High-Performance Computing (HPC) is transforming our world and our businesses, delivering unprecedented insight and innovation to scientists, engineers, analysts, companies, and more. But integrating, testing, validating, and maintaining an HPC system software stack is a costly, ongoing, and time-consuming effort.

Intel® HPC Orchestrator is changing all of that. It enables HPC system designers, installers, and managers to spend less time integrating, configuring, and maintaining a validated, reliable system software stack and more time developing differentiated capabilities for users.

**The Challenge**

HPC system software stacks are made up of dozens of components that must all be integrated and validated before an organization's HPC applications can run on top of that stack. Ensuring stable, reliable versions of all stack components is an enormous task due to the numerous interdependencies and compatibility challenges. This task is never-ending because of the rapid release cycles and updates of individual components.

**Intel® HPC Orchestrator — Solving HPC Integration and Validation Challenges**

Leveraging years of Intel HPC software experience and expertise, Intel HPC Orchestrator is a family of Intel-supported products designed to simplify HPC system software stack implementation and maintenance. It provides a modular pre-integrated, pre-tested, and pre-validated software stack that can significantly reduce the time required to perform those tasks.

Intel HPC Orchestrator is based on the community-developed system software stack from OpenHPC, a Linux Foundation Collaborative Project. The OpenHPC community was formed to integrate commonly required HPC components, such as provisioning tools, resource management, I/O clients, development tools, and a variety of scientific libraries. Intel has been an integral contributor to OpenHPC, including seeding the community with a fully integrated and validated system software framework.

Intel HPC Orchestrator provides advanced testing, validation, and ongoing support across the HPC system software stack.
support for the software platform. It also includes proprietary software to aid in system support and application development, such as the Intel® Parallel Studio XE 2017 Cluster Edition suite, installed and ready for activation with a 90-day evaluation license.

Intel HPC Orchestrator will continue to implement new OpenHPC innovations and improvements into the future, while working to ensure all components work together seamlessly so technical resources can focus on developing and enhancing specific HPC solutions.

The Intel HPC Orchestrator system software platform utilizes a hierarchical structure, allowing the tracking of dependencies across multiple MPI and compiler families. The system software stack is modular and customizable, enabling components to be easily substituted and revalidated. It gives Original Equipment Manufacturers (OEMs) the ability to differentiate and add unique value for their HPC customers, while preserving the application-facing interface that enables Independent Software Vendor (ISV) applications and user applications to run consistently across different systems utilizing Intel HPC Orchestrator system software.

**Benefits Unique to Intel® HPC Orchestrator**

Intel HPC Orchestrator builds on the framework of the OpenHPC system software stack with the addition of proprietary software to add popular development tools, compilers, and libraries—and to assist in supportability of the overall software platform. It also includes a full commercial license with technical support for the Altair PBS Professional® workload manager. The system software is integrated, validated, and supported with updates and technical support provided by a team of experienced Intel HPC software engineers.

### Functional Areas

**Base OS Compatibility**
- SLES 12 SP2, RHEL 7.3, CentOS 7.3

**Administrative Tools**
- Conman®, Ganglia®, Intel® Cluster Checker, Lmod®, LosF®, Nagios®, pdsh, prun, EasyBuild®, Spack®, genders, mrsh, clustershell

**Provisioning**
- Warewulf

**Resource Management**
- PBS Pro®, SLURM, MUNGE®

**Runtimes**
- OpenMP®, Intel® Parallel Studio XE Runtimes for Intel® MPI Lib, Intel® TBB Runtimes, Intel® MKL, Intel® DAAL and Intel® IPP

**I/O Services**
- Lustre® file system client software, shine

**Numerical/Scientific Libraries**
- Boost®, GSL, FFTW, Metis, PETSc, Trilinos®, Hypre®, SuperLU®, MUMPS®, Intel® MKL

**I/O Libraries**
- HDF5 (pHDF5), NetCDF (including C++ and Fortran interfaces), Adios

**Compiler Families**
- GNU (gcc, g++, gfortran), Intel Parallel Studio XE 2017 Cluster Edition (icc, icpc, ifort)

**MPI Families**
- MVAPICH2, OpenMPI, Intel MPI

**Development Tools**
- Autotools (autoconf, automake, libtool), Valgrind, R, SciPy/NumPy, Intel® Inspector

**Performance Tools**
- PAPI, IMB, mpiP, pdtoolkit TAU, Intel® Advisor, Intel® Trace Analyzer and Collector, Intel® VTune Amplifier

### Intel Validated

Intel HPC Orchestrator includes advanced integration testing between components, validation at scale (systems up to 1,000 nodes) and testing on specific platform configurations (e.g., processor and memory). Hardware-specific testing and validation includes new Intel components, including Intel® Xeon® processor v4 family, Intel® Xeon Phi™ product family, and Intel® Omni-Path Fabric, as well as the Lustre® file system client software.

### Intel Supported

The Intel HPC Orchestrator system software platform provides multiple levels of support via OEM and channel partners. The support subscriptions include ongoing, validated system software updates across the software stack. Professional Level 3 support is provided by Intel HPC engineers, covering integration issues for key components to resolution. Open source community components are triaged and provided best-effort support. Level 1 and Level 2 technical support services are also available, as are standard and priority service level agreements. Technical Support for Intel® Parallel Studio XE 2017 Cluster Edition and Lustre® file system client requires purchase of the respective license and support contract, sold separately.

### Key Features and Capabilities

- Stateless and Stateful Provisioning
- Warewulf based
- Bare metal installation
- Image-based install
- Templated installation scripts
- Editable configuration input file
- Hierarchical structure, multiple development environment support
- Multiple MPI families
- Multiple compiler support
- Common scientific libraries included for multiple MPI/compiler combinations
• Includes integrated administrative tools and flexible development environment
• Utilizes common Linux update mechanisms (e.g., YUM, Zypper)

**Intel® Parallel Studio XE Cluster Edition**

Makes it easier to boost application performance on today’s and tomorrow’s highly parallel processors and coprocessors.

**Intel® Performance Libraries**

Ramp up performance on the latest platforms with math, data analytics/machine learning, media, and parallel template libraries.

**Intel Analysis, Profiling & Architecture**

Profile and analyze shared and distributed memory architectures and identify hotspots and performance bottlenecks. Analyze and define parallel architecture methods for vectorization and threading.

**Intel Compilers**

High-performance C/C++/Fortran standards-driven compilers produce optimized code that can run significantly faster by taking advantage of ever-increasing core counts and vector register widths.

**The Right Balance of Simplicity and Customization**

Intel HPC Orchestrator is designed to provide a balance between simplicity and customizability. It combines ease-of-use, performance, and scalability, while allowing for customization. It is targeted at technical and commercial users—including research, enterprise, and academic users—with vertical HPC applications. The software platform enables provisioning of compute nodes from the system head node, utilizing either diskless or diskful boot methods. Intel HPC Orchestrator simplifies system software component integration, validation, and configuration across the HPC system software stack.

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**Intel® HPC ORCHESTRATOR INCLUDES INTEGRATED INSTALLATION OF INTEL® PARALLEL STUDIO XE 2017 CLUSTER EDITION**

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<th><strong>INTEL® PARALLEL STUDIO XE 2017 CLUSTER EDITION COMPONENTS INCLUDED</strong></th>
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<tr>
<td><strong>BUILD</strong></td>
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<tr>
<td>Intel® C/C++ Compiler - industry leading performance</td>
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<td>Intel® Fortran Compiler - industry leading performance</td>
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<td>Intel® Math Kernel Library - fast math library</td>
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<td>Intel® Integrated Performance Primitives - image, signal &amp; data processing</td>
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<td>Intel® Threading Building Blocks - threading library</td>
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<td>Intel® Data Analytics Acceleration Library - machine learning &amp; analytics</td>
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<td>Intel® Distribution for Python* - integrated, high-performance Python environment</td>
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<td><strong>ANALYZE</strong></td>
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<td>Intel® Vtune™ Amplifier XE - performance profiler</td>
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<td>Intel® Advisor - vectorization optimization and thread prototyping</td>
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<td>Intel® Inspector - memory and thread debugging</td>
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<td>Intel® MPI Library - message passing interface library</td>
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<td>Intel® Trace Analyzer and Collector - MPI profiling, tuning, and analysis</td>
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<td>Intel® Cluster Checker - cluster diagnostic expert system</td>
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* 90-day evaluation license provided for system installation. Renewals may be purchased through existing distribution partners.
Additional Engineering Services
The Intel HPC Orchestration system software technical support team of experienced HPC software engineers is available to provide engineering services for customer-specific projects, including:

- System software customization: integration and validation to meet customer specifications
- Specific hardware testing and validation
- System scale testing and validation

Contact hpc.orchestrator@intel.com for more information.

Systems Supported
Base Operating System Compatibility
- SLES 12 for HPC, SP2
- RHEL for HPC 7.3
- CentOS 7.3

Supported Hardware
- Intel® Xeon® processor configurations
- Intel® Xeon Phi™ product family
- Intel® Omni-Path Architecture

At Aspen Systems our mission is to provide leading best-in-class solutions to High Performance Computing (HPC) users and administrators. We are proud to service all key market sectors including government, universities, corporations and anywhere research and science can be found. ISO 9001:2008 Certified. GSA Contract #GS-35F-0192K.

Aspen Systems, turning complex problems into simple solutions.
sales@aspsys.com  |  (303) 431-4606  |  aspsys.com

For more information on Intel® HPC Orchestration, visit www.intel.com/hpcorchorstrator

1 As of v17.02.007 release.
Intel technologies’ features and benefits depend on system configuration and may require enabled hardware, software or service activation. Learn more at intel.com, or from the OEM or retailer.
No computer system can be absolutely secure.
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.
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