Technical white paper

Scalable and efficient High Performance Computing

The HP ProLiant SL6500 Gen8 Scalable System with Intel® Xeon Phi™ Coprocessors

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Introduction

High performance computing (HPC) is being used to address many of today's grand challenges; such as life sciences efforts in designing a new vaccine to avert the next flu pandemic, genetically engineering drugs to fight Alzheimer's, generating highly effective seismic analysis, improving financial instruments, and designing more fuel efficient engines. All of these challenges have one common requirement: more computing power with increased power efficiency at higher densities.

Combining general-purpose and accelerated CPUs – a practice referred to as heterogeneous supercomputing – promises to be the future major architecture due to their wide-ranging generality and superior performance / power ratio. High performance computing is now deployed in a broad range of commercial and academic applications, including:

- Energy/Utilities - Power flow studies are one of the most important aspects of power system planning and operation. Accelerators can deliver improvements measured in orders of magnitude for these simulations.
- Seismic analysis – Software providers have found that accelerators are especially effective for processing multi-terabytes of raw seismic data
- Communications - Antenna array design involves repeated simulation to tune the many parameters involved. Offloading the optimization workload onto accelerators reduces that time significantly.
- Financial instruments - Options pricing, risk analysis, algorithmic trading, and Monte Carlo simulation can all benefit from accelerators.
- Weather simulation - Most climate models in use today are typically run at global resolutions of 100 to 200 km. This level of resolution limits the ability to model cloud-system behaviors, accelerators enable models to run at less than 4 km.
- Genomics and Life Sciences - Sequencing and protein docking are very compute-intensive tasks that see a large performance benefit by using accelerators.

The HP ProLiant SL6500 Gen8 Scalable System is the third-generation of GPU-enabled server systems from HP, embodying the experience and knowledge from a well-established history of deploying HPC clusters. The result is an efficient balanced and modular system that offers varied compute, storage, and accelerator configurations to enable you to optimize your infrastructure for many different HPC workloads.

The ProLiant SL6500 Gen8 Scalable System family now includes the new HP ProLiant SL250s Gen8 and HP ProLiant SL270s Gen8 servers. This third generation of accelerator and coprocessor-enabled servers enable you to create massively scalable systems that offer integrated application and power management, very efficient power and cooling, and higher compute densities than ever before. The SL250s and SL270s also support the new Intel® Xeon Phi™ Coprocessors, accelerators, which deliver new levels of compute performance using the Intel Many Integrated Core (MIC) design.

HP ProLiant SL6500 Gen8 Scalable System

Designing the HP ProLiant SL6500 Gen8 Scalable System

The design goal for the ProLiant SL6500 Gen8 Scalable System was more computing power with increased power efficiency at higher densities. The shared infrastructure design will accommodate up to eight Intel Xeon Phi Coprocessors with two Intel Xeon® E5-2600 processors and 16 DIMM slots in each server—for a total of 160 Intel Xeon Phi Coprocessors and 40 Intel Xeon E5-2600 processors in a single 42U rack. Performance is enhanced by including x16 PCIe lanes to each Intel Xeon Phi Coprocessors with optional InfiniBand connectivity for fast and reliable cluster interconnect capabilities.

Figure 1. The HP ProLiant SL6500 Gen8 Scalable System

Efficiency goals are achieved through a shared infrastructure; energy efficient fans and optional redundant 94% efficient hot-plug power supplies. The ability to safely provision the right amount of power to the rack, monitor, and manage power is achieved using the SL Advanced Power Manager (SL-APM), and the iLO 4 power management tools.

SL6500 Gen8 Scalable System server nodes

Regardless of your system design, the flexible ProLiant SL6500 Gen8 Scalable System server series enables you to use every slot for any unique requirement today, and then change the configuration as your needs evolve. The SL6500 Gen8 Scalable System supports the ProLiant SL250s Gen8 and SL270s Gen8 SE compute nodes – half-width servers that are respectively 2U and 4U tall. Table 1 provides a quick side by side comparison of the specifications for each of these servers.

Table 1. SL6500 Gen8 Scalable System Series server specifications

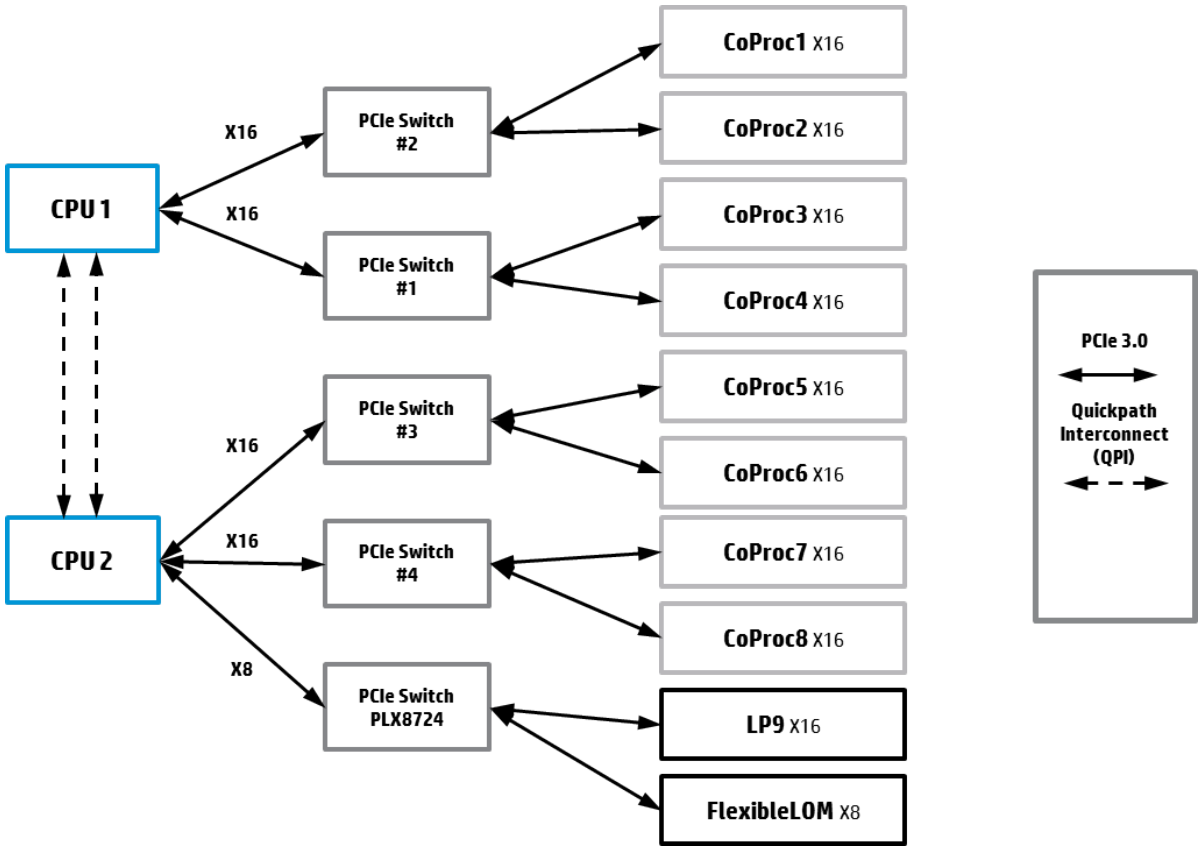
	SL250s Gen 8	SL270s Gen 8 SE
Chassis form factor	4U s6500 chassis	4U s6500 chassis
Server form factor	2U half-width (4 per s6500 chassis)	4U half-width (2 per s6500 chassis)
Intel Processor family	Intel Xeon E5-2600 v2 family	Intel Xeon E5-2600 v2 family
Processor number	1 or 2 One CPU can be utilized so long as no coprocessor is implemented. 2 CPUs must be used when using a coprocessor.	1 or 2 One CPU can be utilized so long as no coprocessor is implemented. 2 CPUs must be used when using a coprocessor.
Processor speed	1.7 through 3.5 GHz	1.7 through 3.5 GHz
Processor cores available	4, 6, 8, 10 or 12	4, 6, 8, 10 or 12
Expansion slots	One PCIe Gen3 x8 LP slot; One x16 PCIe Gen3 FlexLOM slot	Eight PCIe Gen2 x16 coprocessor slots One PCIe Gen3 x8 LP slot One PCIe Gen3 x8 FlexLOM slot
Memory slots	16 DIMM slots	16 DIMM slots
Memory maximum	256 GB	256 GB
Memory type	DDR3 RDIMM or UDIMM	DDR3 RDIMM or UDIMM
Remote management	iLO 4; IPMI 2.0 and DCMI 1.0 SL: Advanced Power Management (SLAPM)	iLO 4; IPMI 2.0 and DCMI 1.0 SL : Advanced Power Management (SLAPM)
Coprocessors	Up to 3 Intel Xeon Phi Coprocessors	Up to 8 Intel Xeon Phi Coprocessors

For the SL250s, each 2U half-width server can deliver 3 Teraflops of Linpack performance. The SL270s, supporting up to eight Intel Xeon Phi coprocessors, can deliver up to 8 Teraflops of performance in a 4U half-width server.

High bandwidth architecture

SL6500 Scalable System servers feature PCIe 3.0 connections to provide high bandwidth data transfer capability between the system core and each Intel Xeon Phi Coprocessor. The ProLiant SL270s Gen8 design uses 72 base PCIe 3.0 lanes and a switching architecture to provide an x16 communication channel to each of the 8 possible Intel Xeon Phi Coprocessors (Figure 2).

Figure 2. PCIe I/O architecture in HP ProLiant SL270s Gen8 servers



FlexibleLOM InfiniBand and 10GbE connectivity

Servers with a NIC embedded on the system board are referred to as using LAN-on-motherboard (LOM) architecture. LOM architecture results in an efficient system design that does not require an add-on option for network functionality. However, the "one size fits all" LOM strategy can create issues. For instance, if the LOM on your server does not match your network infrastructure exactly, you will either have to settle for something less than you wanted, purchase additional hardware to make up the difference, or not use all the features that you purchased. Even if the LOM meets current needs, your network requirements could change in the future, forcing you to abandon system board components (that will continue to draw power) and add another card.

FlexibleLOM technology for HP SL6500 Gen8 Scalable System servers is a variation of LOM architecture that allows the customer to choose the type of NIC to be resident in the server, including ConnectX®-3 InfiniBand. Instead of an embedded NIC, FlexibleLOM uses a system board edge connector that accepts a FlexibleLOM adapter that integrates seamlessly with the server's architecture and form factor.

FlexibleLOM technology uses a standard PCIe 3.0 x16 interface, but does not require any additional CPU resources over standard LOM architecture and does not occupy a regular PCI slot. FlexibleLOM technology maintains the full functionality of LOM architecture including Wake-on-LAN and thermal management. While 1 GB/s is standard, using the optional HP FlexibleLOM capabilities, you can configure the HPC interconnects as any of the following, depending on your performance and latency requirements:

- 1 Gb/s Ethernet (standard)
- 10 Gb/s Ethernet (up to 4)
- 40 Gb/s Ethernet
- 40 Gb/s QDR InfiniBand
- 56 Gb/s FDR InfiniBand

Intel Xeon Phi Coprocessors

HP has collaborated with Intel to ensure the ProLiant SL250s and SL270s Gen8 servers fully exploit the power of Intel Xeon Phi Coprocessors. Intel Xeon Phi Coprocessors, based on the Intel Many Integrated Core Architecture (Intel MIC Architecture) are designed for HPC applications that are highly parallel. Intel Xeon Phi Coprocessors feature smaller, less power-consuming cores and higher cumulative performance (Table 2). This highly parallel architecture has wider vector processing units which provide greater floating-point performance. This results in higher aggregate performance and memory bandwidth.

Table 2. Key specifications of Intel Xeon Phi Coprocessors

	Intel Xeon Phi 5110P	**Intel Xeon Phi 7120P**
Architecture	60 cores/1.053 GHz/240 threads 32 KB L1 I/D cache, 512 KB L2 cache (per core) 8 GB memory with 320 GB/s bandwidth 512-bit wide vector engine Standard PCIe* x16 form factor (requires IA host)	61 cores/1.33 GHz/240 threads 32 KB L1 I/D cache, 512 KB L2 cache (per core) 16 GB memory with 352 GB/s bandwidth 512-bit wide vector engine Standard PCIe* x16 form factor (requires IA host)
Operating System	Linux, IP addressable Host OSs - Red Hat Enterprise Linux 6.x, SuSE Linux 12+	Linux, IP addressable Host OSs - Red Hat Enterprise Linux 6.x, SuSE Linux 12+
Performance	Up to 1 teraflop double-precision performance	Up to 1.2 teraflops double-precision performance Up to 1.3 teraflops (using Turbo Boost)
Power Consumption	225W TDP	300W TDP

Intel Xeon Phi Coprocessors provide up to 61 cores, 244 threads, and 1.2 teraFLOPS of performance, and they come in a variety of configurations to address diverse hardware, software, workload, performance, and efficiency requirements.

The Intel Xeon Phi Coprocessor 5100 series is optimized for high-density computing and is well-suited for workloads that are memory-bandwidth bound, such as STREAM, memory-capacity bound, such as ray-tracing, or both, such as reverse time migration (RTM).

The Intel Xeon Phi Coprocessor 7100 series provides the most features and the highest performance and memory capacity of the Intel Xeon Phi product family. The family supports Intel Turbo Boost Technology 1.0, which increases core frequencies during peak workloads when thermal conditions allow.

The Intel Xeon Phi product family enables break-through results for critical applications in manufacturing, life sciences, and energy. Each coprocessor is capable of up to 1 teraflop of double precision performance.

HP ProLiant SL6500 Gen8 Scalable System integration into HP Cluster Platforms

The HP SL6500 Gen8 Scalable System is available as part of the HP Cluster Platform. This is a comprehensive suite of cluster solution capabilities supporting the HP ProLiant SL Scalable Systems, the HP ProLiant BL BladeSystem, the HP ProLiant DL rack systems, and combinations of any of these. Configuration tools incorporating best cluster practices and HP's years of cluster design and delivery experience help you drive a competitive edge while balancing the pressure on your budget. This innovative, modular package of hardware, software and services is the perfect match for all your scalable computation and data management needs. HP Cluster Platforms provide a choice of processors, operating systems, interconnects, management software as well as factory integration and cluster testing and delivery with HP installation and cluster verification.

The HP Cluster Platform solutions for HP SL6500 Gen8 Scalable Systems deliver an integrated and tested cluster solution based around the HP ProLiant SL server nodes.

The HP Cluster Platform is based on codified best practices for designing, ordering and building the cluster, including the following:

- Configurator for fast and correct ordering; standardized, qualified implementation
- Recommended configurations for nodes, interconnects and storage; enables HP and our partners to confidently deploy clusters in less time
- Direction for manufacturing on where to place components to enable the best airflow and serviceability

It consists of both the hardware and the software options required to implement and support an HPC cluster solution, and can include all of the following:

- HP SL6500 Gen8 server systems with choices of HP ProLiant SL200 series server nodes with Intel Xeon Phi coprocessors
- Choice of operating systems (RHEL or SLES Linux)
- HP Insight Cluster Management Utility
- Adaptive MOAB HPC Suite, or the Adaptive Workload Optimization Pack (Intel-MPI, Adaptive MOAB)
- Altair PBS Professional

The HP Cluster Platform offers the simplicity and affordability of a completely configured and tested cluster solution in one place.

Unified Cluster Management

Management is a critical component of any accelerator-enabled HPC environment. To ease the burden of managing tens of thousands of compute nodes—both CPUs and accelerators—HP offers the HP Insight Cluster Management Utility (Insight CMU). Entering its thirteenth year of development and use in clustered environments, this accelerator aware cluster management software continues to evolve as each new architecture and operating system are released.

Working in all HP certified Linux-based environments and systems, Insight CMU is designed as a light-weight, flexible management system with an intuitive graphical interface that enables you to visualize your entire cluster. Depending on your needs, you can manage multiple clusters all at once or one at a time.

This “cluster friendly” solution allows you to measure numerous characteristics of the server environment, including memory and rate of I/O reads and writes for each server. It also measures and can set alerts for temperature, fan speeds and hardware health metrics, including accelerator metrics. Insight CMU allows you to perform operations on multiple servers, including starting them up and shutting them down. In addition, you can install the OS on one or 1000 servers, all from scratch, in less than an hour. All of these valuable cluster management capabilities are available with the new HP ProLiant SL Gen8 servers.

HP Adaptive Workload Optimization Pack

HP’s Adaptive Workload Optimization Pack, based on Adaptive computing’s Moab software includes Coprocessor-aware enhancements to the Moab workload scheduler. These enhancements improve the efficiency of applications that use coprocessors by having Adaptive MOAB schedule jobs to Coprocessors according to their requirements and the available coprocessor resources. Through this automated capability, Adaptive MOAB enables workloads to be efficiently distributed to coprocessors. The Adaptive MOAB enhancements also provide a mechanism for acting on problems detected by the coprocessors and rescheduling the job if necessary.

HP Integrated Lights-Out (iLO 4)

The iLO Management Engine with Integrated Lifecycle Management provides new levels of performance and quality of service with HP Active Health System (AHS and Agentless Management. Monitoring the health of HPC solutions has traditionally required running monitoring software on the systems in an HPC solution, which can degrade HPC compute performance by stealing cycles from the system’s primary computational tasks. Because of this, many HPC sites minimize monitoring in order to reduce performance impact. Unfortunately, this results in a decreased ability to monitor server health and to predict server problems before they happen. With AHS and Agentless Management, the iLO 4 Management Engine performs all of the server monitoring – allowing you to actively monitor server health without impacting server performance. This gives you significantly more information on the state of the system, information letting you predict problems and analyze problems that might be occurring across the cluster.

iLO 4 Agentless Management doesn’t use the system CPU. Instead, it runs on the iLO 4 processor and is therefore not dependent on the operating system. iLO supports a complete separation of system management and data processing, not just on the LAN connections, but also within the system itself. With the iLO 4 Management Engine in ProLiant Gen8 servers, the base hardware monitoring and alerting capability is built into the system and starts working the moment that a power cord is connected to the server.

The Active Health System is always on, acting as a change tracking and run-time diagnostic telemetry system. This capability is built into iLO 4 and requires no setup, no configuration and no SW to install. The AHS stores up to 2 years of daily runtime telemetry.

The three game-changing features for iLO 4 (Agentless Management, Active Health System and Embedded Remote Support) are all iLO Standard features and are included with ProLiant Gen8 servers without requiring any additional cost or licensing.

HP SL Advanced Power Manager

The HP SL Advanced Power Manager (SL- APM) is a rack-level solution for the SL6500 Gen8 Scalable System which enables advanced power management of SL6500s installed in racks using a Command Line Interface (CLI) or scripting over SSH, Telnet or a serial port. Each SL-APM module is capable of managing up to 10 s6500 chassis in a single 42U rack – allowing it to manage up to 40 SL250s or 20 SL270s servers. The SL-APM module uses HP's SL Rack Dynamic Power Capping capability to monitor and manage power consumption.

SL Rack Dynamic Power Capping gives you the ability to cap the power utilization for SL6500 systems. Using this capability, you can set a power limit, or cap, for each individual SL6500 system that the SL-APM module manages. The SL6500's chassis controller then controls overall power usage for the SL6500 by managing the power utilization of the components in each server node, including that of the fans and the main processors as well as the Intel Xeon Phi coprocessors.

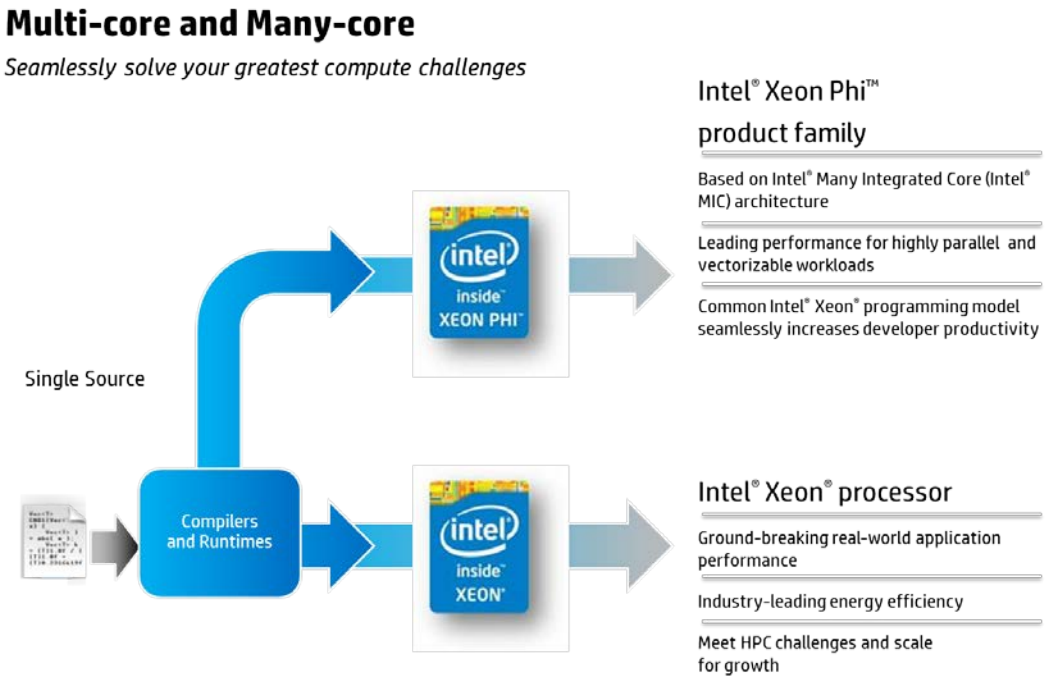
Because it is dynamic power capping, the SL-APM dynamically reallocates the power caps for individual server nodes within the SL6500 based on the nodes current compute workloads. This helps ensure that the enclosure power cap is maintained with as little impact – if any – on overall cluster performance.

SL Rack Dynamic Power Capping with the SL-APM is a powerful tool that allows you to safely provision the appropriate amount of power to Hyperscale rack environments while avoiding tripping circuit breakers at peak power. Without dynamic power capping, you would typically be forced to overprovision power by up to 100% of normal consumption to avoid possible outages.

Programming using Intel Xeon Phi Coprocessors

Intel Xeon Phi Coprocessors use the same programming model that is used on Intel Xeon processors, allowing for common source code that can execute on either Xeon processors or Xeon Phi™ Coprocessors.

Figure 3. Intel Multi-core and Many-core programming model (graphic courtesy of Intel Corporation)



In addition to being easy to use, Intel Xeon Phi Coprocessors also deliver all of the following benefits:

- They are visible to applications as a full computer with an operating system, allowing you to process all x86, Linux, IP addressable, and common source code.
- They can run offloaded code. If you've already written code to offload to an accelerator, Intel Xeon Phi Coprocessors can run that as well.
- They support standard Message Passing Interface (MPI), standard compilers, and standard tools
- They run in a single node or cluster

HP HPC Partner ecosystem for Intel Xeon Phi Coprocessors

A rich portfolio of partners providing an ecosystem for solutions is critical to the success of any product. To drive the success of Intel Xeon Phi Coprocessor-enabled systems, HP works with a series of partners in three primary areas:

- Coprocessor development environments and tools
- Systems and libraries
- Coprocessor-enabled applications

As Table 3 shows, The HP HPC partner ecosystem for systems supporting the Intel Xeon Phi Coprocessors is already in place, offering a growing list of products from industry-leading independent software vendors. This makes it easy for you to deploy and use coprocessor-enabled systems.

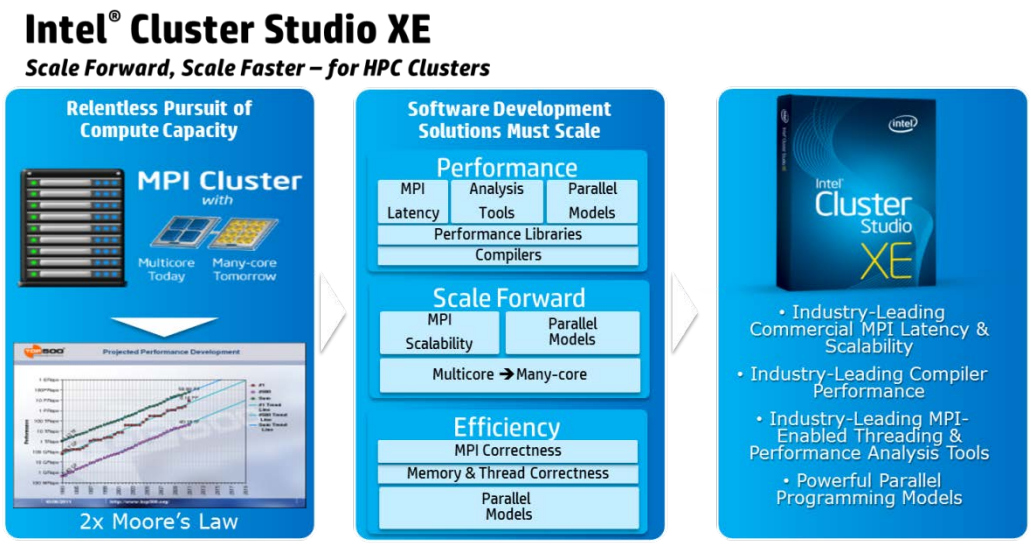
Table 3. Intel Xeon Phi Coprocessor Developer Ecosystem

HPC compilers, tools and libraries	HPC Partner Solutions
Numerical Packages	AccelerEyes Mathematica MATLAB
Debuggers and profilers	Allinea DDT Roguewave Totalview
Coprocessor compilers	Intel Studio XE
Parallelizing compilers	Intel Cluster Studio XE
Libraries	Acceleware Intel MPI

Intel Cluster Studio XE development environment

Intel Cluster Studio XE (Figure 4) is the primary development environment for developers leveraging MPI to develop and deploy highly parallel programs that require cluster level computations. Typical customers would be involved in oil and gas exploration, advanced physics simulations, life science applications – where problems can be parallelized across many servers.

Figure 4. Intel Cluster Studio XE (graphic courtesy of Intel Corporation)



Parallel compute models need to scale on both multi-CPU and many core (Coprocessor) environments. The key in doing this is a tool set that ensures correctness and optimally utilizes all CPU and Coprocessor resources, getting your app working quickly and efficiently on platforms – both today's and future. With alternative technologies, you typically have to re-write your program and some applications can't be rewritten because they're too large or complex. Intel Cluster Studio XE addresses these issues. This tool set puts together the industry leading MPI library that continues to scale. It pairs this with Intel C++ and Fortran compilers, as well as performance libraries and powerful programming models. Intel Cluster Studio XE is the package that allows you to take advantage of the hardware, and allows you to write both MPI and hybrid MPI programs.

Additional Coprocessor development tools

- **Allinea tools:** Allinea MAP: shows you where the computational bottlenecks in your code are and which would benefit from offloading to Coprocessors; Allinea DDT parallel debugger: shows you exactly how your code behaves on the Coprocessor hardware and detects and helps fix bugs
- **RogueWave TotalView:** Comprehensive tool for verifying, debugging and optimizing complex applications
- **Altair PBS Professional:** Portable Batch System (PBS) technology helps customers optimize the utilization of enterprise computing environments by intelligently aggregating and scheduling computational resources (workload scheduling).
- **Adaptive Computing MOAB:** The Adaptive Workload Optimization Pack provides everything to quickly and easily complete an HPC cluster in one integrated package. It provides all the capabilities to optimize workload performance including comprehensive workload scheduling and management, industry-leading messaging passing interface (MPI), and seamless integration with HP Insight Cluster Management Utility (CMU) for reduced administration and improved control.
- **Platform LSF:** fast, scalable service-oriented architecture grid computing middleware; delivers speed-to-value through unparalleled application performance; built on top of a utility-based infrastructure-sharing platform—a perfect complement to HP Converged Infrastructure.

Systems and libraries

Systems and libraries provide the operating environment and common routines to help build HPC applications for various industries. These include:

- **Numerical Algorithms Group (NAG)** libraries - offers 1600+ tried and tested routines that are both flexible and portable; remains at the core of thousands of programs and applications spanning the globe
- **MathWorks – MATLAB -** the language of technical computing used across several industries with native support for Coprocessors on your desktop or on clusters; MATLAB users can take advantage of Xeon Phi Coprocessor-enabled devices through built-in Coprocessor accelerated functions.
- **Wolfram Research: Mathematica** - routines and libraries for Coprocessors for various industries
- **RogueWare**: - IMSL numerical libraries
- **Accelereyes -** ArrayFire OpenCL libraries
- **Acceleware -** Provides Parallel Computing software solutions, consulting and training for Xeon Phi Coprocessors to the Oil & Gas and Computer-Aided Engineering markets.

Coprocessor solutions

The Conte System at Purdue University

For the third year in a row, Purdue University has confirmed its lead in the rarified realm of supercomputing by unveiling Conte, the nation's fastest university-owned supercomputer, developed in a collaboration with HP, Intel, and Mellanox.

Conte is the highest-ranking campus supercomputer on the June 2013 Top500.org list of international supercomputers.

Purdue's latest supercomputer surpasses the nation's previous fastest university-owned leading machine, Carter, which was built in 2011 and is still in operation at Purdue.

"We don't do this only to be at the top of a list, although it's nice to have an external measure of our success in delivering the most effective computational tools to our researchers" says Gerry McCartney, vice president for information technology, CIO, and Oesterle Professor of IT. "The reason we do this is because our faculty have a constantly growing need for more and faster computational resources."

Conte clocked in with a sustained, measured maximum speed of 943.38 teraflops and a peak performance of 1.342 petaflops.

To give an idea of how fast that is, Conte can process a problem 15,000 times faster than a 15-inch Apple MacBook Pro, a high-end consumer laptop.

Conte was built with 580 ProLiant SL250 Gen8 servers, each incorporating two Intel Xeon processors and two Intel Xeon Phi coprocessors, integrated with Mellanox 56Gb/S FDR InfiniBand.

Purdue names each of its supercomputers after a faculty member, staff member, or alumnus who made a significant contribution to computing at the university. The 2013 supercomputer is named for Samuel Conte, who helped establish the nation's first computer science program at Purdue in 1962 and served as department head for 17 years.

Supercomputers, like college football teams, have national rankings. Unlike the disputable college rankings, supercomputers are ranked according to a standardized benchmarking test and then ranked by the nonprofit organization Top500.org. The rankings include supercomputers owned by governments, corporations, research centers and universities.

The results of the test are published twice each year in June and November on the organization's website, www.Top500.org.

HPC Workloads suitable for Coprocessors

Innovation is referred to as the foundation for economic growth. Continuing innovation in science and technology often requires ever increasing computing resources, particularly for life sciences, environment modeling, aerospace and automotive industries, financial services, geosciences to name a few.

An example of this is the development of useful weather prediction capabilities. Developing these requires integrating information obtained from observations, analyses, and computer models. Integrating the carbon cycle and ocean biogeochemistry as well as resolving ocean eddies and adding new physics models into simulations will require enormous amounts of additional compute. NASA estimates that it will require up to a Zettaflop of compute capability to achieve the two week theoretical limit for predictability of the daily evolution of weather systems. This represents 1 Million times the computational power of the top 500 supercomputers in the world today.

At the same time, multiple strict requirements are placed on system performance, power consumption, size, response, reliability, portability and design time. Modern high-performance computing systems are rapidly evolving already reaching petaflop and targeting exaflop performance.

As Coprocessor adoption increases, HP will continue to work with partners to provide Coprocessor-enabled solutions. Examples of solution areas we anticipate to effectively use Coprocessors include the following:

- Bio-Informatics and Life Sciences
- Computational Chemistry
- Computational Electromagnetics and Electrodynamics
- Computational Finance
- Computation Fluid Dynamics
- Engineering and Design
- Mathematical computing
- Molecular Dynamics
- Weather, Atmospheric, Ocean Modeling and Space Sciences
- Energy/Oil & Gas

Summary

HP has designed the HP ProLiant Gen8 server nodes SL250s Gen8 and SL270s Gen8 to work with the Intel Xeon Phi Coprocessors. Each Xeon Phi™ Coprocessor can deliver up to one teraflop or more of floating point performance, and up to 8 of these can be installed in a single HP ProLiant SL270s Gen8 server node.

Intel Xeon Phi Coprocessors use the same programming model as HPC applications on standard Intel Xeon processors allowing for common source code that can execute on either.

Even if applications requiring Coprocessors are beyond the scope of your current computing environment, the ProLiant SL6500 Gen8 Scalable Systems are still the right choice for HPC and other workloads with the following qualities:

- Significant application-dependent I/O, such as storage
- Workloads requiring lower latency transfer times to gain performance improvements
- General or sequentially processing
- Non-parallelized HPC applications

To learn more about HP high-performance servers visit hp.com/go/hpc and hp.com/go/xeonphi.

Resources, contacts, or additional links

HP High Performance Computing web page
hp.com/go/hpc

HP Intel Xeon Phi web page
hp.com/go/xeonphi

HP Scalable Systems Products page
http://h17007.www1.hp.com/us/en/enterprise/servers/proliant/scalable/index.aspx#tab=TAB2

HP Insight Cluster Management Utility web page
hp.com/go/icmu

HP SL Advanced Power Manager web page
http://h30094.www3.hp.com/product/sku/10225991/mfg_partno/538084-B21

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