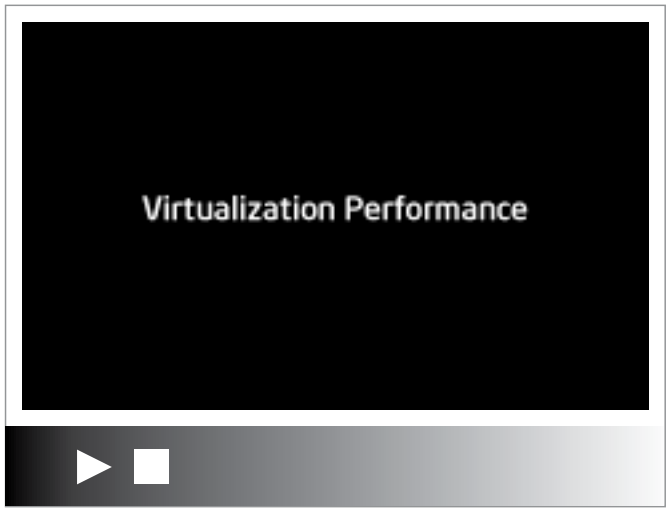
# Leading Virtualization Performance and Energy Efficiency in a Multi-processor Server

Product Brief

**Intel® Xeon® processor 7400 series**




**More Performance. Better Data Center Efficiency.**

With the architecture that's specifically built for virtualization, the Intel® Xeon® processor 7400 series gives you up to 48% better performance[1] and up to 40% better performance in a virtualized environment[2] than previous generations. Intel Xeon processor 7400 series helps provide your data center or business with the performance headroom needed to confidently consolidate applications onto fewer systems using proven virtualization solutions. It also provides the compute power necessary for critical business applications such as ERP and Business Intelligence.

## Performance for Your Data Demanding Business Applications

With enhanced 45nm technology, Intel® Virtualization Technology[3] and 6-core processors with 16 MB of L3 cache per processor, Intel Xeon processor 7400 series-based servers help drive your data-demanding enterprise applications faster. This allows you to be more productive and deliver more computing power and performance without increasing footprint or power demands.

Uniquely architected for data-demanding applications, virtualization and server consolidation, the Intel Xeon processor 7400 series lets you deploy increasingly powerful business tools to track your market-place and identify previously hidden opportunities.

With 50% more cores[4], 16 MB of shared L3 cache—2x the cache-memory capacity of the previous generation[5], and the performance-enhancing and energy-efficient technologies of the Intel Core microarchitecture, Intel Xeon processor 7400 series-based servers provide more computing power and strong, scalable performance. Together, these capabilities help your well-threaded, data demanding applications to perform at their peak. Additional scalable performance includes:

- Up to 48% more performance compared to previous generation of expandable servers[6]
- Up to 40% better performance in a virtualized environment than previous generations[7]
- 36% better performance on ERP applications[8]

**Figure 1.**

## Built for Virtualization, Built for Efficiency

Intel Xeon processor 7400 series is built specifically for virtualization and helps you keep up by optimizing server productivity and efficiency, and supports more virtual machines per server. On a four socket platform, with up to 24 threads and 16 MB of shared L3 cache per processor, you can consolidate your data center onto fewer systems. This may be done while providing the peak load responsiveness needed for the unpredictability of virtualized applications, while still reducing cooling challenges, and giving you more performance and services per square foot.

Intel Xeon processor 7400 series-based servers provide up to 10% reduction in platform power consumption[9] versus those with previous generation processors, with further reductions available with 65 and 50 watt versions, offered by multiple OEM partners for blade and ultra-dense applications.

The Intel Xeon processor 7400 series has integrated virtualization hardware support with Intel Virtualization Technology (Intel VT). Intel VT works by hardware assisting your virtualization environment and, in combination with powerful, reliable processor features, boost asset utilization and IT flexibility while reducing overall operating costs.

You can now build one compatible group of platforms offering maximum flexibility for live migration across all Intel Core microarchitecture-based servers including 1-socket Intel® Xeon® processor 3000 sequence-, 2-socket Intel® Xeon processor 5000 sequence-, and the scalable 4-socket Intel® Xeon® processor 7000 sequence-based servers.

The ability to conduct live VM migration offers tremendous flexibility for fail-over, load-balancing, disaster-recovery, and real-time server maintenance scenarios. And with Intel® VT FlexMigration, you have the capability to add future Intel® Xeon® processor-based systems to the same resource pool. This gives you the power to choose the right server platform to best optimize performance, cost, power, and reliability. These enhancements are further supplemented by additional processor, chipset, and NIC features, including:

- Virtual Machine Device Queues (VMDq), a network silicon technology that off-loads the network I/O management burden from the hypervisor, freeing processor cycles and improving overall system performance.
- Intel® VT FlexPriority, which optimizes virtualization software efficiency by improving interrupt handling.

## Intel Xeon processor 7400 series overview

The Intel Xeon processor 7400 series helps you keep up by optimizing server productivity and efficiency and letting you deploy more virtual machines per server. With powerful multi-core processors, you'll experience better productivity while using fewer servers.

| Features *(click features below to see benefits)* | Benefits |
|---|---|
| 6-Core Processing | |
| Enhanced Intel® Core™ Microarchitecture | |
| 16 MB of L3 Cache | |
| Intel® Virtualization Technology[2] | |
| 1066 MHz Dedicated High-Speed Interconnects (DHSI) | |
| Intel® 64 Architecture | |

## What is the 7000 Sequence?

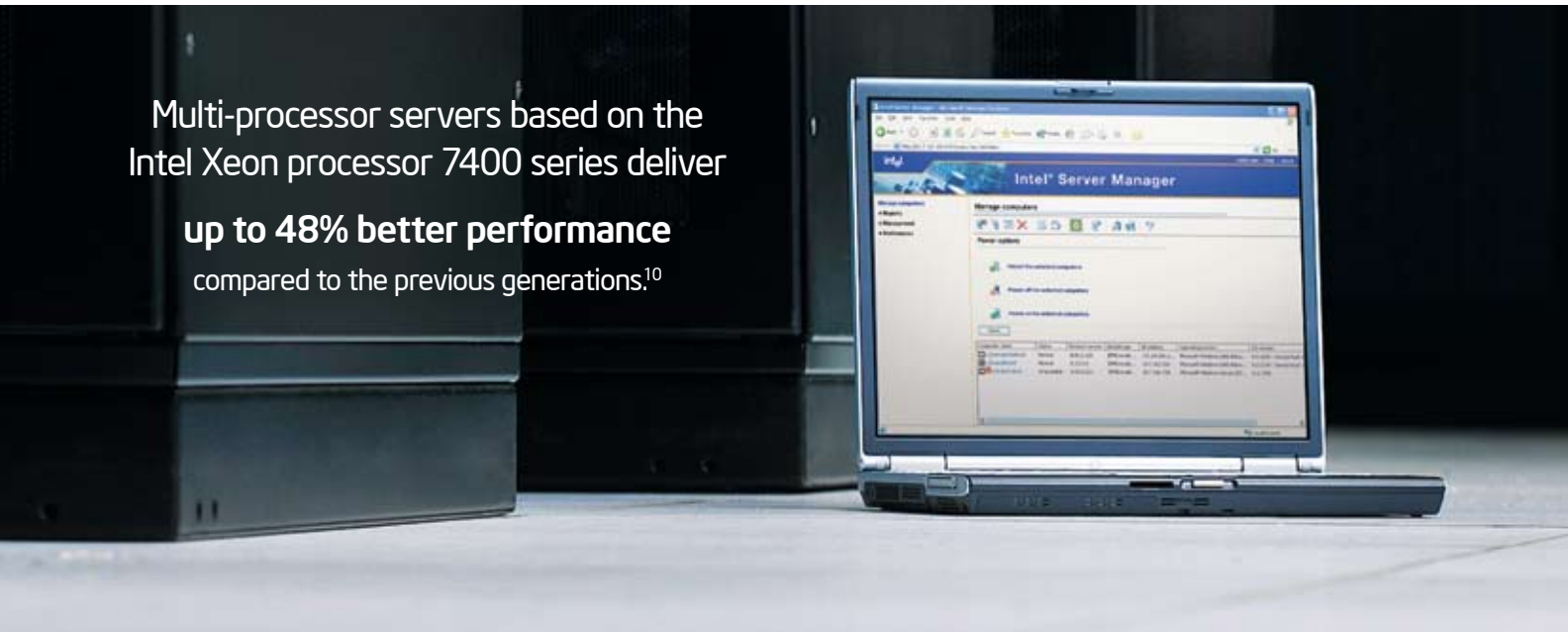
At Intel, our processor series numbers are designed to help clarify processor features, capabilities, and intended usages. Intel offers four processor number sequences for server applications:

- Intel® Xeon® processor 3000 sequence
  One-processor servers for small business, entry, or first server based on the Intel Xeon processor.
- Intel® Xeon® processor 5000 sequence
  Two-processor general-purpose, standard high-volume servers, HPC systems, and workstations based on Intel Xeon processors.
- Intel® Xeon® processor 7000 sequence
  Greater performance and scalability with 4- to 32-processor enterprise servers, with OEM systems supporting up to 16 processors at launch. These processors are designed for virtualization and data-demanding enterprise applications.
- Intel® Itanium® processor 9000 sequence
  Maximum scalability and RAS features for mission-critical workloads with 2- to 512-processor servers based on the Intel Itanium processor.

## SKU list

The Intel Xeon processor 7400 series is available in a range of features to match different computing demands. All processors integrate Intel Virtualization Technology and Intel 64 architecture, and are available in the FC-mPGA8 packaging. Intel Virtualization Technology, Intel FlexMigration, Intel FlexPriority, and Intel 64 architecture are standard on all SKUs. Higher frequency versions of the Intel Xeon processor 7400 series also support Demand-based Switching (DBS).

| Processor Number | Power | Cores Per Processor | Speed | L3 Cache | DBS |
|---|---|---|---|---|---|
| X7460 | 130 W | 6 | 2.66 GHz | 16 MB | Yes |
| E7450 | 90 W | 6 | 2.40 GHz | 12 MB | Yes |
| E7440 | 90 W | 4 | 2.40 GHz | 16 MB | Yes |
| E7430 | 90 W | 4 | 2.13 GHz | 12 MB | No |
| E7420 | 90 W | 4 | 2.13 GHz | 8 MB | No |
| L7455 | 65 W | 6 | 2.13 GHz | 12 MB | No |
| L7445 | 50 W | 4 | 2.13 GHz | 12 MB | No |



# Server Platform Designed for Your Needs

## Intel® 7300 Chipset

The Intel 7300 Chipset improves data movement across Intel Xeon processor 7400 series-based servers by increasing interconnect bandwidth, optimizing system bandwidth, increasing memory capacity, and improving network traffic processing while reducing I/O latency.[11] The Intel 7300 Chipset also has 28 lanes of PCI Express* with support for third-party expanders for additional I/O.

## Intel® Ethernet Server Adapter

Designed for Intel® Xeon® processors with features that distribute I/O processing across multiple CPU cores. Intel Ethernet Server Adapters are optimized for virtualization and include technologies such as Virtual Machine Device Queues (VMDq), which off-load some hypervisor functions to the network silicon, freeing processor cycles and improving overall system performance.

| Platform Features Enabled by the Intel 7300 Chipset with Data Traffic Optimizations Include: | |
|---|---|
| Dedicated High-Speed Interconnects (DHSI) | ▪ DHSI is an independent point-to-point interconnect between each of the four processors and the chipset. DHSI has increased the memory bandwidth by up to 2x over previous-generation multi-processor platforms[12] |
| 64 MB Snoop Filter | ▪ Significantly reduces data traffic on the DHSI providing lower latencies and greater available bandwidth. The snoop filter manages data coherency across processors with a directory of the current cached data, eliminating unnecessary snoops and boosting available bandwidth |
| Fully Buffered DIMM (FBDIMM) Technology | ▪ Provides 4x the memory capacity[13] (up to 256 GB based on 8 GB Fully Buffered DIMM)<br>▪ Increases memory speed to 1066 MHz |
| Intel® I/O Acceleration Technology (Intel® I/OAT) with Next-Generation Improvements (using Intel® Server Adapter) | ▪ Improves CPU utilization and lowers latency through features like low latency interrupts, MSI-X (next-generation interrupt handling) and stateless offloads<br>▪ Direct Cache Access (DCA) leverages Intel® QuickData Technology in the Intel 7300 Chipset, a platform solution designed to maximize the throughput of server data traffic and achieve faster, scalable, and more reliable I/O |

## Reliable Uptime

The Intel 7300 Chipset also builds in enhanced reliability to support continuous server availability and help prevent unplanned downtime.

| Reliability Feature | Benefit |
|---|---|
| Memory ECC | ▪ Detects and corrects single-bit errors |
| Enhanced Memory ECC | ▪ Retry double-bit errors |
| Memory Sparing | ▪ Predicts a failing DIMM and copies the data to a spare memory DIMM, maintaining server availability and uptime |
| Memory Mirroring | ▪ Data is written to two locations in system memory so that if a DRAM device fails, mirrored memory enables continued operation and data availability |
| Memory CRC | ▪ Address and command transmissions are automatically re-tried if a transient error occurs |
| Symmetric Access to All CPUs | ▪ Enables a system to restart and operate if the primary processor fails |

Rollover with your mouse to see what people are saying about the Intel® Xeon® Processor 7400 Series.

Intel offers a complete line of industry-leading single- and multi-port Gigabit and Fast Ethernet controllers. For more information go to: ***www.intel.com/network.***

## For I/O virtualization solutions go to, ***www.intel.com/go/vtc.***

**Configuration information for benchmarks in Figure 1.**
Platform common configuration details: Intel server pre-production platform with four processors Intel® Xeon® Processor X7350 (2.93 GHz, with 2x4M L2 Cache) or Intel® Xeon® Processor X7460 (2.66 GHz with 16M L3 Cache) 1066 MHz system bus, Intel® 7300 Chipset.

**TPC*C benchmark**
**Intel® Xeon® processor X7350 - based platform details**
IBM System x3950* M2 platform with eight Intel® Xeon® processors X7350 2.93 GHz (eight processors/32 cores/32 threads), 8 MB L2 cache, 512 GB memory, Microsoft Windows Server 2003* Enterprise x64 Ent. R2, Microsoft SQL Server 2005* Enterprise x64 Edition. Availability Date 4/1/2008. Application Result at http://www.tpc.org/tpcc/results/tpcc_result_detail asp?id=107102201.

**Intel® Xeon® processor X7460 - based platform details**
IBM* System x3950 M2 platform with eight Intel® Xeon® processors X7460 (2.66 GHz, 16 MB L2 cache, 6 cores) 8 processors/48 cores/48 threads), 512 GB memory, Red Hat Enterprise Linux Adv. Platform 5 Update 2, IBM DB2 ESE 9.5*. Availability Date 12/10/2008. Application benchmark performance certified on Sept 19, 2008 by IBM. Referenced as published at 1,200,632 tpmC and $1.99/tmpC. For more information see http://www.tpc.org/tpcc/results/tpcc_result_detail.asp?id=108081902.

**Performance gain claim based on TPC-E* benchmark details**
**Intel Xeon processor X7350 - based platform details**
Fujitsu Simens* Primergy RX600 S4 server platform with four Intel Xeon processors X7350 2.93 GHz, 2x4 MB L2 cache, 128 GB (32x4 GB) memory, Microsoft SQL Server 2008* Enterprise x64 Edition, Microsoft Windows Server 2008* Enterprise x64 Edition, TPC-E 492.32; Price/Performance: USD 559.88. Availability Date 1/1/09; Processors/Cores/Threads - 4/16/16; Application benchmark performance certified on Sept 10, 2008 by Fujitsu Simens.

**Intel Xeon processor X7460 - based platform details**
IBM* System x 3850 M2 server platform with four Intel Xeon processors X7460 (2.66 GHz, 16 MB L2 cache, 6 cores), 128 GB memory, Microsoft SQL Server 2008 Enterprise x64 Edition, Microsoft Windows Server 2008 Enterprise x64 Edition, TPC-E 729.65; Price/Performance: USD 457.27. Availability Date 10/31/08; Processors/Cores/Threads - 4/24/24; Application benchmark performance certified on Sept 15, 2008 by IBM.

**Reduced Platform power claim based on vConsolidate benchmark on VMware ESX Server results**
Comparison between Intel Xeon Processor 7400 and 7300 series based on vConsolidate benchmark result measured on Vmware ESX Server v3.5.0 by Intel corporation in September 2008.

**Virtualization benchmark**
**vConsolidate on VMware* ESX Server 3.5 benchmark details - Configuration Details**
Intel Xeon processor X7460, platform details: 4U Intel® S7000FC4UR (Fox Cove) Qual Server with four Intel Xeon X7460 (6-core, 16 M cache, 2.66 GHz, 1066FSB), 32 GB memory (16 2 GB FB-DIMM 667 MHz Kingston* KVR667D2D4F5/4G), Fibre Channel Adapter: 2* HBA Dual-Port QLE2462 PCIe* (one idle), storage configuration: EMC Clarion* CX3-40f 4Gb 15-slot array. Single RAID controller with 4 GB cache and a battery, dual PSMs with dual AC inputs. RAID 0, SAN: 10 Hitachi* 146 GB 15 K RAID 0 FC HDD, 2 DELTA* DSP-1570BB, Fans: 8, VMware* ESX Server 3.5 Update 2 RC (Build 94067).

Intel Xeon processor X7350, platform details: 4U Intel® S7000FC4UR (Fox Cove) Qual Server with four Intel Xeon X7350 (8 M cache, 2.93 GHz, 1066FSB) , 32 GB memory (16 2 GB FB-DIMM 667MHz Kingston* KVR667D2D4F5/4G), Fibre Channel Adapter: 2 HBA* Dual-Port QLE2462 PCIe (one idle), Storage configuration: EMC Clarion* CX3-40f 4 Gb 15-slot array. Single RAID controller with 4 GB cache and a battery, dual PSMs with dual AC inputs. RAID 0, SAN: 10 Hitachi* 146 GB 15 K RAID 0 FC HDD, 2 DELTA* DSP-1570BB, Fans: 8, VMware* ESX Server 3.5 Update 1 GA (build 82663).

**SAP SD claim**
**Intel Xeon processor X7350 - based platform details**
IBM* x3850 M2 server platform with four Intel Xeon processors X7350 (2.93 GHz 4 processors/16 cores/16 threads), 8 MB L2 cache, 64 GB memory, Microsoft Windows Server 2003 Enterprise Edition, IBM DB2 9, SAP ERP Release 6.0(2005). Referenced as published at 3,780 users. Certification 2007068 (PDF 41KB).

**Intel Xeon processor X7460 - based platform details**
HP ProLiant* DL580 G5 server platform with four Intel Xeon processors X7460 (2.66 GHz, 16 MB L2 cache, 6 cores), 24 cores, 24 threads, 64 GB memory, Microsoft Windows Server 2003 Enterprise Edition, Microsoft SQL Server 2005, SAP ERP Release 6.0(2005). Referenced as published at 5,155 users. Results submitted for publication to www.SAP.com.

SunFire* x4450 server platform with four Intel Xeon processors X7460 (2.66 GHz, 16 MB L2 cache, 6 cores), 24 cores, 24 threads, 80 GB memory, Solaris* 10 OS, MaxDB 7.6 Database, SAP ERP Release 6.0(2005) – unicode version. Referenced as published at 4,600 users. Certification 2008051.

**SPEC_int* claim**
**Intel Xeon processor X7350 - based platform details**
IBM* System x3850 M2 Server platform with four Intel Xeon processors X7350 2.93 GHz, 2x4 MB L2 cache, 16 x 4GB DDR2-PC5300, 64-Bit SUSE Linux Enterprise Server 10 SP1 Kernel Linux, Intel C++ Compiler for Linux32 and Linux64 Version 10.1 Build 20070725. Results submitted to www.spec.org as of Sept 4, 2007 at 184(SPECint_rate_base2006).

Lenovo* R630 G7 platform with four Xeon processors X7350 2.93 GHz, 2x4 MB L2 cache, 16GB memory (16x1 GB Samsung* DDR2 5300F, 2 rank, CL5-5-5, ECC), disk Seagate* 1x73 GB 10 krpm SAS, 64-Bit SUSE Linux Enterprise Server 10 SP1 kernel linux-cbgm 2.6.16.43-0.5-smp for x86_64, Intel C++ Compiler for Linux32 and Linux64 Version 10.1 Build 20070725. Referenced as published at 178(SPECint_rate_base2006) and 214(SPECint_rate2006).

**Intel Xeon processor X7460 - based platform details**
Fujitsu Siemens* Primergy RX600 S4 server platform with four Intel Xeon processors X7460 (2.66 GHz, 16 MB L2 cache, 6 cores), 64 GB Memory PC2-5300F CL5-5, Disk 73 GB 15 k SAS, SUSE Linux Enterprise Server 10 (x86_64) SP2, Kernel 2.6.16.60-0.21-smp, Intel C++ Compiler 11.0 for Linux Build 20080730 Package ID: l_cc_b_11.0.042. Reference as published at 268(SPECint_rate_base2006) and 291(SPECint_rate2006). Benchmark performed on Aug, 2008 by Fujitsu Siemens Computers.

**SPEC_jbb***
Intel® Xeon® processor X7350 - based platform details for BEA JVM: Dell PowerEdge* R900 server platform with four Intel Xeon processors X7350 2.93 GHz, 8 MB L2 Cache, 1066 MHz FSB, 64 GB memory, BEA JRockit* 6.0 P27.4.0 build P27.4.0-10-90053-1.6.0_02-20071009-1827-Windows-x86_64, Microsoft Windows server 2003 Enterprise x64 Edition SP1. Referenced as published at 446,209 bops and 55,776 bops/JVM. For more information see http://www.spec.org/jbb2005/results/res2007q4/jbb2005-20071105-00410.html.

Intel Xeon processor X7350-based platform details for Sun JVM: Sun Fire* X4450 server platform with four Intel Xeon processors X7350 2.93 GHz, 8 MB L2 Cache, 1066 MHz FSB, 64 GB memory, Java HotSpot* 32-Bit server VM on Solaris, version 1.6.0_06 Performance Release. Referenced as published at 464,355 bops and 58,044 bops/JVM. For more information see http://www.spec.org/osg/jbb2005/results/res2008q2/jbb2005-20080506-00485.html.

**VMmark benchmark configuration details**
Intel® Xeon® processor X7350-based platform: HP Proliant* DL580 G5 server platform with four Intel Xeon processors X7350 2.93 GHz, 2x4 MB L2 cache, 64 GB (16x4 GB) FBDimm memory, VMware ESX 3.5.0 Update 1, Vmmark v1.1 benchmark. Referenced as published at 14.14 @ 10 tiles. For more information see http://www.vmware.com/files/pdf/vmmark/vmmark_hp5.pdf.

Intel® Xeon® processor X7460-based platform: Dell PowerEdge R900* server platform with four Intel Xeon Processors X7460 (2.66 GHz, 16 MB L2 cache, 6 cores), 96 GB memory (24x4 GB 667 MHz ECC CL5 DDR2 dual rank), VMware ESX Server v3.5.0 Update 1, VMmark v1.1. Measured at score 18.49 @ 14 tiles. For more information, see http://www.vmware.com/files/pdf/vmmark/vmmark_dell_R900.pdf.

Intel® Xeon® processor X7460-based platform: IBM System* x3850 M2 server platform with four Intel Xeon Processors X7460 (2.66 GHz, 16 MB L2 cache, 6 cores), 96 GB memory (24x4 GB 667 MHz ECC CL5 DDR2 dual rank), VMware ESX Server v3.5.0 Update 2, VMmark v1.1. Measured at score 19.1 @ 14 tiles. For more information, see http://www.vmware.com/files/pdf/vmmark/vmmark_ibm4.pdf.

AMD Opteron* processor-based platform details: HP Proliant* DL585 G5 using 4x Quad-Core AMD Opteron processor 8360SE (2.5 GHz, 4 sockets/16 total cores/16 total threads), VMware ESX v3.5.0 Update 1, VMmark v1.0. Submitted July 28, 2008. 14.74 @ 10 tiles. For more information, see http://www.vmware.com/files/pdf/vmmark/vmmark_hp3.pdf.

Intel® Xeon® processor X5470-based platform: Dell PowerEdge M600* server platform with two Intel Xeon Processors X5470 (3.33GHz, 6x2MB L2 cache, 4 cores), 32 GB memory (8x4 GB 667 MHz ECC CL5 DDR2 dual rank), VMware ESX Server v3.5.0 Update 2, VMmark v1.1. Measured at score 8.97 @ 6 tiles and submitted to HYPERLINK "http://www.vmware.com/".

**vConsolidate on Microsoft Hyper-V benchmark details**
Comparison between Intel® Xeon® Processor 7400 and 7300 Series based on vConsolidate benchmark result published on Microsoft Windows Server Hyper-V by Principled Technologies http://www.principledtechnologies.com/Clients/Reports/Intel/vConHV2Sys0908.pdf as of September 2008.

**Intel Xeon processor X7460 and X7350-based platform details**
Intel server software development platform (Foxcove) with four Intel Xeon processors X7460 (2.66 GHz, 16 M L3 Cache, 6-cores) or X7350 (2.93 GHz, 8 M L2 Cache, 4-cores) 1066 MHz system bus, 8 MB L2 cache, Clarksboro chipset, 16x4 GB memory FBD PC2-5300F, maximum performance achieved using five CSUs for X7350 and 6 CSUs for X7460. vConsolidate version 2.0 profile 2.

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Performance data is accurate at time of document publication. For latest performance information, visit www.intel.com/performance.

1. Performance gain claim based on TPC-E Benchmark running Intel® Xeon® processor X7350-based platform vs. Intel® Xeon® processor X7460-based platform results September 2008; configuration details above. Reduced Platform power claim based on vConsolidate Benchmark on VMware ESX Server results; configuration details above. Comparison between Intel® Xeon® Processor 7400 and 7300 Series based on vConsolidate benchmark result measured on VMware ESX Server v3.5.0 by Intel Corporation in September 2008.
2. Virtualization performance gain claim based on vConsolidate benchmark running Intel Xeon processor 7350 vs. Intel Xeon processor 7460 results September 2008; configuration details above.
3. Intel Virtualization Technology requires a computer system with a processor, chipset, BIOS, virtual machine monitor (VMM), and applications enabled for virtualization technology. Functionality, performance or other virtualization technology benefits will vary depending on hardware and software configurations. Virtualization technology-enabled BIOS and VMM applications are currently in development.
4. Compared to previous generation processors.
5. Comparing Intel® Xeon® X7350 with 8 MB of L2 to Intel® Xeon® X7460 with 16 MB Shared L3.
6. Performance gain claim based on TPC-E Benchmark running Intel® Xeon® processor X7350-based platform vs. Intel® Xeon® processor X7460-based platform results September 2008; configuration details above. Reduced Platform power claim based on vConsolidate Benchmark on VMware ESX Server results; configuration details above. Comparison between Intel® Xeon® Processor 7400 and 7300 Series based on vConsolidate benchmark result measured on VMware ESX Server v3.5.0 by Intel Corporation in September 2008.
7. Virtualization performance gain claim based on vConsolidate benchmark running Intel Xeon processor 7350 vs. Intel Xeon processor 7460 results September 2008; configuration details above.
8. ERP performance claim based on SAP-SD* benchmark results September 2008; configuration details above.
9. Performance gain claim based on TPC-E Benchmark running Intel® Xeon® processor X7350-based platform vs. Intel® Xeon® processor X7460-based platform results September 2008; configuration details above. Reduced Platform power claim based on vConsolidate Benchmark on VMware ESX Server results; configuration details above. Comparison between Intel® Xeon® Processor 7400 and 7300 Series based on vConsolidate benchmark result measured on VMware ESX Server v3.5.0 by Intel Corporation in September 2008.
10. Performance gain claim based on TPC-E Benchmark running Intel® Xeon® processor X7350-based platform vs. Intel® Xeon® processor X7460-based platform results September 2008; configuration details above. Reduced Platform power claim based on vConsolidate Benchmark on VMware ESX Server results; configuration details above. Comparison between Intel® Xeon® Processor 7400 and 7300 Series based on vConsolidate benchmark result measured on VMware ESX Server v3.5.0 by Intel Corporation in September 2008.
11. Intel® processor numbers are not a measure of performance. Processor numbers differentiate features within each processor series, not across different processor sequences. See http://www.intel.com/products/processor_number for details.
12. As compared to previous platforms.
13. Over previous generations.

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