Maximizing IT Value by Using High-End Server Processors

- Greater than 3x faster performance throughput for estimated 2x server cost
- Estimated 33-percent lower TCO to achieve the same performance throughput

Intel IT has standardized on Intel® Xeon® processors with a core frequency of 2.6 gigahertz (GHz) for two-socket servers to offer maximum IT value for design computing and enterprise server virtualization. Our analysis demonstrates that higher-end processors significantly enhance server performance throughput for a minimal increase in total cost of ownership (TCO).

We compared a wide range of server processor frequencies in our analysis, starting with lower-end Intel® Xeon® processor E5-2603 (four cores, 1.8 GHz) and including higher-end Intel® Xeon® processor E5-2640 (six cores, 2.5 GHz) and Intel® Xeon® processor E5-2670 (eight cores, 2.6 GHz). For Intel's electronic design automation (EDA) workloads, real-world application testing confirmed that servers based on the high-end processor delivered the same performance throughput for an estimated 33-percent lower TCO, as shown in Table 1.

Our analysis demonstrated to Intel IT management and purchasing groups that software acquisition and licensing costs—which represent 3x to 6x the cost of the hardware platform—are the largest drivers of overall TCO for servers deployed at Intel. We concluded that standardizing on high-end processors is a cost-effective way for Intel IT to maximize server return on investment (ROI).

Table 1. Electronic Design Automation (EDA) Performance Throughput and Total Cost of Ownership (TCO). In tests with actual Intel EDA workloads, servers based on high-end 2.6 GHz processors achieved the same performance throughput with lower TCO.

<table>
<thead>
<tr>
<th></th>
<th>Intel® Xeon® Processor E5-2603 (four cores, 1.8 GHz)</th>
<th>Intel® Xeon® Processor E5-2670 (eight cores, 2.6 GHz)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thermal Design Power</td>
<td>80 watts</td>
<td>115 watts</td>
</tr>
<tr>
<td>Relative Performance</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Throughput</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of Servers</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Power Consumed</td>
<td>669 watts</td>
<td>463 watts</td>
</tr>
<tr>
<td>Application Licenses</td>
<td>24</td>
<td>16</td>
</tr>
<tr>
<td>Relative TCO</td>
<td>1.00</td>
<td>0.67</td>
</tr>
</tbody>
</table>

GHz - gigahertz; TCO - total cost of ownership
Background

Intel’s worldwide data center environment includes more than 55,000 servers and supports more than 100,000 employees worldwide. About 80 percent of these servers are used for designing Intel products; the other 20 percent are used for enterprise and manufacturing computing.

We refresh thousands of servers each year, based on a four-year refresh cycle, with a focus on maximizing ROI and business value from each technology investment. To determine the optimum servers for our needs, we analyze both performance throughput and TCO, taking into account the cost of the server; the cost for software, including the OS, applications, and middleware; and data center costs including network, power, and cooling over the expected life of our servers.

We performed an evaluation focused exclusively on processor selection. Our goal was to determine which delivers better value: high-end processors or low-end processors.

Study

We compared the performance throughput and TCO of two-socket servers with varying thermal design power (TDP) and frequency levels starting from 80 watts (W) through 115 W. We evaluated processors ranging from Intel Xeon processor E5-2603 (four cores, 1.8 GHz) at the lower end through Intel Xeon processor E5-2670 (eight cores, 2.6 GHz) at the higher end.

We included the following four-year TCO elements in the analysis:

- **Hardware platforms.** We based our analysis on mainstream two-socket servers from major manufacturers.

- **Software.** We included the license and maintenance costs of software including OS, applications, middleware, security products, backup and restore, and manageability (monitoring, alerting, compliance, patching, and provisioning).

- **Data center.** We included data center power, cooling, hosting, and network connectivity costs.

**DESIGN COMPUTING**

To validate our analysis, we conducted performance throughput testing using actual Intel silicon design data set. The tests included simulation, timing analysis, physical verification, and optical proximity correction (OPC). To obtain the overall performance throughput per server, our tests loaded all the cores in each server: all eight cores in the server based on the dual-socket Intel Xeon processor E5-2603, all 12 cores in the server based on the dual-socket Intel Xeon processor E5-2640, and all 16 cores in the server based on the dual-socket Intel Xeon processor E5-2670. We measured runtime for each application and compared relative job performance throughput. The results are shown in Figure 1.

![Figure 1. Electronic Design Automation (EDA) Performance Throughput Comparison](image)
TCO Analysis

Our analysis of four-year TCO was based on comparing Intel IT server, software, and data center cost ratios. For each platform, the total cost of all software, including maintenance, averaged approximately 3.8x the server cost. Our data center costs included data center depreciation, network connectivity, and power and cooling for four years.

Results are shown in Table 2. We needed 3x more servers based on the low-end Intel Xeon processor E5-2603 to obtain similar throughput of the server based on the Intel Xeon processor E5-2670 (2.6 GHz). With the low-end server, we had a 50-percent increase in the number of software licenses, an 82-percent increase in data center connectivity and hosting costs, and a 44-percent increase in power requirements.

Conclusion

Our analysis demonstrated that higher-end processors deliver the maximum value to Intel IT. The analysis showed that four-year server TCO is dominated by software costs, which typically range from 3x to 6x the cost of the server platform. The costs for data center hosting, connectivity, and power and cooling are also significant factors. The server and, hence, the processor accounts for only a small percentage of overall cost, as shown in Figure 2. High-end processors substantially increase performance throughput and deliver better value to Intel IT.

Based on our analysis, using higher-end processors results in one of the following benefits:

- Substantial performance throughput increase for a modest increase in server cost
- Higher performance throughput for a given TCO
- Lower TCO to achieve the same performance throughput

Based on these performance throughput and TCO advantages, for two-socket servers, Intel IT has standardized on Intel Xeon processors with a core frequency of 2.6 GHz for design computing and enterprise server virtualization needs.

Table 2. Electronic Design Automation (EDA) Performance Throughput and Total Cost of Ownership (TCO) Comparing Higher-end Intel® Xeon® Processors and Lower-end Intel Xeon Processors. In tests with actual Intel EDA workloads, the servers based on high-end processors achieved the same performance throughput for an estimated 33-percent lower TCO.

<table>
<thead>
<tr>
<th></th>
<th>Intel® Xeon® Processors E5-2603</th>
<th>Intel® Xeon® Processors E5-2670</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(Four Cores, 1.8 GHz)</td>
<td>(Eight Cores, 2.6 GHz)</td>
</tr>
<tr>
<td>Thermal Design Power (W)</td>
<td>80</td>
<td>115</td>
</tr>
<tr>
<td>Number of Servers</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Memory</td>
<td>8 GB per core</td>
<td>8 GB per core</td>
</tr>
<tr>
<td>EDA Application Licenses</td>
<td>24</td>
<td>16</td>
</tr>
<tr>
<td>Relative Performance Throughput</td>
<td>1.00</td>
<td>3.14</td>
</tr>
<tr>
<td>Power Consumed (W)</td>
<td>669</td>
<td>463</td>
</tr>
<tr>
<td>Relative Power Consumed</td>
<td>1.44</td>
<td>1.00</td>
</tr>
<tr>
<td>Relative TCO</td>
<td>1.00</td>
<td>0.67</td>
</tr>
</tbody>
</table>

GHz - gigahertz; TCO - total cost of ownership; W - watts
For more straight talk on current topics from Intel's IT leaders, visit www.intel.com/it.

Software and workloads used in performance tests may have been optimized for performance only on Intel microprocessors. Performance tests, such as SYSmark and MobileMark, are measured using specific computer systems, components, software, operations and functions. Any change to any of those factors may cause the results to vary. You should consult other information and performance tests to assist you in fully evaluating your contemplated purchases, including the performance of that product when combined with other products. Configurations: System configurations and performance tests conducted are discussed in detail within the body of this paper. For more information go to www.intel.com/performance.

Intel processor numbers are not a measure of performance. Processor numbers differentiate features within each processor family, not across different processor families. For more information, go to Learn About Intel® Processor Numbers.

INFORMATION IN THIS DOCUMENT IS PROVIDED IN CONNECTION WITH INTEL PRODUCTS. NO LICENSE, EXPRESS OR IMPLIED, BY ESTOPPEL OR OTHERWISE, TO ANY INTELLECTUAL PROPERTY RIGHTS IS GRANTED BY THIS DOCUMENT. EXCEPT AS PROVIDED IN INTEL'S TERMS AND CONDITIONS OF SALE FOR SUCH PRODUCTS, INTEL ASSUMES NO LIABILITY WHATSOEVER AND INTEL DISCLAIMS ANY EXPRESS OR IMPLIED WARRANTY, RELATING TO SALE AND/OR USE OF INTEL PRODUCTS INCLUDING LIABILITY OR WARRANTIES RELATING TO FITNESS FOR A PARTICULAR PURPOSE, MERCHANTABILITY, OR INFRINGEMENT OF ANY PATENT, COPYRIGHT OR OTHER INTELLECTUAL PROPERTY RIGHT.

Intel, the Intel logo, and Xeon are trademarks of Intel Corporation in the U.S. and other countries.

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

AUTHORS
Shesha Krishnapura
Senior Principal Engineer, Intel IT

Ty Tang
Senior Principal Engineer, Intel IT

Vipul Lal
Senior Principal Engineer, Intel IT

Shaji Achuthan
Senior Staff Engineer, Intel IT