



# SCIMA

A Software Controlled Integrated Memory Architecture  
for MegaScale Computing Computing

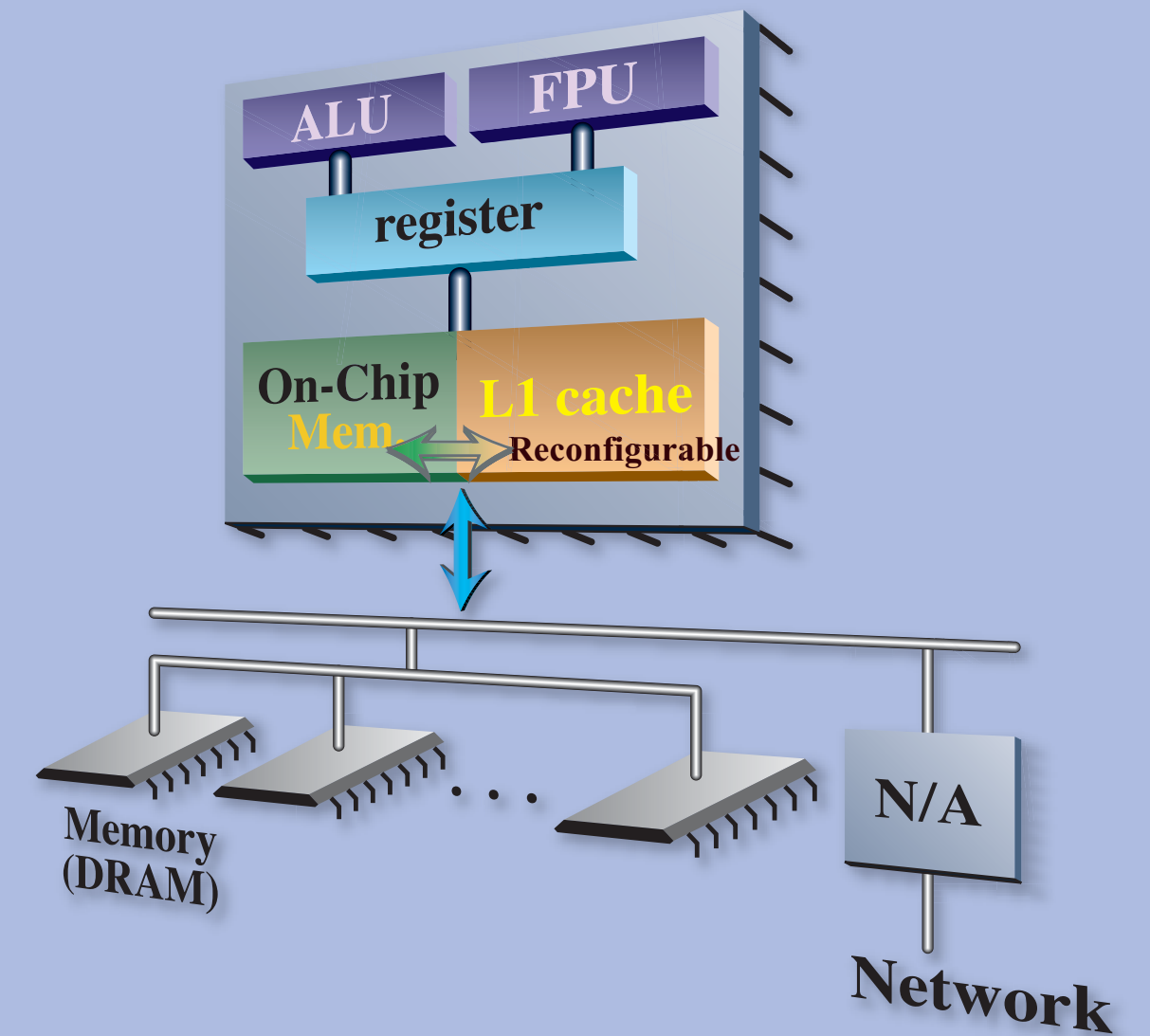
MEGA**SCALE**

## Objective

- ▶ Power Reduction in High-Performance Processors
- ▶ Conventional Cache is not good in HPC (Memory Wall Problem)
  - unwilling line conflicts
  - fixed amount of Off-Chip Memory data transfer

## Architecture

- ▶ Strategy : Software Control
- ▶ Addressable **On-Chip Memory** in addition to conventional cache
  - **On-Chip Memory** and Cache are reconfigurable
- ▶ Reduction of Dynamic / Static Energy Consumption
  - fewer bit switching and less on-chip storage
- ▶ Explicit data transfer between **On-Chip Memory** and Off-Chip Memory
  - **Reusable array**: reserve On-Chip Memory for reuse
  - **Not- Reusable array** : use On-Chip Memory as stream buffers



## Compiler

- ▶ Compiler Optimization using Hint Information
  - reduce programmers' burden
  - indicate only the target loop and the array reusability

```
!$scm opt_reusable(x, y, z)
do ii = 1, N, BLK
  :
  do i = ii, ii+BLK, 1
    :
    z(i,j) = z(i,j) + x(i,k) * y(k,j)
  enddo
enddo
!$scm opt_end(x,y,z)
```

optimize x, y, z  
as reusable

end of optimization

```
!$scm opt_notreusable(x, y)
do i = 1, N
  sum = sum + x(i) * y(i)
enddo
!$scm opt_end(x,y)
```

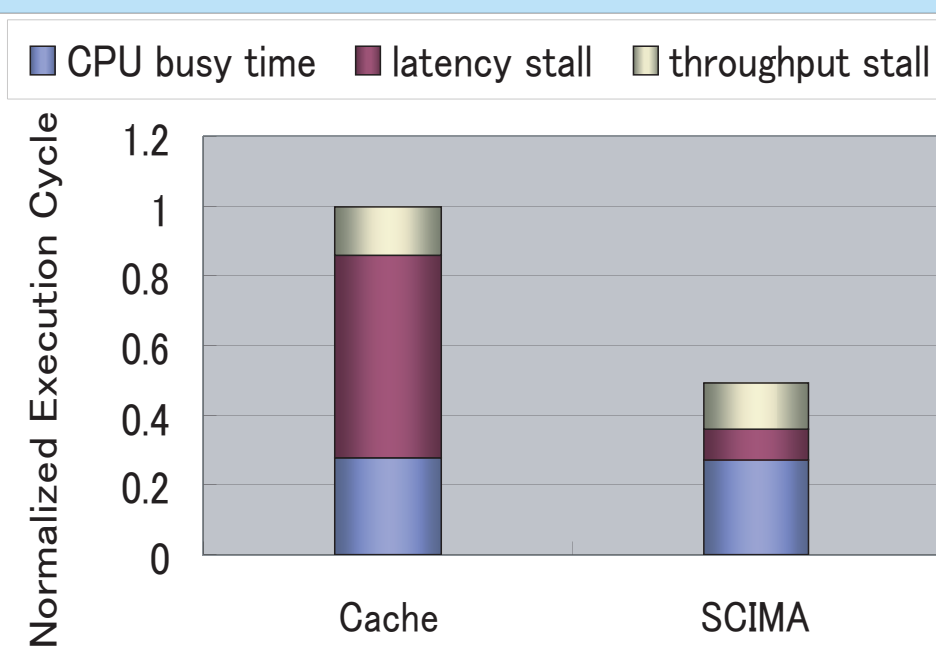
optimize x, y  
as not-reusable

end of optimization

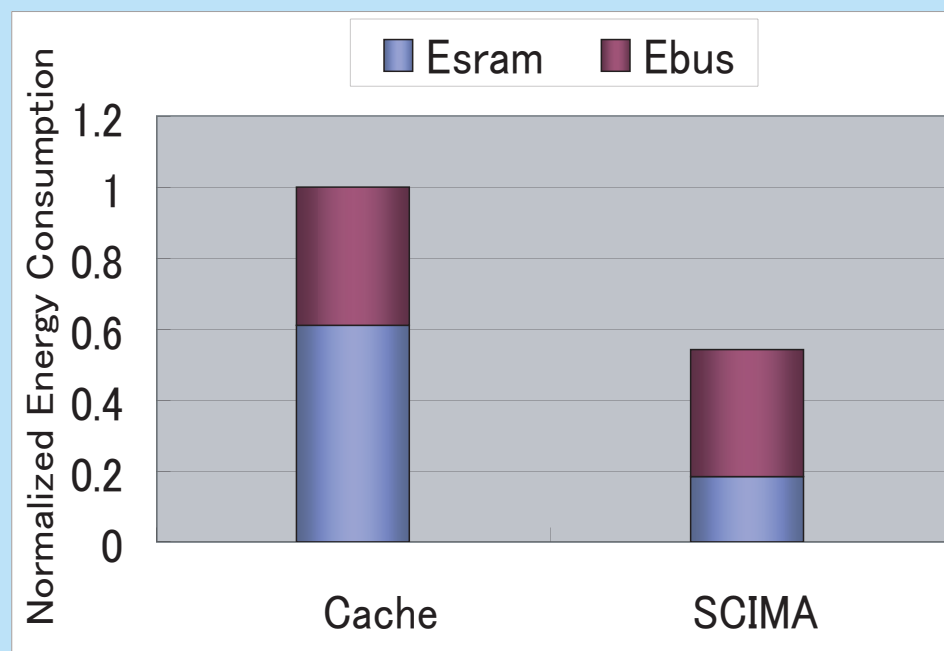
## Evaluation Results

QCD

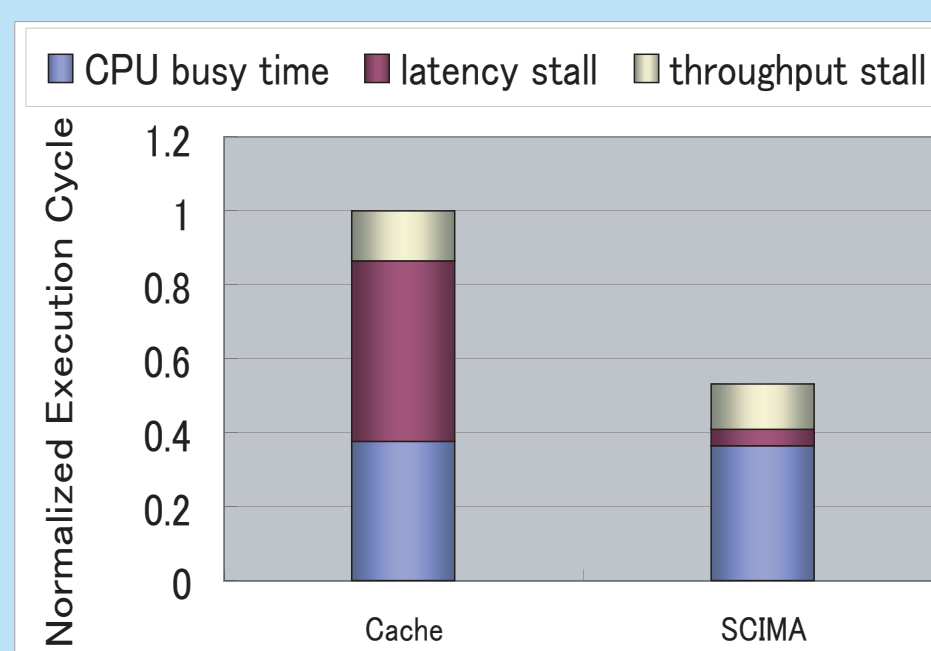
swim



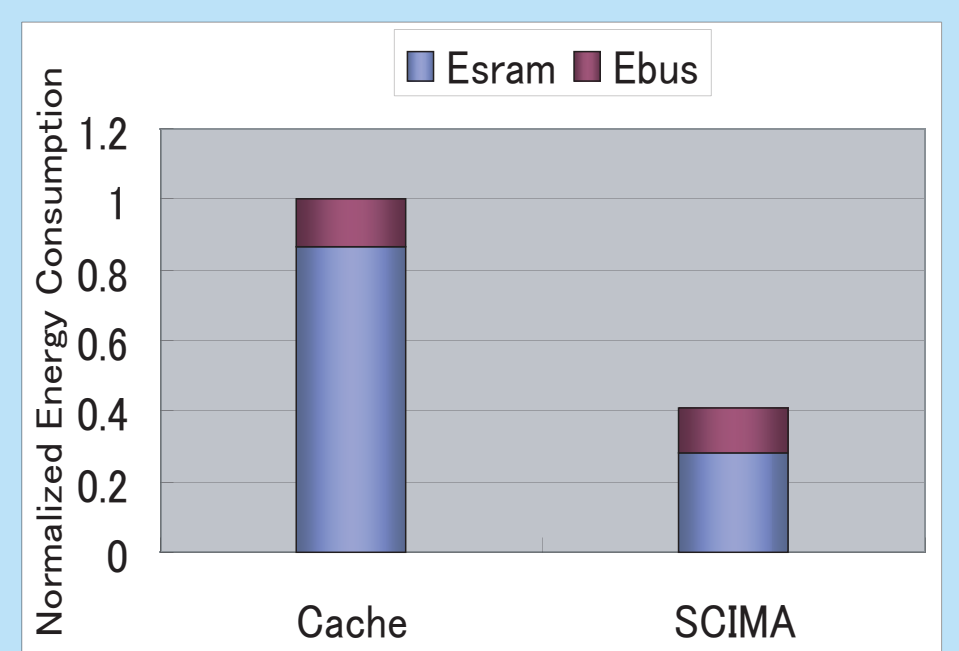
Execution Time



Energy



Execution Time



Energy

SCIMA can reduce both execution time and energy consumption