INTELLIGENT PROCESSORS. TRANSFORMING COMPUTING.
INTELLIGENT PROCESSORS.
TRANSFORMING COMPUTING.
Transform
Intel® Xeon® Processor 5500 Series

Pat Gelsinger
Sr. Vice President, Intel Corporation
General Manager, Digital Enterprise Group
Intel® Xeon® Processor 5500 Series: Transforming Computing

Most Important Server Launch Since Pentium® Pro
15 Billion Connected Devices
Design and Discovery

Intelligent Platform
World’s Most Adaptable Server Platform

Intelligent Choice
Delivers Higher Performance, Lower TCO
Estimated 8 Month Payback for Single-core Server Refresh
Intel® Xeon® Processor 5500 Series: Transforming Computing

Most Important Server Launch Since Pentium® Pro
15 Billion Connected Devices
Design and Discovery

Intelligent Platform
World’s Most Adaptable Server Platform

Intelligent Choice
Delivers Higher Performance, Lower TCO
Estimated 8 Month Payback for Single-core Server Refresh
"Intel is days from launching its major offensive into the server market"

April 9, 1996

Established the Standard High Volume Server
The Foundation of the World Wide Web

Annual Server Unit Shipments

IA High Volume Server
Standards
Software

The Internet Today: 3rd Generation

Ubiquitous

Many

Researchers
Mainframes
Servers, PC's
Cell Phones

*Source: IDC Worldwide Server Tracker, updated 04 2008*
Evolving to the Embedded Internet

15B Devices

Requirements:
- Dynamic
- Efficient
- Scalable Infrastructure

Timeline:
- Mainframes
- Client/Server
- Web
- Cloud Architecture

Terms:
- Pervasive
- Ubiquitous
- Many
- Researchers
Next Gen of High Performance Computing
Transforming Design and Discovery

Design Smarter

Simulation

Analysis

Make New Discoveries

NASA Ames will develop a computational system with one PetaFLOPs peak performance in 2009. “Such a monumental increase in performance will help fulfill NASA’s increasing need for computing capacity...for future missions.”
S. Pete Worden, Ames Director

Top Performing Manufacturers:
• Get product to market 58 days faster
• Have 48% lower prototyping costs

“Scinet has an insatiable demand for performance... investigating the forces that govern the universe. The clusters based on the new Intel® Xeon® 5500 series processor keep us on the leading edge... to enable new discoveries.”
Dr. Chris Loken, Chief Technology Officer

Source: Aberdeen Group
Intel® Xeon® Processor 5500 Series: Transforming Computing

Most Important Server Launch Since Pentium® Pro
15 Billion Connected Devices
Design and Discovery

Intelligent Platform
World’s Most Adaptable Server Platform

Intelligent Choice
Delivers Higher Performance, Lower TCO
Estimated 8 Month Payback for Single-core Server refresh
Engineering Scalability

Supersonic Speed

Huge Capacity

Maximum Fuel Efficiency

Silicon Offers the Opportunity to Scale with a Single Design
Intel® Xeon® 5500 Processor

- 45 nm Hi-K Quad Core processor
- Intelligent Performance
- Adaptable Energy Efficiency
- Flexible Virtualization

A New Generation of Intelligent Server Processors
Intel® Xeon® 5500 Platform

- New Memory Subsystem
- Intel® QuickPath Interconnect
- Intel® Intelligent Power Technology
- New I/O Subsystem

Platform Ready for Future 32nm Products
Intel® Xeon® 5500: Intelligence Built-In

Responsive Performance
- Intel® Microarchitecture Nehalem
- Intel® Turbo Boost Technology
- Intel® Hyper-Threading Technology
- Enhanced Virtualization

Intel® Intelligent Power Technology
- Integrated Power Gates
- Automated Low-Power States
- Intel® Node Manager

Adapts To Your Application and User Environment
Intel® Xeon® 5500 Processor: Turbo Mode

Previous Generation
without Turbo

Threaded Workload at TDP

Intel Xeon® 5500
with Turbo
Intel® Xeon® 5500 Processor: Turbo Mode

Previous Generation
without Turbo

Intel Xeon® 5500
with Turbo

Threaded Workload < TDP
Intel® Xeon® 5500 Processor: Turbo Mode

Previous Generation
without Turbo

Intel Xeon® 5500
with Turbo

Lightly Threaded Workload ≤ TDP
Intel® Xeon® 5500 Processor: Turbo Mode

Previous Generation
without Turbo

Intel Xeon® 5500
with Turbo

Single Threaded Workload < TDP

Intelligently Delivering Optimal Performance and Energy Efficiency
2-Socket Server Performance

The Greatest Intel® Xeon® Performance Leap In History!

![Bar Graphs showing performance and power savings comparison between Intel Xeon processors]

Performance When You Need It. Power Savings When You Don’t

Source: Intel, December 8, 2008. Based on internal testing on pre-production Intel Xeon Processor 5500 based servers. Performance Gains Represent A Blend (GEO Mean) Of Five Common 2-socket Workload Types Across A Range Of Typical Usages
<table>
<thead>
<tr>
<th>Benchmark</th>
<th>Result</th>
<th>Improvement</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPECint* _rate_base2006</td>
<td>240</td>
<td>(+71%)</td>
</tr>
<tr>
<td>SPECpower* _ssj2008</td>
<td>1943</td>
<td>(+71%)</td>
</tr>
<tr>
<td>SPECfp* _rate_base2006</td>
<td>194</td>
<td>(+125%)</td>
</tr>
<tr>
<td>SPECjAppServer*2004</td>
<td>3,975</td>
<td>(+93%)</td>
</tr>
<tr>
<td>TPC*-C</td>
<td>631,766</td>
<td>(+130%)</td>
</tr>
<tr>
<td>SAP-SD* 2-Tier</td>
<td>5,100</td>
<td>(+102%)</td>
</tr>
<tr>
<td>SPECjAppServer*2004</td>
<td>43,593</td>
<td>(+154%)</td>
</tr>
<tr>
<td>TPC*-E</td>
<td>800</td>
<td>(+152%)</td>
</tr>
<tr>
<td>SAP-SD* 2-Tier</td>
<td>71,045</td>
<td>(+140%)</td>
</tr>
<tr>
<td>Fluent* 12.0 benchmark</td>
<td>Geo mean of 6</td>
<td>(+127%)</td>
</tr>
<tr>
<td>SPECjbb*2005</td>
<td>604,417</td>
<td>(+64%)</td>
</tr>
<tr>
<td>SPECWeb*2005</td>
<td>71,045</td>
<td>(+140%)</td>
</tr>
<tr>
<td>Fluent* 12.0 benchmark</td>
<td>Geo mean of 6</td>
<td>(+127%)</td>
</tr>
<tr>
<td>SPECjbb*2005</td>
<td>604,417</td>
<td>(+64%)</td>
</tr>
<tr>
<td>SPECWeb*2005</td>
<td>71,045</td>
<td>(+140%)</td>
</tr>
</tbody>
</table>

Over 30 New 2S Server and Workstation World Records!
Examples of Software Optimized for the Intel® Xeon® 5500

Over 100 Optimized Software Products From Around The World

Americas 49  Europe 37  PRC 15  APAC 12

* The highest gains are typically in applications that are memory bandwidth or latency sensitive. Results vary by application. Other brands and names are the property of their respective owners.
Examples of Software Optimized for the Intel® Xeon® 5500

Over 100 Optimized Software Products From Around The World

Americas 49
Europe 37
PRC 15
APAC 12

With Over 30 Real World Applications Seeing Up to 2-3X Performance Gains*

*The highest gains are typically in applications that are memory bandwidth or latency sensitive. Results vary by application. Other brands and names are the property of their respective owners.
Transforming the Datacenter

“Private Cloud”
Automated, Scalable and On-Demand

Dynamic Resource Management

Server Consolidation

Balanced Platform
Performance, Memory and I/O Capabilities

Efficient Datacenter
Platform/Rack Efficiency, Higher ambient temp

Server Pool Flexibility
Similar Instruction Set Between Servers

Unified Network
10Gb Ethernet for Storage and Network
Technology Foundation for the Dynamic Datacenter

**Compute**
Intel® Xeon® 5500 Platform with Enhanced Compute and I/O Virtualization

**IT Result:**
Workload Agility
Simpler and Lower Cost
Performance for Responsive Scalability

**Network**
10Gb Ethernet with Built-in Support for Unified Fabric

**Storage**
Open Platforms and Performance Breakthroughs (SSDs)
Technology Foundation for the Dynamic Datacenter

Compute
Intel® Xeon® 5500 Platform with Enhanced Compute and I/O Virtualization

Virtualization Performance:
Up to 160% Greater Performance Based on VMware® VMmark®¹

Network
10Gb Ethernet with Built-in Support for Unified Fabric

Storage
Open Platforms and Performance Breakthroughs (SSDs)

¹Compared to the Intel Xeon processor 5400 series based platform
Other brand names are the property of their respective owners.
Most Important Server Launch Since Pentium® Pro
15 Billion Connected Devices
Design and Discovery

Intelligent Platform
World’s Most Adaptable Server Platform

Intelligent Choice
Delivers Higher Performance, Lower TCO
Estimated 8 Month Payback for Single-core Server Refresh
The Server Install Base

Where IT Spends

Innovate
Enhance
Maintain

Intel® Xeon® Shipments

single core | dual core | quad+

2004 | 2005 | 2006 | 2007 | 2008

Estimate 40% Single-core, 40% Dual-core In Traditional IT Infrastructure Today

Source: Gartner IT Key Metrics Data 2008
Source: Intel Internal data
Refresh Benefits

**Performance Refresh**
- 184 Intel® Xeon® 5500 Based Servers
- Up to 9x Performance
- 18% Annual Energy Costs Estimated Reduction

**Efficiency Refresh**
- 21 Intel® Xeon® 5500 Based Servers
- As low as 8 Month Payback
- 90% Annual Energy Costs Estimated Reduction

Source: Intel estimates as of Nov 2008. 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.
<table>
<thead>
<tr>
<th>System</th>
<th>SPECJbb2005*</th>
<th>SPECint*-rate 2006</th>
<th>SPECfp*-rate2006</th>
<th>Cost Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>T5240 SUN* UltraSPARC T2+*</td>
<td>1.18x</td>
<td>1.65x</td>
<td>1.71x</td>
<td>Up to 1.71X</td>
</tr>
<tr>
<td>P570 IBM* POWER6*</td>
<td>2.20x</td>
<td>2.22x</td>
<td>1.86x</td>
<td>Up to 2.45X</td>
</tr>
</tbody>
</table>

Source: UltraSPARC T2+ results published on spec.org. Intel estimates as of Feb 2009. Intel 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. All systems priced with 32GB memory. T5240 actual cost from published pricing information. Estimated price used for 25 Xeon system, based on existing 25 system published pricing information. Estimated price used for 25 P570 system. Other brands and names are the property of their respective owners.
Intel® Xeon® 5500 Platform: Extending IA Leadership in Embedded

- Military
- Aerospace
- Government

- Medical
- Imaging

- Communications
Intel® Xeon® 5500 Platform: Extending IA Leadership in Telecommunications

- Thermal Profile for Telecommunications
- LV SKUs for Ultra Dense Form Factors
- 7 Year Extended Life Product Support
- Telecommunications-Grade Reliability

Ten of the World’s Top Ten TEMs Design with IA
Outstanding Examples of Technologies That Support the Intel® Xeon® 5500 Series

- IBM System x iDataPlex
- HP BladeSystem C-class
- Cisco Unified Computing Solution
- CRAY CX1 Supercomputer
- Verari systems Bladerack 2 X-series
- SenecaData Nexlink StableFlex Modular Server
- Dell PowerEdge Blade Server
- Rackable Systems CloudRack

Other brands and names are the property of their respective owners.
Intel® Xeon® 5500 Series: Worldwide Industry Support

Brodest Ecosystem of Server, Storage & Embedded Partners
Announcing the Data Center Efficiency Challenge

Competition for Video Proposals: Design a More Efficient Data Center

Winners Announced at IDF Fall In San Francisco

Visit Intel’s Server Room Community for More Details
Http://communities.intel.com/openport/community/server
Summary

Most Important Server Introduction Since the Pentium® Pro

Intelligent Platform

Intelligent Choice
Join the Industry’s Xeon® 5500 Processor Series Conversation Online at www.intel.com/server
INTELLIGENT PROCESSORS. TRANSFORMING COMPUTING.
Lincoln Wallen
Head of Research and Development
DreamWorks Animation SKG
Josh Crowe
Vice President of Engineering
Savvis, Inc.
INTELLIGENT PROCESSORS. TRANSFORMING COMPUTING.
Keith Gray
Manager
High Performance & Technical Computing
BP, Inc.

Mazen Rawashdeh
Sr. Director of Operations Infrastructure and Engineering
eBay, Inc.

Paul Ratner
Vice President IT Operations
Humana, Inc.

Josh Crowe
Vice President of Engineering
Savvis, Inc.

Lincoln Wallen
Head of Research and Development
DreamWorks Animation SKG
INTELLIGENT PROCESSORS. TRANSFORMING COMPUTING.
Legal Disclaimers

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 the performance of Intel products, visit http://www.intel.com/technology/resources/limits.htm or call (U.S.) 1-800-628-8686 or 1-916-356-3104.

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® Virtualization Technology requires a computer system with an enabled Intel® processor, BIOS, virtual machine monitor (VMM) and, for some uses, certain platform software enabled for it. Functionality, performance or other benefits will vary depending on hardware and software configurations and may require a BIOS update. Software applications may not be compatible with all operating systems. Please check with your application vendor.

Hyper-Threading Technology requires a computer system with a processor supporting HT Technology and an 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 processors that support HT Technology, see Intel® Technology Website.

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 http://www.intel.com/technology/turboboost.

Intel processor numbers are not a measure of performance. Processor numbers differentiate features within each processor family, not across different processor families. See http://www.intel.com/products/processor_number for details. Intel products are not intended for use in medical, life saving, life sustaining, critical control or safety systems, or in nuclear facility applications. All dates and products specified are for planning purposes only and are subject to change without notice.

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

Copyright © 2009 Intel Corporation. All rights reserved. Intel, the Intel logo, Xeon and Intel Core are trademarks or registered trademarks of Intel Corporation or its subsidiaries in the United States and other countries. All dates and products specified are for planning purposes only and are subject to change without notice.
Benchmark configuration details

- All comparisons based on published/submitted/approval results as of March 30, 2009.
- SPECint_rate_base2006:
  - Baseline Intel® Xeon® processor X5470 based platform details: Fujitsu Siemens PRIMERGY® RX200 S4 server platform with two Intel Xeon processors X5470 3.33GHz, 12MB L2 cache, 1333MHz FSB, 1666MHz memory (6x2GB DDR2 PC2-5300U), 2xRAID, 5.5 x 5.4, with ECO, SUSE Linux Enterprise Server 10 SP2 x86_64 Kernel 2.6.16.5-82.21-sm, Intel C++ Compiler for Linux32® and Linux64® Version 11.0 build 200D0B70. As published at 140. For more information see: https://www.spec.org/cpu2006/results/res06_bib.html.001200801031.1
  - Intel® Xeon® processor X5570 based platform details: Fujitsu PRIMERGY® TX200 S5 server platform with two Intel Xeon processors X5570 2.93GHz, 8MB L3 cache, 6.4GT/s QPI, 48 GB memory (6x8GB PC3-10600R, 2xRAID, 5.5 x 5.4, ECO, SUSE Linux Enterprise Server 10 SP2 x86_64 Kernel 2.6.16.5-82.21-sm, Intel C++ Compiler for Linux32 and Linux64 version 11.0 build 20010131. Submitted to www.spec.org for review as 240 as of March 30, 2009.
- SPECint_rate_base2006:
  - Baseline Intel® Xeon® processor X5482 based platform details: Hewlett-Packard ProLiant DL160 G5p server platform with two Intel Xeon processors X5482 3.20GHz, 12MB L2 cache, 1800MHz FSB, 1600MHz memory (8x2GB 800MHz CL5 FB DIMM), 544-bit SUSE Linux Enterprise Server 10 SP1, Intel C++ Compiler for Linux32 and Linux64 version 10.1 build 20080795. As published at 86.4. For more information see: www.spec.org/cpu2006/results/res06_bib.html.001182901031.1
  - Intel® Xeon® processor X5570 based platform details: Fujitsu PRIMERGY® TX200 S5 server platform with two Quad-Core Intel Xeon processors X5570 2.93GHz, 8MB L3 cache, 6.4GT/s QPI, 24 GB memory (6x8GB PC3-10600R, 2xRAID, 5.5 x 5.4, ECO, SUSE Linux Enterprise Server 10 SP2 x86_64 Kernel 2.6.16.5-82.21-sm, Intel C++ Compiler for Linux32 and Linux64 version 11.0 build 20010131. Submitted to www.spec.org for review as 194 as of March 30, 2009.
  - Intel® Xeon® processor X5570 based platform details: Cisco B200 M1 server platform with two Quad-Core Intel Xeon processors X5570 2.93GHz, 8MB L3 cache, 6.4GT/s QPI, 24 GB memory (8x4GB PC3-10600R, 2xRAID, 5.5 x 5.4, ECO, SUSE Linux Enterprise Server 11 SP2 x86_64 2.6.21.15-2-default, Intel C++ Compiler for Linux32 and Linux64 version 11.0 build 20010131. Result measured at 194 as of March 30, 2009.
- SAP SD 2-Tier:
- TPCC:
  - Baseline Intel® Xeon® processor X5460 based platform details: HP ProLiant ML370 G5 with platform with Intel Xeon processor X5460 3.16GHz (2 processors / 8 cores / 8 threads), 2x8MB L2 cache, 1333 MHz system bus, 64GB memory, Microsoft SQL Server 2005 x64 Enterprise edition SP2, Microsoft Windows Server 2003 Enterprise x64 Edition R2. Referenced as published at 275,149 TPMC and $1.46/MMPC availability date January 7, 2008. For more information see: www.spec.org/cp2006/results/res06_bib.html.001200801031.1
  - Intel® Xeon® processor X5570 based platform details: HP ProLiant DL370 G6 platform with two Intel Xeon processors X5570 2.93GHz (2 processors / 8 cores / 16 threads), 8MB L3 cache, 6.4GT/s QPI, 144 GB memory (11x8GB DDR3), Oracle 11 g database with Oracle Enterprise Linux O5®. Result submitted to www.spec.org as of March 30, 2009.

Performance tests and ratings are measured using specific computer system configurations and may not reflect the actual performance of Intel products as measured by these 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 http://www.intel.com/technology/processors/1329.htm Copyright © 2008, Intel Corporation. Other names and brands may be claimed as the property of others.
Benchmark configuration details

- All comparisons based on published/submitted/approved results as of March 30, 2009.
- TPCE:
- SPE/Cb2005:
  - Intel® Xeon® processor X5570 based platform details: IBM BladeCenter HS22 Server platform* with two Intel Xeon processors X5570 2.93GHz, 8MB L3 cache, 64GB memory (8x4GB DDR1-1333MHz), Microsoft Windows Server 2008 Enterprise x64 Edition, IBM JS 24 JRE 1.6 (build 95846585-20090320-0454-1332-4) run with 4 VM instances. Result measured at 604417 BPS - March 30, 2009.
- SPE/Sort2005:
  - Baseline Intel® Xeon® processor X5460 based platform details: HP ProLiant DL380 G5 server platform with two Intel Xeon processors X5460 3.16GHz, 12MB L2 cache, 32GB memory (8x4GB 667MHz DDR2 FB-DIMM), Red Hat Enterprise Linux 5 (2.6.18-53.el5), Rock Web Server v.4.7 x86_64, Reference as published at 26GB1. For more information see http://www.intel.com/products/chipsets/cpu_details.htm.
  - Intel® Xeon® processor X5570 based platform details: HP ProLiant DL380 G6 platform* with two Intel Xeon processors X5570 2.93GHz, 8MB L3 cache, 64GB memory, 64GB (x4GB DDR3-1066), Red Hat Enterprise Linux 5.2, Rock Web Server v1.4 (x86_64), Result submitted to www.TPC.org for review at 71,045 as of March 30, 2009.
- Fluent:
  - Baseline Intel® Xeon® processor X5482 based platform details: Supermicro X7D92** server platform with two Intel® Xeon® processors X5482 3.20GHz, 12MB L2 cache, 1600MHz FSB, 16GB memory (8x2GB 800MHz DDR2 FB-DIMM), 64-bit Red Hat Enterprise Linux 5.3*. Performance measured using Fluent Version 12.0.3 (Version 12.0.3). Six individual benchmarks are shown as a measure of single node performance. “Overall” performance is the geometric mean of the six individual benchmarks.
  - Intel® Xeon® processor X5570 based platform details: Sun Blade 100EX** server platform with two Intel Xeon processors X5570 2.93GHz, 8MB L3 cache, 64 MB/s, 24GB memory (12x2GB 1066MHz DDR3), 64-bit Sun Solaris Enterprise Server* + 10 SP with ProPack SP2*. Performance measured using Fluent Version 12.0.3. Six individual benchmarks are shown as a measure of single node performance. “Overall” performance is the geometric mean of the six individual benchmarks.

Performance tests and ratings are measured using specific computer systems and/or components. They reflect the approximate performance of Intel products as measured by these 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 http://www.intel.com/PerformanceResources.html Copyright © 2010, Intel Corporation. Other names and brands may be claimed as the property of others.
Benchmark configuration details

- All comparisons based on published/submitted/approved results as of March 30, 2009.
- SPECComp2001

- Intel Xeon processor X5570 based platform details: Oracle 10g 10.1.0.2 server platform* with two Intel Xeon processors X5570 2.93GHz, 8MB L3 cache, 64GT/s QPI, 24GB memory (4x6GB DDR3-1333MHz), Red Hat EL 5.3, Linux Kernel 2.6.18-128.elf SMP x86_64, Binaries built with Intel C/C++ Compiler 11.0 for Linux. Result submitted to www.spec.org for review at 43593 (SPECCompMbase2001) as of March 30, 2009.

- SPECpower_ssj2008
- Baseline: Intel Xeon processor 5430 based platform details: PowerEdge M810 server platform* with two Intel Xeon processors L5430 2.33GHz, 12MB L2 cache, 1333MHz FSB, 8GB memory, Oracle JRockit (r) 8.0 J2K (r27.3.0-486) Linux x86_64, compiled mode. Published at 1135.5 W. For more information see http://www.spec.org/power_ssj2008/refs/pl.php

- Intel Xeon processor X5570 based platform details: Verari Systems, Inc. V61 305 server platform* with two Intel Xeon processor X5570, 2.93GHz, 8 GB (4x2 GB) Microsoft Windows Server 2008 Enterprise Service Pack 2 OS, Oracle JVM (build 28.0.4-114-11048-1.6.0-0_20090702-1851-windows-x86_64, compiled mode) result of 1943 provided by Verari as of 3/30/2009.

- SPECAppServer2004
- Baseline: Intel Xeon processor X5450 based platform details: HP Proliant BL460c G1 server platform* with two Intel Xeon processors X5460 3.16GHz, 12MB L2 cache, 1600MHz memory (8x2GB 667MHz DDR2 4800U/532), Oracle Application Server 10g Release 10.1.3 - java edition, OCA Jrockit(r) 8.0 J2K (r27.3.0-486) Linux x86_64, Oracle Database Enterprise Edition Release 11.1.0.6, Reference as published at 2006. For more information see http://www.spec.org/AppServer2004/refs/pl.php


- VMware
- Baseline: Intel Xeon processor X5450 based platform details: HP Proliant ML370 G5 server platform* with two Intel Xeon processors X5470 3.33GHz, 2x6MB L2 cache, 1333MHz FSB, 48GB memory, VMware 3.5, Update 3 Published at 51.1 Msf7. For more information see www.spec.org/vm35.htm

- Intel Xeon processor X5570 based platform details: Dell PowerEdge R710 server platform* with two Intel Xeon processors X5570 2.93GHz, 8MB L3 cache, 64GT/s QPI, 96 GB memory (12x8 GB DDR3-1066MHz), VMware ESX beta build 150817. Submitted to VMware for review at 23.5 Msf7 tiles.
Xeon 5500 Refresh Slides (System Configurations)

- 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 to Xeon 5500 Refresh Configuration Details
  - Source: Intel internal measurements 2005 - 2008 comparing 2S Xeon 3.8GHz (Irwindale), 8x1GB DIMMs, 1 HDD, 382W power under load to 2S Xeon X5570 (Nehalem 2.93GHz), 6x2GB DIMMs, 1 HDD, 315W power under load.

- Dual Core Xeon 5100 to Xeon 5500 Refresh Configuration Details
  - Source: Intel internal measurements 2005 - 2008 comparing 2S Xeon 5160 (Woodcrest 3.0GHz), 8x2GB DIMMs, 1 HDD, 354W power under load to 2S Xeon X5570 (Nehalem 2.93GHz), 6x2GB DIMMs, 1 HDD, 315W power under load.
# Single Core Energy Efficient Refresh Calculation Details

<table>
<thead>
<tr>
<th></th>
<th>2005</th>
<th>2009</th>
<th>Delta / Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Product</strong></td>
<td>Intel Xeon single core (3.8Ghz w/ 2M cache)</td>
<td>Intel Xeon 5500 series (2.93GHz)</td>
<td></td>
</tr>
<tr>
<td><strong>Performance per Server</strong></td>
<td>50,970 bops (<code>SPECjbb2005</code>*)</td>
<td>447,000 bops (<code>SPECjbb2005</code>*)</td>
<td><strong>Up to 8.8x per/server</strong></td>
</tr>
<tr>
<td><strong>kWh per Server/Day</strong></td>
<td>6.704 (392w active / 228w idle)</td>
<td>4.936 (315W active / 151 idle)</td>
<td>Server active 8hrs and idle for 16 hrs per day</td>
</tr>
</tbody>
</table>

**Desired Performance Target = 9.4 millions business operations per second**

<table>
<thead>
<tr>
<th># Servers needed</th>
<th>184</th>
<th>21</th>
<th><strong>~ 9:1 server consolidation</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td># Racks needed</td>
<td>9 racks</td>
<td>1 rack</td>
<td><strong>9:1 Rack Consolidation</strong></td>
</tr>
<tr>
<td><strong>Total Perf</strong></td>
<td>9.38 million bops</td>
<td>9.38 million bops</td>
<td>Same Performance</td>
</tr>
<tr>
<td><strong>Annual kWhr</strong></td>
<td>451,474</td>
<td>37,938</td>
<td><strong>Estimated 92% lower energy costs</strong></td>
</tr>
<tr>
<td><strong>Annual Energy Costs</strong></td>
<td>$90,295</td>
<td>$7,588</td>
<td>$82,707 electricity costs per year. Assumes $0.10/kWhr and 2x cooling factor</td>
</tr>
<tr>
<td>OS Licensing Costs</td>
<td>$165,600</td>
<td>$18,900</td>
<td>$146,700 less per year. Assumes a RHEL 1yr license at $900</td>
</tr>
</tbody>
</table>

**Annual Cost Savings of **$229,407

| Cost of new HW | n/a | **$147,000** | Assume $7,000 per server |

**Estimated Payback Period of 8 months**
## Single Core Performance Refresh Calculation Details

<table>
<thead>
<tr>
<th></th>
<th>2005</th>
<th>2009</th>
<th>Delta / Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Product</strong></td>
<td>Intel Xeon single core (3.8Ghz w/ 2M cache)</td>
<td>Intel Xeon 5500 series (2.93GHz)</td>
<td></td>
</tr>
<tr>
<td><strong>Performance per Server</strong></td>
<td>50,970 bops SPECjbb2005*</td>
<td>447,000 bops SPECjbb2005*</td>
<td>bops = business operations per second</td>
</tr>
<tr>
<td><strong>Power Consumption per Server</strong></td>
<td>382W active</td>
<td>315W active</td>
<td>Server active 24hr per day (assuming HPC application)</td>
</tr>
<tr>
<td><strong>DC Cooling Factor</strong></td>
<td>1.6 PUE</td>
<td>1.6 PUE</td>
<td></td>
</tr>
<tr>
<td><strong># of Servers</strong></td>
<td>1,637</td>
<td>1,637</td>
<td></td>
</tr>
<tr>
<td><strong>Data Center Performance</strong></td>
<td>83,437,890 bops</td>
<td>731,739,000 bops</td>
<td></td>
</tr>
<tr>
<td><strong>Data Center Power</strong></td>
<td>1,000 KW</td>
<td>825 kW</td>
<td></td>
</tr>
</tbody>
</table>

**Data Center Capability = 1 MW**

**Same Design**

PUE: Power Usage Effectiveness.

**Same Footprint**

Up to 8.8x Performance Increase

**Estimated 18% Lower Power**

# of Servers * Svr Power * PUE
For 50% Lower Platform Idle Power

Configuration details for 50% lower idle power: Intel internal measurements of 221W at idle with Supermicro 2xE5450 (3.0GHz 80W) processors, 8x2GB 667MHz FBDIMMs, 1x700W PSU, 1x320GB SATA hard drive vs. 111W at idle with Supermicro software development platform with 2xE5540 (2.53GHz Nehalem 80W) processors, 6x2GB DDR3-1066 RDIMMs, 1x800W PSU, 1x150GB 10k SATA hard drive. Both systems were running Windows 2008 with USB suspend select enabled and maximum power savings mode for PCIe link state power management. Measurements as of Feb 2009.
**Vs UltraSPARC T2+**

Intel results achieved with 8 cores and 16 threads vs 16 cores and 128 threads for SPARC Enterprise T5240 with 1.4 GHz 8-core UltraSPARC T2+. Intel Xeon Processor 5570 (2.93GHz) vs SUN SPARC T5240 2S/16C 1.4Ghz

SPECjbb2005: T5240 384,934 bops and 24,058 bops/jvm Vs Intel Xeon Processor 5570 604,417 bops (see previous slide for details)

SPECint*rate 2006base T5240: 142 base...Intel Xeon Processor 5570 240 (see previous slides for details)

SPECfp*rate 2006base T5240 :111 base...Intel Xeon Processor 5570 194 base (see previous slides for details)

**Note:** All systems priced with 32GB memory. DL580 currently at $13k, Sun Fire X4150 $11k for systems based on Xeon 5400. Estimating that Nehalem-EP systems will have a 20% premium. T5240 with 32GB memory from SUN website is $36,495

**Vs POWER6**

Intel results achieved with Intel Xeon Processor 5570 2.93Ghz. Vs IBM Power* 570 Server with 2 POWER 6 4.7Ghz processors

SPECjbb2005: P570 205,917 bops and 102,959 bops/jvm Vs Intel Xeon Processor 5570 604,417 bops (see previous slide for details)

SPECint*rate 2006base: P570 106 base...Intel Xeon Processor 5570 240 (see previous slides for details)

SPECfp*rate 2006base: P570 102 base...Intel Xeon Processor 5570 194 base (see previous slides for details)

**Note:** All systems priced with 32GB memory. DL580 currently at $13k, Sun Fire X4150 $11k for systems based on Xeon 5400. Estimating that Nehalem-EP systems will have a 20% premium. Estimated P570 pricing from [http://wpc.org/results/individual_results/IBM/IBM_570_6_20070806_es.pdf](http://wpc.org/results/individual_results/IBM/IBM_570_6_20070806_es.pdf) with 32GB memory 10,195 for base p570 server, plus 2 AC power supplies $3,004, plus 32x 1GB memory activation at $1,515 per GB, plus $92,000 for 4 cpu activations, +$23,000 for the physical processor cards