The Intel® MPI Library is a multi-fabric message passing library that implements the Message Passing Interface, v2 (MPI-2) specification. Use it to switch interconnection fabrics without re-linking.

This Getting Started Guide explains how to use the Intel® MPI Library to compile and run a simple MPI program. This guide also includes basic usage examples and troubleshooting tips.

To quickly start using Intel® MPI Library, print this short guide and walk through the example provided.
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1 About this Document

The goal of this Getting Started Guide is to provide you with a complete command and tuning reference for the Intel® MPI Library.

1.1 Intended Audience

This Getting Started Guide tells a first time user how to install and use the Intel® MPI Library.

1.2 Using Doc Type Field

This Reference Manual contains the following sections:

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<td>Section</td>
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<tr>
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1.3 Conventions and Symbols

The following conventions are used in this document.

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<th>Conventions and Symbols used in this Document</th>
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</table>
1.4 Related Information

To get more information about the Intel® MPI Library, see the following resources:

- Product Web Site
- Intel® MPI Library support
- Intel® Cluster Tools Products
- Intel® Software Development Products
2 Using the Intel® MPI Library

2.1 Usage Model

Using the Intel® MPI Library involves the following steps. These steps are described in the corresponding sections in detail.

![Flowchart representing the usage model for working with the Intel® MPI Library.](image)

2.2 Before you Begin

1. Before using the Intel® MPI Library, ensure that the library, scripts, and utility applications are installed. See Intel® MPI Library for Windows* Installation Guide for installation instructions.

2. For getting proper environment settings, use the following commands from the Start menu:

   Start > Programs> Intel Software Development Tools> Intel(R) MPI Library v3.1 > Build Environment for IA-32
Start > Programs > Intel Software Development Tools > Intel(R) MPI Library v3.1 > Build Environment for Intel® 64

Alternatively, you can open a new console (cmd) window and run one of the following BAT files from the command line.

<installdir>\ia32\bin\mpivars.bat
<installdir>\em64t\bin\mpivars.bat

3. You should have administrator privileges on all nodes of the cluster to start the smpd service on all nodes of the cluster.

2.3 Compiling and Linking

To compile and link an MPI program with the Intel® MPI Library do the following steps:

2. Choose the x64 solution platform.
3. Add <installdir>\em64t\include to the include path.
4. Add <installdir>\em64t\lib to the library path.
5. Add impi.lib (Release) or impid.lib (Debug) to your target link command for C applications.
6. Add impi.lib and impicxx.lib (Release) or impid.lib and impicxxd.lib (Debug) to your target link command for C++ applications. Link application with impimt.lib (Release) impidmt.lib (Debug) for multithreading.
7. Build a program.
8. Place your application and all the dynamic libraries in a shared location or copy them to all the nodes.
9. Run the application using the mpiexec.exe command.

2.4 Setting up SMPD Services

The Intel® MPI Library uses a Simple Multi-Purpose Daemon (SMPD) job startup mechanism. In order to run programs compiled with Microsoft* Visual Studio* (or related), set up a SMPD service.

NOTE: You should have administrator privileges to start the smpd service and all users can launch processes with mpiexec.

To set up SMPD services:
1. During the Intel® MPI Library installation the `smpd` service is started. During installation you can cancel the `smpd` service startup.
2. You can start, restart, stop or remove the `smpd` service manually when the Intel® MPI Library is installed. Find `smpd.exe` in the `<installdir>\em64t\bin`
3. Use the following command on each node of the cluster: > `smpd.exe -remove` to remove the previous `smpd` service.
4. Use the following command on each node of the cluster: > `smpd.exe -install` to install the `smpd` service manually.

2.5 Selecting a Network Fabric

The Intel® MPI Library dynamically selects different fabrics for communication between MPI processes.

To select a specific fabric combination, set the `I_MPI_DEVICE` environment variable to one of the following values:

<table>
<thead>
<tr>
<th><code>I_MPI_DEVICE</code> values</th>
<th>Supported fabric</th>
</tr>
</thead>
<tbody>
<tr>
<td>sock</td>
<td>TCP/Ethernet*/sockets</td>
</tr>
<tr>
<td>shm</td>
<td>Shared memory only (no sockets)</td>
</tr>
<tr>
<td>ssm</td>
<td>TCP + shared memory (for SMP clusters connected via Ethernet*)</td>
</tr>
<tr>
<td>rdma[:&lt;provider&gt;]</td>
<td>InfiniBand* or other RDMA-capable fabric (via specified DAPL* provider)</td>
</tr>
<tr>
<td>rdssm[:&lt;provider&gt;]</td>
<td>TCP + shared memory + DAPL* (for SMP clusters connected via RDMA-capable fabrics)</td>
</tr>
</tbody>
</table>

Ensure the selected fabric is available. For example, use `shm` only if all the processes can communicate with each other via shared memory. Use `rdma` only if all the processes can communicate with each other via a single DAPL provider. Ensure that the `dat.dll` library is in your `%PATH%`. Otherwise, use the `-genv` option for `mpiexec.exe` for setting the `I_MPI_DAT_LIBRARY` environment variable with the fully-qualified path to the `dat.dll` library.

2.6 Running an MPI Program

Use the `mpiexec` command to launch programs linked with the Intel® MPI Library:

> `mpiexec.exe -n <# of processes> myprog.exe`
NOTE: The `wmpiexec` utility is a GUI wrapper for `mpiexec.exe`. See *Intel® MPI Library Reference Manual* for more details.

Use the only required `mpiexec -n` option to set the number of processes on the local node.

Use the `-hosts` option to set names of hosts and number of processes:

```
> mpiexec.exe -hosts 2 host1 2 host2 2 myprog.exe
```

If you are using a network fabric as opposed to the default fabric, use the `-genv` option to set the `I_MPI_DEVICE` variable.

For example, to run an MPI program using the `shm` fabric, type in the following command:

```
> mpiexec.exe -genv I_MPI_DEVICE shm -n <# of processes> myprog.exe
```

You may use the `-configfile` option to run the program:

```
> mpiexec.exe -configfile config_file
```

The configuration file contains:

```
-host host1 -n 1 -genv I_MPI_DEVICE rdssm myprog.exe
-host host2 -n 1 -genv I_MPI_DEVICE rdssm myprog.exe
```

For the `rdma` capable fabric, use the following command:

```
> mpiexec.exe -hosts 2 host1 1 host2 1 -genv I_MPI_DEVICE rdma myprog.exe
```

You can select any supported device. For more information, see Section 2.4 *Selecting a Network Fabric*.

If you successfully run your application using the Intel® MPI Library, you can move your application from one cluster to another and use different fabrics between the nodes without re-linking. If you encounter problems, see *Troubleshooting* for possible solutions.
3  Troubleshooting

Use the following sections to troubleshoot problems with installation, setup, and running applications using the Intel® MPI Library.

3.1 Testing Installation

To ensure that the Intel® MPI Library is installed and functioning, complete a general testing, compile and run a test program.

To test the installation:

1. Verify through the Computer Management that the smpd service is started. It calls the Intel MPI Process Manager.
2. Verify that `<installdir>\ia32\bin` and `<installdir>\ia32\lib\` (`.\em64t\bin` and `.\em64t\lib` for Intel® 64 in 64-bit mode) is in your path:
   
   ```
   > echo %PATH%
   ```
   
   You should see the correct path for each node you test.

3. If you use Intel® compilers, verify that the appropriate directories are included in the path and the LIB environment variables:

   ```
   > mpiexec.exe -hosts 2 host1 1 host2 1 a.bat
   ```
   
   where `a.bat` contains
   
   ```
   echo %PATH%
   ```
   
   You should see the correct directories for these path variables for each node you test. If not, call the appropriate *vars.bat scripts. For example, with Intel® C++ Compiler 9.1 for Windows® for Intel® 64 in 64-bit mode, use the Windows program menu to select:

   Intel(R) Software Development Tools > Intel(R) C++ Compiler 9.1 > Build Environment for Intel® 64
   
   or from the command line:
   
   ```
   %ProgramFiles%\Intel\Compiler\C++\9.1\em64t\bin\iclvars.bat
   ```

4. Under unusual circumstances, you may need to include `<installdir>\ia32\lib directory` (`.\em64t\lib` for Intel® 64 in 64-bit mode) in your LIB. To verify your LIB settings, use the command:

   ```
   > mpiexec.exe -hosts 2 host1 1 host2 1 a.bat
   ```
   
   where `a.bat` contains
   
   ```
   echo %Lib%
   ```
3.2 Compiling and Running a Test Program

The install directory `<installdir>\test` contains test programs which you can use for testing. To compile one of them or your test program, do the following:

1. Compile a test program as described in Section 1.1 Compiling and Linking.
2. If you are using InfiniBand* or other RDMA-capable network hardware and software, verify that everything is functioning.
3. Run the test program with all available configurations on your cluster.
   - Test the `sock` device using:
     ```
     > mpiexec.exe -n 2 -env I_MPI_DEBUG 2 -env I_MPI_DEVICE sock a.out
     ```
     You should see one line of output for each rank, as well as debug output indicating that the `sock` device is used.
   - Test the `ssm` devices using:
     ```
     > mpiexec.exe -n 2 -env I_MPI_DEBUG 2 -env I_MPI_DEVICE ssm a.out
     ```
     You should see one line of output for each rank, as well as debug output indicating that the `ssm` device is used.
   - Test any other fabric devices using:
     ```
     > mpiexec.exe -n 2 -env I_MPI_DEBUG 2 -env I_MPIDEVICE \ 
     <device> a.out
     ```
     where `<device>` can be `shm`, `rdma`, or `rdssm`
     For each of the `mpiexec` commands used, you should see one line of output for each rank, as well as debug output indicating which device was used. The device(s) should agree with the `I_MPIDEVICE` setting.
4 Next Steps

To get more information about the Intel® MPI Library, explore the following resources:

*Release Notes* include key product details. See the *Release Notes* for updated information on requirements, technical support, and known limitations. Use the Windows program menu to select Intel(R) Software Development Tools > Intel(R) MPI Library v3.1 > Intel(R) MPI Library Release Notes for Windows*.

For more information see Websites:

Product Web Site
Intel® MPI Library support
Intel® Cluster Tools Products
Intel® Software Development Products