XcalableMP
Directive-based language eXtension for Scalable Parallel Programming

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

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

Programmig 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[i] is distributed onto 4 nodes

```
int a[12];
#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)
```

Local-view model
- Array section and codimension in XMP/C

```
array_name[start:length]:[node_number]
```

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

Performance

- HPL
  - Theoretical peak: 971.0 TFlops
  - Performance(TFlops): 1346.3 GFlops (82,944 Nodes)

- RandomAccess
  - Performance(GUP/s): 254.2 GUP/s (16,384 Nodes)

- HIMENO Benchmark
  - Performance(GFlops): 186.7 TFlops, 46.3% of peak (16,384 Nodes)

- FFT
  - Performance(GFlops): 186.7 TFlops, 1.6% of peak (82,944 Nodes)

- STREAM
  - Performance(TB/s): 3582.5 TB/s, 67.5% of peak (82,944 Nodes)

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).