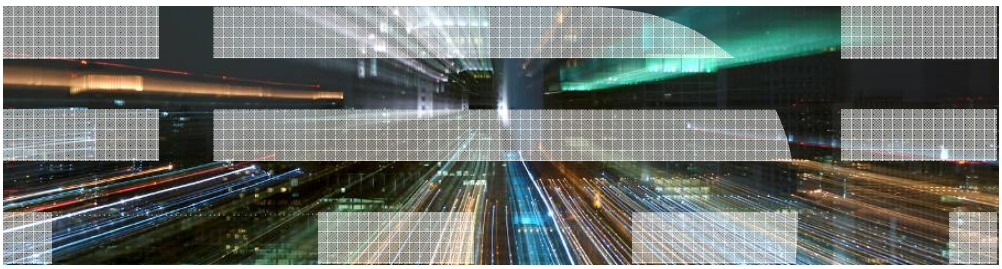
By David Spurway, IBM Power Systems Product Manager

Cost Comparison between IBM Power and Intel



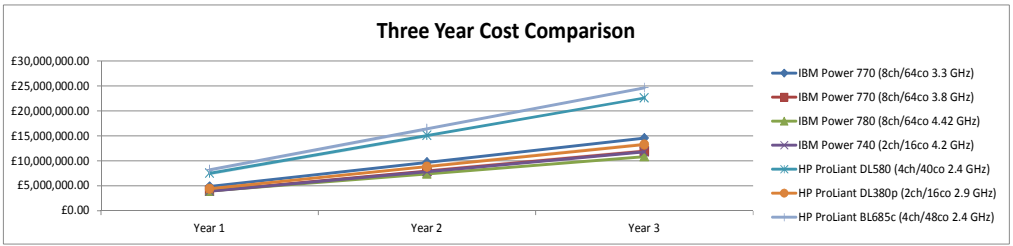
Acknowledgements

- This presentation draws heavily on work by the IBM UK Systems Architect, Stewart Dench.
- The layout of the majority of the presentation also builds on a style from the IBM USA Competitive Sales Consultant, Rick A. Kearns.
- I have also reused the charts created by Steven Atkins, from the Solitaire Interglobal Ltd. “Does your OS Matter?” report.
- The statistics included in the model were passed to me by Andrew Gadsby, who received them from Innes Read of the IBM Software Group Competitive Project Office in the US. Roger Rogers also helped me with the logic involved.
- I also had help working through the algebra for the Central Limit Theorem from IBM UK Financial Management Consultant, Jay Parmar

Agenda

- Results Summary
- Server Selection
- Oracle DB example
  - The initial cost problem
  - All cores are not created equal
  - Virtualisation support
  - Effect of workload spread
  - Benefits of a big pool
  - With or without limits?
  - Software costs
  - Adding redundant server
- WAS example
  - Software costs
  - Adding redundant server
- Combined Oracle and WAS example
- Other benefits
- Summary

Results Summary

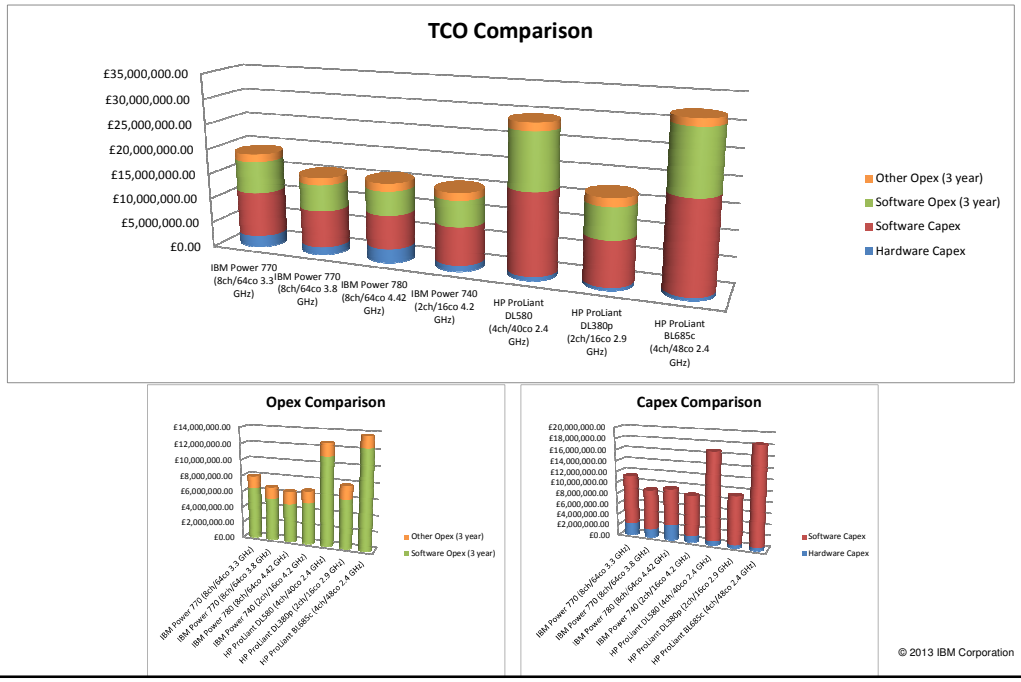


Over 3 years, here are the comparative results against the reference solution, which was using the IBM Power 770 (8ch/64co 3.3 GHz) server:

	IBM Power 770 (8ch/64co 3.3 GHz)	IBM Power 770 (8ch/64co 3.8 GHz)	IBM Power 780 (8ch/64co 4.42 GHz)	IBM Power 740 (2ch/16co 4.2 GHz)	HP ProLiant DL580 (4ch/40co 2.4 GHz)	HP ProLiant DL380p (2ch/16co 2.9 GHz)	HP ProLiant BL685c (4ch/48co 2.4 GHz)
Software License Costs (%Saving)	£8.91m	£7.35m (17%)	£6.67m (25%)	£7.45m (16%)	£15.99m (-80%)	£8.78m (1%)	£17.75m (-99%)
Software Support Costs (%Saving)	£6.37m	£5.25m (18%)	£4.77m (25%)	£5.14m (19%)	£11.01m (-73%)	£6.08m (5%)	£12.25m (-92%)
Hardware Purchases Costs (%Saving)	£2.2m	£1.46m (34%)	£2.69m (-22%)	£1.12m (49%)	£0.68m (69%)	£0.46m (79%)	£0.51m (77%)
Hardware Maintenance (%Saving)	£219k	£145k (34%)	£268k (-22%)	£107k (51%)	£60k (73%)	£35k (84%)	£51k (77%)
People costs (%Saving)	£1232k	£1224k (1%)	£1224k (1%)	£1328k (-8%)	£1408k (-14%)	£1504k (-22%)	£1309k (-6%)
Power costs (%Saving)	£59k	£49k (17%)	£63k (-7%)	£41k (31%)	£108k (-82%)	£89k (-51%)	£42k (30%)
Space costs (%Saving)	£2k	£1k (25%)	£1k (25%)	£2k (0%)	£3k (-63%)	£2k (-19%)	£1k (72%)
Total	**£18.99m**	**£15.47m (19%)**	**£15.68m (17%)**	**£15.19m (20%)**	**£29.26m (-54%)**	**£16.95m (11%)**	**£31.92m (-68%)**

Addressing the common exam question of whether the solution would be cheaper on x86.

Cost Breakdown

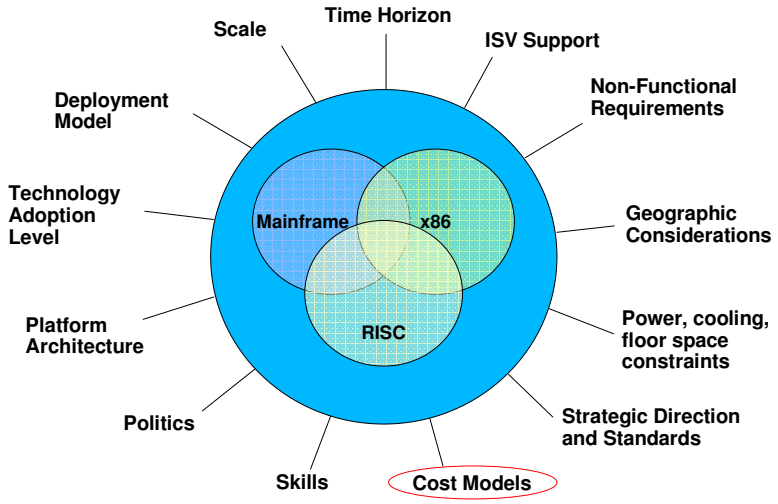


Many Factors Affect Choice

Would you purchase a family car solely on one factor?

Car	Server
Purchase price	Purchase price
Gas mileage, cost of repairs, insurance cost	Cost of operation, power consumption, floor space
Reliability	Reliability
Safety, maneuverability, visibility, vendor service	Availability, disaster recovery, vendor service
Storage capacity, number of seats, towing capacity	Scalability, throughput
Horsepower	Chip performance
Dash board layout Steering wheel location	Instrumentation and skills
Handling, comfort, features	Manageability
Looks, styling, size	Peer and industry recognition

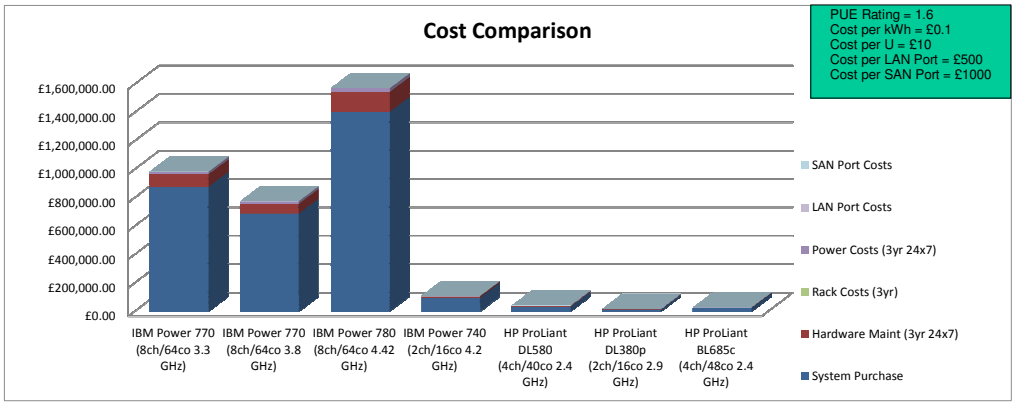
Selecting a Platform



Build up case single server

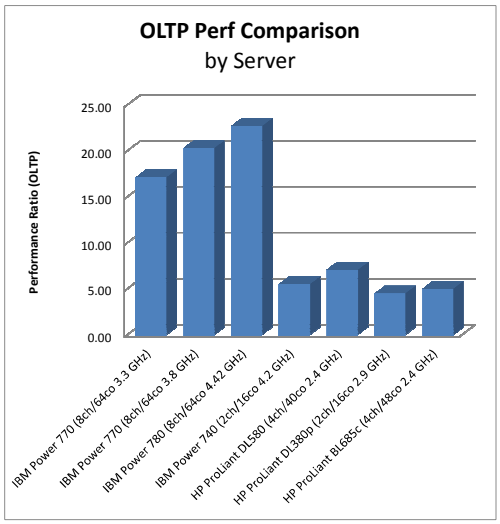
Click for table

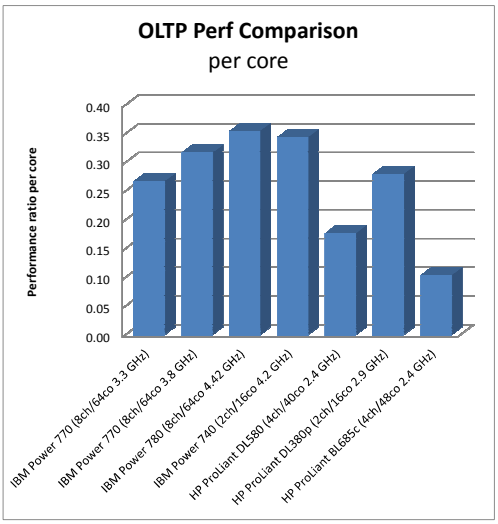
List prices are used at this stage.



Server	IBM Power 770	IBM Power 770	IBM Power 780	IBM Power 740	HP ProLiant DL580	HP ProLiant DL380p	HP ProLiant BL685c
Initial Cost of Ownership	£987,000	£778,000	£1,575,000	£112,000	£45,000	£21,000	£33,000
Cooling Load (watts)	47 to 1	37.05 to 1	75 to 1	5.34 to 1	2.15 to 1	1 to 1	1.58 to 1

OLTP Server Performance





Clear advantage for the new IBM Power Systems, particularly over the systems using AMD or 4 socket Intel

Ideas International and Gartner

- **About Ideas International (IDEAS)**

  IDEAS provides enterprise IT research, insight, analysis, and tools to computer suppliers and consultants (IT Sellers) and large corporations (IT Buyers). The company's research focus areas include servers, storage, software, services, and cloud. Many IDEAS tools are powered by RPE2, the atomic unit of compute. IDEAS is a publicly traded company on the Australian Stock Exchange (ASX:IDE) and has been in business for over 25 years. IDEAS hosts users in over 100 countries and maintains offices in the US, EMEA, and Asia Pacific.

- **31 May 2012**
- IDEAS is pleased to announce that the takeover offer from Gartner is now unconditional and also follows Gartner having received acceptances from more than 93% of the shareholders for the takeover offer.

http://www.ideasinternational.com/Resources/Press-Releases/Gartner-s-takeover-offer-for-IDEAS-is-successful

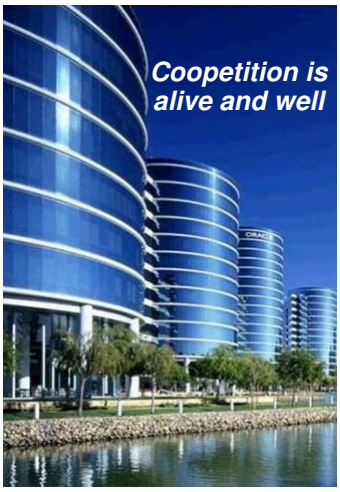
Oracle Certification For VMware and KVM

- Running Oracle in a VMware ESX cluster you must license ALL of the cores in the cluster
- Oracle DOES NOT recognise VMware as "hard partitioning"
- http://blogs.gartner.com/chris-wolf/2010/11/10/oracle-broadens-x86-virtualisation-support-but-work-remains/
- Running Oracle in a VMware ESX cluster is not certified. If support is required for unknown problems then you must recreate the problem without VMware installed view Oracle Metalink document 249212.1

> *Oracle has not certified any of its products on VMware virtualized environments. Oracle Support will assist customers running Oracle products on VMware in the following manner: Oracle will only provide support for issues that either are known to occur on the native OS, or can be demonstrated not to be as a result of running on VMware.*
> *If a problem is a known Oracle issue, Oracle support will recommend the appropriate solution on the native OS. If that solution does not work in the VMware virtualized environment, the customer will be referred to VMware for support. When the customer can demonstrate that the Oracle solution does not work when running on the native OS, Oracle will resume support, including logging a bug with Oracle Development for investigation if required.*

- Red Hat Enterprise Linux 5 integrates Kernel-based Virtual Machine (KVM) and ships Xen as the default hypervisor, so they are supported by Oracle under the Oracle Linux support program. However, Oracle does not support Oracle products on RHEL's KVM/Xen.
- http://www.oracle.com/us/technologies/027617.pdf

IBM and Oracle Have a Long-Standing Relationship



Sustaining relationship of 120K + clients
- Oracle 22 years, PeopleSoft 20 years, JD Edwards 31 years, Siebel 10 years

More than 120K joint technology clients
- And more than 20,000 joint application clients

Vibrant technology relationship
- Sustained investment in skills and resources including dedicated international competency

Market-leading services practice
- IBM GBS is Oracle's #1 SI partner (7,500 joint projects) with 5,000 people dedicated to Oracle

Unrivalled client support process
- Dedicated on-site resources and significant program investments

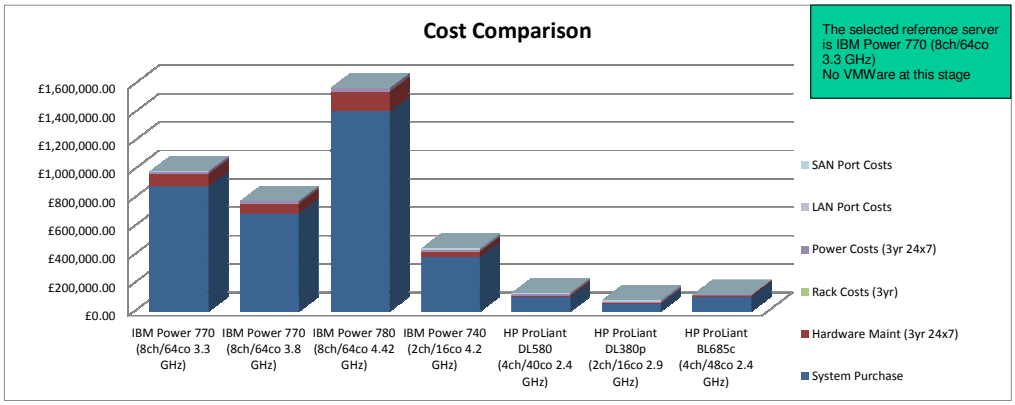
Oracle Databases (along with most other Oracle products) are fully certified on IBM Power Systems, including the use of PowerVM virtualisation, Micropartitioning, PowerHA and Live Partition Mobility (LPM certified for Single Instance DB only).

http://www-03.ibm.com/support/techdocs/atsmastr.nsf/WebIndex/PRS3369

Build up case benchmark

Click for table

Using one of the IBM Power 770 servers (3.3 GHz MMC) as a reference, how many of the other servers are needed to match the performance?

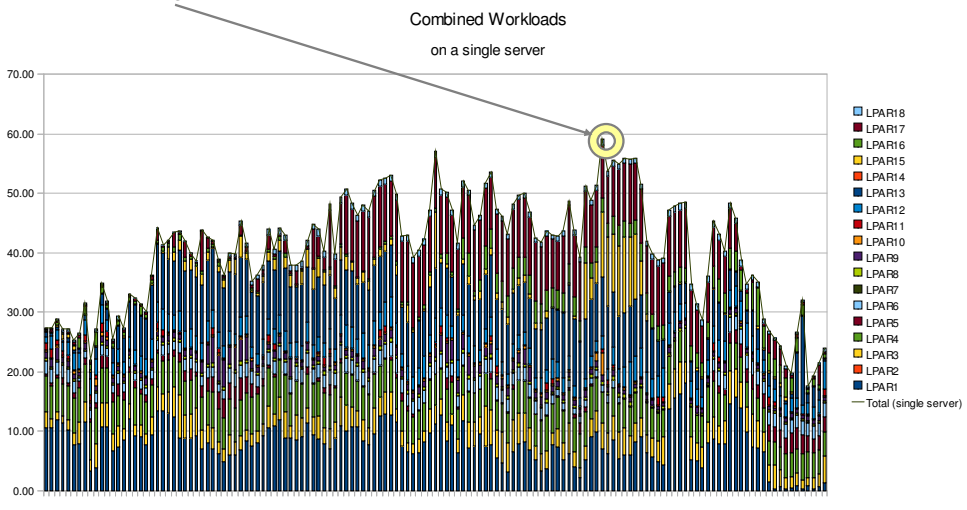


Server	IBM Power 770	IBM Power 770	IBM Power 780	IBM Power 740	HP ProLiant DL580	HP ProLiant DL380p	HP ProLiant BL685c
Perf Factor (Benchmark)	1.00	0.84	0.75	3.11	2.42	3.82	3.43
Number of servers	1	1	1	4	3	4	4

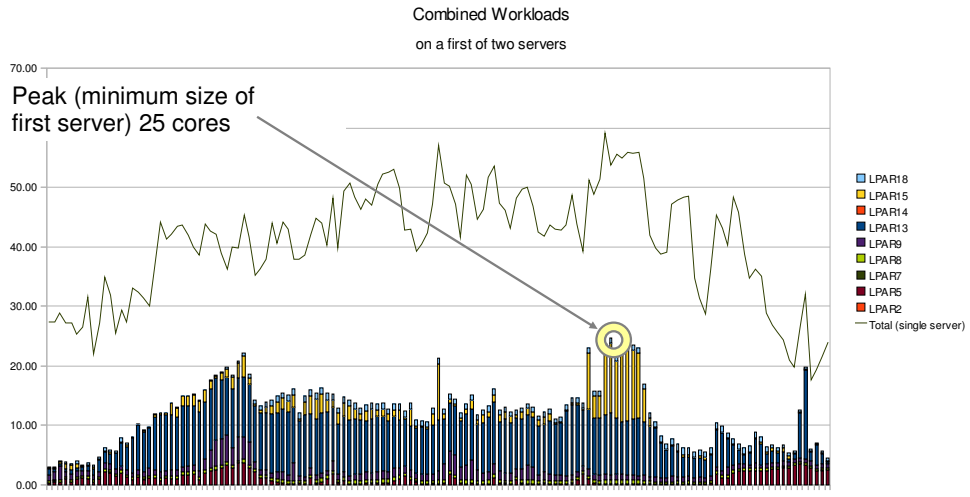
With IBM Power Systems, virtualisation is built into the hardware, adds no overhead and is always on. Less resources are therefore needed, reducing costs.

Resource utilisation through virtualisation
Single Server

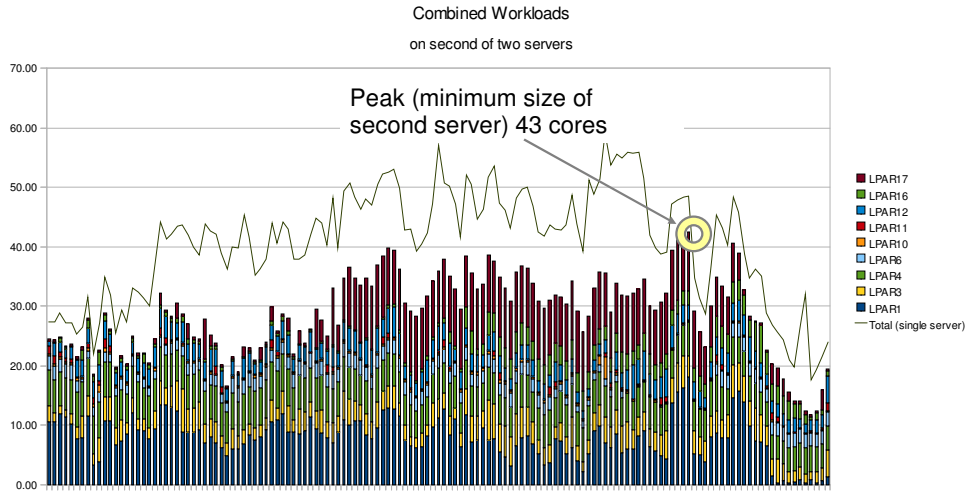
Peak (minimum size of server)
59 cores for single server



Resource utilisation through virtualisation
First server of two



Resource utilisation through virtualisation
Second server of two

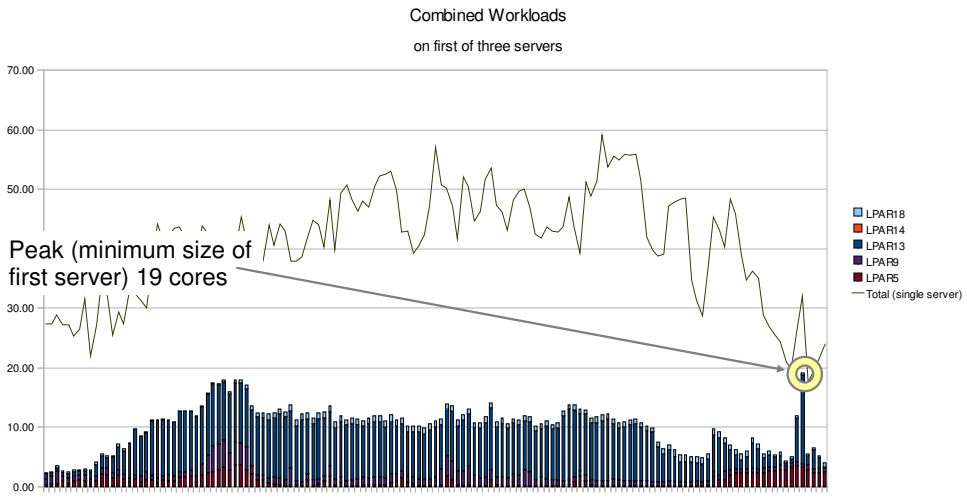


Results of splitting workloads from one server across two

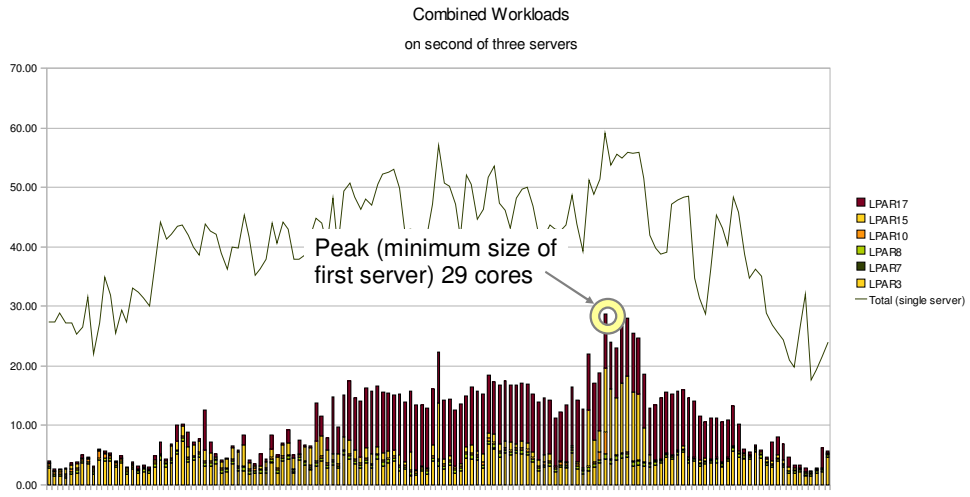
Peak (minimum size of server)
59 cores for single server

Peak (minimum size of first server) 25 cores + Peak (minimum size of second server) 43 cores = A minimum of 68 cores needed in two server solution (an increase of ~15% over single server solution)

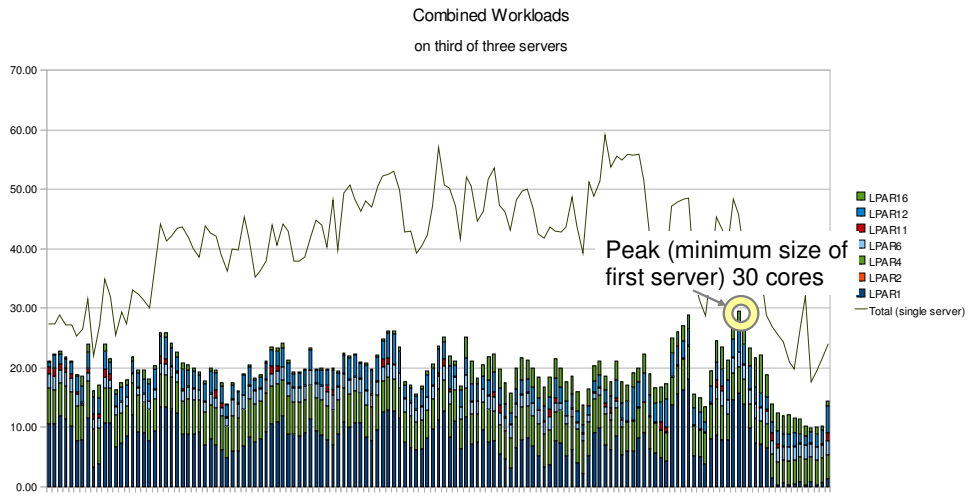
Resource utilisation through virtualisation
First server of three



Resource utilisation through virtualisation
Second server of three



Resource utilisation through virtualisation
Third server of three



Results of splitting workloads from one server across two or three

Peak (minimum size of server)
59 cores

Peak (minimum size of first server) 25 cores + Peak (minimum size of second server) 43 cores = A minimum of 68 cores needed in two server solution (an increase of ~15% over single server solution)

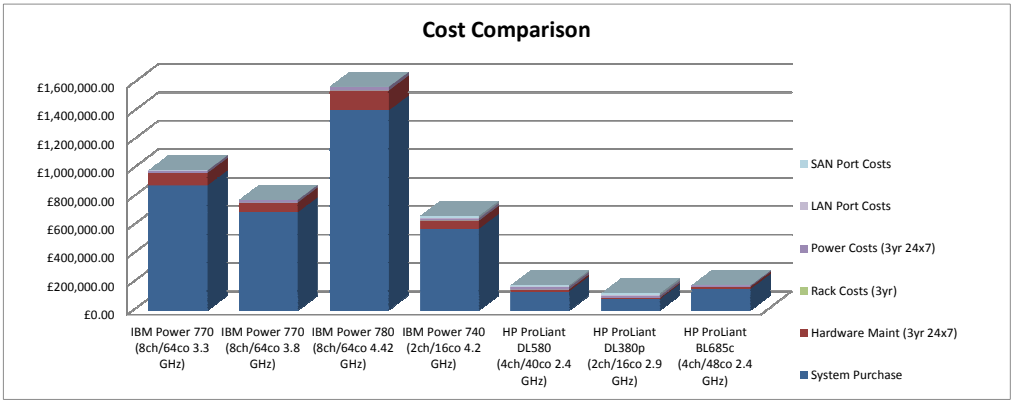
Peak (minimum size of first server) 19 cores + Peak (minimum size of first server) 29 cores + Peak (minimum size of first server) 30 cores

= A minimum of 78 cores needed in three server solution (a further increase of ~15% over two server solution)

Build up case scale out

Click for table

Using this 15% effect per server when scaling out, how many servers are now needed to match the reference?



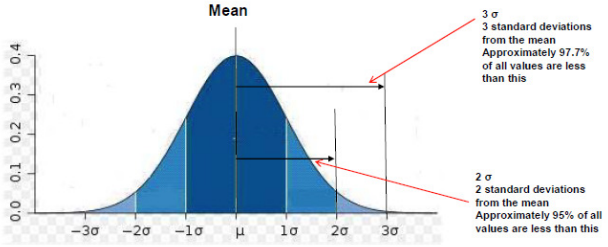
Server	IBM Power 770	IBM Power 770	IBM Power 780	IBM Power 740	HP ProLiant DL580	HP ProLiant DL380p	HP ProLiant BL685c
Overhead for multiple servers	0%	0%	0%	45%	30%	45%	45%
Resulting servers needed	1	1	1	6	4	6	6

IBM Power allows larger pools of virtualised resources. Spikes in workloads can be accommodated with fewer resources. Less resources are therefore needed, reducing costs.

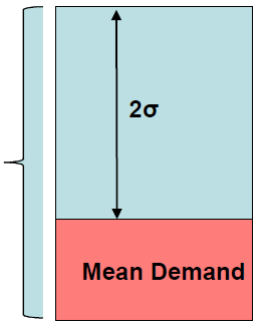
Adding some Statistical Theory to the model - SLAs

Statistical Models Can Be Used To Account For Workload Variability

- Assume a server workload with varying demand over time, that can be modeled as a standard normal distribution. Theory tells us 95% of the values are less than 2 standard deviations away.



To meet a 95% SLA, we need a server with a total capacity of (Mean Demand + 2 σ)



Open paper "A Benchmark Study on Virtualization Platforms for Private Clouds"

Adding some Statistical Theory to the model - Sigma

What Is A Typical Value Of Sigma?

IBM Survey Of Workload Variability In 3200 Servers

Type Of Workload	Average Utilization	Peak Utilization	Sigma
Infrastructure	6%	35%	2.5 * Mean
Web Server	4%	24%	2.5 * Mean
Application	4%	34%	3.75 * Mean
Database	5%	37%	3.25 * Mean
Terminal	6%	45%	3.25 * Mean
E-Mail	4%	34%	3.75 * Mean

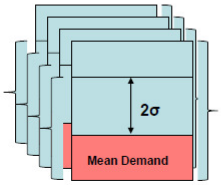
IBM System x™ Servers and VMware Virtual Machine Sizing Guide
Legacy workloads on XEON 2.5-2.8GHz Servers

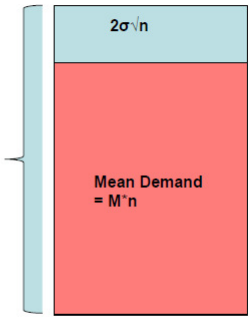
Open paper "A Benchmark Study on Virtualization Platforms for Private Clouds"

Adding some Statistical Theory to the model – Central Limit Theorem

Pooling Variability Drives Normalized σ Down By √n

Headroom is reduced by a factor of the square root of n where n is the number of consolidations





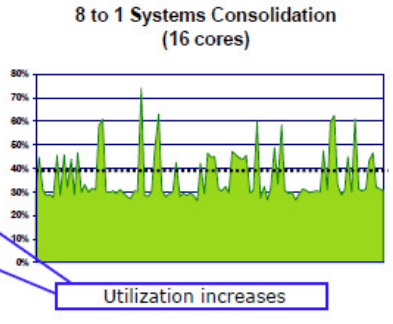
The Mean Demand is going up by n, but the headroom is only going up by √n. Normalized by scale this reduced waste by √n.

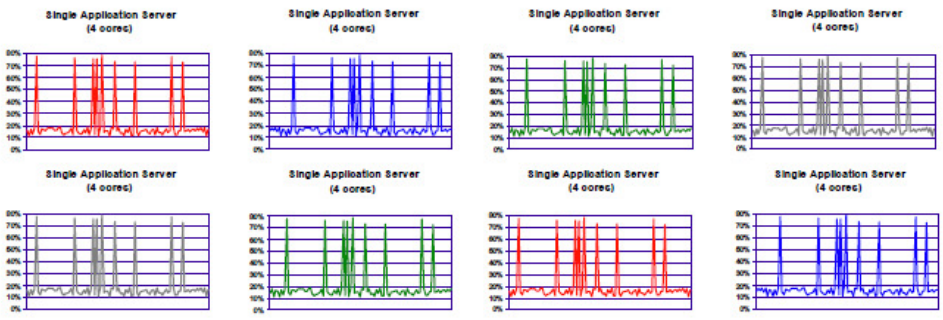
Open paper "A Benchmark Study on Virtualization Platforms for Private Clouds"

Statistical Multiplexing drives up utilisation

- **8** separate workloads on **8** identical systems
  - Average utilization is 17%
  - Peak is 6 times the average
- **8** separate workloads on one system*
  - **Average utilization is 36%**
  - Peaks is 2.76 times the average

* **32 cores reduced to 16 cores (2 to 1)**

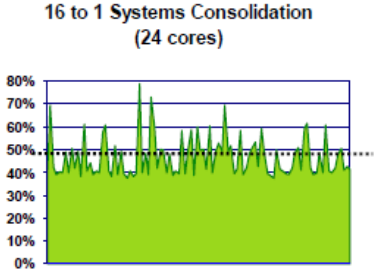


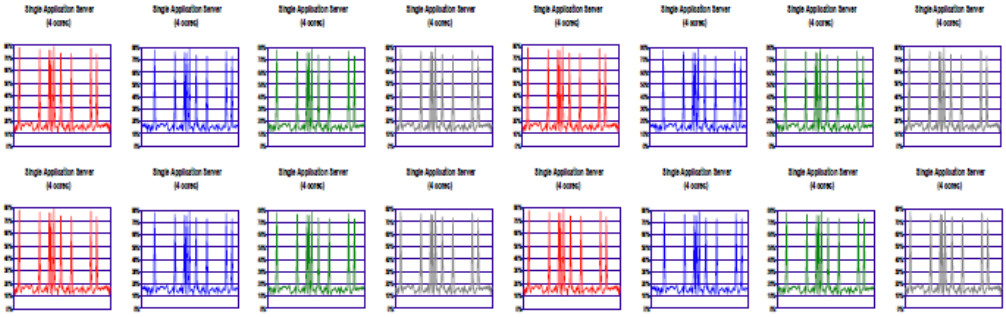


Statistical Multiplexing drives up utilisation – bigger servers are better

- **16** separate workloads on **16** identical systems
  - Average utilization is 17%
  - Peak is 6 times the average
- **16** separate workloads on one system*
  - **Average utilization is 44%**
  - Peaks is 2.25 times the average

64 cores reduced to 24 cores (2.65 to 1)

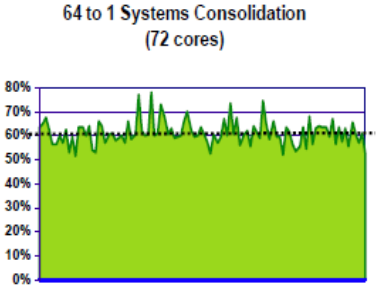


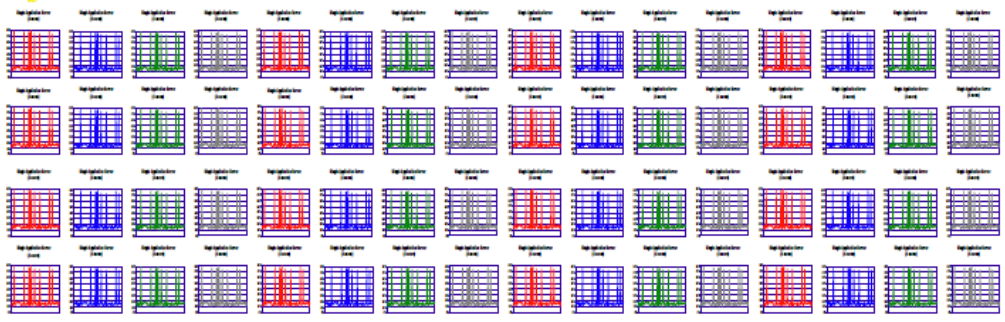


Statistical Multiplexing drives up utilisation – even bigger servers are better

- **64** separate workloads on **64** identical systems
  - Average utilization is 17%
  - Peak is 6 times the average
- **64** separate workloads on one system*
  - **Average utilization is 60%**
  - Peaks is 1.625 times the average

256 cores reduced to 72 cores (3.55 to 1)

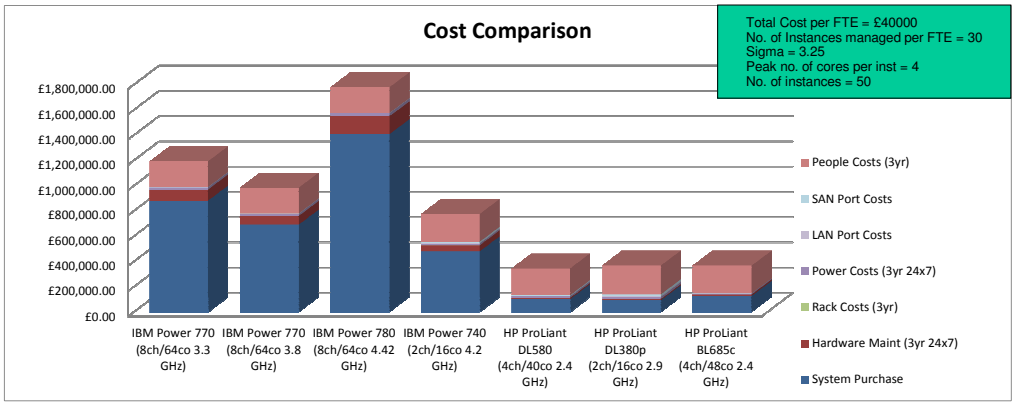




Build up case Central Limit Theorem

Click for table

Using this statistical approach, calculating how many workloads each server is likely to be able to run, how many servers of each type are needed?



Server	IBM Power 770	IBM Power 770	IBM Power 780	IBM Power 740	HP ProLiant DL580	HP ProLiant DL380p	HP ProLiant BL685c
Difference between Average and Peak (Normalised to Peak)	0.48	0.48	0.48	0.67	0.61	0.71	0.67
Number of servers	1	1	1	5	3	7	5

IBM Power allows larger pools of virtualised resources. Spikes in workloads can be accommodated with fewer resources. Less resources are therefore needed, reducing costs.

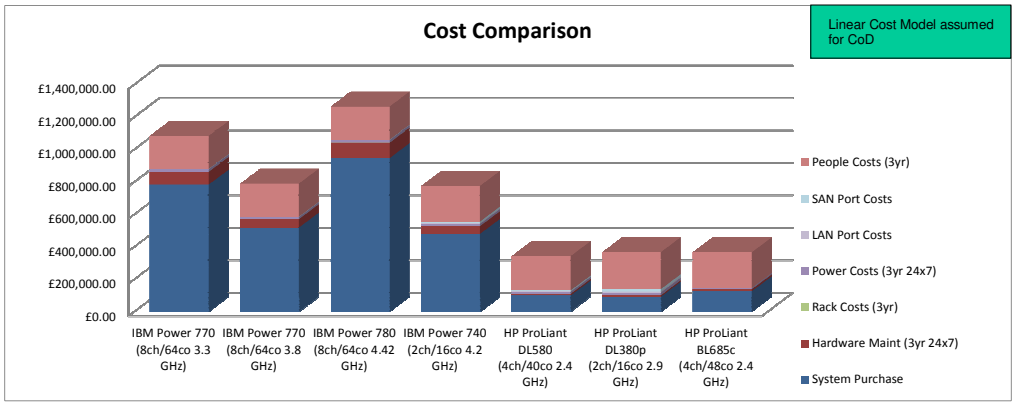
Side by side of method results

Server	IBM Power 770	IBM Power 770	IBM Power 780	IBM Power 740	HP ProLiant DL580	HP ProLiant DL380p	HP ProLiant BL685c
Overhead for multiple servers	0%	0%	0%	45%	30%	45%	45%
Servers (calculated from observed customer data)	1	1	1	6	4	6	6
Servers (calculated from statistical logic)	1	1	1	5	3	7	5
Average Utilisation Rate (Server)	42%	35%	31%	26%	34%	23%	29%
Peak Utilisation Rate (Server)	80%	67%	60%	79%	87%	78%	87%
Difference between Average and Peak (Normalised to Peak)	0.48	0.48	0.48	0.67	0.61	0.71	0.67

Build up case Capacity on Demand

Click for table

Where Capacity on Demand is supported, not all the available cores may be needed to reach the desired peak on the server.



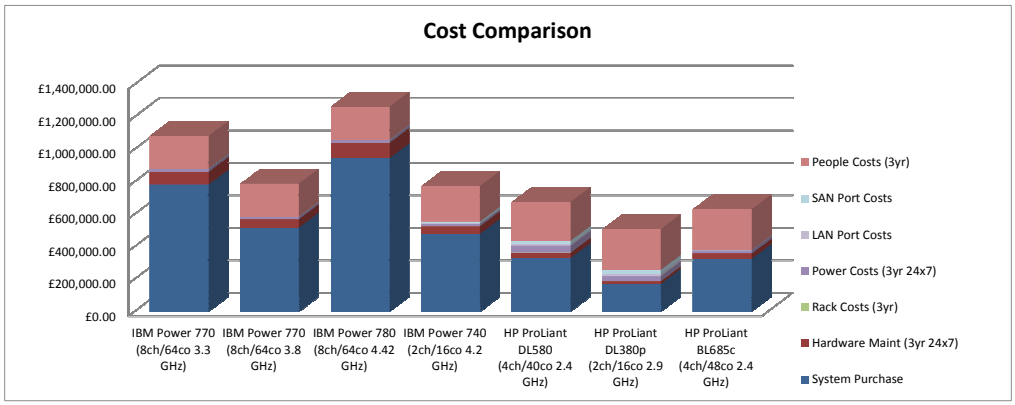
Server	IBM Power 770	IBM Power 770	IBM Power 780	IBM Power 740	HP ProLiant DL580	HP ProLiant DL380p	HP ProLiant BL685c
Active cores	57	48	43	80	120	112	240
Number of servers	1	1	1	5	3	7	5

Larger IBM Power Systems can still be right sized and dynamically upgraded to control initial purchase costs and software license requirements

Build up case Limit DBs

Click for table

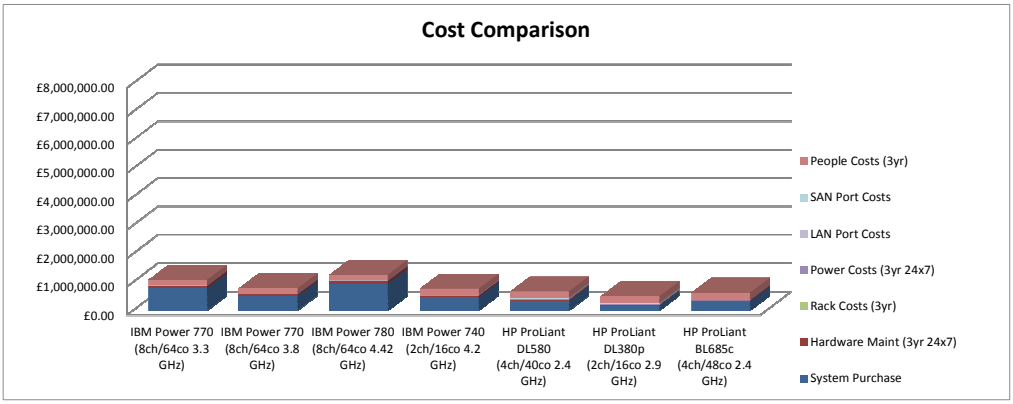
As the Oracle DB instances on the x86 servers are not virtualised, some balance needs to be struck between running a single instance per server and running multiple instances with no workload isolation. I have chosen to avoid CPU Overcommitment on the x86 servers.



Server	IBM Power 770	IBM Power 770	IBM Power 780	IBM Power 740	HP ProLiant DL580	HP ProLiant DL380p	HP ProLiant BL685c
CPU Overcommit Ratio	3.51 to 1	4.17 to 1	4.66 to 1	2.5 to 1	0.88 to 1	0.97 to 1	0.89 to 1
Number of servers	1	1	1	5	10	13	13

Scale change – before software costs are added

Click for table

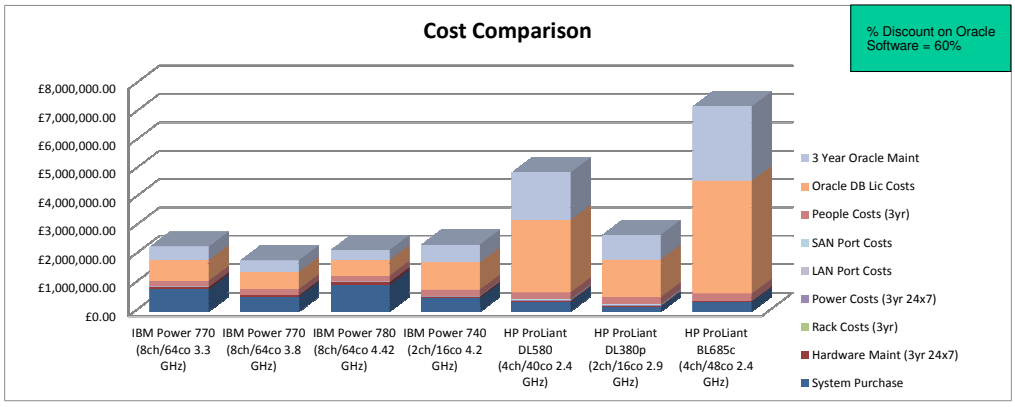


Server	IBM Power 770	IBM Power 770	IBM Power 780	IBM Power 740	HP ProLiant DL580	HP ProLiant DL380p	HP ProLiant BL685c
CPU Overcommit Ratio	3.51 to 1	4.17 to 1	4.66 to 1	2.5 to 1	0.88 to 1	0.97 to 1	0.89 to 1
Number of servers	1	1	1	5	10	13	13

Build up case Oracle DB software

Click for table

Add costs for Oracle Database, taking the Processor Factors into account.

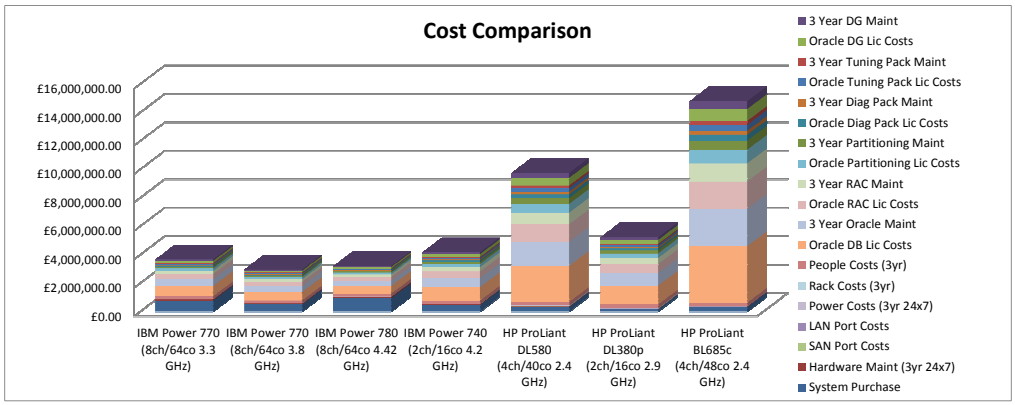


Server	IBM Power 770	IBM Power 770	IBM Power 780	IBM Power 740	HP ProLiant DL580	HP ProLiant DL380p	HP ProLiant BL685c
Oracle Licenses Needed	57	48	43	75	200	104	312
Number of servers	1	1	1	5	10	13	13

Build up case RAC Stack

Click for table

Add the software from a common implementation of Oracle Real Application Cluster and associated other Oracle software.

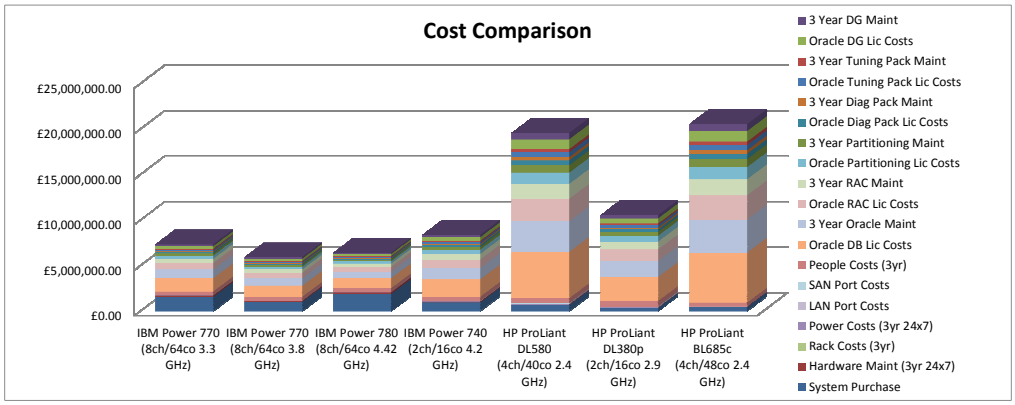


Server	IBM Power 770	IBM Power 770	IBM Power 780	IBM Power 740	HP ProLiant DL580	HP ProLiant DL380p	HP ProLiant BL685c
Oracle Software Costs	£2,592,000	£2,185,000	£1,960,000	£3,412,000	£9,087,000	£4,729,000	£14,171,000
Hardware Costs	£861,000	£569,000	£1,040,000	£526,000	£363,000	£186,000	£358,000

Build up case RAC N+1

Click for table

Add nodes for redundancy, allowing for the option to use different sizes of cluster to control the number of servers needed and the costs involved.

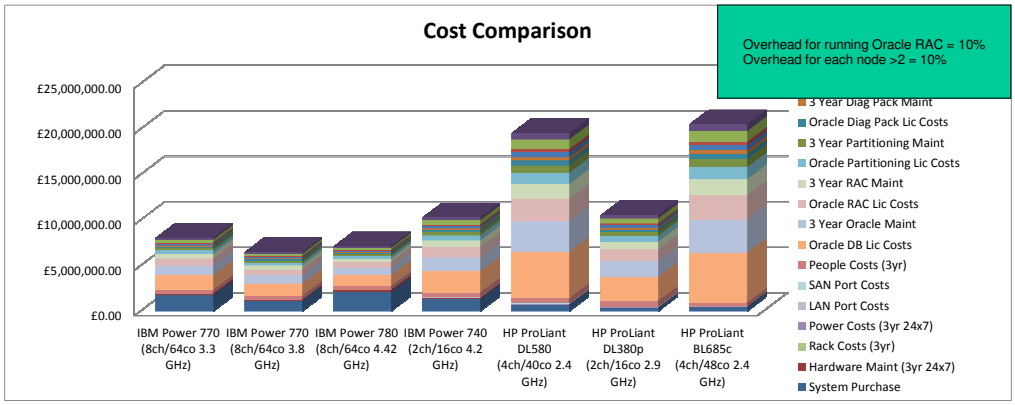


Server	IBM Power 770	IBM Power 770	IBM Power 780	IBM Power 740	HP ProLiant DL580	HP ProLiant DL380p	HP ProLiant BL685c
Server for "+1" in "n+1"	1	1	1	5	10	13	5
Resulting Servers needed	2	2	2	10	20	26	18

Build up case RAC Scalability

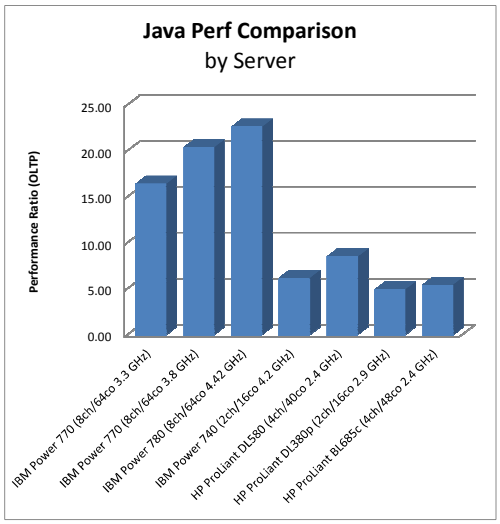
Click for table

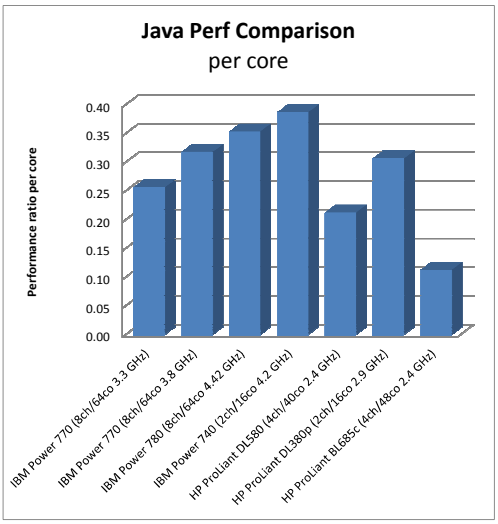
Oracle RAC clusters attract overheads which increase with the size of the cluster. The previous stage of limiting the number of Oracle instances per x86 server can reduce the impact of this effect.



Server	IBM Power 770	IBM Power 770	IBM Power 780	IBM Power 740	HP ProLiant DL580	HP ProLiant DL380p	HP ProLiant BL685c
Performance (with impact of scaling out beyond 1+1)	100%	100%	100%	100%	100%	100%	83%
Resulting Servers needed	2	2	2	14	20	26	18

Java Server Performance

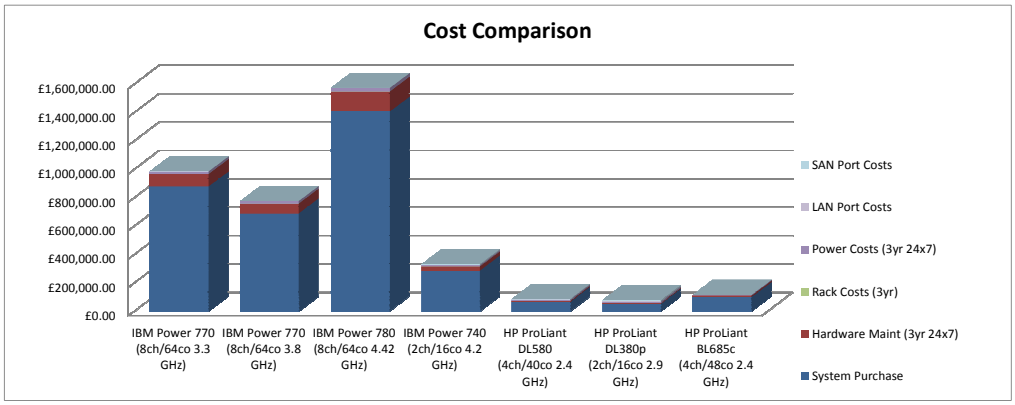




The improvements to the floating point performance with POWER7+ allows a clear benefit for IBM Power Systems for these workloads.

Build up case Java benchmark

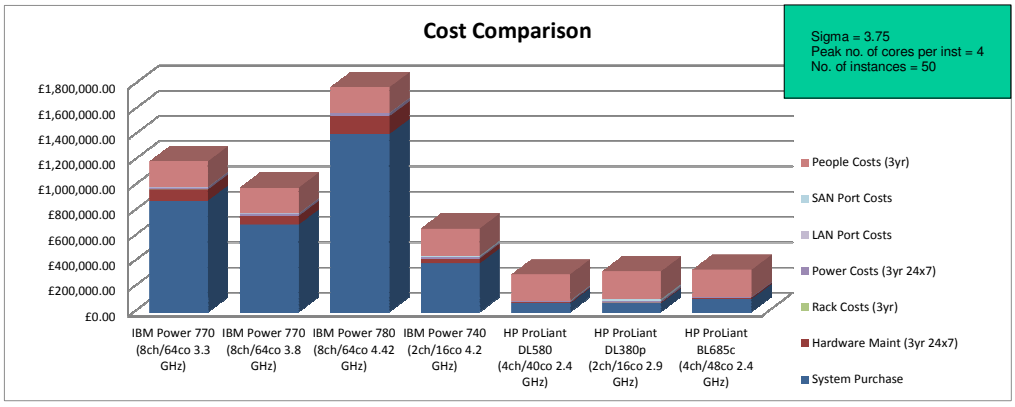
Click for table



Server	IBM Power 770	IBM Power 770	IBM Power 780	IBM Power 740	HP ProLiant DL580	HP ProLiant DL380p	HP ProLiant BL685c
Perf Factor (Benchmark)	1.00	0.81	0.73	2.65	1.93	3.34	3.03
Number of servers	1	1	1	3	2	4	4

Build up case Java Central Limit Theorem

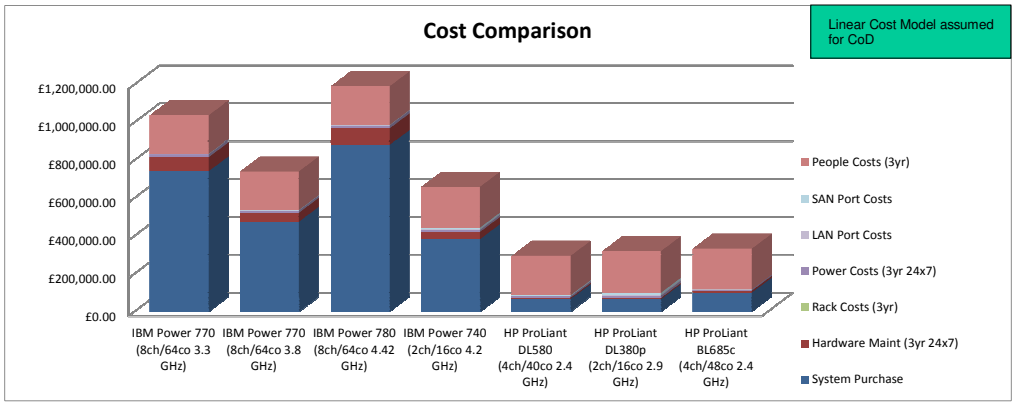
Click for table



Server	IBM Power 770	IBM Power 770	IBM Power 780	IBM Power 740	HP ProLiant DL580	HP ProLiant DL380p	HP ProLiant BL685c
Difference between Average and Peak (Normalised to Peak)	0.51	0.51	0.51	0.68	0.60	0.70	0.68
Number of servers	1	1	1	4	2	5	4

Build up case Java Capacity on Demand

Click for table

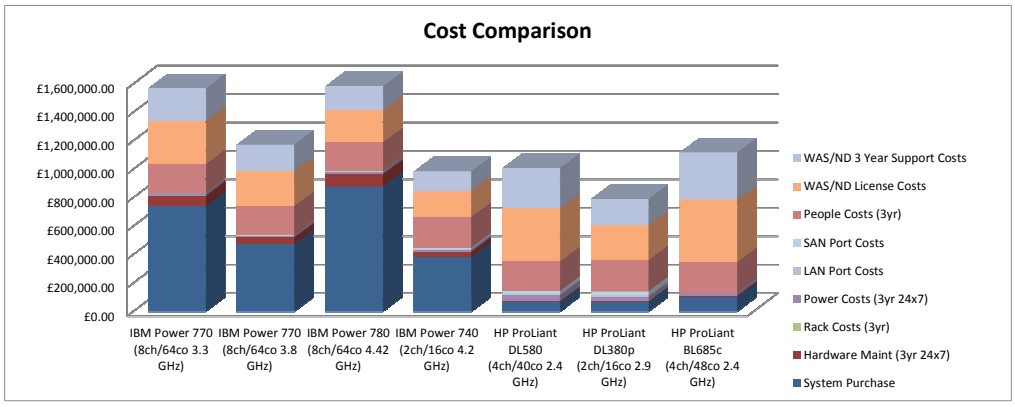


Server	IBM Power 770	IBM Power 770	IBM Power 780	IBM Power 740	HP ProLiant DL580	HP ProLiant DL380p	HP ProLiant BL685c
Active cores	54	44	40	64	80	80	192
Number of servers	1	1	1	4	2	5	4

Larger IBM Power Systems can still be right sized and dynamically upgraded to control initial purchase costs and software license requirements

Build up case WAS

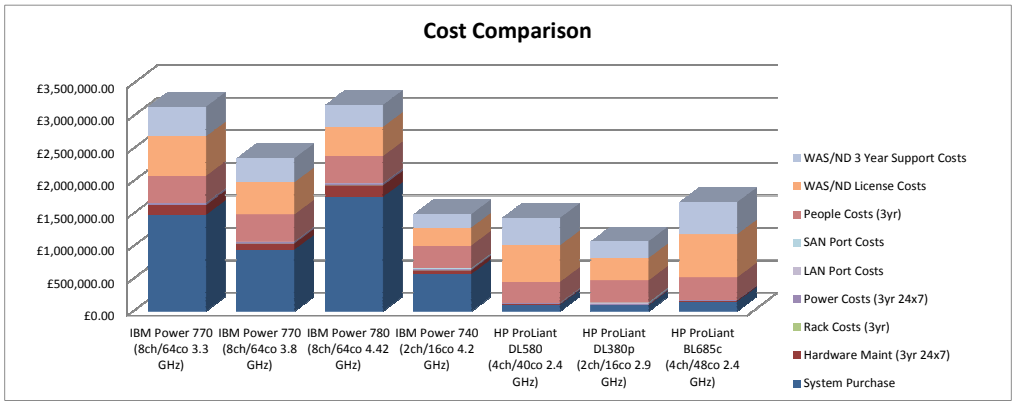
Click for table



Server	IBM Power 770	IBM Power 770	IBM Power 780	IBM Power 740	HP ProLiant DL580	HP ProLiant DL380p	HP ProLiant BL685c
Total PVU	6480	5280	4800	3920	8000	5250	9400
Number of servers	1	1	1	4	2	5	4

Build up case WAS N+1

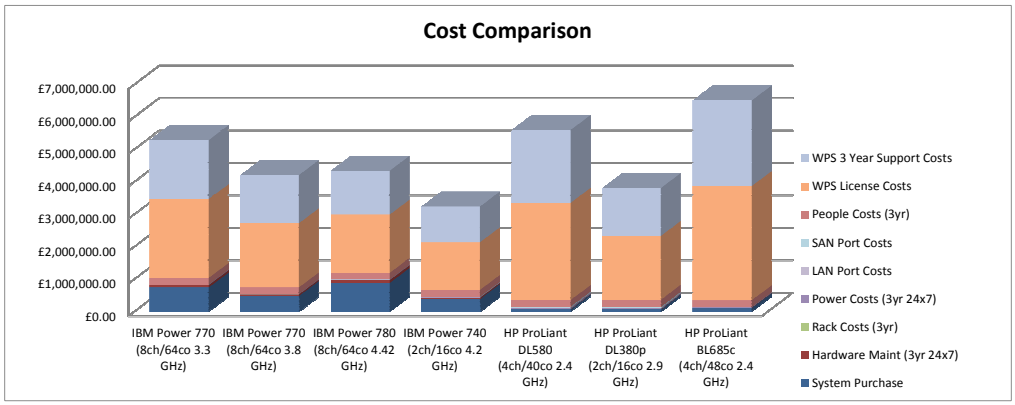
Click for table



Server	IBM Power 770	IBM Power 770	IBM Power 780	IBM Power 740	HP ProLiant DL580	HP ProLiant DL380p	HP ProLiant BL685c
Server for "+1" in "n+1"	1	1	1	2	1	2	2
Resulting Servers needed	2	2	2	6	3	7	6

Build up case WPS

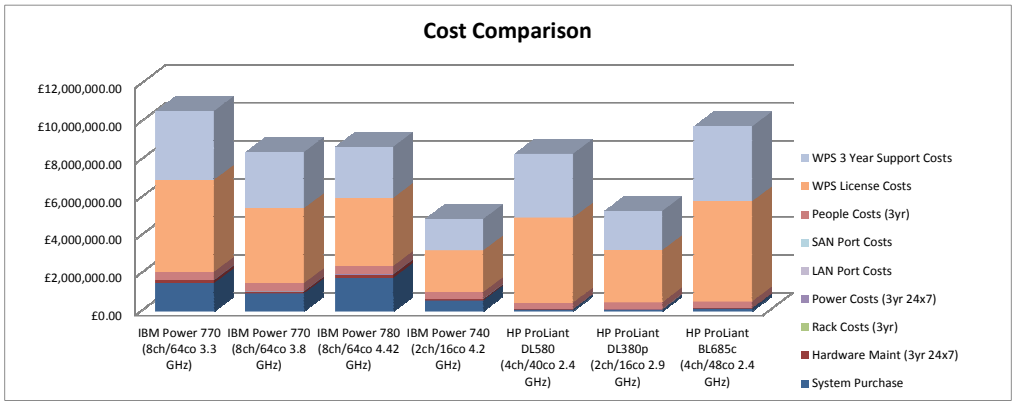
Click for table



Server	IBM Power 770	IBM Power 770	IBM Power 780	IBM Power 740	HP ProLiant DL580	HP ProLiant DL380p	HP ProLiant BL685c
Total PVU	6480	5280	4800	3920	8000	5250	9400
Number of servers	1	1	1	4	2	5	4

Build up case WPS N+1

Click for table

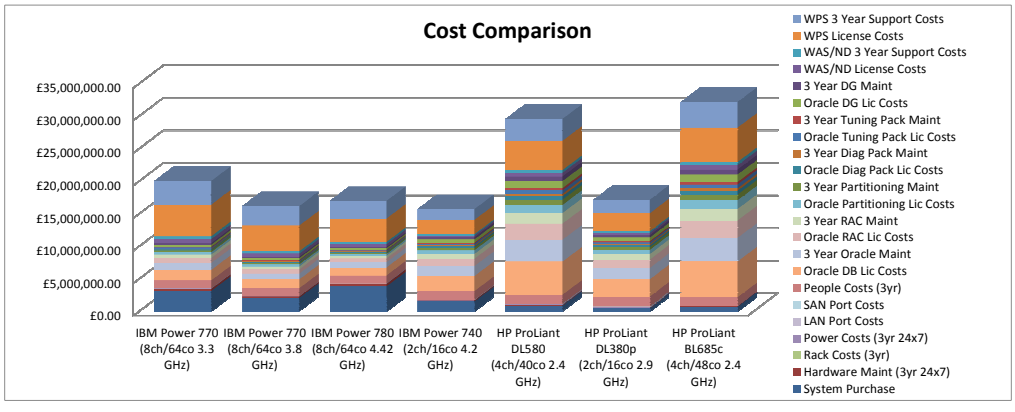


Server	IBM Power 770	IBM Power 770	IBM Power 780	IBM Power 740	HP ProLiant DL580	HP ProLiant DL380p	HP ProLiant BL685c
Server for "+1" in "n+1"	1	1	1	2	1	2	2
Resulting Servers needed	2	2	2	6	3	7	6

Built up case Combined

Click for table

Combining the different virtualised workloads on IBM Power Systems allows the use of Multiple Shared Processor Pools to minimise software costs, and fewer servers need to be added for redundancy, further reducing costs

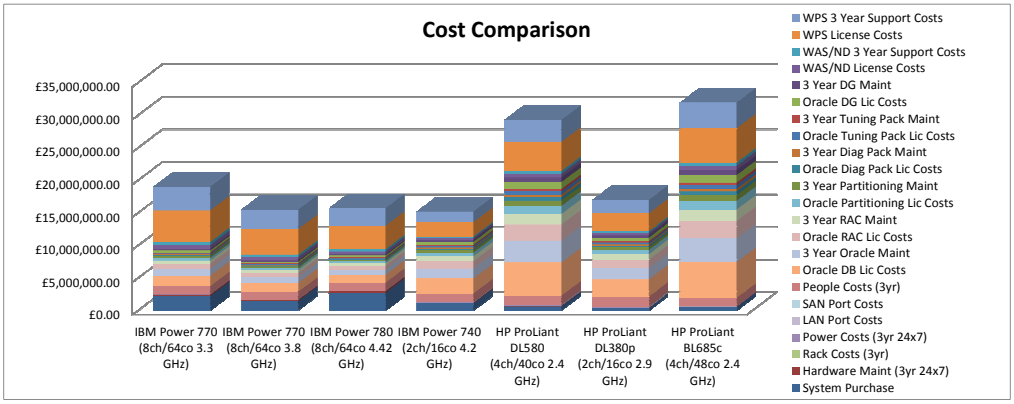


Server	IBM Power 770	IBM Power 770	IBM Power 780	IBM Power 740	HP ProLiant DL580	HP ProLiant DL380p	HP ProLiant BL685c
Mixed/Separate?	Mixed	Mixed	Mixed	Mixed	Separate	Separate	Separate
Total Servers Needed	4	3	3	16	26	38	29

Conclude case

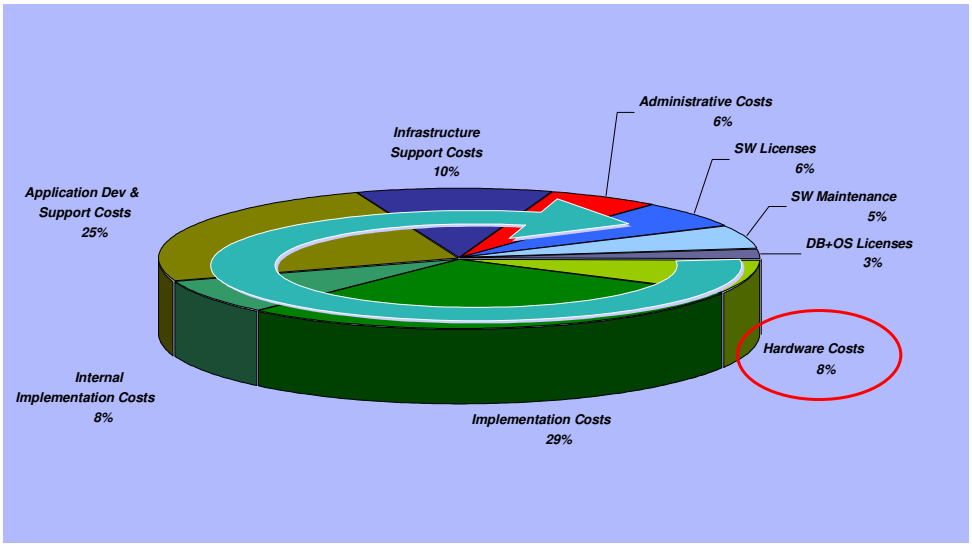
Click for table

The impact of a 30% discount on the hardware is much greater on the more expensive servers, having a greater impact on the overall costs of the solution.



Server	IBM Power 770	IBM Power 770	IBM Power 780	IBM Power 740	HP ProLiant DL580	HP ProLiant DL380p	HP ProLiant BL685c
Discount	30%	30%	30%	30%	30%	30%	30%
Cost Ratio	1.23 to 1	1 to 1	1.1 to 1	1.33 to 1	2.51 to 1	1.42 to 1	2.66 to 1

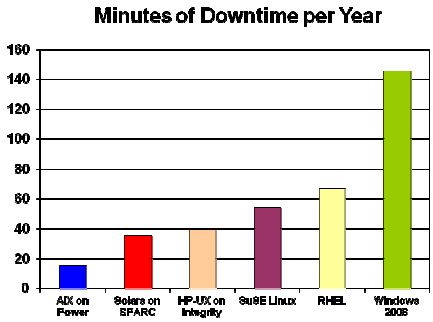
Cost Distribution in a sample ERP Implementation



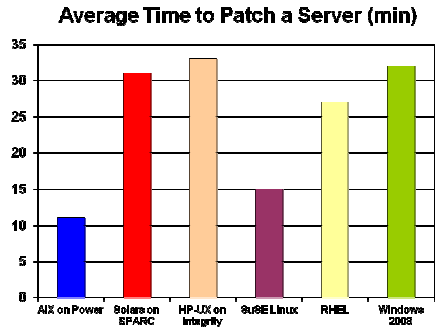
IBM Power Systems with AIX deliver 99.997% up time

January 27, 2011
"For the third year in a row, **IBM AIX Unix operating system** (OS) running on the company's Power System servers scored the highest reliability ratings among 19 different server OS platforms – including other Unix variants, Microsoft's Windows Server, Linux distributions and Apple's Mac OS X."

- Least amount of downtime
  - 15 minutes a year
  - 3.5x-4.5x better than Linux



- The fastest patch time
  - 11 minutes to apply a patch



Source: ITIC 2009 Global Server Hardware & Server OS Reliability Survey Results, July 7, 2009

Results from IBM X-Force 2012 Trend and Risk Report

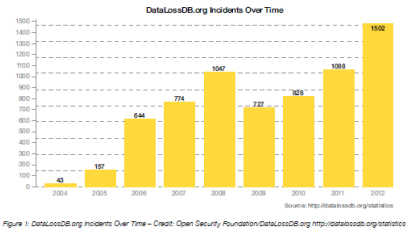
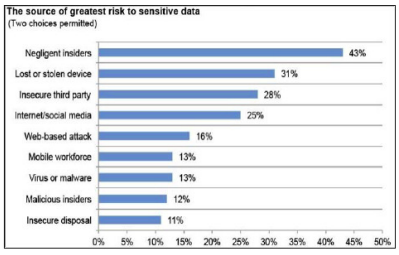


Figure 1: DataLossDB.org Incidents Over Time – Credit: Open Security Foundation/DataLossDB.org http://datalossdb.org/statistics

2012 IBM/Ponemon Institute Survey results
Feb. 27, 2012: IBM and the Ponemon Institute recently conducted a survey of more than 265 C-level executives to determine what organizations believe are the most important factors when considering sensitive data and complying with strict security regulations.



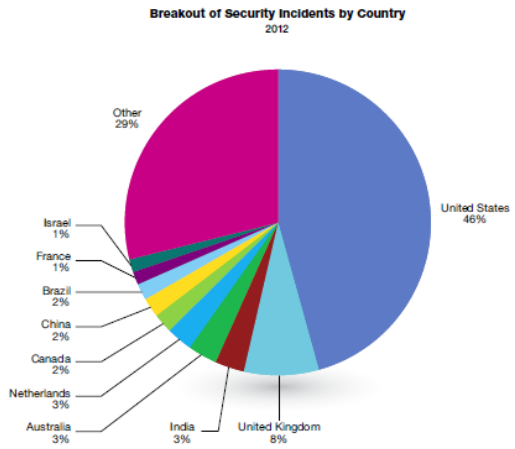


Figure 4: Breakout of Security Incidents by Country – 2012

http://public.dhe.ibm.com/common/ssi/ecm/en/wgl03014usen/WGL03014USEN.PDF

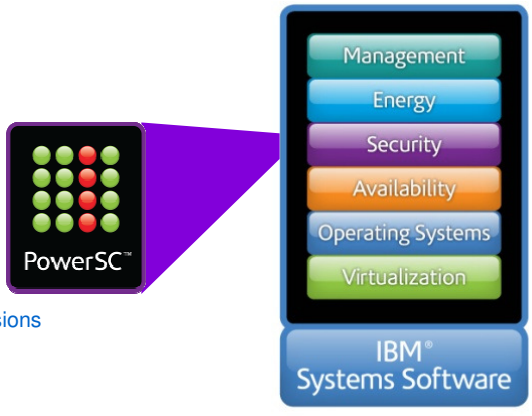
Security Advisories (Operating Systems)

Red Hat Enterprise Linux Server 6 388 Secunia advisories 1437 Vulnerabilities http://secunia.com/advisories/product/32988/	AIX 7.x 27 Secunia advisories 44 Vulnerabilities http://secunia.com/advisories/product/36308/
Red Hat Enterprise Linux Server 5 690 Secunia advisories 2198 Vulnerabilities http://secunia.com/advisories/product/13652/	AIX 6.x 66 Secunia advisories 131 Vulnerabilities http://secunia.com/advisories/product/16995/

PowerSC

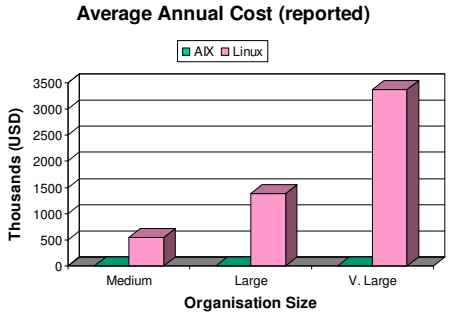
Provides a security and compliance solution designed to protect data centers virtualized with PowerVM enabling Higher Quality Services

- Client Benefits
- Simplifies management and measurement of security & compliance
- Reduces cost of security & compliance
- Improves detection and reporting of security exposures
- Improves the audit capability to satisfy reporting requirements
- Provides "virtualization aware" security extensions



Security breaches - Economic Impact

- The cost of a security breach
  - Strengthening existing IT security and carrying out additional training
  - Contacting those whose records may have been exposed
  - Credit monitoring for those affected
  - Legal action taken by people who may have suffered a financial loss
  - Damage to the company/brand reputation
  - Email blacklisting
  - Impact on share price
  - Costs to regain market position



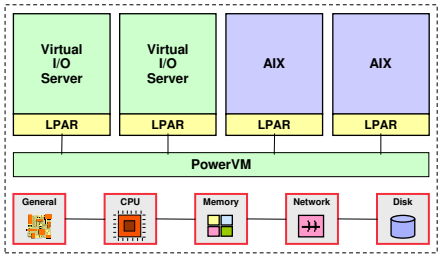
David Hobson, managing director of Global Secure Systems – SC Magazing

Adapted from "Does your OS Matter?" - Solitaire Interglobal Ltd. October 2011

AIX and POWER7 RAS Features

Click for x86 Compare

Virtualisation
- PowerVM is core firmware
- Thin bare metal Hypervisor
- Device driver free Hypervisor
- Redundant VIOS support
- Dynamic LPAR operations
- Separate HMC Users
- Live partition mobility
- HW enforced virtualisation support



AIX
- Integrated LVM and JFS
- SMIT – reduce human errors
- Hot AIX kernel patches
- WPAR and WPAR mobility
- App checkpoint/restart
- Configurable error logs
- Resource monitor & control
- Role based access control
- EAL 4+ security certification

General
- First Failure Data Capture
- Hot-node add/repair
- Redundant clocks & service processors
- Service proc failover
- Concurrent firmware updates
- CEC bus retry / recovery
- Light path diagnostics

CPU/Cache
- Dynamic CPU deallocation
- Processor instruction retry
- Alternate processor recovery
- Dynamic processor sparing
- CPU CUoD
- Processor contained checkstop
- Dynamic cache deallocation and cache line delete

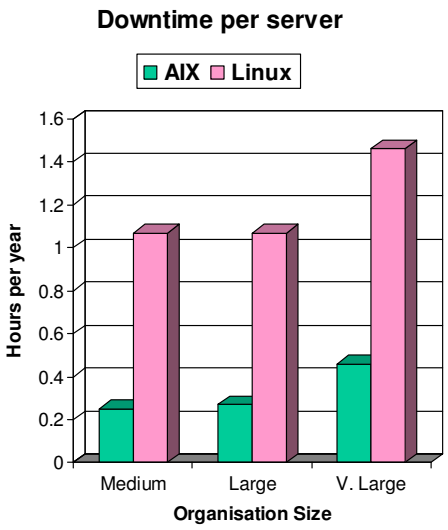
Memory
- DDR ECC Chipkill memory
- Dynamic memory page deallocation
- Storage protection keys
- Memory bit steering / redundant memory
- Dual sided DIMMs
- Hardware memory scrubbing

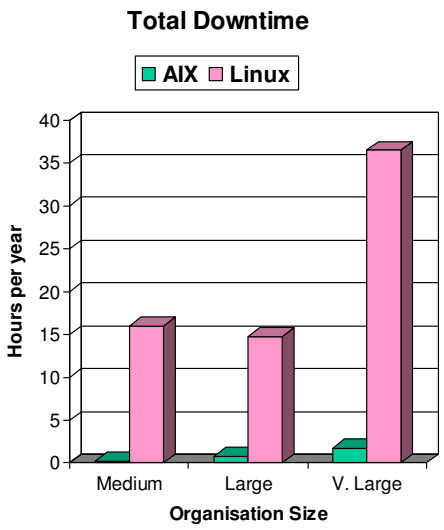
I/O
- Redundant I/O links to I/O drawers
- Independent PCI busses
- Dynamic PCI bus slot deallocation
- Hot swap disk, media, PCI adapters
- Hot I/O drawer add

AIX Security Expert Details

AIX Encrypting Filesystem Details

Server Downtime





Adapted from "Does your OS Matter?" - Solitaire Interglobal Ltd. October 2011

AIX 7 – the best keeps getting better

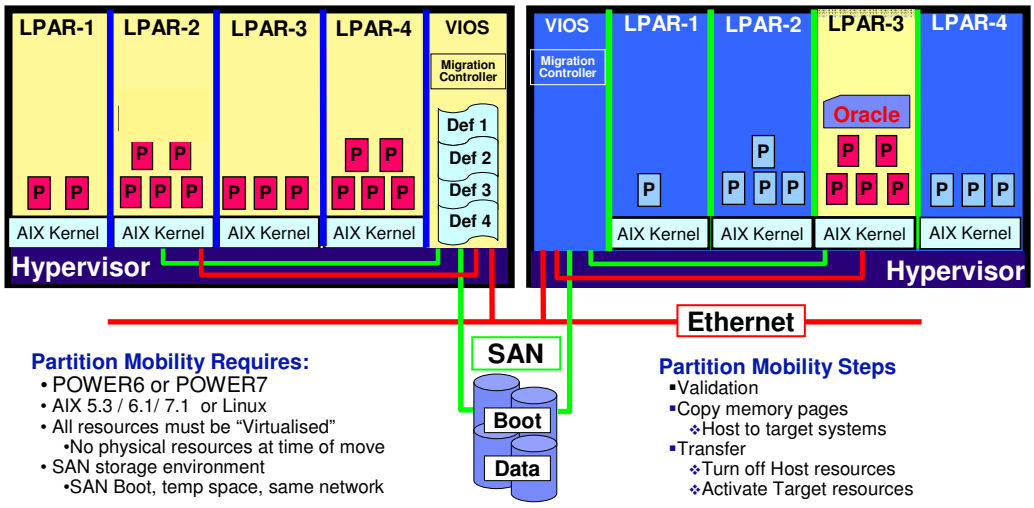
- **Virtualization without limits**
  - Run AIX 5.2 WPARs[1] to consolidate & lower cost of critical business applications on POWER7
- **Resiliency without downtime**
  - Built in clustering simplifies configuration and management, plus provides a foundation for PowerHA solutions
- **Data protection and compliance**
  - Extended administrator options for role based access control
  - Designed for deployments requiring CAPP/EAL4+ certification
- **Management with automation**
  - Simplified profile based configuration management[2]

[1]Requires "AIX 5.2 WPAR for AIX 7" product
[2]Requires IBM Systems Director

https://www14.software.ibm.com/iwm/web/cc/earlyprograms/websphere/aix7ob

Live Partition Mobility On ALL Workloads

Reduce impact of planned outages, relocate workloads to enable growth, provision new technology with no disruption to service



Partition Mobility Requires:

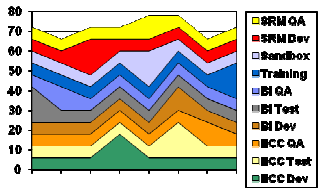
- POWER6 or POWER7
- AIX 5.3 / 6.1/ 7.1 or Linux
- All resources must be "Virtualised"
  - No physical resources at time of move
- SAN storage environment
  - SAN Boot, temp space, same network

Partition Mobility Steps

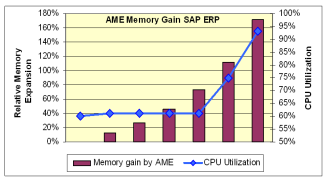
- Validation
- Copy memory pages
  - Host to target systems
- Transfer
  - Turn off Host resources
  - Activate Target resources

Additional Competitive Advantages of PowerVM

Active Memory Sharing



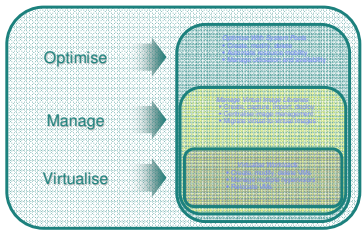
Active Memory™ Expansion



AIX Workload Partitions

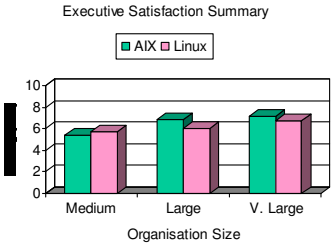
No equivalent function in VMware

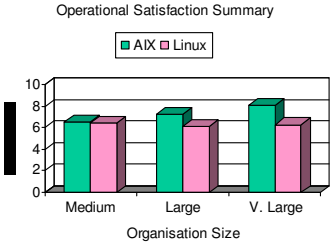
VMcontrol



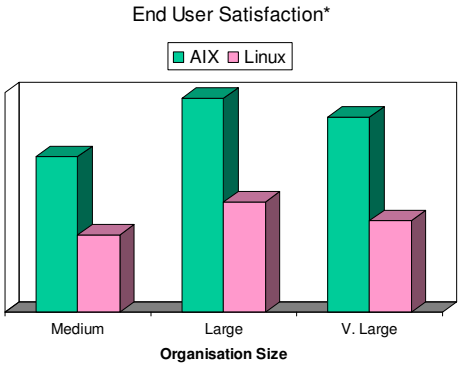
PowerVM

Levels of satisfaction





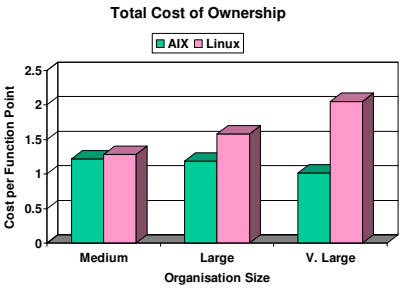
Adapted from "Does your OS Matter?" a survey of over 43,260 environments by Solitaire Interglobal Ltd. October 2011

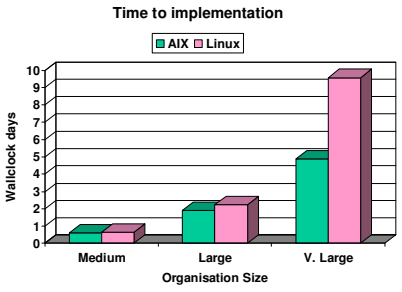


*Calculated as the inverse of user complaints relative to the results for Windows

AIX vs Linux - TCO and Business Agility

- AIX users report
  - –Lower staffing costs overall (due to tools, stability, etc.)
  - –Lower datacentre costs (environmental, facility, etc.)
  - –More highly-leveraged platforms
- …and a definite agility advantage due to
  - –Ability to easily shift resources to accommodate new implementations
  - –Robust toolset for management
  - –Speed of configuration with other system components, e.g. storage





Adapted from "Does your OS Matter?" - Solitaire Interglobal Ltd. October 2011

Summary

- **All cores are not created equal**
  - IBM Power can run more threads faster, which means workloads run faster and less cores are needed, which lowers costs
- **With IBM Power, virtualisation is built into the hardware, adds no overhead and is always on.**
  - Less resources are therefore needed, reducing costs.
- **IBM Power allows larger pools of virtualised resources.**
  - Spikes in workloads can be accommodated with fewer resources. Less resources are therefore needed, reducing costs.
- **Software costs and the facilities requirements can be considerable**
  - IBM Power servers can lower both, allowing high levels of expense to be avoided.
- **IBM Power and AIX then have a number of features that add value above Linux on x86**
  - More secure, less patching needed, can virtualise any workload, LPM, RAS, Active Memory Sharing and Expansion, WPARs, etc

Taking in all these elements, IBM Power Systems offer solutions that can save money over x86 based solutions, and deliver higher levels of business value.

Conclusions and possible next steps

- Hopefully my modelling and ideas have given some food for thought
- But how your company models costs and assigns value is far more important
- Can we work with you on your models, working some of these ideas in, so IBM Power systems can compete effectively for workloads?

Thank you!

David Spurway – IBM Power Systems Product Manager
Email: david.spurway@uk.ibm.com
Phone: 07717 892 896

IBM Power Ask the Experts 2013

09:30 - 10:00	Registration and coffee
10:00 - 11:15	Power Systems Update - Pat O'Rourke: Austin Briefing Centre
11:15 - 12:30	Performance Best Practices with POWER7 - Nigel Griffiths
12:30 - 13:30	Lunch
13:30 - 14:30	Tricks of the Power Masters - Gareth Coates
14:30 - 15:15	Cost Comparison between IBM Power and Intel - David Spurway
15:15 - 15:30	Coffee
15:30 - 16:45	Power Systems Trends and Directions - Pat O'Rourke: Austin Briefing Centre
16:45	Close

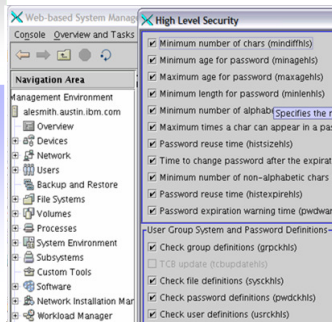
AIX V6.1 Security Expert

Back

How it can help?

Manage Growth, Complexity & Risk

- Can reduce the cost and complexity of security administration by allowing federated management of security profiles across multiple servers
- Enables a more secure IT infrastructure by reducing the effort of maintaining system security
- "Check" functionality can provide additional security by validating that the security profile for each system matches the actual security settings



Realize Innovation

- Allows for new ways to efficiently manage security across multiple AIX systems

What is it?

- A centralized security management tool that can control over 300 security settings from a single console
- Administrators can start from a "Low", "Medium", "High" or "Sarbanes-Oxley" security template and customize settings to met business requirements
- Security settings can be exported and imported as a security profile to multiple systems
- On AIX V6.1, security profiles can be stored in an LDAP directory for ease of distribution
- AIX Security Expert was first included in AIX V5.3 TL5

AIX V6.1 Encrypting Filesystem

Back

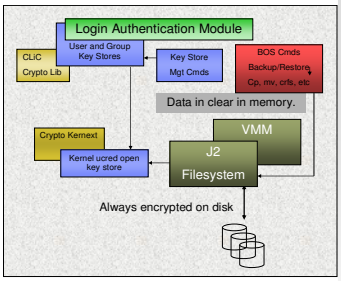
How it can help?

Manage Growth, Complexity & Risk

- Enables improved security by reducing unauthorized access to data, even by privileged users
- Secure backups reduces the exposure of data compromised when backup media is taken outside of secure facilities
- Automatic management of protection keys can reduce the administrative effort of using encrypted data

Realize Innovation

- Provides the capability for additional security for applications that may have security design exposures



What is it?

- The capability to automatically encrypt data in a JFS2 filesystem
- Data can be protected from access by privileged users
- Backup in encrypted or clear formats
- Automated key management - key store open on login, integrated into AIX security authentication
- Each file encrypted with a unique key
- No keys stored in clear in kernel memory
- A variety of AES, and RSA cryptography keys supported

AIX and Linux – Side by Side

Back

	AIX	Linux on x86
Commercial Application Availability	✓ Best	+ Better
Hardware First-Failure Data Capture and diagnostic fault isolation capabilities	✓ Best	− No
Vertical Scalability	✓ Best	= Good
Open Source Application Availability	= Good	+ Better
Virtualization Support	✓ Best	= Good
Dynamic Processor De-allocation	✓ Best	− No
Mainframe inspired Operating System First Failure Data Capture and OS fault isolation	✓ Best	− No
Predictive failure analysis on processors, caches, memory, I/O and DASD	✓ Best	− No
Binary Compatibility	✓ Best	= Good
Manageability	+ Better	= Good

PowerVM delivers superior security to help manage risk and maximize availability

Back

Risk Management Factors	VMware ESX 3.5 *(in VMware Infrastructure 3)*	VMware vSphere 4 & 5	PowerVM
Implementation of virtualization technology	Third-party software add-on	Third-party software add-on	Integrated into server firmware
Isolation of I/O drivers from hypervisor	No	No	Yes (using VIOS)
Live migration across processor generations	No	Some (with Intel FlexMigration)	Yes (Power6-Power7)

Source: http://www.vmware.com/files/pdf/products/vsphere/vmware-what-is-new-vsphere5.pdf

PowerSC Standard Edition

PowerSC provides a security and compliance solution to protect datacenters virtualized with PowerVM enabling higher quality services

Business Requirements

- Compliance and Audit
- Guarantee that the OS has not been hacked or compromised in any way
- Ensure that every Virtual System has appropriate security patches
- Compliance and Audit to External Standards

Trusted Logging
The SVM/VIOS capture all LPAR audit log information in real time.

Trusted Boot
Boot images and OS are cryptographically signed and validated using a virtual Trusted Platform Module (vTPM)

Trusted Network Connect and Patch Management
With the Trusted Network Connection protocol imbedded in the VIOS, we can detect any system attempting to access the network and determine if it is at the correct security patch and update level.

Security Compliance Automation (PowerSC Express)
Pre-built compliance profiles that match various industry standards such as Payment Card Industry, DOD and Sox/Cobit. Activated and Reported on centrally using AIX Profile Manager

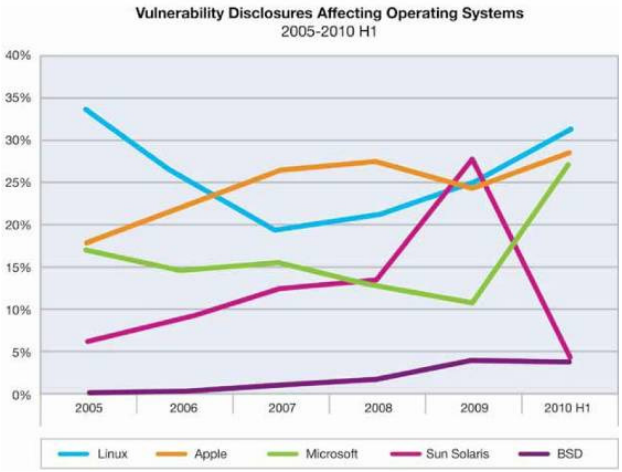
Capabilities

- ✓Tamper-proof logs
- ✓Defense against tampering
- ✓Notification of unpatched systems
- ✓Compliance automation and reporting

AIX Provides Leadership Security*

Operating System	Percentage of Critical and High	Percentage of all OS Vulnerabilities
Microsoft	73%	27%
Apple	9%	29%
Linux	16%	31%
HP-UX	2%	1%
Sun Solaris	0%	4%
BSD	0%	4%
IBM AIX	0%	2%
Others	2%	4%

Table 9: Operating systems with the most critical and high vulnerability disclosures, 2010 H1.

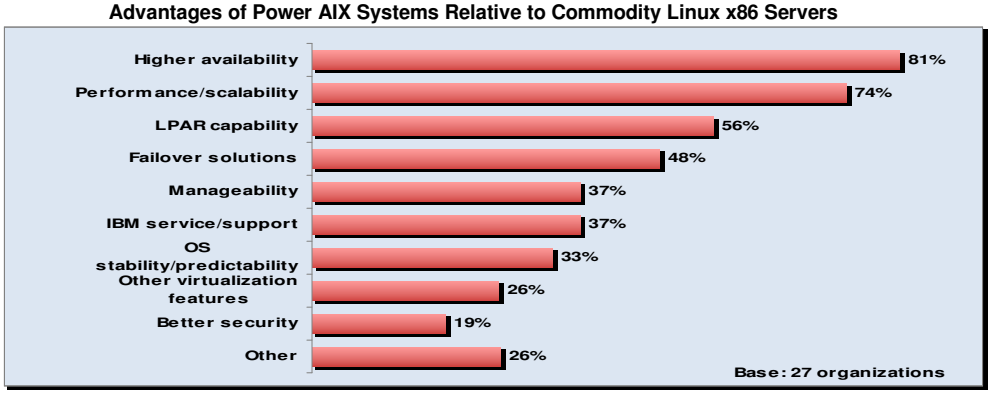


AIX Dropped off the list due to low vulnerabilities!

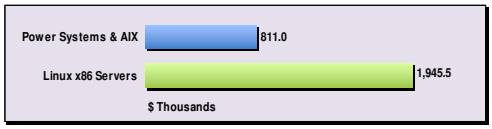
X-Force report – Mid-year 2010 http://www-935.ibm.com/services/us/iss/xforce/trendreports/

AIX/POWER versus Linux/Commodity x86

Advantages of Power AIX Systems Relative to Commodity Linux x86 Servers



Systems Administration cost comparison



From "VALUE PROPOSITION FOR AIX ON IBM POWER SYSTEMS : OWNERSHIP EXPERIENCES COMPARED WITH LINUX ON COMMODITY X86-BASED SERVERS" *International Technology Group ©2010*

Available on ibm.com/AIX

PowerSC PCI profile - example content

Payment Card Industry Data Security Standard V2

Rule	Description	PCI Guide
Crontab permissions	Verifies that root cron jobs are owned and writeable only by root.	Section 2.2.4
Disable fingerd in /etc/inetd.conf	Comments out the entry for fingerd daemon from /etc/inetd.conf	Section 1.1.5
Disable unsecure commands	rlogin, tftp, rcp, rsh	Section 1.1.5b, Section 2.3
Disable X-Server access	Not useful. Runs xhost – to (temporarily) disable X-Server access for root	Sectiion 2.2.4
Enable uucpd in /etc/inetd.conf	Comments out the entry for uucpd daemon in /etc/inetd.conf	Section 1.1.5
Guard host against port scans	shuns vulnerable ports for 5 mins to guard the host against port scans	Section 1.1.5(a,b) and Section 1.2.1(a,b)
Network Allowed Ports	Allows inbound/outbound traffic for only a range or set of ports, and denies all other port traffic	Section 1.2.1
Network option clean_partial_conns	Avoid SYN attacks clean_partial_conns=1	Section 1.3.6
Remove dot from non-root path	Remove current directory from $PATH for non-root users in the files: ~/.profile, ~/.kshrc, ~/.cshrc, ~/.login	Section 2.2.4
Remove guest account	Remove guest account & files (/home/guest)	Section 2.2.4
Root Password Integrity Check	Check roots password against english dictionary	Section 8 Requirements
security.login.disable	Defines the number of unsuccessful login attempts allowed before the port is locked.	8.5.13 Limit repeated access attempts by locking out the user ID after not more than six attempts.
security.login.retries	Sets the number of failed login attempts to a non-root account before it is locked.	8.5.13 Limit repeated access attempts by locking out the user ID after not more than six attempts.
security.password.histsize	Specifies the number of previous passwords that user cannot reuse	Section 8.5.12 Do not allow an individual to submit a new password that is the same as any of the last 4 passwods he or she has used.
security.password.maxage	Specifies the maximum number of weeks before a password can be changed	Section 8.5.9 Change user passwords at least every 90 days.
security.validate.grpck	Verifies the correctness of group definitions. (grpck -y ALL; grpck -n ALL)	Section 8.2.In addition to assigning a unique ID, employ atleast one of the following menthods to authenticate all users. Password or passphrase , Two-factor authentication
System Idle time in minutes	If the system has been idle for some time, require the user to re-enter the password to reactivate the terminal.	Section 8.5.15 If a session has been idle for more than 15 minutes, require the user to reenter the password to reactivate the terminal

Some questions to consider

- What are you planning to run?
- What is the reliability needed?
- How flexible does it need to be?
- Do you have peaks during the year, month, and/or week and how do you handle them?
- How secure does it need to be?
- How complicated it is to install and run?
- What skills your staff already have?
- What would be your evaluation criteria?
- Which of these business needs would have more weight?
- Do you have a total budget assigned for this project?

Build up case single server Table

Back

Server	IBM Power 770	IBM Power 770	IBM Power 780	IBM Power 740	HP ProLiant DL580	HP ProLiant DL380p	HP ProLiant BL685c
Number of Sockets per server	8	8	8	2	4	2	4
Total Cores	64	64	64	16	40	16	48
Processor Speed (GHz)	3.3	3.8	4.42	4.2	2.4	2.9	2.4
System List Cost	£879,000	£690,000	£1,407,000	£96,000	£33,000	£13,000	£25,000
Discount	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
System Purchase	£879,000	£690,000	£1,407,000	£96,000	£33,000	£13,000	£25,000
Hardware Maint (3yr 24x7)	£88,000	£69,000	£141,000	£10,000	£4,000	£2,000	£3,000
Total HW Cost	**£967,000**	**£758,000**	**£1,548,000**	**£106,000**	**£37,000**	**£15,000**	**£28,000**
Rack Units	16	16	16	4	4	2	10
Rack Costs (3yr, rounded down)	£0	£0	£0	£0	£0	£0	£0
Power Load (watts)	3944	3872	5524	604	984	557	341
Cooling Load (watts)	2366	2323	3314	362	590	334	204
Total Power (kW)	6	6	9	1	2	1	1
Power Costs (3yr 24x7)	£17,000	£17,000	£24,000	£3,000	£5,000	£3,000	£2,000
Min Network Ports needed	2	2	2	2	2	2	2
LAN Port Costs	£1,000	£1,000	£1,000	£1,000	£1,000	£1,000	£1,000
Min SAN Ports needed	2	2	2	2	2	2	2
SAN Port Costs	£2,000	£2,000	£2,000	£2,000	£2,000	£2,000	£2,000
Initial Cost of Ownership	**£987,000**	**£778,000**	**£1,575,000**	**£112,000**	**£45,000**	**£21,000**	**£33,000**
Cost Ratio	47 to 1	37.05 to 1	75 to 1	5.34 to 1	2.15 to 1	1 to 1	1.58 to 1
Notes							

Build up case benchmark Table

Back

Server	IBM Power 770	IBM Power 770	IBM Power 780	IBM Power 740	HP ProLiant DL580	HP ProLiant DL380p	HP ProLiant BL685c
Number of servers	1	1	1	4	3	4	4
Perf Factor (Benchmark)	1.00	0.84	0.75	3.11	2.42	3.82	3.43
Total Number of sockets	8	8	8	8	12	8	16
Total Number of cores	64	64	64	64	120	64	192
Processor Speed (GHz)	3.3	3.8	4.42	4.2	2.4	2.9	2.4
System Purchase	£879,000	£690,000	£1,407,000	£382,000	£99,000	£52,000	£100,000
Hardware Maint (3yr 24x7)	£88,000	£69,000	£141,000	£39,000	£10,000	£6,000	£10,000
Total HW Cost	**£967,000**	**£758,000**	**£1,548,000**	**£421,000**	**£109,000**	**£58,000**	**£110,000**
Rack Units	16	16	16	16	12	8	10
Rack Costs (3yr, rounded down)	£0	£0	£0	£0	£0	£0	£0
Power Costs (3yr 24x7)	£17,000	£17,000	£24,000	£11,000	£13,000	£10,000	£6,000
Min Network Ports needed	2	2	2	8	6	8	2
LAN Port Costs	£1,000	£1,000	£1,000	£4,000	£3,000	£4,000	£1,000
Min SAN Ports needed	2	2	2	8	6	8	2
SAN Port Costs	£2,000	£2,000	£2,000	£8,000	£6,000	£8,000	£2,000
Total Cost of Ownership	**£970,000**	**£761,000**	**£1,551,000**	**£433,000**	**£118,000**	**£70,000**	**£113,000**
Cost Ratio	13.86 to 1	10.88 to 1	22.16 to 1	6.19 to 1	1.69 to 1	1 to 1	1.62 to 1

Build up case scale out Table

Back

Server	IBM Power 770	IBM Power 770	IBM Power 780	IBM Power 740	HP ProLiant DL580	HP ProLiant DL380p	HP ProLiant BL685c
Number of servers initially	1	1	1	4	3	4	4
Perf Factor (Benchmark)	1.00	0.84	0.75	3.11	2.42	3.82	3.43
Overhead for multiple servers	0%	0%	0%	45%	30%	45%	45%
Number of reference servers	1	1	1	1	1	1	1
Resulting servers needed	1	1	1	6	4	6	6
Number of Sockets per server	8	8	8	12	16	12	24
Total Cores	64	64	64	64	120	64	192
Processor Speed (GHz)	3.3	3.8	4.42	4.2	2.4	2.9	2.4
System Purchase	£879,000	£690,000	£1,407,000	£573,000	£132,000	£78,000	£150,000
Hardware Maint (3yr 24x7)	£88,000	£69,000	£141,000	£58,000	£14,000	£8,000	£15,000
Total HW Cost	**£967,000**	**£758,000**	**£1,548,000**	**£631,000**	**£146,000**	**£86,000**	**£165,000**
Rack Units	16	16	16	24	16	12	10
Rack Costs (3yr, rounded down)	£0	£0	£0	£0	£0	£0	£0
Power Costs (3yr 24x7)	£17,000	£17,000	£24,000	£16,000	£17,000	£15,000	£9,000
Min Network Ports needed	2	2	2	12	8	12	2
LAN Port Costs	£1,000	£1,000	£1,000	£6,000	£4,000	£6,000	£1,000
Min SAN Ports needed	2	2	2	12	8	12	2
SAN Port Costs	£2,000	£2,000	£2,000	£12,000	£8,000	£12,000	£2,000
Total Cost of Ownership	**£970,000**	**£761,000**	**£1,551,000**	**£649,000**	**£158,000**	**£104,000**	**£168,000**
Cost Ratio	9.33 to 1	7.32 to 1	14.92 to 1	6.25 to 1	1.52 to 1	1 to 1	1.62 to 1

Build up case Central Limit Theorem Table

Back

Server	IBM Power 770	IBM Power 770	IBM Power 780	IBM Power 740	HP ProLiant DL580	HP ProLiant DL380p	HP ProLiant BL685c
Number of servers	1	1	1	5	3	7	5
Total Number of Workloads (DBs)	50	50	50	50	50	50	50
People Costs (3yr)	**£204,000**	**£204,000**	**£204,000**	**£220,000**	**£212,000**	**£228,000**	**£220,000**
Average Utilisation per workload	0.83%	0.70%	0.63%	2.59%	2.02%	3.18%	2.86%
Variability for workload	3.25	3.25	3.25	3.25	3.25	3.25	3.25
Peak Utilisation per workload	6.25%	5.27%	4.71%	19.43%	15.14%	23.86%	21.46%
Smoothed Workloads (per server)	50	50	50	10	17	7	10
Average Utilisation Rate (Server)	**42%**	**35%**	**31%**	**26%**	**34%**	**23%**	**29%**
Peak Utilisation Rate (Server)	**80%**	**67%**	**60%**	**79%**	**87%**	**78%**	**87%**
Target Peak Utilisation	90%	90%	90%	90%	90%	90%	90%
Number of sockets	8	8	8	10	12	14	20
Number of cores	64	64	64	80	120	112	240
Total HW Cost	**£967,000**	**£759,000**	**£1,548,000**	**£526,000**	**£109,000**	**£101,000**	**£138,000**
Rack Units	16	16	16	20	12	14	10
Rack Costs (3yr, rounded down)	£0	£0	£0	£0	£0	£0	£0
Power Costs (3yr 24x7)	£17,000	£17,000	£24,000	£13,000	£13,000	£17,000	£8,000
Min Network Ports needed	2	2	2	10	6	14	2
LAN Port Costs	£1,000	£1,000	£1,000	£5,000	£3,000	£7,000	£1,000
Min SAN Ports needed	2	2	2	10	6	14	2
SAN Port Costs	£2,000	£2,000	£2,000	£10,000	£6,000	£14,000	£2,000
Total Cost of Ownership	**£1,174,000**	**£966,000**	**£1,755,000**	**£761,000**	**£330,000**	**£350,000**	**£361,000**
Cost Ratio	3.56 to 1	2.93 to 1	5.32 to 1	2.31 to 1	1 to 1	1.07 to 1	1.1 to 1

Build up case Capacity on Demand Table

Back

Server	IBM Power 770	IBM Power 770	IBM Power 780	IBM Power 740	HP ProLiant DL580	HP ProLiant DL380p	HP ProLiant BL685c
Number of servers	1	1	1	5	3	7	5
Total Number of Workloads (DBs)	50	50	50	50	50	50	50
People Costs (3yr)	£204,000	£204,000	£204,000	£220,000	£212,000	£228,000	£220,000
Average Utilisation per workload	0.83%	0.70%	0.63%	2.59%	2.02%	3.18%	2.86%
Variability for workload	3.25	3.25	3.25	3.25	3.25	3.25	3.25
Peak Utilisation per workload	6.25%	5.27%	4.71%	19.43%	15.14%	23.86%	21.46%
Smoothed Workloads (per server)	50	50	50	10	17	7	10
Average Utilisation Rate (Full Spec Server)	42%	35%	31%	26%	34%	23%	29%
Peak Utilisation Rate (Full Spec Server)	80%	67%	60%	79%	87%	78%	87%
Target Peak Utilisation	90%	90%	90%	90%	90%	90%	90%
Active cores	57	48	43	80	120	112	240
CPU Overcommit Ratio	3.51 to 1	4.17 to 1	4.66 to 1	2.5 to 1	2.92 to 1	1.79 to 1	2.3 to 1
Total HW Cost	£861,000	£569,000	£1,041,000	£526,000	£109,000	£101,000	£138,000
Rack Units	16	16	16	20	12	14	10
Rack Costs (3yr, rounded down)	£0	£0	£0	£0	£0	£0	£0
Power Costs (3yr 24x7)	£15,000	£13,000	£16,000	£13,000	£13,000	£17,000	£8,000
Min Network Ports needed	2	2	2	10	6	14	2
LAN Port Costs	£1,000	£1,000	£1,000	£5,000	£3,000	£7,000	£1,000
Min SAN Ports needed	2	2	2	10	6	14	2
SAN Port Costs	£2,000	£2,000	£2,000	£10,000	£6,000	£14,000	£2,000
Total Cost of Ownership	£1,083,000	£789,000	£1,264,000	£774,000	£343,000	£367,000	£369,000
Cost Ratio	3.16 to 1	2.31 to 1	3.69 to 1	2.26 to 1	1 to 1	1.07 to 1	1.08 to 1

Build up case Limit DBs Table

Back

Server	IBM Power 770	IBM Power 770	IBM Power 780	IBM Power 740	HP ProLiant DL580	HP ProLiant DL380p	HP ProLiant BL685c
Number of servers	1	1	1	5	10	13	13
People Costs (3yr)	£204,000	£204,000	£204,000	£220,000	£240,000	£252,000	£252,000
Max Workloads Limit	50	50	50	50	5	4	4
Smoothed Workloads (per server)	50	50	50	10	5	4	4
Average Utilisation Rate (Full Spec Server)	42%	35%	31%	26%	10%	12%	11%
Peak Utilisation Rate (Full Spec Server)	80%	67%	60%	79%	39%	53%	47%
Active cores	57	48	43	80	400	208	624
CPU Overcommit Ratio	3.51 to 1	4.17 to 1	4.66 to 1	2.5 to 1	0.88 to 1	0.97 to 1	0.89 to 1
Total HW Cost	£861,000	£569,000	£1,040,000	£526,000	£363,000	£186,000	£358,000
Rack Units	16	16	16	20	40	26	10
Rack Costs (3yr, rounded down)	£0	£0	£0	£0	£1,000	£0	£0
Power Costs (3yr 24x7)	£15,000	£13,000	£16,000	£13,000	£42,000	£31,000	£19,000
Min Network Ports needed	2	2	2	10	20	26	2
LAN Port Costs	£1,000	£1,000	£1,000	£5,000	£10,000	£13,000	£1,000
Min SAN Ports needed	2	2	2	10	20	26	2
SAN Port Costs	£2,000	£2,000	£2,000	£10,000	£20,000	£26,000	£2,000
Total Cost of Ownership	£1,083,000	£789,000	£1,263,000	£774,000	£676,000	£508,000	£632,000
Cost Ratio	2.14 to 1	1.56 to 1	2.49 to 1	1.53 to 1	1.34 to 1	1 to 1	1.25 to 1

Build up case Oracle DB software Table

Back

Server	IBM Power 770	IBM Power 770	IBM Power 780	IBM Power 740	HP ProLiant DL580	HP ProLiant DL380p	HP ProLiant BL685c
Number of servers	1	1	1	5	10	13	13
People Costs (3yr)	£204,000	£204,000	£204,000	£220,000	£240,000	£252,000	£252,000
Average Utilisation Rate (Full Spec Server)	42%	35%	31%	26%	10%	12%	11%
Peak Utilisation Rate (Full Spec Server)	80%	67%	60%	79%	39%	53%	47%
Active cores	57	48	43	80	400	208	624
Sub Cap Cores	57	48	43	75	400	208	624
Total HW Cost	£861,000	£569,000	£1,040,000	£526,000	£363,000	£186,000	£358,000
Oracle License Factor	1	1	1	1	0.5	0.5	0.5
Oracle DB Lic Costs	£726,000	£612,000	£548,000	£956,000	£2,548,000	£1,325,000	£3,974,000
3 Year Oracle Maint	£480,000	£404,000	£362,000	£631,000	£1,682,000	£875,000	£2,623,000
Rack Units	16	16	16	20	40	26	10
Rack Costs (3yr, rounded down)	£0	£0	£0	£0	£1,000	£0	£0
Power Costs (3yr 24x7)	£15,000	£13,000	£16,000	£13,000	£42,000	£31,000	£19,000
Min Network Ports needed	2	2	2	10	20	26	2
LAN Port Costs	£1,000	£1,000	£1,000	£5,000	£10,000	£13,000	£1,000
Min SAN Ports needed	2	2	2	10	20	26	2
SAN Port Costs	£2,000	£2,000	£2,000	£10,000	£20,000	£26,000	£2,000
Total Cost of Ownership (3 yr with Oracle Licenses)	£2,289,000	£1,805,000	£2,173,000	£2,361,000	£4,906,000	£2,708,000	£7,229,000
Cost Ratio (with Licenses)	1.27 to 1	1 to 1	1.21 to 1	1.31 to 1	2.72 to 1	1.51 to 1	4.01 to 1
Total Cost of Ownership (3 yr without Oracle Licenses)	£1,563,000	£1,193,000	£1,625,000	£1,405,000	£2,358,000	£1,383,000	£3,255,000
Cost Ratio	1.32 to 1	1 to 1	1.37 to 1	1.18 to 1	1.98 to 1	1.16 to 1	2.73 to 1

Build up case RAC Stack Table

Back

Server	IBM Power 770	IBM Power 770	IBM Power 780	IBM Power 740	HP ProLiant DL580	HP ProLiant DL380p	HP ProLiant BL685c
Number of servers	1	1	1	5	10	13	13
People Costs (3yr)	£204,000	£204,000	£204,000	£220,000	£240,000	£252,000	£252,000
Active cores	57	48	43	80	400	208	624
Sub Cap Cores	57	48	43	75	400	208	624
Total HW Cost	£861,000	£569,000	£1,040,000	£526,000	£363,000	£186,000	£358,000
Oracle License Factor	1	1	1	1	0.5	0.5	0.5
Oracle DB Lic Costs	£726,000	£612,000	£548,000	£956,000	£2,548,000	£1,325,000	£3,974,000
3 Year Oracle Maint	£480,000	£404,000	£362,000	£631,000	£1,682,000	£875,000	£2,623,000
Oracle RAC Lic Costs	£352,000	£297,000	£266,000	£463,000	£1,234,000	£642,000	£1,925,000
3 Year RAC Maint	£232,000	£196,000	£176,000	£306,000	£815,000	£424,000	£1,270,000
Oracle Partitioning Lic Costs	£176,000	£148,000	£133,000	£232,000	£617,000	£321,000	£962,000
3 Year Partitioning Maint	£116,000	£98,000	£88,000	£153,000	£408,000	£212,000	£635,000
Oracle Diag Pack Lic Costs	£77,000	£65,000	£58,000	£101,000	£269,000	£140,000	£419,000
3 Year Diag Pack Maint	£51,000	£43,000	£39,000	£67,000	£177,000	£93,000	£277,000
Oracle Tuning Pack Lic Costs	£77,000	£65,000	£58,000	£101,000	£269,000	£140,000	£419,000
3 Year Tuning Pack Maint	£51,000	£43,000	£39,000	£67,000	£177,000	£93,000	£277,000
Oracle DG Lic Costs	£153,000	£129,000	£116,000	£202,000	£537,000	£279,000	£837,000
3 Year DG Maint	£101,000	£85,000	£77,000	£133,000	£354,000	£185,000	£553,000
Rack Units	16	16	16	20	40	26	10
Rack Costs (3yr, rounded down)	£0	£0	£0	£0	£1,000	£0	£0
Power Costs (3yr 24x7)	£15,000	£13,000	£16,000	£13,000	£42,000	£31,000	£19,000
Min Network Ports needed	2	2	2	10	20	26	2
LAN Port Costs	£1,000	£1,000	£1,000	£5,000	£10,000	£13,000	£1,000
Min SAN Ports needed	2	2	2	10	20	26	2
SAN Port Costs	£2,000	£2,000	£2,000	£10,000	£20,000	£26,000	£2,000
Total Cost of Ownership (3 yr with Oracle Licenses)	£3,675,000	£2,974,000	£3,223,000	£4,186,000	£9,763,000	£5,237,000	£14,803,000
Cost Ratio (with Licenses)	1.24 to 1	1 to 1	1.09 to 1	1.41 to 1	3.29 to 1	1.77 to 1	4.98 to 1
Total Cost of Ownership (3 yr without Oracle Licenses)	£2,114,000	£1,658,000	£2,044,000	£2,131,000	£4,289,000	£2,390,000	£6,267,000
Cost Ratio	1.28 to 1	1 to 1	1.24 to 1	1.29 to 1	2.59 to 1	1.45 to 1	3.78 to 1

Build up case RAC N+1 Table

Back

Server	IBM Power 770	IBM Power 770	IBM Power 780	IBM Power 740	HP ProLiant DL580	HP ProLiant DL380p	HP ProLiant BL685c
Number of servers for workload	1	1	1	5	10	13	13
Max "n" for "n+1" resilience	1	1	1	1	1	1	3
Server for "+1" in "n+1"	1	1	1	5	10	13	5
Resulting Servers needed	2	2	2	10	20	26	18
Number of OS Images + servers needed	102	102	102	110	120	126	87
People Costs (3yr)	£416,000	£416,000	£416,000	£480,000	£560,000	£608,000	£421,000
Active cores	114	96	86	160	800	416	864
Sub Cap Cores	114	96	86	150	800	416	864
Total HW Cost	£1,722,000	£1,137,000	£2,080,000	£1,051,000	£726,000	£372,000	£495,000
Oracle License Factor	1	1	1	1	0.5	0.5	0.5
Oracle DB Lic Costs	£1,452,000	£1,223,000	£1,096,000	£1,911,000	£5,095,000	£2,650,000	£5,502,000
3 Year Oracle Maint	£959,000	£807,000	£723,000	£1,261,000	£3,363,000	£1,749,000	£3,632,000
Oracle RAC Lic Costs	£704,000	£593,000	£531,000	£926,000	£2,467,000	£1,283,000	£2,665,000
3 Year RAC Maint	£464,000	£391,000	£351,000	£611,000	£1,629,000	£847,000	£1,759,000
Oracle Partitioning Lic Costs	£352,000	£296,000	£266,000	£463,000	£1,234,000	£642,000	£1,332,000
3 Year Partitioning Maint	£232,000	£196,000	£176,000	£306,000	£815,000	£424,000	£880,000
Oracle Diag Pack Lic Costs	£153,000	£129,000	£116,000	£202,000	£537,000	£279,000	£580,000
3 Year Diag Pack Maint	£101,000	£85,000	£77,000	£133,000	£354,000	£185,000	£383,000
Oracle Tuning Pack Lic Costs	£153,000	£129,000	£116,000	£202,000	£537,000	£279,000	£580,000
3 Year Tuning Pack Maint	£101,000	£85,000	£77,000	£133,000	£354,000	£185,000	£383,000
Oracle DG Lic Costs	£306,000	£258,000	£231,000	£403,000	£1,073,000	£558,000	£1,159,000
3 Year DG Maint	£202,000	£170,000	£153,000	£266,000	£708,000	£369,000	£765,000
Rack Units	32	32	32	40	80	52	20
Rack Costs (3yr, rounded down)	£0	£0	£0	£1,000	£2,000	£1,000	£0
Power Costs (3yr 24x7)	£30,000	£25,000	£32,000	£26,000	£83,000	£61,000	£26,000
Min Network Ports needed	4	4	4	20	40	52	4
LAN Port Costs	£2,000	£2,000	£2,000	£10,000	£20,000	£26,000	£2,000
Min SAN Ports needed	4	4	4	20	40	52	4
SAN Port Costs	£4,000	£4,000	£4,000	£20,000	£40,000	£52,000	£4,000
Total Cost of Ownership (3 yr with Oracle Licenses)	£7,353,000	£5,946,000	£6,447,000	£8,405,000	£19,597,000	£10,570,000	£20,568,000
Cost Ratio (with Licenses)	1.24 to 1	1 to 1	1.09 to 1	1.42 to 1	3.3 to 1	1.78 to 1	3.46 to 1
Total Cost of Ownership (3 yr without Oracle Licenses)	£4,233,000	£3,318,000	£4,091,000	£4,298,000	£8,654,000	£4,879,000	£8,750,000
Cost Ratio	1.28 to 1	1 to 1	1.24 to 1	1.3 to 1	2.61 to 1	1.48 to 1	2.64 to 1

Build up case RAC Scalability Table

Back

Server	IBM Power 770	IBM Power 770	IBM Power 780	IBM Power 740	HP ProLiant DL580	HP ProLiant DL380p	HP ProLiant BL685c
Performance impact for running Oracle RAC	10%	10%	10%	10%	10%	10%	10%
Max "n" for "n+1" resilience	1	1	1	1	1	1	3
Performance (with impact of scaling out beyond 1+1)	100%	100%	100%	100%	100%	100%	83%
Avg Util per workload (before RAC overhead)	0.83%	0.70%	0.63%	2.59%	2.02%	3.18%	2.86%
Avg Util per workload (with RAC and scaleout overhead)	0.92%	0.77%	0.69%	2.85%	2.22%	3.50%	3.81%
Resulting Servers needed	2	2	2	14	20	26	18
Number of OS Images needed	102	102	102	114	120	126	87
People Costs (3yr)	£416,000	£416,000	£416,000	£512,000	£560,000	£608,000	£421,000
Peak Utilisation Rate (Full Spec Server)	1	1	1	1	0	1	1
Sub Cap Cores	126	106	96	182	800	416	864
Total HW Cost	£1,904,000	£1,256,000	£2,322,000	£1,471,000	£726,000	£372,000	£495,000
Oracle License Factor	1	1	1	1	0.5	0.5	0.5
Oracle DB Lic Costs	£1,605,000	£1,350,000	£1,223,000	£2,318,000	£5,095,000	£2,650,000	£5,502,000
3 Year Oracle Maint	£1,060,000	£891,000	£807,000	£1,530,000	£3,363,000	£1,749,000	£3,632,000
Oracle RAC Lic Costs	£778,000	£654,000	£593,000	£1,123,000	£2,467,000	£1,283,000	£2,665,000
3 Year RAC Maint	£513,000	£432,000	£391,000	£741,000	£1,629,000	£847,000	£1,759,000
Oracle Partitioning Lic Costs	£389,000	£327,000	£296,000	£562,000	£1,234,000	£642,000	£1,332,000
3 Year Partitioning Maint	£257,000	£216,000	£196,000	£371,000	£815,000	£424,000	£880,000
Oracle Diag Pack Lic Costs	£169,000	£143,000	£129,000	£245,000	£537,000	£279,000	£580,000
3 Year Diag Pack Maint	£112,000	£94,000	£85,000	£162,000	£354,000	£185,000	£383,000
Oracle Tuning Pack Lic Costs	£169,000	£143,000	£129,000	£245,000	£537,000	£279,000	£580,000
3 Year Tuning Pack Maint	£112,000	£94,000	£85,000	£162,000	£354,000	£185,000	£383,000
Oracle DG Lic Costs	£338,000	£285,000	£258,000	£488,000	£1,073,000	£558,000	£1,159,000
3 Year DG Maint	£223,000	£188,000	£170,000	£323,000	£708,000	£369,000	£765,000
Rack Units	32	32	32	56	80	52	20
Rack Costs (3yr, rounded down)	£0	£0	£0	£1,000	£2,000	£1,000	£0
Power Costs (3yr 24x7)	£33,000	£27,000	£35,000	£36,000	£83,000	£61,000	£26,000
Min Network Ports needed	4	4	4	28	40	52	4
LAN Port Costs	£2,000	£2,000	£2,000	£14,000	£20,000	£26,000	£2,000
Min SAN Ports needed	4	4	4	28	40	52	4
SAN Port Costs	£4,000	£4,000	£4,000	£28,000	£40,000	£52,000	£4,000
Total Cost of Ownership (3 yr with Oracle Licenses)	£8,084,000	£6,522,000	£7,141,000	£10,332,000	£19,597,000	£10,570,000	£20,568,000
Cost Ratio (with Licenses)	1.24 to 1	1 to 1	1.1 to 1	1.59 to 1	3.01 to 1	1.63 to 1	3.16 to 1
Total Cost of Ownership (3 yr without Oracle Licenses)	£4,636,000	£3,620,000	£4,513,000	£5,351,000	£8,654,000	£4,879,000	£8,750,000
Cost Ratio	1.29 to 1	1 to 1	1.25 to 1	1.48 to 1	2.4 to 1	1.35 to 1	2.42 to 1

Build up case Java benchmark Table

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Server	IBM Power 770	IBM Power 770	IBM Power 780	IBM Power 740	HP ProLiant DL580	HP ProLiant DL380p	HP ProLiant BL685c
Number of servers	1	1	1	3	2	4	4
Perf Factor (Benchmark)	1.00	0.81	0.73	2.65	1.93	3.34	3.03
Total Number of sockets	8	8	8	6	8	8	16
Total Number of cores	64	64	64	48	80	64	192
Processor Speed (GHz)	3.3	3.8	4.42	4.2	2.4	2.9	2.4
System Purchase	£879,000	£690,000	£1,407,000	£287,000	£66,000	£52,000	£100,000
Hardware Maint (3yr 24x7)	£88,000	£69,000	£141,000	£29,000	£7,000	£6,000	£10,000
Total HW Cost	**£967,000**	**£758,000**	**£1,548,000**	**£316,000**	**£73,000**	**£58,000**	**£110,000**
Rack Units	16	16	16	12	8	8	10
Rack Costs (3yr, rounded down)	£0	£0	£0	£0	£0	£0	£0
Power Costs (3yr 24x7)	£17,000	£17,000	£24,000	£8,000	£9,000	£10,000	£6,000
Min Network Ports needed	2	2	2	6	4	8	2
LAN Port Costs	£1,000	£1,000	£1,000	£3,000	£2,000	£4,000	£1,000
Min SAN Ports needed	2	2	2	6	4	8	2
SAN Port Costs	£2,000	£2,000	£2,000	£6,000	£4,000	£8,000	£2,000
Total Cost of Ownership	**£970,000**	**£761,000**	**£1,551,000**	**£325,000**	**£79,000**	**£70,000**	**£113,000**
Cost Ratio	13.86 to 1	10.88 to 1	22.16 to 1	4.65 to 1	1.13 to 1	1 to 1	1.62 to 1

Build up case Java Central Limit Theorem Table

Back

Server	IBM Power 770	IBM Power 770	IBM Power 780	IBM Power 740	HP ProLiant DL580	HP ProLiant DL380p	HP ProLiant BL685c
Number of servers	1	1	1	4	2	5	4
Total Number of Workloads (DBs)	50	50	50	50	50	50	50
People Costs (3yr)	**£204,000**	**£204,000**	**£204,000**	**£216,000**	**£208,000**	**£220,000**	**£216,000**
Average Utilisation per workload	0.74%	0.59%	0.53%	1.95%	1.42%	2.46%	2.22%
Variability for workload	3.75	3.75	3.75	3.75	3.75	3.75	3.75
Peak Utilisation per workload	6.25%	5.04%	4.54%	16.57%	12.07%	20.90%	18.91%
Smoothed Workloads (per server)	50	50	50	13	25	10	13
Average Utilisation Rate (Server)	**37%**	**30%**	**27%**	**24%**	**35%**	**25%**	**28%**
Peak Utilisation Rate (Server)	**76%**	**61%**	**55%**	**76%**	**89%**	**83%**	**87%**
Target Peak Utilisation	90%	90%	90%	90%	90%	90%	90%
Number of sockets	8	8	8	8	8	10	16
Number of cores	64	64	64	64	80	80	192
Total HW Cost	**£967,000**	**£759,000**	**£1,548,000**	**£421,000**	**£73,000**	**£72,000**	**£110,000**
Rack Units	16	16	16	16	8	10	10
Rack Costs (3yr, rounded down)	£0	£0	£0	£0	£0	£0	£0
Power Costs (3yr 24x7)	£17,000	£17,000	£24,000	£11,000	£9,000	£12,000	£6,000
Min Network Ports needed	2	2	2	8	4	10	2
LAN Port Costs	£1,000	£1,000	£1,000	£4,000	£2,000	£5,000	£1,000
Min SAN Ports needed	2	2	2	8	4	10	2
SAN Port Costs	£2,000	£2,000	£2,000	£8,000	£4,000	£10,000	£2,000
Total Cost of Ownership	**£1,174,000**	**£966,000**	**£1,755,000**	**£649,000**	**£287,000**	**£307,000**	**£329,000**
Cost Ratio	4.1 to 1	3.37 to 1	6.12 to 1	2.27 to 1	1 to 1	1.07 to 1	1.15 to 1

Build up case Java Capacity on Demand Table

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Server	IBM Power 770	IBM Power 770	IBM Power 780	IBM Power 740	HP ProLiant DL580	HP ProLiant DL380p	HP ProLiant BL685c
Number of servers	1	1	1	4	2	5	4
Total Number of Workloads (DBs)	50	50	50	50	50	50	50
People Costs (3yr)	£204,000	£204,000	£204,000	£216,000	£208,000	£220,000	£216,000
Average Utilisation per workload	0.74%	0.59%	0.53%	1.95%	1.42%	2.46%	2.22%
Variability for workload	3.75	3.75	3.75	3.75	3.75	3.75	3.75
Peak Utilisation per workload	6.25%	5.04%	4.54%	16.57%	12.07%	20.90%	18.91%
Smoothed Workloads (per server)	50	50	50	13	25	10	13
Average Utilisation Rate (Full Spec Server)	37%	30%	27%	24%	35%	25%	28%
Peak Utilisation Rate (Full Spec Server)	76%	61%	55%	76%	89%	83%	87%
Target Peak Utilisation	90%	90%	90%	90%	90%	90%	90%
Active cores	54	44	40	64	80	80	192
CPU Overcommit Ratio	3.71 to 1	4.55 to 1	3.75 to 1	2.35 to 1	3.13 to 1	2.5 to 1	2.61 to 1
Total HW Cost	£816,000	£522,000	£968,000	£421,000	£73,000	£72,000	£110,000
Rack Units	16	16	16	16	8	10	10
Rack Costs (3yr, rounded down)	£0	£0	£0	£0	£0	£0	£0
Power Costs (3yr 24x7)	£15,000	£12,000	£15,000	£11,000	£9,000	£12,000	£6,000
Min Network Ports needed	2	2	2	8	4	10	2
LAN Port Costs	£1,000	£1,000	£1,000	£4,000	£2,000	£5,000	£1,000
Min SAN Ports needed	2	2	2	8	4	10	2
SAN Port Costs	£2,000	£2,000	£2,000	£8,000	£4,000	£10,000	£2,000
Total Cost of Ownership	£1,038,000	£741,000	£1,190,000	£660,000	£296,000	£319,000	£335,000
Cost Ratio	3.51 to 1	2.51 to 1	4.03 to 1	2.23 to 1	1 to 1	1.08 to 1	1.14 to 1

Build up case WAS Table

Back

Server	IBM Power 770	IBM Power 770	IBM Power 780	IBM Power 740	HP ProLiant DL580	HP ProLiant DL380p	HP ProLiant BL685c
Number of servers	1	1	1	4	2	5	4
People Costs (3yr)	£204,000	£204,000	£204,000	£216,000	£208,000	£220,000	£216,000
Average Utilisation Rate (Full Spec Server)	37%	30%	27%	24%	35%	25%	28%
Peak Utilisation Rate (Full Spec Server)	76%	61%	55%	76%	89%	83%	87%
Active cores	54	44	40	64	80	80	192
Sub Cap Cores	54	44	40	56	80	75	188
Total HW Cost	£816,000	£522,000	£968,000	£421,000	£73,000	£72,000	£110,000
Total PVU	6480	5280	4800	3920	8000	5250	9400
WAS/ND License Costs	£304,000	£248,000	£225,000	£184,000	£375,000	£247,000	£441,000
WAS/ND 3 Year Support Costs	£228,000	£186,000	£169,000	£138,000	£282,000	£185,000	£331,000
Rack Units	16	16	16	20	40	26	10
Rack Costs (3yr, rounded down)	£0	£0	£0	£0	£1,000	£0	£0
Power Costs (3yr 24x7)	£15,000	£13,000	£16,000	£13,000	£42,000	£31,000	£19,000
Min Network Ports needed	2	2	2	10	20	26	2
LAN Port Costs	£1,000	£1,000	£1,000	£5,000	£10,000	£13,000	£1,000
Min SAN Ports needed	2	2	2	10	20	26	2
SAN Port Costs	£2,000	£2,000	£2,000	£10,000	£20,000	£26,000	£2,000
Total Cost of Ownership (3 yr)	£1,570,000	£1,176,000	£1,585,000	£987,000	£1,011,000	£794,000	£1,120,000
Cost Ratio	1.98 to 1	1.49 to 1	2 to 1	1.25 to 1	1.28 to 1	1 to 1	1.42 to 1

Build up case WAS N+1 Table

Back

Server	IBM Power 770	IBM Power 770	IBM Power 780	IBM Power 740	HP ProLiant DL580	HP ProLiant DL380p	HP ProLiant BL685c
Number of servers for workload	1	1	1	4	2	5	4
Max "n" for "n+1" resilience	3	3	3	3	3	3	3
Server for "+1" in "n+1"	1	1	1	2	1	2	2
Resulting Servers needed	2	2	2	6	3	7	6
Number of OS Images + servers needed	102	102	102	81	78	77	81
People Costs (3yr)	£416,000	£416,000	£416,000	£348,000	£324,000	£336,000	£348,000
Active cores	108	88	80	96	120	112	288
Sub Cap Cores	108	88	80	84	120	105	282
Total HW Cost	£1,632,000	£1,043,000	£1,935,000	£631,000	£109,000	£101,000	£165,000
PVU for Server	120	120	120	70	100	70	50
WAS/ND License Costs	£607,461.12	£494,968.32	£449,971.20	£275,607.36	£562,464.00	£344,509.20	£660,895.20
WAS/ND 3 Year Support Costs	£456,000	£372,000	£338,000	£207,000	£422,000	£259,000	£496,000
Rack Units	32	32	32	24	12	14	10
Rack Costs (3yr, rounded down)	£0	£0	£0	£0	£0	£0	£0
Power Costs (3yr 24x7)	£29,000	£23,000	£30,000	£16,000	£13,000	£17,000	£9,000
Min Network Ports needed	4	4	4	12	6	14	2
LAN Port Costs	£2,000	£2,000	£2,000	£6,000	£3,000	£7,000	£1,000
Min SAN Ports needed	4	4	4	12	6	14	2
SAN Port Costs	£4,000	£4,000	£4,000	£12,000	£6,000	£14,000	£2,000
Total Cost of Ownership (3 yr)	£3,146,461	£2,354,968	£3,174,971	£1,495,607	£1,439,464	£1,078,509	£1,681,895
Cost Ratio	2.92 to 1	2.19 to 1	2.95 to 1	1.39 to 1	1.34 to 1	1 to 1	1.56 to 1

Build up case WPS Table

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Server	IBM Power 770	IBM Power 770	IBM Power 780	IBM Power 740	HP ProLiant DL580	HP ProLiant DL380p	HP ProLiant BL685c
Number of servers	1	1	1	4	2	5	4
People Costs (3yr)	£204,000	£204,000	£204,000	£216,000	£208,000	£220,000	£216,000
Average Utilisation Rate (Full Spec Server)	37%	30%	27%	24%	35%	25%	28%
Peak Utilisation Rate (Full Spec Server)	76%	61%	55%	76%	89%	83%	87%
Active cores	54	44	40	64	80	80	192
Sub Cap Cores	54	44	40	56	80	75	188
Total HW Cost	£816,000	£522,000	£968,000	£421,000	£73,000	£72,000	£110,000
Total PVU	6480	5280	4800	3920	8000	5250	9400
WPS License Costs	£2,427,000	£1,977,000	£1,798,000	£1,468,000	£2,996,000	£1,966,000	£3,520,000
WPS 3 Year Support Costs	£1,820,000	£1,483,000	£1,348,000	£1,101,000	£2,247,000	£1,475,000	£2,640,000
Rack Units	16	16	16	20	40	26	10
Rack Costs (3yr, rounded down)	£0	£0	£0	£0	£1,000	£0	£0
Power Costs (3yr 24x7)	£15,000	£13,000	£16,000	£13,000	£42,000	£31,000	£19,000
Min Network Ports needed	2	2	2	10	20	26	2
LAN Port Costs	£1,000	£1,000	£1,000	£5,000	£10,000	£13,000	£1,000
Min SAN Ports needed	2	2	2	10	20	26	2
SAN Port Costs	£2,000	£2,000	£2,000	£10,000	£20,000	£26,000	£2,000
Total Cost of Ownership (3 yr)	£2,858,000	£2,225,000	£2,539,000	£1,766,000	£2,601,000	£1,837,000	£2,988,000
Cost Ratio	1.62 to 1	1.26 to 1	1.44 to 1	1 to 1	1.48 to 1	1.05 to 1	1.7 to 1

Build up case WPS N+1 Table

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Server	IBM Power 770	IBM Power 770	IBM Power 780	IBM Power 740	HP ProLiant DL580	HP ProLiant DL380p	HP ProLiant BL685c
Number of servers for workload	1	1	1	4	2	5	4
Max "n" for "n+1" resilience	3	3	3	3	3	3	3
Server for "+1" in "n+1"	1	1	1	2	1	2	2
Resulting Servers needed	2	2	2	6	3	7	6
Number of OS Images + servers needed	102	102	102	81	78	77	81
People Costs (3yr)	£416,000	£416,000	£416,000	£348,000	£324,000	£336,000	£348,000
Active cores	108	88	80	96	120	112	288
Sub Cap Cores	108	88	80	84	120	105	282
Total HW Cost	£1,632,000	£1,043,000	£1,935,000	£631,000	£109,000	£101,000	£165,000
PVU for Server	120	120	120	70	100	70	50
WPS License Costs	£4,852,224.00	£3,953,664.00	£3,594,240.00	£2,201,472.00	£4,492,800.00	£2,751,840.00	£5,279,040.00
WPS 3 Year Support Costs	£3,640,000	£2,966,000	£2,696,000	£1,652,000	£3,370,000	£2,064,000	£3,960,000
Rack Units	32	32	32	24	12	14	10
Rack Costs (3yr, rounded down)	£0	£0	£0	£0	£0	£0	£0
Power Costs (3yr 24x7)	£29,000	£23,000	£30,000	£16,000	£13,000	£17,000	£9,000
Min Network Ports needed	4	4	4	12	6	14	2
LAN Port Costs	£2,000	£2,000	£2,000	£6,000	£3,000	£7,000	£1,000
Min SAN Ports needed	4	4	4	12	6	14	2
SAN Port Costs	£4,000	£4,000	£4,000	£12,000	£6,000	£14,000	£2,000
Total Cost of Ownership (3 yr)	£10,575,224	£8,407,664	£8,677,240	£4,866,472	£8,317,800	£5,290,840	£9,764,040
Cost Ratio	2.18 to 1	1.73 to 1	1.79 to 1	1 to 1	1.71 to 1	1.09 to 1	2.01 to 1

Built up case Combined Table

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Server	IBM Power 770	IBM Power 770	IBM Power 780	IBM Power 740	HP ProLiant DL580	HP ProLiant DL380p	HP ProLiant BL685c
Mixed/Separate?	Mixed	Mixed	Mixed	Mixed	Separate	Separate	Separate
Average Utilisation Rate (Full Spec Server)	39.79%	48.98%	43.95%	28.12%	N/A	N/A	N/A
Peak Utilisation Rate (Full Spec Server)	80.11%	89.51%	80.33%	85.12%	N/A	N/A	N/A
Total Servers Needed	4	3	3	16	26	38	29
Number of OS Images needed	304	303	303	316	326	338	298
People Costs (3yr)	£1,232,000	£1,224,000	£1,224,000	£1,328,000	£1,408,000	£1,504,000	£1,309,000
Sub Cap Cores	228	192	174	256	1040	608	1392
Total HW Cost	£3,444,000	£2,274,000	£4,208,000	£1,681,000	£944,000	£544,000	£798,000
Oracle DB Lic Costs	£1,605,000	£1,350,000	£1,223,000	£2,318,000	£5,095,000	£2,650,000	£5,502,000
3 Year Oracle Maint	£1,060,000	£891,000	£807,000	£1,530,000	£3,363,000	£1,749,000	£3,632,000
Oracle RAC Lic Costs	£778,000	£654,000	£593,000	£1,123,000	£2,467,000	£1,283,000	£2,665,000
3 Year RAC Maint	£513,000	£432,000	£391,000	£741,000	£1,629,000	£847,000	£1,759,000
Oracle Partitioning Lic Costs	£389,000	£327,000	£296,000	£562,000	£1,234,000	£642,000	£1,332,000
3 Year Partitioning Maint	£257,000	£216,000	£196,000	£371,000	£815,000	£424,000	£880,000
Oracle Diag Pack Lic Costs	£169,000	£143,000	£129,000	£245,000	£537,000	£279,000	£580,000
3 Year Diag Pack Maint	£112,000	£94,000	£85,000	£162,000	£354,000	£185,000	£383,000
Oracle Tuning Pack Lic Costs	£169,000	£143,000	£129,000	£245,000	£537,000	£279,000	£580,000
3 Year Tuning Pack Maint	£112,000	£94,000	£85,000	£162,000	£354,000	£185,000	£383,000
Oracle DG Lic Costs	£338,000	£285,000	£258,000	£488,000	£1,073,000	£558,000	£1,159,000
3 Year DG Maint	£223,000	£188,000	£170,000	£323,000	£708,000	£369,000	£765,000
WAS/ND License Costs	£608,000	£495,000	£450,000	£276,000	£563,000	£345,000	£661,000
WAS/ND 3 Year Support Costs	£456,000	£372,000	£338,000	£207,000	£422,000	£259,000	£496,000
WPS License Costs	£4,853,000	£3,954,000	£3,595,000	£2,202,000	£4,493,000	£2,752,000	£5,280,000
WPS 3 Year Support Costs	£3,640,000	£2,966,000	£2,696,000	£1,652,000	£3,370,000	£2,064,000	£3,960,000
Rack Units	64	48	48	64	104	76	20
Rack Costs (3yr, rounded down)	£1,000	£1,000	£1,000	£1,000	£3,000	£2,000	£0
Power Costs (3yr 24x7)	£60,000	£49,000	£64,000	£41,000	£108,000	£90,000	£42,000
Min Network Ports needed	8	6	6	32	52	76	4
LAN Port Costs	£4,000	£3,000	£3,000	£16,000	£26,000	£38,000	£2,000
Min SAN Ports needed	8	6	6	32	52	76	4
SAN Port Costs	£8,000	£6,000	£6,000	£32,000	£52,000	£76,000	£4,000
Total Cost of Ownership (3 yr with Oracle Licenses)	£20,031,000	£16,161,000	£16,947,000	£15,706,000	£29,555,000	£17,124,000	£32,172,000
Cost Ratio (with Licenses)	1.28 to 1	1.03 to 1	1.08 to 1	1 to 1	1.89 to 1	1.1 to 1	2.05 to 1

Conclude case Table

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Server	IBM Power 770	IBM Power 770	IBM Power 780	IBM Power 740	HP ProLiant DL580	HP ProLiant DL380p	HP ProLiant BL685c
Mixed/Separate?	Mixed	Mixed	Mixed	Mixed	Separate	Separate	Separate
Average Utilisation Rate (Full Spec Server)	39.79%	48.98%	43.95%	28.12%	N/A	N/A	N/A
Peak Utilisation Rate (Full Spec Server)	80.11%	89.51%	80.33%	85.12%	N/A	N/A	N/A
Resulting Servers needed (Virtualised workloads)	4	3	3	16	6	12	11
Number of OS Images needed	304	303	303	316	326	338	298
People Costs (3yr)	£1,232,000	£1,224,000	£1,224,000	£1,328,000	£1,408,000	£1,504,000	£1,309,000
Sub Cap Cores	228	192	174	256	1040	608	1392
Discount	30.00%	30.00%	30.00%	30.00%	30.00%	30.00%	30.00%
Total HW Cost	£2,411,000	£1,592,000	£2,945,000	£1,177,000	£661,000	£381,000	£559,000
Oracle DB Lic Costs	£1,605,000	£1,350,000	£1,223,000	£2,318,000	£5,095,000	£2,650,000	£5,502,000
3 Year Oracle Maint	£1,060,000	£891,000	£807,000	£1,530,000	£3,363,000	£1,749,000	£3,632,000
Oracle RAC Lic Costs	£778,000	£654,000	£593,000	£1,123,000	£2,467,000	£1,283,000	£2,665,000
3 Year RAC Maint	£513,000	£432,000	£391,000	£741,000	£1,629,000	£847,000	£1,759,000
Oracle Partitioning Lic Costs	£389,000	£327,000	£296,000	£562,000	£1,234,000	£642,000	£1,332,000
3 Year Partitioning Maint	£257,000	£216,000	£196,000	£371,000	£815,000	£424,000	£880,000
Oracle Diag Pack Lic Costs	£169,000	£143,000	£129,000	£245,000	£537,000	£279,000	£580,000
3 Year Diag Pack Maint	£112,000	£94,000	£85,000	£162,000	£354,000	£185,000	£383,000
Oracle Tuning Pack Lic Costs	£169,000	£143,000	£129,000	£245,000	£537,000	£279,000	£580,000
3 Year Tuning Pack Maint	£112,000	£94,000	£85,000	£162,000	£354,000	£185,000	£383,000
Oracle DG Lic Costs	£338,000	£285,000	£258,000	£488,000	£1,073,000	£558,000	£1,159,000
3 Year DG Maint	£223,000	£188,000	£170,000	£323,000	£708,000	£369,000	£765,000
WAS/ND License Costs	£608,000	£495,000	£450,000	£276,000	£563,000	£345,000	£661,000
WAS/ND 3 Year Support Costs	£456,000	£372,000	£338,000	£207,000	£422,000	£259,000	£496,000
WPS License Costs	£4,853,000	£3,954,000	£3,595,000	£2,202,000	£4,493,000	£2,752,000	£5,280,000
WPS 3 Year Support Costs	£3,640,000	£2,966,000	£2,696,000	£1,652,000	£3,370,000	£2,064,000	£3,960,000
Rack Units	64	48	48	64	104	76	20
Rack Costs (3yr, rounded down)	£1,000	£1,000	£1,000	£1,000	£3,000	£2,000	£0
Power Costs (3yr 24x7)	£60,000	£49,000	£64,000	£41,000	£108,000	£90,000	£42,000
Min Network Ports needed	8	6	6	32	52	76	4
LAN Port Costs	£4,000	£3,000	£3,000	£16,000	£26,000	£38,000	£2,000
Min SAN Ports needed	8	6	6	32	52	76	4
SAN Port Costs	£8,000	£6,000	£6,000	£32,000	£52,000	£76,000	£4,000
Total Cost of Ownership (3 yr with Oracle Licenses)	£10,505,000	£8,559,000	£9,393,000	£11,348,000	£21,409,000	£12,145,000	£22,693,000
Cost Ratio (with Licenses)	1.23 to 1	1 to 1	1.1 to 1	1.33 to 1	2.51 to 1	1.42 to 1	2.66 to 1