

Intel® Xeon® Processor 5600 Series

The Next Generation of Intelligent Server Processors

Product Brief

Intel® Xeon® Processor
5600 Series



In many organizations, IT infrastructure has begun to constrain business efficiency and growth. For the past decade, IT has rapidly added low-cost hardware to accommodate business growth. But with data centers now stretched to capacity in terms of power, cooling, and floor space, infrastructure is actually limiting IT from investing in innovation. The Intel® Xeon® processor 5600 series helps IT meet the performance, power, and innovation needs of the data center by delivering a new generation of processors built on 32nm technology that can automatically regulate power consumption, and intelligently adjusts server performance according to your application needs.

Maximize Performance. Minimize Power. Automatically.

As data centers reach the upper limits of their power and cooling capacity, efficiency has become the focus of extending the life of existing data centers and designing new ones. As part of these efforts, IT needs to refresh existing infrastructure with standard enterprise servers that deliver more performance and scalability, more efficiently. The Intel® Xeon® processor 5600 series automatically regulates power consumption and intelligently adjusts server performance according to your application needs, maximizing both energy efficiency and performance. The secret to this compelling combination is Intel's new 32nm Nehalem microarchitecture. Featuring Intel® Intelligent Power Technology® that automatically shifts the CPU and memory into the lowest available power state, while delivering the performance you need, the Intel Xeon processor 5600 series with Intel Microarchitecture Nehalem delivers the same performance as previous-generation servers but uses up to 30 percent less power.¹ And you can achieve up to a 95 percent reduction in energy costs when consolidating your single-core infrastructure with a new infrastructure built on Intel Xeon processor 5600.²

This groundbreaking intelligent server technology features:

- **Intel's new 32nm Microarchitecture Nehalem** built with second-generation high-k and metal gate transistor technology.
- **Intelligent Performance** that automatically optimizes performance to fit business and application requirements and delivers up to 40 percent more performance per watt than Intel® Xeon® processor 5500 series³
- **Automated Energy Efficiency** that scales energy usage to the workload to achieve optimal performance/watt and with new 40 watt processor options and support for lower power DDR3 memory, you can lower your energy costs even further.
- **Flexible virtualization** that offers best-in-class performance and manageability in virtualized environments to improve IT infrastructure and enable up to 15:1 consolidation over two socket, single-core servers.²

New standard enterprise servers and workstations built with this new generation of Intel® process technology offer an unprecedented opportunity to dramatically advance the efficiency of IT infrastructure and provide unmatched business capabilities.

A Smart Investment

Research shows that upgrading to multi-core servers with higher performing, more efficient processors can accelerate data center ROI, saving on power and cooling, space, labor, and software licensing costs. By refreshing IT infrastructure with more energy-efficient systems, you gain capacity to grow and to increase IT performance, reduce energy costs by 95 percent, and realize ROI in 5 months.²

With up to 15x the performance compared to installed single-core servers² and unique virtualization capabilities, Intel Xeon processor 5600 series lets you deliver more business results from every clock cycle, every IT man-hour, every watt, and every inch of data center space. The lower TCO and groundbreaking performance of the Intel Xeon processor 5600 series offers the opportunity to transform the competitiveness of your business and the economics of your data center.

Performance That Adapts to Your Software Environment

Application performance is critical for day-to-day business operations, as well as creating new products and reaching new customers. But many data centers are now at capacity, and new data centers are expensive to build. By refreshing data center infrastructure with more efficient servers, you can deliver additional performance and scalability within the same energy and space footprint.

The Intel Xeon processor 5600 series brings intelligent performance to the most widely deployed server architecture. The Intel Xeon processor 5600 series is the world's most adaptable server platform, adjusting performance and power usage in real time to meet the exact requirements of your computing workloads, while allowing manual adjustment for IT control.

The Intel Xeon processor 5600 series brings together a number of innovative technologies to deliver intelligent performance:

- **Intel® Turbo Boost Technology[§]** together with Intel Intelligent Power Technology, delivers performance on demand, letting processors operate above the rated frequency to speed specific workloads and reduce power consumption during low utilization periods.
- **Intel® Hyper-Threading Technology[¶]** benefits from larger caches and massive memory bandwidth, delivering greater throughput and responsiveness for multi-threaded applications.
- **Intel® QuickPath Technology** and an integrated memory controller speed traffic between processors and I/O controllers for bandwidth-intensive applications, delivering up to 4.4x the bandwidth for technical computing.⁴

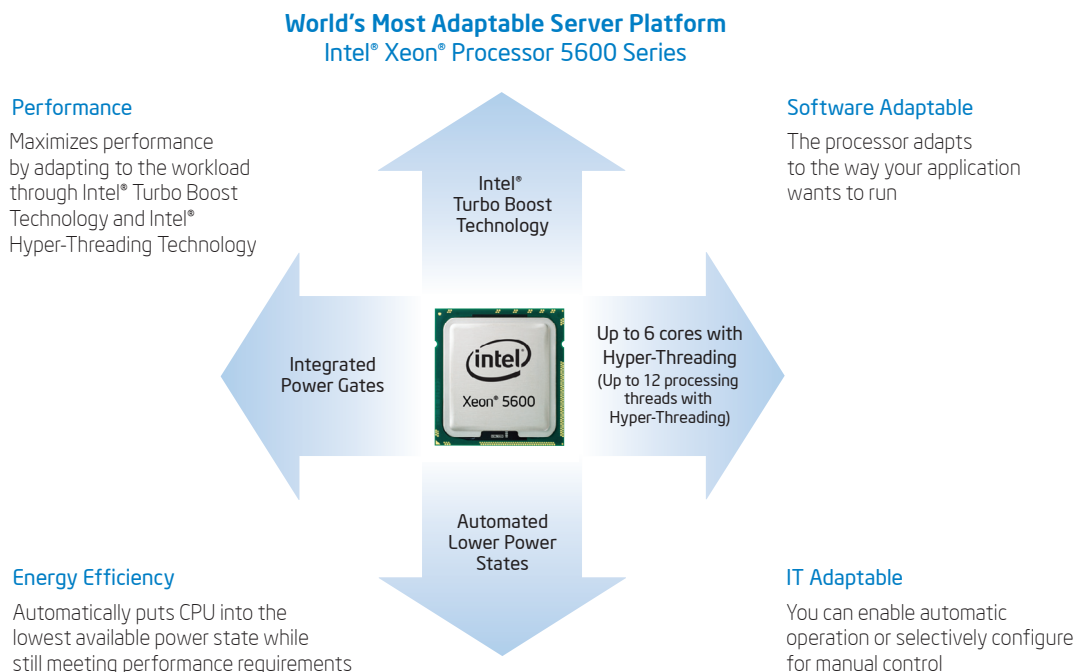
The intelligent performance of the Intel Xeon processor 5600 series also gives IT fine-grained manual control to adapt to changing priorities or to meet service-level agreements (SLAs). For example, Intel Intelligent Power Technology enables policy-based control that allows processors to operate at optimal frequency and power. The operating systems can make this determination automatically, or administrators can designate which applications require high-frequency processing and which should be executed at lower frequencies to conserve power.

Automating Energy Efficiency

After decades of IT build-out, server sprawl is escalating system management costs and outstripping available data center space, power and cooling capabilities. In a recent survey, 42 percent of data center owners said they would exceed power capacity within the next 12-24 months, and 39 percent said they would exceed cooling capacity in the same timeframe.⁵ Energy efficiency is becoming a critical issue in the data center.

Intel Xeon processor 5600 series automatically regulates power consumption to combine industry-leading energy efficiency with intelligent performance that adapts to your workload. With capabilities such as new lower power SKUs and low-voltage memory options that can save up to 10 percent in memory power;⁶ you can achieve up to 40 percent better performance in a similar power envelope.³ And the wide range of CPU, power, and memory options allows you to align your performance and energy requirements without having to make a trade-off in either.

In addition, Intel Intelligent Power Technology makes power available for critical workloads while conserving power when there is less demand. Intel Turbo Boost Technology is also available, which allows processors to deliver higher speed execution on demand by using available power to run at a higher frequency. Intel Xeon processor 5600 series gives you the intelligent performance and flexibility you need to build the data center of the future today.



Maximizing Benefits from Virtualization

Intel Xeon processor 5600 series can also help tame server sprawl by providing up to 15:1 consolidation capacity.² Built on Intel Microarchitecture Nehalem, the Intel Xeon processor 5600 series expands the benefits of virtualization beyond consolidation with innovations that can help boost performance, increase consolidation ratios, and enable servers of different generations to be combined in the same virtualized server pool, improving virtual machine failover, load balancing, and disaster recovery capabilities. With more performance in the same power envelope, you can use virtualization to deliver high-availability solutions with the agility to address disaster recovery and real-time workload balancing so your business can respond to the expected and the unexpected.

Intel Xeon processor 5600 series with next-generation Intel® Virtualization Technology⁵ (Intel® VT) enhances virtualization performance by up to 3.5x and reduces roundtrip virtualization latency by up to 2x.⁷

Other virtualization features include:

- **Intel® Virtualization Technology** (Intel® VT-x) continues to offer investment protection and infrastructure flexibility with multi-generation VM migration across the full range of 32-bit and 64-bit configurations, enabling bigger VM pools.
- **Intel® Virtualization Technology** for Connectivity (Intel® VT-c) provides hardware-assisted I/O that accelerates network performance and simplifies VM migration.
- **Intel® Virtualization Technology** for Directed I/O (Intel® VT-d) helps speed data movement and eliminates much of the performance overhead by giving designated VMs their own dedicated I/O devices, reducing the overhead of the VM migration in managing I/O traffic.


Secure, flexible virtualization

As enterprises become borderless, security attacks rise – from DoS to phishing to malware to data leakage. This keeps security challenges foremost in the minds of IT staff. And with the mixed environment in most data centers, servers are anything but secure. Intel Xeon processor 5600 series has two new security features that help you secure your data by speeding up data encryption and protecting against software attacks at launch.

Data encryption is not new, but new AES instructions from Intel are. In the past, data encryption either required custom hardware, such as security appliances and HDDs, or reduced CPU performance to manage. But with Intel® AES (Advanced Encryption Standard) Technology, you get robust encryption without needing additional appliances or increased performance overhead. In fact, AES-NI improves CPU performance for encryption by as much as a 52 percent for secure Internet transactions,⁸ and allows for broader use of encryption throughout the data center.

Intel® Trusted Execution Technology¹ (Intel® TXT) addresses a critical security need for all server deployments, especially virtualized and cloud-based use models by helping protect your server prior to OS launch or hypervisor launch. Intel TXT complements other malware protections such as anti-virus and intrusion detection to help ensure that only trusted software is on the platform. VMs on trusted platforms are also protected, so you can easily migrate them onto other trusted platforms or create pools of platforms with trusted hypervisors.

Intel Xeon processor 5600 series helps future proof your data center with improved security features for evolving usage models.



Intel® Microarchitecture Nehalem helps lower energy costs with automated energy-efficiency features that put processor power and memory into the lowest available states needed to support current workloads without compromising performance.

Exploring Intel® Microarchitecture Nehalem

The new generation of server processors from Intel provides a foundation for a fully adaptable IT environment. The architecture of these processors is designed with innovative features that adapt performance to software and business needs, help energy consumption for optimum performance and efficiency, and enable virtualization strategies that help your IT infrastructure adapt more quickly to your business needs.

Intel® Turbo Boost Technology

Intel Turbo Boost technology delivers performance when and where it's needed (see Figure 1). This technology allows processors to deliver higher speed execution on demand by using available power to run at a higher frequency.

Intel® Hyper-Threading Technology

Many server and workstation applications lend themselves to parallel, multi-threaded execution. Intel Hyper-Threading Technology enables simultaneous multi-threading within each processor core, up to two threads per core or eight threads per quad-core processor. Hyper-threading reduces computational latency, making optimal use of every clock cycle. For example, while one thread is waiting for a result or event, another thread is executing in that core, to maximize the work from each clock cycle.

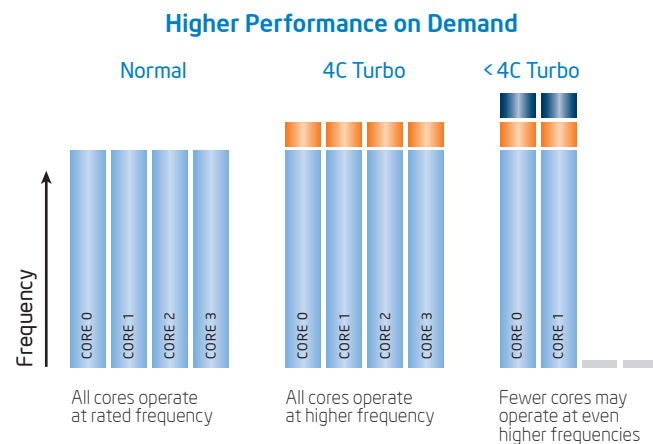


Figure 1. Intel® Turbo Boost Technology increases performance by increasing processor frequency and enabling faster speeds when conditions allow. Illustrated with 4 cores example. Could be up to 6 cores.

Intel® QuickPath Technology

To deliver top performance for bandwidth-intensive applications, the Intel Xeon processor 5600 series features Intel QuickPath Technology (see Figure 2). This new scalable, shared memory architecture delivers memory bandwidth leadership, and up to 4.4x the bandwidth of previous-generation processors.⁴

Intel QuickPath Technology is a platform architecture that provides high-speed (up to 25.6 GB/s), point-to-point connections between processors, and between processors and the I/O hub. Each processor has its own dedicated memory that it accesses directly through an Integrated Memory Controller. In cases where a processor needs to access the dedicated memory of another processor, it can do so through a high-speed Intel® QuickPath Interconnect (Intel® QPI) that links all the processors.

Intel Microarchitecture Nehalem complements the benefits of Intel QPI by enhancing Intel® Smart Cache with an inclusive shared L3 cache that boosts performance while reducing traffic to the processor cores.

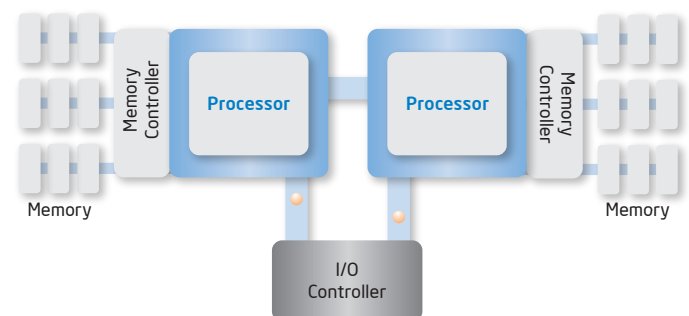


Figure 2. Intel® QuickPath Technology with dedicated per-processor memory and point-to-point connectivity.

Intel® Intelligent Power Technology

Within a single server, Intel Intelligent Power Technology minimizes power consumption when server components are not fully utilized.

- **Integrated Power Gates** (see Figure 3) allow individual idling cores to be reduced to near-zero power independent of other operating cores, reducing processor idle power consumption to 10 watts, versus 16 or 50 watts in prior-generations of Intel processors.⁹ This feature reduces server idle power consumption by up to 50 percent versus a previous generation of two-socket server processors.¹⁰
- **Automated Low-Power States** automatically put processor and memory into the lowest available power states that will meet the requirements of the current workload (see Figure 4). Processors are enhanced with more and lower CPU power states, and the memory and I/O controllers have new power management features.

Intel® Virtualization Technology

Next-generation Intel Virtualization Technology enhances virtualization performance with new hardware-assist capabilities across all elements of your server:

- **Processor:** Improvements to Intel Virtualization Technology (Intel VT-x) provides hardware-assisted page-table management, allowing the guest OS more direct access to the hardware and reducing compute-intensive software translation from the VMM. Intel VT-x also includes Intel VT FlexMigration and Intel VT Flex-Priority, which are capabilities for flexible workload migration and performance optimization across the full range of 32-bit and 64-bit operating environments.
- **Chipset:** Intel Virtualization Technology for Directed I/O (Intel VT-d) helps speed data movement and eliminates much of the performance overhead by giving designated virtual machines their own dedicated I/O devices, thus reducing the overhead of the VMM in managing I/O traffic.

- **Network Adapter:** Intel Virtualization Technology for Connectivity (Intel VT-c) further enhances server I/O solutions by integrating extensive hardware assistance into the I/O devices that are used to connect servers to the data center network and storage infrastructure. Two technologies comprise Intel VT-C: Virtual Machine Device Queues, which accelerates throughput and reduces the load on the VMM and server processors; and PCI-SIG SR-IOV, which delivers near-native throughput and provides dedicated, direct connectivity between VMs and hardware resources.¹¹

What is the 5000 Sequence?

At Intel, our Xeon processor series numbers are intended to help clarify processor features, capabilities and intended usages. Intel offers three Xeon 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. These processors are designed for virtualization and data-demanding enterprise applications.

Automatic Operation or Manual Core Control

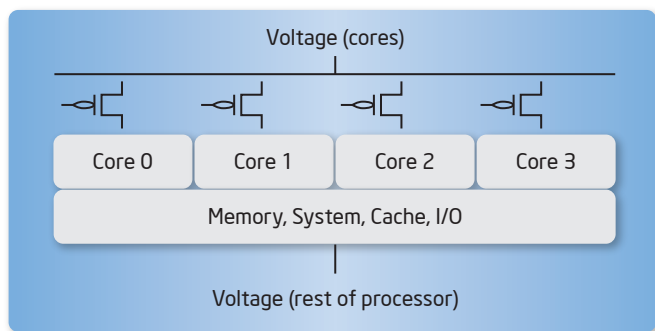


Figure 3. Integrated Power Gates enable idle cores to go to near-zero power independently. Illustrated with 4 cores example. Could be up to 6 cores.

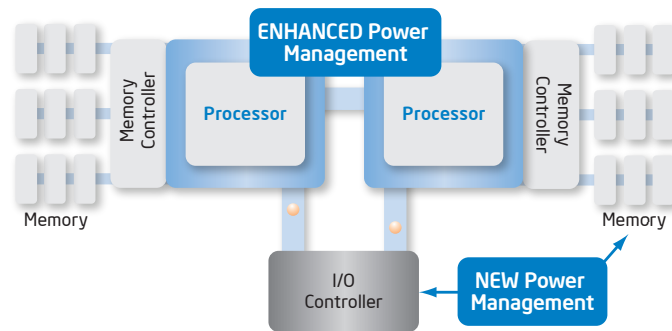


Figure 4. Automated Low-Power States adjusts system power consumption based on real-time load.

Intel Xeon Processor 5600 Series

The Intel Xeon processor 5600 series is available in a range of features to match different computing demands. All processors integrate Intel QuickPath Technology, Intel Intelligent Power Technology and Intel Virtualization Technology. Intel VT FlexMigration, Intel VT FlexPriority, and Intel® 64 Architecture[†] are standard on all SKUs.

Processor Number ^Δ	CPU Frequency	Intel® Turbo Boost Technology	Intel® HT Technology	L3 Cache	Number of Cores	Power	Intel® QPI Link Speed	DDR3 Memory
Intel® Xeon® Processor X5680	3.33 GHz	▪	▪	12 MB	6	130 W	6.4 GT/s ^a	1333, 1066, 800
Intel® Xeon® Processor X5677	3.46 GHz	▪	▪	12 MB	4	130 W	6.4 GT/s	1333, 1066, 800
Intel® Xeon® Processor X5670	2.93 GHz	▪	▪	12 MB	6	95 W	6.4 GT/s	1333, 1066, 800
Intel® Xeon® Processor X5667	3.06 GHz	▪	▪	12 MB	4	95 W	6.4 GT/s	1333, 1066, 800
Intel® Xeon® Processor X5660	2.80 GHz	▪	▪	12 MB	6	95 W	6.4 GT/s	1333, 1066, 800
Intel® Xeon® Processor X5650	2.66 GHz	▪	▪	12 MB	6	95 W	6.4 GT/s	1333, 1066, 800
Intel® Xeon® Processor E5640	2.66 GHz	▪	▪	12 MB	4	80 W	5.86 GT/s	1066, 800
Intel® Xeon® Processor L5640	2.26 GHz	▪	▪	12 MB	6	60 W	5.86 GT/s	1333, 1066, 800
Intel® Xeon® Processor E5630	2.53 GHz	▪	▪	12 MB	4	80 W	5.86 GT/s	1066, 800
Intel® Xeon® Processor L5630	2.13 GHz	▪	▪	12 MB	4	40 W	5.86 GT/s	1066, 800
Intel® Xeon® Processor E5620	2.40 GHz	▪	▪	12 MB	4	80 W	5.86 GT/s	1066, 800
Intel® Xeon® Processor L5609	1.86 GHz			12 MB	4	40 W	4.8 GT/s	1066, 800

^a GT/s = giga-transfers/second

Systems Designed for Your Needs

Standard, Enterprise Servers: Intel® 5520 and 5500 Chipset

Server and workstation platforms based on the Intel® 5520 and 5500 Chipset, combined with the Intel Xeon processor 5600 series, drive breakthrough performance and state-of-the-art technology to performance and mainstream server platforms.

The Intel 5520 Chipset supports the Intel Xeon processor 5600 series at 6.4 GT/s, 5.86 GT/s and 4.8 GT/s speeds via the Intel QuickPath Interconnect. Additionally, this chipset delivers support for 36 lanes of PCI Express 2.0 I/O, Intel VT-c and Intel VT-d enhancements for virtualization OS, Intel® Dynamic Power Node Manager system management, and support for Intel® ICH10, ICH10R and Intel® 6700PXH 64-bit PCI Hub.

The Intel 5500 Chipset supports the Intel Xeon processor 5500 series at 6.4 GT/s, 5.86 GT/s and 4.8 GT/s speeds via the Intel QuickPath Interconnect. Additionally, this chipset delivers support for 24 lanes of PCI Express 2.0 I/O, Intel VT-c and Intel VT-d enhancements for virtualization OS, Intel Dynamic Power Node Manager system management, and support for Intel ICH10, ICH10R and Intel 6700PXH 64-bit PCI Hub.

Workstations: Intel 5520 Chipset in Single or Dual I/O Hub (IOH) Configuration

The Intel 5520 chipset improves data movement across Intel Xeon processor 5500 series-based workstations and HPC systems by increasing interconnect bandwidth, optimizing system bandwidth, increasing memory capacity, and improving network traffic processing while reducing I/O latency.

These platform advancements help to match the improved performance of the Intel Xeon processor 5600 series and include:

- Point-to-point connections via the Intel QuickPath Interconnect at 4.8, 5.86 and 6.4 GT/s speeds
- Dual IOH configuration for higher I/O connectivity, up to 72 lanes for PCI Express 2.0
- Multiple x16 or x8 PCI Express 2.0 graphics card support
- Intel VT-c and Intel VT-d virtualization technology enhancements
- Intel Dynamic Power Node Manager system management support
- Intel ICH10 and ICH10R
- Intel 6700PXH 64-bit PCI Hub

Learn More

For more information on the Intel Xeon processor 5600 series, visit www.intel.com/xeon.

For more information about Intel Microarchitecture Nehalem, visit www.intel.com/technology/architecture-silicon/next-gen.

Intel processor numbers are not a measure of performance. Processor numbers differentiate features within each processor family, not across different processor families. See www.intel.com/products/processor_number for details.

³ Intel® Intelligent Power Technology requires a computer system with an enabled Intel® processor, chipset, BIOS and for some features, an operating system enabled for it. Functionality or other benefits may vary depending on hardware implementation and may require a BIOS and/or operating system update. Please check with your system vendor for details.

⁴ 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>.

⁵ Hyper-Threading Technology requires a computer system with a processor supporting Hyper-Threading Technology and an HT Technology enabled chipset, BIOS and operating system. Performance will vary depending on the specific hardware and software you use. See <http://www.intel.com/info/hyperthreading/> for more information including details on which processors support HT Technology.

⁶ 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.

⁷ No computer system can provide absolute security under all conditions. Intel® Trusted Execution Technology is a security technology under development by Intel and requires for operation a computer system with Intel® Virtualization Technology, an Intel Trusted Execution Technology-enabled processor, chipset, BIOS, Authenticated Code Modules, and an Intel or other compatible measured virtual machine monitor. In addition, Intel Trusted Execution Technology requires the system to contain a TPMv1.2 as defined by the Trusted Computing Group and specific software for some uses. See <http://www.intel.com/technology/security/> for more information.

⁸ 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.

¹ Source: Intel internal measurements based on SPECint_rate_base2006 (Linux). Baseline Configuration and Score on Benchmark: Supremicro™ pre-production system with two Intel® Xeon® processor X5570 (2.93 GHz, 8MB L3, 6.4 GT/s, Quad-core, 95W TDP), BIOS rev 01/06/2010, C3 Disabled, C6 Enabled, Turbo Enabled, HT Enabled, NUMA Enabled, Automatic Fan, 24 GB (6x4 GB DDR3-1333 DR registered ECC), 1x150 GB 10K RPM SATA HDD, 1x800w PSU, SLES 11 kernel: 2.6.27.19-5-default x86_64. Source: Intel internal testing as of Feb 2010. SPECint_rate_base2006 score: 249. New Configuration and Score on Benchmark: Supremicro™ pre-production system with two Intel® Xeon® processor L5640 (2.26 GHz, 12MB L3, 5.86 GT/s, Hex-core, 60W TDP), BIOS rev 01/06/2010, C3 Disabled, C6 Enabled, Turbo Enabled, HT Enabled, NUMA Enabled, Automatic Fan, 24 GB (6x4 GB DDR3-1333 DR registered ECC), 1x150 GB 10K RPM SATA HDD, 1x800w PSU, SLES 11 kernel: 2.6.27.19-5-default x86_64. Source: Intel internal testing as of Feb 2010. SPECint_rate_base2006 score: 257.

² 15:1 consolidation and 5 month ROI claim estimated based on comparison between 2S Single Core Intel® Xeon® 3.80 with 2M L2 Cache and 2S Intel® Xeon® processor X5680 series-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 3.80 GHz 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 (6x4 GB 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.

³ 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, 8 MB L3 cache, 6.4QPI, 8 GB memory (4x2 GB 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 Intel® Xeon® processor X5670 (12M Cache, 2.93 GHz, 6.40 GT/s Intel® QPI), 8 GB memory (4x2 GB DDR3-1333), 1 PSU, Microsoft Windows® Server 2008 Enterprise SP2. Intel internal measurement as of January 15, 2010.

⁴ STREAM_MP-Triad benchmark results comparing 2S Intel® Xeon® Processor E5472 (12M Cache, 3.00 GHz, 1600 MHz FSB), 16 GB memory (8x2 GB FB DDR2-800) based server platform to 2S Intel® Xeon® Processor X5680 (12M Cache, 3.33 GHz, 6.40 GT/s Intel® QPI) based server platform, 24 GB memory (12x4GB DDR3-1333). Source: Intel internal measurements SSG TR#942 and TR#1071 as of 12 February 2010.

⁵ Infoworld, March 26, 2008.

⁶ Based on voltage reduction from 1.50V to 1.35V, using Power (Watts) = I (current) x V (voltage)

⁷ Performance results on VMmark benchmark. Intel® Xeon® processor X5470 data based on published results for HP ProLiant ML370 G5 server platform with Intel® Xeon® processors X5470 3.33 GHz, 2x6 MB L2 cache, 1333 MHz FSB, 48 GB memory, VMware ESX® V3.5.0 Update 3 Published at 9:15@ 7 tiles vs. Intel reference platform using two Intel Xeon processors X5680 (12 M Cache, 3.33 GHz, 6.40 GT/s Intel® QPI), 96 GB memory (12x 8 GB DDR3-800 Reg ECC DIMMs), VMware ESX® V4.0 Update 1. Performance measured at 32.25@ 26 tiles. Roundtrip latency for the different CPU generations based on internal Intel CPU architectural assessments for Intel® Xeon® processor 5600 series (Nehalem) relative to Intel® Xeon® processor 5400 series (Penryn).

⁸ Source: Internal Intel measurements using a web banking workload running PHP and Windows Server 2008 R2, comparing number of banking sessions (users) for an Intel® Xeon® processor X5680 (3.33 GHz) vs. Intel Xeon® processor X5570 (2.93 GHz).

⁹ Per Intel specifications, and depends on processor SKU.

¹⁰ Intel internal measurements of 221W at idle with Supremicro™ 2xE5450 (3.0 GHz 80W) processors, 8x2 GB 667MHz FBDIMMs, 1x700W PSU, 1x320 GB SATA hard drive vs. 108W at idle with Supremicro software development platform with 2xE5640 (2.66 GHz Westmere-EP 80W) processors, 6x2 GB DDR3-1066 RDIMMs, 1x800W PSU, 1x150 GB 10k SATA hard drive. Both systems were running Microsoft Windows® 2008 with USB suspend select enabled and maximum power savings mode for PCIe link state power management. Measurements as of Feb 2009 and Feb 2010.

¹¹ Intel internal measurement. (April 2008) Ixia® IxChariot® 6.4 benchmark. VMware® ESX® v3.5U1. Intel® Xeon® processor E5355, 2.66 GHz, 8 MB L2 cache, 1333MHz system bus, 8GB memory (8x1 GB FB DIMM 667 MHz).

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