Accelerating HPC

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Agenda

• Accelerating HPC
• Intel® QuickAssist Technology Update
• Intel® MIC Architecture
• Summary
Still an Insatiable Need for Computing

- 1 ZFlops
- 100 EFlops
- 10 EFlops
- 1 EFlop
- 100 PFlops
- 10 PFlops
- 1 PFlop
- 10 TFlops
- 1 TFlop
- 100 GFlops
- 10 Gflops
- 1 GFlop
- 100 MFlops


- Climate Simulation
- Genomics Research
- Medical Imaging

Source: www.top500.org
What are we doing to accelerate HPC applications?

• Intel Xeon® Processors and Intel® MIC Architecture.
• Support Open Attach for Application Accelerators – PCIe Gen 2 today, and PCIe Gen 3 in the future.
• Enabling FSB & QPI-FPGA cache coherent heterogeneous systems.
• Intel QuickAssist Technology Initiative.
• OpenCL Standards efforts.
In-socket FPGA Accelerators

Intel® QuickAssist Technology

- Multiple accelerator and attach options with software and ecosystem support
- Performance and scalability based on customer needs and priorities

Simplify The Use and Deployment of Accelerators on Intel® Architecture Platforms
Moore’s Law: Alive and Well at Intel

Intel Innovation-Enabled Technology Pipeline is Full
High Performance Micro-Architecture for PetaScale Deployments

Tick

Tock

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Tock

65nm

Core™ Harpertown

45nm

Penryn Nehalem

32nm

Westmere Sandy Bridge

22nm

Ivy Bridge Future

New instructions:

SSSE3 SSE4.1 SSE4.2 AES AVX Future - FMA

Sponsors of Tomorrow:
Intel® Xeon® Processor 5600 Series
Building on Xeon® 5500 Leadership Capabilities

Higher Frequency
Greater performance at the same power

New 32nm manufacturing Process
Delivering more into the same package

More Cores/More cache
Up to 6 cores, Up to 12MB Cache. Providing more performance for data intensive workloads

DDR3 Memory
Up to 2 x 1333 MHz DIMMs per channel. Greater performance for bandwidth sensitive applications

PCI Express® 2.0
IC 10/10R
Intel® 82599 10GbE Controller

Up to 60% More Performance¹
Better Energy Efficiency
New Security Features

New lower power CPU SKU options for Xeon® 5600

1 Source: Internal Intel measurements for Xeon® X5680 vs. Xeon® X5570 on BlackScholes*. See backup for system configurations.
Intel® Xeon® Processor 7500 Series

Super Node Scalability for HPC

Technology Advantages

- Nehalem architecture
- 8-cores
- 24MB Shared L3 Cache
- 64 DIMM slots support up to 1 terabyte of memory (4 sockets)
- 72 PCIe Gen2 lanes
- Scaling from 2-256 sockets
- Intel Virtualization Technologies
- Mission Critical Class Reliability features

Increased Resources
Larger More Complex Problems
Scalable Performance
From Research to Realization.

Intel® Many Integrated Core Architecture

The Newest Addition to the Intel Server Family. Industry's First General Purpose Many Core Architecture
Intel® MIC Architecture: An Intel Co-Processor Architecture

Many cores and many, many more threads
Standard IA programming and memory model
Knights Ferry

- Software development platform
- Growing availability through 2010
- 32 cores, 1.2 GHz
- 128 threads at 4 threads / core
- 8MB shared coherent cache
- 1-2GB GDDR5
- Bundled with Intel HPC tools

Software development platform for Intel® MIC architecture
The Knights Family

Knights Corner
1st Intel® MIC product
22nm process
>50 Intel Architecture cores

Knights Ferry
Intel® MIC Architecture Programming

Single Source

Common with Intel® Xeon®
• Languages
• C, C++, Fortran compilers
• Intel developer tools and libraries
• Coding and optimization techniques
• Ecosystem support

Eliminates Need for Dual Programming Architecture

Intel® MIC architecture co-processor

Intel® Xeon® processor

Intel® Xeon® processor family

Compilers and Runtimes
IA Programming Flexibility

Programming choices and standards for range of parallel efficiency

Serial Code Node Level
- Fast Scalar performance
- Optimized C/C++, FORTRAN
- Threading and Performance Libraries
- Debug / Analysis Tools

Parallel Node Level
- Multi-core, Multi-socket
- SSE and AVX instructions
- OpenMP
- Threading Building Blocks
- Performance Libraries
- Thread Checker, Cilk

Multi-Node / Cluster Level
- Cluster Tools
- MPI Checker
Summary

• **Scale Performance Forward**
  Optimize your software for multi-core to benefit now,
  - Intel® Xeon® 5600 and Intel® Xeon 7500 today
  - Future Ready for Intel® Xeon® Processors + Intel® MIC Architecture

• Continue to innovate on Intel® Platforms for those applications that may benefit from accelerators.
Performance Claim Backup

- Up to 1.6x performance compared to Xeon 5500 series claim supported by a CPU intensive benchmark (Blackscholes). Intel internal measurement. (Feb 25, 2010)
  - Configuration details: - Blackscholes*
    - Baseline Configuration and Score on Benchmark: Intel pre-production system with two Intel® Xeon® processor X5570 (2.93 GHz, 8 MB last level cache, 6.4 GT/sec QPI), 24GB memory (6x4GB DDR3-1333), 4 x 150GB 10K RPM SATA RAID0 for scratch, Red Hat* EL 5 Update 4 64-bit OS. Source: Intel internal testing as of February 2010. SunGard v3.0 source code compiled with Intel v11.0 compiler. Elapsed time to run benchmark: 18.74 seconds.
    - New Configuration and Score on Benchmark: Intel pre-production system with two Intel® Xeon® processor X5680 (3.33 GHz, 12 MB last level cache, 6.4 GT/sec QPI), 24GB memory (6x4GB DDR3-1333), 4 x 150GB 10K RPM SATA RAID0 for scratch, Red Hat* EL 5 Update 4 64-bit OS. Source: Intel internal testing as of February 2010. SunGard v3.0 source code compiled with Intel v11.0 compiler. Elapsed time to run benchmark: 11.51 seconds.

- Up to 40% higher performance/watt compared to Intel® Xeon® Processor 5500 Series claim supported by performance results on a server side java benchmark in conjunction with power consumption across a load line. Intel internal measurement (Jan 15, 2010)
  - Baseline platform: Intel preproduction server platform with two Quad-Core Intel® Xeon® processor X5570, 2.93 GHz, 8MB L3 cache, 6.4QPI, 8GB memory (4x2GB DDR3-1333), 1 PSU, Microsoft Windows Server 2008 Enterprise SP2. Intel internal measurement as of January 15, 2010.
  - New platform: Intel preproduction server platform with two six-Core Intel® Xeon® processor X5670, 2.93 GHz, 12MB L3 cache, 6.4QPI, 8GB memory (4x2GB DDR3-1333), 1 PSU, Microsoft Windows Server 2008 Enterprise SP2. Intel internal measurement as of January 15, 2010.

- Intel® Xeon® processor 5600 series with Intel microarchitecture Nehalem delivers similar performance as previous-generation servers but uses up to 30 percent less power
  - Baseline Configuration and Score on Benchmark: Fujitsu PRIMERGY RX300 S5 system with two Intel® Xeon® processor sX5570 (2.93 GHz, 8MB L3, 6.4 GT/s, Quad-core, 95W TDP), BIOS rev. R1.09, Turbo Enabled, HT Enabled, NUMA Enabled, 5 x Fans, 24 GB (6x4GB DDR3-1333 DR registered ECC), 1 x Fujitsu MBD2147RC 147GB 10K RPM 2.5” SAS HDD, 1x800W PSU, SLES 11 (X86_64) Kernel 2.6.27.19-S-default. Source: Fujitsu Performance Lab testing as of Mar 2010. SPECint_rate_base2006 score: 250. http://docs.ts.fujitsu.com/dl.aspx?id=0140b19d-56e3-4b24-a01e-26b8a80cfe53
  - New Configuration and Score on Benchmark: Fujitsu PRIMERGY RX300 S6 system with two Intel® Xeon® processors L5640 (2.26 GHz, 12MB L3, 5.86 GT/s, Hex-core, 60W TDP), BIOS rev R1.00A, Turbo Enabled, HT Enabled, NUMA Enabled, 5 x Fans, 24 GB (6x4GB DDR3-1333 LV DR registered ECC), 1 x Fujitsu MBD2147RC 147GB 10K RPM 2.5” SAS HDD, 1x800W PSU, SLES 11 (X86_64) Kernel 2.6.27.19-S-default. Source: Fujitsu Performance Lab testing as of Mar 2010. SPECint_rate_base2006 score: 250 http://docs.ts.fujitsu.com/dl.aspx?id=4af74e10-24b1-4cf8-bb3b-9c4f5f177389