

# HIGH PERFORMANCE MPI HYBRID DEVELOPMENT SUITE



## Intel® Cluster Studio XE 2013 SP1

Product Brief

### Top Features

- Integrated Tool Suite for HPC Application Development
- High Performance MPI Library
- High Performance C++, Fortran Compilers & Powerful Parallel Models for Multicore and Many-core
- Correctness Analysis & Profiling Tools for Shared, Distributed, and Hybrid Applications

“Flow-3D’s unique advantage is its ability for modeling complex fluid flows. As such, it is difficult to enable the parallel performance demanded by our customers. To meet the demand, we actively use the full functionality of Intel® Cluster Studio XE to reduce and find previously undetectable shared and distributed memory errors, and to improve the overall performance and scaling of our software on the different multicore architecture systems used by our customers. In addition to the development benefits, the Cluster Studio XE tools help us to solve unreproducible issues that occur at customer sites.” Dr. Anup Gokarn, Senior Developer, Flow Science, Inc.

### Interoperable Products

- Intel® OpenCL\*

### Available in other configuration(s):

- Intel® Cluster Studio

### OS Support:

- Windows\*
- Linux\*

### Scale Forward, Scale Faster

The evolution of HPC architectures with more cores and wider vectors on more nodes challenges developers in writing applications that leverage these architectural advancements while accommodating result deadlines. The Intel® Cluster Studio XE suite provides a comprehensive set of parallel programming standards driven by C/C++ and Fortran development tools and programming models which enable software developers to efficiently develop, analyze, and optimize HPC applications to scale forward, scale faster, and boost performance for IA-compatible processors, including the Intel® Xeon Phi™ Coprocessor.

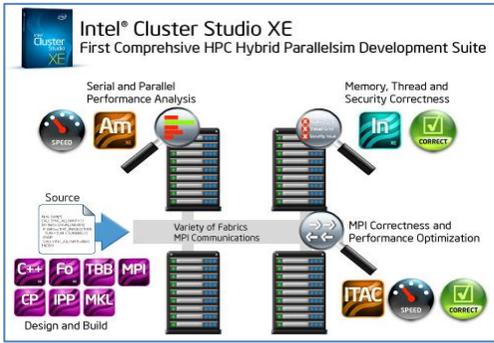
Intel Cluster Studio XE includes the next-generation of software development tools:

- **Intel® MPI Library** - Highly scalable and interconnect independent low latency MPI library
- **Intel® Trace Analyzer and Collector** - MPI communications performance profiler
- **Intel® C, C++ and Fortran Compilers** - Industry-leading compilers
- **Intel® Math Kernel Library (Intel® MKL) and Intel® Integrated Performance Primitives (Intel® IPP)** - Performance libraries for math and multimedia
- **Intel® Threading Building Blocks (Intel® TBB) and Intel® Cilk™ Plus** - Parallel programming models based on threading
- **Intel® Advisor XE** - Threading Prototyping Tool for C/C++, C#, and Fortran architects. Design in scalability. Design out data sharing issues.
- **Intel® VTune™ Amplifier XE** - Performance & thread profiler tunes hybrid MPI / OpenMP applications
- **Intel® Inspector XE** - Thread & Memory debugging finds errors static analysis misses.
- **Static Analysis** - Locate difficult to find defects
- **Intel® MPI Benchmarks** - An open source set of MPI and cluster benchmark kernels



Flow Science Inc. Flow-3D application used Intel® Cluster Studio XE to improve application performance. Image shows simulation results of a launch vehicle draining an oxidizer tank

# Top Features



## Integrated Tool Suite for HPC Development

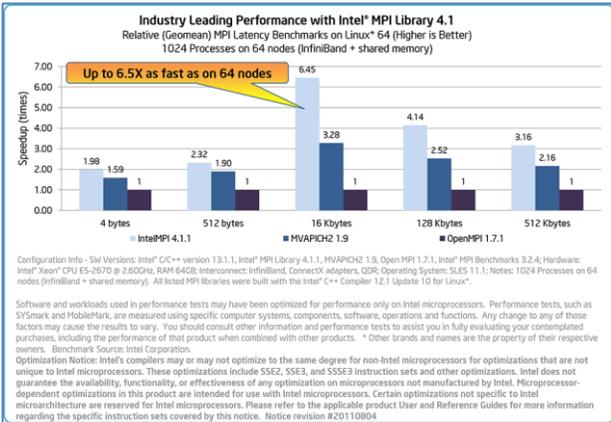
Superior shared, distributed, or hybrid application performance through industry leading Intel compilers, parallel models and libraries with advanced performance optimizations for today's multicore and tomorrow's many-core processors in HPC clusters.

## Industry Leading MPI Library

Intel® MPI Library provides new levels of performance, scalability and flexibility for applications that execute on clusters of Intel® platforms.

- Scaling Up To 120K Processes
- High Performance Low Latency implementation
- Interconnect Independence
- Runtime Fabric Selection
- Application and Cluster Tuning Capability
- Multirail InfiniBand Support
- Berkeley Labs Checkpoint Restart (BLCR) Support

Additional information: <http://intel.ly/intel-mpi>

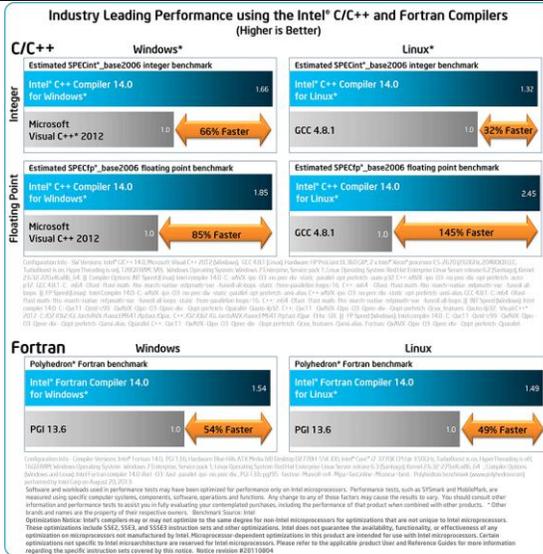
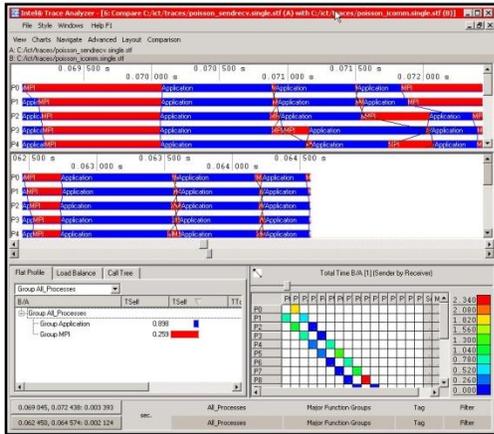


## Intel® Trace Analyzer and Collector

Intel® Trace Analyzer and Collector is a powerful tool for understanding MPI application correctness and behavior.

- Visualize and understand parallel applications behavior
- Evaluate profiling statistics and load balancing
- Analyze performance of subroutines or code blocks
- Learn communications patterns and identify hotspots
- Decrease time to workload

Additional information: <http://intel.ly/traceanalyzer-collector>



## High Performance C, C++, Fortran Compilers & Libraries

Intel® C, C++ and Fortran compilers have built-in optimization technologies and multithreading support that help create code that runs best on the latest Intel® multicore and many-core architectures.

- Multicore and Many-core Optimizations
- Support for distributed memory CAF (Co-Array Fortran)
- Advanced optimization, multithreading, and processor support
- Support for hybrid models of parallelism with MPI and threading models like OpenMP, Intel® Cilk™ Plus, and Intel® Threading Building Blocks (Intel® TBB) methods to boost application performance on clusters
- Industry-leading Intel® Math Kernel Library (Intel® MKL) and Intel® Integrated Performance Primitives (Intel® IPP) include a wealth of routines to improve performance and cut development time.

Additional information: <http://intel.ly/composer-xe>

## Details

Intel® Cluster Studio XE meets the challenges facing HPC developers by providing, for the first time, a comprehensive suite of tools that enables developers to boost HPC application performance and reliability. It combines Intel's proven cluster tools with Intel's advanced threading/memory correctness analysis and performance profiling tools to enable scaling application development for today's and tomorrow's HPC cluster systems.

### Scale Performance

Superior shared, distributed, or hybrid application performance through industry leading Intel compilers, parallel models and libraries with advanced performance optimizations for today's multicore and tomorrow's many-core processors in HPC clusters.

- MPI Latency – Intel® MPI Library is up to 6.5X as fast as alternative MPI libraries
- Compiler Performance – Industry leading Intel C, C++ & Fortran compilers
- Versatile Performance Profiling – Intel® VTune™ Amplifier XE collects a rich set of performance data to optimize serial and parallel performance.
- Threading Prototyping Tool – Intel® Advisor XE allows software architects to quickly predict the performance scaling of different threading designs on large core count systems. Now you can design in scalability and design out data sharing issues.

### Scale Forward

Intel Cluster® Studio XE provides the tools, programming models, and performance libraries that enable developers to develop code that scales on Intel® Xeon® Processors today while easily extending to the Intel® Xeon Phi™ Coprocessor.

- MPI Capacity – Intel® MPI Library scales beyond 120k processes
- Parallel Programming Models – Commercially supported Intel versions of open source Intel® Threading Building Blocks (Intel® TBB) and Intel® Cilk™ Plus for threading parallelism

### Scale Efficiency

The impact of budget and schedule pressure makes it crucial to have the right tools and programming models to rapidly develop and deploy reliable HPC applications. Intel® Cluster Studio XE delivers powerful threading and correctness tools for hybrid applications development and parallel programming models that are simple to adopt.

- Cluster friendly analysis tools – Both Intel® VTune™ Amplifier XE and Intel® Inspector XE install on a cluster and can analyse hybrid applications that use MPI and OpenMP.
- Thread & Memory Debugging – Intel® Inspector XE finds memory and threading errors that traditional regression testing and static analysis miss. Debugger integration speeds diagnosis.
- MPI Correctness – Increased productivity in finding MPI errors
- Parallel Programming Models – Parallelize code using three keywords with Intel® Cilk™ Plus
- Innovative Threading Assistant – Intel® Advisor XE analyses code to identify regions for parallelization potential to improve performance on shared memory code.

## What's New

Feature	Benefit
<b>Increased MPI Performance &amp; Scalability</b>	New connection manager and auto-selection methods increase scalability over RDMA-based interconnects. Improved support for NUMA applications and addition of advanced process pinning controls allow development and deployment for continued capacity growth of HPC systems. The highly scalable Hydra Process Manager is now available for Windows*-based clusters enabling better performance over low-latency RDMA devices.
<b>Updated User Interface &amp; Extended Profiling Support</b>	Intel® Trace Analyzer and Collector now features an updated and improved user interface adding new toolbars, icons, and dialogs for more streamlined analysis flow. Expanded instrumentation support allows greater interoperability for standard profiling interfaces.
<b>Latest Processor Support</b> Haswell-EP, Ivy Bridge, Intel® Xeon Phi™ Coprocessor	Intel consistently offers the first set of tools to take advantage of the latest performance enhancements in the newest Intel product, while preserving compatibility with older Intel and compatible processors. New support includes AVX2, TSX, FMA3 and AVX-512.
<b>New OpenMP 4.0 Support</b>	The compiler and analysis tools now support the key features of OpenMP 4.0, including offloading and SIMD extensions.
<b>Conditional Numerical Reproducibility</b>	Expanded conditional numerical reproducibility support in the Intel® Math Kernel Library (Intel® MKL), offering reproducible results on similar platforms that can include today and tomorrow's architectures.
<b>Fortran and C++ Standards Support</b>	Intel® Fortran Compiler extensively supports the F2003 standard and many parts of the 2008 standard, including co-arrays. Intel demonstrates its commitment to the C++11 standard with additional support in this release.
<b>Additional Debugger Support</b>	Developers can use the GNU Project Debugger* (GDB*) on Linux and the Intel® Debugger Extension to GDB to help debug applications for Intel Xeon Phi coprocessors.
<b>Improved Thread Prototyping Tool, Intel® Advisor XE</b>	Intel® Advisor XE is now easier to learn with new training and an improved assistance window. Pause/resume saves time by eliminating analysis of low risk code.
<b>Multiple OS support, Latest IDEs</b>	Intel tools support the latest Linux distributions and Windows operating systems and compatible with other software development tools. See the <a href="#">System Requirements</a> for details on each tool.

# Purchase Options

Intel® Cluster Studio XE combines all Intel development tools in one suite. It is highlighted in blue below. Single or multi-user licenses along with volume, academic, and student discounts are available.

Suites >>		Intel® Cluster Studio XE	Intel® Parallel Studio XE	Intel® C++ Studio XE	Intel® Fortran Studio XE	Intel® Composer XE	Intel® C++ Composer XE	Intel® Fortran Composer XE
Components	Intel® C / C++ Compiler	●	●	●		●	●	
	Intel® Fortran Compiler	●	●		●	●		●
	Intel® Integrated Performance Primitives <sup>3</sup>	●	●	●		●	●	
	Intel® Math Kernel Library <sup>3</sup>	●	●	●	●	●	●	●
	Intel® Cilk™ Plus	●	●	●		●	●	
	Intel® Threading Building Blocks	●	●	●		●	●	
	Intel® Inspector XE	●	●	●	●			
	Intel® VTune™ Amplifier XE	●	●	●	●			
	Intel® Advisor XE	●	●	●	●			
	Static Analysis	●	●	●	●			
	Intel® MPI Library	●						
	Intel® Trace Analyzer & Collector	●						
	Rogue Wave IMSL* Library <sup>2</sup>							●
Operating System <sup>1</sup>	W, L	W, L	W, L	W, L	W, L	W, L, O	W, L, O	

Note: <sup>1</sup> Operating System: W=Windows\*, L= Linux\*, O= OS X\*. <sup>2</sup> Available in Intel® Visual Fortran Composer XE for Windows with IMSL\*

<sup>3</sup> Not available individually on OS X, it is included in Intel® C++ & Fortran Composer XE suites for OS X

# Technical Specifications

Specs at a Glance	
Processor support	Validated for use with multiple generations of Intel® and compatible processors including but not limited to: 2nd Generation Intel® Core™2 processor, Intel® Core™ 2 processor, Intel® Core™ processor, Intel® Xeon™ processor, and Intel® Xeon Phi™ Coprocessor**.
Operating systems	Windows* and Linux*
Programming languages	Natively supports C, C++ and Fortran development
System requirements	Please refer to <a href="http://www.intel.com/software/products/systemrequirements/">www.intel.com/software/products/systemrequirements/</a> for details on hardware and software requirements.
Support	All product updates, Intel® Premier Support services and Intel® Support Forums are included for one year. Intel Premier Support gives you secure, web-based, engineer-to-engineer support..

\*\*Currently supported on Linux Only



Learn more about Intel Cluster Studio XE

- Click or enter the link below:  
<http://intel.ly/cluster-studio-xe>
- Or scan the QR code on the left



Download a free 30-day evaluation

- Click or enter the link below:  
<http://intel.ly/sw-tools-eval>
- Click on 'Cluster Tools' link

### Optimization Notice

Notice revision #20110804

Intel's compilers may or may not optimize to the same degree for non-Intel microprocessors for optimizations that are not unique to Intel microprocessors. These optimizations include SSE2, SSE3, and SSSE3 instruction sets and other optimizations. Intel does not guarantee the availability, functionality, or effectiveness of any optimization on microprocessors not manufactured by Intel. Microprocessor-dependent optimizations in this product are intended for use with Intel microprocessors. Certain optimizations not specific to Intel microarchitecture are reserved for Intel microprocessors. Please refer to the applicable product User and Reference Guides for more information regarding the specific instruction sets covered by this notice.

