XcalableMP

Directive-based language eXtension for Scalable Parallel Programming

PGAS

Overview

What's XcalableMP ?

- XcalableMP (XMP) is a directive-based PGAS language based on C99 and Fortran95

- XMP supports typical parallelization under "global-view model" programming and enables parallelizing the original sequential code

- XMP also includes coarray features for "local-view model" programming

- Designed by XMP Specification Working Group of the PC Cluster Consortium (*http://www.pccluster.org/en/*)

Implementation Status

- XMP specification ver. 1.2.1 (*http://xcalablemp.org*)
  - Define actions of OpenMP directives in XMP Programs
  - Add Intrinsic/Built-in Transformational Procedures

- Omni compiler ver. 0.9 by RIKEN AICS and University of Tsukuba, Japan (*http://omni-compiler.org*)
  - Open source XMP compiler
  - Interface of Scalasca & tlog profiling tools
  - Supported platforms: The K computer, Fujitsu FX10, Cray XE, HITACHI SR16000, IBM Blue Gene/Q, general Linux clusters, and so on

Programming Model

Execution Model

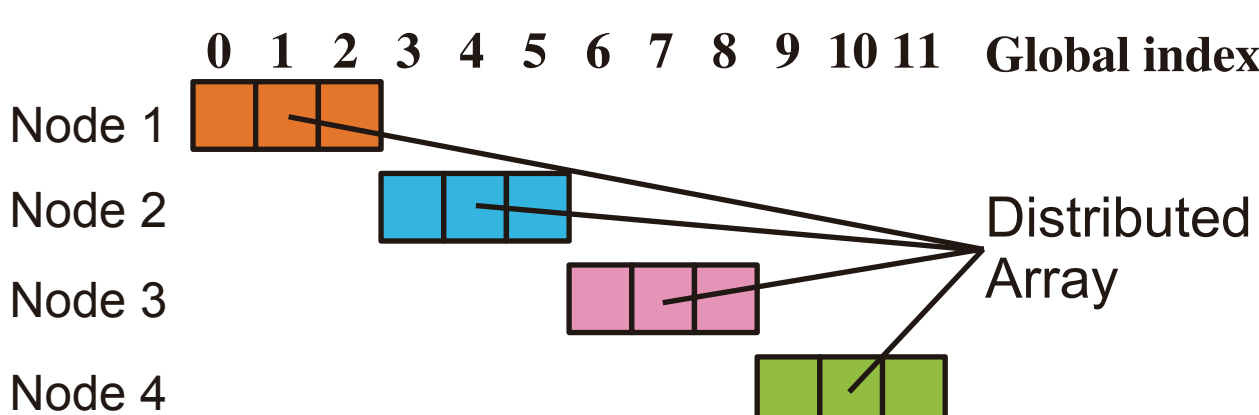- SPMD as a basic execution model
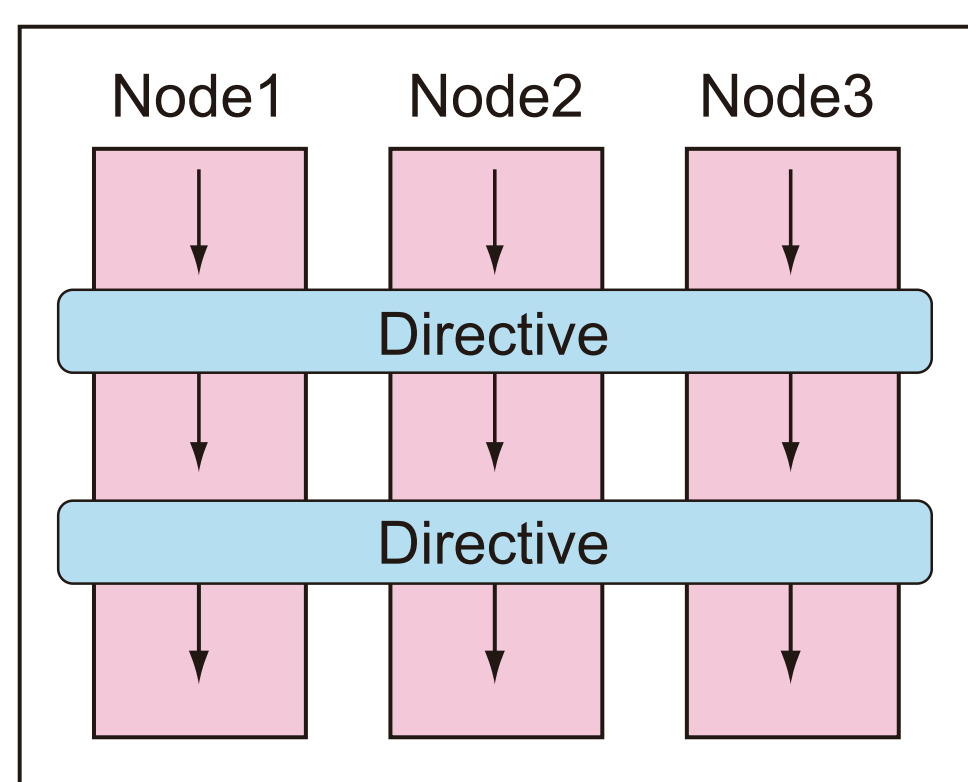
- Communication occurs when a directive is encountered (global-view model)

- One-sided communication occurs when a coarray is referred (local-view model)

Global-view model

- Array a[] is distributed onto 4 nodes

```
int a[12];                              Data mapping
#pragma xmp nodes p(4)
#pragma xmp template t(0:11)
#pragma xmp distribute t(block) onto p
#pragma xmp align a[i] with t(i)
```



```
#pragma xmp loop on t(i) reduction(+s)
for(i = 0; i < 12; i++) {
    a[i] = func(i);
    s += a[i];
}                                       Work mapping
```

Local-view model

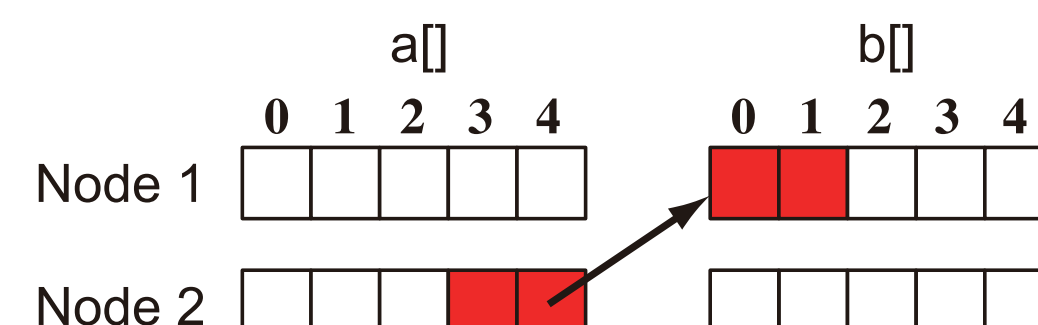- Array section and codimension in XMP/C

array_name[start:length]:[node_number]

Above code means **length** elements from **array_name[start]** to **array_name[start+length-1]** located on a node **node_number** are referred.
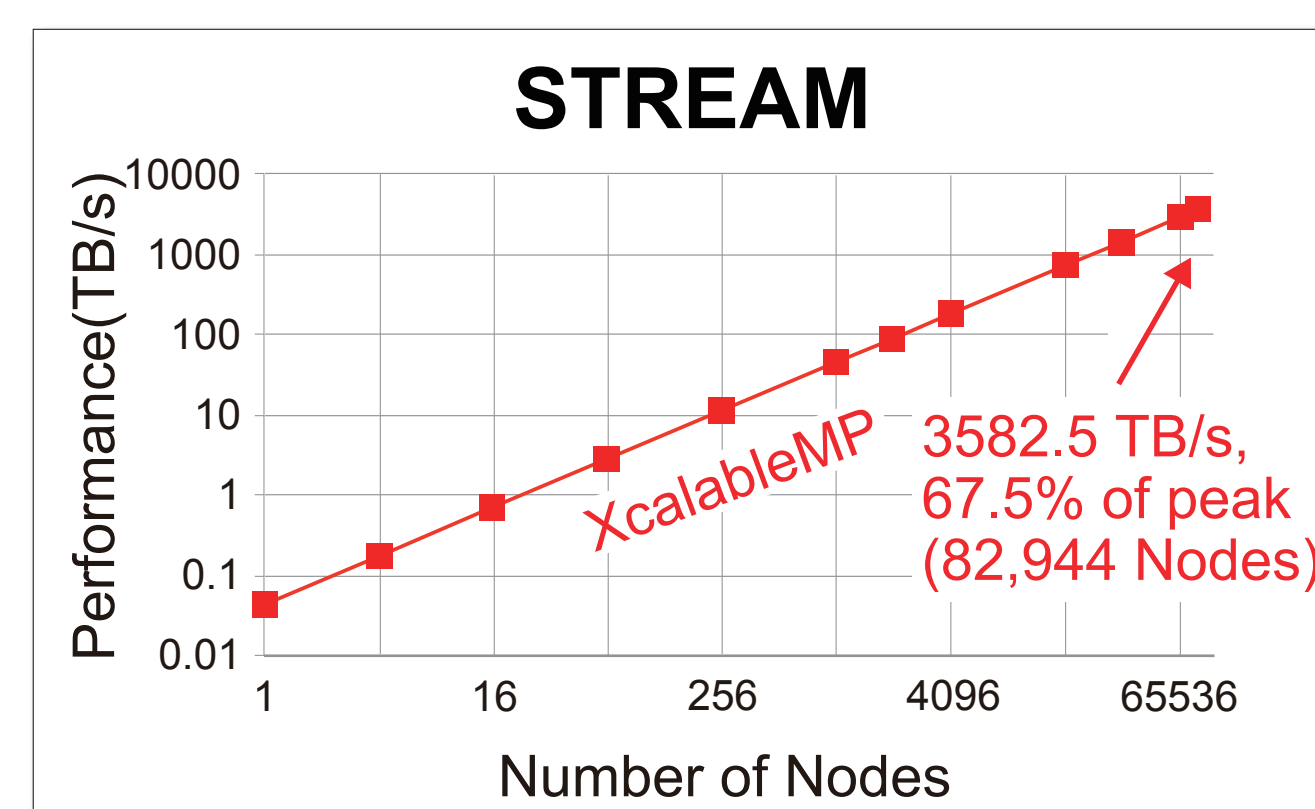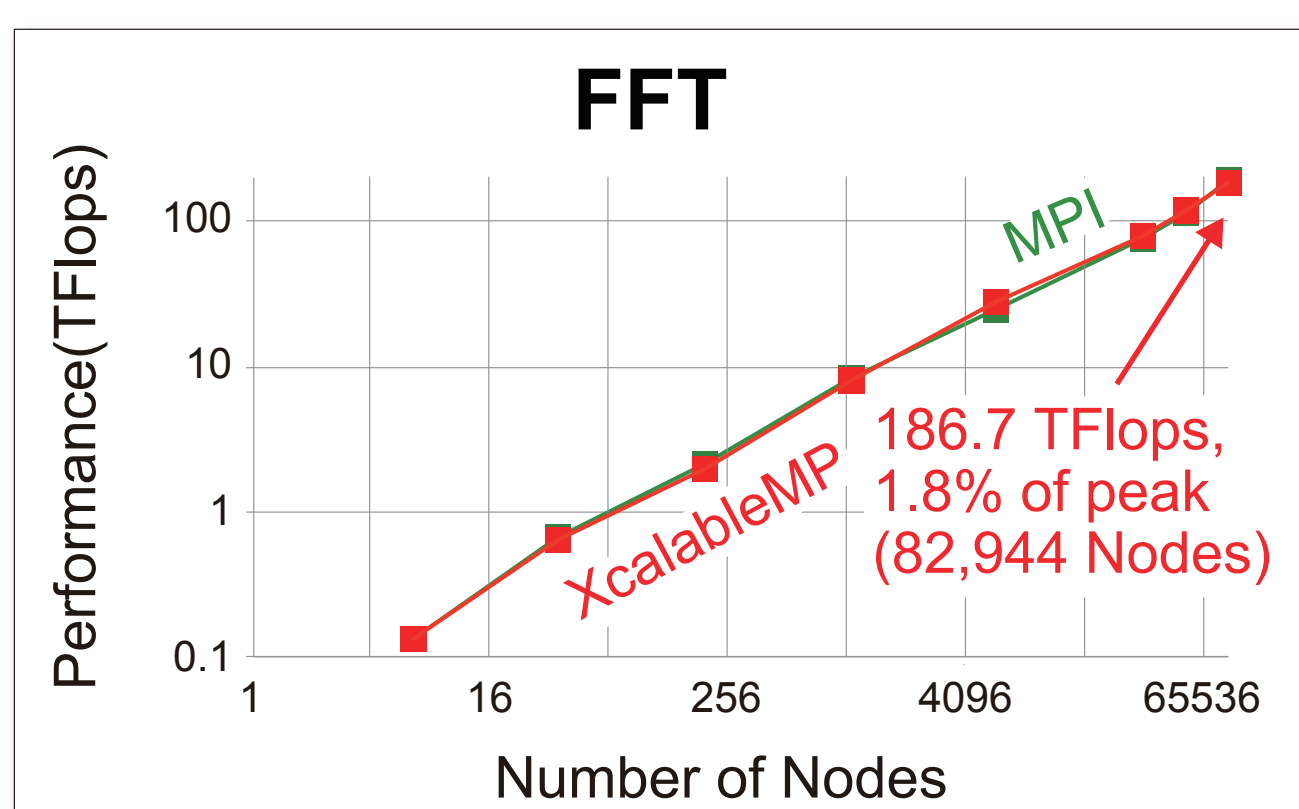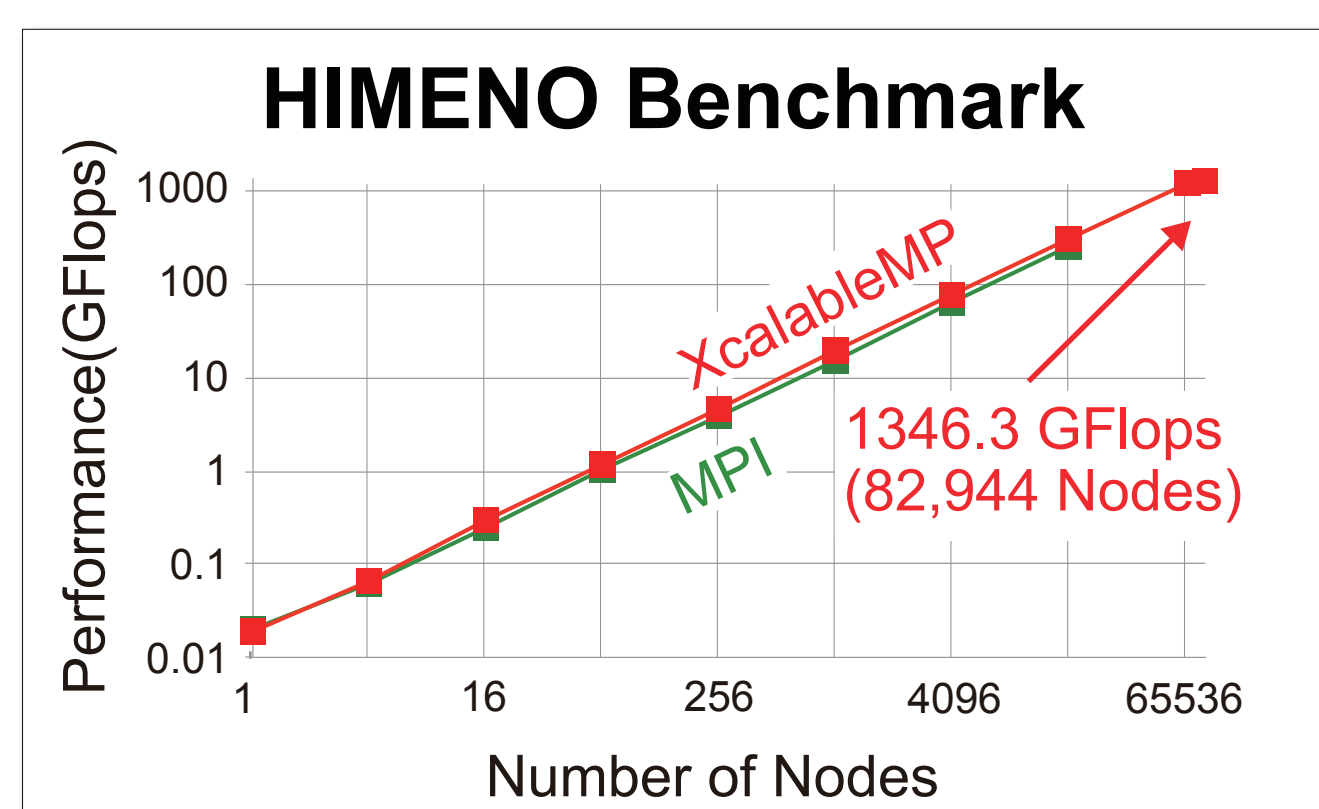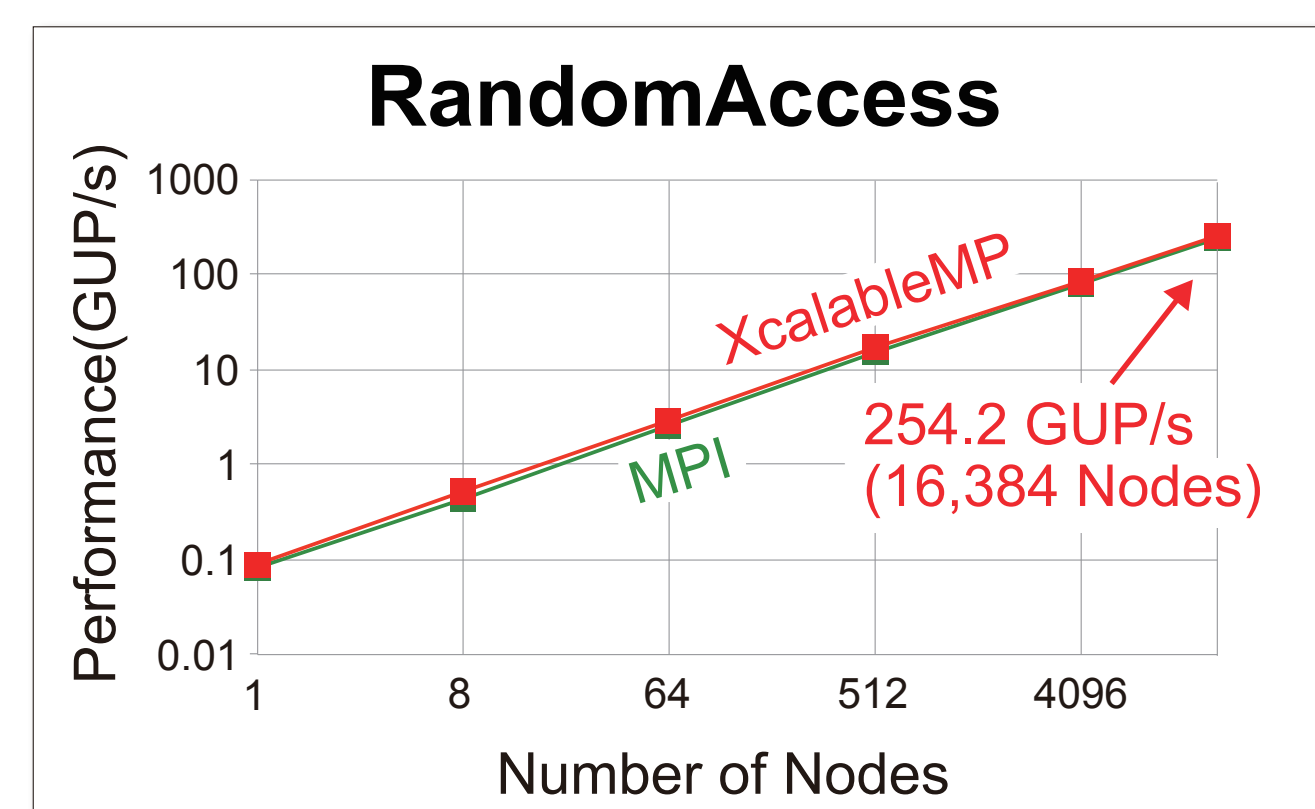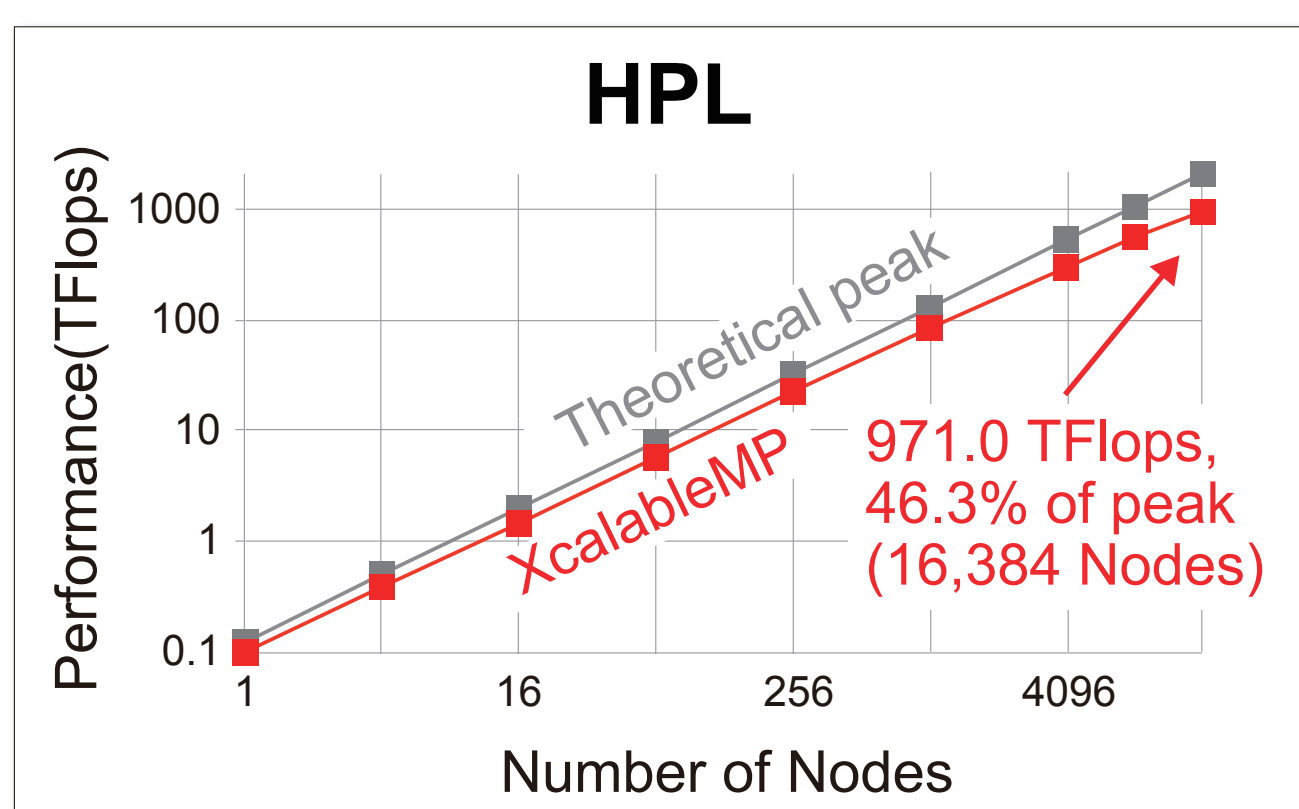
- Coarray adapted for C

```
double a[5]:[*], b[5]:[*];       // Declare
     :
if(me==2)
  b[0:2]:[1] = a[3:2];           // Put
```


Performance

The K computer

- CPU : SPARC64 VIIIfx 2.0GHz, 8Cores, 128GFlops

- Memory : DDR3 SDRAM 16GB, 64GB/s

- Network : Torus fusion six-dimensional mesh/torus network, 5GB/s x 10

We have also been developing the *XcalableACC* programming model which is an extension of XMP using OpenACC for accelerator clusters. For more information, please visit *RIKEN AICS (#2431)*.

Check it out !!