XcalableACC

Directive-based language extension for accelerated clusters

PGAS

What's XcalableACC ?

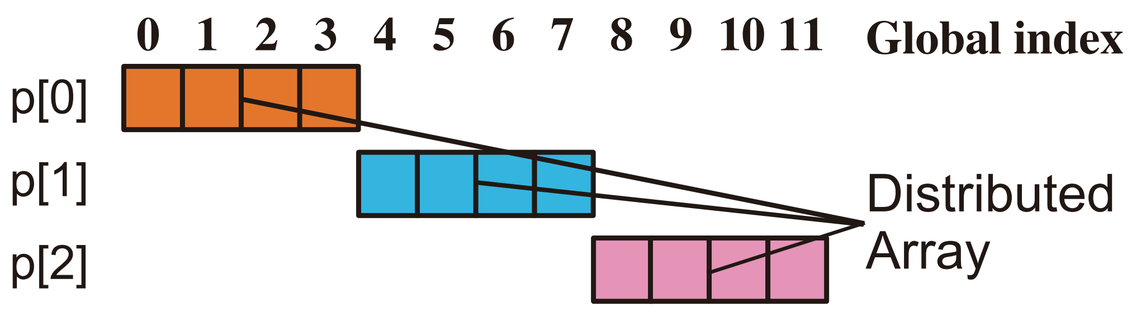
- **XcalableACC** is a PGAS language for accelerated clusters, which is a directive-based language extension of C and Fortran (C++ on the table) based on an XcalableMP PGAS language by using OpenACC
- XcalableACC supports typical parallelization under "global-view model" programming and enables parallelizing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

Global-view model

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

Data mapping

```
int a[12];
#pragma xmp nodes p[3]
#pragma xmp template t[12]
#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] = i;
```

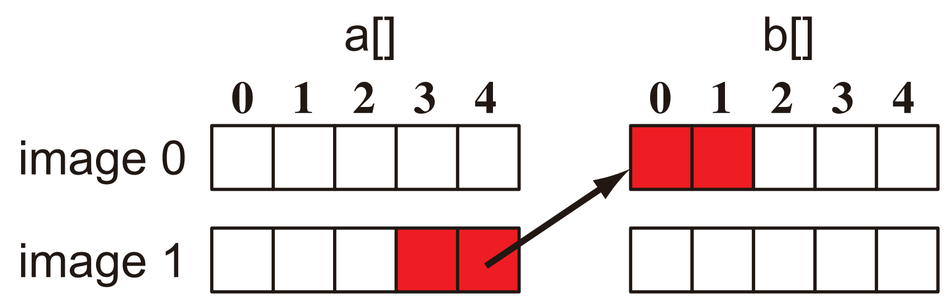
Local-view model

XacalableACC 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.

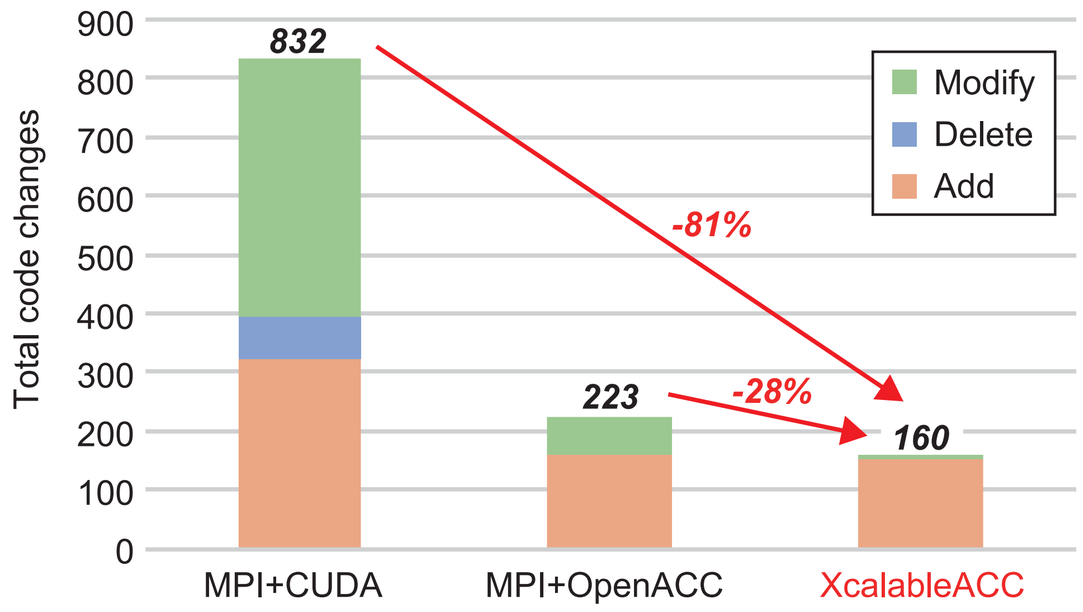
```
double a[5]:[*], b[5]:[*];   // Declare
#pragma acc declare create(a, b)
    :
if(xmpc_this_image()==1){
#pragma acc host_data use_device(a, b)
  b[0:2]:[0] = a[3:2];      // Put
}
```



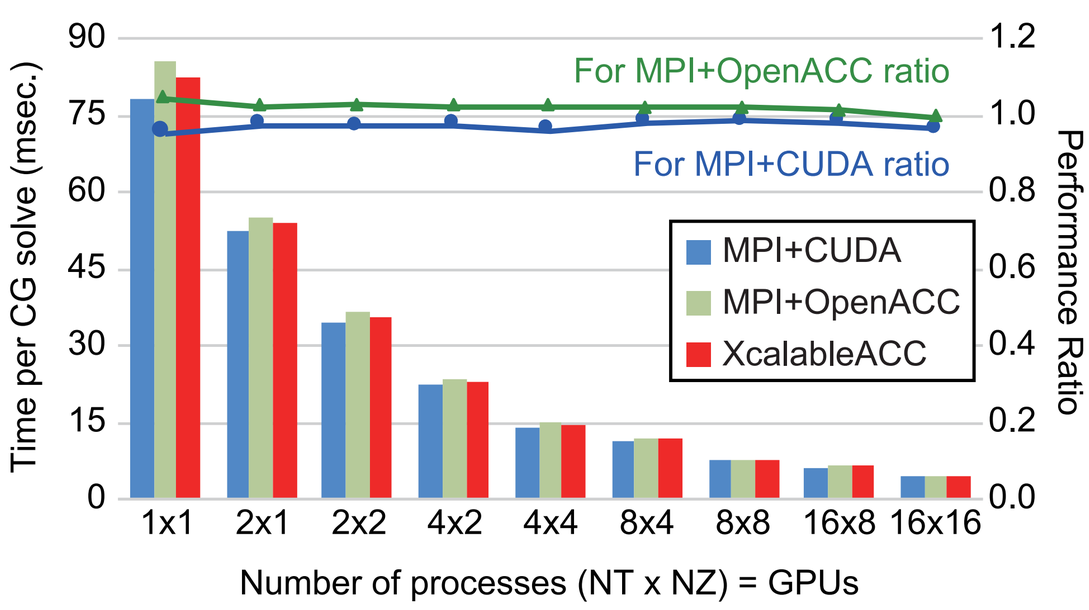
Evaluation using Lattice QCD mini-application

Solve the quantum chromodynamics (QCD) theory of quarks and gluons.

- Productivity
  - Count code changes for developing a parallel code from a serial code (SLOC of a serial code is 842)
  - Total code changes of XcalableACC is the smallest of all



- Performance on HA-PACS/TCA system
  - Each node of HA-PACS/TCA has four GPUs (NVIDIA K20X). We used 256 GPUs on 64 nodes
  - Data size is 32 x 32 x 32 x 32 with strong scaling
  - The performance of XcalableACC is almost the same of those of MPI+OpenACC and MPI+CUDA



For more information, please visit ***RIKEN AICS(#905)*** and ***CCS/JCAHPC, Univ. of Tsukuba(#1843)***