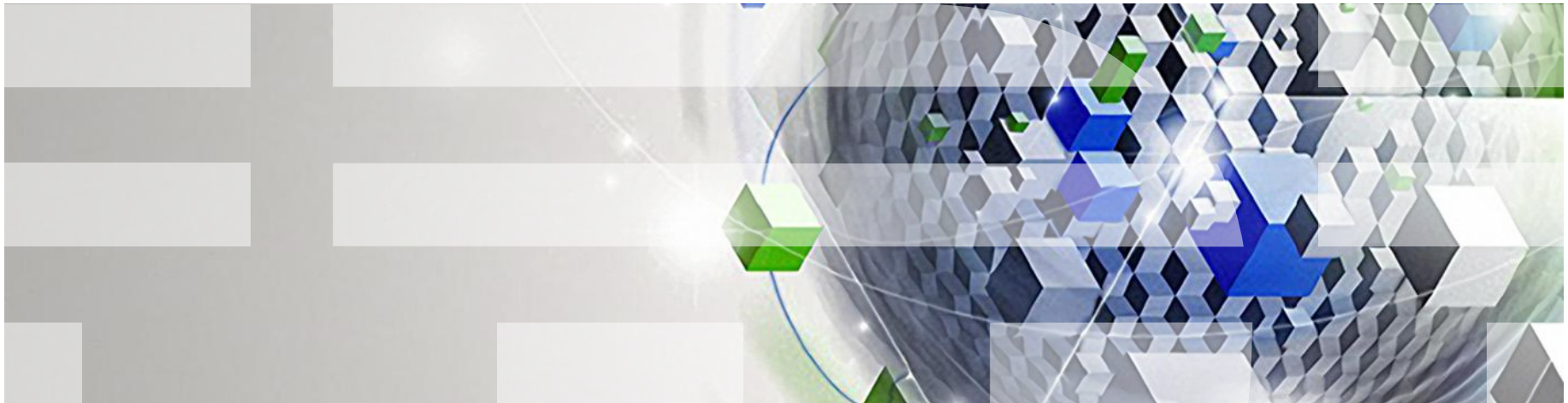# The Advantages of POWER7
over HP/Sun/Dell x86

Steven J Fier
Certified POWER Systems Sales
sjfier@us.ibm.com…

Topics for Discussion

❖ Challenges associated with a typical x86 scale-out deployment

❖ How Power Systems can address those challenges
- Affordable prices offering TCA/TCO savings
- Full range of servers based on POWER7 technology
- Industry leading proven performance
- Dynamic virtualization for increased scalability, utilization and security
- Enterprise reliability, availability and serviceability
- Outstanding energy efficiency
- Ease of management with automation
- Thousands of ISV applications and trusted business solutions
- Choice of operating environments with AIX, IBM i and Linux
- Vast migration skills and services

❖ Backup Information

Power your planet.

The level of complexity continues to grow

81%

of US midmarket growth company CEOs anticipate greater complexity over the next five years.

42%

Feel prepared for it.

6%

Percent of available capacity used by the average commodity server.

30%

Number of servers in some organizations that sit unutilized.

70%

Percent of typical IT budgets devoted to managing, maintaining, securing and upgrading systems rather than building new capabilities, services and applications.

Capitalizing on Complexity. Insights from the Global Chief Executive Officer Study. IBM 2010
http://www-304.ibm.com/businesscenter/cpe/html0/199672.html

Power your planet.

Companies need help to control escalating costs

They are looking at server consolidation to alleviate the challenges associated with x86 scale-out server sprawl

And many are finding that the benefits of consolidation increase with scaling…

PowerVM's industry leading performance and scalability allow customers to consolidate 100's of x86 workloads to a small number of Power servers (well beyond what VMware can provide)
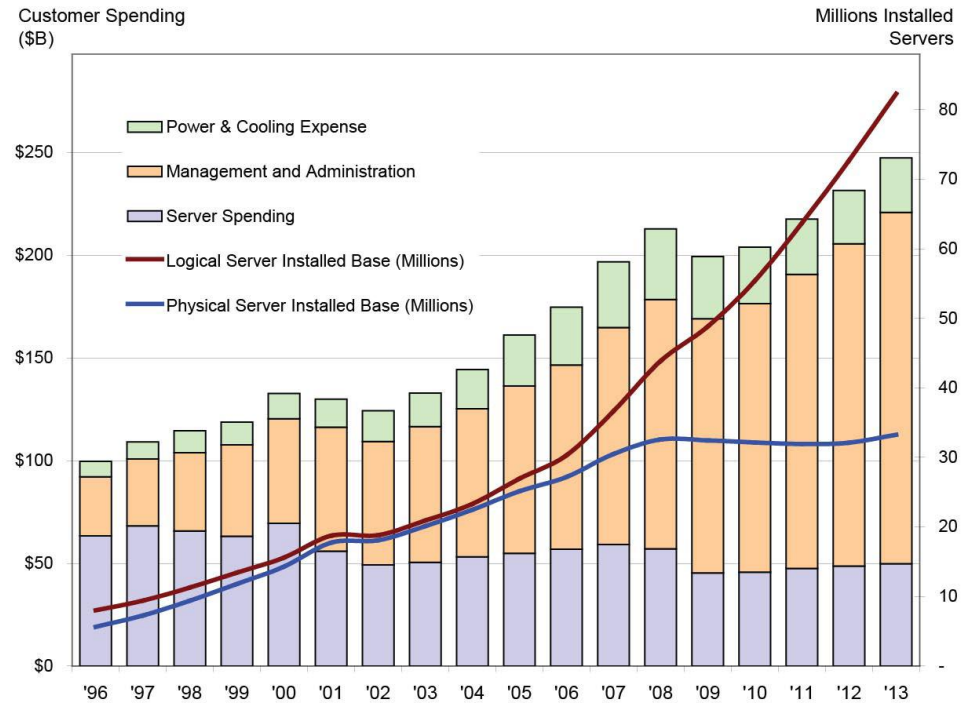

IDC July 2010: The Business Value of Large Scale Server Consolidation

Power your planet.

Systems and infrastructure are reaching a breaking point

Customer challenges with a typical x86 deployment

- Proliferation of servers and networking devices
- Excessive energy usage and heating problems
- Inadequate power and cooling infrastructure
- Data silos and data synchronization
- Expectations that "everything" is connected
- Linear staffing costs
- Skyrocketing software costs
- Unexplained outages

Meanwhile, customer expectations, competitive pressures, regulatory requirements and fiscal pressures are increasing.

Power your planet.
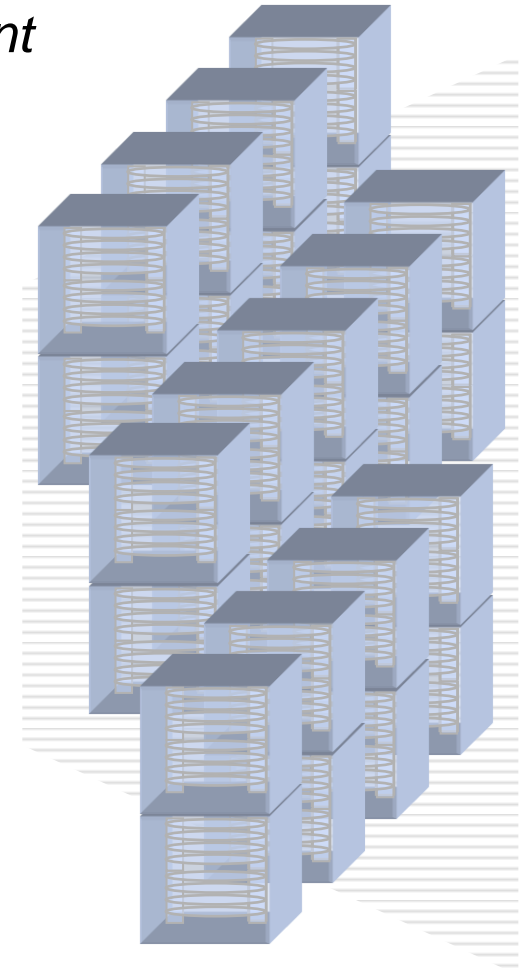
Companies have a choice to make!

There is a myth that x86 is cheaper than POWER

Now, for the rest of the story…

Power your planet.

Intelligent Server Consolidation with Power Systems

1. Affordable prices offering TCA/TCO savings

2. Full range of servers based on POWER7 technology

3. Industry leading proven performance

4. Dynamic virtualization for increased scalability, utilization and security

5. Enterprise reliability, availability and serviceability

6. Outstanding energy efficiency

7. Ease of management with automation

8. Thousands of ISV applications and trusted business solutions

9. Choice of operating environments with AIX, IBM i and Linux

10. Vast migration skills and services

POWER7
BUILT ON

Power

POWER7 servers were designed to help customers alleviate the challenges associated with x86 scale-out deployments

Power your planet.

Power Systems lowers client's total cost of ownership by 38%

$284,129 less.

Three year TCO savings when deploying IBM WebSphere Application Server on five, 12-core IBM Power 730 Express systems with PowerVM on Linux vs. nine, 12-core HP DL380 G7 with VMware on Linux.

For equivalent throughput, the IBM Power 730 Express systems with PowerVM utilized at 69% offers the above savings over HP ProLiant DL380 systems with VMware at 50%.

Five Power 730 Express

WebSphere. software

Nine HP ProLiant DL380 G7

- ✓ $225k less software license / maintenance
- ✓ $64k less OS & virtualization license / maintenance
- ✓ 44% less space

Based on similar throughput systems using IBM internal estimates.

Power your planet.

See WebSphere scenario for more information (WAS2D)

8

Power Systems lowers client's total cost of acquisition by 36%

$190,452 less.

One year TCA savings when deploying IBM WebSphere Application Server on five, 12-core IBM Power 730 Express systems with PowerVM on Linux vs. nine, 12-core HP DL380 G7 with VMware on Linux.

For equivalent throughput, the IBM Power 730 Express systems with PowerVM utilized at 69% has a $30,000 lower 3-year TCO than HP ProLiant DL380 systems with VMware at 50%.

Five Power 730 Express

WebSphere software

Nine HP ProLiant DL380 G7

✓ $160k less software license / maintenance

✓ $34k less OS & virtualization license / maintenance

Based on similar throughput systems using IBM internal estimates.

Power your planet.

See WebSphere scenario for more information (WAS2D)

HE-Midrange Database / Transaction Processing
Power 780 with TurboCore vs. HP Lintel Oracle RAC cluster

Today
Client needs to grow capacity 40%

2x Power 570
(4.7 GHz,16-core each)
1.6 m tpmC

Power 570 Production

Power 570 Dev/Test/HA

Alternatives

2x Power 780 (TurboCore)
(2 nodes, 16-cores, 256 GB each)

Production
(with PowerHA)

Dev/Test/HA

OR

Competitive x86 alternative

4x HP ProLiant DL580 G7
(32-cores, 512 GB each)
•**Oracle RAC for Availability / Scaling**

Production

Dev / Test

Power Advantages

$1.6 million lower TCA
•**Save over $2 million in decreased Oracle license and SWMA costs**

Seamless scalability
-Grow system to over 2x scalability without disruption
-CUoD
-On/Off COD delivers flexibility
-Avoid complexity of Oracle RAC (adding systems requires procurement, deployment, test, reconfiguration of RAC)

Continuous Availability
-System RAS
-PowerVM Live Partition Mobility

PowerVM Enterprise Virtualization can also deliver:
-Higher utilization
-No performance penalty
-Best in class security
-Supported by SAP and Oracle

Power your planet.

us$16 per day

buys one core of POWER7 performance with up to 8GB of memory on an **IBM Power 770 using On/Off Capacity on Demand.**

If you need to add a temporary server to run a new Linux application server for a few days, would you rather **spend thousands on yet another x86 server or just use the Power capacity you need** for less than $100 for a business week?
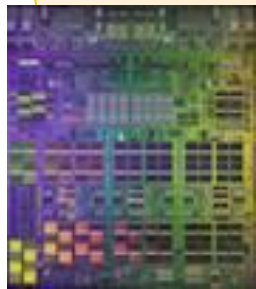
IBM Capacity on Demand

Power your planet.

Customers can depend on Power delivering quality products on time
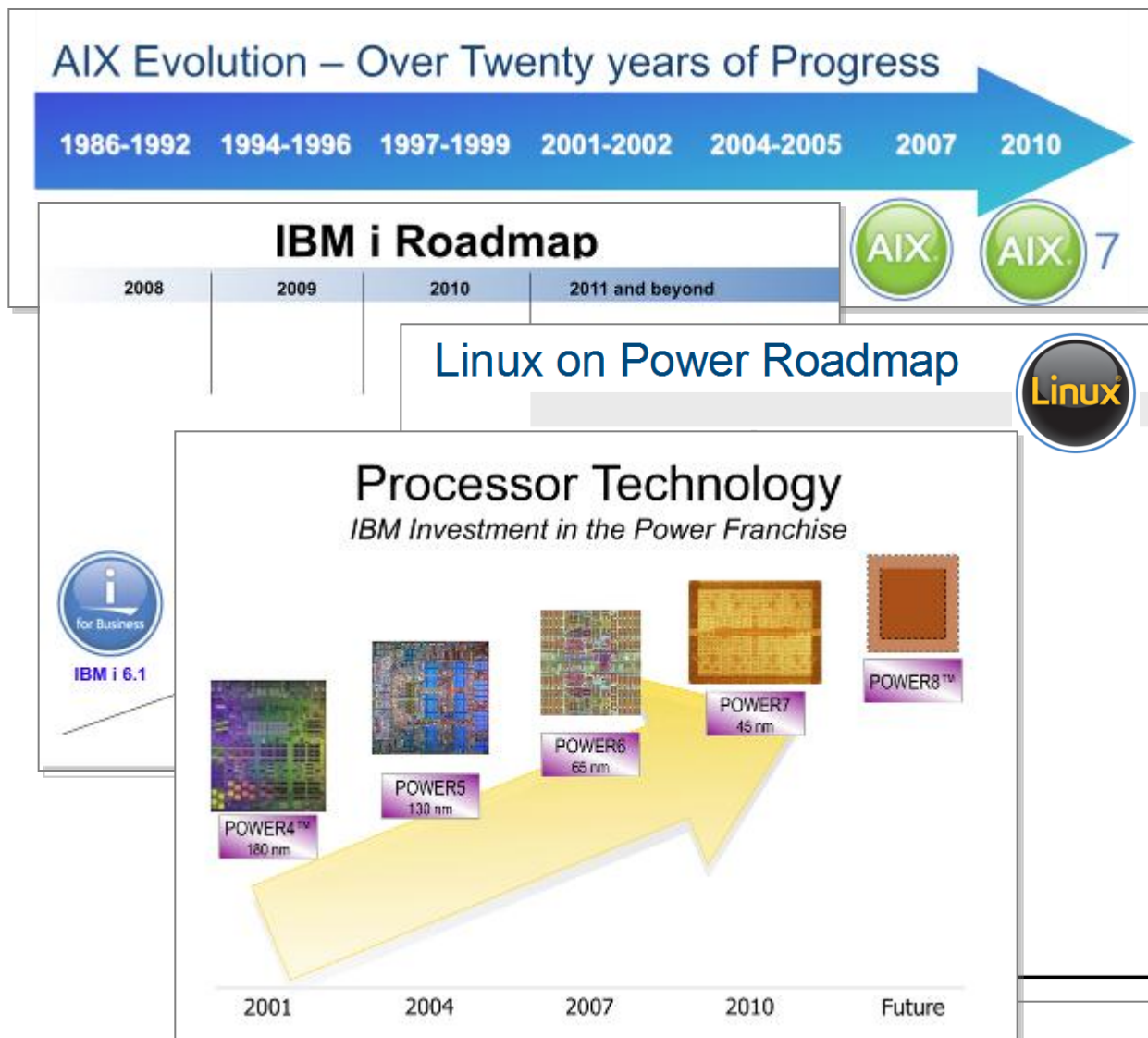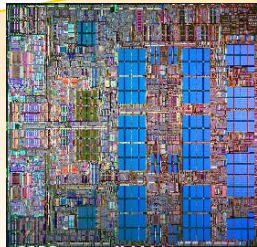

- **Power Systems delivers on commitments**

- **Clear and detailed technology roadmaps**

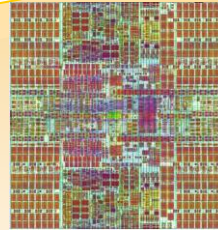- **R&D for continued leadership in server market**

Power your planet.

With industry leading Processor technology today and into the future

POWER8™

POWER7
45 nm

POWER6®
65 nm

POWER5™
130 nm
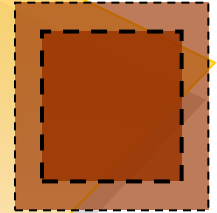
POWER4™
180 nm

• Dual Core • Chip Multi Processing • Distributed Switch • Shared L2 • Dynamic LPARs (32)	• Dual Core • Enhanced Scaling • SMT • Distributed Switch + • Core Parallelism + • FP Performance + • Memory bandwidth + • Virtualization	• Dual Core • High Frequencies • Virtualization + • Memory Subsystem + • Altivec • Instruction Retry • Dyn Energy Mgmt • SMT + • Protection Keys	• Multi Core • On-Chip eDRAM • Power Optimized Cores • Mem Subsystem ++ • SMT++ • Reliability + • VSM & VSX (AltiVec) • Protection Keys+	• Concept Phase

2001   **2004**   **2007**   **2010**

Power your planet.

Virtualization Leadership Begins with the Processor
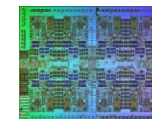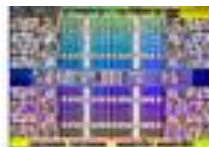
	Intel Nehalem EX	POWER7
Size	596 mm^2	567 mm^2
Transistors	2.3 billion	1.2 billion
Cores	4 / 6 / 8	4 / 6 / 8
Threads per Core	2	4
Maximum Frequency	3.2 GHz	4 GHz
L3 Cache	24 MB SRAM	32 MB eDRAM
Memory Bandwidth	50 GBps	100 GBps
SMP Fabric	100 GBps	360 GBps
Scalability	8 Sockets	32 Sockets

Power your planet.

POWER7 is Designed for Demanding Workloads and Consolidation

	POWER 7 vs. Nehalem-EX (Xeon 7560)	POWER 7 vs. Westmere-EP (Xeon 5680)	POWER 7 vs. Nehalem-EP (Xeon 5570)	POWER 7 vs. Tukwila (Itanium 9350)
Core Count	=	1.33x	2x	2x
Micro-Architecture	++	++	++	++++
Frequency	1.7x	1.16x	1.3x	2.25x
# of Threads / Core	2x	2x	2x	2x (+ SMT vs. HMT)
Cache	1.33x (+ DRAM advantage)	2.67x (+ DRAM advantage)	4x (+ DRAM advantage)	1.1x (+ DRAM advantage)
Memory Bandwidth	3x	5x	5x	3x
SMP Bandwidth	3.5x (+coherency advantage)	7x (+coherency advantage)	7x (+coherency advantage)	3.5x (+coherency advantage)
Max Glueless SMP	4x (32 vs. 8)	16x (32 vs. 2)	16x (32 vs. 2)	4x (32 vs. 8)

Power your planet.

Power Systems lowers client's total cost of acquisition by 59%

$231,646 less.

One year TCA savings when deploying SAP on two, 16-core IBM Power 740 Express systems utilized at 90% with PowerVM on Linux vs. seven, 16-core HP DL580 G7 utilized at 70% with VMware on Microsoft Windows Server 2008.

Power 740 Express

✓ $68k less software license / maintenance costs

HP ProLiant DL580 G7

Based on similar throughput systems using IBM internal estimates.

16   Power your planet.   See SAP Details chart for more information (SAP1234D)

Power Systems lowers client's total cost of acquisition by 61%

$293,184 less.

Three year TCO savings when deploying SAP on two, 16-core IBM Power 740 Express systems utilized at 90% with PowerVM on Linux vs. seven, 16-core HP DL580 G7 utilized at 70% with VMware on Microsoft Windows Server 2008.

Power 740 Express

HP ProLiant DL580 G7

- ✓ $92k less software license / maintenance costs
- ✓ $17k less energy costs
- ✓ 71% less floorspace

Based on similar throughput systems using IBM internal estimates.

Power your planet.   See SAP Details chart for more information (SAP1234D)   © 2010 IBM Corporation

POWER7 has clear Performance Leadership on major workloads
(PER SOCKET vs. Best Published 4/18/10 Intel Offering)

Power your planet.

IBM
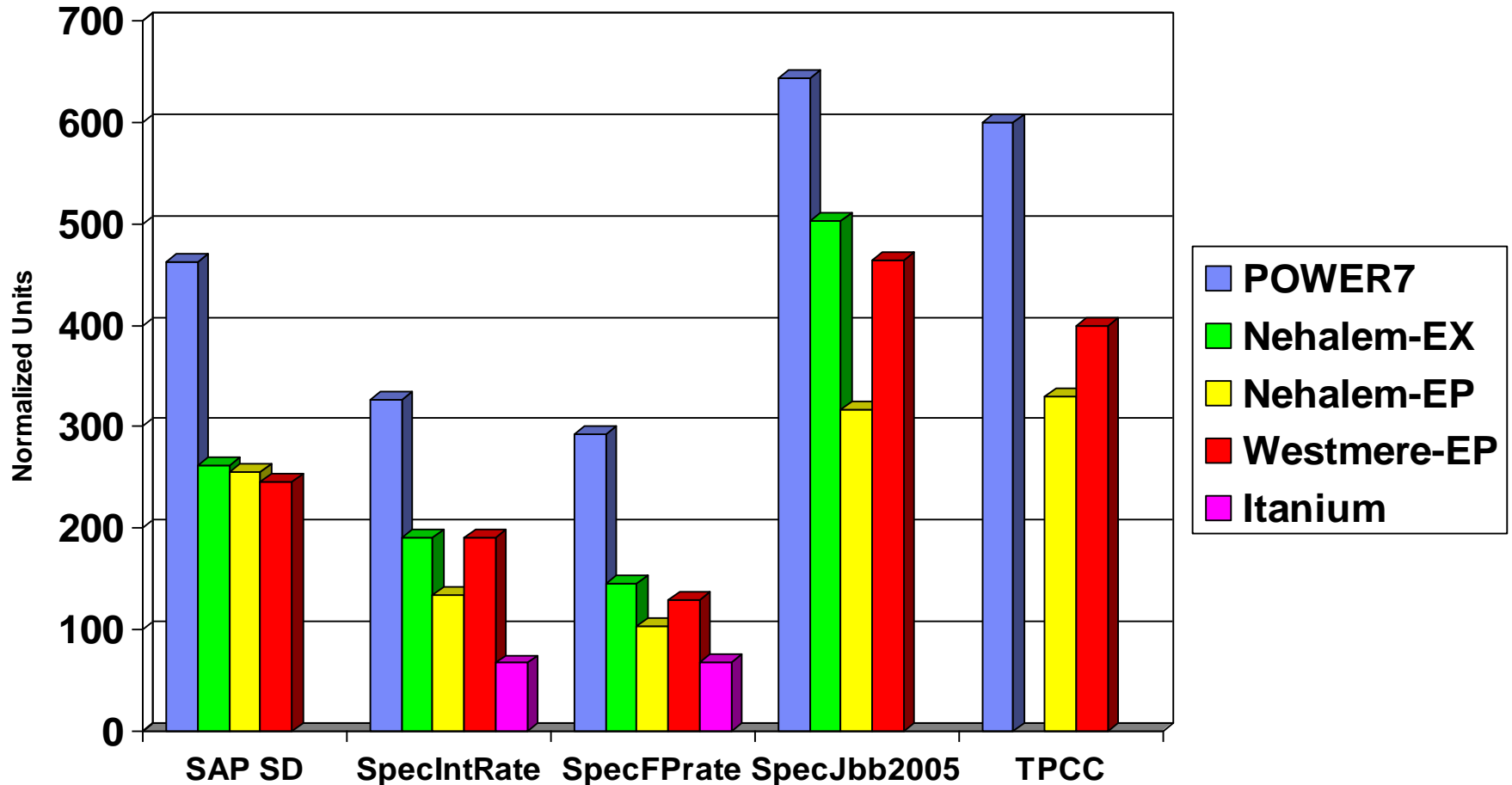
POWER7 allows customers to run more SAPS on less servers

37,000

SAP users on
SAP SD 2 Tier

#1

SAP USERS

Overall

40,000

**Power 780
with DB2®**

2X

30,000

New HP Nehalem-EX

#1

4-socket

20,000

*POWER7 offers more
SAP performance
than any x86 system
in the industry*

1.5X

10,000

0

HP DL580 G7 Nehalem-EX *4/32/64*	Power 750 POWER *4/32/128*	HP DL980 G7 Nehalem-EX *8/64/128*	Power 780 POWER *8/64/256*

◄──── 4 sockets ────► ◄──── 8 sockets ────►

19

Power your planet.

PowerVM builds on IBM's virtualization leadership

A 40-year track record in virtualization innovation continues with PowerVM™

1967   **1973**   **1999**   **2004**   **2008**   **2010**

IBM develops **hypervisor** that would become VM on the mainframe	IBM announces first machines to do **physical partitioning**	IBM announces **LPAR** on POWER™	IBM intro's POWER Hypervisor™ for System p™ and System i™	**IBM ships PowerVM Editions**	PowerVM delivers enhanced storage virtualization
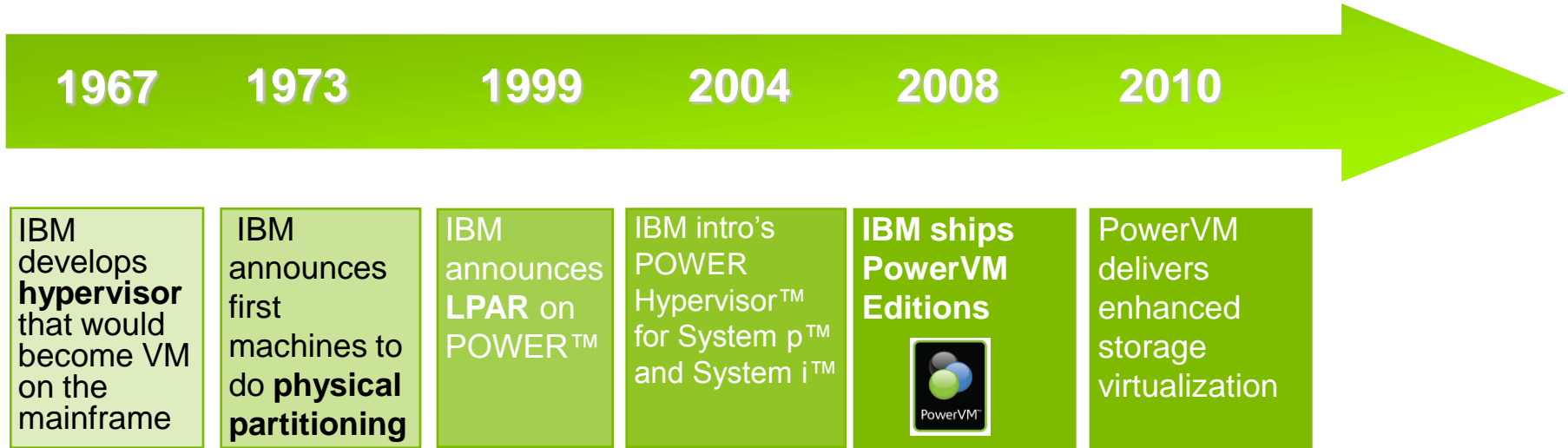
The Power Systems team has integrated PowerVM world-class virtualization into every server – based on best practices gained from IBMers who created the 'gold standard' of mainframe virtualization.

Power is virtualization without limits

Power your planet.

PowerVM delivers superior Scalability, Flexibility, Security and Resilience than VMware

Scalability Factors[1]	VMware ESX 3.5 (VMware Infrastructure 3)	VMware ESX 4.0 (VMware vSphere 4)	PowerVM
Virtual CPUs per VM	4	8	256
Memory per VM	64 GB	255 GB	8192 GB
Live VMs per server	192	320	1000
CPU threads per server	64	64	1024
Memory per server	256 GB	1024 GB	8192 GB

Flexibility Factors[2]

	VMware ESX 3.5	VMware ESX 4.0	PowerVM
Dynamic virtual CPU changes in VM	No	Add (but not Remove)	Yes
Dynamic memory changes in VM	No	Add (but not Remove)	Yes
Dynamic I/O device changes in VM	No	No	Yes
Direct access to I/O devices from within VM	No	Some (with Nehalem)	Yes
Integrated LPAR and WPAR support	No	No	Yes

Risk Management Factors[2]

	VMware ESX 3.5	VMware ESX 4.0	PowerVM
Implementation of virtualization technology	3rd-party software add-on	3rd-party software add-on	Integrated into server firmware
Isolation of I/O drivers from hypervisor	No	No	Yes (using VIOS)
Built-in cross-platform virtualization support	No	No	Yes (PowerVM Lx86)
Live migration across processor generations	No	No	Yes
Maximum simultaneous live migrations	4	4	8

Power your planet.

PowerVM delivers superior scalability to maximize consolidation and cut IT costs

Scalability Factors	VMware ESX 4.0 (in VMware vSphere 4.1)	VMware ESXi 5 (in VMware vSphere 5)	PowerVM
Virtual CPUs per VM	8	32	256
Memory per VM	255 GB	1024 GB	8192 GB
Live VMs per server	320	512	1000
CPU threads per server	160	160	1024
Memory per server	1024 GB	2048 GB	8192 GB

Source: http://www.vmware.com/pdf/vsphere5/r50/vsphere-50-configuration-maximums.pdf

PowerVM™

Power your planet.

PowerVM on POWER7 delivers virtualization without limits with higher performance than VMware for the same virtual workloads

65%

PowerVM outperforms VMware by up to 65% on Power 750, running the same Linux workloads and virtualized resources*

PowerVM runs workloads more efficiently than VMware, with far superior resource utilization, price/performance, resilience and availability

PowerVM™

AIM7 Performance Benchmark Single VM Scaling (Scale-up)

■ vSphere 4 on HP DL380   ■ PowerVM on Power 750

Jobs/min vs Number of virtual CPUs (1vcpu, 2vcpu, 4vcpu, 6vcpu, 8vcpu)
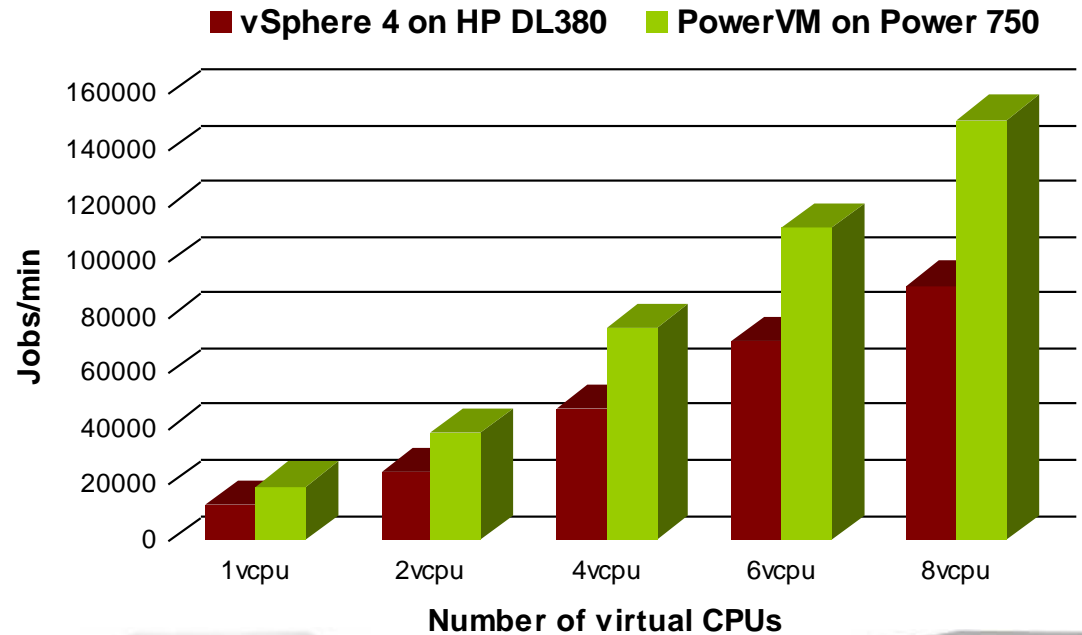
HP DL380 G6

Power 750

* "A Comparison of PowerVM and VMware Virtualization Performance", April 2010
http://www.ibm.com/systems/power/software/virtualization/whitepapers/compare_perf.html

Power your planet.

Software Serviceability with Virtualization

Integrated virtualization (PowerVM):

- – All Power Systems have provided an integrated hypervisor since 2004
- – Every customer uses this built-in virtualization and it cannot be removed
- – Software vendors fully support this virtualized environment

Virtualization add-on products (VMware / KVM / Oracle VM):

- – Most software vendors require removal of virtualization to debug problems
- – Customers are forced to reproduce problem on a "bare metal" system
- – Many problems cannot be reproduced in a lower transaction, unvirtualized, lower-utilization environment
- – Oracle does not support VMware
- – IBM itself requires removal of VMware if the problem cannot be quickly diagnosed

Power your planet.

What is the Performance Penalty for VMware?

'Bare metal' Nehalem-EP outperformed VMware by >60%

…even though the VMWare environment had <u>twice</u> the memory

SAP SD Benchmark results (SAPS/core)	Bare Metal	VMWare
Fujitsu PRIMERGY Model TX300 S5 / RX300 S5	2,271	1,404

For more information:

A Comparison of PowerVM and x86-Based Virtualization Performance

http://www-03.ibm.com/systems/power/software/virtualization/whitepapers/powervm_x86.html

Power your planet.

PowerVM delivers superior security to help manage risk and maximize availability

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)
Built-in cross-platform virtualization support	No	No	Yes (using PowerVM Lx86)
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

PowerVM™

Power your planet.

PowerVM delivers firmware-based security

- Unlike x86-based products such as VMware, the PowerVM hypervisor is secure by design. IBM is the only vendor that has designed the virtualized environment from 'bare metal' through the hypervisor.

- PowerVM hypervisor is part of the digitally-signed firmware with strong cryptography which makes it impossible to remotely install a modified fileset into the EPROMs of Power Systems.

- There are zero vulnerabilities reported against PowerVM by US CERT or by MITRE Corporation

- PowerVM is certified at a CC Evaluated Assurance Level 4+

Remember, zero is a number too …
a very good number in the Security domain.

Power your planet.

PowerVM provides the security customers demand for their mission-critical workloads

PowerVM has never had a single reported security vulnerability
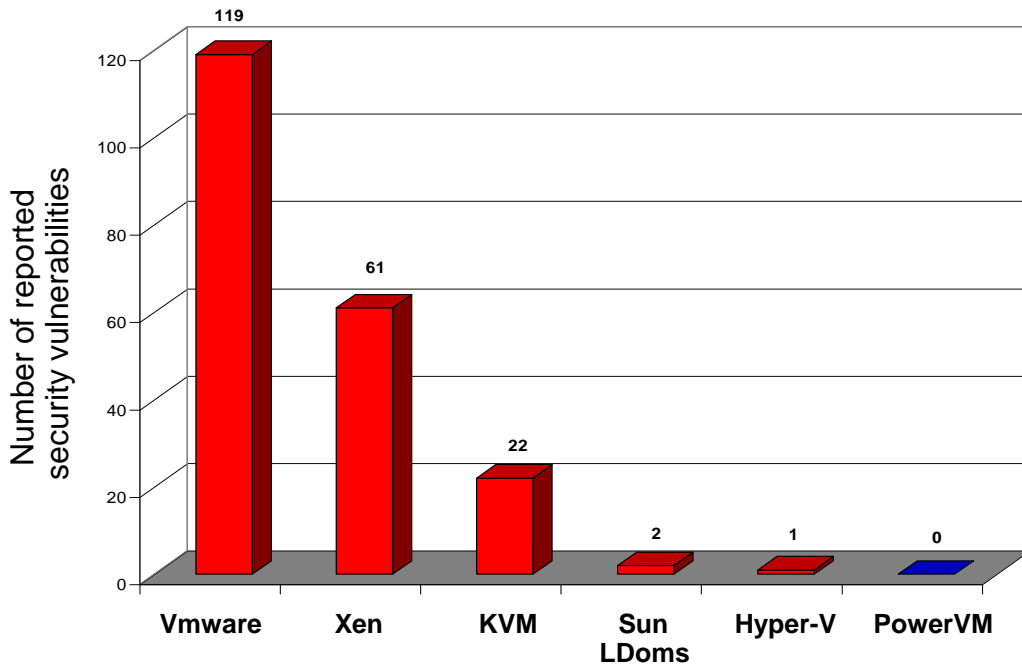
Source: National Vulnerability Database, http://nvd.nist.gov/

"Making sure our website can't get hacked into is a key issue. With IBM, we have been able to keep it tightly locked up and prevent unauthorized access."

— Dr. Chris Yates, CIO Tennis Australia

Power your planet.

PowerVM reduces costs by running more WebSphere workloads on fewer servers than x86 with or without VMware

Scale out, unvirtualized on HP ProLiant DL380

- 15% Utilization
- 1,323.23 EjOPs/System

30 servers/240 cores

Virtualized on HP ProLiant DL380

- 39% Utilization
- 10% VMware Overhead
- 1,323.23 EjOPs/System

13 servers/103 cores

PowerVM on Power 750 Express

- 56% Utilization
- 7,172.93 EjOPs/System

2 servers/48 cores

POWER7 provides more performance with flexible scalability that handles peaks more effectively

- 78% less energy costs
- 69% less space
- 34% lower SW costs

Power your planet.

* Based on WebSphere client requirement 6,000 EjOPs
See WebSphere detail in backup for more information (W6000A)

Reduce cost by eliminating hardware and points-of-failure

Lower network and storage costs
- Save up to 35% on Fiber Channel adapters
- Save up to 55% on ports and cables
- Reduce cost of network operations and maintenance

Less than half the system management and maintenance
- System and firmware updates
- Fewer system outages
- Reduce amount of time on repair actions

Four Power 730 Express
with network and storage connections

Nine HP ProLiant DL380 G7
with network and storage connections

Power your planet.

Customers are moving up to Power for costs savings and improved availability for their applications

>10x improvement in availability by migrating to Power Systems[1]

Three year TCO savings of $461,000 to run SAP landscapes with Oracle DB when you consolidate 29 HP ProLiant DL380 G5 systems with a total of 232 cores utilized at 15% onto two IBM Power 750 Express 32-core systems utilized at 80%.[2]

IBM Power is more reliant than a pile of HP ProLiants.

29 HP ProLiant DL380 G5

two Power 750 Express

✓ 86% less floorspace
✓ 88% less energy costs

(1) Source: ITIC 2009 Global Server Hardware & Server OS Reliability Survey Results, **July 7, 2009. Fully paper is available at ibm.com/aix** (2) see SAP details chart in backup for more information (S461)

Power your planet.

Power is the most reliable platform among UNIX, Lintel and Windows

54% of IT executives and managers say that they require 99.99% or better availability for their applications

Downtime (Hours per Year)

- IBM AIX POWER
- Sun Solaris / SPARC
- HP UX 11/ PA RISC
- Apple MAC
- HP UX 11/ HP Integrity
- Red Hat Enterprise Linux x86
- Windows Server 2008 x86
- Windows Server 2003 x86
- Open Source Linux x86
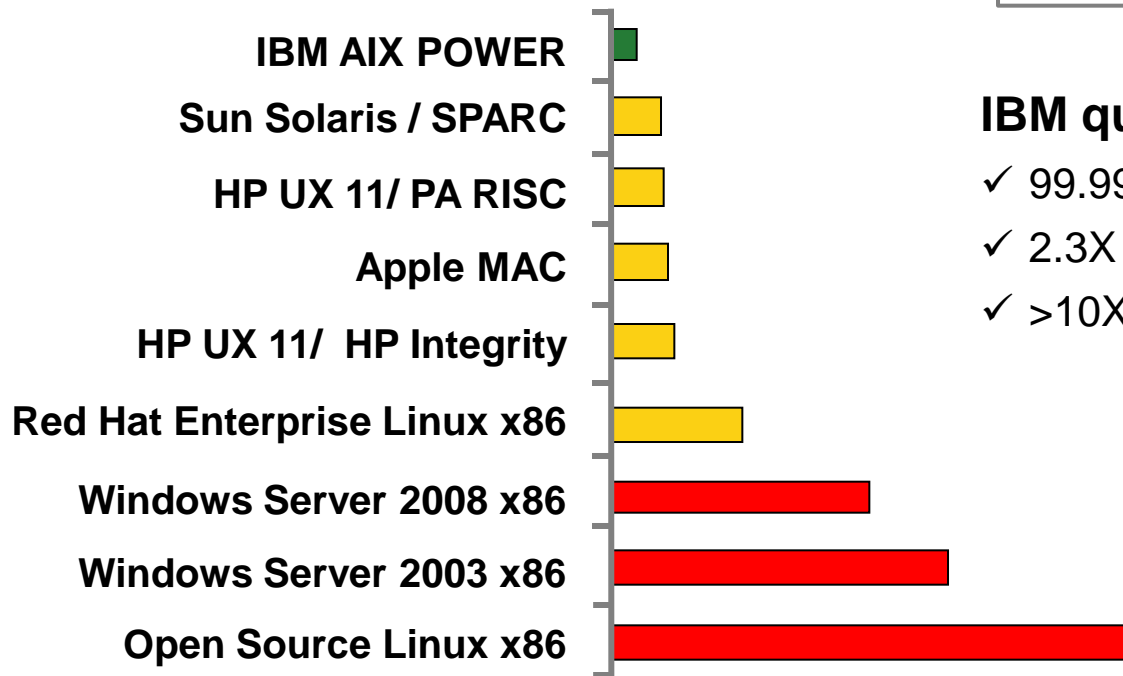
IBM quality of service

✓ 99.997% uptime*

✓ 2.3X better than next UNIX

✓ >10X better than x86-based platforms

POWER7
BUILT ON
Power™

*Source: ITIC 2009 Global Server Hardware & Server OS Reliability Survey Results,
July 7, 2009. Fully paper is available at ibm.com/aix

Power your planet.

Power is resiliency without downtime

- **PowerHA SystemMirror for AIX and i** provide active/standby datacenter and multi-site disk clustering solutions for resiliency

- **Tivoli System Automation for Multiplatforms** delivers full HA support for mission-critical Linux workloads

- **PowerHA pureScale** provides active/active high performance data transfer, cluster coordination, and centralized locking and is built-into DB2 pureScale

- **PowerVM Live Partition Mobility** enables planned system downtime without application downtime

Power your planet.

Power Systems RAS provides the resiliency that x86 can't

RAS Feature	POWER7	x86
Application/Partition RAS		
Live Partition Mobility	Yes	Yes
Live Application Mobility	Yes	No
Partition Availability priority	Yes	No
System RAS		
OS independent First Failure Data Capture	Yes	No
Memory Keys (including OS exploitation)	Yes	No
Processor RAS		
Processor Instruction Retry	Yes	No
Alternate Processor Recovery	Yes	No
Dynamic Processor Deallocation	Yes	No
Dynamic Processor Sparing	Yes	No
Memory RAS		
Chipkill™	Yes	Yes
Survives Double Memory Failures	Yes	No
Selective Memory Mirroring	Yes	No
Redundant Memory	Yes	Yes
I/O RAS		
Extended Error Handling	Yes	No
I/O Adapter Isolation (PCI-Bus and TCEs)	Yes	No

See the following URLs for addition details:
http://www-03.ibm.com/systems/migratetoibm/systems/power/availability.html
http://www-03.ibm.com/systems/migratetoibm/systems/power/virtualization.html

Power your planet.

Power Systems lowers client's total cost of acquisition by 33%

$91,438 less.

Three year TCO savings when deploying SAP on two, 16-core IBM Power 740 Express systems utilized at 90% with PowerVM on Linux vs. seven, 16-core HP DL580 G7 utilized at 70% with VMware on Linux.

Power 740 Express

HP ProLiant DL580 G7

- ✓ $41k less software license / maintenance costs
- ✓ $17k less energy costs
- ✓ 71% less space

Based on similar throughput systems using IBM internal estimates.

Power your planet. See SAP Details chart for more information (SAP1234D)

Extend platform management to service management

- IBM provides **new solutions and integrations** to more easily manage consolidated and virtualized server environments.

- *Systems Director Editions*:

  Monitor and Repair system status

  Deploy and Optimize workloads

  Plan and Document infrastructure

IBM® Systems Director Express Edition

- Remotely monitor, configure and update
- Reduce time required for troubleshooting

IBM Systems Director Standard Edition

- Monitor and manage energy use
- Reduce time to deploy virtual images
- Manage networking systems

IBM Systems Director Enterprise Edition

- Deploy workloads in system pools
- Increase productivity with prioritized information and context
- Generate historical health status reports
- Use predictive capabilities to help with capacity estimation

IBM

21%

IBM® Systems Director

Percent of IT staff who can be reassigned to deliver new services that add business value and increase competitiveness, when IBM Systems Director Editions are used to increase collaboration and productivity in a typical Financial Services IT organization with 45 staff managing 1069 Power AIX and Linux servers.

34 administrators do the maintenance of 45

9 additional architects for innovation

AIX

PowerVM™

Linux®

ZERO increase in staffing.

Power servers
459 AIX physical, 512 AIX virtual
4 Linux physical, 94 Linux virtual

Serious productivity.

Power your planet.

Source: "Value Proposition for IBM Systems Director: Challenges of Operational Management for Enterprise Server Installations" – International Technology Group, 2008

A broad selection of applications that continues to grow

15,000 Applications available when POWER7 was introduced

Power your planet.

Over 2,600 IBM i applications and over 12,500 AIX applications were at supported OS levels (i 6.1, AIX 5.3 & AIX 6.1) at initial POWER7 GA in 1Q2010

© 2010 IBM Corporation
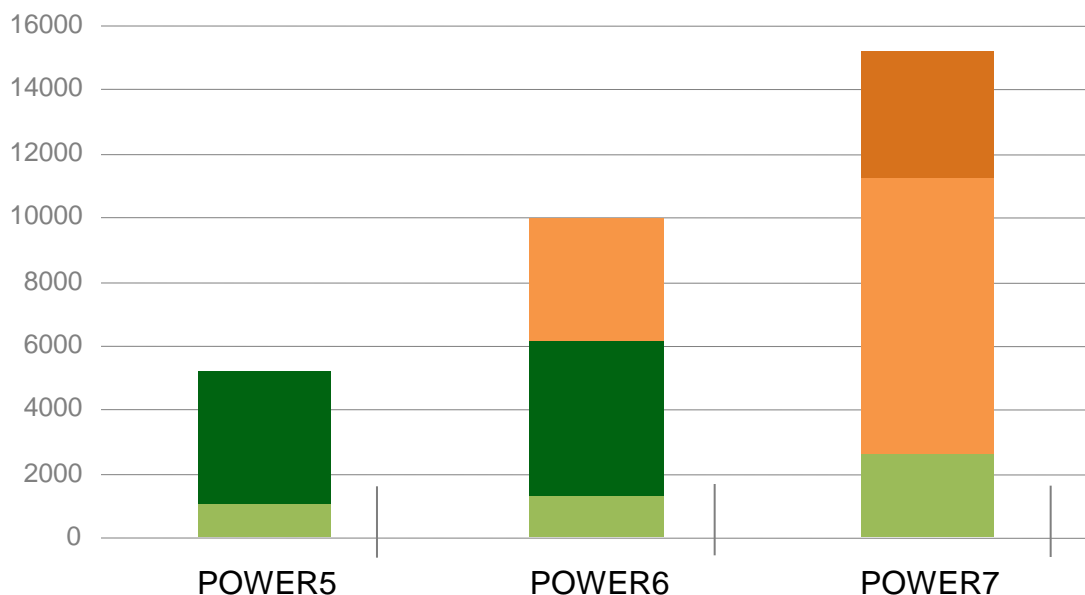
Choice of OS and Middleware

Choose to deploy on AIX, IBM i or Linux – on a single platform

Choice of Operating Systems

AIX
The future of UNIX

i for Business
Total integration with i

Linux
Scalable Linux ready for x86 consolidation

Choice of Middleware

DB2. php WebSphere software

Tivoli software suse redhat

JBoss by Red Hat ORACLE

The Apache Software Foundation
http://www.apache.org/

SYBASE
An SAP Company

All available on POWER7

Power your planet.

IBM Provides Complete Solutions for Linux on Power

IBM Global Services

| Information Management | WebSphere® | Tivoli® | Lotus® | Rational® |

IBM Systems Software

IBM Power Systems

Linux®

IBM Systems Storage

IBM Global Financing
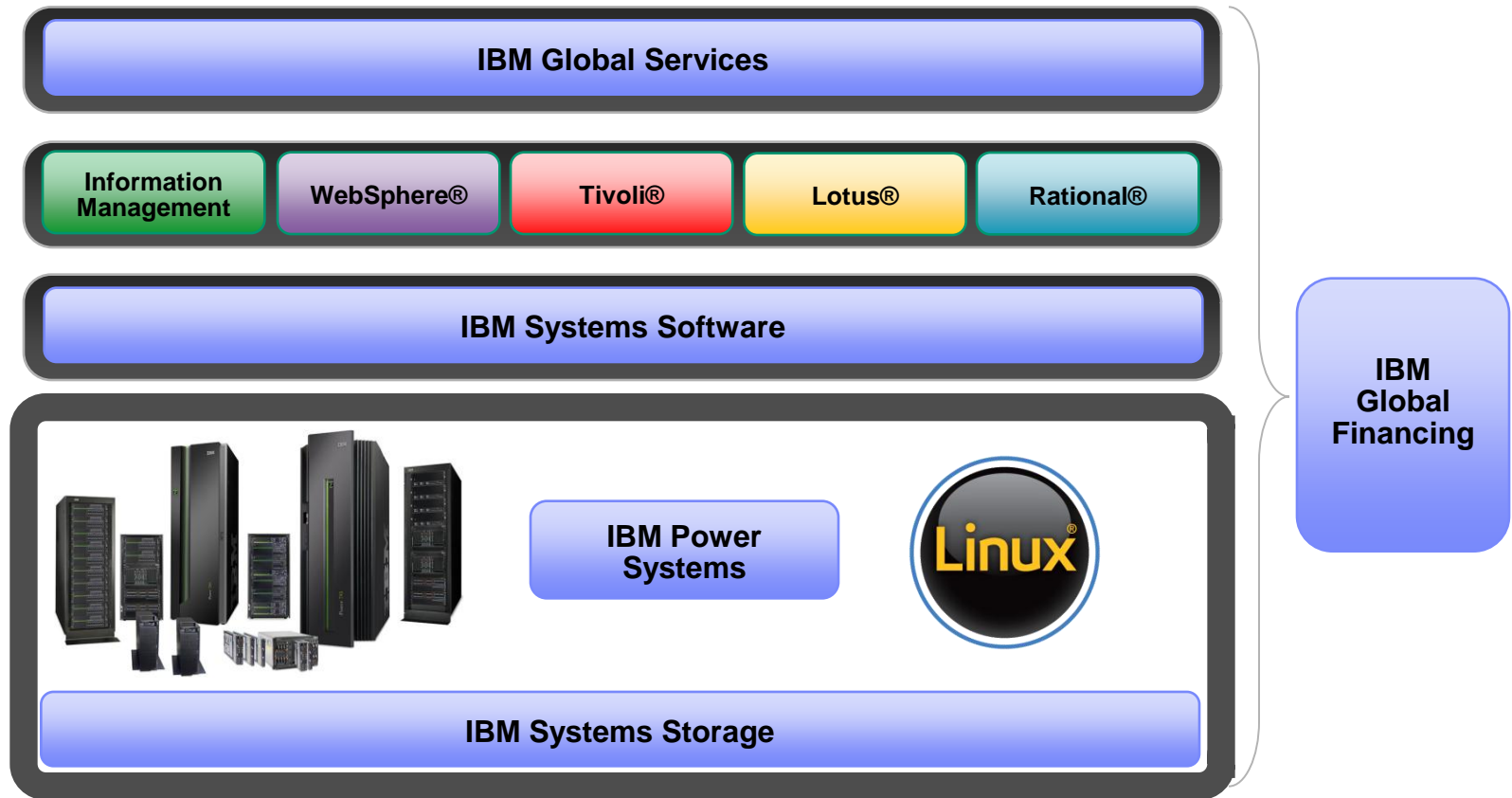
Linux + POWER7 = an industry leading enterprise Linux platform

Power your planet.

IBM collaborates with the Linux community

Make Linux Better	Linux as a Tier 1 OS
Collaboration with clients	Grow Linux Workloads

✱ has been an active participant since 1999

✱ is one of the leading commercial contributors to Linux

✱ has over 600 full-time developers working with Linux and open source
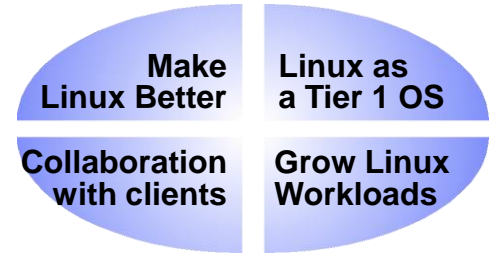
Who Has Contributed to Linux?
(2005 – 2009)

Company Name	Number of Changes	Percent of Total
None	26,644	18.2%
Red Hat	17,981	12.3%
Unknown	11,164	7.6%
IBM	11,151	7.6%
Novell	11,046	7.6%
Intel	7,782	5.3%
Consultant	3,657	2.5%
Oracle	3,513	2.4%
Linux Foundation	2,345	1.6%
SGI	2,317	1.6%
Parallels	1,939	1.3%
Renesas Technology	1,925	1.3%
Academia	1,712	1.2%
Fujitsu	1,592	1.1%
MontaVista	1,564	1.1%
MIPS Technologies	1,537	1.1%
Analog Devices	1,467	1.0%
HP	1,415	1.0%
Freescale	1,375	0.9%
Google	1,261	0.9%

http://www.linuxfoundation.org/publications/whowriteslinux.pdf

Linux Kernel & Subsystem Development

- **Kernel Base Architecture Support**
- **GNU**
- **Security**
- **Systems Management**
- **RAS**
- **Virtualization**
- **Special Projects**
- **Filesystems, and more...**

Expanding the Open Source Ecosystem

- **Apache & Apache Projects**
- **Eclipse**
- **Mozilla Firefox**
- **OpenOffice.org**
- **PHP**
- **Samba, and more...**

Promoting Open Standards & Community Collaboration

- **The Linux Foundation**
- **Linux Standards Base**
- **Common Criteria certification**
- **Open Software Initiative, and more...**

Foster and Protect the Ecosystem

- **Software Freedom Law Center**
- **Free Software Foundation (FSF)**
- **Open Invention Network, and more...**

Power your planet.

Target Workloads for Linux on Power

Power customers are consolidating their Windows
& Linux x86 workloads to Linux on POWER

- **<u>SAP Application Servers</u>** - consolidate SAP application servers currently running on HP/Sun/Dell x86 Windows/Linux to Power

- **<u>Transactional Web/Application Servers</u>** - move web/application servers on HP/Sun/Dell x86 to Power when the database is already on Power

- **<u>File/Print other Open Source Workloads</u>** – replace / consolidate servers currently running on Windows/HP/Sun/Dell x86 to Power
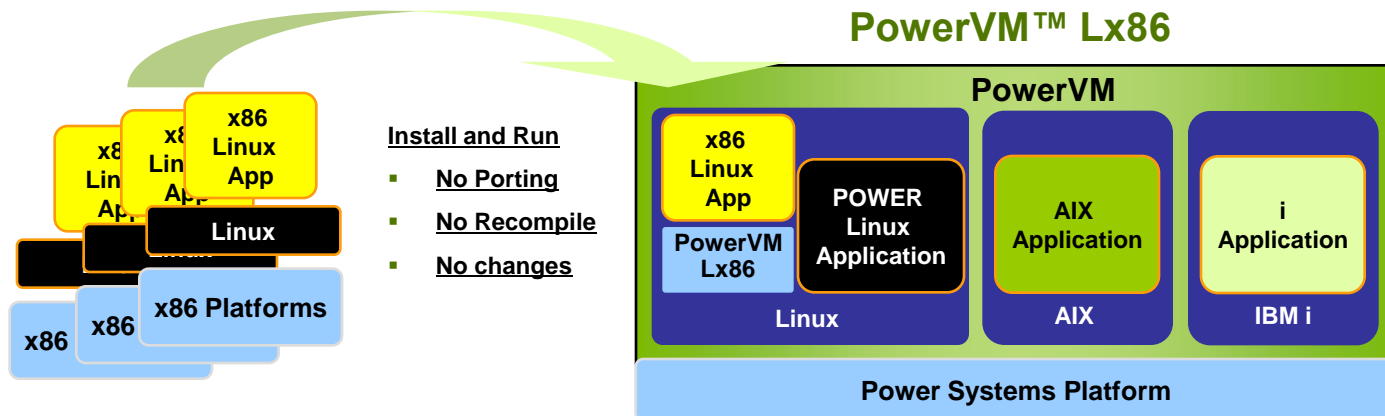
Power your planet.

Reduce cost with cross-platform virtualization on Power

Run x86 Linux applications on Power alongside your AIX, i and Linux on Power applications
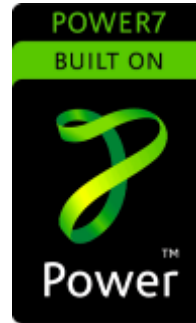
PowerVM™

Simplifies migration of Linux on x86 applications enabling customers to realize the energy and administration savings of consolidation

- Run most existing 32-bit x86 Linux applications with no application changes

- Included with the purchase of PowerVM Editions

- developerWorks download: http://www.ibm.com/developerworks/linux/pave/

PowerVM™ Lx86

PowerVM

x86 Linux App
x86 Linux App
x86 Linux App

Linux

x86 Platforms

x86   x86

Install and Run
- **No Porting**
- **No Recompile**
- **No changes**

x86 Linux App

PowerVM Lx86

POWER Linux Application

Linux

AIX Application

AIX

i Application

IBM i

Power Systems Platform

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Power your planet.

Smarter systems for a Smarter Planet.

Power your planet.

# Backup Information

Power your planet.

TCA = HW (server without storage) + SW (OS, Virtualization, application) + 1 yr Maintenance (HW and SW)
TCO = TCA + 2 yrs of additional HW/SW maintenance + Facility Costs

1 year TCA Power 730 vs HP DL380 G7

Costs 26% less
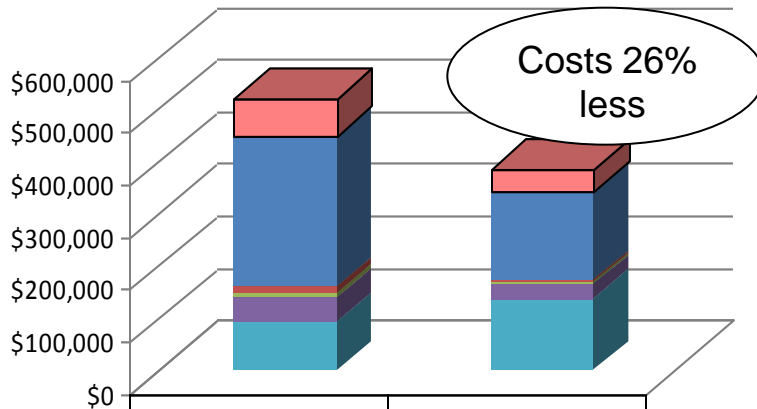
	HP ProLiant DL380 G7 12-core	Power 730 16-core
■ WebSphere S&S	$72,198	$42,784
■ WebSphere	$288,792	$171,136
■ OS Maint	$12,222	$4,740
■ Virtualization Maintenance	$11,066	$4,480
■ Virtualization	$46,654	$27,200
■ HW	$93.195	$138.520
Totals	**$524,127**	**$388,860**

3 year TCO Power 730 vs HP DL380 G7

Costs 31% less
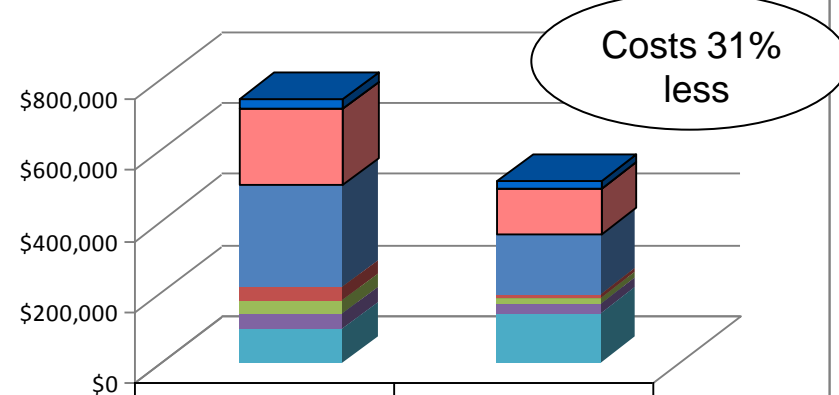
	HP ProLiant DL380 G7 12-core	Power 730 16-core
■ Facilities	$24,127	$18,689
■ WebSphere S&S	$216,594	$128,352
■ WebSphere	$288,792	$171,136
■ OS Maint	$36,666	$14,220
■ Virtualization Maintenance	$36,101.85	$13,440
■ Virtualization	$45,686	$27,200
■ HW	$93,195	$138,520
Totals	**$741,162**	**$511,557**

See WebSphere scenario for more information (WAS.1D)

* For equivalent throughput

Power your planet.

WebSphere Details – Power 730 16-core with Linux & DL 380 G7 12-core with Linux

IBM

More performance per core and system means fewer systems and lower software costs

Four Power 730 Express

- ✓ 1.2 million BOPs/system
- ✓ 16 cores per system
- ✓ 69% Utilization
- ✓ ~370k BOPs headroom per system

Over 50% lower OS and virtualization software costs

Save up to $206k on WebSphere software costs (License / Maintenance)

- ✓ 64 cores
- ✓ x 70 PVU per core
- ✓ = 4,480 PVUs

Nine HP ProLiant DL380 G7

- ✓ 876 thousand BOPs/System
- ✓ 12 cores per system
- ✓ 50% Utilization
- ✓ 20% VMware Overhead
- ✓ 350k BOPs headroom per system

- ✓ 108 cores
- ✓ x 70 PVU per core
- ✓ = 7,560 PVUs

Company / System	JVM Name	JVM Instances	Cores	Chips	HW Threading	BOPs	BOPs/ JVM
HP ProLiant DL360 G7	**IBM J9 VM (build 2.4, J2RE 1.6.0 IBM J9 2.4 Windows Server 2008 amd64-64 jvmwa6460sr5-20090519_35743 (JIT enabled, AOT enabled)**	**6**	**12**	**2**	**No**	**875,975**	**145,996**
IBM Power 730 Express	**JRE 1.6.0 (32-bit) IBM J9 2.4 Linux (build jvmxp3260sr8-20100401_55940(SR8))**	**16**	**16**	**2**	**Yes**	**1,205,289**	**75,331**

Power your planet.

Reduce cost by eliminating hardware and points-of-failure

Lower network and storage costs
- Save up to 35% on Fiber Channel adapters
- Save up to 55% on ports and cables
- Reduce cost of network operations and maintenance

Less than half the system management and maintenance
- System and firmware updates
- Fewer system outages
- Reduce amount of time on repair actions

Four Power 730 Express
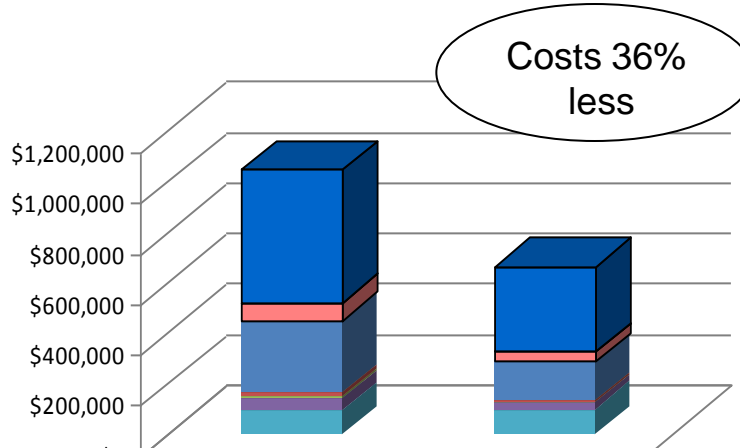**with network and storage connections**

Nine HP ProLiant DL380 G7
with network and storage connections

Power your planet.

TCA = HW (server without storage) + SW (OS, Virtualization, application) + 1 yr Maintenance (HW and SW)
TCO = TCA + 2 yrs of additional HW/SW maintenance + Facility Costs
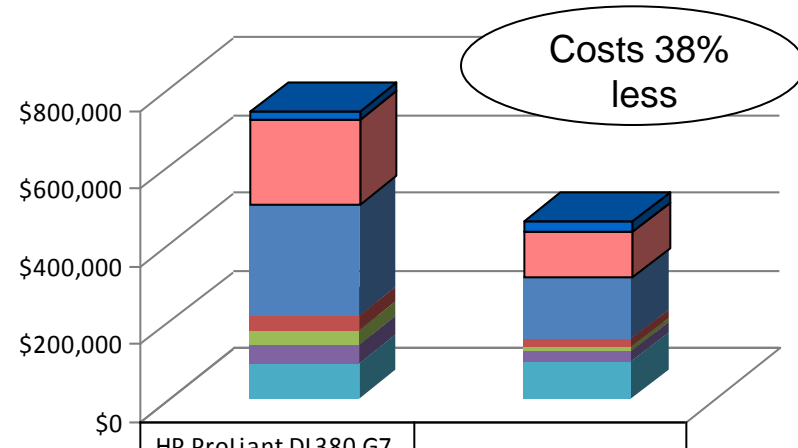
1 year TCA Power 730 vs HP DL380 G7

Costs 36% less

	HP ProLiant DL380 G7 12-core	Power 730 12-core
■ TCA Total	$525,095	$333,675
■ WebSphere S&S	$72,198	$40,110
■ WebSphere	$288,792	$160,440
■ OS Maint	$12,222	$5,925
■ Virtualization Maintenance	$12,034	$4,200
■ Virtualization	$46,654	$25,500
■ HW	$93,195	$97,500
Totals	**$525,095**	**$333,675**

3 year TCO Power 730 vs HP DL380 G7

Costs 38% less

	HP ProLiant DL380 G7 12-core	Power 730 12-core
■ Facilities	$24,127	$23,856
■ WebSphere S&S	$216,594	$120,330
■ WebSphere	$288,792	$160,440
■ OS Maint	$36,666	$17,775
■ Virtualization Maintenance	$36,102	$12,600
■ Virtualization	$46,654	$25,500
■ HW	$93,195	$97,500
Totals	**$742,130**	**$458,001**

*Based on similar throughput systems using IBM internal estimates.

Power your planet.

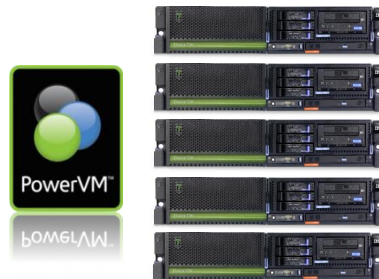# More performance per core and system means fewer systems and lower software costs

Five Power 730 Express

- ✓ 12 cores per system
- ✓ 69% Utilization

Over 50% lower OS and virtualization software costs

**Save up to $225k on WebSphere software costs
(License / Maintenance)**

- ✓ 60 cores
- ✓ x 70 PVU per core
- ✓ = 4,200 PVUs

Nine HP ProLiant DL380 G7

- ✓ 12 cores per system
- ✓ 50% Utilization
- ✓ 20% VMware Overhead

- ✓ 108 cores
- ✓ x 70 PVU per core
- ✓ = 7,560 PVUs

* Performance for Power 730 12-cores is estimated by IBM from relative rPerf values Power 730 12 and16 cores. For additional information, refer to WebSphere Details chart for Power 730 16-core
(WAS.1.4)

Power your planet.

Reduce cost by eliminating hardware and points-of-failure

Lower network and storage costs
- Save up to 20% on Fiber Channel adapters
- Save up to 45% on ports and cables
- Reduce cost of network operations and maintenance

Less than half the system management and maintenance
- System and firmware updates
- Fewer system outages
- Reduce amount of time on repair actions

Four Power 730 Express
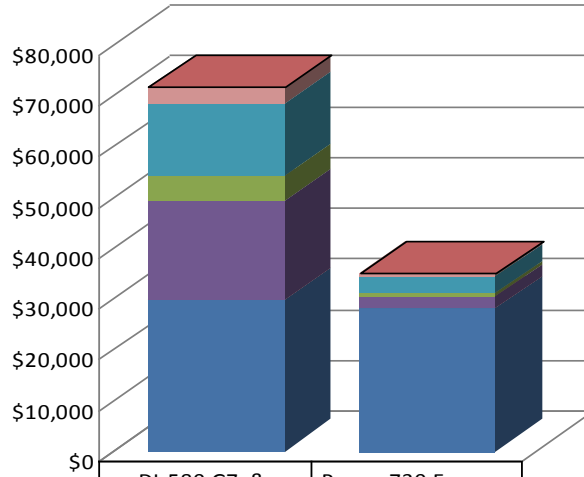**with network and storage connections**

Nine HP ProLiant DL380 G7
with network and storage connections

Power your planet.

TCA = HW (server without storage) + SW (OS, Virtualization, application) + 1 yr Maintenance (HW and SW)
TCO = TCA + 2 yrs of additional HW/SW maintenance + Facility Costs

1 year TCA
Power 730 vs HP DL580 G7

	DL 580 G7 & Windows	Power 730 Express & AIX
Software Lic & Maintenance (1 yr transferred)	$0	$0
Virtualization Maintenance (1 yr)	$3,212	$560
Virtualization License	$14,256	$3,400
OS Maintenance (1 yr)	$4,855	$600
OS License	$19,418	$2,400
HW Maintenance	$0	$0
HW	$30,019	$28,161
Totals	**$71,760**	**$35,121**

3 year TCO
HP DL580 G7 vs. Power 730
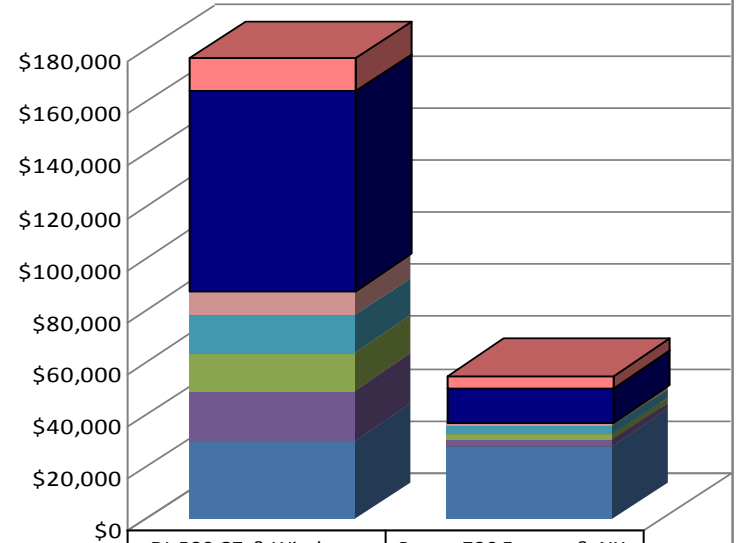
	DL 580 G7 & Windows	Power 730 Express & AIX
Facilities (3 yr)	$12,808	$4,660
Software Maintenance (2 yr)	$76,800	$13,440
Virtualization Maintenance (3 yr)	$9,636	$1,680
Virtualization License	$14,256	$3,400
OS Maintenance (3 yr)	$14,564	$1,800
OS License	$19,418	$2,400
HW Maintenance	$0	$0
HW	$30,019	$28,161
Totals	**$177,500**	**$55,541**

Based on similar throughput systems using IBM internal estimates.

Power your planet.

DOM1D
IBM Power Systems

IBM

More performance per core means fewer cores and lower software costs

One Power 730 Express

- ✓ 2 sockets, 8 cores, 3.0 GHz
- ✓ 64 GB memory
- ✓ 85% Utilization

One HP ProLiant DL580 G7

- ✓ 32 cores, 2.27 GHz
- ✓ 64 GB memory
- ✓ 64% Utilization
- ✓ 20% VMware Overhead

Save $63k on Lotus Domino maintenance in 3 years[3]

- ✓ 8 cores
- ✓ x 70 PVU per core
- ✓ = 560 PVUs

- ✓ 32 cores
- ✓ x 100 PVU per core
- ✓ = 3,200 PVUs

Company / System	Operating System	Virtualization Software	Application Software	Concurrent Mail Users	Rack Units	Watts
HP ProLiant DL580 G7 [4]	Windows Server 2008	VMware vSphere 4.1 Advanced, VMware vCenter Server 4 Standard	Lotus Domino 8.5 Enterprise Edition	15,750 [1,2]	4	595
IBM Power 730 Express [4]	AIX 7.1	PowerVM Express Edition, IBM Systems Director Express Edition	Lotus Domino 8.5 Enterprise Edition	15,750 [1]	2	263

1. Using IBM Systems Workload Estimator and IBM Sizing Guides
2. Using similar IBM system
3. Includes transfer Lotus Domino License
4. Storage not included

53   Power your planet.

TCA = HW (server without storage) + SW (OS, Virtualization, application) + 1 yr Maintenance (HW and SW)
TCO = TCA + 2 yrs of additional HW/SW maintenance + Facility Costs

1 year TCA
Power 740 vs HP DL580 G7
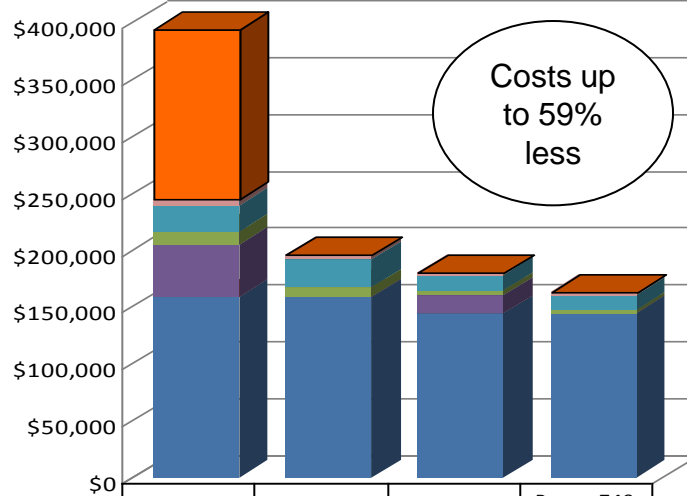
Costs up to 59% less

	DL 580 G7 & Windows	DL 580 G7 & Linux	Power 740 Express & AIX	Power 740 Express & Linux
2500 OS Client Licenses	$150,000	$0	$0	$0
Virtualization Maintenance	$5,456	$5,456	$2,240	$2,240
Virtualization	$23,236	$23,236	$13,600	$13,600
OS Maintenance	$11,466	$9,506	$4,000	$2,370
OS	$45,865	$0	$16,000	$0
HWMA	$0	$0	$0	$0
HW	$158,711	$158,711	$144,878	$144,878
Totals	**$394,734**	**$196,909**	**$180,718**	**$163,088**

3 year TCO
Power 740 vs HP DL580 G7
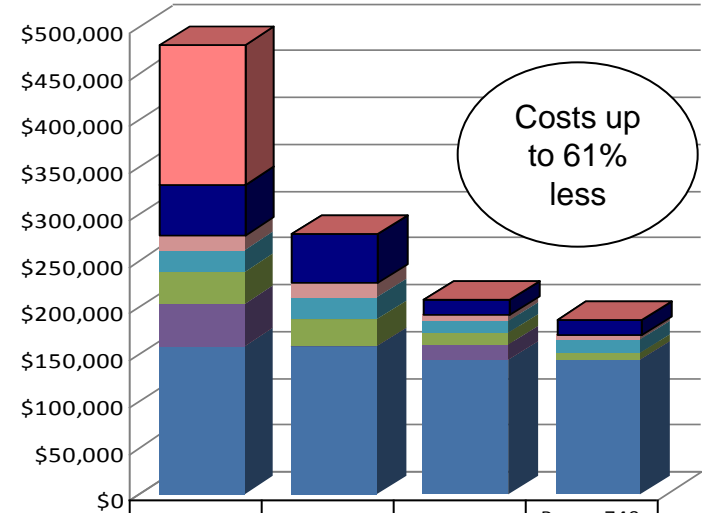
Costs up to 61% less

|	DL 580 G7 & Windows	DL 580 G7 & Linux	Power 740 Express & AIX	Power 740 Express & Linux
2500 OS Client Licenses	$150,000	$0	$0	$0
Facilities	$53,202	$53,202	$16,289	$16,289
Virtualization Maintenance	$16,368	$16,368	$6,720	$6,720
Virtualization	$23,236	$23,236	$13,600	$13,600
OS Maintenance	$34,399	$28,518	$12,000	$7,110
OS	$45,865	$0	$16,000	$0
HWMA	$0	$0	$0	$0
HW	$158,711	$158,711	$144,878	$144,878
Totals	**$481,781**	**$280,035**	**$209,487**	**$188,597**

Power your planet.

More performance per core means fewer cores and lower software costs

Two Power 740 Express

- ✓ 16 cores, 3.55 GHz
- ✓ 256 GB memory
- ✓ 90% Utilization

Seven HP ProLiant DL580 G7

- ✓ 16 cores, 2.27 GHz
- ✓ 128 GB memory
- ✓ 70% Utilization
- ✓ 36% VMware Overhead
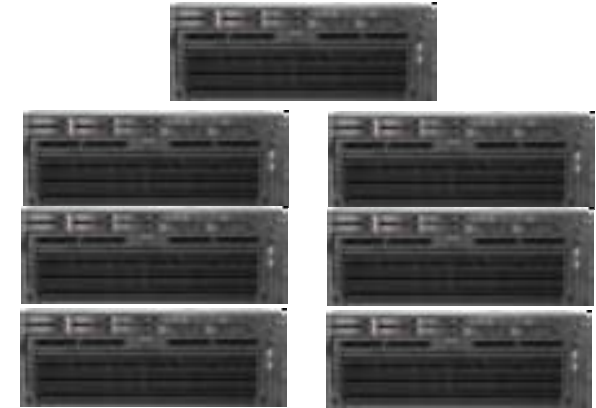
Company / System	Operating System	Virtualization Software	Utilization Efficiency	Rack Units	Watts
HP ProLiant DL580 G7 [1]	**Windows Server 2008 & Linux Red Hat**	**VMware vSphere 4.1 Enterprise, VMware vCenter Server 4 Standard**	**64%**	**4**	**595**
IBM Power 730 Express [1]	**AIX 7.1, Linux Red Hat**	**PowerVM Express Edition, IBM Systems Director Express Edition**	**97%**	**2**	**537**

1. Storage not included
2. Performance for both Power 740 and HP DL580 G7 are estimated using published SAP benchmarks for Power 750 and HP ProLiant DL580 G7 systems.

Power your planet.

WebSphere scenarios – Client requirement 6,000 EjOPs

Scale out, unvirtualized on HP ProLiant DL380
- 15% Utilization
- 1,323.23 EjOPs/System

30 servers/240 cores

Virtualized on HP ProLiant DL380
- 39% Utilization
- 10% VMware Overhead
- 1,323.23 EjOPs/System

13 servers/103 cores

PowerVM on Power 750 Express
- 56% Utilization
- 7,172.93 EjOPs/System

2 servers/48 cores

✓ More performance
✓ Flexible scalability
✓ Handles peaks more effectively
✓ 78% less energy costs
✓ 69% less space
✓ 34% lower SW costs
  (even at 100 PVU vs. 70)

System Name	Result	Java EE Server	DB Server	
HP DL380 G6 X5570/X5560, Novell SLES10, SAP NetWeaver CE 7.1, MaxDB 7.8	**1,323.33**	8 cores, 2 chips	8 cores, 2 chips	HTML | Text
IBM Power 750 with WebSphere Application Server V7 and DB2 9.7 on IBM BladeCenter PS702 IBM	**7,172.93**	32 cores, 4 chips	16 cores, 2 chips	HTML | Text

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SAP detail

* The virtualized system count and energy savings were derived from several factors: A performance factor of 7.88 was determined by SAP 2-tier SD benchmark results for the Power 750, the and the DL380 G6 and the DL380 G5 for using the DL380 G6 as a bridge since it was has results with both the old and new SAP benchmark kits and reducing the ratio based on rPerf ratio of 32-core Power 750 with 3.0GHz processor to 32-core Power 750 with 3.55GHz processor . The benchmark reviewed were current as of April 8, 2010. The benchmark detail is shown on the chart SAP Detailed Benchmark Performance. A virtualized utilization factor of 80% was assumed for the Power 750 Express and a non-virtualized utilization factor of 15% was assumed for the HP ProLiant DL380 G5. Power consumption figures of 1950 W for the IBM Power 750 Express and 1186 W for the DL380G5 and 1348 W for the DLL380 G6 were based on the maximum rates published by IBM and HP respectively. The data for the HP DL380 G5 came from the HP ProLiant DL380 G5 QuickSpecs available at http://h18004.www1.hp.com/products/quickspecs/12477_na/12477_na.html#Overview as April 8, 2010. The data for the DL380 G6 came from three HP ProLiant DL380 G6 QuickSpecs available at http://h18004.www1.hp.com/products/quickspecs/13234_na/13234_na.html#Power%20Specifications as of April 8, 2010. Energy cost based on a Power Usage Effectiveness of 2.0 (representing an efficient datacenter).   Energy cost of $.1021per kWh is based on 2009 YTD US Average Retail price to commercial customers per US DOE at http://www.eia.doe.gov/cneaf/electricity/epm/table5_6_b.html as of April 8, 2010. The reduction, if any, in floor space, power, cooling and software costs depends on the specific customer, environment, application requirements, and the consolidation potential. Actual numbers of virtualized systems supported will depend on workload levels for each replaced system. The Oracle DB Software and Subscriptions savings based on .5 licenses per core for the DL380 G5 and 1 license per core for the Power 750. The DL380 G5 & DL380 G6 DB configurations included Oracle RAC and Partitioning since multiple systems were required for the DB portion of the workload. Oracle list prices from the Oracle Store available through www.oracle.com. Prices are current as of April 8, 2010.

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SAP Detailed Benchmark Performance Comparison

System	Benchmark Users	SAPS	OS	DB Version	SAP version	Cores / processor chips / threads	Certificate Number
IBM Power 750 Express	15600	85220	AIX 6.1	DB2 9.7	SAP enhancement package 4 for SAP ERP 6.0	32 /4 /128	2010004
HP ProLinat DL380G6	3300	18030	Windows Server 2008 Enterprise Edition	SQL Server 2008	SAP ERP 6.0, Enhancement Pack 4 (Unicode)	4 / 2 / 16	2009004
HP ProLinat DL380G6	4995	25000	Windows Server 2003 Enterprise Edition	SQL Server 2005	6.0 (2005)	4 / 2 / 16	2008071
HP ProLiant DL380 G5	2518	12600	Windows Server 2003 Enterprise Edition	SQL Server 2005	6.0 (2005)	4 / 2 / 8	2008047

*Published SAP 2-tier SD benchmark results   http://www.sap.com/solutions/benchmark/sd2tier.epx

This data is used to calculate relative SAPS. It is not intended to be used to project any possible benchmark results that were not actually executed
- Ratio of Power 750 to DL380 G6 = 85222/18030 = 4.7 to 1
- Ratio o fDL380 G5 to DL380 G6 = 12600/25000 = .504 to 1
- Therefore ratio of Power 750 to DL380 G5 = 4.7/.504 = 9.3 to 1

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WebSphere Details

- The virtualized system count and energy savings were derived from several factors: A performance factor was applied to the virtualization scenario based on SPEC® results source: www.spec.org as of April 8, 2010. IBM Power 750 Express (32-core, 4 chips, 8 cores per chip, 3.55 GHz) SPECjbb2005 2,478,929 bops, 77,467 bops/JVM; Dell PowerEdge 2950 III (8-core, 2 chips, 4 cores per chip) 3.33GHz, SPECjbb2005 366,314 bops, 91,579 bops/JVM. The Dell PowerEdge R810 (16-core, 2 chips, 8 cores per chip) 2.26GHz had a SPECjbb2005 result of 1,011,147, 126,393 bops per JVM. The Power 750 relative performance was reduced based on rPerf ratio of 32-core Power 750 with 3.0GHz processor to 32-core Power 750 with 3.55GHz processor A virtualized utilization factor of 80% was assumed for the Power 750 Express and a non-virtualized utilization factor of 13% was assumed for the Dell PowerEdge 2950 III. A virtualized utilization factor of 40% was assumed for the Dell PowerEdge R810.

- Power consumption figures of 1950 W for the IBM Power 750 Express and 653 W for the PowerEdge 2950 III, and 1175 for PowerEdge R810 were based on the maximum rates published by IBM and Dell respectively. The data for the Dell PowerEdge systems came from their respective Datasheets available through www.dell.com as of April 8, 2010. Energy cost based on a Power Usage Effectiveness of 2.0 (representing an efficient datacenter). Energy cost of $.1021per kWh is based on 2009 YTD US Average Retail price to commercial customers per US DOE at http://www.eia.doe.gov/cneaf/electricity/epm/table5_6_b.html as of April 8, 2010. The reduction, if any, in floor space, power, cooling and software costs depends on the specific customer, environment, application requirements, and the consolidation potential.

- Actual numbers of virtualized systems supported will depend on workload levels for each replaced system.

- The WebSphere SWMA savings is based on 50 PVUs per core for the Dell PowerEdge 2950 III and 100 PVUs per core for the Dell PowerEdge R810 and the Power 750. WAS pricing and PVU calculator can be found here: WebSphere Application Server   PVU Calculator
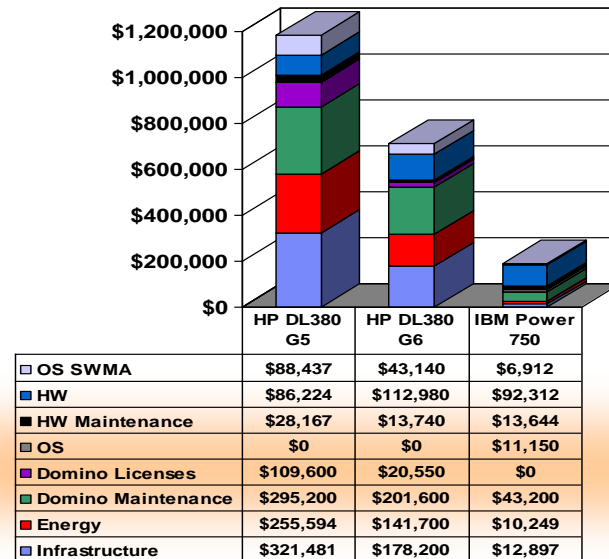
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Domino Detail

* Power consumption figures of 1950 W for the IBM Power 750 Express and the data for the HP DL380 G5 came from the HP ProLiant DL380 G5 QuickSpecs available at http://h18004.www1.hp.com/products/quickspecs/12477_na/12477_na.html#Overview as April 8, 2010. Energy cost based on a Power Usage Effectiveness of 2.0 (representing an efficient datacenter).   Energy cost of $.1021per kWh is based on 2009 YTD US Average Retail price to commercial customers per US DOE at http://www.eia.doe.gov/cneaf/electricity/epm/table5_6_b.html as of April 8, 2010. The reduction, if any, in floor space, power, cooling and software costs depends on the specific customer, environment, application requirements, and the consolidation potential. Actual numbers of virtualized systems supported will depend on workload levels for each replaced system. The Domino SWMA savings based on 50 PVUs per core for the DL380 G5, 70 PVUs per core for the X4270 and 100 PVUs per core for the Power 750.

Power your planet.

Domino Detailed Performance Comparison

System	# Systems	Cores Used per system	Total Cores	System CPU Utilization	HW System Costs	OS Costs	3yr HWMA	Domino License	Domino SWMA	OS SWMA	Energy	Infrastructue	Total TCA	Domino SWMA Savings	Domino SWMA annual	Total Annual Energy
HP Proliant DL380 G5	41	4	164	17%	$86,224	$0	$28,167	$109,600	$295,200	$88,437	$255,595	$321,481	$1,184,704	0%	$98,400	$85,198
HP Proliant DL380 G6	20	4	80	17%	$112,980	$0	$13,740	$20,550	$201,600	$43,140	$141,700	$178,200	$711,910	32%	$67,200	$47,233
Power 750	1	12	12	57%	$92,312	$11,150	$13,664	$0	$43,200	$6,912	$10,249	$12,897	$190,384	85%	$14,400	$3,416

- **Workload – Mail**
  - **52,000 concurrent users**
- **System sizing is based on IBM Workload Estimator (WLE)**
  - **# systems and memory**
- **Energy and facility costs are for processor and do not include storage**
- **System Configurations:**
  - **HP ProLiant DL380 G5**
    - **One quad-core 2.83 GHz processor**
  - **HP ProLiant DL380 G6**
    - **One quad-core 2.53 GHz processors**
  - **Power 750**
    - **Two 6-core 3.3 GHz processors**
- **Pricing**
  - **HP ProLiant pricing based on HP eConfigure Solutions for HP Proliant servers**
  - **IBM Power 750 pricing based on IBM e-config**

Total Cost of Ownership

	HP DL380 G5	HP DL380 G6	IBM Power 750
OS SWMA	$88,437	$43,140	$6,912
HW	$86,224	$112,980	$92,312
HW Maintenance	$28,167	$13,740	$13,644
OS	$0	$0	$11,150
Domino Licenses	$109,600	$20,550	$0
Domino Maintenance	$295,200	$201,600	$43,200
Energy	$255,594	$141,700	$10,249
Infrastructure	$321,481	$178,200	$12,897

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