

## Release\_Notes.txt

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Intel(R) MPI Library 5.0 Update 3 for Linux\* OS  
Release Notes  
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### ----- Overview -----

The Intel(R) MPI Library for Linux\* OS is a multi-fabric message passing library based on ANL\* MPICH3\* and OSU\* MVAPICH2\*.

The Intel(R) MPI Library for Linux\* OS implements the Message Passing Interface, version 3.0 (MPI-3) specification.

To receive technical support and updates, you need to register your Intel(R) Software Development Product. See the Technical Support section.

### Product Contents -----

The Intel(R) MPI Library Runtime Environment (RTO) contains the tools you need to run programs including scalable process management system (Hydra\*) and supporting utilities, shared (.so) libraries, and documentation.

The Intel(R) MPI Library Development Kit (SDK) includes all of the Runtime Environment components and compilation tools: compiler commands (mpicc, mpiicc, etc.), include files and modules, static (.a) libraries, debug libraries, and test codes.

### Related Products and Services -----

Information on Intel(R) Software Development Products is available at <http://www.intel.com/software/products>.

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What's New  
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The Intel(R) MPI Library 5.0 Update 3 for Linux\* OS includes the following new features compared to the Intel(R) MPI Library 5.0 Update 2:

- Support for IBM\* General Parallel File System\* (GPFS\*) through the new environment variable I\_MPI\_EXTRA\_FILESYSTEM
- Support for the new bootstrap server, pbsdsh
- Support for the rename mechanism for the file, stats.txt, to avoid overwriting
- Bug fixes

The Intel(R) MPI Library 5.0 Update 2 for Linux\* OS includes the following new features compared to the Intel(R) MPI Library 5.0 Update 1:

- Single copy intra-node communication using Linux supported cross memory attach (CMA)
- Multi-threaded optimized library is used by default for linking with single and multi-threaded MPI applications
- Added gtool option for running external tools
- Tuning for TMI fabrics on processors using the Haswell microarchitecure
- Enhancements to statistics gathering mode
- Bug fixes

The Intel(R) MPI Library 5.0 Update 1 for Linux\* OS includes the following new features compared to the Intel(R) MPI Library 5.0:

- Changed settings for non-default installation path. If you choose to install Intel(R) MPI Library to a non-default path, impi/<version>.<package> will be appended to the selected installation path. Use symbolic links to this path if you need a specific pathname.
- Directory structure update. New links have been added to always point to the most recently installed version of the Intel(R) MPI Library.
- Bug fixes, including:
  - o Avoid conflict with TMI ADI messages, resolving hangs for LS-Dyna\*
- Collective performance improvements
- Documentation update
- Man pages copyright updated
- Added support for -fopenmp in mpiicc, mpiicpc, and mpiifort
- Improved pinning under job schedulers

The Intel(R) MPI Library 5.0 for Linux\* OS includes the following new features compared to the Intel(R) MPI Library 4.1 Update 3 (see product documentation for more details):

- Improved application binary interface (ABI) compatibility between different MPI implementations
- Improved performance of the OFA fabric on Intel(R) Xeon(TM) E5 V2 and Intel(R) Xeon(TM) E7 V2 family processors
- Add the option I\_MPI\_JOB\_RESPECT\_PROCESS\_PLACEMENT to honour process placement

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from job schedulers

- Remove all IA-32 architecture support
- Add the debug information into optimized single/multi-threaded libraries
- Implement the MPI-3 standard including but not limited to:
  - o Non-blocking collective operations
  - o Fast one-sided operations
  - o Large counts for messages greater than 2GB
- Support for Parallel Distributed Shell\*
- Allow permuted entries in machine file when running a single instance of pmi-proxy
- Support for mixed operating systems in the Hydra process manager (Linux\* OS and Windows\* OS)
- Make the following changes to the documentation:
  - o Change the Intel(R) MPI Library Getting Started Guide to Intel(R) MPI Library User's Guide
  - o Add the Intel(R) MPI Library Getting Started page
  - o Add the tutorial: MPI Tuner for Intel(R) MPI Library
- Bug fixes
- Deprecate MPD process managers

32 Bit Support of Intel(R) MPI Library & Intel(R) Trace Analyzer and Collector Inclusion of 32-bit binaries in the Intel(R) MPI Library and Intel(R) Trace Analyzer and Collector products is being deprecated. If 32-bit support is required, we advise that you remain on Intel(R) MPI Library version 4.1 Updates and Intel(R) Trace Analyzer and Collector version 8.1 Updates, which continue to include 32-bit binaries. The Intel(R) MPI Library 5.0 and Intel(R) Trace Analyzer and Collector 9.0 releases will not include 32-bit binaries. Many developers have already migrated to 64-bit implementations of both their applications and of Intel libraries and tools. If you have concerns about this deprecation, please send us feedback by submitting an issue at the Intel(R) Premier Customer Support site (<http://premier.intel.com>) as soon as possible with your contact information.

The Intel(R) MPI Library 4.1 Build 049 for Linux\* OS is an updated build of the Intel(R) MPI Library 4.1 Build 048 for Linux\* OS and includes the following changes compared to the Intel(R) MPI Library 4.1 Build 048:

- Fix the out-of-session integration with IBM\* Platform\* LSF\* for large jobs
- Improve in the memory consumption when using DAPL\* UD fabric
- Fix the segmentation fault when using I\_MPI\_WAIT\_MODE=1

The Intel(R) MPI Library 4.1 Build 048 for Linux\* OS is an updated build of the Intel(R) MPI Library 4.1 Update 3 for Linux\* OS and includes the following changes compared to the Intel(R) MPI Library 4.1 Update 3:

- Fix the crash of multithreaded MPI\_Bsend with attached buffer
- Fix the crash of MPI\_Alltoall algorithm #1 with special vector datatypes
- Add I\_MPI\_JOB\_RESPECT\_PROCESS\_PLACEMENT environment variable support that controls respect of the Job Scheduler provided process-per-node parameter

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The Intel(R) MPI Library 4.1 Update 3 for Linux\* OS is an update release of the Intel(R) MPI Library for Linux\* OS

The Intel(R) MPI Library 4.1 Update 3 for Linux\* OS includes the following new features compared to the Intel(R) MPI Library 4.1 Update 2 (see product documentation for more details):

- Intel(R) Xeon(TM) E5 V2 and Intel(R) Xeon(TM) E7 V2 family processors additional performance tuning
- New online documentation format
- Bug fixes

The Intel(R) MPI Library 4.1 Update 2 for Linux\* OS is an update release of the Intel(R) MPI Library for Linux\* OS

The Intel(R) MPI Library 4.1 Update 2 for Linux\* OS includes the following new features compared to the Intel(R) MPI Library 4.1 Update 1 (see product documentation for more details):

- Intel(R) Xeon(TM) E5 V2 and Intel(R) Xeon(TM) E7 V2 family processors performance tuning
- Intel(R) Many Integrated Core Architecture (Intel(R) MIC) Architecture performance improvements and heterogeneous performance tuning (MT memcpy)
- Support for Parallel Distributed Shell\*
- Allow permuted entries in machine file when running a single instance of pmi-proxy
- Tag Matching Interface\* (TMI\*) fabric latency and scalability improvements
- Bug fixes

The Intel(R) MPI Library 4.1 Update 1 for Linux\* OS is an update release of the Intel(R) MPI Library for Linux\* OS.

The Intel(R) MPI Library 4.1 Update 1 for Linux\* OS includes the following new features compared to the Intel(R) MPI Library 4.1 (see product documentation for more details):

- Improved Non-Uniform Memory Access\* (NUMA\*) support
- Advanced pinning support: the excluded processor list and respect CPU affinity
- DAPL\* auto provider selection mechanism enhancements
- New OFA connection manager aimed for scalability improvements
- Tag Matching Interface\* (TMI\*) version 1.1 support
- New checkpoint-restart control options
- Extended control options for Intel(R) Xeon Phi(TM) coprocessor operating system
- Intel(R) Xeon Phi(TM) Coprocessor Communication Link (CCL) proxy support
- Checkpoint-restart support through OFA network module and Hydra\* process manager for Intel(R) Xeon Phi(TM) coprocessors
- Tag Matching Interface (TMI) support with Intel(R) True Scale Fabric (former QLogic\*) performance scaled messaging\* (PSM\*) network fabric for the Intel(R) Xeon Phi(TM) Coprocessor

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(codename: Knights Corner)

- Backward compatibility with Intel MPI Library 4.1 based applications
- Optional GUI installation
- Bug Fixes

The Intel(R) MPI Library 4.1 for Linux\* OS is an update release of the Intel(R) MPI Library for Linux\* OS.

The Intel(R) MPI Library 4.1 for Linux\* OS includes the following new features compared to the Intel(R) MPI Library 4.0 Update 3 (see product documentation for more details):

- Support of the Intel(R) Xeon Phi(TM) Coprocessor (codename: Knights Corner) based on Intel(R) Many Integrated Core Architecture (Intel(R) MIC Architecture). See Release Notes Addendum for more information.
- Support for the MPI-2.2 standard
- Backward compatibility with Intel MPI Library 4.0.x based applications
- Support for clusters with different Intel(R) Architecture Processors
- Support Checkpoint-Restart through OFA network module and Hydra process manager, based on the Berkeley Checkpoint-Restart Library\* (blcr) underlying system library.
- Support for the PBS Pro\* job management system
- Support for Intel(R) Composer XE 2013
- New documentation in the HTML format
- Bug Fixes

The Intel(R) MPI Library 4.0 Update 3 for Linux\* OS is an update release of the Intel(R) MPI Library for Linux\* OS.

This release includes the following updates compared to the Intel(R) MPI Library 4.0 Update 2 (see product documentation for more details):

- Performance and scalability improvements
  - o New scalable process manager mpiexec.hydra used by default in the mpirun utility
  - o Shared memory optimizations for platforms with Intel(R) Streaming SIMD Extensions 4.2 (Intel(R) SSE4.2) and Intel(R) AES New Instructions (Intel(R) AES-NI). This functionality is available for both Intel(R) and non-Intel microprocessors, but it may perform additional optimizations for Intel microprocessors than it performs for non-Intel microprocessors.
  - o Dynamic connection mode for shared memory
  - o Scalable hybrid UD/RDMA mode for the DAPL fabric
  - o Accelerated RDMA memory registration cache
  - o Dynamic queue pair (QP) creation and extensible reliable connection (XRC) mode support for the OFA fabric
  - o RDMA over converged ethernet (RoCE) support through the DAPL fabric
  - o TCP scalability improvements

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- o Substantially accelerated and enhanced MPI tuning utility
- Usability improvements
  - o Additional integrated performance monitoring (IPM) statistics summary format
  - o Extended debugging output control
  - o Enhanced processor information utility (cpuinfo)
  - o Bug fixes
- Extended interoperability
  - o Intel(R) Composer XE 2011 Update 6 support
  - o Tight integration with SLURM\* job management systems through the mpiexec.hydra process manager

The Intel(R) MPI Library 4.0 Update 2 for Linux\* OS is an update release of the Intel(R) MPI Library for Linux\* OS.

This release includes the following updates compared to the Intel(R) MPI Library 4.0 Update 1 (see product documentation for more details):

- Usability improvements
  - o Support for SGI\* Altix\* UV\* 1000 pinning with more than 64 cores
  - o Improved static DAPL connections establishment in the wait mode
  - o Improved stability of the shm:ofa fabric
  - o Improved mpiexec.hydra process manager support for SLURM and Cloud
  - o Static libraries compiled using the -fPIC option
  - o Improved error reporting for the Lustre\* file system
  - o Bug fixes
- Extended interoperability
  - o Intel(R) Composer XE 2011 Update 4 support
  - o Ability to call MPI from the Coarray Fortran programs

The Intel(R) MPI Library 4.0 Update 1 for Linux\* OS is an update release of the Intel(R) MPI Library for Linux\* OS.

This release includes the following updates compared to the Intel(R) MPI Library 4.0 (see product documentation for more details):

- Performance and scalability improvements
  - o Improved startup scalability through the mpiexec.hydra process manager
  - o Improved OFA fabric performance
  - o Further optimizations to several collective algorithms
- Usability improvements
  - o Use of ssh for remote connectivity by default (formerly rsh)
  - o Process pinning support for the mpiexec.hydra process manager
  - o Extended process pinning control for hybrid applications through the I\_MPI\_PIN\_DOMAIN and I\_MPI\_PIN\_CELL environment variables
  - o Improved mpitune for easier application tuning
- Extended interoperability
  - o Intel(R) Composer XE 12.0 Beta support

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The Intel(R) MPI Library 4.0 for Linux\* OS includes the following new features compared to the Intel(R) MPI Library 3.2 Update 2 (see product documentation for more details):

- New architecture for better performance and higher scalability
  - o Optimized shared memory path for industry leading latency on multicore platforms
  - o New flexible mechanism for selecting the communication fabrics (I\_MPI\_FABRICS) that complements the classic Intel MPI device selection method (I\_MPI\_DEVICE)
  - o Native InfiniBand\* interface (OFED\* verbs) support with multirail capability for ultimate InfiniBand\* performance
    - Set I\_MPI\_FABRICS=ofa for OFED\* verbs only
    - Set I\_MPI\_FABRICS=shm:ofa for shared memory and OFED\* verbs
    - Set I\_MPI\_OFA\_NUM\_ADAPTERS, etc., for multirail transfers
  - o Tag Matching Interface (TMI) support for higher performance of Intel(R) True Scale Fabric (former QLogic\*) PSM\* and Myricom\* MX\* interconnect interfaces
    - Set I\_MPI\_FABRICS=tmi for TMI only
    - Set I\_MPI\_FABRICS=shm:tmi for shared memory and TMI
  - o Connectionless DAPL\* UD support for limitless scalability of your TOP500 submissions
    - Set I\_MPI\_FABRICS=dapl for DAPL only
    - Set I\_MPI\_FABRICS=shm:dapl for shared memory and DAPL
    - Set I\_MPI\_DAPL\_UD=enable for DAPL UD transfers over DAPL fabric
- Updated MPI performance tuner to extract the last ounce of performance out of your installation
  - o For a certain cluster, based on the Intel(R) MPI Benchmarks (IMB) or a user provided benchmark
  - o For a certain application run
- MPI 2.1 standard conformance
- Experimental dynamic process support
- Experimental fault tolerance support
- Experimental failover support
- Backward compatibility with Intel MPI Library 3.x based applications
- Man pages

### Examples

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Set the I\_MPI\_FABRICS environment variable to select a particular network fabric.

- To use TMI and Intel(R) PSM for shared-memory for intra-node communication, and TMI for inter-node communication, do the following steps:
  1. Copy the <installdir>/etc64/tmi.conf file to the /etc directory. Alternatively you set the TMI\_CONFIG environment variable to point to the location of the tmi.conf file. For instance,

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- ```
$ export TMI_CONFIG=<installdir>/etc64/tmi.conf
```
2. Select tmi for your fabric. For instance,

```
$ export I_MPI_FABRICS=tmi
```

or use -PSM on the mpiexec command line.
  3. Execute an application. For instance,

```
$ mpiexec -n 16 ./IMB-MPI1
```

Set the I\_MPI\_TMI\_PROVIDER environment variable if necessary to select a specific TMI provider. For instance,

```
$export I_MPI_TMI_PROVIDER=psm
```

- If you have two Intel True Scale HCAs per node, both of them will be used by default when you run with 2 or more ranks per node. No option is necessary on the mpiexec command. If you want to use just one of them, set the IPATH\_UNIT variable to e.g.:

```
$export IPATH_UNIT=0 (or =1)
```

- If you have two Intel True Scale HCAs per node, and want to get additional bandwidth performance even when only one MPI rank is active per node, set:

```
$export PSM_MULTIRAIL=0
```

For most applications, it is better not to use this PSM\_MULTIRAIL variable since it increases MPI latency somewhat, but it is helpful for a minority of applications that require additional bandwidth from single ranks.

- On some applications, using Intel MPI's shared memory techniques is better than using PSM's shared memory techniques. To test this, use:

```
$export I_MPI_FABRICS=shm:tmi
```

- To select shared memory for intra-node communication and OFED\* verbs for inter-node communication, do the following steps:

```
$ export I_MPI_FABRICS=shm:ofa
$ mpiexec -n 4 ./IMB-MPI1
```

Set the I\_MPI\_OFA\_NUM\_ADAPTERS environment variable to utilize the multirail capabilities.

```
$ export I_MPI_FABRICS=shm:ofa
$ export I_MPI_OFA_NUM_ADAPTERS=2
$ mpiexec -n 4 ./IMB-MPI1
```

- To use shared memory for intra-node communication and the DAPL\* layer for inter-node communication, do the following steps:

```
$ export I_MPI_FABRICS=shm:dapl
$ mpiexec -n 4 ./IMB-MPI1
```

Set the I\_MPI\_DAPL\_UD environment variable to enable connectionless DAPL\* UD.



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```
$ export I_MPI_FABRICS=shm:dapl
$ export I_MPI_DAPL_UD=enable
$ mpiexec -n 4 ./IMB-MPI1
```

See more details in the Intel(R) MPI Library for Linux\* OS Reference Manual.

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Key Features  
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This release of the Intel(R) MPI Library supports the following major features:

- MPI-1, MPI-2.2 and MPI-3 specification conformance with the following exceptions:
  - o FORTRAN\* 2008 bindings
- Support for any combination of the following interconnection fabrics:
  - o Shared memory
  - o Network fabrics with tag matching capabilities through Tag Matching Interface (TMI), such as Intel(R) True Scale Fabric, Infiniband\*, Myrinet\* and other interconnects
  - o Native InfiniBand\* interface through OFED\* verbs provided by Open Fabrics Alliance\* (OFA\*)
  - o RDMA-capable network fabrics through DAPL\*, such as InfiniBand\* and Myrinet\*
  - o Sockets, for example, TCP/IP over Ethernet\*, Gigabit Ethernet\*, and other interconnects
- Support for the following MPI communication modes related to Intel(R) Xeon Phi(TM) coprocessor:
  - o Communication inside the Intel(R) Xeon Phi(TM) coprocessor
  - o Communication between the Intel(R) Xeon Phi(TM) coprocessor and the host CPU inside one node
  - o Communication between the Intel(R) Xeon Phi(TM) coprocessors inside one node
  - o Communication between the Intel(R) Xeon Phi(TM) coprocessors and host CPU between several nodes
- (SDK only) Support for Intel(R) 64 architecture and Intel(R) MIC Architecture clusters using:
  - o Intel(R) C++ Compiler for Linux\* OS version 13.1 through 15.0 and higher
  - o Intel(R) Fortran Compiler for Linux\* OS version 13.1 through 15.0 and higher
  - o GNU\* C, C++ and Fortran 95 compilers
- (SDK only) C, C++, Fortran 77 and Fortran 90 language bindings
- (SDK only) Dynamic or static linking

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System Requirements  
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The following sections describe supported hardware and software.

## Supported Hardware

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Systems based on the Intel(R) 64 architecture, in particular:

- Intel(R) Core(TM) processor family or higher
- Intel(R) Xeon(R) E5 v3 processor families recommended
- Intel(R) Xeon(R) E7 v2 processor families recommended
- 1 GB of RAM per core
- 2 GB of RAM per core recommended
- 1 GB of free hard disk space

Intel(R) Xeon Phi(TM) Coprocessor (codename: Knights Corner) based on  
Intel(R) MIC Architecture

## Supported Software

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Operating Systems: (issues including installation ones are possible for  
Operating Systems that are not released at the date of Intel(R) MPI Library 5.0  
release)

Systems based on the Intel(R) 64 architecture:

- Red Hat\* Enterprise Linux\* 6, 7,
- Fedora\* 20, 21,
- CentOS\* 6.0,
- SUSE\* Linux Enterprise Server\* 11, 12,
- Ubuntu\* LTS 12.04, 14.04,
- Debian\* 6, 7,

(SDK only) Compilers:

GNU\*: C, C++, Fortran 77 3.3 or higher, Fortran 95 4.0 or higher

Intel(R) C++ Compiler for Linux\* OS 13.1 through 15.0 or higher  
Intel(R) Fortran Compiler for Linux\* OS 13.1 through 15.0 or higher

(SDK only) Supported Debuggers:

Rogue Wave\* Software TotalView\* 6.8 or higher  
Allinea\* DDT\* v1.9.2 or higher  
GNU\* Debuggers

Batch Systems:

Platform\* LSF\* 6.1 or higher  
Altair\* PBS Pro\* 7.1 or higher  
Torque\* 1.2.0 or higher  
Parallelnavi\* NQS\* for Linux\* OS V2.0L10 or higher

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Parallelnavi\* for Linux\* OS Advanced Edition V1.0L10A or higher  
NetBatch\* v6.x or higher  
SLURM\* 1.2.21 or higher  
Sun\* Grid Engine\* 6.1 or higher  
IBM\* LoadLeveler\* 4.1.1.5 or higher  
Platform\* Lava\* 1.0

Recommended InfiniBand Software:

- OpenFabrics\* Enterprise Distribution (OFED\*) 1.5.4.1 or higher.
- Intel(R) True Scale Fabric Host Channel Adapter Host Drivers & Software (OFED+) v7.2.0 or higher.
- Mellanox\* OFED\* 1.5.3-4.0.42 or higher.

Additional Software:

- Python\* 2.2 or higher, including the python-xml module. Python\* distributions are available for download from your OS vendor or at <http://www.python.org> (for Python\* source distributions).
- An XML parser such as expat\* or pyxml\*.
- If using InfiniBand\*, Myrinet\*, or other RDMA-capable network fabrics, a DAPL\* 1.2 standard-compliant provider library/driver is required. DAPL\* providers are typically provided with your network fabric hardware and software.
- DAPL auto provider selection mechanism requires dapl-2.0.37 or higher for Intel(R) Xeon(R) and Intel(R) Manycore Platform Software Stack (Intel(R) MPSS) gold update 3 or higher for Intel (R) Xeon Phi(tm).
- Improved NUMA support requires dapl-2.0.37 or higher
- Intel(R) Many Integrated Core Platform Software Stack (MPSS) 2.1 Beta or higher for the respective host operating system. MPSS may support specific operating system/kernel only. For most recent specific operating system requirements, see <http://software.intel.com/en-us/articles/intel-mpi-library-for-linux-kb/all/> or <http://software.intel.com/mic-developer> .  
Note that the Intel(R) MPI Library is tuned for optimum performance on the latest MPSS versions as of release time.

(SDK only) Supported Languages

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For GNU\* compilers: C, C++, Fortran 77, Fortran 95  
For Intel compilers: C, C++, Fortran 77, Fortran 90, Fortran 95

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Installation Notes  
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See the Intel(R) MPI Library for Linux\* OS Installation Guide for details.

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Documentation  
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Intel(R) MPI Library for Linux\* OS Getting Started page, found in `get_started.html`, contains information on the following subject:

- Compiling and running your MPI program

Intel(R) MPI Library for Linux\* OS User's Guide, found in `User_Guide.htm` (HTML Uncompressed Help) and `User_Guide.pdf`, contains information on the following subjects:

- First steps using the Intel(R) MPI Library
- First-aid troubleshooting actions

Intel(R) MPI Library for Linux\* OS Reference Manual, found in `Reference_Manual.htm` (HTML Uncompressed Help) and `Reference_Manual.pdf`, contains information on the following subjects:

- Command Reference describes commands, options, and environment variables
- Tuning Reference describes environment variables that influence library behavior and performance

Intel(R) MPI Library for Linux\* OS Installation Guide, found in `INSTALL.html`, contains information on the following subjects:

- Obtaining, installing, and uninstalling the Intel(R) MPI Library
- Getting technical support

Tutorial: MPI Tuner for Intel(R) MPI Library, found in `MPI_Tuner_Tutorial.pdf`, contains information on the following subjects:

- How to use the MPI Tuner for Intel(R) MPI Library to get optimized configuration files for the runtime library automatically
- How to troubleshoot the common issues with the MPI tuner

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Special Features and Known Issues  
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Note: The following list includes the information until Intel(R) MPI Library 5.0 is released. For the most up-to-date list of known issues, as well as latest tips and tricks on using the library, visit the Intel(R) MPI Library

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for Linux\* Knowledge Base at

<http://software.intel.com/en-us/articles/intel-mpi-library-for-linux-kb/all/>

- Intel(R) MPI Library 5.0 for Linux\* OS is binary compatible with the majority of Intel MPI Library 4.1.x-based applications. Recompile your application only if you use:
  - o MPI\_Dist\_graph\_create, MPI\_Dist\_graph\_create\_adjacent, MPI\_Dist\_graph\_neighbors, MPI\_Dist\_graph\_neighbors\_count, (C, C++, Fortran)
  - o MPI::Get\_address (C++ only)
- The Intel(R) MPI Library 5.0 is incompatible with some versions of the Mellanox\* OFED drivers, including but not limited to 2.1-1.0.0, and can cause segmentation faults. Upgrade the driver to at least version 2.1-1.0.6 to correct this.
- Hydra hangs when used under versions 7.2 or 7.3 of the GNU\* Debugger gdb.
- In order to run a mixed operating system job (Linux\* and Windows\*), all binaries must link to the same single or multithreaded MPI library. The single and multithreaded libraries are incompatible with each other and should not be mixed. Note that the pre-compiled binaries for the Intel® MPI Benchmarks are inconsistent (Linux\* version links to multithreaded, Windows\* version links to single threaded) and as such, at least one must be rebuilt to match the other.
- Ubuntu\* does not allow attaching a debugger to a non-child process. In order to use -gdb, this must be disabled by setting the sysctl value /proc/sys/kernel/yama/ptrace\_scope to 0.
- The Intel(R) MPI Library does not support using the OFA fabric over an Intel(R) Symmetric Communications Interface (Intel(R) SCI) adapter. If you are using an Intel SCI adapter, such as with Intel(R) Many Integrated Core Architecture, you will need to select a different fabric.
- The PSM TMI provider does not support messages larger than  $2^{32} - 1$  bytes. If you have messages larger than this limit, select a different fabric.
- Intel(R) 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.
- Intel(R) MPI Library 4.1 for Linux\* OS is binary compatible with the majority of Intel MPI Library 4.0.x-based applications. Recompile your application only if you use:
  - o MPI C++ binding

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- Intel(R) MPI Library 4.1 for Linux\* OS implements the MPI-2.2 standard.

On top of this, the aliasing of the send and receive buffers in the following collective routines will be rejected:

- o MPI\_Gather, MPI\_Gatherv
- o MPI\_Scatter, MPI\_Scatterv
- o MPI\_Allgather, MPI\_Allgatherv
- o MPI\_Alltoall, MPI\_Alltoallv, MPI\_Alltoallw

If your application depends on the pre-MPI-2.2 behavior, set the environment variable `I_MPI_COMPATIBILITY` to 4. If your application depends on the pre-MPI-2.1 behavior, set the environment variable `I_MPI_COMPATIBILITY` to 3.

You will see the diagnostic messages below in case of buffer aliasing issue:

```
MPIR_Localcopy(381).....: memcpy arguments alias each other
```

Known applications with such kind of limitations:

SPEC MPI2007 V2.0, VASP 5.3

- Intel(R) MPI Library 4.0 for Linux\* OS is binary compatible with the majority of Intel MPI Library 3.x-based applications. Recompile your application only if you use:
  - o MPI one-sided routines in Fortran (`mpi_accumulate()`, `mpi_alloc_mem()`, `mpi_get()`, `mpi_put()`, `mpi_win_create()`)
  - o MPI C++ binding
- Intel(R) MPI Library 4.0 for Linux\* OS implements the MPI-2.1 standard. The functions of the following MPI routines have changed:
  - o `MPI_Cart_create()`
  - o `MPI_Cart_map()`
  - o `MPI_Cart_sub()`
  - o `MPI_Graph_create()`

If your application depends on the pre-MPI-2.1 behavior, set the environment variable `I_MPI_COMPATIBILITY` to "3".

- The following features are currently available only on Intel(R) 64 architecture:
  - o Native InfiniBand\* interface (OFED\* verbs) support
  - o Multirail capability
  - o Tag Matching Interface (TMI) support
  - o Connectionless DAPL\* UD support
- The Intel(R) MPI Library supports the MPI-2 process model for all fabric combinations with the following exceptions:

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- o I\_MPI\_FABRICS is set to <fabric1>:<fabric2>, where <fabric1> is not shm, and <fabric2> is not equal to <fabric1> (for example, dapl:tcp)
- If communication between two existing MPI applications is established using the process attachment mechanism, the library does not control whether the same fabric has been selected for each application. This situation may cause unexpected applications behavior. Set the I\_MPI\_FABRICS variable to the same values for each application to avoid this issue.
- The following restriction exists for the DAPL-capable network fabrics because it relates to support for the MPI-2 process model: if the size of the information about the host used to establish the communication exceeds a certain DAPL provider value, the application fails with an error message similar to:  

```
[0:host1][../../dapl_module_util.c:397] error(0x80060028):.....: could not\
connect DAPL endpoints: DAT_INVALID_PARAMETER(DAT_INVALID_ARG5)
```
- The Intel(R) MPI Library Development Kit package is layered on top of the Runtime Environment package. See the Intel(R) MPI Library for Linux\* OS Installation Guide for more details.
- The SDK installer checks for the existence of the associated RTO package and installs it if the RTO is missing. If the RTO is already present, its location determines the default SDK location.
- The RTO uninstaller checks for SDK presence and proposes to uninstall the SDK and RTO packages.
- The SDK uninstaller asks the user if the RTO is to be uninstalled as well. The user is able to cancel the uninstallation at this point.
- The Intel(R) MPI Library automatically places consecutive MPI processes onto all processor cores. Use the mpiexec -perhost 1 option or set the I\_MPI\_PERHOST environment variable to 1 in order to obtain the round robin process placement.
- The Intel(R) MPI Library pins processes automatically. Use I\_MPI\_PIN and related environment variables to control process pinning. See the Intel(R) MPI Library for Linux\* OS Reference Manual for more details.
- The Intel(R) MPI Library provides thread-safe libraries up to level MPI\_THREAD\_MULTIPLE. The default level is MPI\_THREAD\_FUNNELED. Follow these rules:
  - o (SDK only) Use the Intel(R) MPI compiler driver option -mt\_mpi to build a thread-safe MPI application.
  - o Do not load thread-safe Intel(R) MPI libraries through dlopen(3).

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- Intel(R) MKL 10.0 may create multiple threads depending on various conditions. Follow these rules to correctly use Intel(R) MKL:
  - o (SDK only) Use the thread safe version of the Intel(R) MPI Library in conjunction with Intel(R) MKL
  - o Set the OMP\_NUM\_THREADS environment variable to 1 to run the application if linked with the non-thread-safe version of the Intel(R) MPI Library
- The Intel(R) MPI Library uses dynamic connection establishment by default for 64 and more processes. To always establish all connections upfront, set the I\_MPI\_DYNAMIC\_CONNECTION environment variable to "disable".
- The Intel(R) MPI Library compiler drivers embed the actual Development Kit library path (default /opt/intel/impi/<version>.<package\_num>) and default Runtime Environment library path /opt/intel/mpi-rt/<version>.<package\_num> into the executables using the -rpath linker option.
- Use the LD\_PRELOAD environment variable to pre-load the appropriate Intel(R) MPI binding library to start an MPICH2 Fortran application in the Intel(R) MPI Library environment.
- The Intel(R) MPI Library enhances message-passing performance on DAPL\*-based interconnects by maintaining a cache of virtual-to-physical address translations in the MPI DAPL\* data transfer path.

Set the environment variable LD\_DYNAMIC\_WEAK to "1" if your program dynamically loads the standard C library before dynamically loading the Intel(R) MPI Library. Alternatively, use the environment variable LD\_PRELOAD to load the Intel(R) MPI Library first.

To disable the translation cache completely, set the environment variable I\_MPI\_RDMA\_TRANSLATION\_CACHE to "disable". Note that you do not need to set the aforementioned environment variables LD\_DYNAMIC\_WEAK or LD\_PRELOAD when you disable the translation cache.

- (SDK only) Always link the standard libc libraries dynamically if you use the DAPL, OFA\*, and TMI fabrics, individually or in combination with the shared memory fabric, to avoid possible segmentation faults.

Note: some compilers may use the -static option implicitly, for example, when using the -fast option for the Intel compilers. Therefore, use the ldd command to verify that the final executable is dynamically linked with the standard libc libraries.

It is safe to link the Intel(R) MPI Library statically through the -static\_mpi option of the compiler drivers. This option does not affect the default linkage method for other libraries.



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- Certain DAPL\* providers may not work or provide worthwhile performance with the Intel(R) MPI Library for Linux\* OS, for example:
  - o Intel(R) True Scale Fabric. Use the TMI libraries included with the Intel(R) MPI Library when running over the Intel(R) True Scale Fabric PSM\* interconnect interface for best performance.
  - o Myricom\*. Use the TMI libraries included with the Intel(R) MPI Library when running over the Myricom\* MX\* interconnect interface for best performance.  
Alternatively, contact Myricom\* or download the DAPL\* provider at <http://sourceforge.net/projects/dapl-myriinet> which supports both the GM\* and MX\* interfaces.
- Depending on Intel(R) True Scale Fabric hardware, PSM\* may not support CPU over-subscription of the node. The maximum amount of processes which can be run on the node is limited and depends on particular Intel(R) True Scale Fabric hardware and amount of CPU cores. The GM DAPL\* provider may not work with the Intel(R) MPI Library for Linux\* OS using some versions of the GM\* drivers. Set `I_MPI_RDMA_RNDV_WRITE=1` to avoid this issue.
- Certain DAPL\* providers may not function properly if your application uses `system(3)`, `fork(2)`, `vfork(2)`, or `clone(2)` system calls. Do not use these system calls or functions based upon them. For example, `system(3)`, with:
  - o OFED\* DAPL\* provider with Linux\* kernel version earlier than official version 2.6.16. Set the `RDMAV_FORK_SAFE` environment variable to enable the OFED workaround with compatible kernel version.
- `MPI_MPROBE` and `MPI_IMPROBE` are not supported by TMI\* fabric.
- The Intel(R) MPI Library requires Python\* 2.2 or higher for process management.
- The Intel(R) MPI Library requires the `python-xml*` package or its equivalent on each node in the cluster for process management.
- The Intel(R) MPI Library requires the `expat*` or `pyxml*` package, or an equivalent XML parser on each node in the cluster for process management.
- The following MPI-2.2 features are not supported by the Intel(R) MPI Library:
  - o Passive target one-sided communication when the target process does not call any MPI functions
- If installation of the Intel(R) MPI Library package fails and shows the error message: "Intel(R) MPI Library already installed" when a package is not actually installed, try the following:
  1. Determine the package number that the system believes is installed by typing:

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```
# rpm -qa | grep intel-mpi
```

This command returns an Intel(R) MPI Library <package name>.

2. Remove the package from the system by typing:

```
# rpm -e <package name>
```

3. Re-run the Intel(R) MPI Library installer to install the package.

### TIP:

To avoid installation errors, always remove the Intel(R) MPI Library packages using the uninstall script provided with the package before trying to install a new package or reinstall an older one.

- Due to an installer limitation, avoid installing earlier releases of the Intel(R) MPI Library packages after having already installed the current release. It may corrupt the installation of the current release and require that you uninstall/reinstall it.
- Certain operating system versions have a bug in the rpm command that prevents installations other than in the default install location. In this case, the installer does not offer the option to install in an alternate location.
- If the mpdboot command fails to start up the MPD, verify that the Intel(R) MPI Library package is installed in the same path/location on all the nodes in the cluster. To solve this problem, uninstall and re-install the Intel(R) MPI Library package while using the same <installdir> path on all nodes in the cluster.
- If the mpdboot command fails to start up the MPD, verify that all cluster nodes have the same Python\* version installed. To avoid this issue, always install the same Python\* version on all cluster nodes.
- Presence of environment variables with non-printable characters in user environment settings may cause the process startup to fail. To work around this issue, the Intel(R) MPI Library does not propagate environment variables with non-printable characters across the MPD ring.
- A program cannot be executed when it resides in the current directory but "." is not in the PATH. To avoid this error, either add "." to the PATH on ALL nodes in the cluster or use the explicit path to the executable or ./<executable> in the mpiexec command line.
- You may get an error message at the end of a Checkpoint-Restart enabled application, if some of the application processes exit in the middle of

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taking a checkpoint image. Such error does not impact the application, thus you can ignore it. To avoid this error, set a larger number than your previous configured value for the <sec> argument of the -checkpoint-interval option. The following error message details are for your reference:

```
[proxy:0:0@hostname] HYDT_ckptpoint_blcr_checkpoint (./tools/ckptpoint/blcr/ckptpoint_blcr.c:313): cr_poll_checkpoint failed: No such process
[proxy:0:0@hostname] ckpoint_thread (./tools/ckptpoint/ckptpoint.c:559):
blcr checkpoint returned error
[proxy:0:0@hostname] HYDT_ckptpoint_finalize (./tools/ckptpoint/ckptpoint.c:878)
: Error in checkpoint thread 0x7
```

- The Intel(R) MPI Library 2.0 and higher supports PMI wire protocol version 1.1. Note that this information is specified as

```
pmi_version = 1
pmi_subversion = 1
```

instead of

```
pmi_version = 1.1
```

as done by the Intel(R) MPI Library 1.0.

- The Intel(R) MPI Library requires the presence of the /dev/shm device in the system. To avoid failures related to the inability to create a shared memory segment, make sure the /dev/shm device is set up correctly.
- The Intel(R) MPI Library uses TCP sockets to pass stdin stream to the application. If you redirect a large file, for example, 5KB, the transfer could take a long time and cause things to hang on the remote side. To avoid this issue, pass large files to the application as command line options.
- (SDK only) Certain operating systems use GNU\* compilers version 4.2 or higher that is incompatible with Intel(R) Professional Edition Compiler 9.1. Use Intel(R) Professional Edition Compilers 11.1 or later on the respective operating systems, for example:
  - o SuSE\* Linux Enterprise Server\* 11
- (SDK only) Certain GNU\* C compilers may generate code that leads to inadvertent merging of some output lines at runtime. This happens when different processes write simultaneously to the standard output and standard error streams. In order to avoid this, use the -fno-builtin-printf option of the respective GNU\* compiler while building your application.
- (SDK only) Certain versions of the GNU\* LIBC library define

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free()/realloc() symbols as non-weak. Use the --allow-multiple-definition GNU\* linker option to link your application.

- (SDK only) A known exception handling incompatibility exists between GNU C++ compilers version 3.x and version 4.x. Use the special -gcc-version=<nnn> option for the compiler drivers mpicxx and mpiicpc to link an application when running in a particular GNU\* C++ environment. The valid <nnn> values are:
  - o 320 if GNU\* C++ version is 3.2.x
  - o 330 if GNU\* C++ version is 3.3.x
  - o 340 if GNU\* C++ version is 3.4.x
  - o 400 if GNU\* C++ version is 4.0.x
  - o 410 if GNU\* C++ version is 4.1.x
  - o 420 if GNU\* C++ version is 4.2.x
  - o 430 if GNU\* C++ version is 4.3.x

A library compatible with the detected version of the GNU\* C++ compiler is used by default. Do not use this option if the gcc version is older than 3.2.

- (SDK only) The Fortran 77 and Fortran 90 tests in the <installdir>/test directory may produce warnings when compiled with the mpif77, etc. compiler commands. You can safely ignore these warnings, or add the -w option to the compiler command line to suppress them.
- (SDK only) In order to use GNU Fortran compiler version 4.0 and higher use the mpif90 compiler driver.
- (SDK only) A known module file format incompatibility exists between the GNU Fortran 95 compilers. Use Intel(R) MPI Library mpif90 compiler driver to automatically uses the appropriate MPI module.
- (SDK only) Perform the following steps to generate bindings for your compiler that is not directly supported by the Intel(R) MPI Library:
  1. Go to the binding directory
    - # cd <installdir>/binding
  2. Extract the binding kit
    - # tar -zxvf intel-mpi-binding-kit.tar.gz
  3. Follow instructions in the README-intel-mpi-binding-kit.txt
- (SDK only) Use the following command to launch an Intel MPI application with Valgrind\* 3.3.0:

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```
# mpiexec -n <# of processes> <other_mpiexec_options> valgrind \
--leak-check=full --undef-value-errors=yes \
--log-file=<logfile>.%p \
--suppressions=<installdir>/etc/valgrind.supp <executable>
```

where:

<logfile>.%p - log file name for each MPI process  
<installdir> - the Intel MPI Library installation path  
<executable> - name of the executable file

- Intel(R) MPI Library doesn't support symbol ":" within filenames for file manipulation routines.
- Note: any routines in the libmpigi library (shipped with the Intel(R) MPI Library) are more highly optimized for Intel microprocessors than for non-Intel microprocessors.
- DAPL auto provider selection mechanism requires dapl-2.0.37 or higher for Intel(R) Xeon(R) and Intel(R) Manycore Platform Software Stack (Intel(R) MPSS) gold update 3 or higher for Intel (R) Xeon Phi(tm)
- Improved NUMA support requires dapl-2.0.37 or higher
- Intel(R) MPI Library supports only Intel(R) Xeon Phi(TM) Coprocessor (codename: Knights Corner) based on Intel(R) MIC Architecture.
- This release of the Intel(R) MPI Library 5.0 for Linux\* OS does not support certain features for Intel(R) Xeon Phi(TM) coprocessor:
  - o MPD process manager
- Intel(R) MPI Library 5.0 for Linux\* OS supports multiple DAPL\* providers for communication between host and Intel(R) Xeon Phi(TM) coprocessor and between several Intel(R) Xeon Phi(TM) coprocessors inside one node. Currently supported providers are DAPL over InfiniBand\* Architecture and DAPL over Intel(R) Symmetric Communications Interface (Intel(R) SCI). This feature requires using symbolic names in the hostfile.
- DAPL auto provider selection mechanism requires dapl-2.0.37 or higher for Intel(R) Xeon(R) and Intel(R) Manycore Platform Software Stack (Intel(R) MPSS) gold update 3 or higher for Intel (R) Xeon Phi(tm)
- Coarray Fortran (CAF) with Intel(R) Fortran Compiler 14 is incompatible with Intel(R) MPI Library 5.0. If using CAF, ensure that either Intel(R) Fortran Compiler 15 or higher is used, or use a 4.x version of Intel(R) MPI Library.
- If you set I\_MPI\_SHM\_LMT=direct, the setting has no effect on Intel(R) MPI Library for Linux\* OS if the Linux\* kernel version is lower than 3.2.

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- The direct copy LMT does not support messages larger than 2<sup>31</sup> - 4K bytes. If you have messages larger than this limit, select a different LMT mechanism.

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Technical Support  
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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(R) Premier Support account at the Registration Center.

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General information on Intel(R) Software Development Products support offerings may be obtained at:

<http://www.intel.com/software/products/support>

The Intel(R) MPI Library home page can be found at:

<http://www.intel.com/go/mpl>

The Intel(R) MPI Library support web site, <http://software.intel.com/en-us/articles/intel-mpl-library-for-linux-kb/all/> provides the latest top technical issues, frequently asked questions, product documentation, and product errata.

Requests for licenses can be directed to the Registration Center at:

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Before submitting a support issue, see the Intel(R) MPI Library for Linux\* OS User's Guide for details on post-install testing to ensure that basic facilities are working.

When submitting a support issue to Intel(R) Premier Support, please provide specific details of your problem, including:

- The Intel(R) MPI Library package name and version information
- Host architecture (for example, Intel(R) 64 architecture)
- Compiler(s) and versions
- Operating system(s) and versions
- Specifics on how to reproduce the problem. Include makefiles, command lines, small test cases, and build instructions. Use <installdir>/test sources as test cases, when possible.

You can obtain version information for the Intel(R) MPI Library package in the file mpisupport.txt.

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### Submitting Issues

- 
- Go to <https://premier.intel.com>
  - Log in to the site. Note that your username and password are case-sensitive.
  - Click on the "Submit Issue" link in the left navigation bar.
  - Choose "Development Environment (tools, SDV, EAP)" from the "Product Type" drop-down list. If this is a software or license-related issue, choose the "Intel(R) MPI Library, Linux\*" from the "Product Name" drop-down list.
  - Enter your question and complete the fields in the windows that follow to successfully submit the issue.

Note: Notify your support representative prior to submitting source code where access needs to be restricted to certain countries to determine if this request can be accommodated.

### Copyright and Licenses

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The Intel(R) MPI Library is based on MPICH2\* from Argonne National Laboratory\* (ANL) and MVAPICH2\* from Ohio State University\* (OSU).

See the information below for additional licenses of the following third party tools used within the Intel(R) MPI Library:  
Silicon Graphics Inc.\* STL, libc, gdf, BOOST\*, my\_getopt, Python\*, AVL Trees\*, Direct Access Programming Library, InfiniBand Verbs Library, and libnuma\*.

#### Silicon Graphics, Inc.\* Standard Template Library

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```
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*
*/
```

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-----

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```

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* LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY
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*/
```

gdf

----

/\*\*

```
* This is copy of the code which implements the GFD(32) hashing of datatypes
* described in this paper:
*
* Julien Langou, George Bosilca, Graham Fagg and Jack Dongarra (2005).
* Hash functions for MPI datatypes.
* In the Proceedings of the 12th European PVM/MPI Users' Group Meeting, Sorrento,
* Italy, September 2005.
* Springer's Lecture Notes in Computer Science, LCNS-3666:76-83, 2005.
* related software.
*
* http://www.cs.utk.edu/~library/TechReports/2005/ut-cs-05-552.pdf
* http://www.cs.utk.edu/~langou/articles/LBFD:05/2005-LBFD.html
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my\_getopt

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my\_getopt - a command-line argument parser

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Python\*

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AVL Trees\*

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The Intel MPI library includes altered AVL Trees\* source codes.

Direct Access Programming Library (DAPL)

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InfiniBand Verbs Library

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