IBM

Implementing TCP/IP for OS/390
A Step by Step Approach for MVS
Systems Programmers

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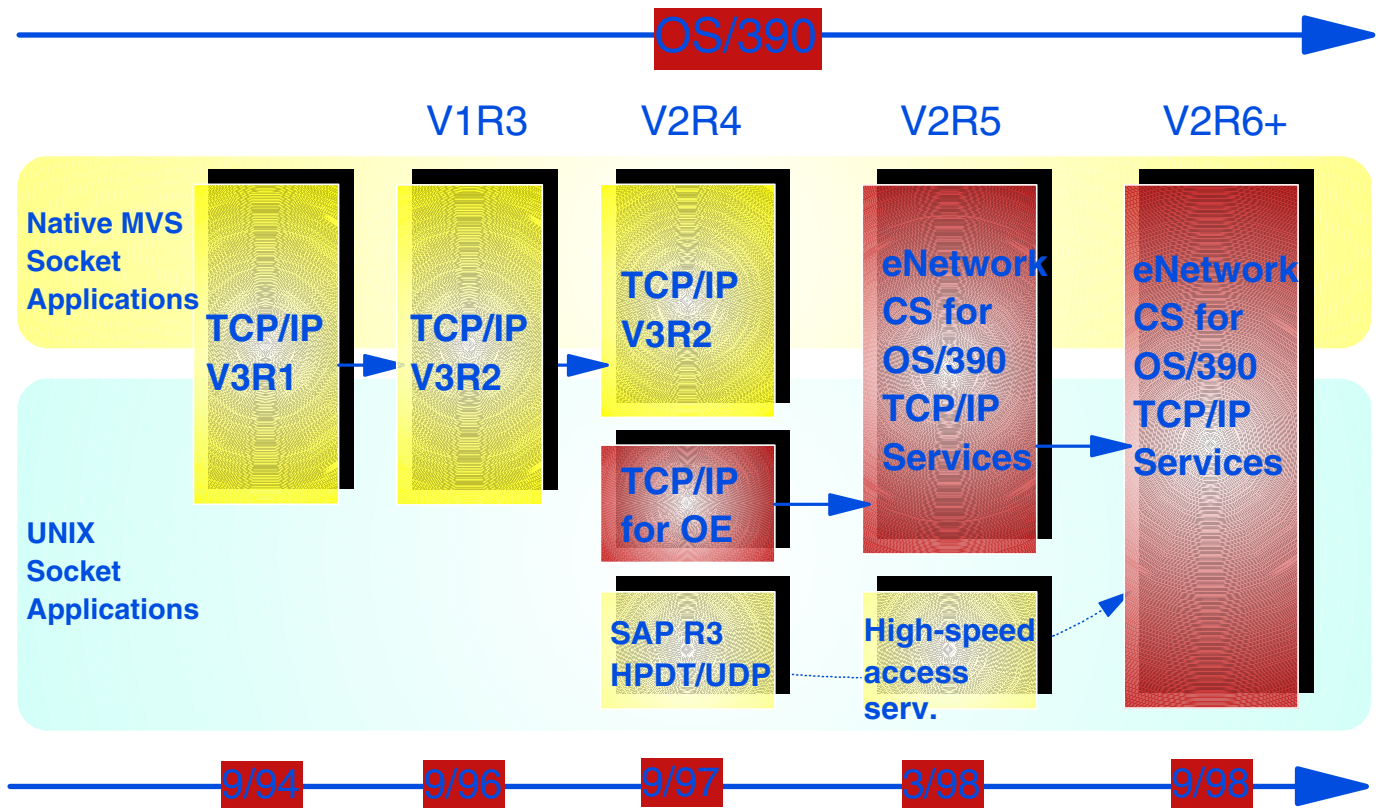**TEICHMN@US.IBM.COM**

Session # 2925

Agenda

Getting started

TCPIP Configuration files

RACF

PARMLIB

Managing TCP/IP

OS/390 TCP/IP Stack Roadmap

OS/390

	V1R3	V2R4	V2R5	V2R6+

Native MVS Socket Applications

TCP/IP V3R1 → TCP/IP V3R2 → TCP/IP V3R2

eNetwork CS for OS/390 TCP/IP Services

eNetwork CS for OS/390 TCP/IP Services

UNIX Socket Applications

TCP/IP for OE

SAP R3 HPDT/UDP

High-speed access serv.

9/94	9/96	9/97	3/98	9/98

Getting Started

Key Configuration Parameters

IP Address

Host name

Domain name

Nameserver IP address

Default router IP address

Network mask

Key TCP/IP Parameter Files

➤ TCP/IP PROFILE dataset
  - ✓ defines network interfaces and assigns IP addresses
  - ✓ specifies servers to be automatically started at TCP/IP initialization
  - ✓ defines preliminary IP routing information specifies TN3270 configuration
  - ✓ starts network device interfaces

➤ TCP/IP TCPDATA dataset or /etc/resolv.conf
  - ✓ specifies name of TCP/IP stack
  - ✓ assigns TCP/IP host and domain names
  - ✓ identifies DNS servers

Configuration File

TCPIP DATA

TCPIP.TCPIP.DATA   or /etc/resolv.conf

PROFILE TCPIP

TCPIP.PROFILE.TCPIP

HOSTS LOCAL

TCPIP.HOSTS.LOCAL
TCPIP.HOSTS.ADDRINFO
TCPIP.HOSTS.SITEINFO

ETC SERVICES
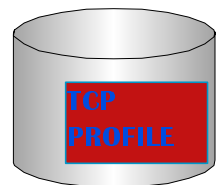
TCPIP.ETC.SERVICES or /etc/services

Defining Device Connection

DEVICE LCS1 LCS   640

LINK TR2 IBMTR   1 LCS1

HOME   9.82.1.190   TR2
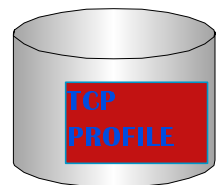
Start LCS1

TCP
PROFILE

Routing

Routing is done based on the definitions in the routing table

Each entry has two key definitions

- Destination
- Next hop
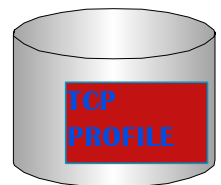 - router
  - local network

Routing

Direct Route - If both the source and destination on the same network

Indirect Route - Destination is on a different network and must be reached via a router.

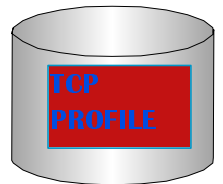Default Route - Used if the destination network can not be reached via the direct or indirect routes.

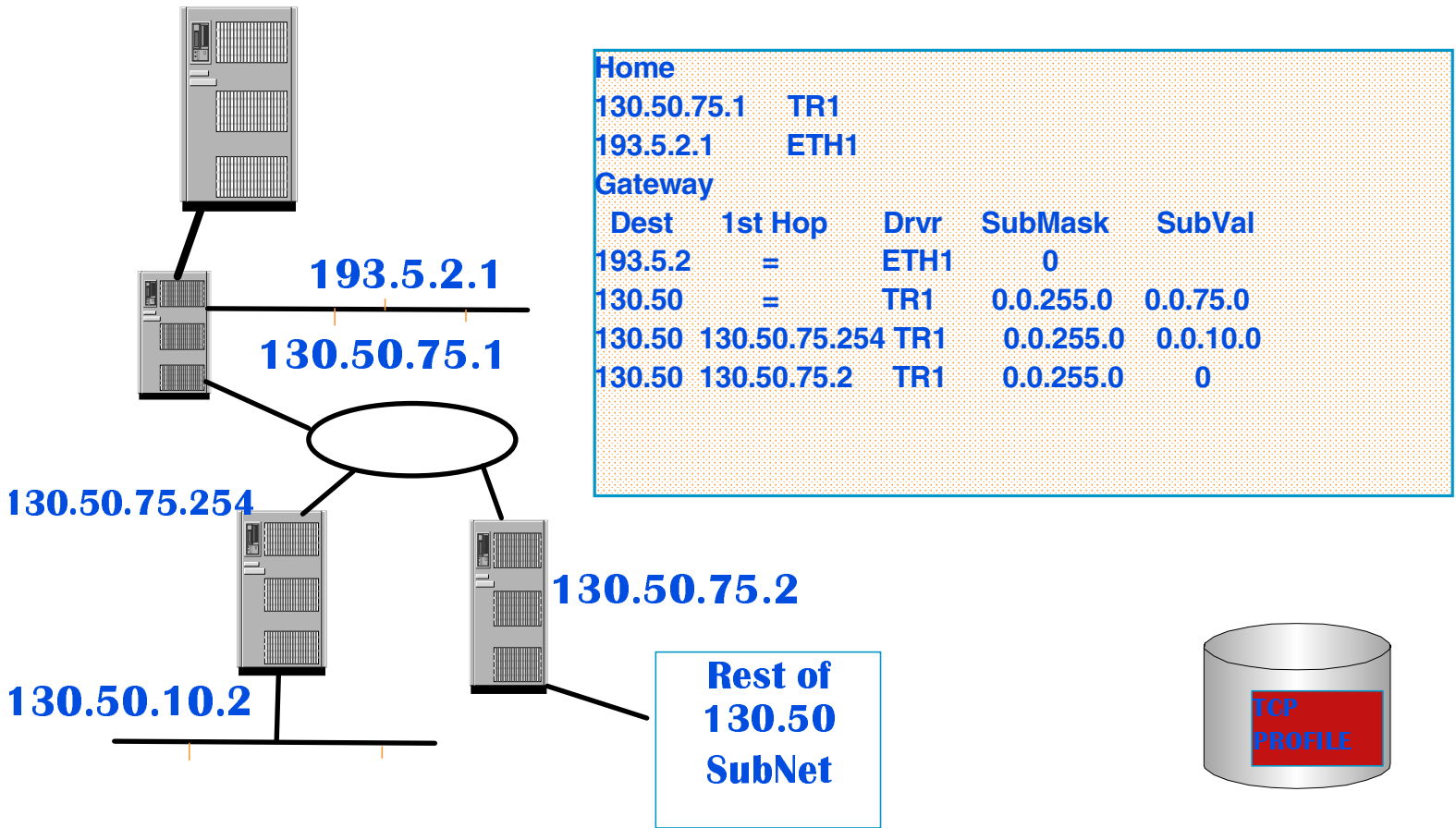TCP PROFILE

Static Routing Table

GATEWAY

; Network	First hop	Driver	Packet size	Subnet mask	Subnet
9	=	TR2	2000	0.255.255.0	0.82.1.0

; ROUTER

DEFAULTNET   9.82.1.103   TR2 DEFAULTSIZE   0

TCP
PROFILE

Subnet Example

```
Home
130.50.75.1     TR1
193.5.2.1       ETH1
Gateway
 Dest       1st Hop       Drvr     SubMask      SubVal
193.5.2       =           ETH1       0
130.50        =           TR1      0.0.255.0    0.0.75.0
130.50  130.50.75.254  TR1      0.0.255.0    0.0.10.0
130.50  130.50.75.2    TR1      0.0.255.0       0
```

193.5.2.1

130.50.75.1

130.50.75.254

130.50.10.2

130.50.75.2

Rest of 130.50 SubNet

TCP PROFILE

Domain Name System

Names that correspond to addresses

Distributed database with well-controlled authority

152.6.2.1	**vmhost12.austin.ibm.com**
131.6.0.7	**risc6000.iadb.org**
9.29.5.2	**www.umd.edu**
35.0.1.215	**gburg.ibm.com**

TCP DATA
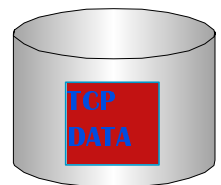
Resolver Data

TCP/IP Resolver:

TCPIP.DATA
hlq.ETC.PROTO
hlq.ETC.SERVICES
hlq.HOSTS.ADDRINFO
hlq.HOSTS.SITEINFO

LE Resolver:

/etc/resolv.conf
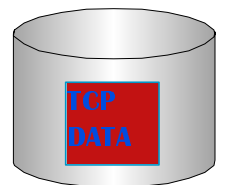/etc/protocol
/etc/services
/etc/hosts

Resolver DATA

HOSTNAME CGIMVS

DOMAINORIGIN WASHINGTON.IBM.COM

NSINTERADDR 9.82.1.107

TCPIPJobName   TCPIP

Datasetprefix   TCP

TCP
DATA

Setting RESOLVER_CONFIG
Environment Variable

- In the UNIX shell:
  - `export RESOLVER_CONFIG="//'USER1.ALFRED.CNTL(TCPDATAT)'"`

- In a BPXBATCH STDENV input file or data set:
  - `RESOLVER_CONFIG=//'USER1.ALFRED.CNTL(TCPDATAT)'`

- In a POSIX(ON) program's EXEC PARM string:
  - ```
//FTPD   EXEC PGM=FTPD,REGION=0K,TIME=NOLIMIT,
// PARM='ENVAR("RESOLVER_CONFIG=/etc/myresolv)/PORT 621'
    ```

# HOSTS LOCAL

## Used for local name/IP address resolution

- Names that can not be handled by the NameServer

- If the NameServer is unavailable

**HOST : 9.82.1.101 : WSCVM.WASHINGTON.IBM.COM,VM ::: :**
**HOST : 9.82.1.102 : WSCMVS.WASHINGTON.IBM.COM.MVS ::: :**
**HOST : 9.82.1.189: GHIDRA.WASHINGTON.IBM.COM,GHIDRA ::: :**
**HOST : 9.82.1.113: CHESPEAK.WASHINGTON.IBM.COM,CHESPEAK ::: :**

# MAKESITE

MAKESITE
(TSO command)

**SITEINFO**

**TCPIP.HOSTS.SITEINFO**

**HOSTS LOCAL**

**TCPIP.HOSTS.LOCAL**

**ADDRINFO**

**TCPIP.HOSTS.ADDRINFO**

# TCP/IP Applications

TN3720 (TELNET)

FTP

telnet

rlogin

# TN3270 Parm

## TCPIP.PROFILE.TCPIP

- **TELNETPARMS**...........
  **PORT**
  **ENDTELNETPARMS**

- **BEGINVTAM**...............
  **TELNETDEVICE**
  **DEFAULTLUS**
  **DEFAULTAPPL**
  **ALLOWAPPL**
  **ENDVTAM**

TCP
PROFILE
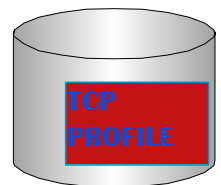
# VTAM Definitions in PROFILE

**TELNETDEVICE 3278-3-E NSX32703 ; 32 line screen**

**TELNETDEVICE 3279-3-E NSX32703 ; 32 line screen**

**TELNETDEVICE 3278-4-E NSX32704 ; 48 line screen**

**TELNETDEVICE 3279-4-E NSX32704 ; 48 line screen**

**DEFAULTLUS**

**TCP00001-TCP00030**

**ALLOWAPPL TSO\* DISCONNECTABLE**

**DEFAULTAPPL TSO**
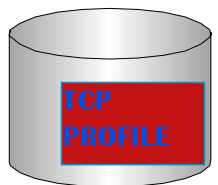
# SYS1.VTAMLST(*tcpappl*)

**TCP     VBUILD TYPE=APPL**

**TCP00001 APPL   AUTH=NVPACE,EAS=1,PARSESS=NO,**
**              MODETAB=ISTINCLM,SESSLIM=YES**

**TCP00002 APPL   AUTH=NVPACE,EAS=1,PARSESS=NO,**
**              MODETAB=ISTINCLM,SESSLIM=YES**

**TCP00003 APPL   AUTH=NVPACE,EAS=1,PARSESS=NO,**
**              MODETAB=ISTINCLM,SESSLIM=YES**

**TCP00004 APPL   AUTH=NVPACE,EAS=1,PARSESS=NO,**
**              MODETAB=ISTINCLM,SESSLIM**

SYS1.
VTAMLST

**VARY NET,ACT,ID=***tcpappl*

# Sockets

**Socket Address= IP Address +  Port Number**

**Client**

ftp

telnet

rlogin

tn3270

**9.82.1.110**

**TCP/IP**

**TCP/IP**

**Server**

ftpd
21

otelnetd
2023

rlogind
513

telnet
23

**9.82.34.3**

# SERVICES

| | |
|---|---|
| ftp | 21/tcp |
| telnet | 23/tcp |
| exec | 512/tcp |
| login | 513/tcp |
| shell | 514/tcp |

TCP. SERVICES

# FTP DATA

```
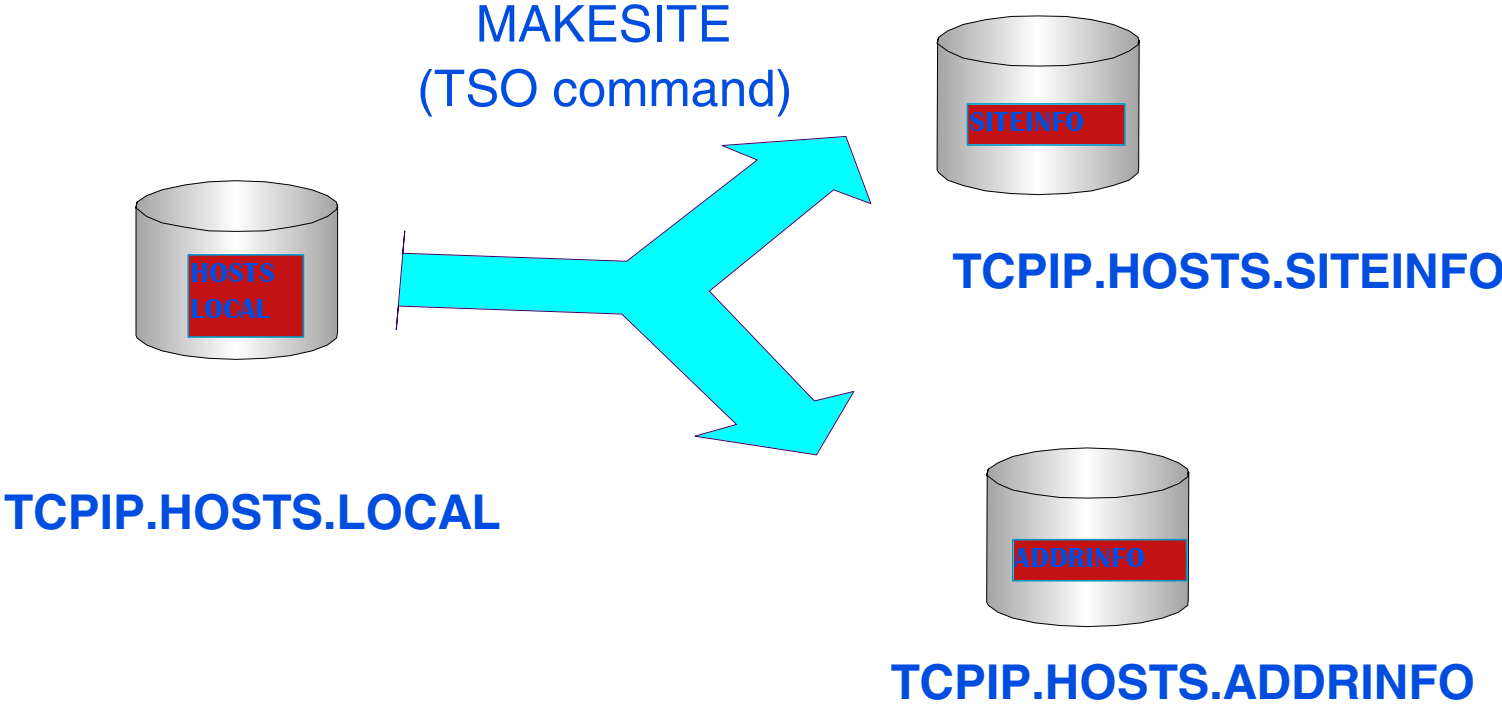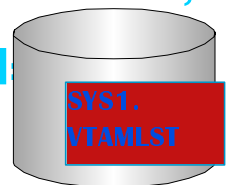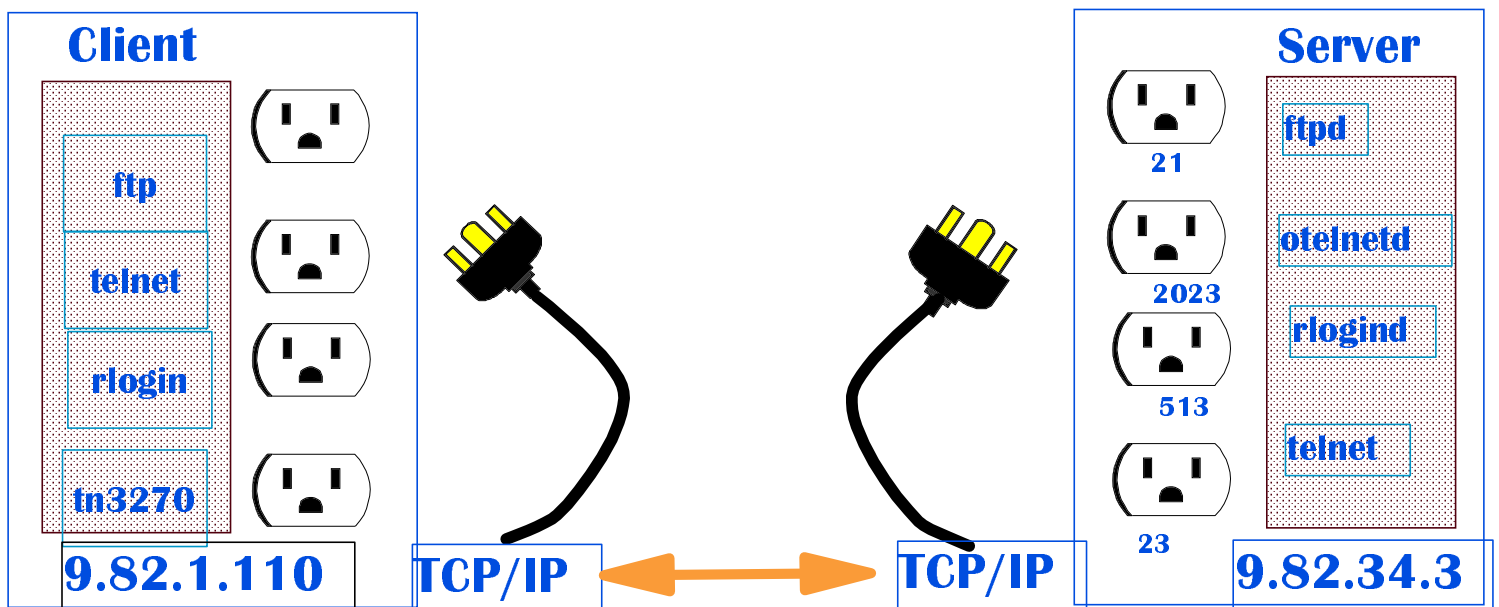AUTOMOUNT    TRUE        ; automatic mount of unmounted volume
AUTORECALL   TRUE        ; automatic recall of migrated data sets
BLOCKSIZE    6233         ; new data set allocation blocksize
DIRECTORY    27           ; new data set allocation directory blocks
FILETYPE     SEQ         ; file transfer mode
LRECL        256          ; new data set allocation lrecl
PRIMARY      1            ; new data set allocation primary space
RECFM        VB           ; new data set allocation record format
SECONDARY    1            ; new data set allocation secondary space
SPACETYPE    TRACK        ; new data set allocation space type
STARTDIR     HFS          ; use HFS directory at connect time
UMASK        022          ; octal UMASK to restrict setting
                          ; of permission bits when creating new hfs fil

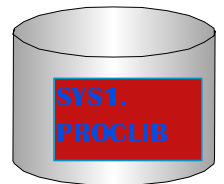UNITNAME     SYSDA        ; new data set allocation unit
```
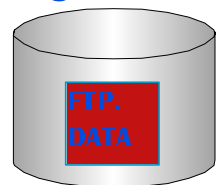
FTP.DATA

FTPD Proc

```
//FTPD   PROC MODULE='FTPD',PARMS=''
//FTPD   EXEC PGM=&MODULE,REGION=4096K,TIME=NOLIMIT,
//      PARM=ENVAR("RESOLVER_CONFIG=/etc/resolv)/&PARMS
//SYSFTPD DD DISP=SHR,DSN=TCPIP.FTP.DATA
```

SYS1.
PROCLIB

To start ftpd at OMVS initialization

/etc/rc

```
# Start the ftp daemon
_BPX_JOBNAME='FTPD'   /usr/sbin/ftpd
```

Additional Applications

Applications

- rlogin

- telnet (into the shell)

- rexec

- shell

use a generic listener called inetd

Configuration Files

/etc/inetd.conf

otelnet stream tcp nowait OMVSKERN /usr/sbin/otelnetd otelnetd -m

shell   stream tcp nowait OMVSKERN /usr/sbin/rshd rshd

login   stream tcp nowait OMVSKERN /usr/sbin/rlogind rlogind -m

exec   stream tcp nowait OMVSKERN /usr/sbin/rexecd rexecd

SERVICES

ftp	21/tcp
telnet	23/tcp
exec	512/tcp
login	513/tcp
shell	514/tcp
otelnet	2023/tcp

TCP.
SERVICES

RLOGIN or TELNET

/etc/inetd.conf
/etc/services

inetd

rlogin
port 513

or

telnet
port 23

opens
socket
binds to
port
listens for
requests
(loop)
fork

ASID=034

closes
files
except
socket
exec

oetelnetd
Server executes
.
spawn

ASID=044

The
shell

ASID=???

-m option on start of oetelnetd then shell will be started in the
same address space

Starting INETD

To start inetd at OMVS initialization
/etc/rc

```
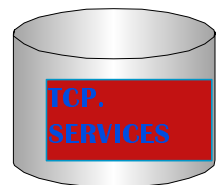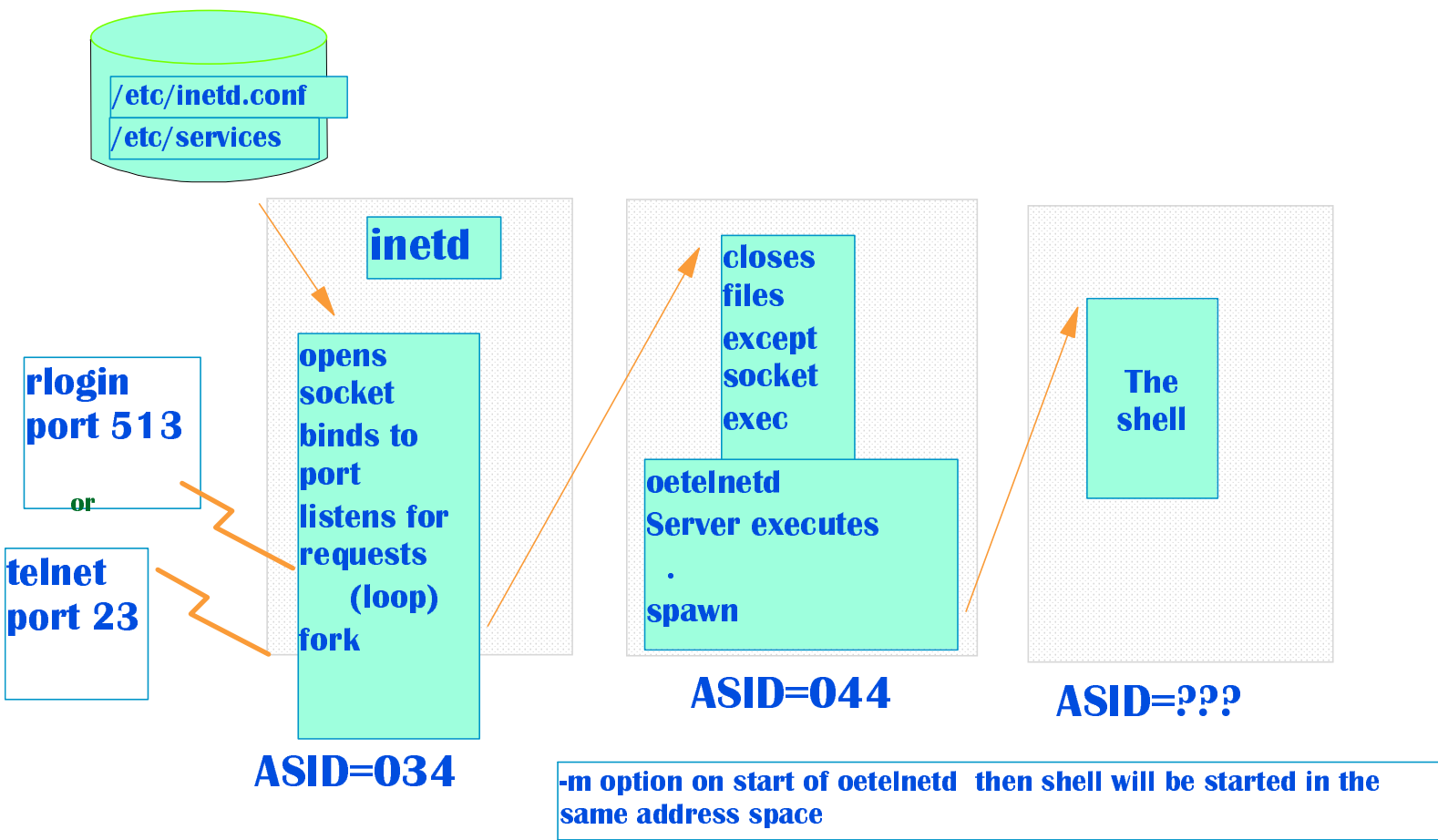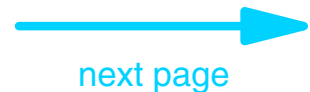# Start the INET daemon for remote login activity
_BPX_JOBNAME='INETD' /usr/sbin/inetd /etc/inetd.conf
```

To start inetd using TCPIP Autolog or via operator command

Starting INETD

Prior to OS390 2.7

```
//INETD PROC
//INETD  EXEC PGM=INETD,TIME=NOLIMIT,
//  PARM='POSIX(ON) ALL31(ON)/ /etc/inetd.conf'
//SYSPRINT DD SYSOUT=*
//SYSIN DD DUMMY
//SYSERR DD SYSOUT=H
//SYSOUT DD SYSOUT=H
//CEEDUMP DD SYSOUT=*
```

OS390 2.7 +

```
//INETD PROC
//* modified to R7 to BPXBATCH to start the inetd from HFS.
//INETD  EXEC PGM=BPXBATCH,TIME=NOLIMIT,
//    PARM='PGM /usr/sbin/inetd /etc/inetd.conf'
//SYSPRINT DD SYSOUT=*
//SYSIN DD DUMMY

//SYSERR DD SYSOUT=H
//SYSOUT DD SYSOUT=H
//CEEDUMP DD SYSOUT=*
```

SYS1.
PROCLIB
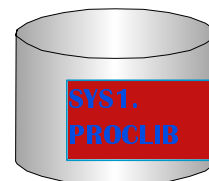
TCPIP PROC

```
//TCPIP    PROC PARMS='CTRACE(CTIEZB00)'
//TCPIP    EXEC PGM=EZBTCPIP,
//         PARM='&PARMS',
//         REGION=0M,TIME=1440
//SYSPRINT DD SYSOUT=*,DCB=(RECFM=VB,.......
//ALGPRINT DD SYSOUT=*,DCB=(RECFM=VB,.......
//SYSOUT   DD SYSOUT=*,DCB=(RECFM=VB,........
//CEEDUMP  DD SYSOUT=*,DCB=(RECFM=VB,.......
//SYSERROR DD SYSOUT=*
//SYSMDUMP DD DUMMY
//PROFILE   DD DISP=SHR,DSN=TCPIP.PROFILE.TCPIP
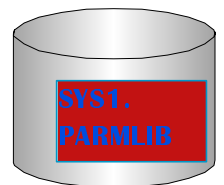//SYSTCPD  DD DISP=SHR,DSN=TCPIP.TCPIP.DATA
```

SYS1.
PROCLIB
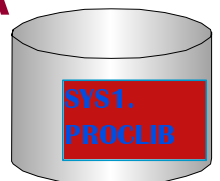
BPXPRMxx

FILESYSTYPE TYPE(IBMUDS) ENTRYPOINT(BPXTUINT)
NETWORK DOMAINNAME(AF_UNIX)
    DOMAINNUMBER(1)
    MAXSOCKETS(64)
    TYPE(IBMUDS)

FILESYSTYPE TYPE(INET) ENTRYPOINT(EZBPFINI)
NETWORK DOMAINNAME(AF_INET)
    DOMAINNUMBER(2)
    MAXSOCKETS(10000)
    TYPE(INET)

SYS1.
PARMLIB

SCHEDxx

PPT PGMNAME(EZAINMAN) NOSWAP NOCANCEL KEY(6) PRIV SYST

PPT PGMNAME(EZBTCPIP) NOSWAP NOCANCEL KEY(6) PRIV SYST

PPT PGMNAME(MVPTNF) NOSWAP NOCANCEL KEY(0) PRIV SYST

PPT PGMNAME(MVPXVMCF) NOSWAP NOCANCEL KEY(0) PRIV SYST

SYS1. PARMLIB
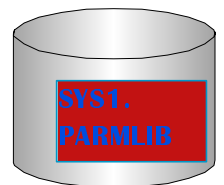
SSN and LPA

IEFSSNxx
SUBSYS SUBNAME(TNF)   /* TCPIP   */
SUBSYS SUBNAME(VMCF)   /* TCPIP   */

CMMNDxx
COM='S EZAZSSI,P=nodename'

LPALSTxx
TCPIP.SEZALPA

SYS1.
PARMLIB
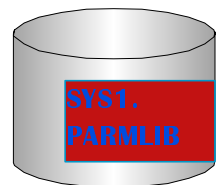
PROGxx or IEAAPFxx

TCPIP.SEZATCP vvvvv,

TCPIP.SEZALINK vvvvv,

TCPIP.SEZALNK2 vvvvv,

TCPIP.SEZAMIG vvvvv,

TCPIP.SEZADSIL vvvvv,

TCPIP.SEZALPA vvvvv

SYS1.
PARMLIB
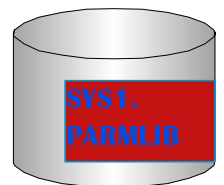
RACF Defiitions

ADDUSER TCPIP DEFLTGRP(OMVSGRP) OMVS(UID(0) HOME('/usr/lpp/tcpip'))

RDEFINE STARTED TCPIP.* STDATA(USER(TCPIP))

RDEFINE STARTED FTPD.* STDATA(USER(TCPIP))

RDEFINE STARTED INETD.* STDATA(USER(TCPIP))

SETROPTS RACLIST(STARTED) REFRESH

DAEMON Authority

RDEFINE FACILITY BPX.DAEMON
 UACC(NONE)

PERMIT BPX.DAEMON CLASS(FACILITY)
 ACCESS(READ) ID(TCPIP)

RALTER PROGRAM *
ADDMEM('TCPIP.SEZALINK'//NOPADCHK)
 UACC(READ)

SETROPTS RACLIST(FACILITY) REFRESH

SETROPTS WHEN(PROGRAM) REFRESH

TCP VARY Commands

VARY TCPIP,TCPPROC,CMD=OBEYFILE,DSN=TEICHMAN.OBEYFIL

VARY TCPIP,TCPPROC,START,CTC1

VARY TCPIP,TCPPROC,CMD=DROP,CONNECTION=5001

TCP VARY Commands

RDEFINE OPERCMDS MVS.VARY.TCPIP.**

PERMIT MVS.VARY.TCPIP.** CL(OPERCMDS) ACCESS(CONTROL) ID(IBMUSER)

PERMIT MVS.VARY.TCPIP.** CL(OPERCMDS) ACCESS(CONTROL) ID(SYSADM)

SETROPTS RACLIST(OPERCMDS) REFRESH

Default UserID

ADDGROUP defgrp OMVS(GID(77777))

ADDUSER defuser DFLTGRP(defgrp) NAME('DEFAULT OE USER') OMVS(UID(99999))

RDEFINE FACILITY BPX.DEFAULT.USER APPLDATA('defuser')

SETR RACLIST(FACILITY) REFRESH

Useful Commands

PING - test the connectivity to another host

      PING 9.19.122.55

    PING ATLLAB131.SD.DFW.IBM.COM

NETSTAT - display configuration and statistical information for this host

    NETSTAT HOME

      displays the IP address

    NETSTAT GATE

      displays the routing information

NSLOOKUP - look up names in a nameserver

    NSLOOKUP FLASH

    NSLOOKUP SOCKS1.SERVER.IBM.COM