Catalyst for Mission Critical Transformation

Kirk Skaugen
Vice President and General Manager
Data Center Group
Intel Corporation

March 30, 2010
San Francisco, California

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Capping Off Intel's Largest Ever Data Center Refresh

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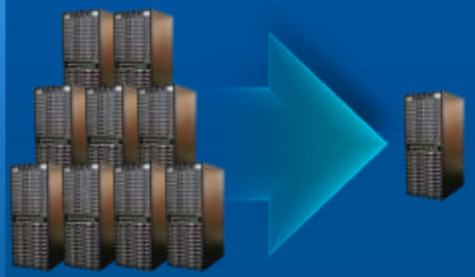
2009: The "Nehalem Effect"

Unprecedented ROI for IT



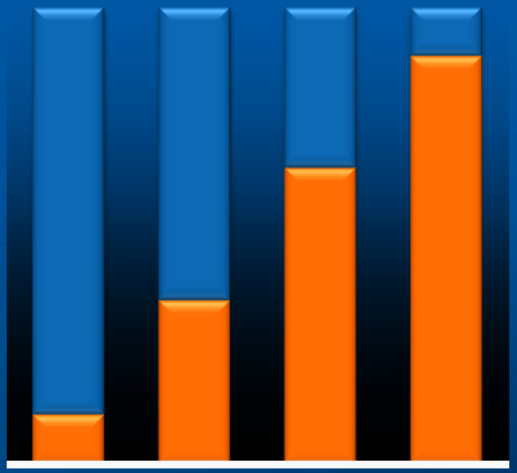
9:1 Consolidation
Estimated 90% Lower Energy Costs[1]
Estimated 8-month Payback[1]

Unprecedented Industry Innovation on Xeon® 5500

230 OEM Solutions
100+ Optimized Software Products

Compelling Value In Economic Downturn

Xeon® 5500 Mix



Source: Intel processor shipment data

[1]Source: Intel estimates as of Jan 2010. Performance comparison using SPECjbb2005 bops (business operations per second). Results have been estimated based on internal Intel analysis and are provided for informational purposes only. Any difference in system hardware or software design or configuration may affect actual performance. For detailed calculations, configurations and assumptions refer to the legal information slide in backup.

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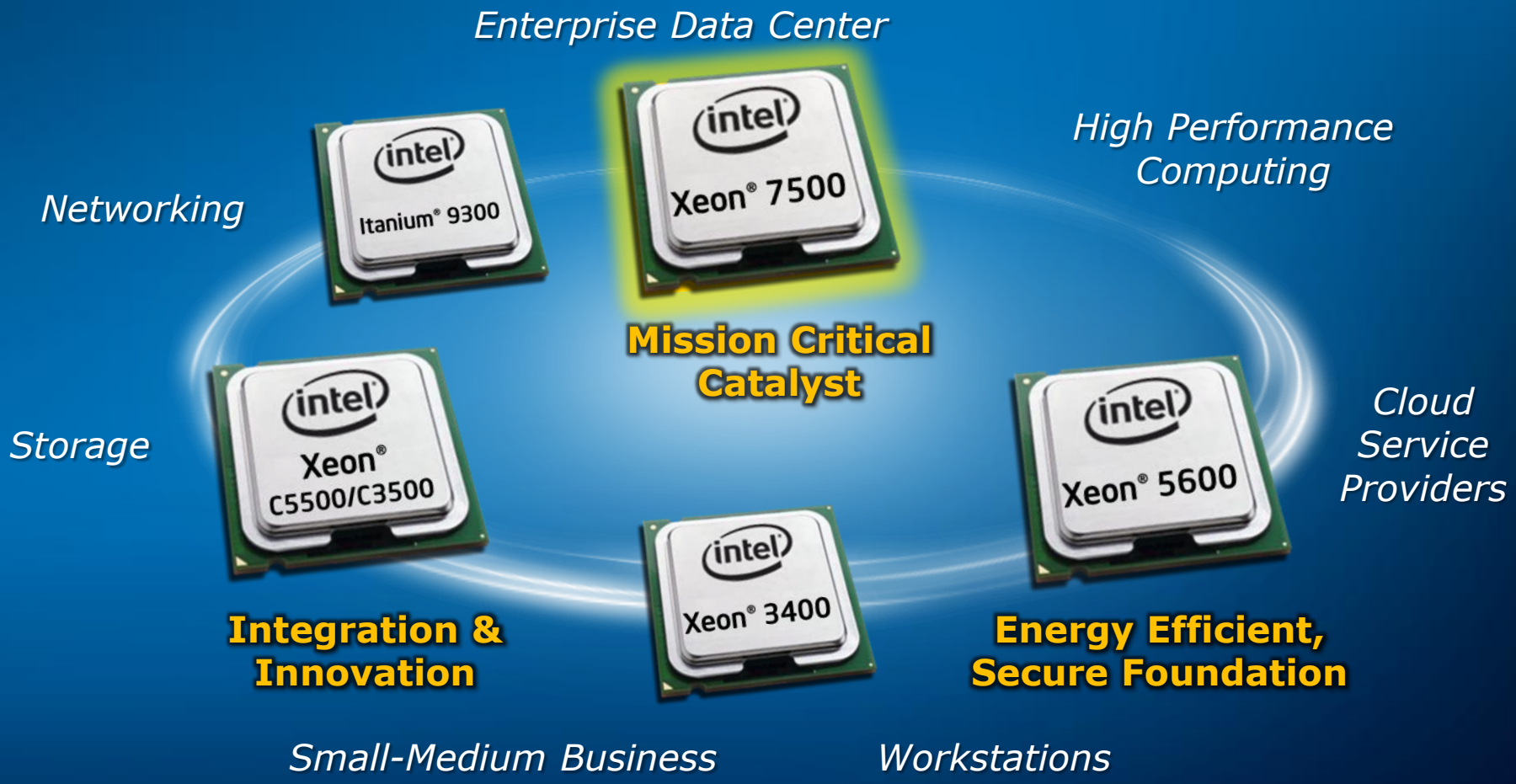
Capping Off Intel's Largest Ever Data Center Refresh



intel Xeon inside
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Growing Demand for Big Servers

Cloud Computing

26% CAGR '09-13[1]

Data Growth & Information Demand

650% Data Growth[2]

Real Time Business Intelligence

$6.8B Market by 2013[3]

High Performance Computing

$11.1B Market by 2013, Supercomputers $3.8B[4]

[1]IDC **eXchange,** Worldwide IT Spending On Cloud Services, Cloud Computing 2010 An IDC Update, **(** http://blogs.idc.com/ie/?p=543**) October** 2009
[2]Gartner Group "Hot Trends and Innovations in Data Centers" over next 5 years, 2009
[3]IDC **Multiclient Study** Worldwide Server Workloads, June 2009
[4]IDC Economic Crisis Response: Wordwide Technical Computing Server 2009-2013 Forecast Update, November 2009, **Doc # 220541**

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2010: "Nehalem Effect" Comes to Mission Critical

Introducing the Intel® Xeon® Processor 7500 Series

- **Historic Xeon Performance Leap**
  - Up to 3X vs. previous generation[1]
  - Up to 20:1 consolidation[2]
- **Breakthrough Capabilities**
  - Scaling from 2 to 256 sockets
  - 4X memory capacity up to 1TB[1]
- **Mission Critical Catalyst**
  - Over 20 new RAS features[1]
  - MCA Recovery in x86

[1] All comparisons vs. previous generation Intel® Xeon® 7400 platforms. Memory capacity is for 4S platform (16DIMMs/socket with 16GB DIMMs). See backup for performance configurations.
[2] See backup for consolidation configurations. Comparisons vs. single core Xeon® MP processor 3.33/8MB

Performance tests and ratings are measured using specific computer systems and/or components and reflect the approximate performance of Intel products as measured by those tests. Any difference in system hardware or software design or configuration may affect actual performance. Buyers should consult other sources of information to evaluate the performance of systems or components they are considering purchasing. For more information on performance tests and on the performance of Intel products, visit Intel Performance Benchmark Limitations. to change without notice.

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The Intel® Xeon® Revolution

The Biggest Performance Leap in Xeon History

Infrastructure — File/Print, Web, LOB App

Database — ERP, HPC

Data Center — Virtualization, BI

1996 2000 2004 2008 2010

Source: Intel internally measured results 15 January 2010. Each bar represents the score or estimated score of best measured/estimated results on the geometric mean of internal benchmarks (server-side Java*, integer throughput, floating-point throughput, ERP, and OLTP). Results have been estimated based on internal Intel analysis and are provided for informational purposes only. Any difference in system hardware or software design or configuration may affect actual performance. Performance tests and ratings are measured using specific computer systems and/or components and reflect the approximate performance of Intel products as measured by those tests. Any difference in system hardware or software design or configuration may affect actual performance. Buyers should consult other sources of information to evaluate the performance of systems or components they are considering purchasing. For more information on performance tests and on the performance of Intel products, Go to: http://www.intel.com/performance/resources/benchmark_limitations.htm. Relative performance is calculated by assigning a baseline value of 1.0 to one benchmark result, and then dividing the actual benchmark result for the baseline platform into each of the specific benchmark results of each of the other platforms, and assigning them a relative performance number that correlates with the performance improvements reported.

intel Xeon inside

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Intel® Xeon® Processor 7500 Performance Records[1]

#1 World Record 64S SPECint*_rate_base2006 10,400 score	**#1 x86 Record** 64S SPECfp*_rate_base2006 6,840 score
#1 World Record 8S TPC Benchmark* E 3,141 tpsE @ $768.92/tpsE (8P/64C/128T)[2]	**#1 8-Socket Record** 8S SAP* SD 2-Tier (Unicode) 16,000 Benchmark Users
#1 Two-Tier Record 4S SAP BI Datamart 854,649 query navigation steps	**#1 8-Socket Record** 8S SPECjbb*2005 3,321,826 BOPS @ 103,807 BOPS/JVM
#1 4-Socket Record 4S TPC Benchmark* E 2,022 tpsE @ $493.92/tpsE (4P/32C/64T)[3]	**#1 4-Socket Windows* Record** 4S SAP* SD 2 Tier (Unicode) 10,450 Benchmark Users
#1 single-node World Record 4S SPECjAppServer*2004 11,057 JOPS@Standard	**#1 single-node Record±** 4S LS-Dyna* Crash Simulation 41,727 seconds car2car
#1 World Record 4S VMmark* v1.1 71.85 score @ 49 tiles	**#1 4-Socket x86 Record** 4S SPECint*_rate_base2006 723 score
#1 2-Socket x86 Record 2S SPECint*_rate_base2006 362 score	**#1 2-Socket Record** 2S SPECjbb*2005 1,011,147 BOPS @ 126,393 BOPS/JVM

Over 20 New x86 Expandable Server World Records!

[1]World record claim based on comparison of like socket server platforms based on x86 architecture unless otherwise stated. Performance results based on published/submitted results **as of March 29, 2010**. See http://www.intel.com/performance/server/xeon_mp/summary.htm for details. ±Submitted or published Topcrunch.org

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* Other names and brands may be claimed as the property of others.

2. NEC: Availability is June 24,2010.

3. IBM x3850 X5 server is planned to be generally available March 31, 2010. The total solution availability for the TPC-E benchmark is July 30, 2010.

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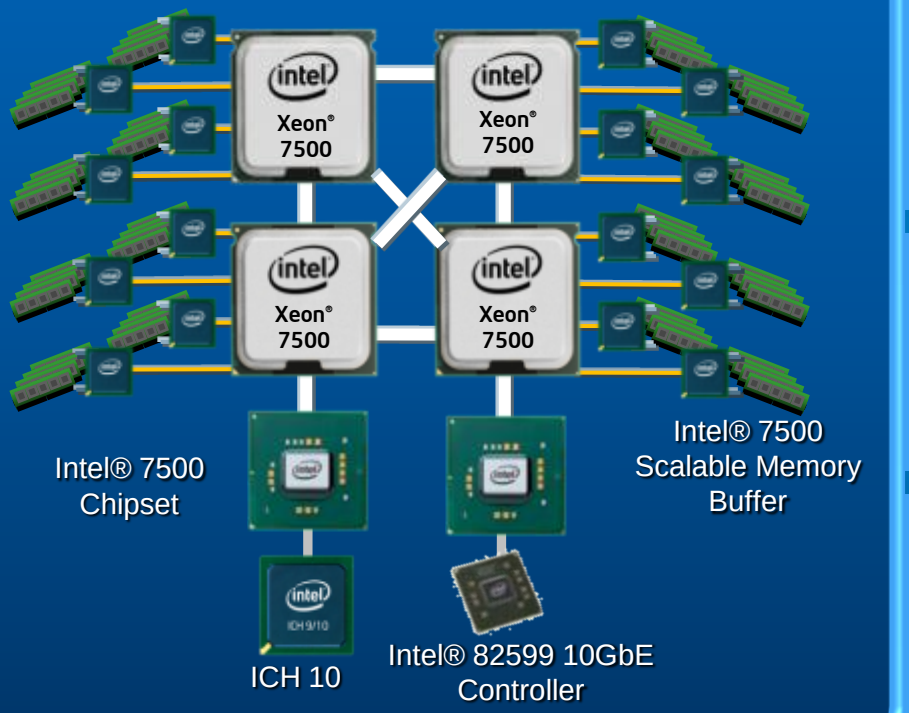
Intel® Xeon® 7500 Breakthrough Capabilities



Scalable Performance

Modular Scaling from 2 to 8 Sockets with QPI and 256 Sockets via OEM NCs

Flexible Virtualization

Up to 8x Memory Bandwidth[1] and 4x Memory Capacity Increases

Advanced Reliability

Over 20 New RAS Features Including MCA Recovery

Enabling New High-end Uses

[1]Over 8x memory bandwidth claim: Intel internally measured relative memory bandwidth comparison of a 4S Intel Xeon processor X7560 based server and a similarly configured 4S Intel Xeon processor X7460 as of 15 January 2010. Performance tests and ratings are measured using specific computer systems and/or components and reflect the approximate performance of Intel products as measured by those tests. Any difference in system hardware or software design or configuration may affect actual performance. Buyers should consult other sources of information to evaluate the performance of systems or components they are considering purchasing. For more information on performance tests and on the performance of Intel products, Go to: http://www.intel.com/performance/resources/benchmark_limitations.htm. Relative performance is calculated by assigning a baseline value of 1.0 to one benchmark result, and then dividing the actual benchmark result for the baseline platform into each of the specific benchmark results of each of the other platforms, and assigning them a relative performance number that correlates with the performance improvements reported.

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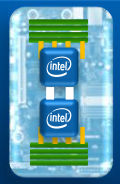
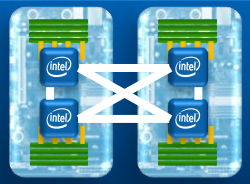
Modular Scaling Innovation

2-sockets
32 DIMMs



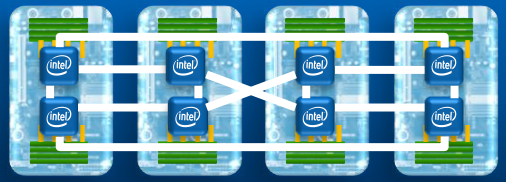
Large Memory 2S Workloads

4-sockets
64 DIMMs



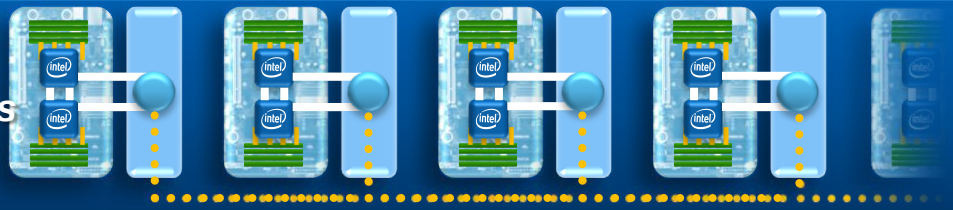
Mainstream 4S Workloads

8-sockets
128 DIMMs



Large Scale 8S Workloads

Ultra-Scaling with
OEM Node Controllers
2+2+… up to 256s



Ultra-Scale Workloads

Xeon® 7500 CPU Socket — *Intel QuickPath Interconnect* — *Memory* — *OEM Node Controller*

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OEM System Innovation

More than 2X the designs, including 4S Racks[1]

2-socket Expandable

RACKS

DELL

IBM

BLADES

DELL

HITACHI Inspire the Next

hp

IBM

First Ever!

4-Socket Blades

cisco

DELL

FUJITSU

HITACHI Inspire the Next

hp

IBM

UNISYS imagine it. done.

75% Increase[1]

8-sockets or Greater

BULL

CRAY THE SUPERCOMPUTER COMPANY

FUJITSU

HITACHI Inspire the Next

hp

IBM

inspur

NEC

ORACLE

sgi

SUPERMICRO

UNISYS imagine it. done.

5X[1]

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[1] Source: Industry data on Intel® Xeon® Processor 7400 Series based designs shipping today and Intel data on Xeon 7500 designs expected to ship beginning today and in the future. Not all OEM system designs shown. *Other names and brands may be claimed as the property of others

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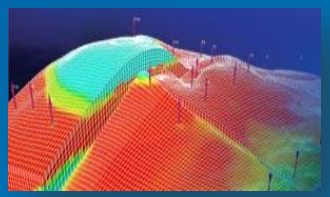
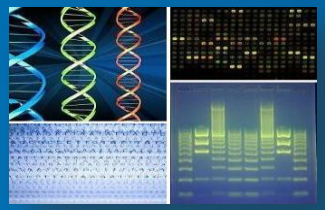
Super Nodes for HPC

FSI

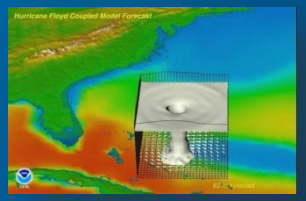
Manufacturing CAE



Energy



Life Science



Weather

Workload Requirements

Maximum Scalability

Large Memory & Cache

Minimize Node to Node Communication

Maximize Density

Transformative Designs on Xeon® 7500

BULL CISCO CRAY THE SUPERCOMPUTER COMPANY DELL hp IBM ORACLE sgi SUPERMICRO

Large Scale Consolidation and Virtualization

2005

20 racks of Intel® Xeon® Single Core Servers

2010

Efficiency Refresh 20:1

1 rack of Intel® Xeon® 7500 Based Servers

Up to **92%** Annual Energy Cost Reduction (estimated)

As Low as **12 Month** Payback (estimated)

– OR –

New Uses

Intel® Xeon® 7500 Based Servers

Mission Critical VMs (>8GB)

Multi-Tier Consolidation

Greater Flexibility

12 month ROI claim estimated based on comparison between 4S Intel® Xeon® MP CPU 3.3Ghz (Single core w/ HT, 1MB L2, 8MB L3, Potomac) and 4S Intel® Xeon® X7560 (8 core, 2.26GHz) based servers. Calculation includes analysis based on performance, power, cooling, electricity rates, operating system annual license costs and estimated server costs. This assumes 42U racks, $0.10 per kWh, cooling costs are 2x the server power consumption costs, operating system license cost of $900/year per server, per server cost of $36,000 based on estimated list prices, and estimated server utilization rates. All dollar figures are approximate. SPECint_rate_base2006* performance and power results are measured for X7560 and Xeon 3.3GHz based servers. Platform power was measured during the steady state window of the benchmark run and at idle. Performance gain compared to baseline was 20x.Baseline platform (measured score of 33.8): Intel server with four MP Intel® Xeon® processor 3.33Ghz (single core w/HT, 1MB L2, 8MB L3), 16GB memory (8x2GB DDR2-400), 2 hard drives, 1 power supply, using Redhat EL 5.3 x86_64 operating system New platform (measured score of 705): Intel internal reference server with four Intel® Xeon® Processor X7560 (24M Cache, 2.26 GHz, 6.40 GT/s Intel® QPI, Intel Hyper-Threading Technology, Intel Turbo Boost Technology), 256GB memory (64x 4GB QR DDR3-1333), 1 hard drive, 2 power supplies, using SuSE* LINUX 11, cpu2006.1.1.ic11.1.linux64.binaries.nov242009.tar.bz2 binaries. Performance tests and ratings are measured using specific computer systems and/or components and reflect the approximate performance of Intel products as measured by those tests. Any difference in system hardware or software design or configuration may affect actual performance. Buyers should consult other sources of information to evaluate the performance of systems or components they are considering purchasing. For more information on performance tests and on the performance of Intel products, visit Intel Performance Benchmark Limitations.

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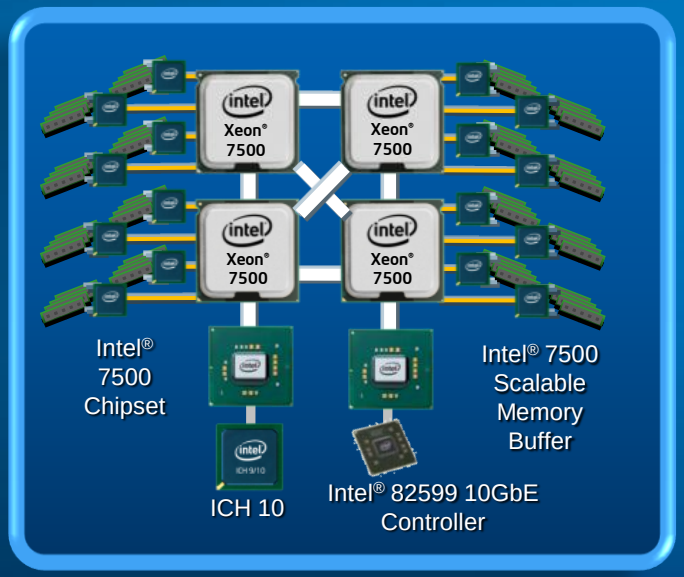
Advanced Reliability Starts with Silicon

>20 New RAS Features in Xeon® 7500 Platforms[1]



Protects Your Data

- Corrupt Data Containment Mode
- Viral Mode
- Intel® QPI Packet Protection via CRC (8bit and 16bit rolling)

Increases Availability

- MCA Recovery
- Intel® SMI Lane Failover
- Intel® SMI Clock Failover
- Intel® SMI Packet Retry
- Intel® QPI Self-Healing
- Intel® QPI Clock Failover
- Intel® QPI Packet Retry
- Single-Core Disable for Fault Resilient Boot
- SDDC plus Random Bit Error Recovery
- Memory Rank Sparing

Minimizes Planned Downtime

- Corrected Machine Check Interrupt (CMCI) with OS Predictive Failure Analysis
- Memory Board Hot Add
- Memory On-lining
- CPU Board Hot Add at Intel® QPI
- OS CPU On-lining
- OS IOH On-lining
- Out-of-band Access to Uncore MCA Registers

[1] Not all Intel® Xeon® Processor 7500 Series based platform RAS features are listed. Please visit www.Intel.com/products/server for a complete list of features.

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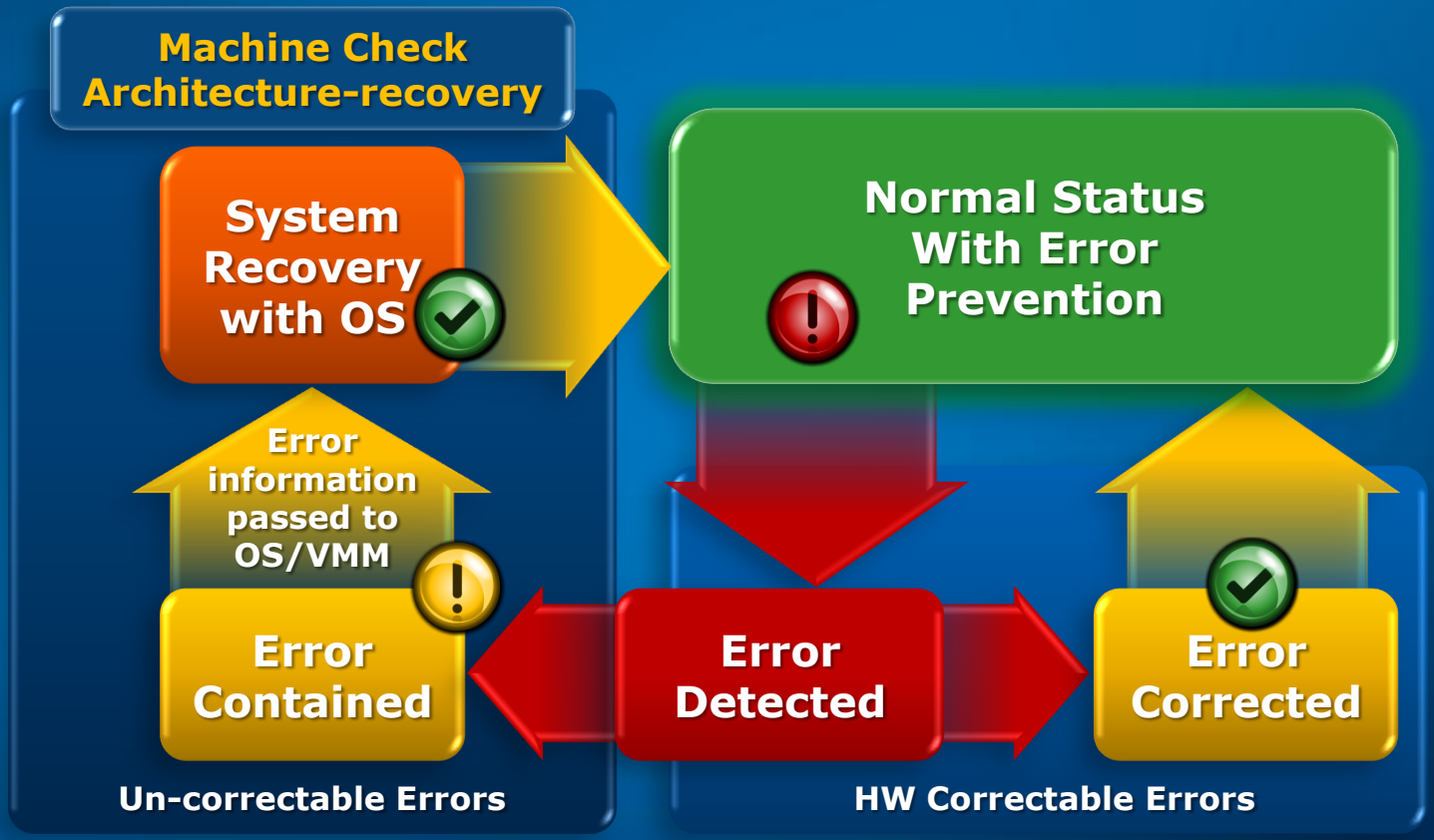
Machine Check Architecture Recovery

First Ever on x86 Servers



Allows Recovery From Otherwise Fatal System Errors

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Catalyst for Mission Critical Ecosystem

Software Vendors Supporting High-End Intel® Xeon® 7500 Features

"With XenApp on the Intel Xeon Processor 7500 Series, we see no barrier whatsoever to running a thousand users per server. We can replace a rack or more of servers with a single server…"

CITRIX®

Simon Crosby, CTO, Data Center and Cloud

"The leadership performance of DB2 on new Intel® Xeon® processor 7500 series based systems is the direct result of the deep collaboration between IBM and Intel, delivering more value …"

IBM

Berni Schiefer, Distinguished Engineer, Information Management Performance and Benchmarks

"The combination of Microsoft's Windows Server 2008 R2, SQL Server 2008 R2, and Intel's Xeon 7500 delivers performance and reliability that was previously only possible on high-priced, power hungry RISC servers and mainframes. Now with the ability to scale up to 256 logical processors…"

Microsoft

Bill Laing, Corporate VP, Windows Server & Cloud Division

"SUSE Linux Enterprise 11 is highly tuned for scalable performance on the Intel Xeon processor 7500 series. With support for up to 2,048 cores…and a range of reliability features to recover smoothly, we expect to see fast adoption as an alternative to expensive proprietary platforms."

Novell®

Carlos Montero-Luque, VP, Business and Product Management, Open Platform Solutions (Linux)

"We've worked very hard to make the Oracle database run extremely efficiently on the Intel platform. With the new Xeon processors, we expect customers to be able to run bigger databases, with much better response times, while paying a lot less."

ORACLE®

Juan Loaiza, Senior Vice President, Systems Technology

"Red Hat Enterprise Linux has a well-deserved reputation for reliability, availability, serviceability, scalability and performance and is designed to take advantage of these new capabilities. We believe the combination of Red Hat and Intel are a game-changer for Mission-Critical computing."

redhat.

Paul Cormier, Exec VP & President, Products and Technologies

"The new levels of reliability and performance delivered by the Intel Xeon processor 7500 series are impressive. We expect customers to benefit when used together with innovative SAP enterprise solutions."

SAP®

Vishal Sikka, Member of The Executive Board of SAP AG

"The combination of this new processor family and VMware vSphere™ reduces operational costs and brings higher levels of security and availability to large, business-critical applications running in virtualized environments"

vmware®

Stephen Herrod, CTO and Senior VP, Research and Development

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Business Intelligence Spiral

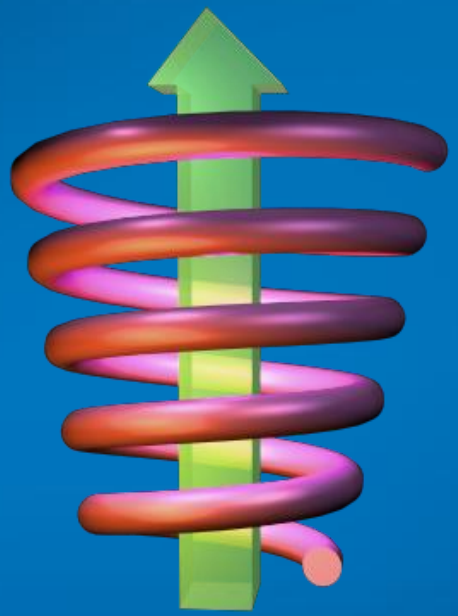
Increasing Demands

Massive Data Volume
Click Streams, Sensors, RFID, etc.

Rich Data Types

Real-Time
Forecasting & Insight

Continuous Analytics



Xeon® 7500 Delivers

Massive Parallelism
16 Threads/socket

Huge In-Memory DB's
1TB in 4S, 2TB in 8S

Ultra-Scalability

Advanced Reliability

"IBM has demonstrated InfoSphere Warehouse scaling linearly up to 10TB of XML data on IBM System Storage DS8700 - with no impact to query response times. This kind of efficient scalability improves the economics of solving complex business problems with IBM analytics solutions on Intel Architecture."

IBM

Salvatore Vella, VP Development,
Database Servers and Data Warehousing

Fujitsu PRIMEQUEST* 1800E servers now enable multiple users to run queries of 2.5 billion operational data records in record time with the BI capabilities of SAP NetWeaver*.
SAP BI-Datamart Benchmark, 854,649 query navigation steps.

FUJITSU SAP

World Record Result!

New Era for Real Time Business Intelligence

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[1] Please see backup for performance configuration details.
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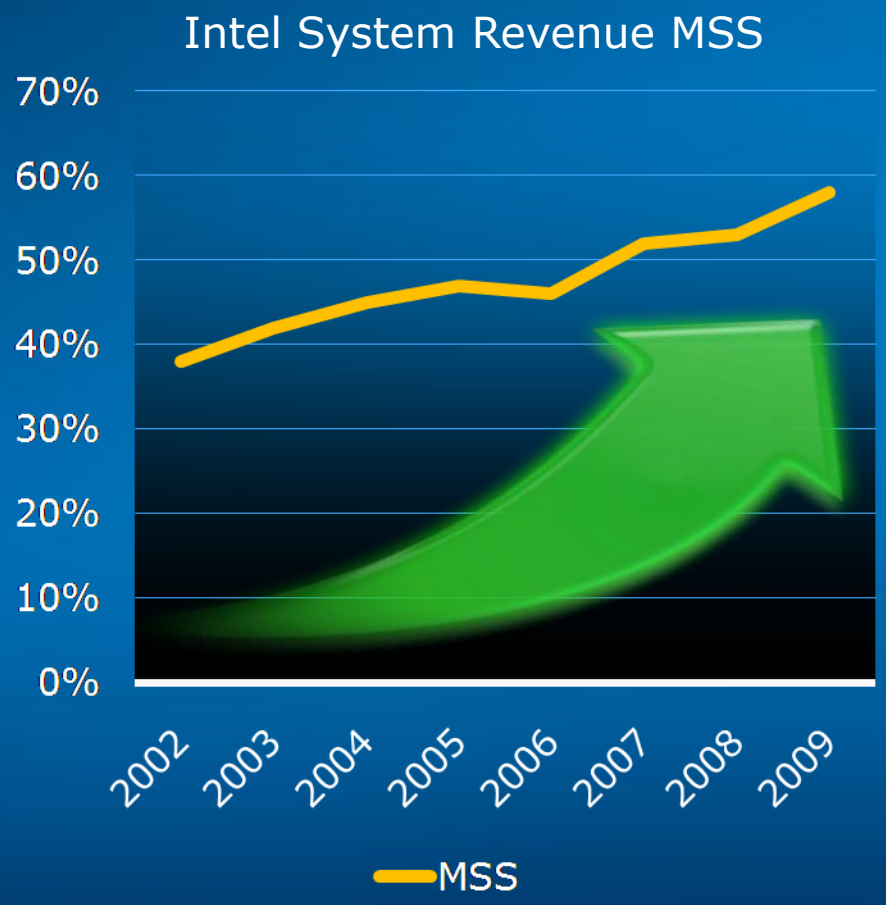
Catalyst for Mission Critical Transformation



Source: IDC's Server Tracker Q4'09 , Feb 2010

- Intel® Xeon® 7500 Delivers
  - Unmatched TCO
  - Scalability and Reliability
  - Ecosystem Support

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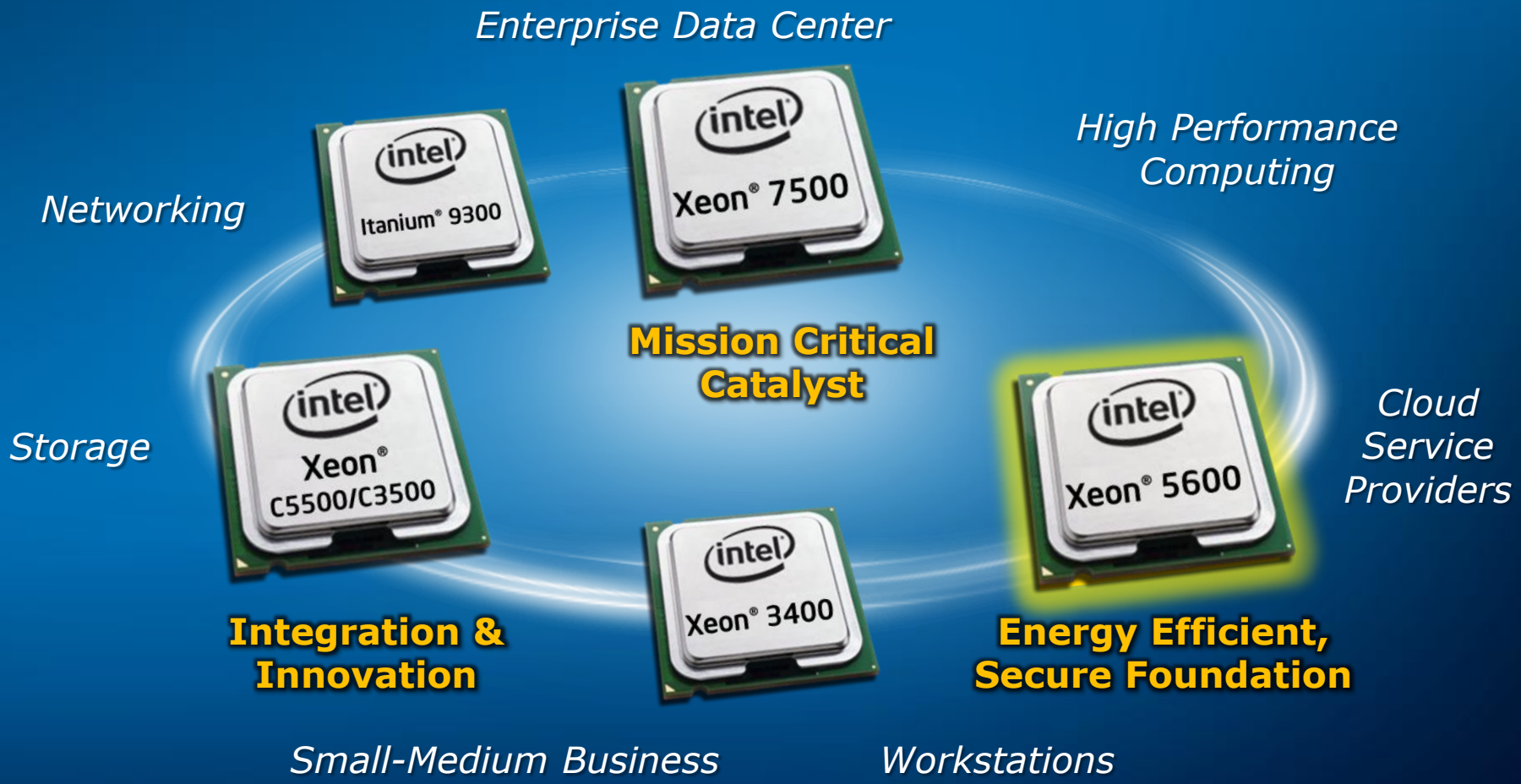
Capping Off Intel's Largest Ever Data Center Refresh



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2010: 2-socket Platform Refresh

Intel® Xeon® Processor 5600 Series

- **Better Energy Efficiency**
  - Up to 30% lower power[1]
  - Up to 15:1 consolidation[3]
- **More Performance**
  - Up to 60% increase[2]
- **Secure Virtualization**
  - Encrypt today, measure and enforce tomorrow

1 Source: Internal Intel estimates comparing Xeon® X5570 vs. L5640 SKUs using SPECint_rate_2006.

2 Source: Internal Intel measurements for Xeon® X5680 vs. Xeon® X5570 on BlackScholes*.

[3] Source: Intel estimates as of Jan 2010. Performance comparison using SPECjbb2005 bops (business operations per second). Results have been estimated based on internal Intel analysis and are provided for informational purposes only. Any difference in system hardware or software design or configuration may affect actual performance. For detailed calculations, configurations and assumptions refer to the legal information slide in backup.

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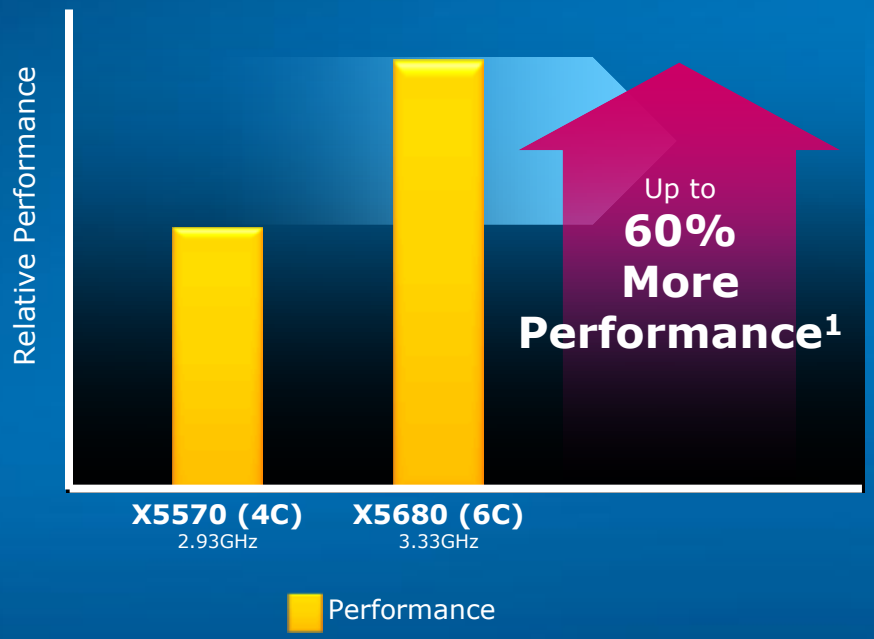
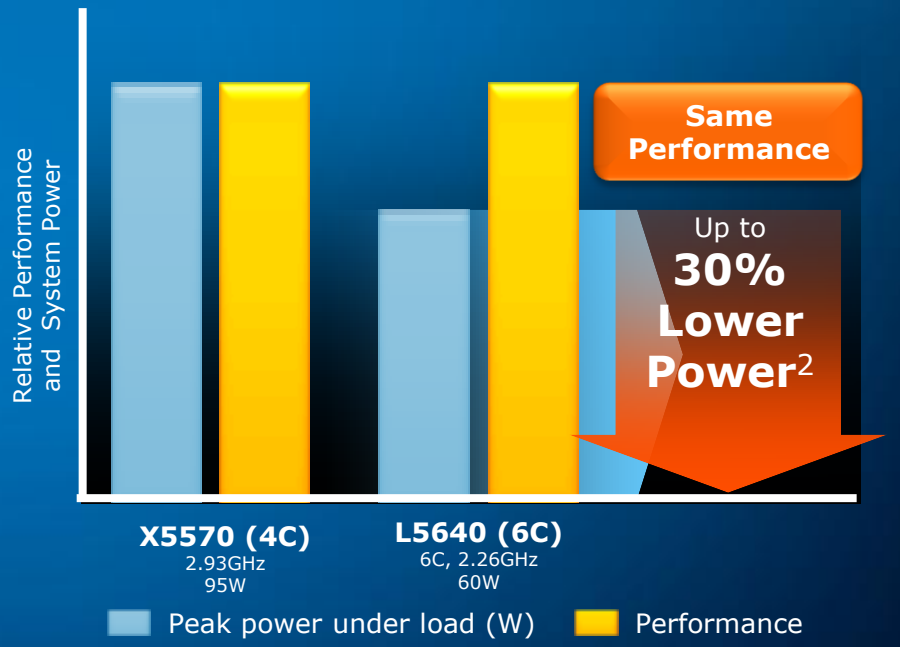
Greater Data Center Efficiency
with Intel® 32nm Logic Technology

Xeon® X5680 vs. Xeon® X5570
Performance Comparison



Xeon® L5640 vs. Xeon® X5570
Power and Performance Comparison



Delivering Leading Performance and Energy Efficiency

1 Source: Internal Intel measurements comparing Xeon X5680 vs. X5570 SKUs using Black Scholes.
2 Source: Fujitsu Performance measurements comparing Xeon L5650 vs X5570 SKUs using SPECint_rate_base2006
http://docs.ts.fujitsu.com/dl.aspx?id=0140b19d-56e3-4b24-a01e-26b8a80cfe53
http://docs.ts.fujitsu.com/dl.aspx?id=4af74e10-24b1-4cf8-bb3b-9c4f5f177389
See backup for system configurations.

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Intel® Xeon® 5600 Performance Publications

VMmark*

35.83 @ 26 tiles (+42%)
ESX 4

SAP-SD* 2-Tier

4,860 SD Users (+27%)
SAP* ERP 6.0

SPECpower*_ssj2008
(single-node server)

2,927 ssj_ops/watt (+42%)
IBM J9* JVM

SPECint*_base2006

Base Score: 39 (+10%)

SPECpower*_ssj2008
(multi-node server)

3,038 ssj_ops/watt (+31%)
IBM J9* JVM

SPECjAppServer*2004

5185.4 JOPS (+30%)
Oracle WebLogic* Server

SPECjEnterprise*2010

1,599.5 EjOPS (+33%)

SPEComp*Mbase2001

52,314 base score (+20%)

SPEComp*Lbase2001

278,603 score

SPECWeb*2005

104,422 score (+25%)
Rock Web* Server

Over NINE New x86 2S Server & Workstation World Records!

Percentage gains shown are based on comparison to Xeon 5500 series; Performance results based on published/submitted results as of March 30, 2010. Platform configuration details are available at http://www.intel.com/performance/server/xeon/summary.htm *Other names and brands may be claimed as the property of others Performance tests and ratings are measured using specific computer systems and/or components and reflect the approximate performance of Intel products as measured by those tests. Any difference in system hardware or software design or configuration may affect actual performance. Buyers should consult other sources of information to evaluate the performance of systems or components they are considering purchasing. For more information on performance tests and on the performance of Intel products, visit Intel Performance Benchmark Limitations

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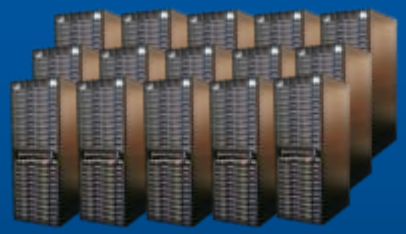
2-Socket Server Refresh in 2010

2005



15 Racks of Intel® Xeon® Single Core Servers

2010

Efficiency Refresh 15:1

1 rack of Intel® Xeon® 5600 Based Servers

Up to 95% Annual Energy Cost Reduction (estimated)

As Low as 5 Month Payback (estimated)

– OR –

Performance Refresh 1:1

15 racks of Intel® Xeon® 5600 Based Servers

Up to 15x Performance

8% Annual Energy Costs Reduction (estimated)

Source: Intel estimates as of Jan 2010. Performance comparison using SPECjbb2005 bops (business operations per second). Results have been estimated based on internal Intel analysis and are provided for informational purposes only. Any difference in system hardware or software design or configuration may affect actual performance. For detailed calculations, configurations and assumptions refer to the legal information slide in backup.

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The Cost of Waiting in 2010

Approximately 1 million servers have had their replacement delayed by a year.

Source: Gartner http://www.gartner.com/it/page.jsp?id=1209913

Monthly costs for NOT refreshing 50 Single-core Servers with 3 Intel® Xeon® 5600 Servers

Software support:	**$5,092** *per month*
Utility costs:	**$1,858** *per month*
Warranty costs:	**$3,125** *per month*

up to **$10,000** *per month*[1]

[1] Monthly Savings in utility and SW support costs determined by comparing the incremental costs associated with not refreshing 50 older single-core servers purchased back in 2005 vs. refreshing on an approximate 15:1 ratio with a Xeon 5680-based servers in Year 1. Warranty cost assumes $750/year per server if purchased after the initial OEM 3-year warranty period has expired. Actual total cost is $10,075. Source: Consolidation ratio calculated using the Xeon Server Refresh Savings Estimator (www.intel.com/go/xeonestimator) and uses publicly available RHEL OS support costs, default utility settings, and SPECint*_rate_base2006 performance and power data for the Xeon® X5680 as found in the backup. See the backup for system configurations.

intel Xeon inside

Sponsors of Tomorrow. intel

Foundation for a Secure Infrastructure

New Security Features with Intel® Xeon® Processor 5600 series

Intel® Advanced Encryption Standard New Instructions (Intel AES-NI)

ORACLE

Microsoft

McAfee

Increases Encryption Performance to Enable Broad Usage

Ready for Today

Intel® Trusted Execution Technology (Intel TXT)

vmware

Parallels

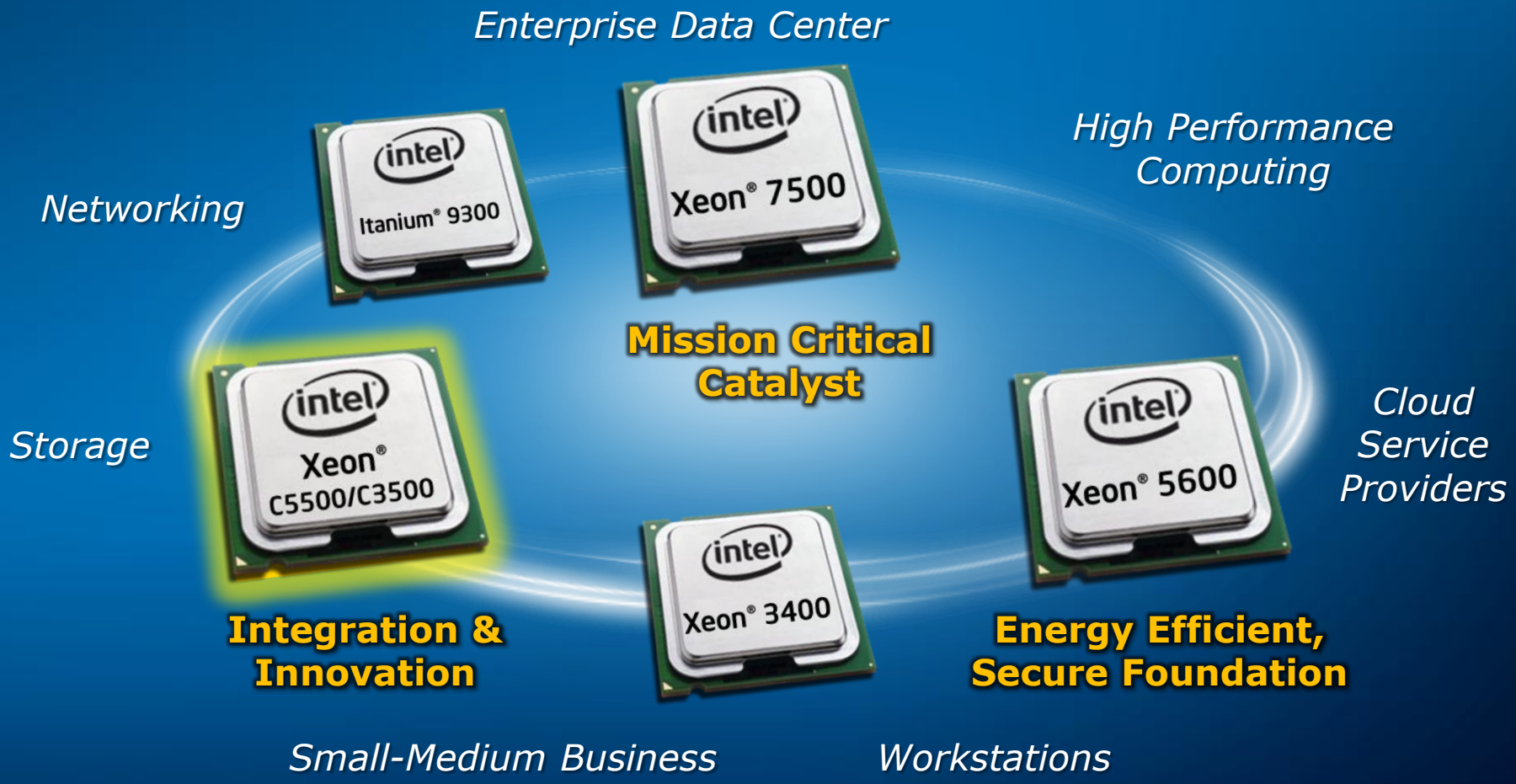
HyTrust

Prevents the Insertion of Malicious Software Prior to VMM Launch

Ready for Tomorrow

No computer system can provide absolute security under all conditions. Intel® Trusted Execution Technology (Intel® TXT) requires a computer system with Intel® Virtualization Technology, an Intel TXT-enabled processor, chipset, BIOS, Authenticated Code Modules and an Intel TXT-compatible measured launched environment (MLE). The MLE could consist of a virtual machine monitor, an OS or an application. In addition, Intel TXT requires the system to contain a TPM v1.2, as defined by the Trusted Computing Group and specific software for some uses. For more information, see here. *Other names and brands may be claimed as the property of others

Capping Off Intel's Largest Ever Data Center Refresh



Xeon inside
Sponsors of Tomorrow.

"Nehalem Effect" in Storage and Networking

Xeon® 7500		Compute Intensive Storage Applications, Data Deduplication
Xeon® 5500 **Xeon® 5600**		Maximum Performance and I/O Connectivity, Encryption and CRC
Xeon® C5500 **Xeon® C3500**		Optimum Performance Density, Integrated Storage and Networking Tech.

Xeon Emerging as Essential Data Center Ingredient

Storage and Networking Vendors Adopting Intel Architecture

Over 100 Intel® Xeon® Designs

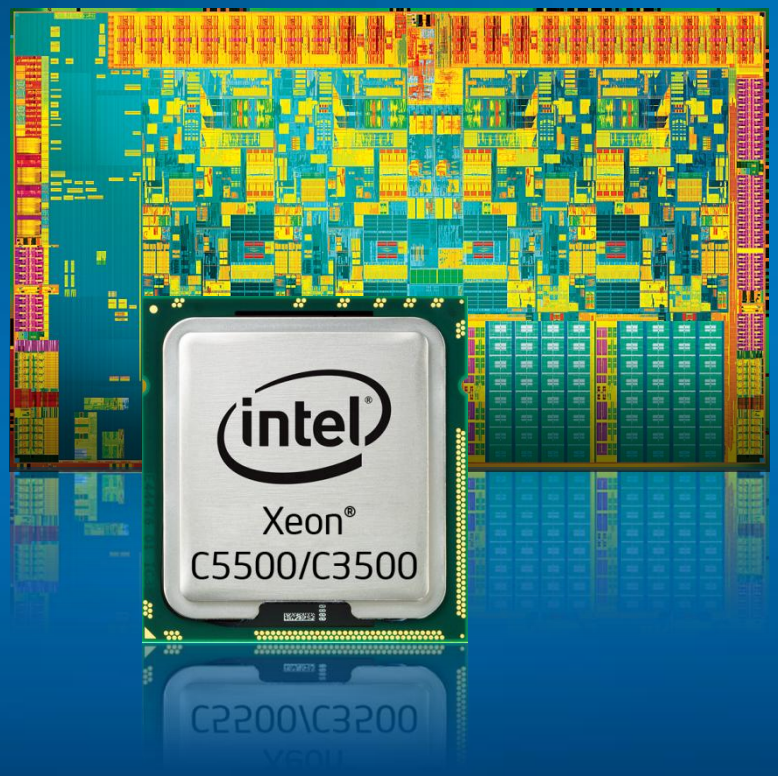
Excellent Progress Across the Board

*Other names and brands may be claimed as the property of others

Sponsors of Tomorrow.™ intel

2010: Essential Storage and Networking Ingredient

Intel® Xeon® Processor C5500/C3500 Series



- **Scalability from 1-4 cores**
  - 2S for multiple design options
- **High Integration**
  - Improved performance density
- **Better Energy Efficiency**
  - Up to 27W reduction vs. previous generation[1]

1 Source: Intel estimate based on TDP and removal/integration of Intel 5520 chipset features on previous generation embedded platform.

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Summary: Foundation for the Next Generation Data Center

Enterprise Data Center

High Performance Computing

Networking

Mission Critical Catalyst

Storage

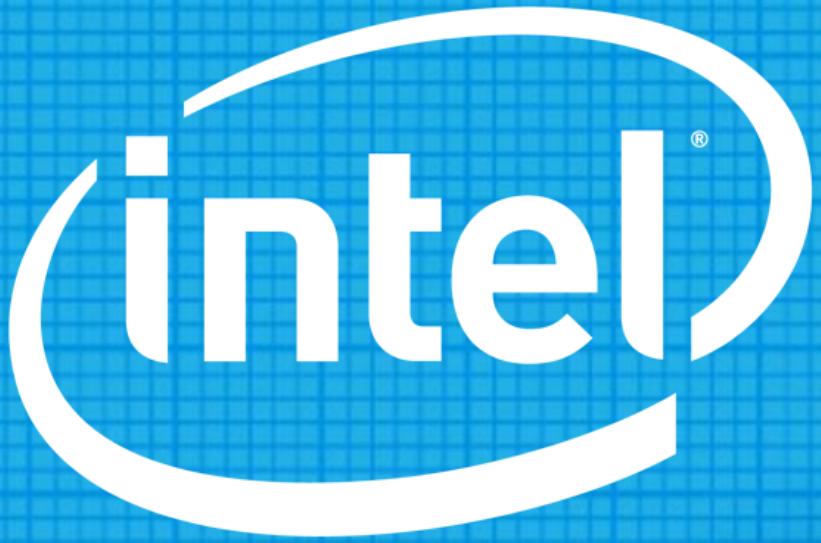
Cloud Service Providers

Integration & Innovation

Energy Efficient, Secure Foundation

Small-Medium Business

Workstations



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Intel® Hyper-Threading Technology (Intel® HT Technology) requires a computer system with a processor supporting Intel® HT Technology and an Intel® HT Technology-enabled chipset, BIOS, and operating system. Performance will vary depending on the specific hardware and software you use. For more information including details on which processors support Intel® HT Technology, see www.intel.com/products/ht/hyperthreading_more.htm.

Intel® Turbo Boost Technology requires a Platform with a processor with Intel Turbo Boost Technology capability. Intel Turbo Boost Technology performance varies depending on hardware, software and overall system configuration. Check with your platform manufacturer on whether your system delivers Intel Turbo Boost Technology. For more information, see www.intel.com/technology/turboboost.

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All products, computer systems, dates, and figures specified are preliminary based on current expectations, and are subject to change without notice.

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Backup

intel Xeon inside
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12 Month Single Core Refresh ROI Claim

- 12 month ROI claim estimated based on comparison between 4S Intel® Xeon® MP CPU 3.3Ghz (Single core w/ HT, 1MB L2, 8MB L3, Potomac) and 4S Intel® Xeon® X7560 (8 core, 2.26GHz) based servers. Calculation includes analysis based on performance, power, cooling, electricity rates, operating system annual license costs and estimated server costs. This assumes 42U racks, $0.10 per kWh, cooling costs are 2x the server power consumption costs, operating system license cost of $900/year per server, per server cost of $36,000 based on estimated list prices, and estimated server utilization rates. All dollar figures are approximate. SPECint_rate_base2006* performance and power results are measured for X7560 and Xeon 3.3GHz based servers. Platform power was measured during the steady state window of the benchmark run and at idle. Performance gain compared to baseline was 20x.
  - Baseline platform (measured score of 33.8): Intel server with four Intel® Xeon® MP CPU 3.3Ghz (single core w/HT, 1MB L2, 8MB L3) processors, 16GB memory (8x2GB DDR2-400), 2 hard drives, 1 power supply, using Redhat EL 5.3 x86_64 operating system
  - New platform (measured score of 709): Intel internal reference server with four Intel® Xeon® Processor X7560 (24M Cache, 2.26 GHz, 6.40 GT/s Intel® QPI, Intel Hyper-Threading Technology, Intel Turbo Boost Technology), 128GB memory (64x 2GB QR DDR3-1333), 1 hard drive, 2 power supplies, using SuSE* LINUX 11, cpu2006.1.1.ic11.1.linux64.binaries.nov242009.tar.bz2 binaries.
- Performance tests and ratings are measured using specific computer systems and/or components and reflect the approximate performance of Intel products as measured by those tests. Any difference in system hardware or software design or configuration may affect actual performance. Buyers should consult other sources of information to evaluate the performance of systems or components they are considering purchasing. For more information on performance tests and on the performance of Intel products, visit Intel Performance Benchmark Limitations.

Source: Results have been estimated based on internal Intel analysis and are provided for informational purposes only. Any difference in system hardware or software design or configuration may affect actual performance.

intel Xeon inside
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Business Intelligence Spiral
SAP BI-Datamart System Configuration Details

World record claim based on performance results published/submitted results as of March 26, 2010. See http://www.intel.com/performance/server/xeon_mp/summary.htm for the full list of record benchmarks.

SAP* BI Data Mart Standard Application Benchmark details:

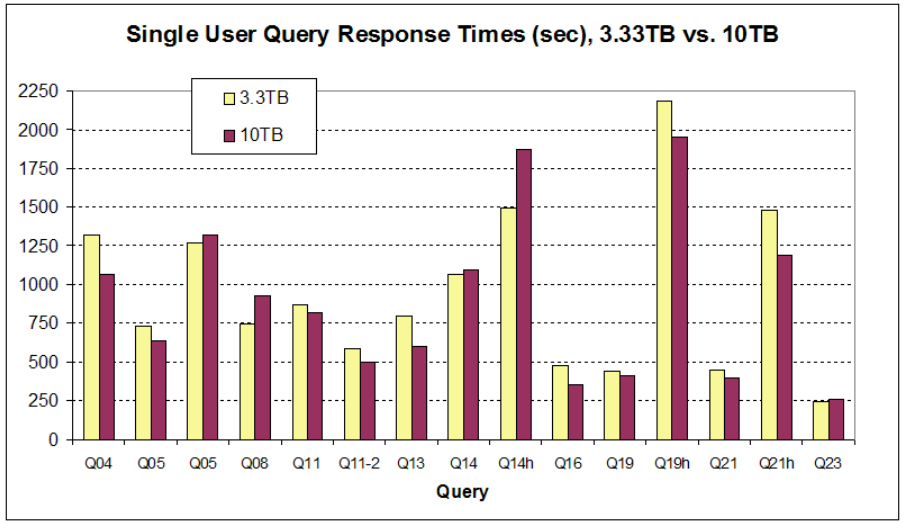
4S Intel® Xeon® processor X7560 based platform details

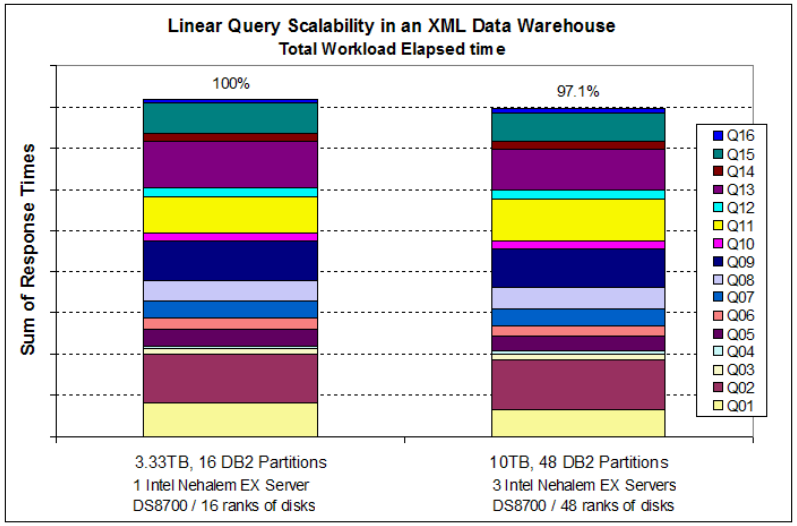
- Fujitsu PRIMERGY* RX600S5 server platform with four Intel® Xeon® processors X7560 (24M cache, 2.26 GHz, 6.40GT/s Intel® QPI), 128GB memory (64x 2GB DDR3-1066 REG ECC), SUSE* LINUX Enterprise Server 10, Oracle* 11g Real Application Clusters (RAC), SAP NetWeaver* 7.0 (non-Unicode). Referenced as published at a score of 854,649 query navigation steps. The SAP certification number was not available at press time and can be found at the following Web page: www.sap.com/benchmark.

Performance tests and ratings are measured using specific computer systems and/or components and reflect the approximate performance of Intel products as measured by those tests. Any difference in system hardware or software design or configuration may affect actual performance. Buyers should consult other sources of information to evaluate the performance of systems or components they are considering purchasing. For more information on performance tests and on the performance of Intel products, Go to: http://www.intel.com/performance/resources/benchmark_limitations.htm.

Business Intelligence Spiral
IBM InfoSphere* Results Details

- Scaled from 1 → 3 NHM-EX nodes
  - 1.83B → 5.5B XML documents
  - 3.33TB → 10TB XML data
- Complex financial transaction decision model with 16 SQL/XML queries
  - Less than 3% query performance degradation up to 10TB!





intel Xeon inside
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Business Intelligence Spiral
IBM InfoSphere* System Configuration Details

- 3 IBM System x* 3850 X5 servers
  - Four Intel® Xeon® processors X7560 (24M Cache, 2.26GHz, 6.4GT/s Intel QPI) each for total of 96 cores (192 threads)
  - 384 GB RAM
  - Red Hat* Enterprise Linux 5.4
  - 1 test driver to drive workload
- IBM* Storage Systems DS8700
  - 384 disks, direct connect to the 3 servers
- IBM* DB2 v97FP1
  - 48 database partitions.
  - 2 cores/partition
  - 8 disks/partition (4 disks/core)

Performance tests and ratings are measured using specific computer systems and/or components and reflect the approximate performance of Intel products as measured by those tests. Any difference in system hardware or software design or configuration may affect actual performance. Buyers should consult other sources of information to evaluate the performance of systems or components they are considering purchasing. For more information on performance tests and on the performance of Intel products, Go to:
http://www.intel.com/performance/resources/benchmark_limitations.htm.

Performance Claim Backup

- Up to 1.6x performance compared to Xeon 5500 series claim supported by a CPU intensive benchmark (Blackscholes). Intel internal measurement. (Feb 25, 2010)
  - Configuration details: - Blackscholes*
  - Baseline Configuration and Score on Benchmark:- Intel pre-production system with two Intel® Xeon® processor X5570 (2.93 GHz, 8 MB last level cache, 6.4 GT/sec QPI), 24GB memory (6x4GB DDR3-1333), 4 x 150GB 10K RPM SATA RAID0 for scratch, Red Hat* EL 5 Update 4 64-bit OS. Source: Intel internal testing as of February 2010. SunGard v3.0 source code compiled with Intel v11.0 compiler. Elapsed time to run benchmark: 18.74 seconds.
  - New Configuration and Score on Benchmark:- Intel pre-production system with two Intel® Xeon® processor X5680 (3.33 GHz, 12 MB last level cache, 6.4 GT/sec QPI), 24GB memory (6x4GB DDR3-1333), 4 x 150GB 10K RPM SATA RAID0 for scratch, Red Hat* EL 5 Update 4 64-bit OS. Source: Intel internal testing as of February 2010. SunGard v3.0 source code compiled with Intel v11.0 compiler. Elapsed time to run benchmark: 11.51 seconds.
- Up to 40% higher performance/watt compared to Intel® Xeon® Processor 5500 Series claim supported by performance results on a server side java benchmark in conjunction with power consumption across a load line. Intel internal measurement (Jan 15, 2010)
  - Baseline platform: Intel preproduction server platform with two Quad-Core Intel® Xeon® processor X5570, 2.93 GHz, 8MB L3 cache, 6.4QPI, 8GB memory (4x2GB DDR3-1333), 1 PSU, Microsoft Windows Server 2008 Enterprise SP2. Intel internal measurement as of January 15,2010.
  - New platform: Intel preproduction server platform with two six-Core Intel® Xeon® processor X5670, 2.93 GHz, 12MB L3 cache, 6.4QPI, 8GB memory (4x2GB DDR3-1333), 1 PSU, Microsoft Windows Server 2008 Enterprise SP2. Intel internal measurement as of January 15, 2010.
- Intel® Xeon® processor 5600 series with Intel microarchitecture Nehalem delivers similar performance as previous-generation servers but uses up to 30 percent less power
  - Baseline Configuration and Score on Benchmark: Fujitsu PRIMERGY RX300 S5 system with two Intel® Xeon® processor sX5570 (2.93 GHz, 8MB L3, 6.4 GT/s, Quad-core, 95W TDP), BIOS rev. R1.09 , Turbo Enabled, HT Enabled, NUMA Enabled, 5 x Fans, 24 GB (6x4GB DDR3-1333 DR registered ECC), 1 x Fujitsu MBD2147RC 147GB 10K RPM 2.5" SAS HDD, 1x800W PSU, SLES 11 (X86_64) Kernel 2.6.27.19-5-default. Source: Fujitsu Performance Lab testing as of Mar 2010. SPECint_rate_base2006 score: 250. http://docs.ts.fujitsu.com/dl.aspx?id=0140b19d-56e3-4b24-a01e-26b8a80cfe53
  - New Configuration and Score on Benchmark: Fujitsu PRIMERGY RX300 S6 system with two Intel® Xeon® processors L5640 (2.26 GHz, 12MB L3, 5.86 GT/s, Hex-core, 60W TDP), BIOS rev R1.00A , Turbo Enabled, HT Enabled, NUMA Enabled, 5 x Fans, 24 GB (6x4GB DDR3-1333 LV DR registered ECC), 1 x Fujitsu MBD2147RC 147GB 10K RPM 2.5" SAS HDD, 1x800W PSU, SLES 11 (X86_64) Kernel 2.6.27.19-5-default. Source: Fujitsu Performance Lab testing as of Mar 2010. SPECint_rate_base2006 score: 250 http://docs.ts.fujitsu.com/dl.aspx?id=4af74e10-24b1-4cf8-bb3b-9c4f5f177389

Performance Summary Backup

Performance Summary and World Record Benchmarks

42% gain on Single Node server SPECpower*_ssj2008 over previous generation processors supported by the following:

- Baseline configuration and score: Referenced as published at 2,053 overall ssj_ops/watt www.spec.org/power_ssj2008/results/res2009q4/power_ssj2008-20091023-00205.html.
- New configuration and score: IBM x3650 M3* was configured with the Intel Xeon processor X5670 (2.93GHz, 256KB L2 cache per core, 12MB L3 cache per processor—12 cores/2 chips/6 cores per chip) and 12GB of PC3L-10600R (6 x 2GB) memory and ran IBM Java 6 Runtime Environment* and Microsoft Windows Server 2008* R2 Enterprise x64 Edition. Score: 2,927 overall ssj_ops/watt. Submitted and in review at www.spec.org

33% gain on SPECjEnterprise2010 over previous generation processors supported by the following:

- Baseline Configuration and Score: 1194. 8 EjOPS http://www.spec.org/jEnterprise2010/results/res2010q1/jEnterprise2010-20100210-00005.html
- New Configuration and Score: 1599.5 EjOPS IBM BladeCenter HS22 server was configured with the Intel® Xeon® Processor X5670 (2.93GHz, 256KB L2 cache per core, 12MB L3 cache per processor—12 cores/2 chips/6 cores per chip) and 24GB of memory, and ran WebSphere Application Server V7, IBM J9 Java™6 Runtime Environment, and Novell SUSE Linux® Enterprise Server 10 SP3. An IBM System x3650 M2 system was used as the database server, which used two quad-core Intel Xeon X5570 (2.93GHz) processors and ran IBM DB2 9.7 Enterprise Server and Novell SUSE Linux Enterprise Server 10 SP2. Submitted and in review at www.spec.org

27% boost on SAP enhancement package 4 for SAP ERP 6.0 Unicode over previous generation supported by the following:

- Baseline Configuration and Score: 3800 Number of SAP SD benchmark users http://download.sap.com/download.epd?context=40E2D9D5E00EEF7C259FFE6AB54898440C838DED66684AFD7D58B23A917F4C0D
- New Configuration and Score : Fujitsu PRIMERGY RX300 S6 system with two Intel® Xeon® processor X5680 (3.33 GHz, 12MB L3, 6.4 GT/s, Hex-core, 130W TDP), 88 GB main memory, Windows Server 2008 Enterprise Edition, SQL Server 2008, SAP ERP 6.0 (Unicode). Source: www.sap.com Score: 4,860 Number of SAP SD benchmark users (See www.sap.com/benchmark for Certificate #2010007).

10% gain on SPECint_base2006 over previous generation supported by the following:

- Baseline Configuration and Score: 35.4 base score Referenced as published at: http://www.spec.org/cpu2006/results/res2010q1/cpu2006-20100209-09620.html
- New Configuration and Score: 39 base score Referenced as published at: http://www.spec.org/cpu2006/results/res2010q1/cpu2006-20100301-09740.html

42% gain on VMmark* over previous generation supported by the following:

- Baseline Configuration and Score: Cisco result referenced as published at 25.06 at 17 tiles. For more information see www.vmware.com/files/pdf/vmmark/VMmark-Cisco-2010-01-12-B200M1.pdf
- New Configuration and Score on Benchmark:- Cisco UCS B250 M2 platform with two Intel® Xeon® processor X5680 (3.33 GHz, 12MB L3, 6.4 GT/s, 6-core, 130W TDP), Turbo Enabled, HT Enabled, 192GB memory (48x4GB DDR3 1333), EMC CLARiiON CX4-240 storage system with 25x73GB SSD, 20 x 450GB 15K RPM, 5 x 300GB 15K RPM, VMware vSphere 4,0 U1 Source: www.cisco.com. Score of 35.83@26 tiles. For more information see: www.cisco.com/en/US/prod/ps10265/at_work_promo.html#~industry_benchmarks.

Performance Summary Backup

World Record Benchmarks (continued)

31% gain on Multi-Node server SPECpower*_ssj2008 over previous generation supported by the following:

- Baseline Configuration and Score: 2,316 overall ssj_ops/watt
- http://www.spec.org/power_ssj2008/results/res2009q4/power_ssj2008-20090908-00195.html
- New Configuration and Score: IBM dx360 M3 system with the Intel® Xeon® Processor X5670 (2.93GHz with 256KB L2 cache per core and 12MB L3 cache per processor—2 chips/12 cores/6 cores per chip), 12GB of memory, one 50GB solid state drive, and IBM J9 Java 6 (using a 1500MB heap), and Microsoft® Windows® Server 2008 R2 Datacenter Edition2. Source: IBM testing as of Mar 2010. SPECpower_ssj2008 score: 3,038 overall ssj_ops/watt. Submitted and in review at www.spec.org

25% boost on SPECweb2005 over previous generation supported by the following:

- Baseline Configuration and Score: SPECweb2005 Score 83,198
- http://www.spec.org/osg/web2005/results/res2009q4/web2005-20091202-00144.html
- Fujitsu PRIMERGY TX300 S6 system with two Intel® Xeon® processors X5680 (3.33 GHz, 12MB L3, 6.4 GT/s, Hex-core, 130W TDP), Turbo Enabled, HT Enabled, NUMA Enabled, 96 GB (12x8GB DDR3-1333 DR registered ECC), 8 x Seagate 73GB 15K RPM 3.5" SAS HDD (internal) plus 48 x Seagate 146GB 15K RPM 3.5" SAS HDD (storage subsystem), Red Hat Enterprise Linux 5.3 (2.6.18-128.el5 x86_64), Accoria Networks Rock Web Server v1.4.8 (x86_64). Source: Fujitsu Performance Lab testing as of Mar 2010. SPECweb2005 score: 104422 (SPECweb2005_Banking = 162000, SPECweb2005_Ecommerce = 177000, SPECweb2005_Support = 88000)
- http://docs.ts.fujitsu.com/dl.aspx?id=2ce10d43-bc0a-4479-bd2b-a67387d57959

20% gain on SPECompM*base2001 & 17% gain on SPECompL*base2001 over previous generation supported by the following:

- Baseline Configuration and Score: http://www.spec.org/omp/results/res2009q2/omp2001-20090413-00350.html
- http://www.spec.org/omp/results/res2009q2/omp2001-20090413-00349.html
- New Configuration and Score: Cisco UCS B200 M2 platform with two Intel® Xeon® processor X5680 (3.33 GHz, 12MB L3, 6.4 GT/s, 6-core, 130W TDP), Turbo Enabled, HT Enabled, 48 GB (12x4GB DDR3-1333 registered ECC), 1x73GB 15K RPM SAS HDD, RHEL 5.4 Operating system, SPEC binaries were built with Intel Compiler 11.1. Source: Cisco internal measurement as of March 2010. SPECompMbase2001 score of 52,314;SPEC ompLbase2001 score of 278,603 or more information see: www.cisco.com/en/US/prod/ps10265/at_work_promo.html#~industry_benchmarks.

30% gain on SPECjAppServer2004 over previous generation supported by the following:

- Baseline Configuration and Score: 3975.13 JOPS@Standard http://www.spec.org/osg/jAppServer2004/results/res2009q1/jAppServer2004-20090310-00128.html
- New Configuration and Score: Cisco UCS C250 M2 platform with two Intel® Xeon® processor X5680 (3.33 GHz, 12MB L3, 6.4 GT/s, 6-core, 130W TDP), Turbo Enabled, HT Enabled, H/W Prefetcher Disabled, Adj. Cache Line Prefetch Disabled, DCU Prefecher Disabled, DCU IP Prefetcher Disabled. 96 GB (24x4GB DDR3-1333 registered ECC), 2x73GB 15K RPM SAS HDD, Oracle Enterprise Linux 5 Update 3 x86_64, Oracle WebLogic Server Standard Edition Release 10.3.3, Oracle JRockit(R) 6.0 JDK (R28.0.0-587) (Linux x86 64bit). EMC CLARiiON CX4-240 storage system with 60 x 450GB 15K RPM. Source: Result submitted to www.spec.org as of Feb 24, 2010. 5,185.45 SPECjAppServer2004 JOPS@Standard

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5 Month Single Core Refresh ROI Claim

- 5 month ROI claim estimated based on comparison between 2S Single Core Intel® Xeon® 3.80 with 2M L2 Cache and 2S Intel® Xeon® X5680 based servers. Calculation includes analysis based on performance, power, cooling, electricity rates, operating system annual license costs and estimated server costs. This assumes 8kW racks, $0.10 per kWh, cooling costs are 2x the server power consumption costs, operating system license cost of $900/year per server, per server cost of $7200 based on estimated list prices and estimated server utilization rates. All dollar figures are approximate. Performance and power comparisons are based on measured server side java benchmark results (Intel Corporation Feb 2010). Platform power was measured during the steady state window of the benchmark run and at idle. Performance gain compared to baseline was 15x.
  - Baseline platform: Intel server platform with two 64-bit Intel Xeon Processor 3.80Ghz with 2M L2 Cache, 800 FSB, 8x1GB DDR2-400 memory, 1 hard drive, 1 power supply, Microsoft* Windows* Server 2003 Ent. SP1, Oracle* JRockit* build P27.4.0-windows-x86_64 run with 2 JVM instances
  - New platform: Intel server platform with two Intel® Xeon® Processor X5680 (12M Cache, 3.33 GHz, 6.40 GT/s Intel® QPI), 24 GB memory (6x4GB DDR3-1333), 1 SATA 10krpm 150GB hard drive, 1 800w power supply, Microsoft Windows Server 2008 64 bit SP2, Oracle* JRockit* build P28.0.0-29 run with 4 JVM instances
- Performance tests and ratings are measured using specific computer systems and/or components and reflect the approximate performance of Intel products as measured by those tests. Any difference in system hardware or software design or configuration may affect actual performance. Buyers should consult other sources of information to evaluate the performance of systems or components they are considering purchasing. For more information on performance tests and on the performance of Intel products, visit Intel Performance Benchmark Limitations.

Single Core Energy Efficient Refresh Calculation Details

	2005	2010	Delta / Notes
Product	Intel® Xeon® 3.8GHz with 2M cache	Intel® Xeon® X5680 (3.33GHz)	
Performance per Server	1	**Up to 15x increase**	Intel internal measurements on a server side java benchmark as of Feb 2010
Server Power Idle / Active Power	228W idle / 382W active	117W idle / 383W active	Server idle for 16 hours per day and active for 8 hours per day
# Servers needed	315	21	~ 15:1 server consolidation
# Racks needed	15 racks	1 rack	**15:1 Rack Consolidation**
Annual Server kWh	772,904	37,938	**Up to 95% lower energy costs**
Total Annual Energy Costs	$154,581	$7,588	$146,993 electricity cost reduction per year. Assumes $0.10/kWhr and 2x cooling factor
Operating System Licensing Costs	$283,500	$18,900	$264,600 less per year Assumes a RHEL 1yr license at $900 Source www.dell.com as of 12/16/08
Estimated Annual Cost Savings of $411,593			
Cost of new HW	n/a	$151,200	Assume $7,200 per server
Estimated Payback Period of 5 months			