Intel® Xeon Phi™ Coprocessor
Highly-parallel Processing for Unparalleled Discovery

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Server Platform product manager
Intel PPMG
Today’s Toughest Challenges Present the Greatest Compute Complexity

- Scientific Research
  - Climate/weather modeling
  - Medical imaging
  - Energy exploration
  - Simulations

- Industry competitiveness
  - Pharmaceutical research
  - Financial analyses
  - New product design
  - CAD/manufacturing
  - Digital content creation

- National security
  - Computational arms race
  - Total compute performance by country
Highly-parallel Processing for Unparalleled Discovery

* Seamlessly solve your most important problems of any scale

**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

Single Source

Compilers and Runtimes
Timeline of Many-Core at Intel

**Era of Tera CTO Keynote & “The Power Wall”**

- 2004: Many-core technology Strategic Planning
- 2005: Many-core R&D agenda & BU Larrabee development
- 2006: Tera-scale computing research program (80+ projects)
- 2007: Workloads, simulators, software & insights from Intel Labs
- 2008: Universal Parallel Computing Research Centers
- 2009: 1 Teraflops SGEMM on Larrabee @ SC’09
- 2010: Many-core applications research community
- 2011: Intel® Xeon Phi™ Coprocessor enters Top500 at #150 (pre-launch)

**Key Events:**
- Teraflops Research Processor (Polaris)
- Single-chip Cloud Computer (Rock Creek)

2. Source: www.top500.org June 2012

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. For more information go to http://www.intel.com/performance
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
- Linux operating system, IP addressable
- Standard programming languages and tools

**Leading to Groundbreaking results**

- Up to 1 TeraFlop/s double precision peak performance
- Enjoy up to 2.2x higher memory bandwidth than on an Intel® Xeon® processor E5 family-based server.
- Up to 4x more performance per watt than with an Intel® Xeon® processor E5 family-based server.

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For more information go to [http://www.intel.com/performance](http://www.intel.com/performance). Notes 1, 2, and 3 see backup for system configuration details.
Intel® Xeon Phi™ Coprocessors: They’re So Much More

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

Restrictive architectures vs. It’s a supercomputer on a chip

- Operate as a compute node
- Run a full OS
- Program to MPI
- Run x86 code
- Run offloaded code

Custom HW Acceleration vs. Intel® Xeon Phi™ Coprocessor

- GPU
- ASIC
- FPGA
- Run restricted code
- Run offloaded code

Source: Intel Estimates

Restrictive architectures limit the ability for applications to use arbitrary nested parallelism, functions calls and threading models.
Extending to New Dimensions
Where does your application fit?

<table>
<thead>
<tr>
<th>HPC Applications</th>
<th>Enterprise Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy – Seismic Applications</td>
<td>Search</td>
</tr>
<tr>
<td>Digital content creation</td>
<td>Parallel Databases</td>
</tr>
<tr>
<td>Climate modeling &amp; weather prediction</td>
<td>Business Intelligence / Data Mining</td>
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<tr>
<td>Financial analyses, trading</td>
<td></td>
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<tr>
<td>Medical imaging and biophysics</td>
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<td>Molecular Modeling</td>
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<td>Computational Fluid Dynamics</td>
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<td>DNA Sequencing</td>
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<td>Electronic Design Automation</td>
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<tr>
<td>Government/ Defense</td>
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<tr>
<td>Computer Aided Design &amp; Manufacturing</td>
<td></td>
</tr>
</tbody>
</table>

…and more
Intel® Xeon Phi™ Coprocessor: SKU Positioning

3100: Outstanding Parallel Computing Solution
- Ideal for Compute Bound Workloads (Monte Carlo, Black-Scholes, HPL, LifeSc, etc)
- Active and Passive Cooling for Wide Range of Svr/WS Usages

5100: Optimized for High Density Environments
- Ideal for Memory BW Bound (STREAM, Energy) & Memory Capacity Bound (DCC, Energy)
- Innovative Dense Form Factor, Lowest TDP Passively Cooled Cards

7100: Highest Level of Features
- Premium Offering for Most Demanding Users
- Passively Cooled, with or without Thermal Solution, Enabling Large Deployments
### Intel® Xeon Phi™ Coprocessor Planning Roadmap

<table>
<thead>
<tr>
<th></th>
<th>3100 Outstanding Parallel Computing Solution</th>
<th>5100 Optimized for High Density Environments</th>
<th>7100 Highest Level of Features</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Q4 2012 Early-Ship (NDA)</strong></td>
<td><img src="#" alt="3120P" /> 57 cores @ 1.1 Ghz 6GB GDDR5 @ 5.0GT/s 12 channels 300W</td>
<td><img src="#" alt="5110P" /> 60 cores @ 1.053 Ghz 8GB GDDR5 @ 5.0GT/s 16 channels 225W</td>
<td><img src="#" alt="SE10P" /> 61 cores @ 1.1 Ghz 8GB GDDR5 @ 5.5GT/s 16 channels 300W</td>
</tr>
<tr>
<td><strong>Q1 2013</strong></td>
<td><img src="#" alt="3120A" /> 57 cores @ 1.1 Ghz 6GB GDDR5 @ 5.0GT/s 12 channels 300W</td>
<td><img src="#" alt="5120D" /> 60 cores @ 1.053 Ghz 8GB GDDR5 @ 5.5GT/s 16 channels 245W</td>
<td><img src="#" alt="SE10X" /> 61 cores @ 1.1 Ghz 8GB GDDR5 @ 5.5GT/s 16 channels 300W</td>
</tr>
<tr>
<td><strong>Q2 2013</strong></td>
<td><img src="#" alt="7120P" /> 61 cores @ TBD 8GB GDDR5 @ 5.5GT/s 16 channels 300W</td>
<td><img src="#" alt="7120X" /> 61 cores @ TBD 8GB GDDR5 @ 5.5GT/s 16 channels 300W</td>
<td></td>
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</tbody>
</table>

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**All SKUs, pricing and features are PRELIMINARY and are subject to change without notice**

**SE10P/X have limited quantities and available only to previously identified customers**
Intel® Xeon Phi™ Coprocessor

Silicon Cores: 57-61
Silicon Max Freq: 1.05-1.25 GHz
Double Precision Peak Performance: 1003-1220 GFLOP
GDDR5 Devices: 24-32
Memory Capacity: 6-8GB
Memory Channels: 12-16
Form Factors: Refer to picture: passive, active, dense form factor (DFF), no thermal solution (NTS)
Memory/BW Peak: 240-352 GT/s
Total Cache: 28.5-30.5MB
Board TDP: 225-300 Watts
PCIE: PCIe Gen 2 x16, I/O speeds up to: KNC → Host: 7.0 GB/s; Host → KNC: 6.7 GB/s
Misc.
- Product codename: Knights Corner
- Based on 22nm process
- ECC enabled
- Turbo not currently available
Power/ Mgmt
- Future node manager support
- IMPI including Intel Coprocessor Communications Link
Tools
- Intel C++/C/FORTRAN compilers, Intel Math Kernel Library
- Debuggers, Performance and Correctness Analysis Tools
- OpenMP, MPI, OFED messaging infrastructure (Linux only), OpenCL
- Programming Models: Offload, Native and mixed Offload+Native
OS
- RHEL 6.x, SuSE 11.1, Microsoft Windows 8 Server, Win 7, Win 8

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## Intel® Xeon Phi™ Coprocessor Family Reference Table

<table>
<thead>
<tr>
<th>Processor Brand Name</th>
<th>Codename</th>
<th>Process</th>
<th>SKU #</th>
<th>Form Factor, Thermal</th>
<th>Board TDP (Watts)</th>
<th>Max # of Cores</th>
<th>Clock Speed (GHz)</th>
<th>Peak Double Precision (GFLOP)</th>
<th>GDDR5 Memory Speeds (GT/s)</th>
<th>Peak Memory BW</th>
<th>Memory Capacity (GB)</th>
<th>Total Cache (MB)</th>
<th>Production Si Stepping</th>
<th>Turbo Enabled</th>
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<td>SE10P</td>
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<td>1073.6</td>
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<td>SE10X</td>
<td>PCIe Card, No Thermal Solution</td>
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<td>61</td>
<td>1.1</td>
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<td>B</td>
<td>N</td>
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<td>7120X</td>
<td>PCIe Card, No Thermal Solution</td>
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<td></td>
<td>5120D</td>
<td>Dense Form, No Thermal Solution</td>
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<td>60</td>
<td>1.053</td>
<td>1011</td>
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<td>352</td>
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<td>3120P</td>
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<td>3120A</td>
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<td>240</td>
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<td>28.5</td>
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SKU Availability & Pricing Guidelines

This table represents recommended customer pricing for Intel® Xeon Phi™ coprocessor 5110P and approximate recommended pricing for all other SKUs.

Intel will have limited availability of SE10P, SE10X and 5110P in Q4 2012.

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<th>7100 Highest Level of Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>3120P</td>
<td>5110P</td>
<td>SE10P/X</td>
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<tr>
<td>3120A</td>
<td>5120D</td>
<td>7120P/X</td>
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<table>
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<tbody>
<tr>
<td>~$1,695</td>
<td>~$1,695</td>
<td>$2,649</td>
<td>~$2,755</td>
<td>--</td>
<td>~$4,129</td>
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Next Intel® Xeon Phi™ Processor: Knights Landing

- Available in Intel cutting-edge 14 nanometer process
- Stand alone CPU or PCIe coprocessor – not bound by ‘offloading’ bottlenecks
- Integrated on-package memory – Leadership compute and memory bandwidth

All products, computer systems, dates and figures specified are preliminary based on current expectations, and are subject to change without notice.
Intel® Xeon Phi™ Coprocessor- Game Changer for HPC

Build your applications on a known compute platform... and watch them take off sooner.

“We ported millions of lines of code in only days and completed accurate runs. Unparalleled productivity... most of this software does not run on a GPU and never will”.

— Robert Harrison, National Institute for Computational Sciences, Oak Ridge National Laboratory

Intel® Xeon Phi™ Coprocessor

Intel® Development Tools extend to Intel® Xeon Phi™ Coprocessor

Leading developer tools for performance on nodes and clusters

Shared Memory Programming Development

Intel® C/C++ and Fortran Compilers w/OpenMP
Intel® MKL, Intel® Cilk Plus, Intel® TBB, and Intel® IPP
Intel® Inspector XE, Intel® VTune™ Amplifier XE, Intel® Advisor

Distributed & Shared Memory Programming Development

Intel® MPI Library
Intel® Trace Analyzer and Collector
Intel® Parallel Studio XE
Highly parallel and vectorized applications will run even faster on Intel® Xeon Phi™ Coprocessors.

Most applications will still run best on multi-core Intel® Xeon® processors.

Optimizing code often delivers significant performance gains.

RUNNING EXISTING SERIAL SOFTWARE

RUNNING OPTIMIZED SOFTWARE
# Software Development Ecosystem\(^1\) for Intel® Xeon Phi™ Coprocessor

<table>
<thead>
<tr>
<th>Open Source</th>
<th>Commercial</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compilers, Run environments</td>
<td>gcc (kernel build only, not for applications), python*</td>
</tr>
<tr>
<td></td>
<td>Intel® C++ Compiler, Intel® Fortran Compiler, MYO, CAPS* HMPP* 3.2.5 (Beta) compiler, PGI*, PGAS GPI (Fraunhofer ITWM*), ISPC</td>
</tr>
<tr>
<td>Debugger</td>
<td>gdb</td>
</tr>
<tr>
<td></td>
<td>Intel Debugger, RogueWave* TotalView* 8.9, Allinea* DDT 3.3</td>
</tr>
<tr>
<td>Libraries</td>
<td>TBB(^2), MPICH2 1.5, FFTW, NetCDF</td>
</tr>
<tr>
<td></td>
<td>NAG*, Intel® Math Kernel Library, Intel® MPI Library, Intel® OpenMP*, Intel® Cilk™ Plus (in Intel compilers), MAGMA*, Accelereyes* ArrayFire 2.0 (Beta), Boost C++ Libraries 1.47+</td>
</tr>
<tr>
<td>Profiling &amp; Analysis Tools</td>
<td>Intel® VTune™ AmplifierXE, Intel® Trace Analyzer &amp; Collector, Intel® Inspector XE, Intel® Advisor XE, TAU* – ParaTools* 2.21.4</td>
</tr>
<tr>
<td>Virtualization</td>
<td>ScaleMP* vSMP Foundation 5.0, Xen* 4.1.2+</td>
</tr>
</tbody>
</table>

\(^1\)These are all announced as of November 2012. Intel has said there are more actively being developed but are not yet announced. \(^2\)Commercial support of Intel TBB available from Intel.
54 OEMs Announcing Support at Xeon Phi Launch

SC12 Announcement – info on Intel.com/xeonphi

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Developing Today on Intel® Xeon Phi™ Coprocessors

SC12 Announcement – info on Intel.com/xeonphi

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Intel Roadmap to Exascale

Intel’s Exascale Goal
Reach Exascale by 2018 with Intel technologies including Intel® Xeon Phi™ Coprocessors

Intel® Xeon Phi™ Product Family
Key ingredient in Intel Exascale Roadmap
• Programmability
• Power efficiency
• Scalability
• Resiliency

Future options subject to change without notice.