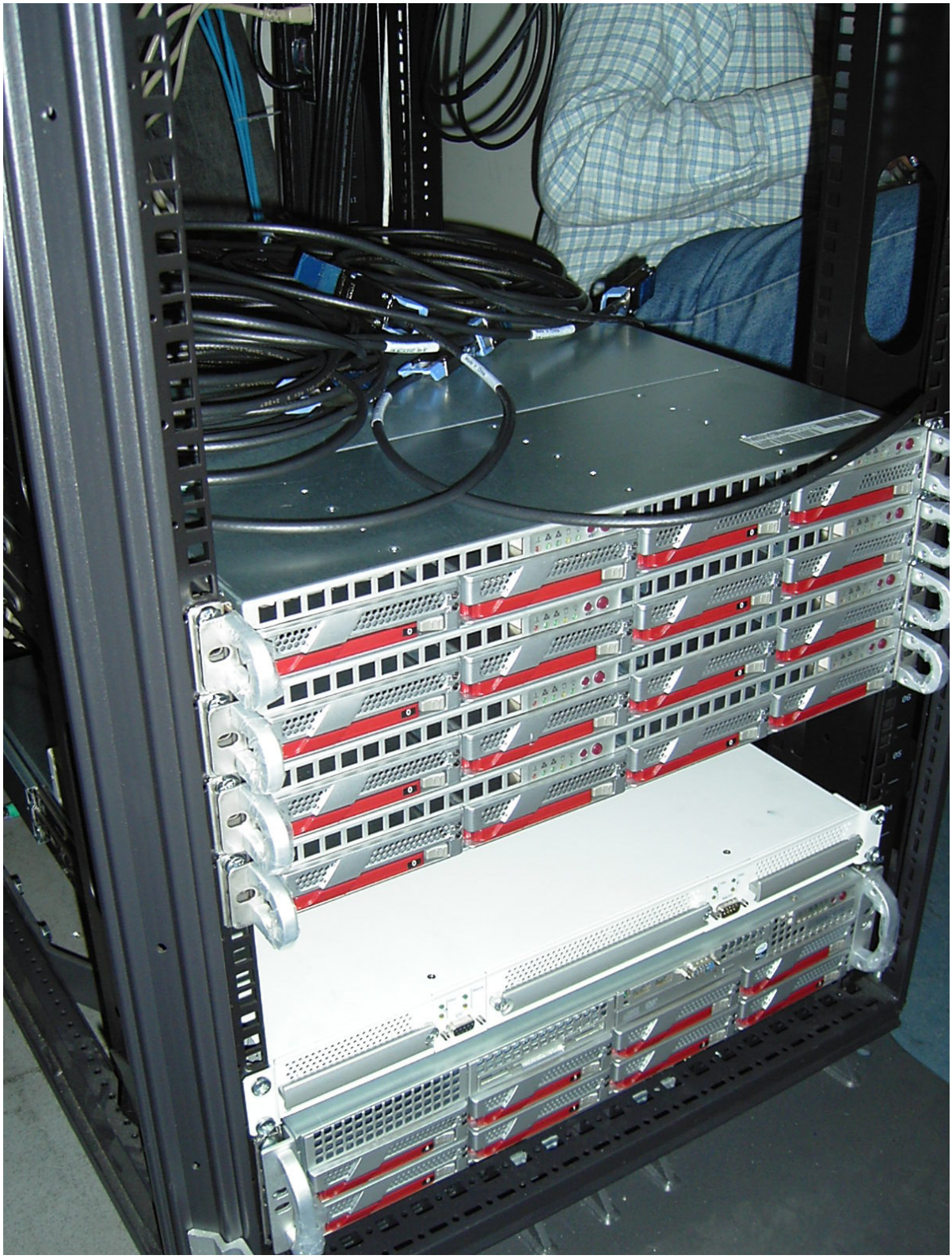
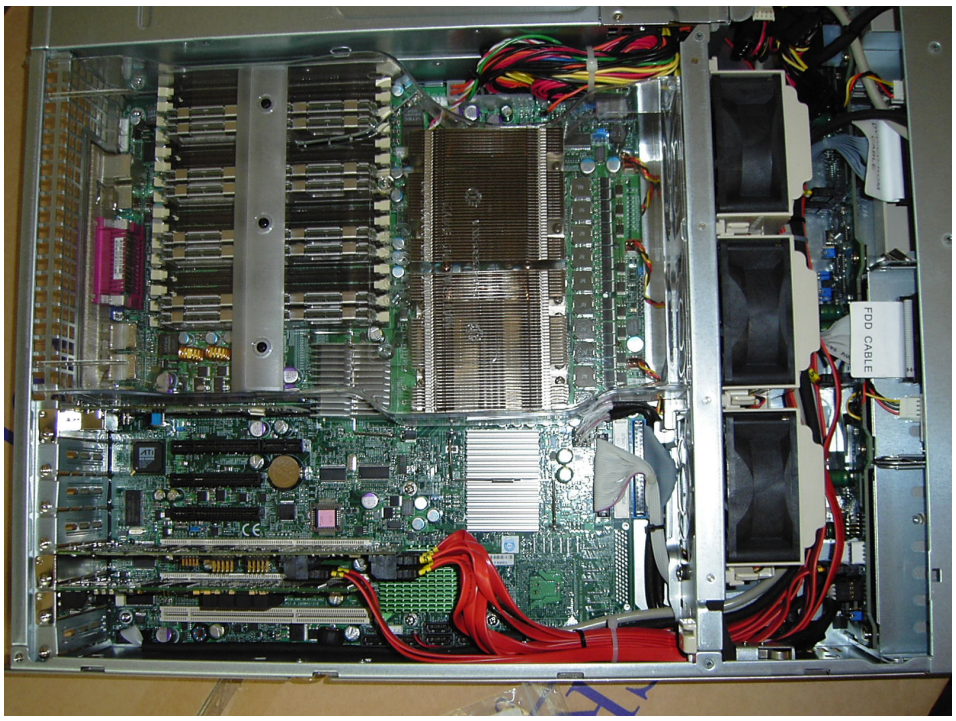
EnerGRID Cluster (http://192.168.20.11/ganglia/)

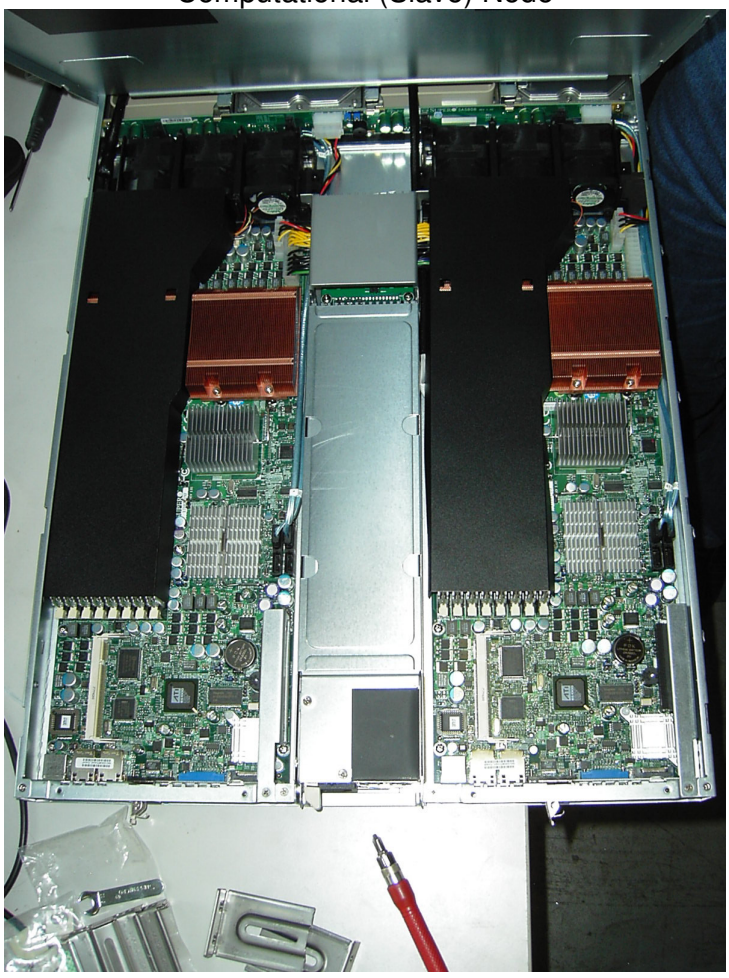
Overview



Master Node



Computational (Slave) Node



Exercise 1

Log in on the Cluster

meso@energrid:~$ cd UsingMPI/simplempi/

meso@energrid:~/UsingMPI/simplempi$ cd

meso@energrid:~$ module avail
------------ /apps/modules/modulefiles/applications ------------
openfoam/1.4.1
------------ /apps/modules/modulefiles/development ------------
fftw2/2.1.5-gcc-openmpi intel64-rt/10.0.025 openmpi/1.2.5-gcc4.2.2
gcc/4.2.2 intelmpi-rt/3.0.043
git/1.5.4.2 mvapich2/0.9.8p3-gcc4.2.2
------------ /apps/modules/modulefiles/system ------------
maui/current mpiexec/current ofed/current torque/current

meso@energrid:~$ module list
Currently Loaded Modulefiles:
1) torque/current 2) openfoam/1.4.1

meso@energrid:~$ module load openmpi

meso@energrid:~$ cd UsingMPI/simplempi/

For C++ lovers…

meso@energrid:~/UsingMPI/simplempi$ make clean
rm -rf *.o pi3 cpi pi pit matvec matmat *~ PI*
(cd f90 ; make --no-print-directory clean)
rm -f *.o pi3 pit matvec matmat *~

meso@energrid:~/UsingMPI/simplempi$ make
/apps/openmpi/1.2.5-gcc4.2.2/bin/mpif77 -o pi3 pi3.f
/apps/openmpi/1.2.5-gcc4.2.2/bin/mpicc -m64 -fPIC -o cpi cpi.c
/apps/openmpi/1.2.5-gcc4.2.2/bin/mpiCC -m64 -fPIC -o pi pi.cc
/apps/openmpi/1.2.5-gcc4.2.2/bin/mpif77 -o pit pit.f
/apps/openmpi/1.2.5-gcc4.2.2/bin/mpif77 -o matvec matvec.f
/apps/openmpi/1.2.5-gcc4.2.2/bin/mpif77 -o matmat matmat.f

meso@energrid:~/UsingMPI/simplempi$ vi pi.cc

[or meso@energrid:~/UsingMPI/simplempi$ nano pi.cc]

Go to the web site…

- http://www-unix.mcs.anl.gov/mpi/usingmpi/examples/main.htm
- Using MPI in Simple Programs
- C++ program for calculating pi

Check the meaning of the subroutines on the web site…

- http://www-unix.mcs.anl.gov/mpi/www/
- e.g. MPI_Bcast http://www-unix.mcs.anl.gov/mpi/www/www3/MPI_Bcast.html
- e.g. MPI_Reduce http://www-unix.mcs.anl.gov/mpi/www/www3/MPI_Reduce.html

meso@energrid:~/UsingMPI/simplempi$ ./pi
Enter the number of intervals: (0 quits)
1000000 [million]

1 processors in this business
pi is approximately 3.14159, Error is 2.88658e-14
Enter the number of intervals: (0 quits)
1000000000 [billion]

1 processors in this business
pi is approximately 3.14159, Error is 1.77636e-13
Enter the number of intervals: (0 quits)
0

1 processors in this business

meso@energrid:~/UsingMPI/simplempi$ mpirun -np 4 ./pi
Enter the number of intervals: (0 quits)
1000000

4 processors in this business
pi is approximately 3.14159, Error is 1.10134e-13
Enter the number of intervals: (0 quits)
1000000000

4 processors in this business
pi is approximately 3.14159, Error is 2.4869e-14
Enter the number of intervals: (0 quits)
0

4 processors in this business

For FORTRAN lovers…

meso@energrid:~/UsingMPI/simplempi$ vi matvec.f

[meso@energrid:~/UsingMPI/simplempi$ nano matvec.f]

Go to the web site…

- http://www-unix.mcs.anl.gov/mpi/usingmpi/examples/main.htm
- Using MPI in Simple Programs
- Fortran program for matrix-vector multiplication

meso@energrid:~/UsingMPI/simplempi$ ./matvec

[CTRL + C for interrupting]

meso@energrid:~/UsingMPI/simplempi$ mpirun -np 8 ./matvec

meso@energrid:~/UsingMPI/simplempi$ vi matmat.f

[or meso@energrid:~/UsingMPI/simplempi$ nano matmat.f]

Go to the web site…

- http://www-unix.mcs.anl.gov/mpi/usingmpi/examples/main.htm
- Using MPI in Simple Programs
- Fortran program for matrix-matrix multiplication

```
meso@energrid:~/UsingMPI/simplempi$ ./matmat
 Process          0  of          1  is alive
```

[CTRL + C for interrupting]

```
meso@energrid:~/UsingMPI/simplempi$ mpirun -np 8 ./matmat
 Process          0  of          8  is alive
 Process          5  of          8  is alive
 Process          7  of          8  is alive
 Process          6  of          8  is alive
 Process          1  of          8  is alive
 Process          2  of          8  is alive
 Process          3  of          8  is alive
 Process          4  of          8  is alive
 c(          1 ,          1 ) =    5050.00000000000
```

[results follow…]

For F90 lovers…

meso@energrid:~/UsingMPI/simplempi$ cd f90/

```
meso@energrid:~/UsingMPI/simplempi/f90$ make clean
rm -f *.o pi3 pit matvec matmat  *~

meso@energrid:~/UsingMPI/simplempi/f90$ make
/apps/openmpi/1.2.5-gcc4.2.2/bin/mpif90  -o pi3 pi3.f90
/apps/openmpi/1.2.5-gcc4.2.2/bin/mpif90  -o pit pit.f90
/apps/openmpi/1.2.5-gcc4.2.2/bin/mpif90  -o matvec matvec.f90
/apps/openmpi/1.2.5-gcc4.2.2/bin/mpif90  -o matmat matmat.f90
```

Exercise 2

Log in on the Cluster

```
meso@energrid:~$ cd UsingMPI/simplempi/

meso@energrid:~/UsingMPI/simplempi$ cd

meso@energrid:~$ module avail
------------ /apps/modules/modulefiles/applications ------------
openfoam/1.4.1
------------ /apps/modules/modulefiles/development ------------
fftw2/2.1.5-gcc-openmpi   intel64-rt/10.0.025       openmpi/1.2.5-gcc4.2.2
gcc/4.2.2                 intelmpi-rt/3.0.043
git/1.5.4.2               mvapich2/0.9.8p3-gcc4.2.2
------------ /apps/modules/modulefiles/system ------------
maui/current    mpiexec/current ofed/current    torque/current

meso@energrid:~$ module list
Currently Loaded Modulefiles:
 1) torque/current  2) openfoam/1.4.1

meso@energrid:~$ module load openmpi

meso@energrid:~$ cd UsingMPI/intermediate/

meso@energrid:~/UsingMPI/intermediate$ make clean
rm -f *.o oned twod *~ PI*
(cd f90 ; make --no-print-directory clean)
rm -f *.o  *~

meso@energrid:~/UsingMPI/intermediate$ make
/apps/openmpi/1.2.5-gcc4.2.2/bin/mpif77  -c oned.f
/apps/openmpi/1.2.5-gcc4.2.2/bin/mpif77  -c onedbase.f
/apps/openmpi/1.2.5-gcc4.2.2/bin/mpif77  -c sweep.f
/apps/openmpi/1.2.5-gcc4.2.2/bin/mpif77  -c diff.f
/apps/openmpi/1.2.5-gcc4.2.2/bin/mpif77  -c exchng1.f
/apps/openmpi/1.2.5-gcc4.2.2/bin/mpif77  -c decomp.f
/apps/openmpi/1.2.5-gcc4.2.2/bin/mpif77 -o oned oned.o onedbase.o sweep.o diff.o
exchng1.o decomp.o
/apps/openmpi/1.2.5-gcc4.2.2/bin/mpif77  -c twod.f
/apps/openmpi/1.2.5-gcc4.2.2/bin/mpif77  -c twodbase.f
/apps/openmpi/1.2.5-gcc4.2.2/bin/mpif77  -c sweep2.f
/apps/openmpi/1.2.5-gcc4.2.2/bin/mpif77  -c diff2d.f
/apps/openmpi/1.2.5-gcc4.2.2/bin/mpif77  -c exchng2.f
/apps/openmpi/1.2.5-gcc4.2.2/bin/mpif77  -c fndnbr2d.f
/apps/openmpi/1.2.5-gcc4.2.2/bin/mpif77 -o twod twod.o twodbase.o sweep2.o diff2d.o
exchng2.o decomp.o fndnbr2d.o

meso@energrid:~/UsingMPI/intermediate$ vi oned.f
```

[or meso@energrid:~/UsingMPI/intermediate$ nano oned.f]

Go to the web site…

- http://www-unix.mcs.anl.gov/mpi/usingmpi/examples/main.htm
- Intermediate MPI
- Jacobi with one-dimensional decomposition: Main Program

```
meso@energrid:~/UsingMPI/intermediate$ mpirun -np 8 ./oned
 Converged after        17600  Iterations in    6.94037508964539       secs
```

```
meso@energrid:~/UsingMPI/intermediate$ vi twod.f
```

[or meso@energrid:~/UsingMPI/intermediate$ nano twod.f]

Go to the web site…

- http://www-unix.mcs.anl.gov/mpi/usingmpi/examples/main.htm
- Intermediate MPI
- Jacobi with two-dimensional decomposition: Main Program

```
meso@energrid:~/UsingMPI/intermediate$ mpirun -np 8 ./twod
```

[results follow…]

```
9616  Difference is   1.001263559124851E-005
9618  Difference is   1.000732795065261E-005
9620  Difference is   1.000202342179653E-005
```