BUSINESS BRIEF

Data Center
High Performance Computing

(intel)

New Intel® Xeon® Processor Scalable Family Improves HPC Performance

New processor integrates latest Intel® innovations to speed the most demanding and diverse HPC workloads

Together, the Intel® Xeon® processor Scalable platform innovations can offer new or upgraded HPC deployments performance improvements of up to 1.73x for HPC workloads when compared to the previous generation.[4]

Systems based on the Intel® Xeon® processor Scalable family (formerly known as Purley) offer a new and powerful platform to increase the performance of systems ranging from the smallest high-performance computing (HPC) clusters to the world's largest supercomputers. The new platform combines the latest processors, Intel® Omni-Path Architecture (Intel® OPA), Intel® Optane and 3D NAND SSDs, and enhanced support for the latest software, plus many more Intel innovations that together unlock greater scale, performance, and more advanced HPC capabilities. With better integration among these elements, researchers and government agencies utilizing HPC systems will realize faster insights from their data, leading to breakthrough scientific discoveries previously impossible. Similarly, corporations and organizations of all sizes will benefit from more rapid innovation, bringing better products to market faster than ever before.

Today's HPC challenges

Modern high-performance computing systems are built using an extensive set of technologies including multi-core processors, large caches, fast memory, high-bandwidth inter-processor fabrics, and broad I/O capabilities. For example, scientific simulations and engineering models reliant on supercomputers must maintain data integrity and performance efficiency at scale. Increases in parallelism among the most powerful HPC systems drive the need for high-performance system interconnects with low latency, energy efficiency, and high bandwidth to achieve balanced performance as systems scale to ever-larger sizes.

From an application perspective, those adopting HPC technology must evaluate various workload scenarios and the ideal software and hardware to enable them. Software innovation takes advantage of features in underlying hardware which can accelerate the development process for HPC applications. Combining the new Intel Xeon processor Scalable family and Intel® Xeon Phi™ processors, Intel delivers a broad range of Intel® architecture products, ensuring application portability across Intel based solutions. Today's software can take full advantage of this wealth of capabilities by utilizing programming models and techniques that make the most of the hardware innovations.

HPC workloads such as visualization, simulation, analytics and artificial intelligence each place unique demands on the components of an HPC system. Though workloads within a single organization or research institution may vary, the latest Intel platform delivers the capability and agility to reduce the need for dedicated systems running specialized hardware and software for those unique workloads. Multipurpose systems lessen the cost of acquiring and managing HPC clusters while simultaneously increasing overall system efficiency.

With a highly integrated portfolio of best in class technologies, and optimized software tools and libraries, Intel delivers an extensive and flexible framework based on a common programming model, driving HPC code modernization.

Newest Intel technologies accelerate today's supercomputers

Today's HPC systems must balance the needs for higher performance and cost-efficiency to meet the growing demands of organizations. Innovative technologies in compute, memory, fabric, storage, and system software break through the performance, memory and I/O barriers of the past to unleash HPC innovation. For example, the latest generation processors more than double[1] their predecessors' performance for deep learning training and inference performance. Combined, these and more technological advancements from Intel forge better integration among nodes and encourage broader support for tools, applications, computing density, reliability, and system optimization.

The Intel Xeon processor Scalable family offers platform improvements enhancing each of the following elements:

- **The latest Intel® Xeon® processors** deliver the world's best performance for compute and data-intensive workloads, providing 28 cores on tap[1]. Faster performance is due also to significant increases in memory and I/O bandwidth with six memory channels and 48 PCIe lanes.

- **Intel Omni-Path Architecture (Intel® OPA)** provides 100Gbps bandwidth and low-latency next-generation fabric for HPC clusters. The denser 48-port switch chip delivers a 33 percent increase over the traditional 36-port switch ASIC historically used for InfiniBand, reducing the needed number of switches. Additional cost savings derive from a reduction in cabling-related cost, power consumption, space requirements and ongoing system maintenance. Together, these advancements can lower fabric costs by up to 61 percent[2]. Additionally, Intel OPA achieves up to 9 percent higher application performance and up to 37 percent lower fabric cost on average compared to InfiniBand EDR.[3]

Intel® Xeon® Processor Scalable Family with Intel® Omni-Path Architecture.
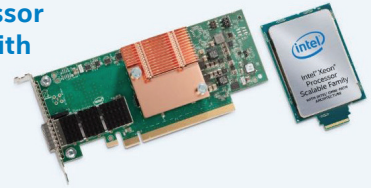
- **Intel® Advanced Vector Extensions 512 (Intel® AVX 512)** boosts performance for the most demanding computational workloads, with up to double the number of FLOPS per clock cycle compared to the previous generation.

- **Integrated Intel® QuickAssist Technology**, with hardware acceleration for cryptography and data compression, frees the host processor to focus on other critical tasks.

- **Intel® 3D NAND SSDs** (solid state drives) offer the higher performance and reliability that users expect from modern storage systems while supporting increased densities, making them an excellent choice to replace older hard disk drive-based storage solutions.

- **PCIe-based Intel® Optane™ SSDs**, underpinned by the Intel Xeon processor Scalable platform, offer the revolutionary new 3D Xpoint™ memory media. Intel Optane SSDs are the first product to combine memory and storage functionality. With an industry-leading combination of high throughput, low latency, high QoS, and ultra-high endurance, this innovative storage solution is optimized to break through data access bottlenecks.

- **Intel FPGA solutions** offer another useful complement to the new Intel Xeon processor Scalable family, providing best-in-class energy efficiency in addition to outstanding reconfigurability for evolving HPC workloads leading to lower TCO.

- **Converged Parallel Programming for Intel Xeon processor Scalable family and Intel® Xeon Phi™ Processor** create a highly integrated portfolio of best in class technologies, software tools, and libraries. The new Intel Xeon processor Scalable family offers an unparalleled flexible framework, based on a common programming model, supporting code modernization initiatives across AI frameworks.

  - **High-performance library building blocks** harness the power of Intel hardware and high-productivity tools and platforms that simplify and streamline workflows.

  - **Optimizations for deep learning frameworks for Intel® architecture** including Neon, Caffe, Theano, Torch, and TensorFlow, deliver increased value and performance for data scientists on Intel platforms. Intel® Parallel Studio XE 2017, a developer toolkit HPC applications, includes performance libraries: Intel® Math Kernel Library for Deep Neural Networks (Intel MKL-DNN) to accelerate deep learning frameworks on Intel architecture and Intel Data Analytics Acceleration Library (Intel DAAL) to speed big data analytics.

  - **Intel® Modern Code Developer Program** advances supercomputing expertise by offering developers and data scientists more accessible online and face-to-face Code Modernization technical sessions. These educational opportunities focus on techniques such as vectorization, multi-threading, multi-node programming, memory considerations, and data layout.

Intel® Xeon® processor Scalable family offers platform enhancements

28 CORES
on tap deliver world's best performance for compute and data-intensive workloads[1]

UP TO 61 PERCENT LOWER FABRIC COSTS
with Intel Omni-Path Architecture[2]

BOOST PERFORMANCE
for the most demanding computational workloads with Intel® AVX 512

Intel Optane SSDs are the
1ST PRODUCT TO COMBINE MEMORY AND STORAGE
functionality.

CONVERGED PARALLEL PROGRAMMING
for Intel Xeon processor Scalable family and Intel® Xeon Phi™ Processor

Together, all these platform innovations can offer new or upgraded HPC deployments performance improvements of up to 1.73x[4] for HPC workloads when compared to the previous generation. Combined with Intel Omni-Path Architecture, and the platform's incorporation of the latest instruction set for running modern applications and tools, the Intel Xeon processor Scalable family will propel HPC into the next decade.

HOW INTEL HPC SOLUTIONS CAN HELP YOU

Talk to your preferred system provider and find out how the Intel Xeon processor Scalable family can advance your organization's HPC implementation.

Learn more at **intel.com/hpc**.

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[1] https://www.intel.com/content/www/us/en/benchmarks/xeon-scalable-benchmark.html
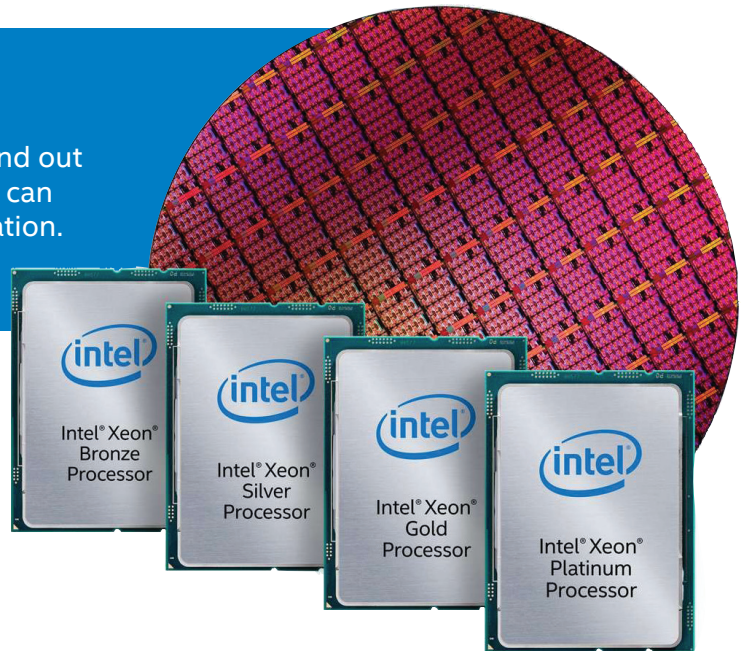
[2] Configuration assumes a 750-node cluster, and number of switch chips required is based on a full bisectional bandwidth (FBB) Fat-Tree configuration. Intel® OPA uses one fully-populated 768-port director switch, and Mellanox EDR solution uses a combination of 648-port director switches and 36-port edge switches. Intel and Mellanox component pricing from www.kernelsoftware.com, with prices as of May 5, 2016. Compute node pricing based on Dell PowerEdge R730 server from www.dell.com, with prices as of November 3, 2015. Intel® OPA pricing based on estimated reseller pricing based on projected Intel MSRP pricing at time of launch.

[3] 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. IOU Non-posted prefetch disabled. Intel® Omni-Path Architecture (Intel® OPA):Intel Fabric Suite 10.0.1.0.50. Intel Corporation Device 24f0 – Series 100 HFI ASIC (Production silicon). OPA Switch: Series 100 Edge Switch – 48 port (Production silicon). 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.

[4] Up to 1.73x claim based on LAMMPS: LAMMPS is a classical molecular dynamics code and an acronym for Large-scale Atomic/Molecular Massively Parallel Simulator. It is used to simulate the movement of atoms to develop better therapeutics, improve alternative energy devices, develop new materials, and more. E5-2697 v4: 2S Intel® Xeon® processor E5-2697 v4, 2.3GHz, 36 cores, Intel® Turbo Boost Technology and Intel® Hyperthreading Technology on, BIOS 86B0271.R00, 8x16GB 2400MHz DDR4, Red Hat Enterprise Linux* 7.2 kernel 3.10.0-327. Gold 6148: 2S Intel® Xeon® Gold 6148 processor, 2.4GHz, 40 cores, Intel® Turbo Boost Technology and Intel® Hyperthreading Technology on, BIOS 86B.01.00.0412.R00, 12x16GB 2666MHz DDR4, Red Hat Enterprise Linux* 7.2 kernel 3.10.0-327.