



Competitive Guide

Quad-Core Intel® Xeon® Processor-based Systems

Business Enterprise

Competitive Comparison

Quad-Core Intel® Xeon® Processor-based Platforms vs. AMD Opteron*



Quad-Core Reality Through Practical Innovation

Offering the industry's first standard high-volume quad-core server micro-processor, Intel unveils a powerful, new technology within its proven Intel® Xeon® processor family of products.

The Quad-Core Intel® Xeon® processor 5300^A series provides breakthrough performance and energy-efficiency for the ultimate in powerful, dense and reliable general-purpose servers.

Key platform features include:

- Lower power 64-bit quad-core processors* based on Intel® Core™ microarchitecture improve performance per watt, delivering up to 50% more performance over previous generations within the same power envelope
- Intel® Virtualization Technology⁵ which provides hardware-assisted virtualization, and the broadest industry virtualization software support combine to help optimize data center effectiveness and consolidate more applications on fewer servers
- New dual independent point-to-point bus and faster front side bus speed driving up to 3x bandwidth improvements versus single-core Intel Xeon processors with DDR2-400 memory
- Fully buffered DDR2 DIMM memory (FB-DIMM) for more throughput, higher capacity and improved reliability
- Platform supports both dual-core and quad-core processors using the same socket for both processors, assuring investment protection and a smooth path for upgrading existing dual-core servers



Better Performance

Better Performance per Watt at the System Level

Proven and Reliable Solution

Better for Virtualization



Extending Innovation

Your existing servers with Dual-Core Intel® Xeon® processors 5100^a series are socket compatible with Quad-Core Intel Xeon processor 5300 series.[†] They can be added to your existing infrastructure seamlessly and without disruption. Your existing legacy software will also run on quad-core processors with no code changes or revisions, providing even greater investment protection. And with most software, you'll instantly experience the outstanding performance gains quad-core delivers.

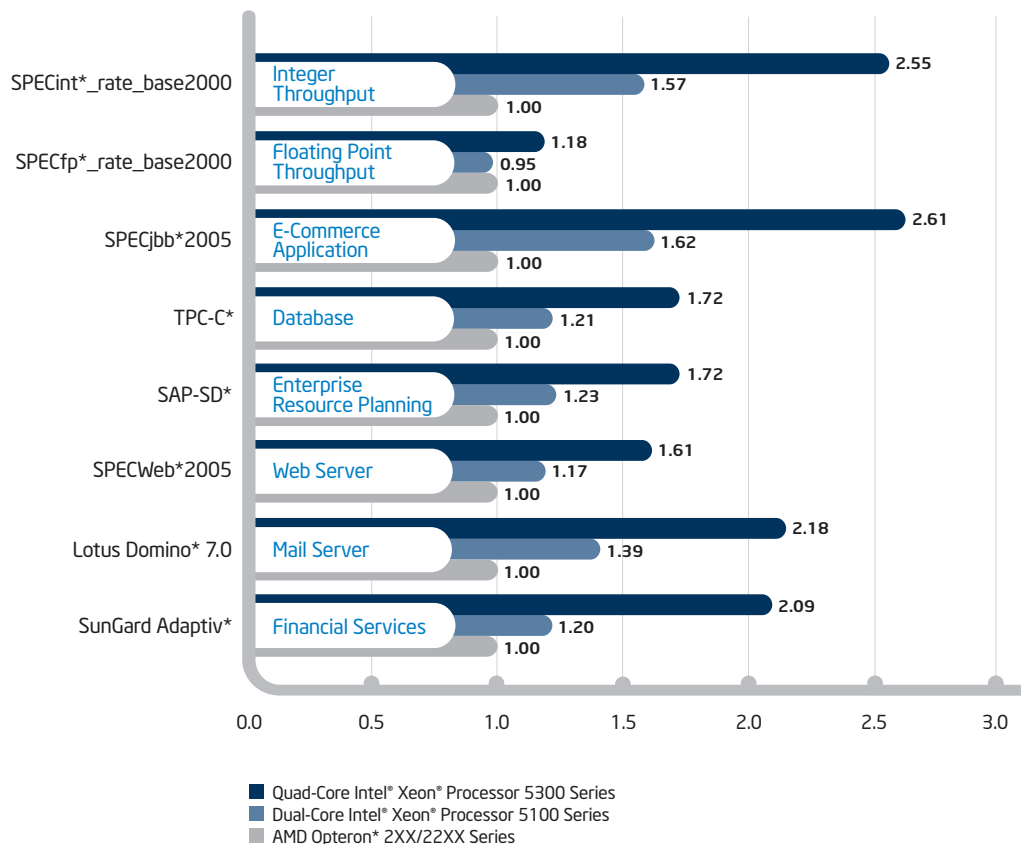
Built on Experience

Quad-Core Intel Xeon processors are built on the proven and advanced Intel Core microarchitecture. By using an already proven dual-core technology as a base for design, Intel is able to deliver a proven and reliable solution for quad-core technology reducing implementation risk and manufacturing costs through a dual-die implementation on high-volume 65nm process technology.

Breakthrough Performance: Quad-Core Intel® Xeon® Processor-based Platforms vs. Dual-Core AMD Opteron* Processor-based Platforms

Breakthrough Performance for Servers*

(Higher is better.)

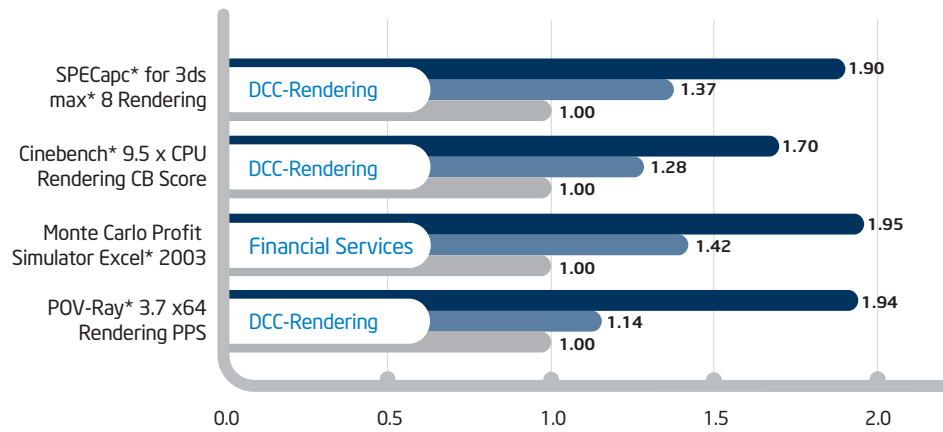


For more information on published performance results, please go to www.intel.com/performance/server/xeon.



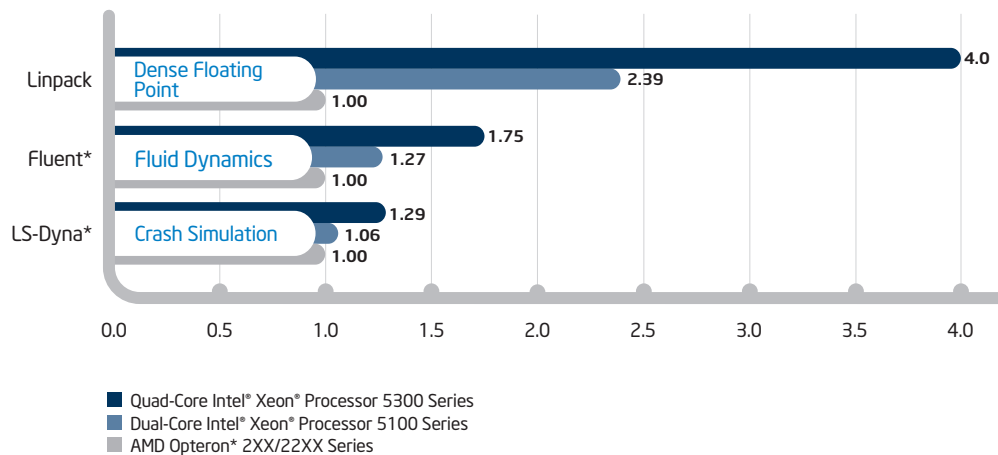
Breakthrough Performance for Workstations

(Higher is better.)



Breakthrough Performance for High Performance Computing

(Higher is better.)



For more information on published performance results, please go to www.intel.com/performance/server/xeon.

Comparing the Architectures

Key Architecture Advantages

Intel® Core™ Microarchitecture

- 4 instructions per cycle vs. 3 instruction per cycle for AMD Opteron* 2000 series processor

Dual Independent Point-to-Point Bus

- Up to 3x system bandwidth increase vs. previous generation, resulting in higher performance

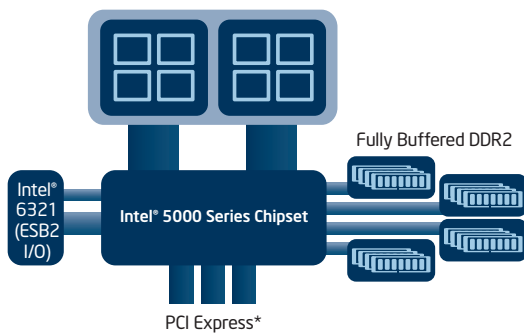
Intel® Smart Cache

- 8 MB shared cache, up to 4 MB fully accessible by each core, lowering memory latency and increasing performance

Fully Buffered DIMMs

- Increases memory capacity and throughput
- Simultaneously read and write helps reduce latency at peak load
- Allows for maximum capacity at full bandwidth

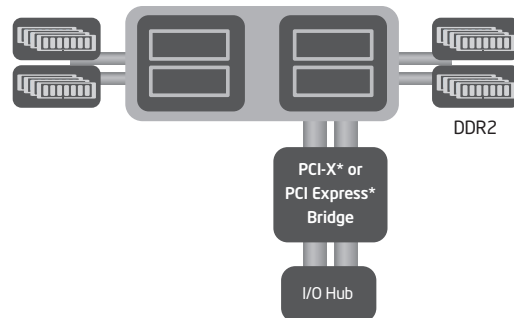
Quad-Core Intel® Xeon® Processor



Advantages

- 4X cache and up to 4 MB accessible to each core (fewer cache misses)
- Wider bus solely for data (higher data bandwidth)
- Full speed memory at full capacity

Dual-Core AMD Opteron* 2000 Series Processor



Limitations

- Smaller cache and only 1 MB accessible to each core
- Sacrifice memory capacity for bandwidth
- Requires both processors for max memory BW and capacity
- Shared link for Data and Address (lower data bandwidth)



	Quad-Core Intel® Xeon® processor (5300 [^] series)	Opteron* (Socket 1207)		
System Bus Format	Bi-direction, discrete (separate address and data bus)	Uni-directional, encoded packet (shared address and data bus)		
System Bus Width	64 bits	16 bits (each direction)		
System Bus Peak Bandwidth	21 GB/s	8 GB/s		
Cache Size/Accessible per Core	8 MB (Intel® Smart Cache)/ Full 4 MB accessible per core	2x1M discrete/only 1M accessible per core		
Memory	Fully Buffered DDR2-667	DDR2-400	DDR2-533	DDR2-667
Peak Memory Bandwidth	21 GB/s	12.8 GB/s ⁺	17 GB/s ⁺	21 GB/s ⁺
Maximum Memory	64 GB	64 GB	64 GB	64 GB ^{**}

[^]With two processors installed.

^{**}Limited to certain OEM configurations.

Value of Fully Buffered DDR2

Why FB-DIMM?

Fully Buffered DIMM (FB-DIMM) is the next evolution in memory technology for servers and workstations that value both capacity and bandwidth. With older memory technologies, as the signaling rates are increased, the number of DIMMs supported per channel decreases. Therefore, there was a trade-off between overall memory capacity and bandwidth. FB-DIMM offers the no-compromise solution by providing maximum capacity at the highest bandwidth.

What is FB-DIMM?

Previous memory technologies used a shared parallel interface with all DIMMs on the same bus. FB-DIMM is based on a high-speed point-to-point interface that uses a buffer, referred to as the AMB (Advanced Memory Buffer), to decouple the memory interface from the DRAM components. Decoupling allows the memory bus to run at full speed no matter how many DIMMs are installed, and allows simultaneous reads and writes while still using industry standard commodity DDR2 DRAMs to keep down costs.

Reliability Built In

FB-DIMM technology offers better RAS (reliability, availability, serviceability) by complementing Intel's existing enhanced data ECC protection (error-correcting code) with enhanced CRC (Cyclic Redundancy Checking). Enhanced CRC checks the transfer of all addresses, commands, and data and automatically retries when an error is detected, allowing for uninterrupted operation in case of transient errors. Finally, there is an AMB pass-through mode whereby if part of the AMB fails, it switches into repeater mode. That DIMM is effectively turned off, but the memory requests are passed in both directions.

For more information on the new Quad-Core Intel Xeon processor, go to www.intel.com/quadcoreserver.

Leading Energy Efficiency

Why Does System Power Matter?

IT managers are faced with the challenge of a growing need for higher compute density and constant pressure to lower overall spending. The cost of electricity is the second highest data center cost, only second to labor. Lowering the power (watts) of each system helps increase compute density within a rack or a fixed footprint and also helps reduce operational cost associated with powering both the servers directly and the associated cooling.

How is Intel Driving New Levels of Power Efficiency?

Intel has a comprehensive approach to improving power efficiency resulting in better optimized data centers and lower overall cost. First, Intel has already incorporated strained silicon into its 65nm processor technology to improve transistor performance and decrease power. Intel is shifting to the Intel Core microarchitecture, further reducing the power consumed by the processor. Three power levels for the Quad-Core Intel Xeon processor 5300 series are being offered: 50, 80, and 120 watts. Intel will manufacture increased numbers of 50 and 80 watt versions to help meet demand and technology needs, as well as to deliver new levels of energy-efficiency in our quad-core offering. These processors, designed to meet the increasingly challenging compute and data needs of your business infrastructure, deliver as much as 150% better performance than AMD.^o

Additionally, the Intel[®] power toolkit helps IT managers fit more servers within each rack. Finally, demand-based switching with Enhanced Intel SpeedStep[®] technology helps lower utility costs.

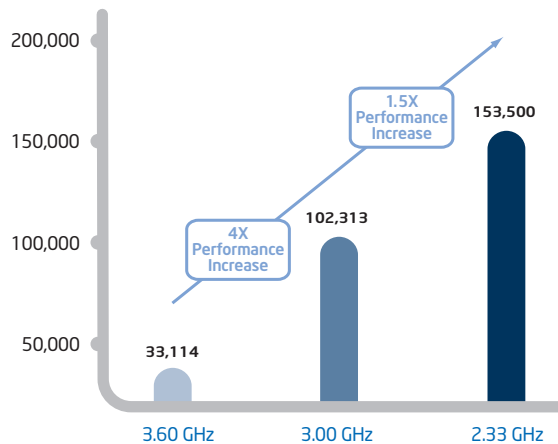
Intel[®] Virtualization Technology

Intel continues to deliver advanced platform features, adding even more value and capabilities to your servers. Intel Virtualization Technology is a set of hardware enhancements to Intel[®] server and client platforms that can improve traditional software-based virtualization solutions. Servers based on Quad-Core Intel Xeon processors are ideal for infrastructure virtualization on dense 2-way form factors, and with up to 50% more performance over previous-generation Dual-Core Intel Xeon processor-based servers, more applications can be consolidated on smaller and more power-efficient systems.

More Performance In A Stable Power Infrastructure

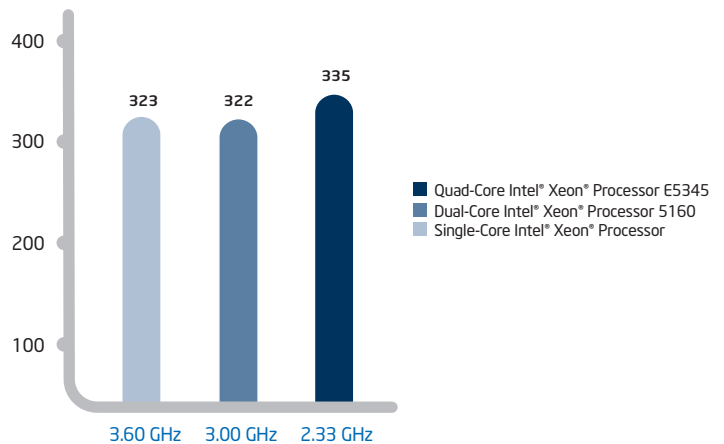
Performance (Business Operations per Second)

(Higher is better.)



System Power (Measured System Watts)

(Lower is better.)



SPECjbb 2005

Configuration Details: Data Source: Intel internal measurement - November 2006. System power was measured during the steady-state of window of the performance run.

- **Intel[®] Xeon[®] processor 3.60 GHz-based platform details:** Intel[®] preproduction Server platform with two 64-bit Intel[®] Xeon[®] processors 3.60 GHz with 2 MB L2 Cache and 800 MHz system bus and 8 GB (8x1024 MB) DDR2-400 memory, Microsoft Windows[®] Server x32 Enterprise Edition, Windows 2003[®] Enterprise Edition, BEA JRockit[®] 5.0 JVM. Run with 1 JVM instance.
- **Dual-Core Intel[®] Xeon[®] processor 5160 based platform details:** Intel[®] preproduction Server platform with two Dual-Core Intel[®] Xeon[®] processors 5160, 3.00 GHz with 4 MB L2 Cache, dual 1333 MHz system bus, 8 GB (8x1 GB) 667 MHz FB-DIMM memory, Windows 2003[®] Enterprise Edition, BEA JRockit[®] 5.0 P26.4.0. Run with two JVM instances.
- **Quad-Core Intel[®] Xeon[®] processor E5345 based platform details:** Intel[®] preproduction Server platform with two Quad-Core Intel[®] Xeon[®] processors E5345, 2.33 GHz with 2x4 MB L2 Cache, 1333 MHz system bus, 8 GB (8x1 GB) 667 MHz FB-DIMM memory, Windows 2003[®] Enterprise Edition, BEA JRockit[®] 5.0 P26.4.0. Run with two JVM instances.

Different Approaches to Energy Efficiency

Intel® Xeon® processor-based platforms

- New platform: a balanced approach
- Intel Core microarchitecture
- 65nm process technology
- Intel Virtualization Technology

AMD Opteron*-based platforms

- Performance gains tied to increases in frequency
- No new efficient microarchitecture
- One generation behind on process technology
- No hardware-level virtualization technology

1. SPECint_rate_base2000

Data Source: Published/Submitted results as of Nov. 14, 2006.

Configuration Details:

Dual-Core AMD Opteron® Processor Model 2220SE platform details: Tyan Thunder K9QE (S4985)* Server platform with two Dual-Core AMD Opteron® processors Model 2220SE, 2.80 GHz with 2x1 MB L2 cache, 8x512 MB, DDR2-667 memory, SUSE Linux Enterprise Server 9* SP3 (64-bit), SPEC binaries built with PathScale EKOPath* Compiler Suite, Release 2.3. Referenced as published at 78.3.

Dual-Core Intel® Xeon® Processor 5160-based platform details: Dell PowerEdge 2950* Server platform with two Dual-Core Intel® Xeon® Processors 5160, 3.00 GHz with 4 MB L2 Cache, 1333 MHz system bus, 8 GB (8x1 GB) DDR2 FB-DIMM memory, Microsoft Windows Server® 2003, SPEC binaries built with Intel® C/C++ Compiler 9.1. Referenced as published at 123.

Quad-Core Intel® Xeon® Processor X5355-based platform details: Fujitsu Siemens PRIMERGY RX300 S3* Server platform with two Quad-Core Intel® Xeon® Processors X5355, 2.66 GHz with 2x4 MB L2 Cache, 1333 MHz system bus, 8 GB (8x1 GB) DDR2-RAM memory, Microsoft Windows 2003* Enterprise Edition, SPEC binaries built with Intel® C/C++ Compiler 9.1. Measured at 200.

2. SPECfp_rate_base2000

Data Source: Published/Submitted results as of Nov. 14, 2006.

Dual-Core AMD Opteron® Processor Model 2220SE-based platform details: Tyan Thunder K9QE (S4985)* Server platform with two Dual-Core AMD Opteron® processors Model 2220SE, 2.80 GHz with 2x1 MB L2 cache, 4 GB (8x512 MB) DDR2-667 memory, SUSE Linux Enterprise Server 9* SP3 (64-bit), SPEC binaries built with PathScale EKOPath* Compiler Suite, Release 2.3. Referenced as published at 87.9.

Dual-Core Intel® Xeon® Processor 5160-based platform details: Dell PowerEdge 2950* Server platform with two Dual-Core Intel® Xeon® Processor 5160, 3.00 GHz with 4 MB L2 Cache, 1333 MHz system bus, 8 GB (8x1 GB) FB-DIMM memory, Red Hat Enterprise Linux 4* Advanced Server Update 3 EM64T, SPEC binaries built with Intel® C/C++ Compiler 9.0. Referenced as published at 83.4.

Quad-Core Intel® Xeon® Processor X5355-based platform details: Fujitsu Siemens Computers PRIMERGY RX300 S3* Server platform with two Quad-Core Intel® Xeon® Processors X5355, 2.66 GHz with 2x4 MB L2 Cache, 1333 MHz system bus, 8 GB (8x1 GB) DDR2 memory, 64-bit SUSE Linux Enterprise Server 10*, SPEC binaries built with Intel® C/C++ Compiler 9.1. Measured at 104.

3. SPECjbb 2005

Data Source: Published/Submitted results as of Nov. 14, 2006.

Dual-Core AMD Opteron® Processor Model 2220SE-based platform details: Tyan Computer Corporation Thunder K9QE (S4985)* Server platform with two Dual-Core AMD Opteron® processors Model 2220SE, 2.80 GHz with 2x1 MB L2 Cache, 8 GB (8x1024 MB) DDR2-667 memory, Microsoft Windows Server® 2003 Enterprise x64 Edition SP1 (64-bit) IBM Corporation IBM J9 VM*. Referenced as published at 80617 bops and 40,309 bops/jvm.

Dual-Core Intel® Xeon® Processor 5160-based platform details: Dell PowerEdge 2950* Server platform with two Dual-Core Intel® Xeon® Processors 5160, 3.00 GHz with 4 MB L2 Cache, 1333 MHz system bus, 16 GB (4x4 GB) DDR2-667 FB-DIMM memory, Microsoft Windows Server® 2003 Enterprise x64 Edition + SP1, BEA JRockit* 5.0 P27.1.0. Measured at 130,589 bops and bops/jvm.

Quad-Core Intel® Xeon® Processor X5355-based platform details: Dell PowerEdge 2950* Server platform with two Quad-Core Intel® Xeon® Processors X5355, 2.66 GHz with 2x4 MB L2 Cache, 1333 MHz system bus, 16 GB (8x2 GB) 667MHz DDR2 FB-DIMM memory, Microsoft Windows Server® 2003 Enterprise x64 Edition + SP1, BEA JRockit* 5.0 P27.1.0. Measured at 210,065 bops and 105,033 bops/jvm.

4. TPC-C

Data Source: Published/Submitted results as of Nov. 14, 2006.

Dual-Core AMD Opteron® Processor Model 2220-based platform details: HP ProLiant DL385 G2* server platform with two Dual-Core AMD Opteron® processors Model 2220SE 2.80 GHz, (2 processors/4 cores/4 threads), 32 GB (8x4 GB) DDR2 memory, Microsoft Windows Server® 2003 Enterprise x64 Edition, Database Software Microsoft SQL Server® 2005 Enterprise x64 Edition. Referenced as published at 139,693 tpmC; \$2.28/tpmC.

Dual-Core Intel® Xeon® Processor 5160-based platform details: HP ProLiant ML370 G5* Server platform with two Dual-Core Intel® Xeon® processors 5160, (2 processors/4 cores/4 threads), 3.00 GHz with 4 MB L2 Cache, 1333 MHz system bus, 64 GB (16x4 GB) FB-DIMM memory, Microsoft Windows Server® 2003 Enterprise x64 Edition, Database Software Microsoft SQL Server® 2005 Enterprise x64 Edition. Referenced as published at 169,360 tpmC; \$2.93/tpmC.

Quad-Core Intel® Xeon® Processor X5355-based platform details: HP ProLiant ML370 G5* platform with two Quad-Core Intel® Xeon® Processors X5355, (2 processors / 8 cores / 8 threads), 2.66 GHz with 2x4 MB L2 Cache, 1333 MHz system bus, 64 GB (16x4 GB) FB-DIMM memory, Microsoft Windows Server® 2003 Enterprise x64 Edition, Database Software Microsoft SQL Server® 2005 Enterprise x64 Edition. Referenced as published at 240,737 tpmC; \$1.85/tpmC.

5. SAP-SD 2-Tier

Data Source: Published/Submitted results as of Nov. 14, 2006.

Dual-Core AMD Opteron® Processor Model 2218-based platform details: HP ProLiant BL480c* platform with two Dual-Core AMD Opteron® processors Model 2218 2.6 GHz, 1 MB L2 cache per core, 16 GB main memory, Microsoft Windows Server® 2003 Enterprise Edition, SQL Server® 2005 database, SAP ECC Release 5.0. Referenced as published at 1047 SD users.

Dual-Core Intel® Xeon® Processor 5160-based platform details: IBM System x3650* server platform with two Intel® Xeon® Processors 5160, 3.00 GHz with 4 MB L2 Cache, 1333 MHz system bus, 24 GB FB-DIMM memory, Microsoft Windows Server 2003 Enterprise Edition, DB2 UDB 8.2.2 database, SAP ECC Release 5.0. Result published at 1285 users.

Quad-Core Intel® Xeon® Processor X5355-based platform details: HP ProLiant BL480c* platform with two Quad-Core Intel® Xeon® Processors X5355, 2.66 GHz with 2x4 MB L2 Cache, 1333 MHz system bus, 32 GB 667 MHz FB-DIMM memory, Windows Server® 2003 Enterprise Edition, SQL Server® 2005 database, SAP ECC Release 6.0. Results published at 1,806 users.

6. SPECweb 2005

Data Source: Published/Submitted results as of Nov. 14, 2006.

Dual-Core AMD Opteron® Processor Model 285-based platform details: HP ProLiant DL145 G2* Server platform with two Dual-Core AMD Opteron® processors Model 285, 2.6 GHz with 2x1 MB L2 Cache, 16 GB (8x2 GB) PC3200 memory, 64-bit RHEL 4 U2 (2.6.9-22 ELsmp x86_64), 64-bit Acacia Rock Web Server* 1.3.3 HTTPS software, and Apache Tomcat* 5.5.9. Referenced as published at 11,293.

Dual-Core Intel® Xeon® Processor 5160-based platform details: HP ProLiant DL380 G5* Server platform with two Dual-Core Intel® Xeon® Processors 5160, 3.00 GHz with 4 MB L2 Cache, 1333 MHz system bus, 32 GB FB-DIMM memory, Windows Server® 2003 SP1, Rock Web Server v1.4.0. Referenced as published at 13,257.

Quad-Core Intel® Xeon® Processor X5355-based platform details: Fujitsu Siemens PRIMERGY TX300 S3* Server platform with two Quad-Core Intel® Xeon® Processors X5355, 2.66 GHz with 2x4 MB L2 Cache, 1333 MHz system bus, 32 GB (8x4 GB) DDR2-RAM PC2-5300F memory, Red Hat Enterprise Linux 4* ES U4, Rock Web Server v1.4.0. Results submitted at 18,160.

7. Lotus Domino 7.0

Data Source: Published/Submitted results as of Nov. 14, 2006.

Dual-Core AMD Opteron® Processor Model 285-based platform details: HP ProLiant DL385* Server platform with two Dual-Core AMD Opteron® processors Model 285, 2.60 GHz, 8 GB memory, Windows Server® 2003 OS, 17,000 concurrent, active users; Transactions per minute throughput value of 13927

Dual-Core Intel Xeon Processor 5160-based platform details: Intel® Server Pre-Production platform with two Dual-Core Intel® Xeon® Processors 5160, 3.00 GHz with 4 MB L2 Cache, 1333 MHz system bus, 16 GB (8x2 GB) FB-DIMM memory, SUSE Linux Enterprise Server 9.0* SP3, 22,000 concurrent, active users; Transactions per minute throughput value of 19,297.

Quad-Core Intel® Xeon® Processor X5355-based platform details: Intel® Server Pre-Production platform with two Quad-Core Intel® Xeon® Processor X5355, 2.66 GHz with 2x4 MB L2 Cache, 1333 MHz system bus, 32 GB 667 MHz FB-DIMM memory, SUSE Linux Enterprise Server 9.0* SP3, 22,000 concurrent, active users; Transactions per minute throughput value of 30,379.

8. SunGard Adaptiv

Data Source: Published/Submitted results as of Nov. 14, 2006.

Dual-Core AMD Opteron® Processor Model 2220SE-based platform details: Server platform with two Dual-Core AMD Opteron® processors Model 2220SE, 2.80 GHz, 8 GB PC3200 memory, Microsoft Windows Server® x32 Enterprise Edition, SunGard Adaptiv® Credit Risk 64-bit version workload.

Dual-Core Intel® Xeon® Processor 5160-based platform details: Intel® preproduction Server platform with two Dual-Core Intel® Xeon® Processors 5160, 3.00 GHz with 4 MB L2 Cache, dual 1333 MHz system bus, 8 GB (8x1 GB) 667 MHz FB-DIMM memory; Microsoft Windows Server® x32 Enterprise Edition, SunGard Adaptiv® Credit Risk 64-bit version workload.

Quad-Core Intel® Xeon® Processor X5355-based platform details: Intel® preproduction Server platform with two Quad-Core Intel® Xeon® Processors X5355, 2.66 GHz with 2x4 MB L2 Cache, 1333 MHz system bus, 8 GB (8x1 GB) 667 MHz FB-DIMM memory, Microsoft Windows Server® x32 Enterprise Edition, SunGard Adaptiv® Credit Risk 64-bit version workload.

9. SPECcapc for 3ds max 8 Rendering

Workstation Benchmarks Performance Disclaimers — best published or measured results.

SPECcapc 3ds max® 8 — Rendering Score — Performance comparison of 2x Quad-Core Intel® Xeon® Processors X5355 (Intel internal reference workstation using X5000 chipset) scoring compared to 2x AMD Opteron® processors 285 (Sun Ultra™ 40) as of Nov. 7, 2006. Actual performance may vary. Source: HP

continued from previous page

10. Cinebench 9.5 x CPU Rendering CB Score

Workstation Benchmarks Performance Disclaimers — best published or measured results.

Cinebench® 9.5 x-CPU CB score — Performance comparison of 2x Quad-Core Intel® Xeon® Processors X5355 (HP xw8400 workstation using Intel X5000 chipset) scoring compared to 2x AMD Opteron® processors 285 (Sun Ultra® 40) as of Nov. 7, 2006. Actual performance may vary. Source: HP.

11. Monte Carlo Profit Simulator Excel 2003

Workstation Benchmarks Performance Disclaimers — best published or measured results.

Monte Carlo Profit Simulator using Microsoft Excel® 2003 completion time — sales and cost comparison simulating profits using the longest time to complete on four simultaneous copies. Performance comparison of 2x Quad-Core Intel® Xeon® Processors X5355 (HP xw8400 workstation using X5000 chipset) scoring compared to 2x AMD Opteron® processors 285 (Sun Ultra® 40) as of Nov. 7, 2006. Actual performance may vary. Source: HP.

12. POV-Ray 3.7 x64 Rendering PPS

Workstation Benchmarks Performance Disclaimers — best published or measured results.

POV-Ray® 3.7B15 x64 Rendering PPS score — built-in benchmark performance comparison of 2x Quad-Core Intel® Xeon® Processors X5355 (Intel internal reference workstation using X5000 chipset) scoring compared to 2x AMD Opteron® processors 285 (Sun Ultra® 40) as of Nov. 7, 2006. Actual performance may vary. See <http://www.haveland.com/index.htm?povbench/index.php> for more information. Source: Intel internal testing.

13. Linpack

Data Source: Published/Submitted results as of Nov. 14, 2006.

Dual-Core AMD Opteron® Processor Model 280-based platform details: IBM eServer e326m* server platform with two Dual-Core AMD Opteron® processors Model 280, 2.40 GHz.

Dual-Core Intel® Xeon® Processor 5160-based platform details: Verari Systems RM1220* Server with two Dual-Core Intel® Xeon® Processors 5160, 3.00 GHz with 4 MB L2 Cache, dual 1333 MHz system bus, 16 GB (8x2 GB) 667MHz FB-DIMM memory; Red Hat Enterprise Linux 4; Update 2, EM64T, Intel® Linpack 3.0.1.

Quad-Core Intel® Xeon® Processor X5355-based platform details: Verari Systems RM2220* Server with two Quad-Core Intel® Xeon® Processors X5355, 2.66 GHz with 8 MB L2 Cache, dual 1333 MHz system bus, 8 GB (8x1 GB) 667 MHz FB-DIMM memory; Red Hat Enterprise Linux 4; Update 4, EM64T, Intel® Linpack 3.0.1.

14. Fluent

Data Source: Published/Submitted results as of Nov. 14, 2006.

Dual-Core AMD Opteron® Processor Model 275-based platform details: IBM LS20* platform with two 2.2 GHz L2 Cache 2x1024 KB.

Dual-Core Intel® Xeon® Processor 5160-based platform details: Intel® preproduction customer reference board with two Dual-Core Intel® Xeon® Processors 5160, 3.00 GHz with 4 MB L2 Cache, dual 1333 MHz system bus, 8 GB (8x1 GB) 667 MHz FB-DIMM memory; Red Hat Enterprise Linux 4; Update 2, EM64T, Fluent 6.2.16.*

Quad-Core Intel® Xeon® Processor X5355-based platform details: IBM System x3650* server platform with two Quad-Core Intel® Xeon® Processors X5355, 2.66 GHz with 8 MB L2 Cache, dual 1333 MHz system bus, 12 GB (12x1 GB) FB-DIMM memory; Red Hat Enterprise Linux AS release 4; Nahant update 4, EM64T, Fluent 6.3.*

15. LS-Dyna

Data Source: Published/Submitted results as of Nov. 14, 2006.

Dual-Core AMD Opteron® Processor Model 285-based platform details: HP DL145* platform with two 2.6 GHz L2 Cache 2x1024 KB.

Dual-Core Intel® Xeon® Processor 5160-based platform details: Intel® preproduction customer reference board with two Dual-Core Intel® Xeon® Processors 5160, 3.00 GHz with 4 MB L2 Cache, dual 1333 MHz system bus, 8 GB (8x1 GB) 667 MHz FB-DIMM memory; Red Hat Enterprise Linux 4; Update 2, EM64T, LS-DYNA mpp970.5434a.*

Quad-Core Intel® Xeon® Processor X5355-based platform details: IBM System x3650* server platform with two Quad-Core Intel® Xeon® Processors X5355, 2.66 GHz with 8 MB L2 Cache, dual 1333 MHz system bus, 12 GB (12x1 GB) FB-DIMM memory; Red Hat Enterprise Linux AS release 4; Nahant update 4, EM64T, LS-DYNA mpp970s.*

Disclaimers:

*Relative performance for each benchmark is calculated by taking the actual benchmark result for the first platform tested and assigning it a value of 1.0 as a baseline. Relative performance for the remaining platforms tested was calculated by 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.

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, reference http://www.intel.com/performance/resources/benchmark_limitations.htm or call (U.S.) 1-800-628-8686 or 1-916-356-3104.

*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.

*64-bit computing on Intel architecture requires a computer system with a processor, chipset, BIOS, operating system, device drivers and applications enabled for Intel® 64 architecture. Processors will not operate (including 32-bit operation) without an Intel® 64 architecture-enabled BIOS. Performance will vary depending on your hardware and software configurations. Consult with your system vendor for more information.

*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.

*Compatibility and upgradeability to Quad-Core Intel® Xeon® processor 5300 series is determined by the manufacturer. Please check with your OEM to determine compatibility and upgradeability.

*Measured SPECint_rate for Clovertown 2.66/1333 vs published AMD Opteron 2220 SE (2.8 GHz, socket F)

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