IT@Intel Brief

Intel Information Technology
64-Bit Computing
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Faster Silicon Design with Intel® Xeon® Processor 7500 Series

- Up to 2.68x increased throughput compared with Intel® Xeon® processor 7400 series
- Up to 5.76x increased throughput compared with Intel® Xeon® processor 7100 series

Silicon design requires significant computing resources. The largest, most 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.

To assess the potential benefits of four-socket servers based on Intel® Xeon® processor 7500 series for silicon design, we recently conducted tests using large multi-threaded and distributed electronic design automation (EDA) applications operating on current Intel® silicon design datasets. Servers based on Intel Xeon processor 7500 series include up to 8 cores per processor, 4x the memory capacity of previous generations, and an integrated memory controller providing greater memory bandwidth.

By utilizing all the available cores, the server completed complex silicon design workloads 1.65x to 2.68x faster than a server based on Intel® Xeon® processor 7400 series, and up to 5.76x faster than a server based on Intel® Xeon® processor 7100 series, as shown in Figure 1.

Based on our results, Intel Xeon processor 7500 series offers significant throughput improvements compared to prior generations; these improvements can help accelerate long-running silicon design jobs, thereby helping to reduce the time required to bring new silicon designs to market.

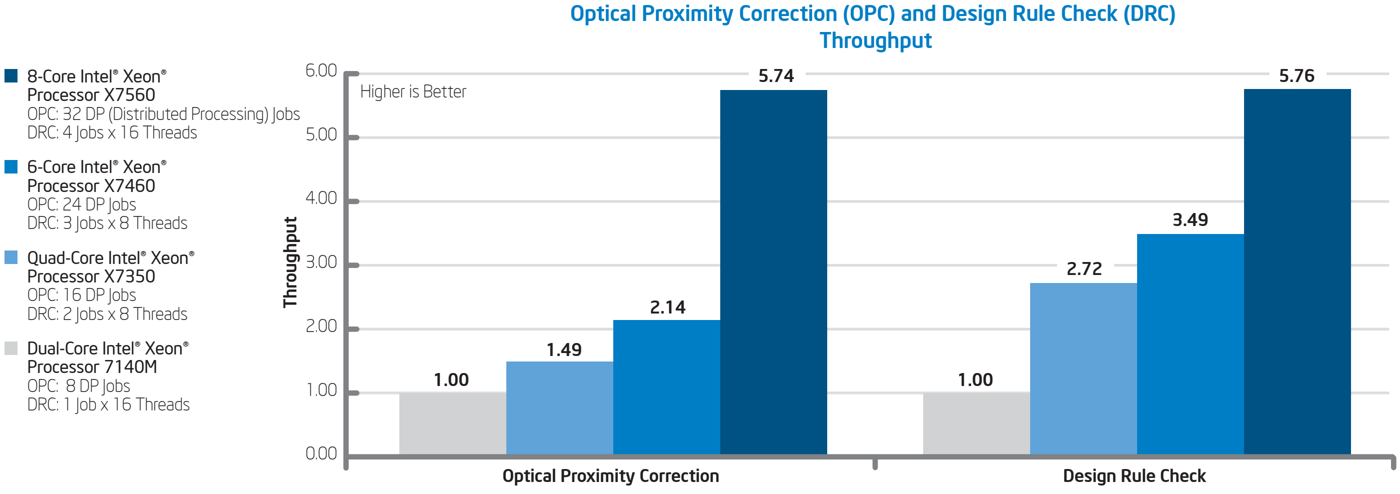


Figure 1. Intel IT tests compare throughput of four-socket servers running electronic design automation (EDA) applications.

Business Challenge

Silicon chip design engineers at Intel face the challenges of integrating more features into ever-shrinking silicon chips, bringing products to market faster, and keeping design engineering and manufacturing costs low. As design complexity increases, the requirements for compute capacity also increase, so 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 Intel Xeon processor 7500 series to accelerate silicon design compared with servers based on previous processors.

Intel Xeon processor 7500 series includes new features that can increase EDA throughput. Each processor has up to 8 cores and up to 24 MB of shared L3 cache. Four-socket servers based on this processor include up to 32 cores and can run up to 64 simultaneous threads using Intel® Hyper-Threading Technology (Intel® HT Technology). They provide 4x the memory capacity and higher memory bandwidth compared with previous generations, using a new integrated memory controller, 64 memory slots, and faster DDR3 memory. A four-socket platform based on Intel Xeon processor 7500 series is shown in Figure 2, along with the previous generations for comparison.

Our goal was to determine whether these features would increase EDA application throughput, enabling us to accelerate key design tasks and potentially bring products to market more quickly.

Test Methodology

We ran tests using two industry-leading EDA applications 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

Test configurations are shown in Table 1.

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 applications to utilize all the available cores. This resulted in multiple simultaneous jobs on each platform, as shown in Table 2.

With the optical proximity correction (OPC) distributed application, we ran one design job per core, resulting in 32 simultaneous jobs on the Intel Xeon processor X7560-based server.

With the design rule check (DRC) multi-threaded application, we enabled Intel HT Technology where available; this provided 64 logical cores on the Intel Xeon processor X7560-based server, enabling us to run four 16-threaded jobs simultaneously.

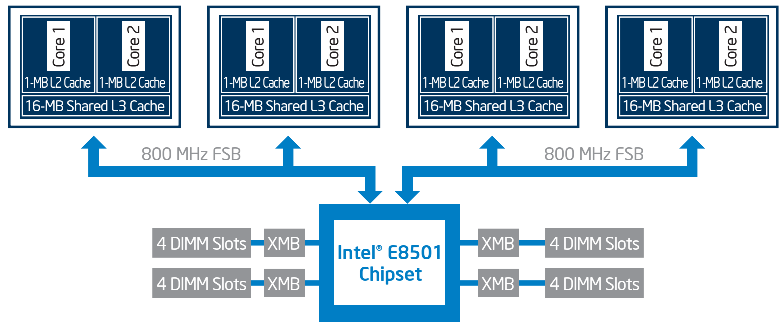
Table 1. Test System Specifications

	Intel® Xeon® Processor 7140M	Intel® Xeon® Processor X7350	Intel® Xeon® Processor X7460	Intel® Xeon® Processor X7560
Cores per Processor	2	4	6	8
Speed	3.4 GHz	2.93 GHz	2.66 GHz	2.26 GHz
Process Technology	65nm	65nm	45nm	45nm
Cache per Processor	2x1 MB L2, 16 MB L3	2x4 MB L2	3x3 MB L2, 16 MB L3	24 MB L3
Intel® Turbo Boost Technology	N/A	N/A	N/A	Enabled
Hyper-Threading	Disabled (OPC) Enabled (DRC)	N/A	N/A	Disabled (OPC) Enabled (DRC)
NUMA Mode	N/A	N/A	N/A	Enabled
Chipset	Intel® E8501	Intel® 7300	Intel® 7300	Intel® 7500
Front Side Bus/Intel® QPI Speed	800 MHz Dual Shared	1066 MHz DHSI	1066 MHz DHSI	6.4 GT/s Intel QPI
RAM	64 GB (16x4 GB)	128 GB (32x4 GB)	128 GB (32x4 GB)	256 GB (64x4 GB)
RAM Type	DDR2-400	FB-DIMM-667	FB-DIMM-667	DDR3-1333[1]
Hard Drives	2x73 GB 10K RPM SCSI	2x73 GB 10K RPM SAS	2x73 GB 10K RPM SAS	2x146 GB 10K RPM SAS

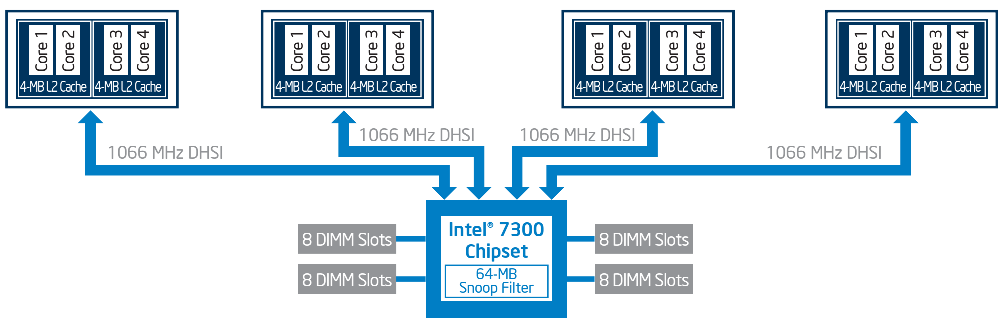
DDR - double data rate; **DHSI** - dedicated high speed interconnect; **DRC** - design rule check; **FB-DIMM** - fully buffered dual in-line memory module; **Intel® QPI** - Intel® QuickPath Interconnect; **NUMA** - non-uniform memory access; **OPC** - optical proximity correction

[1] On Intel® Xeon® processor X7560, DDR3-1333 RAM runs at 1067 MHz.

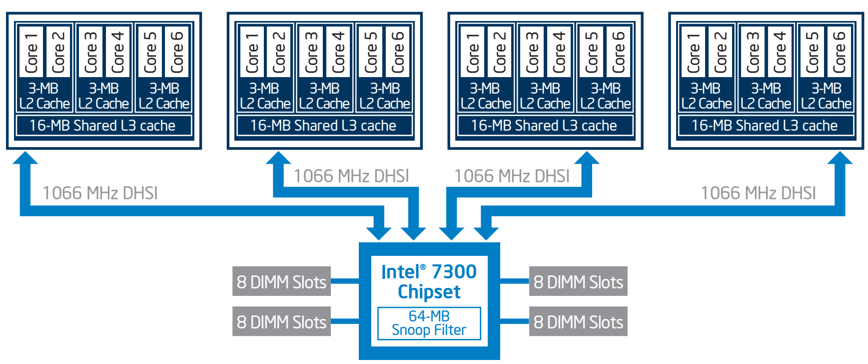
Four-Socket Server Based on Intel® Xeon® Processor 7100 Series with Intel® E8501 Chipset



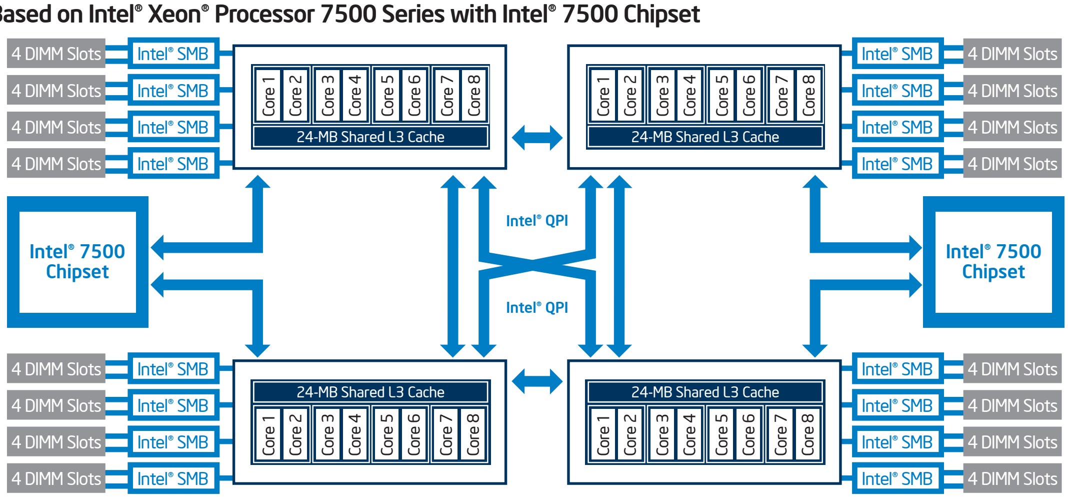
Four-Socket Server Based on Intel® Xeon® Processor 7300 Series with Intel® 7300 Chipset



Four-Socket Server Based on Intel® Xeon® Processor 7400 Series with Intel® 7300 Chipset



Four-Socket Server Based on Intel® Xeon® Processor 7500 Series with Intel® 7500 Chipset



DHSI – dedicated high speed interconnect; DIMM – dual in-line memory module; FSB – front side bus; Intel® QPI – Intel® QuickPath Interconnect at 6.4 GT/s; Intel® SMB – Intel® 7500 Scalable Memory Buffer; 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

Optical Proximity Correction (OPC) - Distributed Workload				
	Intel® Xeon® Processor 7140M	Intel® Xeon® Processor X7350	Intel® Xeon® Processor X7460	Intel® Xeon® Processor X7560
Number of Jobs	8 Distributed Jobs	16 Distributed Jobs	24 Distributed Jobs	32 Distributed Jobs
Total Time to Process 561 Templates	1:51:00	1:14:20	0:51:49	0:19:21
Relative Throughput	1.00	1.49	2.14	5.74

Design Rule Check (DRC) - Multi-Threaded Workload				
	Intel® Xeon® Processor 7140M	Intel® Xeon® Processor X7350	Intel® Xeon® Processor X7460	Intel® Xeon® Processor X7560
Number of Jobs and Threads	1 Job x 16 Threads/Job	2 Jobs x 8 Threads/Job	3 Jobs x 8 Threads/Job	4 Jobs x 16 Threads/Job
Total Iterations Needed to Complete 12 jobs	12	6	4	3
Total Time to Complete 12 Jobs	119:29:12	43:53:24	34:12:32	20:44:14
Relative Throughput	1.00	2.72	3.49	5.76

Results

The server based on Intel Xeon processor X7560 completed the test workloads 1.65x to 2.68x faster than the system based on Intel Xeon processor X7460, and 5.74x to 5.76x faster than the system based on Intel Xeon processor 7140M, as shown in Table 2 and Figure 1.

Conclusion

Intel Xeon processor 7500 series has the potential to deliver significant benefits for silicon design at Intel. We anticipate that the faster 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 Intel Xeon processor 7500 series 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, two new servers based on Intel Xeon processor X7560 could replace up to 11 older servers based on Intel Xeon processor 7140M.

Based on our evaluation, we plan to deploy systems based on the Intel Xeon processor 7500 series in order to achieve these benefits for our silicon design teams and for Intel IT.

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