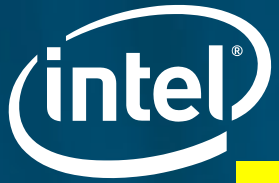


NDA—Under embargo until Monday, June 20th 2016 at 6:30pm CEST (9:30am PT)

Fuel Your Insight

Intel® Scalable System Framework @ ISC16

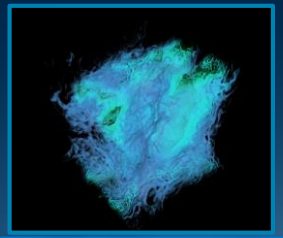
Charles Wuischpard
Vice President, Data Center Group
General Manager, HPC Platform Group

Hugo Saleh
Director of Marketing
HPC Platform Group

MANY WORKLOADS | ONE FRAMEWORK

Modeling & Simulation

High Performance Data Analytics



Machine Learning

Visualization

Intel Scalable System Framework

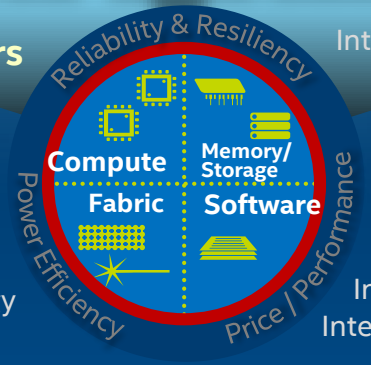
Intel® Xeon Phi™ Processors

Intel® Xeon® Processors

Intel® Solutions for Lustre*

Intel® Optane™ Technology

Intel® Solid State Drive Data Center



Intel® Omni-Path Fabric

Intel® Ethernet

Intel® Silicon Photonics Technology

Intel® HPC Orchestrator

Intel® Software Tools

Intel-Supported Software Defined Visualization

Intel® Cluster Checker

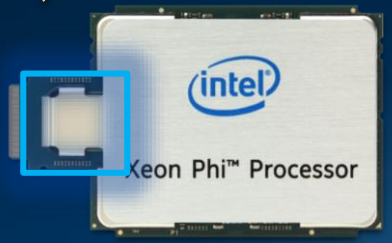
Intel SSF system recommendations

= today

intel

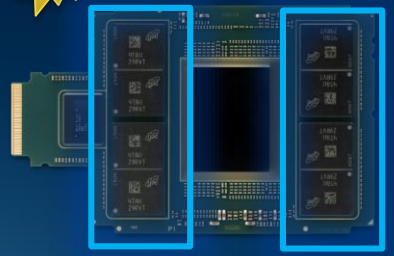
NOW AVAILABLE...INTEL® XEON PHI™ PROCESSOR

1st Integrated Fabric



1st Bootable, Host CPU for Highly-Parallel Workloads

1st Integrated Memory



Leadership performance...

VS. GPU ACCELERATOR

- Up to **5x** Performance[1]
- Up to **8x** Performance/Watt[2]
- Up to **9x** Performance/USD$[3]

...with all the benefits of a CPU

- ✓ Run Any Workload
- ✓ Programmability
- ✓ Power Efficient
- ✓ No PCIe* Bottleneck
- ✓ Large Memory Footprint
- ✓ Scalability & Future-Ready

*Other names and brands may be claimed as the property of others.

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 complete information visit http://www.intel.com/performance/datacenter. Configurations: 1-3 see page 4.

YOUR PATH TO DEEPER INSIGHT

Performance versus NVIDIA GPU Accelerator*

LIFE SCIENCE
Up to
5.0x[1]
Performance
LAMMPS*

VISUALIZATION
Up to
5.2x[2]
Performance
Embree*

FINANCE
Up to
2.7x[3]
Performance
Monte Carlo* DP

ENGINEERING
OIL & GAS
APPLIED SCIENCE
DEFENSE
WEATHER

#1 World record 1-Socket SPECfp*_rate2006 benchmark result[4]

Other names and brands may be claimed as the property of others. SPECfp represents the throughput of 19 common HPC applications ranging from Fluid Dynamics to Speech Recognition – see http://spec.org/cpu2006/CFP2006/.

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intel

CHOOSE YOUR OPTIMIZATION POINT

			INTEGRATED				RECOMMENDED CUSTOMER PRICING[3]
	CORES	GHZ	MEMORY	FABRIC	DDR4	POWER[2]	
7290[1] Best Performance/Node	72	1.5	16GB 7.2 GT/s	Yes	384GB 2400 MHz	245W	$6254
7250 Best Performance/Watt	68	1.4	16GB 7.2 GT/s	Yes	384GB 2400 MHz	215W	$4876
7230 Best Memory Bandwidth/Core	64	1.3	16GB 7.2 GT/s	Yes	384GB 2400 MHz	215W	$3710
7210 Best Value	64	1.3	16GB 6.4 GT/s	Yes	384GB 2133 MHz	215W	$2438

[1]Available beginning in September [2] Plus 15W for integrated fabric
[3] Pricing shown is for parts without integrated fabric. Add additional $278 for integrated fabric versions of these parts. Integrated fabric parts available in October.

WIDESPREAD MARKET ADOPTION^

>100,000
units sold or pending

Major Lab Adoptions*
LANL
LBNL
Sandia
NERSC
Argonne
TACC
Cineca
CEA
T2K
Kyoto
CAS

intel.com/xeonphi/partners

>30 OEM and channel systems

> 30 ISV optimized apps (runs all x86 code)

TOP500 listings (expected)

Developer Systems Starting < $5K

*Other names and brands may be claimed as the property of others.
^Source: Intel estimates

RAPIDLY DELIVERING VALUE TO END USERS

*Delivers up to **58% better** application performance per fabric dollar than EDR[1]*

INTEL® OMNI-PATH ARCHITECTURE

>80,000 nodes sold[2]

Specified in ~1/2 of user RFPs[2]

Sold by *every* major HPC OEM
Bought in *every* geography

Some of the largest system awards

*Alfred Wegener Institute (AWI)**
*Albert Einstein Institute (AEI)**
*Cineca**
*University of Tokyo PT2K**
*Pittsburgh Supercomputing Center**
*Rutgers University**
*TACC**
*US DoE (CTS-1)**

*Other names and brands may be claimed as the property of others.

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 complete information visit http://www.intel.com/performance/datacenter. Configurations: see page 10.

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ADDRESSING THE HPC SOFTWARE STACK HEADACHE

Integration and maintenance are widespread challenges

openHPC

Open source solution for HPC

Community led organization

World-wide participation

39 members since launch
(including non-IA based vendors)

Over 11,000 new worldwide visitors since launch

Version 1.1 now available

NEW

Intel® HPC Orchestrator

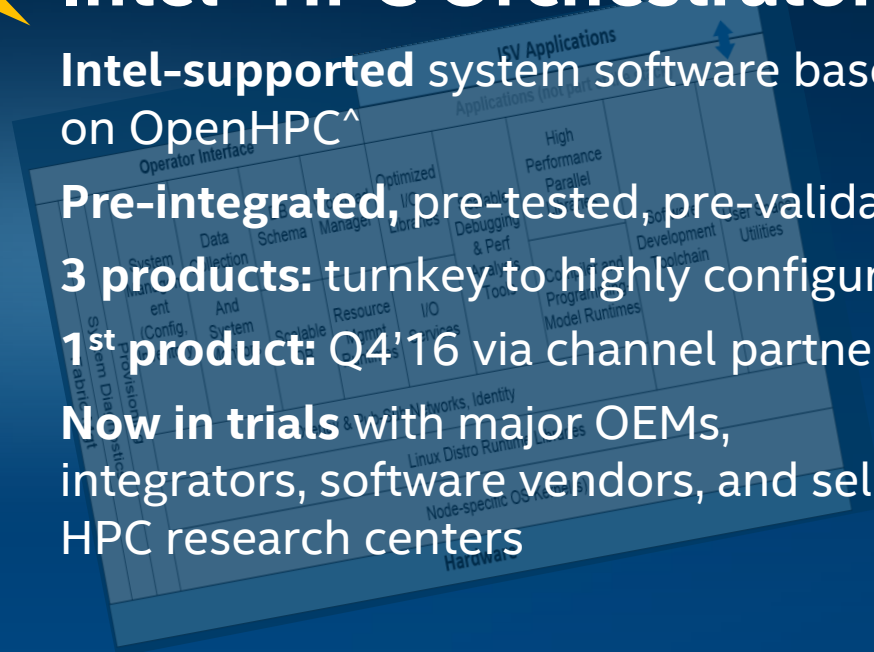
Intel-supported system software based on OpenHPC^

Pre-integrated, pre-tested, pre-validated

3 products: turnkey to highly configurable

1st product: Q4'16 via channel partners

Now in trials with major OEMs, integrators, software vendors, and select HPC research centers



www.intel.com/hpcorchestrator

*Other names and brands may be claimed as the property of others.

^ OpenHPC is an **open source HPC** community. For more information please visit: http://www.openhpc.community/

A VIBRANT AND INNOVATIVE COMMUNITY

Intel® Scalable System Framework Partners

Dozens more expected with the transition of Intel® Cluster Ready program partners to Intel® Scalable System Framework program by end of year

*Other names and brands may be claimed as the property of others.

ENRICHING THE INTEL® SCALABLE SYSTEM FRAMEWORK

HPC Buyer Guidance

Intel® SSF Configurations *of OEM HPC systems:*

- ***Multiple benefits:*** *Intel® SSF value coupled with OEM innovations while preserving software compatibility*
- ***Simplifies purchase decisions*** *for small-to-medium sized systems*

3 REQUIREMENTS

minimum in 2016

INTEL® SSF CONFIGURATION BENEFITS

Software Compatibility
Interoperability
Performance
Total Cost of Ownership

PURCHASE CONFIDENCE

1 **Intel® SSF Ingredients[1]**
Deliver the performance, TCO[2] and interoperability made possible from a balanced design

+

2 **Intel® SSF Architecture System Compatibility**
HPC system design best-practices
Preserves application compatibility

+

3 **Design Validation**
Assures smooth deployments and operation

intel XEON inside™ *AND/OR* intel XEON PHI inside™

INTEL® OMNI-PATH ARCHITECTURE & *OR* **INTEL® ETHERNET SERVER ADAPTERS**

Intel® SSF Architecture Specification
[Public link access June 20th]

Vendor-specific validation[4]

[1] Compute is performed using Intel® Xeon® processor E5-2600 v4 product family and/or intel® Xeon Phi™ processor. Message fabric uses Intel® Omni-Path Fabric or Intel Ethernet Server Adapter. [2]Total cost of ownership. [3]Compliance with an Intel® SSF Reference Design also satisfies. [4]Most major OEMs will self-certify that Intel SSF configurations of their HPC systems meet these three requirements. Smaller providers will joint-certify their configurations with Intel.

LEARN MORE: INTEL® SCALABLE SYSTEM FRAMEWORK

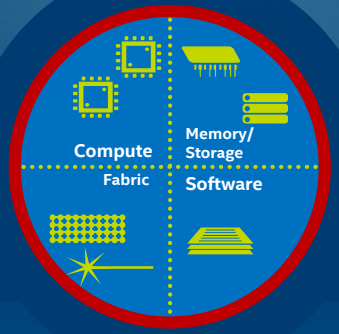
intel

A GREAT TAG TEAM FOR MACHINE LEARNING

ARTIFICIAL INTELLIGENCE

TRAINING

Faster and More Scalable than GPU[1]



Intel® Scalable System Framework

INFERENCE^

Most Widely Deployed for Machine learning[2]

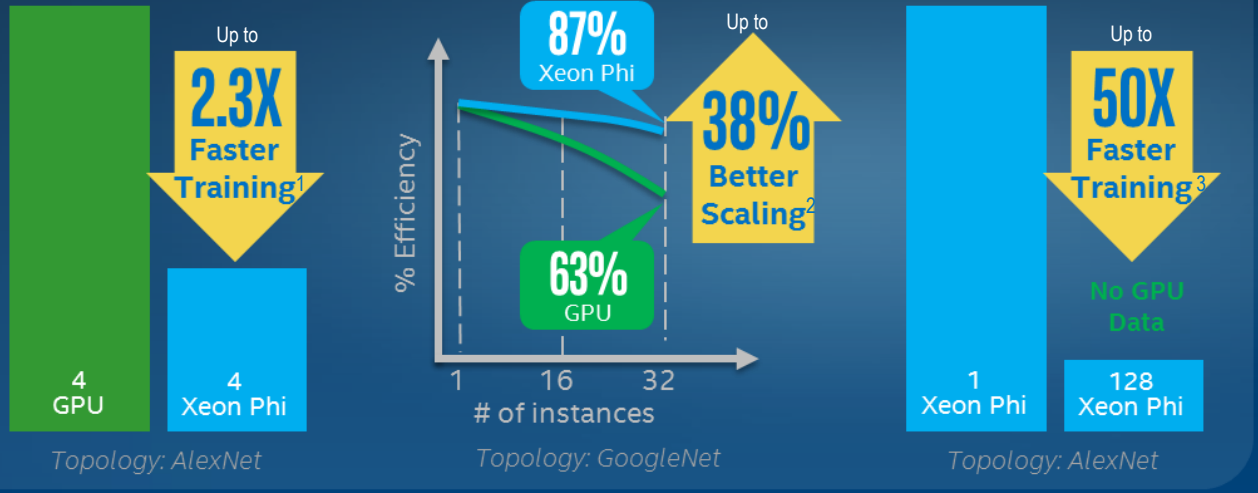
^Also known as scoring or prediction

1. See pages 15-16 for more details
2. *Source: Intel estimates*

YOUR PATH TO DEEPER INSIGHT

TRAINING

X 4 → X 32 → X 128



SCORING

CPU OPTIMIZED

Proven scalability for deep learning

FOCUSED INVESTMENTS FOR MACHINE LEARNING

Enhanced Roadmap

- NEW products optimized to extend leadership

Tools & Libraries

- Deep engagements with open source community to optimize deep learning frameworks for CPU
- Announcing MKL-DNN, open source MKL's deep learning neural network layers

Partner Programs

- Training 100K developers on machine learning
- Early Access program for top research academics

LOOK FOR US AT ISC16

Keynote
Rajeeb Hazra

AI: The Next HPC Workload

Monday, 6/20, 6:00 p.m.

Intel Press Roundtable & Customer Panel

Tuesday, 6/21, 10:00 – 11:00 a.m.

Movenpick Hotel, Matterhorn 1

Marquee Demos

(1) EPFL - 'BRayns' Human Brain Neuron Visualization

(2) Kyoto Univ. - Deep Learning Accelerates Drug Discovery

Intel® Scalable System Framework

Intel® Xeon Phi™ Processor Launch

Celebrate the launch on the exhibit floor directly after the keynote

14 Technical Sessions

WINNER Hans Meuer Most Outstanding ISC research Paper

'Mitigating MPI Message Matching Misery'

50+ Collaboration Hub Presentations

by customers, partners and Intel

Vendor Showdown
Charlie Wuischpard

Monday, 6/20, 1:16 p.m.

Social Media (follow @IntelHPC)

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Results have been estimated or simulated using internal Intel analysis or architecture simulation or modeling, and provided to you for informational purposes. Any differences in your system hardware, software or configuration may affect your actual performance.

Configurations: see each performance slide notes for configurations. For more information go to http://www.intel.com/performance/datacenter.

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Intel does not control or audit third-party benchmark data or the web sites referenced in this document. You should visit the referenced web site and confirm whether referenced data are accurate.

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. SPEC and SPEC MPI* are trademarks of the Standard Performance Evaluation Corporation. See http://www.spec.org for more information.

Intel processors of the same SKU may vary in frequency or power as a result of natural variability in the production process.

Intel technologies' features and benefits depend on system configuration and may require enabled hardware, software or service activation. Performance varies depending on system configuration. No computer system can be absolutely secure. Check with your system manufacturer or retailer or learn more at Intel.com

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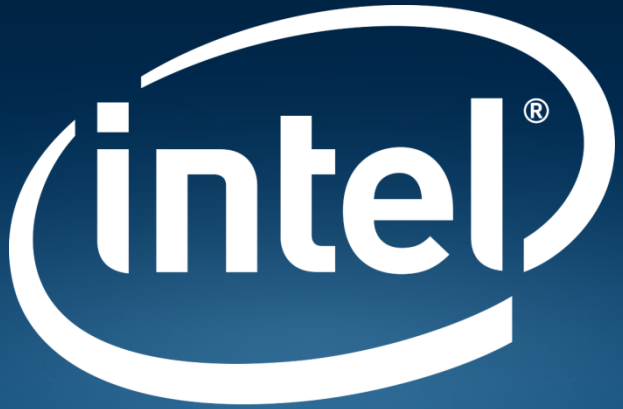

experience
what's inside™

"NOW AVAILABLE…" CONFIGURATIONS

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1. Intel measured results as of June 2016. Up to 5x more timesteps per second, 8x higher performance per watt and 9x better performance per dollar claims based on LAMMPS* Course-Grain Water Simulation using Stillinger- Weber* potential comparison of the following. BASELINE CONFIGURATION: Dual Socket Intel® Xeon® processor E5-2697 v4 (45 M Cache, 2.3 GHz, 18 Cores) with Intel® Hyper-Threading and Turbo Boost Technologies enabled, 128 GB DDR4-2400 MHz memory, Red Hat Enterprise Linux* 6.7 (Santiago), Intel® Omni-Path Host Fabric Interface Adapter 100 Series 1 Port PCIe* x16, Intel® Server Board S2600WT2R, BMC 1.33.9832, FRU/SDR Package 1.09, 1.0 TB SATA drive WD1003FZEX-00MK2A0 System Disk + one NVIDIA Tesla* K80 GPUs, NVIDIA CUDA* 7.5.17 (Driver: 352.39), ECC enabled, persistence mode enabled. Number of MPI tasks on host varied to give best performance. CUDA MPS* used where possible. Mean Benchmark System Power Consumption: 683W. Estimated list price including host: $13,750 source http://www.colfax-intl.com/ND/Servers/CX1350s-XK6.aspx. NEW CONFIGURATION: One node Intel Xeon Phi processor 7250 (16 GB, 1.4 GHz, 68 Cores) in Intel® Server System LADMP2312KXXX41, 96GB DDR4-2400 MHz, quad cluster mode, MCDRAM flat memory mode, Red Hat Enterprise Linux* 6.7 (Santiago) running Intel® Compiler 16.0.2, Intel® MPI 5.1.2.150, Optimization Flags: "-O2 -fp-model fast=2 -no-prec-div -qoverride-limits", Intel® Omni-Path Host Fabric Interface Adapter 100 Series 1 Port PCIe x16, 1.0 TB SATA drive WD1003FZEX-00MK2A0 System Disk. Mean Benchmark System Power Consumption: 378W. Estimated list price: $7300 source Intel Recommended Customer Pricing (RCP).

YOUR PATH TO DEEPER INSIGHT CONFIGURATIONS

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1. Up to **5x** more timesteps per second, 8x higher performance per watt and 9x better performance per dollar claims based on LAMMPS* Course-Grain Water Simulation using Stillinger-Weber* potential comparison of the following. BASELINE CONFIGURATION: Dual Socket Intel® Xeon® processor E5-2697 v4 (45 M Cache, 2.3 GHz, 18 Cores) with Intel® Hyper-Threading and Turbo Boost Technologies enabled, 128 GB DDR4-2400 MHz memory, Red Hat Enterprise Linux* 6.7 (Santiago), Intel® Omni-Path Host Fabric Interface Adapter 100 Series 1 Port PCIe* x16, Intel® Server Board S2600WT2R, BMC 1.33.9832, FRU/SDR Package 1.09, 1.0 TB SATA drive WD1003FZEX-00MK2A0 System Disk + one NVIDIA Tesla* K80 GPUs, NVIDIA CUDA* 7.5.17 (Driver: 352.39), ECC enabled, persistence mode enabled. Number of MPI tasks on host varied to give best performance. CUDA MPS* used where possible. Mean Benchmark System Power Consumption: 683W. Estimated list price including host: $13,750 source http://www.colfax-intl.com/ND/Servers/CX1350s-XK6.aspx. NEW CONFIGURATION: One node Intel Xeon Phi processor 7250 (16 GB, 1.4 GHz, 68 Cores) in Intel® Server System LADMP2312KXXX41, 96GB DDR4-2400 MHz, quad cluster mode, MCDRAM flat memory mode, Red Hat Enterprise Linux* 6.7 (Santiago) running Intel® Compiler 16.0.2, Intel® MPI 5.1.2.150, Optimization Flags: "-O2 -fp-model fast=2 -no-prec-div -qoverride-limits", Intel® Omni-Path Host Fabric Interface Adapter 100 Series 1 Port PCIe x16, 1.0 TB SATA drive WD1003FZEX-00MK2A0 System Disk. Mean Benchmark System Power Consumption: 378W. Estimated list price: $7300 source Intel Recommended Customer Pricing (RCP).
2. Up to **5.2x** faster renderings at 7.6 times better performance per dollar claim based on frames per second (FPS) results with a 1024x1024 image workloads with Intel Embree 2.10.0 using one node Intel Xeon Phi processor 7250 (16 GB, 1.4 GHz, 68 Cores) in Intel® Server System LADMP2312KXXX41, 96GB DDR4-2400 MHz, quad cluster mode, MCDRAM flat memory mode, Red Hat* Enterprise Linux 6.7 scoring 32.5 FPS with an estimated list price of $7,300 compared to hosted NVIDIA Titan X* GPU scoring 6.28 FPS with an estimated list price of $13,750.
3. Up to **2.7x more** options evaluated per second, 2.8 times better performance per watt and 5.1 times superior performance per dollar value claims based on Monte Carlo DP workload results comparing one node Intel Xeon Phi processor 7250 (16 GB, 1.4 GHz, 68 Cores) in Intel® Server System LADMP2312KXXX41, 96GB DDR4-2400 MHz, quad cluster mode, MCDRAM flat memory mode, CentOS* 7.2, quadrant cluster mode, MCDRAM flat memory mode scoring 4.43M options/
second, 355 average watts and estimated list price of $7,300 compared to Supermicro* SYS-1028GR-TR server using Intel® Xeon® processor E5-2699 v4 (55 MB Cache, 2.2 GHz, 22 Cores) with Intel Hyper-Threading and Turbo Boost Tech. enabled, 256 GB DDR4-2133 MHz, Red Hat Enterprise Linux* 7.1 (Maipo) plus NVIDIA Tesla K80* scoring 1.62M options/second, 358 ave. watts (host system was essentially idle) and estimated list price of $13,750.
4. World record claim based on a SPECfp*_rate2006 base score of 842 and peak score of 870 submitted to SPEC.org (considered estimated until published) compared to all other 1-chip results published at https://www.spec.org/cpu2006/results/rfp2006.html as of 14 June 2016. Configuration: Fujitsu PRIMERGY* CX1640 M1 using Intel® Xeon Phi™ processor 7250 (16 GB MCDRAM, 1.4 GHz, 68 Cores) with 192 GB memory, Red Hat Enterprise Linux* 7.2 (3.10.0-327.13.1.el7.mpsp_1.3.2.100.x86_64) running Intel Intel® C++ and Fortran Compilers 16.0.2.181.

RAPIDLY DELIVERING VALUE… CONFIGURATIONS

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1. Configuration for performance testing: Intel® Xeon® Processor E5-2697A v4 dual socket servers. 64 GB DDR4 memory per node, 2133 MHz. RHEL 7.2. BIOS settings: Snoop hold-off timer = 9, Early snoop disabled, Cluster on die disabled. Intel® Omni-Path Architecture (Intel® OPA) Intel Fabric Suite 10.0.1.0.50. Intel Corporation Device 24f0 – Series 100 HFI ASIC (B0 silicon). OPA Switch: Series 100 Edge Switch – 48 port (B0 silicon). IOU Non-posted prefetch disabled. EDR InfiniBand MLNX_OFED_LINUX-3.2-2.0.0.0 (OFED-3.2-2.0.0). Mellanox EDR ConnectX-4 Single Port Rev 3 MCX455A HCA. Mellanox SB7700 - 36 Port EDR InfiniBand switch. IOU Non-posted prefetch enabled. Applications: NAMD:, NAMD V2.11, GROMACS version 5.0.4. LS-DYNA MPP R7.1.2 LAMMPS (Large-scale Atomic/Molecular Massively Parallel Simulator) Feb 16, 2016 stable version release. Quantum Espresso version 5.3.0, WRF version 3.5.1 Spec MPI 2007:. SPEC MPI2007, Large suite, https://www.spec.org/mpi/. All pricing data obtained from www.kernelsoftware.com May 4, 2016. All cluster configurations estimated via internal Intel configuration tool. Cost reduction scenarios described are intended as examples of how a given Intel-based product, in the specified circumstances and configurations, may affect future costs and provide cost savings. Circumstances will vary. Intel does not guarantee any costs or cost reduction. For 16 Node configuration, Fabric hardware assumes one edge switch, 16 network adapters and 16 cables.
2. Intel estimates

YOUR PATH TO DEEPER INSIGHT CONFIGURATIONS

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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 complete information visit http://www.intel.com/performance/datacenter. Configurations:

1. Up to 2.3x faster training per system claim based on AlexNet* topology workload (batch size = 1024) using a large image database running 4-nodes Intel Xeon Phi processor 7250 (16 GB MCDRAM, 1.4 GHz, 68 Cores) in Intel® Server System LADMP2312KXXX41, 96GB DDR4-2400 MHz, quad cluster mode, MCDRAM flat memory mode, Red Hat Enterprise Linux* 6.7 (Santiago), 1.0 TB SATA drive WD1003FZEX-00MK2A0 System Disk, running Intel® Optimized DNN Framework, Intel® Optimized Caffe (internal development version) training 1.33 billion images in 10.5 hours compared to 1-node host with four NVIDIA "Maxwell" GPUs training 1.33 billion images in 25 hours (source: http://www.slideshare.net/NVIDIA/gtc-2016-opening-keynote slide 32).
2. Up to 38% better scaling efficiency at 32-nodes claim based on GoogLeNet deep learning image classification training topology using a large image database comparing one node Intel Xeon Phi processor 7250 (16 GB MCDRAM, 1.4 GHz, 68 Cores) in Intel® Server System LADMP2312KXXX41, DDR4 96GB DDR4-2400 MHz, quad cluster mode, MCDRAM flat memory mode, Red Hat* Enterprise Linux 6.7, Intel® Optimized DNN Framework with 87% efficiency to unknown hosts running 32 each NVIDIA Tesla* K20 GPUs with a 62% efficiency (Source: http://arxiv.org/pdf/1511.00175v2.pdf showing FireCaffe* with 32 NVIDIA Tesla* K20s (Titan Supercomputer*) running GoogLeNet* at 20x speedup over Caffe* with 1 K20).
3. Up to 50x faster training on 128-node as compared to single-node based on AlexNet* topology workload (batch size = 1024) training time using a large image database running one node Intel Xeon Phi processor 7250 (16 GB MCDRAM, 1.4 GHz, 68 Cores) in Intel® Server System LADMP2312KXXX41, 96GB DDR4-2400 MHz, quad cluster mode, MCDRAM flat memory mode, Red Hat Enterprise Linux* 6.7 (Santiago), 1.0 TB SATA drive WD1003FZEX-00MK2A0 System Disk, running Intel® Optimized DNN Framework, training in 39.17 hours compared to 128-node identically configured with Intel® Omni-Path Host Fabric Interface Adapter 100 Series 1 Port PCIe x16 connectors training in 0.75 hours. Contact your Intel representative for more information on how to obtain the binary. For information on workload, see https://papers.nips.cc/paper/4824-Large image database-classification-with-deep-convolutional-neural-networks.pdf.
4. Up to 30x software optimization improvement claim based on CNN training workload running 2S Intel® Xeon® processor E5-2680 v3 running Berkeley Vision and Learning Center* (BVLC) Caffe + OpenBlas* library and then run tuned on the Intel® Optimized Caffe (internal development version) + Intel® Math Kernel Library (Intel® MKL).