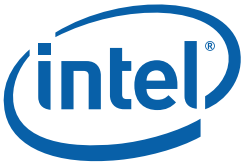

Intel® MPI Library for Linux* OS

Reference Manual

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Contents

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Notice revision #20110804

Revision History

Document Number	Revision Number	Description	Revision Date
315399-001	3.1 Beta	Some new options and variables were added, three new sections “Statistics Gathering Mode”, “Unified Memory Management”, and “Integration into Eclipse* PTP” were created	/07/10/2007
315399-002	3.1	New names of variables were added, new section “Processor Information Utility” was added. Updated and reviewed for style	/10/02/2007
315399-003	3.1 build 038	Local options were added. Sections “Index”, “Glossary”, “Process Identification”, and “Interoperability with OpenMP*” were added	/03/05/2008
315399-004	3.2	Sections “Process pinning”, “Automatic Tuning Utility”, and “Statistic Gathering Mode” were updated	/09/05/2008
315399-005	3.2 Update 1	Section “ILP64 Support” was added, section “Interoperability with OpenMP*” was updated	/03/04/2009
315399-006	4.0 Engineering Preview	Sections “Processor Information Utility”, “Automatic Tuning Utility”, and “Device Control” were updated	/06/24/2009
315399-007	4.0 Beta	Sections “Processor Information Utility”, “Fabrics Control”, “Statistics Gathering Mode”, and “ILP64 Support” were updated. Section “Fault Tolerance” was added	/11/03/2009
315399-008	4.0	Sections “Fabrics Control”, “Environment Variables”, and “Job Startup Command” were updated. Sections “Experimental Scalable Process Management System (Hydra) “and “Dynamic Process Support” were added.	/02/16/2010
315399-009	4.0 Update 1	Sections “Compiler Command Options”, “Scalable Process Management System (Hydra)”, “Job Startup Commands”, “Multipurpose Daemon Commands”, “Environment Variables”, “Process Pinning”, “Tuning Reference”, “Shared Memory Control”, “TCP-capable Network Fabrics Control” and “Disclaimer and Legal Notices” were updated.	/09/23/2010
315399-010	4.0 Update 2	Section “Disclaimer and Legal Notices” was updated.	/04/11/2011
315399-011	4.0 Update 3	Sections “Simplified Job Startup Command”, “Scalable Process Management System (Hydra) Commands”, “Job Startup Commands”, “Processor Information Utility”, “Automatic Tuning Utility”, “Fabrics Control”, “Collective Operation Control”, and “Statistics Gathering Mode” were updated. Sections “Cleaning up Utility”, “Extended Device Control Options”, and “IPM Statistics Format” were added.	/08/31/2011

1 About this Document

This *Reference Manual* provides you with a complete command and tuning reference for the Intel® MPI Library.

The Intel® MPI Library is a multi-fabric message passing library that implements the MessagePassing Interface, v2 (MPI-2) specification. It provides a standard library across Intel® platforms that enable adoption of MPI-2 functions as their needs dictate.

The Intel® MPI Library enables developers to change or to upgrade processors and interconnects as new technology becomes available without changes to the software or to the operating environment.

The library is provided in the following kits:

- *The Intel® MPI Library Runtime Environment* (RTO) has the tools you need to run programs, including multipurpose daemon* (MPD) and supporting utilities, shared (.so) libraries, and documentation.
- *The Intel® MPI Library Development Kit* (SDK) includes all of the Runtime Environment components plus compilation tools, including compiler commands such as `mpiicc`, include files and modules, static (.a) libraries, debug libraries, trace libraries, and test codes.

1.1 Intended Audience

This *Reference Manual* helps an experienced user understand the full functionality of the Intel® MPI Library.

1.2 Using Doc Type Field

This *Reference Manual* contains the following sections

Table 1.2-1 Document Organization

Section	Description
Section 1 About this Document	Section 1 introduces this document
Section 2 Command Reference	Section 2 describes options and environment variables for compiler commands, job startup commands, and MPD daemon commands as well
Section 3 Tuning Reference	Section 3 describes environment variables used to influence program behavior and performance at run time
Section 4 Statistics Gathering Mode	Section 4 describes how to obtain statistics of MPI communication operations
Section 5 ILP64 Support	Section 5 describes support provided for the ILP64 programming model
Section 6 Unified Memory Management	Section 6 describes the unified memory management subsystem (`i_malloc`)
Section 7 Integration into Eclipse* PTP	Section 7 describes the procedure for integration into Eclipse* Parallel Tools Platform
Section 8 Glossary	Section 8 explains basic terms used in this document

Section 9 Index	Section 9 references options and environment variables names

1.3 Conventions and Symbols

The following conventions are used in this document.

Table 1.3-1 Conventions and Symbols used in this Document

This type style	Document or product names
This type style	Hyperlinks
`This type style`	Commands, arguments, options, file names
`THIS_TYPE_STYLE`	Environment variables
`<this type style>`	Placeholders for actual values
`[ items ]`	Optional items
`{ item | item }`	Selectable items separated by vertical bar(s)
(SDK only)	For Software Development Kit (SDK) users only
`parameter`	Parameter name

1.4 Related Information

The following related documents that might be useful to the user:

Product Web Site

Intel® MPI Library Support

Intel® Cluster Tools Products

Intel® Software Development Products

2 Command Reference

2.1 Compiler Commands

(SDK only)

The following table lists available MPI compiler commands and the underlying compilers, compiler families, languages, and application binary interfaces (ABIs) that they support.

Table 2.1-1 The Intel® MPI Library Compiler Drivers

Compiler Command	Default Compiler	Supported Language(s)	Supported ABI(s)
Generic Compilers			
mpicc	gcc, cc	C	32/64 bit
mpicxx	g++	C/C++	32/64 bit
mpifc	gfortran	Fortran77*/Fortran 95*	32/64 bit
GNU* Compilers Versions 3 and Higher			
mpigcc	gcc	C	32/64 bit
mpigxx	g++	C/C++	32/64 bit
mpif77	g77	Fortran 77	32/64 bit
mpif90	gfortran	Fortran 95	32/64 bit
Intel® Fortran, C++ Compilers Versions 10.0, 10.1, 11.0, 11.1 and Higher			
mpiicc	icc	C	32/64 bit
mpiicpc	icpc	C++	32/64 bit
mpiifort	ifort	Fortran77/Fortran 95	32/64 bit

- Compiler commands are available only in the Intel® MPI Library Development Kit.
- Compiler commands are in the *<installdir>/<arch>*/bin directory. Where *<installdir>* refers to the Intel® MPI Library installation directory and *<arch>* is one of the following architectures:
  - ia32 – IA-32 architecture binaries
  - intel64 – Intel® 64 architecture binaries
- Ensure that the corresponding underlying compilers (32-bit or 64-bit, as appropriate) are already in your PATH.
- To port existing MPI-enabled applications to the Intel® MPI Library, recompile all sources.
- To display mini-help of a compiler command, execute it without any parameters.

2.1.1 Compiler Command Options

-mt_mpi

Use this option to link the thread safe version of the Intel® MPI library at the following levels: MPI_THREAD_FUNNELED, MPI_THREAD_SERIALIZED, or MPI_THREAD_MULTIPLE.

The MPI_THREAD_FUNNELED level is provided by default by the thread safe version of the Intel® MPI library.

NOTE: If you specify either the -openmp or the -parallel options for the Intel® C Compiler, the thread safe version of the library is used.

NOTE: If you specify one of the following options for the Intel® Fortran Compiler, the thread safe version of the library is used:

- -openmp
- -parallel
- -threads
- -reentrancy
- -reentrancy threaded

-static_mpi

Use this option to link the Intel® MPI library statically. This option does not affect the default linkage method for other libraries.

-static

Use this option to link the Intel® MPI library statically. This option is passed to a compiler.

-config=<*name*>

Use this option to source the configuration file. See *Configuration Files* for details.

-profile=<*profile_name*>

Use this option to specify an MPI profiling library. The profiling library is selected using one of the following methods:

- Through the configuration file *<profile_name>*.conf located in the *<installdir>*/*<arch>*/etc. See *Profiles* for details.
- In the absence of the respective configuration file, by linking the library lib*<profile_name>*.so or lib*<profile_name>*.a located in the same directory as the Intel® MPI Library.

-t or -trace

Use the -t or -trace option to link the resulting executable against the Intel® Trace Collector library. This has the same effect as if -profile=vt is used as an argument to mpiicc or another compiler script.

Use the -t=log or -trace=log option to link the resulting executable against the logging Intel® MPI Library and the Intel® Trace Collector libraries. The logging libraries trace internal Intel® MPI Library states in addition to the usual MPI function calls.

To use this option, include the installation path of the Intel® Trace Collector in the VT_ROOT environment variable. Set I_MPI_TRACE_PROFILE to the *<profile_name>* environment variable to specify another profiling library. For example, set I_MPI_TRACE_PROFILE to vtfs to link against the fail-safe version of the Intel® Trace Collector.

-check_mpi

Use this option to link the resulting executable against the Intel® Trace Collector correctness checking library. This has the same effect as if `-profile=vtmc` is used as an argument to `mpiicc` or another compiler script.

To use this option, include the installation path of the Intel® Trace Collector in the `VT_ROOT` environment variable. Set `I_MPI_CHECK_PROFILE` to the *<profile_name>* environment variable to specify another checking library.

-ilp64

Use this option to enable ILP64 support. All integer arguments of the Intel MPI Library are treated as 64-bits values in this case.

NOTE: If you specify the `-i8` option for the Intel® Fortran Compiler, you still have to use the ILP64 option for linkage. See *ILP64 Support* for details.

-dynamic_log

Use this option in combination with the `-t` option to link in the Intel® Trace Collector library dynamically. This option does not affect the default linkage method for other libraries.

To run the resulting programs, include `$VT_ROOT/slib` in the `LD_LIBRARY_PATH` environment variable.

-g

Use this option to compile a program in debug mode and link the resulting executable against the debugging version of the Intel® MPI Library. See *Environment variables*, `I_MPI_DEBUG` for information on how to use additional debugging features with the `-g` builds.

-O

Use this option to enable optimization.

-fast

Use this Intel compiler option to maximize speed across the entire program. This option forces static linkage method for the Intel® MPI Library.

For implications on non-Intel processors, refer to the xHost documentation.

NOTE: It works for `mpiicc`, `mpiicpc`, and `mpiifort` Intel compiler drivers only.

-echo

Use this option to display everything that the command script does.

-show

Use this option to learn how the underlying compiler is invoked. For example, use the following command to see the required compiler flags and options:

```
$ mpiicc -show -c test.c
```

Use the following command to see the required link flags, options, and libraries:

```
$ mpiicc -show -o a.out test.o
```

This is particularly useful for determining the command line for a complex build procedure that directly uses the underlying compilers.

-{cc,cxx,fc,f77,f90}=<*compiler*>

Use this option to select the underlying compiler.

For example, use the following command to select the Intel® C++ Compiler:

```
$ mpicc -cc=icc -c test.c
```

Make sure `icc` is in your path. Alternatively, you can specify the full path to the compiler.

-gcc-version=<*nnn*>

Use this option for compiler drivers `mpicxx` and `mpiicpc` when linking an application running in a particular GNU* C++ environment. The valid `<nnn>` values are:

<*nnn*> value	GNU* C++ version
320	3.2.x
330	3.3.x
340	3.4.x
400	4.0.x
410	4.1.x
420	4.2.x
430	4.3.x

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

-compchk

Use this option to enable compiler setup checks. In this case, each compiler driver performs checks to ensure that the appropriate underlying compiler is set up correctly.

-v

Use this option to print the compiler driver script version and its native compiler version.

2.1.2 Configuration Files

You can create compiler configuration files using the following file naming convention:

```
<installdir>/<arch>/etc/mpi<compiler>-<name>.conf
```

where:

`<arch>` = {ia32,intel64} for the IA-32, and the Intel® 64 architectures

`<compiler>` = {cc,cxx,f77,f90}, depending on the language being compiled

`<name>` = name of underlying compiler with spaces replaced by hyphens

For example, the `<name>` value for `cc -64` is `cc--64`

Before compiling or linking to enable changes to the environment on a per compiler command basis, source these files or use the `-config` option, if it exists.

2.1.3 Profiles

You can select a profile library through the `-profile` option of the Intel® MPI Library compiler drivers. The profile files are located in the `<installdir>/<arch>/etc` directory. The Intel® MPI Library comes with several predefined profiles for the Intel® Trace Collector:

`<installdir>/etc/vt.conf` - regular Intel® Trace Collector library

`<installdir>/etc/vtfs.conf` - fail-safe Intel® Trace Collector library

`<installdir>/etc/vtmc.conf` – correctness checking Intel® Trace Collector library

You can also create your own profile as `<profile_name>.conf`

The following environment variables can be defined there:

`PROFILE_PRELIB` - libraries (and paths) to include before the Intel® MPI Library

`PROFILE_POSTLIB` - libraries to include after the Intel® MPI Library

`PROFILE_INCPATHS` - C preprocessor arguments for any include files

For instance, create a file `/myprof.conf` with the following lines:

```
PROFILE_PRELIB="-L<path_to_myprof>/lib -lmyprof"
PROFILE_INCPATHS="-I<paths_to_myprof>/include"
```

Use the command-line argument `-profile=myprof` for the relevant compile driver to select this new profile.

2.1.4 Environment Variables

I_MPI_{CC,CXX,FC,F77,F90}_PROFILE

(MPI{CC,CXX,FC,F77,F90}_PROFILE)

Specify a default profiling library.

Syntax

`I_MPI_{CC,CXX,FC,F77,F90}_PROFILE=<profile_name>`

Deprecated Syntax

`MPI{CC,CXX,FC,F77,F90}_PROFILE=<profile_name>`

Arguments

`<profile_name>`	Specify a default profiling library

Description

Set this environment variable to select a specific MPI profiling library to be used by default. This has the same effect as if `-profile=<profile_name>` were used as an argument to `mpiicc` or another Intel® MPI Library compiler driver.

I_MPI_TRACE_PROFILE

Specify a default profile for the `-trace` option.

Syntax

I_MPI_TRACE_PROFILE=<profile_name>

Arguments

<profile_name>	Specify a tracing profile name. The default value is vt

Description

Set this environment variable to select a specific MPI profiling library to be used with the -trace option to mpiicc or another Intel® MPI Library compiler driver.

The I_MPI_{CC,CXX,F77,F90}_PROFILE environment variable overrides I_MPI_TRACE_PROFILE.

I_MPI_CHECK_PROFILE

Specify a default profile for the -check_mpi option.

Syntax

I_MPI_CHECK_PROFILE=<profile_name>

Arguments

<profile_name>	Specify a checking profile name. The default value is vtmc

Description

Set this environment variable to select a specific MPI checking library to be used with the -check_mpi option to mpiicc or another Intel® MPI Library compiler driver.

The I_MPI_{CC,CXX,F77,F90}_PROFILE environment variable overrides I_MPI_CHECK_PROFILE.

I_MPI_CHECK_COMPILER

Turn on/off compiler compatibility check.

Syntax

I_MPI_CHECK_COMPILER=<arg>

Arguments

<arg>	Binary indicator
enable | yes | on | 1	Enable checking the compiler
disable | no | off | 0	Disable checking the compiler. This is the default value

Description

If I_MPI_CHECK_COMPILER is set to enable, the Intel MPI compiler drivers check the underlying compiler for compatibility. Normal compilation will be performed only if known version of underlying compiler is used.

I_MPI_{CC,CXX,FC,F77,F90}

(MPICH_{CC,CXX,FC,F77,F90})

Set the path/name of the underlying compiler to be used.

Syntax

I_MPI_{CC,CXX,FC,F77,F90}=<compiler>

Deprecated Syntax

`MPICH_{CC,CXX,FC,F77,F90}=<compiler>`

Arguments

<compiler>	Specify the full path/name of compiler to be used

Description

Set this environment variable to select a specific compiler to be used. Specify the full path to the compiler if it is not located in the search path.

NOTE: Some compilers may require additional command line options.

NOTE: The configuration file is sourced if it exists for a specified compiler. See *Configuration Files* for details.

I_MPI_ROOT

Set the Intel® MPI Library installation directory path.

Syntax

`I_MPI_ROOT=<path>`

Arguments

<path>	Specify the installation directory of the Intel® MPI Library

Description

Set this environment variable to specify the installation directory of the Intel® MPI Library.

VT_ROOT

Set Intel® Trace Collector installation directory path.

Syntax

`VT_ROOT=<path>`

Arguments

<path>	Specify the installation directory of the Intel® Trace Collector

Description

Set this environment variable to specify the installation directory of the Intel® Trace Collector.

I_MPI_COMPILER_CONFIG_DIR

Set the location of the compiler configuration files.

Syntax

`I_MPI_COMPILER_CONFIG_DIR=<path>`

Arguments

<path>	Specify the location of the compiler configuration files. The default value is *<installdir>*`/`*<arch>*`/etc`

Description

Set this environment variable to change the default location of the compiler configuration files.

2.2 Simplified Job Startup Command

mpirun

Syntax

`mpirun <options>`

where *<options> := <mpiexec.hydra options> | [<mpdboot options>] <mpiexec options>*

Arguments

<mpiexec.hydra options>	`mpiexec.hydra` options as described below. This is the default operation mode.
<mpdboot options>	`mpdboot` options as described in the `mpdboot` command description below, except `-n`
<mpiexec options>	`mpiexec` options as described in the `mpiexec` section above

Description

Use this command to launch an MPI job. The `mpirun` command uses `Hydra` or `MPD` as underlying process managers. `Hydra` is the default process manager. Set the `I_MPI_PROCESS_MANAGER` environment variable to change the default value.

The `mpirun` command detects if the MPI job is submitted in a session allocated using a job scheduler like Torque*, PBS Pro*, OpenPBS*, LSF*, Parallelnavi* NQS*, SLURM*, Sun* Grid Engine*, or LoadLeveler*. In this case, the `mpirun` command extracts the host list from the respective environment and uses these nodes automatically according to the above scheme.

In this case, you do not need to create the `mpd.hosts` file. Allocate the session you need by using the particular job scheduler installed on your system, and use the `mpirun` command inside this session to run your MPI job.

When under batch system control, the `mpirun` command ignores the `-r | --rsh` option if `Hydra` is used as the underlying process manager. In this case, the corresponding bootstrap server is used. Use bootstrap specific options or corresponding environment variables explicitly to override the auto detected bootstrap server.

The `mpirun` command silently ignores the `MPD` specific options for compatibility reasons if you select `Hydra` as the active process manager. The following table provides the list of silently ignored and unsupported options. Avoid the usage of unsupported options if the `Hydra` process manager is used.

Ignored mpdboot Options	Ignored mpiexec Options	Unsupported mpdboot Options	Unsupported mpiexec Options
`--loccons`	`-[g]envuser`	`--user=<user> | -u <user>`	`-a`
`--remcons`	`-[g]envexcl`	`--mpd=<mpdcmd> | -m <mpdcmd>`	
`--ordered | -o`	`-m`	`--shell | -s`	
`--maxbranch=<maxbranch> | -b <maxbranch>`	`-ifhn <interface/hostname>`	`-1`	
`--parallel-startup | -p`	`-ecfn <filename>`	`--ncpus=<ncpus>`	

Ignored mpdboot Options	Ignored mpiexec Options	Unsupported mpdboot Options	Unsupported mpiexec Options
	-tvsu		

If you select MPD as the process manager, the mpirun command starts an independent ring of mpd daemons, launch an MPI job, and shut down the mpd ring upon job termination.

The first non mpdboot option (including -n or -np) delimits the mpdboot and mpiexec options. All options up to this point, excluding the delimiting option, are passed to the mpdboot command. All options from this point on, including the delimiting option, are passed to the mpiexec command.

All configuration files and environment variables applicable to the mpdboot and mpiexec commands are also pertinent to mpirun.

The set of hosts is defined by the following rules, which are checked in this order:

1. All host names from the mpdboot host file (either mpd.hosts or the file specified by the -f option).
2. All host names returned by the mpdtrace command, if there is an mpd ring running.
3. Local host (a warning is issued in this case).

I_MPI_MPIRUN_CLEANUP

Control the environment cleanup.

Syntax

I_MPI_MPIRUN_CLEANUP=<*value*>

Arguments

<*value*>	Define the option
enable | yes | on | 1	Enable the environment cleanup
disable | no | off | 0	Disable the environment cleanup. This is the default value

Description

Use this environment variable to define whether to clean up the environment upon the mpirun completion.

I_MPI_PROCESS_MANAGER

Select a process manager to be used by the mpirun command.

Syntax

I_MPI_PROCESS_MANAGER=<*value*>

Arguments

<*value*>	String value
hydra	Use Hydra process manager. This is the default value
mpd	Use MPD process manager

Description

Set this environment variable to select the process manager to be used by the mpirun command.

NOTE: You can run each process manager directly by invoking the mpiexec command for MPD and the mpiexec.hydra command for Hydra.

2.3 Scalable Process Management System (Hydra) Commands

mpiexec.hydra

The `mpiexec.hydra` is a more scalable alternative to the MPD process manager.

Syntax

```
mpiexec.hydra <g-options> <l-options> <executable>
```

or

```
mpiexec.hydra <g-options> <l-options> <executable1> : \
<l-options> <executable2>
```

Arguments

<g-options>	Global options that apply to all MPI processes
<l-options>	Local options that apply to a single arg-set
<executable>	`./a.out` or `path/name` of the executable file

Description

Use the `mpiexec.hydra` utility to run MPI applications without the MPD ring.

By using the first command-line syntax, you can start all MPI processes of the *<executable>* with the single arg-set. For example, the following command executes `a.out` over the specified *<# of processes>*:

```
$ mpiexec.hydra -f <hostsfile> –n <# of processes> ./a.out
```

<hostsfile> is the path/name of the file that has the list of machine names on which the application to run.

By using the second command-line syntax, you can start several MPI programs (or the same) with different arg-sets. For example, the following command executes two different binaries with different arg-sets:

```
$ mpiexec.hydra -f hosts.file –env <VAR1> <VAL1> –n 2 ./a.out : \
            -env <VAR2> <VAL2> -n 2 ./b.out
```

NOTE: If there is no "**.**" in the `PATH` environment variable on all nodes in the cluster, specify *<executable>* as `./a.out` instead of `a.out`.

2.3.1 Global Options

-hostfile <*hostfile*> or -f <*hostsfile*>

Use this option to specify machine names to run an application on. If a machine name is repeated, this name is used only once.

See also the *I_MPI_HYDRA_HOST_FILE* for more details.

NOTE: Use *–perhost*, *-rr* options to change the processes allocation on the cluster nodes.

-machinefile <*machine file*> or –machine <*machine file*>

Use this option to control the process placement through the <*machine file*>. The total number of processes to start is controlled by the –n option as usual.

See *–machinefile* option for more details.

-genv <*ENVVAR*> <*value*>

Use this option to set the <*ENVVAR*> environment variable to the specified <*value*> for all MPI processes.

-genvall

Use this option to enable propagation of all environment variables to all MPI processes.

-genvnone

Use this option to suppress propagation of any environment variables to any MPI processes.

-genvlist <*list of genv var names*>

Use this option to pass a list of environment variables with their current values. <*list of genv var names*> is a comma separated list of environment variables to be sent to the processes.

-pmi-connect <*mode*>

Use this option to choose the PMI message caching mode. Possible values are:

- nocache – do not cache PMI messages.
- cache – cache PMI messages on local pmi_proxy management processes to minimize PMI requests. Cached information is propagated to the child management processes.
- lazy-cache – cache mode without propagation of the PMI information.

The lazy-cache mode is the default mode.

See *I_MPI_HYDRA_PMI_CONNECT* for more details.

-perhost <*# of processes* >, -ppn <*# of processes* >, or -grr <*# of processes*>

Use this option to place the indicated number of consecutive MPI processes on every host in group round robin fashion. See *I_MPI_PERHOST* for more details.

-rr

Use this option to place consecutive MPI processes on different hosts in round robin fashion. This option is equivalent to –perhost 1. See *I_MPI_PERHOST* for more details.

(SDK only) -trace [<*profiling_library*>] or -t [<*profiling_library*>]

Use this option to profile your MPI application using the indicated <*profiling_library*>. If the <*profiling_library*> is not mentioned, the default profiling library libVT.so is used.

Set the *I_MPI_JOB_TRACE_LIBS* environment variable to override the default profiling library.

(SDK only) –check_mpi [<*checking_library*>]

Use this option to check your MPI application using the indicated <*checking_library*>. If <*checking_library*> is not mentioned, the default checking library libVTmc.so is used.

Set the *I_MPI_JOB_CHECK_LIBS* environment variable to override the default checking library.

-configfile <*filename*>

Use this option to specify the file <*filename*> that contains command-line options. Blank lines and lines that start with '#' as the first character are ignored.

-branch-count <*num*>

Use this option to restrict the number of child management processes launched by the mpiexec.hydra command or each pmi_proxy management process.

See I_MPI_HYDRA_BRANCH_COUNT for more details.

-pmi-aggregate or -pmi-noaggregate

Use this option to switch on or off, respectively, the aggregation of the PMI requests. The default value is -pmi-aggregate, which means the aggregation is enabled by default.

See I_MPI_HYDRA_PMI_AGGREGATE for more details.

-tv

Use this option to run <*executable*> under the TotalView* debugger. For example:

```
$ mpiexec.hydra -tv -n <# of processes> <executable>
```

See Environment Variables for information on how to select the TotalView* executable file.

NOTE: Set the value of the TVDSVRLAUNCHCMD environment variable to ssh because the TotalView* uses rsh by default.

NOTE: The TotalView* debugger can display message queue state of your MPI program. To enable this feature, do the following steps:

1. Run your <*executable*> with the -tv option.

   ```
   $ mpiexec.hydra-tv -n <# of processes> <executable>
   ```

2. Answer Yes to the question about stopping the mpiexec.hydra job.

To display the internal state of the MPI library textually, select the **Tools** > **Message Queue** command. If you select the **Process Window Tools** > **Message Queue Graph** command, the TotalView* environment variable displays a window that shows a graph of the current message queue state. For more information, see the TotalView* environment variable.

-tva <*pid*>

Use this option to attach the TotalView* debugger to an existing Intel® MPI job. Use the mpiexec.hydra process id as <*pid*>. For example:

```
$ mpiexec.hydra -tva <pid>
```

-idb

Use this option to run <*executable*> under the Intel® Debugger. For example:

```
$ mpiexec.hydra -idb -n <# of processes> <executable>
```

Include the installation path of the Intel® Debugger in the IDB_HOME environment variable.

By default, the Intel® Debugger runs in an Xterm terminal window. See the I_MPI_HYDRA_IDB_TERMINAL environment variable for information on how to select terminal for Intel® Debugger.

-idba <pid>

Use this option to attach the Intel® Debugger to an existing MPI job. Use the mpiexec.hydra process id as <pid>. For example:

```
$ mpiexec.hydra -idba <pid>
```

-gdb

Use this option to run <executable> under the GNU* debugger. For example:

```
$ mpiexec.hydra-gdb -n <# of processes> <executable>
```

-gdba <pid>

Use this option to attach the GNU* debugger to the existing Intel® MPI job. For example:

```
$ mpiexec.hydra-gdba <pid>
```

-nolocal

Use this option to avoid running <executable> on the host where the mpiexec.hydra is launched. You can use this option on clusters that deploy a dedicated master node for starting the MPI jobs and a set of dedicated compute nodes for running the actual MPI processes.

-hosts <nodelist>

Use this option to specify a particular <nodelist> on which the MPI processes are to be run. For example, the following commands run the executable a.out on hosts host1 and host2:

```
$ mpiexec.hydra-n 2 -hosts host1,host2 ./a.out
```

NOTE: If <nodelist> consists of only one node, this option is interpreted as a local option. See Local Options for details.

-iface <interface>

Use this option to choose the appropriate network interface. For example, if the IP emulation of your InfiniBand* network is configured on ib0, you can use -iface ib0.

See *I_MPI_HYDRA_IFACE* for more details.

-demux <mode>

Use this option to set poll or select polling mode for multiple I/O. The default is poll.

See *I_MPI_HYDRA_DEMUX* for more details.

-enable-x or -disable-x

Use this option to control the Xlib traffic forwarding. The default value is -disable-x, which means the Xlib traffic will not be forwarded.

-l

Use this option to insert the MPI process rank at the beginning of all lines written to the standard output.

-tune [<arg >]

where:

<arg> = {<dir_name>, <configuration_file>}.

Use this option to optimize the Intel® MPI Library performance through using the data collected by the `mpitune` utility.

If *<arg>* is not specified, the best-fit tune options are selected for the given configuration. The default location of the configuration file is *<installdir>*`/`*<arch>*`/etc` directory. You can override this default location by explicitly stating: *<arg>*`=`*<dir_name>*. The provided configuration file is used if you set *<arg>*`=`*<configuration_file>*.

-s <*spec*>

Use this option to direct standard input to the specified MPI processes.

Arguments

<spec>	Define MPI process ranks
`all`	Use all processes
<l>`,`*<m>*`,`*<n>*	Specify an exact list and use processes *<l>*, *<m>* and *<n>* only. The default value is zero
<k>`,`*<l>*`-`*<m>*`,`*<n>*	Specify a range and use processes *<k>*, *<l>* through *<m>*, and *<n>*

-noconf

Use this option to disable processing of the `mpiexec.hydra` configuration files described in *Configuration Files*.

-ordered-output

Use this option to avoid intermingling of data output from the MPI processes. This option affects both the standard output and the standard error streams.

NOTE: To use this option, end the last line output by each process with the end-of-line (`'\n'`) character. Otherwise the application may stop responding.

-path <*directory*>

Use this option to specify the path to *<executable>* .

-cleanup

Use this option to create a temporary file containing information about the launched processes. The file name is `mpiexec_${username}_$PPID.log`, where `PPID` is a parent process `PID`. This file is created in the temporary directory selected by the *-tmpdir* option. This file is used by the `mpicleanup` utility. If a job terminates successfully, the `mpiexec.hydra` command automatically removes this file.

See *I_MPI_HYDRA_CLEANUP* for more details.

-tmpdir

Use this option to set a directory for temporary files.

See *I_MPI_TMPDIR* for more details.

-version or -V

Use this option to display the version of the Intel® MPI Library.

2.3.1.1 Bootstrap Options

-bootstrap <*bootstrap server*>

Use this option to select a built-in bootstrap server to use. A bootstrap server is the basic remote node access mechanism that is provided on any system. Hydra supports multiple runtime bootstrap servers such as `ssh, rsh, fork, slurm, ll, lsf, sge,` and `jmi` to launch processes. The default bootstrap server is `ssh`. By setting `slurm`, `ll`, `lsf`, or `sge`, you use the corresponding `srun`, `llspawn.stdio`, `blaunch`, and `qrsh` internal job scheduler utilities to launch service processes under a particular job scheduler.

To enable the tight integration with SLURM*, use the `jmi` bootstrap server. Tight integration provides registering processes identifiers to job schedulers. These identifiers count used resources by a particular job and cleanup the nodes if a job termination occurs.

See the *-bootstrap jmi* description and the *I_MPI_HYDRA_BOOTSTRAP* environment variable for details.

-bootstrap-exec <*bootstrap server*>

Use this option to set the executable to be used as a bootstrap server. Possible values are `ssh, rsh, fork,` and `slurm`. The default bootstrap server is `ssh`. For example:

```
$ mpiexec.hydra -bootstrap ssh –bootstrap-exec /usr/bin/ssh \
-f hosts.file –env <VAR1> <VAL1> –n 2 ./a.out
```

See *I_MPI_HYDRA_BOOTSTRAP* for more details.

-bootstrap jmi

Use this option to enable tight integration with SLURM* job schedulers. The tight integration is implemented by using particular job scheduler API or utility. If you specify this option, the default `libjmi.so` library is loaded. You can overwrite the default library name through the `I_MPI_HYDRA_JMI_LIBRARY` environment variable.

See *I_MPI_HYDRA_JMI_LIBRARY* for more details.

2.3.1.2 Binding Options

-binding

Use this option to pin MPI processes to a particular CPU and avoid undesired process migration. In the following syntax, the quotes may be omitted for one-member list. Each parameter is responsible for a single pinning property.

This option is available for both Intel® and non-Intel microprocessors, but it may perform additional optimizations for Intel microprocessors than it performs for non-Intel microprocessors.

Syntax

`-binding "<parameter>=<value>[;<parameter>=<value> …]"`

Parameters

pin	Pinning switch
`enable | yes | on | 1`	Turn on the pinning property. This is the default value

disable | no | off | 0	Turn off the pinning property

cell	Pinning resolution power
unit	Basic processor unit (logical CPU)
core	Processor core in multi-core system

map	Determined mapping
spread	The processes are mapped consecutively to separate processor cells. Thus, the processes do not share the common resources by the adjacent cells.
scatter	The processes are mapped to separate processor cells. Adjacent processes are mapped on the cells that are the most remote according to multi-core topology.
bunch	The processes are mapped to separate processor cells by #processes/#sockets processes per socket. Each socket processor portion is a set of the cells that are the closest according to multi-core topology.
p0,p1,…,pn	The processes are mapped on the separate processors in the way that the processors are specified in the p0,p1,…,pn list: ith process is mapped on pi processor pi is one of the following values: alone processor number like n, range of processor numbers like n-m, -1 The -1 value means no pinning for corresponding process.
[m0,m1,…,mn]	i^{th} process is mapped on the processor subset that is defined by m_i hexadecimal mask using the following rule: jth processor is included into m_i subset if j^{th} bit of m_i equals to 1.

domain	Processor domain set on a node
cell	Each domain of the set is a single processor cell (unit or core)
core	Each domain of the set consists of the processor cells that share a particular core.
cache1	Each domain of the set consists of the processor cells that share a particular level 1 cache.
cache2	Each domain of the set consists of the processor cells that share a particular level 2 cache.
cache3	Each domain of the set consists of the processor cells that share a particular level 3 cache.

cache	The set whose elements are the largest domains among cache1, cache2, and cache3
socket	Each domain of the set consists of the processor cells that are located on a particular socket.
node	All processor cells on a node are arranged into a single domain.
<size>[:<layout>]	Each domain of the set consists of *<size>* processor cells. *<size>* may have the following values: auto – domain size = #cells/#processes omp – domain size = OMP_NUM_THREADS environment variable value positive integer – exact value of domain size Domain size is limited by the node size. Each member location inside the domain is defined by the optional *<layout>* parameter value: compact – as close with others as possible according to multi-core topology scatter - as far away from others as possible according to multi-core topology range – by BIOS numbering of processors If *<layout>* parameter is omitted, compact is assumed as the value of *<layout>*.

order	Linear ordering of the domains
compact	Order the domain set so that adjacent domains are the closest according to multi-core topology
scatter	Order the domain set so that adjacent domains are the most remote according to multi-core topology
range	Order the domain set according to processor BIOS numbering

offset	Domain list offset
<n>	Integer number that indicates the starting domain among the linear ordered domains. This domain gets zero number. The numbers of other domains will be cyclic shifted conformably

2.3.1.3 Communication Subsystem Options

-rmk *<RMK>*

Use this option to select resource management kernel to be used. Intel® MPI Library only supports pbs.

See *I_MPI_HYDRA_RMK* for more details.

2.3.1.4 Other Options

-verbose

Use this option to print debug information from mpiexec.hydra, such as:

- Service processes arguments
- Environment variables and arguments passed to start an application
- PMI requests/responses during a job life cycle

See I_MPI_HYDRA_DEBUG for more details.

-print-rank-map

Use this option to print rank mapping.

-print-all-exitcodes

Use this option to print exit codes of all processes.

2.3.2 Local Options

-n <*# of processes*> or -np <*# of processes*>

Use this option to set the number of MPI processes to run with the current arg-set.

-env <*ENVVAR*> <*value*>

Use this option to set the `<ENVVAR>` environment variable to the specified `<value>` for all MPI processes in the current arg-set.

-envall

Use this option to propagate all environment variables in the current environment.

See I_MPI_HYDRA_ENV for more details.

-envnone

Use this option to suppress propagation of any environment variables to the MPI processes in the current arg-set.

-envlist <*list of env var names*>

Use this option to pass a list of environment variables with their current values. `<list of env var names>` is a comma separated list of environment variables to be sent to the processes.

-host <*nodename*>

Use this option to specify a particular `<nodename>` on which the MPI processes are to be run. For example, the following command executes `a.out` on hosts `host1` and `host2`:

```
$ mpiexec.hydra-n 2 -hosts host1 ./a.out : -n 2 -hosts host2 ./a.out
```

-path <*directory*>

Use this option to specify the path to `<executable>` to be run in the current arg-set.

-wdir <*directory*>

Use this option to specify the working directory in which `<executable>` runs in the current arg-set.

-umask <*umask*>

Use this option to perform the `umask <umask>` command for the remote process.

2.3.3 Extended Device Control Options

-rdma

Use this option to select an RDMA-capable network fabric for inter-nodes communication. The application attempts to use first available RDMA-capable network fabric from the list `dapl` or `ofa`. If no such fabric is available, other fabrics from the list `tcp` or `tmi` are used. This option is equivalent to the `-genv I_MPI_FABRICS_LIST dapl,ofa,tcp,tmi -genv I_MPI_FALLBACK 1` setting.

-RDMA

Use this option to select an RDMA-capable network fabric for inter-nodes communication. The application attempts to use first available RDMA-capable network fabric from the list `dapl` or `ofa`. The application fails if no such fabric is found. This option is equivalent to the `-genv I_MPI_FABRICS_LIST dapl,ofa -genv I_MPI_FALLBACK 1` setting.

-dapl

Use this option to select DAPL capable network fabric for inter-nodes communication. The application attempts to use DAPL capable network fabric. If no such fabric is available, another fabric from the list `tcp,tmi` or `ofa` is used. This option is equivalent to the `-genv I_MPI_FABRICS_LIST dapl,tcp,tmi,ofa -genv I_MPI_FALLBACK 1` setting.

-DAPL

Use this option to select DAPL capable network fabric for inter-nodes communication. The application fails if no such fabric is found. This option is equivalent to the `-genv I_MPI_FABRICS_LIST dapl -genv I_MPI_FALLBACK 0` setting.

-ib

Use this option to select OFA capable network fabric for inter-nodes communication. The application attempts to use OFA capable network fabric. If no such fabric is available, another fabrics from the list `dapl,tcp` or `tmi` is used. This option is equivalent to the `-genv I_MPI_FABRICS_LIST ofa,dapl,tcp,tmi -genv I_MPI_FALLBACK 1` setting.

-IB

Use this option to select OFA capable network fabric for inter-nodes communication. The application fails if no such fabric is found. This option is equivalent to the `-genv I_MPI_FABRICS_LIST ofa -genv I_MPI_FALLBACK 0` setting.

-tmi

Use this option to select TMI capable network fabric for inter-nodes communication. The application attempts to use TMI capable network fabric. If no such fabric is available, another fabric from the list `dapl,tcp` or `ofa` is used. This option is equivalent to the `-genv I_MPI_FABRICS_LIST tmi,dapl,tcp,ofa -genv I_MPI_FALLBACK 1` setting.

-TMI

Use this option to select TMI capable network fabric for inter-nodes communication. The application fails if no such fabric is found. This option is equivalent to the `-genv I_MPI_FABRICS_LIST tmi -genv I_MPI_FALLBACK 0` setting.

-mx

Use this option to select Myrinet MX* network fabric for inter-nodes communication. The application attempts to use Myrinet MX* network fabric. If no such fabric is available, another fabrics from the list `dapl,tcp` or `ofa` is used. This option is equivalent to the `-genv I_MPI_FABRICS_LIST tmi,dapl,tcp,ofa -genv I_MPI_TMI_PROVIDER mx -genv I_MPI_DAPL_PROVIDER mx -genv I_MPI_FALLBACK 1` setting.

-MX

Use this option to select Myrinet MX* network fabric for inter-nodes communication. The application fails if no such fabric is found. This option is equivalent to the `-genv I_MPI_FABRICS_LIST tmi -genv I_MPI_TMI_PROVIDER mx -genv I_MPI_FALLBACK 0` setting.

-psm

Use this option to select Qlogic* network fabric for inter-nodes communication. The application attempts to use Qlogic* network fabric. If no such fabric is available, another fabrics from the list `dapl,tcp` or `ofa` is used. This option is equivalent to the `-genv I_MPI_FABRICS_LIST tmi,dapl,tcp,ofa -genv I_MPI_TMI_PROVIDER psm -genv I_MPI_FALLBACK 1` setting.

-PSM

Use this option to select Qlogic* network fabric for inter-nodes communication. The application fails if no such fabric is found. This option is equivalent to the `-genv I_MPI_FABRICS_LIST tmi -genv I_MPI_TMI_PROVIDER psm -genv I_MPI_FALLBACK 0` setting.

-gm

Use this option to select Myrinet* GM* network fabric for inter-nodes communication. This option is equivalent to the `-genv I_MPI_DEVICE rdssm:GmHca0 -genv I_MPI_FALLBACK_DEVICE 1` setting.

NOTE: This environment variable is deprecated and supported mostly for backward compatibility.

-GM

Use this option to select Myrinet* GM* network fabric for inter-nodes communication. The application fails if no such fabric is found. This option is equivalent to the `-genv I_MPI_DEVICE rdssm:GmHca0 -genv I_MPI_FALLBACK_DEVICE 0` setting.

NOTE: This environment variable is deprecated and supported mostly for backward compatibility.

2.3.4 Environment Variables

I_MPI_HYDRA_HOST_FILE

Set the hosts file to run the application.

Syntax

`I_MPI_HYDRA_HOST_FILE=<arg>`

Deprecated Syntax

`HYDRA_HOST_FILE=<arg>`

Arguments

<arg>	String parameter
<hostsfile>	Full or relative path to hosts file

Description

Set this environment variable to specify the hosts file.

I_MPI_HYDRA_DEBUG

Print out the debug information.

Syntax

I_MPI_HYDRA_DEBUG=<arg>

Arguments

<arg>	Binary indicator
enable | yes | on | 1	Turn on the debug output
disable | no | off | 0	Turn off the debug output. This is the default value

Description

Set this environment variable to 1 to enable the debug mode and 0 to turn off the debug mode.

I_MPI_HYDRA_ENV

Set it to all to pass the environment.

Syntax

I_MPI_HYDRA_ENV=<arg>

Arguments

<arg>	String parameter
all	Full or relative path to hosts file

Description

By default, the launching node environment is passed to the executables as long as it does not overwrite any of the environment variables that have been preset by the remote shell.

I_MPI_JOB_TIMEOUT, I_MPI_MPIEXEC_TIMEOUT

(MPIEXEC_TIMEOUT)

Set the timeout period for mpiexec.hydra.

Syntax

I_MPI_JOB_TIMEOUT=<timeout>

I_MPI_MPIEXEC_TIMEOUT=<timeout>

Deprecated Syntax

MPIEXEC_TIMEOUT=<timeout>

Arguments

<timeout>	Define mpiexec.hydra timeout period in seconds
<n> >= 0	The default timeout value is zero, which means no timeout

Description

Set this environment variable to make mpiexec.hydra terminate the job in <timeout> seconds after its launch. The <timeout> value should be greater than zero. Otherwise the environment variable setting is ignored.

NOTE: Set the I_MPI_JOB_TIMEOUT environment variable in the shell environment before executing the mpiexec.hydra command. Do not use the -genv or -env options to set the <timeout> value. Those options are used only for passing environment variables to the MPI process environment.

I_MPI_JOB_TIMEOUT_SIGNAL

(MPIEXEC_TIMEOUT_SIGNAL)

Define the signal when a job is terminated because of a timeout.

Syntax

I_MPI_JOB_TIMEOUT_SIGNAL=<number>

Deprecated Syntax

MPIEXEC_TIMEOUT_SIGNAL=<number>

Arguments

<number>	Define signal number
<n> > 0	The default value is 9 (SIGKILL)

Description

Define a signal number for the stop of a task if the timeout period specified by I_MPI_JOB_TIMEOUT expires. If you set a signal number unsupported by the system, mpiexec.hydra prints a warning message and continues task termination using the default signal number 9 (SIGKILL).

I_MPI_JOB_ABORT_SIGNAL

Define a signal to be sent to all processes when a job is terminated unexpectedly.

Syntax

I_MPI_JOB_ABORT_SIGNAL=<number>

Arguments

<number>	Define signal number
<n> > 0	The default value is 9 (SIGKILL)

Description

Set this environment variable to define a signal for task termination. If you set an unsupported signal number, mpiexec.hydra prints a warning message and uses the default signal 9 (SIGKILL).

I_MPI_JOB_SIGNAL_PROPAGATION

(MPIEXEC_SIGNAL_PROPAGATION)

Control signal propagation.

Syntax

I_MPI_JOB_SIGNAL_PROPAGATION=<arg>

Deprecated Syntax

MPIEXEC_SIGNAL_PROPAGATION=<arg>

Arguments

<arg>	Binary indicator
enable | yes | on | 1	Turn on propagation
disable | no | off | 0	Turn off propagation. This is the default value

Description

Set this environment variable to control propagation of the signals (SIGINT, SIGALRM, and SIGTERM) that may be received by the MPD daemons. If you enable signal propagation, the received signal is sent to all processes of the MPI job. If you disable signal propagation, all processes of the MPI job are stopped with the default signal 9 (SIGKILL).

I_MPI_HYDRA_BOOTSTRAP

Set the bootstrap server.

Syntax

I_MPI_HYDRA_BOOTSTRAP=<arg>

Arguments

<arg>	String parameter
ssh | rsh | fork | slurm | ll | lsf | sge | jmi	The remote node access mechanism. The default is ssh

Description

Set this environment variable to specify the bootstrap server.

I_MPI_HYDRA_BOOTSTRAP_EXEC

Set the executable to be used as bootstrap server.

Syntax

I_MPI_HYDRA_BOOTSTRAP_EXEC=<arg>

Arguments

<arg>	String parameter
ssh | rsh | fork| slurm | ll | lsf | sge | jmi	The remote node access mechanism. The default is ssh

Description

Set this environment variable to specify the executable to be used as bootstrap server.

I_MPI_HYDRA_RMK

Use the resource management kernel.

Syntax

I_MPI_HYDRA_RMK=<*arg*>

Arguments

<*arg*>	String parameter
<*rmk*>	Resource management kernel. The only supported value is pbs

Description

Set this environment variable to use resource management kernel. Intel® MPI Library only supports pbs.

I_MPI_HYDRA_PMI_CONNECT

Define PMI messages processing method.

Syntax

I_MPI_HYDRA_PMI_CONNECT=<*value*>

Arguments

<*value*>	An algorithm to be used
nocache	Do not cache PMI messages
cache	Cache PMI messages on local pmi_proxy management processes to minimize PMI requests. Cached information is propagated to child management processes
lazy-cache	cache mode without propagation. This is default value

Description

Use this environment variable to select the PMI messages processing method. If -pmi-connect is explicitly presented in the mpiexec.hydra command line, I_MPI_HYDRA_PMI_CONNECT is ignored.

I_MPI_PERHOST

Define the default settings for the -perhost option in the mpiexec and mpiexec.hydra command.

Syntax

I_MPI_PERHOST=<*value*>

Arguments

<*value*>	Define a value that is used for the -perhost option by default
integer > 0	Exact value for the option
all	All logical CPUs on a node
allcores	All cores (physical CPUs) on a node

Description

Set this environment variable to define the default setting for the -perhost option. If -perhost is explicitly presented in the command line, I_MPI_PERHOST has no effect. The -perhost option is assumed with its value if I_MPI_PERHOST is defined.

I_MPI_JOB_TRACE_LIBS

Choose the libraries to preload through the `-trace` option.

Syntax

`I_MPI_JOB_TRACE_LIBS=<arg>`

Deprecated Syntax

`MPIEXEC_TRACE_LIBS=<arg>`

Arguments

`<arg>`	String parameter
`<list>`	Blank separated list of libraries to preload. The default value is `vt`

Description

Set this environment variable to choose an alternative library for preloading through the `-trace` option.

I_MPI_JOB_CHECK_LIBS

Choose the libraries to preload through the `-check_mpi` option.

Syntax

`I_MPI_JOB_CHECK_LIBS=<arg>`

Arguments

`<arg>`	String parameter
`<list>`	Blank separated list of libraries to preload. The default value is `vtmc`

Description

Set this environment variable to choose an alternative library for preloading through the `-check_mpi` option.

I_MPI_HYDRA_BRANCH_COUNT

Set branch count.

Syntax

`I_MPI_HYDRA_BRANCH_COUNT =<num>`

Arguments

`<num>`	Number
`<n> >= 0`	Default value • `-1` if less than 128 nodes used. It means do not use hierarchical structure • `32`, if more than 127 nodes used

Description

Set this environment variable to restrict the number of child management processes launched by `mpiexec.hydra` or each `pmi_proxy` management process.

I_MPI_HYDRA_PMI_AGGREGATE

Turn on/off PMI messages aggregation.

Syntax

I_MPI_HYDRA_PMI_AGGREGATE=<arg>

Arguments

<arg>	Binary indicator
enable | yes | on | 1	Enable PMI messages aggregation. This is the default value
disable | no | off | 0	Disable PMI messages aggregation

Description

Set this environment variable to enable/disable PMI messages aggregation.

I_MPI_HYDRA_IDB_TERMINAL

Set the terminal emulator for Intel® Debugger.

Syntax

I_MPI_HYDRA_IDB_TERMINAL=*<arg>*

Arguments

<arg>	String parameter
xterm	Select Xterm terminal emulator. This is default value
screen	Select screen terminal emulator

Description

Set this environment variable to specify the terminal emulator for Intel® Debugger.

I_MPI_HYDRA_GDB_REMOTE_SHELL

Set the remote shell command to run GNU* debugger.

Syntax

I_MPI_HYDRA_GDB_REMOTE_SHELL=*<arg>*

Arguments

<arg>	String parameter
ssh	Select Secure Shell (SSH). This is default value
rsh	Select Remote shell (RSH)

Description

Set this environment variable to specify the remote shell command to run GNU* debugger on non-local machines. You can use this environment variable to specify any command that has the same syntax as SSH or RSH.

I_MPI_ HYDRA_JMI_LIBRARY

Define the default setting of JMI library to be used by Hydra process manager.

Syntax

I_MPI_JMI_ HYDRA_LIBRARY=<value>

Arguments

<value>	Define a string value, name, or path to JMI dynamic library
Libjmi_slurm.so.1.0	Set the library name or full path to library name. The default value is libjmi.so

Description

Set this environment variable to define the JMI library to be loaded by Hydra processor manager. Set the full path to the library if it is not to LD_LIBRARY_PATH environment variable. If mpirun is used, the JMI library is automatically detected and set. You do not need to set this environment variable.

I_MPI_HYDRA_IFACE

Set the network interface.

Syntax

I_MPI_HYDRA_IFACE=<arg>

Arguments

<arg>	String parameter
<network interface>	The network interface configured in your system

Description

Set this environment variable to specify the network interface to use. For example, use -iface ib0, if the IP emulation of your InfiniBand network is configured on ib0.

I_MPI_HYDRA_DEMUX

Set the demux mode.

Syntax

I_MPI_HYDRA_DEMUX=<arg>

Arguments

<arg>	String parameter
poll | select	Multiple I/O demux mode engine

Description

Set this environment variable to specify the multiple I/O demux mode engine. The default is Poll.

I_MPI_HYDRA_CLEANUP

Control the creation of the default mpicleanup input file.

Syntax

I_MPI_HYDRA_CLEANUP=<value>

Arguments

<value>	Binary indicator
enable | yes | on | 1	Enable the mpicleanup input file creation

disable | no | off | 0	Disable the mpicleanup input file creation. This is the default value

Description

Set the I_MPI_HYDRA_CLEANUP environment variable to create the input file for the mpicleanup utility.

I_MPI_TMPDIR

(TMPDIR)

Set the temporary directory.

Syntax

I_MPI_TMPDIR=*<arg>*

Arguments

<arg>	String parameter
<path>	Set the temporary directory. The default value is /tmp

Description

Set this environment variable to specify the temporary directory to store the mpicleanup input file.

2.3.5 Cleaning up Utility

mpicleanup

Clean up the environment after an abnormally terminated MPI run under the mpiexec.hydra process manager.

Syntax

```
mpicleanup  [ -i <input_file> | -t -f <hostsfile> ] [ -r <rshcmd> ] \
            [ -b <branch_count> ] [-p] [-s | -d] [-h] [-V]
```

or

```
mpicleanup [ --input <input_file> | --total --file <hostsfile> ] \
           [ --rsh <rshcmd> ] [ --branch <branch_count> ] [ --parallel ] \
           [ --silent | --verbose ] [ --help ] [ --version ]
```

Arguments

-i <input_file> | --input <input_file>	Specify the input file generated by mpiexec.hydra. The default value is mpiexec_${username}_$PPID.log located in the temporary directory regulated by I_MPI_TMPDIR, TMPDIR or /tmp directory
-t | --total	Use the total mode to stop all user processes on specified machines. This option is not applicable for the root user
-f *<hostsfile>* | --file *<hostsfile>*	Specify the file containing a list of machines to clean up on
-r *<rshcmd>* |	Specify the remote shell to use. The default shell is ssh

--rsh <rshcmd>	
-b <branch_count> | --branch <branch_count>	Specify a machines number to restrict the number of the child processes. The default value is 32
-p | --parallel	Use the parallel launch mode. This option is only applicable if all hosts are available. Otherwise a part of machines may stay in an undetermined state
-s | --silent	Suppress extra output generation
-d | --verbose	Output verbose information
-h | --help	Display a help message
-V | --version	Display Intel® MPI Library version information

Description

Use this command to clean up the environment after an abnormal MPI job termination.

For example, use the following command to stop processes mentioned in the input file generated by the prior mpiexec.hydra invocation:

```
$ mpicleanup
```

or

```
$ mpicleanup –-input /path/to/input.file
```

Use the following command to stop all user's processes on the machines specified in the hostsfile file:

```
$ mpicleanup --file hostsfile --total
```

2.4 Multipurpose Daemon Commands

mpd

Start mpd daemon.

Syntax

```
mpd [ --help ] [ -V ] [ --version ] [ --host=<host> --port=<portnum> ] \
    [ --noconsole ] [ --trace ] [ --echo ] [ --daemon ] [ --bulletproof ] \
    [ --i fhn <interface/hostname> ] [ --listenport <listenport> ]
```

Arguments

--help	Display a help message
-V | --version	Display the Intel® MPI Library version information
-h <host> -p <portnum> | --host=<host> --port= <portnum>	Specify the host and port to be used for entering an existing ring. The --host and --port options must be specified together
-n | --noconsole	Do not create a console at startup
-t | --trace	Print internal MPD trace information

-e | --echo	Print a port number at startup to which other mpds may connect
-d | --daemon	Start mpd in daemon mode. By default, the interactive mode is enabled
--bulletproof	Turn MPD bulletproofing on
--ifhn=<*interface/hostname*>	Specify <*interface/hostname*> to use for MPD communications
-l <listenport> | --listenport= <listenport>	Specify the mpd listening port

Description

Multipurpose daemon* (MPD) is the Intel® MPI Library process management system for starting parallel jobs. Before running a job, start mpd daemons on each host and connect them into a ring. Long parameter names may be abbreviated to their first letters by using only one hyphen and no equal sign. For example,

```
$ mpd –h masterhost -p 4268 –n
```

is equivalent to

```
$ mpd --host=masterhost --port=4268 –noconsole
```

If a file named .mpd.conf is presented in the user's home directory, only the user can have read and write privileges. The file must minimally contain a line with secretword=<*secretword*>. Create the mpd.conf file in the /etc directory instead of .mpd.conf in the root's home directory to run mpd as root. We do not recommend starting the MPD ring under the root account.

mpdboot

Start mpd ring.

Syntax

```
mpdboot  [ -h ] [ -V ] [ -n <#nodes>] [ -f <hostsfile> ] [ -r <rshcmd> ] \
         [ -u <user> ] [ -m <mpdcmd> ] [ --loccons ] [ --remcons ] \
         [ -s ] [ -d ] [ -v ] [ -1 ] [ --ncpus=<ncpus> ] [ -o ] \
         [ -b <maxbranch> ] [ -p ]
```

or

```
mpdboot  [ --help ] [ --version ] [ --totalnum=<#nodes> ] \
         [ --file=<hostsfile> ] [ --rsh=<rshcmd> ] [ --user=<user> ] \
         [ --mpd=<mpdcmd> ] [ --loccons ] [ --remcons ] [ --shell ] \
         [ --debug ] [ --verbose ] [ -1 ] [ --ncpus=<ncpus> ] [ --ordered ]
         [ --maxbranch=<maxbranch> ] [ --parallel-startup ]
```

Arguments

-h | --help	Display a help message
-V | --version	Display Intel® MPI Library version information
-d | --debug	Print debug information
–v | --verbose	Print extra verbose information. Show the <*rshcmd*> attempts

-n <#nodes> | --totalnum=<#nodes>	Number of nodes in mpd.hosts on which daemons are started
-r <rshcmd> | --rsh=<rshcmd>	Specify remote shell to start daemons and jobs. The default value is ssh
-f <hostsfile> | --file=<hostsfile>	Path/name of the file that has the list of machine names on which the daemons are started
-1	Remove the restriction of starting only one mpd per machine
-m <mpdcmd> | --mpd=<mpdcms>	Specify the full path name of the mpd on the remote hosts
-s | --shell	Specify the shell
-u <user> | --user=<user>	Specify the user
--loccons	Do not create local MPD consoles
--remcons	Do not create remote MPD consoles
--ncpus=<ncpus>	Indicate how many processors to use on the local machine (other nodes are listed in the hosts file)
-o | --ordered	Start all the mpd daemons in the exact order as specified in the mpd.hosts file
-b <maxbranch> | --maxbranch=<maxbranch>	Use this option to indicate the maximum number of the mpd daemons to enter the mpd ring under another. This helps to control the parallelism of the mpd ring start. The default value is four
-p |--parallel-startup	Use this option to allow parallel fast starting of mpd daemons under one local root. No daemon checking is performed. This option also supports shells which do not transfer the output from the remote commands

Description

Start the mpd daemons on the specified number of nodes by providing a list of node names in <mpd.hosts>.

The mpd daemons are started using the ssh command by default. If the ssh connectivity is not enabled, use the -r rsh option to switch over to rsh. Make sure that all nodes in the cluster can connect to each other through the ssh command without a password or, if the -r rsh option is used, through the rsh command without a password.

NOTE: The mpdboot command spawns an MPD daemon on the host machine, even if the machine name is not listed in the mpd.hosts file.

mpdexit

Shut down a single mpd daemon.

Syntax

```
mpdexit [ --help ] [ -V ] [--version ] <mpdid>
```

Arguments

--help	Display a help message
-V | --version	Display Intel® MPI Library version information
<*mpdid*>	Specify the mpd daemon to kill

Description

Use this command to cause the single mpd daemon to exit. Use <*mpdid*> obtained through the mpdtrace -l command in the form <*hostname*>_<*port number*>.

mpdallexit

Shut down all mpd daemons on all nodes.

Syntax

```
mpdallexit [ --help ] [ -V ] [ --version ]
```

Arguments

--help	Display a help message
-V | --version	Display Intel® MPI Library version information

Description

Use this command to shutdown all MPD rings you own.

mpdcleanup

Clean up the environment after an mpd crash.

Syntax

```
mpdcleanup  [ -h ] [ -V ] [ -f <hostsfile> ] [ -r <rshcmd> ] [ -u <user> ] \
            [ -c <cleancmd> ] [ -a]
```

or

```
mpdcleanup  [ --help ] [ --version ] [ --file=<hostsfile> ] \
             [ --rsh=<rshcmd> ] [ --user=<user> ] [ --clean=<cleancmd> ] \
             [ --all]
```

Arguments

-h | --help	Display a help message
-V | --version	Display Intel® MPI Library version information
-f <*hostsfile*> | --file=<*hostsfile*>	Specify the file containing a list of machines to clean up
-r <*rshcmd*> | --rsh=<*rshcmd*>	Specify the remote shell to use
-u <*user*> | --user=<*user*>	Specify the user

-c <cleancmd> | --clean=<cleancmd>	Specify the command to use for removing the UNIX* socket. The default command is /bin/rm –f
-a | --all	Kill all mpd daemons related to the current settings of the I_MPI_JOB_CONTEXT environment variable on all hosts specified in <hostsfile>

Description

Use this command to clean up the environment after an mpd crash. It removes the UNIX* socket on local and remote machines or kills all mpd daemons related to the current environment controlled by the I_MPI_JOB_CONTEXT environment variable.

For instance, use the following command to remove the UNIX sockets on machines specified in the hostsfile file:

```
$ mpdcleanup --file=hostsfile
```

Use the following command to kill the mpd daemons on the machines specified in the hostsfile file:

```
$ mpdcleanup --file=hostsfile --all
```

mpdtrace

Determine whether mpd is running.

Syntax

```
mpdtrace [ --help ] [ -V ] [ --version ] [ -l ]
```

Arguments

--help	Display a help message
-V | --version	Display Intel® MPI Library version information
-l	Show MPD identifiers instead of the hostnames

Description

Use this command to list the hostnames or identifiers of all mpds in the ring. The output identifiers have the form <hostname>_<port number>.

mpdcheck

Check for configuration problems on the host or print configuration information about this host.

Syntax

```
mpdcheck [ -v ] [ -l ] [ -h ] [ --help ] [ -V ] [ --version ]

mpdcheck –pc [ -v ] [ -l]

mpdcheck -f <host_file> [ -ssh ] [ -v ] [ -l]

mpdcheck –s [ -v ] [ -l]

mpdcheck -c < server_host> <server_port> [ -v ] [ -l]
```

Arguments

-h | --help	Display a help message
-V | --version	Display Intel® MPI Library version information
-pc	Print configuration information about a local host
-f <host_file>	Print information about the hosts listed in <host_file>

-ssh	Invoke testing of ssh on each remote host. Use in conjunction with the -f option
-s	Run mpdcheck as a server on one host
-c <server_host> <server_port>	Run mpdcheck as a client on the current or different host. Connect to the <server_host> <server_port>
-l	Print diagnostic messages in extended format
-v	Print the actions that mpdcheck is performing

Description

Use this command to check configuration problems on the cluster nodes. Any output started with *** indicates a potential problem.

If you have problems running parallel jobs through mpd on one or more hosts, try to run the script once on each of those hosts.

mpdringtest

Test the MPD ring.

Syntax

```
mpdringtest [ --help ] [ -V ] [ --version ] <number of loops>
```

Arguments

--help	Display a help message
-V | --version	Display Intel® MPI Library version information
<number of loops>	Number of loops

Description

Use this command to test how long it takes for a message to circle the mpd ring.

mpdlistjobs

List the running processes for a particular set of MPI jobs.

Syntax

```
mpdlistjobs [ -h ] [ -V ] [ -u <username> ] [ -a <jobalias> ] [ -j <jobid> ]
```

or

```
mpdlistjobs [ --help ] [ --version ] [ --user=<username> ] \
            [ --alias=<jobalias> ] [ --jobid=<jobid> ]
```

Arguments

-h | --help	Display a help message
-V | --version	Display Intel® MPI Library version information
-u <username>| --user=<username>	List jobs of a particular user
-a <jobalias> | --alias=<jobalias>	List information about the particular job specified by <jobalias>
-j <jobid> |	List information about the particular job specified by <jobid>

--jobid=<jobid>	

Description

Use this command to list the running processes for a set of MPI jobs. All jobs for the current machine are displayed by default.

mpdsigjob

Apply a signal to a process running an application.

Syntax

```
mpdsigjob [ --help ] [ -V ] [ --version ] <sigtype> \
          [-j <jobid> | -a <jobalias> ] [-s | -g ]
```

Arguments

--help	Display a help message
-V | --version	Display Intel® MPI Library version information
<sigtype>	Specify the signal to send
-a <jobalias>	Send a signal to the job specified by <jobalias>
-j <jobid>	Send a signal to the job specified by <jobid>
-s	Deliver a signal to a single user process
-g	Deliver a signal to a group of processes. This is the default behavior

Description

Use this command to deliver a specific signal to the processes of a running job. The desired signal is the first argument. Specify only one of two options: -j or –a.

mpdkilljob

Kill a job.

Syntax

```
mpdkilljob [ --help ] [ -V ] [ --version ] [ <jobnum> ] [ -a <jobalias> ]
```

Arguments

--help	Display a help message
-V | --version	Display Intel® MPI Library version information
<jobnum>	Kill the job specified by <jobnum>
-a <jobalias>	Kill the job specified by <jobalias>

Description

Use this command to kill the job specified by <jobnum> or by <jobalias>. Obtain <jobnum> and <jobalias> from the mpdlistjobs command. The <jobid> field has the following format: <jobnum>@<mpdid>.

mpdhelp

Print brief help concerning MPD commands.

Syntax

```
mpdhelp [ -V ] [ --version ]
```

Arguments

-V | --version	Display Intel® MPI Library version information

Description

Use this command to obtain a brief help message concerning MPD commands.

2.4.1 Job Startup Commands

mpiexec

Syntax

```
mpiexec <g-options> <l-options> <executable>
```

or

```
mpiexec <g-options> <l-options> <executable1> : \
<l-options> <executable2>
```

or

```
mpiexec –configfile <file>
```

Arguments

<g-options>	Global options that apply to all MPI processes
<l-options>	Local options that apply to a single arg-set
<executable>	./a.out or path/name of the executable file
<file>	File with command-line options

Description

By using the first command-line syntax, you can start all MPI processes of the *<executable>* with the single arg-set. For example, the following command executes a.out over the specified *<# of processes>*:

```
$ mpiexec –n <# of processes> ./a.out
```

By using the second command-line syntax, you can start several MPI programs or the same MPI program with different arg-sets. For example, the following command would run each given executable on a different host:

```
$ mpiexec –n 2 –host host1 ./a.out : \
          -n 2 –host host2 ./b.out
```

In the third command-line syntax, read the command line from specified *<file>*. For a command with a single arg-set, the entire command should be specified on a single line in *<file>*. For a command with multiple arg-sets, each arg-set should be specified on a single, separate line in *<file>*. Global options should always appear at the beginning of the first line in *<file>*.

MPD daemons must already be running in order for mpiexec to succeed.

NOTE: If there is no "." in the PATH environment variable on all nodes in the cluster, specify <executable> as ./a.out rather than a.out.

2.4.1.1 Extended Device Control Options

Use these options to select a specific fabric combination.

The exact combination of fabrics depends on the number of processes started per node.

If all processes start on one node, the Intel® MPI library uses shm intra-node communication regardless of the selected option from the list in this topic.

If the number of started processes is less than or equal to the number of available nodes, the library uses the first available fabric from the list of fabrics for inter-nodes communication.

For other cases, the library uses shm for intra-node communication, and the first available fabric from the list of fabrics for inter-nodes communication. See *I_MPI_FABRICS* and *I_MPI_FABRICS_LIST* for more details.

The shm fabric is available for both Intel® and non-Intel microprocessors, but it may perform additional optimizations for Intel microprocessors than it performs for non-Intel microprocessors.

-rdma

Use this option to select an RDMA-capable network fabric for inter-nodes communication. The application attempts to use first available RDMA-capable network fabric from the list dapl or ofa. If no such fabric is available, other fabrics from the list tcp or tmi are used. This option is equivalent to the -genv I_MPI_FABRICS_LIST dapl,ofa,tcp,tmi -genv I_MPI_FALLBACK 1 setting.

-RDMA

Use this option to select an RDMA-capable network fabric for inter-nodes communication. The application attempts to use first available RDMA-capable network fabric from the list dapl or ofa. The application fails if no such fabric is found. This option is equivalent to the -genv I_MPI_FABRICS_LIST dapl,ofa -genv I_MPI_FALLBACK 1 setting.

-dapl

Use this option to select DAPL capable network fabric for inter-nodes communication. The application attempts to use DAPL capable network fabric. If no such fabric is available, another fabrics from the list tcp,tmi or ofa is used. This option is equivalent to the -genv I_MPI_FABRICS_LIST dapl,tcp,tmi,ofa -genv I_MPI_FALLBACK 1 setting.

-DAPL

Use this option to select DAPL capable network fabric for inter-nodes communication. The application fails if no such fabric is found. This option is equivalent to the -genv I_MPI_FABRICS_LIST dapl -genv I_MPI_FALLBACK 0 setting.

-ib

Use this option to select OFA capable network fabric for inter-nodes communication. The application attempts to use OFA capable network fabric. If no such fabric is available, another fabrics from the list dapl,tcp or tmi is used. This option is equivalent to the -genv I_MPI_FABRICS_LIST ofa,dapl,tcp,tmi -genv I_MPI_FALLBACK 1 setting.

-IB

Use this option to select OFA capable network fabric for inter-nodes communication. The application fails if no such fabric is found. This option is equivalent to the -genv I_MPI_FABRICS_LIST ofa -genv I_MPI_FALLBACK 0 setting.

-tmi

Use this option to select TMI capable network fabric for inter-nodes communication. The application attempts to use TMI capable network fabric. If no such fabric is available, another fabrics from the list

dapl,tcp or ofa is used. This option is equivalent to the -genv I_MPI_FABRICS_LIST tmi,dapl,tcp,ofa -genv I_MPI_FALLBACK 1 setting.

-TMI

Use this option to select TMI capable network fabric for inter-nodes communication. The application will fail if no such fabric is found. This option is equivalent to the -genv I_MPI_FABRICS_LIST tmi -genv I_MPI_FALLBACK 0 setting.

-mx

Use this option to select Myrinet MX* network fabric for inter-nodes communication. The application attempts to use Myrinet MX* network fabric. If no such fabric is available, another fabrics from the list dapl,tcp or ofa is used. This option is equivalent to the -genv I_MPI_FABRICS_LIST tmi,dapl,tcp,ofa -genv I_MPI_TMI_PROVIDER mx -genv I_MPI_DAPL_PROVIDER mx -genv I_MPI_FALLBACK 1 setting.

-MX

Use this option to select Myrinet MX* network fabric for inter-nodes communication. The application fails if no such fabric is found. This option is equivalent to the -genv I_MPI_FABRICS_LIST tmi -genv I_MPI_TMI_PROVIDER mx -genv I_MPI_FALLBACK 0 setting.

-psm

Use this option to select Qlogic* network fabric for inter-nodes communication. The application attempts to use Qlogic* network fabric. If no such fabric is available, another fabrics from the list dapl,tcp or ofa is used. This option is equivalent to the -genv I_MPI_FABRICS_LIST tmi,dapl,tcp,ofa -genv I_MPI_TMI_PROVIDER psm -genv I_MPI_FALLBACK 1 setting.

-PSM

Use this option to select Qlogic* network fabric for inter-nodes communication. The application fails if no such fabric is found. This option is equivalent to the -genv I_MPI_FABRICS_LIST tmi -genv I_MPI_TMI_PROVIDER psm -genv I_MPI_FALLBACK 0 setting.

-gm

Use this option to select Myrinet* GM* network fabric for inter-nodes communication. This option is equivalent to the -genv I_MPI_DEVICE rdssm:GmHca0 -genv I_MPI_FALLBACK_DEVICE 1 setting.

NOTE: This environment variable is deprecated and supported mostly for backward compatibility.

-GM

Use this option to select Myrinet* GM* network fabric for inter-nodes communication. The application fails if no such fabric is found. This option is equivalent to the -genv I_MPI_DEVICE rdssm:GmHca0 -genv I_MPI_FALLBACK_DEVICE 0 setting.

NOTE: This environment variable is deprecated and supported mostly for backward compatibility.

2.4.1.2 Global Options

-version or -V

Use this option to display Intel® MPI Library version information.

-h or -help or --help

Use this option to display the mpiexec help message.

-tune [<*arg* >]

where:

<arg> = {<dir_name>, <configuration_file>}.

Use this option to optimize the Intel® MPI Library performance using data collected by the `mpitune` utility.

If *<arg>* is not specified, the best-fit tune options will be selected for the given configuration. The default location of the configuration file is *<installdir>*/*<arch>*/`etc` directory. You can override this default location by explicitly stating: *<arg>=<dir_name>*. The provided configuration file is used if you set *<arg>=<configuration_file>*.

See *Automatic Tuning Utility* for more details.

-nolocal

Use this option to avoid running *<executable>* on the host where the `mpiexec` is launched. This option is useful, for example, on clusters that deploy a dedicated master node for starting the MPI jobs, and a set of compute nodes for running the actual MPI processes.

-perhost *<# of processes>*

Use this option to place the indicated number of consecutive MPI processes on every host in group round robin fashion. The total number of processes to start is controlled by the `-n` option as usual.

The `mpiexec` command controls how the ranks of the processes are allocated to the nodes in the cluster. By default, `mpiexec` uses group round-robin assignment of ranks to nodes, putting consecutive MPI processes on all processor cores.

To change this default behavior, set the number of processes per host by using the `-perhost` option, and set the total number of processes by using the `-n` option. See *Local Options* for details. The first *<# of processes>* indicated by the `-perhost` option is executed on the first host; the next *<# of processes>* is executed on the next host, and so on.

See also the *I_MPI_PERHOST* environment variable.

-rr

Use this option to place consecutive MPI processes onto different host in round robin fashion. This option is equivalent to `-perhost 1`.

-grr *<# of processes>*

Use this option to place the indicated number of consecutive MPI processes on every host in group round robin fashion. This option is equivalent to `-perhost` *<# of processes>*.

-ppn *<# of processes>*

Use this option to place the indicated number of consecutive MPI processes on every host in group round robin fashion. This option is equivalent to `-perhost` *<# of processes>*.

-machinefile *<machine file>*

Use this option to control the process placement through *<machine file>*. The total number of processes to start is controlled by the `-n` option as usual.

A machine file is a list of fully qualified or short host names, one name per line. Blank lines and lines that start with `#` as the first character are ignored.

By repeating a host name, you place additional processes on this host. You can also use the following format to avoid repetition of the same host name: *<host name>:<number of processes>*. For example, the following machine files:

```
host1

host1

host2

host2

host3
```

is equivalent to:

```
host1:2

host2:2

host3
```

It is also possible to specify the network interface used for communication for each node: *<host name>:<number of processes>* [ifhn=*<interface_host_name>*].

NOTE: The `-machinefile`, `-ppn`, `-rr`, and `-perhost` options are intended for process distribution. Do not use them simultaneously. Otherwise `–machinefile` takes precedence.

-g<*l-option*>

Use this option to apply the named local option *<l-option>* globally. See *Local Options* for a list of all local options. During the application startup, the default value is the `–genvuser` option. The options `–genvnone, -genvuser, -genvall` have the lowest priority, `–genvlist, -genvexcl` have higher priority than the previous set. The `–genv` option has the highest priority. Local options have higher priority than the global options.

-genv <*ENVVAR*> <*value*>

Use this option to set the *<ENVVAR>* environment variable to the specified *<value>* for all MPI processes.

-genvuser

Use this option to propagate all user environment variables to all MPI processes, with the exception of the following system environment variables: `$HOSTNAME, $HOST, $HOSTTYPE, $MACHTYPE, $OSTYPE`. This is the default setting.

-genvall

Use this option to enable propagation of all environment variables to all MPI processes.

-genvnone

Use this option to suppress propagation of any environment variables to any MPI processes.

(SDK only) -trace [<*profiling_library*>] or -t [<*profiling_library*>]

Use this option to profile your MPI application using the indicated *<profiling_library>*. If the *<profiling_library>* is not mentioned, the default profiling library `libVT.so` is used.

Set the `I_MPI_JOB_TRACE_LIBS` environment variable to override the default profiling library.

NOTE: It is not necessary to link your application against the profiling library before execution.

(SDK only) -check_mpi [<checking_library>]

Use this option to check your MPI application using the indicated <checking_library>. If <checking_library> is not mentioned, the default checking library libVTmc.so is used.

Set the I_MPI_JOB_CHECK_LIBS environment variable to override the default checking library.

NOTE: It is not necessary to link your application against the checking library before execution.

-tv

Use this option to run <executable> under the TotalView* debugger. For example:

```
$ mpiexec -tv -n <# of processes> <executable>
```

See *Environment Variables* for information on how to select the TotalView* executable file.

NOTE: Ensure the environment variable TVDSVRLAUNCHCMD=ssh because the TotalView* uses rsh by default.

NOTE: The TotalView* debugger has a feature to displays the message queue state of your MPI program. To use the state display feature, do the following steps:

1. Run your <executable> with -tv option.

   ```
   $ mpiexec -tv -n <# of processes> <executable>
   ```

2. Answer **Yes** to the question about stopping the Python* job.

To display the internal state of the MPI library textually, select **Tools** > **Message Queue** command. If you select the **Process Window Tools** > **Message Queue Graph** command, the TotalView* displays a window that shows a graph of the current message queue state. For more information, see TotalView*.

-tva <jobid>

Use this option to attach the TotalView* debugger to existing <jobid>. For example:

```
$ mpiexec -tva <jobid>
```

-tvsu

Use this option to run <executable> for later attachment with the TotalView* debugger. For example:

```
$ mpiexec -tvsu -n <# of processes> <executable>
```

NOTE: To debug the running Intel® MPI job, attach the TotalView* to the Python* instance that is running the mpiexec script.

-idb

Use this option to run <executable> under the Intel® Debugger. For example:

```
$ mpiexec -idb -n <# of processes> <executable>
```

Include the installation path of the Intel® Debugger in the IDB_HOME environment variable.

-idba <jobid>

Use this option to attach the Intel® Debugger to the existing <jobid>. For example:

```
$ mpiexec -idba <jobid>
```

-gdb

Use this option to run *<executable>* under the GNU* debugger. For example:

```
$ mpiexec -gdb -n <# of processes> <executable>
```

-gdba <*jobid*>

Use this option to attach the GNU* debugger to the existing *<jobid>*. For example:

```
$ mpiexec -gdba <jobid>
```

-a <*alias*>

Use this option to assign *<alias>* to the job.

-ordered-output

Use this option to avoid intermingling of data output by the MPI processes. This option affects both the standard output and standard error streams.

NOTE: For this option to work, the last line output by each process must end with the end-of-line ('\n') character. Otherwise the application may stop responding.

-m

Use this option to merge output lines.

-l

Use this option to insert the MPI process rank at the beginning of all lines written to the standard output.

-s <*spec*>

Use this option to direct standard input to the specified MPI processes.

Arguments

<spec>	Define MPI process ranks
`all`	Use all processes
<l>,<m>,<n>	Specify an exact list and use processes *<l>*, *<m>* and *<n>* only. The default value is zero
<k>,<l>-<m>,<n>	Specify a range and use processes *<k>*, *<l>* through *<m>*, and *<n>*

-noconf

Use this option to disable processing of the `mpiexec` configuration files described in the section *Configuration Files.*

-ifhn <*interface/hostname*>

Use this option to specify the network interface for communication with the local MPD daemon. The *<interface/hostname>* should be an IP address or a hostname associated with the alternative network interface.

-ecfn <*filename*>

Use this option to output XML exit codes to the file <*filename*>.

-configfile <*filename*>

Use this option to specify the file <*filename*> that contains command-line options. Blank lines and lines that start with # as the first character are ignored. For example, the configuration file contains the following commands to run the executables a.out and b.out using the rdssm device over host1 and host2 respectively:

```
-host host1 -env I_MPI_DEBUG 2 -env I_MPI_DEVICE rdssm -n 2 ./a.out
-host host2 -env I_MPI_DEBUG 2 -env I_MPI_DEVICE rdssm -n 2 ./b.out
```

To launch a MPI application according to the parameters above, use:

```
$ mpiexec –configfile <filename>
```

NOTE: This option may only be used alone. It terminates parsing of the mpiexec command line.

2.4.1.3 Local Options

-n <*# of processes*> or -np <*# of processes*>

Use this option to set the number of MPI processes to run with the current arg-set.

-env <*ENVVAR*> <*value*>

Use this option to set the <*ENVVAR*> environment variable to specified <*value*> for all MPI processes in the current arg-set.

-envuser

Use this option to propagate all user environment variables with the exception of the following variables: $HOSTNAME, $HOST, $HOSTTYPE, $MACHTYPE, $OSTYPE. This is the default setting.

-envall

Use this option to propagate all environment variables in the current environment.

-envnone

Use this option to suppress propagation of any environment variables to the MPI processes in the current arg-set.

-envlist <*list of env var names*>

Use this option to pass a list of environment variables with their current values. <*list of env var names*> is a comma separated list of environment variables to be sent to the processes. If this option is used several times in the command line, all variables listed in the arguments are included into one list.

-envexcl <*list of env var names*>

Use this option to suppress propagation of the listed environment variables to the MPI processes in the current arg-set.

-host <*nodename*>

Use this option to specify a particular <*nodename*> on which the MPI processes in the current arg-set are to be run. For example, the following command runs the executable a.out on host host1 only:

```
$ mpiexec -n 2 -host host1 ./a.out
```

-path <*directory*>

Use this option to specify the path to <*executable*> that is to be run in the current arg-set.

-wdir <*directory*>

Use this option to specify the working directory in which <*executable*> is to be run in the current arg-set.

-umask <*umask*>

Use this option to perform the umask <*umask*> command for the remote process.

2.4.1.4 Configuration Files

The mpiexec configuration files specify the default options applied to all mpiexec commands.

If any of these files exist, their contents are prefixed to the command-line options for mpiexec in the following order:

1. System-wide <*installdir*>/etc/mpiexec.conf. The default location of the configuration file is the <*installdir*>/<*arch*>/etc.
2. User-specific $HOME/.mpiexec.conf
3. Session-specific $PWD/mpiexec.conf

You can override these files by defining environment variables and using command line options. You can skip these configuration files by using the mpiexec -noconf option.

You can create or modify these files. They contain mpiexec command-line options. Blank lines and lines that start with # are ignored. For example, to specify a default device, add the following line to the respective mpiexec.conf file:

```
-genv I_MPI_DEVICE <device>
```

2.4.1.5 Environment Variables

I_MPI_DEBUG

Print out debugging information when an MPI program starts running.

Syntax

```
I_MPI_DEBUG=<level>[,<flags>]
```

Arguments

<*level*>	Indicate level of debug information provided
0	Output no debugging information. This is the default value
1	Output verbose error diagnostics
2	Confirm which I_MPI_FABRICS (I_MPI_DEVICE) was used
3	Output effective MPI rank, pid and node mapping table

4	Output process pinning information
5	Output Intel MPI-specific environment variables
> 5	Add extra levels of debug information

<flags>	Comma-separated list of debug flags
pid	Show process id for each debug message
tid	Show thread id for each debug message for multithreaded library
time	Show time for each debug message
datetime	Show time and date for each debug message
host	Show host name for each debug message
level	Show level for each debug message
scope	Show scope for each debug message
line	Show source line number for each debug message
file	Show source file name for each debug message
nofunc	Do not show routine name
norank	Do not show rank
flock	Synchronize debug output from different process or threads
nobuf	Do not use buffered I/O for debug output

Description

Set this environment variable to control the output of the debugging information.

You can specify the output file name for debug information by setting the I_MPI_DEBUG_OUTPUT environment variable.

Each printed line has the following format:

[<identifier>] <message>

where *<identifier>* identifies the MPI process that produced the message, while *<message>* contains the debugging output.

The *<identifier>* is an MPI process rank if *<level>* is an unsigned number. If the '+' sign is added in front of the *<level>* number, the *<identifier>* contains a rank#pid@hostname tuple. Here, rank is the MPI process rank, pid is the UNIX process id, and hostname is the host name as defined at process launch time.

For example, the following command:

```
$ mpiexec -n 1 -env I_MPI_DEBUG 2 ./a.out
```

may produce the following output:

```
[0] MPI startup(): shared memory data transfer mode
```

while the command

```
$ mpiexec –n 1 -env I_MPI_DEBUG +2 ./a.out
```

or

```
$ mpiexec –n 1 -env I_MPI_DEBUG 2,pid,host ./a.out
```

may produce the following output:

```
[0#1986@mpicluster001]  MPI startup(): shared memory data transfer mode
```

NOTE: Compiling with `mpiicc -g` causes considerable amount of additional debug information to be printed.

I_MPI_DEBUG_OUTPUT

Set output file name for debug information.

Syntax

`I_MPI_DEBUG_OUTPUT =<arg>`

Arguments

<arg>	String value
stdout	Output to stdout - default value
stderr	Output to stderr
<file_name>	Specify the output file name for debug information

Description

Set this environment variable if you want to split output of debug information from the output produced by an application. If you use format like '*%r*', '*%p*' or '*%h*', rank, pid or host name is added to the file name accordingly.

I_MPI_PERHOST

Define the default settings for the `-perhost` option in the `mpiexec` command.

Syntax

`I_MPI_PERHOST=<value>`

Arguments

<value>	Define the default process layout
<n> > 0	*<n>* processes per node
`all`	All logical CPUs on a node
`allcores`	All cores (physical CPUs) on a node

Description

Set this environment variable to define the default setting for the `-perhost` option. If `-perhost` is explicitly called in the command line, the `I_MPI_PERHOST` environment variable has no effect. The `-perhost` option assumes the value of the `I_MPI_PERHOST` environment variable if this environment variable is defined.

NOTE: `I_MPI_PERHOST` is incompatible with the `mpiexec -host` option. The `I_MPI_PERHOST` environment variable is ignored in this case.

I_MPI_PRINT_VERSION

Print library version information.

Syntax

I_MPI_PRINT_VERSION=<arg>

Arguments

<arg>	Binary indicator
enable | yes | on | 1	Print library version information.
disable | no | off | 0	No action. This is the default value.

Description

Set this environment variable to enable/disable printing of Intel® MPI library version information when an MPI application starts running.

(SDK only) I_MPI_JOB_TRACE_LIBS

(MPIEXEC_TRACE_LIBS)

Choose the libraries to preload through the -trace option.

Syntax

I_MPI_JOB_TRACE_LIBS=<arg>

Deprecated Syntax

MPIEXEC_TRACE_LIBS=<arg>

Arguments

<arg>	String parameter
<list>	Blank separated list of libraries to preload. The default value is vt

Description

Set this environment variable to choose an alternative library for preloading by the -trace option.

(SDK only) I_MPI_JOB_CHECK_LIBS

Choose the libraries to preload through the -check_mpi option.

Syntax

I_MPI_JOB_CHECK_LIBS=<arg>

Arguments

<arg>	String parameter
<list>	Blank separated list of libraries to preload. The default value is vtmc

Description

Set this environment variable to choose an alternative library for preloading by the -check_mpi option.

I_MPI_JOB_STARTUP_TIMEOUT

Set the mpiexec job startup timeout.

Syntax

I_MPI_JOB_STARTUP_TIMEOUT=<*timeout*>

Arguments

<*timeout*>	Define mpiexec job startup timeout period in seconds
<*n*> >= 0	The default timeout value is 20 seconds

Description

Set this environment variable to make mpiexec wait for the job to start in <*timeout*> seconds after its launch. The <*timeout*> value should be greater than zero. Otherwise the environment variable setting is ignored and a warning message is printed. Setting this environment variable may make sense on large clusters with a lot of nodes where the job startup time may exceed the default value.

NOTE: Set the I_MPI_JOB_STARTUP_TIMEOUT environment variable in the shell environment before executing the mpiexec command. Do not use the -genv or -env options for setting the <*timeout*> value. Those options are used only for passing environment variables to the MPI process environment.

I_MPI_JOB_TIMEOUT

(MPIEXEC_TIMEOUT)

Set the mpiexec timeout.

Syntax

I_MPI_JOB_TIMEOUT=<*timeout*>

Deprecated Syntax

MPIEXEC_TIMEOUT=<*timeout*>

Arguments

<*timeout*>	Define mpiexec timeout period in seconds
<*n*> **>=** 0	The default timeout value is zero, meaning no timeout

Description

Set this environment variable to make mpiexec terminate the job in <*timeout*> seconds after its launch. The <*timeout*> value should be greater than zero. Otherwise the environment variable setting is ignored.

NOTE: Set the I_MPI_JOB_TIMEOUT environment variable in the shell environment before executing the mpiexec command. Do not use the -genv or -env options for setting the <*timeout*> value. Those options are used only for passing environment variables to the MPI process environment.

I_MPI_JOB_TIMEOUT_SIGNAL

(MPIEXEC_TIMEOUT_SIGNAL)

Define a signal to be used when a job is terminated because of a timeout.

Syntax

I_MPI_JOB_TIMEOUT_SIGNAL=<*number*>

Deprecated Syntax

MPIEXEC_TIMEOUT_SIGNAL=<*number*>

Arguments

<*number*>	Define signal number
<*n*> > 0	The default value is 9 (SIGKILL)

Description

Define a signal number for task termination upon the timeout period specified by the environment variable I_MPI_JOB_TIMEOUT. If you set a signal number unsupported by the system,, mpiexec prints a warning message and continues task termination using the default signal number 9 (SIGKILL).

I_MPI_JOB_ABORT_SIGNAL

Define a signal to be sent to all processes when a job is terminated unexpectedly.

Syntax

I_MPI_JOB_ABORT_SIGNAL=<*number*>

Arguments

<*number*>	Define signal number
<*n*> > 0	The default value is 9 (SIGKILL)

Description

Set this environment variable to define a signal for task termination. If you set an unsupported signal number, mpiexec prints a warning message and uses the default signal 9 (SIGKILL).

I_MPI_JOB_SIGNAL_PROPAGATION

(MPIEXEC_SIGNAL_PROPAGATION)

Control signal propagation.

Syntax

I_MPI_JOB_SIGNAL_PROPAGATION=<*arg*>

Deprecated Syntax

MPIEXEC_SIGNAL_PROPAGATION=<*arg*>

Arguments

<*arg*>	Binary indicator
enable | yes | on | 1	Turn on propagation.

disable | no | off | 0	Turn off propagation. This is the default value

Description

Set this environment variable to control propagation of the signals (SIGINT, SIGALRM, and SIGTERM) that may be received by the MPD daemons. If signal propagation is enabled, the received signal is sent to all processes of the MPI job. If signal propagation is disabled, all processes of the MPI job are stopped with the default signal 9 (SIGKILL).

I_MPI_OUTPUT_CHUNK_SIZE

Set the size of the stdout/stderr output buffer.

Syntax

I_MPI_OUTPUT_CHUNK_SIZE=*<size>*

Arguments

<size>	Define output chunk size in kilobytes
<n> > 0	The default chunk size value is 1 KB

Description

Set this environment variable to increase the size of the buffer used to intercept the standard output and standard error streams from the processes. If the *<size>* value is not greater than zero, the environment variable setting is ignored and a warning message is displayed.

Use this setting for applications that create significant amount of output from different processes. With the -ordered-output mpiexec option, this setting helps to prevent the output from garbling.

NOTE: Set the I_MPI_OUTPUT_CHUNK_SIZE environment variable in the shell environment before executing the mpiexec command. Do not use the -genv or -env options for setting the *<size>* value. Those options are used only for passing environment variables to the MPI process environment.

I_MPI_PMI_EXTENSIONS

Turn on/off the use of the Intel® MPI Library Process Management Interface (PMI) extensions.

Syntax

I_MPI_PMI_EXTENSIONS=*<arg>*

Arguments

<arg>	Binary indicator
enable | yes | on | 1	Turn on the PMI extensions
disable | no | off | 0	Turn off the PMI extensions

Description

The Intel® MPI Library automatically detects if your process manager supports the PMI extensions. If supported, the extensions substantially decrease task startup time. Set I_MPI_PMI_EXTENSIONS to disable if your process manager does not support these extensions.

I_MPI_JOB_FAST_STARTUP

(I_MPI_PMI_FAST_STARTUP)

Turn on/off the faster Intel® MPI Library process startup algorithm.

Syntax

`I_MPI_JOB_FAST_STARTUP=<arg>`

Deprecated Syntax

`I_MPI_PMI_FAST_STARTUP=<arg>`

Arguments

<arg>	Binary indicator
`enable | yes | on | 1`	Turn on the algorithm for fast startup. This is the default value
`disable | no | off | 0`	Turn off the algorithm for fast startup

Description

The new algorithm significantly decreases the application startup time. Some DAPL providers may be overloaded during startup of large number of processes (greater than 512). To avoid this problem, turn off this algorithm by setting the `I_MPI_JOB_FAST_STARTUP` environment variable to `disable`.

TOTALVIEW*

Select a particular TotalView* executable file to use.

Syntax

`TOTALVIEW=<path>`

Arguments

<path>	Path/name of the TotalView* executable file instead of the default `totalview`

Description

Set this environment variable to select a particular TotalView* executable file.

IDB_HOME

Set the Intel® Debugger installation directory path.

Syntax

`IDB_HOME=<path>`

Arguments

<path>	Specify the installation directory of the Intel® Debugger

Description

Set this environment variable to specify the installation directory of the Intel® Debugger.

2.4.2 Configuration Files

$HOME/.mpd.conf

This optional configuration file contains an `mpd` daemon password. Create it before setting up the `mpd` daemons. Use it to control access to the daemons by various Intel® MPI Library users.

Syntax

The file has a single line:

`secretword=<mpd password>`

or

`MPD_SECRETWORD=<mpd password>`

Description

An arbitrary `<mpd password>` string only controls access to the `mpd` daemons by various cluster users. Do not use Linux* OS login passwords here.

Place the `$HOME/.mpd.conf` file on a network-mounted file system, or replicate this file so that it is accessible as `$HOME/.mpd.conf` on all nodes of the cluster.

When `mpdboot` is executed by some non-root `<user>`, this file should have user and ownership set to `<user>` and `<<user>'s group>` accordingly. The access permissions should be set to `600` mode (only user has read and write privileges).

NOTE: `MPD_SECRETWORD` is a synonym for `secretword`.

mpd.hosts

This file has a list of node names which the `mpdboot` command uses to start `mpd` daemons.

Ensure that this file is accessible by the user who runs `mpdboot` on the node where the `mpdboot` command is actually invoked.

Syntax

The format of the `mpd.hosts` file is a list of node names, one name per line. Blank lines and the portions of any lines that follow a `#` character are ignored.

2.4.3 Environment Variables

I_MPI_JOB_CONFIG_FILE

(I_MPI_MPD_CONF)

Set the path/name of the `mpd` configuration file.

Syntax

`I_MPI_JOB_CONFIG_FILE=<path/name>`

Deprecated Syntax

`I_MPI_MPD_CONF=<path/name>`

Arguments

`<path/name>`	Absolute path of the MPD configuration file

Description

Set this environment variable to define the absolute path of the file that is used by the `mpdboot` script instead of the default value `${HOME}/.mpd.conf`.

I_MPI_JOB_CONTEXT

(MPD_CON_EXT)

Set a unique name for the `mpd` console file. This enables you to run several `mpd` rings under the same user account.

Syntax

`I_MPI_JOB_CONTEXT=<tag>`

Deprecated Syntax

`MPD_CON_EXT=<tag>`

Arguments

<tag>	Unique MPD identifier

Description

Set this environment variable to different unique values to allow several MPD rings to co-exist. Each MPD ring is associated with a separate `I_MPI_JOB_CONTEXT` value. Once this environment variable is set, you can start one MPD ring and work with it without affecting other available MPD rings. Set the appropriate `I_MPI_JOB_CONTEXT` value to work with a particular MPD ring. See *Simplified Job Startup Command* to learn about an easier way to run several Intel® MPI Library jobs at once.

I_MPI_JOB_TAGGED_PORT_OUTPUT

Turn on/off the use of the tagged `mpd` port output.

Syntax

`I_MPI_JOB_TAGGED_PORT_OUTPUT=<arg>`

Arguments

<arg>	Binary indicator
`enable | yes | on | 1`	Turn on the tagged output. This is the default value
`disable | no | off | 0`	Turn off the tagged output

Description

The tagged output format works at the `mpdboot` stage and prevents a failure during startup due to unexpected output from a remote shell like `ssh`. `mpdboot` sets this environment variable to `1` automatically. Set `I_MPI_JOB_TAGGED_PORT_OUTPUT` to `disable` if you do not want to use the new format.

I_MPI_MPD_CHECK_PYTHON

Turn on/off the Python* versions check at the MPD ring startup stage.

Syntax

`I_MPI_MPD_CHECK_PYTHON=<arg>`

Arguments

<arg>	Binary indicator

enable | yes | on | 1	Check for Python version compatibility
disable | no | off | 0	Do not check the Python version compatibility. This is the default value

Description

Set this environment variable to enable compatibility checking of Python versions installed on the cluster nodes. This may lead to increased MPD ring startup time. The MPD behavior is undefined if incompatible Python versions are installed on the cluster.

If I_MPI_MPD_CHECK_PYTHON is set to enable and the compatibility check fails, mpdboot exits abnormally and print a diagnostic message. An MPD ring is not started.

I_MPI_MPD_RSH

Set the remote shell to start mpd daemons.

Syntax

I_MPI_MPD_RSH =<*arg*>

Arguments

<*arg*>	String parameter
<*remote shell*>	The remote shell

Description

Set this environment variable to define the default setting for the --rsh *mpdboot* option. If --rsh is explicitly called in the command line, the I_MPI_MPD_RSH environment variable has no effect. The --rsh option assumes the value of the I_MPI_MPD_RSH environment variable if this variable is defined.

I_MPI_MPD_TMPDIR

TMPDIR

Set a temporary directory for the MPD subsystem.

Syntax

I_MPI_MPD_TMPDIR=<*arg*>

TMPDIR=<*arg*>

Arguments

<*arg*>	String parameter
<*directory name*>	A string that points to a scratch space location. The default value is /tmp

Description

Set one of these environment variables to specify an alternative scratch space location. The MPD subsystem creates its own files in the directory specified by these environment variables. If both environment variables point to valid directories, the value of the TMPDIR environment variable is ignored.

NOTE: The `mpd2.console_*` file full path length can be limited in some operating systems. You hit this limitation if you get the following diagnostic message: `socket.error: AF_UNIX path too long`. Decrease the length of the *<directory name>* string to avoid this issue.

NOTE: If *<arg>* points to a distributed file system (PANFS, PVFS, etc.), the `mpd` demons may not start. If this happens, set the `I_MPI_MPD_TMPDIR` and `TMPDIR` to point to a standard file system (ext2, ext3, NFS, etc.).

I_MPI_MPD_CLEAN_LOG

Control the removal of the log file upon MPD termination.

Syntax

`I_MPI_MPD_CLEAN_LOG=`*<value>*

Arguments

<value>	Define the value
`enable | yes | on | 1`	Remove the log file
`disable | no | off | 0`	Keep the log file. This is the default value

Description

Set this environment variable to define the `mpdallexit` behavior. If you enable this environment variable, the `mpdallexit` removes the log file created during its execution. If you disable this environment variable, the `mpdallexit` keeps the log file.

NOTE:

2.5 Processor Information Utility

cpuinfo

The `cpuinfo` utility provides processor architecture information.

Syntax

```
cpuinfo [[-]<options>]]
```

Arguments

`<options>`	Sequence of one-letter options. Each option is responsible for the specific part of printed data
`g`	General information about single cluster node
`i`	Logical processors identification
`d`	Node decomposition table
`c`	Cache sharing by logical processors
`s`	Microprocessor signature hexadecimal fields (Intel platform notation)
`f`	Microprocessor feature flags (Intel platform notation)
`A`	Replacer of all available options union
`gidc`	Default sequence
`?`	Utility usage info

Description

The `cpuinfo` utility prints out the processor architecture information that can be used to define suitable process pinning settings. The output consists of a number of tables. Each table corresponds to one of the single options listed in the arguments table. See the following examples.

- **General information about single node** shows the processor product name, number of packages/sockets on the node, core and threads numbers on the node and within each package, and SMT mode enabling.
- **Logical processor identification** table identifies threads, cores, and packages of each logical processor accordingly.

  Processor – logical processor number.
  Thread Id – unique processor identifier within a core.
  Core Id – unique core identifier within a package.
  Package Id – unique package identifier within a node.
- **Node decomposition table** shows the node contents. Each entry contains the information on packages, cores, and logical processors.

  Package Id – physical package identifier.
  Cores Id – list of core identifiers that belong to this package.
  Processors Id – list of processors that belong to this package. This list order directly corresponds to the core list. A group of processors enclosed in brackets belongs to one core.
- **Cache sharing by logical processors** shows information of sizes and processors groups, which share particular cache level.

  Size – cache size in bytes.
  Processors – a list of processor groups enclosed in the parentheses those share this cache or *no sharing* otherwise.

- **Microprocessor signature** table shows signature values: extended family, extended model, family, model, type, and stepping.
- **Microprocessor feature flags** indicate what features the microprocessor supports. The Intel platform notation is used.

NOTE: The architecture information is available on systems based on the IA-32 and Intel® 64 architectures.

The `cpuinfo` utility is available for both Intel® microprocessors and non-Intel microprocessors, but it may provide only partial information about non-Intel microprocessors.

Examples

`cpuinfo` output for the processor of Intel® microarchitecture code name Sandy Bridge:

```
$ cpuinfo A

Intel(R) Processor information utility, Version 4.0 Update 3 Build 20110526
Copyright (C) 2005-2011 Intel Corporation.  All rights reserved.

=====  Processor composition  =====
Processor name    : Genuine Intel(R)
Packages(sockets) : 2
Cores             : 16
Processors(CPUs)  : 32
Cores per package : 8
Threads per core  : 2

=====  Processor identification  =====
Processor       Thread Id.    Core Id.          Package Id.
0               0             0                       0
1               0             1                       0
2               0             2                       0
3               0             3                       0
4               0             4                       0
5               0             5                       0
6               0             6                       0
7               0             7                       0
8               0             0                       1
9               0             1                       1
10              0             2                       1
11              0             3                       1
12              0             4                       1
13              0             5                       1
14              0             6                       1
15              0             7                       1
16              1             0                       0
17              1             1                       0
18              1             2                       0
19              1             3                       0
20              1             4                       0
21              1             5                       0
22              1             6                       0
23              1             7                       0
24              1             0                       1
25              1             1                       1
26              1             2                       1
27              1             3                       1
28              1             4                       1
29              1             5                       1
30              1             6                       1
31              1             7                       1
```

```
=====  Placement on packages  =====
Package Id.     Core Id.      Processors
0               0,1,2,3,4,5,6,7       (0,16)(1,17)(2,18)(3,19)(4,20)(5,21)(6,22)(7,23)
1               0,1,2,3,4,5,6,7       (8,24)(9,25)(10,26)(11,27)(12,28)(13,29)(14,30)(15,31)

=====  Cache sharing  =====
Cache  Size     Processors
L1          32 KB       (0,16)(1,17)(2,18)(3,19)(4,20)(5,21)(6,22)(7,23)(8,24)(9,25)(10,26)(11,27)(12,28)(13,29)(14,30)(15,31)
L2          256 KB      (0,16)(1,17)(2,18)(3,19)(4,20)(5,21)(6,22)(7,23)(8,24)(9,25)(10,26)(11,27)(12,28)(13,29)(14,30)(15,31)
L3          20  MB      (0,1,2,3,4,5,6,7,16,17,18,19,20,21,22,23)(8,9,10,11,12,13,14,15,24,25,26,27,28,29,30,31)

=====  Processor Signature  =====
 _________ ________ ______ ________ _______ _____________
| xFamily | xModel | Type | Family | Model | Stepping |
|_________|________|______|________|_______|_____________|
| 00      | 0      | 2    | 6      | d     | 3        |
|_________|________|______|________|_______|_____________|

=====  Processor Feature Flags  =====
 _____ ___________ ________ _________ ________ _____ _____ _____ _____ _______ _________ _____ _____ _____
| SSE3 | PCLMULDQ | DTES64 | MONITOR | DS-CPL | VMX | SMX | EIST | TM2 | SSSE3 | CNXT-ID | FMA | CX16 | xTPR |
|______|__________|________|_________|________|_____|_____|______|_____|_______|_________|_____|______|______|
| 1    | 1        | 1      | 1       | 1      | 1   | 1   | 1    | 1   | 1     | 0       | 0   | 1    | 1    |
|______|__________|________|_________|________|_____|_____|______|_____|_______|_________|_____|______|______|

 _____ _____ _____ ________ ________ ________ _______ ________ _____________ _____ _______ _________ _____
| PDCM | PCID | DCA | SSE4.1 | SSE4.2 | x2APIC | MOVBE | POPCNT | TSC-DEADLINE | AES | XSAVE | OSXSAVE | AVX |
|______|______|_____|________|________|________|_______|________|______________|_____|_______|_________|_____|
| 1    | 1    | 1   | 1      | 1      | 1      | 0     | 1      | 1            | 1   | 1     | 1       | 1   |
|______|______|_____|________|________|________|_______|________|______________|_____|_______|_________|_____|

 _____ _____ ____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ ________
| FPU | VME | DE | PSE | TSC | MSR | PAE | MCE | CX8 | APIC | SEP | MTRR | PGE | MCA | CMOV | PAT | PSE-36 |
|_____|_____|____|_____|_____|_____|_____|_____|_____|______|_____|______|_____|_____|______|_____|________|
| 1   | 1   | 1  | 1   | 1   | 1   | 1   | 1   | 1   | 1    | 1   | 1    | 1   | 1   | 1    | 1   | 1      |
|_____|_____|____|_____|_____|_____|_____|_____|_____|______|_____|______|_____|_____|______|_____|________|

 _____ _______ ____ ______ _____ _______ _____ ______ ____ _____ ____ _____
| PSN | CLFSH | DS | ACPI | MMX | FXSR | SSE | SSE2 | SS | HTT | TM | PBE |
|_____|_______|____|______|_____|______|_____|______|____|_____|____|_____|
| 0   | 1     | 1  | 1    | 1   | 1    | 1   | 1    | 1  | 1   | 1  | 1   |
|_____|_______|____|______|_____|______|_____|______|____|_____|____|_____|
```

3 Tuning Reference

The Intel® MPI Library provides an automatic tuning utility to help you select optimal values for many environment variables that can be used to influence program behavior and performance at run time.

3.1 Automatic Tuning Utility

mpitune

Use the `mpitune` utility to find optimal settings for the Intel® MPI Library relevant to your cluster configuration or your application.

Syntax

```
mpitune  [ -a \"<application command line>\" ] [ -of <file-name> ] \
         [ -t \"<test_cmd_line>\" ] [ -cm ] [ -d ] [ -D ] \
         [ -dl [d1[,d2…[,dN]]] ] [ -fl [f1[,f2…[,fN]]] ] [ -er ] \
         [ -hf <hostsfile> ] [ -h ] [ -hr {min:max|min:|:max} ] \
         [ -i <count> ] [ -mr {min:max|min:|:max} ] [ -od <outputdir> ] \
         [ -odr <outputdir> ] [ -r <rshcmd> ] [ -pr {min:max|min:|:max} ] \
         [ -sf [file-path] ] [ -ss ] [ -s ] [ -td <dir-path> ] \
         [ -tl <minutes> ] [ -mh ] [ -os <opt1,…,optN> ] \
         [ -oe <opt1,…,optN> ] [ -V ] [ -vi {percent} ; -vix {X factor} ] \
         [ -zb ] [ -t ] [ -so ] [ -ar \"reg-expr\" ] [ -trf <appoutfile> ] \
         [ -m {base|optimized} ] [ -avd {min|max} ] [ -pm {mpd|hydra} ] \
         [ -co ] [ -sd ] [ -soc ]
```

or

```
mpitune  [ --application \"<app_cmd_line>\" ] [ --output-file <file-name> ] \
         [ --test \"<test_cmd_line>\" ] [ --cluster-mode ] [ --debug ] \
         [ --distinct ] [ --device-list[d1[,d2,… [,dN]]] ] \
         [ --fabric-list [f1[,f2…[,fN]]] ] [ --existing-ring ] \
         [ --host-file <hostsfile> ] [ --help ] \
         [ --host-range {min:max|min:|:max} ] [ --iterations <count> ] \
         [ --message-range {min:max|min:|:max} ] \
         [ --output-directory <outputdir> ] \
         [ --output-directory-results <outputdir> ] [ --rsh <rshcmd> ] \
         [ --ppn-range {min:max|min:|:max} ;
           --perhost-range {min:max|min:|:max} ] \
         [ --session-file [file-path] ] [ --show-session ] [ --silent ] \
```

```
[ --temp-directory <dir-path> ] [ --time-limit <minutes> ] \
[ --master-host ] [ --options-set <opt1,…,optN> ] \
[ --options-exclude <opt1,…,optN> ] [ --version ] \
[ --valuable-improvement ; --valuable-improvement-x   {X factor} ] \
[ --zero-based ] [ --trace] [ --scheduler-only ] \
[ --application-regexp \"reg-expr\" ] \
[ --test-regexp-file <appoutfile> ] [ --model {base|optimized} ] \
[ --application-value-direction {min|max} ] \
[ --process-manager {mpd|hydra} ] [ -co ] [ -sd ] [ -soc ]
```

Arguments

-a \"<app_cmd_line>\" | --application \"<app_cmd_line>\"	Switch on the application-specific mode. Quote the full command line as shown including the backslashes
-of <file-name> | --output-file <file-name>	Specify the name of the application configuration file to be generated in the application-specific mode. By default, use the file name $PWD/app.conf
-t \"<test_cmd_line>\" | --test \"<test_cmd_line>\"	Replace the default Intel® MPI Benchmarks by the indicated benchmarking program in the cluster-specific mode. Quote the full command line as shown including the backslashes
-cm {exclusive|full} | --cluster-mode {exclusive|full}	Set the cluster usage mode full – maximum number of tasks are executed. This is the default mode exclusive – only one task is executed on the cluster at a time
-d | --debug	Print out the debug information
-D | --distinct	Tune all options separately from each other. This argument is applicable only for the cluster-specific mode
-dl [d1[,d2…[,dN]]] | --device-list [d1[,d2,…[,dN]]]	Select the device(s) you want to tune. Any previously set fabrics are ignored.. By default, use all devices listed in the <installdir>/<arch>/etc/devices.xml file
-fl [f1[,f2…[,fN]]] | --fabric-list [f1[,f2…[,fN]]]	Select the fabric(s) you want to tune. Any previously set devices are ignored. By default, use all fabrics listed in the <installdir>/<arch>/etc/fabrics.xml file
-er | --existing-ring	Use an existing MPD ring. By default, a new MPD ring is created. This argument is applicable only if I_MPI_PROCESS_MANAGER is set to mpd.
-hf <hostsfile> | --host-file <hostsfile>	Specify an alternative host file name. By default, use the $PWD/mpd.hosts
-h | --help	Display the help message
-hr {min:max|min:|:max} | --host-range {min:max|min:|:max}	Set the range of hosts used for testing. The default minimum value is 1. The default maximum value is the number of hosts defined by the mpd.hosts or the existing MPD ring. The min: or :max format uses the default values as appropriate
-i <count> | --iterations <count>	Define how many times to run each tuning step. Higher iteration counts increase the tuning time, but may also

	increase the accuracy of the results. The default value is 3
-mr {min:max|min:|:max} | --message-range {min:max|min:|:max}	Set the message size range. The default minimum value is 0. The default maximum value is 4194304 (4mb). By default, the values are given in bytes. They can also be given in the following format: 16kb, 8mb or 2gb. The min: or :max format uses the default values as appropriate
-od <outputdir> | --output-directory <outputdir>	Specify the directory name for all output files: log-files, session-files, local host-files and report-files. By default, use the current directory. This directory should be accessible from all hosts
-odr <outputdir> | --output-directory-results <outputdir>	Specify the directory name for the resulting configuration files. By default, use the current directory in the application-specific mode and the <installdir>/<arch>/etc in the cluster-specific mode. If <installdir>/<arch>/etc is unavailable, $PWD is used as the default value in the cluster-specific mode
-r <rshcmd> | --rsh <rshcmd>	Specify the remote shell used to start daemons (as applicable) and jobs. The default value is ssh.
-pr {min:max|min:|:max} | --ppn-range {min:max|min:|:max} | --perhost-range {min:max|min:|:max}	Set the maximum number of processes per host. The default minimum value is 1. The default maximum value is the number of cores of the processor. The min: or :max format uses the default values as appropriate
-sf [file-path] | --session-file [file-path]	Continue the tuning process starting from the state saved in the file-path session file
-ss | --show-session	Show information about the session file and exit. This option works only jointly with the –sf option
-s | --silent	Suppress all diagnostics
-td <dir-path> | --temp-directory <dir-path>	Specify a directory name for the temporary data. Use $PWD/mpitunertemp by default. This directory should be accessible from all hosts
-tl <minutes> | --time-limit <minutes>	Set mpitune execution time limit in minutes. The default value is 0, which means no limitations
-mh | --master-host	Dedicate a single host to run the mpitune
-os <opt1,…,optN>| --options-set <opt1,…,optN>	Use mpitine to tune the only required options you have set in the option values
-oe <opt1,…,optN>| --options-exclude <opt1,…,optN>	Exclude the settings of the indicated Intel® MPI Library options from the tuning process
-V | --version	Print out the version information
-vi {percent} | --valuable-improvement {percent} -vix {X factor} | --valuable-improvement-x	Control the threshold for performance improvement. The default threshold is 3%

{X factor}	
-zb | --zero-based	Set zero as the base for all options before tuning. This argument is applicable only for the cluster-specific mode
-t | --trace	Print out error information such as error codes and tuner traceback
-so | --scheduler-only	Create the list of tasks to be executed, display the tasks, and terminate execution
-ar \"reg-expr\" | --application-regexp \"reg-expr\"	Use reg-expr to determine the performance expectations of the application. This option is applicable only for the application-specific mode. The reg-expr setting should contain only one group of numeric values which is used by mpitune for analysis. Use backslash for symbols when setting the value of this argument in accordance with the operating system requirements
-trf <appoutfile> | --test-regexp-file <appoutfile>	Use a test output file to check the correctness of the regular expression. This argument is applicable only for the cluster-specific mode when you use the -ar option
-m {base|optimized} | --model {base|optimized}	Specify the search model: • Set base to use the old model • Set optimized to use the new faster search model. This is the default value
-avd {min|max} | --application-value-direction {min|max}	Specify the direction of the value optimization : • Set min to specify that lower is better. For example, use this value when optimizing the wall time • Set max to specify that higher is better. For example, use this value when optimizing the solver ratio
-pm {mpd|hydra} | --process-manager {mpd|hydra}	Specify the process manager used to run the benchmarks. The default value is hydra
-co | --collectives-only	Tune collective operations only
-sd | --save-defaults	Use mpitune to save the default values of the Intel® MPI Library options
-soc | --skip-options-check	Specify whether to check the command line options

Deprecated Options

Deprecated Option	New Option
--outdir	-od | --output-directory
--verbose	-d | --debug
--file	-hf | --host-file
--logs	-lf | --log-file
--app	-a | --application

Description

Use the mpitune utility to create a set of Intel® MPI Library configuration files that contain optimal settings for a particular cluster or application. You can reuse these configuration files in the mpirun job launcher by using the -tune option. If configuration files from previous mpitune sessions exist, mpitune creates a copy of the existing files before starting execution.

The MPI tuner utility operates in two modes:

- Cluster-specific, evaluating a given cluster environment using either the Intel® MPI Benchmarks or a user-provided benchmarking program to find the most suitable configuration of the Intel® MPI Library. This mode is used by default.
- Application-specific, evaluating the performance of a given MPI application to find the best configuration for the Intel® MPI Library for the particular application. Application tuning is enabled by the `--application` command line option.

3.1.1 Cluster-specific Tuning

Run this utility once after the Intel® MPI Library installation and after every cluster configuration change (processor or memory upgrade, network reconfiguration, etc.). Do this under the user account that was used for the Intel® MPI Library installation or appropriately set the tuner data directory through the `--output-directory` option and the results directory through the `--output-directory-results` option.

If there are any configuration files in the *<installdir>/<arch>*`/etc` directory, the recorded Intel® MPI Library configuration settings are used automatically by `mpiexec` with the `-tune` option.

For example:

- Collect configuration settings for the cluster hosts listed in the `./mpd.hosts` file by using the Intel® MPI Benchmarks

  ```
  $ mpitune
  ```

- Use the optimal recorded values when running on the cluster

  ```
  $ mpiexec -tune -n 32 ./myprog
  ```

The job launcher finds a proper set of configuration options based on the following execution conditions: communication fabrics, number of hosts and processes, etc. If you have write access permission for `<installdir>/<arch>/etc`, all generated files are saved in this directory; otherwise the current working directory is used.

3.1.1.1 Replacing the Default Benchmark

This tuning feature is an extension of the cluster-specific tuning mode in which you specify a benchmarking application that will be used for tuning.

The Intel® MPI Benchmarks executables, which are more optimized for Intel microprocessors than for non-Intel microprocessors, are used by default. This may result in different tuning settings on Intel microprocessors than on non-Intel microprocessors.

For example:

1. Collect the configuration settings for the cluster hosts listed in the `./mpd.hosts` file by using the desired benchmarking program

   ```
   $ mpitune –-test \”benchmark –param1 –param2\”
   ```

2. Use the optimal recorded values for your cluster

   ```
   $ mpiexec -tune -n 32 ./myprog
   ```

3.1.2 Application-specific Tuning

Run the tuning process for any kind of MPI application by specifying its command line to the tuner. Performance is measured as inversed execution time of the given application. To reduce the overall tuning time, use the shortest representative application workload if applicable.

For example:

1. Collect configuration settings for the given application

```
$ mpitune --application \"mpiexec -n 32 ./myprog\" –of ./myprog.conf
```

2. Use the optimal recorded values for your application

```
$ mpiexec –tune ./myprog.conf -n 32 ./myprog
```

Based on the default tuning rules, the automated tuning utility evaluates a full set of the library configuration parameters to minimize the application execution time. By default, all generated files will be saved in the current working directory.

NOTE: The resulting application configuration file contains the optimal Intel® MPI Library parameters for this application only. If you want to tune the Intel® MPI Library for the same application in a different configuration (number of hosts, workload, etc.), you may need to rerun the automated tuning utility by using the desired configuration.

The automated tuning utility will overwrite the existing application configuration files by default. You should use a naming convention for your various application files to create and select the correct file when you need it.

3.1.3 Tuning Utility Output

Upon completion of the tuning process, the Intel® MPI Library tuning utility records the chosen values in the configuration file in the following format:

```
-genv I_MPI_DYNAMIC_CONNECTION 1
-genv I_MPI_ADJUST_REDUCE 1:0-8
```

The Intel MPI Library tuning utility ignores any environment variables that have no effect on the application when the difference between probes is at the noise level (1%). In this case, the utility does not set the environment variable and preserves the default library heuristics.

In the case of the tuning application having significant run-to-run performance variation, the Intel MPI Library tuning utility might select divergent values for the same environment variable under the same conditions. To improve decision accuracy, increase the number of iterations for each test run with the `--iterations` command line option. The default value for the iteration number is `3`.

3.2 Process Pinning

Use this feature to pin particular MPI process to a corresponding CPU and avoid undesired process migration. This feature is available on operating systems that provide the necessary kernel interfaces.

3.2.1 Process Identification

Two schemes are used to identify logical processors in a system:

1. System-defined logical enumeration

2. Topological enumeration based on three-level hierarchical identification through triplets (package/socket, core, thread)

The number of a logical CPU is defined as the corresponding position of this CPU bit in the kernel affinity bit-mask. Use the `cpuinfo` utility, provided with your Intel MPI Library installation, or the `cat /proc/cpuinfo` command to find out the logical CPU numbers.

The three-level hierarchical identification uses triplets that provide information about processor location and their order. The triplets are hierarchically ordered (package, core, and thread).

See the example below for one possible processor numbering scenario with two sockets, four cores (two cores per socket), and eight logical processors (two processors per core).

NOTE: Logical and topological enumerations are not the same.

Table 3.2-1 Logical Enumeration

0	4	1	5	2	6	3	7

Table 3.2-2 Hierarchical Levels

Socket	0	0	0	0	1	1	1	1
Core	0	0	1	1	0	0	1	1
Thread	0	1	0	1	0	1	0	1

Table 3.2-3 Topological Enumeration

0	1	2	3	4	5	6	7

Use the `cpuinfo` utility to identify the correspondence between the logical and topological enumerations. See *Processor Information Utility* for more details.

3.2.2 Environment Variables

I_MPI_PIN

Turn on/off process pinning.

Syntax

`I_MPI_PIN=<arg>`

Arguments

`<arg>`	Binary indicator
`enable | yes | on | 1`	Enable process pinning. This is the default value
`disable | no | off | 0`	Disable processes pinning

Description

Set this environment variable to turn off the process pinning feature of the Intel® MPI Library.

I_MPI_PIN_MODE

Choose the pinning method.

Syntax

I_MPI_PIN_MODE=<pinmode>

Arguments

<pinmode>	Choose the CPU pinning mode
mpd	Pin processes inside the MPD. This is the default value on the SGI* Altix* platform
lib	Pin processes inside the Intel MPI Library. This is the default value on other platforms

Description

Set the I_MPI_PIN_MODE environment variable to choose the pinning method. This environment variable is valid only if the I_MPI_PIN environment variable is enabled.

Set this environment variable to lib to make the Intel® MPI Library pin the processes. In this mode there is no chance to co-locate the process CPU and its memory.

Set the I_MPI_PIN_MODE environment variable to mpd to make the mpd daemon pin processes through system specific means, if they are available. The pinning is done before the MPI process launch. Therefore, it is possible to co-locate the process CPU and memory in this case. This pinning method has an advantage over a system with Non-Uniform Memory Architecture (NUMA) like SGI* Altix*. Under NUMA, a processor can access its own local memory faster than non-local memory.

NOTE: It is not recommended to change the default settings.

I_MPI_PIN_PROCESSOR_LIST (I_MPI_PIN_PROCS)

Define a processor subset and the mapping rules for MPI processes within this subset.

Syntax

I_MPI_PIN_PROCESSOR_LIST=<value>

The environment variable value has three syntax forms:

1. <proclist>
2. [<procset>] [:[grain=<grain>] [,shift=<shift>]\
   [,preoffset=<preoffset>] [,postoffset=<postoffset>]
3. [<procset>][:map=<map>]

Deprecated Syntax

I_MPI_PIN_PROCS=<proclist>

NOTE: The postoffset keyword has offset alias.

NOTE: The second form of the pinning procedure has three steps:

1. Cyclic shift of the source processor list on preoffset*grain value.
2. Round robin shift of the list derived on the first step on shift*grain value.
3. Cyclic shift of the list derived on the second step on the postoffset*grain value.

The resulting processor list is used for the consecutive mapping of MPI processes (i-th rank is mapped to the i-th list member).

NOTE: The grain, shift, preoffset, and postoffset parameters have a unified definition style.

This environment variable is available for both Intel® and non-Intel microprocessors, but it may perform additional optimizations for Intel microprocessors than it performs for non-Intel microprocessors.

Arguments

<proclist>	A comma-separated list of logical processor numbers and/or ranges of processors. The process with the i-th rank is pinned to the i-th processor in the list. The number should not exceed the amount of processors on a node
<l>	Processor with logical number *<l>*
<l>-<m>	Range of processors with logical numbers from *<l>* to *<m>*
<k>,<l>-<m>	Processors *<k>*, as well as *<l>* through *<m>*

<procset>	Specify a processor subset based on the topological numeration. The default value is `allcores`
`all`	All logical processors. This subset is defined to be the number of CPUs on a node
`allcores`	All cores (physical CPUs). This subset is defined to be the number of cores on a node. This is the default value. If Intel® Hyper-Threading Technology is disabled, `allcores` equals to `all`
`allsocks`	All packages/sockets. This subset is defined to be the number of sockets on a node

<map>	The mapping pattern used for process placement
`bunch`	The processes are mapped as close as possible on the sockets
`scatter`	The processes are mapped as remotely as possible so as not to share common resources: FSB, caches, core
`spread`	The processes are mapped consecutively with the possibility not to share common resources

<grain>	Specify the pinning granularity cell for a defined *<procset>*. The minimal *<grain>* is a single element of the *<procset>*. The maximal grain is the number of *<procset>* elements in a socket. The *<grain>* value must be a multiple of the *<procset>* value. Otherwise, minimal grain is assumed. The default value is the minimal *<grain>*
<shift>	Specify the round robin shift of the granularity cells for the *<procset>*. *<shift>* is measured in the defined *<grain>* units. The *<shift>* value must be positive integer. Otherwise, no shift is performed. The default value is no shift
<preoffset>	Specify the cyclic shift of the processor subset *<procset>* defined before the round robin shifting on the *<preoffset>* value. The value is measured in the defined *<grain>* units. The *<preoffset>* value must be non negative integer. Otherwise, no shift is performed. The default

	value is no shift
<postoffset>	Specify the cyclic shift of the processor subset <procset> derived after round robin shifting on the <postoffset> value. The value is measured in the defined <grain> units. The <postoffset> value must be non-negative integer. Otherwise no shift is performed. The default value is no shift

<n>	Specify an explicit value of the corresponding parameters previously mentioned. <n> is non-negative integer
fine	Specify the minimal value of the corresponding parameter
core	Specify the parameter value equal to the amount of the corresponding parameter units contained in one core
cache1	Specify the parameter value equal to the amount of the corresponding parameter units that share an L1 cache
cache2	Specify the parameter value equal to the amount of the corresponding parameter units that share an L2 cache
cache3	Specify the parameter value equal to the amount of the corresponding parameter units that share an L3 cache
cache	The largest value among cache1, cache2, and cache3
socket | sock	Specify the parameter value equal to the amount of the corresponding parameter units contained in one physical package/socket
half | mid	Specify the parameter value equal to socket/2
third	Specify the parameter value equal to socket/3
quarter	Specify the parameter value equal to socket/4
octavo	Specify the parameter value equal to socket/8

Description

Set the I_MPI_PIN_PROCESSOR_LIST environment variable to define the processor placement. To avoid conflicts with differing shell versions, the environment variable value may need to be enclosed in quotes.

NOTE: This environment variable is valid only if I_MPI_PIN is enabled.

The I_MPI_PIN_PROCESSOR_LIST environment variable has three different syntax variants:

1. Explicit processor list. This comma-separated list is defined in terms of logical processor numbers. The relative node rank of a process is an index to the processor list such that the i-th process is pinned on i-th list member. This permits the definition of any process placement on the CPUs.

   For example, process mapping for I_MPI_PROCESSOR_LIST=p0,p1,p2,…,pn is as follows:

Rank on a node	0	1	2	…	n-1	N
Logical CPU	p0	p1	p2	…	pn-1	Pn

2. grain/shift/offset mapping. This method provides cyclic shift of a defined grain along the processor list with steps equal to shift*grain and a single shift on offset*grain at the end. This shifting action is repeated shift times.

For example: grain = 2 logical processors, shift = 3 grains, offset = 0.

Legend:

gray – MPI process grains

A) red – processor grains chosen on the 1st pass

B) cyan - processor grains chosen on the 2nd pass

C) green - processor grains chosen on the final 3rd pass

D) Final map table ordered by MPI ranks

A)

0 1			2 3			. . .	2n-2 2n-1		
0 1	2 3	4 5	6 7	8 9	10 11	. . .	6n-6 6n-5	6n-4 6n-3	6n-2 6n-1

B)

0 1	2n 2n+1		2 3	2n+2 2n+3		. . .	2n-2 2n-1	4n-2 4n-1	
0 1	2 3	4 5	6 7	8 9	10 11	. . .	6n-6 6n-5	6n-4 6n-3	6n-2 6n-1

C)

0 1	2n 2n+1	4n 4n+1	2 3	2n+2 2n+3	4n+2 4n+3	. . .	2n-2 2n-1	4n-2 4n-1	6n-2 6n-1
0 1	2 3	4 5	6 7	8 9	10 11	. . .	6n-6 6n-5	6n-4 6n-3	6n-2 6n-1

D)

0 1	2 3	…	2n-2 2n-1	2n 2n+1	2n+2 2n+3	…	4n-2 4n-1	4n 4n+1	4n+2 4n+3	… 6n-2 6n-1
0 1	6 7	…	6n-6 6n-5	2 3	8 9	…	6n-4 6n-3	4 5	10 11	… 6n-2 6n-1

3. Predefined mapping scenario. In this case popular process pinning schemes are defined as keywords selectable at runtime. There are two such scenarios: `bunch` and `scatter`.

In the `bunch` scenario the processes are mapped proportionally to sockets as closely as possible. This makes sense for partial processor loading. In this case the number of processes is less than the number of processors.

In the `scatter` scenario the processes are mapped as remotely as possible so as not to share common resources: FSB, caches, cores.

In the example below there are two sockets, four cores per socket, one logical CPU per core, and two cores per shared cache.

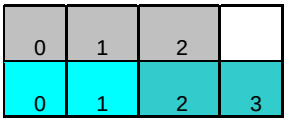
Legend:

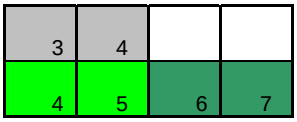
gray – MPI processes

cyan – 1st socket processors

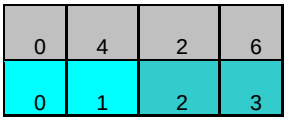
green – 2nd socket processors

Same color defines a processor pair sharing a cache





`bunch` scenario for 5 processors



`scatter` scenario for full loading

Examples

1. To pin the processes to CPU0 and CPU3 on each node globally, use the following command:
```
$ mpirun -genv I_MPI_PIN_PROCESSOR_LIST 0,3 \
         -n <# of processes> <executable>
```
2. To pin the processes to different CPUs on each node individually (CPU0 and CPU3 on host1 and CPU0, CPU1 and CPU3 on host2), use the following command:
```
$ mpirun –host host1 -env I_MPI_PIN_PROCESSOR_LIST 0,3 \
   -n <# of processes> <executable> : \
   -host host2 -env I_MPI_PIN_PROCESSOR_LIST 1,2,3 \
   -n <# of processes> <executable>
```
3. To print extra debug information about process pinning, use the following command:
```
$ mpirun –genv I_MPI_DEBUG 4 –m –host host1 \
   -env I_MPI_PIN_PROCESSOR_LIST 0,3 -n <# of processes> <executable> :\
   -host host2 -env I_MPI_PIN_PROCESSOR_LIST 1,2,3 \
   -n <# of processes> <executable>
```

NOTE: If the number of processes is greater than the number of CPUs used for pinning, the process list is wrapped around to the start of the processor list.

I_MPI_PIN_CELL

Set this environment variable to define the pinning resolution granularity. `I_MPI_PIN_CELL` specifies the minimal processor cell allocated when an MPI process is running.

Syntax

`I_MPI_PIN_CELL=<cell>`

Arguments

`<cell>`	Specify the resolution granularity
`unit`	Basic processor unit (logical CPU)
`core`	Physical processor core

Description

Set this environment variable to define the processor subset used when a process is running. You can choose from two scenarios:

- all possible CPUs in a system (`unit` value)
- all cores in a system (`core` value)

The environment variable has effect on both pinning kinds:

- one-to-one pinning through the I_MPI_PIN_PROCESSOR_LIST environment variable
- one-to-many pinning through the I_MPI_PIN_DOMAIN environment variable

The default value rules are:

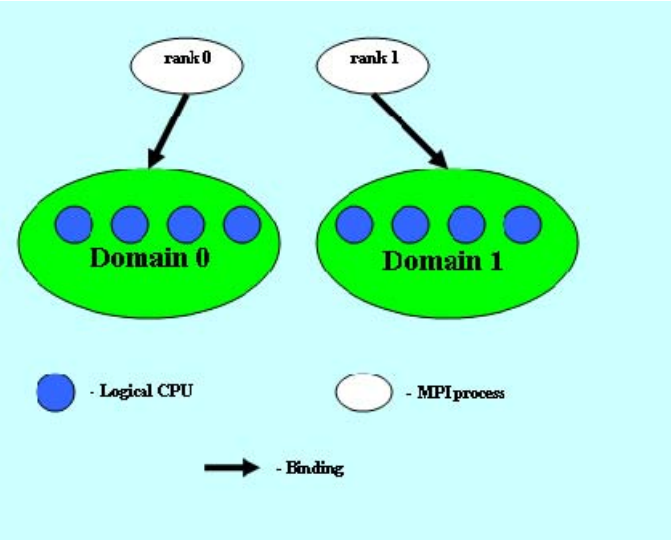
- If you use I_MPI_PIN_DOMAIN, then the cell granularity is unit.
- If you use I_MPI_PIN_PROCESSOR_LIST, then the following rules apply:
  - When the number of processes is greater than the number of cores, the cell granularity is unit.
  - When the number of processes is equal to or less than the number of cores, the cell granularity is core.

NOTE: The core value is not affected by the enabling/disabling of Hyper-threading technology in a system.

3.2.3 Interoperability with OpenMP*

I_MPI_PIN_DOMAIN

The Intel® MPI Library provides an additional environment variable to control process pinning for hybrid Intel MPI Library applications. This environment variable is used to define a number of non-overlapping subsets (domains) of logical processors on a node, and a set of rules on how MPI processes are bound to these domains by the following formula: *one MPI process per one domain*. See the picture below.



Picture 3.2-1 Domain Example

Each MPI process can create a number of children threads for running within the corresponding domain. The process threads can freely migrate from one logical processor to another within the particular domain. There are no domains defined by default so they should all be created explicitly.

If the I_MPI_PIN_DOMAIN environment variable is defined, then the I_MPI_PIN_PROCESSOR_LIST environment variable setting is ignored.

If the I_MPI_PIN_DOMAIN environment variable is not defined, then MPI processes are pinned according to the current value of the I_MPI_PIN_PROCESSOR_LIST environment variable.

The I_MPI_PIN_DOMAIN environment variable has the following syntax forms:

1. Domain description through multi-core terms
2. Domain description through domain size and domain member layout
3. Explicit domain description through bit mask

The following tables describe these syntax forms.

Multi-core Shape

I_MPI_PIN_DOMAIN=<*mc-shape*>

<*mc-shape*>	Define domains through multi-core terms
core	Each domain consists of the logical processors that share a particular core. The number of domains on a node is equal to the number of cores on the node
socket | sock	Each domain consists of the logical processors that share a particular socket. The number of domains on a node is equal to the number of sockets on the node. This is the recommended value.
node	All logical processors on a node are arranged into a single domain
cache1	Logical processors that share a particular level 1 cache are arranged into a single domain
cache2	Logical processors that share a particular level 2 cache are arranged into a single domain
cache3	Logical processors that share a particular level 3 cache are arranged into a single domain
cache	The largest domain among cache1, cache2, and cache3 is selected

Explicit Shape

I_MPI_PIN_DOMAIN=<*size*>[:<*layout*>]

<*size*>	Define a number of logical processors in each domain (domain size)
omp	The domain size is equal to the OMP_NUM_THREADS environment variable value. If the OMP_NUM_THREADS environment variable is not set, each node is treated as a separate domain.
auto	The domain size is defined by the formula size=#cpu/#proc, where #cpu is the number of logical processors on a node, and #proc is the number of the MPI processes started on a node
<*n*>	The domain size is defined by a positive decimal number <*n*>

<*layout*>	Ordering of domain members. The default value is compact
platform	Domain members are ordered according to their BIOS numbering (platform-depended numbering)
compact	Domain members are located as close to each other as possible in terms of common resources (cores, caches, sockets, etc.). This is the default value
scatter	Domain members are located as far away from each other as possible in terms of common resources (cores, caches, sockets, etc.)

Explicit Domain Mask

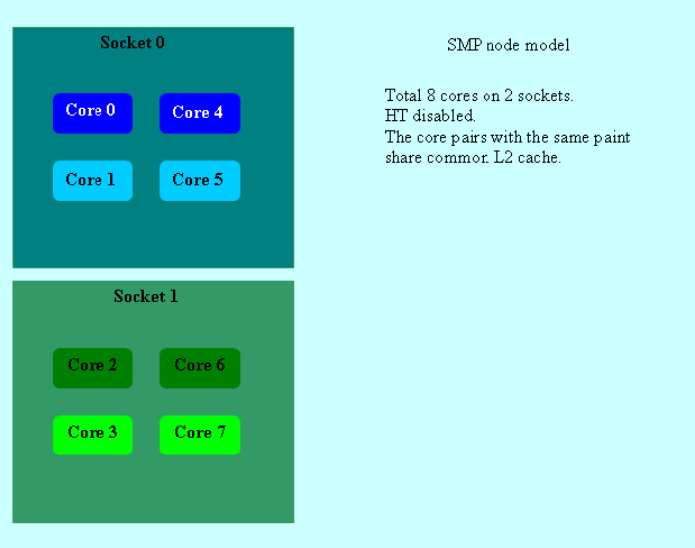
I_MPI_PIN_DOMAIN=<*masklist*>

<*masklist*>	Define domains through the comma separated list of hexadecimal numbers (domain masks)
[m_1,…,m_n]	Each m_i number defines one separate domain. The following rule is used: the i^{th} logical processor is included into the domain if the corresponding m_i value is set to 1. All remaining processors are put into a separate domain. BIOS numbering is used

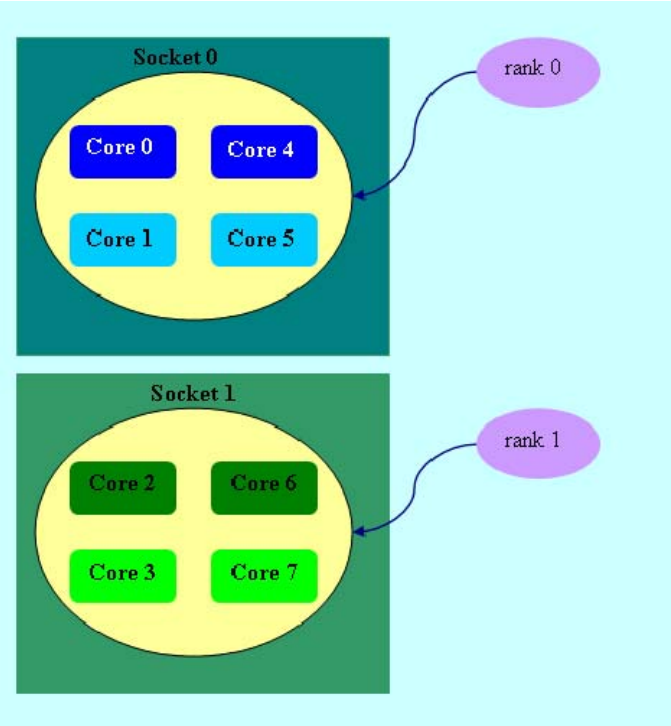
NOTE: These options are available for both Intel® and non-Intel microprocessors, but they may perform additional optimizations for Intel microprocessors than they perform for non-Intel microprocessors.

NOTE: To pin OpenMP processes/threads inside the domain, the corresponding OpenMP feature (KMP_AFFINITY environment variable) should be used.

See the following model of an SMP node in the examples below:

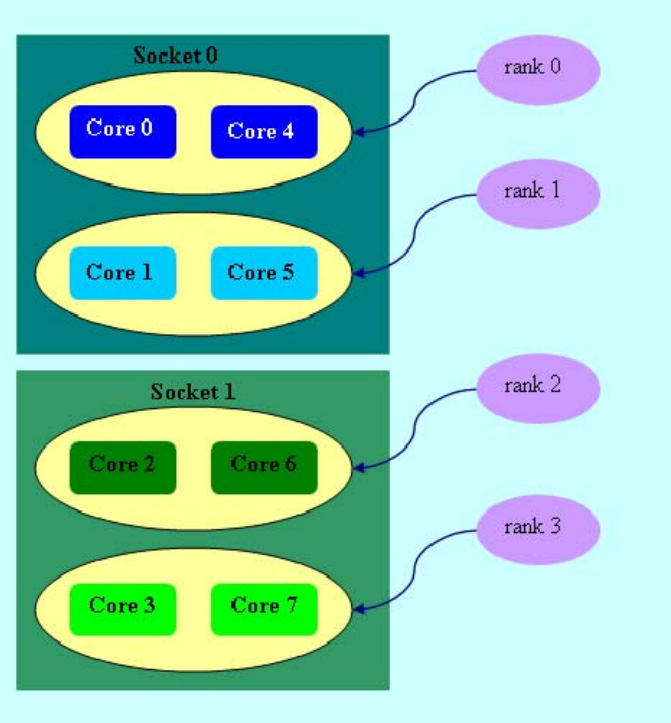


Picture 3.2-2 Model of a Node



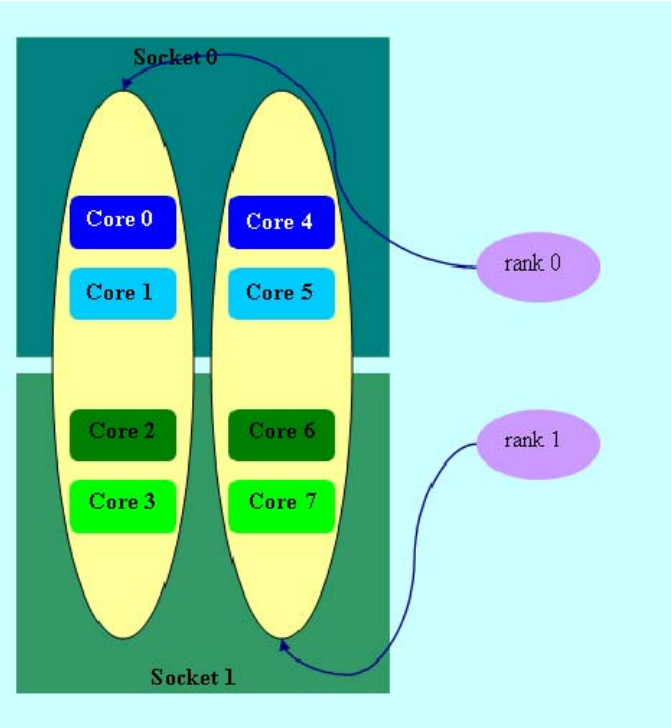
Picture 3.2-3 `mpiexec -n 2 -env I_MPI_PIN_DOMAIN socket ./a.out`

Two domains are defined according to the number of sockets. Process rank 0 can migrate on all cores on the 0-th socket. Process rank 1 can migrate on all cores on the first socket.



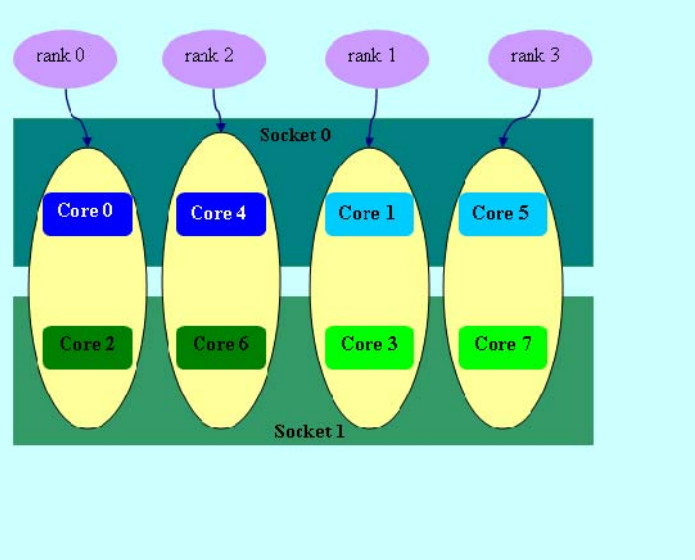
Picture 3.2-4 `mpiexec -n 4 -env I_MPI_PIN_DOMAIN cache2 ./a.out`

Four domains are defined according to the amount of common L2 caches. Process rank 0 runs on cores {0,4} that share an L2 cache. Process rank 1 runs on cores {1,5} that share an L2 cache as well, and so on.



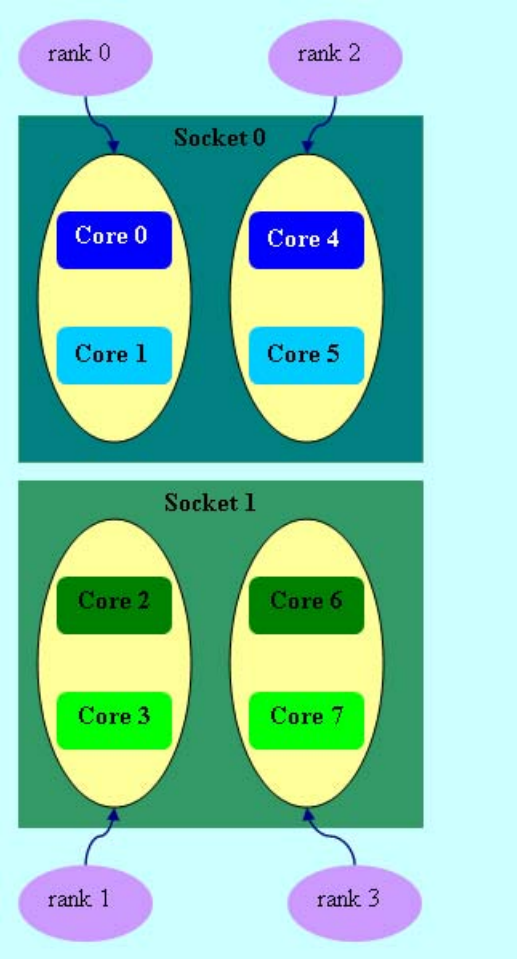
Picture 3.2-5 `mpiexec -n 2 -env I_MPI_PIN_DOMAIN 4:platform ./a.out`

Two domains with size=4 are defined. The fist domain contains cores {0,1,2,3}, and the second domain contains cores {4,5,6,7}. Domain members (cores) have consecutive numbering as defined by the `platform` option.



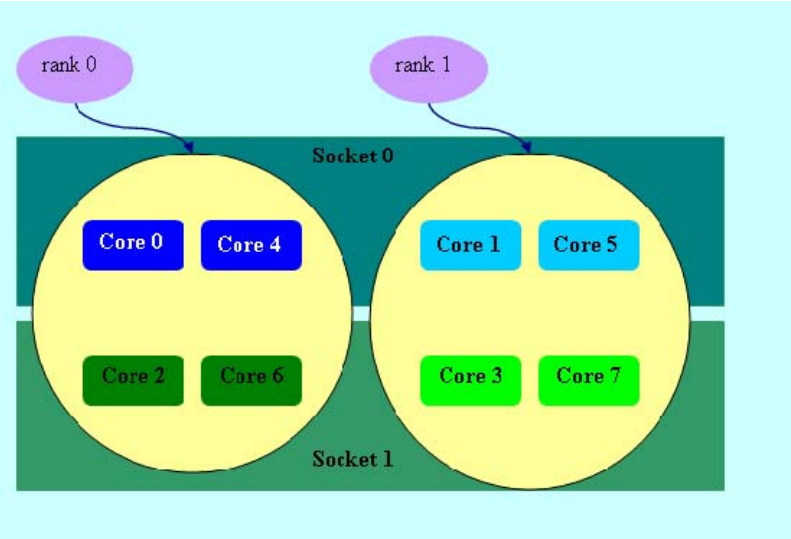
Picture 3.2-6 `mpiexec -n 4 -env I_MPI_PIN_DOMAIN auto:scatter ./a.out`

Domain size=2 (defined by the number of CPUs=8 / number of processes=4), `scatter` layout. Four domains {0,2}, {1,3}, {4,6}, {5,7} are defined. Domain members do not share any common resources.



Picture 3.2-7 `mpiexec -n 4 -env I_MPI_PIN_DOMAIN omp:platform ./a.out setenv OMP_NUM_THREADS=2`

Domain size=2 (defined by `OMP_NUM_THREADS=2`), `platform` layout. Four domains {0,1}, {2,3}, {4,5}, {6,7} are defined. Domain members (cores) have consecutive numbering.



Picture 3.2-8 `mpiexec -n 2 -env I_MPI_PIN_DOMAIN [55,aa] ./a.out`

The fist domain is defined by the 0x55 mask. It contains all cores with even numbers {0,2,4,6}. The second domain is defined by the 0xAA mask. It contains all cores with odd numbers {1,3,5,7}.

I_MPI_PIN_ORDER

Set this environment variable to define the mapping order for MPI processes to domains as specified by the `I_MPI_PIN_DOMAIN` environment variable.

Syntax

`I_MPI_PIN_ORDER=<order>`

Arguments

<order>	Specify the ranking order
`range`	The domains are ordered according to the processor's BIOS numbering. This is a platform-dependent numbering
`scatter`	The domains are ordered so that adjacent domains have minimal sharing of common resources
`compact`	The domains are ordered so that adjacent domains share common resources as much as possible. This is the default value

Description

The optimal setting for this environment variable is application-specific. If adjacent MPI processes prefer to share common resources, such as cores, caches, sockets, FSB, use the `compact` value. Otherwise, use the `scatter` value. Use the `range` value as needed.

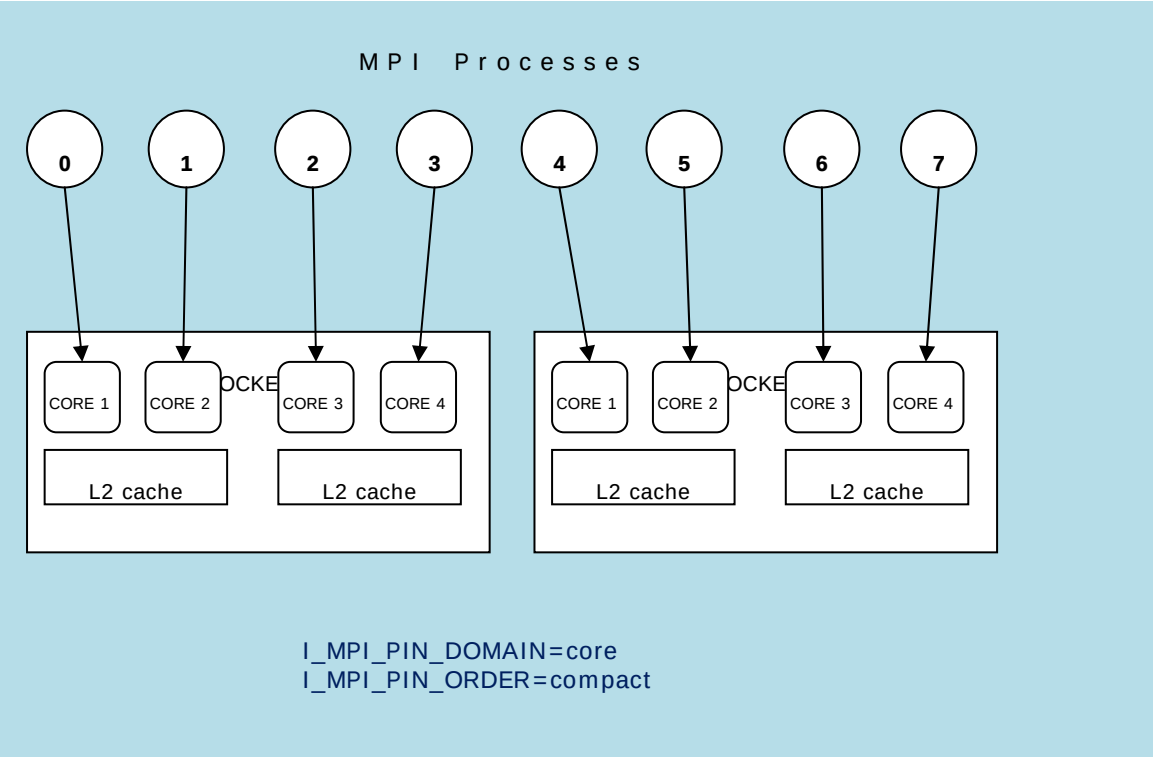
The options `scatter` and `compact` are available for both Intel® and non-Intel microprocessors, but they may perform additional optimizations for Intel microprocessors than they perform for non-Intel microprocessors.

Example

Assume we have:

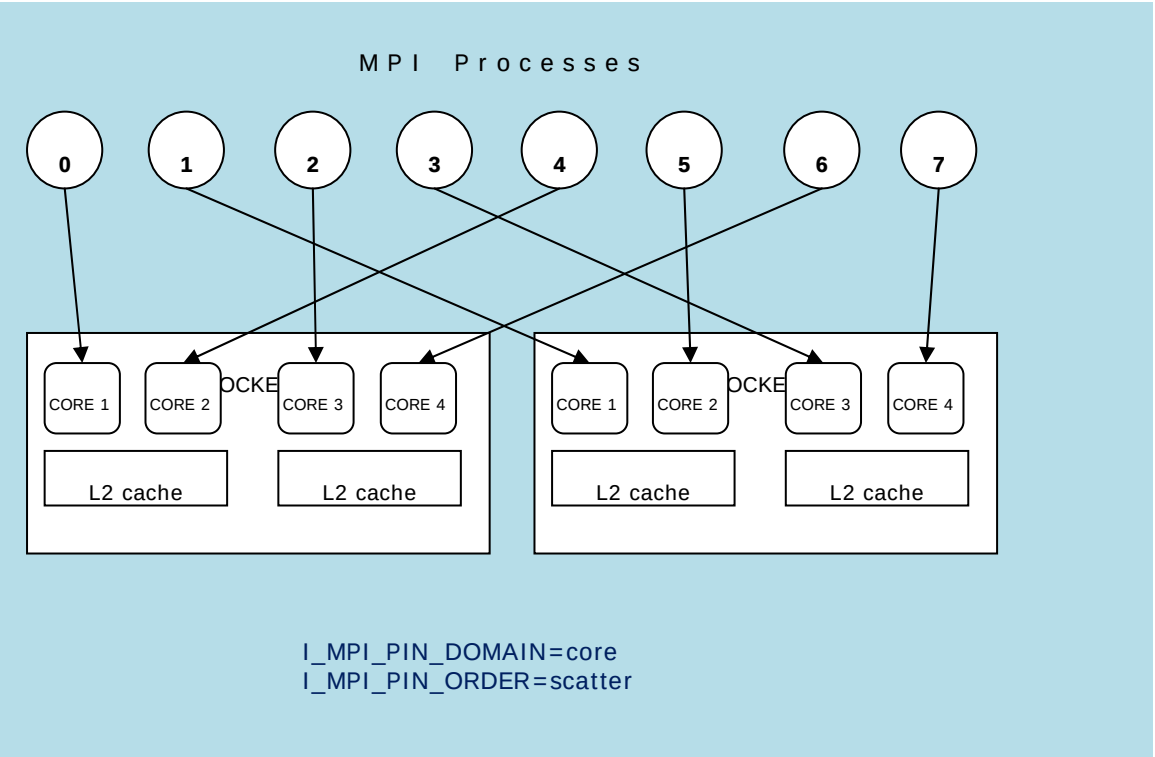
- Two socket node with four cores and a shared L2 cache for corresponding core pairs.
- 8 MPI processes we want to run on the node using
    - The following settings:
      `I_MPI_PIN_DOMAIN=core`

```
I_MPI_PIN_ORDER=compact
```



Picture 3.2-9 Compact Order Example

- The following settings:
  ```
  I_MPI_PIN_DOMAIN=core
  I_MPI_PIN_ORDER=scatter
  ```



Picture 3.2-10 Scatter Order Example

3.3 Fabrics Control

3.3.1 Communication Fabrics Control

I_MPI_FABRICS

(I_MPI_DEVICE)

Select the particular network fabrics to be used.

Syntax

I_MPI_FABRICS=*<fabric>*|*<intra-node fabric>*:*<inter-nodes fabric>*

Where *<fabric>* := {shm, dapl, tcp, tmi, ofa}

<intra-node fabric> := {shm, dapl, tcp, tmi, ofa}

<inter-nodes fabric> := {dapl, tcp, tmi, ofa}

Deprecated Syntax

I_MPI_DEVICE=*<device>*[:*<provider>*]

Arguments

<fabric>	Define a network fabric
shm	Shared-memory
dapl	DAPL–capable network fabrics, such as InfiniBand*, iWarp*, Dolphin*, and XPMEM* (through DAPL*)
tcp	TCP/IP-capable network fabrics, such as Ethernet and InfiniBand* (through IPoIB*)
tmi	TMI-capable network fabrics including Qlogic*, Myrinet*, (through Tag Matching Interface)
ofa	OFA-capable network fabric including InfiniBand* (through OFED* verbs)

Correspondence with I_MPI_DEVICE

<device>	*<fabric>*
sock	tcp
shm	shm
ssm	shm:tcp
rdma	dapl
rdssm	shm:dapl
<provider>	Optional DAPL* provider name (only for the rdma and the rdssm devices) I_MPI_DAPL_PROVIDER=*<provider>* or I_MPI_DAPL_UD_PROVIDER=*<provider>*

Use the *<provider>* specification only for the {rdma,rdssm} devices.

For example, to select the OFED* InfiniBand* device, use the following command:

```
$ mpiexec -n <# of processes> \
            -env I_MPI_DEVICE rdssm:OpenIB-cma <executable>
```

For these devices, if <provider> is not specified, the first DAPL* provider in the /etc/dat.conf file is used.

Description

Set this environment variable to select a specific fabric combination. If the requested fabric(s) is not available, Intel® MPI Library can fall back to other fabric(s). See I_MPI_FALLBACK for details. If the I_MPI_FABRICS environment variable is not defined, Intel® MPI Library selects the most appropriate fabric combination automatically.

The exact combination of fabrics depends on the number of processes started per node.

- If all processes start on one node, the library uses shm intra-node communication.
- If the number of started processes is less than or equal to the number of available nodes, the library uses the first available fabric from the fabrics list for inter-nodes communication.
- For other cases, the library uses shm for intra-node communication, and the first available fabric from the fabrics list for inter-nodes communication. See I_MPI_FABRICS_LIST for details.

The shm fabric is available for both Intel® and non-Intel microprocessors, but it may perform additional optimizations for Intel microprocessors than it performs for non-Intel microprocessors.

NOTE: The combination of selected fabrics ensures that the job runs, but this combination may not provide the highest possible performance for the given cluster configuration.

For example, to select shared-memory as the chosen fabric, use the following command:

```
$ mpiexec -n <# of processes> -env I_MPI_FABRICS shm <executable>
```

To select shared-memory and DAPL–capable network fabric as the chosen fabric combination, use the following command:

```
$ mpiexec -n <# of processes> -env I_MPI_FABRICS shm:dapl <executable>
```

To enable Intel® MPI Library to select most appropriate fabric combination automatically, use the following command:

```
$ mpiexec -n <# of procs> -perhost <# of procs per host> <executable>
```

Set the level of debug information to 2 or higher to check which fabrics have been initialized. See I_MPI_DEBUG for details. For example:

```
[0] MPI startup(): shm and dapl data transfer modes
```

or

```
[0] MPI startup(): tcp data transfer mode
```

NOTE: If the I_MPI_FABRICS environment variable and the I_MPI_DEVICE environment variable are set at the same level (command line, environment, configuration files), the I_MPI_FABRICS environment variable has higher priority than the I_MPI_DEVICE environment variable.

I_MPI_FABRICS_LIST

Define a fabrics list.

Syntax

I_MPI_FABRICS_LIST=<*fabrics list*>

Where <*fabrics list*> := <*fabric*>,…,<*fabric*>

<*fabric*> := {dapl, tcp, tmi, ofa}

Arguments

<*fabrics list*>	Specify a fabrics list
dapl,ofa,tcp,tmi	This is the default value
dapl,tcp,ofa,tmi	If you specify I_MPI_WAIT_MODE=enable, this is the default value

Description

Set this environment variable to define a list of fabrics. The library uses the fabrics list to choose the most appropriate fabrics combination automatically. For more information on fabric combination, see *I_MPI_FABRICS*

For example, if I_MPI_FABRICS_LIST=dapl,tcp, I_MPI_FABRICS is not defined, and the initialization of DAPL-capable network fabrics fails, the library falls back to TCP-capable network fabric. For more information on fallback, see *I_MPI_FALLBACK*.

I_MPI_FALLBACK

(I_MPI_FALLBACK_DEVICE)

Set this environment variable to enable fallback to the first available fabric.

Syntax

I_MPI_FALLBACK=<*arg*>

Deprecated Syntax

I_MPI_FALLBACK_DEVICE=<*arg*>

Arguments

<*arg*>	Binary indicator
enable | yes | on | 1	Fall back to the first available fabric. This is the default value if I_MPI_FABRICS(I_MPI_DEVICE) environment variable is not set
disable | no | off | 0	Terminate the job if MPI cannot initialize the one of the fabrics selected by the I_MPI_FABRICS environment variable. This is the default value if you set I_MPI_FABRICS(I_MPI_DEVICE) environment variable

Description

Set this environment variable to control fallback to the first available fabric.

If I_MPI_FALLBACK is set to enable and an attempt to initialize a specified fabric fails, the library uses the first available fabric from the list of fabrics. See *I_MPI_FABRICS_LIST* for details.

If I_MPI_FALLBACK is set to disable and an attempt to initialize a specified fabric fails, the library terminates the MPI job.

NOTE: If I_MPI_FABRICS is set and I_MPI_FALLBACK=enable, the library falls back to fabrics with higher numbers in the fabrics list. For example, if I_MPI_FABRICS=dapl, I_MPI_FABRICS_LIST=ofa,tmi,dapl,tcp, I_MPI_FALLBACK=enable and the

initialization of DAPL-capable network fabrics fails, the library falls back to TCP-capable network fabric.

I_MPI_EAGER_THRESHOLD

Change the eager/rendezvous message size threshold for all devices.

Syntax

I_MPI_EAGER_THRESHOLD=<nbytes>

Arguments

<nbytes>	Set the eager/rendezvous message size threshold
> 0	The default <nbytes> value is equal to 262144 bytes

Description

Set this environment variable to control the protocol used for point-to-point communication:

- Messages shorter than or equal in size to <nbytes> are sent using the eager protocol.
- Messages larger than <nbytes> are sent using the rendezvous protocol. The rendezvous protocol uses memory more efficiently.

I_MPI_INTRANODE_EAGER_THRESHOLD

Change the eager/rendezvous message size threshold for intra-node communication mode.

Syntax

I_MPI_INTRANODE_EAGER_THRESHOLD=<nbytes>

Arguments

<nbytes>	Set the eager/rendezvous message size threshold for intra-node communication
> 0	The default <nbytes> value is equal to 262144 bytes for all fabrics except shm. For shm, cutover point is equal to the value of I_MPI_SHM_CELL_SIZE environment variable

Description

Set this environment variable to change the protocol used for communication within the node:

- Messages shorter than or equal in size to <nbytes> are sent using the eager protocol.
- Messages larger than <nbytes> are sent using the rendezvous protocol. The rendezvous protocol uses the memory more efficiently.

If I_MPI_INTRANODE_EAGER_THRESHOLD is not set, the value of I_MPI_EAGER_THRESHOLD is used.

I_MPI_INTRANODE_DIRECT_COPY

Turn on/off the intranode direct copy communication mode.

Syntax

I_MPI_INTRANODE_DIRECT_COPY=<arg>

Arguments

<arg>	Binary indicator

enable | yes | on | 1	Turn on the direct copy communication mode
disable | no | off | 0	Turn off the direct copy communication mode. This is the default value

Description

Set this environment variable to specify the communication mode within the node. If the direct copy communication mode is enabled, data transfer algorithms are selected according to the following scheme:

- Messages shorter than or equal to the threshold value of the I_MPI_INTRANODE_EAGER_THRESHOLD environment variable are transferred using the shared memory.
- Messages larger than the threshold value of the I_MPI_INTRANODE_EAGER_THRESHOLD environment variable are transferred through the direct process memory access.

I_MPI_SPIN_COUNT

Control the spin count value.

Syntax

I_MPI_SPIN_COUNT=*<scount>*

Arguments

<scount>	Define the loop spin count when polling fabric(s)
> 0	The default *<scount>* value is equal to 1 when more than one process runs per processor/core. Otherwise the value equals 250

Description

Set the spin count limit. The loop for polling the fabric(s) spins *<scount>* times before freeing the processes if no incoming messages are received for processing. Smaller values for *<scount>* cause the Intel® MPI Library to release the processor more frequently.

Use the I_MPI_SPIN_COUNT environment variable for tuning application performance. The best value for *<scount>* can be chosen on an experimental basis. It depends on the particular computational environment and application.

I_MPI_SCALABLE_OPTIMIZATION

(I_MPI_SOCK_SCALABLE_OPTIMIZATION)

Turn on/off scalable optimization of the network fabric communication.

Syntax

I_MPI_SCALABLE_OPTIMIZATION=*<arg>*

Deprecated Syntax

I_MPI_SOCK_SCALABLE_OPTIMIZATION=*<arg>*

Arguments

<arg>	Binary indicator
enable | yes | on | 1	Turn on scalable optimization of the network fabric communication. This is the default for 16 or more processes
disable | no | off | 0	Turn off scalable optimization of the network fabric communication.

	This is the default for less than 16 processes

Description

Set this environment variable to enable scalable optimization of the network fabric communication. In most cases, using optimization decreases latency and increases bandwidth for a large number of processes.

NOTE: Old notification `I_MPI_SOCK_SCALABLE_OPTIMIZATION` is equal to `I_MPI_SCALABLE_OPTIMIZATION` for `tcp` fabric.

I_MPI_WAIT_MODE

Turn on/off wait mode.

Syntax

`I_MPI_WAIT_MODE=<arg>`

Arguments

<arg>	Binary indicator
`enable | yes | on | 1`	Turn on the wait mode
`disable | no | off | 0`	Turn off the wait mode. This is the default

Description

Set this environment variable to control the wait mode. If this mode is enabled, the processes wait for receiving messages without polling the fabric(s). This mode can save CPU time for other tasks.

Use the Native POSIX Thread Library* with the wait mode for `shm` communications.

NOTE: To check which version of the thread library is installed, use the following command:

```
$ getconf GNU_LIBPTHREAD_VERSION
```

I_MPI_DYNAMIC_CONNECTION

(I_MPI_USE_DYNAMIC_CONNECTIONS)

Turn on/off the dynamic connection establishment.

Syntax

`I_MPI_DYNAMIC_CONNECTION=<arg>`

Deprecated Syntax

`I_MPI_USE_DYNAMIC_CONNECTIONS=<arg>`

Arguments

<arg>	Binary indicator
`enable | yes | on | 1`	Turn on the dynamic connection establishment. This is the default for 64 or more processes
`disable | no | off | 0`	Turn off the dynamic connection establishment. This is the default for less than 64 processes

Description

Set this environment variable to control dynamic connection establishment.

- If this mode is enabled, all connections are established at the time of the first communication between each pair of processes.
- If this mode is disabled, all connections are established upfront.

The default value depends on a number of processes in the MPI job. The dynamic connection establishment is off if a total number of processes is less than 64.

3.3.2 Shared Memory Control

I_MPI_SHM_CACHE_BYPASS

(I_MPI_CACHE_BYPASS)

Control the message transfer algorithm for the shared memory.

Syntax

`I_MPI_SHM_CACHE_BYPASS=<arg>`

Deprecated Syntax

`I_MPI_CACHE_BYPASS=<arg>`

Arguments

<arg>	Binary indicator
`enable | yes | on | 1`	Enable message transfer bypass cache. This is the default value
`disable | no | off | 0`	Disable message transfer bypass cache

Description

Set this environment variable to enable/disable message transfer bypass cache for the shared memory. When enabled, the MPI sends the messages greater than or equal in size to the value specified by the `I_MPI_SHM_CACHE_BYPASS_THRESHOLD` environment variable through the bypass cache. This feature is enabled by default.

I_MPI_SHM_CACHE_BYPASS_THRESHOLDS

(I_MPI_CACHE_BYPASS_THRESHOLDS)

Set the messages copying algorithm threshold.

Syntax

`I_MPI_SHM_CACHE_BYPASS_THRESHOLDS=<nb_send>,<nb_recv>[,<nb_send_pk>,<nb_recv_pk>]`

Deprecated Syntax

`I_MPI_CACHE_BYPASS_THRESHOLDS=<nb_send>,<nb_recv>[,<nb_send_pk>,<nb_recv_pk>]`

Arguments

<nb_send>	Set the threshold for sent messages in the following situations: • Processes are pinned on cores that are not located in the same physical processor package • Processes are not pinned
`>= 0`	• For machines optimized with Intel® Streaming SIMD Extensions 4.2 (Intel® SSE4.2) or Intel® AES New Instructions (Intel® AES-

	NI), the default <nb_send> value is -1. This value disables the copying bypass cache • For other architectures, the default <nb_send> value is 16,384 bytes
<nb_recv>	Set the threshold for received messages in the following situations: • Processes are pinned on cores that are not located in the same physical processor package • Processes are not pinned
>= 0	• For machines optimized with Intel® SSE4.2, the default <nb_send> value is -1. This value disables the copying bypass cache • For machines optimized with Intel® AES-NI, the default <nb_send> value is MAX(1Mb, L3/NP), where L3 indicates the size of Level 3 cache and NP indicates the number of processes on the node • For other architectures, the default <nb_recv_pk> value is 2,097,152 bytes
<nb_send_pk>	Set the threshold for sent messages when processes are pinned on cores located in the same physical processor package
>= 0	The default <nb_send_pk> value is -1 (copying bypass cache is disabled)
<nb_recv_pk>	Set the threshold for received messages when processes are pinned on cores located in the same physical processor package
>= 0	• For machines optimized with Intel® SSE4.2, the default <nb_send> value is -1. This value disables the copying bypass cache • For machines optimized with Intel® AES-NI, the default <nb_send> value is MAX(1Mb, L3/NP), where L3 indicates the size of Level 3 cache and NP indicates the number of processes on the node • For other architectures, the default <nb_recv_pk> value is 2,097,152 bytes

Description

Set this environment variable to control the thresholds for the message copying algorithm. MPI copies messages greater than or equal in size to the defined threshold values so that the messages bypass the cache. The value of -1 disables cache bypass. This environment variable is valid only when I_MPI_SHM_CACHE_BYPASS is enabled.

This environment variable is available for both Intel and non-Intel microprocessors, but it may perform additional optimizations for Intel microprocessors than it performs for non-Intel microprocessors.

I_MPI_SHM_FBOX

Control the usage of the shared memory fast-boxes.

Syntax

I_MPI_SHM_FBOX=<arg>

Arguments

<arg>	Binary indicator
enable | yes | on | 1	Turn on the usage of fast-boxes. This is the default value
disable | no | off | 0	Turn off the usage of fast-boxes

Description

Set this environment variable to control the usage of fast-boxes. Each pair of MPI processes on the same computing node has two shared memory fast-boxes, for sending and receiving eager messages.

Turn off the usage of fast-boxes to avoid the overhead of message synchronization when the application uses mass transfer of short non-blocking messages.

I_MPI_SHM_FBOX_SIZE

Set the size of the shared memory fastbox.

Syntax

I_MPI_SHM_FBOX_SIZE=*<nbytes>*

Arguments

<nbytes>	Size of shared memory fastbox in bytes
> 0	The default *<nbytes>* value is equal to 65,472 bytes

Description

Set this environment variable to define the size of shared memory fast-boxes. The value must be multiple of 64.

I_MPI_SHM_CELL_NUM

Change the number of cells in the shared memory receiving queue.

Syntax

I_MPI_SHM_CELL_NUM=*<num>*

Arguments

<num>	The number of shared memory cells
> 0	The default value is 128

Description

Set this environment variable to define the number of cells in the shared memory receive queue. Each MPI process has own shared memory receive queue, where other processes put eager messages. The queue is used when shared memory fast-boxes are blocked by another MPI request.

I_MPI_SHM_CELL_SIZE

Change the size of shared memory cell.

Syntax

I_MPI_SHM_CELL_SIZE=<nbytes>

Arguments

<nbytes>	Size of shared memory cell in bytes
> 0	The default <nbytes> value is equal to 65,472 bytes

Description

Set this environment variable to define the size of shared memory cells. The value must be a multiple of 64.

If a value is set, I_MPI_INTRANODE_EAGER_THRESHOLD is also changed and becomes equal to the given value.

I_MPI_SHM_LMT

Control the usage of large message transfer (LMT) mechanism for the shared memory.

Syntax

I_MPI_SHM_LMT=<arg>

Deprecated Syntax

I_MPI_INTRANODE_DIRECT_COPY=<arg>

Arguments

<arg>	Binary indicator
shm	Turn on the usage of shared memory copy LMT mechanism. This is the default value on Linux OS*
direct	Turn on the usage of direct copy LMT mechanism. This is the default value on Windows OS*
disable | no | off | 0	Turn off the usage of LMT mechanism

Description

Set this environment variable to control the usage of the large message transfer (LMT) mechanism. To transfer rendezvous messages, you can use the LMT mechanism by employing either of the following implementations:

- Use intermediate shared memory queues to send messages.
- Use direct copy mechanism that transfers messages without intermediate buffer.

NOTE: Two arguments of the I_MPI_SHM_LMT environment variable are related to the I_MPI_INTRANODE_DIRECT_COPY environment variable:

- I_MPI_SHM_LMT=direct is equal to the deprecated setting I_MPI_INTRANODE_DIRECT_COPY=enable.
- I_MPI_SHM_LMT=shm is equal to the deprecated setting I_MPI_INTRANODE_DIRECT_COPY=disable.

I_MPI_SHM_LMT_BUFFER_NUM

(I_MPI_SHM_NUM_BUFFERS)

Change the number of shared memory buffers for the large message transfer (LMT) mechanism.

Syntax

I_MPI_SHM_LMT_BUFFER_NUM=<num>

Deprecated Syntax

I_MPI_SHM_NUM_BUFFERS=<num>

Arguments

<num>	The number of shared memory buffers for each process pair
> 0	The default value is 8

Description

Set this environment variable to define the number of shared memory buffers between each process pair.

I_MPI_SHM_LMT_BUFFER_SIZE

(I_MPI_SHM_BUFFER_SIZE)

Change the size of shared memory buffers for the LMT mechanism.

Syntax

I_MPI_SHM_LMT_BUFFER_SIZE=<nbytes>

Deprecated Syntax

I_MPI_SHM_BUFFER_SIZE=<nbytes>

Arguments

<nbytes>	The size of shared memory buffers in bytes
> 0	The default <nbytes> value is equal to 32,768 bytes

Description

Set this environment variable to define the size of shared memory buffers for each pair of processes.

I_MPI_SSHM

Control the usage of the scalable shared memory mechanism.

Syntax

I_MPI_SSHM =<arg>

Arguments

<arg>	Binary indicator
enable | yes | on | 1	Turn on the usage of this mechanism
disable | no | off | 0	Turn off the usage of this mechanism. This is the default value

Description

Set this environment variable to control the usage of an alternative shared memory mechanism. This mechanism replaces the shared memory fast-boxes, receive queues and LMT mechanism.

If a value is set, the I_MPI_INTRANODE_EAGER_THRESHOLD environment variable is changed and becomes equal to 262,144 bytes.

I_MPI_SSHM_BUFFER_NUM

Change the number of shared memory buffers for the alternative shared memory mechanism.

Syntax

I_MPI_SSHM_BUFFER_NUM=<*num*>

Arguments

<*num*>	The number of shared memory buffers for each process pair
> 0	The default value is 4

Description

Set this environment variable to define the number of shared memory buffers between each process pair.

I_MPI_SSHM_BUFFER_SIZE

Change the size of shared memory buffers for the alternative shared memory mechanism.

Syntax

I_MPI_SSHM_BUFFER_SIZE=<*nbytes*>

Arguments

<*nbytes*>	The size of shared memory buffers in bytes
> 0	The default <*nbytes*> value is 65,472 bytes

Description

Set this environment variable to define the size of shared memory buffers for each pair of processes.

I_MPI_SSHM_DYNAMIC_CONNECTION

Control the dynamic connection establishment for the alternative shared memory mechanism.

Syntax

I_MPI_SSHM_DYNAMIC_CONNECTION=<*arg*>

Arguments

<*arg*>	Binary indicator
enable | yes | on | 1	Turn on the dynamic connection establishment
disable | no | off | 0	Turn off the dynamic connection establishment. This is the default value

Description

Set this environment variable to control the dynamic connection establishment.

- If this mode is enabled, all connections are established at the time of the first communication between each pair of processes.
- If this mode is disabled, all connections are established upfront.

I_MPI_SHM_BYPASS

(I_MPI_INTRANODE_SHMEM_BYPASS, I_MPI_USE_DAPL_INTRANODE)

Turn on/off the intra-node communication mode through network fabric along with shm.

Syntax

I_MPI_SHM_BYPASS=<arg>

Deprecated Syntaxes

I_MPI_INTRANODE_SHMEM_BYPASS=<arg>

I_MPI_USE_DAPL_INTRANODE=<arg>

Arguments

<arg>	Binary indicator
enable | yes | on | 1	Turn on the intra-node communication through network fabric
disable | no | off | 0	Turn off the intra-node communication through network fabric. This is the default

Description

Set this environment variable to specify the communication mode within the node. If the intra-node communication mode through network fabric is enabled, data transfer algorithms are selected according to the following scheme:

- Messages shorter than or equal in size to the threshold value of the I_MPI_INTRANODE_EAGER_THRESHOLD environment variable are transferred using shared memory.
- Messages larger than the threshold value of the I_MPI_INTRANODE_EAGER_THRESHOLD environment variable are transferred through the network fabric layer.

NOTE: This environment variable is applicable only when shared memory and a network fabric are turned on either by default or by setting the I_MPI_FABRICS environment variable to shm:<fabric> or an equivalent I_MPI_DEVICE setting. This mode is available only for dapl and tcp fabrics.

I_MPI_SHM_SPIN_COUNT

Control the spin count value for the shared memory fabric.

Syntax

I_MPI_SHM_SPIN_COUNT=<scount>

Arguments

<scount>	Define the spin count of the loop when polling the shm fabric
> 0	When internode communication uses the dapl or tcp fabric, the default <scount> value is equal to 100 spins When internode communication uses the ofa, tmi or dapl (DAPL UD-enabled only) fabric, the default <scount> value is equal to 10 spins

Description

Set the spin count limit of the shared memory fabric to increase the frequency of polling. This configuration allows polling of the shm fabric <scount> times before the control is passed to the

overall network fabric polling mechanism. See I_MPI_SPIN_COUNT for details on higher level fabrics polling.

To tune application performance, use the I_MPI_SHM_SPIN_COUNT environment variable. You can choose the best value for <scount> on an experimental basis. It depends largely on the application and the particular computation environment. An increase in the <scount> value will benefit multi-core platforms when the application uses topological algorithms for message passing.

3.3.3 DAPL-capable Network Fabrics Control

I_MPI_DAPL_PROVIDER

Define the DAPL provider to load.

Syntax

I_MPI_DAPL_PROVIDER=<name>

Arguments

<name>	Define the name of DAPL provider to load

Description

Set this environment variable to define the name of DAPL provider to load. This name is also defined in the dat.conf configuration file.

I_MPI_DAT_LIBRARY

Select the DAT library to be used for DAPL* provider.

Syntax

I_MPI_DAT_LIBRARY=<library>

Arguments

<library>	Specify the DAT library for DAPL provider to be used. Default values are libdat.so or libdat.so.1 for DAPL* 1.2 providers and libdat2.so or libdat2.so.2 for DAPL* 2.0 providers

Description

Set this environment variable to select a specific DAT library to be used for DAPL provider. If the library is not located in the dynamic loader search path, specify the full path to the DAT library. This environment variable affects only on DAPL and DAPL UD capable fabrics.

I_MPI_DAPL_TRANSLATION_CACHE

(I_MPI_RDMA_TRANSLATION_CACHE)

Turn on/off the memory registration cache in the DAPL path.

Syntax

I_MPI_DAPL_TRANSLATION_CACHE=<arg>

Deprecated Syntax

I_MPI_RDMA_TRANSLATION_CACHE=<arg>

Arguments

<arg>	Binary indicator

enable | yes | on | 1	Turn on the memory registration cache. This is the default
disable | no | off | 0	Turn off the memory registration cache

Description

Set this environment variable to turn on/off the memory registration cache in the DAPL path.

The cache substantially increases performance, but may lead to correctness issues in certain rare situations. See product *Release Notes* for further details.

I_MPI_DAPL_TRANSLATION_CACHE_AVL_TREE

Enable/disable the AVL tree* based implementation of the RDMA translation cache in the DAPL path.

Syntax

I_MPI_DAPL_TRANSLATION_CACHE_AVL_TREE=*<arg>*

Arguments

<arg>	Binary indicator
enable | yes | on | 1	Turn on the AVL tree based RDMA translation cache
disable | no | off | 0	Turn off the AVL tree based RDMA translation cache. This is the default value

Description

Set this environment variable to enable the AVL tree based implementation of RDMA translation cache in the DAPL path. When the search in RDMA translation cache handles over 10,000 elements, the AVL tree based RDMA translation cache is faster than the default implementation.

I_MPI_DAPL_DIRECT_COPY_THRESHOLD

(I_MPI_RDMA_EAGER_THRESHOLD, RDMA_IBA_EAGER_THRESHOLD)

Change the threshold of the DAPL direct-copy protocol.

Syntax

I_MPI_DAPL_DIRECT_COPY_THRESHOLD=*<nbytes>*

Deprecated Syntaxes

I_MPI_RDMA_EAGER_THRESHOLD=*<nbytes>*

RDMA_IBA_EAGER_THRESHOLD=*<nbytes>*

Arguments

<nbytes>	Define the DAPL direct-copy protocol threshold
> 0	The default *<nbytes>* value is equal to 16456 bytes

Description

Set this environment variable to control the DAPL direct-copy protocol threshold. Data transfer algorithms for the DAPL-capable network fabrics are selected based on the following scheme:

- Messages shorter than or equal to *<nbytes>* are sent using the eager protocol through the internal pre-registered buffers. This approach is faster for short messages.

- Messages larger than <nbytes> are sent using the direct-copy protocol. It does not use any buffering but involves registration of memory on sender and receiver sides. This approach is faster for large messages.

This environment variable is available for both Intel® and non-Intel microprocessors, but it may perform additional optimizations for Intel microprocessors than it performs for non-Intel microprocessors.

I_MPI_DAPL_EAGER_MESSAGE_AGGREGATION

Control the use of concatenation for adjourned MPI send requests. Adjourned MPI send requests are those that cannot be sent immediately.

Syntax

I_MPI_DAPL_EAGER_MESSAGE_AGGREGATION =<arg>

Arguments

<arg>	Binary indicator
enable | yes | on | 1	Enable the concatenation for adjourned MPI send requests
disable | no | off | 0	Disable the concatenation for adjourned MPI send requests. This is the default value

Set this environment variable to control the use of concatenation for adjourned MPI send requests intended for the same MPI rank. In some cases, this mode can improve the performance of applications, especially when MPI_Isend() is used with short message sizes and the same destination rank, such as:

```
for( i = 0; i< NMSG; i++)
    {ret = MPI_Isend( sbuf[i], MSG_SIZE,  datatype,  dest , tag, \
      comm, &req_send[i]);
    }
```

I_MPI_DAPL_DYNAMIC_CONNECTION_MODE

(I_MPI_DYNAMIC_CONNECTION_MODE, I_MPI_DYNAMIC_CONNECTIONS_MODE)

Choose the algorithm for establishing the DAPL* connections.

Syntax

I_MPI_DAPL_DYNAMIC_CONNECTION_MODE=<arg>

Deprecated Syntax

I_MPI_DYNAMIC_CONNECTION_MODE=<arg>

I_MPI_DYNAMIC_CONNECTIONS_MODE=<arg>

Arguments

<arg>	Mode selector
reject	Deny one of the two simultaneous connection requests. This is the default
disconnect	Deny one of the two simultaneous connection requests after both connections have been established

Description

Set this environment variable to choose the algorithm for handling dynamically established connections for DAPL-capable fabrics according to the following scheme:

- In the `reject` mode, if two processes initiate the connection simultaneously, one of the requests is rejected.
- In the `disconnect` mode, both connections are established, but then one is disconnected. The `disconnect` mode is provided to avoid a bug in certain DAPL* providers.

I_MPI_DAPL_SCALABLE_PROGRESS

(I_MPI_RDMA_SCALABLE_PROGRESS)

Turn on/off scalable algorithm for DAPL read progress.

Syntax

`I_MPI_DAPL_SCALABLE_PROGRESS=<arg>`

Deprecated Syntax

`I_MPI_RDMA_SCALABLE_PROGRESS=<arg>`

Arguments

<arg>	Binary indicator
`enable | yes | on | 1`	Turn on scalable algorithm. When the number of processes is larger than `128`, this is the default value
`disable | no | off | 0`	Turn off scalable algorithm. When the number of processes is less than or equal to `128`, this is the default value

Description

Set this environment variable to enable scalable algorithm for the DAPL read progress. In some cases, this provides advantages for systems with many processes.

I_MPI_DAPL_BUFFER_NUM

(I_MPI_RDMA_BUFFER_NUM, NUM_RDMA_BUFFER)

Change the number of internal pre-registered buffers for each process pair in the DAPL path.

Syntax

`I_MPI_DAPL_BUFFER_NUM=<nbuf>`

Deprecated Syntaxes

`I_MPI_RDMA_BUFFER_NUM=<nbuf>`

`NUM_RDMA_BUFFER=<nbuf>`

Arguments

<nbuf>	Define the number of buffers for each pair in a process group
`> 0`	The default value is `16`

Description

Set this environment variable to change the number of the internal pre-registered buffers for each process pair in the DAPL path.

NOTE: The more pre-registered buffers are available, the more memory is used for every established connection.

I_MPI_DAPL_BUFFER_SIZE

(I_MPI_RDMA_BUFFER_SIZE, I_MPI_RDMA_VBUF_TOTAL_SIZE)

Change the size of internal pre-registered buffers for each process pair in the DAPL path.

Syntax

`I_MPI_DAPL_BUFFER_SIZE=<nbytes>`

Deprecated Syntaxes

`I_MPI_RDMA_BUFFER_SIZE=<nbytes>`

`I_MPI_RDMA_VBUF_TOTAL_SIZE=<nbytes>`

Arguments

<nbytes>	Define the size of pre-registered buffers
> 0	The default *<nbytes>* value is equal to 16,640 bytes

Description

Set this environment variable to define the size of the internal pre-registered buffer for each process pair in the DAPL path. The actual size is calculated by adjusting the *<nbytes>* to align the buffer to an optimal value.

I_MPI_DAPL_RNDV_BUFFER_ALIGNMENT

(I_MPI_RDMA_RNDV_BUFFER_ALIGNMENT, I_MPI_RDMA_RNDV_BUF_ALIGN)

Define the alignment of the sending buffer for the DAPL direct-copy transfers.

Syntax

`I_MPI_DAPL_RNDV_BUFFER_ALIGNMENT=<arg>`

Deprecated Syntaxes

`I_MPI_RDMA_RNDV_BUFFER_ALIGNMENT=<arg>`

`I_MPI_RDMA_RNDV_BUF_ALIGN=<arg>`

Arguments

<arg>	Define the alignment for the sending buffer
> 0 and a power of 2	The default value is 128

Set this environment variable to define the alignment of the sending buffer for DAPL direct-copy transfers. When a buffer specified in a DAPL operation is aligned to an optimal value, the data transfer bandwidth may be increased.

I_MPI_DAPL_RDMA_RNDV_WRITE

(I_MPI_RDMA_RNDV_WRITE, I_MPI_USE_RENDEZVOUS_RDMA_WRITE)

Turn on/off the RDMA Write-based rendezvous direct-copy protocol in the DAPL path.

Syntax

`I_MPI_DAPL_RDMA_RNDV_WRITE=<arg>`

Deprecated Syntaxes

I_MPI_RDMA_RNDV_WRITE=<arg>

I_MPI_USE_RENDEZVOUS_RDMA_WRITE=<arg>

Arguments

<arg>	Binary indicator
enable | yes | on | 1	Turn on the RDMA Write rendezvous direct-copy protocol
disable | no | off | 0	Turn off the RDMA Write rendezvous direct-copy protocol

Description

Set this environment variable to select the RDMA Write-based rendezvous direct-copy protocol in the DAPL path. Certain DAPL* providers have a slow RDMA Read implementation on certain platforms. Switching on the rendezvous direct-copy protocol based on the RDMA Write operation can increase performance in these cases. The default value depends on the DAPL provider attributes.

I_MPI_DAPL_CHECK_MAX_RDMA_SIZE

(I_MPI_RDMA_CHECK_MAX_RDMA_SIZE)

Check the value of the DAPL attribute, max_rdma_size.

Syntax

I_MPI_DAPL_CHECK_MAX_RDMA_SIZE=<arg>

Deprecated Syntax

I_MPI_RDMA_CHECK_MAX_RDMA_SIZE=<arg>

Arguments

<arg>	Binary indicator
enable | yes | on | 1	Check the value of the DAPL* attribute max_rdma_size
disable | no | off | 0	Do not check the value of the DAPL* attribute max_rdma_size. This is the default value

Description

Set this environment variable to control message fragmentation according to the following scheme:

- If this mode is enabled, the Intel® MPI Library fragmentizes the messages bigger than the value of the DAPL attribute max_rdma_size
- If this mode is disabled, the Intel® MPI Library does not take into account the value of the DAPL attribute max_rdma_size for message fragmentation

I_MPI_DAPL_MAX_MSG_SIZE

(I_MPI_RDMA_MAX_MSG_SIZE)

Control message fragmentation threshold.

Syntax

I_MPI_DAPL_MAX_MSG_SIZE=<*nbytes*>

Deprecated Syntax

I_MPI_RDMA_MAX_MSG_SIZE=<*nbytes*>

Arguments

<*nbytes*>	Define the maximum message size that can be sent through DAPL without fragmentation
> 0	If the I_MPI_DAPL_CHECK_MAX_RDMA_SIZE environment variable is enabled, the default <*nbytes*> value is equal to the max_rdma_size DAPL attribute value. Otherwise the default value is MAX_INT

Description

Set this environment variable to control message fragmentation size according to the following scheme:

- If the I_MPI_DAPL_CHECK_MAX_RDMA_SIZE environment variable is set to disable, the Intel® MPI Library fragmentizes the messages whose sizes are greater than <*nbytes*>.
- If the I_MPI_DAPL_CHECK_MAX_RDMA_SIZE environment variable is set to enable, the Intel® MPI Library fragmentizes the messages whose sizes are greater than the minimum of <*nbytes*> and the max_rdma_size DAPL* attribute value.

I_MPI_DAPL_CONN_EVD_SIZE

(I_MPI_RDMA_CONN_EVD_SIZE, I_MPI_CONN_EVD_QLEN)

Define the event queue size of the DAPL event dispatcher for connections.

Syntax

I_MPI_DAPL_CONN_EVD_SIZE=<*size*>

Deprecated Syntaxes

I_MPI_RDMA_CONN_EVD_SIZE=<*size*>
I_MPI_CONN_EVD_QLEN=<size>

Arguments

<*size*>	Define the length of the event queue
> 0	The default value is 2*number of processes + 32 in the MPI job

Description

Set this environment variable to define the event queue size of the DAPL event dispatcher that handles connection related events. If this environment variable is set, the minimum value between <*size*> and the value obtained from the provider is used as the size of the event queue. The provider is required to supply a queue size that is at least equal to the calculated value, but it can also provide a larger queue size.

I_MPI_DAPL_SR_THRESHOLD

Change the threshold of switching send/recv to rdma path for DAPL wait mode.

Syntax

I_MPI_DAPL_SR_THRESHOLD=<arg>

Arguments

<nbytes>	Define the message size threshold of switching send/recv to rdma
>= 0	The default <nbytes> value is 256 bytes

Description

Set this environment variable to control the protocol used for point-to-point communication in DAPL wait mode:

- Messages shorter than or equal in size to <nbytes> are sent using DAPL send/recv data transfer operations.
- Messages greater in size than <nbytes> are sent using DAPL RDMA WRITE or RDMA WRITE immediate data transfer operations.

I_MPI_DAPL_SR_BUF_NUM

Change the number of internal pre-registered buffers for each process pair used in DAPL wait mode for send/recv path.

Syntax

I_MPI_DAPL_SR_BUF_NUM=<nbuf>

Arguments

<nbuf>	Define the number of send/recv buffers for each pair in a process group
> 0	The default value is 32

Description

Set this environment variable to change the number of the internal send/recv pre-registered buffers for each process pair.

I_MPI_DAPL_RDMA_WRITE_IMM

(I_MPI_RDMA_WRITE_IMM)

Enable/disable RDMA Write with immediate data InfiniBand (IB) extension in DAPL wait mode.

Syntax

I_MPI_DAPL_RDMA_WRITE_IMM=<arg>

Deprecated syntax

I_MPI_RDMA_WRITE_IMM=<arg>

Arguments

<arg>	Binary indicator
enable | yes | on | 1	Turn on RDMA Write with immediate data IB extension
disable | no | off | 0	Turn off RDMA Write with immediate data IB extension

Description

Set this environment variable to utilize RDMA Write with immediate data IB extension. The algorithm is enabled if this environment variable is set and a certain DAPL provider attribute indicates that RDMA Write with immediate data IB extension is supported.

I_MPI_DAPL_DESIRED_STATIC_CONNECTIONS_NUM

Define the number of processes that establish DAPL static connections at the same time.

Syntax

`I_MPI_DAPL_DESIRED_STATIC_CONNECTIONS_NUM=<num_processess>`

Arguments

<num_processess>	Define the number of processes that establish DAPL static connections at the same time
> 0	The default *<num_processess>* value is equal to 256

Description

Set this environment variable to control the algorithm of DAPL static connection establishment.

If the number of processes in the MPI job is less than or equal to *<num_processess>*, all MPI processes establish the static connections simultaneously. Otherwise, the processes are distributed into several groups. The number of processes in each group is calculated to be close to *<num_processess>*. Then static connections are established in several iterations, including intergroup connection setup.

3.3.4 DAPL UD-capable Network Fabrics Control

I_MPI_DAPL_UD

Enable/disable using DAPL UD path.

Syntax

`I_MPI_DAPL_UD=<arg>`

Arguments

<arg>	Binary indicator
enable | yes | on | 1	Turn on using DAPL UD IB extension
disable | no | off | 0	Turn off using DAPL UD IB extension. This is the default value

Description

Set this environment variable to enable DAPL UD path for transferring data. The algorithm is enabled if you set this environment variable and a certain DAPL provider attribute indicates that UD IB extension is supported.

I_MPI_DAPL_UD_PROVIDER

Define the DAPL provider to work with IB UD transport.

Syntax

`I_MPI_DAPL_UD_PROVIDER=<name>`

Arguments

<name>	Define the name of DAPL provider to load

Description

Set this environment variable to define the name of DAPL provider to load. This name is also defined in the `dat.conf` configuration file. Make sure that specified DAPL provider supports UD IB extension.

I_MPI_DAPL_UD_DIRECT_COPY_THRESHOLD

Change the message size threshold of the DAPL UD direct-copy protocol.

Syntax

`I_MPI_DAPL_UD_DIRECT_COPY_THRESHOLD=`*`<nbytes>`*

Arguments

<nbytes>	Define the DAPL UD direct-copy protocol threshold
`> 0`	The default *<nbytes>* value is equal to `16456` bytes

Description

Set this environment variable to control the DAPL UD direct-copy protocol threshold. Data transfer algorithms for the DAPL-capable network fabrics are selected based on the following scheme:

- Messages shorter than or equal to *<nbytes>* are sent using the eager protocol through the internal pre-registered buffers. This approach is faster for short messages.
- Messages larger than *<nbytes>* are sent using the direct-copy protocol. It does not use any buffering but involves registration of memory on sender and receiver sides. This approach is faster for large messages.

This environment variable is available for both Intel® and non-Intel microprocessors, but it may perform additional optimizations for Intel microprocessors than it performs for non-Intel microprocessors.

I_MPI_DAPL_UD_RECV_BUFFER_NUM

Change the number of the internal pre-registered UD buffers for receiving messages.

Syntax

`I_MPI_DAPL_UD_RECV_BUFFER_NUM=`*`<nbuf>`*

Arguments

<nbuf>	Define the number of buffers for receiving messages
`> 0`	The default value is `16 + n*4` where `n` is a total number of process in MPI job

Description

Set this environment variable to change the number of the internal pre-registered buffers for receiving messages. These buffers are common for all connections or process pairs.

NOTE: The pre-registered buffers use up memory, however they help avoid the loss of packets.

I_MPI_DAPL_UD_SEND_BUFFER_NUM

Change the number of internal pre-registered UD buffers for sending messages.

Syntax

I_MPI_DAPL_UD_SEND_BUFFER_NUM=<nbuf>

Arguments

<nbuf>	Define the number of buffers for sending messages
> 0	The default value is 16 + n*4 where n is a total number of process in MPI job

Description

Set this environment variable to change the number of the internal pre-registered buffers for sending messages. These buffers are common for all connections or process pairs.

NOTE: The pre-registered buffers use up memory, however they help avoid the loss of packets.

I_MPI_DAPL_UD_ACK_SEND_POOL_SIZE

Change the number of ACK UD buffers for sending messages.

Syntax

I_MPI_DAPL_UD_ACK_SEND_POOL_SIZE=<nbuf>

Arguments

<nbuf>	Define the number of ACK UD buffers for sending messages
> 0	The default value is 256

Description

Set this environment variable to change the number of the internal pre-registered ACK buffers for sending service messages. These buffers are common for all connections or process pairs.

I_MPI_DAPL_UD_ACK_RECV_POOL_SIZE

Change the number of ACK UD buffers for receiving messages.

Syntax

I_MPI_DAPL_UD_ACK_RECV_POOL_SIZE=<nbuf>

Arguments

<nbuf>	Define the number of ACK UD buffers for receiving messages
> 0	The default value is 512+n*4, where n is total number of process in MPI job

Description

Set this environment variable to change the number of the internal pre-registered ACK buffers for receiving service messages. These buffers are common for all connections or process pairs.

I_MPI_DAPL_UD_TRANSLATION_CACHE

Turn on/off the memory registration cache in the DAPL UD path.

Syntax

I_MPI_DAPL_UD_TRANSLATION_CACHE=<arg>

Arguments

<arg>	Binary indicator
enable | yes | on | 1	Turn on the memory registration cache. This is the default
disable | no | off | 0	Turn off the memory registration cache

Description

Set this environment variable to turn off the memory registration cache in the DAPL UD path.

Using the cache substantially improves performance. See product *Release Notes* for further details.

I_MPI_DAPL_UD_TRANSLATION_CACHE_AVL_TREE

Enable/disable the AVL* tree based implementation of RDMA translation cache in the DAPL UD path.

Syntax

I_MPI_DAPL_UD_TRANSLATION_CACHE_AVL_TREE=*<arg>*

Arguments

<arg>	Binary indicator
enable | yes | on | 1	Turn on the AVL tree based RDMA translation cache
disable | no | off | 0	Turn off the AVL tree based RDMA translation cache. This is the default value

Description

Set this environment variable to enable the AVL tree based implementation of RDMA translation cache in the DAPL UD path. When the search in RDMA translation cache handles over 10,000 elements, the AVL tree based RDMA translation cache is faster than the default implementation.

I_MPI_DAPL_UD_REQ_EVD_SIZE

Define the event queue size of the DAPL UD event dispatcher for sending data transfer operations.

Syntax

I_MPI_DAPL_UD_REQ_EVD_SIZE=*<size>*

Arguments

<size>	Define the length of the event queue
> 0	The default value is 2,000

Description

Set this environment variable to define the event queue size of the DAPL event dispatcher that handles completions of sending DAPL UD data transfer operations (DTO). If this environment variable is set, the minimum value between *<size>* and the value obtained from the provider is used as the size of the event queue. The provider is required to supply a queue size that is at least equal to the calculated value, but it can also provide a larger queue size.

I_MPI_DAPL_UD_CONN_EVD_SIZE

Define the event queue size of the DAPL UD event dispatcher for connections.

Syntax

I_MPI_DAPL_UD_CONN_EVD_SIZE=<size>

Arguments

<size>	Define the length of the event queue
> 0	The default value is 2*number of processes + 32

Description

Set this environment variable to define the event queue size of the DAPL event dispatcher that handles connection related events. If this environment variable is set, the minimum value between <size> and the value obtained from the provider is used as the size of the event queue. The provider is required to supply a queue size that is at least equal to the calculated value, but it can also provide a larger queue size.

I_MPI_DAPL_UD_RECV_EVD_SIZE

Define the event queue size of the DAPL UD event dispatcher for receiving data transfer operations.

Syntax

I_MPI_DAPL_UD_RECV_EVD_SIZE=<size>

Arguments

<size>	Define the length of the event queue
> 0	The default value depends on the number UD and ACK buffers

Description

Set this environment variable to define the event queue size of the DAPL event dispatcher that handles completions of receiving DAPL UD data transfer operations (DTO). If this environment variable is set, the minimum value between <size> and the value obtained from the provider is used as the size of the event queue. The provider is required to supply a queue size that is at least equal to the calculated value, but it can also provide a larger queue size.

I_MPI_DAPL_UD_RNDV_MAX_BLOCK_LEN

Define maximum size of block that is passed at one iteration of DAPL UD direct-copy protocol.

Syntax

I_MPI_DAPL_UD_RNDV_MAX_BLOCK_LEN=<nbytes>

Arguments

<arg>	Define maximum size of block that is passed at one iteration of DAPL UD direct-copy protocol
> 0	The default value is 1,048,576

Set this environment variable to define the maximum size of memory block that is passed at one iteration of DAPL UD direct-copy protocol. If the size of message in direct-copy protocol is greater than given value, the message will be divided in several blocks and passed in several operations.

I_MPI_DAPL_UD_RNDV_BUFFER_ALIGNMENT

Define the alignment of the sending buffer for the DAPL UD direct-copy transfers.

Syntax

I_MPI_DAPL_UD_RNDV_BUFFER_ALIGNMENT=<*arg*>

Arguments

<*arg*>	Define the alignment of the sending buffer
> 0 and a power of 2	The default value is 16

Set this environment variable to define the alignment of the sending buffer for DAPL direct-copy transfers. When a buffer specified in a DAPL operation is aligned to an optimal value, this may increase data transfer bandwidth.

I_MPI_DAPL_UD_RNDV_COPY_ALIGNMENT_THRESHOLD

Define threshold where alignment is applied to send buffer for the DAPL UD direct-copy transfers.

Syntax

I_MPI_DAPL_UD_RNDV_COPY_ALIGNMENT_THRESHOLD=<*nbytes*>

Arguments

<*nbytes*>	Define send buffer alignment threshold
> 0 and a power of 2	The default value is 32,768

Set this environment variable to define the threshold where the alignment of the sending buffer is applied in DAPL direct-copy transfers. When a buffer specified in a DAPL operation is aligned to an optimal value, this may increase data transfer bandwidth.

I_MPI_DAPL_UD_RNDV_DYNAMIC_CONNECTION

Control the algorithm of dynamic connection establishment for DAPL UD endpoints used in the direct copy protocol.

Syntax

I_MPI_DAPL_UD_RNDV_DYNAMIC_CONNECTION=<*arg*>

Arguments

<*arg*>	Binary indicator
enable | yes | on | 1	Turns on the dynamic connection mode. This is the default value
disable | no | off | 0	Turns off the dynamic connections mode

Set this variable to control the dynamic connection establishment of DAPL UD endpoints used in the direct copy protocol.

If you disable the dynamic connection mode, all possible connections are established during the MPI startup phase.

If you enable the mode, the connection is established when an application calls the MPI function to pass the data from one process to another and invokes the communication between the two processes.

NOTE: For the RNDV dynamic connection mode, the size of the messages passed in the data is larger than the value you set in the I_MPI_DAPL_UD_DIRECT_COPY_THRESHOLD environment variable.

I_MPI_DAPL_UD_EAGER_DYNAMIC_CONNECTION

Control the algorithm of the dynamic connection establishment for DAPL UD endpoints used in eager protocol.

Syntax

I_MPI_DAPL_UD_EAGER_DYNAMIC_CONNECTION=<*arg*>

Arguments

<*arg*>	Binary indicator
enable | yes | on | 1	Turn on the dynamic connection mode. If the number of processes is over 64, this is the default value
disable | no | off | 0	Turn off the dynamic connections mode

Set this variable to control the dynamic connection establishment of DAPL UD endpoints involved in eager protocol. Eager protocol is used to transfer messages through internal pre-registered buffers.

If you disable this mode, all possible connections are established during MPI startup phase.

If you enable this mode, the connection is established when an application calls the MPI function to pass the data from one process to another and invokes the communication between the two processes.

NOTE: For the eager dynamic connection mode, the size of the messages passed in the data is shorter than or equal to the value you set in the I_MPI_DAPL_UD_DIRECT_COPY_THRESHOLD environment variable.

I_MPI_DAPL_UD_DESIRED_STATIC_CONNECTIONS_NUM

Define the number of processes that establish DAPL static connections at the same time.

Syntax

I_MPI_DAPL_UD_DESIRED_STATIC_CONNECTIONS_NUM=<*num_processess*>

Arguments

<*num_processess*>	Define the number of processes that establish DAPL UD static connections at the same time
> 0	The default value is equal to 200

Description

Set this environment variable to control the algorithm of DAPL UD static connections establishment.

If the number of processes in an MPI job is less than or equal to <*num_processess*>, all MPI processes establish the static connections simultaneously. Otherwise, the processes are distributed into several groups. The number of processes in each group is calculated to be close to <*num_processess*>. Then static connections are established in several iterations, including intergroup connection setup.

I_MPI_DAPL_UD_RDMA_MIXED

Control the use of the DAPL UD/RDMA mixed communication.

Syntax

I_MPI_DAPL_UD_RDMA_MIXED =<*arg*>

Arguments

<arg>	Binary indicator
enable | yes | on | 1	Turn on the use of DAPL UD/RDMA mixed communication
disable | no | off | 0	Turn off the use of DAPL UD/RDMA mixed communication. This is the default value

Description

Set this environment variable to enable the DAPL UD/RDMA mixed mode for transferring data. In the DAPL UD/RDMA mixed mode, small messages are passed through the UD transport and large messages are passed through the RDMA transport. If you set the I_MPI_DAPL_UD_RDMA_MIXED environment variable and a certain DAPL provider attribute indicates that UD IB extension is supported, the DAPL UD/RDMA mixed mode is enabled.

The following set of I_MPI_DAPL_UD* environment variables also controls the DAPL UD/RDMA mixed mode:

- I_MPI_DAPL_UD_PROVIDER
- I_MPI_DAPL_UD_EAGER_DYNAMIC_CONNECTION
- I_MPI_DAPL_UD_RNDV_DYNAMIC_CONNECTION
- I_MPI_DAPL_UD_DIRECT_COPY_THRESHOLD
- I_MPI_DAPL_UD_RECV_BUFFER_NUM
- I_MPI_DAPL_UD_SEND_BUFFER_NUM
- I_MPI_DAPL_UD_NUMBER_CREDIT_UPDATE
- I_MPI_DAPL_UD_ACK_SEND_POOL_SIZE
- I_MPI_DAPL_UD_ACK_RECV_POOL_SIZE
- I_MPI_DAPL_UD_RESENT_TIMEOUT
- I_MPI_DAPL_UD_MAX_MSG_SIZE
- I_MPI_DAPL_UD_SEND_BUFFER_SIZE
- I_MPI_DAPL_UD_REQ_EVD_SIZE
- I_MPI_DAPL_UD_REQUEST_QUEUE_SIZE
- I_MPI_DAPL_UD_MULTIPLE_EAGER_SEND
- I_MPI_DAPL_UD_NA_SBUF_LIMIT
- I_MPI_DAPL_UD_RECV_EVD_SIZE
- I_MPI_DAPL_UD_CONNECTION_TIMEOUT
- I_MPI_DAPL_UD_PORT
- I_MPI_DAPL_UD_CREATE_CONN_QUAL,
- I_MPI_DAPL_UD_FINALIZE_RETRY_COUNT
- I_MPI_DAPL_UD_FINALIZE_TIMEOUT
- I_MPI_DAPL_UD_TRANSLATION_CACHE
- I_MPI_DAPL_UD_TRANSLATION_CACHE_AVL_TREE
- I_MPI_DAPL_UD_TRANSLATION_CACHE_MAX_ENTRY_NUM
- I_MPI_DAPL_UD_TRANSLATION_CACHE_MAX_MEMORY_SIZE
- I_MPI_DAPL_UD_PKT_LOSS_OPTIMIZATION
- I_MPI_DAPL_UD_DFACTOR
- I_MPI_DAPL_UD_DESIRED_STATIC_CONNECTIONS_NUM
- I_MPI_DAPL_UD_CONN_EVD_SIZE
- I_MPI_DAPL_UD_RNDV_BUFFER_ALIGNMENT
- I_MPI_DAPL_UD_RNDV_COPY_ALIGNMENT_THRESHOLD

The following set of environment variables is specific for DAPL UD/RDMA mixed mode:

- I_MPI_DAPL_UD_MAX_RDMA_SIZE
- I_MPI_DAPL_UD_MAX_RDMA_DTOS

I_MPI_DAPL_UD_MAX_RDMA_SIZE

Control the maximum message size that can be sent though the RDMA for DAPL UD/RDMA mixed mode.

Syntax

I_MPI_DAPL_UD_MAX_RDMA_SIZE =<*nbytes*>

Arguments

<*nbytes*>	Define the maximum message size that can be sent through RDMA without fragmentation
> 0	The default <*nbytes*> value is 4 MB

Description

Set this environment variable to define the maximum message size that can be sent though RDMA protocol for the DAPL UD/RDMA mixed mode. If the message size is greater than this value, this message is divided into several fragments and is sent by several RDMA operations.

I_MPI_DAPL_UD_MAX_RDMA_DTOS

Control the maximum number of uncompleted RDMA operations per connection for the DAPL UD/RDMA mixed mode.

Syntax

I_MPI_DAPL_UD_MAX_RDMA_DTOS=<*arg*>

Arguments

<*arg*>	Define the maximum number of RDMA operations per connection
> 0	The default <*arg*> value is 8

Description

Set this environment variable to define the maximum number of RDMA operations per connection for the DAPL UD/RDMA mixed mode.

3.3.5 TCP-capable Network Fabrics Control

I_MPI_TCP_NETMASK

(I_MPI_NETMASK)

Choose the network interface for MPI communication over TCP-capable network fabrics.

Syntax

I_MPI_TCP_NETMASK=<*arg*>

Arguments

<arg>	Define the network interface (string parameter)
<interface_mnemonic>	Mnemonic of the network interface: ib or eth
ib	Select IPoIB*
eth	Select Ethernet. This is the default value
<interface_name>	Name of the network interface Usually the UNIX* driver name followed by the unit number
<network_address>>	Network address. The trailing zero bits imply netmask
<network_address/ netmask>	Network address. The *<netmask>* value specifies the netmask length
<list of interfaces>	A colon separated list of network addresses and interface names

Description

Set this environment variable to choose the network interface for MPI communication over TCP-capable network fabrics. If you specify a list of interfaces, the first available interface on the node will be used for communication.

Examples

- Use the following setting to select the IP over InfiniBand* (IPoIB) fabric:
  I_MPI_TCP_NETMASK=ib
- Use the following setting to select the specified network interface for socket communications:
  I_MPI_TCP_NETMASK=ib0
- Use the following setting to select the specified network for socket communications. This setting implies the 255.255.0.0 netmask:
  I_MPI_TCP_NETMASK=192.169.0.0
- Use the following setting to select the specified network for socket communications with netmask set explicitly:
  I_MPI_TCP_NETMASK=192.169.0.0/24
- Use the following setting to select the specified network interfaces for socket communications:
  I_MPI_TCP_NETMASK=192.169.0.5/24:ib0:192.169.0.0

I_MPI_TCP_BUFFER_SIZE

Change the size of the TCP socket buffers.

Syntax

I_MPI_TCP_BUFFER_SIZE=*<nbytes>*

Arguments

<nbytes>	Define the size of the TCP socket buffers
> 0	The default *<nbytes>* value is equal to default value of the TCP socket buffer size on your Linux system.

Description

Set this environment variable to manually define the size of the TCP socket buffers. The TCP socket buffer size is restricted by the existing TCP settings on your Linux system.

Use the I_MPI_TCP_BUFFER_SIZE environment variable for tuning your application's performance for a given number of processes.

NOTE: TCP socket buffers of a large size can require more memory for an application with large number of processes. Alternatively, TCP socket buffers of a small size can considerably decrease the bandwidth of each socket connection especially for 10 Gigabit Ethernet and IPoIB (see *I_MPI_TCP_NETMASK* for details).

I_MPI_TCP_POLLING_MODE

Set this environment variable to define a polling mode.

Syntax

I_MPI_TCP_POLLING_MODE=*<mode>*

Arguments

<mode>	Specify the polling mode
poll	The polling mode based on the poll() function. This is *the* default value
epoll[:edge]	The polling mode based on the epoll() function as an edge-triggered interface
epoll:level	The polling mode based on the epoll() function as a level-triggered interface

Set this environment variable to select the polling mode for the tcp fabric.

Use the I_MPI_TCP_POLLING_MODE environment variable for tuning application performance. You can choose the best polling mode on an experimental basis. The best mode depends on the specific application and on the number of processes. The epoll polling mode is a preferable mode in the following situations:

- for large number of processes
- for APP client-server type
- for MPI_ANY_SOURCE tag matching

3.3.6 TMI-capable Network Fabrics Control

I_MPI_TMI_LIBRARY

Select the TMI library to be used.

Syntax

I_MPI_TMI_LIBRARY=*<library>*

Arguments

<library>	Specify a TMI library to be used instead of the default libtmi.so

Description

Set this environment variable to select a specific TMI library. Specify the full path to the TMI library if the library does not locate in the dynamic loader search path.

I_MPI_TMI_PROVIDER

Define the name of the TMI provider to load.

Syntax

`I_MPI_TMI_PROVIDER=<name>`

Arguments

<name>	name of the TMI provider to load

Description

Set this environment variable to define the name of the TMI provider to load. The name must also be defined in the tmi.conf configuration file.

I_MPI_TMI_PROBE_INTERVAL

Define the frequency that the TMI module probes the internal control messages.

Syntax

`I_MPI_TMI_PROBE_INTERVAL=<value>`

Arguments

<value>	Define the frequency that the TMI module probes the internal control messages
`integer > 0`	Exact value for the option

Description

Set this environment variable to define how often the TMI module should probe for incoming internal control messages. A larger value means less frequent probes. The value `1` means that a probe happens each time the TMI module is polled for progress. The default setting is `20`.

Reducing the probe frequency helps improve the performance when there are a large number of unexpected messages. The trade-off is longer response time for the internal control messages. In MPI 4.0, the internal control messages only affect the MPI functions for one-sided operations (RMA).

3.3.7 OFA*-capable Network Fabrics Control

I_MPI_OFA_NUM_ADAPTERS

Set the number of connection adapters.

Syntax

`I_MPI_OFA_NUM_ADAPTERS=<arg>`

Arguments

<arg>	Define the maximum number of connection adapters used
`>0`	Use the specified number of adapters. The default value is `1`

Description

Set the number of the used adapters. If the number is greater than the available number of adapters, all the available adaptors are used.

I_MPI_OFA_ADAPTER_NAME

Set the name of adapter that is used.

Syntax

I_MPI_OFA_ADAPTER_NAME=<*arg*>

Arguments

<*arg*>	Define the name of adapter
Name	Use the specified adapter. By default, any adapter can be used

Description

Set the name of adaptor to be used. If the adapter with specified name does not exist, the library returns error. This has effect only if I_MPI_OFA_NUM_ADAPTERS=1.

I_MPI_OFA_NUM_PORTS

Set the number of used ports on each adapter.

Syntax

I_MPI_OFA_NUM_PORTS=<*arg*>

Arguments

<*arg*>	Define the number of ports that are used on each adapter
> 0	Use the specified number of ports. The default value is 1

Description

Set the number of used ports on each adaptor. If the number is greater than the available number of ports, all the available ports are used.

I_MPI_OFA_NUM_RDMA_CONNECTIONS

Set the maximum number of connections that use the rdma exchange protocol.

Syntax

I_MPI_OFA_NUM_RDMA_CONNECTIONS=<*num_conn*>

Arguments

<*num_conn*>	Define the maximum number of connections that use the rdma exchange protocol
>= 0	Create the specified number of connections that use the rdma exchange protocol. The rest processes use the send/ receive exchange protocol
-1	Create $\log_2$(number of processes) rdma connections
>= number of processes	Create rdma connections for all processes. This is the default value

Description

There are two exchange protocols between two processes: send/receive and rdma. This environment variable specifies the maximum amount of connections that use rdma protocol.

RDMA protocol is faster but requires more resources. For a large application, you can limit the number of connections that use the rdma protocol so that only processes that actively exchange data use the rdma protocol.

I_MPI_OFA_SWITCHING_TO_RDMA

Set the number of messages that a process should receive before switching this connection to RDMA exchange protocol.

Syntax

I_MPI_OFA_SWITCHING_TO_RDMA=<*number*>

Arguments

<*number*>	Define the number of messages that the process receives before switching to use the rdma protocol
>= 0	If this process receives <*number*> of messages, start using the rdma protocol

Description

Count the number of messages received from the specific process. The connection achieved the specified number tries to switch to rdma protocol for exchanging with that process. The connection will not switch to rdma protocol if the maximum number of connections that use the rdma exchange protocol defined in I_MPI_OFA_NUM_RDMA_CONNECTIONS has been reached.

I_MPI_OFA_RAIL_SCHEDULER

Set the method of choosing rails for short messages.

Syntax

I_MPI_OFA_RAIL_SCHEDULER=<*arg*>

Arguments

<*arg*>	Mode selector
ROUND_ROBIN	Next time use next rail
FIRST_RAIL	Always use the first rail for short messages
PROCESS_BIND	Always use the rail specific for process

Description

Set the method of choosing rails for short messages. The algorithms are selected according to the following scheme:

- In the ROUND_ROBIN mode, the first message is sent using the first rail; the next message is sent using the second rail, and so on.
- In the FIRST_RAIL mode, the first rail is always used for short messages.
- In the PROCESS_BIND mode, the process with the smallest rank uses the first rail, and the next uses the second rail.

I_MPI_OFA_TRANSLATION_CACHE

Turn on/off the memory registration cache.

Syntax

I_MPI_OFA_TRANSLATION_CACHE=<arg>

Arguments

<arg>	Binary indicator
enable | yes | on | 1	Turn on the memory registration cache. This is the default
disable | no | off | 0	Turn off the memory registration cache

Description

Set this environment variable to turn on/off the memory registration cache.

The cache substantially increases performance, but may lead to correctness issues in certain situations. See product *Release Notes* for further details.

I_MPI_OFA_TRANSLATION_CACHE_AVL_TREE

Enable/disable the AVL tree* based implementation of the RDMA translation cache.

Syntax

I_MPI_OFA_TRANSLATION_CACHE_AVL_TREE=<arg>

Arguments

<arg>	Binary indicator
enable | yes | on | 1	Turn on the AVL tree based RDMA translation cache
disable | no | off | 0	Turn off the AVL tree based RDMA translation cache. This is the default value

Description

Set this environment variable to enable the AVL tree based implementation of RDMA translation cache in the OFA path. When the search in RDMA translation cache handles over 10,000 elements, the AVL tree based RDMA translation cache is faster than the default implementation.

I_MPI_OFA_USE_XRC

Control the use of extensible reliable connection (XRC) capability.

Syntax

I_MPI_OFA_USE_XRC=<arg>

Arguments

<arg>	Binary indicator
enable | yes | on | 1	Turn on the use of XRC.
disable | no | off | 0	Turn off the use of XRC. This is the default

Description

Set this environment variable to control the use of XRC when you are using a large cluster with several thousands of nodes.

I_MPI_OFA_DYNAMIC_QPS

Control the library to create queue pairs (QPs) dynamically.

Syntax

I_MPI_OFA_DYNAMIC_QPS=<arg>

Arguments

<arg>	Binary indicator
enable | yes | on | 1	Create QPs dynamically. This is the default value if the number of processes is larger than or equal 2,000
disable | no | off | 0	Create all QPs during the init stage. This is the default value if the number of processes is less than 2,000

Description

Set this environment variable to turn on dynamic creation of QPs.

I_MPI_OFA_PACKET_SIZE

Set the size of the packet used for sending.

Syntax

I_MPI_OFA_PACKET_SIZE=<arg>

Arguments

<arg>	Define the size of packet in bytes
> 0	Use the specified packet size. The default value is 8192

Description

Set the packet size in bytes. If the number is negative, the size is set to 8.

I_MPI_OFA_LIBRARY

Set the name of the used OFA library.

Syntax

I_MPI_OFA_LIBRARY=<arg>

Arguments

<arg>	Define the name of the OFA library
Name	Use the specified library. By default, the name is libibverbs.so

Description

Set the name of the InfiniBand* (IB*) library. If the library with the specified name does not exist, an error is returned.

I_MPI_OFA_NONSWITCH_CONF

Define the nonstandard template for port connections.

Syntax

I_MPI_OFA_NONSWITCH_CONF=<arg>

Arguments

<arg>	Define the template for port connections
Name	Use the specified template

Description

The nodes in clusters are normally connected the way so that $port_i$ of a node can access $port_i$ of all other nodes. Use this environment variable if ports are connected in a nonstandard way. The following example is the template format:

```
host1@port11#port12#...#host2@port21#port22....
```

$Port_i^j$ defines the port used to send from $host_i$ to $host_j$

For example:

```
node1@1#1#2#node2@2#1#1#node3@1#2#1#
```

This sample specifies the following configuration:

- Port1 of node1 connected to port2 of node2
- Port2 of node1 connected to port1 of node3
- Port1 of node2 connected to port2 of node3
- Port2 of node2 connected to port1 of node2
- Port1 of node3 connected to port2 of node1
- Port2 of node3 connected to port1 of node2

Port1 is always used to communicate with itself (loopback).

3.3.8 Failover Support in the OFA* Device

The Intel® MPI Library recognizes the following events to detect hardware issues:

- `IBV_EVENT_QP_FATAL` Error occurred on a QP and it transitioned to error state
- `IBV_EVENT_QP_REQ_ERR` Invalid request local work queue error
- `IBV_EVENT_QP_ACCESS_ERR` Local access violation error
- `IBV_EVENT_PATH_MIG_ERR` A connection failed to migrate to the alternate path
- `IBV_EVENT_CQ_ERR` CQ is in error (CQ overrun)
- `IBV_EVENT_SRQ_ERR` Error occurred on an SRQ
- `IBV_EVENT_PORT_ERR` Link became unavailable on a port
- `IBV_EVENT_DEVICE_FATAL` CA is in `FATAL` state

Intel® MPI Library stops using port or whole adapter for communications if one of these issues is detected. The communications will be continued through the available port or adapter if application is running in the multi-rail mode. The application will be aborted if no healthy ports/adapters are available.

Intel® MPI Library also recognizes the following event

- `IBV_EVENT_PORT_ACTIVE` Link became active on a port

The event indicates that the port can be used again and is enabled for communications.

3.4 Dynamic Process Support

The Intel® MPI Library provides support for the MPI-2 process model what allows creation and cooperative termination of processes after an MPI application has started. It provides

- a mechanism to establish communication between the newly created processes and the existing MPI application
- a process attachment mechanism to establish communication between two existing MPI applications even when one of them does not spawn the other

The existing MPD ring (see *mpdboot* for details) is used for the placement of the spawned processes in the round robin fashion. The first spawned process is placed after the last process of the parent group. A specific network fabric combination is selected using the usual fabrics selection algorithm (see *I_MPI_FABRICS* and *I_MPI_FABRICS_LIST* for details).

For example, to run a dynamic application, use the following commands:

```
$ mpdboot -n 4 -r ssh

$ mpiexec -n 1 -gwdir <path_to_executable> -genv I_MPI_FABRICS shm:tcp
<spawn_app>
```

In the example, the `spawn_app` spawns 4 dynamic processes. If the `mpd.hosts` contains the following information,

```
host1
host2
host3
host4
```

the original spawning process is placed on `host1`, while the dynamic processes is distributed as follows: 1 – on `host2`, 2 – on `host3`, 3 – on `host4`, and 4 – again on `host1`.

To run a client-server application, use the following commands on the server host:

```
$ mpdboot -n 1

$ mpiexec -n 1 -genv I_MPI_FABRICS shm:dapl <server_app> > <port_name>
```

and use the following commands on the intended client hosts:

```
$ mpdboot -n 1

$ mpiexec -n 1 -genv I_MPI_FABRICS shm:dapl <client_app> < <port_name>
```

To run a simple MPI_COMM_JOIN based application, use the following commands on the intended host:

```
$ mpdboot -n 1 -r ssh

$ mpiexec -n 1 -genv I_MPI_FABRICS shm:ofa <join_server_app> <
<port_number>

$ mpiexec -n 1 -genv I_MPI_FABRICS shm:ofa <join_client_app> <
<port_number>
```

3.5 Collective Operation Control

Each collective operation in the Intel® MPI Library supports a number of communication algorithms. In addition to highly optimized default settings, the library provides two ways to control the algorithm selection explicitly: the novel I_MPI_ADJUST environment variable family and the deprecated I_MPI_MSG environment variable family. They are described in the following sections.

These environment variables are available for both Intel® and non-Intel microprocessors, but they may perform additional optimizations for Intel microprocessors than they perform for non-Intel microprocessors.

3.5.1 I_MPI_ADJUST Family

I_MPI_ADJUST_<*opname*>

Control collective operation algorithm selection.

Syntax

I_MPI_ADJUST_<*opname*>=<*algid*>[:<*conditions*>][;<*algid*>:<*conditions*>[…]]

Arguments

<*algid*>	Algorithm identifier
>= 0	The default value of zero selects the reasonable settings

<*conditions*>	A comma separated list of conditions. An empty list selects all message sizes and process combinations
<*l*>	Messages of size <*l*>
<*l*>-<*m*>	Messages of size from <*l*> to <*m*>, inclusive
<*l*>@<*p*>	Messages of size <*l*> and number of processes <*p*>
<*l*>-<*m*>@<*p*>-<*q*>	Messages of size from <*l*> to <*m*> and number of processes from <*p*> to <*q*>, inclusive

Description

Set this environment variable to select the desired algorithm(s) for the collective operation <*opname*> under particular conditions. Each collective operation has its own environment variable and algorithms. See below.

Table 3.5-1 Environment Variables, Collective Operations, and Algorithms

Environment Variable	Collective Operation	Algorithms
I_MPI_ADJUST_ALLGATHER	MPI_Allgather	1. Recursive doubling algorithm 2. Bruck's algorithm 3. Ring algorithm 4. Topology aware Gatherv + Bcast algorithm

I_MPI_ADJUST_ALLGATHERV	MPI_Allgatherv	1. Recursive doubling algorithm 2. Bruck's algorithm 3. Ring algorithm 4. Topology aware Gatherv + Bcast algorithm
I_MPI_ADJUST_ALLREDUCE	MPI_Allreduce	1. Recursive doubling algorithm 2. Rabenseifner's algorithm 3. Reduce + Bcast algorithm 4. Topology aware Reduce + Bcast algorithm 5. Binomial gather + scatter algorithm 6. Topology aware binominal gather + scatter algorithm 7. Shumilin's ring algorithm 8. Ring algorithm
I_MPI_ADJUST_ALLTOALL	MPI_Alltoall	1. Bruck's algorithm 2. Isend/Irecv + waitall algorithm 3. Pair wise exchange algorithm 4. Plum's algorithm
I_MPI_ADJUST_ALLTOALLV	MPI_Alltoallv	1. Isend/Irecv + waitall algorithm 2. Plum's algorithm
I_MPI_ADJUST_ALLTOALLW	MPI_Alltoallw	1. Isend/Irecv + waitall algorithm
I_MPI_ADJUST_BARRIER	MPI_Barrier	1. Dissemination algorithm 2. Recursive doubling algorithm 3. Topology aware dissemination algorithm 4. Topology aware recursive doubling algorithm 5. Binominal gather + scatter algorithm 6. Topology aware binominal gather + scatter algorithm
I_MPI_ADJUST_BCAST	MPI_Bcast	1. Binomial algorithm 2. Recursive doubling algorithm 3. Ring algorithm 4. Topology aware binomial algorithm 5. Topology aware recursive doubling algorithm 6. Topology aware ring algorithm 7. Shumilin's bcast algorithm
I_MPI_ADJUST_EXSCAN	MPI_Exscan	1. Partial results gathering algorithm 2. Partial results gathering regarding algorithm layout of processes

I_MPI_ADJUST_GATHER	MPI_Gather	1. Binomial algorithm 2. Topology aware binomial algorithm 3. Shumilin's algorithm
I_MPI_ADJUST_GATHERV	MPI_Gatherv	1. Linear algorithm 2. Topology aware linear algorithm
I_MPI_ADJUST_REDUCE_SCATTER	MPI_Reduce_scatter	1. Recursive having algorithm 2. Pair wise exchange algorithm 3. Recursive doubling algorithm 4. Reduce + Scatterv algorithm 5. Topology aware Reduce + Scatterv algorithm
I_MPI_ADJUST_REDUCE	MPI_Reduce	1. Shumilin's algorithm 2. Binomial algorithm 3. Topology aware Shumilin's algorithm 4. Topology aware binomial algorithm 5. Rabenseifner's algorithm 6. Topology aware Rabenseifner's algorithm
I_MPI_ADJUST_SCAN	MPI_Scan	1. Partial results gathering algorithm 2. Topology aware partial results gathering algorithm
I_MPI_ADJUST_SCATTER	MPI_Scatter	1. Binomial algorithm 2. Topology aware binomial algorithm 3. Shumilin's algorithm
I_MPI_ADJUST_SCATTERV	MPI_Scatterv	1. Linear algorithm 2. Topology aware linear algorithm

The message size calculation rules for the collective operations are described in the table below. Here, "n/a" means that the corresponding interval *<l>-<m>* should be omitted.

Table 3.5-2 Message Collective Functions

Collective Function	Message Size Formula
MPI_Allgather	recv_count*recv_type_size
MPI_Allgatherv	total_recv_count*recv_type_size
MPI_Allreduce	count*type_size
MPI_Alltoall	send_count*send_type_size
MPI_Alltoallv	n/a
MPI_Alltoallw	n/a

MPI_Barrier	n/a
MPI_Bcast	count*type_size
MPI_Exscan	count*type_size
MPI_Gather	recv_count*recv_type_size if MPI_IN_PLACE is used, otherwise send_count*send_type_size
MPI_Gatherv	n/a
MPI_Reduce_scatter	total_recv_count*type_size
MPI_Reduce	count*type_size
MPI_Scan	count*type_size
MPI_Scatter	send_count*send_type_size if MPI_IN_PLACE is used, otherwise recv_count*recv_type_size
MPI_Scatterv	n/a

Examples

1. Use the following settings to select the second algorithm for MPI_Reduce operation:
   I_MPI_ADJUST_REDUCE=2
2. Use the following settings to define the algorithms for MPI_Reduce_scatter operation:
   I_MPI_ADJUST_REDUCE_SCATTER=4:0-100,5001-10000;1:101-3200,2:3201-5000;3

In this case. algorithm 4 will be used for the message sizes from 0 up to 100 bytes and from 5001 to 10000 bytes, algorithm 1 will be used for the message sizes from 101 up to 3200 bytes, algorithm 2 will be used for the message sizes from 3201 up to 5000 bytes, and algorithm 3 will be used for all other messages.

3.5.2 I_MPI_MSG Family

These environment variables are deprecated and supported mostly for backward compatibility. Use the I_MPI_ADJUST environment variable family whenever possible.

I_MPI_FAST_COLLECTIVES

Control the default library behavior during selection of the most appropriate collective algorithm.

Syntax

I_MPI_FAST_COLLECTIVES=<*arg*>

Arguments

<*arg*>	Binary indicator
enable | yes | on | 1	Fast collective algorithms are used. This is the default value
disable | no | off | 0	Slower and safer collective algorithms are used

Description

The Intel® MPI Library uses advanced collective algorithms designed for better application performance by default. The implementation makes the following assumptions:

- It is safe to utilize the flexibility of the MPI standard regarding the order of execution of the collective operations to take advantage of the process layout and other opportunities.

- There is enough memory available for allocating additional internal buffers.

Set the I_MPI_FAST_COLLECTIVES environment variable to disable if you need to obtain results that do not depend on the physical process layout or other factors.

NOTE: Some optimizations controlled by this environment variable are of an experimental nature. In case of failure, turn off the collective optimizations and repeat the run.

I_MPI_BCAST_NUM_PROCS

Control MPI_Bcast algorithm thresholds.

Syntax

I_MPI_BCAST_NUM_PROCS=*<nproc>*

Arguments

<nproc>	Define the number of processes threshold for choosing the MPI_Bcast algorithm
> 0	The default value is 8

I_MPI_BCAST_MSG

Control MPI_Bcast algorithm thresholds.

Syntax

I_MPI_BCAST_MSG=*<nbytes1,nbytes2>*

Arguments

<nbytes1,nbytes2>	Define the message size threshold range (in bytes) for choosing the MPI_Bcast algorithm
> 0 nbytes2 >= nbytes1	The default pair of values is 12288,524288

Description

Set these environment variables to control the selection of the three possible MPI_Bcast algorithms according to the following scheme (See Table 3.5-1 for algorithm descriptions):

1. The first algorithm is selected if the message size is less than *<nbytes1>*, or the number of processes in the operation is less than *<nproc>*.
2. The second algorithm is selected if the message size is greater than or equal to *<nbytes1>* and less than *<nbytes2>*, and the number of processes in the operation is a power of two.
3. If none of the above conditions is satisfied, the third algorithm is selected.

I_MPI_ALLTOALL_NUM_PROCS

Control MPI_Alltoall algorithm thresholds.

Syntax

I_MPI_ALLTOALL_NUM_PROCS=*<nproc>*

Arguments

<nproc>	Define the number of processes threshold for choosing the MPI_Alltoall algorithm

> 0	The default value is 8

I_MPI_ALLTOALL_MSG

Control MPI_Alltoall algorithm thresholds.

Syntax

I_MPI_ALLTOALL_MSG=<*nbytes1,nbytes2*>

Arguments

<*nbytes1,nbytes2*>	Defines the message size threshold range (in bytes) for choosing the MPI_Alltoall algorithm
> 0 nbytes2 >= nbytes1	The default pair of values is 256,32768

Description

Set these environment variables to control the selection of the three possible MPI_Alltoall algorithms according to the following scheme (See Table 3.5-1 for algorithm descriptions):

1. The first algorithm is selected if the message size is greater than or equal to <*nbytes1*>, and the number of processes in the operation is not less than <*nproc*>.
2. The second algorithm is selected if the message size is greater than <*nbytes1*> and less than or equal to <*nbytes2*>, or if the message size is less than <*nbytes2*> and the number of processes in the operation is less than <*nproc*>.
3. If none of the above conditions is satisfied, the third algorithm is selected.

I_MPI_ALLGATHER_MSG

Control MPI_Allgather algorithm thresholds.

Syntax

I_MPI_ALLGATHER_MSG=<*nbytes1,nbytes2*>

Arguments

<*nbytes1,nbytes2*>	Define the message size threshold range (in bytes) for choosing the MPI_Allgather algorithm
> 0 nbytes2 >= nbytes1	The default pair of values is 81920,524288

Description

Set this variable to control the selection of the three possible MPI_Allgather algorithms according to the following scheme (See Table 3.5-1 for algorithm descriptions):

1. The first algorithm is selected if the message size is less than <*nbytes2*> and the number of processes in the operation is a power of two.
2. The second algorithm is selected if the message size is less than <*nbytes1*> and number of processes in the operation is not a power of two.
3. If none of the above conditions is satisfied, the third algorithm is selected.

I_MPI_ALLREDUCE_MSG

Control MPI_Allreduce algorithm thresholds.

Syntax

I_MPI_ALLREDUCE_MSG=<*nbytes*>

Arguments

<*nbytes*>	Define the message size threshold (in bytes) for choosing the MPI_Allreduce algorithm
> 0	The default value is 2048

Description

Set this environment variable to control the selection of the two possible MPI_Allreduce algorithms according to the following scheme (See Table 3.5-1 for algorithm descriptions):

1. The first algorithm is selected if the message size is less than or equal <*nbytes*>, or the reduction operation is user-defined, or the count argument is less than the nearest power of two less than or equal to the number of processes.
2. If the above condition is not satisfied, the second algorithm is selected.

I_MPI_REDSCAT_MSG

Control the MPI_Reduce_scatter algorithm thresholds.

Syntax

I_MPI_REDSCAT_MSG=<*nbytes1,nbytes2*>

Arguments

<*nbytes*>	Define the message size threshold range (in bytes) for choosing the MPI_Reduce_scatter algorithm
> 0	The default pair of values is 512,524288

Description

Set this environment variable to control the selection of the three possible MPI_Reduce_scatter algorithms according to the following scheme (See Table 3.5-1 for algorithm descriptions):

1. The first algorithm is selected if the reduction operation is commutative and the message size is less than <*nbytes2*>.
2. The second algorithm is selected if the reduction operation is commutative and the message size is greater than or equal to <*nbytes2*>, or if the reduction operation is not commutative and the message size is greater than or equal to <*nbytes1*>.
3. If none of the above conditions is satisfied, the third algorithm is selected.

I_MPI_SCATTER_MSG

Control MPI_Scatter algorithm thresholds.

Syntax

I_MPI_SCATTER_MSG=<*nbytes*>

Arguments

<*nbytes*>	Define the buffer size threshold range (in bytes) for choosing the MPI_Scatter algorithm
> 0	The default value is 2048

Description

Set this environment variable to control the selection of the two possible MPI_Scatter algorithms according to the following scheme (See Table 3.5-1 for algorithm descriptions):

1. The first algorithm is selected on the intercommunicators if the message size is greater than *<nbytes>*.
2. If the above condition is not satisfied, the second algorithm is selected.

I_MPI_GATHER_MSG

Control MPI_Gather algorithm thresholds.

Syntax

I_MPI_GATHER_MSG=*<nbytes>*

Arguments

<nbytes>	Define the buffer size threshold range (in bytes) for choosing the MPI_Gather algorithm
> 0	The default value is 2048

Description

Set this environment variable to control the selection of the two possible MPI_Gather algorithms according to the following scheme (See Table 3.5-1 for algorithm descriptions):

1. The first algorithm is selected on the intercommunicators if the message size is greater than *<nbytes>*.
2. If the above condition is not satisfied, the second algorithm is selected.

3.6 Extended File System Support

The Intel® MPI Library provides loadable shared modules to provide native support for the following file systems:

- Panasas* ActiveScale* File System (PanFS)
- Parallel Virtual File System, Version 2 (Pvfs2)
- Lustre* File System

Set the I_MPI_EXTRA_FILESYSTEM environment variable to on to enable parallel file system support. Set the I_MPI_EXTRA_FILESYSTEM_LIST environment variable to request native support for the specific file system. For example, to request native support for Panasas* ActiveScale* File System, do the following:

```
$ mpiexec -env I_MPI_EXTRA_FILESYSTEM on \
  -env I_MPI_EXTRA_FILESYSTEM_LIST panfs -n 2 ./test
```

3.6.1 Environment Variables

I_MPI_EXTRA_FILESYSTEM

Turn on/off native parallel file systems support.

Syntax

I_MPI_EXTRA_FILESYSTEM=<*arg*>

Arguments

<*arg*>	Binary indicator
enable | yes | on | 1	Turn on native support for the parallel file systems
disable | no | off | 0	Turn off native support for the parallel file systems. This is the default value

Description

Set this environment variable to enable parallel file system support. The I_MPI_EXTRA_FILESYSTEM_LIST environment variable must be set to request native support for the specific file system.

I_MPI_EXTRA_FILESYSTEM_LIST

Select specific file systems support.

Syntax

I_MPI_EXTRA_FILESYSTEM_LIST=<*fs*>[, <*fs*>, ... , <*fs*>]

Arguments

<*fs*>	Define a target file system
panfs	Panasas* ActiveScale* File System
pvfs2	Parallel Virtual File System, Version 2
lustre	Lustre* File System

Description

Set this environment variable to request support for the specific parallel file system. This environment variable is handled only if the I_MPI_EXTRA_FYLESYSTEM is enabled. The Intel® MPI Library will try to load shared modules to support the file systems specified by I_MPI_EXTRA_FILESYSTEM_LIST.

3.7 Compatibility Control

The Intel® MPI Library 4.0 implements the MPI-2.1 standard. The following MPI routines are changed:

- MPI_Cart_create
- MPI_Cart_map
- MPI_Cart_sub
- MPI_Graph_create

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

I_MPI_COMPATIBILITY

Select the runtime compatibility mode.

Syntax

I_MPI_COMPATIBILITY=<value>

Arguments

<value>	Define compatibility mode
3	Enable the Intel® MPI Library 3.x compatibility mode
4	Disable the Intel® MPI Library 3.x compatibility mode and enable the Intel® MPI Library 4.0 compatible mode. This is the default value

Description

Set this environment variable to choose the Intel® MPI runtime compatible mode.

3.8 Miscellaneous

I_MPI_TIMER_KIND

Select the timer used by the MPI_Wtime and MPI_Wtick calls.

Syntax

I_MPI_TIMER_KIND=<timername>

Arguments

<timername>	Define the timer type
gettimeofday	If this setting is chosen, the MPI_Wtime and MPI_Wtick functions will work through the function gettimeofday(2). This is the default value
rdtsc	If this setting is chosen, the MPI_Wtime and MPI_Wtick functions will use the high resolution RDTSC timer

Description

Set this environment variable to select either the ordinary or RDTSC timer.

NOTE: The resolution of the default gettimeofday(2) timer may be insufficient on certain platforms.

4 Statistics Gathering Mode

4.1 Native Statistics Format

The Intel® MPI Library has a built-in statistics gathering facility that collects essential performance data without disturbing the application execution. The collected information is output onto a text file. This section describes the environment variables used to control the built-in statistics gathering facility, and provides example output files.

I_MPI_STATS

Control statistics collection. Expand values of `I_MPI_STATS` environment variable additionally to existing values.

Syntax

`I_MPI_STATS=[n-] m`

Arguments

`n, m`	Possible stats levels of the output information
`1`	Output the amount of data sent by each process
`2`	Output the number of calls and amount of transferred data
`3`	Output statistics combined according to the actual arguments
`4`	Output statistics defined by a buckets list
`10`	Output collective operation statistics for all communication contexts

Description

Set this environment variable to control the amount of the statistics information collected and output onto the log file. No statistics are output by default.

NOTE: `n, m` represent the positive integer numbers define range of output information. The statistics from level `n` to level `m` inclusive are output. Omitted *n* value assumes to be 1.

I_MPI_STATS_SCOPE

Select the subsystem(s) to collect statistics for.

Syntax

`I_MPI_STATS_SCOPE=<subsystem>[:<ops>][;<subsystem>[:<ops>][…]]`

Arguments

<subsystem>	Define the target subsystem(s)
`all`	Collect statistics data for all operations. This is the default value
`coll`	Collect statistics data for all collective operations
`p2p`	Collect statistics data for all point-to-point operations

<ops>	Define the target operations as a comma separated list
Allgather	MPI_Allgather
Allgatherv	MPI_Allgatherv
Allreduce	MPI_Allreduce
Alltoall	MPI_Alltoall
Alltoallv	MPI_Alltoallv
Alltoallw	MPI_Alltoallw
Barrier	MPI_Barrier
Bcast	MPI_Bcast
Exscan	MPI_Exscan
Gather	MPI_Gather
Gatherv	MPI_Gatherv
Reduce_scatter	MPI_Reduce_scatter
Reduce	MPI_Reduce
Scan	MPI_Scan
Scatter	MPI_Scatter
Scatterv	MPI_Scatterv
Send	Standard transfers (MPI_Send, MPI_Isend, MPI_Send_init)
Bsend	Buffered transfers (MPI_Bsend, MPI_Ibsend, MPI_Bsend_init)
Csend	Point-to-point operations inside the collectives. This internal operation serves all collectives
Rsend	Ready transfers (MPI_Rsend, MPI_Irsend, MPI_Rsend_init)
Ssend	Synchronous transfers (MPI_Ssend, MPI_Issend, MPI_Ssend_init)

Description

Set this environment variable to select the target subsystem to collects statistics for. All collective and point-to-point operations, including the point-to-point operations performed inside the collectives are covered by default.

Examples

1. The default settings are equivalent to:
   ```
   I_MPI_STATS_SCOPE=coll;p2p
   ```
2. Use the following settings to collect statistics for the MPI_Bcast, MPI_Reduce, and all point-to-point operations:
   ```
   I_MPI_STATS_SCOPE=p2p;coll:bcast,reduce
   ```
3. Use the following settings to collect statistics for the point-to-point operations inside the collectives:
   ```
   I_MPI_STATS_SCOPE=p2p:csend
   ```

I_MPI_STATS_BUCKETS

Identify a list of ranges for message sizes and communicator sizes that will be used for collecting statistics.

Syntax

I_MPI_STATS_BUCKETS=<msg>[@<proc>][,<msg>[@<proc>]]…

Arguments

<msg>	Specify range of message sizes in bytes
<l>	Single value of message size
<l>-<m>	Range from *<l>* to *<m>*

<proc>	Specify range of processes (ranks) for collective operations
<p>	Single value of communicator size
<p>-<q>	Range from *<p>* to *<q>*

Description

Set the I_MPI_STATS_BUCKETS environment variable to define a set of ranges for message sizes and communicator sizes.

Level 4 of the statistics provides profile information for these ranges.

If I_MPI_STATS_BUCKETS environment variable is not used, then level 4 statistics is not gathered.

If a range is omitted then the maximum possible range is assumed.

Examples

To specify short messages (from 0 to 1000 bytes) and long messages (from 50000 to 100000 bytes), use the following setting:

```
-env I_MPI_STATS_BUCKETS 0-1000,50000-100000
```

To specify messages that have 16 bytes in size and circulate within four process communicators, use the following setting:

```
-env I_MPI_STATS_BUCKETS "16@4"
```

NOTE: When the *@* symbol is present, the environment variable value must be enclosed in quotes.

I_MPI_STATS_FILE

Define the statistics output file name.

Syntax

I_MPI_STATS_FILE=*<name>*

Arguments

<name>	Define the statistics output file name

Description

Set this environment variable to define the statistics output file. The stats.txt file is created in the current directory by default.

The statistics data is blocked and ordered according to the process ranks in the MPI_COMM_WORLD communicator. The timing data is presented in microseconds. For example, with the following settings in effect

```
I_MPI_STATS=4
I_MPI_STATS_SCOPE=p2p;coll:allreduce
```

the statistics output for a simple program that performs only one `MPI_Allreduce` operation may look as follows:

```
Intel(R) MPI Library Version 4.0
____ MPI Communication Statistics ____

Stats level: 4
P2P scope:< FULL >
Collectives scope:< Allreduce >

~~~~ Process 0 of 2 on node svlmpihead01 lifetime = 414.13

Data Transfers
Src     Dst    Amount(MB)   Transfers
----------------------------------------
000 --> 000    0.000000e+00 0
000 --> 001    7.629395e-06 2
========================================
Totals         7.629395e-06 2

Communication Activity
Operation      Volume(MB)   Calls
----------------------------------------
P2P
Csend          7.629395e-06 2
Send           0.000000e+00 0
Bsend          0.000000e+00 0
Rsend          0.000000e+00 0
Ssend          0.000000e+00 0
Collectives
Allreduce       7.629395e-06      2
========================================

Communication Activity by actual args
P2P
Operation      Dst    Message size Calls
-----------------------------------------
Csend
1       1      4            2
Collectives
Operation      Context      Algo   Comm size    Message size Calls  Cost(%)
-------------------------------------------------------------------------
```

```
Allreduce
1             0            1     2            4            2       44.96
================================================================================

~~~~ Process 1 of 2 on node svlmpihead01 lifetime = 306.13

Data Transfers
Src     Dst    Amount(MB)   Transfers
----------------------------------------
001 --> 000    7.629395e-06 2
001 --> 001    0.000000e+00 0
========================================
Totals         7.629395e-06 2

Communication Activity
Operation      Volume(MB)   Calls
----------------------------------------
P2P
Csend          7.629395e-06 2
Send           0.000000e+00 0
Bsend          0.000000e+00 0
Rsend          0.000000e+00 0
Ssend          0.000000e+00 0
Collectives
Allreduce       7.629395e-06      2
========================================

Communication Activity by actual args
P2P
Operation      Dst    Message size Calls
--------------------------------------------
Csend
1       0      4            2
Collectives
Operation      Context      Comm size    Message size Calls  Cost(%)
------------------------------------------------------------------------
Allreduce
1       0      2            4            2      37.93
========================================================================

____ End of stats.txt file ____
```

In the example above all times are measured in microseconds. The message sizes are counted in bytes. **MB** means megabyte equal to 2^{20} or 1 048 576 bytes. The process life time is calculated as a stretch of time between `MPI_Init` and `MPI_Finalize`. The **Algo** field indicates the number of algorithm used by this operation with listed arguments. The **Cost** field represents a particular collective operation execution time as a percentage of the process life time.

4.2 IPM Statistics Format

The Intel® MPI Library supports integrated performance monitoring (IPM) summary format as part of the built-in statistics gathering mechanism described above. You do not need to modify the source code or re-link your application to collect this information.

The `I_MPI_STATS_BUCKETS` environment variable is not applicable to the IPM format. The `I_MPI_STATS_ACCURACY` environment variable is available to control extra functionality.

The Intel® MPI Library also supports an optional `ipm` region feature. This feature requires the source code modification. The `MPI_Pcontrol` function can be used.

4.2.1 Region Control

Region is a named part of the source code marked by the start/end points through the standard `MPI_Pcontrol` function calls. The `MPI_Pcontrol` function isn't used for the following special permanent regions:

- Main region contains statistics information about all MPI calls from `MPI_Init` to `MPI_Finalize`. Main region gets the `"*"` name in output.
- Complementary region contains statistics information not included into any named region. The region gets the `"ipm_noregion"` name in output.

If named regions are not used, the main regions and the complementary regions are identical and the complementary region is ignored.

Each region contains its own independent statistics information about MPI functions called inside the region.

The Intel® MPI Library supports the following types of regions:

- Discontiguous (several open and close).
- Intersected.
- Covering a subset of MPI processes (part of the `MPI_COMM_WORLD` environment variable).

A region is opened by the `MPI_Pcontrol(1, name)` call and closed by the `MPI_Pcontrol(-1, name)` call where `name` is a zero terminated string with the region name.

All open regions are closed automatically inside the `MPI_Finalize` environment variable.

I_MPI_STATS

Control the statistics data output format.

Syntax

`I_MPI_STATS=<level>`

Argument

`<level>`	Level of statistics data
`ipm`	Summary data throughout all regions
`ipm:terse`	Basic summary data

Description

Set this environment variable to `ipm` to get the statistics output that contains region summary. Set this environment variable to `ipm:terse` argument to get the brief statistics output.

I_MPI_STATS_FILE

Define the output file name.

Syntax

`I_MPI_STATS_FILE=<name>`

Argument

<name>	File name for statistics data gathering

Description

Set this environment variable to change the statistics output file name from the default name of `stats.ipm`.

I_MPI_STATS_SCOPE

Define a semicolon separated list of subsets of MPI functions for statistics gathering.

Syntax

`I_MPI_STATS_SCOPE=<subset>[;<subset>[;…]]`

Argument

<subset>	Target subset
`all2all`	Collect statistics data for all to all kind of collective functions
`all2one`	Collect statistics data for all to one kind of collective functions
`attr`	Collect statistics data for attribute control functions
`comm`	Collect statistics data for communicator control functions
`err`	Collect statistics data for error handling functions
`group`	Collect statistics data for group support functions
`init`	Collect statistics data for initialize/finalize functions
`io`	Collect statistics data for input/output support function
`one2all`	Collect statistics data for one to all kind of collective functions
`recv`	Collect statistics data for receive functions
`req`	Collect statistics data for request support functions
`rma`	Collect statistics data for one sided communication functions
`scan`	Collect statistics data for scan collective functions
`send`	Collect statistics data for send functions
`sendrecv`	Collect statistics data for send/receive functions
`serv`	Collect statistics data for additional service functions
`spawn`	Collect statistics data for dynamic process functions
`status`	Collect statistics data for status control function
`sync`	Collect statistics data for barrier synchronization

time	Collect statistics data for timing support functions
topo	Collect statistics data for topology support functions
type	Collect statistics data for data type support functions

Description

Use this environment variable to define a subset or subsets of MPI functions for statistics gathering specified by the following table. A union of all subsets is used by default.

Table 4.2-1 Stats Subsets of MPI Functions

all2all *MPI_Allgather* *MPI_Allgatherv* *MPI_Allreduce* *MPI_Alltoll* *MPI_Alltoallv* *MPI_Alltoallw* *MPI_Reduce_scatter* **all2one** *MPI_Gather* *MPI_Gatherv* *MPI_Reduce* **attr** *MPI_Comm_create_keyval* *MPI_Comm_delete_attr* *MPI_Comm_free_keyval* *MPI_Comm_get_attr* *MPI_Comm_set_attr* *MPI_Comm_get_name* *MPI_Comm_set_name* *MPI_Type_create_keyval* *MPI_Type_delete_attr* *MPI_Type_free_keyval* *MPI_Type_get_attr* *MPI_Type_get_name* *MPI_Type_set_attr* *MPI_Type_set_name* *MPI_Win_create_keyval* *MPI_Win_delete_attr* *MPI_Win_free_keyval* *MPI_Win_get_attr* *MPI_Win_get_name* *MPI_Win_set_attr* *MPI_Win_set_name* *MPI_Get_processor_name* **comm** *MPI_Comm_compare* *MPI_Comm_create* *MPI_Comm_dup* *MPI_Comm_free* *MPI_Comm_get_name* *MPI_Comm_group* *MPI_Comm_rank* *MPI_Comm_remote_group* *MPI_Comm_remote_size* *MPI_Comm_set_name* *MPI_Comm_size* *MPI_Comm_split* *MPI_Comm_test_inter* *MPI_Intercomm_create* *MPI_Intercomm_merge* **err** *MPI_Add_error_class* *MPI_Add_error_code* *MPI_Add_error_string* *MPI_Comm_call_errhandler* *MPI_Comm_create_errhandler* *MPI_Comm_get_errhandler* *MPI_Comm_set_errhandler* *MPI_Errhandler_free* *MPI_Error_class* *MPI_Error_string* *MPI_File_call_errhandler* *MPI_File_create_errhandler*	*MPI_File_get_errhandler* *MPI_File_set_errhandler* *MPI_Win_call_errhandler* *MPI_Win_create_errhandler* *MPI_Win_get_errhandler* *MPI_Win_set_errhandler* **group** *MPI_Group_compare* *MPI_Group_difference* *MPI_Group_excl* *MPI_Group_free* *MPI_Group_incl* *MPI_Group_intersection* *MPI_Group_range_excl* *MPI_Group_range_incl* *MPI_Group_rank* *MPI_Group_size* *MPI_Group_translate_ranks* *MPI_Group_union* **init** *MPI_Init* *MPI_Init_thread* *MPI_Finalize* **io** *MPI_File_close* *MPI_File_delete* *MPI_File_get_amode* *MPI_File_get_atomicity* *MPI_File_get_byte_offset* *MPI_File_get_group* *MPI_File_get_info* *MPI_File_get_position* *MPI_File_get_position_shared* *MPI_File_get_size* *MPI_File_get_type_extent* *MPI_File_get_view* *MPI_File_iread_at* *MPI_File_iread* *MPI_File_iread_shared* *MPI_File_iwrite_at* *MPI_File_iwrite* *MPI_File_iwrite_shared* *MPI_File_open* *MPI_File_preallocate* *MPI_File_read_all_begin* *MPI_File_read_all_end* *MPI_File_read_all* *MPI_File_read_at_all_begin* *MPI_File_read_at_all_end* *MPI_File_read_at_all* *MPI_File_read_at* *MPI_File_read* *MPI_File_read_ordered_begin* *MPI_File_read_ordered_end* *MPI_File_read_ordered* *MPI_File_read_shared* *MPI_File_seek* *MPI_File_seek_shared* *MPI_File_set_atomicity* *MPI_File_set_info* *MPI_File_set_size* *MPI_File_set_view* *MPI_File_sync* *MPI_File_write_all_begin* *MPI_File_write_all_end* *MPI_File_write_all* *MPI_File_write_at_all_begin* *MPI_File_write_at_all_end*

MPI_File_write_at_all
MPI_File_write_at
MPI_File_write
MPI_File_write_ordered_begin
MPI_File_write_ordered_end
MPI_File_write_ordered
MPI_File_write_shared
MPI_Register_datarep

one2all
MPI_Bcast
MPI_Scatter
MPI_Scatterv

recv
MPI_Recv
MPI_Irecv
MPI_Recv_init
MPI_Probe
MPI_Iprobe

req
MPI_Start
MPI_Startall
MPI_Wait
MPI_Waitall
MPI_Waitany
MPI_Waitsome
MPI_Test
MPI_Testall
MPI_Testany
MPI_Testsome
MPI_Cancel
MPI_Grequest_start
MPI_Grequest_complete
MPI_Request_get_status
MPI_Request_free

rma
MPI_Accumulate
MPI_Get
MPI_Put
MPI_Win_complete
MPI_Win_create
MPI_Win_fence
MPI_Win_free
MPI_Win_get_group
MPI_Win_lock
MPI_Win_post
MPI_Win_start
MPI_Win_test
MPI_Win_unlock
MPI_Win_wait

scan
MPI_Exscan
MPI_Scan

send
MPI_Send
MPI_Bsend
MPI_Rsend
MPI_Ssend
MPI_Isend
MPI_Ibsend
MPI_Irsend
MPI_Issend
MPI_Send_init
MPI_Bsend_init
MPI_Rsend_init
MPI_Ssend_init

sendrecv
MPI_Sendrecv
MPI_Sendrecv_replace

serv
MPI_Alloc_mem
MPI_Free_mem
MPI_Buffer_attach
MPI_Buffer_detach
MPI_Op_create
MPI_Op_free

spawn
MPI_Close_port
MPI_Comm_accept
MPI_Comm_connect
MPI_Comm_disconnect
MPI_Comm_get_parent
MPI_Comm_join
MPI_Comm_spawn
MPI_Comm_spawn_multiple
MPI_Lookup_name
MPI_Open_port
MPI_Publish_name
MPI_Unpublish_name

status
MPI_Get_count
MPI_Status_set_elements
MPI_Status_set_cancelled
MPI_Test_cancelled

sync
MPI_Barrier

time
MPI_Wtick
MPI_Wtime

topo
MPI_Cart_coords
MPI_Cart_create
MPI_Cart_get
MPI_Cart_map
MPI_Cart_rank
MPI_Cart_shift
MPI_Cart_sub
MPI_Cartdim_get
MPI_Dims_create
MPI_Graph_create
MPI_Graph_get
MPI_Graph_map
MPI_Graph_neighbors
MPI_Graphdims_get
MPI_Graph_neighbors_count
MPI_Topo_test

type	
MPI_Get_address *MPI_Get_elements* *MPI_Pack* *MPI_Pack_external* *MPI_Pack_external_size* *MPI_Pack_size* *MPI_Type_commit* *MPI_Type_contiguous* *MPI_Type_create_darray* *MPI_Type_create_hindexed* *MPI_Type_create_hvector* *MPI_Type_create_indexed_block* *MPI_Type_create_resized* *MPI_Type_create_struct* *MPI_Type_create_subarray* *MPI_Type_dup* *MPI_Type_free* *MPI_Type_get_contents* *MPI_Type_get_envelope* *MPI_Type_get_extent* *MPI_Type_get_true_extent* *MPI_Type_indexed* *MPI_Type_size* *MPI_Type_vector* *MPI_Unpack_external* *MPI_Unpack*	

I_MPI_STATS_ACCURACY

Use the `I_MPI_STATS_ACCURACY` environment variable to decrease statistics output.

Syntax

`I_MPI_STATS_ACCURACY=<percentage>`

Argument

<percentage>	Float threshold value

Description

Set this environment variable to collect data only on those MPI functions that take a larger portion of the elapsed time as a percentage of the total time spent inside all MPI calls.

Example

The following example represents a simple application code and IPM summary statistics format:

```
int main (int argc, char *argv[])
{
    int i, rank, size, nsend, nrecv;

    MPI_Init (&argc, &argv);

    MPI_Comm_rank (MPI_COMM_WORLD, &rank);
    nsend = rank;

    MPI_Wtime();

    for (i = 0; i < 200; i++)
    {
        MPI_Barrier(MPI_COMM_WORLD);
    }

    /* open “reduce” region for all processes */
    MPI_Pcontrol(1, "reduce");
    for (i = 0; i < 1000; i++)
        MPI_Reduce(&nsend, &nrecv, 1, MPI_INT, MPI_MAX, 0, MPI_COMM_WORLD);

    /* close “reduce” region */
```

```
    MPI_Pcontrol(-1, "reduce");

    if (rank == 0)
    {
        /* “send” region for 0-th process only */
        MPI_Pcontrol(1, "send");
        MPI_Send(&nsend, 1, MPI_INT, 1, 1, MPI_COMM_WORLD);
        MPI_Pcontrol(-1, "send");
    }
    if (rank == 1)
    {
        MPI_Recv(&nrecv, 1, MPI_INT, 0, 1, MPI_COMM_WORLD, MPI_STATUS_IGNORE);
    }

    /* reopen “reduce” region */
    MPI_Pcontrol(1, "reduce");
    for (i = 0; i < 1000; i++)
        MPI_Reduce(&nsend, &nrecv, 1, MPI_INT, MPI_MAX, 0, MPI_COMM_WORLD);

    MPI_Wtime();
    MPI_Finalize ();

    return 0;
}
Command:
mpiexec –n 4 –env I_MPI_STATS ipm:terse ./a.out
Stats output:
################################################################################
#
# command : ./a.out (completed)
# host    : svlmpihead01/x86_64_Linux       mpi_tasks : 4 on 1 nodes
# start   : 05/25/11/05:44:13               wallclock : 0.092012 sec
# stop    : 05/25/11/05:44:13               %comm     : 98.94
# gbytes  : 0.00000e+00 total               gflop/sec : NA
#
################################################################################


Command:
mpiexec –n 4 –env I_MPI_STATS ipm ./a.out
Stats output:
################################################################################
#
# command : ./a.out (completed)
# host    : svlmpihead01/x86_64_Linux       mpi_tasks : 4 on 1 nodes
# start   : 05/25/11/05:44:13               wallclock : 0.092012 sec
# stop    : 05/25/11/05:44:13               %comm     : 98.94
# gbytes  : 0.00000e+00 total               gflop/sec : NA
#
################################################################################
# region  : *   [ntasks] = 4
#
#                          [total]       <avg>         min           max
# entries                  4             1             1             1
# wallclock                0.332877      0.0832192     0.0732641     0.0920119
# user                     0.047992      0.011998      0.006999      0.019996
# system                   0.013997      0.00349925    0.002999      0.004
# mpi                      0.329348      0.082337      0.0723064     0.0912335
# %comm                                  98.9398       98.6928       99.154
# gflop/sec                NA            NA            NA            NA
# gbytes                   0             0             0             0
#
#
#                          [time]        [calls]       <%mpi>        <%wall>
# MPI_Init                 0.236192      4             71.71         70.95
# MPI_Reduce               0.0608737     8000          18.48         18.29
# MPI_Barrier              0.027415      800           8.32          8.24
# MPI_Recv                 0.00483489    1             1.47          1.45
# MPI_Send                 1.50204e-05   1             0.00          0.00
# MPI_Wtime                1.21593e-05   8             0.00          0.00
# MPI_Finalize             3.33786e-06   4             0.00          0.00
```

```
# MPI_Comm_rank           1.90735e-06   4             0.00          0.00
# MPI_TOTAL               0.329348      8822          100.00        98.94
################################################################################
# region  : reduce   [ntasks] = 4
#
#                         [total]       <avg>         min           max
# entries                 8             2             2             2
# wallclock               0.0638561     0.015964      0.00714302    0.0238571
# user                    0.034994      0.0087485     0.003999      0.015997
# system                  0.003999      0.00099975    0             0.002999
# mpi                     0.0608799     0.01522       0.00633883    0.0231845
# %comm                                 95.3392       88.7417       97.1808
# gflop/sec               NA            NA            NA            NA
# gbytes                  0             0             0             0
#
#
#                         [time]        [calls]       <%mpi>        <%wall>
# MPI_Reduce              0.0608737     8000          99.99         95.33
# MPI_Finalize            3.33786e-06   4             0.01          0.01
# MPI_Wtime               2.86102e-06   4             0.00          0.00
# MPI_TOTAL               0.0608799     8008          100.00        95.34
################################################################################
# region  : send   [ntasks] = 4
#
#                         [total]       <avg>         min           max
# entries                 1             0             0             1
# wallclock               2.89876e-05   7.24691e-06   1e-06         2.59876e-05
# user                    0             0             0             0
# system                  0             0             0             0
# mpi                     1.50204e-05   3.75509e-06   0             1.50204e-05
# %comm                                 51.8165       0             57.7982
# gflop/sec               NA            NA            NA            NA
# gbytes                  0             0             0             0
#
#
#                         [time]        [calls]       <%mpi>        <%wall>
# MPI_Send                1.50204e-05   1             100.00        51.82
################################################################################
# region  : ipm_noregion   [ntasks] = 4
#
#                         [total]       <avg>         min           max
# entries                 13            3             3             4
# wallclock               0.26898       0.0672451     0.0661182     0.068152
# user                    0.012998      0.0032495     0.001         0.004999
# system                  0.009998      0.0024995     0             0.004
# mpi                     0.268453      0.0671132     0.0659676     0.068049
# %comm                                 99.8039       99.7721       99.8489
# gflop/sec               NA            NA            NA            NA
# gbytes                  0             0             0             0
#
#
#                         [time]        [calls]       <%mpi>        <%wall>
# MPI_Init                0.236192      4             87.98         87.81
# MPI_Barrier             0.027415      800           10.21         10.19
# MPI_Recv                0.00483489    1             1.80          1.80
# MPI_Wtime               9.29832e-06   4             0.00          0.00
# MPI_Comm_rank           1.90735e-06   4             0.00          0.00
# MPI_TOTAL               0.268453      813           100.00        99.80
################################################################################
```

5 Fault Tolerance

Intel® MPI Library provides extra functionality to enable fault tolerance support in the MPI applications. The MPI standard does not define behavior of MPI implementation if one or several processes of MPI application are abnormally aborted. By default, Intel® MPI Library aborts the whole application if any process stops.

Set the environment variable `I_MPI_FAULT_CONTINUE` to `on` to change this behavior. For example,

```
$ mpiexec -env I_MPI_FAULT_CONTINUE on -n 2 ./test
```

An application can continue working in the case of MPI processes an issue if the issue meets the following requirements:

- An application sets error handler `MPI_ERRORS_RETURN` to communicator `MPI_COMM_WORLD` (all new communicators inherit error handler from it)
- An application uses master-slave model and the application will be stopped only if the master is finished or does not respond
- An application uses only point-to-point communication between a master and a number of slaves. It does not use inter slave communication or MPI collective operations.
- Handle a certain MPI error code on a point-to-point operation with a particular failed slave rank for application to avoid further communication with this rank. The slave rank can be blocking/non-blocking send, receive, probe and test,
- Any communication operation can be used on subset communicator. If error appears in collective operation, any communication inside this communicator will be prohibited.
- Master failure means the job stops.

5.1 Environment Variables

I_MPI_FAULT_CONTINUE

Turn on/off support for fault tolerant applications.

Syntax

`I_MPI_FAULT_CONTINUE=<arg>`

Arguments

<arg>	Binary indicator
`enable | yes | on | 1`	Turn on support for fault tolerant applications
`disable | no | off | 0`	Turn off support for fault tolerant applications. This is default value

Description

Set this environment variable to provide support for fault tolerant applications.

5.2 Usage Model

An application sets MPI_ERRORS_RETURN error handler and checks return code after each communication call. If a communication call does not return, MPI_SUCCESS destination process should be marked unreachable and exclude communication with it. For example:

```
if(live_ranks[rank]) {
      mpi_err = MPI_Send(buf, count, dtype, rank, tag, MPI_COMM_WORLD);
      if(mpi_err != MPI_SUCCESS) {
            live_ranks[rank] = 0;
      }
}
```

In the case of non-blocking communications, errors can appear during wait/test operations.

6 ILP64 Support

The term *ILP64* means that integer, long, and pointer data entities all occupy 8 bytes. This differs from the more conventional LP64 model in which only long and pointer data entities occupy 8 bytes while integer entities stay at 4 byte size. More information on the historical background and the programming model philosophy can be found for example in http://www.unix.org/version2/whatsnew/lp64_wp.html

6.1 Using ILP64

Use the following options to enable the ILP64 interface

- Use the Fortran compiler driver option `-i8` for separate compilation and the `-ilp64` option for separate linkage. For example,

```
$ mpiifort -i8 -c test.f
$ mpiifort -ilp64 -o test test.o
```

- Use the `mpiexec -ilp64` option to preload the ILP64 interface. For example,

```
$ mpiexec -ilp64 -n 2 ./myprog
```

6.2 Known Issues and Limitations

- Data type counts and other arguments with values larger than 2^{31}-1 are not supported.
- Special MPI types `MPI_FLOAT_INT`, `MPI_DOUBLE_INT`, `MPI_LONG_INT`, `MPI_SHORT_INT`, `MPI_2INT`, `MPI_LONG_DOUBLE_INT`, `MPI_2INTEGER` are not changed and still use a 4-byte integer field.
- Predefined communicator attributes `MPI_APPNUM`, `MPI_HOST`, `MPI_IO`, `MPI_LASTUSEDCODE`, `MPI_TAG_UB`, `MPI_UNIVERSE_SIZE`, and `MPI_WTIME_IS_GLOBAL` are returned by the functions `MPI_GET_ATTR` and `MPI_COMM_GET_ATTR` as 4-byte integers. The same holds for the predefined attributes that may be attached to the window and file objects.
- Do not use the `-i8` option to compile MPI callback functions, such as error handling functions, user-defined reduction operations, etc.
- You have to use a special ITC library if you want to use the Intel® Trace Collector with the Intel MPI ILP64 executable files. If necessary, the Intel MPI `mpiifort` compiler driver will select the correct ITC library automatically.
- Use the `mpif.h` file instead of the MPI module in Fortran90* applications. The Fortran module supports 32-bit `INTEGER` size only.
- There is currently no support for C and C++ applications.

7 Unified Memory Management

The Intel® MPI Library provides a way to replace the memory management subsystem by a user-defined package. You may optionally set the following function pointers:

- i_malloc
- i_calloc
- i_realloc
- i_free

These pointers also affect the C++ new and delete operators.

The respective standard C library functions are used by default.

The following contrived source code snippet illustrates the usage of the unified memory subsystem:

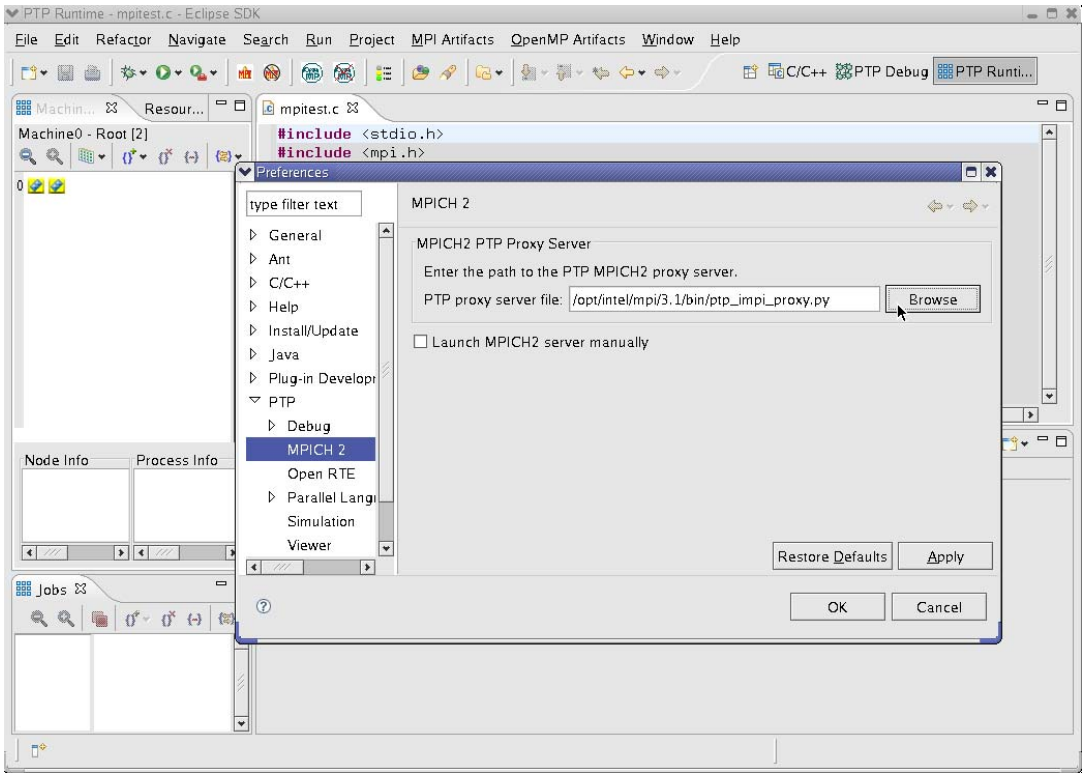
```
#include <i_malloc.h>
#include <my_malloc.h>

int main( int argc, int argv )
{
    // override normal pointers
    i_malloc = my_malloc;
    i_calloc = my_calloc;
    i_realloc = my_realloc;
    i_free = my_free;

#ifdef _WIN32
    // also override pointers used by DLLs
    i_malloc_dll = my_malloc;
    i_calloc_dll = my_calloc;
    i_realloc_dll = my_realloc;
    i_free_dll = my_free;
#endif

    // now start using Intel(R) libraries
}
```

8 Integration into Eclipse* PTP

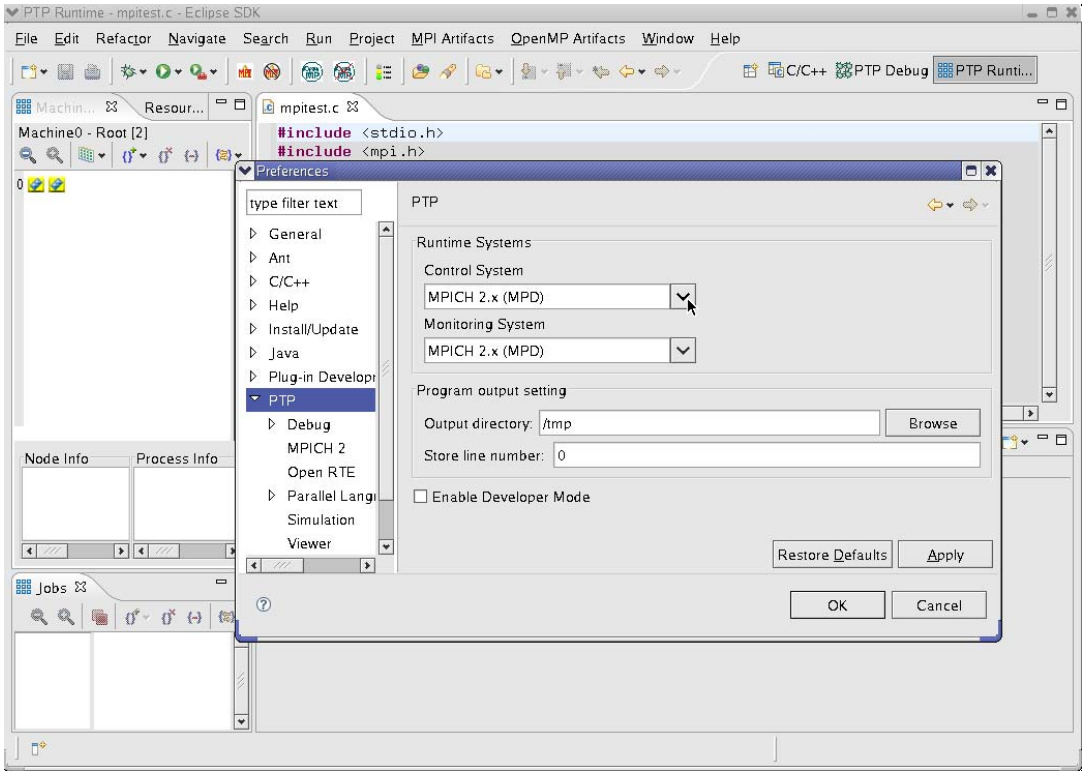
The Intel® MPI Library can be used with the Eclipse* Parallel Tools Platform (PTP). You can launch parallel applications on the existing MPD ring from the Eclipse PTP graphical user interface. The MPD ring must be started prior to the PTP startup.

Perform the following configuration steps to use PTP with the Intel® MPI Library:

1. Set the `PTPPATH` environment variable to specify the location of the `ptplib.py` module.
2. Select Window->Preferences from the Eclipse main menu. Select PTP->MPICH 2 preference page.
3. Specify the full path to the `ptp_impi_proxy.py` file, for example, `<installdir>/bin/ptp_impi_proxy.py`. Click the **Apply** button.



4. Go to the PTP preference page.
5. Select MPICH2* (MPD) in both Control System and Monitoring System drop down menus. If MPICH2* (MPD) is already selected, click the **OK** button and restart Eclipse.



6. Switch to the PTP Runtime perspective.
7. In the Machines view you will see the cluster nodes on which the MPD ring is currently working.
8. Refer to the PTP User's Guide for more information. The PTP documentation is available at: http://www.eclipse.org/ptp/doc.php

9 Glossary

hyper-threading technology	A feature within the IA-32 family of processors, where each processor core provides the functionality of more than one logical processor.
logical processor	The basic modularity of processor hardware resource that allows a software executive (OS) to dispatch task or execute a thread context. Each logical processor can execute only one thread context at a time.
multi-core processor	A physical processor that contains more than one processor core.
multi-processor platform	A computer system made of two or more physical packages.
processor core	The circuitry that provides dedicated functionalities to decode, execute instructions, and transfer data between certain sub-systems in a physical package. A processor core may contain one or more logical processors.
physical package	The physical package of a microprocessor capable of executing one or more threads of software at the same time. Each physical package plugs into a physical socket. Each physical package may contain one or more processor cores.
processor topology	Hierarchical relationships of “shared vs. dedicated” hardware resources within a computing platform using physical package capable of one or more forms of hardware multi-threading.

10 Index