IT@Intel Brief

Intel IT
Business Solutions
IT Efficiency and Employee Productivity
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Increasing Design Throughput with Workstations Based on New Intel® Xeon® Processor E5-2600 v2 Product Family

- 6.09x performance increase compared to the quad-core Intel® Xeon® processor 5400 series
- Enables increase in design engineer productivity
- Potential for faster time to market and quality improvements

In Intel IT tests simulating the daily workflow of a silicon design engineer, a workstation based on the new Intel® Xeon® processor E5-2600 v2 product family completed multiple, concurrent electronic design automation (EDA) application workloads up to 6.09x faster than a workstation based on Intel Xeon processor 5400 series and up to 1.29x faster than a workstation based on previous-generation Intel Xeon processor E5-2600 series. Performance comparisons are shown in Figure 1.

In our tests, each system completed a total of 48 jobs, using multiple front-end and back-end EDA applications operating on actual Intel silicon design workloads. With a total of 24 processor cores, the workstation based on Intel® Xeon® processor E5-2697 v2 provided higher throughput by running 24 jobs concurrently and completing them more quickly.

High-performance workstations based on the new Intel Xeon processor E5-2600 v2 product family let engineers create and test designs more quickly using multiple EDA applications concurrently. This allows faster design iterations with more demanding design workloads, accelerating a product's time to market. It also allows more validation cycles, enabling improvements in product quality.

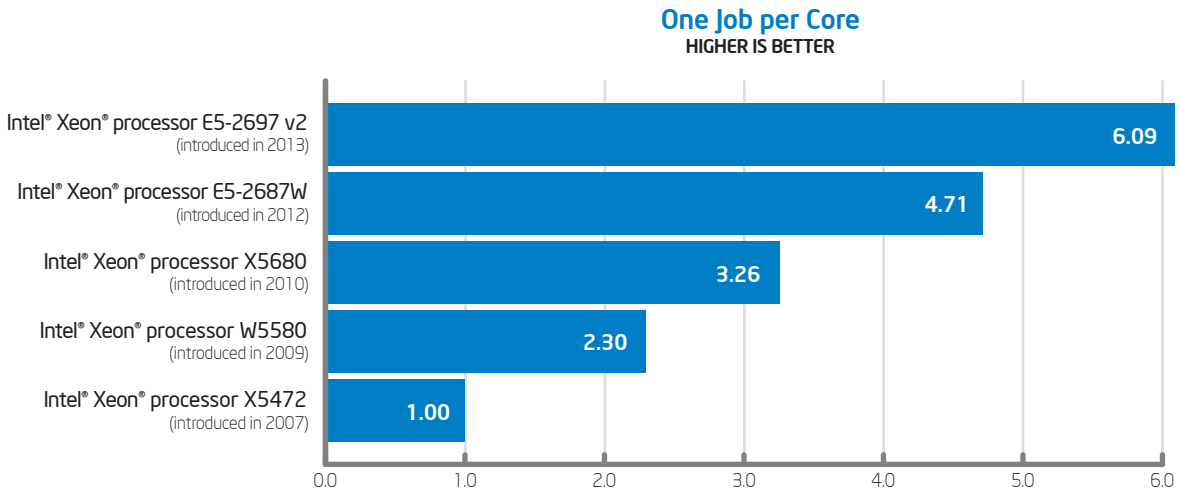

Figure 1. Relative performance of dual-socket workstations running multiple front-end and back-end electronic design automation applications.
Intel internal measurements; July, August 2013.

Business Challenge

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.

In a typical workday, each design engineer works simultaneously on several of the functional blocks of a silicon design. For each block, the engineer uses an iterative design method in which each front-end (logical) design stage is followed by a corresponding back-end (physical) design stage, as shown in Figure 2. Each of these design stages is supported by EDA applications that run on engineering workstations based on Intel® Xeon® processors. Each application workload is processor-intensive and can take from several minutes to hours to complete.

In the past, design engineers staggered design tasks due to limitations in the number of processor cores, CPU speed, and memory capacity of each workstation.

However, as processor performance increased, a new category of workstations has emerged, based on the new Intel Xeon processor E5-2600 v2 product family. These processors act as expert workbenches, allowing engineers to more quickly create and test design ideas by running suites of multiple front-end and back-end EDA applications concurrently.

The new Intel Xeon processor E5-2600 v2 product family is based on 22nm process technology, which provides greater performance per watt, and includes up to 12 cores per processor. This product family offers several features that help to maximize performance:

- Intel® Advanced Vector Extensions accelerate floating-point intensive applications.
- Intel® Turbo Boost Technology 2.0[1] delivers more performance upside potential.
- PCI Express* 3.0 support gives better I/O latency and bandwidth.
- High-bandwidth, low-latency bi-direction ring interconnect allows faster access to the 30-MB multi-banked last-level L3 cache.
- Intel® Hyper-Threading Technology[2] enables up to 24 computational threads per socket.
- Integrated memory controller with four DDR3 memory channels and 46-bit physical addressing facilitates greater memory capacity.

Dual-socket workstations based on the new Intel Xeon processor E5-2600 v2 product family include RAM capacity of up to 1536 GB (with 64-GB DIMMS, using 24 memory slots) to support more demanding workloads and run more EDA applications simultaneously.

To evaluate the impact on design engineers' productivity, we performed tests to compare a workstation based on the new Intel Xeon processor E5-2600 v2 product family with workstations based on previous processor generations.

[1] 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 system manufacturer. Performance varies depending on hardware, software, and system configuration. For more information, visit www.intel.com/go/turbo.

[2] Available on select Intel® Core™ processors. Requires an Intel® Hyper-Threading Technology-enabled system; consult with your PC manufacturer. Performance will vary depending on the specific hardware and software used. For more information, including details on which processors support Intel HT Technology, visit www.intel.com/info/hyperthreading.

Test Methodology

We compared five dual-socket workstations, each based on a different processor generation.

- **Intel® Xeon® processor X5472-based workstation.** This workstation included two quad-core processors, based on 45nm process technology, for a total of eight cores.
- **Intel® Xeon® processor W5580-based workstation.** This workstation included two quad-core processors, based on 45nm process technology, for a total of eight cores.
- **Intel® Xeon® processor X5680-based workstation.** This workstation included two six-core processors, based on 32nm process technology, for a total of 12 cores.
- **Intel® Xeon® processor E5-2687W-based workstation.** This workstation included two eight-core processors, based on 32nm process technology, for a total of 16 cores.
- **Intel® Xeon® processor E5-2697 v2-based workstation.** This workstation included two 12-core processors, based on 22nm process technology, for a total of 24 cores.

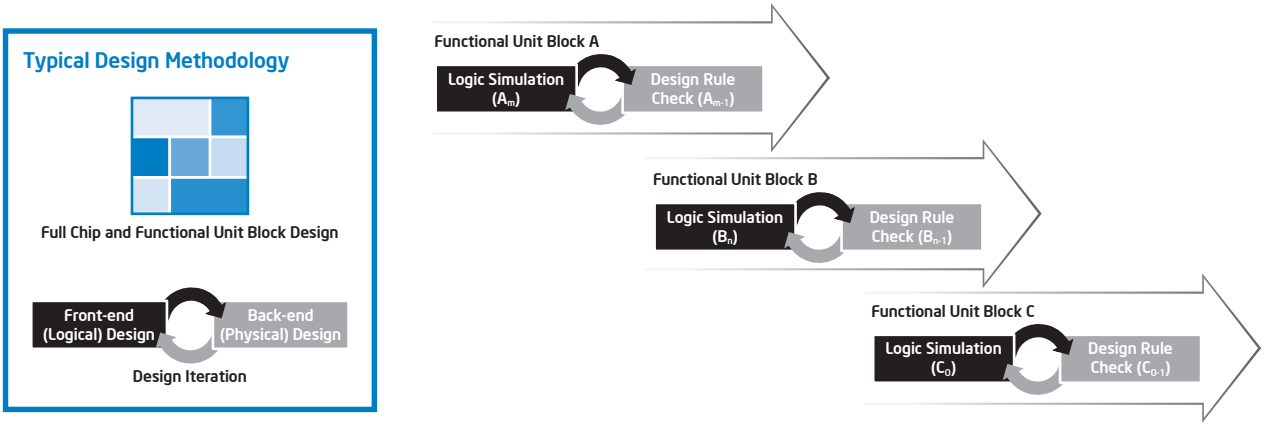

Figure 2. Day in the life of a silicon design engineer. An engineer typically works simultaneously on several of the functional blocks in each silicon design; each block is designed using an iterative process supported by front-end and back-end electronic design automation applications.

Test system specifications are shown in Table 1.

We designed our tests to represent a typical workday, in which a silicon design engineer is working on multiple design tasks concurrently, using front-end and back-end design applications.

Our goal was to compare the design throughput of each workstation by measuring the time required to complete a total of 48 silicon design jobs: 24 front-end jobs and 24 back-end jobs.

Our tests used industry-leading 32-bit and 64-bit front-end (logic simulation) and back-end (design rule check) EDA applications operating on actual Intel® processor and chipset design workloads.

We ran one concurrent job or application process per physical core. An engineer might use this approach in order to maximize the raw performance of individual applications. In our tests, this resulted in sets of eight to 24 concurrent jobs, depending on the number of cores. When each set had completed, we submitted the next set of eight to 24 jobs. We continued this process until the workstation had completed all 48 jobs.

Results

In the tests, the Intel Xeon processor E5-2697 v2-based workstation completed the 48 jobs 6.09x faster than the workstation based on Intel Xeon processor X5472 and 1.29x faster than the workstation based on Intel Xeon processor E5-2687W, as shown in Table 2.

With a total of 24 cores, the Intel Xeon processor E5-2697 v2-based workstation was able to run 24 jobs concurrently with good performance, and therefore completed the 48 jobs in fewer steps than the other workstations. This resulted in a faster overall completion time.

Table 1. Test System Specifications

	Intel® Xeon® Processor 5400 Series	Intel® Xeon® Processor 5500 Series	Intel® Xeon® Processor 5600 Series	Intel® Xeon® Processor E5-2600 Product Family	Intel® Xeon® Processor E5-2600 v2 Product Family
Processor	2x Intel® Xeon® processor X5472	2x Intel® Xeon® processor W5580	2x Intel® Xeon® processor X5680	2x Intel® Xeon® processor E5-2687W	2x Intel® Xeon® processor E5-2697 v2
Cores per Processor	4	4	6	8	12
Speed	3.0 GHz	3.2 GHz	3.33 GHz	3.10 GHz	2.7 GHz
Intel® Turbo Boost Technology	NA	Enabled	Enabled	Enabled	Enabled
Intel Hyper-Threading Technology	NA	Disabled	Disabled	Disabled	Disabled
Chipset	Intel® 5400 Chipset	Intel® 5520 Chipset	Intel 5520 Chipset	Intel® C600 Chipset	Intel C600 Chipset
Interconnects	1600 MHz Front-Side Bus	6.4 GT/s Intel® QuickPath Interconnect (Intel® QPI)	6.4 GT/s Intel® QPI	Dual 8.0 GT/s Intel® QPI	Dual 8.0 GT/s Intel® QPI
RAM	64 GB (8 x 8 GB)	96 GB (12 x 8 GB)	96 GB (12 x 8 GB)	128 GB (16 x 8 GB)	128 GB (16 x 8 GB)
RAM Type	DDR2-667 Fully Buffered DIMM	DDR3-1333 MHz (operating at 1066 MHz)	DDR3-1333 MHz	DDR3-1333 MHz	DDR3-1600 MHz
Hard Drive	500 GB, 7200 RPM SATA, 3.0 Gb/s	500 GB, 7200 RPM SATA, 3.0 Gb/s	500 GB, 7200 RPM SATA, 3.0 Gb/s	1 TB, 7200 RPM SATA, 6.0 Gb/s	1 TB, 7200 RPM SATA, 6.0 Gb/s
OS	64-bit Linux*	64-bit Linux	64-bit Linux	64-bit Linux	64-bit Linux

DDR - double data rate; **DIMM** - dual in-line memory module; **GB** - gigabytes; **Gb/s** - gigabits per second; **GHz** - gigahertz; **GT/s** - gigatransfers per second; **MHz** - megahertz; **NA** - Not Applicable; **RPM** - revolutions per minute; **SATA** - serial advanced technology attachment; **TB** - terabyte

Table 2. Relative Performance and Runtimes Note: The reported times (hh:mm:ss) are the maximum job runtimes observed within each step.

Workload	Intel® Xeon® Processor X5472 8 Jobs per Set, 6 Steps	Intel® Xeon® Processor W5580 8 Jobs per Set, 6 Steps	Intel® Xeon® Processor X5680 12 Jobs per Set, 4 Steps	Intel® Xeon® Processor E5-2687W 16 Jobs per Set, 3 Steps	Intel® Xeon® Processor E5-2697 v2 24 Jobs per Set, 2 Steps
Logic Simulation - Tool B (4 Jobs)	0:57:08	0:28:44	0:29:16	0:25:02	0:36:02
Logic Simulation - Tool B (4 Jobs)					
Logic Simulation - Tool B (4 Jobs)	1:00:44	0:24:45			
Logic Simulation - Tool B (4 Jobs)			0:30:56		
Logic Simulation - Tool B (4 Jobs)	1:06:19	0:28:35		0:35:10	
Logic Simulation - Tool B (4 Jobs)					
Design Rule Check - Tool B 2 Distributed Processes x 2 Threads	1:29:13	0:36:36	0:39:14		0:38:14
Design Rule Check - Tool C 4 Threads					
Design Rule Check - Tool B 2 Distributed Processes x 2 Threads	1:24:29	0:38:41		0:35:55	
Design Rule Check - Tool C 4 Threads			0:39:14		
Design Rule Check - Tool B 2 Distributed Processes x 2 Threads	1:34:45	0:39:43			
Design Rule Check - Tool B 2 Distributed Processes x 2 Threads					
Total Run Time	**7:32:38**	**3:17:04**	**2:18:40**	**1:36:07**	**1:14:16**
Relative Performance	**1.00**	**2.30**	**3.26**	**4.71**	**6.09**

Conclusion

The availability of workstations based on the new Intel Xeon processor E5-2600 v2 product family has broad implications for silicon design. In the past, design engineers staggered design tasks due to limitations in processing power and the number of cores available. Now, design engineers can run more jobs concurrently with good performance. In addition, each processing core offers faster performance, reducing total design time.

This allows engineers to analyze the results of each design stage sooner, make necessary design changes, and quickly run the next design iteration—resulting in increased design engineer productivity and faster semiconductor product design. Engineers can also run more validation cycles, identifying problems earlier in product development to improve quality.

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.

Based on our test results, we are establishing workstations based on Intel Xeon processor E5-2600 v2 product family as our standard for Intel IT internal workstation deployments, including refreshes of older systems.

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