Create Faster Code—Faster

Intel® Parallel Studio XE 2017
Intel Software Development Tools

What it Does

- **Lets you develop faster code.** Boost application performance that scales on today’s and next-generation processors.
- **Helps you code faster.** Use a toolset that simplifies creating fast, reliable parallel code.
- **Includes** industry-leading compiler(s), libraries, parallel models, high-performance Python* packages powered by native Intel® Performance Libraries, vectorization and threading advisor, memory and threading debugger, performance profiler, and more.

What's New

- **Scale to next-generation platforms** including latest Intel® Xeon Phi™ processor. Optimizations for AVX-512, high bandwidth memory, and explicit vectorization for compiler and analysis tools.
- **Faster deep learning on Intel® architecture.** Optimize deep learning model training with Intel® Math Kernel Library neural network functions. Intel® Data Analytics Acceleration Library introduces new deep learning functionality, which is faster than popular open source alternatives.
- **Faster Python application performance.** Intel® Distribution for Python provides easy access to high-performance Python, powered by native Intel Performance Libraries, in an integrated distribution package. Identify the bottlenecks in Python and mixed native and Python code using Intel® VTune™ Amplifier XE.
- **Quick first look.** Snapshot features of Intel VTune Amplifier XE and Intel® Trace Analyzer and Collector help you quickly assess application performance.

Why Consider Intel Parallel Studio XE?

You’re developing software that needs to run faster. Your software performs big data analytics, medical imaging, time-critical financial analysis, simulations (e.g., CFD or weather), machine/deep learning, or one of thousands of tasks that need to get done now. You’re already using other development tools (e.g., GNU®, XCode®, or Visual Studio*) on Linux®, OS X®, and Windows*.

What you need is a toolset that’s compatible with the way you already work—and that makes it easier to speed code execution. Intel® Parallel Studio XE is a performance tool suite that boosts application speed by taking advantage of the ever-increasing core count and vector registers width available in Intel® Xeon® processors and Intel Xeon Phi processors and coprocessors.
Intel Parallel Studio XE Editions

<table>
<thead>
<tr>
<th>Edition</th>
<th>What it Does</th>
<th>What it Includes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Composer Edition</td>
<td>Build fast code using industry-leading compilers, performance libraries, and high-performance Python packages</td>
<td>C++ and/or Fortran* compilers, performance libraries, parallel models, and Python packages powered by native Intel Performance Libraries.</td>
</tr>
<tr>
<td>Cluster Edition</td>
<td>Adds MPI cluster tools</td>
<td>Professional Edition plus MPI cluster communications library, MPI error checking/tuning and a cluster diagnostic expert system.</td>
</tr>
</tbody>
</table>

One Year of Product Support and Updates Included

Product purchase provides you access to and support for new updates and releases, as well as older versions. It also entitles you to private, direct, and responsive answers to product questions, along with access to decades of product experience from our user community through forums and a library of self-help documents.

Composer Edition

- **Get better performance** with a simple recompile using industry-leading and standards driven C++ and Fortran compilers.
- **Simplify adding parallelism** with built-in, intuitive, parallel models and vectorization support.
- **Drop advanced libraries**, optimized for the latest hardware, right into your code.

<table>
<thead>
<tr>
<th>Component</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>C/C++ Compiler</td>
<td>• Industry-leading, standards-based C/C++ application performance with OpenMP* support.</td>
</tr>
<tr>
<td></td>
<td>• Drop-in compatible with popular compilers, development environments, and operating systems.</td>
</tr>
<tr>
<td></td>
<td>• Superior vectorization and parallelization capabilities using SIMD Data Layout Templates.</td>
</tr>
</tbody>
</table>

**Boost C++ application performance on Windows* & Linux* using Intel® C++ Compiler (higher is better)**

![Performance Chart](image)

*Windows Estimated SPECint®_rate_base2006, Linux Estimated SPECint®_rate_base2006
Composer Edition (continued)

- Industry-leading Fortran application performance.
- Boost standards-based, coarray Fortran performance.
- Extensive support for Fortran standards, OpenMP, and more.
- Compatible with leading development environments and compiler.

**Fortran Compiler**

**Intel® Fortran Compiler**

**Details**

- Industry-leading Fortran application performance.
- Boost standards-based, coarray Fortran performance.
- Extensive support for Fortran standards, OpenMP, and more.
- Compatible with leading development environments and compiler.

**Boost Fortran application performance on Windows® & Linux® using Intel® Fortran Compiler**

(higher is better)

<table>
<thead>
<tr>
<th></th>
<th>Windows</th>
<th>Linux</th>
</tr>
</thead>
<tbody>
<tr>
<td>PGI Fortran* 15.0.1</td>
<td>1.86</td>
<td>1.43</td>
</tr>
<tr>
<td>Intel Fortran 17.0</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>OpenMP 45.2</td>
<td>1.14</td>
<td>1.26</td>
</tr>
<tr>
<td>PGI* 16.4</td>
<td>1.29</td>
<td>1.87</td>
</tr>
<tr>
<td>Intel Fortran 17.0</td>
<td>1.50.1</td>
<td></td>
</tr>
</tbody>
</table>

**Windows**

Relative geomean performance, Polyhedron benchmark—higher is better

**Intel Distribution for Python**

- Delivers faster Python application performance in an easy, integrated distribution for Windows, OS X, and Linux.
- Accelerates NumPy/SciPy/scikit-learn packages with native Intel Performance Libraries such as Intel Math Kernel Libraries for multithreaded performance benefits.

**Python Performance as a Percentage of C/Intel® MKL for Intel® Xeon® Processors**

(higher is better)

Configuration info: apt-get installed with apt-get, Ubuntu 16.10, python 3.5.2, numpty 1.1.0, scipy 0.17.0, ptpylib: installed with pip, Ubuntu 16.10, python 3.5.2, numpty 1.1.1, scipy 0.18.1, Intel Python Intel Distribution for Python 2017, Hardware: Intel; Intel xeon CPU E5-2680 v3 @ 2.30 GHz 2 sockets, 16 cores each, HT=off, 64 GB of RAM, 64 DHMs of 8GB@1213MHz, Xeon FPN: Intel® Xeon® Phi™ CPU 7210 1.36 GHz, 96 GB of RAM, 6 DHMs of 16GIB@1200MHz

[See additional configuration information on page 9.]
Math Library
Intel Math Kernel Library

- Fastest and most-used math library for Intel® and compatible processors.
- Highly tuned for best performance on older, newer, and future processors before they are released.
- De facto standard APIs for simple code integration.

Data Analytics and Machine Learning Library
Intel® Data Analytics Acceleration Library (Intel® DAAL)

- Helps applications make better predictions faster, and analyzes larger data sets with the same compute resources.
- Reduces application development time via a wide selection of preoptimized advanced analytics algorithms.
- Includes connectors to popular data sources and can be used with any data platform.
### Optimized Building Blocks for Image, Signal, and Data Applications

**Intel® Integrated Performance Primitives**

- Highly optimized using Intel® Streaming SIMD Extensions (Intel® SSE) and Intel® Advanced Vector Extensions (Intel® AVX, Intel® AVX2) instruction sets so your application will perform faster on existing and future Intel® processors.
- Cross-OS support: Windows, OS X, and Linux libraries.
- Reduces costs and time associated with software development and maintenance.

#### Details

**Intel® IPP Data Compression and Decompression Performance Boost vs. ZLIB Library**

<table>
<thead>
<tr>
<th>Speedup</th>
<th>Intel® IPP</th>
<th>ZLIB 1.2.8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compression (Lower)</td>
<td>1.9x</td>
<td>1</td>
</tr>
<tr>
<td>Compression (Upper)</td>
<td>2.1x</td>
<td>1</td>
</tr>
<tr>
<td>Decompression</td>
<td>1.1x</td>
<td>1</td>
</tr>
</tbody>
</table>

*Comparison for: Same input size 10 million elements vector (1 MB/100 MB) 100 iterations 64-bit Intel Core i7-6700K turbo boost* Speedup calculation: Performance difference between Intel® IPP and ZLIB 1.2.8 divided by ZLIB 1.2.8 performance. *The results and performance may vary based on your specific hardware and software environment. The performance results or ratings are for reference purposes only. They should not be considered as a specific performance guarantee for your product.*

**Optimization Notes:** 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 for non-Intel microprocessors. Microarchitecture-dependent optimizations in this product are intended for use with Intel microprocessors. Certain optimizations not specific to Intel microprocessors 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. Notice number 2012-0084.

### Threading Library

**Intel® Threading Building Blocks**

- Widely used C++ template library for task parallelism.
- Maps your logical tasks onto threads with full support for nested parallelism.
- Uses proven, efficient parallel patterns and work-stealing to support the load balance of unknown task execution time.
- Compatible with multiple compilers and Intel®-compatible processors.
- Flow graph feature allows developers to easily express dependency and data flow graphs.

**Excellent Performance Scalability with Intel® Threading Building Blocks 2017 on Intel® Xeon® Processor**

<table>
<thead>
<tr>
<th>Speedup</th>
<th>Linear</th>
<th>Pi</th>
<th>Primes</th>
<th>Sudoku</th>
<th>Tachyon</th>
<th>EMBREE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hardware threads</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>
## Composer Edition (continued)

<table>
<thead>
<tr>
<th>Component</th>
<th>Details</th>
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</table>
| Standards-based Parallel Model (OpenMP*) | • Performance-oriented implementation of OpenMP 4.0 and initial support for 4.5.  
• Support for Intel® SSE and the latest AVX® instruction sets. |
| Fortran Numerical Analysis (Rogue Wave IMSL® Library) | • Numerical analysis functions for Fortran applications with a comprehensive set of 1,000+ mathematics and statistics algorithms.  
• Available as an add-on for any Intel Parallel Studio XE suite (included in Intel Parallel Studio XE Composer Edition for Fortran with Rogue Wave® IMSL®). |

## Professional Edition

Includes everything in Composer Edition plus:

- **Advanced performance profiler** to tune application performance, scalability and memory access
- **Vectorization and threading advisor** to optimize vectorization and quickly prototype threading designs
- **Memory and thread debugger** to efficiently find memory errors and intermittent threading errors

<table>
<thead>
<tr>
<th>Component</th>
<th>Details</th>
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</table>
| Performance Profiler (Intel VTune Amplifier XE) | • Accurately profile C, C++, Fortran, Python, Go®, Java*, or a mix of coding languages  
• Diverse data for CPU, GPU, threading, memory, cache, and storage.  
• Fast answers: rich analysis turns data into insight. |
## Professional Edition (continued)

<table>
<thead>
<tr>
<th>Component</th>
<th>Details</th>
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</table>
| **Vectorization and Threading Advisor** Intel® Advisor | - Vectorize and thread your code- or performance dies on modern processors.  
- Get trip counts, data dependencies, memory access patterns, and more.  
- Follow an easy optimization workflow with tips for faster code. |
| **Memory and Thread Debugger** Intel® Inspector | - Find root-cause memory and threading errors early, before you release.  
- Quickly debug intermittent races and deadlocks. |

## Cluster Edition

Includes everything in the Professional Edition plus tools to:

- **Accelerate applications' performance** on Intel architecture-based clusters with multiple fabric flexibility.
- **Profile MPI applications** to quickly finding bottlenecks, achieving high performance for parallel cluster applications.
- **Verify** that cluster components continue working together throughout the cluster life cycle.

<table>
<thead>
<tr>
<th>Component</th>
<th>Details</th>
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</table>
| **Message Passing Interface Library** Intel® MPI Library | - A performance-optimized MPI library supporting the MPI 3.1 standard  
- Makes applications perform better on Intel architecture-based clusters with multiple fabric flexibility.  
- Sustained scalability—low latencies, higher bandwidth and increased processes.  
- Full hybrid support for multi-core and many-core systems. |
Cluster Edition (continued)

**Component** | **Details**
--- | ---
**Message Passing Interface Library**<br>**Intel® MPI Library (Continued)** |  
**MPI Tuning and Analysis**<br>**Intel® Trace Analyzer and Collector** |  
**Cluster Diagnostic Expert System in a Tool**<br>**Intel® Cluster Checker** |  

### Superior Performance with Intel® MPI Library

<table>
<thead>
<tr>
<th>Speedup (times)</th>
<th>8 bytes</th>
<th>16 Kbytes</th>
<th>256 Kbytes</th>
<th>1 Mbyte</th>
</tr>
</thead>
<tbody>
<tr>
<td>IntelMPI 2017</td>
<td>1.34</td>
<td>1.28</td>
<td>1.27</td>
<td>1.26</td>
</tr>
<tr>
<td>OpenMPI-1.7.0.0</td>
<td>1.01</td>
<td>1.01</td>
<td>1.01</td>
<td>1.01</td>
</tr>
<tr>
<td>MVAPICH2-2.2.8RC1</td>
<td>0.96</td>
<td>0.96</td>
<td>0.96</td>
<td>0.96</td>
</tr>
</tbody>
</table>

- Boost big data analytics and machine learning performance with easy-to-use library

### Specifications At a Glance

**Processors**<br>Supports multiple generations of Intel and compatible processors including, but not limited to, Intel® Core™ processors, Intel Xeon processors, and Intel Xeon Phi processors and coprocessors.

**Languages**<br>Compatible with compilers from Microsoft, GCC, Intel, and others that follow standards.
- C, C++, Fortran, Python, Java\(^1\), Go\(^1\)

**Operating Systems**<br>Windows, Linux, and OS X\(^2\)

**Development Environment**<br>Microsoft Visual Studio (Windows), Eclipse (Linux), XCode (OS X).
- Compatible with GNU tools (Linux).

**Additional Details**<br>See [www.intel.com/software/products/systemrequirements/](http://www.intel.com/software/products/systemrequirements/)

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\(^1\) Intel VTune Amplifier only.
\(^2\) OS X developers can choose between the C++ or Fortran versions of the Composer Edition.
What’s Included in Intel Parallel Studio XE

<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>Intel C++ Compiler</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Intel® Fortran Compiler</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Intel Distribution for Python</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Intel Math Kernel Library</td>
<td>✓</td>
<td>✓</td>
</tr>
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<td>Intel® Threading Building Blocks</td>
<td>✓</td>
<td>✓</td>
</tr>
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<td>Intel® Integrated Performance Primitives</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>OpenMP</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Intel VTune Amplifier XE</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Intel® Advisor</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Intel® Inspector</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Intel® MPI Library</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Intel® Trace Analyzer and Collector</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Intel® Cluster Checker</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Rogue Wave IMSL® Library</td>
<td>Bundled and Add-On</td>
<td>Add-On</td>
</tr>
</tbody>
</table>

Operating System (Development Environment)
- Windows (Visual Studio)
- Linux (GNU)
- OS X® (XCode)

1 Available with a single language (C++ or Fortran) or both languages.
2 Available on Windows, Linux, and OS X.
3 Available bundled in a suite or standalone.
4 Available as an add-on to any Windows Fortran suite or bundled with a version of the Composer Edition.
5 Available as single language suites on OS X.

Learn more about Intel Parallel Studio XE

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