Intel® Parallel Studio XE 2015 Update 4 Cluster Edition

Release Notes

8 May 2015

Contents

1   Introduction

Intel® Parallel Studio XE Cluster Edition for Windows* and Linux* OS accelerates parallel software development on cluster systems based on Intel® 64 architectures, as well as Intel® Many Integrated Core Architecture (Intel® MIC Architecture) on Linux* OS. For Intel® MIC Architecture, only Intel® Xeon Phi™ coprocessor (codename: Knights Corner) is supported.

Intel® Parallel Studio XE Cluster Edition provides a software tools environment for **hybrid parallel programming** (message passing and threading).

Intel® Parallel Studio XE Cluster Edition supports hybrid parallel programming application development using Intel® MPI Library with optimized parallel libraries, performance analysis, and benchmarks. Intel® Parallel Studio XE Cluster Edition saves software developers time and improves performance on distributed computing systems.

Intel® Parallel Studio XE Cluster Edition for Linux OS and Windows* OS supports critical parts of the message-passing interface (MPI) application development process including:

- Compiler support through Intel® C++ Compiler XE and Intel® Fortran Compiler XE. Intel® C++ Compiler XE and Intel® Fortran Compiler XE for Windows* and Linux* OS provide support for Intel® Many Integrated Core Architecture (Intel® MIC

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Architecture). Intel® C++ Compiler XE for Windows* and Linux* OS provide support for offload to Intel® Graphics Technology.

- Intel® MPI Library 5.0 Update 3, which implements the Message Passing Interface 3.0 Standard (MPI-3.0). Intel MPI library enables multiple interconnect solutions with a single implementation. Intel® MPI Library for Linux* OS supports Intel® Many Integrated Core Architecture (Intel® MIC Architecture).

- Intel® Trace Analyzer and Collector 9.0 Update 3
  - o Intel® Trace Collector provides event-based tracing in cluster applications through an instrumentation library that ensures low overhead in execution. The trace information provides performance data, statistics, and multi-threaded events on Intel® 64 and Intel® Many Integrated Core Architecture (Intel® MIC Architecture).
  - o Intel® Trace Analyzer provides visual analysis of application activities gathered by the Intel Trace Collector.
  - o A message checking component of the Intel Trace Collector provides a novel MPI correctness technology that detects errors with data types, buffers, communicators, point-to-point messages and collective operations, deadlocks, and data corruption.

- Application tuning with optimized mathematical library functions from Intel® Math Kernel Library (Intel® MKL) that includes ScaLAPACK* solvers and Cluster DFTs (Discrete Fourier Transforms). Intel® MKL for Linux* OS support Intel® Many Integrated Core Architecture (Intel® MIC Architecture).

- Intel® MPI Benchmarks that makes it easy to gather performance information about a cluster system.

On completing the Intel® Parallel Studio XE Cluster Edition installation process, locate the `Doc_Index.htm` file in the doc folder on the master node of the cluster. This file is a documentation map to navigate to various information resources of the Intel® Parallel Studio XE Cluster Edition.

2 Product Contents

The table below lists the product components and related documentation.

Component	Version	Documentation
Intel® Advisor XE	2015 Update 1	documentation_advisor_xe.htm
Intel® C++ Compiler XE	15.0 Update 4	startup_wc.htm for Windows* OS startup_lc.htm for Linux* OS
Intel® Fortran Compiler XE	15.0 Update 4	startup_wf.htm for Windows* OS startup_lf.htm for Linux* OS
Intel® Inspector XE	2015 Update 1	documentation_inspector.htm
Intel® Integrated Performance Primitives (Intel® IPP)	8.2 Update 2	ipp_documentation.htm
Intel® Math Kernel Library (Intel® MKL)	11.2 Update 3	mkl_documentation.htm
Intel® MPI Benchmarks	4.0 Update 2	IMB_Users_Guide.htm Readme_Addendum_for_MIC_Architecture.txt (Linux* OS only)
Intel® MPI Library	5.0 Update 3	Doc_Index.html for Linux* OS Doc_Index.htm for Windows* OS
Intel® Threading Building Blocks (Intel® TBB)	4.3 Update 5	tbb_documentation.htm
Intel® Trace Analyzer and Collector	9.0 Update 3	ITA_Reference_Manual.htm ITC_Reference_Manual.htm
Intel® VTune™ Amplifier XE	2015 Update 4	documentation_amplifier.htm
GNU* Project Debugger (GDB*) (GPL licensed)	7.8 (host) 7.7 (Coprocessor)	
Microsoft* Visual Studio* Shell for Intel® Visual Fortran **(For Windows* OS; installs only on the master node)**		**NOTE:** Intel® Parallel Studio XE Cluster Edition for Windows* OS provides Microsoft Visual Studio 2010 Shell. As a prerequisite, if you install the included Microsoft Visual Studio 2010 Shell, additional Microsoft software may be required to be installed prior to beginning the installation of the Intel® Parallel Studio XE Cluster Edition. **Microsoft .NET* 4.0 Framework is required for Microsoft***

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		Visual Studio* 2010 Shell. If you do not have this framework installed already, you can download the installer from: http://www.microsoft.com/en-us/download/details.aspx?id=17851

3 What's New

This section highlights important changes from the previous product version. For more information on what is new in each component, please read the individual component release notes.

Changes since Intel® Parallel Studio XE 2015 Update 3 Cluster Edition:
- All components updated to current versions.
- Documentation updates.

Changes since Intel® Parallel Studio XE 2015 Update 2 Cluster Edition:
- All components updated to current versions.
- Documentation updates.

Changes since Intel® Parallel Studio XE 2015 Update 1 Cluster Edition:
- All components updated to current versions.
- Intel® Composer XE:
  - o Support added for Fedora* 21
- Intel® Integrated Performance Primitives:
  - o Support added for Fedora* 21
- Intel® Math Kernel Library:
  - o Support added for Fedora* 21
- Intel® MPI Library:
  - o Support for GPFS added via I_MPI_EXTRA_FILESYSTEM.
  - o Support added for pbsdsh.
  - o If stats.txt is detected, it is renamed to avoid overwriting.
  - o .Bug fixes
- Intel® Threading Building Blocks
  - o Support added for Fedora* 21
- Intel® Trace Analyzer and Collector:
  - o Support for OpenMP* regions
  - o Bug fixes
  - o MPI Performance Snapshot (MPS) 9.0.3 Preview:

- Support for Intel® Many Integrated Core Architecture (Intel® MIC Architecture).
- Improved accuracy of Intel® MPI Library native statistics.
- Statistics are now collected using the -mps option for mpirun. See Collecting Statistics.
- Reduced memory consumption.
- Intel® VTune™ Amplifier XE:
  o GPU Architecture Diagram
  o "TSX Hotspots" analysis.
  o "Bandwidth" analysis improvements.
  o GPU Profiling on Linux*
  o EBS with stacks for RT kernel and RT applications.
  o Driverless EBS with stacks via Perf.

Changes since Intel® Parallel Studio XE 2015 Cluster Edition:
- All components updated to current versions.
- Improved the custom install directory process.
- Intel® Advisor XE:
  o Incorporated new Intel® Cilk™ Plus overheads.
- Intel® Composer XE:
  o Support for Intel® Advanced Vector Extensions 512 instructions for IA-32 and Intel® 64 architectures in 15.0.1.
  o Tools->Options and Project Menu Labels changes in 2015 Update 1.
  o First update with Japanese Localization
- Intel® Inspector XE:
  o Added support for DWARF Version 4 symbolics.
  o New uninitialized memory error detection algorithm that uses deeper analysis method to substantially reduce the number of false positives.
  o Major performance improvement in threading error analysis.
- Intel® Integrated Performance Primitives:
  o Added additional optimization for the newest Intel® Atom™ and 4th generation Intel® Core™ (code-named Haswell) processors.
  o Fixed a number of known in the previous release issues.
- Intel® Math Kernel Library:
  o Introduced support of Intel® Advanced Vector Extensions 512 (Intel® AVX-512) on Next Generation Intel® Xeon® processors (codenamed Skylake) for Windows* and Linux* versions of Intel MKL
  o BLAS: improved optimizations for Intel® AVX and AVX2
  o LAPACK: Introduced support for LAPACK version 3.5
  o FFT: Introduced Automatic Offload mode for 1D Batch FFT on Intel® Many Integrated Core Architecture (Intel® MIC Architecture)
  o Cluster FFT: Improved performance of Hybrid (OpenMP+MPI) mdoe

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- o Parallel Direct Sparse Solver for Clusters: Added support for many factorization steps with the same reordering (maxfct > 1)
  - o Intel MKL PARDISO: Added support for Shur complement, including return of explicit Shur complement matrix and solving the system through Shur complement
  - o VML: introduced new Environment variable, MKL_VML_MODE to control the accuracy behavior
- Intel® MPI Library:
  - o The Intel® MPI Library now defaults to linking with the multi-threaded optimized library.
  - o Single copy intra-node communication using Linux* supported cross memory attach (CMA).
  - o Added gtool option for running external tools.
- Intel® Threading Building Blocks
  - o The ability to split blocked_ranges in a proportion, used by affinity_partitioner since version 4.2 Update 4, became a formal extension of the Range concept.
  - o More checks for an incorrect address to release added to the debug version of the memory allocator.
  - o Different kind of solutions for each TBB example were merged.
- Intel® Trace Analyzer and Collector:
  - o MPI Performance Snapshot.
  - o Intel® Trace Analyzer GUI available on OS*X.
- Intel® VTune™ Amplifier XE:
  - o Support for Intel® Xeon® processor E5 v3 family, including General Exploration, Bandwidth, and TSX Exploration analysis.
  - o Support for the Intel® microarchitecture code name Broadwell, including General Exploration analysis.
  - o Spin and Overhead Time metrics classified by reasons for OpenMP* analysis.

Changes since Intel® Cluster Studio XE 2013 SP1:
- All components updated to current versions.
- The directory structure has been modified to align with Intel® Parallel Studio XE.
  - o There is no longer a separate icsxe folder.
  - o Documentation and build environment scripts are now in a common folder, `<install-dir>\Parallel Studio XE 2015` for Windows* and `<install-dir>/parallel_studio_xe_2015` for Linux*.
  - o The Intel® MPI Library and Intel® Trace Analyzer and Collector now have links in the installation root folder which will be updated to the latest installed version.
- 32 Bit Support of Intel® MPI Library & Intel® Trace Analyzer and Collector is deprecated. For details, see http://software.intel.com/en-us/articles/intel-cluster-tools-deprecation-information.

- The Intel® Debugger is no longer included in Intel® Parallel Studio XE Cluster Edition. An Intel-extended version of the GNU* Project Debugger (GDB*) is provided.
- Intel® Math Kernel Library (Intel MKL) Parallel Direct Sparse Solver for Clusters:
  - Introduced Intel MKL Parallel Direct Sparse Solver for Clusters, a distributed memory version of Intel MKL PARDISO direct sparse solver.
  - Added distributed CSR format, support of distributed matrices, RHS, and/or distributed solutions.
  - Added support of solving of systems with multiple right hand sides.
  - Added cluster support of factorization and solving steps.
- Intel® Composer XE
  - New Optimization Report interface, structure, and options. Users of existing options `-opt-report`, `-vec-report`, `-openmp-report`, and `-par-report` are strongly encouraged to consult the Intel® Compiler User's Guide for additional details.
  - GNU* GDB 7.7 with improved Fortran and Intel® Cilk™ Plus support.
  - Additional OpenMP* 4.0 support.
  - Enforce same code to be executed regardless of data alignment with `/Qopt-dynamic-align-` (Windows*) or `-no-opt-dynamic-align` (Linux*).
  - Enable threadsafe profile generation with PGO.
  - New pragma directives to control inlining behavior per function.
  - New `INTEL_PROF_DYN_PREFIX` environment variable to add custom prefix to PGO `.dyn` filenames.
  - Added Microsoft* Visual Studio* property "Use MPI Library" in the Intel IDE integration to explicitly specify which MPI library to use with Intel® Math Kernel Library cluster configurations.
  - Debug information now in DWARF Version 3 formmat by default in Linux*.
  - Intel® Fortran Composer XE specific updates:
    - Full Fortran 2003 support.
    - Added Fortran 2008 BLOCK construct feature.
    - Added option `/Qinit:snan` (Windows*) `-init=snan`(Linux*) to help find uninitialized variables at run-time by initializing floating-point variables to signaling NaNs.
  - Intel® C++ Composer XE specific updates:
    - Compiler offload to Intel® Graphics Technology is supported.
    - `-ansi-alias` enabled by default on Linux*. This may change your application's runtime behavior. Users are strongly encouraged to consult the Intel® C++ Composer XE Release Notes for details.
    - Full C++ 11 language support.
    - Intel® Cilk™ Plus changes.
    - Microsoft vectorcall calling convention supported.
    - Control diagnostic strictness of Pointer Checker for problems with pointers to structure fields.

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- Added `aligned_new` header.
- Improved debugging of lambda functions.
- SIMD data types updated to allow use of arithmetic and logical operators.
- Added Microsoft* Visual Studio* property "Base Platform Toolset" in the Intel IDE integration to explicitly specify which Visual Studio toolset to use with the Intel® C++ Compiler.
- Improvements to the Intel® Performance Guide for giving guidance for applications with flat performance profiles.

- Intel® Integrated Performance Primitives (IPP)
  - Support of the next domains in IPP is deprecated: Audio Coding (ippAC), Speech Coding (ippSC), Image Compression (ippJP), Video Coding (ippVC) and Small Matrices (ippMX).
  - Introduced new functionality for Image Processing and Computer Vision: Gaussian mixture model (GMM), FastN, Line Suppression, Histogram of Oriented Gradients (HOG), New Histogram, LBPImage with mode support, Adaptive Threshold, New Warp Affine and several new color format conversion functions.
  - Added possibility for manual dispatching of IPP libraries by supported CPU features (ippSetCpuFeatures function) instead of deprecated now mechanism for dispatching by CPU type (ippGetCpuType and ippInitCpu).
  - Added several new functionalities for Signal Processing: new multi-rate FIRs and delay line manipulation functions for FIR Sparse filters.
  - Due to many customers' requests, the deprecation messages were removed from all in-place functions.

4   System Requirements

Processor Requirements
Systems based on Intel® 64 architecture:

Intel® Core™ processor family or higher

Intel® Xeon® E5 2600/1600 v2 processor families recommended

Intel® Xeon® E7 v2 processor families recommended

NOTE: It is assumed that the processors listed above are configured into homogeneous clusters. For Windows* OS, only processors based on the Intel® 64 architecture are supported.

Disk Space Requirements
100 GB of disk space (minimum)

NOTE: During the installation process, the installer may need up to 12 GB of temporary disk storage to manage the intermediate installation files.

Operating System Requirements

The operating systems listed below are supported by all components on Intel® 64 Architecture. Individual components may support additional operating systems and architecture configurations. See the individual component release notes for full details.

- Intel® Cluster Ready
- Debian* 6.0, 7.0
- Fedora* 20, 21
- Red Hat Enterprise Linux* 5, 6, 7
- SUSE Linux Enterprise Server* 11, 12
- Ubuntu* 12.04 LTS, 14.04 LTS
- Microsoft* Windows* 7, 8.x
- Microsoft* Windows* Server 2008, 2008 R2, 2012

The Intel® MPI Library and Intel® Trace Analyzer and Collector are supported on Intel® Cluster Ready systems and HPC versions of the listed versions of Microsoft* Windows* Server. These components are not supported on Ubuntu non-LTS systems.

IA-32 support has been removed from the Intel® MPI Library and Intel® Trace Analyzer and Collector. Other components of Intel® Parallel Studio XE Cluster Edition still support IA-32 on the listed operating systems.

Support for Microsoft* Windows XP* has been removed from Intel® Parallel Studio XE.

Intel® Cluster Ready is an applications platform architecture standard for Linux* OS clusters. Please convey to your users the Linux* OS platform needed for your MPI application with:

This application has been verified to run correctly on Linux* OS clusters that conform to the Intel® Cluster Ready platform architecture. Each Intel® Cluster Ready system is shipped and tested with a diagnostic tool: Intel® Cluster Checker. Intel® Cluster Checker is used to validate operability and compliance, as well as overall system health. On an Intel® Cluster Ready system, start with these commands to easily view diagnostic logs:

```
$ . /opt/intel/clck/<version>/clckvars.sh

$ cluster-check --report
```

For more information on Intel® Cluster Ready and on the alliance of partner vendors, please visit http://www.intel.com/go/cluster.

Memory Requirements

2 GB RAM (minimum)

Intel® Professional Edition C++ Compiler and Intel® Fortran Compilers

For all of the Intel® architectures, the version number on the Intel compilers should be 13.1 or higher.

Additional Software Requirements

Development for a 32-bit on a 64-bit host may require optional library components (ia32-libs, lib32gcc1, lib32stdc++6, libc6-dev-i386, gcc-multilib, g++-multilib) to be installed from your Linux distribution.

5   Installation Notes

For instructions on installing and uninstalling the Intel® Parallel Studio XE Cluster Edition on Linux* OS and Windows* OS, see the Installation Guide.

6   Documentation

The documentation index file Doc_Index.htm provides hyperlinks to the Intel® Parallel Studio XE Cluster Edition documentation.

7   Issues and Limitations

1. There have been situations where during the installation process, `/tmp` has been filled up. We recommend that you have **at least 12 GB of free space** in `/tmp` when installing the Intel® Parallel Studio XE Cluster Edition. Also, the installer script install.sh has the command-line options:

    `-t [FOLDER]`

    or

    `--tmp-dir [FOLDER]`

    where `[FOLDER]` is a directory path, which can direct the use of intermediate storage to another disk partition referenced by `[FOLDER]`. `[FOLDER]` should be a non-shared storage location on each node of the cluster. Note that `[FOLDER]` should also contain **at least 12 GB of free space**.

2. On Linux* OS, if any software component of the Intel® Parallel Studio XE Cluster Edition is detected as pre-installed on the head node, that software component will not be processed by the Intel Cluster Studio installer. There is a similar problem on Windows* OS in the 'Modify' mode. For Windows* OS, if some software component of the Intel® Parallel Studio XE Cluster Edition is pre-installed on the head node using the Intel Cluster Studio installer, that software component will not be installed on the compute nodes of the cluster. For either Linux* OS or Windows* OS, if you already installed some

of the software components only on the head node, and you want to install them on the other nodes using the Intel Cluster Studio installer, you need to uninstall such components from the head node manually before starting the installer.

3. If you use the Intel® MPI Library command `mpirun` with the Intel® Inspector XE as follows:

```
mpirun -f ./mpd.hosts -nolocal -ppn 1 -n 4 inspxe-cl -c ti2 -r
r003_{mpirank} `pwd`/inspxe_mpirank.exe inspxe-cl -c mi2 -r
r000_{mpirank} `pwd`/inspxe_mpirank.exe
```

where the above command line is collecting two types of instrumentation data (`ti2` and `mi2`), and you encounter a run-time error that may look as follows:

```
HYDU_create_process (./utils/launch/launch.c:94): execvp error on
file r000_{mpirank} (No such file or directory)
```

In this case, you can use the `mpiexec` command in lieu of the `mpirun` command:

```
mpiexec -nolocal -ppn 1 -n 4 inspxe-cl -c ti2 -r
/shared/cluster_common/inspector_test/cluster/r003_{mpirank}
`pwd`/inspxe_mpirank.exe inspxe-cl -c mi2 -r r000_{mpirank}
inspxe_mpirank.exe
```

where `/shared/cluster_common/inspector_test/cluster/r003_{mpirank}` is a shared path for collecting `ti2` instrumentation data.

Alternatively, you can create a Bourne* Shell or C Shell script that contains instrumentation information that may look as follows:

```
inspxe-cl -c ti2 -r
/shared/cluster_common/inspector_test/cluster/r003_{mpirank}
`pwd`/inspxe_mpirank.exe inspxe-cl -c mi2 -r r000_{mpirank}
inspxe_mpirank.exe
```

Using Bourne* Shell syntax, the script might be called `run.sh`, where it is used with the `mpirun` command in the following manner:

```
mpirun -ppn 1 -n 4 ./run.sh
```

You also need to remove the `-nolocal` command-line option because the `-f <hosts_file>` option was not specified, and therefore all processes are started locally.

4. Intel® Parallel Studio XE Cluster Edition for Windows* OS requires **the creation and use of symbolic links for installation of the Intel® software product components**. If you have a File Allocation Table (FAT32) file system deployed on your Windows* OS

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platform, these symbolic links cannot be created and the integrity of the Intel® Parallel Studio XE Cluster Edition installation is compromised.

5. For Intel® MIC Architecture, Intel® MPI Library supports only Intel® Xeon Phi™ coprocessor (codename: Knights Corner).

   This release of the Intel® MPI Library for Linux* OS does not support the MPD process manager for Intel® Xeon Phi™ coprocessor.

   Intel® MPI Library for Linux* OS supports multiple DAPL* providers for communication between the host and the Intel® Xeon Phi™ coprocessor and between several Intel® Xeon Phi™ coprocessors inside one node.
   Currently supported providers are DAPL over InfiniBand* Architecture and DAPL over Intel® Symmetric Communication Interface (Intel® SCI). This feature requires using symbolic names in the host file.

6. Intel® Software Manager will always install to either `/opt` or `$HOME` on Linux* OS even if a custom installation path is chosen. This can slow installation when the destination folder is a slow NFS shared folder, even if locally hosted.

7. Coarray Fortran (CAF) with Intel® Fortran Compiler 14 is incompatible with Intel® MPI Library 5.0. If using CAF, ensure that either Intel® Fortran Compiler 15 or higher is used, or use a 4.x version of Intel® MPI Library.

8. The default cluster installation of the Intel® Parallel Studio XE 2015 Cluster Edition, the Intel® MPI Library Version 5.0, and the Intel® Trace Analyzer and Collector Version 9.0 will not work on a default Windows* Server 2012 installation due to Microsoft* .NET Framework 3.5 not being installed. To work around this issue install Microsoft* .NET Framework Version 3.5.

8   Technical Support

Your feedback is very important to us. To receive technical support for the tools provided in this product and technical information including FAQ's and product updates, you need to register for an Intel® Premier Support account at the Intel® Registration Center.

NOTE: Registering for support varies for release product or pre-release products (alpha, beta, etc.) – only released software products have support web pages at http://software.intel.com/sites/support/.

To register for an account, please visit the Intel® Registration Center website at http://www.intel.com/software/products/registrationcenter/index.htm. If you have forgotten your password, please email a request to: quadsupport@mailbox.intel.com. Please do not email your technical issue to this email address.

The product support web site, located under the SUPPORT tab of the http://www.intel.com/go/clustertools product page, provides top technical issues, FAQs & Known Issues, Documentation and Training, and product errata. For more information, and to connect with the Intel HPC community, visit the Intel® Clusters and HPC Technology forum: https://software.intel.com/en-us/forums/intel-clusters-and-hpc-technology.

Submitting Issues

To submit an issue via the Intel Premier Support website, please perform the following steps:

1. Ensure that Java* and JavaScript* are enabled in your browser.
2. Go to https://premier.intel.com/.
3. Type in your Login and Password. Both are case-sensitive.
4. Accept the "Confidentiality Statement" if prompted. You will only have to do this the first time you log in.
5. Click the "Submit Issue" button in the upper right corner.
6. Search for a product (e.g. "Parallel Studio XE Cluster Edition") and select from the dynamic drop-down list. Hit Next.
7. Complete the fields and enter a description of your issue. You may attach a log file or a reproducer at this time. Hit Next.
8. Review the text you have entered and hit Submit.

Follow these guidelines when forming your problem report or product suggestion:

1. Describe your difficulty or suggestion. For problem reports, please be as specific as possible (for example, including compiler and link command-line options), so that we may reproduce the problem. Please include a small test case if possible.
2. Describe your system configuration information. Be sure to include specific information that may be applicable to your setup: operating system, name and version number of the installed applications, and anything else that may be relevant to helping us address your concern.

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