IBM Power Systems – The Ultimate Platform for Compute Intensive Workloads

- 9,000+ Patents since 2001
- $4.2B Investment in POWER7 & POWER7+
- 100+ Industry leading benchmarks
- 200M Pages processed in 3 seconds by IBM Watson for healthcare delivering personalized medicine & cancer research
- 5 of 10 World’s fastest super-computers run on POWER, including Sequoia
- 88% More SAP Users per core than x86 when running on POWER7+
- 3,000+ Competitive displacements
- 20,000+ ISV apps running on IBM Power Systems
- #1 UNIX server revenue share leader 6 years running

http://www-03.ibm.com/systems/power/hardware/benchmarks/

#ibmpowersystems
IBM POWER Processor Roadmap

- **3 Year Revolution**
- **18 month “+” evolution**

**First Dual Core in Industry**
- Dual Core
- Chip Multi Processing
- Distributed Switch
- Shared L2
- Dynamic LPARs (32)
- 180nm

**Hardware Virtualization for Unix & Linux**
- Dual Core & Quad Core Md
- Enhanced Scaling
- 2 Thread SMT
- Distributed Switch +
- Core Parallelism +
- FP Performance +
- Memory bandwidth +
- 130nm, 90nm

**Fastest Processor in Industry**
- Dual Core
- High Frequencies
- Virtualization +
- Memory Subsystem +
- AltiVec
- Instruction Retry
- Dyn Energy Mgmt
- 2 Thread SMT +
- Protection Keys +
- 65nm

**Most POWERful & Scalable Processor in Industry**
- 4, 6, 8 Core
- 32MB On-Chip eDRAM
- Power Optimized Cores
- Mem Subsystem ++
- 4 Thread SMT++
- Reliability +
- VSM & VSX
- Protection Keys +
- 45nm, 32nm

IBM is the leader in Processor and Server design
10Yr History Four Quarter Average Revenue Share

UNIX Server Rolling Four Quarter Average Revenue Share
According to IDC

IBM Power Systems ships over 3X the volume of high value systems vs. HP, Oracle or other vendors

Worldwide Server Unit Share >$100K

- Industry’s most popular enterprise servers
- Sustained performance leadership
- Leadership virtualization efficiency
- Bullet proof security
- Business resiliency for mission critical applications
- Non-disruptive growth with CoD
- Cloud enabled for greater flexibility

Source: IDC Server Tracker Q212 Release, August 2012
IBM plans for future 22 nm technology are subject to change.
POWER7+
POWER7+

POWER7 45 nm

POWER7 32 nm

Add additional Cache
POWER7+

- POWER7 45 nm
- POWER7 32 nm

Add additional Cache
Add on Chip Accelerators
Benefits of eDRAM for POWER7+

With eDRAM

2.1B Transistors
567 mm²

Without eDRAM

5.4B Transistors
950 mm²

IBM’s eDRAM Benefits:
- Greater density: 1/3 the space of 6T SRAM implementation
- Less power requirements: 1/5 the standby power
- Fewer soft errors: Soft Error Rate 250x lower than SRAM
- Better Performance
POWER7+ RAS Specific Features

- **New Power On Reset Engine (PORE)**
  - Enables a processor core to be re-initialized while system remains up and running
  - Directly used to:
    - *Allow for Concurrent Firmware Updates*: In cases where a processor initialization register value needs to be changed

- **L3 Cache dynamic column repair**
  - New self-healing capability that complements cache line delete
  - Uses PORE feature to substitute a failing bit-line for a spare during run-time.

- **New Fabric Bus Dynamic Lane Repair**
  - POWER7+ has spare bit lanes that can dynamically be repaired (using PORE)
    - For Busses that connect CEC drawers
    - Avoids any repair action or outage related to a single bit failure.
POWERN7+ Processors & Architecture

**Faster Performance**
- Faster frequencies… up to 4.4 GHz
  POWER7+ processors
- 10 MB L3 Cache
- Random number generator
- Enhanced Single Precision Floating Point performance
- Enhanced GX system bus

**Increased Efficiency and Flexibility**
- Active Memory Expansion accelerator
- On-chip encryption acceleration for AIX
- Delivering 5x more performance per watt
- Enhanced energy / power gating
- 20 Virtual Machines per core

**Better Availability**
- Self-healing capability for L3 Cache functions
- Dynamic processor fabric bus repair
- Processor re-initialization

POWERN7+ 32 nm
## Processor Designs

<table>
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<tr>
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<th>POWER5</th>
<th>POWER5+</th>
<th>POWER6</th>
<th>POWER7</th>
<th>POWER7+</th>
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</thead>
<tbody>
<tr>
<td><strong>Technology</strong></td>
<td>130nm</td>
<td>90nm</td>
<td>65nm</td>
<td>45nm</td>
<td>32nm</td>
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<tr>
<td><strong>Size</strong></td>
<td>389 mm²</td>
<td>245 mm²</td>
<td>341 mm²</td>
<td>567 mm²</td>
<td>567 mm²</td>
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<td><strong>Transistors</strong></td>
<td>276 M</td>
<td>276 M</td>
<td>790 M</td>
<td>1.2 B</td>
<td>2.1 B</td>
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<tr>
<td><strong>Cores</strong></td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>8</td>
<td>8</td>
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<tr>
<td><strong>Frequencies</strong></td>
<td>1.65 GHz</td>
<td>1.9 GHz</td>
<td>4 - 5 GHz</td>
<td>3 – 4 GHz</td>
<td>3.6 – 4.4+ GHz</td>
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<tr>
<td><strong>L2 Cache</strong></td>
<td>1.9MB Shared</td>
<td>1.9MB Shared</td>
<td>4MB / Core</td>
<td>256 KB per Core</td>
<td>256 KB per Core</td>
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<tr>
<td><strong>L3 Cache</strong></td>
<td>36MB</td>
<td>36MB</td>
<td>32MB</td>
<td>4MB / Core</td>
<td>10MB / Core</td>
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<td><strong>Memory Cntrl</strong></td>
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<td>1</td>
<td>2 / 1</td>
<td>2 / 1</td>
<td>2 / 1</td>
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<td><strong>Architecture</strong></td>
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<td>Out of Order</td>
<td>In of Order</td>
<td>Out of Order</td>
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<td><strong>LPAR</strong></td>
<td>10 / Core</td>
<td>10 / Core</td>
<td>10 / Core</td>
<td>10 / Core</td>
<td>20 / Core</td>
</tr>
</tbody>
</table>
Transition from POWER6

Cores:
- 8 Intelligent Cores / chip (socket)
- 4 and 6 Intelligent Cores available on some models
- 12 execution units per core
- Out of order execution
- 4 Way SMT per core
- 32 threads per chip
- L1 – 32 KB I Cache / 32 KB D Cache per core
- L2 – 256 KB per core

Chip:
- 32MB Intelligent L3 Cache on chip

Memory:
- Dual DDR3 Controllers
- 100 GB/s sustained Memory bandwidth / chip

Scalability:
- Up to 32 Sockets
- 360 GB/s peak SMP bandwidth / chip
- 590 GB/s peak I/O bandwidth / chip
- Up to 20,000 coherent operations in flight

Energy:
- Aggressive processor Nap & Sleep modes
- 10% “Over clock” when thermals are good
POWER6 - POWER7 Compare

POWER6

- Core
- L2 Cache
- L3 Cache
- Fabric Bus Controller
- Memory Ctrl
- GX Bus Cntrl
- GX+ Bridge
- Memory+

POWER7

- Core
- L2 Cache
- L3 Cache
- Memory Interface

- Up to 8 cores / die
- 3rd Generation Multithreading – SMT4
- Integrated on-chip L3 Cache – lower latency
- 4th Generation SMP Fabric Bus
- Energy Optimized Design
Conceptual diagrams above show one of several options to result in 6-core or 4-core chips.
POWER7 / POWER7+ Module Packaging

Power 795
Single Chip Glass Ceramic

Power 775
Quad-chip MCM

Power 770 / 780
Single Chip Glass Ceramic

Power 710 / 730
Single Chip Organic

Power 720 / 740
Single Chip Organic

Power 750 / 760
Dual Chip Organic

Power 770 / 780
Single Chip Organic

POWER7

POWER7

POWER7+
POWER7+ DCM

One Socket
Two POWER7+ Chips
- 4 Core option
- 6 Core option

Results in
- 8 Core DCM
- 12-Core DCM
Processor Frequencies

- The single decimal GHz values used in announcement letters and brochures (for example 3.6) are simplified descriptions of the actual GHz provided by IBM.
- The actual frequencies are 3 digit numbers:

<table>
<thead>
<tr>
<th>Announcement Letter Values</th>
<th>Actual Values</th>
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<tr>
<td>POWER7+</td>
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<tr>
<td>4-core @ 3.6 GHz</td>
<td>4 Core @ 3.612 GHz</td>
</tr>
<tr>
<td>6-core @ 4.2 GHz</td>
<td>6 Core @ 4.284 GHz</td>
</tr>
<tr>
<td>8-core @ 4.2 GHz</td>
<td>8 Core @ 4.228 GHz</td>
</tr>
<tr>
<td>POWER7+</td>
<td></td>
</tr>
<tr>
<td>8-core @ 4.3 GHz</td>
<td>8 Core @ 4.312 GHz</td>
</tr>
<tr>
<td>12-core @ 4.2 GHz</td>
<td>12 Core @ 4.284 GHz</td>
</tr>
<tr>
<td>16-core @ 3.6 GHz</td>
<td>16 Core @ 3.612 GHz</td>
</tr>
<tr>
<td>16-core @ 4.2 GHz</td>
<td>16 Core @ 4.228 GHz</td>
</tr>
</tbody>
</table>
POWER7+ Active Memory Expansion

- POWER7+ AME Hardware Accelerator
  - Enhanced Power Systems value for AIX
  - On-chip enhancement

- Compared to POWER7, more efficient memory expansion (less processor overhead for the same compression/decompression – or even more equivalent memory for the same processor overhead)

Note expansion percentage very workload dependent
Benefit of POWER7+ HW Accelerator

- **Less CPU for the same amount of memory expansion**
  - Can then run more partitions or work per partition
  - If fewer cores needed, may result in lower software licensing

- **OR more memory expansion for the same amount of processor**
  - Better able to relieve memory shortages and improve performance
  - May be able to do more work

Work done by hardware accelerator

Work done with software
Even with POWER7+ hardware accelerator there is some resource required.

POWER7+ uses on-chip hardware accelerator to do some of the compression / decompression work. There is a knee-of-cure relationship for CPU resource required for memory expansion

- Even with POWER7+ hardware accelerator there is some resource required.
- The more memory expansion done, the more CPU resource required

Knee varies depending on how compressible memory contents are
## POWER7 vs Intel Poulson

<table>
<thead>
<tr>
<th></th>
<th>POWER7</th>
<th>POWER7+</th>
<th>Intel Poulson</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cores</td>
<td>8</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Threads per Core</td>
<td>4</td>
<td>4</td>
<td>2</td>
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<tr>
<td>Frequency</td>
<td>4.0 GHz</td>
<td>4.5 GHz</td>
<td>2.53 GHz</td>
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<tr>
<td>Chip Size</td>
<td>567mm²</td>
<td>567mm²</td>
<td>544 mm²</td>
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<tr>
<td>Technology</td>
<td>45nm SOI 11 LM EDRAM</td>
<td>32nm SOI 13 LM Edram</td>
<td>32nm 9 LM</td>
</tr>
<tr>
<td>Max Socket support</td>
<td>32</td>
<td>32</td>
<td>32</td>
</tr>
<tr>
<td>Power</td>
<td>250 Watts</td>
<td>250 Watts</td>
<td>170 Watts</td>
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<tr>
<td>Spec_int Rate/Chip</td>
<td>340</td>
<td>390</td>
<td>180</td>
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<tr>
<td>Memory BW (70% utilization)</td>
<td>96GB/s (16 DDR3 channels)</td>
<td>96GB/s (16 DDR3 channels)</td>
<td>45 GB/s (4 DDR3 channels)</td>
</tr>
<tr>
<td>L3</td>
<td>32MB</td>
<td>80MB</td>
<td>32MB</td>
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<tr>
<td>Extras</td>
<td>Advanced Prefetch HPC Features Energy management Turbo Mode/Core</td>
<td>Need to add</td>
<td>QPI busses to IO interfaces</td>
</tr>
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</table>

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<table>
<thead>
<tr>
<th></th>
<th>POWER7</th>
<th>Oracle T4</th>
<th>Oracle T5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cores</td>
<td>8</td>
<td>8</td>
<td>16</td>
</tr>
<tr>
<td>Frequency</td>
<td>4.0 Ghz</td>
<td>3.0 Ghz</td>
<td>3.6 GHz</td>
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<tr>
<td>Chip Size</td>
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<td>403mm2</td>
<td>450 mm2 (est)</td>
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<tr>
<td>Technology</td>
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<td>40nm TSMC 12LM</td>
<td>28nm TSMC xxLM</td>
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<td></td>
<td>EDRAM</td>
<td></td>
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<tr>
<td>Max Socket support</td>
<td>32</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>Power</td>
<td>250 Watts</td>
<td>240 Watts</td>
<td>240 Watts (est)</td>
</tr>
<tr>
<td>Spec_int Rate/Chip</td>
<td>340</td>
<td>170 (est)</td>
<td>300 (est)</td>
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<tr>
<td>Memory BW (70% utilization)</td>
<td>96GB/s (16 DDR3 channels)</td>
<td>24GB/s (4 DDR3 channels)</td>
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</tr>
<tr>
<td>L3</td>
<td>32MB</td>
<td>4MB</td>
<td>12MB</td>
</tr>
<tr>
<td>Extras</td>
<td>Advanced Prefetch HPC Features Energy management Turbo Mode/Core</td>
<td>16 lanes PCI 2X10 Gb Enet Encryption/Decryption</td>
<td>32 PCI lanes (est) 2X10 Gb Enet</td>
</tr>
</tbody>
</table>
Memory Channel Bandwidth Evolution

**POWER5**
- Memory Performance: 2x DIMM
- DDR2 @ 553 MHz
  - Effective Bandwidth: 1.1 GB/s

**POWER6**
- Memory Performance: 4x DIMM
- DDR2 @ 553 / 667 MHz
  - Effective Bandwidth: 2.6 GB/sec

**POWER7**
- Memory Performance: 6x DIMM
- DDR3 @ 1066 MHz
  - Effective Bandwidth: 6.4 GB/sec
POWER7+ technology in a mid-range system provides enterprise class availability, modular flexibility and Capacity on Demand for critical business workloads

**What’s New**
- POWER7+ technology brings faster frequencies and larger L3 cache sizes which helps improve performance by over 20% on most workloads
- Hardware assisted memory compression helps reduce memory requirements without penalizing performance
- Hardware assisted AIX file system encryption improves security without penalizing performance
- Improved RAS and energy efficiency features improve system attractiveness
- Increased VM’s per core improve virtualization efficiency

**Features / Business Value**
- Industry leading performance per system and per-core, especially OLTP/database applications
- Advanced virtualization capabilities including Micro-Partitions and the ability to move live applications from one physical system to another without user interruption which enables higher system utilization and efficiency
- Extraordinary reliability with comprehensive redundancy and system enablement for reduced unplanned downtime and elimination of planned application downtime
- Modular systems design, Utility CoD, and Hot-Node Add capabilities for easy “pay-as-you-grow” scenarios that respond quickly to change yet are easy on the bottom line
- Highly stable and reliable POWER roadmap

**Client Benefits**
- Easily handles virtualized consolidation of large mission critical applications and workloads
- Enables OLTP workloads to be managed in the most demanding service level agreements
- Supports highly secure environments for commercial applications
- Enables flexible, non-disruptive growth for highly available workloads
Power Systems Virtualization – Tier Consolidation & Virtualization –

ISV Pricing on Power 64 core system
DB: 38 cores
WebSphere: 1920 PVUs
Do not pay for VIO server or CUoD cores

Virtual Network WebSphere to DB works at memory speeds
Reduce impact of planned outages, relocate workloads to enable growth, provision new technology with no disruption to service.

Partition Mobility Requires:
- POWER6
- AIX 5.3 / 6.1 or Linux
- All resources must be “Virtualized”
  - No real resources
- SAN storage environment
  - SAN Boot, temp space, same network

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

The number of DB licenses needed does not change before and after the migration.
Customer Shared Pool

Server 020256D3D Combined Micropartition CPU Utilization (Stacked)
# POWER7+ RAS Feature Overview

<table>
<thead>
<tr>
<th>RAS Item</th>
<th>Power 750+</th>
<th>Power 760+</th>
<th>Power 770+</th>
<th>Power 780+</th>
<th>Power 795</th>
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</thead>
<tbody>
<tr>
<td>Redundant / Hot Swap Fans &amp; Blowers</td>
<td>●</td>
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<td>●</td>
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<tr>
<td>Hot Swap DASD / Media / PCI Adapters</td>
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<td>Concurrent Firmware Update</td>
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<td>Redundant / Hot Swap Power Supplies</td>
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<td>Dual disk controllers (split backplane)</td>
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<td>Redundant System Clocks</td>
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<td>Hot GX Adapter Add and Cold Repair</td>
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<tr>
<td>Hot-node Add / Cold-node Repair</td>
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<td>Hot-node Repair / Hot-memory Add</td>
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<td>Dynamic Service Processor &amp; System Clock Failover</td>
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<td>Hot-node Repair / Hot-memory Add for all nodes”</td>
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<td>Power Pools</td>
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</tr>
</tbody>
</table>

* Requires two or more nodes
POWER7+ continues to deliver more

Performance per Watt

- >5X increase in performance per watt over POWER6+
- >10X increase in performance per watt since POWER5+
- >10 years of changing the server landscape

<table>
<thead>
<tr>
<th>Model</th>
<th>rPerf</th>
<th>KWatts</th>
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<tbody>
<tr>
<td>POWER4™</td>
<td></td>
<td></td>
</tr>
<tr>
<td>p670 1.1 GHz</td>
<td></td>
<td>6.71</td>
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<tr>
<td>rPerf: 24.46</td>
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<tr>
<td>POWER4+™</td>
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<tr>
<td>p670 1.5 GHz</td>
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<td>6.71</td>
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<tr>
<td>rPerf: 46.79</td>
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<tr>
<td>POWER5™</td>
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<td>p5-570 1.65 GHz</td>
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<td>5.2</td>
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<tr>
<td>rPerf: 68.4</td>
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<tr>
<td>POWER5+™</td>
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<tr>
<td>p570 1.9 GHz</td>
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<td>5.2</td>
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<td>rPerf: 85.20</td>
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<tr>
<td>POWER6™</td>
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</tr>
<tr>
<td>Power 570 4.7 GHz</td>
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<td>5.6</td>
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<tr>
<td>rPerf: 134.35</td>
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<tr>
<td>POWER6+™</td>
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<tr>
<td>Power 570 4.2 GHz</td>
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<td>5.6</td>
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<td>rPerf: 193.25</td>
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<tr>
<td>POWER7™</td>
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<tr>
<td>Power 780 3.8 GHz</td>
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<td>6.9</td>
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<tr>
<td>rPerf: 685.09</td>
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<tr>
<td>POWER7+™</td>
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<tr>
<td>Power 780 3.7 GHz</td>
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<td>7.7</td>
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<tr>
<td>rPerf: 1380.19</td>
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</tbody>
</table>

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The most energy efficient 4-socket system on the planet

The first Energy Star certified RISC system

Power 750

Most energy efficient systems

<table>
<thead>
<tr>
<th>System</th>
<th>Performance Per Watt</th>
</tr>
</thead>
<tbody>
<tr>
<td>Itanium HP rx6600</td>
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</tr>
<tr>
<td>SPARC Sun T5440</td>
<td></td>
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<tr>
<td>x86 HP DL585</td>
<td></td>
</tr>
<tr>
<td>POWER7 Power 750 with PowerVM</td>
<td></td>
</tr>
</tbody>
</table>
2012 Power Systems leadership

- Performance redefined
- Scalability
- Virtualization
- Availability
- Security

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Powering 5 of the world’s top 10 supercomputers

100+ Industry Leading Benchmarks
9,000+ Patents since 2001
3,000+ Competitive migrations 1Q 2010-3Q 2012
<table>
<thead>
<tr>
<th>CPU Model</th>
<th>GHz (core/socket)</th>
<th>GHz (core)</th>
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<tr>
<td>POWER7+ 710</td>
<td>3.6 GHz (4): 28,400 (4)</td>
<td>4.3 GHz (4): 59,700 (8)</td>
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<td>4.2 GHz (6): 49,400 (6)</td>
<td>4.2 GHz (6): 89,200 (12),</td>
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<td>4.2 GHz (8): 64,500 (8)</td>
<td>3.6 GHz (8): 104,700 (16)</td>
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<tr>
<td></td>
<td></td>
<td>4.2 GHz (8): 117,600 (16)</td>
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<tr>
<td>POWER7+ 720</td>
<td>3.6 GHz (4): 28,400 (4)</td>
<td>4.2 GHz (6): 49,000 (6), 91,700 (12)</td>
</tr>
<tr>
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<td>3.6 GHz (6, 42,400 (6),</td>
<td>3.6 GHz (8): 56,300 (8), 106,500 (16)</td>
</tr>
<tr>
<td></td>
<td>3.6 GHz (8): 56,300 (8)</td>
<td>4.2 GHz (8): 64,500 (8), 120,000 (16)</td>
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<tr>
<td>POWER7+ 750</td>
<td>3.5 GHz (8): 52,000 (8), 96,000 (16), 141,500 (24), 185 (32)</td>
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<tr>
<td></td>
<td>4.0 GHz (8): 59,000 (8), 108,000 (16), 158,000 (24), 208,000 (32)</td>
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<tr>
<td>POWER7+ 760</td>
<td>3.1 GHz (12): 69,800 (12), 129,000 (24), 194,700 (36), 258,000 (48)</td>
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<td>3.4 GHz (12): 75,200 (12), 137,000 (24), 209,000 (36), 274,000 (48)</td>
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<td></td>
<td>POWER7+ 710</td>
<td>POWER7+ 730</td>
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<tr>
<td><strong>POWER7+ 710</strong></td>
<td>3.6 GHz (4): 53.9 (4)</td>
<td>4.3 GHz (4): 120.4 (8),</td>
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<tr>
<td></td>
<td>4.2 GHz (6): 90.6 (6)</td>
<td>4.2 GHz (6): 176.6 (12),</td>
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<td></td>
<td>4.2 GHz (8): 115.5 (8)</td>
<td>3.6 GHz (8): 197.7 (16)</td>
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<tr>
<td><strong>POWER7+ 720</strong></td>
<td>3.6 GHz (4): 53.9 (4)</td>
<td>4.2 GHz (6): 90.6 (6), 176.6 (12)</td>
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<td>3.6 GHz (6): 79.5 (6),</td>
<td>3.6 GHz (8): 102.4 (8), 197.7 (16)</td>
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<td>3.6 GHz (8): 102.4 (8)</td>
<td>3.6 GHz (8): 197.7 (16)</td>
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<tr>
<td><strong>POWER7+ 750</strong></td>
<td>3.5 GHz (8): 104.5 (8),</td>
<td>4.0 GHz (8): 117.1 (8), 220.7 (16),</td>
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<td>197.0 (16), 275.9 (24),</td>
<td>3.5 GHz (8): 104.5 (8), 197.0 (16),</td>
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<td>354.9 (32)</td>
<td>4.0 GHz (8): 117.1 (8), 220.7 (16),</td>
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<td><strong>POWER7+ 760</strong></td>
<td>3.1 GHz (12): 142.1 (12),</td>
<td>3.4 GHz (12): 142.1 (12), 264.8 (24),</td>
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<td></td>
<td>264.8 (24), 370.7 (36),</td>
<td>3.4 GHz (12): 142.1 (12), 264.8 (24),</td>
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<td></td>
<td>476.7 (48)</td>
<td>3.4 GHz (12): 142.1 (12), 264.8 (24),</td>
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<td>3.4 GHz (12): 151.4 (12),</td>
<td>3.4 GHz (12): 151.4 (12), 264.8 (24),</td>
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<td>282.1 (24), 395.0 (36),</td>
<td>3.4 GHz (12): 151.4 (12), 264.8 (24),</td>
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<td></td>
<td>507.8 (48)</td>
<td>3.4 GHz (12): 151.4 (12), 264.8 (24),</td>
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</table>
Q & A
IBM Power Systems
5 February 2013 Announcement
Hardware Deep Dive

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Fußnoten zum vorherigen Slide
Reference the PowerLinux 7R2 SAP SD 2-Tier Performance chart in the 710/730/7R2 section

(1) The SAP Sales and Distribution (SD) Standard Application Benchmark performed on December 9, 2012 by IBM in Austin, TX, USA, has been certified with the following data: Number of SAP SD benchmark users: 8,016, Average dialog response time: 0.98 seconds, Throughput: Fully processed order line 876,000 items/hour, Dialog steps/hour: 2,628,000, SAPS: 43,800, Average database request time 0.020 sec / 0.018 sec (dialog/update): CPU utilization of central server: 99% Operating system, central server: SUSE Linux Enterprise Server 11 SP2, RDBMS: DB2 10, SAP Business Suite software: SAP enhancement package 5 for SAP ERP 6.0, Configuration: Central server: IBM PowerLinux 7R2, 2 processors / 16 cores / 64 threads, IBM POWER7+, 4.22 GHz, 32 KB (I) and 32 KB (D) L1 cache, and 256 KB L2 cache per core, 10 MB L3 cache per core, 256 GB main memory. The SAP certification number was not available at press time and can be found at the following Web page:
www.sap.com/benchmark

(2) The SAP Sales and Distribution (SD) Standard Application Benchmark performed on December 24, 2012 by Cisco Systems in Walldorf, Germany, was certified on January 8, 2013, with the following data: Number of SAP SD benchmark users: 6,530 Average dialog response time: 0.98 seconds, Throughput: Fully processed order line items per hour: 713,670, Dialog steps per hour: 2,141,000, SAPS: 35,680 Average database request time (dialog/update): 0.015 sec / 0.036 sec, CPU utilization of central server: 99% Operating system, central server: Red Hat Enterprise Linux 6.3 RDBMS: Sybase ASE 15.7 SAP Business Suite software: SAP enhancement package 5 for SAP ERP 6.0 Configuration: Central server: Cisco UCS B200 M3, 2 processors / 16 cores / 32 threads, Intel Xeon Processor E5-2690, 2.90 GHz, 64 KB L1 cache and 256 KB L2 cache per core, 20 MB L3 cache per processor, 256 GB main memory
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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, Siebel, PeopleSoft  http://www.oracle.com/apps_benchmark/
Baan  http://www.ssglobal.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.storag perfor mance.org/results

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- GPC: [http://www.spec.org/gpc](http://www.spec.org/gpc)
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- 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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Revised April 2, 2007