Intel® Xeon Phi™ Coprocessor
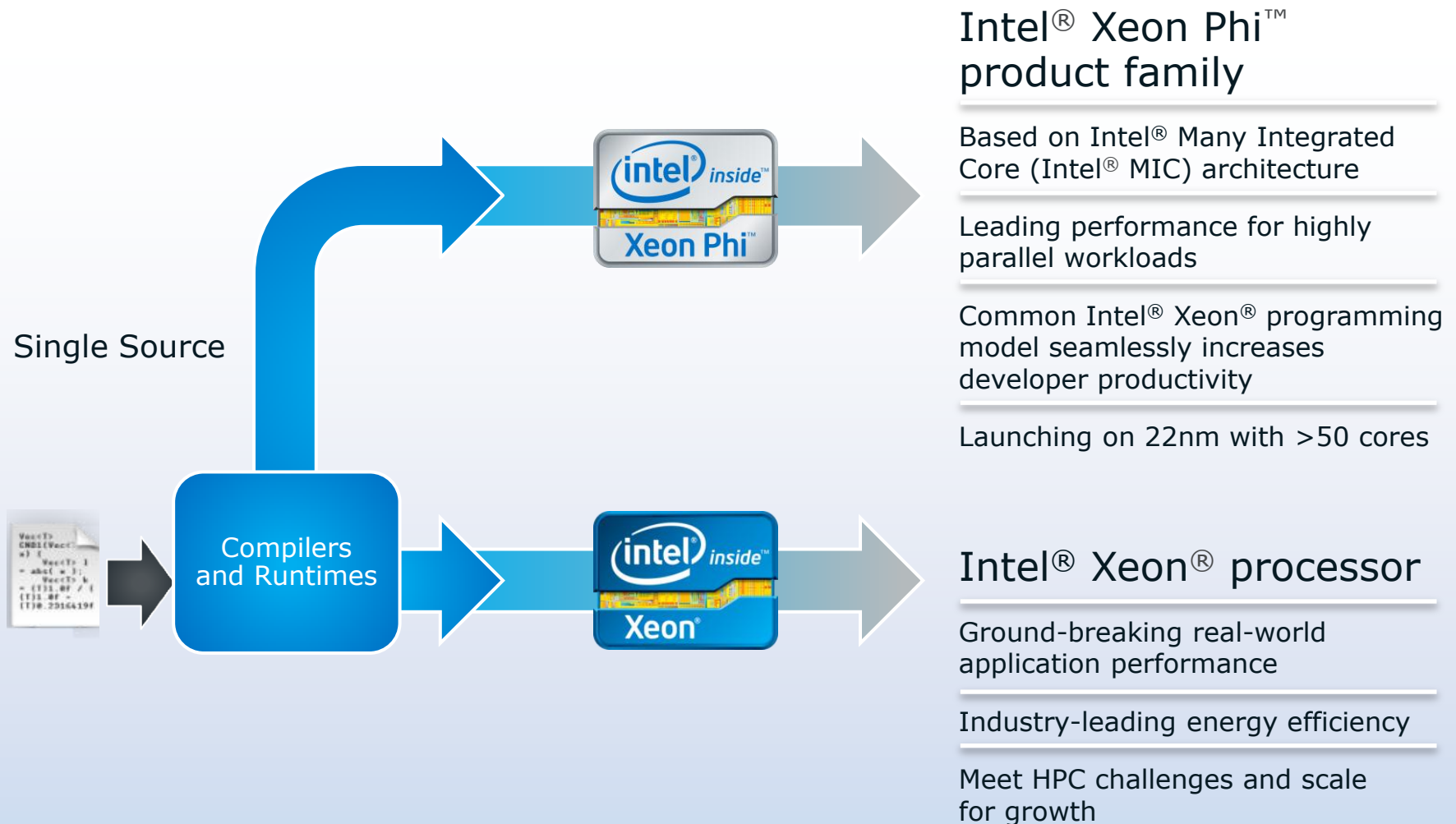## Highly-Parallel Processing

April 2013

Marius Cornea

Intel Corporation

Highly-Parallel Processing
Seamlessly solves most important problems of any scale

Single Source

Compilers and Runtimes

Intel® Xeon Phi™ product family

Based on Intel® Many Integrated Core (Intel® MIC) architecture

Leading performance for highly parallel workloads

Common Intel® Xeon® programming model seamlessly increases developer productivity

Launching on 22nm with >50 cores

Intel® Xeon® processor

Ground-breaking real-world application performance

Industry-leading energy efficiency

Meet HPC challenges and scale for growth

Introducing Intel® Xeon Phi™ Coprocessors

Highly-parallel Processing for Unparalleled Discovery

Groundbreaking Differences

Up to 61 IA cores/1.1 GHz/ 244 Threads

Up to 8GB memory with up to 352 GB/s bandwidth

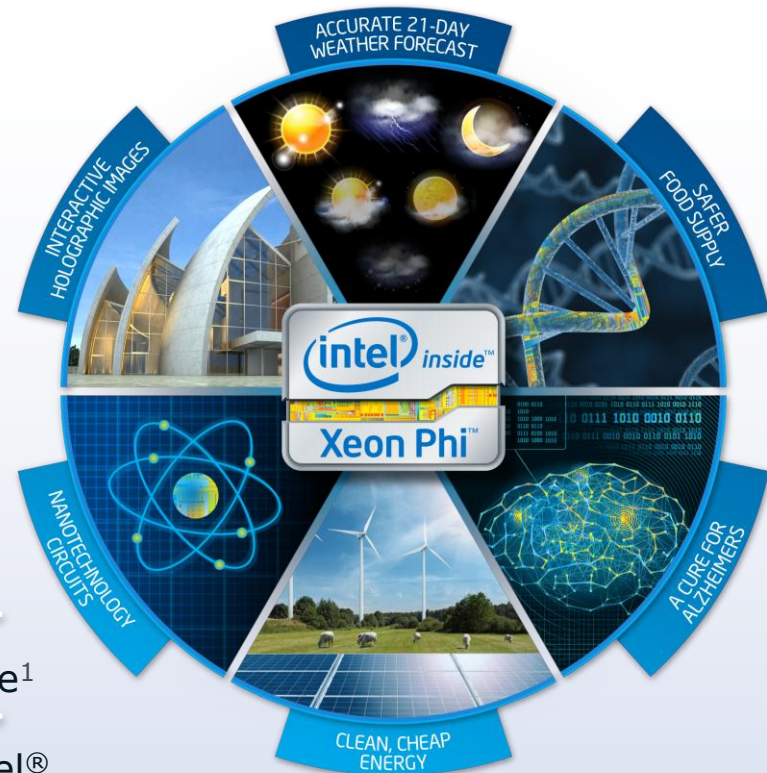512-bit SIMD instructions; fma

Linux operating system, IP addressable

Standard programming languages and tools

Leading to Groundbreaking Results

Up to 1 TeraFlop/s double precision peak performance[1]

Up to 2.2x higher memory bandwidth than on an Intel® Xeon® processor E5 family-based server.[2]

Up to 4x more performance per watt than with an Intel® Xeon® processor E5 family-based server. [3]

ACCURATE 21-DAY WEATHER FORECAST

INTERACTIVE HOLOGRAPHIC IMAGES

SAFER FOOD SUPPLY

NANOTECHNOLOGY CIRCUITS

A CURE FOR ALZHEIMERS

CLEAN, CHEAP ENERGY

(intel) inside™
Xeon Phi™

Intel® Xeon Phi™ Coprocessors Much More Than That

General purpose IA Hardware leads to less idle time for your investment.

Restrictive architectures

It's a supercomputer on a chip

GPU
ASIC
FPGA

Operate as a compute node

Run a full OS

Program to MPI

Run x86 code

Run restricted code

Run offloaded code

Custom HW Acceleration

Intel® Xeon Phi™ Coprocessor

Restrictive architectures limit the ability for applications to use arbitrary nested parallelism, functions calls and threading models

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Shipping in 2012

Intel® Xeon Phi™ Coprocessor 5110P

Performance

Up to 1 TFLOP of double-precision (peak)[1]

8GB GDDR5
320 GB/s Bandwidth
Passive form factor at
225W TDP

Programmability

C, C++, Fortran
Intel and 3rd party tools

Intel and
3rd party tools

Applications

Memory Bandwidth /
Capacity Bound workloads

Ideal for
Molecular Modeling,
Digital Content Creation,
and Energy

Ideal for memory bandwidth and memory capacity bound workloads

Shipping in 2013
Intel® Xeon Phi™ Coprocessor 3100 Product Family

Performance

Up to 1 TFLOP of
double-precision (peak)[1]

6GB GDDR5
240 GB/s Bandwidth
Active and passive form
factors at 300W TDP

Programmability

C, C++, Fortran
Intel and 3rd party tools

Intel and
3rd party tools

Applications

Compute Bound
workloads

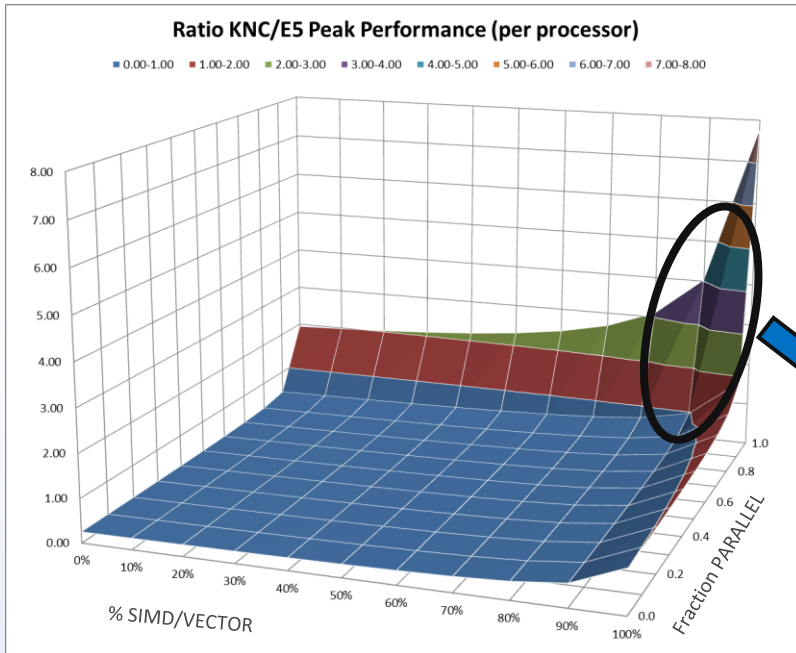DNA Sequencing

Ideal for MonteCarlo,
Black-Scholes,
Life Sciences

Ideal for compute bound workloads

Intel® Xeon Phi™ Coprocessor:
Increases Application Performance up to 10x

Application Performance Examples

Ratio KNC/E5 Peak Performance (per processor)

■ 0.00-1.00 ■ 1.00-2.00 ■ 2.00-3.00 ■ 3.00-4.00 ■ 4.00-5.00 ■ 5.00-6.00 ■ 6.00-7.00 ■ 7.00-8.00

Customer	Application	Performance Increase[1] vs. 2S Xeon*
Los Alamos	Molecular Dynamics	Up to 2.52x
Acceleware	8th order isotropic variable velocity	Up to 2.05x
Jefferson Labs	Lattice QCD	Up to 2.27x
Financial Services	BlackScholes SP Monte Carlo SP	Up to 7x Up to 10.75x
Sinopec	Seismic Imaging	Up to 2.53x[2]
Sandia Labs	miniFE (Finite Element Solver)	Up to 2x[3]
Intel Labs	Ray Tracing (incoherent rays)	Up to 1.88x[4]

- Intel® Xeon Phi™ coprocessor accelerates highly parallel & vectorizable applications. (graph above)

- Table provides examples of such applications

* Xeon = Intel® Xeon® processor;
* Xeon Phi = Intel® Xeon Phi™ coprocessor

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

(intel)

Synthetic Benchmark Summary (Intel® MKL) (5110P)

SGEMM
(GF/s)

Up to 2.7X

Higher is Better

2000	
1500	1,729
1000	85% Efficient
500	640
0	

2S Intel® Xeon® Processor — 1 Intel® Xeon Phi™ coprocessor

DGEMM
(GF/s)

Up to 2.7X

Higher is Better

1000	
800	833
600	82% Efficient
400	
200	309
0	

2S Intel® Xeon® processor — 1 Intel® Xeon Phi™ coprocessor
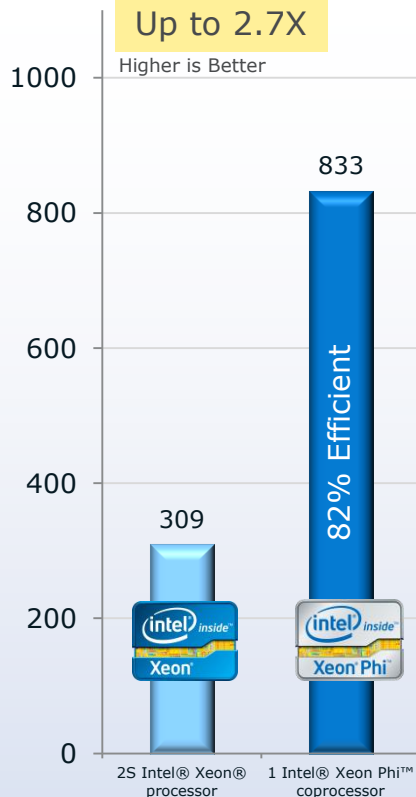
SMP Linpack
(GF/s)

Up to 2.3X

Higher is Better

1000	
800	722
600	71% Efficient
400	
200	303
0	

2S Intel® Xeon® processor — 1 Intel® Xeon Phi™ coprocessor
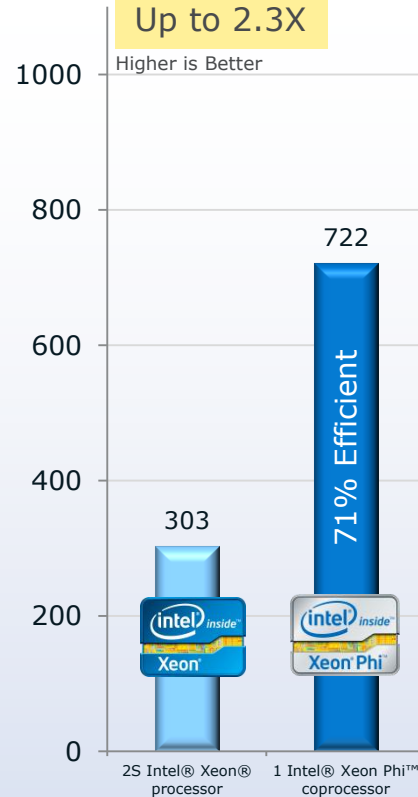
STREAM Triad
(GB/s)

Up to 2.1X

Higher is Better

200	171
150	159
100	ECC On / ECC Off
50	78
0	

2S Intel® Xeon® processor — 1 Intel® Xeon Phi™ coprocessor — 1 Intel® Xeon Phi™ coprocessor
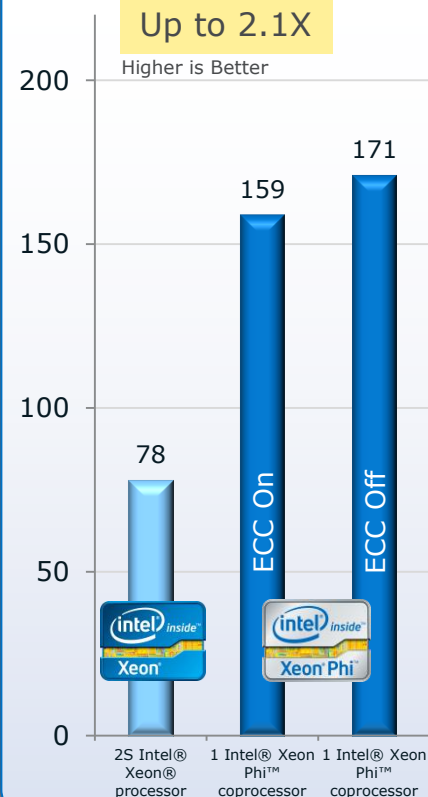
Coprocessor results: Benchmark run 100% on coprocessor, no help from Intel® Xeon® processor host (aka native)

Notes
1. **Intel® Xeon® Processor E5-2670 used for all SGEMM Matrix = 13824 x 13824 , DGEMM Matrix 7936 x 7936, SMP Linpack Matrix 30720 x 30720**
2. **Intel® Xeon Phi™ coprocessor 5110P (ECC on) with "Gold Release Candidate" SW stack SGEMM Matrix = 11264 x 11264, DGEMM Matrix 7680 x 7680, SMP Linpack Matrix 26872 x 28672**

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 results as of October 26, 2012   C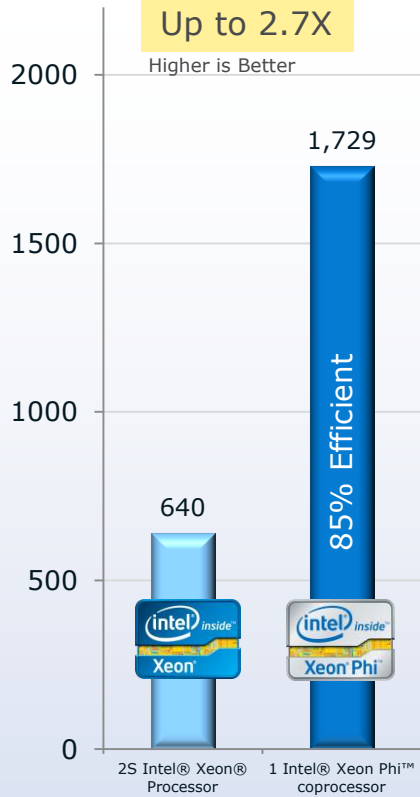onfiguration Details: Please reference slide speaker notes. **For more information go to http://www.intel.com/performance**
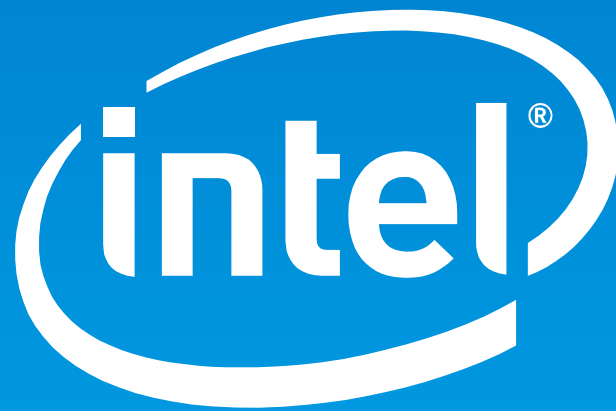
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1. Peak DP FLOPS claim based on calculated theoretical peak double precision performance capability for a single coprocessor. 16 DP FLOPS/clock/core * 60 cores * 1.053GHz = 1.0108 TeraFlop/s.

2. Memory Bandwidth: 2 socket Intel® Xeon® processor E5-2600 product family server vs. Intel® Xeon Phi™ coprocessor (2.2x: Measured by Intel October 2012. 2 socket E5-2670 (8 core, 2.6GHz) vs. 1 Intel® Xeon Phi™ coprocessor SE10P (61 cores, 1.1GHz) on STREAM Triad benchmark 79.5 GB/s vs. 175GB/s) (TR 2012B)

3. Performance/Watt: 2 socket Intel® Xeon® processor E5-2670 server vs. a single Intel® Xeon Phi™ coprocessor SE10P (Intel Measured DGEMM perf/watt score 309 GF/s @ 335W vs. 829 GF/s @ 195W) (TR 2028B)