IT@Intel Brief

Intel IT
IT Competitive Advantage
IT Efficiency
February 2014

Accelerating Silicon Design with the Intel® Xeon® Processor E7-4800 v2 Product Family

- 1.84x increased throughput compared with previous generation Intel® Xeon® processor E7-4800 series.
- 14.40x increased throughout compared with Intel® Xeon® processor 7100 series.

Silicon design is one of the most critical business functions at Intel, and it requires significant computing resources. Larger and more compute-intensive design jobs require four-socket servers, which offer greater processing power and memory capacity to help ensure these long-running jobs are completed to meet critical design timelines. Accordingly, large-memory four-socket servers are an essential component of the Intel IT high-performance computing (HPC) silicon design environment.

Intel IT recently conducted tests to assess the potential benefits to silicon design of four-socket servers based on the Intel® Xeon® processor E7-4800 v2 product family. These servers include up to 15 cores and 37.5 MB last-level cache per processor—50 percent more cores than the previous generation. They also provide 3x the maximum memory, by supporting 64-GB DIMMs,[1] for application workloads that require large memory capacity. Our tests used a large multi-threaded electronic design automation (EDA) application operating on current Intel silicon design data sets.

This new server completed a complex silicon design workload 1.84x faster than a server based on previous generation Intel® Xeon® processor E7-4800 series and 14.40x faster than a server based on the Intel® Xeon® processor 7100 series, as shown in Figure 1.

Based on our results, the Intel Xeon processor E7-4800 v2 product family offers significant throughput improvements compared to prior generations; these improvements can accelerate long-running silicon design jobs, thereby helping to reduce the time required to bring new silicon designs to market.

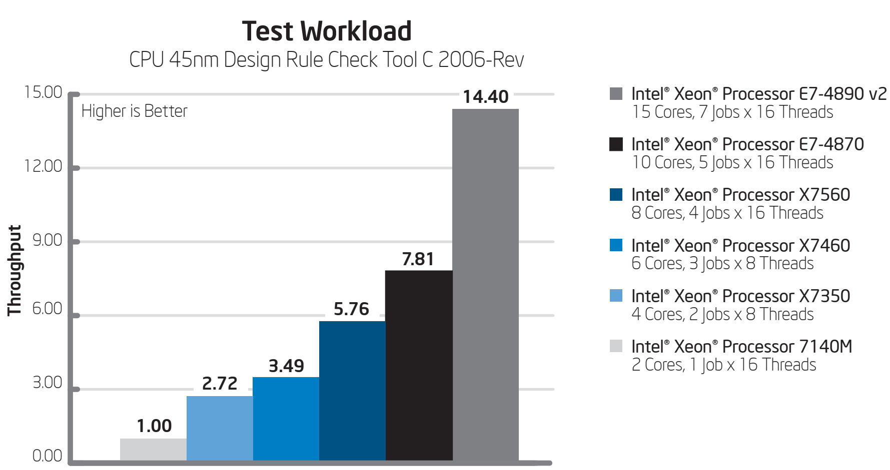


Figure 1. Four-socket servers based on the Intel® Xeon® processor E7-4800 v2 product family completed silicon design workloads 14.40x faster than previous generation processors in Intel IT tests. Intel internal measurements, January 2014.

Business Challenge

To continue to deliver on the promise of Moore's Law, silicon chip design engineers at Intel face the challenges of integrating more features into ever-shrinking silicon chips, bringing products to market more quickly and keeping design engineering and manufacturing costs low. As design complexity increases, the requirements for compute capacity also increase; therefore, refreshing servers and workstations with faster systems is cost effective and offers a competitive advantage by enabling faster chip design.

The largest, most compute-intensive back-end design jobs require servers with considerable processing power, memory capacity, and memory bandwidth. Servers also must provide higher availability, along with support for large local disk drives, to help ensure completion of these long-running design jobs to meet critical design timelines.

We conducted performance comparison tests using EDA applications and current silicon design workloads to evaluate the potential of servers based on the Intel Xeon processor E7-4800 v2 product family to accelerate silicon design compared with servers based on previous processors.

The Intel Xeon processor E7-4800 v2 product family includes new features that can increase EDA throughput, including up to 15 cores and up to 37.5 MB of last-level cache—50 percent more cores than the previous generation. Four-socket servers based on these processors include up to 60 cores and can run up to 120 simultaneous threads using Intel® Hyper-Threading Technology (Intel® HT Technology). They provide 3x the memory capacity compared with previous generations, supporting up to 1.5 TB of memory per socket using 24 64-GB DIMMs (a total of up to 6 TB of memory per server). Figure 2 shows a four-socket platform based on the Intel Xeon processor E7-4800 v2 product family, along with the previous generations for comparison.

The Intel Xeon processor E7-4800 v2 product family is more energy efficient than previous generations, delivering increased performance within the same power envelope due to the use of 22nm process technology and features such as Intel® Intelligent Power Technology, which automatically shifts the CPU and memory into the lowest available power state.

The purpose of our tests was to measure the EDA application throughput improvement we could achieve using servers based on the Intel Xeon processor E7-4800 v2 product family. Increased EDA throughput would enable us to accelerate key design tasks and potentially bring products to market more quickly.

Test Methodology

We ran tests using an industry-leading design rule check (DRC) EDA application operating on our chip design workloads on four-socket servers based on different Intel® processor generations:

- Intel® Xeon® processor 7140M with two cores
- Intel® Xeon® processor X7350 with four cores
- Intel® Xeon® processor X7460 with six cores
- Intel® Xeon® processor X7560 with eight cores
- Intel® Xeon® processor E7-4870 with 10 cores
- Intel® Xeon® processor E7-4890 v2 with 15 cores

Table 1 shows the test configurations.

We recorded throughput for each platform, measuring and comparing the time taken to complete a specific number of design workloads.

To maximize throughput, we configured the application to utilize most of the available cores. This resulted in multiple simultaneous jobs on each platform, as shown in Table 2. We enabled Intel HT Technology where available; this provided 120 logical cores on the server based on Intel Xeon processor E7-4890 v2, enabling us to run seven 16-threaded jobs simultaneously.

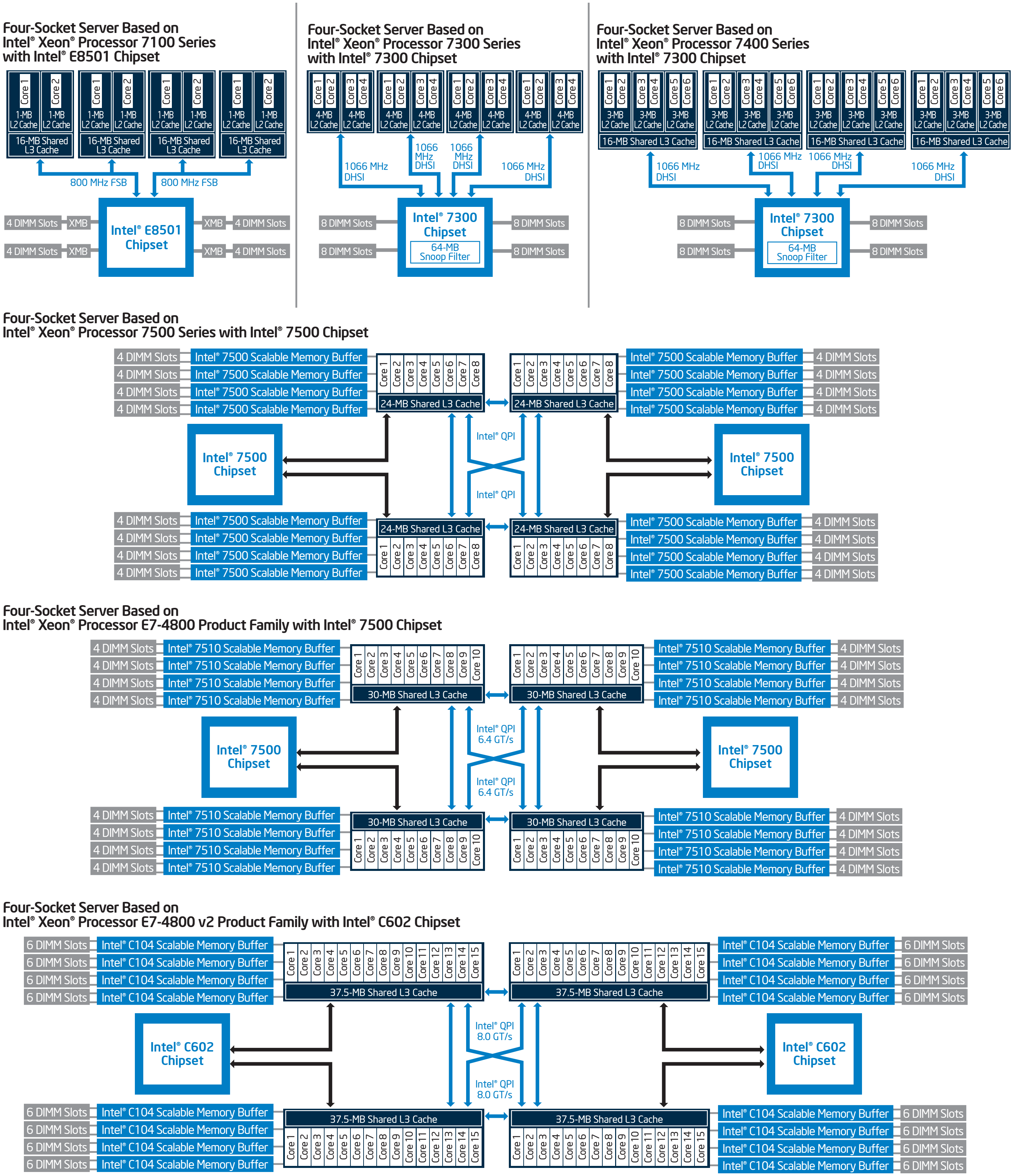
Table 1. Test System Specifications

	Intel® Xeon® Processor 7140M	Intel® Xeon® Processor X7350	Intel® Xeon® Processor X7460	Intel® Xeon® Processor X7560	Intel® Xeon® Processor E7-4870	Intel® Xeon® Processor E7-4890 v2
Cores per Processor	2	4	6	8	10	15
Speed	3.4 GHz	2.93 GHz	2.66 GHz	2.26 GHz	2.4 GHz	2.8 GHz
Process Technology	65nm	65nm	45nm	45nm	32nm	22nm
Last-Level Cache per Processor	16 MB	2 x 4 MB	16 MB	24 MB	30 MB	37.5 MB
Intel® Turbo Boost Technology	N/A	N/A	N/A	Enabled	Enabled	Enabled
Hyper-Threading	Enabled	N/A	N/A	Enabled	Enabled	Enabled
NUMA Mode	N/A	N/A	N/A	Enabled	Enabled	Enabled
Chipset	Intel® E8501	Intel® 7300	Intel® 7300	Intel® 7500	Intel® 7500	Intel® C602
Front Side Bus/ Intel® QPI Speed	800 MHz Dual Shared	1066 MHz DHSI	1066 MHz DHSI	6.4 GT/s Intel QPI	6.4 GT/s Intel QPI	8.0 GT/s Intel QPI
RAM	64 GB (16x 4 GB)	128 GB (32x 4 GB)	128 GB (32x 4 GB)	256 GB (64x 4 GB)	512 GB (64x 8 GB)	512 GB (64x 8 GB)
RAM Type	DDR2-400	FB-DIMM-667	FB-DIMM-667	DDR3-1333[∞]	DDR3-1333[∞]	DDR3-1600[§]
Hard Drives	2 x 73 GB 10K RPM SCSI	2 x 73 GB 10K RPM SAS	2 x 73 GB 10K RPM SAS	2 x 146 GB 10K RPM SAS	2 x 146 GB 10K RPM SAS	2x 300 GB 15K RPM SAS

Intel® QPI - Intel® QuickPath Interconnect

[∞] DDR3-1333 runs at 1066 MHz on Intel® Xeon® processor X7560 and Intel® Xeon® processor E7-4870.

[§] DDR3-1600 runs at 1333 MHz on Intel® Xeon® processor E7-4890 v2.



Intel® QPI – Intel® QuickPath Interconnect; XMB – eXternal memory bridge

Figure 2. Four-socket servers based on different generations of Intel® Xeon® processors.

Table 2. Results of Intel IT Tests Comparing Throughput of Four-Socket Servers Running Electronic Design Automation (EDA) Applications

Design Rule Check Application - CPU 45nm Design Testcase; 43 GB Peak Memory Per Job						
	Intel® Xeon® Processor 7140M	Intel® Xeon® Processor X7350	Intel® Xeon® Processor X7460	Intel® Xeon® Processor X7560	Intel® Xeon® Processor E7-4870	Intel® Xeon® Processor E7-4890 v2
Number of Jobs and Threads per Iteration	1 Job x 16 Threads/Job	2 Jobs x 8 Threads/Job	3 Jobs x 8 Threads/Job	4 Jobs x 16 Threads/Job	5 Jobs x 16 Threads/Job	7 Jobs x 16 Threads/Job
Total Iterations Needed to Complete 420 Jobs	420	210	140	105	84	60
Total Time to Complete 420 Jobs	4182:02:00	1536:09:00	1197:18:40	725:47:53	535:42:02	290:25:17
Relative Throughput	1.00	2.72	3.49	5.76	7.81	14.40

Results

With 1.50x as many cores as the previous-generation system based on Intel Xeon processor E7-4870, the server based on Intel Xeon processor E7-4890 v2 completed the workloads 1.84x faster, representing a greater-than-linear increase in throughput. It was 14.40x faster than the system based on Intel Xeon processor 7140M. Results are shown in Table 2 and Figure 1.

Conclusion

The Intel Xeon processor E7-4800 v2 product family has the potential to deliver significant benefits for silicon design at Intel. Our testing indicated that servers based on the Intel Xeon processor E7-4800 v2 product family could be an efficient platform for our large design workloads; the server based on this product family delivered a greater-than-linear performance increase, relative to the growth in the number of cores and cache size, compared with the previous server generation based on the Intel Xeon processor E7-4800 product family.

We anticipate that the faster throughput performance will allow engineers to accelerate key design tasks in Intel's HPC environment, potentially helping us to bring products to market more quickly.

Our results suggest that other technical applications with large memory requirements, such as simulation and verification applications in the auto, aeronautical, oil and gas, and life sciences industries, could see similar improvements.

Systems based on the Intel Xeon processor E7-4800 v2 product family are also expected to help control operational and software licensing costs by achieving greater throughput using fewer systems than were necessary with previous generations of processors. Based on our results, one new server based on the Intel Xeon processor E7-4890 v2 could replace up to about 15 older servers based on the Intel Xeon processor 7140M.

Based on our evaluation, we plan to deploy systems based on the Intel Xeon processor E7-4800 v2 product family in order to achieve these benefits for our silicon design teams and for Intel IT.

For more straight talk on current topics from Intel's IT leaders, visit www.intel.com/IT.

AUTHORS

Shesha Krishnapura
Senior Principal Engineer, Intel IT

Vipul Lal
Senior Principal Engineer, Intel IT

Ty Tang
Senior Principal Engineer, Intel IT

Shaji Achuthan
Senior Staff Engineer, Intel IT

[1] Intel IT tests used 8-GB DIMMs.

Look Inside.™