



PRODUCT BRIEF

# The Intelligent Choice for Evolving Data Centers

Intel® Xeon® Processor  
E5-4600/2600/2400/1600 Product Families



## Intel® Xeon® Processor E5-4600/2600/2400/1600<sup>1</sup> Product Families

IT organizations around the world are driving higher value into their businesses by virtualizing their data centers to reduce costs and adding automation to improve service levels, efficiency, and agility. Intel® Xeon® processor-based servers provide the foundation for this innovation. They account for the majority of all servers in today's virtualized data centers and clouds, and they also power many of today's highest-performing workstations.



### Up to 80 Percent Higher Performance

The Intel Xeon processor E5-4600/2600/2400/1600 product families deliver up to 80 percent higher performance<sup>2</sup> than their predecessors (see Table 1 on page 2). They provide more cores, cache, and memory capacity, along with bigger, faster communication pathways to move data more quickly. Two key technologies deliver additional high-value performance boosts:

- **Faster performance for peak workloads.** Intel® Turbo Boost Technology 2.0<sup>3</sup> automatically increases processor frequencies to take advantage of power and thermal headroom. This second-generation technology provides higher frequencies and greater intelligence so you gain even more performance when you need it, with greater energy efficiency.
- **Up to 2x performance gains** for floating point operations.<sup>4</sup> Intel® Advanced Vector Extensions (Intel® AVX) provides new instructions that can significantly improve<sup>5</sup> performance for applications that rely on floating point or vector computations. Up to 70 percent additional performance can be realized by using the 4-socket Intel Xeon processor E5-4600 product family in the same form factor.<sup>6</sup>

### Eliminating Network Bottlenecks

The Intel Xeon processor E5-4600/2600/2400/1600 product families open the floodgates for faster communications in dense virtual environments, both within the server and with external network and storage devices.

- **Intel® Integrated I/O for up to 2x higher bandwidth.**

The Intel Xeon processor E5-4600/2600/2400/1600 product families are the first Intel Xeon processors to have PCI Express\* 3.0 integrated on the processor die. They reduce latency by up to 30 percent,<sup>7</sup> provide up to 80 PCIe lanes per 2-socket server (160 lanes per 4-socket server), and support the PCIe 3.0 specification, which improves bandwidth by as much as 2x.<sup>8</sup>

- **Putting data right where you need it—fast.**

Intel® Data Direct I/O Technology enables direct data transfers from storage to cache. It more than doubles I/O performance<sup>9</sup> and reduces the need for performance-sapping memory accesses. Data flows faster to keep processor cores more productive and your applications more responsive.

### Strengthening Security in the Enterprise— and the Cloud

The Intel Xeon processor E5-4600/2600/2400/1600 product families provide a better foundation for protecting your business, especially when deploying sensitive applications on shared infrastructure.

- **Faster, stronger, enterprise-wide data protection.** Intel®

Advanced Encryption Standard New Instructions (Intel® AES-NI)<sup>10</sup> accelerates and strengthens encryption to enable faster and more secure online transactions and improved data protection. By improving performance and reducing overhead, it allows you to implement encryption pervasively to protect your business using compatible software from leading vendors, such as Oracle\*, Microsoft\*, and McAfee\*.

- **Hardened protection for virtual and cloud environments.** Establish trusted pools of virtual resources with Intel® Trusted Execution Technology (Intel® TXT).<sup>11</sup> Intel TXT ensures that physical servers and hypervisors boot only into cryptographically verified “known good states.” It safeguards your business more effectively by protecting your platform from the insertion of malware during or prior to launch.

### Driving Down Energy Costs at Every Level

Power and cooling costs have risen sharply, and now account for up to half of the operating expenses in many data centers.<sup>12</sup> The Intel Xeon processor E5-4600/2600/2400/1600 product families help you get more value out of every watt by optimizing performance versus energy consumption, not only for individual servers, but also for racks, rows, and entire data centers.

- **Industry-leading energy efficiency per server.** Intel® Intelligent Power Technology<sup>13</sup> has been enhanced to optimize performance versus power consumption even more effectively as server workloads vary. More sensors, finer-grained control, faster control loops, and more accurate optimizations increase power savings with little or no impact on application performance.

- **Automated control of server power.** Intel® Node Manager lets you monitor and control server power and set maximum limits for each server. You can use it to increase rack densities, adjust cooling based on actual demand, improve business continuity, and dynamically balance resources to accomplish more while spending less.
- **Power optimization across your data center.** Intel® Data Center Manager plugs into existing management frameworks to enable power and thermal monitoring and management for individual servers and groups of servers. With this tool, you gain unprecedented insight and control over power, cooling, and performance throughout your data center.

### Optimized Platform Solutions

Intel delivers higher overall value by engineering complete, highly-optimized platform solutions. The Intel® C600 series chipset and Intel® 10 Gigabit Ethernet solutions, for example, help to ensure high performance across diverse workloads and also provide advanced functionality, such as integrated serial attached SCSI (SAS) and Fiber Channel over Ethernet (FCoE). They can help you simplify, consolidate, and accelerate storage and network connectivity in today's virtual and cloud environments. They also extend Intel Intelligent Power Technology to optimize performance versus energy-efficiency across your server platform.

**Table 1. Intel® Xeon® processor E5-4600/2600/2400/1600 product families overview**

| FEATURES  | BENEFITS   |
|---|--|
| <b>High Performance for the Broadest Range of Applications and Environments</b> |  |
| Advanced multi-core, multi-threaded processing                                  | <ul style="list-style-type: none"> <li>▪ Up to 8 cores and 16 threads per socket</li> <li>▪ Ideal for virtualized data centers and public/private cloud deployments</li> </ul>   |
| Larger memory and cache configurations  | <ul style="list-style-type: none"> <li>▪ Up to 20 MB of last level cache for fast access to frequently used data</li> <li>▪ Up to 24 DIMMs per two-socket server and up to 48 DIMMs per four-socket server to support multiple data-hungry VMs</li> <li>▪ Faster maximum memory speeds than the previous generation (1600 MHz versus 1333 MHz)</li> </ul>  |
| Higher performance for peak workloads   | <ul style="list-style-type: none"> <li>▪ Intel® Turbo Boost Technology 2.0<sup>3</sup> takes advantage of power and thermal headroom to increase processor frequencies for peak workloads</li> <li>▪ Provides more and higher performance boosts and improved efficiency versus the previous generation</li> </ul>   |
| Higher performance for HPC applications   | <ul style="list-style-type: none"> <li>▪ Intel® Advanced Vector Extensions (Intel® AVX) accelerates vector and floating point computations by increasing maximum vector size from 128 to 256 bits</li> <li>▪ Provides up to 2x performance boost<sup>4</sup> for floating point operations, which can significantly increase performance for high performance computing (HPC)<sup>5</sup> applications</li> </ul>  |
| <b>Optimized Data Center Solutions to Reduce Costs</b>                          |  |
| Industry-leading I/O performance  | <ul style="list-style-type: none"> <li>▪ Intel® Integrated I/O provides up to 40 PCIe* lanes per socket, reduces latency by up to 30 percent<sup>6</sup>, and supports the PCIe* 3.0 specification, which improves bandwidth by as much as 2x<sup>7</sup>.</li> <li>▪ Intel® Data Direct I/O provides up to 2.3x higher I/O performance<sup>8</sup> by transmitting data directly from storage to cache</li> </ul> |
| The first integrated storage and server processor                               | <ul style="list-style-type: none"> <li>▪ Supports key storage processor features, including non-transparent bridging to increase scalability; the ability to connect multiple systems, each with access to the other's memory window; accelerated RAID, which eliminates the need for a custom ASIC to perform RAID 5 operations</li> </ul>  |
| Stronger, faster encryption to protect data                                     | <ul style="list-style-type: none"> <li>▪ Intel® Advanced Encryption Standards New Instructions (Intel® AES-NI)<sup>10</sup> enables pervasive encryption with fast application response times</li> </ul>   |
| Hardened protection for virtual/cloud environments                              | <ul style="list-style-type: none"> <li>▪ Intel® Trusted Execution Technology (Intel® TXT)<sup>11</sup> lets IT establish trusted pools of virtualized resources for stronger security in virtual and cloud environments</li> </ul>   |
| Industry-leading energy-efficiency  | <ul style="list-style-type: none"> <li>▪ Intel® Intelligent Power Technology<sup>13</sup> dynamically manages CPU and memory energy states as workloads vary to minimize power without slowing performance</li> <li>▪ More sensors, finer-grained control, faster control loops, and greater accuracy increase power savings versus the prior generation</li> </ul>  |
| Comprehensive monitoring and control  | <ul style="list-style-type: none"> <li>▪ Intel® Node Manager lets IT monitor and control server power</li> <li>▪ Intel® Data Center Manager lets IT dynamically optimize energy-consumption at every level, including individual servers, racks, rows, and entire data centers</li> </ul>  |

**Table 2. Intel® Xeon® processor E5 family specifications**

| PROCESSOR NUMBER <sup>1</sup>          | CPU FREQUENCY | INTEL® TURBO BOOST TECHNOLOGY | INTEL® HT TECHNOLOGY | L3 CACHE | NUMBER OF CORES | POWER | INTEL® QPI LINK SPEED | DDR3 MEMORY |
|--|---------------|-------------------------------|----------------------|----------|-----------------|-------|-----------------------|-------------|
| <b>For 4-Socket Servers - Advanced</b> |               |                               |                      |          |                 |       |                       |             |
| Intel® Xeon® Processor E5-4650         | 2.7 GHz       | 2.0                           | ▪                    | 20 MB    | 8               | 130 W | 8.0 GT/s              | 1600        |
| Intel® Xeon® Processor E5-4650L        | 2.6 GHz       | 2.0                           | ▪                    | 20 MB    | 8               | 115 W | 8.0 GT/s              | 1600        |
| Intel® Xeon® Processor E5-4640         | 2.4 GHz       | 2.0                           | ▪                    | 20 MB    | 8               | 95 W  | 8.0 GT/s              | 1600        |
| <b>For 4-Socket Servers - Standard</b> |               |                               |                      |          |                 |       |                       |             |
| Intel® Xeon® Processor E5-4620         | 2.2 GHz       | 2.0                           | ▪                    | 16 MB    | 8               | 95 W  | 7.2 GT/s              | 1333        |
| Intel® Xeon® Processor E5-4617         | 2.9 GHz       | 2.0                           | –                    | 15 MB    | 6               | 130 W | 7.2 GT/s              | 1600        |
| Intel® Xeon® Processor E5-4610         | 2.4 GHz       | 2.0                           | ▪                    | 15 MB    | 6               | 95 W  | 7.2 GT/s              | 1333        |
| <b>For 4-Socket Servers - Basic</b>    |               |                               |                      |          |                 |       |                       |             |
| Intel® Xeon® Processor E5-4607         | 2.2 GHz       | –                             | ▪                    | 12 MB    | 6               | 95 W  | 6.4 GT/s              | 1066        |
| Intel® Xeon® Processor E5-4603         | 2.0 GHz       | –                             | ▪                    | 10 MB    | 4               | 95 W  | 6.4 GT/s              | 1066        |
| <b>For 2-Socket Servers - Advanced</b> |               |                               |                      |          |                 |       |                       |             |
| Intel® Xeon® Processor E5-2690         | 2.9 GHz       | 2.0                           | ▪                    | 20 MB    | 8               | 135 W | 8.0 GT/s              | 1600        |
| Intel® Xeon® Processor E5-2680         | 2.7 GHz       | 2.0                           | ▪                    | 20 MB    | 8               | 130 W | 8.0 GT/s              | 1600        |
| Intel® Xeon® Processor E5-2670         | 2.6 GHz       | 2.0                           | ▪                    | 20 MB    | 8               | 115 W | 8.0 GT/s              | 1600        |
| Intel® Xeon® Processor E5-2667         | 2.9 GHz       | 2.0                           | ▪                    | 15 MB    | 6               | 130 W | 8.0 GT/s              | 1600        |
| Intel® Xeon® Processor E5-2665         | 2.4 GHz       | 2.0                           | ▪                    | 20 MB    | 8               | 115 W | 8.0 GT/s              | 1600        |
| Intel® Xeon® Processor E5-2660         | 2.2 GHz       | 2.0                           | ▪                    | 20 MB    | 8               | 95 W  | 8.0 GT/s              | 1600        |
| Intel® Xeon® Processor E5-2650         | 2.0 GHz       | 2.0                           | ▪                    | 20 MB    | 8               | 95 W  | 8.0 GT/s              | 1600        |
| Intel® Xeon® Processor E5-2650L        | 1.8 GHz       | 2.0                           | ▪                    | 20 MB    | 8               | 70 W  | 8.0 GT/s              | 1600        |
| Intel® Xeon® Processor E5-2643         | 3.3 GHz       | 2.0                           | ▪                    | 10 MB    | 4               | 130 W | 8.0 GT/s              | 1600        |
| Intel® Xeon® Processor E5-2637         | 3.0 GHz       | 2.0                           | ▪                    | 5 MB     | 2               | 80 W  | 8.0 GT/s              | 1600        |
| Intel® Xeon® Processor E5-2470         | 2.3 GHz       | 2.0                           | ▪                    | 20MB     | 8               | 95W   | 8.0 GT/s              | 1600        |
| Intel® Xeon® Processor E5-2450         | 2.1 GHz       | 2.0                           | ▪                    | 20MB     | 8               | 95W   | 8.0 GT/s              | 1600        |
| Intel® Xeon® Processor E5-2450L        | 1.8 GHz       | 2.0                           | ▪                    | 20MB     | 8               | 70W   | 8.0 GT/s              | 1600        |
| <b>For 2-Socket Servers - Standard</b> |               |                               |                      |          |                 |       |                       |             |
| Intel® Xeon® Processor E5-2640         | 2.5 GHz       | 2.0                           | ▪                    | 15 MB    | 6               | 95 W  | 7.2 GT/s              | 1333        |
| Intel® Xeon® Processor E5-2630         | 2.3 GHz       | 2.0                           | ▪                    | 15 MB    | 6               | 95 W  | 7.2 GT/s              | 1333        |
| Intel® Xeon® Processor E5-2630L        | 2.0 GHz       | 2.0                           | ▪                    | 15 MB    | 6               | 60 W  | 7.2 GT/s              | 1333        |
| Intel® Xeon® Processor E5-2620         | 2.0 GHz       | 2.0                           | ▪                    | 15 MB    | 6               | 95 W  | 7.2 GT/s              | 1333        |
| Intel® Xeon® Processor E5-2440         | 2.4 GHz       | 2.0                           | ▪                    | 15 MB    | 6               | 95 W  | 7.2 GT/s              | 1333        |
| Intel® Xeon® Processor E5-2430         | 2.2 GHz       | 2.0                           | ▪                    | 15 MB    | 6               | 95 W  | 7.2 GT/s              | 1333        |
| Intel® Xeon® Processor E5-2430L        | 2.0 GHz       | 2.0                           | ▪                    | 15 MB    | 6               | 60 W  | 7.2 GT/s              | 1333        |
| Intel® Xeon® Processor E5-2420         | 1.9 GHz       | 2.0                           | ▪                    | 15 MB    | 6               | 95 W  | 7.2 GT/s              | 1333        |
| <b>For 2-Socket Servers - Basic</b>    |               |                               |                      |          |                 |       |                       |             |
| Intel® Xeon® Processor E5-2609         | 2.4 GHz       | –                             | –                    | 10 MB    | 4               | 80 W  | 6.4 GT/s              | 1066        |
| Intel® Xeon® Processor E5-2603         | 1.8 GHz       | –                             | –                    | 10 MB    | 4               | 80 W  | 6.4 GT/s              | 1066        |
| Intel® Xeon® Processor E5-2407         | 2.2 GHz       | –                             | –                    | 10 MB    | 4               | 80 W  | 6.4 GT/s              | 1066        |
| Intel® Xeon® Processor E5-2403         | 1.8 GHz       | –                             | –                    | 10 MB    | 4               | 80 W  | 6.4 GT/s              | 1066        |
| <b>For 2-Socket Workstations</b>       |               |                               |                      |          |                 |       |                       |             |
| Intel® Xeon® Processor E5-2687W        | 3.1 GHz       | 2.0                           | ▪                    | 20 MB    | 8               | 150 W | 8.0 GT/s              | 1600        |
| <b>For 1-Socket Workstations</b>       |               |                               |                      |          |                 |       |                       |             |
| Intel® Xeon® Processor E5-1660         | 3.3 GHz       | 2.0                           | ▪                    | 15 MB    | 6               | 130 W | N/A                   | 1600        |
| Intel® Xeon® Processor E5-1650         | 3.2 GHz       | 2.0                           | ▪                    | 12 MB    | 6               | 130 W | N/A                   | 1600        |
| Intel® Xeon® Processor E5-1620         | 3.6 GHz       | 2.0                           | ▪                    | 10 MB    | 4               | 130 W | N/A                   | 1600        |

To learn more about Intel® Xeon® processor E5-4600/2600/2400/1600 product families, visit [www.intel.com/products/server/processor/xeonE5/index.htm](http://www.intel.com/products/server/processor/xeonE5/index.htm)

<sup>1</sup> 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](http://www.intel.com/products/processor_number) for details.

<sup>2</sup> Source: Performance comparison using best submitted/published 2-socket server results on the SPECfp\*\_rate\_base2006 benchmark as of 6 March 2012. Baseline score of 271 published by Itautec on the Servidor Itautec MX203\* and Servidor Itautec MX223\* platforms based on the prior generation Intel® Xeon® processor X5690. New score of 492 submitted for publication by Dell on the PowerEdge T620 platform and Fujitsu on the PRIMERGY RX300 S7\* platform based on the Intel® Xeon® processor E5-2690. For additional details, please visit <http://www.spec.org>. Intel does not control or audit the design or implementation of third party benchmark data or Web sites referenced in this document. Intel encourages all of its customers to visit the referenced Web sites or others where similar performance benchmark data are reported and confirm whether the referenced benchmark data are accurate and reflect performance of systems available for purchase.

<sup>3</sup> Requires a system with Intel® Turbo Boost Technology. Intel Turbo Boost Technology and Intel Turbo Boost Technology 2.0 are only available on select Intel® processors. Consult your PC manufacturer. Performance varies depending on hardware, software, and system configuration. For more information, visit <http://www.intel.com/go/turbo>

<sup>4</sup> Performance comparison using Linpack benchmark. Baseline score of 159.4 based on Intel internal measurements as of 5 December 2011 using a Supermicro® X8DTN+ system with two Intel® Xeon® processor X5690, Turbo Enabled, EIST Enabled, Hyper-Threading Enabled, 48 GB RAM, Red Hat® Enterprise Linux Server 6.1 beta for x86\_64. New score of 347.7 based on Intel internal measurements using an Intel® Rose City platform with two Intel® Xeon® processor E5-2690, Turbo Enabled or Disabled, EIST Enabled, Hyper-Threading Enabled, 64 GB RAM, Red Hat® Enterprise Linux Server 6.1 beta for x86\_64.

<sup>5</sup> Source: Intel internal measurements showing 62 percent, 78 percent, and 94 percent higher performance for the Intel Xeon processor E5 product family versus the Intel Xeon processor 5600 series on the SPECfp\*\_rate2006, STREAM, and Linpack benchmarks, respectively. Configurations: Benchmark: SPECfp\*\_rate2006 Intel Xeon processor E5 product family-based server: Intel® C606 Chipset-based CRB system with two Intel® Xeon® Sandy Bridge EP B-0 Stepping Processors (8-Core, 2.7GHz, 20MB L3 cache, 8.0 GT/s), 8 x 4GB 1333 RDIMMs, Turbo Disabled, HT Disabled, Red Hat Enterprise Linux 5.5, Kernel 2.6.35. Intel Xeon processor 5600 series-based server: Cisco B200-M1 system with two Intel® Xeon® X5690 Processors (6-Core, 3.46 GHz, 12MB L3 cache, 6.4 GT/s), 6 x 4GB 1333 RDIMMs, Turbo Enabled, HT Enabled, SuSe Linux Enterprise Server 11 (x86\_64), Kernel 2.6.27-15-2-default RC4. Benchmark: Stream® Triad (Windows®) Intel Xeon processor E5 product family-based server: Intel® C606 Chipset-based CRB system with two Intel® Xeon® Sandy Bridge EP B-0 Stepping Processors (8-Core, 2.7GHz, 20MB L3 cache, 8.0 GT/s), 8 x 8GB dual-rank 1600 RDIMMs (1 DPC), Turbo Enabled, HT Enabled, Microsoft Windows Server 2008 R2\*, Intel internal Windows StreamMP. Source: Intel internal testing as of January 2011. Score (Normalized relative to X5670 baseline): NTWs: 1.78, RFOs: 2.05. Intel Xeon processor 5600 series-based server: Intel® 5520 Chipset-based CRB system with two Intel® Xeon® X5670 Processors (6-Core, 2.93GHz, 12MB L3 cache, 6.4 GT/s), 6 x 4GB dual-rank 1333 RDIMMs (1 DPC), Turbo Enabled, HT Enabled, Microsoft Windows Server 2008 R2\*, Intel internal Windows StreamMP. Source: Intel internal testing as of January 2011. Score (Normalized relative to X5670 baseline): NTWs: 1.0, RFOs: 1.0. Benchmark: Linpack® Intel Xeon processor E5 product family-based server: Intel® C606 Chipset-based CRB system with two Intel® Xeon® Sandy Bridge EP B-0 Stepping Processors (8-Core, 2.7GHz, 20MB L3 cache, 8.0 GT/s), 8 x 4GB 1333 RDIMMs, Turbo Disabled, HT Disabled, Red Hat Enterprise Linux 5.5, Kernel 2.6.35. Intel Xeon processor 5600 series-based server: Cisco B200-M1 system with two Intel® Xeon® X5690 Processors (6-Core, 3.46 GHz, 12MB L3 cache, 6.4 GT/s), 6 x 4GB 1333 RDIMMs, Turbo Enabled/Disabled, HT Enabled/Disabled, SuSe Linux Enterprise Server 11 (x86\_64), Kernel 2.6.27-15-2-default RC4.

<sup>6</sup> Additional floating point throughput operations performance up to 70 percent claim based on performance comparisons using best measured 2- and 4-socket server results on the SPECfp\*\_rate\_base2006 (Source: TR#1195) Baseline 2-socket populated Intel® C606 Chipset-based customer reference server using two Intel® Xeon® processors E5-2690 (8C, 20M Cache, 2.9GHz, 8.0GT/s Intel® QPI), 64GB memory (8x 8GB DDR3-1600 DIMMs), Red Hat® Enterprise LINUX 6.1, Intel Compiler 12.0. Score: SPECfp\*\_rate\_base2006 = 486. New 4-socket populated Intel® C606 Chipset-based customer reference server using four Intel® Xeon® processors E5-4650 (8C, 20M Cache, 2.7GHz, 8.0GT/s Intel® QPI), 128GB memory (16x 8GB DDR3-1600 DIMMs), Red Hat® Enterprise LINUX 6.1, Intel Compiler 12.1. Score: SPECfp\*\_rate\_base2006 = 825.

<sup>7</sup> Intel measurements of average time for an I/O device read to local system memory under idle conditions. Improvement compares Xeon processor E5-2600 product family (230 ns) vs. Xeon processor 5500 series (340 ns). Baseline Configuration: Green City system with two Intel® Xeon processor E5520 (2.26GHz, 4C), 12GB memory @ 1333, C-States Disabled, Turbo Disabled, SMT Disabled, Rubicon® PCIe\* 2.0 x8. New Configuration: Meridian system with two Intel® Xeon processor E5-2665 (C0 stepping, 2.4GHz, 8C), 32GB memory @1600 MHz, C-States Enabled, Turbo Enabled. The measurements were taken with a LeCroy® PCIe\* protocol analyzer using Intel internal Rubicon (PCIe\* 2.0) and Florin (PCIe\* 3.0) test cards running under Windows® 2008 R2 w/SP1.

<sup>8</sup> 8 GT/s and 128b/130b encoding in PCIe 3.0 specification enables double the interconnect bandwidth over the PCIe 2.0 specification. Source: [http://www.pcisig.com/news\\_room/November\\_18\\_2010\\_Press\\_Release/](http://www.pcisig.com/news_room/November_18_2010_Press_Release/)

<sup>9</sup> Source: The claim of up to 2.3x I/O performance is based on Intel internal measurements comparing 1-socket SNB data for an L2 forwarding test using 8x10 GbE ports for the Intel® Xeon® processor E5 product family versus the Intel® Xeon® processor 5600 series.

<sup>10</sup> Testing with Oracle Database Enterprise Edition 11.2.0.2 with Transparent Data Encryption (TDE) AES-256 shows as much as a 10x speedup when inserting one million rows 30 times into an empty table on the Intel® Xeon processor X5680 (3.33 GHz, 36 MB RAM) using Intel IPP routines, compared to the Intel® Xeon® processor X5560 (2.93 GHz, 36 MB RAM) without Intel IPP.

<sup>11</sup> 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 TPM v1.2 as defined by the Trusted Computing Group and specific software for some uses. See <http://www.intel.com/technology/security/> for more information. Intel® AES-NI requires a computer system with an AES-NI enabled processor, as well as non-Intel software to execute the instructions in the correct sequence. AES-NI is available on select Intel® processors. For availability, consult your reseller or system manufacturer. For more information, see Intel® Advanced Encryption Standard Instructions (AES-NI) <http://software.intel.com/en-us/articles/intel-advanced-encryption-standard-instructions-aes-ni/>

<sup>12</sup> "Power Surge. The heat is rising—and costs, too—as tightly packed servers consume gobs of electricity." Darrell Dunn, InformationWeek, Feb. 27, 2006.

<sup>13</sup> 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.

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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.

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