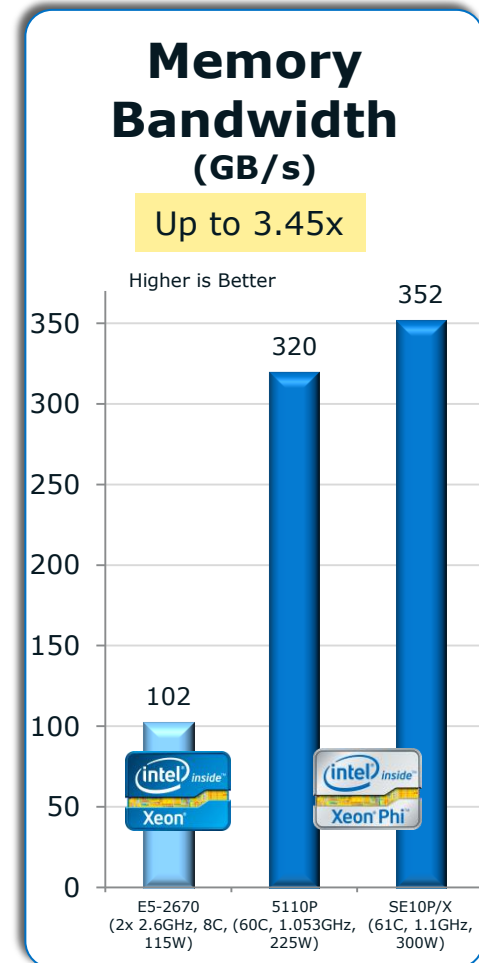
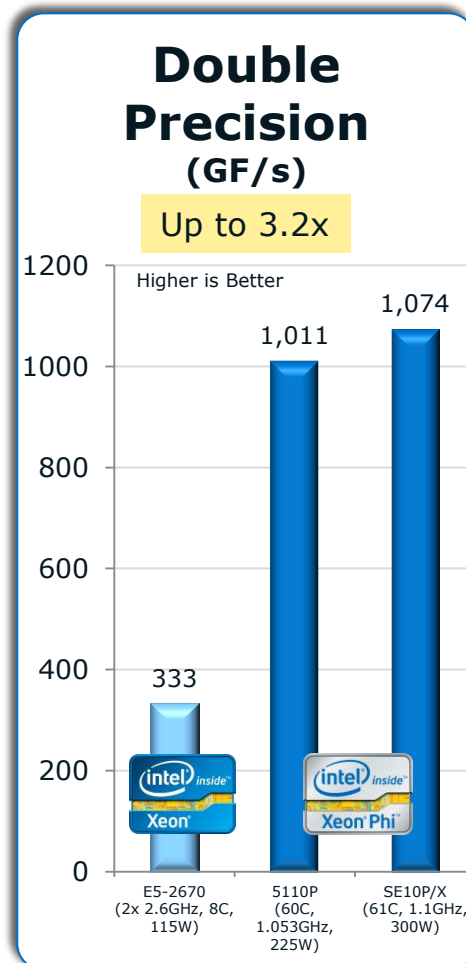
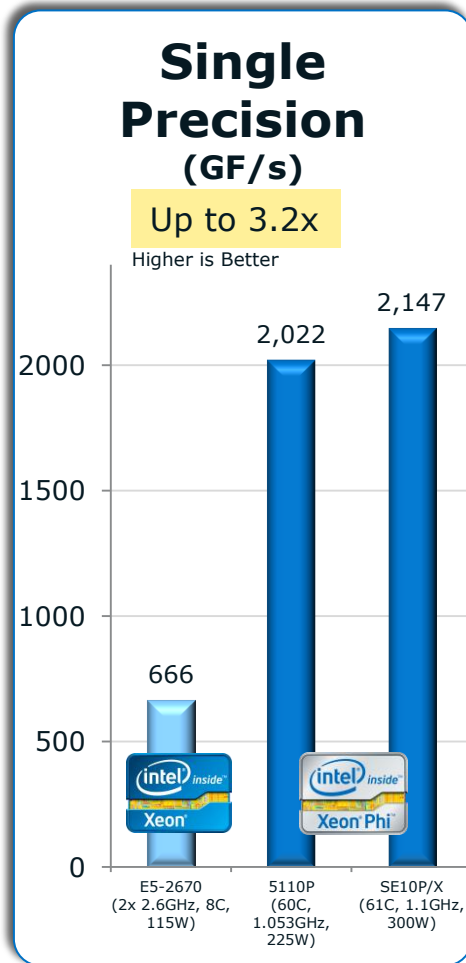


Intel® Xeon Phi™ Product Family Performance

Rev 1.2
4/16/13

Theoretical Maximums

(Intel® Xeon® processor E5-2670 vs. Intel® Xeon Phi™ coprocessor 5110P & SE10P/X)



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.

Source: Intel as of October 17, 2012. Configuration Details in backup. For more information, go to <http://www.intel.com/performance>.



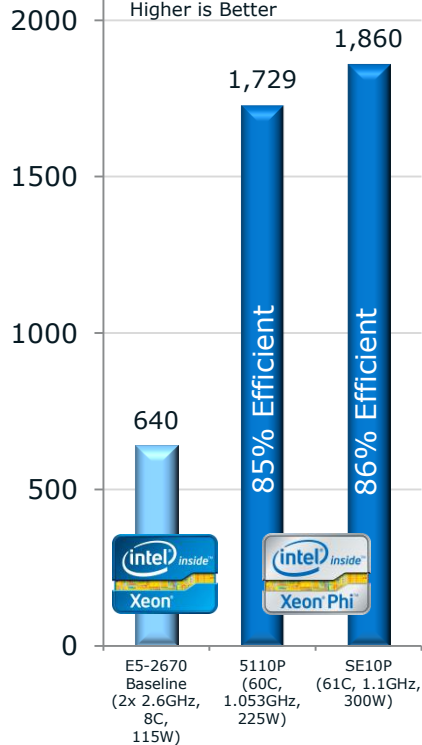
Synthetic Benchmark Summary

Intel® Math Kernel Library (Intel® MKL)

SGEMM (GF/s)

Up to 2.9X

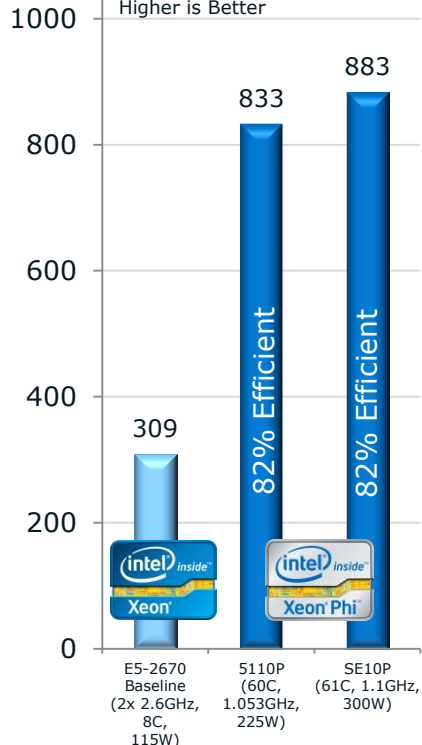
Higher is Better



DGEMM (GF/s)

Up to 2.8X

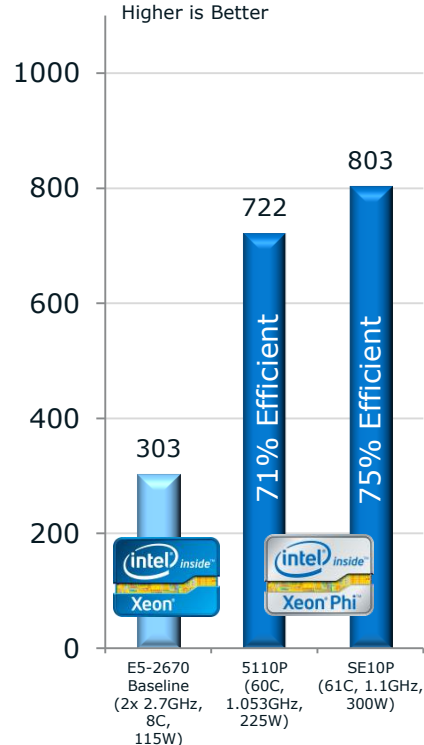
Higher is Better



SMP LINPACK

Up to 2.6X

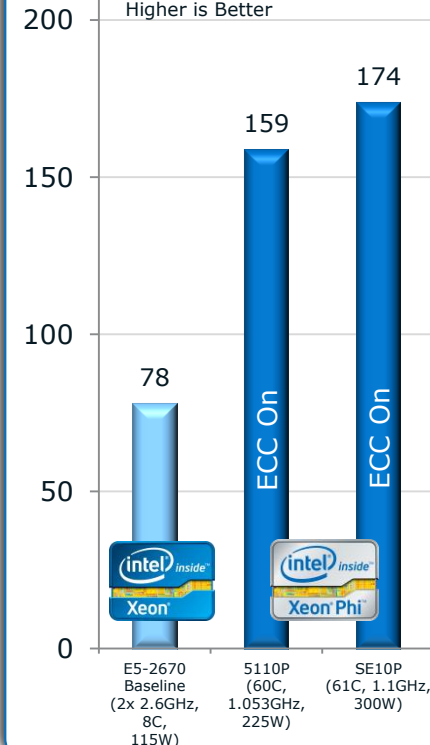
Higher is Better



STREAM Triad (GB/s)

Up to 2.2X

Higher is Better



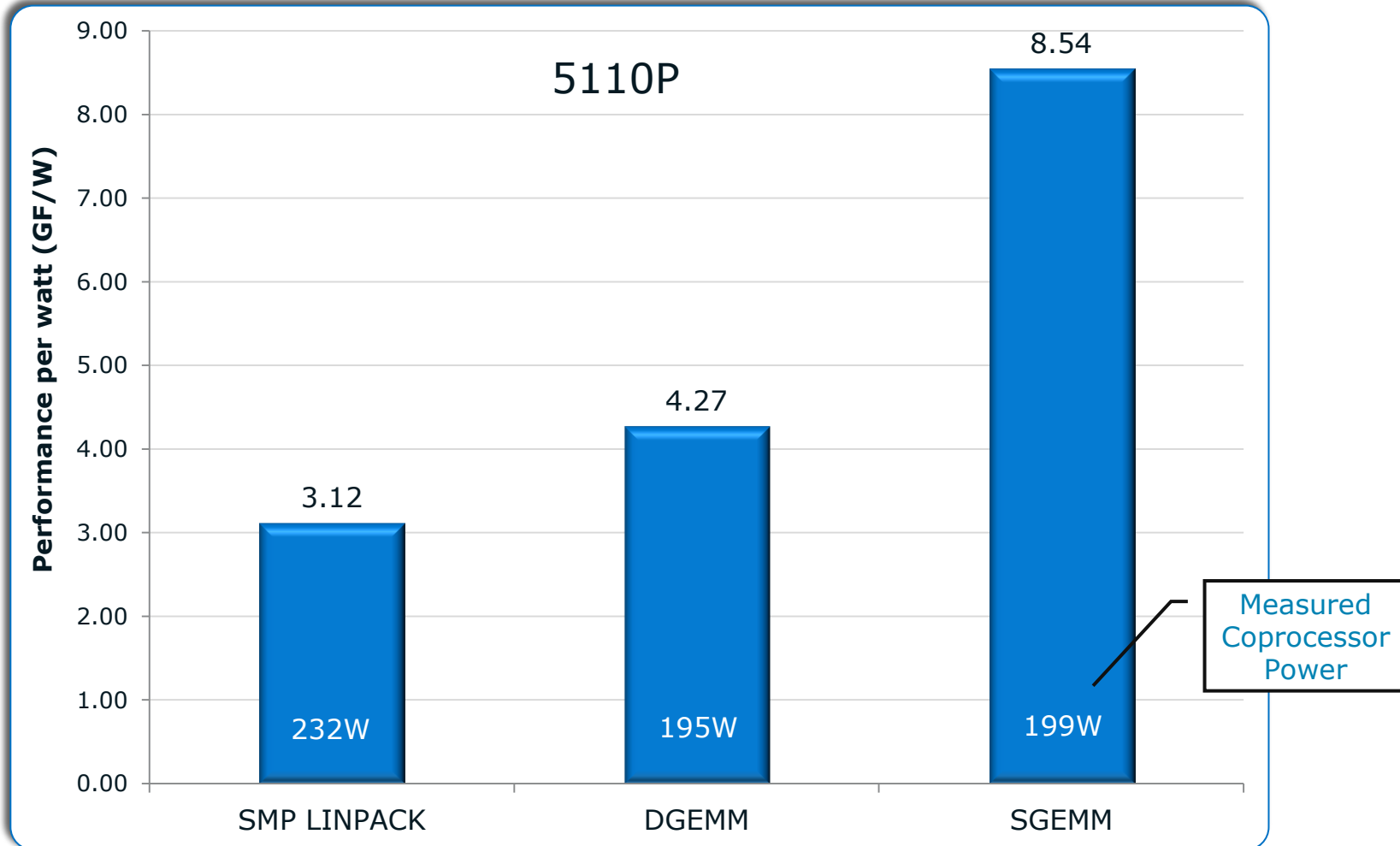
Coprocessor results: Benchmark run 100% on coprocessor, no help from Intel® Xeon® processor host (aka native)

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. Intel® MKL not used in STREAM triad benchmark.

Source: Intel Measured results as of October 26, 2012. Configuration Details in backup. For more information, go to <http://www.intel.com/performance>.



Performance Per Watt (Performance/Coprocessor power)



Coprocessor results: Benchmark run 100% on coprocessor, no help from Intel® Xeon® processor host (aka native)

Notes

1. Intel® Xeon Phi™ coprocessor 5110P (ECC on)

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.

Intel® Xeon Phi™ Coprocessor:

Increases Application Performance up to 10x

Updated

Segment	Customer	Application	Performance Increase ¹ vs. 2S Xeon*
Energy	Acceleware	8 th order isotropic variable velocity	Up to 2.23x
	Sinopec	Seismic Imaging	Up to 2.53x ²
	CNPC (China Oil & Gas)	GeoEast Pre-Stack Time Migration (Seismic)	Up to 3.54x ²
Financial Services	Financial Services	BlackScholes SP Monte Carlo SP	Up to 7.5x Up to 10.75x
Physics	Jefferson Labs	Lattice QCD	Up to 2.79x
Finite Element	Sandia Labs	miniFE (Finite Element Solver)	Up to 2x ³ Up to 1.3x ⁵
Solid State Physics	ZIB (Zuse-Institut Berlin)	Ising 3D (Solid State Physics)	Up to 3.46x
Digital Content Creation/Video	Intel Labs	Ray Tracing (incoherent rays)	Up to 1.88x ⁴
	NEC	Video Transcoding	Up to 3.0x ²
Astronomy	CSIRO/ASKAP (Australia Astronomy)	tHogbom Clean (Astronomy image smear removal)	Up to 2.27x
	TUM (Technische Universität München)	SG++ (Astronomy Adaptive Sparse Grids/Data Mining)	Up to 1.7x
Fluid Dynamics	AWE (Atomic Weapons Establishment - UK)	Cloverleaf (2D Structured Hydrodynamics)	1.77x

Notes:

1. 2S Xeon* vs. 1 Xeon Phi* (preproduction HW/SW & Application running 100% on coprocessor unless otherwise noted)
2. 2S Xeon* vs. 2S Xeon* + 2 Xeon Phi* (offload)
3. 8 node cluster, each node with 2S Xeon* (comparison is cluster performance with and without 1 Xeon Phi* per node) (Hetero)
4. Intel Measured Oct. 2012
5. 8 node cluster, each node with 2S Xeon* (comparison is cluster performance with Xeon only vs. Xeon Phi* only (1 Xeon Phi* per node) (Native)

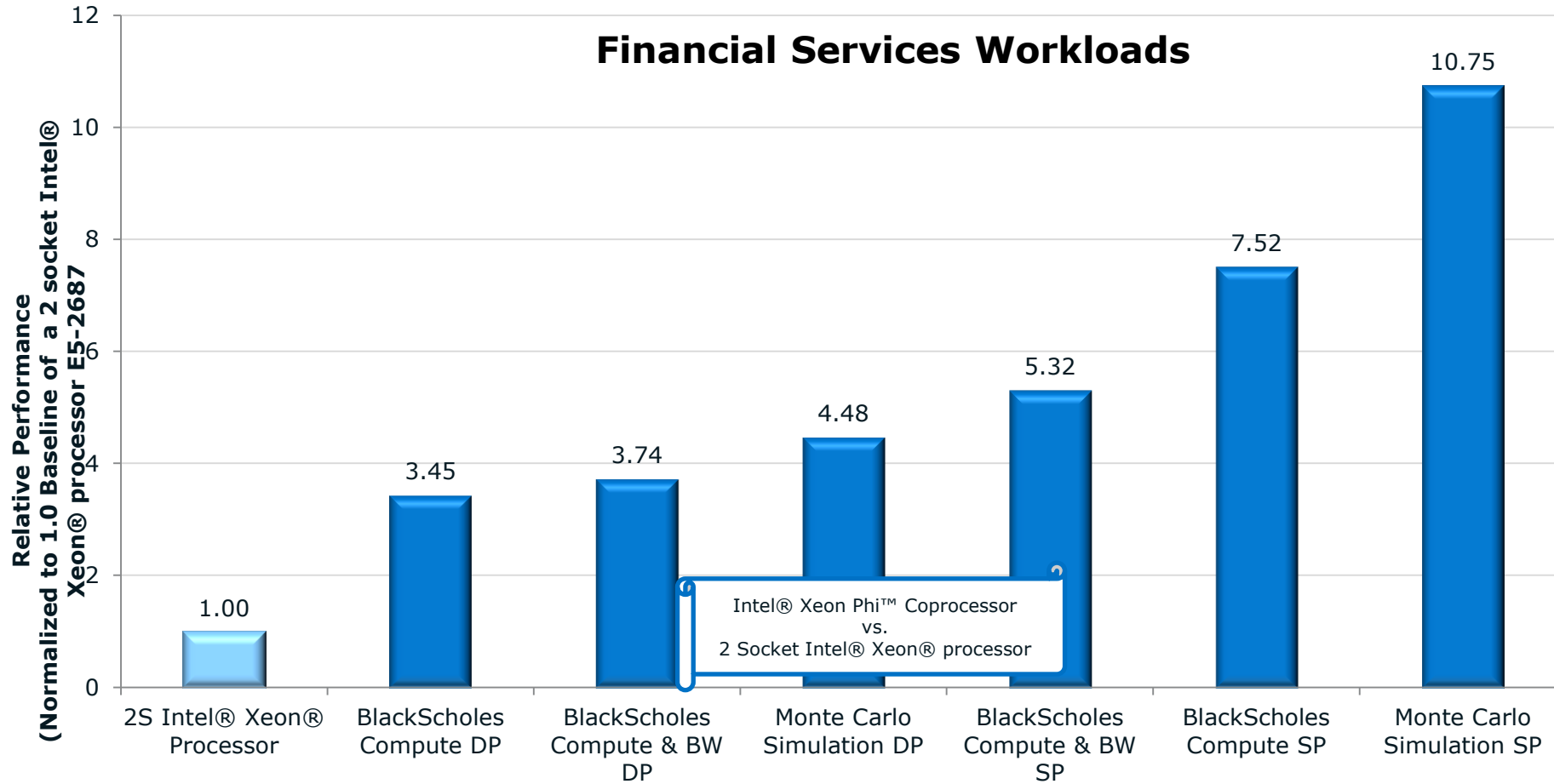
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Source: Customer Measured results as of October 22, 2012. Configuration Details: Please reference slide speaker notes.

For more information go to <http://www.intel.com/performance>



Intel® Xeon Phi™ Coprocessor vs. 2S Intel® Xeon® processor (Intel® MKL)



Coprocessor results: Benchmark run 100% on coprocessor, no help from Intel® Xeon® processor host (aka native)

- Notes
- 2 X Intel® Xeon® Processor E5-2670 (2.6GHz, 8C, 115W)
 - Intel® Xeon Phi™ coprocessor SE10 (ECC on) with pre-production SW stack

Higher SP results are due to certain Single Precision transcendental functions in the Intel® Xeon Phi™ coprocessor which are not present in the Intel® Xeon® processor

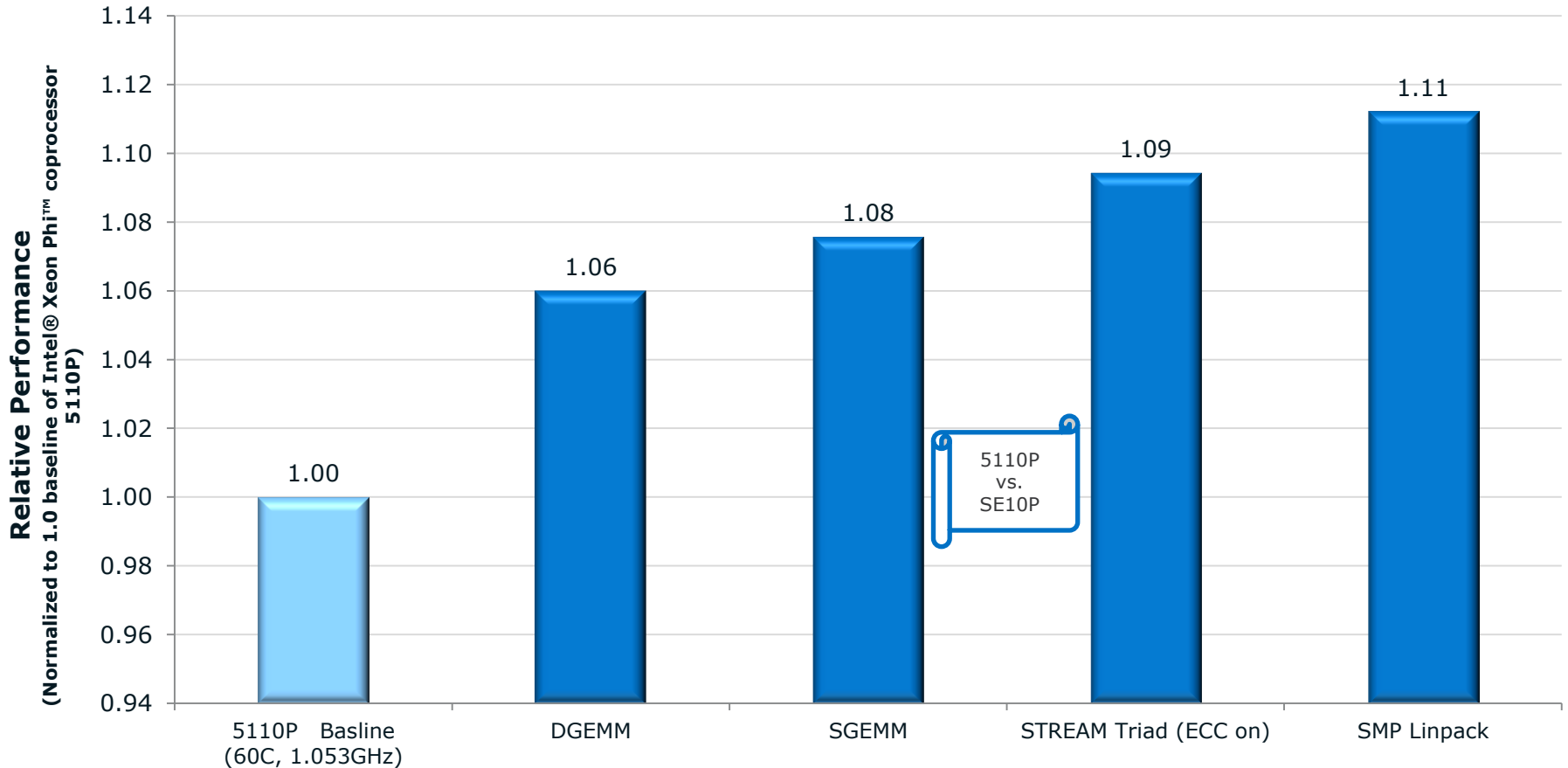
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Please reference slide speaker notes. For more information go to <http://www.intel.com/performance>



Intel® Xeon Phi™ Coprocessor (5110P vs. SE10P)

Intel® Xeon Phi™ Coprocessor 5110P (60C, 1.053GHz, 8GB @ 5.0GT/s, 225W TDP) vs. Intel® Xeon Phi™ Coprocessor SE10P (61C, 1.1GHz, 8GB @ 5.5GT/s, 300W TDP)



Intel® Xeon Phi™ coprocessor SE10P delivers up to 11% higher performance vs. 5110P

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.



Intel® Xeon Phi™ Coprocessor PCIe Transfer Capabilities

New

	SE10 (61 cores, 1.093GHz, 8GB, 5.5GT/s)	5110P (60 cores, 1.053GHz, 8GB, 5.0GT/s)
Host to Device (PCIe Download)	6.88 GB/s	6.91 GB/s
Device to Host (PCIe Readback)	6.98 GB/s	6.95 GB/s

Notes:

1. Clocksource set to TSC, Power Management turned off
2. Using pragma transfers

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. Source: Intel Measured as of October 2012. Configuration Details: Please reference slide speaker notes. **For more information go to <http://www.intel.com/performance>**



Backup

Theoretical Maximum Configuration Details

Configuration Details:

As of October 16, 2012

Host Platform:

2-Socket Crown Pass Software Development Platform: 2x Intel® Xeon® processor E5-2670 (20 M cache, 2.6 GHz, 8.0 GT/s Intel QPI, 115 W TDP) Memory @ 1600MHz

Coprocessor Details:

Intel® Xeon Phi™ coprocessor 5110P: 60 cores, 1.053 GHz, 8 GB Memory@5.0 GT/s, 225 W TDP

Intel® Xeon Phi™ coprocessor SE10: 61 cores, 1.1 GHz, 8 GB Memory@5.5 GT/s, 300 W TDP

Theoretical values calculations:

SP Xeon: $16 \text{ Flops/clock} * 8 \text{ cores/socket} * 2 \text{ sockets} * 2.6 \text{ GHz} = 665.6 \text{ GF/s}$

SP Xeon Phi SE10: $32 \text{ Flops/clock} * 61 \text{ cores} * 1.1 \text{ GHz} = 2147.2 \text{ GF/s}$

SP Xeon Phi 5110P: $32 \text{ Flops/clock} * 60 \text{ cores} * 1.053 \text{ GHz} = 2021.76 \text{ GF/s}$

DP Xeon: $8 \text{ Flops/clock} * 8 \text{ cores/socket} * 2 \text{ sockets} * 2.6 \text{ GHz} = 332.8 \text{ GF/s}$

DP Xeon Phi SE10: $16 \text{ Flops/clock} * 61 \text{ cores} * 1.1 \text{ GHz} = 1073.6 \text{ GF/s}$

DP Xeon Phi 5110P: $16 \text{ Flops/clock} * 60 \text{ cores} * 1.053 \text{ GHz} = 1010.88 \text{ GF/s}$

Mem BW Xeon: $8 \text{ bytes/channel} * 4 \text{ channels} * 2 \text{ sockets} * 1.6 \text{ GHz} = 102.4 \text{ GB/s}$

Mem BW Xeon Phi SE10: $4 \text{ bytes/channel} * 16 \text{ channels} * 5.5 \text{ GT/s} = 352 \text{ GB/s}$

Mem BW Xeon Phi 5110P: $4 \text{ bytes/channel} * 16 \text{ channels} * 5.0 \text{ GT/s} = 320 \text{ GB/s}$

Synthetic Benchmark Configuration Details

Configuration Details:

As of October 26, 2012

Intel® Xeon® Processor Platform:

2-Socket Canoe Pass Software Development Platform: 2x Intel Xeon processor E5-2670 (20 M cache, 2.6 GHz, 8.0 GT/s Intel QPI, 115W TDP) 64 GB Memory @ 1600 MHz, RHEL 6.3, Turbo on, HT off, EIST Enabled, Power: Performance mode

Platform Hosting the Coprocessor:

2-Socket Crown Pass Software Development Platform: 2x Intel Xeon processor E5-2670 (20 M cache, 2.6 GHz, 8.0 GT/s Intel QPI, 115 W TDP) 32 GB Memory @ 1600 MHz, RHEL 6.0

Coprocessor Details:

Intel® Xeon Phi™ coprocessor 5110P: 60 cores, 1.053 GHz, 8 GB Memory@5.0 GT/s, 225 W TDP (B1 step)

Intel® Xeon Phi™ coprocessor SE10P: 61 cores, 1.1 GHz, 8 GB Memory@5.5 GT/s, 300 W TDP (B1 step)

Software Stack:

“Gold” Release Candidate Software Stack:

MPSS 2.1.4346-16 (Flash: 2.1.01.0375; Coprocessor OS: 2.6.34.11-g65c0cd9; Driver: 4346-16)

Intel Cluster Studio XE 2013 Update 1 (Compiler: Composer_XE_2013.1.117; Intel® MKL: 11.0.1)

SGEMM/DGEMM/SMP LINPACK

Intel Xeon: Source: TR1325

Intel Xeon Phi: Source: TR2028C

STREAM* Triad

2x Intel Xeon processor E5-2670 (20 M cache, 2.6 GHz, 8.0 GT/s Intel QPI, 115 W) 64 GB Memory @ 1600 MHz, Score 78.5 GB/s. Source: Intel TR#1241

Intel Xeon Phi coprocessor: 64 MB matrix size, 2 MB pages enabled, ECC on/off (Oct 26, 2012, Gold RC SW stack) (Source: Intel TR #2012B)

Performance Per Watt Configuration Details

Platform Hosting the Coprocessor:

2-Socket Crown Pass Software Development Platform: 2x Intel® Xeon® processor E5-2670 (20 M cache, 2.6 GHz, 8.0 GT/s Intel QPI, 115 W TDP) 32 GB Memory @ 1600 MHz, RHEL 6.2 (measured in a non-production open chassis)

Coprocessor Details:

Intel® Xeon Phi™ coprocessor 5110P: 60 cores, 1.053 GHz, 8 GB Memory@5.0 GT/s, 225 W TDP (B1-Step)

Software Stack:

“Pre-Gold” Release Candidate Software Stack:

MPSS 2.1.4346-16 (Flash: 2.1.01.0375; Coprocessor OS: 2.6.34.11-g65c0cd9; Driver: 4346-16)

Intel® Cluster Studio XE 2013 Update 1 (Compiler: Composer_XE_2013.1.117; Intel® MKL: 11.0.1), TSC = on, Power Mgmt = disabled

SGEMM/DGEMM/SMP LINPACK (both Intel Xeon and Intel Xeon Phi)

Source: TR2028C

1 Intel® Xeon Phi™ coprocessor Score/power (measured)

	Score	Power (coprocessor power only)
SGEMM	1700 GF/S	199 W
DGEMM	833 GF/s	195 W
SMP Linpack	723 GF/s	232 W

Application Benchmark Configuration Data

Source 8th Order isotropic variable velocity model:

Acceleware Configuration Details:

Host: Two Intel® Xeon® processor E5-2690 (8C, 2.9GHz, 130W)

Coprocessor: B0 ES2 61C, 1.091GHz, 8GB @ 5.5GT/s)

Application: 8th order isotropic variable velocity model

Score: 43.5 seconds (Xeon); 19.5 seconds (Xeon Phi)

Lattice QCD:

Jefferson Labs Configuration Details:

Host: Two Intel® Xeon® processor E5-2680 (8C, 2.7GHz, 130W)

Coprocessor: ES2 B1, 61 core, 1.091GHz, 8GB @ 5.5GT/s)

Application: 32x24x40x96 volumes Compressed Gauges

Score: 120GB/s (Xeon only); 335GB/s (Xeon Phi)

Financial Services:

Monte Carlo & Black Scholes (SP):

Host: Two Intel® Xeon® processor E5-2670 (8C, 2.6GHz, 115W)

Coprocessor: ES2 B1, 61 core, 1.091GHz, 8GB @ 5.5GT/s)

Application: Black Scholes Compute (Single Precision)

Score: 4.47866 Bopt/sec (Xeon only); 33.689 Bopt/sec (Xeon Phi)

Application: Monte Carlo Simulation (Single Precision)

Score: 45,501 opt/sec (Xeon only); 489,354 opt/sec (Xeon Phi)

Sinopec:

RTM

Host: Two Intel® Xeon® processor E5-2680 (8C, 2.7GHz, 130W), 32GB memory, default BIOS settings

Coprocessor: 2x ES2 B1, 61 core, 1.091GHz, 8GB @ 5.5GT/s)

Application: Split Step Fourier PsDM algorithm (Pre-stack depth migration)

Score: 1342 seconds (2S Xeon only); 528.6 seconds (2S Xeon + 2 Xeon Phi)

CSIRO/ASKAP:

tHogbom Clean

Host: Two Intel® Xeon® processor E5-2670 (8C, 2.6GHz, 115W), 64GB memory, default BIOS settings

Coprocessor: ES2 B0, 61 core, 1.091GHz, 8GB @ 5.5GT/s) (Early Gold SW release...4663-11...not production)

Application: tHogbom Clean

Time: 182 Cleaning iterations/sec (2S Xeon only); 413.2 Cleaning iterations/sec (1 Xeon Phi)

TUM (Technische Universitat Munchen)

SG++ (adaptive Sparse Grids, used for data mining in scientific problems)

Host: Two Intel® Xeon® processor E5-2670 (8C, 2.6GHz, 115W), 64GB memory, default BIOS settings

Coprocessor: ES2 B0, 61 core, 1.091GHz, 8GB @ 5.5GT/s) (Beta MPSS 3653, Composer XE 2013.1.115)

Application: SG++

Time: 134.24 GFLOP/s (2S Xeon only); 228.46 GFLOP/s (1 Xeon Phi)

ZIB (Zuse-Institut Berlin) :

Ising 3D (Solid State Physics, simulate atoms, computes spin behavior in a 128x128x128 grid)

Host: Two Intel® Xeon® processor E5-2670 (8C, 2.6GHz, 115W), 64GB memory, default BIOS settings

Coprocessor: ES2 B0, 61 core, 1.091GHz, 8GB @ 5.5GT/s)

Application: Ising 3D

Time: 0.0431 ns/update (2S Xeon only); 0.0124 ns/update (1 Xeon Phi)

AWE (Atomic Weapons Establishment – United Kingdom):

Cloverleaf (2D structured Hydrodynamics – a fluid Dynamics mini-app)

Host: Two Intel® Xeon® processor E5-2670 (8C, 2.6GHz, 115W), 64GB memory, default BIOS settings

Coprocessor: ES2 B1, 61 core, 1.091GHz, 8GB @ 5.5GT/s) (MPSS 3552, Composer XE 2013.1.117)

Application: Cloverleaf

Time: 50.22 sec (2S Xeon only); 28.31 sec (1 Xeon Phi)

Application Benchmark Configuration Data (cont.)

Source MiniFE Solver:

Sandia Labs Configuration Details:

Host: Two Intel® Xeon® processor E5-2670 (8C, 2.6GHz, 115W)

Coprocessor: ES1 B0, 61 core, 1.091GHz, 8GB @ 5.5GT/s)

Cluster with 8 nodes and FDR fabric; Beta SW Stack

Application: miniFE Solver 390x390x390 Double Precision

Score: 2.34 seconds (Xeon only); 1.15 seconds (Xeon + Xeon Phi) (8 nodes, symmetric)

Score: 2.34 seconds (Xeon only); 1.77 seconds (8 Xeon Phi only) (native)

Intel Labs:

Ray Tracing

Host: Two Intel® Xeon® processor E5-2680 (8C, 2.7GHz, 130W), 32GB memory, default BIOS settings

Coprocessor: ES2 B0, 61 core, 1.091GHz, 8GB @ 5.5GT/s)

Application: Ray Tracing Benchmark, Ambient Occlusion (4 Million Triangles, 1024 x 1024 resolution, total 17,825,792 rays per frame)

Score: 61.61 Million Rays/sec (2S Xeon only); 115.85 Million Rays/sec (Xeon Phi)

NEC: (Source NEC: See 328604-001us.pdf @ <http://software.intel.com/en-us/articles/sdp-case-studies>)

Video Transcoding:

Host: Two Intel® Xeon® processor E5-26xx

Coprocessor: 2 x SE10P, 61 core, 1.091GHz, 8GB @ 5.5GT/s)

Application: conversion of Standard Definition video to High Definition Video

Score: 10 frames per second (2S Xeon only, optimized code); 30 frames per second (2S Xeon + 2 Xeon Phi)

CNPC BGP Geoeast PSTM:

Seismic

Host: Two Intel® Xeon® processor E5-2687 (8C, 3.1GHz, 150W), 64GB memory, default BIOS settings

Coprocessor: ES2 B0, 61 core, 1.091GHz, 8GB @ 5.5GT/s)

Application: CNPC BDP Geoeast PSTM

Time: 1100 sec (2S Xeon only); 311 sec (2S Xeon + 2 Xeon Phi)

Financial Services Workload Configuration Data

Configuration Details:

As of October 22, 2012

Platform Hosting the Coprocessor (& platform for 2S Intel® Xeon® processor baseline):

2-Socket Crown Pass Software Development Platform: 2x Intel Xeon processor E5-2670 (20 M cache, 2.6 GHz, 8.0 GT/s Intel QPI, 115 W TDP) 32GB Memory @ 1600 MHz, RHEL 6.0

Coprocessor Details:

Intel® Xeon Phi™ coprocessor SE10: 61 cores, 1.1 GHz, 8 GB Memory@5.5 GT/s, 300 W TDP (active cooling solution) (B1 step)

Software Stack:

“Gold” Release Candidate Software Stack:

MPSS 2.1.4346-17 (Flash: 2.1.01.0375; Coprocessor OS: 2.6.34.11-g65c0cd9; Driver: 4346-16)

Intel® Cluster Studio XE 2013 Update 1 (Compiler: Composer_XE_2013.1.117; Intel® MKL: 11.0.1)

Results measured by Shuo Li

	<u>2S Intel® Xeon® processor</u>	<u>Intel® Xeon Phi™ coprocessor</u>
Monte Carlo Simulation SP (native)	45,501	489,354 opt/sec
Monte Carlo Simulation DP	21,817	97,846 opt/sec
Black Scholes Compute SP	4.8023	33.689 Bopt/sec
Black Scholes Compute DP	2.2957	5.851 Bopt/sec
Black Scholes Compute & Bandwidth SP	3.8684	20.571 Bopt/sec
Black Scholes Compute & Bandwidth DP	1.2471	4.665 Bopt/sec

5110P vs. SE10P Configuration Data

Configuration Details:

As of October 26, 2012

Host Platform:

2-Socket Crown Pass Software Development Platform: 2x Intel® Xeon® processor E5-2670 (20 M cache, 2.6 GHz, 8.0 GT/s Intel QPI, 115W TDP) 32 GB Memory @ 1600MHz, RHEL 6.0

Coprocessor Details:

Intel® Xeon Phi™ coprocessor 5110P: 60 cores, 1.053 GHz, 8 GB Memory@5.0 GT/s, 225 W TDP (B1 step)

Intel® Xeon Phi™ coprocessor SE10: 61 cores, 1.1 GHz, 8 GB Memory@5.5 GT/s, 300 W TDP (B1 step)

Software Stack:

“Gold” Release Candidate Software Stack:

MPSS 2.1.4346-16 (Flash: 2.1.01.0375; Coprocessor OS: 2.6.34.11-g65c0cd9; Driver: 4346-16)

Intel® Cluster Studio XE 2013 Update 1 (Compiler: Composer_XE_2013.1.117; Intel® MKL: 11.0.1)

SGEMM/DGEMM/SMP Linpack

Source: TR2028C

Matrix Size	5110P	SE10
SGEMM	11264 x 11264	15360 x 15360
DGEMM	7680 x 7680	7680 x 7680
SMP Linpack	28672 x 28672	28672 x 28672

Score	5110P	SE10
SGEMM	1729.94 GF/s	1860.87 GF/s
DGEMM	833.17 GF/s	883.27 GF/s
SMP Linpack	722.88 GF/s	803.3 GF/s
STREAM Triad	159 GB/s	174 GB/s

STREAM* Triad

Intel® Xeon Phi™ coprocessor: 64 M matrix size, 2 MB pages enabled, ECC on (Oct 26, 2012) (Source TR 2012B) 5110P = 159 GB/s, SE10 P (174 GB/s)

PCIe Transfer Bandwidth

Configuration Details:

As of October 26, 1012

Platform Hosting the Coprocessor:

2 Socket Crown Pass Software Development Platform: 2x Intel Xeon processor E5-2670 (20M cache, 2.6GHz, 8.0GT/s Intel QPI, 115W TDP) 32GB Memory @ 1600MHz, RHEL 6.0

Coprocessor Details:

Intel® Xeon Phi™ coprocessor 5110P: 60cores, 1.053GHz, 8GB Memory@5.0GT/s, 225W TDP (B1 step)

Intel® Xeon Phi™ coprocessor SE10P: 61cores, 1.1GHz, 8GB Memory@5.5GT/s, 300W TDP (B1 step)

Software Stack:

“Gold” Software Stack:

MPSS 2.1.4346-16 (Flash: 2.1.01.0375; Coprocessor OS: 2.6.34.11-g65c0cd9; Driver: 4346-16)

Intel Cluster Studio XE 2013 Update 1 (Compiler: Composer_XE_2013.1.117; Intel® MKL: 11.0.1)

Xeon Phi: Source: TR2028C

Optimization Notice

Optimization Notice

Intel's compilers may or may not optimize to the same degree for non-Intel microprocessors for optimizations that are not unique to Intel microprocessors. These optimizations include SSE2, SSE3, and SSE3 instruction sets and other optimizations. Intel does not guarantee the availability, functionality, or effectiveness of any optimization on microprocessors not manufactured by Intel.

Microprocessor-dependent optimizations in this product are intended for use with Intel microprocessors. Certain optimizations not specific to Intel microarchitecture are reserved for Intel microprocessors. Please refer to the applicable product User and Reference Guides for more information regarding the specific instruction sets covered by this notice.

Notice revision #20110804

Legal Disclaimers

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.

Relative performance is calculated by assigning a baseline value of 1.0 to one benchmark result, and then dividing the actual benchmark result for the baseline platform into each of the specific benchmark results of each of the other platforms, and assigning them a relative performance number that correlates with the performance improvements reported.

Results have been estimated based on internal Intel analysis and are provided for informational purposes only. Any difference in system hardware or software design or configuration may affect actual performance.

Intel does not control or audit the design or implementation of third party benchmarks or Web sites referenced in this document. Intel encourages all of its customers to visit the referenced Web sites or others where similar performance benchmarks are reported and confirm whether the referenced benchmarks are accurate and reflect performance of systems available for purchase.

Intel® Hyper-Threading Technology available on select Intel® Xeon® processors. Requires an Intel® HT Technology-enabled system. Consult your PC manufacturer. Performance will vary depending on the specific hardware and software used. For more information including details on which processors support HT Technology, visit <http://www.intel.com/info/hyperthreading>.

Intel® Turbo Boost Technology requires a platform with a processor with Intel Turbo Boost Technology capability. Intel Turbo Boost Technology performance varies depending on hardware, software and overall system configuration. Check with your platform manufacturer on whether your system delivers Intel Turbo Boost Technology. For more information, see <http://www.intel.com/technology/turboboost>.

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