

# MPICH-Madeleine Quick Start

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## Abstract

MPICH-Madeleine is a new free implementation of the MPI standard based on the MPICH implementation and the multi-protocol communication library called Madeleine. It aims to efficiently exploit clusters of clusters with heterogeneous networks. This manual presents a short overview on how to install and use MPICH-Madeleine. The full manual for MPICH-Madeleine is available at <http://runtime.bordeaux.inria.fr/mpi/manual/>.

The latest version of this document is available from the following URL: <http://runtime.bordeaux.inria.fr/mpi/quickStart/>.

If you have any questions concerning MPICH-Madeleine, please, send an email to [mpich-mad-users@lists.gforge.inria.fr](mailto:mpich-mad-users@lists.gforge.inria.fr).

**Keywords:** MPI, Communication, Heterogeneous networks.

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# Chapter 1

## Installing MPICH-Madeleine

### 1.1 Getting the Source Code

MPICH-Madeleine files are hosted by the project MPICH-Madeleine on the InriaGforge at <https://gforge.inria.fr/projects/mpich-mad/>.

You need to download the package for MPICH-Madeleine as well as the one for PM2. The latest release for these two packages, `pm2` and `mpich-mad`, is available from the main page of the project MPICH-Madeleine at <https://gforge.inria.fr/projects/mpich-mad/> under the tab **Latest File Releases**.

Note that the latest release for the package `pm2` is also available from the main page of the project PM2 at <https://gforge.inria.fr/projects/pm2/>.

### 1.2 Required development tools

The following development tools are required to compile MPICH-Madeleine:

- GNU C Compiler `gcc` (version 3.2 and higher).
- GNU `make` (version 3.81 and higher).
- GNU Bison (<http://www.gnu.org/software/bison/>) and Flex (<http://www.gnu.org/software/flex/>).

### 1.3 Prerequisites

If you plan to use Myrinet and SCI, you must get the appropriate drivers. Madeleine III supports Myrinet networks through the GM and MX drivers and SCI networks through the SISI driver. The default installation directories for these drivers are:

- `/opt/gm` for Myrinet/GM;
- `/opt/mx` for Myrinet/MX;
- `/opt/DIS` for SCI/SISI.

In case, your installation differs from these directories, you will need to set the following environment variables to point to your own installation directories:

```
% setenv MX_DIR /softs/mx
% setenv GM_DIR /softs/gm
% setenv SISCO_PATH /opt/DIS
```

The second step is then to create symbolic links from the sub-directory `.mpich-mad` in your home directory pointing to the drivers's distributions:

- A link to the GM distribution (including header files, libraries, ...) called `gm`, such as:

```
% mkdir $HOME/.mpich-mad
% cd $HOME/.mpich-mad
% ln -s /opt/gm gm
```

- AND/OR a link to the MX distribution (including header files, libraries, ...) called `mx`, such as:

```
% mkdir $HOME/.mpich-mad
% cd $HOME/.mpich-mad
% ln -s /opt/mx mx
```

- AND/OR a link to the SISCO distribution called `DIS`, such as:

```
% mkdir $HOME/.mpich-mad
% cd $HOME/.mpich-mad
% ln -s /opt/DIS DIS
```

The name of these links are **important**, so please respect them.

## 1.4 Installing PM2

Here are the required steps to install PM2.

1. Choose an installation directory for PM2, and set the environment variable `PM2_ROOT` to this directory.

```
% setenv PM2_ROOT $HOME/soft/pm2
```

2. Go in the parent directory of the directory `PM2_ROOT` and unpack the PM2 archive;

```
% cd $HOME/soft
% tar zxf pm2-2005-03-16.tar.gz
```

If your tar does not accept the option `z`, use:

```
% gunzip -c pm2-2005-03-16.tar.gz | tar xf -
```

You should end up with a directory named `pm2` as indicated by the environment variable `PM2_ROOT`.

3. You need to add to your PATH the directory pm2/bin.

```
% setenv PATH ${PM2_ROOT}/bin:${PATH}
```

4. PM2 is installed.

## 1.5 Installing MPICH-Madeleine

Here are the required steps to install MPICH-Madeleine.

1. Go in some directory of your choice, and unpack the MPICH-Madeleine archive;

```
% cd $HOME/soft
% tar zxf mpich-mad-2005-03-16.tar.gz
```

If your tar does not accept the option z, use:

```
% gunzip -c mpich-mad-2005-03-16.tar.gz | tar xf -
```

You should end up with a directory named mpich-mad.

2. Choose an installation directory for MPICH-Madeleine, and set the environment variable MPICH\_MAD\_ROOT to this directory.

```
% setenv MPICH_MAD_ROOT $HOME/soft/mpich-mad-install
```

3. Configure MPICH-Madeleine by issuing the following commands:

```
% cd mpich-mad
% ./configure --prefix=$MPICH_MAD_ROOT --with-arch=LINUX --with-device=ch_mad:--pm2root
```

4. Build MPICH-Madeleine. That step might take some time.

```
% make
```

5. Install the MPICH-Madeleine commands.

```
% make install
```

6. Note: do NOT get rid off the PM2 source after the installation. It is still needed by users to compile and run their applications!

7. Users can add to their `PATH` the element `mpich-mad-install/bin` in order to easily access the commands `mpicc` and `mpirun`.

```
% setenv PATH ${MPICH_MAD_ROOT}/bin:${PATH}
```

8. You also need to define the following environment variable which is needed by PM2.

```
% setenv LEO_RSH "ssh -n -f"
```

## 1.6 Summary of Environment Variables

Here the list of environment variables you need to set (preferably in your login files such as `$HOME/.cshrc`) before being able to compile and execute MPICH-Madeleine applications.

```
## Directory where PM2 is installed
setenv PM2_ROOT $HOME/soft/pm2

## Directory where MPICH-Madeleine is installed
setenv MPICH_MAD_ROOT $HOME/soft/mpich-mad-install

## Access to the PM2 commands
setenv PATH ${PM2_ROOT}/bin:${PATH}

## Access to the MPI commands
setenv PATH ${MPICH_MAD_ROOT}/bin:${PATH}
```

## Chapter 2

# Running MPICH-Madeleine Programs

The sub-directory `example/basics` of the MPICH-Madeleine source directory contains basic examples that can be used to test your MPICH-Madeleine installation. We will go through this section by using the program `mpi.c`.

### 2.1 Compiling the application

Compile your application with `mpicc`.

```
% cd mpich-mad/examples/basic
% $MPICH_MAD_ROOT/bin/mpicc -o mpi mpi.c
```

### 2.2 Location of the executable

MPI expects to locate the executable on the local machine, and at the same location on the remote machines. In our example, the location of the executable is `$PWD/mpi.e.g /home/mpich-user/mpi.c` and this location must be valid on any machine running the application. See in the full guide at <http://runtime.futurs.inria.fr/mpi/manual/Section3.html#Section3.1> to overcome this restriction.

### 2.3 Defining the machines to run the application on

- You need to define the network configuration file `localnet.cfg`. This file should be sitting in the directory `$MPICH_MAD_ROOT/etc` and describes the different available networks.

```

networks : (
  {
    name : myrinet;
    hosts : (node-40.bordeaux.grid5000.fr,
             node-41.bordeaux.grid5000.fr,
             node-42.bordeaux.grid5000.fr,
             node-43.bordeaux.grid5000.fr);
    dev   : mx;
  },
  {
    name : tcp;
    hosts : (node-15.bordeaux.grid5000.fr,
             node-16.bordeaux.grid5000.fr,
             node-17.bordeaux.grid5000.fr,
             node-18.bordeaux.grid5000.fr);
    dev   : tcp;
  },
  {
    name : gateway;
    hosts : (node-40.bordeaux.grid5000.fr,
             node-15.bordeaux.grid5000.fr);
    dev   : tcp;
  }
);

```

A network is defined with its name (tag `name`), a list of machines it includes (tag `hosts`), and the identifier of the device connecting these machines (tag `dev`, should be one of the predefined identifiers recognized by Madeleine).

- Define the machines you wish to run your application on. When using a OAR reservation, the application will be launched on the machines reserved by OAR. You can also specify a list of machines by setting the environment variable `MPI_HOST_FILE` to a file containing the list of the machines you wish to use.

```

% cat $OAR_NODEFILE
node-16.bordeaux.grid5000.fr
node-41.bordeaux.grid5000.fr
node-47.bordeaux.grid5000.fr
% cat $MPI_HOST_FILE
node-16.bordeaux.grid5000.fr
node-41.bordeaux.grid5000.fr
%

```

- You need to make sure you can connect to the machines – you wish to use to run your application – using the SSH protocol. MPI applications are launched using the PM2's mechanisms to remotely connect to the machines, this requires a SSH access to the machines without password or pass-phrase. You might need to change the definition of the environment variable `LEO_RSH` to match the configuration of your SSH connection. Here an example to test your configuration is working:

```
% echo $LEO_RSH
ssh -n -f
% $LEO_RSH jack uname -a
% Linux jack 2.6.4-fkt #14 SMP Thu Sep 23 2004 i686 GNU/Linux

%
```

## 2.4 Executing the application

- Start your application using the command `mpirun` taking in parameter the number of processes to launch and the name of the application. The number of processes does not have to be the number of machines in the machine file (as specified above). MPICH-Madeleine will use a subset of these machines, or will start more than one process per machine accordingly.

```
% $MPICH_MAD_ROOT/bin/mpirun -np 2 cpi
```

- It is also possible to use the parameter `-machinefile` to specify the file name containing the list of machines to use to run the application on.

```
% $MPICH_MAD_ROOT/bin/mpirun -machinefile $MPI_HOST_FILE -np 2 cpi
```

- You should obtain an output similar to:

```
Process 0 of 2 on your_machine
pi is approximately 3.1415926544231318, Error is 0.0000000008333387
wall clock time = 1.094123
Process 1 of 2 on your_machine
```

- Your network configuration file can define more than one network to connect a same set of nodes. Such a configuration allows to switch easily between different networks when executing an application.

```

networks : (
  {
    name : tcp;
    hosts : (node-40.bordeaux.grid5000.fr,
             node-41.bordeaux.grid5000.fr,
             node-42.bordeaux.grid5000.fr,
             node-43.bordeaux.grid5000.fr);
    dev   : tcp;
  },
  {
    name : myrinet;
    hosts : (node-40.bordeaux.grid5000.fr,
             node-41.bordeaux.grid5000.fr,
             node-42.bordeaux.grid5000.fr,
             node-43.bordeaux.grid5000.fr);
    dev   : mx;
  }
);

```

By default, MPICH-Madeleine will use the first network to connect the nodes. You can use the environment variable `MPICH_MAD_PROTOCOL` to use another defined network.

```

% $MPICH_MAD_ROOT/bin/mpirun -np 2 cpi
... Uses TCP
% export MPICH_MAD_PROTOCOL=mx
% $MPICH_MAD_ROOT/bin/mpirun -np 2 cpi
... Uses MX
%

```

- If you wish to start your application under the debugger, you can use the option `-gdb`. All the processes of the MPI application will be launched through `gdb`, the GNU debugger.

```

% mpirun -gdb -np 2 cpi

```