Brief
June 2015

IT@Intel
Accelerating Silicon Design with the Intel® Xeon® Processor E7-8800 v3 Product Family

- 1.18x increased throughput compared with previous-generation Intel® Xeon® processor E7-4800 v2 series.
- 17.04x 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 E7-8800 v3 product family. These servers include up to 18 cores and 45 MB last-level cache per processor—20 percent more cores than the previous generation. They support 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 1.18x faster than a server based on previous-generation Intel® Xeon® processor E7-4800 v2 series and 17.04x 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 E7-8800 v3 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.

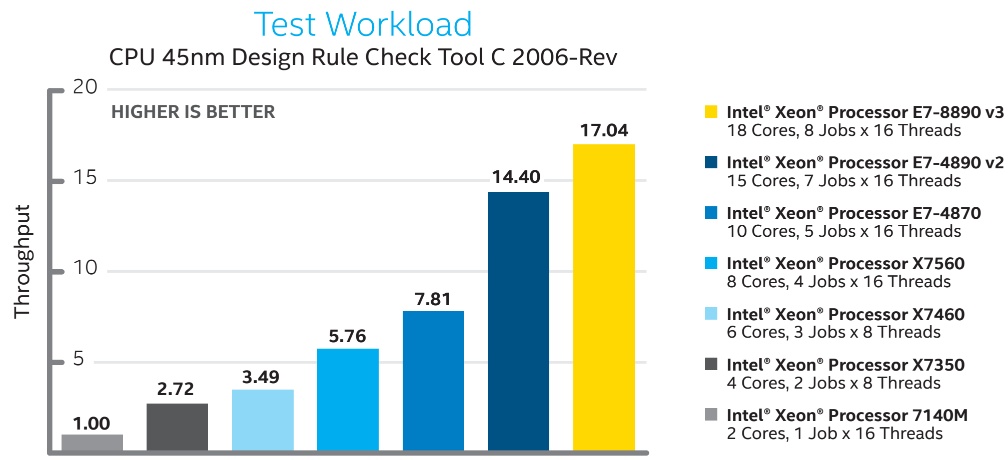

Figure 1. Four-socket servers based on the Intel® Xeon® processor E7-8800 v3 product family completed silicon design workloads 17.04x faster than a server based on the Intel® Xeon® processor 7100 series in Intel IT tests. Intel internal measurements, February 2015.

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

Contents

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 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 E7-8800 v3 product family to accelerate silicon design compared with servers based on previous generations of processors.

The Intel Xeon processor E7-8800 v3 product family includes new features that can increase EDA throughput, including up to 18 cores and up to 45 MB of last-level cache—20 percent more cores than the previous generation. Four-socket servers based on these processors include up to 72 physical cores and can run up to 144 simultaneous threads using Intel® Hyper-Threading Technology[2] (Intel® HT Technology). They support large memory capacity up to 6 TB per server with higher-capacity 64 GB DIMMs. Figure 2 shows a four-socket platform based on the Intel Xeon processor E7-8800 v3 product family, along with the previous generations for comparison.

20% MORE CORES

Intel Xeon processor E7-8800 v3 product family includes up to 18 cores and up to 45 MB of last-level cache.

The Intel Xeon processor E7-8800 v3 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[2], 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 E7-8800 v3 product family with a higher core count. Increased EDA throughput would enable us to accelerate key design tasks and potentially bring products to market more quickly.

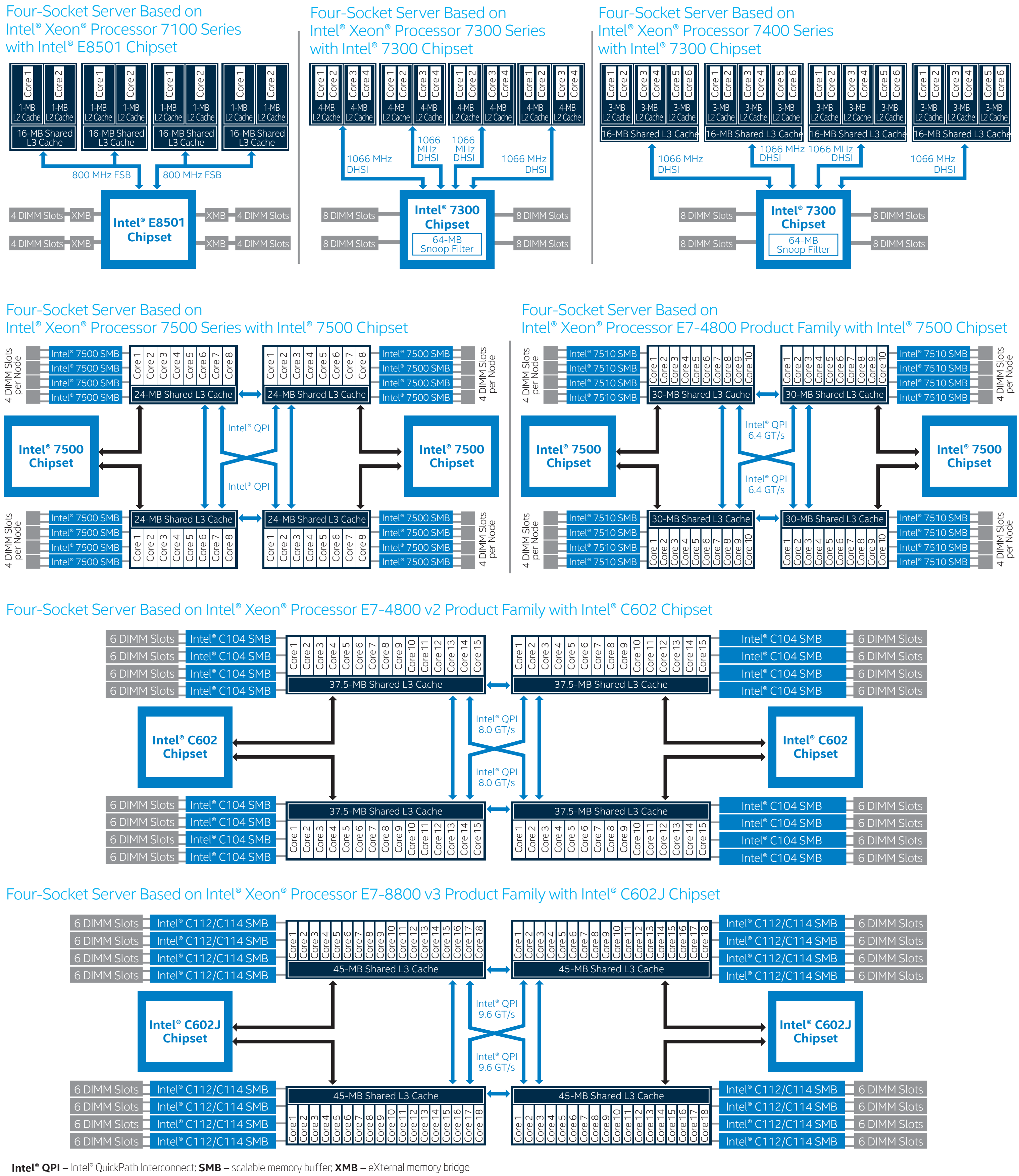

Figure 2. Four-socket servers based on different generations of Intel® Xeon® processors.

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
- Intel® Xeon® processor E7-8890 v3 with 18 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 144 logical cores on the server based on Intel Xeon processor E7-8890 v3, enabling us to run eight 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	Intel® Xeon® Processor E7-8890 v3
Cores per Processor	2	4	6	8	10	15	18
Speed	3.4 GHz	2.93 GHz	2.66 GHz	2.26 GHz	2.4 GHz	2.8 GHz	2.5 GHz
Process Technology	65nm	65nm	45nm	45nm	32nm	22nm	22nm
Last-Level Cache per Processor	16 MB	2 x 4 MB	16 MB	24 MB	30 MB	37.5 MB	45 MB
Intel® Turbo Boost Technology	N/A	N/A	N/A	Enabled	Enabled	Enabled	Enabled
Hyper-Threading	Enabled	N/A	N/A	Enabled	Enabled	Enabled	Enabled
NUMA Mode	N/A	N/A	N/A	Enabled	Enabled	Enabled	Enabled
Chipset	Intel® E8501	Intel® 7300	Intel® 7300	Intel® 7500	Intel® 7500	Intel® C602	Intel® C602J
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	9.6 GT/s Intel QPI
RAM	64 GB (16 x 4 GB)	128 GB (32 x 4 GB)	128 GB (32 x 4 GB)	256 GB (64 x 4 GB)	512 GB (64 x 8 GB)	512 GB (64 x 8 GB)	512 GB (64 x 8 GB)
RAM Type	DDR2-400	FB-DIMM-667	FB-DIMM-667	DDR3-1333	DDR3-1333	DDR3-1600	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	2 x 300 GB 15K RPM SAS	1 x 1.2 TB 10K RPM SAS

Intel® QPI - Intel® QuickPath Interconnect

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	Intel® Xeon® Processor E7-8890 v3
Number of Jobs	1	2	3	4	5	7	8
Threads per Iteration	16	8	8	16	16	16	16
Total Iterations Needed to Complete 840 Jobs	840	420	280	210	168	120	105
Total Time to Complete 840 Jobs	8364:04:00	3072:18:00	2394:37:20	1451:35:45	1071:24:05	580:50:34	490:43:06
Relative Throughput	**1.00**	**2.72**	**3.49**	**5.76**	**7.81**	**14.40**	**17.04**

Results

With 20 percent more cores than the previous-generation system based on Intel Xeon processor E7-4890 v2, the server based on Intel Xeon processor E7-8890 v3 completed the workloads 1.18x faster, and 17.04x faster than the system based on Intel Xeon processor 7140M. Results are shown in Table 2 and Figure 1.

Conclusion

The Intel Xeon processor E7-8800 v3 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 E7-8800 v3 product family could be an efficient platform for our large memory design workloads; the server based on this product family delivered a better throughput increase, due to the growth in the number of cores, better architecture, and cache size compared to the previous server generation based on the Intel Xeon processor E7-4800 v2 product family.

We anticipate that the faster throughput performance will allow engineers to run in parallel more key large-memory 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, depending on the workload characteristics.

Systems based on the Intel Xeon processor E7-8800 v3 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-generation processors. Based on our results, one new server based on the Intel Xeon processor E7-8890 v3 could replace up to about 17 older servers based on the Intel Xeon processor 7140M.

Based on our evaluation, we plan to deploy systems based on the Intel Xeon processor E7-8800 v3 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 intel.com/IT.

IT@Intel

We connect IT professionals with their IT peers inside Intel. Our IT department solves some of today's most demanding and complex technology issues, and we want to share these lessons directly with our fellow IT professionals in an open peer-to-peer forum.

Our goal is simple: improve efficiency throughout the organization and enhance the business value of IT investments.

Follow us and join the conversation:

- Twitter
- #IntelIT
- LinkedIn
- IT Center Community

Visit us today at intel.com/IT or contact your local Intel representative if you would like to learn more.

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

[2] Intel technologies' features and benefits depend on system configuration and may require enabled hardware, software or service activation. Performance varies depending on system configuration. Check with your system manufacturer or retailer or learn more at intel.com.

0615/WWES/KC/PDF