XcalableACC

Directive-based language extension for accelerated clusters

PGAS

What's XcalableACC ?

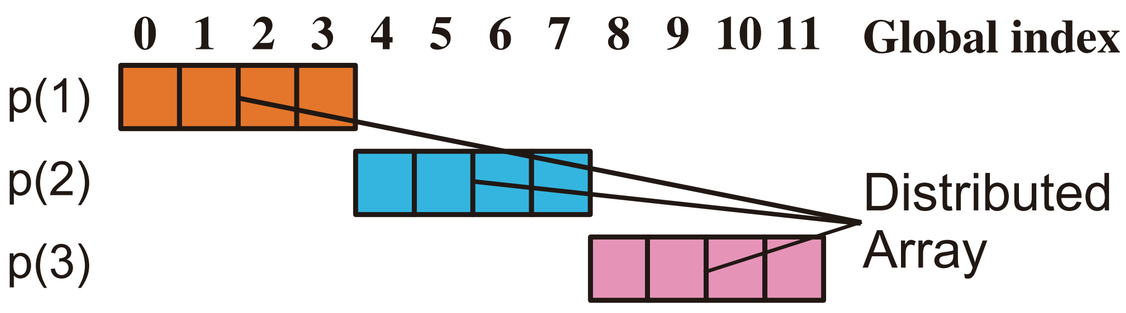
- **XcalableACC (XACC)** is a PGAS language for accelerated clusters, which is a directive-based language extension of C and Fortran based on an XcalableMP PGAS language by using OpenACC.
- XACC supports typical parallelization under "global-view model" programming and enables parallelizing the original sequential code by using simple directives.
- XACC also includes coarray features for "local-view model" programming.

Global-view model

Array a[] is distributed onto an accelerator on each nodes.

Data mapping

```
int a[12];
#pragma xmp nodes p(3)
#pragma xmp template t(0:11)
#pragma xmp distribute t(block) onto p
#pragma xmp align a[i] with t(i)
#pragma acc enter data copyin(a)
```



Two directives parallelize a for-statement.

Work mapping

```
#pragma xmp loop on t(i)
#pragma acc parallel loop
for(i = 0; i < 12; i++)
  a[i] = func(i);
```

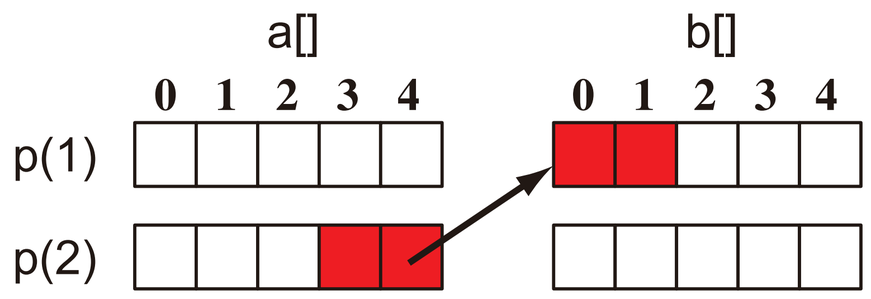
Local-view model

XACC C language defines array section and codimension equivalent to CAF.

```
x[start:length]:[node_number]
```

Above code means **length** elements from **x[start]** to **x[start+length-1]** located on **node_number** are referred.

```
double a[5]:[*], b[5]:[*];   // Declare
#pragma acc declare create(a, b)
     :
if(me==2){
#pragma acc host_data use_device(a, b)
  b[0:2]:[1] = a[3:2];       // Put
}
```



Evaluation

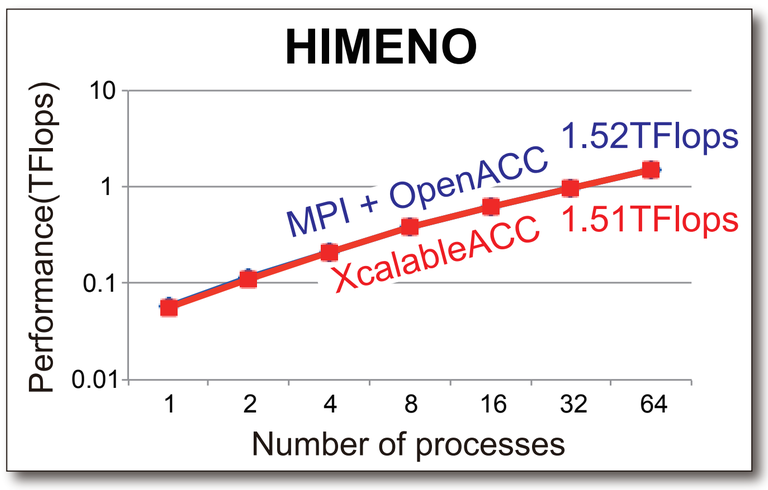
- Benchmark
  - HIMENO is a stencil code which evaluates the performance of incompressible fluid analysis code.
  - NPB CG is a benchmark to solve minimum eigenvalue of symmetric and positive definite sparse matrix using the conjugate gradient method.
- Performance on HA-PACS/TCA system
  - Node Specification

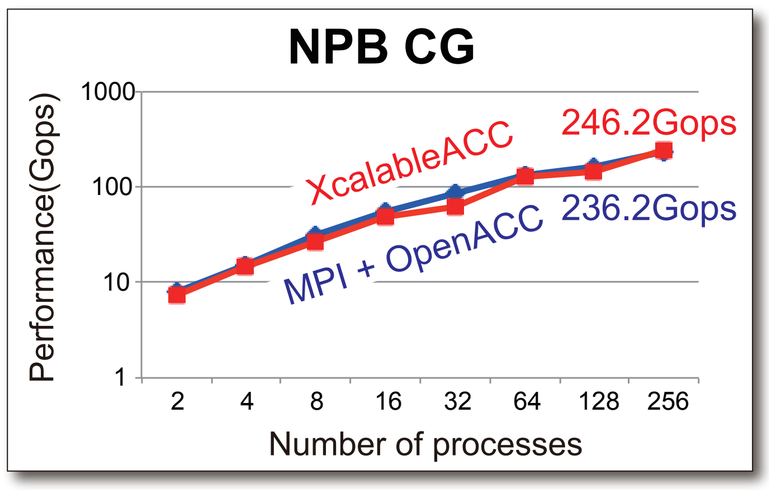
    CPU : Ivy Bridge E5-2680v2 x 2, Mem. : DDR3 128GB 59.7GB/s x 2, GPU : NVIDIA K20X GDDR5 6GB 250GB/s x 4, Network : InfiniBand 8GB/s

- Productivity (Source lines of Code)

	HIMENO	NPB CG
XcalableACC (a, b)	198 (34, 9)	609 (48, 20)
MPI + OpenACC (b)	328 (13)	772 (24)

(a) Number of XcalableMP directives
(b) Number of OpenACC directives





For more information, please visit ***RIKEN AICS(#2521)*** and ***Univ. of Tsukuba(#1927)***