Power your planet.
Smarter Systems for a Smarter Planet.

Jeff Howard, Director, IBM Power Systems Marketing
August 2010
Agenda

✓ New Power Systems for a Smarter Planet

✓ New POWER7 Solutions

✓ The Importance of Consolidation of Workloads in a Virtualized World

✓ The Business Value of Consolidating Server Environments on IBM Power Systems

✓ Summary and Q&A

✓ Jeff Howard, Director, IBM Power Systems Marketing

✓ Arvind Krishna, General Manager, Information Management, IBM Software

✓ Jean Bozman, Research Vice President, Enterprise Platforms Group, IDC

✓ Randy Perry, Research Vice President, Business Value Strategy, IDC

✓ Jeff Howard, Director, Power Systems Marketing, IBM Systems and Technology
2,600 successful Power Migration Factory migrations to date. There were over 500 Power migrations during 2009, with more than 90% from Sun and HP customers (including x86 consolidation). In 1H10 alone, Power® Systems achieved over 500 competitive migrations.
A mandate for change is a mandate for smart.

**First, the world is becoming instrumented.**
Sensors are being embedded everywhere: in cars, appliances, cameras, roads, pipelines...even in medicine and livestock.

**Second, our world is becoming interconnected.**
Think of a trillion connected and intelligent things, and the oceans of data they will produce.

**Third, all of those instrumented and interconnected things are becoming intelligent.**
They are being linked to powerful new back-end systems that can process all that data, and to advanced analytics capable of turning it into real insight, in real time.
With smarter solutions on Power Systems, clients of all sizes are leveraging new capabilities for significant benefits.

**Retail**
10k per day

**Banking**
600 billion

**Telecom**
1.5 million

**Healthcare**
1.67 million

**Traffic**
20 million

**Cities**
500 thousand

Transactions automatically tracked and analyzed by **SuperPharm in Trinidad** after implementing a smarter retail solution with WebSphere and DB2 on Power.

Number of Japanese Yen deposited into 400,000 new accounts after only 18 months since startup of **SBI Sumishin Net Bank in Japan** – an internet-only bank on Power.

Number of new customers per month processed by **Bharti Airtel of India** on Power Systems and IBM Storage – now servicing over 110 million total mobile phone customers.

Number of annual cases with records entered into a new open, digital medical records system on Linux on Power improving disease management at **Peking University People’s Hospital**.

Number of fare transactions per day on Power – 2x previous capacity – allowing single card payment across tolls, buses and trains for **Singapore Land Transport Authority**.

Number of devices monitored on the **City of Austin**, Texas’s smart energy grid that offers 1 million consumers dynamic pricing and lower energy bills, running on Power Systems.
Making smart systems smarter.

How much smarter?

6% 30% 70%

Percent of available capacity used by the average commodity server.

Number of servers in some organizations that sit unutilized.

Percent of typical IT budgets devoted to managing, maintaining, securing and upgrading systems rather than building new capabilities, services and applications.
Virtualizing infrastructure benefits large healthcare providers

Zero intervention

To add more processing capacity to support application and business growth

The challenge
Respond to unplanned business functions or applications, bringing them online the same day while reducing administration and infrastructure costs.

The solution
Power Systems and PowerVM enabled the UPMC infrastructure team to focus on development, service improvement and complex issues. CPU provisioning is no longer a major event; it’s a standard procedure.

“Processor virtualization has given UPMC the ability to provide capacity very quickly and efficiently at no additional cost.”

Bill Hirsch
Manager, Systems Support
University of Pittsburgh Medical Center
Transformations to “smarter” solutions require smarter systems that:

- Scale quickly and efficiently
- Optimize workload performance
- Flexibly flow resources
- Avoid downtime
- Save energy
- Automate management tasks
Power your planet.
Smarter systems for a Smarter Planet.
Power your planet.
New systems, software and solutions for businesses of all sizes.

- **Power is market momentum.**
  - Record HP/Sun to Power migrations
  - Record x86 consolidations
  - Smarter Planet implementations

- **Power is workload optimizing systems.**
  - The most powerful, scalable UNIX system ever.
  - The most affordable Express systems for x86 consolidation.
  - The future of UNIX: scalable consolidation with simplified, highly availability cluster management

- **Power is Integrated Value.**
  - Comprehensive Analytics system for rapid insights
  - Scalable, highly available transaction systems
  - A cloud infrastructure and management stack

Power your planet.
Power your planet.

**Workload-Optimizing Systems**

**Virtualization without Limits**
- Drive over 90% utilization
- Dynamically scale per demand

**Resiliency without Downtime**
- Roadmap to continuous availability
- High availability systems & scaling

**Dynamic Energy Optimization**
- 70-90% energy cost reduction
- EnergyScale™ technologies

**Management with Automation**
- VMControl to manage virtualization
- Automation to reduce task time

**AIX - the future of UNIX**
- Total integration with i
- Scalable Linux ready for x86 consolidation

Smarter Systems for a Smarter Planet.
New

Power 795

✓ New High-end
✓ 24 to 256 Cores
✓ 8 TB memory
✓ TurboCore
✓ 3.7, 4.0 or 4.25 GHz
✓ 1,000 VMs with PowerVM
✓ Capacity on Demand
✓ Enterprise RAS
✓ 24x7 Warranty
✓ PowerCare

Power your planet.
Superdome in a Book

The capacity of a 128-core HP Integrity Superdome at 50% utilization can be consolidated into a single 32-core IBM Power 795 system book at 80% utilization, reducing by 75% the cores that must be licensed and maintained and dramatically increasing energy efficiency.

See Superdome in a Book for more details
PowerVM on POWER7 delivers virtualization without limits with higher performance and scalability than VMware for the same virtual workloads

65%

PowerVM outperforms VMware by up to 65% on Power 750, with linear scaling that maximizes resource utilization with 4x as many virtual CPUs\(^1\)

And POWER7 enterprise servers with PowerVM scale far beyond the limits imposed by x86 architecture and VMware with up to 32x* as many virtual CPUs

1 “A Comparison of PowerVM and VMware Virtualization Performance”, March 2010

*All statements regarding IBM’s future direction and intent are subject to change or withdrawal without notice, and represent goals and objectives only. Some features require the purchase of additional software components.
Reduce cost and simplify with massive consolidation

Consolidating into the Power 795 substantially reduces costs, floorspace and energy

1 IBM Power 570
2 HP Superdomes
5 HP rx6600s
100 HP DL380 G5s
50 Sun T5220s
5 Sun M4000s

One IBM Power 795
Smarter Telecommunications with Power 795

1.9 Billion

wireless devices will be sold every year starting in 2012

IMPROVE OPERATIONAL EFFICIENCIES AND REDUCE COSTS
Simplify processes, enhance automation to boost productivity, increase profitability, enable funding of innovation, business expansion, and critical transformation initiatives.

DIFFERENTIATE THE CUSTOMER EXPERIENCE

Power 795 for Operational & Business Support Systems

- Optimized for Comverse, AsianInfo, Amdocs, and LHS
- Scales for massive growth in billing data
- Reduces lost revenue due to downtime with “Rock solid” reliability and redundancy
- Improves customer retention accuracy by as much as 50% with scalable analytics
- Reduces operational costs through large scale consolidation

1.9 Billion wireless devices will be sold every year starting in 2012

SMATER COMMUNICATIONS

ENABLE NEW SERVICES AND BUSINESS MODELS.

SMARTER COMMUNICATIONS
Power enables hyper-growth in telecommunications

110 million

Customers demanding real-time requests for service and support

“Thanks to IBM, we’re working smarter the bigger we get. Our partnership with IBM has brought us the right level of business understanding and the right level of technology understanding to achieve this kind of scale and agility.”

Mehul Shah, Chief Architect, Bharti Airtel

The challenge
Bharti Airtel needed systems automation to handle skyrocketing growth at the same time as helping them raise their average revenue per client.

The solution
An IBM WebSphere and Power Systems solution enabled Bharti to automate routine transactions and provide flawless customer service.
4 times more scale

Than the largest Sun systems enables telecom companies to grow without disruption as their customer base explodes – while using up to 25% less energy.
PowerVM allows a single virtual machine to scale from 1/10\textsuperscript{th} of a POWER7 processor to 256 POWER7 processors – and back - on a Power 795 almost instantly – more than 32x the scalability of any single virtual machine under VMware on HP ProLiant x86 systems. This allows customer relationship applications to get the capacity they need when they need it to maintain service levels – and return it when they are done (something VMware doesn’t do.)

Serious responsiveness.
4 to 1

Number of 64-core POWER6 595 4.2GHz systems that can be consolidated into a single IBM Power 795 high-end system, delivering over 46% more performance, reducing energy consumption by 56% & floor space by 50%.

Each system
64 x 4.2GHz
2 TB memory
2 I/O drawers,

256 cores

→

256 x 4.0 GHz
8TB memory
8 I/O drawers

256 cores

Serious consolidation.

Power your planet.
IBM innovation enabling clients to transform their data centers

Logical Partitions 1999
Dynamic LPARs 2001
CUoD 2002
Micro-partitioning 2004
Virtual I/O 2004
Live Partition Mobility 2007
Utility CoD 2007
Power Flex … deploying a comprehensive virtualization infrastructure

**flex·i·ble** [flek-sə-bəl] characterized by a ready capability to adapt to new, different, or changing requirements*

Multi-system virtualization infrastructure providing a highly available and flexible IT environment to support clients’ most demanding business resiliency objectives – leveraging years of IBM innovations.

- At least two systems enables **active-active availability**
- **Allocate and rebalance** processor and memory
- Live Partition Mobility for **flexible workload movement**
- **Seamless growth** with Capacity on Demand
- On/Off Processor days for **extra capacity**

Serious flexibility.

*source: www.miriam-webster.com
New Power Express System Highlights

Affordability with outstanding performance, energy efficiency and reliability

Power 710 Express

2U - 1 Socket
4, 6 or 8 cores
Maximum memory: 64 GB
PCIe: 4 low profile

Dense, attractively priced 1-socket server that fits seamlessly in your existing infrastructure

Power 720 Express

4U - 1 Socket
4, 6 or 8 cores
Maximum memory: 128 GB
PCIe: 4 + 4 low profile
Up to 4 I/O drawers

Affordable, flexible rack or tower server for distributed applications or a complete, integrated business system with IBM i

Power 730 Express

2U - 2 Socket
8, 12 or 16 cores
Maximum memory: 128 GB
PCIe: 4 low profile

High performance, energy efficient server ideal for running multiple application and infrastructure workloads in a virtualized environment

Power 740 Express

4U - 2 Socket
4, 6, 8, 12, or 16 cores
Maximum memory: 256 GB
PCIe: 4 + 4 low profile
Up to 8 I/O drawers

High-performance, flexible, configurable and reliable midsize database and consolidation server

All systems above have 3 year warranty
Future workloads. Today’s utility is not only thinking about the datacenter managing a PC network or an ERP system. It’s expecting the grid to manage itself, reading meters not once a month…but every 15 minutes and reading smart grid sensors every 2 seconds.

For 500,000 meters over the course of the year…

- 6M transactions once per month
- 180M transactions once per day
- 4.3B transactions once per hour
- 17.3B transactions every 15 minutes
Smarter grids managed by Power make smarter cities

500,000
Number of devices monitored on the City of Austin smart energy grid

The challenge
The City of Austin needed to implement a billing system for its Smart Grid initiative to offer unique customer service options including substantial self service and the ability to offer dynamic pricing.

The solution
By providing consumers with real-time information on their energy consumption, Smart Grids managed by Power Systems help customers better manage their energy usage and lower their monthly bills.

City of Austin, Texas
Enabled by p5-510
$244,000 less.

Three year TCA savings when deploying IBM WebSphere Application Server on four, 16-core IBM Power 730 Express systems with PowerVM vs. nine, 12-core HP DL380 G7 with VMware Save 18% on system TCA, 41% on WebSphere license and maintenance, use 56% less space, and 42% of the energy costs.

For equivalent throughput, the IBM Power 730 Express systems with PowerVM utilized at 65% has a $32,000 lower 3-year TCA than HP ProLiant DL380 systems with VMware at 50%.

For WebSphere, IBM Power gives you the edge over a pile of HP ProLiant.

Nine HP ProLiant DL380 G7

Four Power 730 Express

See WebSphere detail for more information
AIX 7 – the future of UNIX

- **Virtualization without limits**
  - Run AIX 5.2 WPARs¹ 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 management²

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*Requires “AIX 5.2 WPAR for AIX 7” product
²Requires IBM Systems Director

Download the open beta for AIX 7 now!

https://www14.software.ibm.com/iwm/web/cc/earlyprograms/websphere/aix7ob
Power is Cloud Optimized
Delivering superior qualities of service for the most mission critical workloads

- Leadership virtualization capabilities for superior performance, scalability, security and drive systems up to 90% utilization
- Complete resource control with integrated server, virtualization, network and storage management
- Improve customer service & reduce IT labor hours by up to 67% with automatic provisioning of resources requested via a self-service portal

Selected Power Cloud Offerings

**PowerVM and VMControl**
Industrial strength virtualization coupled with automated resource balancing and virtual image management

**IBM Service Delivery Manager**
Pre-integrated software stack for automated IT service deployment, resource monitoring and service availability

**IBM Cloudburst**
Integrated service management platform with network, servers, storage, quickstart services that enables the fastest private cloud deployment today

“Building a Dynamic Infrastructure with IBM Power Systems” IBM SWG Competitive Project Office, March 2010
All statements regarding IBM’s future direction and intent are subject to change or withdrawal without notice, and represent goals and objectives only. Some features require the purchase of additional software components. Please see Disclaimer slide.
IBM Power Systems

Power is Integrated Value

IBM pureScale Application System
Always-available, scalable transaction processing system for a tightly-integrated, pre-configured, pre-optimized solution based on Power 770

IBM Cloudburst™
First ever pre-packaged cloud environment ready for the most mission critical production workloads*

IBM Smart Analytics System
Pre-integrated, pre-optimized analytics platform built on POWER7 technology for rapid time to value

IBM Rational Appliance
Complete integrated development environment including industry leading development tools and compilers on POWER7 Express Servers

*Statement of Direction. All statements regarding IBM's future direction and intent are subject to change or withdrawal without notice, and represent goals and objectives only.
Power your planet.
POWER7 Solutions for a Smarter Planet.

Arvind Krishna, General Manager, Information Management, IBM Software
August 2010
Introducing Smarter Systems for a Smarter Planet
IBM POWER7 and IBM Software Optimization

73% better
performance using a single JVM of WebSphere on POWER7 vs. competitive application server on Nehalem

86% lower cost
for DB2 on IBM Power 780 than Oracle on Sun

40% better utilization
Up to 40% better system utilization with the latest compilers, exploiting POWER7 architecture

10,000
Transactions daily with automatic sales analysis, demand planning and forecasting for over 15,000 stock items

"With a framework and guidance from VAI and IBM, we revolutionized Trinidad’s pharmacy business."

Christian Anderson
Chief Operations Officer
SuperPharm

1 IBM CPO Internal Study
2 CPO Study - DB2 on POWER7 Delivers The Most Efficient TPC-C Result EVER!
3 As much as 40% improved throughput vs. Power6 for the identify duplicates process One example of performance improvement, TSM 6.2
Introducing IBM pureScale Application System

*EVERYTHING* you need for Transaction Processing and Database Applications

**Ultimate flexibility**
- Buy only what you need, when you need it
- Scale up, scale out, scale within

**Superior price/performance**
- DB2, WebSphere Application Server, and POWER7 deliver industry leading price/performance

**Unmatched application integrity**
- Only IBM maintains consistent transaction integrity across all test scenarios*
- Delivers application transparency

* Source: Whitepaper: IBM WAS Delivers Transaction Integrity for J2EE Applications

90%

IBM Power 770 drives up to 90% server utilization with industry-leading virtualization
Introducing IBM Rational Power Appliance
What smart organizations want and need for faster results

EVERYTHING you need for Application Development

- Rapidly deploy, optimized development platform
- Eclipse-based tools for AIX*
- Consolidated, change management platform
- Development & test for pureScale Application System and more

20% or more improvement in developer productivity Rational Developer for Power Systems

*Individual tools available for i and Linux.

Power your planet.

Introducing IBM Smart Analytics System 7700
What smart organizations want and need for faster results

EVERYTHING you need for Business Analytics – not just a data warehouse appliance…

IBM Smart Analytics System 7700

Superior price/performance

- Architected for POWER7
- 4x more cores per module
- 50% reduction in floor space
- 2x storage capacity per data module
- Solution acceleration from Solid State Drive (SSD)

*compared to prior.

- Significant increase in assortment accuracy
- Big improvement in avoiding stock-outs of popular brands
- Delivering insight to 3,400 stores & 4,000 staff
The Importance of Consolidation of Workloads in a Virtualized World

Jean S. Bozeman
Research Vice President
Enterprise Platforms Group

August 2010
Server Capability (and Density) Soars

Total Server CPUs and Cores per Year

- Annual Cores Shipping
- Annual CPUs

Year:
- '97
- '98
- '99
- '00
- '01
- '02
- '03
- '04
- '05
- '06
- '07
- '08
- '09

CPU Shipments:
- '97: 0
- '98: 0
- '99: 1
- '00: 1
- '01: 1
- '02: 1
- '03: 1
- '04: 1
- '05: 1
- '06: 1
- '07: 1
- '08: 1
- '09: 2

Cores Shipments:
- '97: 0
- '98: 0
- '99: 1
- '00: 1
- '01: 1
- '02: 1
- '03: 1
- '04: 1
- '05: 1
- '06: 1
- '07: 1
- '08: 1
- '09: 2
Q. Using a 1-10 Scale, rate the following criteria for their importance in your decision to virtualize your servers.

**Virtualization Drivers**

- Reduce Power & Cooling Needs
- Improve Disaster Recovery
- Simplify Server Management
- Reduce Server Maintenance Costs
- Reduce Server Deployment Time
- Reduce Server Acquisition Cost
- Improve Availability
- Increase Server Consolidation
- Improve Server UT

Source: Server Virtualization 2009, n = 405
Virtualization Leaves its Mark and Primes the Market for Change

Source: IDC Server Virtualization 2009
New Economic Model for the Datacenter
Shifts to Automation Tools are a Requirement

WW Spending on Servers, Power and Cooling, and Management/Administration

Customer Spending ($B)

- Physical Server Installed Base (Millions)
- Logical Server Installed Base (Millions)
- Power & Cooling Expense
- Management Cost
- Server Spending

Millions Installed Servers

56 million virtual machines by 2012

'96 '97 '98 '99 '00 '01 '02 '03 '04 '05 '06 '07 '08 '09 '10 '11 '12 '13
New Economic Model for the Datacenter
Shifts to Automation Tools are a Requirement

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- Management Cost
- Server Spending

56 million virtual machines by 2012

Virtualization Management Gap

Millions Installed Servers

'96 '97 '98 '99 '00 '01 '02 '03 '04 '05 '06 '07 '08 '09 '10 '11 '12 '13
Scalable Server Strengths

- Scalable Servers Host The Majority of Business Processing Workloads, by Annual Revenue Spend
  - OLTP, ERP, CRM, Scalable Database

- Highly controllable virtualization and built-in workload management

- High uptime, high utilization levels

- On-board RAS reliability features
The “New Normal”
Shifting Business Goals Impact Technology Goals

Q. Prioritize the following business goals as they relate to your organization by allocating 100 points among them.

- A more balanced view of end-user business goals is returning to market
- With virtualization, focus has been on cutting costs
- Customers are again beginning to look for additional business benefits from IT
- Technology will clearly play an important role in future business initiatives

![Business Goal Prioritization Chart]

- Speed time to market
- Increase market share
- Improve quality/accuracy
- Increase revenue
- Increase customer sat.
- Reduce costs

Source: IDC Enterprise Platforms Surveys
Economics are Driving Change in the Datacenter

Consolidation brings Operational Savings

Virtualization Improves Server Utilization, Supports Workload Consolidation

Consolidation addresses IT “pain points” of maintenance, management, and power/cooling costs
The Business Value of Consolidating Server Environments on IBM Power Systems

Randy Perry
Vice President, Business Value Strategy

August 2010
Over the past several months, IDC has conducted research to explore the business value of consolidating workloads on Power servers.

The multi-phased project has included a combination of in-depth interviews with companies who have consolidated on Power, the custom development of an ROI model and final deliverable of a summary IDC white paper.
IDC conducted a study in 2010 with organizations consolidating on Power Systems…

**Demographics**
- Seven companies based in Western Europe, the U.S. and Russia
- Average size – 58,900 employees; 51,425 users
- Industries - retail, finance, healthcare, energy, education
- Deployed 1-8 large scale POWER6 systems

**Key findings**
- Consolidation the number of server CPUs by 87%
- Average utilization increased from 24% to 79%
- UNIX servers reduced by 92%
- x86 servers reduced 97%
- Overall, companies realized over $12M in benefits annually from an initial investment of $4.4M
Annual Benefits of Consolidation

Key Benefit Drivers

• Demand for increased automation means companies save $6 in avoided cost for every $1 in consolidation savings
• 20-40% increase in performance
• Reduced downtime by 94%
• Reduced help desk issues by 92%
• Freed up the resources of the equivalent of two IT staff by increasing productivity
IDC used a discounted (12%) cash flow three-year ROI analysis. The present-value, discounted analysis accounts for the cost of capital needed to purchase the solution plus risk factor. Payback occurs in less than one year - at ~8 months- however this is after consolidation which can take from 3 months to several years to implement.

**3 Year ROI Analysis**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Benefits</strong></td>
<td>$565,020</td>
</tr>
<tr>
<td><strong>Investment</strong></td>
<td>$120,540</td>
</tr>
<tr>
<td><strong>Net Present Value</strong></td>
<td>$444,570</td>
</tr>
<tr>
<td><strong>ROI</strong></td>
<td>369%</td>
</tr>
<tr>
<td><strong>Payback (months)</strong></td>
<td>7.8</td>
</tr>
</tbody>
</table>
Leadership Power Systems Portfolio

The broadest portfolio of scalable systems delivers industry-leading performance, energy efficiency and seamless, modular growth

Power Express Servers
• Higher qualities of service at affordable prices
• Easy to purchase and deploy
• Energy Efficient

Power Enterprise Servers
• Modular growth and upgradeability
• Capacity on Demand
• Enterprise RAS

Web, Infrastructure, Collaboration, and Distributed Applications

Analytics

Business/Transaction Processing

Consolidation
Power is...

Workload-Optimizing Systems

Virtualization without Limits

Resiliency without Downtime

Dynamic Energy Optimization

Management with Automation

Integrated Value
Power your planet.

Smarter systems for a Smarter Planet.
Backup
Superdome in a Book: The IBM Power 795 delivers leadership performance and consolidation capability vs. HP high-end servers. For example, the capacity of 1 128-core HP Integrity Superdome utilized at 50% can be delivered with a single 32 core IBM Power 795 server book utilized at 80%, reducing the number of cores by 75% and decreasing energy consumption by up to 65%.

Substantiation:

<table>
<thead>
<tr>
<th>System</th>
<th>Cores</th>
<th>Peak Result</th>
<th>Perf/Watt</th>
<th>Util</th>
<th>Effective Performance</th>
<th>Effective Perf/Core</th>
<th>Max Watts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power 795</td>
<td>32</td>
<td>1,440</td>
<td>173</td>
<td>80%</td>
<td>1,152</td>
<td>36</td>
<td>8,341</td>
</tr>
<tr>
<td>HP Superdome</td>
<td>128</td>
<td>1,648</td>
<td>68</td>
<td>50%</td>
<td>824</td>
<td>6</td>
<td>24,392</td>
</tr>
</tbody>
</table>

Performance per watt is calculated by dividing the performance in the table above by the recommended maximum power. Actual power used by the systems will be less than this value for all of the systems. The worst-case maximum power requirement for a 32-core Power 795 is 8,341 watts and is available in the Power 795 site planning guide at: http://publib.boulder.ibm.com/infocenter/powersys/v3r1m5/index.jsp?topic=/p7hdx/power_systems.htm

The power consumption figure of 24,392 W for the HP Superdome was based on the maximum rates published by HP. The information for the HP Integrity Superdome is in "QuickSpecs HP Integrity Superdome Servers 16- processor, 32-processor, 64- processor Systems" available at www.hp.com. The virtualized system count and energy savings were derived from several factors:

The virtualized system count and energy savings were derived from several factors:

- A performance ratio factor was applied to the virtualization scenario based on SPECint_rate2006. The performance factor is simply the SPECint_rate2006 result per core of the Power 795 divided by the per core result of the HP system
- Power 795 (32-core, 4 chips, 8 cores per chip, 4.0 GHz) SPECint_rate2006 1,440 peak submitted on August 17, 2010. HP Superdome (128-core, 64 chips, 2 cores per chip) 1.6 GHz, SPECint_rate2006 1648 peak published September 2006. Data valid as of 08/12/2010.

The reduction 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 IBM Power 795 delivers leadership performance and consolidation capability vs. HP and Sun high-end servers. For example, 10 HP Integrity Superdome 128-core systems utilized at 50% can be consolidated into a single 256 core IBM Power 795 server utilized at 80%, thus saving 80% of the cores for software licensing and reducing reducing energy costs by over 75%.

**Substantiation:**

<table>
<thead>
<tr>
<th>System Name</th>
<th>Systems</th>
<th>Cores/system</th>
<th>Chips/system</th>
<th>Cores / chip</th>
<th>Threads/core</th>
<th>Peak result</th>
<th>Date</th>
<th>Utilization / system</th>
<th>Effective Performance (result x systems x Util %)</th>
<th>Energy (watts)</th>
</tr>
</thead>
<tbody>
<tr>
<td>IBM Power 795</td>
<td>1</td>
<td>256</td>
<td>32</td>
<td>8</td>
<td>4</td>
<td>11,200</td>
<td>Aug 2010*</td>
<td>80%</td>
<td>8,960 *</td>
<td>41,129 System + 1 Expansion</td>
</tr>
<tr>
<td>HP Superdome</td>
<td>10</td>
<td>128</td>
<td>64</td>
<td>2</td>
<td>1</td>
<td>1,648</td>
<td>Sep 2006</td>
<td>50%</td>
<td>8,240</td>
<td>24,392*10 = 243,920</td>
</tr>
</tbody>
</table>

Power consumption figure of the IBM Power 795 is the max published energy usage in the Power 795 announcement letter + max energy for 1 powered expansion unit. The power consumption figure of 24,392 W for the HP Superdome was based on the maximum rates published by HP. The information for the HP Integrity Superdome is in “QuickSpecs HP Integrity Superdome Servers 16-processor, 32-processor, 64-processor Systems” available at www.hp.com. The virtualized system count and energy savings were derived from several factors:

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Power 795 (256-core, 32 chips, 8 cores per chip, 4.0 GHz) SPECint_rate2006 11,200 peak submitted on Aug 17, 2010. HP Superdome (128-core, 64 chips, 2 cores per chip) 1.6 GHz, SPECint_rate2006 1648 peak published September 2006. Data valid as 08/11/2010.

SPEC® results available at: www.spec.org.

The reduction 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.

Consolidated systems effective capacity requirements are calculated by taking the published peak capacity for SPECint_rate2006 for that system, multiplying times the number of systems consolidated and the estimated percent of utilization for that system. The sum of all systems is calculated to be less than the capacity of the Power 795.

Power 795 (256-core, 32 chips, 8 cores per chip, 4.0 GHz) SPECint_rate2006 of 11,200 peak to be submitted on August 17, 2010.

Reduction 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.

SPECint_rate 2006 available from www.spec.org as of 8/2/2010
IBM Power 795 delivers performance with efficiency

...over **3X** the performance per core of HP Superdome

...over **4X** the performance per core of Sun M9000

**Performance Per Core**

<table>
<thead>
<tr>
<th>System</th>
<th>Chip/Core/Thread</th>
<th>Date</th>
<th>SPECint_rate2006</th>
<th>Per core</th>
<th>Energy requirement (WATTs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>IBM Power 795 (4 GHz POWER7)</td>
<td>8/256/1024</td>
<td>August 17, 2010</td>
<td>11,200</td>
<td>43.75</td>
<td>28,529</td>
</tr>
<tr>
<td>IBM Power 595 (5 GHz POWER6)</td>
<td>32/64/128</td>
<td>April 2008</td>
<td>2,083</td>
<td>32.5</td>
<td>27,500</td>
</tr>
<tr>
<td>Sun SPARC Enterprise M9000</td>
<td>64/256/512</td>
<td>October 2009</td>
<td>2,586</td>
<td>10.1</td>
<td>38,180</td>
</tr>
<tr>
<td>HP Integrity Superdome (1.6 GHz Itanium 2)</td>
<td>64/128/128</td>
<td>September 2006</td>
<td>1,648</td>
<td>12.875</td>
<td>24,392</td>
</tr>
</tbody>
</table>

Source: [http://www.spec.org](http://www.spec.org)  
*IBM results submitted on August 17, 2010. All other results as of 08/05/10. Not all results listed. Performance per KWatt is calculated by dividing the performance by the recommended maximum power usage for site planning. This defines the requirement for the power infrastructure. Actual power used by the systems will be less than this value for all of the systems. For HP systems, this information is contained in the QuickSpecs available through [www.hp.com](http://www.hp.com). For Sun systems, this information is available through the respective Site Planning Guides available through [www.sun.com](http://www.sun.com).
Power 730 server consolidation of T2000 servers substantiation

Notes:
1. SPEC® and the benchmark names SPECRate®, SPECint®, and SPECjbb® are registered trademarks of the Standard Performance Evaluation Corporation. Competitive benchmark results stated reflect results published on www.spec.org as of August 17, 2010. The comparison presented below is based on a consolidation of a legacy 8-core Sun SPARC Enterprise T2000 UltraSPARC T1 servers into a 16 core IBM Power 730. For the latest SPEC benchmark results, visit http://www.spec.org.

2. SPECjbb2005 results are:

POWER7: IBM Power 730 Express with 12 chips, and 16 cores and four threads per core with a result of 1,216,983 bops and 76,061 bops/jvm submitted to SPEC on August 17, 2010.

SPARC: Sun Microsystems Sun SPARC Enterprise T2000 with 1 chips, 8 cores and 4 threads per core with a result of 74,356 bops and 18,591 bops/jvm.

*The virtualized system count and energy savings were derived from several factors:

A performance ratio factor of 24.7X was applied to the virtualization scenario based on SPECjbb2005. Power 730 (16-core, 2 chips, 16 cores per chip, 3.55 GHz) 1,216,983 bops, submitted on 8/17/2010; Sun SPARC Enterprise T2000 (8-core, 1 chips, 8 cores per chip) 1.4 GHz, SPECjbb2005 74,356 bops. The performance factor is simply the SPECjbb2005 result of the Power 730 Express divided by the result of the competitive Sun SPARC Enterprise T2000 server.

A virtualization factor of 3X was applied to the virtualization scenario using utilization assumptions derived from an Alinean white paper on server consolidation. The tool assumes 19% utilization of existing servers and 60% utilization of new servers. Source - www.ibm.com/services/us/cio/optimize/opt_wp_ibm_systemp.pdf.

Calculation Summary: the Power 730 to the Sun T2000 performance ratio is 16.37 Multiply by 3 for the virtualization factor. Hence, 16.37 * 3 = 49 T2000 servers can be consolidated into one 730 server.

The Sun T2000 is 2U in height and 21 can fit into a 42U rack. The 730 is 2U in height.

One 730 server is 16 cores per system. A Sun T2000 has 8 cores per system. 49 systems multiplied by 8 cores is 392 cores. The Power 730 Express has 95% less cores.

$244,000 less. Three year TCA savings when deploying IBM WebSphere Application Server on four, 16-core IBM Power 730 Express systems with PowerVM vs. nine, 12-core HP DL380 G7 with VMware. Save 18% on system TCA, 41% on WebSphere license and maintenance, use 56% less space, and 42% of the energy costs.

Based on estimated equivalent throughput workloads on a Power 730 Express vs. a HP ProLiant DL380 G7 system. The virtualized system count was derived from the following factors: A performance factor was applied to the virtualization scenario based on SPEC® results source: www.spec.org as of August 12, 2010. IBM Power 730 Express (16-core, 2 chips, 8 cores per chip, 3.55 GHz) SPECjbb2005 1,216,983 bops, 76,061 bops/JVM; A HP ProLiant DL360 G7 (12-core, 2 chips, 6 cores/chip, 2.93 GHz) SPECjbb2005 875,975 bops, 145,996 bops/JVM performance was used with equivalent processor and memory for the HP ProLiant DL380 G7. A 20% performance adjustment to the HP ProLiant DL380 G7 for VMware based on results published by VMware and IBM in conjunction with VMware that demonstrate a 10-20% performance overhead. A virtualized utilization factor of 65% was assumed for the Power 730 Express and 50% for the HP ProLiant DL380 G7. The difference in virtualization is based on the additional capacity of the Power 730 in a virtual environment and targeting similar headroom for each system for peaks in demand.

<table>
<thead>
<tr>
<th>System</th>
<th>Benchmark</th>
<th>Cores</th>
<th>Syst Evaluated</th>
<th>Effective BOPs</th>
<th>Syst Reqt</th>
<th>Systems</th>
<th>Total cores</th>
</tr>
</thead>
<tbody>
<tr>
<td>HP DL380 G7</td>
<td>SPECjbb 875.98</td>
<td>12</td>
<td>12-core, 2.93 GHz</td>
<td>350.39</td>
<td>9</td>
<td>9</td>
<td>108</td>
</tr>
<tr>
<td>Power 730</td>
<td>1,216.98</td>
<td>16</td>
<td>16-core, 3.55 GHz</td>
<td>832.14</td>
<td>3.8</td>
<td>4</td>
<td>64</td>
</tr>
</tbody>
</table>

Software savings are based on IBM SWG 70 PVUs per core on both systems and a difference of 108 cores for the HP ProLiant systems (7,560 total PVUs) vs. 64 cores on the Power 730 (4,480 total PVUs).

Power consumption figures of 1,100 W for the IBM Power 730 Express and 848 W for the HP ProLiant DL380 G7 were based on the maximum rates published by IBM and HP respectively. Actual power usage will be less for systems in normal operation. The data for the HP ProLiant systems came from their respective Datasheets available through www.hp.com as of August 12, 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.

Prices for HP ProLiant DL380 G7 systems from www.hp.com. IBM prices are list price in USD. Prices from resellers may vary. Prices are subject to change without notice.

<table>
<thead>
<tr>
<th>System Name</th>
<th>JVM</th>
<th>JVM Instances</th>
<th>Cores</th>
<th>Processor chips</th>
<th>HW Threading</th>
<th>bops</th>
<th>Bops / JVM</th>
</tr>
</thead>
<tbody>
<tr>
<td>IBM Power 730 Express</td>
<td>JRE 1.6.0 (32-bit) IBM J9 2.4 AIX [build jvmmap3260s07-20091214_49398(SR7)]</td>
<td>16</td>
<td>16</td>
<td>2</td>
<td>Yes</td>
<td>1,216,983</td>
<td>76,061</td>
</tr>
<tr>
<td>HP ProLiant DL360 G7</td>
<td>IBM J9 VM (build 2.4, J2RE 1.6.0 IBM J9 2.4 Windows Server 2008 amd64-64 jvmwa6460s3r3-20090519_35743 (JIT enabled, AOT enabled)</td>
<td>6</td>
<td>12</td>
<td>2</td>
<td>Yes</td>
<td>875,975</td>
<td>145,996</td>
</tr>
</tbody>
</table>

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Revised September 26, 2006
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IBM benchmark results can be found in the IBM Power Systems Performance Report at http://www.ibm.com/systems/p/hardware/system_perf.html.

All performance measurements were made with AIX or AIX 5L operating systems unless otherwise indicated to have used Linux. For new and upgraded systems, AIX Version 4.3, AIX 5L or AIX 6 were used. All other systems used previous versions of AIX. The SPEC CPU2006, SPEC2000, LINPACK, and Technical Computing benchmarks were compiled using IBM's high performance C, C++, and FORTRAN compilers for AIX 5L and Linux. For new and upgraded systems, the latest versions of these compilers were used: XL C Enterprise Edition V7.0 for AIX, XL C/C++ Enterprise Edition V7.0 for AIX, XL FORTRAN Enterprise Edition V9.1 for AIX, XL C/C++ Advanced Edition V7.0 for Linux, and XL FORTRAN Advanced Edition V9.1 for Linux. The SPEC CPU95 (retired in 2000) tests used preprocessors, KAP 3.2 for FORTRAN and KAP/C 1.4.2 from Kuck & Associates and VAST-2 v4.01X8 from Pacific-Sierra Research. The preprocessors were purchased separately from these vendors. Other software packages like IBM ESSL for AIX, MASS for AIX and Kazushige Goto’s BLAS Library for Linux were also used in some benchmarks.

For a definition/explanation of each benchmark and the full list of detailed results, visit the Web site of the benchmark consortium or benchmark vendor.

TPC http://www.tpc.org
SPEC http://www.spec.org
Pro/E http://www.proe.com
GPC http://www.spec.org/gpc
VolanoMark http://www.volano.com
STREAM http://www.cs.virginia.edu/stream/
SAP http://www.sap.com/benchmark/
Oracle Applications http://www.oracle.com/apps_benchmark/
PeopleSoft - To get information on PeopleSoft benchmarks, contact PeopleSoft directly
Baan http://www.ssaqglobal.com
Fluent http://www.fluent.com/software/fluent/index.htm
TOP500 Supercomputers http://www.top500.org/
Ideas International http://www.ideasinternational.com/benchmark/bench.html
Storage Performance Council http://www.storageperformance.org/results

Revised March 12, 2009
Notes on HPC benchmarks and values

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SPEC http://www.spec.org
Pro/E http://www.proe.com
GPC http://www.spec.org/gpc
STREAM http://www.cs.virginia.edu/stream/
Fluent http://www.fluent.com/software/fluent/index.htm
TOP500 Supercomputers http://www.top500.org/
AMBER http://amber.scripps.edu/
FLUENT http://www.fluent.com/software/fluent/fl5bench/index.htm
GAMESS http://www.msg.chem.iastate.edu/gamess
GAUSSIAN http://www.gaussian.com
ANSYS http://www.ansys.com/services/hardware-support-db.htm
Click on the "Benchmarks" icon on the left hand side frame to expand. Click on "Benchmark Results in a Table" icon for benchmark results.

ECLIPSE http://www.sis.slb.com/content/software/simulation/index.asp?seg=geoquest&
MM5 http://www.mmm.ucar.edu/mm5/
MSC.NASTRAN http://www.mscsoftware.com/support/prod%5Fsupport/nastran/performance/v04_sngl.cfm
NAMD http://www.ks.uiuc.edu/Research/namd
HMMER http://hmmer.janelia.org/
http://powerdev.osuosl.org/project/hmmerAltivecGen2mod

Revised March 12, 2009
Notes on performance estimates

rPerf for AIX

rPerf (Relative Performance) is an estimate of commercial processing performance relative to other IBM UNIX systems. It is derived from an IBM analytical model which uses characteristics from IBM internal workloads, TPC and SPEC benchmarks. The rPerf model is not intended to represent any specific public benchmark results and should not be reasonably used in that way. The model simulates some of the system operations such as CPU, cache and memory. However, the model does not simulate disk or network I/O operations.

- rPerf estimates are calculated based on systems with the latest levels of AIX and other pertinent software at the time of system announcement. Actual performance will vary based on application and configuration specifics. The IBM eServer pSeries 640 is the baseline reference system and has a value of 1.0. Although rPerf may be used to approximate relative IBM UNIX commercial processing performance, actual system performance may vary and is dependent upon many factors including system hardware configuration and software design and configuration. Note that the rPerf methodology used for the POWER6 systems is identical to that used for the POWER5 systems. Variations in incremental system performance may be observed in commercial workloads due to changes in the underlying system architecture.

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========================================================================

CPW for IBM i

Commercial Processing Workload (CPW) is a relative measure of performance of processors running the IBM i operating system. Performance in customer environments may vary. The value is based on maximum configurations. More performance information is available in the Performance Capabilities Reference at: www.ibm.com/systems/i/solutions/perfmgmt/resource.html