

Hands-on “MPI with Intel Xeon and Intel Xeon Phi Architecture”

1) Compile and run a MPI application on Xeon

```
mpiicc mpitest.c -o ~/mpitest  
export I_MPI_FABRICS=tcp  
mpirun -host localhost -n 10 ~/mpitest
```

1.1) Change the amount of ranks to 15 and execute again

```
mpirun -host localhost -n 15 ~/mpitest
```

2) Execute the application on two nodes (Xeon):

```
scp ~/mpitest phi03:~/  
mpirun -host localhost -n 10 ~/mpitest : -host phi03 -n 10 ~/mpitest
```

3) Compile and run the code on Intel Xeon Phi.

```
Use variable I_MPI_MIC to enable the mic to execute MPI  
export I_MPI_MIC=1  
mpiicc mpitest.c -o ~/mpitest.mic -mmic  
mpirun -host mic0 -n 10 ~/mpitest
```

4) Execute the application on several Xeon Phi Coprocessors:

```
mpirun -host mic0 -n 10 ~/mpitest.mic : -host mic1 -n 10 ~/mpitest.mic : -host mic2 -n 10  
~/mpitest.mic : -host mic3 -n 10 ~/mpitest.mic
```

5) Execute the application on two Xeon nodes and several Xeon Phi Coprocessors:

```
mpirun -host localhost -n 10 ~/mpitest : -host phi03 -n 10 ~/mpitest.mic : -host mic0 -n 10  
~/mpitest.mic : -host mic1 -n 10 ~/mpitest.mic : -host mic2 -n 10 ~/mpitest.mic : -host mic3 -n 10 ~/mpitest.mic
```

6) MPI Pinning

```
export I_MPI_DEBUG=4 mpirun -host localhost -n 10 ~/mpitest
```

Note that after executing the application the pinning report is generated on the standard output:

```
[0] MPI startup(): Rank  Pid  Node name      Pin cpu  
[0] MPI startup(): 0    50344  phi02.ncc.unesp.br {0,1,2,3,36,37,38}
```

```
[0] MPI startup(): 1    50345  phi02.ncc.unesp.br {4,5,6,39,40,41,42}
[0] MPI startup(): 2    50346  phi02.ncc.unesp.br {7,8,9,10,43,44,45}
[0] MPI startup(): 3    50347  phi02.ncc.unesp.br {11,12,13,46,47,48,49}
[0] MPI startup(): 4    50348  phi02.ncc.unesp.br {14,15,16,17,50,51,52}
[0] MPI startup(): 5    50349  phi02.ncc.unesp.br {18,19,20,53,54,55,56}
[0] MPI startup(): 6    50350  phi02.ncc.unesp.br {21,22,23,24,57,58,59}
[0] MPI startup(): 7    50351  phi02.ncc.unesp.br {25,26,27,60,61,62,63}
[0] MPI startup(): 8    50352  phi02.ncc.unesp.br {28,29,30,31,64,65,66}
[0] MPI startup(): 9    50353  phi02.ncc.unesp.br {32,33,34,67,68,69,70}
```

6.1) group resources by domain

```
export I_MPI_PIN_DOMAIN=node
mpirun -host phi02 -n 10 ~/mpitest
```

6.1) group resources by socket

```
export I_MPI_PIN_DOMAIN=socket
mpirun -host phi02 -n 10 ~/mpitest
```

7) MPI and OpenMP Pinning

```
mpiicc mpiOpenMPtest.c -o ~/mpiOpenMPtest -fopenmp
mpiicc mpiOpenMPtest.c -o ~/mpiOpenMPtest.mic -fopenmp -mmic
export OMP_NUM_THREADS=2
export KMP_AFFINITY=verbose,scatter
export I_MPI_PIN_DOMAIN=socket
mpirun -host phi02 -n 2 ~/mpiOpenMPtest
```

Note that each rank will fork two threads using only the resources of its domain

Define different mpi/openmp affinity in each rank

```
mpirun -host phi02 -n 2 -env KMP_AFFINITY=verbose,scatter -env OMP_NUM_THREADS=2 env
I_MPI_PIN_DOMAIN=cache1 ~/mpiOpenMPtest : -host mic0 -n 2 -env OMP_NUM_THREADS=4 -env
I_MPI_PIN_DOMAIN=cache1 -env KMP_AFFINITY=verbose,scatter -env LD_LIBRARY_PATH=/opt/intel/lib/mic/
~/mpiOpenMPtest
```