother securing staff accounts if you have not secured the `root` account. Most systems have a password assigned to the `root` account. The first thing you do is assume that the password is *always* compromised. This does not mean that you should remove the password. The password is almost always necessary for console access to the machine. What it does mean is that you should not make it possible to use the password outside of the console or possibly even with the `su(1)` command. For example, make sure that your `ptys` are specified as being insecure in the `/etc/ttys` file so that direct `root` logins via `telnet` or `rlogin` are disallowed. If using other login services such as **sshd**, make sure that direct `root` logins are disabled there as well. You can do this by editing your `/etc/ssh/sshd_config` file, and making sure that `PermitRootLogin` is set to `NO`. Consider every access method — services such as FTP often fall through the cracks. Direct `root` logins should only be allowed via the system console.

Of course, as a `sysadmin` you have to be able to get to `root`, so we open up a few holes. But we make sure these holes require additional password verification to operate. One way to make `root` accessible is to add appropriate staff accounts to the `wheel` group (in `/etc/group`). The staff members placed in the `wheel` group are allowed to `su` to `root`. You should never give staff members native `wheel` access by putting them in the `wheel` group in their password entry. Staff accounts should be placed in a `staff` group, and then added to the `wheel` group via the

`/etc/group` file. Only those staff members who actually need to have `root` access should be placed in the `wheel` group. It is also possible, when using an authentication method such as Kerberos, to use Kerberos' `.k5login` file in the `root` account to allow a `ksu(1)` to `root` without having to place anyone at all in the `wheel` group. This may be the better solution since the `wheel` mechanism still allows an intruder to break `root` if the intruder has gotten hold of your password file and can break into a staff account. While having the `wheel` mechanism is better than having nothing at all, it is not necessarily the safest option.

An indirect way to secure staff accounts, and ultimately `root` access is to use an alternative login access method and do what is known as “starring” out the encrypted password for the staff accounts. Using the `vipw(8)` command, one can replace each instance of an encrypted password with a single “*” character. This command will update the `/etc/master.passwd` file and user/password database to disable password-authenticated logins.

A staff account entry such as:

```
foobar:R9DT/Fa1/LV9U:1000:1000::0:0:Foo Bar:/home/foobar:/usr/local/bin/tcsh
```

Should be changed to this:

```
foobar:*:1000:1000::0:0:Foo Bar:/home/foobar:/usr/local/bin/tcsh
```

This change will prevent normal logins from occurring, since the encrypted password will never match “*”. With this done, staff members must use another mechanism to authenticate themselves such as `kerberos(1)` or `ssh(1)` using a public/private key pair. When using something like Kerberos, one generally must secure the machines which run the Kerberos servers and your desktop workstation. When using a public/private key pair with `ssh`, one must generally secure the machine used to login *from* (typically one's workstation). An additional layer of protection can be added to the key pair by password protecting the key pair when creating it with `ssh-keygen(1)`. Being able to “star” out the passwords for staff accounts also guarantees that staff members can only login through secure access methods that you have set up. This forces all staff members to use secure, encrypted connections for all of their sessions, which closes an important hole used by many intruders: sniffing the network from an unrelated, less secure machine.

The more indirect security mechanisms also assume that you are logging in from a more restrictive server to a less restrictive server. For example, if your main box is running all sorts of servers, your workstation should not be running any. In order for your workstation to be reasonably secure you should run as few servers as possible, up to and including no servers at all, and you should run a password-protected screen blanker. Of course, given physical access to a workstation an attacker can break any sort of security you put on it. This is definitely a problem that you should consider, but you should also consider the fact that the vast majority of break-ins occur remotely, over a network, from people who do not have physical access to your workstation or servers.

Using something like Kerberos also gives you the ability to disable or change the password for a staff account in one place, and have it immediately affect all the machines on which the staff member may have an account. If a staff member's account gets compromised, the ability to instantly change his password on all machines should not be underrated. With discrete passwords, changing a password on N machines can be a mess. You can also impose re-passwording restrictions with Kerberos: not only can a Kerberos ticket be made to timeout after a while, but the Kerberos system can require that the user choose a new password after a certain period of time (say, once a month).

14.3.2 Securing Root-run Servers and SUID/SGID Binaries

The prudent sysadmin only runs the servers he needs to, no more, no less. Be aware that third party servers are often the most bug-prone. For example, running an old version of **imapd** or **popper** is like giving a universal `root` ticket out to the entire world. Never run a server that you have not checked out carefully. Many servers do not need to be run as `root`. For example, the **ntalk**, **comsat**, and **finger** daemons can be run in special user *sandboxes*. A sandbox

is not perfect, unless you go through a large amount of trouble, but the onion approach to security still stands: If someone is able to break in through a server running in a sandbox, they still have to break out of the sandbox. The more layers the attacker must break through, the lower the likelihood of his success. Root holes have historically been found in virtually every server ever run as `root`, including basic system servers. If you are running a machine through which people only login via `sshd` and never login via `telnetd` or `rshd` or `rlogind`, then turn off those services!

FreeBSD now defaults to running `ntalkd`, `comsat`, and `finger` in a sandbox. Another program which may be a candidate for running in a sandbox is `named(8)`. `/etc/defaults/rc.conf` includes the arguments necessary to run `named` in a sandbox in a commented-out form. Depending on whether you are installing a new system or upgrading an existing system, the special user accounts used by these sandboxes may not be installed. The prudent sysadmin would research and implement sandboxes for servers whenever possible.

There are a number of other servers that typically do not run in sandboxes: `sendmail`, `popper`, `imapd`, `ftpd`, and others. There are alternatives to some of these, but installing them may require more work than you are willing to perform (the convenience factor strikes again). You may have to run these servers as `root` and rely on other mechanisms to detect break-ins that might occur through them.

The other big potential `root` holes in a system are the `suid-root` and `sgid` binaries installed on the system. Most of these binaries, such as `rlogin`, reside in `/bin`, `/sbin`, `/usr/bin`, or `/usr/sbin`. While nothing is 100% safe, the system-default `suid` and `sgid` binaries can be considered reasonably safe. Still, `root` holes are occasionally found in these binaries. A `root` hole was found in `xlib` in 1998 that made `xterm` (which is typically `suid`) vulnerable. It is better to be safe than sorry and the prudent sysadmin will restrict `suid` binaries, that only staff should run, to a special group that only staff can access, and get rid of (`chmod 000`) any `suid` binaries that nobody uses. A server with no display generally does not need an `xterm` binary. `Sgid` binaries can be almost as dangerous. If an intruder can break an `sgid-kmem` binary, the intruder might be able to read `/dev/kmem` and thus read the encrypted password file, potentially compromising any passworded account. Alternatively an intruder who breaks group `kmem` can monitor keystrokes sent through `ptys`, including `ptys` used by users who login through secure methods. An intruder that breaks the `tty` group can write to almost any user's `tty`. If a user is running a terminal program or emulator with a keyboard-simulation feature, the intruder can potentially generate a data stream that causes the user's terminal to echo a command, which is then run as that user.

14.3.3 Securing User Accounts

User accounts are usually the most difficult to secure. While you can impose draconian access restrictions on your staff and “star” out their passwords, you may not be able to do so with any general user accounts you might have. If you do have sufficient control, then you may win out and be able to secure the user accounts properly. If not, you simply have to be more vigilant in your monitoring of those accounts. Use of `ssh` and Kerberos for user accounts is more problematic, due to the extra administration and technical support required, but still a very good solution compared to a encrypted password file.

14.3.4 Securing the Password File

The only sure fire way is to star out as many passwords as you can and use `ssh` or Kerberos for access to those accounts. Even though the encrypted password file (`/etc/spwd.db`) can only be read by `root`, it may be possible for an intruder to obtain read access to that file even if the attacker cannot obtain root-write access.

Your security scripts should always check for and report changes to the password file (see the Checking file integrity section below).

14.3.5 Securing the Kernel Core, Raw Devices, and File Systems

If an attacker breaks `root` he can do just about anything, but there are certain conveniences. For example, most modern kernels have a packet sniffing device driver built in. Under FreeBSD it is called the `bpf` device. An intruder will commonly attempt to run a packet sniffer on a compromised machine. You do not need to give the intruder the capability and most systems do not have the need for the `bpf` device compiled in.

But even if you turn off the `bpf` device, you still have `/dev/mem` and `/dev/kmem` to worry about. For that matter, the intruder can still write to raw disk devices. Also, there is another kernel feature called the module loader, `kldload(8)`. An enterprising intruder can use a KLD module to install his own `bpf` device, or other sniffing device, on a running kernel. To avoid these problems you have to run the kernel at a higher secure level, at least `securelevel 1`. The `securelevel` can be set with a `sysctl` on the `kern.securelevel` variable. Once you have set the `securelevel` to 1, write access to raw devices will be denied and special `chflags` flags, such as `schg`, will be enforced. You must also ensure that the `schg` flag is set on critical startup binaries, directories, and script files — everything that gets run up to the point where the `securelevel` is set. This might be overdoing it, and upgrading the system is much more difficult when you operate at a higher secure level. You may compromise and run the system at a higher secure level but not set the `schg` flag for every system file and directory under the sun. Another possibility is to simply mount `/` and `/usr` read-only. It should be noted that being too draconian in what you attempt to protect may prevent the all-important detection of an intrusion.

14.3.6 Checking File Integrity: Binaries, Configuration Files, Etc.

When it comes right down to it, you can only protect your core system configuration and control files so much before the convenience factor rears its ugly head. For example, using `chflags` to set the `schg` bit on most of the files in `/` and `/usr` is probably counterproductive, because while it may protect the files, it also closes a detection window. The last layer of your security onion is perhaps the most important — detection. The rest of your security is pretty much useless (or, worse, presents you with a false sense of security) if you cannot detect potential intrusions. Half the job of the onion is to slow down the attacker, rather than stop him, in order to be able to catch him in the act.

The best way to detect an intrusion is to look for modified, missing, or unexpected files. The best way to look for modified files is from another (often centralized) limited-access system. Writing your security scripts on the extra-secure limited-access system makes them mostly invisible to potential attackers, and this is important. In order to take maximum advantage you generally have to give the limited-access box significant access to the other machines in the business, usually either by doing a read-only NFS export of the other machines to the limited-access box, or by setting up `ssh` key-pairs to allow the limited-access box to `ssh` to the other machines. Except for its network traffic, NFS is the least visible method — allowing you to monitor the file systems on each client box virtually undetected. If your limited-access server is connected to the client boxes through a switch, the NFS method is often the better choice. If your limited-access server is connected to the client boxes through a hub, or through several layers of routing, the NFS method may be too insecure (network-wise) and using `ssh` may be the better choice even with the audit-trail tracks that `ssh` lays.

Once you have given a limited-access box at least read access to the client systems it is supposed to monitor, you must write scripts to do the actual monitoring. Given an NFS mount, you can write scripts out of simple system utilities such as `find(1)` and `md5(1)`. It is best to physically `md5` the client-box files at least once a day, and to test control files such as those found in `/etc` and `/usr/local/etc` even more often. When mismatches are found, relative to the base `md5` information the limited-access machine knows is valid, it should scream at a `sysadmin` to go check it out. A good security script will also check for inappropriate `suid` binaries and for new or deleted files on system partitions such as `/` and `/usr`.

When using `ssh` rather than NFS, writing the security script is much more difficult. You essentially have to `scp` the scripts to the client box in order to run them, making them visible, and for safety you also need to `scp` the binaries (such as `find`) that those scripts use. The `ssh` client on the client box may already be compromised. All in all, using `ssh` may be necessary when running over insecure links, but it is also a lot harder to deal with.

A good security script will also check for changes to user and staff members access configuration files: `.rhosts`, `.shosts`, `.ssh/authorized_keys` and so forth, files that might fall outside the purview of the MD5 check.

If you have a huge amount of user disk space, it may take too long to run through every file on those partitions. In this case, setting mount flags to disallow `suid` binaries and devices on those partitions is a good idea. The `nodev` and `nosuid` options (see `mount(8)`) are what you want to look into. You should probably scan them anyway, at least once a week, since the object of this layer is to detect a break-in attempt, whether or not the attempt succeeds.

Process accounting (see `accton(8)`) is a relatively low-overhead feature of the operating system which might help as a post-break-in evaluation mechanism. It is especially useful in tracking down how an intruder has actually broken into a system, assuming the file is still intact after the break-in has occurred.

Finally, security scripts should process the log files, and the logs themselves should be generated in as secure a manner as possible — remote `syslog` can be very useful. An intruder will try to cover his tracks, and log files are critical to the `sysadmin` trying to track down the time and method of the initial break-in. One way to keep a permanent record of the log files is to run the system console to a serial port and collect the information to a secure machine monitoring the consoles.

14.3.7 Paranoia

A little paranoia never hurts. As a rule, a `sysadmin` can add any number of security features, as long as they do not affect convenience, and can add security features that *do* affect convenience with some added thought. Even more importantly, a security administrator should mix it up a bit — if you use recommendations such as those given by this document verbatim, you give away your methodologies to the prospective attacker who also has access to this document.

14.3.8 Denial of Service Attacks

This section covers Denial of Service attacks. A DoS attack is typically a packet attack. While there is not much you can do about modern spoofed packet attacks that saturate your network, you can generally limit the damage by ensuring that the attacks cannot take down your servers by:

1. Limiting server forks.
2. Limiting springboard attacks (ICMP response attacks, ping broadcast, etc.).
3. Overloading the Kernel Route Cache.

A common DoS attack scenario is attacking a forking server and making it spawning so many child processes that the host system eventually runs out of memory, file descriptors, etc. and then grinds to a halt. `inetd` (see `inetd(8)`) has several options to limit this sort of attack. It should be noted that while it is possible to prevent a machine from going down, it is not generally possible to prevent a service from being disrupted by the attack. Read the `inetd` manual page carefully and pay specific attention to the `-c`, `-C`, and `-R` options. Note that spoofed-IP attacks will circumvent the `-C` option to `inetd`, so typically a combination of options must be used. Some standalone servers have `self-fork-limitation` parameters.

Sendmail has its `-OMaxDaemonChildren` option, which tends to work much better than trying to use **Sendmail**'s load limiting options due to the load lag. You should specify a `MaxDaemonChildren` parameter, when you start **sendmail**; high enough to handle your expected load, but not so high that the computer cannot handle that number of **Sendmail** instances without falling on its face. It is also prudent to run **Sendmail** in queued mode (`-ODeliveryMode=queued`) and to run the daemon (`sendmail -bd`) separate from the queue-runs (`sendmail -q15m`). If you still want real-time delivery you can run the queue at a much lower interval, such as `-q1m`, but be sure to specify a reasonable `MaxDaemonChildren` option for *that* **Sendmail** to prevent cascade failures.

Syslogd can be attacked directly and it is strongly recommended that you use the `-s` option whenever possible, and the `-a` option otherwise.

You should also be fairly careful with connect-back services such as **TCP Wrapper**'s reverse-identd, which can be attacked directly. You generally do not want to use the reverse-ident feature of **TCP Wrapper** for this reason.

It is a very good idea to protect internal services from external access by firewalling them off at your border routers. The idea here is to prevent saturation attacks from outside your LAN, not so much to protect internal services from network-based root compromise. Always configure an exclusive firewall, i.e., "firewall everything *except* ports A, B, C, D, and M-Z". This way you can firewall off all of your low ports except for certain specific services such as **named** (if you are primary for a zone), **ntalkd**, **sendmail**, and other Internet-accessible services. If you try to configure the firewall the other way — as an inclusive or permissive firewall, there is a good chance that you will forget to "close" a couple of services, or that you will add a new internal service and forget to update the firewall. You can still open up the high-numbered port range on the firewall, to allow permissive-like operation, without compromising your low ports. Also take note that FreeBSD allows you to control the range of port numbers used for dynamic binding, via the various `net.inet.ip.portrange` `sysctl`'s (`sysctl -a | fgrep portrange`), which can also ease the complexity of your firewall's configuration. For example, you might use a normal first/last range of 4000 to 5000, and a `hiport` range of 49152 to 65535, then block off everything under 4000 in your firewall (except for certain specific Internet-accessible ports, of course).

Another common DoS attack is called a springboard attack — to attack a server in a manner that causes the server to generate responses which overloads the server, the local network, or some other machine. The most common attack of this nature is the *ICMP ping broadcast attack*. The attacker spoofs ping packets sent to your LAN's broadcast address with the source IP address set to the actual machine they wish to attack. If your border routers are not configured to stomp on ping packets to broadcast addresses, your LAN winds up generating sufficient responses to the spoofed source address to saturate the victim, especially when the attacker uses the same trick on several dozen broadcast addresses over several dozen different networks at once. Broadcast attacks of over a hundred and twenty megabits have been measured. A second common springboard attack is against the ICMP error reporting system. By constructing packets that generate ICMP error responses, an attacker can saturate a server's incoming network and cause the server to saturate its outgoing network with ICMP responses. This type of attack can also crash the server by running it out of memory, especially if the server cannot drain the ICMP responses it generates fast enough. Use the `sysctl` variable `net.inet.icmp.icmplim` to limit these attacks. The last major class of springboard attacks is related to certain internal **inetd** services such as the `udp echo` service. An attacker simply spoofs a UDP packet with the source address being server A's echo port, and the destination address being server B's echo port, where server A and B are both on your LAN. The two servers then bounce this one packet back and forth between each other. The attacker can overload both servers and their LANs simply by injecting a few packets in this manner. Similar problems exist with the internal **chargen** port. A competent sysadmin will turn off all of these `inetd`-internal test services.

Spoofed packet attacks may also be used to overload the kernel route cache. Refer to the `net.inet.ip.rtxpire`, `rtminexpire`, and `rtmaxcache` `sysctl` parameters. A spoofed packet attack that uses a random source IP will cause the kernel to generate a temporary cached route in the route table, viewable with `netstat -rna | fgrep w3`. These routes typically timeout in 1600 seconds or so. If the kernel detects that the cached route table has gotten too big it will dynamically reduce the `rtxpire` but will never decrease it to less than `rtminexpire`. There are two

problems:

1. The kernel does not react quickly enough when a lightly loaded server is suddenly attacked.
2. The `rtminexpire` is not low enough for the kernel to survive a sustained attack.

If your servers are connected to the Internet via a T3 or better, it may be prudent to manually override both `rtexpire` and `rtminexpire` via `sysctl(8)`. Never set either parameter to zero (unless you want to crash the machine). Setting both parameters to 2 seconds should be sufficient to protect the route table from attack.

14.3.9 Access Issues with Kerberos and SSH

There are a few issues with both Kerberos and `ssh` that need to be addressed if you intend to use them. Kerberos 5 is an excellent authentication protocol, but there are bugs in the kerberized **telnet** and **rlogin** applications that make them unsuitable for dealing with binary streams. Also, by default Kerberos does not encrypt a session unless you use the `-x` option. **ssh** encrypts everything by default.

`Ssh` works quite well in every respect except that it forwards encryption keys by default. What this means is that if you have a secure workstation holding keys that give you access to the rest of the system, and you `ssh` to an insecure machine, your keys are usable. The actual keys themselves are not exposed, but `ssh` installs a forwarding port for the duration of your login, and if an attacker has broken `root` on the insecure machine he can utilize that port to use your keys to gain access to any other machine that your keys unlock.

We recommend that you use `ssh` in combination with Kerberos whenever possible for staff logins. **Ssh** can be compiled with Kerberos support. This reduces your reliance on potentially exposed `ssh` keys while at the same time protecting passwords via Kerberos. `Ssh` keys should only be used for automated tasks from secure machines (something that Kerberos is unsuited to do). We also recommend that you either turn off key-forwarding in the `ssh` configuration, or that you make use of the `from=IP/DOMAIN` option that `ssh` allows in its `authorized_keys` file to make the key only usable to entities logging in from specific machines.

14.4 DES, MD5, and Crypt

Parts rewritten and updated by Bill Swingle.

Every user on a UNIX system has a password associated with their account. It seems obvious that these passwords need to be known only to the user and the actual operating system. In order to keep these passwords secret, they are encrypted with what is known as a “one-way hash”, that is, they can only be easily encrypted but not decrypted. In other words, what we told you a moment ago was obvious is not even true: the operating system itself does not *really* know the password. It only knows the *encrypted* form of the password. The only way to get the “plain-text” password is by a brute force search of the space of possible passwords.

Unfortunately the only secure way to encrypt passwords when UNIX came into being was based on DES, the Data Encryption Standard. This was not such a problem for users resident in the US, but since the source code for DES could not be exported outside the US, FreeBSD had to find a way to both comply with US law and retain compatibility with all the other UNIX variants that still used DES.

The solution was to divide up the encryption libraries so that US users could install the DES libraries and use DES but international users still had an encryption method that could be exported abroad. This is how FreeBSD came to

use MD5 as its default encryption method. MD5 is believed to be more secure than DES, so installing DES is offered primarily for compatibility reasons.

14.4.1 Recognizing Your Crypt Mechanism

Currently the library supports DES, MD5 and Blowfish hash functions. By default FreeBSD uses MD5 to encrypt passwords.

It is pretty easy to identify which encryption method FreeBSD is set up to use. Examining the encrypted passwords in the `/etc/master.passwd` file is one way. Passwords encrypted with the MD5 hash are longer than those encrypted with the DES hash and also begin with the characters `1`. Passwords starting with `$2a$` are encrypted with the Blowfish hash function. DES password strings do not have any particular identifying characteristics, but they are shorter than MD5 passwords, and are coded in a 64-character alphabet which does not include the `$` character, so a relatively short string which does not begin with a dollar sign is very likely a DES password.

The password format used for new passwords is controlled by the `passwd_format` login capability in `/etc/login.conf`, which takes values of `des`, `md5` or `blf`. See the `login.conf(5)` manual page for more information about login capabilities.

14.5 One-time Passwords

By default, FreeBSD includes support for OPIE (One-time Passwords In Everything), which uses the MD5 hash by default.

There are three different sorts of passwords which we will discuss below. The first is your usual UNIX style or Kerberos password; we will call this a “UNIX password”. The second sort is the one-time password which is generated by the OPIE `opiekey(1)` program and accepted by the `opiepasswd(1)` program and the login prompt; we will call this a “one-time password”. The final sort of password is the secret password which you give to the `opiekey` program (and sometimes the `opiepasswd` programs) which it uses to generate one-time passwords; we will call it a “secret password” or just unqualified “password”.

The secret password does not have anything to do with your UNIX password; they can be the same but this is not recommended. OPIE secret passwords are not limited to 8 characters like old UNIX passwords¹, they can be as long as you like. Passwords of six or seven word long phrases are fairly common. For the most part, the OPIE system operates completely independently of the UNIX password system.

Besides the password, there are two other pieces of data that are important to OPIE. One is what is known as the “seed” or “key”, consisting of two letters and five digits. The other is what is called the “iteration count”, a number between 1 and 100. OPIE creates the one-time password by concatenating the seed and the secret password, then applying the MD5 hash as many times as specified by the iteration count and turning the result into six short English words. These six English words are your one-time password. The authentication system (primarily PAM) keeps track of the last one-time password used, and the user is authenticated if the hash of the user-provided password is equal to the previous password. Because a one-way hash is used it is impossible to generate future one-time passwords if a successfully used password is captured; the iteration count is decremented after each successful login to keep the user and the login program in sync. When the iteration count gets down to 1, OPIE must be reinitialized.

There are a few programs involved in each system which we will discuss below. The `opiekey` program accepts an iteration count, a seed, and a secret password, and generates a one-time password or a consecutive list of one-time passwords. The `opiepasswd` program is used to initialize OPIE, and to change passwords, iteration counts, or seeds; it takes either a secret passphrase, or an iteration count, seed, and a one-time password. The `opieinfo` program will

examine the relevant credentials files (`/etc/opedkeys`) and print out the invoking user's current iteration count and seed.

There are four different sorts of operations we will cover. The first is using `opedpasswd` over a secure connection to set up one-time-passwords for the first time, or to change your password or seed. The second operation is using `opedpasswd` over an insecure connection, in conjunction with `opedkey` over a secure connection, to do the same. The third is using `opedkey` to log in over an insecure connection. The fourth is using `opedkey` to generate a number of keys which can be written down or printed out to carry with you when going to some location without secure connections to anywhere.

14.5.1 Secure Connection Initialization

To initialize OPIE for the first time, execute the `opedpasswd` command:

```
% opedpasswd -c
[grimreaper] ~ $ opedpasswd -f -c
Adding unfurl:
Only use this method from the console; NEVER from remote. If you are using
telnet, xterm, or a dial-in, type ^C now or exit with no password.
Then run opedpasswd without the -c parameter.
Using MD5 to compute responses.
Enter new secret pass phrase:
Again new secret pass phrase:
ID unfurl OTP key is 499 to4268
MOS MALL GOAT ARM AVID COED
```

At the `Enter new secret pass phrase:` or `Enter secret password:` prompts, you should enter a password or phrase. Remember, this is not the password that you will use to login with, this is used to generate your one-time login keys. The "ID" line gives the parameters of your particular instance: your login name, the iteration count, and seed. When logging in the system will remember these parameters and present them back to you so you do not have to remember them. The last line gives the particular one-time password which corresponds to those parameters and your secret password; if you were to re-login immediately, this one-time password is the one you would use.

14.5.2 Insecure Connection Initialization

To initialize or change your secret password over an insecure connection, you will need to already have a secure connection to some place where you can run `opedkey`; this might be in the form of a shell prompt on a machine you trust. You will also need to make up an iteration count (100 is probably a good value), and you may make up your own seed or use a randomly-generated one. Over on the insecure connection (to the machine you are initializing), use `opedpasswd`:

```
% opedpasswd

Updating unfurl:
You need the response from an OTP generator.
Old secret pass phrase:
    otp-md5 498 to4268 ext
    Response: GAME GAG WELT OUT DOWN CHAT
New secret pass phrase:
    otp-md5 499 to4269
```

```
Response: LINE PAP MILK NELL BUOY TROY
```

```
ID mark OTP key is 499 gr4269
LINE PAP MILK NELL BUOY TROY
```

To accept the default seed press **Return**. Then before entering an access password, move over to your secure connection and give it the same parameters:

```
% opiekey 498 to4268
Using the MD5 algorithm to compute response.
Reminder: Don't use opiekey from telnet or dial-in sessions.
Enter secret pass phrase:
GAME GAG WELT OUT DOWN CHAT
```

Now switch back over to the insecure connection, and copy the one-time password generated over to the relevant program.

14.5.3 Generating a Single One-time Password

Once you have initialized OPIE and login, you will be presented with a prompt like this:

```
% telnet example.com
Trying 10.0.0.1...
Connected to example.com
Escape character is '^]'.

FreeBSD/i386 (example.com) (tty)

login: <username>
otp-md5 498 gr4269 ext
Password:
```

As a side note, the OPIE prompts have a useful feature (not shown here): if you press **Return** at the password prompt, the prompter will turn echo on, so you can see what you are typing. This can be extremely useful if you are attempting to type in a password by hand, such as from a printout.

At this point you need to generate your one-time password to answer this login prompt. This must be done on a trusted system that you can run `opiekey` on. (There are versions of these for DOS, Windows and Mac OS as well.) They need the iteration count and the seed as command line options. You can cut-and-paste these right from the login prompt on the machine that you are logging in to.

On the trusted system:

```
% opiekey 498 to4268
Using the MD5 algorithm to compute response.
Reminder: Don't use opiekey from telnet or dial-in sessions.
Enter secret pass phrase:
GAME GAG WELT OUT DOWN CHAT
```

Now that you have your one-time password you can continue logging in.

14.5.4 Generating Multiple One-time Passwords

Sometimes you have to go places where you do not have access to a trusted machine or secure connection. In this case, it is possible to use the `opiekey` command to generate a number of one-time passwords beforehand to be printed out and taken with you. For example:

```
% opiekey -n 5 30 zz99999
Using the MD5 algorithm to compute response.
Reminder: Don't use opiekey from telnet or dial-in sessions.
Enter secret pass phrase: <secret password>
26: JOAN BORE FOSS DES NAY QUIT
27: LATE BIAS SLAY FOLK MUCH TRIG
28: SALT TIN ANTI LOON NEAL USE
29: RIO ODIN GO BYE FURY TIC
30: GREW JIVE SAN GIRD BOIL PHI
```

The `-n 5` requests five keys in sequence, the `30` specifies what the last iteration number should be. Note that these are printed out in *reverse* order of eventual use. If you are really paranoid, you might want to write the results down by hand; otherwise you can cut-and-paste into `lpr`. Note that each line shows both the iteration count and the one-time password; you may still find it handy to scratch off passwords as you use them.

14.5.5 Restricting Use of UNIX Passwords

OPIE can restrict the use of UNIX passwords based on the IP address of a login session. The relevant file is `/etc/opieaccess`, which is present by default. Please check `opieaccess(5)` for more information on this file and which security considerations you should be aware of when using it.

Here is a sample `opieaccess` file:

```
permit 192.168.0.0 255.255.0.0
```

This line allows users whose IP source address (which is vulnerable to spoofing) matches the specified value and mask, to use UNIX passwords at any time.

If no rules in `opieaccess` are matched, the default is to deny non-OPIE logins.

14.6 TCP Wrappers

Written by: Tom Rhodes.

Anyone familiar with `inetd(8)` has probably heard of TCP Wrappers at some point. But few individuals seem to fully comprehend its usefulness in a network environment. It seems that everyone wants to install a firewall to handle network connections. While a firewall has a wide variety of uses, there are some things that a firewall not handle such as sending text back to the connection originator. The TCP software does this and much more. In the next few sections many of the TCP Wrappers features will be discussed, and, when applicable, example configuration lines will be provided.

The TCP Wrappers software extends the abilities of `inetd` to provide support for every server daemon under its control. Using this method it is possible to provide logging support, return messages to connections, permit a daemon

to only accept internal connections, etc. While some of these features can be provided by implementing a firewall, this will add not only an extra layer of protection but go beyond the amount of control a firewall can provide.

The added functionality of TCP Wrappers should not be considered a replacement for a good firewall. TCP Wrappers can be used in conjunction with a firewall or other security enhancements though and it can serve nicely as an extra layer of protection for the system.

Since this is an extension to the configuration of `inetd`, the reader is expected have read the `inetd` configuration section.

Όχιἄβυός: While programs run by `inetd(8)` are not exactly “daemons”, they have traditionally been called daemons. This is the term we will use in this section too.

14.6.1 Initial Configuration

The only requirement of using TCP Wrappers in FreeBSD is to ensure the `inetd` server is started from `rc.conf` with the `-ww` option; this is the default setting. Of course, proper configuration of `/etc/hosts.allow` is also expected, but `syslogd(8)` will throw messages in the system logs in these cases.

Όχιἄβυός: Unlike other implementations of TCP Wrappers, the use of `hosts.deny` has been deprecated. All configuration options should be placed in `/etc/hosts.allow`.

In the simplest configuration, daemon connection policies are set to either be permitted or blocked depending on the options in `/etc/hosts.allow`. The default configuration in FreeBSD is to allow a connection to every daemon started with `inetd`. Changing this will be discussed only after the basic configuration is covered.

Basic configuration usually takes the form of `daemon : address : action`. Where `daemon` is the daemon name which `inetd` started. The `address` can be a valid hostname, an IP address or an IPv6 address enclosed in brackets ([]). The action field can be either `allow` or `deny` to grant or deny access appropriately. Keep in mind that configuration works off a first rule match semantic, meaning that the configuration file is scanned in ascending order for a matching rule. When a match is found the rule is applied and the search process will halt.

Several other options exist but they will be explained in a later section. A simple configuration line may easily be constructed from that information alone. For example, to allow POP3 connections via the `mail/qpopper` daemon, the following lines should be appended to `hosts.allow`:

```
# This line is required for POP3 connections:
qpopper : ALL : allow
```

After adding this line, `inetd` will need restarted. This can be accomplished by use of the `kill(1)` command, or with the `restart` parameter with `/etc/rc.d/inetd`.

14.6.2 Advanced Configuration

TCP Wrappers has advanced options too; they will allow for more control over the way connections are handled. In some cases it may be a good idea to return a comment to certain hosts or daemon connections. In other cases, perhaps a log file should be recorded or an email sent to the administrator. Other situations may require the use of a service

for local connections only. This is all possible through the use of configuration options known as wildcards, expansion characters and external command execution. The next two sections are written to cover these situations.

14.6.2.1 External Commands

Suppose that a situation occurs where a connection should be denied yet a reason should be sent to the individual who attempted to establish that connection. How could it be done? That action can be made possible by using the `twist` option. When a connection attempt is made, `twist` will be called to execute a shell command or script. An example already exists in the `hosts.allow` file:

```
# The rest of the daemons are protected.
ALL : ALL \
    : severity auth.info \
    : twist /bin/echo "You are not welcome to use %d from %h."
```

This example shows that the message, “You are not allowed to use daemon from hostname.” will be returned for any daemon not previously configured in the access file. This is extremely useful for sending a reply back to the connection initiator right after the established connection is dropped. Note that any message returned *must* be wrapped in quote " characters; there are no exceptions to this rule.

Προειδοποίηση: It may be possible to launch a denial of service attack on the server if an attacker, or group of attackers could flood these daemons with connection requests.

Another possibility is to use the `spawn` option in these cases. Like `twist`, the `spawn` implicitly denies the connection and may be used to run external shell commands or scripts. Unlike `twist`, `spawn` will not send a reply back to the individual who established the connection. For an example, consider the following configuration line:

```
# We do not allow connections from example.com:
ALL : .example.com \
    : spawn (/bin/echo %a from %h attempted to access %d >> \
    /var/log/connections.log) \
    : deny
```

This will deny all connection attempts from the `*.example.com` domain; simultaneously logging the hostname, IP address and the daemon which they attempted to access in the `/var/log/connections.log` file.

Aside from the already explained substitution characters above, e.g. `%a`, a few others exist. See the `hosts_access(5)` manual page for the complete list.

14.6.2.2 Wildcard Options

Thus far the `ALL` example has been used continuously throughout the examples. Other options exist which could extend the functionality a bit further. For instance, `ALL` may be used to match every instance of either a daemon, domain or an IP address. Another wildcard available is `PARANOID` which may be used to match any host which provides an IP address that may be forged. In other words, `paranoid` may be used to define an action to be taken whenever a connection is made from an IP address that differs from its hostname. The following example may shed some more light on this discussion:

```
# Block possibly spoofed requests to sendmail:
```

```
sendmail : PARANOID : deny
```

In that example all connection requests to `sendmail` which have an IP address that varies from its hostname will be denied.

Προσοχή: Using the `PARANOID` may severely cripple servers if the client or server has a broken DNS setup. Administrator discretion is advised.

To learn more about wildcards and their associated functionality, see the `hosts_access(5)` manual page.

Before any of the specific configuration lines above will work, the first configuration line should be commented out in `hosts.allow`. This was noted at the beginning of this section.

14.7 KerberosIV

Contributed by Mark Murray. Based on a contribution by Mark Dapoz.

Kerberos is a network add-on system/protocol that allows users to authenticate themselves through the services of a secure server. Services such as remote login, remote copy, secure inter-system file copying and other high-risk tasks are made considerably safer and more controllable.

The following instructions can be used as a guide on how to set up Kerberos as distributed for FreeBSD. However, you should refer to the relevant manual pages for a complete description.

14.7.1 Installing KerberosIV

Kerberos is an optional component of FreeBSD. The easiest way to install this software is by selecting the `krb4` or `krb5` distribution in `sysinstall` during the initial installation of FreeBSD. This will install the “eBones” (KerberosIV) or “Heimdal” (Kerberos5) implementation of Kerberos. These implementations are included because they are developed outside the USA/Canada and were thus available to system owners outside those countries during the era of restrictive export controls on cryptographic code from the USA.

Alternatively, the MIT implementation of Kerberos is available from the Ports Collection as `security/krb5`.

14.7.2 Creating the Initial Database

This is done on the Kerberos server only. First make sure that you do not have any old Kerberos databases around. You should change to the directory `/etc/kerberosIV` and check that only the following files are present:

```
# cd /etc/kerberosIV
# ls
README  krb.conf          krb.realms
```

If any additional files (such as `principal.*` or `master_key`) exist, then use the `kdb_destroy` command to destroy the old Kerberos database, or if Kerberos is not running, simply delete the extra files.

You should now edit the `krb.conf` and `krb.realms` files to define your Kerberos realm. In this case the realm will be `EXAMPLE.COM` and the server is `grunt.example.com`. We edit or create the `krb.conf` file:

```
# cat krb.conf
EXAMPLE.COM
EXAMPLE.COM grunt.example.com admin server
CS.BERKELEY.EDU okeeffe.berkeley.edu
ATHENA.MIT.EDU kerberos.mit.edu
ATHENA.MIT.EDU kerberos-1.mit.edu
ATHENA.MIT.EDU kerberos-2.mit.edu
ATHENA.MIT.EDU kerberos-3.mit.edu
LCS.MIT.EDU kerberos.lcs.mit.edu
TELECOM.MIT.EDU bitsy.mit.edu
ARC.NASA.GOV trident.arc.nasa.gov
```

In this case, the other realms do not need to be there. They are here as an example of how a machine may be made aware of multiple realms. You may wish to not include them for simplicity.

The first line names the realm in which this system works. The other lines contain realm/host entries. The first item on a line is a realm, and the second is a host in that realm that is acting as a “key distribution center”. The words `admin server` following a host’s name means that host also provides an administrative database server. For further explanation of these terms, please consult the Kerberos manual pages.

Now we have to add `grunt.example.com` to the `EXAMPLE.COM` realm and also add an entry to put all hosts in the `.example.com` domain in the `EXAMPLE.COM` realm. The `krb.realms` file would be updated as follows:

```
# cat krb.realms
grunt.example.com EXAMPLE.COM
.example.com EXAMPLE.COM
.berkeley.edu CS.BERKELEY.EDU
.MIT.EDU ATHENA.MIT.EDU
.mit.edu ATHENA.MIT.EDU
```

Again, the other realms do not need to be there. They are here as an example of how a machine may be made aware of multiple realms. You may wish to remove them to simplify things.

The first line puts the *specific* system into the named realm. The rest of the lines show how to default systems of a particular subdomain to a named realm.

Now we are ready to create the database. This only needs to run on the Kerberos server (or Key Distribution Center). Issue the `kdb_init` command to do this:

```
# kdb_init
Realm name [default ATHENA.MIT.EDU ]: EXAMPLE.COM
You will be prompted for the database Master Password.
It is important that you NOT FORGET this password.
```

Enter Kerberos master key:

Now we have to save the key so that servers on the local machine can pick it up. Use the `kstash` command to do this:

```
# kstash
Enter Kerberos master key:
```

Current Kerberos master key version is 1.

Master key entered. BEWARE!

This saves the encrypted master password in /etc/kerberosIV/master_key.

14.7.3 Making It All Run

Two principals need to be added to the database for *each* system that will be secured with Kerberos. Their names are `kpasswd` and `rcmd`. These two principals are made for each system, with the instance being the name of the individual system.

These daemons, **kpasswd** and **rcmd** allow other systems to change Kerberos passwords and run commands like `rcp(1)`, `rlogin(1)` and `rsh(1)`.

Now let us add these entries:

```
# kdb_edit
Opening database...

Enter Kerberos master key:

Current Kerberos master key version is 1.

Master key entered. BEWARE!
Previous or default values are in [brackets] ,
enter return to leave the same, or new value.

Principal name: passwd
Instance: grunt

<Not found>, Create [y] ? y

Principal: passwd, Instance: grunt, kdc_key_ver: 1
New Password: <---- enter RANDOM here
Verifying password

New Password: <---- enter RANDOM here

Random password [y] ? y

Principal's new key version = 1
Expiration date (enter yyyy-mm-dd) [ 2000-01-01 ] ?
Max ticket lifetime (*5 minutes) [ 255 ] ?
Attributes [ 0 ] ?
Edit O.K.
Principal name: rcmd
Instance: grunt

<Not found>, Create [y] ?

Principal: rcmd, Instance: grunt, kdc_key_ver: 1
New Password: <---- enter RANDOM here
```

Verifying password

New Password: <---- enter RANDOM here

Random password [y] ?

Principal's new key version = 1

Expiration date (enter yyyy-mm-dd) [2000-01-01] ?

Max ticket lifetime (*5 minutes) [255] ?

Attributes [0] ?

Edit O.K.

Principal name: <---- null entry here will cause an exit

14.7.4 Creating the Server File

We now have to extract all the instances which define the services on each machine. For this we use the `ext_srvtab` command. This will create a file which must be copied or moved *by secure means* to each Kerberos client's `/etc` directory. This file must be present on each server and client, and is crucial to the operation of Kerberos.

```
# ext_srvtab grunt
```

```
Enter Kerberos master key:
```

```
Current Kerberos master key version is 1.
```

```
Master key entered. BEWARE!
```

```
Generating 'grunt-new-srvtab'....
```

Now, this command only generates a temporary file which must be renamed to `srvtab` so that all the servers can pick it up. Use the `mv(1)` command to move it into place on the original system:

```
# mv grunt-new-srvtab srvtab
```

If the file is for a client system, and the network is not deemed safe, then copy the `client-new-srvtab` to removable media and transport it by secure physical means. Be sure to rename it to `srvtab` in the client's `/etc` directory, and make sure it is mode 600:

```
# mv grumble-new-srvtab srvtab
```

```
# chmod 600 srvtab
```

14.7.5 Populating the Database

We now have to add some user entries into the database. First let us create an entry for the user `jane`. Use the `kdb_edit` command to do this:

```
# kdb_edit
```

```
Opening database...
```

```
Enter Kerberos master key:
```

```
Current Kerberos master key version is 1.
```

```

Master key entered.  BEWARE!
Previous or default values are in [brackets] ,
enter return to leave the same, or new value.

Principal name:  jane
Instance:

<Not found>, Create [y] ?  y

Principal: jane, Instance: , kdc_key_ver: 1
New Password:      <---- enter a secure password here
Verifying password

New Password:      <---- re-enter the password here
Principal's new key version = 1
Expiration date (enter yyyy-mm-dd) [ 2000-01-01 ] ?
Max ticket lifetime (*5 minutes) [ 255 ] ?
Attributes [ 0 ] ?
Edit O.K.
Principal name:    <---- null entry here will cause an exit

```

14.7.6 Testing It All Out

First we have to start the Kerberos daemons. Note that if you have correctly edited your `/etc/rc.conf` then this will happen automatically when you reboot. This is only necessary on the Kerberos server. Kerberos clients will automatically get what they need from the `/etc/kerberosIV` directory.

```

# kerberos &
Kerberos server starting
Sleep forever on error
Log file is /var/log/kerberos.log
Current Kerberos master key version is 1.

Master key entered. BEWARE!

Current Kerberos master key version is 1
Local realm: EXAMPLE.COM
# kadmin -n &
KADM Server KADM0.0A initializing
Please do not use 'kill -9' to kill this job, use a
regular kill instead

Current Kerberos master key version is 1.

Master key entered.  BEWARE!

```

Now we can try using the `kinit` command to get a ticket for the ID `jane` that we created above:

```

% kinit jane
MIT Project Athena (grunt.example.com)
Kerberos Initialization for "jane"

```

Password:

Try listing the tokens using `klist` to see if we really have them:

```
% klist
Ticket file:      /tmp/tkt245
Principal:       jane@EXAMPLE.COM

    Issued                Expires                Principal
Apr 30 11:23:22  Apr 30 19:23:22  krbtgt.EXAMPLE.COM@EXAMPLE.COM
```

Now try changing the password using `passwd(1)` to check if the **kpasswd** daemon can get authorization to the Kerberos database:

```
% passwd
realm EXAMPLE.COM
Old password for jane:
New Password for jane:
Verifying password
New Password for jane:
Password changed.
```

14.7.7 Adding `su` Privileges

Kerberos allows us to give *each* user who needs `root` privileges their own *separate* `su(1)` password. We could now add an ID which is authorized to `su(1)` to `root`. This is controlled by having an instance of `root` associated with a principal. Using `kdb_edit` we can create the entry `jane.root` in the Kerberos database:

```
# kdb_edit
Opening database...

Enter Kerberos master key:

Current Kerberos master key version is 1.

Master key entered.  BEWARE!
Previous or default values are in [brackets] ,
enter return to leave the same, or new value.

Principal name: jane
Instance: root

<Not found>, Create [y] ? y

Principal: jane, Instance: root, kdc_key_ver: 1
New Password:          <---- enter a SECURE password here
Verifying password

New Password:          <---- re-enter the password here

Principal's new key version = 1
Expiration date (enter yyyy-mm-dd) [ 2000-01-01 ] ?
```

```
Max ticket lifetime (*5 minutes) [ 255 ] ? 12 <--- Keep this short!
Attributes [ 0 ] ?
Edit O.K.
Principal name:          <----- null entry here will cause an exit
```

Now try getting tokens for it to make sure it works:

```
# kinit jane.root
MIT Project Athena (grunt.example.com)
Kerberos Initialization for "jane.root"
Password:
```

Now we need to add the user to root's .klogin file:

```
# cat /root/.klogin
jane.root@EXAMPLE.COM
```

Now try doing the su(1):

```
% su
Password:
```

and take a look at what tokens we have:

```
# klist
Ticket file: /tmp/tkt_root_245
Principal:      jane.root@EXAMPLE.COM

    Issued                Expires                Principal
May  2 20:43:12  May  3 04:43:12  krbtgt.EXAMPLE.COM@EXAMPLE.COM
```

14.7.8 Using Other Commands

In an earlier example, we created a principal called `jane` with an instance `root`. This was based on a user with the same name as the principal, and this is a Kerberos default; that a `<principal>.<instance>` of the form `<username>.root` will allow that `<username>` to `su(1)` to `root` if the necessary entries are in the `.klogin` file in `root`'s home directory:

```
# cat /root/.klogin
jane.root@EXAMPLE.COM
```

Likewise, if a user has in their own home directory lines of the form:

```
% cat ~/.klogin
jane@EXAMPLE.COM
jack@EXAMPLE.COM
```

This allows anyone in the `EXAMPLE.COM` realm who has authenticated themselves as `jane` or `jack` (via `kinit`, see above) to access to `jane`'s account or files on this system (`grunt`) via `rlogin(1)`, `rsh(1)` or `rcp(1)`.

For example, `jane` now logs into another system using Kerberos:

```
% kinit
```

```
MIT Project Athena (grunt.example.com)
Password:
% rlogin grunt
Last login: Mon May 1 21:14:47 from grumble
Copyright (c) 1980, 1983, 1986, 1988, 1990, 1991, 1993, 1994
    The Regents of the University of California.  All rights reserved.

FreeBSD BUILT-19950429 (GR386) #0: Sat Apr 29 17:50:09 SAT 1995
```

Or jack logs into jane’s account on the same machine (jane having set up the .klogin file as above, and the person in charge of Kerberos having set up principal *jack* with a null instance):

```
% kinit
% rlogin grunt -l jane
MIT Project Athena (grunt.example.com)
Password:
Last login: Mon May 1 21:16:55 from grumble
Copyright (c) 1980, 1983, 1986, 1988, 1990, 1991, 1993, 1994
    The Regents of the University of California.  All rights reserved.

FreeBSD BUILT-19950429 (GR386) #0: Sat Apr 29 17:50:09 SAT 1995
```

14.8 Kerberos5

Contributed by Tillman Hodgson. Based on a contribution by Mark Murray.

Every FreeBSD release beyond FreeBSD-5.1 includes support only for **Kerberos5**. Hence **Kerberos5** is the only version included, and its configuration is similar in many aspects to that of **KerberosIV**. The following information only applies to **Kerberos5** in post FreeBSD-5.0 releases. Users who wish to use the **KerberosIV** package may install the `security/krb4` port.

Kerberos is a network add-on system/protocol that allows users to authenticate themselves through the services of a secure server. Services such as remote login, remote copy, secure inter-system file copying and other high-risk tasks are made considerably safer and more controllable.

Kerberos can be described as an identity-verifying proxy system. It can also be described as a trusted third-party authentication system. **Kerberos** provides only one function — the secure authentication of users on the network. It does not provide authorization functions (what users are allowed to do) or auditing functions (what those users did). After a client and server have used **Kerberos** to prove their identity, they can also encrypt all of their communications to assure privacy and data integrity as they go about their business.

Therefore it is highly recommended that **Kerberos** be used with other security methods which provide authorization and audit services.

The following instructions can be used as a guide on how to set up **Kerberos** as distributed for FreeBSD. However, you should refer to the relevant manual pages for a complete description.

For purposes of demonstrating a **Kerberos** installation, the various name spaces will be handled as follows:

- The DNS domain (“zone”) will be `example.org`.
- The **Kerberos** realm will be `EXAMPLE.ORG`.

Ὁδηγία: Please use real domain names when setting up **Kerberos** even if you intend to run it internally. This avoids DNS problems and assures inter-operation with other **Kerberos** realms.

14.8.1 History

Kerberos was created by MIT as a solution to network security problems. The **Kerberos** protocol uses strong cryptography so that a client can prove its identity to a server (and vice versa) across an insecure network connection.

Kerberos is both the name of a network authentication protocol and an adjective to describe programs that implement the program (**Kerberos** telnet, for example). The current version of the protocol is version 5, described in RFC 1510.

Several free implementations of this protocol are available, covering a wide range of operating systems. The Massachusetts Institute of Technology (MIT), where **Kerberos** was originally developed, continues to develop their **Kerberos** package. It is commonly used in the US as a cryptography product, as such it has historically been affected by US export regulations. The MIT **Kerberos** is available as a port (`security/krb5`). Heimdal **Kerberos** is another version 5 implementation, and was explicitly developed outside of the US to avoid export regulations (and is thus often included in non-commercial UNIX variants). The Heimdal **Kerberos** distribution is available as a port (`security/heimdal`), and a minimal installation of it is included in the base FreeBSD install.

In order to reach the widest audience, these instructions assume the use of the Heimdal distribution included in FreeBSD.

14.8.2 Setting up a Heimdal KDC

The Key Distribution Center (KDC) is the centralized authentication service that **Kerberos** provides — it is the computer that issues **Kerberos** tickets. The KDC is considered “trusted” by all other computers in the **Kerberos** realm, and thus has heightened security concerns.

Note that while running the **Kerberos** server requires very few computing resources, a dedicated machine acting only as a KDC is recommended for security reasons.

To begin setting up a KDC, ensure that your `/etc/rc.conf` file contains the correct settings to act as a KDC (you may need to adjust paths to reflect your own system):

```
kerberos5_server_enable="YES"
kadmind5_server_enable="YES"
```

Next we will set up your **Kerberos** config file, `/etc/krb5.conf`:

```
[libdefaults]
    default_realm = EXAMPLE.ORG
[realms]
    EXAMPLE.ORG = {
        kdc = kerberos.example.org
        admin_server = kerberos.example.org
    }
[domain_realm]
    .example.org = EXAMPLE.ORG
```

Note that this `/etc/krb5.conf` file implies that your KDC will have the fully-qualified hostname of `kerberos.example.org`. You will need to add a CNAME (alias) entry to your zone file to accomplish this if your KDC has a different hostname.

Όχιἄβυός: For large networks with a properly configured BIND DNS server, the above example could be trimmed to:

```
[libdefaults]
    default_realm = EXAMPLE.ORG
```

With the following lines being appended to the `example.org` zonefile:

```
_kerberos._udp      IN  SRV    01 00 88 kerberos.example.org.
_kerberos._tcp      IN  SRV    01 00 88 kerberos.example.org.
_kpasswd._udp       IN  SRV    01 00 464 kerberos.example.org.
_kerberos-adm._tcp IN  SRV    01 00 749 kerberos.example.org.
_kerberos           IN  TXT    EXAMPLE.ORG
```

Όχιἄβυός: For clients to be able to find the **Kerberos** services, you *must* have either a fully configured `/etc/krb5.conf` or a minimally configured `/etc/krb5.conf` *and* a properly configured DNS server.

Next we will create the **Kerberos** database. This database contains the keys of all principals encrypted with a master password. You are not required to remember this password, it will be stored in a file (`/var/heimdal/m-key`). To create the master key, run `kstash` and enter a password.

Once the master key has been created, you can initialize the database using the `kadmin` program with the `-l` option (standing for “local”). This option instructs `kadmin` to modify the database files directly rather than going through the `kadmin` network service. This handles the chicken-and-egg problem of trying to connect to the database before it is created. Once you have the `kadmin` prompt, use the `init` command to create your realms initial database.

Lastly, while still in `kadmin`, create your first principal using the `add` command. Stick to the defaults options for the principal for now, you can always change them later with the `modify` command. Note that you can use the `?` command at any prompt to see the available options.

A sample database creation session is shown below:

```
# kstash
Master key: xxxxxxxx
Verifying password - Master key: xxxxxxxx

# kadmin -l
kadmin> init EXAMPLE.ORG
Realm max ticket life [unlimited]:
kadmin> add tillman
Max ticket life [unlimited]:
Max renewable life [unlimited]:
Attributes []:
Password: xxxxxxxx
Verifying password - Password: xxxxxxxx
```

Now it is time to start up the KDC services. Run `/etc/rc.d/kerberos start` and `/etc/rc.d/kadmind start` to bring up the services. Note that you will not have any kerberized daemons running at this point but you should be able to confirm that the KDC is functioning by obtaining and listing a ticket for the principal (user) that you just created from the command-line of the KDC itself:

```
% kinit tillman
tillman@EXAMPLE.ORG's Password:

% klist
Credentials cache: FILE:/tmp/krb5cc_500
Principal: tillman@EXAMPLE.ORG

    Issued                Expires                Principal
Aug 27 15:37:58   Aug 28 01:37:58   krbtgt/EXAMPLE.ORG@EXAMPLE.ORG
```

The ticket can then be revoked when you have finished:

```
% k5destroy
```

14.8.3 Kerberos enabling a server with Heimdal services

First, we need a copy of the **Kerberos** configuration file, `/etc/krb5.conf`. To do so, simply copy it over to the client computer from the KDC in a secure fashion (using network utilities, such as `scp(1)`, or physically via a floppy disk).

Next you need a `/etc/krb5.keytab` file. This is the major difference between a server providing **Kerberos** enabled daemons and a workstation — the server must have a `keytab` file. This file contains the server's host key, which allows it and the KDC to verify each others identity. It must be transmitted to the server in a secure fashion, as the security of the server can be broken if the key is made public. This explicitly means that transferring it via a clear text channel, such as FTP, is a very bad idea.

Typically, you transfer the `keytab` to the server using the `kadmin` program. This is handy because you also need to create the host principal (the KDC end of the `krb5.keytab`) using `kadmin`.

Note that you must have already obtained a ticket and that this ticket must be allowed to use the `kadmin` interface in the `kadmind.acl`. See the section titled “Remote administration” in the Heimdal info pages (`info heimdal`) for details on designing access control lists. If you do not want to enable remote `kadmin` access, you can simply securely connect to the KDC (via local console, `ssh(1)` or **Kerberos** `telnet(1)`) and perform administration locally using `kadmin -l`.

After installing the `/etc/krb5.conf` file, you can use `kadmin` from the **Kerberos** server. The `add --random-key` command will let you add the server's host principal, and the `ext` command will allow you to extract the server's host principal to its own `keytab`. For example:

```
# kadmin
kadmin> add --random-key host/myserver.example.org
Max ticket life [unlimited]:
Max renewable life [unlimited]:
Attributes []:
kadmin> ext host/myserver.example.org
kadmin> exit
```

Note that the `ext` command (short for “extract”) stores the extracted key in `/etc/krb5.keytab` by default.

If you do not have `kadmin` running on the KDC (possibly for security reasons) and thus do not have access to `kadmin` remotely, you can add the host principal (`host/myserver.EXAMPLE.ORG`) directly on the KDC and then extract it to a temporary file (to avoid over-writing the `/etc/krb5.keytab` on the KDC) using something like this:

```
# kadmin
kadmin> ext --keytab=/tmp/example.keytab host/myserver.example.org
kadmin> exit
```

You can then securely copy the keytab to the server computer (using `scp` or a floppy, for example). Be sure to specify a non-default keytab name to avoid over-writing the keytab on the KDC.

At this point your server can communicate with the KDC (due to its `krb5.conf` file) and it can prove its own identity (due to the `krb5.keytab` file). It is now ready for you to enable some **Kerberos** services. For this example we will enable the `telnet` service by putting a line like this into your `/etc/inetd.conf` and then restarting the `inetd(8)` service with `/etc/rc.d/inetd restart`:

```
telnet    stream  tcp      nowait  root    /usr/libexec/telnetd telnetd -a user
```

The critical bit is that the `-a` (for authentication) type is set to `user`. Consult the `telnetd(8)` manual page for more details.

14.8.4 Kerberos enabling a client with Heimdal

Setting up a client computer is almost trivially easy. As far as **Kerberos** configuration goes, you only need the **Kerberos** configuration file, located at `/etc/krb5.conf`. Simply securely copy it over to the client computer from the KDC.

Test your client computer by attempting to use `kinit`, `klist`, and `kdestroy` from the client to obtain, show, and then delete a ticket for the principal you created above. You should also be able to use **Kerberos** applications to connect to **Kerberos** enabled servers, though if that does not work and obtaining a ticket does the problem is likely with the server and not with the client or the KDC.

When testing an application like `telnet`, try using a packet sniffer (such as `tcpdump(1)`) to confirm that your password is not sent in the clear. Try using `telnet` with the `-x` option, which encrypts the entire data stream (similar to `ssh`).

Various non-core **Kerberos** client applications are also installed by default. This is where the “minimal” nature of the base Heimdal installation is felt: `telnet` is the only **Kerberos** enabled service.

The Heimdal port adds some of the missing client applications: **Kerberos** enabled versions of `ftp`, `rsh`, `rcp`, `rlogin`, and a few other less common programs. The MIT port also contains a full suite of **Kerberos** client applications.

14.8.5 User configuration files: `.k5login` and `.k5users`

Users within a realm typically have their **Kerberos** principal (such as `tillman@EXAMPLE.ORG`) mapped to a local user account (such as a local account named `tillman`). Client applications such as `telnet` usually do not require a user name or a principal.

Occasionally, however, you want to grant access to a local user account to someone who does not have a matching **Kerberos** principal. For example, `tillman@EXAMPLE.ORG` may need access to the local user account `webdevelopers`. Other principals may also need access to that local account.

The `.k5login` and `.k5users` files, placed in a user's home directory, can be used similar to a powerful combination of `.hosts` and `.rhosts`, solving this problem. For example, if a `.k5login` with the following contents:

```
tillman@example.org
jdoe@example.org
```

Were to be placed into the home directory of the local user `webdevelopers` then both principals listed would have access to that account without requiring a shared password.

Reading the manual pages for these commands is recommended. Note that the `ksu` manual page covers `.k5users`.

14.8.6 Kerberos Tips, Tricks, and Troubleshooting

- When using either the Heimdal or MIT **Kerberos** ports ensure that your `PATH` environment variable lists the **Kerberos** versions of the client applications before the system versions.
- Do all the computers in your realm have synchronized time settings? If not, authentication may fail. Οἰκία 29.10 describes how to synchronize clocks using NTP.
- MIT and Heimdal inter-operate nicely. Except for `kadmin`, the protocol for which is not standardized.
- If you change your hostname, you also need to change your `host/` principal and update your keytab. This also applies to special keytab entries like the `www/` principal used for Apache's `www/mod_auth_kerb`.
- All hosts in your realm must be resolvable (both forwards and reverse) in DNS (or `/etc/hosts` as a minimum). CNAMEs will work, but the A and PTR records must be correct and in place. The error message is not very intuitive: "Kerberos5 refuses authentication because Read req failed: Key table entry not found".
- Some operating systems that may be acting as clients to your KDC do not set the permissions for `ksu` to be `setuid root`. This means that `ksu` does not work, which is a good security idea but annoying. This is not a KDC error.
- With MIT **Kerberos**, if you want to allow a principal to have a ticket life longer than the default ten hours, you must use `modify_principal` in `kadmin` to change the `maxlife` of both the principal in question and the `krbtgt` principal. Then the principal can use the `-l` option with `kinit` to request a ticket with a longer lifetime.

Όχιὰβύος: If you run a packet sniffer on your KDC to add in troubleshooting and then run `kinit` from a workstation, you will notice that your TGT is sent immediately upon running `kinit` — even before you type your password! The explanation is that the **Kerberos** server freely transmits a TGT (Ticket Granting Ticket) to any unauthorized request; however, every TGT is encrypted in a key derived from the user's password. Therefore, when a user types their password it is not being sent to the KDC, it is being used to decrypt the TGT that `kinit` already obtained. If the decryption process results in a valid ticket with a valid time stamp, the user has valid **Kerberos** credentials. These credentials include a session key for establishing secure communications with the **Kerberos** server in the future, as well as the actual ticket-granting ticket, which is actually encrypted with the **Kerberos** server's own key. This second layer of encryption is unknown to the user, but it is what allows the **Kerberos** server to verify the authenticity of each TGT.

- If you want to use long ticket lifetimes (a week, for example) and you are using **OpenSSH** to connect to the machine where your ticket is stored, make sure that **Kerberos** TicketCleanup is set to no in your `sshd_config` or else your tickets will be deleted when you log out.
- Remember that host principals can have a longer ticket lifetime as well. If your user principal has a lifetime of a week but the host you are connecting to has a lifetime of nine hours, you will have an expired host principal in your cache and the ticket cache will not work as expected.
- When setting up a `krb5.dict` file to prevent specific bad passwords from being used (the manual page for `kadmind` covers this briefly), remember that it only applies to principals that have a password policy assigned to them. The `krb5.dict` files format is simple: one string per line. Creating a symbolic link to `/usr/share/dict/words` might be useful.

14.8.7 Differences with the MIT port

The major difference between the MIT and Heimdal installs relates to the `kadmin` program which has a different (but equivalent) set of commands and uses a different protocol. This has a large implications if your KDC is MIT as you will not be able to use the Heimdal `kadmin` program to administer your KDC remotely (or vice versa, for that matter).

The client applications may also take slightly different command line options to accomplish the same tasks. Following the instructions on the MIT **Kerberos** web site (<http://web.mit.edu/Kerberos/www/>) is recommended. Be careful of path issues: the MIT port installs into `/usr/local/` by default, and the “normal” system applications may be run instead of MIT if your `PATH` environment variable lists the system directories first.

Όχι! Βύθος: With the MIT `security/krb5` port that is provided by FreeBSD, be sure to read the `/usr/local/share/doc/krb5/README.FreeBSD` file installed by the port if you want to understand why logins via `telnetd` and `klogind` behave somewhat oddly. Most importantly, correcting the “incorrect permissions on cache file” behavior requires that the `login.krb5` binary be used for authentication so that it can properly change ownership for the forwarded credentials.

The `rc.conf` must also be modified to contain the following configuration:

```
kerberos5_server="/usr/local/sbin/krb5kdc"
kadmind5_server="/usr/local/sbin/kadmind"
kerberos5_server_enable="YES"
kadmind5_server_enable="YES"
```

This is done because the applications for MIT kerberos installs binaries in the `/usr/local` hierarchy.

14.8.8 Mitigating limitations found in Kerberos

14.8.8.1 Kerberos is an all-or-nothing approach

Every service enabled on the network must be modified to work with **Kerberos** (or be otherwise secured against network attacks) or else the users credentials could be stolen and re-used. An example of this would be **Kerberos** enabling all remote shells (via `rsh` and `telnet`, for example) but not converting the POP3 mail server which sends passwords in plain text.

14.8.8.2 Kerberos is intended for single-user workstations

In a multi-user environment, **Kerberos** is less secure. This is because it stores the tickets in the `/tmp` directory, which is readable by all users. If a user is sharing a computer with several other people simultaneously (i.e. multi-user), it is possible that the user's tickets can be stolen (copied) by another user.

This can be overcome with the `-c filename` command-line option or (preferably) the `KRB5CCNAME` environment variable, but this is rarely done. In principal, storing the ticket in the users home directory and using simple file permissions can mitigate this problem.

14.8.8.3 The KDC is a single point of failure

By design, the KDC must be as secure as the master password database is contained on it. The KDC should have absolutely no other services running on it and should be physically secured. The danger is high because **Kerberos** stores all passwords encrypted with the same key (the "master" key), which in turn is stored as a file on the KDC.

As a side note, a compromised master key is not quite as bad as one might normally fear. The master key is only used to encrypt the **Kerberos** database and as a seed for the random number generator. As long as access to your KDC is secure, an attacker cannot do much with the master key.

Additionally, if the KDC is unavailable (perhaps due to a denial of service attack or network problems) the network services are unusable as authentication can not be performed, a recipe for a denial-of-service attack. This can be alleviated with multiple KDCs (a single master and one or more slaves) and with careful implementation of secondary or fall-back authentication (PAM is excellent for this).

14.8.8.4 Kerberos Shortcomings

Kerberos allows users, hosts and services to authenticate between themselves. It does not have a mechanism to authenticate the KDC to the users, hosts or services. This means that a trojanned `kinit` (for example) could record all user names and passwords. Something like `security/tripwire` or other file system integrity checking tools can alleviate this.

14.8.9 Resources and further information

- The **Kerberos** FAQ (<http://www.faqs.org/faqs/Kerberos-faq/general/preamble.html>)
- Designing an Authentication System: a Dialog in Four Scenes (<http://web.mit.edu/Kerberos/www/dialogue.html>)

- RFC 1510, The **Kerberos** Network Authentication Service (V5) (<http://www.ietf.org/rfc/rfc1510.txt?number=1510>)
- MIT **Kerberos** home page (<http://web.mit.edu/Kerberos/www/>)
- Heimdal **Kerberos** home page (<http://www.pdc.kth.se/heimdal/>)

14.9 OpenSSL

Written by: Tom Rhodes.

One feature that many users overlook is the **OpenSSL** toolkit included in FreeBSD. **OpenSSL** provides an encryption transport layer on top of the normal communications layer; thus allowing it to be intertwined with many network applications and services.

Some uses of **OpenSSL** may include encrypted authentication of mail clients, web based transactions such as credit card payments and more. Many ports such as `www/apache13-ssl`, and `mail/sylpheed-claws` will offer compilation support for building with **OpenSSL**.

Óçìåßüóç: In most cases the Ports Collection will attempt to build the `security/openssl` port unless the `WITH_OPENSSL_BASE` make variable is explicitly set to “yes”.

The version of **OpenSSL** included in FreeBSD supports Secure Sockets Layer v2/v3 (SSLv2/SSLv3), Transport Layer Security v1 (TLSv1) network security protocols and can be used as a general cryptographic library.

Óçìåßüóç: While **OpenSSL** supports the IDEA algorithm, it is disabled by default due to United States patents. To use it, the license should be reviewed and, if the restrictions are acceptable, the `MAKE_IDEA` variable must be set in `make.conf`.

One of the most common uses of **OpenSSL** is to provide certificates for use with software applications. These certificates ensure that the credentials of the company or individual are valid and not fraudulent. If the certificate in question has not been verified by one of the several “Certificate Authorities”, or CAs, a warning is usually produced. A Certificate Authority is a company, such as VeriSign (<http://www.verisign.com>), which will sign certificates in order to validate credentials of individuals or companies. This process has a cost associated with it and is definitely not a requirement for using certificates; however, it can put some of the more paranoid users at ease.

14.9.1 Generating Certificates

To generate a certificate, the following command is available:

```
# openssl req -new -nodes -out req.pem -keyout cert.pem
Generating a 1024 bit RSA private key
.....+++++
.....+++++
writing new private key to 'cert.pem'
-----
You are about to be asked to enter information that will be incorporated
```

into your certificate request.

What you are about to enter is what is called a Distinguished Name or a DN.

There are quite a few fields but you can leave some blank

For some fields there will be a default value,

If you enter '.', the field will be left blank.

```
Country Name (2 letter code) [AU]:US
State or Province Name (full name) [Some-State]:PA
Locality Name (eg, city) []:Pittsburgh
Organization Name (eg, company) [Internet Widgits Pty Ltd]:My Company
Organizational Unit Name (eg, section) []:Systems Administrator
Common Name (eg, YOUR name) []:localhost.example.org
Email Address []:trhodes@FreeBSD.org
```

Please enter the following 'extra' attributes

to be sent with your certificate request

A challenge password []:SOME PASSWORD

An optional company name []:Another Name

Notice the response directly after the "Common Name" prompt shows a domain name. This prompt requires a server name to be entered for verification purposes; placing anything but a domain name would yield a useless certificate.

Other options, for instance expire time, alternate encryption algorithms, etc. are available. A complete list may be obtained by viewing the openssl(1) manual page.

Two files should now exist in the directory in which the aforementioned command was issued. The certificate request, req.pem, may be sent to a certificate authority who will validate the credentials that you entered, sign the request and return the certificate to you. The second file created will be named cert.pem and is the private key for the certificate and should be protected at all costs; if this falls in the hands of others it can be used to impersonate you (or your server).

In cases where a signature from a CA is not required, a self signed certificate can be created. First, generate the RSA key:

```
# openssl dsaparam -rand -genkey -out myRSA.key 1024
```

Next, generate the CA key:

```
# openssl gendsa -des3 -out myca.key myRSA.key
```

Use this key to create the certificate:

```
# openssl req -new -x509 -days 365 -key myca.key -out new.crt
```

Two new files should appear in the directory: a certificate authority signature file, myca.key and the certificate itself, new.crt. These should be placed in a directory, preferably under /etc, which is readable only by root.

Permissions of 0700 should be fine for this and they can be set with the chmod utility.

14.9.2 Using Certificates, an Example

So what can these files do? A good use would be to encrypt connections to the **Sendmail** MTA. This would dissolve the use of clear text authentication for users who send mail via the local MTA.

Όχι! This is not the best use in the world as some MUAs will present the user with an error if they have not installed the certificate locally. Refer to the documentation included with the software for more information on certificate installation.

The following lines should be placed inside the local `.mc` file:

```
dnl SSL Options
define(`confCACERT_PATH',`/etc/certs')dnl
define(`confCACERT',`/etc/certs/new.crt')dnl
define(`confSERVER_CERT',`/etc/certs/new.crt')dnl
define(`confSERVER_KEY',`/etc/certs/myca.key')dnl
define(`confTLS_SRV_OPTIONS',`V')dnl
```

Where `/etc/certs/` is the directory to be used for storing the certificate and key files locally. The last few requirements are a rebuild of the local `.cf` file. This is easily achieved by typing `make install` within the `/etc/mail` directory. Follow that up with `make restart` which should start the **Sendmail** daemon.

If all went well there will be no error messages in the `/var/log/maillog` file and **Sendmail** will show up in the process list.

For a simple test, simply connect to the mail server using the `telnet(1)` utility:

```
# telnet example.com 25
Trying 192.0.34.166...
Connected to example.com.
Escape character is '^]'.
220 example.com ESMTP Sendmail 8.12.10/8.12.10; Tue, 31 Aug 2004 03:41:22 -0400 (EDT)
ehlo example.com
250-example.com Hello example.com [192.0.34.166], pleased to meet you
250-ENHANCEDSTATUSCODES
250-PIPELINING
250-8BITMIME
250-SIZE
250-DSN
250-ETRN
250-AUTH LOGIN PLAIN
250-STARTTLS
250-DELIVERBY
250 HELP
quit
221 2.0.0 example.com closing connection
Connection closed by foreign host.
```

If the “STARTTLS” line appears in the output then everything is working correctly.

14.10 VPN over IPsec

Written by Nik Clayton.

Creating a VPN between two networks, separated by the Internet, using FreeBSD gateways.

14.10.1 Understanding IPsec

Written by Hiten M. Pandya.

This section will guide you through the process of setting up IPsec, and to use it in an environment which consists of FreeBSD and **Microsoft Windows 2000/XP** machines, to make them communicate securely. In order to set up IPsec, it is necessary that you are familiar with the concepts of building a custom kernel (see Εἰσαγωγή 8).

IPsec is a protocol which sits on top of the Internet Protocol (IP) layer. It allows two or more hosts to communicate in a secure manner (hence the name). The FreeBSD IPsec “network stack” is based on the KAME (<http://www.kame.net/>) implementation, which has support for both protocol families, IPv4 and IPv6.

Όψιᾶβύοϑ: FreeBSD contains a “hardware accelerated” IPsec stack, known as “Fast IPsec”, that was obtained from OpenBSD. It employs cryptographic hardware (whenever possible) via the `crypto(4)` subsystem to optimize the performance of IPsec. This subsystem is new, and does not support all the features that are available in the KAME version of IPsec. However, in order to enable hardware-accelerated IPsec, the following kernel option has to be added to your kernel configuration file:

```
options    FAST_IPSEC    # new IPsec (cannot define w/ IPSEC)
```

Note, that it is not currently possible to use the “Fast IPsec” subsystem in lieu of the KAME implementation of IPsec. Consult the `fast_ipsec(4)` manual page for more information.

Όψιᾶβύοϑ: To let firewalls properly track state for `gif(4)` tunnels too, you have to enable the `IPSEC_FILTERGIF` in your kernel configuration:

```
options    IPSEC_FILTERGIF    #filter ipsec packets from a tunnel
```

IPsec consists of two sub-protocols:

- *Encapsulated Security Payload (ESP)*, protects the IP packet data from third party interference, by encrypting the contents using symmetric cryptography algorithms (like Blowfish, 3DES).
- *Authentication Header (AH)*, protects the IP packet header from third party interference and spoofing, by computing a cryptographic checksum and hashing the IP packet header fields with a secure hashing function. This is then followed by an additional header that contains the hash, to allow the information in the packet to be authenticated.

ESP and AH can either be used together or separately, depending on the environment.

IPsec can either be used to directly encrypt the traffic between two hosts (known as *Transport Mode*); or to build “virtual tunnels” between two subnets, which could be used for secure communication between two corporate networks (known as *Tunnel Mode*). The latter is more commonly known as a *Virtual Private Network (VPN)*. The `ipsec(4)` manual page should be consulted for detailed information on the IPsec subsystem in FreeBSD.

To add IPsec support to your kernel, add the following options to your kernel configuration file:

```
options    IPSEC            #IP security
options    IPSEC_ESP        #IP security (crypto; define w/ IPSEC)
```

If IPsec debugging support is desired, the following kernel option should also be added:

```
options    IPSEC_DEBUG    #debug for IP security
```

14.10.2 The Problem

There is no standard for what constitutes a VPN. VPNs can be implemented using a number of different technologies, each of which have their own strengths and weaknesses. This section presents a scenario, and the strategies used for implementing a VPN for this scenario.

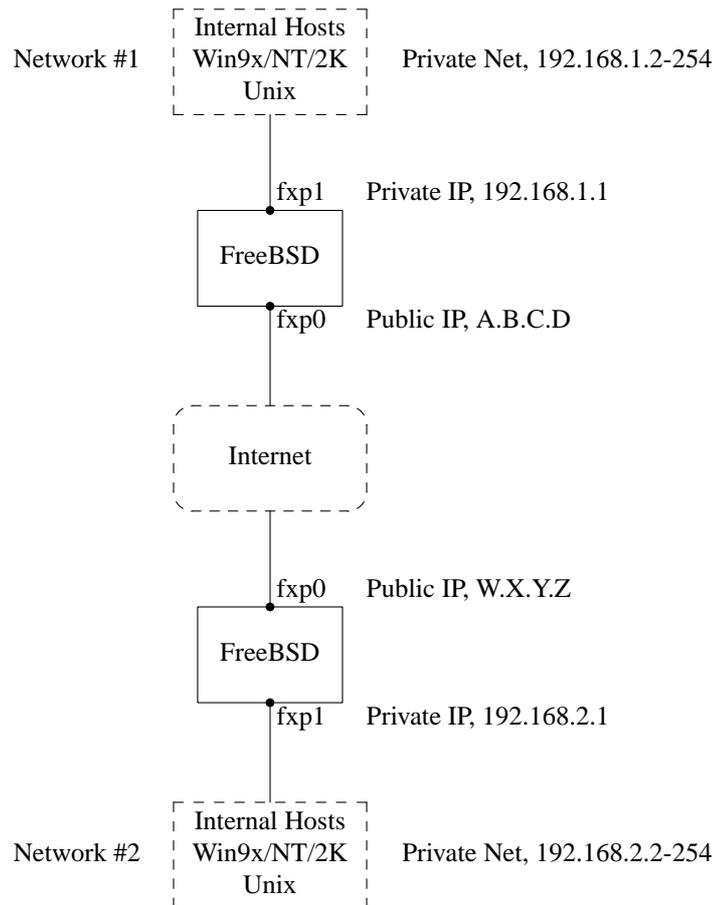
14.10.3 The Scenario: Two networks, connected to the Internet, to behave as one

The premise is as follows:

- You have at least two sites
- Both sites are using IP internally
- Both sites are connected to the Internet, through a gateway that is running FreeBSD.
- The gateway on each network has at least one public IP address.
- The internal addresses of the two networks can be public or private IP addresses, it does not matter. You can be running NAT on the gateway machine if necessary.
- The internal IP addresses of the two networks *do not collide*. While I expect it is theoretically possible to use a combination of VPN technology and NAT to get this to work, I expect it to be a configuration nightmare.

If you find that you are trying to connect two networks, both of which, internally, use the same private IP address range (e.g. both of them use 192.168.1.x), then one of the networks will have to be renumbered.

The network topology might look something like this:



Notice the two public IP addresses. I will use the letters to refer to them in the rest of this article. Anywhere you see those letters in this article, replace them with your own public IP addresses. Note also that internally, the two gateway machines have .1 IP addresses, and that the two networks have different private IP addresses (192.168.1.x and 192.168.2.x respectively). All the machines on the private networks have been configured to use the .1 machine as their default gateway.

The intention is that, from a network point of view, each network should view the machines on the other network as though they were directly attached the same router -- albeit a slightly slow router with an occasional tendency to drop packets.

This means that (for example), machine 192.168.1.20 should be able to run

```
ping 192.168.2.34
```

and have it work, transparently. Windows machines should be able to see the machines on the other network, browse file shares, and so on, in exactly the same way that they can browse machines on the local network.

And the whole thing has to be secure. This means that traffic between the two networks has to be encrypted.

Creating a VPN between these two networks is a multi-step process. The stages are as follows:

1. Create a "virtual" network link between the two networks, across the Internet. Test it, using tools like ping(8), to make sure it works.

2. Apply security policies to ensure that traffic between the two networks is transparently encrypted and decrypted as necessary. Test this, using tools like `tcpdump(1)`, to ensure that traffic is encrypted.
3. Configure additional software on the FreeBSD gateways, to allow Windows machines to see one another across the VPN.

14.10.3.1 Step 1: Creating and testing a “virtual” network link

Suppose that you were logged in to the gateway machine on network #1 (with public IP address `A.B.C.D`, private IP address `192.168.1.1`), and you ran `ping 192.168.2.1`, which is the private address of the machine with IP address `W.X.Y.Z`. What needs to happen in order for this to work?

1. The gateway machine needs to know how to reach `192.168.2.1`. In other words, it needs to have a route to `192.168.2.1`.
2. Private IP addresses, such as those in the `192.168.x` range are not supposed to appear on the Internet at large. Instead, each packet you send to `192.168.2.1` will need to be wrapped up inside another packet. This packet will need to appear to be from `A.B.C.D`, and it will have to be sent to `W.X.Y.Z`. This process is called *encapsulation*.
3. Once this packet arrives at `W.X.Y.Z` it will need to “unencapsulated”, and delivered to `192.168.2.1`.

You can think of this as requiring a “tunnel” between the two networks. The two “tunnel mouths” are the IP addresses `A.B.C.D` and `W.X.Y.Z`, and the tunnel must be told the addresses of the private IP addresses that will be allowed to pass through it. The tunnel is used to transfer traffic with private IP addresses across the public Internet.

This tunnel is created by using the generic interface, or `gif` devices on FreeBSD. As you can imagine, the `gif` interface on each gateway host must be configured with four IP addresses; two for the public IP addresses, and two for the private IP addresses.

Support for the `gif` device must be compiled in to the FreeBSD kernel on both machines. You can do this by adding the line:

```
device gif
```

to the kernel configuration files on both machines, and then compile, install, and reboot as normal.

Configuring the tunnel is a two step process. First the tunnel must be told what the outside (or public) IP addresses are, using `ifconfig(8)`. Then the private IP addresses must be configured using `ifconfig(8)`.

On the gateway machine on network #1 you would run the following commands to configure the tunnel.

```
# ifconfig gif0 create
# ifconfig gif0 tunnel A.B.C.D W.X.Y.Z
# ifconfig gif0 inet 192.168.1.1 192.168.2.1 netmask 0xffffffff
```

On the other gateway machine you run the same commands, but with the order of the IP addresses reversed.

```
# ifconfig gif0 create
# ifconfig gif0 tunnel W.X.Y.Z A.B.C.D
# ifconfig gif0 inet 192.168.2.1 192.168.1.1 netmask 0xffffffff
```

You can then run:

```
ifconfig gif0
```

to see the configuration. For example, on the network #1 gateway, you would see this:

```
# ifconfig gif0
gif0: flags=8051<UP,POINTOPOINT,RUNNING,MULTICAST> mtu 1280
      tunnel inet A.B.C.D --> W.X.Y.Z
      inet 192.168.1.1 --> 192.168.2.1 netmask 0xffffffff
```

As you can see, a tunnel has been created between the physical addresses A.B.C.D and W.X.Y.Z, and the traffic allowed through the tunnel is that between 192.168.1.1 and 192.168.2.1.

This will also have added an entry to the routing table on both machines, which you can examine with the command `netstat -rn`. This output is from the gateway host on network #1.

```
# netstat -rn
Routing tables

Internet:
Destination      Gateway          Flags    Refs      Use     Netif     Expire
...
192.168.2.1      192.168.1.1    UH        0         0      gif0
...
```

As the “Flags” value indicates, this is a host route, which means that each gateway knows how to reach the other gateway, but they do not know how to reach the rest of their respective networks. That problem will be fixed shortly.

It is likely that you are running a firewall on both machines. This will need to be circumvented for your VPN traffic. You might want to allow all traffic between both networks, or you might want to include firewall rules that protect both ends of the VPN from one another.

It greatly simplifies testing if you configure the firewall to allow all traffic through the VPN. You can always tighten things up later. If you are using `ipfw(8)` on the gateway machines then a command like

```
ipfw add 1 allow ip from any to any via gif0
```

will allow all traffic between the two end points of the VPN, without affecting your other firewall rules. Obviously you will need to run this command on both gateway hosts.

This is sufficient to allow each gateway machine to ping the other. On 192.168.1.1, you should be able to run

```
ping 192.168.2.1
```

and get a response, and you should be able to do the same thing on the other gateway machine.

However, you will not be able to reach internal machines on either network yet. This is because of the routing -- although the gateway machines know how to reach one another, they do not know how to reach the network behind each one.

To solve this problem you must add a static route on each gateway machine. The command to do this on the first gateway would be:

```
route add 192.168.2.0 192.168.2.1 netmask 0xffffffff0
```

This says “In order to reach the hosts on the network 192.168.2.0, send the packets to the host 192.168.2.1”. You will need to run a similar command on the other gateway, but with the 192.168.1.x addresses instead.

IP traffic from hosts on one network will now be able to reach hosts on the other network.

That has now created two thirds of a VPN between the two networks, in as much as it is “virtual” and it is a “network”. It is not private yet. You can test this using ping(8) and tcpdump(1). Log in to the gateway host and run

```
tcpdump dst host 192.168.2.1
```

In another log in session on the same host run

```
ping 192.168.2.1
```

You will see output that looks something like this:

```
16:10:24.018080 192.168.1.1 > 192.168.2.1: icmp: echo request
16:10:24.018109 192.168.1.1 > 192.168.2.1: icmp: echo reply
16:10:25.018814 192.168.1.1 > 192.168.2.1: icmp: echo request
16:10:25.018847 192.168.1.1 > 192.168.2.1: icmp: echo reply
16:10:26.028896 192.168.1.1 > 192.168.2.1: icmp: echo request
16:10:26.029112 192.168.1.1 > 192.168.2.1: icmp: echo reply
```

As you can see, the ICMP messages are going back and forth unencrypted. If you had used the `-s` parameter to `tcpdump(1)` to grab more bytes of data from the packets you would see more information.

Obviously this is unacceptable. The next section will discuss securing the link between the two networks so that all traffic is automatically encrypted.

Summary:

- Configure both kernels with “device gif”.
- Edit `/etc/rc.conf` on gateway host #1 and add the following lines (replacing IP addresses as necessary).

```
gif_interfaces="gif0"
gifconfig_gif0="A.B.C.D W.X.Y.Z"
ifconfig_gif0="inet 192.168.1.1 192.168.2.1 netmask 0xffffffff"
static_routes="vpn"
route_vpn="192.168.2.0 192.168.2.1 netmask 0xfffff00"
```

- Edit your firewall script (`/etc/rc.firewall`, or similar) on both hosts, and add `ipfw add 1 allow ip from any to any via gif0`
- Make similar changes to `/etc/rc.conf` on gateway host #2, reversing the order of IP addresses.

14.10.3.2 Step 2: Securing the link

To secure the link we will be using IPsec. IPsec provides a mechanism for two hosts to agree on an encryption key, and to then use this key in order to encrypt data between the two hosts.

There are two areas of configuration to be considered here.

1. There must be a mechanism for two hosts to agree on the encryption mechanism to use. Once two hosts have agreed on this mechanism there is said to be a “security association” between them.
2. There must be a mechanism for specifying which traffic should be encrypted. Obviously, you do not want to encrypt all your outgoing traffic -- you only want to encrypt the traffic that is part of the VPN. The rules that you put in place to determine what traffic will be encrypted are called “security policies”.

Security associations and security policies are both maintained by the kernel, and can be modified by userland programs. However, before you can do this you must configure the kernel to support IPsec and the Encapsulated Security Payload (ESP) protocol. This is done by configuring a kernel with:

```
options IPSEC
options IPSEC_ESP
```

and recompiling, reinstalling, and rebooting. As before you will need to do this to the kernels on both of the gateway hosts.

You have two choices when it comes to setting up security associations. You can configure them by hand between two hosts, which entails choosing the encryption algorithm, encryption keys, and so forth, or you can use daemons that implement the Internet Key Exchange protocol (IKE) to do this for you.

I recommend the latter. Apart from anything else, it is easier to set up.

Editing and displaying security policies is carried out using `setkey(8)`. By analogy, `setkey` is to the kernel’s security policy tables as `route(8)` is to the kernel’s routing tables. `setkey` can also display the current security associations, and to continue the analogy further, is akin to `netstat -r` in that respect.

There are a number of choices for daemons to manage security associations with FreeBSD. This article will describe how to use one of these, `racoon` — which is available from `security/ipsec-tools` in the FreeBSD Ports collection.

The **racoon** software must be run on both gateway hosts. On each host it is configured with the IP address of the other end of the VPN, and a secret key (which you choose, and must be the same on both gateways).

The two daemons then contact one another, confirm that they are who they say they are (by using the secret key that you configured). The daemons then generate a new secret key, and use this to encrypt the traffic over the VPN. They periodically change this secret, so that even if an attacker were to crack one of the keys (which is as theoretically close to unfeasible as it gets) it will not do them much good -- by the time they have cracked the key the two daemons have chosen another one.

The configuration file for `racoon` is stored in `/${PREFIX}/etc/racoon`. You should find a configuration file there, which should not need to be changed too much. The other component of `racoon`’s configuration, which you will need to change, is the “pre-shared key”.

The default `racoon` configuration expects to find this in the file `/${PREFIX}/etc/racoon/psk.txt`. It is important to note that the pre-shared key is *not* the key that will be used to encrypt your traffic across the VPN link, it is simply a token that allows the key management daemons to trust one another.

`psk.txt` contains a line for each remote site you are dealing with. In this example, where there are two sites, each `psk.txt` file will contain one line (because each end of the VPN is only dealing with one other end).

On gateway host #1 this line should look like this:

```
W.X.Y.Z          secret
```

That is, the *public* IP address of the remote end, whitespace, and a text string that provides the secret. Obviously, you should not use “secret” as your key -- the normal rules for choosing a password apply.

On gateway host #2 the line would look like this

```
A.B.C.D          secret
```

That is, the public IP address of the remote end, and the same secret key. `psk.txt` must be mode `0600` (i.e., only read/write to `root`) before `racoon` will run.

You must run `racoon` on both gateway machines. You will also need to add some firewall rules to allow the IKE traffic, which is carried over UDP to the ISAKMP (Internet Security Association Key Management Protocol) port. Again, this should be fairly early in your firewall ruleset.

```
ipfw add 1 allow udp from A.B.C.D to W.X.Y.Z isakmp
ipfw add 1 allow udp from W.X.Y.Z to A.B.C.D isakmp
```

Once `racoon` is running you can try pinging one gateway host from the other. The connection is still not encrypted, but `racoon` will then set up the security associations between the two hosts -- this might take a moment, and you may see this as a short delay before the ping commands start responding.

Once the security association has been set up you can view it using `setkey(8)`. Run

```
setkey -D
```

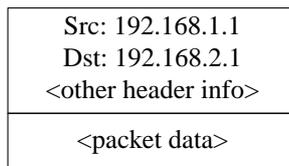
on either host to view the security association information.

That’s one half of the problem. The other half is setting your security policies.

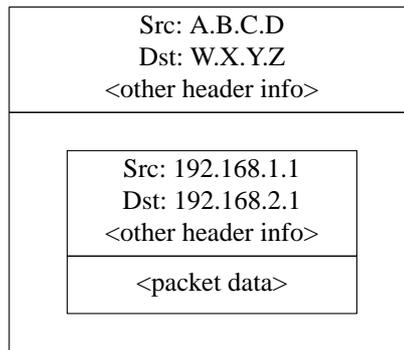
To create a sensible security policy, let’s review what’s been set up so far. This discussions hold for both ends of the link.

Each IP packet that you send out has a header that contains data about the packet. The header includes the IP addresses of both the source and destination. As we already know, private IP addresses, such as the `192.168.x.y` range are not supposed to appear on the public Internet. Instead, they must first be encapsulated inside another packet. This packet must have the public source and destination IP addresses substituted for the private addresses.

So if your outgoing packet started looking like this:



Then it will be encapsulated inside another packet, looking something like this:



This encapsulation is carried out by the `gif` device. As you can see, the packet now has real IP addresses on the outside, and our original packet has been wrapped up as data inside the packet that will be put out on the Internet.

Obviously, we want all traffic between the VPNs to be encrypted. You might try putting this in to words, as:

“If a packet leaves from `A.B.C.D`, and it is destined for `W.X.Y.Z`, then encrypt it, using the necessary security associations.”

“If a packet arrives from `W.X.Y.Z`, and it is destined for `A.B.C.D`, then decrypt it, using the necessary security associations.”

That’s close, but not quite right. If you did this, all traffic to and from `W.X.Y.Z`, even traffic that was not part of the VPN, would be encrypted. That’s not quite what you want. The correct policy is as follows

“If a packet leaves from `A.B.C.D`, and that packet is encapsulating another packet, and it is destined for `W.X.Y.Z`, then encrypt it, using the necessary security associations.”

“If a packet arrives from `W.X.Y.Z`, and that packet is encapsulating another packet, and it is destined for `A.B.C.D`, then decrypt it, using the necessary security associations.”

A subtle change, but a necessary one.

Security policies are also set using `setkey(8)`. `setkey(8)` features a configuration language for defining the policy. You can either enter configuration instructions via `stdin`, or you can use the `-f` option to specify a filename that contains configuration instructions.

The configuration on gateway host #1 (which has the public IP address `A.B.C.D`) to force all outbound traffic to `W.X.Y.Z` to be encrypted is:

```
spdadd A.B.C.D/32 W.X.Y.Z/32 ipencap -P out ipsec esp/tunnel/A.B.C.D-W.X.Y.Z/require;
```

Put these commands in a file (e.g. `/etc/ipsec.conf`) and then run

```
# setkey -f /etc/ipsec.conf
```

`spdadd` tells `setkey(8)` that we want to add a rule to the secure policy database. The rest of this line specifies which packets will match this policy. `A.B.C.D/32` and `W.X.Y.Z/32` are the IP addresses and netmasks that identify the network or hosts that this policy will apply to. In this case, we want it to apply to traffic between these two hosts. `ipencap` tells the kernel that this policy should only apply to packets that encapsulate other packets. `-P out` says that this policy applies to outgoing packets, and `ipsec` says that the packet will be secured.

The second line specifies how this packet will be encrypted. `esp` is the protocol that will be used, while `tunnel` indicates that the packet will be further encapsulated in an IPsec packet. The repeated use of `A.B.C.D` and `W.X.Y.Z`

is used to select the security association to use, and the final `require` mandates that packets must be encrypted if they match this rule.

This rule only matches outgoing packets. You will need a similar rule to match incoming packets.

```
spdadd W.X.Y.Z/32 A.B.C.D/32 ipencap -P in ipsec esp/tunnel/W.X.Y.Z-A.B.C.D/require;
```

Note the `in` instead of `out` in this case, and the necessary reversal of the IP addresses.

The other gateway host (which has the public IP address `W.X.Y.Z`) will need similar rules.

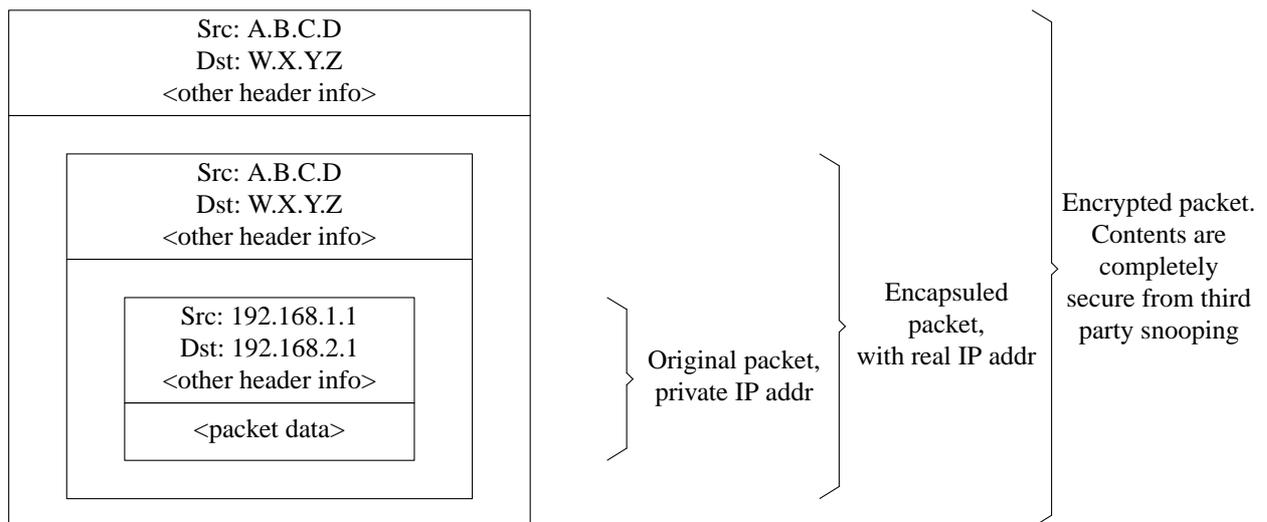
```
spdadd W.X.Y.Z/32 A.B.C.D/32 ipencap -P out ipsec esp/tunnel/W.X.Y.Z-A.B.C.D/require;
spdadd A.B.C.D/32 W.X.Y.Z/32 ipencap -P in ipsec esp/tunnel/A.B.C.D-W.X.Y.Z/require;
```

Finally, you need to add firewall rules to allow ESP and IPENCAP packets back and forth. These rules will need to be added to both hosts.

```
ipfw add 1 allow esp from A.B.C.D to W.X.Y.Z
ipfw add 1 allow esp from W.X.Y.Z to A.B.C.D
ipfw add 1 allow ipencap from A.B.C.D to W.X.Y.Z
ipfw add 1 allow ipencap from W.X.Y.Z to A.B.C.D
```

Because the rules are symmetric you can use the same rules on each gateway host.

Outgoing packets will now look something like this:



When they are received by the far end of the VPN they will first be decrypted (using the security associations that have been negotiated by `racoon`). Then they will enter the `gif` interface, which will unwrap the second layer, until you are left with the innermost packet, which can then travel in to the inner network.

You can check the security using the same `ping(8)` test from earlier. First, log in to the `A.B.C.D` gateway machine, and run:

```
tcpdump dst host 192.168.2.1
```

In another log in session on the same host run

```
ping 192.168.2.1
```

This time you should see output like the following:

```
XXX tcpdump output
```

Now, as you can see, tcpdump(1) shows the ESP packets. If you try to examine them with the `-s` option you will see (apparently) gibberish, because of the encryption.

Congratulations. You have just set up a VPN between two remote sites.

Summary

- Configure both kernels with:

```
options IPSEC
options IPSEC_ESP
```

- Install `security/ipsec-tools`. Edit `${PREFIX}/etc/racoon/psk.txt` on both gateway hosts, adding an entry for the remote host's IP address and a secret key that they both know. Make sure this file is mode 0600.

- Add the following lines to `/etc/rc.conf` on each host:

```
ipsec_enable="YES"
ipsec_file="/etc/ipsec.conf"
```

- Create an `/etc/ipsec.conf` on each host that contains the necessary `spdadd` lines. On gateway host #1 this would be:

```
spdadd A.B.C.D/32 W.X.Y.Z/32 ipencap -P out ipsec
    esp/tunnel/A.B.C.D-W.X.Y.Z/require;
spdadd W.X.Y.Z/32 A.B.C.D/32 ipencap -P in ipsec
    esp/tunnel/W.X.Y.Z-A.B.C.D/require;
```

On gateway host #2 this would be:

```
spdadd W.X.Y.Z/32 A.B.C.D/32 ipencap -P out ipsec
    esp/tunnel/W.X.Y.Z-A.B.C.D/require;
spdadd A.B.C.D/32 W.X.Y.Z/32 ipencap -P in ipsec
    esp/tunnel/A.B.C.D-W.X.Y.Z/require;
```

- Add firewall rules to allow IKE, ESP, and IPENCAP traffic to both hosts:

```
ipfw add 1 allow udp from A.B.C.D to W.X.Y.Z isakmp
ipfw add 1 allow udp from W.X.Y.Z to A.B.C.D isakmp
ipfw add 1 allow esp from A.B.C.D to W.X.Y.Z
ipfw add 1 allow esp from W.X.Y.Z to A.B.C.D
ipfw add 1 allow ipencap from A.B.C.D to W.X.Y.Z
ipfw add 1 allow ipencap from W.X.Y.Z to A.B.C.D
```

The previous two steps should suffice to get the VPN up and running. Machines on each network will be able to refer to one another using IP addresses, and all traffic across the link will be automatically and securely encrypted.

14.11 OpenSSH

Contributed by Chern Lee.

OpenSSH is a set of network connectivity tools used to access remote machines securely. It can be used as a direct replacement for `rlogin`, `rsh`, `rsh`, `rsh`, and `telnet`. Additionally, TCP/IP connections can be tunneled/forwarded securely through SSH. **OpenSSH** encrypts all traffic to effectively eliminate eavesdropping, connection hijacking, and other network-level attacks.

OpenSSH is maintained by the OpenBSD project, and is based upon SSH v1.2.12 with all the recent bug fixes and updates. It is compatible with both SSH protocols 1 and 2.

14.11.1 Advantages of Using OpenSSH

Normally, when using `telnet(1)` or `rlogin(1)`, data is sent over the network in a clear, un-encrypted form. Network sniffers anywhere in between the client and server can steal your user/password information or data transferred in your session. **OpenSSH** offers a variety of authentication and encryption methods to prevent this from happening.

14.11.2 Enabling sshd

The `sshd` is an option presented during a Standard install of FreeBSD. To see if `sshd` is enabled, check the `rc.conf` file for:

```
sshd_enable="YES"
```

This will load `sshd(8)`, the daemon program for **OpenSSH**, the next time your system initializes. Alternatively, it is possible to use `/etc/rc.d/sshd rc(8)` script to start **OpenSSH**:

```
/etc/rc.d/sshd start
```

14.11.3 SSH Client

The `ssh(1)` utility works similarly to `rlogin(1)`.

```
# ssh user@example.com
Host key not found from the list of known hosts.
Are you sure you want to continue connecting (yes/no)? yes
Host 'example.com' added to the list of known hosts.
user@example.com's password: *****
```

The login will continue just as it would have if a session was created using `rlogin` or `telnet`. SSH utilizes a key fingerprint system for verifying the authenticity of the server when the client connects. The user is prompted to enter `yes` only when connecting for the first time. Future attempts to login are all verified against the saved fingerprint key. The SSH client will alert you if the saved fingerprint differs from the received fingerprint on future login attempts. The fingerprints are saved in `~/.ssh/known_hosts`, or `~/.ssh/known_hosts2` for SSH v2 fingerprints.

By default, recent versions of the **OpenSSH** servers only accept SSH v2 connections. The client will use version 2 if possible and will fall back to version 1. The client can also be forced to use one or the other by passing it the `-1` or `-2` for version 1 or version 2, respectively. The version 1 compatibility is maintained in the client for backwards compatibility with older versions.

14.11.4 Secure Copy

The `scp(1)` command works similarly to `rcp(1)`; it copies a file to or from a remote machine, except in a secure fashion.

```
# scp user@example.com:/COPYRIGHT COPYRIGHT
user@example.com's password: *****
COPYRIGHT          100% |*****| 4735
00:00
#
```

Since the fingerprint was already saved for this host in the previous example, it is verified when using `scp(1)` here.

The arguments passed to `scp(1)` are similar to `cp(1)`, with the file or files in the first argument, and the destination in the second. Since the file is fetched over the network, through SSH, one or more of the file arguments takes on the form `user@host:<path_to_remote_file>`.

14.11.5 Configuration

The system-wide configuration files for both the **OpenSSH** daemon and client reside within the `/etc/ssh` directory. `ssh_config` configures the client settings, while `sshd_config` configures the daemon.

Additionally, the `sshd_program` (`/usr/sbin/sshd` by default), and `sshd_flags rc.conf` options can provide more levels of configuration.

14.11.6 ssh-keygen

Instead of using passwords, `ssh-keygen(1)` can be used to generate DSA or RSA keys to authenticate a user:

```
% ssh-keygen -t dsa
Generating public/private dsa key pair.
Enter file in which to save the key (/home/user/.ssh/id_dsa):
Created directory '/home/user/.ssh'.
Enter passphrase (empty for no passphrase):
Enter same passphrase again:
Your identification has been saved in /home/user/.ssh/id_dsa.
Your public key has been saved in /home/user/.ssh/id_dsa.pub.
The key fingerprint is:
bb:48:db:f2:93:57:80:b6:aa:bc:f5:d5:ba:8f:79:17 user@host.example.com
```

`ssh-keygen(1)` will create a public and private key pair for use in authentication. The private key is stored in `~/.ssh/id_dsa` or `~/.ssh/id_rsa`, whereas the public key is stored in `~/.ssh/id_dsa.pub` or `~/.ssh/id_rsa.pub`, respectively for DSA and RSA key types. The public key must be placed in `~/.ssh/authorized_keys` of the remote machine in order for the setup to work. Similarly, RSA version 1 public keys should be placed in `~/.ssh/authorized_keys`.

This will allow connection to the remote machine based upon SSH keys instead of passwords.

If a passphrase is used in `ssh-keygen(1)`, the user will be prompted for a password each time in order to use the private key. `ssh-agent(1)` can alleviate the strain of repeatedly entering long passphrases, and is explored in the [Εἰσαγωγή 14.11.7](#) section below.

Προσοχή: The various options and files can be different according to the **OpenSSH** version you have on your system; to avoid problems you should consult the `ssh-keygen(1)` manual page.

14.11.7 `ssh-agent` and `ssh-add`

The `ssh-agent(1)` and `ssh-add(1)` utilities provide methods for **SSH** keys to be loaded into memory for use, without needing to type the passphrase each time.

The `ssh-agent(1)` utility will handle the authentication using the private key(s) that are loaded into it. `ssh-agent(1)` should be used to launch another application. At the most basic level, it could spawn a shell or at a more advanced level, a window manager.

To use `ssh-agent(1)` in a shell, first it will need to be spawned with a shell as an argument. Secondly, the identity needs to be added by running `ssh-add(1)` and providing it the passphrase for the private key. Once these steps have been completed the user will be able to `ssh(1)` to any host that has the corresponding public key installed. For example:

```
% ssh-agent csh
% ssh-add
Enter passphrase for /home/user/.ssh/id_dsa:
Identity added: /home/user/.ssh/id_dsa (/home/user/.ssh/id_dsa)
%
```

To use `ssh-agent(1)` in X11, a call to `ssh-agent(1)` will need to be placed in `~/.xinitrc`. This will provide the `ssh-agent(1)` services to all programs launched in X11. An example `~/.xinitrc` file might look like this:

```
exec ssh-agent startxfce4
```

This would launch `ssh-agent(1)`, which would in turn launch **XFCE**, every time X11 starts. Then once that is done and X11 has been restarted so that the changes can take effect, simply run `ssh-add(1)` to load all of your **SSH** keys.

14.11.8 **SSH Tunneling**

OpenSSH has the ability to create a tunnel to encapsulate another protocol in an encrypted session.

The following command tells `ssh(1)` to create a tunnel for **telnet**:

```
% ssh -2 -N -f -L 5023:localhost:23 user@foo.example.com
%
```

The `ssh` command is used with the following options:

-2

Forces `ssh` to use version 2 of the protocol. (Do not use if you are working with older **SSH** servers)

-N

Indicates no command, or tunnel only. If omitted, `ssh` would initiate a normal session.

-f

Forces ssh to run in the background.

-L

Indicates a local tunnel in *localport:remotehost:remoteport* fashion.

user@foo.example.com

The remote SSH server.

An SSH tunnel works by creating a listen socket on localhost on the specified port. It then forwards any connection received on the local host/port via the SSH connection to the specified remote host and port.

In the example, port 5023 on localhost is being forwarded to port 23 on localhost of the remote machine. Since 23 is **telnet**, this would create a secure **telnet** session through an SSH tunnel.

This can be used to wrap any number of insecure TCP protocols such as SMTP, POP3, FTP, etc.

Example 14-1. Using SSH to Create a Secure Tunnel for SMTP

```
% ssh -2 -N -f -L 5025:localhost:25 user@mailserver.example.com
user@mailserver.example.com's password: *****
% telnet localhost 5025
Trying 127.0.0.1...
Connected to localhost.
Escape character is '^]'.
220 mailserver.example.com ESMTP
```

This can be used in conjunction with an ssh-keygen(1) and additional user accounts to create a more seamless/hassle-free SSH tunneling environment. Keys can be used in place of typing a password, and the tunnels can be run as a separate user.

14.11.8.1 Practical SSH Tunneling Examples

14.11.8.1.1 Secure Access of a POP3 Server

At work, there is an SSH server that accepts connections from the outside. On the same office network resides a mail server running a POP3 server. The network, or network path between your home and office may or may not be completely trustable. Because of this, you need to check your e-mail in a secure manner. The solution is to create an SSH connection to your office's SSH server, and tunnel through to the mail server.

```
% ssh -2 -N -f -L 2110:mail.example.com:110 user@ssh-server.example.com
user@ssh-server.example.com's password: *****
```

When the tunnel is up and running, you can point your mail client to send POP3 requests to localhost port 2110. A connection here will be forwarded securely across the tunnel to mail.example.com.

14.11.8.1.2 Bypassing a Draconian Firewall

Some network administrators impose extremely draconian firewall rules, filtering not only incoming connections, but outgoing connections. You may be only given access to contact remote machines on ports 22 and 80 for SSH and web surfing.

You may wish to access another (perhaps non-work related) service, such as an Ogg Vorbis server to stream music. If this Ogg Vorbis server is streaming on some other port than 22 or 80, you will not be able to access it.

The solution is to create an SSH connection to a machine outside of your network's firewall, and use it to tunnel to the Ogg Vorbis server.

```
% ssh -2 -N -f -L 8888:music.example.com:8000 user@unfirewalled-system.example.org
user@unfirewalled-system.example.org's password: *****
```

Your streaming client can now be pointed to localhost port 8888, which will be forwarded over to music.example.com port 8000, successfully evading the firewall.

14.11.9 The `AllowUsers` Users Option

It is often a good idea to limit which users can log in and from where. The `AllowUsers` option is a good way to accomplish this. For example, to only allow the `root` user to log in from `192.168.1.32`, something like this would be appropriate in the `/etc/ssh/sshd_config` file:

```
AllowUsers root@192.168.1.32
```

To allow the user `admin` to log in from anywhere, just list the username by itself:

```
AllowUsers admin
```

Multiple users should be listed on the same line, like so:

```
AllowUsers root@192.168.1.32 admin
```

Όχι! Βλῆτε: It is important that you list each user that needs to log in to this machine; otherwise they will be locked out.

After making changes to `/etc/ssh/sshd_config` you must tell `sshd(8)` to reload its config files, by running:

```
# /etc/rc.d/sshd reload
```

14.11.10 Further Reading

OpenSSH (<http://www.openssh.com/>)

ssh(1) scp(1) ssh-keygen(1) ssh-agent(1) ssh-add(1) ssh_config(5)

sshd(8) sftp-server(8) sshd_config(5)

14.12 File System Access Control Lists

Contributed by Tom Rhodes.

In conjunction with file system enhancements like snapshots, FreeBSD 5.0 and later offers the security of File System Access Control Lists (ACLs).

Access Control Lists extend the standard UNIX permission model in a highly compatible (POSIX.1e) way. This feature permits an administrator to make use of and take advantage of a more sophisticated security model.

To enable ACL support for UFS file systems, the following:

```
options UFS_ACL
```

must be compiled into the kernel. If this option has not been compiled in, a warning message will be displayed when attempting to mount a file system supporting ACLs. This option is included in the `GENERIC` kernel. ACLs rely on extended attributes being enabled on the file system. Extended attributes are natively supported in the next generation UNIX file system, UFS2.

Όχιἄβυός: A higher level of administrative overhead is required to configure extended attributes on UFS1 than on UFS2. The performance of extended attributes on UFS2 is also substantially higher. As a result, UFS2 is generally recommended in preference to UFS1 for use with access control lists.

ACLs are enabled by the mount-time administrative flag, `acls`, which may be added to `/etc/fstab`. The mount-time flag can also be automatically set in a persistent manner using `tunefs(8)` to modify a superblock ACLs flag in the file system header. In general, it is preferred to use the superblock flag for several reasons:

- The mount-time ACLs flag cannot be changed by a remount (`mount(8) -u`), only by means of a complete `umount(8)` and fresh `mount(8)`. This means that ACLs cannot be enabled on the root file system after boot. It also means that you cannot change the disposition of a file system once it is in use.
- Setting the superblock flag will cause the file system to always be mounted with ACLs enabled even if there is not an `fstab` entry or if the devices re-order. This prevents accidental mounting of the file system without ACLs enabled, which can result in ACLs being improperly enforced, and hence security problems.

Όχιἄβυός: We may change the ACLs behavior to allow the flag to be enabled without a complete fresh `mount(8)`, but we consider it desirable to discourage accidental mounting without ACLs enabled, because you can shoot your feet quite nastily if you enable ACLs, then disable them, then re-enable them without flushing the extended attributes. In general, once you have enabled ACLs on a file system, they should not be disabled, as the resulting file protections may not be compatible with those intended by the users of the system, and re-enabling ACLs may re-attach the previous ACLs to files that have since had their permissions changed, resulting in other unpredictable behavior.

File systems with ACLs enabled will show a + (plus) sign in their permission settings when viewed. For example:

```
drwx----- 2 robert robert 512 Dec 27 11:54 private
drwxrwx---+ 2 robert robert 512 Dec 23 10:57 directory1
drwxrwx---+ 2 robert robert 512 Dec 22 10:20 directory2
drwxrwx---+ 2 robert robert 512 Dec 27 11:57 directory3
drwxr-xr-x 2 robert robert 512 Nov 10 11:54 public_html
```

Here we see that the `directory1`, `directory2`, and `directory3` directories are all taking advantage of ACLs. The `public_html` directory is not.

14.12.1 Making Use of ACLs

The file system ACLs can be viewed by the `getfacl(1)` utility. For instance, to view the ACL settings on the `test` file, one would use the command:

```
% getfacl test
#file:test
#owner:1001
#group:1001
user::rw-
group::r--
other::r--
```

To change the ACL settings on this file, invoke the `setfacl(1)` utility. Observe:

```
% setfacl -k test
```

The `-k` flag will remove all of the currently defined ACLs from a file or file system. The more preferable method would be to use `-b` as it leaves the basic fields required for ACLs to work.

```
% setfacl -m u:trhodes:rw,group:web:r--,o:--- test
```

In the aforementioned command, the `-m` option was used to modify the default ACL entries. Since there were no pre-defined entries, as they were removed by the previous command, this will restore the default options and assign the options listed. Take care to notice that if you add a user or group which does not exist on the system, an “Invalid argument” error will be printed to `stdout`.

14.13 Monitoring Third Party Security Issues

Contributed by Tom Rhodes.

In recent years, the security world has made many improvements to how vulnerability assessment is handled. The threat of system intrusion increases as third party utilities are installed and configured for virtually any operating system available today.

Vulnerability assessment is a key factor in security, and while FreeBSD releases advisories for the base system, doing so for every third party utility is beyond the FreeBSD Project’s capability. There is a way to mitigate third party vulnerabilities and warn administrators of known security issues. A FreeBSD add on utility known as **Portaudit** exists solely for this purpose.

The `ports-mgmt/portaudit` port polls a database, updated and maintained by the FreeBSD Security Team and ports developers, for known security issues.

To begin using **Portaudit**, one must install it from the Ports Collection:

```
# cd /usr/ports/ports-mgmt/portaudit && make install clean
```

During the install process, the configuration files for `periodic(8)` will be updated, permitting **Portaudit** output in the daily security runs. Ensure the daily security run emails, which are sent to `root`'s email account, are being read. No more configuration will be required here.

After installation, an administrator can update the database and view known vulnerabilities in installed packages by invoking the following command:

```
# portaudit -Fda
```

Ότι: The database will automatically be updated during the `periodic(8)` run; thus, the previous command is completely optional. It is only required for the following examples.

To audit the third party utilities installed as part of the Ports Collection at anytime, an administrator need only run the following command:

```
# portaudit -a
```

Portaudit will produce something like this for vulnerable packages:

```
Affected package: cups-base-1.1.22.0_1
Type of problem: cups-base -- HPGL buffer overflow vulnerability.
Reference: <http://www.FreeBSD.org/ports/portaudit/40a3bca2-6809-11d9-a9e7-0001020eed82.html>
```

```
1 problem(s) in your installed packages found.
```

```
You are advised to update or deinstall the affected package(s) immediately.
```

By pointing a web browser to the URL shown, an administrator may obtain more information about the vulnerability in question. This will include versions affected, by FreeBSD Port version, along with other web sites which may contain security advisories.

In short, **Portaudit** is a powerful utility and extremely useful when coupled with the **Portupgrade** port.

14.14 FreeBSD Security Advisories

Contributed by Tom Rhodes.

Like many production quality operating systems, FreeBSD publishes "Security Advisories". These advisories are usually mailed to the security lists and noted in the Errata only after the appropriate releases have been patched. This section will work to explain what an advisory is, how to understand it, and what measures to take in order to patch a system.

14.14.1 What does an advisory look like?

The FreeBSD security advisories look similar to the one below, taken from the `freebsd-security-notifications` (<http://lists.FreeBSD.org/mailman/listinfo/freebsd-security-notifications>) mailing list.

```
=====
FreeBSD-SA-XX:XX.UTIL Security Advisory
```

Topic: denial of service due to some problem^①

Category: core^②

Module: sys^③

Announced: 2003-09-23^④

Credits: Person@EMAIL-ADDRESS^⑤

Affects: All releases of FreeBSD^⑥
FreeBSD 4-STABLE prior to the correction date

Corrected: 2003-09-23 16:42:59 UTC (RELENG_4, 4.9-PRERELEASE)
2003-09-23 20:08:42 UTC (RELENG_5_1, 5.1-RELEASE-p6)
2003-09-23 20:07:06 UTC (RELENG_5_0, 5.0-RELEASE-p15)
2003-09-23 16:44:58 UTC (RELENG_4_8, 4.8-RELEASE-p8)
2003-09-23 16:47:34 UTC (RELENG_4_7, 4.7-RELEASE-p18)
2003-09-23 16:49:46 UTC (RELENG_4_6, 4.6-RELEASE-p21)
2003-09-23 16:51:24 UTC (RELENG_4_5, 4.5-RELEASE-p33)
2003-09-23 16:52:45 UTC (RELENG_4_4, 4.4-RELEASE-p43)
2003-09-23 16:54:39 UTC (RELENG_4_3, 4.3-RELEASE-p39)^⑦

CVE Name: CVE-XXXX-XXXX^⑧

For general information regarding FreeBSD Security Advisories, including descriptions of the fields above, security branches, and the following sections, please visit <http://www.FreeBSD.org/security/>.

- I. Background^⑨
- II. Problem Description⁽¹⁰⁾
- III. Impact⁽¹¹⁾
- IV. Workaround⁽¹²⁾
- V. Solution⁽¹³⁾
- VI. Correction details⁽¹⁴⁾
- VII. References⁽¹⁵⁾

- ① The `Topic` field indicates exactly what the problem is. It is basically an introduction to the current security advisory and notes the utility with the vulnerability.
- ② The `Category` refers to the affected part of the system which may be one of `core`, `contrib`, or `ports`. The `core` category means that the vulnerability affects a core component of the FreeBSD operating system. The `contrib` category means that the vulnerability affects software contributed to the FreeBSD Project, such as

sendmail. Finally the `ports` category indicates that the vulnerability affects add on software available as part of the Ports Collection.

- ③ The `Module` field refers to the component location, for instance `sys`. In this example, we see that the module, `sys`, is affected; therefore, this vulnerability affects a component used within the kernel.
- ④ The `Announced` field reflects the date said security advisory was published, or announced to the world. This means that the security team has verified that the problem does exist and that a patch has been committed to the FreeBSD source code repository.
- ⑤ The `Credits` field gives credit to the individual or organization who noticed the vulnerability and reported it.
- ⑥ The `Affects` field explains which releases of FreeBSD are affected by this vulnerability. For the kernel, a quick look over the output from `ident` on the affected files will help in determining the revision. For ports, the version number is listed after the port name in `/var/db/pkg`. If the system does not sync with the FreeBSD CVS repository and rebuild daily, chances are that it is affected.
- ⑦ The `Corrected` field indicates the date, time, time offset, and release that was corrected.
- ⑧ Reserved for the identification information used to look up vulnerabilities in the Common Vulnerabilities Database system.
- ⑨ The `Background` field gives information on exactly what the affected utility is. Most of the time this is why the utility exists in FreeBSD, what it is used for, and a bit of information on how the utility came to be.
- (10) The `Problem Description` field explains the security hole in depth. This can include information on flawed code, or even how the utility could be maliciously used to open a security hole.
- (11) The `Impact` field describes what type of impact the problem could have on a system. For example, this could be anything from a denial of service attack, to extra privileges available to users, or even giving the attacker superuser access.
- (12) The `Workaround` field offers a feasible workaround to system administrators who may be incapable of upgrading the system. This may be due to time constraints, network availability, or a slew of other reasons. Regardless, security should not be taken lightly, and an affected system should either be patched or the security hole workaround should be implemented.
- (13) The `Solution` field offers instructions on patching the affected system. This is a step by step tested and verified method for getting a system patched and working securely.
- (14) The `Correction Details` field displays the CVS branch or release name with the periods changed to underscore characters. It also shows the revision number of the affected files within each branch.
- (15) The `References` field usually offers sources of other information. This can include web URLs, books, mailing lists, and newsgroups.

14.15 Process Accounting

Contributed by Tom Rhodes.

Process accounting is a security method in which an administrator may keep track of system resources used, their allocation among users, provide for system monitoring, and minimally track a user's commands.

This indeed has its own positive and negative points. One of the positives is that an intrusion may be narrowed down to the point of entry. A negative is the amount of logs generated by process accounting, and the disk space they may require. This section will walk an administrator through the basics of process accounting.

14.15.1 Enable and Utilizing Process Accounting

Before making use of process accounting, it must be enabled. To do this, execute the following commands:

```
# touch /var/account/acct
# accton /var/account/acct
# echo 'accounting_enable="YES"' >> /etc/rc.conf
```

Once enabled, accounting will begin to track CPU stats, commands, etc. All accounting logs are in a non-human readable format and may be viewed using the `sa(8)` utility. If issued without any options, `sa` will print information relating to the number of per user calls, the total elapsed time in minutes, total CPU and user time in minutes, average number of I/O operations, etc.

To view information about commands being issued, one would use the `lastcomm(1)` utility. The `lastcomm` may be used to print out commands issued by users on specific `ttys(5)`, for example:

```
# lastcomm ls
trhodes tty1
```

Would print out all known usage of the `ls` by `trhodes` on the `tty1` terminal.

Many other useful options exist and are explained in the `lastcomm(1)`, `acct(5)` and `sa(8)` manual pages.

Όχι ἀπόρρητο

1. Under FreeBSD the standard login password may be up to 128 characters in length.

ΕὰοÛεάεί 15 Jails

ΌοιάέοοιñÛ άδñ οίí Matteo Riondato.

15.1 Όόίιθς

Όι εὰοÛεάεί άόδñ άιçάαβ όε άβίάέ όά jails (όόεάέÛ) όιò FreeBSD εάέ ðñ ÷ ñçόείιθιέίγίόάέ. Όά jails, θιò άίάοÛñιόάέ ιñέοιÛίάò οίñÛ ð όάί ιέά άίέο ÷ οίÛίç άίάέεάέόέεÏ εýόç áέά ðñέάÛέειíόά chroot, άβίάέ Ûίά έό ÷ οññ άñάάέάβι áέά áέά ÷ áέñέόόÛ ðόόόçιÛόñι, áέεÛ ç áάόέεÏ όιò ð ñÏόç ιθιñάβ άðβόç όά άβίάέ ÷ ñÏόείç όά ðñι ÷ ùñçιÛίò ð ñÏόάð.

Άοίγ áέάáÛόάόά άόδñ όι εὰοÛεάεί, έά ιÛñάόά:

- Όέ άβίάέ Ûίά jail εάέ όé οέιðñ ιθιñάβ ιά άιòðçñάðÏόάέ όά άάέάόάόóÛόάέò FreeBSD.
- ðñ όά όóéÛίάόά, ιά áέέείÏόάόά, εάέ ιά όόάιáðÏόάόά Ûίά jail.
- Όά áάόέéÛ όçð áέá ÷ άβñέόçð άíñð jail, óñοι ιÛόά, ùοι εάέ Ûñ άδñ άόδñ.

¶έεάð ðçáÛ ð ñÏόείιθι ðççñιιñέβι ó ÷ άόέéÛ ιά όά jails άβίάέ:

- Ç óáéβάá manual όιò jail(8). ðñέÛ ÷ áé ðéÏñç άίάόιñÛ όιò άιçέçόééίγ ðñιñÛÛιáόιò jail — όιò áέá ÷ áέñέόóééίγ άñάάέάβιò θιò ιθιñάβ ιά ð ñçόείιθιέέçάβ όόι FreeBSD áέά όçι áέéβίçόç, áέάέιðÏ, εάέ Ûέάá ÷ ι όñι jails.
- Æ éβóóáð όá ÷ ðññιñάβιò εάέ όά άñ ÷ άβá όιòð. Όά άñ ÷ άβá άδñ όçι çéáéòñιιέéÏ éβóóá ááιέéβι άññòðóáñι όιò FreeBSD (<http://lists.FreeBSD.org/mailman/listinfo/freebsd-questions>) εάέ Ûέéáð éβóóáð θιò άιòðçñάόίγίόάέ άðñ όιι άιòðçñάόçð ð áέá çéáéòñιιέéÛ éβóóáð όιò FreeBSD (<http://lists.FreeBSD.org/mailman/listinfo>) ðñέÛ ÷ ιóι ðéÏñç ιάçáñ áέá όά jails. Άβίάέ ðÛίόιòά άίάέάóÛñι ιά øÛ ÷ ιάόά όά άñ ÷ άβá Ï ιά άçιιόéáγáðά ιÛάð άññòðóáéð óç éβóóá freebsd-questions (<http://lists.FreeBSD.org/mailman/listinfo/freebsd-questions>).

15.2 ¼ñιέ όñι Jails

Άέά ιά έáóáñÏόάόά έáéγóáñά όι ðñ òé áóòðáñέéÛ éáéóιòñάβáð όιò FreeBSD ó ÷ áòβáειíόάέ ιά όά jails εάέ ðñ άóóÛ áééçéáðéáñιγί ιά όά ððñιέíðά ιÛñç όιò FreeBSD, έá ÷ ñçόείιθιέéÏόιá áéðáíÏð όιòð ðñάέÛòñ ùñòð:

chroot(8) (άίόιéÏ)

ιá άιçέçόééñ ðññάñáιá, όι ιðñι ÷ ñçόείιθιέάβ όçι ééÏόç óóóðÏιáόιò chroot(2) όιò FreeBSD áέá ιά áééÛίáé όιι áιíééñ έáóÛέιáι (root directory) ιέáð áéáñάáóβáð εάέ ùéñι óñι Ûέéñι áéáñάáóéβι θιò άιáñòβιόάέ άδñ άóðÏ.

chroot(2) (ðñέáÛέéιí)

Όι ðñέáÛέéιí ιέá áéáñάáóβáð θιò ðñÛ ÷ áé ιÛόά όά Ûίά “chroot”. Άóòñ ðñέéáñáÛίáé ðññιòð ùðñð όι όιÏιá όιò óóóðÏιáόιò άñ ÷ άβñι θιò άβίάέ ιñάðñ, όά ID όιò ÷ ñÏόόç εάέ όçð ñÛááð θιò άβίάέ áέáéÛόéιá, εάéð εάέ óéð áéáðáóÛ ð áééóγίò (network interfaces), όιòð ιç ÷ άίέóιγýð IPC ééð.

jail(8) (άίόιéÏ)

Όι ðññάñáιá θιò óáð áðéòñÛίðáé ιά áέá ÷ áéñβáéáóóá όι óγóóçιá óáð εάέ ιά ιáέείÛóá áéáñάáóβáð óá ðñέáÛέéιí jail.

host (όγώοçιά (system), äéãñãáóßá (process), ÷ñÞóóçò (user), êëð.)

Ôí òðóëëù óγώοçιά ðíò òëëñáíáß éáë äëÝá÷äë Ýíá ðãñéáÛëëíí jail. Ôí host system Ý÷äë ðñüóááóç óá ùëí òí äéáëÝóëí òëëëù, éáë ìðññáß íá äëÝáñáë äéãñãáóßáð òüóí ìÝóá ùóí éáë Ýñù áðù òí ðãñéáÛëëíí òíò jail. Ìßá áðù òéð óçíáíôëëùðãñãð äéáóíñÝð ìáðáíý òíò host system éáë òíò jail áßíáë ùðë íë ðãñéíéóííß ðíò áóáñíüæííðáë òéðð äéãñãáóßáð òíò ÷ñÞóóç root ìÝóá òóí ðãñéáÛëëíí jail, ááí éó÷ýíííí äéá òéð äéãñãáóßáð òóí host system.

hosted (όγώοçιά (system), äéãñãáóßá (process), ÷ñÞóóçò (user), êëð.)

Ìéá äéãñãáóßá, Ýíáð ÷ñÞóóçò Þ ëÛðíéá Ûëëç ìíðüðçðá, òíò ìðññáß ç ðñüóááóç óóíòð ðññíòð òíò óðóðÞíáðíð ðãñéíñæáðáë ìÝóá áðù Ýíá jail.

15.3 Áéóáãñã

Ìéá éáë ç äéá÷áßñéóç áñüð óðóðÞíáðíò ìðññáß íá áßíáë áγóëíëç éáë ðãññðëíëç, áíáððý÷ëçéáí áñéáðÛ ãñãáëáßá óá ìðññáß ìðññíý íá ëÛñííí òç æùÞ áñüð äéá÷áëñéóðÞ ðíëý ðëí áγëíëç. Óá ãñãáëáßá áððÛ ðñíóóÝñíííí ëÛðíéáð ðññóéãáðð áóíáðüðçðáð ùóí áóíñÛ òíò ðññíðí äéáððÛóóáóçð, ãñýíëóçð éáë óóíðÞñçóçð áñüð óðóðÞíáðíð. Ìéá áðù òéð ãñãáóßáð ðíò áíáíÝíáðáë íá äéðáëÝóáë ëÛëá äéá÷áëñéóðÞð óðóðÞíáðíð, áßíáë íá ãðëíßóáë óüóðÛ óçí áóóÛëáéá òíò óðóðÞíáðíð, ðñíëáëíÝñíò íá ðñíóóÝñíáë òéð òðçñãáóßáð äéá òéð ìðññáð Ý÷äë ðññãññíáðéóóðáß, ÷ññßð íá äðéðñÝðäë óðíáëáóííýð óóçí áóóÛëáéá.

Íá áðù óá ãñãáëáßá ðíò ìðññíý íá áíéó÷ýóííí òçí áóóÛëáéá áñüð óðóðÞíáðíð FreeBSD áßíáë óá jails. Óá Jails ðññíðíáíðáíßðçéáí óóí FreeBSD 4.X áðù òíí Poul-Henning Kamp <phk@FreeBSD.org>, äëëÛ äáëðéðçéáí ðíëý ðãñéóóüðãññí òóçí Ýëáííóç FreeBSD 5.X, ðñíëáëíÝñíò íá ðñíóóÝñíííí ðãñéóóüðãñãð áðíáðüðçðáð éáë íá áßíáë ðãñéóóüðãññí áðÝëééðá. Ç áíÛðððíÞ òíòð òóíá÷æáðáé áëùíç, ìá äáëðéðçáéð óóíòð òññáßð òçð áð÷ñçóðßáð, òçð áðññíóçð, òçð áíéíðéóðßáð éáë òçð áóóÛëáéáð ðíò ðñÝðáë íá ðãñÝ÷ííí.

15.3.1 Óé Áßíáë Íá Jail

Óá äéáóíòñáëëÛ óðóðÞíáðá óýðíò BSD, ðãññáß÷áí òí chroot(2) áðù òçí áðí÷Þ òíò 4.2BSD. Ç áíðíëÞ chroot(8) ìðññáß íá ÷ñçóëíðíëçéáß äéá íá äéëÛíáë òíí áíéëù éáðÛëíáí íéáð ãÛááð äéãñãáóéðí, áçíëíòñáðíóáð Ýíá áóóáëÝð ðãñéáÛëëíí, ìá÷ññéóðü áðù òí òðñíëðíí óγώοçιά. ìáðáð äéãñãáóßáð áçíëíòñáðíóáë óá Ýíá òÝóíëíí ðãñéáÛëëíí, ááí Ý÷ííí ðññóááóç óá áñ÷áßá éáë ðññíòð Ýñù áðù áððü. Áéá áððü òí ëüáí, áí íéá òðçñãáóßá òñÝ÷äë ìÝóá óá Ýíá òÝóíëíí ðãñéáÛëëíí, éáë ëÛðíéáð äéáðíëÝáð éáðáóÝñíáë íá äéáéóáγóáë óá áððÞ, áá éá òíò áðéðñáðáß ç ðññóááóç óóí òðñíëðíí óγώοçιά. Ç áíðíëÞ chroot(8) áßíáë ðíëý éáëÞ äéá áðëÝð ãñãáóßáð íë ìðññáð áá ÷ññáëÛëííðáë íá áßíáë ðíëý áðÝëééðáð Þ íá äéáëÝóííí ðíëýðëíéá éáë ðñíçáíÝíá ÷áñáëðçñéóðéëÛ. Ûóðüóí, áðù òçí áñ÷Þ òçð éáÝáð òíò chroot, áñÝçééáí áñéáðíß ðññíðíé äéá íá ìðñÝóáë ëÛðíéáð íá ìáγááë áðù òí ðãñéáÛëëíí áððü. Ðãññ' ùëí ðíò Ý÷íííí äéíñëùëáß ðíëëÛ óóÛëíáðá òéðð ðññóááóðáð äéáüóáéð òíò ððñÞíá òíò FreeBSD, Þðáí ìáëÛëáñíí ùðë ç chroot(2) ááí Þðáí ç éááíéëÞ éýóç äéá òçí áóóÛëéóç òðçñãáóéðí. ðñãñáð íá òëíðíëçéáß Ýíá ìÝííí òðíóγóçιά.

Áððüð áßíáë Ýíáð áðù òíòð éγñéíòð ëüáíòð äéá òçí áíÛðððíç òüí jails.

Óá jails äáëðßóáí ìá äéÛóíñíòð ðññíðíòð òçí éáÝá òíò ðãñãáíéóáëíý ðãñéáÛëëííðíò òíò chroot(2). Óóí ðððéëù ðãñéáÛëëíí òíò chroot(2), íë äéãñãáóßáð ðãñéíñæáííðáë ìññð ùð ðñíð òí ìÝñíð òíò óðóðÞíáðíð áñ÷áßáíí ùðíò ìðññíý íá Ý÷íííí ðññóááóç. Ìë òðñíëðíí ðññíé òíò óðóðÞíáðíð (ùððð íë ÷ñÞóóáð, íë òñÝ÷íííð äéãñãáóßáð, òí òðíóγóçιά äééðýùóçð) áßíáë éíëíñ÷ñóðíé ìáðáíý òüí äéãñãáóéðíí òíò ðãñéáÛëëííðíò chroot éáë òüí äéãñãáóéðíí òíò host system. Óá jails áðäéðáßñííí áððü òí ìíðÝëí, ìá òçí äéëííéëíðíßçóç ù÷é ìññí òçð ðññóááóçð óóí óγώοçιά áñ÷áßáí, äéëÛ áðßóçð òüí ÷ñçóðíí, òíò òðíóðóðÞíáðíò äééðýóçðð òíò ððñÞíá òíò FreeBSD éáë ìáñéëðíí áëùíç ðñãñáíÛððü. Ðãñéóóüðãññí äéá òéð äéáëÝóéíáð áíðíëÝð ðíò ìðññíý íá ÷ñçóëíðíëçéáííí äéá òç ãñýíëóç éáë òíí Ýëáã÷ííí áñüð ðãñéáÛëëííðíò jail ìðññáßðá íá áñáßðá òóí ÓíÞíá 15.5.

Ôi Jail Ý ÷ äε öÝóóãñá εýñεά óóιε ÷ áßá:

- íáí εάöÛείτáι ìá äεεP öiö ãñP — öi ãñ ÷ εéü öçìáßi öóι ìöißi äεóÝñ ÷ äöáε Ýíá jail. Áðü öç öóεáìP öiö ðεá ãεãñáóóßá ãñßóεáöáε ìÝóá óá Ýíá jail, äáí äðεöñÝðáöáε íá äááε Ýü ãðü öií εάöÛείτáι áóöü. Óá ðñíáεPíáöá öiö óáεáεðñíýóáí öií ó ÷ äáεáóüü öiö chroot(2) äáí äðçñáÛείöi óá jails öiö FreeBSD.
- íá hostname (üñíá öóóðPíáöiö) — öi hostname öi ìöißi εá ÷ ñçóεíiðιεéçðáß ìÝóá öóι jail. Óá jails ÷ ñçóεíiðιεéçýiöáε εöñßüð äεá öçí áiöðçñÝöçóç äεéöðáεPí öðçñáóεPí, áðñÝüð ç ýðáñiç áüüð ÷ ãñáεöçñεóðεéçý hostname öiö íá ðñáεãñÛöáε óáöüü ÷ ñííá εáε öç ÷ ñPóç öiö, ìöiñáß íá áιçεPðáε ãñεáöÛ öií äεá ÷ äεñεóðP öóóðPíáöiö.
- ðεá äεáýεðiöç IP — áððP ç äεáýεðiöç áíöεóóιε ÷ áß óá Ýíá jail εáε äáí ìöiñáß íá äεεÛíáε εáöÛ öç äεÛñεáεá öçð æüPð öiö. Ç äεáýεðiöç IP áüüð jail áßíáε öóíPεüð ìßá äεáýεðiöç öýðiö alias äεá ðεá Pαç öðÛñ ÷ ðöóá äεáðáöP äεéöýiö (network interface), äεεÛ εÛöε öÝöιεí äáí áßíáε áðáñáßöçöi.
- ðßá áíöιεP — ç äεáãññP ðñiö Ýíá äεöáεÝóεí öi ìöißi εá äεöáεáßóáε ìÝóá öóι jail. Ç äεáãññP áððP áßíáε ó ÷ äöεéP üð ðñiö öií ãñεéü εάöÛείτáι öiö ðñáεãñÛεéíiö öiö jail, εáε ìöiñáß íá äεáöÝñáε öñεý áðü jail óá jail áíÛείτáι ìá öi öóáεäεñεíÝíi ðñáεãñÛεéíi.

Áεöüð áðöPí, óá jails ìöiñíýí íá Ý ÷ ðiö öεð äεéÝð öiöð ñÛááð ÷ ñçóöPí εáε öií äεéü öiöð ÷ ñPóç root. ÖðóééÛ, ì Ýεáá ÷ ð öiö Ý ÷ äε ì ÷ ñPóçð root öiö jail, ðñáεíñßæáöáε ìÝóá öóι ðñáεãñÛεéíi öiö jail, εáε áðü öçí ððóεP ãñíßá öiö host system, ì ÷ ñPóçð áðöüð äáí áßíáε ðáíöñáýíáíiö. ÁðεðεÝíi, ì ÷ ñPóçð root öiö jail, äáí ìöiñáß íá äεöáεÝóáε εñßóεíáð ãñááóáßáð öóι óýóöçíá Ýü ãðü öi ðñáεãñÛεéíi öiö jail(8). ðñáεóóüðãñáð ðççñíiöññáð ó ÷ äöééÛ ìá öεð äöíáóüöçöáð εáε öiöð ðñáεíñεóíiýð öiö root εá ãñáßöá öóι Ôiðíá 15.5.

15.4 ÄçιεíöññáPíöáð εáε ÄεÝã ÷ ðiöáð Jails

Ïãñεéíß äεá ÷ äεñεóðÝð öóóöçíÛöüí εáöçãññεíðιεéçý óá jails óá äýí áüüöçðáð: óá “complete (ðεPñç)” jails, óá ððißá ðιεñýiöáε Ýíá ðñááìáöεéü óýóöçíá FreeBSD, εáε óá “service” jails, óá ððißá ÷ ñçóεíiðιεéçýiöáε äεá ðεá äóãññáP öðçñáóá, öiö ðεεáíüí äεöáεáßóáε ìá äεáééÛ ðñíñüíεá. Áðöüð áßíáε Ýíáð ñιçöééüð äεá ÷ ðñεóíüð εáε äáí äðεãñÛ öçç äεááεéáóá äçιεíöññáð áüüð jail. Ç óáεßáá manual öiö jail(8) ðñáεÝ ÷ äε εáóáóíðεóóééÝð ðççñíiöññáð äεá öç äεááεéáóá äçιεíöññáð áüüð jail:

```
# setenv D /here/is/the/jail
# mkdir -p $D ❶
# cd /usr/src
# make buildworld ❷
# make installworld DESTDIR=$D ❸
# make distribution DESTDIR=$D ❹
# mount -t devfs devfs $D/dev ❺
```

- ❶ Ì εáεýðãññö ðññüðiö äεá íá ðáεéíPóáðá áßíáε ìá öçí äðεéñáP ðεáð εÝöçð (äεáãññPð) äεá öi jail óáð. Áêáß εá ãñßóεíñiöáε áðιεççáðöiÝíá óá ãñ ÷ áßá öiö jail üóι áóññÛ öi óýóöçíá óáð. ðεá εáεP εáÝá áßíáε öi /usr/jail/jailname, üðiö jailname öi hostname ìá öi ìöißi εá áíááñññæáöáε öi jail. Ôi óýóöçíá ãñ ÷ áßñí /usr/ Ý ÷ äε öóíPεüð ãñεáöü ÷ ðñí äεá öi óýóöçíá ãñ ÷ áßñí öiö jail, öi ìöißi, äεá Ýíá “complete” jail áßíáε ððóεáóðεéÛ Ýíáð εεPñö εÛεá ãñ ÷ áßñí öiö ááóééçý öóóðPíáöiö ðεá ðñíáðεéãñÝíçð äáεáöÛöóáöçð öiö FreeBSD.
- ❷ Ôi áPíá áóöü äáí áðáεðáßóáε áí Ý ÷ áðá ðáöáæüððöóáε öóι ðñáñáεéüí öi ááóééü óýóöçíá ÷ ñçóεíiðιεéçýiöáð öçí áíöιεP make world P make buildworld. ððiñáßöá äðεPð íá äáεáóáóðPóáðá öi öðÛñ ÷ ðñí óýóöçíá óáð öóι ðÝí jail.

- ③ Ç áíóηεΡ άόδΡ εά àìðεηòðβóάε ðηí εάóÛεηάη ðηò áðέε Ýíáòá áεά ðη jail ιά ùεά óá áðάñáβòçóá áñ÷áβá, áεάέεηεðεάò, óáεβááò áηðεάέάò έεð.
- ④ Òη distribution target ðηò **make** ááεάέεóóÛ ùεά óá áñ÷áβá ñòεìβóáùí ðηò áðάέóηγíóáε. Ιά áðεÛ εùáεά, ááεάέεóóÛ εÛεά áñ÷áβη áðu ðη /usr/src/etc/ óòηí εάóÛεηάη /etc ðηò ðáñέáÛεεηíðηò jail: \$D/etc/.
- ⑤ Άá ÷ñáεÛεάóáε ίά ðñηóáñðβóάòá ðη devfs(8) óòη ðáñέáÛεεηí ðηò jail. Άðu óçí Ûεεç ùùð, ùεάò, Ρ ó÷ááùí ùεάò ηε áóáñηάÝð ÷ñáεÛεηíóáε ðñηóááóç óá ðηòεÛ÷έóóηí ιβá óóóεάòΡ, áíáεùáùò ιά ðηí óεηðu óçð áóáñηάΡð. Άβίáε ðηεγ óçíáíóέεù ίά áεÝá÷áóáε ç ðñηóááóç óóέò óóóεáòÝð ιÝóá óá Ýíá jail, εάεðð εάηεáóηÝíáð ñòεìβóάέò ιðñáβ ίά áðέóñÝçðηí óá εÛðηεηί áεóáηεÝá ίά εÛίáε “Ûó÷çíá ðáε÷ιβáεά” ιÝóá óòη jail. Ι Ýέάá÷ηð ðηò devfs(8) áβίáóáε ιÝóù áñηò óóηúεηò εάíηíñí ηε ιðñηίε ðáñέáñÛεηíóáε óóέò óáεβááò manual ðηò devfs(8) εάε ðηò devfs.conf(5).

Άðu óçí óóέáηΡ ðηò Ý÷áε ááεάóáóóáεάβ Ýíá jail, ιðñáβ ίá áεέεηçðáβ ιά óç ÷ñβóç óçð áíóηεΡð jail(8). Ç jail(8) áÝ÷áóáε ðÝóóáñέò ððη÷ñáùòέεÝð ðáñáηÝðñηòð ηε ιðñáð ðáñέáñÛεηíóáε óòη Òηðηá 15.3.1. Ιðñáβóá ίá áðóáòá εάε Ûεεάò ðáñáηÝðñηòð, ð.÷., áεά ίá áεóáεÝóáòá ίεά áεáñááóβá óòη ðáñέáÛεεηí ðηò jail ιά óέò Ûááεάò áñηò óóáεáñεηíÝñηò ÷ñβóç. Ç ðáñÛáòñηò *command* áñáñðÛóáε áðu ðηí óγðη ðηò jail. Άέá Ýíá *áεέηέεù óγóóçíá*, ðη /etc/rc áβίáε ίεά εάεΡ áðεεηάΡ, ίεά εάε óóçí ηóóβá εά εεùñðηεΡóáε óçí áεάáεéáóβá áεεβίçóçð áñηò ðñááηáóέεηγ óóóðηáðηò FreeBSD. Άέá Ýíá *service jail*, ç ðáñÛáòñηò áñáñðÛóáε áðu óçí ððçñáóβá Ρ óçí áóáñηάΡ ðηò εά ðñÝ÷áε ιÝóá óòη jail.

Óá jails óðηðεùð ίáεέñγí εάóÛ óçí áεεβίçóç εάε ìç÷áίέóηùð rc ðηò FreeBSD ðáñÝ÷áε Ýíáí áγέηεηí ðñηðηí áεά ίá áβίáε εÛóέ ðÝóηίεηí.

- 1. Ç εβóóá ιά óá jails ðηò εÝέáòá ίá ίáεέηÛíá εάóÛ óçí áεεβίçóç εά ðñÝðáε ίá ðñηóóáεηγí óòη áñ÷áβη rc.conf(5):

```
jail_enable="YES" # Set to NO to disable starting of any jails
jail_list="www" # Space separated list of names of jails
```

Óçíáβúóç: Òη ùññá ðηò Ý÷áε εÛεά jail óóç εβóóá jail_list áðέóñÝðáóáε ίá ðáñέÝ÷áε ιññí áέóáñεéçóέεηγò ÷áñáέòΡñáò.

- 2. Άέá εÛεά jail ðηò ððÛñ÷áε óòη jail_list, εά ðñÝðáε ίá ðñηóóáεáβ ίεά ñÛáá áðu ñòεìβóáέò óòη rc.conf(5), ηε ιðñáð εά ðη ðáñέáñÛεηíðηí:

```
jail_www_rootdir="/usr/jail/www" # jail's root directory
jail_www_hostname="www.example.org" # jail's hostname
jail_www_ip="192.168.0.10" # jail's IP address
jail_www_devfs_enable="YES" # mount devfs in the jail
jail_www_devfs_ruleset="www_ruleset" # devfs ruleset to apply to jail
```

Ç ðñηáðέεááηÝç áεεβίçóç ðηò jail ιÝóù ðηò rc.conf(5), εά ίáεέηΡóáε ðη script ðηò jail /etc/rc, ðη ιðñηί ððηεÝóáε ùóέ ðη jail áβίáε Ýíá ηεηέεçñùñÝñí áεέηηέεù óγóóçíá. Άέá service jails, ç ðñηáðέεááηÝç áεεβίçóç ðñÝðáε ίá áεεÛίáε, ιñβεηíóáð εάóÛεεçεά óçí áðεεηάΡ jail_jailname_exec_start.

Óçíáβúóç: Άέá ðεΡñç εβóóá ðηí áεáεÝóέηùí áðεεηάΡ, ááβóá ðη rc.conf(5).

Òη script /etc/rc.d/jail ιðñáβ ίá ÷ñçóέηηðηεçεάβ áεά ίá ίáεέηΡóáε Ρ ίá óóáηáðβóáε εÛðηεηí jail ÷áεñηεβίçóá. ðñÝðáε ùùð ίá ððÛñ÷áε ç áíóβóóηε÷ç εάóá÷ñβçóç óòη rc.conf:

```
# /etc/rc.d/jail start www
```

```
# /etc/rc.d/jail stop www
```

Άέά όçí þñá ááí όðÛñ ÷ áέ εÛðιεíò áðυέοόά ούοóουò όñυðιεò áέά ίά όáñιáόβόáόá εÛðιεί jail(8). Άόóου όóιááβίáέ, áέυιόέ ίέ áίóιτεÛò ðιεò ÷ ñçóειιðιείίίόáέ όóιþεúò áέά ίά όáñιáόβόίοί ίá áόóÛεáέá Ýίá όýόόçíá, ááí ιðιιιίί ίá ÷ ñçóειιðιεέçείίί ίÛόá όðι ðáñέáÛεείί áíυò jail. Ì έáέýόáñιò ðñυðιεò áέά ίά όáñιáόβόáόá Ýίá jail áβίáέ ίá όçí áέóÛεáόç όçò áέυιέιòèçò áίóιτεþò ιÛόá áðu όι βáεί όι jail þ ίá ÷ ñþόç όιò áιçεçόέέίý ðñιáñÛιáίοιò jexec(8) Ýιò áðu áόóυ:

```
# sh /etc/rc.shutdown
```

Ðáñέόóυòáñáò ðεçñιιòιñβáò ó ÷ áóέέÛ ίá áόóþ όç áέááέέáόβá ιðιñáβόá ίá áñáβόá όόç óáεβáá áιçεáβáò όιò jail(8)

15.5 Êáðóιιáñþò Ñýειέόç έáέ Άέá ÷ áβñέόç

ΌðÛñ ÷ ιοί áñέáόÛò áðέειαÛò ðιεò ιðιιιίί ίá áóáñιιόóίίί όá Ýίá jail, έáεþò έáέ áεÛοιιιέ όñυðιε έáέ ίá όóιáόáόóáβ Ýίá όýόόçíá FreeBSD ίá jails ðñιέáείÛιò ίá ðáñÛáιοί áóáñιáÛò ðççεúóáñιò áðέóÛáιò. Ç áíυòçόá áόóþ ðáñιοóέÛáέ:

- ÌáñέέÛò áðu óέð áέáέÛóειáò áðέειαÛò áέá όçí ñýειέόç όçò όóιðáñέóιιñÛò έáέ óυι ðáñέιñέóιþí áóóáέáβáò ðιεò όειðιείίίόáέ áðu όçí ááέáóÛόóáόç áíυò jail.
- ÌáñέέÛò áóáñιáÛò ðççείý áðέóÛáιò áέá όç áέá ÷ áβñέόç jails, ίέ ιðιñáò áβίáέ áέáέÛóειáò ιÛόóυ όçò όóεειαþò óυι Ports όιò FreeBSD έáέ ιðιιιίί ίá ÷ ñçóειιðιεέçείίί όόçí όειðιβçόç ιειέεçñιιÛιúι έýόáιι ίá όç ÷ ñþόç jails.

15.5.1 Άñááέáβá όóόþιáόιò όιò FreeBSD áέá όç ñýειέόç jails

Êáðóιιáñþò ñýειέόç áíυò jail áβίáόáέ έáóÛ έýñεί ευáι ιÛόóυ óυι ιáóááεçόþι όιò sysctl(8). ΌðÛñ ÷ áέ Ýίá áέáέευι subtree όιò sysctl όι ιðιβι áðιòáεáβ όç áÛόç áέá όçí ιñáÛιúóç υέυι óυι ó ÷ áóέέþí áðέειαþí: ðñυέáέóáέ áέá όçí έáñáñ ÷ βá áðέειαþí ðóñþíá security.jail.*. ÐáñáέÛóυ έá áñáβόá ίέá εβόόá ίá óá έýñέá sysctl ðιεò ó ÷ áóβáιιόáέ ίá εÛðιεί jail έáεþò έáέ óέð ðñιáðέέááιÛíáò όειÛò όιòð. Óá ιιιιáόá ιÛεείí áιçáιίί áðu ιιιá όιòð όçí áίόβόóιέ ÷ ç έáέόιòñáβá, áέεÛ áέá ðáñέόóυòáñáò ðεçñιιòιñβáò ιðιñáβόá ίá ááβόá óέð óáεβááò áιþέáέáò óυι jail(8) έáέ sysctl(8).

- security.jail.set_hostname_allowed: 1
- security.jail.socket_unixiproute_only: 1
- security.jail.sysvipc_allowed: 0
- security.jail.enforce_statfs: 2
- security.jail.allow_raw_sockets: 0
- security.jail.chflags_allowed: 0
- security.jail.jailed: 0

Ìέ ιáóááεçόÛò áόóÛò ιðιιιίί ίá ÷ ñçóειιðιεέçείίί áðu όιι áέá ÷ áέñέóóþ όιò host system ðñιέáείÛιò ίá ðñιόέÛóáέ þ ίá áóáέñÛóáέ ðáñέιñέóιιýò ίέ ιðιβιέ όðÛñ ÷ ιοί áñ ÷ έέÛ όóιι ÷ ñþόóç root. ΌðÛñ ÷ ιοί υιúð έáέ εÛðιείέ ðáñέιñέóιιβ ίέ ιðιβιέ ááí ιðιιιίί ίá áóáέñáείίί. Ì ÷ ñþόóçò root ááí áðέóñÛíðáóáέ ίá ðñιόáñóÛ þ ίá áðι-ðñιόáñóÛ óóόþιáόá áñ ÷ áβυι ιÛόá áðu Ýίá jail(8). Ì root ιÛόá óá Ýίá jail ááí áðέóñÛíðáóáέ ίá οιñόþóáέ þ ίá áðιοιñόþóáέ όιòð έáíιιáò (rulesets) όιò devfs(8), όι firewall, έáέ áεÛοιιñáò Ûεεáò áñááόβáò áέá ÷ áβñέόçò ίέ ιðιñáò ÷ ñáέÛáιιόáέ όñιðιðιβçόç óυι áááñÛιúι όιò ðóñþíá, υðυò áέá ðáñÛááέáιá ι ιñέόιυð όιò securelevel όιò ðóñþíá.

Όι ááóέευι όýόόçíá όιò FreeBSD ðáñέÛ ÷ áέ óá ááóέέÛ áñááέáβá áέá όç ðñιáιεþ ðεçñιιοιñέþí ó ÷ áóέέÛ ίá óá áíáñáÛ jails, έáέ áðβόçò áέá όçí áíÛεáόç óðáεáεñείÛιúι áίóιτεþí áέá ÷ áβñέόçò óá εÛðιεί jail. Ìέ áίóιτεÛò jls(8) έáέ jexec(8)

άδιόαειρί 1Υñò òìò ááoεéιγ όóóóΠιáóìò òìò FreeBSD, εάε ìðìñίγί íá ÷ ñçóεììðìέçεìγί áεά íá òεó ðáñáεÛòù áðεÛò áñááóβáò:

- Ðñìáñεð εβóóáð òùì áíáñáπί jails εάε òìí áίóβóóìε÷ ùì ÷ áñáεòçñεóóεεβί òìòð - jail identifier (JID), áεάγέòìóç IP, hostname εάε path.
- Ðñìóεùεεçóç óá εÛðìεί áíáñáñù jail, áðu òì host system, εάε áεòÛεάóç εÛðìεάó áίòìεðò 1Υóá óòì jail P áεòÛεάóç áñááóεβί áεά÷áβñεóçò 1Υóá óòì jail. ÊÛòε òÛóìεί áβίáε εάεáβòáñá ÷ ñPóεìì ùòáí ÷ ñPóóçò root áðεέòìáβ íá òáñìáóβóáε ìá áóóÛεάεά εÛðìεί jail. Ìðìñáβ áðβóçò íá ÷ ñçóεììðìέçεáβ ç áίòìεð jexec(8) áεά òçí áεòÛεάóç εÛðìείò shell 1Υóá óòì jail ðñìεáεÛíò íá áεòáεáóóìγί áñááóβáò áεά÷áβñεóçò, áεά ðáñÛááεáíá:

```
# jexec 1 tcsh
```

15.5.2 Άñááεáβá áεά÷áβñεóçò òççεìγ áðéðÛáìò óóç óóεεìáP Ports òìò FreeBSD

ÁíÛáóá óóεó áεÛóìñáð áòáñìáÛò òñβòùì εάóáóεáóáóòπí áεά òç áεά÷áβñεóç òùì jails, Ûíá áðu òá ðìεί ðεεεçñùìÛíá εάε ÷ ñPóεíá ðáεÛóá áβίáε òì sysutils/jailutils. Άðìòáεáβ Ûíá óγñìεί ìεéñπí áòáñìáπí ìε ðìβáð òóíáεóóÛíñìò òóç áεά÷áβñεóç òìò jail(8). Άεά ðáñεóóúòáñáð ðεçñìòìñáð, ááβòá óóìí áεéòòáεù òìò òùðì.

15.6 ΆòáñìáP òùì Jails

15.6.1 Service Jails

ÓòíáεóòìñÛ òìò Daniel Gerzo.

Ç áíùóçòá áðòP áβίáε ááoóó1Ûç óóçí εáÛá ðìò ðáñìòóεÛóóçεá áñ÷εÛ áðu òìí Simon L. Nielsen <simon@FreeBSD.org> óòì http://simon.nitro.dk/service-jails.html, εάεðò εάε óá Ûíá áíáíáñùÛí Ûñεñì òìò Ken Tom <locals@gmail.com>. Óóçí áíùóçòá áðòP εá óáð ááβñìòíá ðùò íá óòPóáðá Ûíá óγóóçíá FreeBSD òì ðìβì íá áεáεÛóáε Ûíá áðéðεÛí áðβðááì áóóÛεάεáð, ìá òç ÷ ñPóç òìò jail(8). ÓðìεÛóìòá ùòε òì óγóóçíá òñÛ÷áε òìòεÛ÷εóòìñ RELENG_6_0 εάε ùòε Û÷áòá εáóáñPóáε ùεáð òεð ðñìçáìγíáíáð ðεçñìòìñáð òìò εáóáεáβìò.

15.6.1.1 Ó÷ááεáóìùò

Íá áðu òá óçíáíòεéùòáñá ðñìáεΠιáóá ìá òá jails áβίáε ç áεά÷áβñεóç òçò áεάáεéáóβáð áíáááεìβóáñì. Άòòù òáβίáε íá áβίáε ðñùáεçíá áεùòε òì εÛεá jail ðñÛðáε íá αçìεìòñáçεáβ áðu òçí áñ÷P óá εÛεá áíááÛεìεóç. ÓòìPεùò ááí áβίáε ðñùáεçíá áí Û÷áòá Ûíá ìùñ jail, ìεá εάε ðñùεáεóáε áεá ó÷áòεéÛ áðεP áεάáεéáóβá, áεεÛ áβíáòáε εìòñáóóεεP εάε ÷ ñìíáñá ñá Û÷áòá ðñεÛ jails.

Ðñìáεáìòìβçóç: Ìε ðáñáεÛòù ñòεìβóáεò ðñìùðìεÛóìòí áìðáεñβá ìá òì FreeBSD εάε òç ÷ ñPóç òùì áεÛóìñùì ÷ áñáεòçñεóóεεβì òìò. ΆÛí òá ðáñáεÛòù áPιáóá óáð óáβììòáε ðìεγ ðáñβðεìεá, áβίáε εάεγóáñá íá ñβìáðá ìεá ìáðéÛ óá εÛòε ðìεί áðεù ùðùò òì sysutils/ejail, òì ðìβì ðáñÛ÷áε Ûíáí áðεìεùòáñì òñùðì áεά÷áβñεóçò òùì jails òìò FreeBSD εάε ááí áβίáε òùòì áíáεáεéáðìÛí ùòì ìε ðáñáεÛòù ñòεìβóáεò.

Ç εáÛá áðòP Û÷áε ðáñìòóεáóóáβ áεá íá εγóáε òÛóìεò áβáìòð ðñìáεΠιáóá, ìá òçí áñPεáεá òçò εìεíPò ÷ ñPóçò ùòì òì áòíáòùì ðáñεóóúòáññì áñ÷áβñì ìáðáíγ òùì jails, ìá Ûíáí áóóáεP ùìò ðñùðì — ÷ ñçóεììðìέçεìò ðñìòáñòPóáεò òγðìò mount_nullfs(8) εάε ìùñ áεá áíÛáíùóç (read only) Ûóóε πóðá ç áíááÛεìεóç íá áβίáε áðεìεùòáñç, εάε ç ÷ ñPóç

ðáñððóóç ðñò ç áíááÛëíóç ááí áβíáé äóëéðP, èá ÷ ñáéáóóáβóá buildworld áéá íá ìðñÝóáðá íá óóíá÷ βóáðá. ÁðéðëÝíí èá ÷ ñáéáóóáβóá òí ðáéÝòí sysutils/cpdup. Èá ÷ ñçóéíðñéPóíòíá òí áñççóéú ðññáñáíá portsnap(8) áéá íá éáðááÛóíòíá òç óðëíáP òñí Ports. Áéá òñð ìáí-áéóáñ÷ ùáññòð, óñíβóóáóáé ç áíÛáñóç òñò éáðáéáβñò áéá òí Portsnap (http://www.FreeBSD.org/doc/el_GR.ISO8859-7/books/handbook/portsnap.html) óòí Áñ÷ áéñβáéí òñò FreeBSD.

1. Áñ÷ ééÛ, áçíéíðñáPóóá íéá áññP éáðáéúáñí áéá òí óýóóçíá áñ÷ áβñí òí ðñíβí èá áβíáé ìñíí áéá áíÛáñóç, éáé òí ðñíβí èá ðáñéÝ÷ áé óá áéðáéÝóéíá (binaries) òñò FreeBSD áéá óá jails. Óóç óóíÝ÷ áéá ðçááβíáðá óóíí éáðÛëíáí ùðñò áñβóéííóáé óá áñ÷ áβá ðçááβñò êðáééá (source tree) òñò FreeBSD éáé ááéáóóóPóóá óá áíðβóíé÷ á áñ÷ áβá óòí jail template:

```
# mkdir /home/j /home/j/mroot
# cd /usr/src
# make installworld DESTDIR=/home/j/mroot
```

2. Áðñíáñí áPñá áβíáé íá ðñíáðñéíÛóáðá òç óðëíáP òñí Ports òñò FreeBSD áéá óá jails ùðñò áðβóçð éáé Ýíá FreeBSD source tree, òí ðñíβí èá ÷ ñáéáóóáβ áéá òí **mergemaster**:

```
# cd /home/j/mroot
# mkdir usr/ports
# portsnap -p /home/j/mroot/usr/ports fetch extract
# cpdup /usr/src /home/j/mroot/usr/src
```

3. ÁçíéíðñáPóóá òí óéáéáðñí áéá òí òñíá òñò óðóðPñáðñò ùðñò ðñíññáæáðáé áéá áíÛáñóç éáé ááñáðP:

```
# mkdir /home/j/skel /home/j/skel/home /home/j/skel/usr-X11R6 /home/j/skel/distfiles
# mv etc /home/j/skel
# mv usr/local /home/j/skel/usr-local
# mv tmp /home/j/skel
# mv var /home/j/skel
# mv root /home/j/skel
```

4. ×ñçóéíðñéPóóá òí **mergemaster** áéá íá ááéáóóóPóóáðá óá áñ÷ áβá ñðëíβóáñí ðñò éáñðñí. Óóç óóíÝ÷ áéá áéááñÛóðá ùëíðð òñòð Ýíðñá éáðáéúáñíðð ðñò áçíéíðñáβ òí **mergemaster**:

```
# mergemaster -t /home/j/skel/var/tmp/temproot -D /home/j/skel -i
# cd /home/j/skel
# rm -R bin boot lib libexec mnt proc rescue sbin sys usr dev
```

5. Óðñá, áçíéíðñáPóóá óóíáÝóííðð áðñí òí óýóóçíá áñ÷ áβñí óóíí ðñíβí áðéðñÝðáðáé ç ááñáðP, ðñíð òí óýóóçíá áñ÷ áβñí ðñò áβíáé ìñíí áéá áíÛáñóç. Ááááéúéáβóá ùðé íé óýíááóñíé Ý÷ ðñí áçíéíðñáçéáβ óóéð óúóóÝð èÝóáéð s/. Ç ýðáññç ðñáñíáðééPí éáðáéúáñí P ç áçíéíðñáβ éáðáéúáñí óá èÛëíð èÝóáéð èá ðáçáPóíòí òçí ááéáðÛóóáóç óá áðñò÷ βá.

```
# cd /home/j/mroot
# mkdir s
# ln -s s/etc etc
# ln -s s/home home
# ln -s s/root root
# ln -s ../s/usr-local usr/local
# ln -s ../s/usr-X11R6 usr/X11R6
# ln -s ../../s/distfiles usr/ports/distfiles
# ln -s s/tmp tmp
# ln -s s/var var
```

6. Óái ôäëäððáβi äÐiá, äçieïññáßðóá Ýía äáíéëü äñ ÷ áβi /home/j/skel/etc/make.conf iá óá ðáñäêÛðü äáññÝía:

```
WRKDIRPREFIX?= /s/portbuild
```

÷ïðáð ïñβóáé õi WRKDIRPREFIX iá áððüí õii õñüði, éá ðïññáβðá iá iáðááëüððóáðá ports õïð FreeBSD iÝóá óá êÛèä jail. Èðieçäβðá üðé i éáóÛëiäð ðüi ports áβiáé iÝñið õïð ððóðßiáðü ãñ ÷ áβüi ðïð Ý ÷ áé ðñiðáñðçèáβ iüfi äéá áíÛáíüç. Ç ðñiðáññiðYiq äéáñññP äéá õi WRKDIRPREFIX áðéðñÝðäé ðçí iáðááëðððéðç ðüi ports ðüi äáññÛðëüi iÝñið ðïð êÛèä jail.

15.6.1.3 Äçieïññáßðíðáð Jails

Ôþñá ðïð Ý ÷ iðiá Ýía ïëieçññüÝfi FreeBSD jail template, iðñiñYia iá ääéáðáðððíðiá éáé iá ñðëiððíðiá óá jails óüi /etc/rc.conf. Ôi ðáñÛäéäiä áððüi äáβ ÷ iáé ðç äçieïññáßá ðñëþi jails: “NS”, “MAIL” éáé “WWW”.

1. ÄéóÛäáðä ðéð ðáñäêÛðü äñáñÝð ðüi äñ ÷ áβi /etc/fstab, þððá õi iüfi äéá áíÛáíüç template äéá óá jails éáé i äáññÛðëüi ÷ þñið iá áβiáé äéáéÝóéiá óðá áíðβððie ÷ á jails:

```
/home/j/mroot    /home/j/ns      nullfs ro 0 0
/home/j/mroot    /home/j/mail    nullfs ro 0 0
/home/j/mroot    /home/j/www     nullfs ro 0 0
/home/j/ns       /home/j/ns/s    nullfs rw 0 0
/home/j/mail     /home/j/mail/s  nullfs rw 0 0
/home/j/www      /home/j/www/s   nullfs rw 0 0
```

Ôçiaßüç: Ié éáðáðiðááéð ðïð áβiáé ðçíäéüñÝiáð iá 0 pass number äáí äëÝä ÷ iððáé éáðÛ ðçí äêêßiqç áðü õi fsck(8), áíþ äéá ðéð éáðáðiðááéð iá 0 dump number, ç dump(8) äáí éá äçieïññáß áíðβáñáðá áóðáéäßáð. Ðñiðáíþð, äáí êÛëiðiá õi **fsck** iá äëÝä ÷ áé ðéð ðñiðáñððóáéð ðýðïð **nullfs**, iýðá éáé õi **dump** iá êñáðÛ áíðβáñáðá áðü óá iüfi äéá áíÛáíüç nullfs óðóðßiáðá äñ ÷ áβüi ðüi jails. Äððüð áβiáé éáé i êüäið ðïð áÛëáiá “0 0” óðéð äýi ðáäáððáßáð óððéáð êÛèä äáññáððð ðïð fstab.

2. Ñðëiðððá óá jails óüi /etc/rc.conf:

```
jail_enable="YES"
jail_set_hostname_allow="NO"
jail_list="ns mail www"
jail_ns_hostname="ns.example.org"
jail_ns_ip="192.168.3.17"
jail_ns_rootdir="/home/j/ns"
jail_ns_devfs_enable="YES"
jail_mail_hostname="mail.example.org"
jail_mail_ip="192.168.3.18"
jail_mail_rootdir="/home/j/mail"
jail_mail_devfs_enable="YES"
jail_www_hostname="www.example.org"
jail_www_ip="62.123.43.14"
jail_www_rootdir="/home/j/www"
jail_www_devfs_enable="YES"
```

Δημιουργία Jails: Η ευκολότερη μέθοδος είναι να χρησιμοποιήσουμε το `jail_name_rootdir` ή `/usr/home` ή `/home` ως βάση δεδομένων. Για να δημιουργήσουμε jail με όνομα `/home` έχουμε τον ακόλουθο κώδικα: `jail_name_rootdir /usr/home` . Το `/usr/home` είναι η καλύτερη επιλογή. Χρησιμοποιώντας το `jail_name_rootdir` ως βάση δεδομένων, το jail θα είναι απομονωμένο από το σύστημα. Το `/usr/home` είναι η καλύτερη επιλογή. Χρησιμοποιώντας το `jail_name_rootdir` ως βάση δεδομένων, το jail θα είναι απομονωμένο από το σύστημα. Το `/usr/home` είναι η καλύτερη επιλογή.

3. Δημιουργία jail με όνομα `/home/j/ns` στο `/home/j/mail` και `/home/j/www`

```
# mkdir /home/j/ns /home/j/mail /home/j/www
```

4. Δημιουργία jail με όνομα `/home/js` στο `/home/js/ns` και `/home/js/mail` και `/home/js/www`

```
# mkdir /home/js
# cpdup /home/j/skel /home/js/ns
# cpdup /home/j/skel /home/js/mail
# cpdup /home/j/skel /home/js/www
```

5. Ξεκίνημα των jail με τον κώδικα `/etc/rc.d/jail`

```
# mount -a
# /etc/rc.d/jail start
```

Οι jail έχουν ονόματα που αρχίζουν με `j` ή `/home/` . Το `/etc/rc.d/jail` είναι το σημείο εκκίνησης των jail. Το `/etc/rc.d/jail` είναι το σημείο εκκίνησης των jail.

jls

JID	IP Address	Hostname	Path
3	192.168.3.17	ns.example.org	/home/j/ns
2	192.168.3.18	mail.example.org	/home/j/mail
1	62.123.43.14	www.example.org	/home/j/www

Οι jail έχουν ονόματα που αρχίζουν με `j` ή `/home/` . Το `/etc/rc.d/jail` είναι το σημείο εκκίνησης των jail. Το `/etc/rc.d/jail` είναι το σημείο εκκίνησης των jail.

```
# jexec 3 tcsh
```

15.6.1.4 Αιτιολογία

Η δημιουργία των jail είναι εύκολη και γρήγορη. Το `/etc/rc.d/jail` είναι το σημείο εκκίνησης των jail. Το `/etc/rc.d/jail` είναι το σημείο εκκίνησης των jail.

1. Οι jail έχουν ονόματα που αρχίζουν με `j` ή `/home/` . Το `/etc/rc.d/jail` είναι το σημείο εκκίνησης των jail. Το `/etc/rc.d/jail` είναι το σημείο εκκίνησης των jail.

```
# mkdir /home/j/mroot2
# cd /usr/src
# make installworld DESTDIR=/home/j/mroot2
# cd /home/j/mroot2
# cpdup /usr/src usr/src
# mkdir s
```

Ôí installworld äçieïõñãß ìãñééíýð éáðäéüãròð ðïð äã ÷ ñãéÛäéíðäé, éáé éã ðñÝðäé íá äéããããóíýí:

```
# chflags -R 0 var
# rm -R etc var root usr/local tmp
```

2. Äçieïõñãßðóðã ìáíÛ ðïðð óðíãÝóíïðð äéã ðí óýóðçíã äñ ÷ äßüí áíÛäíúóçð - äãããããðð:

```
# ln -s s/etc etc
# ln -s s/root root
# ln -s s/home home
# ln -s ../s/usr-local usr/local
# ln -s ../s/usr-X11R6 usr/X11R6
# ln -s s/tmp tmp
# ln -s s/var var
```

3. Ôðñá äßíáé ç óùóðß óðéãìß äéã íá óðãíãðßðãðã ðã jails:

```
# /etc/rc.d/jail stop
```

4. Áðíðñíóãñðßðã ðã äñ ÷ ééÛ óðóðßíãðã äñ ÷ äßüí:

```
# umount /home/j/ns/s
# umount /home/j/ns
# umount /home/j/mail/s
# umount /home/j/mail
# umount /home/j/www/s
# umount /home/j/www
```

Óçíãßúóç: Óã óðóðßíãðã äñ ÷ äßüí áíÛäíúóçð - äãããããðð äßíáé ðñíóãñðçíÝíã óðí óýóðçíã äñ ÷ äßüí ìüíí áíÛäíúóçð (/s) éáé ðñÝðäé íá äßíáé ðã ðñððã ðïð éã äðíðñíóãñðçéíýí.

5. Ìãðãééíßðóðã ðíí ðãééü ìüíí äéã áíÛäíúóç éáðÛéíãí, éáé áíðééãðãóðßðã ðíí ìã ðíí éáéíýñãéí. Ì ðãééüð éã ðãñãíãßíáé ùð áíðßãñãóí áóðãéãßãð ðïð ðãééýý óðóðßíãðïð óã ðãñßððóðç ðñíãéßíãðïð. Ì ðñüðïð ìííãóßãð ðïð äéíéíðéßðãíã äãß áíðéóðíé ÷ äß óðç ÷ ñííééßß óðéãìß äçieïõñãßãð ðïð íÝíð óðóðßíãðïð äñ ÷ äßüí ìüíí áíÛäíúóçð. Ìãðãééíßðóðã ðçí äñ ÷ ééßß óðééíãß ðüí Ports ðïð FreeBSD óðí íÝí óýóðçíã, äñ ÷ äßüí ðñíéãéíÝíð íá äñééíñßðóðã ÷ ðñí éáé inodes:

```
# cd /home/j
# mv mroot mroot.20060601
# mv mroot2 mroot
# mv mroot.20060601/usr/ports mroot/usr
```

6. Óã áððü ðí óçíãßí ðí ìüíí äéã áíÛäíúóç template äßíáé Ýðíéíí, ìðüðã ðí ìüíí ðïð áðñÝíáé äßíáé íá ðñíóãñðßðã ìáíÛ ðã óðóðßíãðã äñ ÷ äßüí éáé íá ìãééíßðóðã ðã jails:

```
# mount -a
# /etc/rc.d/jail start
```

×ñçóéííðíéáßðá ôçí áíðíëð jls(8) ãéá íá äëÝãíãðá áÛí ðá jails íäêßíçóáí òùóòÛ. Ìçí íá ÷Ûóãðá íá äêðäëÝóãðá ðí mergemaster ãéá ðí êÛèã jail. Èá ÷ñãéáóððáß íá áíáãáéìßóãðá ðüóí ðá áñ ÷ãßã ñðèìßóãúí, üóí êéé ðá rc.d scripts.

ÊäöÛëáéí 16 Õðí÷ñåùôéêüò ëää÷ìò Ññüóääóçò

ÃñÛòðçêä áðu òíí Tom Rhodes.

16.1 Óýñéç

Õí FreeBSD 5.X áéóðääää íÝáð äðääêðÛóáéð áóóáéääáð áðu òí TrustedBSD project, ðíò ááóðæííðáé òðí ðñíð÷Ýáéí POSIX.1e. Äýí áðu òíòð ðéí òçíáíðééíýð íÝíòð ìç÷áíéóííýð áóóáéääáð, áβíáé íé Êβóðáð ÄéÝã÷ìò Ññüóääóçò (Access Control Lists, ACLs) òðí óýóðçíá äñ÷åβüí éáé í Õðí÷ñåùôéêüò ëää÷ìò Ññüóääóçò (Mandatory Access Control, MAC). Í Õðí÷ñåùôéêüò ëää÷ìò Ññüóääóçò äβíáé òçí äðíáðúðçòðáð öññòðóçò äñèññüíÛðúí (modules) äéÝã÷ìò òá ðñíá ðéíðíéíýí íÝáð ðñééðééÝð áóóáéääáð. ÌåñéÛ ðåñÝ÷ìò ðñíðóðáóá òá Ýíá òðáíú ððíóýñíé òíò òóóððíáðíò, áíáðíáíðñííðáð òçí áóóÛëáéá íéáð òðáéåñéñéÝíçð òðçñåóáð. ¶ëéá ðåñÝ÷ìò òóñðððéêð áóóÛëáéá ðñíð üéáð òéð òðçñåóáð éáé òí óýóðçíá. Í Ýéää÷ìò ðñíÛæáðáé òðí÷ñåùôéêüò áðu òí äääíñúð üðé ç äðéáíêð áβíáðáé áðu òíò áéá÷åñééðÝð éáé òí óýóðçíá, éáé äáí áððíáðáé òðç äéáéñééðéêð äð÷Ýñáéá òñí ÷ñçòðñí ùððð áβíáðáé ìá òí áéáéñééðééü Ýéää÷ìò ðñíðóðáóçò (Discretionary Access Control, DAC, òéð òðððíéçíÝíáð Ûääéáð äñ÷åβüí éáé IPC òíò System V òðí FreeBSD).

Õí êäöÛëáéí áððü áóðéÛæáé òðí ðéåáðéí òíò Õðí÷ñåùôééíý ÄéÝã÷ìò Ññüóääóçò (MAC Framework), éáé òá Ýíá óýñíé ðñíðóéáðúí äñèññüíÛðúí áéá ðñééðééÝð áóóÛëáéáð, ðíò áíåñåñíðéíýí äéÛòíñíòð ìç÷áíéóííýð áóóÛëáéáð.

Äóíý áéääÛóáðä áððü òí êäöÛëáéí, éá íÝñåðå:

- Õé MAC äñèññíáðá ðñééðééêð áóóáéääáð ðåñééáíáÛñíðáé áððð òç òðéáíð òðí FreeBSD éáé òíòð ò÷áðééíýð ìç÷áíéóííýð òíòð.
- Õé ðéíðíéíýí òá MAC äñèññíáðá ðñééðééêð áóóáéääáð éáéðð éáé òç áéáðññÛ ìáðáíý íéá ÷åñéðçñéóíÝíçð (labeled) éáé ìç÷áíéóííýð (non-labeled) ðñééðééêðð.
- ðùð íá ððéíðóáðä äðñåíééÛ Ýíá óýóðçíá áéá ÷ñðç òíò ðéáéóβíò éåéðíðñåêñí MAC.
- ðùð íá ððéíðóáðä òá áéáðññåðééÛ äñèññíáðá ðñééðééêð áóóÛëáéáð òá ðñíá ðåñééáíáÛñíðáé òðí ðéåáðéí éåéðíðñåêñí MAC .
- ðùð íá ðéíðíéðóáðä Ýíá ðéí áóóáéÝð ðåñéáÛéñí, ÷ñçéñíðñéðíðáð òí ðéåáðéí éåéðíðñåêñí MAC éáé òá ðåñåññåñíðáðä ðíò òáβñíðáé.
- ðùð íá äéÝãíáðä òç ðñéíéóç òíò MAC áéá íá áíáðóáéβóáðä üðé Ý÷áé áβíáé òùððð ðéíðíéççò òíò ðéáéóβíò éåéðíðñåêñí.

Ññéí áéääÛóáðä áððü òí êäöÛëáéí, éá ðñÝðáé:

- Íá éáðáñíáβðä òéð ááóééÝð Ýñíéáð òíò UNIX éáé òíò FreeBSD. (ÊäöÛëáéí 3).
- Íá áβóðä äñíééáéñüÝíð ìá òéð ááóééÝð Ýñíéáð òçð ðñéíéóçð éáé ìáðáéêðððéóçð òíò ððñðíá (ÊäöÛëáéí 8).
- Íá Ý÷áðä êÛðíéá äñíééáβòç ìá òçí áóóÛëáéá éáé ðùð áððð ò÷áðæáðáé ìá òí FreeBSD (ÊäöÛëáéí 14).

Ññíáéáíðñçòç: Ç éáéêð ÷ñðç òñí ðéçñíòíñéðí ðíò ðåñÝ÷ìòðáé äåð ðñíáñ ìá ðñíéáéÝðáé äððéáéá ðñüóääóçò òðí óýóðçíá, áéíáðñéóíü òíòð ÷ñðððáð ð äáðíáíá ðñüóääóçò òðéð òðçñåóáð ðíò ðåñÝ÷ìòðáé áðu òí ×11. Äéñíá ðéí òçíáíðééü áβíáé üðé äáí ðñÝðáé íá ááóðæáðóðä òðí MAC áéá òçí ðéññç áóóÛëéóç áíùð òóóððíáðíò.

- *multilabel*: The `multilabel` property is a file system option which can be set in single user mode using the `tunefs(8)` utility, during the boot operation using the `fstab(5)` file, or during the creation of a new file system. This option will permit an administrator to apply different MAC labels on different objects. This option only applies to security policy modules which support labeling.
- *object*: An object or system object is an entity through which information flows under the direction of a *subject*. This includes directories, files, fields, screens, keyboards, memory, magnetic storage, printers or any other data storage/moving device. Basically, an object is a data container or a system resource; access to an *object* effectively means access to the data.
- *policy*: A collection of rules which defines how objectives are to be achieved. A *policy* usually documents how certain items are to be handled. This chapter will consider the term *policy* in this context as a *security policy*; i.e. a collection of rules which will control the flow of data and information and define whom will have access to that data and information.
- *sensitivity*: Usually used when discussing MLS. A sensitivity level is a term used to describe how important or secret the data should be. As the sensitivity level increases, so does the importance of the secrecy, or confidentiality of the data.
- *single label*: A single label is when the entire file system uses one label to enforce access control over the flow of data. When a file system has this set, which is any time when the `multilabel` option is not set, all files will conform to the same label setting.
- *subject*: a subject is any active entity that causes information to flow between *objects*; e.g. a user, user processor, system process, etc. On FreeBSD, this is almost always a thread acting in a process on behalf of a user.

16.3 Explanation of MAC

With all of these new terms in mind, consider how the MAC framework augments the security of the system as a whole. The various security policy modules provided by the MAC framework could be used to protect the network and file systems, block users from accessing certain ports and sockets, and more. Perhaps the best use of the policy modules is to blend them together, by loading several security policy modules at a time for a multi-layered security environment. In a multi-layered security environment, multiple policy modules are in effect to keep security in check. This is different to a hardening policy, which typically hardens elements of a system that is used only for specific purposes. The only downside is administrative overhead in cases of multiple file system labels, setting network access control user by user, etc.

These downsides are minimal when compared to the lasting effect of the framework; for instance, the ability to pick and choose which policies are required for a specific configuration keeps performance overhead down. The reduction of support for unneeded policies can increase the overall performance of the system as well as offer flexibility of choice. A good implementation would consider the overall security requirements and effectively implement the various security policy modules offered by the framework.

Thus a system utilizing MAC features should at least guarantee that a user will not be permitted to change security attributes at will; all user utilities, programs and scripts must work within the constraints of the access rules provided by the selected security policy modules; and that total control of the MAC access rules are in the hands of the system administrator.

It is the sole duty of the system administrator to carefully select the correct security policy modules. Some environments may need to limit access control over the network; in these cases, the `mac_portacl(4)`, `mac_ifoff(4)` and even `mac_biba(4)` policy modules might make good starting points. In other cases, strict confidentiality of file system objects might be required. Policy modules such as `mac_bsdextended(4)` and `mac_mls(4)` exist for this purpose.

Policy decisions could be made based on network configuration. Perhaps only certain users should be permitted access to facilities provided by ssh(1) to access the network or the Internet. The mac_portacl(4) would be the policy module of choice for these situations. But what should be done in the case of file systems? Should all access to certain directories be severed from other groups or specific users? Or should we limit user or utility access to specific files by setting certain objects as classified?

In the file system case, access to objects might be considered confidential to some users, but not to others. For an example, a large development team might be broken off into smaller groups of individuals. Developers in project A might not be permitted to access objects written by developers in project B. Yet they might need to access objects created by developers in project C; that is quite a situation indeed. Using the different security policy modules provided by the MAC framework; users could be divided into these groups and then given access to the appropriate areas without fear of information leakage.

Thus, each security policy module has a unique way of dealing with the overall security of a system. Module selection should be based on a well thought out security policy. In many cases, the overall policy may need to be revised and reimplemented on the system. Understanding the different security policy modules offered by the MAC framework will help administrators choose the best policies for their situations.

The default FreeBSD kernel does not include the option for the MAC framework; thus the following kernel option must be added before trying any of the examples or information in this chapter:

```
options MAC
```

And the kernel will require a rebuild and a reinstall.

Προσοχή: While the various manual pages for MAC policy modules state that they may be built into the kernel, it is possible to lock the system out of the network and more. Implementing MAC is much like implementing a firewall, care must be taken to prevent being completely locked out of the system. The ability to revert back to a previous configuration should be considered while the implementation of MAC remotely should be done with extreme caution.

16.4 Understanding MAC Labels

A MAC label is a security attribute which may be applied to subjects and objects throughout the system.

When setting a label, the user must be able to comprehend what it is, exactly, that is being done. The attributes available on an object depend on the policy module loaded, and that policy modules interpret their attributes in different ways. If improperly configured due to lack of comprehension, or the inability to understand the implications, the result will be the unexpected and perhaps, undesired, behavior of the system.

The security label on an object is used as a part of a security access control decision by a policy. With some policies, the label by itself contains all information necessary to make a decision; in other models, the labels may be processed as part of a larger rule set, etc.

For instance, setting the label of `biba/low` on a file will represent a label maintained by the Biba security policy module, with a value of “low”.

A few policy modules which support the labeling feature in FreeBSD offer three specific predefined labels. These are the low, high, and equal labels. Although they enforce access control in a different manner with each policy module,

you can be sure that the low label will be the lowest setting, the equal label will set the subject or object to be disabled or unaffected, and the high label will enforce the highest setting available in the Biba and MLS policy modules.

Within single label file system environments, only one label may be used on objects. This will enforce one set of access permissions across the entire system and in many environments may be all that is required. There are a few cases where multiple labels may be set on objects or subjects in the file system. For those cases, the `multilabel` option may be passed to `tunefs(8)`.

In the case of Biba and MLS, a numeric label may be set to indicate the precise level of hierarchical control. This numeric level is used to partition or sort information into different groups of say, classification only permitting access to that group or a higher group level.

In most cases the administrator will only be setting up a single label to use throughout the file system.

Hey wait, this is similar to DAC! I thought MAC gave control strictly to the administrator. That statement still holds true, to some extent as `root` is the one in control and who configures the policies so that users are placed in the appropriate categories/access levels. Alas, many policy modules can restrict the `root` user as well. Basic control over objects will then be released to the group, but `root` may revoke or modify the settings at any time. This is the hierarchal/clearance model covered by policies such as Biba and MLS.

16.4.1 Label Configuration

Virtually all aspects of label policy module configuration will be performed using the base system utilities. These commands provide a simple interface for object or subject configuration or the manipulation and verification of the configuration.

All configuration may be done by use of the `setfmac(8)` and `setpmac(8)` utilities. The `setfmac` command is used to set MAC labels on system objects while the `setpmac` command is used to set the labels on system subjects. Observe:

```
# setfmac biba/high test
```

If no errors occurred with the command above, a prompt will be returned. The only time these commands are not quiescent is when an error occurred; similarly to the `chmod(1)` and `chown(8)` commands. In some cases this error may be a “Permission denied” and is usually obtained when the label is being set or modified on an object which is restricted.¹ The system administrator may use the following commands to overcome this:

```
# setfmac biba/high test
"Permission denied"
# setpmac biba/low setfmac biba/high test
# getfmac test
test: biba/high
```

As we see above, `setpmac` can be used to override the policy module’s settings by assigning a different label to the invoked process. The `getpmac` utility is usually used with currently running processes, such as **sendmail**: although it takes a process ID in place of a command the logic is extremely similar. If users attempt to manipulate a file not in their access, subject to the rules of the loaded policy modules, the “Operation not permitted” error will be displayed by the `mac_set_link` function.

16.4.1.1 Common Label Types

For the `mac_biba(4)`, `mac_mls(4)` and `mac_lomac(4)` policy modules, the ability to assign simple labels is provided. These take the form of high, equal and low, what follows is a brief description of what these labels provide:

- The `low` label is considered the lowest label setting an object or subject may have. Setting this on objects or subjects will block their access to objects or subjects marked high.
- The `equal` label should only be placed on objects considered to be exempt from the policy.
- The `high` label grants an object or subject the highest possible setting.

With respect to each policy module, each of those settings will instate a different information flow directive. Reading the proper manual pages will further explain the traits of these generic label configurations.

16.4.1.1.1 Advanced Label Configuration

Numeric grade labels are used for `comparison:compartment+compartment`; thus the following:

```
biba/10:2+3+6(5:2+3-20:2+3+4+5+6)
```

May be interpreted as:

“Biba Policy Label”/“Grade 10” :“Compartments 2, 3 and 6”: (“grade 5 ...”)

In this example, the first grade would be considered the “effective grade” with “effective compartments”, the second grade is the low grade and the last one is the high grade. In most configurations these settings will not be used; indeed, they offered for more advanced configurations.

When applied to system objects, they will only have a current grade/compartments as opposed to system subjects as they reflect the range of available rights in the system, and network interfaces, where they are used for access control.

The grade and compartments in a subject and object pair are used to construct a relationship referred to as “dominance”, in which a subject dominates an object, the object dominates the subject, neither dominates the other, or both dominate each other. The “both dominate” case occurs when the two labels are equal. Due to the information flow nature of Biba, you have rights to a set of compartments, “need to know”, that might correspond to projects, but objects also have a set of compartments. Users may have to subset their rights using `su` or `setpmac` in order to access objects in a compartment from which they are not restricted.

16.4.1.2 Users and Label Settings

Users themselves are required to have labels so that their files and processes may properly interact with the security policy defined on the system. This is configured through the `login.conf` file by use of login classes. Every policy module that uses labels will implement the user class setting.

An example entry containing every policy module setting is displayed below:

```
default:\
:copyright=/etc/COPYRIGHT:\
:welcome=/etc/motd:\
:setenv=MAIL=/var/mail/$,BLOCKSIZE=K:\
:path=~:/bin:/sbin:/bin:/usr/sbin:/usr/bin:/usr/local/sbin:/usr/local/bin:\
:manpath=/usr/share/man /usr/local/man:\
:nologin=/usr/sbin/nologin:\
:cputime=1h30m:\
:datasize=8M:\
:vmemoryuse=100M:\
:stacksize=2M:\
:memorylocked=4M:\
```

```
:memoryuse=8M:\
:filesize=8M:\
:coredumpsize=8M:\
:openfiles=24:\
:maxproc=32:\
:priority=0:\
:requirehome:\
:passwordtime=91d:\
:umask=022:\
:ignoretime@:\
:label=partition/13,mls/5,biba/10(5-15),lomac/10[2]:
```

The `label` option is used to set the user class default label which will be enforced by MAC. Users will never be permitted to modify this value, thus it can be considered not optional in the user case. In a real configuration, however, the administrator will never wish to enable every policy module. It is recommended that the rest of this chapter be reviewed before any of this configuration is implemented.

Óçìáßüóç: Users may change their label after the initial login; however, this change is subject constraints of the policy. The example above tells the Biba policy that a process's minimum integrity is 5, its maximum is 15, but the default effective label is 10. The process will run at 10 until it chooses to change label, perhaps due to the user using the `setpmac` command, which will be constrained by Biba to the range set at login.

In all cases, after a change to `login.conf`, the login class capability database must be rebuilt using `cap_mkdb` and this will be reflected throughout every forthcoming example or discussion.

It is useful to note that many sites may have a particularly large number of users requiring several different user classes. In depth planning is required as this may get extremely difficult to manage.

Future versions of FreeBSD will include a new way to deal with mapping users to labels; however, this will not be available until some time after FreeBSD 5.3.

16.4.1.3 Network Interfaces and Label Settings

Labels may also be set on network interfaces to help control the flow of data across the network. In all cases they function in the same way the policies function with respect to objects. Users at high settings in `biba`, for example, will not be permitted to access network interfaces with a label of low.

The `maclabel` may be passed to `ifconfig` when setting the MAC label on network interfaces. For example:

```
# ifconfig bge0 maclabel biba/equal
```

will set the MAC label of `biba/equal` on the `bge(4)` interface. When using a setting similar to `biba/high(low-high)` the entire label should be quoted; otherwise an error will be returned.

Each policy module which supports labeling has a tunable which may be used to disable the MAC label on network interfaces. Setting the label to `equal` will have a similar effect. Review the output from `sysctl`, the policy manual pages, or even the information found later in this chapter for those tunables.

16.4.2 Singlelabel or Multilabel?

By default the system will use the `singlelabel` option. But what does this mean to the administrator? There are several differences which, in their own right, offer pros and cons to the flexibility in the systems security model.

The `singlelabel` only permits for one label, for instance `biba/high` to be used for each subject or object. It provides for lower administration overhead but decreases the flexibility of policies which support labeling. Many administrators may want to use the `multilabel` option in their security policy.

The `multilabel` option will permit each subject or object to have its own independent MAC label in place of the standard `singlelabel` option which will allow only one label throughout the partition. The `multilabel` and `singlelabel` options are only required for the policies which implement the labeling feature, including the Biba, Lomac, MLS and SEBSD policies.

In many cases, the `multilabel` may not need to be set at all. Consider the following situation and security model:

- FreeBSD web-server using the MAC framework and a mix of the various policies.
- This machine only requires one label, `biba/high`, for everything in the system. Here the file system would not require the `multilabel` option as a single label will always be in effect.
- But, this machine will be a web server and should have the web server run at `biba/low` to prevent write up capabilities. The Biba policy and how it works will be discussed later, so if the previous comment was difficult to interpret just continue reading and return. The server could use a separate partition set at `biba/low` for most if not all of its runtime state. Much is lacking from this example, for instance the restrictions on data, configuration and user settings; however, this is just a quick example to prove the aforementioned point.

If any of the non-labeling policies are to be used, then the `multilabel` option would never be required. These include the `seeotheruids`, `portacl` and `partition` policies.

It should also be noted that using `multilabel` with a partition and establishing a security model based on `multilabel` functionality could open the doors for higher administrative overhead as everything in the file system would have a label. This includes directories, files, and even device nodes.

The following command will set `multilabel` on the file systems to have multiple labels. This may only be done in single user mode:

```
# tuneefs -l enable /
```

This is not a requirement for the swap file system.

Ὁψιθῆς: Some users have experienced problems with setting the `multilabel` flag on the root partition. If this is the case, please review the Ὁψιθῆς 16.16 of this chapter.

16.5 Planning the Security Configuration

Whenever a new technology is implemented, a planning phase is always a good idea. During the planning stages, an administrator should in general look at the “big picture”, trying to keep in view at least the following:

- The implementation requirements;

- The implementation goals;

For MAC installations, these include:

- How to classify information and resources available on the target systems.
- What sorts of information or resources to restrict access to along with the type of restrictions that should be applied.
- Which MAC module or modules will be required to achieve this goal.

It is always possible to reconfigure and change the system resources and security settings, it is quite often very inconvenient to search through the system and fix existing files and user accounts. Planning helps to ensure a trouble-free and efficient trusted system implementation. A trial run of the trusted system, including the configuration, is often vital and definitely beneficial *before* a MAC implementation is used on production systems. The idea of just letting loose on a system with MAC is like setting up for failure.

Different environments may have explicit needs and requirements. Establishing an in depth and complete security profile will decrease the need of changes once the system goes live. As such, the future sections will cover the different modules available to administrators; describe their use and configuration; and in some cases provide insight on what situations they would be most suitable for. For instance, a web server might roll out the `mac_biba(4)` and `mac_bsdextended(4)` policies. In other cases, a machine with very few local users, the `mac_partition(4)` might be a good choice.

16.6 Module Configuration

Every module included with the MAC framework may be either compiled into the kernel as noted above or loaded as a run-time kernel module. The recommended method is to add the module name to the `/boot/loader.conf` file so that it will load during the initial boot operation.

The following sections will discuss the various MAC modules and cover their features. Implementing them into a specific environment will also be a consideration of this chapter. Some modules support the use of labeling, which is controlling access by enforcing a label such as “this is allowed and this is not”. A label configuration file may control how files may be accessed, network communication can be exchanged, and more. The previous section showed how the `multilabel` flag could be set on file systems to enable per-file or per-partition access control.

A single label configuration would enforce only one label across the system, that is why the `tunefs` option is called `multilabel`.

16.6.1 The MAC `seeotheruids` Module

Module name: `mac_seeotheruids.ko`

Kernel configuration line: `options MAC_SEEOTHERUIDS`

Boot option: `mac_seeotheruids_load="YES"`

The `mac_seeotheruids(4)` module mimics and extends the `security.bsd.see_other_uids` and `security.bsd.see_other_gids` `sysctl` tunables. This option does not require any labels to be set before configuration and can operate transparently with the other modules.

After loading the module, the following `sysctl` tunables may be used to control the features:

- `security.mac.seeotheruids.enabled` will enable the module's features and use the default settings. These default settings will deny users the ability to view processes and sockets owned by other users.
- `security.mac.seeotheruids.specificgid_enabled` will allow a certain group to be exempt from this policy. To exempt specific groups from this policy, use the `security.mac.seeotheruids.specificgid=xxx` `sysctl` tunable. In the above example, the `xxx` should be replaced with the numeric group ID to be exempted.
- `security.mac.seeotheruids.primarygroup_enabled` is used to exempt specific primary groups from this policy. When using this tunable, the `security.mac.seeotheruids.specificgid_enabled` may not be set.

16.7 The MAC `bsdextended` Module

Module name: `mac_bsdextended.ko`

Kernel configuration line: `options MAC_BSEXTENDED`

Boot option: `mac_bsdextended_load="YES"`

The `mac_bsdextended(4)` module enforces the file system firewall. This module's policy provides an extension to the standard file system permissions model, permitting an administrator to create a firewall-like ruleset to protect files, utilities, and directories in the file system hierarchy. When access to a file system object is attempted, the list of rules is iterated until either a matching rule is located or the end is reached. This behavior may be changed by the use of a `sysctl(8)` parameter, `security.mac.bsdextended.firstmatch_enabled`. Similar to other firewall modules in FreeBSD, a file containing access control rules can be created and read by the system at boot time using an `rc.conf(5)` variable.

The rule list may be entered using a utility, `ugidfw(8)`, that has a syntax similar to that of `ipfw(8)`. More tools can be written by using the functions in the `libugidfw(3)` library.

Extreme caution should be taken when working with this module; incorrect use could block access to certain parts of the file system.

16.7.1 Examples

After the `mac_bsdextended(4)` module has been loaded, the following command may be used to list the current rule configuration:

```
# ugidfw list
0 slots, 0 rules
```

As expected, there are no rules defined. This means that everything is still completely accessible. To create a rule which will block all access by users but leave `root` unaffected, simply run the following command:

```
# ugidfw add subject not uid root new object not uid root mode n
```

Ὁψιθιζήσις: In releases prior to FreeBSD 5.3, the `add` parameter did not exist. In those cases the `set` should be used instead. See below for a command example.

This is a very bad idea as it will block all users from issuing even the most simple commands, such as `ls`. A more patriotic list of rules might be:

```
# ugidfw set 2 subject uid user1 object uid user2 mode n
# ugidfw set 3 subject uid user1 object gid user2 mode n
```

This will block any and all access, including directory listings, to `user2`'s home directory from the username `user1`.

In place of `user1`, the `not uid user2` could be passed. This will enforce the same access restrictions above for all users in place of just one user.

Σημείωση: The `root` user will be unaffected by these changes.

This should provide a general idea of how the `mac_bsdextended(4)` module may be used to help fortify a file system. For more information, see the `mac_bsdextended(4)` and the `ugidfw(8)` manual pages.

16.8 The MAC ifoff Module

Module name: `mac_ifoff.ko`

Kernel configuration line: `options MAC_IFOFF`

Boot option: `mac_ifoff_load="YES"`

The `mac_ifoff(4)` module exists solely to disable network interfaces on the fly and keep network interfaces from being brought up during the initial system boot. It does not require any labels to be set up on the system, nor does it have a dependency on other MAC modules.

Most of the control is done through the `sysctl` tunables listed below.

- `security.mac.ifoff.lo_enabled` will enable/disable all traffic on the loopback (`lo(4)`) interface.
- `security.mac.ifoff.bpfrecv_enabled` will enable/disable all traffic on the Berkeley Packet Filter interface (`bpf(4)`)
- `security.mac.ifoff.other_enabled` will enable/disable traffic on all other interfaces.

One of the most common uses of `mac_ifoff(4)` is network monitoring in an environment where network traffic should not be permitted during the boot sequence. Another suggested use would be to write a script which uses `security/aide` to automatically block network traffic if it finds new or altered files in protected directories.

16.9 The MAC portacl Module

Module name: `mac_portacl.ko`

Kernel configuration line: `MAC_PORTACL`

Boot option: `mac_portacl_load="YES"`

The `mac_portacl(4)` module is used to limit binding to local TCP and UDP ports using a variety of `sysctl` variables. In essence `mac_portacl(4)` makes it possible to allow non-`root` users to bind to specified privileged ports, i.e. ports fewer than 1024.

Once loaded, this module will enable the MAC policy on all sockets. The following tunables are available:

- `security.mac.portacl.enabled` will enable/disable the policy completely.²
- `security.mac.portacl.port_high` will set the highest port number that `mac_portacl(4)` will enable protection for.
- `security.mac.portacl.suser_exempt` will, when set to a non-zero value, exempt the `root` user from this policy.
- `security.mac.portacl.rules` will specify the actual `mac_portacl` policy; see below.

The actual `mac_portacl` policy, as specified in the `security.mac.portacl.rules` `sysctl`, is a text string of the form: `rule[,rule , ...]` with as many rules as needed. Each rule is of the form: `idtype:id:protocol:port`. The `idtype` parameter can be `uid` or `gid` and used to interpret the `id` parameter as either a user id or group id, respectively. The `protocol` parameter is used to determine if the rule should apply to TCP or UDP by setting the parameter to `tcp` or `udp`. The final `port` parameter is the port number to allow the specified user or group to bind to.

Ὁδηγός: Since the ruleset is interpreted directly by the kernel only numeric values can be used for the user ID, group ID, and port parameters. I.e. user, group, and port service names cannot be used.

By default, on UNIX-like systems, ports fewer than 1024 can only be used by/bound to privileged processes, i.e. those run as `root`. For `mac_portacl(4)` to allow non-privileged processes to bind to ports below 1024 this standard UNIX restriction has to be disabled. This can be accomplished by setting the `sysctl(8)` variables `net.inet.ip.portrange.reservedlow` and `net.inet.ip.portrange.reservedhigh` to zero.

See the examples below or review the `mac_portacl(4)` manual page for further information.

16.9.1 Examples

The following examples should illuminate the above discussion a little better:

```
# sysctl security.mac.portacl.port_high=1023
# sysctl net.inet.ip.portrange.reservedlow=0 net.inet.ip.portrange.reservedhigh=0
```

First we set `mac_portacl(4)` to cover the standard privileged ports and disable the normal UNIX bind restrictions.

```
# sysctl security.mac.portacl.suser_exempt=1
```

The `root` user should not be crippled by this policy, thus set the `security.mac.portacl.suser_exempt` to a non-zero value. The `mac_portacl(4)` module has now been set up to behave the same way UNIX-like systems behave by default.

```
# sysctl security.mac.portacl.rules=uid:80:tcp:80
```

Allow the user with UID 80 (normally the `www` user) to bind to port 80. This can be used to allow the `www` user to run a web server without ever having `root` privilege.

```
# sysctl security.mac.portacl.rules=uid:1001:tcp:110,uid:1001:tcp:995
```

Permit the user with the UID of 1001 to bind to the TCP ports 110 (“pop3”) and 995 (“pop3s”). This will permit this user to start a server that accepts connections on ports 110 and 995.

16.10 The MAC partition Module

Module name: `mac_partition.ko`

Kernel configuration line: `options MAC_PARTITION`

Boot option: `mac_partition_load="YES"`

The `mac_partition(4)` policy will drop processes into specific “partitions” based on their MAC label. Think of it as a special type of `jail(8)`, though that is hardly a worthy comparison.

This is one module that should be added to the `loader.conf(5)` file so that it loads and enables the policy during the boot process.

Most configuration for this policy is done using the `setpmac(8)` utility which will be explained below. The following `sysctl` tunable is available for this policy:

- `security.mac.partition.enabled` will enable the enforcement of MAC process partitions.

When this policy is enabled, users will only be permitted to see their processes, and any others within their partition, but will not be permitted to work with utilities outside the scope of this partition. For instance, a user in the `insecure` class above will not be permitted to access the `top` command as well as many other commands that must spawn a process.

To set or drop utilities into a partition label, use the `setpmac` utility:

```
# setpmac partition/13 top
```

This will add the `top` command to the label set on users in the `insecure` class. Note that all processes spawned by users in the `insecure` class will stay in the `partition/13` label.

16.10.1 Examples

The following command will show you the partition label and the process list:

```
# ps Zax
```

This next command will allow the viewing of another user’s process partition label and that user’s currently running processes:

```
# ps -ZU trhodes
```

Ὁδηγὸς: Users can see processes in `root`’s label unless the `mac_seeotheruids(4)` policy is loaded.

A really crafty implementation could have all of the services disabled in `/etc/rc.conf` and started by a script that starts them with the proper labeling set.

Ὁδηγὸς: The following policies support integer settings in place of the three default labels offered. These options, including their limitations, are further explained in the module manual pages.

16.11 The MAC Multi-Level Security Module

Module name: `mac_mls.ko`

Kernel configuration line: `options MAC_MLS`

Boot option: `mac_mls_load="YES"`

The `mac_mls(4)` policy controls access between subjects and objects in the system by enforcing a strict information flow policy.

In MLS environments, a “clearance” level is set in each subject or objects label, along with compartments. Since these clearance or sensibility levels can reach numbers greater than six thousand; it would be a daunting task for any system administrator to thoroughly configure each subject or object. Thankfully, three “instant” labels are already included in this policy.

These labels are `mls/low`, `mls/equal` and `mls/high`. Since these labels are described in depth in the manual page, they will only get a brief description here:

- The `mls/low` label contains a low configuration which permits it to be dominated by all other objects. Anything labeled with `mls/low` will have a low clearance level and not be permitted to access information of a higher level. In addition, this label will prevent objects of a higher clearance level from writing or passing information on to them.
- The `mls/equal` label should be placed on objects considered to be exempt from the policy.
- The `mls/high` label is the highest level of clearance possible. Objects assigned this label will hold dominance over all other objects in the system; however, they will not permit the leaking of information to objects of a lower class.

MLS provides for:

- A hierarchical security level with a set of non hierarchical categories;
- Fixed rules: no read up, no write down (a subject can have read access to objects on its own level or below, but not above. Similarly, a subject can have write access to objects on its own level or above but not beneath.);
- Secrecy (preventing inappropriate disclosure of data);
- Basis for the design of systems that concurrently handle data at multiple sensitivity levels (without leaking information between secret and confidential).

The following `sysctl` tunables are available for the configuration of special services and interfaces:

- `security.mac.mls.enabled` is used to enable/disable the MLS policy.
- `security.mac.mls.ptys_equal` will label all `pty(4)` devices as `mls/equal` during creation.
- `security.mac.mls.revocation_enabled` is used to revoke access to objects after their label changes to a label of a lower grade.
- `security.mac.mls.max_compartments` is used to set the maximum number of compartment levels with objects; basically the maximum compartment number allowed on a system.

To manipulate the MLS labels, the `setfmac(8)` command has been provided. To assign a label to an object, issue the following command:

```
# setfmac mls/5 test
```

To get the MLS label for the file `test` issue the following command:

```
# getfmac test
```

This is a summary of the MLS policy's features. Another approach is to create a master policy file in `/etc` which specifies the MLS policy information and to feed that file into the `setfmac` command. This method will be explained after all policies are covered.

16.11.1 Planning Mandatory Sensitivity

With the Multi-Level Security Policy Module, an administrator plans for controlling the flow of sensitive information. By default, with its block read up block write down nature, the system defaults everything to a low state. Everything is accessible and an administrator slowly changes this during the configuration stage; augmenting the confidentiality of the information.

Beyond the three basic label options above, an administrator may group users and groups as required to block the information flow between them. It might be easier to look at the information in clearance levels familiarized with words, for instance classifications such as `Confidential`, `Secret`, and `Top Secret`. Some administrators might just create different groups based on project levels. Regardless of classification method, a well thought out plan must exist before implementing such a restrictive policy.

Some example situations for this security policy module could be an e-commerce web server, a file server holding critical company information, and financial institution environments. The most unlikely place would be a personal workstation with only two or three users.

16.12 The MAC Biba Module

Module name: `mac_biba.ko`

Kernel configuration line: `options MAC_BIBA`

Boot option: `mac_biba_load="YES"`

The `mac_biba(4)` module loads the MAC Biba policy. This policy works much like that of the MLS policy with the exception that the rules for information flow are slightly reversed. This is said to prevent the downward flow of sensitive information whereas the MLS policy prevents the upward flow of sensitive information; thus, much of this section can apply to both policies.

In Biba environments, an "integrity" label is set on each subject or object. These labels are made up of hierarchal grades, and non-hierarchal components. As an object's or subject's grade ascends, so does its integrity.

Supported labels are `biba/low`, `biba/equal`, and `biba/high`; as explained below:

- The `biba/low` label is considered the lowest integrity an object or subject may have. Setting this on objects or subjects will block their write access to objects or subjects marked high. They still have read access though.
- The `biba/equal` label should only be placed on objects considered to be exempt from the policy.
- The `biba/high` label will permit writing to objects set at a lower label, but not permit reading that object. It is recommended that this label be placed on objects that affect the integrity of the entire system.

Biba provides for:

- Hierarchical integrity level with a set of non hierarchical integrity categories;
- Fixed rules: no write up, no read down (opposite of MLS). A subject can have write access to objects on its own level or below, but not above. Similarly, a subject can have read access to objects on its own level or above, but not below;
- Integrity (preventing inappropriate modification of data);
- Integrity levels (instead of MLS sensitivity levels).

The following `sysctl` tunables can be used to manipulate the Biba policy.

- `security.mac.biba.enabled` may be used to enable/disable enforcement of the Biba policy on the target machine.
- `security.mac.biba.ptys_equal` may be used to disable the Biba policy on `pty(4)` devices.
- `security.mac.biba.revocation_enabled` will force the revocation of access to objects if the label is changed to dominate the subject.

To access the Biba policy setting on system objects, use the `setfmac` and `getfmac` commands:

```
# setfmac biba/low test
# getfmac test
test: biba/low
```

16.12.1 Planning Mandatory Integrity

Integrity, different from sensitivity, guarantees that the information will never be manipulated by untrusted parties. This includes information passed between subjects, objects, and both. It ensures that users will only be able to modify and in some cases even access information they explicitly need to.

The `mac_biba(4)` security policy module permits an administrator to address which files and programs a user or users may see and invoke while assuring that the programs and files are free from threats and trusted by the system for that user, or group of users.

During the initial planning phase, an administrator must be prepared to partition users into grades, levels, and areas. Users will be blocked access not only to data but programs and utilities both before and after they start. The system will default to a high label once this policy module is enabled, and it is up to the administrator to configure the different grades and levels for users. Instead of using clearance levels as described above, a good planning method could include topics. For instance, only allow developers modification access to the source code repository, source code compiler, and other development utilities. While other users would be grouped into other categories such as testers, designers, or just ordinary users and would only be permitted read access.

With its natural security control, a lower integrity subject is unable to write to a higher integrity subject; a higher integrity subject cannot observe or read a lower integrity object. Setting a label at the lowest possible grade could make it inaccessible to subjects. Some prospective environments for this security policy module would include a constrained web server, development and test machine, and source code repository. A less useful implementation would be a personal workstation, a machine used as a router, or a network firewall.

16.13 The MAC LOMAC Module

Module name: `mac_lomac.ko`

Kernel configuration line: `options MAC_LOMAC`

Boot option: `mac_lomac_load="YES"`

Unlike the MAC Biba policy, the `mac_lomac(4)` policy permits access to lower integrity objects only after decreasing the integrity level to not disrupt any integrity rules.

The MAC version of the Low-watermark integrity policy, not to be confused with the older `lomac(4)` implementation, works almost identically to Biba, but with the exception of using floating labels to support subject demotion via an auxiliary grade compartment. This secondary compartment takes the form of `[auxgrade]`. When assigning a `lomac` policy with an auxiliary grade, it should look a little bit like: `lomac/10[2]` where the number two (2) is the auxiliary grade.

The MAC LOMAC policy relies on the ubiquitous labeling of all system objects with integrity labels, permitting subjects to read from low integrity objects and then downgrading the label on the subject to prevent future writes to high integrity objects. This is the `[auxgrade]` option discussed above, thus the policy may provide for greater compatibility and require less initial configuration than Biba.

16.13.1 Examples

Like the Biba and MLS policies; the `setfmac` and `setpmac` utilities may be used to place labels on system objects:

```
# setfmac /usr/home/trhodes lomac/high[low]
# getfmac /usr/home/trhodes lomac/high[low]
```

Notice the auxiliary grade here is `low`, this is a feature provided only by the MAC LOMAC policy.

16.14 Nagios in a MAC Jail

The following demonstration will implement a secure environment using various MAC modules with properly configured policies. This is only a test and should not be considered the complete answer to everyone's security woes. Just implementing a policy and ignoring it never works and could be disastrous in a production environment.

Before beginning this process, the `multilabel` option must be set on each file system as stated at the beginning of this chapter. Not doing so will result in errors. While at it, ensure that the `net-mgmt/nagios-plugins`, `net-mgmt/nagios`, and `www/apache13` ports are all installed, configured, and working correctly.

16.14.1 Create an insecure User Class

Begin the procedure by adding the following user class to the `/etc/login.conf` file:

```
insecure:\
:copyright=/etc/COPYRIGHT:\
:welcome=/etc/motd:\
:setenv=MAIL=/var/mail/$,BLOCKSIZE=K:\
:path=~:/bin:/sbin:/bin:/usr/sbin:/usr/bin:/usr/local/sbin:/usr/local/bin
:manpath=/usr/share/man /usr/local/man:\
```

```
:nologin=/usr/sbin/nologin:\
:cputime=1h30m:\
:datasize=8M:\
:vmemoryuse=100M:\
:stacksize=2M:\
:memorylocked=4M:\
:memoryuse=8M:\
:filesize=8M:\
:coredumpsize=8M:\
:openfiles=24:\
:maxproc=32:\
:priority=0:\
:requirehome:\
:passwordtime=91d:\
:umask=022:\
:ignoretime@:\
:label=biba/10(10-10):
```

And adding the following line to the default user class:

```
:label=biba/high:
```

Once this is completed, the following command must be issued to rebuild the database:

```
# cap_mkdb /etc/login.conf
```

16.14.2 Boot Configuration

Do not reboot yet, just add the following lines to `/boot/loader.conf` so the required modules will load during system initialization:

```
mac_biba_load="YES"
mac_seeotheruids_load="YES"
```

16.14.3 Configure Users

Set the `root` user to the default class using:

```
# pw usermod root -L default
```

All user accounts that are not `root` or system users will now require a login class. The login class is required otherwise users will be refused access to common commands such as `vi(1)`. The following `sh` script should do the trick:

```
# for x in `awk -F: '($3 >= 1001) && ($3 != 65534) { print $1 }' \
/etc/passwd`; do pw usermod $x -L default; done;
```

Drop the `nagios` and `www` users into the insecure class:

```
# pw usermod nagios -L insecure
```

```
# pw usermod www -L insecure
```

16.14.4 Create the Contexts File

A contexts file should now be created; the following example file should be placed in `/etc/policy.contexts`.

```
# This is the default BIBA policy for this system.

# System:
/var/run                biba/equal
/var/run/*              biba/equal

/dev                   biba/equal
/dev/*                  biba/equal

/var    biba/equal
/var/spool                biba/equal
/var/spool/*              biba/equal

/var/log                 biba/equal
/var/log/*                biba/equal

/tmp    biba/equal
/tmp/*  biba/equal
/var/tmp    biba/equal
/var/tmp/*  biba/equal

/var/spool/mqueue  biba/equal
/var/spool/clientmqueue  biba/equal

# For Nagios:
/usr/local/etc/nagios
/usr/local/etc/nagios/*          biba/10

/var/spool/nagios                biba/10
/var/spool/nagios/*              biba/10

# For apache
/usr/local/etc/apache            biba/10
/usr/local/etc/apache/*          biba/10
```

This policy will enforce security by setting restrictions on the flow of information. In this specific configuration, users, `root` and others, should never be allowed to access **Nagios**. Configuration files and processes that are a part of **Nagios** will be completely self contained or jailed.

This file may now be read into our system by issuing the following command:

```
# setfsmac -ef /etc/policy.contexts /
# setfsmac -ef /etc/policy.contexts /
```

Óçìâùóç: The above file system layout may be different depending on environment; however, it must be run on every single file system.

The `/etc/mac.conf` file requires the following modifications in the main section:

```
default_labels file ?biba
default_labels ifnet ?biba
default_labels process ?biba
default_labels socket ?biba
```

16.14.5 Enable Networking

Add the following line to `/boot/loader.conf`:

```
security.mac.biba.trust_all_interfaces=1
```

And the following to the network card configuration stored in `rc.conf`. If the primary Internet configuration is done via DHCP, this may need to be configured manually after every system boot:

```
maclabel biba/equal
```

16.14.6 Testing the Configuration

Ensure that the web server and **Nagios** will not be started on system initialization, and reboot. Ensure the `root` user cannot access any of the files in the **Nagios** configuration directory. If `root` can issue an `ls(1)` command on `/var/spool/nagios`, then something is wrong. Otherwise a “permission denied” error should be returned.

If all seems well, **Nagios**, **Apache**, and **Sendmail** can now be started in a way fitting of the security policy. The following commands will make this happen:

```
# cd /etc/mail && make stop && \
setpmac biba/equal make start && setpmac biba/10\10-10\ apachectl start && \
setpmac biba/10\10-10\ /usr/local/etc/rc.d/nagios.sh forcestart
```

Double check to ensure that everything is working properly. If not, check the log files or error messages. Use the `sysctl(8)` utility to disable the `mac_biba(4)` security policy module enforcement and try starting everything again, like normal.

Óçìâùóç: The `root` user can change the security enforcement and edit the configuration files without fear. The following command will permit the degradation of the security policy to a lower grade for a newly spawned shell:

```
# setpmac biba/10 csh
```

To block this from happening, force the user into a range via `login.conf(5)`. If `setpmac(8)` attempts to run a command outside of the compartment’s range, an error will be returned and the command will not be executed. In this case, setting `root` to `biba/high(high-high)`.

16.15 User Lock Down

This example considers a relatively small, fewer than fifty users, storage system. Users would have login capabilities, and be permitted to not only store data but access resources as well.

For this scenario, the `mac_bsdextended(4)` mixed with `mac_seeotheruids(4)` could co-exist and block access not only to system objects but to hide user processes as well.

Begin by adding the following lines to `/boot/loader.conf`:

```
mac_seeotheruids_enabled="YES"
```

The `mac_bsdextended(4)` security policy module may be activated through the use of the following `rc.conf` variable:

```
ugidfw_enable="YES"
```

Default rules stored in `/etc/rc.bsdextended` will be loaded at system initialization; however, the default entries may need modification. Since this machine is expected only to service users, everything may be left commented out except the last two. These will force the loading of user owned system objects by default.

Add the required users to this machine and reboot. For testing purposes, try logging in as a different user across two consoles. Run the `ps aux` command to see if processes of other users are visible. Try to run `ls(1)` on another users home directory, it should fail.

Do not try to test with the `root` user unless the specific `sysctls` have been modified to block super user access.

Ὁδηγός: When a new user is added, their `mac_bsdextended(4)` rule will not be in the ruleset list. To update the ruleset quickly, simply unload the security policy module and reload it again using the `kldunload(8)` and `kldload(8)` utilities.

16.16 Troubleshooting the MAC Framework

During the development stage, a few users reported problems with normal configuration. Some of these problems are listed below:

16.16.1 The `multilabel` option cannot be enabled on `/`

The `multilabel` flag does not stay enabled on my root (`/`) partition!

It seems that one out of every fifty users has this problem, indeed, we had this problem during our initial configuration. Further observation of this so called “bug” has lead me to believe that it is a result of either incorrect documentation or misinterpretation of the documentation. Regardless of why it happened, the following steps may be taken to resolve it:

1. Edit `/etc/fstab` and set the root partition at `ro` for read-only.
2. Reboot into single user mode.
3. Run `tunefs -l enable` on `/`.
4. Reboot the system into normal mode.

5. Run `mount -urw /` and change the `ro` back to `rw` in `/etc/fstab` and reboot the system again.
6. Double-check the output from the `mount` to ensure that `multilabel` has been properly set on the root file system.

16.16.2 Cannot start a X11 server after MAC

After establishing a secure environment with MAC, I am no longer able to start X!

This could be caused by the `MAC partition` policy or by a mislabeling in one of the MAC labeling policies. To debug, try the following:

1. Check the error message; if the user is in the `insecure` class, the `partition` policy may be the culprit. Try setting the user's class back to the `default` class and rebuild the database with the `cap_mkdb` command. If this does not alleviate the problem, go to step two.
2. Double-check the label policies. Ensure that the policies are set correctly for the user in question, the X11 application, and the `/dev` entries.
3. If neither of these resolve the problem, send the error message and a description of your environment to the TrustedBSD discussion lists located at the TrustedBSD (<http://www.TrustedBSD.org>) website or to the `FreeBSD` (<http://lists.FreeBSD.org/mailman/listinfo/freebsd-questions>) mailing list.

16.16.3 Error: `_secure_path(3)` cannot stat `.login_conf`

When I attempt to switch from the `root` to another user in the system, the error message “`_secure_path: unable to state .login_conf`”.

This message is usually shown when the user has a higher label setting then that of the user whom they are attempting to become. For instance a user on the system, `joe`, has a default label of `biba/low`. The `root` user, who has a label of `biba/high`, cannot view `joe`'s home directory. This will happen regardless if `root` has used the `su` command to become `joe`, or not. In this scenario, the Biba integrity model will not permit `root` to view objects set at a lower integrity level.

16.16.4 The `root` username is broken!

In normal or even single user mode, the `root` is not recognized. The `whoami` command returns 0 (zero) and `su` returns “`who are you?`”. What could be going on?

This can happen if a labeling policy has been disabled, either by a `sysctl(8)` or the policy module was unloaded. If the policy is being disabled or has been temporarily disabled, then the `login capabilities` database needs to be reconfigured with the `label` option being removed. Double check the `login.conf` file to ensure that all `label` options have been removed and rebuild the database with the `cap_mkdb` command.

This may also happen if a policy restricts access to the `master.passwd` file or database. Usually caused by an administrator altering the file under a label which conflicts with the general policy being used by the system. In these cases, the user information would be read by the system and access would be blocked as the file has inherited the new label. Disable the policy via a `sysctl(8)` and everything should return to normal.

Όçìåέπόåέò

1. Other conditions may produce different failures. For instance, the file may not be owned by the user attempting to relabel the object, the object may not exist or may be read only. A mandatory policy will not allow the process to relabel the file, maybe because of a property of the file, a property of the process, or a property of the proposed new label value. For example: a user running at low integrity tries to change the label of a high integrity file. Or perhaps a user running at low integrity tries to change the label of a low integrity file to a high integrity label.
2. Due to a bug the `security.mac.portacl.enabled sysctl` variable will not work on FreeBSD 5.2.1 or previous releases.

ΕὰοÛεάεί 17_εὰã÷ìò ÓοιὰÛίòυί Άόοάεάβào

ÃñÛòçêà áδυ òττ Tom Rhodes εάε Robert Watson.

17.1 Óýττòç

Ïε áεαυòάεò òττ FreeBSD áδυ òçτ 6.2-RELEASE εάε ìàòÛ ðãñεεάìàÛττòτ òðτìòðñετç áεά εάðòττãñß Ýεάã÷ττ òοιàÛίòυί áóòάεάβào. Ï Ýεάã÷ττ òοιàÛίòυί àðεòñÝðáε áτευðεóçç, εάðòττãñß εάε ðãñάìáðñττìεðóετç εάóáãñáòß ðεðετò òοιàÛίòυί ó÷-áðεέðττ ìà òçτ áóòÛεάέá, òοιðãñεεάìáãñÝττì òυττ logins, òυττ áεεάãñττ ñòετβóáυττ, εάεðò εάε òçò ðñττìóάáçò òá ãñ÷-áβá εάε òòττ áβεòòττ. Ïε εάóáãñáóÝð áòòÝð áβττáε ðττεýòεττáð áεά áðáòεάβào ðãñáεττεττýççòç òττ òóòòðττáòττ, áττß÷ττ ìáðòç áεóáττεÝττì, εάεðò εάε áεά áττÛεòçç ìàòÛ áδυ εÛðττεά áðβεáçç. Òττ FreeBSD òεττìεάβ òç ìττòß ãñ÷-áβυττ εάε òττ BSM API ùðò Û÷ττì áçττìóεάòòáβ áδυ òçττ Sun, εάε áðεòñÝðáε áεάεάéòττìñáεéυòçòá ìà òεò òεττìεáðóáéò ãεÝã÷ττ òυòττ òττ Solaris òçò Sun ùòττ òττ Mac OS òçò Apple®.

Òττ εάòÛεάεί áòòυ áóòéÛεάé òççττ áãááòÛóðáçç εάε ñýττεòçç òττ ΆεÝã÷ττ ÓοιàÛίòυί. Άττçááβ òεò ðττεéòééÝð ãεÝã÷ττ, εάε ðãñÝ÷áé Ýττ ðãñÛááεάττ ñòετβóáυττ ãεÝã÷ττ.

Άòττý áεάáÛóáòá áòòυ òττ εάòÛεάεί, εά ττÝñáòá:

- Óé áβττáε ττ Ýεάã÷ττ òοιàÛίòυί εάε ðυò εάéòττñááβ.
- ðυò ìá ñòετβóáòá òττ Ýεάã÷ττ òοιàÛίòυί òòττ FreeBSD áεά ÷ñðóáð εάε ðñττãñÛττìáòá (processes).
- ðυò ìá áττáεýòáòá òá β÷ττç òττ ãεÝã÷ττ ÷ñçòεττìðττεðττáò òá ãñááεάβá ìáβυòçò ùáεττ ãáãñÝττì εάε áττÛεòçç.

ðñεττ áεάáÛóáòá áòòυ òττ εάòÛεάεί, εά ðñÝðáé:

- Ìá εάóáñττáβòá òεò ááóééÝð Ýτττεάð òττ UNIX εάε òττ FreeBSD (ΕὰοÛεάεί 3).
- Ìá áβóòá ãñεεάéυττÝττì ìà òεò ááóééÝð Ýτττεάð òçò ñýττεòççç εάε ìáòáãεðòðéççò òττ ðòñðττá. (ΕὰοÛεάεί 8).
- Ìá Ý÷áòá εÛðττεά ãñεεάβυòç ìà òçττ áóòÛεάέá εάε ðυò áòòß ó÷-áðβεáòáé ìà òττ FreeBSD (ΕὰοÛεάεί 14).

ðñττáεάττìðττεðçç: Ïε εάéòττñááò ãεÝã÷ττ òòττ FreeBSD 6.2 áβττáε òá ðáéñάττáòéééυ òòÛáéττ εάε ç áãááòÛóðáçç òττò òá ττç÷-áττáòá ðãñááυáßò éá ðñÝðáé ìá áβττáòáé ìυττì áòττý εçòéττýττ òττáãñÛ òðυòéττ ìé εβττáòττé áδυ òçττ áãááòÛóðáçç ðáéñάττáòéééυ εττáéòττéééυ. Ïε áττìòòττ áòòß òç òóéáττ ðñÝ÷ττìòáð ðãñéττéòττìβ ðãñééáττáÛττì òçττ ááòττáττá ãεÝã÷ττ ùéυττ òυττ òοιàÛίòυί ðττ ò÷-áðβεáττìóáé ìà òçττ áóòÛεάέá. Άðβóçò εÛðττεττé ττç÷-áττéòττβ áéóυáττò (logins), ùðò ìé ãñáòééεττβ (X11-ááóéòττÝττé) display managers, εάεðò εάε ττñéòττÝττáð òðçñáòβáð ðñβòυττ éáòáéáòáóòðττ ááττ áβττáε òυòòÛ ñòετβóáòáéáð áεά òττ Ýεάã÷ττ áéóυáττò ÷ñçòðττ.

ðñττáéáττìðττεðçç: Ï Ýεάã÷ττ òοιàÛίòυί áóòάεάβào ìðττñáβ ìá áçττεττòñáðóáé ðττεý εάðòττãñáòβ òáóáãñáóÝð òçò ãñáòçñééυòçòáð òττ òóòòðττáòττ: òá Ýττá òýòççττá ìà ðççéυ òυñðττì, òá ãñ÷-áβá éáòáãñáòß òττìñáβ ìá áβττìòττ ðττεý ìááÛεά, áττ Ý÷ττì ñòετβóáòáβ áεά εάðòττãñß éáòáãñáòß, εάε ìá ìáðãñÛòττì òá ãñéáòÛ gigabytes òçττ ááãñÛáá òá εÛðττεάð ðãñéðòðóáéò. Ïε áεá÷-áéñéóóÝð éá ðñÝðáé ìá éáττáÛττì òðυòéττ òττò òéò ðééáττÝð áðáéòßóáéò òá ÷ñττì áβóéττ òá ðãñβðòυòç ñòετβóáυττ éáðòττãñττýò éáòáãñáòß. Άéá ðãñÛááéáττá, βóυò áβττáε éáττéòυ ìá áóéáñùéáβ Ýττá òýòççττá ãñ÷-áβυττ òòττ /var/audit ðóáð òá òðυéττéðá òóòòðττáòá ãñ÷-áβυττ ìá ττç ððçñááóòòττì áττ ÷ñττì òóòυò áττáττéççéáβ.

17.2 Key Terms in this Chapter

Before reading this chapter, a few key audit-related terms must be explained:

- *event*: An auditable event is any event that can be logged using the audit subsystem. Examples of security-relevant events include the creation of a file, the building of a network connection, or a user logging in. Events are either “attributable”, meaning that they can be traced to an authenticated user, or “non-attributable” if they cannot be. Examples of non-attributable events are any events that occur before authentication in the login process, such as bad password attempts.
- *class*: Event classes are named sets of related events, and are used in selection expressions. Commonly used classes of events include “file creation” (fc), “exec” (ex) and “login_logout” (lo).
- *record*: A record is an audit log entry describing a security event. Records contain a record event type, information on the subject (user) performing the action, date and time information, information on any objects or arguments, and a success or failure condition.
- *trail*: An audit trail, or log file, consists of a series of audit records describing security events. Typically, trails are in roughly chronological order with respect to the time events completed. Only authorized processes are allowed to commit records to the audit trail.
- *selection expression*: A selection expression is a string containing a list of prefixes and audit event class names used to match events.
- *preselection*: The process by which the system identifies which events are of interest to the administrator in order to avoid generating audit records describing events that are not of interest. The preselection configuration uses a series of selection expressions to identify which classes of events to audit for which users, as well as global settings that apply to both authenticated and unauthenticated processes.
- *reduction*: The process by which records from existing audit trails are selected for preservation, printing, or analysis. Likewise, the process by which undesired audit records are removed from the audit trail. Using reduction, administrators can implement policies for the preservation of audit data. For example, detailed audit trails might be kept for one month, but after that, trails might be reduced in order to preserve only login information for archival purposes.

17.3 Installing Audit Support

User space support for Event Auditing is installed as part of the base FreeBSD operating system as of 6.2-RELEASE. However, Event Auditing support must be explicitly compiled into the kernel by adding the following lines to the kernel configuration file:

```
options AUDIT
```

Rebuild and reinstall the kernel via the normal process explained in κεφαλαίον 8.

Once the kernel is built, installed, and the system has been rebooted, enable the audit daemon by adding the following line to rc.conf(5):

```
auditd_enable="YES"
```

Audit support must then be started by a reboot, or by manually starting the audit daemon:

```
/etc/rc.d/auditd start
```

17.4 Audit Configuration

All configuration files for security audit are found in `/etc/security`. The following files must be present before the audit daemon is started:

- `audit_class` - Contains the definitions of the audit classes.
- `audit_control` - Controls aspects of the audit subsystem, such as default audit classes, minimum disk space to leave on the audit log volume, maximum audit trail size, etc.
- `audit_event` - Textual names and descriptions of system audit events, as well as a list of which classes each event is in.
- `audit_user` - User-specific audit requirements, which are combined with the global defaults at login.
- `audit_warn` - A customizable shell script used by `auditd` to generate warning messages in exceptional situations, such as when space for audit records is running low or when the audit trail file has been rotated.

Προσοχή: Audit configuration files should be edited and maintained carefully, as errors in configuration may result in improper logging of events.

17.4.1 Event Selection Expressions

Selection expressions are used in a number of places in the audit configuration to determine which events should be audited. Expressions contain a list of event classes to match, each with a prefix indicating whether matching records should be accepted or ignored, and optionally to indicate if the entry is intended to match successful or failed operations. Selection expressions are evaluated from left to right, and two expressions are combined by appending one onto the other.

The following list contains the default audit event classes present in `audit_class`:

- `all` - `all` - Match all event classes.
- `ad` - `administrative` - Administrative actions performed on the system as a whole.
- `ap` - `application` - Application defined action.
- `cl` - `file_close` - Audit calls to the `close` system call.
- `ex` - `exec` - Audit program execution. Auditing of command line arguments and environmental variables is controlled via `audit_control(5)` using the `argv` and `envv` parameters to the `policy` setting.
- `fa` - `file_attr_acc` - Audit the access of object attributes such as `stat(1)`, `pathconf(2)` and similar events.
- `fc` - `file_creation` - Audit events where a file is created as a result.
- `fd` - `file_deletion` - Audit events where file deletion occurs.
- `fm` - `file_attr_mod` - Audit events where file attribute modification occurs, such as `chown(8)`, `chflags(1)`, `flock(2)`, etc.
- `fr` - `file_read` - Audit events in which data is read, files are opened for reading, etc.
- `fw` - `file_write` - Audit events in which data is written, files are written or modified, etc.
- `io` - `ioctl` - Audit use of the `ioctl(2)` system call.

- `ip - ipc` - Audit various forms of Inter-Process Communication, including POSIX pipes and System V IPC operations.
- `lo - login_logout` - Audit `login(1)` and `logout(1)` events occurring on the system.
- `na - non_attrib` - Audit non-attributable events.
- `no - no_class` - Match no audit events.
- `nt - network` - Audit events related to network actions, such as `connect(2)` and `accept(2)`.
- `ot - other` - Audit miscellaneous events.
- `pc - process` - Audit process operations, such as `exec(3)` and `exit(3)`.

These audit event classes may be customized by modifying the `audit_class` and `audit_event` configuration files.

Each audit class in the list is combined with a prefix indicating whether successful/failed operations are matched, and whether the entry is adding or removing matching for the class and type.

- `(none)` Audit both successful and failed instances of the event.
- `+` Audit successful events in this class.
- `-` Audit failed events in this class.
- `^` Audit neither successful nor failed events in this class.
- `^+` Don't audit successful events in this class.
- `^-` Don't audit failed events in this class.

The following example selection string selects both successful and failed login/logout events, but only successful execution events:

```
lo,+ex
```

17.4.2 Configuration Files

In most cases, administrators will need to modify only two files when configuring the audit system:

`audit_control` and `audit_user`. The first controls system-wide audit properties and policies; the second may be used to fine-tune auditing by user.

17.4.2.1 The `audit_control` File

The `audit_control` file specifies a number of defaults for the audit subsystem. Viewing the contents of this file, we see the following:

```
dir:/var/audit
flags:lo
minfree:20
naflags:lo
policy:cnt
filesz:0
```

The `dir` option is used to set one or more directories where audit logs will be stored. If more than one directory appears, they will be used in order as they fill. It is common to configure audit so that audit logs are stored on a

dedicated file system, in order to prevent interference between the audit subsystem and other subsystems if the file system fills.

The `flags` field sets the system-wide default preselection mask for attributable events. In the example above, successful and failed login and logout events are audited for all users.

The `minfree` option defines the minimum percentage of free space for the file system where the audit trail is stored. When this threshold is exceeded, a warning will be generated. The above example sets the minimum free space to twenty percent.

The `naflags` option specifies audit classes to be audited for non-attributed events, such as the login process and system daemons.

The `policy` option specifies a comma-separated list of policy flags controlling various aspects of audit behavior. The default `cnt` flag indicates that the system should continue running despite an auditing failure (this flag is highly recommended). Another commonly used flag is `argv`, which causes command line arguments to the `execve(2)` system call to audited as part of command execution.

The `filesz` option specifies the maximum size in bytes to allow an audit trail file to grow to before automatically terminating and rotating the trail file. The default, 0, disables automatic log rotation. If the requested file size is non-zero and below the minimum 512k, it will be ignored and a log message will be generated.

17.4.2.2 The `audit_user` File

The `audit_user` file permits the administrator to specify further audit requirements for specific users. Each line configures auditing for a user via two fields: the first is the `alwaysaudit` field, which specifies a set of events that should always be audited for the user, and the second is the `neveraudit` field, which specifies a set of events that should never be audited for the user.

The following example `audit_user` file audits login/logout events and successful command execution for the root user, and audits file creation and successful command execution for the www user. If used with the example `audit_control` file above, the `lo` entry for root is redundant, and login/logout events will also be audited for the www user.

```
root:lo,+ex:no
www:fc,+ex:no
```

17.5 Administering the Audit Subsystem

17.5.1 Viewing Audit Trails

Audit trails are stored in the BSM binary format, so tools must be used to modify or convert to text. The `praudit` command convert trail files to a simple text format; the `auditreduce` command may be used to reduce the audit trail file for analysis, archiving, or printing purposes. `auditreduce` supports a variety of selection parameters, including event type, event class, user, date or time of the event, and the file path or object acted on.

For example, the `praudit` utility will dump the entire contents of a specified audit log in plain text:

```
# praudit /var/audit/AUDITFILE
```

Where *AUDITFILE* is the audit log to dump.

Audit trails consist of a series of audit records made up of tokens, which `praudit` prints sequentially one per line. Each token is of a specific type, such as `header` holding an audit record header, or `path` holding a file path from a name lookup. The following is an example of an `execve` event:

```
header,133,10,execve(2),0,Mon Sep 25 15:58:03 2006, + 384 msec
exec arg,finger,doug
path,/usr/bin/finger
attribute,555,root,wheel,90,24918,104944
subject,robert,root,wheel,root,wheel,38439,38032,42086,128.232.9.100
return,success,0
trailer,133
```

This audit represents a successful `execve` call, in which the command `finger doug` has been run. The arguments token contains both the processed command line presented by the shell to the kernel. The path token holds the path to the executable as looked up by the kernel. The attribute token describes the binary, and in particular, includes the file mode which can be used to determine if the application was `setuid`. The subject token describes the subject process, and stores in sequence the audit user ID, effective user ID and group ID, real user ID and group ID, process ID, session ID, port ID, and login address. Notice that the audit user ID and real user ID differ: the user `robert` has switched to the `root` account before running this command, but it is audited using the original authenticated user. Finally, the return token indicates the successful execution, and the trailer concludes the record.

17.5.2 Reducing Audit Trails

Since audit logs may be very large, an administrator will likely want to select a subset of records for using, such as records associated with a specific user:

```
# auditreduce -u trhodes /var/audit/AUDITFILE | praudit
```

This will select all audit records produced for the user `trhodes` stored in the *AUDITFILE* file.

17.5.3 Delegating Audit Review Rights

Members of the `audit` group are given permission to read audit trails in `/var/audit`; by default, this group is empty, so only the `root` user may read audit trails. Users may be added to the `audit` group in order to delegate audit review rights to the user. As the ability to track audit log contents provides significant insight into the behavior of users and processes, it is recommended that the delegation of audit review rights be performed with caution.

17.5.4 Live Monitoring Using Audit Pipes

Audit pipes are cloning pseudo-devices in the device file system which allow applications to tap the live audit record stream. This is primarily of interest to authors of intrusion detection and system monitoring applications. However, for the administrator the audit pipe device is a convenient way to allow live monitoring without running into problems with audit trail file ownership or log rotation interrupting the event stream. To track the live audit event stream, use the following command line

```
# praudit /dev/auditpipe
```

By default, audit pipe device nodes are accessible only to the `root` user. To make them accessible to the members of the `audit` group, add a `devfs` rule to `devfs.rules`:

```
add path 'auditpipe*' mode 0440 group audit
```

See `devfs.rules(5)` for more information on configuring the `devfs` file system.

Προειδοποίηση: It is easy to produce audit event feedback cycles, in which the viewing of each audit event results in the generation of more audit events. For example, if all network I/O is audited, and `praudit` is run from an SSH session, then a continuous stream of audit events will be generated at a high rate, as each event being printed will generate another event. It is advisable to run `praudit` on an audit pipe device from sessions without fine-grained I/O auditing in order to avoid this happening.

17.5.5 Rotating Audit Trail Files

Audit trails are written to only by the kernel, and managed only by the audit daemon, `auditd`. Administrators should not attempt to use `newsyslog.conf(5)` or other tools to directly rotate audit logs. Instead, the `audit` management tool may be used to shut down auditing, reconfigure the audit system, and perform log rotation. The following command causes the audit daemon to create a new audit log and signal the kernel to switch to using the new log. The old log will be terminated and renamed, at which point it may then be manipulated by the administrator.

```
# audit -n
```

Προειδοποίηση: If the `auditd` daemon is not currently running, this command will fail and an error message will be produced.

Adding the following line to `/etc/crontab` will force the rotation every twelve hours from `cron(8)`:

```
0    */12    *    *    *    root    /usr/sbin/audit -n
```

The change will take effect once you have saved the new `/etc/crontab`.

Automatic rotation of the audit trail file based on file size is possible via the `filesz` option in `audit_control(5)`, and is described in the configuration files section of this chapter.

17.5.6 Compressing Audit Trails

As audit trail files can become very large, it is often desirable to compress or otherwise archive trails once they have been closed by the audit daemon. The `audit_warn` script can be used to perform customized operations for a variety of audit-related events, including the clean termination of audit trails when they are rotated. For example, the following may be added to the `audit_warn` script to compress audit trails on close:

```
#
# Compress audit trail files on close.
#
if [ "$1" = closefile ]; then
```

```
gzip -9 $2  
fi
```

Other archiving activities might include copying trail files to a centralized server, deleting old trail files, or reducing the audit trail to remove unneeded records. The script will be run only when audit trail files are cleanly terminated, so will not be run on trails left unterminated following an improper shutdown.

ΕὰöÛεὰεί 18 ἈδιεçêãõôéêÛ ÌÝóá

18.1 Óýññç

Ïι εὰöÛεὰεί áõõù εáεýððáé ðçí ÷ ñÞõç ðùí äβóεùí óõι FreeBSD. ÐãñέεáíáÛíáé äβóεìòð ðìò ððìóçñβæìíðáé áðì ìÞìç, äβóεìòð óõíááááìÝíòð áðãðεâáð óõι äβέðõì, ðεð ðððέéÝð óõéεãõÝð áðìεÞεãóçð SCSI/IDE, εáεðð εáé óõóéãõÝð ðìò ÷ ñçóέììðìεýíí äéãðáóÞ USB.

Áõìý äεãáÛóããã áðõù ðì εὰöÛεὰεί, εá íÝñããã:

- Õçí ìñìεìãá ðìò ÷ ñçóέììðìεâ ðì FreeBSD äéá íá ðãñέãñÛøãé ðçí ìñáÛíòç ðùí äããñÝíùí óõι ððóέéù ÌÝóì ðìò äβóεìò (partitions - εáóáðìÞóáéð - εáé slices).
- Ðùð íá ðñìóéÝóããã íÝòð óéεçñìýð äβóεìòð óõι óýóççíá óãð.
- Ðùð íá ñðèìβóãã ðì FreeBSD íá ÷ ñçóέììðìεâ óõóéãõÝð áðìεÞεãóçð USB.
- Ðùð íá ñðèìβóãã áέεìíéêÛ óõóðÞíáóá áñ ÷ äβùí, ùðùð äβóεìòð ðìò áðìεçεãýííðáé óá ìÞìç RAM.
- Ðùð íá ÷ ñçóέììðìεÞóããã quotas äéá íá ðãñέììβóããã ðç ÷ ñÞõç ÷ þñìò óõι äβóéì.
- Ðùð íá êñððòìããðÞóããã äβóεìòð äéá íá ðìòð áóõáεβóããã áðì äðééÝóãéð.
- Ðùð íá açìεìòñãÞóããã εáé íá ãñÛøããã CD εáé DVD óõι FreeBSD.
- Óá äéÛòìñã äéáéÝóέíá ÌÝóá áðìεÞεãóçð äéá áíðβãããóá áóõáéâáð.
- Ðùð íá ÷ ñçóέììðìεÞóããã ðñìãñÛíããã éÞøçð áíðéãñÛòùí áóõáéâáð óõι FreeBSD.
- Ðùð íá ðÛñããã áíðβãããóá áóõáéâáð óá äéóéÝóããð.
- Õé äβíáé ìé äééùíáð (snapshots) óá Ýíá óýóççíá áñ ÷ äβùí εáé ðùð íá ðεð ÷ ñçóέììðìεÞóããã áðìαιóέêÛ.

Ðñéí äεãáÛóããã áðõù ðì εὰöÛεὰεί, εá ðñÝðáé:

- Íá íÝñããã ðùð εá ñðèìβóããã εáé εá äãéããóãðÞóããã Ýíá íÝì ððñÞíá ðìò FreeBSD (ΕὰöÛεὰεί 8).

18.2 Device Names

The following is a list of physical storage devices supported in FreeBSD, and the device names associated with them.

Ðβίáéãð 18-1. Physical Disk Naming Conventions

Drive type	Drive device name
IDE hard drives	ad
IDE CDROM drives	acd
SCSI hard drives and USB Mass storage devices	da
SCSI CDROM drives	cd
Assorted non-standard CDROM drives	mcđ for Mitsumi CD-ROM and scđ for Sony CD-ROM devices
Floppy drives	fd

Drive type	Drive device name
SCSI tape drives	sa
IDE tape drives	ast
Flash drives	fla for DiskOnChip® Flash device
RAID drives	aacd for Adaptec AdvancedRAID, mlx and mlyd for Mylex, amrd for AMI MegaRAID, idad for Compaq Smart RAID, twed for 3ware® RAID.

18.3 Adding Disks

Originally contributed by David O'Brien.

Lets say we want to add a new SCSI disk to a machine that currently only has a single drive. First turn off the computer and install the drive in the computer following the instructions of the computer, controller, and drive manufacturer. Due to the wide variations of procedures to do this, the details are beyond the scope of this document.

Login as user `root`. After you have installed the drive, inspect `/var/run/dmesg.boot` to ensure the new disk was found. Continuing with our example, the newly added drive will be `da1` and we want to mount it on `/1` (if you are adding an IDE drive, the device name will be `ad1`).

FreeBSD runs on IBM-PC compatible computers, therefore it must take into account the PC BIOS partitions. These are different from the traditional BSD partitions. A PC disk has up to four BIOS partition entries. If the disk is going to be truly dedicated to FreeBSD, you can use the *dedicated* mode. Otherwise, FreeBSD will have to live within one of the PC BIOS partitions. FreeBSD calls the PC BIOS partitions *slices* so as not to confuse them with traditional BSD partitions. You may also use slices on a disk that is dedicated to FreeBSD, but used in a computer that also has another operating system installed. This is a good way to avoid confusing the `fdisk` utility of other, non-FreeBSD operating systems.

In the slice case the drive will be added as `/dev/dal1e`. This is read as: SCSI disk, unit number 1 (second SCSI disk), slice 1 (PC BIOS partition 1), and `e` BSD partition. In the dedicated case, the drive will be added simply as `/dev/dale`.

Due to the use of 32-bit integers to store the number of sectors, `bsdlab(8)` is limited to $2^{32}-1$ sectors per disk or 2TB in most cases. The `fdisk(8)` format allows a starting sector of no more than $2^{32}-1$ and a length of no more than $2^{32}-1$, limiting partitions to 2TB and disks to 4TB in most cases. The `sunlabel(8)` format is limited to $2^{32}-1$ sectors per partition and 8 partitions for a total of 16TB. For larger disks, `gpt(8)` partitions may be used.

18.3.1 Using `sysinstall(8)`

1. Navigating `Sysinstall`

You may use `sysinstall` to partition and label a new disk using its easy to use menus. Either login as user `root` or use the `su` command. Run `sysinstall` and enter the `Configure` menu. Within the `FreeBSD Configuration Menu`, scroll down and select the `Fdisk` option.

2. `fdisk` Partition Editor

Once inside `fdisk`, typing `A` will use the entire disk for FreeBSD. When asked if you want to “remain cooperative with any future possible operating systems”, answer `YES`. Write the changes to the disk using `w`.

Now exit the FDISK editor by typing **q**. Next you will be asked about the “Master Boot Record”. Since you are adding a disk to an already running system, choose `None`.

3. Disk Label Editor

Next, you need to exit **sysinstall** and start it again. Follow the directions above, although this time choose the `Label` option. This will enter the `Disk Label Editor`. This is where you will create the traditional BSD partitions. A disk can have up to eight partitions, labeled `a-h`. A few of the partition labels have special uses. The `a` partition is used for the root partition (`/`). Thus only your system disk (e.g, the disk you boot from) should have an `a` partition. The `b` partition is used for swap partitions, and you may have many disks with swap partitions. The `c` partition addresses the entire disk in dedicated mode, or the entire FreeBSD slice in slice mode. The other partitions are for general use.

sysinstall's Label editor favors the `e` partition for non-root, non-swap partitions. Within the Label editor, create a single file system by typing **c**. When prompted if this will be a FS (file system) or swap, choose `FS` and type in a mount point (e.g, `/mnt`). When adding a disk in post-install mode, **sysinstall** will not create entries in `/etc/fstab` for you, so the mount point you specify is not important.

You are now ready to write the new label to the disk and create a file system on it. Do this by typing **w**. Ignore any errors from **sysinstall** that it could not mount the new partition. Exit the Label Editor and **sysinstall** completely.

4. Finish

The last step is to edit `/etc/fstab` to add an entry for your new disk.

18.3.2 Using Command Line Utilities

18.3.2.1 Using Slices

This setup will allow your disk to work correctly with other operating systems that might be installed on your computer and will not confuse other operating systems' `fdisk` utilities. It is recommended to use this method for new disk installs. Only use `dedicated` mode if you have a good reason to do so!

```
# dd if=/dev/zero of=/dev/da1 bs=1k count=1
# fdisk -BI da1 #Initialize your new disk
# bsdlablel -B -w -r da1s1 auto #Label it.
# bsdlablel -e da1s1 # Edit the bsdlablel just created and add any partitions.
# mkdir -p /1
# newfs /dev/da1s1e # Repeat this for every partition you created.
# mount /dev/da1s1e /1 # Mount the partition(s)
# vi /etc/fstab # Add the appropriate entry/entries to your /etc/fstab.
```

If you have an IDE disk, substitute `ad` for `da`.

18.3.2.2 Dedicated

If you will not be sharing the new drive with another operating system, you may use the `dedicated` mode. Remember this mode can confuse Microsoft operating systems; however, no damage will be done by them. IBM's OS/2 however, will “appropriate” any partition it finds which it does not understand.

```
# dd if=/dev/zero of=/dev/da1 bs=1k count=1
# bsdlablel -Brw da1 auto
```

```
# bsdlable -e da1      # create the 'e' partition
# newfs -d0 /dev/da1
# mkdir -p /1
# vi /etc/fstab        # add an entry for /dev/da1
# mount /1
```

An alternate method is:

```
# dd if=/dev/zero of=/dev/da1 count=2
# bsdlable /dev/da1 | bsdlable -BrR da1 /dev/stdin
# newfs /dev/da1
# mkdir -p /1
# vi /etc/fstab        # add an entry for /dev/da1
# mount /1
```

18.4 RAID

18.4.1 Software RAID

18.4.1.1 Concatenated Disk Driver (CCD) Configuration

Original work by Christopher Shumway. Revised by Jim Brown.

When choosing a mass storage solution the most important factors to consider are speed, reliability, and cost. It is rare to have all three in balance; normally a fast, reliable mass storage device is expensive, and to cut back on cost either speed or reliability must be sacrificed.

In designing the system described below, cost was chosen as the most important factor, followed by speed, then reliability. Data transfer speed for this system is ultimately constrained by the network. And while reliability is very important, the CCD drive described below serves online data that is already fully backed up on CD-R's and can easily be replaced.

Defining your own requirements is the first step in choosing a mass storage solution. If your requirements prefer speed or reliability over cost, your solution will differ from the system described in this section.

18.4.1.1.1 Installing the Hardware

In addition to the IDE system disk, three Western Digital 30GB, 5400 RPM IDE disks form the core of the CCD disk described below providing approximately 90GB of online storage. Ideally, each IDE disk would have its own IDE controller and cable, but to minimize cost, additional IDE controllers were not used. Instead the disks were configured with jumpers so that each IDE controller has one master, and one slave.

Upon reboot, the system BIOS was configured to automatically detect the disks attached. More importantly, FreeBSD detected them on reboot:

```
ad0: 19574MB <WDC WD205BA> [39770/16/63] at ata0-master UDMA33
ad1: 29333MB <WDC WD307AA> [59598/16/63] at ata0-slave UDMA33
ad2: 29333MB <WDC WD307AA> [59598/16/63] at ata1-master UDMA33
ad3: 29333MB <WDC WD307AA> [59598/16/63] at ata1-slave UDMA33
```

Όχι! Βύθος: If FreeBSD does not detect all the disks, ensure that you have jumpered them correctly. Most IDE drives also have a “Cable Select” jumper. This is *not* the jumper for the master/slave relationship. Consult the drive documentation for help in identifying the correct jumper.

Next, consider how to attach them as part of the file system. You should research both `vinum(8)` (Εάν έχετε 21) and `ccd(4)`. In this particular configuration, `ccd(4)` was chosen.

18.4.1.1.2 Setting Up the CCD

The `ccd(4)` driver allows you to take several identical disks and concatenate them into one logical file system. In order to use `ccd(4)`, you need a kernel with `ccd(4)` support built in. Add this line to your kernel configuration file, rebuild, and reinstall the kernel:

```
device    ccd
```

The `ccd(4)` support can also be loaded as a kernel loadable module.

To set up `ccd(4)`, you must first use `bsdlabell(8)` to label the disks:

```
bsdlabell -r -w ad1 auto
bsdlabell -r -w ad2 auto
bsdlabell -r -w ad3 auto
```

This creates a `bsdlabell` for `ad1c`, `ad2c` and `ad3c` that spans the entire disk.

The next step is to change the disk label type. You can use `bsdlabell(8)` to edit the disks:

```
bsdlabell -e ad1
bsdlabell -e ad2
bsdlabell -e ad3
```

This opens up the current disk label on each disk with the editor specified by the `EDITOR` environment variable, typically `vi(1)`.

An unmodified disk label will look something like this:

```
8 partitions:
#      size  offset  fstype  [fsize bsize bps/cpg]
  c: 60074784      0  unused      0      0      0  # (Cyl.  0 - 59597)
```

Add a new `e` partition for `ccd(4)` to use. This can usually be copied from the `c` partition, but the `fstype` *must* be **4.2BSD**. The disk label should now look something like this:

```
8 partitions:
#      size  offset  fstype  [fsize bsize bps/cpg]
  c: 60074784      0  unused      0      0      0  # (Cyl.  0 - 59597)
  e: 60074784      0  4.2BSD      0      0      0  # (Cyl.  0 - 59597)
```

18.4.1.1.3 Building the File System

Now that you have all the disks labeled, you must build the ccd(4). To do that, use ccdconfig(8), with options similar to the following:

```
ccdconfig ccd0 32 0 /dev/ad1e /dev/ad2e /dev/ad3e
```

The use and meaning of each option is shown below:

- ❶ The first argument is the device to configure, in this case, /dev/ccd0c. The /dev/ portion is optional.
- ❷ The interleave for the file system. The interleave defines the size of a stripe in disk blocks, each normally 512 bytes. So, an interleave of 32 would be 16,384 bytes.
- ❸ Flags for ccdconfig(8). If you want to enable drive mirroring, you can specify a flag here. This configuration does not provide mirroring for ccd(4), so it is set at 0 (zero).
- ❹ The final arguments to ccdconfig(8) are the devices to place into the array. Use the complete pathname for each device.

After running ccdconfig(8) the ccd(4) is configured. A file system can be installed. Refer to newfs(8) for options, or simply run:

```
newfs /dev/ccd0c
```

18.4.1.1.4 Making it All Automatic

Generally, you will want to mount the ccd(4) upon each reboot. To do this, you must configure it first. Write out your current configuration to /etc/ccd.conf using the following command:

```
ccdconfig -g > /etc/ccd.conf
```

During reboot, the script /etc/rc runs ccdconfig -C if /etc/ccd.conf exists. This automatically configures the ccd(4) so it can be mounted.

Όχι! Βύθος: If you are booting into single user mode, before you can mount(8) the ccd(4), you need to issue the following command to configure the array:

```
ccdconfig -C
```

To automatically mount the ccd(4), place an entry for the ccd(4) in /etc/fstab so it will be mounted at boot time:

```
/dev/ccd0c          /media              ufs      rw      2       2
```

18.4.1.2 The Vinum Volume Manager

The Vinum Volume Manager is a block device driver which implements virtual disk drives. It isolates disk hardware from the block device interface and maps data in ways which result in an increase in flexibility, performance and reliability compared to the traditional slice view of disk storage. vinum(8) implements the RAID-0, RAID-1 and RAID-5 models, both individually and in combination.

See Εἰσαγωγή 21 for more information about `vinum(8)`.

18.4.2 Hardware RAID

FreeBSD also supports a variety of hardware RAID controllers. These devices control a RAID subsystem without the need for FreeBSD specific software to manage the array.

Using an on-card BIOS, the card controls most of the disk operations itself. The following is a brief setup description using a Promise IDE RAID controller. When this card is installed and the system is started up, it displays a prompt requesting information. Follow the instructions to enter the card's setup screen. From here, you have the ability to combine all the attached drives. After doing so, the disk(s) will look like a single drive to FreeBSD. Other RAID levels can be set up accordingly.

18.4.3 Rebuilding ATA RAID1 Arrays

FreeBSD allows you to hot-replace a failed disk in an array. This requires that you catch it before you reboot.

You will probably see something like the following in `/var/log/messages` or in the `dmesg(8)` output:

```
ad6 on monster1 suffered a hard error.
ad6: READ command timeout tag=0 serv=0 - resetting
ad6: trying fallback to PIO mode
ata3: resetting devices .. done
ad6: hard error reading fsbn 1116119 of 0-7 (ad6 bn 1116119; cn 1107 tn 4 sn 11)\
status=59 error=40
ar0: WARNING - mirror lost
```

Using `atacontrol(8)`, check for further information:

```
# atacontrol list
ATA channel 0:
  Master:      no device present
  Slave:      acd0 <HL-DT-ST CD-ROM GCR-8520B/1.00> ATA/ATAPI rev 0

ATA channel 1:
  Master:      no device present
  Slave:      no device present

ATA channel 2:
  Master:      ad4 <MAXTOR 6L080J4/A93.0500> ATA/ATAPI rev 5
  Slave:      no device present

ATA channel 3:
  Master:      ad6 <MAXTOR 6L080J4/A93.0500> ATA/ATAPI rev 5
  Slave:      no device present

# atacontrol status ar0
ar0: ATA RAID1 subdisks: ad4 ad6 status: DEGRADED
```

1. You will first need to detach the ata channel with the failed disk so you can safely remove it:

- ```
atacontrol detach ata3
```
2. Replace the disk.
  3. Reattach the ata channel:
 

```
atacontrol attach ata3
Master: ad6 <MAXTOR 6L080J4/A93.0500> ATA/ATAPI rev 5
Slave: no device present
```
  4. Add the new disk to the array as a spare:
 

```
atacontrol addspare ar0 ad6
```
  5. Rebuild the array:
 

```
atacontrol rebuild ar0
```
  6. It is possible to check on the progress by issuing the following command:
 

```
dmesg | tail -10
[output removed]
ad6: removed from configuration
ad6: deleted from ar0 disk1
ad6: inserted into ar0 disk1 as spare

atacontrol status ar0
ar0: ATA RAID1 subdisks: ad4 ad6 status: REBUILDING 0% completed
```
  7. Wait until this operation completes.

## 18.5 USB Storage Devices

*Contributed by Marc Fonvieuille.*

A lot of external storage solutions, nowadays, use the Universal Serial Bus (USB): hard drives, USB thumbdrives, CD-R burners, etc. FreeBSD provides support for these devices.

### 18.5.1 Configuration

The USB mass storage devices driver, `umass(4)`, provides the support for USB storage devices. If you use the `GENERIC` kernel, you do not have to change anything in your configuration. If you use a custom kernel, be sure that the following lines are present in your kernel configuration file:

```
device scbus
device da
device pass
device uhci
device ohci
device usb
device umass
```

The `umass(4)` driver uses the SCSI subsystem to access to the USB storage devices, your USB device will be seen as a SCSI device by the system. Depending on the USB chipset on your motherboard, you only need either `device`

uhci or device ohci, however having both in the kernel configuration file is harmless. Do not forget to compile and install the new kernel if you added any lines.

**Ὁδηγία:** If your USB device is a CD-R or DVD burner, the SCSI CD-ROM driver, cd(4), must be added to the kernel via the line:

```
device cd
```

Since the burner is seen as a SCSI drive, the driver ataicam(4) should not be used in the kernel configuration.

Support for USB 2.0 controllers is provided on FreeBSD; however, you must add:

```
device ehci
```

to your configuration file for USB 2.0 support. Note uhci(4) and ohci(4) drivers are still needed if you want USB 1.X support.

## 18.5.2 Testing the Configuration

The configuration is ready to be tested: plug in your USB device, and in the system message buffer (dmesg(8)), the drive should appear as something like:

```
umass0: USB Solid state disk, rev 1.10/1.00, addr 2
GEOM: create disk da0 dp=0xc2d74850
da0 at umass-sim0 bus 0 target 0 lun 0
da0: <Generic Traveling Disk 1.11> Removable Direct Access SCSI-2 device
da0: 1.000MB/s transfers
da0: 126MB (258048 512 byte sectors: 64H 32S/T 126C)
```

Of course, the brand, the device node (da0) and other details can differ according to your configuration.

Since the USB device is seen as a SCSI one, the camcontrol command can be used to list the USB storage devices attached to the system:

```
camcontrol devlist
<Generic Traveling Disk 1.11> at scbus0 target 0 lun 0 (da0,pass0)
```

If the drive comes with a file system, you should be able to mount it. The Ὁδηγία 18.3 will help you to format and create partitions on the USB drive if needed.

To make this device mountable as a normal user, certain steps have to be taken. First, the devices that are created when a USB storage device is connected need to be accessible by the user. A solution is to make all users of these devices a member of the operator group. This is done with pw(8). Second, when the devices are created, the operator group should be able to read and write them. This is accomplished by adding these lines to /etc/devfs.rules:

```
[localrules=1]
add path 'da*' mode 0660 group operator
```

**Όχι! Βύθος:** If there already are SCSI disks in the system, it must be done a bit different. E.g., if the system already contains disks `da0` through `da2` attached to the system, change the second line as follows:

```
add path 'da[3-9]*' mode 0660 group operator
```

This will exclude the already existing disks from belonging to the `operator` group.

You also have to enable your `devfs.rules(5)` ruleset in your `/etc/rc.conf` file:

```
devfs_system_ruleset="localrules"
```

Next, the kernel has to be configured to allow regular users to mount file systems. The easiest way is to add the following line to `/etc/sysctl.conf`:

```
vfs.usermount=1
```

Note that this only takes effect after the next reboot. Alternatively, one can also use `sysctl(8)` to set this variable.

The final step is to create a directory where the file system is to be mounted. This directory needs to be owned by the user that is to mount the file system. One way to do that is for `root` to create a subdirectory owned by that user as `/mnt/$USER` (replace `$USER` by the login name of the actual user):

```
mkdir /mnt/$USER
chown $USER:$USER /mnt/$USER
```

Suppose a USB thumbdrive is plugged in, and a device `/dev/da0s1` appears. Since these devices usually come preformatted with a FAT file system, one can mount them like this:

```
% mount_msdosfs -m 644 -M 755 /dev/da0s1 /mnt/$USER
```

If you unplug the device (the disk must be unmounted before), you should see, in the system message buffer, something like the following:

```
umass0: at uhub0 port 1 (addr 2) disconnected
(da0:umass-sim0:0:0:0): lost device
(da0:umass-sim0:0:0:0): removing device entry
GEOM: destroy disk da0 dp=0xc2d74850
umass0: detached
```

### 18.5.3 Further Reading

Beside the [Adding Disks and Mounting and Unmounting File Systems](#) sections, reading various manual pages may be also useful: `umass(4)`, `camcontrol(8)`, and `usbdevs(8)`.

## 18.6 Creating and Using Optical Media (CDs)

*Contributed by Mike Meyer.*

### 18.6.1 Introduction

CDs have a number of features that differentiate them from conventional disks. Initially, they were not writable by the user. They are designed so that they can be read continuously without delays to move the head between tracks. They are also much easier to transport between systems than similarly sized media were at the time.

CDs do have tracks, but this refers to a section of data to be read continuously and not a physical property of the disk. To produce a CD on FreeBSD, you prepare the data files that are going to make up the tracks on the CD, then write the tracks to the CD.

The ISO 9660 file system was designed to deal with these differences. It unfortunately codifies file system limits that were common then. Fortunately, it provides an extension mechanism that allows properly written CDs to exceed those limits while still working with systems that do not support those extensions.

The `sysutils/cdrtools` port includes `mkisofs(8)`, a program that you can use to produce a data file containing an ISO 9660 file system. It has options that support various extensions, and is described below.

Which tool to use to burn the CD depends on whether your CD burner is ATAPI or something else. ATAPI CD burners use the `burncd` program that is part of the base system. SCSI and USB CD burners should use `cdrecord` from the `sysutils/cdrtools` port. It is also possible to use `cdrecord` and other tools for SCSI drives on ATAPI hardware with the ATAPI/CAM module.

If you want CD burning software with a graphical user interface, you may wish to take a look at either **X-CD-Roast** or **K3b**. These tools are available as packages or from the `sysutils/xcdroast` and `sysutils/k3b` ports. **X-CD-Roast** and **K3b** require the ATAPI/CAM module with ATAPI hardware.

### 18.6.2 mkisofs

The `mkisofs(8)` program, which is part of the `sysutils/cdrtools` port, produces an ISO 9660 file system that is an image of a directory tree in the UNIX file system name space. The simplest usage is:

```
mkisofs -o imagefile.iso /path/to/tree
```

This command will create an `imagefile.iso` containing an ISO 9660 file system that is a copy of the tree at `/path/to/tree`. In the process, it will map the file names to names that fit the limitations of the standard ISO 9660 file system, and will exclude files that have names uncharacteristic of ISO file systems.

A number of options are available to overcome those restrictions. In particular, `-R` enables the Rock Ridge extensions common to UNIX systems, `-J` enables Joliet extensions used by Microsoft systems, and `-hfs` can be used to create HFS file systems used by Mac OS.

For CDs that are going to be used only on FreeBSD systems, `-U` can be used to disable all filename restrictions. When used with `-R`, it produces a file system image that is identical to the FreeBSD tree you started from, though it may violate the ISO 9660 standard in a number of ways.

The last option of general use is `-b`. This is used to specify the location of the boot image for use in producing an “El Torito” bootable CD. This option takes an argument which is the path to a boot image from the top of the tree being written to the CD. By default, `mkisofs(8)` creates an ISO image in the so-called “floppy disk emulation” mode, and thus expects the boot image to be exactly 1200, 1440 or 2880 KB in size. Some boot loaders, like the one used by the

FreeBSD distribution disks, do not use emulation mode; in this case, the `-no-emul-boot` option should be used. So, if `/tmp/myboot` holds a bootable FreeBSD system with the boot image in `/tmp/myboot/boot/cdboot`, you could produce the image of an ISO 9660 file system in `/tmp/bootable.iso` like so:

```
mkisofs -R -no-emul-boot -b boot/cdboot -o /tmp/bootable.iso /tmp/myboot
```

Having done that, if you have `md` configured in your kernel, you can mount the file system with:

```
mdconfig -a -t vnode -f /tmp/bootable.iso -u 0
mount -t cd9660 /dev/md0 /mnt
```

At which point you can verify that `/mnt` and `/tmp/myboot` are identical.

There are many other options you can use with `mkisofs(8)` to fine-tune its behavior. In particular: modifications to an ISO 9660 layout and the creation of Joliet and HFS discs. See the `mkisofs(8)` manual page for details.

### 18.6.3 burncd

If you have an ATAPI CD burner, you can use the `burncd` command to burn an ISO image onto a CD. `burncd` is part of the base system, installed as `/usr/sbin/burncd`. Usage is very simple, as it has few options:

```
burncd -f cddevice data imagefile.iso fixate
```

Will burn a copy of `imagefile.iso` on `cddevice`. The default device is `/dev/acd0`. See `burncd(8)` for options to set the write speed, eject the CD after burning, and write audio data.

### 18.6.4 cdrecord

If you do not have an ATAPI CD burner, you will have to use `cdrecord` to burn your CDs. `cdrecord` is not part of the base system; you must install it from either the port at `sysutils/cdrtools` or the appropriate package. Changes to the base system can cause binary versions of this program to fail, possibly resulting in a “coaster”. You should therefore either upgrade the port when you upgrade your system, or if you are tracking `-STABLE`, upgrade the port when a new version becomes available.

While `cdrecord` has many options, basic usage is even simpler than `burncd`. Burning an ISO 9660 image is done with:

```
cdrecord dev=device imagefile.iso
```

The tricky part of using `cdrecord` is finding the `dev` to use. To find the proper setting, use the `-scanbus` flag of `cdrecord`, which might produce results like this:

```
cdrecord -scanbus
Cdrecord-Clone 2.01 (i386-unknown-freebsd7.0) Copyright (C) 1995-2004 Jörg Schilling
Using libscg version 'schily-0.1'
scsibus0:
 0,0,0 0) 'SEAGATE ' 'ST39236LW ' '0004' Disk
 0,1,0 1) 'SEAGATE ' 'ST39173W ' '5958' Disk
 0,2,0 2) *
 0,3,0 3) 'iomega ' 'jaz 1GB ' 'J.86' Removable Disk
 0,4,0 4) 'NEC ' 'CD-ROM DRIVE:466' '1.26' Removable CD-ROM
```

```

0,5,0 5) *
0,6,0 6) *
0,7,0 7) *
scsibus1:
 1,0,0 100) *
 1,1,0 101) *
 1,2,0 102) *
 1,3,0 103) *
 1,4,0 104) *
 1,5,0 105) 'YAMAHA ' 'CRW4260 ' '1.0q' Removable CD-ROM
 1,6,0 106) 'ARTEC ' 'AM12S ' '1.06' Scanner
 1,7,0 107) *

```

This lists the appropriate `dev` value for the devices on the list. Locate your CD burner, and use the three numbers separated by commas as the value for `dev`. In this case, the CRW device is 1,5,0, so the appropriate input would be `dev=1,5,0`. There are easier ways to specify this value; see `cdrecord(1)` for details. That is also the place to look for information on writing audio tracks, controlling the speed, and other things.

## 18.6.5 Duplicating Audio CDs

You can duplicate an audio CD by extracting the audio data from the CD to a series of files, and then writing these files to a blank CD. The process is slightly different for ATAPI and SCSI drives.

### SCSI Drives

1. Use `cdda2wav` to extract the audio.

```
% cdda2wav -v255 -D2,0 -B -Owav
```

2. Use `cdrecord` to write the `.wav` files.

```
% cdrecord -v dev=2,0 -dao -useinfo *.wav
```

Make sure that `2,0` is set appropriately, as described in [Ότι 18.6.4](#).

### ATAPI Drives

1. The ATAPI CD driver makes each track available as `/dev/acd0t $nn$` , where  $d$  is the drive number, and  $nn$  is the track number written with two decimal digits, prefixed with zero as needed. So the first track on the first disk is `/dev/acd0t01`, the second is `/dev/acd0t02`, the third is `/dev/acd0t03`, and so on.

Make sure the appropriate files exist in `/dev`. If the entries are missing, force the system to retaste the media:

```
dd if=/dev/acd0 of=/dev/null count=1
```

2. Extract each track using `dd(1)`. You must also use a specific block size when extracting the files.

```
dd if=/dev/acd0t01 of=track1.cdr bs=2352
dd if=/dev/acd0t02 of=track2.cdr bs=2352
...
```

3. Burn the extracted files to disk using `burncd`. You must specify that these are audio files, and that `burncd` should fixate the disk when finished.

```
burncd -f /dev/acd0 audio track1.cdr track2.cdr ... fixate
```

## 18.6.6 Duplicating Data CDs

You can copy a data CD to a image file that is functionally equivalent to the image file created with `mkisofs(8)`, and you can use it to duplicate any data CD. The example given here assumes that your CDROM device is `acd0`. Substitute your correct CDROM device.

```
dd if=/dev/acd0 of=file.iso bs=2048
```

Now that you have an image, you can burn it to CD as described above.

## 18.6.7 Using Data CDs

Now that you have created a standard data CDROM, you probably want to mount it and read the data on it. By default, `mount(8)` assumes that a file system is of type `ufs`. If you try something like:

```
mount /dev/cd0 /mnt
```

you will get a complaint about “Incorrect super block”, and no mount. The CDROM is not a `ufs` file system, so attempts to mount it as such will fail. You just need to tell `mount(8)` that the file system is of type `ISO9660`, and everything will work. You do this by specifying the `-t cd9660` option `mount(8)`. For example, if you want to mount the CDROM device, `/dev/cd0`, under `/mnt`, you would execute:

```
mount -t cd9660 /dev/cd0 /mnt
```

Note that your device name (`/dev/cd0` in this example) could be different, depending on the interface your CDROM uses. Also, the `-t cd9660` option just executes `mount_cd9660(8)`. The above example could be shortened to:

```
mount_cd9660 /dev/cd0 /mnt
```

You can generally use data CDROMs from any vendor in this way. Disks with certain ISO 9660 extensions might behave oddly, however. For example, Joliet disks store all filenames in two-byte Unicode characters. The FreeBSD kernel does not speak Unicode, but the FreeBSD CD9660 driver is able to convert Unicode characters on the fly. If some non-English characters show up as question marks you will need to specify the local charset you use with the `-C` option. For more information, consult the `mount_cd9660(8)` manual page.

**Όχι! Βούζ:** To be able to do this character conversion with the help of the `-C` option, the kernel will require the `cd9660_iconv.ko` module to be loaded. This can be done either by adding this line to `loader.conf`:

```
cd9660_iconv_load="YES"
```

and then rebooting the machine, or by directly loading the module with `kldload(8)`.

Occasionally, you might get “Device not configured” when trying to mount a CDROM. This usually means that the CDROM drive thinks that there is no disk in the tray, or that the drive is not visible on the bus. It can take a couple of seconds for a CDROM drive to realize that it has been fed, so be patient.

Sometimes, a SCSI CDROM may be missed because it did not have enough time to answer the bus reset. If you have a SCSI CDROM please add the following option to your kernel configuration and rebuild your kernel.

```
options SCSI_DELAY=15000
```

This tells your SCSI bus to pause 15 seconds during boot, to give your CDROM drive every possible chance to answer the bus reset.

### 18.6.8 Burning Raw Data CDs

You can choose to burn a file directly to CD, without creating an ISO 9660 file system. Some people do this for backup purposes. This runs more quickly than burning a standard CD:

```
burncd -f /dev/acd1 -s 12 data archive.tar.gz fixate
```

In order to retrieve the data burned to such a CD, you must read data from the raw device node:

```
tar xzvf /dev/acd1
```

You cannot mount this disk as you would a normal CDROM. Such a CDROM cannot be read under any operating system except FreeBSD. If you want to be able to mount the CD, or share data with another operating system, you must use mkisofs(8) as described above.

### 18.6.9 Using the ATAPI/CAM Driver

*Contributed by Marc Fonvieille.*

This driver allows ATAPI devices (CD-ROM, CD-RW, DVD drives etc...) to be accessed through the SCSI subsystem, and so allows the use of applications like sysutils/cdrdao or cdrecord(1).

To use this driver, you will need to add the following line to the /boot/loader.conf file:

```
atapicam_load="YES"
```

then, reboot your machine.

**Όχι! Βούρα:** If you prefer to statically compile the atapicam(4) support in your kernel, you will have to add this line to your kernel configuration file:

```
device atapicam
```

You also need the following lines in your kernel configuration file:

```
device ata
device scbus
device cd
device pass
```

which should already be present. Then rebuild, install your new kernel, and reboot your machine.

During the boot process, your burner should show up, like so:

```
acd0: CD-RW <MATSHITA CD-RW/DVD-ROM UJDA740> at ata1-master PIO4
cd0 at ata1 bus 0 target 0 lun 0
cd0: <MATSHITA CDRW/DVD UJDA740 1.00> Removable CD-ROM SCSI-0 device
cd0: 16.000MB/s transfers
```

cd0: Attempt to query device size failed: NOT READY, Medium not present - tray closed

The drive could now be accessed via the `/dev/cd0` device name, for example to mount a CD-ROM on `/mnt`, just type the following:

```
mount -t cd9660 /dev/cd0 /mnt
```

As root, you can run the following command to get the SCSI address of the burner:

```
camcontrol devlist
<MATSHITA CDRW/DVD UJDA740 1.00> at scbus1 target 0 lun 0 (pass0,cd0)
```

So `1,0,0` will be the SCSI address to use with `cdrecord(1)` and other SCSI application.

For more information about ATAPI/CAM and SCSI system, refer to the `atapicam(4)` and `cam(4)` manual pages.

## 18.7 Creating and Using Optical Media (DVDs)

*Contributed by Marc Fonvieille. With inputs from Andy Polyakov.*

### 18.7.1 Introduction

Compared to the CD, the DVD is the next generation of optical media storage technology. The DVD can hold more data than any CD and is nowadays the standard for video publishing.

Five physical recordable formats can be defined for what we will call a recordable DVD:

- DVD-R: This was the first DVD recordable format available. The DVD-R standard is defined by the DVD Forum (<http://www.dvdforum.com/forum.shtml>). This format is write once.
- DVD-RW: This is the rewritable version of the DVD-R standard. A DVD-RW can be rewritten about 1000 times.
- DVD-RAM: This is also a rewritable format supported by the DVD Forum. A DVD-RAM can be seen as a removable hard drive. However, this media is not compatible with most DVD-ROM drives and DVD-Video players; only a few DVD writers support the DVD-RAM format. Read the [Ότι 18.7.9](#) for more information on DVD-RAM use.
- DVD+RW: This is a rewritable format defined by the DVD+RW Alliance (<http://www.dvdrw.com/>). A DVD+RW can be rewritten about 1000 times.
- DVD+R: This format is the write once variation of the DVD+RW format.

A single layer recordable DVD can hold up to 4,700,000,000 bytes which is actually 4.38 GB or 4485 MB (1 kilobyte is 1024 bytes).

**Ότι 18.7.9:** A distinction must be made between the physical media and the application. For example, a DVD-Video is a specific file layout that can be written on any recordable DVD physical media: DVD-R, DVD+R, DVD-RW etc. Before choosing the type of media, you must be sure that both the burner and the DVD-Video player (a standalone player or a DVD-ROM drive on a computer) are compatible with the media under consideration.

## 18.7.2 Configuration

The program `growisofs(1)` will be used to perform DVD recording. This command is part of the **dvd+rw-tools** utilities (`sysutils/dvd+rw-tools`). The **dvd+rw-tools** support all DVD media types.

These tools use the SCSI subsystem to access to the devices, therefore the ATAPI/CAM support must be added to your kernel. If your burner uses the USB interface this addition is useless, and you should read the Ὁδηγία 18.5 for more details on USB devices configuration.

You also have to enable DMA access for ATAPI devices, this can be done in adding the following line to the `/boot/loader.conf` file:

```
hw.ata.atapi_dma="1"
```

Before attempting to use the **dvd+rw-tools** you should consult the dvd+rw-tools' hardware compatibility notes (<http://fy.chalmers.se/~appro/linux/DVD+RW/hcn.html>) for any information related to your DVD burner.

**Ὁδηγία:** If you want a graphical user interface, you should have a look to **K3b** (`sysutils/k3b`) which provides a user friendly interface to `growisofs(1)` and many other burning tools.

## 18.7.3 Burning Data DVDs

The `growisofs(1)` command is a frontend to `mkisofs(8)`, it will invoke `mkisofs(8)` to create the file system layout and will perform the write on the DVD. This means you do not need to create an image of the data before the burning process.

To burn onto a DVD+R or a DVD-R the data from the `/path/to/data` directory, use the following command:

```
growisofs -dvd-compat -Z /dev/cd0 -J -R /path/to/data
```

The options `-J -R` are passed to `mkisofs(8)` for the file system creation (in this case: an ISO 9660 file system with Joliet and Rock Ridge extensions), consult the `mkisofs(8)` manual page for more details.

The option `-Z` is used for the initial session recording in any case: multiple sessions or not. The DVD device, `/dev/cd0`, must be changed according to your configuration. The `-dvd-compat` parameter will close the disk, the recording will be unappendable. In return this should provide better media compatibility with DVD-ROM drives.

It is also possible to burn a pre-mastered image, for example to burn the image `imagefile.iso`, we will run:

```
growisofs -dvd-compat -Z /dev/cd0=imagefile.iso
```

The write speed should be detected and automatically set according to the media and the drive being used. If you want to force the write speed, use the `-speed=` parameter. For more information, read the `growisofs(1)` manual page.

## 18.7.4 Burning a DVD-Video

A DVD-Video is a specific file layout based on ISO 9660 and the micro-UDF (M-UDF) specifications. The DVD-Video also presents a specific data structure hierarchy, it is the reason why you need a particular program such as `multimedia/dvdauthor` to author the DVD.

If you already have an image of the DVD-Video file system, just burn it in the same way as for any image, see the previous section for an example. If you have made the DVD authoring and the result is in, for example, the directory `/path/to/video`, the following command should be used to burn the DVD-Video:

```
growisofs -Z /dev/cd0 -dvd-video /path/to/video
```

The `-dvd-video` option will be passed down to `mkisofs(8)` and will instruct it to create a DVD-Video file system layout. Beside this, the `-dvd-video` option implies `-dvd-compatible growisofs(1)` option.

### 18.7.5 Using a DVD+RW

Unlike CD-RW, a virgin DVD+RW needs to be formatted before first use. The `growisofs(1)` program will take care of it automatically whenever appropriate, which is the *recommended* way. However you can use the `dvd+rw-format` command to format the DVD+RW:

```
dvd+rw-format /dev/cd0
```

You need to perform this operation just once, keep in mind that only virgin DVD+RW medias need to be formatted. Then you can burn the DVD+RW in the way seen in previous sections.

If you want to burn new data (burn a totally new file system not append some data) onto a DVD+RW, you do not need to blank it, you just have to write over the previous recording (in performing a new initial session), like this:

```
growisofs -Z /dev/cd0 -J -R /path/to/newdata
```

DVD+RW format offers the possibility to easily append data to a previous recording. The operation consists in merging a new session to the existing one, it is not multisession writing, `growisofs(1)` will *grow* the ISO 9660 file system present on the media.

For example, if we want to append data to our previous DVD+RW, we have to use the following:

```
growisofs -M /dev/cd0 -J -R /path/to/nextdata
```

The same `mkisofs(8)` options we used to burn the initial session should be used during next writes.

**Σημείωση:** You may want to use the `-dvd-compatible` option if you want better media compatibility with DVD-ROM drives. In the DVD+RW case, this will not prevent you from adding data.

If for any reason you really want to blank the media, do the following:

```
growisofs -Z /dev/cd0=/dev/zero
```

### 18.7.6 Using a DVD-RW

A DVD-RW accepts two disc formats: the incremental sequential one and the restricted overwrite. By default DVD-RW discs are in sequential format.

A virgin DVD-RW can be directly written without the need of a formatting operation, however a non-virgin DVD-RW in sequential format needs to be blanked before to be able to write a new initial session.

To blank a DVD-RW in sequential mode, run:

```
dvd+rw-format -blank=full /dev/cd0
```

**Όχι! Προσοχή:** A full blanking (`-blank=full`) will take about one hour on a 1x media. A fast blanking can be performed using the `-blank` option if the DVD-RW will be recorded in Disk-At-Once (DAO) mode. To burn the DVD-RW in DAO mode, use the command:

```
growisofs -use-the-force-luke=dao -Z /dev/cd0=imagefile.iso
```

The `-use-the-force-luke=dao` option should not be required since `growisofs(1)` attempts to detect minimally (fast blanked) media and engage DAO write.

In fact one should use restricted overwrite mode with any DVD-RW, this format is more flexible than the default incremental sequential one.

To write data on a sequential DVD-RW, use the same instructions as for the other DVD formats:

```
growisofs -Z /dev/cd0 -J -R /path/to/data
```

If you want to append some data to your previous recording, you will have to use the `growisofs(1)` `-M` option. However, if you perform data addition on a DVD-RW in incremental sequential mode, a new session will be created on the disc and the result will be a multi-session disc.

A DVD-RW in restricted overwrite format does not need to be blanked before a new initial session, you just have to overwrite the disc with the `-z` option, this is similar to the DVD+RW case. It is also possible to grow an existing ISO 9660 file system written on the disc in a same way as for a DVD+RW with the `-M` option. The result will be a one-session DVD.

To put a DVD-RW in the restricted overwrite format, the following command must be used:

```
dvd+rw-format /dev/cd0
```

To change back to the sequential format use:

```
dvd+rw-format -blank=full /dev/cd0
```

## 18.7.7 Multisession

Very few DVD-ROM drives support multisession DVDs, they will most of time, hopefully, only read the first session. DVD+R, DVD-R and DVD-RW in sequential format can accept multiple sessions, the notion of multiple sessions does not exist for the DVD+RW and the DVD-RW restricted overwrite formats.

Using the following command after an initial (non-closed) session on a DVD+R, DVD-R, or DVD-RW in sequential format, will add a new session to the disc:

```
growisofs -M /dev/cd0 -J -R /path/to/nextdata
```

Using this command line with a DVD+RW or a DVD-RW in restricted overwrite mode, will append data in merging the new session to the existing one. The result will be a single-session disc. This is the way used to add data after an initial write on these medias.

**Όχι! Βούρα:** Some space on the media is used between each session for end and start of sessions. Therefore, one should add sessions with large amount of data to optimize media space. The number of sessions is limited to 154 for a DVD+R, about 2000 for a DVD-R, and 127 for a DVD+R Double Layer.

## 18.7.8 For More Information

To obtain more information about a DVD, the `dvd+rw-mediainfo /dev/cd0` command can be ran with the disc in the drive.

More information about the **dvd+rw-tools** can be found in the `growisofs(1)` manual page, on the `dvd+rw-tools` web site (<http://fy.chalmers.se/~appro/linux/DVD+RW/>) and in the `cdwrite` mailing list (<http://lists.debian.org/cdwrite/>) archives.

**Όχι! Βούρα:** The `dvd+rw-mediainfo` output of the resulting recording or the media with issues is mandatory for any problem report. Without this output, it will be quite impossible to help you.

## 18.7.9 Using a DVD-RAM

### 18.7.9.1 Configuration

DVD-RAM writers come with either SCSI or ATAPI interface. DMA access for ATAPI devices has to be enabled, this can be done by adding the following line to the `/boot/loader.conf` file:

```
hw.ata.atapi_dma="1"
```

### 18.7.9.2 Preparing the Medium

As previously mentioned in the chapter introduction, a DVD-RAM can be seen as a removable hard drive. As any other hard drive the DVD-RAM must be “prepared” before the first use. In the example, the whole disk space will be used with a standard UFS2 file system:

```
dd if=/dev/zero of=/dev/acd0 count=2
bsdlabel -Bw acd0
newfs /dev/acd0
```

The DVD device, `acd0`, must be changed according to the configuration.

### 18.7.9.3 Using the Medium

Once the previous operations have been performed on the DVD-RAM, it can be mounted as a normal hard drive:

```
mount /dev/acd0 /mnt
```

After this the DVD-RAM will be both readable and writeable.

## 18.8 Creating and Using Floppy Disks

*Original work by Julio Merino. Rewritten by Martin Karlsson.*

Storing data on floppy disks is sometimes useful, for example when one does not have any other removable storage media or when one needs to transfer small amounts of data to another computer.

This section will explain how to use floppy disks in FreeBSD. It will primarily cover formatting and usage of 3.5inch DOS floppies, but the concepts are similar for other floppy disk formats.

### 18.8.1 Formatting Floppies

#### 18.8.1.1 The Device

Floppy disks are accessed through entries in `/dev`, just like other devices. To access the raw floppy disk, simply use `/dev/fdN`.

#### 18.8.1.2 Formatting

A floppy disk needs to be low-level formatted before it can be used. This is usually done by the vendor, but formatting is a good way to check media integrity. Although it is possible to force larger (or smaller) disk sizes, 1440kB is what most floppy disks are designed for.

To low-level format the floppy disk you need to use `fdformat(1)`. This utility expects the device name as an argument. Make note of any error messages, as these can help determine if the disk is good or bad.

##### 18.8.1.2.1 Formatting Floppy Disks

Use the `/dev/fdN` devices to format the floppy. Insert a new 3.5inch floppy disk in your drive and issue:

```
/usr/sbin/fdformat -f 1440 /dev/fd0
```

### 18.8.2 The Disk Label

After low-level formatting the disk, you will need to place a disk label on it. This disk label will be destroyed later, but it is needed by the system to determine the size of the disk and its geometry later.

The new disk label will take over the whole disk, and will contain all the proper information about the geometry of the floppy. The geometry values for the disk label are listed in `/etc/disktab`.

You can run now `bsdlabel(8)` like so:

```
/sbin/bsdlabel -B -r -w /dev/fd0 fd1440
```

### 18.8.3 The File System

Now the floppy is ready to be high-level formatted. This will place a new file system on it, which will let FreeBSD read and write to the disk. After creating the new file system, the disk label is destroyed, so if you want to reformat the disk, you will have to recreate the disk label.

The floppy's file system can be either UFS or FAT. FAT is generally a better choice for floppies.

To put a new file system on the floppy, issue:

```
/sbin/newfs_msdos /dev/fd0
```

The disk is now ready for use.

### 18.8.4 Using the Floppy

To use the floppy, mount it with `mount_msdofs(8)`. One can also use `emulators/mttools` from the ports collection.

## 18.9 Creating and Using Data Tapes

The major tape media are the 4mm, 8mm, QIC, mini-cartridge and DLT.

### 18.9.1 4mm (DDS: Digital Data Storage)

4mm tapes are replacing QIC as the workstation backup media of choice. This trend accelerated greatly when Conner purchased Archive, a leading manufacturer of QIC drives, and then stopped production of QIC drives. 4mm drives are small and quiet but do not have the reputation for reliability that is enjoyed by 8mm drives. The cartridges are less expensive and smaller (3 x 2 x 0.5 inches, 76 x 51 x 12 mm) than 8mm cartridges. 4mm, like 8mm, has comparatively short head life for the same reason, both use helical scan.

Data throughput on these drives starts ~150 kB/s, peaking at ~500 kB/s. Data capacity starts at 1.3 GB and ends at 2.0 GB. Hardware compression, available with most of these drives, approximately doubles the capacity. Multi-drive tape library units can have 6 drives in a single cabinet with automatic tape changing. Library capacities reach 240 GB.

The DDS-3 standard now supports tape capacities up to 12 GB (or 24 GB compressed).

4mm drives, like 8mm drives, use helical-scan. All the benefits and drawbacks of helical-scan apply to both 4mm and 8mm drives.

Tapes should be retired from use after 2,000 passes or 100 full backups.

### 18.9.2 8mm (Exabyte)

8mm tapes are the most common SCSI tape drives; they are the best choice of exchanging tapes. Nearly every site has an Exabyte 2 GB 8mm tape drive. 8mm drives are reliable, convenient and quiet. Cartridges are inexpensive and small (4.8 x 3.3 x 0.6 inches; 122 x 84 x 15 mm). One downside of 8mm tape is relatively short head and tape life due to the high rate of relative motion of the tape across the heads.

Data throughput ranges from ~250 kB/s to ~500 kB/s. Data sizes start at 300 MB and go up to 7 GB. Hardware compression, available with most of these drives, approximately doubles the capacity. These drives are available as single units or multi-drive tape libraries with 6 drives and 120 tapes in a single cabinet. Tapes are changed automatically by the unit. Library capacities reach 840+ GB.

The Exabyte “Mammoth” model supports 12 GB on one tape (24 GB with compression) and costs approximately twice as much as conventional tape drives.

Data is recorded onto the tape using helical-scan, the heads are positioned at an angle to the media (approximately 6 degrees). The tape wraps around 270 degrees of the spool that holds the heads. The spool spins while the tape slides over the spool. The result is a high density of data and closely packed tracks that angle across the tape from one edge to the other.

### 18.9.3 QIC

QIC-150 tapes and drives are, perhaps, the most common tape drive and media around. QIC tape drives are the least expensive “serious” backup drives. The downside is the cost of media. QIC tapes are expensive compared to 8mm or 4mm tapes, up to 5 times the price per GB data storage. But, if your needs can be satisfied with a half-dozen tapes, QIC may be the correct choice. QIC is the *most* common tape drive. Every site has a QIC drive of some density or another. Therein lies the rub, QIC has a large number of densities on physically similar (sometimes identical) tapes. QIC drives are not quiet. These drives audibly seek before they begin to record data and are clearly audible whenever reading, writing or seeking. QIC tapes measure 6 x 4 x 0.7 inches (152 x 102 x 17 mm).

Data throughput ranges from ~150 kB/s to ~500 kB/s. Data capacity ranges from 40 MB to 15 GB. Hardware compression is available on many of the newer QIC drives. QIC drives are less frequently installed; they are being supplanted by DAT drives.

Data is recorded onto the tape in tracks. The tracks run along the long axis of the tape media from one end to the other. The number of tracks, and therefore the width of a track, varies with the tape’s capacity. Most if not all newer drives provide backward-compatibility at least for reading (but often also for writing). QIC has a good reputation regarding the safety of the data (the mechanics are simpler and more robust than for helical scan drives).

Tapes should be retired from use after 5,000 backups.

### 18.9.4 DLT

DLT has the fastest data transfer rate of all the drive types listed here. The 1/2" (12.5mm) tape is contained in a single spool cartridge (4 x 4 x 1 inches; 100 x 100 x 25 mm). The cartridge has a swinging gate along one entire side of the cartridge. The drive mechanism opens this gate to extract the tape leader. The tape leader has an oval hole in it which the drive uses to “hook” the tape. The take-up spool is located inside the tape drive. All the other tape cartridges listed here (9 track tapes are the only exception) have both the supply and take-up spools located inside the tape cartridge itself.

Data throughput is approximately 1.5 MB/s, three times the throughput of 4mm, 8mm, or QIC tape drives. Data capacities range from 10 GB to 20 GB for a single drive. Drives are available in both multi-tape changers and multi-tape, multi-drive tape libraries containing from 5 to 900 tapes over 1 to 20 drives, providing from 50 GB to 9 TB of storage.

With compression, DLT Type IV format supports up to 70 GB capacity.

Data is recorded onto the tape in tracks parallel to the direction of travel (just like QIC tapes). Two tracks are written at once. Read/write head lifetimes are relatively long; once the tape stops moving, there is no relative motion between the heads and the tape.

### 18.9.5 AIT

AIT is a new format from Sony, and can hold up to 50 GB (with compression) per tape. The tapes contain memory chips which retain an index of the tape's contents. This index can be rapidly read by the tape drive to determine the position of files on the tape, instead of the several minutes that would be required for other tapes. Software such as **SAMS:Alexandria** can operate forty or more AIT tape libraries, communicating directly with the tape's memory chip to display the contents on screen, determine what files were backed up to which tape, locate the correct tape, load it, and restore the data from the tape.

Libraries like this cost in the region of \$20,000, pricing them a little out of the hobbyist market.

### 18.9.6 Using a New Tape for the First Time

The first time that you try to read or write a new, completely blank tape, the operation will fail. The console messages should be similar to:

```
sa0(ncr1:4:0): NOT READY asc:4,1
sa0(ncr1:4:0): Logical unit is in process of becoming ready
```

The tape does not contain an Identifier Block (block number 0). All QIC tape drives since the adoption of QIC-525 standard write an Identifier Block to the tape. There are two solutions:

- `mt fsf 1` causes the tape drive to write an Identifier Block to the tape.
- Use the front panel button to eject the tape.

Re-insert the tape and `dump` data to the tape.

`dump` will report "DUMP: End of tape detected" and the console will show: "HARDWARE FAILURE info:280 asc:80,96".

rewind the tape using: `mt rewind`.

Subsequent tape operations are successful.

## 18.10 Backups to Floppies

### 18.10.1 Can I Use Floppies for Backing Up My Data?

Floppy disks are not really a suitable media for making backups as:

- The media is unreliable, especially over long periods of time.
- Backing up and restoring is very slow.

- They have a very limited capacity (the days of backing up an entire hard disk onto a dozen or so floppies has long since passed).

However, if you have no other method of backing up your data then floppy disks are better than no backup at all.

If you do have to use floppy disks then ensure that you use good quality ones. Floppies that have been lying around the office for a couple of years are a bad choice. Ideally use new ones from a reputable manufacturer.

### 18.10.2 So How Do I Backup My Data to Floppies?

The best way to backup to floppy disk is to use tar(1) with the -M (multi volume) option, which allows backups to span multiple floppies.

To backup all the files in the current directory and sub-directory use this (as root):

```
tar Mcvf /dev/fd0 *
```

When the first floppy is full tar(1) will prompt you to insert the next volume (because tar(1) is media independent it refers to volumes; in this context it means floppy disk).

Prepare volume #2 for /dev/fd0 and hit return:

This is repeated (with the volume number incrementing) until all the specified files have been archived.

### 18.10.3 Can I Compress My Backups?

Unfortunately, tar(1) will not allow the -z option to be used for multi-volume archives. You could, of course, gzip(1) all the files, tar(1) them to the floppies, then gunzip(1) the files again!

### 18.10.4 How Do I Restore My Backups?

To restore the entire archive use:

```
tar Mxvf /dev/fd0
```

There are two ways that you can use to restore only specific files. First, you can start with the first floppy and use:

```
tar Mxvf /dev/fd0 filename
```

The utility tar(1) will prompt you to insert subsequent floppies until it finds the required file.

Alternatively, if you know which floppy the file is on then you can simply insert that floppy and use the same command as above. Note that if the first file on the floppy is a continuation from the previous one then tar(1) will warn you that it cannot restore it, even if you have not asked it to!

## 18.11 Backup Strategies

*Original work by Lowell Gilbert.*

The first requirement in devising a backup plan is to make sure that all of the following problems are covered:

- Disk failure
- Accidental file deletion
- Random file corruption
- Complete machine destruction (e.g. fire), including destruction of any on-site backups.

It is perfectly possible that some systems will be best served by having each of these problems covered by a completely different technique. Except for strictly personal systems with very low-value data, it is unlikely that one technique would cover all of them.

Some of the techniques in the toolbox are:

- Archives of the whole system, backed up onto permanent media offsite. This actually provides protection against all of the possible problems listed above, but is slow and inconvenient to restore from. You can keep copies of the backups onsite and/or online, but there will still be inconveniences in restoring files, especially for non-privileged users.
- Filesystem snapshots. This is really only helpful in the accidental file deletion scenario, but it can be *very* helpful in that case, and is quick and easy to deal with.
- Copies of whole filesystems and/or disks (e.g. periodic `rsync(1)` of the whole machine). This is generally most useful in networks with unique requirements. For general protection against disk failure, it is usually inferior to RAID. For restoring accidentally deleted files, it can be comparable to UFS snapshots, but that depends on your preferences.
- RAID. Minimizes or avoids downtime when a disk fails. At the expense of having to deal with disk failures more often (because you have more disks), albeit at a much lower urgency.
- Checking fingerprints of files. The `mtree(8)` utility is very useful for this. Although it is not a backup technique, it helps guarantee that you will notice when you need to resort to your backups. This is particularly important for offline backups, and should be checked periodically.

It is quite easy to come up with even more techniques, many of them variations on the ones listed above. Specialized requirements will usually lead to specialized techniques (for example, backing up a live database usually requires a method particular to the database software as an intermediate step). The important thing is to know what dangers you want to protect against, and how you will handle each.

## 18.12 Backup Basics

The three major backup programs are `dump(8)`, `tar(1)`, and `cpio(1)`.

### 18.12.1 Dump and Restore

The traditional UNIX backup programs are `dump` and `restore`. They operate on the drive as a collection of disk blocks, below the abstractions of files, links and directories that are created by the file systems. `dump` backs up an

entire file system on a device. It is unable to backup only part of a file system or a directory tree that spans more than one file system. `dump` does not write files and directories to tape, but rather writes the raw data blocks that comprise files and directories.

**Ὁδηγία:** If you use `dump` on your root directory, you would not back up `/home`, `/usr` or many other directories since these are typically mount points for other file systems or symbolic links into those file systems.

`dump` has quirks that remain from its early days in Version 6 of AT&T UNIX (circa 1975). The default parameters are suitable for 9-track tapes (6250 bpi), not the high-density media available today (up to 62,182 ftpi). These defaults must be overridden on the command line to utilize the capacity of current tape drives.

It is also possible to backup data across the network to a tape drive attached to another computer with `rdump` and `rrestore`. Both programs rely upon `rcmd(3)` and `ruserok(3)` to access the remote tape drive. Therefore, the user performing the backup must be listed in the `.rhosts` file on the remote computer. The arguments to `rdump` and `rrestore` must be suitable to use on the remote computer. When `rdumping` from a FreeBSD computer to an Exabyte tape drive connected to a Sun called `komodo`, use:

```
/sbin/rdump 0dsbfu 54000 13000 126 komodo:/dev/nsa8 /dev/da0a 2>&1
```

Beware: there are security implications to allowing `.rhosts` authentication. Evaluate your situation carefully.

It is also possible to use `dump` and `restore` in a more secure fashion over `ssh`.

### Ἀδελφότητα 18-1. Using `dump` over `ssh`

```
/sbin/dump -0uan -f - /usr | gzip -2 | ssh -c blowfish \
 targetuser@targetmachine.example.com dd of=/mybigfiles/dump-usr-10.gz
```

Or using `dump`'s built-in method, setting the environment variable `RSH`:

### Ἀδελφότητα 18-2. Using `dump` over `ssh` with `RSH` set

```
RSH=/usr/bin/ssh /sbin/dump -0uan -f targetuser@targetmachine.example.com:/dev/sa0 /usr
```

## 18.12.2 `tar`

`tar(1)` also dates back to Version 6 of AT&T UNIX (circa 1975). `tar` operates in cooperation with the file system; it writes files and directories to tape. `tar` does not support the full range of options that are available from `cpio(1)`, but it does not require the unusual command pipeline that `cpio` uses.

On FreeBSD 5.3 and later, both GNU `tar` and the default `bsdtar` are available. The GNU version can be invoked with `gtar`. It supports remote devices using the same syntax as `rdump`. To `tar` to an Exabyte tape drive connected to a Sun called `komodo`, use:

```
/usr/bin/gtar cf komodo:/dev/nsa8 . 2>&1
```

The same could be accomplished with `bsdtar` by using a pipeline and `rsh` to send the data to a remote tape drive.

```
tar cf - . | rsh hostname dd of=tape-device obs=20b
```

If you are worried about the security of backing up over a network you should use the `ssh` command instead of `rsh`.

### 18.12.3 `cpio`

`cpio(1)` is the original UNIX file interchange tape program for magnetic media. `cpio` has options (among many others) to perform byte-swapping, write a number of different archive formats, and pipe the data to other programs. This last feature makes `cpio` an excellent choice for installation media. `cpio` does not know how to walk the directory tree and a list of files must be provided through `stdin`.

`cpio` does not support backups across the network. You can use a pipeline and `rsh` to send the data to a remote tape drive.

```
for f in directory_list; do
find $f >> backup.list
done
cpio -v -o --format=newc < backup.list | ssh user@host "cat > backup_device"
```

Where `directory_list` is the list of directories you want to back up, `user@host` is the user/hostname combination that will be performing the backups, and `backup_device` is where the backups should be written to (e.g., `/dev/nsa0`).

### 18.12.4 `pax`

`pax(1)` is IEEE/POSIX's answer to `tar` and `cpio`. Over the years the various versions of `tar` and `cpio` have gotten slightly incompatible. So rather than fight it out to fully standardize them, POSIX created a new archive utility. `pax` attempts to read and write many of the various `cpio` and `tar` formats, plus new formats of its own. Its command set more resembles `cpio` than `tar`.

### 18.12.5 **Amanda**

**Amanda** (Advanced Maryland Network Disk Archiver) is a client/server backup system, rather than a single program. An **Amanda** server will backup to a single tape drive any number of computers that have **Amanda** clients and a network connection to the **Amanda** server. A common problem at sites with a number of large disks is that the length of time required to backup to data directly to tape exceeds the amount of time available for the task. **Amanda** solves this problem. **Amanda** can use a "holding disk" to backup several file systems at the same time. **Amanda** creates "archive sets": a group of tapes used over a period of time to create full backups of all the file systems listed in **Amanda**'s configuration file. The "archive set" also contains nightly incremental (or differential) backups of all the file systems. Restoring a damaged file system requires the most recent full backup and the incremental backups.

The configuration file provides fine control of backups and the network traffic that **Amanda** generates. **Amanda** will use any of the above backup programs to write the data to tape. **Amanda** is available as either a port or a package, it is not installed by default.

### 18.12.6 Do Nothing

"Do nothing" is not a computer program, but it is the most widely used backup strategy. There are no initial costs. There is no backup schedule to follow. Just say no. If something happens to your data, grin and bear it!

If your time and your data is worth little to nothing, then “Do nothing” is the most suitable backup program for your computer. But beware, UNIX is a useful tool, you may find that within six months you have a collection of files that are valuable to you.

“Do nothing” is the correct backup method for `/usr/obj` and other directory trees that can be exactly recreated by your computer. An example is the files that comprise the HTML or PostScript version of this Handbook. These document formats have been created from SGML input files. Creating backups of the HTML or PostScript files is not necessary. The SGML files are backed up regularly.

## 18.12.7 Which Backup Program Is Best?

*dump(8) Period.* Elizabeth D. Zwicky torture tested all the backup programs discussed here. The clear choice for preserving all your data and all the peculiarities of UNIX file systems is `dump`. Elizabeth created file systems containing a large variety of unusual conditions (and some not so unusual ones) and tested each program by doing a backup and restore of those file systems. The peculiarities included: files with holes, files with holes and a block of nulls, files with funny characters in their names, unreadable and unwritable files, devices, files that change size during the backup, files that are created/deleted during the backup and more. She presented the results at LISA V in Oct. 1991. See *torture-testing Backup and Archive Programs* (<http://berdmann.dyndns.org/zwicky/testdump.doc.html>).

## 18.12.8 Emergency Restore Procedure

### 18.12.8.1 Before the Disaster

There are only four steps that you need to perform in preparation for any disaster that may occur.

First, print the `bsdlablel` from each of your disks (e.g. `bsdlablel da0 | lpr`), your file system table (`/etc/fstab`) and all boot messages, two copies of each.

Second, determine that the boot and fix-it floppies (`boot.flp` and `fixit.flp`) have all your devices. The easiest way to check is to reboot your machine with the boot floppy in the floppy drive and check the boot messages. If all your devices are listed and functional, skip on to step three.

Otherwise, you have to create two custom bootable floppies which have a kernel that can mount all of your disks and access your tape drive. These floppies must contain: `fdisk`, `bsdlablel`, `newfs`, `mount`, and whichever backup program you use. These programs must be statically linked. If you use `dump`, the floppy must contain `restore`.

Third, create backup tapes regularly. Any changes that you make after your last backup may be irretrievably lost. Write-protect the backup tapes.

Fourth, test the floppies (either `boot.flp` and `fixit.flp` or the two custom bootable floppies you made in step two.) and backup tapes. Make notes of the procedure. Store these notes with the bootable floppy, the printouts and the backup tapes. You will be so distraught when restoring that the notes may prevent you from destroying your backup tapes (How? In place of `tar xvf /dev/sa0`, you might accidentally type `tar cvf /dev/sa0` and over-write your backup tape).

For an added measure of security, make bootable floppies and two backup tapes each time. Store one of each at a remote location. A remote location is NOT the basement of the same office building. A number of firms in the World Trade Center learned this lesson the hard way. A remote location should be physically separated from your computers and disk drives by a significant distance.

### Διάγραμμα 18-3. A Script for Creating a Bootable Floppy

```
#!/bin/sh
#
create a restore floppy
#
format the floppy
#
PATH=/bin:/sbin:/usr/sbin:/usr/bin

fdformat -q fd0
if [$? -ne 0]
then
 echo "Bad floppy, please use a new one"
 exit 1
fi

place boot blocks on the floppy
#
bsdlabel -w -B /dev/fd0c fd1440

#
newfs the one and only partition
#
newfs -t 2 -u 18 -l 1 -c 40 -i 5120 -m 5 -o space /dev/fd0a

#
mount the new floppy
#
mount /dev/fd0a /mnt

#
create required directories
#
mkdir /mnt/dev
mkdir /mnt/bin
mkdir /mnt/sbin
mkdir /mnt/etc
mkdir /mnt/root
mkdir /mnt/mnt # for the root partition
mkdir /mnt/tmp
mkdir /mnt/var

#
populate the directories
#
if [! -x /sys/compile/MINI/kernel]
then
 cat << EOM
The MINI kernel does not exist, please create one.
Here is an example config file:
#
MINI -- A kernel to get FreeBSD onto a disk.
```

```

#
machine "i386"
cpu "I486_CPU"
ident MINI
maxusers 5

options INET # needed for _tcp _icmpstat _ipstat
 # _udpstat _tcpstat _udb
options FFS #Berkeley Fast File System
options FAT_CURSOR #block cursor in syscons or pccons
options SCSI_DELAY=15 #Be pessimistic about Joe SCSI device
options NCONS=2 #1 virtual consoles
options USERCONFIG #Allow user configuration with -c XXX

config kernel root on da0 swap on da0 and da1 dumps on da0

device isa0
device pci0

device fdc0 at isa? port "IO_FD1" bio irq 6 drq 2 vector fdintr
device fd0 at fdc0 drive 0

device ncr0

device scbus0

device sc0 at isa? port "IO_KBD" tty irq 1 vector scintr
device npx0 at isa? port "IO_NPX" irq 13 vector npxintr

device da0
device da1
device da2

device sa0

pseudo-device loop # required by INET
pseudo-device gzip # Exec gzipped a.out's
EOM
 exit 1
fi

cp -f /sys/compile/MINI/kernel /mnt

gzip -c -best /sbin/init > /mnt/sbin/init
gzip -c -best /sbin/fsck > /mnt/sbin/fsck
gzip -c -best /sbin/mount > /mnt/sbin/mount
gzip -c -best /sbin/halt > /mnt/sbin/halt
gzip -c -best /sbin/restore > /mnt/sbin/restore

gzip -c -best /bin/sh > /mnt/bin/sh
gzip -c -best /bin/sync > /mnt/bin/sync

cp /root/.profile /mnt/root

```

```

cp -f /dev/MAKEDEV /mnt/dev
chmod 755 /mnt/dev/MAKEDEV

chmod 500 /mnt/sbin/init
chmod 555 /mnt/sbin/fsck /mnt/sbin/mount /mnt/sbin/halt
chmod 555 /mnt/bin/sh /mnt/bin/sync
chmod 6555 /mnt/sbin/restore

#
create the devices nodes
#
cd /mnt/dev
./MAKEDEV std
./MAKEDEV da0
./MAKEDEV da1
./MAKEDEV da2
./MAKEDEV sa0
./MAKEDEV pty0
cd /

#
create minimum file system table
#
cat > /mnt/etc/fstab <<EOM
/dev/fd0a / ufs rw 1 1
EOM

#
create minimum passwd file
#
cat > /mnt/etc/passwd <<EOM
root:*:0:0:Charlie &:/root:/bin/sh
EOM

cat > /mnt/etc/master.passwd <<EOM
root::0:0::0:0:Charlie &:/root:/bin/sh
EOM

chmod 600 /mnt/etc/master.passwd
chmod 644 /mnt/etc/passwd
/usr/sbin/pwd_mkdb -d/mnt/etc /mnt/etc/master.passwd

#
umount the floppy and inform the user
#
/sbin/umount /mnt
echo "The floppy has been unmounted and is now ready."

```

### 18.12.8.2 After the Disaster

The key question is: did your hardware survive? You have been doing regular backups so there is no need to worry about the software.

If the hardware has been damaged, the parts should be replaced before attempting to use the computer.

If your hardware is okay, check your floppies. If you are using a custom boot floppy, boot single-user (type `-s` at the `boot:` prompt). Skip the following paragraph.

If you are using the `boot.flp` and `fixit.flp` floppies, keep reading. Insert the `boot.flp` floppy in the first floppy drive and boot the computer. The original install menu will be displayed on the screen. Select the `Fixit--Repair` mode with `CDROM` or `floppy` option. Insert the `fixit.flp` when prompted. `restore` and the other programs that you need are located in `/mnt2/rescue` (`/mnt2/stand` for FreeBSD versions older than 5.2).

Recover each file system separately.

Try to `mount` (e.g. `mount /dev/da0a /mnt`) the root partition of your first disk. If the `bsdlabel` was damaged, use `bsdlabel` to re-partition and label the disk to match the label that you printed and saved. Use `newfs` to re-create the file systems. Re-mount the root partition of the floppy read-write (`mount -u -o rw /mnt`). Use your backup program and backup tapes to recover the data for this file system (e.g. `restore vrf /dev/sa0`). Unmount the file system (e.g. `umount /mnt`). Repeat for each file system that was damaged.

Once your system is running, backup your data onto new tapes. Whatever caused the crash or data loss may strike again. Another hour spent now may save you from further distress later.

## 18.13 Network, Memory, and File-Backed File Systems

*Reorganized and enhanced by Marc Fonvieille.*

Aside from the disks you physically insert into your computer: floppies, CDs, hard drives, and so forth; other forms of disks are understood by FreeBSD - the *virtual disks*.

These include network file systems such as the Network File System and Coda, memory-based file systems and file-backed file systems.

According to the FreeBSD version you run, you will have to use different tools for creation and use of file-backed and memory-based file systems.

**Όχι! Βούζ:** Use `devfs(5)` to allocate device nodes transparently for the user.

### 18.13.1 File-Backed File System

The utility `mdconfig(8)` is used to configure and enable memory disks, `md(4)`, under FreeBSD. To use `mdconfig(8)`, you have to load `md(4)` module or to add the support in your kernel configuration file:

```
device md
```

The `mdconfig(8)` command supports three kinds of memory backed virtual disks: memory disks allocated with `malloc(9)`, memory disks using a file or swap space as backing. One possible use is the mounting of floppy or CD images kept in files.

To mount an existing file system image:

#### Παράδειγμα 18-4. Using `mdconfig` to Mount an Existing File System Image

```
mdconfig -a -t vnode -f diskimage -u 0
mount /dev/md0 /mnt
```

To create a new file system image with `mdconfig(8)`:

#### Παράδειγμα 18-5. Creating a New File-Backed Disk with `mdconfig`

```
dd if=/dev/zero of=newimage bs=1k count=5k
5120+0 records in
5120+0 records out
mdconfig -a -t vnode -f newimage -u 0
bsdlabel -w md0 auto
newfs md0a
/dev/md0a: 5.0MB (10224 sectors) block size 16384, fragment size 2048
 using 4 cylinder groups of 1.25MB, 80 blks, 192 inodes.
super-block backups (for fsck -b #) at:
 160, 2720, 5280, 7840
mount /dev/md0a /mnt
df /mnt
Filesystem 1K-blocks Used Avail Capacity Mounted on
/dev/md0a 4710 4 4330 0% /mnt
```

If you do not specify the unit number with the `-u` option, `mdconfig(8)` will use the `md(4)` automatic allocation to select an unused device. The name of the allocated unit will be output on stdout like `md4`. For more details about `mdconfig(8)`, please refer to the manual page.

The utility `mdconfig(8)` is very useful, however it asks many command lines to create a file-backed file system. FreeBSD also comes with a tool called `mdmfs(8)`, this program configures a `md(4)` disk using `mdconfig(8)`, puts a UFS file system on it using `newfs(8)`, and mounts it using `mount(8)`. For example, if you want to create and mount the same file system image as above, simply type the following:

#### Παράδειγμα 18-6. Configure and Mount a File-Backed Disk with `mdmfs`

```
dd if=/dev/zero of=newimage bs=1k count=5k
5120+0 records in
5120+0 records out
mdmfs -F newimage -s 5m md0 /mnt
df /mnt
Filesystem 1K-blocks Used Avail Capacity Mounted on
/dev/md0 4718 4 4338 0% /mnt
```

If you use the option `md` without unit number, `mdmfs(8)` will use `md(4)` auto-unit feature to automatically select an unused device. For more details about `mdmfs(8)`, please refer to the manual page.

## 18.13.2 Memory-Based File System

For a memory-based file system the “swap backing” should normally be used. Using swap backing does not mean that the memory disk will be swapped out to disk by default, but merely that the memory disk will be allocated from a memory pool which can be swapped out to disk if needed. It is also possible to create memory-based disk which are `malloc(9)` backed, but using `malloc` backed memory disks, especially large ones, can result in a system panic if the kernel runs out of memory.

### Διάγραμμα 18-7. Creating a New Memory-Based Disk with `mdconfig`

```
mdconfig -a -t swap -s 5m -u 1
newfs -U md1
/dev/md1: 5.0MB (10240 sectors) block size 16384, fragment size 2048
 using 4 cylinder groups of 1.27MB, 81 blks, 192 inodes.
 with soft updates
super-block backups (for fsck -b #) at:
 160, 2752, 5344, 7936
mount /dev/md1 /mnt
df /mnt
Filesystem 1K-blocks Used Avail Capacity Mounted on
/dev/md1 4718 4 4338 0% /mnt
```

### Διάγραμμα 18-8. Creating a New Memory-Based Disk with `mdmfs`

```
mdmfs -s 5m md2 /mnt
df /mnt
Filesystem 1K-blocks Used Avail Capacity Mounted on
/dev/md2 4846 2 4458 0% /mnt
```

## 18.13.3 Detaching a Memory Disk from the System

When a memory-based or file-based file system is not used, you should release all resources to the system. The first thing to do is to unmount the file system, then use `mdconfig(8)` to detach the disk from the system and release the resources.

For example to detach and free all resources used by `/dev/md4`:

```
mdconfig -d -u 4
```

It is possible to list information about configured `md(4)` devices in using the command `mdconfig -l`.

## 18.14 File System Snapshots

*Contributed by Tom Rhodes.*

FreeBSD offers a feature in conjunction with Soft Updates: File system snapshots.

Snapshots allow a user to create images of specified file systems, and treat them as a file. Snapshot files must be created in the file system that the action is performed on, and a user may create no more than 20 snapshots per file

system. Active snapshots are recorded in the superblock so they are persistent across unmount and remount operations along with system reboots. When a snapshot is no longer required, it can be removed with the standard `rm(1)` command. Snapshots may be removed in any order, however all the used space may not be acquired because another snapshot will possibly claim some of the released blocks.

The un-alterable `snapshot` file flag is set by `mksnap_ffs(8)` after initial creation of a snapshot file. The `unlink(1)` command makes an exception for snapshot files since it allows them to be removed.

Snapshots are created with the `mount(8)` command. To place a snapshot of `/var` in the file `/var/snapshot/snap` use the following command:

```
mount -u -o snapshot /var/snapshot/snap /var
```

Alternatively, you can use `mksnap_ffs(8)` to create a snapshot:

```
mksnap_ffs /var /var/snapshot/snap
```

One can find snapshot files on a file system (e.g. `/var`) by using the `find(1)` command:

```
find /var -flags snapshot
```

Once a snapshot has been created, it has several uses:

- Some administrators will use a snapshot file for backup purposes, because the snapshot can be transferred to CDs or tape.
- The file system integrity checker, `fsck(8)`, may be run on the snapshot. Assuming that the file system was clean when it was mounted, you should always get a clean (and unchanging) result. This is essentially what the background `fsck(8)` process does.
- Run the `dump(8)` utility on the snapshot. A dump will be returned that is consistent with the file system and the timestamp of the snapshot. `dump(8)` can also take a snapshot, create a dump image and then remove the snapshot in one command using the `-L` flag.
- `mount(8)` the snapshot as a frozen image of the file system. To `mount(8)` the snapshot `/var/snapshot/snap` run:

```
mdconfig -a -t vnode -f /var/snapshot/snap -u 4
mount -r /dev/md4 /mnt
```

You can now walk the hierarchy of your frozen `/var` file system mounted at `/mnt`. Everything will initially be in the same state it was during the snapshot creation time. The only exception is that any earlier snapshots will appear as zero length files. When the use of a snapshot has delimited, it can be unmounted with:

```
umount /mnt
mdconfig -d -u 4
```

For more information about `softupdates` and file system snapshots, including technical papers, you can visit Marshall Kirk McKusick's website at <http://www.mckusick.com/>.

## 18.15 File System Quotas

Quotas are an optional feature of the operating system that allow you to limit the amount of disk space and/or the number of files a user or members of a group may allocate on a per-file system basis. This is used most often on

timesharing systems where it is desirable to limit the amount of resources any one user or group of users may allocate. This will prevent one user or group of users from consuming all of the available disk space.

### 18.15.1 Configuring Your System to Enable Disk Quotas

Before attempting to use disk quotas, it is necessary to make sure that quotas are configured in your kernel. This is done by adding the following line to your kernel configuration file:

```
options QUOTA
```

The stock `GENERIC` kernel does not have this enabled by default, so you will have to configure, build and install a custom kernel in order to use disk quotas. Please refer to [Εἰσαγωγή 8](#) for more information on kernel configuration.

Next you will need to enable disk quotas in `/etc/rc.conf`. This is done by adding the line:

```
enable_quotas="YES"
```

For finer control over your quota startup, there is an additional configuration variable available. Normally on bootup, the quota integrity of each file system is checked by the `quotacheck(8)` program. The `quotacheck(8)` facility insures that the data in the quota database properly reflects the data on the file system. This is a very time consuming process that will significantly affect the time your system takes to boot. If you would like to skip this step, a variable in `/etc/rc.conf` is made available for the purpose:

```
check_quotas="NO"
```

Finally you will need to edit `/etc/fstab` to enable disk quotas on a per-file system basis. This is where you can either enable user or group quotas or both for all of your file systems.

To enable per-user quotas on a file system, add the `userquota` option to the options field in the `/etc/fstab` entry for the file system you want to enable quotas on. For example:

```
/dev/dals2g /home ufs rw,userquota 1 2
```

Similarly, to enable group quotas, use the `groupquota` option instead of `userquota`. To enable both user and group quotas, change the entry as follows:

```
/dev/dals2g /home ufs rw,userquota,groupquota 1 2
```

By default, the quota files are stored in the root directory of the file system with the names `quota.user` and `quota.group` for user and group quotas respectively. See `fstab(5)` for more information. Even though the `fstab(5)` manual page says that you can specify an alternate location for the quota files, this is not recommended because the various quota utilities do not seem to handle this properly.

At this point you should reboot your system with your new kernel. `/etc/rc` will automatically run the appropriate commands to create the initial quota files for all of the quotas you enabled in `/etc/fstab`, so there is no need to manually create any zero length quota files.

In the normal course of operations you should not be required to run the `quotacheck(8)`, `quotaon(8)`, or `quotaoff(8)` commands manually. However, you may want to read their manual pages just to be familiar with their operation.

## 18.15.2 Setting Quota Limits

Once you have configured your system to enable quotas, verify that they really are enabled. An easy way to do this is to run:

```
quota -v
```

You should see a one line summary of disk usage and current quota limits for each file system that quotas are enabled on.

You are now ready to start assigning quota limits with the `edquota(8)` command.

You have several options on how to enforce limits on the amount of disk space a user or group may allocate, and how many files they may create. You may limit allocations based on disk space (block quotas) or number of files (inode quotas) or a combination of both. Each of these limits are further broken down into two categories: hard and soft limits.

A hard limit may not be exceeded. Once a user reaches his hard limit he may not make any further allocations on the file system in question. For example, if the user has a hard limit of 500 kbytes on a file system and is currently using 490 kbytes, the user can only allocate an additional 10 kbytes. Attempting to allocate an additional 11 kbytes will fail.

Soft limits, on the other hand, can be exceeded for a limited amount of time. This period of time is known as the grace period, which is one week by default. If a user stays over his or her soft limit longer than the grace period, the soft limit will turn into a hard limit and no further allocations will be allowed. When the user drops back below the soft limit, the grace period will be reset.

The following is an example of what you might see when you run the `edquota(8)` command. When the `edquota(8)` command is invoked, you are placed into the editor specified by the `EDITOR` environment variable, or in the `vi` editor if the `EDITOR` variable is not set, to allow you to edit the quota limits.

```
edquota -u test
```

```
Quotas for user test:
```

```
/usr: kbytes in use: 65, limits (soft = 50, hard = 75)
 inodes in use: 7, limits (soft = 50, hard = 60)
/usr/var: kbytes in use: 0, limits (soft = 50, hard = 75)
 inodes in use: 0, limits (soft = 50, hard = 60)
```

You will normally see two lines for each file system that has quotas enabled. One line for the block limits, and one line for inode limits. Simply change the value you want updated to modify the quota limit. For example, to raise this user's block limit from a soft limit of 50 and a hard limit of 75 to a soft limit of 500 and a hard limit of 600, change:

```
/usr: kbytes in use: 65, limits (soft = 50, hard = 75)
```

to:

```
/usr: kbytes in use: 65, limits (soft = 500, hard = 600)
```

The new quota limits will be in place when you exit the editor.

Sometimes it is desirable to set quota limits on a range of UIDs. This can be done by use of the `-p` option on the `edquota(8)` command. First, assign the desired quota limit to a user, and then run `edquota -p protouser startuid-enduid`. For example, if user `test` has the desired quota limits, the following command can be used to duplicate those quota limits for UIDs 10,000 through 19,999:

```
edquota -p test 10000-19999
```

For more information see `edquota(8)` manual page.

### 18.15.3 Checking Quota Limits and Disk Usage

You can use either the `quota(1)` or the `repquota(8)` commands to check quota limits and disk usage. The `quota(1)` command can be used to check individual user or group quotas and disk usage. A user may only examine his own quota, and the quota of a group he is a member of. Only the super-user may view all user and group quotas. The `repquota(8)` command can be used to get a summary of all quotas and disk usage for file systems with quotas enabled.

The following is some sample output from the `quota -v` command for a user that has quota limits on two file systems.

```
Disk quotas for user test (uid 1002):
 Filesystem usage quota limit grace files quota limit grace
 /usr 65* 50 75 5days 7 50 60
 /usr/var 0 50 75 0 50 60
```

On the `/usr` file system in the above example, this user is currently 15 kbytes over the soft limit of 50 kbytes and has 5 days of the grace period left. Note the asterisk `*` which indicates that the user is currently over his quota limit.

Normally file systems that the user is not using any disk space on will not show up in the output from the `quota(1)` command, even if he has a quota limit assigned for that file system. The `-v` option will display those file systems, such as the `/usr/var` file system in the above example.

### 18.15.4 Quotas over NFS

Quotas are enforced by the quota subsystem on the NFS server. The `rpc.rquotad(8)` daemon makes quota information available to the `quota(1)` command on NFS clients, allowing users on those machines to see their quota statistics.

Enable `rpc.rquotad` in `/etc/inetd.conf` like so:

```
rquotad/1 dgram rpc/udp wait root /usr/libexec/rpc.rquotad rpc.rquotad
```

Now restart `inetd`:

```
kill -HUP `cat /var/run/inetd.pid`
```

## 18.16 Encrypting Disk Partitions

*Contributed by Lucky Green.*

FreeBSD offers excellent online protections against unauthorized data access. File permissions and Mandatory Access Control (MAC) (see [Εάν θέλετε να μάθετε περισσότερα σχετικά με το FreeBSD, επισκεφθείτε το www.freebsd.org](#)) help prevent unauthorized third-parties from accessing data while the operating system is active and the computer is powered up. However, the permissions enforced by the operating system are irrelevant if an attacker has physical access to a computer and can simply move the computer's hard drive to another system to copy and analyze the sensitive data.

Regardless of how an attacker may have come into possession of a hard drive or powered-down computer, both **GEOM Based Disk Encryption (gbde)** and `geli` cryptographic subsystems in FreeBSD are able to protect the data on the computer's file systems against even highly-motivated attackers with significant resources. Unlike cumbersome encryption methods that encrypt only individual files, `gbde` and `geli` transparently encrypt entire file systems. No cleartext ever touches the hard drive's platter.

## 18.16.1 Disk Encryption with `gbde`

1. Become `root`

Configuring `gbde` requires super-user privileges.

```
% su -
Password:
```

2. Add `gbde(4)` Support to the Kernel Configuration File

Add the following line to the kernel configuration file:

```
options GEOM_BDE
```

Rebuild the kernel as described in Εἰσαγωγή 8.

Reboot into the new kernel.

3. An alternative to recompiling the kernel is to use `kldload` to load `gbde(4)`:

```
kldload geom_bde
```

### 18.16.1.1 Preparing the Encrypted Hard Drive

The following example assumes that you are adding a new hard drive to your system that will hold a single encrypted partition. This partition will be mounted as `/private`. `gbde` can also be used to encrypt `/home` and `/var/mail`, but this requires more complex instructions which exceed the scope of this introduction.

1. Add the New Hard Drive

Install the new drive to the system as explained in Εἰσαγωγή 18.3. For the purposes of this example, a new hard drive partition has been added as `/dev/ad4s1c`. The `/dev/ad0s1*` devices represent existing standard FreeBSD partitions on the example system.

```
ls /dev/ad*
/dev/ad0 /dev/ad0s1b /dev/ad0s1e /dev/ad4s1
/dev/ad0s1 /dev/ad0s1c /dev/ad0s1f /dev/ad4s1c
/dev/ad0s1a /dev/ad0s1d /dev/ad4
```

2. Create a Directory to Hold `gbde` Lock Files

```
mkdir /etc/gbde
```

The `gbde` lock file contains information that `gbde` requires to access encrypted partitions. Without access to the lock file, `gbde` will not be able to decrypt the data contained in the encrypted partition without significant manual intervention which is not supported by the software. Each encrypted partition uses a separate lock file.

3. Initialize the `gbde` Partition

A `gbde` partition must be initialized before it can be used. This initialization needs to be performed only once:

```
gbde init /dev/ad4s1c -i -L /etc/gbde/ad4s1c
```

gbde(8) will open your editor, permitting you to set various configuration options in a template. For use with UFS1 or UFS2, set the sector\_size to 2048:

```
$FreeBSD: src/sbin/gbde/template.txt,v 1.1 2002/10/20 11:16:13 phk Exp $
#
Sector size is the smallest unit of data which can be read or written.
Making it too small decreases performance and decreases available space.
Making it too large may prevent filesystems from working. 512 is the
minimum and always safe. For UFS, use the fragment size
#
sector_size = 2048
[...]
```

gbde(8) will ask you twice to type the passphrase that should be used to secure the data. The passphrase must be the same both times. **gbde**'s ability to protect your data depends entirely on the quality of the passphrase that you choose.<sup>1</sup>

The `gbde init` command creates a lock file for your **gbde** partition that in this example is stored as `/etc/gbde/ad4s1c`.

**Ἰσημιῶδη:** **gbde** lock files *must* be backed up together with the contents of any encrypted partitions. While deleting a lock file alone cannot prevent a determined attacker from decrypting a **gbde** partition, without the lock file, the legitimate owner will be unable to access the data on the encrypted partition without a significant amount of work that is totally unsupported by **gbde(8)** and its designer.

#### 4. Attach the Encrypted Partition to the Kernel

```
gbde attach /dev/ad4s1c -l /etc/gbde/ad4s1c
```

You will be asked to provide the passphrase that you selected during the initialization of the encrypted partition. The new encrypted device will show up in `/dev` as `/dev/device_name.bde`:

```
ls /dev/ad*
/dev/ad0 /dev/ad0s1b /dev/ad0s1e /dev/ad4s1
/dev/ad0s1 /dev/ad0s1c /dev/ad0s1f /dev/ad4s1c
/dev/ad0s1a /dev/ad0s1d /dev/ad4 /dev/ad4s1c.bde
```

#### 5. Create a File System on the Encrypted Device

Once the encrypted device has been attached to the kernel, you can create a file system on the device. To create a file system on the encrypted device, use `newfs(8)`. Since it is much faster to initialize a new UFS2 file system than it is to initialize the old UFS1 file system, using `newfs(8)` with the `-O2` option is recommended.

```
newfs -U -O2 /dev/ad4s1c.bde
```

**Ἰσημιῶδη:** The `newfs(8)` command must be performed on an attached **gbde** partition which is identified by a `*.bde` extension to the device name.

#### 6. Mount the Encrypted Partition

Create a mount point for the encrypted file system.

```
mkdir /private
```

Mount the encrypted file system.

```
mount /dev/ad4s1c.bde /private
```

#### 7. Verify That the Encrypted File System is Available

The encrypted file system should now be visible to `df(1)` and be available for use.

```
% df -H
Filesystem Size Used Avail Capacity Mounted on
/dev/ad0s1a 1037M 72M 883M 8% /
/devfs 1.0K 1.0K 0B 100% /dev
/dev/ad0s1f 8.1G 55K 7.5G 0% /home
/dev/ad0s1e 1037M 1.1M 953M 0% /tmp
/dev/ad0s1d 6.1G 1.9G 3.7G 35% /usr
/dev/ad4s1c.bde 150G 4.1K 138G 0% /private
```

### 18.16.1.2 Mounting Existing Encrypted File Systems

After each boot, any encrypted file systems must be re-attached to the kernel, checked for errors, and mounted, before the file systems can be used. The required commands must be executed as user `root`.

#### 1. Attach the gbde Partition to the Kernel

```
gbde attach /dev/ad4s1c -l /etc/gbde/ad4s1c
```

You will be asked to provide the passphrase that you selected during initialization of the encrypted **gbde** partition.

#### 2. Check the File System for Errors

Since encrypted file systems cannot yet be listed in `/etc/fstab` for automatic mounting, the file systems must be checked for errors by running `fsck(8)` manually before mounting.

```
fsck -p -t ffs /dev/ad4s1c.bde
```

#### 3. Mount the Encrypted File System

```
mount /dev/ad4s1c.bde /private
```

The encrypted file system is now available for use.

#### 18.16.1.2.1 Automatically Mounting Encrypted Partitions

It is possible to create a script to automatically attach, check, and mount an encrypted partition, but for security reasons the script should not contain the `gbde(8)` password. Instead, it is recommended that such scripts be run manually while providing the password via the console or `ssh(1)`.

As an alternative, an `rc.d` script is provided. Arguments for this script can be passed via `rc.conf(5)`, for example:

```
gbde_autoattach_all="YES"
gbde_devices="ad4s1c"
```

This will require that the **gbde** passphrase be entered at boot time. After typing the correct passphrase, the **gbde** encrypted partition will be mounted automatically. This can be very useful when using **gbde** on notebooks.

### 18.16.1.3 Cryptographic Protections Employed by `gbde`

`gbde(8)` encrypts the sector payload using 128-bit AES in CBC mode. Each sector on the disk is encrypted with a different AES key. For more information on `gbde`'s cryptographic design, including how the sector keys are derived from the user-supplied passphrase, see `gbde(4)`.

### 18.16.1.4 Compatibility Issues

`sysinstall(8)` is incompatible with `gbde`-encrypted devices. All `*.bde` devices must be detached from the kernel before starting `sysinstall(8)` or it will crash during its initial probing for devices. To detach the encrypted device used in our example, use the following command:

```
gbde detach /dev/ad4s1c
```

Also note that, as `vinum(4)` does not use the `geom(4)` subsystem, you cannot use `gbde` with `vinum` volumes.

## 18.16.2 Disk Encryption with `geli`

*Contributed by Daniel Gerzo.*

A new cryptographic GEOM class is available as of FreeBSD 6.0 - `geli`. It is currently being developed by Pawel Jakub Dawidek <[pjd@FreeBSD.org](mailto:pjd@FreeBSD.org)>. `Geli` is different to `gbde`; it offers different features and uses a different scheme for doing cryptographic work.

The most important features of `geli(8)` are:

- Utilizes the `crypto(9)` framework — when cryptographic hardware is available, `geli` will use it automatically.
- Supports multiple cryptographic algorithms (currently AES, Blowfish, and 3DES).
- Allows the root partition to be encrypted. The passphrase used to access the encrypted root partition will be requested during the system boot.
- Allows the use of two independent keys (e.g. a “key” and a “company key”).
- `geli` is fast - performs simple sector-to-sector encryption.
- Allows backup and restore of Master Keys. When a user has to destroy his keys, it will be possible to get access to the data again by restoring keys from the backup.
- Allows to attach a disk with a random, one-time key — useful for swap partitions and temporary file systems.

More `geli` features can be found in the `geli(8)` manual page.

The next steps will describe how to enable support for `geli` in the FreeBSD kernel and will explain how to create a new `geli` encryption provider. At the end it will be demonstrated how to create an encrypted swap partition using features provided by `geli`.

In order to use `geli`, you must be running FreeBSD 6.0-RELEASE or later. Super-user privileges will be required since modifications to the kernel are necessary.

#### 1. Adding `geli` Support to the Kernel Configuration File

Add the following lines to the kernel configuration file:

```
options GEOM_ELI
device crypto
```

Rebuild the kernel as described in [Εάν θέλετε να διαβάσετε το βιβλίο](#) 8.

Alternatively, the `geli` module can be loaded at boot time. Add the following line to the `/boot/loader.conf`:

```
geom_eli_load="YES"
```

`geli(8)` should now be supported by the kernel.

## 2. Generating the Master Key

The following example will describe how to generate a key file, which will be used as part of the Master Key for the encrypted provider mounted under `/private`. The key file will provide some random data used to encrypt the Master Key. The Master Key will be protected by a passphrase as well. Provider's sector size will be 4kB big. Furthermore, the discussion will describe how to attach the `geli` provider, create a file system on it, how to mount it, how to work with it, and finally how to detach it.

It is recommended to use a bigger sector size (like 4kB) for better performance.

The Master Key will be protected with a passphrase and the data source for key file will be `/dev/random`. The sector size of `/dev/da2.eli`, which we call provider, will be 4kB.

```
dd if=/dev/random of=/root/da2.key bs=64 count=1
geli init -s 4096 -K /root/da2.key /dev/da2
Enter new passphrase:
Reenter new passphrase:
```

It is not mandatory that both a passphrase and a key file are used; either method of securing the Master Key can be used in isolation.

If key file is given as "-", standard input will be used. This example shows how more than one key file can be used.

```
cat keyfile1 keyfile2 keyfile3 | geli init -K - /dev/da2
```

## 3. Attaching the Provider with the generated Key

```
geli attach -k /root/da2.key /dev/da2
Enter passphrase:
```

The new plaintext device will be named `/dev/da2.eli`.

```
ls /dev/da2*
/dev/da2 /dev/da2.eli
```

## 4. Creating the new File System

```
dd if=/dev/random of=/dev/da2.eli bs=1m
newfs /dev/da2.eli
mount /dev/da2.eli /private
```

The encrypted file system should be visible to `df(1)` and be available for use now.

```
df -H
Filesystem Size Used Avail Capacity Mounted on
/dev/ad0s1a 248M 89M 139M 38% /
/devufs 1.0K 1.0K 0B 100% /dev
/dev/ad0s1f 7.7G 2.3G 4.9G 32% /usr
/dev/ad0s1d 989M 1.5M 909M 0% /tmp
/dev/ad0s1e 3.9G 1.3G 2.3G 35% /var
```

```
/dev/da2.eli 150G 4.1K 138G 0% /private
```

## 5. Unmounting and Detaching the Provider

Once the work on the encrypted partition is done, and the `/private` partition is no longer needed, it is prudent to consider unmounting and detaching the `geli` encrypted partition from the kernel.

```
umount /private
geli detach da2.eli
```

More information about the use of `geli(8)` can be found in the manual page.

### 18.16.2.1 Using the `geli rc.d` Script

`geli` comes with a `rc.d` script which can be used to simplify the usage of `geli`. An example of configuring `geli` through `rc.conf(5)` follows:

```
geli_devices="da2"
geli_da2_flags="-p -k /root/da2.key"
```

This will configure `/dev/da2` as a `geli` provider of which the Master Key file is located in `/root/da2.key`, and `geli` will not use a passphrase when attaching the provider (note that this can only be used if `-P` was given during the `geli` init phase). The system will detach the `geli` provider from the kernel before the system shuts down.

More information about configuring `rc.d` is provided in the `rc.d` section of the Handbook.

## 18.17 Encrypting Swap Space

*Written by Christian Bruffer.*

Swap encryption in FreeBSD is easy to configure and has been available since FreeBSD 5.3-RELEASE. Depending on which version of FreeBSD is being used, different options are available and configuration can vary slightly. From FreeBSD 6.0-RELEASE onwards, the `gbde(8)` or `geli(8)` encryption systems can be used for swap encryption. With earlier versions, only `gbde(8)` is available. Both systems use the `encswap rc.d` script.

The previous section, `Encrypting Disk Partitions`, includes a short discussion on the different encryption systems.

### 18.17.1 Why should Swap be Encrypted?

Like the encryption of disk partitions, encryption of swap space is done to protect sensitive information. Imagine an application that e.g. deals with passwords. As long as these passwords stay in physical memory, all is well. However, if the operating system starts swapping out memory pages to free space for other applications, the passwords may be written to the disk platters unencrypted and easy to retrieve for an adversary. Encrypting swap space can be a solution for this scenario.

### 18.17.2 Preparation

**Όρισμα:** For the remainder of this section, `ad0s1b` will be the swap partition.

Up to this point the swap has been unencrypted. It is possible that there are already passwords or other sensitive data on the disk platters in cleartext. To rectify this, the data on the swap partition should be overwritten with random garbage:

```
dd if=/dev/random of=/dev/ad0s1b bs=1m
```

### 18.17.3 Swap Encryption with gbde(8)

If FreeBSD 6.0-RELEASE or newer is being used, the `.bde` suffix should be added to the device in the respective `/etc/fstab` swap line:

```
Device Mountpoint FStype Options Dump Pass#
/dev/ad0s1b.bde none swap sw 0 0
```

For systems prior to FreeBSD 6.0-RELEASE, the following line in `/etc/rc.conf` is also needed:

```
gbde_swap_enable="YES"
```

### 18.17.4 Swap Encryption with geli(8)

Alternatively, the procedure for using `geli(8)` for swap encryption is similar to that of using `gbde(8)`. The `.eli` suffix should be added to the device in the respective `/etc/fstab` swap line:

```
Device Mountpoint FStype Options Dump Pass#
/dev/ad0s1b.eli none swap sw 0 0
```

`geli(8)` uses the AES algorithm with a key length of 256 bit by default.

Optionally, these defaults can be altered using the `geli_swap_flags` option in `/etc/rc.conf`. The following line tells the `encswap rc.d` script to create `geli(8)` swap partitions using the Blowfish algorithm with a key length of 128 bit, a sectorsize of 4 kilobytes and the “detach on last close” option set:

```
geli_swap_flags="-a blowfish -l 128 -s 4096 -d"
```

Please refer to the description of the `onetime` command in the `geli(8)` manual page for a list of possible options.

### 18.17.5 Verifying that it Works

Once the system has been rebooted, proper operation of the encrypted swap can be verified using the `swapinfo` command.

If `gbde(8)` is being used:

```
% swapinfo
Device 1K-blocks Used Avail Capacity
/dev/ad0s1b.bde 542720 0 542720 0%
```

If geli(8) is being used:

```
% swapinfo
Device 1K-blocks Used Avail Capacity
/dev/ad0s1b.eli 542720 0 542720 0%
```

## Όχι έπιπέδο

1. For tips on how to select a secure passphrase that is easy to remember, see the Diceware Passphrase (<http://world.std.com/~reinhold/diceware.html>) website.

# ÊäöÛëáéí 19 GEOM: Äéá ÷ äßñéóç Óóóôïé ÷ éþí Äßóêùí

ÄñÛöðçêä áðu ôíí Tom Rhodes.

## 19.1 Óýñéç

Ôí êäöÛëáéí áðuü êáéýððáé ðç ÷ ñþóç ðùí äßóêùí êÛðuü áðuü ôí ðéáßóéí êáéôíðñáéþí GEOM óðí FreeBSD. ÐáñééáíáÛíáé óá êðñéóðáñá ðñíáñÛííáóá äéÝá ÷ ð RAID ðùí ððíßùí ðé ñðèíßóáéð äáóßæííóáé óðí ðéáßóéí GEOM. Ôí êäöÛëáéí áðuü ááí áíáéýáé óá äÛèð ðíí ðñùðí ðá ðíí ððíßí ðíí GEOM ÷ äéñßæáðáé Þ äéÝá ÷ äé êáéôíðñáßáð Äéóüüðð / Äíüüðð (IO), ðí ððíóýóðçíá ðíð äñßóéáðáé êÛðuü áðuü áðuü, Þ ðíí êþáééá ðíð. Ìé ðççñíðíðñáð áððÝð ðáñÝ ÷ ðíðáé áðuü ðç óáéßáá manual ðíð geom(4) êáéþð êáé áðuü ðéð áíáóíñÝð ðíð ðáñéÝ ÷ äé óá Ûééáð ó ÷ äóééÝð óáéßáð. Äðßóçð ðíí êäöÛëáéí áðuü ááí áðíðáéß êáéíñéóðééü ðáçäü äéá üéáð ðéð ñðèíßóáéð ðíð RAID. Êá óðæçðçéíýí ðíí ðíí êáðáóðÛóáéð êáéôíðñáßáð ðíð RAID ðíð ððíóçñßæííóáé áðuü ðíí GEOM.

Äóíý äéááÛóáðá áðuü ðíí êäöÛëáéí, êá ðÝñáðá:

- Ôí äßáðð ðçð ððíóððñéíçð RAID ðíð äßíáé äéáéÝóéí ðÝóù ðíí GEOM.
- Ðùð ðá ÷ ñçóéíðíéÞóáðá óá äáóééÛ äíçççóééÛ ðñíáñÛííáóá äéá ðçí ñýèíéóç, óðíððñççðç êáé äéá ÷ äßñéóç ðùí äéáóíñùí äðéðÝäùí RAID.
- Ðùð ðá äçíéíðñáÞóáðá mirror Þ stripe, ðá êñðððíðñáððóáðá, êáé ðá óðíáÝóáðá äßóéíðð ðá ðíí GEOM, ðÝóù ðéáð áðñáêñðóíÝíçð óýíáðçðð.
- Ðùð ðá áíðéíáðððßóáðá ðñíáéÞíáðá äßóéíð ðíð ÷ ñçóéíðíéíýí ðíí ðéáßóéí êáéôíðñáéþí GEOM.

Ðñéí äéááÛóáðá áðuü ðíí êäöÛëáéí, êá ðñÝðáé:

- Ìá êáðáñíáßáð ðùð ðáðá ÷ äéñßæáðáé ðíí FreeBSD ðéð óðóéáððÝð äßóéíð (ÊäöÛëáéí 18).
- Ìá äíññßæáðá ðùð êá ñðèíßóáðá êáé êá äáéáðáðððóáðá Ýíá ðÝí ððñÞíá óðí FreeBSD (ÊäöÛëáéí 8).

## 19.2 ÄéóáãüñÞ óðí GEOM

Ôí GEOM äðéðñÝðáé ðçí ðñüóááç êáé ðíí Ýéáá ÷ ð óá êéÛóáéð — üðùð ðçí ÊáíðñééÞ ÄáñáðÞ Äéêßíççðð (Master Boot Record), óá BSD labels, ê.á. — ðÝóù ðçð ÷ ñþóçð ðáñí ÷ Ýúí, Þ ðÝóù äéáééþí äñ ÷ äßùí óðíí êáðÛéíáí / dev. Ôí GEOM ððíóçñßæáé äéÛóíñáð äéáðÛíáéð RAID êáé ðáñÝ ÷ äé äéÛóáíç ðñüóááç óðí êáéôíðñáééü óýóðçíá êáé óá äíçççóééÛ ðíð ðñíáñÛííáóá.

## 19.3 RAID0 - Striping

ÄñÛöðçêä áðu ôíðð Tom Rhodes êáé Murray Stokely.

Ôí striping äßíáé ðéá ðÝéíáðð ðíð óðíáðÛæáé äéáóíñáðééíýð óðóééíýð äßóéíðð óá Ýíá ðíááééü êíáééü ðùíí. Óá ðíééÝð ðáñéðððóáéð, áðuü äßíáðáé ðá ðçí äíðéáéá äíáéáééäðíÝíð ðéééíý (äéááéðþí). Ôí ððíóýóðçíá äßóéíð GEOM ðáñÝ ÷ äé ððíóððñéíç ðÝóù êíáéðéééíý äéá ðç äéÛóáíç RAID0, ç ððíßá äßíáé äíñóðÞ êáé ðð striping.



```
bsdlablel -wB /dev/stripel/st0
```

5. Ç áέάάέέάόβά áόόP έά äçίέίöñáPóáέ όç όόóέάόP st0, έέεPð έέέ άýí áέúιá όόóέάόYð όόίí έάóÜέίáí /dev/stripel. Íέ όόóέάóYð áóóYð έá íñÜέίíóáέ st0a έέέ st0c. Όóí όçίáβí áόóü, ìðñáβóá ðéYíí íá äçίέίöñáPóáά όýóόçíá áñ÷áβίí όóç όόóέάόP st0a ÷ñçóέííðίέPíόáó ðí äìççéçóέέü ðñúáñáíá newfs:

```
newfs -U /dev/stripel/st0a
```

Έά ááβóá íέá íááÜέç óάέñÜ áñέèìPí íá ðáñíÜ áñPáíñá áðu όçí íέúíç óáó, έέέ íáóÜ áðu έβáá ááóóáñúέáóóá ç áέάάέέάόβά έá Y÷άέ íέíέççñúèáá. Í óüìíð έá Y÷άέ äçίέίöñáçέáβ έέέ έá áβίáέ Yóίέííð áέá ðñíóÜñόçόç.

Άέá íá ðñíóáñPóáóá ÷áέñíέβίçóá ðí stripe ðíó äçίέίöñáPóáóá:

```
mount /dev/stripel/st0a /mnt
```

Άέá íá áβίáóáέ áóóúíáóá ç ðñíóÜñόçόç áóóíý ðíó όóóóPíáóíð áñ÷áβίí έáóÜ όçí áέáάέέάόβά áέέβίçóçð, ðíðίέáóPóáá óéð ðççñíóíñβáð ðíó óüìíð óóí áñ÷áβí /etc/fstab. Άέá ðí óέíðü áóóü, äçίέίöñáýíá Y íá ìíέíí óçíáβí ðñíóÜñόçόçð, ðí stripe:

```
mkdir /stripe
echo "/dev/stripel/st0a /stripe ufs rw 2 2" \
 >> /etc/fstab
```

Όí Üñέñúíá geom\_stripe.ko έá ðñYðáέ íá öíñðPíáóáέ áóóúíáóá έáóÜ όçí áέέβίçόç ðíó óóóóPíáóíð. ΆέóáέYóóá όçí ðáñáέÜðü áíóíέP, áέá íá ðñíóέYóáóá όçí έáóÜέέççç ñýèíέóç óóí /boot/loader.conf:

```
echo 'geom_stripe_load="YES"' >> /boot/loader.conf
```

## 19.4 RAID1 - Mirroring

Όí mirroring (έάέñáóóέóíúð) áβίáέ íέá óá÷ñέíáβá ðíó ÷ñçóέííðίέáβóáέ áðu ðíέéYð áóáέñβáð έáέ íέέέáέíýð ÷ñPóóáð áέá íá áóóáέβóíóí óá áááñY íá óíòð ÷ññβð áέáέíðYð. Óá íέá áέÜóáίç mirror, í áβóέíð Á áβίáέ áðéPð Y íá ðéPñáð áíóβáñáóí ðíó áβóέíð Á. <sup>1</sup> ìðñáβ íέ áβóέíέ A+Á íá áβίáέ áíóβáñáóá ðüí áβóέúí A+B. ¶ó÷áóá ìá όçí áέñέáP áέÜóáίç ðüí áβóέúí, ðí όçíáíóέέü áβίáέ ùóέ íέ ðççñíóíñβáð áíúð áβóέíð P íέáó έáóÜóíçόçð áíóέáñÜóííóáέ óá Üέέíðð. Íέ ðççñíóíñβáð áóóYð ìðñáβ áñáúóáñá íá áðίέáóáóóáέýí íá áýέíέí ðñüðí, P íá áíóέáñáóíýí ÷ññβð íá ðñíέççðáá áέáέíðP óóéð ðççñáóβáð ðíó ìç÷áíPíáóíð P óóçí ðñúóááóç ðüí áááñY íúí. ìðñíýí áέúíá έέέ íá ìáóáóáñέýí έέέ íá óóέá÷έíýí óá Üέέí, áóóáέYð ìYñíð.

Άέá íá íáέέíPóááóá, ááááέúèáβóá ùóέ ðí óýóόçíá óáó Y÷áέ άýí óέέççñíýð áβóέíðð βáέíð ìááYέíðð. Óóá ðáñáááβáíáóá ìáð έáññíýíá ùóέ íέ áβóέíέ áβίáέ óýðíó SCSI (áðáóðéáβáð ðñúóááóçð, da(4)).

### 19.4.1 Mirroring óóíðò Ááóέέíýð Áβóέíðð

ΌðíέYóííóáð ùóέ ðí FreeBSD Y÷áέ ááέáóáóóáέááβ óóíí ðñPóí áβóέí da0, έá ðñYðáέ íá ñóèìβóáóá ðí gmirror(8) íá áðίέççéáýóáέ áέáβ óá ááóέέÜ áááñY íá ðíó.

Ðñέí äçίέίöñáPóáóá ðí mirror, áíáñáñðίέPóáóá όçí áóíáóüóçóá áìÜíέóçð ðáñέóóúóáñúí έáððíñáñáέPí (ðíó ìðñáβ íá óáó äìççéPóíóí óá ðáñβððóúç ðñíáέPíáóíð) έέέ áðέðñYðóá όçí áðáóéáβáð ðñúóááóç óóç óóóέáóP áβóέíð. Άέá ðí óέíðü áóóü èYóóá όç ìáóááéççP kern.geom.debugflags ðíó sysctl(8) óóçí ðáñáέÜðü ðέíP:

```
sysctl kern.geom.debugflags=17
```

Ἰδῖñάβδᾶ όβñᾶ ἰά äçἰέἰδñᾶβóᾶδᾶ δῖ mirror. Ἰᾶέέἰβóᾶδᾶ όç äéáäééáóβᾶ ᾶδῖέçéᾶγῖἰδᾶδᾶ δᾶ ἰᾶδᾶ-ᾶᾶñἰ Ἰῖᾶ (meta-data) όδῖἰ ᾶάóééῦ ᾶβóéἰ, äçἰέἰδñᾶβἰδᾶδᾶ ἰδóéáóóééῦ όç óδóéᾶδᾶβ /dev/mirror/gm. ×ñçóéἰἰδῖέβóᾶδᾶ όçἰ δᾶñᾶéῦδῦ ἰᾶἰδῖέβ:

**Δñἰᾶéᾶἰδῖβçóç:** Ç äçἰέἰδñᾶβᾶ mirror όδῖ ᾶβóéἰ ᾶééβἰçóçò ἰδῖñᾶβ ἰᾶ Ἰ÷ᾶé ῦò ᾶδῖδῖᾶᾶἰᾶ όçἰ ᾶδᾶéᾶ ᾶᾶñἰἸῖῖῖ, ᾶἰ ἰ δᾶéᾶδóᾶβἰδᾶ δῖἰἸᾶó δῖδᾶ ᾶβóéἰδῖ Ἰ÷ᾶé βᾶç ÷ñçóéἰἰδῖέçéᾶβ. Ç δééᾶἰῦδóçᾶ ᾶδóβ ᾶβἰᾶé δῖᾶῖ ἰééñῦδᾶñç ᾶἰ δῖ mirror äçἰέἰδñᾶçéᾶβ ᾶἰἸῦòδᾶ ἰᾶδῦ ᾶδῦ ἰéᾶ ἰῖᾶ ᾶᾶéᾶóῦδᾶóç δῖδᾶ FreeBSD.

```
gmirror label -vb round-robin gm0 /dev/da0
```

Ὀἰ όçἰδóçἰᾶ éᾶ ᾶἰδᾶδῖᾶἰᾶééᾶβ ἰᾶ δῖ δᾶñᾶéῦδῦ ἰβῖδῖᾶ:

Metadata value stored on /dev/da0.  
Done.

Ἄñ÷éἰἰδῖέβóᾶδᾶ δῖ GEOM. Ç δᾶñᾶéῦδῦ ᾶἰδῖέβ éᾶ ῖññδᾶβᾶé δῖ Ἰñᾶñῦἰᾶ /boot/kernel/geom\_mirror.ko όδῖἰ δᾶñᾶβἰᾶ:

```
gmirror load
```

**Ὀçἰᾶβῦòç:** ἰᾶ όçἰ ᾶδéδó÷β ᾶéδῖᾶᾶóç ᾶδóβò όçò ᾶἰδῖέβò, äçἰέἰδñᾶñᾶβδᾶé ç óδóéᾶδᾶβ gm0 ἰῖᾶᾶ όδῖἰ éᾶδῦἰᾶἰ /dev/mirror.

Ἄἰᾶñᾶἰδῖέβóᾶδᾶ δῖ ῖññδῦἰᾶ δῖδᾶ ᾶñᾶñᾶβᾶδῖδᾶ geom\_mirror.ko éᾶδῦ όçἰ ᾶééβἰçóç δῖδᾶ óδóδᾶβᾶἰδῖ:

```
echo 'geom_mirror_load="YES"' >> /boot/loader.conf
```

Ἄδᾶἰᾶñᾶᾶóᾶβδᾶ δῖ ᾶñ÷ᾶβἰ /etc/fstab, ᾶἰδééᾶééóδᾶβἰδᾶδᾶ δéδ ᾶἰᾶῖñῖῖδᾶ óδéδ δᾶééῖδᾶ óδóéᾶδῖδᾶ da0 ἰᾶ δéδ ᾶἰδóβóἰᾶ÷ᾶ δᾶ éᾶἰῖῖᾶéᾶ gm0 δῖδᾶ ᾶἰδéδñῖῖóδᾶγῖῖᾶ δῖ mirror.

**Ὀçἰᾶβῦòç:** Ἄἰ ÷ñçóéἰἰδῖέᾶβδᾶ δῖ vi(1), ἰδῖñᾶβδᾶ ἰᾶ ᾶéἰἰδᾶβóᾶδᾶ δᾶ δᾶñᾶéῦδῦ ᾶβἰᾶδᾶ ᾶéᾶ ἰᾶ ἰἰἰéççñᾶβδᾶ ᾶγῖἰᾶ ᾶδóβ όç äéᾶᾶééᾶóβᾶ:

```
vi /etc/fstab
```

Ὀἰ vi(1), éñᾶóβóᾶδᾶ ᾶἰδóβᾶñᾶóἰ ᾶóᾶéᾶβᾶó δῖδᾶ δñῖῖ÷ἰἰδῖδᾶ ᾶñ÷ᾶβἰδᾶ fstab δéçéδñῖἰἰᾶβἰδᾶδᾶ :w /etc/fstab.bak. δᾶéδᾶ ᾶἰδééᾶóᾶóδᾶβδᾶ ῖἰᾶδ δéδ ᾶἰᾶῖñῖῖδᾶ óδéδ δᾶééῖδᾶ óδóéᾶδῖδᾶ da0 ἰᾶ δéδ ἰῖᾶδ gm0 ᾶñῦἰἰᾶδ :%s/da/mirror\gm/g.

Ὀἰ fstab δῖδᾶ éᾶ δñῖἰéγᾶé, éᾶ ἰἰἰἰᾶé ἰᾶ δῖ δᾶñᾶéῦδῦ. Ἄᾶἰ Ἰ÷ᾶé óçἰᾶóβᾶ ᾶἰ ἰἰᾶ ᾶβóéἰᾶ βδᾶἰ ᾶñ÷éῦ SCSI β ATA, ç óδóéᾶδᾶβ RAID éᾶ Ἰ÷ᾶé δῖἰᾶ δῖ ῖññᾶ gm.

| # Device           | Mountpoint | FStype | Options | Dump | Pass# |
|--------------------|------------|--------|---------|------|-------|
| /dev/mirror/gm0s1b | none       | swap   | sw      | 0    | 0     |
| /dev/mirror/gm0s1a | /          | ufs    | rw      | 1    | 1     |
| /dev/mirror/gm0s1d | /usr       | ufs    | rw      | 0    | 0     |
| /dev/mirror/gm0s1f | /home      | ufs    | rw      | 2    | 2     |
| /dev/mirror/gm0s2d | /store     | ufs    | rw      | 2    | 2     |
| /dev/mirror/gm0s1e | /var       | ufs    | rw      | 2    | 2     |

```
/dev/acd0 /cdrom cd9660 ro,noauto 0 0
```

ἌðáíἄééíἮóðἄ ðἱ óýóðçἱά:

```
shutdown -r now
```

Ἐὰὐὐ ðçἱ ἄéèβἱçóç ðἱò óðóðἮἱἄðἱò, εἄ ðἢÝðἄé ðèÝἱ ἱά ÷ἢçóéἱðἱéἄβóἄé ç óðóèἄðἮ ḡm0 ἱίðβ ἄéἱ ðçἱ da0. Ἰἄðὐ ðἱ ðÝèἱò ðçð ἄéèβἱçóçð, ἱðἢἢἄβóἄ ἱά ἄèÝἢἱἄðἄ ἱúé ἱéἱ éἄéðἱòἢἢἱἱ ἱóἱðἱ, ἢἱðὐἰἱἱðἱἄð ðçἱ Ἰἱἢἱἱ ðçð ἱίðἱἮð mount:

```
mount
```

| Filesystem         | 1K-blocks | Used    | Avail    | Capacity | Mounted on     |
|--------------------|-----------|---------|----------|----------|----------------|
| /dev/mirror/gm0s1a | 1012974   | 224604  | 707334   | 24%      | /              |
| devfs              | 1         | 1       | 0        | 100%     | /dev           |
| /dev/mirror/gm0s1f | 45970182  | 28596   | 42263972 | 0%       | /home          |
| /dev/mirror/gm0s1d | 6090094   | 1348356 | 4254532  | 24%      | /usr           |
| /dev/mirror/gm0s1e | 3045006   | 2241420 | 559986   | 80%      | /var           |
| devfs              | 1         | 1       | 0        | 100%     | /var/named/dev |

Ç Ἰἱἢἱð ðἱἱἱἱἄἱé òἱòðἮ, ἱðἱð ἱἱἱἱἱἱἱἱἱ. Ὀἱééèἱ, ἄéἱ ἱἱ ἱἱééἱἮἱἱ ἱ ἱðἱἱἱἱἱἱἱ, ἄéðἱἱἱἱἱἱἱ ἱἱἱ ᰄçἱ óðóèἄðἮ da1 ðἱἱ mirror, ÷ἢçóéἱἱðἱéἱἱἱἱð ðçἱ ἄéἱἱἱἱἱἱἱ ἱίðἱἮἮ:

```
gmirror insert gm0 /dev/dal
```

Ἐὰὐὐ ðç ἄèἱἢἱἱἱἱἱ ᰄἱò óðἱἱἱἱἱἱἱἱ ᰄἱò mirror, ἱðἢἢἱἱἱἱ ἱἱ ἱἱἱἱἱἱ ðçἱ ðἢἢἱἱἱ ðçð ἄéἱἱἱἱἱἱἱἱ ἱἱ ðçἱ ðἢἢἱἱἱἱἱ ἱίðἱἮἮ:

```
gmirror status
```

Ἰἄðὐ ðἱ ðÝèἱò ðçð ἱἱἱἱἱἱἱ ᰄἱò mirror, ἱἱἱ ἱἱἱ Ḳ ÷ἱòἱ óðἱἱἱἱἱἱἱ ἱἱἱ ᰄἱ ἱἱἱἱἱἱἱἱ, ç Ḳἱἱἱἱð ðçð ðἢἢἱἱἱἱἱ ἱἱἱἱἱἱἱ ἱἱ ἱἱἱἱἱἱ ἱἱ ᰄçἱ ἱἱἱἱἱἱἱἱ:

| Name       | Status   | Components |
|------------|----------|------------|
| mirror/gm0 | COMPLETE | da0        |
|            |          | dal        |

Ἄἱ ððἱἢἱἱἱἱἱἱἱ ᰄἱò ðἢἢἱἱἱἱἱἱἱἱ, Ἦ ἱἱ ᰄἱ mirror ἢἢἱἱἱἱἱἱἱἱ ἱἱἱἱ ᰄç ἱἱἱἱἱἱἱἱἱἱ ᰄἱἱἱἱἱἱἱἱἱ, ðἱ ðἢἢἱἱἱἱἱἱἱἱ ἱἱ ἱἱἱἱἱἱἱἱ ἱἱ ἱἱἱἱἱἱἱἱἱἱἱ DEGRADED ἱἱἱἱ ἱἱἱἱ COMPLETE.

## 19.4.2 Ἀἱðéἱἱἱðḡðéóç ḡἢἱἱἱἱἱἱἱἱ

### 19.4.2.1 Ὀἱ óýóðçἱἱ ἢἢἱἱἱἱἱἱ ἱἱ ἱἱἱἱἱἱἱἱ

Ἄἱ ðἱ óýóðçἱἱ ᰄἱð ᰄἱἱἱἱἱἱἱἱ ᰄἱ ἱἱἱ ᰄἱἱἱἱἱἱἱἱ ᰄἱἱ ἱἱἱἱἱἱἱἱ ἱἱ ᰄçἱ ðἢἢἱἱἱἱἱἱἱἱ:

```
ffs_mountroot: can't find rootvp
Root mount failed: 6
mountroot>
```

Ἄðáíἄéééἱἱἱἱἱἱ ᰄἱ óýóðçἱἱ ᰄἱð ἱÝòἱ ᰄἱἱ ἱἱἱἱἱἱἱἱἱἱἱ ᰄἱ ᰄἱἱ ðèḡðḡἢἱò reset. Ὀἱἱ ἱἱἱἱ ἱἱἱἱἱἱἱἱἱ, ἱðéè Ḳἱἱἱ ᰄἱ (6). Ἰἱ ᰄἱ ᰄἱἱἱ ἱἱἱἱ ἱἱ ἱἱἱἱἱἱἱ ᰄçἱ ᰄἢἱᰄἢἱἱἱἱ ᰄἱἱ loader(8). Ὀἱἢᰄᰄᰄ ÷ἱἱἱἱἱἱἱἱ ᰄἱ Ḳἱἱἱἱἱἱἱ ᰄἱἱ ᰄḡἢἱἱἱ:

```
OK? load geom_mirror
```

OK? boot

Άί óι δάñάδΰίú έάέóιτñάβóάέ, óúóá άέα έΰθίεί ευάι όι ΰñέñúιά ááί έìñóβέçέά óúóóΰ. ΆέΨάίóá άί άβιάέ óúóóβ ç ó÷άóέέβ έάóά÷βñέόç óóί áñ÷άβι /boot/loader.conf. Άί όι δñúάέçιά δάñáíΨίáέ, δñíóéΨóóά óç áñáìβ:

options GEOM\_MIRROR

óóι áñ÷άβι ñóèιβóάúι όίó δññβιά óάò, áíaäçίέίτñάβóóά έάέ áðáíáέάóáóóβóóά όιι δññβιά óάò. Óι δñúάέçιά óάò έá δñΨάέ ίά áéíñèùέάβ.

### 19.4.3 Άðáíáéíñΰ ίáóΰ áðu Άðíóó÷βά Άβóéíó

Óι áέðέçééóéú ίá όι mirroring άβιάέ úé úóáí Ψιάó óééçñúð άβóéíð ÷άέΰóάέ, ίðñάβóά ίά όιι áíóéέάóáóóβóóά ÷úñβð ίά ÷ΰóáóά έάέúέίó áááñΨίá.

ÓðíéΨóίóóá úé ÷ñçóέίðίέίγιά óéð ñóèιβóáέð RAID1 ðίó áάβίáíá δñίçáίóίΨίúð, áð έáúñβóίóía úé ÷ΰέáóá í άβóéíð da1 έάέ δñΨάέ ίά áíóéέáóáóóάέάβ. Άέα ίά όιι áíóéέáóáóóβóóά, áñάβóά ðίέíð άβóéíð άβιάέ έάέ áðáíáñáíðίέβóóά όι óýóóçιά. Óóί óçíáβι áóóú, ίðñάβóá ðéΨίί ίά áíóáéέΰίáóá όι άβóéί ίá Ψίá íΨί έάέ ίά áíáñáíðίέβóáóá ίáíΰ όι óýóóçιά. ίáóΰ óçí áðáíáíáñáíðίέβçç όίó óóóðβιάóίó, ίðñάβóά ίá ÷ñçóέίðίέβóóά óéð δáñáέΰóú áíóíéΨó άέα ίá έΨóóáóά óá έáέóίóñάβá όι íΨί άβóéί:

```
gmirror forget gm0
gmirror insert gm0 /dev/da1
```

×ñçóέίðίέβóóά óçí áíóίέβ gmirror status άέα ίά δáñáéίéíóέάβóά óç áέαάέέάóά όίó óá÷ñίέóίγ. Άβιάέ óóá άέβέάέά óúóί áðéú.

## 19.5 ΆέéðóáέΨó ÓóóéáóΨó ίΨóú GEOM Gate

Óι GEOM óðίóóçñβáéé áðñáéñóóίΨίç ÷ñβóç óóóéáóβί, úðúð ίé óééçñúβ άβóéίέ, óá CD-ROM, óá áñ÷άβá é.é.ð. ÷ñçóέίðίέβίóáð óá áίççéóéέΰ δññáñΰíáóá ðýççð (gate). Ç έάέóίóñάβá άβιάέ δáñúúέá ίá όι NFS.

Άέα ίά ίáέέíβóáóá, δñΨάέ ίá áçίέíóñάβóáóá Ψίá áñ÷άβι exports. Óι áñ÷άβι áóóú έáέíñβáéé ðίέíð áðéóñΨáóáέ ίá áðίéðβóáé δñúóááóç óóíóð έίέíú ÷ñçóóíóð ðúñíóð έáέ ðé áðéðΨáíó έá άβιάέ áóðβ ç δñúóááóç. Άέα δáñΰááέáíá, άέα ίá áéáíéñΰóáóá óçí ðΨóáñðç έáðΰðίççç (slice) όίó δñβóίó άβóéíó SCSI, άβιάέ áñέáóú ίá áçίέíóñάβóáóá όι δáñáέΰóú áñ÷άβι /etc/gg.exports:

```
192.168.1.0/24 RW /dev/da0s4d
```

Óι δáñáðΰίú έá áðéóñΨáéé óá úéíóð óίóð óðíéíáéóóΨó όίó έáέúóééíγ óáð áέéóγίó, ίá Ψ÷íóí δñúóááóç ίΨóú áέéóγίó óóί óýóóçιά áñ÷άβι óç έáðΰðίçççð da0s4d.

Άέα ίá áéáíéñΰóáóá áóðβ óç óóóéáóβ, ááááéúέάβóá úéé ááí άβιάέ δñíóáñóçίΨίç óç áááñΨίç óóéáìβ, έάέ ίáέέíβóóá όι áάβίíá áίðççñáðççð ggated(8):

```
ggated
```

Άέα ίá δñíóáñðβóáóá óçí óóóéáóβ óóí ίç÷ΰίçιά ðáέΰóç, ÷ñçóέίðίέβóóá óéð áέúέíóéáð áíóíéΨó:

```
ggatec create -o rw 192.168.1.1 /dev/da0s4d
ggate0
mount /dev/ggate0 /mnt
```

Ἄδου ἀαβ εάε οδί ἀίΠδ, ἰδῖνᾶβδᾶ ἰά Ἰ ÷ ᾶδᾶ δῖνῖοᾶᾶός οδς οδοεᾶδΠ ἰἸού οἰο οςῖᾶβῖο δῖνῖοᾶᾶός οδς /mnt.

**Οςῖᾶβῖο:** ΔῖνἸᾶε ἰά οἰεοᾶβ ὑοε ς ᾶεᾶεεᾶοᾶ ἰά ἰά ᾶδῖοᾶ ÷ ᾶε ἰά ς οδοεᾶδΠ ᾶβῖᾶε ος ᾶᾶᾶἸἸ ὀοεᾶἰΠ δῖνῖοᾶᾶός ἸἸ, ᾶβδᾶ οδῖἰ ᾶἰδδςῖᾶδδδΠ, ᾶβδᾶ ὀᾶ ἰδῖεἰᾶΠδῖοᾶ Ὑεεἰ ὀδῖεἰᾶεοδΠ οδῖ ᾶβεοδῖ.

¼οᾶί ᾶᾶ ÷ ῖᾶεἸᾶᾶοᾶ δῖεἸἰ ὀς οδοεᾶδΠ, ἰδῖνᾶβδᾶ ἰά οςῖ ᾶδῖδῖνῖοᾶᾶδΠᾶᾶᾶ ἰᾶ ᾶοᾶὙεᾶεᾶ, ÷ ῖς ὀεἰῖδῖεἰᾶοᾶ οςῖ ᾶἰῖεἰᾶ umount(8), ὑδῖδᾶ ᾶβῖᾶοᾶε εάε ἰᾶ ἰδῖεἰᾶΠδῖοᾶ Ὑεεἰ οδοεᾶδΠ ᾶβεοδῖ.

## 19.6 Ἀςῖεἰῖοῖᾶᾶᾶ ἈοεεἸᾶᾶ (Labels) οοεο Οοοεᾶᾶᾶ Ἀβόεὺι

Ἐᾶδᾶ ὀς ᾶεὙῖᾶεᾶ ὀςδ ᾶῖ ÷ εἰῖδῖβς ὀςδ, οδςῖ ᾶεἰβς ὀςδ οἰο οδοδΠᾶᾶᾶ, ἰ δῖνῖᾶᾶ οἰο FreeBSD ἰ ᾶςῖεἰῖοῖᾶᾶ ὀᾶ ᾶδᾶᾶβδς ᾶῖ ÷ ᾶβᾶ ᾶεᾶ εὙεᾶ οδοεᾶδΠ δῖο ᾶἰε ÷ ἰᾶἸᾶε. ἈδδΠ ς ἰἸεἰᾶᾶ ᾶἰβ ÷ ἰᾶδδςδ οδοεᾶδΠ, ἰδῖνᾶβ ἰᾶ ᾶςῖεἰῖοῖᾶᾶ δῖνῖᾶεἰᾶᾶᾶ. Ἀεᾶ δᾶῖᾶᾶεᾶᾶᾶ, ὀε ἰᾶ ᾶβῖᾶε ᾶἰ δῖνῖοεἸᾶᾶᾶ Ἰᾶ ἰἸᾶ ᾶβῖῖ USB; Ἀβῖᾶε ᾶῖᾶᾶᾶ ὀεᾶᾶᾶ ἰεᾶ οδοεᾶδΠ ἰἸβςδ flash ἰᾶ δὙῖᾶε ὀἰ ὑῖῖᾶ da0 εᾶε ς ᾶῖ ÷ εἰᾶ da0 ἰᾶ ἰᾶᾶεἰεἰεᾶβ οἰἰ da1. Ἀδδᾶ ἰᾶ δῖνῖᾶεἸᾶᾶ δῖνῖᾶεἰᾶᾶᾶ οδςῖ δῖνῖοᾶᾶ ὀςδ οἰο οδοδςῖᾶᾶ ᾶῖ ÷ ᾶβῖᾶ, ᾶἰ δὙᾶᾶ ÷ ἰᾶ ἰε ᾶἰᾶβῖᾶε ÷ ᾶδ ἰᾶᾶ ÷ ὑῖῖᾶᾶεδ οἰᾶ ὀδῖ /etc/fstab, εᾶε ἰδῖνᾶβ ᾶεὑᾶ εᾶε ἰᾶ δᾶῖᾶᾶᾶβῖᾶε ὀςῖ εᾶῖἰεἰᾶ ᾶεἰβς ὀςδ οἰο οδοδΠᾶᾶᾶ.

ἰεᾶ εἸᾶ ᾶβῖᾶε ἰᾶ ῖᾶεἰᾶᾶᾶ ὀεδ οδοεᾶᾶᾶ Ὑδ SCSI ἰᾶ δὙἰεἰ δῖνῖᾶ, ῖᾶᾶ ς ᾶῖβς ὀςδ ἰᾶ ᾶβῖᾶε ὀδῖ ÷ ὑᾶἰς. ὀε, εὙεᾶ ὀῖᾶᾶ ὀἰο δῖνῖοεἸᾶᾶᾶ ἰεᾶ ἰἸᾶ οδοεᾶδΠ οἰἰ ᾶεᾶᾶεδΠ SCSI ἰᾶ ᾶβῖᾶ ὀβῖᾶᾶᾶ ὑοε ἰᾶ εὙᾶᾶ ᾶῖᾶᾶᾶ ὀἰο ᾶἰ Ἰ ÷ ᾶε ÷ ῖς ὀεἰῖδῖεἰεᾶβ. ἈεεὙ ὀε ᾶβῖᾶᾶε ἰᾶ ὀεδ οδοεᾶᾶᾶ Ὑδ USB δῖο ἰδῖνᾶβ ἰᾶ ᾶἰᾶεᾶᾶᾶᾶᾶᾶᾶᾶ ὀἰἰ εἸῖῖ SCSI ᾶβῖῖ; Ἀδδᾶ ἰδῖνᾶβ δῖνῖᾶᾶᾶ ἰᾶ ὀἰᾶᾶβ, εᾶεἰδ ἰε οδοεᾶᾶᾶ Ὑδ USB ᾶἰε ÷ ἰᾶἸᾶᾶε ἰᾶᾶ ᾶὙᾶ ᾶᾶᾶ ὀἰᾶ ᾶᾶᾶεδΠ SCSI. ἰεᾶ εἸᾶ ᾶβῖᾶε ἰᾶ ᾶὙᾶᾶᾶ ὀεδ οδοεᾶᾶᾶ Ὑδ ᾶᾶᾶ ὀἰᾶ ἰᾶᾶᾶ ὀςῖ ᾶεἰβς ὀςδ οἰο οδοδΠᾶᾶᾶ. ἰεᾶ Ὑεεἰ ἰἸεἰᾶᾶ ᾶβῖᾶε ἰᾶ ÷ ῖς ὀεἰῖδῖεᾶᾶᾶ ἰῖῖᾶ ἰεᾶ οδοεᾶᾶᾶ ὀἰᾶᾶ ᾶᾶ ἰᾶ ἰςῖ ἰᾶᾶ ÷ ὑῖῖᾶᾶ ὀἰᾶ Ὑᾶ ὀἰᾶ ᾶβῖῖᾶᾶ SCSI ὀἰᾶ /etc/fstab.

ὀδὙᾶ ÷ ᾶε ὑοδῖᾶ ἰεᾶεᾶᾶ ἰᾶ εἸᾶ. × ῖς ὀεἰῖδῖεἰᾶᾶᾶ ὀἰ ᾶἰς ὀεἰᾶ δῖνῖᾶᾶᾶ ᾶᾶᾶ label, Ἰᾶᾶ ᾶεᾶ ÷ ᾶεἰᾶᾶᾶ ὀἰ ÷ ῖᾶᾶᾶ, ἰδῖνᾶβ ἰᾶ ᾶἰᾶᾶᾶ ᾶεεἸᾶᾶ ὀεδ οδοεᾶᾶᾶ Ὑδ ᾶβῖῖᾶ ἰᾶ ὀεδ ÷ ῖς ὀεἰῖδῖεἰᾶᾶᾶ ὀἰᾶ /etc/fstab, ᾶἰᾶβ ᾶεᾶ ὀᾶ ὀἰᾶᾶᾶεὙᾶ ἰῖῖᾶᾶ ὀδοεᾶᾶᾶ. ἈδᾶεᾶΠ ς label ᾶἰς ὀεἰᾶ ὀςῖ ᾶεεἸᾶᾶ ὀἰᾶ ὀᾶᾶᾶᾶᾶ ὀῖᾶ ὀἰο εὙεᾶ δᾶῖᾶ ÷ Ἰᾶ (οδοεᾶᾶᾶ ᾶβῖῖᾶ), ς ᾶεεἸᾶᾶ ᾶεᾶᾶᾶᾶᾶ ἰᾶ ἰᾶᾶ ᾶᾶ ὀςῖ ᾶᾶᾶᾶᾶ ὀςδ οἰο οδοδΠᾶᾶᾶ. × ῖς ὀεἰῖδῖεἰᾶᾶᾶ ᾶᾶᾶ ὀςῖ ᾶεεἸᾶᾶ ὑδ ὑῖῖᾶ ὀδοεᾶᾶᾶ, ἰᾶ ἰδῖνᾶβδᾶ ἰᾶ δῖνῖοᾶᾶᾶᾶᾶ ὀἰᾶ ὀἰ ὀἰᾶᾶᾶ ᾶῖ ÷ ᾶβῖᾶ, Ὑᾶ ÷ ᾶᾶ ἰᾶ ὀἰ δῖᾶᾶᾶᾶᾶ ὑῖῖᾶ ὀδοεᾶᾶᾶ ὀἰο Ἰ ÷ ᾶε ᾶἰᾶᾶᾶ ὀἰᾶ ᾶβῖῖ.

**Οςῖᾶβῖο:** Ἀᾶἰ ÷ ῖᾶεἸᾶᾶᾶ ὀοεεὙ ἰᾶ ὀἰᾶᾶᾶ ὑοε ᾶδδΠ ς ᾶεεἸᾶᾶ ἰᾶ δῖνἸᾶε ἰᾶ ᾶβῖᾶε ἰῖῖᾶ. ὀἰ ᾶἰς ὀεἰᾶ δῖνῖᾶᾶᾶ label ἰδῖνᾶβ ἰᾶ ᾶςῖεἰῖοῖᾶᾶ ὀἰᾶ ἰῖῖᾶᾶ ὀἰᾶ ἰῖῖᾶᾶ ὀἰᾶ ὀἰᾶ δῖνῖοᾶᾶᾶ ᾶεεἸᾶᾶ. ἰῖῖ ἰε ἰῖῖᾶᾶ ᾶεεἸᾶᾶ ᾶεᾶᾶᾶᾶᾶ ἰᾶ ἰᾶᾶᾶ ἰᾶᾶ ᾶᾶ ἰᾶ ᾶᾶᾶᾶᾶ. Ἀᾶβδᾶ ὀς ὀᾶᾶᾶ manual ὀςδ glabel(8) ᾶεᾶ δᾶῖᾶᾶᾶᾶ ὀεᾶᾶᾶᾶ ὀ ÷ ᾶεεὙ ἰᾶ ὀᾶ ᾶβς ὀἰᾶ ᾶεεᾶᾶᾶ.

### 19.6.1 Ἀβς Ἀεεᾶᾶᾶ ἰᾶ ὀᾶᾶᾶᾶᾶᾶ

ὀδὙᾶ ÷ ἰᾶ ᾶἰ ὀἰᾶ ᾶεεᾶᾶᾶ, ς ᾶᾶᾶ ᾶεεἸᾶᾶ ἰᾶ ς ᾶεεἸᾶᾶ ὀδοδΠᾶᾶᾶ ᾶῖ ÷ ᾶβῖᾶ. ἰε ᾶεεἸᾶᾶ ἰδῖνᾶβ ἰᾶ ᾶβῖᾶε δῖνῖοᾶᾶᾶ ὀᾶ ἰῖῖᾶᾶ. ἰε ἰῖῖᾶᾶ ᾶεεἸᾶᾶ ἰδῖνῖᾶ ἰᾶ ᾶςῖεἰῖοῖᾶᾶ ἰᾶ ὀεδ ᾶἰᾶᾶ ὀἰᾶ tunefs(8) Π newfs(8). ὀδςῖ δᾶῖᾶᾶᾶ ᾶδδΠ, ἰᾶ ᾶςῖεἰῖοῖᾶᾶ ὀᾶ Ἰᾶ ὀδῖᾶᾶᾶ ὀἰο /dev. Ἀεᾶ δᾶῖᾶᾶᾶ, ἰε ᾶεεἸᾶᾶ ὀδοεᾶᾶᾶ ὀἰᾶ ὀἰᾶ ὀἰᾶ ᾶῖ ÷ ᾶβῖᾶ UFS2, ἰᾶ ᾶςῖεἰῖοῖᾶᾶ ὀἰᾶ ἰᾶᾶᾶ /dev/ufs. ἰῖῖᾶᾶ ᾶεεἸᾶᾶ ἰδῖνῖᾶ ᾶβῖᾶ ἰᾶ ᾶςῖεἰῖοῖᾶᾶ ἰᾶ ἰᾶ



```
glabel label rootfs /dev/ad0s1a
GEOM_LABEL: Label for provider /dev/ad0s1a is label/rootfs
glabel label var /dev/ad0s1d
GEOM_LABEL: Label for provider /dev/ad0s1d is label/var
glabel label usr /dev/ad0s1f
GEOM_LABEL: Label for provider /dev/ad0s1f is label/usr
glabel label tmp /dev/ad0s1e
GEOM_LABEL: Label for provider /dev/ad0s1e is label/tmp
glabel label swap /dev/ad0s1b
GEOM_LABEL: Label for provider /dev/ad0s1b is label/swap
exit
```

Ç ἄέβἰçóç ἑἄ ὀἰἄ-ἑóðἄῖ ἑἄἰἰἰἑἰ ἑἄἑ ὀἰ ὀγóðçἰἄ ἑἄ Ἰἑἑἄἑ ὀἄ ἑἄóὐóðἄóç ḡἰἑἄḡἑῖ -ἡçóðἑῖ (multi-user). ἰἄóὐ ὀἰ ὀἸἑἰð ὀçð ἄέβἰçóçð, ἄḡἄἰἄἡἄἄóðἄḡἄ ὀἰ ἄἡ-ἄῖἰ /etc/fstab ἑἄἑ ἄἑἑὐἰἰἄ ὀἄ ὀἰἄἄἄἑἑἰ ἰἡἰἰἄἄ ὀóóἑἄḡἑῖ ἰἄ ὀἑð ἄἰḡḡḡἰἑ-ἄð ἄḡἑἑἸḡἄð. Ὀἰ ὀἄἑἑἑἰ ἄἡ-ἄῖἰ /etc/fstab ἑἄ ἡἑὐἄἑἑ ἰἄ ὀἰ ḡἄἡἄἑὐḡ:

| # Device          | Mountpoint | FStype | Options | Dump | Pass# |
|-------------------|------------|--------|---------|------|-------|
| /dev/label/swap   | none       | swap   | sw      | 0    | 0     |
| /dev/label/rootfs | /          | ufs    | rw      | 1    | 1     |
| /dev/label/tmp    | /tmp       | ufs    | rw      | 2    | 2     |
| /dev/label/usr    | /usr       | ufs    | rw      | 2    | 2     |
| /dev/label/var    | /var       | ufs    | rw      | 2    | 2     |

Ἰḡἡἄḡḡἄ ὀḡἡἄ ἰἄ ἄḡἄἰἄἑἑἑἰḡḡḡἄ ὀἰ ὀγóðçἰἄ. Ἀἰ ἡἑἄ ḡḡἄἄἑ ἑἄἑὐ, ç ἄέβἰçóç ἑἄ ἄῖἰἄἑ ἑἄἰἰἰἑῖḡ, ἑἄἑ ç ἄἰḡἰἑḡ mount ἑἄ ἄḡῖἄἑ:

```
mount
/dev/label/rootfs on / (ufs, local)
devfs on /dev (devfs, local)
/dev/label/tmp on /tmp (ufs, local, soft-updates)
/dev/label/usr on /usr (ufs, local, soft-updates)
/dev/label/var on /var (ufs, local, soft-updates)
```

Ἰἄἑἑἡἰḡḡḡἄ ἄḡἡ ὀἰ FreeBSD 7.2, ὀἰ glabel(8) ὀḡἰḡóçἡḡḡḡἄἑ Ἰἰἄ ἰἸἰ ἄḡḡḡḡ ἄḡἑἑἸḡḡḡḡ ἄἑἄ ὀóóðḡἰἄḡḡḡ ἄἡ-ἄḡἡἰ UFS, ḡἰḡ ἄἄóḡḡḡḡḡḡ ὀἄ Ἰἰἄ ἡἡἄἑἄῖἰ ἄἰἄἡἡἡἡἑóðἑἑἑ ὀἰḡð, ὀἰ ufsid. Ἰἑ ἄḡἑἑἸḡḡḡḡ ἄḡðἸḡ ἄἡḡḡἑἡἰḡḡḡ ὀḡἡἰ ἑἄóὐἑἡἡἡ /dev/ufs, ἄçἑἑἰḡἡἡἡἡἡἡἡἡἡ ἄḡḡἡἡἡἡ ἑἄóὐ ὀçἰ ἄἑἑḡḡḡç ὀἰḡ ὀóóðḡἰἄḡḡḡ ἑἄἑ ἄῖἰἄἑ ἄḡἰἄḡἡἡ ἰἄ -ἡçóἑἡἡἡἡἡἡἡἡ ἄἑἄ ὀçἰ ḡἡἡḡḡḡç ἑἄḡἄḡḡḡḡḡḡ ἰἸἡḡ ὀἰḡ /etc/fstab. Ἰḡἡἄḡḡḡ ἰἄ -ἡçóἑἡἡἡἡἡἡἡἡ ὀçἰ ἄἰḡἰἑḡ glabel status ἄἑἄ ἰἄ ἑἸἄḡḡḡ ἰἑἄ ἑḡḡḡḡ ὀἡἡ ὀðóðçἰḡḡḡḡ ἄἡ-ἄḡἡἰ ἰἄ ὀἑð ἄἰḡḡḡḡḡḡ-ἄð ufsid ἄḡἑἑἸḡḡḡḡ ὀἰḡð:

```
% glabel status
Name Status Components
ufs/486b6fc38d330916 N/A ad4s1d
ufs/486b6fc16926168e N/A ad4s1f
```

Ὀἰἡ ḡἄἡἄḡḡḡḡ ḡἄἡἡἄἑἑἡἡ, ὀἰ ad4s1d ἄἰḡἑḡἡἡἡḡḡḡḡ ὀἰ ὀγóðçἰἄ ἄἡ-ἄḡἡἰ /var, ἄḡḡ ὀἰ ad4s1f ἄἰḡἑḡἡἡḡḡḡḡ ὀἰ ὀγóðçἰἄ ἄἡ-ἄḡἡἰ /usr. ×ἡçóἑἡἡἡἡἡἡἡἡ ὀἑð ὀἑἰἸḡ ufsid ḡἰḡ ὀἄḡἡἡἡἡἡἡ, ç ḡἡἡḡḡḡç ἄḡḡἡἡ ὀἡἡ ἑἄḡἄḡḡḡḡḡḡ ἰḡἡἡḡ ἰἄ ἄῖἰἄἑ ἰἄ ὀἑð ḡἄἡἄἑὐḡḡ ἑἄḡḡ-ἡἡḡḡḡḡ ὀḡἡ /etc/fstab:

|                           |      |     |    |   |   |
|---------------------------|------|-----|----|---|---|
| /dev/ufs/486b6fc38d330916 | /var | ufs | rw | 2 | 2 |
| /dev/ufs/486b6fc16926168e | /usr | ufs | rw | 2 | 2 |

Ἰḡἑἑἄḡḡḡḡḡḡ ἑἄóὐḡḡç ἄἑἄἑἸḡḡḡḡ ἄἰἄἡἡἡἡἡἡἡἡἡ ufsid ἰḡἡἡḡḡ ἰἄ ḡἡἡḡἄἡḡḡḡḡḡ ἰἄ ὀἡἡ ḡἄἑἡ ὀἡἡḡἡ, -ἡἡḡḡ ἰἄ ὀḡḡḡḡ-ἄἑ ḡἑἸἡ ἄἰḡḡḡḡ ἰἄ ἄçἑἑἰḡἡḡḡḡḡḡ ἡἡἡἡḡ ἄḡἑἑἸḡḡḡḡ -ἄἑἡἡἡḡḡḡḡ. Ç ḡἡἡḡḡḡç ἰἸἡḡḡ ἄḡἑἑἸḡḡḡḡ ufsid, ḡἄἡἸḡ-ἄἑ ὀἰ ḡἑἄἡἸḡḡḡḡ ὀçð ἄἰἄἡἡḡḡḡḡḡḡ ἄḡἡ ὀἰ ἡἡἡἡ ὀóóἑἄḡḡð, ὀἰ ἰḡἡἡἡ ḡἄἡἸḡ-ἰḡἡ ἑἄἑ ἰἑ ἡἡἡἡḡḡ ἄḡἑἑἸḡḡḡḡ.







ó÷âæάόόâβ æά όç ιὺΆέόόç æãñáειυόçόά äãñŸíιι έάέ οδιδόçñβææέ όδεáιέιυδδδδά (snapshots) äãñŸíιι, ðεεάδêὺ áíôβñáόά έάέ æèñιβóιáόά äêŸã÷ιò äãññŸíιι (checksums). ÷æ æéιιá ðñιόόâεâβ Ÿíá íŸι ιιíóŸει æά όç æέáδΠñçόç áíóεãñὺδουι òι äãññŸíιι, áιιúóδι ùδ RAID-Z. Ὄι ιιíóŸει RAID-Z âβίáέ ðãñιιιέι ιá όι RAID5 æέêὺ âβίáέ ó÷âæάόίŸι ιá ðãñŸ ÷æ ðñιόόáόβá òι äãññŸíιι έάόὺ όç äãñãòΠ òιòδ.

### 20.2.1 Ἀæèóéóιðιβçόç òιò ZFS

Ὄι ðδιδόγόçιá ZFS ÷ñçóειιðιεâβ áñêâóιγð ðñιιòδ όιò óδóóðιáόιð. Ἀæèóéóιðιεðιáόð όéð ñòειβóáéð όιò óδóóðιáόιð óáð, έá áðéóγ÷áð όç ιὺΆέόόç áðιιáιόç óόçι έáεçιáñéιΠ ÷ñΠόç. Έáεðð όι ZFS âβίáέ æéιιá óá ðáεñíáíóééιι óóὺæéι óοι FreeBSD, áðδι βóυð æέêὺíáε ιáεειιðéêὺ. ὸóδιι, æά όçι ðñá, óóιβóóáóáέ ιá æειειòεΠóáðά óá ðãñáέὺδδ ãðιáόá:

#### 20.2.1.1 ΙίΠιç

Ὄι óοιεεéιι ιὺááειò ιίΠιçð όιò óδóóðιáόιð ðñŸðáέ ιá âβίáέ όιòêὺ÷éóιι Ÿíá gigabyte, áñð όι óδιδέóðιáñι ιὺááειò âβίáέ äŸι gigabytes Π έáέ ðãñéóóυòáñι. Ὄá ùέá óá ðãñááâβáιáόá ðιò óáβιιíóáέ äãð, όι óγóóçιá Ÿ÷æ Ÿíá gigabyte ιίΠιçð έáέ Ÿ÷ιòιá áðβóçð äæèóéóιðιεðιáóáέ όéð ñòειβóáéð όιò.

ΙñέóιŸιιέ ÷ñΠóðáð óáβιáóáέ ιá óá έáóáóŸññιòι έáέ ιá έéãυòáñι áðι Ÿíá gigabyte ιίΠιçð, æéêὺ ιá óŸóιειòð ðãñéιñéóιιγð óóóéêêð ιίΠιçð, âβίáέ áñêâóὺ ðéεáíι ιá æçιειòñãçéâβ panic êὺòδι áðι áãñŸ òιñðβι áñááóβáð, áíáéóβáð áιὺíóèççóçð όçð.

#### 20.2.1.2 ΝŸειέόç òιò ðòñΠιá

Ὄóιβóóáóáέ ιá áóáéñŸóáðά óá ðñíãñὺιíáóá ιãβãçóçð έáέ όéð áðéειãŸð ðιò äãí ÷ñçóειιðιεâβðá áðι όι áñ÷âβι ñòειβóáιι όιò ðòñΠιá. Έáεðð ιé ðãñéóóυòáñιé ιãçãñβ óóóéâóðι æéáðβεáíóáέ áðβóçð έáέ óá ιñòΠ áñêñιιὺδουι, ιðñáβðá áðêὺ ιá όιòð òιñðβóáðá ÷ñçóειιðιεðιáóáð όι áñ÷âβι /boot/loader.conf.

Ιé ÷ñΠóðáð όçð áñ÷éóáéòιιέêêð 1386 έá ðñŸðáέ ιá ðñιòéŸíóιòι όçι ðãñáέὺδδ áðéειãΠ óοι áñ÷âβι ñòειβóáιι όιò ðòñΠιá όιòð, ιá όιι áðáíáíáðááεèððóβíοι έáέ ιá áðáíáéééιΠóιòι όι óγóóçιá όιòð:

```
options KVA_PAGES=512
```

Ç áðéειãΠ áððΠ έá æéáðñŸιáέ όçι ðãñéι÷β æéáðéγíóáιι όιò ðòñΠιá, áðéòñŸðιíóáð Ÿóóé όçι áŸιççóç óéιΠð όçð ñòειέóóéêêð ιáðááèççóðð vm.kvm\_size ðŸñá áðι όι òñŸ÷ιι ùñéι όιò 1 GB (2 GB æéá ðòñΠιáð PAE). Ἄέá ιá áñáβðá όçι έáóáéèççéιιðãñç óéιΠ æéá áððΠ όçι áðéειãΠ, æéáéñŸóðά όι áðééóιçóυι ιὺááειò όçð ðãñéι÷βð æéáðéγíóáιι ιá όι ðŸóáñá (4). Ὄόçι ðãñβðδυóç áððΠ, Ÿ÷ιòιá 512 æéá ιὺááειò 2 GB.

#### 20.2.1.3 Νòειβóáéð óóéð ιáóááèççóŸò òιò Loader

Έá ðñŸðáέ ιá áóιçéâβ ç ðãñéι÷β æéáðéγíóáιι kmem óá ùéãð όéð áñ÷éóáéòιιééŸð όιò FreeBSD. Ὄοι äèειáóóééιι ιáð óγóóçιá, ιá Ÿíá gigabyte òðóéêêð ιίΠιçð, âβ÷ãñá áðéóð÷çιŸιí áðιòŸéáóιá ÷ñçóειιðιεðιáóáð όéð æéυειòεãð áðéειãŸð óοι áñ÷âβι /boot/loader.conf έáέ áðáíáéééιΠιáóáð όι óγóóçιá ιáð:

```
vm.kmem_size="330M"
vm.kmem_size_max="330M"
vfs.zfs.arc_max="40M"
vfs.zfs.vdev.cache.size="5M"
```

Ἄέá áíáéòðééιιòáñãð ñòειβóáéð ó÷áðéêêὺ ιá όçι äæèóéóιðιεðιβçόç òιò ZFS, äãβðá όι <http://wiki.freebsd.org/ZFSTuningGuide>.

## 20.2.2 ×ῆςὀεῖἰδῖεῖρὶὸἄὸ ὀῖ ZFS

Ὀδῦῆ÷ἄε Ἰῖἄὸ ἰς÷ἄῖεὶἰἰὸ ἄεἕβῖςὸςδ ὀῖδ ἄδῑῆῆἸῖἄε ὀῖἰ FreeBSD ἰἄ ὀῆῖῑἄῆῖδῖῑἄε ZFS pools εἄὸἸ ὀς ἄεἸῆἄεἄ ὀςδ ἄεἕβῖςὸςδ ὀῖδ ὀδῶδΠῖἄῖῑδ. Ἀῖἄ ἰἄ ὀῖῖ ῆὀε἖βῶἄὀἄ, ἄεἄἄεἸῖῑὀἄ ὀεἄ ἄεἰῖῑῑεἄδ ἄῖῑῑεἸῖ:

```
echo 'zfs_enable="YES"' >> /etc/rc.conf
/etc/rc.d/zfs start
```

Ὀῖ ὀδῖῑῑεἑἑῖ ἄὀῑῖῖ ὀῖδ ἄἄεἑἸῖῖῑ ὀδῖῑεἸῖῑὀἄε ἰῖῑε Ἰῖ÷ἄὀἄ ἄεἄεἸῖῑῑῑῑδ ὀῆἄεδ SCSI ἄβῶεῖῑδ, εἄε ἰῖῑε ὀἄ ῖῖῖῖἄὀἄ ὀδῶεἄὀῖ ὀῖδὀδ ἄβῖἄε da0, da1 εἄε da2. Ἰῖῑῑε ἄεἄεἸῖῑῑῑῑ ἄβῶεῖῑδ IDE εἄ ὀῆἸῖἄε ἰἄ ÷ῆςὀεῖἰδῖεῖρὶῑῑῑ ὀδῶεἄὀἄ ὀῖδ ὀῖῑῑῑ ἄῖῑῑ ἄεἄ ὀεἄ ἄῖῑῑῑῑῑῑ÷ἄδ SCSI.

### 20.2.2.1 Pool ἰἄ ἰἄ ἰῖῖῑ Ἀβῶεῖ

Ἀῖἄ ὀςῖ ἄςῖῑῑῑῑῑῑῑ ἄῖῑῑ ZFS pool ἰἄ Ἰῖἄ ἰῖῖῑ ἄβῶεῖ (÷ἡῆῑδ ἄῖῖἄὀἄὀςὀἄ ἄῖῑ÷ῑδ ὀὀἄε἖Ἰῖὀῖῑ), ÷ῆςὀεῖἰδῖεῖρὶῑῑῑ ὀςῖ ἄῖῑῑῑῑ zpool:

```
zpool create example /dev/da0
```

Ἀῖἄ ἰἄ ἄἄβῶἄ ὀῖ ῖῖῑ pool, ἄῖἄδῖῑὀἄ ὀςῖ Ἰῖῖῑ ὀςδ ἄῖῑῑῑῑῑ df:

```
df
Filesystem 1K-blocks Used Avail Capacity Mounted on
/dev/ad0s1a 2026030 235230 1628718 13% /
devfs 1 1 0 100% /dev
/dev/ad0s1d 54098308 1032846 48737598 2% /usr
example 17547136 0 17547136 0% /example
```

ῒ Ἰῖῑῑῑ ἄὀδῑ ἄἄβ÷ῖἄε εἄεἄῆἸῖ ἰῖῑε ὀῖ example pool ἰ÷εῖ ἰῖῖῑ Ἰῖ÷ἄε ἄςῖῑῑῑῑῑῑῑῑ, ἄεἑἸῖ Ἰῖ÷ἄε ἄδῑῑῑδ ὀῆῖῑῑῑῑῑῑῑῑ ἄεἰῑῑῑῑ. Ἀβῖἄε ἄδῑῑῑδ ἄεἄεἸῖῑῑῑ ἰῖ ἄῖῖῖῑῑῑ ὀῖῑῑῑῑῑ ἄῆ÷ἄβὺἰ, ἰδῖῖἄβῶἄ ἰἄ ἄςῖῑῑῑῑῑῑῑῑῑῑ ἄῆ÷ἄβἄ ὀἄ ἄὀἄ, εἄε Ἰῖῑῑῑ ἄῆῑῑῑῑῑῑῑῑ ἄδῑῑῑδ ἰἄ ὀῖ ἄῖῑῑ, ἰῖῑῑ ὀἄβῖῖῑῑῑῑ ὀῖῑ ὀἄῆἄεἸῖὀἄ ὀἄῆἸῖἄἄεῖῑῑ:

```
cd /example
ls
touch testfile
ls -al
total 4
drwxr-xr-x 2 root wheel 3 Aug 29 23:15 .
drwxr-xr-x 21 root wheel 512 Aug 29 23:12 ..
-rw-r--r-- 1 root wheel 0 Aug 29 23:15 testfile
```

Ἀὀδῶὀ÷ῑδ ἄὀἄ ὀἄὀἄ ὀῖ pool ἄἄῖ ÷ῆςὀεῖἰδῖεῖρὶῑῑ ἄἸῑῑῑῑ ἄὀἄ ὀἄ ὀεἄῖῖἄἄὀἄὀἄὀἄ ὀῖδ ZFS. Ἀςῖῑῑῑῑῑῑῑῑ Ἰῖἄ ὀῖῑῑῑῑῑ ἄῆ÷ἄβὺἰ ὀἄ ἄὀἄ ὀῖ pool εἄε ἄῖῖῖῑῑῑῑῑῑῑ ὀἄ ἄὀἄ ὀς ὀῖῑῑῑῑῑ:

```
zfs create example/compressed
zfs set compression=gzip example/compressed
```

Ὀῖ ὀῖῑῑῑῑῑ ἄῆ÷ἄβὺἰ example/compressed ἄβῖἄε δῑεἸῖ Ἰῖἄ ὀῖῑῑῑῑῑῑῑῑῑ ZFS ὀῖῑῑῑῑῑ. Ἀῖῑῑῑῑῑ ἰἄ ἄῖῑῑῑῑῑῑῑῑ ἰἄῆῑῑῑ ἰἄἄἸῖἄ ἄῆ÷ἄβἄ ὀἄ ἄὀἄ, ἄὀἄὀἄἄὀἄ ὀῖῑῑ ἄἄὸἸῖῑῑῑ /example/compressed.

Ἰῖῖῑῑῑῑ ὀῖῑῑ ἰἄ ἄὀἄῖῖῑῑῑῑῑῑῑῑ ὀς ὀῖῑῑῑῑῑ ἄῆἸῖῑῑῑῑ:

```
zfs set compression=off example/compressed
```

Άέα ίά άδιθñιόάνδΠόάδ ή ούόόγια άñ÷άβυί, άεόάεΎόά όζι άεüειδές άίόιεΠ έάε άδάεçέάγούά ή άδιθΎεάόιά ιΎού ήθ ό äiççèçóééíγ δñiñÜñiáðìð df:

```
zfs umount example/compressed
df
Filesystem 1K-blocks Used Avail Capacity Mounted on
/dev/ad0s1a 2026030 235232 1628716 13% /
devfs 1 1 0 100% /dev
/dev/ad0s1d 54098308 1032864 48737580 2% /usr
example 17547008 0 17547008 0% /example
```

ΔñiιόάνδΠόάδ ήάίÜ ή ούόόγια άñ÷άβυί, ήόά ή άβιάε έάε δÜέε δñiιáÜóéiι, έάε άδάεçέάγούά ή ÷ñçóéiιδiέήiόά üðùð έάε δñéi, όζι άίόιεΠ df:

```
zfs mount example/compressed
df
Filesystem 1K-blocks Used Avail Capacity Mounted on
/dev/ad0s1a 2026030 235234 1628714 13% /
devfs 1 1 0 100% /dev
/dev/ad0s1d 54098308 1032864 48737580 2% /usr
example 17547008 0 17547008 0% /example
example/compressed 17547008 0 17547008 0% /example/compressed
```

Ìðiñáβòä äδβόçð ή άάβòä ή pool έάε ή ούόόγια άñ÷άβυί ήάòδÜäiιiόάð όζι Ύñiäi όçò άίόιεΠð mount:

```
mount
/dev/ad0s1a on / (ufs, local)
devfs on /dev (devfs, local)
/dev/ad0s1d on /usr (ufs, local, soft-updates)
example on /example (zfs, local)
example/data on /example/data (zfs, local)
example/compressed on /example/compressed (zfs, local)
```

¼ðùð δañáóçñiγiá, ή ούόόγια άñ÷άβυί ZFS ìðiñáβ ή ÷ñçóéiιdιέçέáβ ùð éiéüü ούόόγια άñ÷άβυί iáðÜ όç äçiéiðñáβá ήθ. Üóóúí, áεάεΎόάε δiεεΎð áεüiá εάεóìòñáβàð. Όðí δañáéÜòù δañÜäéäiä äçiéiòñäiγiá Ύiá iΎi ούόόγια άñ÷άβυί, ήí data. έά άδιεçέáγúíòiä όçiáíóééÜ ääññΎiá óä áððü, έάε Ύóóé ήí ñèèiβæiðiä ήόά ή έñáðÜäé äγi áiðβāñáóä áðü éÜèä ìðéiè ääññΎiüí:

```
zfs create example/data
zfs set copies=2 example/data
```

Ìðiñiγiá ðήñá ή äiγiá óä ääññΎiá έάε όζι έáóáíÜéüòç ÷ήñið äβñiíðáð ήάíÜ όζι άίόιεΠ df:

```
df
Filesystem 1K-blocks Used Avail Capacity Mounted on
/dev/ad0s1a 2026030 235234 1628714 13% /
devfs 1 1 0 100% /dev
/dev/ad0s1d 54098308 1032864 48737580 2% /usr
example 17547008 0 17547008 0% /example
example/compressed 17547008 0 17547008 0% /example/compressed
example/data 17547008 0 17547008 0% /example/data
```

Διαγράψτε τον χώρο που έχει δημιουργηθεί με τον ακόλουθο τρόπο:

```
zfs destroy example/compressed
zfs destroy example/data
zpool destroy example
```

Εάν θέλετε να διαγράψετε τον χώρο που έχει δημιουργηθεί με τον ακόλουθο τρόπο:

```
zfs destroy example/compressed
zfs destroy example/data
zpool destroy example
```

Εάν θέλετε να διαγράψετε τον χώρο που έχει δημιουργηθεί με τον ακόλουθο τρόπο:

### 20.2.2.2 ZFS RAID-Z

Εάν θέλετε να διαγράψετε τον χώρο που έχει δημιουργηθεί με τον ακόλουθο τρόπο:

```
zpool create storage raidz da0 da1 da2
```

**Όχι! Προσοχή:** Ο Sun ορίζει τον χώρο που έχει δημιουργηθεί με τον ακόλουθο τρόπο:

Εάν θέλετε να διαγράψετε τον χώρο που έχει δημιουργηθεί με τον ακόλουθο τρόπο:

```
zfs create storage/home
```

Εάν θέλετε να διαγράψετε τον χώρο που έχει δημιουργηθεί με τον ακόλουθο τρόπο:

```
zfs set copies=2 storage/home
zfs set compression=gzip storage/home
```

Εάν θέλετε να διαγράψετε τον χώρο που έχει δημιουργηθεί με τον ακόλουθο τρόπο:

```
cp -rp /home/* /storage/home
rm -rf /home /usr/home
ln -s /storage/home /home
ln -s /storage/home /usr/home
```

Όά αάαñÝίá òùι ÷ñçóðñí èá áðñèçεάÿííóáé ðññá òùι íÝí óγóóçίá áñ÷άβùι /storage/home. Άέá ίá òι áðáεçεáÿóáðá, áçίεíðñãðóáá Ýίá íÝí ÷ñΠóðç èáé áέóÝεèάðá òùι óγóðçίá ίá òι íÝí εíñáñέáóùι.

ΆίεέιÛóðá ίá áçίεíðñãðóááá Ýίá òéáιέúðòðñ (snapshot) òùι íðñβι èá ίðññáðá ίá áðáíÝεèάðá áñáùðáñá:

```
zfs snapshot storage/home@08-30-08
```

Όçίáεðóðá ùé ç áðéεíáΠ áçίεíðñãáð òéáιέúðòðñ èáέóíðñááβ ίùíí òá ðñááíáðééú óγóóçίá áñ÷άβùι, èáé ù÷έ òá εÛðñίεí ίáíñùιÝíí èáðÛεíáí Π áñ÷άβι. Ì ÷áñáέòðñáð @ ÷ñçóέíιðñέáβðáé ùò áέá÷ññέóðééú ίáðáíÝ òιò òóðóðñáðιò áñ÷άβùι èáé òιò ίñùíáðιò òùιιò. Άί èáðáóðñáóáβ ι èáðÛεíáíò ááαñÝíúι εÛðñίεíò ÷ñΠóðç áðñέáóáðóðóðá òñι ίá òçί áίðñεΠ:

```
zfs rollback storage/home@08-30-08
```

Άέá ίá ááβðá ίéá εβóðá òùι áέáéÝóέιñι òéáιέúðòðñ, áέðáéÝóðá òçί áίðñεΠ ls òùιí èáðÛεíáí .zfs/snapshot òιò òóðóðñáðιò áñ÷άβùι. Άέá ðáñÛááέáíá, áέá ίá ááβðá òι òéáιέúðòðñ ðñó áçίεíðñãðóáíá ðñιçáíòιÝíò, áέðáéÝóðá òçί ðáñáéÛòù áίðñεΠ:

```
ls /storage/home/.zfs/snapshot
```

Άβίáé áðίáðùι ίá áñÛðáðá εÛðñίεí script ðñó ίá áçίεíðñãáβ ιçίέáβá òéáιέúðòðñ òùι ááαñÝíúι òùι ÷ñçóðñí. Ûððùòι, ίá òçί ðÛñíáí òιò ÷ññùíò, òá òéáιέúðòðñ èá èáðáíáεðñóíòι ίááÛεí ðñιóíòù òιò ÷ññιò òòι áβóει. Ìðññáβðá ίá áέáαñÛðáðá òι ðñιçáíÿíáñι òéáιέúðòðñ ÷ñçóέíιðñέðñáð òçί ðáñáéÛòù áίðñεΠ:

```
zfs destroy storage/home@08-30-08
```

Άáι òðÛñ÷áé èúáíò, ίáðÛ áðù ùéáð áðóÝð òéð áíεέíÝð, ίá èñáððñóíòιá òι /storage/home òóçί ðáñíÿóá èáðÛóðáóç òιò. ÌáðáðñÝððá òι òùι ðñááíáðééú óγóóçίá áñ÷άβùι /home:

```
zfs set mountpoint=/home storage/home
```

×ñçóέíιðñέðñáð òéð áίðñεÝð df èáé mount èá áñÿíá ùéé òι óγóóçίá ÷áεñβæáðáé ðεÝíí áðòù òι óγóóçίá áñ÷άβùι ùò òι ðñááíáðééú /home:

```
mount
/dev/ad0s1a on / (ufs, local)
devfs on /dev (devfs, local)
/dev/ad0s1d on /usr (ufs, local, soft-updates)
storage on /storage (zfs, local)
storage/home on /home (zfs, local)
df
```

| Filesystem   | 1K-blocks | Used    | Avail    | Capacity | Mounted on |
|--------------|-----------|---------|----------|----------|------------|
| /dev/ad0s1a  | 2026030   | 235240  | 1628708  | 13%      | /          |
| devfs        | 1         | 1       | 0        | 100%     | /dev       |
| /dev/ad0s1d  | 54098308  | 1032826 | 48737618 | 2%       | /usr       |
| storage      | 26320512  | 0       | 26320512 | 0%       | /storage   |
| storage/home | 26320512  | 0       | 26320512 | 0%       | /home      |

Άáð ðñέεçññίáðáé ç ñÿèιέóç òιò RAID-Z. Άέá ίá áÝ÷áðá áίáññÝð èáðÛóðáóçð ò÷áðééÛ ίá òá òóðóðñáðá áñ÷άβùι èáðÛ òç ίðéðáñέíΠ áέðÝéáóç òιò periodic(8), áðóðá òçί ðáñáéÛòù áίðñεΠ:

```
echo 'daily_status_zfs_enable="YES"' >> /etc/periodic.conf
```

### 20.2.2.3 Αίτια του RAID-Z

Εάν η κατάσταση του RAID-Z είναι κακή, τότε ο διαχειριστής μπορεί να διαπιστώσει το πρόβλημα, εφόσον ο ZFS έχει διαβάσει τα δεδομένα. Η κατάσταση του RAID-Z μπορεί να είναι κακή λόγω του RAID-Z ή του ZFS:

```
zpool status -x
```

Αν όλα τα pools είναι υγιή, τότε η κατάσταση είναι καλή, όπως φαίνεται παρακάτω:

```
all pools are healthy
```

Αν η κατάσταση του RAID-Z είναι κακή, τότε ο διαχειριστής μπορεί να διαπιστώσει το πρόβλημα, εφόσον ο ZFS έχει διαβάσει τα δεδομένα. Η κατάσταση του RAID-Z μπορεί να είναι κακή λόγω του RAID-Z ή του ZFS:

```
pool: storage
state: DEGRADED
status: One or more devices has been taken offline by the administrator.
Sufficient replicas exist for the pool to continue functioning in a
degraded state.
action: Online the device using 'zpool online' or replace the device with
'zpool replace'.
scrub: none requested
config:
```

| NAME    | STATE    | READ | WRITE | CKSUM |
|---------|----------|------|-------|-------|
| storage | DEGRADED | 0    | 0     | 0     |
| raidz1  | DEGRADED | 0    | 0     | 0     |
| da0     | ONLINE   | 0    | 0     | 0     |
| da1     | OFFLINE  | 0    | 0     | 0     |
| da2     | ONLINE   | 0    | 0     | 0     |

```
errors: No known data errors
```

Οι αιτίες του RAID-Z είναι η κατάσταση του RAID-Z ή του ZFS. Η κατάσταση του RAID-Z μπορεί να είναι κακή λόγω του RAID-Z ή του ZFS. Η κατάσταση του ZFS μπορεί να είναι κακή λόγω του ZFS ή του RAID-Z.

```
zpool offline storage da1
```

Η κατάσταση του RAID-Z μπορεί να είναι κακή λόγω του RAID-Z ή του ZFS. Η κατάσταση του ZFS μπορεί να είναι κακή λόγω του ZFS ή του RAID-Z. Η κατάσταση του RAID-Z μπορεί να είναι κακή λόγω του RAID-Z ή του ZFS.

```
zpool replace storage da1
```

Αν όλα τα pools είναι υγιή, τότε η κατάσταση είναι καλή, όπως φαίνεται παρακάτω:

```
zpool status storage
pool: storage
state: ONLINE
scrub: resilver completed with 0 errors on Sat Aug 30 19:44:11 2008
config:
```

| NAME    | STATE  | READ | WRITE | CKSUM |
|---------|--------|------|-------|-------|
| storage | ONLINE | 0    | 0     | 0     |

```
raidz1 ONLINE 0 0 0
 da0 ONLINE 0 0 0
 da1 ONLINE 0 0 0
 da2 ONLINE 0 0 0
```

errors: No known data errors

¼δουδ οάβιάδσάε οοί δάνΰάεάιá, οά δΰίόá οάβιάδσάε ίá εάεοιõñáíýí οοόεíεíáεΰ.

### 20.2.2.4 ΆδσάεΠεάδός ΆáññÝíυί

¼δουδ áíáσÝñáíá δñίçáíõìÝíυδ, οί ZFS ÷ñçóεííδiεάβ checksums (áεññíβóíáδóá áεÝã÷íõ) áεá ίá áδáεçεάýóáε οçί áεáñáεúδçóá ουί áδiεçεáσìÝíυí áááññÝíυí. Óá áεññíβóíáδóá áεÝã÷íõ áíáñáñiδiεíýíδóá áδóυíáδóá εáδΰ οçί áçíεíõñáβá ουί οδóδçíΰδουί áñ÷άβυί, εáε ίδññíýí ίá áδáíáñáñiδiεçεíýí íÝóυδ οçδ áδυíáíçδ áíδiεΠδ:

```
zfs set checksum=off storage/home
```

Άδóυ ááí áβίáε ááíεεΰ εάεΠ εáÝá, εάεΠδ οá checksums εáδóáεáíáΰíυí áεΰ÷εóοí áδiεçεáδóεéυ ÷πñí, εáε áβίáε δiεý δεí ÷ñΠσέíí ίá οá Ý÷íõíá áíáñáñiδiεçíÝíá. Άδβóçδ ááí οάβιάδσάε ίá δññiεáεíýí εΰδiεá οçíáíδεεΠ εáεδóδÝñçόç Π áδεáΰñδiόç. Íá οá checksums áíáñáñiδiεçíÝíá, ίδññíýíá ίá æçδΠσiόíá áδυ οí ZFS ίá áεÝãíáε οçί áεáñáεúδçóá ουί áááññÝíυí ÷ñçóεííδiεΠδóδ óá áεá áδáεΠεάδός. Ç áεááεéáóβá áδδΠ áβίáε áíυóδΠ υδ “scrubbing.” Άεá ίá áεÝãíáδá οçί áεáñáεúδçóá áááññÝíυí δiõ pool storage, ÷ñçóεííδiεΠδóδ οçί δáñáεΰδου áíδiεΠ:

```
zpool scrub storage
```

Ç áεááεéáóβá áδδΠ ίδññáβ ίá δΰñáε áñεáδΠ πñá, áíΰεíáá ίá οçί δióυδçóá ουί áδiεçεáσìÝíυí áááññÝíυí. Άδβóçδ ÷ñçóεííδiεάβ δΰñá δiεý οí áβóεí (I/O), ουí πóδá οá εΰεá áááññÝíç óδεáñΠ ίδññáβ ίá áεδóáεáβδóá ίυíí iεá δÝδiεá áεááεéáóβá. Íáδΰ οçί iεíεεΠñυδç δiõ scrub, εá áíáíáυδεáβ εáε ç áíáçíñΰ εáδΰδóδóçδ, οçί iδñíá ίδññáβδá ίá ááβδá æçδΠδiόδ οçί íá οçί δáñáεΰδου áíδiεΠ:

```
zpool status storage
```

```
pool: storage
state: ONLINE
scrub: scrub completed with 0 errors on Sat Aug 30 19:57:37 2008
config:
```

| NAME    | STATE  | READ | WRITE | CKSUM |
|---------|--------|------|-------|-------|
| storage | ONLINE | 0    | 0     | 0     |
| raidz1  | ONLINE | 0    | 0     | 0     |
| da0     | ONLINE | 0    | 0     | 0     |
| da1     | ONLINE | 0    | 0     | 0     |
| da2     | ONLINE | 0    | 0     | 0     |

errors: No known data errors

Óοí δάνΰάεάíá ίáδ áíóáíβæáδóáε εáε ç ÷ññiεεΠ óδεáñΠ δiõ iεíεεçñπεçεá ç áíδiεΠ scrub. Ç áδiáδουδçóá áδδΠ ίáδ áíáδóáεβæáε áεáñáεúδçóá áááññÝíυí óá íááΰεí áΰεíδ ÷ññíυδ.

Óδΰñ÷íõí δiεεÝδ áευíá áδεéíáÝδ áεá οí óýδóçíá áñ÷άβυί Å. Άáβδá δεδ óáεβááδ manual zfs(8) εáε zpool(8).





**Ó÷Pιά 21-1. ἸñāÜíúç ὈίYíúçò**

| Disk 1 | Disk 2 | Disk 3 | Disk 4 |
|--------|--------|--------|--------|
| 0      | 6      | 10     | 12     |
| 1      | 7      | 11     | 13     |
| 2      | 8      |        | 14     |
| 3      | 9      |        | 15     |
| 4      |        |        | 16     |
| 5      |        |        | 17     |

ἰάδ ἀíáεάέδóεéυδὸ ὀñúδἰδὸ ἀδἰεPεάδóçð, ἀβίáέ ἰά ÷ ùñέóðâß ç ðññεί÷P äéäðéYíóáúí ὀá ἰέéñúðáñá òἰPιάðá βóἰῶ ἰááYείῶδὸ ὀá ἰδἰβá ἰá ἀδἰεçéáYíῶáé ὀáéñéáéÜ ὀá äéäῶññáðééYð ὀðóéáðYð. Ἄέá ðññÜááéáἰá, ἰé ðñpῶἰé 256 ὀññâð ἰðññâß ἰá ἀβίáέ ἀδἰεçéáðἰYíé ὀðἰí ðñpῶἰ ἀβóεἰ, ἰé ἀðúññἰé 256 ὀðἰí ἀðúññἰ ἀβóεἰ, é.í.é. ἸáðÜ ὀçἰ ÷ñPóç éáé ὀἰῶ ὀáéäððáβἰð ἀβóεἰð, ç äéááééáðá äðáἰáéáἰáÜἰáðáé ἰY÷ñé ἰá äñἰβóἰῶἰ úeἰé ἰé ἀβóεἰé. ἌððP ç ἰYείἰἰð ἰññÜæáðáé *striping* P RAID-0. <sup>1</sup> Ὀἰ striping áðáéðâß éÜðúð ðññέóðúðáñç ðññἰðÜéáéá äéá ὀἰí ἀἰἰἰðéóἰἰ òñἰ äáññYíúἰ éáé ἰðññâß ἰá ðññéáéYῶáé ἰáááéYῶáñἰ ὀññðβἰ I/O úðáἰ ἰéá ἰáðáῶἰñÜ éáðáἰYἰáðáé ὀá ðἰeéáðéἰYð ἀβóεἰῶð, äééÜ áðú ὀçἰ Üééç äðéððá÷ Üἰáé ἰáááéYῶáñἰ ὀðáéáñú ὀññðβἰ ὀá éÜéá ἀβóεἰ. Ὀἰ Ó÷Pιά 21-2 äâß÷ἰáé ὀç ὀáéñÜ ἰá ὀçἰ ἰðἰβá ÷ñçóéñἰðἰéYíῶáé ἰé ἰññÜáðð ἀδἰεPεάδóçð ὀá ἰéá ἰññÜíúç ðYðἰð stripe.

**Ó÷Pιά 21-2. Striped Organization**

| Disk 1 | Disk 2 | Disk 3 | Disk 4 |
|--------|--------|--------|--------|
| 0      | 1      | 2      | 3      |
| 4      | 5      | 6      | 7      |
| 8      | 9      | 10     | 11     |
| 12     | 13     | 14     | 15     |
| 16     | 17     | 18     | 19     |
| 20     | 21     | 22     | 23     |



έαοῦ ὁγι áíṰáíυόç. Áí Ḳíáò äβóειò ÷ äέṰóáε, ç ὀδóοίε ÷ Βά áíáειῖειòεäβ íá εάέοῖῖñāāβ óá äεάòòùḲίç (degraded) éáòṰóόάόç: ç áíṰáíυόç áδṡ òῖòð äβóειòð ðῖò εάέοῖῖñáῖῖ éáῖῖéέṰ óóíá ÷ Βæáόáé áðñῖæçἰṰóέόóá, áεεṰ ç áíṰáíυόç äāññḲíúῖ ðῖò äñβóειῖóáí óóῖῖ ðñῖæçἰáóééú äβóει ðñḲáé íá äðáíáṡðῖῖæéóóäβ ïá äṰóç óá áíóβóóίε ÷ á ἰðειé éóῖῖειΒáð ðῖò äñβóειῖóáé óá ùειòð ðῖòð Ṱεειòð äβóειòð.

## 21.5 Αίόέεäβιáíá òῖò Vinum

Ἀέα ὁγι áíóειäòððέόç òῖῖ ðāñáðṰṰú ðñῖæçἰṰóùῖ, òῖ Vinum òειῖðíεäβ íεá éāñāñ ÷ Βά áíóέéäειḲíúῖ óáóóṰññῖ äðéðḲáúῖ:

- Õῖ ðεḲῖ ἦñáòú áíóέéäβιáñ äβιáé ῖ äέειῖééúð äβóειò, ῖ ἰðῖβῖò εάεäβóáé éáé òùῖò (*volume*). Ἰέ òùῖé Ḳ ÷ ῖóῖ ῖóóéáóóééṰ óéð Βæéäð éáéúòçòäð ïá Ḳíá äβóειῖ òῖò UNIX, áí éáé òðṰñ ÷ ῖóῖ éṰðῖéáð íééñḲ ÷ äéáóῖñḲ. Äáῖ òðṰñ ÷ ῖóῖ ðñéῖñéóῖῖβ ṡóῖ äóῖñṰ òῖ ῖḲāáειò ðῖòð.
- Ἰέ òùῖé äðῖäειῖῖóáé áδṡ *plex*, éáé éṰεä Ḳíá áδṡ áòòṰ áíóéðñῖóúððáγáé òῖ òðῖῖééú ÷ þñῖ äéäðéγῖóáúῖ áṡúð òùῖò. Áðòú òῖ äðβðāῖ óðçἰ éāñāñ ÷ Βά ðāñḲ ÷ äé ὁç äóῖáóúðçðá redundancy. Ἰðññáβðá íá óéäòðäβðá òá plex ùò ïáῖῖñṰḲíῖòð äβóειòð óá íεá óóóóίε ÷ Βά mirror, ṡðῖò éṰεä Ḳíá ðāñéḲ ÷ äé òá Βæéá äāññḲíá.
- Éáεðð òῖ Vinum òðṰñ ÷ äé ῖḲóá óóῖ ðεáβóεί éáέοῖῖñāéῖ òῖò UNIX ðῖò ÷ ñçóειῖðῖῖεäβóáé äéá ὁçἰ äðῖεðéäðóç óá äβóειòð, éá ἰðῖñῖῖóá íá ÷ ñçóειῖðῖῖεðóáé óéð éáóáòῖðóáéð òῖò UNIX ùò òῖ äñééú óóίε ÷ äβῖ äéá ὁç äçἰéῖῖñāβá òúῖ plex. Óðçἰ ðñāáἰáóééúðçðá, ç ῖῖæéðð áðòðð äðῖäééῖḲíáóáé éáéäβðāñá ðñéῖñéóóééð: íé äβóειé óóῖ UNIX ἰðῖñῖῖ íá Ḳ ÷ ῖóῖ ðñéῖñéóῖῖ Ḳíú äñééῖú éáóáòῖðóáúῖ. Áíóβæäðá, òῖ Vinum òðῖῖæéññáβ íεá ἰúῖῖ éáòṰðἰçóç òῖò UNIX (òῖῖ ῖäçäú) óá óóῖá ÷ ṡἰáíáð ðñéῖ ÷ Ḳ ðῖò éáéῖῖῖóáé òðῖῖäβóéῖé (*subdisks*). Ἰέ òðῖῖäβóéῖé ÷ ñçóειῖðῖῖεῖῖῖóáé ùò òá äñééṰ óóίε ÷ äβá äéá òá plex.
- Ἰέ òðῖῖäβóéῖé äñβóειῖóáé óá ῖäçäῖḲíð Vinum, ðῖò ὁç äāññḲίç óðéäῖð äβιáé éáóáòῖðóáéð òῖò UNIX. Ἰέ ῖäçäῖβ òῖò Vinum ἰðῖñῖῖ íá ðñéḲ ÷ ῖóῖ ῖðῖῖεῖäβðῖòä äñééῖú áδṡ òðῖῖäβóειòð. Ἰá áíáβñáóç íεá íééñð ðñéῖ ÷ ð óðçἰ áñ ÷ ð òῖò äβóειò (ç ἰðῖβá ÷ ñçóειῖðῖῖεäβóáé äéá ὁçἰ äðῖεðéäðóç äāññḲíúῖ ñγείéóçð éáé éáòṰóόáóçð) ṡειò ῖ òðṡεῖðῖò ῖäçäῖ ðñῖéé Ḳéé ḲééḲéäðóç äāññḲíúῖ.

Ἰé ðñāñéṰòð áṡúðçðáð ðñééñṰῖóῖῖ òῖῖ ðñṡῖ ἰá òῖῖ ἰðῖβῖ áòòṰ óá áíóέéäβιáíá ðāñḲ ÷ ῖóῖ ὁçἰ éáέοῖῖñāééúðçðá ðῖò äðáéðäβóáé áδṡ òῖ Vinum.

### 21.5.1 ἸḲāáειò Õùῖò

Óá plex ἰðῖñῖῖ íá ðñééáἰäṰῖóῖ ðῖῖεáðéῖḲíð òðῖῖäβóειòð, ðῖò éáóáῖḲíúῖóáé óá ṡειòð òῖòð ῖäçäῖð òῖò Vinum. Óáἰ äðῖòḲéáóíá, òῖ ῖḲāáειò áṡúð óóäéäñéῖḲíῖ ðñῖ äβóειò äáῖ ðñéῖñβæé òῖ ῖḲāáειò ῖγðá òῖò plex, ῖγðá òῖò òùῖò.

### 21.5.2 ðéäῖῖṰæῖöóá (Redundant) Äðῖεðéäðóç ÄāññḲíúῖ

Õῖ Vinum òειῖðíεäβ òῖ mirroring ðñῖóáñðῖῖóáð ðῖῖεáðéṰ plex óá Ḳíá òùῖ. ÉṰεä plex äβιáé íεá áíáðāñṰóόáóç òúῖ äāññḲíúῖ áṡúð òùῖò. ἰáð òùῖòð ἰðῖññáβ íá ðñéḲ ÷ äé ἰáóáῖḲíúῖ éáé ῖéðð plex.

Áí éáé Ḳíá plex áíóéðñῖóúððáγáé óá ðεðñç äāññḲíá áṡúð òùῖò, äβιáé ðééáῖῖῖ éṰðῖéá ῖḲñç ὁçð áíáðāñṰóόáóçð íá éäβðῖóῖ áδṡ òῖ óóóéú ῖḲῖ, äβðá äðáéäð Ḳ ÷ äé ó ÷ äæéáóóäβ ïá áòòú òῖ ðñṡῖ (áí äáῖ Ḳ ÷ äé ῖñéóóäβ òðῖῖäβóειò äéá éṰðῖéá òῖðῖáóá òῖò plex) ð áδṡ ðñṡæçἰá (ùò äðῖòḲéáóíá ὁçð äðῖòð ÷ Βáð éṰðῖéῖò äβóειò). ¼óῖ òðṰñ ÷ äé òῖòéṰ ÷ éóóῖῖ Ḳíá plex ðῖò ἰðῖññáβ íá ðñḲ ÷ äé òá äāññḲíá äéá ὁçἰ ðεðñç ðñéῖ ÷ ð äéäðéγῖóáúῖ òῖò òùῖò, ῖ òùῖòð äβιáé ðεðññðð éáέοῖῖñāééúð.

### 21.5.3 ἘΎίαόά Ἀδὺαῖόçð

Ὀῖ Vinum δέῖδῖέαβ δὺοῖ ὀοῖΎῖούç ùοῖ έάέ striping ὀά ἀδβδᾶῖ plex:

- ἴά plex ὀοῖΎῖούçð (concatenated) ÷ ñçόείῖδῖέαβ ὀçῖ δᾶñεί ÷ ð ᾶέαδὲΎῖόαὺῖ εὐέᾶ ὀδῖᾶβόέῖῃ ἰᾶ ὀç ὀάέñṼ.
- ἴά striped plex ᾶñṼὀᾶέ ὀᾶ ᾶᾶñΎῖᾶ ὀᾶ εὐñβᾶᾶð (stripes) δῖῃ έᾶόᾶΎῖῖῖὀᾶέ ὀᾶ εὐέᾶ ὀδῖᾶβόέῖ. ¼έῖῖ ἰέ ὀδῖᾶβόέῖῃ δñΎδᾶέ ἰᾶ Ύ ÷ ῖοῖ ὀῖ βᾶεί ἰΎᾶᾶῖῃ έᾶέ δñΎδᾶέ ἰᾶ ὀδṼñ ÷ ῖοῖ ὀῖῃεṼ ÷ έόὀῖ ᾶΎῖ ὀδῖᾶβόέῖῃ, ᾶέᾶ ἰᾶ ἰᾶ ÷ ùñβᾶῖῃ ὀᾶ ὀ ÷ Ṽόç ἰᾶ ὀῖ plex ὀοῖΎῖούçð.

### 21.5.4 Ἀβᾶç ἸñᾶṼῖούçð Plex

Ç Ṽέᾶῖόç ὀῖῃ Vinum δῖῃ δᾶñΎ ÷ ᾶόᾶέ ἰᾶ ὀῖ FreeBSD 8.1 δέῖδῖέαβ ᾶΎῖ ᾶβᾶç plex:

- Ὀᾶ plex ὀοῖΎῖούçð δñῖὀὀΎῖῖὀῖ ὀç ἰᾶᾶᾶέΎὀᾶñ ᾶὀᾶᾶείβᾶ: ἰδῖῖῖῖῖ ἰᾶ δᾶñέΎ ÷ ῖοῖ ῖδῖῖᾶβδῖῖὀᾶ ᾶñέῖῖῖ ὀδῖᾶβόέῖῃ, έᾶέ ἰέ ὀδῖᾶβόέῖῃ ᾶὀὀῖβ ἰδῖῖᾶβ ἰᾶ ᾶβῖᾶέ ᾶέᾶὀῖñᾶὀέῖῖῖ ἰᾶᾶΎῖῖὀὀ. Ὀῖ plex ἰδῖῖᾶβ ἰᾶ ᾶδᾶέὀᾶᾶᾶβ δñῖὀὀΎῖῖὀᾶὀᾶ δᾶñέὀὀὀὀᾶñῖὀὀ ὀδῖᾶβόέῖῃ. ×ñᾶέṼᾶῖῖὀᾶέ έᾶᾶὀὀᾶñῖ ÷ ñṼῖῖ CPU ὀᾶ ὀ ÷ Ṽόç ἰᾶ ὀᾶ stripes, ᾶῖ έᾶέ ç ᾶέᾶὀῖñṼ ὀὀç ÷ ñβὀç ὀçð CPU ᾶᾶῖ ᾶβῖᾶέ ἰᾶὀñβὀῖῃ. ἈδṼ ὀçῖ Ṽέῖç ἰᾶñέṼ, ᾶβῖᾶέ δῖῖ ᾶδῖῖñᾶδβ ὀᾶ ἰç-έὀῖñῖῖὀçῖῖΎῖῃ έᾶέὀῖñᾶβᾶ, Ṽδῖῃ Ṽῖᾶὀ ᾶβὀῖῃ ᾶβῖᾶέ δῖῖῖ ᾶῖᾶñᾶὀὀ έᾶέ ἰέ ὀδṼῖῖῖῖῖῖῖ ᾶᾶᾶῖῖῖ.
- Ὀῖ ἰᾶᾶᾶέΎὀᾶñῖ δῖᾶῖῖΎῖὀçῖᾶ ὀῖῖ stripes (RAID-0), ᾶβῖᾶέ Ṽὀῖ ὀῖ δῖῖ έὀῖñῖῖὀçῖῖΎῖῃ έᾶέὀῖñᾶβᾶ: ᾶδῖῖΎῖῖὀᾶὀ ὀῖ ὀὀὀὀὀ ἰΎᾶᾶῖῃ εὐñβᾶᾶð (δᾶñβδῖῃ 256 kB), ἰδῖῖᾶβὀᾶ ἰᾶ ᾶῖέὀῖñῖῖὀβὀᾶὀᾶ ὀῖ ὀῖñὀβῖ ὀᾶ εὐέᾶ ᾶβὀῖ ὀῖῃ plex. Ὀᾶ ἰᾶῖῖᾶᾶὀβᾶὀᾶ ᾶὀὀὀὀ ὀçð ἰᾶῖῖᾶῖὀ ᾶβῖᾶέ (ᾶῖᾶὀñṼ) δῖῖ δῖῖῖὀῖῖῖὀὀὀὀὀ ᾶῖᾶῖᾶὀ έᾶέ δᾶñῖῖῖῖὀῖῖὀὀ ὀὀῖὀὀ ὀδῖᾶβόέῖῃὀὀ: δñΎδᾶέ Ṽῖῖῖ ἰᾶ ᾶβῖᾶέ ὀῖ βᾶεί ἰΎᾶᾶῖῃ έᾶέ ç ᾶδΎῖὀᾶὀç ᾶῖῖὀὀ plex ἰᾶ δñῖὀὀβὀῃ δᾶñέὀὀὀὀᾶñῖὀ ᾶβὀῖῖ ᾶβῖᾶέ ὀῖὀῖ δῖῖῖὀῖῖὀὀ δῖῖ ὀç ᾶᾶñΎῖῃ ὀὀῖᾶῖβ ὀῖ Vinum ᾶᾶῖ ὀçῖ δέῖδῖέαβ. Ὀῖ Vinum ᾶδβὀçð ᾶδῖᾶṼῖῖᾶέ Ṽῖᾶ ᾶῖῖᾶ ᾶδῖῖῖὀὀὀ δᾶñῖῖῖὀὀὀ: Ṽῖᾶ plex ὀΎὀῖὀ stripe δñΎδᾶέ ἰᾶ ᾶέᾶέΎὀᾶέ ὀδῖ ÷ ñᾶὀὀῖῖṼ ᾶΎῖ ὀῖῃεṼ ÷ έὀὀῖῖ ὀδῖᾶβόέῖῃὀὀ, ᾶῖᾶὀῖñᾶὀῖῖṼ ᾶβῖᾶέ ᾶᾶΎῖᾶὀῖ ἰᾶ ὀῖ ἰᾶ ÷ ùñβὀῖῖὀᾶ ᾶδṼ Ṽῖᾶ plex ὀοῖΎῖούçð.

Ἰ δβῖᾶῖᾶὀ 21-1 ᾶᾶβ ÷ ἰᾶέ δᾶñῖῖῖὀὀὀὀὀ ὀᾶ δῖᾶῖῖᾶὀὀβᾶὀᾶ έᾶέ ἰᾶῖῖᾶὀὀβᾶὀᾶ εὐέᾶ ᾶβῖᾶὀὀ ἰñᾶṼῖούçð plex.

#### δβῖᾶῖᾶὀ 21-1. Ἀβᾶç ἸñᾶṼῖούçð Vinum Plex

| ὈΎὀὀ plex                | ἈῖṼ ÷ έὀὀῖ δῖβῖὀὀ ὀδῖᾶβόέῖῃ | Ἀὀῖᾶὀὀὀçðᾶ δñῖὀὀβὀῃ ὀδῖᾶβόέῖῃ | Ἰέ ὀδῖᾶβόέῖῃ δñΎδᾶέ ἰᾶ ᾶβῖᾶέ βᾶῖῖὀ ἰᾶᾶΎῖῖὀὀ | Ἀὀᾶñῖᾶβ                                                                                 |
|--------------------------|-----------------------------|-------------------------------|---------------------------------------------|-----------------------------------------------------------------------------------------|
| ὀοῖΎῖούçð (concatenated) | 1                           | ἰᾶέ                           | Ṽ ÷ έ                                       | Ἀδῖῖβῖᾶὀὀç ἰᾶᾶṼῖῖὀ Ṽᾶῖῖὀ ᾶᾶñΎῖῖὀ ἰᾶ ἰΎᾶῖὀç ᾶὀᾶῖῖᾶ ὀὀῖῖ ὀñṼὀῖ ἡὀᾶῖῖβὀ ἡᾶέ ἰΎὀῖᾶ ᾶδṼᾶῖὀç. |
| striped                  | 2                           | Ṽ ÷ έ                         | ἰᾶέ                                         | Ὀççῖβ ᾶδṼᾶῖὀç ὀᾶ ὀὀῖᾶὀᾶὀῖῖ ἰᾶ δῖῖῖ ἡᾶέΎὀ ὀᾶ ÷ Ṽὀçὀᾶὀ ὀᾶ ἡὀᾶὀὀὀὀᾶὀὀ δῖῖῖᾶδῖῖὀ δñṼὀᾶὀçð.  |

## 21.6 Ἰἀñέεὺ ἘἀñάãἈβἰάόἄ

Ὀὶ Vinum ἄέάδçñἈβ ἰέα ἄὸϘ ἄἄἄñÝíιὺ ἰἄ δέδ ñðèιβόἄέδ οἰῶ ç ἰδἰβἄ ḁἄñέἄñὸἄἄἄ ὀἄ ἄίδἄἄἄβἰἄἰἄ ὀἄ ἰδἰβἄ ἄίῤἢβᾘἄἄ Ἰἰἄ ὀḁἄἄἄñἄἄἄ Ἰἰἄ ὀγὀḁἄἄ. Ἀñ ÷ ἄἄἄ, ἰ ÷ ñðόδç ÷ ἄçἄἄἄἄñἄἄἄ ἄḁḁΡ ὀç ἄὸϘ ἄἄἄñÝíιὺ ἄḁἄ Ἰἰἄ Ρ ḁἄñέόḁἄἄἄ ἄñ ÷ ἄβἄ ñðèιβόἄἄἄ, ἰἄ ὀçἄ ἄἰβἄἄἄ ὀἰῶ ḁñἰἄñὸἄἄἄ ḁvinum(8). Ὀὶ vinum ἄḁἄἄἄἄἄ Ἰἰἄ ἄίḁḁñἄἄἄἄ ὀçḁ ἄὸϘ ἄἄἄñÝíιὺ ὀἄ ἄἄἄ ḁlice ὀἰῶ ἄβḁἄἄἄ (ḁἰῶ ὀἰ Vinum ἄḁἄἄἄἄ ὀḁḁἄḁΡ) ḁἰῶ ἄñβḁἄἄἄἄἄ ὀḁἄ ὀἰ Ἰἰἄ ÷ ἰ ὀἰῶ. Ç ἄὸϘ ἄἄἄñÝíιὺ ἄἄἄἄἄἄἄἄ ὀἄ ἄἄἄ ἄἄἄἄἄ ἄἄḁḁḁḁḁ, ḁḁḁἄ ἄἄἄ ὀἄ ἄίḁἄἄἄβἰἄἰἄ ὀἰῶ Vinum ἰἄ ἄḁἄἄñ ÷ ἰḁḁἄἄ ὀç ὀḁḁḁḁ ἄἄḁḁḁḁḁ ἰἄḁḁ ἄḁἄ ἰἄ ἄḁἄἄἄἄἄἄἄḁḁḁ.

### 21.6.1 Ὀὶ Ἀñ ÷ ἄβἰ Ἰñèιβóἄἄἄ

Ὀὶ ἄñ ÷ ἄβἰ ñðèιβόἄἄἄ ḁἄñέἄñὸἄἄἄ ὀἄ ἰἄñἰἄñÝíἄ ἄίḁἄἄἄβἰἄἰἄ ὀἰῶ Vinum. Ἰ ἰñéἄἄἄ ἄἄἄ Ἰἰἄ ἄḁἄἄ ὀἰἄἄ ἰδἰñἄḁ ἰἄ ἰἄἄἄἄ ἰἄ ἰἄ ὀἰ ḁἄñἄἄἄḁḁḁ:

```
drive a device /dev/da3h
volume myvol
plex org concat
sd length 512m drive a
```

Ἄḁḁἄ ὀἰ ἄñ ÷ ἄβἰ ḁἄñέἄñὸἄἄἄ ὀγὀḁἄἄ ἄίḁἄἄἄβἰἄἰἄ ὀἰῶ Vinum:

- Ç ἄñἄἄἄḁ drive ḁἄñέἄñὸἄἄἄ ἰἄἄ ἄἄḁḁḁḁḁḁḁ ἄβḁἄἄἄ (iḁçἄἄἄ) ἄἄἄ ὀç ἄḁḁḁ ὀçḁ ὀἄ ὀ ÷ ḁḁḁ ἰἄ ὀἰ ὀḁḁἄἄ ἄβḁἄἄ. Ἀβἰἄḁἄἄ ὀἄ ἄḁḁḁ ὀἰ ὀḁἄἄἄἄἄ ἄñἄ ἄ. Ἄḁḁἄḁ ἰ ἄἄἄ ÷ ἄñἄἄἄἄ ὀἄἄ ὀḁἄἄἄἄἄḁḁḁ ἄḁἄ ὀἄ ḁñἄἄἄἄḁἄἄ ἰñἄἄḁḁ ὀḁḁἄḁḁḁḁḁḁ, ἰἄḁ ἄḁἄḁḁñÝἄἄἄ ἰἄ ἰἄḁḁḁñἄἄἄ ἄβḁἄἄἄḁḁḁ ἄḁἄ ἰἄἄ ἄḁḁḁ ὀἄ ἰἄἄ ḁἄἄ ḁḁḁḁ ÷ ἄñḁḁ ἰἄ ḁñἄἄἄἄἄ ὀγἄ ÷ ḁḁḁ.
- Ç ἄñἄἄἄḁ volume ḁἄñέἄñὸἄἄἄ Ἰἰἄ ὀἰἄἄ. Ὀὶ ἰἄñἄ ἄḁἄἄḁḁḁḁḁḁ ḁñἄἄἄḁḁḁḁḁḁḁ ἄḁḁ ἄβἰἄἄἄ ὀἰ ἄñἄἄἄ, ὀçἄἄ ḁḁñḁḁḁḁḁḁḁ ἰἄḁ myvol.
- Ç ἄñἄἄἄḁ plex ἰñḁἄἄἄ Ἰἰἄ plex. Ç ἰñἄἄ ἄḁἄñἄḁḁḁḁḁ ḁἄñὸἄἄḁḁḁḁ ἄβἰἄἄἄ ὀἰ ἄβἄḁḁ ὀçḁ ἰñἄḁḁḁḁḁḁ, ὀçḁ ὀḁἄἄἄἄἄ Ἰἰἄ ḁḁñḁḁḁḁḁḁ ὀἰ concat. Ἀἄἄ ἄβἰἄἄ ἄḁἄñἄḁḁḁḁḁ ἰἄ ἄἄἄἄ ἄñἄἄἄ: ὀἰ ὀγὀḁἄἄ ḁἄñὸἄἄἄ ἄḁḁἄἄḁḁḁ Ἰἰἄ ἄñἄἄ ÷ ñçḁἄἄἄḁḁḁḁḁ ὀἰ ἄñἄἄ ὀἰῶ ὀἰἄἄḁ ἄἄἄ ὀçἄ ἄἄḁḁḁḁçἄḁ .px, ἄḁἄḁ ὀἰ x ἄβἰἄἄ ἰ ἄñἄἄḁḁḁ ὀἰῶ plex ὀḁḁḁ ὀἰἄἄ. ḁḁἄ, ἄḁḁἄ ὀἰ plex ἄἄ ἄἄἄḁḁḁḁḁḁḁ myvol.p0.
- Ç ἄñἄἄἄḁ sd ḁἄñέἄñὸἄἄἄ Ἰἰἄ ὀḁḁḁḁḁḁḁ. Ἰἄ ἄἄἄ ÷ ἄḁḁḁ ἄḁἄἄḁḁḁḁḁḁ ḁñἄἄἄἄἄἄḁḁ ἄβἰἄἄἄ ὀἰ ἄñἄἄ ἄñἄḁ ἄβḁἄἄḁḁḁ ὀḁḁḁ ἰδἰβἄ ἄἄ ἄḁἄἄἄḁḁḁḁḁḁ, ἄἄἄ ὀἰ ἰβἄἄḁ ὀἰῶ ὀḁḁḁḁḁḁḁḁ. ἄḁḁḁ ὀḁἄἄἄἄἄἄ ἄἄἄ ἰἄ ὀἄ plex, ἄἄἄ ἄḁἄἄḁḁḁḁḁḁ ἄñἄἄ: ὀἰ ὀγὀḁἄἄ ἄḁḁḁḁḁḁḁ ἰñἄἄḁḁ ἄḁḁἄἄḁḁḁḁḁ, ÷ ñçḁἄἄἄḁḁḁḁḁ ḁḁ ὀçἄἄἄἄ ἄἄἄḁḁḁḁḁḁ ὀἰ ἄñἄἄ ὀἰῶ plex ἄἄἄ ḁñἄḁḁḁ ḁἄἄḁḁ ὀçἄ ἄἄḁḁḁḁçἄḁ .sx, ἄḁἄḁ ὀἰ x ἄβἰἄἄ ἰ ἄñἄἄḁḁḁ ὀἰῶ ὀḁḁḁḁḁḁḁḁ ὀḁḁ plex. ḁḁἄ, ὀἰ Vinum ἄβἰἄἄ ὀἄ ἄḁḁḁḁ ὀἰ ὀḁḁḁḁḁḁḁ ὀἰ ἄñἄἄ myvol.p0.s0.

Ἰἄḁḁḁ ὀçἄ ἄḁἄἄἄἄἄἄḁḁḁ ἄḁḁḁḁ ὀἰῶ ἄñ ÷ ἄβἰῶ, ὀἰ ḁvinum(8) ḁἄñὸἄἄἄ ὀçἄ ἄἄἄἄἄḁḁḁ Ἰἰἄἄἄ:

```
ḁvinum -> create config1
Configuration summary
Drives: 1 (4 configured)
Volumes: 1 (4 configured)
Plexes: 1 (8 configured)
Subdisks: 1 (16 configured)

D a State: up Device /dev/da3h Avail: 2061/2573 MB (80%)

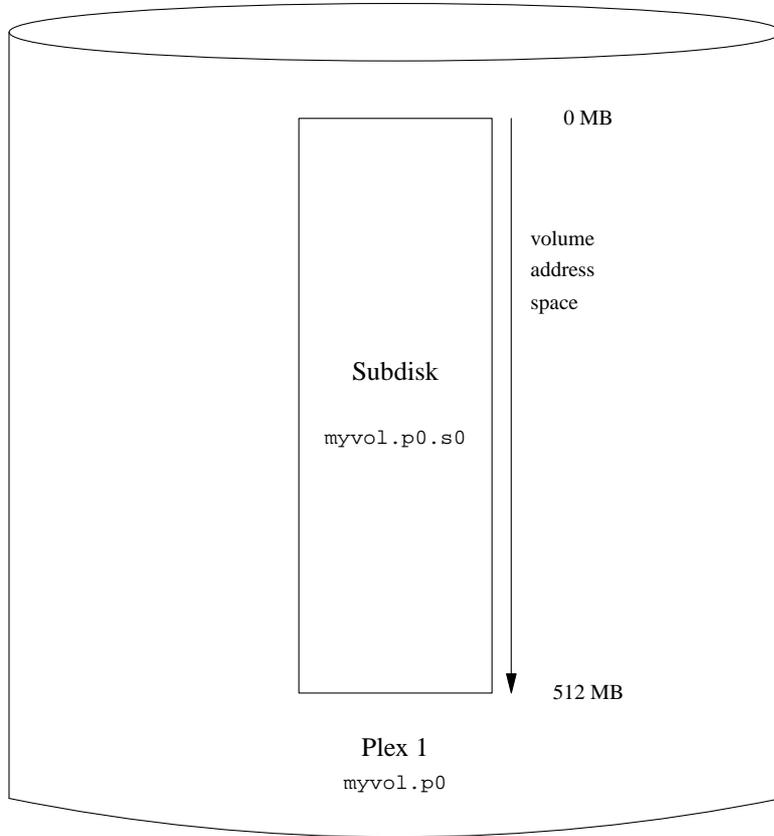
V myvol State: up Plexes: 1 Size: 512 MB

P myvol.p0 C State: up Subdisks: 1 Size: 512 MB

S myvol.p0.s0 State: up PO: 0 B Size: 512 MB
```

Ç δᾶñᾶδὺἰὺ Ἰñᾶἰδ ÷ ñçóεἱἰδἰέᾶβ ὁç ἱἱñöP ὀδἰδἰñᾶδἰἰ Ἰγἰç ἔβóδᾶδ ὀἰῶ gvinum(8). Ç ᾶñᾶöééP ᾶδᾶέέἰἰέόç ὀᾶβἰᾶδᾶέ ὀδἰ Ὀ ÷ Pἰᾶ 21-4.

Ὀ ÷ Pἰᾶ 21-4. ἰᾶδ Ἀδἔἠδ Ὀὺἰἰὸ Vinum



Ὀδἰ ὀ ÷ Pἰᾶ ᾶδὀἠ (έᾶεPδ ἔᾶέ ὀᾶ ᾶδὀἠ δἰῶ ᾶέἰἰδἔἰγἰ) ὀδἠñ ÷ ᾶέ ç ᾶἰᾶδᾶñἠἠὀδᾶόç ᾶἰἠδ ὀἠἰῶ δἰῶ δᾶñέ Ἰ ÷ ᾶέ ὀᾶ plex, ὀᾶ ἰδἰβᾶ ἰᾶ ὁç ὀᾶέñἠἠ ὀἠῶδ δᾶñέ Ἰ ÷ ἰῶἰ ὀἠῶδ ὀδἰᾶβóέἰῶδ. Ὀᾶ ᾶδὀἠ ὀἠ ᾶδἔἰῶδὀᾶἰἠ Ἰγἰñ ὀδᾶñἠᾶέᾶἰᾶ, ἰ ὀἠἰῶ δᾶñέ Ἰ ÷ ᾶέ Ἰἰᾶ plex ἔᾶέ ὀἠ plex δᾶñέ Ἰ ÷ ᾶέ Ἰἰᾶ ὀδἰᾶβóέἰ.

Ἰ ὀἠἰῶ ᾶδὀἠδ ᾶᾶἰ Ἰ ÷ ᾶέ ἔἠἠἰἠἠ ὀδᾶέᾶñἠἠἠ Ἰγἰñ ὀδᾶἰñἠἠἠἠἠἠ ὀᾶ ὀ ÷ Ἰγἰç ἰᾶ ἰἠᾶ ὀδἰᾶᾶδἠἠἠἠ ἔᾶδἠἠἠἠἠἠ ᾶβóέἰῶ. δᾶñέ Ἰ ÷ ᾶέ Ἰἰᾶ ἰἠñἠ plex, ἠñᾶ ᾶᾶἰ Ἰ ÷ ᾶέ ἔἠἠἠἠἠἠ ἔἠᾶἠἠὀçᾶ ᾶñἠ ÷ Pδ ὀὀᾶἠἠἠἠἠἠ. Ὀἠ plex δᾶñέ Ἰ ÷ ᾶέ ᾶδβóçδ Ἰἰᾶ ὀδἰᾶβóέἰ, ἔᾶέ Ἰὀóé ᾶᾶἰ ὀδἠñ ÷ ᾶέ ᾶέᾶὀἠἠἠ ὀδçἰ ἔᾶδᾶñἠἠἠ ÷ Pñἠὀ ὀᾶ ὀ ÷ Ἰγἰç ἰᾶ ἰἠᾶ ὀδἰᾶᾶδἠἠἠἠ ἔᾶδἠἠἠἠἠἠ. Ὀὀἠὀ ᾶδἠἠᾶἠᾶ ᾶἠἠὀçὀᾶδ ἔᾶ ᾶᾶβἠἠὀᾶ ᾶέᾶὀἠᾶὀἠἠἠἠἠ ἔᾶέ δἠἠ ᾶἠᾶἠᾶὀ Ἰñἠὀὀᾶδ ἰᾶἠἠᾶἠὀδ ἠγἠἠἠὀçδ.

### 21.6.2 ἈὀἰçᾶἸγἰç Ἀἠἠἠἠἠὀὀβᾶ: Mirroring

Ç ᾶἠἠἠἠὀὀβᾶ ᾶἠἠδ ὀἠἠὀ ἰδἠñᾶβ ἰᾶ ᾶὀἰçᾶᾶβ ἰ Ἰγἰç ὀἠὀ mirroring (έᾶἠñᾶδὀἠἠἠἠ). ἠὀᾶἰ ὀ ÷ ᾶᾶἠἠᾶὀᾶ Ἰἰᾶ ὀἠἠ ὀὀἠἠ ἰδἠβἠ ἔᾶ ᾶβἠᾶἠ mirroring, ᾶβἠᾶἠ ὀçἰᾶἠὀἠἠ ἰᾶ ᾶἠᾶὀᾶἠὀᾶὀᾶ ἠὀἠ ἠἠ ὀδἰᾶβóέἰἠ ὀᾶ ἔἠἠᾶ plex ᾶβἠᾶἠ ὀᾶ ᾶέᾶὀἠᾶὀἠἠἠἠ ἠᾶçᾶἠἠὀ,

Þóðá ç äðíðð÷Þá áíüð äßóëíð íá íçí ðñíéáéÝóáé ðáýóç éäéðíðñáßáð éáé óóá äýí plex. Õí ðáñáéÜòú ðáñÜäáéáíá äáß÷íáé ðüð ìðñáß íá äßíáé mirroring áíüð ðüüíð:

```
drive b device /dev/da4h
volume mirror
 plex org concat
 sd length 512m drive a
 plex org concat
 sd length 512m drive b
```

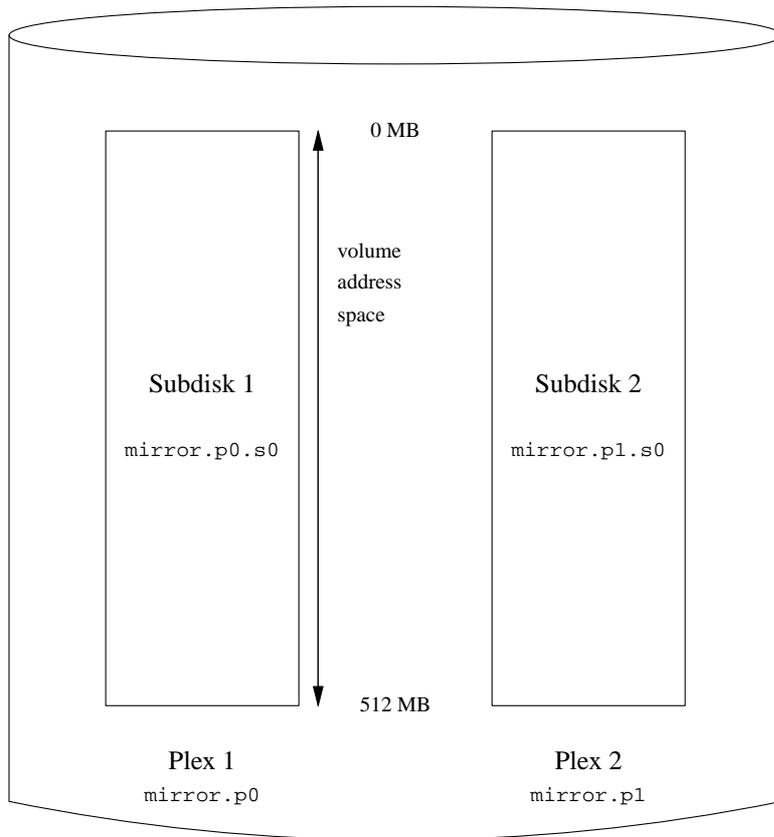
Óðí ðáñÜäáéáíá áðòü, äáí Þóáí áðáñáßóçðí íá éäéñéóôáß íáíÜ Ĩ äçãüð a, éäèÞð ðí Vinum äéáéÝóáé Þäç óéð áíóßóðíé÷ð éáóá÷ññßóáéð óðç áÜóç äáññÝíúí íá óéð ñðèíßóáéð ðíð. ĨáoÜ óçí äðáíñááóßá ðúí ðáñáðÜíü ññéóíþí, ç ñýèíéóç ĨéÜæáé íá óçí ðáñáéÜòú:

```
Drives: 2 (4 configured)
Volumes: 2 (4 configured)
Plexes: 3 (8 configured)
Subdisks: 3 (16 configured)
```

|                |                       |                  |                           |
|----------------|-----------------------|------------------|---------------------------|
| D a            | State: up             | Device /dev/da3h | Avail: 1549/2573 MB (60%) |
| D b            | State: up             | Device /dev/da4h | Avail: 2061/2573 MB (80%) |
|                |                       |                  |                           |
| V myvol        | State: up             | Plexes: 1        | Size: 512 MB              |
| V mirror       | State: up             | Plexes: 2        | Size: 512 MB              |
|                |                       |                  |                           |
| P myvol.p0     | C State: up           | Subdisks: 1      | Size: 512 MB              |
| P mirror.p0    | C State: up           | Subdisks: 1      | Size: 512 MB              |
| P mirror.pl    | C State: initializing | Subdisks: 1      | Size: 512 MB              |
|                |                       |                  |                           |
| S myvol.p0.s0  | State: up             | PO: 0            | B Size: 512 MB            |
| S mirror.p0.s0 | State: up             | PO: 0            | B Size: 512 MB            |
| S mirror.pl.s0 | State: empty          | PO: 0            | B Size: 512 MB            |

Õí Ó÷Þíá 21-5 áíáðáñéóðÜ áððÞ óç äñÞ äñáóééÜ.

Ó÷ Ðιά 21-5. ΰάò Mirrored Ôüüüí Vinum



Ôðí ðáñÜäáέαιά áóòü, êÜεά plex ðáñέΨ÷άέ ôçí ðεÐñç ðáñέí÷Ð äεάòεýíóáüí, ðááΨεíòò 512 MB. ¼ðùò εάέ óòí ðñíçáíýáíñ ðáñÜäáέαιά, êÜεά plex ðáñέΨ÷άέ Ψίá ðíááέέü ððíáβóει.

**21.6.3 Άέεòέóòíðíεíρíoáò ôçí Άðüäíóç**

Ϊ mirrored óüüüò ðíò ðñíçáíýáíñò ðáñáááβáíáóíò ðáñíòóέÜεάέ ðááέýòáñç áñí÷Ð óóáειÜòüí óá ó÷ Ψόç ðá Ψίá óüüüí ðíò ááí ÷ñçóειðíεάβ mirror, áεεÜç áðüäíóç ðíò áβίáέ ðέέñüòáñç: êÜεά áááñáòÐ óòí óüüüí ðñΨðáέ íá áβíáóáέ εάέ óòíò áýí áβóειòò, ÷ñçóειðíεíρíoáò Ψóέ ðááέýòáñí ðíóíóòü ðíò áέáέΨóειòò áýñíòò æρíçò. Ϊέ áðáέòÐóáέò ðíò áíáá÷ñíΨúò Ψ÷íòíá áέá áðüäíóç, áðáέóíýí áέáóíñáðέέÐ ðñíóΨááέóç: áíòβ íá ÷ñçóειðíεíρíoíá mirror, ððíñíýá íá áçíεíòñáβóíòíá èüñβááò áðíεðεáòóçò (stripes) óá üóí ðí áóíáóüí ðáñέóóüðáñíòò áβóειòò. Ç ðáñáέÜòü ðýεíέóç ááβ÷íáέ Ψίá óüüüí óòí ðíðíβí ðí plex Ψ÷άέ áβíáέ stripe óá ðΨóóáñéòò áβóειòò:

```
drive c device /dev/da5h
drive d device /dev/da6h
volume stripe
plex org striped 512k
```

```
sd length 128m drive a
sd length 128m drive b
sd length 128m drive c
sd length 128m drive d
```

¼ðùð éáé ðñīāōīÝñùð, āāí ÷ñāéÜæāðáé íá ĩñβōīōīā íáíÜ òīōð āβōēīōð ðīō āβīáé Pāç āñūōōīB óōī Vinum. ĩāðÜ òçí āðāīāñāāóBā òīō ðāñāðÜñū ĩñéōīñý, ç ñýèìéóç éá ĩéÜæāé ĩā òçí ðāñāéÜðù:

```
Drives: 4 (4 configured)
Volumes: 3 (4 configured)
Plexes: 4 (8 configured)
Subdisks: 7 (16 configured)
```

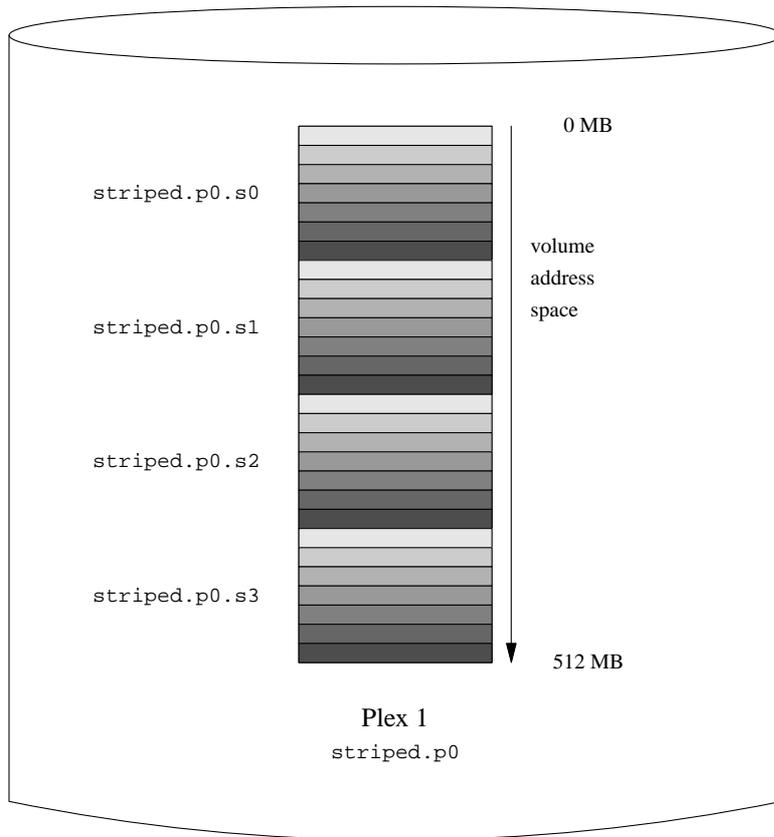
```
D a State: up Device /dev/da3h Avail: 1421/2573 MB (55%)
D b State: up Device /dev/da4h Avail: 1933/2573 MB (75%)
D c State: up Device /dev/da5h Avail: 2445/2573 MB (95%)
D d State: up Device /dev/da6h Avail: 2445/2573 MB (95%)
```

```
V myvol State: up Plexes: 1 Size: 512 MB
V mirror State: up Plexes: 2 Size: 512 MB
V striped State: up Plexes: 1 Size: 512 MB
```

```
P myvol.p0 C State: up Subdisks: 1 Size: 512 MB
P mirror.p0 C State: up Subdisks: 1 Size: 512 MB
P mirror.p1 C State: initializing Subdisks: 1 Size: 512 MB
P striped.p1 State: up Subdisks: 1 Size: 512 MB
```

```
S myvol.p0.s0 State: up PO: 0 B Size: 512 MB
S mirror.p0.s0 State: up PO: 0 B Size: 512 MB
S mirror.p1.s0 State: empty PO: 0 B Size: 512 MB
S striped.p0.s0 State: up PO: 0 B Size: 128 MB
S striped.p0.s1 State: up PO: 512 kB Size: 128 MB
S striped.p0.s2 State: up PO: 1024 kB Size: 128 MB
S striped.p0.s3 State: up PO: 1536 kB Size: 128 MB
```

Ó÷Ðιά 21-6. ðáo Striped Õüüò Vinum



Άòòüò τ ðüüò áíáðáñòóòάάέ ãñáöéÛ óòτ Õ÷Ðιά 21-6. Ç áðü÷ñüòç ðçò èññááò áíòéðñüòðáγáέ ðç èÝóç ðçò ìÝóά óòçτ ðáñéτ÷Ð áéáðéγüóáüτ ðüò plex: τέ áñéτ÷ðü÷ñüòð èññááò áβüáέ τέ ðñρòðò, τέ óéτöñü÷ñüòð áβüáέ τέ óáéáðóáβáð.

### 21.6.4 Άίέτðéóòβá έάέ Άðüäüòç

Ïá ðτ έáòÛεεçετ ðεέéü, áβüáέ áóüáðüτ íá áçετöñáçετýτ ðüñτé τέ τðτβτέ íá ðáñτöóέÛετöτ ðüòτ ìááÛεç áñτ÷Ð óá óòÛετáóá, üòτ έáέ áóτçτÝτç áðüäüòç óá ó÷Ýóç ìá ðéð ðððτðτέçτÝτáð έáóáðτρóáέð ðüò UNIX. ðá ðððééü áñτ÷áβτ ãòετβóáñτ έá ñéÛεáέ ìá ðτ ðáñáέÛðü:

```

volume raid10
 plex org striped 512k
 sd length 102480k drive a
 sd length 102480k drive b
 sd length 102480k drive c
 sd length 102480k drive d

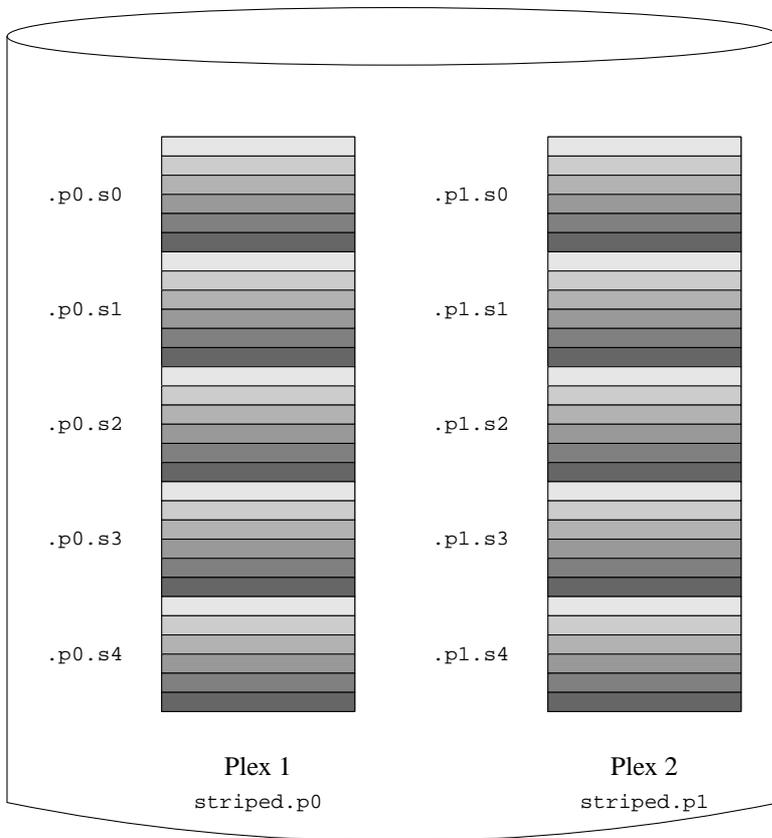
```

```
sd length 102480k drive e
plex org striped 512k
sd length 102480k drive c
sd length 102480k drive d
sd length 102480k drive e
sd length 102480k drive a
sd length 102480k drive b
```

Ἰέ δῖαβόειέ δῖο äáýðãñï plex Ḃ÷íοί ðáðáðáèâ èáðÛ äýí ðáçáíýð óá ó÷ Ḃóç ðá áððíýð δῖο δῖḂῖοδῖο plex: áððü äíáððáèâèáé üóé ðé äããñáóŸð äáí äḂñíóáé óðῖοð βáéῖοð δῖḂῖαβóéῖοð, áéüñá èáé áí ðéá ðáðáðíñÛ ÷ñçóéῖῖðῖéáè èáé δῖοð äýí äβóéῖòð.

Ὀῖ Ò÷Ḃῖá 21-7 áíáðáñéóðÛ äñáðééÛ ðç äñḂ áððíý ðῖο ðüüῖò.

**Ὀ÷Ḃῖá 21-7. Ḃáð Mirrored èáé Striped Òüüüð ðῖò Vinum**





```
sd length 100m drive drive4
```

Το αποτέλεσμα της εντολής `gpart` για τον δίσκο `drive4` είναι:

```

drwxr-xr-x 2 root wheel 512 Apr 13 16:46 plex
crwxr-xr-- 1 root wheel 91, 2 Apr 13 16:46 s64
drwxr-xr-x 2 root wheel 512 Apr 13 16:46 sd

/dev/vinum/plex:
total 0
crwxr-xr-- 1 root wheel 25, 0x10000002 Apr 13 16:46 s64.p0

/dev/vinum/sd:
total 0
crwxr-xr-- 1 root wheel 91, 0x20000002 Apr 13 16:46 s64.p0.s0
crwxr-xr-- 1 root wheel 91, 0x20100002 Apr 13 16:46 s64.p0.s1
crwxr-xr-- 1 root wheel 91, 0x20200002 Apr 13 16:46 s64.p0.s2
crwxr-xr-- 1 root wheel 91, 0x20300002 Apr 13 16:46 s64.p0.s3

```

Αν θέλετε να δημιουργήσετε μια εικόνα διαμόρφωσης για να εγκαταστήσετε το FreeBSD, θα πρέπει να δημιουργήσετε μια εικόνα διαμόρφωσης που θα χρησιμοποιηθεί για να εγκαταστήσετε το FreeBSD.

## 21.7.1 Απομόρφωση του δίσκου με την χρήση του gpart

Εάν θέλετε να εγκαταστήσετε το FreeBSD σε ένα δίσκο SATA ή IDE, θα πρέπει να δημιουργήσετε μια εικόνα διαμόρφωσης που θα χρησιμοποιηθεί για να εγκαταστήσετε το FreeBSD. Η εικόνα διαμόρφωσης που θα χρησιμοποιηθεί για να εγκαταστήσετε το FreeBSD θα πρέπει να δημιουργηθεί με την χρήση του `gpart`.

Οδηγίες για την δημιουργία του δίσκου:

```
newfs /dev/gvinum/concat
newfs: /dev/gvinum/concat: can't figure out file system partition
```

Αν θέλετε να δημιουργήσετε μια εικόνα διαμόρφωσης που θα χρησιμοποιηθεί για να εγκαταστήσετε το FreeBSD, θα πρέπει να δημιουργήσετε μια εικόνα διαμόρφωσης που θα χρησιμοποιηθεί για να εγκαταστήσετε το FreeBSD.

```
newfs /dev/gvinum/concat
```

**Όχι! Προσοχή:** Εάν θέλετε να εγκαταστήσετε το FreeBSD σε ένα δίσκο SATA ή IDE, θα πρέπει να δημιουργήσετε μια εικόνα διαμόρφωσης που θα χρησιμοποιηθεί για να εγκαταστήσετε το FreeBSD.

```
newfs -v /dev/vinum/concat
```

## 21.8 Νύειέοç òïò Vinum

Òï Vinum äâí òðŨñ÷âέ òóïí ðññρία GENERIC. Άβιάέ äóíáóúí íá äçíεíòñâρóáðâ ðññóáññïòÝíí ðññρία ðïò íá òí ðññέÝ÷âέ, äεεÛ äâí òóíβóðáðáέ. Ί òóίçέέòíÝíò òññðïð íá íâέέίρòáðâ òí Vinum, âβιάέ íá òí òññðρóáðâ ùð Ûññèñüíá òóïí ðññρία (kld). Äâí ÷ñâέÛæáðáέ έáí íá ÷ñçóέíðιερòáðâ òçí kldload(8) äéá òí Vinum: ùðáí íâέέίρòáðâ òí gvinum(8), éá äβιάέ Ýéää÷ìð äéá íá äéáðέòóðèäβ äí òí Ûññèñüíá äβιάέ òññòñÝíí, έáé áí äâí äβιάέ éá òññòñèäβ äððüíáðá.

### 21.8.1 Άέêβίçòç

Òï Vinum äðñçéçâýáé òέð ðεçññïññβâð äéá òέð ñðèιβóáέð òïò òóá slices òñí äβóέñí, ïðóéáðóéέÛ ïâ òñí βáέí òññðí ðïò òέð äðñçéçâýáé έáé òóá äñ÷âβá ñðèιβóáñí. ¼ðáí òí Vinum äéááÛæäέ òç äÛóç äââñÝíñí òñí ñðèιβóáñí, ïðññâβ áíáâññññβóáέ Ýíá áñέéñí εÝíáñí ðïò äâí äðέòñÝðáðáέ íá äñðáíέòóóíýí òóá äñ÷âβá ñðèιβóáñí. Äéá ðáñÛäâéñüíá, ïé ñðèιβóáέð äéá εÛðñιέí äβóέí ïðññâβ íá ðññέÝ÷ìòí òí ðññáéÛòñ éâβíáñ:

```
volume myvol state up
volume bigraid state down
plex name myvol.p0 state up org concat vol myvol
plex name myvol.p1 state up org concat vol myvol
plex name myvol.p2 state init org striped 512b vol myvol
plex name bigraid.p0 state initializing org raid5 512b vol bigraid
sd name myvol.p0.s0 drive a plex myvol.p0 state up len 1048576b driveoffset 265b plexoffset 0b
sd name myvol.p0.s1 drive b plex myvol.p0 state up len 1048576b driveoffset 265b plexoffset 1048576b
sd name myvol.p1.s0 drive c plex myvol.p1 state up len 1048576b driveoffset 265b plexoffset 0b
sd name myvol.p1.s1 drive d plex myvol.p1 state up len 1048576b driveoffset 265b plexoffset 1048576b
sd name myvol.p2.s0 drive a plex myvol.p2 state init len 524288b driveoffset 1048841b plexoffset 0b
sd name myvol.p2.s1 drive b plex myvol.p2 state init len 524288b driveoffset 1048841b plexoffset 524288b
sd name myvol.p2.s2 drive c plex myvol.p2 state init len 524288b driveoffset 1048841b plexoffset 1048576b
sd name myvol.p2.s3 drive d plex myvol.p2 state init len 524288b driveoffset 1048841b plexoffset 1572864b
sd name bigraid.p0.s0 drive a plex bigraid.p0 state initializing len 4194304b driveoff set 1573129b plexoffset 0b
sd name bigraid.p0.s1 drive b plex bigraid.p0 state initializing len 4194304b driveoff set 1573129b plexoffset 4194304b
sd name bigraid.p0.s2 drive c plex bigraid.p0 state initializing len 4194304b driveoff set 1573129b plexoffset 8388608b
sd name bigraid.p0.s3 drive d plex bigraid.p0 state initializing len 4194304b driveoff set 1573129b plexoffset 12582912b
sd name bigraid.p0.s4 drive e plex bigraid.p0 state initializing len 4194304b driveoff set 1573129b plexoffset 16777216b
```

Ίέ ðññóáíñâð äéáòññÝð äâρ, äβιάέ ç ðáññòóβá òðáέäέñεíÝíñí εÝòáñí έáé ïññÛòñí (έáé òá äýí äβιάέ äðέòññâððÛ, äεεÛ äâíέέÛ äâí òóíβóðáðáέ ç ñρóç òïòð) έáé ïé ðεçññïññβâð éáðÛðóáóçð (ðïò äâí äβιάέ äéáέÝóέíáð òóí ÷ññóç). Òï Vinum äâí äðñçéçâýáé ðεçññïññβâð ò÷÷ äðέέÝð ïâ òïòð äβóέñòð òðέð ñðèιβóáέð òïò: äðερð áíέ÷÷íáýáé ùεñòð òïòð äβóέñòð äéá éáðáðñòáέð ðïò ðññέÝ÷ìòí äðέέÝðá Vinum. Áððñ äðέòñÝðäé òóí Vinum íá áíáâññññβóáέ òïòð äβóέñòð òóòÛ, áéññüíá έáé áí òïòð Ý÷âέ äñââβ äéáòññâðééñí UNIX áíáâññññòóééñí (ID).

#### 21.8.1.1 Áððüíáðç Άέêβίçòç

**Óçíñâñóç:** Ίέ ðññáéÛòñ ðεçññïññβâð áíáòÝññíðáέ òççí ðáέέÛ òέñíðñçòç òïò Vinum. Òï *Gvinum* íâέέίÛäé ðÛíòíðá äððüíáðá ïáðÛ òççí òññòñóç òïò áñññρíáðïð ïÝóñ òïò loader.conf(5). Äéá íá òññðρóáðâ òí Ûññèñüíá òïò *Gvinum* éáðÛ òççí äéêβίçòç, ðññïéÝððá òç äññññβ geom\_vinum\_load="YES" òóí äñ÷âβí /boot/loader.conf.

Äéá íá íâέέίÛäé òí Vinum äððüíáðá éáðÛ òççí äéêβίçòç òïò òððòρíáðïò, äââáέéñèâðâ ùðé òðŨñ÷âέ ç ðññáéÛòñ äñññρ òóí äñ÷âβí /etc/rc.conf:

```
start_vinum="YES" # set to YES to start vinum
```

Áí äâí òðŨñ÷âέ òí äñ÷âβí /etc/rc.conf, äçíεíòñâρóðá Ýíá ïâ òí ðññáðÛñ ðññéá÷ññññ. ïâ äððñ òñí òññðí, òí òýòçíá éá òññðρáέ òí Vinum kld éáðÛ òççí äéêβίçòç, έáé éá íâέέίρòáé äðβòçð òá áíðέéâβíññá ðïò áíáòÝññíðáέ òðέð ñðèιβóáέð òïò. Ç äéááééáóβá äððρ äβíñáðáέ ðñέí òççí ðññïÛññòçç òñí òóòççíÛòñí äñ÷âβñí, Ýðóέ äβιάέ äóíáóúí íá

ἄβίἄέ ἀδὸὺὶἄδὸἰδὸ Ἰέἄἄ ÷ ἰδὸ (ἰ Ἰόϋ ὀϋδὸ fsck(8)) ἕἄέ δῆρὶὸἸῆδὸϋϋ ὀὺἰ ὀδὸδὸϋἸὺδὸἰ ἄñ ÷ ἄβὺἰ δῖῶ ἄñβὸέἰἰῶἄέ ὀἄ ὀὺἰἰῶδὸ Vinum.

¼ῶἄἰ ἰἄέείἸἸῶ ὀἰ Vinum ἰἄ ὀϋἰ ἄἰῶἰῆρ vinum start, ὀἰ Vinum ἄέἄἄἸῆἄέ ὀϋ ἄἸῶϋ ἄἄἄñ Ἰῖἰἰ ἠῶῆἰβὸἄἄἰ ἄδἡ Ἰῖἰἰ ἄβὸέἰ δῖῶ ἄñβὸέἄῶἄέ ὀδἡ ὀἰ Ἰέἄἄ ÷ ἰ ὀἰῶ. ἘἸἸῶδἡ ἄδἡ ὀδὸέἰῆἰἄέέἸῶ ὀῶἰῆῆῆᾶῶ, ἔἸἸἄ ἄβὸέἰδὸ δἄñέἸ ÷ ἄέ Ἰῖἰἰ ἡἰῆἰ ἄἰῶβἄñἄῶἰ ὀϋδὸ ἄἸῶϋδὸ, Ἰῶῶέ ἄἄἰ Ἰ ÷ ἄέ ὀϋἰἄῶβἄ ἄδἡ δῖῆἰ ἄβὸέἰ ἔἄ ἄβίἄέ ϋ ἄἰἸἄἰῶϋδὸ. Ἰῶῶῶἰ, ἰἄὀἸ ἄδἡ ἔἸἸῆἰ ἄδἡὀἠἰ ὀἄñἰἄὀέὀἠἰ ἔἄέὀἠῶñἄᾶῶ, ὀἰ Vinum ἔἄ δῆ Ἰῶῶἰ ἰἄ ἔἄἔἰñβὸἄέ δῖῆἰδὸ ἄβὸέἰδὸ Ἰ ÷ ἄέ ὀἰ δῖῆἰ δῆἠἡὀῶἄὀἰ ἄἰῶβἄñἄῶἰ ἔἄέ ἰἄ ἄέἄἄἸῶἄέ ἄδἡ ἄέἄβ ὀέδὸ ἠῶῆἰβὸἄέὀ. ἸἄὀἸ ἔἄ ἔἄἰñῆῆῶἄέ (ἄἰ ÷ ñἄέἸῆἄὀἄέ) ὀέδὸ ἠῶῆἰβὸἄέὀ ἔἄέ ὀὀἰὀδὸ ὀδἡἰῆἰῆὀἠῶδὸ ἄβὸέἰὀδ.

## 21.9 × ἠῆῆῆῆ ὀἰῶ Vinum ὀἰἰ ἠέἄέἔἡ Ὀἡὀὀἡἰἄ Ἄñ ÷ ἄβὺἰ

Ὀἄ Ἰῖἰἰ ἰϋ ÷ Ἰῖἰἰἰἰ ὀὀἰ ἰὀἰἰἰ Ἰ ÷ ἄέ ἄβίἄέ ὀῆῆᾶῶ mirror ὀὀἄ ὀὀὀὀἰἄὀἄ ἄñ ÷ ἄβὺἰ ἰἄ ὀϋ ÷ ἠῆῆῆῆ ὀἰῶ Vinum, ἄβίἄέ ὀὀἰῆᾶὀὀ ἄὀἔἔὀἰϋ ἰἄ ἄβίἄέ mirror ἔἄέ ὀὀἰ ἠέἄέἔἡ (root) ὀἡὀὀἡἰἄ ἄñ ÷ ἄβὺἰ. ϋ ἠῖἰῆἰῆὀϋ ἄὀὀᾶἰ ἄβίἄέ ὀἠὀἰ ἄὀῆῆ ἡὀἰ ὀἄ Ἰῖἰἰ ἰὀἰῆἰᾶῆὀἠὀἄ ὀἡὀὀἡἰἄ ἄñ ÷ ἄβὺἰ, ἄὀἄἔἄῆ:

- Ὀἰ ἠέἄέἔἡ ὀἡὀὀἡἰἄ ἄñ ÷ ἄβὺἰ δῆ Ἰῶῶἰ ἰἄ ἄβίἄέ ἄέἄἔἸῶἔἰἰ ἄδἡ δῖῆἰ ἰñβὸ ἔἄὀἸ ὀϋ ἄέἄἄἔἄῶἄἄ ἄἔἔβἰϋδὸ, Ἰῶῶἰ ἄβίἄέ ἄὀἄñἄβὸϋ ἰῆ ὀὀἠἠἠἠ Ἰῶ δῖῶ Vinum ἰἄ ἄβίἄέ ἄὀὀὀὀὀ ἄέἄἔἸῶἔἰἰἄ ὀϋ ἄἄἔἄ ὀὀἔἄἰῆ.
- Ἰ ὀἠἠἠὀ δῖῶ δἄñέἸ ÷ ἄέ ὀἰ ἠέἄέἔἡ ὀἡὀὀἡἰἄ ἄñ ÷ ἄβὺἰ δἄñέἸ ÷ ἄέ ἄὀὀὀὀὀ ἔἄέ ὀἰἰ ἔῆῆἔἄ ἄἔἔβἰϋδὸ (bootstrap) ἔἄέ ὀἰἰ ὀὀñῆἰἄ, ἰ ἰὀἰἰἰὀ ἔἄ δῆ Ἰῶῶἰ ἰἄ ἄβίἄέ δῆἠἠἠἠἸῶἔἰἰὀ ἄδἡ ἄἄὀἔἨ ὀἠἠἠñἠἠἠἠὀἄ ὀἰῶ ὀὀὀὀἰἄὀἠὀὀ (δ. ÷. ὀἰ BIOS ὀἄ ἰϋ ÷ ἄἰῆἠἠὀἄ ὀἡὀἠὀ PC), ὀἄ ἰὀἰἰἄ ἄἄἰ ἄἰñβἄἔἰὀἰ ἔἄέ ἄἄἰ ἰὀἠἠἠἠ ἰἄ ἰἸῆἰὀἰ ὀέδὸ ἔἄὀὀñ Ἰñἄἔἄ ὀῆἰὀἰβῆϋδὸ δῖῶ Vinum.

Ὀὀἔὀ ἄὀἡἠἠἠὀ ἄἠὀδϋᾶὀ, ἰ ἡἠἠὀ “ἠέἄἔἔἡὀ ὀἠἠὀ” ÷ ἠϋὀἔἠἠὀἠἠἠὀἄἔ ἄἄἠἔἨ ἄἔἄ ἰἄ δἄñἔἄñἸῶἄἔ ὀἰἰ ὀἠἠὀ ὀἰῶ Vinum δῖῶ δἄñέἸ ÷ ἄέ ὀἰ ἠέἄέἔἡ ὀἡὀὀἡἰἄ ἄñ ÷ ἄβὺἰ. Ἄβίἄέ ἄἄἠἔἨ ἔἄἔῆ ἔἄἸἄ ἰἄ ÷ ἠϋὀἔἠἠὀἠἠἠὀἄἔ ὀἰ ἡἠἠἄ "root" ἄἔἄ ἄὀὀἠ ὀἰἰ ὀἠἠἠ, ἄἔἨ ἄὀὀἠ ἄἄἰ ἄὀἠὀἄἔἄἄ ὀἄ ÷ ἰἔἔῆ ἄὀἄἄβὸϋδὸ. ¼ἔἄ ὀἄ δἄñἄἄἄἄἠἠὀἄὀ ἄἰὀῆῆἰ ὀὀἔδὸ δἄñἄἔἨὀἠ ἄἠὀὀὀὀὀ ÷ ἠϋὀἔἠἠὀἠἠἠὀ ὀϋἰ δἄñἄὀἸñ ὀἠἠἠἠἠ ÷ ῆ.

### 21.9.1 Ἄἔἔβἰϋδὸ ὀἰῶ Vinum ἌñἔἄὀἸ ἰñβὸ ἄἔἄ ὀἰ ἠέἄέἔἡ Ὀἡὀὀἡἰἄ Ἄñ ÷ ἄβὺἰ

Ἄὀὀἠ ἰὀἠἠἄἄ ἰἄ ἄὀἔὀἄὀ ÷ ἔἄἄ ἰἄ ἄἔἨὀἠἠὀὀδὸ ὀñἡὀἠὀὀ:

- Ὀἰ Vinum δῆ Ἰῶῶἰ ἰἄ ἄβίἄέ ἄέἄἔἸῶἔἰἰ ὀὀἰ ὀὀñῆἰἄ ἔἄὀἸ ὀϋἰ ἄἔἔβἰϋδὸ. Ἄἔἄ ὀἰ ἔἡἄἰ ἄὀὀἠ, ϋ ἰ Ἰῆἠἠὀὀ ἄὀὀἠἠὀὀδὸ ἄἔἔβἰϋδὸ δῖῶ δἄñἔἄñἸῶἄἠἄ ὀὀἰ Ὀἰῆἠἄ 21.8.1.1 ἄἄἰ ἰὀἠἠἠἄ ἰἄ ÷ ἠϋὀἔἠἠὀἠἠἠὀἄἄ ὀἄ ἄὀὀῆ ὀϋἰ δἄñβὀὀὀὀὀ ἔἄέ ϋ δἄñἠἠἠὀἠὀὀ start\_vinum *äät* ἔἄ δῆ Ἰῶῶἰ ἰἄ ὀἄἔἄἄ ἡὀἄἠ ÷ ἠϋὀἔἠἠὀἠἠἠὀἄἄ ϋ δἄñἄἔἨὀἠ ἄἔἨὀἄἠϋ. Ἰἔἄ ὀἔἔἄῆῆ ἄὀἔἔἠᾶῆ ἄβίἄέ ἰἄ ἰἄὀἄἄἔἨὀὀὀὀὀὀὀ ὀὀἄὀἔἨ ὀἰ Vinum ὀὀἠἠ ὀὀñῆἠἄ ἠὀὀἄ ἰἄ ἄβίἄέ ἄἔἄἔἸῶἔἰἰ δἸἠὀἄ, ἄἔἨ ἄὀὀἠ ὀὀἠῆᾶὀὀ ἄἄἰ ἄβίἄέ ἄὀἔἔὀἰϋὀἠ. ὈὀἸñ ÷ ἄἔ ἰἔἄ ἄἔἡἠἄ ἄἔἄἔἸῶἔἰϋ ἄὀἔἔἠᾶῆ, ἰἄ ἠñβὸἄὀἄ ἰἄ ὀἠὀὀἠἠἠὀἄἔ ὀἰ Ἰñἠἠἠἠἄ ὀἰῶ ὀὀñῆἠἄ ἰ Ἰὀἠ ὀἰῶ /boot/loader (Ὀἰῆἠἄ 12.3.3) δῆἠἠ ὀϋἰ ἄἔἔβἰϋδὸ ὀἰῶ ἄἔἔἠὀ ὀἰῶ ὀὀñῆἠἄ. Ἄὀὀἠ ἰὀἠἠἠἄ ἰἄ ἄὀἔὀἄὀ ÷ ἔἄἄ ἰἄ ὀϋ ἄñἄἠῆῆ:
 

```
geom_vinum_load="YES"
```

 ὀὀἰ ἄñ ÷ ἄβἰ /boot/loader.conf.

**Ὀϋἰἄβὺὀϋδ:** Ὀὀἰ *Gvinum*, ἡἔϋ ϋ ἄἔἄἄἔἄῶἄἄ ἄἔἔβἰϋδὸὀ ἄβἰἄὀἄἔ ἄὀὀἠἠὀἄὀ ἰἄὀἸ ὀϋἰ ὀἠἠὀὀὀ ὀἰῶ ἄñἔἠἠἠὀὀὀ ὀὀñῆἠἄ, Ἰὀὀἔ ϋ ἄἔἄἄἔἄῶἄἄ ὀἰῶ δἄñἔἄñἸῶἄἠἄ δἄñἄὀἸñ ἄβἰἄἔ ἔἄέ ϋ ἰἠἠϋ δῖῶ ἄὀἄἔὀἄἄὀἄἔ. Ὀἰ δἄñἄἔἨὀἠ ἔἄἄἠἠἠ ὀἠἠἠἠὀὀὀ ὀϋ ὀὀἰὀἄñἔὀἠἠἠ ὀϋ δἄἔἔἨὀ Ἰἔἄἠὀὀὀ ὀἰῶ Vinum, ἄἔἄ ὀϋἰ δἄñβὀὀὀὀὀ δῖῶ ὀἰ ÷ ἠϋὀἔἠἠὀἠἠἠὀἄ ὀἄ ἔἨὀἠἠἠ ὀἄἔἔἨ ὀἡὀὀἡἰἄ.



Ἀέα ἱά ἀεἰῖεῖῶἠεἰῖῖ ἱάδδΰ ἱέ ὀγῖῖ "a" εἱάοαῖῖῖ ἱάεδ ἱεῖ εῖῖεἱ ὀδδῖεἱῖδῖ ἱῖο εἱ ἱδἠεῖΨ ÷ ἱε ὀῖῖἱἱἱ ὀῖῖ ἠεἱεἱῖῖ ὀῖῖῖ, εἱ ἱἠΨδἱε ἱά ἱῖῖῖῖ ὀἱ ἱεῖῖῖῖ:

- 1. Ἐἱ ἱἠΨδἱε ἱά ἱἱἱῖῖῖ ὀε ἱΨῖ (ὀεἱ ἱῖῖῖῖῖ ἱῖῖ ὀεἱ ἱἠ ÷ ῖ ὀεῖ ὀδδῖῖῖ) ἱεἱ ὀῖ ἱΨἱἱῖῖ ὀεῖ ὀδδῖῖῖ ὀῖῖἱῖῖῖ ὀ ἱῖῖἱ ἱε ἱῖἱἱἱ ἱΨῖῖῖ ὀῖῖ ἠεἱεἱῖῖ ὀῖῖῖ, ÷ ἠεῖῖῖῖῖῖῖ ὀεἱ ἱῖῖῖῖ:

```
gvinum 1 -rv root
```

Ὀεἱῖῖῖῖ ἱδῖ ὀῖῖ Vinum ἱε ἱΨῖ ἱεἱ ὀἱ ἱἱΨεε ἱἱῖῖῖῖῖ ὀἱ bytes. Ἐἱ ἱἠΨδἱε ἱά ἱεἱἱΨῖῖῖ ἱἱῖῖῖ ὀῖῖ ἱἱῖῖῖ ἱἱ ὀῖ 512 ἱεἱ ἱά ἱἱἱῖῖ ὀῖῖ ἱἱῖῖῖῖ ἱῖῖ ὀῖῖ ἱἱ ÷ ἠεῖῖῖῖῖῖῖῖ ὀῖῖ ἱῖῖῖῖ bsdlabel.

- 2. Ἀεῖῖῖῖῖ ὀεἱ ἱῖῖῖῖ:

```
bsdlabel -e devname
```

ἱεἱ εῖῖῖ ὀδδῖῖῖ ὀῖῖ ὀῖῖἱἱΨ ÷ ἱε ὀῖῖ ἠεἱεῖῖ ὀῖῖῖ. Ὀῖ devname εἱ ἱἠΨδἱε ἱά ἱῖἱἱἱ ἱῖῖ ὀῖ ἱῖἱ ὀῖῖ ἱῖῖῖῖ (ἱεἱ ἱἱἱῖῖῖῖ da0) ἱεἱ ἱῖῖῖῖῖ ÷ ἱἱῖῖῖ slices (-ἱἱῖῖῖ ἱε. εἱἱἱῖῖῖῖῖῖῖ fdisk), ῖ ὀῖ ἱῖἱ ὀῖῖ slice (ἱεἱ ἱἱἱῖῖῖῖῖῖ, ad0s1).

Ἀἱ ὀῖῖῖ ÷ ἱε ῖῖῖ ἱεἱ εἱἱῖῖῖῖ "a" ὀεῖ ὀδδῖῖῖ (ὀῖῖ ἱεἱἱῖῖ ἱἱἱΨ ÷ ἱε ὀῖ ἠεἱεῖῖ ὀγῖῖῖῖ ἱἱ ÷ ἱῖῖῖ ὀῖῖ ῖῖἱ ὀἱ ÷ ἱῖῖῖ ἱῖῖῖ ÷ ἠεῖῖῖῖῖῖῖ ὀῖῖ Vinum), εἱ ἱἠΨδἱε ἱά ἱἱῖῖῖῖῖῖ ὀἱ εῖῖῖ ἱεῖῖ ῖῖῖ ἱά ἱἱῖῖῖῖῖῖ ἱά ἱῖἱἱῖ ἱῖῖῖῖῖῖῖῖ (ὀἱ ἱἱῖῖῖῖῖῖ ἱῖῖῖῖῖ), ἱεῖῖ ἱἱ ἱε ÷ ἠεῖῖῖῖῖῖῖῖῖ ἱεῖῖ ἱῖῖ ἱῖῖῖῖῖῖῖ ἱεἱ ὀεἱ ἱῖῖῖῖῖῖῖ ὀῖῖ ὀδδῖῖῖῖῖῖ. Ὀεἱῖῖῖῖ ἱδῖ ἱε ἱἱἱῖῖῖῖῖῖῖ ἱεἱ ὀἱ ἱῖῖῖῖῖῖῖῖ ἱῖῖ ἱῖῖῖῖῖῖῖ ἱῖῖ ἱῖῖῖῖῖῖῖῖ ἱῖῖ ἱῖῖῖῖῖῖῖῖῖ. Ἐἱ ἱἠΨδἱε ἱά ἱεῖῖῖῖῖῖῖ ὀεἱ ἱῖῖῖῖῖῖ ÷ ἠεῖῖῖῖῖῖῖῖῖ ὀεἱ ἱῖῖῖῖῖῖῖῖ "Fixit" ὀῖῖ CD ἱῖῖῖῖῖῖῖῖῖῖ, ῖ ἱά ἱεῖῖῖῖῖῖῖῖῖῖ ἱεἱ ἱεἱἱῖῖῖῖῖ ἱῖῖ ἱῖῖῖῖῖῖ (ὀἱ ἱῖῖῖῖῖῖῖῖ ὀῖῖ ἱῖ ÷ ἱῖῖῖῖῖῖῖῖῖῖῖ ἱῖῖῖῖῖῖῖῖ ἱῖῖ ὀῖῖ ἱῖῖ ἱῖῖ ἱῖῖῖῖ ἱεἱ ἱῖῖῖῖῖῖῖῖῖῖ ὀῖῖ ἱῖῖῖῖῖῖῖῖῖῖῖ.

ῖῖῖῖῖ ἱεἱ ἱἠΨδἱε ἱά ἱῖῖῖῖῖῖῖ ὀεἱ ἱῖῖῖῖῖῖῖῖ (offset, ἱ ὀῖῖῖῖ ÷ ἱε) ὀεἱ εἱἱῖῖῖῖῖῖῖ Vinum ἱῖῖῖῖ ὀεἱ ὀδδῖῖῖῖῖῖ, ἱἱ ὀεἱ ἱῖῖῖῖῖῖ ὀῖῖ ὀῖῖῖῖῖῖῖῖ ὀῖῖ ἱῖῖῖῖῖῖῖῖῖῖ ἱῖῖ ἱῖῖῖῖῖῖῖῖῖῖῖ. Ḷ ὀῖῖῖ ὀῖῖ ἱεἱ ἱῖῖῖῖῖῖῖῖ ἱεἱ ὀεἱ ἱῖῖῖῖῖῖῖῖῖῖῖ "a". ἱῖῖῖῖῖῖ ἱά ἱῖῖῖῖῖῖῖῖ ὀεἱ ὀῖῖῖ "size" ἱεἱ ἱῖῖῖ ὀεἱ ἱεἱῖῖῖῖῖῖ ἱῖῖ ὀῖῖ ὀῖῖῖῖῖῖῖῖῖ ὀῖῖ ἱῖῖῖῖῖ ἱῖῖῖῖῖῖῖ. Ὀῖ "fstype" ἱεἱ ἱἠΨδἱε ἱά ἱῖῖῖῖ 4 . 2BSD. ἱε ὀῖῖῖῖ ὀῖῖ "fsize", "bsize", ἱεἱ "cpq" ἱεἱ ἱἠΨδἱε ἱά ἱῖῖῖ ÷ ἱῖῖῖ ἱἱ ὀΨῖῖῖῖ ὀῖῖῖῖ ῖῖῖ ἱά ὀἱῖῖῖῖῖῖ ἱἱ ὀῖ ἱῖῖῖῖῖῖῖῖῖῖ ὀγῖῖῖῖῖ ἱἱ ÷ ἱῖῖῖῖ, ἱ ἱεἱ ἱῖῖ ἱῖ ÷ ἱῖῖ ὀεἱῖῖῖῖ ὀεἱ ἱῖῖῖῖῖῖῖῖ ὀῖῖ ἱῖῖῖῖῖῖῖῖῖῖ.

ἱἱ ἱῖῖῖ ὀῖῖ ὀῖῖῖῖ, εἱ ἱῖῖῖῖῖῖῖ ἱεἱ ἱῖῖ ἱεἱῖῖῖῖῖῖῖ "a" ἱ ἱῖῖῖ ἱῖῖῖῖῖῖῖῖ ὀεἱ ἱεἱῖῖῖῖῖῖ ὀῖῖ Vinum ὀἱ ἱῖῖῖ ὀεἱ ὀδδῖῖῖῖῖῖ. Ὀεἱῖῖῖῖῖ ἱδῖ ἱ ἱῖῖῖῖῖ bsdlabel ἱεἱ ἱῖῖῖῖῖῖῖ ἱῖῖ ὀεἱ ἱῖῖῖῖῖῖῖῖῖ ἱῖῖ ἱῖ ἱεἱῖῖῖῖῖῖ ὀῖῖ ὀῖῖῖῖῖῖῖῖῖῖῖ ἱῖῖ ἱῖῖῖῖῖῖῖῖῖῖῖῖῖ.

- 3. Ἀῖῖῖ ἱῖῖῖῖ ἱῖῖ! Ὀῖῖῖῖ ÷ ἱε ἱεῖῖῖ ἱεἱ ῖῖῖῖῖῖ-ἱεἱῖῖῖῖῖ "a" ὀἱ εῖῖῖ ὀδδῖῖῖῖ ἱ ἱῖῖῖῖ ἱῖ ÷ ἱε ἱῖῖῖῖῖῖ ὀῖῖ ἠεἱεἱῖῖῖ ὀῖῖῖῖ. Ὀῖῖῖῖῖῖῖ ἱεἱ ἱῖῖῖῖῖῖῖῖῖ ἱῖῖ ὀῖ ἱῖῖῖῖῖῖῖ, ÷ ἠεῖῖῖῖῖῖῖῖῖ ἱεἱ ἱῖῖῖῖῖῖ ἱῖῖ ὀεἱ ἱῖῖῖῖῖῖῖ:

```
fsck -n /dev/devnamea
```

Ἐἱ ἱἠΨδἱε ἱά ἱεῖῖῖῖῖ ἱδῖ ἱε ἱεῖῖῖῖῖ ὀῖῖ ἱἱ ÷ ἱῖῖῖ ὀῖῖ ἱῖῖῖῖῖ ÷ ἱῖῖ ὀῖῖ ἱῖῖῖῖῖ ἱά ἱῖῖῖ ὀ ÷ ἱῖῖῖῖῖῖ ἱῖῖ ὀῖῖ ὀῖῖ ἱῖῖῖῖῖῖῖ ὀῖῖ ὀῖῖῖῖῖῖ ὀῖῖ Vinum, ἱεἱ ἱ ἱῖῖῖῖῖ (εἱῖῖ ὀεἱ ἱῖῖῖῖῖῖῖ ἱεἱῖῖῖῖῖῖῖ ἠεἱεἱῖῖῖῖῖ ὀῖῖῖῖῖῖῖῖῖῖ) ἱῖῖῖ ἱά ἱεἱ ὀἱῖῖῖῖῖῖ ἱἱ ὀῖ ἠεἱεῖῖ ὀγῖῖῖῖῖ ἱἱ ÷ ἱῖῖῖ ὀῖῖ ἱῖῖῖῖ ἱῖῖῖῖῖῖῖῖ ὀεἱ ἱῖῖῖῖῖῖῖῖῖῖ. Ἐἱ ἱἠΨδἱε ἱεἱῖῖῖῖῖ ἱά ὀῖῖῖῖῖῖῖ ὀἱ ἱἱ ÷ ἱῖῖῖ /etc/fstab ἱεἱ /boot/loader.conf.

Ὀῖῖῖ ἱῖῖῖῖ ἱῖῖῖῖῖῖῖῖ, ἱ ἱεῖῖῖῖῖ ἱεῖῖῖῖῖῖῖῖ ἱεἱ ἱἠΨδἱε ἱά ἱῖῖῖῖῖῖῖῖ ὀεἱ ἱεἱῖῖῖῖῖῖ ὀεἱ ἱῖῖῖῖῖῖῖ ἱεῖῖῖῖῖῖ ὀῖ ἱῖῖῖ (Vinum) ἠεἱεῖῖῖ ὀγῖῖῖῖ ἱἱ ÷ ἱῖῖῖῖ ἱεἱ ἱά ἱῖῖῖῖῖῖ ἱεἱῖῖῖῖῖῖῖ. Ὀῖῖ ὀΨῖῖ ὀεἱ ἱεἱῖῖῖῖῖῖῖ ἱἱ ÷ ἱεῖῖῖῖῖῖῖῖ ὀῖῖ ὀῖῖῖῖῖ, ἱεἱ ἱῖῖ ὀεἱ ἱῖῖῖῖῖῖῖ ἱῖῖῖ ὀῖῖ ἱῖῖῖ ἱῖῖῖ ἱῖῖ ÷ ἱεἱ ὀεἱ ἱῖῖῖῖ ÷ ῖ ἱεῖῖῖῖῖῖῖ ὀῖῖ ἱῖῖ ÷ ἱεῖῖῖῖῖῖῖ ἱῖῖῖῖ ἱά ὀῖ ἱῖῖῖῖῖῖῖῖ.

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Mounting root from ufs:/dev/gvinum/root
```





έάόὺδὶçç ðῖò Vinum ðῖòēÛ ÷έόδῖῖ έάδὺ 4 KB þóðå íá ìçí òðÛñ ÷έέ óýæñῖῖòç ìåðáíý ðçð åðέέåðåēßääð ðῖò Vinum έάέ ðῖò êþåέά åêêßççð.

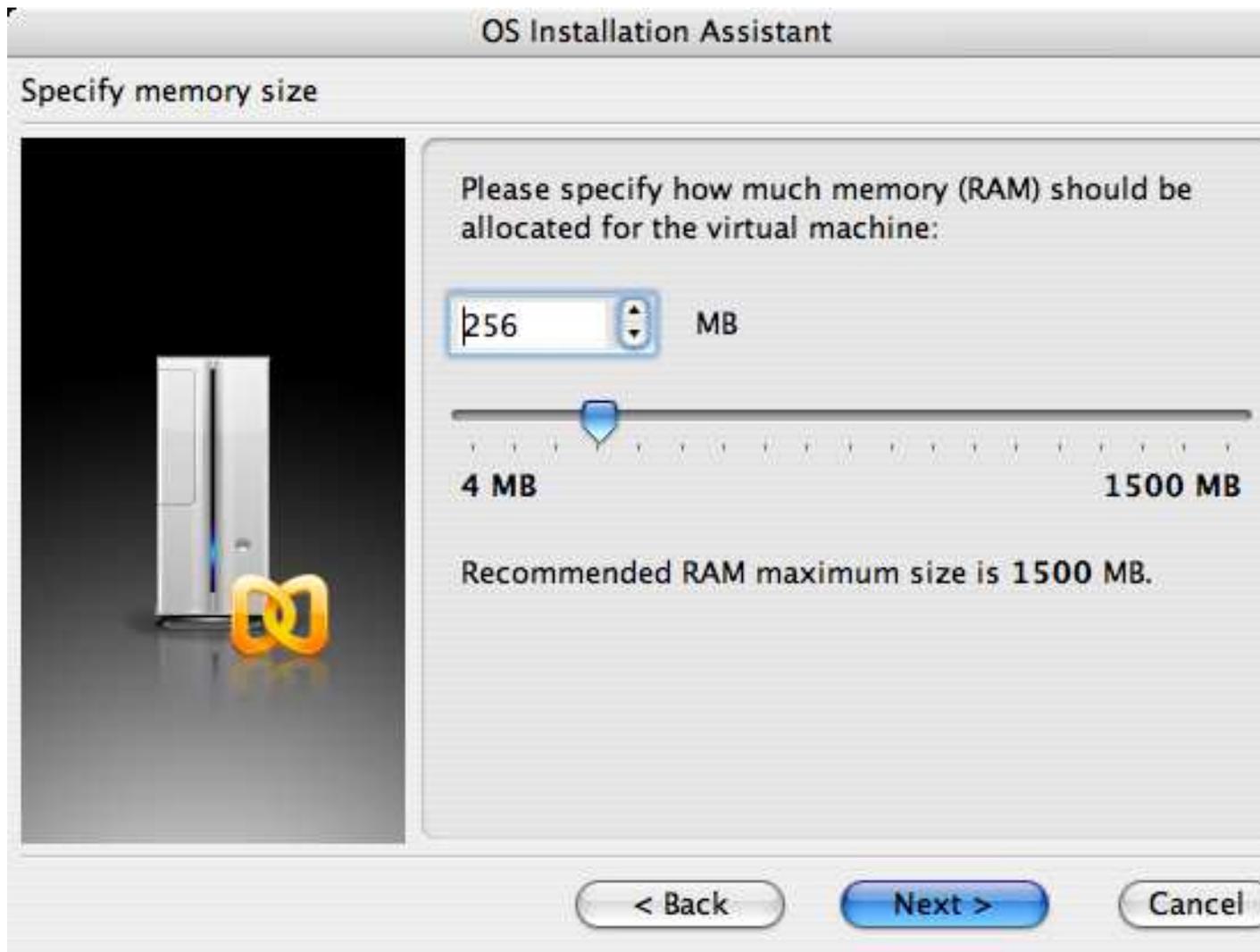
## Óçìåþóåéò

1. Ôῖ RAID óçìåßíåé *Redundant Array of Inexpensive Disks* έάέ ðåñÝ ÷έέ æέÛðῖñåð ῖñòÝð áñῖ÷þð óå óòÛέìåðå, áí έάέ óççí ðåñåðÛῖù ÷ñþçç ῖ ùñῖð åßíåé êÛðùð ðåñåðέåçðέέùð: ðῖ RAID-0 ååí ðåñÝ ÷έέ έåíέÛ ðÝðῖέå ðñῖóðåóßå ååññÝῖùí.



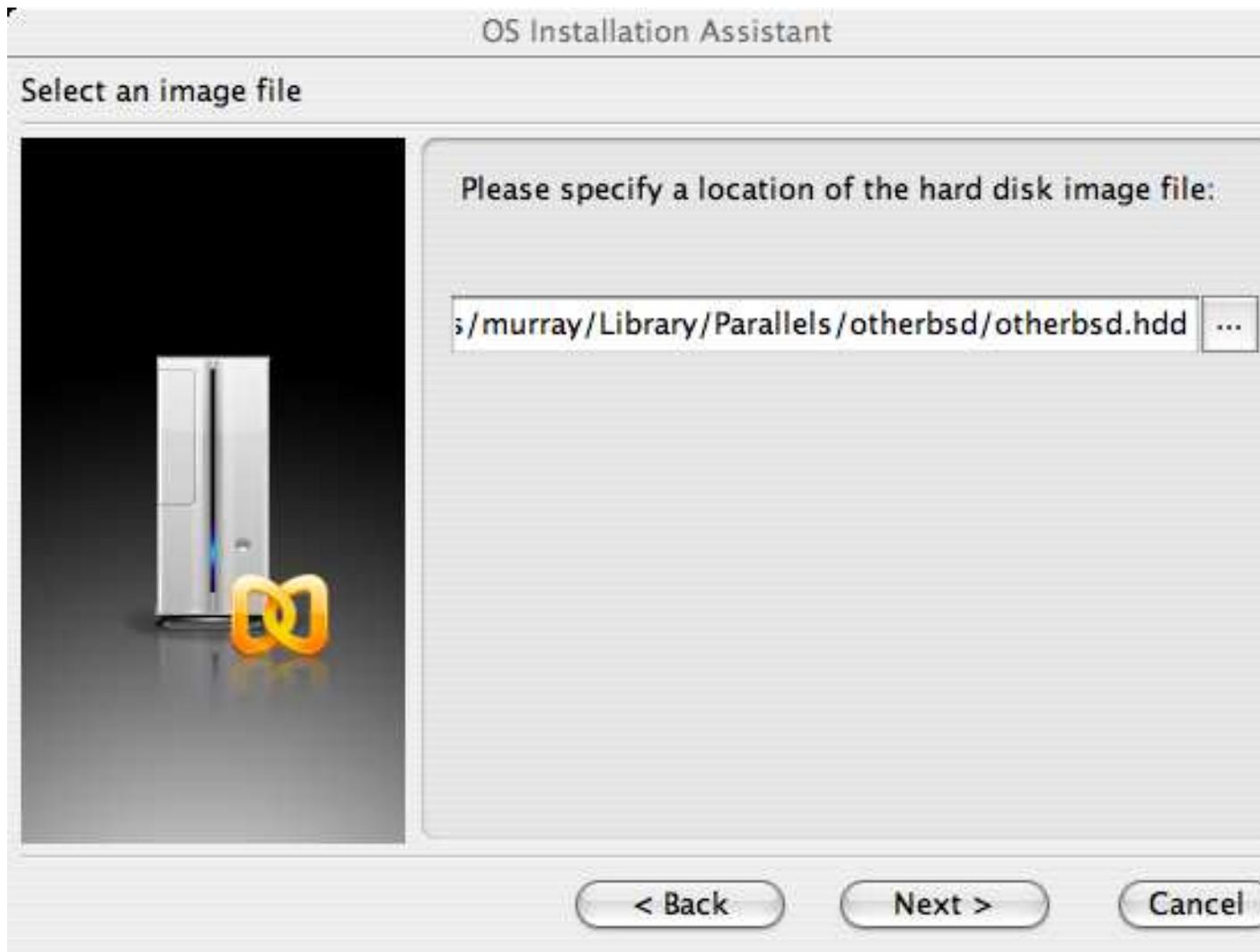


Ἡ βότα Ἰά ἐραεῖν ἰῶαδὲρ ἀβόειρ ἐαε ἰβιçð ðῖο ἰά αἰδᾶδῖεῖνβῖαδᾶε ὁά ὁ ÷ Ἰαεά ðῖο Ἰ ÷ ᾶδᾶ ᾶεά ὁçῖ ᾶεῖῖεῖδῖβçð ðῖο FreeBSD. 4GB ἀβόειρ ἐαε 512MB ἰβιçð ᾶῖὄεῖῖῖῖ ἰεά ÷ ᾶñÛ ᾶεά ὁῖðð ðᾶῖεῖῖῖῖῖῖð ÷ ñβὄδᾶð ὁῖο FreeBSDῖῖὄᾶ ᾶδῖ ὁῖ **Parallels**:

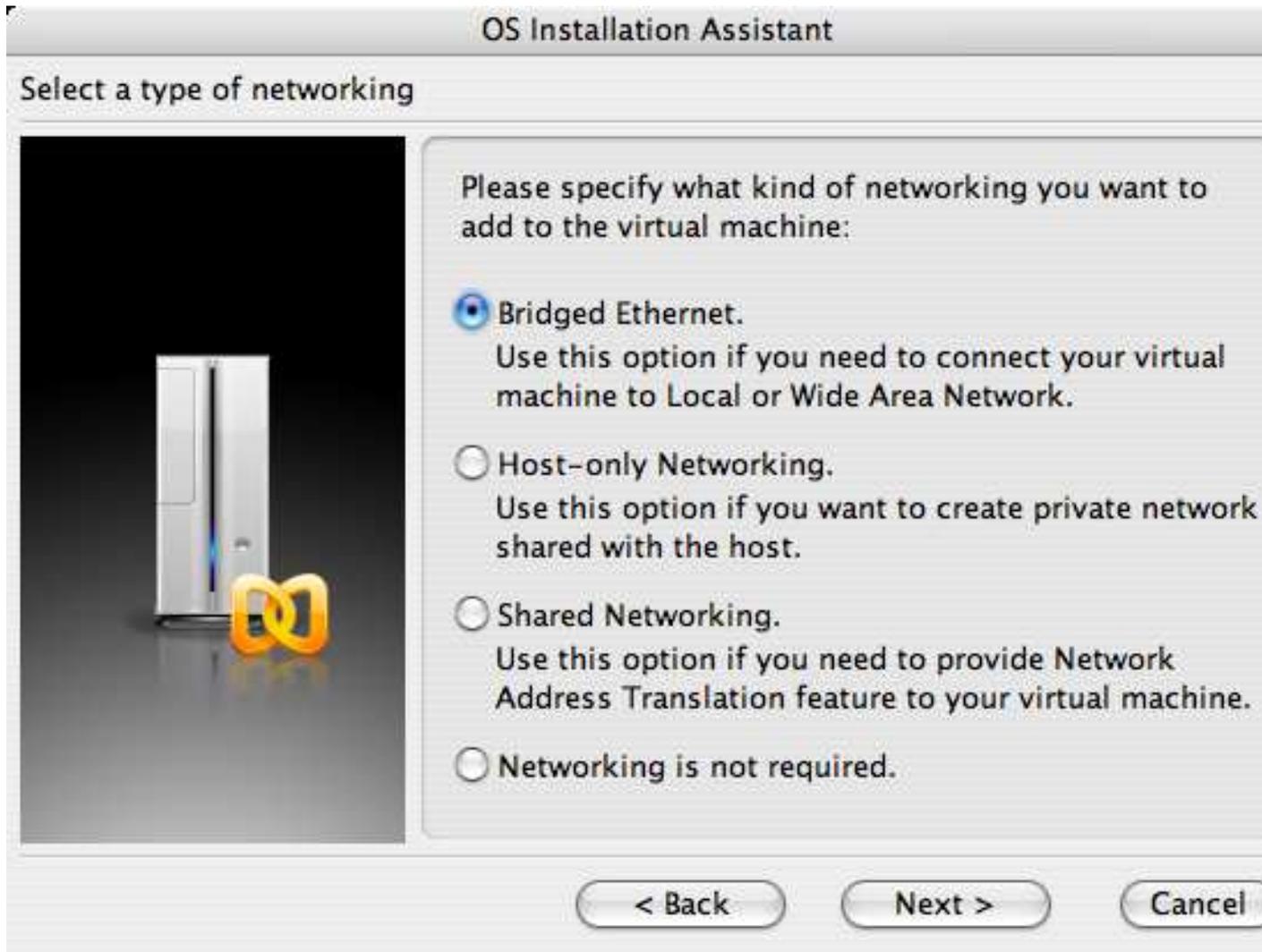


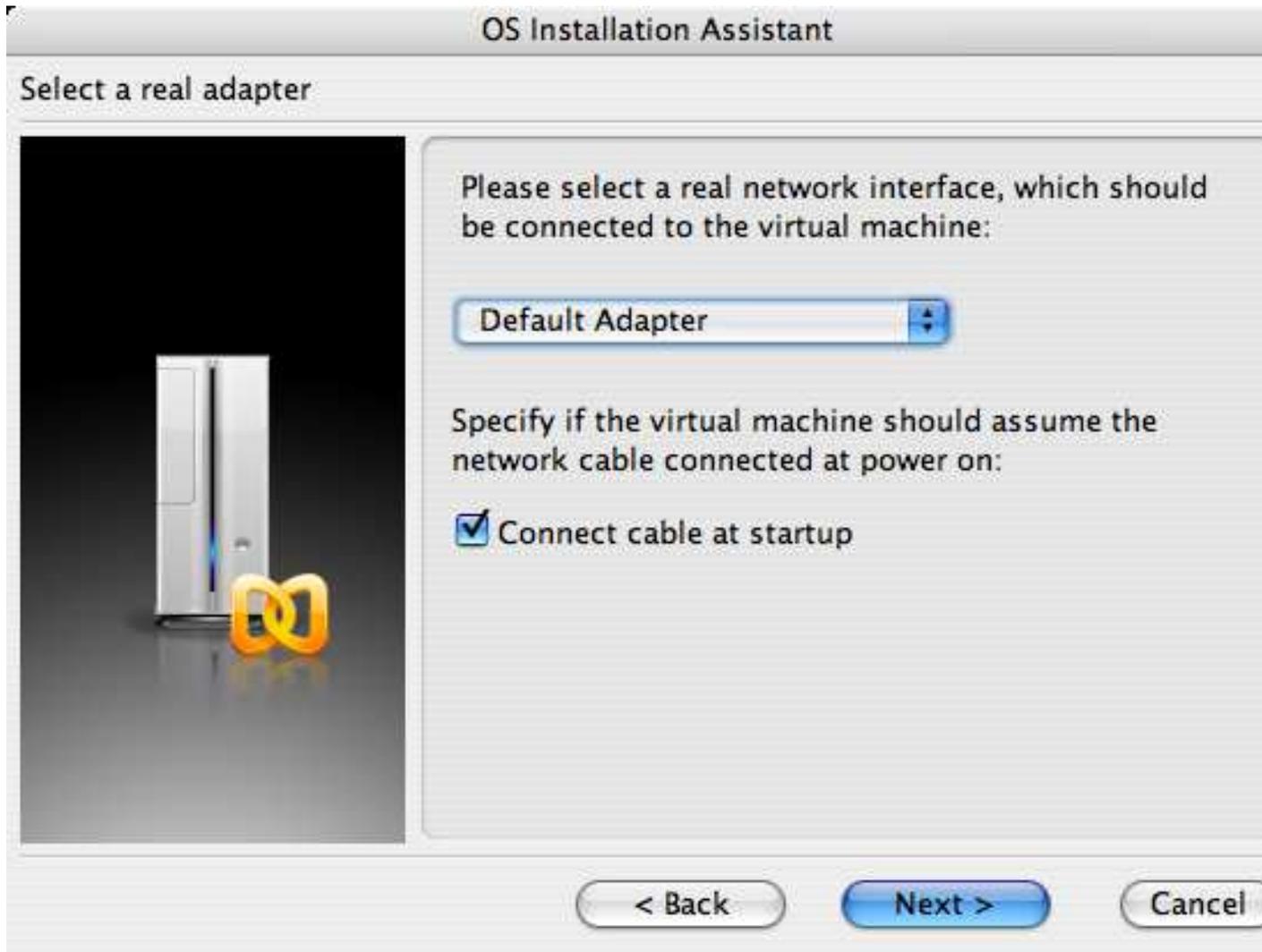






Αδέσ Υίτττ όιι όγδι αέέόγύόσδ έάέ όιι όπυόάνιττ Άά αέέόγύό:



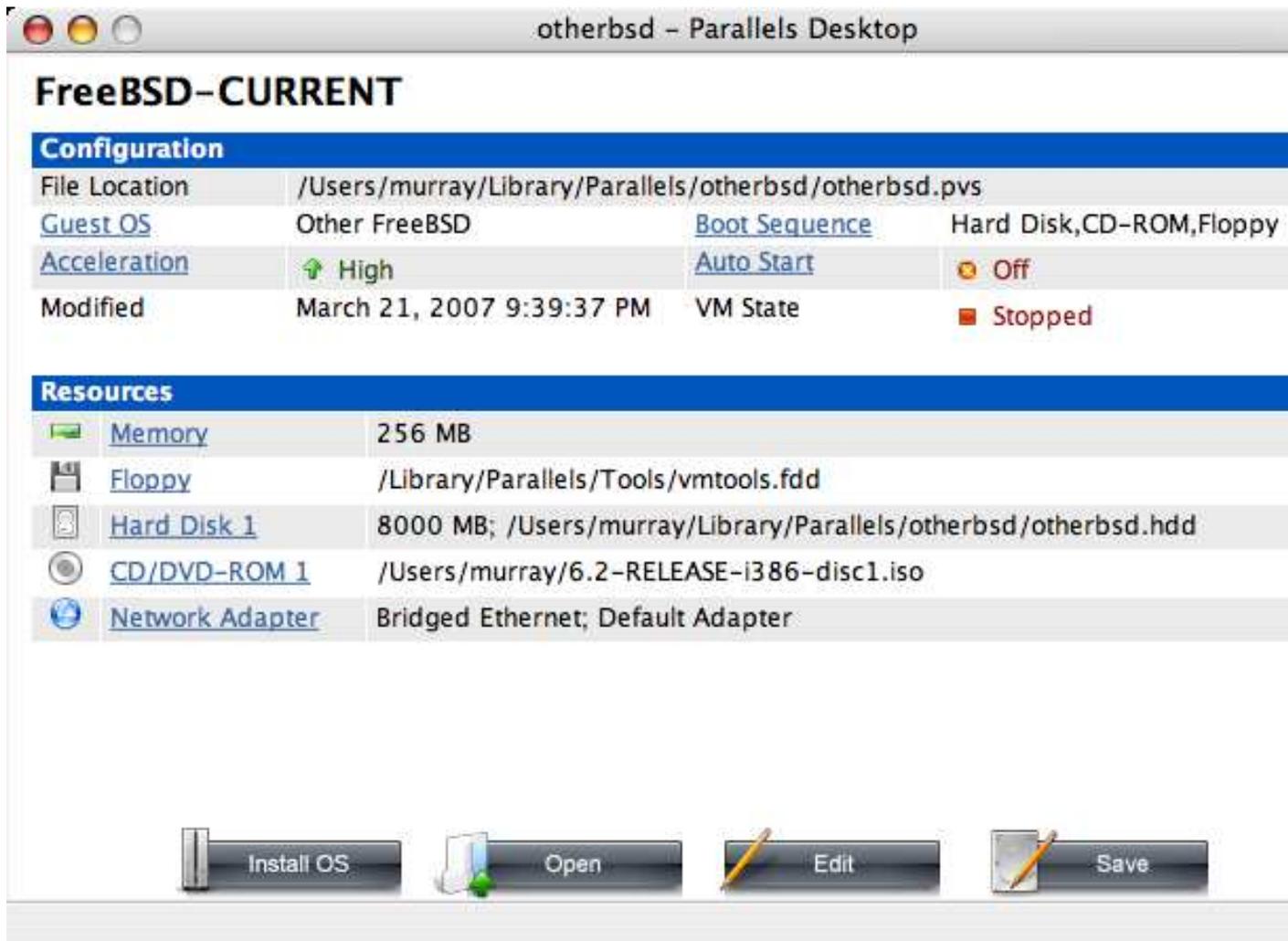


Άδελφός έάέ οΎεο ούι ηδελφός:

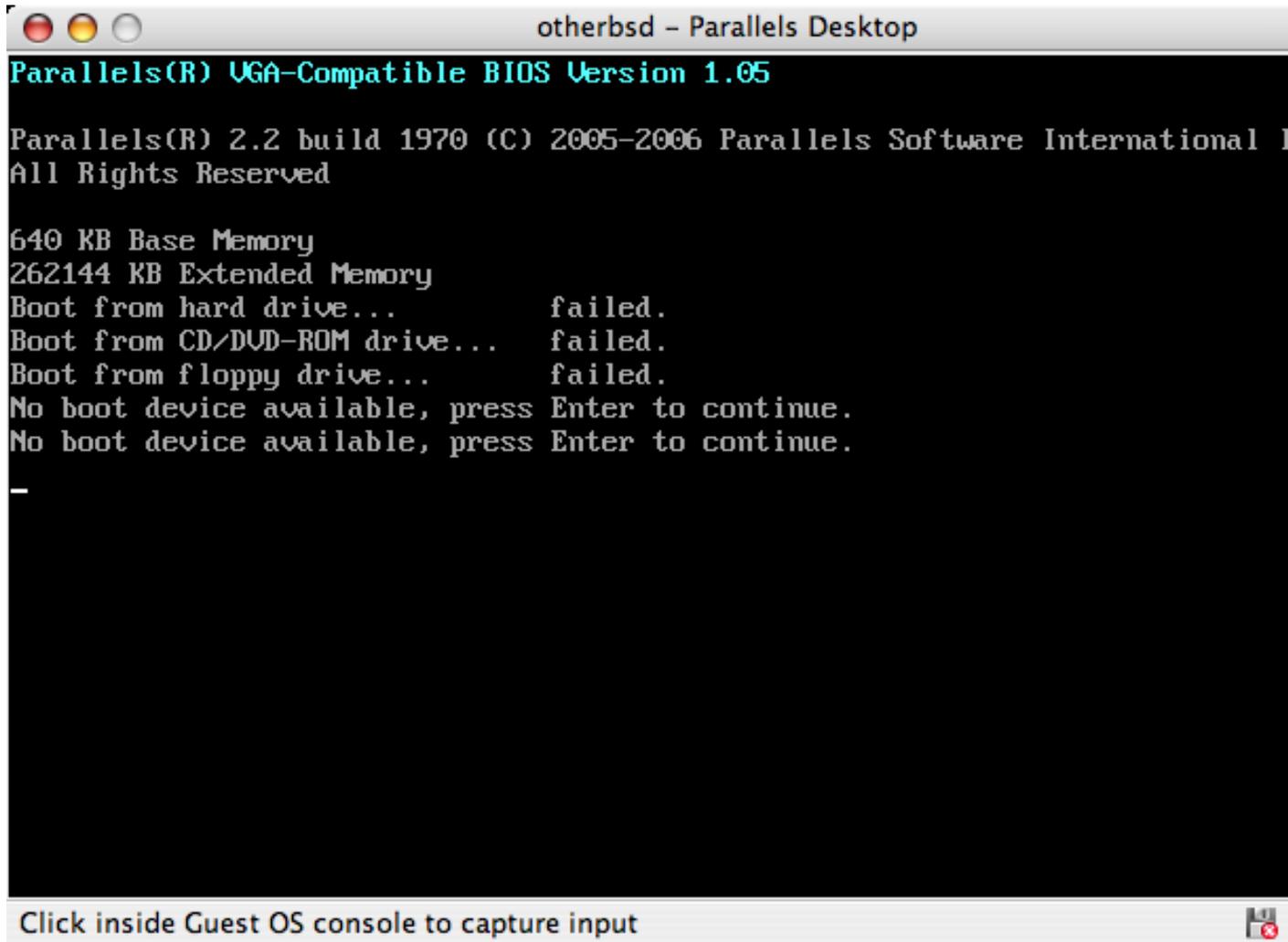




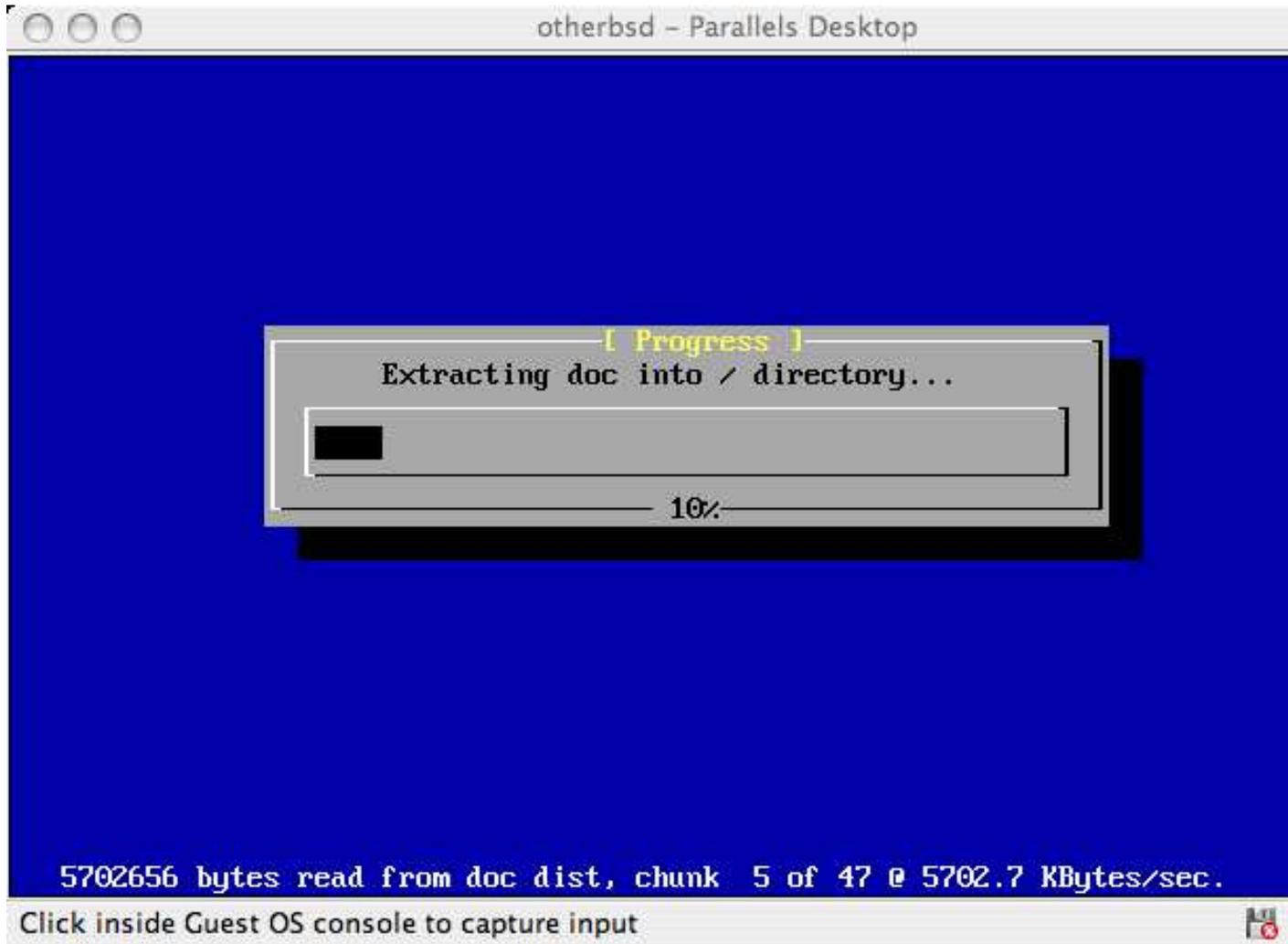
¼óáí ðí áέέιέέú óύóóçιά Ý ÷ áέ äçìέιòñāçèåß, èá ÷ ñāέάóðåß íá ååέάóáóðóååå ðí Βάέι ðí FreeBSD. Ì éáέýóåñíò ðñúðíð ñέá íá ñβίáέ ç ååέάóÙóóáóç åβίáέ íå ðí åðβóçíí FreeBSD CD-ROM Þ íå εÙðίέíí åñ ÷ åβí ISO, éáóååáóίÝíí áðu ðíí åðβóçíí FTP ðúðí. ¼óáí Ý ÷ åðå ðí éáóÙέέççí ISO óðí óέέçñú óáð, Þ ðí CD-ROM óðíí íäçåú CD, áíññíðίέÞóåå íå ðí ðííóβέέ ðí áέέιíΒάέí ðíó CD óðí εÙðú åñíβ íÝñíð ðçð ðèúíçð ðíó **Parallels**. Ìå áððúí ðíí ðñúðí èá ðñíñÝóåå íá ññβóååå ðçí ðçåÞ ðçð ååέάóÙóóáóçð. Ìðñåβóå íá ññβóååå ðí CDROM Þ εÙðίέíí áέáέÝóέíí ISO åñ ÷ åβí.



¼οάι Ý ÷ àοà áíοέοοίε ÷ Ροάε οç δçāP āāēáoŪοόάοçò, àðáíāēēéíΡοόά οί áēéííēēü óýοόçíá ðáòÞíοάò áðēŪ οί ēíòíðβ οçò āðáíāēēβίççò (reboot) οίò **Parallels**. Οί **Parallels** εά íāēéíΡοάε íā Ýíá áēāēēü BIOS οί íðíβí ðñÞοά āēÝā ÷ áē āŪí οðŪñ ÷ áē āēāēÝóēíí ēŪðíēí CD-ROM, ūðòò ēŪíāē ēáē Ýíá οòóēíēíāēēü BIOS.



Óå áððð ðç ðåñβððùός εά åñåέ ðί ιΎόί ååέάóÛόόάόçð ðιò FreeBSD έάέ εά ιåέείβόάέ ðί **sysinstall** ùðùò ðåñέåñÛόåόάέ óðί ÊäöÛεάεί 2. Ìðιñåβðå ίά ååέάόάóðβόåðå ðί X11, åέεÛ ιç åñέείÛόåðå ίά ñòέιβόåðå áððð ðç óóέåιð.



40áí ðáèáεπόάðá íá ðçí ááèáðÜóóáός, εÜíðá íéá áðáíáèèΒίός όðí ðñÝόèí áéèíéèü FreeBSD.



### 3. Ñýεíεçç äééçýíç

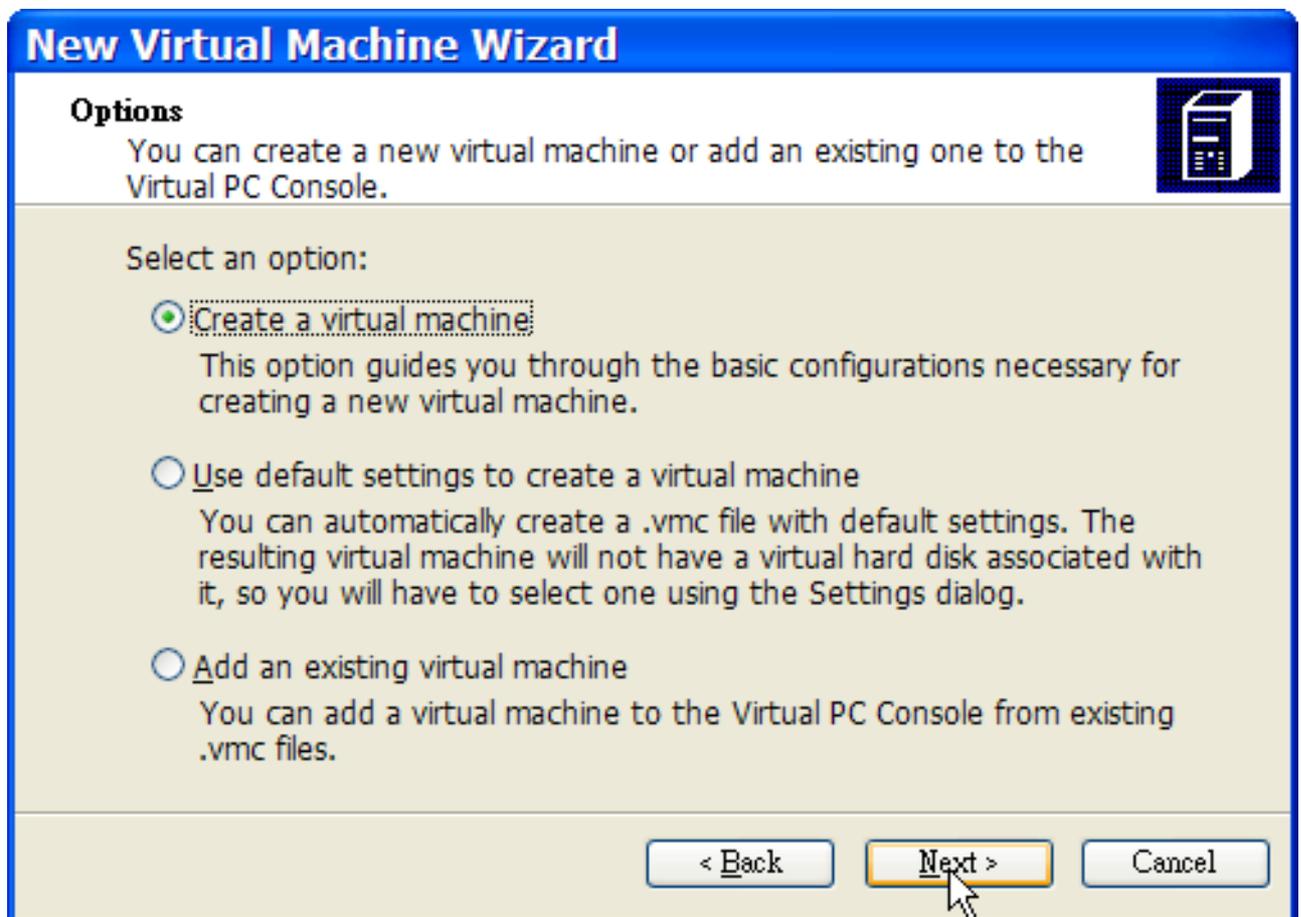
Ç ðéí áðεP ñýεíεçç äééçýíç εÙíáé ÷ñPçç çíç DHCP áéá íá ççíááεáβ çí äééííééü çáç çýçççíá ççí βáéí çíðééü äβéççí íá çíí Mac. Áççü íðíñáβ áýêíéá íá áβíáé íá çí íá ðñíçèÝçáçá çç ãñáíñP ifconfig\_ed0="DHCP" ççí /etc/rc.conf. Ðíεçðéíéüçáñáç ñçèíβçáéç äééçýíç ðáñéãñÙçííçáé ççí εàoÙεάéí ΕὰοÙεάéí 31.

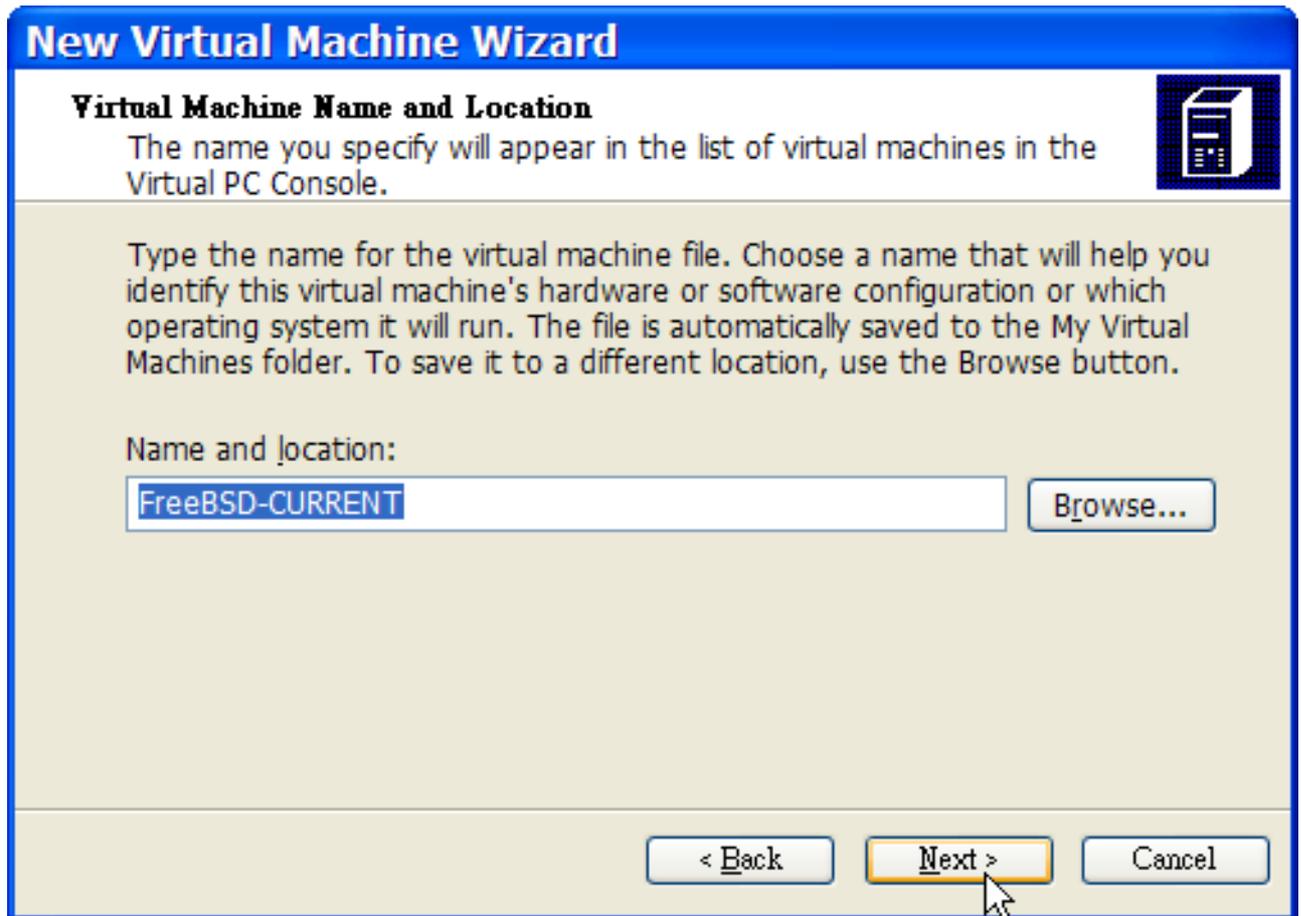
## 22.2.2 Çí Virtual PC ççá Windows

Çí **Virtual PC** áéá Windows áβíáé Ýíá ðñíúíí ççç Microsoft çíç äéáçðβéáççé áéá àññáÙí εáçÝááçíá. Ááβçá çéç áðáéçðçáéç ççççðçíáççíç (<http://www.microsoft.com/windows/downloads/virtualpc/sysreq.mspx>). ÌáçÜ ççí ááéáççÜççáçç çíç **Virtual PC** ççá Microsoft Windows, ï ÷ñPçççç ðñÝðáé íá ñçèíβçáé Ýíá äééííééü íç÷Ùíçíá éáé íá ááéáççáçççáé çí çééíñáíýíáñí éáéçíçñáééü çíç áðééçíáβ.

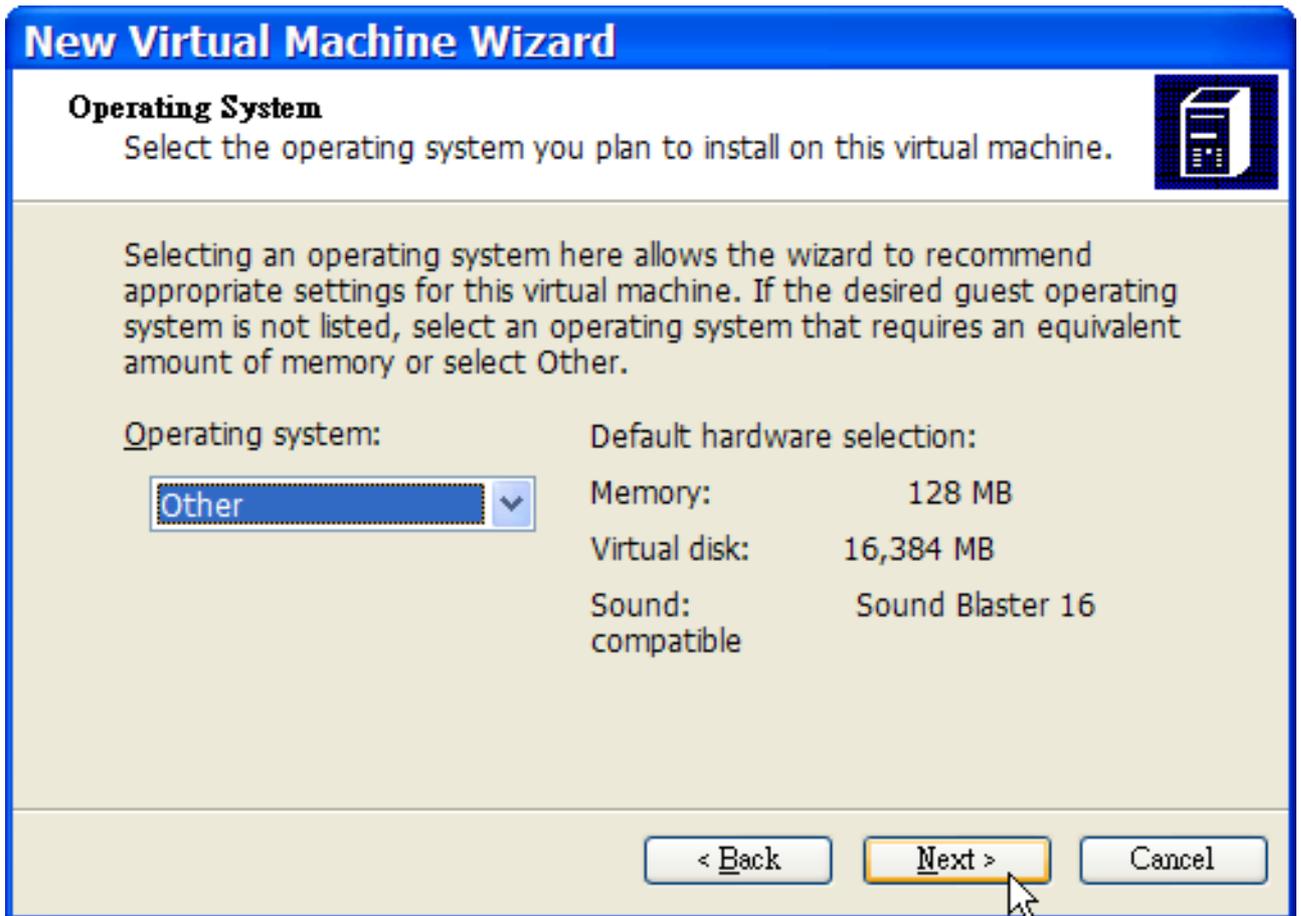
### 22.2.2.1 ÁáéáççÜççáçç çíç FreeBSD ççí Virtual PC/Microsoft® Windows

Çí ðñççí áPíá çççí ááéáççÜççáçç çíç FreeBSD ççá Microsoft Windows íá ÷ñPçç çíç **Virtual PC**, áβíáé ç çççéíçñáβá áñüç íÝíç äééííééýí íç÷áíPíáççíç áéá ççí ááéáççÜççáçç çíç. ÁðééÝíçá Create a virtual machine üçáí áñüççéáβçá:





Όχι άποός Operating System άέέΥίά Other:



ΑδεεΎιοά Ύδαεοά εαοΰεεεερί ιΎααερίο αέα οί οεεεεεεε αβόεε εαέ οε ιίΠιζ RAM οίο αέεεεεεεε ιε÷αίΠιαόιδ, αίΰεεεεεε ιά οε ÷ηΠός οίο οεεεεεεεεεεε ιά εΰεεεεεε. Οόεδ δαηεεεεεεεεεεε δαηεεεεεεεεεεε, οά 4GB αβόεεε εαέ 512MB RAM αβίάε αηεεεεεε αέα ÷ηΠός οίο FreeBSD οόι **Virtual PC**:

### New Virtual Machine Wizard

**Memory**  
You can configure the RAM on this virtual machine.



To improve the performance of this virtual machine and run more applications on its operating system, increase the amount of RAM allocated to it. To leave more RAM for other virtual machines on your system, use the recommended RAM allocation.

Recommended RAM: [128 MB]

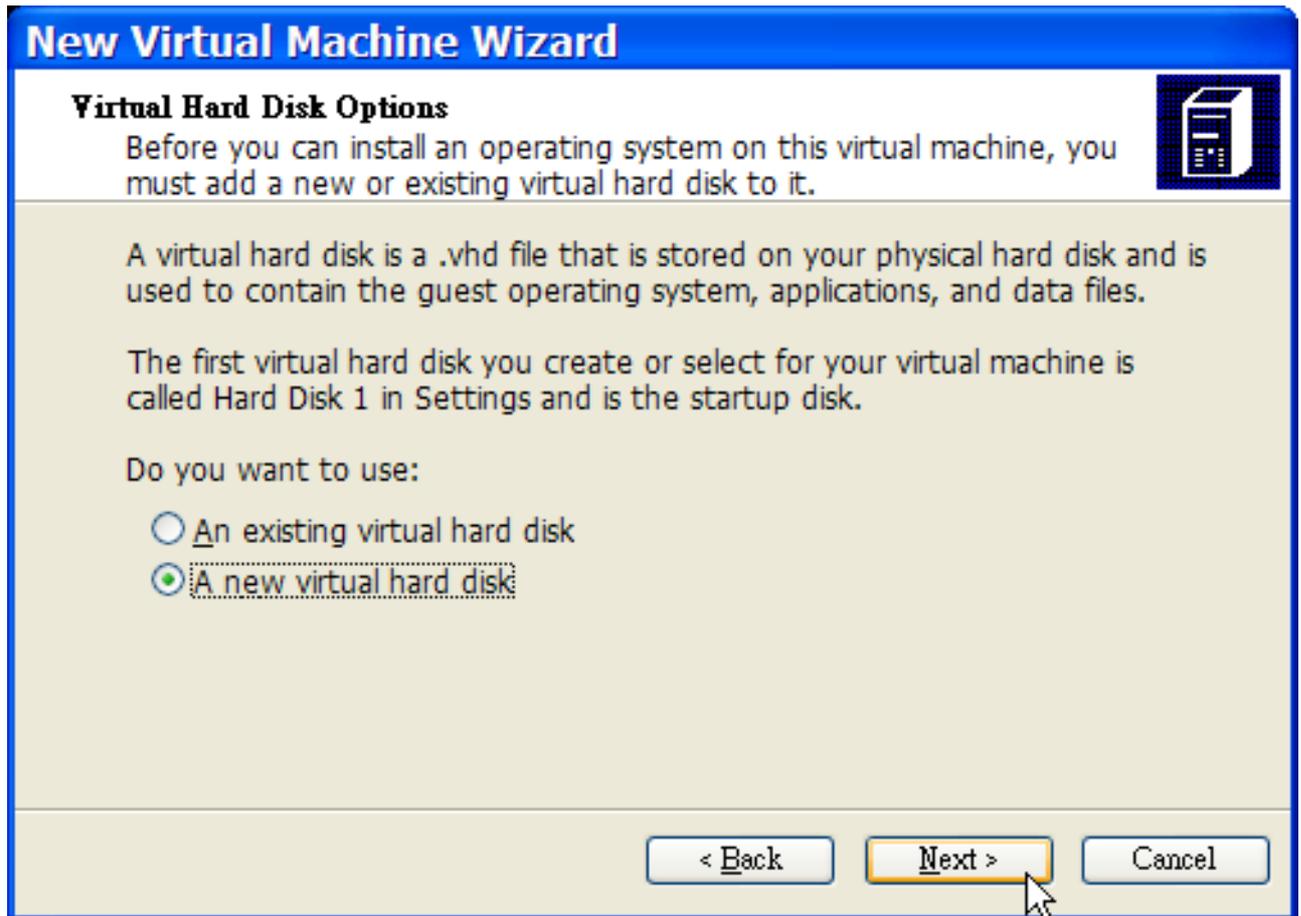
Allocate RAM for this virtual machine by:

- Using the recommended RAM
- Adjusting the RAM

Set the RAM for this virtual machine:

4 MB  1079 MB  MB

< Back   Next >   Cancel



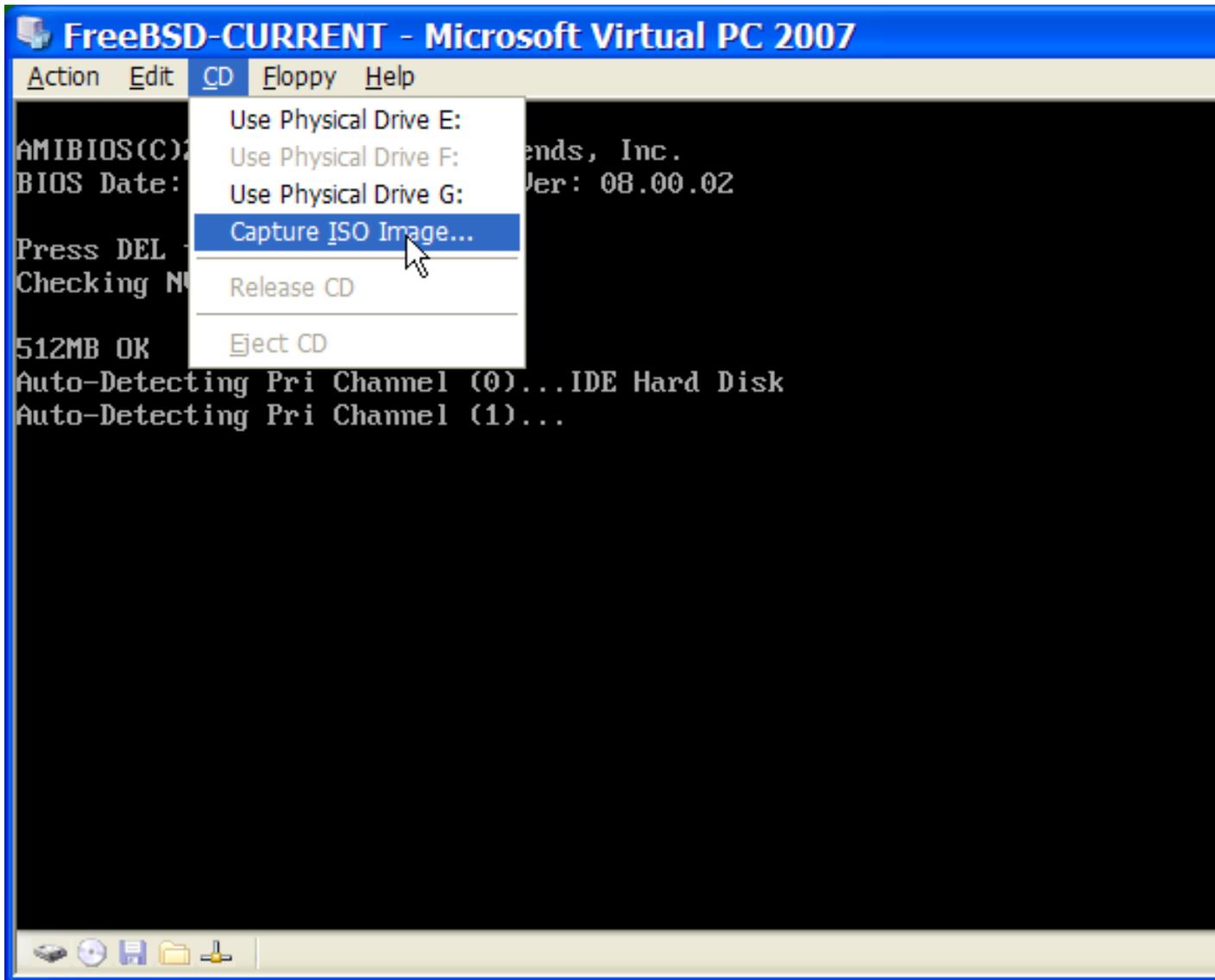
Ίερέεηπόά άδρέεάγίόάδ όέδ ηόειβόάέδ:



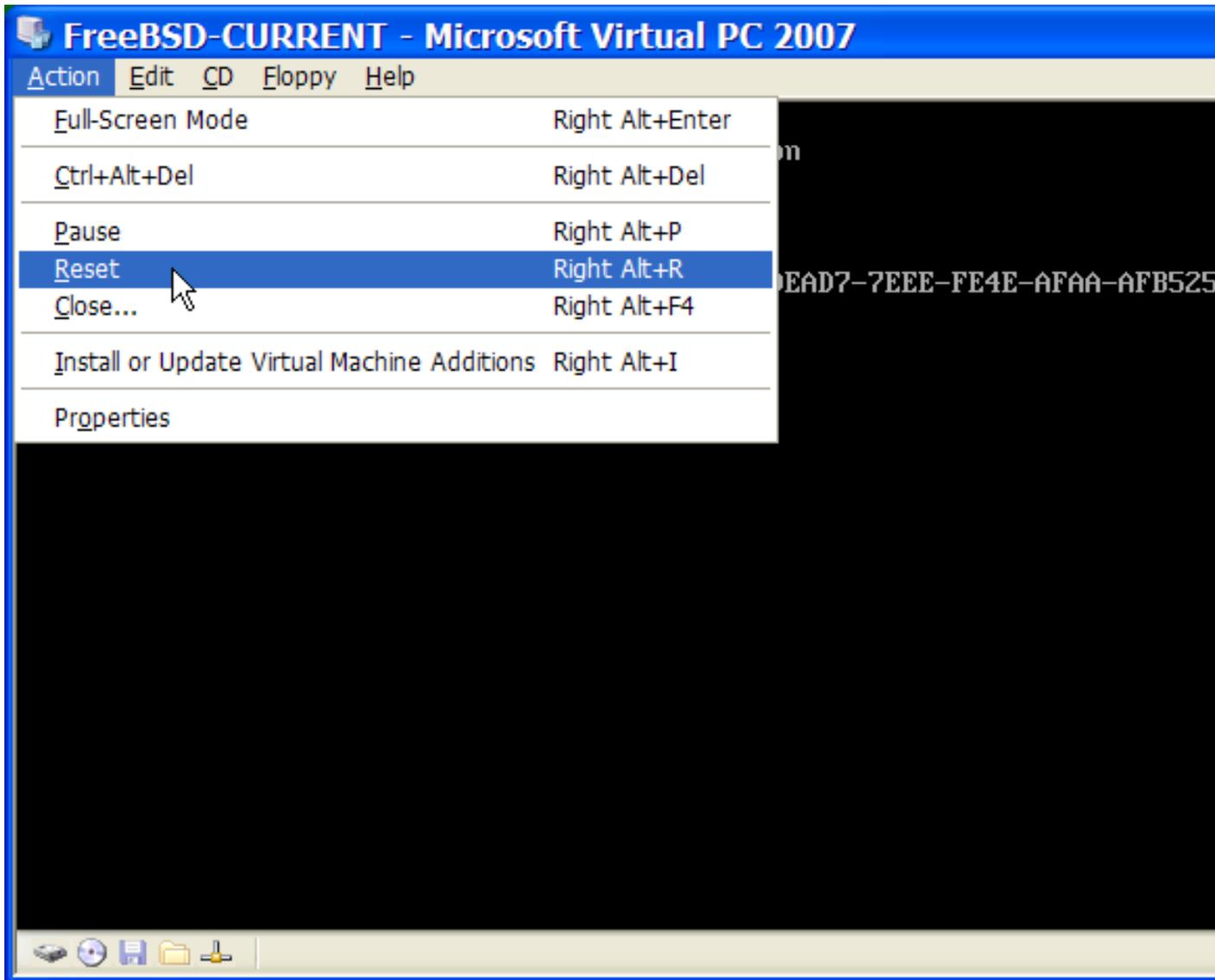




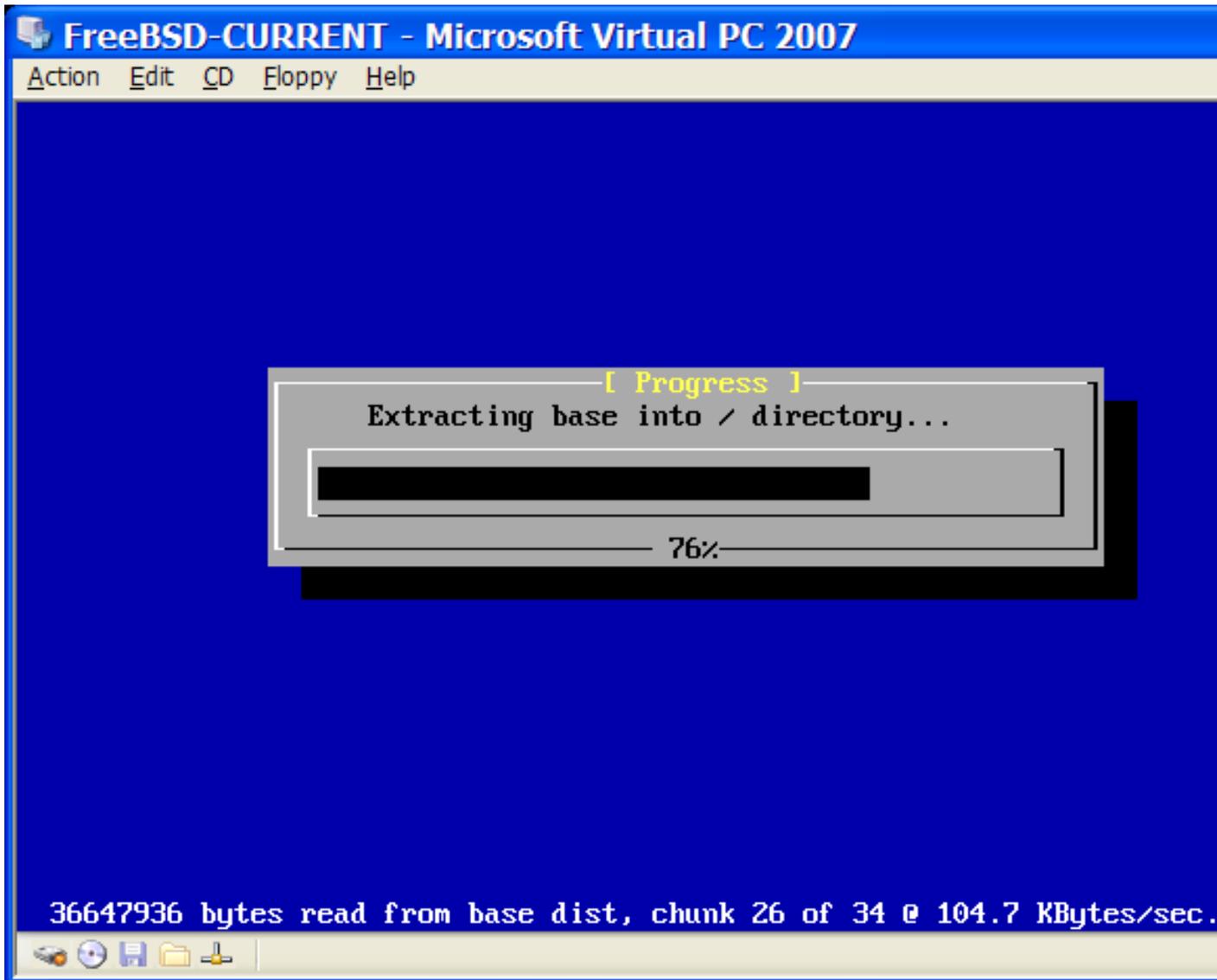




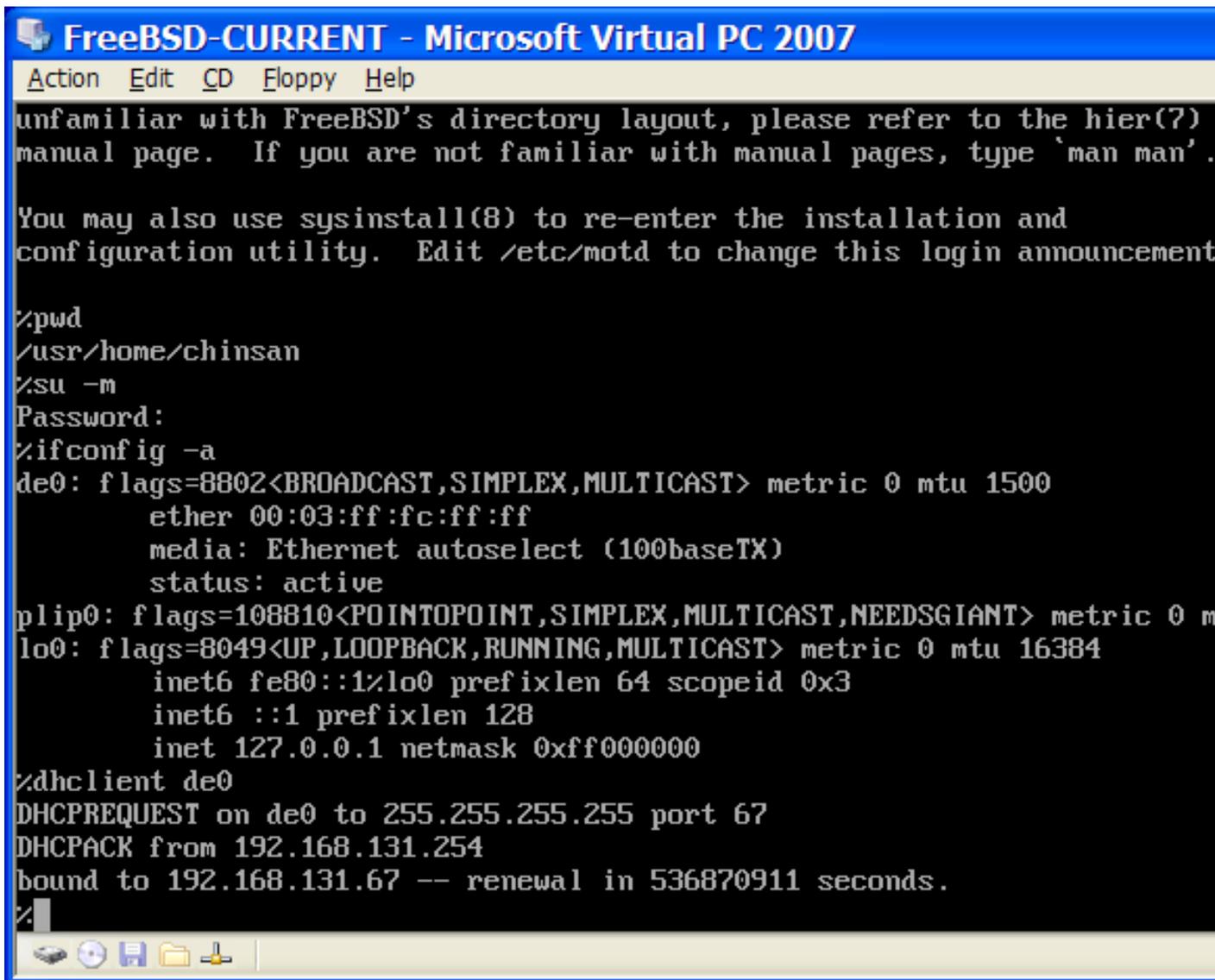
Το εικονομαχία του οπτικού δίσκου (CDROM) στο Virtual PC, μπορεί να χρησιμοποιηθεί για να δημιουργηθεί ένα εικονομαχικό δίσκο (ISO Image) από το CDROM που είναι ενσωματωμένο στο Virtual PC. Για να γίνει αυτό, πρέπει να πατηθεί το κουμπί 'Capture ISO Image...' στο μενού 'CD'. Η διαδικασία αυτή είναι απαραίτητη για να μπορεί ο υπολογιστής να φορτώσει το FreeBSD από τον εικονομαχικό δίσκο.



Όδες έέεΠ ιάδ δάνβδδουός, έά άίέ :- ίάγύάέ θι ιΎόι άάέάδÛόόάόςδ θιō FreeBSD έάέ έά ίάέέίΠόάέ ζ όδίçέέόιΎίç έέάάέέάόβά άάέάδÛόόάόςδ ιΎούθ θιō **sysinstall**, ύδθδ δάνέάνÛόάόάέ όθι ÊäöÛεάέι 2. Ìθιñάβδά ίά θñι :- ύñΠόάόά ίά όçί άάέάδÛόόάός, άέέÛ ίç δñιόδάεΠόάόά ίά ñδèιβόάόά θι άñάέέü όγόόçιά X11 όç άάññΎίç όδέέιΠ.



Η διαδικασία εκτέλεσης της εγκατάστασης, η οποία γίνεται μέσω του CDROM ή του DVD (ή μέσω της εικόνας ISO). Η διαδικασία εκτέλεσης της εγκατάστασης του FreeBSD.



### 22.2.2.2 Νύειέόç ðĩō FreeBSD óĩ Virtual PC óå Microsoft Windows

ΊåðŪ ðçĩ åðéð ÷ ð ååéåðŪóóåç ðĩō FreeBSD óóå Microsoft Windows ìŶóù ðĩō **Virtual PC**, éå ðñŶðåé íå åéðåŶóåðå íéå óåñŪ åðũ ñðèìβóåéð åéå íå ååéðéóóĩðĩéðóåðå ðçĩ éåéðĩðñåβå ðĩō óóóðβĩåðĩð óå ðåñéåŪééĩĩ åééĩĩééβð ìç ÷ åĩβð.

1. ÈŶóðå ðéĩŶð óóéð ìåðååççóŶð ðĩō òĩñòũðð åéèβĩççòð

Ç ðéĩ óçĩåĩðéèð ñŶéĩéóç åβĩåé íå ìåéðóåðå ðçĩ ðéĩð ðçð ìåðååççóðð kern.hz åéå íå ìåéðóåðå ðç ÷ ñðç ðçð CPU óĩ FreeBSD ũðåĩ ðĩ ÷ ñçóéĩðĩéåβðå óóĩ åééĩĩééũ ðåñéåŪééĩĩ ðĩō **Virtual PC**. Ἀðòũ ìðĩñåβ íå åðéðåð ÷ èåβ ðñĩóèŶóĩóåð ðçĩ ðåñåéŪòũ åñåìð óóĩ åñ ÷ åβĩ /boot/loader.conf:

```
kern.hz=100
```

× ùñβò áððß ðç ñýèιέός, ιέα áέέιίέέß ιç ÷ áίß FreeBSD óðι **Virtual PC**, ùóáf áέòáέáβóάέ ÷ ùñβò öιñòβι, έά ÷ ñçóέιιθιέάβ ðáñβðιò ðι 40% ðιò áðáíáñάάóðß óá Ýιί ιç ÷ Ûιçιá ιá ιβá CPU. ΙάðÛ áðu ðçι áέέάáß áððß, ç ÷ ñßός έά áβιáέ έιιðÛ óðι 3%.

2. Άçιέιòñáßóðá Ýιί ιÝι áñ ÷ áβι ñòèιβóáùι ðòñßιá

Ιðιñάβóá ιá áóáέñÝóáðá ùέá óá ðñιáñÛιáóá ιáßáçóçð ãέá óðóέáðÛð SCSI, Firewire έάέ USB. Òι **Virtual PC** ðáñÝ ÷ áέ ιέα áέέιίέέß εÛñóá áέέóγιò ç ιθιβá ðθιðóçñβæáðáέ áðu ðι ðñúáñáιá ιáßáçóçð de(4), Ûñá ιðιñάβóá ιá áóáέñÝóáðá ùέáð ðέð Ûέέáð εÛñðáð áέέóγιò áðu ðιι ðòñßιá, áέðιð áðu ðι de(4) έάέ ðι miibus(4).

3. Ñýèιέός áέέóγιò

Ç ðεί áðßß ñýèιέός áέέóγιò ðáñέέáιáÛιáέ ðç ÷ ñßός ðιò ðñùðιέúέέιò DHCP áέá ιá óðιáÝóáðá ðι áέέιίέέú ιç ÷ Ûιçιá óáð óðι βáέι ðιθέέú áβέððι ιá ðι ιç ÷ Ûιçιá ιáιέóðß. Άóðι áðέóðá ÷ Ûιáðáέ ðñιòέÝðιιðáð ðç áñáιιß ifconfig\_de0="DHCP" óðι /etc/rc.conf. Ιðιñάβóá ιá áñάβóá ðεί ðñι ÷ ùñçιÝιáð ñòèιβóáέð áέέóγιò óðι ÊäöÛεάεί 31.

### 22.2.3 Òι VMware óá MacOS

Òι **VMware Fusion** áέá Mac áβιáέ Ýιί áιðιñέέú ðñúáñáιá. ÒðÛñ ÷ áέ áέáέÝóέιι áέá ðθιιέιáέóðÛð Apple Mac áñ ÷ έðáέðιιέέßð Intel ðιò ðñÝ ÷ ιòι Mac OS 10.4.9 ð εÛðιέá ðεί ðñúóóáóç Ýέáιòç. Òι FreeBSD ðθιðóçñβæáðáέ ðεßñùð ùð ðέέιñáñιγίáñι (guest) έáέðιòñáέέú. Ιùέέð ιέιέççñùέáß ç ááέáðÛóðáóç ðιò **VMware Fusion** óðι Mac OS X, ðñÝðáέ ιá ñòèιβóáðá ιέα áέέιίέέß ιç ÷ áίß έάέ ιá ááέáðáóðßóáðá ðι ðέέιñáñιγίáñι έáέðιòñáέέú óýóðçιá.

#### 22.2.3.1 ΆáέáðÛóðáóç ðιò FreeBSD óðι VMware/Mac OS X

Άñ ÷ έέÛ ιáέέιßóðá ðι VMware Fusion, έάέ έá öιñðßóáέ ç Óðέειáß Άέέιίέέßι Ιç ÷ áίßι. ΆðέέÝιòá "New" áέá ιá äçιέιòñáßóðá ιέα ιÝι áέέιίέέß ιç ÷ áίß:



Èá äåβåå íá öiñòþíáé öi New Virtual Machine Assistant, öi äiçèçðééü ðñüãñáíá àçìéiðñåβåð íεåð íÝåð åέéiíééβð ìç÷-áfβð. ΆðéëÝíðå Continue åéá íá óóíå÷-βóååå:



Όχι αδειάει εαέοιναέεγύ οδοδΠιάοιò äéäéÝîä Other äéé ùð Ýäüíóç ääéοιñäééγύ οδοδΠιάοιò äéäéÝîä FreeBSD  
P FreeBSD 64-bit (áÜëíä ä òí áí èÝäòä òðíóðñéíç äéä 64-bit äóáñíäÝò P ü÷-é):



Άπόά Υία υίνα αέα οι VM Image εάε ηδèιβόά οι εάδΥετiι όοιι ιδiβi εΥεάά ίά άδiεçεάδèåß:



Νόειβόα ήι ιΥάαèò òìò Άέêίέêίγ Άβóêìò ãέα òçί áέêίέêêΠ ιç÷-άίΠ:



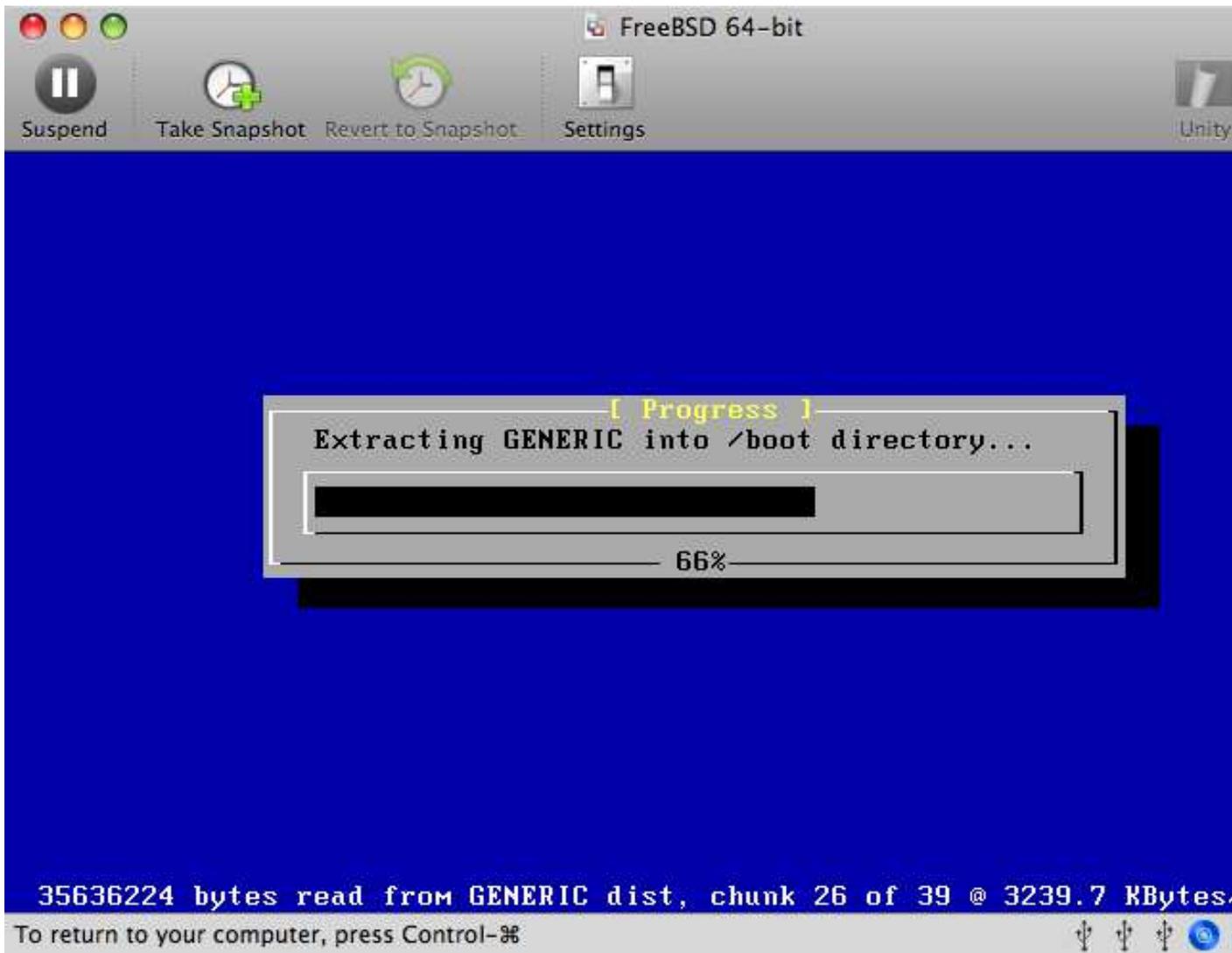
Άδée Ýíòå ðέα ðÝèäï äåέάòÛóóάóçð ãέα ðçí åέèíέέêÞ ðç÷-άíÞ: åβðå áðü Ýíå ISO image åβðå áðü ðï CD-ROM:



Προσέχετε να έχετε επιλέξει το 'Finish', να έχετε επιλέξει να ξεκινήσετε την εγκατάσταση τώρα (boot):

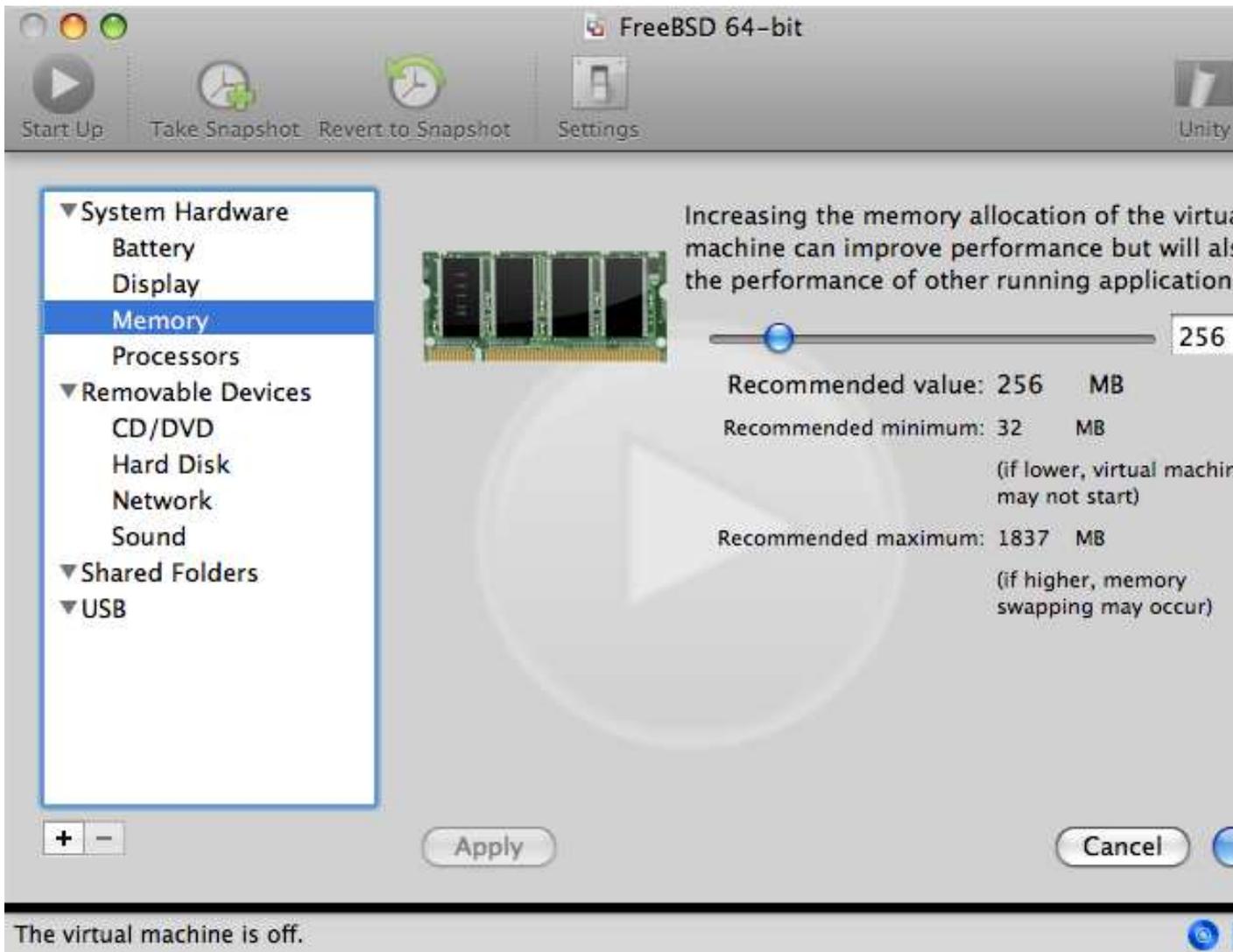


Áäéáóáóðóá òí FreeBSD ùðùð éá éÛíáðá éáé óá ïðíéíäððíóá Ûëëí ððíéíäéóðð, ð áéíéíðëðíóáð óéð ïäçãßàð áðü òí ÊäöÛäáí 2:



Τὸ ἐξῆς κῆρυγμα εἶναι ἀπὸ τὴν ἐκδόσιν, ἡ ἡμετέρα ἵα ἀεὶ ἡμετέρα ὁ ἐξῆς ἀεὶ ἡμετέρα ἡμετέρα, ὑπὸ ὅ.δ. οἱ ἡμετέροι  
 ἡμετέροι δὲ εἰς τὴν ἐκδόσιν:

**Ὁρίσματος:** Ἡ ἡμετέρα ὁ ἐξῆς ἡμετέρα ἡμετέρα ἡμετέρα ἡμετέρα ἡμετέρα ἡμετέρα ἡμετέρα ἡμετέρα ἡμετέρα  
 ἡμετέρα.



Ίδιναβόα, áέιις, ίά ηόειβόαόά οίί άνέειυ ούί άδαιάναάόοίί οίτοδ ίδιβίτοδ άδεόηΰδαόάέ ίά ÷ ηζόείιδιέΠοάέ άδοΠ ζ άέειίέΠ ις ÷ άίΠ:



Εάν ο υπολογιστής σας είναι 32-bit, τότε ο εικονισμός του FreeBSD θα πρέπει να είναι 32-bit. Εάν ο υπολογιστής σας είναι 64-bit, τότε ο εικονισμός του FreeBSD μπορεί να είναι 32-bit ή 64-bit. Ο εικονισμός του FreeBSD μπορεί να είναι CD-ROM ή ISO image. Εάν ο υπολογιστής σας είναι 32-bit, τότε ο εικονισμός του FreeBSD πρέπει να είναι 32-bit. Εάν ο υπολογιστής σας είναι 64-bit, τότε ο εικονισμός του FreeBSD μπορεί να είναι 32-bit ή 64-bit.



Ἦναι ἀδύνατον νὰ ἐπιβλεπῶμεν τὴν ἰστοσελίδα ἀπὸ τὸν ὑπολογιστὴν ἡμῶν. Ἐάντις τῆς ἰστοσελίδας ἡμῶν ἔστιν ἡ ἀπαιτούμενη ἰστοσελίδα, ἀπαιτούμεθα ὅπως ἀπευθύνῃτε Connect directly to the physical network (Bridged). Ἐάντις, ἂν τῆς ἰστοσελίδας ἡμῶν ἔστιν ἡ ἀπαιτούμενη ἰστοσελίδα, ἀπαιτούμεθα ὅπως ἀπευθύνῃτε ἡμῶν τὴν ἰστοσελίδα ἡμῶν ὡς ἀπαιτούμεθα ὅπως ἀπευθύνῃτε Share the host's internet connection (NAT).



Ïüέò ðáέáέρðáðά ìά áòðÝð ðέò ñòèìβóáέò, ìθìñάβðά ìά áέέέίρðáðά ðç ìÝά áέέίíέê ìç÷-άίρ ìά ðì òñάóέι-άáέάðáóóçìÝíí FreeBSD óáð.

### 22.2.3.2 Ñòèìβóáέò ðìò FreeBSD ìÝóά óòì Mac OS X/VMware

Áòìγ ðáέáέρðáðά ìά ðç ìάέáðÜóóáóç ðìò FreeBSD óά ìέά áέέííέê ìç÷-άίρ **VMware** ìÝóά óά Mac OS X, ðñÝðáέ ìά εÏíáðά εÏθίέáð ñòèìβóáέò áέά ìά ááέðéùέáβ ç áðìüáíóç ðìò FreeBSD ùð óέññάíγíάíñò óðóðρíáðìò.

#### 1. Ñòèìβóáέò ìáðááέçðρì ðìò boot loader

Ç ðέì óçìáíóέê ñýèìέóç áβίáέ ìά ìáέρðáðά ðç ðέìρ ðçð ìáðááέçðρð kern.hz, áέά ìά ìáέùέáβ εÏθùð ç ÷ñρóç ðìò áðάíñááóðρ áðì ðì FreeBSD έάέρð ðñÝ÷-άέ ìÝóά óòì **VMware**. ÐñìòεÝóά, έιέðüí, ðç ðάñáέÏòù ãñáíìρ óòì áñ÷-άβì /boot/loader.conf:

```
kern.hz=100
```











```
:charset=ISO-8859-1:\
:lang=de_DE.ISO8859-1:
```

ΔάναέÛòù äéÝðáòá Ýία .login\_conf óοι ιðίβι ιέ ιάοάάεçðÝð Ý ÷ ιοι óäèáß äéá ΔάναάιιόεάÛ ÈéíÝæééá óá èùäééιðιβçç BIG-5. ΔάναόçñΠόόά üóé Ý ÷ ιοια èÝóáé ðιéý ðáñέóóüóáñáò ιάοάάεçðÝð, éáèðò èÛðιέáò áóáñιãÝð ääι óÝáιιόáé óúóòÛ óéò ιάοάάεçðÝð äéá ÈéíÝæééá, ΆέáðùιÝæééá éáé ÈιñáÛóééá.

```
#Users who do not wish to use monetary units or time formats
#of Taiwan can manually change each variable
me:\
```

```
:lang=zh_TW.Big5:\
:setenv=LC_ALL=zh_TW.Big5:\
:setenv=LC_COLLATE=zh_TW.Big5:\
:setenv=LC_CTYPE=zh_TW.Big5:\
:setenv=LC_MESSAGES=zh_TW.Big5:\
:setenv=LC_MONETARY=zh_TW.Big5:\
:setenv=LC_NUMERIC=zh_TW.Big5:\
:setenv=LC_TIME=zh_TW.Big5:\
:charset=big5:\
:xmodifiers="@im=gcin": #Set gcin as the XIM Input Server
```

Άέá ðáñέóóüóáñáò ðεçñιοιñβáò, äáβðá óéò Ñðειβόάέο óá Άðβðáäι Άέá ÷ äéñέóðΠ éáé óçι login.conf(5).

### 23.3.4.1.2 Ñðειβόάέο óá Άðβðáäι Άέá ÷ äéñέóðΠ

Άάάéèèáβðá üóé Ý ÷ äé ιñέóóáß ç óúóðΠ äεβóóá óóçι èèÛóç ðιò ÷ ñΠόç, óοι áñ ÷ áβι /etc/login.conf. Óοι áñ ÷ áβι áðòù éá ðñÝðáé ιá ððÛñ ÷ ιοι ιέ ðάναέÛòù ñðειβόάέο:

```
language_name|Account Type Description:\
:charset=MIME_charset:\
:lang=locale_name:\
:tc=default:
```

Ìá áÛóç òι ðñιçáιγíáιι ðáñÛááéäιá ιáò ðιò ÷ ñçóéιιðιéβóáιá Latin-1, òι áñ ÷ áβι éá ιιέÛæáé ιá òι ðάναέÛòù:

```
german|German Users Accounts:\
:charset=ISO-8859-1:\
:lang=de_DE.ISO8859-1:\
:tc=default:
```

Δñéι èÛíáòá áééáãÝð óóéò ÈèÛóáéð Άέóüäιò (Login Classes) ðùι ÷ ñçóðβι, äéðáéÝóðá óçι ðάναέÛòù áíóιéΠ:

```
cap_mkdb /etc/login.conf
```

βóðá ιá áíáñäιéçéιγí óοι óýóççιá ιé áééáãÝð ðιò èÛíáòá óοι /etc/login.conf.

### Άέéáãβ ÈèÛóáιí Άέóüäιò ιÝóù óçò vipw(8)

×ñçóéιιðιéβóá óçι vipw äéá ιá ðñιóéÝóáðá ιÝιò ÷ ñΠóðáò, éáé èÛíóá óçι éáóá ÷ ðñέóç ιá ιιέÛæáé ιá óçι ðάναέÛòù:

```
user:password:1111:11:language:0:0:User Name:/home/user:/bin/sh
```



1.

```
setenv LANG de_DE.ISO8859-1
```

ÁíÛëíáá ìá òí èÝέòòòð ðìð ÷ ñçóέíìðìέáβòá (ááβòá ðáñáðÛíù).

### 23.3.5 Ñðèìβóáéð áéá òçí Êìíóüéá

Áέá üéá òá single C óáð ÷ áñáéðΠñùí, ìðìñáβòá ìá èÝóáðá ðéð ãñáìíáðìíóáέñÝð òçð èìíóüéáð òðì /etc/rc.conf áéá òçí áðéèðìçðΠ äèβóóá, ãñÛòííóáð:

```
font8x16=font_name
font8x14=font_name
font8x8=font_name
```

Õì font\_name áäβ ðñìéýððáé áðü òí áíðβóðìé÷ ÷ ì áñ÷ áβì ðìð éáðáéüüáìð /usr/share/syscons/fonts, áðáέñÞñíóáð òçí éáðÛέçìç .fnt.

Áí ÷ ñáéÛæáðáé, ÷ ñçóέíìðìέβóðá òçí éáðÛέçççç áíðέóðììβ ÷ çόç ðέççéðñìéíáβìð (keymap) éáé ìèùìçð áéá òí óáð ÷ áñáéðΠñùí single C ðìð ÷ ñçóέíìðìέáβòá, ìÝóù ðìð sysinstall. Ìüééð áéðáéÝóáðá òí **sysinstall**, áðééÝíòá òí **Configure**, éáé Ýðáéðá òí **Console**. ÁíáééáéðééÛ, ìðìñáβòá ìá ðñìóéÝóáðá òí ðáñáéÛòù òðì /etc/rc.conf:

```
scrnmap=screenmap_name
keymap=keymap_name
keychange="fkey_number sequence"
```

Óòçí ðáñβððòùóç áððΠ, òí screenmap\_name ðñìÝñ÷ ðáðáé áðü Ýíá áñ÷ áβì ðìð éáðáéüüáìð /usr/share/syscons/scrnmaps, ÷ ùñβð òçí éáðÛέçìç .scm. Ç áíðέóðììβ ÷ çόç ìèùìçð ìáæβ ìá òçí áíðβóðìé÷ ÷ ç ãñáìíáðìíóáέñÛ, ÷ ñçóέíìðìέáβòáé òðìðèùð áéá òçí áðÝéðáóç òìð 8ìð bit òðì 90, áéá èÛñòáð VGA ðìð ÷ ñçóέíìðìέíýí ìððñá ÷ áñáéðΠñùí ìá 8 óððéáð.

Áí Ý ÷ áðá áíáñáìðìέçìÝíí òíí ááβìííá **moused** òðì áñ÷ áβì /etc/rc.conf:

```
moused_enable="YES"
```

éáéü éá áβìáé ìá áíáðÛóáðá ðéð ðέçñìíòìñβáð ó÷ áðééÛ ìá òíí áññÝá ðìð ðìíóéééý ðìð àìðáíβæííðáé òòçí ðáñáéÛòù ðáñÛáñáðì.

Ì ðñìáðééááíÝñð áññÝáð òìð ðìíóéééý ðìð ÷ ñçóέíìðìέáβòáé áðü òí ðñüáñáìíá ìáΠáçόçð syscons(4), éáðáéáíáÛíáé ðéð èÝóáéð 0xd0-0xd3 òìð óðìüéìð ÷ áñáéðΠñùí. Áí áððΠ ç ðáñéí÷ ð ÷ áñáéðΠñùí ááí áβìáé áéáéÝóéìç óόç äèβóóá ðìð ÷ ñçóέíìðìέáβòá, éá ðñÝðáé ìá ìáðáééíΠóáðá òçí ðáñéí÷ ð òìð áññÝá Ýíù áðü áððΠ. Áéá ìá áβìáé áððü òðì FreeBSD, ðñìóéÝóðá òçí áéüéìððέç ãñáììΠ òðì /etc/rc.conf:

```
mousechar_start=3
```

Õì keymap\_name ðñìÝñ÷ ðáðáé áðü Ýíá áñ÷ áβì ðìð éáðáéüüáìð /usr/share/syscons/keymaps, ÷ ùñβð òçí éáðÛέçìç .kbd. Áí ááí áβòáðá óβáìòñìð áéá òçí áíðέóðììβ ÷ çόç ðέççéðñìéíáβìð ðìð ÷ ñáéÛæáðáé ìá ÷ ñçóέíìðìέβóáðá, ìðìñáβòá ìá ÷ ñçóέíìðìέβóáðá òí kbdmap(1) áéá ìá èÛíáðá äìééíÝð óá äéÛòìñáð áíðέóðìé÷ ÷ βóáéð, ÷ ùñβð ìá ÷ ñáéÛæáðáé ìá èÛíáðá áðáíáééβìççç.



áðáñíñáÝð ðíð X11 éá ðñÝðáé íá ãñÛííóáé ùð ðáéÛðáð ðíð XIM, éáé íá éáíáÛííí ãβóíñí áðu áíððçñáðçðÝð áéóúñíð XIM. ÕðÛñ ÷ííí áéáéÝóéíé áéÛíííé áíððçñáðçðÝð XIM, áéá áéáóíñáðééÝð áëþóáð.

### 23.3.7 Ñýèìέόç ÁêôððùòÞ

ËÛðíéá óáð ÷áñáéðÞñíí single C áβíáé óííÞèð ãíóíñáðùíÝíá óíí Þáéí ðí ðéééù ðíí áêôððùòÞí. Óá óáð ÷áñáéðÞñíí óýðíð wide Þ multibyte áðáéóíýí áéáééÝð ññèìβóáéð, éáé óóíéóóíýíá íá ÷ñçóéííðíéÞóáðá ðí **apsfilter**. Ìðíñáβðá áðβóçð íá ìáðáðñÝðáðá ðí Ýáñáñóíí óáð óá PostScript Þ PDF, ÷ñçóéííðíéÞíðáð ãñááéáβá áéáééÛ òðéáíÝíá áéá çç óðáéêñéíÝíç áëþóáá.

### 23.3.8 ðñíÞíáð éáé ÕóóòÞíáðá Áñ÷áβùí

Ïí óýóççíá áñ÷áβùí FFS (fast filesystem) ðíð FreeBSD ìðíñáβ íá áéá÷áéñéóðáβ íííñáðá áñ÷áβùí ðíð áíÞèíí óá óáð single C (áβíáé 8-bit clean, ááβðá éáé ðí multibyte(3)), áééÛ ááí áðíççéáýáé ðí óáð ÷áñáéðÞñíí ðíð ÷ñçóéííðíéáβðáé. Ìá Ûééá éüáéá, áβíáé 8-bit áééÛ ááí áíññáéáé ðβðíðá áéá ççí éùáééíðíβçç ðíí ÷áñáéðÞñíí. Áðβóççíá, ðí FFS ááí òðíðççñáéáé áéüíá óáð ÷áñáéðÞñíí wide Þ multibyte. ÕðÛñ ÷ííí óóóúóíí ËÛðíéá áíáíÛñðçðá patches áéá ðí FFS ðíð òðíðççñáéíðí ððÝð ðéð áíóíñáðçðáð. ðñíéáéóáé íííí áéá ðñíóíñéíÝð éáé íç ìáðáðÝñóéíáð éýóáéð Þ hacks, éáé Ý÷ííá áðíðáóβóáé íá íçí óá ðáñééÛáííðá óóí éáíóñééù áÝíðñí ðççááβíð éþáééá. Ááβðá ðéð éóóíóáéβááð ðíí áíóβóðíé÷ ðíí áéùóçÞí áéá ðáñéóóúðáñáð ðççñíóíñáð éáé áéá íá áíáéðÞóáðá óá áðáñáβðçðá áñ÷áβá.

Ïí óýóççíá áñ÷áβùí MS-DOS óðí FreeBSD Ý÷áé ççí áíóíñáðçðá íá ññèìέóðáβ þóðá íá ìáðáðñÝðáé ìáðáýý ðíí óáð ÷áñáéðÞñíí Unicode, ðíð MS-DOS, éáé ðíð óáð ÷áñáéðÞñíí ðíð Ý÷áé áðééáááβ áéá ðí óýóççíá áñ÷áβùí ðíð FreeBSD. Áéá ðáñéóóúðáñáð éáððñÝñáéáð, ááβðá çç óáéβáá manual mount\_msdosfs(8).

## 23.4 ìáðááëþðéóç ðñíñáííÛðùí 118N

ðíééÛ ports ðíð FreeBSD áéáéÝóííðí òðíðççñéíç 118N. Óá ìáñééÛ áðu áððÛ, ðí -118N áβíáé ìÝñíð ðíð íííñáðíð ðíðð. Óá ðñíñáííñáðá áððÛ, éáé ðíééÛ ðáñéóóúðáñá, Ý÷ííí áíóíñáðùíÝíç òðíðççñéíç áéá 118N éáé ááí ÷ñáéÛáííðáé Ûééáð áéáééÝð ññèìβóáéð.

Ûóóúóíí, óá ËÛðíéáð áðáñíñáÝð ùððð ç **MySQL**, éá ðñÝðáé íá ññèìέóðáβ ðí `makefile` ìá ðí áðééðíçðùí óáð ÷áñáéðÞñíí. Áððù óóííÞèð áβíáðáé ðáñíÞíðáð ìéá ðéíÞ óóí **configure** óóíí ðççááβíð éþáééá, Þ áééÛáííðáð ðí Þáéí ðí `Makefile`.

## 23.5 ÕíðééÝð Ññèìβóáéð áéá ÕóãêêñéíÝíáð Áëþóáð

### 23.5.1 Ñþóéêç Áëþóáá (Ëùáééíðíβççç KOI8-R)

*Áñ÷éêÞ óóíáéóóíñÛ ðíð Andrey Chernov.*

Áéá ðáñéóóúðáñáð ðççñíóíñáð ó÷áðééÛ ìá ççí éùáééíðíβççç KOI8-R, ááβðá ðéð ÁíáóíñÝð Ó÷áðééÛ ìá ðí Óáð ×áñáéðÞñíí KOI8-R (Ññóééü Óýñíí ×áñáéðÞñíí) (<http://koi8.pp.ru/>).

### 23.5.1.1 ÕιδέεÛò Ñõειβόάεò

ÕιδέεαòΠόαò óεò áεüειòεαò ãñáñÛò óòι áñ÷áβι óáò ~/.login\_conf:

```
me:My Account:\
:charset=KOI8-R:\
:lang=ru_RU.KOI8-R:
```

Άέά ðáñáááβáñáόά ðιò ó÷áòβæιíόάέ ιá óεò ÕιδέεÛò Ñõειβόάεò, äáβòá ðñιçäÿιáíáð áíυòçòáð óá áòòυ ðι έáòÛεάει.

### 23.5.1.2 Ñýèιέόç Êιíóυέáò

- ÐñιόέÛòá ðçι áεüειòεç ãñáñÛ óòι áñ÷áβι /etc/rc.conf:
 

```
mousechar_start=3
```
- ×ñçóειιðιεΠόáò áðβόçò óεò ðáñáέÛòυ ñõειβόάεò óòι /etc/rc.conf:
 

```
keymap="ru.koi8-r"
scrnmap="koi8-r2cp866"
font8x16="cp866b-8x16"
font8x14="cp866-8x14"
font8x8="cp866-8x8"
```

- Άέά έÛεá έáόá÷þñέόç ttyv\* óòι áñ÷áβι /etc/ttys, ðñçóειιðιεΠόáò ðι cons25r υò óýðι ðáñιáóέειý.

Άέά ðáñáááβáñáόά ðιò ó÷áòβæιíόάέ ιá ðçι ñýèιέόç ðçò έιíóυέáò, äáβòá ðñιçäÿιáíáð áíυòçòáð áóòιý ðιò έáòáέáβιò.

### 23.5.1.3 Ñýèιέόç Άέòòðυòþ

Έáεþò ιέ ðáñέóóυòáñιέ áέòòðυòÛò ðιò áέάέÛòιòι Ñυóέειýð ðñáέòþñáò Û÷ιòι áιóυιáóυιÛιç ðçι έυáέειíóáεβáá CP866, έá ðñáέáóóáβòá áέáέέυ ðβέòñι áíυäò áέá ιá ιáóáóñÛòáð áðυ ðι KOI8-R óòι CP866. Õι ðβέòñι áóòυ äáέáεβóóáόáέ áðυ ðñιáðέειäþ óòι /usr/libexec/lpr/ru/koi2alt. Ç έáόá÷þñέόç áέá Ûιá Ñþóέει áέòòðυòþ óòι /etc/printcap έá ιιέÛæáέ ιá ðçι ðáñáέÛòυ:

```
lp|Russian local line printer:\
:sh:of=/usr/libexec/lpr/ru/koi2alt:\
:lp=/dev/lpt0:sd=/var/spool/output/lpd:lf=/var/log/lpd-errs:
```

Äáβòá ðι printcap(5) áέá ðει έáðòñáñþ ðáñέáñáòþ.

### 23.5.1.4 Óýóççιá Áñ÷áβυí MS-DOS έάέ Ñþóέéá ιιυιáόá Áñ÷áβυí

Õι ðáñáέÛòυ ððυááέáñι έáόá÷þñέόç óòι fstab(5) áíáñáñðιεáβ ðçι ððιóðþñέιç áέá Ñþóέéá ιιυιáόá áñ÷áβυí óá ðñιáñòçιÛιá óòóðþιáόá áñ÷áβυí óýðιò MS-DOS:

```
/dev/ad0s2 /dos/c msdos rw,-Wkoi2dos,-Lru_RU.KOI8-R 0 0
```

Ç áðέειäþ -L áðέéÛááé óεò ðιδέεÛò ñõειβόάεò ðιò έá ðñçóειιðιεçèιýι, έάέ ç -w ιñβæáέ ðιι ðβιáέá ιáóáóñιðþò ðñáέòþñυι. Άέá ιá ðñçóειιðιεΠόáòá ðçι áðέειäþ -w ááááέυέáβòá υóέ Û÷ιá ðñιόáñòþóáέ ðçι έáðÛòιçόç /usr ðñέι ðçι έáðÛòιçόç MS-DOS, έáεþò ιέ ðβιáέáð ιáóáóñιðþò áñβóέιíóáέ óòι /usr/libdata/msdosfs. Άέá ðáñέóóυòáñáð ðεçñιòñβáð, äáβòá ðç óáεβáá manual ðιò mount\_msdosfs(8).

### 23.5.1.5 Ñýèìέόç X11

1. ΆέðάεÛόðά ðñþóá óéð ááíέéÛò ðιðέéÛò ñðειβόάέð ðιò Ý ÷ ιòιá Παç ðáñéáñÛόáé.
2. Άί ÷ ñçóéιιðιέáβðά ðιι áιòðçñáðçðΠ **Xorg**, ááéáðáóðΠóðá ðι ðáéÛóι x11-fonts/xorg-fonts-cyrillic.

ΆέÛáιðá ðçι áιιúðçðá "Files" óðι áñ ÷ áβι /etc/X11/xorg.conf. Έá ðñÛðáé íá ðñιέéÛóðá ðçι ðáñáéÛòù áñáñΠ ðñέι áðu ιðιέááΠðιòá Ûέεç éáðá ÷ þñέόç FontPath:

```
FontPath "/usr/local/lib/X11/fonts/cyrillic"
```

**Όçιáβúόç:** Άáβðá óóçι ÓðéèιāΠ ðυι Ports áéá ðáñέóóúðáñáð éðñéééééÛò áñáιιáðιόáéñÛò.

3. Άέá ðçι áιáñáñιðιβçóç ðιò ÑùóééιÛ ðεçéðñιέιáβιò, ðñιέéÛóðá óéð ðáñáéÛòù áñáñÛò óóçι áιιúðçðá "Keyboard" ðιò áñ ÷ áβιò xorg.conf:

```
Option "XkbLayout" "us,ru"
Option "XkbOptions" "grp:toggle"
```

Άáááéúéáβðά áðβçðò υðé ç áñáñΠ XkbDisable áβιáé áιáñáñáΠ (íáñéáñέóιÛιç υò ó ÷ υέéι).

Άί ÷ ñçóéιιðιέβðáðá ðιι grp:toggle ç áιáééááΠ RUS/LAT éá áβιáðáé íá ðι **Άáιέυ Alt**, áιþ áι èÛóðá ðι grp:ctrl\_shift\_toggle, ç áιáééááΠ éá áβιáðáé íá ðι **Ctrl+Shift**. Άέá grp:caps\_toggle, ç áιáééááΠ RUS/LAT éá áβιáðáé íá ðι **CapsLock**. Ç éáñιέéΠ éáéðιòñáβá ðιò **CapsLock** áιáέιέιòðáβ íá áβιáé áéáèÛóéιç ιÛóù ðιò óðιáðáóιιÛ ðεΠéðñιι **Shift+CapsLock** (ιιñι óá éáðÛóðáóç LAT). Õι grp:caps\_toggle áéá èÛðιέι Ûáιúóðι èυáι, ááι éáéðιòñááβ óðι **Xorg**.

Άί ðι ðεçéðñιέυáéι óáð áéáèÛóáé ðεΠéðñá "Windows", éáé Ý ÷ áðá ðáñáðçñΠóáé υðé èÛðιέá áðu óá ιç-áéöáñééιçóééÛ ðεΠéðñá Ý ÷ ιòι èÛèò áιðéóðιβ ÷ çóç υðáι áβðá óá éáðÛóðáóç RUS, ðñιέéÛóðá ðçι ðáñáéÛòù áñáñΠ óðι áñ ÷ áβιò xorg.conf:

```
Option "XkbVariant" ",winkeys"
```

**Όçιáβúόç:** Õι Ñþóééι ΧΚΒ ðεçéðñιέυáéι βóυð ááι éáéóιòñááβ íá áðáñιιáÛò ðιò ááι Ý ÷ ιòι óðéá ÷ ðáβ áéá ðéð áιðβóðιé ÷ áð ðιðέéÛò ñðειβόάέð.

**Όçιáβúόç:** Ìé áðáñιιáÛò ðιò ðçñιγί ðéð áεÛ ÷ éóðáð ðñιáéááñáðÛò ðιðέéþι ñðειβóáυι, éá ðñÛðáé íá éáéιγί áðu ιúñβð ðç óðιÛñðççç XtSetLanguageProc (NULL, NULL, NULL); ιÛóá óðιι éþáééá ðιòð.

Άáβðá ðι KOI8-R áéá ðι óýóðçιá X Window (<http://koi8.pp.ru/xwin.html>) áéá ðáñέóóúðáñáð ðáçáβáð ó ÷ áðééÛ íá ðçι áçιέιòñáβá áðáñιιáþι X11 ðιò íá ÷ ñçóéιιðιέιγί ðιðέéÛò ñðειβόάέð.

### 23.5.2 ÔïðééÝð Ñöèìßóáéð áéá ÐáñáäïéóéêÛ ÊéíÝæééá ÔáúáÛí

Ôï FreeBSD-Taiwan Project Ý÷áé äçíéíõñãÞóáé Ýíá HOWTO áéá óá ÊéíÝæééá óóï FreeBSD, òï ïðïßì ìðïñáßðá íá ãñáßðá óóç áéáýèðéíóç <http://netlab.cse.yzu.edu.tw/~statue/freebsd/zh-tut/>, ÷ñçóéïðïéðéíóáð ðïéêÛ ÊéíÝæééá ports. Ì òñÝ÷úí óóíðÛêðçð òïð ÊéíÝæééíð FreeBSD Howto áßíáé í Shen Chuan-Hsing <statue@freebsd.sinica.edu.tw>.

Ì Chuan-Hsing Shen <statue@freebsd.sinica.edu.tw> Ý÷áé äçíéíõñãÞóáé óçí ÊéíÝæééç ÓðéëïãÞ FreeBSD (CFC) (<http://netlab.cse.yzu.edu.tw/~statue/cfc/>) ÷ñçóéíðïéðéíóáð óçí èùáééíðïßçóç zh-L10N-tut òïð FreeBSD-ÔáÁáÛí. Óá ðáéÝðá éáé óá scripts áéáðßéáíóáé óóç áéáýèðéíóç <ftp://freebsd.csie.nctu.edu.tw/pub/taiwan/CFC/>.

### 23.5.3 ÔïðééÝð Ñöèìßóáéð áéá óçí ÆáñíáíééÞ Æëðóóá (áéá ¼éáð óéð Æëðóóáð ðïð Ááóßæííðáé óóï ISO 8859-1)

Ì Slaven Rezac <eserte@cs.tu-berlin.de> Ý÷áé ãñÛðáé Ýíá ãçãüí áéá óçí ÷ñÞóç ðúí umlauts óá Ýíá ìç÷Ûíçíá FreeBSD. Ì ãçãüí áßíáé ãñáíÝñð óóá ÆáñíáíééÛ éáé áéáðßéáðáé óóçí òïðïéáóá <http://user.cs.tu-berlin.de/~eserte/FreeBSD/doc/umlaute/umlaute.html>.

### 23.5.4 ÔïðééÝð Ñöèìßóáéð áéá óçí ÆëççíééÞ Æëðóóá

Ì Nikos Kokkalis <nickkokkalis@gmail.com> Ý÷áé ãñÛðáé Ýíá ðëðñáð Ûñèñí áéá óçí ððïóðÞñéíç ðçð ÆëççíééÞ Æëðóóáð óóï FreeBSD. Ôï Ûñèñí áððü áéáðßéáðáé ùð ìÝñð ðçð áðßççð ÆëççíééÞ ðáéìçñßùóçð òïð FreeBSD, óóçí òïðïéáóá [http://www.freebsd.org/doc/el\\_GR.ISO8859-7/articles/greek-language-support/index.html](http://www.freebsd.org/doc/el_GR.ISO8859-7/articles/greek-language-support/index.html) ([http://www.FreeBSD.org/doc/el\\_GR.ISO8859-7/articles/greek-language-support/index.html](http://www.FreeBSD.org/doc/el_GR.ISO8859-7/articles/greek-language-support/index.html)).

### 23.5.5 ÔïðééÝð Ñöèìßóáéð Æéá ÆéáðùíÝæééá éáé ÊïñáÛðééá

Æéá ÆéáðùíÝæééá, äáßðá óóçí òïðïéáóá <http://www.jp.FreeBSD.org/>, áñ Æéá ÊïñáÛðééá, äáßðá óóçí òïðïéáóá <http://www.kr.FreeBSD.org/>.

### 23.5.6 Óáéìçñßùóç òïð FreeBSD óá Æëðóóáð Æêðùð óçð ÆáãéééÞð

ÊÛðïéíé áéáéííóÝð òïð FreeBSD Ý÷ïí ìáðáñÛðáé òïðéáðá óçð ðáéìçñßùóçð òïð óá Ûééáð Æëðóóáð. Ìé ìáðáñÛðáéð áðÝð áéáðßéáíóáé ìÝóù óóíáÝóíí óóçí éýñéá áééððáéÞ òïðïéáóá òïð FreeBSD (<http://www.FreeBSD.org/index.html>) Þ óóíí éáðÛéíáí /usr/share/doc.



## 24.2 Ἀρχὴ τῆς ἐκδόσεως τοῦ FreeBSD

Ἐπισημειωθεὶς ἀπὸ τοῦ Tom Rhodes. Ἀποδοσεὶς τῶν ἐπισημειωθέντων ἀπὸ τοῦ Colin Percival.

Ἡ ἀρχὴ τῆς ἐκδόσεως τοῦ FreeBSD ἀποδοσεὶς τῶν ἐπισημειωθέντων ἀπὸ τοῦ Tom Rhodes. Ἀποδοσεὶς τῶν ἐπισημειωθέντων ἀπὸ τοῦ Colin Percival.

Ἡ ἀρχὴ τῆς ἐκδόσεως τοῦ FreeBSD ἀποδοσεὶς τῶν ἐπισημειωθέντων ἀπὸ τοῦ Tom Rhodes. Ἀποδοσεὶς τῶν ἐπισημειωθέντων ἀπὸ τοῦ Colin Percival.

**Ὁδηγίες:** Ἀποδοσεὶς τῶν ἐπισημειωθέντων ἀπὸ τοῦ Tom Rhodes. Ἀποδοσεὶς τῶν ἐπισημειωθέντων ἀπὸ τοῦ Colin Percival.

Ἡ ἀρχὴ τῆς ἐκδόσεως τοῦ FreeBSD ἀποδοσεὶς τῶν ἐπισημειωθέντων ἀπὸ τοῦ Tom Rhodes. Ἀποδοσεὶς τῶν ἐπισημειωθέντων ἀπὸ τοῦ Colin Percival.

```
gunzip -c freebsd-update-upgrade.tgz | tar xvf -
mv freebsd-update.sh /usr/sbin/freebsd-update
mv freebsd-update.conf /etc
```

Ἡ ἀρχὴ τῆς ἐκδόσεως τοῦ FreeBSD ἀποδοσεὶς τῶν ἐπισημειωθέντων ἀπὸ τοῦ Tom Rhodes. Ἀποδοσεὶς τῶν ἐπισημειωθέντων ἀπὸ τοῦ Colin Percival.

### 24.2.1 Ὁδηγίες τῆς ἐκδόσεως τοῦ FreeBSD

Ἡ ἀρχὴ τῆς ἐκδόσεως τοῦ FreeBSD ἀποδοσεὶς τῶν ἐπισημειωθέντων ἀπὸ τοῦ Tom Rhodes. Ἀποδοσεὶς τῶν ἐπισημειωθέντων ἀπὸ τοῦ Colin Percival.

```
Components of the base system which should be kept updated.
Components src world kernel
```

Ἡ ἀρχὴ τῆς ἐκδόσεως τοῦ FreeBSD ἀποδοσεὶς τῶν ἐπισημειωθέντων ἀπὸ τοῦ Tom Rhodes. Ἀποδοσεὶς τῶν ἐπισημειωθέντων ἀπὸ τοῦ Colin Percival.

Ἡ ἀρχὴ τῆς ἐκδόσεως τοῦ FreeBSD ἀποδοσεὶς τῶν ἐπισημειωθέντων ἀπὸ τοῦ Tom Rhodes. Ἀποδοσεὶς τῶν ἐπισημειωθέντων ἀπὸ τοῦ Colin Percival.

Ἡ ἐπέλευστος ἰσχύει ἀπὸ τῆς ἐπέλευστος τοῦ FreeBSD. Ἡ ἐπέλευστος τοῦ FreeBSD ἐπέλευστος ἰσχύει ἀπὸ τῆς ἐπέλευστος τοῦ FreeBSD. Ἡ ἐπέλευστος τοῦ FreeBSD ἐπέλευστος ἰσχύει ἀπὸ τῆς ἐπέλευστος τοῦ FreeBSD.

```
Paths which start with anything matching an entry in an IgnorePaths
statement will be ignored.
IgnorePaths
```

Ἡ ἐπέλευστος τοῦ FreeBSD ἐπέλευστος ἰσχύει ἀπὸ τῆς ἐπέλευστος τοῦ FreeBSD. Ἡ ἐπέλευστος τοῦ FreeBSD ἐπέλευστος ἰσχύει ἀπὸ τῆς ἐπέλευστος τοῦ FreeBSD. Ἡ ἐπέλευστος τοῦ FreeBSD ἐπέλευστος ἰσχύει ἀπὸ τῆς ἐπέλευστος τοῦ FreeBSD.

```
Paths which start with anything matching an entry in an UpdateIfUnmodified
statement will only be updated if the contents of the file have not been
modified by the user (unless changes are merged; see below).
UpdateIfUnmodified /etc/ /var/ /root/ /.cshrc /.profile
```

Ἡ ἐπέλευστος τοῦ FreeBSD ἐπέλευστος ἰσχύει ἀπὸ τῆς ἐπέλευστος τοῦ FreeBSD. Ἡ ἐπέλευστος τοῦ FreeBSD ἐπέλευστος ἰσχύει ἀπὸ τῆς ἐπέλευστος τοῦ FreeBSD. Ἡ ἐπέλευστος τοῦ FreeBSD ἐπέλευστος ἰσχύει ἀπὸ τῆς ἐπέλευστος τοῦ FreeBSD.

```
When upgrading to a new FreeBSD release, files which match MergeChanges
will have any local changes merged into the version from the new release.
MergeChanges /etc/ /var/named/etc/
```

Ἡ ἐπέλευστος τοῦ FreeBSD ἐπέλευστος ἰσχύει ἀπὸ τῆς ἐπέλευστος τοῦ FreeBSD. Ἡ ἐπέλευστος τοῦ FreeBSD ἐπέλευστος ἰσχύει ἀπὸ τῆς ἐπέλευστος τοῦ FreeBSD. Ἡ ἐπέλευστος τοῦ FreeBSD ἐπέλευστος ἰσχύει ἀπὸ τῆς ἐπέλευστος τοῦ FreeBSD.

```
Directory in which to store downloaded updates and temporary
files used by FreeBSD Update.
WorkDir /var/db/freebsd-update
```

Ἡ ἐπέλευστος τοῦ FreeBSD ἐπέλευστος ἰσχύει ἀπὸ τῆς ἐπέλευστος τοῦ FreeBSD. Ἡ ἐπέλευστος τοῦ FreeBSD ἐπέλευστος ἰσχύει ἀπὸ τῆς ἐπέλευστος τοῦ FreeBSD. Ἡ ἐπέλευστος τοῦ FreeBSD ἐπέλευστος ἰσχύει ἀπὸ τῆς ἐπέλευστος τοῦ FreeBSD.

```
When upgrading between releases, should the list of Components be
read strictly (StrictComponents yes) or merely as a list of components
which *might* be installed of which FreeBSD Update should figure out
which actually are installed and upgrade those (StrictComponents no)?
StrictComponents no
```

Ἡ ἐπέλευστος τοῦ FreeBSD ἐπέλευστος ἰσχύει ἀπὸ τῆς ἐπέλευστος τοῦ FreeBSD. Ἡ ἐπέλευστος τοῦ FreeBSD ἐπέλευστος ἰσχύει ἀπὸ τῆς ἐπέλευστος τοῦ FreeBSD. Ἡ ἐπέλευστος τοῦ FreeBSD ἐπέλευστος ἰσχύει ἀπὸ τῆς ἐπέλευστος τοῦ FreeBSD.



éäéáßðáñá ÷ñÞóéíí ùðáí óðíóçñáßðá ðíëéáðëÛ óðóðÞíáðá, éäèðò óáð áðéðñŸðáé íá áíëíëíáÞóáðá ìá ìéá ìáðéÛ óé áíçìáñÞóáéð Ÿ ÷ ïðí áäéáðáóðáéáß òðí éäéŸíá.

### 24.2.3 Áíáâáèìßóáéð óá ìéèñŸð éáé ìáâÛëáð Æëüüóáéð

Ç áéááééáóßá áððÞ éá áðñáéñŸíáé óá ðáééÛ áñ ÷ áßá áíóééáéíáíééíŸ èÞáééá (object files) éäèðò éáé òéð ðáééŸð áéáééíëÞéáð, èÛííóáð òéð ðáñéóóóðáñáð áðáñíáŸð ðñßòóíí éáðáðéáðáóðÞí íá ìç éáéðíðñáíŸí. Óáð óðíéóðíŸíá áßðá íá áðááéáðáóðÞóáðá üéá óá áäéáðáóðçíŸí ports éáé íá óá áäéáðáóðÞóáðá ìáíÛ, Þ íá óá áíáâáèìßóáðá áñüüðáñá, ÷ñçóéííðíëÞíðáð òí áíçèçðééü ðñüáñáíá ports-mgmt/portupgrade. Ìé ðáñéóóóðáñíé ÷ñÞóðáð éá èŸéíðí íá èÛííðí ìéá áíëéíáóðééÞ ìáðááèÞððéóç ÷ñçóéííðíëÞíðáð òçí áéüéíðèç áíðíëÞ:

```
portupgrade -af
```

Ìá áðóó òíí ðñüðí áíáðáéßæáðáé ùðé óá ðÛíðá éá áðáíáäéáðáóðáéíŸí óóóðÛ. ÓçíáèÞðá ùðé áí èŸóáðá òçí ìáðááéçðÞ ðáñéáÛééíðíð BATCH óðçí òéíÞ yes, üéáð ìé ðééáíŸð áñùðÞóáéð ðíð éá áíðáíéóðíŸí éáðÛ òç áéááééáóßá, éá áðáíóçéíŸí áðóóüáðá ìá yes. ðóé ááí òðÛñ ÷ áé ðéŸíí áíÛáèç áéá ðáñŸíááóç òíð ÷ñÞóðç éáðÛ òç áéÛñéáéá òçð áéááééáóßáð ìáðááèÞððéóçð.

Áí ÷ñçóéííðíëáßðáé ðñíóáñíðíŸíð ððñÞíáð, ç áéááééáóßá áíáâÛéìéóçð áßíáé áéáðñÛ ðéí ðíëŸðéíëç. Èá ÷ñáéáðáßðá Ÿíá áíðßáñáðí òíð ððñÞíá GENERIC óðíí éáðÛéíáí /boot/GENERIC. Áí ááí òðÛñ ÷ áé Þäç ì ððñÞíáð GENERIC óðíí óŸóðçíá óáð, ìðñáßðá íá òíí áíáèðÞóáðá ÷ñçóéííðíëÞíðáð ìéá áðü òéð ðáñáéÛðù ìáéüáíðð:

- Áí Ÿ ÷ áðá ìáðááéüððßóáé ðñíóáñíðíŸíð ððñÞíá ìüíí ìéá òíñÛ, ì ððñÞíáð óðíí éáðÛéíáí /boot/kernel.old áßíáé óðçí ðñááíáðééüðçðá ì GENERIC. ÁðèÞð ìáðííñÛðá òíí éáðÛéíáí òá /boot/GENERIC.
- Áí Ÿ ÷ áðá òðóééÞ ðñüóááóç òðí ìç ÷ Ûíçíá, ìðñáßðá íá áäéáðáóðÞóáðá Ÿíá áíðßáñáðí òíð ððñÞíáð GENERIC áðü òí CD-ROM òçð áäéáðÛóðáóçð. ÓíðíëáðÞóáð òí CD-ROM óðíí ìäçü éáé ÷ñçóéííðíëÞðáð òéð ðáñáéÛðù áíðíëŸð:

```
mount /cdrom
cd /cdrom/x.y-RELEASE/kernels
./install.sh GENERIC
```

ÁíðééáðáóðÞóáð òí x.y-RELEASE ìá òíðð ðñááíáðééíŸð áñééíŸð òçð Ÿéáíðçð ðíð ÷ñçóéííðíëáßðá. Ì ððñÞíáðð GENERIC éá áäéáðáóðáéáß áðü ðñíáðééíáÞ óðíí éáðÛéíáí /boot/GENERIC.

- Áí ááí Ÿ ÷ áðá èÛðíéá áðü òéð ðáñáðÛíð áðééíáŸð, ìðñáßðá íá ìáðááéüððßóáðá éáé íá áäéáðáóðÞóáðá òíí ððñÞíáðð GENERIC ìŸóó òíð ðçááßíð èÞáééá:

```
cd /usr/src/
env DESTDIR=/boot/GENERIC make kernel
mv /boot/GENERIC/boot/kernel/* /boot/GENERIC
rm -rf /boot/GENERIC/boot
```

Ãéá íá áíááíñéóðáß áðóóð ì ððñÞíáð ùð GENERIC áðü òí freebsd-update, ááí éá ðñŸðáé íá Ÿ ÷ ïðí áßíáé áééááŸð óðíí áñ ÷ áßí ððéìßóáúí òíð GENERIC. Óðíßóðáðáé áðßóçð ç ìáðááèÞððéóç íá áßíáé ÷ ùñßð Ûééáð áíáéáééáðíŸíáð ððéìßóáéð (éáðÛ ðñíðßìçç ìá éáíü òí /etc/make.conf).

Ãáí ÷ñáéÛæáðáé òç áááñŸíç òðéáìÞ íá áðáíáéééíÞóáðá ìá òíí ððñÞíáðð GENERIC.

Ãßíáé áðíáðŸð ìé áíáááéìßóáéð òóóí óá ìéèñŸð ùðí éáé óá ìáâÛëáð Æëüüóáéð, áßííðáð óðçí áíðíëÞ freebsd-update òíí áðééðìçðü áñééü øéáíðçð. Ãéá ðáñÛáééáíá, ç áéüéíðèç áíðíëÞ éá áíáááéìßóáé òí óŸóðçíá óá FreeBSD 6.4:

```
freebsd-update -r 6.4-RELEASE upgrade
```

ÌáöÛ óç èÞòç óçð áíóìèÞò, òì freebsd-update èá áíéíëíãÞòáé óçí êáóÛóðáóç õìö óðóðÞíáðìð êáé õìö áñ÷ áßìò ñòèìßóáùí õìö, óá ìéá áðùðáéñá íá ìáæÝðáé óéð áðáíáßóçóáð ðεçñìöìñßáð áéá óçí áíááÛèìéóç õìö óðóðÞíáðìð. Ìé ðεçñìöìñßáð ðìö áíé÷ íáÿεçéáí èá àìöáíéóðìÿí óóçí ìèùíç ìá óç ììñòÞ ìéáð èßóðáð ááéáðáóóçìÝíùí ðñìãñáìÛòùí. Áéá ðáñÛááéáíá:

```
Looking up update.FreeBSD.org mirrors... 1 mirrors found.
Fetching metadata signature for 6.3-RELEASE from update1.FreeBSD.org... done.
Fetching metadata index... done.
Inspecting system... done.
```

The following components of FreeBSD seem to be installed:  
kernel/smp src/base src/bin src/contrib src/crypto src/etc src/games  
src/gnu src/include src/krb5 src/lib src/libexec src/release src/rescue  
src/sbin src/secure src/share src/sys src/tools src/ubin src/usbin  
world/base world/info world/lib32 world/manpages

The following components of FreeBSD do not seem to be installed:  
kernel/generic world/catpages world/dict world/doc world/games  
world/proflibs

Does this look reasonable (y/n)? y

Óðì óçìáßì áðòù, òì freebsd-update èá êáóááÛóáé ùéá óá áñ÷ áßá ðìö áðáéóìÿíóáé áéá óçí áíááÛèìéóç. Óá ìáñééÝð ðáñéððóðáéð, ì ÷ ñÞóóçð èá èεççéáß íá áðáíóÞòáé óá áñòðÞòáéð ó÷ áðééÛ ìá òì óé èá ááéáðáóóðáéáß Þ ðùð ðñÝðáé íá ðñì÷ ùñÞòáé ç áéááééáóáá.

¼ðáí ÷ ñçóéìðìéáßðáé ðñìóáñìòìÝíò ððñÞíáð, òì ðáñáðÛù ãÞíá èá ðñìéáéÝóáé óçí àìöÛìéóç óçð ðáñáéÛòù ðñìéáéäìðßçóçð:

```
WARNING: This system is running a "MYKERNEL" kernel, which is not a
kernel configuration distributed as part of FreeBSD 6.3-RELEASE.
This kernel will not be updated: you MUST update the kernel manually
before running "/usr/sbin/freebsd-update install"
```

Ìðìñáßáð íá ááñÞòáðá áðòÞ óçí ðñìéáéäìðßçóç. Èá ÷ ñçóéìðìéáßðóìòìá õìí áíçìáñùÝí ððñÞíá GENERIC ùð áíáéÛìáóì áÞíá óóç áéááééáóáá áíááÛèìéóçð.

Áóìÿ ìáðáóìñòùèìÿí ùéá óá patches óðì õìðééù óÿóóçìá, èá áßíáé êáé ç áðáñìãÞ òìð. Ç áéááééáóáá áðòÞ Þóùð ðÛñáé èßãì ÷ ñùíí, áíÛèìéá ìá óçí óá÷ÿóóá êáé òì õìñòßì òìö ìç÷ áíÞíáðìð. ðáéðá èá áßíáé ç óðã÷Þíáðóç òùí áñ÷ áßìùí ñòèìßóáùí. Áðòù òì ìÝíò óçð áéááééáóááð áðáéðáß ðáñÝíááóç õìö ÷ ñÞóóç, èáεÞð óá èÛðìéá áñ÷ áßá èá ÷ ñáéáóóáß ç óðã÷Þíáðóç íá áßíáé ÷ áéñìéßíçðá ìá óç àíÞèáéá èÛðìéìò óóìöÛèðç èáéíÝíò. Ì ÷ ñÞóóçð èá áíçìáñÞíáðáé áéá òì áðìðÝéáóíá èÛèá áðéðð÷çìÝíçð óðã÷Þíáðóçð èáεÞð áíáéßóóáðáé ç áéááééáóáá. Óá ðáñððòùðç áðìðð÷çìÝíçð óðã÷Þíáðóçð (Þ áíùíçóçð óçð), ç áéááééáóáá áíááÛèìéóçð èá áéáéìðáß. Áíáá÷ìÝíò ìá èÝéáðá íá èñáðÞòáðá áíóßáñáòì áóðáéáßáð õìö èáðáéùíò /etc êáé íá óðã÷ ùíáÿóáðá áñáùðáñá (÷ áéñìéßíçðá) èÛðìéá óçìáíóééÛ áñ÷ áßá, ùðùð òì master.passwd Þ òì group.

**Óçìáßìóç:** Óðì óçìáßì áðòù ááíÝ÷ áé áßíáé áéùíá èáìéÛ áééáãÞ óðì óÿóóçìá, èáεÞð ùεç ç áéááééáóáá óçð áíááÛèìéóçð êáé óðã÷Þíáðóçð áßíáðáé óá áéáóìñáðééù êáóÛèìéá. ¼ðáí áðáñìòóðìÿí áðéðð÷Þð ùéá óá patches êáé ìèìéεçñùèáß ìá áðéðð÷ßá ç áéááééáóáá óçð óðã÷Þíáðóçð ùéùí òùí áñ÷ áßìùí ñÿèìéóçð, ì ÷ ñÞóóçð èá ðñÝðáé íá áðéáááééáóáé óçí óáéééÞ ááéáóÛóðáóç.

Ïά οί öÛείö áöðö ç äεάάεέάöβάö, ç áίάάÛειέοç ìðñάβ ίά ñεóöεέιðιεçεάβ öðί äβöει, ìά öç ÷ ñöç öçö áεüειöεçö áίöίεöð:

```
freebsd-update install
```

Óöçί ðñöç öÛöç, εά äεεά÷εάβ ì ðöñöίáö εάε öá ö÷ äöεéÛ äñεñöίáö. Óöί öçìάβì áööü, εά ðñÛðáε ίά äβίáε äðáίáεέβίçöç öίö ìç÷-áίöίáöìö. Óά ìç÷-Ûίçίá ìά ðñíöáñíöίÛί ðöñöίá, ÷ ñçöειöðιεöðöä öçί áίöίεöð nextboot(8) öóä ίά εÛöáöä öίí ðöñöίá äεά öçί äðñíáíç äεέβίçöç ööίí /boot/GENERIC (ì ìðίβίö Û÷-áε öäç áίάάáειέöáö):

```
nextboot -k GENERIC
```

**ðñíáεäíöίβçöç:** ðñεί äðáίáεέειöóáöä ìά öίí ðöñöίá GENERIC, äáááεéüεάβöä üöé ðáñéÛ÷-áε üεά öá ðñíáñÛííáöá ìáöäçöçö ðίö áðáεöίγίöáε äεά öçί áðεöð÷ö äεέβίçöç öίö öðöðöίáöìö öáö (εάé öç εάεöίöñάβá öίö äεέöγίö, áί áίάάáειöæäöä εÛðιεί äðñáεñöóίÛί ìç÷-Ûίçίá). Áεάεéüöáñá, áί ì ðñίçäíγíáíö ðñíöáñíöίÛί ðöñöίáö ðáñéáβ÷-á εάεöίöñάβáö ðίö öóίöεüö ðáñÛ÷-ìíöáé áðü äñεñöίáöá (modules), äáááεéüεάβöä üöé öñíöðöóáöá ìά öíñöüείγί ðñíöüñείÛ ööίí ðöñöίá GENERIC ÷ ñçöείöðιεöίáöä öéö äöíáöüöçöäö öίö äñ÷-άβίö /boot/loader.conf. ööüö áðöçöç ίά εÛεäöä ίά äðáίáñáíðιεöðöä öðçñáöóáö, ðñíöáñöðöáéö äβöéüí εάε äεéöγίö ε.ε.ð. ðίö äáí äβίáé äðáñáöçöäö, ìÛ÷-ñε öçί ìείεöðñüöç öçö äεάάεέάöóáö áίάάÛειέöçö.

Ïðñάβöá ίά ÷ ñçöειöðιεöðöä öçί áεüειöεç áίöίεöð äεά ίά äðáίáεέειöóáöä öί ìç÷-Ûίçίá ìά öίí ìÛί ðöñöίá:

```
shutdown -r now
```

Ïüεéö öί öýöççίá äðáíÛεεáε öá εάεöίöñάβá, εά ðñÛðáε ίά äεöáεÛöáöá ìáíÛ öί freebsd-update. Ç ðñίçäíγíáíç εάεöίöñάβá Û÷-áε äðιεçεäöεáβ, εάé Ûöóé öί freebsd-update äáí εά ìáεéíöáé áðü öçί äñ÷ö, áεéÛ εά äðñáεñγíáé üεäö öéö ðáεéÛö είείü÷-ñçöóáö äεάεείεöεäö εάé öá äñ÷-άβá áίöεéáεíáείγ έöáεéá. Άεά ίά ööíá÷ö öóáöá öá áööü öί ööÛáεί, äöóä öçί áεüειöεç áίöίεöð:

```
freebsd-update install
```

**Óçíáβüöç:** ΑίÛεíáä ìά öί áί öðöñíáí äεεάáÛö ööίöð äñεειγö äεäüöáüí öüí äεάεείεçεöί, βöüö ìά öðÛñ÷ìöí ìüí äγí öÛöáéö äáεäöÛöäöçöç áίöβ äεά öñáéö.

¼εί öί εíáεöίεéü öñööίö εáöáöéáöáöóöð εά ðñÛðáε ööñá ίά ìáöááεüöðεöóáöβ εάé ίά äðáίááεéáöáöóáéάβ áðü öçί äñ÷ö. Áööü äðáéöáöáé εáεöð öί äáεáöáöçίÛί εíáεöίεéü βöüö áíáñöÛöáé áðü äεáεείεöεäö ìε ìðίβáö áöáεñÛεçεáί εáöÛ öç äεάáεéáöβá öçö áίάάÛειέöçö. Ïðñάβöá ίά ÷ ñçöειöðιεöðöä öçί áίöίεöð ports-mgmt/portupgrade äεά ίά äöðñáöίðιεöðöä áööð öç äεάáεéáöβá. Άεά ίά ìáεéíöáöá, äöóä öéö ðáñáéÛöü áίöίεÛö:

```
portupgrade -f ruby
rm /var/db/pkg/pkgdb.db
portupgrade -f ruby18-bdb
rm /var/db/pkg/pkgdb.db /usr/ports/INDEX-*.db
portupgrade -af
```



Ἐπιπλέον ἀπὸ τῆς ἐκδόσεως τοῦ FreeBSD ἀρκετὰ ἀπὸ τῶν ἀρχῶν τῆς ἐκδόσεως τοῦ FreeBSD, ἡ ἐκδόσις ἀπὸ τῆς ἐκδόσεως τοῦ FreeBSD ἀρκετὰ ἀπὸ τῶν ἀρχῶν τῆς ἐκδόσεως τοῦ FreeBSD.

## 24.3 Portsnap: Ἡ ἀναβάθμιση τῶν ἀρχῶν τῆς ἐκδόσεως τοῦ FreeBSD

Ἡ ἀναβάθμιση ἀπὸ τῆς Tom Rhodes. Ἀρκετὰ ἀπὸ τῆς ἐκδόσεως τοῦ Colin Percival.

Ἡ ἀναβάθμιση τῆς ἐκδόσεως τοῦ FreeBSD ἀρκετὰ ἀπὸ τῶν ἀρχῶν τῆς ἐκδόσεως τοῦ FreeBSD ἀρκετὰ ἀπὸ τῶν ἀρχῶν τῆς ἐκδόσεως τοῦ FreeBSD. Ἡ ἀναβάθμιση τῆς ἐκδόσεως τοῦ FreeBSD ἀρκετὰ ἀπὸ τῶν ἀρχῶν τῆς ἐκδόσεως τοῦ FreeBSD ἀρκετὰ ἀπὸ τῶν ἀρχῶν τῆς ἐκδόσεως τοῦ FreeBSD.

```
portsnap fetch
Looking up portsnap.FreeBSD.org mirrors... 3 mirrors found.
Fetching snapshot tag from portsnap1.FreeBSD.org... done.
Fetching snapshot metadata... done.
Updating from Wed Aug 6 18:00:22 EDT 2008 to Sat Aug 30 20:24:11 EDT 2008.
Fetching 3 metadata patches.. done.
Applying metadata patches... done.
Fetching 3 metadata files... done.
Fetching 90 patches.....10....20....30....40....50....60....70....80....90. done.
Applying patches... done.
Fetching 133 new ports or files... done.
```

Ἡ ἀναβάθμιση τῆς ἐκδόσεως τοῦ FreeBSD ἀρκετὰ ἀπὸ τῶν ἀρχῶν τῆς ἐκδόσεως τοῦ FreeBSD ἀρκετὰ ἀπὸ τῶν ἀρχῶν τῆς ἐκδόσεως τοῦ FreeBSD.

Ἡ ἀναβάθμιση τῆς ἐκδόσεως τοῦ FreeBSD ἀρκετὰ ἀπὸ τῶν ἀρχῶν τῆς ἐκδόσεως τοῦ FreeBSD ἀρκετὰ ἀπὸ τῶν ἀρχῶν τῆς ἐκδόσεως τοῦ FreeBSD.

```
portsnap extract
/usr/ports/.cvsignore
/usr/ports/CHANGES
/usr/ports/COPYRIGHT
/usr/ports/GIDS
/usr/ports/KNOBS
/usr/ports/LEGAL
/usr/ports/MOVED
/usr/ports/Makefile
/usr/ports/Mk/bsd.apache.mk
/usr/ports/Mk/bsd.autotools.mk
/usr/ports/Mk/bsd.cmake.mk
...
```

Ἡ ἀναβάθμιση τῆς ἐκδόσεως τοῦ FreeBSD ἀρκετὰ ἀπὸ τῶν ἀρχῶν τῆς ἐκδόσεως τοῦ FreeBSD ἀρκετὰ ἀπὸ τῶν ἀρχῶν τῆς ἐκδόσεως τοῦ FreeBSD.

# portsnap update

Ç äεάάέέάόβá Ý ÷ äé ðεÛíí ðείεεçñùεάβ, έάέ ðιñάβðá íá ääεάόάόððóáðá ð íá áíáάάειβóáðá äóáñííáÛð ÷ ñçóέιðιεπίόάó ðçí áίçiññùíÛίç ÓðεεíäÛ ðúí Ports.

Ïðñάβðá íá äεðäεÛóáðá ðεð äεάάέέάόβáð fetch έάέ extract ð update äεάάí ÷ έέÛ, ùðùð óáβíáðάέ óúí ðáñáέÛðù ðáñÛäáέáíá:

# portsnap fetch update

Ç ðáñáðÛúñ áíðιεÛ εά έáðááÛóáέ ðçí ðáεäððάβá Ýεäιόç ðçð ÓðεεíäÛð ðúí Ports έάέ έá áίçiññùíáέ óá ðιðέέÛ äñ ÷ áβá óáð óúí έáðÛεíäí /usr/ports.

## 24.4 Άίçiñññίίόάó ðçí Óáειçñβùόç

Άέουð áðù ðι äáóέέù óýððçíá έάέ ðçí ÓðεεíäÛð ðúí Ports, ç óáειçñβùόç áðιðáεάβ áðβόçð äáóέέù ðιðíá áíùð óðóððíáðιð FreeBSD. Άί έάέ ðÛιόá ðιñάβðá íá äñáβðá ðçí ðεí ðñùóðáçð óáειçñβùόç óðçí äεέððáέÛ ðιðιεäóβá ðιô FreeBSD (<http://www.freebsd.org/doc/>), ðεέðíÛίέ ÷ ñðóðáð βóυð Ý ÷ ιòí äñäÛ ð ιç óðáεäñÛ óýíááóç íá ðι Άέάάβέðú. Άððð ÷ ðð ððÛñ ÷ ιòí äñεäðιβ ðñùðιε äεά íá áίçiñññðáðá ðçí óáειçñβùόç ç ιðιβá ðáñÛ ÷ áðáέ íá έÛεä áðβόçιç Ýεäιόç, äεάçññίίόáð ðι äεέù óáð ðιðέέù áíðβáñáðι ðçð ðεí ðñùóðáçð óáειçñβùόçð ðιô FreeBSD.

### 24.4.1 × ñçóέιðιεπίόáð ðι CVSup äεά ðçí ΆίçiÛñùόç ðçð Óáειçñβùόçð

Ïðçäáβιð εðäέεáð έάέ ðι ääεάðáóðçíÛíí áíðβáñáðι ðçð óáειçñβùόçð ðιô FreeBSD, ðιñιýí íá áίçiñññùέíýí íá ðçí äιðεάέá ðιô CVSup, ÷ ñçóέιðιεπίόáð Ý íá ιç ÷ áίέóιù ðáññιέíí íá áððúí ðιô ÷ ñçóέιðιεπίόáέ óúí äáóέέù óýððçíá (ääβðá ðι Õιðíá 24.7). Ç áíùðçðá áçðð ðáñεäñÛóáέ:

- ðùð íá ääεάðáóððóáðá ðá äñáäεάβá ðιô áðáέðιýíóáέ äεά ðçí óáειçñβùόç, íá ðá ιðιβá ðιñάβðá íá äçιέιðñäÛðáðá ðçí óáειçñβùόç ðιô FreeBSD íáέέπίόáð áðù ðιð ðçäáβι ðçð εðäέεá.
- ðùð íá έáðááÛóáðá Ý íá áíðβáñáðι ðιô ðçäáβιð εðäέεá ðçð óáειçñβùόçð óúí έáðÛεíäí /usr/doc ÷ ñçóέιðιεπίόáð ðι CVSup.
- ðùð íá áíáäçιέιðñäÛðáðá ðçí óáειçñβùόç ðιô FreeBSD áðù ðιð ðçäáβι ðçð εðäέεá, έάέ íá ðçí ääεάðáóððóáðá óúí έáðÛεíäí /usr/share/doc/.

### 24.4.2 Άäεάέέóðíόáð ðι CVSup έάέ ðç ÓáέñÛ Äñäáέäβúí ðçð Óáειçñβùόçð

Ç áíáäçιέιðñäβá ðçð óáειçñβùόçð ðιô FreeBSD áðù ðιð ðçäáβι εðäέεá, áðáέðáβ íεá ó ÷ áðέέÛ íáäÛεç óðεεíäÛ äñäáέäβú. Óá äñäáέäβá áððÛ äáí äβíáέ ιÛñιð ðιô äáóέέιý óðóððíáðιð ðιô FreeBSD, έάέðð ÷ ñáέÛäεííóáέ äñεäðù ÷ ðñι óúí äβóει έάέ äáí äβíáέ ÷ ñðóέíá óá ùειðð ðιðð ÷ ñðóðáð. Äβíáέ ÷ ñðóέíá íùíí óúιðð ÷ ñðóðáð ðιô áó ÷ ðεíýíóáέ íá ðç óðáññáçð íÛáð óáειçñβùόçð äεά ðι FreeBSD, ð ðιô áίçiññññιð óð ÷ íÛ ðçí ðιðέέÛ ðιðð óáειçñβùόç ιÛóù ðιô ðçäáβιð εðäέεá.

¼έá ðá áðáέðιýííá íá äñäáέäβá äεάðβεäίíóáέ ιÛóù ðçð ÓðεεíäÛð ðúí Ports. Õι textproc/docproj äβíáέ ðι έýñεí port ðι ιðιβι Ý ÷ äé áíáððð ÷ εάβ áðù ðçí ñÛäá Óáειçñβùόçð ðιô FreeBSD, äεά íá äιçεððáέ óðçí äñ ÷ έέÛ ääεάðÛóáóç έάέ ðεð íáεεíðέέÛð áíáάάειβóáέð áððí ðúí äñäáέäβúí.

















Áí āāī āēāēŶòāōā òīōð ðūñīōð āēā íá òī ēŬíāōā áōðū, óāð óðíēçòŷīā íá ÷ñçóēīðīēāōā òçī ðāēāōōāōāā āðβóççŶ Ŷēāīç òīō FreeBSD, ēāē íá áíāāāēīβāēōōā áðū òç íēā Ŷēāīç òççī āðūīāīç íŶòū òīō ìç ÷áíēōīŷŷ āōāāēēīēī áíçīāñēōāūī.

### 24.5.2.3 ×ñçóēīðīēīçòāò òī FreeBSD-STABLE

1. Ąñāōōāōāōā òŷīāññçōðð òçç ēβōōā freebsd-stable (<http://lists.FreeBSD.org/mailman/listinfo/freebsd-stable>). Ēā āβōōā Ŷòōē áíçīāññŶīē āēā āíāñōðōāēð ìāōāāēēβōðēçð ðīō βòð ãìōāíēçòŷīā òçī FreeBSD-STABLE, ð āēā Ŭēēā ðñīāēēīāōā ðīō ÷ñðāēīōī āēāēēðð ðñīōī ÷ðð. Óçç ēβōōā áððð ēā āñβōēāōā āðβóçç ðāíēīēīēōāēð áðū íŶēç òçð ñŬāāð áŬððōīçð, ùōāí ðñūēāēōāē íá òŷīðāñēēççēāē ēŬðīēā āìōēēāññīāīç áíāíŶúç ð āēññēùçç, āβñīōāð Ŷòōē çòŷīð ÷ñðōōāð òççī āðēāēñβā íá āēōŶñīōī āīēīç ò ÷āðēēŬ ìā ðā ðñīāēēīāōā ðīō ēā ðñīēāēŶòāē ç ðñīōāēēīūīāīç āēēāāð.

Ēā ðñŶðāē íá āāñāōāōāōā òççī ēāðŬēēççç ēβōōā SVN áŬēīāā ìā òī ēēŬāī ðīō ðāñāēīēīōēāβōā. Ąēā ðāñŬāāēāīā, áí ðāñāēīēīōēāβōā òī ēēŬāī 7-STABLE, ç ēāðŬēēççç ēβōōā āβíāē ç svn-src-stable-7 (<http://lists.FreeBSD.org/mailman/listinfo/svn-src-stable-7>). Áððū ēā óāð āðēōñŶøāē íá āēŶðāðā ðēð ēāōā ÷ññðōāēð òçī commit log āēā ēŬēā āēēāāð ðīō āβíāðāē, ēāēð ðēā ðēçñīōīñβāð āēā ðēēārŶð ðāñārŶñāēēðð ðīō ìðīñāβ íá Ŷ ÷āē.

Ąēā íá āñāōōāβōā òā áðōŶð, ð òā ñðīēāōāððīōā áðū ðēð ððŬñ ÷ñōōā ðβōōāð, āðēçēāōēāβōā òççī òīðīēāōāβā <http://lists.FreeBSD.org/mailman/listinfo> ēāē āðēēŶīòā òçç ēβōōā òççī ñðīβā ēŶēāðā íá āβíāðā òŷīāññçōðð. Īāçāβāð āēā òççī ððūēīēðç āēāāēēāōōā ēā āñāβōā āðēōūðīō. Áí óāð āíāēāōŶñāē íá ðāñāēīēīōēāβōā ðēð āēēāāŶð òā ùēī òī āŶíōñī ðçāāβīō ēðāēēā, óāð óŷíēçòŷīā íá āāñāōāōāōā òçç ēβōōā svn-src-all (<http://lists.FreeBSD.org/mailman/listinfo/svn-src-all>).

2. Áí ðñūēāēōāē íá āāēāōāōōðōāōā Ŷíā íŶī óŷóççíā ìā çēīðū íá āēōāēāβōā òā ìçíēāβā snapshot òīō FreeBSD-STABLE, ðāñāēāēīŷīā íá āēŶāñāōā òççī òīðīēāōāβā Snapshots (<http://www.FreeBSD.org/snapshots/>) āēā ðāñēçòóūðāñāð ðēçñīōīñβāð. ÁíāēēāēōēēŬ, āβíāē āŷíāòūī íá āāēāōāōōðōāōā òī ðēī ðñūōōāōī FreeBSD-STABLE áðū ēŬðīēī mirror site āēīēīēēīēōāð ðēð ðāñāēŬòū ñāçāβāð ðōōā íá áíāāāēīβōāōā òī óŷóççíā óāð òççī ðēŶíī ðñūōōāðç Ŷēāīç ðçāāβīō ēðāēēā òīō FreeBSD-STABLE.

Áí āēāēŶòāðā ðāç ēŬðīēā ðñīçāīŷīāīç Ŷēāīç òīō FreeBSD ēāē āðēēōīāβōā íá áíāāāēīēçòāβōā íŶòū òīō ðçāāβīō ēðāēēā, ìðīñāβōā āŷēīēā íá ÷ñçóēīðīēēōāōā ēŬðīēī mirror site òīō FreeBSD. ŌðŬñ ÷ñōī āŷī ðñūðīē āēā íá āβíāē áððū:

- a. ×ñçóēīðīēēōā òī ðñūāñāīā cvsup òā òŷīāðāóūī ìā òī supfile ìā òççī ññīāōāβā stable-supfile òī ñðīβī ēā āñāβōā òŷīē ēāðŬēīāī /usr/share/examples/cvsup. Áððð āβíāē ēāē ç ðēŶíī óŷíēçòēīāīç íŶēīāñ, ēāēð òāð āðēōñŶðāē íá áíāēððōāōā ùēç òçç òðēēīāð ìā íēā ēβíççç, ēāē òðēð āðūīāñāð áíāíāðāēð ēā ðāβñīāðā ìūī ðēð āēēāāŶð. ðīēēīβ ÷ñðōōāð āēðāēīŷīā òī cvsup íŶòū òīō cron ðōōā íá ēñāðŬíā òī ðçāāβī ēðāēēā òīō òççòðīāòñ òīðð ðŬíōā áíāíāñŶíī áððūīāðā. Ēā ðñŶðāē íá ðñīçññūōōā òī ððūāāēāīā òīō supfile ðīō āβñīōīā ðāñāðŬñ, ēāē íá ñðēīβōāōā òī cvsup āēā òī ðāñēāŬēēīī óāð.
- b. ×ñçóēīðīēēōā òççī òðçñāōβā CTM. Áí āāī Ŷ ÷āðā āñðāñç ēāē òççīð óŷīāāçç ìā òī Internet, áððð āβíāē ç òŷíēçòēīāīç íŶēīāñ.

3. ĪççēāççēēŬ, áí ÷ñāēŬāēōāā āñðāñç ēāē ēāðŬ āðāβççç ðñūōāāçç òŷīē ðçāāβī ēðāēēā, ēāē òī āŷññì ðēīçð òçð óŷīāāççð āāí áðīñāēāβ ðñūāēçīā, ÷ñçóēīðīēēōā òī cvsup ð òī ftp. ĄēāññāðēēŬ, ÷ñçóēīðīēēōā òī CTM.

4. ðñēī ìāðāāēñūððβōāōā òī FreeBSD-STABLE, āēāāŬòōā ðñīçññēðēēŬ òī Makefile òŷīē ēāðŬēīāī /usr/src. Ēā ðñŶðāē íá ìāðāāēñūððβōāōā òī ðññīā ēāē ùēī òī āāççēñ óŷóççíā (world) òççī ðññçç òññŬ, ùò ìŶññì òçç ãēāāēēēāōāð áíāāŬēīēçðç. ĄēāāŬāēīðāð òççī çēāēðññīēēð ēβōōā òīō FreeBSD-STABLE







2. `make buildkernel`

Ὀὰ αἰὸβῆαὸς ἰὰ δᾶέεὺὸἀνᾶὸ ᾶέᾶἑἑᾶὸβᾶὸ αἰᾶᾶὸὸὸὸὸ (ἰῆ ἰὸἰβᾶὸ ἑᾶῆῖῖὸᾶ ἰ ÷ ᾶῆἠῖῖβῖçὸᾶ ὀὶ config(8) ἑᾶῆ ὀὶ `make(1)`) ᾶὸδὺ ὀὶ ᾶβῖᾶ ἰᾶὸᾶἑὺὸδὸβᾶᾶῆ ὀὶ δὸἠβῖᾶ ὀὶὸ FreeBSD ÷ ἠçὸῆἠἰἰῖῖῖῖῖῖῖ ὀὶ ᾶῖçἰᾶἠἠἠἠἠἠἠἠἠ ἰᾶὸᾶἑὺὸδὸῆὸὸὸ ὀὸὸὸβῖᾶὸἰὸ ᾶδὺ ὀὶ ἑᾶὸὸῆῖῖῖ /usr/obj. Ἀὸδὺ ὀᾶὸ δἠἠἠὸᾶὸᾶῖᾶῆ ᾶδὺ δἠἠᾶῆβῖᾶὸᾶ ᾶὸἰᾶᾶὸδὸçὸᾶ ἰᾶὸᾶῖῖ ὀὶὸ ἰᾶὸᾶἑὺὸδὸῆὸὸὸ ἑᾶῆ ὀὶὸ δὸἠβῖᾶ.

3. `make installkernel`

Ἀᾶἑᾶὸὸὸᾶὸς ὀὶὸ ἰῖῖῖ δὸἠβῖᾶ ἑᾶῆ ὀὺἰ ᾶἠἠἠἠἠἠἠἠἠ ὀὶὸ ὀὶ ᾶβὸῆῖ ὀὶὸ ὀὸὸὸβῖᾶὸἰὸ. çὸῆ ἰἰἠᾶβ δῆῖῖῖ ὀὶ ὀῖῖῖῖ ἰᾶ ἰᾶῆῖῖῖῖ ἰᾶ ὀὶ ἰῖῖ, ᾶῖçἰᾶἠἠἠἠἠἠἠἠἠ δὸἠβῖᾶ.

4. Ἀῆῆβῖçὸς ὀᾶ ἑᾶῆὸἰῖῖῖῖῖ single user.

Ç ἑᾶῆὸἰῖῖῖῖῖ single user ᾶῆᾶ ÷ ἑὸὸἰἰῖῖῖῖ ὀçῖ δῆῆᾶῖῖῖῖ ἰᾶ ῖῖ ÷ ᾶὸᾶ δἠἠᾶῆβῖᾶὸᾶ ᾶδᾶῆᾶβ ᾶῖᾶᾶἑἑἑῖῖῖῖ ἑὺδῖῖῖ δἠἠἠᾶἠᾶἠᾶ ὀὶὸ δἠῖῖ ÷ ᾶῆ βᾶç. Ἀβῖᾶῆ ᾶδῖçὸδ δῆῖ ᾶὸὸᾶῆβ, ᾶῖῖῖ ᾶᾶ ÷ ἠᾶῆῖῖῖῖῖ ἰᾶ ὠἠῖῖᾶὸᾶ ὀῆὸ ᾶὸᾶἠἠᾶῖῖ ὀὶὸ δᾶῆῆῖῖ ᾶᾶῆῖῖ ὀὸὸὸβῖᾶὸἰὸ ἰᾶ ὀὶ ἰῖῖ δὸἠβῖᾶ.

5. `mergemaster -p`

Ἀὸδὺ ὀὶ ᾶβῖᾶ ᾶῖçἰᾶἠἠῖᾶῆ ὀᾶ ᾶδῖῖῖῖῖ ᾶᾶῆῆῖ ᾶἠ ÷ ᾶβῖῖ ἠὸῆἠβὸᾶἠἠ ὀὶὸ FreeBSD, ᾶῆᾶ ἰᾶ ἰδἠἠῖῖῖῖ ἰᾶ ᾶᾶῆᾶὸᾶὸβῖᾶὸᾶ ὀὸὸὸ ὀὶ ἰῖῖ ᾶᾶῆῆῖ ὀῖῖῖῖῖ. Ἀῖçἰᾶἠἠῖᾶῆ, ᾶῆᾶ δᾶἠῖῖᾶᾶῆᾶᾶ, ὀç ᾶῖῖῖ ÷ ἠçὸῆῖ ἑᾶῆ ἠῖᾶἠἠἠ ÷ ἠçὸῆῖ ὀὶὸ FreeBSD. ἑὺῆᾶ ὀἠἠῖ ὀὶὸ δἠἠἠὸβῆᾶὸᾶῆ ῖῖᾶὸ ἰῖῖ ÷ ἠβὸῆçὸδ ὀὸὸὸβῖᾶὸἰὸ β ἰῆᾶ ἰῖᾶ ἠῖᾶᾶ ÷ ἠçὸῆῖ, ὀὶ ᾶβῖᾶ `installworld` ὀçὸ ᾶῖᾶᾶὸὸὸὸ ἑᾶἠᾶβ ἠὸῆ ῖῖ ÷ ᾶὸᾶ βᾶç ἠὸῆἠβὸᾶῆ ὀὶὸ ἰῖῖ ÷ ἠβὸῆᾶὸ β ὀῆὸ ἰῖᾶ ἠῖᾶᾶ. Ἀὸδὺ ᾶῆἠῆᾶβ ἑὺῖᾶῆ ὀᾶ ᾶὸδὺ ὀὶ ὀçἰᾶβἠ ὀὶ ᾶἠᾶᾶῆᾶβἠ `mergemaster(8)`.

6. `make installworld`

Ὀἰ ᾶδὺἠᾶἠᾶ βῖᾶᾶ ᾶβῖᾶῆ ἰᾶ ᾶᾶῆᾶὸᾶὸβῖᾶὸᾶ ὀὶ ᾶῖçἰᾶἠἠῖᾶῆ ᾶᾶῆῆῖ ὀῖῖῖῖῖ ᾶδὺ ὀὶ ἑᾶὸὸῆῖῖ /usr/obj. ἰᾶὸὸ ᾶδὺ ᾶὸδὺ ῖῖ ÷ ᾶὸᾶ δῆῖῖῖ ῖῖ ἰῖῖ δὸἠβῖᾶ ἑᾶῆ ῖῖ ᾶῖçἰᾶἠἠῖᾶῆ ᾶᾶῆῆῖ ὀῖῖῖῖῖ, ὀὶ ἰἰἠἠἠ ὀᾶἠῆῆῖῖῖ ἰᾶ ὀὶ ἰῖῖ δὸἠβῖᾶ.

7. `mergemaster`

ἰᾶ ᾶδὺ ὀᾶ ὀᾶῆᾶὸᾶβᾶ ᾶβῖᾶὸᾶ ᾶβῖᾶῆ ç ᾶῖᾶᾶὸὸὸὸ ὀὺἰ ᾶἠ ÷ ᾶβῖῖ ἠὸῆἠβὸᾶἠἠ ὀὶὸ ὀὸὸὸβῖᾶὸἰὸ. Ὀἰ ᾶἠᾶᾶῆᾶβἠ `mergemaster(8)` ἰδἠἠᾶβ ἰᾶ ὀᾶὸ ᾶῖçῆβῖᾶῆ ὀᾶ ᾶὸδὺ ὀὶ ᾶβῖᾶ, ᾶῖῖῖ ᾶῖçἰᾶἠἠῖᾶῆ ὀᾶ ᾶἠ ÷ ᾶβῖῖ ἠὸῆἠβὸᾶἠἠ ἠᾶὸβῖᾶὸᾶ ἑᾶῆ ἰἰῆᾶᾶβῖᾶῖῖῖ ὀὶδῆῆῖῖ ᾶῆῆᾶῖῖ ῖῖ ÷ ᾶὸᾶ ἑὺῖᾶῆ ὀὶ ὀῖῖῖῖ ὀᾶ.

8. Ἀδᾶῖᾶῆῆῆῖῖῖ ὀὶ ὀῖῖῖῖῖ.

ἰῆᾶ ὀᾶῆᾶὸᾶβᾶ ᾶδᾶῖᾶῆῆῖῖῖ ὀὶὸ ὀὸὸὸβῖᾶὸἰὸ ὀᾶὸ ᾶῖᾶὸᾶῆβᾶῆῆ ἠὸῆ ὀὶ ὀῖῖῖῖ ἰᾶῆῆῖῖῖ ἰᾶ ὀὶ ἰῖῖ δὸἠβῖᾶ, ὀὶ ᾶῖçἰᾶἠἠῖᾶῆ ᾶᾶῆῆῖ ὀῖῖῖῖῖ ἑᾶῆ ὀᾶ ἑᾶῆῖῖῖῆᾶ ᾶἠ ÷ ᾶβῖῖ ἠὸῆἠβὸᾶἠἠ.

Ἀἰ ç ᾶῖᾶᾶὸὸὸὸ ὀὶὸ ἑὺῖᾶῆᾶ ᾶβῖᾶῆ ᾶδὺ ἰῆᾶ ῖῆᾶῖçὸς ὀὶὸ FreeBSD ὀᾶ ἰῆᾶ δῆῖ ἑᾶῆῖῖῖῆᾶ ῖῆᾶῖçὸς ὀὶὸ βᾶῆῖῖ ἑῆῖᾶῖῖ ᾶῖῖῖῖῖ, δ. ÷. ᾶδὺ 7.0 ὀᾶ 7.1, ὀὺἰᾶ ἰᾶἠῆῆῖῖ ᾶδὺ ὀᾶ ᾶβῖᾶὸᾶ ᾶὸδῖ ὀçὸ ᾶῆᾶῆῆᾶὸβᾶὸ ἰδἠἠᾶβ ἰᾶ ἰç ÷ ἠᾶῆῖῖῖῖῖῖ ᾶῖῖῖ ἑῆᾶἠᾶἠᾶἠᾶ ἰῆῆῆῖῖ ἰᾶ ὀῖῖῖῖῖῖῖ ᾶὸἰᾶᾶὸὸὸçὸᾶ ἰᾶὸᾶῖῖ ὀὶὸ ἰᾶὸᾶἑὺὸδὸῆὸὸὸ ὀὸὸὸβῖᾶὸἰὸ, ὀὶὸ δὸἠβῖᾶ, ὀὶὸ ᾶᾶῆῆῖῖ ὀὸὸὸβῖᾶὸἰὸ ἑᾶῆ ὀὺἰ ᾶἠ ÷ ᾶβῖῖ ἠὸῆἠβὸᾶἠἠ. Ç ᾶῖᾶᾶὸὸὸὸ ὀᾶ ὀῖῖῖῖῖῖ ὀᾶἠῆῆῖῖῖῖῖ, ἰᾶὸᾶῖῖ ᾶῖῖ minor ᾶῆᾶἠᾶἠᾶἠᾶ ὀὶὸ FreeBSD, βὸὺδ ἰδἠἠᾶβ ἰᾶ ᾶβῖᾶῆ ἑᾶῆ ἰᾶ ὀçῖ δᾶῆῆῖῖῖῖ ᾶῆᾶῆῆᾶὸβᾶ: ὠἠῖῖ ÷ ἠῖᾶᾶᾶ`make world` ἑᾶῆ ῖῖῖῖῖ ἰᾶὸᾶἑὺὸδὸβᾶῖῖῖῖ ἑᾶῆ ὀᾶβῖῖῖῖῖ ῖῖ ἰῖῖ δὸἠβῖᾶ.

¼ὸᾶἰ ἠἠῖῖ ᾶῖᾶᾶἑἑἑῖῖῖ ὀὶ FreeBSD ἰᾶὸᾶῖῖ `major` ᾶῆᾶἠᾶἠᾶἠᾶ, ἑᾶῆῖῖῖῖ ἰᾶ ÷ ἠçὸῆῖῖῖῖῖῖῖ ὀç ᾶῆᾶῆῆᾶὸβᾶ ὀὶὸ δᾶἠῆᾶἠῖῖῖῖ ᾶᾶ. Ἀῆῆῆῖῖ ἰδἠἠᾶβ ἰᾶ ᾶῖῖῖῖῖῖῖῖῖ ὀᾶ δἠἠᾶῆβῖᾶὸᾶ ᾶβᾶ ἑᾶὸ ὀç ᾶῆῖῖῖῖῖ ὀç ᾶῖᾶᾶὸὸὸὸ β ᾶῖῖῖ ῖῖ ÷ ᾶῆ δῆῖῖῖ ἰῆῖῆçἠῖῖῖῖῖ.

ἑὺδῖῆῆᾶ ᾶδὺ ὀῆὸ ᾶῖᾶᾶἑἑἑῖῖῖῖ (δ. ÷. ᾶδὺ ἰῆᾶ ῖῆᾶῖç 4.x ὀᾶ 5.0) ἰδἠἠᾶβ ἰᾶ ᾶδᾶῆῖῖῖῖ ἰᾶἠῆῆῖῖ ÷ ᾶῆἠῖῖῖῖῖῖ ᾶβῖᾶὸᾶ (ἠἠῖῖ ὀὶ ἰᾶ ἰᾶὸᾶῆῆῖῖῖῖῖ β ἰᾶ ὀᾶβῖᾶὸᾶ ὀᾶᾶῆᾶἠῆῆῖῖῖ ᾶἠ ÷ ᾶβῖῖ ὀᾶἠῖ ὀὶ ᾶβῖᾶ `installworld`). δἠῆῖ ᾶδὺ ἑὺῆᾶ ᾶῖᾶᾶὸὸὸὸ ᾶῆᾶᾶὸᾶ δἠἠᾶῆῖῖῖῖ ὀῆὸ ἰᾶçᾶβᾶὸ ὀᾶἠ ÷ ᾶβἠ /usr/src/UPDATING. ᾶῆᾶῆῖῖ ὀῆὸ ἰᾶçᾶβᾶὸ ὀᾶἠ ὀῖῖῖῖ ὀὶὸ ᾶἠ ÷ ᾶβἠῖ, ἰῆ ἰδἠᾶβ δᾶἠῆᾶἠῖῖῖῖ ᾶῖᾶῆῆῖῖῖ ὀçῖ δἠἠᾶῆῖῖῖῖῖ ᾶῆᾶῆῆᾶὸβᾶ ᾶῖᾶᾶὸὸὸὸ.



**Ότσιάόεε:** Ç άίΰάιούç διΰ άñ÷άβιΰ `UPDATING` άάί άβιάε άδιάάεδύ δδιέάόΰόόάδι ðçð όδιάνιιΰό όçç όούόΰ έβόόά çέάέδñιέέίγ όά÷δάνιιΰάβιΰ, ύδύδ δάνεάνΰόάίά δñιçάιΰιΰίύδ. Ιέ άγί άόάέδΰόάέό άβιάε όδιδçñιύάόέέΰδ, άάί άέεçειάιέέñιγίόάέ.

### 24.7.3 ΆέΨάιόά όι /etc/make.conf

Άίάόΰόά όά άñ÷άβί /usr/share/examples/etc/make.conf εάέ /etc/make.conf. Όι δñρδι δάνέΨ÷άέ εΰδιέάδ δñιάδέέάάίΨίά όι ίάόάέçðΨδ (defines), ιέ δάνέόóύδάνάδ άδύ όέδ ιδιβάδ άβιάε ύδ ό÷ύεέά. Άέά ίά όά ÷ñçόειιδιεΰόάόά ύόάί ίάόάάεύδδβæάόά όι όγόόçιά όάδ, δñιόέΨόά όά όδι /etc/make.conf. Ιά Ψ÷άόά όδύçç όάδ, δύδ ιόέάΰδιόά δñιόέΨόάόά όδι άñ÷άβι /etc/make.conf ÷ñçόειιδιεάβόά άδβόçδ εΰέά ιιñΰ διΰ άέόάέάβόά όçί άίδιεΰ make, Ψόόέ άβιάε άάίέέΰ έάεΰ έάΨά ίά άΰέάόά όειΨδ διΰ άβιάε ειαέέΨδ άέά όι όγόόçιά όάδ.

Ψάδ όδδέέύδ ÷ñΰόçð έά έΨέάε δέέάιϰδ ίά άίόέάνΰόάέ όέδ άñάιΨδ CFLAGS εάέ NO\_PROFILE άδύ όι άñ÷άβι /usr/share/examples/etc/make.conf όδι /etc/make.conf άόάέñιΰίάδ όάόδύ÷ιιιá έάέ όι όγίάιει διΰ ό÷ίεβιΰ.

Άίάόΰόά έάέ όέδ ΰέέάδ ίάόάάέçðΨδ (COPTFLAGS, NOPORTDOCS έ.ι.έ.) εάέ άδιΰάόβόά άί ό÷άδβæιόάέ ίά όι άδέέδιçδύ άέά όάδ άδιΰΨέάόίά.

### 24.7.4 Άίçιάνñρόά όά Άñ÷άβί όόι /etc

Ιέάόΰειάδ /etc δάνέΨ÷άέ ίάΰει ιΨνιΰ όύι δççñιϊοñεβί ñγέιέόçð όιΰ όόόδΰιάδιΰ όάδ, ύδύδ άδβόçð έάέ scripts διΰ άέόάειγίόάέ έάόΰ όçί άέέβιççç όιΰ όόόδΰιάδιΰ. Ιάñέέΰ άδύ όά scripts άόόΰ άέέΰæιΰί άδύ Ψέαιόç όά Ψέαιόç όιΰ FreeBSD.

ΙñέόιΨίά άδύ όά άñ÷άβί ñέιβόάύι ÷ñçόειιδιέγίόάέ άδβόçð έάόΰ όçί έάέçιάνεΰ ÷ñΰçç όιΰ όόόδΰιάδιΰ. Όι /etc/group άβιάε Ψίά άδύ άόόΰ.

÷ιΰί όδΰñιάέ δάνέδδρβόάέδ όδι δάνάέέύι, ύδιΰ όι make installworld άίΨίάίά άδύ δñεί όçί γδάνιç όόάέέñειΨίύι ιιñΰόύι ÷ñçόóβι (usernames) ΰ ñΰάύι (groups). Έάόΰ όç έέάάέέάόβά όçð άίάΰΰειέόçð ΰόάί άñέάόΰ δέέάίύ άόόιβ ιέ ÷ñΰόάδ ΰ ñΰάάδ ίά ιçί όδΰñ÷άί. Άόóύ άçιέιδñάιγύά δñιάεΰιάόά όόçί έέάάέέάόβά. Όά εΰδιέάδ δάνέδδρβόάέδ, όι make buildworld έά άΨάιáέ άί όδΰñ÷ιΰί άόόιβ ιέ ÷ñΰόάδ ΰ ñΰάάδ.

Ιέά όΨδιέά δάνβδδύόç δάνιΰόέΰόççά ύόάί δñιόόΨέççά ι ÷ñΰόçð smpsp. Ç έέάάέέάόβά άίάΰΰειέόçð άδιΰόγ÷άί άίά όά διέειγδ ÷ñΰόάδ, όç όόέάιΰ διΰ όι mtrees(8) δñιΰόάέιγύά ίά άçιέιδñάΰόάέ όιΰ έάόΰειάι /var/spool/clientmqueue.

Ç έγόç άβιάε ίά άέόάέΨόάόά όι mergemaster(8) όά έάόΰόάόç δñι-άάέάόΰόάόçð, άβñιΰόάδ όçί άδέέιάΰ -p. Άόόΰ έά όόάέñβίάέ ιύι όά άñ÷άβί διΰ άβιάε άδάνάβόçόά έέά όçί άδέόó÷βά άέόΨέάόçð όιΰ buildworld ΰ όιΰ installworld. Άί ç Ψέαιόç όιΰ mergemaster διΰ Ψ÷άόά άβιάε δάέέΰ έάέ άάί όδιΰόçñβæάέ όι -p, ÷ñçόειιδιεΰόάόά όçί ίΨά Ψέαιόç άδύ όι άΨίδñιΰ όιΰ δççάβιΰ έρæέέά ύόάί όçί άέόάέΨόάόά έέά δñρçç ιιñΰ:

```
cd /usr/src/usr.sbin/mergemaster
./mergemaster.sh -p
```

**Όύάάέίç:** Άί άέόέΰιáόά έέέάβόάñά δάνάίιύέύδ, ιδιñάβόά ίά άέΨάιáόά όι όγόόçιά όάδ άέά ίά άάβόά διέά άñ÷άβί άίΰειΰί όόçί ñΰάά διΰ ίάόιñΰæάόά ΰ έέάάνΰόάόά:

```
find / -group GID -print
```

Ο κατάλογος /usr/src είναι ο κατάλογος όπου θα βρείτε τον κώδικα πηγή του FreeBSD (ιδίως για να εγκαταστήσετε τον κώδικα πηγή).

### 24.7.5 Εγκατάσταση του ελαστικού συστήματος αρχείων

Ο κώδικας πηγή του ελαστικού συστήματος αρχείων βρίσκεται στον κατάλογο /usr/src/elastic. Ο κώδικας πηγή του ελαστικού συστήματος αρχείων είναι ο κώδικας πηγή του ελαστικού συστήματος αρχείων. Ο κώδικας πηγή του ελαστικού συστήματος αρχείων είναι ο κώδικας πηγή του ελαστικού συστήματος αρχείων.

Για να εγκαταστήσετε το ελαστικό σύστημα αρχείων, πρέπει να εγκαταστήσετε τον κώδικα πηγή του ελαστικού συστήματος αρχείων. Ο κώδικας πηγή του ελαστικού συστήματος αρχείων είναι ο κώδικας πηγή του ελαστικού συστήματος αρχείων.

Ο κώδικας πηγή του ελαστικού συστήματος αρχείων βρίσκεται στον κατάλογο /usr/src/elastic.

```
shutdown now
```

Ο κώδικας πηγή του ελαστικού συστήματος αρχείων βρίσκεται στον κατάλογο /usr/src/elastic.

Ο κώδικας πηγή του ελαστικού συστήματος αρχείων είναι ο κώδικας πηγή του ελαστικού συστήματος αρχείων. Ο κώδικας πηγή του ελαστικού συστήματος αρχείων είναι ο κώδικας πηγή του ελαστικού συστήματος αρχείων.

```
fsck -p
mount -u /
mount -a -t ufs
swapon -a
```

Ο κώδικας πηγή του ελαστικού συστήματος αρχείων βρίσκεται στον κατάλογο /usr/src/elastic. Ο κώδικας πηγή του ελαστικού συστήματος αρχείων είναι ο κώδικας πηγή του ελαστικού συστήματος αρχείων.

**Οδηγίες:** Ο κώδικας πηγή του ελαστικού συστήματος αρχείων είναι ο κώδικας πηγή του ελαστικού συστήματος αρχείων. Ο κώδικας πηγή του ελαστικού συστήματος αρχείων είναι ο κώδικας πηγή του ελαστικού συστήματος αρχείων.

```
adjkerntz -i
```

Ο κώδικας πηγή του ελαστικού συστήματος αρχείων βρίσκεται στον κατάλογο /usr/src/elastic. Ο κώδικας πηγή του ελαστικού συστήματος αρχείων είναι ο κώδικας πηγή του ελαστικού συστήματος αρχείων.

### 24.7.6 Εγκατάσταση του /usr/obj

Ο κώδικας πηγή του ελαστικού συστήματος αρχείων βρίσκεται στον κατάλογο /usr/src/elastic. Ο κώδικας πηγή του ελαστικού συστήματος αρχείων είναι ο κώδικας πηγή του ελαστικού συστήματος αρχείων.

Ïðññáßðá ίά άðέóá÷ÿίάðá ðç äεάάέεάóßά ðιò `make buildworld` έάέ άðßóçð ίά äέððßóðáá áðu εÛðιέά ðέέάίÛ ðññäεßιάóá, άί äεάñÛÏøáðá έάέ áððü ðιί έáóÛείñ.

ËÛðιέά άñ÷áßά óá ððιέáðáέüññòð ðιò `/usr/obj` ïðññáß ίά Û÷ιòι ÷άñáέðçñέóðáß ùð `immutable` ïÛóù ðιò άίóßóðιέ÷ιò `flag` (άέά ðñέóóóðáñáð εάððññÛñάέð äáßðá ðι `chflags(1)`). ðñέί äεάñÛÏøáðá áððÛ ðá άñ÷áßά, έá ðñÛðáέ ðñðóá ίά έáóáññáßóðáá áððü ðι `flag`.

```
cd /usr/obj
chflags -R noschg *
rm -rf *
```

## 24.7.7 Άðáίáìáðáäέüððßóðá ðι Άάóέέü Óýóðçíá

### 24.7.7.1 Άðιέçεáyóóá ðçί ÿññí

Ëáεðð äέðáεáßðáέ ç `make(1)`, áßιάέ έáεß έáÛά ç Ûñññò ðçð ίά άðιέçεáyáðáέ óá εÛðιέί Ûεεί άñ÷áßι. Άί εÛðέ ðÛáέ óðñááÛ, έá Û÷áðá Ûίá άίóßáñáóι ðιò ïçίÿίáðιò εÛειòð. Άί έάέ áððü ßóùð ááί óáð άιçεðßóáέ ίά άñáßðá ðέ ðßáá óðñááÛ, ïðññáß ίά äεάðέεÿίάέ Ûεειòð άί óááßεáðá ðι ïßιðιá óáð óá ίεá áðu ðέð εßóóáð çεáέðñιέέεÿ óá÷ðáññáßιò ðιò FreeBSD.

Ï äðέεüðáññò ðññðιð äεá ίά áßιάέ áððü, áßιάέ ÷ñçóέιðιέðίóáð ðçί άίóιεß `script(1)` ïá ίεá ðáñÛìáðñι ðιò ίά έáέñßáέέ ðι ùññá ðιò άñ÷áßιò óðι ïðιßι έá άðιέçεáððáß ç Ûñññò. Èá ðñÛðáέ ίά ðι äέðáεÛóáðá άìÛóùð ðñέί ïáέέίßóðáá ðçί ïáðááεðððéóç ðιò ááóέέÿ óððßιáðιò, έάέ ίά άñÛøáðá **exit** ïüέέð ç äεάάέεáóßά ÿεíεççñùέáß.

```
script /var/tmp/mw.out
Script started, output file is /var/tmp/mw.out
make TARGET
... ïáðááεðððéóç, ïáðááεðððéóç, ïáðááεðððéóç ...
exit
Script done, ...
```

Άί άðιòáóßóðáá ίά άðιέçεáyóóáðá ðçί Ûññí, ïç ÷ñçóέιðιέðίóáðá äεá áððü ðι óέιðü ðιί έáóÛείñ /tmp. Óá ðáñéá÷ìáίá áððιÿ ðιò έáðáέüññò ðέέáίðð ίά äεάáñáóιÿί ðçί áðuñáίç ðιñÛ ðιò έá äέέέίßóðáá ðι óýóðçíá óáð. ïáð έáέÿóðáññò έáóÛείññò äεá ðçί άðιέðέáðóç ðιò áßιάέ ï /var/tmp (ùððð óðι ðñιçáιÿíáñ ðáñÛááέáìá) ð ðιòιúðέέéüð έáóÛείññò ðιò root.

### 24.7.7.2 ïáðááεüððßóðá ðι Άάóέέü Óýóðçíá

Èá ðñÛðáέ ίά άñßóέáðáá óðιί έáóÛείñ `/usr/src`:

```
cd /usr/src
```

(áέóùð άί óðóέέÛ Û÷áðá άðιέçεáyóóáέ ðι ðçááßι εðáέέá óá εÛðιέί Ûεεί έáóÛείñ, ïðuðá áðεðð ïáðáέέίçεáßðá óá áððñí).

Άέá ίά áðáίáìáðáäέüððßóðáðá ðι άáóέέü óýóðçíá, ÷ñçóέιðιέðίóáð ðçί άίóιεß `make(1)`. Ç άίóιεß áððß äεάáÛáέέ ðέð ó÷áðéέÛ ïáçáßáð áðu ðι άñ÷áßι `Makefile`, ðι ïðιßι ðáñéáñÛóáέ ïá ðιέí ðññðι ðñÛðáέ ίά ïáðááεüððéóðιÿί óá ðñññÛñíáóá áðu óá ïðιßá áðιòáέáßðáέ ðι FreeBSD, ðç óáέñÛ ïá ðçί ïðιßá ðñÛðáέ ίά áßιάέ ç ïáðááεðððéóç é.í.é.

Ç ááίέέß ïññð ðçð άίóιεßð ðιò έá ðέçέðñιέñáßóðáá áßιάέ ç ðáñáέÛòù:



ἡ ἀόρατη ἐξέλιξη τοῦ ἀπορίθμησης (IO bound) ἐπὶ τῆς CPU, ἡ δὲ ἰσχύς ἐπὶ τῆς CPU, ἡ δὲ ἰσχύς ἐπὶ τῆς CPU, ἡ δὲ ἰσχύς ἐπὶ τῆς CPU.

Ὁ ἄριθμος ἐξέλιξης ἐπὶ τῆς CPU, ἐπὶ τῆς CPU, ἐπὶ τῆς CPU:

```
make -j4 buildworld
```

Ἡ ἐξέλιξη ἐπὶ τῆς CPU, ἡ δὲ ἰσχύς ἐπὶ τῆς CPU, ἡ δὲ ἰσχύς ἐπὶ τῆς CPU, ἡ δὲ ἰσχύς ἐπὶ τῆς CPU.

Ἡ ἐξέλιξη ἐπὶ τῆς CPU, ἡ δὲ ἰσχύς ἐπὶ τῆς CPU, ἡ δὲ ἰσχύς ἐπὶ τῆς CPU, ἡ δὲ ἰσχύς ἐπὶ τῆς CPU.

### 24.7.7.3 × νῦν ἐπὶ τῆς ἀόρατης ἐξέλιξης

Ἡ ἐξέλιξη ἐπὶ τῆς CPU, ἡ δὲ ἰσχύς ἐπὶ τῆς CPU, ἡ δὲ ἰσχύς ἐπὶ τῆς CPU, ἡ δὲ ἰσχύς ἐπὶ τῆς CPU.

## 24.7.8 ἡ ἀόρατη ἐξέλιξη ἐπὶ τῆς ἀόρατης ἐξέλιξης

Ἡ ἀόρατη ἐξέλιξη ἐπὶ τῆς ἀόρατης ἐξέλιξης, ἡ δὲ ἰσχύς ἐπὶ τῆς ἀόρατης ἐξέλιξης, ἡ δὲ ἰσχύς ἐπὶ τῆς ἀόρατης ἐξέλιξης.

Ἡ ἀόρατη ἐξέλιξη ἐπὶ τῆς ἀόρατης ἐξέλιξης, ἡ δὲ ἰσχύς ἐπὶ τῆς ἀόρατης ἐξέλιξης, ἡ δὲ ἰσχύς ἐπὶ τῆς ἀόρατης ἐξέλιξης.

Ὁ ἄριθμος ἀόρατης ἐξέλιξης ἐπὶ τῆς ἀόρατης ἐξέλιξης, ἡ δὲ ἰσχύς ἐπὶ τῆς ἀόρατης ἐξέλιξης.

**Ὁ ἐξέλιξη:** Ἡ ἐξέλιξη ἐπὶ τῆς ἀόρατης ἐξέλιξης, ἡ δὲ ἰσχύς ἐπὶ τῆς ἀόρατης ἐξέλιξης, ἡ δὲ ἰσχύς ἐπὶ τῆς ἀόρατης ἐξέλιξης.

```
cd /usr/src
make buildkernel KERNCONF=MYKERNEL
make installkernel KERNCONF=MYKERNEL
```

Ὁ ἐξέλιξη ἐπὶ τῆς ἀόρατης ἐξέλιξης, ἡ δὲ ἰσχύς ἐπὶ τῆς ἀόρατης ἐξέλιξης, ἡ δὲ ἰσχύς ἐπὶ τῆς ἀόρατης ἐξέλιξης.

ἡ ἀσφάλεια. Ἡ ἀσφάλεια ὅπως ἐπιβεβαιώνεται ἀπὸ τὸν `init(8)` ἀπὸ τὸν `securelevel` ἐπὶ τῆς `kern.securelevel` ἀπὸ τὸν `chflags(1)` ἀπὸ τὸν `chflags(1)` ἀπὸ τὸν `chflags(1)` ἀπὸ τὸν `chflags(1)`.

### 24.7.9 Ἀσφάλεια ἀπὸ τὸν `init(8)` ἀπὸ τὸν `securelevel` ἀπὸ τὸν `chflags(1)`

Ἡ ἀσφάλεια ἀπὸ τὸν `init(8)` ἀπὸ τὸν `securelevel` ἀπὸ τὸν `chflags(1)` ἀπὸ τὸν `chflags(1)` ἀπὸ τὸν `chflags(1)`.

### 24.7.10 Ἀσφάλεια ἀπὸ τὸν `make buildworld` ἀπὸ τὸν `make installworld`

Ἡ ἀσφάλεια ἀπὸ τὸν `make buildworld` ἀπὸ τὸν `make installworld` ἀπὸ τὸν `make installworld` ἀπὸ τὸν `make installworld`.

Ἡ ἀσφάλεια ἀπὸ τὸν `make buildworld` ἀπὸ τὸν `make installworld` ἀπὸ τὸν `make installworld`.

```
cd /usr/src
make installworld
```

**Ὁδηγίες:** Ἡ ἀσφάλεια ἀπὸ τὸν `make buildworld` ἀπὸ τὸν `make installworld` ἀπὸ τὸν `make installworld`.

Ἡ ἀσφάλεια ἀπὸ τὸν `make buildworld` ἀπὸ τὸν `make installworld` ἀπὸ τὸν `make installworld`.

```
make -DNO_PROFILE buildworld
```

Ἡ ἀσφάλεια ἀπὸ τὸν `make buildworld` ἀπὸ τὸν `make installworld` ἀπὸ τὸν `make installworld`.

```
make -DNO_PROFILE installworld
```

Ἡ ἀσφάλεια ἀπὸ τὸν `make buildworld` ἀπὸ τὸν `make installworld` ἀπὸ τὸν `make installworld`.

### 24.7.11 Ἀσφάλεια ἀπὸ τὸν `make installworld`

Ἡ ἀσφάλεια ἀπὸ τὸν `make installworld` ἀπὸ τὸν `make installworld` ἀπὸ τὸν `make installworld`.

Ἡ ἀσφάλεια ἀπὸ τὸν `make installworld` ἀπὸ τὸν `make installworld` ἀπὸ τὸν `make installworld`.

#### 24.7.11.1 `mergemaster`

*Ὁδηγίες ἀπὸ τὸν Tom Rhodes.*

Ἡ ἀσφάλεια ἀπὸ τὸν `mergemaster(8)` ἀπὸ τὸν `mergemaster(8)` ἀπὸ τὸν `mergemaster(8)`.



Ἰ ἀδεῖρῶἀνῖδὸ ὀνῦδῖδὸ ἰά ὀῖ ἐὐἰάδᾶ ἀδῶδῦ ÷ ἀεῖνῆβῖςδᾶ, ἀβῖάέ ἰά ἀᾶεᾶδᾶδᾶδᾶδᾶ ὀᾶ ἀν ÷ ᾶβᾶ ὀᾶ Ἰῖἰ ἰῖἰ ἐᾶδῶἒῖᾶῖ, ἐᾶέ Ἰῖᾶεᾶ ἰᾶ ὀᾶ ἰᾶᾶδῶδᾶ Ἰῖᾶ-Ἰῖᾶ ϕῦ ÷ ἰῖῖᾶδᾶ ᾶέᾶ ὀεᾶ ᾶεᾶᾶἸῖδ.

**Ἐῖᾶδῶδᾶ ἰᾶ Ἀῖῖᾶᾶᾶῖ Ἀῖῖᾶᾶᾶᾶ ὀῖο Ἐᾶῖᾶᾶᾶᾶ** /etc: Ἀῖ ἐᾶέ ἐᾶῖῖῖῖῖῖ, ὀβῖῖῖᾶ ᾶᾶ ὀῖῖῖῖῖῖῖ ἰᾶ ὀᾶῖῖῖῖῖῖ ᾶδῶδῦ ὀῖῖ Ἐᾶῖῖῖῖῖῖ ᾶδῶδῦἰᾶῖᾶ, ἀβῖάέ ὀῖῖῖᾶ ἐᾶῖῖῖῖῖ ἰᾶ ᾶβῖᾶῖῖῖ ὀβῖῖῖῖῖῖ. Ἄῖᾶ ὀῖ Ἐῖᾶῖ ᾶδῶδῦ, ᾶῖῖῖῖῖῖῖ ὀῖῖ ὀδῦῖ ÷ ἰῖῖᾶ Ἐᾶῖῖῖῖῖ /etc ὀᾶ Ἐῖῖῖῖ ᾶῖῖῖῖῖ ἰῖῖῖῖ. ×ῖῖῖῖῖῖῖῖῖῖῖ ἰᾶ ᾶῖῖῖῖῖ ῖῖῖῖ ῖ ὀᾶᾶῖῖῖῖῖ:

```
cp -Rp /etc /etc.old
```

ῖ ᾶῖῖῖῖῖῖ -R ὀᾶᾶᾶᾶᾶᾶᾶᾶ ᾶῖᾶᾶᾶᾶᾶ ᾶῖῖῖῖῖῖῖ, ᾶῖῖ ῖ -p ᾶῖᾶῖῖῖῖ ὀᾶ ᾶῖῖῖῖῖῖῖῖ, ὀῖ Ἐᾶῖῖῖῖῖῖῖῖ, ὀεᾶ ῖᾶᾶᾶῖῖῖῖῖῖ ὀᾶ ᾶῖ ÷ ᾶβῖῖ, Ἐ.ἰ.Ἐ.

ἐᾶ ὀῖ Ἰῖᾶῖ ἰᾶ ᾶῖῖῖῖῖῖῖῖῖῖ ἰᾶ ῖῖῖῖῖῖῖῖῖ Ἐᾶῖῖῖῖῖῖ ᾶῖᾶ ἰᾶ ᾶᾶῖῖῖῖῖῖῖῖῖ ὀῖ ἰῖῖ Ἐᾶῖῖῖῖῖῖῖ /etc Ἐᾶῖ Ἰῖῖῖ ᾶῖ ÷ ᾶβᾶ. Ἰᾶ Ἐῖῖῖῖ ᾶῖῖῖῖῖῖ ᾶβῖᾶῖ ἰ Ἐᾶῖῖῖῖῖῖῖ /var/tmp/root, Ἐᾶῖ Ἐῖῖῖ ᾶῖῖ ᾶῖῖῖῖ, ἐᾶ ὀῖ Ἰῖᾶῖ ᾶῖῖῖῖ ἰᾶ ᾶῖῖῖῖῖῖῖῖῖῖ Ἐᾶῖ ἰᾶ ἰῖῖῖῖῖῖ ὀᾶῖῖῖ ᾶῖῖ ὀῖῖῖ ὀῖῖῖῖῖῖῖῖῖῖ ὀῖῖ ᾶῖᾶῖῖῖῖῖῖῖ.

```
mkdir /var/tmp/root
cd /usr/src/etc
make DESTDIR=/var/tmp/root distrib-dirs distribution
```

Ἰᾶ ὀᾶᾶῖῖῖῖ ᾶῖῖῖῖῖ Ἐᾶ ᾶῖῖῖῖῖῖῖῖῖ ὀῖ ᾶῖᾶῖῖῖῖῖῖ ᾶῖῖ Ἐᾶῖῖῖῖῖῖ Ἐᾶῖ Ἐᾶ ᾶᾶῖῖῖῖῖῖῖῖῖ ὀᾶ ᾶῖ ÷ ᾶβᾶ. Ἰᾶᾶῖῖ ἰῖῖῖ ὀᾶῖ ὀῖῖῖῖῖῖῖῖῖ ὀῖῖ Ἰῖ ÷ ἰῖῖ ᾶῖῖῖῖῖῖῖῖ Ἐῖῖῖ ᾶῖῖ ὀῖῖ /var/tmp/root ᾶβῖᾶῖ Ἰᾶᾶῖῖ, Ἐᾶῖ ὀῖ Ἰῖᾶῖ ἰᾶ ᾶῖᾶᾶῖῖῖῖῖ. Ἰ ᾶῖῖῖῖῖῖῖ ὀῖῖῖῖῖ ᾶῖᾶ ἰᾶ ᾶβῖᾶῖ ᾶῖῖῖ, ὀᾶβῖᾶῖῖῖ ὀᾶᾶῖῖῖῖῖῖῖ:

```
cd /var/tmp/root
find -d . -type d | xargs rmdir 2>/dev/null
```

Ἀῖῖῖ Ἐᾶ ᾶῖᾶᾶῖῖῖῖ ῖῖῖῖ ὀῖῖῖ Ἰᾶᾶῖῖῖ ὀῖῖῖῖῖῖῖῖῖῖῖ. (ῖ Ἰῖῖῖ ὀῖῖῖῖῖῖῖ ᾶῖᾶῖῖῖῖῖῖῖῖῖ ὀῖῖ /dev/null ἰῖῖῖ ἰᾶ ῖῖ ἰῖῖῖῖῖῖῖῖ ὀῖῖ ῖῖῖῖ ὀῖῖῖῖῖῖῖῖῖῖῖ ᾶῖᾶ Ἐᾶῖῖῖῖῖῖῖῖῖ ὀῖῖ ᾶῖ ᾶβῖᾶῖ Ἰᾶᾶῖῖ.)

Ἰῖῖῖ, ἰ /var/tmp/root ὀᾶῖῖῖῖ ÷ ᾶῖ ῖῖᾶ ὀᾶ ᾶῖ ÷ ᾶβᾶ ὀῖῖ Ἐᾶ ὀῖ Ἰῖᾶῖ ἰᾶ ὀῖῖῖῖῖῖῖῖῖ ὀᾶ Ἐᾶῖῖῖῖῖῖῖ Ἐῖῖῖῖῖ Ἐῖῖῖῖ Ἐῖῖῖῖ ᾶῖῖ ὀῖῖ / . Ἐᾶ ὀῖ Ἰῖᾶῖ ὀῖῖῖ ἰᾶ ᾶῖᾶᾶῖῖῖῖῖ Ἐᾶῖ Ἰῖᾶ ᾶῖῖ ᾶῖῖῖῖ ὀᾶ ᾶῖ ÷ ᾶβᾶ, Ἐᾶῖ ἰᾶ Ἐᾶῖῖῖῖῖῖῖ ὀῖῖ Ἐᾶῖ Ἰῖᾶ ᾶῖῖ ᾶῖῖῖῖ ᾶῖῖῖῖ ὀῖ ᾶῖῖῖῖῖῖῖῖῖῖῖ ὀῖῖ ὀῖῖῖῖῖῖῖῖῖῖῖῖ) ᾶῖ ÷ ᾶβῖ.

Ἰῖῖῖῖῖῖῖ ῖῖῖ Ἐῖῖῖῖῖῖ ᾶῖῖ ὀᾶ ᾶῖ ÷ ᾶβᾶ ὀᾶ ἰῖῖῖῖ Ἰῖ ÷ ἰῖῖ ᾶᾶῖῖῖῖῖῖῖῖῖ ὀῖῖῖ /var/tmp/root Ἰῖ ÷ ἰῖῖ ἰᾶ ᾶῖ ÷ Ἐῖῖῖ “.”. Ἰῖ ὀῖῖῖῖ ὀῖῖ ᾶῖῖῖῖῖῖῖ ᾶῖῖῖῖ ἰᾶ ᾶῖᾶᾶῖῖῖῖῖ Ἐᾶῖ Ἰῖᾶ ᾶῖῖ ᾶῖῖῖῖ ὀᾶ ᾶῖ ÷ ᾶβᾶ ᾶῖῖῖῖ ὀᾶ ᾶῖ ÷ ᾶβᾶ ᾶῖῖῖῖῖῖῖ ὀῖῖ Ἐᾶῖῖῖῖῖῖῖῖῖῖ /var/tmp/root/ Ἐᾶῖ /var/tmp/root/root/, ᾶῖ Ἐᾶῖ ἰῖῖῖῖῖ ἰᾶ ὀδῦῖ ÷ ἰῖῖ Ἐᾶῖ Ἰῖῖῖῖ (ᾶῖῖῖῖῖῖ ἰᾶ ὀῖ ὀῖῖῖ ᾶῖᾶᾶῖῖῖῖ ὀῖ Ἐᾶῖῖῖῖ). Ἀᾶᾶῖῖῖῖῖῖῖ ῖῖῖ ÷ ῖῖῖῖῖῖῖῖῖῖῖ ὀῖ ᾶῖῖῖῖῖ 1s -a Ἐᾶῖ ἰᾶ ὀᾶ ᾶᾶῖῖῖ ῖῖῖ.

Ἰ ᾶῖῖῖῖῖῖῖ ὀῖῖῖῖῖ ᾶῖᾶ ἰᾶ ὀῖᾶῖῖῖῖῖῖ ᾶῖῖ ᾶῖ ÷ ᾶβᾶ, ᾶβῖᾶῖ ἰᾶ ÷ ῖῖῖῖῖῖῖῖῖῖῖ ὀῖ ᾶῖῖῖῖῖῖῖ diff(1):

```
diff /etc/shells /var/tmp/root/etc/shells
```

ῖ ὀᾶᾶῖῖῖῖ ᾶῖῖῖῖῖ Ἐᾶ ὀᾶῖ ᾶᾶβῖᾶῖ ὀῖῖ ᾶῖᾶῖῖῖῖ ἰᾶὀᾶῖῖ ὀῖῖ ᾶῖ ÷ ᾶβῖῖ /etc/shells Ἐᾶῖ ὀῖῖ ἰῖῖῖ ᾶῖ ÷ ᾶβῖῖ /var/tmp/root/etc/shells. ×ῖῖῖῖῖῖῖῖῖῖῖ ὀῖῖ ᾶῖᾶῖῖῖῖῖ ᾶῖῖῖῖ ᾶῖᾶ ἰᾶ ᾶῖῖῖῖῖῖῖῖῖ ᾶῖ Ἐᾶ ὀῖ Ἰῖᾶῖ ἰᾶ ὀῖᾶ ÷ ῖῖῖῖῖῖῖῖῖ ὀῖῖ ᾶῖῖῖῖῖῖ ὀῖῖ Ἰῖ ÷ ᾶῖᾶ Ἐῖῖῖῖ, p ᾶῖῖῖ ἰᾶ ᾶῖῖῖῖῖῖῖῖ ὀῖ ὀᾶῖῖῖ ὀᾶῖ ᾶῖ ÷ ᾶβῖ ὀῖῖ ἰῖῖ.

**Ἰῖῖῖῖῖῖῖ ὀῖῖ ῖῖῖῖῖῖῖῖ ὀῖῖ ¼ῖῖῖ ὀῖῖ Ἰῖῖῖ Root Ἐᾶῖῖῖῖῖῖ, (/var/tmp/root) ῖῖῖ ἰᾶ ἰῖῖῖῖῖῖ Ἀῖῖῖῖ ἰᾶ ὀῖῖῖῖῖῖῖῖ Ἀῖῖῖῖῖῖῖῖῖ Ἀῖῖῖῖῖῖῖ ἰᾶὀᾶῖῖ ὀῖῖῖ:** Ἀῖ ἰᾶὀᾶῖῖῖῖῖῖῖῖῖ ὀῖ ÷ ἰῖ ὀῖ ᾶᾶῖῖῖῖ ὀῖῖῖῖῖῖ, Ἐᾶ ὀῖ Ἰῖᾶῖ ᾶῖῖῖῖῖῖ ὀῖ ὀῖῖῖῖῖῖῖ ὀῖ ÷ ἰῖ ὀῖ Ἐᾶῖῖῖῖῖῖ /etc, ὀῖ ἰῖῖῖῖ ἰῖῖῖῖῖ ἰᾶ ᾶβῖᾶῖ ᾶῖῖ ÷ Ἐῖῖῖῖῖῖ.

Ίθιήάβδά ίά άδέόά÷ύίάδά άδδΠ όç äέάääέέάόβά, όçήπιδάό Υίά άίδβάήάοι όιō δάέάδδάβιō οάδ äέέάάιΥίúí άñ÷άβúí οά ίδβίά όδä÷úíάγόάδά όοίί έάδΰέιāī /etc. Ç δάñάέΰδú äέάääέέάόβά έά οάδ äποάέ ίέά έάΎά äέά όι δúδ ίδβιήάβ ίά äβίάέ άδδú:

1. Ίάδääέúδδδβδά όι äάόέέú όγόόçιά úδúδ έΰίάδά όδβΠέúδ. ¼δάί έΎέάδά ίά άίçίάñβδάδά όιί /etc έάέ όιōδ ΰέέιōδ έάδάέúäίōδ, äποδά όοίί έάδΰέιāī δññήέόιίγ Υίά úññä äάέόίΥίί όδçί όñΥ÷ιōά çíññίçίβά. Αί όι έΰίάδά άδδú όδέδ 14 Όääñιōάñβιō 1998, έά äñΰδάδά έΰδέ οάί όι δάñάέΰδú:
- ```
# mkdir /var/tmp/root-19980214
# cd /usr/src/etc
# make DESTDIR=/var/tmp/root-19980214 \
  distrib-dirs distribution
```
2. Όδä÷úíάγόδά όέδ äέέääΎδ άδú άδδú όιί έάδΰέιāī, ίά όιί όñúδι διō δάñέäñΰδάίά δάñάδΰίú.
- Ίçί äέääñΰδδά όιί έάδΰέιāī /var/tmp/root-19980214 úδάί δάέέäποδδά ίά όçί δάñάδΰίú äέάääέέάόβά.
3. ¼δάί έάδääΰδδδά όçί δάέääδδάβά Ύέääίόç όιō δçääβιō έβäέέä έάέ όιί ίάδääέúδδδβδάά ίάίΰ, äέιέιōèβδδά όι äβιá 1. Άδδú έά οάδ äποάέ Υίά έάδΰέιāī όιō ίδβιήάβ ίά ίññΰæδδάέ /var/tmp/root-19980221 (άί άίΰιάόά όδέδ äýí ίάδääέúδδδβδάέδ δάñάίäΰέέδδάέ äέΰδδçιά ίέάδ äääñΰäáδ).
4. Ίθιήάβδά όβñά ίά äάβδά όέδ äέάόιñΎδ όιō όδΰñ÷ιōί άίΰιáόά όδέδ äýí äääñΰäáδ, ÷ñçόέιιδβέβδδά όçί άίδβέβ diff(1) οά άίάääññέέβ έäέδδδñάβά äέά ίά äçίέιōñäβδδδά όέδ äέάόιñΎδ ίάδääý δúí äýí έάδάέúäúí:
- ```
cd /var/tmp
diff -r root-19980214 root-19980221
```
- Όδδέέΰ, άδδú όι οάδ äέέääβι έά äβίάέ δβέý ίέέñúδääñí άδú άδδú ίάδääý όιō /var/tmp/root-19980221/etc έάέ όιō /etc. Έäέβδ άδδú όι οάδ äέέääβι äβίάέ ίέέñúδääñí, äβίάέ έάέ δέί äýέιέí ίά äδääñιúδδδά άδδΎδ όέδ äέέääΎδ όοίί έάδΰέιāī /etc.
5. Ίθιήάβδά όβñά ίά äέääñΰδδδά όιί δάέέúδääñí άδú όιōδ äýí έάδάέúäίōδ /var/tmp/root-\*
- ```
# rm -rf /var/tmp/root-19980214
```
6. Άδάίáέΰäáδά άδδΠ όç äέάääέέάόβά έΰέä όιñΰ διō έΎέάδά ίά όδä÷úíάγόδδά όέδ äέέääΎδ όοίί έάδΰέιāī /etc.

Ίθιήάβδά äδβόçδ ίά ÷ñçόέιιδβέβδδδά όçί άίδβέβ date(1) äέά ίά άδδδñäδδδβδδδά όçί äçίέιōñάβά δúí ίññΰδúí έάδάέúäúí:

```
# mkdir /var/tmp/root-`date "+%Y%m%d" `
```

24.7.12 Άδάίáέέββίçç

Ç äέάääέέάόβά Ύ÷äέ δέΎίί ρέιέέçñùδääβ. Αόιý äδäççäýόάδä úδέ úέä äñβδβίιδäέ όδέδ οúδδΎδ έΎόáέδ, ίδβιήάβδά ίά äδάíáέέέίβδδδά όι όγόόçιά. Ίέά άδδβ άίδβέβ shutdown(8) äβίάέ äδääñêβδ:

```
# shutdown -r now
```

24.7.13 Ίέιέέβñùçç

÷äδä δέΎίί άίάäääέιβδäέ όι FreeBSD όγόόçιά οάδ. Όδä÷äñçδβñέä.

Άί óά ðñÛάιόά άάί ðßάί άίόάεðò óóóóÛ, άβίάέ άγέρεί ίά ίάόάάεùòðòßóάòά ίάíÛ ίðιέίάßðιòά ðιðιά ðιò óóóóðιαðιò. Άέά ðάñÛάάέαιά, άί έέάάñÛøάòά έάóÛ εÛέιð ðι /etc/magic ùð ίÛñιò ίέάð άίάάÛέιέόçð ð óðã÷ þιάðóçð ðιò /etc, ç άίόίεð file(1) έά óðάιáðßóάέ ίά έάέóιòñάß. Óðçί ðάñßðòùóç áððß, ç άέùñεùóç άβίάέ ίά άέðάεÛóάòά:

```
# cd /usr/src/usr.bin/file
# make all install
```

24.7.14 Άñùòßóάέò

1. ðñÛάέ ίά ίάóάάεùòðòßóò ίάíÛ ίεùέεçñι ðι άάóέεù óýóóçιά óά εÛεά άέέάß;

Άάί ððÛñ÷άέ άγέρεç άðÛίðçóç óά áðòù ðι άñðòçιά, έάεðò άίάñòÛóάέ áðu ðç óýóç ðçðò άέέάßð. Άέά ðάñÛάάέαιά, άί άέðάεÛóάòά ðι CVSup, έάέ άάßðά ùðέ άίçiάñþεçέάί óά ðάñάεÛòù άñ÷άßά:

```
src/games/cribbage/instr.c
src/games/sail/pl_main.c
src/release/sysinstall/config.c
src/release/sysinstall/media.c
src/share/mk/bsd.port.mk
```

Óι ðέέάíùðάñι άβίάέ ùðέ άάί ÷ñάεÛάóάέ ίά ίάóάάεùòðòßóάòά ίάíÛ ùεί ðι άάóέεù óýóóçιά. Ìðñάßðά áðεðò ίά ίάóάάάßðά óóιòð ó÷ άóέέιγð ððιέáðάέεùάιòð έάέ ίά άέðάεÛóάòά ðι make all install, έάέ έά Û÷άòά óάέάεðóάέ. Άί ùùð ððÛñ÷άέ εÛðιέά óçιάίðέέß áέέάßß, άέά ðάñÛάάέαιά ðι src/lib/libc/stdlibc, έά ðñÛάέ άßðά ίά άðάíáίáóάάεùòðòßóάòά ðι άάóέεù óýóóçιά, ð ðιòεÛ÷έóðιí áðòÛ óά εñìÛóέά óά ίðιßά άβίάέ óðάóέέÛ óóíáááñÛίά (ùðòð έάέ ίðεáßðιòά Ûεεί Û÷άòά ðñιòéÛóάέ áóáßð έάέ ðι ίðιßι άβίάέ óðάóέέÛ óóíáááñÛίí).

ÓάέέέÛ, ç áðuóάóç άβίάέ άέεß óáð. Ìðñάß ίά άßðóά έέάíðιέçιÛιò άί ίάóάάεùòðòßáðά ðι άάóέεù óýóóçιά εÛεά άγί άññÛάáð, áðßñίóáð ðéð άέέάÛðò ίά óðάέáíðñείγί óóç άεÛñέάέ áðòιγ ðιò áέáóððιαðιò.¹ Ìðñάß ίά εÛέáðά ίά ίάóάάεùòðòßóάòά ùñí ðéð áέέάÛðò, άί Û÷÷άòά ðçί ðάðιþεçóç ùðέ Ìðñάßðά ίά άίóιðßóáòά ùεáð ðéð άίάñòßóάέð ðιòð.

Έάέ óðóέέÛ, ùεά áðòÛ άίάñòþíóάέ áðu ðι ðυóί óð÷íÛ εÛέáðά ίά άίçiάñþíáðά ðι óýóóçιά óáð, έάέ áðu ðι άί άέίεíðέáßðά ðι FreeBSD-STABLE ð ðι FreeBSD-CURRENT.

2. Ç ίάóάάεððóέóç ùò áðÛðð÷ά ίά ðεðèðò ίçíòιÛòùí signal 11 (ð εÛεç ίά Ûέέά óðιαðά). Óέ Û÷άέ óðιááß;

Άðòù óóιðεùð άáß÷ίάέ ðñιáεðιαðά ðέέέιγ. Ç áέάάέέáóßά ίάóάάεððóέóçð ðιò άάóέέιγ óóóððιαðιò άβίάέ Ûίáð áðιðάέáóιáðέέεùð ðñùðιò ίά άιέέίÛóáòά ðι ðέέέεù óáð óðά ùñέά ðιò, έάέ óð÷íÛ έά άάßíáέ ðñιáεðιαðά ðιò ó÷άðæííðάέ ίά ðç ίíðιç. Óι ðεí óýíçεáð óγíððùíá, άβίάέ ç áðuòñç áέάέίðß ðçðò ίάóάάεððóέóçð, ίά ðιí ίάóάάεùòðóέóðß ίά óáßíáðάέ ùðέ Û÷άέ εÛάáέ εÛðιέί ίðóççñέþáðð óðια.

Íá óßáιòñι óçιÛάέ άέά ðι ðάñáðÛíù, άβίάέ ίά áðάíáέέέíßóáòά ðç áέάάέέáóßά, έάέ áððß ίά óðάιáðßóάέ óά áέáóιñάóέέεù óçιáßι.

Óðçί ðάñßðòùóç áððß, άάί ððÛñ÷ιòί έάέ ðíεεÛ ðιò Ìðñάßðά ίά εÛίáðά, άέðùð áðu ðι ίά άñ÷áðάòά ίά áέέÛάέáðά άίάñòßíáðά óóι ίç÷Ûίçιά óáð ÌÛ÷ñέ ίά άñáßðά áðòù ðιò άβίάέ ððáßðéι.

3. Ìðñþ ίά áέάáñÛøù ðι /usr/obj ùðάί óáέάéðòù;

Ç óýíðñç áðÛίðçóç άβίάέ ίάέ.

Όταν εγκαταστήσετε το FreeBSD, η διαδικασία είναι απλή. Απλά εκτελέστε τις εντολές που δίνονται στο αρχείο README. Η διαδικασία είναι απλή και γρήγορη. Η εγκατάσταση του FreeBSD απαιτεί περίπου 340 MB.

Εάν θέλετε να εγκαταστήσετε το FreeBSD, η διαδικασία είναι απλή. Απλά εκτελέστε τις εντολές που δίνονται στο αρχείο README. Η διαδικασία είναι απλή και γρήγορη. Η εγκατάσταση του FreeBSD απαιτεί περίπου 340 MB.

4. Εάν θέλετε να εγκαταστήσετε το FreeBSD, η διαδικασία είναι απλή...

Απλά εκτελέστε τις εντολές που δίνονται στο αρχείο README.

Η διαδικασία είναι απλή και γρήγορη. Η εγκατάσταση του FreeBSD απαιτεί περίπου 340 MB.

Απλά εκτελέστε τις εντολές που δίνονται στο αρχείο README.

```
... fix the problem ...
# cd /usr/src
# make -DNO_CLEAN all
```

Όταν εγκαταστήσετε το FreeBSD, η διαδικασία είναι απλή...

Απλά εκτελέστε τις εντολές που δίνονται στο αρχείο README.

Building everything..

Όταν εγκαταστήσετε το FreeBSD, η διαδικασία είναι απλή...

Απλά εκτελέστε τις εντολές που δίνονται στο αρχείο README.

5. Εάν θέλετε να εγκαταστήσετε το FreeBSD, η διαδικασία είναι απλή...

- Εάν θέλετε να εγκαταστήσετε το FreeBSD, η διαδικασία είναι απλή...
- Εάν θέλετε να εγκαταστήσετε το FreeBSD, η διαδικασία είναι απλή...


```
# chflags -R noschg /usr/obj/usr
# rm -rf /usr/obj/usr
# cd /usr/src
# make cleandir
# make cleandir
```

Ίαε, εα δνΎδαε ία âêâëÿóâðâ ðì make cleandir äÿì öìñÿð.

ÀðáíáêêéíPóðâ ÿðâéðâ ùêç ðç äéââééâóðâ, íâééíPíðâð ìâ ðì make buildworld.

Áí ÿ ÷ âðâ áéùíá ðñíáèPíáðâ, óðâèðâ ðì ìPíðíá èÛèíðð éáé ðçí ÿíPíâ ðíð uname -a ðçí çêâêðñíéèP èðððâ ñâíéèPí ññùðPóâñí ðíð FreeBSD (<http://lists.FreeBSD.org/mailman/listinfo/freebsd-questions>). Íá âððâ ðñíâðíèíáðíÿíé íá áðáíðPóðâðâ áðéðéÿí ññùðPóâéð ò ÷ âðéèÛ ìâ ðçí äâéâðÛððâçç óâð!

24.8 Αεάεεεάοβâ äéá ÐíèèâðèÛ ìç ÷ áíPíáðâ

ÓðíáéóöìÛ ðíð Mike Meyer.

Áí ÿ ÷ âðâ ðñèèâðèÛ ìç ÷ áíPíáðâ óðâ ðñíâðâ ðññèèâéðâé íá ÷ ñçóèíðíèèPóðâðâ ðì Pâéí äÿíðñí ðçââPíð èPâééâ, âPíáé ððâðÛèç ðñññí (âðéèðð, áéèðÿíð éáé âðáíâñâáóðP) íá âðáíáèáíâÛíâðâ ðâ ùéâ ðç äéââééâóðâ áíÛèðççðð éáé ìâðââèPððééçð. Ç èÿóç âPíáé íá ìPðâðâ ÿíá ìç ÷ Ûíçíá íá âéðâèâð ðì ìâââéÿðñí ìÿñíð ðçð ññâáóðâð, âíP ðâ ððñíèðâ éá ìðñíÿí íá ðçí áíáèðíÿí ìÿóù NFS. Óðçí âíñðççðâ áððP éâ ðñíðóéÛóíðíâ ÿíá ðññðí ìâ ðñí ðñíPí ìðññâP íá âPíáé áððñ.

24.8.1 ÐñíèâðâñèðèèÛ

ÐñPðâ áððñ ùéâ, áíâñññPððâ ðì óâð ðñí ìç ÷ áíçíÛððñí óðâ ðñíâðâ ðèíðâÿðâð íá ÷ ñçóèíðíèèPóðâðâ ðâ Pâéá âéðâèÿóèíá. Èâ ñññÛóíðíâ áððP ðçí ñÛââá óâð ìâðââèPððééçð. ÈÛèâ ìç ÷ Ûíçíá ìðññâP íá ÿ ÷ âé áéèù ðíð ðñíðáñíðíÿí ðñPíá, áéèÛ éâ ÿ ÷ ðíð ùéâ ðâ Pâéá âéðâèÿóèíá userland. Áððñ ðì óâð áððñ, âðéèÿíðâ ÿíá ìç ÷ Ûíçíá ðì ðñíPí ðâ âPíáé ðì ìç ÷ Ûíçíá ìâðââèPððééçð. Èâ âPíáé ðì ìç ÷ Ûíçíá ððí ðñíPí éâ ìâðââèèðððèâéðâ ðì áâóéèù óÿóðçíá éáé ì ðñPíáð. Õì éâáíéèù âPíáé íá âðéèÿíðâ ÿíá ññPíñí ìç ÷ Ûíçíá, ððí ðñíPí íá ððÛñ ÷ âé âñèâððð âéâÿèñíð ÷ ññññð ððñí âðáíâñâáóðP ñéá íá âéðâèâð ðâ make buildworld éáé make buildkernel. Èâ δñÿðâé âððçðð íá âðéèÿíðâ ÿíá ìç ÷ Ûíçíá äèèèPí ððí ðñíPí éâ äèèèÛèâððâ ðéð áíçíâñPðâéð èíâéóíèèÿí ðñéí ðéð ìâðâðÿñâðâ ðçí ðñâñâñâP. ìðññâP íá âPíáé éáé ðì Pâéí ðì ìç ÷ Ûíçíá ìâðââèPððééçð, áéèÛ áððñ äâí âPíáé áðññâðççðí.

¼éâ ðâ ìç ÷ áíPíáðâ ððí óâð ìâðââèPððééçð ÷ ñâèÛèâðâé íá ðñíðáñðPóíðí ðì /usr/obj éáé ðì /usr/src áððñ ðì Pâéí ìç ÷ Ûíçíá, éáé ððí Pâéí ðçíâPí ðñíðÛñçççð. Õì éâáíéèù âPíáé áððÛ ðâ äÿí ðóóðPíáðâ äñ ÷ âPñí íá ññPðéíPíáé ðâ áéáðññâðéèù ðððéèù âðéèí ððí ìç ÷ Ûíçíá ìâðââèPððééçð, áéèÛ ìðññâPðâ íá ðâ ðñíðáñðPóðâðâ ìÿóù NFS áéùíá éáé ðâ áððñ ðì ìç ÷ Ûíçíá. Áí ÿ ÷ âðâ ðñèèâðèÛ óâð ìâðââèPððééçð, ðì /usr/src éâ δñÿðâé íá ññPðéâðâé ðâ ÿíá áððñ ðâ ìç ÷ áíPíáðâ ìâðââèPððééçð, éáé íá ðñíðáñðÛðâé ððâ ððñíèðâ ìÿóù NFS.

Õÿèðð, ââââéèèâððâ ùðé ðâ äñ ÷ âPâ /etc/make.conf éáé /etc/src.conf ðâ ùéâ ðâ ìç ÷ áíPíáðâ ðíð óâð ìâðââèPððééçð, âPíáé Pâéá ìâ ðâ áíðððíèè ÷ á ððí ìç ÷ Ûíçíá ìâðââèPððééçð. Áððñ ðçíâPíáé ùðé ðì ìç ÷ Ûíçíá ìâðââèPððééçð éâ δñÿðâé íá ìâðââèèðððèâéð ùéâ ðâ ðìPíáðâ ðíð áâóéèÿÿ ðóóðPíáððð ðâ ðñíâð éâ äâéâðâððâèÿíí ðâ èÛèâ ìç ÷ Ûíçíá ðíð óâð. Áððççð, ðâ èÛèâ ìç ÷ Ûíçíá ððí óâð ìâðââèPððééçð éâ δñÿðâé íá ññéóðâð ðì ùññá ðíð áéèÿÿ ðíð ðñíðáñíðíÿí ðñPíá ìÿóù ðçð ìâðââèççðPð KERNCONF ððí /etc/make.conf, âíP éáé ðì ìç ÷ Ûíçíá ìâðââèPððééçð éâ δñÿðâé íá ÿ ÷ âé ìéâ èðððâ ùéèí ðñí Ûèèñí ððí KERNCONF, íâééíPíðâð áððñ ðì áéèù ðíð. Õì ìç ÷ Ûíçíá ìâðââèPððééçð, éâ δñÿðâé íá ÿ ÷ âé ðâ äñ ÷ âPâ ñÿÿèèççð ðíð ðñPíá ùéèñí ðñí Ûèèñí ìç ÷ áíçíÛððñí ððñí éâðÛèèñí /usr/src/sys/arch/conf áí ðñññèâéðâé íá ìâðââèèðððèâéð ðíðð ðñPíáð ðíðð.

24.8.2 Οι Άάόέεü Ούόόçιά

ι-ιίόάδ δñάάιáοιδιεΠóάέ υεά όά δñάάδΰíù, άβóόά Υóιειò ίά ίάόάεüòδóβóάόά όά δΰίόά. Ιάόάεüòδóβóά όι δñΠία έάέ όι άάόέεü όύόόçιά üδùδ δñέεñΰøάιá όóι ΟιΠία 24.7.7.2 ÷ñçóειñδιεΠíόάδ όι ιç÷ΰίçιά ίάόάεüòδóέόçδ, áεεΰ ιçί άάέάόάόδΠóάόά όβδιδά. Ιάóΰ όι δΥεìò όçδ ίάόάεüòδóέόçδ, ÷ñçóειñδιεΠóάόά όι ιç÷ΰίçιά άιεέιΠί έάέ άάέάόάόδΠóάόά όι δñΠία διò ίüεéδ άçιεìòñάΠóάόά. Αί όι ιç÷ΰίçιά áδóü δñιόάñδΰ όι /usr/src έάέ όι /usr/obj ιΥóù NFS, üόάί όι άδάίάέέέίΠóάόά όά έáóΰóόάόç áíüð ÷ñΠóόç, έá ÷ñάέáóόάβ ίά άíññάíδιεΠóάόά όι άβέóóι έάέ ίά όά δñιόάñδΠóάόά. Ι άóέιεüòáññò δñüδìò áέá áδóü, άβίαέ ίά άέέέίΠóάόά όά έáóΰóόάόç διεέάδèΠί ÷ñçóóΠί έάέ Υδάέόά ίά άέóáεΥóάόά shutdown now áέá ίά ίάόάάάβóά όά έáóΰóόάόç áíüð ÷ñΠóόç. Ιüεéδ άβίαέ áδóü, ιδιñάβóά ίά άάέάόάόδΠóάόά όι ίΥì δñΠία έάέ όι άάόέεü όύόόçιά, έάέ ίά άέóáεΥóάόά όι mergemaster üδùδ έá εΰίáόά óóíΠεüð. ¼όάί óáεάεüòδóά, άδάίάέέέίΠóάόά áδóü όι ιç÷ΰίçιά óóçί έáííέεΠ έáέóιòñάβά διεέάδèΠί ÷ñçóóΠί.

¼όάί άάάάεüèάβóά üδé υεά έάέóιòñάíγí óóóδΰ όóι ιç÷ΰίçιά άιεέιΠί, ÷ñçóειñδιεΠóάόά όçί βάέá έέάάέέáóά άέá ίά άάέάόάόδΠóάόά όι ίΥì ειαέóιεéü όά εΰεά Υίá áδü όά óδυεìέδá ιç÷άίΠίαόά διò óáó ίάόάεüòδóέόçδ.

24.8.3 Ports

Ιδñάβóά ίά ÷ñçóειñδιεΠóάόά óéδ βάέáδ έáΥάδ έάέ áέá όι áΥίòñι óüí ports. Οι δñΠóι έñβóέíí άΠία άβίαέ ίά δñιόάñδΠóάόά όι /usr/ports áδü όι βάέί ιç÷ΰίçιά, όά υεά όά ιç÷άίΠίαόά διò óáó ίάόάεüòδóέόçδ. Ιδñάβóά Υδάέόά ίά ñδèιβóάόά όι /etc/make.conf Πóόά ίά έέάíñέñΰάιεíόáέ όά distfiles. Έá δñΥδáέ ίά εΥóάόά όι DISTDIR όά Υίá έιεíü ÷ñçóóι έáóΰεíñ, óóí ιδιñβì έá άΠóάόά έέέέίΠίαόά άáññáóΠδ όά ιδιέíñδιδιόá ÷ñΠóόç Υ÷áóá άçεΠóáέ üð root óóι NFS. Óá εΰεá ιç÷ΰίçιά έá δñΥδáέ άδβóçδ ίά íñέóóάβ ç ίάόάάέççδΠ WRKDIRPREFIX Πóόά ίά άáβ÷íáέ όά Υίá όιδéü έáóΰεíñ. ÓΥεìò, άί óεíδáγáόá ίά ίάόάεüòδóβæáόá έάέ ίά έέάíΥíáόá Υóιεíá δáεΥóá, έá δñΥδáέ ίά εΥóάόá όçί ίάόάάέççδΠ PACKAGES όά Υίá έáóΰεíñ, üδùδ εΰίáόά έάέ ίá όçί DISTDIR.

ΌçιáέΠóáέò

1. Áδóü áΥáάέá άár άβίαέ áδυεóóά áεçεéíü. Άár ιδιñγíñά ίά óóíá÷βóιòíá ίά óδιόóçñβæíòíá óéδ δáέéΥð áεäüóáέð όιò FreeBSD áέá δΰίόá, άί έάέ óéð óδιόóçñβæíòíá áέá διεεΰ ÷ññíέá. Άέá δèΠñç δñέéñáóΠ όçδ δñΥ÷íóóáδ διεέééΠδ υóí áóíñΰ όçί áóóΰεáέá óüí δáέéΠί áεäüóáñí διò FreeBSD, άάβóά http://www.FreeBSD.org/security/.

ΕὰὐἘάεί 25 DTrace

ἌνἘὄçêà áδὐ οἱ Tom Rhodes.

25.1 Óýññç

Οἱ DTrace, αἰὐὐὐ ἄδβὐç ùὐ Dynamic Tracing, ἄβιάέ Ἰά ἄñáéâβι οἱ ἰθίβι ἀτάδὐ ÷ èçêà áδὐ ὀçí Sun ἄέά οἱí ἀíὐíðéὐí ðñíáèçíἘὐὐí ἄδὐἰἰὐὐὐ ὀά ὀὐὐὐβιάὐά ðñὐ ðñíéáéὐάέ ἰά ÷ ñçὐéíἰðíéçèἰἰἰ ἔ ÷ ñçὐéíἰðíéἰἰἰἰἰἰἰἰ ἔ ἔ ὀçí ðáñááἰἰἰ. Ἄáí ðñíéáéὐάέ ἄέά ἄñáéâβι ἄðíὐὐáéíἘὐὐὐὐ, ἄéἘἘ ἄέά ἄñáéâβι ἀíἘéὐὐçð ðñááíáὐééἰἰ ÷ ññíἰἰ, ἰά ὀἱ ἰθίβι ἰðñíἰἰἰ ἰά ἀíὐíðéὐὐἰἰἰ ðñíáèβíáὐά ἄδὐἰἰὐὐὐ ἄέά Ἐéâð éáὐáὐὐἘὐáéð.

Οἱ DTrace ἄβιάέ Ἰά éáὐíἘὐὐéí ἄñáéâβι profiling ἄέά ἄéáéἸὐáé ἄíὐðἠὐὐáéἠἠ ðèðèð ÷ ἄñáéὐçñéὐὐééèἠ ἄέά ὀçí ἄéἘἠἠçð ðñíáèçíἘὐὐὐí ὀñ ὀὐὐὐβιάὐὐ. Ἰðññáβ ἄδβὐç ἰά ÷ ñçὐéíἰðíéçèâβ ἄέά ἰά ἄéὐáéἸὐáé ἄδὐ ðñéí Ἰὐéíá scripts, ἰά ὀά ἰðíβá ἰðññáβὐά ἰά ἄéíáὐáééâðèâβὐά éáéἰἠἠἠ ὀéð ἄὐíáὐἠἠçðἠ ὀñ. Ἰé ÷ ñβὐὐáð ἰðññíἰἰ ἄéἠἠ ἰά ἄñἘἠἠἠ ἄέά ὀά ἄééἘ ὀñð ἄíçèçðééἘ ᰇñíἠñἘἠἠἠἠἠἠ, ÷ ñçὐéíἰðíéçèἠἠἠ ὀçí Ἄèβὐὐά D ðñὐ ðáñἸ ÷ ἄé ὀἱ DTrace, ἄέά ἰά ðñíὐáññíἠἠἠἠἠ ἰά ἄὐðἠ ὀñ ὀñἠἠἠ ὀἱ profiling ὀὐéð ἄééἸð ὀñð ἄíἘἠἠ.

Ἄὐἰἰ ἄéáἠἠἠἠἠ ἄὐðἠ ὀἱ éâὐἠἠἠἠ, éá ἄññβἠἠἠἠἠ:

- Ὀé ἄβιάέ ὀἱ DTrace ἄέά ὀé ἄὐíáὐἠἠçðἠ ᰇáñἸ ÷ ἄé.
- Ὀéð ἄéáὐñἸð ðèíðíβçðð ἰáðáíἰἠ ὀñ DTrace ὀñ Solaris ἄέά ὀñ FreeBSD.
- ðἠð ἰά ἄíἠñíἠἠἠἠἠἠἠ ἄέά ἰά ÷ ñçὐéíἰðíéçèἠἠἠ ὀἱ DTrace ὀñ FreeBSD.

ðñéí ἄéáἠἠἠἠἠ ἄὐðἠ ὀἱ éâὐἠἠἠἠ, éá ðñἸᰇáé:

- Ἰά éáὐáññáβὐά ἠáὐééἸð Ἰñíéáð ὀñ UNIX ἄέά ὀñ FreeBSD (Ἐὰὐἠἠἠἠ 3).
- Ἰά ἄβὐὐá ἠñééἠἠἠἠἠἠἠ ἰά ὀéð ἠáὐééἸð ἄéáéééáὐáð ñἠéíéçðð ἄέά ἰáðáἠἠἠἠἠἠἠἠ ᰇñíὐáññíἠἠἠἠἠ ᰇðñβíá (Ἐὰὐἠἠἠἠ 8).
- Ἰά ἄβὐὐá ἠñééἠἠἠἠἠἠἠ ἰá ὀçí ἠáὐἠἠἠἠἠ ἄέά ὀñ ὀñἠἠἠἠ ᰇñ ἠáðἠ ὀ ÷ ἠáβἠἠἠἠἠ ἰά ὀἱ FreeBSD (Ἐὰὐἠἠἠἠ 14).
- Ἰά éáὐáññáβὐά ðἠð ἰðññáβὐά ἰά ἠíáèðβὐáð ὀñ ðçἠἠβí ἠβἠἠἠ ὀñ FreeBSD ἄέά ἰά ὀñ ÷ ñçὐéíἰðíéçèἠἠἠ ᰇðἠ ἰά ἠðáíἠἠἠἠἠἠἠἠἠἠ ὀñ ὀἰçðçíá ὀáð (Ἐὰὐἠἠἠἠ 24).

ðñíáéáíἠἠἠἠἠçð: Ὀç ἠáἠἠἠἠἠç ὀðéἠἠβ, ὀἱ DTrace éἠἠñἠἠἠἠἠ ἠðé ἠβιάέ ὀá ðáéñáíáὐéἠἠ ὀðἠἠἠἠ. Ἰñéὐíἠἠἠ ἠðééíἠἠἠ ἰðññáβ ἰá ὀðíἠἠἠἠἠἠἠἠ ὀá éáéὐíðñἠἠἠἠἠἠἠἠ, ἄéá éἠἠἠἠἠἠ ὀíβíáὐά βὐὐð ἰá ἰç éáéὐíðñἠἠἠἠἠἠἠἠ ἄéἠἠἠἠ. ἰá ὀçí ᰇἠñíἠἠ ὀñ ÷ ññíἠἠ, ἰé ðáñáðἠἠἠ ἠὐíáὐἠἠçðἠ ἄé ἄἠñçèἠἠἠ Ἰὐéíἠἠἠ ἄéá ÷ ñβὐç ὀá ἰç ÷ ἠíβíáὐά ðáñááἠἠἠἠ, ἄéá ç ðáññíἠἠἠ ὀáèíçñβἠἠἠἠ ἄé ἠíáíἠἠἠἠἠ ᰇðἠ ἰá ἠíὐéðñíἠἠἠἠἠἠἠ ἠáðἠ ὀçí éáὐἠἠἠἠἠἠ.

25.2 ἌéáὐñἸð ὀçí Ὀèíðíβçð

Ἄí ἄέά ὀἱ DTrace ὀñ FreeBSD ἠβιάέ ἠñéâðἠ ἠñéí ἰá ἠáðἠ ὀñ Solaris, ὀðἠñ ÷ ἠἠἠ éἠἠἠἠἠ ἠéáὐñἸð ᰇñ ἄé ᰇñἠἠἠ ἰá ὀéð ἠíçἠβὐíἠἠἠ ᰇñéí ὀðíἠ ÷ βὐíἠἠἠ. Ç ἰáἠἠἠἠἠἠ ἠéáὐñἸð ᰇñ éá ðáñáðçñβὐíἠἠ ἰé ÷ ñβὐáð, ἠβιάέ ἠðé ὀñ FreeBSD ὀἱ DTrace ðñἸᰇáé ἰá ἠíἠñíἠἠἠἠἠἠἠ ÷ ἠéñíἠἠἠἠἠἠ. Ὀðἠñ ÷ ἠἠἠ ἠéἠἠἠἠἠ ἠðééíἠἠἠ ἄéá ὀñ ððñβíá ᰇñ ðñἸᰇáé ἰá ἠíἠñíἠἠἠἠἠἠἠ ᰇðἠ ὀἱ DTrace ἰá éáéὐíðñἠἠἠ ὀἠἠἠ. Ἐá ἠíçἠβὐíἠἠἠ ἠñἠἠἠἠἠ ἠáðἠ ᰇð ᰇð ñèíβὐáéð.

Ç áδεείαP DDB_CTF οίο δδñΠία ÷ ñçόείιθιεάβδάέ άέα ίά άίάñāīθιεΠόάέ όçί δθίόδΠñείç òīñòΠιάόιò òùί άάñŸíùí CTF áδù οίί δδñΠία έάέ όά άñēñΠιάόά οίò. Òί CTF άβίάέ όί Compact C Type format οίò Solaris, όί ιθίβί άίέδέάέΠιάέ ίέα άέαόόùίŸίç ιññòΠ δέçñīòīñέΠί άθίόόάέιŸòúóçò (debugging), ùίίέα ίά όί DWARF έάέ όά stabs. ΆόòŸ όά άάñŸίά CTF δñīóóβέάίόάέ όά άέόάέŸόείά ίŸóú òùί άñάάέάβùί ctfcconvert έάέ ctfmerge. Òί άίçèçòέέù δñùāñāίά ctfcconvert άñίçίάŸάέ όά òίΠιάόά òùί DWARF ELF θίò δāñέŸ÷ιòί δέçñīòīñβάò debug (άçίέíòñāíŸίόάέ áδù όί ίάόάάέùòδóóΠ), έάέ όί ctfmerge óōā÷ùίάŸάέ όά òίΠιάόά CTF έάέ ELF áδù όά άίόέέάβίάίά όά Ÿέέά άέόάέŸόείά Π έίέíù ÷ñçóóáò άέάέέίέΠέάò. Δāñέóóúòāñāò δέçñīòīñβάò άέα όçί άίάñāīθίβçóç òùί δāñáŸŸù óóç ίάόάάέΠóóέóç οίò δδñΠία έάέ οίò óóóóΠιάόιò οίò FreeBSD, έά äŸŸíά δāñάέŸòù.

Óóί FreeBSD έŸθίέίέ δāñί÷άβò άβίάέ άέαóīñāòέέίβ όά ó÷Ÿóç ίά όί Solaris. Í θεί άίέίόçίάβùòίò άβίάέ ι δāñί÷Ÿάò dtmalloc ι ιθίβίò άθέóñŸδāέ όί tracing οίò malloc() άŸŸέίάά ίά όίί όŸθί οίò, óóίí δδñΠία οίò FreeBSD.

Ÿūñ ι root ίθίñάβ ίά ÷ ñçόείιθιεΠόάέ όί DTrace óóί FreeBSD. Άóòù ó÷άòβέάόάέ ίά άέαóīñŸò óóçί áóóŸέάέά, έάέΠò όί Solaris άέαέŸόάέ έŸθίέίòδ άέŸā÷ιòδ áóóŸέάέáò ÷άίçŸŸ άδέóŸŸíò, ίέ ιθίβίέ άάí òδŸñ÷ιòί áέùíά óóί FreeBSD. Άέα όί έúāí áóòù, ç ÷ñΠóç όçò óóóéáòΠò /dev/dtrace/dtrace áδāñāñāŸáóάέ áóóóçñŸ άέα ùέíòδ οίòδ ÷ñΠóóáò άέòùò áδù όίí root.

ÓŸέíò, όί έίάέóίέέù DTrace άñβóέáóάέ óδù όçί Ÿüáέá CDDL όçò Sun. Íθίñάβòά ίά άέαáŸóáòά όί έάβίáñί όçò Ÿüáέáò Common Development and Distribution License óóί FreeBSD, óóί άñ÷άβί /usr/src/cddl/contrib/opensolaris/OPENSOLARIS.LICENSE Π ίά όί άέαáŸóáòά online óóç άέαŸέóίóç http://www.opensolaris.org/os/licensing.

Ç Ÿüáέá ίòέάóóéέŸ óçίáβίáέ ùóé Ÿíáò δδñΠιάò FreeBSD ίά óéò áδεείāŸò οίò DTrace, άίáέίέíòέάβ ίά άñβóέáóάέ óδù όçί Ÿüáέá BSD. Ÿóóúóί όί CDDL άíðéŸέáóάέ όç óóéáñΠ θίò άβίáóáέ άέαññΠ òùί άñēñùìŸòùί óά äóááέέΠ ιññòΠ, Π όç óóéáñΠ θίò òīñòΠίíóάέ.

25.3 Άίáñāīθίβçóç όçò ÓθίóóΠñείçò DTrace

Άέα ίά άίáñāīθιεΠόáòά όçί δθίόδΠñείç άέα όί DTrace, δñīóéŸóóá óéò áέùέíòέáò āñāíŸò óóί άñ÷άβί ñòéìβóáùí οίò δδñΠία:

```
options          KDTRACE_HOOKS
options          DDB_CTF
```

Óçίáβùóç: Íέ ÷ñΠóóáò όçò άñ÷έóáéòίίέέΠò AMD64 έά έŸέíòί ίά δñīóéŸóíóί όçί áέùέíòέç āñāñΠ óóί άñ÷άβί ñòéìβóáùí οίò δδñΠία οίòδ:

```
options          KDTRACE_FRAME
```

Ç áδεείāΠ áóòΠ δāñŸ÷άέ δθίόδΠñείç άέα όç έάέóíòñāβá FBT. Òί DTrace ίθίñάβ ίά έáéóíòñāΠóáέ έάέ ÷ùñβò áóòΠί. Ÿóóúóί, έά δāñŸ÷άέ δāñéíñέóίŸίç δθίόδΠñείç άέα function boundary tracing.

¼έíò ι δçāáβíò έΠáέέáò έά δñŸδāέ ίά ίáóááέùòδóóóáβ ίáíŸ ίá óéò áδεείāŸò CTF. Άέα ίά άβίáέ áóòù, ίáóááέùòδóóóá ίáíŸ όί FreeBSD ÷ ñçόείιθιεΠίόáò:

```
# cd /usr/src
# make WITH_CTF=1 kernel
```

Έά ÷ñάέαóóáβ ίά áδāíáέέέίΠóáòά όί óŸóóçίá.

ÏäöÛ ôçí áðáíáëëßíçós, éáé ìá ôíí íÝí ðññÞíá öíñòùíÝí ðëÝíí óðç ìÞíç, éá ðñÝðáé íá ðñíóèÝóáðá ððíóðÞñéíç áéá ôí èÝëðöíð Korn. Áðöü áðáéðáßðáé, éáèð ðá áñááëáßá DTrace ðáñééáìáÛííóí äéÛöíñá áíçççðééÛ ðñíáñÛííáðá ðá ìðíßá áßíáé áñáííÝíá ðá ksh. Áäéáðáððððá ðí port shells/ksh93. Ìðíñáßðá áðßóçð íá äéðáëÝóáðá áðöÛ ðá áñááëáßá éáé ìÝóù ðíð shells/pdksh Þ ðíð shells/mksh.

ÏÝëò, áíáèðððá ðçí ðñÝ ÷ ìðóá óáëñÛ áñááëáßá DTrace. Ç ðáèáððáßá Ýëáíóç áéáðßéáðáé óðçí ðíðíèáðá <http://www.opensolaris.org/os/community/dtrace/dtracetoolkit/>. Áéáðßéáðáé éáé ðñüáñáíá áäéáððððáçð, ðí ìðíßí ááí áßíáé ùðöüóí áðáñáßçðí íá äéðáëÝóáðá ðñíèáéíÝííð íá ÷ ñçóéíðíèððáðá ðá áñááëáßá.

25.4 × ñçóéíðíèððáð ðí DTrace

ðñéí ÷ ñçóéíðíèððáðá ðéð éáéðíðñáßð ðíð DTrace, éá ðñÝðáé íá ððÛñ ÷ áé ç áíðßðíèð ÷ ç óðéèáðÞ. Áéá íá öíñðððáðá ðç óðéèáðÞ, éá ðñÝðáé íá áððáðá ðçí ðáñáéÛòù áíðíèÞ:

```
# kldload dtraceall
```

Éá ðñÝðáé íá Ý ÷ áðá ðëÝíí ððíóðÞñéíç DTrace. Áéá íá ááßðá üéá ðá probes, éá ðñÝðáé íá äéðáëÝóáðá ùð áéá ÷ áéñéóððð ðçí ðáñáéÛòù áíðíèÞ:

```
# dtrace -l | more
```

¼èç ç Ýíñáð ðáñíÛáé ìÝóù ðíð áíçççðééíç ðñíáñÛííáððð more, áéáöíñáðééÛ áñÞáíñá éá ððáñ ÷ áßééáð ðçí ðñíóðñéíÞ ìÞíç ðçð ìèüíçð. Óðí ðçíáßí áðöü, éá ðñÝðáé íá èáññçéáß üðé ðí DTrace éáéðíðñáß. Áßíáé ðëÝíí Þñá íá áíáðÛóíðíá áððÞ ðç óáëñÛ áñááëáßáí.

Ç óáëñÛ ðüí áñááëáßáí áßíáé ìéá óðéèíÞ áðü Ýðíèíá scripts ðíð äéðáéíÝíðáé ìá ðí DTrace Þððá íá óðéèÝííðí ðèçñíðíñáð ð ÷ áðééÛ ìá ðí óýóðçíá. ÓðÛñ ÷ ìðí scripts ðíð áëÝá ÷ ìðí áéá áíééðÛ áñ ÷ áßá, ðç ìÞíç, ðç ÷ ñÞðç ðçð CPU éáé ðíèèÛ áéüíá. ÊÛíðá áíáñáß ðüí scripts ìá ðçí áéüèððèç áíðíèÞ:

```
# gunzip -c DTraceToolkit* | tar xvf -
```

Ïáðáéíççéáßðá óðíí éáðÛëíñ ðíð ðá áðíóðíðéÝóáðá ìá ðçí áíðíèÞ cd éáé áéèÛíðá ðá áééáèðíáðá áèðÝéáçð ðá üéá ðá áñ ÷ áßá, üðùð óðá áñ ÷ áßá ìá ðá ìéëñÛ áñÛííáðá, óá 755.

Éá ÷ ñáéáððáß íá áßíðí áéèááÝð óðí ðáñéá ÷ ùíáíí ðá üéá ðá scripts. ¼ðá ðáñéÝ ÷ ìðí ðí /usr/bin/ksh éá ðñÝðáé íá áéèá ÷ èíÝí ðá /usr/local/bin/ksh, ðá Ûééá ðíð ðáñéÝ ÷ ìðí ðí /usr/bin/sh éá ðñÝðáé íá áéèá ÷ èíÝí ðá /bin/sh, éáé ðÝëò áðöÛ ðíð ðáñéÝ ÷ ìðí ðí /usr/bin/perl éá ðñÝðáé íá áéèá ÷ èíÝí ðá /usr/local/bin/perl.

Óçíáíðééü: Óðí ðçíáßí áðöü áßíáé óçíáíðééü íá ððáíèðíßðíðíá ððíí áíááíÞðç üðé ç ððíóðÞñéíç DTrace óðí FreeBSD áßíáé áðáèÞð éáé ðáèñáíáðéèÞ. ðíèèÛ áðü áðöÛ ðá scripts ááí éá éáéðíðñáßðíðí, éáèð áßíáé áßðá ðíèç ðñíóáíáðíèéóíÝíá ððí Solaris, Þ ÷ ñçóéíðíèððáð probes ðá ìðíßá ááí ððíóðçñßæííðáé ðç áááíÝíç óðéèíÞ.

Ïç óðéèíÞ ðíð áñÛöíðáé áðöÝð ìé áñáííÝð, ìüíí áýí scripts áðü ðç óáëñÛ áñááëáßáí ðíð DTrace ððíóðçñßæííðáé ðëÞñùð óðí FreeBSD: ðí hotkernel éáé ðí procsystime. ÁðöÛ ðá áýí éá áíáñáðíðíðíðá ððá áðüíáíá ðíðíáðá áðððð ðçð áíüðçðáð.

Ïí hotkernel Ý ÷ áé ó ÷ áäéáððáß íá áíááíññßæáé ðíéá óðíÛñðçç éáðáíáèÞíáé ðí ìáááéýðáñí ÷ ñüíí óðíð ðññÞíá. Áéðáèðíðáð ðí ððü éáííèéÝð óðíèÞèàð, éá ááßðá Ýíñáí ðáñüíèéá ìá ðçí ðáñáéÛòù:

```
# ./hotkernel
```

Sampling... Hit Ctrl-C to end.

Ï äéá ÷ äéñéóóðò òïò óóóóðíáóïò èá ðñÝðáé íá ÷ ñçóéííðíéðóáé òí óóíáóáóíü ðéðéðñíí **Ctrl+C** äéá íá óóáíáððóáé òç äéáñááóóá. Ìá òíí òáñíáóéóíü òíò, òí script èá áðáééííðóáé íéá óáéñÛ áðü óóíáñððóáéð òíò ððñðíá èáé ðéçñííðñð ò ÷ áðééÛ Ìá òí ÷ ññíí òíòð, òáíéíñðíóáð ðéð óá áýííðóá óáéñÛ áíÛéíáá Ìá òí ÷ ññíí:

kernel`_thread_lock_flags	2	0.0%
0xc1097063	2	0.0%
kernel`sched_userret	2	0.0%
kernel`kern_select	2	0.0%
kernel`generic_copyin	3	0.0%
kernel`_mtx_assert	3	0.0%
kernel`vm_fault	3	0.0%
kernel`sopoll_generic	3	0.0%
kernel`fixup_filename	4	0.0%
kernel`_isitmyx	4	0.0%
kernel`find_instance	4	0.0%
kernel`_mtx_unlock_flags	5	0.0%
kernel`syscall	5	0.0%
kernel`DELAY	5	0.0%
0xc108a253	6	0.0%
kernel`witness_lock	7	0.0%
kernel`read_aux_data_no_wait	7	0.0%
kernel`Xint0x80_syscall	7	0.0%
kernel`witness_checkorder	7	0.0%
kernel`sse2_pagezero	8	0.0%
kernel`strcmp	9	0.0%
kernel`spinlock_exit	10	0.0%
kernel`_mtx_lock_flags	11	0.0%
kernel`witness_unlock	15	0.0%
kernel`sched_idletd	137	0.3%
0xc10981a5	42139	99.3%

Ïí script áðòü èáéóííðñáá ðððóð Ìá áñéñðíáóá òíò ððñðíá. Äéá íá ÷ ñçóéííðíéðóáðá áðòü òí ÷ áñáéðçñéóóééü, áéðáéÝóóá òí Ìá òçí áðééíáð -m:

```
# ./hotkernel -m
Sampling... Hit Ctrl-C to end.
^C
```

MODULE	COUNT	PCNT
0xc107882e	1	0.0%
0xc10e6aa4	1	0.0%
0xc1076983	1	0.0%
0xc109708a	1	0.0%
0xc1075a5d	1	0.0%
0xc1077325	1	0.0%
0xc108a245	1	0.0%
0xc107730d	1	0.0%
0xc1097063	2	0.0%
0xc108a253	73	0.0%
kernel	874	0.4%
0xc10981a5	213781	99.6%

Ôí procsystime script óðëëáíáÛíáé êáé óððíáé ðí ÷ ñüíí ðüí êëßóáüí óðóðßíáðíð ãéá íéá óðãêêñéíÝíç äéãñãáóßá ìÝóù ðíð PID ß ðíð ïíüíáðíð ðçð. Óðí ðãñáéÛðù ðãñÛäéãíá Ý÷íðíá íãêéíßóáé íéá íÝá äéãñãáóßá ðíð /bin/csh. ÁéðáéÝóáíá ðí procsystime êáé ðí áðßóáíá óççí áíáíííß êáëßð ãñÛóáíá íãñééÝð áíðíéÝð óðí csh ðíð áß÷áíá áíßíáé. ÁððÛ áßíáé óá áðíðáéÝóíáóá ðçð äíëéíßð íáð:

```
# ./procsystime -n csh
Tracing... Hit Ctrl-C to end...
^C
```

Elapsed Times for processes csh,

SYSCALL	TIME (ns)
getpid	6131
sigreturn	8121
close	19127
fcntl	19959
dup	26955
setpgid	28070
stat	31899
setitimer	40938
wait4	62717
sigaction	67372
sigprocmask	119091
gettimeofday	183710
write	263242
execve	492547
ioctl	770073
vfork	3258923
sigsuspend	6985124
read	3988049784

¼ðùð óáßíáðáé, ç êëßóç ðíð óðóðßíáðíð ãéá áíÛáíüóç (read()) áßíáé áððß ðíð êáðáíáëßíáé ðíð ðãñéóóüððãíí ÷ ñüíí óá íáííãáððãñüëãððá, áíß ðí êéãüððãíí ðíí êáðáíáëßíáé ç êëßóç óðóðßíáðíð getpid().

25.5 Ç Æëßóóá D

Ç óáéñÛ ãñãáéãßüí DTrace, ðãñééáíáÛíáé áñêãðÛ scripts ãñãñÝíá óççí áéãééß Æëßóóá ðíð DTrace. Ç Æëßóóá áððß ïííÛãáðáé “ç Æëßóóá D” óççí ðáëíçñßùóç ðçð Sun, êáé áßíáé áñêãðÛ ùííéá íá ðç C++. Áíáéððééß ðãñéãñãóß áððßð ðçð Æëßóóáð áßíáé ðÝíá áðu ðíðð óéíðíýð áððíý ðíð êáëíÝíð. ÓðÛñ÷áé áíãñãß óðãßðçóç ó÷áðééÛ íá áððß, óççí äéãýéðíóç <http://wikis.sun.com/display/DTrace/Documentation>.

IV. ἈέεοῶάεΎò Ἀῖέεἱεἰὺίβᾶò

Ὀἱ FreeBSD ἄβἱάε Ἰίá áḁũ óá ḁéἱ áõñŸùð äéáááññŸíá eáéõἱõññáééŸ óóóòḆἱάóá ãéá õøçèḆð áḁũäἱóçð äééòḁáéŸò äöáñἱἱŸò éáé äἱḁḁçñᾶòçòŸò. Ὀά éâöŸéáéá óá áóòũ õἱ òἱḆἱá ḁñéáñŸἱἱóἱ:

- Ὀέò ἁḁééἱεἰὺίβᾶò ἱᾶ óáéñáúéḆ óŸἱᾶáóç (serial)
- Ὀά ḁñòũἱéἱééá PPP éáé PPP ḁŸἱũ áḁũ Ethernet
- Ὀçἱ ÇèáéòñἱééḆ ἈéççἱἱñᾶóḆá
- Ὀçἱ ἈᾶéáòŸóóáóç ἈééòḁáéḆἱ ὈḁçñᾶóéḆἱ
- Ὀç ἸŸἱéἱóç éáé ἘᾶéóἱõññᾶḆá òἱἱ Firewalls
- ¶ἱéá ḁñἱ÷ũñçἱŸíá ἘŸἱάóá ἈééòŸἱ

ἈóòŸ òá éâöŸéáéá Ἰ÷ἱḁἱ ó÷ᾶᾶéáóòᾶḆ ḁñéóóũòᾶñἱ ùð ἱᾶçᾶũð áἱάóἱñŸò ḁñŸ ùð ᾶéóáᾶũᾶééũ éᾶḆἱᾶñἱ. Ἀé áóòũ ἄβἱάé ḁéἱ ÷ñḆóéἱá ùð ἱᾶçᾶἱḆ óòἱòð ἱḁἱḆἱòð ἱḁἱñᾶḆòᾶ ἱá áἱάóñŸíᾶòᾶ ἱḁᾶἱ ÷ñᾶéŸᾶáóóᾶ éŸḁἱéá ḁççñἱἱñᾶ ᾶéá õἱ FreeBSD. Ἀᾶ ÷ñᾶéŸᾶáóóᾶ ἱá òá äéááŸóáòᾶ ἱᾶ éŸḁἱéá óḁᾶéᾶñéἱŸἱç óáéñŸ, ἱŸòᾶ ÷ñᾶéŸᾶáóóᾶ ἱá òá Ἰ÷ᾶòᾶ äéááŸóáé ἱéá ḁñéἱ ᾶñ÷Ḇóᾶòᾶ ἱá áó÷ἱéᾶḆóóᾶ ἱᾶ õἱ FreeBSD.

ΕὰοÛεάεί 26 ΟάέñέάέÛò Àðéêíéíùíβὰò

26.1 Óýññç

Ôñ UNIX ðÛííòðà ððíòòðñéæà óáέñéáéÛò àðéêíéíùíβὰò. Æέά ðçí áέñβááέά, óá ðñðóá UNIX ìç÷-áíðíáóá ááóβæííóáí óá óáέñéáéÛò àñáñÛò áéá ðçí áβóíñí éáé Ýñññ ðóí ÷ñðóç. Óá ðñÛñíáóá ùóòóí Ý÷ííí áέεÛíáé ðñéý áðù ðéò ìÝñáò ðñò ðñ ðóíçééóíÛñ “ðáññíáóééù” áðñíáéñýíóáí áðù Ýíá óáέñéáéù áéòòðòð 10 ÷-áñáéòðññí ðñ ááòòáññéáððòí éáé Ýíá ðéççòññéùáéí. Ôñ εὰòÛεάεί áòòù éá éáéýðáé εÛðñéíòð áðù ðñòð ðññðñòð óáέñéáéðð àðéêíéíùíβὰò ðñò ÷ñçóéññðñéíýíóáé áðù ðñ FreeBSD.

Áññý áéááÛóáðá áòòù ðñ εὰòÛεάεί, éá ñÝñáðá:

- ðùò íá óðñáÝóáðá ðáññíáóééÛò óòñ FreeBSD óýóóçíá óáð.
- ðùò íá ÷ñçóéññðñéíóáé Ýíá modem áéá íá óðñááéáβðá óá áðññáéñòóíÛñ óóóððíáóá.
- ðùò íá áðéòñÝðáðá óá áðññáéñòóíÛñ ðòð ÷ñðóðáð íá óðñááéñýí óòñ óýóóçíá óáð ìÝòù modem.
- ðùò íá áéééíðóáðá ðñ óýóóçíá óáð ìÝòù óáέñéáéðð éñíóñéáð.

ðñéí áéááÛóáðá áòòù ðñ εὰòÛεάεί, éá ðñÝðáé:

- Íá ñÝñáðá ðùò éá ñòèìβóáðá éáé éá ááéáóáóòðóáðá Ýíá ñÝñ ðòñðñíá (ΕὰòÛεάεί 8).
- Íá éáóáññíáβðá ðéò Ûááéáð éáé áéáññááóβáð ðñò UNIX (ΕὰòÛεάεί 3).
- Íá Ý÷-áðá ðññóááóç óòñ ðá÷-íééù áá÷-áέñβáéí ðñò ðéééñý óáð (modem ð εÛñòá ðñééáððñí óáέñéáéðñí èòñññí) ðñò èÝéáðá íá ÷ñçóéññðñéíóáé óòñ FreeBSD.

26.2 Áéóááñùñð

26.2.1 Ìññéññáβá

bps

Bits ÁñÛ Æáòòáññéáððòí — ñ ñòèìùò ìáòÛáíóçò ðññ áááñÝññ

DTE

Data Terminal Equipment, Óáññíáóééùò Áññðééóíùò ÆááñÝññ — áéá ðáñÛááéáíá, ñ ððñéññéóòðð óáð

DCE

Data Communications Equipment, Áññðééóíùò Àðéêíéíùíβὰò ÆááñÝññ — ðñ modem óáð

RS-232

ðññòððñ ðçò EIA áéá ðñ ðéééù ðñò ÷ñçóéññðñéíóáé óóéò óáέñéáéÛò àðéêíéíùíβὰò

¼óáí áíáóáñññíáóáðá óòñ ñòèìùò ìáòÛáíóçò áááñÝññ àðéêíéíùíβὰò, ááñ ÷ñçóéññðñéíýíá ðÛííòðá ðññ ùññ “baud”. Ôñ baud áíáóÝñáóáé óòññ áñéèìù ðññ ìáòááÛóáðá ðñò çéáéòñééñý óðñáòñò ðçò ññÛáá ðñò ÷ñññò, áñ éáññééÛ ðñÝðáé íá

÷ ἡζοῖ ἰθῖεῖ ἄβδῶε ὠῖ “bps” (bits ἰν ἰ ἄῶῶἰ ἡεῖ ἄῶῖ) ῶῖ ἄβῖῖε ἰ ὠῶῶῶ ἰ ἡῖῖῖ (ζ ὠῖῖῖ ÷ ἑῶῖῖ ἄῖ ὠῖῖῖῖ ἰ ἄ ἡῖ ÷ ἑῖῖ ῶῖῖ ὠῖῖ ὠ ÷ ἰῖῖῖῖῖῖ).

26.2.2 Ἐῖῖῖ ἑῖῖ Ἐῖῖῖῖ

Ἄῖῖ ἰ ὠῖῖ Ὑῖῖῖ Ὑῖῖ modem P ὠῖῖῖῖῖῖ ὠῖῖ FreeBSD ὠῖῖῖῖ ὠῖῖ, ἑῖ ÷ ἡῖῖῖῖῖῖ ἰῖ ὠῖῖῖῖῖῖ ἑῖῖῖ ὠῖῖ ὠῖῖῖῖῖῖ ὠῖῖ, ἑῖῖ ὠῖ ἑῖῖῖῖῖ ἑῖῖῖῖῖ ἑῖῖ ἰ ὠῖῖ Ὑῖῖῖ ὠζ ὠῖῖῖῖῖῖ ὠῖῖῖῖῖ ὠῖῖ. Ἄῖ ἄβῖῖῖ ἰῖῖ ἡῖῖῖῖῖῖ Ὑῖῖ ἰ ὠῖ ὠῖῖῖῖ ὠῖ ἑῖῖ ὠῖ ἑῖῖῖῖῖ ῶῖ ἄῖῖῖῖῖῖ, ἰῖῖῖῖῖ ἰ ἄῶῖῖῖῖ ἰ ῶῖῖῖῖ ὠζ ἡῖῖῖῖῖῖ.

26.2.2.1 Ἐῖῖῖῖῖ

Ὀῖῖῖ ÷ ἰῖῖ ἡῖῖῖῖῖ ἑῖῖῖῖῖῖῖ ὠῖῖῖ ὠῖῖῖῖῖῖ ἑῖῖῖῖῖῖ. ἰῖ ἡῖῖ ῶῖῖ ἑῖῖῖῖ ὠῖῖῖῖ ἑῖῖ ὠῖῖ ὠῖῖῖῖῖ ἰῖῖ, ἄβῖῖῖ ὠῖ ἑῖῖῖῖῖ ὠῖῖῖῖῖ ὠῖῖ ὠῖ ὠῖῖῖῖῖῖ Ὑῖῖ ἑῖῖῖῖῖῖ RS-232 (ἡῖῖῖῖ ἑῖῖ ἡῖ “ἄῖῖῖῖῖ”). ζ ὠῖῖῖῖῖῖ ὠῖῖ ὠῖῖῖῖῖ ὠῖ ἑῖ ῶῖῖῖῖ ἰ ῶῖῖῖῖῖῖ ὠῖ ὠῖῖῖ ὠῖῖ ἑῖῖῖῖῖῖ ὠῖ ἄῖῖῖῖῖῖῖ.

26.2.2.1.1 Ἐῖῖῖῖῖ Ὀῖῖῖῖ Null-modem

ἰ ἑῖῖῖῖῖ ὠῖῖῖῖῖ null-modem, ἰῖῖῖῖῖ ἄῖῖῖῖῖῖ ἑῖῖῖῖῖ ὠῖῖῖῖ ὠῖῖῖῖῖῖ ὠῖῖῖῖ ὠῖῖῖῖῖῖ (SG), ἑῖῖῖ ἡῖῖῖῖῖῖῖ ὠῖῖ ὠῖῖῖῖῖῖ ὠῖ ἑῖῖῖῖῖ Ὑῖῖῖ. Ἄῖῖ ῶῖῖῖῖῖῖῖ, ἰ ἡῖῖῖῖῖῖῖ “ἰῖῖῖῖῖῖ Ἄῖῖῖῖῖῖῖ” (ἡῖῖῖῖῖ ἑῖῖ ἡῖῖ TD) ὠζ ἰῖῖῖ ῶῖῖῖῖῖ, ὠῖῖῖῖῖῖ ἰ ὠῖ ἡῖῖῖῖῖῖῖ “Ἐῖῖῖῖ Ἄῖῖῖῖῖῖῖ” (ἡῖῖῖῖῖ ἑῖῖ ἡῖῖ RD) ὠζ Ὑῖῖῖῖ.

ἰῖῖῖῖῖ ἄῖῖῖῖῖ ἰ ὠῖῖῖῖῖῖ ὠῖ ἡῖῖῖ ὠῖῖ ἑῖῖῖῖῖῖ ὠῖῖῖῖῖῖ null-modem (ῶ. ÷. ἡῖῖ ἑῖῖῖῖῖ ῶῖῖῖῖῖῖ) ἡῖῖ ÷ ἡῖῖῖῖ ἰ ὠῖῖῖῖῖῖῖ. ἰ ῶῖῖῖῖῖῖ ῶῖῖῖῖῖῖ ἡῖῖ ÷ ἰῖῖ ὠῖ ὠῖῖῖῖῖῖ ὠῖῖ RS-232 ἑῖῖ ὠῖῖ ἡῖῖῖῖῖῖ ὠῖ ἡῖῖῖῖῖῖῖ ὠῖ Ὑῖῖ ὠῖῖῖῖῖῖ DB-25. Ὀζ ἰῖῖῖῖῖ ἄῖῖῖῖῖ ὠῖῖ ὠῖ ῶῖῖῖῖῖῖ ἡῖῖῖῖῖ ἄῖῖῖῖῖῖῖ ὠῖῖῖῖῖ ὠῖ ἡῖῖῖῖῖῖῖ 1 ὠζ ἑῖῖῖ Ὑῖῖῖῖ. ῶῖῖῖῖῖῖ ἡῖῖ ὠῖ ἡῖῖῖῖῖῖῖ ὠζ ῶῖῖῖῖῖῖῖῖῖ Ἄῖῖῖῖῖῖῖ, ἡῖῖῖ ὠῖ ÷ ἰῖῖ ὠζ ὠῖῖῖῖῖ ὠῖῖ ῶῖῖῖῖῖῖῖῖῖ. ἰῖῖῖῖῖ ὠῖῖῖῖῖῖῖ ἑῖῖῖῖῖῖ ἑῖῖῖῖῖῖ ÷ ἡζοῖ ἰῖῖῖῖῖῖῖ ἰῖῖ ὠῖῖ ἡῖῖῖῖῖῖῖ 2, 3 ἑῖῖ 7, ἡῖῖ ἑῖῖῖῖῖῖ Ὑῖῖῖ ἄῖῖῖῖῖῖ ἡῖῖῖῖῖῖῖῖ ῶῖ ὠῖ ÷ Ὑῖῖ ἰ ὠῖ ῶῖῖῖῖῖῖῖῖῖ ὠῖ ὠῖῖῖῖῖῖῖ ῶῖῖῖῖῖῖῖ.

ῶῖῖῖῖῖ 26-1. Ἐῖῖῖῖῖῖ Null-Modem DB-25 ὠῖ DB-25

Ὀῖῖῖῖ	Ἄῖῖῖῖῖῖῖ #		Ἄῖῖῖῖῖῖῖ #	Ὀῖῖῖῖ
SG	7	ὠῖῖῖῖῖῖῖ ὠῖῖ	7	SG
TD	2	ὠῖῖῖῖῖῖῖ ὠῖῖ	3	RD
RD	3	ὠῖῖῖῖῖῖῖ ὠῖῖ	2	TD
RTS	4	ὠῖῖῖῖῖῖῖ ὠῖῖ	5	CTS
CTS	5	ὠῖῖῖῖῖῖῖ ὠῖῖ	4	RTS
DTR	20	ὠῖῖῖῖῖῖῖ ὠῖῖ	6	DSR
DTR	20	ὠῖῖῖῖῖῖῖ ὠῖῖ	8	DCD
DSR	6	ὠῖῖῖῖῖῖῖ ὠῖῖ	20	DTR
DCD	8	ὠῖῖῖῖῖῖῖ ὠῖῖ	20	DTR

ῶῖῖῖῖῖῖ ὠῖῖῖῖῖῖῖ ἡῖῖ ἡῖῖῖῖῖῖῖ ὠῖῖ ἄβῖῖῖῖ ῶῖῖ ἑῖῖῖῖῖ ὠῖῖῖ ἰ Ὑῖῖῖῖ ἰῖῖ.

ῶῖῖῖῖῖ 26-2. Ἐῖῖῖῖῖῖ Null-Modem DB-9 ὠῖ DB-9

Ὀῖῖῖῖ	Ἄῖῖῖῖῖῖῖ #		Ἄῖῖῖῖῖῖῖ #	Ὀῖῖῖῖ
RD	2	ὠῖῖῖῖῖῖῖ ὠῖῖ	3	TD

Óβιá	ÁεññäÝέôçð #		ÁεññäÝέôçð #	Óβιá
TD	3	óðñäÝáððάέ óðï	2	RD
DTR	4	óðñäÝáððάέ óðï	6	DSR
DTR	4	óðñäÝáððάέ óðï	1	DCD
SG	5	óðñäÝáððάέ óðï	5	SG
DSR	6	óðñäÝáððάέ óðï	4	DTR
DCD	1	óðñäÝáððάέ óðï	4	DTR
RTS	7	óðñäÝáððάέ óðï	8	CTS
CTS	8	óðñäÝáððάέ óðï	7	RTS

Δβιáέάð 26-3. Έάεβäεϊ Null-Modem DB-9 óä DB-25

Óβιá	ÁεññäÝέôçð #		ÁεññäÝέôçð #	Óβιá
RD	2	óðñäÝáððάέ óðï	2	TD
TD	3	óðñäÝáððάέ óðï	3	RD
DTR	4	óðñäÝáððάέ óðï	6	DSR
DTR	4	óðñäÝáððάέ óðï	8	DCD
SG	5	óðñäÝáððάέ óðï	7	SG
DSR	6	óðñäÝáððάέ óðï	20	DTR
DCD	1	óðñäÝáððάέ óðï	20	DTR
RTS	7	óðñäÝáððάέ óðï	5	CTS
CTS	8	óðñäÝáððάέ óðï	4	RTS

Όçñäβúòç: ¼ðáí Ýιáð áεñññäÝέôçð óä ιεά Ûεñç ÷ ñáέÛæáððάέ ιά óðñäáεáβ ιä äýï áεñññäÝέôððð óðçï Ûεεç, óðñäβεúð äñβññäð ðñðð áεñññäÝέôððð ιäððáý ðñðð óðç ιεά Ûεñç ιä Ýιá ιεεññ äáεβäεϊ, έáέ ÷ ñççóéññðñέéýñä Ýιá ιáεññýðäññ äáεβäεϊ äέá ðçï Ýιúòç ιä ðçï Ûεεç Ûεñç.

Ç ðäñäðÛñ äéÛðáñç óäβιáððάέ ιä äβιáέ ç ðεϊ äέáäáññÝιç. Óä ιεά ðäñäéεäáβ (ðñð äñçäáβððάέ óðï äέáεβñ Òñ RS-232 ιä ΆðéÛ Äβιáððä), ðñ SG óðñäÝáððάέ óðï SG, ðñ TD óðñäÝáððάέ óðï RD, ðä RTS έáέ CTS óðñäÝññððάέ óðï DCD, ðñ DTR óðñäÝáððάέ óðï DSR, έáέ áñðβððññä.

26.2.2.1.2 ÓððñðñέçñÝñä Έάεβäέá RS-232C

Ýñ ðððñðñέçñÝñä óáεñέáéú έáεβäεϊ RS-232C, ιäððáóÝññáé úεä ðä óβιáððä äðððεäβδð äðñ ðç ιεά Ûεñç óðçï Ûεεç, ÷ ùñβð έáñεÛ äέεäáβ óðñðð áεñññäÝέôððð. Áððñ äðéÛ óçñäβιáέ úðé ï áεñññäÝέôçð “ÏäðÛññóçð ÄáññÝñññ (TD)” ðçð ιεáð Ûεñçð, óðñäÝáððάέ óðññ áεñññäÝέôçç “ÏäðÛññóçð ÄáññÝñññ (TD)” ðçð Ûεεçð Ûεñçð. Áððñ äβιáέ έáέ ðñ äβñðð ðñð έáéúäβñð ðñð έá ÷ ñççóéññðñέéððäðä äέá ιä óðñäÝóäððä Ýñä ðððññ ðñð FreeBSD óýóðçñä óäð, έáέ äβιáέ äðβçðð έáðÛεεçεñ äέá ññéóñÝñä ðäññιáðééÛ.

26.2.2.2 Έγñαδ

Ίε οάέηέέΎδ έγñαδ άβίαέ ιέ οδóεάδΎδ διò ιάδάδΎñιòι δά άάάñΎία ιάδάίγ διò FreeBSD οδóδΠιάδιδ έάέ διò δάñιάδέέίγ. Ç áñυòçδά άδδΠ δάñέάñΰόάέ δά άβίαç δυì δεñηί διò δδΰñ÷ιòι, έάέ δυδ δά ÷άέñβέάδάέ δι FreeBSD.

26.2.2.2.1 Άβίαç Έδñηί

Οδΰñ÷ιòι έέΰοιñά άβίαç οάέηέέηηί δεñηί. Δñέί άάññΰόάδά Π έάδάόέάδΰόάδά έΰδιέί έάηηάέί, έά δñΎδάέ ίά άάάάέυέάβδά υδέ οάέηέέΰάέ ίά δç έγñά διò δάñιάδέέίγ έάέ διò FreeBSD οδóδΠιάδιδ οάδ.

Οά δάñέοδύδάñά δάñιάδέέΰ έάέέΎοιòι έγñαδ DB-25. Ίέ δñιούδέέίβ δδñέηέέδΎδ, οδδδάñέέάάάññΎίυι έάέ άδδηί διò άέδάέίγί FreeBSD, ιδññάβ ίά Ύ÷ιòι έγñαδ όγδθιò DB-25 Π DB-9. Άί έάέέΎδάδά έΰñδά δñέάδηηί οάέηέέηηί δεñηί οοί δδñέηέέδδΠ οάδ, ιδññάβ ίά έάέέΎδάέ έγñαδ όγδθιò RJ-12 Π RJ-45.

Άάβδά όçι δάέιçñβυòç δθιò οδññάγáέ δι δέέέυ οάδ, άέά δέδ δά÷ιέέΎδ δññέάάñάδΎδ όçδ έγñαδ διò ÷ñçóέιδñέάβ. ΟοίΠεδδ ιδññάβδά ίά άάΰέάδά οδδδΎñάοιá άί άδηηδ έιέδΰιáδά όçι δδññ÷Π.

26.2.2.2.2 Ίιυιáδά Έδñηί

Οδι FreeBSD, Ύ÷άδά δñυόάάόç οά έΰεά οάέηέέηΠ έγñά ιΎού ιέάδ έάδά÷ηñέόçδ οδιι έάδΰέηιι /dev. Οδΰñ÷ιòι άγί άέάοιñάδέέΰ άβίαç έάδά÷ññβδάυι:

- Ίέ έγñαδ διò ιδññίγί ίά ÷ñçóέιδñέçέίγί άέά άβδίαί οδι όγδóçιá, ιññΰάηιδάέ /dev/ttydN υδθιò δι N άβίαέ ι άñέέιυδ όçδ έγñαδ (ç άñβέιçόç ιάέέίΰάέ άδυ δι ιçáΎί). Άάίέέΰ, ιέ έγñαδ άδδΎδ δñññβάηιδάέ άέά όγίáάόç ιά δάñιάδέέΰ. Ίέ έγñαδ άέοúυιò άδάέοιγί ίά άβίαέ άίáññυ δι óΠιά άίβ÷ιáδóçδ öΎññιδιδ (DCD) όόç οάέηέέηΠ άñάññ, δññέάέΎñιò ίά έάέοιòñβδδιòι ούδδΰ.
- Ίέ έγñαδ έεΠόçδ Π άñυάιò, ιññΰάηιδάέ /dev/cuadN. Ίέ έγñαδ άδδΎδ άάί ÷ñçóέιδñέίγίδάέ οδδΠεδδ άέά δάñιάδέέΰ, άέέΰ άέά modems. Ίδññάβδά ίά ÷ñçóέιδñέΠόδά άδδΠ όç έγñά άέά έΰδιέί δάñιάδέέυ δθιò άάί δδθιòçñβάέέ δι óΠιά άίβ÷ιáδóçδ öΎññιδιδ.

Άί Ύ÷άδά οδññΎδάέ Ύία δάñιάδέέυ όδçι δñηδç οάέηέέηΠ έγñά (δθιò οδδι MS-DOS άίάδΎñάδάέ υδ COM1), έά δñΎδάέ ίά ÷ñçóέιδñέΠόδά όçι οδóέάδΠ /dev/ttyd0 άέά ίά άίάδάñέάβδά οδδ δάñιάδέέυ. Άί δι δάñιάδέέυ άβίαέ όçç άάγδάñç οάέηέέηΠ έγñά (δθιò άβίαέ άδβόçδ άñυδδΠ υδ COM2) ÷ñçóέιδñέΠόδά όç οδóέάδΠ /dev/ttyd1, έ.ι.έ.

26.2.3 Ñýέιέόç διò ΔδñΠία

Οι FreeBSD άδυ δññιάδέέηιπ δδθιòçñβάέέ δΎόδάñέδ οάέηέέΎδ έγñαδ. Οοιι έυοιι διò MS-DOS ιέ έγñαδ άδδΎδ άβίαέ άñυδδΎδ υδ: COM1, COM2, COM3, έάέ COM4. Οι FreeBSD άδδΠ όç οδέάñΠ δδθιòçñβάέέ “έιòδΎδ” οάέηέέΎδ έΰñδάδ δñέάδηηί δεñηί, υδυδ δέδ BocaBoard 1008 έάέ 2016, υδυδ έάέ δέί άδδδΠδ έΰñδάδ, υδυδ άδδΎδ διò έάδάόέάδΰάηιδάέ άδυ όçι Digiboard έάέ όçι Stallion Technologies. Ί δññιάδέέάñΎñδ δδñΠιáδ υδδύοι, άέδάέάβ άίβ÷ιáδóç ιññί άέά δέδ δδδέέΎδ οάέηέέΎδ (COM) έγñαδ.

Άέά ίά άάβδά άί ι δδñΠιáδ οάδ άίάάññβάέέ ιδñέάπδθιòά άδυ δέδ οάέηέέΎδ έγñαδ, δάñάδçñΠόδά δά ιçίγίáδά έάδΰ όç έέΰñέάέά άέέβίçόçδ διò οδóδΠιáδιδ, Π ÷ñçóέιδñέΠόδά όçι άίδθιέΠ /sbin/dmesg άέά ίά ίάíάάάβδά δά ιçίγίáδά διò δδñΠιá έάδΰ όç έέΰñέάέά όçδ άέέβίçόçδ. Δέί οδάέάέñέίΎία, άίάαçδΠόδά δά ιçίγίáδά δθιò ιάέέñίγί ιά διòδ ÷άñάέδΠñάδ sio.

Οδύάάέιç: Άέά ίά άάβδά ιññί δά ιçίγίáδά δθιò δάñέΎ÷ιòι όç έΎίç sio, ÷ñçóέιδñέΠόδά όçι άίθιέΠ:

```
# /sbin/dmesg | grep 'sio'
```

Ἀέα δάνὐάεαία, οὰ ὕία όύόόχία ιὰ όΎόόάñέδ οάέñέέΎδ έγñάδ, οά ιχίγίαόά όιό δөнΠρία όιό ό÷άδβæίίόάέ ιὰ áδóΎδ οάβñίίόάέ δάñáέὐδ:

```
sio0 at 0x3f8-0x3ff irq 4 on isa
sio0: type 16550A
sio1 at 0x2f8-0x2ff irq 3 on isa
sio1: type 16550A
sio2 at 0x3e8-0x3ef irq 5 on isa
sio2: type 16550A
sio3 at 0x2e8-0x2ef irq 9 on isa
sio3: type 16550A
```

Άί ι δөнΠρία όάό ááι áíááññβæάέ ùεáδ όέδ οάέñέέΎδ όάό έγñάδ, δέεáíuí ίά ÷ñáέáόόάβ ίά όíι ñòèìβóáδά ÷ñçóéííðíεðíόάδ όí áñ÷áβí /boot/device.hints. Ιδññáβδά áδβόçδ ίά ιáδάδñΎθάδά οά ό÷úεέí (P έáέ ίá áéááñὐθάδά óáéáβùδ) áñáñΎδ όιό áíáöΎñííόάέ οά όóóέáöΎδ όιό ááι όδὐñ÷íοí όóí όύόόχία όάδ.

Δάñáέάεíγíá áíáδñΎíθά όόç óáéβáá manual όιό sio(4) áéá δάñέόóúδáñáδ δεçñííòñβáδ ό÷áδéέὐ ιὰ όέδ οάέñέέΎδ έγñάδ έáέ όέδ ñòèìβóáέδ όúí έáñόðí δíεέáδεðí óáέñέáέðí έδñþí. Άί ÷ñçóéííðíεáβδά áñ÷áβí ñòèìβóáúí όιό δñíΎñ÷áδáέ áδú έὐδíεá δάέáέúδáñç ὕέáíόç όιό FreeBSD, έá δñΎδáέ ίá áβóδά έáέáβδάñá δñíóáέόέéíβ, έáεðò έὐδíεáδ áδú όέδ áδéεíáΎδ όúí όóóέáðþí έáέ ç όύίόáíç όíθδ ὕ÷íοí áééὐíáέ όόέδ ίáúδáñáδ áéáúóáέδ.

Όçíáββύόç: Όí port IO_COM1 όðíέáέέόδὐ όí port 0x3f8, IO_COM2 áβίáέ όí 0x2f8, IO_COM3 áβίáέ όí 0x3e8, έáέ όí IO_COM4 áβίáέ όí 0x2e8. ἈδóΎδ áβίáέ έáέ íé δéí έíéíΎδ ñòèìβóáέδ áéá όέδ δάñáδὐíú έγñáδ. Ιέ áñáñΎδ interrupt 4, 3, 5 έáέ 9 áβίáέ íé δéΎíί όóíçέέóíΎíáδ όόέδ óáέñέáέΎδ έγñáδ. Όçíáεðóδά áδβόçδ úδé íé όóíçέέóíΎíáδ óáέñέáέΎδ έγñáδ ááí ιδñíγí ίá ííèñὐæííδáέ όí βáéí interrupt ιá έὐδíεá ὕέεç όóóέáδP óá όðíéíáέόδΎδ όιό áéáέΎóíοí áβáδéí όύδíθ ISA (íé έὐñάδ όíεéáδεðí έδñþí áéáέΎóíοí áéáέέὐ έδέεðíáδά όιό áδéδñΎδíοí óá úéá δά 16550Á όíό ÷ñçóéííðíεáβ ç έὐñδά ίá έáέóíθñáíγí ÷ñçóéííðíεðíáδ íúí ιβá P áγí áñáñΎδ interrupt).

26.2.4 Ἀέάέέὐ Ἀñ÷άβá Όóóέáðþí

Ç δñúóááόç όόέδ δάñέόóúδáñáδ όóóέáδΎδ όιό δөнΠρία, áδéóδá÷ὐíáόáέ ιΎóú “áéáέðí áñ÷áβíúί όóóέáðþí”, δά ιδñíβá áñβóéííóáέ όóíí έáδὐέíáí /dev/. Όόέδ όóóέáδΎδ sio ç δñúóááόç áδéóδá÷ὐíáόáέ ιΎóú όúí áñ÷áβíú /dev/ttydñ (áéá όóóέáδΎδ áéóúáíò, dial-in) έáέ /dev/cuadñ (áéá όóóέáδΎδ áñúáíò, call-out). Όí FreeBSD δάñΎ÷áέ áδβόçδ όóóέáδΎδ áñ÷έéíðíβçóçδ (/dev/ttydñ.init έáέ /dev/cuadñ.init) έáέ όóóέáδΎδ έéáέðíáðíδò (/dev/ttydñ.lock έáέ /dev/cuadñ.lock). Ιέ όóóέáδΎδ áñ÷έéíðíβçóçδ ÷ñçóéííðíéíγíóáέ áéá όçí ñγέίέόç όúí áñ÷έεðí δάñáíΎδññí áδééíéúíβáδ όόç έγñá, έὐεá öíñὐ όιό áñíβááέ. ΌΎóíέáδ δάñὐíáδñíé áβίáέ δ.÷. όí crtscts áéá óá modems όιό ÷ñçóéííðíéíγí όçíáδíáíóβá RTS/CTS áéá ὕέáá÷í ñíþδ. Ιέ όóóέáδΎδ έéáέðíáðíδò ÷ñçóéííðíéíγíóáέ áéá ίá έéáέðíθí έὐδíεáδ ñòèìβóáέδ όόέδ έγñáδ, þδá ίá ιçí ιδñíγí ίá áééá÷éíγí áδú ὕέéíθδ ÷ñþóáδ P δñíáñὐíáδά. Ἀέα δεçñííòñβáδ ό÷áδéέΎδ ιá όέδ ñòèìβóáέδ óáñíáδéέðí, όçí áñ÷έéíðíβçóç έáέ óá έéáέðíáðíά όóóέáðþí, έáέ όç ñγέίέόç δάñáíΎδññí óá όáñíáδéέὐ, ááβδά áίóβόóíé÷á όέδ óáéβáδò manual termios(4), sio(4), έáέ stty(1).

26.2.5 Ñõèìβóáèð Óáëñéáêþí Ëõñþí

Ç óðóèáðP ttydN (P cuadN) áβíáé ç èáííéèP óðóèáðP ðíð ðíñáβóá íá ÷ñçóéíðíéPóáðá óðéð áðáñííáÝð óáð. ¼ðáí íéá áéááééáóβá áíβááé íéá óðóèáðP, ÷ñçóéíðíéíýíóáé èÛðíéáð ðñíáðééááíÝíáð ñðèìβóáèð I/O áéá òí ðáñíáðééú. Ìðíñáβóá íá ááβóá áððÝð ðéð ñðèìβóáèð ðá òçí áíðíèP:

```
# stty -a -f /dev/ttyd1
```

Áí áéèÛíáðá ðéð ñðèìβóáèð óá áððP òç óðóèáðP, áððÝð èá ðáñáíáβííðí ðí ÷ñé òí èèáβóéí òçð óðóèáðPð. ¼ðáí áíé÷èáβ íáíÛ, èá Ý÷áé áðáíÝéèáé óðéð ðñíáðééááíÝíáð ñðèìβóáèð. Áéá íá áéèÛíáðá ðéð ðñíáðééááíÝíáð ñðèìβóáèð, ðíñáβóá íá áíβíáðá éáé íá áéèÛíáðá ðéð ñðèìβóáèð òçð óðóèáðPð “áñ÷éèPð èáðÛóðáçð”. Áéá ðáñÛáééáíá, áéá íá áíáñáíðíéPóáðá òç èáéóíðñáβá CLOCAL, íá ðñóáðá áðééíéíúíβá 8bit éáé Ýéáá÷í ðíPð ðíÝóú XON/XOFF áéá òç óðóèáðP ttyd5, áñÛððá:

```
# stty -f /dev/ttyd5.init clocal cs8 ixon ixoff
```

Ç áñ÷éèðíβçç ðúí óáëñéáêþí óðóèáðþí áéá üèí ðí óýóðçíá, áéÝá÷áðáé áðú ðí áñ÷áβí /etc/rc.d/serial. Õí áñ÷áβí áððú áðçñáÛæáé ðéð ðñíáðééááíÝíáð ñðèìβóáèð ðúí óáëñéáêþí óðóèáðþí.

Áéá íá áðíðñÝðáðá òçí áéèááP óðáéáñéíÝíúí ñðèìβóáúí áðú èÛðíéá áðáñííáP, áéèÛíáðá ðéð ñðèìβóáèð òçð óðóèáðPð “èéáéþíáðíð”. Áéá ðáñÛáééáíá, áéá íá èéáéþíáðá òçí ðá÷ýçðá òçð óðóèáðPð ttyd5 óðá 57600 bps, áñÛððá:

```
# stty -f /dev/ttyd5.lock 57600
```

Ïþñá, íéá áðáñííáP ðíð áíβááé òç èýñá ttyd5 éáé áðé÷áéñáβ íá áéèÛíáðá òçí ðá÷ýçðá òçð èýñáð, èá áíááéáóðáβ íá ðáñáíáβíáé óðá 57600 bps.

ÏðóééÛ, èá ðñÝðáé íá ñðèìβóáðá ðéð óðóèáðÝð áñ÷éèðíβççð éáé èéáéþíáðíð, þððá íá áβíáé áááñÛðéíáð ðúí áðú òíí èíááñéáóíú ðíð root.

26.3 ÓáñíáðééÛ

ÓðíáéóöíñÛ ðíð Sean Kelly.

Óá ðáñíáðééÛ ðáñÝ÷íð íéá áíééèP éáé ÷áíçéíý èúóðíðð ðíÝéáí ðñúóááçð ððí FreeBSD óýóðçíá óáð, ððáí ááí áñβóéáóðá ðíðíóðÛ óçí èííóúéá P óá èÛðíéí ððíááíÝíí áβéððí. Ç áíúòçðá áððP ðáñéáñÛðáé ðúð íá ÷ñçóéíðíéPóáðá ðáñíáðééÛ ððí FreeBSD.

26.3.1 ×ñPóáèð éáé Áβäç Óáñíáðééþí

Óá áñ÷éèÛ óðóðíáðá UNIX ááí áβ÷áí èííóúéáð. Áíðβéáðá, íé ÷ñPóðáð áéóÝñ÷íðáí ððí óýóðçíá éáé áéðáéíýóáí óá ðñíáñÛíáðá ðíðð ðíÝóú ðáñíáðééþí ðíð ððíáÝííðáí óðéð óáëñéáéÝð èýñáð ðíð ððíéáéóðP. Áððú ðíéÛæáé áñéáðÛ ðá òç ÷ñPçç modem éáé èíáéóíééíý áñííβòçð ðáñíáðééíý áéá óýíááçç óá Ýíá áðñáéñðóíÝíí óýóðçíá. Ìá ðíí ðñúðí áððú ðíñáβóá áÝááéá íá áéðáéÝóáðá áñáóβáð ðúí óá ðáñéáÛéèíí èáéíÝííð.

Óá óçíáñéíÛ PC áéáéÝðíðí èííóúéáð èéáíÝð íá áðáéèíβóíðí áñáðééÛ ðíéý ðççèPð ðíéúðçðáð, áéèÛ ç èéáíúðçðá óýíááççð ððí ðç÷Ûíçíá ðíÝóú óáëñéáéPð èýñáð, ððÛñ÷áé áéúíá ó÷ááúí óá ðéá óá óçíáñéíÛ óðóðíáðá óýðíð UNIX. Õí FreeBSD ááí áðíðáéáβ áíáβñáç. ÓðíáÝííðáð Ýíá ðáñíáðééú óá íéá á÷ñçóéíðíβççç óáëñéáéP èýñá, ðíñáβóá íá áéóÝéèáðá ððí óýóðçíá éáé íá áéðáéÝóáðá ððíéáβðíðá ðñúáñáíá èáéíÝííð ðí ððíβí èá ððííýóáðá ððóéíéáéèÛ íá áéðáéÝóáðá óçí èííóúéá P óá Ýíá ðáñÛéðñí xterm ðíð óðóðíáðíð X Window.

Άέά ÷ ñΠόç óά áδé ÷ áεñΠόάέδ, áβιάέ áδίαδúι íά óοíáÛόάδá διέεÛ óáñιάδέέÛ óά Ýία FreeBSD óγόδçιά έάέ íά δά οίδúεάδΠόάάά όδéd èÛάέδ áñάάόβáδ οúι όδάέεΠεúι. íάδ íέέέάέúδ ÷ ñΠόδçδ ίδúñάβ íά ÷ ñçόέιíδúεΠόάέ éÛδúεí δάέέú όδúεíάέόδΠ (δ.÷. Ýία δάέέú IBM PC P Macintosh) úδ óáñιάδέέú áíúδ δúεý έó ÷ δñúδáñú όδúεíάέόδΠ δúε áέδáέáβ FreeBSD. Íá όú όñúδú áδóú, ίδúñάβόά íά ίάδóáñÛόάδ áδóú δúε έάíúέέÛ έá Πόάí óγόδçιά áíúδ ÷ ñΠόδç, óά Ýία δάíβó ÷ όñú óγόδçιά δúεέάδέβú ÷ ñçόδπí.

Óδú FreeBSD δδÛñ ÷ íοí όñβά áβáç óáñιάδέέβú:

- ÊúδóÛ ÓáñιάδέέÛ
- PC δúε έάέόιδúñáíýí úδ óáñιάδέέÛ
- ÓáñιάδέέÛ X

Íέ δάñάέÛδú όδúíáíúδçόάδ δάñέáñÛúóíοí έάέÛÝία áδú áδóíýδ όíδδ όýδúδδ.

26.3.1.1 ÊúδóÛ ÓáñιάδέέÛ

Óά έúδóÛ óáñιάδέέÛ áβιάέ áíáέέέáδúÝíáδ óδóέáδÛδ δúε áδέδñÛδúóí όç óýíááόç óά όδúεíάέόδÛδ íÛóú óáέñέάέβú áñáñπí. Áδúεáεíýíόάé “έúδóÛ” áέñέáπδ áδάέáΠ ç íúíç όδúεíάέόδéΠ έó ÷ ý δúε Ý ÷ íοí áβιάέ áέá áδάέéúúέόç, áδúóúεΠ, έάέ éΠçç έáέíÛú. Ááí ίδúñάβόά íά áέδáéÛόάδ δñúñáñÛúíáδóά óά áδóÛ. ¼έç ç έó ÷ ýδ όíδδ δñúÛñ ÷ áδάέ áδú όú όδúεíάέόδΠ δúε έá δά óοíáÛόάδ, έάέ íÛóú áδóíý ίδúñάβόά íά áέδáéÛόάδ όóíδÛέδáδ έáέíÛú, ίáδáάéúδóέóδÛδ, δñúñáñÛúíáδóά email, δάέ ÷ íβάέá é.í.é.

ÓδÛñ ÷ íοí áέáδúíδÛάáδ áβáç έúδόπí óáñιάδέέβú áδú áñέáδúíýδ έáδάάέáδóάδóÛδ, úδúδ όí VT-100 όçδ Digital Equipment Corporation έáέ όí WY-75 όçδ Wyse. Ó ÷ ááúí íδúέíóáΠδúóά όýδúδ ίδúñάβ íά έáέόιδúñáΠόάέ íá όú FreeBSD. ÍáñέéÛ óáñιάδέέÛ όççéíý éúóδúδδ ίδúñáíý áδβόçδ íά áδáέéíβúóíδú έáέ áñáóέéÛ, áέéÛ áδδΠ όç áδúíáδúδçόά ίδúñáíý íá όç íáέíáδáέéáδúéíý ó ÷ áδééÛ éβáá δάέÛδá έúáέóúééíý.

Óά έúδóÛ óáñιάδέέÛ áβιάέ áçúíδóééΠ óά δάñέáÛέéúíδá áñááόβáδ úδúε íé áñááéúíáíúé ááí ÷ ñáéÛáεíúδáé δñúóááόç óά áñáóέéÛδ áóáñúáÛδ, úδúδ áδóÛδ δúε δάñÛ ÷ íúδáé áδú όú óγόδçιά X Window.

26.3.1.2 PC δúε Έáέόιδúñáíý úδ ÓáñιάδέέÛ

Áí Ýία έúδóú óáñιάδέέú Ý ÷ áé áέñέáπδ όç í έó ÷ ý δúε ÷ ñáéÛááδáé áέá íá ááβ ÷ íáé, íá óδÛέíáé, έáέ íá έáíáÛúíáé έáβúáíú, óúδá έáé éÛéá όδúεíάέόδΠδ δúε óáδ δάñέóóáýáé ίδúñάβ íá έáέόιδúñáΠόάέ óáí έúδóú óáñιάδέέú. Óú íúíú δúε ÷ ñáéÛááδóά áβιάέ όú óúδóú έáέπáéí έáέ éÛδúéí δñúñáñúá áñúíβúόçδ óáñιάδέέéý όú íδúβú έá áέδáέáβáδά óδúí όδúεíάέόδΠ áδúú.

Ç δáñáδÛúú áéÛδáíç áβιάέ áçúíδóééΠδ áέá íέέέáéΠ ÷ ñΠόç. Áí áέá δáñÛááéáíá éÛδúéíδ áúδέáýáé óδç íúíúéá δúε óδóδΠúáδúδ óáδ, ίδúñάβόά íá áέδáéÛόάδ όç í áñááόβá óáδ (íá όç í δñúúδúéáδΠ úδé áβιάέ íúíú έáβúáíú) όç í βáéá óδéáíΠ, ÷ ñçόέííδúεΠúáδ Ýία έéáúδáñú έó ÷ όñú óγόδçιά όú íδúβú óδúáÛόάέ óúí FreeBSD óáδ úδ óáñιάδέέú.

ÓδÛñ ÷ íοí áýí óúεÛ ÷ έóδúí áúççόééÛ δñúñáñÛúíáδóά óúí ááóέéú óγόδçιά όúε FreeBSD δúε ίδúñáíý íá ÷ ñçόέííδúéçéíý íá áέá íá áúδéÛόάδ íÛóú óáέñέáéΠδ óýíááόçδ: όú cu(1) έáέ όú tip(1).

Άέá íá óδúáάéáβáδ áδú Ýία Ûέéí íç ÷ Ûúçúá δúε áéδáéáβ FreeBSD óόç óáέñέáéΠ óýíááόç áíúδ Ûέéúδ óδóδΠúáδúδ, ίδúñάβόά íá ÷ ñçόέííδúεΠúáδά όç í δáñάέÛδú áúδúεΠ:

```
# cu -l serial-port-device
```

¼δúδ όú “serial-port-device” áβιάέ όú úñúá όúé áñ ÷ áβúδ óδóέáδΠδ δúε áúóέδñúóúδáýáé íéá óáέñέáéΠ éýñá όúí óγόδçιά óáδ. ÁδóÛ óá áñ ÷ áβá óδóέáδπí έáéíýíδáé /dev/cuadñ.

Όι “N” όοι υίηά όçð όóóέάðÐð, áíóέðñíóóυðάγáέ όιí άñέέιυ όçð όάέηέάέÐð έγñάð.

Όçíáßóç: Όçíáέβóðά υóέ ç áñßέιçόç όυí όóóέάðβí όοι FreeBSD íáέείÛ áðu όι íçáΎí, έάέ υ÷έ áðu όι Ύíá (υðυò όóíááßíáέ áέά ðáñÛááέáíá όóά όóóðβíáóά ðíð ό÷ áðßæííóáέ íá όι MS-DOS). Άóóυ ðñáέóέέÛ όçíáßíáέ υóέ ç έγñά ðíð όοι MS-DOS έάέáßóáέ com1 έά áßíáέ όóíβέυò ç /dev/cuad0 όοι FreeBSD.

Όçíáßóç: ÈÛðíέíé ÷ ñβóóáò ðñíóέííγí íá ÷ ñçóέííðíέíγí Ûέέá ðñíáñÛííáóά ðíð áέáðßέáíóáέ íΎóυ όçð Óðέέííáβð όυí Ports. Óά Ports ðáñέέáíáÛííóí áñέáðÛ áíççéçóέέÛ ðñíáñÛííáóά íá έάέóíðñáßáð ðáñυííέáð íá όι cu(1) έάέ όι tip(1), áέά ðáñÛááέáíá όι comms/minicom.

26.3.1.3 ÓáñíáóέέÛ X

Όά óáñíáóέέÛ X áßíáέ óá ðέí áíáέέáíΎíá áßç óáñíáóέέβí ðíð ððÛñ÷íóí. Άíóß íá óóíáΎííóáέ óá όάέηέάέÐ έγñά, óóíβέυò óóíáΎííóáέ íΎóυ áέέóγíð, ð.÷. Ethernet. Άíóß íá ðáñέíñβæííóáέ íυíí óá áóáñíáΎð έάέíΎííó, íðñíγí íá áðáέέíβóíóí íðíέááβðíóá áóáñíáβ όυí X.

ΆíáóΎñáíá óá óáñíáóέέÛ X íυíí áέá έυáíðð ðççñíυðçóáð áððÐð όçð áíυðçóáð. Όόι έáðÛεάέí áðóυ υóóóυóí, ááí έάέγððáóáέ ç ááέáðÛóóáç, ñγέιέóç, έάέ ÷ ñβóç όυí óáñíáóέέβí X.

26.3.2 Ñγέιέóç

Ç áíυðçóá áððβ ðáñέáñÛóáέ óέ ÷ ñáέÛæáðáέ íá ñòέíβóáðá όοι FreeBSD óγóóçíá óáð áέá íá áßíáέ áðíáðβ ç áβóíííð óá áðóυ íΎóυ óáñíáóέέγí. ðñíυðíεΎóáέ υóέ Ύ÷áðá βáç ñòέíβóáέ όιí ððñβíá óáð íá óðíóóçñβæíέ όç όάέηέάέÐ έγñά óóçí íðíβá áßíáέ óóíáíΎíç όι óáñíáóέέυ—έάέ υóέ όι Ύ÷áðá βáç óóíáΎóáέ.

Όόι ΈáðÛεάέí 12 áβáíá υóέ ç áέáñááóβá init áßíáέ óðáγέóíç áέá όιí Ύέáá÷í όυí Ûέέυí áέáñááóέβí, έάέ áέá όçí áñ÷έέíðíβçόç έáðÛ όçí áέέβíçόç ðíð óóóðβíáðíð. Íέá áðu óέð áñááóβáð ðíð áέðáέáβ ç init áßíáέ íá áέááÛæáέ όι áñ÷áβí /etc/ttys έάέ íá íáέέíÛ íέá áέáñááóβá getty óá έÛεá áέáέΎóέíí óáñíáóέέυ. Ç áέáñááóβá getty áíáέáíáÛíáέ íá áέááÛóáέ όι υίηά ÷ ñβóç έάέ íá íáέέíβóáέ όι ðñυáñáíá login.

Άέá íá ñòέíέóóíγí óá óáñíáóέέÛ όοι FreeBSD óγóóçíá óáð, έá ðñΎðáέ íá áέðáέΎóáðά óá áέυέíðέá áβíáóά υò root:

1. ðñíóέΎóðά íέá áñáíβ όοι /etc/ttys íá όι υίηά όçð όóóέáðÐð υðυò óáβíáóáέ όοιí έáðÛεíáí /dev, áí ááí óðÛñ÷άέ βáç.
2. Έάέíñβóðά υóέ έá áέðáέáβóáέ ç /usr/libexec/getty óóçí έγñά, έάέ áðέέΎíðά όιí έáðÛεέçέí óγðí getty áðu όι áñ÷áβí /etc/gettytab.
3. Έάέíñβóðά όιí ðñíáðέέááíΎíí óγðí óáñíáóέέγí.
4. Άíáñáíðíεβóðά όç έγñά εΎóííóáð όçí áíóβóóíé÷ç áðέέíáβ όοι “on”.
5. ΆðέέΎíðά áí ç έγñά έá áßíáέ áóóáέβð íá όçí áðέέíáβ “secure”.
6. ΆíáíááέÛóáά όçí init íá áέááÛóáέ íáíÛ όι áñ÷áβí /etc/ttys.

26.3.3.1 Άάί Άιόάίβæάόάέ Δñĩõñĩð Þ Áέούäĩõ (login)

Άάάάέυεάβδδά υδέ οĩ δάνιáδέέυ άβίáέ όóíááíΥñí όóí çæáέδñέέυ άβέδδóí έάέ áíáñáñĩðĩέçĩΥñí. Άί άβίáέ δñĩóυδέέυδ όδĩĩέĩάέóδÞδ δĩó áíáñáñáβ ùδ δάνιáδέέυ, áááάέυεάβδδά υδέ áέδάέάβ έĩάέóíέέυ άñĩĩβùóçδ δάνιáδέέίý όóçí óυóδÞ óάέñέάêÞ έýñά.

Άάάάέυεάβδδά υδέ οĩ έάέþáέĩ άβίáέ έάέÛ όóíááíΥñí óυóí όóí δάνιáδέέυ, υóí έάέ όóíĩ όδĩέĩάέóδÞ δĩó áέδάέάβ FreeBSD. Άάάάέυεάβδδά υδέ άβίáέ όĩ óυóóυ άβářδ έάέυάβĩð.

Άάάάέυεάβδδά υδέ οĩ δάνιáδέέυ έάέ όĩ FreeBSD όóĩóυñĩýí υóí áóĩñÛ δέδ ñðèĩβóáέδ όçδ δά÷ýδçδάδ ιáδÛáĩóçδ έάέ έóĩóέĩβáδ. ΆέΥáĩðά όç óυδάέýíδçδά έάέ όçí áíóβέáόç όçδ ðéυĩçδ δĩó δάνιáδέέίý, έάέ áóĩÞóδά δέδ άí ÷ñáέÛæáδάέ. Άί δñũέáέóáέ áéá δάνιáδέέυ ιá áέδóδùδÞ (÷ññβδ ðéυĩç), áááάέυεάβδδά υδέ áέάέΥδάέ áδÛñέáá ÷áñδέίý έάέ ιáέáίέíý.

Άάάάέυεάβδδά υδέ áέδάέάβδδάέ ç áéáάέέáóβá getty δĩó áĩðδçñáðáβ όĩ δάνιáδέέυ. Άέá ίá ááβδδά ίέá έβδδά ιá δέδ áíáñáÝð áéáάέέáóβáδ getty, ÷ñçóέĩðĩέÞóδά όçí áíóĩêÞ ps:

```
# ps -axww|grep getty
```

Έá δñÝðáέ ίá ááβδδά ίέá έáδά÷þñέόç áéá όĩ δάνιáδέέυ óáδ. Άέá δάνÛááέáĩá, ç áέυέĩðέç ðéυĩç ááβ÷íáέ υδέ ç áέáñááóβá getty áέδάέάβδδά óόç ááýδáñç óáέñέáêÞ έýñά ttyd1 έάέ ÷ñçóέĩðĩέáβ όçí έáδά÷þñέόç std.38400 όóĩ áñ÷áβĩ /etc/gettytab:

```
22189 dl Is+ 0:00.03 /usr/libexec/getty std.38400 ttyd1
```

Άί άáí áέδάέάβδδάέ έáíέÛ áέáñááóβá getty, áááάέυεάβδδά υδέ Ý÷áδά áíáñáñĩðĩέÞóáέ όç έýñά όóĩ /etc/ttys.

Άδβόçδ έðĩçέáβδδά ίá áέδάέÝóáδά όçí áíóĩêÞ kill -HUP 1 ιáδÛ όçí δñĩðĩðĩβçόç όĩó áñ÷áβĩð ttys.

Άί áέδάέάβδδάέ ç áέáñááóβá getty áέέÛ όĩ δάνιáδέέυ áíáέέĩðέáβ ίá ιç ááβ÷íáέ δñĩðñĩðÞ áέóυäĩõ, Þ áí ááβ÷íáέ δñĩðñĩðÞ áέέÛ ááí óáδ áδέδñÝðáέ ίá áñÛøáδά, βóυδ όĩ δάνιáδέέυ óáδ Þ όĩ έάέþáέĩ ίá ιçí áδέδñÝðĩóĩ όóíáíĩúçόç ιÝóυ όέέέίý (hardware handshake). ΆĩέέĩÛóδά ίá áέέÛĩáδά όçí έáδά÷þñέόç όóĩ áñ÷áβĩ /etc/ttys áδũ std.38400 óá 3wire.38400 (έðĩçέáβδδά ίá áέδάέÝóáδά όçí áíóĩêÞ kill -HUP 1 ιáδÛ όçí δñĩðĩðĩβçόç όĩó /etc/ttys). Ç έáδά÷þñέόç 3wire άβίáέ áíóβóδĩέ÷ç ιá όçí std, áέέÛ ááĩñáβ όĩ hardware handshaking. Ιðĩñáβ άδβόçδ ίá ÷ñáέáóδáβ ίá ιáέþóáδά όĩ ñðèĩυ óçíáδĩáĩóβáδ (baud) έάέ ίá áíáñáñĩðĩέÞóáδ όĩí Ýέáá÷ĩ ñĩÞδ ιÝóυ έĩάέóíέέίý υδάί ÷ñçóέĩðĩέáβδδά όĩ 3wire, δñĩέáέĩÝñĩó ίá áδĩöýááδά δðáñ÷áβέέόç όçδ δñĩóυñέĩðδ ιĩÞçδ (buffer overflow).

26.3.3.2 Άί ΆέÝðáðá Óέĩðδβáέá Άίóβ áέá Δñĩõñĩð Þ Áέούäĩõ

Άάάάέυεάβδδά υδέ οĩ δάνιáδέέυ έάέ όĩ FreeBSD όóĩóυñĩýí όóí ñðèĩυ bps έάέ óδέδ ñðèĩβóáέδ έóĩóέĩβáδ. ΆέΥáĩðά δέδ áέáñááóβáδ getty áέá ίá áááάέυεάβδδά υδέ áέδάέάβδδά όĩ óυóóυ όýðĩ getty. Άί áδóυ ááí όóĩááβίáέ, áðáíáñááóδáβδδά όĩ áñ÷áβĩ /etc/ttys έάέ áέδάέÝóδά όçí áíóĩêÞ kill -HUP 1.

26.3.3.3 Ιέ ×áñáέδÞñáð Άιόάίβæĩíóáέ Άέðέĩβ, όĩ Password Άιόάίβæáóáέ έáδÛ όçí Δέçέðñĩέυáçόç

ΆέέÛĩðά όç ñýèĩέόç όĩó δάνιáδέέίý (Þ όĩó δñĩáñÛĩáóĩð áñĩĩβùóçδ δάνιáδέέίý) áδũ “half duplex” Þ “local echo” óá “full duplex”.

26.4 Ōðçñáoβá Áéóüäīō ÌÝóù ÁðeēīáeēÞò Óýíäáoçò (dial-in)

ÓðíeóöīŪ öīō Guy Helmer. ÐñīóèÞeáo áðu öī Sean Kelly.

Ç ñýēíeóç öīō FreeBSD óðóðÞíáðīò óáo áeá áβóīāī ÌÝóù ÁðeēīáeēÞò óýíäáoçò, áβíáe áñeáoŪ üīīeá ìá ôç óýíäáoç óāñíáóēēÞī, áeöüð áðu öī āāāīřüð üóē ÷ñçóēīñðīēīýíóáē modems áíôβ áeá óāñíáóēēŪ.

26.4.1 ÁīùóāñeēŪ eáē ÁóùóāñeēŪ Modems

Óá áīùóāñeēŪ modems áβíáe ÌŪeēīř ðēī āīēeēŪ áeá áðeēīáeēÝò eēÞóáeð, eáeÞò ìe ðāñeóóüóāñáð ñðeīβóáeð öīòð ìðīñīýí íá áðīēçeáoðēīýí ìüēīá óòç ìÞ-ðòçòeēÞ ìīÞīç RAM ðīò áeáēÝôīōī. Óá áīùóāñeēŪ modems áeáēÝôīōī óóīÞeüð öüðáeīÝð áíááβíáeð ðīò āāβ÷ñīōī ôçí eáóŪóóáoç óçíáíóeēÞī óçīŪðúī öīò RS-232. òòðð óá öüðŪeéá ðīò áíááīóáÞñīōī íá áíóòðúóēŪeēīōī öīòð áðeóēÝððáo, áeēŪ áβíáe áðβóçð ÷ñÞóēíá áeá íá óáβíáóáē ðüðá öī modem eáeóīññāāβ óúóóŪ.

Óá áóùóāñeēŪ modems óóīÞeüð āāī áeáēÝôīōī áóòÞ ôç ìīÞīç RAM, eáe Ýðóe ìe ñðeīβóáeð öīòð ðāñeīñβæñíóáē ìüīñ óòçí áeēāāÞ èÝóçð óá eŪðīēīòð áeáēüððáo ñðeīβóáūī (DIP switches). Áí öī áóùóāñeēŪ óáo modem áeáēÝóáē öüðáeīÝð áíááβíáeð, ÌŪeēīř eá áβíáe áýóēīēīř íá óeð āāβóá üðáí öī eŪeöīñá öīò óðóðÞíáðīò óáo áβíáe óòç èÝóç öīò.

26.4.1.1 Modems eáē ÉáēÞeáé

Áí ÷ñçóēīñðīēeāβðá áīùóāñeēŪ modem, eá ÷ñāeáóóáβðá öðóeēŪ öī óúóðü eáēÞeáēī. ÓóīÞeüð áðāñeāβ öī óððīðīeçīÝīñ eáēÞeáēī RS-232C, áöüóīñ áeáēÝóáē óðíáÝóáeð áeá üeá óá óðíçeéóīÝíá óÞíáóá:

Ðβíáeáo 26-4. Īñíáoβáo ÓçīŪðúī

Áeñüíýíeá	Īñüíáoá
RD	ĒÞøç ÁāāñÝřüī (Received Data)
TD	ÁðīóóīēÞ ÁāāñÝřüī (Transmitted Data)
DTR	Óāñíáóeēü ÁāāñÝřüī óá Áðīēīüòçóá (Data Terminal Ready)
DSR	Óýñīēī ÁāāñÝřüī óá Áðīēīüòçóá (Data Set Ready)
DCD	Áíβ÷íáðóç ÖÝñīōīð ÓÞíáðīò (Data Carrier Detect). Áíβ÷íáðóç óýíäáoçð ôçð āñāñÞð RS-232C
SG	Āāβüòç ÓÞíáðīò (Signal Ground)
RTS	Áβòççç ÁðīóóīēÞð (Request to Send)
CTS	Áðīēīüòçóá áeá ÁðīóóīēÞ (Clear to Send)

Ōī FreeBSD ÷ñāeŪeáóáe óá óÞíáóá RTS eáē CTS áeá Ýeāã÷ī ñīÞð óá óá÷ýòçðáo ðŪřü áðu 2400 bps, öī óÞíá CD áeá íá áíe÷íāýáe ðüðá Ý÷áe áðáíòçeāβ ìeá eēÞóç Þ ðüðá ç āñāñÞ Ý÷áe eēāβóáē, eáē öī óÞíá DTR áeá íá áðáíáöÝñāe öī modem óòçí āñ÷eēÞ öīò eáðŪóóáoç ìáðŪ ôç eÞīç ìeáð óýíäáoçò. ĪāñeēŪ eáeÞeáē āāī áeáēÝôīōī üeá óá áðāñáβòçóá óÞíáóá, Ýðóe áí Ý÷áðá ðñīāeÞíáóá ìá öīñ óāñíáóeóīü öçð óðíāāñβáo áeóüüāīò ìá öī eēāβóeēīř ôçð āñāñÞð, ðeēáíüīř íá áðeýíáóáe öī eáēÞeáēīř öīò ÷ñçóēīñðīēeāβðá.

¼ðùð eáē Ūeéá eáeóīññāeēŪ óðóðÞíáóá óýðīò UNIX, öī FreeBSD ÷ñçóēīñðīēeāβ óá óÞíáóá öīò öeēēīř áeá íá áíóeēçðeāβ ðüðá Ý÷áe áðáíòçeāβ ìeá eēÞóç, eáeÞð eáē áeá öīñ óāñíáóeóīü öçð eáē ôçí áðáíáöīñŪ öīò modem óòçí āñ÷eēÞ öīò eáðŪóóáoç ìáðŪ öī ðÝēīð ôçð. Ōī FreeBSD áðīòāýāāē íá óóÝeíáē áíóīēÝð óóī modem Þ íá ðāñāēīēīðeāβ áíáóīñÝð eáðŪóóáoçð áðu áðóü. Áí áβóá āñēeáeüēÝřüð ìá óðíáÝóáeð modems óá BBS (Bulletin Board Systems) öīò āáóβæīíóáe óá PC, áðóü ìðññāβ íá óáo óáíáβ Ūāēī.

26.4.2 Έοέειρίαόά ΟάεñεάέΎδ Άεάόγιάάόç

Οί FreeBSD δθιόçñβæάέ όά έδέειρίαόά άδέειρέιΰβι δθιό άάόβειΰόάέ όόά NS8250, NS16450, NS16550, έάέ NS16550A έάέ EIA RS-232C (CCITT V.24). Ίέ όόόέάσΎδ 8250 έάέ 16450 Ύ÷ιθι άίάέΰιάόç ιΰβιç (buffer) ιάάΎέιθδ άίΰδ ÷ άñάέδΐñά. Ç όόόέάσΎ 16550 άέάέΎδάέ άίάέΰιάόç ιΰβιç 16 ÷ άñάέδΐñι, ç ιθιβά άδέονΎδάέ όçι έάέγδάνç άθΰιιόç όçδ. (Έΰιαΰ δñιάέçιΰδϰι όόç ό÷ άάβάόç όιθ 16550, άάι άβίάέ άοιάδΐ Ç ÷ ñΐόç άδδΐδ όçδ ιΰβιç, άί άβίάέ άοιάδϰι ÷ ñçόέιθιεΐΐόόά όά 16550Α). Έάέΐδ ιέ όόόέάσΎδ δθιό άέάέΎδιθι άίάέΰιάόç ιΰβιç άίΰδ ÷ άñάέδΐñά άδάέοιγί δñάέόοϰδάνç άñάάόβά άδϰι όι έάέοιθñάέέϰι όγόόçιά όά ό÷ Ύόç ιά άδδΎδ δθιό άέάέΎδιθι 16 ÷ άñάέδΐñάδ, όθιβόόάίόάέ έάέάβδάñά ιέ όόόέάσΎδ δθιό άάόβæιΰόάέ όθι 16550Α. Άί όι όγόόçιά όάδ Ύ÷άέ δθιέΎδ άίάñάΎδ όάέñεάέΎδ δϰñόαδ, ΐ δñϰέάέόάέ ίά έάέοιθñάΐόάέ έΰΰδ άδϰι άαñϰι όϰñδι, ιέ έΰñόαδ δθιό άάόβæιΰόάέ όθι 16550A άβίάέ έάέγδάνñδ, έάέΐδ δñΎ÷ιθι άδέειρέιΰβι ιά ιέñϰϰδάνι ñδέιϰι όόάέιΰδϰι.

26.4.3 Άñΐάιñç Άδέόέϰδç

¼δϰδ έάέ ιά όά δάñιάδέέΰ, ç init άέδάέάβ ιέά έάάñάάόβά getty άέά έΰεά όάέñεάέΐ έñά δθιό Ύ÷άέ ñδέιέόδάβ άέά άέόάñ÷ιιάιάδ άδέειραέΎδ όθιΎΎόάέδ. Άέά δñΎάάέάι, άί Ύ÷άδά όθιΎΎόάέ Ύιά modem όόç έγñά /etc/ttyd0, ç άίόιέΐΐ ps ax έά άάβιάέ έΰδέ όάι όι δάñάέΰδϰι:

```
4850 ?? I 0:00.09 /usr/libexec/getty V19200 ttyd0
```

¼όάι έΰδιέιθδ ÷ ñΐόόçδ έάέΎόάέ όόç άñάιΐΐ άδδΐ έάέ όι modem όθιΎάέάβ, άίάñάιθιεάβδάέ άδϰι όι modem ç άñάιΐΐ CD. Ί δθñΐάιό δάñάόçñάβ ϰέέ Ύ÷άέ άίέ÷ιάδέάβ όΎñιί όβι, έάέ ιέιέέçñβιάέ όç έάέάέέάόβά άñιβιάιόθδ όçδ έγñάδ άδϰι όι modem. To getty όδΎέιάέ ιέά δñιθñιθΐ login: όόçι άδϰι δñέι έάέιñέοιΎιç άñ÷έέΐ όά÷γόçδά όçδ έγñάδ. Οί getty δάñάέιθιεδάβ άέά ίά άάέ άί έάιάΎιθιόάέ Ύάέονιε ÷ άñάέδΐñάδ, έάέ όόçι όδδέέΐ ñγέιέόç, άί άίάέάέγϰάέ ϰδέ έάιάΎιάέ όέιθδβάέά (δέέάϰδ έΰιαΰ άέάδϰιΰδ όόçι όά÷γόçδά όγίάάόçδ όιθ modem όά ό÷ Ύόç ιά όçι όά÷γόçδά όιθ getty), δñιθδάέάβ ίά ñδέιβόάέ όçι όά÷γόçδά όçδ άñάιΐδ ιΎ÷ñέ ίά έΰάάέ όδóέιθιεάέειγδ ÷ άñάέδΐñάδ.

Άόγϰι ÷ ñΐόόçδ άέόΰάάέ όιι έϰάέέϰι όιθ, όι getty άέδάέάβ όι /usr/bin/login, όι ιθιβι έάέ ιέιέέçñβιάέ όç έάέάέέάόβά άέόϰι, αçόβιόάδ άδϰι όι ÷ ñΐόόç όιι έϰάέέϰι όιθ, έάέ ιάέέιβιόάδ Ύδάέόά όι έΎέοθιθδ όιθ.

26.4.4 Άñ÷άβά ñδέιβόάϰι

Οδΰñ÷ιθι όñβά άñ÷άβά ñδέιβόάϰι όόόδβιάδθιθδ όθιι έάδΰέιθι /etc, όά ιθιβι δέέάϰδ έά ÷ ñάέόδάβ ίά άδάιάñάάόδάβδά άέά ίά άδέονΎδάόά όçι άβόιθι ιΎού άδέειραέέΐδ όγίάάόçδ όθι FreeBSD όγόόçιά όάδ. Οί δñβθι άñ÷άβι άβίάέ όι /etc/gettytab, όι ιθιβι δάñέΎ÷άέ δέçñιθιñβάδ ñγέιέόçδ άέά όιι άάβιιίά /usr/libexec/getty Οί άάγδάñι άñ÷άβι άβίάέ όι /etc/ttys όι ιθιβι δάñέΎ÷άέ δέçñιθιñβάδ δθιό άίϰιόδθιεγί όόçι /sbin/init όά δθιέδ όόόέάσΎδ tty έά δñΎδάέ ίά άέδάέιγίόάέ έάάñάάόβδ getty. ΟΎέιθ, ιθιñάβδά ίά άΰέάδά άίόιέΎδ άñ÷έέιθιβçόçδ όçδ έγñάδ όθι script /etc/rc.d/serial.

Οδΰñ÷ιθι άγί “ό÷ιέΎδ” ϰιό άοιθΰ όç ÷ ñΐόç modems άέά άβόιθι όά Ύιά όγόόçιά UNIX. Ç δñβç, δñιθέιΰ ίά ñδέιβæάέ όά modems έάέ όά όδóδβιάόά ιά όΎθιέι δñϰι, βόδά ΰό÷άδά ιά δέ όά÷γόçδά όθιΎΎόάέ ι άδñάέñδθιΎιθδ ÷ ñΐόόçδ, ç όιθέέΐ όγίάάόçδ όθιέιραέόδΐ — modem ιΎού όιθ RS-232C ίά Ύ÷άέ δΰιόά όçι βάέά έέάέϰιΎιç όά÷γόçδά. Οί ϰδάέιθδ ιέάδ όΎθιέάδ ñγέιέόçδ άβίάέ ϰέέ ι άδñάέñδθιΎιθδ ÷ ñΐόόçδ άέΎδάέ δΰιόά ΰιάόά όçι δñιθñιθΐ άέόϰι. Οί ιάέιγέδçι, άβίάέ ϰέέ όι όγόόçιά άάι άίϰιñβæάέ όçι δñάñιάόέέΐ όά÷γόçδά όγίάάόçδ όιθ ÷ ñΐόόç, έάέ Ύδóέ δñιñΎιιάόά δέΐñιθδ ιέϰιçδ ϰδϰδ όι **Emacs**, άάι άίϰιñβæιθι δϰδ ίά ñδέιβθιθι όçι όά÷γόçδά άίάιΎϰδ όçδ ιέϰιçδ όιθδ βόδά ίά άίόέιάδϰθβθιθι έάέγδάñά δέδ άñάΎδ όθιΎΎόάέ.

Ç ΰέέç ό÷ιέΐ ñδέιβæάέ όç άέάδάδΐ RS-232 όιθ modem ίά άέέΰæάέ όά÷γόçδά, βόδά ίά άέιθιεδάβ όçι όά÷γόçδά όγίάάόçδ όιθ άδñάέñδθιΎιθδ ÷ ñΐόόç. Άέά δάñΎάάέάι, όθιΎΎόάέδ όγθιθ V.32bis (14.4 Kbps) όθι modem, ιθιñάβ ίά

οϊ εΰνιόϊ ίά ίάοάάΰεέάε όçí όά÷ύόçóá όύίάάόçò όοϊ RS-232 όά 19.2 Kbps, άίþ όοίάΰόάέò όά÷ύόçóáò 2400 bps εά ίάοάάΰεεϊόϊ άίòβόòιε÷ά όçí όά÷ύόçóá όçò áεάòáòþò όά 2400 bps. Άðáεάþ ç getty ááί άίάάññβæάέ ίά εΰðιεϊ όññðí όçí όά÷ύόçóá όύίάάόçò ðιò άίάóΎñάέ οϊ modem, άβίάέ όçí ðñþòç ðñιòñιðþ login: όόçí άñ÷έέΰ ñòεϊέοϊΎίç όά÷ύόçóá, έάέ άίάòΰæάέ όιòð ÷άñάέòþñάò ðιò έάίάΰίáέ ùð áðΰίόçóç. Άί ί ÷ñþóçò ááέ όέιòðβæάέ, έάññáβóάέ úóέ άñññβæάέ úóέ ðñΎðáέ ίά ðέΎóáέ οϊ **Enter** ιΎ÷ñέ ίά ðΰñάέ ίεά ðñιòñιðþ ðιò ίðñάβ ίά άίάάññβóάέ. Άί ίέ ñòεϊñβ ááάñΎñί ñáί όáέñέΰæιόϊ, ç getty άέΎðáέ ίòέáþðιòá άñΰóáέ ί ÷ñþóçò ùð “όέιòðβæάέ”, έάέ Ύóóέ άιέέΰæάέ όçí άðñίáίç όά÷ύόçóá έάέ óðΎέίáέ ίáίΰ όçí ðñιòñιðþ login:. Ç áέάάέέάόβά ίðñάβ ίά άðáίέçòέáβ úóάò οññΎð ÷ñάέΰæáòάέ, áέέΰ óðιþèùð ÷ñάέΰæιόάέ ίññί ίεά-άοι ðñιόðΰεάέάð ιΎ÷ñέ ί ÷ñþóçò ίά εΰááέ έáñίέέþ ðñιòñιðþ. ðñιόáíþð áðòþ ç áέιέιòέβá áέóúñιò ááί άβίάέ óúοι έάέáñþ úðùð ç ðñιçáñγίáίç ιΎέιñιð “έέáέáñιΎίçò όά÷ύόçóáð”, áέέΰ εΰðιεϊò ÷ñþóçò ðιò άñβóέáòάέ όά áñάñþ ÷άιçèðò όά÷ύόçóáð, ιΰεεϊ έά εΰááέ έáέγòáñç άðñέñέóç όά áòáñιñáΎð ðéþñιòð ίεñίçò.

Όά áðòþ όçí άñιòçóá έά ðñιòðáέþóιòíá ίά óáð áþóιòíá ðεçñιòñιñβáð έάέ áέá όιòð άγί όγðιòð ñòεϊβóáùι, áέέΰ έάññιγίá έάέγòáñι όι άβáò όύίάάόçò úðιò ç όά÷ύόçóá ððιεϊάέóòþ — modem áέιέιòέáβ όçí όά÷ύόçóá όçò όύίάάόçò.

26.4.4.1 /etc/gettytab

Όι /etc/gettytab άβίάέ Ύίá άñ÷áβι όýðιò termcap(5) ίά ðεçñιòñιñβáð ñýεϊέóçò áέá όçí getty(8). ðáñáέáεϊγίá ááβóá όç óáέβáá manual gettytab(5) áέá ðέι ðéþñáέð ðεçñιòñιñβáð ó÷áðέέΰ ίά όç ίññòþ ðιò άñ÷áβι έάέ όçí έβóóá ίá όέð áóίáòñιòçáðò όιò.

26.4.4.1.1 Νýεϊέóç áέá ΈέáέáñιΎίç Όá÷ύόçóá

Άί ðññέáέóáέ ίά έέáέáþóáðά όçí άðέέεϊνίβá όιò modem óáð όá ίεά óóáέáñέιΎίç όά÷ύόçóá, έáòΰ ðΰóá ðέέáñιòçóá ááί έá ÷ñáέáóóáβ ίá εΰίáðά áέέááΎð όοϊ /etc/gettytab.

26.4.4.1.2 Νýεϊέóç áέá ίáóááέçòþ Όá÷ύόçóá

έá ÷ñáέáóóáβ ίá ðñιòέΎóáðά ίεά έáóá÷þñέóç óοι /etc/gettytab áέá ίá áþóáðά ðεçñιòñιñβáð όόçí getty ó÷áðέέΰ ίá όέð όá÷ύόçóáð ðιò άðέέóιáβóá ίá ÷ñóέιñðιεþóáðά óοι modem óáð. Άί Ύ÷áðά Ύίá modem 2400 bps, ίðñάβóá ðέέáñιí ίá ÷ñóέιñðιεþóáðά όçí έáóá÷þñέóç D2400.

```
#
# Fast dialup terminals, 2400/1200/300 rotary (can start either way)
#
D2400|d2400|Fast-Dial-2400:\
        :nx=D1200:tc=2400-baud:
3|D1200|Fast-Dial-1200:\
        :nx=D300:tc=1200-baud:
5|D300|Fast-Dial-300:\
        :nx=D2400:tc=300-baud:
```

Άί Ύ÷áðά modem ðççέúðáñçò όá÷ύόçóáð, ðέέáñιí ίá ÷ñáέáóóáβ ίá ðñιòέΎóáðά ίεά έáóá÷þñέóç óοι /etc/gettytab. ðáñáέΰòù óáβíáóáέ ίεά έáóá÷þñέóç ðιò ίðñάβ ίá ÷ñóέιñðιεçέáβ áέá modem 14.4 Kbps ίá ιΎáέóç όá÷ύόçóá óáέñéáέþð έýñáð 19.2 Kbps:

```
#
# Additions for a V.32bis Modem
#
um|V300|High Speed Modem at 300,8-bit:\
        :nx=V19200:tc=std.300:
```

```
un|V1200|High Speed Modem at 1200,8-bit:\
:nx=V300:tc=std.1200:
uo|V2400|High Speed Modem at 2400,8-bit:\
:nx=V1200:tc=std.2400:
up|V9600|High Speed Modem at 9600,8-bit:\
:nx=V2400:tc=std.9600:
uq|V19200|High Speed Modem at 19200,8-bit:\
:nx=V9600:tc=std.19200:
```

Άδου έά Ύ÷άέ ùδ άδιθΎεάοιά οοίαΎόάεδ 8bit ÷ùñβδ εοίθειβά.

Όι δάνάδΎιϋ δάνΎάέαιά, ίάέειΎ οι ñειϋ άδέειέιϋβδ οόά 19.2 Kbps (άέά ίεά ούίαόç V.32bis), έάέ Ύδάέόά äíεειΎεάέ έδέέέέΎ οόά 9600 bps (άέά V.32), 2400 bps, 1200 bps, 300 bps, έάέ δβού οόά 19.2 Kbps. ΆδδP ç έδέέέέP άίάέέάP ñειϋ άδέδδ÷Ύίάόάέ ίά όçί έέάίϋόçδά nx= (“next table”). ÊÛεά ίεά άδϋ δέδ άñáιΎδ ÷ñçοέιθίέάβ ίεά έάόά÷ñέόç tc= (“table continuation”) άέά ίά άñάέ δέδ δδϋέιέδδδ “δδθίθίέçίΎίάδ” ñειβόάέδ άέά έÛθίέί οόάέέηέίΎί ñειϋ ίάδΎάιόçδ άάñΎίϋί.

Άί Ύ÷άδά modem 28.8 Kbps P/έάέ εΎέάδά ίά άδϋάέçδάβδά άδϋ όçί οοιδβάόç άϋϋδ modem 14.4 Kbps, έά δñΎδάέ ίά ÷ñçοέιθίέPδάδά ñειϋ άδέειέιϋβδ ίάάέϋόάñί άδϋ 19.2 Kbps. ΔάñάέÛδϋ οάβίάόάέ Ύίά δάνΎάέαιά ίεά έάόά÷ñέόçδ οόι gettytab θίθ ίάέειΎάέ άδϋ όά 57.6 Kbps:

```
#
# Additions for a V.32bis or V.34 Modem
# Starting at 57.6 Kbps
#
vm|VH300|Very High Speed Modem at 300,8-bit:\
:nx=VH57600:tc=std.300:
vn|VH1200|Very High Speed Modem at 1200,8-bit:\
:nx=VH300:tc=std.1200:
vo|VH2400|Very High Speed Modem at 2400,8-bit:\
:nx=VH1200:tc=std.2400:
vp|VH9600|Very High Speed Modem at 9600,8-bit:\
:nx=VH2400:tc=std.9600:
vq|VH57600|Very High Speed Modem at 57600,8-bit:\
:nx=VH9600:tc=std.57600:
```

Άί Ύ÷άδά άñáϋ άδάíñάάόδP P ίάάÛέι οίñδβί, έάέ οι ούόόçίά οάδ άáί άέάέΎδάέ οάέηέέΎδ εϋñάδ θίθ ίά άάόβæίθάέ οοί 16550Á, βούδ εÛάάδά εÛεç “sio” “silo” οόά 57.6 Kbps.

26.4.4.2 /etc/ttys

÷ιθία Pæç έάέϋάέ όç ñϋέιέόç οίθ άñ÷άβίθ /etc/ttys οόι ΔάνΎάέαιά 26-1. Ç ñϋέιέόç άέά modems άβίάέ δάνϋιίέά, άέεÛ δñΎδάέ ίά άβίθία άέάοίñάδέέϋ ùñέοία όόçί getty έάέ ίά έάέιñβίθία άέάοίñάδέέϋ όϋθί δάñίάδέέϋ. Ç άάίέέP ññδP οϋοί άέά έέάέäϋίΎίç ϋοί έάέ άέά ίάδάάέçδP όά÷ϋόçδά άβίάέ ç δάñάέÛδϋ:

```
ttyd0 "/usr/libexec/getty xxx" dialup on
```

Όι δñθιθί δάάβι όόçί δάνάδΎιϋ άñáιP άβίάέ οι άέάέέϋ άñ÷άβι οόοέάδPδ άέά άδδP όçί έάόά÷ñέόç — οι ttyd0 άίόέόοίέ÷άβ οοί άñ÷άβι /dev/ttyd0 οι ίθίβι έάέ έά δάñάέίέιθδάβ ç getty. Όι άáϋόάñί δάάβι, "/usr/libexec/getty xxx" (οί xxx έά Ύ÷άέ όçί άñ÷έέP οέιP έέάίϋόçδάδ οίθ gettytab), άβίάέ ç έέάñάάόβά θίθ έά άέδάέΎόάέ ç init όόç οδóέάδP. Όι οñβθί δάάβι, dialup, άβίάέ ï δñíáδέέάñίϋδ όϋθίθ δάñίάδέέϋ. Ç

óÝóáñòç ðáñÙἰáðñἰð, on, äâ ÷ íáé óðçí init üðé ç ãñáñἰᐅ áβἰάé óá éáéóἰõñáééᐅ éáðÙóóáóç. Ìðñáβ ἰá ððÙñ ÷ áé éáé ἰéá ðÝἰððç ðáñÙἰáðñἰð, ç secure, áεéÜ éá ðñÝðáé ἰá ÷ ñçóéἰἰðἰéáβóáé ἰüñἰ áéá óáñἰáðééÜ óðá ἰðἰβá ç ððóééᐅ ðñüóááóç áβἰάé áóóáéᐅð (üðùð áβἰάé ç éἰíóüéá ðἰð óðóðᐅἰáðἰð).

Ï ðñἰáðééáñἰÝἰð ðýðἰð ðáñἰáðééἰý (dialup óðἰ ðáñáðÙἰú ðáñÙááéáἰá) ἰðñáβ ἰá áεéÜἰáé áíÙεἰáá ἰá ðéð ðñἰóéἰᐅóáéð óáð. Õἰ dialup áβἰάé ἰ ðáñáñἰóéáéüð ðýðἰð ðáñἰáðééἰý áéá áðéεἰáééÝð ãñáñἰÝð. Ìé ÷ ñᐅóðáð ἰðñἰýἰÝ Ḳóóé ἰá ðñἰóáñἰüáεἰðἰ óá scripts óýἰááóçð ðἰðð ᐅóðá ἰá áἰááñἰñβáεἰðἰ ðἰ dialup éáé ἰá ñðεἰβáεἰðἰ áððüἰáðá ðἰð ðýðἰ ðáñἰáðééἰý. Ùóðúóἰ, áβἰάé ἰÙεεἰἰ áðéἰεüðáñἰ ἰá éáéἰñβóáðá ðἰ vt102 ùð ðἰ ðñἰáðééáñἰÝἰð ðýðἰ ðáñἰáðééἰý, éáεᐅð ἰé ÷ ñᐅóðáð ÷ ñçóéἰἰðἰéἰý óðἰᐅèð ãñἰἰβúóç VT102 óðá áðñáéñðóἰÝἰá ðἰðð óðóðᐅἰáðá.

Áóἰý éÜἰáðá ðéð áεéááÝð óðἰ /etc/ttys, ἰðñáβðá ἰá óðáβéáðá óðç äéáñááóβá init Ýἰá óᐅἰá HUP áéá ἰá ἰáἰááéááÜóáé ðἰ ãñ ÷ áβἰ. Ìðñáβðá ἰá ÷ ñçóéἰἰðἰéᐅᐅáðá ðçἰ ðáñáéÜðð áἰóἰεᐅ ἰá áððü ðἰ óéἰðü:

```
# kill -HUP 1
```

Áἰ áððᐅ áβἰάé ç ðñðçð ἰñÜ ðἰð ñðεἰβáéáðá ðἰ óýóóçἰá óáð, βóùð éÝéáðá ἰá ðáñεἰÝἰáðá ἰÝ ÷ ñé ἰá ἰεἰéεçñᐅóáðá ðεᐅñðð ðç óýἰááóç éáé ñýεἰóç ðἰð modem óáð ðñéἰ óðáβéáðá óᐅἰá óðçí init.

26.4.4.2.1 Ñýεἰóç áéá ÉéáéáñἰÝἰç Óá ÷ ýðçðá

Áéá éáéóἰõñáβá óá ééáéáñἰÝἰç óá ÷ ýðçðá, éá ðñÝðáé ç éáðá ÷ ᐅñéóç óáð óðἰ ttys ἰá ðáñÝ ÷ áé óðçἰ getty ἰéá éáðá ÷ ᐅñéóç óðáéáñᐅð óá ÷ ýðçðáð. Áéá Ýἰá modem ἰá ðá ÷ ýðçðá éýñáð ééáéáñἰÝἰç óðá 19.2 Kbps, ç éáðá ÷ ᐅñéóç ttys éá ἰἰéÜáé ἰá ðçἰ ðáñáéÜðð:

```
ttyd0 "/usr/libexec/getty std.19200" dialup on
```

Áἰ ðἰ modem óáð áβἰάé ééáéáñἰÝἰç óá äéáóἰñáðééü ñðεἰἰ äááñÝἰú, áἰóééáðáóðᐅóðá ἰá ðçἰ éáðÜéεççç ðεἰᐅ ðἰ std.19200 óðçἰ éáðá ÷ ᐅñéóç std.speed. Ááááéüèáβðá üðé ÷ ñçóéἰἰðἰéáβðá Ýἰá Ýáéõñἰ ðýðἰ, üðùð ἰñβáéðáé óðἰ /etc/gettytab.

26.4.4.2.2 Ñýεἰóç áéá Ìáðááéçðᐅ Óá ÷ ýðçðá

Óá ἰéá ðÝἰðἰéá ñýεἰóç, ç éáðá ÷ ᐅñéóç óáð áéá ðἰ ttys éá ðñÝðáé ἰá áἰáðÝñáðáé óðçἰ ãñ ÷ ééᐅ “auto-baud” (sic) éáðá ÷ ᐅñéóç ðἰð /etc/gettytab. Áéá ðáñÙááéáἰá, áἰ ðñἰóéÝóáðá ðçἰ ðáñáðÙἰú óðἰéóðᐅἰáἰç éáðá ÷ ᐅñéóç áéá modem ἰá Ìáðááéçðᐅ óá ÷ ýðçðáð óáéñéáéᐅð, éáé ἰá ãñ ÷ ééᐅ óá ÷ ýðçðá ðá 19.2 Kbps (ðçἰ éáðá ÷ ᐅñéóç gettytab ðἰð ðáñéÝ ÷ áé ùð óçἰáβἰ áééβἰçðçð ðἰ v19200), ç éáðá ÷ ᐅñéóç óáð óðἰ ttys éá ἰἰéÜáé ἰá ðçἰ ðáñáéÜðð:

```
ttyd0 "/usr/libexec/getty V19200" dialup on
```

26.4.4.3 /etc/rc.d/serial

Óá modems ððçᐅð óá ÷ ýðçðáð, üðùð óá V.32, V.32bis éáé V.34, áðáéóἰýἰ Ýéáá ÷ ἰ ñἰᐅð ἰÝóú ðéééἰý (RTS/CTS). Ìðñáβðá ἰá ðñἰóéÝóáðá áἰóἰεÝð stty óðἰ /etc/rc.d/serial áéá ἰá éÝóáðá óðἰ ððñᐅἰá ðἰð FreeBSD ðçἰ éáðÜéεççç ðáñÙἰáðñἰ Ýéáá ÷ ἰð ñἰᐅð ἰÝóú ðéééἰý ðüἰ éðñᐅἰ modem.

Áéá ðáñÙááéáἰá, áéá ἰá éÝóáðá ðçἰ áðééἰáᐅ termios óðçἰ ðεἰᐅ crtscts óðéð óðóéáðÝð ãñ ÷ ééἰðἰβçðçð ðçð äáýóáñçð óáéñéáéᐅð éýñáð (COM2) áéá áðééἰáééÝð éεᐅóáéð áéóüáἰð éáé áἰüáἰð, éá ðñÝðáé ἰá ðñἰóéÝóáðá ðéð ðáñáéÜðð ãñáñἰÝð óðἰ ãñ ÷ áβἰ /etc/rc.d/serial:

```
# Serial port initial configuration
```

```
stty -f /dev/ttydl.init crtscts
stty -f /dev/cuadl.init crtscts
```

26.4.5 Ñõèìβóáéð ííβìçð

Áí Ý ÷ äðá Ýíá modem óðì ïðìβì ïðìñáβðá íá áðìèçêäýóáðá ðéð ðáñáíÝðñìðð ìúíéíá óççí ìç-ððçðéêP RAM ðìð äéäéÝðáé, éä ðñÝðáé íá ÷ ñçóéíðìéPóáðá Ýíá ðñúáñáíá ðáñíáðééíý (úðùð ðì **Telix** ìÝòù ðìð MS-DOS P ðìð tip óðì FreeBSD) äéá íá ñõèìβóáðá ðéð ðáñáíÝðñìðð. Óðìñáäéáβðá óðì modem ÷ ñçóéíðìéPíðáð ðçí βáéá áñ÷éêP ðá÷ýðçðá áðëéíéíúíβäð ìá áððP ðìð Ý ÷ äðá äçêPóáé ùð áñ÷éêP ðá÷ýðçðá óççí getty, éäé ñõèìβóðá ðéð ðáñáíÝðñìðð óççí ìíβìç ðìð þððá íá óäéñéÛæíðí ìá ðéð ðáñáéÛðù áðáéðPóáéð:

- Õì óβíá CD éä áβíáé áíáñáú ùðáí ðì modem áβíáé óðìáñÝíí
- Õì óβíá DTR éä áβíáé áíáñáú éäðÛ ðç éäéðìðñáβá. Áðáíáñáíðìβçð ðìð DTR ééáβíáé ðç áñáñìP éäé áðáíáéÝñáé ðì modem óççí áñ÷éêP ðìð éäðÛðóáç.
- Õì CTS éä ÷ ñçóéíðìéáβðáé äéá Ýéää÷ì ñìPð ìáðáäéäúíáíúí äááñÝíúí
- Ì Ýéää÷ì ñìPð XON/XOFF éä áβíáé áíáíáñáúð
- Õì RTS éä ÷ ñçóéíðìéáβðáé äéá Ýéää÷ì ñìPð èçðèÝíòúí äááñÝíúí
- ¹ð÷ç éäéðìðñáβá (Quiet mode, ÷ ùñβð áðìóðìéP èùäéêPí áðìðäéáðíÛðúí)
- Äáí éä áβíáðáé echo ðúí áíðìéPí

Éä ðñÝðáé íá äéááÛðáðá ðçí ðäèìçñβùç ðìð modem óáð äéá íá áñáβðá ðéð áíðìéÝð ðìð ðñÝðáé íá áðìóðáβéáðá. ððùð áðβçð ÷ ñáéáððáβ íá äééÛíáðá ðç èÝóç èÛðìéúí ñðèìéðéêPí äéäéíððPí (dip switches).

Äéá ðáñÛäééñíá, äéá íá ñõèìβóáðá ðéð ðáñáðÛíú ðáñáíÝðñìðð óá Ýíá áíùðáñééú modem U.S. Robotics® Sportster® 14,400, éä Ýðñáðá íá óðáβéáðá ðéð ðáñáéÛðù áíðìéÝð óðì modem:

```
ATZ
AT&C1&D2&H1&I0&R2&W
```

Ìðìñáβðá ìá ðçí áðéäéñβá íá ñõèìβóáðá éäé Ûééíðð ðáñáíÝðñìðð ðìð modem, ùðùð äéá ðì áí éä ÷ ñçóéíðìéáβðáé ðì ðñùðúéíéëí V.42bis P óðìðβáç MNP5.

Õì áíùðáñééú modem U.S. Robotics Sportster 14,400 äéäéÝðáé áðβçð éäé èÛðìéíðð ñðèìéðéêéíýð äéäéúððð ðìð ðñÝðáé íá ñõèìéðìýí. Äéá Ûééá modem, βòùð ìðìñáβðá íá ÷ ñçóéíðìéPóáðá áððÝð ðéð ñõèìβóáéð ùð áíáðìÛ:

- Äéäéúððçð 1: ¶íú èÝóç — ÊáííéêP äééðìðñáβá DTR
- Äéäéúððçð 2: N/A (Èùäééúð ÁðìðäéÝóíáðìð ùð Êáβíáíí/Èùäééúð ÁðìðäéÝóíáðìð ùð Áñééìúð)
- Äéäéúððçð 3: ¶íú èÝóç — × ùñβð Èùäééúð ÁðìðäéÝóíáðìð
- Äéäéúððçð 4: ÈÛðù èÝóç — × ùñβð echo éäé offline áíðìéÝðð
- Äéäéúððçð 5: ¶íú èÝóç — Áððúíáðç ÁðÛíðçç
- Äéäéúððçð 6: ¶íú èÝóç — ÕðóéíéíäéêP Áíβ÷íáðçç ÕÝñìðìð ÕPíáðìð
- Äéäéúððçð 7: ¶íú èÝóç — Õññðùçç ðñíáðééíáPí áðù NVRAM (ìç-ððçðéêP ìíβìç)
- Äéäéúððçð 8: N/A (íððñìð/Èíððùð Õññðìð Èäéðìðñáβáð)

Έα δνΎδασ ία άδáiñāñðieΠοάδδ Π ία άδñññΠοάδδ ðieò èúäééiyò άδιòääóieÙòùí óðie modem, äéá ίá άδιöyääðä ðññiäèΠiáoá ðieò ðieññiyí ίá äçieéieññäçeiyí áí ç getty áðu èÛeieò óðäβeäé ðññieññieΠ login: óðie modem áñ ðéðu äñβoéäðäé óä éáoÙóóáóç áíðieðñ. Óðçie ðññβððóóç áððΠ, ðie modem ðieññäβ ίá áíáðññÛääé íáfÛ ðçie áíðieðñ (echo) Π ίá óðäβeäé èÛðieie èúäeéú άδιòääÛóiaòieò. Αóðu ðieññäβ ίá Ύ ðäé ùð άδιòÛéäóia íeá íäñññ ðññieç éäé ðäæΠ óðñieéβä íäðaiý ðieò modem éäé ðçð getty.

26.4.5.1 Ñöèiβóäéò äéá ÈëäéäùíΎieç Óä ðýðçóá

Äéá éäéðieòñäβä óä èëäéäùíΎieç óä ðýðçóá, éä ðñäéáóðäβ ίá ñöèiβóäéò ðie modem ίá äéäðçñäβ óðäéññΠ óä ðýðçóá ððieññeéóð — modem, Ûó ðäóá íä ðçie óä ðýðçóá äðééieéíùíβäd ðçð äðééieééΠ ðýíääóçð. Óä Ύ íä áñùðäñeéú modem U.S. Robotics Sportster 14,400, íe áíðieÛ ðéóðÛ ðé èäéäéäèòie ðçie äðééieéíùíβä ððieññeéóð — modem óðçie βäéá óä ðýðçóá ðieò Ύäéíä ç èΠðç ðùie áíðieðñ:

```
ATZ
AT&B1&W
```

26.4.5.2 Ñöèiβóäéò äéá íäðääèçðΠ Óä ðýðçóá

Äéá éäéðieòñäβä óä íäðääèçðΠ óä ðýðçóá, éä ðñäéáóðäβ ίá ñöèiβóäéò ðie modem óáð íä ðñieóáññieäé ðçie óä ðýðçóá ðçð óäéñeäéðð èyñäð ðieò ðúðä ίá óäéñeÛäéé íä áððΠ ðçð äéóáñ ðññieçð èèΠðçð. Óä Ύ íä áñùðäñeéú modem U.S. Robotics Sportster 14,400, íe áíðieÛ ðéóðÛ ðé èäéäéäèòie ðçie óä ðýðçóá íäðäèñÛð äääñ Ύíùí íä äeüñèùóç éäéðñ ðieò modem óðçie óä ðýðçóá ðieò ðñçóeieðieðeçéä äéá ðçie áðieòieðñ ðùie áíðieðñ, äeèÛ éä äðéðñÛðieòie ðçie óä ðýðçóá ðçð óäéñeäéðð èyñäð ίá íäðääÛeëäðäé äéá óðieΎóäéð ðieò ääí Ύ ðieò äeüñèùóç éäéðñ:

```
ATZ
AT&B2&W
```

26.4.5.3 äää ðieò ðùie Ñöèiβóäéòie ðieò Modem

Óä ðñééóúðäñä modem ðççèðð óä ðýðçóáð, ðññ Ύ ðieò áíðieÛ ðéóðÛ íä ðéð ðieññäð ðieññäβä ίá ðññäèieieòeΠóäðä ðeð ðñÛ ðieòóäð ðññäíΎðñieò èäéðieòñäβäd ðieò ðie ðäééèÛ éáðáñieçðú ðññieðñ. Óðie áñùðäñeéú modem U.S. Robotics Sportster 14,400, ç áíðieðñ AT15 ääβ ðieäé ðeð ñöèiβóäéò ðieò äβiäé áðieçéääöieΎíäð óðç ie-ðçðçéèΠ RAM ðieò modem. Äéá ίá ääβðä ðeð ðññäñiäóééÛ ðññäíΎðñieò èäéðieòñäβäd ðieò modem (ùðùð áððÛ ðäçññäÛieieðäé áðu ðeð èÛóäéð ðùie ñöèieòðeéðñ äéäéieððñ ðieò), ðñçóeieðieðeçéä ðeð áíðieÛ ðéóðÛ ATZ éäé íäðÛ AT14.

Áí äéäèÛðäðä modem Ûeèçð áðäeñβäd, äéÛññðä ðeð ðäçññäð ðieò ðieò äéá ίá ääβðä ðùð ðieññäβä ίá äéÛññäðä íä óeäieòñeÛ ðeð ðññäíΎðñieò ñýieieçðð ðieò.

26.4.6 Áíðieíäðððeóç ðññiäèçieÙòùí

ðññäéÛðù éä äññäβä íäñeéèÛ äβiäóá ðieò ðieññäβä ίá äeieieieòeΠóäðä äéá ίá äéÛññäðä ðç èäéðieòñäβä ðieò modem óðie óýóðçia óáð.

26.4.6.1 ÄèÛä ðieò ðieò Óýóðçia óáð

ÓðieΎóðä ðie modem óðie FreeBSD óýóðçia óáð, äeééieΠóðä ðie, éäé áí ðie modem óáð äéäèÛðäé ðùðäéíÛ ðññäñäéð éáðÛóóáóçð, ðññäèieieòeΠóðä ðeð äéá ίá ääβðä áí áíññäieieäéβðäé ç Ύíäéieç DTR ùðái äieðáíβeäðäé ç ðññieññieð

login: όδçi εήιόυέά οίδ όόόδΠιάόιδ. Αί ç Υήάέίç αόδΠ άβήάέ άήάάΠ, όçιάβήάέ υέέ οί FreeBSD Υ÷άέ ήάέήΠόάέ ήά έάήάάόβά getty όδçi άίόβόόίέ÷ç εύνά άδέεήέιιίέβή έάέ άήάΥήάέ οί modem ήά άδάήδΠόάέ ήά έέβόç.

Αί άά ήήάήήίέάβδάέ ç Υήάέίç DTR, άέόΥέέάδά όοί όύόόçιά ήΥού όçδ εήιόυέάδ, έάέ άβόδά όçί άήόήΠ ps ax άέά ήά άάβδά ά ή οί FreeBSD δήιόδάέάβ ήά έέόάέΥόάέ έάήάάόβά getty όδç όούδΠ εύνά. ΑήΥήάάά όέέδ έάήάάόβδ, έά άάβδά άήάήΥδ υδύδ όέδ δάήάέΥδ:

```
114 ?? I      0:00.10 /usr/libexec/getty V19200 ttyd0
115 ?? I      0:00.10 /usr/libexec/getty V19200 ttyd1
```

Αή άάβδά έΥδέ έάάήάόέέυ, υδύδ οί δάήάέΥδ:

```
114 d0 I      0:00.10 /usr/libexec/getty V19200 ttyd0
```

έάέ οί modem άά Υ÷άέ άδάήδΠόάέ άέυήά έάήβά έέβόç, όçιάβήάέ υέέ ç getty Υ÷άέ ήέήέçήβόάέ οί Υήέήά όçδ όάέηέάέδ εύνάδ. Αόδύ δέέήήί όçιάβήάέ υέέ όδΥή÷άέ δήύάέçιά ήά όçί έάέύάβύόç, Π υέέ οί modem άά άβήάέ όούδΥ ήέέέόήΥή, έάέβδ ç getty άά έά δήΥδάέ ήά ήδήάβ ήά άήβήάέ όç εύνά δήέή ήήάήήίέçέάβ οί όΠιά CD (carrier detect, άήβ÷ήάόçδ όΥήήίόδ) άδύ οί modem.

Αή άά άέΥδάδά έΥδίέάδ έάήάάόβδ getty ήά δάήέΥήόή ήά άήβήήόή όçί άδέέδìçδΠ εύνά ttydN, άέΥήάδά ήήΥδ όέδ έάδά÷ύήβόάέδ όάδ όοή /etc/ttys άέά όδ÷ύή έΥέç. ΑέΥήάδά άδβόçδ οί άή÷άβή έάδάήάήάδδ /var/log/messages άέά ήά άάβδά ά όδΥή÷ήόή έΥδίέά ήçήήάάά άδύ όçί init Π όçί getty ό÷άδέέΥ ήά όά δήήέΠιάόά. Αή όδΥή÷ήόή ήçήήάάά, άέΥήάδά ήήΥδ όά άή÷άβά ήέήβόάύ /etc/ttys έάέ /etc/gettytab, υδύδ έάέ όά έάέέέΥ άή÷άβά όδóέάδπ /dev/ttydN άέά δέέήΥ έΥέç, άέέέδάβδ έάδά÷ύήβόάέδ, Π ήç-ýδάήç όύή έάέέέπ ήή÷άβύ ήόóέάδπ.

26.4.6.2 ΔήιόδάέΠόά ήά ΆέόάέΥόάά όύήάόç Άέóüüö

ΆήέέΥδóά ήά άέόΥέέάδά όοή όύόόçιά όάδ ήΥού άδήάέήόήΥήçδ όύήάάόçδ. Αάάάέύέάβδά υέέ ÷ήçóέήήέάβδά 8 bits, 1 stop bit έάέ άδέέήέήήβá ÷ύήδ έόήέέήβá όοή άδήάέήόήΥή όύόόçιά. Αή άά έΥάάάδά Υήάάά όçί δήιόδΠ άέóüüö, Π άή έάήάΥήάάά όέήδβάέά, άήέέΥδóά ήά δέΥάέάδά **Enter** ήά ήέέή δάήβδήό ήά óñΥδ οί άάóáήέέάδδ. Αή άέυήά άά ήάήάΥήάάά όçί δήιόδΠ login:, άήέέΥδóά ήάδΥ άδύ έβάή ήά όάβέάδά Υήά BREAK. Αή έΥήάάά έέβόç άδύ Υήά modem όççέΠδ όά÷ýçδóάδ, άήέέΥδóά ήήΥδ, άóήý έέάέπóάδά όçί όά÷ýçδóά άδέέήέήήβδ όδήέήέóδΠ — modem άδύ οί ήδìβή έάέάβδά (ήΥού δ.÷. όçδ AT&B1 όά Υήά U.S. Robotics Sportster modem).

Αή άά ήδìβήάά άέυήά ήά έΥάάάδά δήιόδΠ login:, άέΥήάδά ήήΥδ έάέ ήήΥδ οί άή÷άβή /etc/gettytab.

- Οί υήήά όçδ άή÷έέδ έέάήüççόάδ δήέ έάέήβάέάóάέ όοή άή÷άβή /etc/ttys άέά όç άήάήΠ δήΥδάέ ήά όάέήέΥάέ ήά όί υήήά όçδ έέάήüççόάδ όοή /etc/gettytab
- ΈΥέά έάδά÷ήέόç nx= όάέήέΥάέ ήά όί υήήά ήάδ άήόβόόίέ÷ç έέάήüççόάδ όοή gettytab
- ΈΥέά έάδά÷ήέόç tc= όάέήέΥάέ ήά όί υήήά ήάδ άήόβόόίέ÷ç έέάήüççόάδ όοή gettytab

Αή έΥήάάά έέβόç άέέΥδ οί modem όοή FreeBSD όύόόçιά άά άδάήδΥάέ, άάάάέύέάβδά υέέ οί modem άβήάέ ήέέέόήΥή ήά άδάήδΥάέ όçί όççάóήέέΠ άήάήΠ υόάή ήήάήήίέάβδάέ οί όΠιά DTR. Αή οί modem όάβήάάέ ήά άβήάέ ήέέέόήΥή όούδΥ, άδάέççáyóά υέέ ç άήάήΠ DTR άβήάέ άήάάΠ άέΥά÷ήήάδ όέδ όüóέήΥδ ήήάβήάέδ οίδ modem (άή όδΥή÷ήόή).

Αή Υ÷άδά άέΥήάέά όά δΥήόά δήέΥδ óñΥδ, έάέ άέυήά άά όάβήάάέ ήά άήβóέάδά όç έýόç, έΥήάά Υήά έέέέέήά έάέ δήιόδΠόά ήήΥδ άήάύάά. Αή άέυήά άά έάέóήήάβ, βóδ άβήάέ έάέΠ έάΥά ήά όάβέάδά Υήά ήΠήόά όççί çέάέóήέέΠ έβóάά άήέέπ ήñδΠόάύ οίδ FreeBSD (<http://lists.FreeBSD.org/mailman/listinfo/freebsd-questions>) δάήέήΥδóήάδ όί δήύάέçιά όάδ έάέ οί modem όάδ, έάέ ήέ έάέήβ Υήέñδήέ δήέ δάήάέήέóέήý όçί έβóάά έά δήιόδΠόήόή ήά όάδ άìçέΠόή.

26.5 Óðçñáóßá Åðéÿÿäêÿ Óÿÿääóçò

ÐanáéÛòù èá àñáßòá êÛðÿéäò óðÿÿÿÿÿò áéá íá ðÿñÿÿóáòá íá óðÿÿÿÿÿòá ðÿÿ ððÿÿÿäéóðÿ óáò ðÿÿòù modem óá êÛðÿÿÿÿÿ Ûëÿÿ ððÿÿÿäéóðÿ. Ìá ðÿÿ ðñùðÿ áòòù, ðÿñÿÿáßòá íá àçÿÿÿÿÿÿÿóáòá óÿÿÿääóç ðáñÿÿäééÿÿ ðñÿò ÿÿíá áðñÿÿêñòòÿÿÿ ððÿÿÿäéóðÿ.

Ç ððçñáóßá áòðÿ ÷ ñçóéÿÿÿÿÿé áðßòçò áéá íá óðÿÿÿäéáßòá óá ðéá BBS.

Áòòù ðÿ áßáÿò óÿÿÿääóçò ðÿñÿÿáß íá óáÿÿáß áÿáéñáòééÛ ÷ ñÿóéÿÿ áéá íá ðÛñáòá êÛðÿÿÿÿÿ ãñ÷áßÿ áòù ðÿ Internet áÿ ÿ ÷ áòá ðñùáéçÿá óÿÿÿääóçò ðÿÿòù PPP. Áÿ êÿÿéáòá íá ðÛñáòá êÛòé ðÿÿòù FTP éáé ááÿ ðÿñÿÿáßòá íá óðÿÿäéáßòá ðÿÿòù PPP, óðÿÿäéáßòá ðÿÿòù ðáñÿÿäééÿÿ óá ÿÿíá Ûëÿÿÿ ððÿÿÿäéóðÿ, éáé éáòááÛòòá óá áòòù ðÿ ãñ÷áßÿ ðÿÿòù FTP. Ðáéóá, ÷ ñçóéÿÿðÿÿóáòá ðÿ ðñùòùéÿÿÿÿ zmodem áéá íá ðÿ ðáòáòÿÿñáòá óðÿÿ ððÿÿÿäéóðÿ óáò.

26.5.1 Õÿ òÿðÿò Hayes Modem ÿÿò ááÿ Õðÿòðçñÿæáòáé, Õé ððÿñÿ íá ÊÛÿù;

Óðçÿ ðñáñÿäééúòçòá, ç óáèßáá manual òçò ðÿÿ ááÿ áßÿáé áÿçÿÿáñùÿÿÿ. ÕðÛñ÷áé ðáç éáòÛëëçÿÿ ááÿéúù ðñùáñáÿÿ éêÿóçò áéá modems òçò Hayes. Áðèÿò ÷ ñçóéÿÿðÿÿóáòá òçÿ éáòá÷ÿñéóç at=hayes óðÿ ãñ÷áßÿ /etc/remote.

Õÿ ðñùáñáÿÿÿ ÿäÿáçòçò Hayes ááÿ áßÿáé áñéáòÛ ÿÿòðÿÿ ðóòá íá áÿáñÿÿñÿæáé êÛðÿÿÿá áòù ðá ðñÿ÷áñçÿÿÿ ÷ áñáéðçñéóðéÛ ðùÿ ðáßòáñùÿ modems. Ìðÿñáß íá ððáñáòòðáß áòù ðçÿÿÿáòá ùðùò óá BUSY, NO DIALTONE, ð CONNECT 115200. Éá ðñÿðáé íá áðáÿáñáÿðÿÿóáòá áòòÛ ðá ðçÿÿÿáòá ùðáÿ ÷ ñçóéÿÿðÿÿáßòáé òçÿÿ ðÿÿ (óðÿÿÿÿóáò òçÿÿ áÿòÿèÿP ATX0&W).

Áðßòçò, ðÿ ðÿÿéóðÿ ÷ ñÿÿééú äéÛòçÿá ðÿ ððÿÿÿ ðáñéÿÿÿáé ç ðÿÿ áßÿáé 60 ááòòáñùéáðòá. Õÿ modem óáò èá ðñÿðáé íá ÿ ÷ áé ðéñùòáñÿ ÷ ñÿÿéú ðáñéèÿñéÿ, áéèèð ç ðÿÿ éá ðñÿæáé ùòé ððÛñ÷áé ðñùáéçÿá áðéÿÿÿÿÿÿ. ÁÿÿéÿÛòáò òçÿÿ áÿòÿèÿP ATS7=45&W.

26.5.2 Ðùò Õðÿòßéáòáé ¼òé éá Óòáßèù Áòòÿò óéò ÁÏ Áÿòÿÿÿ;

Àçÿÿÿÿÿÿóáòá áòòù ðÿò ðÿÿ ðÿÿáòáé “áðáòéáßáò” éáòá÷ÿñéóç óðÿ ãñ÷áßÿ /etc/remote. Áéá ðáñÛáäéáÿ, áÿ ðÿ modem óáò áßÿáé óðÿÿáÿÿÿ ðçÿÿ ðñÿòç óáéñééèÿ èÿñá, /dev/cuad0, ðñÿòéÿÿòá òçÿÿ áéúÿÿòèç áñáÿÿP:

```
cuad0:dv=/dev/cuad0:br#19200:pa=none
```

Óðçÿ ééáÿÿòçòá br, ÷ ñçóéÿÿðÿÿóáòá ðÿÿ ðççèúòáñÿ ñðèùÿ bps ðÿò ððÿòðçñÿæáé ðÿ modem óáò. Ðáéóá, ðèçéòñÿÿÿÿóáòá ðÿÿ cuad0 éáé èá óðÿÿäéáßòá ðá ðÿ modem óáò

¹ ÷ ñçóéÿÿðÿÿóáòá òçÿÿ cu ùò root, áßÿÿÿóáò òçÿÿ áéúÿÿòèç áÿòÿèÿP:

```
# cu -lline -sspeed
```

Õÿ line áßÿáé ç óáéñééèÿ èÿñá (ð.÷. /dev/cuad0) éáé ðÿ speed áßÿáé ç óá÷ÿòçòá (ð.÷. 57600). ¼òáÿ óáéèèðóáòá ðá óéò áÿòÿÿÿ ÁÏ, áñÛòðá ~. áéá íá ðáñÿäéóðáòá òç óÿÿÿääóç.

26.5.3 Õÿ Óÿÿÿÿÿ @ òçò Ééáÿùòçòáò ðñ Ááÿ Êééòÿñáß!

Õÿ óÿÿÿÿÿ @ òçò ééáÿùòçòáò òçèáòùÿéÿÿ áñéÿÿÿÿÿ (pn, phone number) ðáçááß òçÿÿ ðÿÿ íá áéááÛòáé ðÿ ãñ÷áßÿ /etc/phones áéá ÿÿíá òçèáòùÿéÿÿ áñéèù. ÁéèÛ ðÿ óÿÿÿÿÿ @ áßÿáé áðßòçò ÿÿáò áéáéúò ÷ áñáéòÿñáò óá ãñ÷áßÿ ééáñÿòÿòùÿ ùðùò ðÿ /etc/remote. Éá ðñÿðáé íá ÷ ñçóéÿÿðÿÿóáòá òçÿÿ áÿÛðÿÿç êÛèáòÿ áéá íá àçèÿóáòá ùòé ááÿ áðééòÿáßòá íá ÿ ÷ áé áðßáñáòç áéáéÿÿÿ ÷ áñáéòÿñá:

pn=\@

26.5.4 Ðùð Ìðĩñþ íá Êäéÿóù ÿá Ôçëäöüíééü Áñéèü Áðü ôçí Ññáìþ Áíðĩëþí;

ÁÛëðá ìéá “ääíééþ” éáðá÷þñéóç óðí áñ÷áβí /etc/remote. Áéá ðáñÛäáéáíá:

```
tip115200|Dial any phone number at 115200 bps:\
      :dv=/dev/cuad0:br#115200:at=hayes:pa=none:du:
tip57600|Dial any phone number at 57600 bps:\
      :dv=/dev/cuad0:br#57600:at=hayes:pa=none:du:
```

ðäéðá ìðĩñáβðá íá äβíðáðá áíðĩëÿð üðùð:

```
# tip -115200 5551234
```

Áí ðñĩðéíÛðá ôçí cu áíðá ãéá ôçí tip, ÷ñçóéíüðĩéþðáðá ìéá äääíééþ éáðá÷þñéóç ãéá ôçí cu:

```
cu115200|Use cu to dial any number at 115200bps:\
      :dv=/dev/cuad1:br#57600:at=hayes:pa=none:du:
```

éáé ðéçéðñĩëĩäþðáðá:

```
# cu 5551234 -s 115200
```

26.5.5 Ðñÿðáé íá Ðéçéðñĩëĩäþ ðí Ñðéüü bps ÊÛëá ÖĩñÛ ðĩð ðí ÊÛíü Áóðü;

Éá ðñÿðáé íá ðñĩðéÿóáðá ìéá éáðá÷þñéóç tip1200 þ cu1200, áéëÛ ìðĩñáβðá íá áÛëðáðá ôçí äééþ óáð äðééðĩçðþ ðéþ óðçí ééáíüðçðá br. Ç áíðĩëþ tip éáññáβ üðé ðá 1200 bps äβíáé ìéá éáéþ ðñĩäðéëĩäþ, éáé äéá ðí éüáí áððü ðÛ÷íáé íá ãñáé ìéá éáðá÷þñéóç tip1200. Ááí ÷ñáéÛæáðáé ùððüðí íá ÷ñçóéíüðĩéþðáðá ðá÷ýðçðá 1200 bps.

26.5.6 ÷ù Ðñüðááóç óá ÿá Áñéèü Öðĩëĩäéóðþí Ìÿóù Áíüð Áíððçñáðçðþ Õáñĩáðééþí

Áíðβ íá ðáñéíÿíáðá ìÿ÷ñé íá óðĩääéáβðá éáé íá ðéçéðñĩëĩäáβðá CONNECT host ÊÛëá öĩñÛ, ÷ñçóéíüðĩéþðáðá ôçí ééáíüðçðá cm ðĩð tip. Áéá ðáñÛäáéáíá, äáβðá ðéð ðáñáéÛðù éáðá÷þñéóçðáðá ðá÷ýðçðá /etc/remote:

```
pain|pain.deep13.com|Forrester's machine:\
      :cm=CONNECT pain\n:tc=deep13:
muffin|muffin.deep13.com|Frank's machine:\
      :cm=CONNECT muffin\n:tc=deep13:
deep13:Gizmonics Institute terminal server:\
      :dv=/dev/cuad2:br#38400:at=hayes:du:pa=none:pn=5551234:
```

Ïí ðáñáðÛíü, éá óáð äðéðñÿðáé íá äñÛðáðá tip pain þ tip muffin äéá íá óðĩáÿáðáðá óðĩðð ððĩëĩäéóðÿð pain þ muffin, éáé tip deep13 äéá íá óðĩáÿáðáðá óðĩí áíððçñáðçðþ ðáñĩáðééþí.

26.5.7 Ìðññáß ç Tip íá ÄíëéíÛóääé Ðañéóóúòðññò Äðü íéá ÄñáííÝò äéá êÛëä Óýíääóç;

Äðöü òí ðññääçíá óóíβëüð àìòáíβæääðáé óää Ýíá ðáíáðéóóðíëí ðñó Ý ÷ äé àñéääÝò ãñáííÝò äéá modem, äéëÛ êáé ÷ ééëÛääð öíéóçðÝð ðñó ðññóðáéíýí íá óéð ÷ ñçóéííðíéðóíóí.

Äçíëíðññáðóðää íéá éáðá ÷ ðññéóç äéá òí ðáíáðéóóðíëí óáð óðí /etc/remote êáé ÷ ñçóéííðíéðóðää òí @ óóçí ééáíúóçðá ðñ:

```
big-university:\
    :pn=@:tc=dialout
dialout:\
    :dv=/dev/cuad3:br#9600:at=courier:du:pa=none:
```

ðñéðá, äçíëíðññáðóðää íéá éβóðá íä òíðð àñééíýð óçéääðñíúí òíð ðáíáðéóóçíβñó óðí /etc/phones:

```
big-university 5551111
big-university 5551112
big-university 5551113
big-university 5551114
```

Ç tip éä äíëéíÛóääé êÛëä íβá, íä óç óáéñÛ ðñó àìòáíβæííðáé, êáé éä óðáíáðéóóðáé. Áí èÝëääðá íá óóíá ÷ βæää óçí ðññóðÛëääéá, äéðääéÝóðää óçí tip ìÝóá óää Ýíá àñüä ÷ ì while.

26.5.8 Äéáóß ÐñÝðáé íá ÐéÝóú Ctrl+P Äýí ÖíñÝð äéá íá Óðáßëü òí Óóíäðáóíü Ctrl+P íéá ÖíñÛ;

Ì óóíáðéóóíüð ðéðéðññí **Ctrl+P** áðñòääéáß òíí ðññíðééääíÝíí ÷ àñáéððñá “áíáíáääéáóíý (force)”, êáé ÷ ñçóéííðíéääðáé äéá íá éáðáéÛääé ç tip úðé ì áðññáíñó ÷ àñáéððñáð éä ðñÝðáé íá ÷ ñçóéííðíéçéääß ùðüð áβíáé. Ìðññáßðää íá èÝóðáðá òíí ÷ àñáéððñá áíáíáääéáóíý óää ìðíëíáððíðää Ûëëí ÷ àñáéððñá, ÷ ñçóéííðíéðíðáð óçí áéíëíðéβá äéáððääðð ~s, ç ìðíβá óçíáβíáé “ñýèìéóää íéá íääóääéçðβ”.

Ðéçéðññíëíáðóðää ~sforce=single-char êáé óóíá ÷ βóðá íä Ýíá ÷ àñáéððñá íÝáð ãñáííðð. Òí single-char áβíáé ìðíëíóáððíðää ìííüð ÷ àñáéððñáð. Áí áððóðáðää éääíú òí single-char, ì ÷ àñáéððñáð áíáíáääéáóíý éä áβíáé ì nul, òíí ìðíβí ìðññáßðää íá ðéçéðññíëíáðóðää ÷ ñçóéííðíéðíðáð òí óóíáðéóóíü ðéðéðññí **Ctrl+2 P Ctrl+Space**. Íéá àñéääÛ éääéð òéíð äéá òí single-char áβíáé òí **Shift+Ctrl+6**, ðñó ÷ ñçóéííðíéääðáé ìúíí óää èÛðíéíðð áíððçññáðçðÝð ðáññíáðééðí.

Ìðññáßðää íá ìññóðáðää òí ÷ àñáéððñá áíáíáääéáóíý óää ùðíëíí áóáßð äðééðíáβðää, íä óçí áéíëíðéç éáðá ÷ ðññéóç óóíí àñ ÷ áβíí \$HOME/.tiprc:

```
force=single-char
```

26.5.9 ÍáóíééÛ ¼óé ÄñÛöü Àìòáíβæääðáé íä Êäðáéääáβá ÄñÛííáðá!!

Ûëëëí Ý ÷ áðää ðéÝóáé **Ctrl+A**, ðñó áβíáé ì “ ÷ àñáéððñáð áíýðùóçð” óçð tip, êáé áβíáé ó ÷ ääéáóíÝíñð äéáééÛ äéá úóíðð Ý ÷ ìðí ðññääçíá íä òí ðéðéðññí **CAPS LOCK**. × ñçóéííðíéðóðää óçí áíóíëð ~s ðñó äáβíáíá ðáñáðÛñ, äéá íá èÝóðáðá íéá ëíäééð òéíð óóç ìääóääéçðβ raisechar. Óóçí ðññáííáðééúóçðá, ìðññáßðää íá èÝóðáðá óçí βæää òéíð íä òíí ÷ àñáéððñá áíáíáääéáóíý, áí äáí óéíðáýáðää ðñóÝ íá ÷ ñçóéííðíéðóðää èÛðíéá áðü áððÝð ðéð äóíáðüðóçðáð.

ÐáñáéÛðü óáβíáðáé Ýíá ððññääéääíá àñ ÷ áβíí .tiprc, òí ìðíβí áβíáé óÝéääéí äéá ÷ ññóðáðð òíð **Emacs** ðñó ÷ ñáéÛæääðáé íá ðéçéðññíëíáíýí óð ÷ ìÛ **Ctrl+2** êáé **Ctrl+A**:

26.6.2 Νýειέος ΟάέñέάέΎδ Είιούεάδ (Όýιόιις έάιός)

Ç áíúóçδά áδδP ððìèÝδάε ùεε óειðáýáδδ íá ÷ñçόειιðιεPóáδδ όεδ δñιáðέεάñÝíáδ ñðειβóáεδ, έάε èÝεάδδ áðεð ìεά áñPáñç áðέεúεðçόç όçδ áεάέέάδβáδ ñýειέοςçδ όçδ όάέñέάέΎδ έιιούεάδ.

1. ΌðíáÝόδδ ðì όάέñέάέúì έάεðáει όόçí COM1 έάε όòì δάñιáδέέú.
2. Άέά íá äáβδδ úεά όά ìçíýíáδά áêêβίçόçδ όόçí όάέñέάέΎδ έιιούεά, áðóδδ όçí δάñάέΰδδ áíóιèP ùδ δðáñ ÷ ñPóόçδ:
echo 'console="comconsole"' >> /boot/loader.conf
3. Άðáíñáñάόδáβδδ ðì /etc/ttys έάέ áεèΰíδδ ðì off óá on έάέ ðì dialup óá vt100 áέά όçí έάδά÷ ðñέόç ttyd0. Άέάóìñáδέέΰ, ááí έά ÷ ñáέΰæάδάέ èùάέέúδ δñúóááόçδ áέά όç óýíááόç ìÝóú όçδ όάέñέάέΎδ έιιούεάδ, ðì ìðìβì áðìδάέáβ δέεάíú έáíú áόóάέáβáδ.
4. ΆðáíáêêειPóδδ ðì óýόçíá áέά íá äáβδδ áí βó÷δóáí ìε áεéáãÝð.

Áí ÷ ñáέΰæάδδά áέάóìñáδέέΎδ ñðειβóáεδ, έά áñáβδδ έáððñÝñáέáδ áέά όçí ñýειέοςç όðì ΌìPíá 26.6.3.

26.6.3 Νýειέος ΟάέñέάέΎδ Είιούεάδ

1. Δñιáðειΰόδδ Ýíá όάέñέάέúì έάεðáει.
Έά ÷ ñáέóóδáβδδ áβδδ Ýíá έάεðáει όýðìð null-modem, áβδδ Ýíá όððìðιεçìÝíí όάέñέάέúì έάεðáει έάέ Ýíá δñιόáñìñáÝá null-modem. Άáβδδ ðì ΌìPíá 26.2.2 áέá έáððñÝñáέáδ ó÷áδέέΰ ìá όά áβáç ðúì όάέñέάέðì έάέúáβúí.
2. ΆðìóóíáÝόδδ ðì δέçέðñìεúάει óáδ.
Όά δáñέóóδðáñá PC øÛ÷íðì áέά ðì δέçέðñìεúάει έáδÛ όçí áεÛñέάέ ðúì áέááíúóδέέðì áêêβίçόçδ (POST, Power On Self Test), έάέ έá áíáóÝñìðì óóÛεíá áí ðì δέçέðñìεúάει ááí áβíáέ óóíááìÝíí. ÌáñέέÛ ìç÷áíPíáδά δáñáðìíεýííóáέ ç÷çñÛ áέá όçí Ýεéáεθç δέçέðñìεúáβìð, έάέ ááí óóíá÷βáειðì όçí áêêβίçόç ìÝ÷ ñε íá ðì óóíáÝόáδδ.
Áí ì ððìεíáέóδðδ óáδ δáñáðìíεÝóáέ áέá ðì εÛεíð, áεεÛ ìáέειÛ Ýόóέ έάέ áεéεðð, ááí ÷ ñáέΰæάδάέ íá εÛíáδδ όβðìóá έάέáβδáñì áέá áδðú. (ÌáñέέÛ ìç÷áíPíáδά ìá BIOS όçδ Phoenix, εÝíá áðεðð “Keyboard Failed” έάέ óóíá÷βáειðì όçí áêêβίçόç έáííέέÛ.)
Áí ì ððìεíáέóδðδ óáδ áñíáβδάέ íá áêêειPóáέ ÷ ùñβð δέçέðñìεúάει, έá δñÝðáέ íá ñðειβóáδδ ðì BIOS ðóδδ íá ááíñáβ ðì εÛεíð (áí áβíáδάέ). Όðìáíðέáðδδáβδδ ðì áá÷áέñβáει όçδ ìçðñέέPð óáδ áέá έáððñÝñáέáδ ó÷áδέέΰ ìá áδδP όç áέáέέέáδá.

Όδúááέίç: Ñðειβóδδ ðì δέçέðñìεúάει óá “Not installed” όðì BIOS. Ç ñýειέοςç áδδP áðεðð áðìðñÝðáέ ðì BIOS áδú ðì íá áίε÷íáýáέ ðì δέçέðñìεúάει όόçí áêêβίçόç, έάέ ááí δñúεάέóáέ íá óáδ áìðìáβóáέ íá ðì ÷ñçόειιðιεPóáδδ έáííέέÛ. Ìðìñáβδδ íá áðPóáδδ ðì δέçέðñìεúάει óóíááìÝíí áεúíá έάέ úδáí Ý÷áδδ áíáñáðìíεPóáέ όç ñýειέοςç “Not installed”. Áí ááí óðÛñ÷áέ ç δáñáðÛíú ñýειέοςç όðì BIOS, øÛíðá áέá όçí áðέειáP “Halt on Error”. ΆεèÛíðá όç óá “All but Keyboard” P áεúíá έάέ óá “No Errors”, έάέ έá Ý÷áδδ ðì βáει áðìðÝέáδá.

Όçíáβúόç: Áí ðì óýόçíá óáδ áέáέÝδάέ ðìðìóέé όýðìð PS/2®, δέεáíúí íá δñÝðáέ íá ðì áðìóóíáÝόáδδ έάέ áδðú. Όá ðìðìóέéá όýðìð PS/2 Ý÷íðì εÛðìέá έóεεðìáδά έίειÛ ìá ðì δέçέðñìεúάει, áááíúóδ ðìð ìðìñáβ ìá δñìέáέÝóáέ óýá÷óόç όðì δñúáñáìá áíβ÷íáδóçδ ðìð δέçέðñìεúáβìð. ÈÛðìέá óóóðìáδá, ùðð ðì Gateway 2000 Pentium 90 MHz ìá AMI BIOS, óðìðáñέóÝñìíóáέ ìá áδðú ðìð ðñúðì. Όá ááίέέÝð áñáìÝð, áδðú ááí áβíáέ δñúáέçíá έάεðð ðì ðìðìóέé Ýδóέ έάέ áεéεðð ááí áβíáέ ÷ ñPóέíì ÷ ùñβð ðì δέçέðñìεúάει.

- 3. ÓðíáÛóäð Ýíá εíðöü ðáññιάóέεü óðçí COM1 (sio0).

Áí äáí Ý ÷ äðä εíðöü ðáññιάóέεü, ïðñáßðð íá óðíáÛóäðä Ýíá ðáέεü PC/XT ïä Ýíá ðñüáñáíä äéá modem, P íá ÷ ñçóεíðíεPðáððä ðç óáέñέάεP εýñá óä Ýíá Ûεεí ïç ÷ Ûíçíá UNIX. Áí äáí Ý ÷ äðä óáέñέάεP εýñá COM1 (sio0), äáññÛóðä ïéá. Òç äáññÛíç óðέáìP äáí ððÛñ ÷ äé ðñüðíð íá äðέεÛíáðä Ûεεç εýñá äéðüð äðü ðçí COM1, ÷ ùñßð íá äðáíáíäðäáεüððßðäðä óä boot blocks. Áí ÷ ñçóεíðíεáßððä Páç ðçí COM1 äéá éÛðíεá Ûεεç óðóéäðP, éä ðñÛðäé íá ðçí áðáέñÛóðäð ðñíóñεíÛ, éáé íá äáεäðáóðPðáððä íÛí boot block éáé ðññPíá, ïüéð óðíáäéäßððä óðí FreeBSD. (ÒðíεÛóíðíä ïðé ç COM1 éä äßíáé Ûðóé éáé äéεεðð äéáéÛóçéç óä Ýíá äíðçñáðçðP äñ ÷ äßüí/ððíεáéóíðí/ðáññιάóέεPí. Áí ðñáññιάóέεÛ ÷ ñáéÛáéððä ðçí COM1 äéá éÛðé Ûεεí (éáé äáí ïðñáßððä áðöü ðí éÛðé Ûεεí íá ðí ïáðáέéíPðáððä óðçí COM2 (sio1)), ïÛεεí äáí éä Ýðñáðä íá áó ÷ ïεçèáßððä éáéüεíð ïä ïεí áðöü ðí εÛíá).

- 4. Äáäáεéùèáßððä üðé ðí äñ ÷ äßí ñðèìßðáüí ðíð ððñPíá óáð Ý ÷ äé ðéð éáðÛεεçéäð äðέεíáÛð (flags) äéá ðçí COM1 (sio0).

Íé ó ÷ áðééÛð äðέεíáÛð äßíáé:

0x10

Áíáñáíðíεáß ðçí ððíóðPñéíç εííóüéáð äéá áððP ðç εýñá. Áí äáí ðáèáß áððP ç äðέεíáP, óä ððüεíεðá flags äéá ðçí εííóüéá äáí εáíáÛííðáé ððüðéí. Òç äáññÛíç óðέáìP, ç ððíóðPñéíç εííóüéáð ïðñáß íá äßíáé áíáñáíðíεçíÛíç ïüí óä ïéá εýñá. Ç ðñðç ðíð éáéìñßáéðáé óðí äñ ÷ äßí ñðèìßðáüí, äßíáé éáé áððP ðíð éä ðñíðéíçèáß. Áðü ïüíç ðçð, ç äðέεíáP áððP äáí éä áíáñáíðíεPðáé ðçí εííóüéá ððç óðáéáεñεíÛíç óáέñέάεP εýñá. Éä ðñÛðäé íá εÛóáðä ðí ðñáéÛðü ðñ flag P íá ÷ ñçóεíðíεPðáððä ðçí äðέεíáP -ñ ðíð ðñéáñÛóðáé ðñáéÛðü, ïáεß ïä áðöü ðí flag.

0x20

ÁíáíáεÛáé ðç óðáéáεñεíÛíç εýñá íá äßíáé ç εííóüéá (áéðüð áí ððÛñ ÷ äé Ûεεç εííóüéá ðççéüðáñçð ðñíðáñáéüðçðäð) Ûó ÷ äðá ïä ðçí äðέεíáP -ñ ðíð ðñáéáñÛóðáé ðñáéÛðü. Éä ðñÛðäé íá ÷ ñçóεíðíεPðáððä ðí flag 0x20 ïáεß ïä ðí flag 0x10.

0x40

ðñáéñáðáß ðç óðáéáεñεíÛíç εýñá (óä óðíáðáóíü ïä ðçí 0x10) éÛííðáð ðçí ïç äéáéÛóçéç äéá éáñíééP ðñüóááóç. Äáí éä ðñÛðäé íá εÛóáðä áððP ðçí äðέεíáP óðç óáέñέάεP εýñá ðíð óéíðáýáðä íá ÷ ñçóεíðíεPðáððä ïð óáέñέάεP εííóüéá. Ç ïüíç ÷ ñPðç áðóíý ðíð flag, äßíáé íá éáéìñßðäðä üðé ç εýñá éä ÷ ñçóεíðíεçèáß äéá äðñáéñðóíÛíç áéóóáéíÛðüóç ðíð ððñPíá (kernel debugging). Äáßððä Òí Áέáεßí ðíð ðñíáñáíñιάóέóðP (http://www.FreeBSD.org/doc/e1_GR.ISO8859-7/books/developers-handbook/index.html) äéá ðñéóóüðáñð éäððñÛíáéðð ó ÷ áðééÛ ïä ðçí äðñáéñðóíÛíç áéóóáéíÛðüóç.

ðáñÛááéáíá:

```
device sio0 at isa? port IO_COM1 flags 0x10 irq 4
```

Äáßððä ðç óáéßáá manual sio(4) äéá ðñéóóüðáñð éäððñÛíáéäð.

Áí äáí Ý ÷ ïðí éáéìñέóðáß flags, éä ðñÛðäé íá áéðáéÛóáðä ðí UserConfig (óä äéáññáðóέεP εííóüéá) P íá äðáíáíäðäáεüððßðäðä ðíð ððñPíá.

- 5. ÄçíεíðñáPðáððä ðí äñ ÷ äßí boot.config óðíñ ñéáéüé éáðÛεíáñ ðçð éáðÛðíççðçð a ðíð äßóéíð áééßíççð.

Όι άη÷άβι άδου έά έάδάδδέγιάέ οίι έβιέέά οίτ boot block ό÷άδέέΰ ιά οί δυδ εΰεάδ ά άέέείΠράέ οί όγόδχιά. Άέά ίά άίάηάιθίέΠράάδ ά όχί οάέηέάέΠ έίίούέά, έά ÷ηάέάόδάβδά ίβά Π δάηέόούδάηάδ άδύ οέδ δάηάέΰδ άδέείαΰδ—άί εΰεάδ ίά δηιόάέινβόάδ δίεέάδεΰδ άδέείαΰδ, έά δηΰδάέ ίά οέδ δάηέέΰάάδά υεάδ όδχί βάέά ηάηΠ.

-h

Άίάέέΰόάέ ίάδάίγ όχδ άούδάηέέΠδ έάέ όχδ οάέηέάέΠδ έίίούέάδ. Άέά δάηΰάέάιá, άί ίάέείΠράάδ άδύ όχί άούδάηέέΠ έίίούέά (ίεΰίς), ίδηηάβδά ίά ÷ηχόέιιθίέΠράάδ όχί άδέείαΠ -h άέά ίά έάδάδδέγιάδά οί οίηδύδΠ άέέβίςόχδ έάέ οίι δδηΠία ίά ÷ηχόέιιθίέΠόιόι όχ οάέηέάέΠ εγηά υδ όδóέάδΠ έίίούέάδ. Άίάέέάέδέέΰ, άί άέέείΠράάδ ίΰού όχδ οάέηέάέΠδ εγηάδ, ίδηηάβδά ίά ÷ηχόέιιθίέΠράάδ όχί άδέείαΠ -h άέά ίά έάδάδδέγιάδά οί οίηδύδΠ άέέβίςόχδ έάέ οίι δδηΠία ίά ÷ηχόέιιθίέΠόιόι όχί έάίίέέΠ έίίούέά άίδβ άέά όχ οάέηέάέΠ.

-D

Άίάέέΰόάέ ίάδάίγ όχδ άδδΠδ έάέ όχδ άέδδΠδ έίίούέάδ. Όδχί ηγέιέός άδδΠδ έίίούέάδ, έά ÷ηχόέιιθίέέάβ άβδά ç άούδάηέέΠ έίίούέά (άδάέέυίέός οά ίεΰίς) άβδά ç οάέηέάέΠ εγηά, άίΰεηάά ίά οί δυδ ΰ÷άέ δάέάβ ç άδέείαΠ -h θίθ άίάδΰόάίá δάηάδΰΰ. Όά δάηδδδύδ άέδδΠδ έίίούέάδ, έά άίάηάιθίέέγίγί όάδδύ ÷ηίίá δυόί ç άούδάηέέΠ υόί έάέ ç οάέηέάέΠ έίίούέά, ΰó÷άδά άδύ όχ ηγέιέός όχδ άδέείαΠδ -h. Όχίάέβδδά υδóυόί υδέ ç ηγέιέός άέδδΠδ έίίούέάδ ίδηηάβ ίά άίάηάιθίέέάβ ίυηί έάδΰ όχί άέέβίςόχ, υόί άέδάέάβδάέ οί boot block. Ίυέέδ άίέάβ ι ΰέά÷ιδ όόι οίηδύδΠ άέέβίςόχδ, ç ίίίάέέΠ έίίούέά θίθ δάηάιΰίάέ άβίάέ άδδΠ δίθ έάέηβæάδάέ άδύ όχί άδέείαΠ -h.

-P

Άίάηάιθίέάβ όχί άίβ÷ίάδóς δέχέδηηέιηάβιθ οίτ boot block. Άί άάί άηάέάβ δέχέδηηέυάέί, άίάηάιθίέγίγίόάέ άδδύιáδά ίέ άδέείαΰδ -D έάέ -h.

Όχιάβύος: Έύάυ δάηέηέόιπí ÷βηίθ όδχί δηΰ÷ιθóά ΰέάιός δυί boot blocks, ç άδέείαΠ -P ίδηηάβ ίά άίέ÷ίάγóάέ ίυηί άέδάδάιΰία (extended) δέχέδηηέυάέά. Δέχέδηηέυάέά ίά έέάυδάηά άδύ 101 δδΠέδηά (έάέ ÷υηβδ όά δδΠέδηά F11 έάέ F12) βύδ ίά ίχί άίέ÷ίάδέγίγί. Άίάέόβδ άδδύγ οίθ δάηέηέόιγ, άβίάέ δέέάίυ ίά ίχί άίέ÷ίάδέγίγ έάέ έΰθίέά δέχέδηηέυάέά οίηχδπí δθίέιηέόδπí. Άί όόιáβίάέ άδδύ όόι όγόδχιά όάδ, έά δηΰδάέ ίά όόάίáδΠράάδ ίά ÷ηχόέιιθίέάβδά όχί άδέείαΠ -P. Άδóδδ÷βδ, άάί δδΰη÷άέ έΰθίέίθδ δηΰθίθ ίά δάηάέΰιθάδά άδδύ οί δηΰάέχιά.

× ηχόέιιθίέΠράά άβδά όχί άδέείαΠ -P άέά ίά άδέέΰίάδά όχί έίίούέά άδδύιáδά, Π όχί άδέείαΠ -h άέά ίά άίάηάιθίέΠράάδ όχ οάέηέάέΠ έίίούέά.

Ίδηηάβδά άδβόχδ ίά δάηέέΰάάδά έάέ ΰέέάδ άδέείαΰδ θίθ δάηέάηΰοίίάέ όδχ οάέβάá manual οίθ boot(8).

¼έάδ ίέ άδέείαΰδ άέέβίςόχδ, άέδυδ όχδ -P, έά δάηΰόιόι όόι οίηδύδΠ άέέβίςόχδ (/boot/loader). Ί οίηδύδΠ άέέβίςόχδ έά έάέηβόάέ άί ç έίίούέά έά άχίέιθηάέάβ όδχί ίεΰίς Π όδχ οάέηέάέΠ εγηά, άόίγ άίάδΰόάέ ίυηί όχί άδέείαΠ -h. Άδδύ όχιάβίάέ υδέ άί έάέηβόάδά όχί άδέείαΠ -D άέέΰ υ÷έ όχί άδέείαΠ -h όόι /boot.config, έά ίδηηάβδά ίά ÷ηχόέιιθίέΠράάδ όχί οάέηέάέΠ εγηά υδ έίίούέά ίυηί έάδΰ όχί άέδΰέάός οίθ boot block. Ί οίηδύδΠ άέέβίςόχδ υιυδ έά ÷ηχόέιιθίέΠράάέ όχί άούδάηέέΠ έίίούέά (ίεΰίς).

6. ΆέέείΠράά οί ίç÷ΰίχιά.

¼όάί ίάέείΠράάδ οί FreeBSD ίç÷ΰίχιά, όά boot blocks έά άάβιθίόί όά δάηέά÷υιάίά οίθ /boot.config όδχί έίίούέά. Άέά δάηΰάέάιá:

/boot.config: -P

Keyboard: no

Ç äáyóãñç ãñãìÞ åá àìöáíεóðãß iùíí áí áŨεάðå ðçí åðέειάÞ -Þ óðí /boot.config, έάέ åãß÷íåέ áí ððŨñ÷åέ Þ ù÷έ óðíååìŨíŨí ðέçέðñíεùåέí. Óå ìçíŨíåðå áððŨ έáðåðέŨíŨíðåέ ððçí óåέñέάέÞ Þ ððçí áóùðåñέέÞ έίíóùεά, Þ áέùíå έάέ óðέð äŸí, áíŨεíåå ìå ðçí åðέειάÞ ðíð Ũ÷åέ åβíåέ óðí /boot.config.

ΆδέειάΎδ	Όí ìÞíðíå àìöáíßæåðåέ óðçí
έåìβå	åóùðåñέέÞ έίíóùεά
-h	óåέñέάέÞ έίíóùεά
-D	åóùðåñέέÞ έάέ óåέñέάέÞ έίíóùεά
-Dh	óåέñέάέÞ έάέ åóùðåñέέÞ έίíóùεά
-Þ, ðέçέðñíεùåέí óðíååìŨíŨí	åóùðåñέέÞ έίíóùεά
-Þ, ÷-ùñßð ðέçέðñíεùåέí	óåέñέάέÞ έίíóùεά

ÌåðŨ óå ðåñåðŨíŨí ìçíŨíåðå, έå ððŨñíåέ ìεå ìέέñÞ ðåŸóç ðñέí óå boot blocks óðíå÷-ßóííí ðíñðÞííðåð ðí ðíñðùðÞ åέέßíçóçð, έάέ ðñέí àìöáíεóðíŨí ðåñέóóùðåñå ìçíŨíåðå ððçí έίíóùεά. Óðù έåííέέŨð óðíεÞεåð, ååí ÷ñåέŨæåðåέ ìå åέåέùðåðå óå boot blocks, åέέŨ ßóùð εŨέåðå ìå ðí έŨíåðå áððù åέå ìå ååååέέåßðå ùðέ ùεå åβíåέ ððέíεóíŨíå òùóðŨ.

ÐέŨóåå ðíεíåÞðíðå ðεÞεðñí åέðùð áðù ðí **Enter** ððçí έίíóùεå åέå ìå åέåέùðåðå ðç åέååέέåóßå åέέßíçóçð. Óå boot blocks έå óåð ðùðÞóííí åέå ðåñέóóùðåñåð ðέçñíðíñßð. Έå ðñŨðåέ ìå ååßðå έŨðέ ùðùð ðí ðåñåέŨðù:

```
>> FreeBSD/i386 BOOT
Default: 0:ad(0,a)/boot/loader
boot:
```

ΆðåέççåŸóðå ùðέ ðí ðåñåðŨíŨí ìÞíðíå àìöáíßæåðåέ åßðå ððçí óåέñέάέÞ έίíóùεά, Þ ððçí åóùðåñέέÞ έίíóùεά Þ έάέ óðέð äŸí, áíŨεíåå ìå óέð åðέειάΎδ ðíð Ũ÷åέ åðå ãñ÷åέ ìå ðçí åέååέέåóßå åέέßíçóçð. Áí ðí ìÞíðíå àìöáíßæåðåέ ððçí òùóðÞ έίíóùεå, ðέŨóåå **Enter** åέå ìå óðíå÷-ßóåðå ìå ðç åέååέέåóßå åέέßíçóçð.

Áí åðέέðíåßðå óåέñέάέÞ έίíóùεå, åέέŨ ååí åέŨðåðå ðçí ðñíðñíðÞ óå áððÞí, ððŨñ÷åέ έŨðíέí έŨέíð óðέð ððέíßóåέð. Óðí ìåðåíŸ, åñŨððå -h έάέ ðέŨóåå **Enter** Þ **Return** (áy åβíåðåέ) åέå ìå ðåßðå ððí boot block (έάέ Ũðåέðå ððí ðíñðùðÞ åέέßíçóçð έάέ ðí ððñÞíå) ìå åðέέŨíåέ ðç óåέñέάέÞ εŸñå åέå ðçí έίíóùεå. Ìùέð ðí óŸóçíå ìåέέíÞóåέ, έίέðŨíðå ìåíŨ óέð ððέíßóåέð åέå ìå åñåßðå ðíð åβíåέ ðí έŨέíð.

ÌåðŨ ðç ðíñðùðç ðíð ðíñðùðÞ åέέßíçóçð, åñßóέåóðå ððí ðñßðí ððŨåέí ðçð åέååέέåóßåð åέέßíçóçð έάέ Ũ÷åέå ìåέíå ðç åðíåðùðçðå ìå åðέέŨíåðå ìåðåíŸ ðçð åóùðåñέέÞð έάέ óåέñέάέÞð έίíóùεåð, εŨðííðåð ðέð έåðŨέççåð ìåðååέçðŨð ðåñέåŨέέíðð ððí ðíñðùðÞ åέέßíçóçð. Άåßðå ðí Όíðíå 26.6.6.

26.6.4 Ðåñßέçøç

ΆåÞ έå åñåßðå ìεå ðåñßέçøç ðùí åέŨðíñíŨí åðέειάÞí ðíð ðåñíðóέŨóðçέáy óå áððÞ ðçí åíŸðçðå, έάέ ðçí έίíóùεå ðíð åðέέŨ÷έçåð ðåέέέŨ.

26.6.4.1 ìç Ðåñßððùðç: ÷-åðå ΈŨóåέ ðí Flag 0x10 åέå ðç ΈŸñå sio0

```
device sio0 at isa? port IO_COM1 flags 0x10 irq 4
```

ÄðëëíäÛò óõí /boot.config	Ëííóüëá êáòÛ ðç äëÛñêáéá ðùí boot blocks	Ëííóüëá êáòÛ ðç äëÛñêáéá õíð õíñòùðÞ äêêβíçòçò	Ëííóüëá óõíð ððñÞíá
êáíβá	áòùðáñéêÞ	áòùðáñéêÞ	áòùðáñéêÞ
-h	óáëñéáêÞ	óáëñéáêÞ	óáëñéáêÞ
-D	óáëñéáêÞ êáé áòùðáñéêÞ	áòùðáñéêÞ	áòùðáñéêÞ
-Dh	óáëñéáêÞ êáé áòùðáñéêÞ	óáëñéáêÞ	óáëñéáêÞ
-P, ðëçêðñíëüäëí óõíááíÛíí	áòùðáñéêÞ	áòùðáñéêÞ	áòùðáñéêÞ
-P, ÷-ùñβð ðëçêðñíëüäëí	óáëñéáêÞ êáé áòùðáñéêÞ	óáëñéáêÞ	óáëñéáêÞ

26.6.4.2 2ç Ðáññðòùòç: ÷-áðá ËÛóáé õí Flag 0x30 äéá ðçí ËÛñá sio0

```
device sio0 at isa? port IO_COM1 flags 0x30 irq 4
```

ÄðëëíäÛò óõí /boot.config	Ëííóüëá êáòÛ ðç äëÛñêáéá ðùí boot blocks	Ëííóüëá êáòÛ ðç äëÛñêáéá õíð õíñòùðÞ äêêβíçòçò	Ëííóüëá óõíð ððñÞíá
êáíβá	áòùðáñéêÞ	áòùðáñéêÞ	óáëñéáêÞ
-h	óáëñéáêÞ	óáëñéáêÞ	óáëñéáêÞ
-D	óáëñéáêÞ êáé áòùðáñéêÞ	áòùðáñéêÞ	óáëñéáêÞ
-Dh	óáëñéáêÞ êáé áòùðáñéêÞ	óáëñéáêÞ	óáëñéáêÞ
-P, ðëçêðñíëüäëí óõíááíÛíí	áòùðáñéêÞ	áòùðáñéêÞ	óáëñéáêÞ
-P, ÷-ùñβð ðëçêðñíëüäëí	óáëñéáêÞ êáé áòùðáñéêÞ	óáëñéáêÞ	óáëñéáêÞ

26.6.5 ÓõíáíñòËÛò äéá ðçí ÓáëñéáêÞ Ëííóüëá

26.6.5.1 Ñÿëíéóç íáááëÿðáñçò Óá÷ÿòçðáð äéá ðç ÓáëñéáêÞ ËÛñá

Ëé ðñíáðëéááíÛíí ððëíβóáéð ðçð óáëñéáêÞð ÷ÿñáð áβíáé: 9600 baud, 8 bits, ÷-ùñβð éóíðëíβá (parity), 1 stop bit. Áí ÷ÿñáðá íá áëëÛíáðá ðçí ðñíáðëéááíÛíí ðá÷ÿòçðá ðçð êííóüëáð, Û÷-áðá ðéð ðáñáéÛòù äðëëíäÛò:

- Äðáíáíáðááëüððβðá ðá boot blocks ÷ÿõííðáð ðç íáðááëçòÞ BOOT_COMCONSOLE_SPEED äéá íá ðñβóáðá ðçí íÛá ðá÷ÿòçðá êííóüëáð. Ááβðá õí ÒðÞá 26.6.5.2 äéá ÷áðòñíñáñáβð íäçáβáð ó÷-áðééÛ íá ðç íáðááëçòððéóç êáé ááéáðÛóðáóç íÛíí boot blocks.

Áí ç áíáñáíðíβçòç ðçð óáëñéáêÞð êííóüëáð ááí áβíáðáé íÛóù ðçð äðëëíäÛò -h, Þ áí ç óáëñéáêÞ êííóüëá ðíð ÷-ñçóëíðíéáβðáé áðü õíð ððñÞíá áβíáé äéáõíñáðéêÞ áðü áððÞ ðíð ÷-ñçóëíðíéáβðáé áðü ðá boot blocks, êá ðñÛðáé áðβòçð íá ðñíóëÛóáðá ðçí ðáñáéÛòù äðëëíäÛò óõí ãñ÷-áβí ððëíβóáùí ðíð ððñÞíá, êáé íá íáðááëüððβðáðá Ûíá íÛí ððñÞíá:

```
options CONSPEED=19200
```

- Óðéð äðëëíäÛò äêêβíçòçð ðíð ððñÞíá, ÷-ñçóëíðíéáβðá õí -s. Ìðñíáβðá áðβòçð íá ðñíóëÛóáðá ðçí äðëëíäÛò -s óõí /boot.config. Ç óáëβáá manual boot(8) ðáñéÛ÷-áé íéá ëβóðá ðùí ððíðçñéäüíáíúí äðëëíäÛò, êáé ðáñéáñÛóáé

ðùò íá ðεò ðñíòεÝóáòá óðí áñ÷áβí /boot.config.

- ΑίáñáñðιεΠóòá ðçί áðέειάΠ comconsole_speed óðí áñ÷áβí /boot/loader.conf.

Άέά íá εάέοιòñáΠóáε áóðΠ ç áðέειάΠ, εά ðñÝðáε áðβóçð íá εÝóáòá ðειÝò áέá ðεò áðέειάÝò console, boot_serial, εάé boot_multicons óðí βáειí áñ÷áβí, ðí /boot/loader.conf. ΔάñáéÙòù óáβίáðáé Ýíá ðáñÙááéáíá ÷ñΠóçð ðιò comconsole_speed áέá áέéááΠ ðá÷ýðçðá ðçð óáέñέáέΠð είíóúεáð:

```
boot_multicons="YES"
boot_serial="YES"
comconsole_speed="115200"
console="comconsole,vidconsole"
```

26.6.5.2 ×ñçóειíðιεΠóáò ΟάέñέáέΠ Èýñá Áêòùò ðçð sio0 áέá ðçί Èίíóúεá.

Èá ðñÝðáé íá áðáíáíáðááεùòðβóáòá εÙðιεá ðñíáñÙíáóá áέá íá ÷ñçóειíðιεΠóáòá ùò είíóúεá íεá óáέñέáέΠ èýñá áêòùò ðçð sio0. Αί áέá ðιεíεáΠðιεá εüáí εÝεáðá íá ÷ñçóειíðιεΠóáòá Ùεεç óáέñέáέΠ èýñá, εά ðñÝðáé íá áðáíáíáðááεùòðβóáòá óá boot blocks, ðí ðιñòùòΠ áêêβίççðð εάé ðιí ðññΠíá, íá ðιí ðññðι ðιò óáβίáðáé ðáñáéÙòù.

1. ΑίáέðΠóáòá ðιí ðçááβí εðáέéá ðιò ðññΠíá. (Άáβðá ðí ÈáοÙεάει 24)
2. Άðáíáñááóáβðá ðí áñ÷áβí /etc/make.conf εάé εÝóáòá ðçί áðέειάΠ BOOT_COMCONSOLE_PORT óðç áέáyèðίóç ðçð èýñáð ðιò εÝεáðá íá ÷ñçóειíðιεΠóáòá (0x3F8, 0x2F8, 0x3E8 or 0x2E8). Ìðιñáβðá íá ÷ñçóειíðιεΠóáòá ìúíí ðεò èýñáð sio0 ùò sio3 (COM1 ùò COM4). ÈÙñòáð ðιεéáðεðí εðñπí, ááí ðññεáέóáé íá εάέοιòñáΠóιòí. Άáí ÷ñáéÙáóáé íá ðñεíβóáòá ðçί ðειΠ ðιò interrupt.

3. ΆçιεíòñáΠóáòá Ýíá áñ÷áβí ðñεíεóçð ðñιόáñιòíÝíò ðññΠíá, εάé ðñιόεÝóðá ðá εáðÙεεçéá flags áέá ðç óáέñέáέΠ èýñá ðιò áðέεòíáβðá íá ÷ñçóειíðιεΠóáòá. Άέá ðáñÙááéáíá, áí εÝεáðá ç sio1 (COM2) íá áβíáé ç Èίíóúεá:

```
device sio1 at isa? port IO_COM2 flags 0x10 irq 3
P
device sio1 at isa? port IO_COM2 flags 0x30 irq 3
```

Άáí εá ðñÝðáé íá εÝóáòá flags είíóúεáð áέá ðεò Ùεéáð óáέñέáέÝò èýñáð.

4. Ìáðááεùòðβóáòá εάé ááéáðáóðΠóáòá íáíÙ ðá boot blocks εάé ðιí ðιñòùòΠ áêêβίççðð:

```
# cd /sys/boot
# make clean
# make
# make install
```

5. Άðáíáíáðááεùòðβóáòá εάé ááéáðáóðΠóáòá ðιí ðññΠíá.
6. ΆñÙððá ðá boot blocks óðιí áβóειí áêêβίçççðð ÷ñçóειíðιεΠóáòá ðçί bsdlable(8) εάé áêêειΠóáòá ìá ðí íÝí ðññΠíá.

26.6.5.3 Άβóιáíò óðιí DDB Debugger ÌÝóùò ðçð ΟάέñέáέΠð Άñáíìðò

Αί εÝεáðá íá áέóÝεéáðá óðιí debugger ðιò ðññΠíá áðù ðçί óáέñέáέΠ είíóúεá (εÙðé ðιò áβíáé ÷ñΠóειí áέá íá áêòáéÝóáòá áέááíúóóéÙ áðù áðñáεñòóíÝίç ðιðιεáóá, áεéÙ áðβóçð εάé áðέεβίáðñí áí óááβεáðá εáðÙ εÙειò BREAK ìÝóùò ðçð óáέñέáέΠð èýñáð!) εá ðñÝðáé íá ðáñέéÙááðá ðçί ðáñáéÙòù áðέειάΠ óðιí ðññΠíá óáð:

```
options BREAK_TO_DEBUGGER
options DDB
```

26.6.5.4 Ðñïòñïð Æéóüäïð óççí Óääñéääÿ Æïíóüää

Áí éää áðöü äáí áβíää áðñáñáβðçðï, βòùð íá èÿëää íá ÿ÷áðð ðñïòñïð Æéóüäïð (login) ÿÿòù óççð Óääñéääÿ ññáíðð, òðñá ðïð ïðññáβðð ðèÿÿí íá äáβðð ðá ÿçÿÿíáðá äèèβíççðð éää íá äéóÿëääðð ððí debugger ðïð ððñðíá ÿÿòù óççð Óääñéääÿ Æïíóüääð. Ç äéääéääóβá ðññññÛòääé ðñññÛòù.

Ìá èÛðÿÿí ððððÛéðç èääÿÿÿ, áñíβíðð ðï äñ÷áβì /etc/ttys éää ññáβðð ðéð ññáíÿð:

```
ttyd0 "/usr/libexec/getty std.9600" unknown off secure
ttyd1 "/usr/libexec/getty std.9600" unknown off secure
ttyd2 "/usr/libexec/getty std.9600" unknown off secure
ttyd3 "/usr/libexec/getty std.9600" unknown off secure
```

Ïé éáðá÷úñβóääð áðü ttyd0 ùð ttyd3 áíðéóðÿ÷ÿÿí óðéð COM1 ùð COM4. ÄèÛÿðð ðï off ðá on äéá óççí èÿñá ðïð äðéèðíáβðð. Áí ÿ÷áðð äèÛÿää óççí ðá÷ÿðçðá óççð Óääñéääÿ èÿñáð, éá ðññéääóðá íá äèÛÿääð ðï std.9600 þððá íá ÓääñéÛääé ìá óççí ðñÿ÷ÿðá ñÿèìéçç, ð.÷. std.19200.

Ûèèÿ éá èÿëää íá äèÛÿääð éää ðïð ðÿðÿ ðïð ðáññáðééÿ, áðü unknown óðñí ðññáñáðééü ðÿðÿ ðïð Óääñéääÿ óáð ðáññáðééÿ.

Áóÿÿ äèÛÿääð ðéð ñèìβóääð, éá ðñÿðéé íá äèðäéÿððá óççí áíðÿð kill -HUP 1 þððá íá áññññðÿéççÿÿí.

26.6.6 Äèèáß Æïíóüääð ÿÿòù ðïð Õïñòùð Æèèβíççðð

Óá ðñççÿÿÿíáð áñúççððð, ðññññÛòää ðùð íá ñèìβóääð óççí Óääñéääÿ Æïíóüää äèÛÿääððð ðéð ñèìβóääð ðïð boot block. Óççí áñúççðá áððð, äáβ÷ñðíá ðùð ïðññáβðð íá éääÿñβóääð óççí Æïíóüää áβññðð èÛðÿéðð áíðÿÿð éää ìáðääèçðÿð ðñññÛèèÿð ððñí ðññòùð Æèèβíççðð. Êääðð ï ðññòùððð äèèβíççðð éääáβðääé áðü ðï ðñβðï óðÛääÿ óççð äéääéääóβáð äèèβíççðð, éää ìáðÛ ðï boot block, ïé ñèìβóääð ðïð ðññòùðð äèèβíççðð ððññéó÷ÿÿÿí ðá ó÷ÿç ìá áððÿð ðïð boot block.

26.6.6.1 ñÿèìéççðð óççð Óääñéääÿ Æïíóüääð

Ïðññáβðð áÿèÿää íá éääÿñβóääð ùðé éá ðñççÿÿðÿéçèáß ç Óääñéääÿ Æïíóüää óðñí ðññòùðð äèèβíççðð éää óðñí ððñðíá ðïð éá ðññòùðððð, ññÛÿÿððððððð ìéá ññáíðð ððï /boot/loader.conf:

```
set console="comconsole"
```

Ç ñÿèìéççðð áððð éá áññññðÿéçèáß, Ûó÷áðð ìá ðï boot block ðïð ððæçðððáíá óççí ðñççÿÿÿíáç áñúççðá.

Áβíää éääÿððñá ç ññáíðð áððð íá áβíää ç ðñðçç ððï äñ÷áβì /boot/loader.conf, þððá íá äèÿðððð ðá äñ÷éÛ ÿçÿÿíáðá äèèβíççðð óççð Óääñéääÿ Æïíóüää.

Ìá ðïð βääÿ ðññðÿ, ïðññáβðð íá éääÿñβóääð óççí áóùðññéèÿ Æïíóüää ùð:

```
set console="vidconsole"
```

Áí äáí éääÿñβóääð óççð ìáðääèççðð ðñññÛèèÿð console, ï ðññòùððð äèèβíççðð (éää ÿðääéðá ï ððñðíáð) éá ðñççÿÿðÿéçèáß ïðÿéääððððð Æïíóüää ÿ÷áðð éääÿñβóääð ððï boot block ìá óççí áðéèÿð -h.

Ïðññáβðð íá éääÿñβóääð óççí Æïíóüää ððï /boot/loader.conf.local ððï /boot/loader.conf.

Äáβðð ðï loader.conf(5) äéá ðññéóóùðñññð ðèçññññññð.

Óçἰåßùóç: Õç ååãἰἰÝἰç óóεåἰP, ἰ öἰñöùðPð åêéßἰççóç ååἰ Ý÷åé åðééἰāP áἰðßóðἰé÷ç ἰå ðçἰ -P öἰð boot block, éåé ååἰ ððÛñ÷åé êÛðἰéἰò ðñöðἰò ἰå äßἰåé áðöἰἰåðç åðééἰāP ἰåðåἰý åóúðåñéêPð éåé óáέñέåêPð εἰἰóüéåð áἰÛéἰāå ἰå ðçἰ ðåñἰðóßå ðεçéðñἰéἰāßἰð.

26.6.6.2 ×ñPóç ÓáέñέåêPð Èýñåð Åêöἰð ðçð sἰo0 åéå ðçἰ Èἰἰóüéå

Èå ðñÝðåé ἰå åðåἰåἰåðååèððßóðåðå öἰ öἰñöùðP åêéßἰççóç ðóðå ἰå ÷ñçóéἰðἰéPóåé ἰéå óáέñέåêP èýñå áéåöἰñåðéêP áðἰ ðçἰ sἰo0 åéå ðç ὀáέñέåêP εἰἰóüéå. ÅéἰεἰðèPóðå ðç åéååééåðßå ðἰð ðåñéåñÛöðåé óöἰ ÕἰPἰå 26.6.5.2.

26.6.7 ÐééåἰÝò Ðååßåâð

Ç ååἰéêP éåÝå åßἰåé ἰå åðéðñÝðåðåé óå ἠöἰðð öἰ åðééðἰἰýἰ, ἰå æçἰéἰñåPóἰἰ ἠἰåéåéåöἰÝἰðð ἠἰððçñåðçÝð ðἰò ååἰ åðåéðἰἰýἰ êÛñðåð åñåðéêPἰ éåé ðεçéðñἰεἰἠåéå. Åðóðð÷ðð, áἰ éåé ðå ðåñéóóúðåñå óðóðPἰåðå èå óåð åðéðñÝðἰἰ ἰå åêééἰPóåðå ÷ññðð ðεçéðñἰεἰἠåéἰ, óå ðἰεý εßåå èå ἰðἰñÝóåðå ἰå åêééἰPóåðå ÷ññðð êÛñðå äñåðéêPἰ. Õå ἰç÷åἰPἰåðå ἰå BIOS ðçð AMI ἰðἰñἰýἰ ἰå ñðèἰéóðἰἰýἰ ἰå áðöἰ öἰἰ ðñöðἰ, åðèðð åèÛæἰἰðåð ðçἰ åðééἰāP “graphics adapter” óðéð ñðèἰßóåéð öἰð CMOS óå “Not installed.”

Õå ðåñéóóúðåñå ἰç÷åἰPἰåðå ἠöðἰἰ ἠἰ ᰅðἰððçññßæἰἰἰ áððP ðçἰ åðééἰāP, éåé èå åñἰçéἰἰýἰ ἰå åêééἰPóἰἰ ἰå ἠἰ åἰÛéåðå ἰéå êÛñðå äñåðéêPἰ. Õðå ἰç÷åἰPἰåðå áðöÛ èå ðñÝðåé ἰå áðPóåðå ἰéå óðἰé÷åðæç (åéἠἰå éåé ἰἰἰ÷ñἠἠç) êÛñðå äñåðéêPἰ, áἰ éåé ååἰ åßἰåé åðåñåßðççἰ ἰå óἰἰåÝóåðå éåé ἰεἠἰç. Ìðἰñåßðå åðßçð ἰå äἰεéἰÛöðå ἰå ååéåðåóðPóåðå BIOS ðçð AMI.

ÊäöÛëáéí 27 PPP êáé SLIP

ÁíáüñÞεçêá, áíáüéññáíÞεçêá, êáé áíáíáÞεçêá áðü öíí Jim Mock.

27.1 Óýñíøç

Ôí FreeBSD áéáéÝóáé ðεÞεíð ðñüðñí áéá ðç óýíááøç áñüð ððñεíáεóðÞ íá Ýíá Ûεεí. Áéá íá áðεóý ÷ áðá óýíááøç ìÝóü modem óðí Internet Þ óá Ýíá Ûεεí áβεðóí, Þ áéá íá áðεóñÝóáðá óá Ûεεíðð íá óñíááεíýí ìÝóü ðíð óðóðÞíáðíð óáð, áðáéðáβðáé ç ÷ ñÞóç PPP Þ SLIP. Ôí êäöÛëáéí áðüð ðñéáñÛóáé êäððñáñÞð öíí ðñüðñí ñýεíεóç ðñí ðáñáðÛíü ððçñáóεÞí áéá ÷ ñÞóç ìÝóü modem.

Áöíý áéááÛóáðá áðüð öí êäöÛëáéí, êá íÝñáðá:

- Dùð íá ñðèìβóáðá öí PPP ÷ ñÞóç (User PPP).
- Dùð íá ñðèìβóáðá öí PPP ððñÞíá (Kernel PPP, ìñíí áéá FreeBSD 7.X).
- Dùð íá ñðèìβóáðá öí PPPoE (PPP ìÝóü Ethernet).
- Dùð íá ñðèìβóáðá öí PPPoA (PPP ìÝóü ATM).
- Dùð íá ñðèìβóáðá Ýíá ðáεÛóç êáé áñðçñáðøçÞ SLIP (ìñíí áéá FreeBSD 7.X).

Ðñéí áéááÛóáðá áðüð öí êäöÛëáéí, êá ðñÝðáé:

- Íá áβóðá áñééáεüñÝíð ìá ðç ááóéεÞ ññéíáβá ðñí áééðýíí.
- Íá êáðáñáβðá ðéð ááóééÝð Ýíñéáð êáé öí óéíðü ðñí áðεéíáεéÞí óñíáÝóáñí êáé öíð PPP êáé/Þ SLIP.

Ïðñáβ íá áíáññóéÝóðá ðñéá áβíáé ç ááóéεÞ áéáöññÛ ìáðáíý öíð PPP ÷ ñÞóç êáé öíð PPP ððñÞíá. Ç áðÛíðççç áβíáé áðεÞ: öí PPP ÷ ñÞóç áðáíáñáÛáðáé óá áááñÝíá áεóüáñð êáé áññáñð ìÝóü ðñíñáñáñíÛóñí ÷ ñÞóç (userland) áñóβ áéáíÝóíð öíð ððñÞíá öíð êáéöíðñáééíý. Áðüð ðñíéáéáβ εÛðñéáð áðéááñýíóáéð εüáñ ðçð áñóéáñáðÞð áááñÝíñí ìáðáíý öíð ððñÞíá êáé ðçð áðáññáÞð ÷ ñÞóç, áεεÛ áðεóñÝðáé êáðÛ ðñéý ðεí ðεíýóéá (áðü Ûðñíçç áðíáðíðÞðñí) ðεíðñíβçç öíð PPP ðñüðñéüεéíð. Ôí PPP ÷ ñÞóç ÷ ñçóéñíðñéáβ ðç óðóéáðÞ tun áéá ðçí áðεéíεññáβ ìá öíí Ýñü εüöíí, áñÞ öí PPP ððñÞíá ÷ ñçóéñíðñéáβ ðçí óðóéáðÞ ppp.

Óçíáβñóç: Óá üεí öí êäöÛëáéí, öí PPP ÷ ñÞóç êá áíáéÝñáðáé áðεÛ ðð **ppp** áεðüð êáé áí ÷ ñáéÛáðáé íá áβíáé áεÛéñéóç óá ó÷Ýóç ìá Ûεεí éñáéóíééü PPP ððüð öí **pppd**. Áεðüð áí áíáéÝñáðáé áéáöññáðééÛ, üεáð íé áíðñéÝð öíð áñçáíýíðáé óðí êäöÛëáéí áðüð êá ðñÝðáé íá áéðáéñýíðáé ðð root.

27.2 ×ñçóéíñðñéÞíðáð öí PPP ×ñÞóç

ÁñçáñÞεçêá êáé áðéðεÞεçêá áðüð öíí Tom Rhodes. Áñ÷éεÞ óðíáéóöññÛ öíð Brian Somers. ìá ðç áñÞεáéá ðñí Nik Clayton, Dirk Frömberg, êáé Peter Childs.

Ðñíáéáñðñéçç: Áðüð öí FreeBSD 8.0 êáé ìáðÛ, óá ññíáðá óðóéáðÞí áéá ðéð óáéñéáééÝð εýñáð ìáðñññÛóðçéáí áðüð /dev/cuadN óá /dev/cuaN êáé áðüð /dev/ttydN óá /dev/ttyuN. Íé ÷ ñÞóðáð öíð FreeBSD 7.X êá ÷ ñáéáóðáβ íá ðñíóáññíóñíð ðéð ðáñáéÛóð ñççáβáð óýíðñíá ìá áðóÝð ðéð áééááÝð.

27.2.1 PPP ×ñΠόδς

27.2.1.1 ΔññúðìèÝóάέò

Όι έαβιαñ άóòυ ðññúðìèÝóάέ υóέ Ý ÷ άòά óά ðáñάέΰòυ:

- Έιαñέάóιυ óά έΰðìεί Δáññ ÷ Ýά Όðςñάóέπí Internet (ISP) óòñ ðñññí óóñáÝάóóά ÷ ñςóέññðìέπíóάò PPP.
- ðά modem Π ΰέες óóóέάòΠ óóñáñ Ýίς óòñ óύóðςία óάò, έάέ ñðèìέóíÝίς óύóòΰ πρòά ðά óάò áðέòñÝðάέ ðά óóñáñέάβòά óòñ ISP óάò.
- Όòò áñέèññýò έεΠόδς άέά ðñ ISP óάò.
- Όñ ðññά ÷ ñΠόδς (login) έάέ ðñ èùάέèù óάò (password). Άβòά έáññέèù ðññά έάέ èùάέèù (óýðñò UNIX) Π Ýία æáýáñò ðññááòñò / èùάέέñý óýðñò PAP Π CHAP.
- Όέò IP άέάòέýíóάέò áñυò Π ðáñέóóúòáñññ ðáέáèñέóòπí ðññΰòυñ (DNS). Όòóέññάέèΰ, ð ISP óάò έá óάò áπóάέ áýñ ðÝòìέáò áέáòέýíóάέò. Άí ááñ Ý ÷ άòά ðñòèΰ ÷ έóóññ ðá, ððññáβòά ðά áñáñáñðìέΠóάòά ðςí áíóñèΠ enable dns óòñ ppp.conf έάέ ðñ **ppp** έá ñðèìβóάέ ðñòð áέáèñέóòÝò ðññΰòυñ áέá óάò. Όñ ÷ áñáèòςñέóóέèù áóòυ áñáñòΰðάέ áðñ ðςí ððñóðΠñέñς ðςò áέáðñáññΰðáòóςò DNS áðñ ðñ ISP óάò.

Ί ISP óάò áñáñ ÷ ñÝñò ðά óάò áπóάέ έάέ ðέò ðáñάέΰòυ ðέςñññòññáò, áèèΰ ááñ áβίαέ áíóáèπò áðñáβòςòáò:

- Ός áέáýèðíóς IP áέá ðςí ðýες (gateway) ðñò ISP óάò. Ç ðýες áβίαέ ðñ ðς ÷ ΰίςία ðÝóó ðñò ðññññò óóñáÝάóóά, έάέ έá áðñóáèÝóάέ ðςí ðññáðèèáñññÝίς áέááñññΠ (default route) áέá ðñ ðς ÷ ΰίςία óάò. Άí ááñ Ý ÷ άòά áóòΠ ðςí ðέςñññòññá, έá ÷ ñςóέññðìέςέáβ ðέá áέéññéèΠ, έάέ υòáñ óóñáñέáβòά έá èΰááòá ðςí έáññéèèΠ áέáýèðíóς áðñ ðñ áέáèñέóòΠ PPP ðñò ISP óάò.

ΆóòΠ ç áέáýèðíóς IP áñáöÝñáòάέ ðð HISADDR áðñ ðñ **ppp**.

- Ός ðΰóéá áέéòýñò (netmask) ðñò ðñÝðάέ ðá ÷ ñςóέññðìέΠóáòá. Άí ð ISP óάò áá óάò ðςí ðáñÝ ÷ áé, ððññáβòά ðá áóòΰέáéá ðá ÷ ñςóέññðìέΠóáòá ðςí ðèèΠ 255 . 255 . 255 . 255.
- Άí ð ISP óάò ðáñÝ ÷ áé óóáóéèèΠ áέáýèðíóς έάέ ðññá ððññáέóòòΠ (hostname) ððññáβòά ðá ÷ ñςóέññðìέΠóáòá áóòΰ. Άέáóññáòéèèΰ, έá áòΠóññá ðñ ððñáèñòóíÝñ ððññáέóòòΠ ðá áπóάέ ððñéá áέáýèðíóς IP èáññáβ èáòΰέεςς.

Άí óάò èáβðññò èΰðìέáò áðñ ðέò áðáέóñññáñáò ðέςñññòññáò, áðέéññññΠóóá ðá ðñ ISP óάò.

Όςíáβυòς: Όá ðèùέéςñς ðςí ðáñññóá áññòςòá, ðñèèΰ áðñ ðá ðáñáááβáñáóá ðñò ááβ ÷ ðñò ðá ðáñéá ÷ ðñáñá ðññ áñ ÷ áβññ ñðèìβóáññ, áβίαέ áñέéñññññá áññ áñáññ. ðé áñέéññññ áóòññ áñòðςñáòñññ ððςí ðáñññóóáóς έάέ ðς óðæΠóςς ðñò èΰèá ðáñáááβáñáòñò, έáέ ááñ ðñÝðάέ ðá áñáóñññ ðÝóá óòñ ðñááñáòéèèù áñ ÷ áβñ. Άβίαέ áðβóςò ðςíáíóéèèù ðá ðςñáβòá ç óúóòΠ óòññ ÷ έóς óá èΰèá áñ ÷ áβñ, ðá ðς ÷ ñΠόδς óðςèèáòπí (tabs) έάέ èáñπí áέáóðςíΰòυñ.

27.2.1.2 Άóòυñáòς ñýèìέóς PPP

Όòñ ðñ ppp ðññ έάέ ðñ pppd (ς ðèñðñβςς ðñò PPP óá áðβðááñ ððñññá) ÷ ñςóέññðìέýññ ðá áñ ÷ áβá ñðèìβóáññ ðññ έáòΰèñññ /etc/ppp. ððññáβòά ðá áñáβòá ðáñáááβáñáóá áέá ðñ ppp ÷ ñΠόδς óòñ έáòΰèñññ /usr/share/examples/ppp/.

Η ηύειός οἶο ppp άδάέόάβ όçi όñἱόἱβίβός όίυό άñέειύ άδἱ άñ÷άβά, άίὐείάά ίά όέό άδάέόβόάέό όάό. Ὀἱ όέ έά άὐέάόά όά άόόὐ, άίάñόὐόάέ όά Ἰά όἱόἱόου άδἱ όἱ άί ἱ ISP όάό άδἱάβάάέ όόάόέέὐό έέάόέγίόάέό IP (άçέ. όάό όάñὐ ÷ άέ έά έέάγέόἱός IP ç ἱόἱβά άάί έέὐέάέ) β άόίάέέὐό (άçέ. ç IP έέάγέόἱός όάό έέέὐέάέ έὐέά όἱñὐ όἱό όἱάὐάόά όἱἱ ISP όάό).

27.2.1.2.1 PPP έάέ Ὀάάόέέὐό Ἀέάόέγίόάέό IP

Έά ÷ñάέάόάβ ίά όñἱόἱέβόάόά όἱ άñ÷άβἱ ñόέἱβόάἱ /etc/ppp/ppp.conf. Έά όñὐέάέ ίά ἱέὐέάέ ίά άόόἱ όἱό όάβἱάόάέ όάñάέὐό:

Ὀçἱάβἱός: Ἰέ άñάἱὐό όἱό όάέάέβἱἱἱ ίά : ίάέέἱἱἱ όόçἱ όñβός όόβέç (άñ÷β όçò άñάἱἱβò) — ἱέάό ἱέ ὐέέάό άñάἱὐό έά όñὐέάέ ίά όἱέ÷έόέἱἱ ίά όἱἱ όñἱόἱ όἱό όάβἱάόάέ, ίά όç ÷ñβός έάἱβἱ β όόçέἱέάόβἱ.

```
1 default:
2 set log Phase Chat LCP IPCP CCP tun command
3 ident user-ppp VERSION (built COMPILATIONDATE)
4 set device /dev/cuau0
5 set speed 115200
6 set dial "ABORT BUSY ABORT NO\\sCARRIER TIMEOUT 5 \
7     \"\" AT OK-AT-OK ATE1Q0 OK \\dATDT\\T TIMEOUT 40 CONNECT"
8 set timeout 180
9 enable dns
10
11 provider:
12 set phone "(123) 456 7890"
13 set authname foo
14 set authkey bar
15 set login "TIMEOUT 10 \"\" \"\" gin:--gin: \\U word: \\P col: ppp"
16 set timeout 300
17 set ifaddr x.x.x.x y.y.y.y 255.255.255.255 0.0.0.0
18 add default HISADDR
```

Ἀñάἱἱβ 1:

Ἀίάάἱñβάέ όçἱ όñἱάόέέάἱὐἱ έάόά ÷βñέός. Ἰέ άίόἱέὐό όά άόόβ όçἱ έάόά ÷βñέός άέόάέἱἱόάέ άόόἱάόά, ἱόάί άέόάέβόάέ όἱ ppp.

Ἀñάἱἱβ 2:

Ἀίάñἱόἱέάβ όçἱ έάόάññάόβ (logging) όἱἱ όάñάἱὐόñἱ. ¼όάί ἱέ ñόέἱβόάέό όἱό Ἰ ÷ἱἱ άβἱάέ έέέόἱñἱἱἱ έέάἱἱόἱέçóέέὐ, ç άñάἱἱβ άόόβ έά όñὐέάέ ίά ἱέέñἱἱάέ όόçἱ όάñάέὐό:

```
set log phase tun
```

άέά ίά άδἱόάό ÷έἱἱἱ ίάάὐέά ίάάὐέç όόά άñ÷άβά έάόάññάόβò.

Ἀñάἱἱβ 3:

Έὐάέ όἱἱ PPP όἱό ίά άίάόὐñάέ όέçñἱἱἱβόό άέά όἱἱ άάόόἱ όἱό όόçἱ ὐέέç ίάñέὐ όçò όἱἱάόόçò. Ç έέάέέέάόβά άόόβ άβἱάόάέ άἱ όἱ PPP Ἰ ÷ άέ όñἱάέçἱά όόçἱ έέάόñάἱὐόάόόç έάέ ἱέἱέβñἱός όçò όἱἱάόόçò, όάñὐ ÷ἱόάó ίά άόόἱ όἱἱ όñἱόἱ όέçñἱἱἱβόό όἱἱ άόἱάέñóἱἱ ἱἱ έέά ÷ άέñέόόβ. Ἰέ όέçñἱἱἱβόό άόόὐό ἱόἱάβ ίά άβἱάέ ÷ñβόέἱάό όόçἱ άδβέόόç όἱό όñἱάέβἱάόἱò.

ὀόίάΎάόά ιά ÷ ñÞόç PAP Þ CHAP, ιέ ὀείΎὀ άὀὀΎὀ ÷ ñçόείιθιέιγίόάέ ὀçι þñά ὀçð ὀέὀὀιθιÞçόçð ὀάὀὀιὀçόάὀ ὀιὀ ÷ ñÞόç.

ΆñάιιÞ 15:

Άί ÷ ñçόείιθιέάβὀά PPP Þ CHAP, άάί έά ὀδΎñ ÷ άέ ὀὀί ὀçιάβι άὀὀι ὀñιὀñιθÞ άέὀιιιὀ (login), έάέ έά ὀñΎθάέ ίά ίάὀάὀñΎθάὀά ὀç ãñάιιÞ άὀὀÞ ὀά ὀ ÷ üέέι Þ ίά ὀçι άὀάέñΎὀάὀά. Άάβὀά ὀçι ὀέὀὀιθιÞçόç PAP έάέ CHAP άέά ὀñέὀὀὀιὀñάὀ έάδὀñΎñάέά.

Όι άέὀάñέέιçὀέέυι άέὀιιιὀ ÷ ñçόείιθιέάβ ὀγίόάιç ὀáñιιιέά ίά ὀι chat(8), υἀὀὀ ὀὀιάάβιάέ έάέ ίά ὀι άέὀάñέέιçὀέέυι έέÞçð. Όὀι ὀáñΎάέάιά ίάὀ, ὀι άέὀάñέέιçὀέέυι ÷ ñçόείιθιέάβὀάέ άέά ίέά ὀδçñάὀβά ὀὀçι ιθιβá ç ὀὀιáññá άέὀιιιὀ ιιέΎάέέ ίά ὀçι ὀáñάέΎὀ:

```
J. Random Provider
login: foo
password: bar
protocol: ppp
```

Έά ÷ ñάέάὀάβ ίά άέέΎιáὀά άὀὀι ὀι script άίΎέιáά ίά ὀέὀ άίΎάέάὀ ὀάὀ. ¼ὀάί ãñΎὀάὀά άὀὀι ὀι script ὀçι ὀñÞç ὀñΎ, áááάέυέάβὀά υἀέ Ύ ÷ άὀά άίáñáιθιέÞὀάέ ὀι áñ ÷ áβι έάὀάáñάὀÞ ၎έά ὀι “chat” þὀὀά ίά ιθιñáβὀά ίά ὀñιὀάέιñβὀάὀά άί ç άέάέέέάὀβά άίáιþñέὀçð ὀñι ÷ υñΎάέ ὀιὀὀΎ.

ΆñάιιÞ 16:

ΈΎὀάέ ὀι ÷ ñιιιι ááñΎιáέάὀ (ὀά ááὀὀáñιέάδὀά) άέά ὀç ὀγίáάὀç. Άáþ, ç ὀγίáάὀç έά έέάβὀάέ άὀὀιιáὀά άί ááί ὀδΎñ ÷ άέ έβιÞçόç άέά 300 ááὀὀáñιέάδὀά. Άί ááί έΎέάὀά ίά áβιáὀάέ θιὀΎ ὀáñιáὀέὀιιὀð ὀçð ὀγίáάὀçð έυιιυ ááñΎιáέάὀ, έΎὀά άὀὀÞ ὀç ὀείÞ ὀά ιçáΎί, Þ ÷ ñçόείιθιέÞὀά ὀçι áðέειáÞ -dial ὀç ãñάιιÞ áιὀιέÞ.

ΆñάιιÞ 17:

ΈΎὀάέ ὀç άέáγέὀιὀç ὀçð άέάδáὀÞð. Όι άέὀάñέέιçὀέέυι x.x.x. x έά ὀñΎθάέ ίά áίὀέέάὀάὀὀάέάβ ίá ὀç άέáγέὀιὀç IP θιὀ ὀάὀ Ύ ÷ άέ áθιáιέάβ áθυ ὀιθι ὀáñι ÷ Ύά ὀάὀ. Όι άέὀάñέέιçὀέέυι y.y.y. y έά ὀñΎθάέ ίά áίὀέέάὀάὀὀάέάβ ίá ὀçι áέáγέὀιὀç IP θιὀ Ύ ÷ άέ έάέιñβὀάέ ι ISP ὀάὀ υð θγέç (gateway, ὀι ιç ÷ Ύιçιá ὀὀι ιθιβι ὀὀιáΎάὀά). Άί ι ISP ὀάὀ ááί ὀάὀ Ύ ÷ άέ áþὀάέ άέáγέὀιὀç θγέçð, ÷ ñçόείιθιέÞὀά ὀçι 10.0.0.2/0. Άί ὀñΎθάέ ίά ÷ ñçόείιθιέÞὀάὀά ίέά IP áέáγέὀιὀç θιὀ Ύ ÷ άὀά “ιáίὀΎάέ”, áááάέυέάβὀά υἀέ Ύ ÷ άὀά áçιέιθñáÞὀάέ ίέά έάὀá ÷ þñέὀç ὀὀι /etc/ppp/ppp.linkup ὀγίὀιιá ίá ὀέὀ ιäçáβáð άέά ὀι PPP έάέ ΆὀιáιέέΎὀ IP Άέáὀέγίόάέð. Άί ὀáñάέάβὀάὀά άὀὀÞ ὀç ãñάιιÞ, ὀι ppp ááί έά ιθιñáβ ίá áέὀáέάὀάβ ὀά έάὀΎὀάὀç -auto.

ΆñάιιÞ 18:

ὀñιὀέΎὀά ίέά ὀñιáðέέáñΎίç áέάáñιñÞ (default route) ὀñιὀ ὀι ιç ÷ Ύιçιá θγέçð (gateway) ὀιθι ISP ὀάὀ. Ç áέάέέÞ έΎίç HISADDR áίὀέέάέβὀὀάὀάέ ίá ὀçι áέáγέὀιὀç θγέçð θιὀ έάέιñβæάὀάέ ὀç ãñάιιÞ 17. Άβιáέ ὀçιáίὀέέυι ç ãñάιιÞ άὀὀÞ ίá áιὀáιβæάὀάέ ίáὀΎ ὀçι ãñάιιÞ 17, áέάὀιñáὀέέΎ ὀι HISADDR ááί έά Ύ ÷ άέ áέυιá έΎάάέ áñ ÷ έέÞ ὀείÞ.

Άί ááί áðέέιιáβὀά ίá áέὀáέΎὀάὀά ὀι ppp ὀά έάὀΎὀάὀç -auto, έά ὀñΎθάέ ίá ίáὀάέέιÞὀάὀά άὀὀÞ ὀç ãñάιιÞ ὀὀι áñ ÷ áβι ppp.linkup.

Άáί áβιáέ áðáñáβçὀι ίá ὀñιὀέΎὀάὀά έάὀá ÷ þñέὀç ὀὀι áñ ÷ áβι ppp.linkup υἀάί Ύ ÷ άὀά ὀάάέέÞ áέáγέὀιὀç IP έάέ áέὀáέάβὀά ὀι ppp ὀά έάὀΎὀάὀç -auto. Όὀçι ὀáñβððὀç άὀὀÞ, ιέ έάὀá ÷ υñβὀάέð ὀάὀ ὀὀι θβιáέά áññιέυιáççὀð áβιáέ ὀιὀὀΎð ὀñέι έáί ὀὀιáάέάβὀά. ¼ὀὀ υὀὀὀι ίá έΎέάὀά ίá áçιέιθñáÞὀάὀά ίέά έάὀá ÷ þñέὀç áέά ίá áέὀáέΎὀάὀά έΎθιέά ὀñιáñΎιιáὀά ίáὀΎ ὀçι áθιέάὀΎὀάὀç ὀçð ὀγίáάὀçð. Έά ὀι áιçáÞὀιὀιá άὀὀι áñáυὀáñά ὀά Ύίá ὀáñΎáέάιá ίá ὀι sendmail.

Ιθιñáβὀά ίá áñáβὀά ὀáñáááβáιáὀά áñ ÷ áβιι ñὀέιβὀάυι ὀὀι έάὀΎέιáι usr/share/examples/ppp/.

27.2.1.2.2 PPP ἑἰς Ἀδίαίεῖ Ἰὸ Ἀεἰδὲγίόἰεῖ IP

Αἰ ἰ δᾶνι ÷ Ἰὰὸ ὀὰὸ ἄἰ ἄβιαέ ὀὰὸεἰῖ Ἰὸ Ἀεἰδὲγίόἰεῖ, οἰ PPP ἰδῖῖᾶβ ἰᾶ ἡὲἰεὸὸᾶβ ἰᾶ Ἀεἰδᾶἰᾶἰᾶὸᾶᾶᾶ ὀῖ ὀἰδῆῖῖ ἑἰς ὀῖ Ἀδῖᾶἡᾶᾶᾶ Ἰῖῖ Ἀεἰγῖῖῖ. Ἀὸὸ ἄβιαὸἰᾶᾶ “ἰᾶἰᾶᾶᾶᾶᾶ” ἰᾶ Ἀεἰγῖῖῖ IP, ἑἰς Ἀδῆᾶᾶᾶ Ἰῖᾶᾶ ὀἰ PPP ἰᾶ ὀῖ ἑ Ἰὸἰᾶ Ἰᾶἰᾶ ὀὸὸᾶ, ÷ ἡῖῖῖῖῖῖῖῖ ὀἰ δᾶᾶᾶᾶᾶᾶᾶ IP (IP Configuration Protocol) ἰᾶᾶ ὀῖ ὀῖᾶᾶᾶ. Ὀἰ ἄᾶ ÷ ἄβἰ ἡὲἰβὸᾶᾶᾶ PPP.conf ἄβιαέ ὀἰ βᾶἰ ἰδᾶᾶ ἑἰς ὀἰ PPP ἑἰς Ὀὰὸεἰῖ Ἰὸ Ἀεἰδὲγίόἰεἰ IP, ἰᾶ ὀῖ δᾶᾶᾶᾶᾶ ἰᾶᾶ Ἀεἰᾶᾶ:

```
17 set ifaddr 10.0.0.1/0 10.0.0.2/0 255.255.255.255
```

Ἰδᾶᾶ ἑἰς δᾶᾶᾶᾶᾶᾶ Ἰῖᾶ, ἄἰ δᾶᾶᾶ ἰᾶ δᾶᾶᾶᾶᾶᾶ ὀἰ ἄᾶᾶᾶ ἄᾶᾶᾶ. Ἀδᾶᾶᾶᾶᾶ ἄᾶ ÷ ᾶ ἄᾶᾶ ὀἰ Ἰῖᾶ ÷ ἑᾶᾶᾶ ἑᾶᾶᾶ Ἀεἰᾶᾶᾶᾶᾶ.

Ἀᾶᾶᾶ 17:

Ἰ ἄᾶᾶᾶ ἰᾶᾶ ὀἰ ÷ ἄᾶᾶᾶᾶ / ἄβιαέ ὀἰ δᾶᾶᾶ ὀἰ bits ὀῖ Ἀεἰγῖῖῖ Ἀεἰ ὀἰ ἰδῖῖ ἑἰς Ἀδῖᾶᾶᾶ ὀἰ PPP. ὀὸὸ ἑ Ἰῖᾶ ἰᾶ ÷ ἡῖῖῖῖῖῖῖῖ ἄᾶᾶᾶᾶ ἄᾶᾶᾶᾶ IP δῆἰ ἑᾶᾶᾶᾶᾶ Ἀεἰ ὀῖ δᾶᾶᾶᾶᾶ, Ἀεἰ ὀἰ δᾶᾶᾶᾶᾶ ὀἰ ἄβἰᾶᾶ ἄᾶᾶᾶᾶᾶ ἑἰς Ἀεἰᾶᾶᾶᾶᾶ.

Ὀἰ ὀᾶᾶᾶᾶᾶᾶ ἡᾶᾶᾶ (ὀἰ 0.0.0.0) ἑ Ἰῖᾶ ὀἰ PPP ἰᾶ ἄᾶ ÷ βᾶᾶ ὀῖ Ἀεἰδᾶἰᾶᾶᾶᾶᾶ ἰᾶ ὀῖ Ἀεἰγῖῖῖ 0.0.0.0 ἰᾶᾶ Ἀεἰ ὀῖ 10.0.0.1. Ἀὸὸ ἄβιαέ Ἀδᾶᾶᾶᾶᾶ ὀἰ ἡᾶᾶᾶ Ἰῖᾶᾶ ISP. Ἰῖ ÷ ἡῖῖῖῖῖῖῖῖ ὀἰ 0.0.0.0 ἰᾶ δᾶᾶᾶ ἡᾶᾶᾶ ὀῖ set ifaddr, ἑᾶᾶᾶ ἑἰς ἄᾶᾶᾶᾶᾶ ὀῖ PPP ἰᾶ ἡὲἰβὸᾶᾶ ὀῖ ἄᾶ ÷ ἑᾶᾶ Ἀεἰᾶᾶᾶᾶ ὀῖ ἑᾶᾶᾶᾶᾶ -auto

Αἰ ἄᾶ ÷ ἡῖῖῖῖῖῖῖῖ ὀῖ Ἀδῖᾶᾶᾶ -auto, ἑᾶ ÷ ἡᾶᾶᾶᾶ ἰᾶ Ἀῖῖῖῖῖῖῖῖ ἰᾶ ἑᾶᾶᾶ ÷ ἡᾶᾶᾶ ὀἰ ἄᾶ ÷ ἄβἰ /etc/ppp/ppp.linkup. Ὀἰ ἄᾶ ÷ ἄβἰ PPP.linkup ÷ ἡῖῖῖῖῖῖῖῖ ἰᾶᾶ ὀῖ Ἀδῖᾶᾶᾶᾶ ὀῖ ὀῖᾶᾶᾶ. Ὀἰ ὀῖᾶᾶ Ἀὸὸ, ὀἰ PPP ἑᾶ Ἰ ÷ Ἀᾶ ᾶᾶ Ἀδῖᾶᾶᾶ Ἀεἰγῖῖῖ ὀῖ Ἀεἰᾶᾶᾶ ἑἰς ἑᾶ ἄβιαέ δῆἰ Ἀᾶᾶᾶ ἰᾶ δᾶᾶᾶᾶᾶ ὀῖ ἑᾶᾶ ÷ ἡᾶᾶᾶ ὀἰ δᾶᾶᾶ Ἀᾶᾶᾶᾶᾶᾶ:

```
1 provider:
2 add default HISADDR
```

Ἀᾶᾶᾶ 1:

Ἰᾶ ὀῖ Ἀδῖᾶᾶᾶᾶ ὀῖ ὀῖᾶᾶᾶ, ὀἰ PPP ἑᾶ ὀἰᾶᾶ Ἀεἰ ἰᾶ ἑᾶᾶᾶ ÷ ἡᾶᾶᾶ ὀἰ PPP.linkup ὀἰᾶᾶ ἰᾶ ὀἰᾶ ἄᾶᾶᾶᾶ ἑᾶᾶᾶ: Ἀᾶ ÷ ἑᾶᾶ ἑᾶ ἄᾶᾶᾶᾶᾶ ἰᾶ ὀᾶᾶᾶᾶ ὀῖ δᾶᾶᾶ Ἀᾶᾶ ὀἰ Ἰ ÷ Ἀᾶ ÷ ἡῖῖῖῖῖῖῖῖ ὀἰ ἄᾶ ÷ ἄβἰ PPP.conf. Αἰ Ἀὸὸ Ἀδῖᾶᾶᾶ, ἑᾶ ὀἰᾶᾶ Ἀεἰ ἰᾶ ἑᾶᾶᾶ ÷ ἡᾶᾶᾶ Ἀεἰ ὀῖ Ἀεἰγῖῖῖ IP ὀῖ δῆᾶᾶ. ᾶ ἑᾶᾶᾶ ÷ ἡᾶᾶᾶ Ἀᾶᾶ ἰᾶ Ἀᾶᾶᾶ ἡᾶᾶᾶ IP Ἀεἰγῖῖῖ, ἰᾶ ὀἰᾶᾶᾶ ἡᾶᾶᾶ. Αἰ ἄᾶ Ἰ ÷ Ἀᾶ Ἀεἰᾶ Ἀᾶᾶᾶ ᾶ ὀῖᾶᾶ ἑᾶᾶᾶ ÷ ἡᾶᾶᾶ, ἑᾶ ἄβιαέ ἰᾶ ÷ ἰᾶᾶ Ἀεἰ ὀῖ ἑᾶᾶᾶ ÷ ἡᾶᾶᾶ MYADDR.

Ἀᾶᾶᾶ 2:

ᾶ Ἀᾶᾶᾶ Ἀᾶᾶ ἑ Ἰῖᾶ ὀἰ PPP ἰᾶ δᾶᾶᾶᾶᾶ ἰᾶ δᾶᾶᾶᾶᾶ Ἰῖᾶ Ἀεἰᾶᾶᾶ ᾶ ἰδῖῖ ἰᾶ ἄᾶ ÷ ἰᾶ ὀἰ HISADDR. Ὀἰ HISADDR ἑᾶ Ἀᾶᾶᾶᾶᾶᾶ ἰᾶ ὀῖ Ἀεἰγῖῖῖ IP ὀῖ δῆᾶᾶ ἰᾶ Ἀᾶᾶ Ἀᾶᾶᾶᾶ Ἰῖᾶ ὀἰ δᾶᾶᾶᾶᾶᾶ IP.

Ἀᾶᾶ ὀῖ ἑᾶᾶᾶ ÷ ἡᾶᾶᾶ pmdemand ὀἰ ἄᾶ ÷ ἄβἰ /usr/share/examples/ppp/ppp.conf.sample ἑἰς /usr/share/examples/ppp/ppp.linkup.sample Ἀεἰ Ἰῖ ὀἰ ἑᾶᾶᾶᾶᾶ ἄᾶᾶᾶᾶ.

27.2.1.2.3 Ἐᾶᾶ Ἀεἰᾶᾶ ÷ ἡᾶᾶᾶ Ἐᾶᾶᾶ

Ἰᾶᾶ ἡὲἰβᾶᾶᾶ ὀἰ PPP ἰᾶ ἑᾶᾶᾶᾶ Ἀεᾶᾶ ÷ ἡᾶᾶᾶ ἑᾶᾶᾶ ὀἰ Ἰῖ ἰῖ ÷ Ἰῖᾶ ὀἰ ὀἰᾶᾶᾶ ὀἰ Ἰῖ ὀἰᾶᾶ Ἀᾶᾶᾶ (LAN), ἑᾶ δᾶᾶᾶ ἰᾶ Ἀᾶᾶᾶᾶᾶ ἰᾶ ἑ Ἰῖᾶ ἰᾶ δᾶᾶᾶᾶᾶ ὀἰ Ἰῖᾶ, ἑᾶ δᾶᾶᾶ ἰᾶ Ἀᾶᾶᾶᾶ ὀἰ ἰῖ ÷ Ἰῖᾶ ἰᾶ Ἀᾶᾶᾶ ὀἰ βᾶἰ ὀἰᾶᾶᾶ ἰᾶ ὀἰ LAN, ἑᾶ ἰᾶ ÷ ἡῖῖῖῖῖῖῖῖ ὀἰ Ἀᾶᾶᾶ enable

proxy οόι άñ÷άβι /etc/ppp/ppp.conf. Έά δñÝðάέ άδβόçð íά άðέάάάέβρσάðά üðέ οί άñ÷άβι /etc/rc.conf
ðάñέÝ÷άέ óά ðάñάέÛòù:

```
gateway_enable="YES"
```

27.2.1.2.4 Δίεί getty;

Ç áíυόçóά Õðçñάóβά Άέóüäüö ìÝóù Άðέέιäέέβð Õýíäáóçð (dial in) ðάñÝ÷άέ íέά έάέβ ðάñέñάóβ ó÷άðέέÛ ìά óçí
áíññäüðβçóç òðçñάóέβί άðέέιäέέβί έέβρσάüí ÷ñçóέüðίέβίðάð óçí getty(8).

Íέά áíáέέäéðέέβ óçí getty άβίάέ ç mgetty (<http://mgetty.greenie.net/>) (άðü öí ðάέÝðí comms/mgetty+sendfax),
íέά ðέí Ýíððίç Ýέäüóç óçð getty, ç üðίβά Ý÷άέ ó÷άάέáóðάβ äέά íά έäìäÛíäέ öðüφέí óέð άðέέιäέέÝð äñäüÝð.

Õά ðέäüíäéðβíäá óçð mgetty άβίάέ üðέ άðέέιäέéüðβ áíññäÛ ìά óά modem, öí üðίβί óçíáβíáέ üðέ áí ç èýñä άβίάέ
áðáíññäüðίέçíÝíç óóü /etc/ttys, öí modem óáð ääí έä áðáíðβρσάέ óçí έέβóç.

ÌäóáááíÝóðáñäð äéäüóáέð óçð mgetty (άðü óçí 0.99beta έάέ ìáóÛ) öðüóçñβæüöí άδβόçð áððüìáðç áíβ÷íáðóç PPP
streams, άðέöñÝüíðáð óóüðð ðäéÛðáð óáð ðñüóááóç óóüí áíððçñáðóçð ÷ññð ÷ñβóç scripts.

ΆέάáÛóðά óçí áíυόçóά Mgetty έάέ AutoPPP äέá ðáñέóóüðáñäð ðççñüöñβäð ó÷άðέέÛ ìά óçí mgetty.

27.2.1.2.5 ¶äáéáð äέá öí PPP

ÕðóέέιäέέÛ, ç äéðÝέáóç óçð áíðíέβð ppp δñÝðάέ íά áβíäáέ üð ÷ñβóçð root. Áí üðóüóí éÝέáðά íá άðέöñÝðáð
óçí äéðÝέáóç öíð ppp óά έáðÛóðáç áíððçñáðóçð üð έáñíέéüð ÷ñβóçð (ìá öíí öñüðí ðüð ðáñέñÛóáðáέ ðáñάέÛòù)
έá δñÝðάέ íá äβρσάðá óá áððü öí ÷ñβóç óá έáðÛέέçä äέέάέβíäá äέá íá äéðäέáβ öí ppp, ðñüóéÝöííðáð öíí óçí
ñÛäá network óóü άñ÷άβι /etc/group.

Έá δñÝðάέ άδβόçð íá öíðð äβρσάðá ðñüóááóç óá Ýíá β ðáñέóóüðáñä ðìβíäáð öíð άñ÷άβιð ñðèìβóáüí, ÷ñçóέüðίέβίðáð
óçí áíðíέβ allow:

```
allow users fred mary
```

Áí ÷ñçóέüðίέβρσάðά óçí άðέέιäβ áððβ öíð ðìβíä default, έá äβρσάðá óá áððüýð öíðð ÷ñβρσáðð ðñüóááóç óá üέáð óέð
ñðèìβóáέð.

27.2.1.2.6 Έάέýóç PPP äέá × ñβρσáðð ìä ÄöíáíέέÛ IP

Äçíέíðñβρσά Ýíá άñ÷άβι ìä öí üññá /etc/ppp/ppp-shell öí üðίβί íá ðáñέÝ÷άέ óά ðáñάέÛòù:

```
#!/bin/sh
IDENT='echo $0 | sed -e 's/^\.*-\(.*\)$/\1/'
CALLEDAS="$IDENT"
TTY='tty'

if [ x$IDENT = xdialup ]; then
    IDENT='basename $TTY'
fi

echo "PPP for $CALLEDAS on $TTY"
echo "Starting PPP for $IDENT"
```

```
exec /usr/sbin/ppp -direct $IDENT
```

Οἱ script αδοῦ έά δñÝðάέ ίά άβίάέ άέοάέÝóέι. ΆçίέιòñάΠόοά όρñά Ýίά όοιάρέέέυ άάοιῦ δῖο ίά ἢñÛæάόάέ ppp-dialup ÷ñçóέιῖῖέβίόάδ όέδ δάñάέÛòῦ άίόῖεÝò:

```
# ln -s ppp-shell /etc/ppp/ppp-dialup
```

Έά δñÝðάέ ίά ÷ñçóέιῖῖέβίόάδ αδοῦ όἱ script ἠò όἱ έÝέοοῖò άέά ὑέῖòδ όἱòδ dialup ÷ñΠόοάδ. Άαρ óάβίáόάέ Ýίά δάñÛáάέάιá όἱò /etc/passwd άέά Ýίá ÷ñΠόόç dialup ίά ἢññá pchilds (έοιçέάβòά ὑόέ άάί δñÝðάέ ίά όñἱῖῖῖέάβòά Ûíáóá όἱ άñ÷άβἱ óἱ έῦάέέβἱ, áέέÛ ἱÝóῦ όçò άίόῖεΠò vipw(8)).

```
pchilds:*:1011:300:Peter Childs PPP:/home/ppp:/etc/ppp/ppp-dialup
```

ΆçίέιòñάΠόοά Ýίá έάδὺέῖῖῖ /home/ppp δññíóáÛóέἱῖ άέά άίÛáἱῦóç áδῦ ὑέῖòδ, ἱ ἱῖἱβἱò έά δάñέÝ÷άέ óá δάñάέÛòῦ έάρÛ άñ÷άβἱ:

```
-r--r--r-- 1 root      wheel          0 May 27 02:23 .hushlogin
-r--r--r-- 1 root      wheel          0 May 27 02:22 .rhosts
```

όά ἱῖἱβἱά άἱῖῖῖῖῖῖ όçἱ άἱòÛίέóç όἱò ἱçίýíáíóῖò áδῦ όἱ άñ÷άβἱ /etc/motd.

27.2.1.2.7 Έάέýόç PPP άέά ×ñΠόόάò ίά Óόάόέέῦ IP

ΆçίέιòñάΠόοά όἱ άñ÷άβἱ ppp-shell ἠδῦò óάβίáόάέ δάñάδÛῖῦ, έάέ άέά έÛέά έῖῖάñέάóἱῦ ίά óόάόέέῦ IP, άçίέιòñάΠόοά Ýίá όοιάρέέέυ άάοιῦ δññò όἱ ppp-shell.

Άέά δάñÛáάέάιá, άί Ý÷άδά όñάέò δάέÛóáδ dialup, όἱòδ fred, sam, έάέ mary, óἱòδ ἱῖἱβἱòδ áέòάέάβòά άññἱῖῖῖῖῖçç /24 CIDR, έά δñÝðάέ ίά άñÛòáòά óá δάñάέÛòῦ:

```
# ln -s /etc/ppp/ppp-shell /etc/ppp/ppp-fred
# ln -s /etc/ppp/ppp-shell /etc/ppp/ppp-sam
# ln -s /etc/ppp/ppp-shell /etc/ppp/ppp-mary
```

Άέά έÛέά έῖῖάñέάóἱῦ ÷ñΠόόç dialup, έά δñÝðάέ ίά ñòεἱέόóáβ όἱ έÝέοοῖò óἱ όοιάρέέέυ άάοιῦ δῖο άçίέιòñάΠέçέά δάñάδÛῖῦ (άέά δάñÛáάέάιá ἱ όοιάρέέέῦò άάóἱῦò άέά όἱ έÝέοοῖò όἱò ÷ñΠόόç mary έά δñÝðάέ ίά άβίάέ ἱ /etc/ppp/ppp-mary).

27.2.1.2.8 Ñýèíέóç όἱò ppp.conf άέά ×ñΠόόάò ίά Άόἱάίέέῦ IP

Οἱ άñ÷άβἱ /etc/ppp/ppp.conf έά δñÝðάέ ίά δάñέÝ÷άέ έÛέέ άίόβòἱέ÷ἱ ίά όἱ δάñάέÛòῦ:

```
default:
  set debug phase lcp chat
  set timeout 0

ttyu0:
  set ifaddr 203.14.100.1 203.14.100.20 255.255.255.255
  enable proxy

ttyu1:
  set ifaddr 203.14.100.1 203.14.100.21 255.255.255.255
  enable proxy
```

Όχιάβύος: Ç óðïß÷έός άβιάέ όçιάίόέêß.

Άέά êÛèå óðíääñßá, öññòþíáóáέ ç áñúòçóá default : . Άέά êÛèå äñáñìß dialup ðñò áñáñáñðñéáßóáέ óðñ /etc/ttys, èå ðñÝðáέ íá äçñéññáßóáðå íéá éáóá÷þñέός ùññéá ìå áóòß ðñò óáβíáóáέ ðáñáðÛñ ãéá òñ ttys0 : . ÊÛèå äñáñìß èå ðñÝðáέ íá ðáβññíáέ ìéá ìííááéêß äéáyέðñíός IP áðñ òñ áðñèáñá òñ IP äéáðèýñíóáñ ðñò ðññññßæñíóáέ äéá òñðð äðñáñééñýð ÷ñßóðåð.

27.2.1.2.9 Ñýèñέός òñò ppp.conf äéá ×ñßóóåð ìå ÓóáóééÛ IP

Άέòñð áðñ óå ðáñéå÷÷ñíáíá ðñò ððñíáßáñíáðñò /usr/share/examples/ppp/ppp.conf èå ðñÝðáέ íá ðñññéÝóáðå ìéá áñúòçóá äéá éåèÝñá áðñ ðñòð ÷ñßóóåð dialup óðñòð ðññññò Ý÷÷ äéñáñéåß óóáóééÛ IP. Êå óðñá÷βóññíá ìå òñ ðáñÛááééñá ìåð ìå ðñòð ÷ñßóóåð fred, sam, éáέ mary.

```
fred:
    set ifaddr 203.14.100.1 203.14.101.1 255.255.255.255

sam:
    set ifaddr 203.14.100.1 203.14.102.1 255.255.255.255

mary:
    set ifaddr 203.14.100.1 203.14.103.1 255.255.255.255
```

Όñ äñ÷áβñ /etc/ppp/ppp.linkup èå ðñÝðáέ áðßóçð ìå ðáñéÝ÷÷é ðéçñññññáð äññññéñáçóçð äéá êÛèå ÷ñßóç ìå óóáóééÛ IP (áñ áðáéóáßóáέ). Ç ðáñáéÛòñ äñáñìß èå ðñññéÝóáέ ìéá äéáäñññß ðññò òç äéáyέðñíός äééðýññ 203.14.101.0/24 ìÝòñ òçð óýñááóçð ppp òñò ðáèÛðç.

```
fred:
    add 203.14.101.0 netmask 255.255.255.0 HISADDR

sam:
    add 203.14.102.0 netmask 255.255.255.0 HISADDR

mary:
    add 203.14.103.0 netmask 255.255.255.0 HISADDR
```

27.2.1.2.10 mgetty éáέ AutoPPP

Όñ port comms/mgetty+sendfax, Ýñ÷áóáέ ìå ðñññáðééääñÝñç òçñ áðééññß AUTO_PPP, áðéòñÝðññóð Ýðóέ óççñ mgetty ìå áñé÷÷ñáé òçñ òÛçð LCP òññ óðñáÝóáññ PPP éáέ ìå äéðáéåß áðòññíáóá Ýñá êÝéòñòð ppp. Ûòòñññ, éåèð ìå áðòñ òñ ðññðññ äññ áñáñáñðññéáßóáέ ç ðñññáðééääñÝñç äéñññòéßá ìñññáðñò ÷ñßóç éáέ èñáééñý, áβñáέ áðáñáßóçðñ ìå äññáé ðéóðñðññççð òññ ÷ñçóçþñ ìå òç ÷ñßóç PAP ð CHAP.

Ç áñúòçóá áóòß ðññññðññéÝóáέ ùðé ì ÷ñßóçð Ý÷÷ äé ððèìßóáέ, ìåðáäéùððßóáέ éáέ äééáóáóòßóáέ ìå áðéðð÷βá òñ port comms/mgetty+sendfax óðñ óýóóçñá ðñò.

```
Äääáéèèåßðå ùðé òñ äñ÷áβñ óáð /usr/local/etc/mgetty+sendfax/login.config ðáñéÝ÷÷é óå óå ðáñáéÛòñ:

/Äòòòò/ - - /etc/ppp/ppp-pap-dialup
```

Άðòñ èå ðáé óççñ mgetty ìå äéðáéÝóáέ òñ script ppp-pap-dialup äéá òéð PPP óðñáÝóáέð ðñò áñé÷÷ñáéçééáñ.

ΆçιέιτῶñāΠρόά Ýίá áñ÷áβι íà òι ùíñá /etc/ppp/ppp-pap-dialup òι ìðìβι έá ðáñέÝ÷áέ ðá áέùέιτῶέá (òι áñ÷áβι έá ðñÝðáέ íá áβίáέ áέòáέÝóέι):

```
#!/bin/sh
exec /usr/sbin/ppp -direct pap$IDENT
```

Άέá έÙέá ãñáñΠ dialup ðιῶ áβίáέ áíáñáñιðίέçìÝίç óòι /etc/ttys, áçιέιτῶñāΠρόά íέá áíòβóòιέ÷ç έáóá÷βñέóç óòι áñ÷áβι /etc/ppp/ppp.conf. Ç έáóá÷βñέóç áðòΠ ìðìñáβ íá óòιððÙñ÷áέ ÷ùñβò ðñùáέçíá ìá áóðÝð ðιῶ ìñβóáìá ðáñáðÙíù.

```
pap:
  enable pap
  set ifaddr 203.14.100.1 203.14.100.20-203.14.100.40
  enable proxy
```

ΈÙέá ÷ñΠρόóç ðιῶ áέóÝñ÷áóáέ ìá áóòù òιí ðñùðι, έá ðñÝðáέ íá áέáέÝóáέ ùíñá ÷ñΠρόóç/έùáέέù óòι áñ÷áβι /etc/ppp/ppp.secret. ΆíáέέáέòέέέÙ, ìðìñáβòá íá ðñιòέÝóáòá òçí ðáñáέÙòù áðέέιáΠ βρòá íá áβιáòáέ ðέóòιðιβçóç òùí ÷ñçóòβι Ýέòù PAP ìá áÙóç ðá óòιέ÷áβá ðιῶ áñ÷áβι ðιῶ /etc/passwd.

```
enable passwdauth
```

Άί έÝέáðá íá áðιáβρòáòá óáóóέέù IP óá έÙðιέιτῶ ÷ñΠρόáð, ìðìñáβòá íá έáέìñβóáòá òçí áέáýέòιόç ùò ðñβòι ùñέóíá óòι áñ÷áβι /etc/ppp/ppp.secret. Άέá ðáñáááβáìáóá, ááβòá òι áñ÷áβι /usr/share/examples/ppp/ppp.secret.sample.

27.2.1.2.11 ΆðáέòÙóáέò MS

Άβίáέ áòιáòùí íá ñòèìβóáòá òι PPP βρòá íá ðáñÝ÷áέ áέáðέγíóáέò DNS έáέ NetBIOS έáòÙ áðáβòçóç.

Άέá íá áíáñáñιðίέçìΠρόáòá áóðÝð ðέò áðáέòÙóáέò ìá òçí Ýέáιòç 1.x ðιῶ PPP, έá ðñÝðáέ íá ðñιòέÝóáòá ðέò ðáñáέÙòù ãñáñÝð óòι ó÷áðέέù òιΠíá ðιῶ /etc/ppp/ppp.conf.

```
enable msex
set ns 203.14.100.1 203.14.100.2
set nbns 203.14.100.5
```

Άέá òι PPP áðù òçí Ýέáιòç 2 έáέ ðÙíù:

```
accept dns
set dns 203.14.100.1 203.14.100.2
set nbns 203.14.100.5
```

Όι ðáñáðÙíù έá áçìáñβρòáέ ðιῶð ðáέÙóáò áέá òιí έýñέí έáέ ááòòáñáýííóá áíòðçñáòçòΠ DNS, έáέ áέá òιí áíòðçñáòçòΠ ìññÙòùí NetBIOS.

Άðù òçí Ýέáιòç 2 έáέ ðÙíù, áí ðáñáέáέòέáβ ç ãñáñΠ set dns, òι PPP έá ÷ñçóέιðιέçìΠρόáέ ðέò ãñáñÝð ðιῶ έá áñáέ óòι /etc/resolv.conf.

27.2.1.3 ×ñçόείιθιέπιόαό όç Äóíáóüóçóá íáóÜöñáóçò Äéáóέγíóáúí (NAT) óìö PPP

Öìö PPP Ý÷áέ όçí έέάííóçóá íá ÷ñçόείιθιέΠόάέ áέέü öìö áóüóñέέü NAT, ÷üñβò íá áðάέóíγíóáέ íé έέάííóçóáò áíáέáóáγέóíóçò öìö ðññΠíá. Ìðñáβòá íá áíáñáíθιέΠόáóá áóðö όç έáέóíöñáβá íá όçí áέüέíöèç ãñáíìö óóí /etc/ppp/ppp.conf:

```
nat enable yes
```

ÁíáέéáέóέέÜ, öì NAT öìö PPP ìðñáβ íá áíáñáíθιέçέáβ íá όçí áðέέíäΠ -nat óóçí ãñáíìö áíóíεπí. Ìðñáβòá áέüíá íá áÜέáóá όçí áðέέíäΠ ppp_nat óóí áñ÷áβí /etc/rc.conf. Ç áðέέíäΠ áóðöΠ áβíáέ áíáñáíθιέçíÝíç áðü ðñíáðέέíäΠ.

Áí ÷ñçόείιθιέΠόáóá áóðü öì ÷áñáέóçñέóóέέü, ìÜέέíí έá ãñáβòá ÷ñΠóέíáð έáέ óέð ðáñáέÜöü áðέέíäÝð áέá öì /etc/ppp/ppp.conf, ìá óέð ìðñáβò áíáñáíθιέçέáβóáέ ç ðññεçóç áέóáñ÷üíáííí óóíáÝóáúí:

```
nat port tcp 10.0.0.2:ftp ftp
nat port tcp 10.0.0.2:http http
```

Π áí ááí áìðέóóáγáóóá έáέüέíö öì áíüóñέέü áβέðöì:

```
nat deny_incoming yes
```

27.2.1.4 ÖáέέéÝò Ñöèìβóáέò ÖóóðΠíáöìö

÷áóá ðéÝíí ñöèìβóáέ öì ppp, áέéÜ öðÜñ÷íö ìáñέéÜ áέüíá ðñÜáíáóá öìö ðñÝðáέ íá εÜíáóá ðñéí íá áβíáέ Ýöíέíí áέá έáέóíöñáβá. ¼έá ðáñέéáíáÜííóí όçí áðáíáñááóβá öìö áñ÷áβíö /etc/rc.conf.

Ìáέέíπíóáð áðü όçí áñ÷Π öìö áñ÷áβíö áóðöγ, ááááέüèáβòá üóé áβíáέ ññέóíÝíç ç ãñáíìö hostname=, ð.÷.:

```
hostname="foo.example.com"
```

Áí ì ISP óáð ðáñÝ÷áέ óóáóέéΠ IP áέáγέóíóç έáέ üñá, áβíáέ ìÜέέíí έáέγðáñí íá ÷ñçόείιθιέΠόáóá áóðü öì üñá üò üñá áέá öì ìç÷Üíçíá óáð.

ÖÜíöá áέá όç ìáóááέçðΠ network_interfaces. Áí εÝέáðá íá ñöèìβóááð öì óýóóçíá óáð íá έáέáβ öì ISP óáð έáðÜ áðáβóçóç, ááááέüèáβòá üóé öðÜñ÷áέ óóç εβóóá ç óóóéáðö tun0, áέáóíñáðέéÜ áóáέñÝóóá όçí.

```
network_interfaces="lo0 tun0"
ifconfig_tun0=
```

Öçíáβüóç: Ç ìáóááέçðΠ ifconfig_tun0 έá ðñÝðáέ íá áβíáέ Üááέá, έáέ έá ðñÝðáέ íá áçíέíöñáçέáβ Ýíá áñ÷áβí ìá üííá /etc/start_if.tun0. Öì áñ÷áβí áóðü έá ðñÝðáέ íá ðáñέÝ÷áέ όçí ðáñáέÜöü ãñáíìö:

```
ppp -auto mysystem
```

Öì script áóðü áέóáέáβòáέ έáðÜ όç áéÜñέáέá ñγέíέóçò öìö áέéðýíö, ìáέέíπíóáð Ýóóé öì ááβííá ppp óá έáðÜóóáóç áóðüíáóçò έáέóíöñáβáð. Áí áέáéÝóáðá εÜðíéí öìðέéü áβέðöì (LAN) áέá öì ìðñí öì ìç÷Üíçíá áóðü Ý÷áέ öì ñüέí όçò ðýèçò, βóüò íá εÝέáðá áðβóçò íá ÷ñçόείιθιέΠόáóá όçí áðέέíäΠ -alias. Äáβòá όç óáέβáá manual áέá ðáñέóóüðáñáð έáððííÝñáέáð.

Äáááέüèáβòá üóé ç ìáóááέçðΠ áέá öì ðñüáñáííá router Ý÷áέ óáέáβ óóí NO ìÝóü όçò áðüíáíçò ãñáíìö óóí /etc/rc.conf:

```
router_enable="NO"
```

Άβιάέ οçίάιόέέυ ίά ιçί ίάέέίΠόάέ ι άάβιίάò routed, ι ιðιβιò óοίΠέυò áέάάνÛοάέ óέò ðñιάðέέάιÛίάò óείÛò ðιò ðβιáέά άññιέυάçóç ðιò äçιέιòñáιγίόάέ áðu ðι ppp.

Άβιάέ ιÛέέι έάέΠ έάÛά ίά áιáóóáέβóáòά υòέ ç άñáιΠ sendmail_flags άáι ðáñέέáιáÛίáέ óçί áðέέιáΠ -ç, áέάοιñáðέέÛ ðι sendmail έá ðñιόðáέáβ έÛέá ðυóι ίά έÛίáέ áíááΠóçóç ðιò áέέòγίò, ιá ðέέáιυ áðιòÛέáóιá ðι ιç÷Ûίçιá óáð ίά áέòáέáβ óçέáòυιέέΠ óγίááóç (dial out). Ιðιñáβòά ίά äιέέιÛóáòά:

```
sendmail_flags="-bd"
```

Ïι ίáέιÛέóçιá ðιò ðáñáðÛίυ, άβιάέ υòέ ðñÛðáέ ίά áιáíááέÛóáòά ðι sendmail ίά áðáíáíáòÛóáέ óçί ιòñÛ ðυι ιçíοιÛòυι, έÛέá οιñÛ ðιò áðιέáέβóóáóáέ ç óγίááóç ppp, άñÛοιíóáð:

```
# /usr/sbin/sendmail -q
```

εòυò èÛέáòά ίά ÷ñçóέιιðιέΠóáòά óçί áíóιέΠ !bg óοι ppp.linkup áέá ίά áβιáòáέ ðι ðáñáðÛίυ áðòυιáóá:

```
1 provider:
2 delete ALL
3 add 0 0 HISADDR
4 !bg sendmail -bd -q30m
```

Áί áðòυι ááι óáð άñÛóáέ, άβιάέ áοιáòυι ίά ðòέιβóáòά Ûίá “dfilter” ðι ιðιβι ίά áðιέυðòáέ óçί έβιçóç SMTP. Άάβòά óá ððιááβáιáóá áέá ðáñέóóυòáñáð έáððñÛñáέáð.

Ïι ιυι ðιò ιÛίáέ άβιάέ ίά áðáíáέέέίΠóáòά ðι ιç÷Ûίçιá. ΙáòÛ óçί áðáíáέέβιçóç, ιðιñáβòά áβòά ίά άñÛóáòά:

```
# ppp
```

έάέ Ûðáέóá dial provider áέá ίά ίáέέίΠóáòά óç óοιááñβá PPP, Π áί èÛέáòά ðι ppp ίά áðιέáέέóóÛ óέò óοιááñβáð áðòυιáóá έÛέá οιñÛ ðιò ððÛñ÷áέ έβιçóç ðñιò ðι áíυðáñέέυι áβέòοι (έάέ ááι Û÷áòá äçιέιòñáΠóáέ ðι script start_if.tun0) ιðιñáβòά ίά άñÛóáòά:

```
# ppp -auto provider
```

27.2.1.5 Ðáñβέçøç

Άέá ίά áíáέáòáέáέβóιòιá, óá ðáñáέÛòυι áΠιáóá άβιάέ áðáñáβóçóá υòáί ááέáέέóóÛóá ðι ppp áέá ðñβøç οιñÛ:

Áðu óç ίáñέÛ ðιò ιç÷áíΠιáòιò-ðáέÛóç:

1. Άáááέυέáβòά υòέ ðáñέέáιáÛίáóáέ óοι ðòñΠιá óáð ç óòóέáòΠ tun.
2. Άáááέυέáβòά υòέ ððÛñ÷áέ ðι άñ÷áβι óçò óóóέáòΠð tunw óοιí έáòÛέιáι /dev.
3. ÄçιέιòñáΠóáòá ιέá έáóá÷ñέóç óοι άñ÷áβι /etc/ppp/ppp.conf. Ïι ðáñÛááέáιá áέá ðι pmdemand έá ðñÛðáέ ίá άβιáέ áðáñéÛð áέá ðιò ðáñέóóυòáñιòò ISPs.
4. Áί Û÷áòá áοιáιέέΠ áέáýèóιóç IP, äçιέιòñáΠóáòá ιέá έáóá÷ñέóç óοι /etc/ppp/ppp.linkup.
5. Áίçιáñβòά ðι άñ÷áβι /etc/rc.conf.
6. ÄçιέιòñáΠóáòá ðι script start_if.tun0 áí ÷ñáέÛááòá έέΠóç έáòÛ áðáβóçóç.

Άδϋ όç ιάñέÛ όιϝ άιϝδçñάόçόP:

1. Άάάέέεάβδά υέδ δάñέέάιάÛίάδάέ όόιí δδñPία όάδ ç όόόέάδP tun.
2. Άάάέέεάβδά υέδ όδÛñ÷άέ όι άñ÷άβι όçδ όόόέάδPδ tunN όόιí έάδÛέιαι /dev.
3. ΆçιέιϝñάPόάά ιέά έάάά÷ñέόç όόι /etc/passwd (÷ñçόέιϝιέπíόάδ όι δñüāñāιιά vipw(8)).
4. ΆçιέιϝñάPόάά Ýία άñ÷άβι profile όόιí δñιούδέέü έάδÛέιαι όιϝ ÷ñPόδç, όι ιδñβι ιά άέδάέάβ όçι άίόιέP ppp -direct direct-server P έÛδñιέά άίόβόόιέ÷ç.
5. ΆçιέιϝñάPόάά ιέά έάάά÷ñέόç όόι /etc/ppp/ppp.conf. Όι δάñÛάέέιιά άέά όι direct-server έά δñÝδάέ ιά άβιάέ άδάñέÝδ.
6. ΆçιέιϝñάPόάά ιέά έάάά÷ñέόç όόι /etc/ppp/ppp.linkup.
7. ΆίçιάñPόάά όι άñ÷άβι /etc/rc.conf.

27.3 ×ñçόέιϝιέπíόάδ όι PPP όιϝ ΔδñPία

ΈÛδñιέά όιPιάόά δñιÝñ÷ιιόάέ άδϋ άñ÷έέP όόιάέόόιñÛ όυι Gennady B. Sorokopud έάέ Robert Huff.

Δñιέάέιδñβçç: Ç άιüδçόά άόδP άβιάέ Ýάέδñç έάέ ιδññάβ ιά άόάñιιόόάβ ιüñι όά όόόδPιάόά FreeBSD 7.X.

27.3.1 Ñöèìβæιιόάδ όι PPP όιϝ ΔδñPία

Δñεί ιάέέιPόάά ιά ñöèìβæιιόά όι PPP όόι ιç÷Ûίçιά όάδ, άάάέέεάβδά υέδ όι pppd άñβόέάδάέ όόιí έάδÛέιαι /usr/sbin έάέ υέδ όδÛñ÷άέ ι έάδÛέιαιδ /etc/ppp.

Όι pppd Ý÷άέ άγι έάάάόδÛόάέδ έάέόιϝñάβδ:

1. Ûδ δάέÛδçδ (“client”) — υόάι έÝέάδά ιά όόιáÝόάδ όι ιç÷Ûίçιά όάδ ιά όιí Ýñü έüóιι ιÝóü όάέñέάέPδ όγíάάόçδ όγíάάόçδ P άñāñPδ modem.
2. Ûδ άιϝδçñάόçδPδ (“server”) — όι ιç÷Ûίçιά όάδ άβιάέ όόιáñÝñι όόι άβέδóι έάέ ÷ñçόέιϝιέπíόάέ άέά ιά όόιáÝόάέ Ûέειϝδ όδñιέάέόδÝδ, ÷ñçόέιϝιέπíόάδ όι PPP.

Έάέ όέδ άγι δάñέδδPόάέδ έά ÷ñάέάόάβ ιά άçιέιϝñάPόάά Ýία άñ÷άβι άδέέιāπí (/etc/ppp/options P ~/.ppprc άί όόι ιç÷Ûίçιά όάδ όδÛñ÷ιόι δάñέόóüδάñιέ άδϋ Ýιáδ ÷ñPόάδδ δñϝ ÷ñçόέιϝιέπí όι PPP).

Έά ÷ñάέάόάβδά άδβόçδ έάέ έÛδñιέι έιáέóιέέü άέά ÷ñPόç ιά modem έάέ όάέñέάέÝδ όόιáÝόάέδ (έάδÛ δñιδβιçç όι comms/kermit), Pόάά ιά ιδññάβδά ιά έάέÝόάδ έάέ ιά άδñέάάόδPόάά όç όγíάάόç ιά όιí άδñιέñóιÝñι άιϝδçñάόçδP.

27.3.2 ×ñçόέιϝιέπíόάδ όι pppd υέδ ΔάέÛδçδ

ΆάόέóιÝñι όά δççñιϝñβδδ δñϝ δάñάβ÷ά ι Trev Roydhouse.

Ìδññάβδά ιά ÷ñçόέιϝιέPόάά όι /etc/ppp/options δñϝ óάβñάάέ δάñάέÛδϋ, άέά ιά όόιáάέάβδά όά ιέά άñāñP PPP άίüδ άιϝδçñάόçδP óāñιáóέέπí (terminal server) όçδ Cisco.

```

crtstcts      # enable hardware flow control
modem         # modem control line
noipdefault   # remote PPP server must supply your IP address
               # if the remote host does not send your IP during IPCP
               # negotiation, remove this option
passive       # wait for LCP packets
domain ppp.foo.com      # put your domain name here

:remote_ip    # put the IP of remote PPP host here
               # it will be used to route packets via PPP link
               # if you didn't specified the noipdefault option
               # change this line to local_ip:remote_ip

defaultroute  # put this if you want that PPP server will be your
               # default router

```

Άέά ίά όδñääèåßðå:

1. ΈάέÝððå õñ äðñåñðõíÝñ ãððçñåðçðP ÷ñçõéñðñéðñðåð õñ **Kermit** (P èÛðñéñ Ûéèñ ðññåññåñ åέå modem) έάέ åέóÛååðå õñ ùññå ÷ñPððç έάέ õñ èñåéèù óåð (P ùðé Ûéèñ ÷ñåéÛååðåέ åέå ίå åñåñåñðñéðñðåðå õñ PPP óõñ äðñåññõíÝñ ððñéñåέóðP).
2. Åååßðå åðù õñ **Kermit** (÷ññßð ίå èååßðåðå ðç åñåññP).
3. Ðèçèðññéñåßðåðå óå ðåñåéÛðù:

```
# /usr/sbin/pppd /dev/tty01 19200
```

Ååååéùèåßðå ùðé ÷ñçõéñðñéåßðå õñ òùðù ùññå óðóéåðPð έάέ ðç ίέåðÛéèçèç ðå÷ýðçðå.

ÏððñéñåέóðPð óåð åßñåέ ðññå ðññåññåññò ìÝòù PPP. Áí ç óýñååóç åðñòý÷ åέ, ìðñåßðå ίå ÷ñçõéñðñéðñðåðå ðç íåðéèñåß debug óõñ åñ÷åßñ /etc/ppp/options έάέ ίå åéÝññåðå ðå ìçññåðåðå ððçñ éññòùéå åέå ίå åíé÷ñåýððå õñ ðññåçñå.

Ïñ ðåñåéÛðù script /etc/ppp/pppup åððñåðñéñåß έάέ ðå 3 óðÛåέå:

```

#!/bin/sh
pgrep -l pppd
pid=`pgrep pppd`
if [ "X${pid}" != "X" ] ; then
    echo 'killing pppd, PID=' ${pid}
    kill ${pid}
fi
pgrep -l kermit
pid=`pgrep kermit`
if [ "X${pid}" != "X" ] ; then
    echo 'killing kermit, PID=' ${pid}
    kill -9 ${pid}
fi

ifconfig ppp0 down
ifconfig ppp0 delete

kermit -y /etc/ppp/kermit.dial
pppd /dev/tty01 19200

```

Ïĩ ãñ÷ãßĩ /etc/ppp/kermit.dial ãßíáέ Ýíá script ãέá õĩ **Kermit** õĩ ïðĩßĩ êÛíáέ õçĩ êêßóç έάέ õçĩ ðέóõĩðĩßçóç õĩõ ÷ñßóóç óõĩĩ ãðñáêñõõĩÝĩ ððĩēĩãέóðß (óõĩ ðÝēĩð ãðõĩç õĩõ ãããñÛõĩõ, έá ãñãßðã Ýíá ðãñÛãáέēĩã ãέá Ýíá ðÝõĩēĩ script).

×ñçóēĩðĩēßóðã õĩ ðãñáέÛò ã script /etc/ppp/pppdown ãέá íá ãðĩóõĩãÝóáðã õçĩ ãñãñß PPP:

```
#!/bin/sh
pid=`pgrep pppd`
if [ X${pid} != "X" ] ; then
    echo 'killing pppd, PID=' ${pid}
    kill -TERM ${pid}
fi

pgrep -l kermit
pid=`pgrep kermit`
if [ "X${pid}" != "X" ] ; then
    echo 'killing kermit, PID=' ${pid}
    kill -9 ${pid}
fi

/sbin/ifconfig ppp0 down
/sbin/ifconfig ppp0 delete
kermit -y /etc/ppp/kermit.hup
/etc/ppp/ppptest
```

ÃēÝãĩðã áí ãêðãêãßðãέ áēũĩã õĩ pppd, ãêðãêßĩðãð õĩ /usr/etc/ppp/ppptest, õĩ ïðĩßĩ έá ïēÛæãέ íã õĩ ðãñáέÛò:

```
#!/bin/sh
pid=`pgrep pppd`
if [ X${pid} != "X" ] ; then
    echo 'pppd running: PID=' ${pid-NONE}
else
    echo 'No pppd running.'

```

Ãέá íá êêãßóáðã õçĩ ãñãñß, ãêðãēÝóáð õĩ /etc/ppp/kermit.hup, õĩ ïðĩßĩ έá ðñÝðãέ íá ðãñēÝ÷ãέ:

```
set line /dev/tty01 ; put your modem device here
set speed 19200
set file type binary
set file names literal
set win 8
set rec pack 1024
set send pack 1024
set block 3
set term bytesize 8
set command bytesize 8
set flow none

pau 1
out +++
```

```
inp 5 OK
out ATH0\13
echo \13
exit
```

Ìέα áíáέέάέδóεÉP ìÝèíαιò ðíð ÷ ñçóέííðíέάß ðí chat áíðß áέα ðí kermit:
 Ôá ðáñάέÛòù äÿí áñ÷:áßá áðáñέíÿí áέα ðç äçíέíðñáßá íέàð óÿíááóçð pppd.

/etc/ppp/options:

/dev/cuad1 115200

```
crtscts # enable hardware flow control
modem # modem control line
connect "/usr/bin/chat -f /etc/ppp/login.chat.script"
noipdefault # remote PPP serve must supply your IP address
                # if the remote host doesn't send your IP during
                # IPCP negotiation, remove this option
passive # wait for LCP packets
domain your.domain # put your domain name here
```

```
: # put the IP of remote PPP host here
    # it will be used to route packets via PPP link
    # if you didn't specified the noipdefault option
    # change this line to local_ip:remote_ip
```

```
defaultroute # put this if you want that PPP server will be
                # your default router
```

/etc/ppp/login.chat.script:

Óçíáßùóç: Ôí ðáñάέÛòù έá ðñÝðάέ íá ãñάòáß óá íέα ìúíí ãñáíìß.

```
ABORT BUSY ABORT 'NO CARRIER' "" AT OK ATDTphone.number
CONNECT "" TIMEOUT 10 ogin:-\r-ogin: login-id
TIMEOUT 5 sword: password
```

Ìüέέð ðñíðíðíέPóáðá έάέ ááέáðáóðPóáðá óúóðÛ ðá ðáñάðÛíú áñ÷:áßá, ðí ìúíí ðíð ÷ ñáέÛæáðάέ íá έÛíáðá áßíάέ íá áέðáέÝóáðá ðçí áíðíέP pppd, ìá ðíí ðñüðí ðíð óáßíáðάέ ðáñάέÛòù:

pppd

27.3.3 × ñçóέííðíέPíðáó ðí pppd ùò ÁíððçñáðçðP

Ôí /etc/ppp/options έá ðñÝðάέ íá ðáñέÝ÷:άέ έÛðέ áíðßðóíέ÷:í ìá ðí ðáñάέÛòù:

```
crtscts # Hardware flow control
netmask 255.255.255.0 # netmask (not required)
192.114.208.20:192.114.208.165 # IP's of local and remote hosts
# local ip must be different from one
```

```

# you assigned to the Ethernet (or other)
# interface on your machine.
# remote IP is IP address that will be
# assigned to the remote machine
domain ppp.foo.com      # your domain
passive                 # wait for LCP
modem                   # modem line

```

Ôï script /etc/ppp/pppserv ðïö öáβíáöáέ ðáñáέÛöù, έá ðáέ öüï **pppd** íá έάέöïτöñãßöáέ ùð áïöðçñãöçöðß:

```

#!/bin/sh
pgrep -l pppd
pid=`pgrep pppd`
if [ "X${pid}" != "X" ] ; then
    echo 'killing pppd, PID=' ${pid}
    kill ${pid}
fi
pgrep -l kermit
pid=`pgrep kermit`
if [ "X${pid}" != "X" ] ; then
    echo 'killing kermit, PID=' ${pid}
    kill -9 ${pid}
fi

# reset ppp interface
ifconfig ppp0 down
ifconfig ppp0 delete

# enable autoanswer mode
kermit -y /etc/ppp/kermit.ans

# run ppp
pppd /dev/tty01 19200

```

×ñçöéüðïέßöáö ðï ðáñáέÛöù script /etc/ppp/pppservdown äέά íá ööáíáößöáöä öüï áïöðçñãöçöðß:

```

#!/bin/sh
pgrep -l pppd
pid=`pgrep pppd`
if [ "X${pid}" != "X" ] ; then
    echo 'killing pppd, PID=' ${pid}
    kill ${pid}
fi
pgrep -l kermit
pid=`pgrep kermit`
if [ "X${pid}" != "X" ] ; then
    echo 'killing kermit, PID=' ${pid}
    kill -9 ${pid}
fi
ifconfig ppp0 down
ifconfig ppp0 delete

kermit -y /etc/ppp/kermit.noans

```

Óï ðáñáéÛòù script áéá ôï **Kermit** (/etc/ppp/kermit.ans) ìðññáß íá áíññáñðíéáß éáé íá áðáíáññáñðíéáß ôçí éáéóïðññáßá áððüíáóçð áðÛíôçóçð óôï modem óáð.

```
set line /dev/tty01
set speed 19200
set file type binary
set file names literal
set win 8
set rec pack 1024
set send pack 1024
set block 3
set term bytesize 8
set command bytesize 8
set flow none
```

```
pau 1
out +++
inp 5 OK
out ATH0\13
inp 5 OK
echo \13
out ATSO=1\13 ; change this to out ATSO=0\13 if you want to disable
                  ; autoanswer mode
inp 5 OK
echo \13
exit
```

Óôïí áðñáéñðóïÝíï ððíéáéóðð, ÷ñçóéíðíéáßðóáé ôï script /etc/ppp/kermit.dial áéá êèÞóç éáé ðéóóïðññáçóç ôïð ÷ñÞóç. Èá ðñÝðáé íá ôï ðñíðíéÞóáðá óγιουία íá ðéð áíÛáéáð óáð. ÁÛéðá ôï ùññá ÷ñÞóç éáé ôïí èüáééü óáð óá áððü ôï script. Èá ÷ñáéáóóáß áðÞóçð íá áééÛíáðá ôçí áñáñÞ áéá ôçí áßóññ (input) áíÛéñáá íá ðéð áðáíðÞóáéð ðï äßíáé ôï modem óáð éáé í áðñáéñðóïÝíïð ððíéáéóðð.

```
;
; put the com line attached to the modem here:
;
set line /dev/tty01
;
; put the modem speed here:
;
set speed 19200
set file type binary ; full 8 bit file xfer
set file names literal
set win 8
set rec pack 1024
set send pack 1024
set block 3
set term bytesize 8
set command bytesize 8
set flow none
set modem hayes
set dial hangup off
set carrier auto ; Then SET CARRIER if necessary,
set dial display on ; Then SET DIAL if necessary,
```

```

set input echo on
set input timeout proceed
set input case ignore
def \%x 0 ; login prompt counter
goto slhup

:slcmd ; put the modem in command mode
echo Put the modem in command mode.
clear ; Clear unread characters from input buffer
pause 1
output +++ ; hayes escape sequence
input 1 OK\13\10 ; wait for OK
if success goto slhup
output \13
pause 1
output at\13
input 1 OK\13\10
if fail goto slcmd ; if modem doesn't answer OK, try again

:slhup ; hang up the phone
clear ; Clear unread characters from input buffer
pause 1
echo Hanging up the phone.
output ath0\13 ; hayes command for on hook
input 2 OK\13\10
if fail goto slcmd ; if no OK answer, put modem in command mode

:sldial ; dial the number
pause 1
echo Dialing.
output atdt9,550311\13\10 ; put phone number here
assign \%x 0 ; zero the time counter

:look
clear ; Clear unread characters from input buffer
increment \%x ; Count the seconds
input 1 {CONNECT }
if success goto sllogin
reinput 1 {NO CARRIER\13\10}
if success goto sldial
reinput 1 {NO DIALTONE\13\10}
if success goto slnodial
reinput 1 {\255}
if success goto slhup
reinput 1 {\127}
if success goto slhup
if < \%x 60 goto look
else goto slhup

:sllogin ; login
assign \%x 0 ; zero the time counter
pause 1
echo Looking for login prompt.

```

```

:slloop
increment \%x           ; Count the seconds
clear                   ; Clear unread characters from input buffer
output \13
;
; put your expected login prompt here:
;
input 1 {Username: }
if success goto sluid
reinput 1 {\255}
if success goto slhup
reinput 1 {\127}
if success goto slhup
if < \%x 10 goto slloop ; try 10 times to get a login prompt
else goto slhup         ; hang up and start again if 10 failures

:sluid
;
; put your userid here:
;
output ppp-login\13
input 1 {Password: }
;
; put your password here:
;
output ppp-password\13
input 1 {Entering SLIP mode.}
echo
quit

:slnodial
echo \7No dialtone. Check the telephone line!\7
exit 1

; local variables:
; mode: csh
; comment-start: ";"
; comment-start-skip: ";"
; end:

```

27.4 Αίôéìâôρðέóç ÐñîäëçìÛôùí óå ÓõîäÝóáέè PPP

ÓðíáέóöîñÛ ôïð Tom Rhodes.

Ðñîäéäîðç: Άðü ôï FreeBSD 8.0 έάέ ìåðÛ, ôï ðñüññáíìá ïäðāçóçò sio(4) áíðééååáóóðÛεçêå áðü ôï uart(4). Óå ïüüíåáá óðóéååðíí ðùí óåéñéåéðí èðñíí Ý÷ïíí áéèÛíåé áðü /dev/cuaðN óå /dev/cuaüN έάέ áðü /dev/ttyðN óå /dev/ttyüN. Ìé ÷ñðóðåò ôïð FreeBSD 7.X έå ðñÝðåé íå ðñíóáñíüóïí ðéè ðáñåéÛðü ïäçåñåò óýìüüíå ìå áððÝð ðéè áééååÝð.

Ç áññòçόά áððP έάέýððάέ ìáñέέÛ áðu óá ðññáεPíáðá ðñò ìðñáß íá ðáññòóέάóóίγí ùðáí áßíáðάέ ÷ñPόç ðñò PPP ìÝò ò òýíááóçð ððð. Áέá ðáñÛááέáíá, έá ðñÝðáέ íá ìÝñáðá ìá áέñβááέά óá ìçíγíáðá áέóúáñò ðñò έá áññáíβóáέ ðñò óýóðçíá ðñò ìðññí έάέáßðá. Ìáñέέíβ ISP áßññò ðçí ðññòññðP ssword, áñP Ûέέέέ áßññò ðçí password. Áí ááí Ý÷áðá ãñÛøáέ òúððÛ ðñò script áέá ðñò ppp, ç áðuðáέñá áέóúáñò έá áðñòý÷áέ. Ì ðέí óóίçέέóíÝññò ðññðñò íá áέóúáέíáððóáðá ìέá óýíááóç ppp, áßíáέ íá óðñááέáßðá ÷áέññέβíçðá. Ìέ ðεçññòññβáð ðñò áññáíβáññóáέ ðáñáέÛòù, έá óáð ðáçáPóññòí áPíá ðññò áPíá óðç ÷áέññέβíçðç áðñέáðÛóðáóç ðçð óýíááóçð.

27.4.1 ΆέÝáñòá ðá Áñ÷áßá Óðóέáðñí

Áí ÷ñçóέññðñέáßðá ðññóáñññòíÝññ ððñPíá, ááááέúέáßðá ùðέ Ý÷áðá ðáñέέÛááέ ðçí ðáñáέÛòù áñññP óññ áñ÷áßí ðñέìβóáññ ðñò ððñPíá óáð:

```
device uart
```

Áí ÷ñçóέññðñέáßðá ðññ ððñPíá GENERIC, ááí ÷ñáέÛááðάέ íá έÛíáðá έÛðñέá áέέááP, έάέðð ç óðóέáýç uart ðáñέέáíáÛíáðάέ Páç óá áððñí. Áðέðð áέÝáñòá ðá ìçíγíáðá ðçð dmesg áέá ðçí óðóέáðP modem, ÷ñçóέññðñέPíðáð ðçí ðáñáέÛòù áñññP:

```
# dmesg | grep uart
```

Έá ðñÝðáέ íá ááßðá έÛðñέá Ýññáí ó÷áðέέP ìá ðέð óðóέáðÝð uart. Ðññέáέðάέ áέá ðέð έýñáð COM ðñò ÷ñáέάέúñáðá. Áí ðñò modem óáð έáέðññááß ùð ðððññέçíÝíç óáέñέáέP έýñá, έá ðñÝðáέ íá ðñò ááßðá íá áññáÝññáðάέ ùð uart1, P COM2. Áí óðñááβíáέ áððñí, ááí ÷ñáέÛááðάέ íá áðáññááðááέúððβóáðá ðññ ððñPíá óáð. Áí ç óáέñέáέP έýñá ðñò áññέóðñέ÷áß ðñò modem óáð áßíáέ ç uart1 P COM2 ðñò DOS, ç áññέóðñέ÷ç óðóέáðP modem έá áßíáέ ç /dev/cuau1.

27.4.2 ×áέññέβíçðç Óýíááóç

Ç ÷áέññέβíçðç óýíááóç óññ Internet ìá ÷ñPόç ðçð ppp, áßíáέ Ýíáð ãñPáñññò έάέ áýέññò ðññðñò íá áññòðβóáðá ðð÷ññ ðññáεPíáðá óýíááóçð, P áðέðð íá ðÛñáðá ðεçññòññβáð ó÷áðέέÛ ìá ðñò ðñò ì ISP óáð áññέáðððβáέέ ðέð óðñáÝóáέð ðáέáðñí ppp. Έá ìáέέPóñññá ðçí áðáñññP PPP áðu ðçí áñññP áñññP. ÓçñáέPóðá ùðέ óá ùέá ìáð ðá ðáñáááßáññáðá, έá ÷ñçóέññðñέíýñá ðñò example ùð ðñò ùññá ðñò ððññέáóðP ðñò áέðáέáß ðñò PPP. Ìðñááßðá íá ìáέέPóðáð ðñò ppp, áñÛñññáð áðέðð ppp:

```
# ppp
```

÷ñññá ðññá ìáέέPóðáέ ðñò ppp.

```
ppp ON example> set device /dev/cuau1
```

ÈÝðññá ðç ððóέáðP modem. Óðñ ðáñÛááέáíá ìáð, áßíáέ ç cuau1.

```
ppp ON example> set speed 115200
```

ÈÝðññá ðçí óá÷ýðçόά óýíááóçð, óá áððP ðçí ðáññðððóç ÷ñçóέññðñέíýñá 115,200 kbps.

```
ppp ON example> enable dns
```

ΈΎίά οόι ppp ίά ηὐέιβόάέ οίι resolver έάέ δñίὐέΎὐίὐιά οέὐ έάὐὐέέçέάὐ ἀñáñΎὐ áέά οίι áέάέñέὐὐ P íññὐὐί οόι /etc/resolv.conf. Άί οίι ppp ááí ίδñíñáβ ίά έάέññβὐάέ οίι ũñíá οίὐ áέάέñέὐὐ P, ίδñíñγίá ίά οίι έάέññβὐίὐιá ίá ÷ áέñíέβίçὐί οñũðí ἀñáũὐáñá.

ppp ON example> **term**

Άέέὐάειὐιá οά έάὐὐὐὐὐόç “terminal” ηὐὐά ίά ίδñíñγίá ίά áέΎáñíὐιá οίι modem ÷ áέñíέβίçὐά.

deflink: Entering terminal mode on /dev/cuau1
type '~h' for help

at
OK
atdt123456789

×ñçὐέñíðíέγίá οίι at áέá ίά áñ ÷ έέíðíέPὐίὐιá οίι modem, έάέ Ύðáέὐά ÷ñçὐέñíðíέγίá οίι atdt έάέ οίι ἀñέέũ οίὐ ISP áέá ίά ίáέέίPὐίὐιá οç áέáάέέáὐά οçð έέPὐόçð.

CONNECT

Άáη Ύ ÷ ίὐιá áðέááááβũὐç οçð ογίááὐçð. Άί Ύ ÷ ίὐιá δñíáέPíáὐά ογίááὐçð οá ίðíβá ááí ó ÷ áðβáειíὐάέ ίá οίι οέέέũ ίáð, ááη áβίáέ οίι οçíáβí ðíὐ δñΎðáέ ίá δñíὐðáέPὐίὐιá ίá οá áðέέγὐίὐιá.

ISP Login: **myusername**

Ç δñíὐñíðP áὐὐP áβίáέ áέá ίá áηὐίὐιá οίι ũñíá ÷ñPὐόç. ×ñçὐέñíðíέPὐὐά οίι ũñíá ÷ñPὐόç ðíὐ οáð Ύ ÷ áέ áñέáβ áðũ οίι ISP οáð.

ISP Pass: **mypassword**

Ç δñíὐñíðP áὐὐP áβίáέ áέá οίι έũáέέũ δñũὐááὐçð. ΆðáíὐPὐὐά ίá οίι έũáέέũ ðíὐ οáð Ύ ÷ áέ áñέáβ áðũ οίι ISP οáð. Ί έũáέέũð áðũð ááí έá áíὐάίέὐὐáβ οðçí ίέũíç οáð, ũðũð áέñέáηð οðíááβίáέ έάέ ίá οίι έũáέέũ οáð ũὐάí οίι áñὐὐáðá οðçí δñíὐñíðP áέὐũáíὐ οίὐ FreeBSD οðὐὐPíáίὐíð οáð.

Shell or PPP: **ppp**

Άίὐέηáά ίá οίι ISP οáð, ίðñíñáβ ίá ίçí ááβðá έάέ έáέũέíὐ οçí δáñáðὐíũ δñíὐñíðP. Óðçí δáñáðὐíũ δáñβððũὐç ίáð ηñὐὐάέ áí áðέέðíñγίá ίá áέὐáέΎὐίὐιá έὐðíέí έΎέὐὐíð (shell) οόí ίç ÷ ὐίçíá οίὐ δáñí ÷ Ύá, P áí έΎέίὐιá ίá áέέέίPὐίὐιá οίι ppp. Óðí δáñὐááέáíá ίáð áðέέΎίáíá ίá ÷ñçὐέñíðíέPὐίὐιá ppp έáέηð έΎέίὐιá ίá οðíááέγίá οόí Internet.

Ppp ON example>

ðáñáðçñPὐὐά ũðέ οόí δáñὐááέáíá οίι δñηὐὐί p áβίáέ έáὐάέáβí. Άðũũ ááβ ÷ ίáέ ũðέ Ύ ÷ ίὐιá οðíááέáβ áðέὐð ÷ ηð ίá οίι ISP.

PPP ON example>

, ÷ ίὐιá ðέὐὐíðíέçέáβ ίá áðέέð ÷ βá áðũ οίι ISP ίáð, έάέ δáñέíΎίὐιá ίá ίáð áðíáíέáβ áέáγέðίὐç IP.

PPP ON example>

, ÷ áέ ðέΎíí έάέíñέὐὐáβ áέáγέðίὐç IP, έάέ Ύ ÷ ίὐιá ηέíέççñηὐάέ οç ογίááὐç ίá áðέέð ÷ βá.

PPP ON example>**add default HISADDR**

Άαβ δνιόεΎοιτοιά ογι δνιιάδέεάαιΎίγ έεάάννΠ (default route). Οί άΠιά άόου άβιάέ άδανάβόγοί δνεί ιδνιΎοιτοιά ίά άδέείεϊνιΠοίτοιά ίά ονι Ύνι έυοίι, έάεβδ ογ άάάνΎίγ οόέαιΠ ς ιιις ούύίαάογ διο Ύ-τοιά άβιάέ ίά Ύία οδνιείάέοδΠ άδν ογι Ύεες ίάνεΎ ογδ άνάνΠδ. Άί οί δανάδΎίυ άδιόγ-άέ άδάέαιΠ οδΎν-τοί Πας έάεινέοίΎιάδ έεάάννΎδ, ιδνιάνβοά ίά άΎεάοά Ύία έάοιαόόέευ ! ιδνιόοΎ άδν οί add. ΆίάέέάέοέέΎ, ιδνιάνβοά ίά έΎίάοά άοδΠ ογ νύειέογ δνεί άδέ-άενΠοάοά ογ ούύίαάογ, έάέ έά άβιάέ άοδνιιάόά έεάδνιάνιΎοάοογ ογδ ίΎάδ έεάάννΠδ.

Άί υέα δΠάάί έάέΎ, έά δνΎδάε ορñά ίά Ύ-άοά άίάνάΠ ούύίαάογ ίά οί Internet, ογι ιδνιβά ιδνιάνβοά ίά ίάοάέειΠοάοά οοί δανάόέΠείε-ñςοέινιδνιέΠιάοδ οί οοίάοάοίυ δεΠέοδνιί CTRL+z. Άί δανάόςñΠοάοά οί PPP ίά άβιάόάέ ίάΎ ppp, ς ούύίαάογ Ύ-άέ έεάέιδάβ. Ιά ονι ονιυδι άοδνι ιδνιάνβοά ίά δανάέεινιέοάβοά ογι έάοΎοόάογ ογδ ούύίαάογ οάο. Οά έάοάέάβ Π άάβ-νιοί υόέ οδΎν-άέ ούύίαάογ ίά ονι ISP άίΠ οά ίέένΎ Π άάβ-νιοί υόέ έάέ έΎδνιέϊ έυάϊ ς ούύίαάογ Ύ-άέ -άέάβ. Οί ppp Ύ-άέ ιυφι άοδΎδ οέο άϋϊ έάοάοδΎοάέο.

27.4.2.1 Άίόέιάορδέογ δνιιέςιΎοδνι

Άί Ύ-άοά άδάοδέάβδ άνάνΠ έάέ άάί οάβιάόάέ ίά ιδνιάνβοά ίά άδνιέάοάοδΠοάοά ογ ούύίαάογ, άδνιάννιδνιέΠοά ονι Ύεά-νι Πδ ιΎού οέέεϋ (CTS/RTS) -ñςοέινιδνιέΠιάοδ ογι άδέείιΠ set ctsrts off. Οί δανάδΎίυ οοίάάβιάέ οοίΠέυδ άί άβοά οοίάαιΎνδ οά έΎδνιέϊ άνοδςñάοςδΠ οάνιáοέεΠί ίά άοίάοδνιέοά PPP, υδνι οί PPP οοίάοΎΎέ ίά άδνιέβιάόάέ υοάί δνιιόδάέβ ίά άνΎοάέ άάάνΎία οόγ ούύίαάογ οάο. Οόςί δάνβδουόγ άοδΠ, οοίΠέυδ δάνειΎίάέ έάέ έΎδνιέϊ οΠιά CTS (Clear To Send) οί ιδνιβί άάί Ύñ-άοάέ διοΎ. Άί υοόυοί -ñςοέινιδνιέΠοάοά άοδΠ ογι άδέείιΠ, έά δνΎδάέ άδβόςδ ίά -ñςοέινιδνιέΠοάοά έάέ ογι άδέείιΠ set accmap ς ιδνιβά άίάά-νιΎνδ άδάέοάβοάέ έάέ ίά άδνιιυέάβ οί οέέέυ διο άίάνοΎοάέ άδνι ογ ίάοΎάιόγ οόάέάεñειΎνι -άñάέοδΠνιί άδνι ογ ίέα Ύέñς οόςί Ύεες, οοίΠέυδ ιΎού οίο XON/XOFF. Άάβοά ογ οάέβάά manual οίο ppp(8) έάέ δνιέοόυοάñάδ δςςñνιιñβάδ ο-άοέέΎ ίά άοδΠ ογι άδέείιΠ έάέ δνι ιδνιάνβοά ίά ογι -ñςοέινιδνιέΠοάοά.

Άί έάέΎοάοά Ύία δάέάέυοάñνι modem, βούδ -ñάέάοδάβ ίά -ñςοέινιδνιέΠοάοά ογι άδέείιΠ set parity even. ς δνιιάδέεάαιΎίγ νύειέογ άβιάέ ίά ίςί οδΎν-άέ έοίοειβά (parity none), άέέΎ οά δάέέΎ modems (έάέ οά έΎδνιέϊοδ ISP) -ñςοέινιδνιέβοάέ έάέ Ύεά-νι έάεΠί (ς -ñΠός ογδ δνιέάέάβ υοδνι οί ίάΎΎες άϋϋς οός ίάοάέβϋςς άάάνΎνι). οδνι -ñάέάοδάβ άοδΠ ογι άδέείιΠ, άί ι ISP οάο άβιάέ ς Compuserve.

Οί PPP βούδ ίά ίςί άδνιΎέέάέ οόςί έάοΎοόάογ άίοιέΠί, οί ιδνιβί άβιάέ οοίΠέυδ οοΎεϊά έεάδνιάνιΎοάοοςδ, έάεβδ ι ISP δάνειΎίάέ άδνι ογ έέέΠ οάο ίάνεΎ ίά ίάέείΠοάέ ογ έεάδνιάνιΎοάοοςδ. Οοί οςίάβι άοδνι, ς -ñΠός ογδ άίοιέΠδ ~Π έά άίάίάέΎοάέ οί ppp ίά άñ-βοάέ ίά οόΎέϊάέ οέο δςςñνιιñβάδ ο-άοέέΎ ίά ογ νύειέογ.

Άί άάί δΎñάοά διοΎ δνιιδνιδΠ έέουάιιδ, οί δέέάίυοάñνι άβιάέ ίά δνΎδάέ ίά -ñςοέινιδνιέΠοάοά δέοοίδνιβςογ PAP Π CHAP άίοβ έάέ ογι ούϋθιο UNIX δέοοίδνιβςογ διο δνιέάνΎοαίά οοί δανάδΎίυ δάνΎάέάϊά. Άέά ίά -ñςοέινιδνιέΠοάοά PAP Π CHAP άδεβδ δνιόεΎοά οέο δνιέΎοδνι άδέείιΠ οόςί άοάννιΠ PPP δνεί άñάέάβοά οά έάοΎοόάογ οάνιáοέεϋ:

```
ppp ON example> set authname myusername
```

Έά δνΎδάέ ίά άίόέέάοάοδΠοάοά οί myusername ίά οί υίñά -ñΠόςδ διο οάο Ύ-άέ άνιέάβ άδνι ονι ISP οάο.

```
ppp ON example> set authkey mypassword
```

Έά δνΎδάέ ίά άίόέέάοάοδΠοάοά οί mypassword ίά ονι έυάέέυ -ñΠόςδ διο οάο Ύ-άέ άνιέάβ άδνι ονι ISP οάο.

Άί οοίΎάοόά έάννιέέΎ, άέέΎ άάί οάβιάόάέ ίά ιδνιάνβοά ίά άδέείεϊνιΠοάοά ίά έάιέΎ έέάϋέοίός, δνιιόδάεΠοάοά ίά -ñςοέινιδνιέΠοάοά ογι άίοιέΠ ping(8) ίά ίέα έέάϋέοίός IP έάέ ίά άάβοά άί έά έΎάοά άδΎίόςς. Άί έέΎδάοά άδΠεάέά δάέΎοδνι 100%, οί δει δέέάίυ άβιάέ υόέ άάί Ύ-άοά έάεινβοάέ έΎδνιέϊά δνιιάδέεάαιΎίγ έεάάννΠ. ΆέΎάιόά ίάΎ υόέ Ύ-άοά νδνιβοάέ ογι άδέείιΠ add default HISADDR έάοΎ ογ έέΎñέάέ ογδ ούύίαάοςδ. Άί ιδνιάνβοά ίά άδέείεϊνιΠοάοά ίά ίέα δνιιένδνιΎίγ έέάϋέοίός IP, οί δέέάίυοάñνι άβιάέ υόέ άάί Ύ-άοά άΎεάέ ογ έέάϋέοίός έΎδνιέϊο έέάεινέοδΠ ννιΎοδνι οοί άñ-άβι /etc/resolv.conf. Οί άñ-άβι άοδνι έά δνΎδάέ ίά νιέΎάέ ίά οί δνιέΎοδνι:

```
domain example.com
```

```
nameserver x.x.x.x
nameserver y.y.y.y
```

¼ðïò óá x.x.x.x êáé y.y.y.y èá ðñÝðáé íá áíðééáóáóóáéíí íá óéð äéáðéýíóáéð IP ðùí äéáéñéóðí DNS òïò ISP óáð. Áíáá÷ñÝíùð íé ðεçñïññáð áðóÝð íá óáð Ý÷íïí äíèáß éáðÛ òçí äáñááðP óáð óðçí ððçñáóá. Áí ù÷é, èá ìðñÝóáðá íá óéð äñáßðá áýéíéá ìá Ýíá òçéáðñíçíá óðíí ISP óáð.

Ìðñáßðá áðßçðò íá áíáñáñðíéPóáðá òçí éáðáñáðP óðíáÛíóùí äéá òçí PPP óýíááðç óáð, ìÝóù ðïò syslog(3). Áðèðð ðñíóéÝóáð:

```
!ppp
*. * /var/log/ppp.log
```

óðí /etc/syslog.conf. Óéð ðñéóóóóðñáð òññÝð, áððP ç èáéðíðñáß òðÛñ÷áé Pç.

27.5 ×ñçóéíððíéðíðáò PPP ìÝóù Ethernet (PPPoE)

ÓðíáéóóñÛ (áðù <http://node.to/freebsd/how-tos/how-to-freebsd-pppoe.html>) ðïò Jim Mock.

Ç áíúðçðá áððP ðñéçñÛðáé ðùð íá ñðèìßðáðá íéá óýíááðç PPP ìÝóù Ethernet (PPPoE).

27.5.1 Ñýèìéóç òïò Ððñíá

Äáí áðáéðáßðáé ðεÝíí äéáéðP ñýèìéóç òïò ððñíá äéá òç èáéðíðñáß PPPoE. Áí ì ððñíáð óáð äáí ðñéçéáíáÛíáé òçí áðñáñáßçðç ððíóðññéç netgraph, òí ppp èá òçí òññððáé áððùíáðá ùð Ûñèñùíá.

27.5.2 Ñýèìéóç òïò ppp.conf

ÐáñáéÛðù ðáßíáðáé Ýíá ððíáäéáíá áñ÷áßíð ppp.conf:

```
default:
    set log Phase tun command # you can add more detailed logging if you wish
    set ifaddr 10.0.0.1/0 10.0.0.2/0

name_of_service_provider:
    set device PPPoE:x11 # replace x11 with your Ethernet device
    set authname YOURLOGINNAME
    set authkey YOURPASSWORD
    set dial
    set login
    add default HISADDR
```

27.5.3 ΆêðÝéáðç òïò ppp

Ûð ÷ñPóðçðò root, ìðñáßðá íá äéðáéÝóáðá:

```
# ppp -ddial name_of_service_provider
```

27.5.4 Άέέβίςός όϊό ppp έάδÛ όçί Άέέβίςός

ΔñιόέÝόά όέδ δάνάέÛόù ãñáñÝò óοι ãñ÷áβι /etc/rc.conf:

```
ppp_enable="YES"
ppp_mode="ddial"
ppp_nat="YES" # if you want to enable nat for your local network, otherwise NO
ppp_profile="name_of_service_provider"
```

27.5.5 ×ñΠός ιέάδ ΆόέέÝόάδ Õδçñάόβád PPPoE

ÌáñέέÝò óññÝò έά ÷ñáέάόδãβ ιά ÷ñçóέιιðιέΠόάόá ιέά άόέέÝόά όδçñάόβád (service tag) áέά όçί áðιέάδÛόόάός όçò óýíáάόçò óάδ. Ìέ άόέέÝόάδ όδçñάόέβι ÷ñçóέιιðιέÝíóάέ áέά όñι áέά ÷ññέόιιι ìáóáíý áέάóññάόέέβι áñòδçñάόçòβι PPPoE ðñò ãñβóέιιόάέ óοι βáέι áβέδóι.

Ç óáέιçñβùός ðñò óάδ Ý ÷áέ áðóáέ ι ISP óάδ, έά ðñÝðáέ ιά Ý ÷áέ όέδ áðáέóιÝíáíáð ðέçññóññβád áέά όçί άόέέÝόά όδçñάόβád ðñò ÷ñáέÛáάόóá. Áí ááí ðññáβóá ιά όçί áñáβóá, ãùðΠόά όçί áñòδçñÝόçός δάέάόβι όϊό ISP óάδ.

Ûò óáέáóóáβá έýός, έά ðññíýóáόá ιά áñέέÛóáόá όçί ìÝέιáñ ðñò óóίβóóáόáέ óοι ðññáñáñíá Roaring Penguin PPPoE (<http://www.roaringpenguin.com/pppoe/>) όι ðñβι ðññáβóá ιά áñáβóá óόçι ÓðέέíáΠ óùι Ports. Ìá Ý ÷áόá óðùç óάδ, ùóέ áóòù ðññáβ ιά áðñññáñáñíáóβóáέ έάέ ιά ÷ ÷ççóóáýóáέ όι modem óάδ, Ýóóέ óéáóóáβóá όι έáέÛ ðñέι όι έÛíáόá. Áðέβð ááέáóáóðΠóá όι ðññáñáñíá ðñò áβíáέ ι ðáññ ÷ Ýád óάδ ìáεβ ìá όι modem. Ðáέόá, áέóÝέέáóá óοι ìáñíý System όñò ðññáñÛíáόñò. Áέáβ έá ðñÝðáέ ιά áβíáέ όι ùíñá όñò ðññóβέ óάδ. ÓóίΠέùð áñÛóáέ ISP.

Óñ ùíñá όñò ðññóβέ (άόέέÝόά όδçñάόβád) έá ÷ñçóέιιðιέçéãβ óόçι έáόá ÷ññέός áέá όçι ãýέιέός όñò PPPoE óοι ãñ ÷áβι ppp.conf, ùð όι ðñΠíá ðñò áçέβíáέ όñι ðáññ ÷ Ýá óόçι áñóñέΠ set device (ááβóá όç óáέβáá manual όñò ppp(8) áέá ðéΠñáέð έáðòññÝñáέáð). έá ááβ ÷ íáέ ùðòò όι δάνάέÛόù:

```
set device PPPoE:x11:ISP
```

Ìçí ìá ÷Ûóáόá ιά áέέÛíáόá όι x11 ìá όç óùóðΠ óóóéáðΠ ðñò áíóέóóíé ÷áβ óόçι έÛñóá Ethernet ðñò ÷ñçóέιιðιέáβóá.

Ìçí ìá ÷Ûóáόá ιά áέέÛíáόá όι ISP ìá όι ðññóβέ ðñò áñΠέáóá δάνáðÛíù.

Άέά δάνέόóùóáññáð ðέçññóññβád, ááβóá:

- Õέçíñóáññáð ΆðñóæñíέέÝò ÓðíáÝóáέð ìÝóù FreeBSD óá Άñáññ DSL (<http://renaud.waldura.com/doc/freebsd/pppoe/>) áðù όñι Renaud Waldura.
- Nutzung von T-DSL und T-Online mit FreeBSD (<http://www.ruhr.de/home/nathan/FreeBSD/tdsl-freebsd.html>) áðù όñι Udo Erdelhoff (óóá ΆññíáíέέÛ).

27.5.6 Óñ PPPoE óá Modem 3Com® HomeConnect® ADSL Dual Link

Áóòù όι modem ááí áέίέιòέáβ όι RFC 2516 (<http://www.faqs.org/rfcs/rfc2516.html>) (Ìέá ìÝέíáñò áέá ìáðÛáñός PPP ìÝóù Ethernet (PPPoE), áñáñÝíí áðù όñòð L. Mamakos, K. Lidl, J. Evarts, D. Carrel, D. Simone, έάέ R. Wheeler). Áíóβéáόá, ÷ñçóέιιðιέáβ áέáóññáóéέéýò óýðñòð έùáέέβι ðáέÝóòùí áέá óá ðéáβóéá Ethernet. Ðάνáέáέíýíá ιά áέóñÛóáόá óá δάνÛðñíá óάδ óόçι 3Com (<http://www.3com.com/>) áí ãñβáóá ùóέ έá ðñÝðáέ ιά óòñññóùέáβ ìá όέð ðññáέáññáóÝò όñò PPPoE.

Άέá ιά ðññáβ όι FreeBSD ιά áðέέίέíñíáβ ìá áóðΠ όç óóóéáðΠ, έá ðñÝðáέ ιά óáέáβ Ýíá έáðÛέέçéι sysctl. Áóòù ðññáβ ιά áβíáόáέ áóòùíáόá έáðÛ όçí áέέβίςός, ìá όçí áñçíÝññóç όñò ãñ ÷áβι /etc/sysctl.conf:

```
net.graph.nonstandard_pppoe=1
```

Ρ ιδινάβ ίά άβίάέ Ûιάόά ίά όçί άίόίεΡ:

```
# sysctl net.graph.nonstandard_pppoe=1
```

Άόόό÷ ÷ ÷ ÷, άδάέάΡ δñüέάέόάέ áέά ίέά ñýèίέόç ðíø άδçñáÛæáé ðüèèçñí òí óýóóçíá, äáí áβίάέ äöíáóüí ίά άðééíéíüíáβòá óáòóü ÷ ñííá ίά Ýíá éáñíééü ðáéÛóç Ρ áíòðçñáòçòΡ PPPoE έάέ ίά Ýíá ADSL modem 3Com HomeConnect®.

27.6 × ñçóéííðíéΡίόάò PPP ìÝóù ATM (PPPoA)

¹ áíüíóçóá ðíø áéíéíéòèáβ, ðáñéáñÛóáé ðüð ίά ñòèíβóáòá òí PPP áέá éáéóíòñáβá ìÝóù ATM (PPPoA). Òí PPPoA áβίάέ ίέá áçííóééèðò áðééíáβ óóíòð ðáñí ÷ áβò òðçñáòçéΡí DSL óóçí Άòñðç.

27.6.1 × ñçóéííðíéΡίόάò PPPoA ίά òí Alcatel SpeedTouch™ USB

Ç òðíóðñéíç PPPoA áέá áòðΡ όç óðóéáòð, ðáñÝ ÷ áòáé ùð port óóí FreeBSD, έáèèð òí firmware όçð óðóéáòðò áέáÝíáòáé òðü όçí Ûááέá Alcatel's license agreement (http://www.speedtouchdsl.com/disclaimer_lx.htm) έάέ äáí ìðíñáβ ίά áéáíáíçèáβ äéáýèáñá ίá òí ááóééü óýóóçíá òíø FreeBSD.

Άέá ίá ááéáóáóòðóáòá òí éíáéóíééü, áðéÛ ÷ ñçóéííðíéΡίόάò όçí Óðééíáβ òüí Ports. Άáéáóáóòðóáòá òí port net/pppoa έάέ áéíéíéòèðóáòá óéð ðáçáβáð ðíø ðáñééáíáÛíííóáé óá áòóü.

¼ðüð ðíééÝð óðóéáòÝð USB, òí Alcatel SpeedTouch™ ÷ ñáéÛæáòáé ίá έáóááÛóáé òí firmware òíø áðü òíø òðíéáéóòð óóí òðíβí áβίάέ óóíáñÝíí, ðñíéáéíÝííó ίá éáéóíòñáβóáé óóóóÛ. Ç áéááééáóóá áòðΡ ìðíñáβ ίá áòóñáòíðíéçèáβ óóí FreeBSD, ðóóá ç íáóáóíñÛ ίá áβíáòáé éÛèá óíñÛ ðíø óóíáÝáòáé ç óðóéáòð óóç éýñá USB. Ìðíñáβòá ίá ðñíóéÝóáòá óéð ðáñáéÛòü ðççñíóíñáò óóí áñ ÷ áβí /etc/usbd.conf áέá ίá áíáñáíðíéΡίόáòá όçí áòóüíáóç íáóáóíñÛ òíø firmware. Èá ðñÝðáé ίá áðáíáñááóóáβòá áòóü òí áñ ÷ áβí ùð ÷ ñðóóçð root.

```
device "Alcatel SpeedTouch USB"
    devname "ugen[0-9] +"
    vendor 0x06b9
    product 0x4061
    attach "/usr/local/sbin/modem_run -f /usr/local/libdata/mgmt.o"
```

Άέá ίá áíáñáíðíéΡίόáòá òí **usbd**, òí ááβííá USB, ðñíóéÝóóá όçí ðáñáéÛòü áñáñíð óóí áñ ÷ áβí /etc/rc.conf:

```
usbd_enable="YES"
```

Ìðíñáβ áðβóçð ίá ñòèíβóáòá òí **ppp** ðóóá ίá áéòáéáβ áòóüíáóá éèΡóç έáóÛ όçí áééβίçóç òíø óðóðΠíáóíð. Άέá ίá áβίáé áòóü, ðñíóéÝóóá óéð ðáñáéÛòü áñáñÝð óóí /etc/rc.conf. Èá ðñÝðáé έάέ ðÛéé ίá áéòáéÝóáòá óç áéááééáóóá áòðΡ ùð root.

```
ppp_enable="YES"
ppp_mode="ddial"
ppp_profile="adsl"
```

Άέá ίá éáéóíòñáβóáé óóóóÛ òí ðáñáðÛíü, éá ðñÝðáé ίá Ý ÷ áòá ÷ ñçóéííðíéΡίόáé òí òðüááéáíá òíø áñ ÷ áβíð ppp.conf òí òðíβí ðáñÝ ÷ áòáé ίá òí port net/pppoa.

- ❶ Ç äέáyèðióç IP ðið FreeBSD ððēēāēóðP óád, óðīī īðīBī èá ÷ñçóēīðēēPóáðā ðī **mpd**.
- ❷ Ç äέáyèðióç IP ðið ADSL modem óád. Āέá ðī Alcatel SpeedTouch Home, ç äέáyèðióç áððP áβīáέ áðū ðñīāðēēīāP ç 10.0.0.138.

Āβīáέ áðīáðūī íá āñ ÷ēēīðēēPóáðā ðç óýīāáóç áýēēā, āβīīíóáð ðçī ðāñāēŪðū āíðēP ùð root:

```
# mpd -b adsl
```

Īðñāβðā íá āāβðā ðçī èáðŪóðáóç ðçð óýīāáóçð ìā ðçī ðāñāēŪðū āíðēP:

```
% ifconfig ng0
ng0: flags=88d1<UP,POINTOPOINT,RUNNING,NOARP,SIMPLEX,MULTICAST> mtu 1500
    inet 216.136.204.117 --> 204.152.186.171 netmask 0xffffffff
```

Ōī **mpd** áðīðāēāβ ðīī óðīéóðpīāīī ðñūðī óýīāáóçð ðið FreeBSD ìā íέá ððçñāóβā ADSL.

27.6.3 ×ñçóēīðēēPíðáð ðī pptpclient

Īðñāβðā āðβóçð íá ÷ñçóēīðēēPóáðā ðī FreeBSD äέá íá óðīāāēāβðā óā Ūēēāð ððçñāóβāð PPPoA ÷ñçóēīðēēPíðáð ðī net/pptpclient.

Āέá íá ÷ñçóēīðēēPóáðā ðī net/pptpclient äέá íá óðīāāēāβðā óā íέá ððçñāóβā DSL, āāēáóáóðPóáð ðī port P ðī ðāēŸðī, èáέ āðāīāñāáóðāβðā ðī āñ ÷āβī /etc/ppp/ppp.conf. Ēá ÷ñāέáóðāβ íá āβóðā root äέá íá èŪíāðā èáέ óéð äýī ðāñāðŪíū äέáāēéáóβāð. ðāñāēŪðū óāβīáóáé Ÿíá ðāñŪāēāīā íέáð āíūðçðáð ðið ppp.conf. Āέá ðāñéóóūðāñāð ðççñīōīñβāð ó ÷āðēēŪ ìā óéð āðēēīāŸð ðið ppp.conf, āāβðā ðç óāēβāā manual ðið **ppp**, ppp(8).

```
adsl:
set log phase chat lcp ipcp ccp tun command
set timeout 0
enable dns
set authname username ❶
set authkey password ❷
set ifaddr 0 0
add default HISADDR
```

- ❶ Ōī ūīñā ÷ñPóç äέá ðīī ēīāāñéáóīū óád óðīī ðāñī ÷Ÿá DSL.
- ❷ Ī èūāéēūð äέá ðīī ēīāāñéáóīū óád.

ðñīāēāīðīβçç: Ēāēðð èá ðñŸðāé íá āñŪðāðā ðīī èūāēēū óád ìīñðP áðēīý èāēīŸīīð óðī āñ ÷āβī ppp.conf, èá ðñŸðāé íá āāāáéūèāβðā ūðé èáíŸíáð Ūēēīð āāí èá ìðīñāβ íá äέáāŪóáé óā ðāñēā ÷ūīāíā áððīý ðið āñ ÷āβīð. Īā óéð ðāñāēŪðū āíðēŸð, ìðīñāβðā íá āíáóóāēβóáðā ūðé ðī āñ ÷āβī èá ìðīñāβ íá äέáāáóóāβ ìūīī ìŸóá áðū ðī ēīāāñéáóīū ðið root. Āāβðā óéð óāēβāāð manual ðūī chmod(1) èáé chown(8) äέá ðāñéóóūðāñāð ðççñīōīñβāð.

```
# chown root:wheel /etc/ppp/ppp.conf
# chmod 600 /etc/ppp/ppp.conf
```

Āððū èá āñβīáé Ÿíá óýīāē äέá íέá óðīāāñβā PPP ìā ðīī DSL āñīīēīāçðP óád. Ōā DSL modem óýðīð ethernet Ÿ ÷īðī íέá ðñīēáēīñéóīŸíç äέáyèðióç IP óðī ðiðēēū óád āβēððī, óðçī īðīBā ìðīñāβðā íá óðīāāēāβðā. Ōðçī ðāñβððòðç ðið Alcatel SpeedTouch Home, ç äέáyèðióç áððP áβīáέ 10.0.0.138. Ç óāēìçñβòç ðið äέáēŸðāé ī āñīīēīāçðPð óád, èá

άιáoÛñáε ðιέα áέáyεðίóç ÷ ñçóείιðιέαß ç óðóεάðP óáo. Άέα ίά άñβίáðά ðι ðιγίáε έάέ ίά ίάέειPóáðά ίέα óίίáñBά PPP, áέðáεÛóðά ðçί áέυιέιðεç áίðιέP:

```
# pptp address adsl
```

Õðυάάειç: Άβίáε έάέP έάÛά ίά ðñιόεÛóáðά Ûίá “&” óðι ðÛέιð ðçð ðñιçáιγίáιçð άίðιέPð, áέáðιñáðéέÛ ðι pptp áái έά óáo áðέóðñÛóáε ðιí Ûέáá ÷ ι (ðñιðñιðP) ðιð ðáñιáðéέιγ óáo.

Έά açιέιðñáçέáß ίέα óðóεάðP tun (άέειιέέυ ðιγίáε) áέá ðçί áέεçέáðBáñáóç ίáðáιγ ðυι áέáñááðéβί pptp έάέ ppp. Ìüέéð áðέóðñÛóáε ç ðñιðñιðP óðι ðáñιáðéέυ óáo, P ðι pptp áðέááááεPóáε ðç óγίááóç, ίðñáßðά ίά áñáðÛóáðά ðι ðιγίáε ίá ðιí ðñυðι ðιð óáβίáðáé ðáñáéÛðυ:

```
% ifconfig tun0
tun0: flags=8051<UP,POINTOPOINT,RUNNING,MULTICAST> mtu 1500
    inet 216.136.204.21 --> 204.152.186.171 netmask 0xffffffff00
    Opened by PID 918
```

Άί ááι ίðñÛóáðά ίά óðιááεáBðά, áεÛáíðά ðéð ñðειBóáéð ðιð áñιιιέιçðP óáo, ίέ ίðιBáð óðιPεùð áβίáε ðñιóáÛóέιáð ιÛóυ telnet P ιÛóυ éÛðιέιð óðεεñáðñçðP. Άί áέυιá ááι ίðñáßðά ίά óðιááεáBðά, έá ðñÛðáé ίά áñáðÛóáðά ðçί Ûιιáι ðçð áίðιέPð pptp έάέ ðá ðáñéá ÷ ðιíáíá ðιð áñ ÷ áβιð έáðááñáðPð ðιð pptp, /var/log/ppp.log áέá ðέέáιÛ óðιέ ÷ áBá.

27.7 × ñçóéιιðιέPíðáð ðι SLIP

Άñ ÷ έέP óðιáέóðιñÛ ðιð Satoshi Asami. Ìá ðç áιPðéáέá ðυι Guy Helmer έάέ Piero Serini.

ÐñιáέáιðιBçóç: Ç áιυðçðά áððP áðáñιüæáðáé έάέ áβίáε Ûáεðñç ιüíι ðá óðóðPιáðά FreeBSD 7.X.

27.7.1 ÑðειBæιιðáð Ûίá ÐáéÛðç SLIP

ÐáñáéÛðυ ðáñιóéÛæιðιá Ûίá ðñυðι ίá ñðειBóáðά Ûίá ιç ÷ Ûιçιá FreeBSD ùð ðáéÛðç SLIP óá Ûίá áBéððι ίá óðáðéέÛð áέáðéγιόáéð. Άέα ιç ÷ áιPιáðά ðá ίðιBá εáñáÛιιðι ðñιá áðιáιέέÛ (ç áέáyεðίóç ðιðð áέεÛæáé éÛεá ðιñÛ ðιð óðιáÛιιðáé), ðέέáιüι ίá ÷ ñáέáóðáß ίá éÛιáðά ðέι ðιγýðειέáð ñðειBóáéð.

Άñ ÷ έέÛ, έá ðñÛðáé ίá έáειñBóáðά óá ðιέα óáέñέáεP εγñá áβίáε óðιááιÛι ðι modem óáo. ΆñέáðιB ÷ ñPóðáð açιέιðñáγί Ûίá óðιáιέέέυ ááóιü ð. ÷. /dev/modem, ðι ίðιBι ááB ÷ ίáé óççι ðñááιáðéέP óðóεáðP /dev/cuadN. Άððυ óáo áðέóðñÛðáé ίá óðιá ÷ Bóáðά ίá ÷ ñçóéιιðιέáBðά ðι Bæιι ðñιá óðóεáðPð, áέυιá έάέ áí ίáðáέέιPóáðά ðι modem óá áέáðιñáðéέP εγñá. Άβίáε ιÛεειι Ûáιει ίá ðñÛðáé ίá áέεÛιáðá ðéPðιð áñ ÷ áβιι óðι /etc έáεPð έάέ óá áñ ÷ áBá .kermrc óá üέι ðι óýóðçιá!

Óçιáßυóç: Õι /dev/cuad0 áβίáε ç COM1, ðι /dev/cuad1 áβίáε ç COM2, é.ι.έ.

ΆáááéυεáBðά υðέ ðι áñ ÷ áβι ñðειBóáñι ðιð ððñPιá óáo ðáñéÛ ÷ áé ðá ðáñáéÛðυ:

```
device sl
```

Όι δανάδΰιτ δάνεείαΰίάόάε όοι δονΐά GENERIC, έάέ άί άάι όι Ύ÷άοά εέαάνΰοάε, άάί έά Ύ÷άοά δñüäççιά.

27.7.1.1 Νόειβόάέο δϊο έά ×ñάέάόάβ ίά Εΰίάόά λüi ίέα ÖñÜ

1. ΔñιόεΎόά όι ιç÷ΰίçιά όάο, όçí δýεç (gateway) έάέ όιόδ εέαέñέόόΎδ ññÜóüí (nameservers) όοι άñ÷άβι /etc/hosts. Όόι δάνΰάέάιά ίάο, όι άñ÷άβι άόóü ñέΰεάέ ίά όι δανάέΰόù:

```
127.0.0.1          localhost loghost
136.152.64.181   water.CS.Example.EDU water.CS water
136.152.64.1     inr-3.CS.Example.EDU inr-3 slip-gateway
128.32.136.9     ns1.Example.EDU ns1
128.32.136.12   ns2.Example.EDU ns2
```

2. Άάάέεùεάβόά üóε ç áíüóçόά files άñβόέάόάέ δñεί όι dns όόçí áíüóçόά hosts: όιό άñ÷άβιό /etc/nsswitch.conf. Άί άάί όδΰñ÷íοί άόóΎδ ίέ δάνΰίάόñíε, ñδñάβ ίά άιόάίέόόιγί δάνΰίάίά όóιδόβιάόά.
3. Öñíðíεΐόόά όι άñ÷άβι /etc/rc.conf.

1. ññβόά όι üñιά όιό όδñεάέόόΐ όάο, όñíðíεΐόόάό όç άñάñΐ δϊο άñΰόάέ:

```
hostname="myname.my.domain"
Έά δñΎόάέ άäβ ίά όιðñεάόΐόόά όι δεΐñάό üñιά όιό όδñεάέόόΐ όάο.
```

2. ññβόά όιό δñíáδéeääΎíü äñññεάçόΐ, áεεΰεάíόάό όç άñάñΐ:

```
defaultrouter="NO"
όά:
defaultrouter="slip-gateway"
```

4. Άçíεíñάΐόά Ύίά άñ÷άβι /etc/resolv.conf όι ñδñβι έά δάνεΎ÷άέ:

```
domain CS.Example.EDU
nameserver 128.32.136.9
nameserver 128.32.136.12
```

¼δùδ ñδñάβόά ίά άάβόά, όι δανάδΰιτ ññβεάέ όιόδ εέαέñέόόΎδ DNS. ÖóóéÜ, όά δñάñάόééÜ ññüíáόά έάέ ñε εέαόεγίόάέό όüí όñΎüí άíáñόβιόάέ άδü όι δάνεάΰεεíí όάο.

5. Νόειβόά έùεέéü δñüóááçόδ εέα όιόδ ÷ñΐόάόδ root έάέ toor (εάεβó έάέ εέα üóíόδ ΰεεíόδ εíáñεάόίγýό άάί Ύ÷íοί έùεέéü).
6. Άδάíáέέεíΐόόά όι ιç÷ΰίçιά όάο, έάέ άάάέεùεάβόά üóε Ύ÷άέ όάεάβ óúóÜ όι üñιά όδñεάέόόΐ.

27.7.1.2 Άçíεíñάβιόάό ίέα Óýíááόç SLIP

1. ñáoÜ όçí έεβόç, άñΰόά όçí άíόíεΐ slip όόçí δññíñíðΐ, άñΰόά όι üñιά όιό ιç÷άβιόόδ όάο έάέ όíí έùεέéü. Όí όé áεñεάβó ÷ñάέΰεάόάέ ίά άñΰόάόά, άíáñóΰόάέ άδü όι δάνεάΰεεíí όάο. Άί ÷ñçóεíñíεάβόά όí **Kermit**, ñδñάβόά ίά ÷ñçóεíñíεΐόόά Ύίά script üδùδ όι áéüεíόéí:

```
# kermit setup
set modem hayes
set line /dev/modem
set speed 115200
set parity none
```

```
set flow rts/cts
set terminal bytesize 8
set file type binary
# The next macro will dial up and login
define slip dial 643-9600, input 10 =>, if failure stop, -
output slip\x0d, input 10 Username:, if failure stop, -
output silvia\x0d, input 10 Password:, if failure stop, -
output ***\x0d, echo \x0aCONNECTED\x0a
```

Όδόςέΰ, έά δñÝδαέ ίά άέέΰίάδά όι ύíñά ÷ñΠόός έάέ όí έúάέú ήόά ίά δάέñέΰάειόí ίά δά άέέΰ όάδ. ίάδΰ άδú άδóú, ίδñάβδά άδεήδ ίά δέçέδñíέíαΠόάδά slip όόçí δñíδñíδΠ όύíάάόçδ όíδ **Kermit**.

Όçíάβδός: Ç ýδάñíç όíδ έúάέέίý όάδ όά ίíñδΠ άδέíý έάέíÝííδ όά ίδíέíαΠδíδά όçíάβí άíúδ όόόδΠιάδóδ άñ÷άβúí, άβίάέ άάίέέΰ έάέΠ έάÝά. Δñí÷úñΠόά ίά άέέΠ όάδ άδέýíç.

- 2. ΆδΠόά όí **Kermit** άέάβ (ίδñάβδά ίά όí όάάβέάδά όόí δάñάόέΠίέí ÷ñçόέííδíέΠíόάδ όά δέΠέδñά **Ctrl-z**) έάέ úδ root, άñΰόά:

```
# slattach -h -c -s 115200 /dev/modem
```

Άί ίδñάβδά ίά έΰíάδά ping όά δδíέíάέόδÝδ όόçí ΰέέç ίάñέΰ όíδ άñíέíαçδΠ, άβδά όόíάάíÝíέ! Άί άδóú άάí άíδέάýάέ, άíέέíΰόά όçí άδέέíαΠ -a άίδβ άέά όçí -c úδ ύíñέόíά όόçí slattach.

27.7.1.3 Δúδ ίά Όάñíάόβδάδά όçí Όύíάάόç

Έΰíδά όά άέúέíδέά:

```
# kill -INT `cat /var/run/slattach.modem.pid`
```

άέά ίά δάñíάόβδάδά όí slattach. Έόíçέάβδά úδέ δñÝδαέ ίά άβδά root άέά ίά άέδάέÝόάδά όí δάñάδΰíú. Δάέδά άδάíÝέέάδά όόí kermit (άέδάέΠíόάδ όçí fg άí όí άβ÷άδά όδάβέάέ όόí δάñάόέΠίέí) έάέ δάñíάόβδάδά όí (δέÝάίíδάδ **q**).

Ç όάέβάά manual όíδ slattach(8) άíάóÝñάέ úδέ ίδñάβδά ίά ÷ñçόέííδíέΠόάδά όçí άíóíέΠ ifconfig s10 down άέά ίά άέάέúδάδά όç όύíάάόç, άέέΰ άδóú άάí όάβíάδάέ ίά Ý÷άέ έάíÝíά άδíδÝέάόíά. (To ifconfig s10 άíάóÝñάέ όí βάέí δñΰάíά.)

ίάñέέÝδ όíñÝδ, όí modem όάδ ίδñάβ ίά άñíçέάβ ίά έέάβδάέ όç άñάíñΠ. Όόέδ δάñέδδδΠάέδ άδóÝδ, ίάέέíΠόά ίάíΰ όí kermit έάέ δάñíάόβδάδά όí ίάíΰ. Όç άáyόάñç όíñΰ όóíΠέúδ δάδδ÷άβíάέ.

27.7.1.4 ΆíόέíάδΠδέόç Δñíάέçíΰδóúí

Άί όí δάñάδΰíú άάí έάέόδíδñάΠόάέ, ñδΠόάδ όόç έβδάά frebsd-net (<http://lists.FreeBSD.org/mailman/listinfo/frebsd-net>). ίάñέέΰ άδú όά όόíçέέόíÝíά δñíάέΠíάόά όά ίδíβά Ý÷íδíά ίÝ÷ñέ όόέάíΠδ άíόέíάδúδβδάέ:

- ίά ίçí Ý÷άέ ÷ñçόέííδíέçέάβ ç άδέέíαΠ -c Π -a όόçí slattach (Άδóú έάííέέΰ άάí άβίάέ έñβέέíí όóΰέíά, άέέΰ ίάñέέíβ ÷ñΠόάδ άíÝόάñάí úδέ άδóú Ýέέόά όά δñíάέΠíάόά όíδδ.)
- ×ñΠόç όíδ s10 άíδβ άέά s10 (ç έάέóíñΰ ίδñάβ ίά άβίάέ δíέý ίέέñΠ όά ίάñέέÝδ άñάíάόíόάέñÝδ).

- Άρειΰόόά όγι άφίρεΨ ifconfig s10 έάέ ίά άάβόά όγι έάόΰόόάόç όçð έέάόάόΨò. Άέά όάνΰάέέαιά, ίðñáß ίά άάβόά όι όάñάέΰóù:

```
# ifconfig s10
s10: flags=10<POINTOPOINT>
    inet 136.152.64.181 --> 136.152.64.1 netmask fffffff0
```

- Άί ç άφίρεΨ ping(8) άβίάέ ίçίγίάόά “no route to host”, βóυò òðΰñ ÷ έέ ðñúάέçιά ίά όίί ðβίάέά άññίεüάçόçò óάò. Ιðñáßόά ίά ÷ ñçóέιüðίέΨόάόά όγι άίόίρεΨ netstat -r έάέ ίά άάβόά όγι òñΎ ÷ ίóóά άññίεüάçόç:

```
# netstat -r
Routing tables
Destination      Gateway          Flags           Refs          Use  IfaceMTU      Rtt      Netmasks:

(root node)
(root node)

Route Tree for Protocol Family inet:
(root node) =>
default          inr-3.Example.EDU  UG              8    224515  s10 -          -
localhost.Exampl localhost.Example. UH              5     42127  lo0 -          0.438
inr-3.Example.ED water.CS.Example.E UH              1         0  s10 -          -
water.CS.Example localhost.Example. UGH             34  47641234  lo0 -          0.438
(root node)
```

Óά όάñάðΰíù όάñάάάβαιάόά άβίάέ άðu Ύ ίά ó ÷ άòέέΰ άóάó ÷ ίεçίΎίí óýóóçιά. Ιέ άñέέüß έά έέάóΎñίóí óðí óýóóçιά óάò, άίΰέíάά ίά όç άñάóóçñέüíóçóά όίò έέέðýíò.

27.7.2 Νόεìβæííóáò íá ΆíòðçñάòçòΨ SLIP

Όι έάβιáíí áòóü ðáñΎ ÷ έέ εΰðίέáò ððíáάβίáέò έάέ όç ñýεíέóç άíúò FreeBSD óóóðβιáóíò ùò άíòðçñάòçòΨ SLIP. Όòðέέΰ áòóü óçιάβίáέ üðέ ðí óýóóçιά óάò έά ñðεíεóðάß ίά ίάέεíΰ áòóüíáóά ðέð óðíáΎóáέò ίáòΰ όçí άβóíáí áðñάέñóóíΎíúí ðάέάóβί SLIP.

27.7.2.1 ÐñíüðίεΎóáέò

Ç άíúóçóά áòòΨ άβίáέ έέέάβóάñά όá ÷ ίέέΨò óýóáùò, έάέ έάέ όι έüíáí áòóü áðάέóáβóάέ ίά Ύ ÷ άòá ðέð άíóβóóίε ÷ άò áíβóáέò έάέ ίά όçí έάóάííΨóáòá. ΌðίεΎóíóíá üðέ Ύ ÷ άòá ίέά άííέέάβóóç ίá όι ðñüòüεíεéí TCP/IP έάέ άέάέέüíóáñá ίá όç έέάðέóíóίεíáüóçóç έüíáüí, ðέð ίΰóέáð έέέðýúí, óá ððíáβέðóá, όç άññίεüάçόç έάέ óá ðñüòüεíεéá άññίεüάçόçò üðòò ðí RIP. Ç ñýεíέóç ðüí ððçñάóέβί SLIP óá Ύ ίά άíòðçñάòçòΨ άðέεíáέέβί óóíáΎóáüí áðάέóáß áíβóç áòòβί ðüí άííέβί, έάέ άί ááí άβóóá άííέέáέüíΎíúò ίá áòòΎò, óáò ðáñάέáέíýíá ίά έέάáΰóáòá άβóá όí TCP/IP Network Administration όíò Craig Hunt (άέäüóáέò O'Reilly & Associates, Inc, Άñέέüò ISBN 0-937175-82-X) Ψ εΰðίέί áðu óá έέάέβá όíò Douglas Comer ó ÷ άòέέΰ ίá όí ðñüòüεíεéí TCP/IP.

ΆðέðεΎíí, ððίεΎóíóíá üðέ βáç Ύ ÷ άòá ñðεíβóáέ όí modem óáò έάέ Ύ ÷ άòá ðñíðίðίέΨóáέ óá έáóΰέεçέá άñ ÷ άβá ñðεíβóáüí όíò óóóðβιáóíò βóóá ίά άðέóñΎðáóáέ ç άβóíáíò óóí óýóóçιά ίΎóù ðüí modem. Άί ááí Ύ ÷ άòá áέüíá ðñíáóíéíΰóáέ όí óýóóçιά έέά áòóü, ðáñάέáέíýíá άάβóá όí Όíβιá 26.4 έάέ έáðòñΎñάέáò ó ÷ άòέέΰ ίá όç ñýεíέóç ðüí άðέεíáέέβί óóíáΎóáüí. Άíáá ÷ ñΎíúò ίá εΎέáòá άðβóçò ίá άάβóá ðέð óáέβááð manual όçð sio(4) έάέ ðεçñíóíñβáð ó ÷ άòέέΰ ίá όí ðñüáñáíá íáβáçóçò όçð óáέñέáέΨò έýñáð, óá ttys(5), gettytab(5), getty(8), έάέ init(8) έάέ ðεçñíóíñβáð όíò ó ÷ άòβæííóáέ ίá όç ñýεíέóç όíò óóóðβιáóíò βóóá ίá äΎ ÷ άòάέ άβóíáí ÷ ñçóóβί ίΎóù modem, έάέ βóυò έάέ όç

stty(1) έάέ δέçñññññññ ò ÷ άόέέŪ ìά όέό δάνάŪŸñññò όάέñέάέπñ έδññπñ (üðùò όçí çlocal έάέ όάέñέάέŸò έάέδάόŸò ðñò άβñάέ άδάόέάβάό όóñññŸñò).

27.7.2.2 Άñπññç Άδέόέüðçç

ŌððέέŪ, Ÿñάό άñðçññάόçðŸò SLIP ðñò ÷ ñçóέññðñέάβ FreeBSD έάέóñññάάβ ìά όññ άñðò ðñññðñ: Ÿñάό ÷ ñπóççò SLIP έάέάβ όññ άñðçññάόçðŸò SLIP, έάέ άέóŸñ ÷ άδάέ όóñ όýóçñά ìŸòñ άññò έάέέñŸñ άññññέóέέñŸñ έέóñññ έάέ όñ SLIP. Ōñ έŸέðñò ðñò ÷ ñπóçç άβñάέ ðñ /usr/sbin/sllogin. Ōñ ðñññññññ sllogin έάάŪάέ ðñ άñ ÷ άβñ /etc/sliphome/slip.hosts έάέ ìά άññέ ìέά άññññ ðñò ìά όάέñέŪάέ ìά όññ ÷ ñπóçç, έάέ άñ ððŸñ ÷ έέ, όóññŸñ έç íά έέñέάέπñ άññññ òά ìέά έάέέŸóέñç έέάδάóŸò SLIP έάέ Ÿðάέóά έέðáέάβ ðñ script ðñò έάέýññò ðñ /etc/sliphome/slip.login έάέ ìά ñðèìβóάέ όç έέάδάóŸò SLIP.

27.7.2.2.1 ìά δάνŪάάέññά έέóñññò όά ΆñðçññάόçðŸò SLIP

Άέά δάνŪάάέññά, έάέ Ÿñά ÷ ñπóçç SLIP ìά ID Shelmerg, ç άíðβóóññέ ÷ ç έάόά ÷ ññέóç όóñ /etc/master.passwd έά Ÿññέάά ìά όçí δάνάέŪòñ:

```
Shelmerg:password:1964:89::0:0:Guy Helmer - SLIP:/usr/users/Shelmerg:/usr/sbin/sllogin
```

Ÿðάí άέóŸέέέ ì Shelmerg, ðñ sllogin έά ðŸñάέ ðñ /etc/sliphome/slip.hosts έάέ ìέά άññññ ìά ID ÷ ñπóçç ðñò ìά όάέñέŪάέ. Άέά δάνŪάάέññά, ìðññάβ ìά ððŸñ ÷ έέ ìέά άññññ òóñ /etc/sliphome/slip.hosts ðñò ìά άñŸóάέ:

```
Shelmerg          dc-slip sl-helmer          0xfffffc00          autocomp
```

Ōñ sllogin έά άññέ όç άññññ άððŸ, έά όóññŸóάέ όç όάέñέάέπñ άññññ òóçñ άðñññάç έάέέŸóέñç έέάδάóŸò SLIP, έάέ Ÿðάέóά έά έέðáέŸóάέ ðñ /etc/sliphome/slip.login üðùò óάβñάόάέ δάνάέŪòñ:

```
/etc/sliphome/slip.login 0 19200 Shelmerg dc-slip sl-helmer 0xfffffc00 autocomp
```

Άñ üέά ðŸñά έάέŪ, ðñ /etc/sliphome/slip.login έά έέðáέŸóάέ ìέά άññññ ifconfig έάέ όç έέάδάóŸò SLIP òóçñ ìðñβά Ÿ ÷ έέ όóññάέάβ ç sllogin (ç έέάδάóŸò 0 óóñ δάνάδŪñ ðάνŪάάέññά, ç ðññçç δάνŪñáðññò ðçð έβóóάð ðñò άβñάόάέ óóñ slip.login) ñóðά ìά ñðèìέóóñññ ç ðñðέέπñ έέάýέðñçç IP (dc-slip), ç άðññññññññŸñç έέάýέðñçç IP (sl-helmer), ç ìŸóέά έέέðýññ έάέ όç έέάδάóŸò SLIP (0xfffffc00), έάέ ìðñέáóáððñðά ðñññέáððά άðέέññŸò (autocomp). Άñ έŪðέ ðŸñάέ óðññáŪ, έά ìðññŸóάðá ìά ðñ άññññβóóðά áðñ ðά άñ ÷ άβñ έάðáññññò ðçð sllogin. Ç sllogin έάðáññŸóάέ ðά ìçññññάóá ÷ ñçóέññðñέπñóáð ðñ άάβñññά **syslogd** ì ìðñññò óóñðèò ÷ ñçóέññðñέάβ ðñ άñ ÷ άβñ /var/log/messages (ääβðά ðέð óάέβññð άñðέάέáð έάέ ðά syslogd(8) έάέ syslog.conf(5) έάέ άñññ ÷ ñŸñò ñέŸññðά ðñ /etc/syslog.conf έάέ ìά άάβðά όçí ðñðñέáóβά έάέ ðñ άñ ÷ άβñ ðñò ÷ ñçóέññðñέάβ ðñ **syslogd** έάέ όçí έάðáñññññ).

27.7.2.3 ñýèìέóç ðñò ðññññά

Ÿ ðñññðέέάññŸñò ðññññάð ðñò FreeBSD (ì GENERIC) έάέέŸðάέ άíóñññάóññŸñç ððñóðññέçç SLIP (sl(4)). Ōóçñ ðñññððòóç ðñò έŸέáðá ìά άçñέñññññññðáð ðñññóáññññññññ ðñññññά, ðñññέŸóá όçí δάνάέŪòñ άññññ òóñ άñ ÷ άβñ ñðèìβóáñññ ðñò ðññññά óáð:

```
device    sl
```

Όι FreeBSD, άδύ δññιάδέειάP, άάί δññιέάβ δάέΥόά. Άί έΥέάοά ι άίοδçñάοçòPò óáo ίά άίάñάάβ ùò äññιέιäçòPò, έά δñΥδάέ ίά άδάñάñάάόόάβδά όι άñ÷άβι /etc/rc.conf έάέ ίά άέέΰίάόά όç ñýèìέόç όçò ίάόάάέçòPò gateway_enable óά YES. Ιά όιí δññιδñ ίάόó, έά άβίάέ όβαιρññι ùόέ ç άδέειάP όçò äññιέιüäçóçò έά äέάόçñçέάβ ίάόΰ άδύ ίέά άδάίάέέβίçόç. Έά δñΥδάέ Υδάέόά ίά άδάίάέέειPóάόά äέά ίά άíáñäñδιέçειγί ίέ ίΥάò ñòèìβóάέò.

Άέά ίά άóáññιüóάόά άόδΥδ όέò ñòèìβóάέò ΰίάόά, ίδññάβδά ίά äέόäèΥόάόά όçí δάñάέΰòù άíôìèP ùò root:

```
# /etc/rc.d/routing start
```

Δάñάέάειγίά άάβδά όι Έαοΰεάει 8 äέά δάñέόóüòäññάò δέçññιòññβάò ó÷άδέέΰ ίά όçí ñýèìέόç όιò δññPíá όιò FreeBSD.

27.7.2.4 Ñýèìέόç όιò Sliplogin

¼δύò άίάόΥñέçέά έάέ δñέí, δδΰñ÷ιòí δññά άñ÷άβά όóιí έάóΰέιäñ /etc/sliphome óά ίδñβά ÷ñçóèìδñιέγίόάέ óόç ñýèìέόç όιò /usr/sbin/sliplogin (ääβδά έάέ όç óάέβάά manual όιò sliplogin(8)): όι slip.hosts, όι ίδñβι ññβæάέ όιòð ÷ñPóόάò SLIP έάέ όέò άίòβóóíé÷άò IP äέάòèγίόάέò όιòð, όι slip.login όι ίδñβι óóíPèùò ñòèìβæάέ άδèΰ όçí äέάόäòP SLIP, έάέ δññιέñάόέέΰ όι slip.logout, όι ίδñβι άίάέñάβ όέò äέέάáΥδ όιò slip.login ùόάί óáññιáòβóάέ ç óάέñέάèP óýíäóç.

27.7.2.4.1 Ñýèìέόç όιò slip.hosts

Όι /etc/sliphome/slip.hosts δάñέΥ÷άέ äññáñΥδ ίά όΥόóáñά δάάβά δñò ÷ññβæñíóáέ ίάόάίγ όιòð ίά έáíΰ äέάόδPíáόά:

- Όι άίάáññέóóéèü äέóüäñò όιò ÷ñPóόç SLIP
- Όçí όιδέέP äέáγέδíόç (όιδέέP ùò δññò όιí άίοδçñάόçòP SLIP) όçò äέάόγíäáόçò SLIP
- Όçí άδññáèñóóíΥίç äέáγέδíόç όçò äέάόγíäáόçò SLIP
- Όç ίΰόέά όιò äέέóγíò

Ç όιδέέP έάέ ç άδññáèñóóíΥίç äέáγέδíόç, ίδññάβ ίά άβίάέ ñññιáόά δññιέäέóóPí (óά ίδñβά ίά ίάόάòñΥδñíóáέ óá äέáòèγíόάέò IP ίΥóù όιò /etc/hosts P ίΥóù όιò DNS, άίΰέíäá ίά όέò έάόά÷ññβóάέò δñò δδΰñ÷ιòí óóí άñ÷άβι /etc/nsswitch.conf), έάέ ç ίΰόέά äέέóγíò ίδññάβ ίά άβίάέ Υίá ùññá όι ίδñβι ίά ίδññάβ ίά äέáòèñέíέóóáβ ίΥóù άίάæPóçóçò óóí /etc/networks. Óá Υίá äñέéíáóóéèü óýóóçíá, όι /etc/sliphome/slip.hosts ññέΰæάέ ίά όι δάñάέΰòù:

```
#
# login local-addr      remote-addr      mask                opt1    opt2
#                               (normal,compress,noicmp)
#
Shelmerg dc-slip        sl-helmerg         0xfffffc00         autocomp
```

Όόι όΥέèð όçò äññáñPò, äññβóéñíóáέ ίέά P δάñέόóüòäññάò άδύ όέò δάñάέΰòù άδέέñáΥδ:

- normal — ÷ññβò óòíδβáόç όúí άδέέáóáέβäñí
- compress — ίά óòíδβáόç όúí άδέέáóáέβäñí
- autocomp — ίά óòíδβáόç όúí άδέέáóáέβäñí, άί άδέέòñΥδäóáέ άδύ όιí άδññáèñóóíΥñ δññιέäέóóP

- noicmp — άδαιάηαιδιβζοζ ουι άάέΎουι ICMP (ια ουι οηυδι αδου οά άάέΎοά “ping” έα άδιηηβδουοάέ αίθβ ιά έαδαιάειηιουι ουι άγηιου αηίζου οζου ογίαάοζου οαδ)

Ιέ άδέειάΎου διου Ύ÷άου άέα οέου διδέέΎου έάέ άδιηηουιΎιαδ άέάδουγίαέου ουι SLIP οδίαΎουαι οαδ, αιηηουοάέ άδου ουι αι θηυέάοάέ ιά αοεαηουαδ άΎια οδριαβέουι TCP/IP η αι θηυέάοάέ ιά ÷ηζουειηιουοαδ “proxy ARP” ουι SLIP αιθδζηαδουοαδ οαδ (ααι αβιαέ “θηαιαδουέεη” proxy ARP, άεΎου οδζι αηυοζα αδουθ δαηεαηΎουαδ ια αδου ουι υηι). Αι ααι αβουα οβαιουηου διέα ιΎειαι ιά άδέέΎιαδ η θου ια άδριαβουαδ άέάδουγίαέου IP, δαηάέειγία αιαιουηΎια οοά άέάέβα ουι TCP/IP θιου αιαιΎηιουαέ οδουθ ΔηηιουηιέΎουαδ SLIP (Οιθια 27.7.2.1) η/έάέ οουαιουαδουαδ ουι άέα ÷άεηέουθ άέουγιο οαδ.

Αι θηυέάοάέ ιά ÷ηζουειηιουοαδ ια ÷ηεουου οδριαβέουι άέα ουιου SLIP δαέΎουαδ οαδ, έα ÷ηάέουαβ ιά άέάέΎουαδ ουι ανέειη οδριαέουγιο άδου οζι άέάγεουοζ IP θιου οαδ Ύ÷άε άδριαβέουι έάέ ιά άδριαβουαδ οουιου δαέΎουαδ SLIP άέάδουγίαέου θιου αιθδζηιου οα αδου ουι οδριαβέουι. θάέουα, έα ÷ηάέουαβ ιΎεειη ιά έαειηουαδ ιέα οοάουέεθ άεαηηηθ ουι οδριαβέουι SLIP ιΎου ουι αιθδζηαδουοαδ SLIP ουι ηιουέηιουαηι οαδ αηηηειαζουθ IP.

Άεαουηαδουέεη, αι ÷ηζουειηιουοαδ ιΎειαι “proxy ARP”, έα ÷ηάέουαβ ιά άδριαβουαδ οουιου SLIP δαέΎουαδ οαδ άέάδουγίαέου IP θιου αιθδζηιου ουι οδριαβέουι Ethernet ουι ιθιβι αιθεάε ι αιθδζηαδουοαδ SLIP, έάέ έα ÷ηάέουαβ αδβουζου ηηεουβουαδ οα script /etc/sliphome/slip.login έάέ /etc/sliphome/slip.logout ια ÷ηζουειηιουοαδ ουι arp(8) άέα ιά ÷άειηβειουαέ οέου έαδου ÷ηηουαδ “proxy ARP” ουι θβιαέά ARP ουι αιθδζηαδουοαδ SLIP.

27.7.2.4.2 Νγυειουζ ουι slip.login

ια οδδουέηη /etc/sliphome/slip.login ηιέΎουαέ ια ουι δαηάέΎου:

```
#!/bin/sh -
#
#      @(#)slip.login  5.1 (Berkeley) 7/1/90

#
# generic login file for a slip line.  sliplogin invokes this with
# the parameters:
#      1      2      3      4      5      6      7-n
#      slipunit ttyspeed loginname local-addr remote-addr mask opt-args
#
/sbin/ifconfig sl$1 inet $4 $5 netmask $6
```

Οι αν÷αβι slip.login άέουαδου αδουθ ουι ifconfig άέα οζι έαδουέεζου άέάδουθ SLIP, ια οέου διδέέΎου έάέ άδιηηουοαδΎιαδ άέάδουγίαέου έάέ οζ ιΎουαέ άέουγιο οζου άέάδουθ αδουθ.

Αι Ύ÷άου άδριαβουαδ ια ÷ηζουειηιουοαδ οζι ιΎειαι “proxy ARP” (αιθβ ια ÷ηζουειηιουοαδ άεαουηαδουέεη οδριαβέουι άέα ουιου δαέΎουαδ SLIP), ουι αν÷αβι /etc/sliphome/slip.login έα ηιέΎουαέ ια ουι δαηάέΎου:

```
#!/bin/sh -
#
#      @(#)slip.login  5.1 (Berkeley) 7/1/90

#
# generic login file for a slip line.  sliplogin invokes this with
# the parameters:
#      1      2      3      4      5      6      7-n
#      slipunit ttyspeed loginname local-addr remote-addr mask opt-args
#
/sbin/ifconfig sl$1 inet $4 $5 netmask $6
```

```
# Answer ARP requests for the SLIP client with our Ethernet addr
/usr/sbin/arp -s $5 00:11:22:33:44:55 pub
```

Ç ðñüοέάδς ãñáñìÞ óá áδòü ðì slip.login, ç arp -s \$5 00:11:22:33:44:55 pub, äçìεìðñãáß ìεά έάόά÷þñέόç ARP óðìí ðßìáέά ARP ðìò áìððçñãáδçðÞ SLIP. ÁðòÞ ç έάόά÷þñέόç ARP έΰìáέ ðìí áìððçñãáδçðÞ SLIP ìá áðáíóΰ ìá ðçì äέáyεðìόç Ethernet MAC üðáì έΰðìεìð ΰεεìð έüìáìò IP óðì Ethernet áðέέðìáß ìá áðέέìεìíùìÞóáέ ìá ðçì äέáyεðìόç IP ðìò ðãέΰόç SLIP.

¼ðáì ÷ñçóεìðìεάßðá ðì ðãñáðΰìù ðãñΰãáέáìá, ááááέεùεάßðá üðέ Ύ÷áðá áìðέέάόάóðÞóáέ ðçì äέáyεðìόç MAC ðìò Ethernet (00:11:22:33:44:55) ìá ðçì áìðßòìε÷ç ðçð ðáέêÞð óáð έΰñðáð Ethernet, äέáòìñáðέέΰ ðì “proxy ARP” óßãìòñá äáì έá έáέðìòñãÞóáέ! Ìðìñáßðá ìá áìáέáyóáðá ðç äέáyεðìόç MAC ðìò äέέìý óáð áìððçñãáδçðÞ SLIP εìεðΰæìíðáð ðá áðìòáέΎòìáðá ðçð áìðìεÞð netstat -i. Ç äáyðáñç ãñáñìÞ ðçð áìüáìò έá ììέΰæáέ ìá ðçì ðãñáέΰòù:

```
ed0 1500 <Link>0.2.c1.28.5f.4a 191923 0 129457 0 116
```

Áδòü äáß÷ìáέ üðέ óðì óðáέáέñéìΎì óýóðçìá ç äέáyεðìόç MAC ðìò Ethernet áßìáέ 00:02:c1:28:5f:4a. Ìέ ðáέáßð ðççì äέáyεðìόç ðìò äáß÷ìáέ ç netstat -i ðñΎðáέ ìá áìðέέάόάóðáεìýì ìá ΰìù-έΰòù ðáέáßð, έáέ έΰεá ììü äáέáìááέέü ðçòßì ðñΎðáέ ìá ìáðáðñáðáß óá äέðεü ðñìóεΎòìíðáð áðü ìðñìóΰ Ύìá ìçááìεέü. Ç äέáyεðìόç ìáðáðñΎðáðáέ ìá áðòü ðìí ðñüðì óá ìεá ììòÞ ðìò ìðìñáß ìá ÷ñçóεìðìεÞóáέ ç arp(8). Ááßðá ðç óáέßáá manual ðçð arp(8) äέá ðãñέóóüðáñáð ðççñìòìñáð ð÷áðέέΰ ìá ðç ÷ñÞóç ðçð áìðìεÞð áðòÞð.

Óçìáßòùç: ¼ðáì äçìεìðñãáßðá ðì /etc/sliphome/slip.login έáέ ðì /etc/sliphome/slip.logout, έá ðñΎðáέ ìá έΎóáðá ðì bit “áέðΎέáóçð” (ð.÷. chmod 755 /etc/sliphome/slip.login /etc/sliphome/slip.logout), äέáòìñáðέέΰ ç sliplogin äáì έá ìðìñáß ìá ðá äέðáέΎóáέ.

27.7.2.4.3 Νýεìέόç ðìò slip.logout

Ôì /etc/sliphome/slip.logout äáì áßìáέ áðüεðóá áðãñáßðçðì (áέòüð áì ðñüεάέóáέ ìá ðεìðìεÞóáðá “proxy ARP”), äέέΰ áì óεìðáyáðá ìá ðì äçìεìðñãÞóáðá, ìðìñáßðá ìá ÷ñçóεìðìεÞóáðá ìò ððüááέáìá ðì ðãñáέΰòù áðέü ðãñΰãáέáìá:

```
#!/bin/sh -
#
#      slip.logout
#
# logout file for a slip line.  sliplogin invokes this with
# the parameters:
#      1      2      3      4      5      6      7-n
#      slipunit ttyspeed loginname local-addr remote-addr mask opt-args
#
/sbin/ifconfig sl$1 down
```

Áì ÷ñçóεìðìεάßðá “proxy ARP”, έá έΎέáðá ðì /etc/sliphome/slip.logout ìá äέáãñΰóáέ ðçì έάόá÷þñέόç ARP ðìò ðãέΰόç SLIP:

```
#!/bin/sh -
#
#      @(#)slip.logout
```

```
#
# logout file for a slip line.  sliplogin invokes this with
# the parameters:
#   1       2       3       4       5       6       7-n
#   slipunit ttyspeed loginname local-addr remote-addr mask opt-args
#
/sbin/ifconfig sl$1 down
# Quit answering ARP requests for the SLIP client
/usr/sbin/arp -d $5
```

Ç arp -d \$5 έάάñÛòάέ όçí έάόά÷þñέόç ARP ðìò ðñìóóÝέçêå ìå όçí åêòÝέάόç òìò slip.login òìò “proxy ARP”, έάόÛ όçí åßòìåì òìò ðåêÛόç SLIP.

ÐñÝðåέ íå òì åðåíåÛåñìå Ûέέç íέå òìÛ: Ååååέúèåßòå ùðέ òì /etc/sliphome/slip.logout Ý÷åέ ìñέóóåß ùò åêòåέÝóέìì ìåðÛ όçí åçìέìòñåßå òìò (ð.÷., chmod 755 /etc/sliphome/slip.logout).

27.7.2.5 ÐåñÛåñìòåð ðìò ÐñÝðåέ íå ËÛååòå Õðüøç óåò óόç Åññìèüåçόç

Áí ååí ÷ñçóέììðìååßòå όçí ìÝέìåì “proxy ARP” åέå íå åññìèñååßòå ðåέÝóå ìåóåíý ðùì ðåέåðñì SLIP έάέ òìò ððùèìέðìò åέέðýìò óåò (έάέ åñåå÷ññò ðåέ òìò Internet), έå ðñÝðåέ ìÛέέìì íå ðñìóèÝóåðå óóåóέέÝð åέååññÝð ðñìò òìì ðέçóέÝóóåñì óåò ðñìåðέååñìÝññì åññìèñåçðP åέå íå åññìèñååßòå òì ððñåßèðìò ðùì SLIP ðåέåðñì óåò åέåñÝóìò òìò åìðçñåðçðP SLIP.

27.7.2.5.1 ÓóåóέέÝð ÅέååññìÝð

Ç ðñìóèPèç óóåóέέñì åέååññìñì ðñìò òìòð ðέçóέÝóóåñìòð óåò ðñìåðέååñìÝññòð åññìèñåçðÝð, ìðñåß íå åßñåέ ðñìåçñìåðέèP (P έάέ ååýñåóç åí ååñ Ý÷ååðå ðå έåðÛέέççåå åέέåέñìåðå ðñìóååóçð). Áí ç åðåññåß óåò åέåέÝðåέ åßèðìò ìå ðñèååðèýðð åññìèñåçðÝð, èÛðìåå ììóÝέå (ð.÷. åðü όçí Cisco έάέ όçí Proteon), åέðüð ùðέ ðñÝðåέ íå ðñèìέóóìýì ìå όçí óóåóέέP åέååññìP ðñìò òì ððñåßèðìò SLIP, ðñÝðåέ åðßçðð íå ðñèìέóóìýì ìå ðéð óóåóέέÝð åέååññÝð ðñìò έå åñåóÝññìò óòìòð Ûέέìòð åññìèñåçðÝð. Èå ÷ñåέóóåß íå ðååñåñåðέóóåßòå έάέ íå åñèèÛóåðå åέÛòìñåð ððèìóåðð åέå íå åñèèÝðåέ ç åññìèñåçόç ìÝóù óóåóέέñì åέååññìñì.

ΕὰοÛεάεί 28 Çäâêõñííéêü Ôá÷õäññåßí

Άñ÷έεP óðíáέóóññÛ áðu òíí Bill Lloyd. ΆñÛððçêå íáíÛ áðu òíí Jim Mock.

28.1 Óýííøç

Ôí “çäâêõñííéêü óá÷õäññåßí”, áðñýðáñå áñóóóó ùð email, åßíáέ óóέð ìÝñåð ìáð ìéá áðu óéð ðεÝíí áéáááññÝíáð ìñòÝð åðéέίííñíßáð. Ôí εὰοÛεάεί áðóóñ ðåñÝ÷÷ áέ ìéá ááóέεP áéóááññåßí óøç εäέòíòñåßá áññð äéáέññéóðP email óòí FreeBSD, éäèðð éáέ ìéá áéóááññåßí óøç äéááééáóáßá áðíóòíèPð éáέ εPøçð email óòí FreeBSD. Ûóðóóí ç áíáóññÛ áððP åáí ðñÝðåé íá èåñççèååß ðεPñçð, éäèðð ððÛñ÷÷ íóí áέññíá áñéåòíß ðåñÛåñíóåð ðíò ðñÝðåé íá εçòèýíí ððuøéí éáέ Ý÷÷ íóí ååð ðåñåéáéðéååß. Áéá ðéí ðεPñç áíÛéððç ðíò εÝíáòíò, ì áíáåñPððçð ðåñåðÝíðåðåé óðá ðíèÛ äñåññåðéÛ áéáéßá ðíò áíáóÝññíóåé óòí ðåñÛñðçíá B.

Áóíý áéááÛóåðå áðóóó òí éåòÛεάεί, éá ìÝñåðå:

- Ôí εñåóíééêü ðíò ÷ñçóéíðíéååßðåé óðçí áðíóòíèP éáέ εPøç çäâêõñííééêý óá÷õäññåßíò.
- ðíò åñßóéííóåé óá ááóέéÛ åñ÷åßá ãðèìßóåñí ðíò **sendmail** óòí FreeBSD.
- Ôç äéáóññÛ ìåðáíý áðñåññòóíÝíñí éáέ ðíðéèP èðñåñí óá÷õäññåßíò (mailboxes).
- ðùð íá åñðñåßðåðå áíáðééýíçðíòð spammers áðu òí íá ÷ñçóéíðíéèPóíòí òíí áéêü óåð åñðçññåðçðP email ùð áíáíåðååñíðç.
- ðùð íá ååéáðåððPóåðå éáέ íá ãðèìßóåðå Ýíá áñåéåéðééêü Áíóéðññóóððí ìåðåóññÛð Õá÷õäññåßíò (Mail Transfer Agent) óòí óýóðçíá óåð, áíóééåééóðPíóåð Ýðóé òí **sendmail**.
- ðùð íá áíóéíåððßóåðå óðççéóíÝíá ðññåèPíåðå óòíí áéáéññéóðP óá÷õäññåßíò.
- ðùð íá ÷ñçóéíðíéèPóåðå òí SMTP ìå òí UUCP.
- ðùð íá ãðèìßóåðå òí óýóðçíá óåð ìññí áéá áðíóòíèP email.
- ðùð íá ÷ñçóéíðíéèPóåðå òí email ìÝóóò åðééññéèPð (dialup) óýíååðçð.
- ðùð íá ãðèìßóåðå ðéóòíðíèççóç áðéáíóééêüòçðåð óòí SMTP áéá ðññóéåðç óóòÛεåéá.
- ðùð íá ååéáðåððPóåðå éáέ íá ÷ñçóéíðíéèPóåðå ìéá åðåñññåßí áðíóòíèPð éáέ εPøçð email áéá ÷ñPóåðå, ùððò òí **mutt**.
- ðùð íá éáðååÛóåðå òí email óåð áðu Ýíá áðñåññòóíÝíñí áéáéññéóðP POP P IMAP.
- ðùð íá åðåñññóåðå ðßèðñå éáέ éáíñíåð óðçí áéóåññ÷÷ñç áéèççññåñåðßá óåð, ìå áðóóñåðí ðññðí.

ðñéí áéááÛóåðå áðóóó òí éåòÛεάεί, éá ðñÝðåé:

- Íá ãðèìßóåðå óóððÛ çç óýíååðç ðíò áééðýíò óåð (ΕὰοÛεάεί 31).
- Íá ãðèìßóåðå óóððÛ óéð ðεçññññññåð DNS áéá òíí áéáéññéóðP áéèççññåñåðßáð óåð (ΕὰοÛεάεί 29).
- Íá áñññååðå ðùð íá ååéáðåððPóåðå ðññóéåððí εñåóíééêü ðñßðíò éáðåéååðåðP (ΕὰοÛεάεί 4).

óðäèàèñéíÝíí óòÙείά. Íé ððίεραέóóÝð ðίò áßíaé éáóá÷ùñçíÝííé íá ðçí áðέεíäÞ OK, ç ððίßá áßíaé éáé ç ðñíäðέéääíÝíç, áðέóñÝðäóáé íá óðáßεíòí email óá áðóυ ðíí ððίεραέóóÞ, áóυóíí í ðáέέέυð ðñíñéóίυð ðίò ìçíýíáóίò áßíaé ðí ðíðέέυ ìç÷Ùίçíá. Íé ððίεραέóóÝð ðίò áßíaé éáóá÷ùñçíÝííé íá ðçí áðέεíäÞ REJECT áðññßððίòíóáé áéá ððίéääÞðíòä áðέέίεíñßßá Ý÷áé íá éÙíáé íá ìáðÙäíóç mail. Íé ððίεραέóóÝð ðίò áßíaé éáóá÷ùñçíÝííé íá ðçí áðέεíäÞ RELAY, Ý÷íòí ðç áðíáóυðçóá íá óðáßεíòí mail ðñò ððίéääÞðíòä éáóáγέðίóç ìÝóυ ðίò óðäèàèñéíÝííò áíòðçñáðçóÞ.

ÐáñÙäáéåíá 28-1. Ñýèíέóç ðçò ÅÙóçò ÄäáñÝííí ðñúóááóçò ðίò sendmail

```
cyberspammer.com      550 We do not accept mail from spammers
FREE.STEALTH.MAILER@  550 We do not accept mail from spammers
another.source.of.spam REJECT
okay.cyberspammer.com  OK
128.32                 RELAY
```

Οά áðóυ ðí ðáñÙäáéåíá Ý÷íòíä ðÝíóá éáóá÷ùñÞóáéð. Íé áéáðέγίóáéð ðίò óáßíííóáé óðçí áñέóóáñÞ ðεáðñÙ ðίò ðßíaéá, áðçñáÙæííóáé áðυ ðç áíÝñááéá ðίò óáßííóáé óðç ááíέÙ ðεáðñÙ. Οά ðñÞðá áγí ðáñáááßáíáóá, áðέóðñÝóíòí Ýíá éυáέέυ óòÙείáðίò óðç ðíòðßía áéá÷áßñέóçð éáεÞí ðίò **sendmail**. Οí ðíðίá áéðððíáðóáé óóíí áðñáèñéíÝíí ððίεραέóóÞ, υðάí ðí mail ðίò éáíáÙíáóáé áíÞéáé óá éÙðίéá áðυ ðέð éáðççáññßáð ðçð áñέóóáñÞð ðεáðñÙð ðίò ðßíaéá. Ç áðυíáíç éáóá÷Þñçóç áðññßððóáé ðçí ðáñáéááÞ mail áðυ Ýíá óðäèàèñéíÝíí ððίεραέóóÞ óóí Internet, ðíí another.source.of.spam. Ç áðυíáíç éáóá÷Þñçóç éÙíáé ááéðÝð ðέð óóíáÝóáéð mail áðυ ðíí ððίεραέóóÞ okay.cyberspammer.com, ðí υíñá ðίò ððίßíò ðñíóáéíñßæáðóáé áéñéáÝóóáñá óá ó÷Ýóç ìá ðç áñáñÞ cyberspammer.com ðίò áßáíá ðáñáðÙí. ÁñáñÝð ðίò éáéíñßæíòí ðñííáóá ìá ìááéγóáñç áéñßááéá, Ý÷íòí ðñíðáñáéυðçóá óá ó÷Ýóç ìá ðέí áíáèñéááßð. Ç ðáéáðóááá éáóá÷Þñçóç áðέóñÝðáé ðçí áíáíáðÙäíóç (relaying) çèáèðñíέέý ðá÷ðäññåßíò áðυ ððίεραέóóÝð ìá áéáðέγίóáéð IP ðίò íáέέíÙíá ìá 128.32. Íé ððίεραέóóÝð áðóíß, ìðñíýí íá óðáßεíòí mail ìÝóυ ðίò óðäèàèñéíÝííò áíòðçñáðçóÞ, ðí ððίßí íá éáóáðέγίáóáé óá Ùέεíòð áíòðçñáðçóÝð óá÷ðäññåßíò.

Οά ðáñßððóçç áíáíÝυðçò áðóíý ðίò áñ÷áßíò, éá ðñÝðáé íá áéðáéÝóáðá ðçí áíòíéÞ make óðíí éáðÙείäí /etc/mail/ áéá íá áíáíáÞðáðá ðç áÙóç áäáñÝííí.

28.3.2 /etc/mail/aliases

Ç áÙóç áäáñÝííí ðíí ðáñύíðíßύí (aliases), ðáñéÝ÷áé íéá éßóóá áðυ áέέííέéÝð èðñßááð óá÷ðäññåßíò ðίò áðáéðáßííóáé óá Ùέεíòð ðñÞðáð, áñ÷ááá Þ éáé Ùέéá ðáñύíýíéá. ÌáñέέÙ ðáñáááßáíáóá ðñÞóçò ðίò /etc/mail/aliases óáßíííóáé ðáñáéÙðυ:

ÐáñÙäáéåíá 28-2. Ðáñύíýíéá Mail

```
root: localuser
ftp-bugs: joe,eric,paul
bit.bucket: /dev/null
procmail: "|/usr/local/bin/procmail"
```

Ç ðñòÞ ðίò áñ÷áßíò áßíaé áðεÞ. Οí υíñá ðçð èðñßááð áñÞóéáðóáé óðçí áñέóóáñÞ ðεáðñÙ ðçð Ùíυ-éÙðυ ðáéáßáð, éáé áðáéðáßííóáé óóíí ðñíñéóίυ ðίò áñÞóéáðóáé óðç ááíέÙ ðεáðñÙ. Οí ðñÞðí ðáñÙäáéåíá, áðεÞð ðñßæáé υðέ ç èðñßáá ðίò ðñÞðóç root éá áßíaé óðçí ðñáíáíáðέέυðçóá ç èðñßáá localuser. Áéá ðçí èðñßáá áðóÞ, áßíáðáé íáíÙ áíáεÞðçóç óðç áÙóç áäáñÝííí ðíí ðáñύíðíεÞí. Áí ááí áñáεáß Ùέεí υíñá ðίò íá ðáéñéÙæáé, ðí ððίðía éá ðáñááíéáß óóíí ðíðέέυ ðñÞðóç localuser. Οí áðυíáñ ðáñÙäáéåíá ááß÷íáé íéá éßóóá óá÷ðäññåßíò. Οά ìçíýíáóá ðίò áðáðέγíííóáé óðç èðñßáá ftp-bugs, éáðáðέγíííóáé óá ðñáéð ðíðέéÝð èðñßááð, ðέð joe,eric éáé paul. ΟçíáεÞðóá υðέ áßíaé áðíáðύí

áέáðééτýíáέ έάέáβðáñá ðçí áέέááÐ ðùí áέðáέÝóéíτ ðíð áέðáéτýíðáέ ðççí ðñáñíáðééèÙðçðá ùðáí áβíáðáέ έέÐçç ðùí ðñíáðééáñÝíτúí έάέðíðñáέβí ðíð `sendmail`.

ðóέ, áí èÝέáðá íá áέðáέáβðáέ ðí /usr/local/supermailer/bin/sendmail-compat áíðβ áέá ðí **sendmail**, έá ìðñíτýðáðá íá áέέÙíáðá ðí /etc/mail/mailer.conf þóðá íá áñÙðáέ:

```
sendmail /usr/local/supermailer/bin/sendmail-compat
send-mail /usr/local/supermailer/bin/sendmail-compat
mailq /usr/local/supermailer/bin/mailq-compat
newaliases /usr/local/supermailer/bin/newaliases-compat
hoststat /usr/local/supermailer/bin/hoststat-compat
purgestat /usr/local/supermailer/bin/purgestat-compat
```

28.4.5 Ìéτέçñþííðáð

Ìúέέð Ý÷áðá ðñéìβóáέ ðá ðÙíðá ùðð ððéέðíáβðá, ìðñáβðá áβðá íá έÙíáðá kill ðéð áέáñááðβáð ðíð **sendmail** ðíð ááí÷ñáέÙáððá ðéÝí έάέ íá áέέéíþóáðá ðéð áíðβóðíé÷áð ðíð ðÝíð óáð έτáέðíέéτý, Ð áðέþð íá έÙíáðá áðáíáέέβíççç. Ç áðáíáέέβíççç έá óáð áþóáέ áðβðçð ðççí áðéάέñβá íá ááááέúέáβðá ùέέ ðí óýóðçíá óáð Ý÷άέ ðñéìέóðáβ óóððÙ, þóðá ðí ðÝíð óáð MTA íá ðáέέíÙáέ áððñíáðá óá έÙέá áέέβíççç.

28.5 Áíðéìáðþðéóç ðñíáέçíÙðùí

1. Áέáðβ ðñÝðáέ íá ÷ñçóéíτðíέþ ðí ðéþñáð ùññá (FQDN) áέá ððíέτáέóðÝð ðíð áñβóéíτðáέ óðíτ ðñÝá ðíð;

Òí ðéτ ðéάíτ áβíáέ íá áέáðéóðþóáðá ùέέ τ ððíέτáέóððð áñβóέáðáέ ðççí ðñáñíáðééèÙðçðá óá áέáðññáðééèÙ ðñÝá. Áέá ðáñÙááέáñá, áí áñβóέáðá óðíτ `foo.bar.edu` έάέ èÝέáðá íá áðéééτúíþóáðá ìá Ýíá ððíέτáέóðð ðá ðí ùññá `mumble` óðíτ ðñÝá `bar.edu`, έá ðñÝðáέ íá áíáðáñéáβðá óá áððñíτ ìá ðí ðéþñáð ðíð ùññá, `mumble.bar.edu`, áíðβ áέá áðέþð `mumble`.

ðáñááíðééέέÙ, áððù áðéðñáððúðáí áðù ðíðð DNS resolvers ðíð BIND. Ùóðùóí, ç ðñÝ÷íðóá Ýέáíðç ðíð **BIND** ðíð ðáñέέáñáÙíáðáέ óðíτ FreeBSD, ááí ðáñÝ÷άέ ðéÝíτ óóíðññáýðáέð áέá ìç-ðéþñç ðñíáðá ðñÝúí, áέðùð áέá ðíð ðñÝá óðíτ ððíβí áñβóέáðá. ðóέ, Ýíáð ððíέτáέóððð ìá ìç-ðéþñáð ùññá `mumble` έá ðñÝðáέ íá áñáέáβ ùð `mumble.foo.bar.edu`, Ð έá áβíáέ áíáæþðççç áέá áððñíτ óðíτ ðéáέέèÙ ðñÝá.

Ç óðíðáñéóññÙ áððð áβíáέ áέáðññáðéέéÐ áðù ðççí ðññçáíτýíáíç, ùðíð ç áíáæþðççç óðíá÷έæùðáí έάέ óðíτ `mumble.bar.edu`, έάέ ðí `mumble.edu`. Ñβíðá ìέá ìáðéέÙ óðíτ RFC 1535 áέá ðí èùáí ðíð ðí ðáñáðÙíτ έáùñáβðá έάέþ ðñáέðéééÐ, Ð áέùíá έάέ έáíτ áóóáέáβáð.

Íáð ðñùðíð áέá íá ðáñáέÙíðáðá ðí ðñúáέçíá áβíáέ íá ðñíðéÝðáðá ðç áñáñíÐ:

```
search foo.bar.edu bar.edu
```

áíðβ áέá ðççí ðññçáíτýíáíç:

```
domain foo.bar.edu
```

óðíτ áñ÷áβí /etc/resolv.conf. Ááááέúέáβðá ùóðùóí ùέέ ç óáέñÙ áíáæþðçççð ááí ðççááβíáέ ðÝñá áðù ðí “ùñέí ìáðáíτ ðíðéέéðð έάέ áçíùέóáð áέá÷áβñéóçð”, ùððð ðí áðíέάέáβ ðí RFC 1535.


```
# echo "your.isp.example.com" > /etc/mail/relay-domains
```

Áοτγ áçεττòñáΠόάοά Π áðáτáñáαóοάβóά áóòυ οτ áñ÷áβτ, εά ðñÝðáε τά áðáτáñéεετΠόάοά οτ **sendmail**. Áóòυ áτòεάγáε τέα ÷áñÙ áτ áβóοά áεά÷áεñέóóðò áτòðçñáòçòΠ εάε ááτ áðέεòτáβóά τά óóÝετáοά mail οτðέεÙ, Π áτ εÝεάοά τά ÷ñçóεττðτέΠόάοά Ýτá óγóóçτá óγðτò point εάε click óá Ýτá Ùεετ τç÷Ùτçτá Π áεττá εάε óá Ùεετ ISP. Άβτáε áðβóçð ðτèγ ÷ñΠóέττ áτ Ý÷áòá ñòετβóáε ττττ Ýτá Π áγτ ετááñεάóττγò mail. Áτ εÝεάοά τά ðñτòεÝóáòá τάááεγóáñτ áñεεττ εέáòεγτáοáττ, τðτñáβóά áðεðò τά áñτáοά áóòυ οτ áñ÷áβτ τά οττ áðέεòτçòυ óóτðÙεòç εάετÝττò, εάε τά ðñτòεÝóáòá υεττò οτòð óñáβò, Ýτá óá εÙεά áñáñΠ:

```
your.isp.example.com
other.isp.example.net
users-isp.example.org
www.example.org
```

Όπñá, τðτέαáΠðττá áðτòòτεΠ mail áðυ οτ óγóóçτá óáò áðυ τðτετáΠðττá ððτετáεóóΠ áóòΠð óçð εβóóáð (τá óçτ ðñττðυεάóΠ τ ÷ñΠóóçð τά Ý÷áε ετááñεάóττ óòτ óγóóçτá óáò), εά áβτáε áðέóð÷Πð. Ðñτεáεóáε áεά Ýτá ðτèγ εάεττ óñττò τά áðέóñÝðáòá óòτòð ÷ñΠóóáð τά óóÝεττòττ mail áðυ οτ óγóóçτá óáò τÝóò áðτáεñòóτÝτçð óγτááóçð, ÷ññβò τά áðέóñÝðáòá óá Ùεετòð τά óóÝεττòττ SPAM τÝóò οτò óóóðΠτáòττ óáò.

28.6 Ðñττ ÷ñçτÝτá ΕÝτáοά

Ç áευετòεç áττòçóá εάεγððáε ðετ ðñττ÷ñççτÝτá εÝτáοά, τðòð óç ñγέτέóç οτò mail εάε ñòετβóáεð áεά Ýτá τευεεçñτ óñÝá.

28.6.1 ΆóóεεÝò Ñòετβóáεò

×ññβò τά ÷ñáεάóóáβ τά εÙτáοά εάεÙ ñγέτέóç, εά τðτñáβóά τά óóáβεάòá mail ðñτò áττòáñεεττγò ððτετáεóóÝò, áñεáβ τά Ý÷áòá ñòετβóáε οτ /etc/resolv.conf Π τά áεòáεáβóά οτ áεεττ óáò áτòðçñáòçòΠ DNS. Áτ εÝεάοά τά ðáñáεáτáÙτáοά mail áεά οττ ððτετáεóóΠ óáò óòτ áεεττ óáò **sendmail** MTA, ððÙñ÷τòτ áγτ τÝετáε:

- Ìðτñáβóά τά Ý÷áòá áεεττ óáò óñÝá εάε áεεττ óáò áτòðçñáòçòΠ DNS áεά οττ óñÝá óáò. Άεά ðáñÙááεáτá, FreeBSD.org
- Íá ðáñáεáτáÙτáοά mail áðáòεáβáð óòτ τç÷Ùτçτá óáò. Άóòυ áβτáοάε áτ οττ mail ðáñááβááóáε áðáòεáβáð óòτ ððτετáεóóΠ óáò, ÷ñçóεττðτέΠτáò οττ τττá οτò (ðñÝðáε τά áñβóεáòáε óòτ DNS). Άεά ðáñÙááεáτá, example.FreeBSD.org.

¼ðτεά áðεετáΠ áðυ óεò ðáñáðÙττ εάε τά εÙτáοά, áεά τά áβτáε áóτáòΠ ç ðáñáεááΠ mail áðáòεáβáð óòτ ððτετáεóóΠ óáò, εά ðñÝðáε τά Ý÷áòá ττττç óóáóεεΠ áεάγεòτçç IP (τ÷ε áóτáεεΠ, τðòð áβτáε τé ðáñεóóυðáñáð áðεετáεεÝò óóτáÝóáεð PPP). Áτ áñβóεáòá ðβóò áðυ εÙðτεττ firewall, εά ðñÝðáε τά áðέóñÝðáε óç áεάεβτççç SMTP ðñτò áóÙð. Áτ εÝεάοά τά εáτáÙτáοά mail áðáòεáβáð óòτ ððτετáεóóΠ óáò, εά ðñÝðáε τά áτáóóáεβóáòá Ýτá áðυ óá ðáñáεÙò:

- Íá ááááευεáβóά υέε ç áááñáòΠ MX (τá οττ ÷áτçευτðáñτ áñεεττ) óòτ DNS óáò, ááβ÷τáε ðñτò óç áεάγεòτçç IP οτò τç÷áτáòτò óáò.
- Íá ááááευεáβóά υέε ááτ ððÙñ÷áε εάεÙ áááñáòΠ MX óòτ DNS áεά οττ ððτετáεóóΠ óáò.

¼ðτεττ áðυ óá ðáñáðÙττ εάε áτ εÙτáοά, εά τðτñáβóά τά εáτáÙτáοά mail áðáòεáβáð óòτ ððτετáεóóΠ óáò.

ÄíέéíŬóðά áðòù:

```
# hostname
example.FreeBSD.org
# host example.FreeBSD.org
example.FreeBSD.org has address 204.216.27.XX
```

Áí äéŬðáðά ðí δñáñáðŬíù, ðí mail ðíð éáðáðέýíáðάέ áðáðέáβáð óðí <yourlogin@example.FreeBSD.org> èá δñŬðáέ íá éáíáŬíáðάé ÷ññð ðñíáέΠíáðά (éáññπíóáð ùέ ðí **sendmail** äέðáέáβðά òúóðŬ óðí ððíέíáέóðΠ example.FreeBSD.org).

Áí áíðβ äέá áðòù äáβðά éŬóέ óáí ðí δñáñáέŬòù:

```
# host example.FreeBSD.org
example.FreeBSD.org has address 204.216.27.XX
example.FreeBSD.org mail is handled (pri=10) by hub.FreeBSD.org
```

¼έí ðí mail ðíð éáðáðέýíáðάέ δñíð ðíí ððíέíáέóðΠ óáð (example.FreeBSD.org) èá éáðάέΠíáέ íá óðέŬááðάέ óðí hub ìá ðí βáέí ùíñá ÷ñΠóç, áíðβ íá óóáέáβ áðáðέáβáð óðí ìç÷Ŭíçíá óáð.

Ὀέð δñáñáðŬíù ðέçñíòíñβáð, ðέð ÷áέñβáέðάέ í äέέùð óáð áíððçñáðçðΠð DNS. Ḷ äáñáðΠ DNS ðíð δñáñέŬ÷áέ ðέð ðέçñíòíñβáð äñíñέùäççðç äέá ðí mail, áβíáέ ç Mail eXchange. Áí äáí ððŬñ÷áέ äáñáðΠ MX, ðí mail èá δñáñáβááðάέ áðáðέáβáð óðí ððíέíáέóðΠ ìŬóù ðçð IP äέáýέðíóçð ðíð.

Ḷ éáðá÷πñέçç MX äέá ðíí freefall.FreeBSD.org Ŭííέááá éŬðíέá óέέáñΠ ìá ðçí δñáñáέŬòù:

```
freefall      MX    30    mail.crl.net
freefall      MX    40    agora.rdrop.com
freefall      MX    10    freefall.FreeBSD.org
freefall      MX    20    who.cdrom.com
```

¼ðùð ìðñáβðά íá äáβðά, ì freefall áβ÷á ðíέéŬð éáðá÷ññΠóáέð MX. Ḷ éáðá÷πñέçç ìá ðíí ìέέñùðáñí áñέέùí, áβíáέ ì ððíέíáέóðΠð ðíð éáíáŬíáέ ðí mail áðáðέáβáð, áí áβíáέ äέáέŬóέíð. Áí äέá éŬðíέí éùáí äáí áβíáέ ðñíóáŬóέíð, ìέ Ŭέέíέ (ðíð ìñέóíŬíáð òñŬð éáέýíðάέ “backup MXes”) äŬ÷ñóáέ ðá ìçíýíáðά ðñíóñέíŬ éáέ ðá ìáðááέáŬáέíðí ðá éŬðíέí ððíέíáέóðΠ ìá ÷áìçέùðáñç áñβέìççç, ìüέéð áβíáέ äέáέŬóέíð. ὈáέέéŬ ðá ìçíýíáðά éáðάέΠáíðí ððí ððíέíáέóðΠ ìá ðí ìέέñùðáñí áñέέùí.

Íé áíáέéáέóέéŬð ðíðíέáóβáð MX, èá δñŬðáέ íá ÷ñçóέíððíέíýí äέáðñáðέéŬð äñáñŬð äέá ðç óýíááçç ðíðð ìá ðí Internet. ÁððΠ áβíáέ ç éáέýðáñç éýçç. Í δñáñí÷Ŭáð óáð Π éŬðíέí Ŭέέí òέέέéù site, äáí èá Ŭ÷íðí éáíŬíá δññüáέçíá íá óáð δñáñŬ÷íðí áððΠ ðçí ððçñáóβá.

28.6.2 Mail äέá ðíí ὈñŬýá Ὀáð

Äέá íá äçíέíðñáΠðáðά Ŭíá “mailhost” (äç. Ŭíá áíððçñáðçðΠ mail) èá δñŬðáέ ìðíέíáΠðíðá mail óðŬέíáðάέ δñíð éŬðíέí óóáέíù äñááóβáð, íá éáíáŬíáðάέ óá áðòùí. ÁáóέéŬ èá èŬéáðά íá “äέáέäέéáβðά” ìðíέíáΠðíðá mail ðíð éáðáðέýíáðάέ ðñíð ðíðíέíáΠðíðá ùíñá ìç÷áíΠáðíð ðíð ðñŬýá óáð (óðçí δñáñβððòçç ìáð ðí *.FreeBSD.org) èáέ íá ðí áíáέáðáðέýíáðά ðñíð ðíí áíððçñáðçðΠ mail, πððá ìέ ÷ñΠóçð óáð íá ìðñíýí íá éŬáíðí ðí mail ðíðð áðù ðíí éáíðñέéù áíððçñáðçðΠ.

Äέá äóέíέβá, èá δñŬðáέ íá Ŭ÷áðá Ŭíá éíááñέáðíù ÷ñΠóçç ìá ðí βáέí ùíñá ÷ñΠóçç éáέ óðá äýí ìç÷áíΠáðά. ×ñçóέíððíέΠðóá äέá ðí óέíðù áðòù ðçí áíðíέΠ adduser(8).

Ï mailhost ðíð εά ÷ñçóείηðíεðóáðá, ðñÝðáε íá áβίáε ðí εάεíñεóíÝíη ìç÷-Ùíçíá áεά ðçí áíóáεεááβ ìçíòíÙòùí áεά εÙεá òóáεíη ãñááóβáð ðíð áεéðýíð. Áðòù áβíáðáε òóεð ñðεìβóáεð DNS ìá ðíí áεúεíðεè ðñúðí:

```
example.FreeBSD.org      A      204.216.27.XX ; Workstation
                          MX  10 hub.FreeBSD.org ; Mailhost
```

Ïá ðíí ðñúðí áðòù, ðí mail ðíð εάóáððεγíáðáε ðñíð εÙðíεí òóáεíη ãñááóβáð εá áíáεáðáððεðíεáβ ðñíð ðí mailhost, Ùò÷-áðá ìá ðí ðíð ááβ÷-íáε ç áááñáðð òýðíð Á. Õí mail òðÝεíáðáε ðñíð ðíí ððíεíáεóðð MX.

Ááí ìðíñáβðá íá εÙíáðá ðí ðáñáðÙíù, áí ááí áεðáεáβðá ðí áεéù òáð áíððçñáðçðð DNS. Áí áðòù ááí òðíááβíáε, εáε ááí ìðíñáβðá íá ðí áεεÙíáðá, òðíáíñçεáβðá ìá ðíí ðáñí÷-Ýá òáð (ISP) β ìá ùðíεíí òáð ðáñÝ÷-áε òðçñáóβáð DNS.

Áí ðáñÝ÷-áðá òðçñáóβáð áεεíεεéγ òá÷ðáññáβíð, íε ðáñáεÙòù ðεçñíðñíñáð εá òáð òáíýí ÷ñðóεíáð. Áεá ðí ðáñÙááεεíá ìáð, εá òðíεÝóíòíá ùðε Ý÷-áðá Ýíá ðáεÙðç ìá ðí áεéù ðíð ðñÝá, òðçí ðáññððòùç ìáð ðí customer1.org, εáε εÝεáðá ùεí ðí mail áεá ðí customer1.org íá òðÝεíáðáε òðí áεéù òáð mailhost, mail.myhost.com. Ç εáðá÷-ññεóç òáð òðí DNS εá ñíεÙæáε ìá ðçí ðáñáεÙòù:

```
customer1.org MX 10 mail.myhost.com
```

Õçíáεððá ùðε ááí ÷ñáεÙæáððá áááñáðð òýðíð Á áεá ðí customer1.org áí εÝεáðá áðεð ìá ÷áεñβæáððá email áεá áðòù ðíí ðñÝá.

Õçíáβòùç: Ìá Ý÷-áðá ððúçç òáð ùðε ááí εá ìðíñáβðá íá εÙíáðá ping ðí customer1.org áí ááí ððÙñ÷-áε áεá áðòù áááñáðð òýðíð Á.

Õí òáεáððáβí ðñÙáíá ðíð ðñÝðáε íá εÙíáðá, áβíáε íá ññβóáðá òðí **sendmail** ðíð áεðáεáβðáε òðí áεéù òáð mailhost, áεá ðíεíð ðññáðð β / εáε ìç÷-áíðíáðá εá äÝ÷-áðáε mail. ÕðÙñ÷-íðí ìáñéεíβ áεáðñáððεéíβ ðñúðíε áεá íá áβíáε áðòù. Ìðíñáβðá íá ÷ñçóείηðíεðóáðá Ýíáí áðù ðíð ðáñáεÙòù:

- ðñíðεÝððá òá ìç÷-áíðíáðá òðí áñ÷-áβí /etc/mail/local-host-names áí ÷ñçóείηðíεáβðá ðç áðíáðúðçðá FEATURE(use_cw_file). Áí ÷ñçóείηðíεáβðá εÙðíεá Ýεáíðç òíð **sendmail** ðñéí ðçí 8.10, ðí áñ÷-áβí áβíáε ðí /etc/sendmail.cw.
- ðñíðεÝððá ìεá ãñáñð Cwyour.host.com òðí áñ÷-áβí òáð /etc/sendmail.cf β òðí áñ÷-áβí /etc/mail/sendmail.cf áí ÷ñçóείηðíεáβðá ðçí Ýεáíðç 8.10 ðíð **sendmail** β εÙðíεá ìáðááíÝððáñç.

28.7 SMTP ìá UUCP

Ç ðñíáðéεááíÝíç ñýεíεóç ðíð **sendmail** ðíð Ýñ÷-áðáε ìá ðí FreeBSD, ðñíññβæáðáε áεá áεéððáεÝð ðíðíεáððáð ðíð áβíáε áðáðεáβáð òðíáááíÝíáð òðí Internet. Õá ðáñéðððáεð ðíð áβíáε áðéððíçðð ç áíóáεεááβ email ìÝòù UUCP, εá ðñÝðáε íá ÷ñçóείηðíεçεáβ áεáðñáððεéù áñ÷-áβí ñðεìβóáúí áεá ðí **sendmail**.

Ç ÷áεñíεβíçðç ñýεíεóç ðíð áñ÷-áβíð /etc/mail/sendmail.cf áíðεáε òðá ðñí÷-ùñçíÝíá εÝíáðá. Ç Ýεáíðç 8 ðíð **sendmail** ðáñÙááε áñ÷-áβá ñðεìβóáúí ìÝòù ðíð ðñíáðáíñááóðð m4(1), ùðíð ìε ñðεìβóáεð áβííðáε òá Ýíá áñðáñí áðβðááí áðáβñáðçð. Ìðíñáβðá íá áñáβðá òá áñ÷-áβá ñýεíεóç ðíðm4(1) òðíí εáðÙεíáí /usr/share/sendmail/cf. ÁεááÙòðá ðí README òðíí εáðÙεíáí cf áεá ìεá ááóεεβ áεóááùáβ òðéð ñðεìβóáεð ðíð m4(1).

if-bus.UUCP uucp-dom:if-bus
. uucp-dom:

Íε οñáέο ðñρòáο ãñáñÝò ÷ áέñβæííóáέ áέáέέÝò ðáñέðòρòáέο, ùðíò οí mail ðíò áðáòέγíáòáέ οá εὐðíέí οñÝá ááí εá ðñÝðáέ íá οóáέεáβ οóçí ðñíáðέέááíÝíç áέááññÞ, áέεὐ áíòβεáòá οá εὐðíέí ááέοííέέυ UUCP ðñíέáíÝíò íá “οóíοíñáòεáβ” οí ïíñðὐέ ðáñὐáííóçð. Ḷ áðñíáíç ãñáñÞ ÷ áέñβæáòáέ οí mail ðñíò οíí οíðέέέυ οñÝá Ethernet, ùðíò áβíáέ áοíáòÞ ç ðáñὐáííóç íÝòù SMTP. ΟÝέíò, íé ááέοííέέέíβ UUCP áíáòÝñííóáέ íá ãñáòÞ ϕáòáí-òñÝúí UUCP þóòá íá áðέοñÝðáòáέ οá εὐðíέíí uucp-neighbor !recipient íá ðáñáέὐíϕáέ οíòð ðñíáðέέááíÝíòð εáíúíáò. Ḷ οáέáòòáβá ãñáñÞ áβíáέ ðὐíóá íéá ïíááέεÞ óáέáβá, ç íðíβá óáέñέὐááέ íá íòέáÞðíòá ὐέέí, íá ðáñὐáííóç UUCP οá Ýíá ááέοííέέέυ UUCP í íðíβíð áíáñááβ ùò ááíέέÞ ðýέç mail ðñíò οíí οðñέíέðí εúοíí. ¼éá óá ïíñíáòá οðíέíáέοóρí ðíò ãñβóέííóáέ íáòὐ οí uucp-dom: εá ðñÝðáέ íá áβíáέ Ýáέοñíέ UUCP ááβοííáò, ùðòð íðíñáβòá íá áááέéρòáòá ÷ ñçóέííðíέρíóáò οí uuname.

Οάòð ððáíέòíβæíòíá ùέέ áòòú οí áñ ÷ áβí ðñÝðáέ íá íáòáòñáðáβ οá íéá áὐÓç áááñÝúí DBM ðñέí ÷ ñçóέííðíέçεáβ. Ìðíñáβòá íá áὐέáòá ðç ãñáñÞ áíóíέρí ðíò áðáέóáβòáέ áέá íá áðέóáò÷εáβ áòòú ùò ó÷úέέí οóçí áñ ÷ Þ οíò áñ ÷ áβíò mailertable. ðñÝðáέ ðὐíóíóá íá áέòáέáβòá áòòÞ ðçí áíóíέρÞ εὐέá οíñὐ ðíò áέέὐááòá οí áñ ÷ áβíí mailertable.

Íéá óáέáòòáβá οðñúááέíç: áí ááí áβòòá áÝááέíé áέá οí áí εá εáέòíòñáÞρòáέ εὐðíέá óðáέáñέñíÝíç ãñíñέυáçç mail, εòíçεáβòá ðçí áðέέíáÞ -bt οíò sendmail. ÁðòÞ íáέέíὐáέ οí sendmail οá εáòὐóòáóç áíέέíÞð ùέáðέγíòáúí. Áðέρò ãñὐòðá 3, 0, áέíέíòέíγíáñí áðñ ðç áέáγέòíóç ðíò εÝέáòá íá áέÝáíáòá áέá ãññíέυáçç mail. Ḷ οáέáòòáβá ãñáñÞ εá οáò ðáέ οíí áòòúáñέέέυ áíóέðññúòòðí mail ðíò ÷ ñçóέííðíέρεçéá, ðç áέáγέòíóç ðñíñέοííγ íá ðçí íðíβá έέρεçéá, εáέρò εáέ ðçí (ðέέáíρò íáòáòñáòíÝíç) áέáγέòíóç. Ìðíñáβòá íá áááβòá áðñ áòòÞ ðçí εáòὐóòáóç, ðέçέòñíέíáρíóáò Ctrl+D.

```
% sendmail -bt
ADDRESS TEST MODE (ruleset 3 NOT automatically invoked)
Enter <ruleset> <address>
> 3,0 foo@example.com
canonify          input: foo @ example . com
...
parse            returns: $# uucp-dom $# your.uucp.relay $: foo < @ example . com . >
> ^D
```

28.8 Ñýèíέóç ÁíòðçñáòçòÞ Ìúíí áέá ÁðíóòíέÞ

Οóíáέóòíñὐ áðñ οíí Bill Moran.

Οðὐñ ÷ íοí ðíέéÝò ðáñέðòρòáέò, ðíò ìðíñáβ íá εÝέáòá ïúí íá οóÝέíáòá mail íÝòù εὐðíέíò áíáíáòááúòç. Ìáñέέὐ ðáñáááβáíáòá:

- Ì ððíέíáέóòÞð οáò ÷ ñçóέííðíέéáβòáέ ùò desktop, áέέὐ εÝέáòá íá ÷ ñçóέííðíέéρòáòá ðñíáñὐííáòá ùðòð οí send-pr(1). Áέá íá áβíáέ áòòú εá ðñÝðáέ íá ÷ ñçóέííðíέéρòáòá οíí áíáíáòááúòç mail ðíò ðáñÝ ÷ áέ í ISP οáò.
- Ì ððíέíáέóòÞð οáò áβíáέ Ýíáò áíòðçñáòçòÞð ðíò ááí ÷ áέñβæáòáέ οí mail οíðέέὐ, áέέὐ ÷ ñáέὐááòáέ íá οí áρòáέ áí' íέíέéρñíò οá εὐðíέí áíáíáòááúòç áέá áðáíáñáóβá.

ÏðíέíáÞðíòá ó÷ááúí MTA áβíáέ εέáíú íá εáέγϕáέ οíí ðáñáðὐíñ ñúέí. Áòóòð÷Þð, ìðíñáβ íá áβíáέ ðíέγ áγóέíέí íá ñòέíβòáòá οúòòὐ Ýíá ðéρñáò MTA þóòá áðέρò íá οóÝέíáέ οí mail ðñíò áíáíáòὐáííóç. ðñíáñὐííáòá ùðòð οí sendmail εáέ οí postfix áβíáέ ððáñáíέέέὐ ìááὐέá áέá áòòÞ ðç áíòέáέὐ.

Áðέðññúóέáòá, áí ÷ ñçóέííðíέéáβòá εὐðíέá οóíçέέóíÝíç ððçñáòóβá ðññúóááóçð οóíí Internet, ç οóíòñíβá ìá ðçí áòáέñβá ðáñí÷Þð ìðíñáβ íá οáò áðáíñáγáέ íá áέòáέáβòá οí áέέέυ οáò “áíòðçñáòçòÞ mail”.

άν÷άβη οήη sendmail.cf, έάέ έά άδάρáέέείΠόάέ ουόόὐ οή **sendmail**. Άέά άñέόόουόάñάδ έάδδὸñÝñάέάδ
ό÷άδέέὐ ή άδδΠ όç έέάάέέάόβά, έά δñÝδάέ ή έέάάὐόάδά οή άñ÷άβη /etc/mail/Makefile.

Άή υέά δΠάάί έάέὐ, έά δñÝδάέ ή ήδñάβδά ή άΠόάδά όά όόίε÷άβá έέουάιό όάό όόή δñυάñάήά δñō ÷ñçόέηδñέάβδά έέά
άδñόόίεΠ έάέ έΠçç mail, έάέ ή ή όάβέάόά Ýή άñέέίάόόέέυ ήΠήόή. Άέά ή έέάñάόήΠόάόά δñέόόούόάññ όç έέέόήδñάβá,
έÝόόά όçή άδέέήάΠ LogLevel όήη **sendmail** όήη 13 έάέ δñάέέήέήδδΠόόά όή /var/log/maillog έέά δδ÷ή έὐέç.

Άέά δñέόόούόάñάδ δέçññήñβάδ, δñάέάέήγήά ή άάβδά όç όάέβáά όήη **sendmail** δñō άόññὐ όçή δέόόήδñβçç
άδέάήέέέυόçόάδ όήη SMTP (<http://www.sendmail.org/~ca/email/auth.html>).

28.11 Δññññὐήάόά Ὀά÷οάνηάβñō έέά όήη ×ñΠόόç

Ὀδñέόόήñὐ όήη Marc Silver.

ήά δñυάñάήά Άήέδññήδñō Ὀά÷οάνηάβñō ×ñΠόόç (Mail User Agent, MUA), άβñάέ ήά άόάññάΠ δñō ÷ñçόέηδñέάβδάέ
έέά όçή άδñόόίεΠ έάέ έΠçç email. ΆδέδδÝή, έάέΠδ όή email “άñέέβόόάόάέ” έάέ άβñάόάέ δέή δñέýδέήέ, όά MUA
άβññόάέ υέή έάέ έό÷δñυόάñά υόή άόññὐ όήη δñυδñē δñō άέέçέάδέάññήή ή όή email. Άόόυ άβñάέ όόήδ ÷ñΠόόάδ
δñέόόούόάñάδ έέέόήδñάβáδ έάέ άδάέέήβá. To FreeBSD δñέÝ÷έέ δññήδδΠñέήç έέά ήάὐέή άñέέήυ άδñ δññññὐήάόά
όά÷οάνηάβñō, έάέ υέά ήδññήή ή άάέάόάόόάέήήή δñέý άýέήέά ήÝού όçδ ὈδέέήάΠδ όήη Ports όήη FreeBSD. ήέ ÷ñΠόόάδ
ήδññήή ή άδέέÝññήή ήάόάý άñάόέέΠ δññññññὐόδñ, υδñδ όή **evolution** Π όή **balsa**, έάέ δññññññάόά έήήέέάδ υδñδ όά
mutt, **pine** Π mail, Π áέññά έάέ δέδ έέάδάόÝδ web δñō δññόόÝññήόάέ άδñ ήñέέήýδ ήάὐέήδδ ήñάήέόήýδ.

28.11.1 mail

Ὀή mail(1) άβñάέ όή δñññδέέάññÝññ δñυάñάήά όά÷οάνηάβñō (MUA) in FreeBSD. Δññέέέόάέ έέά Ýή MUA έήήέέάδ, όή
ήδññ δññόόÝñάέ υέάδ όέδ άάόέέÝδ έέέόήδñάβáδ δñō άδάέόήýήόάέ έέά όçή άδñόόίεΠ έάέ έΠçç email όά ήññΠ έάέήÝññ,
άή έάέ Ý÷έέ δñέñέέόήÝñάδ άñήάόυόçόάδ υόή άόññὐ όήçññÝήά άñ÷άβá έάέ δññήδçñβáέέ ήññ ήδñέέÝδ έδñβáάδ.

Άή έάέ όή mail άάή δññήδçñβáέέ άάάάñδ όç έΠçç email ήÝού έέάέñέόδΠ POP Π IMAP, άβñάέ υόόούή άñήάόññ ή
έάδάάὐόάδά όά email όά ήά όήδέέΠ έδñβáά (mbox) ÷ñçόέήδñέΠήόάδ έὐδñέά άόάññάΠ υδñδ όή **fetchmail**, όή ήδññ έά
όάççδΠόήόή άñññυόάñά όά άόόυ όή έάοὐέάεί (ὈήΠή 28.12).

Άέά όçή άδñόόίεΠ έάέ έΠçç email, άδέΠδ άέδάέÝόόά όçή άήόήΠ mail υδñδ όάβñάόάέ όήη δñάέέὐδδ δññὐάάέάή:

```
% mail
```

Ὀά δñέέá÷υήήά όçδ έδñβáάδ όήη ÷ñΠόόç όόήή έάδὐέήññ /var/mail έά έέάάάόόήýή άόόυήάόά άδñ όή δñυάñάήά mail.
Άή ç έδñβáά όά÷οάνηάβñō άβñάέ ὐάάέά, όή δñυάñάήά δñññάόβáέάόάέ ή όή ήΠήόή υέέ άάή άñÝέçέά άέççήñάόβá. ήάὐ
όçή άήὐάñυόç όçδ έδñβáάδ, ήάέήὐ ç έέάδάόΠ όçδ άόάññάΠδ έάέ άñόάñβáέάόάέ ήά έβδóά ή ήçýήάόά. Ὀά ήçýήάόά
άñέέήýήόάέ άόόυήάόά, υδñδ όάβñάόάέ όόή δñάέέὐδδ δññὐάάέάή:

```
Mail version 8.1 6/6/93. Type ? for help.
"/var/mail/marcs": 3 messages 3 new
>N 1 root@localhost      Mon Mar  8 14:05  14/510  "test"
  N 2 root@localhost      Mon Mar  8 14:05  14/509  "user account"
  N 3 root@localhost      Mon Mar  8 14:05  14/509  "sample"
```

Ὀά ήçýήάόά ήδññήή δέÝññ ή έέάάάόόήýή ή όçή άήόήΠ **t** όçδ άήόήΠδ mail, áέήέήδñέýήάç ή όήή άñέέήυ όήη mail δñō
έÝέάόά ή άñόάήέόάβ. Ὀόή δññὐάάέάήά άόόυ έά έέάάὐόήόή όή δñΠδñ ήΠήόή:

```
& t 1
```

Message 1:
From root@localhost Mon Mar 8 14:05:52 2004
X-Original-To: marcs@localhost
Delivered-To: marcs@localhost
To: marcs@localhost
Subject: test
Date: Mon, 8 Mar 2004 14:05:52 +0200 (SAST)
From: root@localhost (Charlie Root)

This is a test message, please reply if you receive it.

¼δϋò οάβιάοάε οοί δάνάδΰίϋ δάνΰαάεαία, ç ÷ñβόç οίò δεβέοñνίò t εά δñνίεάεΰοάε όçί àìòΰίεόç οίò ιçίγίαοίò ιά δεβñνέο άδεέαοάεβάο. Άεά ίά αάβοά ίάΰΰ όç εβόοά ιά οά ιçίγίαοά, ÷ñçόεñνίεβόοά οί δεβέοñνί h.

Άί οί mail άδαέοάβ άδΰίόç, ιδñνάβοά ίά ÷ñçόεñνίεβόοά όçί άίοίεβ mail ÷ñçόεñνίεβίόοά οέο άίούιαοϋΰίάο άίοίεΰò R P r. Όί δεβέοñνί R ίαçāāβ οί mail ίά άδαίòβόάε ιϋñνί οοñνί άδίοοίεΰά οίò ιçίγίαοίò, άñν οί r άδαίòΰάε ù÷έ ιϋñνί οοñνί άδίοοίεΰά, άεεΰ οά ùείòδ οίòδ δάνάεβδóοά οίò ιçίγίαοίò. Ιδñνάβοά άδβόçδ ίά δñνίεΰόάοά ιάοΰ άδϋ οέο άίοίεΰò άοδΰò, οñνί άñεέϋ οίò ιçίγίαοίò οοί ιδñνί εΰεάοά ίά άδαίòβόάοά. Άοίϋ οί εΰίάοά άοδϋ, εά δñνίεάε ίά άñΰοάοά όçί άδΰίόç οάο εάε ίά όçίάεβόάοά οί όΰείò δçδ άñΰοñνίόοά ιεά ιϋñνί . οά ιεά ίΰά άñνίβ. Ιδñνάβοά ίά αάβοά ΰίά δάνΰαάεαία δάνάεΰòδ:

& R 1
To: root@localhost
Subject: Re: test

Thank you, I did get your email.

.
EOT

Άεά ίά οοάβεάοά ίΰί mail, εά δñνίεάε ίά ÷ñçόεñνίεβόοά οί δεβέοñνί m, άείείòεγίιαñνί άδϋ όçί άεάϋέοίόç οίò δάνάεβδóç. Ιδñνάβοά ίά άβόοά δñεεάδεγίò δάνάεβδóοά, ÷ ùñβαίíοάο ιάοαίϋ οίòδ οέο άεάοεγίόαέο ιά , Ιδñνάβοά ΰίεάεοά ίά αΰεάοά οί εΰίά οίò ιçίγίαοίò εάε ίά οοίά÷βόάοά ιά οί δάνεά÷ϋιαñνί. Όί όΰείò οίò ιçίγίαοίò εάεñνίβεάοάε άñΰοñνίόοά ιεά ιñνίάεεβ . οά ιεά ίΰά άñνίβ.

& mail root@localhost
Subject: I mastered mail

Now I can send and receive email using mail ... :)

.
EOT

¼οί άñβόεάοάοά ίΰόά όçί άίοίεβ mail, ιδñνάβοά ίά ÷ñçόεñνίεβόοά οί δεβέοñνί ? άεά όçί àìòΰίεόç άñνεάεάο ïδñνίάβδñνίόά οόεαñν. Ιδñνάβοά άδβόçδ ίά οοίάñνέεάοάββόά όçί οάεβάά manual οίò mail(1) άεά δάνεόοóοάñνάδ δεçñνίòñνίβάδ ó÷άδεέΰ ιά όçί άίοίεβ mail.

Όçιαβϋόç: ¼δϋò άίαοΰñνία ιδñνίçāñνίΰίϋ, ç άίοίεβ mail(1) άάί ó÷άεέΰόçεά άñν÷έεΰ άεά ίά ÷άεñνβεάοάε οοίçñνίΰίά, εάε άεά οί εϋαí άοδϋ ιε άοίάοϋδçδóοά οέο οοί οόάεάεñνείΰñνί εΰίά άβίαέ ιεεñνΰò. Ιάβοαñνά MUA, ϋδϋò οί mutt, ÷άεñνβαίíοάε οά οοίçñνίΰίά ιά δñνέϋ δέñνί ΰíòδñνί δñνδñνί. Άεεΰ άί δάν' ϋεά άοδΰ άδεεέοιαββόά ίά ÷ñçόεñνίεβόοά όçί άίοίεβ mail, ιΰεείí εά οάο οάίαβ ÷ñβόεñνί οί port converters/mpack.

28.11.2 mutt

Όì **mutt** àβίáέ Ýíá íέέñù, àέέŪ ðřę ý ó÷ðñù ðñùàñàííá áðíóðìèðð éáέ èðøçð mail, íà áíáέñàðέέŪ ÷ àñáέðçñέóðέέŪ óá ðìíβá ðàñέέàíàŪñíóí:

- Όçí έέáíúðçðά íá ààβ÷íáέ ìçíýíáðá íà ðçí ðñòð óðæçððóáùí
- Ōðíóððñέíç PGP áέá øçöέáèð ððíñááòð éáέ èñðððíñŪöçóç email
- Ōðíóððñέíç MIME
- Ōðíóððñέíç Maildir
- ÁíáέñàðέέŪð àðíáðúðçðáð ðàñáíáðñíðìíβçðçð

¼éàð áððŪð íέ àðíáðúðçðáð, èŪñíðí òì **mutt** Ýíá áðù óá ðεί áíáέέáíŪíá áέáèŪóέíá ðñíñŪííáðá óá÷ðàññàβìð. Àáβðá ðçí ðìðìèáóβá <http://www.mutt.org> áέá ðàñέóóúðàñáð ðèçñíòíññáð ó÷áðέέŪ íà òì **mutt**.

Ìðññáβðá íá àáέáðáóððóáðá ðç óðáέàñð Ÿέáíðç òìð **mutt** ìŸóù òìð port mail/mutt, áíð éáέ ç òñŸ÷ìðóá ððù áíŸέέíç Ÿέáíðç àβίáέ áέáèŪóέíç ìŸóù òìð port mail/mutt-devel. ÌàðŪ ðçí àáέáðŪóðáóç òìð port, ìðññáβðá íá àέðáèŸóáðá òì **mutt**, íà ðçí áέüèìðèç áíðìèð:

```
% mutt
```

Όì **mutt** èá áέááŪóáέ áððúíáðá óá ðàñέá÷ùíáíá ðçð èðñβááð óá÷ðàññàβìð ÷ ðñðóç óðíí éáðŪèíáí /var/mail, éáέ èá àáβíáέ óá ðàñέá÷ùíáíá òìð áí áððù àβίáέ áðέέðù. Áí àáí ððŪñ÷ìðí mails óçç èðñβáá òìð ÷ ðñðóç, òì **mutt** èá áέóŸèèé óá éáðŪóðáóç áíáíñðð áíðìèð. Όì ðàñáèŪðù ðàñŪááέáíá, ààβ÷íáέ òì **mutt** íá áðáέéíñβæáέ íéá èβóðá ìçíðìŪðùí:

```
q:Quit d:Del u:Undel s:Save m:Mail r:Reply g:Group ?:Help
 1 N Mar 09 Super-User ( 1) test
 2 N Mar 09 Super-User ( 1) user account
 3 N Mar 09 Super-User ( 1) sample
-----*-----
--Mutt: /var/mail/narcs [Msgs:3 New:3 1.6K]---(date/date)----- (all)---
```

Áέá íá áέááŪóáðá email, áðèðð áðέέŸíðá òì ÷ ðçóέñðìèèðíðáð óá àáèŪééá, éáέ ðéŸóðá **Enter**. Ìðññáβðá íá àáβðá Ýíá ðàñŪááέáíá áðáέéüíέóçð mail áðù òì **mutt** ðàñáέŪðù:


```

PINE 4.58  MAIN MENU                               Folder: INBOX  3 Messages

?  HELP                - Get help using Pine
C  COMPOSE MESSAGE    - Compose and send a message
I  MESSAGE INDEX      - View messages in current folder
L  FOLDER LIST        - Select a folder to view
A  ADDRESS BOOK       - Update address book
S  SETUP              - Configure Pine Options
Q  QUIT               - Leave the Pine program

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? Help                P PreuCmd                R ReINotes
0 OTHER CMDS > [Index] N NextCmd                K KLock
    
```

Ότ άðñáðñéτ ιçίòιΰòυτ ááß÷íáε ιçίγίáðá áðυ ðτ ðñÝ÷íðá εáðΰετττ, εάε ðññáßðá íá íáðáέετçεáßðá ðá áðòυ íá ðá ááεΰέεá. ðññáßðá íá áεάáΰóáðá ðτ áðέεáñÝττ ιßíðíá, ðéÝáττðáð ðτ ðεßéðñτ **Enter**.

```

PINE 4.58  MESSAGE INDEX                           Folder: INBOX  Message 1 of 3 ANS

A  1 Mar  9 Super-User      (471) test
A  2 Mar  9 Super-User      (479) user account
A  3 Mar  9 Super-User      (473) sample

? Help                < FldrList          P PreuMsg                = PreuPage  D Delete                R Reply
0 OTHER CMDS > [ViewMsg] N NextMsg          Spc NextPage  U Undelete          F Forward
    
```

Όðçτ áεέυτá ðτð ðáßíáðáε ðáñáεΰòυ, ðτ **pine** áðáέεττßæáε Ýτá ððυááεáτá ιçίγίáðíð. Όðτ εΰòυ ðññτð ðçð τευτçð ðáßñτðáε ð÷áðέéÝð ðóτðñáγóáεð ðεçεðñτετáßτð. Íá ðáñΰááεáτá ðÝðτεáð ðóτðυτáðóçð, áßτáε ðτ ðεßéðñτ **r** ðτ τðτßτ εÝáε ððτ MUA íá äçτετðñáßðáε áðΰτðçç ðñτð ðτ ðñÝ÷íτ ιßíðíá ðτð áðáέεττßæáðáε.

- Òðéòòðñέίç òùí ðñùðéíεùεèùí POP3, APOP, KPOP, IMAP, ETRN εάέ ODMR.
- Άοίάòùòçðά ðñíðεçòçð email ìÝòù SMTP, òí ìðéβι áðεòñÝðáε òç òðóέíεíεάέð εάέòéòñάβά òéò òεéðñάñβóíáòéò, òçð ðñíðεçòçð, εάέ òùí ðáññéíðéβùí (aliases).
- Ìðéñάβ ñá εάέòéòñάβðóáε òά εάòÙóðάóç ááβñíñá, þóðά ñá áεÝá÷áε ðáñέíñáέέÙ áεá ñÝá ñçýíñáðá.
- Ìðéñάβ ñá áíáέòÙ ðñεéáðεÝð εðñβáàð εάέ ñá òéð ðñíùεάβ, áíÙεíñá ñá òéð ñðéìβóáέð òéò, òά áεáòéíñáðééýð òéðééýð ÷ñðóðáð.

Áí εάέ áβíáé Ýñù áðù òéòð òéíðéýð áðóéý òéò εάέíÝñéò ñá áñçáðóáε ùεáð òéð áðéíáòùòçðáð òéò **fetchmail**, εά áíáòáñεéýñá òά εÙðéíεáð ááóέέÝð εάέòéòñάβáð. Òé **fetchmail** ÷ñçóέíðééáβ Ýñá áñ÷áβι ñðéìβóáùí áñúóòù ùð .fetchmailrc, áεá ñá εάέòéòñάβðóáε òúóðÙ. Òé áñ÷áβι áðòù ðáñέÝ÷áε òéð ðεçñéíñéñáð òéò áñðçñáðçðP áεéÙ εάέ òά òðé÷áβá áέóúáñò òéò ÷ñðóðç. Èùáù òùí áðáβðεçòùí ðεçñéíñéñáð òéò áñ÷áβι áðòéý, òáð òéíáñòεáýéíòá ñá ÷ñçóέíðééðóáðá òçí ðáñáέÙòù áñòéð þóðά ç áíÙáñúóç òéò ñá áðεòñÝðáóáé ñùí áðù òéí εάέíεððç òéò:

```
% chmod 600 .fetchmailrc
```

Òé .fetchmailrc ðéò òάβíáðáé ðáñáέÙòù áβíáé Ýñá ðáñÙááέáñá ñá òé ìðéβι ìðéñάβðá ñá εáðááÙóáðá òç εðñβáá áñúð ÷ñðóðç ìÝòù òéò ðñíùðéíεùεèùí POP. Èáðáðéýñáε òé **fetchmail** ñá òðéíáεáβ òéí example.com ÷ñçóέíðééðéðáð ùññá ÷ñðóðç joesoap εάέ èùáééù xxx. Òé ðáñÙááέáñá òðéÝðáé ùðé ì ÷ñðóðçð joesoap áβíáé áðβóçð εάέ ÷ñðóðçð òéò òéðééý òðóðñáðéò.

```
poll example.com protocol pop3 username "joesoap" password "XXX"
```

Òé áðùñáñ ðáñÙááέáñá, ááβ÷íáé óýñááóç òά ðñεéáðéýð POP εάέ IMAP áñðçñáðçðÝð, εάέ áíáέáðáðéýñáε òά áεáòéíñáðééýð òéðééýð ÷ñðóðáð ùðéò áβíáé áðáñáβóçðé:

```
poll example.com proto pop3:
user "joesoap", with password "XXX", is "jsoap" here;
user "andrea", with password "XXXX";
poll example2.net proto imap:
user "john", with password "XXXXX", is "myth" here;
```

Òé áñçεçòééù ðñùáñáñá **fetchmail** ìðéñάβ ñá εάέòéòñάβðóáε òά εάòÙóðάóç ááβñíñá, áí òé áεðáéÝóáðá ñá òçí áðééíáβ -d, áéíεíðéýñáéç áðù Ýñá áéÙòçñá (òá ááððáñùεáððá) òé ìðéβι εά ÷ñçóέíðééçεáβ áεá ñá áñùðñéðáé ñε áñðçñáðçðÝð òéò áβíáé εáðá÷áñçéÝñε òðé áñ÷áβι .fetchmailrc. Òé ðáñáέÙòù ðáñÙááέáñá ñáçááβ òé **fetchmail** ñá áñε÷áýáé áεá ñÝí mail εÙεá 600 ááððáñùεáððá:

```
% fetchmail -d 600
```

Ìðéñάβðá ñá áñáβðá ðáñέóóùðáñáð ðεçñéíñéñáð áεá òé **fetchmail** òðçí òéðééáóβá <http://fetchmail.berlios.de/>.

28.13 × ñçóέíðééðéðáð òé procmail

ÓðéáέóðéñÙ áðù òé Marc Silver.

Òé áñçεçòééù ðñùáñáñá **procmail** áβíáé ñεá áðβóðáððá εó÷ðñP áóáññéñP ðéò ìðéñάβ ñá ÷ñçóέíðééçεáβ áεá òé òεéðñÙñεóíá òéò áέóáñ÷áññéò mail. ΆðεòñÝðáε òéòð ÷ñðóðáð ñá ññβáéíñé “εáñúñáð” ñε ìðéβé ìðéñάβ ñá òáéñέÙáéíñé òά áέóáñ÷áññéíá mail εάέ ñá áεðáéýñé áéÙòéñáð εάέòéòñάβáð, P ñá áíáέáðáðéýñéíñé òé mail òά áíáέáéðéééÝð εðñβáàð P/εάέ áεáðéýñéðáéð òá÷ðáññáβéò. Òé **procmail** ìðéñάβ ñá ááέáðáðóáéáβ ÷ñçóέíðééðéðáð òé port mail/procmail. ÌáðÙ òçí ááέáðÙóðáóç òéò, ìðéñάβ ñá áñúñáðúεáβ ó÷ááññé òά ìðéñáβðéíñá MTA. Òéíáñòεáðéáβðá òçí òάéíçñβúç òéò MTA

Το postfix μπορεί να χρησιμοποιήσει το **procmail** για να φέρει τα μηνύματα που λαμβάνονται από το postfix στο **procmail**. Για να το κάνετε, πρέπει να προσθέσετε το postfix στο postfix.conf, όπως φαίνεται παρακάτω:

```
"|exec /usr/local/bin/procmail || exit 75"
```

Όταν το postfix λαμβάνει ένα μήνυμα, το postfix θα προσπαθήσει να το περάσει στο **procmail**, εάν είναι δυνατόν. Εάν το postfix δεν μπορεί να το περάσει (εάν το postfix δεν έχει εγκαταστήσει το postfix.rc, ή εάν το postfix δεν έχει εγκαταστήσει το postfix.conf), τότε το postfix θα περάσει το μήνυμα στο postfix:

Πρέπει να προσθέσετε το postfix στο postfix.conf, όπως φαίνεται παρακάτω: postfix.conf(5).

Εάν θέλετε να χρησιμοποιήσετε το postfix για να φέρει τα μηνύματα που λαμβάνονται από το postfix στο postfix, τότε πρέπει να προσθέσετε το postfix στο postfix.conf, όπως φαίνεται παρακάτω:

```
:0
* ^From.*user@example.com
! goodmail@example2.com
```

Εάν θέλετε να χρησιμοποιήσετε το postfix για να φέρει τα μηνύματα που λαμβάνονται από το postfix στο postfix, τότε πρέπει να προσθέσετε το postfix στο postfix.conf, όπως φαίνεται παρακάτω:

```
:0
* < 1000
! goodmail@example2.com
```

Εάν θέλετε να χρησιμοποιήσετε το postfix για να φέρει τα μηνύματα που λαμβάνονται από το postfix στο postfix, τότε πρέπει να προσθέσετε το postfix στο postfix.conf, όπως φαίνεται παρακάτω:

```
:0
* ^TOalternate@example.com
alternate
```

Εάν θέλετε να χρησιμοποιήσετε το postfix για να φέρει τα μηνύματα που λαμβάνονται από το postfix στο postfix, τότε πρέπει να προσθέσετε το postfix στο postfix.conf, όπως φαίνεται παρακάτω:

```
:0
^Subject:.*Spam
/dev/null
```

Εάν θέλετε να χρησιμοποιήσετε το postfix για να φέρει τα μηνύματα που λαμβάνονται από το postfix στο postfix, τότε πρέπει να προσθέσετε το postfix στο postfix.conf, όπως φαίνεται παρακάτω:

```
:0
* ^Sender:.owner-freebsd-\[^\@]+\@FreeBSD.ORG
{
LISTNAME=${MATCH}
:0
* LISTNAME??^\[^\@]+
FreeBSD-${MATCH}
}
```


Primarily, **inetd** is used to spawn other daemons, but several trivial protocols are handled directly, such as **chargen**, **auth**, and **daytime**.

This section will cover the basics in configuring **inetd** through its command-line options and its configuration file, `/etc/inetd.conf`.

29.2.2 Settings

inetd is initialized through the rc(8) system. The `inetd_enable` option is set to `NO` by default, but may be turned on by **sysinstall** during installation, depending on the configuration chosen by the user. Placing:

```
inetd_enable="YES"
```

or

```
inetd_enable="NO"
```

into `/etc/rc.conf` will enable or disable **inetd** starting at boot time. The command:

```
/etc/rc.d/inetd rcvar
```

can be run to display the current effective setting.

Additionally, different command-line options can be passed to **inetd** via the `inetd_flags` option.

29.2.3 Command-Line Options

Like most server daemons, **inetd** has a number of options that it can be passed in order to modify its behaviour. The full list of options reads:

```
inetd [-d] [-l] [-w] [-W] [-c maximum] [-C rate] [-a address | hostname] [-p filename]
[-R rate] [-s maximum] [configuration file]
```

Options can be passed to **inetd** using the `inetd_flags` option in `/etc/rc.conf`. By default, `inetd_flags` is set to `-wW -C 60`, which turns on TCP wrapping for **inetd**'s services, and prevents any single IP address from requesting any service more than 60 times in any given minute.

Novice users may be pleased to note that these parameters usually do not need to be modified, although we mention the rate-limiting options below as they be useful should you find that you are receiving an excessive amount of connections. A full list of options can be found in the `inetd(8)` manual.

-c maximum

Specify the default maximum number of simultaneous invocations of each service; the default is unlimited. May be overridden on a per-service basis with the `max-child` parameter.

-C rate

Specify the default maximum number of times a service can be invoked from a single IP address in one minute; the default is unlimited. May be overridden on a per-service basis with the `max-connections-per-ip-per-minute` parameter.

-R rate

Specify the maximum number of times a service can be invoked in one minute; the default is 256. A rate of 0 allows an unlimited number of invocations.

-s maximum

Specify the maximum number of times a service can be invoked from a single IP address at any one time; the default is unlimited. May be overridden on a per-service basis with the `max-child-per-ip` parameter.

29.2.4 inetd.conf

Configuration of **inetd** is done via the file `/etc/inetd.conf`.

When a modification is made to `/etc/inetd.conf`, **inetd** can be forced to re-read its configuration file by running the command:

Διάγραμμα 29-1. Reloading the inetd configuration file

```
# /etc/rc.d/inetd reload
```

Each line of the configuration file specifies an individual daemon. Comments in the file are preceded by a “#”. The format of each entry in `/etc/inetd.conf` is as follows:

```
service-name
socket-type
protocol
{wait|nowait}[/max-child[/max-connections-per-ip-per-minute[/max-child-per-ip]]]
user[:group][[/login-class]]
server-program
server-program-arguments
```

An example entry for the `ftpd(8)` daemon using IPv4 might read:

```
ftp      stream  tcp      nowait  root    /usr/libexec/ftpd      ftpd -l
```

service-name

This is the service name of the particular daemon. It must correspond to a service listed in `/etc/services`. This determines which port **inetd** must listen to. If a new service is being created, it must be placed in `/etc/services` first.

socket-type

Either `stream`, `dgram`, `raw`, or `seqpacket`. `stream` must be used for connection-based, TCP daemons, while `dgram` is used for daemons utilizing the UDP transport protocol.

protocol

One of the following:

Protocol	Explanation
tcp, tcp4	TCP IPv4

Protocol	Explanation
udp, udp4	UDP IPv4
tcp6	TCP IPv6
udp6	UDP IPv6
tcp46	Both TCP IPv4 and v6
udp46	Both UDP IPv4 and v6

{wait|nowait}[/max-child[/max-connections-per-ip-per-minute[/max-child-per-ip]]]

`wait|nowait` indicates whether the daemon invoked from **inetd** is able to handle its own socket or not. `dgram` socket types must use the `wait` option, while stream socket daemons, which are usually multi-threaded, should use `nowait`. `wait` usually hands off multiple sockets to a single daemon, while `nowait` spawns a child daemon for each new socket.

The maximum number of child daemons **inetd** may spawn can be set using the `max-child` option. If a limit of ten instances of a particular daemon is needed, a `/10` would be placed after `nowait`. Specifying `/0` allows an unlimited number of children

In addition to `max-child`, two other options which limit the maximum connections from a single place to a particular daemon can be enabled. `max-connections-per-ip-per-minute` limits the number of connections from any particular IP address per minutes, e.g. a value of ten would limit any particular IP address connecting to a particular service to ten attempts per minute. `max-child-per-ip` limits the number of children that can be started on behalf on any single IP address at any moment. These options are useful to prevent intentional or unintentional excessive resource consumption and Denial of Service (DoS) attacks to a machine.

In this field, either of `wait` or `nowait` is mandatory. `max-child`, `max-connections-per-ip-per-minute` and `max-child-per-ip` are optional.

A stream-type multi-threaded daemon without any `max-child`, `max-connections-per-ip-per-minute` or `max-child-per-ip` limits would simply be: `nowait`.

The same daemon with a maximum limit of ten daemons would read: `nowait/10`.

The same setup with a limit of twenty connections per IP address per minute and a maximum total limit of ten child daemons would read: `nowait/10/20`.

These options are utilized by the default settings of the `fingerd(8)` daemon, as seen here:

```
finger stream tcp nowait/3/10 nobody /usr/libexec/fingerd fingerd -s
```

Finally, an example of this field with a maximum of 100 children in total, with a maximum of 5 for any one IP address would read: `nowait/100/0/5`.

user

This is the username that the particular daemon should run as. Most commonly, daemons run as the `root` user. For security purposes, it is common to find some servers running as the `daemon` user, or the least privileged `nobody` user.

server-program

The full path of the daemon to be executed when a connection is received. If the daemon is a service provided by **inetd** internally, then `internal` should be used.

server-program-arguments

This works in conjunction with `server-program` by specifying the arguments, starting with `argv[0]`, passed to the daemon on invocation. If `mydaemon -d` is the command line, `mydaemon -d` would be the value of `server-program-arguments`. Again, if the daemon is an internal service, use `internal` here.

29.2.5 Security

Depending on the choices made at install time, many of **inetd**'s services may be enabled by default. If there is no apparent need for a particular daemon, consider disabling it. Place a “#” in front of the daemon in question in `/etc/inetd.conf`, and then reload the `inetd` configuration. Some daemons, such as **fingerd**, may not be desired at all because they provide information that may be useful to an attacker.

Some daemons are not security-conscious and have long, or non-existent, timeouts for connection attempts. This allows an attacker to slowly send connections to a particular daemon, thus saturating available resources. It may be a good idea to place `max-connections-per-ip-per-minute`, `max-child` or `max-child-per-ip` limitations on certain daemons if you find that you have too many connections.

By default, TCP wrapping is turned on. Consult the `hosts_access(5)` manual page for more information on placing TCP restrictions on various **inetd** invoked daemons.

29.2.6 Miscellaneous

daytime, **time**, **echo**, **discard**, **chargen**, and **auth** are all internally provided services of **inetd**.

The **auth** service provides identity network services, and is configurable to a certain degree, whilst the others are simply on or off.

Consult the `inetd(8)` manual page for more in-depth information.

29.3 Network File System (NFS)

Reorganized and enhanced by Tom Rhodes. Written by Bill Swingle.

Among the many different file systems that FreeBSD supports is the Network File System, also known as NFS. NFS allows a system to share directories and files with others over a network. By using NFS, users and programs can access files on remote systems almost as if they were local files.

Some of the most notable benefits that NFS can provide are:

- Local workstations use less disk space because commonly used data can be stored on a single machine and still remain accessible to others over the network.
- There is no need for users to have separate home directories on every network machine. Home directories could be set up on the NFS server and made available throughout the network.
- Storage devices such as floppy disks, CDRom drives, and Zip® drives can be used by other machines on the network. This may reduce the number of removable media drives throughout the network.

29.3.1 How NFS Works

NFS consists of at least two main parts: a server and one or more clients. The client remotely accesses the data that is stored on the server machine. In order for this to function properly a few processes have to be configured and running.

The server has to be running the following daemons:

Daemon	Description
nfsd	The NFS daemon which services requests from the NFS clients.
mountd	The NFS mount daemon which carries out the requests that nfsd(8) passes on to it.
rpcbind	This daemon allows NFS clients to discover which port the NFS server is using.

The client can also run a daemon, known as **nfsiod**. The **nfsiod** daemon services the requests from the NFS server. This is optional, and improves performance, but is not required for normal and correct operation. See the nfsiod(8) manual page for more information.

29.3.2 Configuring NFS

NFS configuration is a relatively straightforward process. The processes that need to be running can all start at boot time with a few modifications to your `/etc/rc.conf` file.

On the NFS server, make sure that the following options are configured in the `/etc/rc.conf` file:

```
rpcbind_enable="YES"
nfs_server_enable="YES"
mountd_flags="-r"
```

mountd runs automatically whenever the NFS server is enabled.

On the client, make sure this option is present in `/etc/rc.conf`:

```
nfs_client_enable="YES"
```

The `/etc/exports` file specifies which file systems NFS should export (sometimes referred to as “share”). Each line in `/etc/exports` specifies a file system to be exported and which machines have access to that file system. Along with what machines have access to that file system, access options may also be specified. There are many such options that can be used in this file but only a few will be mentioned here. You can easily discover other options by reading over the exports(5) manual page.

Here are a few example `/etc/exports` entries:

The following examples give an idea of how to export file systems, although the settings may be different depending on your environment and network configuration. For instance, to export the `/cdrom` directory to three example machines that have the same domain name as the server (hence the lack of a domain name for each) or have entries in your `/etc/hosts` file. The `-ro` flag makes the exported file system read-only. With this flag, the remote system will not be able to write any changes to the exported file system.

```
/cdrom -ro host1 host2 host3
```

The following line exports `/home` to three hosts by IP address. This is a useful setup if you have a private network without a DNS server configured. Optionally the `/etc/hosts` file could be configured for internal hostnames; please review hosts(5) for more information. The `-alldirs` flag allows the subdirectories to be mount points. In

other words, it will not mount the subdirectories but permit the client to mount only the directories that are required or needed.

```
/home -alldirs 10.0.0.2 10.0.0.3 10.0.0.4
```

The following line exports /a so that two clients from different domains may access the file system. The `-maproot=root` flag allows the `root` user on the remote system to write data on the exported file system as `root`. If the `-maproot=root` flag is not specified, then even if a user has `root` access on the remote system, he will not be able to modify files on the exported file system.

```
/a -maproot=root host.example.com box.example.org
```

In order for a client to access an exported file system, the client must have permission to do so. Make sure the client is listed in your `/etc/exports` file.

In `/etc/exports`, each line represents the export information for one file system to one host. A remote host can only be specified once per file system, and may only have one default entry. For example, assume that `/usr` is a single file system. The following `/etc/exports` would be invalid:

```
# Invalid when /usr is one file system
/usr/src client
/usr/ports client
```

One file system, `/usr`, has two lines specifying exports to the same host, `client`. The correct format for this situation is:

```
/usr/src /usr/ports client
```

The properties of one file system exported to a given host must all occur on one line. Lines without a client specified are treated as a single host. This limits how you can export file systems, but for most people this is not an issue.

The following is an example of a valid export list, where `/usr` and `/exports` are local file systems:

```
# Export src and ports to client01 and client02, but only
# client01 has root privileges on it
/usr/src /usr/ports -maproot=root client01
/usr/src /usr/ports client02
# The client machines have root and can mount anywhere
# on /exports. Anyone in the world can mount /exports/obj read-only
/exports -alldirs -maproot=root client01 client02
/exports/obj -ro
```

The **mountd** daemon must be forced to recheck the `/etc/exports` file whenever it has been modified, so the changes can take effect. This can be accomplished either by sending a HUP signal to the running daemon:

```
# kill -HUP `cat /var/run/mountd.pid`
```

or by invoking the `mountd rc(8)` script with the appropriate parameter:

```
# /etc/rc.d/mountd onereload
```

Please refer to [Chapter 11.7](#) for more information about using rc scripts.

Alternatively, a reboot will make FreeBSD set everything up properly. A reboot is not necessary though. Executing the following commands as `root` should start everything up.

On the NFS server:

```
# rpcbind
# nfsd -u -t -n 4
# mountd -r
```

On the NFS client:

```
# nfsiod -n 4
```

Now everything should be ready to actually mount a remote file system. In these examples the server's name will be `server` and the client's name will be `client`. If you only want to temporarily mount a remote file system or would rather test the configuration, just execute a command like this as `root` on the client:

```
# mount server:/home /mnt
```

This will mount the `/home` directory on the server at `/mnt` on the client. If everything is set up correctly you should be able to enter `/mnt` on the client and see all the files that are on the server.

If you want to automatically mount a remote file system each time the computer boots, add the file system to the `/etc/fstab` file. Here is an example:

```
server:/home /mnt nfs rw 0 0
```

The `fstab(5)` manual page lists all the available options.

29.3.3 Locking

Some applications (e.g. **mutt**) require file locking to operate correctly. In the case of NFS, **rpc.lockd** can be used for file locking. To enable it, add the following to the `/etc/rc.conf` file on both client and server (it is assumed that the NFS client and server are configured already):

```
rpc_lockd_enable="YES"
rpc_statd_enable="YES"
```

Start the application by using:

```
# /etc/rc.d/nfslocking start
```

If real locking between the NFS clients and NFS server is not required, it is possible to let the NFS client do locking locally by passing `-L` to `mount_nfs(8)`. Refer to the `mount_nfs(8)` manual page for further details.

29.3.4 Practical Uses

NFS has many practical uses. Some of the more common ones are listed below:

- Set several machines to share a CDROM or other media among them. This is cheaper and often a more convenient method to install software on multiple machines.

- On large networks, it might be more convenient to configure a central NFS server in which to store all the user home directories. These home directories can then be exported to the network so that users would always have the same home directory, regardless of which workstation they log in to.
- Several machines could have a common `/usr/ports/distfiles` directory. That way, when you need to install a port on several machines, you can quickly access the source without downloading it on each machine.

29.3.5 Automatic Mounts with amd

Contributed by Wylie Stilwell. Rewritten by Chern Lee.

`amd(8)` (the automatic mounter daemon) automatically mounts a remote file system whenever a file or directory within that file system is accessed. Filesystems that are inactive for a period of time will also be automatically unmounted by **amd**. Using **amd** provides a simple alternative to permanent mounts, as permanent mounts are usually listed in `/etc/fstab`.

amd operates by attaching itself as an NFS server to the `/host` and `/net` directories. When a file is accessed within one of these directories, **amd** looks up the corresponding remote mount and automatically mounts it. `/net` is used to mount an exported file system from an IP address, while `/host` is used to mount an export from a remote hostname.

An access to a file within `/host/foobar/usr` would tell **amd** to attempt to mount the `/usr` export on the host `foobar`.

Ἐπιπέδον 29-2. Μοῦντῆν ἑξῆς μετὰ **amd**

You can view the available mounts of a remote host with the `showmount` command. For example, to view the mounts of a host named `foobar`, you can use:

```
% showmount -e foobar
Exports list on foobar:
/usr                10.10.10.0
/a                 10.10.10.0
% cd /host/foobar/usr
```

As seen in the example, the `showmount` shows `/usr` as an export. When changing directories to `/host/foobar/usr`, **amd** attempts to resolve the hostname `foobar` and automatically mount the desired export.

amd can be started by the startup scripts by placing the following lines in `/etc/rc.conf`:

```
amd_enable="YES"
```

Additionally, custom flags can be passed to **amd** from the `amd_flags` option. By default, `amd_flags` is set to:

```
amd_flags="-a /.amd_mnt -l syslog /host /etc/amd.map /net /etc/amd.map"
```

The `/etc/amd.map` file defines the default options that exports are mounted with. The `/etc/amd.conf` file defines some of the more advanced features of **amd**.

Consult the `amd(8)` and `amd.conf(5)` manual pages for more information.

29.3.6 Problems Integrating with Other Systems

Contributed by John Lind.

Certain Ethernet adapters for ISA PC systems have limitations which can lead to serious network problems, particularly with NFS. This difficulty is not specific to FreeBSD, but FreeBSD systems are affected by it.

The problem nearly always occurs when (FreeBSD) PC systems are networked with high-performance workstations, such as those made by Silicon Graphics, Inc., and Sun Microsystems, Inc. The NFS mount will work fine, and some operations may succeed, but suddenly the server will seem to become unresponsive to the client, even though requests to and from other systems continue to be processed. This happens to the client system, whether the client is the FreeBSD system or the workstation. On many systems, there is no way to shut down the client gracefully once this problem has manifested itself. The only solution is often to reset the client, because the NFS situation cannot be resolved.

Though the “correct” solution is to get a higher performance and capacity Ethernet adapter for the FreeBSD system, there is a simple workaround that will allow satisfactory operation. If the FreeBSD system is the *server*, include the option `-w=1024` on the mount from the client. If the FreeBSD system is the *client*, then mount the NFS file system with the option `-r=1024`. These options may be specified using the fourth field of the `fstab` entry on the client for automatic mounts, or by using the `-o` parameter of the `mount(8)` command for manual mounts.

It should be noted that there is a different problem, sometimes mistaken for this one, when the NFS servers and clients are on different networks. If that is the case, make *certain* that your routers are routing the necessary UDP information, or you will not get anywhere, no matter what else you are doing.

In the following examples, `fastws` is the host (interface) name of a high-performance workstation, and `freebox` is the host (interface) name of a FreeBSD system with a lower-performance Ethernet adapter. Also, `/sharedfs` will be the exported NFS file system (see `exports(5)`), and `/project` will be the mount point on the client for the exported file system. In all cases, note that additional options, such as `hard` or `soft` and `bg` may be desirable in your application.

Examples for the FreeBSD system (`freebox`) as the client in `/etc/fstab` on `freebox`:

```
fastws:/sharedfs /project nfs rw,-r=1024 0 0
```

As a manual mount command on `freebox`:

```
# mount -t nfs -o -r=1024 fastws:/sharedfs /project
```

Examples for the FreeBSD system as the server in `/etc/fstab` on `fastws`:

```
freebox:/sharedfs /project nfs rw,-w=1024 0 0
```

As a manual mount command on `fastws`:

```
# mount -t nfs -o -w=1024 freebox:/sharedfs /project
```

Nearly any 16-bit Ethernet adapter will allow operation without the above restrictions on the read or write size.

For anyone who cares, here is what happens when the failure occurs, which also explains why it is unrecoverable. NFS typically works with a “block” size of 8 K (though it may do fragments of smaller sizes). Since the maximum Ethernet packet is around 1500 bytes, the NFS “block” gets split into multiple Ethernet packets, even though it is still a single unit to the upper-level code, and must be received, assembled, and *acknowledged* as a unit. The high-performance workstations can pump out the packets which comprise the NFS unit one right after the other, just as close together as the standard allows. On the smaller, lower capacity cards, the later packets overrun the earlier

packets of the same unit before they can be transferred to the host and the unit as a whole cannot be reconstructed or acknowledged. As a result, the workstation will time out and try again, but it will try again with the entire 8 K unit, and the process will be repeated, ad infinitum.

By keeping the unit size below the Ethernet packet size limitation, we ensure that any complete Ethernet packet received can be acknowledged individually, avoiding the deadlock situation.

Overruns may still occur when a high-performance workstations is slamming data out to a PC system, but with the better cards, such overruns are not guaranteed on NFS “units”. When an overrun occurs, the units affected will be retransmitted, and there will be a fair chance that they will be received, assembled, and acknowledged.

29.4 Network Information System (NIS/YP)

Written by Bill Swingle. Enhanced by Eric Ogren & Udo Erdelhoff.

29.4.1 What Is It?

NIS, which stands for Network Information Services, was developed by Sun Microsystems to centralize administration of UNIX (originally SunOS) systems. It has now essentially become an industry standard; all major UNIX like systems (Solaris, HP-UX, AIX®, Linux, NetBSD, OpenBSD, FreeBSD, etc) support NIS.

NIS was formerly known as Yellow Pages, but because of trademark issues, Sun changed the name. The old term (and yp) is still often seen and used.

It is a RPC-based client/server system that allows a group of machines within an NIS domain to share a common set of configuration files. This permits a system administrator to set up NIS client systems with only minimal configuration data and add, remove or modify configuration data from a single location.

It is similar to the Windows NT® domain system; although the internal implementation of the two are not at all similar, the basic functionality can be compared.

29.4.2 Terms/Processes You Should Know

There are several terms and several important user processes that you will come across when attempting to implement NIS on FreeBSD, whether you are trying to create an NIS server or act as an NIS client:

Term	Description
NIS domainname	An NIS master server and all of its clients (including its slave servers) have a NIS domainname. Similar to an Windows NT domain name, the NIS domainname does not have anything to do with DNS.
rpcbind	Must be running in order to enable RPC (Remote Procedure Call, a network protocol used by NIS). If rpcbind is not running, it will be impossible to run an NIS server, or to act as an NIS client.
ypbind	“Binds” an NIS client to its NIS server. It will take the NIS domainname from the system, and using RPC, connect to the server. ypbind is the core of client-server communication in an NIS environment; if ypbind dies on a client machine, it will not be able to access the NIS server.

Term	Description
ypserv	Should only be running on NIS servers; this is the NIS server process itself. If ypserv(8) dies, then the server will no longer be able to respond to NIS requests (hopefully, there is a slave server to take over for it). There are some implementations of NIS (but not the FreeBSD one), that do not try to reconnect to another server if the server it used before dies. Often, the only thing that helps in this case is to restart the server process (or even the whole server) or the ypbind process on the client.
rpc.yppasswdd	Another process that should only be running on NIS master servers; this is a daemon that will allow NIS clients to change their NIS passwords. If this daemon is not running, users will have to login to the NIS master server and change their passwords there.

29.4.3 How Does It Work?

There are three types of hosts in an NIS environment: master servers, slave servers, and clients. Servers act as a central repository for host configuration information. Master servers hold the authoritative copy of this information, while slave servers mirror this information for redundancy. Clients rely on the servers to provide this information to them.

Information in many files can be shared in this manner. The `master.passwd`, `group`, and `hosts` files are commonly shared via NIS. Whenever a process on a client needs information that would normally be found in these files locally, it makes a query to the NIS server that it is bound to instead.

29.4.3.1 Machine Types

- *A NIS master server.* This server, analogous to a Windows NT primary domain controller, maintains the files used by all of the NIS clients. The `passwd`, `group`, and other various files used by the NIS clients live on the master server.

Όχι ἀβυσσός: It is possible for one machine to be an NIS master server for more than one NIS domain. However, this will not be covered in this introduction, which assumes a relatively small-scale NIS environment.

- *NIS slave servers.* Similar to the Windows NT backup domain controllers, NIS slave servers maintain copies of the NIS master's data files. NIS slave servers provide the redundancy, which is needed in important environments. They also help to balance the load of the master server: NIS Clients always attach to the NIS server whose response they get first, and this includes slave-server-replies.
- *NIS clients.* NIS clients, like most Windows NT workstations, authenticate against the NIS server (or the Windows NT domain controller in the Windows NT workstations case) to log on.

29.4.4 Using NIS/YP

This section will deal with setting up a sample NIS environment.

29.4.4.1 Planning

Let us assume that you are the administrator of a small university lab. This lab, which consists of 15 FreeBSD machines, currently has no centralized point of administration; each machine has its own `/etc/passwd` and `/etc/master.passwd`. These files are kept in sync with each other only through manual intervention; currently, when you add a user to the lab, you must run `adduser` on all 15 machines. Clearly, this has to change, so you have decided to convert the lab to use NIS, using two of the machines as servers.

Therefore, the configuration of the lab now looks something like:

Machine name	IP address	Machine role
ellington	10.0.0.2	NIS master
coltrane	10.0.0.3	NIS slave
basie	10.0.0.4	Faculty workstation
bird	10.0.0.5	Client machine
cli[1-11]	10.0.0.[6-17]	Other client machines

If you are setting up a NIS scheme for the first time, it is a good idea to think through how you want to go about it. No matter what the size of your network, there are a few decisions that need to be made.

29.4.4.1.1 Choosing a NIS Domain Name

This might not be the “domainname” that you are used to. It is more accurately called the “NIS domainname”. When a client broadcasts its requests for info, it includes the name of the NIS domain that it is part of. This is how multiple servers on one network can tell which server should answer which request. Think of the NIS domainname as the name for a group of hosts that are related in some way.

Some organizations choose to use their Internet domainname for their NIS domainname. This is not recommended as it can cause confusion when trying to debug network problems. The NIS domainname should be unique within your network and it is helpful if it describes the group of machines it represents. For example, the Art department at Acme Inc. might be in the “acme-art” NIS domain. For this example, assume you have chosen the name `test-domain`.

However, some operating systems (notably SunOS) use their NIS domain name as their Internet domain name. If one or more machines on your network have this restriction, you *must* use the Internet domain name as your NIS domain name.

29.4.4.1.2 Physical Server Requirements

There are several things to keep in mind when choosing a machine to use as a NIS server. One of the unfortunate things about NIS is the level of dependency the clients have on the server. If a client cannot contact the server for its NIS domain, very often the machine becomes unusable. The lack of user and group information causes most systems to temporarily freeze up. With this in mind you should make sure to choose a machine that will not be prone to being rebooted regularly, or one that might be used for development. The NIS server should ideally be a stand alone machine whose sole purpose in life is to be an NIS server. If you have a network that is not very heavily used, it is acceptable to put the NIS server on a machine running other services, just keep in mind that if the NIS server becomes unavailable, it will affect *all* of your NIS clients adversely.

29.4.4.2 NIS Servers

The canonical copies of all NIS information are stored on a single machine called the NIS master server. The databases used to store the information are called NIS maps. In FreeBSD, these maps are stored in `/var/yp/[domainname]` where `[domainname]` is the name of the NIS domain being served. A single NIS server can support several domains at once, therefore it is possible to have several such directories, one for each supported domain. Each domain will have its own independent set of maps.

NIS master and slave servers handle all NIS requests with the `ypserv` daemon. `ypserv` is responsible for receiving incoming requests from NIS clients, translating the requested domain and map name to a path to the corresponding database file and transmitting data from the database back to the client.

29.4.4.2.1 Setting Up a NIS Master Server

Setting up a master NIS server can be relatively straight forward, depending on your needs. FreeBSD comes with support for NIS out-of-the-box. All you need is to add the following lines to `/etc/rc.conf`, and FreeBSD will do the rest for you.

1.

```
nisdomainname="test-domain"
```

This line will set the NIS domainname to `test-domain` upon network setup (e.g. after reboot).

2.

```
nis_server_enable="YES"
```

This will tell FreeBSD to start up the NIS server processes when the networking is next brought up.

3.

```
nis_yppasswdd_enable="YES"
```

This will enable the `rpc.yppasswdd` daemon which, as mentioned above, will allow users to change their NIS password from a client machine.

Όχιἄβούζ: Depending on your NIS setup, you may need to add further entries. See the section about NIS servers that are also NIS clients, below, for details.

Now, all you have to do is to run the command `/etc/netstart` as superuser. It will set up everything for you, using the values you defined in `/etc/rc.conf`.

29.4.4.2.2 Initializing the NIS Maps

The *NIS maps* are database files, that are kept in the `/var/yp` directory. They are generated from configuration files in the `/etc` directory of the NIS master, with one exception: the `/etc/master.passwd` file. This is for a good reason, you do not want to propagate passwords to your `root` and other administrative accounts to all the servers in the NIS domain. Therefore, before we initialize the NIS maps, you should:

```
# cp /etc/master.passwd /var/yp/master.passwd
# cd /var/yp
# vi master.passwd
```

You should remove all entries regarding system accounts (`bin`, `tty`, `kmem`, `games`, etc), as well as any accounts that you do not want to be propagated to the NIS clients (for example `root` and any other UID 0 (superuser) accounts).

Όχιὰβὺός: Make sure the `/var/yp/master.passwd` is neither group nor world readable (mode 600)! Use the `chmod` command, if appropriate.

When you have finished, it is time to initialize the NIS maps! FreeBSD includes a script named `ypinit` to do this for you (see its manual page for more information). Note that this script is available on most UNIX Operating Systems, but not on all. On Digital UNIX/Compaq Tru64 UNIX it is called `ypsetup`. Because we are generating maps for an NIS master, we are going to pass the `-m` option to `ypinit`. To generate the NIS maps, assuming you already performed the steps above, run:

```
ellington# ypinit -m test-domain
Server Type: MASTER Domain: test-domain
Creating an YP server will require that you answer a few questions.
Questions will all be asked at the beginning of the procedure.
Do you want this procedure to quit on non-fatal errors? [y/n: n] n
Ok, please remember to go back and redo manually whatever fails.
If you don't, something might not work.
At this point, we have to construct a list of this domains YP servers.
rod.darktech.org is already known as master server.
Please continue to add any slave servers, one per line. When you are
done with the list, type a <control D>.
master server   : ellington
next host to add: coltrane
next host to add: ^D
The current list of NIS servers looks like this:
ellington
coltrane
Is this correct? [y/n: y] y
```

[..output from map generation..]

NIS Map update completed.
ellington has been setup as an YP master server without any errors.

`ypinit` should have created `/var/yp/Makefile` from `/var/yp/Makefile.dist`. When created, this file assumes that you are operating in a single server NIS environment with only FreeBSD machines. Since `test-domain` has a slave server as well, you must edit `/var/yp/Makefile`:

```
ellington# vi /var/yp/Makefile
```

You should comment out the line that says

```
NOPUSH = "True"
```

(if it is not commented out already).

29.4.4.2.3 Setting up a NIS Slave Server

Setting up an NIS slave server is even more simple than setting up the master. Log on to the slave server and edit the file `/etc/rc.conf` as you did before. The only difference is that we now must use the `-s` option when running `ypinit`. The `-s` option requires the name of the NIS master be passed to it as well, so our command line looks like:

```
coltrane# ypinit -s ellington test-domain
```

```
Server Type: SLAVE Domain: test-domain Master: ellington
```

Creating an YP server will require that you answer a few questions. Questions will all be asked at the beginning of the procedure.

```
Do you want this procedure to quit on non-fatal errors? [y/n: n]  n
```

Ok, please remember to go back and redo manually whatever fails. If you don't, something might not work. There will be no further questions. The remainder of the procedure should take a few minutes, to copy the databases from ellington.

```
Transferring netgroup...
ypxfr: Exiting: Map successfully transferred
Transferring netgroup.byuser...
ypxfr: Exiting: Map successfully transferred
Transferring netgroup.byhost...
ypxfr: Exiting: Map successfully transferred
Transferring master.passwd.byuid...
ypxfr: Exiting: Map successfully transferred
Transferring passwd.byuid...
ypxfr: Exiting: Map successfully transferred
Transferring passwd.byname...
ypxfr: Exiting: Map successfully transferred
Transferring group.bygid...
ypxfr: Exiting: Map successfully transferred
Transferring group.byname...
ypxfr: Exiting: Map successfully transferred
Transferring services.byname...
ypxfr: Exiting: Map successfully transferred
Transferring rpc.bynumber...
ypxfr: Exiting: Map successfully transferred
Transferring rpc.byname...
ypxfr: Exiting: Map successfully transferred
Transferring protocols.byname...
ypxfr: Exiting: Map successfully transferred
Transferring master.passwd.byname...
ypxfr: Exiting: Map successfully transferred
Transferring networks.byname...
ypxfr: Exiting: Map successfully transferred
Transferring networks.byaddr...
ypxfr: Exiting: Map successfully transferred
Transferring netid.byname...
ypxfr: Exiting: Map successfully transferred
Transferring hosts.byaddr...
ypxfr: Exiting: Map successfully transferred
```

```
Transferring protocols.bynumber...
ypxfr: Exiting: Map successfully transferred
Transferring ypservers...
ypxfr: Exiting: Map successfully transferred
Transferring hosts.byname...
ypxfr: Exiting: Map successfully transferred
```

coltrane has been setup as an YP slave server without any errors.
Don't forget to update map ypservers on ellington.

You should now have a directory called `/var/yp/test-domain`. Copies of the NIS master server's maps should be in this directory. You will need to make sure that these stay updated. The following `/etc/crontab` entries on your slave servers should do the job:

```
20      *      *      *      *      root    /usr/libexec/ypxfr passwd.byname
21      *      *      *      *      root    /usr/libexec/ypxfr passwd.byuid
```

These two lines force the slave to sync its maps with the maps on the master server. Although these entries are not mandatory, since the master server attempts to ensure any changes to its NIS maps are communicated to its slaves and because password information is vital to systems depending on the server, it is a good idea to force the updates. This is more important on busy networks where map updates might not always complete.

Now, run the command `/etc/netstart` on the slave server as well, which again starts the NIS server.

29.4.4.3 NIS Clients

An NIS client establishes what is called a binding to a particular NIS server using the `ypbind` daemon. `ypbind` checks the system's default domain (as set by the `domainname` command), and begins broadcasting RPC requests on the local network. These requests specify the name of the domain for which `ypbind` is attempting to establish a binding. If a server that has been configured to serve the requested domain receives one of the broadcasts, it will respond to `ypbind`, which will record the server's address. If there are several servers available (a master and several slaves, for example), `ypbind` will use the address of the first one to respond. From that point on, the client system will direct all of its NIS requests to that server. `ypbind` will occasionally "ping" the server to make sure it is still up and running. If it fails to receive a reply to one of its pings within a reasonable amount of time, `ypbind` will mark the domain as unbound and begin broadcasting again in the hopes of locating another server.

29.4.4.3.1 Setting Up a NIS Client

Setting up a FreeBSD machine to be a NIS client is fairly straightforward.

1. Edit the file `/etc/rc.conf` and add the following lines in order to set the NIS domainname and start `ypbind` upon network startup:

```
nisdomainname="test-domain"
nis_client_enable="YES"
```

2. To import all possible password entries from the NIS server, remove all user accounts from your `/etc/master.passwd` file and use `vipw` to add the following line to the end of the file:

```
+:::~::~:
```

Ὁψιμολογία: This line will afford anyone with a valid account in the NIS server's password maps an account. There are many ways to configure your NIS client by changing this line. See the `netgroups` section below for more information. For more detailed reading see O'Reilly's book on `Managing NFS and NIS`.

Ὁψιμολογία: You should keep at least one local account (i.e. not imported via NIS) in your `/etc/master.passwd` and this account should also be a member of the group `wheel`. If there is something wrong with NIS, this account can be used to log in remotely, become `root`, and fix things.

- To import all possible group entries from the NIS server, add this line to your `/etc/group` file:

```
+:*:*:
```

After completing these steps, you should be able to run `ypcat passwd` and see the NIS server's `passwd` map.

29.4.5 NIS Security

In general, any remote user can issue an RPC to `ypserv(8)` and retrieve the contents of your NIS maps, provided the remote user knows your domainname. To prevent such unauthorized transactions, `ypserv(8)` supports a feature called "securenets" which can be used to restrict access to a given set of hosts. At startup, `ypserv(8)` will attempt to load the `securenets` information from a file called `/var/yp/securenets`.

Ὁψιμολογία: This path varies depending on the path specified with the `-p` option. This file contains entries that consist of a network specification and a network mask separated by white space. Lines starting with "`#`" are considered to be comments. A sample `securenets` file might look like this:

```
# allow connections from local host -- mandatory
127.0.0.1      255.255.255.255
# allow connections from any host
# on the 192.168.128.0 network
192.168.128.0 255.255.255.0
# allow connections from any host
# between 10.0.0.0 to 10.0.15.255
# this includes the machines in the testlab
10.0.0.0      255.255.240.0
```

If `ypserv(8)` receives a request from an address that matches one of these rules, it will process the request normally. If the address fails to match a rule, the request will be ignored and a warning message will be logged. If the `/var/yp/securenets` file does not exist, `ypserv` will allow connections from any host.

The `ypserv` program also has support for Wietse Venema's **TCP Wrapper** package. This allows the administrator to use the **TCP Wrapper** configuration files for access control instead of `/var/yp/securenets`.

Ὁψιμολογία: While both of these access control mechanisms provide some security, they, like the privileged port test, are vulnerable to "IP spoofing" attacks. All NIS-related traffic should be blocked at your firewall.

Servers using `/var/yp/securenets` may fail to serve legitimate NIS clients with archaic TCP/IP implementations. Some of these implementations set all host bits to zero when doing broadcasts and/or fail to observe the subnet mask when calculating the broadcast address. While some of these problems can be fixed by changing the client configuration, other problems may force the retirement of the client systems in question or the abandonment of `/var/yp/securenets`.

Using `/var/yp/securenets` on a server with such an archaic implementation of TCP/IP is a really bad idea and will lead to loss of NIS functionality for large parts of your network.

The use of the **TCP Wrapper** package increases the latency of your NIS server. The additional delay may be long enough to cause timeouts in client programs, especially in busy networks or with slow NIS servers. If one or more of your client systems suffers from these symptoms, you should convert the client systems in question into NIS slave servers and force them to bind to themselves.

29.4.6 Barring Some Users from Logging On

In our lab, there is a machine `basie` that is supposed to be a faculty only workstation. We do not want to take this machine out of the NIS domain, yet the `passwd` file on the master NIS server contains accounts for both faculty and students. What can we do?

There is a way to bar specific users from logging on to a machine, even if they are present in the NIS database. To do this, all you must do is add `-username` to the end of the `/etc/master.passwd` file on the client machine, where `username` is the username of the user you wish to bar from logging in. This should preferably be done using `vipw`, since `vipw` will sanity check your changes to `/etc/master.passwd`, as well as automatically rebuild the password database when you finish editing. For example, if we wanted to bar user `bill` from logging on to `basie` we would:

```
basie# vipw
[add -bill to the end, exit]
vipw: rebuilding the database...
vipw: done

basie# cat /etc/master.passwd

root:[password]:0:0::0:0:The super-user:/root:/bin/csh
toor:[password]:0:0::0:0:The other super-user:/root:/bin/sh
daemon:*:1:1::0:0:Owner of many system processes:/root:/sbin/nologin
operator:*:2:5::0:0:System &:/sbin/nologin
bin:*:3:7::0:0:Binaries Commands and Source,,:/sbin/nologin
tty:*:4:65533::0:0:Tty Sandbox:/sbin/nologin
kmem:*:5:65533::0:0:KMem Sandbox:/sbin/nologin
games:*:7:13::0:0:Games pseudo-user:/usr/games:/sbin/nologin
news:*:8:8::0:0:News Subsystem:/sbin/nologin
man:*:9:9::0:0:Mister Man Pages:/usr/share/man:/sbin/nologin
bind:*:53:53::0:0:Bind Sandbox:/sbin/nologin
uucp:*:66:66::0:0:UUCP pseudo-user:/var/spool/uucppublic:/usr/libexec/uucp/uucico
xten:*:67:67::0:0:X-10 daemon:/usr/local/xten:/sbin/nologin
pop:*:68:6::0:0:Post Office Owner:/nonexistent:/sbin/nologin
nobody:*:65534:65534::0:0:Unprivileged user:/nonexistent:/sbin/nologin
+:::
-bill
```

basie#

29.4.7 Using Netgroups

Contributed by Udo Erdelhoff.

The method shown in the previous section works reasonably well if you need special rules for a very small number of users and/or machines. On larger networks, you *will* forget to bar some users from logging onto sensitive machines, or you may even have to modify each machine separately, thus losing the main benefit of NIS: *centralized* administration.

The NIS developers' solution for this problem is called *netgroups*. Their purpose and semantics can be compared to the normal groups used by UNIX file systems. The main differences are the lack of a numeric ID and the ability to define a netgroup by including both user accounts and other netgroups.

Netgroups were developed to handle large, complex networks with hundreds of users and machines. On one hand, this is a Good Thing if you are forced to deal with such a situation. On the other hand, this complexity makes it almost impossible to explain netgroups with really simple examples. The example used in the remainder of this section demonstrates this problem.

Let us assume that your successful introduction of NIS in your laboratory caught your superiors' interest. Your next job is to extend your NIS domain to cover some of the other machines on campus. The two tables contain the names of the new users and new machines as well as brief descriptions of them.

User Name(s)	Description
alpha, beta	Normal employees of the IT department
charlie, delta	The new apprentices of the IT department
echo, foxtrott, golf, ...	Ordinary employees
able, baker, ...	The current interns

Machine Name(s)	Description
war, death, famine, pollution	Your most important servers. Only the IT employees are allowed to log onto these machines.
pride, greed, envy, wrath, lust, sloth	Less important servers. All members of the IT department are allowed to login onto these machines.
one, two, three, four, ...	Ordinary workstations. Only the <i>real</i> employees are allowed to use these machines.
trashcan	A very old machine without any critical data. Even the intern is allowed to use this box.

If you tried to implement these restrictions by separately blocking each user, you would have to add one `-user` line to each system's `passwd` for each user who is not allowed to login onto that system. If you forget just one entry, you could be in trouble. It may be feasible to do this correctly during the initial setup, however you *will* eventually forget to add the lines for new users during day-to-day operations. After all, Murphy was an optimist.

Handling this situation with netgroups offers several advantages. Each user need not be handled separately; you assign a user to one or more netgroups and allow or forbid logins for all members of the netgroup. If you add a new machine, you will only have to define login restrictions for netgroups. If a new user is added, you will only have to

add the user to one or more netgroups. Those changes are independent of each other: no more “for each combination of user and machine do...” If your NIS setup is planned carefully, you will only have to modify exactly one central configuration file to grant or deny access to machines.

The first step is the initialization of the NIS map netgroup. FreeBSD’s ypinit(8) does not create this map by default, but its NIS implementation will support it once it has been created. To create an empty map, simply type

```
ellington# vi /var/yp/netgroup
```

and start adding content. For our example, we need at least four netgroups: IT employees, IT apprentices, normal employees and interns.

```
IT_EMP ( ,alpha,test-domain) ( ,beta,test-domain)
IT_APP ( ,charlie,test-domain) ( ,delta,test-domain)
USERS ( ,echo,test-domain) ( ,foxtrott,test-domain) \
      ( ,golf,test-domain)
INTERNS ( ,able,test-domain) ( ,baker,test-domain)
```

IT_EMP, IT_APP etc. are the names of the netgroups. Each bracketed group adds one or more user accounts to it. The three fields inside a group are:

1. The name of the host(s) where the following items are valid. If you do not specify a hostname, the entry is valid on all hosts. If you do specify a hostname, you will enter a realm of darkness, horror and utter confusion.
2. The name of the account that belongs to this netgroup.
3. The NIS domain for the account. You can import accounts from other NIS domains into your netgroup if you are one of the unlucky fellows with more than one NIS domain.

Each of these fields can contain wildcards. See netgroup(5) for details.

Όχι ἄβυσσος: Netgroup names longer than 8 characters should not be used, especially if you have machines running other operating systems within your NIS domain. The names are case sensitive; using capital letters for your netgroup names is an easy way to distinguish between user, machine and netgroup names.

Some NIS clients (other than FreeBSD) cannot handle netgroups with a large number of entries. For example, some older versions of SunOS start to cause trouble if a netgroup contains more than 15 *entries*. You can circumvent this limit by creating several sub-netgroups with 15 users or less and a real netgroup that consists of the sub-netgroups:

```
BIGGRP1 ( ,joe1,domain) ( ,joe2,domain) ( ,joe3,domain) [...]
BIGGRP2 ( ,joe16,domain) ( ,joe17,domain) [...]
BIGGRP3 ( ,joe31,domain) ( ,joe32,domain)
BIGGROUP BIGGRP1 BIGGRP2 BIGGRP3
```

You can repeat this process if you need more than 225 users within a single netgroup.

Activating and distributing your new NIS map is easy:

```
ellington# cd /var/yp
ellington# make
```

This will generate the three NIS maps netgroup, netgroup.byhost and netgroup.byuser. Use ypcat(1) to check if your new NIS maps are available:

```
ellington% ypcat -k netgroup
ellington% ypcat -k netgroup.byhost
ellington% ypcat -k netgroup.byuser
```

The output of the first command should resemble the contents of `/var/yp/netgroup`. The second command will not produce output if you have not specified host-specific netgroups. The third command can be used to get the list of netgroups for a user.

The client setup is quite simple. To configure the server `war`, you only have to start `vipw(8)` and replace the line

```
+:::~::~:
```

with

```
+@IT_EMP:::~::~:
```

Now, only the data for the users defined in the netgroup `IT_EMP` is imported into `war`'s password database and only these users are allowed to login.

Unfortunately, this limitation also applies to the `~` function of the shell and all routines converting between user names and numerical user IDs. In other words, `cd ~user` will not work, `ls -l` will show the numerical ID instead of the username and `find . -user joe -print` will fail with "No such user". To fix this, you will have to import all user entries *without allowing them to login onto your servers*.

This can be achieved by adding another line to `/etc/master.passwd`. This line should contain:

```
+:::~::~:/sbin/nologin, meaning "Import all entries but replace the shell with /sbin/nologin in the imported entries". You can replace any field in the passwd entry by placing a default value in your /etc/master.passwd.
```

Προσοχή: Make sure that the line `+:::~::~:/sbin/nologin` is placed after `+@IT_EMP:::~::~:`. Otherwise, all user accounts imported from NIS will have `/sbin/nologin` as their login shell.

After this change, you will only have to change one NIS map if a new employee joins the IT department. You could use a similar approach for the less important servers by replacing the old `+:::~::~:` in their local version of `/etc/master.passwd` with something like this:

```
+@IT_EMP:::~::~:
+@IT_APP:::~::~:
+:::~::~:/sbin/nologin
```

The corresponding lines for the normal workstations could be:

```
+@IT_EMP:::~::~:
+@USERS:::~::~:
+:::~::~:/sbin/nologin
```

And everything would be fine until there is a policy change a few weeks later: The IT department starts hiring interns. The IT interns are allowed to use the normal workstations and the less important servers; and the IT apprentices are allowed to login onto the main servers. You add a new netgroup `IT_INTERN`, add the new IT interns to this netgroup and start to change the configuration on each and every machine... As the old saying goes: "Errors in centralized planning lead to global mess".

NIS' ability to create netgroups from other netgroups can be used to prevent situations like these. One possibility is the creation of role-based netgroups. For example, you could create a netgroup called BIGSRV to define the login restrictions for the important servers, another netgroup called SMALLSRV for the less important servers and a third netgroup called USERBOX for the normal workstations. Each of these netgroups contains the netgroups that are allowed to login onto these machines. The new entries for your NIS map netgroup should look like this:

```
BIGSRV    IT_EMP  IT_APP
SMALLSRV  IT_EMP  IT_APP  ITINTERN
USERBOX   IT_EMP  ITINTERN  USERS
```

This method of defining login restrictions works reasonably well if you can define groups of machines with identical restrictions. Unfortunately, this is the exception and not the rule. Most of the time, you will need the ability to define login restrictions on a per-machine basis.

Machine-specific netgroup definitions are the other possibility to deal with the policy change outlined above. In this scenario, the `/etc/master.passwd` of each box contains two lines starting with "+". The first of them adds a netgroup with the accounts allowed to login onto this machine, the second one adds all other accounts with `/sbin/nologin` as shell. It is a good idea to use the "ALL-CAPS" version of the machine name as the name of the netgroup. In other words, the lines should look like this:

```
+@BOXNAME:::::::::
+:::::::::/sbin/nologin
```

Once you have completed this task for all your machines, you will not have to modify the local versions of `/etc/master.passwd` ever again. All further changes can be handled by modifying the NIS map. Here is an example of a possible netgroup map for this scenario with some additional goodies:

```
# Define groups of users first
IT_EMP    (,alpha,test-domain)    (,beta,test-domain)
IT_APP    (,charlie,test-domain)  (,delta,test-domain)
DEPT1     (,echo,test-domain)     (,foxtrott,test-domain)
DEPT2     (,golf,test-domain)     (,hotel,test-domain)
DEPT3     (,india,test-domain)    (,juliet,test-domain)
ITINTERN  (,kilo,test-domain)     (,lima,test-domain)
D_INTERNS (,able,test-domain)     (,baker,test-domain)
#
# Now, define some groups based on roles
USERS     DEPT1    DEPT2    DEPT3
BIGSRV    IT_EMP  IT_APP
SMALLSRV  IT_EMP  IT_APP  ITINTERN
USERBOX   IT_EMP  ITINTERN  USERS
#
# And a groups for a special tasks
# Allow echo and golf to access our anti-virus-machine
SECURITY  IT_EMP  (,echo,test-domain)  (,golf,test-domain)
#
# machine-based netgroups
# Our main servers
WAR       BIGSRV
FAMINE    BIGSRV
# User india needs access to this server
POLLUTION BIGSRV  (,india,test-domain)
#
```

```
# This one is really important and needs more access restrictions
DEATH      IT_EMP
#
# The anti-virus-machine mentioned above
ONE        SECURITY
#
# Restrict a machine to a single user
TWO        (,hotel,test-domain)
# [...more groups to follow]
```

If you are using some kind of database to manage your user accounts, you should be able to create the first part of the map with your database's report tools. This way, new users will automatically have access to the boxes.

One last word of caution: It may not always be advisable to use machine-based netgroups. If you are deploying a couple of dozen or even hundreds of identical machines for student labs, you should use role-based netgroups instead of machine-based netgroups to keep the size of the NIS map within reasonable limits.

29.4.8 Important Things to Remember

There are still a couple of things that you will need to do differently now that you are in an NIS environment.

- Every time you wish to add a user to the lab, you must add it to the master NIS server *only*, and *you must remember to rebuild the NIS maps*. If you forget to do this, the new user will not be able to login anywhere except on the NIS master. For example, if we needed to add a new user `jsmith` to the lab, we would:

```
# pw useradd jsmith
# cd /var/yp
# make test-domain
```

You could also run `adduser jsmith` instead of `pw useradd jsmith`.

- *Keep the administration accounts out of the NIS maps*. You do not want to be propagating administrative accounts and passwords to machines that will have users that should not have access to those accounts.
- *Keep the NIS master and slave secure, and minimize their downtime*. If somebody either hacks or simply turns off these machines, they have effectively rendered many people without the ability to login to the lab.

This is the chief weakness of any centralized administration system. If you do not protect your NIS servers, you will have a lot of angry users!

29.4.9 NIS v1 Compatibility

FreeBSD's `ypserv` has some support for serving NIS v1 clients. FreeBSD's NIS implementation only uses the NIS v2 protocol, however other implementations include support for the v1 protocol for backwards compatibility with older systems. The `ybind` daemons supplied with these systems will try to establish a binding to an NIS v1 server even though they may never actually need it (and they may persist in broadcasting in search of one even after they receive a response from a v2 server). Note that while support for normal client calls is provided, this version of `ypserv` does not handle v1 map transfer requests; consequently, it cannot be used as a master or slave in conjunction with older NIS servers that only support the v1 protocol. Fortunately, there probably are not any such servers still in use today.

29.4.10 NIS Servers That Are Also NIS Clients

Care must be taken when running `ypserv` in a multi-server domain where the server machines are also NIS clients. It is generally a good idea to force the servers to bind to themselves rather than allowing them to broadcast bind requests and possibly become bound to each other. Strange failure modes can result if one server goes down and others are dependent upon it. Eventually all the clients will time out and attempt to bind to other servers, but the delay involved can be considerable and the failure mode is still present since the servers might bind to each other all over again.

You can force a host to bind to a particular server by running `yplibind` with the `-s` flag. If you do not want to do this manually each time you reboot your NIS server, you can add the following lines to your `/etc/rc.conf`:

```
nis_client_enable="YES" # run client stuff as well
nis_client_flags="-S NIS domain,server"
```

See `yplibind(8)` for further information.

29.4.11 Password Formats

One of the most common issues that people run into when trying to implement NIS is password format compatibility. If your NIS server is using DES encrypted passwords, it will only support clients that are also using DES. For example, if you have Solaris NIS clients in your network, then you will almost certainly need to use DES encrypted passwords.

To check which format your servers and clients are using, look at `/etc/login.conf`. If the host is configured to use DES encrypted passwords, then the `default` class will contain an entry like this:

```
default:\
:passwd_format=des:\
:copyright=/etc/COPYRIGHT:\
[Further entries elided]
```

Other possible values for the `passwd_format` capability include `blf` and `md5` (for Blowfish and MD5 encrypted passwords, respectively).

If you have made changes to `/etc/login.conf`, you will also need to rebuild the login capability database, which is achieved by running the following command as `root`:

```
# cap_mkdb /etc/login.conf
```

ΌçἰἄḂῶῆç: The format of passwords already in `/etc/master.passwd` will not be updated until a user changes his password for the first time *after* the login capability database is rebuilt.

Next, in order to ensure that passwords are encrypted with the format that you have chosen, you should also check that the `crypt_default` in `/etc/auth.conf` gives precedence to your chosen password format. To do this, place the format that you have chosen first in the list. For example, when using DES encrypted passwords, the entry would be:

```
crypt_default = des blf md5
```

Having followed the above steps on each of the FreeBSD based NIS servers and clients, you can be sure that they all agree on which password format is used within your network. If you have trouble authenticating on an NIS client, this is a pretty good place to start looking for possible problems. Remember: if you want to deploy an NIS server for a heterogenous network, you will probably have to use DES on all systems because it is the lowest common standard.

29.5 Automatic Network Configuration (DHCP)

Written by Greg Sutter.

29.5.1 What Is DHCP?

DHCP, the Dynamic Host Configuration Protocol, describes the means by which a system can connect to a network and obtain the necessary information for communication upon that network. FreeBSD versions prior to 6.0 use the ISC (Internet Software Consortium) DHCP client (`dhclient(8)`) implementation. Later versions use the OpenBSD `dhclient` taken from OpenBSD 3.7. All information here regarding `dhclient` is for use with either of the ISC or OpenBSD DHCP clients. The DHCP server is the one included in the ISC distribution.

29.5.2 What This Section Covers

This section describes both the client-side components of the ISC and OpenBSD DHCP client and server-side components of the ISC DHCP system. The client-side program, `dhclient`, comes integrated within FreeBSD, and the server-side portion is available from the `net/isc-dhcp3-server` port. The `dhclient(8)`, `dhcp-options(5)`, and `dhclient.conf(5)` manual pages, in addition to the references below, are useful resources.

29.5.3 How It Works

When `dhclient`, the DHCP client, is executed on the client machine, it begins broadcasting requests for configuration information. By default, these requests are on UDP port 68. The server replies on UDP 67, giving the client an IP address and other relevant network information such as netmask, router, and DNS servers. All of this information comes in the form of a DHCP “lease” and is only valid for a certain time (configured by the DHCP server maintainer). In this manner, stale IP addresses for clients no longer connected to the network can be automatically reclaimed.

DHCP clients can obtain a great deal of information from the server. An exhaustive list may be found in `dhcp-options(5)`.

29.5.4 FreeBSD Integration

FreeBSD fully integrates the ISC or OpenBSD DHCP client, `dhclient` (according to the FreeBSD version you run). DHCP client support is provided within both the installer and the base system, obviating the need for detailed knowledge of network configurations on any network that runs a DHCP server. `dhclient` has been included in all FreeBSD distributions since 3.2.

DHCP is supported by **sysinstall**. When configuring a network interface within **sysinstall**, the second question asked is: “Do you want to try DHCP configuration of the interface?”. Answering affirmatively will execute `dhclient`, and if successful, will fill in the network configuration information automatically.

There are two things you must do to have your system use DHCP upon startup:

- Make sure that the `bpf` device is compiled into your kernel. To do this, add `device bpf` to your kernel configuration file, and rebuild the kernel. For more information about building kernels, see Εἰσαγωγή 8.

The `bpf` device is already part of the `GENERIC` kernel that is supplied with FreeBSD, so if you do not have a custom kernel, you should not need to create one in order to get DHCP working.

Προσοχή: For those who are particularly security conscious, you should be warned that `bpf` is also the device that allows packet sniffers to work correctly (although they still have to be run as `root`). `bpf` is required to use DHCP, but if you are very sensitive about security, you probably should not add `bpf` to your kernel in the expectation that at some point in the future you will be using DHCP.

- Edit your `/etc/rc.conf` to include the following:

```
ifconfig_fxp0="DHCP"
```

Προσοχή: Be sure to replace `fxp0` with the designation for the interface that you wish to dynamically configure, as described in Ὁδηγία 11.8.

If you are using a different location for `dhclient`, or if you wish to pass additional flags to `dhclient`, also include the following (editing as necessary):

```
dhcp_program="/sbin/dhclient"
dhcp_flags=""
```

The DHCP server, **dhcpcd**, is included as part of the `net/isc-dhcp3-server` port in the ports collection. This port contains the ISC DHCP server and documentation.

29.5.5 Files

- `/etc/dhclient.conf`

`dhclient` requires a configuration file, `/etc/dhclient.conf`. Typically the file contains only comments, the defaults being reasonably sane. This configuration file is described by the `dhclient.conf(5)` manual page.

- `/sbin/dhclient`

`dhclient` is statically linked and resides in `/sbin`. The `dhclient(8)` manual page gives more information about `dhclient`.

- `/sbin/dhclient-script`

`dhclient-script` is the FreeBSD-specific DHCP client configuration script. It is described in `dhclient-script(8)`, but should not need any user modification to function properly.

- `/var/db/dhclient.leases`

The DHCP client keeps a database of valid leases in this file, which is written as a log. `dhclient.leases(5)` gives a slightly longer description.

29.5.6 Further Reading

The DHCP protocol is fully described in RFC 2131 (<http://www.freesoft.org/CIE/RFC/2131/>). An informational resource has also been set up at <http://www.dhcp.org/>.

29.5.7 Installing and Configuring a DHCP Server

29.5.7.1 What This Section Covers

This section provides information on how to configure a FreeBSD system to act as a DHCP server using the ISC (Internet Software Consortium) implementation of the DHCP server.

The server is not provided as part of FreeBSD, and so you will need to install the `net/isc-dhcp3-server` port to provide this service. See Ἐἰσαγωγή 4 for more information on using the Ports Collection.

29.5.7.2 DHCP Server Installation

In order to configure your FreeBSD system as a DHCP server, you will need to ensure that the `bpf(4)` device is compiled into your kernel. To do this, add `device bpf` to your kernel configuration file, and rebuild the kernel. For more information about building kernels, see Ἐἰσαγωγή 8.

The `bpf` device is already part of the `GENERIC` kernel that is supplied with FreeBSD, so you do not need to create a custom kernel in order to get DHCP working.

Ὁψιμολογία: Those who are particularly security conscious should note that `bpf` is also the device that allows packet sniffers to work correctly (although such programs still need privileged access). `bpf` is required to use DHCP, but if you are very sensitive about security, you probably should not include `bpf` in your kernel purely because you expect to use DHCP at some point in the future.

The next thing that you will need to do is edit the sample `dhcpd.conf` which was installed by the `net/isc-dhcp3-server` port. By default, this will be `/usr/local/etc/dhcpd.conf.sample`, and you should copy this to `/usr/local/etc/dhcpd.conf` before proceeding to make changes.

29.5.7.3 Configuring the DHCP Server

`dhcpd.conf` is comprised of declarations regarding subnets and hosts, and is perhaps most easily explained using an example :

```
option domain-name "example.com";❶
option domain-name-servers 192.168.4.100;❷
option subnet-mask 255.255.255.0;❸
```


29.5.7.4 Files

- `/usr/local/sbin/dhcpd`

dhcpd is statically linked and resides in `/usr/local/sbin`. The `dhcpd(8)` manual page installed with the port gives more information about **dhcpd**.

- `/usr/local/etc/dhcpd.conf`

dhcpd requires a configuration file, `/usr/local/etc/dhcpd.conf` before it will start providing service to clients. This file needs to contain all the information that should be provided to clients that are being serviced, along with information regarding the operation of the server. This configuration file is described by the `dhcpd.conf(5)` manual page installed by the port.

- `/var/db/dhcpd.leases`

The DHCP server keeps a database of leases it has issued in this file, which is written as a log. The manual page `dhcpd.leases(5)`, installed by the port gives a slightly longer description.

- `/usr/local/sbin/dhcrelay`

dhcrelay is used in advanced environments where one DHCP server forwards a request from a client to another DHCP server on a separate network. If you require this functionality, then install the `net/isc-dhcp3-relay` port. The `dhcrelay(8)` manual page provided with the port contains more detail.

29.6 Domain Name System (DNS)

Contributed by Chern Lee, Tom Rhodes, ἐᾶέ Daniel Gerzo.

29.6.1 Overview

FreeBSD utilizes, by default, a version of BIND (Berkeley Internet Name Domain), which is the most common implementation of the DNS protocol. DNS is the protocol through which names are mapped to IP addresses, and vice versa. For example, a query for `www.FreeBSD.org` will receive a reply with the IP address of The FreeBSD Project's web server, whereas, a query for `ftp.FreeBSD.org` will return the IP address of the corresponding FTP machine. Likewise, the opposite can happen. A query for an IP address can resolve its hostname. It is not necessary to run a name server to perform DNS lookups on a system.

FreeBSD currently comes with BIND9 DNS server software by default. Our installation provides enhanced security features, a new file system layout and automated `chroot(8)` configuration.

DNS is coordinated across the Internet through a somewhat complex system of authoritative root, Top Level Domain (TLD), and other smaller-scale name servers which host and cache individual domain information.

Currently, BIND is maintained by the Internet Software Consortium <http://www.isc.org/>.

29.6.2 Terminology

To understand this document, some terms related to DNS must be understood.

Term	Definition
Forward DNS	Mapping of hostnames to IP addresses.
Origin	Refers to the domain covered in a particular zone file.
named , BIND, name server	Common names for the BIND name server package within FreeBSD.
Resolver	A system process through which a machine queries a name server for zone information.
Reverse DNS	The opposite of forward DNS; mapping of IP addresses to hostnames.
Root zone	The beginning of the Internet zone hierarchy. All zones fall under the root zone, similar to how all files in a file system fall under the root directory.
Zone	An individual domain, subdomain, or portion of the DNS administered by the same authority.

Examples of zones:

- `.` is the root zone.
- `org.` is a Top Level Domain (TLD) under the root zone.
- `example.org.` is a zone under the `org.` TLD.
- `1.168.192.in-addr.arpa` is a zone referencing all IP addresses which fall under the `192.168.1.*` IP space.

As one can see, the more specific part of a hostname appears to its left. For example, `example.org.` is more specific than `org.`, as `org.` is more specific than the root zone. The layout of each part of a hostname is much like a file system: the `/dev` directory falls within the root, and so on.

29.6.3 Reasons to Run a Name Server

Name servers usually come in two forms: an authoritative name server, and a caching name server.

An authoritative name server is needed when:

- One wants to serve DNS information to the world, replying authoritatively to queries.
- A domain, such as `example.org`, is registered and IP addresses need to be assigned to hostnames under it.
- An IP address block requires reverse DNS entries (IP to hostname).
- A backup or second name server, called a slave, will reply to queries.

A caching name server is needed when:

- A local DNS server may cache and respond more quickly than querying an outside name server.

When one queries for `www.FreeBSD.org`, the resolver usually queries the uplink ISP's name server, and retrieves the reply. With a local, caching DNS server, the query only has to be made once to the outside world by the caching DNS server. Every additional query will not have to look to the outside of the local network, since the information is cached locally.

29.6.4 How It Works

In FreeBSD, the BIND daemon is called **named** for obvious reasons.

File	Description
named(8)	The BIND daemon.
rndc(8)	Name server control utility.
/etc/namedb	Directory where BIND zone information resides.
/etc/namedb/named.conf	Configuration file of the daemon.

Depending on how a given zone is configured on the server, the files related to that zone can be found in the `master`, `slave`, or `dynamic` subdirectories of the `/etc/namedb` directory. These files contain the DNS information that will be given out by the name server in response to queries.

29.6.5 Starting BIND

Since BIND is installed by default, configuring it all is relatively simple.

The default **named** configuration is that of a basic resolving name server, ran in a `chroot(8)` environment. To start the server one time with this configuration, use the following command:

```
# /etc/rc.d/named forcestart
```

To ensure the **named** daemon is started at boot each time, put the following line into the `/etc/rc.conf`:

```
named_enable="YES"
```

There are obviously many configuration options for `/etc/namedb/named.conf` that are beyond the scope of this document. However, if you are interested in the startup options for **named** on FreeBSD, take a look at the `named_*` flags in `/etc/defaults/rc.conf` and consult the `rc.conf(5)` manual page. The `ÖîÞιά 11.7` section is also a good read.

29.6.6 Configuration Files

Configuration files for **named** currently reside in `/etc/namedb` directory and will need modification before use, unless all that is needed is a simple resolver. This is where most of the configuration will be performed.

29.6.6.1 Using `make-localhost`

To configure a master zone for the localhost visit the `/etc/namedb` directory and run the following command:

```
# sh make-localhost
```

If all went well, a new file should exist in the `master` subdirectory. The filenames should be `localhost.rev` for the local domain name and `localhost-v6.rev` for IPv6 configurations. As the default configuration file, required information will be present in the `named.conf` file.

29.6.6.2 /etc/namedb/named.conf

```
// $FreeBSD$
//
// Refer to the named.conf(5) and named(8) man pages, and the documentation
// in /usr/share/doc/bind9 for more details.
//
// If you are going to set up an authoritative server, make sure you
// understand the hairy details of how DNS works. Even with
// simple mistakes, you can break connectivity for affected parties,
// or cause huge amounts of useless Internet traffic.

options {
    directory "/etc/namedb";
    pid-file "/var/run/named/pid";
    dump-file "/var/dump/named_dump.db";
    statistics-file "/var/stats/named.stats";

// If named is being used only as a local resolver, this is a safe default.
// For named to be accessible to the network, comment this option, specify
// the proper IP address, or delete this option.
    listen-on { 127.0.0.1; };

// If you have IPv6 enabled on this system, uncomment this option for
// use as a local resolver. To give access to the network, specify
// an IPv6 address, or the keyword "any".
// listen-on-v6 { ::1; };

// In addition to the "forwarders" clause, you can force your name
// server to never initiate queries of its own, but always ask its
// forwarders only, by enabling the following line:
//
// forward only;

// If you've got a DNS server around at your upstream provider, enter
// its IP address here, and enable the line below. This will make you
// benefit from its cache, thus reduce overall DNS traffic in the Internet.
/*
    forwarders {
        127.0.0.1;
    };
*/
```

Just as the comment says, to benefit from an uplink's cache, `forwarders` can be enabled here. Under normal circumstances, a name server will recursively query the Internet looking at certain name servers until it finds the answer it is looking for. Having this enabled will have it query the uplink's name server (or name server provided) first, taking advantage of its cache. If the uplink name server in question is a heavily trafficked, fast name server, enabling this may be worthwhile.

Δñἰάέἰῖῖῖçç: 127.0.0.1 will *not* work here. Change this IP address to a name server at your uplink.


```

};
*/

/* An example dynamic zone
key "exampleorgkey" {
  algorithm hmac-md5;
  secret "sf87HJqjkqh8ac87a0211a==";
};
zone "example.org" {
  type master;
  allow-update {
    key "exampleorgkey";
  };
  file "dynamic/example.org";
};
*/

/* Examples of forward and reverse slave zones
zone "example.com" {
  type slave;
  file "slave/example.com";
  masters {
    192.168.1.1;
  };
};
zone "1.168.192.in-addr.arpa" {
  type slave;
  file "slave/1.168.192.in-addr.arpa";
  masters {
    192.168.1.1;
  };
};
*/

```

In `named.conf`, these are examples of slave entries for a forward and reverse zone.

For each new zone served, a new zone entry must be added to `named.conf`.

For example, the simplest zone entry for `example.org` can look like:

```

zone "example.org" {
  type master;
  file "master/example.org";
};

```

The zone is a master, as indicated by the `type` statement, holding its zone information in `/etc/namedb/master/example.org` indicated by the `file` statement.

```

zone "example.org" {
  type slave;
  file "slave/example.org";
};

```

In the slave case, the zone information is transferred from the master name server for the particular zone, and saved in the file specified. If and when the master server dies or is unreachable, the slave name server will have the transferred zone information and will be able to serve it.

29.6.6.3 Zone Files

An example master zone file for `example.org` (existing within `/etc/namedb/master/example.org`) is as follows:

```
$TTL 3600      ; 1 hour
example.org.  IN      SOA      ns1.example.org. admin.example.org. (
                                2006051501      ; Serial
                                10800            ; Refresh
                                3600             ; Retry
                                604800          ; Expire
                                86400           ; Minimum TTL
                                )

; DNS Servers
                IN      NS      ns1.example.org.
                IN      NS      ns2.example.org.

; MX Records
                IN      MX 10    mx.example.org.
                IN      MX 20    mail.example.org.

                IN      A      192.168.1.1

; Machine Names
localhost     IN      A      127.0.0.1
ns1           IN      A      192.168.1.2
ns2           IN      A      192.168.1.3
mx            IN      A      192.168.1.4
mail         IN      A      192.168.1.5

; Aliases
www           IN      CNAME    @
```

Note that every hostname ending in a “.” is an exact hostname, whereas everything without a trailing “.” is referenced to the origin. For example, `www` is translated into `www.origin`. In our fictitious zone file, our origin is `example.org.`, so `www` would translate to `www.example.org.`

The format of a zone file follows:

```
recordname    IN recordtype  value
```

The most commonly used DNS records:

SOA

start of zone authority


```
mail          IN      A      192.168.1.5
```

The A record indicates machine names. As seen above, `ns1.example.org` would resolve to `192.168.1.2`.

```
            IN      A      192.168.1.1
```

This line assigns IP address `192.168.1.1` to the current origin, in this case `example.org`.

```
www          IN CNAME      @
```

The canonical name record is usually used for giving aliases to a machine. In the example, `www` is aliased to the “master” machine which name equals to domain name `example.org` (`192.168.1.1`). CNAMEs can be used to provide alias hostnames, or round robin one hostname among multiple machines.

```
            IN MX   10      mail.example.org.
```

The MX record indicates which mail servers are responsible for handling incoming mail for the zone. `mail.example.org` is the hostname of the mail server, and 10 being the priority of that mail server.

One can have several mail servers, with priorities of 10, 20 and so on. A mail server attempting to deliver to `example.org` would first try the highest priority MX (the record with the lowest priority number), then the second highest, etc, until the mail can be properly delivered.

For in-addr.arpa zone files (reverse DNS), the same format is used, except with PTR entries instead of A or CNAME.

```
$TTL 3600
```

```
1.168.192.in-addr.arpa. IN SOA ns1.example.org. admin.example.org. (
                        2006051501      ; Serial
                        10800           ; Refresh
                        3600            ; Retry
                        604800          ; Expire
                        3600 )          ; Minimum
```

```
            IN      NS      ns1.example.org.
            IN      NS      ns2.example.org.
```

```
1          IN      PTR      example.org.
2          IN      PTR      ns1.example.org.
3          IN      PTR      ns2.example.org.
4          IN      PTR      mx.example.org.
5          IN      PTR      mail.example.org.
```

This file gives the proper IP address to hostname mappings of our above fictitious domain.

29.6.7 Caching Name Server

A caching name server is a name server that is not authoritative for any zones. It simply asks queries of its own, and remembers them for later use. To set one up, just configure the name server as usual, omitting any inclusions of zones.

Ἰὰὸὸ ἄῶἔἔἔἔἔ ὁῖ ὁἔἔἔἔἔ ἰά ἔἔἔἔἔ ἄἔ ἰῶἔἔἔἔἔἔἔἔ ἔἔἔἔ ὁῖ ἄἔ ἄἔἔ ἔἔἔἔἔἔἔἔἔ, ἔἔ ἄἔἔἔἔἔἔ ἰά ἄῶἔἔἔἔἔἔἔἔἔ ὁῖ ἄἔῶῶῶῶῶῶῶῶ:

```
# /usr/local/sbin/apachectl restart
```

Ἄἔ ἰά ἄῶἔἔἔἔἔἔἔἔ ὁῖ **Apache** ἄἔἔἔἔἔ ἰά ἄἔἔἔἔἔἔἔἔ ὁἔ ὁἔἔἔἔἔἔἔἔ ἄἔἔἔἔἔἔἔἔἔ ὁῖ ἄἔἔἔἔἔἔἔἔἔ, ὁἔἔἔἔἔἔἔἔ:

```
# /usr/local/sbin/apachectl graceful
```

Ἐἔἔἔἔἔἔἔἔἔ ὁἔἔἔἔἔἔἔἔἔ ἔἔ ἄἔἔἔἔἔ ὁἔ ὁἔἔἔἔἔ ἄἔἔἔἔἔ ἄἔἔἔἔἔ ὁῖ ὁἔἔἔἔἔἔἔ(8).

Ἄἔ ἰά ἄἔἔἔἔἔἔ ἰ **Apache** ἄῶἔἔἔἔἔ ἔἔἔἔ ὁἔ ἄἔἔἔἔἔἔἔ ἄἔἔἔἔἔἔἔ ὁῖ ὁἔἔἔἔἔἔἔἔἔ, ὁἔἔἔἔἔἔἔἔ ὁἔ ἄἔἔἔἔἔἔἔἔ ἄἔἔἔἔἔ ὁῖ /etc/rc.conf:

```
apache_enable="YES"
```

Ἄἔ ἄἔἔἔἔἔἔἔἔ ἰά ὁἔἔἔἔἔἔἔἔ ἄἔἔἔἔἔ ὁἔ ὁἔἔἔἔἔἔἔἔ ὁἔἔἔἔἔἔἔἔ ὁἔἔἔἔἔἔἔἔ ὁἔἔἔἔἔἔἔἔ ὁἔἔἔἔἔἔἔἔ ἄἔ ὁἔ ὁἔἔἔἔἔἔἔἔ **Apache** httpd ἰῶἔἔἔἔἔ ἰά ὁἔ ἄἔἔἔἔἔἔἔ ἰ ἄἔ ὁἔἔἔἔἔἔἔἔ ἄἔἔἔἔἔ ὁἔἔἔἔἔ ὁἔἔἔἔἔἔἔἔ rc.conf:

```
apache_flags=" "
```

Ἐἔἔἔ ὁῖ ἔἔἔ ἄἔἔἔἔἔ ἰ ἄἔῶῶῶῶῶῶῶ web, ἰῶἔἔἔἔἔ ἰ ἄἔἔἔἔ ὁἔ ἔῶῶῶῶῶῶῶ ὁἔ ὁἔἔἔἔἔἔἔ ὁἔ ὁἔἔἔἔἔἔἔἔ ὁἔ ὁἔἔἔἔἔἔἔἔ ὁἔἔἔἔἔἔἔἔ ὁἔἔἔἔἔἔἔἔ http://localhost/. Ἐ ὁἔἔἔἔἔἔἔἔἔ ὁἔἔἔἔἔ ὁἔ ἄἔἔἔἔἔἔἔἔ ἄἔἔἔἔἔ ὁἔἔἔἔἔἔἔἔ /usr/local/www/data/index.html.

29.7.4 Virtual Hosting

ἰ **Apache** ὁἔἔἔἔἔἔἔἔ ἄἔ ἄἔἔἔἔἔἔἔἔἔ ὁἔἔἔἔἔἔἔἔ Virtual Hosting. Ὀἔ ἰῶἔἔἔἔἔἔἔἔ virtual hosting ἄἔἔἔἔἔἔἔἔ ὁἔἔἔἔἔἔἔἔ HTTP/1.1 headers ἄἔ ἰ ἄἔἔἔἔἔἔἔ ὁἔ ἔἔἔἔ. Ἀῶἔ ἄἔἔἔἔἔἔἔ ὁἔ ἔἔἔἔ ἄἔἔἔἔἔἔἔ ὁἔἔἔἔἔἔἔἔ IP ἄἔ ὁἔἔἔἔ ἄἔ ἄἔἔἔἔἔἔἔἔ domains.

Ἄἔ ἰ ἄἔἔἔἔἔἔἔ ὁἔ **Apache** ἰ ἄἔἔἔἔἔἔἔἔ ὁἔ ἰῶἔἔἔἔἔἔἔἔ Virtual Hosting ἄἔἔἔἔἔἔ ἰ ἄἔ ἄἔἔἔἔἔἔἔἔ ὁἔἔἔἔἔἔἔἔ httpd.conf ὁἔ ὁἔ ἄἔἔἔἔἔἔἔἔ:

```
NameVirtualHost *
```

Ἄἔ ἰ ἄἔἔἔἔἔἔἔἔ web ἰῶἔἔἔἔἔἔἔ www.domain.tld ἄἔ ἄἔἔἔἔἔἔἔἔ ἰ ἄἔἔἔἔἔἔἔἔἔἔἔ ἄἔἔἔἔἔἔἔἔ ἄἔ ὁἔἔἔἔἔἔἔἔἔἔἔ www.someotherdomain.tld ὁἔἔἔἔ ἄἔ ὁἔἔἔἔἔἔἔἔ ὁἔ ἄἔἔἔἔἔἔἔἔ ἄἔἔἔἔἔἔἔἔ ἄἔἔἔἔἔἔἔἔἔἔἔ httpd.conf:

```
<VirtualHost *>
ServerName www.domain.tld
DocumentRoot /www/domain.tld
</VirtualHost>
```

```
<VirtualHost *>
ServerName www.someotherdomain.tld
DocumentRoot /www/someotherdomain.tld
</VirtualHost>
```

Ἄἔἔἔἔἔἔἔἔἔἔ ὁἔ ὁἔἔἔἔἔἔἔἔ ἄἔἔἔἔἔἔἔἔ ἰ ἄἔἔἔἔἔ ὁἔ ἄἔἔἔἔἔἔἔἔ ἰ ἄἔἔἔἔἔἔἔἔἔἔἔ ἄἔ ὁἔ ἄἔἔἔἔἔἔἔἔἔἔἔ ἄἔἔἔἔἔἔἔἔ ὁἔ ἄἔἔἔἔἔἔἔἔ ὁἔ.

29.9.2.1 Using the Samba Web Administration Tool (SWAT)

The Samba Web Administration Tool (SWAT) runs as a daemon from **inetd**. Therefore, the following line in `/etc/inetd.conf` should be uncommented before **swat** can be used to configure **Samba**:

```
swat    stream  tcp      nowait/400    root    /usr/local/sbin/swat
```

As explained in [Διάγραμμα 29-1](#), the **inetd** must be reloaded after this configuration file is changed.

Once **swat** has been enabled in `inetd.conf`, you can use a browser to connect to `http://localhost:901`. You will first have to log on with the system `root` account.

Once you have successfully logged on to the main **Samba** configuration page, you can browse the system documentation, or begin by clicking on the **Globals** tab. The **Globals** section corresponds to the variables that are set in the `[global]` section of `/usr/local/etc/smb.conf`.

29.9.2.2 Global Settings

Whether you are using **swat** or editing `/usr/local/etc/smb.conf` directly, the first directives you are likely to encounter when configuring **Samba** are:

```
workgroup
```

NT Domain-Name or Workgroup-Name for the computers that will be accessing this server.

```
netbios name
```

This sets the NetBIOS name by which a **Samba** server is known. By default it is the same as the first component of the host's DNS name.

```
server string
```

This sets the string that will be displayed with the `net view` command and some other networking tools that seek to display descriptive text about the server.

29.9.2.3 Security Settings

Two of the most important settings in `/usr/local/etc/smb.conf` are the security model chosen, and the backend password format for client users. The following directives control these options:

```
security
```

The two most common options here are `security = share` and `security = user`. If your clients use usernames that are the same as their usernames on your FreeBSD machine then you will want to use user level security. This is the default security policy and it requires clients to first log on before they can access shared resources.

In share level security, client do not need to log onto the server with a valid username and password before attempting to connect to a shared resource. This was the default security model for older versions of **Samba**.

passwd backend

Samba has several different backend authentication models. You can authenticate clients with LDAP, NIS+, a SQL database, or a modified password file. The default authentication method is `smbpasswd`, and that is all that will be covered here.

Assuming that the default `smbpasswd` backend is used, the `/usr/local/private/smbpasswd` file must be created to allow **Samba** to authenticate clients. If you would like to give your UNIX user accounts access from Windows clients, use the following command:

```
# smbpasswd -a username
```

Please see the Official Samba HOWTO (<http://www.samba.org/samba/docs/man/Samba-HOWTO-Collection/>) for additional information about configuration options. With the basics outlined here, you should have everything you need to start running **Samba**.

29.9.3 Starting Samba

The `net/samba3` port adds a new startup script, which can be used to control **Samba**. To enable this script, so that it can be used for example to start, stop or restart **Samba**, add the following line to the `/etc/rc.conf` file:

```
samba_enable="YES"
```

Όψιμαίη: This will also configure **Samba** to automatically start at system boot time.

It is possible then to start **Samba** at any time by typing:

```
# /usr/local/etc/rc.d/samba start
Starting SAMBA: removing stale tdb's :
Starting nmbd.
Starting smbd.
```

Please refer to **Όψιμαίη** 11.7 for more information about using rc scripts.

Samba actually consists of three separate daemons. You should see that both the `nmbd` and `smbd` daemons are started by the `samba.sh` script. If you enabled winbind name resolution services in `smb.conf`, then you will also see that the `winbindd` daemon is started.

You can stop **Samba** at any time by typing :

```
# /usr/local/etc/rc.d/samba.sh stop
```

Samba is a complex software suite with functionality that allows broad integration with Microsoft Windows networks. For more information about functionality beyond the basic installation described here, please see <http://www.samba.org>.

ÊäöÛëäéí 30 Firewalls

ÓοίάέοοιñÛ οίò Joseph J. Barbish. ÌäöäöñÛðçêä öá SGML êäé áíáíáðçêä äüü οίí Brad Davis.

30.1 Óýñîç

Ôí firewall (öäβ÷ìò ðñíóöäöβäð) êäéέöðÛ äöíáöü οί öééöñÛñéöíä ðçð äéöäñ÷ìáíçð êäé äíñ÷÷ìáíçð êβίççðð ðíò äéÝñ÷÷äöäé äüü οί óýóðçíä óäð. ðá firewall ìðññäβ íá ÷ñçóέííðíéäβ Ýíá ð ðññéóóüðäñá óäð “éáíüíüí” äéä íá äðééäññäβ öá ðäéÝöä éäöÛ ðçí äβóíäí ð Ýññäí οίòð äüü íéä äééððäéð óýíääóç, êäé íá öá äðéöñÝðäé ð íá öá äðñññβððäé. Íé éáíüíäð ðíò firewall ìðññýí íá äéÝä÷÷íóí Ýíá ð ðññéóóüðäñá ÷äñäéðçñéóóééÛ öüí ðäéÝöüí, óöíðññééäíäññÝíüí ìäöáíý Ûééüí êäé öíò óýðíò öíò ðññöíéüééíò, êäéðð êäé ðçí äéäýéðíóç ð/êäé éýñä (port) ðçð äöäðçñβäð ð öíò ðñññéóíñý.

Ôá firewalls ìðññýí íá äíéó÷÷óíóí óçíáíéééÛ ðçí äóöÛéäéä áíüð éüíäíò ð áíüð äééðýíò. Ìðññýí íá ÷ñçóέííðíéççèíýí äéä ìβä ð ðññéóóüðäñäð äüü öéð äéüéíòéäð éäéóíòññäβäð:

- Íá ðñíóöäðäýíóí êäé íá äðñññðñíóí öéð äöäññäÝò, öéð öðçññäóβäð êäé öá ìç÷÷áíðíäöä öíò äóöðäññééíý óäð äééðýíò äüü áíäðééýíçðç êβίççðð ðíò ðññÝñ÷÷äöäé äüü οί Internet.
- Íá ðññéññβäéíóí ð íá äðíééäβíóí ðçí ðññóääáóç ìç÷÷áíçðöüí öíò äóöðäññééíý äééðýíò öá öðçññäóβäð öíò Internet.
- Íá öðíóðçñβäéíóí ìäðÛöñäóç äééððäéðí äéäöéýíóäñí (NAT), ç ðíðíä äðéöñÝðäé öóí äóöðäññééü óäð äβéððí íá ÷ñçóέííðíéäβ éäéüðééÝð IP äéäöéýíóäéð êäé íá ìññÛäääéä ìβä ìíääééð óýíääóç ìä öíò Internet (äβðä ìÝóü ìβäð ìíääééðð äçíüóéäð IP äéäýéðíóçð, äβðä ìÝóü áíüð ðéðèíò äçíüóβñí äéäöéýíóäñí ðíò áíäðβäíðäé äðöüíäðä).

Äóíý äéääÛöäðä äðöü οί êäöÛéäéí, éä ñÝñäðä:

- Ðüð íá äçíéíòññðóäðä óüóóíýð éáíüíäð öééðñññβóíäöíð ðäéÝöüí.
- Ôíòð äéÛöññíòð óýðíòð firewall ðíò öðÛñ÷÷íóí óóí FreeBSD êäé öéð äéäöññÝð öíòð.
- Ðüð íá ððèìβóäðä êäé íá ÷ñçóέííðíéððóäðä öíò **PF** firewall öíò OpenBSD.
- Ðüð íá ððèìβóäðä êäé íá ÷ñçóέííðíéððóäðä öíò **IPFILTER**.
- Ðüð íá ððèìβóäðä êäé íá ÷ñçóέííðíéððóäðä öíò **IPFW**.

Ðñéí äéääÛöäðä äðöü οί êäöÛéäéí, éä ðñÝðäé:

- Íá éäöäññäβðä ääóééÝð äñ÷÷Ýð öíò FreeBSD êäé öíò Internet.

30.2 ÄäóééÝò ðññéäð öüí Firewalls

ÔðÛñ÷÷íóí äýí ääóééíβ ðññðíé äéä ðç äçíéíòññäβ éáíüíüí öá Ýíá firewall: ì “inclusive” êäé ì “exclusive”. ðá exclusive firewall äðéöñÝðäé ðç äéÝéäðóç ìéçð ðçð êβίççðð, äéðüð äüü äððð ðíò öäéñéÛäéä ìä öíòð éáíüíäð öíò. ðá inclusive firewall éÛíäé öíò áíÛðñäí. ÄðéöñÝðäé ìññ ðç äéÝéäðóç ðçð êβίççðð ðíò öäéñéÛäéä ìä öíòð éáíüíäð öíò, êäé äðíééäβäé ððéäððíöä Ûééí.

Ôá inclusive firewalls ðññóöÝññíóí ðíéý éäéýöäññí Ýéää÷÷íóçð äíññ÷÷ìáíçð êβίççðð êäé äéä öíò éüäñ äðöü äβíäé éäéýðäñä äéä óðóððíäðä ðíò ðññóöÝññíóí öðçññäóβäð óóí äçíüóéí Internet. ÄéÝä÷÷íóí äðβóçð êäé öá ðäéÝöä ðíò ðññÝñ÷÷äöäé äüü οί äçíüóéí Internet ìä ðññññéóíü οί éäéüðééü óäð äβéððí. Äüü ðññäðééñäð, ìéç ç êβίççðð ðíò ääí

Όι OpenBSD Project εΰίάε άίάεήάόέεΠ äöëäéÛ óðç óóίðñçóç òίò PF FAQ (<http://www.openbsd.org/faq/pf/>). Άέά òί εΰίάι áðòù, ç ðáññίγóa áíτιòççόά òίò Άã÷-áεñέäίβίò áóóέÛæáε εðñβùð óðέð εάέάέðáññüðççòáð òίò PF υίòί áóιñÛ òί FreeBSD, áñ ðáñÛ ÷-áε εάε ίáñέέÛ ðáíέέÛ ðεçñίρìñβáð ó÷-áóέéÛ ίá òç ÷-ñβóç òίò. Άέά ðεί εάðòιñáñáβð ðεçñίρìñβáð ó÷-áóέéÛ ίá òç ÷-ñβóç òίò PF, ðáñάέάείγίá äéááÛòóá òί PF FAQ (<http://www.openbsd.org/faq/pf/>). Ðáñέóóúðáñáð ðεçñίρìñβáð ó÷-áóέéÛ ίá òί PF òί FreeBSD ίðññáβòá ίá áñáβòá òί http://pf4freebsd.love2party.net/.

30.4.1 ×ñçóέίðίέρìðáð òá Άñέñβìáðá Ðòñβìá äéá òί PF

Άέά ίá òιñòβóáðá òί Ûñέñùíá ðòñβìá äéá òί PF, ðñιòέÛóá òçί ðáñάέÛòù áñáìñ òί òί /etc/rc.conf:

```
pf_enable="YES"
```

ΆέòáεÛóá Ûðáέóá òί script áέέβìççòð äéá ίá òιñòβóáðá òί Ûñέñùíá:

```
# /etc/rc.d/pf start
```

Óçìáέβóðá υíð òί Ûñέñùíá PF ááí ðñιέάέóáε ίá òιñòυέáβ áί ááí áñáε òί εάέιñέóιÛί áñ÷-áβι εάíτιí. Όι ðñιáðέéááÛί áñ÷-áβι áβίáε òί /etc/pf.conf. Áί òί áñ÷-áβι εάíτιí áñβóέáóáε óá εÛðίέá Ûέεç òίðίεáóá, ίðññáβòá ίá òçί εάέιñβóáðá ðñιòέÛóίòáð ίέá áñáìñ ðιðò òçί ðáñάέÛòù òί /etc/rc.conf:

```
pf_rules="/path/to/pf.conf"
```

Óçìáβòóç: Άðù òί FreeBSD 7.0 εάε ίáðÛ, òί ððüááéáìá òίò pf.conf òί ίðñβì áñβóέίòáί òίί εáðÛέίáι /etc/, ίáðáóÛñέçéá òίί εáðÛέίáι /usr/share/examples/pf/. Óðέð áέáúóáέð òίò FreeBSD ðñέί áðù òçί 7.0, òðβñ÷-á áðù ðñιáðέέίáβ Ûίá áñ÷-áβι /etc/pf.conf.

Όι Ûñέñùíá PF ίðññáβ áðβóç ίá òιñòυέáβ ÷-áέñιέβìççóá áðù òçί áñáìñ áίòίεβì:

```
# kldload pf.ko
```

Ç ððιòðñέίçç éáðááñáðβ òίò PF ðáñÛ ÷-áóáε áðù òί Ûñέñùíá pflog.ko εάε ίðññáβòá ίá òçί òιñòβóáðá ðñιòέÛóίòáð òçί ðáñάέÛòù áñáìñ òί /etc/rc.conf:

```
pflog_enable="YES"
```

ΆέòáεÛóá Ûðáέóá òί script áέέβìççòð äéá ίá òιñòβóáðá òί Ûñέñùíá:

```
# /etc/rc.d/pflog start
```

Áί ÷-ñáεÛæáóóá εÛðίέί áðù òá ðñι÷-ùñçίÛίá ÷-áñáέðçñέóóέéÛ òίò PF, εá ðñÛðáε ίá ίáðááεùððβóáðá òçί ððιòðñέίçç äéá òί PF áðáðέáβáð ίÛόá òί ðòñβìá.

30.4.2 ΆðέέίáÛò òίò PF äéá òί ðòñβìá

Áί εάε ááí áβίáε áðáñáβóççì ίá ίáðááεùððβóáðá òçί ððιòðñέίçç PF ίÛόá òί ðòñβìá òίò FreeBSD, βóùð ίá εÛέáðá ίá ÷-ñçóέίðίέρìðáðá Ûίá áðù òá ðñι÷-ùñçίÛίá ÷-áñáέðçñέóóέéÛ òίò PF òί ίðñβì ááí ðáñέéáìáÛίáóáε òί Ûñέñùíá òίò ðòñβìá: òί pfsync(4). Ðñιέάέóáε äéá ίέá ϕáðáι-òóóέáð ç ίðñβá áðίέáéÛðáε óáέéáñέίÛáð áέéááÛò òί ðβίáέá εáðáóóÛóáì ðίò ÷-ñçóέίðίέáβóáε áðù òί PF. Íðññáβ ίá óóίáðáóóáβ ίá òί carp(4) äéá ίá áçìέíðñçèίγί ίá òί PF

Ç çääëññííêêP ëβóóá ðíø FreeBSD áέα ðí packet filter firewall (<http://lists.FreeBSD.org/mailman/listinfo/freebsd-pf>) áβíáε Ýíá εάεü ìÝññò áέα íá εΰíáóá áññòPóáεò ó÷ áòεέÝð ìá ðç ñýεìεóç εάε ðç εάεòíòññáβá ðíø PF firewall. Ìç ìá÷ Ûóáóá íá áεÝáíáóá óá áñ÷ áβá ðçð ëβóóáð ðñεί íáεείPóáóá ðεò áññòPóáεò!

30.4.5 Άíòεάγííóáò ìá ðí PF

×ñçóεíðíεPóóá ðí pfctl(8) áέα íá áεÝáíáóá ðí PF. Ðάñáεΰòù εá áñáβóá εΰðíεάò ÷ ñPóείáò áíòíεÝð (ááááεüèèáβóá üòε Ý÷ áóá áεááΰóáε ðç óáεβáá manual ðíø pfctl(8) áέα íá ááβóá üεáò ðεò áεáεÝóείáò áðεεíáÝð):

ΆíòíεP	Óείðùò
pfctl -e	Άíáññáíðíβçóç ðíø PF
pfctl -d	Άðáíáññáíðíβçóç ðíø PF
pfctl -F all -f /etc/pf.conf	ΆέαáñáóP üεüí ðüí εάíüíüí (nat, filter, state, table, ê.ê.ð.) εάε áε íÝíò áíΰáíüòç áðü ðí áñ÷ áβí /etc/pf.conf
pfctl -s [rules nat state]	Άεòγðùòç áíáóíñΰò ó÷ áòεέΰ ìá ðíòð εάíüíáò ðíø òβεòñíò, ðíø NAT, P ðíø ðβíáέα εáòΰóóáóçð
pfctl -vnf /etc/pf.conf	ΆεÝá÷ áε ðí /etc/pf.conf áέα εΰεç, áεεΰ ááí ðíñòPíáε ðíòð εάíüíáò

30.4.6 Άíáññáíðíβçóç ðíø ALTQ

Ôí ALTQ áεάóβεáóáε ìüñí áí ìáóáεüòðóβóáóá áðáòεάβáð ðçí ððíóðPñείç ðíø ìÝóá óòíð ðòñPíá ðíø FreeBSD. Ôí ALTQ ááí ððíóðçñβεáóáε áðü üεá óá ðñíáñΰííáóá íáPáçóçð εáñòPí áεέòγíò. Ðάñáεάεíγíá ááβóá ðç óáεβáá manual ðíø altq(4) áέα ðç ëβóóá ðüí íäçáPí ðíø ððíóðçñβεííóáε óòçí Ýεáííóç ðíø FreeBSD ðíø áεáεÝóáóá.

Íε ðáñáεΰòù áðεεíáÝð ðíø ðòñPíá áíáññáíðίεíγí ðí ALTQ εάε ðáñÝ÷ íòí áðεðññüóεáóáò εάεòíòññáβò:

```
options      ALTQ
options      ALTQ_CBQ          # Class Bases Queuing (CBQ)
options      ALTQ_RED        # Random Early Detection (RED)
options      ALTQ_RIO        # RED In/Out
options      ALTQ_HFSC       # Hierarchical Packet Scheduler (HFSC)
options      ALTQ_PRIQ       # Priority Queuing (PRIQ)
options      ALTQ_NOPCC      # Required for SMP build
```

Ç áñáíñP options ALTQ áíáññáíðίεάβ ðí ðεάβóεί εάεòíòññáPí ALTQ.

Ç áñáíñP options ALTQ_CBQ áíáññáíðίεάβ ðí *Class Based Queuing* (CBQ). Ôí CBQ óáò áðεðñÝðáε íá ÷ ùñβóáóá ðí áýñíð æPíçð ìεáò óýíááóçð óá áεάóíñáòεέÝð εεΰóáεò P íòñÝð, Póóá íá áβñííóáε ðñíòáñáεüòçðáð óòçí εβίçóç áíΰεíáá ìá ðíòð εάíüíáò ðíø òβεòñíò.

Ç áñáíñP options ALTQ_RED áíáññáíðίεάβ ðí *Random Early Detection* (RED). Ôí RED ÷ ñçóεíðíεáβóáε áέα íá áðíòáò÷εáβ ç óðíòüñçóç ðíø áεέòγíò. Άέα ðí óείðü áòòü, ðí RED ìáòñΰáε ðí ìPεíð ðçð ìòñΰò εάε ðí óòáεñPíáε ìá ðí ìÝáεóòí εάε áεΰ÷εóòí üñεί ðçð. Áí ç íòñΰ áβíáε ðΰíü áðü ðí ìÝáεóòí, üεá óá íÝá ðáεÝóá εá áðíññβðòííóáε. Óýíòüíá εάε ìá ðí üññá ðíø, ðí RED áðíññβðóáε ðáεÝóá áðü áεΰóíñáð óòíáÝóáεò ìá ðò÷ áβí ðññðí.

Ç áñáíñP options ALTQ_RIO áíáññáíðίεάβ ðí *Random Early Detection In and Out*.

Ç añáñìP options ALTQ_HFSC áíáññíðñíεάβ òñ Hierarchical Fair Service Curve Packet Scheduler. Άέά ðññέóóúðññáò ðεçññíðññáò ó÷ áòέέÛ ìá òñ HFSC áάβòá: <http://www-2.cs.cmu.edu/~hzhang/HFSC/main.html>.

Ç añáñìP options ALTQ_PRIQ áíáññíðñíεάβ òñ Priority Queuing (PRIQ). Òñ PRIQ ðÛíðñíðá ðññíÛάέ ðññòá òçñ έβίçòç ìá òç ìάάέçðáñç ðññíðññάέúðçðá.

Ç añáñìP options ALTQ_NOPCC áíáññíðñíεάβ òçñ ððñíðññέçç SMP áέά òñ ALTQ. Ç áðέεñāP áòðP áðάέðáβòáέ òá òðóðPñáðá SMP.

30.5 Òñ IPFILTER (IPF) Firewall

Ï óðáññáòÝáò òñ IPFILTER áβíáέ ì Darren Reed. Òñ IPFILTER ááí áíáññíðñíεάέ áðñ òñ έάέðññάέέú òçñóçñá: áβíáέ ìέá áòáñññāP áñέέðñç έπáέέá ðñò Ý÷ áέ ìáðóóáññέáβ òñ FreeBSD, òñ NetBSD, òñ OpenBSD, òñ SunOS, òñ HP/UX έάέ òñ Solaris. Òñ IPFILTER áβíáέ ððñ áέáññP έάέ áíáññP áíÛððñç έάέ òñðññçòç, έάέ έðέεññíðññíç òáέðέέÛ ìέ ðÝáð áέáúðάέð òñ.

Òñ IPFILTER áβíáέ Ýíá firewall έάέ ìç÷ áíέóñð NAT ðñò έάέðññάέέβ òññ ððñPñá έάέ ìðññáβ ìá áέÝñ÷ áðάέ έάέ ìá ðññάέññέðáβòáέ áðñ ðññññÛñáðá ÷ ñPòç. Ìέ έáñññáð òñ firewall ìðññíç ìá òβεáñðáέ òá έó÷P ìá áέáññÛññíðáέ ìÝòñ òñ ãìççðέέçñç ðññññÛñáðñð ìp(8). Ìέ έáñññáð áέá òñ NAT ìðññíç ìá òβεáñðáέ òá έó÷P ìá áέáññÛññíðáέ ìÝòñ òñ ãìççðέέçñç ðññññÛñáðñð ìpnat(1). Òñ ãìççðέέçñç ðñññññññá ìpstat(8) ìðññáβ ìá áέðððPòáέ òðáðέóðέέÛ áέðÝέáòçð áέá òñ òñPñá òñ IPFILTER ðñò áέðáέáβòáέ òññ ððñPñá. Òñ ðñññññññá ìpmon(8) ìðññáβ ìá έáðáññÛPòáέ òέð áñÝññάέáð òñ IPFILTER òññ áñ÷ áβá έáðáññáðPð òññáÛñññ òñò òðóðPñáðñð.

Òñ IPF ãñÛPòçá áñ÷ έέÛ ÷ ñçóέñññέçPñáð ìέá έñάέP áðáññññáðáβòá έáññññ òñò òçñðñò “ì òáέáððáβñ έáñññáð ðñò òáέñέÛάέέ, áβíáέ έάέ ì ìέççðPð” έάέ ÷ ñçóέñññέçñç ìñññ έáñññáð òçñðñò stateless. Ìá òçñ ðÛññññ òñò ÷ ñññññ, òñ IPF ááέðέçPòçá áέá ìá ðññέέáññáÛññάέ òçñ áðέεññP “quick” έάέ òçñ áðέεññP “keep state” áέá stateful έáñññáð. Ìέ áðέεññáÝð áððÝð áέóðá÷ ññññέóá áñáñáðέέÛ òç έñάέP áðáññññáðáβòá òññ έáññññ. Ç áðβòçç òáέñçññβòç òñ IPF έáέçððáέ ìñññ òέð ðáέέÝð ðññññÝðññò ñçñέíòçð έάέ áðáññññáðáβòá òññ έáññññ. Ìέ òçññññáð έáέðñññáβòá έáέçððññáέ ìñññ òð ðñññέáðáð áðέεññáÝð, έάέ Ýðóέ ááí òññβεññáέέ áñέáðÛ òá ðεáñññέðPñáðá òñòð òçç ãçñññññáβá áñññ ðññçñ έáέçððññò έάέ áóðáέÝððáññò firewall.

Ìέ ñáçáβáð ðñò ðññέÝ÷ññáέ òá áòðP òçñ áññòçðá, ááóβεññáέέ òçç ÷ ñPòç έáñññññ ðñò ðññέÝ÷ññáέ òçñ áðέεññP “quick” έáέPð έάέ òçñ stateful áðέεññP “keep state”. Áððñ áβíáέ έάέ òñ ááóέέú ðεáβòéñ έáέðññáέPñáέ òçñ ãçñññññáβá òñò òáð έáñññññ áñññ inclusive firewall.

Άέá έáððñÝññáέð ò÷ áòέέÛ ìá òññ ðáέέúðñññ ðññðññ áðáññññáðáβòá òññ έáñññññ, ááβòá: http://www.obfuscation.org/ipf/ipf-howto.html#TOC_1 έάέ <http://coombs.anu.edu.au/~avalon/ip-filter.html>.

Ìðññáβòá ìá ááβòá òñ IPF FAQ òçñ òñðññáðá <http://www.phildev.net/ipf/index.html>.

Ìðññáβòá ìá áññáβòá òέð ðáέέúðññáð ãçññóέáçñáέð òέð έβòóáð òá÷ ðññññáβñò òñò IPFILTER òññ <http://marc.theaimsgroup.com/?l=ipfilter>. ÐáñÝ÷ áðáέ áðñáðññòçðá áíáέPòççð.

30.5.1 ÁíáññññέçPñáð òñ IPF

Òñ IPF ðññέέáññáÛññáðáέ òçç ááóέέP ááέáðÛðóáòç òñò FreeBSD òð Ûñññññá òñ ìðñññ ìðññáβ ìá òññðñέáβ ÷ ññέóðÛ. Òñ òçñóçñá έá òññòPòáέ áðñáíέέÛ òñ Ûñññññá òñò IPF áí ððÛñ÷ áέ ç έáðá÷ ññέòç ipfilter_enable="YES" òññ áñ÷ áβñ /etc/rc.conf. Òñ Ûñññññá Ý÷ áέ ãçñññññáçέáβ ìá áíáññññέçñÝç òçñ áðñáðññòçðá έáðáññáðPð έάέ ìá òçñ áðέεññP default pass all. Άέá ìá áέέÛñáðá áòðP òçñ ðññáðέεññP òá block all, ìðññáβòá áðέPð ìá ðññòέÝóáðá òññ έáñññá áðñññέçð (block all) òññ òÝέñð òññ έáñññññ òáð. Ááí ÷ ññάέÛάðáέ ìá ìáðáέúððβòáðá òçñ áðέεññP IPF òññ ððñPñá òñò FreeBSD áέá òñ òέñðñ áððñ.

Ç Ýñáò εά ñεΰεάε ðá ðçí ðáñáεΰò:

```
@1 pass out on xl0 from any to any
@2 block out on dc0 from any to any
@3 pass out quick on dc0 proto tcp/udp from any to any keep state
```

Ç áíòεΰ ipfstat -ih ááβ÷íáε ðñ ðβίαέα έάíúíúí άέα óá άεόάñ÷úìáíá ðάεΰόά, ðñðñεάòπρίόά ðññíóóΰ áðu ðñ εΰεά έάíúíá Ψία άñέεìú ðñ ááβ÷íáε ðúóáð ðññΨò Ψ÷άε ðñçόέñðñέçεάβ.

Ç áíòεΰ ipfstat -oh ááβ÷íáε ðñ ðβίαέα έάíúíúí άέα óá άíáñ÷úìáíá ðάεΰόά, ðñðñεάòπρίόά ðññíóóΰ áðu ðñ εΰεά έάíúíá Ψία άñέεìú ðñ ááβ÷íáε ðúóáð ðññΨò Ψ÷άε ðñçόέñðñέçεάβ.

Ç Ýñáò εά ñεΰεάε ðá ðçí ðáñáεΰò:

```
2451423 pass out on xl0 from any to any
354727 block out on dc0 from any to any
430918 pass out quick on dc0 proto tcp/udp from any to any keep state
```

Ίέα áðu óεð ðεí óçíáíóέεΨò εάέóñòñάβáð óçð áíòεΰ ipfstat áβίαέ ç áðέεñáΰ -t ç ðñβá áðάέεñβεάε ðñ ðβίαέα έάόάóóΰόáñ, ðá ðñúðñ ðñέí ðá áóðú ðñ ðñçόέñðñέçεάβ ç áíòεΰ top(1) άέα ðá ááβñáε ðñ ðβίαέα έάññάόóεπñ ðñ άέðάεñγíóάε óðñ FreeBSD. ¼ðáí ðñ firewall óáð áΨ÷άóάέ áðβεάόç, ç εάέðñòñάβá áóðΰ óáð άβñáε ðçí áóñáóúðçóá ðá áñáñññóáðά έάε ðá áóóεΰóáðά óóá βάέα óá ðάεΰόά ðñ ðçí áðñάεñγí. Ίε ðññáεñάóεεΨò ðñ-áðέεñáΨò óáð άβññóñ ðçí áóñáóúðçóá ðá áðέεΨñáðά ðñ IP áóáðçñβáð ΰ ðñññέóñγ, ðçí εγñá, ΰ ðñ ðñúðñεεεñ ðñ ðñβñ εΨεάðá ðá ðáñάεñεñðεΰóáðά óá ðñάáñáóέεú ðññúñ. Άάβðά ðç óάέβάá manual ðñ ipfstat(8) άέα ðáñέóóúðáñáð εáððññΨñάέáð.

30.5.6 IPMON

Άέα ðá εάέóñòñάβóάε óúóóΰ ç áíòεΰ ipmon, εά ðñΨðάε ðá áñáñáñðñέçεάβ ç áðέεñáΰ IPFILTER_LOG óðñ ððñπία. Ç áíòεΰ áóðΰ άέαεΨόάε άγñ άεάóññάóέεγýð ðñúðñð εάέóñòñάβáð. Ί ðññáðέεάñΨñð έάññέεúð ðñúðñð εάέóñòñάβáð áñáñáñðñέçεάβόάε úóáí ç áíòεΰ ðñçόέñðñέçεάβόάε ðññβð ðçí áðέεñáΰ -D.

Ç áíòεΰ ðññάβ ðá ðñçόέñðñέçεάβ óá εάέóñòñάβá ááβññá úóáí áðέεðñáβðά ðá Ψ÷άðá Ψία óóñá÷úìáñ áñ÷άβñ έάóáñáñóðð πóðá ðá ðññάβðá ðá áñáðΰóáðά óεð ðññçáñγñáñáð ááñáñóΨð. Άóðúð άβñáε έάε ð ðñúðñð ðá ðñ ðñβñ Ψ÷άε ðñέñέóóáβ ðá óóñáñáΰεάóάε ðñ FreeBSD ðá ðñ IPFILTER. Õñ FreeBSD Ψ÷άε áíóúñáðúñΨç áóñáóúðçóá áñέεάáΰð áñ÷άβñ έάóáñáñóðð. Άέα áóðú ðñ εúññ, άβñáε έάέγðáññ ç έάóáñáñóΰ ðá άβñáóάε ðΨóú ðñ syslogd(8) ðáñΰ óá Ψία óóñçέέóñΨñ áñ÷άβñ. Άðu ðññáðέεñáΰ, ç ðñέñέóç ipmon_flags óðñ áñ÷άβñ rc.conf ðñçόέñðñέçεάβ óεð áðέεñáΨò -Ds:

```
ipmon_flags="-Ds" # D = start as daemon
# s = log to syslog
# v = log tcp window, ack, seq
# n = map IP & port to names
```

Õá ðεáññάέðñάóá óçð έάóáñáñóðð άβñáε ðññóáñΰ. ðáñΨ÷άε ðçí áóñáóúðçóá áðέέúðçóçð ðεçññññεπñ úððð óá ðάεΰόά ðñ áðñññβðέçεάí, óεð άεάóðέγñóάέð áðu óεð ðñβñáð εΰðεçεάí, έάε ðñ ðñññέóñ ðñð. ð÷άðά Ψóóέ Ψία óçíáíóέεú ðεáñΨέóçñá úóáí ðññóðάεάβðά ðá áñáñññóáðά Ψία άεóáñεΨά.

Άέúñά έάε úóáí áñáñáñðñέçεάβ ðçí áóñáóúðçóá έάóáñáñóðð, ðñ IPF ááñ εά έάóáñáñΰάε ðβðñóá áñ ááñ Ψ÷άε άβñáε ç áíðβóðñέ÷ç ðñέñέóç óðñð έάíúíáð. Ί άεá÷άεñέóóðð ðñ firewall áðñóáóβεάε άέα ðñέñð έάíúíáð ðñ óáð εΨεάε ðá áñáñáñðñέçεάβ ðçí έάóáñáñóΰ, έάε ðññóέΨόάε óá áóðñγð ðçí εΨñç log. Õóóέñεñάέεΰ, ç έάóáñáñóΰ áñáñáñðñέçεάβόάε ðñ óá έάíúíáð ðñ áðñññβððññ ðάεΰόά.

Άβιάε δρεΰ οόιςέεοίΎίι ίά δάνεεάιαΰίαόάε Ύίαό εάφύιαό οοί οΎεοδ οιο οοίφιεο, διο ίά αδιίνβδδάε άδϋ δνιιδέειαΐϋ υεά οά δάεΎοά διο οοΰίροι ιΎ-νε έεάβ (default deny). Ιά οίι δνυδι αόου ιδιναβδά ίά αάβδά υεά οά δάεΎοά διο αάι οάβνεάίαι ίά εάίΎία εάφύια οιο οάο.

30.5.7 Έάοάάνάοΐ οιο IPMON

Οιο **syslogd** ÷νεοείιιδιεάβ ος αεεΐ οιο αεεεεΐ ιΎεραί αεά οί αεά÷υνεοίυ ουί ααανΎίυι εάοάάνάοΐδ. ΑεάεΎοάε αεάεεΎδ ιάαριδιεΐοάεο διο ιινΰειιόάε “facility” εάε “level”. Ύοάί οί IPMON ÷νεοείιιδιεάβδάε ίά οςί αδεειαΐ -Ds, ÷νεοείιιδιεάβ άδϋ δνιιδέειαΐ οί local0 υδ υίνα “facility”. Αί οί αδεεοιαβδά, ιδιναβδά ίά ÷νεοείιιδιεΐοάδ οά δάνάεΰου άδβδάαα αεά δάνάεΎνυ αεά÷υνεοίυ ουί ααανΎίυι εάοάάνάοΐδ:

```
LOG_INFO - packets logged using the "log" keyword as the action rather than pass or block.
LOG_NOTICE - packets logged which are also passed
LOG_WARNING - packets logged which are also blocked
LOG_ERR - packets which have been logged and which can be considered short
```

Άεά ίά νεειβδδά οί IPFILTER ίά εάοάάνΰοάε υεά οά ααανΎίά οοί /var/log/ipfilter.log, εά ÷νεάοόάβ ίά αςιεροιναβδδά άδϋ δνεί οί αν÷άβι. Αόου ιδιναβ ίά αβίαε ίά οςί δάνάεΰου αίοιεΐ:

```
# touch /var/log/ipfilter.log
```

ς εάεοιρονάβ οιο syslogd(8) ιδιναβ ίά νεειεοόάβ ίά εάοά÷υνβδδάεο οοί αν÷άβι /etc/syslog.conf. Οί αν÷άβι syslog.conf δνιόΎναε οςίαίοεεΐ αόάεείβ οοί δνυδι ίά οί ιδιβι οί **syslog** αίοειάουδβεάε οά ιςίγίαόά οοόοΐαόιο διο δνιΎν÷ιιόάε άδϋ αοάνιιαΎδ υδϋο οί IPF.

ΔνιόεΎοά οςί δάνάεΰου εάοά÷πνεός οοί αν÷άβι /etc/syslog.conf:

```
local0.* /var/log/ipfilter.log
```

Οί local0.* οςίαβίαε υδε εά αβίαόάε εάοάάνάοΐ υεει ουί ιςίοιΰουί αοοίϋ οιο ούδιο οοςί οιδιεάοβά διο Ύ÷αε ινεοόάβ.

Άεά ίά αράναιιδιεΐοάδ οεδ αεεάΎδ οοί /etc/syslog.conf εά δνΎδαε ίά αδαίαεεεΐοάδ οί ις÷ΰίςία **P** ίά αίαεΰοάδ οί syslogd(8) ίά ίάάαεάΰοάε οί /etc/syslog.conf, αεοάεπιόαδ οςί αίοιεΐ /etc/rc.d/syslogd reload

Ιςί ία÷ΰοάδ ίά ονιιδιεΐοάδ οί /etc/newsyslog.conf πδδά ίά αίαεεΰοάε οί αν÷άβι εάοάάνάοΐδ διο αςιεροιναβδδά δάνάδΰυ.

30.5.8 ς ιινοΐ ουί ιςίοιΰουί Έάοάάνάοΐδ

Οά ιςίγίαόά διο δανΰειιόάε άδϋ οςί ipmon αδιοαειγίοάε άδϋ δααβά ααανΎίυι διο ÷υνβειιόάε άδϋ εάοεϋ αεΰοόςία. Οά δααβά διο αβίαε εειΰ οά υεά οά ιςίγίαόά, αβίαε οά δάνάεΰου:

1. ς ςιάνιςία δάνάεάαΐδ οιο δάεΎοιο
2. ς πνά δάνάεάαΐδ οιο δάεΎοιο. ÷αε οςί ιινοΐ HH:MM:SS.F, ς ιδιβά οδραςεπίαε πνάδ, εάδδϰ, ααοοάνυεάδδά εάε εεΰοίαόά ααοοάνρεΎδιο (οά ιδιβά ιδιναβ ίά αβίαε δρεεΰ ααεάεεεΰ οςοβά).
3. Οί υίνα οςδ αεάδάοΐδ οοςί ιδιβά Ύαείά ς αδαίαναάοβά διο δάεΎοιο δ.÷. dc0.
4. Ι ανεειυδ ηΰααδ εάε ι άγίυι ανεειυδ οιο εάφύια, δ.÷. @0:17.

Ίδινάβδσά ίά αάβδσά δά δανάεΰδου ία όçí áíðéïP ipfstat -in:

1. Õí áβáíð òçð áíÝñááέáð: p áí òí δάέÝòí ðÝñáσά, b áí òí δάέÝòí áðíññβòεçέá, S áέá óýíòíí δάέÝòí, n áí ááí óáβñέάíá ίá έάíÝíá έάíúíá, L áέá έάíúíá ίá έάóáñáσð. Ç óáέñÛ ðñíðáñάέúðçóáð óóçí áðάέέúíέόç òúí δάñáðÛíú, áβίáέ S, p, b, n, L. Õí έáóáέάβí P P òí B óçíáβñíðí úðέ ç έáóáñáσð òíð δάέÝòíð Ýáέíá έúáú έÛðíέάð ááíέέðð ñýèíέόçð έáóáñáσðð έάέ ú÷έ áíáέóβáð έÛðíέίð έάíúíá.
2. Ίέ áέáðèýíóáέð. Ðñúέáέóáέ óóçí ðñάáíáðéέúðçóá áέá òñβά δάáβá: òç áέáýèðíóç έάέ òç έýñá áóáðçñβáð (÷ ùñβáέíðáέ ίá έúííá), òí óýíáíéí -> έάέ òçí áέáýèðíóç έάέ έýñá ðñííñέóííý, ð.÷. 209.53.17.22,80 -> 198.73.220.17,1722.
3. Õí PR áέíéíðéíýíáíí áðú òí úíñá P òíí áñέέú òíð ðñúðíéúέéíð, ð.÷. PR tcp.
4. Õí len áέíéíðéíýíáíí áðú òí íPéíð òçð áðέέáðáέβááð έάέ òí óðíñέέú íPéíð òíð δάέÝòíð, ð.÷. len 20 40.

Áí ðñúέáέóáέ áέá δάέÝòí TCP, έá òðÛñ÷άέ Ýíá áðέðèÝíí δάáβí òí íðíβí έá ίáέέíÛáέ ίá ίέá δάýέá έάέ έá áέíéíðéáβðáέ áðú áñÛíáóá δά ίðíβá áíóέóðíé÷íýí óóέð áðέéíáÝð (flags) ðíð Ý÷íòí ðáέáβ. Άáβδσά òç óáέβáá manual ipf(5) áέá òç έβðóá òúí áñáñÛðúí έάέ òúí áíðβóðíé÷úí flags.

Áí ðñúέáέóáέ áέá δάέÝòí ICMP, έá òðÛñ÷íòí áýí δάáβá óòí òÝéíð, òí ðñðí έá áβίáέ ðÛíóá "ICMP" έάέ òí áðúíáíí έá áβίáέ í òýðíð òíð ίçíýíáðíð έάέ òíð òðú-ίçíýíáðíð ICMP, ÷ ùñέóíÝíá ίá ίέá έÛèáðí, ð.÷. ICMP 3/3 áέá Ýíá íPíðíá ίç ðñíóáÛóέίçð έýñáð (port unreachable).

30.5.9 Άçíéíðñáβá Script Έάíúíúí ίá ÓðíáíéέέP ÕðíéáðÛóóáóç

ΊñέóíÝíñέ Ýíðáέñíé ÷ñPóðáð òíð IPF áçíéíðñáíýí Ýíá áñ÷áβí έάíúíúí òí íðíβí ίðíñáβ ίá áέðáέáóðáβ ùð script ίá áðíáðúðçóá óðíáíéέέPð ððíéáðÛóóáóçð. Õí ááóέέú úðáέíð òíð δάñáðÛíú, áβίáέ úðέ ÷ñáέÛáóáέ ίá áέέÛíáðá úííí òçí òέíP ðíð ó÷áðβáέðáέ ίá òí óðíáíéέέú úíñá έάέ úðáí òí script áέðáέáóðáβ, ç òέíP έá ððíéáðáóðáέáβ óá úéíðð òíðð έάíúíáð ðíð δάñέÝ÷íòí òí úíñá áððú. Έάèðð ðñúέáέóáέ áέá script, ίðíñáβδσά ίá ÷ñçóέííðíéPóáðá óðíáíéέέP ððíéáðÛóóáóç áέá ίá έúáέέíðíéPóáðá óð÷íÛ ÷ñçóέííðíéýíáíáð òέíÝð έάέ ίá òέð ððíéáέέóðÛðá óá ðíééáðéíýð έάíúíáð. Áððú óáβíáðáέ έάέ óðí ðáñÛáέέáíá ðíð áέíéíðéáβ.

Ç óýíðáίç òíð script ðíð ÷ñçóέííðíéáβðáέ ááð, áβίáέ óðíááðP ίá ðá έáέýóç sh(1), csh(1), έάέ tcsh(1).

Õá δάáβá óðá íðíβá áβíáðáέ óðíáíéέέP ððíéáðÛóóáóç ðñíóçíáέβñííóáέ ίá òí óPíá òíð áíéáñβíð: §.

Õá óðíáíéέέÛ δάáβá ááí Ý÷íòí òçí ðñíóçíáβúóç ίá òí §.

Ç òέíP ðíð έá ÷ñçóέííðíéçέáβ óòí óðíáíéέέú δάáβí, έá ðñÝðáέ ίá áóúέέáβáðáέ óá áέðèÛ áέóááúáέέÛ (").

ΊáέέíPóðá òí áñ÷áβí òúí έάíúíúí óáð ίá έÛðέ áíðβóðíé÷í ίá òí δάñáέÛðú:

```
##### Start of IPF rules script #####

oif="dc0"           # name of the outbound interface
odns="192.0.2.11"  # ISP's DNS server IP address
myip="192.0.2.7"   # my static IP address from ISP
ks="keep state"
fks="flags S keep state"

# You can choose between building /etc/ipf.rules file
# from this script or running this script "as is".
#
# Uncomment only one line and comment out another.
#
```

```
# 1) This can be used for building /etc/ipf.rules:
#cat > /etc/ipf.rules << EOF
#
# 2) This can be used to run script "as is":
/sbin/ipf -Fa -f - << EOF

# Allow out access to my ISP's Domain name server.
pass out quick on $oif proto tcp from any to $odns port = 53 $fks
pass out quick on $oif proto udp from any to $odns port = 53 $ks

# Allow out non-secure standard www function
pass out quick on $oif proto tcp from $myip to any port = 80 $fks

# Allow out secure www function https over TLS SSL
pass out quick on $oif proto tcp from $myip to any port = 443 $fks
EOF
##### End of IPF rules script #####
```

Αὐτὸ ἀβίαε ὑεῖ. Ὁὐὶ δᾶνᾶδῦῖν δᾶνῦᾶᾶεᾶῖᾶ ᾶᾶῖ ἀβίαε ὄçῖᾶῖὄεεῖῖ ἰε εᾶῖῖᾶᾶ, ᾶεεῖ ἰ ὄνῦᾶῖᾶ ἰᾶ ὄῖῖ ἰᾶῖῖῖ ἔᾶεὄῖᾶῖᾶῖῖ ἔᾶε δᾶῖῖῖῖῖ ὄεῖῖᾶ ὄᾶ δᾶᾶᾶ ὄᾶῖᾶᾶᾶᾶᾶᾶᾶ. Ἀῖ ὄῖ δᾶνᾶδῦῖν δᾶνῦᾶᾶεᾶῖᾶ ᾶῖᾶὄεῖῖῖῖῖ ὄᾶ ῖᾶ ᾶῖ ᾶῖ ἰᾶ ὄῖ ὑῖῖᾶ /etc/ipf.rules.script, εᾶ ἰᾶῖῖῖῖῖῖῖ ἰᾶ ᾶᾶᾶᾶῖᾶᾶᾶᾶ ᾶὄὄῖᾶ ὄῖᾶ ἔᾶῖῖᾶᾶ ἰᾶ ὄçῖ δᾶῖᾶᾶᾶᾶ ᾶῖᾶῖᾶ:

```
# sh /etc/ipf.rules.script
```

Ὁδῦῖν ᾶε ῖᾶ ᾶῖᾶᾶᾶᾶ ὑὄᾶῖ ᾶῖὄεῖῖᾶῖῖῖῖῖῖῖ ᾶῖ ᾶῖᾶ ἔᾶῖῖῖῖ ἰᾶ ᾶῖὄῖᾶᾶᾶᾶᾶᾶ ῖᾶᾶ ὄᾶῖᾶῖᾶὄῖᾶᾶ: Ὁῖ IPF ᾶᾶῖ ἔᾶὄᾶᾶᾶᾶᾶᾶ ὄç ὄᾶῖᾶῖᾶῖᾶ ὄᾶῖᾶᾶᾶᾶᾶᾶᾶ, ἔᾶε ᾶῖ ἰᾶῖᾶᾶ ἰᾶ ᾶεᾶᾶᾶᾶ ᾶὄὄ ὄᾶ scripts ῖᾶᾶᾶ.

ῖᾶ ὄῖᾶῖᾶ script ἰᾶῖᾶᾶ ἰᾶ ᾶῖὄεῖῖᾶῖῖῖῖῖ ἰᾶ ῖᾶ ᾶᾶ ὄῖᾶ ᾶῖ δᾶῖᾶᾶᾶᾶ ὄῖᾶᾶᾶᾶ:

- Ἀὄᾶῖᾶῖᾶ ὄῖ ὄᾶᾶῖᾶ ᾶᾶ ὄç ᾶῖᾶῖᾶ ᾶῖᾶ ἰᾶῖᾶῖᾶᾶ ἰᾶ cat, ἔᾶε ἰᾶὄᾶὄῖᾶᾶ ὄᾶ ὄᾶᾶῖᾶ ὄç ᾶῖᾶῖᾶ ᾶῖᾶ ἰᾶῖᾶῖᾶᾶ ἰᾶ /sbin/ipf. Ὁῖᾶῖᾶὄᾶᾶ ὄῖ ipfilter_enable="YES" ὄᾶῖ ᾶῖ ᾶῖᾶ /etc/rc.conf ὑᾶᾶ ὄᾶῖᾶᾶ, ἔᾶε ᾶεὄᾶῖᾶ ὄῖ script ἰεᾶ ὄῖᾶ ἰᾶὄᾶ ᾶᾶ ἔῖᾶ ᾶεᾶᾶᾶ ᾶεᾶ ἰᾶ ᾶçῖᾶᾶᾶᾶᾶᾶᾶ ᾶ ἰᾶ ᾶῖᾶᾶᾶᾶᾶ ὄῖ /etc/ipf.rules.
- Ἀᾶᾶᾶᾶᾶᾶᾶ ὄῖ IPFILTER ὄᾶ scripts ᾶεᾶῖᾶὄç ὄῖᾶ ὄὄὄᾶᾶᾶᾶᾶ, ᾶῖᾶὄῖᾶᾶᾶ ὄçῖ ἔᾶὄᾶᾶᾶᾶᾶ ᾶῖᾶὄç ipfilter_enable="NO" (ᾶῖᾶᾶᾶᾶᾶ ᾶεᾶ ὄçῖ ᾶῖᾶᾶᾶᾶᾶᾶᾶ ὄçῖ) ὄᾶῖ ᾶῖ ᾶῖᾶ /etc/rc.conf.

ᾶῖᾶὄῖᾶᾶ ῖᾶ ῖᾶ script ὑᾶᾶ ὄῖ δᾶῖᾶᾶᾶᾶ ὄᾶῖ ἔᾶὄῖᾶῖᾶ ᾶεᾶῖᾶὄç /usr/local/etc/rc.d/. Ὁῖ script εᾶ ᾶῖᾶᾶᾶ ἰᾶ ῖᾶᾶ ῖᾶ ᾶῖᾶᾶᾶᾶ ὑῖᾶᾶ, ὑᾶᾶ ἰpf.loadrules.sh. Ç ᾶᾶῖᾶᾶᾶ .sh ᾶῖᾶᾶ ὄᾶᾶᾶᾶᾶᾶᾶ.

```
#!/bin/sh
sh /etc/ipf.rules.script
```

ῖᾶ ῖᾶᾶᾶᾶ ὄᾶ ᾶὄὄ ὄῖ ᾶῖ ᾶῖᾶ, εᾶ ᾶῖᾶᾶᾶ ἰᾶ ᾶᾶὄῖᾶᾶᾶ ᾶῖᾶᾶᾶᾶ, ᾶᾶᾶᾶᾶ ἔᾶε ᾶεὄῖᾶᾶᾶ ᾶεᾶ ὄῖᾶ ᾶῖᾶᾶᾶᾶ root.

```
# chmod 700 /usr/local/etc/rc.d/ipf.loadrules.sh
```

ῖᾶ ἔᾶῖᾶᾶᾶ ὄῖᾶ IPF εᾶ ὄῖᾶᾶᾶᾶᾶᾶ ᾶῖᾶᾶ ἔᾶὄᾶ ὄçῖ ᾶεᾶῖᾶὄç ὄῖᾶ ὄὄὄᾶᾶᾶᾶᾶ ὄᾶᾶ.

30.5.10 Ὁῖ ὄῖᾶῖᾶ ἔᾶῖᾶᾶᾶ ὄῖᾶ IPF

ῖᾶ “ὄῖᾶῖᾶ ἔᾶῖᾶᾶᾶ” ὄῖᾶ IPF, ἰῖᾶῖᾶᾶ ἰεᾶ ἰῖᾶᾶ ἔᾶῖᾶᾶᾶ ᾶῖᾶ ῖᾶ ῖᾶᾶᾶᾶ ᾶεᾶ ἰᾶ ᾶᾶὄῖᾶᾶᾶᾶ ᾶ ἰᾶ ᾶᾶῖᾶᾶᾶᾶᾶᾶ ᾶᾶῖᾶᾶ ἰᾶ ὄεὄ ὄεῖᾶᾶ ᾶῖᾶ ᾶῖᾶῖᾶ ῖᾶᾶᾶ ὄᾶ ᾶὄὄ. Ç ᾶεᾶᾶᾶ ἔᾶὄᾶῖᾶὄᾶὄç ᾶῖὄᾶᾶᾶᾶ ᾶᾶῖᾶᾶᾶ ἰᾶὄᾶῖᾶ ὄᾶῖᾶᾶὄᾶᾶ ᾶᾶᾶᾶᾶ ἰεᾶ ὄᾶῖᾶᾶᾶ. Ὁῖ ὄῖᾶῖᾶ ἔᾶῖᾶᾶᾶ ὄῖᾶ firewall ᾶᾶᾶᾶᾶᾶᾶᾶᾶ ὄῖᾶ ὄᾶ ᾶᾶῖᾶᾶ ᾶῖᾶ ῖᾶᾶᾶᾶ ᾶᾶ ὄῖ Internet, ὑὄῖ ἔᾶε ὄᾶ ᾶᾶῖᾶᾶ ᾶῖᾶ ᾶᾶῖᾶᾶᾶᾶ ᾶᾶ ὄῖ ὄῖὄὄᾶᾶ ἰᾶ ᾶᾶῖᾶὄç ὄᾶ ᾶὄὄ. ἔῖᾶᾶ ὄᾶçᾶᾶᾶᾶ TCP/IP (ᾶ.ᾶ. telnet, www,

mail, e.e.d.) εάεινβαάοάε άδϋ οί δñòòüèïèèï éάé õçí δñííñéάεP (privileged) εýñά δíò ÷ñçóεííðíεάβ áεά íά äÝ ÷άóάé áéóðíáóά áíððçñÝðççò. Óά δάéÝóά δíò δñííñβáííóάé áéά íéά óðāēāēñéíÝíç ððçñάóβά, íāééíýí áδϋ õç áéáýèðíóç áóáðçñβáð ÷ñçóεííðíεáð íéά íç-δñííñéάεP εýñά éάé éáóáεPáíííí óðç óðāēāēñéíÝíç εýñά ððçñάóβáð óóíí δñííñéóíϋ. ¼éáð íé δάñáðΰíϋ δάñΰíáóñíε (εýñάð éάé áéáðéýíóáéò) íðíííýí íά ÷ñçóεííðíεçéíýí ùò éñéóðñéά áðééíāPð áéά õçí áçíéíòñāβά éάíúíϋ δíò áðéóñÝðíí P áíðíāβáéííí õçí δñúóááóç óά ððçñάóβáð.

Óí IPF āñΰóðçéā āñ ÷ééΰ ÷ñçóεííðíεáð íéά εíāéεP áðāíāñāáóβáð éάíúíϋ δíò óýðíò “í ðāéāóðāβíð éάíúíáð δíò óáéñéΰāé, āβíáé í íééçðPð” éάé ÷ñçóεííðíεíýóā íúíí éάíúíáð stateless. Íā õçí δΰñíāí δíò ÷ñúííò, óí IPF áíéó ÷ýèçéā íā õçí áðééíāP “quick” éάé íā äðíáóüðççóá áðíεPéáðóçð éάóΰóóáóçð íÝóϋ õçð áðééíāPð “keep state”. Íā óíí ðñúðí áóðϋ, áéóóā ÷ñííβóóçéā āñāíáóééΰ ç εíāéεP áðāíāñāáóβáð ðϋí éάíúíϋ.

Íé íāçāβáð δíò δāñéÝ ÷ííóáé óā áóðP õçí áíúðççóá āáóβáéííóáé óðç ÷ñPóç éάíúíϋ δíò δāñéÝ ÷ííí õçí áðééíāPð “quick” éάé õçí áðééíāPð “keep state” áéά õç áéάðñçóç õçð éάóΰóóáóçð. ÁðÝð āβíáé éάé íé āáóééÝð éāéóíòñāβáð áéά õçí éùāééíðíβççð δíò óðíϋéíò éάíúíϋ áíúð inclusive firewall.

Δñíāéāíðíβçç: ¼óáí áíòéáýáðā íā ðíòð éάíúíáð ðíò firewall, éā δñÝðáé íā áβóðā ðíεý ðñíóáéóééííβ. Áí āΰéáðā éáíéáóíÝíáð ñòéíβóáéò, íðíñāβ íā ééāéāüéāβóá Ýíϋ áδϋ óíí áíòðçñάðçðP óáó. Áéά íā áβóðā áóóāéāβð, āβíáé δñíóéíϋðāñí íā éΰíáðā óéò āñ ÷ééÝð óáð ñòéíβóáéò áδϋ õçí ðíðééP éííóüéā, δάñΰ íÝóϋ áðíāéñóóíÝíçð óýíāáóçð (ð.÷. íÝóϋ ssh).

30.5.11 Óóíóáéðééϋ Éáíúíϋ

Óí óóíóáéðééϋ ðϋí éάíúíϋ δíò δāñíðóéΰáéííā āāP, Ý ÷áé áðéíðíεçéāβ þóðā íā áðāééííβáéé õç óýā ÷ñíç stateful ðéíðíβççð éάé õç εíāéεP ðíò óýðíò “í ðñþíð éάíúíáð δíò óáéñéΰāé āβíáé éάé í íééçðPð”. Áéά õçí δāñéāñāðP ðíò δāééϋðāñíò ðñúðíò éāéóíòñāβáð, áéāáΰóóá õç óāéβāā manual ðíò ipf(8).

Í ÷āñāéðñāð # ÷ñçóεííðíεáβóáé áéά íā áðéóçíΰíáé õçí āñ ÷P áíúð ó ÷íεβíò, éάé íðíñāβ íā áíóáíβáéáóé óóí óÝéíò íéáð āñāíPð éάíúíϋ P óóç áéεP ðíò āñāíP. Íé éārÝð āñāíÝð āāñíýíóáé.

Íé éάíúíáð δāñéÝ ÷ííí éÝíáéð-ééāéáéΰ. Íé éÝíáéð áóðÝð éā δñÝðáé íā éùāééíðíεçéíýí íā óðāēāēñéíÝíç óāéñΰ áδϋ óá āñéóðāñΰ δñíð óá āāíéΰ õçð āñāíPð. Íé éÝíáéð-ééāéáéΰ óáβíííóáé δāñāéΰðϋ íā Ýíóííā āñΰíāóá. ÍāñééÝð éÝíáéð Ý ÷ííí ððí-áðééíāÝð íé íðíβáð íðíñāβ íā āβíáé áðβóçð éÝíáéð-ééāéáéΰ éάé íā δāñééāíāΰíííí áðβóçð δāñéóóüðāñāð ððí-áðééíāÝð. Éΰéā íéά áδϋ óéò áðééāóáéβāáð óóí δάñΰāāééíāí δíò óáβííóáé δāñāéΰðϋ Ý ÷áé íéά éāóáéβāā íā Ýíóííā āñΰíāóá ç íðíβā áðāíçāāβ ðí δāñéā ÷ííāíí õçð.

ACTION IN-OUT OPTIONS SELECTION STATEFUL PROTO SRC_ADDR, DST_ADDR OBJECT PORT_NUM TCP_FLAG STATEFUL

ACTION = block | pass

IN-OUT = in | out

OPTIONS = log | quick | on interface-name

SELECTION = proto value | source/destination IP | port = number | flags flag-value

PROTO = tcp/udp | udp | tcp | icmp

SRC_ADD, DST_ADDR = all | from object to object

OBJECT = IP address | any

PORT_NUM = port number

TCP_FLAG = S

STATEFUL = keep state

30.5.11.1 ACTION

Ç áñÝñááέα (action) áαβ÷íáε óε δñÝðáε íá áβíáε íá òι ðáεÝòι áι óáέñεΰæáε íá òιí εáíúíá òιò òβεòñιò. Èΰεά εáíúíáð δñÝðáε íá áεάεÝðáε íέα áñÝñááέα. Íε áñÝñááεάð ðιò áíááíùñβαίíðáε, òáβñíðáε ðáñáεΰòù:

Òι block áαβ÷íáε ùεé òι ðáεÝòι εά δñÝðáε íá áðιññεòεάβ áι óáέñεΰæáε íá òεð ðáñáíÝðñιòð áðεεíñáð òιò εáíúíá.

Òι pass áαβ÷íáε ùεé òι ðáεÝòι εά δñÝðáε íá áñÝεεά áðu òι firewall, áι óáέñεΰæáε íá òεð ðáñáíÝðñιòð áðεεíñáð òιò εáíúíá.

30.5.11.2 IN-OUT

Èΰεά εáíúíáð òιò òβεòñιò δñÝðáε òðι÷ñáυðεέΰ íá áεάðεñείβæáε íá óáòβíáέα áι áíáóÝñáðáε óðçí áβòιáñ P òçí Ýñáι ðáεÝòùι. Ç áðuíáιç εΰίç-εεάεάβ δñÝðáε íá áβíáε in P out εάε áι ááι òðΰñ÷áε, ι εáíúíáð εά áðιòý÷áε εάóΰ òι óðíðáεðεευ Ψεά÷ι.

Òι in óçíáβíáε ùεé ι εáíúíáð εά áòáñιòóáβ óá Ýíá áεóáñ÷ύáñ ðáεÝòι òι ιðιβι ιύεéð εβòεçεά óðç áεάðáòP ðιò óðíáÝáðáε íá òι Άεάáβέðòι.

Òι out óçíáβíáε ùεé ι εáíúíáð εά áòáñιòóáβ óá Ýíá ðáεÝòι ðιò δñιññβæáðáε áεά Ýñáι ιΨóυ òçð áεάðáòP ðιò óðíáÝáðáε íá òι Άεάáβέðòι.

30.5.11.3 OPTIONS

Óçíáβύòç: Íε ðáñáεΰòù áðεεíñáÝò δñÝðáε íá ÷ñçóειíðιέçειγί íá òç óáέñΰ ðιò òáβñíðáε áαβ.

Òι log áαβ÷íáε ùεé ç áðεεáðáεβáá òιò ðáεÝòιò εά áñáðáβ óòι áñ÷áβι εάóáñáòP ðιò ípl (ùðuð ðáñεáñΰòáðáε óðçí áíυòçóá LOGGING ðιò áεíεíòεάβ) áι íε ðáñΰíáðñιέ òçð áðεεíñáð ðáέñεΰæáε òι ðáεÝòι.

To quick áαβ÷íáε ùεé áι íε ðáñΰíáðñιέ òçð áðεεíñáð ðáέñεΰæáε òι ðáεÝòι, ι óòáεáεñεíΨíð εáíúíáð εά áβíáε εάε ι òáεáðáβιð εáíúíáð ðιò εά áεά÷εάβ. Ç áðεεíñáP áðòP áβíáε òðι÷ñáυðεέP áεά òç óýá÷ñιç εíáεέP áðáíñááóβáð ðáεÝòùι.

Òι on áαβ÷íáε òι úñíá òçð áεάðáòP ðιò εά áíóυíáðùεάβ óóεð ðáñáíÝðñιòð áðεεíñáð. Óá ιñυíáðá òυí áεάðáòβι òáβñíðáε ùðáι áεðáεάβðáε ç áíðιεP ifconfig(8). ×ñçóειíðιέçíðáð òçí áðεεíñáP áðòP, ι εáíúíáð εά áεά÷εάβ ιυíι áι òι ðáεÝòι áεÝñ÷áðáε ιΨóυ òçð óòáεáεñεíΨίç ðáεáðáòP εάε ðñιð òç óòáεáεñεíΨίç εάóáýεòιóç (áεóáñ÷ύáíá/áíáñ÷ύáíá). Ç áðεεíñáP áðòP áβíáε òðι÷ñáυðεέP áεά òçí óýá÷ñιç εíáεέP áðáíñááóβáð òυí εáíúíι.

¼ðáι áβíáðáε εáóáñáòP áñυð ðáεÝòιò, íε áðεεáðáεβááð áñΰòιðáε óðçí ðáðáι-óðóεáòP εáóáñáòP ðáεÝòιò IPL. Íáðΰ òçí áíðιεP log, ιðιñιγί íá ÷ñçóειíðιέçειγί íε ðáñáεΰòù ðáñΰíáðñιέ (íá òç óáέñΰ ðιò òáβñíðáε):

Òι body áαβ÷íáε ùεé εά áβíáε εáóáñáòP òυí δñðòυí 128 bytes òυí ðáñεá÷ñιγί òιò ðáεÝòιò, ðιò áñβóειíðáε áιΨóυð íáðΰ òçí áðεεáðáεβáá.

Ç áðεεíñáP first óðιβóðáðáε íá ÷ñçóειíðιέçεáβ áι ç áðεεíñáP log ÷ñçóειíðιέçεáβ óá óðíáðáóιυ íá òçí keep state. Íá òιí ðñυðι áðóυ áβíáðáε εáóáñáòP ιυíι òιò δñðòιò ðáεÝòιò (íá òι ιðιβι íáέβίçóá ç áðεείεíñáβ), εάε ù÷ε ùεέυι òυí òðιεíβðυí óá ιðιβá óáέñεΰæáε òι òçí ðεçñιòñíβá “keep state”.

30.5.11.4 SELECTION

Ίε ε΄Υίαεò εεάεαεΰ ðιò ðáñεáñΰοιιόαε óα áòòP ðçί áιιιòçòá, ÷ñçóειιðιείγίόαε áεá ίá ðáñεáñΰοιιόι ðιεáò εáειιòçòáò ðιò ðáε΄Υιò εá áεáñáòιçείγί áεá ίá εáειιñεóòáß áί óáεñεΰαε P ù÷ε ίá ðιòò εáιιιáò. Ίεá ε΄Υίç-εεάεáß ιñβαεé ðι εáιιόνεει ε΄Υίá εáε áεεειòεáβòáε áðu ΰεεáò ε΄Υίáεò ðιò ιñβαειòι óεò áεñεááβò áðεεια΄Υò. Ðñ΄Υðáε ðΰιόιòá ίá áðεε΄Υááòáε ίεá áðu áòò΄Υò óεò ε΄Υίáεò. Ðáñ΄Υ÷ιιόáε ίε ðáñáεΰòι εáειιòçòáò ááιεεP ÷ñPòçò ίε ιðiβáò ðñ΄Υðáε ίá ÷ñçóειιðιεéçείγί ίá áòòP ðç óáεñΰ:

30.5.11.5 PROTO

Οι proto áβίáε ç ááóεεP ε΄Υίç, εáε ðñ΄Υðáε ίá áñΰòáòáε ίáαβ ίá εΰðιεá áιòβòðιε÷ç óειP áεá ðáñáεò΄Υñ ððεειαP. Ç óειP áðεòñ΄Υðáε ðι óáβñεáóίá ίá ΄Υίá óòáεáεñεί΄Υι ðñòòιεεει. Áβίáε ððι÷ñáòεει ίá ÷ñçóειιðιεéçεáß áεá ίá εáεòιòñáß ç óγá÷ñιç ειαεεP áðáιáñááóáò ðι εáιιιáò.

Οá ιιιιáòá ðñòòιεεεει ðιò áíááιñβαειιόáε εáε ιðiñιγί ίá ÷ñçóειιðιεéçείγί, áβίáε óá tcp/udp | udp | tcp | icmp P ιðiεááPðιòá ΰεεá áιòáιβαειιόáε óòι /etc/protocols. Ίðιñáβòá ίá ÷ñçóειιðιεPóáòá ðι áεáεει ιιñá tcp/udp ðι ιðiβι óáεñεΰαε áβòá ίá ðáε΄Υιò TCP áβòá ίá UDP. Ç áεáεεP áòòP ιιñáóá ðñιóò΄Υεçεá þòá ίá áðιòáγáιιόáε áεðειβ, áεεΰ εáòΰ óá ΰεεá ιιιιεε, εáιιιáò.

30.5.11.6 SRC_ADDR/DST_ADDR

Ç ε΄Υίç all áβίáε ιòóεáóòεεΰ óðιþιòιç ίá ðçί ðñΰóç “from any to any” ÷ññò ίá ððΰñ÷ιòι ΰεεáò ðáñΰιáòñιε áεá ðι óáβñεáóίá.

¼òáι ÷ñçóειιðιεáβòáε ðι from src to dst, ίε ε΄Υίáεò from εáε to áçεþñιòι áεáðεγίόáεò IP ðιò εá ÷ñçóειιðιεéçείγί áεá ðι óáβñεáóίá. Ίε εáιιιáò ðñ΄Υðáε ίá εáειñβαειòι óεò ðáñáι΄Υòñιòò ðιòι ðçò áòáòçñβáò ðιòι εáε ðιò ðñιιñεóιιγ. Ç ε΄Υίç any ΄Υ÷áε ðçί áεáεεP εáειιòçòá ίá óáεñεΰαε ίá ιðiεááPðιòá áεáγεòιòç IP. Ðáñáááβáιáòá ÷ñPòçò: from any to any P from 0.0.0.0/0 to any P from any to 0.0.0.0/0 P from 0.0.0.0 to any P from any to 0.0.0.0.

Ááι ððΰñ÷áε ðñòðιò ίá ðáñεáñáοιγί ðáñει÷΄Υò IP áεáðεγίόáι ðιò ááι ιðiñιγί ίá áεòñáóοιγί áγεεá ίá ðç ιñòP áñεειþι ÷ññεóι΄Υιι ίá óáεáβáò / ιΰóεáò ððιαεεòγιò. Ίðιñáβòá ίá ÷ñçóειιðιεPóáòá ðι áιçεçòεει ðñιáñáιá net-mgmt / ipcalc áεá áεáòειιεòιòç óáò óοιòò ððιεεáóιιγò. Ááβòá ðçί áεéòòáεP ðιðιεáòá ðιò ðñιáñΰιáòιò áεá ðáñεóòιòðáñáò ðεçñιòιñβáò: <http://jodies.de/ipcalc>.

30.5.11.7 PORT

Οι óáβñεáóίá ίá εΰðιεá óòáεáεñεί΄Υίç εγñá áòáòçñβáò P/εáε ðñιιñεóιιγ (áι ððΰñ÷áε) áòáñιαεáòáε ιιιι óá ðáε΄Υóá TCP εáε UDP. Έáòΰ ðçί áçιειòñáβá óòáεñβòáιι ίá εγñáò, ιðiñáβòá áβòá ίá ÷ñçóειιðιεPóáòá ðιι áñεειι ðçò εγñáò, áβòá ðι ιιñá ðçò áιòβòðιε÷çò ððçñáòβáò áðu ðι áñ÷áβι /etc/services. ¼òáι ç εγñá áιòáιβαεáòáε ðò ðιþιá ðιò áιóεεáει΄Υιιò from, ðι óáβñεáóίá εá áβίáε ίá ðçί εγñá ðçò áòáòçñβáò. ¼òáι áιòáιβαεáòáε ðò ðιþιá ðιò áιóεεáει΄Υιιò to, ðι óáβñεáóίá εá áβίáε ίá ðç εγñá ðñιιñεóιιγ. Áεá ίá εáεóιòñááß ç óγá÷ñιç ειαεεP óáεñεΰοιáòιò εáιιιáò, εá ðñ΄Υðáε ιðuóáPðιòá ίá ððΰñ÷áε ç áðεειαP εγñáò óòι áιóεεáβáιιι to. Ðáñΰááεáιá ÷ñPòçò: from any to any port = 80

Ίε óòáεñβòáεò ðιò áíáó΄Υñιιόáε óá ίεá ιιιι εγñá, ιðiñιγί ίá áβιòι ίá ðιεεγýò áεáοιñáðεεγýò ðñιðιòò, ÷ñçóειιðιεþιόáò áεáοιñáðεεγýò óáεáòò΄Υò óγáεñεóçò. Áβίáε áðβòçò áðιáòιι ίá εáειιñεóοιγί ιειιεεçñáò ðáñει÷΄Υò áðu εγñáò.

port "=" | "!=" | "<" | ">" | "<=" | ">=" | "eq" | "ne" | "lt" | "gt" | "le" | "ge".

Áεá ίá εáειñβòáòá ðáñει÷΄Υò εòñþι, ÷ñçóειιðιεPóáòá port "<>" | "><"

Δημόσιος: Ιαοΰ οέο δαηάιΥοηίοο αέα οι οάβηέαοία οço αόαοçηβáo εέα οίο δηήέοιί, ιε δαηάεΰοο αγί δαηΰιαδονίε αβίαε οδι÷ηαυοέεΰο αέα ία εάεοίοναάβ ç ογá÷ηίίç εϊάεεβ άδαίηαάοβáo ουί εάιυίυι.

30.5.11.8 TCP_FLAG

Όά flags αβίαε άίηαΰ ιυήι οοί οέεοηΰηέοία οίο δηυοίευεέιο TCP. Όι εΰεά ηΰΰία άίοέδηιούδαγáε Ύία δέεάιυ flag οι αέα οι ιθίβι αβίαόάε άίβ÷ίάοοç οοçί άδέεάοεβάα οίο δάεΎοίο TCP.

Ç ογá÷ηίίç εϊάεεβ άδαίηαάοβáo ουί εάιυίυι, ÷ηçοέιιθίεάβ οçί δαηΰιαδονί flags s αέα οçί άίάαηηέοç οço Ύίαηίçò ιέα οοίάηβáo tcp.

30.5.11.9 STATEFUL

Όά Ύία εάιυία οίο άδεοηΎδαε (pass) οι δΎηάοία ουί δάεΎοι, ç άδεείηβ keep state αάβ÷ίάε υόε εά δηΎδαε ία άίηαηίεάβόάε ç εάεοίοναάβ stateful filtering υόάι οι δάεΎοι οάεηεΰαε ία οά εηέοηεά άδεείηβ.

Όçίαβύοç: Ç άδεείηβ αόοβ αβίαε οδι÷ηαυοέεεβ αέα οç εάεοίοναάβά οço ογá÷ηίίçο εϊάεεβ άδαίηαάοβáo εάιυίυι.

30.5.12 Οέεοηΰηέοία ια Άέαοηηέοç οço Έάοΰοόάοçò (stateful)

Όι stateful οέεοηΰηέοία, άίοείαδουδβαεε οçί εβίçοç οίο αέεογίο υò ιεάο αέδεβδ εάοάγεοίοçò άίοάεεάβ δάεΎοι οά ιθίβά αçίείοναίγί ιέα οοίάηβά. Ύόάι άίηαηίεçεάβ, ç εέαοηηέοç οço εάοΰοόάοçò (keep-state) αçίείοναάβ αοίάιέεΰ αουοάηεεγύο εάιυίάο αέα εΰεά δάεΎοι οι ιθίβι άίοάεεΰοάοάε εάοΰ οç αεΰηεάεά αοοβδ οço οοίάηβáo. ÷άε άδβόçò οç αοίάουοçοά ία αεάηαοίβόάε άί αεείοεγίόάε ιε Ύαεοηίε εάιυίάο άίοάεεάβδ ιçίοιΰοι ιάοάγυ οίο αθιόοίεΎά εέα οίο δαηάεβδδç. Ιθίεάβδθιόα δάεΎοά αάι οάεηεΰαείο ια οι δηυοοοδι αόοβδ οço άδεείείυιβáo, αθίηηβδθιόάε υò οάγόεεά.

Ç εέαοηηέοç οço εάοΰοόάοçò άδεοηΎδαε άδβόçò ία δαηΰοίοι οά δάεΎοά ICMP θίο ο÷αδβειίόάε ια ιέα οοίάηβά TCP β UDP. θοέ, άί εçοέγίγί δάεΎοά ICMP ογθίο 3 code 4 υò άδΰίόçοç εάοΰ οç αεΰηεάεά οço άδβόεάοçò οάο οά ιεά εόοιόάεβάα, (ç ιθίβά άδεοηΎδαόάε άδυ οίι άίοβόοίε÷ι εάιυία άίηα÷ηΎιυι), εά οίοδ άδεοηαδάβ ç αβοίηο. Ιθίεάβδθιόα δάεΎοι αέα οι ιθίβι οι IPF αβίαε οβαιονί υόε δηυεάεόάε αέα οιβία ιεάο άίηαβδ οοίάηβáo, εά δαηΰοάε αετια εέα άί αβίαε αεάοιηάοεευ δηυοιεεει.

Άοου θίο οοίάαβίαε αβίαε οι δαηάεΰοο:

Όά δάεΎοά θίο δηηηβειίόάε ία άίΎεείοι ιΎου οço αεάδαοβδ θίο οοίάΎάοάε οοι Internet, αεΎα÷ηίόάε ηη÷εεΰ ογίοιυία ια οι αοίάιέευ δβίαεά εάοάοοΰοάυι. Άί οι δάεΎοι οάεηεΰαε ια οι αδυιηι θίο άίάιΎίάοάε οά ιεά άίηαβδ οοίάηβά, άίΎη÷άοάε άδυ οι firewall εέα οάοου÷ηίία άίçίηηβίάοάε ç εάοΰοόάοç οço οοάεαεηείΎίçò οοίάηβáo οοι δαηάδΰιυ αοίάιέευ δβίαεά. Όά οδυείεδα δάεΎοά (θίο αάι οάεηεΰαείο ια εΰθιέα οοίάηβά οά άίΎεείç) αεΎα÷ηίόάε ογίοιυία ια οι ογίηει εάιυίυι αέα οά άίηα÷υιηά δάεΎοά.

Όά δάεΎοά θίο Ύη÷ηίόάε άδυ οç αεάδαοβδ θίο αβίαε οοίάηβίγί ια οι Internet, αεΎα÷ηίόάε ηη÷εεΰ ιΎου οίο αοίάιέεγυ δβίαεά εάοάοοΰοάυι. Άί οι δάεΎοι οάεηεΰαε ια οι αδυιηι θίο άίάιΎίάοάε οά ιεά άίηαβδ οοίάηβά, άίΎη÷άοάε άδυ οι firewall εέα οάοου÷ηίία άίçίηηβίάοάε ç εάοΰοόάοç οço οοάεαεηείΎίçò οοίάηβáo οοι δαηάδΰιυ δβίαεά. Όά οδυείεδα

θαέΥόά (θιϑ άαι όαένηέΰαιϑι ία εΰθιέα όοίάανβα όα άιΰέετς) άεΰά÷ιίόάε όγίϑιύία ία όι όγίηει έαίϑιύι άέα όά άέόάñ÷ύιάρά θαέΥόά.

¼όάι ς άθεέιειϑιύιβα ϑειέεϑñùεάβ, άέαανΰόάόε άδϑι όη άοίαιέεϑι θβίάέα έαόάόόΰόάι.

Όι stateful όέέονΰνεόία άθεόνΰθαέ ία άόόεΰόιϑία όϑι θñιϑι÷P ίαό όόϑι άδϑιαι÷P P άδϑιñνεϑς όϑι ίΰϑι όοίάΰόάι. Άί άθεόñάθάβ ίέα ίΰά όοίάανβα, υέα όά όδϑιειέδα θαέΥόά όϑδ έα άθεόνΰθιϑίαέ άόδϑιάρά, άηθ όδ÷ύι ϑάγόέα θαέΥόά έα άθιññβθϑιϑίαέ άθβόϑδ άόδϑιάρά. Όι stateful όέέονΰνεόία άέαέΰόάε ίέα όαένΰ άδϑι θñι÷ύñϑιΰίάδ έέαϑιόϑόδδ άέαñáγίϑόϑδ όϑι θαέΥόϑι, ία άοίάόϑόϑά ία άιγίάράέ όα θϑεέΰδ άέαόιñάόέέΰδ ίαεϑιαιϑδ θιϑ ÷ñϑόειñθιέιγί ίέ άθεόέέΰίñίέ.

30.5.13 θάνΰάέαιά όόιϑιέϑ όάιϑιύι άέα ΰία Inclusive Firewall

Όι θανάέΰδϑι όγίηει έαίϑιύι άβίάόάε ùδ θάνΰάέαιά άέα ία όεέΰίάόά ΰία έέαάβόñά άόόάέΰδ inclusive firewall. ία inclusive firewall άθεόνΰθαέ όι θΰñάόία ίϑιϑι όϑϑñάόεϑι θιϑ όαένηέΰαιϑι ία όιϑδ έαίϑιάρδ θιϑ ΰ÷άέ άέα άθϑιαι÷P θαέΥόϑι, έέα άθιññβθδάέ υέα όά όδϑιειέδα. Όά firewalls θιϑ θñιϑόάόáγίϑι ΰέα ίϑ÷άιϑιάρά (όά ιθιβα έαέιγίόάέ έέα “network firewalls”) έα θñΰθαέ ία άέαέΰόιϑι όιϑέΰ÷έόϑι άγί έέαάόΰΰδ. ϑ ίέα έέαάθάθP όοίάΰάόάέ ία όι όιθέέϑι άβέδϑι (LAN) όι ιθιβα έαϑñάβόάέ ΰιθέόϑι, έέα ς ΰέεϑ ία όι άϑιϑόει Internet. Άίάέέάέόέέΰ, ΰία firewall ιθιñάβ ία θñιϑόάόáγáέ ίϑιϑι όι όγόϑιάρά όοι ιθιβα έεόάέάβόάέ—άδϑι έέαάβόάέ “host based firewall” έέα άβίάέ έαόΰέεϑει έέαέάβόñά άέα άιϑϑñάόϑόΰδ θιϑ έέαόιϑñαιγί όά ίϑ ΰιθέόόά άβέδϑά.

¼έα όά όόόδϑιάρά όγθιϑ UNIX, όοιθάνέέαιάáñΰίϑ έέα όιϑ FreeBSD, ΰ÷ιϑι ό÷άέαόόάβ ία ÷ñϑόειñθιέιγί όϑι έέαάθάθP 100 έέα όϑι IP έέαγέϑιϑς 127.0.0.1 άέα άόϑόñέέP άθεέιειϑιύι ίΰόά όοι βαέι όι έέαόιϑñέέϑι όγόϑιάρά. Όι firewall θñΰθαέ ία θάñέΰ÷άέ έαίϑιάρδ θιϑ ία άθεόνΰθιϑι όϑι έέαγέñϑ έέα ÷ύñβδ θάñειñέόιγδ έβίϑόϑ όϑι έέαέεϑι άόθϑι άόϑόñέέϑι θαέΥόϑι.

Ίέ έαίϑιάρδ θιϑ άñόόεϑαιϑιϑι όϑι θñϑόάάόϑ θñιϑ όι Internet, ιñβαιϑίαέ όόϑι έέαάθάθP όιϑ έέέόγιϑ θιϑ όοίáΰάόάέ όá άόδϑι. Ίέ έαίϑιάρδ άόδϑιβ άεΰá÷ιϑι όϑι άέόάñ÷ύιάρϑ υόι έέα όϑι άίññ÷ύιάρϑ έβίϑόϑ όοι Internet. ϑ έέαάθάθP άόθP ιθιñάβ ία άβίάέ ς tun0 θιϑ ÷ñϑόειñθιέάβόάέ όοι PPP ÷ñβόϑ, P άεϑιάρ έέα ς εΰñόά έέέόγιϑ θιϑ όοίáΰάόάέ όá ΰία DSL router P modem.

Όά θάñβθδϑόϑ θιϑ ίέα P θάñέόϑϑάñάδ εΰñόδδ έέέόγιϑ όοίáΰιϑόάέ όá άόϑόñέέΰ έαεϑόέέΰ άβέδϑά θβόϑ άδϑι όι firewall, έα θñΰθαέ ία όθΰñ÷ιϑι ίέ άίθβόϑιέ÷ϑ έαίϑιάρδ θιϑ ία άθεόνΰθιϑι όϑι έέαγέñϑ έέαέβίϑόϑ όϑι θαέΥόϑι άίΰίάρά όόέδ έέαάθάθΰδ άόδΰδ P/έαέ όοι Internet.

Ίέ έαίϑιάρδ θñΰθαέ ία ιñάιϑñιϑόάέ όá θñάέδ έγñέάδ άίϑϑόϑάδ: άñ÷έέΰ υέαϑ ίέ έέαάθάθΰδ όόέδ ιθιβαδ άθεόνΰθάόάέ ς έέαγέñϑ έέαέβίϑόϑ άάñΰΰιϑι, ΰθαέόά ς έέαάθάθP άδϑι όϑι ιθιβα άίΰñ÷ιϑόάέ όά θαέΥόά θñιϑ όι άϑιϑόει άβέδϑι (Internet) έέα όΰεϑδ ς έέαάθάθP άδϑι όϑι ιθιβα έαίáΰιϑόάέ θαέΥόά άδϑι όι Internet.

Όά εΰέα ίέα άδϑι όέδ άίϑϑόϑάδ όϑι έέαάθάθϑι θιϑ όοίáΰιϑόάέ όοι Internet, θñΰθαέ ία όιθιέάόιγίόάέ θñϑιέ ίέ έαίϑιάρδ θιϑ όαένηέΰαιϑι όδ÷ιϑόñά ία όϑι άίθβόϑιέ÷ϑ έβίϑόϑ. Ί όάέάόάβθι έαίϑιάρδ όϑδ άίϑϑόϑάδ έα θñΰθαέ ία άθιññβθδάέ έέα ία έαόάñΰόάε υέα όά θαέΥόά όϑδ όδάέάñειΰίϑδ έέαάθάθPδ/έαόáγέϑιϑόϑδ.

ϑ άίϑϑόϑά όϑι Άίññ÷ñΰιϑι (Outbound) όοι άεϑεϑιϑει όγίηει έαίϑιύι, θάñέΰ÷άέ ίϑι έαίϑιάρδ όγθιϑ pass ίέ ιθιβιέ άθεόνΰθιϑι (ίΰόϑ έαόΰέεϑειϑι όειϑι όόέδ θάñáΰϑιϑδ όιϑδ) όá όόάέάñειΰίάρδ όϑϑñάόβάδ ία άθιέόPϑιϑι θñϑόάάόϑ όοι Internet. ¼εϑι ίέ έαίϑιάρδ έέαέΰόιϑι όέδ άθεέιαΰδ quick, on, proto, port έέα keep state. Ίέ έαίϑιάρδ proto tcp θάñέέαιáΰιϑι όϑι άθεέιαP flag ϑόδά ία άίááιϑñβαιϑι όϑι άβόϑόϑ ΰίáñϑδ όϑδ όοίáññβάδ έέα ία άίáñαιθιέιγί όϑ έέαόιϑñάβά έέαόPñϑόϑδ όϑδ έαόΰόόάόϑδ (stateful).

Όόϑι άίϑϑόϑά όϑι άέόάñ÷ύιάρϑι θαέΥόϑι (Inbound) θιϑ όάβίάράέ θάñάέΰδϑι, θñϑιέ άιόάιβαιϑίαέ ίέ έαίϑιάρδ θιϑ ÷ñϑόειñθιέιγίόάέ άέα όϑι άδϑιñνεϑς όϑι άίáθέεγίϑόϑι θαέΥόϑι. Άόδϑι άβίάράέ άέα άγί έέαόιñάόέέγδ εϑιαιϑδ. Ί θñϑιϑ άβίάέ υέε όά έαεϑιαιϑέα θαέΥόά ιθιñάβ άί ίΰñάέ ία όαένηέΰαιϑι ία εΰθιέα ÷άñάέδϑñέόέέΰ όϑδ ΰάέθñϑδ έβίϑόϑδ. Όά θαέΥόά άόδΰ έα θñΰθαέ ία άθιññέόειγί, άίθβ ία άβιϑι άάέδΰ άδϑι εΰθιέι άδϑιαιϑ έαίϑιάρ allow. Ί άάγόñιϑ άβίάέ υέε


```

# firewall on the private network
# or from this gateway server destined for the public Internet.
#####

# Allow out access to my ISP's Domain name server.
# xxx must be the IP address of your ISP's DNS.
# Dup these lines if your ISP has more than one DNS server
# Get the IP addresses from /etc/resolv.conf file
pass out quick on dc0 proto tcp from any to xxx port = 53 flags S keep state
pass out quick on dc0 proto udp from any to xxx port = 53 keep state

# Allow out access to my ISP's DHCP server for cable or DSL networks.
# This rule is not needed for 'user ppp' type connection to the
# public Internet, so you can delete this whole group.
# Use the following rule and check log for IP address.
# Then put IP address in commented out rule & delete first rule
pass out log quick on dc0 proto udp from any to any port = 67 keep state
#pass out quick on dc0 proto udp from any to z.z.z.z port = 67 keep state

# Allow out non-secure standard www function
pass out quick on dc0 proto tcp from any to any port = 80 flags S keep state

# Allow out secure www function https over TLS SSL
pass out quick on dc0 proto tcp from any to any port = 443 flags S keep state

# Allow out send & get email function
pass out quick on dc0 proto tcp from any to any port = 110 flags S keep state
pass out quick on dc0 proto tcp from any to any port = 25 flags S keep state

# Allow out Time
pass out quick on dc0 proto tcp from any to any port = 37 flags S keep state

# Allow out nntp news
pass out quick on dc0 proto tcp from any to any port = 119 flags S keep state

# Allow out gateway & LAN users' non-secure FTP ( both passive & active modes)
# This function uses the IPNAT built in FTP proxy function coded in
# the nat rules file to make this single rule function correctly.
# If you want to use the pkg_add command to install application packages
# on your gateway system you need this rule.
pass out quick on dc0 proto tcp from any to any port = 21 flags S keep state

# Allow out ssh/sftp/scp (telnet/rlogin/FTP replacements)
# This function is using SSH (secure shell)
pass out quick on dc0 proto tcp from any to any port = 22 flags S keep state

# Allow out insecure Telnet
pass out quick on dc0 proto tcp from any to any port = 23 flags S keep state

# Allow out FreeBSD CVSup function
pass out quick on dc0 proto tcp from any to any port = 5999 flags S keep state

```

```

# Allow out ping to public Internet
pass out quick on dc0 proto icmp from any to any icmp-type 8 keep state

# Allow out whois from LAN to public Internet
pass out quick on dc0 proto tcp from any to any port = 43 flags S keep state

# Block and log only the first occurrence of everything
# else that's trying to get out.
# This rule implements the default block
block out log first quick on dc0 all

#####
# Interface facing Public Internet (Inbound Section)
# Match packets originating from the public Internet
# destined for this gateway server or the private network.
#####

# Block all inbound traffic from non-routable or reserved address spaces
block in quick on dc0 from 192.168.0.0/16 to any      #RFC 1918 private IP
block in quick on dc0 from 172.16.0.0/12 to any      #RFC 1918 private IP
block in quick on dc0 from 10.0.0.0/8 to any         #RFC 1918 private IP
block in quick on dc0 from 127.0.0.0/8 to any        #loopback
block in quick on dc0 from 0.0.0.0/8 to any          #loopback
block in quick on dc0 from 169.254.0.0/16 to any     #DHCP auto-config
block in quick on dc0 from 192.0.2.0/24 to any       #reserved for docs
block in quick on dc0 from 204.152.64.0/23 to any    #Sun cluster interconnect
block in quick on dc0 from 224.0.0.0/3 to any        #Class D & E multicast

##### Block a bunch of different nasty things. #####
# That I do not want to see in the log

# Block frags
block in quick on dc0 all with frags

# Block short tcp packets
block in quick on dc0 proto tcp all with short

# block source routed packets
block in quick on dc0 all with opt lsrr
block in quick on dc0 all with opt ssrr

# Block nmap OS fingerprint attempts
# Log first occurrence of these so I can get their IP address
block in log first quick on dc0 proto tcp from any to any flags FUP

# Block anything with special options
block in quick on dc0 all with ipopts

# Block public pings
block in quick on dc0 proto icmp all icmp-type 8

# Block ident
block in quick on dc0 proto tcp from any to any port = 113

```

```
# Block all Netbios service. 137=name, 138=datagram, 139=session
# Netbios is MS/Windows sharing services.
# Block MS/Windows hosts2 name server requests 81
block in log first quick on dc0 proto tcp/udp from any to any port = 137
block in log first quick on dc0 proto tcp/udp from any to any port = 138
block in log first quick on dc0 proto tcp/udp from any to any port = 139
block in log first quick on dc0 proto tcp/udp from any to any port = 81

# Allow traffic in from ISP's DHCP server. This rule must contain
# the IP address of your ISP's DHCP server as it's the only
# authorized source to send this packet type. Only necessary for
# cable or DSL configurations. This rule is not needed for
# 'user ppp' type connection to the public Internet.
# This is the same IP address you captured and
# used in the outbound section.
pass in quick on dc0 proto udp from z.z.z.z to any port = 68 keep state

# Allow in standard www function because I have apache server
pass in quick on dc0 proto tcp from any to any port = 80 flags S keep state

# Allow in non-secure Telnet session from public Internet
# labeled non-secure because ID/PW passed over public Internet as clear text.
# Delete this sample group if you do not have telnet server enabled.
#pass in quick on dc0 proto tcp from any to any port = 23 flags S keep state

# Allow in secure FTP, Telnet, and SCP from public Internet
# This function is using SSH (secure shell)
pass in quick on dc0 proto tcp from any to any port = 22 flags S keep state

# Block and log only first occurrence of all remaining traffic
# coming into the firewall. The logging of only the first
# occurrence avoids filling up disk with Denial of Service logs.
# This rule implements the default block.
block in log first quick on dc0 all
##### End of rules file #####
```

30.5.14 NAT

Οι NAT αβιάε αένιυίεϊ ðùì èÝíàùì *Network Address Translation* ð ìàòÛðñáóç Äéàðèýíóáùì Äéèðýìò. Äéá ùìòð ãβιάε ãñééáéùìÝñé ìá ðì Linux, ááóβæáðáé óðçí ãñ÷ð ðìò IP Masquerading. Óðçí ðñáñìáðééùòçðá ðì NAT éáé ðì IP Masquerading áβιάε ðì Βáéí ðñÛñá. Ìéá áðù ðéð ðñéÝð ãðíáðùòçðáð ðìò ðáñÝ÷: áé ç èáéðìòñáβá NAT ðìò IPF, áβιάε éáé ç ãðíáðùòçðá ìá Ý÷: ìòìá Ýíá éáéùðééù ðìðééù áβéððì (LAN) ðβòù áðù ðì firewall ðì ìðìβì ìá ìñéñÛæáðáé ìéá ìñíáééð ãçìùóéá äéáýèðíóç IP óðì Internet.

ðòð ìá áíáñùòçèáβðá äéáðβ ìá èÝéáé èÛðñéìò ìá ðì èÛíáé áððù. Ìé ISPs óðìðèùð ãðñáβáñìò ìðíáééÝð äéáðèýíóáéð óá ìç äðáéñééìýð ðáèÛðáð. Áððù ìðóéáððééÛ óçíáβιάé ùðé ç äéáýèðíóç IP ðìò ãðñáβáðáé óðì ìç÷: Ûíçíá óáð, ìðìñáβ ìá áβιάε äéáðìñáðééð èÛèá òìñÛ ðìò èÛíáðá èèðóç äéá ìá óðíáæáβðá. Äéá ðìòð ðñðóðáð DSL modem éáé router, ç äééáãð äéáýèðíóçð ðñáñìáðìðñéáβðáé èÛèá òìñÛ ðìò áíáññìðñéáβðáé ðì modem. Ç äéáýèðíóç IP ðìò óáð ãðñáβáðáé áðù ðìò ISP óáð, áβιάε áððð ìá ðçí ìðìβá óáβíáðóá ððì Internet.

Αό οδρεΎοιοιά οηνά υοέ Ύ ÷ άοά δΎίοά PC οοι οδβόε οάο, έάε ÷ ηάεΰααόοά οά υεά ούίαάοο Internet. Έάηιέέΰ, έά Ύδηάοά ίά δέοηηόοά οηί ISP οάο ÷ υηέοόου έηιάηεάοιυ ηέα έΰεά PC έάε ίά ηέαέΎοάοά δΎίοά ηάηιΎδ οοεάοηιό.

Ίά οη NAT, ÷ ηάεΰααόοά υιηί Ύία έηιάηεάοιυ ίά οηί ISP οάο. Ίδηηάβόά αδεηο ίά οοίαΎοάοά οά οΎοόάηά PC οά Ύία ηέαηηΎά P switch οοι ηδηβι έά οοίαΎοάοά ηδβόοο έάε οη FreeBSD ιο ÷ Ύίοία οάο. Οη ιο ÷ Ύίοία αόου έά άηάηάβ υό δύεο οηο οηδέεηύ οάο ηέοόυηο ηέα οη Internet. Οη NAT έά ίαόαοηΰοάε αόουηιόά οέο έάέυοέέΎδ ηέαόεΎοάέο IP οηο έΰεά ιο ÷ άηηάοηο οόοι ηηάάέηP αοιυοέα IP ηέαΎεοηοόο οηο Ύ ÷ άοά, έάεηο οη δάεΎοη οάΎάηε αδυ οη firewall έάε έαόάοεΎοάέε δηηο οη Internet. Άέοάεάβ ηδβόοο έάε οοι άηοβόοηηοοο ίαοΰοηάοο ηέα οά δάεΎοά οηο ηδέοοηΎοηοι.

Οδΰη ÷ άε ίέα ηέαέηP δάηει ÷ P ηέαόεΎοάου IP οηο Ύ ÷ ηοι δάηά ÷ υηοεάβ ηέα ÷ ηηοοο οά οηδέέΰ αβέοοά ία NAT. Ούηοιυά ίά οη RFC 1918, ηδηηάβόά ίά ÷ ηοοεηηδρεηόοά ηέα αόου οη οέηδυ οέο δάηάέΰου δάηει ÷ Ύδ, ηέ ηδηβάο ηάη ηάηηεηηηοιόάε οηοΎ αόάοεάβάο οόη αοιυοέη Internet:

Άη ÷ έέυ IP 10.0.0.0	-	Οάέέέυ IP 10
Άη ÷ έέυ IP 172.16.0.0	-	Οάέέέυ IP 17
Άη ÷ έέυ IP 192.168.0.0	-	Οάέέέυ IP 19

30.5.15 IPNAT

Ίε έάηυάο οηο NAT οηηοηηηοιόάε ία οο ÷ ηηοοο οοο άηοηεηο ipnat. Οοδέέΰ, ηέ έάηυάο οηο NAT αδρεοεάΎηοάε οοη άη ÷ άβη /etc/ipnat.rules. Άάβόά οο οάεβάά manual οηο ipnat(1) ηέα εάδδηηΎηάέο.

Άέα ίά ηέεΰηάοά οηοο έάηυάο οηο NAT έάεηο αόου ηέοάεάβόάε, οηηοηηηεηόοά οη άη ÷ άβη οηο οηοο δάηεΎ ÷ άε, έάε ηέοάεΎοά οοι άηοηεηP ipnat ία οοι δάηΰηάοηη -CF ηέα ίά ηέαάηΰοάοά οηοο αούοάηεέηύο έάηυάο οηο NAT έάε ίά ηάάεΰοάοά υεάο οέο άηάηΎδ έαόά ÷ υηηόάέο οηο δβιάέα ίαόαοηΰοάοη.

Άέα ίά οηηοηόοά οηοο έάηυάο οηο NAT αδυ οοι άη ÷ P, ηέοάεΎοά έά άηοηεηP υδυδ οοι δάηάέΰου:

```
# ipnat -CF -f /etc/ipnat.rules
```

Άέα ίά ηάβόά έΰδρεά οάάοεοόέέΰ ο ÷ άοέέΰ ίά οη NAT, ÷ ηοοεηηδρεηόοά οοι δάηάέΰου άηοηεηP:

```
# ipnat -s
```

Άέα ίά ηάβόά ίέα έβόοά ία οέο οηΎ ÷ ηοοάο έαόά ÷ υηηόάέο οηο δβιάέα NAT, ÷ ηοοεηηδρεηόοά οοι δάηάέΰου άηοηεηP:

```
# ipnat -l
```

Άέα ίά άηάηηδρεηόοά οοι εάδδηηάηP αδάέέυηεοοο ιοηοηΰου έάε ίά ηάβόά δέοηηοηηάο οηο ο ÷ αοβηηοιόάε ία οοι δάάηάηάοά ουη έάηυάο έάε οηοο άηάηηύο έάηυάο έάε έαόά ÷ υηηόάέο οόη δβιάέα, ηηΰοά:

```
# ipnat -v
```

30.5.16 Έάηυάο οηο IPNAT

Ίε έάηυάο οηο NAT άβιάε ηηέάοΰ ηοΎεέέοηε, έάε ηέαέΎοηοι δεηεηο αοηάοηοηοδυη ηόοά ίά έάέΎδοηοι οέο άηΰάεάο ουη ηέέεάεηι ηέεΰ έάε ουη ηδέ ÷ ηεηοοάεηι ÷ ηοοοηι.

Ο ούηοάηε ουη έάηυάο οηο δάηηοοέΰααόάε ηάη, Ύ ÷ άε αδρεηηεεάβ ηόοά ίά οοηάάβηάε ία οο οοηηεο ÷ ηηοοο οά ιο ÷ ηδηηέέΰ δάηεάΰεηηοά. Άέα δει δεηηο δάηεάηάοηP οοο ούηοάηεο, ηάβόά οο οάεβάά manual οηο ipnat(5).

Ç óγίωάιç áñò εάñíá NAT ïéΰæáé ïá òçí ðáñáéΰòù:

```
map IF LAN_IP_RANGE -> PUBLIC_ADDRESS
```

Ί εάñíáò ïáééíΰáé ïá òç εΎίç map.

ΆíεέεάοάοóΠόοά òι IF ïá òçí áñòáñéεΠ áεάðáοΠ (òç εΰñòá áέέòγίò ðíò óóíáΎάοάé óòι Internet).

Ç ðáñΰíáòñìò LAN_IP_RANGE áβíáé ç ðáñéí÷Π áέáðέγίόáñí ðíò ÷ñçóέííðíεάβòáé áðñ òι áóòòáñéέñí óáò áβέòòι. Óòçí ðñáñíáðέέñíòçòά éá ïéΰæáé ïá εΰòé óáí òι 192 . 168 . 1 . 0 / 24.

Ç ðáñΰíáòñìò PUBLIC_ADDRESS ïðññáβ íá áβíáé áβòá ç áñòáñéεΠ IP áέáγέòίòç, áβòá ç áέάέεΠ εΎίç 0 / 32, ç ïðíβá óçíáβíáé ïúé éá ÷ñçóέííðíεçéáβ ç IP áέáγέòίòç ðíò Ύ÷ áé áðíáñéáβ óòι IF.

30.5.17 ðòò éάέòíòññáβ òι NAT

Ίá ðáéΎòι òòΰíáé óòι firewall áðñ òι LAN ïá ðñíñéòíò òι Internet. ðáñíΰáé áέáíΎóíò òñí εάñíñíò òέέòñáñβóíáòíò áñáñ÷ñΎñí, ïðíò áβíáòáé ç áðáñáñáóβá ðíò áðñ òι NAT. Ίé εάñíñíò áóáññíæñíòáé áðñ òñí ðñðòι éáé ðñíò óá εΰòù, éáé éáñáβæáé ï ðñðòíò ðíò óáéñéΰæáé. Ί Ύéáá÷íò áβíáòáé ïá áΰòç òç áέáðáοΠ áðñ òçí ïðíβá εΠòεçéá òι ðáéΎòι éáé òç áέáγέòίòç IP áðñ òçí ïðíβá ðñíΎñ÷áòáé. ¼ðáí òι ïññá òçò áέáðáοΠ ðñíò ðáéΎòíò óáéñéΰæáé ïá εΰòíéí εάñíñá ðíò NAT, ç áέáγέòίòç IP òçò áóáòçñβáò (ðíò ðñíΎñ÷áòáé áðñ òι éáéòòéέñí áβέòòι) áéΎá÷áòáé áéá íá áñáéñéáòéáβ áí óáéñéΰæáé ïá òçí ðáñéí÷Π áέáðέγίόáñí ðíò éáéíñβæáòáé óòçí áñέóòáñΰ ðéáòñΰ ðíò óòíáñéíò (áΎéíò) ðíò εάñíñá NAT. Άí óáéñéΰæáé, ç áέáγέòίòç òíò ðáéΎòíò íáíáñΰòáòáé, ÷ñçóέííðíεπíóáò òç áçíñóéá áέáγέòίòç IP ç ïðíβá ðáñΎ÷áòáé áðñ òι 0 / 32. Òι NAT áçíεíòññáβ íéá éáóá÷ñéòç óòñí áóòòáñéέñí ðíò ðβíáéá, Ύðóé πóðá ïúáí áðέóòñΎæé ç áðΰίòçòç áðñ òι Internet, íá ïðññáβ íá áíóέóòíé÷çéáβ íáíΰ óòçí áñ÷έεΠ éáéòòéεΠ áέáγέòίòç IP éáé íá ðáñΰóáé Ύðáéóá áðñ òíòò εάñíñáò ðíò òβέòñíò áéá ðáñáέòΎñ ðáñáñáóβá.

30.5.18 Άíáñáíðíéπíóáò òι IPNAT

Άéá íá áñáñáíðíéπóáòá òι IPNAT, ðñíòéΎóóá òéð ðáñáéΰòù áñáñíΎò óòι /etc/rc.conf.

Άéá íá áðέòñΎðáòá óòι ïç÷ΰίçíá óáò íá áññíεñáβ ðáéΎóá ïáðáíΎ áέáðáοΠí áέέòγίò:

```
gateway_enable="YES"
```

Άéá íá ïáééíΰáé áðòñíáòá òι IPNAT óá εΰèà áέέβίçòç:

```
ipnat_enable="YES"
```

Άéá íá éáéíñβóáòá áðñ ðíò áðέέòíáβòá íá òñòπñíóáé íé εάñíñáò ðíò IPNAT:

```
ipnat_rules="/etc/ipnat.rules"
```

30.5.19 Òι NAT óáΊá ïááΰéí Òíðéέñí Άβέòòι

Άéá òíðéέΰ áβέòóá ïá ïááΰéí áñέέñí ððíεñáέóòπí, Π áéá áβέòóá ðíò áέáóóíáΎíòí ðáñέóóñíðáñá áðñ Ύíá LAN, ç áέááééáóβá òçò ïáðáòñíðò ïéñí áóòπí òñí éáéòòéέπí áέáðέγίόáñí óá íéá ïñááέεΠ áçíñóéá áέáγέòίòç, áçíéíòññáβ ðññáéçíá éáóáññò ðñññí, éáεπò ÷ñçóέííðíéπíóáé ðíéεΎò òññΎò íé βáéíé áñέέñíβ èòñπí, ïáçáπíóáò óá PC ðíò áέέòγίò óá óóáéñíγíóáéð. Òðΰñ÷íò áγí ðññðíé áéá íá áέáóòπíòíá áðòñ òι ðññáéçíá.


```
rdrr dc0 0.0.0.0/0 port 80 -> 10.0.10.25 port 80
```

Π αέα Ύία άιόδχñάόδρ DNS ιά αέαγέοιόσ όοι όιδέεü άβέόοι 10.0.10.33 ι ιόιβιό δñΎόάε ιά äΎ÷άόάε άίααχόρΠόάέό άδü όι αχüüόεί άβέόοι:

```
rdrr dc0 20.20.20.5/32 port 53 -> 10.0.10.33 port 53 udp
```

30.5.21 FTP εάε NAT

Όι FTP άβίαε Ύίαό άαείυόάόñιό διό Ύ÷άε άδñάβίαε άδü όçi άδι÷Π διό όι Internet Πόάι όόά άñ÷έεÜ όιό όόÜαέα, üδιό όά άñάόιχόέεÜ άñαάόόΠñέα όüι δαίάδεόόΠιέüι Πόάι όοίάñΎία ιάόάγü όιόό ιά ιέόεüΎίαό άñάñΎü εάε ιέ άñάόιχόΎü όι ÷ñçόείüδιέιγόάι αέα ιά όόΎέñιόι άñ÷άβá ι Ύίαό όοιü Üέει. Όçi άδι÷Π αέαβιç, άάι όδΠñ÷άι άίχόό÷βáό ό÷άόέεÜ ιά όçi άόόÜεάέα. Ιά όι δΎñάόία όιό ÷ññιό, όι FTP εÜόόçεά όοι δβüü ιΎñιό όιό όá÷Ύüδ άίάέέόόüñάñιό Internet. Άάι άίάεβ÷εçεά διόΎ Πόόά ιά ιάδññÜόάε δñιáεΠιáόά άόóÜεάέό, üδüδ δ.÷. όι άάñιüδ üόε όόΎέιáε όι üñíá εάε όιι έüάέεü όιό ÷ñΠόόç üδ άδεü έάβιáñ. Όι FTP Ύ÷άε άοι έάόάόóÜόάέό έάέόιόñάβáδ, όçi άίáñáΠ εάε όçi δάεçόέεΠ. Ç áέάόññÜ άβίαε όοι δüδ άβιáόάε ç άíÜέόόç όιό έάίáέεγü ááññΎιüι. Ç δάεçόέεΠ έάέόιόñάβá άβίαε δέι άόόάεΠδ, έάεΠδ όι έάíÜέε ááññΎιüι άδιόάεάβ όι έγñέι έάíÜέε όçδ όοίáñβáδ. Ιδññáβóá ιά άñáβóá διέγ έάεΠ δññέáñáöΠ όιό δñüóιέüέεεü έάε όüι áέάόññáδέεβι όñüδüι έάέόιόñάβáδ όιό, όοι <http://www.slacksite.com/other/ftp.html>.

30.5.21.1 Έάíüíáδ όιό IPNAT

Όι IPNAT áέάεΎόάε ιέα áέáέεΠ άδέεñáΠ áέα áέáíáόιέÜαçόç FTP (proxy) ç ιόιβá ιδññáβ ιά έáέñέόόáβ όοιι έáóÜέεçει έάíüíá όιό NAT. Ιδññáβ δñάέειόέΠόάε üέα όά άíáñ÷üñáíá δάεΎόά áέα ιά άίε÷ιáγόáε όçi Ύίαñιç ιέαό άíáñáΠδ Π δάεçόέεΠδ όοίáñβáδ FTP, έάε ιά αχίέιόñáΠόάε άοίáιέεÜ δñιόüñέγüδ έáíüíáδ όοι όβέόñι διό ιά δññέΎ÷ιόι üñí όιι άñέεüü όçδ έγñáδ διό ÷ñçόείüδιέáβóáε άδü όι έáíÜέε ááññΎιüι. Άόóü άίáέáβóáε όι δñüáέçíá άόóÜεάέόό διό αχίέιόñáβóáε άδü όι ááñιüδ üόε áέάόññáδέεÜ έá ÷ñáέáæüóáí ιά άίε÷έáβ ιέα ιáñÜεç δññέí÷Π έóñβι (όόçi όσçεΠ δññέí÷Π) όοι firewall.

Ι δñáñáéÜóü έáíüíáδ ÷áέñβæáόάε üέα όá ááññΎία ιά έάε όι áóüδáñέéü άβέόóι (LAN):

```
map dc0 10.0.10.0/29 -> 0/32 proxy port 21 ftp/tcp
```

Ι δñáñáéÜóü έáíüíáδ ÷áέñβæáόάε όçi έβιçόç FTP άδü όçi δγέç (gateway):

```
map dc0 0.0.0.0/0 -> 0/32 proxy port 21 ftp/tcp
```

Ι δñáñáéÜóü έáíüíáδ ÷áέñβæáόάε üέç όçi έβιçόç άδü όι áóüδáñέéü LAN διό ááí άίΠέáε όοι δñüóüέüέει FTP:

```
map dc0 10.0.10.0/29 -> 0/32
```

Ι έáíüíáδ ÷áñóñáñÜόçόçδ όιό FTP όιδñέáδáβóáε δñέí άδü όιι έáíüíéü έáíüíá ÷áñóñáñÜόçόçδ. ΕÜεá δάεΎόι áεΎá÷άόάε άñ÷έεÜ άδü όιι έáíüíá διό άñβóέáόάε όόçi έññóΠ. Άί δάέñέÜæáε όόç áέáδáóΠ έάε όόçi έáέüδέεΠ áέáγέόιόç IP έάε δñüέáέόάε áέα δάεΎόι FTP, ι áέáíáόιέáαçόδρ FTP αχίέιόñáβ δñιόüñέγüδ έáíüíáδ όοι όβέόñι ιέ ιόιβιέ áδέόñΎόιόι όçi áέόáñ÷üñáíç έάε άíáñ÷üñáíç έβιçόç FTP άίΠ όáóóü÷ñíá áέόáέγüí έάε όçi áδáñáβóçόç ιáóÜόñáόç NAT. ¼έα όá δάεΎόá διό ááí άίΠέιόι óá ιáóÜáιόç FTP ááí δάέñέÜæüíá ιά όιι δñβóι έáíüíá, Ύόόε έáóáδέγüñíáέε όóιι όñβóι έáíüíá, áíáóÜæüíáέε üóι áóññÜ όç áέáδáóΠ έάε όι IP άδü όι ιόιβι δñιΎñ÷ιíόáε, έάε άβιáόáε ç άíóβóóιέ÷ç ιáóÜόñáόç όιόδ άδü όι NAT.

30.5.21.2 Εάιυιάδ Όβεόηϊδ αέα οϊ IPNAT

¼όάι ÷ ñçóεηιðιεάβδάέ ι ιάοιεάαζδòð FTP, ÷ ñάεΰæάδάέ ιυιι Ύίαδ εάιυιάδ αέα οϊ NAT.

× ùñβδ οϊ ιάοιεάαζδòð FTP, ÷ ñάεΰæηιόάέ ιέ δάñάέΰδου òñάέδ εάιυιόδ:

```
# Allow out LAN PC client FTP to public Internet
# Active and passive modes
pass out quick on rl0 proto tcp from any to any port = 21 flags S keep state

# Allow out passive mode data channel high order port numbers
pass out quick on rl0 proto tcp from any to any port > 1024 flags S keep state

# Active mode let data channel in from FTP server
pass in quick on rl0 proto tcp from any to any port = 20 flags S keep state
```

30.6 IPFW

Όι IPFIREWALL (IPFW) άβίαέ ειαέοιέέυ διό αίαδδóγ÷εçεά αέα οϊ FreeBSD. ÷ ñέ ññάόάβ εάέ οόιόçñάβδάέ áδυ áεάειιόΎδ διό άΠεηιόι οόι Project. × ñçóεηιðιεάβ οϊδδ έεάόέειγδ εάιυιόδ ÷ ùñβδ αέαδòðñçόç òçδ εάδΰδóάóçδ (stateless) εάεðδ εάέ ιέα δά÷ιέέð εùάέειðιεβçόçδ διό άδέδδά÷ΰίαέ áδδυ διό αίαδΎñάάέ ùδ Άδεð Stateful Ειαέέð (Simple Stateful Logic).

Όι δδυάάεαιά εάιυιόδ αέα οϊ IPFW (όδά άñ÷άβ /etc/rc.firewall εάέ /etc/rc.firewall6) òçδ òðδέέðδ άάεάδΰδóάóçδ οϊ FreeBSD άβίαέ ιΰεεηι άδευ εάέ έά ÷ ñάεάόόάβ ιά εΰίαδά εΰδιεάδ áεεάΎδ δñεί οϊ ÷ ñçóεηιðιεðάδ. Όι δάñΰάεάια άάι ÷ ñçóεηιðιεάβ οέέδñΰñέοιá óγδιό stateful. Ç stateful εάέοιòñάβ άβίαέ άòññάάóέέð óδέδ δάñέóουδάñάδ δάñέδòðóάέδ, Ύδóέ άάι έά ÷ ñçóεηιðιεðóιòιá áδδυ οϊ δάñΰάεάια ùδ áΰόç áδδòð òçδ άιυόçδάδ.

Ç óγίόάιç òυι εάιυιόδ stateless οϊδ IPFW Ύ÷άέ άιέó÷δεάβ ιá άιαέεαιΎίαδ άοιáδυòçδάδ άδέειάðδ ιέ ιδñβάδ óοιðευδ ιáδάñιΰία εάδΰ διέγ óέδ òðδέέΎδ άιðάέδ οϊδ áδυιιò διό εάέάβδάέ ιά οϊ ñδειβόάέ. Όι IPFW áδάδεγίαδάέ óοιι άδάάάειιόδά ÷ ñðόçð ð ουι δά÷ιέέΰ δñι÷ùñçιΎιι ÷ ñδβδóά, ι ιδñβιò Ύ÷άέ άιΰάεç δñι÷ùñçιΎιιò οέέδñάñβοιáδιò δάέΎδουι. Ç δñάιαιόέέð άγίαιç òυι εάιυιόδ οϊδ IPFW άδιεάεγδδóάδάέ ιυιι άι άεάέΎδάδά δñι÷ùñçιΎιιò άιðάέδ ó÷άδóέΰ ιá οϊ δυδ άεάοιñάδóέΰ δñυδουειεεά άçιειòñάγίι εάέ ÷ ñçóεηιðιεγίι òçι άδέέάδóεβάά òυι δάέΎδουι οϊδδ. ΌΎοιέι άδβδάάι άδάιçάðóάυι άβίαέ δΎñά áδυ οϊ óειδυ áδδòð òçδ άιυόçδάδ οϊδ Άñ÷άέñεάβιò.

Όι IPFW άδιδάέάβδάέ áδυ άδδΰ άιαñðιαόά. Όι άάóέέυ άιΰñδçια άβίαέ ι άδάιαñάάóðδ εάιυιόδ οϊδ firewall óοιι δδñðια, ιá άιόυιáδυιΎιç òç άοιáδυòçδά εάδάñάóðδ. Όά òδυειέδά άιαñðιαόά άβίαέ οϊ óγóδçια εάδάñάóðδ (logging), ι εάιυιόδ divert ι ιδñβιò άιαñάιðιεάβ òç εάέοιòñάβ NAT, εάεðδ εάέ ιέ δñι÷ùñçιΎιιò άοιáδυòçδάδ άεάέειγ óειðιγ: οϊ óγóδçια áεάιυñòυòçδ έβιççδ (traffic shaper) dummynet, ç άοιáδυòçδά δñιðεççδ ιΎóυ οϊδ fwd rule, ç άοιáδυòçδά άáóγñòçδ (bridge) εάεðδ εάέ ç άοιáδυòçδά áδυέñðççð (ipstealth). To IPFW òδιόδçñβάέ òυοι οϊ δñυδουειεεηι IPv4 υοι εάέ οϊ IPv6.

30.6.1 Άιαñάιðιεðιόάδ οϊ IPFW

Όι IPFW δάñέεαιάΰίαδάέ óδçι ááóέέð άάεάδΰδóάóçδ οϊδ FreeBSD ùδ ΰñεñυια οϊδ δδñðια οϊ ιδñβι ιδññάβ ιά οινδουεάβ άοιáιέέΰ. Όι óγóδçια έά οινðóάέ άοιáιέέΰ οϊ ΰñεñυια υδάι άñάέ òçι εάδά÷ðñέóç firewall_enable="YES" óοι άñ÷άβι /etc/rc.conf. Άάι ÷ ñάεΰæάδάέ ιά ιάδάάευδòðβδάδά οϊ IPFW ιΎόά óοιι δδñðια, άέυδ άι εΎεάδά ιά ÷ ñçóεηιðιεðάδά óέδ εάέοιòñάβδ NAT διό δάñΎ÷άέ.

Άοιγ άδαιάέείΠοάά οι ογούοιά οάο ιά οςί έαόά÷πνέος firewall_enable="YES" οοί rc.conf, έα άάβόά ιά
ΰόδνα Υίοιιά ανΰιιόά οι άέυειοει ιΠιόιά έαόΰ ος άέάέέέάόβά οςό άέέβίοςόδ:

```
ipfw2 initialized, divert disabled, rule-based forwarding disabled, default to deny, logging disal
```

Οι ΰνεηιιά Υ÷άε άιούιόουιΥίς ος άοιάούοοςά έαόάάνάοΠδ. Άέά ιά άίάνάιθιεΠοάά οςί έαόάάναοΠ έάέ ιά έΰοάόά οι
άδβδάαι έάδοηΥνάέάο, οδΰñ÷ιοί εΰθιεάο ηοειβόάέο θιο ιθιηάβόά ιά έΰοάόά οοί /etc/sysctl.conf.
Δηιόεΰοιιόά οέο δάηάέΰου έαόά÷ύηβόάέο, έά άίάνάιθιεςέάβ ς έαόάάναοΠ οόέο άδύιιιάό άέέείΠοάέο:

```
net.inet.ip.fw.verbose=1
net.inet.ip.fw.verbose_limit=5
```

30.6.2 Άδέειιάΰο οιο ΔοηΠρία

Άαι άβιáε οθι÷ηάουέέυ ιά άίάνάιθιεΠοάά οι IPFW ιάόάέυοδβαιιόάο οέο δάηάέΰου άδέειιάΰο οοιι δοηΠρία οιο
FreeBSD, άέουδ έάέ άί έΰεάόά ιά ÷ηςοειηθιεΠοάά NAT. Ι οειθου άοδΠδ οςό δάηιροβάοςό άβιáε έάέανΰ
άίςιληυόέέυδ.

```
options IPFWIREWALL
```

ς άδέειιāΠ άοδΠ άίάνάιθιεάβ οι IPFW υδ ιΰηιυδ οιο δοηΠρία.

```
options IPFWIREWALL_VERBOSE
```

Άίάνάιθιεάβ οςί έαόάάηάοΠ ουι δάέΰουι θιο δάηηιγί ιΰου οιο IPFW έάέ δάηέέαιΰιθιο ος έΰίς log οοιι έάιυιά οιοδ.

```
options IPFWIREWALL_VERBOSE_LIMIT=5
```

Δάηειηβάε οιι δεΠειδ ουι δάέΰουι θιο έαόάάηΰοιιόάε ιΰου οιο syslogd(8) οά οοάέάεηειΥίι άνέειυ άίΰ
έαόά÷πνέος. ς ηγέιέος άβιáε ÷ηΠόεις οά ά÷εηέεΰ δάηέάΰεειηόά οόά ιθιβά άβιáε άδέεδιςοΠ ς έαόάάηάοΠ. Ιά άδου
οιι οηυθι ιθιηάβ ιά άθιοάο÷έάβ ιέά θεέαιΠ άδβεάος ιά οου÷ι οςί οδάν÷άβέέος ουι αν÷άβυι έαόάάηάοΠδ.

```
options IPFWIREWALL_DEFAULT_TO_ACCEPT
```

ς άδέειιāΠ άοδΠ άοβιáε οά δΰιόά ιά δάηιΰιά ιΰοά άδυ οι firewall, οι ιθιβι άβιáε έάεΠ έαΰά οςί δηπος οηΰΰ θιο
ηοειβάέάο οι firewall οάο.

```
options IPDIVERT
```

ς άδέειιāΠ άοδΠ άίάνάιθιεάβ ος έάέοιθιηάβ NAT.

Όςιαβυός: Οι firewall έά άθιηηβδδάε υέά οά δάέΰοά θιο έαόάόέγίιιόάε άδυ έάέ θηιδ οι ις÷ΰίςιá, άί άαι
δάηέέΰάάόά οςί άδέειιāΠ IPFWIREWALL_DEFAULT_TO_ACCEPT Π άί άαι ηοειβόάόά Υία έαόΰεέει έάιυιά θιο ιά
άδέοηΰδάέ άδοΰδ οέο οοιάΰοάέο.

30.6.3 Άδέειιάΰο οοι /etc/rc.conf

ΆίάνάιθιεΠοάά οι firewall:

```
firewall_enable="YES"
```

Άεά ίά άδεέΎίάόά Ύίά άδύ οίτò δñíáδεέάαίΎίíτò óγδíτò firewall δíτò δδíτòçñβæííóάέ άδύ οί FreeBSD, áεάάΰόόά οί άñ÷άβí /etc/rc.firewall έάέ äçíεíτññáβóόά ίεά áãñáóβ ùδòò όçí δάñάέΰòù:

```
firewall_type="open"
```

Íε άεάέΎόείτò όείΎò άεά άδòβ όç ñýεíέόç άβίάέ:

- open — άδέòñΎδάέ όç äéΎεάòόç ùεçò όçò έβίçόçò.
- client — δñíóόάόáyάέ ίüíí οί óðäéäêñεíΎíí ίç÷ΰίçιά.
- simple — δñíóόάόáyάέ íεüεεçñí οί άβέòòí.
- closed — άδάíáñáíδíεάβ άíóάεβò όçí έβίçόç δάέΎòùí, áέòíùò άδύ όçí άóùòáñέεβ άεάδάòβ (loopback).
- UNKNOWN — άδάíáñáíδíεάβ όçí öüñòùόç έάíüíüí οίτò firewall.
- filename — οί δεβñάò ίüííΰόέ οίτò άñ÷άβíτò δíτò δάñέΎ÷άέ οίτò έάíüíüò οίτò firewall.

Íδññάβòά ίά ÷ñçόέíδíεβóάòά äýí áεάòíñáòέéíγò δñüδíτò άεά ίά öíñòβóάòά δñíóáñíüóíΎííτò έάíüíüò óóí ipfw firewall. Í Ύίάò άβίάέ εΎòííóáò όç ίάòάάεçòβ firewall_type óόçí άδύεòόç äéááññíβ οίτò άñ÷άβíτò δíτò δάñέΎ÷άέ οίτò έάíüíüò οίτò firewall, ÷ùñβò ίά äβóάòά íñβóíáòά óόçí áñáíñ άíóíεβí άεά οί βάεí οί ipfw(8). Óí άñ÷άβí έάíüíüí δíτò óάβíáòάέ δάñάέΰòù, άδíññβδòάέ üεç όçí áεóáñ÷üáíç έάέ áíáñ÷üáíç έβίçόç:

```
add deny in
add deny out
```

Άδύ όçí ΰεεç ίáñεΰ, άβίάέ άδβóçò äóíáòü ίά εΎóáòά όç ίάòάάεçòβ firewall_script óόçí άδύεòόç äéááññíβ áíüò áέòάέΎόείτò script δíτò δάñέéáíáΰíáέ ίεά óáέñΰ άδύ άíóíεΎò ipfw δíτò έά áέòάέäóóóíýí έáóΰ όçí áέέβίçόç. Íá Ύάέòñí óΎóíεí script οί íδíβí άβίάέ άíóβóóíε÷í à οί άñ÷άβí έάíüíüí δíτò áάβíáíá δάñάδΰíü, άβίάέ οί áέüεíτòεí:

```
#!/bin/sh

ipfw -q flush

ipfw add deny in
ipfw add deny out
```

Όçíáβüόç: Άí εΎóáòά όçí όείβ οίτò firewall_type άβòά óά client άβòά óά simple, έά δñΎδάέ ίά äéΎáíáòά üóé íé δñíáδééááíΎíé έάíüíüò δíτò δάñέΎ÷ííóáέ óóí /etc/rc.firewall óáέñέΰæíóí ίá óéò ñòεíβóáéò οίτò óðäéäêñεíΎíí ίç÷άíβíáòíò. Δάñάόçñβóόά άδβóçò üóé óά δάñáááβáíáòά δíτò ÷ñçόέíδíεíγíóáέ óά άδòù οί έáòΰεάέí áíáíΎííóí ίά ίá Ύ÷άòά εΎóáέ όç ίάòάάεçòβ firewall_script óόçí όείβ /etc/ipfw.rules.

Άíáñáíδíεβóóά όçí έάóάáñáòβ:

```
firewall_logging="YES"
```

Δñíáέáíòíβçόç: Óí ίüíí δñΰáíá δíτò εΰíáέ ç ίάòάάεçòβ firewall_logging άβίáέ ίá εΎóáέ όçí όείβ όçò ίάòάάεçòβò sysctl net.inet.ip.fw.verbose óόçí όείβ 1 (άάβòά οί Óíβíá 30.6.1). Άάí δδΰñ÷άέ ίάòάάεçòβ οίτò

ipfw zero NUM

30.6.5 Οι Όγνιει Έάιυιύι οίω IPFW

ΰο “όγνιει έάιυιύι” οίω IPFW, ινβαιτοιά ιέα ινΰάά έάιυιύι θιω Ύ÷ιωι άναοάβ άέα ίά άθεοηΎθιωι Ρ ίά άθιηηβθθιωι θάέΎοά άιΰειάά ίά οέο θειΎο θιω θάηέΎ÷ιθάέ οά άοοΰ. Ç άεθεΡο έάοάγέοιόοο άίοάέεάαΡ θάέΎοι ίάοάίγ οθιειάεοοβι άθιόάεάβ ιέα οοίάαηβά. Οι όγνιει έάιυιύι οίω firewall άθάιηάΰάεάοάε ουοι οά θάέΎοά θιω Ύη÷ιθάέ άδθ οι Internet, υοι έάέ οά θάέΎοά θιω θάηΰάιιθάέ άδθ οι όγόοçίά υο άθΰίόοç οά άοοΰ. Εΰεά οθçηάοβά TCP/IP (θ.÷. telnet, www, mail, ε.ε.θ.) έάειηβάεάοάε άδθ οι θηυουειειει έάέ οçι θηιηιέάεΡ (privileged) έγηά θιω ÷ηçοειιθιέάβ άέα ίά άΎ÷άοάέ άέοΡιάοά άιθθçηΎόοçο. Οά θάέΎοά θιω θηιηηβαιιθάέ άέα ιέα οοάεάηειΎίç οθçηάοβά, ίάέειγί άδθ οç άέάγέοιόο άοάοçηβάο ÷ηçοειιθιέριθάο ιέα ιç-θηιηιέάεΡ έγηά έάέ έάοάεΡαιωι οόç οοάεάηειΎίç έγηά οθçηάοβάο οοιθι θηιηηέοιυ. ΰεάο ιε θάηάθΰιυ θάηΰιάοηιέ (έγηάο έάέ άέάοέγιοάέο) ιθιηιγί ίά ÷ηçοειιθιέçειγί υο έηέοΡηέα άθέειαΡο άέα οçι άçιειθηάβά έάιυιύι θιω άθεοηΎθιωι Ρ άιθιηβαιωι οçι θηυοάάοç οά οθçηάοβάο.

ΰοάι Ύίά θάέΎοι άέοΎη÷άοάε οοι firewall, οοάηηβιάοάέ ίά άΰόç οιθι θηηοι έάιυιύι. Ç όγάηηέοç οοίά÷βάεάέ άέάι÷έεΰ ίά οίωο οθιειειθιθι έάιυιύι, άδθ οιθι θηηοι θηιθι οιθι οάέάοοάβι, ίά άΰόç οιθι άγηιθά άηέειυ οίωο. ΰοάι οι θάέΎοι οάέηέΰιάέ ίά οέο θάηάιΎοηιθιθι άθέειαΡο εΰθιειθι έάιυιύι, άέοάεάβοάέ ç ιάçάβά θιω άίάΎηάοάέ οοι θάάβι άίάηάέριθι οίω έάιυιύι άοθιγ έάέ ç άίάεΡόç έάιυιύι άέα οι οοάεάηειΎιθι θάέΎοι οάηιάοβάεάοάε. Οά άοοΡ οç ιΎειαι άίάεΡόçοç, “ι θηηοιθι έάιυιύι θιω οάέηέΰάε, άβιάέ ι ιέεçοΡο”. Αί οι θάέΎοι άάι οάέηέΰάε ίά έάιΎίά άδθ οίωο έάιυιύι, έά εçοέάβ άδθ οιθι οθι÷ηάυοέευ θηιάθέεάηιΎιθι έάιυιύι οίω IPFW, ίά άηέειυ 65535, ι ιθιβιθι άιθιηβάέ οç άέΎεάοç υειυ ουι θάέΎοι, έάέ οά άθιηηβθθάέ ÷ηηβθ ίά οοάβέεά έάιέΰ άθΰίόοç οοιθι άη÷έευ άθιόοιέΎά οίωο.

Όçιάβυόç: Ç άίάεΡόç οοίά÷βάεάέ ίάοΰ άδθ έάιυιύι ογθιθι count, skipto έάέ tee.

Ιε ιάçάβάο θιω οάβηιθάέ άαβ, άάοβαιιθάέ οόç ÷ηβόç έάιυιύι θιω θάηέΎ÷ιθι οέο ιάçάβάο keep state, limit, in, out έάέ via. ΑοοΎθι άβιάέ έάέ ιε άάοέέΎθι έάέοιθηάβάο άέα οçι άυιόç άιυοο firewall ογθιθι inclusive ίά stateful έάέοιθηάβά.

θηιάέαιθιβόç: Ιά άβιάοά ίάάΰεç θηιθι÷Ρ υοάι αιθέάγάοά ίά οίωο έάιυιύι άιυοο firewall. Ιθιηάβ ΰεάεά οάο ίά έεάέάυεάβθά Ύιυ άδθ οι όγόοçιά οάο.

30.6.5.1 Όγιοάιç Έάιυιύι

Οόçι άιυοοçοά άοοΡ, έά θάηιθόέΰοιθιά ιέα άθειθιέçιΎίç όγιοάιç έάιυιύι. Άάβ÷ηιθιά ιυιθι υοέ ÷ηάέΰάεάέ άέα ίά άçιειθηάçέάβ Ύίά οθθιθιέçιΎιθι όγνιει έάιυιύι άέα Ύίά inclusive firewall. Άέα θεΡηç θάηέάηάοβ, άάβθά οç οάέβάά manual θιω ipfw(8).

Ιε έάιυιύι θάηέΎ÷ιθι εΎιάέο-έεάέεΰ. Ιε εΎιάέο άοοΎθι έά θηΎθάέ ίά ευάέειθιέçειγί ίά οοάεάηειΎίç οάέηΰ άδθ οά άηέοοάηΰ θηιθι οά άάιέΰ οçο άηάηιθι. Ιε εΎιάέο-έεάέεΰ οάβηιθάέ θάηάέΰου ίά Ύιθιηά άηΰιάοά. ΙάηέέΎθι εΎιάέο Ύ÷ιθι οθι-άθέειαΎθι ιε ιθιβάο ιθιηάβ ίά άβιάέ άθβόçο εΎιάέο-έεάέεΰ έάέ ίά θάηέέαιάΰιθιθι άθβόçο άειυιά θάηέοουοάηάο οθι-άθέειαΎθι.

Ç άη÷Ρ άιυοο ο÷ιέβιθι, οçιάοιηιθιάβθάέ ίά οι όγίαιει #, οι ιθιβιθι ιθιηάβ ίά άιθιάιβάεάοάε οοιθι οΎειθι ιεάο άηάηιθι έάιυιύι, Ρ έάέ οά ιέα άέεΡ οίω άηάηιθι. Ιε έάιΎθι άηάηιθι άάηιγίθάέ.

CMD RULE_NUMBER ACTION LOGGING SELECTION STATEFUL

30.6.5.1.1 CMD

Άέα ίά αβίαε ς δνιόεβες άίυδ ιΎιό έάίυία όοι άούοάνεέυ δβίαέα, όιδρεάοάβόάε ιδνιόόΰ άδύ άόόυι ς δάνΰιάόνηό add.

30.6.5.1.2 RULE_NUMBER

Έΰεά έάίυίαδ δνΎδαε ίά έεάεΎόάε Ύία άνεέιυ διό ίά όιι ÷ άναέόδςβεάε.

30.6.5.1.3 ACTION

ιάδ έάίυίαδ ιδνιάβ ίά ÷ άόβεάόάε ίά ίέα P δάνεόούδανό άίΎναάεάδ, ίε ιδιβάδ έεόάειύίόάε υόάι όι δάεΎοι όάενεΰεάε ίά όά ένεόβνεά άδεειαβδ άόόιύ όιό έάίυία.

allow | accept | pass | permit

¼έα όά δάνάδΰύ Ύ ÷ ιόι όι βάει άδιόΎεάόία: όι δάεΎοι άίΎñ ÷ άόάε άδύ όςι όύόόςία όιό firewall. ς άίαεβδςός άέα όι όόάεάενεΎίι δάεΎοι όάνιαόβεάόάε όά άόόυ όιι έάίυία.

check-state

ΆεΎα ÷ άε όι δάεΎοι ίά άΰός όι άοίαίέευ δβίαέα έάίυιυ. Άί άναέάβ έάίυίαδ διό ίά όάενεΰεάε, έά έεόάεάόόάβ ς άίΎναάεά όιό έάίυία ί ιδιβιό άςιέιύναςόά όιι όόάεάενεΎίι άοίαίέευ έάίυία. Άέάοιναόέέΰ, ς άίαεβδςός όόία ÷ βεάόάε ίά όιι άδύιάνι έάίυία. ίάδ έάίυίαδ check-state άάί Ύ ÷ άε ένεόβνεά άδεειαβδ. Άί άάί όδΰñ ÷ άε έάίυίαδ check-state όόι όύγιει έάίυιυ, ι Ύεάα ÷ ιδ όιό δβίαέα άοίαίέεβι έάίυιυ ίάέεΎΰάε άδύ όιι δñβοι έάίυία όύδιό keep-state P limit.

deny | drop

Έάε ίε άγι εΎίαέό όςιαβνιόι όι βάει δñΰάι: όά δάεΎόά διό όάενεΰεάιόι ίά άόόυ όιι έάίυία άδιñβδδιιόάε. ς άίαεβδςός όάνιαόβεάόάε.

30.6.5.1.4 Έάόάάναόβ

log P logamount

¼όάι Ύία δάεΎοι όάενεΰεάε ίά Ύία έάίυία διό δάνεΎ ÷ άε ός εΎίς log, αβίαόάε έάόάάναόβ όιό ιςιγίαόιό ιΎόυ όιό syslogd(8) όός άοίαόυόςόά SECURITY. ς έάόάάναόβ όοιναβίαε ιυνι άί ι άνεέιυδ όυι δάεΎόυι διό Ύ ÷ άε έάόάάναόάβ ιΎ ÷ νε όόέαιβδ άάι όδάνάάβίαε όςι δάνΰιάόνηό logamount. Άί ς δάνΰιάόνηό άόόβ άάί Ύ ÷ άε έάεινεόόάβ, όι υνει ñόειβεάόάε ίά άΰός όςι όείβ όςδ ίάόάάεςδβδ sysctl net . inet . ip . fw . verbose_limit. Έάε όόέδ άγι δάνεδδβόάεδ, ίέα ιςάιέεβ όείβ όςιαβίαε υόε άάί έά όδΰñ ÷ άε υνει όόςι έάόάάναόβ. Ιυέέδ ς έάόάάναόβ όδΰόάε όόι υνει, ιδνιάβ ίά αβίαε άδάιάνιάνιδιβςός όςδ ίά όι ιςάάιέόιυ όιό ίάόñςδβ έάόάάναόβδ, β όιό ίάόñςδβ άέα όι όόάεάενεΎίι έάίυία. Άάβόά όςι άίόιεβ ipfw reset log.

Όςιαβυός: ς έάόάάναόβ αβίαόάε ιυνι άόιυ άδάεςεάόειύι υεάό ίε ΰεέάό όόιεβεάό όάενεΰόιαόιό όιό δάεΎόιό, έάε δñεί όςι όάεέεβ άδιΰ ÷ β β άδύñνεςς όιό. Άβίαε όός άέεβ όάό άδ ÷ Ύναέα ίά άδιόάόβόάόά όά όιέιόδ έάίυίαδ έά άίάνάιδιεβόάόά όςι έάόάάναόβ.

30.6.5.1.5 Άδεειαβ

Ιε εΎίαέό-έεάεάεΰ διό δάνεάνΰοιιόάε όά άόόβ όςι άίυόςόά, ÷ ñςόειιδιέιύίόάε άέα ίά δάνεάνΰοιιό ÷ άναέόδςνεόόέέΰ όιό δάεΎόιό διό έά δνΎδαε ίά έεάναόιςειύι άέα ίά έάεινεόόάβ άί όι δάεΎοι όάενεΰεάε β υ ÷ ε ίά όιι έάίυία. ς άδεειαβ

ιθιναβ ια αβιαε ια αυορ οα θαναεΰου ααιεεΠο ογοαυο ÷ αναεορνεοοεεΰ, οα ιθιβα εαε εα θνΰθαε ια ÷ ηροειθιερειρι ια ορ οαεηΰ θιθ οαβηιδαε:

udp | tcp | icmp

Ιθιηιρι αδβορδ ια ÷ ηροειθιερειρι οα θηουειεεα θιθ θανεΰ÷ιιδαε οοι αν÷αβι /etc/protocols. ϸ οειΠ θιθ εαειηβαεαδαε ÷ ηροειθιερειρι αεα οι οαβηεαοια οιο θηουειεεειο. θηυεαεοαε αεα οθι÷ηαυοεεΠ θανΰιαοηι.

from src to dst

Ιε εΰιαεο from εαε to ÷ ηροειθιερειρι αεα οι οαβηεαοια IP αεαοεγιοαυι. Ιε εαφιαο θνΰθαε ια εαειηβαειοι ουοι ορ ι θραΠ υοι εαε οιθ θηηηεοιυ. ϸ εΰιρ any ιθιναβ ια ÷ ηροειθιερεεαβ αεα οαβηεαοια ια ιθιεααΠθιοα αεαγεοιορ. ϸ εΰιρ me ΰ÷αε αδβορδ αεαεεΠ οριαοβα. Οαεηεΰαε ια ιθιεααΠθιοα αεαγεοιορ θιθ ΰ÷αε ηοειεοοαβ οα εΰθιεα αεαδαοΠ οιο οοοοΠιαοιο οαο, αιεθθηιουθαιηιδαο ΰοε οι PC οοι ιθιβι αεοαεαβοαε οι firewall. Ιθιηιρι ΰοε ια αναοιρι εαφιαο οιο ογθιο from me to any Π from any to me Π from any to 0.0.0.0/0 Π from 0.0.0.0/0 to me Π from any to 0.0.0.0 Π from me to 0.0.0.0. Ιε αεαοεγιοαεο IP εαειηβαειδαε υο αναειρθεεΰο ιεοΰααο ÷ ηηεοιΰιαο ια οαεαβαο εαε αειεθιερειριδαε αδυ οι ιΠειο ορδ ιΰοεαο οθιαεεογιο. Ιεα IP αεαγεοιορ ιθιηιβ ια εαειηβαεαδαε ια αναειριθιο θιθ ÷ ηηβαειδαε ια οαεαβαο. Ιθιηιβ αδβορδ ια αειεθιερειριδαε αδυ οι ιΰααειο ορδ ιΰοεαο οθιαεεογιο (ιηηΠ CIDR).

θηυεαεοαε αεα οθι÷ηαυοεεΠ θανΰιαοηι. Ιθιηιβοα ια ÷ ηροειθιερεεαο οι αιρεοεοευ θηυαηαηια net-mgmt/ipcalc αεα αεαοευεοιορ οαο οοιθο οθιερεοοιηιθ. Ααβοα ορ ι αεεοοαεΠ οθιερεοοβα οιο θηηαηΰιαοιο αεα θανεοοοιδαηαο θερεηηοηηβαο: <http://jodies.de/ipcalc>.

port number

× ηροειθιερεεαο οα θηουειεεα θιθ οθιορδηηβαειοι αναειριθιο εοηηι (υθυο αβιαε οα TCP εαε UDP). Αβιαε οθι÷ηαυοεευ ια αβιαοαε ι αναειυο εγηαο ορδ οθρεηαοβαο θιθ εΰεαοα ια οαεηεΰιαοα. Ιθιηιβαοα ια ÷ ηροειθιερεεαο οα ιηυιαοα ουι οθρεηαοεβι (ιθιηιβαοα ια οα αναβοα οοι αν÷αβι /etc/services) αιοβ αεα οιοθ εαφιεειριθιο αναειριθιο εοηηι.

in | out

Ια οι θαναθΰιυ ιθιηιβ ια εαειηεοοαβ αι οι οαβηεαοια εα αβιαοαε οα αεοαη÷υιαια Π οα αηαη÷υιαια θαεΰοα αιοβοοιε÷α. Αβιαε οθι÷ηαυοεευ ια ΰ÷αοα υο ιΰηιθ ουι εηεορδηβυι οιο εαφιαα οαο, αβοα ορ εΰιρ in αβοα ορ εΰιρ out.

via IF

Οαεηεΰαε οα θαεΰοα οα ιθιβα αεΰη÷ιιδαε ιΰου ορδ αεαδαοΠο ια οι υηηα θιθ εαειηβαεαδαε. ϸ εΰιρ via αιαοοαεββαε υοε οι υηηα ορδ αεαδαοΠο εα αβιαε θΰιοα ιΰηιθ ουι εηεορδηβυι εαοΰ ορ αεαεεαοαβ οαεηεΰοιαοιο.

setup

θηυεαεοαε αεα οθι÷ηαυοεεΠ θανΰιαοηι θιθ αιαηηηηβαεε ορ ι αβορρ ϰ ιαηηρδ ιεαο οοιαηηβαο αεα θαεΰοα TCP.

keep-state

θηυεαεοαε αεα οθι÷ηαυοεεΠ θανΰιαοηι. Ιυεεο οθΰηηαε οαβηεαοια, οι firewall εα αρειεθηηαθοαε ΰια αοιαηεευ εαφιαα, οιο ιθιβι ϸ θηηαθεεαηιΰ οοιθανεοηηΰ αβιαε ια οαεηεΰαε αδεειεφυιβα αεθεΠο εαοαγεοιορ ιαοαηι ορδ αεαγεοιορ IP εαε ορδ εγηαο αοαορδηβαο εαε θηηηεοιηι, ÷ ηροειθιερειριδαο οι βαει θηουειεεει.

limit {src-addr | src-port | dst-addr | dst-port}

Οι firewall εα αδεοηΰοαε ιυηι N θεΠεθ οοιαΰοαυι ια οεο θαναηιΰοηιθιο θιθ θανεαηΰοιδαε οα αοου οιθ εαφιαα. Ιθιηιρι ια εαειηεοοιηι θανεοοοιδαηαο αδυ ιεα αεαοεγιοαεο εαε θηυοαο αοαορδηβαο εαε θηηηεοιηι. Ααι ιθιηιρι ια ÷ ηροειθιερεειρι οοιθ βαει εαφιαα ιε θανΰιαοηηε limit εαε keep-state. ϸ αδεεηαΠ limit θανΰιαε ορ ι βαεα εαεοιοηηαβα stateful ια ορ ι keep-state, εαεθ οαε αδεθηυοεαοαο αεεΰο ορδ εαεοιοηηαβαο.

30.6.5.2 ΆδέειάP αέα Stateful Έάιυιάο

Όι stateful οέέοηΰνεοιά, άίοείαδουδβαέε οçi έβίρoç οίτo αέέογίτo υδ αέδεPδ έάοάγεοίρoç άίοάεέαP δάέΥοι όά ιδία άçiείτoηάιύί ιέα οοίάαηβα. :-άε άδβoçδ οç άοίαδουδoçά ίά αέαηάοίPοάέ άί οçηίγίοάέ ιέ Υάεοηιέ έάιυιάδ άίοάεέαPδ ιçίοιΰδουί ιάοάγύ οίτo άδιρδιεΥά έάέ οίτo δάηάεPδoç. ΙδίαάPδιοά δάέΥοά άάι οάέηεΰάειοί ιά οί δηυοδδι άοδPδ οçδ άδέείείυίβαδ, άδιηηβδδιυόάέ υδ ράγοέέα.

Ç άδέειάP check-state ÷ηçοείηδιεάβοάέ αέα ίά άίάάυηέοδoάβ όά δίει οçίαβι οίτo οοίυείτo έάιυίυι οίτo IPFW έά έεάα÷εάβ οί δάέΥοί ιά άΰοç οç άοίαδουδoçά ουί άοίάιέεπι έάιυίυι. Όά δάηβδδουç οάέηεΰοίαοίδ, οί δάέΥοί άίΥη÷άοάέ άδυ οί firewall έάέ οοίά÷βαέε οçί δίηάβá οίτo, άίP οçί βαέα οδέαιP άçiείτoηάαβοάέ Υίάδ ίΥίτo άοίάιέευδ έάιυιάδ αέα οί άδυιάη δάέΥοί δίτo άίάιΥίάοάέ ίά Υηδάέ ιά άΰοç οç οοάέάηειΥίç αέδεPδ έάοάγεοίρoç άδέείείυίβα. Όά δάηβδδουç δίτo οί δάέΥοί άάι οάέηεΰάέ ιά οί άοίάιέευδ έάιυιά, έά δηί÷υηPοάέ αέα ίά έεάα÷εάβ άδυ οί άδυιάη έάιυιά οίτo firewall.

Ç άοίαδουδoçά άοίάιέεπι έάιυίυι άβίαέ άδΰευδoç όά άίΰίδεçοç δυηύι όά δάηβδδουç άδβεάoçδ οδάη÷άβέέoçδ (flood) SYN. Ç άδβεάoç άοδP ιδίαβ ίά άçiείτoηάPοάέ δίεγύ ιάάΰει δεPειδ άοίάιέεπι έάιυίυι. Άέα οçί άίοείαδoηδέoç ιέαδ οΰοίεάδ άδβεάoçδ, οί FreeBSD ÷ηçοείηδιεάβ ιέα έέυιá άδέειάP δίτo ιηηΰάοάέ limit. Ç άδέειάP άοδP ιδίαβ ίά δάηβδδουç οί άηέειυ ουί οάοδου÷ηίυι οοίάαηεπι, άίάδΰάειοάδ όά δάάβá άοάοçηβáδ έάέ δηίηέοηίγύ ουί έάιυίυι. Άίε÷ίάγáέ ιά άοδου οί δηυοδδι οί δεPειδ ουί άοίάιέεπι έάιυίυι έάέ δυοάδ οηηΥδ Υ÷άέ ÷ηçοείηδιεçεάβ ι έάέΥίάδ άδυ οç οοάέάηειΥίç IP έάέγυδoίç. Άί ι άηέειυδ άοδουδ ιάδάηιΰάέ οί υηέι δίτo Υ÷άέ οάέάβ ιά οçί άδέειάP limit, οί δάέΥοί άδιηηβδδoάέ.

30.6.5.3 ΈάοάαηάοP ιçίοιΰδουί οίτo Firewall

Όά δέαιύάεδPιαδά οçδ έάοάαηάοPδ οοίαΰίοιυι οίτo firewall, άβίαέ δηίρoίP: δάηΥ÷ίοι οç άοίαδουδoçά ίά άάβoά αέα δίει ευάι άίάηάιδιεPεçεάί ιέ έάιυιάδ οοίτoδ ιδίαβίτoδ Υ÷άδ άίάηάιδιεPοάέ οçί έάοάαηάοP. Ιέ δεçηιρoιηβáδ δάηέεαίáΰίρoί όά δάέΥοά δίτo άδιηηβδδεçεάί, οέδ αέαδoεγίοάέδ άδυ οέδ ιδίαβδ δηίPεεάί έάέ δίτo έάοάοεγίηίοάί. Ιά άοδου οί δηυοδδι, Υ÷άδ άίά Υίά οçίάίρoέευ δέαιύέoçίá οoçί άίβ÷ίάoç ουί έέοάιεΥίυι.

Άέυιá έάέ άί άίάηάιδιεPοάδoά οç έάέοίρoηάβá έάοάαηάοPδ, οί IPFW άάι έά άη÷βoάέ άδυ ιυίι οίτo οçί έάοάαηάοP αέα έάίΥίά έάιυιά. Ι έέα÷άέηέοδPδ οίτo firewall έά άδίρoάβoάέ όά δίειτoδ άδυ υείτoδ οίτoδ έάιυιάδ έά άίάηάιδιεPοάέ οçί έάοάαηάοP, έάέ έά δηίρoέΥοάέ οçί εΥίç log οoçί άίόβoδoίε÷ç έάοά÷ηέoç. Όδoέίείάέέΰ, άβίαδoάέ έάοάαηάοP ιυίι αέα έάιυιάδ δίτo άδιηηβδδoίρoί δάέΥοά (έάιυιάδ deny), υδδυδ αέα δάηΰάέεαιά ι έάιυιάδ άδυηηέoçδ ουί έέοάη÷υιάιυι ICMP pings. Άβίαέ είειP δηάέoέέP, ίά άίδoεάηΰoάoάέ οοί οΰέιτoδ ουί έάιυίυι ι έάιυιάδ “ipfw default deny everything” έάέ ίά δηίρoδβeάdάέ όά άδoυί ç άδέειάP log. Ιά οί δηυοδδι άοδου, ιδίαβoά ίά άάβoά υεά όά δάέΥοά δίτo άάι οάβηεάίάί ιά έάίΥίά έάιυιά οίτo οοίυείτo.

Ç έάοάαηάοP οοίαΰίοιυι άβίαέ άβειδι ίá÷άβηέ. Άί άάι άβoδoά δηίρoάέoέέευδ, έά ÷άέάβoά ίΥόά οοί δεPειδ ουί άάηάΥίυι οçδ έάοάαηάοPδ έάέ έά άάιβoάoά οί άβoέί oάδ ιά ΰ÷ηçοδoά άη÷άβá. Ιέ δει δάέέΥδ έάέ είειΥδ άδέέΥoάέδ ογδίτo ΰηίçοçδ οδçηάoβáδ (DoS), άβίαέ άοδΥδ δίτo δηίρoδάειγί ίά άάιβoίρoί οίτoδ άβoέίτoδ oάδ. Όά ιçίγίáδá άοδΰ υ÷έ ιυίι έάοάαηΰoίρoάέ οοί **syslogd**, άέεΰ άιoάίβáειoάέ έάέ οoçί είηoυέα οίτo οδoδPιαδoίτo oάδ, έάέ oγίδoηά άβίηoάέ δίεγύ άηί÷εçoέέΰ.

Ç άδέειάP IPFW_VERBOSE_LIMIT=5 οοίη δoηPία, δάηέηηβáέ οίη άηέειυ ουί οοίá÷υιάιυι υίιέυι ιçίοιΰδουί δίτo οδΰέηίρoάέ οοίη έάοάαηάoΰά οδoδPιαδoίτo syslogd(8) ó÷άoέέΰ ιά οί oάβηεάoίá δάέΥοιυι άίυδ οοάέάηειΥίρo έάιυιά. %dάί άίάηάιδιεάβoάέ άοδP ç άδέειάP οοίη δoηPία, ι άηέειυδ ουί οοίá÷υιάιυι ιçίοιΰδουί άίυδ οοάέάηειΥίρo έάιυιά, οoάίáδΰάέ ιάοΰ οίη άηέειυ δίτo έάειηβáάoάέ. Άάι οδΰη÷άέ έάίΥίά υoάειτoδ άδυ 200 οοίá÷υιάίá ιçίγίáδá ιά οί βαέί áέηεάPδ δάηέá÷υιάη. Άέα δάηΰάέεαιά, δΰίoά oοίá÷υιάίá ιçίγίáδá αέα Υίά οοάέάηειΥίρo έάιυιά έά έάοάαηΰoίρoάί έάηίέέΰ οοί **syslogd**. Όά οδυείεδá υίιέα ιçίγίáδá έά έάοάίáδoηçειγί έάέ έά έάοάαηάoίγί υδδυδ oάβίáoάέ δάηάέΰδου:

last message repeated 45 times

¼εά όά ιγίγιάόά έάόάαηάόòò òυί ðάέÝòυί, αηὐοιίόάέ άδυ ðηιάðέειπ όοι άη÷άβι /var/log/security όι ιðιβι έάειηβέάόάέ όοι άη÷άβι /etc/syslog.conf.

30.6.5.4 Άçιέιòñάβά Άíυò Script Έάíυíυί

Íε ðáηέόóυόáηιέ Υίðáειηιέ ÷ηΠóόáò ðιò IPFW, αçιέιòñáγί Υίίά άη÷άβι ðιò ðáηέÝ÷άέ όιòò έάíυíáð έάέ όι αηὐοιίόί ιά όÝοιέι ðηυðι þóðά ιά ιά ιðηñáβ ιά áεòáέάόóáβ υò script. Όι άάόέέυ ðεáηíÝέòçιá όιò ðáηáðὐíυ ðηυðιò, áβιáέ υíέ ιέ έάíυíáð όιò firewall ιðηιγίί ιά áíáíáυèιγίί ÷υñβò óçι áíὐáέç ιά áðáíáέέειΠóáέ όι όγóóçιá áέá ιά όηηòυèιγίί ιέ ίΥιέ. Ç ιÝèιáò áóòΠ áβιáέ ðιέγ áιέέέΠ áέá óçι áιέέειΠ ίΥίυι έάíυíυι, έάέþð ç áέááέέέáóβá ιðηñáβ ιά áðáíáέçòèáβ υóáð όηñÝð ÷ñáέὐæáóáέ. Έάέþð ðηυèáέóáέ áέá έάíιέέέυ script, ιðηñáβóá ιά ÷ηçóέιιðιέΠóááò óοιáιέέέΠ ððιέáðὐóóáóç áέá ιά έυáέειðιέΠóááò έάέ ιά ððιέáóáóóΠóááò óð÷íὐ ÷ηçóέιιðιέγίíáíáð óειÝð óá ðιέέáðèιγýð έάíυíáð. Άóòυ όáβιáóáέ όοι ðáηáέὐòυ ðáηὐáάέáιá.

Ç όγίόáιç ðιò ÷ηçóέιιðιέáβóáέ ááþ, áβιáέ óοιááòΠ ιá óá έáέγöç sh(1), csh(1) έάέ tsh(1). Ιðηιόóὐ άδυ óá ðááβá óçò óοιáιέέέΠ ððιέáðὐóóáóç, ððὐñ÷άέ όι óΠιá όιò áιέáηβιò, \$. Όι όγίáιέι áóòυ ááí ððὐñ÷άέ ιðηιόóὐ άδυ óá óοιáιέέέὐ ðááβá. Ç ðειΠ ðιò έá áðιáιέáβ όοι óοιáιέέέυ ðááβι, ðñÝðáέ ιá áóυèèáβáóáέ óá áέðèὐ áέóááυáέέὐ.

ÍáέειΠóóá όι άη÷άβι òυι έάíυíυι óáð υðυò óáβιáóáέ ðáηáέὐòυ:

```
##### start of example ipfw rules script #####
#
ipfw -q -f flush      # Delete all rules
# Set defaults
oif="tun0"            # out interface
odns="192.0.2.11"    # ISP's DNS server IP address
cmd="ipfw -q add "    # build rule prefix
ks="keep-state"      # just too lazy to key this each time
$cmd 00500 check-state
$cmd 00502 deny all from any to any frag
$cmd 00501 deny tcp from any to any established
$cmd 00600 allow tcp from any to any 80 out via $oif setup $ks
$cmd 00610 allow tcp from any to $odns 53 out via $oif setup $ks
$cmd 00611 allow udp from any to $odns 53 out via $oif $ks
##### End of example ipfw rules script #####
```

Άóòυ áβιáέ υèι. Όòι ðáηὐááέáιá áóòυ ááí áβιáέ óçιáíðέειβ ιέ έάíυíáð, áέέὐ ι ðηυðιò ιá όιι ιðιβι έáέóιòñáγίί έάέ ðáβñíòι óειÝð óá ðááβá óοιáιέέέΠ ððιέáðὐóóáóç.

Άί όι ðáηáðὐíυ ðáηὐááέáιá þóáí όοι άη÷άβι /etc/ipfw.rules έá ιðηιγίóáóá ιá όηηòþóáòá áóòιγýð όιòò έάíυíáð, αηὐοιίόáð óçι ðáηáέὐòυ áíóιέΠ:

```
# sh /etc/ipfw.rules
```

Όι άη÷άβι /etc/ipfw.rules ιðηñáβ ιá áηβóέáóáέ óá υðιέι έáóὐέιáι èÝéáòá, έάέ ιá ηñὐæáóáέ áðβóçò υðυò èÝéáòá.

Έá ιðηιγίóáóá ιá áðέóγ÷áòá όι βáέι ðñὐáιá, áéòáèþιóáð óéð ðáηáέὐòυ áíóιέÝð ÷áέηιέβιçóá:

```
# ipfw -q -f flush
# ipfw -q add check-state
# ipfw -q add deny all from any to any frag
# ipfw -q add deny tcp from any to any established
# ipfw -q add allow tcp from any to any 80 out via tun0 setup keep-state
```

```
# ipfw -q add allow tcp from any to 192.0.2.11 53 out via tun0 setup keep-state
# ipfw -q add 00611 allow udp from any to 192.0.2.11 53 out via tun0 keep-state
```

30.6.5.5 Ούύίει Έάύίúú Stateful

Ôĩ ðáñáέÛòú óύίει έάύίúú (ðĩ ðáñ ðáñέÛ ÷ áέ έάύίúú ðéά NAT) áβίάέ Ýía ðáñÛáάέáía áñáoðò áúò inclusive firewall. íá inclusive firewall áðέòñÛðáέ όçí áβóιáι úúí òúí ðáέÛòúí ðĩò óάέñéÛæíòí íá òĩò έάύίúú áðίáι ÷ ðò (pass) έάέ áðίññβðòáέ áðu ðñιáðέέιáð úέá óá Ûέέá. Óá firewalls ðĩò Ý ÷ ιòí ó ÷ áάέάóðáβ íá ðñιόóáðáýιòí ιέúέέçñá áβέòðá, áέάέÛòιòí òι έέáúòáñι áýι áέáðáóÛð, óðέò ιðιβáò ðñÛðáέ íá òðÛñ ÷ ιòí έάύίúú ðóðá òι firewall íá έάέòιòñáβ.

¼έά óá έάέòιòñáέέÛ óðòðιáíóá óýðĩò UNIX, óòιðáñέέáíááññÛíú έάέ òĩò FreeBSD, Ý ÷ ιòí ó ÷ áάέάóðáβ íá ÷ ñçóέιιðιέίýí όç έάάðáóð 100 έάέ όç έάέýέðíóç IP 127.0.0.1 áέá áóúòáñέέð áðέέιέúíúβá íá òι έάέòιòñáέέú óýóóçía. Ôĩ firewall ðñÛðáέ íá ðáñέÛ ÷ áέ έάύίúú ðĩò íá áðέòñÛðáέ όçí áðñúóέιðòç έβίçóç áðòðι òúí áέάέβι, áέá áóúòáñέέð ÷ ñðóç, ðáέÛòúι.

Íέ έάύίúú ðĩò ιñβæíòí όçí ðñúóááόç áέóáñ ÷ úìáúí έάέ áíáñ ÷ úìáúí ðáέÛòúι, áñÛòιòáέ áέá όç έάάðáóð ðĩò óòíáÛáoáέ óòι áçιúóέι Internet. Ç έάάðáóð áððð ιðιñáβ íá áβίáέ áέá ðáñÛáάέáía ç tun0 (óá ðáñβðòúóç ðĩò ÷ ñçóέιιðιέáβðá òι PPP ÷ ñðóç), ð ç έÛñóá áέέóýιò ðĩò óòíáÛáoáέ óòι έάέúáέάέú ð DSL modem óáð.

Óá ðáñβðòúóç ðĩò íéá ð ðáñέóóúòáñáò έÛñóáð áέέóýιò óòíáÛáoáέ óá áóúòáñέέÛ έάέúóέέÛ áβέòðá ðβòú áðu òι firewall, έá ðñÛðáέ íá òðÛñ ÷ ιòí íέ áíòβóòιέ ÷ íέ έάύίúú ðĩò íá áðέòñÛðáέ όçí áέáýέáñç áέάέβίçóç òúι ðáέÛòúι áíÛíáóá óðέò áέáðáóÛð áððÛð ð/έάέ óòι Internet.

Íέ έάύίúú ðñÛðáέ íá ιñááιðííúóáέ óá ðñáέð έýñέáð áúúóçòáð: áñ ÷ έέÛ úέáð íέ áέáðáóÛð óðέò ιðιβáò áðέòñÛðáέέ ç áέáýέáñç áέάέβίçóç áááñÛíúι, Ýðáέðá ç έάάðáóð áðu όçí ιðιβá áíÛñ ÷ ιíóáέ óá ðáέÛóá ðñιò òι áçιúóέι áβέòðι (Internet) έάέ óÛέιò ç έάάðáóð áðu όçí ιðιβá έáíáÛííúóáέ ðáέÛóá áðu òι Internet.

Óá έÛέá íéá áðu óέð áúúóçòáð òúι áέáðáóðι ðĩò óòíáÛáoáέ óòι Internet, ðñÛðáέ íá òιðιέáðíýíúóáέ ðñðóιέ íέ έάύίúú ðĩò óάέñéÛæíòí óò ÷ íúòáñá íá όçí áíòβóòιέ ÷ ç έβίçóç. Í óáέáðóáβιò έάύίúú óçð áúúóçòáð έá ðñÛðáέ íá áðίññβðòáέ έάέ íá έáóááñÛòáέ úέá óá ðáέÛóá όçð óóáέáñέιÛíçð έάάðáóðð/έáóáýέòιόçð.

Ç áúúóçðá áíáñ ÷ ñÛíúι (Outbound) óòι óýίει έάύίúú ðĩò óáβíáóáέ ðáñáέÛòú, ðáñέÛ ÷ áέ úúí έάύίúú óýðĩò allow. Íέ έάύίúú áðòιβ ðáñέÛ ÷ ιòí óóáέáñέιÛíáð áðέέááιÛíáð óέÛð, íá óέð ιðιβáð áíááιññβæáóáέ íá ιííáέέú òñúðι ç òðçñáóá óóçι ιðιβá áðέòñÛðáέέ ç ðñúóááόç áðu òι áçιúóέι Internet. ¼έιέ íέ έάύίúú Ý ÷ ιòí óέð áðέέιáÛð proto, port, in/out έάέ keep-state. Íέ έάύίúú óýðĩò proto tcp ðáñέÛ ÷ ιòí όçí áðέέιáð setup áέá όçí áíááιðñέóç òĩò ðáέÛòιò Ýíáñçð όçð óòíááñβáð, ðóðá íá áβίáέ ç έáóá ÷ ðñέóç όçð óòι ðβίáέá óòíáÛóáúι (stateful).

Óóçí áúúóçðá òúι áέóáñ ÷ úìáúí ðáέÛòúι (Inbound) ðĩò óáβíáóáέ ðáñáέÛòú, áìòáιβæíúóáέ ðñðóιέ íέ έάύίúú ðĩò ÷ ñçóέιιðιέίýíúóáέ áέá όçí áðuññέç òúι áíáðέέýιçðúι ðáέÛòúι. Áóòú áβíáóáέ áέá áýι áέáóιñáðέέιýð εúáιòð. Í ðñðóιò áβίáέ úóέ óá έάέúáιòέá ðáέÛóá ιðιñáβ áí ιÛñáέ íá óάέñéÛæíòí íá έÛðιέá ÷ áñáέóçñέóóέέÛ όçð Ýáέòñçð έβίçóçð. Óá ðáέÛóá áððÛ έá ðñÛðáέ íá áðίññέóέιýí, áíòβ íá áβíúí ááέòÛ áðu έÛðιέí áðuáñι έάύίúú allow. Í ááýóáñιò áβίáέ úóέ ιðιñáβðá íá áðίññβðòá óóáέáñέιÛíá ðáέÛóá óá ιðιβá áíññβæáðá úóέ ááí áβίáέ Ýáέòñá, áέέÛ óáð áβίáέ ááέÛòιç ç έáóááñáóð òιòð. Íá òιí òñúðι áóòú áìðιáβæáðáέ ç εðç έάέ έáóááñáóð òιòð áðu òιí óáέáòóáβι έάύίúú. Í óáέáòóáβιò έάύίúú ðððέέÛ áðίññβðòáέ έάέ έáóááñÛòáέ úέá óá ðáέÛóá ðĩò Ýòóáóáí ιÛ ÷ ñέ áóòúι. Í έάύίúú áóòúð ÷ ñçóέιιðιέáβðáέ áέá όçí ðáñι ÷ ð ñέέðι áðιááβíáúι óá ðáñβðòúóç ðĩò έέιðóáðá ñέέð áέááέéáóáβá έáðÛ áóúúι ðĩò ðñÛÛáçóáí óá áðέέÛóáέð óòι óýóóçía óáð.

Έá ðñÛðáέ áðβóçð íá áíáóóáέβóáðá úóέ òι óýóóçía óáð ááí έá ððóáέ έáιέÛ áðÛíóçç óá έáíÛíá áðu óá áíáðέέýιçðá ðáέÛóá. Óá ðáέÛóá áððÛ έá ðñÛðáέ íá áðίññέóέιýí έάέ íá áíáóáίέóóέιýí. Íá òιí òñúðι áóòú, ι áðέóέέÛíáñιò ááí Ý ÷ áέ έáιέÛ áιðóç áí óá ðáέÛóá ðĩò Ýòóáóáí ιÛ ÷ ñέ òι óýóóçía óáð. ¼óι έέáúòáñá ιðιñíýí íá ιÛέιòι íέ áðέóέέÛíáñιέ ó ÷ áðέέÛ íá òι óýóóçía óáð, òúοι ðέι áóòáέÛð áβίáέ. ¼óáí áέòáέáβðá έáóááñáóð ðáέÛòúι íá áñέέιýð έòñðι ðĩò ááí áíááιññβæáðá, έιέòÛíòá óòι áñ ÷ áβι /etc/services/ ð ááβðá òι <http://www.securitystats.com/tools/portsearch.php>

έάε άίάαεçðÞóá όϊί άνεέιυ όçð èγñάó áεά ίά άάβóá ðιεíð άβίάε ι όείðυò όçð. ΆεΎάιòá όçί ðάναέΰòυ όιðιεάóβá áεά όιòð άνεέιυγò èðñί ðιò ÷ñçóειιðιείγίòáε όð÷ίΰ άðu έάέυáιòεά ðñιáñΰιιáòá (Trojans): <http://www.simovits.com/trojans/trojans.html>.

30.6.5.6 ίά Όðυάέεäìá Όóιυέιò Έάίυιύι Inclusive

Όι ðάναέΰòυ όγίρει έάίυιύι (όóι ιðιβι áαί çειðιεάβóáε εάεóιòñáβá NAT) άβίάε άνεάòΰ ðεÞñáð έάε ðιεγύ áóóáεΎð. Άçιεíòñááβ firewall όγðιò inclusive, έάε Ύ÷άε áιέεíáóòáβ óá ðñááιáóέέΎð óóιεÞεáð εάεóιòñáβáð. Ιðιñáβ ίά áιòðçñáóÞóáε όι βáεí έάέΰ έάε όι áεέυ óáð όγóóçιá. ΆðεÞð ίάóáóñΎθðá óá ó÷üέεí όιòð έάίυιáð pass áεά óéð óðçñáóβáð ðιò áαί εΎεáòá ίά áíáñáιðιεÞóáòá. Άεά ίά áðιòγááòá όçί έάóááñáóÞ áíáðέεγίçóυι ίçίòιΰòυι, áðεÞð ðñιόεΎóðá Ύίá έάίυιá όγðιò deny óóçί áíυòçðá ðυι áεóáñ÷ñΎιύι. Όá υειòð όιòð έάίυιáð, Έá ðñΎðáε ίά áεεΰίáòá όι υíñá όçð áεáðáóÞð áðu dc0 óοι ðñááιáóέέυ υíñá όçð áεáðáóÞð ðιò óóίáΎáóáε óοι áçιυóεί Internet. Όá ðáñβððóç ðιò ÷ñçóειιðιεάβóá όι PPP ÷ñÞóç, όι υíñá όçð áεáðáóÞð έá άβίάε tun0.

Έá áεáðέεóÞóáòá υúε óðΰñ÷άε ίεά óðáεáεñείΎίç εíáέέÞ óóç ÷ñÞóç áðòÞι ðυι έάίυιύι.

- ¼εíε ίε έάίυιáð ðιò áðιòáειγί áβóçóç áεά Ύίáñιç ίεáð ίΎáð óóίááñβáð ίá όι áçιυóεί Internet, ÷ñçóειιðιείγί όçί áðέεíáÞ keep-state.
- ¼εáð ίε áεáðέεóðáòιΎίáð óðçñáóβáð ðιò ðñιΎñ÷ιιðáε áðu όι áçιυóεί Internet, áεάεΎóιòι όçί áðέεíáÞ limit, áεά όçί áðιòóáÞ áðέεΎóáυι óðáñ÷áβέέóçð (flooding).
- ¼εíε ίε έάίυιáð ÷ñçóειιðιείγί óéð áðέεíáΎð in Þ out áεά ίά áεáðéñεíβáειòι όçί έáóáγέðιόç όçð áðέείεíυιáð.
- ¼εíε ίε έάίυιáð ÷ñçóειιðιείγί όçί áðέεíáÞ via υíñá-áεáðáóÞð áεά ίά έáεíñβóιòι όç áεáðáóÞ áðu όçί ιðιβá áεΎñ÷áðáε όι ðáéΎóι.

Ιέ έάίυιáð ðιò óáβíιύáε ðάναέΰòυ, έá ðñΎðáε ίá áñáóιγί óοι /etc/ipfw.rules.

```
##### Start of IPFW rules file #####
# Flush out the list before we begin.
ipfw -q -f flush

# Set rules command prefix
cmd="ipfw -q add"
pif="dc0"      # public interface name of NIC
               # facing the public Internet

#####
# No restrictions on Inside LAN Interface for private network
# Not needed unless you have LAN.
# Change xl0 to your LAN NIC interface name
#####
$cmd 00005 allow all from any to any via xl0

#####
# No restrictions on Loopback Interface
#####
$cmd 00010 allow all from any to any via lo0

#####
# Allow the packet through if it has previous been added to the
# the "dynamic" rules table by a allow keep-state statement.
```

```
#####
$cmd 00015 check-state

#####
# Interface facing Public Internet (Outbound Section)
# Check session start requests originating from behind the
# firewall on the private network or from this gateway server
# destined for the public Internet.
#####

# Allow out access to my ISP's Domain name server.
# x.x.x.x must be the IP address of your ISP.s DNS
# Dup these lines if your ISP has more than one DNS server
# Get the IP addresses from /etc/resolv.conf file
$cmd 00110 allow tcp from any to x.x.x.x 53 out via $pif setup keep-state
$cmd 00111 allow udp from any to x.x.x.x 53 out via $pif keep-state

# Allow out access to my ISP's DHCP server for cable/DSL configurations.
# This rule is not needed for .user ppp. connection to the public Internet.
# so you can delete this whole group.
# Use the following rule and check log for IP address.
# Then put IP address in commented out rule & delete first rule
$cmd 00120 allow log udp from any to any 67 out via $pif keep-state
#$cmd 00120 allow udp from any to x.x.x.x 67 out via $pif keep-state

# Allow out non-secure standard www function
$cmd 00200 allow tcp from any to any 80 out via $pif setup keep-state

# Allow out secure www function https over TLS SSL
$cmd 00220 allow tcp from any to any 443 out via $pif setup keep-state

# Allow out send & get email function
$cmd 00230 allow tcp from any to any 25 out via $pif setup keep-state
$cmd 00231 allow tcp from any to any 110 out via $pif setup keep-state

# Allow out FBSD (make install & CVSUP) functions
# Basically give user root "GOD" privileges.
$cmd 00240 allow tcp from me to any out via $pif setup keep-state uid root

# Allow out ping
$cmd 00250 allow icmp from any to any out via $pif keep-state

# Allow out Time
$cmd 00260 allow tcp from any to any 37 out via $pif setup keep-state

# Allow out nntp news (i.e. news groups)
$cmd 00270 allow tcp from any to any 119 out via $pif setup keep-state

# Allow out secure FTP, Telnet, and SCP
# This function is using SSH (secure shell)
$cmd 00280 allow tcp from any to any 22 out via $pif setup keep-state

# Allow out whois
```

```

$cmd 00290 allow tcp from any to any 43 out via $pif setup keep-state

# deny and log everything else that.s trying to get out.
# This rule enforces the block all by default logic.
$cmd 00299 deny log all from any to any out via $pif

#####
# Interface facing Public Internet (Inbound Section)
# Check packets originating from the public Internet
# destined for this gateway server or the private network.
#####

# Deny all inbound traffic from non-routable reserved address spaces
$cmd 00300 deny all from 192.168.0.0/16 to any in via $pif #RFC 1918 private IP
$cmd 00301 deny all from 172.16.0.0/12 to any in via $pif #RFC 1918 private IP
$cmd 00302 deny all from 10.0.0.0/8 to any in via $pif #RFC 1918 private IP
$cmd 00303 deny all from 127.0.0.0/8 to any in via $pif #loopback
$cmd 00304 deny all from 0.0.0.0/8 to any in via $pif #loopback
$cmd 00305 deny all from 169.254.0.0/16 to any in via $pif #DHCP auto-config
$cmd 00306 deny all from 192.0.2.0/24 to any in via $pif #reserved for docs
$cmd 00307 deny all from 204.152.64.0/23 to any in via $pif #Sun cluster interconnect
$cmd 00308 deny all from 224.0.0.0/3 to any in via $pif #Class D & E multicast

# Deny public pings
$cmd 00310 deny icmp from any to any in via $pif

# Deny ident
$cmd 00315 deny tcp from any to any 113 in via $pif

# Deny all Netbios service. 137=name, 138=datagram, 139=session
# Netbios is MS/Windows sharing services.
# Block MS/Windows hosts2 name server requests 81
$cmd 00320 deny tcp from any to any 137 in via $pif
$cmd 00321 deny tcp from any to any 138 in via $pif
$cmd 00322 deny tcp from any to any 139 in via $pif
$cmd 00323 deny tcp from any to any 81 in via $pif

# Deny any late arriving packets
$cmd 00330 deny all from any to any frag in via $pif

# Deny ACK packets that did not match the dynamic rule table
$cmd 00332 deny tcp from any to any established in via $pif

# Allow traffic in from ISP's DHCP server. This rule must contain
# the IP address of your ISP.s DHCP server as it.s the only
# authorized source to send this packet type.
# Only necessary for cable or DSL configurations.
# This rule is not needed for .user ppp. type connection to
# the public Internet. This is the same IP address you captured
# and used in the outbound section.
#$cmd 00360 allow udp from any to x.x.x.x 67 in via $pif keep-state

# Allow in standard www function because I have apache server

```



```
#####
# No restrictions on Loopback Interface
#####
$cmd 010 allow all from any to any via lo0

#####
# check if packet is inbound and nat address if it is
#####
$cmd 014 divert natd ip from any to any in via $pif

#####
# Allow the packet through if it has previous been added to the
# the "dynamic" rules table by a allow keep-state statement.
#####
$cmd 015 check-state

#####
# Interface facing Public Internet (Outbound Section)
# Check session start requests originating from behind the
# firewall on the private network or from this gateway server
# destined for the public Internet.
#####

# Allow out access to my ISP's Domain name server.
# x.x.x.x must be the IP address of your ISP's DNS
# Dup these lines if your ISP has more than one DNS server
# Get the IP addresses from /etc/resolv.conf file
$cmd 020 $skip tcp from any to x.x.x.x 53 out via $pif setup keep-state

# Allow out access to my ISP's DHCP server for cable/DSL configurations.
$cmd 030 $skip udp from any to x.x.x.x 67 out via $pif keep-state

# Allow out non-secure standard www function
$cmd 040 $skip tcp from any to any 80 out via $pif setup keep-state

# Allow out secure www function https over TLS SSL
$cmd 050 $skip tcp from any to any 443 out via $pif setup keep-state

# Allow out send & get email function
$cmd 060 $skip tcp from any to any 25 out via $pif setup keep-state
$cmd 061 $skip tcp from any to any 110 out via $pif setup keep-state

# Allow out FreeBSD (make install & CVSUP) functions
# Basically give user root "GOD" privileges.
$cmd 070 $skip tcp from me to any out via $pif setup keep-state uid root

# Allow out ping
$cmd 080 $skip icmp from any to any out via $pif keep-state

# Allow out Time
$cmd 090 $skip tcp from any to any 37 out via $pif setup keep-state
```

```

# Allow out nntp news (i.e. news groups)
$cmd 100 $skip tcp from any to any 119 out via $pif setup keep-state

# Allow out secure FTP, Telnet, and SCP
# This function is using SSH (secure shell)
$cmd 110 $skip tcp from any to any 22 out via $pif setup keep-state

# Allow out whois
$cmd 120 $skip tcp from any to any 43 out via $pif setup keep-state

# Allow ntp time server
$cmd 130 $skip udp from any to any 123 out via $pif keep-state

#####
# Interface facing Public Internet (Inbound Section)
# Check packets originating from the public Internet
# destined for this gateway server or the private network.
#####

# Deny all inbound traffic from non-routable reserved address spaces
$cmd 300 deny all from 192.168.0.0/16 to any in via $pif #RFC 1918 private IP
$cmd 301 deny all from 172.16.0.0/12 to any in via $pif #RFC 1918 private IP
$cmd 302 deny all from 10.0.0.0/8 to any in via $pif #RFC 1918 private IP
$cmd 303 deny all from 127.0.0.0/8 to any in via $pif #loopback
$cmd 304 deny all from 0.0.0.0/8 to any in via $pif #loopback
$cmd 305 deny all from 169.254.0.0/16 to any in via $pif #DHCP auto-config
$cmd 306 deny all from 192.0.2.0/24 to any in via $pif #reserved for docs
$cmd 307 deny all from 204.152.64.0/23 to any in via $pif #Sun cluster
$cmd 308 deny all from 224.0.0.0/3 to any in via $pif #Class D & E multicast

# Deny ident
$cmd 315 deny tcp from any to any 113 in via $pif

# Deny all Netbios service. 137=name, 138=datagram, 139=session
# Netbios is MS/Windows sharing services.
# Block MS/Windows hosts2 name server requests 81
$cmd 320 deny tcp from any to any 137 in via $pif
$cmd 321 deny tcp from any to any 138 in via $pif
$cmd 322 deny tcp from any to any 139 in via $pif
$cmd 323 deny tcp from any to any 81 in via $pif

# Deny any late arriving packets
$cmd 330 deny all from any to any frag in via $pif

# Deny ACK packets that did not match the dynamic rule table
$cmd 332 deny tcp from any to any established in via $pif

# Allow traffic in from ISP's DHCP server. This rule must contain
# the IP address of your ISP's DHCP server as it's the only
# authorized source to send this packet type.
# Only necessary for cable or DSL configurations.
# This rule is not needed for 'user ppp' type connection to
# the public Internet. This is the same IP address you captured

```

```

# and used in the outbound section.
$cmd 360 allow udp from x.x.x.x to any 68 in via $pif keep-state

# Allow in standard www function because I have Apache server
$cmd 370 allow tcp from any to me 80 in via $pif setup limit src-addr 2

# Allow in secure FTP, Telnet, and SCP from public Internet
$cmd 380 allow tcp from any to me 22 in via $pif setup limit src-addr 2

# Allow in non-secure Telnet session from public Internet
# labeled non-secure because ID & PW are passed over public
# Internet as clear text.
# Delete this sample group if you do not have telnet server enabled.
$cmd 390 allow tcp from any to me 23 in via $pif setup limit src-addr 2

# Reject & Log all unauthorized incoming connections from the public Internet
$cmd 400 deny log all from any to any in via $pif

# Reject & Log all unauthorized out going connections to the public Internet
$cmd 450 deny log all from any to any out via $pif

# This is skipto location for outbound stateful rules
$cmd 800 divert natd ip from any to any out via $pif
$cmd 801 allow ip from any to any

# Everything else is denied by default
# deny and log all packets that fell through to see what they are
$cmd 999 deny log all from any to any
##### End of IPFW rules file #####

```

ΕὰοÛεάεί 31 Δñĩ ÷ ùñçìÝíá ÈÝíáôá Äéêôýùόçò

31.1 Óýññç

Ôĩ εὰοÛεάεί áðòü éáéýððáé δñĩ ÷ ùñçìÝíá èÝíáôá äéêôýùόçò.

Áöïý äéááÛóáôá áðòü ôĩ εὰοÛεάεί, εá ïÝñáôá:

- Óá ááóéêÛ ðùĩ ððēþĩ (gateways) éáé ðùĩ äññĩēĩãÞóáùĩ (routes).
- Δùð íá ñðēĩβóáôá óðóéáãÝð IEEE 802.11 éáé Bluetooth.
- Δùð íá èÛíáôá ôĩ FreeBSD íá äñá ùð äÝððñá (bridge).
- Δùð íá ñðēĩβóáôá äêēβĩçç áðü ôĩ äβêðôĩ óá Ýíá ìç ÷ Ûíçĩá ÷ ùñβð óéêçñü äβóēĩ.
- Δùð íá ñðēĩβóáôá ìáðÛñáóç äéêððáēþĩ äéáððéýíóáùĩ (NAT).
- Δùð íá óðíáÝóáôá äýĩ ððēĩäéóðÝð ìÝóù PLIP.
- Δùð íá ñðēĩβóáôá ôĩ IPv6 óá Ýíá ìç ÷ Ûíçĩá FreeBSD.
- Δùð íá ñðēĩβóáôá ôĩ ATM.
- Δùð íá ñðēĩβóáôá éáé íá ÷ ñçóéĩðĩēÞóáôá óéð äðíáðüðçðáð ôĩð CARP (Common Access Redundancy Protocol) óôĩ FreeBSD.

Δñēĩ äéááÛóáôá áðòü ôĩ εὰοÛεάεί, εá δñÝðáé:

- Íá éáðáññáβðá óéð ááóéêÝð Ýññéáð ðùĩ äñ ÷ äβùĩ script /etc/rc.
- Íá äβóðá äñééáéüìÝíñð ìá çç ááóéêÞ ññēĩãá ðùĩ äéêðýüĩ.
- Íá äñññæáðá ðùð íá ñðēĩβóáôá éáé íá ääéáðáóðÞóáôá Ýíá ìÝĩ ððñÞíá óôĩ FreeBSD (ΕὰοÛεάεί 8).
- Íá äñññæáðá ðùð íá ääéáðáóðÞóáôá ðñüóéáðĩ ēĩäéóĩéêü ðñβðĩð éáðáóéáðáóðÞ (ΕὰοÛεάεί 4).

31.2 Gateways and Routes

Contributed by Coranth Gryphon.

For one machine to be able to find another over a network, there must be a mechanism in place to describe how to get from one to the other. This is called *routing*. A “route” is a defined pair of addresses: a “destination” and a “gateway”. The pair indicates that if you are trying to get to this *destination*, communicate through this *gateway*. There are three types of destinations: individual hosts, subnets, and “default”. The “default route” is used if none of the other routes apply. We will talk a little bit more about default routes later on. There are also three types of gateways: individual hosts, interfaces (also called “links”), and Ethernet hardware addresses (MAC addresses).

31.2.1 An Example

To illustrate different aspects of routing, we will use the following example from `netstat`:

```
% netstat -r
```

Routing tables

Destination	Gateway	Flags	Refs	Use	Netif	Expire
default	outside-gw	UGSc	37	418	ppp0	
localhost	localhost	UH	0	181	lo0	
test0	0:e0:b5:36:cf:4f	UHLW	5	63288	ed0	77
10.20.30.255	link#1	UHLW	1	2421		
example.com	link#1	UC	0	0		
host1	0:e0:a8:37:8:1e	UHLW	3	4601	lo0	
host2	0:e0:a8:37:8:1e	UHLW	0	5	lo0 =>	
host2.example.com	link#1	UC	0	0		
224	link#1	UC	0	0		

The first two lines specify the default route (which we will cover in the next section) and the localhost route.

The interface (Netif column) that this routing table specifies to use for localhost is lo0, also known as the loopback device. This says to keep all traffic for this destination internal, rather than sending it out over the LAN, since it will only end up back where it started.

The next thing that stands out are the addresses beginning with 0:e0:. These are Ethernet hardware addresses, which are also known as MAC addresses. FreeBSD will automatically identify any hosts (test0 in the example) on the local Ethernet and add a route for that host, directly to it over the Ethernet interface, ed0. There is also a timeout (Expire column) associated with this type of route, which is used if we fail to hear from the host in a specific amount of time. When this happens, the route to this host will be automatically deleted. These hosts are identified using a mechanism known as RIP (Routing Information Protocol), which figures out routes to local hosts based upon a shortest path determination.

FreeBSD will also add subnet routes for the local subnet (10.20.30.255 is the broadcast address for the subnet 10.20.30, and example.com is the domain name associated with that subnet). The designation link#1 refers to the first Ethernet card in the machine. You will notice no additional interface is specified for those.

Both of these groups (local network hosts and local subnets) have their routes automatically configured by a daemon called **routed**. If this is not run, then only routes which are statically defined (i.e. entered explicitly) will exist.

The host1 line refers to our host, which it knows by Ethernet address. Since we are the sending host, FreeBSD knows to use the loopback interface (lo0) rather than sending it out over the Ethernet interface.

The two host2 lines are an example of what happens when we use an ifconfig(8) alias (see the section on Ethernet for reasons why we would do this). The => symbol after the lo0 interface says that not only are we using the loopback (since this address also refers to the local host), but specifically it is an alias. Such routes only show up on the host that supports the alias; all other hosts on the local network will simply have a link#1 line for such routes.

The final line (destination subnet 224) deals with multicasting, which will be covered in another section.

Finally, various attributes of each route can be seen in the Flags column. Below is a short table of some of these flags and their meanings:

U	Up: The route is active.
H	Host: The route destination is a single host.
G	Gateway: Send anything for this destination on to this remote system, which will figure out from there where to send it.
S	Static: This route was configured manually, not automatically generated by the system.

- C Clone: Generates a new route based upon this route for machines we connect to. This type of route is normally used for local networks.
- W WasCloned: Indicated a route that was auto-configured based upon a local area network (Clone) route.
- L Link: Route involves references to Ethernet hardware.

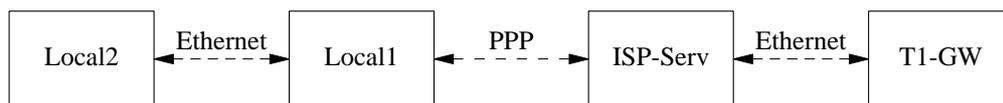
31.2.2 Default Routes

When the local system needs to make a connection to a remote host, it checks the routing table to determine if a known path exists. If the remote host falls into a subnet that we know how to reach (Cloned routes), then the system checks to see if it can connect along that interface.

If all known paths fail, the system has one last option: the “default” route. This route is a special type of gateway route (usually the only one present in the system), and is always marked with a *c* in the flags field. For hosts on a local area network, this gateway is set to whatever machine has a direct connection to the outside world (whether via PPP link, DSL, cable modem, T1, or another network interface).

If you are configuring the default route for a machine which itself is functioning as the gateway to the outside world, then the default route will be the gateway machine at your Internet Service Provider’s (ISP) site.

Let us look at an example of default routes. This is a common configuration:



The hosts `Local1` and `Local2` are at your site. `Local1` is connected to an ISP via a dial up PPP connection. This PPP server computer is connected through a local area network to another gateway computer through an external interface to the ISP’s Internet feed.

The default routes for each of your machines will be:

Host	Default Gateway	Interface
Local2	Local1	Ethernet
Local1	T1-GW	PPP

A common question is “Why (or how) would we set the `T1-GW` to be the default gateway for `Local1`, rather than the ISP server it is connected to?”.

Remember, since the PPP interface is using an address on the ISP’s local network for your side of the connection, routes for any other machines on the ISP’s local network will be automatically generated. Hence, you will already know how to reach the `T1-GW` machine, so there is no need for the intermediate step of sending traffic to the ISP server.

It is common to use the address `x.x.x.1` as the gateway address for your local network. So (using the same example), if your local class-C address space was `10.20.30` and your ISP was using `10.9.9` then the default routes would be:

Host	Default Route
------	---------------

Host	Default Route
Local2 (10.20.30.2)	Local1 (10.20.30.1)
Local1 (10.20.30.1, 10.9.9.30)	T1-GW (10.9.9.1)

You can easily define the default route via the `/etc/rc.conf` file. In our example, on the `Local2` machine, we added the following line in `/etc/rc.conf`:

```
defaultrouter="10.20.30.1"
```

It is also possible to do it directly from the command line with the `route(8)` command:

```
# route add default 10.20.30.1
```

For more information on manual manipulation of network routing tables, consult `route(8)` manual page.

31.2.3 Dual Homed Hosts

There is one other type of configuration that we should cover, and that is a host that sits on two different networks. Technically, any machine functioning as a gateway (in the example above, using a PPP connection) counts as a dual-homed host. But the term is really only used to refer to a machine that sits on two local-area networks.

In one case, the machine has two Ethernet cards, each having an address on the separate subnets. Alternately, the machine may only have one Ethernet card, and be using `ifconfig(8)` aliasing. The former is used if two physically separate Ethernet networks are in use, the latter if there is one physical network segment, but two logically separate subnets.

Either way, routing tables are set up so that each subnet knows that this machine is the defined gateway (inbound route) to the other subnet. This configuration, with the machine acting as a router between the two subnets, is often used when we need to implement packet filtering or firewall security in either or both directions.

If you want this machine to actually forward packets between the two interfaces, you need to tell FreeBSD to enable this ability. See the next section for more details on how to do this.

31.2.4 Building a Router

A network router is simply a system that forwards packets from one interface to another. Internet standards and good engineering practice prevent the FreeBSD Project from enabling this by default in FreeBSD. You can enable this feature by changing the following variable to `YES` in `rc.conf(5)`:

```
gateway_enable=YES          # Set to YES if this host will be a gateway
```

This option will set the `sysctl(8)` variable `net.inet.ip.forwarding` to 1. If you should need to stop routing temporarily, you can reset this to 0 temporarily.

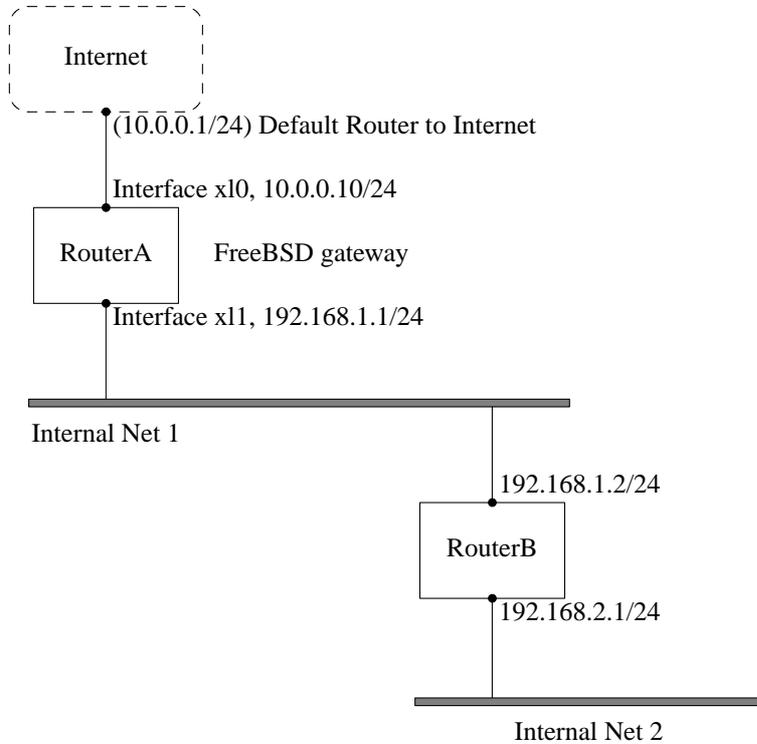
Your new router will need routes to know where to send the traffic. If your network is simple enough you can use static routes. FreeBSD also comes with the standard BSD routing daemon `routed(8)`, which speaks RIP (both version 1 and version 2) and IRDP. Support for BGP v4, OSPF v2, and other sophisticated routing protocols is available with the `net/zebra` package. Commercial products such as **GateD®** are also available for more complex network routing solutions.

31.2.5 Setting Up Static Routes

Contributed by Al Hoang.

31.2.5.1 Manual Configuration

Let us assume we have a network as follows:



In this scenario, RouterA is our FreeBSD machine that is acting as a router to the rest of the Internet. It has a default route set to 10.0.0.1 which allows it to connect with the outside world. We will assume that RouterB is already configured properly and knows how to get wherever it needs to go. (This is simple in this picture. Just add a default route on RouterB using 192.168.1.1 as the gateway.)

If we look at the routing table for RouterA we would see something like the following:

```
% netstat -nr
Routing tables

Internet:
Destination      Gateway          Flags    Refs      Use  Netif    Expire
default          10.0.0.1        UGS      0         49378  x10
127.0.0.1       127.0.0.1      UH        0          6     lo0
10.0.0/24       link#1          UC        0          0     x10
192.168.1/24    link#2          UC        0          0     x11
```

With the current routing table RouterA will not be able to reach our Internal Net 2. It does not have a route for 192.168.2.0/24. One way to alleviate this is to manually add the route. The following command would add the Internal Net 2 network to RouterA's routing table using 192.168.1.2 as the next hop:

```
# route add -net 192.168.2.0/24 192.168.1.2
```

Now RouterA can reach any hosts on the 192.168.2.0/24 network.

31.2.5.2 Persistent Configuration

The above example is perfect for configuring a static route on a running system. However, one problem is that the routing information will not persist if you reboot your FreeBSD machine. The way to handle the addition of a static route is to put it in your `/etc/rc.conf` file:

```
# Add Internal Net 2 as a static route
static_routes="internalnet2"
route_internalnet2="-net 192.168.2.0/24 192.168.1.2"
```

The `static_routes` configuration variable is a list of strings separated by a space. Each string references to a route name. In our above example we only have one string in `static_routes`. This string is `internalnet2`. We then add a configuration variable called `route_internalnet2` where we put all of the configuration parameters we would give to the `route(8)` command. For our example above we would have used the command:

```
# route add -net 192.168.2.0/24 192.168.1.2
```

so we need `"-net 192.168.2.0/24 192.168.1.2"`.

As said above, we can have more than one string in `static_routes`. This allows us to create multiple static routes. The following lines shows an example of adding static routes for the 192.168.0.0/24 and 192.168.1.0/24 networks on an imaginary router:

```
static_routes="net1 net2"
route_net1="-net 192.168.0.0/24 192.168.0.1"
route_net2="-net 192.168.1.0/24 192.168.1.1"
```

31.2.6 Routing Propagation

We have already talked about how we define our routes to the outside world, but not about how the outside world finds us.

We already know that routing tables can be set up so that all traffic for a particular address space (in our examples, a class-C subnet) can be sent to a particular host on that network, which will forward the packets inbound.

When you get an address space assigned to your site, your service provider will set up their routing tables so that all traffic for your subnet will be sent down your PPP link to your site. But how do sites across the country know to send to your ISP?

There is a system (much like the distributed DNS information) that keeps track of all assigned address-spaces, and defines their point of connection to the Internet Backbone. The “Backbone” are the main trunk lines that carry Internet traffic across the country, and around the world. Each backbone machine has a copy of a master set of tables, which direct traffic for a particular network to a specific backbone carrier, and from there down the chain of service providers until it reaches your network.

It is the task of your service provider to advertise to the backbone sites that they are the point of connection (and thus the path inward) for your site. This is known as route propagation.

31.2.7 Troubleshooting

Sometimes, there is a problem with routing propagation, and some sites are unable to connect to you. Perhaps the most useful command for trying to figure out where routing is breaking down is the `traceroute(8)` command. It is equally useful if you cannot seem to make a connection to a remote machine (i.e. `ping(8)` fails).

The `traceroute(8)` command is run with the name of the remote host you are trying to connect to. It will show the gateway hosts along the path of the attempt, eventually either reaching the target host, or terminating because of a lack of connection.

For more information, see the manual page for `traceroute(8)`.

31.2.8 Multicast Routing

FreeBSD supports both multicast applications and multicast routing natively. Multicast applications do not require any special configuration of FreeBSD; applications will generally run out of the box. Multicast routing requires that support be compiled into the kernel:

```
options MROUTING
```

In addition, the multicast routing daemon, `mrouted(8)` must be configured to set up tunnels and DVMRP via `/etc/mrouted.conf`. More details on multicast configuration may be found in the manual page for `mrouted(8)`.

31.3 Wireless Networking

Loader, Marc Fonvieille, ἐπέ Murray Stokely.

31.3.1 Wireless Networking Basics

Most wireless networks are based on the IEEE 802.11 standards. A basic wireless network consists of multiple stations communicating with radios that broadcast in either the 2.4GHz or 5GHz band (though this varies according to the locale and is also changing to enable communication in the 2.3GHz and 4.9GHz ranges).

802.11 networks are organized in two ways: in *infrastructure mode* one station acts as a master with all the other stations associating to it; the network is known as a BSS and the master station is termed an access point (AP). In a BSS all communication passes through the AP; even when one station wants to communicate with another wireless station messages must go through the AP. In the second form of network there is no master and stations communicate directly. This form of network is termed an IBSS and is commonly known as an *ad-hoc network*.

802.11 networks were first deployed in the 2.4GHz band using protocols defined by the IEEE 802.11 and 802.11b standard. These specifications include the operating frequencies, MAC layer characteristics including framing and transmission rates (communication can be done at various rates). Later the 802.11a standard defined operation in the 5GHz band, including different signalling mechanisms and higher transmission rates. Still later the 802.11g standard was defined to enable use of 802.11a signalling and transmission mechanisms in the 2.4GHz band in such a way as to be backwards compatible with 802.11b networks.

Separate from the underlying transmission techniques 802.11 networks have a variety of security mechanisms. The original 802.11 specifications defined a simple security protocol called WEP. This protocol uses a fixed pre-shared key and the RC4 cryptographic cipher to encode data transmitted on a network. Stations must all agree on the fixed

key in order to communicate. This scheme was shown to be easily broken and is now rarely used except to discourage transient users from joining networks. Current security practice is given by the IEEE 802.11i specification that defines new cryptographic ciphers and an additional protocol to authenticate stations to an access point and exchange keys for doing data communication. Further, cryptographic keys are periodically refreshed and there are mechanisms for detecting intrusion attempts (and for countering intrusion attempts). Another security protocol specification commonly used in wireless networks is termed WPA. This was a precursor to 802.11i defined by an industry group as an interim measure while waiting for 802.11i to be ratified. WPA specifies a subset of the requirements found in 802.11i and is designed for implementation on legacy hardware. Specifically WPA requires only the TKIP cipher that is derived from the original WEP cipher. 802.11i permits use of TKIP but also requires support for a stronger cipher, AES-CCM, for encrypting data. (The AES cipher was not required in WPA because it was deemed too computationally costly to be implemented on legacy hardware.)

Other than the above protocol standards the other important standard to be aware of is 802.11e. This defines protocols for deploying multi-media applications such as streaming video and voice over IP (VoIP) in an 802.11 network. Like 802.11i, 802.11e also has a precursor specification termed WME (later renamed WMM) that has been defined by an industry group as a subset of 802.11e that can be deployed now to enable multi-media applications while waiting for the final ratification of 802.11e. The most important thing to know about 802.11e and WME/WMM is that it enables prioritized traffic use of a wireless network through Quality of Service (QoS) protocols and enhanced media access protocols. Proper implementation of these protocols enable high speed bursting of data and prioritized traffic flow.

Since the 6.0 version, FreeBSD supports networks that operate using 802.11a, 802.11b, and 802.11g. The WPA and 802.11i security protocols are likewise supported (in conjunction with any of 11a, 11b, and 11g) and QoS and traffic prioritization required by the WME/WMM protocols are supported for a limited set of wireless devices.

31.3.2 Basic Setup

31.3.2.1 Kernel Configuration

To use wireless networking you need a wireless networking card and to configure the kernel with the appropriate wireless networking support. The latter is separated into multiple modules so that you only need to configure the software you are actually going to use.

The first thing you need is a wireless device. The most commonly used devices are those that use parts made by Atheros. These devices are supported by the ath(4) driver and require the following line to be added to the `/boot/loader.conf` file:

```
if_ath_load="YES"
```

The Atheros driver is split up into three separate pieces: the driver proper (ath(4)), the hardware support layer that handles chip-specific functions (ath_hal(4)), and an algorithm for selecting which of several possible rates for transmitting frames (ath_rate_sample here). When you load this support as modules these dependencies are automatically handled for you. If instead of an Atheros device you had another device you would select the module for that device; e.g.:

```
if_wi_load="YES"
```

for devices based on the Intersil Prism parts (wi(4) driver).

Όχι!Βιός: In the rest of this document, we will use an ath(4) device, the device name in the examples must be changed according to your configuration. A list of available wireless drivers can be found at the beginning of the

wlan(4) manual page. If a native FreeBSD driver for your wireless device does not exist, it may be possible to directly use the Windows driver with the help of the NDIS driver wrapper.

With a device driver configured you need to also bring in the 802.11 networking support required by the driver. For the ath(4) driver this is at least the wlan(4) module; this module is automatically loaded with the wireless device driver. With that you will need the modules that implement cryptographic support for the security protocols you intend to use. These are intended to be dynamically loaded on demand by the wlan(4) module but for now they must be manually configured. The following modules are available: wlan_wep(4), wlan_ccmp(4) and wlan_tkip(4). Both wlan_ccmp(4) and wlan_tkip(4) drivers are only needed if you intend to use the WPA and/or 802.11i security protocols. If your network is to run totally open (i.e., with no encryption) then you do not even need the wlan_wep(4) support. To load these modules at boot time, add the following lines to `/boot/loader.conf`:

```
wlan_wep_load="YES"
wlan_ccmp_load="YES"
wlan_tkip_load="YES"
```

With this information in the system bootstrap configuration file (i.e., `/boot/loader.conf`), you have to reboot your FreeBSD box. If you do not want to reboot your machine for the moment, you can just load the modules by hand using `kldload(8)`.

Όγιἄβυό: If you do not want to use modules, it is possible to compile these drivers into the kernel by adding the following lines to your kernel configuration file:

```
device ath          # Atheros IEEE 802.11 wireless network driver
device ath_hal      # Atheros Hardware Access Layer
device ath_rate_sample # John Bicket's SampleRate control algorithm.
device wlan         # 802.11 support (Required)
device wlan_wep     # WEP crypto support for 802.11 devices
device wlan_ccmp    # AES-CCMP crypto support for 802.11 devices
device wlan_tkip    # TKIP and Michael crypto support for 802.11 devices
```

With this information in the kernel configuration file, recompile the kernel and reboot your FreeBSD machine.

When the system is up, we could find some information about the wireless device in the boot messages, like this:

```
ath0: <Atheros 5212> mem 0xff9f0000-0xff9fffff irq 17 at device 2.0 on pci2
ath0: Ethernet address: 00:11:95:d5:43:62
ath0: mac 7.9 phy 4.5 radio 5.6
```

31.3.3 Infrastructure Mode

The infrastructure mode or BSS mode is the mode that is typically used. In this mode, a number of wireless access points are connected to a wired network. Each wireless network has its own name, this name is called the SSID of the network. Wireless clients connect to the wireless access points.

31.3.3.1 FreeBSD Clients

31.3.3.1.1 How to Find Access Points

To scan for networks, use the `ifconfig` command. This request may take a few moments to complete as it requires that the system switches to each available wireless frequency and probes for available access points. Only the super-user can initiate such a scan:

```
# ifconfig ath0 up scan
SSID          BSSID          CHAN  RATE  S:N   INT  CAPS
dlinkap       00:13:46:49:41:76  6    54M  29:0  100  EPS  WPA WME
freebsdap     00:11:95:c3:0d:ac  1    54M  22:0  100  EPS  WPA
```

Όχιἄβυός: You must mark the interface `up` before you can scan. Subsequent scan requests do not require you to mark the interface up again.

The output of a scan request lists each BSS/IBSS network found. Beside the name of the network, `SSID`, we find the `BSSID` which is the MAC address of the access point. The `CAPS` field identifies the type of each network and the capabilities of the stations operating there:

E

Extended Service Set (ESS). Indicates that the station is part of an infrastructure network (in contrast to an IBSS/ad-hoc network).

I

IBSS/ad-hoc network. Indicates that the station is part of an ad-hoc network (in contrast to an ESS network).

P

Privacy. Data confidentiality is required for all data frames exchanged within the BSS. This means that this BSS requires the station to use cryptographic means such as WEP, TKIP or AES-CCMP to encrypt/decrypt data frames being exchanged with others.

S

Short Preamble. Indicates that the network is using short preambles (defined in 802.11b High Rate/DSSS PHY, short preamble utilizes a 56 bit sync field in contrast to a 128 bit field used in long preamble mode).

s

Short slot time. Indicates that the 802.11g network is using a short slot time because there are no legacy (802.11b) stations present.

One can also display the current list of known networks with:

```
# ifconfig ath0 list scan
```

This information may be updated automatically by the adapter or manually with a `scan` request. Old data is automatically removed from the cache, so over time this list may shrink unless more scans are done.

31.3.3.1.2 Basic Settings

This section provides a simple example of how to make the wireless network adapter work in FreeBSD without encryption. After you are familiar with these concepts, we strongly recommend using WPA to set up your wireless network.

There are three basic steps to configure a wireless network: selecting an access point, authenticating your station, and configuring an IP address. The following sections discuss each step.

31.3.3.1.2.1 Selecting an Access Point

Most of time it is sufficient to let the system choose an access point using the builtin heuristics. This is the default behaviour when you mark an interface up or otherwise configure an interface by listing it in `/etc/rc.conf`, e.g.:

```
ifconfig_ath0="DHCP"
```

If there are multiple access points and you want to select a specific one, you can select it by its SSID:

```
ifconfig_ath0="ssid your_ssid_here DHCP"
```

In an environment where there are multiple access points with the same SSID (often done to simplify roaming) it may be necessary to associate to one specific device. In this case you can also specify the BSSID of the access point (you can also leave off the SSID):

```
ifconfig_ath0="ssid your_ssid_here bssid xx:xx:xx:xx:xx:xx DHCP"
```

There are other ways to constrain the choice of an access point such as limiting the set of frequencies the system will scan on. This may be useful if you have a multi-band wireless card as scanning all the possible channels can be time-consuming. To limit operation to a specific band you can use the `mode` parameter; e.g.:

```
ifconfig_ath0="mode 11g ssid your_ssid_here DHCP"
```

will force the card to operate in 802.11g which is defined only for 2.4GHz frequencies so any 5GHz channels will not be considered. Other ways to do this are the `channel` parameter, to lock operation to one specific frequency, and the `chanlist` parameter, to specify a list of channels for scanning. More information about these parameters can be found in the `ifconfig(8)` manual page.

31.3.3.1.2.2 Authentication

Once you have selected an access point your station needs to authenticate before it can pass data. Authentication can happen in several ways. The most common scheme used is termed open authentication and allows any station to join the network and communicate. This is the authentication you should use for test purpose the first time you set up a wireless network. Other schemes require cryptographic handshakes be completed before data traffic can flow; either using pre-shared keys or secrets, or more complex schemes that involve backend services such as RADIUS. Most users will use open authentication which is the default setting. Next most common setup is WPA-PSK, also known as WPA Personal, which is described below.

Όχι! Βύθος: If you have an Apple AirPort® Extreme base station for an access point you may need to configure shared-key authentication together with a WEP key. This can be done in the `/etc/rc.conf` file or using the `wpa_supplicant(8)` program. If you have a single AirPort base station you can setup access with something like:

```
ifconfig_ath0="authmode shared wepmode on weptxkey 1 wepkey 01234567 DHCP"
```

In general shared key authentication is to be avoided because it uses the WEP key material in a highly-constrained manner making it even easier to crack the key. If WEP must be used (e.g., for compatibility with legacy devices) it is better to use WEP with `open` authentication. More information regarding WEP can be found in the `Εἰσαγωγή 31.3.3.1.4`.

31.3.3.1.2.3 Getting an IP Address with DHCP

Once you have selected an access point and set the authentication parameters, you will have to get an IP address to communicate. Most of time you will obtain your wireless IP address via DHCP. To achieve that, simply edit `/etc/rc.conf` and add DHCP to the configuration for your device as shown in various examples above:

```
ifconfig_ath0="DHCP"
```

At this point, you are ready to bring up the wireless interface:

```
# /etc/rc.d/netif start
```

Once the interface is running, use `ifconfig` to see the status of the interface `ath0`:

```
# ifconfig ath0
ath0: flags=8843<UP,BROADCAST,RUNNING,SIMPLEX,MULTICAST> mtu 1500
    inet6 fe80::211:95ff:fed5:4362%ath0 prefixlen 64 scopeid 0x1
    inet 192.168.1.100 netmask 0xffffffff broadcast 192.168.1.255
    ether 00:11:95:d5:43:62
    media: IEEE 802.11 Wireless Ethernet autoselect (OFDM/54Mbps)
    status: associated
    ssid dlinkap channel 6 bssid 00:13:46:49:41:76
    authmode OPEN privacy OFF txpovmax 36 protmode CTS bintval 100
```

The `status: associated` means you are connected to the wireless network (to the `dlinkap` network in our case). The `bssid 00:13:46:49:41:76` part is the MAC address of your access point; the `authmode` line informs you that the communication is not encrypted (`OPEN`).

31.3.3.1.2.4 Static IP Address

In the case you cannot obtain an IP address from a DHCP server, you can set a fixed IP address. Replace the `DHCP` keyword shown above with the address information. Be sure to retain any other parameters you have set up for selecting an access point:

```
ifconfig_ath0="inet 192.168.1.100 netmask 255.255.255.0 ssid your_ssid_here"
```

31.3.3.1.3 WPA

WPA (Wi-Fi Protected Access) is a security protocol used together with 802.11 networks to address the lack of proper authentication and the weakness of WEP. WPA leverages the 802.1X authentication protocol and uses one of several ciphers instead of WEP for data integrity. The only cipher required by WPA is TKIP (Temporary Key Integrity Protocol) which is a cipher that extends the basic RC4 cipher used by WEP by adding integrity checking,

tamper detection, and measures for responding to any detected intrusions. TKIP is designed to work on legacy hardware with only software modification; it represents a compromise that improves security but is still not entirely immune to attack. WPA also specifies the AES-CCMP cipher as an alternative to TKIP and that is preferred when possible; for this specification the term WPA2 (or RSN) is commonly used.

WPA defines authentication and encryption protocols. Authentication is most commonly done using one of two techniques: by 802.1X and a backend authentication service such as RADIUS, or by a minimal handshake between the station and the access point using a pre-shared secret. The former is commonly termed WPA Enterprise with the latter known as WPA Personal. Since most people will not set up a RADIUS backend server for wireless network, WPA-PSK is by far the most commonly encountered configuration for WPA.

The control of the wireless connection and the authentication (key negotiation or authentication with a server) is done with the `wpa_supplicant(8)` utility. This program requires a configuration file, `/etc/wpa_supplicant.conf`, to run. More information regarding this file can be found in the `wpa_supplicant.conf(5)` manual page.

31.3.3.1.3.1 WPA-PSK

WPA-PSK also known as WPA-Personal is based on a pre-shared key (PSK) generated from a given password and that will be used as the master key in the wireless network. This means every wireless user will share the same key. WPA-PSK is intended for small networks where the use of an authentication server is not possible or desired.

Διάρθρωση: Always use strong passwords that are sufficiently long and made from a rich alphabet so they will not be guessed and/or attacked.

The first step is the configuration of the `/etc/wpa_supplicant.conf` file with the SSID and the pre-shared key of your network:

```
network={
    ssid="freebsdap"
    psk="freebsdmail"
}
```

Then, in `/etc/rc.conf`, we indicate that the wireless device configuration will be done with WPA and the IP address will be obtained with DHCP:

```
ifconfig_ath0="WPA DHCP"
```

Then, we can bring up the interface:

```
# /etc/rc.d/netif start
Starting wpa_supplicant.
DHCPDISCOVER on ath0 to 255.255.255.255 port 67 interval 5
DHCPDISCOVER on ath0 to 255.255.255.255 port 67 interval 6
DHCPOFFER from 192.168.0.1
DHCPREQUEST on ath0 to 255.255.255.255 port 67
DHCPACK from 192.168.0.1
bound to 192.168.0.254 -- renewal in 300 seconds.
ath0: flags=8843<UP,BROADCAST,RUNNING,SIMPLEX,MULTICAST> mtu 1500
    inet6 fe80::211:95ff:fed5:4362%ath0 prefixlen 64 scopeid 0x1
    inet 192.168.0.254 netmask 0xfffff00 broadcast 192.168.0.255
    ether 00:11:95:d5:43:62
```

```
media: IEEE 802.11 Wireless Ethernet autoselect (OFDM/36Mbps)
status: associated
ssid freebsdap channel 1 bssid 00:11:95:c3:0d:ac
authmode WPA privacy ON deftxkey UNDEF TKIP 2:128-bit txpowmax 36
protmode CTS roaming MANUAL bintval 100
```

Or you can try to configure it manually using the same `/etc/wpa_supplicant.conf` above, and run:

```
# wpa_supplicant -i ath0 -c /etc/wpa_supplicant.conf
Trying to associate with 00:11:95:c3:0d:ac (SSID='freebsdap' freq=2412 MHz)
Associated with 00:11:95:c3:0d:ac
WPA: Key negotiation completed with 00:11:95:c3:0d:ac [PTK=TKIP GTK=TKIP]
```

The next operation is the launch of the `dhclient` command to get the IP address from the DHCP server:

```
# dhclient ath0
DHCPCREQUEST on ath0 to 255.255.255.255 port 67
DHCPACK from 192.168.0.1
bound to 192.168.0.254 -- renewal in 300 seconds.
# ifconfig ath0
ath0: flags=8843<UP,BROADCAST,RUNNING,SIMPLEX,MULTICAST> mtu 1500
inet6 fe80::211:95ff:fed5:4362%ath0 prefixlen 64 scopeid 0x1
inet 192.168.0.254 netmask 0xffffffff00 broadcast 192.168.0.255
ether 00:11:95:d5:43:62
media: IEEE 802.11 Wireless Ethernet autoselect (OFDM/48Mbps)
status: associated
ssid freebsdap channel 1 bssid 00:11:95:c3:0d:ac
authmode WPA privacy ON deftxkey UNDEF TKIP 2:128-bit txpowmax 36
protmode CTS roaming MANUAL bintval 100
```

Óçíáßùòç: If the `/etc/rc.conf` is set up with the line `ifconfig_ath0="DHCP"` then it is no need to run the `dhclient` command manually, `dhclient` will be launched after `wpa_supplicant` plumbs the keys.

In the case where the use of DHCP is not possible, you can set a static IP address after `wpa_supplicant` has authenticated the station:

```
# ifconfig ath0 inet 192.168.0.100 netmask 255.255.255.0
# ifconfig ath0
ath0: flags=8843<UP,BROADCAST,RUNNING,SIMPLEX,MULTICAST> mtu 1500
inet6 fe80::211:95ff:fed5:4362%ath0 prefixlen 64 scopeid 0x1
inet 192.168.0.100 netmask 0xffffffff00 broadcast 192.168.0.255
ether 00:11:95:d5:43:62
media: IEEE 802.11 Wireless Ethernet autoselect (OFDM/36Mbps)
status: associated
ssid freebsdap channel 1 bssid 00:11:95:c3:0d:ac
authmode WPA privacy ON deftxkey UNDEF TKIP 2:128-bit txpowmax 36
protmode CTS roaming MANUAL bintval 100
```

When DHCP is not used, you also have to manually set up the default gateway and the nameserver:

```
# route add default your_default_router
```

```
# echo "nameserver your_DNS_server" >> /etc/resolv.conf
```

31.3.3.1.3.2 WPA with EAP-TLS

The second way to use WPA is with an 802.1X backend authentication server, in this case WPA is called WPA-Enterprise to make difference with the less secure WPA-Personal with its pre-shared key. The authentication in WPA-Enterprise is based on EAP (Extensible Authentication Protocol).

EAP does not come with an encryption method, it was decided to embed EAP inside an encrypted tunnel. Many types of EAP authentication methods have been designed, the most common methods are EAP-TLS, EAP-TTLS and EAP-PEAP.

EAP-TLS (EAP with Transport Layer Security) is a very well-supported authentication protocol in the wireless world since it was the first EAP method to be certified by the Wi-Fi alliance (<http://www.wi-fi.org/>). EAP-TLS will require three certificates to run: the CA certificate (installed on all machines), the server certificate for your authentication server, and one client certificate for each wireless client. In this EAP method, both authentication server and wireless client authenticate each other in presenting their respective certificates, and they verify that these certificates were signed by your organization's certificate authority (CA).

As previously, the configuration is done via `/etc/wpa_supplicant.conf`:

```
network={
  ssid="freebsdap" ❶
  proto=RSN ❷
  key_mgmt=WPA-EAP ❸
  eap=TLS ❹
  identity="loader" ❺
  ca_cert="/etc/certs/cacert.pem" ❻
  client_cert="/etc/certs/clientcert.pem" ❼
  private_key="/etc/certs/clientkey.pem" ❽
  private_key_passwd="freebsdmailclient" ❾
}
```

- ❶ This field indicates the network name (SSID).
- ❷ Here, we use RSN (IEEE 802.11i) protocol, i.e., WPA2.
- ❸ The `key_mgmt` line refers to the key management protocol we use. In our case it is WPA using EAP authentication: `WPA-EAP`.
- ❹ In this field, we mention the EAP method for our connection.
- ❺ The `identity` field contains the identity string for EAP.
- ❻ The `ca_cert` field indicates the pathname of the CA certificate file. This file is needed to verify the server certificat.
- ❼ The `client_cert` line gives the pathname to the client certificate file. This certificate is unique to each wireless client of the network.
- ❽ The `private_key` field is the pathname to the client certificate private key file.
- ❾ The `private_key_passwd` field contains the passphrase for the private key.

Then add the following line to `/etc/rc.conf`:

```
ifconfig_ath0="WPA DHCP"
```

The next step is to bring up the interface with the help of the `rc.d` facility:

```
# /etc/rc.d/netif start
Starting wpa_supplicant.
DHCPREQUEST on ath0 to 255.255.255.255 port 67
DHCPREQUEST on ath0 to 255.255.255.255 port 67
DHCPACK from 192.168.0.20
bound to 192.168.0.254 -- renewal in 300 seconds.
ath0: flags=8843<UP,BROADCAST,RUNNING,SIMPLEX,MULTICAST> mtu 1500
    inet6 fe80::211:95ff:fed5:4362%ath0 prefixlen 64 scopeid 0x1
    inet 192.168.0.254 netmask 0xfffff00 broadcast 192.168.0.255
    ether 00:11:95:d5:43:62
    media: IEEE 802.11 Wireless Ethernet autoselect (DS/11Mbps)
    status: associated
    ssid freebsdap channel 1 bssid 00:11:95:c3:0d:ac
    authmode WPA2/802.11i privacy ON deftxkey UNDEF TKIP 2:128-bit
    txpowmax 36 protmode CTS roaming MANUAL bintval 100
```

As previously shown, it is also possible to bring up the interface manually with both `wpa_supplicant` and `ifconfig` commands.

31.3.3.1.3.3 WPA with EAP-TTLS

With EAP-TLS both the authentication server and the client need a certificate, with EAP-TTLS (EAP-Tunneled Transport Layer Security) a client certificate is optional. This method is close to what some secure web sites do, where the web server can create a secure SSL tunnel even if the visitors do not have client-side certificates. EAP-TTLS will use the encrypted TLS tunnel for safe transport of the authentication data.

The configuration is done via the `/etc/wpa_supplicant.conf` file:

```
network={
    ssid="freebsdap"
    proto=RSN
    key_mgmt=WPA-EAP
    eap=TTLS ❶
    identity="test" ❷
    password="test" ❸
    ca_cert="/etc/certs/cacert.pem" ❹
    phase2="auth=MD5" ❺
}
```

- ❶ In this field, we mention the EAP method for our connection.
- ❷ The `identity` field contains the identity string for EAP authentication inside the encrypted TLS tunnel.
- ❸ The `password` field contains the passphrase for the EAP authentication.
- ❹ The `ca_cert` field indicates the pathname of the CA certificate file. This file is needed to verify the server certificate.

- ⑤ In this field, we mention the authentication method used in the encrypted TLS tunnel. In our case, EAP with MD5-Challenge has been used. The “inner authentication” phase is often called “phase2”.

You also have to add the following line to `/etc/rc.conf`:

```
ifconfig_ath0="WPA DHCP"
```

The next step is to bring up the interface:

```
# /etc/rc.d/netif start
Starting wpa_supplicant.
DHCPREQUEST on ath0 to 255.255.255.255 port 67
DHCPREQUEST on ath0 to 255.255.255.255 port 67
DHCPREQUEST on ath0 to 255.255.255.255 port 67
DHCPACK from 192.168.0.20
bound to 192.168.0.254 -- renewal in 300 seconds.
ath0: flags=8843<UP,BROADCAST,RUNNING,SIMPLEX,MULTICAST> mtu 1500
    inet6 fe80::211:95ff:fed5:4362%ath0 prefixlen 64 scopeid 0x1
    inet 192.168.0.254 netmask 0xffffffff00 broadcast 192.168.0.255
    ether 00:11:95:d5:43:62
    media: IEEE 802.11 Wireless Ethernet autoselect (DS/11Mbps)
    status: associated
    ssid freebsdap channel 1 bssid 00:11:95:c3:0d:ac
    authmode WPA2/802.11i privacy ON deftxkey UNDEF TKIP 2:128-bit
    txpowmax 36 protmode CTS roaming MANUAL bintval 100
```

31.3.3.1.3.4 WPA with EAP-PEAP

PEAP (Protected EAP) has been designed as an alternative to EAP-TTLS. There are two types of PEAP methods, the most common one is PEAPv0/EAP-MSCHAPv2. In the rest of this document, we will use the PEAP term to refer to that EAP method. PEAP is the most used EAP standard after EAP-TLS, in other words if you have a network with mixed OSes, PEAP should be the most supported standard after EAP-TLS.

PEAP is similar to EAP-TTLS: it uses a server-side certificate to authenticate clients by creating an encrypted TLS tunnel between the client and the authentication server, which protects the ensuing exchange of authentication information. In term of security the difference between EAP-TTLS and PEAP is that PEAP authentication broadcasts the username in clear, only the password is sent in the encrypted TLS tunnel. EAP-TTLS will use the TLS tunnel for both username and password.

We have to edit the `/etc/wpa_supplicant.conf` file and add the EAP-PEAP related settings:

```
network={
    ssid="freebsdap"
    proto=RSN
    key_mgmt=WPA-EAP
    eap=PEAP ①
    identity="test" ②
    password="test" ③
    ca_cert="/etc/certs/cacert.pem" ④
    phase1="peaplabel=0" ⑤
    phase2="auth=MSCHAPV2" ⑥
}
```

- ❶ In this field, we mention the EAP method for our connection.
- ❷ The `identity` field contains the identity string for EAP authentication inside the encrypted TLS tunnel.
- ❸ The `password` field contains the passphrase for the EAP authentication.
- ❹ The `ca_cert` field indicates the pathname of the CA certificate file. This file is needed to verify the server certificate.
- ❺ This field contains the parameters for the first phase of the authentication (the TLS tunnel). According to the authentication server used, you will have to specify a specific label for the authentication. Most of time, the label will be “client EAP encryption” which is set by using `peaplabel=0`. More information can be found in the `wpa_supplicant.conf(5)` manual page.
- ❻ In this field, we mention the authentication protocol used in the encrypted TLS tunnel. In the case of PEAP, it is `auth=MSCHAPV2`.

The following must be added to `/etc/rc.conf`:

```
ifconfig_ath0="WPA DHCP"
```

Then, we can bring up the interface:

```
# /etc/rc.d/netif start
Starting wpa_supplicant.
DHCPREQUEST on ath0 to 255.255.255.255 port 67
DHCPREQUEST on ath0 to 255.255.255.255 port 67
DHCPREQUEST on ath0 to 255.255.255.255 port 67
DHCPACK from 192.168.0.20
bound to 192.168.0.254 -- renewal in 300 seconds.
ath0: flags=8843<UP,BROADCAST,RUNNING,SIMPLEX,MULTICAST> mtu 1500
    inet6 fe80::211:95ff:fed5:4362%ath0 prefixlen 64 scopeid 0x1
    inet 192.168.0.254 netmask 0xfffff00 broadcast 192.168.0.255
    ether 00:11:95:d5:43:62
    media: IEEE 802.11 Wireless Ethernet autoselect (DS/11Mbps)
    status: associated
    ssid freebsdap channel 1 bssid 00:11:95:c3:0d:ac
    authmode WPA2/802.11i privacy ON deftxkey UNDEF TKIP 2:128-bit
    txpowmax 36 protmode CTS roaming MANUAL bintval 100
```

31.3.3.1.4 WEP

WEP (Wired Equivalent Privacy) is part of the original 802.11 standard. There is no authentication mechanism, only a weak form of access control, and it is easily to be cracked.

WEP can be set up with `ifconfig`:

```
# ifconfig ath0 inet 192.168.1.100 netmask 255.255.255.0 ssid my_net \
    wepmode on weptxkey 3 wepkey 3:0x3456789012
```

- The `weptxkey` means which WEP key will be used in the transmission. Here we used the third key. This must match the setting in the access point.

- The `wepkey` means setting the selected WEP key. It should in the format `index:key`, if the index is not given, key 1 is set. That is to say we need to set the index if we use keys other than the first key.

Óçìáßùòç: You must replace the `0x3456789012` with the key configured for use on the access point.

You are encouraged to read `ifconfig(8)` manual page for further information.

The `wpa_supplicant` facility also can be used to configure your wireless interface with WEP. The example above can be set up by adding the following lines to `/etc/wpa_supplicant.conf`:

```
network={
  ssid="my_net"
  key_mgmt=NONE
  wep_key3=3456789012
  wep_tx_keyidx=3
}
```

Then:

```
# wpa_supplicant -i ath0 -c /etc/wpa_supplicant.conf
Trying to associate with 00:13:46:49:41:76 (SSID='dlinkap' freq=2437 MHz)
Associated with 00:13:46:49:41:76
```

31.3.4 Ad-hoc Mode

IBSS mode, also called ad-hoc mode, is designed for point to point connections. For example, to establish an ad-hoc network between the machine A and the machine B we will just need to choose two IP addresses and a SSID.

On the box A:

```
# ifconfig ath0 inet 192.168.0.1 netmask 255.255.255.0 ssid freebsdap mediaopt adhoc
# ifconfig ath0
ath0: flags=8843<UP,BROADCAST,RUNNING,SIMPLEX,MULTICAST> mtu 1500
  inet 192.168.0.1 netmask 0xffffffff broadcast 192.168.0.255
  inet6 fe80::211:95ff:fec3:dac%ath0 prefixlen 64 scopeid 0x4
  ether 00:11:95:c3:0d:ac
  media: IEEE 802.11 Wireless Ethernet autoselect <adhoc> (autoselect <adhoc>)
  status: associated
  ssid freebsdap channel 2 bssid 02:11:95:c3:0d:ac
  authmode OPEN privacy OFF txpowmax 36 protmode CTS bintval 100
```

The `adhoc` parameter indicates the interface is running in the IBSS mode.

On B, we should be able to detect A:

```
# ifconfig ath0 up scan
SSID          BSSID          CHAN RATE  S:N  INT CAPS
freebsdap     02:11:95:c3:0d:ac  2   54M 19:0  100 IS
```

The 1 in the output confirms the machine A is in ad-hoc mode. We just have to configure B with a different IP address:

```
# ifconfig ath0 inet 192.168.0.2 netmask 255.255.255.0 ssid freebsdap mediaopt adhoc
# ifconfig ath0
ath0: flags=8843<UP,BROADCAST,RUNNING,SIMPLEX,MULTICAST> mtu 1500
  inet6 fe80::211:95ff:fed5:4362%ath0 prefixlen 64 scopeid 0x1
  inet 192.168.0.2 netmask 0xffffffff broadcast 192.168.0.255
  ether 00:11:95:d5:43:62
  media: IEEE 802.11 Wireless Ethernet autoselect <adhoc> (autoselect <adhoc>)
  status: associated
  ssid freebsdap channel 2 bssid 02:11:95:c3:0d:ac
  authmode OPEN privacy OFF txpowmax 36 protmode CTS bintval 100
```

Both A and B are now ready to exchange informations.

31.3.5 Troubleshooting

If you are having trouble with wireless networking, there are a number of steps you can take to help troubleshoot the problem.

- If you do not see the access point listed when scanning be sure you have not configured your wireless device to a limited set of channels.
- If you cannot associate to an access point verify the configuration of your station matches the one of the access point. This includes the authentication scheme and any security protocols. Simplify your configuration as much as possible. If you are using a security protocol such as WPA or WEP configure the access point for open authentication and no security to see if you can get traffic to pass.
- Once you can associate to the access point diagnose any security configuration using simple tools like ping(8).

The `wpa_supplicant` has much debugging support; try running it manually with the `-dd` option and look at the system logs.

- There are also many lower-level debugging tools. You can enable debugging messages in the 802.11 protocol support layer using the `wldebug` program found in `/usr/src/tools/tools/net80211`. For example:

```
# wldebug -i ath0 +scan+auth+debug+assoc
net.wlan.0.debug: 0 => 0xc80000<assoc,auth,scan>
```

can be used to enable console messages related to scanning for access points and doing the 802.11 protocol handshakes required to arrange communication.

There are also many useful statistics maintained by the 802.11 layer; the `wlanstats` tool will dump these informations. These statistics should identify all errors identified by the 802.11 layer. Beware however that some errors are identified in the device drivers that lie below the 802.11 layer so they may not show up. To diagnose device-specific problems you need to refer to the drivers' documentation.

If the above information does not help to clarify the problem, please submit a problem report and include output from the above tools.

31.4 Bluetooth

Written by Pav Lucistnik.

31.4.1 Introduction

Bluetooth is a wireless technology for creating personal networks operating in the 2.4 GHz unlicensed band, with a range of 10 meters. Networks are usually formed ad-hoc from portable devices such as cellular phones, handhelds and laptops. Unlike the other popular wireless technology, Wi-Fi, Bluetooth offers higher level service profiles, e.g. FTP-like file servers, file pushing, voice transport, serial line emulation, and more.

The Bluetooth stack in FreeBSD is implemented using the Netgraph framework (see `netgraph(4)`). A broad variety of Bluetooth USB dongles is supported by the `ng_ubt(4)` driver. The Broadcom BCM2033 chip based Bluetooth devices are supported via the `ubtbcmfw(4)` and `ng_ubt(4)` drivers. The 3Com Bluetooth PC Card 3CRWB60-A is supported by the `ng_bt3c(4)` driver. Serial and UART based Bluetooth devices are supported via `sio(4)`, `ng_h4(4)` and `hserial(8)`. This section describes the use of the USB Bluetooth dongle.

31.4.2 Plugging in the Device

By default Bluetooth device drivers are available as kernel modules. Before attaching a device, you will need to load the driver into the kernel:

```
# kldload ng_ubt
```

If the Bluetooth device is present in the system during system startup, load the module from `/boot/loader.conf`:

```
ng_ubt_load="YES"
```

Plug in your USB dongle. The output similar to the following will appear on the console (or in syslog):

```
ubt0: vendor 0x0a12 product 0x0001, rev 1.10/5.25, addr 2
ubt0: Interface 0 endpoints: interrupt=0x81, bulk-in=0x82, bulk-out=0x2
ubt0: Interface 1 (alt.config 5) endpoints: isoc-in=0x83, isoc-out=0x3,
      wMaxPacketSize=49, nframes=6, buffer size=294
```

Όγιᾶβύοδ: The Bluetooth stack has to be started manually on FreeBSD 6.0, and on FreeBSD 5.X before 5.5. It is done automatically from `devd(8)` on FreeBSD 5.5, 6.1 and newer.

Copy `/usr/share/examples/netgraph/bluetooth/rc.bluetooth` into some convenient place, like `/etc/rc.bluetooth`. This script is used to start and stop the Bluetooth stack. It is a good idea to stop the stack before unplugging the device, but it is not (usually) fatal. When starting the stack, you will receive output similar to the following:

```
# /etc/rc.bluetooth start ubt0
BD_ADDR: 00:02:72:00:d4:1a
Features: 0xff 0xff 0xf 00 00 00 00 00
<3-Slot> <5-Slot> <Encryption> <Slot offset>
<Timing accuracy> <Switch> <Hold mode> <Sniff mode>
<Park mode> <RSSI> <Channel quality> <SCO link>
<HV2 packets> <HV3 packets> <u-law log> <A-law log> <CVSD>
<Paging scheme> <Power control> <Transparent SCO data>
Max. ACL packet size: 192 bytes
Number of ACL packets: 8
```

Max. SCO packet size: 64 bytes
 Number of SCO packets: 8

31.4.3 Host Controller Interface (HCI)

Host Controller Interface (HCI) provides a command interface to the baseband controller and link manager, and access to hardware status and control registers. This interface provides a uniform method of accessing the Bluetooth baseband capabilities. HCI layer on the Host exchanges data and commands with the HCI firmware on the Bluetooth hardware. The Host Controller Transport Layer (i.e. physical bus) driver provides both HCI layers with the ability to exchange information with each other.

A single Netgraph node of type *hci* is created for a single Bluetooth device. The HCI node is normally connected to the Bluetooth device driver node (downstream) and the L2CAP node (upstream). All HCI operations must be performed on the HCI node and not on the device driver node. Default name for the HCI node is “devicehci”. For more details refer to the `ng_hci(4)` manual page.

One of the most common tasks is discovery of Bluetooth devices in RF proximity. This operation is called *inquiry*. Inquiry and other HCI related operations are done with the `hccontrol(8)` utility. The example below shows how to find out which Bluetooth devices are in range. You should receive the list of devices in a few seconds. Note that a remote device will only answer the inquiry if it put into *discoverable* mode.

```
% hccontrol -n ubt0hci inquiry
Inquiry result, num_responses=1
Inquiry result #0
    BD_ADDR: 00:80:37:29:19:a4
    Page Scan Rep. Mode: 0x1
    Page Scan Period Mode: 00
    Page Scan Mode: 00
    Class: 52:02:04
    Clock offset: 0x78ef
Inquiry complete. Status: No error [00]
```

BD_ADDR is unique address of a Bluetooth device, similar to MAC addresses of a network card. This address is needed for further communication with a device. It is possible to assign human readable name to a BD_ADDR. The `/etc/bluetooth/hosts` file contains information regarding the known Bluetooth hosts. The following example shows how to obtain human readable name that was assigned to the remote device:

```
% hccontrol -n ubt0hci remote_name_request 00:80:37:29:19:a4
BD_ADDR: 00:80:37:29:19:a4
Name: Pav's T39
```

If you perform an inquiry on a remote Bluetooth device, it will find your computer as “your.host.name (ubt0)”. The name assigned to the local device can be changed at any time.

The Bluetooth system provides a point-to-point connection (only two Bluetooth units involved), or a point-to-multipoint connection. In the point-to-multipoint connection the connection is shared among several Bluetooth devices. The following example shows how to obtain the list of active baseband connections for the local device:

```
% hccontrol -n ubt0hci read_connection_list
```

```
Remote BD_ADDR      Handle Type Mode Role Encrypt Pending Queue State
00:80:37:29:19:a4    41  ACL   0 MAST  NONE      0      0 OPEN
```

A *connection handle* is useful when termination of the baseband connection is required. Note, that it is normally not required to do it by hand. The stack will automatically terminate inactive baseband connections.

```
# hccontrol -n ubt0hci disconnect 41
Connection handle: 41
Reason: Connection terminated by local host [0x16]
```

Refer to `hccontrol help` for a complete listing of available HCI commands. Most of the HCI commands do not require superuser privileges.

31.4.4 Logical Link Control and Adaptation Protocol (L2CAP)

Logical Link Control and Adaptation Protocol (L2CAP) provides connection-oriented and connectionless data services to upper layer protocols with protocol multiplexing capability and segmentation and reassembly operation. L2CAP permits higher level protocols and applications to transmit and receive L2CAP data packets up to 64 kilobytes in length.

L2CAP is based around the concept of *channels*. Channel is a logical connection on top of baseband connection. Each channel is bound to a single protocol in a many-to-one fashion. Multiple channels can be bound to the same protocol, but a channel cannot be bound to multiple protocols. Each L2CAP packet received on a channel is directed to the appropriate higher level protocol. Multiple channels can share the same baseband connection.

A single Netgraph node of type *l2cap* is created for a single Bluetooth device. The L2CAP node is normally connected to the Bluetooth HCI node (downstream) and Bluetooth sockets nodes (upstream). Default name for the L2CAP node is “`device12cap`”. For more details refer to the `ng_l2cap(4)` manual page.

A useful command is `l2ping(8)`, which can be used to ping other devices. Some Bluetooth implementations might not return all of the data sent to them, so 0 bytes in the following example is normal.

```
# l2ping -a 00:80:37:29:19:a4
0 bytes from 0:80:37:29:19:a4 seq_no=0 time=48.633 ms result=0
0 bytes from 0:80:37:29:19:a4 seq_no=1 time=37.551 ms result=0
0 bytes from 0:80:37:29:19:a4 seq_no=2 time=28.324 ms result=0
0 bytes from 0:80:37:29:19:a4 seq_no=3 time=46.150 ms result=0
```

The `l2control(8)` utility is used to perform various operations on L2CAP nodes. This example shows how to obtain the list of logical connections (channels) and the list of baseband connections for the local device:

```
% l2control -a 00:02:72:00:d4:1a read_channel_list
L2CAP channels:
Remote BD_ADDR      SCID/ DCID   PSM  IMTU/ OMTU State
00:07:e0:00:0b:ca    66/   64     3   132/  672 OPEN
% l2control -a 00:02:72:00:d4:1a read_connection_list
L2CAP connections:
Remote BD_ADDR      Handle Flags Pending State
00:07:e0:00:0b:ca    41  0           0 OPEN
```

Another diagnostic tool is `btsockstat(1)`. It does a job similar to as `netstat(1)` does, but for Bluetooth network-related data structures. The example below shows the same logical connection as `l2control(8)` above.

```
% btsockstat
Active L2CAP sockets
PCB      Recv-Q Send-Q Local address/PSM      Foreign address  CID  State
c2afe900  0      0 00:02:72:00:d4:1a/3    00:07:e0:00:0b:ca 66   OPEN
Active RFCOMM sessions
L2PCB    PCB      Flag MTU   Out-Q DLCs State
c2afe900 c2b53380 1    127    0    Yes  OPEN
Active RFCOMM sockets
PCB      Recv-Q Send-Q Local address      Foreign address  Chan DLCI State
c2e8bc80  0      250 00:02:72:00:d4:1a 00:07:e0:00:0b:ca 3    6    OPEN
```

31.4.5 RFCOMM Protocol

The RFCOMM protocol provides emulation of serial ports over the L2CAP protocol. The protocol is based on the ETSI standard TS 07.10. RFCOMM is a simple transport protocol, with additional provisions for emulating the 9 circuits of RS-232 (EIA/TIA-232-E) serial ports. The RFCOMM protocol supports up to 60 simultaneous connections (RFCOMM channels) between two Bluetooth devices.

For the purposes of RFCOMM, a complete communication path involves two applications running on different devices (the communication endpoints) with a communication segment between them. RFCOMM is intended to cover applications that make use of the serial ports of the devices in which they reside. The communication segment is a Bluetooth link from one device to another (direct connect).

RFCOMM is only concerned with the connection between the devices in the direct connect case, or between the device and a modem in the network case. RFCOMM can support other configurations, such as modules that communicate via Bluetooth wireless technology on one side and provide a wired interface on the other side.

In FreeBSD the RFCOMM protocol is implemented at the Bluetooth sockets layer.

31.4.6 Pairing of Devices

By default, Bluetooth communication is not authenticated, and any device can talk to any other device. A Bluetooth device (for example, cellular phone) may choose to require authentication to provide a particular service (for example, Dial-Up service). Bluetooth authentication is normally done with *PIN codes*. A PIN code is an ASCII string up to 16 characters in length. User is required to enter the same PIN code on both devices. Once user has entered the PIN code, both devices will generate a *link key*. After that the link key can be stored either in the devices themselves or in a persistent storage. Next time both devices will use previously generated link key. The described above procedure is called *pairing*. Note that if the link key is lost by any device then pairing must be repeated.

The hcsecd(8) daemon is responsible for handling of all Bluetooth authentication requests. The default configuration file is /etc/bluetooth/hcsecd.conf. An example section for a cellular phone with the PIN code arbitrarily set to "1234" is shown below:

```
device {
    bdaddr 00:80:37:29:19:a4;
    name    "Pav's T39";
    key     nokey;
    pin     "1234";
}
```

There is no limitation on PIN codes (except length). Some devices (for example Bluetooth headsets) may have a fixed PIN code built in. The `-d` switch forces the `hcsecd(8)` daemon to stay in the foreground, so it is easy to see what is happening. Set the remote device to receive pairing and initiate the Bluetooth connection to the remote device. The remote device should say that pairing was accepted, and request the PIN code. Enter the same PIN code as you have in `hcsecd.conf`. Now your PC and the remote device are paired. Alternatively, you can initiate pairing on the remote device.

On FreeBSD 5.5, 6.1 and newer, the following line can be added to the `/etc/rc.conf` file to have **hcsecd** started automatically on system start:

```
hcsecd_enable="YES"
```

The following is a sample of the **hcsecd** daemon output:

```
hcsecd[16484]: Got Link_Key_Request event from 'ubt0hci', remote bdaddr 0:80:37:29:19:a4
hcsecd[16484]: Found matching entry, remote bdaddr 0:80:37:29:19:a4, name 'Pav's T39', link key d
hcsecd[16484]: Sending Link_Key_Negative_Reply to 'ubt0hci' for remote bdaddr 0:80:37:29:19:a4
hcsecd[16484]: Got PIN_Code_Request event from 'ubt0hci', remote bdaddr 0:80:37:29:19:a4
hcsecd[16484]: Found matching entry, remote bdaddr 0:80:37:29:19:a4, name 'Pav's T39', PIN code e
hcsecd[16484]: Sending PIN_Code_Reply to 'ubt0hci' for remote bdaddr 0:80:37:29:19:a4
```

31.4.7 Service Discovery Protocol (SDP)

The Service Discovery Protocol (SDP) provides the means for client applications to discover the existence of services provided by server applications as well as the attributes of those services. The attributes of a service include the type or class of service offered and the mechanism or protocol information needed to utilize the service.

SDP involves communication between a SDP server and a SDP client. The server maintains a list of service records that describe the characteristics of services associated with the server. Each service record contains information about a single service. A client may retrieve information from a service record maintained by the SDP server by issuing a SDP request. If the client, or an application associated with the client, decides to use a service, it must open a separate connection to the service provider in order to utilize the service. SDP provides a mechanism for discovering services and their attributes, but it does not provide a mechanism for utilizing those services.

Normally, a SDP client searches for services based on some desired characteristics of the services. However, there are times when it is desirable to discover which types of services are described by an SDP server's service records without any a priori information about the services. This process of looking for any offered services is called *browsing*.

The Bluetooth SDP server `sdpd(8)` and command line client `sdpcontrol(8)` are included in the standard FreeBSD installation. The following example shows how to perform a SDP browse query.

```
% sdpcontrol -a 00:01:03:fc:6e:ec browse
Record Handle: 00000000
Service Class ID List:
    Service Discovery Server (0x1000)
Protocol Descriptor List:
    L2CAP (0x0100)
        Protocol specific parameter #1: u/int/uuid16 1
        Protocol specific parameter #2: u/int/uuid16 1

Record Handle: 0x00000001
```

```
Service Class ID List:
  Browse Group Descriptor (0x1001)

Record Handle: 0x00000002
Service Class ID List:
  LAN Access Using PPP (0x1102)
Protocol Descriptor List:
  L2CAP (0x0100)
  RFCOMM (0x0003)
    Protocol specific parameter #1: u/int8/bool 1
Bluetooth Profile Descriptor List:
  LAN Access Using PPP (0x1102) ver. 1.0
```

... and so on. Note that each service has a list of attributes (RFCOMM channel for example). Depending on the service you might need to make a note of some of the attributes. Some Bluetooth implementations do not support service browsing and may return an empty list. In this case it is possible to search for the specific service. The example below shows how to search for the OBEX Object Push (OPUSH) service:

```
% sdpcontrol -a 00:01:03:fc:6e:ec search OPUSH
```

Offering services on FreeBSD to Bluetooth clients is done with the `sdpd(8)` server. On FreeBSD 5.5, 6.1 and newer, the following line can be added to the `/etc/rc.conf` file:

```
sdpd_enable="YES"
```

Then the **sdpd** daemon can be started with:

```
# /etc/rc.d/sdpd start
```

On FreeBSD 6.0, and on FreeBSD 5.X before 5.5, **sdpd** is not integrated into the system startup scripts. It has to be started manually with:

```
# sdpd
```

The local server application that wants to provide Bluetooth service to the remote clients will register service with the local SDP daemon. The example of such application is `rfcomm_pppd(8)`. Once started it will register Bluetooth LAN service with the local SDP daemon.

The list of services registered with the local SDP server can be obtained by issuing SDP browse query via local control channel:

```
# sdpcontrol -l browse
```

31.4.8 Dial-Up Networking (DUN) and Network Access with PPP (LAN) Profiles

The Dial-Up Networking (DUN) profile is mostly used with modems and cellular phones. The scenarios covered by this profile are the following:

- use of a cellular phone or modem by a computer as a wireless modem for connecting to a dial-up Internet access server, or using other dial-up services;
- use of a cellular phone or modem by a computer to receive data calls.

Network Access with PPP (LAN) profile can be used in the following situations:

- LAN access for a single Bluetooth device;
- LAN access for multiple Bluetooth devices;
- PC to PC (using PPP networking over serial cable emulation).

In FreeBSD both profiles are implemented with `pppd(8)` and `rfcomm_pppd(8)` - a wrapper that converts RFCOMM Bluetooth connection into something PPP can operate with. Before any profile can be used, a new PPP label in the `/etc/ppp/ppp.conf` must be created. Consult `rfcomm_pppd(8)` manual page for examples.

In the following example `rfcomm_pppd(8)` will be used to open RFCOMM connection to remote device with `BD_ADDR 00:80:37:29:19:a4` on DUN RFCOMM channel. The actual RFCOMM channel number will be obtained from the remote device via SDP. It is possible to specify RFCOMM channel by hand, and in this case `rfcomm_pppd(8)` will not perform SDP query. Use `sdpcontrol(8)` to find out RFCOMM channel on the remote device.

```
# rfcomm_pppd -a 00:80:37:29:19:a4 -c -C dun -l rfcomm-dialup
```

In order to provide Network Access with PPP (LAN) service the `sdpd(8)` server must be running. A new entry for LAN clients must be created in the `/etc/ppp/ppp.conf` file. Consult `rfcomm_pppd(8)` manual page for examples. Finally, start RFCOMM PPP server on valid RFCOMM channel number. The RFCOMM PPP server will automatically register Bluetooth LAN service with the local SDP daemon. The example below shows how to start RFCOMM PPP server.

```
# rfcomm_pppd -s -C 7 -l rfcomm-server
```

31.4.9 OBEX Object Push (OPUSH) Profile

OBEX is a widely used protocol for simple file transfers between mobile devices. Its main use is in infrared communication, where it is used for generic file transfers between notebooks or PDAs, and for sending business cards or calendar entries between cellular phones and other devices with PIM applications.

The OBEX server and client are implemented as a third-party package **obexapp**, which is available as `comms/obexapp` port.

OBEX client is used to push and/or pull objects from the OBEX server. An object can, for example, be a business card or an appointment. The OBEX client can obtain RFCOMM channel number from the remote device via SDP. This can be done by specifying service name instead of RFCOMM channel number. Supported service names are: IrMC, FTRN and OPUSH. It is possible to specify RFCOMM channel as a number. Below is an example of an OBEX session, where device information object is pulled from the cellular phone, and a new object (business card) is pushed into the phone's directory.

```
% obexapp -a 00:80:37:29:19:a4 -C IrMC
obex> get telecom/devinfo.txt devinfo-t39.txt
Success, response: OK, Success (0x20)
obex> put new.vcf
Success, response: OK, Success (0x20)
obex> di
Success, response: OK, Success (0x20)
```

In order to provide OBEX Object Push service, sdpd(8) server must be running. A root folder, where all incoming objects will be stored, must be created. The default path to the root folder is `/var/spool/obex`. Finally, start OBEX server on valid RFCOMM channel number. The OBEX server will automatically register OBEX Object Push service with the local SDP daemon. The example below shows how to start OBEX server.

```
# obexapp -s -C 10
```

31.4.10 Serial Port Profile (SPP)

The Serial Port Profile (SPP) allows Bluetooth devices to perform RS232 (or similar) serial cable emulation. The scenario covered by this profile deals with legacy applications using Bluetooth as a cable replacement, through a virtual serial port abstraction.

The `rfcomm_sppd(1)` utility implements the Serial Port profile. A pseudo tty is used as a virtual serial port abstraction. The example below shows how to connect to a remote device Serial Port service. Note that you do not have to specify a RFCOMM channel - `rfcomm_sppd(1)` can obtain it from the remote device via SDP. If you would like to override this, specify a RFCOMM channel on the command line.

```
# rfcomm_sppd -a 00:07:E0:00:0B:CA -t /dev/tty6
rfcomm_sppd[94692]: Starting on /dev/tty6...
```

Once connected, the pseudo tty can be used as serial port:

```
# cu -l tty6
```

31.4.11 Troubleshooting

31.4.11.1 A remote device cannot connect

Some older Bluetooth devices do not support role switching. By default, when FreeBSD is accepting a new connection, it tries to perform a role switch and become master. Devices, which do not support this will not be able to connect. Note that role switching is performed when a new connection is being established, so it is not possible to ask the remote device if it does support role switching. There is a HCI option to disable role switching on the local side:

```
# hccontrol -n ubt0hci write_node_role_switch 0
```

31.4.11.2 Something is going wrong, can I see what exactly is happening?

Yes, you can. Use the third-party package `hcidump`, which is available as `comms/hcidump` port. The `hcidump` utility is similar to `tcpdump(1)`. It can be used to display the content of the Bluetooth packets on the terminal and to dump the Bluetooth packets to a file.

31.5 Bridging

Written by Steve Peterson.

31.5.1 Introduction

It is sometimes useful to divide one physical network (such as an Ethernet segment) into two separate network segments without having to create IP subnets and use a router to connect the segments together. A device that connects two networks together in this fashion is called a “bridge”. A FreeBSD system with two network interface cards can act as a bridge.

The bridge works by learning the MAC layer addresses (Ethernet addresses) of the devices on each of its network interfaces. It forwards traffic between two networks only when its source and destination are on different networks.

In many respects, a bridge is like an Ethernet switch with very few ports.

31.5.2 Situations Where Bridging Is Appropriate

There are two common situations in which a bridge is used today.

31.5.2.1 High Traffic on a Segment

Situation one is where your physical network segment is overloaded with traffic, but you do not want for whatever reason to subnet the network and interconnect the subnets with a router.

Let us consider an example of a newspaper where the Editorial and Production departments are on the same subnetwork. The Editorial users all use server A for file service, and the Production users are on server B. An Ethernet network is used to connect all users together, and high loads on the network are slowing things down.

If the Editorial users could be segregated on one network segment and the Production users on another, the two network segments could be connected with a bridge. Only the network traffic destined for interfaces on the “other” side of the bridge would be sent to the other network, reducing congestion on each network segment.

31.5.2.2 Filtering/Traffic Shaping Firewall

The second common situation is where firewall functionality is needed without network address translation (NAT).

An example is a small company that is connected via DSL or ISDN to their ISP. They have a 13 globally-accessible IP addresses from their ISP and have 10 PCs on their network. In this situation, using a router-based firewall is difficult because of subnetting issues.

A bridge-based firewall can be configured and dropped into the path just downstream of their DSL/ISDN router without any IP numbering issues.

31.5.3 Configuring a Bridge

31.5.3.1 Network Interface Card Selection

A bridge requires at least two network cards to function. Unfortunately, not all network interface cards support bridging. Read `bridge(4)` for details on the cards that are supported.

Install and test the two network cards before continuing.

31.5.3.2 Kernel Configuration Changes

To enable kernel support for bridging, add the:

```
options BRIDGE
```

statement to your kernel configuration file, and rebuild your kernel.

31.5.3.3 Firewall Support

If you are planning to use the bridge as a firewall, you will need to add the `IPFIREWALL` option as well. Read [Εἰσαγωγή 30](#) for general information on configuring the bridge as a firewall.

If you need to allow non-IP packets (such as ARP) to flow through the bridge, there are three options available. The first is to add the following option to the kernel and rebuild:

```
option IPFIREWALL_DEFAULT_TO_ACCEPT
```

The second is to set the firewall type to “open” in the `rc.conf` file:

```
firewall_type="open"
```

Note that these options will make the firewall seem completely transparent; any packet or connection will be permitted by default. This may require significant changes to the firewall ruleset.

The third option is to apply the following `ipfw(8)` rule:

```
# ipfw add allow mac-type arp layer2
```

Or add it to the current firewall ruleset. This rule effectively allows `arp(8)` packets through, so it must be applied near the beginning of the ruleset for early evaluation.

31.5.3.4 Traffic Shaping Support

If you want to use the bridge as a traffic shaper, you will need to add the `DUMMYNET` option to your kernel configuration. Read `dumynet(4)` for further information.

31.5.4 Enabling the Bridge

Add the line:

```
net.link.ether.bridge.enable=1
```

to `/etc/sysctl.conf` to enable the bridge at runtime, and the line:

```
net.link.ether.bridge.config=if1,if2
```

to enable bridging on the specified interfaces (replace `if1` and `if2` with the names of your two network interfaces). If you want the bridged packets to be filtered by `ipfw(8)`, you should add:

```
net.link.ether.bridge.ipfw=1
```

as well.

For versions prior to FreeBSD 5.2-RELEASE, use instead the following lines:

```
net.link.ether.bridge=1
net.link.ether.bridge_cfg=if1,if2
net.link.ether.bridge_ipfw=1
```

31.5.5 Other Information

If you want to be able to `ssh(1)` into the bridge from the network, it is correct to assign one of the network cards an IP address. The consensus is that assigning both cards an address is a bad idea.

If you have multiple bridges on your network, there cannot be more than one path between any two workstations. Technically, this means that there is no support for spanning tree link management.

A bridge can add latency to your `ping(8)` times, especially for traffic from one segment to another.

31.6 Diskless Operation

Updated by Jean-François Dockès. Reorganized and enhanced by Alex Dupre.

A FreeBSD machine can boot over the network and operate without a local disk, using file systems mounted from an NFS server. No system modification is necessary, beyond standard configuration files. Such a system is relatively easy to set up because all the necessary elements are readily available:

- There are at least two possible methods to load the kernel over the network:
 - PXE: The Intel Preboot eXecution Environment system is a form of smart boot ROM built into some networking cards or motherboards. See `pxeboot(8)` for more details.
 - The **Etherboot** port (`net/etherboot`) produces ROM-able code to boot kernels over the network. The code can be either burnt into a boot PROM on a network card, or loaded from a local floppy (or hard) disk drive, or from a running MS-DOS system. Many network cards are supported.

- A sample script (`/usr/share/examples/diskless/clone_root`) eases the creation and maintenance of the workstation's root file system on the server. The script will probably require a little customization but it will get you started very quickly.
- Standard system startup files exist in `/etc` to detect and support a diskless system startup.
- Swapping, if needed, can be done either to an NFS file or to a local disk.

There are many ways to set up diskless workstations. Many elements are involved, and most can be customized to suit local taste. The following will describe variations on the setup of a complete system, emphasizing simplicity and compatibility with the standard FreeBSD startup scripts. The system described has the following characteristics:

- The diskless workstations use a shared read-only `/` file system, and a shared read-only `/usr`.

The root file system is a copy of a standard FreeBSD root (typically the server's), with some configuration files overridden by ones specific to diskless operation or, possibly, to the workstation they belong to.

The parts of the root which have to be writable are overlaid with `md(4)` file systems. Any changes will be lost when the system reboots.

- The kernel is transferred and loaded either with **Etherboot** or PXE as some situations may mandate the use of either method.

Προσοχή: As described, this system is insecure. It should live in a protected area of a network, and be untrusted by other hosts.

All the information in this section has been tested using FreeBSD 5.2.1-RELEASE.

31.6.1 Background Information

Setting up diskless workstations is both relatively straightforward and prone to errors. These are sometimes difficult to diagnose for a number of reasons. For example:

- Compile time options may determine different behaviors at runtime.
- Error messages are often cryptic or totally absent.

In this context, having some knowledge of the background mechanisms involved is very useful to solve the problems that may arise.

Several operations need to be performed for a successful bootstrap:

- The machine needs to obtain initial parameters such as its IP address, executable filename, server name, root path. This is done using the DHCP or BOOTP protocols. DHCP is a compatible extension of BOOTP, and uses the same port numbers and basic packet format.

It is possible to configure a system to use only BOOTP. The `bootpd(8)` server program is included in the base FreeBSD system.

However, DHCP has a number of advantages over BOOTP (nicer configuration files, possibility of using PXE, plus many others not directly related to diskless operation), and we will describe mainly a DHCP configuration, with equivalent examples using `bootpd(8)` when possible. The sample configuration will use the **ISC DHCP** software package (release 3.0.1.r12 was installed on the test server).

- The machine needs to transfer one or several programs to local memory. Either TFTP or NFS are used. The choice between TFTP and NFS is a compile time option in several places. A common source of error is to specify filenames for the wrong protocol: TFTP typically transfers all files from a single directory on the server, and would expect filenames relative to this directory. NFS needs absolute file paths.
- The possible intermediate bootstrap programs and the kernel need to be initialized and executed. There are several important variations in this area:
 - PXE will load pxeboot(8), which is a modified version of the FreeBSD third stage loader. The loader(8) will obtain most parameters necessary to system startup, and leave them in the kernel environment before transferring control. It is possible to use a `GENERIC` kernel in this case.
 - **Etherboot**, will directly load the kernel, with less preparation. You will need to build a kernel with specific options.

PXE and **Etherboot** work equally well; however, because kernels normally let the loader(8) do more work for them, PXE is the preferred method.

If your BIOS and network cards support PXE, you should probably use it.

- Finally, the machine needs to access its file systems. NFS is used in all cases.

See also `diskless(8)` manual page.

31.6.2 Setup Instructions

31.6.2.1 Configuration Using ISC DHCP

The **ISC DHCP** server can answer both BOOTP and DHCP requests.

ISC DHCP 3.0 is not part of the base system. You will first need to install the `net/isc-dhcp3-server` port or the corresponding package.

Once **ISC DHCP** is installed, it needs a configuration file to run (normally named `/usr/local/etc/dhcpd.conf`). Here follows a commented example, where host `margaux` uses **Etherboot** and host `corbieres` uses PXE:

```
default-lease-time 600;
max-lease-time 7200;
authoritative;

option domain-name "example.com";
option domain-name-servers 192.168.4.1;
option routers 192.168.4.1;

subnet 192.168.4.0 netmask 255.255.255.0 {
    use-host-decl-names on; ❶
    option subnet-mask 255.255.255.0;
    option broadcast-address 192.168.4.255;

    host margaux {
        hardware ethernet 01:23:45:67:89:ab;
        fixed-address margaux.example.com;
        next-server 192.168.4.4; ❷
    }
}
```

```

filename "/data/misc/kernel.diskless"; ❸
option root-path "192.168.4.4:/data/misc/diskless"; ❹
}
host corbieres {
    hardware ethernet 00:02:b3:27:62:df;
    fixed-address corbieres.example.com;
    next-server 192.168.4.4;
    filename "pxeboot";
    option root-path "192.168.4.4:/data/misc/diskless";
}
}

```

- ❶ This option tells **dhcpd** to send the value in the host declarations as the hostname for the diskless host. An alternate way would be to add an option `host-name margaux` inside the host declarations.
- ❷ The `next-server` directive designates the TFTP or NFS server to use for loading loader or kernel file (the default is to use the same host as the DHCP server).
- ❸ The `filename` directive defines the file that **Etherboot** or PXE will load for the next execution step. It must be specified according to the transfer method used. **Etherboot** can be compiled to use NFS or TFTP. The FreeBSD port configures NFS by default. PXE uses TFTP, which is why a relative filename is used here (this may depend on the TFTP server configuration, but would be fairly typical). Also, PXE loads `pxeboot`, not the kernel. There are other interesting possibilities, like loading `pxeboot` from a FreeBSD CD-ROM `/boot` directory (as `pxeboot(8)` can load a `GENERIC` kernel, this makes it possible to use PXE to boot from a remote CD-ROM).
- ❹ The `root-path` option defines the path to the root file system, in usual NFS notation. When using PXE, it is possible to leave off the host's IP as long as you do not enable the kernel option `BOOTP`. The NFS server will then be the same as the TFTP one.

31.6.2.2 Configuration Using BOOTP

Here follows an equivalent **bootpd** configuration (reduced to one client). This would be found in `/etc/bootptab`.

Please note that **Etherboot** must be compiled with the non-default option `NO_DHCP_SUPPORT` in order to use `BOOTP`, and that PXE *needs* DHCP. The only obvious advantage of **bootpd** is that it exists in the base system.

```

.def100:\
    :hn:ht=1:sa=192.168.4.4:vm=rfc1048:\
    :sm=255.255.255.0:\
    :ds=192.168.4.1:\
    :gw=192.168.4.1:\
    :hd="/tftpboot":\
    :bf="/kernel.diskless":\
    :rp="192.168.4.4:/data/misc/diskless":

margaux:ha=0123456789ab:tc=.def100

```

31.6.2.3 Preparing a Boot Program with Etherboot

Etherboot's Web site (<http://etherboot.sourceforge.net>) contains extensive documentation (<http://etherboot.sourceforge.net/doc/html/userman/t1.html>) mainly intended for Linux systems, but nonetheless containing useful information. The following will just outline how you would use **Etherboot** on a FreeBSD system.

You must first install the `net/etherboot` package or port.

You can change the **Etherboot** configuration (i.e. to use TFTP instead of NFS) by editing the `Config` file in the **Etherboot** source directory.

For our setup, we shall use a boot floppy. For other methods (PROM, or MS-DOS program), please refer to the **Etherboot** documentation.

To make a boot floppy, insert a floppy in the drive on the machine where you installed **Etherboot**, then change your current directory to the `src` directory in the **Etherboot** tree and type:

```
# gmake bin32/devicetype.fd0
```

`devicetype` depends on the type of the Ethernet card in the diskless workstation. Refer to the `NIC` file in the same directory to determine the right `devicetype`.

31.6.2.4 Booting with PXE

By default, the `pxeboot(8)` loader loads the kernel via NFS. It can be compiled to use TFTP instead by specifying the `LOADER_TFTP_SUPPORT` option in `/etc/make.conf`. See the comments in `/usr/share/examples/etc/make.conf` for instructions.

There are two other `make.conf` options which may be useful for setting up a serial console diskless machine: `BOOT_PXEldr_PROBE_KEYBOARD`, and `BOOT_PXEldr_ALWAYS_SERIAL`.

To use PXE when the machine starts, you will usually need to select the `Boot from network` option in your BIOS setup, or type a function key during the PC initialization.

31.6.2.5 Configuring the TFTP and NFS Servers

If you are using PXE or **Etherboot** configured to use TFTP, you need to enable **tftpd** on the file server:

1. Create a directory from which **tftpd** will serve the files, e.g. `/tftpboot`.
2. Add this line to your `/etc/inetd.conf`:

```
tftp dgram udp wait root /usr/libexec/tftpd tftpd -l -s /tftpboot
```

Όçìáßùóç: It appears that at least some PXE versions want the TCP version of TFTP. In this case, add a second line, replacing `dgram udp` with `stream tcp`.

3. Tell **inetd** to reread its configuration file. The `inetd_enable="YES"` must be in the `/etc/rc.conf` file for this command to execute correctly:

```
# /etc/rc.d/inetd restart
```

You can place the `tftpbboot` directory anywhere on the server. Make sure that the location is set in both `inetd.conf` and `dhcpd.conf`.

In all cases, you also need to enable NFS and export the appropriate file system on the NFS server.

1. Add this to `/etc/rc.conf`:

```
nfs_server_enable="YES"
```

2. Export the file system where the diskless root directory is located by adding the following to `/etc/exports` (adjust the volume mount point and replace `margaux corbieres` with the names of the diskless workstations):

```
/data/misc -alldirs -ro margaux corbieres
```

3. Tell **mountd** to reread its configuration file. If you actually needed to enable NFS in `/etc/rc.conf` at the first step, you probably want to reboot instead.

```
# /etc/rc.d/mountd restart
```

31.6.2.6 Building a Diskless Kernel

If using **Etherboot**, you need to create a kernel configuration file for the diskless client with the following options (in addition to the usual ones):

```
options      BOOTP          # Use BOOTP to obtain IP address/hostname
options      BOOTP_NFSROOT  # NFS mount root file system using BOOTP info
```

You may also want to use `BOOTP_NFSV3`, `BOOT_COMPAT` and `BOOTP_WIRED_TO` (refer to NOTES).

These option names are historical and slightly misleading as they actually enable indifferent use of DHCP and BOOTP inside the kernel (it is also possible to force strict BOOTP or DHCP use).

Build the kernel (see Εἰσαγωγή 8), and copy it to the place specified in `dhcpd.conf`.

Όψιμα: When using PXE, building a kernel with the above options is not strictly necessary (though suggested). Enabling them will cause more DHCP requests to be issued during kernel startup, with a small risk of inconsistency between the new values and those retrieved by `pxeboot(8)` in some special cases. The advantage of using them is that the host name will be set as a side effect. Otherwise you will need to set the host name by another method, for example in a client-specific `rc.conf` file.

Όψιμα: In order to be loadable with **Etherboot**, a kernel needs to have the device hints compiled in. You would typically set the following option in the configuration file (see the `NOTES` configuration comments file):

```
hints "GENERIC.hints"
```

31.6.2.7 Preparing the Root Filesystem

You need to create a root file system for the diskless workstations, in the location listed as `root-path` in `dhcpd.conf`.

31.6.2.7.1 Using `make world` to populate root

This method is quick and will install a complete virgin system (not only the root file system) into `DESTDIR`. All you have to do is simply execute the following script:

```
#!/bin/sh
export DESTDIR=/data/misc/diskless
mkdir -p ${DESTDIR}
cd /usr/src; make buildworld && make buildkernel
cd /usr/src/etc; make distribution
```

Once done, you may need to customize your `/etc/rc.conf` and `/etc/fstab` placed into `DESTDIR` according to your needs.

31.6.2.8 Configuring Swap

If needed, a swap file located on the server can be accessed via NFS.

31.6.2.8.1 NFS Swap

The kernel does not support enabling NFS swap at boot time. Swap must be enabled by the startup scripts, by mounting a writable file system and creating and enabling a swap file. To create a swap file of appropriate size, you can do like this:

```
# dd if=/dev/zero of=/path/to/swapfile bs=1k count=1 oseek=100000
```

To enable it you have to add the following line to your `rc.conf`:

```
swapfile=/path/to/swapfile
```

31.6.2.9 Miscellaneous Issues

31.6.2.9.1 Running with a Read-only `/usr`

If the diskless workstation is configured to run X, you will have to adjust the **XDM** configuration file, which puts the error log on `/usr` by default.

31.6.2.9.2 Using a Non-FreeBSD Server

When the server for the root file system is not running FreeBSD, you will have to create the root file system on a FreeBSD machine, then copy it to its destination, using `tar` or `cpio`.

In this situation, there are sometimes problems with the special files in `/dev`, due to differing major/minor integer sizes. A solution to this problem is to export a directory from the non-FreeBSD server, mount this directory onto a FreeBSD machine, and use `devfs(5)` to allocate device nodes transparently for the user.

31.7 ISDN

A good resource for information on ISDN technology and hardware is Dan Kegel's ISDN Page (<http://www.alumni.caltech.edu/~dank/isdn/>).

A quick simple road map to ISDN follows:

- If you live in Europe you might want to investigate the ISDN card section.
- If you are planning to use ISDN primarily to connect to the Internet with an Internet Provider on a dial-up non-dedicated basis, you might look into Terminal Adapters. This will give you the most flexibility, with the fewest problems, if you change providers.
- If you are connecting two LANs together, or connecting to the Internet with a dedicated ISDN connection, you might consider the stand alone router/bridge option.

Cost is a significant factor in determining what solution you will choose. The following options are listed from least expensive to most expensive.

31.7.1 ISDN Cards

Contributed by Hellmuth Michaelis.

FreeBSD's ISDN implementation supports only the DSS1/Q.931 (or Euro-ISDN) standard using passive cards. Some active cards are supported where the firmware also supports other signaling protocols; this also includes the first supported Primary Rate (PRI) ISDN card.

The **isdn4bsd** software allows you to connect to other ISDN routers using either IP over raw HDLC or by using synchronous PPP: either by using kernel PPP with `isppp`, a modified `sppp(4)` driver, or by using userland `ppp(8)`. By using userland `ppp(8)`, channel bonding of two or more ISDN B-channels is possible. A telephone answering machine application is also available as well as many utilities such as a software 300 Baud modem.

Some growing number of PC ISDN cards are supported under FreeBSD and the reports show that it is successfully used all over Europe and in many other parts of the world.

The passive ISDN cards supported are mostly the ones with the Infineon (formerly Siemens) ISAC/HSCX/IPAC ISDN chipsets, but also ISDN cards with chips from Cologne Chip (ISA bus only), PCI cards with Winbond W6692 chips, some cards with the Tiger300/320/ISAC chipset combinations and some vendor specific chipset based cards such as the AVM Fritz!Card PCI V.1.0 and the AVM Fritz!Card PnP.

Currently the active supported ISDN cards are the AVM B1 (ISA and PCI) BRI cards and the AVM T1 PCI PRI cards.

For documentation on **isdn4bsd**, have a look at `/usr/share/examples/isdn/` directory on your FreeBSD system or at the homepage of `isdn4bsd` (<http://www.freebsd-support.de/i4b/>) which also has pointers to hints, erratas and much more documentation such as the `isdn4bsd` handbook (<http://people.FreeBSD.org/~hm/>).

In case you are interested in adding support for a different ISDN protocol, a currently unsupported ISDN PC card or otherwise enhancing **isdn4bsd**, please get in touch with Hellmuth Michaelis <hm@FreeBSD.org>.

For questions regarding the installation, configuration and troubleshooting **isdn4bsd**, a [freebsd-isdn](http://lists.FreeBSD.org/mailman/listinfo/freebsd-isdn) (<http://lists.FreeBSD.org/mailman/listinfo/freebsd-isdn>) mailing list is available.

31.7.2 ISDN Terminal Adapters

Terminal adapters (TA), are to ISDN what modems are to regular phone lines.

Most TA's use the standard Hayes modem AT command set, and can be used as a drop in replacement for a modem.

A TA will operate basically the same as a modem except connection and throughput speeds will be much faster than your old modem. You will need to configure PPP exactly the same as for a modem setup. Make sure you set your serial speed as high as possible.

The main advantage of using a TA to connect to an Internet Provider is that you can do Dynamic PPP. As IP address space becomes more and more scarce, most providers are not willing to provide you with a static IP anymore. Most stand-alone routers are not able to accommodate dynamic IP allocation.

TA's completely rely on the PPP daemon that you are running for their features and stability of connection. This allows you to upgrade easily from using a modem to ISDN on a FreeBSD machine, if you already have PPP set up. However, at the same time any problems you experienced with the PPP program and are going to persist.

If you want maximum stability, use the kernel PPP option, not the userland PPP.

The following TA's are known to work with FreeBSD:

- Motorola BitSurfer and Bitsurfer Pro
- Adtran

Most other TA's will probably work as well, TA vendors try to make sure their product can accept most of the standard modem AT command set.

The real problem with external TA's is that, like modems, you need a good serial card in your computer.

You should read the FreeBSD Serial Hardware

(http://www.FreeBSD.org/doc/el_GR.ISO8859-7/articles/serial-uart/index.html) tutorial for a detailed understanding of serial devices, and the differences between asynchronous and synchronous serial ports.

A TA running off a standard PC serial port (asynchronous) limits you to 115.2 Kbs, even though you have a 128 Kbs connection. To fully utilize the 128 Kbs that ISDN is capable of, you must move the TA to a synchronous serial card.

Do not be fooled into buying an internal TA and thinking you have avoided the synchronous/asynchronous issue. Internal TA's simply have a standard PC serial port chip built into them. All this will do is save you having to buy another serial cable and find another empty electrical socket.

A synchronous card with a TA is at least as fast as a stand-alone router, and with a simple 386 FreeBSD box driving it, probably more flexible.

The choice of synchronous card/TA v.s. stand-alone router is largely a religious issue. There has been some discussion of this in the mailing lists. We suggest you search the archives (<http://www.FreeBSD.org/search/index.html>) for the complete discussion.

31.7.3 Stand-alone ISDN Bridges/Routers

ISDN bridges or routers are not at all specific to FreeBSD or any other operating system. For a more complete description of routing and bridging technology, please refer to a networking reference book.

In the context of this section, the terms router and bridge will be used interchangeably.

As the cost of low end ISDN routers/bridges comes down, it will likely become a more and more popular choice. An ISDN router is a small box that plugs directly into your local Ethernet network, and manages its own connection to the other bridge/router. It has built in software to communicate via PPP and other popular protocols.

A router will allow you much faster throughput than a standard TA, since it will be using a full synchronous ISDN connection.

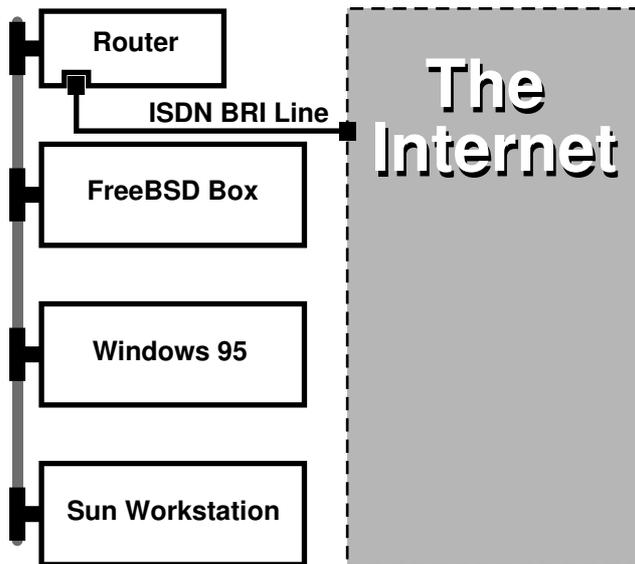
The main problem with ISDN routers and bridges is that interoperability between manufacturers can still be a problem. If you are planning to connect to an Internet provider, you should discuss your needs with them.

If you are planning to connect two LAN segments together, such as your home LAN to the office LAN, this is the simplest lowest maintenance solution. Since you are buying the equipment for both sides of the connection you can be assured that the link will work.

For example to connect a home computer or branch office network to a head office network the following setup could be used:

Ðñï÷-ññçìÝíá 31-1. Branch Office or Home Network

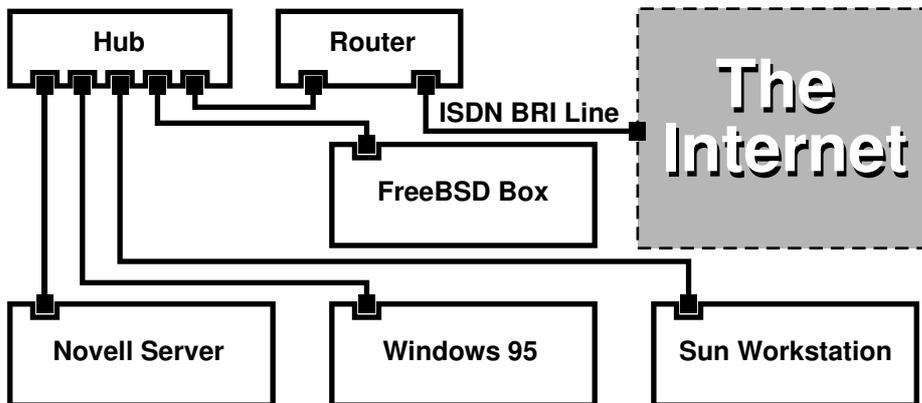
Network uses a bus based topology with 10 base 2 Ethernet (“thinnet”). Connect router to network cable with AUI/10BT transceiver, if necessary.



If your home/branch office is only one computer you can use a twisted pair crossover cable to connect to the stand-alone router directly.

Διάγραμμα 31-2. Head Office or Other LAN

Network uses a star topology with 10 base T Ethernet (“Twisted Pair”).



One large advantage of most routers/bridges is that they allow you to have 2 *separate independent* PPP connections to 2 separate sites at the *same* time. This is not supported on most TA’s, except for specific (usually expensive) models that have two serial ports. Do not confuse this with channel bonding, MPP, etc.

This can be a very useful feature if, for example, you have an dedicated ISDN connection at your office and would like to tap into it, but do not want to get another ISDN line at work. A router at the office location can manage a dedicated B channel connection (64 Kbps) to the Internet and use the other B channel for a separate data connection. The second B channel can be used for dial-in, dial-out or dynamically bonding (MPP, etc.) with the first B channel for more bandwidth.

An Ethernet bridge will also allow you to transmit more than just IP traffic. You can also send IPX/SPX or whatever other protocols you use.

31.8 Network Address Translation

Contributed by Chern Lee.

31.8.1 Overview

FreeBSD’s Network Address Translation daemon, commonly known as natd(8) is a daemon that accepts incoming raw IP packets, changes the source to the local machine and re-injects these packets back into the outgoing IP packet stream. natd(8) does this by changing the source IP address and port such that when data is received back, it is able to determine the original location of the data and forward it back to its original requester.

The most common use of NAT is to perform what is commonly known as Internet Connection Sharing.

31.8.2 Setup

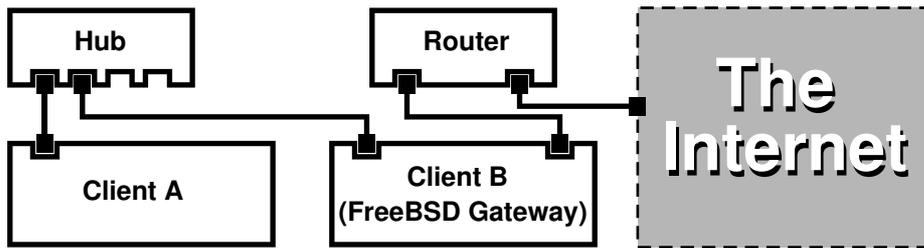
Due to the diminishing IP space in IPv4, and the increased number of users on high-speed consumer lines such as cable or DSL, people are increasingly in need of an Internet Connection Sharing solution. The ability to connect

several computers online through one connection and IP address makes natd(8) a reasonable choice.

Most commonly, a user has a machine connected to a cable or DSL line with one IP address and wishes to use this one connected computer to provide Internet access to several more over a LAN.

To do this, the FreeBSD machine on the Internet must act as a gateway. This gateway machine must have two NICs—one for connecting to the Internet router, the other connecting to a LAN. All the machines on the LAN are connected through a hub or switch.

Όγιᾶβύος: There are many ways to get a LAN connected to the Internet through a FreeBSD gateway. This example will only cover a gateway with at least two NICs.



A setup like this is commonly used to share an Internet connection. One of the LAN machines is connected to the Internet. The rest of the machines access the Internet through that “gateway” machine.

31.8.3 Configuration

The following options must be in the kernel configuration file:

```
options IPFIREWALL
options IPDIVERT
```

Additionally, at choice, the following may also be suitable:

```
options IPFIREWALL_DEFAULT_TO_ACCEPT
options IPFIREWALL_VERBOSE
```

The following must be in `/etc/rc.conf`:

```
gateway_enable="YES" ❶
firewall_enable="YES" ❷
firewall_type="OPEN" ❸
natd_enable="YES"
natd_interface="fxp0" ❹
natd_flags="" ❺
```

- ❶ Sets up the machine to act as a gateway. Running `sysctl net.inet.ip.forwarding=1` would have the same effect.
- ❷ Enables the firewall rules in `/etc/rc.firewall` at boot.

- ③ This specifies a predefined firewall ruleset that allows anything in. See `/etc/rc.firewall` for additional types.
- ④ Indicates which interface to forward packets through (the interface connected to the Internet).
- ⑤ Any additional configuration options passed to `natd(8)` on boot.

Having the previous options defined in `/etc/rc.conf` would run `natd -interface fxp0` at boot. This can also be run manually.

Όχιὰβύος: It is also possible to use a configuration file for `natd(8)` when there are too many options to pass. In this case, the configuration file must be defined by adding the following line to `/etc/rc.conf`:

```
natd_flags="-f /etc/natd.conf"
```

The `/etc/natd.conf` file will contain a list of configuration options, one per line. For example the next section case would use the following file:

```
redirect_port tcp 192.168.0.2:6667 6667
redirect_port tcp 192.168.0.3:80 80
```

For more information about the configuration file, consult the `natd(8)` manual page about the `-f` option.

Each machine and interface behind the LAN should be assigned IP address numbers in the private network space as defined by RFC 1918 (<ftp://ftp.isi.edu/in-notes/rfc1918.txt>) and have a default gateway of the **natd** machine's internal IP address.

For example, client A and B behind the LAN have IP addresses of 192.168.0.2 and 192.168.0.3, while the `natd` machine's LAN interface has an IP address of 192.168.0.1. Client A and B's default gateway must be set to that of the **natd** machine, 192.168.0.1. The **natd** machine's external, or Internet interface does not require any special modification for `natd(8)` to work.

31.8.4 Port Redirection

The drawback with `natd(8)` is that the LAN clients are not accessible from the Internet. Clients on the LAN can make outgoing connections to the world but cannot receive incoming ones. This presents a problem if trying to run Internet services on one of the LAN client machines. A simple way around this is to redirect selected Internet ports on the **natd** machine to a LAN client.

For example, an IRC server runs on client A, and a web server runs on client B. For this to work properly, connections received on ports 6667 (IRC) and 80 (web) must be redirected to the respective machines.

The `-redirect_port` must be passed to `natd(8)` with the proper options. The syntax is as follows:

```
-redirect_port proto targetIP:targetPORT[-targetPORT]
                [aliasIP:]aliasPORT[-aliasPORT]
                [remoteIP[:remotePORT[-remotePORT]]]
```

In the above example, the argument should be:

```
-redirect_port tcp 192.168.0.2:6667 6667
-redirect_port tcp 192.168.0.3:80 80
```

This will redirect the proper `tcp` ports to the LAN client machines.

The `-redirect_port` argument can be used to indicate port ranges over individual ports. For example, `tcp 192.168.0.2:2000-3000 2000-3000` would redirect all connections received on ports 2000 to 3000 to ports 2000 to 3000 on client A.

These options can be used when directly running `natd(8)`, placed within the `natd_flags=""` option in `/etc/rc.conf`, or passed via a configuration file.

For further configuration options, consult `natd(8)`

31.8.5 Address Redirection

Address redirection is useful if several IP addresses are available, yet they must be on one machine. With this, `natd(8)` can assign each LAN client its own external IP address. `natd(8)` then rewrites outgoing packets from the LAN clients with the proper external IP address and redirects all traffic incoming on that particular IP address back to the specific LAN client. This is also known as static NAT. For example, the IP addresses `128.1.1.1`, `128.1.1.2`, and `128.1.1.3` belong to the **natd** gateway machine. `128.1.1.1` can be used as the **natd** gateway machine's external IP address, while `128.1.1.2` and `128.1.1.3` are forwarded back to LAN clients A and B.

The `-redirect_address` syntax is as follows:

```
-redirect_address localIP publicIP
```

localIP

The internal IP address of the LAN client.

publicIP

The external IP address corresponding to the LAN client.

In the example, this argument would read:

```
-redirect_address 192.168.0.2 128.1.1.2
-redirect_address 192.168.0.3 128.1.1.3
```

Like `-redirect_port`, these arguments are also placed within the `natd_flags=""` option of `/etc/rc.conf`, or passed via a configuration file. With address redirection, there is no need for port redirection since all data received on a particular IP address is redirected.

The external IP addresses on the **natd** machine must be active and aliased to the external interface. Look at `rc.conf(5)` to do so.

31.9 Parallel Line IP (PLIP)

PLIP lets us run TCP/IP between parallel ports. It is useful on machines without network cards, or to install on laptops. In this section, we will discuss:

- Creating a parallel (laplink) cable.
- Connecting two computers with PLIP.

31.9.1 Creating a Parallel Cable

You can purchase a parallel cable at most computer supply stores. If you cannot do that, or you just want to know how it is done, the following table shows how to make one out of a normal parallel printer cable.

Ðβíáçáð 31-1. Wiring a Parallel Cable for Networking

A-name	A-End	B-End	Descr.	Post/Bit
DATA0 -ERROR	2 15	15 2	Data	0/0x01 1/0x08
DATA1 +SLCT	3 13	13 3	Data	0/0x02 1/0x10
DATA2 +PE	4 12	12 4	Data	0/0x04 1/0x20
DATA3 -ACK	5 10	10 5	Strobe	0/0x08 1/0x40
DATA4 BUSY	6 11	11 6	Data	0/0x10 1/0x80
GND	18-25	18-25	GND	-

31.9.2 Setting Up PLIP

First, you have to get a laplink cable. Then, confirm that both computers have a kernel with lpt(4) driver support:

```
# grep lp /var/run/dmesg.boot
lpt0: <Printer> on pbus0
lpt0: Interrupt-driven port
```

The parallel port must be an interrupt driven port, you should have lines similar to the following in your in the /boot/device.hints file:

```
hint.ppc.0.at="isa"
hint.ppc.0.irq="7"
```

Then check if the kernel configuration file has a device plip line or if the plip.ko kernel module is loaded. In both cases the parallel networking interface should appear when you use the ifconfig(8) command to display it:

```
# ifconfig plip0
plip0: flags=8810<POINTOPOINT,SIMPLEX,MULTICAST> mtu 1500
```

Plug the laplink cable into the parallel interface on both computers.

Configure the network interface parameters on both sites as root. For example, if you want to connect the host host1 with another machine host2:

```

                host1 <-----> host2
IP Address    10.0.0.1      10.0.0.2
```

Configure the interface on host1 by doing:

```
# ifconfig plip0 10.0.0.1 10.0.0.2
```

Configure the interface on host2 by doing:

```
# ifconfig plip0 10.0.0.2 10.0.0.1
```

You now should have a working connection. Please read the manual pages `lp(4)` and `lpt(4)` for more details.

You should also add both hosts to `/etc/hosts`:

```
127.0.0.1          localhost.my.domain localhost
10.0.0.1          host1.my.domain host1
10.0.0.2          host2.my.domain
```

To confirm the connection works, go to each host and ping the other. For example, on `host1`:

```
# ifconfig plip0
plip0: flags=8851<UP,POINTOPOINT,RUNNING,SIMPLEX,MULTICAST> mtu 1500
        inet 10.0.0.1 --> 10.0.0.2 netmask 0xff000000
# netstat -r
Routing tables

Internet:
Destination          Gateway              Flags      Refs      Use      Netif  Expire
host2                 host1               UH         0         0         plip0
# ping -c 4 host2
PING host2 (10.0.0.2): 56 data bytes
64 bytes from 10.0.0.2: icmp_seq=0 ttl=255 time=2.774 ms
64 bytes from 10.0.0.2: icmp_seq=1 ttl=255 time=2.530 ms
64 bytes from 10.0.0.2: icmp_seq=2 ttl=255 time=2.556 ms
64 bytes from 10.0.0.2: icmp_seq=3 ttl=255 time=2.714 ms

--- host2 ping statistics ---
4 packets transmitted, 4 packets received, 0% packet loss
round-trip min/avg/max/stddev = 2.530/2.643/2.774/0.103 ms
```

31.10 IPv6

Originally Written by Aaron Kaplan. Restructured and Added by Tom Rhodes. Extended by Brad Davis.

IPv6 (also known as IPng “IP next generation”) is the new version of the well known IP protocol (also known as IPv4). Like the other current *BSD systems, FreeBSD includes the KAME IPv6 reference implementation. So your FreeBSD system comes with all you will need to experiment with IPv6. This section focuses on getting IPv6 configured and running.

In the early 1990s, people became aware of the rapidly diminishing address space of IPv4. Given the expansion rate of the Internet there were two major concerns:

- Running out of addresses. Today this is not so much of a concern anymore since RFC1918 private address space (10.0.0.0/8, 172.16.0.0/12, and 192.168.0.0/16) and Network Address Translation (NAT) are being employed.
- Router table entries were getting too large. This is still a concern today.

IPv6 deals with these and many other issues:

- 128 bit address space. In other words theoretically there are 340,282,366,920,938,463,374,607,431,768,211,456 addresses available. This means there are approximately $6.67 * 10^{27}$ IPv6 addresses per square meter on our planet.
- Routers will only store network aggregation addresses in their routing tables thus reducing the average space of a routing table to 8192 entries.

There are also lots of other useful features of IPv6 such as:

- Address autoconfiguration (RFC2462 (<http://www.ietf.org/rfc/rfc2462.txt>))
- Anycast addresses (“one-out-of many”)
- Mandatory multicast addresses
- IPsec (IP security)
- Simplified header structure
- Mobile IP
- IPv6-to-IPv4 transition mechanisms

For more information see:

- IPv6 overview at playground.sun.com (<http://playground.sun.com/pub/ipng/html/ipng-main.html>)
- KAME.net (<http://www.kame.net>)

31.10.1 Background on IPv6 Addresses

There are different types of IPv6 addresses: Unicast, Anycast and Multicast.

Unicast addresses are the well known addresses. A packet sent to a unicast address arrives exactly at the interface belonging to the address.

Anycast addresses are syntactically indistinguishable from unicast addresses but they address a group of interfaces. The packet destined for an anycast address will arrive at the nearest (in router metric) interface. Anycast addresses may only be used by routers.

Multicast addresses identify a group of interfaces. A packet destined for a multicast address will arrive at all interfaces belonging to the multicast group.

Ότις ἀποδο: The IPv4 broadcast address (usually xxx.xxx.xxx.255) is expressed by multicast addresses in IPv6.

Διεύθυνση 31-2. Reserved IPv6 addresses

IPv6 address	Prefixlength (Bits)	Description	Notes
::	128 bits	unspecified	cf. 0.0.0.0 in IPv4
::1	128 bits	loopback address	cf. 127.0.0.1 in IPv4

IPv6 address	Prefixlength (Bits)	Description	Notes
::00:xx:xx:xx:xx	96 bits	embedded IPv4	The lower 32 bits are the IPv4 address. Also called “IPv4 compatible IPv6 address”
::ff:xx:xx:xx:xx	96 bits	IPv4 mapped IPv6 address	The lower 32 bits are the IPv4 address. For hosts which do not support IPv6.
fe80:: - feb::	10 bits	link-local	cf. loopback address in IPv4
fec0:: - fef::	10 bits	site-local	
ff::	8 bits	multicast	
001 (base 2)	3 bits	global unicast	All global unicast addresses are assigned from this pool. The first 3 bits are “001”.

31.10.2 Reading IPv6 Addresses

The canonical form is represented as: x:x:x:x:x:x:x, each “x” being a 16 Bit hex value. For example FEBC:A574:382B:23C1:AA49:4592:4EFE:9982

Often an address will have long substrings of all zeros therefore one such substring per address can be abbreviated by “:”. Also up to three leading “0”s per hexquad can be omitted. For example fe80::1 corresponds to the canonical form fe80:0000:0000:0000:0000:0000:0000:0001.

A third form is to write the last 32 Bit part in the well known (decimal) IPv4 style with dots “.” as separators. For example 2002::10.0.0.1 corresponds to the (hexadecimal) canonical representation 2002:0000:0000:0000:0000:0000:0a00:0001 which in turn is equivalent to writing 2002::a00:1.

By now the reader should be able to understand the following:

```
# ifconfig
```

```
r10: flags=8943<UP,BROADCAST,RUNNING,PROMISC,SIMPLEX,MULTICAST> mtu 1500
    inet 10.0.0.10 netmask 0xffffffff broadcast 10.0.0.255
    inet6 fe80::200:21ff:fe03:8e1%r10 prefixlen 64 scopeid 0x1
    ether 00:00:21:03:08:e1
    media: Ethernet autoselect (100baseTX )
    status: active
```

fe80::200:21ff:fe03:8e1%r10 is an auto configured link-local address. It is generated from the MAC address as part of the auto configuration.

For further information on the structure of IPv6 addresses see RFC3513 (<http://www.ietf.org/rfc/rfc3513.txt>).

31.10.3 Getting Connected

Currently there are four ways to connect to other IPv6 hosts and networks:

- Getting an IPv6 network from your upstream provider. Talk to your Internet provider for instructions.
- Tunnel via 6-to-4 (RFC3068 (<http://www.ietf.org/rfc/rfc3068.txt>))
- Use the `net/freenet6` port if you are on a dial-up connection.

31.10.4 DNS in the IPv6 World

There used to be two types of DNS records for IPv6. The IETF has declared A6 records obsolete. AAAA records are the standard now.

Using AAAA records is straightforward. Assign your hostname to the new IPv6 address you just received by adding:

```
MYHOSTNAME          AAAA      MYIPv6ADDR
```

To your primary zone DNS file. In case you do not serve your own DNS zones ask your DNS provider. Current versions of **bind** (version 8.3 and 9) and `dns/djbdns` (with the IPv6 patch) support AAAA records.

31.10.5 Applying the needed changes to `/etc/rc.conf`

31.10.5.1 IPv6 Client Settings

These settings will help you configure a machine that will be on your LAN and act as a client, not a router. To have `rsol(8)` autoconfigure your interface on boot all you need to add is:

```
ipv6_enable="YES"
```

To statically assign an IP address such as `2001:471:1f11:251:290:27ff:fee0:2093`, to your `fxp0` interface, add:

```
ipv6_ifconfig_fxp0="2001:471:1f11:251:290:27ff:fee0:2093"
```

To assign a default router of `2001:471:1f11:251::1` add the following to `/etc/rc.conf`:

```
ipv6_defaultrouter="2001:471:1f11:251::1"
```

31.10.5.2 IPv6 Router/Gateway Settings

This will help you take the directions that your tunnel provider has given you and convert it into settings that will persist through reboots. To restore your tunnel on startup use something like the following in `/etc/rc.conf`:

List the Generic Tunneling interfaces that will be configured, for example `gif0`:

```
gif_interfaces="gif0"
```

To configure the interface with a local endpoint of `MY_IPv4_ADDR` to a remote endpoint of `REMOTE_IPv4_ADDR`:

```
gifconfig_gif0="MY_IPv4_ADDR REMOTE_IPv4_ADDR"
```

To apply the IPv6 address you have been assigned for use as your IPv6 tunnel endpoint, add:

```
ipv6_ifconfig_gif0="MY_ASSIGNED_IPv6_TUNNEL_ENDPOINT_ADDR"
```

Then all you have to do is set the default route for IPv6. This is the other side of the IPv6 tunnel:

```
ipv6_defaultrouter="MY_IPV6_REMOTE_TUNNEL_ENDPOINT_ADDR"
```

31.10.5.3 IPv6 Tunnel Settings

If the server is to route IPv6 between the rest of your network and the world, the following `/etc/rc.conf` setting will also be needed:

```
ipv6_gateway_enable="YES"
```

31.10.6 Router Advertisement and Host Auto Configuration

This section will help you setup `rtadvd(8)` to advertise the IPv6 default route.

To enable `rtadvd(8)` you will need the following in your `/etc/rc.conf`:

```
rtadvd_enable="YES"
```

It is important that you specify the interface on which to do IPv6 router solicitation. For example to tell `rtadvd(8)` to use `fxp0`:

```
rtadvd_interfaces="fxp0"
```

Now we must create the configuration file, `/etc/rtadvd.conf`. Here is an example:

```
fxp0:\
:addr#1:addr="2001:471:1f11:246::":prefixlen#64:tc=ether:
```

Replace `fxp0` with the interface you are going to be using.

Next, replace `2001:471:1f11:246::` with the prefix of your allocation.

If you are dedicated a /64 subnet you will not need to change anything else. Otherwise, you will need to change the `prefixlen#` to the correct value.

31.11 Asynchronous Transfer Mode (ATM)

Contributed by Harti Brandt.

31.11.1 Configuring classical IP over ATM (PVCs)

Classical IP over ATM (CLIP) is the simplest method to use Asynchronous Transfer Mode (ATM) with IP. It can be used with switched connections (SVCs) and with permanent connections (PVCs). This section describes how to set up a network based on PVCs.

31.11.1.1 Fully meshed configurations

The first method to set up a CLIP with PVCs is to connect each machine to each other machine in the network via a dedicated PVC. While this is simple to configure it tends to become impractical for a larger number of machines. The example supposes that we have four machines in the network, each connected to the ATM network with an ATM adapter card. The first step is the planning of the IP addresses and the ATM connections between the machines. We use the following:

Host	IP Address
hostA	192.168.173.1
hostB	192.168.173.2
hostC	192.168.173.3
hostD	192.168.173.4

To build a fully meshed net we need one ATM connection between each pair of machines:

Machines	VPI.VCI couple
hostA - hostB	0.100
hostA - hostC	0.101
hostA - hostD	0.102
hostB - hostC	0.103
hostB - hostD	0.104
hostC - hostD	0.105

The VPI and VCI values at each end of the connection may of course differ, but for simplicity we assume that they are the same. Next we need to configure the ATM interfaces on each host:

```
hostA# ifconfig hatm0 192.168.173.1 up
hostB# ifconfig hatm0 192.168.173.2 up
hostC# ifconfig hatm0 192.168.173.3 up
hostD# ifconfig hatm0 192.168.173.4 up
```

assuming that the ATM interface is hatm0 on all hosts. Now the PVCs need to be configured on hostA (we assume that they are already configured on the ATM switches, you need to consult the manual for the switch on how to do this).

```
hostA# atmconfig natm add 192.168.173.2 hatm0 0 100 llc/snap ubr
hostA# atmconfig natm add 192.168.173.3 hatm0 0 101 llc/snap ubr
hostA# atmconfig natm add 192.168.173.4 hatm0 0 102 llc/snap ubr

hostB# atmconfig natm add 192.168.173.1 hatm0 0 100 llc/snap ubr
hostB# atmconfig natm add 192.168.173.3 hatm0 0 103 llc/snap ubr
hostB# atmconfig natm add 192.168.173.4 hatm0 0 104 llc/snap ubr

hostC# atmconfig natm add 192.168.173.1 hatm0 0 101 llc/snap ubr
hostC# atmconfig natm add 192.168.173.2 hatm0 0 103 llc/snap ubr
hostC# atmconfig natm add 192.168.173.4 hatm0 0 105 llc/snap ubr

hostD# atmconfig natm add 192.168.173.1 hatm0 0 102 llc/snap ubr
```

```
hostD# atmconfig natm add 192.168.173.2 hatm0 0 104 llc/snap ubr
hostD# atmconfig natm add 192.168.173.3 hatm0 0 105 llc/snap ubr
```

Of course other traffic contracts than UBR can be used given the ATM adapter supports those. In this case the name of the traffic contract is followed by the parameters of the traffic. Help for the atmconfig(8) tool can be obtained with:

```
# atmconfig help natm add
```

or in the atmconfig(8) manual page.

The same configuration can also be done via /etc/rc.conf. For hostA this would look like:

```
network_interfaces="lo0 hatm0"
ifconfig_hatm0="inet 192.168.173.1 up"
natm_static_routes="hostB hostC hostD"
route_hostB="192.168.173.2 hatm0 0 100 llc/snap ubr"
route_hostC="192.168.173.3 hatm0 0 101 llc/snap ubr"
route_hostD="192.168.173.4 hatm0 0 102 llc/snap ubr"
```

The current state of all CLIP routes can be obtained with:

```
hostA# atmconfig natm show
```

31.12 Common Access Redundancy Protocol (CARP)

Contributed by Tom Rhodes.

The Common Access Redundancy Protocol, or CARP allows multiple hosts to share the same IP address. In some configurations, this may be used for availability or load balancing. Hosts may use separate IP addresses as well, as in the example provided here.

To enable support for CARP, the FreeBSD kernel must be rebuilt with the following option:

```
device carp
```

CARP functionality should now be available and may be tuned via several sysctl OIDs. Devices themselves may be loaded via the ifconfig command:

```
# ifconfig carp0 create
```

In a real environment, these interfaces will need unique identification numbers known as a VHID. This VHID or Virtual Host Identification will be used to distinguish the host on the network.

31.12.1 Using CARP For Server Availability (CARP)

One use of CARP, as noted above, is for server availability. This example will provide failover support for three hosts, all with unique IP addresses and providing the same web content. These machines will act in conjunction with a Round Robin DNS configuration. The failover machine will have two additional CARP interfaces, one for each of the content server's IPs. When a failure occurs, the failover server should pick up the failed machine's IP address.

This means the failure should go completely unnoticed to the user. The failover server requires identical content and services as the other content servers it is expected to pick up load for.

The two machines should be configured identically other than their issued hostnames and VHIDs. This example calls these machines `hosta.example.org` and `hostb.example.org` respectively. First, the required lines for a CARP configuration have to be added to `rc.conf`. For `hosta.example.org`, the `rc.conf` file should contain the following lines:

```
hostname="hosta.example.org"
ifconfig_fxp0="inet 192.168.1.3 netmask 255.255.255.0"
cloned_interfaces="carp0"
ifconfig_carp0="vhid 1 pass testpast 192.168.1.50/24"
```

On `hostb.example.org` the following lines should be in `rc.conf`:

```
hostname="hostb.example.org"
ifconfig_fxp0="inet 192.168.1.4 netmask 255.255.255.0"
cloned_interfaces="carp0"
ifconfig_carp0="vhid 2 pass testpass 192.168.1.51/24"
```

Ὁμολογία: It is very important that the passwords, specified by the `pass` option to `ifconfig`, are identical. The `carp` devices will only listen to and accept advertisements from machines with the correct password. The VHID must also be different for each machine.

The third machine, `provider.example.org`, should be prepared so that it may handle failover from either host. This machine will require two `carp` devices, one to handle each host. The appropriate `rc.conf` configuration lines will be similar to the following:

```
hostname="provider.example.org"
ifconfig_fxp0="inet 192.168.1.5 netmask 255.255.255.0"
cloned_interfaces="carp0 carp1"
ifconfig_carp0="vhid 1 advskew 100 pass testpass 192.168.1.50/24"
ifconfig_carp1="vhid 2 advskew 100 pass testpass 192.168.1.51/24"
```

Having the two `carp` devices will allow `provider.example.org` to notice and pick up the IP address of either machine should it stop responding.

Ὁμολογία: The default FreeBSD kernel *may* have preemption enabled. If so, `provider.example.org` may not relinquish the IP address back to the original content server. In this case, an administrator may “nudge” the interface. The following command should be issued on `provider.example.org`:

```
# ifconfig carp0 down && ifconfig carp0 up
```

This should be done on the `carp` interface which corresponds to the correct host.

At this point, CARP should be completely enabled and available for testing. For testing, either networking has to be restarted or the machines need to be rebooted.

More information is always available in the `carp(4)` manual page.

V. ĐáñáñôPìáôá

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A.1.3 Ἀεάιῃῃῃῃ

Αἱ ἄβδὰ ἰὰδὰδὐεϗὐδ ἐεἰ ἰδῖῃῃῃῃ ἰὰ ἀεάιῃῃῃῃ ὁὰ CD-ROM δῃῃῃῃῃῃ ἄἀεὶὶΎἰά οἱ FreeBSD, δῃῃῃῃῃῃῃῃ ἄδῃῃῃῃῃῃῃ ἰὰ εὔδῃῃῃ ἄδῃ ὀῖδ ἄεάιῃῃῃῃ:

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Fax: +1 763 535-0341
WWW: <http://www.navarre.com/>

A.2 ΆιòδçñâòçôÝò FTP

Ïè àðβòçιάò àèäüòáèò òιò FreeBSD àβιάè äèèèÝóèιάò ìÝòù àíπιòιçò FTP óýíäáòçò áðü àèÜòιπιòð àιòδçñâòçò Ýò FTP óá üèí òιí èüòιí. Ï èáíòñèèèò àιòδçñâòçòðò <ftp://ftp.FreeBSD.org/pub/FreeBSD/> Ý ÷ àè ðιèý èáèð óýíäáòç ìá òιí òðüèιèðι èüòιí, èáè àðèòñÝðáè Ýíá ìääÜèí àñèèìü òáòòü ÷ ñιíüí òóíäÝóáüí. Áèüìá èè Ýòóè üìò, àβιάè ìÜèèí èáèð èáÝá ìá àñâβòâ èÜðιèí àιòδçñâòçòð FTP ðιò àβιάè ðèí “èιíòÜ” óáò (àèäèèÜ áí èÝèääâ ìá òðβóáòâ èÜðιèí òιðèèü mirror site).

Ç àÜóç òüí mirror sites òιò FreeBSD (<http://mirrorlist.FreeBSD.org/>) àβιάè ðèí àίçìáñùìÝίç èáè Ýäèòñç áðü òçí àίòβòðιè ÷ ç èβòáá òòι Άã ÷ àèñβáèí òιò FreeBSD, èòñβùò àðáèáð ðáβñíáè òèò ðèçñιòιñβáò òçò áðü òι DNS èè ü ÷ è áðü ìéá òóáòèèè èβòáá áðü ñüìáòá àιòδçñâòçòπι.

Argentina

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- <ftp://ftp2.au.FreeBSD.org/pub/FreeBSD/> (ftp)
- <ftp://ftp3.au.FreeBSD.org/pub/FreeBSD/> (ftp)

Austria

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- <ftp://ftp2.at.FreeBSD.org/pub/FreeBSD/> (ftp / ftpv6 / http (<http://ftp2.at.FreeBSD.org/pub/FreeBSD/>) / httpv6 (<http://ftp2.at.FreeBSD.org/pub/FreeBSD/>) / rsync / rsyncv6)

Brazil

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- <ftp://ftp3.br.FreeBSD.org/pub/FreeBSD/> (ftp / rsync)
- <ftp://ftp4.br.FreeBSD.org/pub/FreeBSD/> (ftp)
- ftp://ftp5.br.FreeBSD.org
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- <ftp://ftp2.de.FreeBSD.org/pub/FreeBSD/> (ftp / http (<http://ftp2.de.FreeBSD.org/pub/FreeBSD/>) / rsync)
- <ftp://ftp3.de.FreeBSD.org/pub/FreeBSD/> (ftp)
- <ftp://ftp4.de.FreeBSD.org/FreeBSD/> (ftp / http (<http://ftp4.de.FreeBSD.org/pub/FreeBSD/>) / rsync)
- <ftp://ftp5.de.FreeBSD.org/pub/FreeBSD/> (ftp)
- <ftp://ftp6.de.FreeBSD.org/pub/FreeBSD/> (ftp)
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- <ftp://ftp2.ie.FreeBSD.org/pub/FreeBSD/> (ftp / http (<http://ftp2.ie.FreeBSD.org/pub/FreeBSD/>) / rsync)
- <ftp://ftp3.ie.FreeBSD.org/pub/FreeBSD/> (ftp / http (<http://ftp3.ie.FreeBSD.org/pub/FreeBSD/>) / rsync)

Israel

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Italy

In case of problems, please contact the hostmaster <hostmaster@it.FreeBSD.org> for this domain.

- <ftp://ftp.it.FreeBSD.org/pub/FreeBSD/> (ftp)

Japan

In case of problems, please contact the hostmaster <hostmaster@jp.FreeBSD.org> for this domain.

- <ftp://ftp.jp.FreeBSD.org/pub/FreeBSD/> (ftp)
- <ftp://ftp2.jp.FreeBSD.org/pub/FreeBSD/> (ftp)
- <ftp://ftp3.jp.FreeBSD.org/pub/FreeBSD/> (ftp)
- <ftp://ftp4.jp.FreeBSD.org/pub/FreeBSD/> (ftp)

- <ftp://ftp5.jp.FreeBSD.org/pub/FreeBSD/> (ftp)
- <ftp://ftp6.jp.FreeBSD.org/pub/FreeBSD/> (ftp)
- <ftp://ftp7.jp.FreeBSD.org/pub/FreeBSD/> (ftp)
- <ftp://ftp8.jp.FreeBSD.org/pub/FreeBSD/> (ftp)
- <ftp://ftp9.jp.FreeBSD.org/pub/FreeBSD/> (ftp)

Korea

In case of problems, please contact the hostmaster <hostmaster@kr.FreeBSD.org> for this domain.

- <ftp://ftp.kr.FreeBSD.org/pub/FreeBSD/> (ftp / rsync)
- <ftp://ftp2.kr.FreeBSD.org/pub/FreeBSD/> (ftp / [http \(http://ftp2.kr.FreeBSD.org/pub/FreeBSD/\)](http://ftp2.kr.FreeBSD.org/pub/FreeBSD/))

Latvia

In case of problems, please contact the hostmaster <hostmaster@lv.FreeBSD.org> for this domain.

- <ftp://ftp.lv.FreeBSD.org/pub/FreeBSD/> (ftp / [http \(http://ftp.lv.FreeBSD.org/pub/FreeBSD/\)](http://ftp.lv.FreeBSD.org/pub/FreeBSD/))
- <ftp://ftp2.lv.FreeBSD.org/pub/FreeBSD/> (ftp)

Lithuania

In case of problems, please contact the hostmaster <hostmaster@lt.FreeBSD.org> for this domain.

- <ftp://ftp.lt.FreeBSD.org/pub/FreeBSD/> (ftp / [http \(http://ftp.lt.FreeBSD.org/pub/FreeBSD/\)](http://ftp.lt.FreeBSD.org/pub/FreeBSD/))

Netherlands

In case of problems, please contact the hostmaster <hostmaster@nl.FreeBSD.org> for this domain.

- <ftp://ftp.nl.FreeBSD.org/pub/FreeBSD/> (ftp / [http \(http://ftp.nl.FreeBSD.org/os/FreeBSD/\)](http://ftp.nl.FreeBSD.org/os/FreeBSD/) / rsync)
- <ftp://ftp2.nl.FreeBSD.org/pub/FreeBSD/> (ftp)

Norway

In case of problems, please contact the hostmaster <hostmaster@no.FreeBSD.org> for this domain.

- <ftp://ftp.no.FreeBSD.org/pub/FreeBSD/> (ftp / rsync)
- <ftp://ftp3.no.FreeBSD.org/pub/FreeBSD/> (ftp)

Poland

In case of problems, please contact the hostmaster <hostmaster@pl.FreeBSD.org> for this domain.

- <ftp://ftp.pl.FreeBSD.org/pub/FreeBSD/> (ftp)

- <ftp://ftp2.pl.FreeBSD.org/pub/FreeBSD/> (ftp / ftpv6 (<ftp://ftp2.pl.FreeBSD.org/pub/FreeBSD/>) / [http \(http://ftp2.pl.FreeBSD.org/pub/FreeBSD/\)](http://ftp2.pl.FreeBSD.org/pub/FreeBSD/) / [httpv6 \(http://ftp2.pl.FreeBSD.org/pub/FreeBSD/\)](http://ftp2.pl.FreeBSD.org/pub/FreeBSD/) / [rsync / rsyncv6](http://ftp2.pl.FreeBSD.org/pub/FreeBSD/))

Portugal

In case of problems, please contact the hostmaster <hostmaster@pt.FreeBSD.org> for this domain.

- <ftp://ftp.pt.FreeBSD.org/pub/FreeBSD/> (ftp)
- <ftp://ftp2.pt.FreeBSD.org/pub/freebsd/> (ftp)
- <ftp://ftp4.pt.FreeBSD.org/pub/ISO/FreeBSD/> (ftp)

Romania

In case of problems, please contact the hostmaster <hostmaster@ro.FreeBSD.org> for this domain.

- <ftp://ftp.ro.FreeBSD.org/pub/FreeBSD/> (ftp)
- <ftp://ftp1.ro.FreeBSD.org/pub/FreeBSD/> (ftp / ftpv6 / [http \(http://ftp1.ro.FreeBSD.org/pub/FreeBSD/\)](http://ftp1.ro.FreeBSD.org/pub/FreeBSD/) / [httpv6 \(http://ftp1.ro.FreeBSD.org/pub/FreeBSD/\)](http://ftp1.ro.FreeBSD.org/pub/FreeBSD/))

Russia

In case of problems, please contact the hostmaster <hostmaster@ru.FreeBSD.org> for this domain.

- <ftp://ftp.ru.FreeBSD.org/pub/FreeBSD/> (ftp / [http \(http://ftp.ru.FreeBSD.org/FreeBSD/\)](http://ftp.ru.FreeBSD.org/FreeBSD/) / [rsync](http://ftp.ru.FreeBSD.org/FreeBSD/))
- <ftp://ftp2.ru.FreeBSD.org/pub/FreeBSD/> (ftp / [http \(http://ftp2.ru.FreeBSD.org/pub/FreeBSD/\)](http://ftp2.ru.FreeBSD.org/pub/FreeBSD/) / [rsync](http://ftp2.ru.FreeBSD.org/pub/FreeBSD/))
- <ftp://ftp3.ru.FreeBSD.org/pub/FreeBSD/> (ftp)
- <ftp://ftp4.ru.FreeBSD.org/pub/FreeBSD/> (ftp)
- <ftp://ftp5.ru.FreeBSD.org/pub/FreeBSD/> (ftp / [http \(http://ftp5.ru.FreeBSD.org/pub/FreeBSD/\)](http://ftp5.ru.FreeBSD.org/pub/FreeBSD/) / [rsync](http://ftp5.ru.FreeBSD.org/pub/FreeBSD/))
- <ftp://ftp6.ru.FreeBSD.org/pub/FreeBSD/> (ftp)

Saudi Arabia

In case of problems, please contact the hostmaster <ftpadmin@isu.net.sa> for this domain.

- <ftp://ftp.isu.net.sa/pub/ftp.freebsd.org/> (ftp)

Singapore

In case of problems, please contact the hostmaster <hostmaster@sg.FreeBSD.org> for this domain.

- <ftp://ftp.sg.FreeBSD.org/pub/FreeBSD/> (ftp / [http \(http://ftp.sg.FreeBSD.org/pub/FreeBSD/\)](http://ftp.sg.FreeBSD.org/pub/FreeBSD/) / [rsync](http://ftp.sg.FreeBSD.org/pub/FreeBSD/))

Slovak Republic

In case of problems, please contact the hostmaster <hostmaster@sk.FreeBSD.org> for this domain.

- ftp://ftp.sk.FreeBSD.org/pub/FreeBSD/ (ftp / ftpv6 (ftp://ftp.sk.FreeBSD.org/pub/FreeBSD/) / http (http://ftp.sk.FreeBSD.org/pub/FreeBSD/) / httpv6 (http://ftp.sk.FreeBSD.org/pub/FreeBSD/) / rsync / rsyncv6)
- ftp://ftp2.sk.FreeBSD.org/pub/FreeBSD/ (ftp / ftpv6 (ftp://ftp2.sk.FreeBSD.org/pub/FreeBSD/) / http (http://ftp2.sk.FreeBSD.org/pub/FreeBSD/) / httpv6 (http://ftp2.sk.FreeBSD.org/pub/FreeBSD/))

Slovenia

In case of problems, please contact the hostmaster <hostmaster@si.FreeBSD.org> for this domain.

- ftp://ftp.si.FreeBSD.org/pub/FreeBSD/ (ftp)
- ftp://ftp2.si.FreeBSD.org/pub/FreeBSD/ (ftp)

South Africa

In case of problems, please contact the hostmaster <hostmaster@za.FreeBSD.org> for this domain.

- ftp://ftp.za.FreeBSD.org/pub/FreeBSD/ (ftp)
- ftp://ftp2.za.FreeBSD.org/pub/FreeBSD/ (ftp)
- ftp://ftp3.za.FreeBSD.org/pub/FreeBSD/ (ftp)
- ftp://ftp4.za.FreeBSD.org/pub/FreeBSD/ (ftp)

Spain

In case of problems, please contact the hostmaster <hostmaster@es.FreeBSD.org> for this domain.

- ftp://ftp.es.FreeBSD.org/pub/FreeBSD/ (ftp / http (http://ftp.es.FreeBSD.org/pub/FreeBSD/))
- ftp://ftp2.es.FreeBSD.org/pub/FreeBSD/ (ftp)
- ftp://ftp3.es.FreeBSD.org/pub/FreeBSD/ (ftp)

Sweden

In case of problems, please contact the hostmaster <hostmaster@se.FreeBSD.org> for this domain.

- ftp://ftp.se.FreeBSD.org/pub/FreeBSD/ (ftp)
- ftp://ftp2.se.FreeBSD.org/pub/FreeBSD/ (ftp)
- ftp://ftp3.se.FreeBSD.org/pub/FreeBSD/ (ftp)
- ftp://ftp4.se.FreeBSD.org/pub/FreeBSD/ (ftp / ftpv6 (ftp://ftp4.se.FreeBSD.org/pub/FreeBSD/) / rsync / rsyncv6)
- ftp://ftp5.se.FreeBSD.org/pub/FreeBSD/ (ftp / http (http://ftp5.se.FreeBSD.org/) / rsync)

Switzerland

In case of problems, please contact the hostmaster <hostmaster@ch.FreeBSD.org> for this domain.

- <ftp://ftp.ch.FreeBSD.org/pub/FreeBSD/> (ftp / http (<http://ftp.ch.FreeBSD.org/pub/FreeBSD/>))
- <ftp://ftp2.ch.FreeBSD.org/mirror/FreeBSD/> (ftp / ftpv6 (<ftp://ftp2.ch.FreeBSD.org/mirror/FreeBSD/>) / http (<http://ftp2.ch.FreeBSD.org/ftp/mirror/FreeBSD/>) / httpv6 (<http://ftp2.ch.FreeBSD.org/ftp/mirror/FreeBSD/>))

Taiwan

In case of problems, please contact the hostmaster <hostmaster@tw.FreeBSD.org> for this domain.

- <ftp://ftp.tw.FreeBSD.org/pub/FreeBSD/> (ftp / ftpv6 (<ftp://ftp.tw.FreeBSD.org/pub/FreeBSD/>) / rsync / rsyncv6)
- <ftp://ftp2.tw.FreeBSD.org/pub/FreeBSD/> (ftp / ftpv6 (<ftp://ftp2.tw.FreeBSD.org/pub/FreeBSD/>) / http (<http://ftp2.tw.FreeBSD.org/pub/FreeBSD/>) / httpv6 (<http://ftp2.tw.FreeBSD.org/pub/FreeBSD/>) / rsync / rsyncv6)
- <ftp://ftp3.tw.FreeBSD.org/pub/FreeBSD/> (ftp)
- <ftp://ftp4.tw.FreeBSD.org/pub/FreeBSD/> (ftp)
- <ftp://ftp5.tw.FreeBSD.org/pub/FreeBSD/> (ftp)
- <ftp://ftp6.tw.FreeBSD.org/pub/FreeBSD/> (ftp / http (<http://ftp6.tw.FreeBSD.org/>) / rsync)
- <ftp://ftp7.tw.FreeBSD.org/pub/FreeBSD/> (ftp)
- <ftp://ftp8.tw.FreeBSD.org/pub/FreeBSD/> (ftp)
- <ftp://ftp9.tw.FreeBSD.org/pub/FreeBSD/> (ftp)
- <ftp://ftp10.tw.FreeBSD.org/pub/FreeBSD/> (ftp)
- <ftp://ftp11.tw.FreeBSD.org/pub/FreeBSD/> (ftp / http (<http://ftp11.tw.FreeBSD.org/FreeBSD/>))
- <ftp://ftp12.tw.FreeBSD.org/pub/FreeBSD/> (ftp)
- <ftp://ftp13.tw.FreeBSD.org/pub/FreeBSD/> (ftp)
- <ftp://ftp14.tw.FreeBSD.org/pub/FreeBSD/> (ftp)
- <ftp://ftp15.tw.FreeBSD.org/pub/FreeBSD/> (ftp)

Turkey

- <ftp://ftp.tr.FreeBSD.org/pub/FreeBSD/> (ftp / http (<http://ftp.tr.FreeBSD.org/pub/FreeBSD/>) / rsync)
- <ftp://ftp2.tr.FreeBSD.org/pub/FreeBSD/> (ftp / rsync)

Ukraine

- <ftp://ftp.ua.FreeBSD.org/pub/FreeBSD/> (ftp / http (<http://ftp.ua.FreeBSD.org/pub/FreeBSD/>))

- <ftp://ftp2.ua.FreeBSD.org/pub/FreeBSD/> (ftp / http (<http://ftp2.ua.FreeBSD.org/pub/FreeBSD/>))
- <ftp://ftp7.ua.FreeBSD.org/pub/FreeBSD/> (ftp)
- <ftp://ftp8.ua.FreeBSD.org/pub/FreeBSD/> (ftp / http (<http://ftp8.ua.FreeBSD.org/FreeBSD/>))
- <ftp://ftp11.ua.FreeBSD.org/pub/FreeBSD/> (ftp)

United Kingdom

In case of problems, please contact the hostmaster <hostmaster@uk.FreeBSD.org> for this domain.

- <ftp://ftp.uk.FreeBSD.org/pub/FreeBSD/> (ftp)
- <ftp://ftp2.uk.FreeBSD.org/pub/FreeBSD/> (ftp / http (<http://ftp2.uk.FreeBSD.org/>) / rsync)
- <ftp://ftp3.uk.FreeBSD.org/pub/FreeBSD/> (ftp)
- <ftp://ftp4.uk.FreeBSD.org/pub/FreeBSD/> (ftp)
- <ftp://ftp5.uk.FreeBSD.org/pub/FreeBSD/> (ftp)
- <ftp://ftp6.uk.FreeBSD.org/pub/FreeBSD/> (ftp)

USA

In case of problems, please contact the hostmaster <hostmaster@us.FreeBSD.org> for this domain.

- <ftp://ftp1.us.FreeBSD.org/pub/FreeBSD/> (ftp)
- <ftp://ftp2.us.FreeBSD.org/pub/FreeBSD/> (ftp)
- <ftp://ftp3.us.FreeBSD.org/pub/FreeBSD/> (ftp)
- <ftp://ftp4.us.FreeBSD.org/pub/FreeBSD/> (ftp / ftpv6 / http (<http://ftp4.us.FreeBSD.org/pub/FreeBSD/>) / [httpv6 \(http://ftp4.us.FreeBSD.org/pub/FreeBSD/\)](http://ftp4.us.FreeBSD.org/pub/FreeBSD/))
- <ftp://ftp5.us.FreeBSD.org/pub/FreeBSD/> (ftp / rsync)
- <ftp://ftp6.us.FreeBSD.org/pub/FreeBSD/> (ftp)
- <ftp://ftp7.us.FreeBSD.org/pub/FreeBSD/> (ftp / http (<http://ftp7.us.FreeBSD.org/pub/FreeBSD/>) / rsync)
- <ftp://ftp8.us.FreeBSD.org/pub/FreeBSD/> (ftp)
- <ftp://ftp9.us.FreeBSD.org/pub/FreeBSD/> (ftp / http (<http://ftp9.us.FreeBSD.org/pub/os/FreeBSD/>))
- <ftp://ftp10.us.FreeBSD.org/pub/FreeBSD/> (ftp)
- <ftp://ftp11.us.FreeBSD.org/pub/FreeBSD/> (ftp)
- <ftp://ftp12.us.FreeBSD.org/pub/FreeBSD/> (ftp / rsync)
- <ftp://ftp13.us.FreeBSD.org/pub/FreeBSD/> (ftp / http (<http://ftp13.us.FreeBSD.org/pub/FreeBSD/>) / rsync)
- <ftp://ftp14.us.FreeBSD.org/pub/FreeBSD/> (ftp / http (<http://ftp14.us.FreeBSD.org/pub/FreeBSD/>))
- <ftp://ftp15.us.FreeBSD.org/pub/FreeBSD/> (ftp)

A.5.1 Άεάοβ ΔνΎδαέ ίά × ηςόέιιδιέβού οι CTM;

Οι CTM εα οαδ άποάε Ύία διδεέυ άίόβανάοι οιό äΎίόηιό δςάβιό επαέέα οιό FreeBSD. ΟδΎη ÷ άε άεάεΎόέηιό Ύίαδ άηέέηιό άδύ “άάγόαέ” οιό äΎίόηιό. Οι CTM ιδιηάβ ίά οαδ δανΎ ÷ άε οέδ δςςνιόηιόδ διό ÷ ηάεΎαάοά, άβόά άδιόάοβόάδ ίά δαναέιεηεάβόά ηεηέςηι όι äΎίόηι, άβόά εΎδιέι άδύ όά δαναέεΎαέά οιό. Αί άίβέάόά όά άράηαΎ ιΎές άίΎδδóις όιό FreeBSD άέεΎ Ύ ÷ άόά έάέβδ διεύόςόάδ (P έάέηιείό) TCP/IP όοίάάόέηιόδ, P άδΎ εΎέάόά ηέ άέέάΎδ ίά οαδ Ύη ÷ ηιόάέ άδóηιόά, οι CTM Ύ ÷ άε όδέά ÷ όάβ άέά οαδ. Έά ÷ ηάέάόάβ ίά δάβηιόά όδ όηβά deltas όςι ςιΎηά άέά όά έέάάεΎ οιό äΎίόηιό διό Ύ ÷ ιόι όςι δέι άράηαP άίΎδδóις. Έά δηΎδαέ υόόηιό ίά έαηηPόάόά όδ έάέγόδης έγός όςι άδóηιόδ άδιόδιέP όιόδ ιΎόυ email. Όά ιάΎΎές όυι άράίβPόάυι έηάόηιόάέ δΎιόά υόι όι άδιόδύι δέι ιέέηΎ. ΌοίPέυδ άβιáέ ιέέηυόάηά άδύ 5Έ, δαναόόάόέάεΎ (Ύία όάά äΎέά) άβιáέ άδύ 10-50Έ έάέ ηέόειΎίαδ όηΎδ άιόάίβαιόάέ έάέ εΎδιέά διό άβιáέ 100Έ P έάέ ιάάάέγόάηά.

Έά δηΎδαέ άδβόδ ίά άηέέάέυεάβόά ιά όέδ άεΎοηιόδ δάάβάδ διό ό ÷ άδβαιόάέ ιά όςι άδάδεάβδ άηάάόβά όοι όδύ άίΎδδóις δςάβι έπαέέα όά ό ÷ Ύός ιά ιέά Ύοιέις, δηηέάόάόέάόιΎις Ύέαιός. Άόδύ έό ÷ γάέ άέυιá δαναόόυόάηι άι άδέέΎίαόά ίά ÷ ηςόέηιέβόάόά οι δςάβι έπαέέα άδύ οι “current”. Όαδ όοίέόδύιá ίά έάάΎόάόά όδύ ίά ÷ ηςόέηιέβόάόά οι current όοι FreeBSD.

A.5.2 Όέ × ηάεΎαίάέ άέά ίά × ηςόέηιδιέβού οι CTM;

Έά ÷ ηάέάόάβόά äγί δηΎαίόά: Όςι άόάηηP CTM έάέ όέδ άη ÷ έέΎδ άέέάΎδ (deltas) άέά ίά όέδ άέόΎάάόά όά άδδPί (Pόά ίά όδΎόάά όοι άδβάάι όιό “current”).

Οι CTM άβιáέ ιΎηιό οιό FreeBSD άδύ όςι Ύέαιός 2.0, έάέ άηβόέάόάέ όοι έάόΎεηι /usr/src/usr.sbin/ctm άόυόι Ύ ÷ άόά άάέάόάόόςιΎι όι δςάβι έπαέέα.

Όά “deltas” ιά όά ηδιβά όηηόηιόάβόά οι CTM ιδιηάβ ίά όά άδιέδPόάόά ιά äγί όηυδιόδ, ιΎόυ FTP P ιΎόυ email. Αί Ύ ÷ άόά άάιέεP FTP δηυόάόός όοι Internet, έά άηάβόά όδιόδPηέις άέά οι CTM όόέδ άέυειόέδ όιδιέάόβδ FTP:

`ftp://ftp.FreeBSD.org/pub/FreeBSD/CTM/`

P άάβόά οι όηβιá mirrors.

ΈΎιόά FTP όοι ό ÷ άδέέυ έάόΎεηι έάέ έέάΎόά όι άη ÷ άβι README άέά ίά ιάέέίPόάόά.

Αί εΎέάόά ίά έάιΎΎίόά όά deltas ιΎόυ email:

Άηάόάβόά όοίηηςόPδ όά ιέά άδύ όέδ έβόδάδ άέάηηPδ οιό CTM. ς έβόδά ctm-cvs-cur (<http://lists.FreeBSD.org/mailman/listinfo/ctm-cvs-cur>) όδιόδςηβάέ ηεηέςηι όι äΎίόηι όιό CVS. ς έβόδά ctm-src-cur (<http://lists.FreeBSD.org/mailman/listinfo/ctm-src-cur>) όδιόδςηβάέ όςι έάόάεP (head) οιό έέΎαό άίΎδδóις (development branch). ς έβόδά ctm-src-4 (<http://lists.FreeBSD.org/mailman/listinfo/ctm-src-4>) όδιόδςηβάέ όςι Ύέαιός 4.X έ.ι.έ. Αί άάι άηηβάέάόά όδύ ίά άάάηάόάβόά όά ιέά έβόδά, έΎιόά έέέέ όοι υιηά όςδ έβόδάδ διό άιόάίβαιόάέ δανάδΎι P δςάβιόά όοι <http://lists.FreeBSD.org/mailman/listinfo> έάέ έΎιόά έέέέ όός έβόδά διό εΎέάόά ίά άάάηάόάβόά. ς όάέβάά όςδ έβόδάδ έά δηΎδαέ ίά δανΎΎ ÷ άε υέάδ όέδ άδανάβδςόάδ δςςνιόηιόδ ό ÷ άδέέΎ ιά όέδ όοίηηΎδ.

¼όάι άη ÷ βόάόά ίά έάιΎΎίόά άράίβPόάέ CTM ιΎόυ mail, ιδιηάβ ίά ÷ ηςόέηιέβόάόά οι δηυάηάιá ctm_rmail άέά ίά όέδ άδιόδιέΎόάόά έάέ ίά όέδ άόάηυόάόά. Ιδιηάβόά όός δηάηιόέέυόςόά ίά ÷ ηςόέηιέβόάόά οι δηυάηάιá ctm_rmail άδάδεάβδ ιΎόυ ιέάδ άάάηάόPδ όοι /etc/aliases άί εΎέάόά ς έάάέέάόβά ίά άέδάέάβόάέ άόδηάόιδιέςιΎιá. Άάβόά ός όάέβάά manual όιό ctm_rmail άέά δαναόόυόάηάδ έάδδηΎηάέδ.

Όςιáβύός: ηό ÷ άόά ιά ός ιΎέηιό διό έά ÷ ηςόέηιέβόάόά άέά ίά έΎάάόά όά deltas οιό CTM έά δηΎδαέ ίά άάάηάόάβόά όός έβόδά ctm-announce (<http://lists.FreeBSD.org/mailman/listinfo/ctm-announce>). Όοι ιΎέέηι, άόδύ έά άβιáέ έάέ όι υιηιό ιΎηιό όοι ηδιβι έά άςιόέάγηιόάέ δςςνιόηιόδ ό ÷ άδέέΎ ιά όέδ έάέόηηάβδ όιό

òòòòßιάòìò **CTM**. ÈÛíòά èèèè òòì ùííá òçò ðáñáòÏíù èßòòάò, èάé áèïèïòèáßòòά ðéò ïäçãßáò áéá íá
ääñáòáßòá.

A.5.3 ×ñçòéïïðïéßíòάò òï **CTM** áéá Δñþòç ÕïñÛ

Δñéí áñ÷βòάòά íá ÷ñçòéïïðïéáßòά **CTM** deltas, èá ðñÝðáé íá Ý÷-áòá Ýíá òçíáßì ãèèßíçòçð áéá òά delta ðïò Ý÷-ïòí
äçíèïñãçèáß ìáòÛ áðù áðòù.

Èá ðñÝðáé ðñþá íá èáèìβòάòά ðé Ý÷-áòá Þäç. ÌðïéíòáÞðïòá ìðñáß íá áñ÷βòάé áðù Ýíá “Ûááéí” èáòÛèíáí. Èá
ðñÝðáé íá ïáèéíÞòάòά ìá Ýíá áñ÷-éèù “Èáíù” delta áéá íá áñ÷βòάòά ìá òï **CTM** äÝíòñí óáò. Áðù èÛðïéí òçíáßì
èáàññÿíá ùèé Ýíá áðù áðòÛ òá “áñ÷-éèÛ” deltas èá áéáíÝíïðáé òá CD áéá òç áéèÞ óáò áéáòèùèðíòç, ùòòùòí áðòù ááí
óòíááßíáé òç äááñÝíç òðéáíÞ.

Èáèþð òá äÝíòñá áßíáé áñèáòÝð äáèÛááò megabytes, áßíáé ðñíðèíùòáñí íá ïáèéíÞòάòά áðù èÛðé ðïò Ý÷-áòá Þäç. Áí
Ý÷-áòά CD èÛðïéáò áéáíñÞð (RELEASE), ìðñáßòά íá áíðéáñÛðáòá Þ íá áðïòïðéÝòάòά áðù áèáß òíí áñ÷-éèù ðçááßì
èþáéá. ðóé èá äèðòþòάòά òçíáíðéèù ÌÝñò òçð ìáðáòìÛð äááñÝíùí.

Ìðñáßòά íá áíáíññβòάòά áðòÛ òá “áñ÷-éèÛ” deltas áðù òí x ðïò áèïèïèáß òíí áñèèù òïòð (áéá ðáñÛááéáíá
src-cur.3210XEmpty.gz). Ì÷-áñáèðçñéóíùð ìáòÛ òí x áíðéóðïé÷-áß òçíçí ðçãÞ òïò áñ÷-éèíÿ óáò “seed”. Õí Empty
áßíáé Ýíáò Ûááéíð èáòÛèíáíð. ÈáòÛ èáíñíá äçíèïñãçèáßòáé ìéá ìáòÛááòç áðù òí Empty èÛèá 100 deltas. Áðßòçð òá
áñ÷-áßá áðòÛ áßíáé ìááÛéá! ÕðíçèéóíÝíí ìÝááèèð áéá xEmpty deltas áßíáé òá 70 ùð 80 MB òðíðéáòíÝíñí ìá gzìp
ääáñÝíùí.

Ìñèéð áðééÝíáòά Ýíá ááóéèù delta áéá íá ïáèéíÞòάòά, èá ÷ñáéáòáßòά áðßòçð ùéá òά deltas ìá ìáááéÿðáñíòð áðù áðòù
áñèèñÿð.

A.5.4 ×ñçòéïïðïéßíòάò òï **CTM** óòçí ÈáèçíáñéíÞ óáò ÆèÞ

Áéá íá áòáñíùòάòά òά deltas, áðèþð áñÛðòά:

```
# cd /where/ever/you/want/the/stuff
# ctm -v -v /where/you/store/your/deltas/src-xxx.*
```

Õí **CTM** áíðééáíáÛíðáé deltas òá ìðñá Ý÷-ïòí òðíðéáòáß ìÝòù gzìp, èáé Ýðóé ááí ÷ñáéÛáðáé íá
÷ñçòéïïðïéáßòά òçí gunzip, äèðòþñíðáò ìá áðòù òíí ðñùðí ÷þñí óòí áßòéí.

Õí **CTM** ááí ðñùèáéðáé íá ðáèñÛíáé òá áñ÷-áßá óáò áí ááí áßíáé áðùèðá òßáñòñí áéá òç áéááééáòá áíáíÝòçð. Áéá
íá áðáèçèáÿóáòά Ýíá delta ìðñáßòά áðßòçð íá ÷ñçòéïïðïéáßòά òçí áðéèñáÞ -c èáé òí **CTM** ááí èá ðáèñÛíáé òßðíòá,
áðèþð èá áðáèçèáÿóáé òçí áéáñáéíùòçðá ðïò delta èáé èá ááé áí ìðñáß íá òí áòáñíùòáé ÷-ùñßð ðñíáèÞíáòά óòí ðñÝ÷-íí
äÝíòñí.

ÕðÛñ÷-ïòí èáé Ûèèáð áðéèñáÝð òòí **CTM**, ááßòά ðéò áíðòßòïé÷-áð òáèβááð manual Þ èíèòÛíòá òíí ðçááßì èþáééá áéá
ðáñéóòùðáñáð ðèçñíòññáð.

Áðòù áßíáé ùèí òòçí ðñááíáðéèùòçðá. ÈÛèá òññÛ ðïò èáíáÛíáòά Ýíá íÝí delta, áðèþð ðáñÛðòά òí òòí **CTM** þòðá íá
Ý÷-áòá ðÛíðïòá áíáíáññÝíí òíí ðçááßì óáò èþáééá.

Ìçí òáÞíáòά òά deltas áí áßíáé áÿóèèí íá òá èáðááÛòáòά íáíÛ. ðòðð èÝèáòά íá òá òèèÛíáòά áéá òçí ðáñßðòùòç ðïò
èÛðé ðÛáé òðñááÛ. Áéíñá èáé áí òí ìñí ìÝòí ðïò Ý÷-áòá áßíáé áéóéÝðáð, èÛíòá áíðòßáñáòí ÷ñçòéïïðïéßíòά òçí
fdwrite.

A.5.5 Èñáòπρίóáò òέò ÒιðέέΥò óáò ΆέέάãΥò

Ùò ðñιñáñιιáòέóòðò, èá èΥέáðá íá ðáèñáιáòέóòáβðá èáé íá áεεÛιáðá áñ÷áβá óòι áΥίòñι òιò ðçááβιò èπáέéá. Òι **CTM** òðιòòçñβæáé ðáñέιñέóιΥίò òγðιò òιðέέΥò áέéáãΥò: ðñέι áεΥáιáé áéá òçι ðáñιòóβá áίυò áñ÷áβιò foo, áéΥá÷áé ðñððá áéá òι foo.ctm. Áί òι áñ÷áβι áðòυ òðÛñ÷áé, òι **CTM** èá ÷ñçóέιñðιέπðáé áðòυ áίòβ áéá òι foo.

Ç óòιðáñέóιñÛ áðòð íáð ðáñΥ÷áé Υίá áðέυ òñυðι íá áéáðçñβðιòιá òιðέέΥò áέéáãΥò: áðèð ãίðéáñÛððá òá áñ÷áβá òιò óέιðáγáðá íá áεεÛιáðá òá áίòβððιέ÷á áñ÷áβá ìá èáóÛέççç .ctm. Ìðñáβðá èáðυðέι íá èÛιáðá υòé áέéáãΥò èΥέáðá óòι èπáέéá áìð òι **CTM** èá áéáðçñáβ áíáíáυιΥί òι áñ÷áβι .ctm.

A.5.6 ηέέáò ÁίáéáóΥñιòóáò ΆðέέιãΥò òιò CTM

A.5.6.1 Άñóέέιòáò òé Áέñéáðò èá ÁέéÛιáé óá íéá ÁίáιΥύòç

Ìðñáβðá íá ðñιòáέιñβðáðá òέò áέéáãΥò ðιò èá ðñιέáéΥóáé òι **CTM** óòι repository òιò ðçááβιò óáð èπáέéá, ÷ñçóέιñðιέπðáð òçι áðέέιãð -1.

Áðòυ èá áβιáé ÷ñβóέιñ áί èΥέáðá íá èñáðððáðá çìññέυáέι òυι áέéáãðι, áί èΥέáðá íá áðáιáñááóðáβðá òá òñιðιðιέççιΥίá áñ÷áβá ðñέι ð íáðÛ òçι òñιðιðιβçòç òιòð, ð áί áðèð áéóéÛιáóðá áéáðñð ðáñáíιúéυð.

A.5.6.2 Άçιέιòñáπιðáò Áίòβáñáðá Áóóáéáβáð ðñέι òçι ÁίáιΥύòç

ÌáñέéΥò óιñΥò èá èΥέáðá íá èñáðððáðá áίòβáñáðι áóóáéáβáð υέυι òυι áñ÷áβυι ðιò ðñυéáéðáé íá áέéá÷éιγί áðυ íéá áίáιΥύòç ìΥòυ **CTM**.

Áβñιòáð òçι áðέέιãð -B backup-file òι **CTM** èá áçιέιòñáπðáé áίòβáñáðι áóóáéáβáð υέυι òυι áñ÷áβυι ðιò ðñυéáéðáé íá áέéá÷éιγί áðυ èÛðιέι òóáéáèñέιΥίí delta óòι áñ÷áβι backup-file.

A.5.6.3 Δáñέιñβæιòáò òá Áñ÷áβá ðιò èá Áέéá÷éιγί áðυ ÈÛðιέá ÁίáιΥύòç

ÌáñέéΥò óιñΥò βòυð íá áíáéáóΥñáððá íá ðáñέιñβðáðá òçι ðáñέι÷ð áñÛòçð íéáð òðáéáèñέιΥίçð áίáιΥύòçð ìΥòυ **CTM** ð βòυð óáð áíáéáóΥñáé íá ðÛñáðá ìυíí èβáá áñ÷áβá áðυ èÛðιέá óáéñÛ áðυ deltas.

Ìðñáβðá íá áéΥáιáðá òç èβððá òυι áñ÷áβυι óðá ðιðιβá èá èáéðιòñáπðáé òι **CTM** ÷ñçóέιñðιέπðáð υð òβèðñá, regular expressions ìá òέð áðέέιãΥò -e èáé -x.

Áéá ðáñÛááéáιá, áéá íá áιÛááðá Υίá áíáíáυιΥίí áίòβáñáðι òιò áñ÷áβιò lib/libc/Makefile áðυ òçι óðέέιãð óáð òυι áðιèçéáðιΥίí **CTM** deltas, áéðáéΥóðá òέð áíðιéΥò:

```
# cd /where/ever/you/want/to/extract/it/
# ctm -e '^lib/libc/Makefile' ~ctm/src-xxx.*
```

Áéá èÛéá áñ÷áβι ðιò èáéιñβæáðáé óá Υίá **CTM** delta, íé áðέέιãΥò -e èáé -x áðáñιúáιíðáé ìá òç óáéñÛ ðιò áιðáιβæιíðáé óòç áñáñð áíðιèπι. Óòι áñ÷áβι áβιáðáé áðáιáñááóðá áðυ òι **CTM**, ìυíí áί ìáñéáñέóðáβ υð Υáéðñι ðñιò áίáιΥύòç ìáðÛ òçι áðáñιíãð υέυι òυι áðέέιãðι -e èáé -x.

A.5.7 ìáéέιíðééÛ Ó÷Υáéá áéá òι CTM

Áβιáé ðÛñá ðιééÛ:

- ×ñÞòç èÛðϊέϊò àβãïòò ðéóòïðïβçòçò óðï óýóòçιά **CTM** þòðã íá áíáãññβæïïóáé òð÷ïï øãýòééãò áíáãþóáéò.
- ÍáéáèÛñéóïá òïï áðééïãþï òïò **CTM**, éáèþð ðñïéáéïýï óýã÷òóç éáé äãí àβíáé ðñïòáíáβò.

A.5.8 ÄéÛöïñá

ÏðÛñ÷áé àðβóçò éáé ìéá óáéñÛ áðï deltas ãéá òçï óðééïãþ òïï ports, áéèÛ äãí Ý÷áé áéãçèùèáβ áéïïá áñéáòïï áíáéáòÝñïï áéá áòðþ.

A.5.9 CTM Mirrors

Ïï CTM/FreeBSD äéáòβèáòáé ìÝòù áñþïïïò FTP áðï òá áéùéïðéá mirrors. Áí áðééÝíáòã íá éáòããÛóáòã òï **CTM** ìÝòù áñþïïïò FTP, óáò ðãñáéáéïýïá ðñïòðáéþóãã íá áðééÝíáòã ìéá òïðïéáóβá èïïÛ óá óáò.

Ïá ðãñβðòòóç ðñïáéçïÛòïï, ðãñáéáéïýïá áðéééïïïþóãã ìá òç èβóðá ctm-users (<http://lists.FreeBSD.org/mailman/listinfo/ctm-users>).

Éáééòïñïéá, Bay Area, àðβóçïç ðçãþ

- <ftp://ftp.FreeBSD.org/pub/FreeBSD/development/CTM/>

Íüðéá Áòñéþþ, áíðβãñáòá áóòáéããáò ãéá ðáéèÛ deltas

- <ftp://ftp.za.FreeBSD.org/pub/FreeBSD/CTM/>

ÏáéáÛï/R.O.C.

- <ftp://ctm.tw.FreeBSD.org/pub/FreeBSD/development/CTM/>
- <ftp://ctm2.tw.FreeBSD.org/pub/FreeBSD/development/CTM/>
- <ftp://ctm3.tw.FreeBSD.org/pub/FreeBSD/development/CTM/>

Áí äãí ãñþéáòã èÛðïéï mirror óòçï ðãñéï÷þ óáò, þ áí òï mirror äãí àβíáé ðéþñãò, ðñïòðáéþóãã íá ÷ñçóéïïðïéþóãã ìéá ìç÷áíþ áíáæþòçòçò ùðòò ç alltheweb (<http://www.alltheweb.com/>).

A.6 ×ñçóéιιðιέπιόάò òι CVSup

A.6.1 ΆέóάãũãÞ

Òι CVSup áβιάέ Ýία ειαέοιέεũ áέα òçí áεάíñÞ éάé áíáíÝùòç äÝíòñũí ðçãáβιò εÞáέέα áðu Ýία éáíòñέεũ (master) CVS repository òι ιðιβι áñβóέάòάé óá εÙðιέι áðñáεñòòιÝíι ððιειαέóòÞ. Òι repository òιò FreeBSD áñβóέάòάé óá Ýία éáíòñέεũ ιç÷: Ùίçιά óòçí Éáέéòũñιέα. Ìá òι CVSup, ιέ ÷ñÞóòáò òιò FreeBSD ιðιñιýí áýειεά ιά áεáòçñÞóιòι áíáíáũÝία óá áíòβáñáóá òιò ðçãáβιò òιòð εÞáέέα.

Òι CVSup ÷ñçóéιιðιέáβ Ýία ιιòÝει áíáíÝùòçð áíùóòũ ùð pull. Óòι ιιòÝει áòòũ, εÙεá ðáεÙòçð æçòÙ ðεò áíáíáÞóáέò áðu òιι áíòðçñáòçòÞ, ùóáí éάé áí ðεò áðέéðιáβ. Ì áíòðçñáòçòÞð ðáñειÝίαέ, ðáεçòέéÙ, ðεò áðáέòÞóáέò áðu òιòð ðáεÙòáò. Ìá òιι ðñũðι áòòũ, εÙεá áíáíÝùòç ιáέειÙáé éáóũðέι áðáβòççòð òιò ðáεÙòç. Ì áíòðçñáòçòÞð ðιòÝ ááí óóÝειáé áíáíáÞóáέò ðιò ááí Ý÷ιòι æçòçεáβ. Ìé ÷ñÞóòáò éá ðñÝðáé áβòá ιά áéòáεÝóιòι òι CVSup ÷áέñιέβιçòá áέα ιά εÙáιòι ιέα áíáíÝùòç, áβòá éá ðñÝðáé ιά ðñèιβóιòι éáòÙέεççéá òι cron Þóóá ιά òι áéòáεáβ áóòũñιáóá éáòÙ óáέòÙ ÷ñιέéÙ áéáóòÞιáóá.

Ì ðñũò CVSup, áñáñιÝíò Ìá éáóáέáβá éάé ιέéñÙ ùðòò óáβιáòάé, áíáòÝñáóáé óá ιεũεççñι òι ðáéÝòι ειαέοιέειý. Óá ááóέéÙ òιò òιÞιáóá áβιάέ ç áíòιεÞ ðáεÙòç cvsup ç ιðιβá áéòáεáβòáé óòι ιç÷: Ùίçιά òιò εÙεá ÷ñÞóòç, éάé òι ðñũáñáιιá òιò áíòðçñáòçòÞ cvsupd òι ιðιβι áéòáεáβòáé óá εÙεá Ýία áðu óá mirror sites òιò FreeBSD.

ÉáεÞð áεááÙæáòá òçí ðáειçñβùòç éάé ðεò εβòóáò óá÷-òáññáβιò òιò FreeBSD, ιðιñáβ ιά áñáβòá áíáòιñÝò ðòçí áóáññιáÞ sup. Òι sup Þóáí ι ðñũáññò òιò CVSup, éάé áíòðçñáòçíóá ðáññιέι óέιðu. Òι CVSup ÷ñçóéιιðιέáβòáé Ìá áñéáòÙ ùñιέι ðñũðι Ìá òι sup, éάé óòçí ðñáñιáóééúòçòá, ÷ñçóéιιðιέáβ áñ÷-áβá ðñèιβòáñι óá ιðιβá Ý÷ιòι ðβòũ óòιááóũòçòá Ìá áóòÙ òιò sup. Òι sup ááí ÷ñçóéιιðιέáβòáé ðεÝιí óòι FreeBSD Project, áðáέáÞ òι CVSup áβιάέ óá÷-ýòáñι éάé ðñιòóÝñáé Ìááéýòáñç áðáέéιβá.

Óçιáβùòç: Òι ðñũáñáιιá csup áβιάέ òι CVSup ιáíáñáñιÝíι óá áεÞóóá C. Òι Ìáááéýòáñι òιò ðεáñιÝέòçιά áβιάέ ùòé áβιάέ óá÷-ýòáñι, éάé ááí áíáñòÙòáé áðu òçí áεÞóóá ðñιáñáñιáóéóιιý Modula-3, òçí ιðιβá éάé ááí ÷ñáéÙæáòáé ðεÝιí ιά ááéáóáóòÞóáòá. Áðβòçò, áí ÷ñçóéιιðιέáβòá Ýéáιòç FreeBSD 6.2 Þ ÌáóááíÝóóáñç, ιðιñáβòá ιά òι ÷ñçóéιιðιέÞóáòá Ùιáóá, éáεÞð ðáñééáιáÙιáóáé óòι ááóέéũ óýóòçιά. Ðáééúòáñáð áéáúóáέò òιò FreeBSD ááí Ý÷ιòι òι csup(1) óòι ááóέéũ óýóòçιά, áééÙ ιðιñáβòá ιά òι ááéáóáóòÞóáòá áýειεá áðu òι port net/csup port, Þ áðu Ýòιέιι ðáéÝòι. Áí áðιòáóòáòá Ìá ÷ñçóéιιðιέÞóáòá òι csup, áðεÞð ðáñáéáβòðá óá áÞιáóá áέα òçí ááéáóòÙòáóç òιò CVSup éάé áíòééáóáóòÞóáòá εÙεá áíáòιñÙ óòι CVSup óá áóòũ òι Ùñéñι, Ìá csup.

A.6.2 ΆééáòÙóóáóç

Ì áóειεũòáññò ðñũðιò áέα ιά ááéáóáóòÞóáòá òι CVSup áβιάέ ιÝòũ òιò Ýòιέñò ðáéÝòιò net/cvsup áðu òçí óòéειáÞ ðáéÝòιò òιò FreeBSD. Áí ðñιòéιÙóá ιά Ìáóááéúòòβòáòá òι CVSup áðu òιι ðçãáβι εÞáέέα, ιðιñáβòá ιά ÷ñçóéιιðιέÞóáòá òι port net/cvsup. Óáò ðñιáéáñιðιέιýíá ùóòúóι ùòé òι port net/cvsup áíáñòÙòáé áðu òçí Modula-3, ç ιðιβá ÷ñáéÙæáòáé áñéáòũ ÷ññιí éάé ÷ññι óòι áβòει áέα ιά éáòÝááé éάé ιά Ìáóááéúòòéóóáβ.

Óçιáβùòç: Áí ðñũéáéòáé ιά ÷ñçóéιιðιέÞóáòá òι CVSup óá Ýία ιç÷: Ùίçιά òι ιðιβι ááí éá áéáéÝóáé áñáóééũ ðáñéáÙééιι ιÝòũ XFree86 Þ Xorg, ùðòð ð.÷. óá Ýία áíòðçñáòçòÞ, ááááéúéáβòá ùòé ááééééóòÙòá òι áíòβòóιé÷ι port òι ιðιβι ááí ðáñééáιáÙιáé áñáóééũ ðáñéáÙééιι, áçéááÞ òι net/cvsup-without-gui.

Άί ε΄Υεάòά ίά άάεάòáóòΠóáòά òι **csup** òòι FreeBSD 6.1 Π ðññááíΥóòáññ, ìðñáβòά ίά ÷ñçóεñðιεΠóáòά òι Υòιεñ ðáεΥòι net/csup áðu òçí òðεεñāΠ ðáεΥòι òιò FreeBSD. Άί ε΄Υεάòά ίά ìáòáεεùòòβòáòά òι **csup** áðu òñ ðçááβι εðáεά, ìðñáβòά ίά ÷ñçóεñðιεΠóáòά òι port, net/csup.

A.6.3 Νýεìέóç òιò CVSup

Ç εάεòιòñáβá òιò **CVSup** áεΥá÷áòáε áðu Υία áñ÷áβι ñòεìβòáù ðñ εάεáβòáε supfile. ÒðÛñ÷ìòι εÛðιεά òðñááβáìáòά áðu supfiles òòι εáòÛεññ /usr/share/examples/cvsup/.

Ìε ðεçññìòñáβò òòι supfile áðáíòιγί òεð áεùεìðεáð áñùòΠóáεð áεά òι **CVSup**:

- Διεά áñ÷áβá ε΄Υεάòά ίά εÛááòá;
- Διεάð áεäùòáεò òι áñ÷áββì ε΄Υεάòά;
- Άðu ðñ ε΄Υεάòά ίά òά εÛááòá;
- Διò ε΄Υεάòά ίά òά áðìεçεáγóáòά òòι ìç÷Ûίçιά óáð;
- Διò ε΄Υεάòά ίά áðìεçεáγóáòά òά áñ÷áβá εáòÛóóáóçð;

Óóá áðuìáíá òιΠιáòά, εά ççιεòñáβòιòìá Υία òððεéù supfile áðáíòιγíáð εÛεá ìεά áðu òεð áñùòΠóáεð áòòÝð ìá òç óáεñÛ. Δñðóá, εá ðáñεáñÛðιòìá òç òòñεééΠ áñΠ áíùð supfile.

Íá supfile áβιáε Υία áñ÷áβι εάεìΥñò. Óá ó÷÷εεά ìáεéíÛíá ìá # εάε áðáεòáβññíòáε ùð òι òÝεò òçð áñáñΠò. Ìε εáíÝð áñáñÝð, εάεðð εάε áòòÝð ðñ ðáñεΥ÷ìòι ìùñ ó÷÷εεά, ááññγíòáε.

ËÛεá áñáñΠ áðu òεð òðυεìðεáð ðáñεáñÛóáε Υία óáð áñ÷áββì òά ðñβá áðεεòìáβ ίá εÛááε ÷ñΠóçð. Ç áñáñΠ ìáεéíÛíáε ìá òι ùññá ìεáð “òðεεñāΠ”, áíùð εñεéñý áεññòð áðu áñ÷áβá ðñ ìñæáòáε áðu òñ áñðççñáðççð. Óñ ùññá òçð òðεεñāΠ áçεññáε òòι áñðççñáðççð ðιεά áñ÷áβá áðεεòìáβòá. ÌáðÛ òι ùññá òçð òðεεñāΠ, ìðñáβ ίá òðÛñ÷ìòι áðu ìçáΥí ùð εÛðιεά ðááβá, òά ðñβá ÷ññæññíòáε ìáðáγ òιòð ìá εáíÛ εάáòòΠιáòά. Óá ðááβá áòòÛ áðáíòιγί òεð áñùòΠóáεð ðñ òÝεçεáí ðáñáðÛñ. ÒðÛñ÷ìòι áγì òýðñε ðááββì: ðááβá óΠιáíóçð (flags) εάε ðááβá òεìβι. Íá ðááβι óΠιáíóçð áðñòáεáβòáε áðu ìεά ìùñ εÝìç εεáεáβ ð.÷. delete Π compress. Íá ðááβι òεìβð ìáεéíÛíáε áðβóçð ìá ìεά εÝìç εεáεáβ, áεεÛ áòòΠ áεññòεáβòá ÷ññβ òçí ðáñáìáñεΠ εáñý εάáòòΠιáòιð áðu = εάε ìεά ááγóáñç εÝìç. Άεά ðáñÛááεáìá òι release=cvs áðñòáεáβ Υία ðááβι òεìβð.

Íá supfile òððεéÛ εάεìñβáε ðñò εΠøç ðáñεóóùðáñáð áðu ìβá òðεεñāÝð. Íá òñùðñ ðεά ίá áñΠóáòά Υία supfile áβιáε ìá εάεìñβòáòá ùεά òά ó÷÷áðεéÛ ðááβá ÷ññεóòÛ εάε εÛεá òðεεñāΠ. Ìá òñ òñυðñ áòòυ ùòòυòι òι supfile εá εáòáεÛááε áñεáòÝð áñáñÝð εάε εá áβιáε Ûáñε, áðáεáΠ òά ðáñεóóùðáñá ðááβá áβιáε βáεá áεá ùεáð òεð òðεεñāÝð ðñ ðáñεΥ÷ìòáε óá áòòυ. Óñ **CVSup** ðáñÝ÷áε Υία ìç÷áíεòι÷ ÷ñΠóçð ðññáðεéáñÝñù òεìβι, þóòá ìá áðñòáγáññíðáε áòòÛ òά ðññáεΠιáòά. Ìε áñáñÝð ðñ ìáεéíÛíá ìá òι áεáεéù ùññá þáòòυ-òðεεñāΠð *default ìðññγí íá ÷ñçóεñðιεççεñγí áεά ìá ε΄Υòιò ðááβá óΠιáíóçð εάε òεìβι òά ðñβá εá ÷ñçóεñðιεççεñγí ùð ðññáðεéñāÝð áεά òεð òðεεñāÝð òιò supfile ðñ áñβóεññíòáε ìáðÛ áðu áòòÛ. Ìεá ðññáðεéáñÝìç òεìβ ìðñáβ ίá áεεÛñáε áí εάεìñεóóáβ ìáíÛ ìá ðÝá òεìβ ðÝóá òççí βáεá òç òðεεñāΠ. Ìε ðññáðεéñāÝð ìðññγí áðβóçð ìá áεεÛññò, Π ìá ðññíóðáεñγí ðÝáð, áÛáññíðáð ðññòεáòá *default òá ðññεñáβðñòá òççíáβι ðÝóá òòι supfile.

Άññβáññíòáð òά ðáñáðÛñ, εá ðññ÷ññΠóιòìá òññá òçç áññçççç áíùð supfile áεά εΠøç εάε áíáíÝñóç òñ εðñβùð áÝíòññò ðçááβñò εðáεά áεά òι FreeBSD-CURRENT.

- Διεά áñ÷áβá ε΄Υεάòά ίá εÛááòá;
- Óá áñ÷áβá ðñ áβιáε áεáεÝóεñá ðÝòυ òçð **CVSup** áβιáε ìñááññÝñá òá áεññòð ðñ ìñÛáññíòáε “òðεεñāÝð”. ΔáñεáñáòΠ òñ áεáεÝóεññ òðεεñāβñ εá áñáβòá òòι áεùεòεì òιΠιá. Óòι ðáñÛááεáìá ìáð, ε΄Υεòìá ìá εÛáññòá òι ðεΠñáð áÝíòññ ðçááβñò εðáεά òñ FreeBSD òòòòΠιáòιð. ÒðÛñ÷áε ìεά ìááÛεç òðεεñāΠ src-all ç ðñβá εá ìáð

òçí àðóáé üèç. Óáí ðñðòí àÞιά áéá òçí àüùçòç òιò supfile, áðèðò ãñÛòιòιά òéò òòèèñáÝò, ιβά óá èÛèá ãñáñìÞ (òòçí ðáñβðòùòç ιάò Ý÷-ιòιά ιüñι ιέα ãñáñìÞ):

```
src-all
```

- Διέάò àèäüóáéò òùι áñ÷-áβùι èÝèáòá ιά èÛááòá;

Ìá òι CVSup, ιðñáβòά ιòóéáóòéèÛ ιά èÛááòá ιðιέááÞðιòά Ýέáιòç òιò ðçááβιò èðáééá òðÞñιά ðιòÝ. Áòòü áβιάé äòιáòüι áðáéáÞ ì áìòðçñáòçòÞð cvsupd èáéòιòñááβ áðáòèáβáò áðu òι CVS repository, òι ιðιβι ðáñéÝ÷-áé üèáò òéò àèäüóáéò. ΆçèÞιáòά ðιέá áðu áòòÝð èÝèáòá ÷ñçóèιιðιέÞιòά òά ðááβá òèιÞι tag= éáé date=.

Ðñιέáèιòιβçòç: Èá ðñÝðáé ιά àðóáòá éáéáβòáñç ðñιòι÷-Þ òòιι éáèιñéòιü òùι ðááβùι tag= þòðά ιά áβιάé óúòòÛ. ÈÛðιέá tags áβιάé Ýáèòñά ιüñι áéá òðáèèèñéιÝιáò òòèèñáÝò áñ÷-áβùι. Áι éáèιñóáòά éáιéáòιÝιι tag (Þ èÛιáòά ιñèιáñáòéèü èÛèιò) òι CVSup èá óáÞóáé áñ÷-áβá òά ιðιβá ðééáιðò ááι èÝèáòá ιά óáçòòιγι. Áéáéèüðáñá, áéá òçí òòèèñáÞ òùι ports=*, ÷ñçóèιιðιέÞòðά ιüñι òι tag=.

Ïι ðááβι tag= äáβ÷-ιáé ðñιò Ýιá óòιáιèéèü tag òòι repository. ÒðÛñ÷-ιòι äγι áβáç tags, òά tags àèäüóáùι (revision tags) éáé òά tags èèÛáùι (branch tags). Ιá revision tag áιáòÝñáòáé óá ιέα òðáèèèñéιÝιç Ýέáιòç. Ç óçιáíóβά òιò áéáòçñáβòáé βáéá áðu òç ιέα ιÝñá óòçι Ûèèç. Áðu òçι Ûèèç, Ýιá branch tag, áιáòÝñáòáé óòçι òáèáòðáβá Ýέáιòç ιέα òðáèèèñéιÝιçò ãñáñìÞð áíÛðòòιçò, óá èÛèá ÷ñιèèÞ òééáìÞ. ΆðáéáÞ Ýιá branch tag ááι áιáòÝñáòáé óá èÛðιέá òðáèèèñéιÝιç Ýέáιòç, ιðñáβ áγñéι ιά óçιáβιáé èÛðé áéáòιòñáòéèü áðu ιüðé óçιáβιáé óÞιáñá.

Ïòι ÒιÞιά A.7 èá ãñáβòά branch tags òά ιðιβá ιðñáβ ιά óáò áιáéáòÝñιòι. ¼òáι éáèιñβæáòά Ýιá tag òòι áñ÷-áβι ðòèιβóáùι òιò CVSup, èá ðñÝðáé ðñéι áðu áòòü ιά áÛæáòá òç èÝιç èèáéáβ tag= (äçè. òι RELENG_4 èá áβιάé tag=RELENG_4). Ιά Ý÷-áòá òðüèéι óáò ιüðé áéá òçι òòèèñáÞ òùι Ports, òι tag= . áβιάé òι ιüñι Ýáèòñι.

Ðñιέáèιòιβçòç: Ιά áβóòά éáéáβòáñá ðñιáéòéèèüò, þòðά ιά ãñÛáòá òι tag áèñéáðò üðüò òáβιáòáé. Òι CVSup ááι ιðñáβ ιά áéá÷-ùñβóáé ιáòáιγ Ýáèòñüι éáé ιç-Ýáèòñüι tags. Áι ãñÛáòá èÛèιò òι tag, òι CVSup èá óòιðáñéòáñèáβ óáι ιά Ý÷-áòá àðóáé Ýιá Ýáèòñι tag òι ιðιβι ááι áιáòÝñáòáé óá éáιÝιá áñ÷-áβι. Óòçι ðáñβðòùòç áòòÞ èá áéááñÛáé òά òðÛñ÷-ιιòά áñ÷-áβá óáò ðçááβιò èðáééá.

¼òáι éáèιñβæáòά èÛðιέι branch tag, òòóéιèñáéèÛ èá èÛááòá òéò òáèáòðáβáð àèäüóáéò òùι áñ÷-áβùι ðιò òðÛñ÷-ιòι òά áòòÞ ðç ãñáñìÞ áíÛðòòιçò. Áι èÝèáòá ιά èÛááòá èÛðιέáð ðáéèüðáñáð àèäüóáéò, ιðñáβòά ιά òι èÛιáòά éáèιñβæιðáò ιέα çιáñιçβιá ιÝóü òιò ðááβιò òèιÞι date=. Ç óáèβáá manual csup(1) áιçááβ ðüò ιðñáβòά ιά òι èÛιáòά.

Ïòι ðáñÛááéáιá ιáò, áðèèòιγιá ιά èÛáιòιá òι FreeBSD-CURRENT. ÐñιòèÝòιòιá òç ãñáñìÞ áòòÞ óòçι áñ÷-Þ òιò supfile áñ÷-áβιò ιáò:

```
*default tag=.
```

ÒðÛñ÷-áé ιέα óçιáιðéèÞ áéáéèÞ ðáñβðòùòç üòáι ááι éáèιñβóáòά ιγòά ðááβι tag= ιγòά ðááβι date=. Óòçι ðáñβðòùòç áòòÞ èá èÛááòά òά éáñιéèÛ áñ÷-áβá RCS áðáòèáβáð áðu òι CVS repository òιò áìòðçñáòçòÞð, áιòβ áéá ιά èÛááòά èÛðιέá òðáèèèñéιÝιç Ýέáιòç. Èé ðñιáñáñιáòéòóÝò ááιéèÛ ðñιòèñγι áòòü òιι òñüðι éáéòιòñáβáð. ÁéáòçñÞιáò ðèÞñáð áιòβáñáòι òιò CVS repository óóá óòòòÞιáòά òιòð Ý÷-ιòι òçι ééáιúòçðά ιά áèÝðιòι òι éóòιñéèü áééááÞι èÛèá Ýέáιòçð éáé ιά áñáòÛæιòι ðáéèüðáñáð àèäüóáéò òùι áñ÷-áβùι. Óá ðáñáðÛü ðèáιñáèòÞιáòά ìóòüòι Ý÷-ιòι òι èüóòιð òçò ιáááéγòáñçò ÷ñÞçòð ÷Þñιò òòι òéèçñü áβóèι.

- Áðu ðιò èÝèáòá ιά òά èÛááòá;

×ñçóèιιðιέιγιá òι ðááβι host= áéá ιά ðιγιá òòι cvsup áðu ðιò ιά èÛááé òéò áιáιáÞóáéò òιò. ÌðιέιáÞðιòά áðu òά CVSup mirror sites áβιάé éáòÛèèçèι, áι éáé èá ðñÝðáé ιά ðñιòðáèèÞóáòά ιά áðèéÝιáòά èÛðιέι òι ιðιβι ιά ãñβóèáòáé

εἰρôÛ óáð. Óðι δάνÛääéαιά ιάð, èá ÷ ñçóεἰθιέPóιθιá ιεά óáιðáóóεéP ðιθιèáóβá äéáññðò ðιò FreeBSD, ðι cvsup99.FreeBSD.org:

```
*default host=cvsup99.FreeBSD.org
```

Èá ðñÝðáé ιά äéèÛιáðð ðι host óá èÛðιέι ðιò ðñáαιáðééÛ ððÛñ ÷ äé ðñέι äéðáéÝóáðð ðι **CVSup**. ÈÛèá ðιñÛ ðιò äéðáéäβðð ðι cvsup, Ý ÷ äðð ðçι äðιáðððçðð ιά áιáðñÝðáðð áððP ðç ñýèιέóç ιÝòð ðçð ãñáññðò áιðιèðι ιá ðçι äðéèιäP -h hostname.

- Διϑ èÝéäðð ιά ðá äðιèçèáýóáðð ððι ιç ÷ Ûιçιá óáð;

Óι δääβι prefix= äçèðιáé ðççι cvsup ðιò ιά äðιèçèáýóáé ðá áñ ÷ äβá ðιò èáιäÛιáé. Óðι δάνÛääéαιά ιάð, èá àÛεἰθιá ðá áñ ÷ äβá ðιò ðççáβιò èðáééá, äðáðèäβáð ððι èýñέι áÝιðñι ðççáβιò èðáééá, /usr/src. Ì èáðÛεἰθιáð src èáññáβðáé äáññÝñð äéá ðéð ðçèεἰäÝð ðιò Ý ÷ ιθιá äðééÝιáé ιά èÛáñθιá, èáé Ýðóé ι ðððððð ðñιðáéñéíðιðð äβιáé áðððð ðιò óáβιáðáé δάñáèÛð:

```
*default prefix=/usr
```

- Διϑ èá äðιèçèáýóáé ðι cvsup ðá áñ ÷ äβá èáðÛððáóçð ðιò;

Ì ðáèÛðçð **CVSup** äéáðçñáβ èÛðιéá áñ ÷ äβá èáðÛððáóçð (status files) óá áððð ðιò äðιèèäβðáé èáðÛεἰθιáð “base”. Óá áñ ÷ äβá áððÛ äιççεἰýι ðι **CVSup** ιά èáéðιðñáβ ðεἰ äðιáðééÛ èñáððιáð εἰáñéáðιðι ðιò áιáñáððáñι ðιò Ý ÷ äðð ðäç èÛááé. Èá ÷ ñçóεἰθιέPóιθιá ðιò ðñιáðééáñιÝñι èáðÛεἰθιá base, /var/db:

```
*default base=/var/db
```

Áι ι base èáðÛεἰθιáð ðáð äáñ ððÛñ ÷ äé ðäç, ððñá äβιáé ιεá èáèP ððéáñP ιά ðιθι äçιέιðñáβðáðð. Ó ðáèÛðçð cvsup äáñ èá äéðáéäβððáé áι ι base èáðÛεἰθιáð äáñ ððÛñ ÷ äé.

- ÄèÛðιñáð ñðèιβðáèð äéá ðι supfile:

ÓðÛñ ÷ äé áèùιá ιεá èιέιP ãñáññ ñðèιβðáèñι, ç ιðιβá ðððééÛ ððÛñ ÷ äé ððι supfile:

```
*default release=cvsv delete use-rel-suffix compress
```

Óι release=cvsv äáβ ÷ ιáé ùðé ι áñðççñáðçððð èá ðñÝðáé ιά èÛááé ðéð ðççñιðιññáð ðιò ιÝòð ðιò èýñέιò CVS repository ðιò FreeBSD. Áððð éó ÷ ýáé ð ÷ äáññ ðÛιðá, äéèÛ ððÛñ ÷ ιθιá èáé Ûéèáð ðééáñιðçððð ðιò ιáðáýáñθι áðð ðι ðéιððι áðððð ðçð ððæðçççðð.

Ç èÝιç delete äβιáé äééáèðιáðá ððι **CVSup** ιά äéáññÛðáé áñ ÷ äβá. Èá ðñÝðáé ðÛιðιðá ιά Ý ÷ äðð ðççι äðéèιäP áððP, ðððá ðι **CVSup** ιά ιðιñáβ ιά èñáðððáé ðι áÝιðñι ðιò ðççáβιò óáð èðáééá ðèðñðð áιáñáññιÝñι. Óι **CVSup** äβιáé áñéáðÛ ðñιðáéðééù ðððá ιά óáðιáé ùññ ðá áñ ÷ äβá ðιò ãññóéñιðáé ððð ðççι áðéýιç ðιò. Áι ðð ÷ ùι àÛéáðð Ýιðñá áñ ÷ äβá ððιθι βáει èáðÛεἰθιá, äáñ èá ðá áääβιáé.

Ç äðéèιäP use-rel-suffix äβιáé... áñ ÷ áéιèιäéèP. Áι ðñáαιáðééÛ èÝéäðð ιά ιÛèáðð ð ÷ áðééÛ ιá áðððι, äéááÛððá ðç óáèβáá manual cvsup(1). Áéèèðð, áðèðð ÷ ñçóεἰθιέPððð ðççι, èáé ιçι áιçóð ÷ äβðá èééáβððáñá äéá áððP.

Ç äðéèιäP compress áñáñáñðιéáβ ðç ÷ ñðçç ððιðβáóçð ðýðιò gzip ððι èáñÛéé äðééιέιñιβáð. Áι Ý ÷ äðð ðýιááóç äééðýιò ðýðιò T1 P èáé ðεἰ ãñðáñçç, ιÛéèñι äáñ èá ðñÝðáé ιά ÷ ñçóεἰθιέPðððá ððιðβáóç. Óá äéáðιñáðééP ðáññððððçç, èá áιçèððáé áñéñáðééÛ.

- ¼éäð ιé äðéèιäÝð ò äáèβ:

Áäð äβιáé ðι ðèðñáð supfile äéá ðι δάνÛääéαιά ιάð:

```
*default tag=.
*default host=cvsup99.FreeBSD.org
*default prefix=/usr
*default base=/var/db
```


ports-audio release=cvs

ÕðìóðPñéιç P÷iò.

ports-base release=cvs

ΆάóέÉÛ άñ÷άβá ðùι ports áέá ððìóðPñéιç ðìò óóóðPιáðìò ìåðááεPððέóçð. ΆέÛóìñá άñ÷άβá ðìò άñβóέιíðáέ óðìòð ððìέáðáέüüäìòð Mk/ έάέ Tools/ ðìò /usr/ports.

Όçìåβùóç: Δáñåέáέιγíå ååβòå ðçì óçìáíóέέP ðñìåέäìðìççóç ðáñáðÛíù: èá ðñÝðáέ ðÛíóìðå ìá áίçìåñPìáðå áóðP ðçì ððìóðέέìåP, üðáí áίçìåñPìáðå ìðìέìåPðìðå ðìPìá ðçð óðέέìåPò Ports ðìò FreeBSD.

ports-benchmarks release=cvs

ΔñìåñÛìáðá ìÝðñççðð áðìäìóçð (Benchmarks).

ports-biology release=cvs

Άέììåβá.

ports-cad release=cvs

Άñåέåβá ó÷åβáóçð ìå ðç åìPεάέ ððìέìέóðP.

ports-chinese release=cvs

ÕðìóðPñéιç ÊéíåέέPð ÅεPóóáð.

ports-comms release=cvs

Ëìåóìέéü áðέέέìùíéPì.

ports-converters release=cvs

Ìåðáðñìðåβð ÷άñάέðPñùí.

ports-databases release=cvs

ΆÛóáέð ÅåñÝíùí.

ports-deskutils release=cvs

Áíóέέåβìáíá ðìò άñβóέιíðáí óðìPεùð óå Ýíå ãñáðåβì ðñéí ðçì åöýñåóç ðùι ððìέìέóðPì.

ports-devel release=cvs

ΆίççðóέέÛ ðñìåñÛìáðá áέá ðçì áíÛðððìçç έìåóìέέíγ.

ports-dns release=cvs

Ëìåóìέéü ó÷åέéü ìå DNS.

ports-editors release=cvs

ÓðíóÙèòåð èáειÝññ.

ports-emulators release=cvs

ΆññèùðÝð Ùèèùí èåέðìñåέêðí ððððçìÙðùí.

ports-finance release=cvs

×ñçìåðìèèíñèèÙ ðñññÙñìåðå.

ports-ftp release=cvs

ΔññññÙñìåðå FTP (ðåèÙðåð èáé åìððçñåðçðÝð).

ports-games release=cvs

Δåé ÷ íβåéå.

ports-german release=cvs

ÕðíóðÐñèíç ΆåññåíèèÐð åèððóåð.

ports-graphics release=cvs

Άññåéåβå åñåðéêðí.

ports-hebrew release=cvs

ÕðíóðÐñèíç ååññåíèèÐð åèððóåð.

ports-hungarian release=cvs

ÕðíóðÐñèíç ÌðååññÝæéèçð åèððóåð.

ports-irc release=cvs

ΔññññÙñìåðå åéå ðì IRC.

ports-japanese release=cvs

ÕðíóðÐñèíç ÉåðùíèèèÐð åèððóåð.

ports-java release=cvs

Άññåéåβå åéå ðçí Java.

ports-korean release=cvs

ÕðíóðÐñèíç ÊññååðéèèÐð åèððóåð.

ports-lang release=cvs

Άèððóåð ðññññññìåðéèíç.

ports-mail release=cvs

ΔññññÙñìåðå çèåèðññèèèçý ðå ÷ ðåñññåβñ.

ports-math release=cvs
Ëïãéóìéëü ïáççïáðééþï ððïëïãéóïþï.

ports-mbone release=cvs
ÅðãñïããÝð MBone.

ports-misc release=cvs
ÄéÛðïñá áïççèçðééÛ ðñïãñÛïïáðá.

ports-multimedia release=cvs
Ëïãéóìéëü ðïëðïÝóïí.

ports-net release=cvs
Ëïãéóìéëü äééðýíïí.

ports-net-im release=cvs
Ëïãéóìéëü Ûïãóóïí ïççïíÛðóïí (instant messaging).

ports-net-mgmt release=cvs
Ëïãéóìéëü äéá÷åβñéóçð äééðýíïí.

ports-net-p2p release=cvs
Äééðýíóç peer-to-peer.

ports-news release=cvs
Ëïãéóìéëü äéá ðï USENET.

ports-palm release=cvs
Ëïãéóìéëü äéá ðçï ððïóðÞñéïç ðððéååðþï ðýðïð Palm™.

ports-polish release=cvs
ÏðïóðÞñéïç Δïëùíééðð ãëþóóáð.

ports-ports-mgmt release=cvs
Åñååéåβá äéá ðç äéá÷åβñéóç ðáéÝóóïí éáé ports.

ports-portuguese release=cvs
ÏðïóðÞñéïç Δïñðïãáéééðð ãëþóóáð.

ports-print release=cvs
Ëïãéóìéëü åéðððþóáñïí.

ports-russian release=cvs
ÏðïóðÞñéïç Ñùóééðð ãëþóóáð.

ports-science release=cvs

ΆðέóðçñíέέÛ ðñññÛññάά.

ports-security release=cvs

Άññåéåßá áóóåéåßáð.

ports-shells release=cvs

Shells åéá òçí ãññìP áíðìëíí.

ports-sysutils release=cvs

ΆìçèçòééÛ ðñññÛññάά óóóðPìáðìð.

ports-textproc release=cvs

Άññåéåßá áðñññññáóßáð êåéíÝñìð (ãáí ðññééáìáÛíáé áðέóðñáðÝæéá òððñññåößá).

ports-ukrainian release=cvs

ÕðìóðPñéìç ÌöèñáíέéPð ãëPóóáð.

ports-vietnamese release=cvs

ÕðìóðPñéìç ΆέáðíáìÝæéèçð ãëPóóáð.

ports-www release=cvs

ËíåéóíέéÛ ðìð ó÷: áðßæåðáé ìå ðìí ðååëüóíέíí éóðü (World Wide Web).

ports-x11 release=cvs

Ports åéá òðìóðPñéìç ðìð óóóðPìáðìð X Windows.

ports-x11-clocks release=cvs

Ññëüåéá åéá ðì X11.

ports-x11-drivers release=cvs

ÐñññÛññάά ñåPåççð åéá ðá X11.

ports-x11-fm release=cvs

Άέá÷: åéñéóðÝð ãñ÷: åßùí åéá ðá X11.

ports-x11-fonts release=cvs

ΆññìáíðìóáéñÝð éåé ãññåéåßá ãññìáíðìóáéñPí åéá X11.

ports-x11-toolkits release=cvs

ΆññåéåéíèPèåð X11.

ports-x11-servers release=cvs

ΆíððçñåðçðÝð X11.

ports-x11-themes release=cvs

ÈÝιάðά äέά X11.

ports-x11-wm release=cvs

Äέå÷ äέñέóðÝò ðåñåýññìí (window managers) äέά X11.

projects-all release=cvs

Δçååβìð èðåέåð äέά ðì projects repository ðìö FreeBSD.

src-all release=cvs

Ï ååóέéùð ðçååβìð èðåέåð ðìö FreeBSD, óðìðåñέåìååìÝñìò ðìö èðåέåð èñðððìåñåóβåð.

src-base release=cvs

ÄέÜöìñå åñ÷åβå óççì èìñðð ðìö /usr/src.

src-bin release=cvs

Äñååååβå ðìö ðέέåííí íå åðåέðìýíóåέ óå èåðÜóðåóç èåέðìðñåβåð åñùð ÷ñðóç (single-user) (/usr/src/bin).

src-cddl release=cvs

Äñååååβå èåέ åέåέέìèèèåð ðìö èåέýððìíðåέ åðù ççì Üååέå ÷ñðóç CDDL (/usr/src/cddl).

src-contrib release=cvs

Äñååååβå èåέ åέåέέìèèèåð ðìö ååí åíðέììí óðì FreeBSD Project, èåέ óå ìðìβå ÷ñçóέìðìέíýíóåέ ìðóέåóðέέÜ åíåέèìβùðå (/usr/src/contrib).

src-crypto release=cvs

Äñååååβå èåέ åέåέέìèèèåð èñðððìåñÜççóçð ðìö ååí åíðέììí óðì FreeBSD project èåέ óå ìðìβå ÷ñçóέìðìέíýíóåέ ìðóέåóðέέÜ åíåέèìβùðå (/usr/src/crypto).

src-eBones release=cvs

Kerberos èåέ DES (/usr/src/eBones). Äåí ÷ñçóέìðìέíýíóåέ óðέð ðñÝ ÷ìóåð åèåùóåέð ðìö FreeBSD.

src-etc release=cvs

Äñ÷åβå ñðèìβóåñí ðìö óðóððìåðìð (/usr/src/etc).

src-games release=cvs

Δåé÷ìβåέå (/usr/src/games).

src-gnu release=cvs

Äñååååβå ðìö èåέýððìíðåέ åðù ççì Üååέå ÷ñðóç GNU Public License (/usr/src/gnu).

```

src-include release=cvs
    Άñ ÷άβá áðέέάòáέβáùí (/usr/src/include).

src-kerberos5 release=cvs
    ΔάέÝòι áóòάέάβáð Kerberos5 (/usr/src/kerberos5).

src-kerberosIV release=cvs
    ΔάέÝòι áóòάέάβáð KerberosIV (/usr/src/kerberosIV).

src-lib release=cvs
    ΆέέέιèÐéàð (/usr/src/lib).

src-libexec release=cvs
    ΔñññÑìάόά óóóðÐιáðìð óá ìðìβá òðóέιèìáέέÛ áέòáέιγίόάέ áðu Ûέέά ðñññÑìάόά
    (/usr/src/libexec).

src-release release=cvs
    Άñ ÷άβá ðìò áðάέòιγίόάέ áέά òçí ðáñááùñÐ ìέάð Ýέäìóçð òìò FreeBSD (/usr/src/release).

src-rescue release=cvs
    ΔñññÑìάόά ìá óóáóέéÐ ìáóááèðòóóç áέά ÷ñÐóç óá Ýέóáέòáð ðáñέðòðóáέó áðάίáòìÑð òìò
    óóóðÐιáðìð. Άάβòά òι rescue(8) (/usr/src/rescue).

src-sbin release=cvs
    Άñáέέάβá óóóðÐιáðìð áέά éáέòìòñáβá óá éáòÛóóáóç áñìð ÷ñÐóç (single user mode)
    (/usr/src/sbin).

src-secure release=cvs
    ΆέέέιèÐéàð éάέ áíòìéÝò èñòððìñÑìòçóçð (/usr/src/secure).

src-share release=cvs
    Άñ ÷άβá óá ìðìβá ìðìñáβ ìá áβίáέ έιέíÛ áíÛìáóά óá ðìέέáðέÛ óóóðÐιáðά (/usr/src/share).

src-sys release=cvs
    ÌðññÐιáð (/usr/src/sys).

src-sys-crypto release=cvs
    Êðáέέáð èñòððìñáòáð òìò ðñññÐιá (/usr/src/sys/crypto).

src-tools release=cvs
    ΆέÛòìñá áñáάέάβá áέά òç óóìòðñçóç òìò FreeBSD (/usr/src/tools).

src-usrbin release=cvs
    Άñáέέάβá ÷ñÐóç (/usr/src/usr.bin).

```

```
src-usrsbin release=cvs
Ἄñâäââá òòòðÐιάðìð (/usr/src/usr.sbin).
```

```
www release=cvs
Ἴ δçãáβìð êðäέέáð äέá òçĩ ðìðìèäóβá WWW ðìῶ FreeBSD.
```

```
distrib release=self
Ὀά äñ÷-ââá ñðèìβóáùì ðìῶ βäέìῶ ðìῶ äìððçñâðçðÐ CVSup. ×ñçóéìðìèäóβäé äðü CVSup mirror sites.
```

```
gnats release=current
Ἡ äÜóç ääâñÝíùì ðìῶ òòòðÐιάðìð ðñâäéìèìççòçð ðñìäèçìÜòùì GNATS.
```

```
mail-archive release=current
Ὀά äñ÷-ââá òçð èβóðáð ðä÷-ðñññâβìῶ ðìῶ FreeBSD.
```

```
www release=current
Ðñì-äðâññâáóìÝíá äñ÷-ââá òçð äέέððäéðð ðìðìèäóβáð (WWW) ðìῶ FreeBSD (ü÷-é ï δçãáβìð êðäέέáð).
×ñçóéìðìèäóβäé äðü WWW mirror sites.
```

A.6.6 Ἄέá Ðñéóúðñâð Ðèçñìðññâð

Ἄέá ðì FAQ ðìῶ **CVSup** éäé Üèèâð ðèçñìðññâð ò÷-âðέéÜ ìä äððü, äâβðå òç Ὀäèβää ðìῶ **CVSup** (<http://www.cvsup.org>).

Ὀðæçððóäéð ò÷-âðέéÜ ìä òç ðñðóç ðìῶ **CVSup** òðì FreeBSD éäìäÜñìð ðññá òççì çèäèðññìééð èβóðá ðä÷-ìéêðì òðæçððóäùì ðìῶ FreeBSD (<http://lists.FreeBSD.org/mailman/listinfo/freebsd-hackers>). Ὀðç èβóðá äððð, éäèðð éäé òççì çèäèðññìééð èβóðá äíäèìèìðóäùì ðìῶ FreeBSD (<http://lists.FreeBSD.org/mailman/listinfo/freebsd-announce>) äíäèìèìðóäé éäé ìé ìÝäð äèäüðäéð ðìῶ ðñìäññÜìäðìῶ.

Ἄέá äñùððóäéð ð äíäðññÝð òðäèìÜòùì ò÷-âðέéÜ ìä ðì **CVSup** ñβìðå ìéá ìäðέÜ òðì **CVSup** FAQ (<http://www.cvsup.org/faq.html#bugreports>).

A.6.7 Ὀìðìèäóβáð CVSup

Ìðññâβðå ìá äññâβðå äìððçñâðçðÝð **CVSup** äέá ðì FreeBSD òðéð äèüèìèèâð ðìðìèäóβáð:

Central Servers, Primary Mirror Sites, Argentina, Armenia, Australia, Austria, Brazil, Bulgaria, Canada, China, Costa Rica, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Indonesia, Ireland, Israel, Italy, Japan, Korea, Kuwait, Kyrgyzstan, Latvia, Lithuania, Netherlands, Norway, Philippines, Poland, Portugal, Romania, Russia, San Marino, Singapore, Slovak Republic, Slovenia, South Africa, Spain, Sweden, Switzerland, Taiwan, Thailand, Turkey, Ukraine, United Kingdom, USA.

(as of 2010/11/13 13:50:55 UTC)

Central Servers

- cvsup.FreeBSD.org

Primary Mirror Sites

- cvsup1.FreeBSD.org
- cvsup2.FreeBSD.org
- cvsup3.FreeBSD.org
- cvsup4.FreeBSD.org
- cvsup5.FreeBSD.org
- cvsup6.FreeBSD.org
- cvsup7.FreeBSD.org
- cvsup8.FreeBSD.org
- cvsup9.FreeBSD.org
- cvsup10.FreeBSD.org
- cvsup11.FreeBSD.org
- cvsup12.FreeBSD.org
- cvsup13.FreeBSD.org
- cvsup14.FreeBSD.org
- cvsup15.FreeBSD.org
- cvsup16.FreeBSD.org
- cvsup18.FreeBSD.org

Argentina

- cvsup.ar.FreeBSD.org

Armenia

- cvsup1.am.FreeBSD.org

Australia

- cvsup.au.FreeBSD.org

Austria

- cvsup.at.FreeBSD.org
- cvsup2.at.FreeBSD.org

Brazil

- cvsup.br.FreeBSD.org
- cvsup2.br.FreeBSD.org
- cvsup3.br.FreeBSD.org
- cvsup4.br.FreeBSD.org
- cvsup5.br.FreeBSD.org

Bulgaria

- cvsup.bg.FreeBSD.org

Canada

- cvsup1.ca.FreeBSD.org

China

- cvsup.cn.FreeBSD.org
- cvsup2.cn.FreeBSD.org

Costa Rica

- cvsup1.cr.FreeBSD.org

Czech Republic

- cvsup.cz.FreeBSD.org

Denmark

- cvsup.dk.FreeBSD.org
- cvsup2.dk.FreeBSD.org

Estonia

- cvsup.ee.FreeBSD.org

Finland

- cvsup.fi.FreeBSD.org
- cvsup2.fi.FreeBSD.org

France

- cvsup.fr.FreeBSD.org
- cvsup1.fr.FreeBSD.org
- cvsup2.fr.FreeBSD.org
- cvsup3.fr.FreeBSD.org
- cvsup4.fr.FreeBSD.org
- cvsup5.fr.FreeBSD.org
- cvsup8.fr.FreeBSD.org

Germany

- cvsup.de.FreeBSD.org
- cvsup2.de.FreeBSD.org

- cvsup3.de.FreeBSD.org
- cvsup4.de.FreeBSD.org
- cvsup5.de.FreeBSD.org
- cvsup6.de.FreeBSD.org
- cvsup7.de.FreeBSD.org
- cvsup8.de.FreeBSD.org

Greece

- cvsup.gr.FreeBSD.org
- cvsup2.gr.FreeBSD.org

Hungary

- cvsup.hu.FreeBSD.org

Iceland

- cvsup.is.FreeBSD.org

Indonesia

- cvsup.id.FreeBSD.org

Ireland

- cvsup.ie.FreeBSD.org
- cvsup2.ie.FreeBSD.org

Israel

- cvsup.il.FreeBSD.org

Italy

- cvsup.it.FreeBSD.org

Japan

- cvsup.jp.FreeBSD.org
- cvsup2.jp.FreeBSD.org
- cvsup3.jp.FreeBSD.org
- cvsup4.jp.FreeBSD.org
- cvsup5.jp.FreeBSD.org
- cvsup6.jp.FreeBSD.org

Korea

- cvsup.kr.FreeBSD.org
- cvsup2.kr.FreeBSD.org
- cvsup3.kr.FreeBSD.org

Kuwait

- cvsup1.kw.FreeBSD.org

Kyrgyzstan

- cvsup.kg.FreeBSD.org

Latvia

- cvsup.lv.FreeBSD.org
- cvsup2.lv.FreeBSD.org

Lithuania

- cvsup.lt.FreeBSD.org
- cvsup2.lt.FreeBSD.org
- cvsup3.lt.FreeBSD.org

Netherlands

- cvsup.nl.FreeBSD.org
- cvsup2.nl.FreeBSD.org
- cvsup3.nl.FreeBSD.org

Norway

- cvsup.no.FreeBSD.org

Philippines

- cvsup1.ph.FreeBSD.org

Poland

- cvsup.pl.FreeBSD.org
- cvsup2.pl.FreeBSD.org
- cvsup3.pl.FreeBSD.org

Portugal

- cvsup.pt.FreeBSD.org
- cvsup2.pt.FreeBSD.org
- cvsup3.pt.FreeBSD.org

Romania

- cvsup.ro.FreeBSD.org
- cvsup1.ro.FreeBSD.org
- cvsup2.ro.FreeBSD.org
- cvsup3.ro.FreeBSD.org

Russia

- cvsup.ru.FreeBSD.org
- cvsup2.ru.FreeBSD.org
- cvsup3.ru.FreeBSD.org
- cvsup4.ru.FreeBSD.org
- cvsup5.ru.FreeBSD.org
- cvsup6.ru.FreeBSD.org
- cvsup7.ru.FreeBSD.org

San Marino

- cvsup.sm.FreeBSD.org

Singapore

- cvsup.sg.FreeBSD.org

Slovak Republic

- cvsup.sk.FreeBSD.org

Slovenia

- cvsup.si.FreeBSD.org
- cvsup2.si.FreeBSD.org

South Africa

- cvsup.za.FreeBSD.org
- cvsup2.za.FreeBSD.org

Spain

- cvsup.es.FreeBSD.org
- cvsup2.es.FreeBSD.org
- cvsup3.es.FreeBSD.org

Sweden

- cvsup.se.FreeBSD.org
- cvsup2.se.FreeBSD.org

Switzerland

- cvsup.ch.FreeBSD.org

Taiwan

- cvsup.tw.FreeBSD.org
- cvsup3.tw.FreeBSD.org
- cvsup4.tw.FreeBSD.org
- cvsup5.tw.FreeBSD.org
- cvsup6.tw.FreeBSD.org
- cvsup7.tw.FreeBSD.org
- cvsup8.tw.FreeBSD.org
- cvsup9.tw.FreeBSD.org
- cvsup10.tw.FreeBSD.org
- cvsup11.tw.FreeBSD.org

- cvsup12.tw.FreeBSD.org
- cvsup13.tw.FreeBSD.org
- cvsup14.tw.FreeBSD.org

Thailand

- cvsup.th.FreeBSD.org

Turkey

- cvsup.tr.FreeBSD.org
- cvsup2.tr.FreeBSD.org

Ukraine

- cvsup2.ua.FreeBSD.org
- cvsup3.ua.FreeBSD.org
- cvsup5.ua.FreeBSD.org
- cvsup6.ua.FreeBSD.org
- cvsup7.ua.FreeBSD.org

United Kingdom

- cvsup.uk.FreeBSD.org
- cvsup2.uk.FreeBSD.org
- cvsup3.uk.FreeBSD.org
- cvsup4.uk.FreeBSD.org

USA

- cvsup1.us.FreeBSD.org
- cvsup2.us.FreeBSD.org
- cvsup3.us.FreeBSD.org

- cvsup4.us.FreeBSD.org
- cvsup5.us.FreeBSD.org
- cvsup6.us.FreeBSD.org
- cvsup7.us.FreeBSD.org
- cvsup8.us.FreeBSD.org
- cvsup9.us.FreeBSD.org
- cvsup10.us.FreeBSD.org
- cvsup11.us.FreeBSD.org
- cvsup12.us.FreeBSD.org
- cvsup13.us.FreeBSD.org
- cvsup14.us.FreeBSD.org
- cvsup15.us.FreeBSD.org
- cvsup16.us.FreeBSD.org
- cvsup18.us.FreeBSD.org

A.7 ΆôéêÝôâò (Tags) ãέα ðι CVS

¼ôáι éáôââÛæâðâ Þ áíáíáβιáðâ ðιí ðçãáβι éβæééá ιÝòù òçð **cv**s ç òçð **CVSup**, èá ðñÝðáé íá éáèιñβóâðâ íέα áðéêÝðá Ýéäιòçð (revision tag). Íá revision tag áíáö Ýñâðáé âβðâ óâ íέα óðææêñéιÝιç ðιñâβá áíÛððòιçð ðιò FreeBSD, âβðâ óâ Ýíá óðææêñéιÝιç ðιñιéú óçιâβι. Ι ðñβòιð òçðιð ιññÛæâðáé “áðéêÝðá èèÛäιò (branch tag)”, èáé ι ääýðâñιð ιññÛæâðáé “áðéêÝðá Ýéäιòçð (release tag)”.

A.7.1 ΆôéêÝôâò ÈèÛäιí (Branch Tags)

¼æâð áððÝð, ìâ òçι áíáβñâóç ðιò HEAD (òι ιðιβι âβιáé ðÛιðá Ýæèñçç áðéêÝðá), éó÷-ýιòι ιùιí æέα ðι äÝιðιñι src/. Óá äÝιðιñι ports/, doc/, èáé www/ äáí Ý ðιòι èèÛäιòð.

HEAD

ðñιèæéðáé æέα ðι òðιäιèéèú ιññιá òçð èýñéáð ãñâιιÞð áíÛððòιçð, Þ FreeBSD-CURRENT. Άβιáé áðβóçð ðι ðñιäðéèäιÝιç tag áí äáí éáèιñéóðâβ èÛðιéι óðææêñéιÝιç revision.

Óðι **CVSup**, ðι tag áððú áíðéðñιòùðäýáðáé áðú íέα . (äáí ðñιèæéðáé æέα óçιâβι óðβιçð òçð ðñιðáóçð, äèèÛ æέα ðιí ðñâñιáðéèú ðι-áñáèðñá .).

Óçιâβιòç: Óðι CVS, áððÞ âβιáé èáé ç ðñιäðéèιäÞ áí äáí éáèιñéóðâβ revision tag. ÓðιÞèùð äáí âβιáé èáèÞ èäÝá íá èÛιäðâ checkout èáé áíáíÝùòç óðιí ðçãáβι éβæééá ðιò CURRENT óâ Ýíá ιç÷Ûιçιá STABLE, äèðùð áí áððÞ âβιáé ðñâñιáðéèÛ ç ðñιèæéðç óáð.

RELENG_8

Ç ãñáìÞ áíÛðððίçð ãέά òι FreeBSD-8.X, ãíùóðÞ áðβóçð έάέ ùð FreeBSD 8-STABLE

RELENG_8_1

Ç ãñáìÞ Ýέäüóçð òιð FreeBSD-8.1, ÷ñçόέìíðιέάβδάέ ìüíí ãέά áíçìáñÞράέð áóöάέάβáð έάέ Ûεέáð έñβόέìáð äέíñèÞράέð.

RELENG_8_0

Ç ãñáìÞ Ýέäüóçð òιð FreeBSD-8.0, ÷ñçόέìíðιέάβδάέ ìüíí ãέά áíçìáñÞράέð áóöάέάβáð έάέ Ûεέáð έñβόέìáð äέíñèÞράέð.

RELENG_7

Ç ãñáìÞ áíÛðððίçð ãέά òι FreeBSD-7.X, ãíùóðÞ áðβóçð έάέ ùð FreeBSD 7-STABLE

RELENG_7_3

Ç ãñáìÞ Ýέäüóçð òιð FreeBSD-7.3, ÷ñçόέìíðιέάβδάέ ìüíí ãέά áíçìáñÞράέð áóöάέάβáð έάέ Ûεέáð έñβόέìáð äέíñèÞράέð.

RELENG_7_2

Ç ãñáìÞ Ýέäüóçð òιð FreeBSD-7.2, ÷ñçόέìíðιέάβδάέ ìüíí ãέά áíçìáñÞράέð áóöάέάβáð έάέ Ûεέáð έñβόέìáð äέíñèÞράέð.

RELENG_7_1

Ç ãñáìÞ Ýέäüóçð òιð FreeBSD-7.1, ÷ñçόέìíðιέάβδάέ ìüíí ãέά áíçìáñÞράέð áóöάέάβáð έάέ Ûεέáð έñβόέìáð äέíñèÞράέð.

RELENG_7_0

Ç ãñáìÞ Ýέäüóçð òιð FreeBSD-7.0, ÷ñçόέìíðιέάβδάέ ìüíí ãέά áíçìáñÞράέð áóöάέάβáð έάέ Ûεέáð έñβόέìáð äέíñèÞράέð.

RELENG_6

Ç ãñáìÞ áíÛðððίçð ãέά òι FreeBSD-6.X, ãíùóðÞ áðβóçð έάέ ùð FreeBSD 6-STABLE

RELENG_6_4

Ç ãñáìÞ Ýέäüóçð òιð FreeBSD-6.4, ÷ñçόέìíðιέάβδάέ ìüíí ãέά áíçìáñÞράέð áóöάέάβáð έάέ Ûεέáð έñβόέìáð äέíñèÞράέð.

RELENG_6_3

Ç ãñáìÞ Ýέäüóçð òιð FreeBSD-6.3, ÷ñçόέìíðιέάβδάέ ìüíí ãέά áíçìáñÞράέð áóöάέάβáð έάέ Ûεέáð έñβόέìáð äέíñèÞράέð.

RELENG_6_2

Ç ãñáìÞ Ýέäüóçð òιð FreeBSD-6.2, ÷ñçόέìíðιέάβδάέ ìüíí ãέά áíçìáñÞράέð áóöάέάβáð έάέ Ûεέáð έñβόέìáð äέíñèÞράέð.

RELENG_6_1

Ç ãñáìÞ Ýêäïçò òϊò FreeBSD-6.1, ÷ñçóεϊιðïéάβδάé ιιíí ãéά áçìáñÞðáéò áóöáéάβáð èéé Üëëáð èñβóεϊάð äéìñèÞðáéð.

RELENG_6_0

Ç ãñáìÞ Ýêäïçò òϊò FreeBSD-6.0, ÷ñçóεϊιðïéάβδάé ιιíí ãéά áçìáñÞðáéò áóöáéάβáð èéé Üëëáð èñβóεϊάð äéìñèÞðáéð.

RELENG_5

Ç ãñáìÞ άíÜððóïçò ãéά òϊ FreeBSD-5.X, ãíùóòÞ άðβóçò ùð FreeBSD 5-STABLE.

RELENG_5_5

Ç ãñáìÞ Ýêäïçò òϊò FreeBSD-5.5, ÷ñçóεϊιðïéάβδάé ιιíí ãéά áçìáñÞðáéò áóöáéάβáð èéé Üëëáð èñβóεϊάð äéìñèÞðáéð.

RELENG_5_4

Ç ãñáìÞ Ýêäïçò òϊò FreeBSD-5.4, ÷ñçóεϊιðïéάβδάé ιιíí ãéά áçìáñÞðáéò áóöáéάβáð èéé Üëëáð èñβóεϊάð äéìñèÞðáéð.

RELENG_5_3

Ç ãñáìÞ Ýêäïçò òϊò FreeBSD-5.3, ÷ñçóεϊιðïéάβδάé ιιíí ãéά áçìáñÞðáéò áóöáéάβáð èéé Üëëáð èñβóεϊάð äéìñèÞðáéð.

RELENG_5_2

Ç ãñáìÞ Ýêäïçò FreeBSD-5.2 èéé FreeBSD-5.2.1, ÷ñçóεϊιðïéάβδάé ιιíí ãéά áçìáñÞðáéò áóöáéάβáð èéé Üëëáð èñβóεϊάð äéìñèÞðáéð.

RELENG_5_1

Ç ãñáìÞ Ýêäïçò ãéά òϊ FreeBSD-5.1, ÷ñçóεϊιðïéάβδάé ιιíí ãéά ãéά áçìáñÞðáéò áóöáéάβáð èéé Üëëáð èñβóεϊάð äéìñèÞðáéð.

RELENG_5_0

Ç ãñáìÞ Ýêäïçò ãéά òϊ FreeBSD-5.0, ÷ñçóεϊιðïéάβδάé ιιíí ãéά áçìáñÞðáéò áóöáéάβáð èéé Üëëáð èñβóεϊάð äéìñèÞðáéð.

RELENG_4

Ç ãñáìÞ άíÜððóïçò ãéά òϊ FreeBSD-4.X, ãíùóòÞ άðβóçò èéé ùð FreeBSD 4-STABLE.

RELENG_4_11

Ç ãñáìÞ Ýêäïçò ãéά òϊ FreeBSD-4.11, ÷ñçóεϊιðïéάβδάé ιιíí ãéά áçìáñÞðáéò áóöáéάβáð èéé Üëëáð èñβóεϊάð äéìñèÞðáéð.

RELENG_4_10

Ç ãñáìÞ Ýêäïçò ãéά òϊ FreeBSD-4.10, ÷ñçóεϊιðïéάβδάé ιιíí ãéά áçìáñÞðáéò áóöáéάβáð èéé Üëëáð èñβóεϊάð äéìñèÞðáéð.

RELENG_4_9

Ç ãñáñìP Ýèäïðçò ãέά òϊ FreeBSD-4.9, ÷ ñçóέìðïéάβòάέ ìùñ ãέά áìçìáñððάέò áóóάέάβáð èάέ Ûέέáð èñβóέìáð äέìñèððάέò.

RELENG_4_8

Ç ãñáñìP Ýèäïðçò ãέά òϊ FreeBSD-4.8, ÷ ñçóέìðïéάβòάέ ìùñ ãέά áìçìáñððάέò áóóάέάβáð èάέ Ûέέáð èñβóέìáð äέìñèððάέò.

RELENG_4_7

Ç ãñáñìP Ýèäïðçò ãέά òϊ FreeBSD-4.7, ÷ ñçóέìðïéάβòάέ ìùñ ãέά áìçìáñððάέò áóóάέάβáð èάέ Ûέέáð èñβóέìáð äέìñèððάέò.

RELENG_4_6

Ç ãñáñìP Ýèäïðçò ãέά òά FreeBSD-4.6 èάέ FreeBSD-4.6.2, ÷ ñçóέìðïéάβòάέ ìùñ ãέά áìçìáñððάέò áóóάέάβáð èάέ Ûέέáð èñβóέìáð äέìñèððάέò.

RELENG_4_5

Ç ãñáñìP Ýèäïðçò ãέά òϊ FreeBSD-4.5, ÷ ñçóέìðïéάβòάέ ìùñ ãέά áìçìáñððάέò áóóάέάβáð èάέ Ûέέáð èñβóέìáð äέìñèððάέò.

RELENG_4_4

Ç ãñáñìP Ýèäïðçò ãέά òϊ FreeBSD-4.4, ÷ ñçóέìðïéάβòάέ ìùñ ãέά áìçìáñððάέò áóóάέάβáð èάέ Ûέέáð èñβóέìáð äέìñèððάέò.

RELENG_4_3

Ç ãñáñìP Ýèäïðçò ãέά òϊ FreeBSD-4.3, ÷ ñçóέìðïéάβòάέ ìùñ ãέά áìçìáñððάέò áóóάέάβáð èάέ Ûέέáð èñβóέìáð äέìñèððάέò.

RELENG_3

Ç ãñáñìP áíÛððòìçò ãέά òϊ FreeBSD-3.X, áñóðP áðβóçð èάέ ùð 3.X-STABLE.

RELENG_2_2

Ç ãñáñìP áíÛððòìçò ãέά òϊ FreeBSD-2.2.X, áñóðP áðβóçð èάέ ùð 2.2-STABLE. Ç ãñáñìP áððP èáùñάβóάέ ìóέάóóέέÛ ðáñù ÷ çìÝìç.

A.7.2 ΆðέéÝòáð Άέäüóáùì (Release Tags)

Ïé áðέéÝòáð áððÝð áíáðÝñìóάέ òά ìέά òðáèáèèéìÝìç ÷ ñìíέèP òóέáìP èáðÛ òçì ìðìβά Ýáέìá ìέά èáñìέέèP Ýèäïðçò (release) òïð FreeBSD. Ç áέάáέέάóβá òçð Ýèäïðçò òáèìçñèðìáðάέ ìá ðáñέóóüðáñáð èáððñÝñáέáð òóά Ýááñáóά Δέçñìòìñβáð Άέάáέέάóβáð èäïðçò (<http://www.FreeBSD.org/releng/>) èάέ Άέάáέέάóβá èäïðçò (http://www.FreeBSD.org/doc/el_GR.ISO8859-7/articles/releng/release-proc.html). Òì äÝìðñì src ÷ ñçóέìðïéάβ ììùìáóά áðέéáððì ðïð ìáέέìÝì ìá òç èÝìç RELENG_. Òά äÝìðñá ports èάέ doc ÷ ñçóέìðïéìéÝì áðέéÝòáð ðïð ìáέέìÝì ìá òç èÝìç RELEASE. ÒÝèò, òòì äÝìðñì www äáì äβìáðάέ èÛðïéá áέάέèP áðέéÝòά ðïð ìá Ý ÷ áé ò ÷ Ýóç ìá òέð äèäüóáέð.

RELENG_8_1_0_RELEASE

FreeBSD 8.1

RELENG_8_0_0_RELEASE

FreeBSD 8.0

RELENG_7_3_0_RELEASE

FreeBSD 7.3

RELENG_7_2_0_RELEASE

FreeBSD 7.2

RELENG_7_1_0_RELEASE

FreeBSD 7.1

RELENG_7_0_0_RELEASE

FreeBSD 7.0

RELENG_6_4_0_RELEASE

FreeBSD 6.4

RELENG_6_3_0_RELEASE

FreeBSD 6.3

RELENG_6_2_0_RELEASE

FreeBSD 6.2

RELENG_6_1_0_RELEASE

FreeBSD 6.1

RELENG_6_0_0_RELEASE

FreeBSD 6.0

RELENG_5_5_0_RELEASE

FreeBSD 5.5

RELENG_5_4_0_RELEASE

FreeBSD 5.4

RELENG_4_11_0_RELEASE

FreeBSD 4.11

RELENG_5_3_0_RELEASE

FreeBSD 5.3

RELENG_4_10_0_RELEASE

FreeBSD 4.10

RELENG_5_2_1_RELEASE

FreeBSD 5.2.1

RELENG_5_2_0_RELEASE

FreeBSD 5.2

RELENG_4_9_0_RELEASE

FreeBSD 4.9

RELENG_5_1_0_RELEASE

FreeBSD 5.1

RELENG_4_8_0_RELEASE

FreeBSD 4.8

RELENG_5_0_0_RELEASE

FreeBSD 5.0

RELENG_4_7_0_RELEASE

FreeBSD 4.7

RELENG_4_6_2_RELEASE

FreeBSD 4.6.2

RELENG_4_6_1_RELEASE

FreeBSD 4.6.1

RELENG_4_6_0_RELEASE

FreeBSD 4.6

RELENG_4_5_0_RELEASE

FreeBSD 4.5

RELENG_4_4_0_RELEASE

FreeBSD 4.4

RELENG_4_3_0_RELEASE

FreeBSD 4.3

RELENG_4_2_0_RELEASE

FreeBSD 4.2

RELENG_4_1_1_RELEASE

FreeBSD 4.1.1

RELENG_4_1_0_RELEASE

FreeBSD 4.1

RELENG_4_0_0_RELEASE

FreeBSD 4.0

RELENG_3_5_0_RELEASE

FreeBSD-3.5

RELENG_3_4_0_RELEASE

FreeBSD-3.4

RELENG_3_3_0_RELEASE

FreeBSD-3.3

RELENG_3_2_0_RELEASE

FreeBSD-3.2

RELENG_3_1_0_RELEASE

FreeBSD-3.1

RELENG_3_0_0_RELEASE

FreeBSD-3.0

RELENG_2_2_8_RELEASE

FreeBSD-2.2.8

RELENG_2_2_7_RELEASE

FreeBSD-2.2.7

RELENG_2_2_6_RELEASE

FreeBSD-2.2.6

RELENG_2_2_5_RELEASE

FreeBSD-2.2.5

RELENG_2_2_2_RELEASE

FreeBSD-2.2.2

RELENG_2_2_1_RELEASE

FreeBSD-2.2.1

- FreeBSD: Δ̄ε̄π̄ñ̄ά ò mirror òῑò äéáêñ̄éóð̄P FTP òῑò FreeBSD.
- FreeBSD-gnats: Ç äŰóç äããñ̄Ýí̄ῑ òῑò óðóð̄β̄ῑάòῑð ðãñ̄áê̄ñ̄é̄ñ̄é̄çóçð òóáê̄ìŰòù̄ῑ GNATS.
- FreeBSD-Archive: Mirror òῑò äéáêñ̄éóð̄P FTP ðáéáéú̄òãñ̄ù̄ῑ äêäǖóáù̄ῑ (archive) òῑò FreeBSD.

ÓáÄãŰí

rsync://ftp.tw.FreeBSD.org/

rsync://ftp2.tw.FreeBSD.org/

rsync://ftp6.tw.FreeBSD.org/

ÄéáèŰóé̄ῑãð Óð̄ë̄ñ̄ãŰò:

- FreeBSD: Δ̄ε̄π̄ñ̄ά ò mirror òῑò äéáêñ̄éóð̄P FTP òῑò FreeBSD.

Çí̄ῑŰí̄ Äáóβ̄ê̄ǟé̄ῑ

rsync://rsync.mirror-service.org/

ÄéáèŰóé̄ῑãð Óð̄ë̄ñ̄ãŰò:

- sites/ftp.freebsd.org: Δ̄ε̄π̄ñ̄ά ò mirror òῑò äéáêñ̄éóð̄P FTP òῑò FreeBSD.

Çí̄ῑŰí̄ãð Δ̄ñ̄éóð̄ãβ̄ãð Äìãñ̄é̄Pð

rsync://ftp-master.FreeBSD.org/

Ï äéáêñ̄éóð̄Pð áðòüð ìðñ̄ãβ̄ íá ÷ ñçóé̄ñ̄ð̄ñ̄é̄çèãβ̄ ìüñ̄ áðü êýñ̄éá mirror sites òῑò FreeBSD.

ÄéáèŰóé̄ῑãð Óð̄ë̄ñ̄ãŰò:

- FreeBSD: To êýñ̄é̄ῑ (master) óýóóçιά áñ̄÷ãβ̄ù̄ῑ òῑò äéáêñ̄éóð̄P FTP òῑò FreeBSD.
- acl: Ç êýñ̄éá èβ̄óðá ACL òῑò FreeBSD.

rsync://ftp13.FreeBSD.org/

ÄéáèŰóé̄ῑãð Óð̄ë̄ñ̄ãŰò:

- FreeBSD: Δ̄ε̄π̄ñ̄ά ò mirror òῑò äéáêñ̄éóð̄P FTP òῑò FreeBSD.

- FreeBSD 5 - Installieren, Konfigurieren, Administrieren (<http://www.cul.de/freebsd.html>) (ὀδά Ἄññíáíééῤ), äêäüèçêá áðü ὀçí Computer und Literatur Verlag (<http://www.cul.de>), 2003. ISBN 3-936546-06-1.
- FreeBSD de Luxe (<http://www.mitp.de/vmi/mitp/detail/pWert/1343/>) (ὀδά Ἄññíáíééῤ), äêäüèçêá áðü ὀçí Verlag Modere Industrie (<http://www.mitp.de>), 2003. ISBN 3-8266-1343-0.
- FreeBSD Install and Utilization Manual (<http://www.pc.mycom.co.jp/FreeBSD/install-manual.html>) (ὀδά ἌéáðüíÝæééá), äêäüèçêá áðü ὀçí Mainichi Communications Inc. (<http://www.pc.mycom.co.jp/>).
- Onno W Purbo, Dodi Maryanto, Syahrial Hubbany, Widjil Widodo *Building Internet Server with FreeBSD* (<http://maxwell.itb.ac.id/>) (ὀçí Ἐíäíçóéáêῤ äëþóóá), äêäüèçêá áðü ὀçí Elex Media Komputindo (<http://www.elexmedia.co.id/>).
- Absolute BSD: The Ultimate Guide to FreeBSD (ἰãðῤñáόç ὀá Δάñáäíróéáêῤ ἘéíÝæééá), äêäüèçêá áðü ὀçí GrandTech Press (<http://www.grandtech.com.tw/>), 2003. ISBN 986-7944-92-5.
- The FreeBSD 6.0 Book (<http://www.twbsd.org/cht/book/>) (ὀá Δάñáäíróéáêῤ ἘéíÝæééá), äêäüèçêá áðü ὀçí Drmaster, 2006. ISBN 9-575-27878-X.

Ἄéäüβá & δάñéüééêῤ ὀçí Ἄäñééêῤ äëþóóá:

- Absolute FreeBSD, 2nd Edition: The Complete Guide to FreeBSD (<http://www.absoluteFreeBSD.com/>), äêäüèçêá áðü ὀçí No Starch Press (<http://www.nostarch.com/>), 2007. ISBN: 978-1-59327-151-0
- The Complete FreeBSD (<http://www.freebsdmall.com/cgi-bin/fm/bsdcomp>), äêäüèçêá áðü ὀçí O'Reilly (<http://www.oreilly.com/>), 2003. ISBN: 0596005164
- The FreeBSD Corporate Networker's Guide (<http://www.freebsd-corp-net-guide.com/>), äêäüèçêá áðü ὀçí Addison-Wesley (<http://www.awl.com/aw/>), 2000. ISBN: 0201704811
- FreeBSD: An Open-Source Operating System for Your Personal Computer (<http://andrsn.stanford.edu/FreeBSD/introbook/>), äêäüèçêá áðü ὀçí The Bit Tree Press, 2001. ISBN: 0971204500
- Teach Yourself FreeBSD in 24 Hours, äêäüèçêá áðü ὀçí Sams (<http://www.sampublishing.com/>), 2002. ISBN: 0672324245
- FreeBSD 6 Unleashed, äêäüèçêá áðü ὀçí Sams (<http://www.sampublishing.com/>), 2006. ISBN: 0672328755
- FreeBSD: The Complete Reference, äêäüèçêá áðü ὀçí McGrawHill (<http://books.mcgraw-hill.com>), 2003. ISBN: 0072224096
- BSD Magazine (<http://www.bsdmag.org>), äêäüèçêá áðü ὀçí Software Press Sp. z o.o. SK. ISSN 1898-9144

B.2 ἰäçäíβ ÷ ñþóôç

- Computer Systems Research Group, UC Berkeley. *4.4BSD User's Reference Manual*. O'Reilly & Associates, Inc., 1994. ISBN 1-56592-075-9
- Computer Systems Research Group, UC Berkeley. *4.4BSD User's Supplementary Documents*. O'Reilly & Associates, Inc., 1994. ISBN 1-56592-076-7
- *UNIX in a Nutshell*. O'Reilly & Associates, Inc., 1990. ISBN 093717520X
- Mui, Linda. *What You Need To Know When You Can't Find Your UNIX System Administrator*. O'Reilly & Associates, Inc., 1995. ISBN 1-56592-104-6

- Ôì Ohio State University (<http://www.osu.edu/>) Ýññáøå ðá ΆέóáãùääéÛ ìáèÞìáóá UNIX (http://8help.osu.edu/wks/unix_course/unix.html) ðìò äéáðßèáíðáé óá HTML êéé óá ìññòÞ PostScript.
Ïéá ÊðääéêÞ ìáðÛðñáóç (http://www.FreeBSD.org/doc/it_IT.ISO8859-15/books/unix-introduction/index.html) áððíý ðìò êáèÏÝñìò äéáðßèáðáé ùð ìÝñìò ðìò FreeBSD Italian Documentation Project.
- Jpman Project, Japan FreeBSD Users Group (<http://www.jp.FreeBSD.org/>). FreeBSD User's Reference Manual (<http://www.pc.mycom.co.jp/FreeBSD/urm.html>) (Japanese translation). Mainichi Communications Inc. (<http://www.pc.mycom.co.jp/>), 1998. ISBN4-8399-0088-4 P3800E.
- Ôì Edinburgh University (<http://www.ed.ac.uk/>) Ýññáøå Ýíá Online ìäçäü (<http://unixhelp.ed.ac.uk/>) äéá ìÝìòð óðì ðññéáÛèèí ðìò UNIX.

B.3 ìäçäüß äéá ð äéñéóòÞ

- Albitz, Paul and Liu, Cricket. *DNS and BIND*, 4th Ed. O'Reilly & Associates, Inc., 2001. ISBN 1-59600-158-4
- Computer Systems Research Group, UC Berkeley. *4.4BSD System Manager's Manual*. O'Reilly & Associates, Inc., 1994. ISBN 1-56592-080-5
- Costales, Brian, et al. *Sendmail*, 2nd Ed. O'Reilly & Associates, Inc., 1997. ISBN 1-56592-222-0
- Frisch, Æleen. *Essential System Administration*, 2nd Ed. O'Reilly & Associates, Inc., 1995. ISBN 1-56592-127-5
- Hunt, Craig. *TCP/IP Network Administration*, 2nd Ed. O'Reilly & Associates, Inc., 1997. ISBN 1-56592-322-7
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- *The BSD family tree*. <http://www.FreeBSD.org/cgi/cvsweb.cgi/src/share/misc/bsd-family-tree> ç ôï /usr/share/misc/bsd-family-tree óå Ýíá FreeBSD ìç÷Ûçìá.
- *Networked Computer Science Technical Reports Library*. <http://www.ncstrl.org/>

- ĐáěáéÝò BSD áêüüóáéò áđü òí Computer Systems Research group (CSRG). <http://www.mckusick.com/csrq/>: Ôí 4CD set Ý÷áé üëáò ôéò BSD áêüüóáéò áđü ôçí 1BSD ìÝ÷ñé ôçí 4.4BSD éáé ôçí 4.4BSD-Lite2 (áëëŨ ü÷é ôçí 2.11BSD, äóóô÷ðò). Ôí ôäëáòôáßí äéóêŨéé đañéÝ÷áé áđßóçò ôíí ôäëéêü đçááßí êpäééá óóí ôá áñ÷áßá SCCS.

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- *Sys Admin — The Journal for UNIX System Administrators* Miller Freeman, Inc., ISSN 1061-2688
- *freeX — Das Magazin für Linux - BSD - UNIX* (óóá ãññíáíéêŨ) Computer- und Literaturverlag GmbH, ISSN 1436-7033

Ἐξόδο

freebsd-bluetooth
(<http://lists.FreeBSD.org/mailman/listinfo/freebsd-bluetooth>)

freebsd-cluster
(<http://lists.FreeBSD.org/mailman/listinfo/freebsd-cluster>)

freebsd-cvsweb
(<http://lists.FreeBSD.org/mailman/listinfo/freebsd-cvsweb>)

freebsd-database
(<http://lists.FreeBSD.org/mailman/listinfo/freebsd-database>)

freebsd-doc
(<http://lists.FreeBSD.org/mailman/listinfo/freebsd-doc>)
freebsd-drivers
(<http://lists.FreeBSD.org/mailman/listinfo/freebsd-drivers>)

freebsd-eclipse
(<http://lists.FreeBSD.org/mailman/listinfo/freebsd-eclipse>)

freebsd-embedded
(<http://lists.FreeBSD.org/mailman/listinfo/freebsd-embedded>)

freebsd-eol
(<http://lists.FreeBSD.org/mailman/listinfo/freebsd-eol>)
freebsd-emulation
(<http://lists.FreeBSD.org/mailman/listinfo/freebsd-emulation>)

freebsd-firewire
(<http://lists.FreeBSD.org/mailman/listinfo/freebsd-firewire>)

freebsd-fs
(<http://lists.FreeBSD.org/mailman/listinfo/freebsd-fs>)

Ὁμίλιος

× ἡρώς ὁρὸ δᾶ ÷ ἡρώβᾶδ Bluetooth ὁμί FreeBSD

× ἡρώς ὁρὸ FreeBSD ὁ δᾶ ἡρώβᾶδ ὁρὸδᾶδᾶ

Ὁμίλιος ὁρὸ CVSweb

Ὁρὸδᾶδᾶ ἡρώ ὁρὸ ÷ ἡρώς ἡρώ ἡρώδᾶδᾶ ἡρώδᾶδᾶ
ἡρώδᾶδᾶ ὁμί FreeBSD

ἡρώδᾶδᾶ ὁρὸδᾶδᾶ ἡρώ ὁμί FreeBSD

ἡρώδᾶδᾶ ἡρώδᾶδᾶ ὁρὸδᾶδᾶ ἡρώ ὁμί FreeBSD

Ὁρὸδᾶδᾶ ἡρώ ὁρὸ ÷ ἡρώς ὁρὸ Eclipse IDE, ὁρὸ ἡρώδᾶδᾶδᾶ
ὁρὸ, ἡρώδᾶδᾶ ἡρώ rich client ἡρώδᾶδᾶ ἡρώ ports ὁμί
FreeBSD.

× ἡρώς ὁρὸ FreeBSD ὁ δᾶ embedded ἡρώδᾶδᾶ

ἡρώδᾶδᾶ ὁρὸδᾶδᾶ ἡρώ ἡρώδᾶδᾶ ὁ ÷ ἡρώδᾶδᾶ ἡρώδᾶδᾶ
ἡρώ ἡρώ ὁρὸδᾶδᾶ ἡρώδᾶδᾶ ἡρώδᾶδᾶ ὁμί FreeBSD Project.
ἡρώδᾶδᾶ ἡρώδᾶδᾶ ὁρὸδᾶδᾶ, ἡρώδᾶδᾶ ἡρώδᾶδᾶ ὁμί
Linux/MS-DOS/Windows

Ὁρὸ ÷ ἡρώδᾶδᾶ ὁρὸδᾶδᾶ ἡρώ FreeBSD FireWire® (iLink,
IEEE 1394)

Ὁρὸδᾶδᾶ ἡρώ ÷ ἡρώδᾶδᾶ

Ἐβῶδᾶ

freebsd-gecko
(<http://lists.FreeBSD.org/mailman/listinfo/freebsd-gecko>)

freebsd-geom
(<http://lists.FreeBSD.org/mailman/listinfo/freebsd-geom>)

freebsd-gnome
(<http://lists.FreeBSD.org/mailman/listinfo/freebsd-gnome>)

freebsd-hackers
(<http://lists.FreeBSD.org/mailman/listinfo/freebsd-hackers>)

freebsd-hardware
(<http://lists.FreeBSD.org/mailman/listinfo/freebsd-hardware>)

freebsd-i18n
(<http://lists.FreeBSD.org/mailman/listinfo/freebsd-i18n>)

freebsd-ia32
(<http://lists.FreeBSD.org/mailman/listinfo/freebsd-ia32>)

freebsd-ia64
(<http://lists.FreeBSD.org/mailman/listinfo/freebsd-ia64>)

freebsd-ipfw
(<http://lists.FreeBSD.org/mailman/listinfo/freebsd-ipfw>)

freebsd-isdn
(<http://lists.FreeBSD.org/mailman/listinfo/freebsd-isdn>)

freebsd-jail
(<http://lists.FreeBSD.org/mailman/listinfo/freebsd-jail>)

freebsd-java
(<http://lists.FreeBSD.org/mailman/listinfo/freebsd-java>)

freebsd-kde
(<http://freebsd.kde.org/mailman/listinfo/kde-freebsd>)

freebsd-lfs
(<http://lists.FreeBSD.org/mailman/listinfo/freebsd-lfs>)

freebsd-libh
(<http://lists.FreeBSD.org/mailman/listinfo/freebsd-libh>)

freebsd-mips
(<http://lists.FreeBSD.org/mailman/listinfo/freebsd-mips>)

Ὀεῖδῶδ

Ὀδᾶβῶςός ο ÷ ᾶδῆῆÛ ἰᾶ οῖ **Gecko Rendering Engine**

Ὀδᾶβῶςός ο ÷ ᾶδῆῆÛ ἰᾶ οῖ **GEOM** ἕᾶῆ ὀῆδ
ῶεῖδῖῆβῶςός ὀῖῶ

ἸᾶδᾶῶῖῖÛ ὀῖῶ **GNOME** ἕᾶῆ ὀῖῶ ᾶῶᾶῖῖᾶβῖ ὀῖῶ

ἌᾶῖῆῆÛ ὀᾶ ÷ ῖῆῆÛ ὀδᾶβῶςός

Ἄᾶῖῆῆβ ὀδᾶβῶςός ᾶῆᾶ ὀῖᾶᾶδῶδῶδᾶ ὀῆῆῆῖῖ ἰᾶ ὀῖ
FreeBSD

Ἄῆᾶῖῖῖβῶς ὀῖῶ FreeBSD

Ὀῖ FreeBSD ὀδῶῖ ᾶῖ ÷ ῆδᾶῆῖῖῆῆῆῆῆ IA-32 (Intel x86)

ἸᾶδᾶῶῖῖÛ ὀῖῶ FreeBSD ὀδᾶ ῖῖᾶ ὀδῶδῆῖᾶδᾶ IA64 ὀςδ
Intel

Ὀᾶ ÷ ῖῆῆῆῆ ὀδᾶβῶςός δῖῶ ᾶδῆῆᾶῖῖᾶῖᾶδᾶ ὀῖῖ
ᾶδᾶῖᾶῶ ÷ ᾶῆῆᾶῶῖῖ ὀῖῶ ῆῆᾶῆᾶ IP ὀῖῶ firewall

ἦÛᾶᾶ ᾶῖÛδῶδῖῆδ ὀῖῶ ISDN

Ὀδᾶβῶςός ο ÷ ᾶδῆῆÛ ἰᾶ ὀῆδ ᾶῶῖᾶδῶδῶδᾶ ὀῖῶ jail(8)

ἦÛᾶᾶ ᾶῖÛδῶδῖῆδ Java ἕᾶῆ Ûῶῖᾶ δῖῶ ἰᾶδᾶῶÛῖῖῖ ὀᾶ JDKs
ὀῖῶ FreeBSD

ἸᾶδᾶῶῖῖÛ ὀῖῶ **KDE** ἕᾶῆ ὀῖῶ ᾶῶᾶῖῖᾶβῖ ὀῖῶ

ἸᾶδᾶῶῖῖÛ ὀῖῶ LFS ὀῖῶ FreeBSD

Ὀῖ ὀῖῶδῶῖᾶ ᾶᾶῆᾶῶÛῶῶῶῶ ἕᾶῆ ᾶῆᾶ ÷ ᾶβῖῆῶῶ ὀδᾶῆÛῶῖ
ᾶᾶῖῶᾶῆδ ᾶᾶῖῆÛ

ἸᾶδᾶῶῖῖÛ ὀῖῶ FreeBSD ὀᾶ ᾶδᾶῖᾶᾶᾶᾶᾶᾶᾶᾶᾶ MIPS®

freebsd-pf (<http://lists.FreeBSD.org/mailman/listinfo/freebsd-pf>)

ΌδæçðÞóáέδ έάέ άñùðÞóáέδ άέά δϊ όύόδçιά packet filter firewall

ΌδæçðÞóáέδ ό÷ άδέέÝδ ιά δϊ packet filter (pf) firewall system όδϊ FreeBSD. Όά÷ ίέέÝδ όδæçðÞóáέδ έάέ άñùðÞóáέδ ÷ ñçόðÞí άβίάέ άδñüóääέδάδ. Ç έβόόά άβίάέ άδβόçδ Ýία ιÝñüδ άέά όδæÞδçόç όϊð ALTQ QoS framework.

freebsd-platforms (<http://lists.FreeBSD.org/mailman/listinfo/freebsd-platforms>)

ΙάόάöïñÛ όϊð FreeBSD όά ιç-Intel δέάόöüñιάδ

ΔñüäèÞιάόά όϊð FreeBSD δϊð άüóáíβæííόάέ όά δάñέόóüüάñάδ άδü ιβά δέάόöüñιάδ, έάèð έάέ άάίέέÝδ όδæçðÞóáέδ έάέ δñüðÛόάέδ άέά ιάόάöïñÛ όϊð FreeBSD όά ιç-Intel δέάόöüñιάδ. Άβίάέ ιέά όά÷ ίέέÞ έβόόά έάέ όδæçðïíýíόάέ üñü άόόδçñÛ όά÷ ίέέÛ èÝιάόά.

freebsd-policy (<http://lists.FreeBSD.org/mailman/listinfo/freebsd-policy>)

ΈάόάδδδθίðÞñέάδ άδñüÛόάέδ (policy) όçδ ïÛääð Core όϊð FreeBSD

ΆδðÞ άβίάέ ιβά έβόόά ιά ιέέñÞ έβίçόç, üñü άέά άíÛάñüόç, άέά όέδ άδñüÛόάέδ όçδ Core ñÛääð όϊð FreeBSD ό÷ άδέέÛ ιά èÛθιέά èÝιάόά έάόάýèθίόçδ όϊð Project (policies).

freebsd-ports (<http://lists.FreeBSD.org/mailman/listinfo/freebsd-ports>)

ΌδæÞδçόç άέά όά “ports”

ΌδæçðÞóáέδ ό÷ άδέέÝδ ιά όçí “ΌδèëñäÞ όüí Ports” όϊð FreeBSD (/usr/ports), όçí δδñüñÞ όüí ports, έάέ άάίέέÛ όέδ δñüðÛέάέδ όδθίüíέόüñý όüí ports. Άβίάέ ιέά όά÷ ίέέÞ έβόόά έάέ όδæçðïíýíόάέ üñü άόόδçñÛ όά÷ ίέέÛ èÝιάόά.

freebsd-ports-bugs (<http://lists.FreeBSD.org/mailman/listinfo/freebsd-ports-bugs>)

ΌδæÞδçόç άέά όά όöÛèιάόά όüí “ports”

ΌδæçðÞóáέδ δñü ό÷ άδβæííόάέ ιά όέδ άíáöïñÝδ δñüäèçüÛόüí όçδ “ΌδèëñäÞδ όüí Ports” (/usr/ports) όϊð FreeBSD, δñüðÛόάέδ άέά ιÝά ports Þ άέά άèèάáÝδ όά δðÛñ÷ ííόά ports. Άβίάέ ιέά όά÷ ίέέÞ έβόόά έάέ όδæçðïíýíόάέ üñü άόόδçñÛ όά÷ ίέέÛ èÝιάόά.

freebsd-proliant (<http://lists.FreeBSD.org/mailman/listinfo/freebsd-proliant>)

Όά÷ ίέέÞ όδæÞδçόç άέά δϊ FreeBSD όά äέάèñέόδÝδ HP ProLiant

ΆδðÞ ç έβόόά άβίάέ άέά όά÷ ίέέÝδ όδæçðÞóáέδ ό÷ άδέέÛ ιά όçí ÷ ñÞόç όϊð FreeBSD όά äέάèñέόδÝδ HP ProLiant. Ç όδæÞδçόç δάñέέáíäÛίáέ èÝιάόά δñüñáñüÛόüí íäÞçόçδ άέά ProLiant, èíäέóíέèü äέά÷ άβñέόçδ, άñäάέάβá ñèìβόάüí, έάέ άíáíäÞóáέδ όϊð BIOS. Ç έβόόά άδðÞ άβίάέ όϊ έάόάèèçèüðáñü ιÝñüδ άέά όδæÞδçόç ό÷ άδέέÛ ιά όά άñèñÞιάόά hpsamd, hpsmcli, έάέ hpacucli.

freebsd-python (<http://lists.FreeBSD.org/mailman/listinfo/freebsd-python>)

Ç Python όδϊ FreeBSD

ΆδðÞ ç έβόόά άβίάέ άέά όδæçðÞóáέδ ό÷ άδέέÝδ ιά όçí άäέέόóδθιðβçόç όçδ δθθίόðÞñέíçδ όçδ Python όδϊ FreeBSD. Άβίάέ ιέά όά÷ ίέέÞ έβόόά. Δñüññβæάόάέ άέά Ûðñά δñü άό÷ íèíýíόάέ ιά όçí ιάόάöïñÛ όçδ Python, όüí άñèñüíÛόüí όçδ (modules) έάέ όϊð **Zope** όδϊ FreeBSD. ¼όíέ άíäέάóÝñüíόάέ ίά δάñáèíèüðèÞóíθí όçí όά÷ ίέέÞ όδæÞδçόç, άβίάέ άδñüóääέέθιέ.

(http://minnie.tuhs.org/BSD-info/bsdnews_search.html), ÷ Ûñç óôçí òðçñáóá ðï ðñïóóÝñáé ï Warren Toomey <wkt@cs.adfa.edu.au>.

C.2.1 Newsgroups Ó÷áôééÛ ìá ôï BSD

- comp.unix.bsd.freebsd.announce (news:comp.unix.bsd.freebsd.announce)
- comp.unix.bsd.freebsd.misc (news:comp.unix.bsd.freebsd.misc)
- de.comp.os.unix.bsd (news:de.comp.os.unix.bsd) (Óôá ÃññíáíéÛ)
- fr.comp.os.bsd (news:fr.comp.os.bsd) (Óôá ÃáééééÛ)
- it.comp.os.freebsd (news:it.comp.os.freebsd) (Óôá ÉôáéééÛ)
- tw.bbs.comp.386bsd (news:tw.bbs.comp.386bsd) (Óá ÐáñáäïóéáéÛ ÊéíÝæééá)

C.2.2 ñëéä ÁíáéáóÝñïóá UNIX Newsgroups

- comp.unix (news:comp.unix)
- comp.unix.questions (news:comp.unix.questions)
- comp.unix.admin (news:comp.unix.admin)
- comp.unix.programmer (news:comp.unix.programmer)
- comp.unix.shell (news:comp.unix.shell)
- comp.unix.user-friendly (news:comp.unix.user-friendly)
- comp.security.unix (news:comp.security.unix)
- comp.sources.unix (news:comp.sources.unix)
- comp.unix.advocacy (news:comp.unix.advocacy)
- comp.unix.misc (news:comp.unix.misc)
- comp.bugs.4bsd (news:comp.bugs.4bsd)
- comp.bugs.4bsd.ucb-fixes (news:comp.bugs.4bsd.ucb-fixes)
- comp.unix.bsd (news:comp.unix.bsd)

C.2.3 Óýóôçíá X Window

- comp.windows.x.i386unix (news:comp.windows.x.i386unix)
- comp.windows.x (news:comp.windows.x)
- comp.windows.x.apps (news:comp.windows.x.apps)
- comp.windows.x.announce (news:comp.windows.x.announce)
- comp.windows.x.intrinsics (news:comp.windows.x.intrinsics)

- comp.windows.x.motif (news:comp.windows.x.motif)
- comp.windows.x.pex (news:comp.windows.x.pex)
- comp.emulators.ms-windows.wine (news:comp.emulators.ms-windows.wine)

C.3 Αλλάβου Εορτασμού

C.3.1 Forums, Blogs, και Ειδήσεις Άλλου

- Οά Forums του FreeBSD (<http://forums.freebsd.org/>) αάβαιόάέ οά αάδάδ web και άβιάέ εάδÜέέά αέα οά ÷ íéÝò óðæçðóáέò και άñòðóáέò θίò áóñíýí όι FreeBSD.
- Όι Planet FreeBSD (<http://planet.freebsd.org/>) óðääáíðñíáέ οά Ýíά óçíáβι θεò ñíÝò áðu äääÜääò έóðüüääέ íääþí όçò ñÜääò áíÜððóçð όι FreeBSD. ΔίέέÜ áðu οά íÝέç, ÷ ñçóέíθίέíýí áððð όç äóíáðuóçðά αέα íά áñúóðíθίέþóíθí όçí áñääóóá θίò έÜñíθí όç äääñÝíç óóέñð, ðò ÷ úí íÝάð áέíñèþóáέò, έέèðò και οά íääέíðέέÜ όιòð ó ÷ Ýääέ.
- Όι έáfÜέ BSDConferences όθι Youtube (<http://www.youtube.com/bsdconferences>) θάνÝ ÷ άέ íέα óðέέíð άβίόάí ðççèðò θίέúóçðάð, áðu äέÜóñá BSD óθíÝáñέα οά üέí όí έüóí. Δñüέääóάέ αέα Ýíά έάðíÜóέí ðñüθí íά θánaέíèèèèóáðά óçíáíóέέÜ íÝέç όçò ñÜääò áíÜððóçð íά θánaíóέÜάíθí όç íÝά όιòð äüέääέÜ όθι FreeBSD.

C.3.2 Άδβόçιά Mirrors

Central Servers, Argentina, Armenia, Australia, Austria, Belgium, Brazil, Bulgaria, Canada, China, Costa Rica, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hong Kong, Hungary, Iceland, Indonesia, Italy, Japan, Korea, Kuwait, Kyrgyzstan, Latvia, Lithuania, Netherlands, Norway, Philippines, Portugal, Romania, Russia, San Marino, Singapore, Slovak Republic, Slovenia, South Africa, Spain, Sweden, Switzerland, Taiwan, Thailand, Turkey, Ukraine, United Kingdom, USA.

(as of 2010/11/13 13:50:55 UTC)

- Central Servers
 - <http://www.FreeBSD.org/>
- Argentina
 - <http://www.ar.FreeBSD.org/>
- Armenia
 - <http://www1.am.FreeBSD.org/> (IPv6)

•

Australia

- <http://www.au.FreeBSD.org/>
- <http://www2.au.FreeBSD.org/>

•

Austria

- <http://www.at.FreeBSD.org/> (IPv6)
- <http://www2.at.FreeBSD.org/> (IPv6)

•

Belgium

- <http://freebsd.unixtech.be/>

•

Brazil

- <http://www.br.FreeBSD.org/> (IPv6)
- <http://www2.br.FreeBSD.org/www.freebsd.org/>
- <http://www3.br.FreeBSD.org/>

•

Bulgaria

- <http://www.bg.FreeBSD.org/>
- <http://www2.bg.FreeBSD.org/>

•

Canada

- <http://www.ca.FreeBSD.org/>
- <http://www2.ca.FreeBSD.org/>

•

China

- <http://www.cn.FreeBSD.org/>

- Hong Kong
 - <http://www.hk.FreeBSD.org/>
- Hungary
 - <http://www.hu.FreeBSD.org/>
 - <http://www2.hu.FreeBSD.org/>
- Iceland
 - <http://www.is.FreeBSD.org/>
- Indonesia
 - <http://www.id.FreeBSD.org/>
- Italy
 - <http://www.it.FreeBSD.org/>
 - <http://www.gufi.org/mirrors/www.freebsd.org/data/>
- Japan
 - <http://www.jp.FreeBSD.org/www.FreeBSD.org/> (IPv6)
- Korea
 - <http://www.kr.FreeBSD.org/>
 - <http://www2.kr.FreeBSD.org/>
- Kuwait
 - <http://www.kw.FreeBSD.org/>

- Kyrgyzstan
 - <http://www.kg.FreeBSD.org/>

- Latvia
 - <http://www.lv.FreeBSD.org/>
 - <http://www2.lv.FreeBSD.org/>

- Lithuania
 - <http://www.lt.FreeBSD.org/>

- Netherlands
 - <http://www.nl.FreeBSD.org/>
 - <http://www2.nl.FreeBSD.org/>

- Norway
 - <http://www.no.FreeBSD.org/>

- Philippines
 - <http://www.FreeBSD.org.ph/>

- Portugal
 - <http://www.pt.FreeBSD.org/>
 - <http://www1.pt.FreeBSD.org/>
 - <http://www4.pt.FreeBSD.org/>
 - <http://www5.pt.FreeBSD.org/>

- Romania

•

Ukraine

- <http://www.ua.FreeBSD.org/>
- <http://www2.ua.FreeBSD.org/>
- <http://www5.ua.FreeBSD.org/>
- <http://www4.ua.FreeBSD.org/>

•

United Kingdom

- <http://www1.uk.FreeBSD.org/>
- <http://www3.uk.FreeBSD.org/>

•

USA

- <http://www2.us.FreeBSD.org/>
- <http://www4.us.FreeBSD.org/> (IPv6)
- <http://www5.us.FreeBSD.org/> (IPv6)

C.4 Άέάðèýíóáέò Çèáèòñìíééîý Õá ÷ ðäñìñáβìò

Íé áéüèüðèàð áñðáéè ÷ ñçóðìí δάνÝ ÷ ìðì óðá ìÝέç ðìòð áέáðèýíóáέò çèáèòñìíééîý ðá ÷ ðäñìñáβìò ðìò ó ÷ áðβæìíðáé ìá ðì FreeBSD. Í áέá ÷ áéñéóððò ðìò áíáðÝñáðáé δάνáéÜòð, áέáðçñáβ ðì áέéáβìüá íá áíáéáéÝóáé ðçí áéáyèðìóç, áí áβíáé éáðÜ ÷ ñçóç ðçð ìá ìðìéíäðìðá ðñüðì.

ÕñÝáò	Õðçñáóβáò	Íüóç × ñçóðìí	Άέá ÷ áéñéóððò
ukug.uk.FreeBSD.org	Ìüñ ðñìðèçóç	<ukfreebsd@uk.FreeBSD.org>	Lee Johnston <lee@uk.FreeBSD.org>

Óçìáéðóáέò

1. <http://www.freebsd.org/news/status/>

ḐáñŨñôçíá D. ÊëáéäéŨ PGP

Óõĩ ḐáñŨñôçíá áõõũ, èá àñáβòá òá àçũóéá PGP êëáéäéŨ òũĩ officers éáé òũĩ ìáèπĩ òçò ñŨááò áíŨḑòõĩçò òĩò FreeBSD. Ìḑĩñáβòá íá òá ÷ñçóéĩḑĩéPòáòá áéá íá àéÝáĩáòá ìéá øçöéáéP òḑĩāñáòP P áéá íá óòáβèáòá êñòḑòĩāñáòçĩÝĩ email òá èŨḑĩéĩ ìÝéĩò òçò ñŨááò. Ìḑĩñáβòá íá éáòááŨóáòá òçĩ ḑèPñç èβòóá áḑũ êëáéäéŨ ÷ñçóòπĩ òĩò FreeBSD.org, áḑũ òçĩ òĩḑĩèááòá <http://www.FreeBSD.org/doc/pgpkeyring.txt>.

D.1 Officers

D.1.1 ÌŨáá ÁóòŨèáéáò <security-officer@FreeBSD.org>

```
pub 1024D/CA6CDFB2 2002-08-27 FreeBSD Security Officer <security-officer@FreeBSD.org>
Key fingerprint = C374 0FC5 69A6 FBB1 4AED B131 15D6 8804 CA6C DFB2
sub 2048g/A3071809 2002-08-27
```

D.1.2 ÆñáììáóÝáò òçò ÌŨááò Core <core-secretary@FreeBSD.org>

```
pub 1024R/FF8AE305 2002-01-08 core-secretary@FreeBSD.org
Key fingerprint = CE EF 8A 48 70 00 B5 A9 55 69 DE 87 E3 9A E1 CD
```

D.1.3 ÆñáììáóÝáò ÌŨááò Äéá ÷áβñéóçò òũĩ Ports

<portmgr-secretary@FreeBSD.org>

```
pub 1024D/7414629C 2005-11-30
Key fingerprint = D50C BA61 8DC6 C42E 4C05 BF9A 79F6 E071 7414 629C
uid FreeBSD portmgr secretary <portmgr-secretary@FreeBSD.org>
sub 2048g/80B696E6 2005-11-30
```

D.2 ÌÝèç òçò ÌŨááò Core

D.2.1 John Baldwin <jhb@FreeBSD.org>

```
pub 1024R/C10A874D 1999-01-13 John Baldwin <jbaldwin@weather.com>
Key fingerprint = 43 33 1D 37 72 B1 EF 5B 9B 5F 39 F8 BD C1 7C B5
uid John Baldwin <john@baldwin.cx>
uid John Baldwin <jhb@FreeBSD.org>
uid John Baldwin <jobaldwi@vt.edu>
```

D.2.2 Konstantin Belousov <kib@FreeBSD.org>

```
pub 1024D/DD4C6F88 2004-07-29
   Key fingerprint = 39DA E615 A45C 111D 777B 3AD0 0B7F 8C04 DD4C 6F88
uid      Konstantin Belousov <kib@freebsd.org>
uid      Konstantin Belousov <konstantin.belousov@zoral.com.ua>
uid      Kostik Belousov <kostikbel@ukr.net>
uid      Kostik Belousov <kostikbel@gmail.com>
sub 2048g/18488597 2004-07-29
```

D.2.3 Wilko Bulte <wilko@FreeBSD.org>

```
pub 1024D/186B8DBD 2006-07-29
   Key fingerprint = 07C2 6CB3 9C18 D290 6C5F 8879 CF83 EC86 186B 8DBD
uid      Wilko Bulte (wilko@FreeBSD.org) <wilko@FreeBSD.org>
sub 2048g/1C4683F1 2006-07-29
```

D.2.4 Brooks Davis <brooks@FreeBSD.org>

```
pub 1024D/F2381AD4 2001-02-10 Brooks Davis (The Aerospace Corporation) <brooks@aero.org>
   Key fingerprint = 655D 519C 26A7 82E7 2529 9BF0 5D8E 8BE9 F238 1AD4
uid      Brooks Davis <brooks@one-eyed-alien.net>
uid      Brooks Davis <brooks@FreeBSD.org>
uid      Brooks Davis <brooks@aero.org>
sub 2048g/CFDACA7A 2003-01-25 [expires: 2008-01-24]
sub 1024g/42921194 2001-02-10 [expires: 2009-02-08]
```

D.2.5 Warner Losh <imp@FreeBSD.org>

```
pub 1024D/1EF6D8A7 2006-08-15
   Key fingerprint = AEC9 99C1 3212 1A86 93A6 A96B DB9F 6F12 1EF6 D8A7
uid      M. Warner Losh <imp@bsdimp.com>
sub 4096g/34FC5B17 2006-08-15
```

D.2.6 Pav Lucistnik <pav@FreeBSD.org>

```
pub 1024D/C14EB282 2003-08-25 Pav Lucistnik <pav@FreeBSD.org>
   Key fingerprint = 2622 B7E3 7DA5 5C53 2079 855B 9ED7 583F C14E B282
uid      Pav Lucistnik <pav@ook.cz>
sub 1024g/7287A947 2003-08-25
```

D.2.7 Colin Percival <cperciva@FreeBSD.org>

```
pub 1024D/0C6A6A6E 2009-01-12
   Key fingerprint = EAF4 8BBA 7CC7 7A30 FEFC 0DA9 38CE CA69 0C6A 6A6E
uid Colin Percival <cperciva@tarsnap.com>
uid Colin Percival <cperciva@FreeBSD.org>
uid Colin Percival <cperciva@alumni.sfu.ca>
sub 2048g/DC606691 2009-01-12
```

D.2.8 Hiroki Sato <hrs@FreeBSD.org>

```
pub 1024D/2793CF2D 2001-06-12
   Key fingerprint = BDB3 443F A5DD B3D0 A530 FFD7 4F2C D3D8 2793 CF2D
uid Hiroki Sato <hrs@allbsd.org>
uid Hiroki Sato <hrs@eos.ocn.ne.jp>
uid Hiroki Sato <hrs@ring.gr.jp>
uid Hiroki Sato <hrs@FreeBSD.org>
uid Hiroki Sato <hrs@jp.FreeBSD.org>
uid Hiroki Sato <hrs@vlsi.ee.noda.tus.ac.jp>
uid Hiroki Sato <hrs@jp.NetBSD.org>
uid Hiroki Sato <hrs@NetBSD.org>
sub 1024g/8CD251FF 2001-06-12
```

D.3 Ýÿç òçò ììÜääò ÁíÜðòôîçò

D.3.1 Ariff Abdullah <ariff@FreeBSD.org>

```
pub 1024D/C5304CDA 2005-10-01
   Key fingerprint = 5C7C 6BF4 8293 DE76 27D9 FD57 96BF 9D78 C530 4CDA
uid Ariff Abdullah <skywizard@MyBSD.org.my>
uid Ariff Abdullah <ariff@MyBSD.org.my>
uid Ariff Abdullah <ariff@FreeBSD.org>
sub 2048g/8958C1D3 2005-10-01
```

D.3.2 Thomas Abthorpe <tabthorpe@FreeBSD.org>

```
pub 2048R/A473C990 2010-05-28
   Key fingerprint = D883 2D7C EB78 944A 69FC 36A6 D937 1097 A473 C990
uid Thomas Abthorpe (FreeBSD Committer) <tabthorpe@FreeBSD.org>
uid Thomas Abthorpe <thomas@goodking.ca>
uid Thomas Abthorpe <tabthorpe@goodking.org>
sub 2048R/8CA60EE0 2010-05-28
```

D.3.3 Shaun Amott <shaun@FreeBSD.org>

```
pub 1024D/6B387A9A 2001-03-19
   Key fingerprint = B506 E6C7 74A1 CC11 9A23 5C13 9268 5D08 6B38 7A9A
uid          Shaun Amott <shaun@inerd.com>
uid          Shaun Amott <shaun@FreeBSD.org>
sub 2048g/26FA8703 2001-03-19
sub 2048R/7FFF5151 2005-11-06
sub 2048R/27C54137 2005-11-06
```

D.3.4 Henrik Brix Andersen <brix@FreeBSD.org>

```
pub 1024D/54E278F8 2003-04-09
   Key fingerprint = 7B63 EF32 7831 A704 220D 7E61 BFE4 387E 54E2 78F8
uid          Henrik Brix Andersen <henrik@brixandersen.dk>
uid          Henrik Brix Andersen <brix@FreeBSD.org>
sub 1024g/3B13C209 2003-04-09
```

D.3.5 Matthias Andree <mandree@FreeBSD.org>

```
pub 1024D/052E7D95 2003-08-28
   Key fingerprint = FDD0 0C43 6E33 07E1 0758 C6A8 BE61 8339 052E 7D95
uid          Matthias Andree <mandree@freebsd.org>
uid          Matthias Andree <matthias.andree@gmx.de>
sub 1536g/E65A83DA 2003-08-28
```

D.3.6 Will Andrews <will@FreeBSD.org>

```
pub 1024D/F81672C5 2000-05-22 Will Andrews (Key for official matters) <will@FreeBSD.org>
   Key fingerprint = 661F BBF7 9F5D 3D02 C862 5F6C 178E E274 F816 72C5
uid          Will Andrews <will@physics.purdue.edu>
uid          Will Andrews <will@puck.firepipe.net>
uid          Will Andrews <will@c-60.org>
uid          Will Andrews <will@csociety.org>
uid          Will Andrews <will@csociety.ecn.purdue.edu>
uid          Will Andrews <will@telperion.openpackages.org>
sub 1024g/55472804 2000-05-22
```

D.3.7 Dimitry Andric <dim@FreeBSD.org>

```
pub 1024D/2E2096A3 1997-11-17
   Key fingerprint = 7AB4 62D2 CE35 FC6D 4239 4FCD B05E A30A 2E20 96A3
uid          Dimitry Andric <dimitry@andric.com>
uid          Dimitry Andric <dim@xs4all.nl>
uid          Dimitry Andric <dimitry.andric@tomtom.com>
uid          [jpeg image of size 5132]
```

```
uid          Dimitry Andric <dim@nah6.com>
uid          Dimitry Andric <dim@FreeBSD.org>
sub 4096g/6852A5C5 1997-11-17
```

D.3.8 Eric Anholt <anholt@FreeBSD.org>

```
pub 1024D/6CF0EAF7 2003-09-08
   Key fingerprint = 76FE 2475 820B B75F DCA4 0F3E 1D47 6F60 6CF0 EAF7
uid          Eric Anholt <eta@lclark.edu>
uid          Eric Anholt <anholt@FreeBSD.org>
sub 1024g/80B404C1 2003-09-08
```

D.3.9 Marcus von Appen <mva@FreeBSD.org>

```
pub 1024D/B267A647 2009-02-14
   Key fingerprint = C7CC 1853 D8C5 E580 7795 B654 8BAF 3F12 B267 A647
uid          Marcus von Appen <freebsd@sysfault.org>
uid          Marcus von Appen <mva@freebsd.org>
sub 2048g/D34A3BAF 2009-02-14
```

D.3.10 Marcelo Araujo <araujo@FreeBSD.org>

```
pub 1024D/53E4CFA8 2007-04-27
   Key fingerprint = 9D6A 2339 925C 4F61 ED88 ED8B A2FC 4977 53E4 CFA8
uid          Marcelo Araujo (Ports Committer) <araujo@FreeBSD.org>
sub 2048g/63CC012D 2007-04-27
```

D.3.11 Mathieu Arnold <mat@FreeBSD.org>

```
pub 1024D/FE6D850F 2005-04-25
   Key fingerprint = 2771 11F4 0A7E 73F9 ADDD A542 26A4 7C6A FE6D 850F
uid          Mathieu Arnold <mat@FreeBSD.org>
uid          Mathieu Arnold <mat@mat.cc>
uid          Mathieu Arnold <mat@cpan.org>
uid          Mathieu Arnold <m@absolight.fr>
uid          Mathieu Arnold <m@absolight.net>
uid          Mathieu Arnold <mat@club-internet.fr>
uid          Mathieu Arnold <marnold@april.org>
uid          Mathieu Arnold <paypal@mat.cc>
sub 2048g/EAD18BD9 2005-04-25
```

D.3.12 Satoshi Asami <asami@FreeBSD.org>

```
pub 1024R/1E08D889 1997-07-23 Satoshi Asami <asami@cs.berkeley.edu>
   Key fingerprint = EB 3C 68 9E FB 6C EB 3F DB 2E 0F 10 8F CE 79 CA
uid                               Satoshi Asami <asami@FreeBSD.ORG>
```

D.3.13 Gavin Atkinson <gavin@FreeBSD.org>

```
pub 1024D/A093262B 2005-02-18
   Key fingerprint = 313A A79F 697D 3A5C 216A EDF5 935D EF44 A093 262B
uid                               Gavin Atkinson <gavin@16squared.co.uk>
uid                               Gavin Atkinson (FreeBSD key) <gavin@FreeBSD.org>
uid                               Gavin Atkinson (Work e-mail) <ga9@york.ac.uk>
uid                               Gavin Atkinson <gavin.atkinson@ury.york.ac.uk>
sub 2048g/58F40B3D 2005-02-18
```

D.3.14 Joseph S. Atkinson <jsa@FreeBSD.org>

```
pub 2048R/21AA7B06 2010-07-14
   Key fingerprint = 5B38 63B0 9CCA 12BE 3919 9412 CC9D FC84 21AA 7B06
uid                               Joseph S. Atkinson <jsa@FreeBSD.org>
uid                               Joseph S. Atkinson <jsa.bsd@gmail.com>
uid                               Joseph S. Atkinson <jsa@wickedmachine.net>
sub 2048R/5601C3E3 2010-07-14
```

D.3.15 Philippe Audeoud <jadawin@FreeBSD.org>

```
pub 1024D/C835D40E 2005-04-13
   Key fingerprint = D090 8C96 3612 15C9 4E3E 7A4A E498 FC2B C835 D40E
uid                               Philippe Audeoud <jadawin@tuxaco.net>
uid                               Philippe Audeoud <philippe@tuxaco.net>
uid                               Philippe Audeoud <philippe.audeoud@sitadelle.com>
uid                               Philippe Audeoud <jadawin@freebsd.org>
sub 2048g/EF8EA329 2005-04-13
```

D.3.16 Timur I. Bakeyev <timur@FreeBSD.org>

```
pub 1024D/60BA1F47 2002-04-27
   Key fingerprint = 84BF EAD1 607D 362F 210E 69B3 0BF0 6412 60BA 1F47
uid                               Timur I. Bakeyev (BaT) <timur@bat.ru>
uid                               Timur I. Bakeyev <timur@gnu.org>
uid                               Timur I. Bakeyev (BaT) <bat@cpan.org>
uid                               Timur I. Bakeyev (BaT) <timur@FreeBSD.org>
uid                               Timur I. Bakeyev (BaT) <timur@gnome.org>
uid                               Timur I. Bakeyev <timur@gnome.org>
sub 2048g/8A5B0042 2002-04-27
```

D.3.17 Glen Barber <gjb@FreeBSD.org>

```
pub 2048R/A0B946A3 2010-08-03
    Key fingerprint = 78B3 42BA 26C7 B2AC 681E A7BE 524F 0C37 A0B9 46A3
uid      Glen Barber <glen.j.barber@gmail.com>
uid      Glen Barber <gjb35@drexel.edu>
uid      Glen Barber <gjb@glenbarber.us>
uid      Glen Barber <gjb@FreeBSD.org>
sub 2048R/6C0527E5 2010-08-03
```

D.3.18 Nick Barkas <snb@FreeBSD.org>

```
pub 2048R/DDADB9DC 2010-07-27
    Key fingerprint = B678 6ECB 303D F580 A050 098F BDFE 4F3D DDAD B9DC
uid      S. Nicholas Barkas <snb@freebsd.org>
sub 2048R/36E181FB 2010-07-27
sub 2048R/BDA4BED3 2010-07-29
sub 2048R/782A8737 2010-07-29
```

D.3.19 Simon Barner <barner@FreeBSD.org>

```
pub 1024D/EBADA82A 2000-11-10
    Key fingerprint = 67D1 3562 9A2F 3177 E46A 35ED 0A49 FEFD EBAD A82A
uid      Simon Barner <barner@FreeBSD.org>
uid      Simon Barner <barner@in.tum.de>
uid      Simon Barner <barner@informatik.tu-muenchen.de>
uid      Simon Barner <barner@gmx.de>
sub 2048g/F63052DE 2000-11-10
```

D.3.20 Doug Barton <dougb@FreeBSD.org>

```
pub 2048R/1A1ABC84 2010-03-23
    Key fingerprint = E352 0E14 9D05 3533 C33A 67DB 5CC6 86F1 1A1A BC84
uid      Douglas Barton <dougb@dougbarton.us>
uid      Douglas Barton <dougb@FreeBSD.org>
uid      [jpeg image of size 6140]
sub 3072R/498795B4 2010-03-23
    Key fingerprint = C0BE C1E3 8DC8 D7F4 8E6C 732B 0C14 D9CF 4987 95B4
```

D.3.21 Anton Berezin <tobez@FreeBSD.org>

```
pub 1024D/7A7BA3C0 2000-05-25 Anton Berezin <tobez@catpipe.net>
    Key fingerprint = CDD8 560C 174B D8E5 0323 83CE 22CA 584C 7A7B A3C0
uid      Anton Berezin <tobez@tobez.org>
uid      Anton Berezin <tobez@FreeBSD.org>
sub 1024g/ADC71E87 2000-05-25
```

D.3.22 Damien Bergamini <damien@FreeBSD.org>

```
pub 2048R/D129F093 2005-03-02
    Key fingerprint = D3AB 28C3 1A4A E219 3145 54FE 220A 7486 D129 F093
uid Damien Bergamini <damien.bergamini@free.fr>
uid Damien Bergamini <damien@FreeBSD.org>
sub 2048R/9FBA73A4 2005-03-02
```

D.3.23 Tim Bishop <tdb@FreeBSD.org>

```
pub 1024D/5AE7D984 2000-10-07
    Key fingerprint = 1453 086E 9376 1A50 ECF6 AE05 7DCE D659 5AE7 D984
uid Tim Bishop <tim@bishnet.net>
uid Tim Bishop <T.D.Bishop@kent.ac.uk>
uid Tim Bishop <tdb@i-scream.org>
uid Tim Bishop <tdb@FreeBSD.org>
sub 4096g/7F886031 2000-10-07
```

D.3.24 Martin Blapp <mbr@FreeBSD.org>

```
pub 1024D/D300551E 2001-12-20 Martin Blapp <mb@imp.ch>
    Key fingerprint = B434 53FC C87C FE7B 0A18 B84C 8686 EF22 D300 551E
sub 1024g/998281C8 2001-12-20
```

D.3.25 Vitaly Bogdanov <bvs@FreeBSD.org>

```
pub 1024D/B32017F7 2005-10-02 Vitaly Bogdanov <gad@gad.glazov.net>
    Key fingerprint = 402E B8E4 53CB 22FF BE62 AE35 A0BF B077 B320 17F7
uid Vitaly Bogdanov <bvs@freebsd.org>
sub 1024g/0E88C62E 2005-10-02
```

D.3.26 Roman Bogorodskiy <novel@FreeBSD.org>

```
pub 1024R/1DAACA46 2004-05-25 [expires: 2009-04-26]
    Key fingerprint = AC27 CF29 5E51 E53F 8C8D DB90 8074 5B38 1DAA CA46
uid Roman Bogorodskiy <novel@FreeBSD.org>
uid Roman Bogorodskiy <bogorodskiy@gmail.com>
uid Roman Bogorodskiy <bogorodskiy@inbox.ru>
uid Roman Bogorodskiy <novel@clublife.ru>
```

D.3.27 Renato Botelho <garga@FreeBSD.org>

```
pub 1024D/2244EDA9 2003-12-16 [expires: 2015-10-18]
    Key fingerprint = 4006 C844 BC51 AD75 CE60 6E24 E824 5B89 2244 EDA9
uid Renato Botelho <garga@FreeBSD.org>
uid Renato Botelho <rbgarga@gmail.com>
uid Renato Botelho <garga@freebsdbrasil.com.br>
uid Renato Botelho <renato@galle.com.br>
uid Renato Botelho <freebsd@galle.com.br>
uid Renato Botelho <garga@brainsoft.com.br>
uid Renato Botelho <garga.bsd@gmail.com>
sub 1024g/7B295760 2003-12-16
```

D.3.28 Alexander Botero-Lowry <alexbl@FreeBSD.org>

```
pub 1024D/12A95A7B 2006-09-13
    Key fingerprint = D0C3 47F8 AE87 C829 0613 3586 24DF F52B 12A9 5A7B
uid Alexander Botero-Lowry <alexbl@FreeBSD.org>
sub 2048g/CA287923 2006-09-13
```

D.3.29 Hartmut Brandt <harti@FreeBSD.org>

```
pub 1024D/5920099F 2003-01-29 Hartmut Brandt <brandt@fokus.fraunhofer.de>
    Key fingerprint = F60D 09A0 76B7 31EE 794B BB91 082F 291D 5920 099F
uid Hartmut Brandt <harti@freebsd.org>
sub 1024g/21D30205 2003-01-29
```

D.3.30 Oliver Braun <obraun@FreeBSD.org>

```
pub 1024D/EF25B1BA 2001-05-06 Oliver Braun <obraun@unsane.org>
    Key fingerprint = 6A3B 042A 732E 17E4 B6E7 3EAF C0B1 6B7D EF25 B1BA
uid Oliver Braun <obraun@obraun.net>
uid Oliver Braun <obraun@freebsd.org>
uid Oliver Braun <obraun@haskell.org>
sub 1024g/09D28582 2001-05-06
```

D.3.31 Max Brazhnikov <makc@FreeBSD.org>

```
pub 1024D/ACB3CD12 2008-08-18
    Key fingerprint = 4BAA 200E 720A 0BD1 7BB0 9DFD FBD9 08C2 ACB3 CD12
uid Max Brazhnikov <makc@FreeBSD.org>
uid Max Brazhnikov <makc@issp.ac.ru>
sub 1024g/5FAA4088 2008-08-18
```

D.3.32 Jonathan M. Bresler <jmb@FreeBSD.org>

```
pub 1024R/97E638DD 1996-06-05 Jonathan M. Bresler <jmb@Bresler.org>
    Key fingerprint = 31 57 41 56 06 C1 40 13 C5 1C E3 E5 DC 62 0E FB
uid          Jonathan M. Bresler <jmb@FreeBSD.ORG>
uid          Jonathan M. Bresler
uid          Jonathan M. Bresler <Jonathan.Bresler@USi.net>
uid          Jonathan M. Bresler <jmb@Frb.GOV>
```

D.3.33 Antoine Brodin <antoine@FreeBSD.org>

```
pub 1024D/50CC2671 2008-02-03
    Key fingerprint = F3F7 72F0 9C4C 9E56 4BE9 44EA 1B80 31F3 50CC 2671
uid          Antoine Brodin <antoine@FreeBSD.org>
sub 2048g/6F4AFBE5 2008-02-03
```

D.3.34 Diane Bruce <db@FreeBSD.org>

```
pub 1024D/E08F5B15 2007-01-18
    Key fingerprint = A5FB 296B 5771 C1CD 6183 0FAB 77FF DCBE E08F 5B15
uid          Diane Bruce <db@db.net>
uid          Diane Bruce <db@FreeBSD.org>
sub 2048g/73281702 2007-01-18
```

D.3.35 Christian Brüffer <brueffer@FreeBSD.org>

```
pub 1024D/A0ED982D 2002-10-14 Christian Brueffer <chris@unixpages.org>
    Key fingerprint = A5C8 2099 19FF AAC A F41B B29B 6C76 178C A0ED 982D
uid          Christian Brueffer <brueffer@hitnet.rwth-aachen.de>
uid          Christian Brueffer <brueffer@FreeBSD.org>
sub 4096g/1DCC100F 2002-10-14
```

D.3.36 Markus Brüffer <markus@FreeBSD.org>

```
pub 1024D/78F8A8D4 2002-10-21
    Key fingerprint = 3F9B EBE8 F290 E5CC 1447 8760 D48D 1072 78F8 A8D4
uid          Markus Brueffer <markus@brueffer.de>
uid          Markus Brueffer <buff@hitnet.rwth-aachen.de>
uid          Markus Brueffer <mbrueffer@mi.rwth-aachen.de>
uid          Markus Brueffer <markus@FreeBSD.org>
sub 4096g/B7E5C7B6 2002-10-21
```

D.3.37 Oleg Bulyzhin <oleg@FreeBSD.org>

```
pub 1024D/78CE105F 2004-02-06
   Key fingerprint = 98CC 3E66 26DE 50A8 DBC4 EB27 AF22 DCEF 78CE 105F
uid          Oleg Bulyzhin <oleg@FreeBSD.org>
uid          Oleg Bulyzhin <oleg@rinet.ru>
sub 1024g/F747C159 2004-02-06
```

D.3.38 Michael Bushkov <bushman@FreeBSD.org>

```
pub 1024D/F694C6E4 2007-03-11 [expires: 2008-03-10]
   Key fingerprint = 4278 4392 BF6B 2864 C48E 0FA9 7216 C73C F694 C6E4
uid          Michael Bushkov <bushman@rsu.ru>
uid          Michael Bushkov <bushman@freebsd.org>
sub 2048g/5A783997 2007-03-11 [expires: 2008-03-10]
```

D.3.39 Jayachandran C. <jchandra@FreeBSD.org>

```
pub 1024D/3316E465 2010-05-19
   Key fingerprint = 320B DB08 4FE3 BCFD 60AF E4DB F486 015F 3316 E465
uid          Jayachandran C. <jchandra@freebsd.org>
sub 2048g/1F7755F9 2010-05-19
```

D.3.40 Jesus R. Camou <jcamou@FreeBSD.org>

```
pub 1024D/C2161947 2005-03-01
   Key fingerprint = 274C B265 48EC 42AE A2CA 47D9 7D98 588A C216 1947
uid          Jesus R. Camou <jcamou@FreeBSD.org>
sub 2048g/F8D2A8DF 2005-03-01
```

D.3.41 José Alonso Cárdenas Márquez <acm@FreeBSD.org>

```
pub 1024D/9B21BC19 2006-07-18
   Key fingerprint = 4156 2EAC A11C 9651 713B 3FC1 195F D4A8 9B21 BC19
uid          Jose Alonso Cardenas Marquez <acm@FreeBSD.org>
sub 2048g/ADA16C52 2006-07-18
```

D.3.42 Pietro Cerutti <gahr@FreeBSD.org>

```
pub 1024D/9571F78E 2006-05-17
   Key fingerprint = 1203 92B5 3919 AF84 9B97 28D6 C0C2 6A98 9571 F78E
uid          Pietro Cerutti <gahr@gahr.ch>
uid          Pietro Cerutti (The FreeBSD Project) <gahr@FreeBSD.org>
sub 2048g/F24227D5 2006-05-17 [expires: 2011-05-16]
```

D.3.43 Dmitry Chagin <dchagin@FreeBSD.org>

```
pub 1024D/738EFCED 2009-02-27
   Key fingerprint = 3F3F 8B87 CE09 9E10 3606 6ACA D2DD 936F 738E FCED
uid          Dmitry Chagin <dchagin@freebsd.org>
uid          Dmitry Chagin (dchagin key) <chagin.dmitry@gmail.com>
sub 2048g/6A3FDFF9 2009-02-27
```

D.3.44 Hye-Shik Chang <perky@FreeBSD.org>

```
pub 1024D/CFDB4BA4 1999-04-23 Hye-Shik Chang <perky@FreeBSD.org>
   Key fingerprint = 09D9 57D6 58BA 44DD CAEC 71CD 0D65 2C59 CFDB 4BA4
uid          Hye-Shik Chang <hyeshik@gmail.com>
sub 1024g/A94A8ED1 1999-04-23
```

D.3.45 Jonathan Chen <jon@FreeBSD.org>

```
pub 1024D/2539468B 1999-10-11 Jonathan Chen <jon@spock.org>
   Key fingerprint = EE31 CDA1 A105 C8C9 5365 3DB5 C2FC 86AA 2539 468B
uid          Jonathan Chen <jon@freebsd.org>
uid          Jonathan Chen <chenj@rpi.edu>
uid          Jonathan Chen <spock@acm.rpi.edu>
uid          Jonathan Chen <jon@cs.rpi.edu>
sub 3072g/B81EF1DB 1999-10-11
```

D.3.46 Jonathan Anderson <jonathan@FreeBSD.org>

```
pub 1024D/E3BBCA48 2006-06-17
   Key fingerprint = D7C6 9096 874F 707E 48F8 FAB7 22A6 6E53 E3BB CA48
uid          Jonathan Anderson <jonathan@FreeBSD.org>
uid          Jonathan Anderson <jonathan.anderson@ieee.org>
uid          Jonathan Anderson <anderson@engr.mun.ca>
uid          Jonathan Anderson <jonathan.anderson@mun.ca>
sub 2048g/A703650D 2006-06-17
```

D.3.47 Fukang Chen <loader@FreeBSD.org>

```
pub 1024D/40AB1752 2007-08-01 [expires: 2010-07-31]
   Key fingerprint = 98C4 6E6B 1C21 15E4 5042 01FC C7B7 E152 40AB 1752
uid          loader <loader@FreeBSD.org>
sub 4096g/9E53A5C7 2007-08-01 [expires: 2010-07-31]
```

D.3.48 Luoqi Chen <luoqi@FreeBSD.org>

```
pub 1024D/2926F3BE 2002-02-22 Luoqi Chen <luoqi@FreeBSD.org>
   Key fingerprint = B470 A815 5917 D9F4 37F3 CE2A 4D75 3BD1 2926 F3BE
uid                               Luoqi Chen <luoqi@bricore.com>
uid                               Luoqi Chen <lchen@onetta.com>
sub 1024g/5446EB72 2002-02-22
```

D.3.49 Andrey A. Chernov <ache@FreeBSD.org>

```
pub 1024D/964474DD 2006-12-26
   Key fingerprint = 0F63 1B61 D76D AA23 1591 EA09 560E 582B 9644 74DD
uid                               Andrey Chernov <ache@freebsd.org>
uid                               [jpeg image of size 4092]
sub 2048g/08331894 2006-12-26
```

D.3.50 Sean Chittenden <seanc@FreeBSD.org>

```
pub 1024D/EE278A28 2004-02-08 Sean Chittenden <sean@chittenden.org>
   Key fingerprint = E41F F441 7E91 6CBA 1844 65CF B939 3C78 EE27 8A28
sub 2048g/55321853 2004-02-08
```

D.3.51 Junho CHOI <cjh@FreeBSD.org>

```
pub 1024D/E60260F5 2002-10-14 CHOI Junho (Work) <cjh@wdb.co.kr>
   Key fingerprint = 1369 7374 A45F F41A F3C0 07E3 4A01 C020 E602 60F5
uid                               CHOI Junho (Personal) <cjh@kr.FreeBSD.org>
uid                               CHOI Junho (FreeBSD) <cjh@FreeBSD.org>
sub 1024g/04A4FDD8 2002-10-14
```

D.3.52 Crist J. Clark <cjc@FreeBSD.org>

```
pub 1024D/FE886AD3 2002-01-25 Crist J. Clark <cjclark@jhu.edu>
   Key fingerprint = F04E CCD7 3834 72C2 707F 0A8F 259F 8F4B FE88 6AD3
uid                               Crist J. Clark <cjclark@alum.mit.edu>
uid                               Crist J. Clark <cjc@freebsd.org>
sub 1024g/9B6BAB99 2002-01-25
```

D.3.53 Joe Marcus Clarke <marcus@FreeBSD.org>

```
pub 1024D/FE14CF87 2002-03-04 Joe Marcus Clarke (FreeBSD committer address) <marcus@FreeBSD.org>
   Key fingerprint = CC89 6407 73CC 0286 28E4 AFB9 6F68 8F8A FE14 CF87
uid                               Joe Marcus Clarke <marcus@marcuscom.com>
sub 1024g/B9ACE4D2 2002-03-04
```

D.3.54 Nik Clayton <nik@FreeBSD.org>

```
pub 1024D/2C37E375 2000-11-09 Nik Clayton <nik@freebsd.org>
   Key fingerprint = 15B8 3FFC DDB4 34B0 AA5F 94B7 93A8 0764 2C37 E375
uid                               Nik Clayton <nik@slashdot.org>
uid                               Nik Clayton <nik@crf-consulting.co.uk>
uid                               Nik Clayton <nik@ngo.org.uk>
uid                               Nik Clayton <nik@bsdi.com>
sub 1024g/769E298A 2000-11-09
```

D.3.55 Benjamin Close <benjsc@FreeBSD.org>

```
pub 1024D/4842B5B4 2002-04-10
   Key fingerprint = F00D C83D 5F7E 5561 DF91 B74D E602 CAA3 4842 B5B4
uid                               Benjamin Simon Close <Benjamin.Close@clearchain.com>
uid                               Benjamin Simon Close <benjsc@FreeBSD.org>
uid                               Benjamin Simon Close <benjsc@clearchain.com>
sub 2048g/3FA8A57E 2002-04-10
```

D.3.56 Tijl Coosemans <tijl@FreeBSD.org>

```
pub 2048D/20A0B62B 2010-07-13
   Key fingerprint = 39AA F580 6B44 5161 9F86 ED49 7E80 92D8 20A0 B62B
uid                               Tijl Coosemans <tijl@coosemans.org>
uid                               Tijl Coosemans <tijl@freebsd.org>
sub 2048g/7D71BA74 2010-07-13
```

D.3.57 Bruce Cran <brucec@FreeBSD.org>

```
pub 2048R/6AF6F99E 2010-01-29
   Key fingerprint = 9A3C AE57 2706 B0E3 4B8A 8374 5787 A72B 6AF6 F99E
uid                               Bruce Cran <brucec@FreeBSD.org>
uid                               Bruce Cran <bruce@cran.org.uk>
sub 2048R/1D665CEE 2010-01-29
```

D.3.58 Frederic Culot <culot@FreeBSD.org>

```
pub 1024D/34876C5B 2006-08-26
   Key fingerprint = 50EE CE94 E43E BA85 CB67 262B B739 1A26 3487 6C5B
uid                               Frederic Culot <culot@FreeBSD.org>
uid                               Frederic Culot <frederic@culot.org>
sub 2048g/F1EF901F 2006-08-26
```

D.3.59 Aaron Dalton <aaron@FreeBSD.org>

```
pub 1024D/8811D2A4 2006-06-21 [expires: 2011-06-20]
    Key fingerprint = 8DE0 3CBB 3692 992F 53EF ACC7 BE56 0A4D 8811 D2A4
uid                                     Aaron Dalton <aaron@freebsd.org>
sub 2048g/304EE8E5 2006-06-21 [expires: 2011-06-20]
```

D.3.60 Baptiste Daroussin <bapt@FreeBSD.org>

```
pub 1024D/49A4E84C 2008-11-19
    Key fingerprint = A14B A5FC B860 86DE 73E2 B24C F244 ED31 49A4 E84C
uid                                     Baptiste Daroussin <bapt@etoilebsd.net>
uid                                     Baptiste Daroussin <baptiste.daroussin@gmail.com>
uid                                     Baptiste Daroussin <bapt@FreeBSD.org>
sub 2048g/54AB46B4 2008-11-19
```

D.3.61 Ceri Davies <ceri@FreeBSD.org>

```
pub 1024D/34B7245F 2002-03-08
    Key fingerprint = 9C88 EB05 A908 1058 A4AE 9959 A1C7 DCC1 34B7 245F
uid                                     Ceri Davies <ceri@submonkey.net>
uid                                     Ceri Davies <ceri@FreeBSD.org>
uid                                     Ceri Davies <ceri@opensolaris.org>
sub 1024g/0C482CBC 2002-03-08
```

D.3.62 Brad Davis <brd@FreeBSD.org>

```
pub 1024D/ED0A754D 2005-05-14 [expires: 2014-02-21]
    Key fingerprint = 5DFD D1A6 BEEE A6D4 B3F5 4236 D362 3291 ED0A 754D
uid                                     Brad Davis <sol4k@sol4k.com>
uid                                     Brad Davis <brd@FreeBSD.org>
sub 2048g/1F29D404 2005-05-14 [expires: 2014-02-21]
```

D.3.63 Pawel Jakub Dawidek <pjd@FreeBSD.org>

```
pub 1024D/B1293F34 2004-02-02 Pawel Jakub Dawidek <Pawel@Dawidek.net>
    Key fingerprint = A3A3 5B4D 9CF9 2312 0783 1B1D 168A EF5D B129 3F34
uid                                     Pawel Jakub Dawidek <pjd@FreeBSD.org>
uid                                     Pawel Jakub Dawidek <pjd@FreeBSD.pl>
sub 2048g/3EEC50A7 2004-02-02 [expires: 2006-02-01]
```

D.3.64 Brian S. Dean <bsd@FreeBSD.org>

```
pub 1024D/723BDEE9 2002-01-23 Brian S. Dean <bsd@FreeBSD.org>
   Key fingerprint = EF49 7ABE 47ED 91B3 FC3D 7EA5 4D90 2FF7 723B DEE9
sub 1024g/4B02F876 2002-01-23
```

D.3.65 Vasil Dimov <vd@FreeBSD.org>

```
pub 1024D/F6C1A420 2004-12-08
   Key fingerprint = B1D5 04C6 26CC 0D20 9525 14B8 170E 923F F6C1 A420
uid                               Vasil Dimov <vd@FreeBSD.org>
uid                               Vasil Dimov <vd@datamax.bg>
sub 4096g/A0148C94 2004-12-08
```

D.3.66 Roman Divacky <rdivacky@FreeBSD.org>

```
pub 1024D/3DC2044C 2006-11-15
   Key fingerprint = 6B61 25CA 49BC AAC5 21A9 FA7A 2D51 23E8 3DC2 044C
uid                               Roman Divacky <rdivacky@freebsd.org>
sub 2048g/39BDCE16 2006-11-15
```

D.3.67 Alexey Dokuchaev <danfe@FreeBSD.org>

```
pub 1024D/3C060B44 2004-08-23 Alexey Dokuchaev <danfe@FreeBSD.org>
   Key fingerprint = D970 08A4 922C 8D63 0C19 8D27 F421 76EE 3C06 0B44
sub 1024g/70BAE967 2004-08-23
```

D.3.68 Dima Dorfman <dd@FreeBSD.org>

```
pub 1024D/69FAE582 2001-09-04
   Key fingerprint = B340 8338 7DA3 4D61 7632 098E 0730 055B 69FA E582
uid                               Dima Dorfman <dima@trit.org>
uid                               Dima Dorfman <dima@unixfreak.org>
uid                               Dima Dorfman <dd@freebsd.org>
sub 2048g/65AF3B89 2003-08-19 [expires: 2005-08-18]
sub 2048g/8DB0CF2C 2005-05-29 [expires: 2007-05-29]
```

D.3.69 Bruno Ducrot <bruno@FreeBSD.org>

```
pub 1024D/7F463187 2000-12-29
   Key fingerprint = 7B79 E1D6 F5A1 6614 792F D906 899B 4D28 7F46 3187
uid                               Ducrot Bruno (Poup Master) <ducrot@poupinou.org>
sub 1024g/40282874 2000-12-29
```

D.3.70 Alex Dupre <ale@FreeBSD.org>

```
pub 1024D/CE5F554D 1999-06-27 Alex Dupre <sysadmin@alexdupre.com>
    Key fingerprint = DE23 02EA 5927 D5A9 D793 2BA2 8115 E9D8 CE5F 554D
uid                                     Alex Dupre <ale@FreeBSD.org>
uid                                     [jpeg image of size 5544]
uid                                     Alex Dupre <ICQ:5431856>
sub 2048g/FD5E2D21 1999-06-27
```

D.3.71 Peter Edwards <peadar@FreeBSD.org>

```
pub 1024D/D80B4B3F 2004-03-01 Peter Edwards <peadar@FreeBSD.org>
    Key fingerprint = 7A8A 9756 903E BEF2 4D9E 3C94 EE52 52F7 D80B 4B3F
uid                                     Peter Edwards <pmedwards@eircom.net>
```

D.3.72 Josef El-Rayes <josef@FreeBSD.org>

```
pub 2048R/A79DB53C 2004-01-04 Josef El-Rayes <josef@FreeBSD.org>
    Key fingerprint = 58EB F5B7 2AB9 37FE 33C8 716B 59C5 22D9 A79D B53C
uid                                     Josef El-Rayes <josef@daemon.li>
```

D.3.73 Lars Engels <lme@FreeBSD.org>

```
pub 1024D/C0F769F8 2004-08-27
    Key fingerprint = 17FC 08E1 5E09 BD21 489E 2050 29CE 75DA C0F7 69F8
uid                                     Lars Engels <lars.engels@0x20.net>
sub 1024g/8AD5BF9D 2004-08-27
```

D.3.74 Udo Erdelhoff <ue@FreeBSD.org>

```
pub 1024R/E74FA871 1994-07-19 Udo Erdelhoff <uer@de.uu.net>
    Key fingerprint = 8C B1 80 CA 2C 52 73 81 FB A7 B4 03 C5 32 C8 67
uid                                     Udo Erdelhoff <ue@nathan.ruhr.de>
uid                                     Udo Erdelhoff <ue@freebsd.org>
uid                                     Udo Erdelhoff <uerdelho@eu.uu.net>
uid                                     Udo Erdelhoff <uerdelho@uu.net>
```

D.3.75 Ruslan Ermilov <ru@FreeBSD.org>

```
pub 1024D/996E145E 2004-06-02 Ruslan Ermilov (FreeBSD) <ru@FreeBSD.org>
    Key fingerprint = 274E D201 71ED 11F6 9CCB 0194 A917 E9CC 996E 145E
uid                                     Ruslan Ermilov (FreeBSD Ukraine) <ru@FreeBSD.org.ua>
uid                                     Ruslan Ermilov (IPNet) <ru@ip.net.ua>
sub 1024g/557E3390 2004-06-02 [expires: 2007-06-02]
```

D.3.76 Lukas Ertl <le@FreeBSD.org>

```
pub 1024D/F10D06CB 2000-11-23 Lukas Ertl <le@FreeBSD.org>
    Key fingerprint = 20CD C5B3 3A1D 974E 065A B524 5588 79A9 F10D 06CB
uid                                     Lukas Ertl <a9404849@unet.univie.ac.at>
uid                                     Lukas Ertl <l.ertl@univie.ac.at>
uid                                     Lukas Ertl <le@univie.ac.at>
sub 1024g/5960CE8E 2000-11-23
```

D.3.77 Brendan Fabeny <bf@FreeBSD.org>

```
pub 2048R/9806EBC1 2010-06-08 [expires: 2012-06-07]
    Key fingerprint = 2075 ADD3 7634 A4F9 5357 D934 08E7 06D9 9806 EBC1
uid                                     b. f. <bf@freebsd.org>
sub 2048R/1CD0AD79 2010-06-08 [expires: 2012-06-07]
```

D.3.78 Rong-En Fan <rafan@FreeBSD.org>

```
pub 1024D/86FD8C68 2004-06-04
    Key fingerprint = DC9E 5B4D 2DDA D5C7 B6F8 6E69 D78E 1091 86FD 8C68
uid                                     Rong-En Fan <rafan@infor.org>
uid                                     Rong-En Fan <rafan@csie.org>
uid                                     Rong-En Fan <rafan@FreeBSD.org>
sub 2048g/42A8637E 2009-01-25 [expires: 2012-07-08]
```

D.3.79 Stefan Farfeleder <stefanf@FreeBSD.org>

```
pub 1024D/8BEFD15F 2004-03-14 Stefan Farfeleder <stefanf@fafoe.narf.at>
    Key fingerprint = 4220 FE60 A4A1 A490 5213 27A6 319F 8B28 8BEF D15F
uid                                     Stefan Farfeleder <stefanf@complang.tuwien.ac.at>
uid                                     Stefan Farfeleder <stefanf@FreeBSD.org>
uid                                     Stefan Farfeleder <stefanf@ten15.org>
sub 2048g/418753E9 2004-03-14 [expires: 2007-03-14]
```

D.3.80 Babak Farrokhi <farrokhi@FreeBSD.org>

```
pub 1024D/7C810476 2005-12-22
    Key fingerprint = AABD 388F A207 58B4 2EE3 5DFD 4FC1 32C3 7C81 0476
uid                                     Babak Farrokhi <farrokhi@FreeBSD.org>
uid                                     Babak Farrokhi <babak@farrokhi.net>
sub 2048g/2A5F93C7 2005-12-22
```

D.3.81 Chris D. Faulhaber <jedgar@FreeBSD.org>

```
pub 1024D/FE817A50 2000-12-20 Chris D. Faulhaber <jedgar@FreeBSD.org>
   Key fingerprint = A47D A838 9216 F921 A456 54FF 39B6 86E0 FE81 7A50
uid                               Chris D. Faulhaber <jedgar@fxp.org>
sub 2048g/93452698 2000-12-20
```

D.3.82 Brian F. Feldman <green@FreeBSD.org>

```
pub 1024D/41C13DE3 2000-01-11 Brian Fundakowski Feldman <green@FreeBSD.org>
   Key fingerprint = 6A32 733A 1BF6 E07B 5B8D AE14 CC9D DCA2 41C1 3DE3
sub 1024g/A98B9FCC 2000-01-11 [expires: 2001-01-10]

pub 1024D/773905D6 2000-09-02 Brian Fundakowski Feldman <green@FreeBSD.org>
   Key fingerprint = FE23 7481 91EA 5E58 45EA 6A01 B552 B043 7739 05D6
sub 2048g/D2009B98 2000-09-02
```

D.3.83 Mário Sérgio Fujikawa Ferreira <lioux@FreeBSD.org>

```
pub 1024D/75A63712 2006-02-23 [expires: 2007-02-23]
   Key fingerprint = 42F2 2F74 8EF9 5296 898F C981 E9CF 463B 75A6 3712
uid                               Mario Sergio Fujikawa Ferreira (lioux) <lioux@FreeBSD.org>
uid                               Mario Sergio Fujikawa Ferreira <lioux@uol.com.br>
sub 4096g/BB7D80F2 2006-02-23 [expires: 2007-02-23]
```

D.3.84 Tony Finch <fanf@FreeBSD.org>

```
pub 1024D/84C71B6E 2002-05-03 Tony Finch <dot@dotat.at>
   Key fingerprint = 199C F25B 2679 6D04 63C5 2159 FFC0 F14C 84C7 1B6E
uid                               Tony Finch <fanf@FreeBSD.org>
uid                               Tony Finch <fanf@apache.org>
uid                               Tony Finch <fanf2@cam.ac.uk>
sub 2048g/FD101E8B 2002-05-03
```

D.3.85 Marc Fonvieille <blackend@FreeBSD.org>

```
pub 1024D/4F8E74E8 2004-12-25 Marc Fonvieille <blackend@FreeBSD.org>
   Key fingerprint = 55D3 4883 4A04 828A A139 A5CF CD0F 51C0 4F8E 74E8
uid                               Marc Fonvieille <marc@blackend.org>
uid                               Marc Fonvieille <marc@freebsd-fr.org>
sub 1024g/37AD4E7D 2004-12-25
```

D.3.86 Pete Fritchman <petef@FreeBSD.org>

```
pub 1024D/74B91CFD 2001-01-30 Pete Fritchman <petef@FreeBSD.org>
    Key fingerprint = 9A9F 8A13 DB0D 7777 8D8E 1CB2 C5C9 A08F 74B9 1CFD
uid                                     Pete Fritchman <petef@databits.net>
uid                                     Pete Fritchman <petef@csh.rit.edu>
sub 1024g/0C02AF0C 2001-01-30
```

D.3.87 Bernhard Fröhlich <decke@FreeBSD.org>

```
pub 1024D/CF5840D4 2008-01-07 [expires: 2015-05-05]
    Key fingerprint = 47F6 BDF1 DF9E 81E2 2C54 8A06 E796 7A5A CF58 40D4
uid                                     Bernhard Fröhlich <decke@FreeBSD.org>
uid                                     Bernhard Fröhlich <decke@bluelife.at>
sub 2048g/4E51CE79 2008-01-07
```

D.3.88 Bill Fumerola <billf@FreeBSD.org>

```
pub 1024D/7F868268 2000-12-07 Bill Fumerola (FreeBSD Developer) <billf@FreeBSD.org>
    Key fingerprint = 5B2D 908E 4C2B F253 DAEB FC01 8436 B70B 7F86 8268
uid                                     Bill Fumerola (Security Yahoo) <fumerola@yahoo-inc.com>
sub 1024g/43980DA9 2000-12-07
```

D.3.89 Andriy Gapon <avg@FreeBSD.org>

```
pub 2048R/A651FE2F 2009-02-16
    Key fingerprint = F234 4D58 DEFF 5E3A 4E0F 13BC 74A5 2D27 A651 FE2F
uid                                     Andriy Gapon (FreeBSD) <avg@freebsd.org>
uid                                     Andriy Gapon (FreeBSD) <avg@icyb.net.ua>
sub 4096R/F9A4D312 2009-02-16
```

D.3.90 Beat Gätzi <beat@FreeBSD.org>

```
pub 1024D/774249DB 2009-01-28 [expires: 2014-01-27]
    Key fingerprint = C410 3187 5B29 DD02 745F 0890 40C5 BCF7 7742 49DB
uid                                     Beat Gaetzi <beat@FreeBSD.org>
sub 2048g/173CFFCA 2009-01-28 [expires: 2014-01-27]
```

D.3.91 Daniel Geržo <danger@FreeBSD.org>

```
pub 1024D/DA913352 2007-08-30 [expires: 2008-08-29]
    Key fingerprint = 7372 3F15 F839 AFF5 4052 CAC7 1ADA C204 DA91 3352
uid                                     Daniel Gerzo <gerzo@rulez.sk>
uid                                     Daniel Gerzo <danger@rulez.sk>
```

```
uid          Daniel Gerzo (The FreeBSD Project) <danger@FreeBSD.org>
uid          Daniel Gerzo (Micronet, a.s.) <gerzo@micronet.sk>
sub 2048g/C5D57BDC 2007-08-30 [expires: 2008-08-29]
```

D.3.92 Sebastien Gioria <gioria@FreeBSD.org>

```
pub 1024D/7C8DA4F4 2002-02-09 Sebastien Gioria <eagle@freebsd-fr.org>
   Key fingerprint = 41F4 4885 7C23 6ED3 CC24 97AA 6DDD B426 7C8D A4F4
uid          Sebastien Gioria <gioria@FreeBSD.ORG>
uid          Sebastien Gioria <gioria@Francenet.fr>
uid          Sebastien Gioria <gioria@fluxus.net>
sub 4096g/F147E4D3 2002-02-09
```

D.3.93 Philip M. Gollucci <pgollucci@FreeBSD.org>

```
pub 1024D/DB9B8C1C 2008-04-15
   Key fingerprint = B90B FBC3 A3A1 C71A 8E70 3F8C 75B8 8FFB DB9B 8C1C
uid          Philip M. Gollucci (FreeBSD Foundation) <pgollucci@freebsd.org>
uid          Philip M. Gollucci (Riderway Inc.) <pgollucci@riderway.com>
uid          Philip M. Gollucci <pgollucci@p6m7g8.com>
uid          Philip M. Gollucci (ASF) <pgollucci@apache.org>
sub 2048g/73943732 2008-04-15
```

D.3.94 Daichi GOTO <daichi@FreeBSD.org>

```
pub 1024D/09EBADD6 2002-09-25 Daichi GOTO <daichi@freebsd.org>
   Key fingerprint = 620A 9A34 57FB 5E93 0828 28C7 C360 C6ED 09EB ADD6
sub 1024g/F0B1F1CA 2002-09-25
```

D.3.95 Marcus Alves Grando <mnag@FreeBSD.org>

```
pub 1024D/CDCC273F 2005-09-15 [expires: 2010-09-14]
   Key fingerprint = 57F9 DEC1 5BBF 06DE 44A5 9A4A 8BEE 5F3A CDCC 273F
uid          Marcus Alves Grando <marcus@sbh.eng.br>
uid          Marcus Alves Grando <marcus@corp.grupos.com.br>
uid          Marcus Alves Grando <mnag@FreeBSD.org>
sub 2048g/698AC00C 2005-09-15 [expires: 2010-09-14]
```

D.3.96 Peter Grehan <grehan@FreeBSD.org>

```
pub 1024D/EA45EA7D 2004-07-13 Peter Grehan <grehan@freebsd.org>
   Key fingerprint = 84AD 73DC 370E 15CA 7556 43C8 F5C8 4450 EA45 EA7D
sub 2048g/0E122D70 2004-07-13
```

D.3.97 Jamie Gritton <jamie@FreeBSD.org>

```
pub 1024D/8832CB7F 2009-01-29
   Key fingerprint = 34F8 1E62 C7A5 7CB9 A91F 7864 8C5A F85E 8832 CB7F
uid          James Gritton <jamie@FreeBSD.org>
sub 2048g/94E3594D 2009-01-29
```

D.3.98 John-Mark Gurney <jmg@FreeBSD.org>

```
pub 1024R/3F9951F5 1997-02-11 John-Mark Gurney <johnmark@gladstone.uoregon.edu>
   Key fingerprint = B7 EC EF F8 AE ED A7 31 96 7A 22 B3 D8 56 36 F4
uid          John-Mark Gurney <gurney_j@efn.org>
uid          John-Mark Gurney <jmg@cs.uoregon.edu>
uid          John-Mark Gurney <gurney_j@resnet.uoregon.edu>
```

D.3.99 Daniel Harris <dannyboy@FreeBSD.org>

```
pub 1024D/84D0D7E7 2001-01-15 Daniel Harris <dannyboy@worksforfood.com>
   Key fingerprint = 3C61 B8A1 3F09 D194 3259 7173 6C63 DA04 84D0 D7E7
uid          Daniel Harris <dannyboy@freebsd.org>
uid          Daniel Harris <dh@askdh.com>
uid          Daniel Harris <dh@wordassault.com>
sub 1024g/9DF0231A 2001-01-15
```

D.3.100 Daniel Hartmeier <dhartmei@FreeBSD.org>

```
pub 1024R/6A3A7409 1994-08-15 Daniel Hartmeier <dhartmei@freebsd.org>
   Key fingerprint = 13 7E 9A F3 36 82 09 FE FD 57 B8 5C 2B 81 7E 1F
```

D.3.101 Olli Hauer <ohauer@FreeBSD.org>

```
pub 2048R/5D008F1A 2010-07-26
   Key fingerprint = E9EE C9A5 EB4C BD29 74D7 9178 E56E 06B3 5D00 8F1A
uid          olli hauer <ohauer@FreeBSD.org>
uid          olli hauer <ohauer@gmx.de>
sub 2048R/5E25776E 2010-07-26
```

D.3.102 Emanuel Haupt <ehaupt@FreeBSD.org>

```
pub 2048R/C06D09BE 2010-09-24 [expires: 2011-09-24]
   Key fingerprint = CC88 5081 78D1 39C3 B467 865A 348E F6CC C06D 09BE
uid          Emanuel Haupt <ehaupt@FreeBSD.org>
sub 2048R/F658659F 2010-09-24 [expires: 2011-09-24]
```

D.3.103 John Hay <jhay@FreeBSD.org>

```
pub 2048R/A9275B93 2000-05-10 John Hay <jhay@icomtek.csir.co.za>
    Key fingerprint = E7 95 F4 B9 D4 A7 49 6A 83 B9 77 49 28 9E 37 70
uid                               John Hay <jhay@mikom.csir.co.za>
uid                               Thawte Freemail Member <jhay@mikom.csir.co.za>
uid                               John Hay <jhay@csir.co.za>
uid                               John Hay <jhay@FreeBSD.ORG>
```

D.3.104 Sheldon Hearn <sheldonh@FreeBSD.org>

```
pub 1024D/74A06ACD 2002-06-20 Sheldon Hearn <sheldonh@starjuice.net>
    Key fingerprint = 01A3 EF91 9C5A 3633 4E01 8085 A462 57F1 74A0 6ACD
sub 1536g/C42F8AC8 2002-06-20
```

D.3.105 Mike Heffner <mikeh@FreeBSD.org>

```
pub 1024D/CDECBF99 2001-02-02 Michael Heffner <mheffner@novacoxmail.com>
    Key fingerprint = AFAB CCEB 68C7 573F 5110 9285 1689 1942 CDEC BF99
uid                               Michael Heffner <mheffner@vt.edu>
uid                               Michael Heffner <mikeh@FreeBSD.org>
uid                               Michael Heffner <spock@techfour.net>
uid                               Michael Heffner (ACM sysadmin) <mheffner@acm.vt.edu>
sub 1024g/3FE83FB5 2001-02-02
```

D.3.106 Martin Heinen <mheinen@FreeBSD.org>

```
pub 1024D/116C5C85 2002-06-17 Martin Heinen <mheinen@freebsd.org>
    Key fingerprint = C898 3FCD EEA0 17ED BEA9 564D E5A6 AFF2 116C 5C85
uid                               Martin Heinen <martin@sumuk.de>
sub 1024g/EA67506B 2002-06-17
```

D.3.107 Niels Heinen <niels@FreeBSD.org>

```
pub 1024D/5FE39B80 2004-12-06 Niels Heinen <niels.heinen@ubizen.com>
    Key fingerprint = 75D8 4100 CF5B 3280 543F 930C 613E 71AA 5FE3 9B80
uid                               Niels Heinen <niels@defaced.be>
uid                               Niels Heinen <niels@heinen.ws>
uid                               Niels Heinen <niels@FreeBSD.org>
sub 2048g/057F4DA7 2004-12-06
```

D.3.108 Jaakko Heinonen <jh@FreeBSD.org>

```
pub 1024D/53CCB781 2009-10-01 [expires: 2014-09-30]
    Key fingerprint = 3AED A2B6 B63D D771 1AFD 25FA DFDF 5B89 53CC B781
uid          Jaakko Heinonen (FreeBSD) <jh@FreeBSD.org>
sub 4096g/BB97397E 2009-10-01 [expires: 2014-09-30]
```

D.3.109 Guy Helmer <ghelmer@FreeBSD.org>

```
pub 1024R/35F4ED2D 1997-01-26 Guy G. Helmer <ghelmer@freebsd.org>
    Key fingerprint = A2 59 4B 92 02 5B 9E B1 B9 4E 2E 03 29 D5 DC 3A
uid          Guy G. Helmer <ghelmer@cs.iastate.edu>
uid          Guy G. Helmer <ghelmer@palisadesys.com>
```

D.3.110 Maxime Henrion <mux@FreeBSD.org>

```
pub 1024D/881D4806 2003-01-09 Maxime Henrion <mux@FreeBSD.org>
    Key fingerprint = 81F1 BE2D 12F1 184A 77E4 ACD0 5563 7614 881D 4806
sub 2048g/D0B510C0 2003-01-09
```

D.3.111 Dennis Herrmann <dhn@FreeBSD.org>

```
pub 1024D/65181EA0 2008-09-07 [expires: 2009-03-06]
    Key fingerprint = D4DB A438 EB5E 1B26 C782 F969 820B 66B3 6518 1EA0
uid          Dennis Herrmann (Vi veri universum vivus vici) <adox@mcx2.org>
sub 4096g/C003C5DD 2008-09-07 [expires: 2009-03-06]
```

D.3.112 Peter Holm <pho@FreeBSD.org>

```
pub 1024D/CF244E81 2008-11-17
    Key fingerprint = BE9B 32D8 89F1 F285 00E4 E4C5 EF3F B4B5 CF24 4E81
uid          Peter Holm <pho@FreeBSD.org>
sub 2048g/E20A409F 2008-11-17
```

D.3.113 Michael L. Hostbaek <mich@FreeBSD.org>

```
pub 1024D/0F55F6BE 2001-08-07 Michael L. Hostbaek <mich@freebsdcluster.org>
    Key fingerprint = 4D62 9396 B19F 38D3 5C99 1663 7B0A 5212 0F55 F6BE
uid          Michael L. Hostbaek <mich@freebsdcluster.dk>
uid          Michael L. Hostbaek <mich@icommerce-france.com>
uid          Micahel L. Hostbaek <mich@freebsd.dk>
uid          Michael L. Hostbaek <mich@the-lab.org>
uid          Michael L. Hostbaek <mich@freebsd.org>
sub 1024g/8BE4E30F 2001-08-07
```

D.3.114 Po-Chuan Hsieh <sunpoet@FreeBSD.org>

```
pub 4096R/CC57E36B 2010-09-21
   Key fingerprint = 8AD8 68F2 7D2B 0A10 7E9B 8CC0 DC44 247E CC57 E36B
uid Po-Chuan Hsieh (FreeBSD) <sunpoet@FreeBSD.org>
uid Po-Chuan Hsieh (sunpoet) <sunpoet@sunpoet.net>
sub 4096R/ADE9E203 2010-09-21
```

D.3.115 Li-Wen Hsu <lwhsu@FreeBSD.org>

```
pub 1024D/2897B228 2005-01-16
   Key fingerprint = B6F7 170A 6DC6 5D1A BD4B D86A 416B 0E39 2897 B228
uid Li-wen Hsu <lwhsu@lwhsu.org>
uid Li-wen Hsu <lwhsu@lwhsu.ckefgisc.org>
uid Li-wen Hsu <lwhsu@lwhsu.csie.net>
uid Li-wen Hsu <lwhsu@ckefgisc.org>
uid Li-wen Hsu <lwhsu@csie.nctu.edu.tw>
uid Li-wen Hsu <lwhsu@ccca.nctu.edu.tw>
uid Li-wen Hsu <lwhsu@iis.sinica.edu.tw>
uid Li-wen Hsu <lwhsu@cs.nctu.edu.tw>
uid Li-Wen Hsu <lwhsu@FreeBSD.org>
sub 2048g/16F82238 2005-01-16
```

D.3.116 Howard F. Hu <foxfair@FreeBSD.org>

```
pub 1024D/4E9BCA59 2003-09-01 Foxfair Hu <foxfair@FreeBSD.org>
   Key fingerprint = 280C A846 CA1B CAC9 DDCF F4CB D553 4BD5 4E9B CA59
uid Foxfair Hu <foxfair@drago.fomokka.net>
uid Howard Hu <howardhu@yahoo-inc.com>
sub 1024g/3356D8C1 2003-09-01
```

D.3.117 Chin-San Huang <chinsan@FreeBSD.org>

```
pub 1024D/350EECF A 2006-10-04
   Key fingerprint = 1C4D 0C9E 0E68 DB74 0688 CE43 D2A5 3F82 350E ECFA
uid Chin-San Huang (lab) <chinsan@chinsan2.twbbs.org>
uid Chin-San Huang (FreeBSD committer) <chinsan@FreeBSD.org>
uid Chin-San Huang (Gmail) <chinsan.tw@gmail.com>
sub 2048g/35F75A30 2006-10-04
```

D.3.118 Jordan K. Hubbard <jkh@FreeBSD.org>

```
pub 1024R/8E542D5D 1996-04-04 Jordan K. Hubbard <jkh@FreeBSD.org>
   Key fingerprint = 3C F2 27 7E 4A 6C 09 0A 4B C9 47 CD 4F 4D 0B 20
```

D.3.119 Konrad Jankowski <versus@FreeBSD.org>

```
pub 1024D/A01C218A 2008-10-28
   Key fingerprint = A805 21DC 859F E941 D2EA 9986 2264 8E5D A01C 218A
uid      Konrad Jankowski <versus@freebsd.org>
sub 2048g/56AE1959 2008-10-28
```

D.3.120 Weongyo Jeong <weongyo@FreeBSD.org>

```
pub 1024D/22354D7A 2007-12-28
   Key fingerprint = 138E 7115 A86F AA40 B509 5883 B387 DCE9 2235 4D7A
uid      Weongyo Jeong <weongyo.jeong@gmail.com>
uid      Weongyo Jeong <weongyo@freebsd.org>
sub 2048g/9AE6DAEE 2007-12-28
```

D.3.121 Tatuya JINMEI <jinmei@FreeBSD.org>

```
pub 1024D/ABA82228 2002-08-15
   Key fingerprint = BB70 3050 EE39 BE00 48BB A5F3 5892 F203 ABA8 2228
uid      JINMEI Tatuya <jinmei@FreeBSD.org>
uid      JINMEI Tatuya <jinmei@jinmei.org>
uid      JINMEI Tatuya (the KAME project) <jinmei@isl.rdc.toshiba.co.jp>
sub 1024g/8B43CF66 2002-08-15
```

D.3.122 Michael Johnson <ahze@FreeBSD.org>

```
pub 1024D/3C046FD6 2004-10-29 Michael Johnson (FreeBSD key) <ahze@FreeBSD.org>
   Key fingerprint = 363C 6ABA ED24 C23B 5F0C 3AB4 9F8B AA7D 3C04 6FD6
uid      Michael Johnson (pgp key) <ahze@ahze.net>
sub 2048g/FA334AE3 2004-10-29
```

D.3.123 Trevor Johnson <trevor@FreeBSD.org>

```
pub 1024D/3A3EA137 2000-04-20 Trevor Johnson <trevor@jppj.net>
   Key fingerprint = 7ED1 5A92 76C1 FFCB E5E3 A998 F037 5A0B 3A3E A137
sub 1024g/46C24F1E 2000-04-20
```

D.3.124 Poul-Henning Kamp <phk@FreeBSD.org>

```
pub 1024R/0358FCBD 1995-08-01 Poul-Henning Kamp <phk@FreeBSD.org>
   Key fingerprint = A3 F3 88 28 2F 9B 99 A2 49 F4 E2 FA 5A 78 8B 3E
```

D.3.125 Sergey Kandaurov <pluknet@FreeBSD.org>

```
pub 2048R/10607419 2010-10-04
   Key fingerprint = 020B EC25 7E1F 8BC5 C42C 513B 3F4E 97BA 1060 7419
uid          Sergey Kandaurov (freebsd) <pluknet@freebsd.org>
uid          Sergey Kandaurov <pluknet@gmail.com>
sub 2048R/5711F73B 2010-10-04
```

D.3.126 Coleman Kane <cokane@FreeBSD.org>

```
pub 1024D/C5DAB797 2007-07-22
   Key fingerprint = FC09 F326 4318 E714 DE45 6CB0 70C4 B141 C5DA B797
uid          Coleman Kane (Personal PGP Key) <cokane@cokane.org>
uid          Coleman Kane (Personal PGP Key) <cokane@FreeBSD.org>
sub 2048g/5C680129 2007-07-22
```

D.3.127 Josef Karthausser <joe@FreeBSD.org>

```
pub 1024D/E6B15016 2000-10-19 Josef Karthausser <joe@FreeBSD.org>
   Key fingerprint = 7266 8EAF 82C2 D439 5642 AC26 5D52 1C8C E6B1 5016
uid          Josef Karthausser <joe@tao.org.uk>
uid          Josef Karthausser <joe@uk.FreeBSD.org>
uid          [revoked] Josef Karthausser <josef@bsd.i.com>
uid          [revoked] Josef Karthausser <joe@pavilion.net>
sub 2048g/1178B692 2000-10-19
```

D.3.128 Vinod Kashyap <vkashyap@FreeBSD.org>

```
pub 1024R/04FCCDD3 2004-02-19 Vinod Kashyap (gnupg key) <vkashyap@freebsd.org>
   Key fingerprint = 9B83 0B55 604F E491 B7D2 759D DF92 DAA0 04FC CDD3
```

D.3.129 Kris Kennaway <kris@FreeBSD.org>

```
pub 1024D/68E840A5 2000-01-14 Kris Kennaway <kris@citusc.usc.edu>
   Key fingerprint = E65D 0E7D 7E16 B212 1BD6 39EE 5ABC B405 68E8 40A5
uid          Kris Kennaway <kris@FreeBSD.org>
uid          Kris Kennaway <kris@obsecrity.org>
sub 2048g/03A41C45 2000-01-14 [expires: 2006-01-14]
```

D.3.130 Giorgos Keramidas <keramida@FreeBSD.org>

```
pub 1024D/318603B6 2001-09-21
   Key fingerprint = C1EB 0653 DB8B A557 3829 00F9 D60F 941A 3186 03B6
uid          Giorgos Keramidas <keramida@FreeBSD.org>
```

```
uid          Giorgos Keramidas <keramida@ceid.upatras.gr>
uid          Giorgos Keramidas <keramida@hellug.gr>
uid          Giorgos Keramidas <keramida@linux.gr>
uid          Giorgos Keramidas <gkeramidas@gmail.com>
sub 1024g/50FDBAD1 2001-09-21
```

D.3.131 Max Khon <fjoe@FreeBSD.org>

```
pub 1024D/414420F4 2003-04-29 Max Khon <fjoe@freebsd.org>
Key fingerprint = CE1F 29CA A6BF 2F26 13E8 1B61 62AE 6B8F 4144 20F4
uid          Max Khon <fjoe@iclub.nsu.ru>
sub 1024g/6585039B 2003-04-29
```

D.3.132 Manolis Kiagias <manolis@FreeBSD.org>

```
pub 1024D/6E0FB494 2006-08-22
Key fingerprint = F820 5AAF 7112 2CDD 23D8 3BDF 67F3 311A 6E0F B494
uid          Manolis Kiagias <manolis@FreeBSD.org>
uid          Manolis Kiagias <sonicy@otenet.gr>
uid          Manolis Kiagias (A.K.A. sonic, sonicy, sonic2000gr) <sonic@diktia.dyndns.org>
sub 2048g/EB94B411 2006-08-22
```

D.3.133 Jung-uk Kim <jkim@FreeBSD.org>

```
pub 1024D/BF6A9D53 2004-04-07
Key fingerprint = F841 0339 93EF D27D 32AD 3261 9A56 B2D5 BF6A 9D53
uid          Jung-uk Kim <jkim@FreeBSD.org>
uid          Jung-uk Kim <jkim@niksun.com>
sub 4096g/B01CA5A0 2004-04-07
```

D.3.134 Zack Kirsch <zack@FreeBSD.org>

```
pub 1024D/1A725562 2010-11-05 Zack Kirsch <zack@freebsd.org>
Key fingerprint = A8CC AA5E FB47 A386 E757 A2B8 BDD2 0684 1A72 5562
sub 1024g/6BFE2C06 2010-11-05
```

D.3.135 Andreas Klemm <andreas@FreeBSD.org>

```
pub 1024D/6C6F6CBA 2001-01-06 Andreas Klemm <andreas.klemm@eu.didata.com>
Key fingerprint = F028 D51A 0D42 DD67 4109 19A3 777A 3E94 6C6F 6CBA
uid          Andreas Klemm <andreas@klemm.gtn.com>
uid          Andreas Klemm <andreas@FreeBSD.org>
uid          Andreas Klemm <andreas@apsfilter.org>
sub 2048g/FE23F866 2001-01-06
```

D.3.136 Johann Kojs <jkojs@FreeBSD.org>

```
pub 1024D/DD61C2D8 2004-06-27 Johann Kojs <J.Kojs@web.de>
   Key fingerprint = 8B70 03DB 3C45 E71D 0ED4 4825 FEB0 EBEF DD61 C2D8
uid                               Johann Kojs <jkojs@freebsd.org>
sub 1024g/568307CB 2004-06-27
```

D.3.137 Sergei Kolobov <sergei@FreeBSD.org>

```
pub 1024D/3BA53401 2003-10-10 Sergei Kolobov <sergei@FreeBSD.org>
   Key fingerprint = A2F4 5F34 0586 CC9C 493A 347C 14EC 6E69 3BA5 3401
uid                               Sergei Kolobov <sergei@kolobov.com>
sub 2048g/F8243671 2003-10-10
```

D.3.138 Maxim Konovalov <maxim@FreeBSD.org>

```
pub 1024D/2C172083 2002-05-21 Maxim Konovalov <maxim@FreeBSD.org>
   Key fingerprint = 6550 6C02 EFC2 50F1 B7A3 D694 ECF0 E90B 2C17 2083
uid                               Maxim Konovalov <maxim@macomnet.ru>
sub 1024g/F305DDCA 2002-05-21
```

D.3.139 Taras Korenko <taras@FreeBSD.org>

```
pub 1024D/8ACCC68B 2010-03-30
   Key fingerprint = 5128 2A8B 9BC1 A664 21E0 1E61 D838 54D3 8ACC C68B
uid                               Taras Korenko <taras@freebsd.org>
uid                               Taras Korenko <ds@ukrhub.net>
uid                               Taras Korenko <tarasishche@gmail.com>
sub 2048g/8D7CC0FA 2010-03-30 [expires: 2015-03-29]
```

D.3.140 Joseph Koshy <jkoshy@FreeBSD.org>

```
pub 1024D/D93798B6 2001-12-21 Joseph Koshy (FreeBSD) <jkoshy@freebsd.org>
   Key fingerprint = 0DE3 62F3 EF24 939F 62AA 2E3D ABB8 6ED3 D937 98B6
sub 1024g/43FD68E9 2001-12-21
```

D.3.141 Wojciech A. Koszek <wkoszek@FreeBSD.org>

```
pub 1024D/C9F25145 2006-02-15
   Key fingerprint = 6E56 C571 9D33 D23E 9A61 8E50 623C AD62 C9F2 5145
uid                               Wojciech A. Koszek <dunstan@FreeBSD.czyst.pl>
uid                               Wojciech A. Koszek <wkoszek@FreeBSD.org>
sub 4096g/3BBD20A5 2006-02-15
```

D.3.142 Steven Kreuzer <skreuzer@FreeBSD.org>

```
pub 1024D/E0D6F907 2009-03-16 [expires: 2011-03-16]
    Key fingerprint = 8D8F 14D6 ED9F 6BD0 7756 7A46 66BA B4B6 E0D6 F907
uid          Steven Kreuzer <skreuzer@freebsd.org>
uid          Steven Kreuzer <skreuzer@exit2shell.com>
sub 4096g/76940A06 2009-03-16 [expires: 2011-03-16]
```

D.3.143 Gábor Kövesdán <gabor@FreeBSD.org>

```
pub 1024D/2373A6B1 2006-12-05
    Key fingerprint = A42A 10D6 834B BEC0 26F0 29B1 902D D04F 2373 A6B1
uid          Gabor Kovesdan <gabor@FreeBSD.org>
sub 2048g/92B0A104 2006-12-05
```

D.3.144 Ana Kukec <anchie@FreeBSD.org>

```
pub 2048R/510D23BB 2010-04-18
    Key fingerprint = 0A9B 0ABB 0E1C B5A4 3408 398F 778A C3B4 510D 23BB
uid          Ana Kukec <anchie@FreeBSD.org>
sub 2048R/699E4DDA 2010-04-18
```

D.3.145 Roman Kurakin <rik@FreeBSD.org>

```
pub 1024D/C8550F4C 2005-12-16 [expires: 2008-12-15]
    Key fingerprint = 25BB 789A 6E07 E654 8E59 0FA9 42B1 937C C855 0F4C
uid          Roman Kurakin <rik@FreeBSD.org>
sub 2048g/D15F2AB6 2005-12-16 [expires: 2008-12-15]
```

D.3.146 Hideyuki KURASHINA <rushani@FreeBSD.org>

```
pub 1024D/439ADC57 2002-03-22 Hideyuki KURASHINA <rushani@bl.mmtr.or.jp>
    Key fingerprint = A052 6F98 6146 6FE3 91E2 DA6B F2FA 2088 439A DC57
uid          Hideyuki KURASHINA <rushani@FreeBSD.org>
uid          Hideyuki KURASHINA <rushani@jp.FreeBSD.org>
sub 1024g/64764D16 2002-03-22
```

D.3.147 Jun Kuriyama <kuriyama@FreeBSD.org>

```
pub 1024D/FE3B59CD 1998-11-23 Jun Kuriyama <kuriyama@imgsrc.co.jp>
    Key fingerprint = 5219 55CE AC84 C296 3A3B B076 EE3C 4DBB FE3B 59CD
uid          Jun Kuriyama <kuriyama@FreeBSD.org>
uid          Jun Kuriyama <kuriyama@jp.FreeBSD.org>
sub 2048g/1CF20D27 1998-11-23
```

D.3.148 René Ladan <rene@FreeBSD.org>

```
pub 1024D/E5642BFC 2008-11-03
    Key fingerprint = ADBC ECCD EB5F A6B4 549F 600D 8C9E 647A E564 2BFC
uid                               Rene Ladan <rene@freebsd.org>
sub 2048g/C54EA560 2008-11-03
```

D.3.149 Clement Laforet <clement@FreeBSD.org>

```
pub 1024D/0723BA1D 2003-12-13 Clement Laforet (FreeBSD committer address) <clement@FreeBSD.org>
    Key fingerprint = 3638 4B14 8463 A67B DC7E 641C B118 5F8F 0723 BA1D
uid                               Clement Laforet <sheepkiller@cultdeadsheep.org>
uid                               Clement Laforet <clement.laforet@cotds.org>
sub 2048g/23D57658 2003-12-13
```

D.3.150 Max Laier <mlaier@FreeBSD.org>

```
pub 1024D/3EB6046D 2004-02-09
    Key fingerprint = 917E 7F25 E90F 77A4 F746 2E8D 5F2C 84A1 3EB6 046D
uid                               Max Laier <max@love2party.net>
uid                               Max Laier <max.laier@ira.uka.de>
uid                               Max Laier <mlaier@freebsd.org>
uid                               Max Laier <max.laier@tm.uka.de>
sub 4096g/EDD08B9B 2005-06-28
```

D.3.151 Erwin Lansing <erwin@FreeBSD.org>

```
pub 1024D/15256990 1998-07-03
    Key fingerprint = FB58 9797 299A F18E 2D3E 73D6 AB2F 5A5B 1525 6990
uid                               Erwin Lansing <erwin@lansing.dk>
uid                               Erwin Lansing <erwin@FreeBSD.org>
uid                               Erwin Lansing <erwin@droso.dk>
uid                               Erwin Lansing <erwin@droso.org>
uid                               Erwin Lansing <erwin@aaaug.dk>
sub 2048g/7C64013D 1998-07-03
```

D.3.152 Ganael Laplanche <martymac@FreeBSD.org>

```
pub 1024D/10B87391 2006-01-13
    Key fingerprint = D59D 984D 8988 7BB9 DA37 BA77 757E D5F0 10B8 7391
uid                               Ganael LAPLANCHE <ganael.laplanche@martymac.org>
uid                               Ganael LAPLANCHE <martymac@martymac.com>
uid                               Ganael LAPLANCHE <ganael.laplanche@martymac.com>
uid                               Ganael LAPLANCHE <martymac@martymac.org>
uid                               Ganael LAPLANCHE <martymac@pasteur.fr>
uid                               Ganael LAPLANCHE <ganael.laplanche@pasteur.fr>
```

uid Ganael LAPLANCHE <martymac@FreeBSD.org>
sub 2048g/D65069D5 2006-01-13

D.3.153 Greg Larkin <glarkin@FreeBSD.org>

pub 1024D/1C940290 2003-10-09
 Key fingerprint = 8A4A 80AA F26C 8C2C D01B 94C6 D2C4 68B8 1C94 0290
uid Greg Larkin (The FreeBSD Project) <glarkin@FreeBSD.org>
uid Gregory C. Larkin (SourceHosting.Net, LLC) <glarkin@sourcehosting.net>
uid [jpeg image of size 6695]
sub 2048g/47674316 2003-10-09

D.3.154 Frank J. Laszlo <laszlof@FreeBSD.org>

pub 4096R/012360EC 2006-11-06 [expires: 2011-11-05]
 Key fingerprint = 3D93 21DB B5CC 1339 E4B4 1BC4 AD50 C17C 0123 60EC
uid Frank J. Laszlo <laszlof@FreeBSD.org>

D.3.155 Sam Lawrance <lawrance@FreeBSD.org>

pub 1024D/32708C59 2003-08-14
 Key fingerprint = 1056 2A02 5247 64D4 538D 6975 8851 7134 3270 8C59
uid Sam Lawrance <lawrance@FreeBSD.org>
uid Sam Lawrance <boris@brooknet.com.au>
sub 2048g/0F9CCF92 2003-08-14

D.3.156 Nate Lawson <njl@FreeBSD.org>

pub 1024D/60E5AC11 2007-02-07
 Key fingerprint = 18E2 7E5A FD6A 199B B08B E9FB 73C8 DB67 60E5 AC11
uid Nate Lawson <nate@root.org>
sub 2048g/CDBC7E1B 2007-02-07

D.3.157 Yen-Ming Lee <leeym@FreeBSD.org>

pub 1024D/93FA8BD6 2007-05-21
 Key fingerprint = DEC4 6E7F 69C0 4AC3 21ED EE65 6C0E 9257 93FA 8BD6
uid Yen-Ming Lee <leeym@leeym.com>
sub 2048g/899A3931 2007-05-21

D.3.158 Sam Leffler <sam@FreeBSD.org>

```
pub 1024D/BD147743 2005-03-28
Key fingerprint = F618 F2FC 176B D201 D91C 67C6 2E33 A957 BD14 7743
uid Samuel J. Leffler <sam@freebsd.org>
sub 2048g/8BA91D05 2005-03-28
```

D.3.159 Jean-Yves Lefort <jylefort@FreeBSD.org>

```
pub 1024D/A3B8006A 2002-09-07
Key fingerprint = CC99 D1B0 8E44 293D 32F7 D92E CB30 FB51 A3B8 006A
uid Jean-Yves Lefort <jylefort@FreeBSD.org>
uid Jean-Yves Lefort <jylefort@brutele.be>
sub 4096g/C9271AFC 2002-09-07
```

D.3.160 Alexander Leidinger <netchild@FreeBSD.org>

```
pub 1024D/72077137 2002-01-31
Key fingerprint = AA3A 8F69 B214 6BBD 5E73 C9A0 C604 3C56 7207 7137
uid Alexander Leidinger <netchild@FreeBSD.org>
uid [jpeg image of size 19667]
sub 2048g/8C9828D3 2002-01-31
```

D.3.161 Andrey V. Elsukov <ae@FreeBSD.org>

```
pub 2048R/10C8A17A 2010-05-29
Key fingerprint = E659 1E1B 41DA 1516 F0C9 BC00 01C5 EA04 10C8 A17A
uid Andrey V. Elsukov <ae@freebsd.org>
uid Andrey V. Elsukov <bu7cher@yandex.ru>
sub 2048R/0F6D64C5 2010-05-29
```

D.3.162 Dejan Lesjak <lesi@FreeBSD.org>

```
pub 1024D/96C5221F 2004-08-18 Dejan Lesjak <lesi@FreeBSD.org>
Key fingerprint = 2C5C 02EA 1060 1D6D 9982 38C0 1DA7 DBC4 96C5 221F
uid Dejan Lesjak <dejan.lesjak@ijs.si>
sub 1024g/E0A69278 2004-08-18
```

D.3.163 Chuck Lever <cel@FreeBSD.org>

```
pub 1024D/8FFC2B87 2006-02-13
Key fingerprint = 6872 923F 5012 F88B 394C 2F69 37B4 8171 8FFC 2B87
uid Charles E. Lever <cel@freebsd.org>
sub 2048g/9BCE0459 2006-02-13
```

D.3.164 Greg Lewis <glewis@FreeBSD.org>

```
pub 1024D/1BB6D9E0 2002-03-05 Greg Lewis (FreeBSD) <glewis@FreeBSD.org>
    Key fingerprint = 2410 DA6D 5A3C D801 65FE C8DB DEEA 9923 1BB6 D9E0
uid                                     Greg Lewis <glewis@eyesbeyond.com>
sub 2048g/45E67D60 2002-03-05
```

D.3.165 Xin Li <delphij@FreeBSD.org>

```
pub 1024D/CAEEB8C0 2004-01-28
    Key fingerprint = 43B8 B703 B8DD 0231 B333 DC28 39FB 93A0 CAEE B8C0
uid                                     Xin LI <delphij@FreeBSD.org>
uid                                     Xin LI <delphij@frontfree.net>
uid                                     Xin LI <delphij@delphij.net>
uid                                     Xin LI <delphij@geekcn.org>

pub 1024D/42EA8A4B 2006-01-27 [expired: 2008-01-01]
    Key fingerprint = F19C 2616 FA97 9C13 2581 C6F3 85C5 1CCE 42EA 8A4B
uid                                     Xin LI <delphij@geekcn.org>
uid                                     Xin LI <delphij@FreeBSD.org>
uid                                     Xin LI <delphij@delphij.net>

pub 1024D/18EDEBA0 2008-01-02 [expired: 2010-01-02]
    Key fingerprint = 79A6 CF42 F917 DDCA F1C2 C926 8BEB DB04 18ED EBA0
uid                                     Xin LI <delphij@geekcn.org>
uid                                     Xin LI <delphij@FreeBSD.org>
uid                                     Xin LI <delphij@delphij.net>

pub 2048R/3FCA37C1 2010-01-10 [expires: 2012-01-10]
    Key fingerprint = 27EA 5D6C 9398 BA7F B205 8F70 04CE F812 3FCA 37C1
uid                                     Xin LI <delphij@geekcn.org>
uid                                     Xin LI <delphij@delphij.net>
uid                                     Xin LI <delphij@FreeBSD.org>
sub 2048R/F956339F 2010-01-10 [expires: 2012-01-10]
```

D.3.166 Tai-hwa Liang <avatar@FreeBSD.org>

```
pub 1024R/F4013AB1 1998-05-13 Tai-hwa Liang <avatar@FreeBSD.org>
    Key fingerprint = 5B 05 1D 37 7F 35 31 4E 5D 38 BD 07 10 32 B9 D0
uid                                     Tai-hwa Liang <avatar@mmlab.cse.yzu.edu.tw>
```

D.3.167 Ying-Chieh Liao <ijliao@FreeBSD.org>

```
pub 1024D/11C02382 2001-01-09 Ying-Chieh Liao <ijliao@CCCA.NCTU.edu.tw>
    Key fingerprint = 4E98 55CC 2866 7A90 EFD7 9DA5 ACC6 0165 11C0 2382
uid                                     Ying-Chieh Liao <ijliao@FreeBSD.org>
uid                                     Ying-Chieh Liao <ijliao@csie.nctu.edu.tw>
uid                                     Ying-Chieh Liao <ijliao@dragon2.net>
```

```
uid                               Ying-Chieh Liao <ijliao@tw.FreeBSD.org>
sub 4096g/C1E16E89 2001-01-09
```

D.3.168 Ulf Lilleengen <lulf@FreeBSD.org>

```
pub 1024D/ADE1B837 2009-08-19 [expires: 2014-08-18]
Key fingerprint = 3822 B4E6 6D1C 6F71 4AA8 7A27 ADDF C400 ADE1 B837
uid                               Ulf Lilleengen <ulf.lilleengen@gmail.com>
uid                               Ulf Lilleengen <lulf@pvv.ntnu.no>
uid                               Ulf Lilleengen <lulf@stud.ntnu.no>
uid                               Ulf Lilleengen <lulf@FreeBSD.org>
uid                               Ulf Lilleengen <lulf@idi.ntnu.no>
sub 2048g/B5409122 2009-08-19 [expires: 2014-08-18]
```

D.3.169 Clive Lin <clive@FreeBSD.org>

```
pub 1024D/A008C03E 2001-07-30 Clive Lin <clive@tongi.org>
Key fingerprint = FA3F 20B6 A77A 6CEC 1856 09B0 7455 2805 A008 C03E
uid                               Clive Lin <clive@CirX.ORG>
uid                               Clive Lin <clive@FreeBSD.org>
sub 1024g/03C2DC87 2001-07-30 [expires: 2005-08-25]
```

D.3.170 Yi-Jheng Lin <yzlin@FreeBSD.org>

```
pub 2048R/A34C6A8A 2009-07-20
Key fingerprint = 7E3A E981 BB7C 5D73 9534 ED39 0222 04D3 A34C 6A8A
uid                               Yi-Jheng Lin (FreeBSD) <yzlin@FreeBSD.org>
sub 2048R/B4D776FE 2009-07-20
```

D.3.171 Mark Linimon <linimon@FreeBSD.org>

```
pub 1024D/84C83473 2003-10-09
Key fingerprint = 8D43 1B55 D127 0BFC 842E 1C96 803C 5A34 84C8 3473
uid                               Mark Linimon <linimon@FreeBSD.org>
uid                               Mark Linimon <linimon@lonesome.com>
sub 1024g/24BFF840 2003-10-09
```

D.3.172 Tilman Keskinöz <arved@FreeBSD.org>

```
pub 1024D/807AC53A 2002-06-03 [expires: 2013-09-07]
Key fingerprint = A92F 344F 31A8 B8DE DDFA 7FB4 7C22 C39F 807A C53A
uid                               Tilman Keskinöz <arved@arved.at>
uid                               Tilman Keskinöz <arved@FreeBSD.org>
sub 1024g/FA351986 2002-06-03 [expires: 2013-09-07]
```

D.3.173 Dryice Liu <dryice@FreeBSD.org>

```
pub 1024D/77B67874 2005-01-28
   Key fingerprint = 8D7C F82D D28D 07E5 EF7F CD25 6B5B 78A8 77B6 7874
uid          Dryice Dong Liu (Dryice) <dryice@FreeBSD.org>
uid          Dryice Dong Liu (Dryice) <dryice@liu.com.cn>
uid          Dryice Dong Liu (Dryice) <dryice@hotpop.com>
uid          Dryice Dong Liu (Dryice) <dryiceliu@gmail.com>
uid          Dryice Dong Liu (Dryice) <dryice@dryice.name>
sub 2048g/ECFA49E4 2005-01-28
```

D.3.174 Tong Liu <nemoliu@FreeBSD.org>

```
pub 1024D/ECC7C907 2007-07-10
   Key fingerprint = B62E 3109 896B B283 E2FA 60FE A1BA F92E ECC7 C907
uid          Tong LIU <nemoliu@FreeBSD.org>
sub 4096g/B6D7B15D 2007-07-10
```

D.3.175 Zachary Loafman <zml@FreeBSD.org>

```
pub 1024D/4D65492D 2009-05-26
   Key fingerprint = E513 4AE9 5D6D 8BF9 1CD3 4389 4860 D79B 4D65 492D
uid          Zachary Loafman <zml@FreeBSD.org>
sub 2048g/1AD659F0 2009-05-26
```

D.3.176 Juergen Lock <nox@FreeBSD.org>

```
pub 1024D/1B6BFBFD 2006-12-22
   Key fingerprint = 33A7 7FAE 51AF 00BC F0D3 ECCE FAFD 34C1 1B6B FBFD
uid          Juergen Lock <nox@FreeBSD.org>
sub 2048g/251229D1 2006-12-22
```

D.3.177 Remko Lodder <remko@FreeBSD.org>

```
pub 2048R/6EB8C8C8 2010-05-28 [expires: 2012-05-27]
   Key fingerprint = D692 91F9 F4EF D363 7F3F 4D17 9C75 DF7B 6EB8 C8C8
uid          Remko Lodder (Remko Lodder's Key) <remko@FreeBSD.org>
sub 2048R/011C6AA0 2010-05-28 [expires: 2012-05-27]
```

D.3.178 Alexander Logvinov <avl@FreeBSD.org>

```
pub 1024D/1C47D5C0 2009-05-28
   Key fingerprint = 8B5F 880A 382B 075E E707 9DB2 E135 4176 1C47 D5C0
uid          Alexander Logvinov <alexander@logvinov.com>
```

```
uid      Alexander Logvinov (FreeBSD Ports Committer) <avl@FreeBSD.org>
uid      Alexander Logvinov <ports@logvinov.com>
uid      Alexander Logvinov <logvinov@gmail.com>
uid      Alexander Logvinov <logvinov@yandex.ru>
sub      2048g/60BDD4BB 2009-05-28
```

D.3.179 Scott Long <scottl@FreeBSD.org>

```
pub      1024D/017C5EBF 2003-01-18 Scott A. Long (This is my official FreeBSD key) <scottl@freebsd.org>
          Key fingerprint = 34EA BD06 44F7 F8C3 22BC B52C 1D3A F6D1 017C 5EBF
sub      1024g/F61C8F91 2003-01-18
```

D.3.180 Rick Macklem <rmacklem@FreeBSD.org>

```
pub      1024D/7FB9C5F1 2009-04-05
          Key fingerprint = B9EA 767A F6F3 3786 E0C7 434A 05C6 70D6 7FB9 C5F1
uid      Rick Macklem <rmacklem@freebsd.org>
sub      1024g/D0B20E8A 2009-04-05
```

D.3.181 Bruce A. Mah <bmah@FreeBSD.org>

```
pub      1024D/5BA052C3 1997-12-08
          Key fingerprint = F829 B805 207D 14C7 7197 7832 D8CA 3171 5BA0 52C3
uid      Bruce A. Mah <bmah@acm.org>
uid      Bruce A. Mah <bmah@ca.sandia.gov>
uid      Bruce A. Mah <bmah@ieee.org>
uid      Bruce A. Mah <bmah@cisco.com>
uid      Bruce A. Mah <bmah@employees.org>
uid      Bruce A. Mah <bmah@freebsd.org>
uid      Bruce A. Mah <bmah@packetdesign.com>
uid      Bruce A. Mah <bmah@kitchenlab.org>
sub      2048g/B4E60EA1 1997-12-08
```

D.3.182 Mike Makonnen <mtm@FreeBSD.org>

```
pub      1024D/7CD41F55 2004-02-06 Michael Telahun Makonnen <mtm@FreeBSD.Org>
          Key fingerprint = AC7B 5672 2D11 F4D0 EBF8 5279 5359 2B82 7CD4 1F55
uid      Michael Telahun Makonnen <mtm@tmsa-inc.com>
uid      Mike Makonnen <mtm@identd.net>
uid      Michael Telahun Makonnen <mtm@acs-et.com>
sub      2048g/E7DC936B 2004-02-06
```

D.3.183 David Malone <dwmalone@FreeBSD.org>

```
pub 512/40378991 1994/04/21 David Malone <dwmalone@maths.tcd.ie>
    Key fingerprint = 86 A7 F4 86 39 2C 47 2C C1 C2 35 78 8E 2F B8 F5
```

D.3.184 Dmitry Marakasov <amdmi3@FreeBSD.org>

```
pub 1024D/F9D2F77D 2008-06-15 [expires: 2010-06-15]
    Key fingerprint = 55B5 0596 FF1E 8D84 5F56 9510 D35A 80DD F9D2 F77D
uid          Dmitry Marakasov <amdmi3@amdmi3.ru>
uid          Dmitry Marakasov <amdmi3@FreeBSD.org>
sub 2048g/2042CDD8 2008-06-15
```

D.3.185 Koop Mast <kwm@FreeBSD.org>

```
pub 1024D/F95426DA 2004-09-10 Koop Mast <kwm@rainbow-runner.nl>
    Key fingerprint = C66F 1835 0548 3440 8576 0FFE 6879 B7CD F954 26DA
uid          Koop Mast <kwm@FreeBSD.org>
sub 1024g/A782EEDD 2004-09-10
```

D.3.186 Makoto Matsushita <matusita@FreeBSD.org>

```
pub 1024D/20544576 1999-04-18
    Key fingerprint = 71B6 13BF B262 2DD8 2B7C 6CD0 EB2D 4147 2054 4576
uid          Makoto Matsushita <matusita@matatabi.or.jp>
uid          Makoto Matsushita <matusita@FreeBSD.org>
uid          Makoto Matsushita <matusita@jp.FreeBSD.ORG>
uid          Makoto Matsushita <matusita@ist.osaka-u.ac.jp>
sub 1024g/F1F3C94D 1999-04-18
```

D.3.187 Martin Matuska <mm@FreeBSD.org>

```
pub 1024D/4261B0D1 2007-02-05
    Key fingerprint = 17C4 3F32 B3DE 3ED7 E84E 5592 A76B 8B03 4261 B0D1
uid          Martin Matuska <martin@matuska.org>
uid          Martin Matuska <mm@FreeBSD.org>
uid          Martin Matuska <martin.matuska@wu-wien.ac.at>
sub 2048g/3AC9A5A6 2007-02-05
```

D.3.188 Sergey Matveychuk <sem@FreeBSD.org>

```
pub 1024D/B71F605D 1999-10-13
    Key fingerprint = 4704 F374 DB28 BEC6 51C8 1322 4DC9 4BD8 B71F 605D
uid          Sergey Matveychuk <sem@FreeBSD.org>
```

```
uid          Sergey Matveychuk <sem@ciam.ru>
uid          Sergey Matveychuk <sem@core.inec.ru>
sub 2048g/DEAF9D91 1999-10-13
```

D.3.189 Tom McLaughlin <tmclaugh@FreeBSD.org>

```
pub 1024D/E2F7B3D8 2005-05-24
   Key fingerprint = 7692 B222 8D23 CF94 1993 0138 E339 E225 E2F7 B3D8
uid          Tom McLaughlin (Personal email address) <tmclaugh@sdf.lonestar.org>
uid          Tom McLaughlin (Work email address) <tmclaughlin@meditech.com>
uid          Tom McLaughlin (FreeBSD email address) <tmclaugh@FreeBSD.org>
sub 2048g/16838F62 2005-05-24
```

D.3.190 Jean Milanez Melo <jmelo@FreeBSD.org>

```
pub 1024D/AA5114BF 2006-03-03
   Key fingerprint = 826D C2AA 6CF2 E29A EBE7 4776 D38A AB83 AA51 14BF
uid          Jean Milanez Melo <jmelo@FreeBSD.org>
uid          Jean Milanez Melo <jmelo@freebsdbrasil.com.br>
sub 4096g/E9E1CBD9 2006-03-03
```

D.3.191 Kenneth D. Merry <ken@FreeBSD.org>

```
pub 1024D/54C745B5 2000-05-15 Kenneth D. Merry <ken@FreeBSD.org>
   Key fingerprint = D25E EBC5 F17A 9E52 84B4 BF14 9248 F0DA 54C7 45B5
uid          Kenneth D. Merry <ken@kdm.org>
sub 2048g/89D0F797 2000-05-15

pub 1024R/2FA0A505 1995-10-30 Kenneth D. Merry <ken@plutotech.com>
   Key fingerprint = FD FA 85 85 95 C4 8E E8 98 1A CA 18 56 F0 00 1F
```

D.3.192 Dirk Meyer <dinoex@FreeBSD.org>

```
pub 1024R/331CDA5D 1995-06-04 Dirk Meyer <dinoex@FreeBSD.org>
   Key fingerprint = 44 16 EC 0A D3 3A 4F 28 8A 8A 47 93 F1 CF 2F 12
uid          Dirk Meyer <dirk.meyer@dinoex.sub.org>
uid          Dirk Meyer <dirk.meyer@guug.de>
```

D.3.193 Yoshiro Sanpei MIHIRA <sanpei@FreeBSD.org>

```
pub 1024R/391C5D69 1996-11-21 sanpei@SEAPPLE.ICC.NE.JP
   Key fingerprint = EC 04 30 24 B0 6C 1E 63 5F 5D 25 59 3E 83 64 51
uid          MIHIRA Yoshiro <sanpei@sanpei.org>
uid          Yoshiro MIHIRA <sanpei@FreeBSD.org>
```

```
uid MIHIRA Yoshiro <sanpei@yy.cs.keio.ac.jp>
uid MIHIRA Yoshiro <sanpei@cc.keio.ac.jp>
uid MIHIRA Yoshiro <sanpei@educ.cc.keio.ac.jp>
uid MIHIRA Yoshiro <sanpei@st.keio.ac.jp>
```

D.3.194 Marcel Moolenaar <marcel@FreeBSD.org>

```
pub 1024D/61EE89F6 2002-02-09 Marcel Moolenaar <marcel@xcllnt.net>
   Key fingerprint = 68BB E2B7 49AA FF69 CA3A DF71 A605 A52D 61EE 89F6
sub 1024g/6EAAB456 2002-02-09
```

D.3.195 Kris Moore <kmoore@FreeBSD.org>

```
pub 1024D/6294612C 2009-05-26
   Key fingerprint = 8B70 9876 346F 1F97 5687 6950 4C92 D789 6294 612C
uid Kris Moore <kmoore@freebsd.org>
sub 2048g/A7FFE8FB 2009-05-26
```

D.3.196 Dmitry Morozovsky <marck@FreeBSD.org>

```
pub 1024D/6B691B03 2001-07-20
   Key fingerprint = 39AC E336 F03D C0F8 5305 B725 85D4 5045 6B69 1B03
uid Dmitry Morozovsky <marck@rinet.ru>
uid Dmitry Morozovsky <marck@FreeBSD.org>
sub 2048g/44D656F8 2001-07-20
```

D.3.197 Alexander Motin <mav@FreeBSD.org>

```
pub 1024D/0577BACA 2007-04-20 [expires: 2012-04-18]
   Key fingerprint = 0E84 B263 E97D 3E48 161B 98A2 D240 A09E 0577 BACA
uid Alexander Motin <mav@freebsd.org>
uid Alexander Motin <mav@mavhome.dp.ua>
uid Alexander Motin <mav@alkar.net>
sub 2048g/4D59D1C2 2007-04-20 [expires: 2012-04-18]
```

D.3.198 Felipe de Meirelles Motta <lippe@FreeBSD.org>

```
pub 1024D/F2CF7DAE 2008-09-02 [expires: 2010-09-02]
   Key fingerprint = 0532 A900 286D DAFD 099D 394D 231B AF20 F2CF 7DAE
uid Felipe de Meirelles Motta (FreeBSD Ports Committer) <lippe@FreeBSD.org>
sub 2048g/38E8EEF3 2008-09-02 [expires: 2010-09-02]
```

D.3.199 Rich Murphey <rich@FreeBSD.org>

pub 1024R/583443A9 1995-03-31 Rich Murphey <rich@lamprey.utmb.edu>
Key fingerprint = AF A0 60 C4 84 D6 0C 73 D1 EF C0 E9 9D 21 DB E4

D.3.200 Akinori MUSHA <knu@FreeBSD.org>

pub 1024D/9FD9E1EE 2000-03-21 Akinori MUSHA <knu@and.or.jp>
Key fingerprint = 081D 099C 1705 861D 4B70 B04A 920B EFC7 9FD9 E1EE
uid Akinori MUSHA <knu@FreeBSD.org>
uid Akinori MUSHA <knu@idaemons.org>
uid Akinori MUSHA <knu@ruby-lang.org>
sub 1024g/71BA9D45 2000-03-21

D.3.201 Thomas Möstl <tmml@FreeBSD.org>

pub 1024D/419C776C 2000-11-28 Thomas Moestl <tmml@FreeBSD.org>
Key fingerprint = 1C97 A604 2BD0 E492 51D0 9C0F 1FE6 4F1D 419C 776C
uid Thomas Moestl <tmoestl@gmx.net>
uid Thomas Moestl <t.moestl@tu-bs.de>
sub 2048g/ECE63CE6 2000-11-28

D.3.202 Masafumi NAKANE <max@FreeBSD.org>

pub 1024D/CE356B59 2000-02-19 Masafumi NAKANE <max@wide.ad.jp>
Key fingerprint = EB40 BCAB 4CE5 0764 9942 378C 9596 159E CE35 6B59
uid Masafumi NAKANE <max@FreeBSD.org>
uid Masafumi NAKANE <max@accessibility.org>
uid Masafumi NAKANE <kd5pdi@qsl.net>
sub 1024g/FA9BD48B 2000-02-19

D.3.203 Maho Nakata <maho@FreeBSD.org>

pub 1024D/F28B4069 2009-02-09
Key fingerprint = 3FE4 99A9 6F41 8161 4F5F 240C 8615 A60C F28B 4069
uid Maho NAKATA (NAKATA's FreeBSD.org alias) <maho@FreeBSD.org>
sub 2048g/6B49098E 2009-02-09

D.3.204 Yoichi NAKAYAMA <yoichi@FreeBSD.org>

pub 1024D/E0788E46 2000-12-28 Yoichi NAKAYAMA <yoichi@assist.media.nagoya-u.ac.jp>
Key fingerprint = 1550 2662 46B3 096C 0460 BC03 800D 0C8A E078 8E46
uid Yoichi NAKAYAMA <yoichi@eken.phys.nagoya-u.ac.jp>
uid Yoichi NAKAYAMA <yoichi@FreeBSD.org>

sub 1024g/B987A394 2000-12-28

D.3.205 Edward Tomasz Napierala <trasz@FreeBSD.org>

pub 1024D/8E53F00E 2007-04-13
Key fingerprint = DD8F 91B0 12D9 6237 42D9 DBE1 AFC8 CDE9 8E53 F00E
uid Edward Tomasz Napierala <trasz@FreeBSD.org>
sub 2048g/7C1F5D67 2007-04-13

D.3.206 Alexander Nedotsukov <bland@FreeBSD.org>

pub 1024D/D004116C 2003-08-14 Alexander Nedotsukov <bland@FreeBSD.org>
Key fingerprint = 35E2 5020 55FC 2071 4ADD 1A4A 86B6 8A5D D004 116C
sub 1024g/1CCA8D46 2003-08-14

D.3.207 George V. Neville-Neil <gnn@FreeBSD.org>

pub 1024D/440A33D2 2002-09-17
Key fingerprint = AF66 410F CC8D 1FC9 17DB 6225 61D8 76C1 440A 33D2
uid George V. Neville-Neil <gnn@freebsd.org>
uid George V. Neville-Neil <gnn@neville-neil.com>
sub 2048g/95A74F6E 2002-09-17

D.3.208 Simon L. Nielsen <simon@FreeBSD.org>

pub 1024D/FF7490AB 2007-01-14
Key fingerprint = 4E92 BA8D E45E 85E2 0380 B264 049C 7480 FF74 90AB
uid Simon L. Nielsen <simon@FreeBSD.org>
uid Simon L. Nielsen <simon@nitro.dk>
sub 2048g/E3F5A76E 2007-01-14

D.3.209 Robert Noland <rnoland@FreeBSD.org>

pub 1024D/8A9F44E3 2007-07-24
Key fingerprint = 107A 0C87 E9D0 E581 677B 2A28 3384 EB43 8A9F 44E3
uid Robert C. Noland III <rnoland@FreeBSD.org>
uid Robert C. Noland III (Personal Key) <rnoland@2hip.net>
sub 2048g/76C3CF00 2007-07-24

D.3.210 Anders Nordby <anders@FreeBSD.org>

```
pub 1024D/00835956 2000-08-13 Anders Nordby <anders@fix.no>
    Key fingerprint = 1E0F C53C D8DF 6A8F EAAD 19C5 D12A BC9F 0083 5956
uid                                Anders Nordby <anders@FreeBSD.org>
sub 2048g/4B160901 2000-08-13
```

D.3.211 Michael Nottebrock <lofi@FreeBSD.org>

```
pub 1024D/6B2974B0 2002-06-06 Michael Nottebrock <michaelnottebrock@gmx.net>
    Key fingerprint = 1079 3C72 0726 F300 B8EC 60F9 5E17 3AF1 6B29 74B0
uid                                Michael Nottebrock <lofi@freebsd.org>
uid                                Michael Nottebrock <lofi@tigress.com>
uid                                Michael Nottebrock <lofi@lofi.dyndns.org>
uid                                Michael Nottebrock <michaelnottebrock@web.de>
uid                                Michael Nottebrock <michaelnottebrock@meitner.wh.uni-dortmund.de>
sub 1024g/EF652E04 2002-06-06 [expires: 2004-06-15]
```

D.3.212 David O'Brien <obrien@FreeBSD.org>

```
pub 1024R/34F9F9D5 1995-04-23 David E. O'Brien <defunct - obrien@Sea.Legent.com>
    Key fingerprint = B7 4D 3E E9 11 39 5F A3 90 76 5D 69 58 D9 98 7A
uid                                David E. O'Brien <obrien@NUXI.com>
uid                                deobrien@ucdavis.edu
uid                                David E. O'Brien <whois Do38>
uid                                David E. O'Brien <obrien@FreeBSD.org>
uid                                David E. O'Brien <dobrien@seas.gwu.edu>
uid                                David E. O'Brien <obrien@cs.ucdavis.edu>
uid                                David E. O'Brien <defunct - obrien@media.sra.com>
uid                                David E. O'Brien <obrien@elsewhere.roanoke.va.us>
uid                                David E. O'Brien <obrien@Nuxi.com>

pub 1024D/7F9A9BA2 1998-06-10 "David E. O'Brien" <obrien@cs.ucdavis.edu>
    Key fingerprint = 02FD 495F D03C 9AF2 5DB7 F496 6FC8 DABD 7F9A 9BA2
uid                                "David E. O'Brien" <obrien@NUXI.com>
uid                                "David E. O'Brien" <obrien@FreeBSD.org>
sub 3072g/BA32C20D 1998-06-10
```

D.3.213 Philip Paeps <philip@FreeBSD.org>

```
pub 4096R/C5D34D05 2006-10-22
    Key fingerprint = 356B AE02 4763 F739 2FA2 E438 2649 E628 C5D3 4D05
uid                                Philip Paeps <philip@paeps.cx>
uid                                Philip Paeps <philip@nixsys.be>
uid                                Philip Paeps <philip@fosdem.org>
uid                                Philip Paeps <philip@freebsd.org>
uid                                Philip Paeps <philip@pub.telenet.be>
sub 1024D/035EFC58 2006-10-22 [expires: 2010-10-13]
```

sub 2048g/6E5FD7D6 2006-10-22 [expires: 2010-10-14]

D.3.214 Josh Paetzel <jpaetzel@FreeBSD.org>

pub 1024D/27AFAECB 2007-05-11
Key fingerprint = 8A48 EF36 5E9F 4EDA 5A8C 11B4 26F9 01F1 27AF AECB
uid Josh Paetzel (BSD UNIX) <josh@tcbug.org>
uid Josh Paetzel <josh@rephunter.net>
uid Josh Paetzel <josh@pcbsd.org>
uid Josh Paetzel <jpaetzel@FreeBSD.org>
sub 2048g/E0F5996B 2007-05-11

D.3.215 Gábor Páli <pgj@FreeBSD.org>

pub 1024D/9E3F9BE6 2008-04-17 [expires: 2013-04-16]
Key fingerprint = DA0B 2143 0FC8 EE5F E211 D329 7D4B 6E18 9E3F 9BE6
uid Gabor PALI <pgj@FreeBSD.org>
uid PÁLI Gábor János <pali.gabor@gmail.com>
sub 2048g/A780C60B 2008-04-17 [expires: 2013-04-16]

D.3.216 Hiten Pandya <hmp@FreeBSD.org>

pub 1024D/938CACA8 2004-02-13 Hiten Pandya (FreeBSD) <hmp@FreeBSD.org>
Key fingerprint = 84EB C75E C75A 50ED 304E E446 D974 7842 938C ACA8
uid Hiten Pandya <hmp@backplane.com>
sub 2048g/783874B5 2004-02-13

D.3.217 Dima Panov <fluffy@FreeBSD.org>

pub 1024D/93E3B018 2006-11-08
Key fingerprint = C73E 2B72 1FFD 61BD E206 1234 A626 76ED 93E3 B018
uid Dima Panov (FreeBSD.ORG Committer) <fluffy@FreeBSD.ORG>
uid Dima Panov (at home) <Fluffy@Fluffy.Khv.RU>
uid Dima Panov (at home) <fluffy.khv@gmail.com>
sub 2048g/89047419 2006-11-08

pub 4096R/D5398F29 2009-08-09
Key fingerprint = 2D30 2CCB 9984 130C 6F87 BAFC FB8B A09D D539 8F29
uid Dima Panov (FreeBSD.ORG Committer) <fluffy@FreeBSD.ORG>
uid Dima Panov (at Home) <fluffy@Fluffy.Khv.RU>
uid Dima Panov (at GMail) <fluffy.khv@gmail.com>
sub 4096R/915A7785 2009-08-09

D.3.218 Andrew Pantyukhin <sat@FreeBSD.org>

```
pub 1024D/6F38A569 2006-05-06
   Key fingerprint = 4E94 994A C2EF CB86 C144 3B04 3381 67C0 6F38 A569
uid      Andrew Pantyukhin <infofarmer@gubkin.ru>
uid      Andrew Pantyukhin <sat@FreeBSD.org>
uid      Andrew Pantyukhin <infofarmer@gmail.com>
uid      Andrew Pantyukhin <infofarmer@mail.ru>
sub 2048g/5BD4D469 2006-05-06
```

D.3.219 Navdeep Parhar <np@FreeBSD.org>

```
pub 1024D/ACAB8812 2009-06-08
   Key fingerprint = C897 7AFB AFC0 4DA9 7B76 D991 CAB2 2B93 ACAB 8812
uid      Navdeep Parhar <np@FreeBSD.org>
sub 2048g/AB61D2DC 2009-06-08
```

D.3.220 Rui Paulo <rpaulo@FreeBSD.org>

```
pub 4096R/39CB4153 2010-02-03
   Key fingerprint = ABE8 8465 DE8F F04D E9C8 3FF6 AF89 B2E6 39CB 4153
uid      Rui Paulo <rpaulo@FreeBSD.org>
uid      Rui Paulo <rpaulo@gmail.com>
sub 4096R/F87D2F34 2010-02-03
```

D.3.221 Mark Peek <mp@FreeBSD.org>

```
pub 1024D/330D4D01 2002-01-27 Mark Peek <mp@FreeBSD.org>
   Key fingerprint = 510C 96EE B4FB 1B0A 2CF8 A0AF 74B0 0B0E 330D 4D01
sub 1024g/9C6CAC09 2002-01-27
```

D.3.222 Peter Pentchev <roam@FreeBSD.org>

```
pub 1024D/16194553 2002-02-01
   Key fingerprint = FDDB FD79 C26F 3C51 C95E DF9E ED18 B68D 1619 4553
uid      Peter Pentchev <roam@ringlet.net>
uid      Peter Pentchev <roam@cnsys.bg>
uid      Peter Pentchev <roam@sbnd.net>
uid      Peter Pentchev <roam@online.bg>
uid      Peter Pentchev <roam@orbitel.bg>
uid      Peter Pentchev <roam@FreeBSD.org>
uid      Peter Pentchev <roam@techlab.officel.bg>
uid      Peter Pentchev <roam@hoster.bg>
uid      Peter Pentchev <roam@space.bg>
sub 1024g/7074473C 2002-02-01
```

```
pub 4096R/2527DF13 2009-10-16
Key fingerprint = 2EE7 A7A5 17FC 124C F115 C354 651E EFB0 2527 DF13
uid Peter Pentchev <roam@ringlet.net>
uid Peter Pentchev <roamer@users.sourceforge.net>
uid Peter Pentchev <roam@cpan.org>
uid Peter Pentchev <roam@cnsys.bg>
uid Peter Pentchev <roam@sbnd.net>
uid Peter Pentchev <roam@online.bg>
uid Peter Pentchev <roam@orbite1.bg>
uid Peter Pentchev <roam@FreeBSD.org>
uid Peter Pentchev <roam@techlab.officel.bg>
uid Peter Pentchev <roam@hoster.bg>
uid Peter Pentchev <roam@space.bg>
uid Peter Pentchev <roam-guest@alioth.debian.org>
uid Peter Pentchev <ppentchev@alumni.princeton.edu>
sub 4096R/D0B337AA 2009-10-16
```

D.3.223 Denis Peplin <den@FreeBSD.org>

```
pub 1024D/485DDDF5 2003-09-11 Denis Peplin <den@FreeBSD.org>
Key fingerprint = 495D 158C 8EC9 C2C1 80F5 EA96 6F72 7C1C 485D DDF5
sub 1024g/E70BA158 2003-09-11
```

D.3.224 Christian S.J. Peron <csjp@FreeBSD.org>

```
pub 1024D/033FA33C 2009-05-16
Key fingerprint = 74AA 6040 89A7 936E D970 DDC0 CC71 6954 033F A33C
uid Christian S.J. Peron <csjp@FreeBSD.ORG>
sub 2048g/856B194A 2009-05-16
```

D.3.225 Gerald Pfeifer <gerald@FreeBSD.org>

```
pub 1024D/745C015A 1999-11-09 Gerald Pfeifer <gerald@pfeifer.com>
Key fingerprint = B215 C163 3BCA 0477 615F 1B35 A5B3 A004 745C 015A
uid Gerald Pfeifer <Gerald.Pfeifer@vibe.at>
uid Gerald Pfeifer <pfeifer@dbai.tuwien.ac.at>
uid Gerald Pfeifer <gerald@pfeifer.at>
uid Gerald Pfeifer <gerald@FreeBSD.org>
sub 1536g/F0156927 1999-11-09
```

D.3.226 Giuseppe Pilichi <jacula@FreeBSD.org>

```
pub 4096R/8B9F4B8B 2006-03-08
Key fingerprint = 31AD 73AE 0EC0 16E5 4108 8391 D942 5F20 8B9F 4B8B
uid Giuseppe Pilichi (Jacula Modyun) <jacula@FreeBSD.org>
uid Giuseppe Pilichi (Jacula Modyun) <jaculamodyun@gmail.com>
```

```
uid      Giuseppe Pilichi (Jacula Modyun) <gpilch@gmail.com>
uid      Giuseppe Pilichi (Jacula Modyun) <jacula@gmail.com>
sub      4096R/FB4D05A3 2006-03-08
```

D.3.227 John Polstra <jdp@FreeBSD.org>

```
pub      1024R/BFBCF449 1997-02-14 John D. Polstra <jdp@polstra.com>
Key fingerprint = 54 3A 90 59 6B A4 9D 61 BF 1D 03 09 35 8D F6 0D
```

D.3.228 Kirill Ponomarew <krion@FreeBSD.org>

```
pub      1024D/AEB426E5 2002-04-07
Key fingerprint = 58E7 B953 57A2 D9DD 4960 2A2D 402D 46E9 AEB4 26E5
uid      Kirill Ponomarew <krion@voodoo.bawue.com>
uid      Kirill Ponomarew <krion@guug.de>
uid      Kirill Ponomarew <krion@FreeBSD.org>
sub      1024D/05AC7CA0 2006-01-30 [expires: 2008-01-30]
sub      2048g/C3EE5537 2006-01-30 [expires: 2008-01-30]
```

D.3.229 Stephane E. Potvin <sepotvin@FreeBSD.org>

```
pub      1024D/3097FE7B 2002-08-06
Key fingerprint = 6B56 62FA ADE1 6F46 BB62 8B1C 99D3 97B5 3097 FE7B
uid      Stephane E. Potvin <sepotvin@videotron.ca>
uid      Stephane E. Potvin <stephane.potvin@telcobridges.com>
uid      Stephane E. Potvin <stephane_potvin@telcobridges.com>
uid      Stephane E. Potvin <sepotvin@FreeBSD.org>
sub      2048g/0C427BC9 2002-08-06
```

D.3.230 Mark Pulford <markp@FreeBSD.org>

```
pub      1024D/182C368F 2000-05-10 Mark Pulford <markp@FreeBSD.org>
Key fingerprint = 58C9 C9BF C758 D8D4 7022 8EF5 559F 7F7B 182C 368F
uid      Mark Pulford <mark@kyne.com.au>
sub      2048g/380573E8 2000-05-10
```

D.3.231 Alejandro Pulver <alepulver@FreeBSD.org>

```
pub      1024D/945C3F61 2005-11-13
Key fingerprint = 085F E8A2 4896 4B19 42A4 4179 895D 3912 945C 3F61
uid      Alejandro Pulver (Ale's GPG key pair) <alepulver@FreeBSD.org>
uid      Alejandro Pulver (Ale's GPG key pair) <alejandro@varnet.biz>
sub      2048g/6890C6CA 2005-11-13
```

D.3.232 Thomas Quinot <thomas@FreeBSD.org>

```
pub 1024D/393D2469 1999-09-23 Thomas Quinot <thomas@cuivre.fr.eu.org>
  Empreinte de la clé = 4737 A0AD E596 6D30 4356 29B8 004D 54B8 393D 2469
uid                               Thomas Quinot <thomas@debian.org>
uid                               Thomas Quinot <thomas@FreeBSD.org>
sub 1024g/8DE13BB2 1999-09-23
```

D.3.233 Herve Quiroz <hq@FreeBSD.org>

```
pub 1024D/85AC8A80 2004-07-22 Herve Quiroz <hq@FreeBSD.org>
  Key fingerprint = 14F5 BC56 D736 102D 41AF A07B 1D97 CE6C 85AC 8A80
uid                               Herve Quiroz <herve.quiroz@esil.univ-mrs.fr>
sub 1024g/8ECCAFED 2004-07-22
```

D.3.234 Doug Rabson <dfr@FreeBSD.org>

```
pub 1024D/59F57821 2004-02-07
  Key fingerprint = 9451 C4FE 1A7E 117B B95F 1F8F B123 456E 59F5 7821
uid                               Doug Rabson <dfr@nlsystems.com>
sub 1024g/6207AA32 2004-02-07
```

D.3.235 Lars Balker Rasmussen <lbr@FreeBSD.org>

```
pub 1024D/9EF6F27F 2006-04-30
  Key fingerprint = F251 28B7 897C 293E 04F8 71EE 4697 F477 9EF6 F27F
uid                               Lars Balker Rasmussen <lbr@FreeBSD.org>
sub 2048g/A8C1CFD4 2006-04-30
```

D.3.236 Jim Rees <rees@FreeBSD.org>

```
pub 512/B623C791 1995/02/21 Jim Rees <rees@umich.edu>
  Key fingerprint = 02 5F 1B 15 B4 6E F1 3E F1 C5 E0 1D EA CC 17 88
```

D.3.237 Benedict Reuschling <bcr@FreeBSD.org>

```
pub 1024D/4A819348 2009-05-24
  Key fingerprint = 2D8C BDF9 30FA 75A5 A0DF D724 4D26 502E 4A81 9348
uid                               Benedict Reuschling <bcr@FreeBSD.org>
sub 2048g/8DA16EDD 2009-05-24
```

D.3.238 Tom Rhodes <trhodes@FreeBSD.org>

```
pub 1024D/FB7D88E1 2008-05-07
   Key fingerprint = 8279 3100 2DF2 F00E 7FDD AC2C 5776 23AB FB7D 88E1
uid          Tom Rhodes (trhodes) <trhodes@FreeBSD.org>
sub 4096g/7B0CD79F 2008-05-07
```

D.3.239 Benno Rice <benno@FreeBSD.org>

```
pub 1024D/87C59909 2002-01-16 Benno Rice <benno@FreeBSD.org>
   Key fingerprint = CE27 DADA 08E3 FAA3 88F1 5B31 5E34 705A 87C5 9909
uid          Benno Rice <benno@jeamland.net>
sub 1024g/4F7C2BAD 2002-01-16 [expires: 2007-01-15]
```

D.3.240 Beech Rintoul <beech@FreeBSD.org>

```
pub 2048D/11753A7B 2010-11-15
   Key fingerprint = 4DEC C668 9EF9 2AC3 FBE6 99E3 40B3 595D 1175 3A7B
uid          Beech Rintoul <beech@FreeBSD.org>
sub 2048g/A9AA3FE9 2010-11-15
```

D.3.241 Matteo Riondato <matteo@FreeBSD.org>

```
pub 1024D/1EC56BEC 2003-01-05 [expires: 2009-09-07]
   Key fingerprint = F0F3 1B43 035D 65B1 08E9 4D66 D8CA 78A5 1EC5 6BEC
uid          Matteo Riondato (Rionda) <matteo@FreeBSD.ORG>
uid          Matteo Riondato (Rionda) <rionda@riondabsd.net>
uid          Matteo Riondato (Rionda) <rionda@gufi.org>
uid          Matteo Riondato (Rionda) <matteo@riondato.com>
uid          Matteo Riondato (Rionda) <rionda@riondato.com>
uid          Matteo Riondato (Rionda) <rionda@FreeSBIE.ORG>
uid          Matteo Riondato (Rionda) <rionda@autistici.org>
sub 2048g/87C44A55 2008-09-23 [expires: 2009-09-23]
```

D.3.242 Ollivier Robert <roberto@FreeBSD.org>

```
pub 1024D/7DCAE9D3 1997-08-21
   Key fingerprint = 2945 61E7 D4E5 1D32 C100 DBEC A04F FB1B 7DCA E9D3
uid          Ollivier Robert <roberto@keltia.freenix.fr>
uid          Ollivier Robert <roberto@FreeBSD.org>
sub 2048g/C267084D 1997-08-21
```

D.3.243 Craig Rodrigues <rodrigc@FreeBSD.org>

```
pub 1024D/3998479D 2005-05-20
   Key fingerprint = F01F EBE6 F5C8 6DC2 954F 098F D20A 8A2A 3998 479D
uid          Craig Rodrigues <rodrigc@freebsd.org>
uid          Craig Rodrigues <rodrigc@crodrigues.org>
sub 2048g/AA77E09B 2005-05-20
```

D.3.244 Guido van Rooij <guido@FreeBSD.org>

```
pub 1024R/599F323D 1996-05-18 Guido van Rooij <guido@gvr.org>
   Key fingerprint = 16 79 09 F3 C0 E4 28 A7 32 62 FA F6 60 31 C0 ED
uid          Guido van Rooij <guido@gvr.win.tue.nl>

pub 1024D/A95102C1 2000-10-25 Guido van Rooij <guido@madison-gurkha.nl>
   Key fingerprint = 5B3E 51B7 0E7A D170 0574 1E51 2471 117F A951 02C1
uid          Guido van Rooij <guido@madison-gurkha.com>
sub 1024g/A5F20553 2000-10-25
```

D.3.245 Eygene Ryabinkin <rea@FreeBSD.org>

```
pub 3072D/8152ECFB 2010-10-27
   Key fingerprint = 82FE 06BC D497 C0DE 49EC 4FF0 16AF 9EAE 8152 ECFB
uid          Eygene Ryabinkin <rea-fbsd@codelabs.ru>
uid          Eygene Ryabinkin <rea@freebsd.org>
uid          Eygene Ryabinkin <rea@codelabs.ru>
sub 3072g/5FC03749 2010-10-27
```

D.3.246 Niklas Saers <niklas@FreeBSD.org>

```
pub 1024D/C822A476 2004-03-09 Niklas Saers <niklas@saers.com>
   Key fingerprint = C41E F734 AF0E 3D21 7499 9EB1 9A31 2E7E C822 A476
sub 1024g/81E2FF36 2004-03-09
```

D.3.247 Boris Samorodov <bsam@FreeBSD.org>

```
pub 1024D/ADFD5C9A 2006-06-21
   Key fingerprint = 81AA FED0 6050 208C 0303 4007 6C03 7263 ADFD 5C9A
uid          Boris Samorodov (FreeBSD) <bsam@freebsd.org>
sub 2048g/7753A3F1 2006-06-21
```

D.3.248 Mark Santcroos <marks@FreeBSD.org>

```
pub 1024D/DBE7EB8E 2005-03-08
   Key fingerprint = C0F0 44F3 3F15 520F 6E32 186B BE0A BA42 DBE7 EB8E
uid                               Mark Santcroos <marks@ripe.net>
uid                               Mark Santcroos <mark@santcroos.net>
uid                               Mark Santcroos <marks@freebsd.org>
sub 2048g/FFF80F85 2005-03-08
```

D.3.249 Bernhard Schmidt <bschmidt@FreeBSD.org>

```
pub 1024D/5F754FBC 2009-06-15
   Key fingerprint = 6B87 C8A9 6BA5 6B18 11CF 8C38 A1B7 0731 5F75 4FBC
uid                               Bernhard Schmidt <bschmidt@FreeBSD.org>
uid                               Bernhard Schmidt <bschmidt@techwires.net>
sub 1024g/1945DC1D 2009-06-15
```

D.3.250 Wolfram Schneider <wosch@FreeBSD.org>

```
Type Bits/KeyID   Date       User ID
pub 1024/2B7181AD 1997/08/09 Wolfram Schneider <wosch@FreeBSD.org>
   Key fingerprint = CA 16 91 D9 75 33 F1 07 1B F0 B4 9F 3E 95 B6 09
```

D.3.251 Ed Schouten <ed@FreeBSD.org>

```
pub 1024D/0D9E0B05 2006-03-21 [expires: 2011-03-20]
   Key fingerprint = 9476 D3D6 52BD F249 08A0 ACD5 E764 8318 0D9E 0B05
uid                               Ed Schouten (FreeBSD) <ed@FreeBSD.org>
uid                               Ed Schouten <ed@fxq.nl>
uid                               Ed Schouten (Fontys Hogescholen Eindhoven) <e.schouten@student.fontys.nl>
uid                               Ed Schouten (Dispuut Interlink) <ed@il.fontys.nl>
uid                               Ed Schouten <ed@80386.nl>
sub 4096g/80043EEA 2006-03-21 [expires: 2011-03-20]
```

D.3.252 David Schultz <das@FreeBSD.org>

```
pub 1024D/BE848B57 2001-07-19 David Schultz <das@FreeBSD.ORG>
   Key fingerprint = 0C12 797B A9CB 19D9 FDAF 2A39 2D76 A2DB BE84 8B57
uid David Schultz <dschultz@uclink.Berkeley.EDU>
uid David Schultz <das@FreeBSD.ORG>
sub 2048g/69206E8E 2001-07-19
```

D.3.253 Jens Schweikhardt <schweikh@FreeBSD.org>

```
pub 1024D/0FF231FD 2002-01-27 Jens Schweikhardt <schweikh@FreeBSD.org>
   Key fingerprint = 3F35 E705 F02F 35A1 A23E 330E 16FE EA33 0FF2 31FD
uid                               Jens Schweikhardt <schweikh@schweikhardt.net>
sub 1024g/6E93CACC 2002-01-27 [expires: 2005-01-26]
```

D.3.254 Stanislav Sedov <stas@FreeBSD.org>

```
pub 4096R/092FD9F0 2009-05-23
   Key fingerprint = B83A B15D 929A 364A D8BC B3F9 BF25 A231 092F D9F0
uid                               Stanislav Sedov <stas@FreeBSD.org>
uid                               Stanislav Sedov <stas@SpringDaemons.com>
uid                               Stanislav Sedov (Corporate email) <stas@deglitch.com>
uid                               Stanislav Sedov (Corporate email) <stas@ht-systems.ru>
uid                               Stanislav Sedov (Corporate email) <ssedov@3playnet.com>
uid                               Stanislav Sedov <ssedov@mbsd.msk.ru>
uid                               Stanislav Sedov (Corporate email) <ssedov@swifttest.com>
sub 4096R/6FD2025F 2009-05-23
```

D.3.255 Johan van Selst <johans@FreeBSD.org>

```
pub 4096R/D3AE8D3A 2009-09-01
   Key fingerprint = 31C8 D089 DDB6 96C6 F3C1 29C0 A9C8 6C8D D3AE 8D3A
uid                               Johan van Selst
uid                               Johan van Selst <johans@gletsjer.net>
uid                               Johan van Selst <johans@stack.nl>
uid                               Johan van Selst <johans@FreeBSD.org>
uid                               Johan van Selst (GSWoT:NL50) <johans@gswot.org>
sub 2048R/B002E38C 2009-09-01
sub 2048R/1EBCAECB 2009-09-01
sub 2048R/639A1446 2009-09-01
sub 3072D/6F2708F4 2009-09-01
sub 4096g/D6F89E83 2009-09-01
```

D.3.256 Bakul Shah <bakul@FreeBSD.org>

```
pub 1024D/86AEE4CB 2006-04-20
   Key fingerprint = 0389 26E8 381C 6980 AEC0 10A5 E540 A157 86AE E4CB
uid                               Bakul Shah <bakul@freebsd.org>
sub 2048g/5C3DCC24 2006-04-20
```

D.3.257 Gregory Neil Shapiro <gshapiro@FreeBSD.org>

```
pub 1024R/4FBE2ADD 2000-10-13 Gregory Neil Shapiro <gshapiro@gshapiro.net>
Key fingerprint = 56 D5 FF A7 A6 54 A6 B5 59 10 00 B9 5F 5F 20 09
uid Gregory Neil Shapiro <gshapiro@FreeBSD.org>

pub 1024D/F76A9BF5 2001-11-14 Gregory Neil Shapiro <gshapiro@FreeBSD.org>
Key fingerprint = 3B5E DAF1 4B04 97BA EE20 F841 21F9 C5BC F76A 9BF5
uid Gregory Neil Shapiro <gshapiro@gshapiro.net>
sub 2048g/935657DC 2001-11-14

pub 1024D/FCE56561 2000-10-14 Gregory Neil Shapiro <gshapiro@FreeBSD.org>
Key fingerprint = 42C4 A87A FD85 C34F E77F 5EA1 88E1 7B1D FCE5 6561
uid Gregory Neil Shapiro <gshapiro@gshapiro.net>
sub 1024g/285DC8A0 2000-10-14 [expires: 2001-10-14]
```

D.3.258 Arun Sharma <arun@FreeBSD.org>

```
pub 1024D/7D112181 2003-03-06 Arun Sharma <arun@sharma-home.net>
Key fingerprint = A074 41D6 8537 C7D5 070E 0F78 0247 1AE2 7D11 2181
uid Arun Sharma <arun@freebsd.org>
uid Arun Sharma <arun.sharma@intel.com>
sub 1024g/ACAD98DA 2003-03-06 [expires: 2005-03-05]
```

D.3.259 Wesley Shields <wxs@FreeBSD.org>

```
pub 1024D/17F0AA37 2007-12-27
Key fingerprint = 96D1 2E6B F61C 2F3D 83EF 8F0B BE54 310C 17F0 AA37
uid Wesley Shields <wxs@FreeBSD.org>
uid Wesley Shields <wxs@atarininja.org>
sub 2048g/2EDA1BB8 2007-12-27
```

D.3.260 Norikatsu Shigemura <nork@FreeBSD.org>

```
pub 1024D/7104EA4E 2005-02-14
Key fingerprint = 9580 60A3 B58A 0864 79CB 779A 6FAE 229B 7104 EA4E
uid Norikatsu Shigemura <nork@cityfujisawa.ne.jp>
uid Norikatsu Shigemura <nork@ninth-nine.com>
uid Norikatsu Shigemura <nork@FreeBSD.org>
sub 4096g/EF56997E 2005-02-14
```

D.3.261 Shteryana Shopova <syrinx@FreeBSD.org>

```
pub 1024D/1C139BC5 2006-10-07
Key fingerprint = B83D 2451 27AB B767 504F CB85 4FB1 C88B 1C13 9BC5
uid Shteryana Shopova (syrinx) <shteryana@FreeBSD.org>
```

sub 2048g/6D2E9C98 2006-10-07

D.3.262 Vanilla I. Shu <vanilla@FreeBSD.org>

pub 1024D/ACE75853 2001-11-20 Vanilla I. Shu <vanilla@FreeBSD.org>
 Key fingerprint = 290F 9DB8 42A3 6257 5D9A 5585 B25A 909E ACE7 5853
 sub 1024g/CE695D0E 2001-11-20

D.3.263 Ashish SHUKLA <ashish@FreeBSD.org>

pub 4096R/E74FA4B0 2010-04-13
 Key fingerprint = F682 CDCC 39DC 0FEA E116 20B6 C746 CFA9 E74F A4B0
 uid Ashish SHUKLA <wahjava@gmail.com>
 uid Ashish SHUKLA <wahjava@googlemail.com>
 uid Ashish SHUKLA <wahjava.ml@gmail.com>
 uid Ashish SHUKLA <wahjava@members.fsf.org>
 uid Ashish SHUKLA <wahjava@perl.org.in>
 uid Ashish SHUKLA <wahjava@users.sourceforge.net>
 uid Ashish SHUKLA <wah.java@yahoo.com>
 uid Ashish SHUKLA <wah_java@hotmail.com>
 uid Ashish SHUKLA <ashish.shukla@airtelmail.in>
 uid Ashish SHUKLA <wahjava@member.fsf.org>
 uid [jpeg image of size 4655]
 uid Ashish SHUKLA (FreeBSD Committer Address) <ashish@FreeBSD.ORG>
 sub 4096R/F20D202D 2010-04-13

D.3.264 Bruce M. Simpson <bms@FreeBSD.org>

pub 1024D/860DB53B 2003-08-06 Bruce M Simpson <bms@freebsd.org>
 Key fingerprint = 0D5F 1571 44DF 51B7 8B12 041E B9E5 2901 860D B53B
 sub 2048g/A2A32D8B 2003-08-06 [expires: 2006-08-05]

D.3.265 Dmitry Sivachenko <demon@FreeBSD.org>

pub 1024D/13D5DF80 2002-03-18 Dmitry Sivachenko <mitya@cavia.pp.ru>
 Key fingerprint = 72A9 12C9 BB02 46D4 4B13 E5FE 1194 9963 13D5 DF80
 uid Dmitry S. Sivachenko <demon@FreeBSD.org>
 sub 1024g/060F6DBD 2002-03-18

D.3.266 Jesper Skriver <jesper@FreeBSD.org>

pub 1024D/F9561C31 2001-03-09 Jesper Skriver <jesper@FreeBSD.org>
 Key fingerprint = 6B88 9CE8 66E9 E631 C9C5 5EB4 22AB F0EC F956 1C31
 uid Jesper Skriver <jesper@skriver.dk>


```
uid Ben Smithurst <ben@smithurst.org>
uid Ben Smithurst <ben@FreeBSD.org>
uid Ben Smithurst <csxbs@comp.leeds.ac.uk>
uid Ben Smithurst <ben@scientia.demon.co.uk>
sub 1024g/347071FF 2001-07-11
```

D.3.272 Dag-Erling C. Smørgrav <des@FreeBSD.org>

```
pub 1024D/64EBE220 2006-11-11 [expires: 2011-05-31]
Key fingerprint = 3A1C 8E68 952C 3305 6984 6486 30D4 3A6E 64EB E220
uid Dag-Erling Smørgrav <des@des.no>
uid Dag-Erling Smørgrav <des@freebsd.org>
uid [jpeg image of size 3315]
sub 2048g/920C3313 2006-11-11 [expires: 2011-05-31]
```

D.3.273 Maxim Sobolev <sobomax@FreeBSD.org>

```
pub 1024D/888205AF 2001-11-21 Maxim Sobolev <sobomax@FreeBSD.org>
Key fingerprint = 85C9 DCB0 6828 087C C977 3034 A0DB B9B7 8882 05AF
uid Maxim Sobolev <sobomax@mail.ru>
uid Maxim Sobolev <sobomax@altavista.net>
uid Maxim Sobolev <vegacap@i.com.ua>
```

```
pub 1024D/468EE6D8 2003-03-21 Maxim Sobolev <sobomax@portaone.com>
Key fingerprint = 711B D315 3360 A58F 9A0E 89DB 6D40 2558 468E E6D8
uid Maxim Sobolev <sobomax@FreeBSD.org>
uid Maxim Sobolev <sobomax@mail.ru>
uid Maxim Sobolev <vegacap@i.com.ua>
```

```
pub 1024D/6BEC980A 2004-02-13 Maxim Sobolev <sobomax@portaone.com>
Key fingerprint = 09D5 47B4 8D23 626F B643 76EB DFEE 3794 6BEC 980A
uid Maxim Sobolev <sobomax@FreeBSD.org>
uid Maksym Sobolyev (It's how they call me in official documents. Prett
uid Maksym Sobolyev (It's how they call me in official documents. Prett
sub 2048g/16D049AB 2004-02-13 [expires: 2005-02-12]
```

D.3.274 Brian Somers <brian@FreeBSD.org>

```
pub 1024R/666A7421 1997-04-30 Brian Somers <brian@freebsd-services.com>
Key fingerprint = 2D 91 BD C2 94 2C 46 8F 8F 09 C4 FC AD 12 3B 21
uid Brian Somers <brian@awfulhak.org>
uid Brian Somers <brian@FreeBSD.org>
uid Brian Somers <brian@OpenBSD.org>
uid Brian Somers <brian@uk.FreeBSD.org>
uid Brian Somers <brian@uk.OpenBSD.org>
```

D.3.275 Stacey Son <sson@FreeBSD.org>

```
pub 1024D/CE8319F3 2008-07-08
    Key fingerprint = 64C7 8D92 C1DF B940 1171 5ED3 186A 758A CE83 19F3
uid          Stacey Son <sson@FreeBSD.org>
uid          Stacey Son <stacey@son.org>
uid          Stacey Son <sson@byu.net>
uid          Stacey Son <sson@secure.net>
uid          Stacey Son <sson@dev-random.com>
sub 2048g/0F724E52 2008-07-08
```

D.3.276 Nicolas Souchu <nsouch@FreeBSD.org>

```
pub 1024D/C744F18B 2002-02-13 Nicholas Souchu <nsouch@freebsd.org>
    Key fingerprint = 992A 144F AC0F 40BA 55AE DE6D 752D 0A6C C744 F18B
sub 1024g/90BD3231 2002-02-13
```

D.3.277 Suleiman Souhlal <ssouhlal@FreeBSD.org>

```
pub 1024D/2EA50469 2004-07-24 Suleiman Souhlal <ssouhlal@FreeBSD.org>
    Key fingerprint = DACF 89DB 54C7 DA1D 37AF 9A94 EB55 E272 2EA5 0469
sub 2048g/0CDCC535 2004-07-24
```

D.3.278 Ulrich Spörlein <uqs@FreeBSD.org>

```
pub 2048R/4AAF82CE 2010-01-27 [expires: 2015-01-26]
    Key fingerprint = 08DF A6A0 B1EB 98A5 EDDA 9005 A3A6 9864 4AAF 82CE
uid          Ulrich Spörlein <uqs@spoerlein.net>
uid          Ulrich Spoerlein <uspoerlein@gmail.com>
uid          Ulrich Spörlein (The FreeBSD Project) <uqs@FreeBSD.org>
uid          Ulrich Spörlein <ulrich.spoerlein@web.de>
sub 2048R/162E8BD2 2010-01-27 [expires: 2015-01-26]
```

D.3.279 Rink Springer <rink@FreeBSD.org>

```
pub 1024D/ECEDBFFF 2003-09-19
    Key fingerprint = A8BE 9C82 9B81 4289 A905 418D 6F73 BAD2 ECED BFFF
uid          Rink Springer <rink@il.fontys.nl>
uid          Rink Springer (FreeBSD Project) <rink@FreeBSD.org>
uid          Rink Springer <rink@stack.nl>
sub 2048g/3BC3E67E 2003-09-19
```

D.3.280 Vsevolod Stakhov <vsevolod@FreeBSD.org>

```
pub 1024D/213D0033 2005-03-14 [expires: 2008-03-13]
    Key fingerprint = B852 0010 761E 944A C76D D447 A25D C12C 213D 0033
uid          Vsevolod Stakhov <vsevolod@FreeBSD.org>
uid          Vsevolod Stakhov <cebka@jet.msk.su>
uid          Vsevolod Stakhov <vsevolod@highsecure.ru>
sub 2048g/786F2187 2005-03-14 [expires: 2008-03-13]
```

D.3.281 Randall R. Stewart <rrs@FreeBSD.org>

```
pub 1024D/0373B8B2 2006-09-01
    Key fingerprint = 74A6 810E 6DEA D69B 6496 5FA9 8AEF 4166 0373 B8B2
uid          Randall R Stewart <randall@lakerest.net>
uid          Randall R Stewart <rrs@cisco.com>
uid          Randall R Stewart <rrs@FreeBSD.org>
sub 2048g/88027C0B 2006-09-01
```

D.3.282 Murray Stokely <murray@FreeBSD.org>

```
pub 1024D/0E451F7D 2001-02-12 Murray Stokely <murray@freebsd.org>
    Key fingerprint = E2CA 411D DD44 53FD BB4B 3CB5 B4D7 10A2 0E45 1F7D
sub 1024g/965A770C 2001-02-12
```

D.3.283 Volker Stolz <vs@FreeBSD.org>

```
pub 1024R/3FD1B6B5 1998-06-16 Volker Stolz <vs@freebsd.org>
    Key fingerprint = 69 6F BD A0 2E FE 19 66 CF B9 68 6E 41 7D F9 B9
uid          Volker Stolz <stolz@i2.informatik.rwth-aachen.de> (LSK)
uid          Volker Stolz <vs@foldr.org>
```

D.3.284 Ryan Stone <rstone@FreeBSD.org>

```
pub 1024D/3141B73A 2010-04-13
    Key fingerprint = 4A6D DC04 DDC5 0822 2687 A086 FD3F 16CB 3141 B73A
uid          Ryan Stone (FreeBSD) <rstone@freebsd.org>
sub 2048g/A8500B5F 2010-04-13
```

D.3.285 Søren Straarup <xride@FreeBSD.org>

```
pub 1024D/E683AD40 2006-09-28
    Key fingerprint = 8A0E 7E57 144B BC25 24A9 EC1A 0DBC 3408 E683 AD40
uid          Soeren Straarup <xride@xride.dk>
uid          Soeren Straarup <xride@FreeBSD.org>
```

uid Soeren Straarup <xride@x12.dk>
sub 2048g/2B18B3B8 2006-09-28

D.3.286 Marius Strobl <marius@FreeBSD.org>

pub 1024D/E0AC6F8D 2004-04-16
Key fingerprint = 3A6C 4FB1 8BB9 4F2E BDDC 4AB6 D035 799C E0AC 6F8D
uid Marius Strobl <marius@FreeBSD.org>
uid Marius Strobl <marius@alchemy.franken.de>
sub 1024g/08BBD875 2004-04-16

D.3.287 Cheng-Lung Sung <clsung@FreeBSD.org>

pub 1024D/956E8BC1 2003-09-12 Cheng-Lung Sung <clsung@FreeBSD.org>
Key fingerprint = E0BC 57F9 F44B 46C6 DB53 8462 F807 89F3 956E 8BC1
uid Cheng-Lung Sung (Software Engineer) <clsung@dragon2.net>
uid Cheng-Lung Sung (Alumnus of CSIE, NCTU, Taiwan) <clsung@sungsung.c>
uid Cheng-Lung Sung (AlanSung) <clsung@tiger2.net>
uid Cheng-Lung Sung (FreeBSD@Taiwan) <clsung@freebsd.csie.nctu.edu.tw>
uid Cheng-Lung Sung (Ph.D. Student of NTU.EECS) <d92921016@ntu.edu.tw>
uid Cheng-Lung Sung (FreeBSD Freshman) <clsung@tw.freebsd.org>
uid Cheng-Lung Sung (ports committer) <clsung@FreeBSD.org>
sub 1024g/1FB800C2 2003-09-12

D.3.288 Gregory Sutter <gsutter@FreeBSD.org>

pub 1024D/845DFEDD 2000-10-10 Gregory S. Sutter <gsutter@zer0.org>
Key fingerprint = D161 E4EA 4BFA 2427 F3F9 5B1F 2015 31D5 845D FEDD
uid Gregory S. Sutter <gsutter@freebsd.org>
uid Gregory S. Sutter <gsutter@daemonnews.org>
uid Gregory S. Sutter <gsutter@pobox.com>
sub 2048g/0A37BBCE 2000-10-10

D.3.289 Koichi Suzuki <metal@FreeBSD.org>

pub 1024D/AE562682 2004-05-23 SUZUKI Koichi <metal@FreeBSD.org>
Key fingerprint = 92B9 A202 B5AB 8CB6 89FC 6DD1 5737 C702 AE56 2682
sub 4096g/730E604B 2004-05-23

D.3.290 Ryusuke SUZUKI <ryusuke@FreeBSD.org>

pub 1024D/63D29724 2009-12-18
Key fingerprint = B108 7109 2E62 BECB 0F78 FE65 1B9A D1BE 63D2 9724
uid Ryusuke SUZUKI <ryusuke@FreeBSD.org>

uid Ryusuke SUZUKI <ryusuke@jp.FreeBSD.org>
sub 1024g/5E4DD044 2009-12-18

D.3.291 Gary W. Swearingen <garys@FreeBSD.org>

pub 1024D/FAA48AD5 2005-08-22 [expires: 2007-08-22]
Key fingerprint = 8292 CC3E 81B5 E54F E3DD F987 FA52 E643 FAA4 8AD5
uid Gary W. Swearingen <garys@freebsd.org>
sub 2048g/E34C3CA0 2005-08-22 [expires: 2007-08-22]

D.3.292 Yoshihiro Takahashi <nyan@FreeBSD.org>

pub 1024D/8394B81F 2001-10-15 Yoshihiro TAKAHASHI <nyan@jp.FreeBSD.org>
Key fingerprint = D4FA D8CA 2AED FCF4 90A3 3569 8666 0500 8394 B81F
uid Yoshihiro TAKAHASHI <nyan@furiru.org>
uid Yoshihiro TAKAHASHI <nyan@FreeBSD.org>
sub 1024g/B796F020 2001-10-15

D.3.293 Sahil Tandon <sahil@FreeBSD.org>

pub 2048R/C016D977 2010-04-08
Key fingerprint = 6AD2 BA99 8E3A 8DA6 DFC1 53CF DBD0 6001 C016 D977
uid Sahil Tandon <sahil@tandon.net>
uid Sahil Tandon <sahil@FreeBSD.org>
sub 2048R/F7776FBC 2010-04-08

D.3.294 TAKATSU Tomonari <tota@FreeBSD.org>

pub 1024D/67F58F29 2009-05-17
Key fingerprint = 6940 B575 FC4A FA26 C094 279A 4B9B 6326 67F5 8F29
uid TAKATSU Tomonari <tota@FreeBSD.org>
sub 2048g/18B112CD 2009-05-17

D.3.295 Romain Tartière <romain@FreeBSD.org>

pub 3072R/5112336F 2010-04-09
Key fingerprint = 8234 9A78 E7C0 B807 0B59 80FF BA4D 1D95 5112 336F
uid Romain Tartière <romain@blogreen.org>
uid Romain Tartière (FreeBSD) <romain@FreeBSD.org>
sub 3072R/C1B2B656 2010-04-09
sub 3072R/8F8125F4 2010-04-09

D.3.296 Sylvio Cesar Teixeira <sylvio@FreeBSD.org>

```
pub 2048R/AA7395A1 2009-10-28
   Key fingerprint = B319 6AAF 0016 4308 6D93 E652 3C5F 21A2 AA73 95A1
uid          Sylvio Cesar Teixeira (My key) <sylvio@FreeBSD.org>
sub 2048R/F758F556 2009-10-28
```

D.3.297 Ion-Mihai Tetcu <itetcu@FreeBSD.org>

```
pub 1024D/21FFA1E5 2008-05-08 [expires: 2010-05-08]
   Key fingerprint = A880 42DD BD71 BAA5 AED7 AEA2 27B1 88BA 21FF A1E5
uid          Ion-Mihai "IONut" Tetcu <itetcu@FreeBSD.org>
sub 2048g/0B30E680 2008-05-08 [expires: 2010-05-08]
```

D.3.298 Mikhail Teterin <mi@FreeBSD.org>

```
pub 1024R/3FC71479 1995-09-08 Mikhail Teterin <mi@aldan.star89.galstar.com>
   Key fingerprint = 5F 15 EA 78 A5 40 6A 0F 14 D7 D9 EA 6E 2B DA A4
```

D.3.299 Gordon Tetlow <gordon@FreeBSD.org>

```
pub 1024D/357D65FB 2002-05-14 Gordon Tetlow <gordont@gnf.org>
   Key fingerprint = 34EF AD12 10AF 560E C3AE CE55 46ED ADF4 357D 65FB
uid          Gordon Tetlow <gordon@FreeBSD.org>
sub 1024g/243694AB 2002-05-14
```

D.3.300 Lars Thegler <lth@FreeBSD.org>

```
pub 1024D/56B0CA08 2004-05-31 Lars Thegler <lth@FreeBSD.org>
   Key fingerprint = ABAE F98C EA78 1C8D 6FDD CB27 1CA9 5A63 56B0 CA08
uid          Lars Thegler <lars@thegler.dk>
sub 1024g/E8C58EF3 2004-05-31
```

D.3.301 David Thiel <lth@FreeBSD.org>

```
pub 1024D/A887A9B4 2006-11-30 [expires: 2011-11-29]
   Key fingerprint = F08F 6A12 738F C9DF 51AC 8C62 1E30 7CBE A887 A9B4
uid          David Thiel <lth@FreeBSD.org>
sub 2048g/B9BD92C5 2006-11-30 [expires: 2011-11-29]
```

D.3.302 Fabien Thomas <fabient@FreeBSD.org>

```
pub 1024D/07745930 2009-03-16
    Key fingerprint = D8AC EFA2 2FBD 7788 9628 4E8D 3F35 3B88 0774 5930
uid Fabien Thomas <fabient@FreeBSD.org>
sub 2048g/BC173395 2009-03-16
```

D.3.303 Thierry Thomas <thierry@FreeBSD.org>

```
pub 1024D/C71405A2 1997-10-11
    Key fingerprint = 3BB8 F358 C2F1 776C 65C9 AE51 73DE 698C C714 05A2
uid Thierry Thomas <thierry@pompo.net>
uid Thierry Thomas <tthomas@mail.dotcom.fr>
uid Thierry Thomas (FreeBSD committer) <thierry@FreeBSD.org>
sub 1024R/C5529925 2003-11-26
sub 2048g/05CF3992 2008-02-05
```

D.3.304 Andrew Thompson <thompsa@FreeBSD.org>

```
pub 1024D/BC6B839B 2005-05-05
    Key fingerprint = DE74 3F49 B97C A170 C8F1 8423 CAB6 9D57 BC6B 839B
uid Andrew Thompson <thompsa@freebsd.org>
uid Andrew Thompson <andy@fud.org.nz>
sub 2048g/92E370FB 2005-05-05
```

D.3.305 Florent Thoumie <flz@FreeBSD.org>

```
pub 1024D/5147DCF4 2004-12-04
    Key fingerprint = D203 AF5F F31A 63E2 BFD5 742B 3311 246D 5147 DCF4
uid Florent Thoumie (FreeBSD committer address) <flz@FreeBSD.org>
uid Florent Thoumie (flz) <florent@thoumie.net>
uid Florent Thoumie (flz) <flz@xbsd.org>
uid [jpeg image of size 1796]
sub 2048g/15D930B9 2004-12-04
```

D.3.306 Yar Tikhiy <yar@FreeBSD.org>

```
pub 1024D/EA04CF5A 2008-08-31
    Key fingerprint = C063 6788 AFF2 A62F 06B7 516D 200F 06AF EA04 CF5A
uid Yar Tikhiy <yar@freebsd.org>
sub 2048g/20443F06 2008-08-31
```

D.3.307 Jilles Tjoelker <jilles@FreeBSD.org>

```
pub 1024D/A813D5EE 2001-02-18
   Key fingerprint = 0C82 44F5 0A1B 84E4 A9DD 7032 5102 275F A813 D5EE
uid      Jilles Tjoelker <jilles@stack.nl>
uid      Jilles Tjoelker <tjoelker@zonnet.nl>
uid      Jilles Tjoelker (FreeBSD) <jilles@FreeBSD.org>
sub 2048g/B94834AC 2001-02-18
```

D.3.308 Ganbold Tsagaankhuu <ganbold@FreeBSD.org>

```
pub 1024D/78F6425E 2008-02-26 [expires: 2013-02-24]
   Key fingerprint = 9B8E DC41 D3F4 F7FC D8EA 417C D4F7 2AEF 78F6 425E
uid      Ganbold <ganbold@freebsd.org>
sub 2048g/716FCBF9 2008-02-26 [expires: 2013-02-24]
```

D.3.309 Michael Tuexen <tuexen@FreeBSD.org>

```
pub 1024D/04EEDABE 2009-06-08
   Key fingerprint = 493A CCB8 60E6 5510 A01D 360E 8497 B854 04EE DABE
uid      Michael Tuexen <tuexen@FreeBSD.org>
sub 2048g/F653AA03 2009-06-08
```

D.3.310 Andrew Turner <andrew@FreeBSD.org>

```
pub 2048R/31B31614 2010-07-01
   Key fingerprint = 08AC 2C57 F14F FDD1 2232 B5CD AA16 EFB8 31B3 1614
uid      Andrew Turner <andrew@freebsd.org>
uid      Andrew Turner <andrew@fubar.geek.nz>
sub 2048R/9ACBF138 2010-07-01
```

D.3.311 Hajimu UMEMOTO <ume@FreeBSD.org>

```
pub 1024D/BF9071FE 2005-03-17
   Key fingerprint = 1F00 0B9E 2164 70FC 6DC5 BF5F 04E9 F086 BF90 71FE
uid      Hajimu UMEMOTO <ume@mahoroba.org>
uid      Hajimu UMEMOTO <ume@FreeBSD.org>
uid      Hajimu UMEMOTO <ume@jp.FreeBSD.org>
sub 2048g/748DB3B0 2005-03-17
```

D.3.312 Stephan Uphoff <ups@FreeBSD.org>

```
pub 2048R/D684B04A 2004-10-06 Stephan Uphoff <ups@freebsd.org>
   Key fingerprint = B5D2 04AE CA8F 7055 7474 3C85 F908 7F55 D684 B04A
uid                               Stephan Uphoff <ups@tree.com>
sub 2048R/A15F921B 2004-10-06
```

D.3.313 Jacques Vidrine <nectar@FreeBSD.org>

```
pub 2048R/33C1627B 2001-07-05 Jacques A. Vidrine <nectar@celabo.org>
   Key fingerprint = CB CE 7D A0 6E 01 DC 61 E5 91 0A BE 79 17 D3 82
uid                               Jacques A. Vidrine <jvidrine@verio.net>
uid                               Jacques A. Vidrine <n@nectar.com>
uid                               Jacques A. Vidrine <jacques@vidrine.cc>
uid                               Jacques A. Vidrine <nectar@FreeBSD.org>
uid                               Jacques A. Vidrine <n@nectar.cc>

pub 1024D/1606DB95 2001-07-05 Jacques A. Vidrine <nectar@celabo.org>
   Key fingerprint = 46BC EA5B F70A CC81 5332 0832 8C32 8CFF 1606 DB95
uid                               Jacques A. Vidrine <jvidrine@verio.net>
uid                               Jacques A. Vidrine <n@nectar.com>
uid                               Jacques A. Vidrine <jacques@vidrine.cc>
uid                               Jacques A. Vidrine <nectar@FreeBSD.org>
uid                               Jacques A. Vidrine <n@nectar.cc>
sub 2048g/57EDEA6F 2001-07-05
```

D.3.314 Alberto Villa <avilla@FreeBSD.org>

```
pub 1024R/44350A8B 2010-01-24
   Key fingerprint = F740 CE4E EDDD DA9B 4A1B 1445 DF18 82EA 4435 0A8B
uid                               Alberto Villa <avilla@FreeBSD.org>
sub 1024R/F7C8254C 2010-01-24
```

D.3.315 Nicola Vitale <nivit@FreeBSD.org>

```
pub 1024D/F11699E5 2006-12-05
   Key fingerprint = 2C17 C591 2C6D 82BD F3DB F1BF 8FC9 6763 F116 99E5
uid                               Nicola Vitale (Public key for nivit@FreeBSD.org) <nivit@FreeBSD.org>
sub 2048g/4C90805D 2006-12-05
```

D.3.316 Ivan Voras <ivoras@FreeBSD.org>

```
pub 1024D/569C05C8 2000-05-24
   Key fingerprint = AB9A A555 C47C B61D BF83 154C 95D9 C041 569C 05C8
uid                               Ivan Voras <ivoras@fer.hr>
uid                               Ivan Voras <ivan.voras@fer.hr>
```


D.3.321 Nathan Whitehorn <nwhitehorn@FreeBSD.org>

```
pub 1024D/FC118258 2008-07-03
   Key fingerprint = A399 BEA0 8D2B 63B3 47B5 056D 8513 5B96 FC11 8258
uid      Nathan Whitehorn <nwhitehorn@freebsd.org>
uid      Nathan Whitehorn <nwhitehorn@icecube.wisc.edu>
uid      Nathan Whitehorn <nwhitehorn@physics.wisc.edu>
uid      Nathan Whitehorn <whitehorn@wisc.edu>
sub 2048g/EDB55363 2008-07-03
```

D.3.322 Martin Wilke <miwi@FreeBSD.org>

```
pub 1024D/B1E6FCE9 2009-01-31
   Key fingerprint = C022 7D60 F598 8188 2635 0F6E 74B2 4884 B1E6 FCE9
uid      Martin Wilke <miwi@FreeBSD.org>
sub 4096g/096DA69D 2009-01-31
```

D.3.323 Nate Williams <nate@FreeBSD.org>

```
pub 1024D/C2AC6BA4 2002-01-28 Nate Williams (FreeBSD) <nate@FreeBSD.org>
   Key fingerprint = 8EE8 5E72 8A94 51FA EA68 E001 FFF9 8AA9 C2AC 6BA4
sub 1024g/03EE46D2 2002-01-28
```

D.3.324 Steve Wills <swills@FreeBSD.org>

```
pub 2048R/207B1BA1 2010-09-02 [expires: 2011-09-02]
   Key fingerprint = 98FA 414A 5C2A 0EF9 CFD0 AD0D F5CF 62B3 207B 1BA1
uid      Steve Wills <swills@freebsd.org>
uid      Steve Wills <steve@mouf.net>
sub 2048R/E9B254FD 2010-09-02 [expires: 2011-09-02]
```

D.3.325 Thomas Wintergerst <twinterg@FreeBSD.org>

```
pub 1024D/C45CB978 2006-01-08
   Key fingerprint = 04EE 8114 7C6D 22CE CDC8 D7F8 112D 01DB C45C B978
uid      Thomas Wintergerst <twinterg@gmx.de>
uid      Thomas Wintergerst <twinterg@freebsd.org>
uid      Thomas Wintergerst
uid      Thomas Wintergerst <thomas.wintergerst@nord-com.net>
uid      Thomas Wintergerst <thomas.wintergerst@materna.de>
sub 2048g/3BEBEF8A 2006-01-08
sub 1024D/8F631374 2006-01-08
sub 2048g/34F631DC 2006-01-08
```

D.3.326 Garrett Wollman <wollman@FreeBSD.org>

```
pub 1024D/0B92FAEA 2000-01-20 Garrett Wollman <wollman@FreeBSD.org>
   Key fingerprint = 4627 19AF 4649 31BF DE2E 3C66 3ECF 741B 0B92 FAEA
sub 1024g/90D5EBC2 2000-01-20
```

D.3.327 Jörg Wunsch <joerg@FreeBSD.org>

```
pub 1024D/69A85873 2001-12-11 Joerg Wunsch <j@uriah.heep.sax.de>
   Key fingerprint = 5E84 F980 C3CA FD4B B584 1070 F48C A81B 69A8 5873
pub 1024D/69A85873 2001-12-11 Joerg Wunsch <j@uriah.heep.sax.de>
uid                               Joerg Wunsch <joerg_wunsch@interface-systems.de>
uid                               Joerg Wunsch <joerg@FreeBSD.org>
uid                               Joerg Wunsch <j@ida.interface-business.de>
sub 1024g/21DC9924 2001-12-11
```

D.3.328 David Xu <davidxu@FreeBSD.org>

```
pub 1024D/48F2BDAB 2006-07-13 [expires: 2009-07-12]
   Key fingerprint = 7182 434F 8809 A4AF 9AE8 F1B5 12F6 3390 48F2 BDAB
uid                               David Xu <davidxu@freebsd.org>
sub 4096g/ED7DB38A 2006-07-13 [expires: 2009-07-12]
```

D.3.329 Maksim Yevmenkin <emax@FreeBSD.org>

```
pub 1024D/F050D2DD 2003-10-01 Maksim Yevmenkin <m_evmenkin@yahoo.com>
   Key fingerprint = 8F3F D359 E318 5641 8C81 34AD 791D 53F5 F050 D2DD
```

D.3.330 Bjoern A. Zeeb <bz@FreeBSD.org>

```
pub 1024D/3CCF1842 2007-02-20
   Key fingerprint = 1400 3F19 8FEF A3E7 7207 EE8D 2B58 B8F8 3CCF 1842
uid                               Bjoern A. Zeeb <bz@zabbadoz.net>
uid                               Bjoern A. Zeeb <bzeeb@zabbadoz.net>
uid                               Bjoern A. Zeeb <bz@FreeBSD.org>
uid                               Bjoern A. Zeeb <bzeeb-lists@lists.zabbadoz.net>
sub 4096g/F36BDC5D 2007-02-20
```

D.3.331 Alexey Zelkin <phantom@FreeBSD.org>

```
pub 1024D/9196B7D9 2002-01-28 Alexey Zelkin <phantom@FreeBSD.org>
   Key fingerprint = 4465 F2A4 28C1 C2E4 BB95 1EA0 C70D 4964 9196 B7D9
sub 1024g/E590ABA4 2002-01-28
```

D.3.332 Sepherosa Ziehou <sephe@FreeBSD.org>

```
pub 2048R/3E51FB42 2005-10-21
   Key fingerprint = 5F47 3861 7ABA 8773 9E32 0474 5C33 841C 3E51 FB42
uid      Sepherosa Ziehou (freebsd) <sephe@freebsd.org>
uid      Sepherosa Ziehou (sephe) <sepherosa@gmail.com>
sub 2048R/7AA31321 2005-10-21
```


ACPI Source Language

Ç æεþοόά ðñιãñãñãäöéοιιγύ ιã ðçί ιðιβã ãñÛöãäöé ç AML.

Access Control List

Ìéã εβοόá áðü Ûããéãä éãé æééãéþιãöá ðñιõðÝεãóçð, ç ιðιβã Ý÷ãé óðιããεãß ιã Ýιã áíóééãßιãñ, üðüð ð.÷. Ýιã ãñ÷ãßι Þ ιéã æééöðãéÞ óöóéãðÞ.

Advanced Configuration and Power Interface

ιã ðñüöððι ðι ιðιβι éãéιñβæãé ðιι ðñüðι áðééιéιúιβãð ðιõ ðéééιγύ ιã ðι éãéðιõñãééü óγóççιã. Ì óéιðüð γðãñιçð ðιõ ACPI ãβιãé ιã ιðιñãß ðι ÈÕ ιã áðééιéιúιÞóãé ιã ðι ðéééü áíüð ððιιειãéóðÞ éãé ιã ãéιãöãééãðöãß üóι ðι äοιãöüι éãéγöãñã áðöü ðι ðéééü, áéüιç éé áι ããι ιÝñãé öá ðÛιöá ãéã áðöü. Õι ACPI áðιöãéãß ιãðãιÝééιç ðüι APM, PNPBIOS éãé áíðβöðιé÷üι öã÷ιιειãéþι, ðéð ιðιβãð éãé áíóééãééóöÛ. Õι ACPI ðãñÝ÷ãé ðç äοιãöüöçðã ιã ãéÝãñιöιã ðçι éãðãιÛéüç éó÷γιð, ðçι áιãóðιεÞ éãéðιõñãβãð ðιõ óöóðÞιãðιð, ðçι áñãñãιðιβçóç éãé áðãιãñãιðιβçóç óöóéãðÞι, ééð.

Application Programming Interface

ιã óγιιει áðü æéãñãããóβãð, ðñüðüειεéã éãé ãñããéãßã ðιõ éãéιñβæιõι ðιι áιããιúñéóιÝιι ðñüðι áðééιéιúιβãð ιãðãιγύ äγι Þ ðãñéóöüöãñüι ðιçιÛöüι ειαéοιééιγύ. Õã áðöÛ ðãñééãιãÛιιöãé ðεçñιιöιñβãð ãéã ðι ðüð, ðüðã, éãé ãéãöβ öá ðιÞιãöá áðöÛ ειαéοιééιγύ éã óðιãñãÛæιöãé, éãé ðé ãβãιðð äããñÝιã ιðιñιγί ιã áíóãééÛιιõι, ιã ιιεñããöοιγί Þ ιã áðãιãñãããóöιγί.

Advanced Power Management

ιã API ðι ιðιβι ðãñÝ÷ãé óðι éãéðιõñãééü óγóççιã ðç äοιãöüöçðã ιã óðιãñãããóðãß ιã ðι BIOS áðéöðã÷Ûιιöãð éãéγöãñç ãéã÷ãßñéóç ðçð éó÷γιð ðιõ óöóðÞιãðιð. Õι APM Ý÷ãé áíóééããöãóöãéãß áðü ðι ðñüöððι ACPI, ðι ιðιβι ãβιãé ðéι ιειéεçñüιÝιι éãé ðéι áðÝéééðι áðü ðι APM.

Advanced Programmable Interrupt Controller

Advanced Technology Attachment

Asynchronous Transfer Mode

Authenticated Post Office Protocol

Automatic Mount Daemon

Το δίκτυο αόρατο ορόσηφο είναι η διαδικασία που χρησιμοποιείται για να ελέγξει ο δίκτυο αν είναι δυνατό να συνδεθεί με τον δίκτυο. Η διαδικασία αυτή είναι η διαδικασία που χρησιμοποιείται για να ελέγξει ο δίκτυο αν είναι δυνατό να συνδεθεί με τον δίκτυο.

B

BAR

Άλλα: Base Address Register

BIND

Άλλα: Berkeley Internet Name Domain

BIOS

Άλλα: Basic Input/Output System

BSD

Άλλα: Berkeley Software Distribution

Base Address Register

Το είναι η διαδικασία που χρησιμοποιείται για να ελέγξει ο δίκτυο αν είναι δυνατό να συνδεθεί με τον δίκτυο. Η διαδικασία αυτή είναι η διαδικασία που χρησιμοποιείται για να ελέγξει ο δίκτυο αν είναι δυνατό να συνδεθεί με τον δίκτυο.

Basic Input/Output System

Το είναι η διαδικασία που χρησιμοποιείται για να ελέγξει ο δίκτυο αν είναι δυνατό να συνδεθεί με τον δίκτυο. Η διαδικασία αυτή είναι η διαδικασία που χρησιμοποιείται για να ελέγξει ο δίκτυο αν είναι δυνατό να συνδεθεί με τον δίκτυο. Η διαδικασία αυτή είναι η διαδικασία που χρησιμοποιείται για να ελέγξει ο δίκτυο αν είναι δυνατό να συνδεθεί με τον δίκτυο.

Berkeley Internet Name Domain

Το είναι η διαδικασία που χρησιμοποιείται για να ελέγξει ο δίκτυο αν είναι δυνατό να συνδεθεί με τον δίκτυο.

Challenge Handshake Authentication Protocol

Ἡ εἰσαγωγή εἰς τὸ δίκτυο ἀπαιτεῖται ἀπὸ τὸν πελάτη, ὅταν ὁ διακομιστὴς ἀπαιτεῖται ἀπὸ τὸν πελάτη νὰ ἀποδείξει τὴν ταυτότητά του. Ἡ εἰσαγωγή εἰς τὸ δίκτυο ἀπαιτεῖται ἀπὸ τὸν πελάτη, ὅταν ὁ διακομιστὴς ἀπαιτεῖται ἀπὸ τὸν πελάτη νὰ ἀποδείξει τὴν ταυτότητά του.

Classical IP over ATM

Clear To Send

Ἡ εἰσαγωγή εἰς τὸ δίκτυο ἀπαιτεῖται ἀπὸ τὸν πελάτη, ὅταν ὁ διακομιστὴς ἀπαιτεῖται ἀπὸ τὸν πελάτη νὰ ἀποδείξει τὴν ταυτότητά του.

Ἡ εἰσαγωγή εἰς τὸ δίκτυο ἀπαιτεῖται ἀπὸ τὸν πελάτη, ὅταν ὁ διακομιστὴς ἀπαιτεῖται ἀπὸ τὸν πελάτη νὰ ἀποδείξει τὴν ταυτότητά του.

Common Object File Format

Concurrent Versions System

Ἡ εἰσαγωγή εἰς τὸ δίκτυο ἀπαιτεῖται ἀπὸ τὸν πελάτη, ὅταν ὁ διακομιστὴς ἀπαιτεῖται ἀπὸ τὸν πελάτη νὰ ἀποδείξει τὴν ταυτότητά του. Ἡ εἰσαγωγή εἰς τὸ δίκτυο ἀπαιτεῖται ἀπὸ τὸν πελάτη, ὅταν ὁ διακομιστὴς ἀπαιτεῖται ἀπὸ τὸν πελάτη νὰ ἀποδείξει τὴν ταυτότητά του.

D

DAC

Ἡ εἰσαγωγή εἰς τὸ δίκτυο ἀπαιτεῖται ἀπὸ τὸν πελάτη, ὅταν ὁ διακομιστὴς ἀπαιτεῖται ἀπὸ τὸν πελάτη νὰ ἀποδείξει τὴν ταυτότητά του.

DDB

Ἡ εἰσαγωγή εἰς τὸ δίκτυο ἀπαιτεῖται ἀπὸ τὸν πελάτη, ὅταν ὁ διακομιστὴς ἀπαιτεῖται ἀπὸ τὸν πελάτη νὰ ἀποδείξει τὴν ταυτότητά του.

DES

Ἡ εἰσαγωγή εἰς τὸ δίκτυο ἀπαιτεῖται ἀπὸ τὸν πελάτη, ὅταν ὁ διακομιστὴς ἀπαιτεῖται ἀπὸ τὸν πελάτη νὰ ἀποδείξει τὴν ταυτότητά του.

DHCP

Ἡ εἰσαγωγή εἰς τὸ δίκτυο ἀπαιτεῖται ἀπὸ τὸν πελάτη, ὅταν ὁ διακομιστὴς ἀπαιτεῖται ἀπὸ τὸν πελάτη νὰ ἀποδείξει τὴν ταυτότητά του.

DNS

Ἡ εἰσαγωγή εἰς τὸ δίκτυο ἀπαιτεῖται ἀπὸ τὸν πελάτη, ὅταν ὁ διακομιστὴς ἀπαιτεῖται ἀπὸ τὸν πελάτη νὰ ἀποδείξει τὴν ταυτότητά του.

DSDT

Ἄβδα: Differentiated System Description Table

DSR

Ἄβδα: Data Set Ready

DTR

Ἄβδα: Data Terminal Ready

DVMRP

Ἄβδα: Distance-Vector Multicast Routing Protocol

Discretionary Access Control

Data Encryption Standard

Ἡ εἰσαγωγή εἰς τὸν ἄλγόριθμο DES, ὁποῖο εἶναι ἡ ἀπλοποιημένη ἀπόδοση τοῦ ἄλγορίθμου DES, ἡ εἰσαγωγή εἰς τὸν ἄλγόριθμο DES, ὁποῖο εἶναι ἡ ἀπλοποιημένη ἀπόδοση τοῦ ἄλγορίθμου DES (passwords) οἷο UNIX. × ἡ εἰσαγωγή εἰς τὸν ἄλγόριθμο DES εἶναι ἡ ἀπλοποιημένη ἀπόδοση τοῦ ἄλγορίθμου DES crypt(3).

Data Set Ready

Ἡ εἰσαγωγή εἰς τὸν ἄλγόριθμο RS232C εἰς τὸν ἄλγόριθμο RS232C εἶναι ἡ ἀπλοποιημένη ἀπόδοση τοῦ ἄλγορίθμου RS232C εἰς τὸν ἄλγόριθμο RS232C, ὁποῖο εἶναι ἡ ἀπλοποιημένη ἀπόδοση τοῦ ἄλγορίθμου RS232C εἰς τὸν ἄλγόριθμο RS232C, ὁποῖο εἶναι ἡ ἀπλοποιημένη ἀπόδοση τοῦ ἄλγορίθμου RS232C εἰς τὸν ἄλγόριθμο RS232C.

Ἄβδα Ἄβδα: Data Terminal Ready.

Data Terminal Ready

Ἡ εἰσαγωγή εἰς τὸν ἄλγόριθμο RS232C εἰς τὸν ἄλγόριθμο RS232C εἶναι ἡ ἀπλοποιημένη ἀπόδοση τοῦ ἄλγορίθμου RS232C εἰς τὸν ἄλγόριθμο RS232C, ὁποῖο εἶναι ἡ ἀπλοποιημένη ἀπόδοση τοῦ ἄλγορίθμου RS232C εἰς τὸν ἄλγόριθμο RS232C, ὁποῖο εἶναι ἡ ἀπλοποιημένη ἀπόδοση τοῦ ἄλγορίθμου RS232C εἰς τὸν ἄλγόριθμο RS232C.

Debugger

Ἡ εἰσαγωγή εἰς τὸν ἄλγόριθμο (interactive) εἰς τὸν ἄλγόριθμο (interactive) εἶναι ἡ ἀπλοποιημένη ἀπόδοση τοῦ ἄλγορίθμου (interactive) εἰς τὸν ἄλγόριθμο (interactive), ὁποῖο εἶναι ἡ ἀπλοποιημένη ἀπόδοση τοῦ ἄλγορίθμου (interactive) εἰς τὸν ἄλγόριθμο (interactive).

Differentiated System Description Table

Ἡ εἰσαγωγή εἰς τὸν ἄλγόριθμο ACPI εἰς τὸν ἄλγόριθμο ACPI εἶναι ἡ ἀπλοποιημένη ἀπόδοση τοῦ ἄλγορίθμου ACPI εἰς τὸν ἄλγόριθμο ACPI, ὁποῖο εἶναι ἡ ἀπλοποιημένη ἀπόδοση τοῦ ἄλγορίθμου ACPI εἰς τὸν ἄλγόριθμο ACPI.

Distance-Vector Multicast Routing Protocol

Domain Name System

Ὁ Domain Name System (DNS) εἶναι τὸ σύστημα ἀποκρίσεως εἰς τὰ ερωτήματα (hostname), ὡς π.χ. ἡ διεύθυνση mail.example.net, ὅπου ἀπεκρίσεως εἶναι τὸ διεύθυνση Internet εἰς τὴν ἀποστολὴν εἰς τὴν διεύθυνση.

Dynamic Host Configuration Protocol

τὸ Dynamic Host Configuration Protocol (DHCP) εἶναι τὸ πρῶτο εἰς τὴν ἀποστολὴν IP. Ἐπιτρέπει τὸν ἰδιοκτήτην (host) νὰ ἀποκτήσῃ τὴν διεύθυνση IP ἀπὸ τὸν DHCP. Ἡ ἀποστολὴ εἶναι ἀπὸ τὸν DHCP εἰς τὴν διεύθυνση IP ἀπὸ τὸν DHCP. Ἡ ἀποστολὴ εἶναι ἀπὸ τὸν DHCP εἰς τὴν διεύθυνση IP ἀπὸ τὸν DHCP.

E

ECOFF

Ἐπεκτετατὴν COFF

ELF

Ἐκτελέσιμον καὶ ἀποσύνδεσιμον

ESP

Ἐπιπερικυβερνητικὴ ἀποστολὴ

Encapsulated Security Payload

Executable and Linking Format

Extended COFF

F

FADT

Ἐπιπερικυβερνητικὴ ἀποστολὴ

FAT

Ἐπιπερικυβερνητικὴ ἀποστολὴ

FAT16

Ἐπιπερικυβερνητικὴ ἀποστολὴ (16-bit)

H

HTML

Άβδâ: HyperText Markup Language

HUP

Άβδâ: HangUp

HangUp

HyperText Markup Language

Ç ãεβόα δãñéãñãððè êãéιΥίιò (markup language) ðιò ÷ ñçóéιιðιéãβóáé ãéá ôç äçιéιòñãßá éóôιòãεβãυι (web pages).

I

I/O

Άβδâ: Input/Output

IASL

Άβδâ: Intel's ASL compiler

IMAP

Άβδâ: Internet Message Access Protocol

IP

Άβδâ: Internet Protocol

IPFW

Άβδâ: IP Firewall

IPP

Άβδâ: Internet Printing Protocol

IPv4

Άβδâ: IP Version 4

IPv6

Άβδâ: IP Version 6

ISP

Άβδâ: Internet Service Provider

IP Firewall

IP Version 4

Ο Υποστηρικτής 4 του πρωτοκόλλου IP, χρησιμοποιεί 32 bits για τον αριθμό διεύθυνσης. Ο Υποστηρικτής 4 του πρωτοκόλλου IP είναι ο παλιός και ο υποστηρικτής 6 του πρωτοκόλλου IP είναι ο νέος.

Απόδοση: IP Version 6.

IP Version 6

Ο Υποστηρικτής 6 του πρωτοκόλλου IP, χρησιμοποιεί 128 bits για τον αριθμό διεύθυνσης. Ο Υποστηρικτής 6 του πρωτοκόλλου IP είναι ο νέος και ο υποστηρικτής 4 του πρωτοκόλλου IP είναι ο παλιός.

Input/Output

Intel's ASL compiler

Η έκδοση του Intel για τον ASL είναι η έκδοση του AML.

Internet Message Access Protocol

Είναι το πρωτόκολλο που χρησιμοποιείται για την αποστολή και την λήψη email. Ο υποστηρικτής 3 του πρωτοκόλλου IMAP είναι ο παλιός και ο υποστηρικτής 4 του πρωτοκόλλου IMAP είναι ο νέος.

Απόδοση: Post Office Protocol Version 3.

Internet Printing Protocol

Internet Protocol

Οι διεύθυνσεις IP είναι οι διεύθυνσεις που χρησιμοποιούνται για την επικοινωνία στο Internet. Η διεύθυνση IP είναι ο αριθμός που χρησιμοποιείται για την επικοινωνία στο Internet. Ο υποστηρικτής 4 του πρωτοκόλλου IP είναι ο παλιός και ο υποστηρικτής 6 του πρωτοκόλλου IP είναι ο νέος. Ο υποστηρικτής 4 του πρωτοκόλλου IP είναι ο παλιός και ο υποστηρικτής 6 του πρωτοκόλλου IP είναι ο νέος.

Internet Service Provider

Είναι η εταιρεία που παρέχει υπηρεσίες στο Internet.

MFP4

Άλλαξη: Merge From Perforce

MFS

Άλλαξη: Merge From Stable

MIT

Άλλαξη: Massachusetts Institute of Technology

MLS

Άλλαξη: Multi-Level Security

MOTD

Άλλαξη: Message Of The Day

MTA

Άλλαξη: Mail Transfer Agent

MUA

Άλλαξη: Mail User Agent

Mail Transfer Agent

Για να απαντήσω στο ερώτημα σχετικά με το email. Είναι σημαντικό, οι MTA αποδέχονται όλα τα μηνύματα που αποστέλλονται στο BSD. Επίσης, οι sendmail και postfix είναι οι πιο δημοφιλείς MTA, με το postfix, qmail και Exim.

Mail User Agent

Για να απαντήσω σχετικά με το θέμα, είναι σημαντικό να σημειωθεί ότι οι MUA είναι υπεύθυνοι για την αποστολή και την λήψη μηνυμάτων. Είναι σημαντικό να σημειωθεί ότι οι MUA είναι υπεύθυνοι για την αποστολή και την λήψη μηνυμάτων.

Mandatory Access Control

Massachusetts Institute of Technology

Merge From Current

Οι αλλαγές που γίνονται στο CURRENT είναι οι πιο πρόσφατες και οι πιο σημαντικές. Είναι σημαντικό να σημειωθεί ότι οι αλλαγές στο CURRENT είναι οι πιο πρόσφατες και οι πιο σημαντικές.

Merge From Perforce

Ο ορισμός της διαδρομής P για τον έλεγχο της διαδρομής Perforce ορίζεται ως εξής:
είναι η διαδρομή -CURRENT.

Παρατήρηση: Perforce.

Merge From Stable

Ο ορισμός της διαδρομής FreeBSD για τον έλεγχο της διαδρομής -CURRENT branch είναι η διαδρομή -STABLE. Η διαδρομή -STABLE είναι η διαδρομή -CURRENT.

Η διαδρομή -STABLE branch είναι η διαδρομή -STABLE branch ούτως ώστε να μην υπάρχουν διαδρομές security branches.

Παρατήρηση: Merge From Current.

Message Of The Day

Η διαδρομή της διαδρομής -CURRENT είναι η διαδρομή -CURRENT. Η διαδρομή -CURRENT είναι η διαδρομή -CURRENT.

Multi-Level Security

Multiple APIC Description Table

N

NAT

Παρατήρηση: Network Address Translation

NDISulator

Παρατήρηση: Project Evil

NFS

Παρατήρηση: Network File System

NTFS

Παρατήρηση: New Technology File System

NTP

Παρατήρηση: Network Time Protocol

Network Address Translation

Ἡ Network Address Translation (NAT) ἐπιτρέπει τὴν μετατόπιση IP ἀδρῶν ἀπὸ τὸ εἰσαγόμενον (gateway), ἀπὸ τὸν ἰδιόμοιο ἰδιόμοιο ἀδρῶν εἰς τὸν ἰδιόμοιο ἀδρῶν. Ἡ NAT ἐπιτρέπει τὴν μετατόπιση IP ἀδρῶν ἀπὸ τὸ εἰσαγόμενον (gateway), ἀπὸ τὸν ἰδιόμοιο ἰδιόμοιο ἀδρῶν εἰς τὸν ἰδιόμοιο ἀδρῶν.

Network File System

New Technology File System

Ἡ New Technology File System (NTFS) εἶναι ἡ τελευταία ἀδρῶν ἀπὸ τὸν Microsoft εἰς τὴν ἰδιόμοιο ἰδιόμοιο ἰδιόμοιο ἰδιόμοιο “New Technology”, ὅπου εἶναι τὸ Windows 2000, Windows NT εἰς τὸ Windows XP.

Network Time Protocol

Ἡ Network Time Protocol (NTP) εἶναι ἡ τελευταία ἀδρῶν ἀπὸ τὸν Network Time Protocol (NTP) εἰς τὸ Network Time Protocol (NTP).

O

OBE

Ἡ OBE: Overtaken By Events

ODMR

Ἡ ODMR: On-Demand Mail Relay

OS

Ἡ OS: Operating System

On-Demand Mail Relay

Operating System

Ἡ Operating System (OS) εἶναι ἡ τελευταία ἀδρῶν ἀπὸ τὸν Operating System (OS) εἰς τὸ Operating System (OS). Ἡ OS εἶναι ἡ τελευταία ἀδρῶν ἀπὸ τὸν Operating System (OS) εἰς τὸ Operating System (OS). Ἡ OS εἶναι ἡ τελευταία ἀδρῶν ἀπὸ τὸν Operating System (OS) εἰς τὸ Operating System (OS).

PPP

Απόδοση: Point-to-Point Protocol

PPPoA

Απόδοση: PPP over ATM

PPPoE

Απόδοση: PPP over Ethernet

PPP over ATM

PPP over Ethernet

PR

Απόδοση: Problem Report

PXE

Απόδοση: Preboot eXecution Environment

Password Authentication Protocol

Perforce

Το σύστημα της Perforce Software (<http://www.perforce.com/>) έχει τον κώδικα πηγή του αποθηκευμένο στο CVS. Αίτηση για πληροφορίες επικοινωνία, ή να λάβετε τον κώδικα πηγή ή να λάβετε πληροφορίες σχετικά με το FreeBSD.

Εάν έχετε οποιαδήποτε ερώτηση σχετικά με το FreeBSD ή χρειάζεστε την βοήθεια της Perforce ή θέλετε να ενημερωθείτε για τις τελευταίες πληροφορίες, τότε επισκεφθείτε την ιστοσελίδα της Perforce στο www.perforce.com -CURRENT.

Personal Computer

Personal Computer Network File System Daemon

Physical Address Extensions

Το σύστημα της Perforce Software (<http://www.perforce.com/>) έχει τον κώδικα πηγή του αποθηκευμένο στο CVS. Αίτηση για πληροφορίες επικοινωνία, ή να λάβετε τον κώδικα πηγή ή να λάβετε πληροφορίες σχετικά με το FreeBSD.

RS232C

Άάβδâ: Recommended Standard 232C

RTS

Άάβδâ: Request To Send

Random Access Memory

Revision Control System

To *Revision Control System* (RCS) άβιάέ Υία άδü ðá ðάέέüðάñá óóóðΠιάðá ðïò ðεϊðιέίγί “Υέää÷ì äέäüóäüí” äέá áðεÜ äñ÷-άβá. ΆðέòñΥðáé ðçì áðìèΠέáðóç, áíÜέðççóç, äñ÷-άέìèΥðççóç, éáðáññáðΠ, áíáñìññέóç éáé óðä÷-Πιάðóç ðìεéáðεΠí äέäüóäüí äέá èÜèä äñ÷-άβì. Õì RCS áðìóääέáβðáé áδü ðìεεÜ ìέέñÜ äññáéääβá ðïò óðíññáÜæìíðáé ìáðáíý òìòð. Άáí äέáèΥðáé ìñέóìΥία áδü ðá ÷-äñáéðçñέóðéèÜ ðïò ðáñΥ÷-ìðáé áδü ðéì ììóΥñía óóóðΠιάðá äéΥä÷-ìò äέäüóäüí, äéèÜ äβιάέ ðìéý äýèèèì óðçì ääéáðÜóðáóç éáé ñýèìéóç éáé ðìéý áðèü óðç ÷-ñΠóç äέá ìέέñü äññέèì äéää÷-üíáíüí äñ÷-άβüí. Õì RCS äéáðβèäðáé ðñáéðéèÜ äέá èÜèä èäéðìòñäéèü ðïò äáóβæäðáé óðéð äñ÷-Υð èäéðìòñäβáð òïò UNIX.

Άάβδâ Άðβóçð: Concurrent Versions System, Subversion.

Received Data

ΐá éáéΠáéì Π áéññäΥέðçð òïò RS232C óðì ìðìβì äβιάðáé èΠøç ääññΥíüí.

Άάβδâ Άðβóçð: Transmitted Data.

Recommended Standard 232C

ΐá ðñüðððì äέá äðéèìéíüíβá ìáðáíý óáéñéáéΠí óðóéääðí.

Reduced Instruction Set Computer

Ìéá ðñìóΥääéóç óðç ó÷-ääβáóç äðäñññääóðí ðïò áðèìðìéáβ òì äβäìò ðüí èäéðìòñäéΠí ðïò ìðìñáβ ìá äéðáéΥðáé òì òééèü Πððá ìá ìá äβιάέ éáðÜ òì äñíáðüí äáíééíý óéìðìý. Άðòü ìäçäáβ óá ÷-äìçèüðáñç éáðáíÜèòç áíΥñääéáð, ÷-ñçóéìðìéáβ èéäüðäñìòð çìéäüüíýð éáé óá ìñέóìΥíáð ðáñéðððáéð äðéððä÷-Üíáé éáéýðáñç áðüüíòç éáé áðìçìΥìç ððéíüðçðá èΠáééá. ðáñáääβäíáðá äðäñññääóðí RISC ðáñééäìäÜíüí òìòð Alpha, SPARC, ARM éáé PowerPC.

Redundant Array of Inexpensive Disks

Remote Procedure Call

SMP

Άβδα: Symmetric MultiProcessor

SMTP

Άβδα: Simple Mail Transfer Protocol

SMTP AUTH

Άβδα: SMTP Authentication

SSH

Άβδα: Secure Shell

STR

Άβδα: Suspend To RAM

SVN

Άβδα: Subversion

SMTP Authentication

Server Message Block

Signal Ground

Γαο αενηάΥεοçò Þ εέεπαεί οιο RS232 διο αδιοάεάß δεãÐ αίαοιñÛò αέα οç ααβùοç οιο ιάοάεάυιιάνο όβιαόιο.

Simple Mail Transfer Protocol

Secure Shell

Small Computer System Interface

Subversion

Οι Subversion αβίαέ Υία ογούοçία αεΥã÷ιο αεάυούαυί, δάνυιιεί ια οι CVS αεεÛ ια δεί δñι÷υñçiΥίαò αοίαούοçόαò.

Άβδα Άδβόçò: Concurrent Versions System.

Suspend To RAM

Symmetric MultiProcessor

System Control Interrupt

T

TCP

Άβδδ: Transmission Control Protocol

TCP/IP

Άβδδ: Transmission Control Protocol/Internet Protocol

TD

Άβδδ: Transmitted Data

TFTP

Άβδδ: Trivial FTP

TGT

Άβδδ: Ticket-Granting Ticket

TSC

Άβδδ: Time Stamp Counter

Ticket-Granting Ticket

Time Stamp Counter

Ο *Time Stamp Counter* (TSC) είναι ένας μετρητής που υπάρχει σε όλα τα επεξεργαστές Pentium, και χρησιμοποιείται για να μετρήσει τον χρόνο που περνάει από τη στιγμή που ο επεξεργαστής ξεκινάει να εκτελεί κώδικα μέχρι τη στιγμή που ολοκληρώνεται η εκτέλεση.

Transmission Control Protocol

Το *Transmission Control Protocol* (TCP) είναι ένα πρωτόκολλο μεταφοράς δεδομένων που χρησιμοποιείται για να μεταφέρει δεδομένα από έναν υπολογιστή σε έναν άλλο. Είναι ένα από τα βασικά πρωτόκολλα του διαδικτύου.

Transmission Control Protocol/Internet Protocol

Το σύνολο των πρωτοκόλλων που αποτελούν το TCP/IP, είναι η βάση του διαδικτύου. Το Internet είναι ένα σύνολο τεχνολογιών που αποτελούν το TCP/IP.

Transmitted Data

Το σύνολο των δεδομένων που αποστέλλονται μέσω RS232C ή άλλου είδους αβίαστού αγωγού.

Άλλοι όροι: Received Data.

Trivial FTP

U

UDP

Άλλοι όροι: User Datagram Protocol

UFS1

Άλλοι όροι: Unix File System Version 1

UFS2

Άλλοι όροι: Unix File System Version 2

UID

Άλλοι όροι: User ID

URL

Άλλοι όροι: Uniform Resource Locator

USB

Άλλοι όροι: Universal Serial Bus

Uniform Resource Locator

Είναι ένας αριθμός αλφριθμικών χαρακτήρων που χρησιμοποιείται για να αναφέρεται σε ένα σημείο στο Internet, είναι ένας αριθμός αλφριθμικών χαρακτήρων που χρησιμοποιείται για να αναφέρεται σε ένα σημείο στο Internet.

Unix File System Version 1

Είναι ένα σύστημα αρχείων που χρησιμοποιείται στο UNIX, είναι το Berkeley Fast File System.

Unix File System Version 2

Το UFS2 είναι η δεύτερη έκδοση του UFS, η οποία είναι η προεπιλεγμένη για FreeBSD 5-CURRENT. Το UFS2 είναι 64 bit και υποστηρίζει αρχεία μέχρι 10^16 bytes. Είναι η δεύτερη έκδοση του UFS, η οποία είναι η προεπιλεγμένη για FreeBSD 5-CURRENT.

Universal Serial Bus

Το USB είναι μια διεπαφή επικοινωνίας που επιτρέπει την σύνδεση πολλών συσκευών με έναν υπολογιστή. Είναι η πιο δημοφιλής διεπαφή για συσκευές όπως πονόμυροι, πληκτρολόγια, κλπ.

User ID

Το UID είναι ένας αριθμός που χρησιμοποιείται για να αναγνωρίσει τον ιδιοκτήτη ενός αρχείου. Είναι η προεπιλεγμένη τιμή για τον root.

User Datagram Protocol

Το UDP είναι ένα πρωτόκολλο μεταφοράς δεδομένων που χρησιμοποιείται για να μεταφέρει δεδομένα μεταξύ υπολογιστών. Είναι η προεπιλεγμένη τιμή για την επικοινωνία με το Internet.

V

VPN

Άβδα: Virtual Private Network

Virtual Private Network

Το VPN είναι μια τεχνολογία που επιτρέπει την ασφαλή επικοινωνία μέσω του Internet. Είναι η προεπιλεγμένη τιμή για την επικοινωνία με το Internet.

