# OSCAR Parallelizing and Power Reducing Compiler

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Multigrain Parallelization

- □ OSCAR compiler exploits three kinds of parallelism from the program automatically and simultaneously
  - ■ Coarse-grain parallelism
  - ■ Loop parallelism
  - ■ Near fine grain parallelism

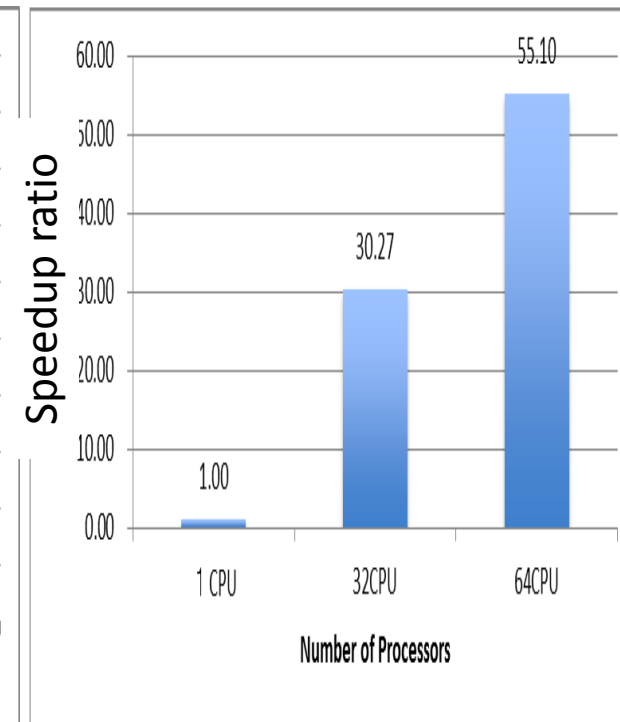
DOALL   Sequential LOOP   SB   BB
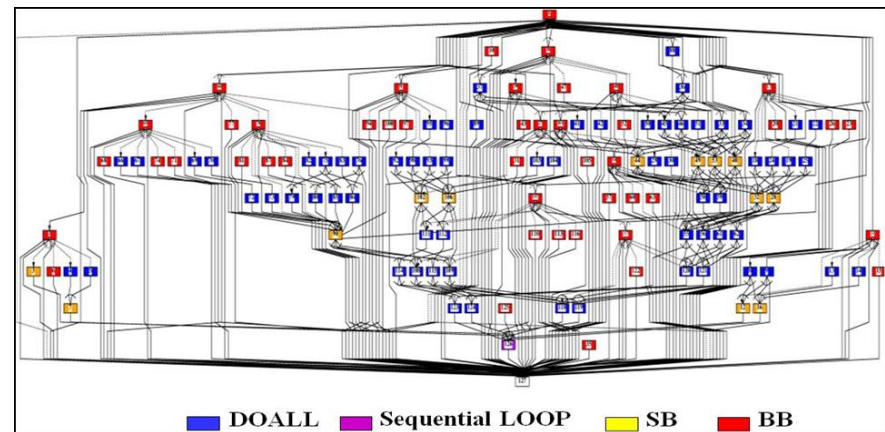
Performance Evaluation : Cancer Treatment Carbon Ion Radiotherapy

- ☐ 8.9 times speedup by 12 processors
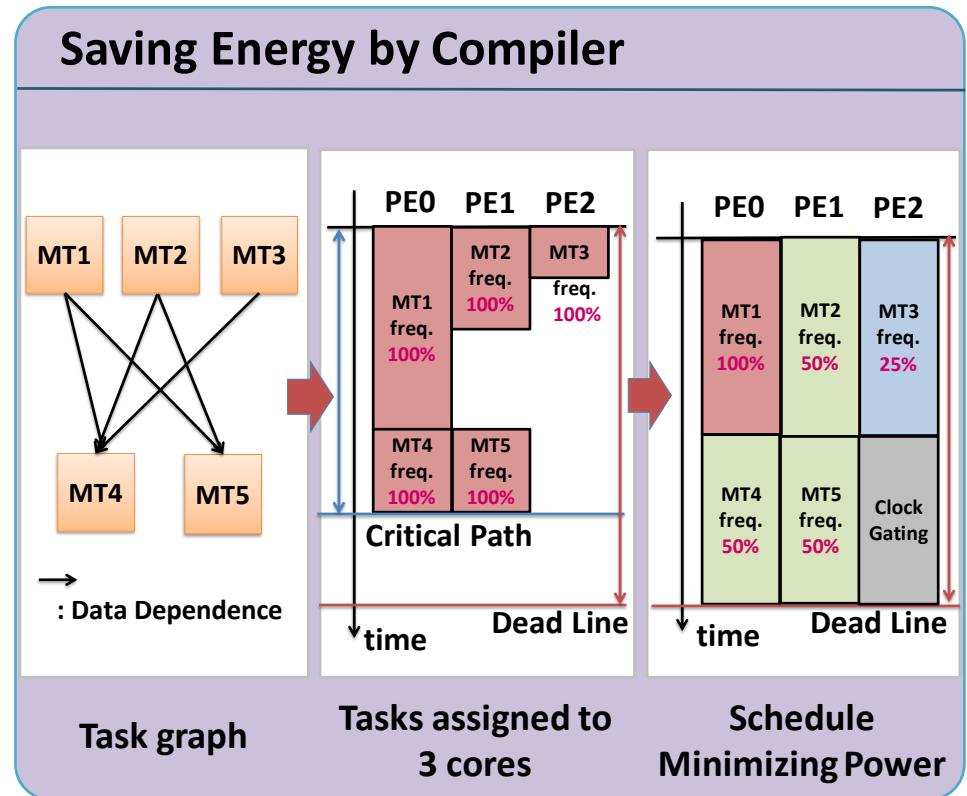- ☐ 55 times speedup by 64 processors
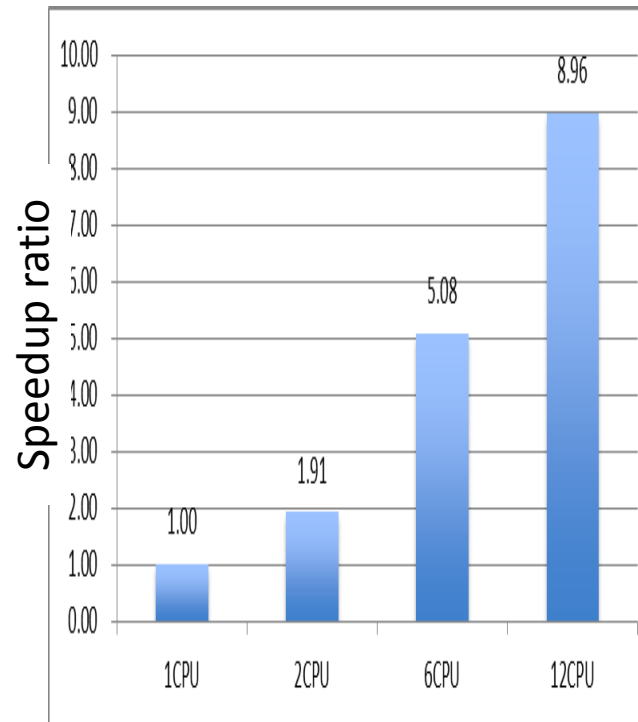
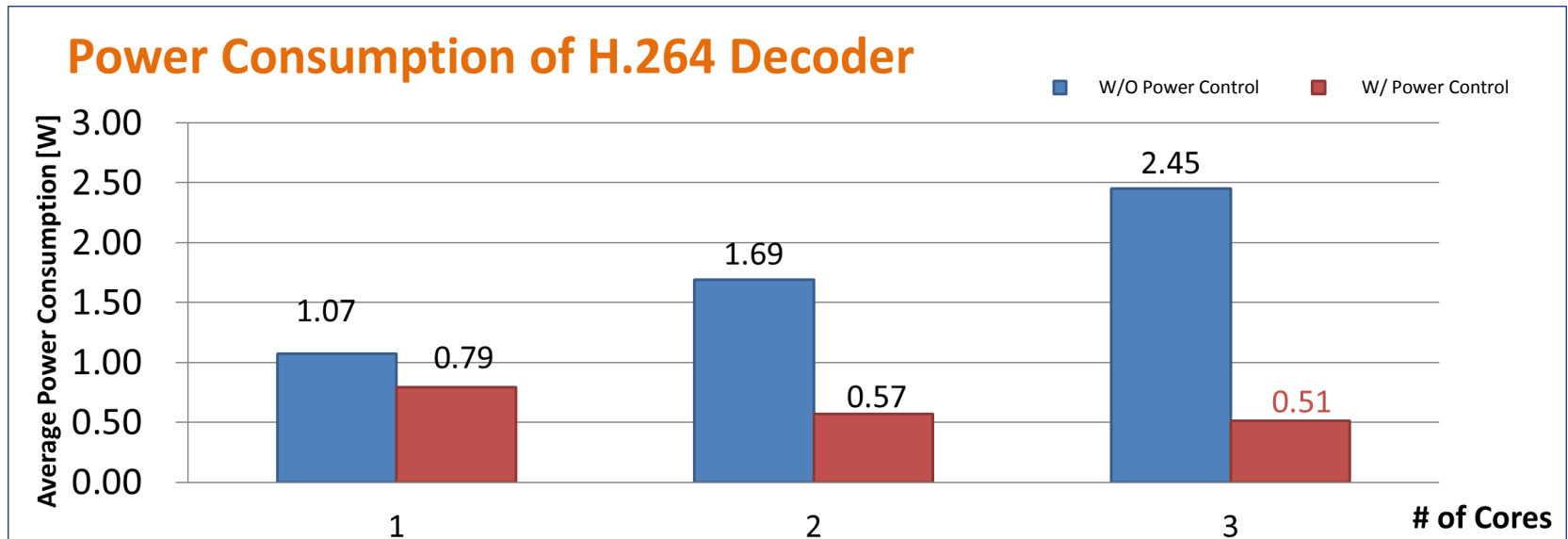Intel Xeon X5670
2.93GHz 12 core SMP
(Hitachi HA8000)

IBM Power 7 64 core SMP
(Hitachi SR16000)

Power Reduction

□ OSCAR compiler generates the parallelized and power reduced software automatically

■ Supporting ALL shared-memory multicore

Saving Energy by Compiler

Task graph

: Data Dependence

MT1 MT2 MT3

MT4 MT5

Tasks assigned to 3 cores

PE0 PE1 PE2

MT1 freq. 100%

MT2 freq. 100%

MT3 freq. 100%

MT4 freq. 100%

MT5 freq. 100%

Critical Path

time   Dead Line

Schedule Minimizing Power

PE0 PE1 PE2

MT1 freq. 100%

MT2 freq. 50%

MT3 freq. 25%

MT4 freq. 50%

MT5 freq. 50%

Clock Gating

time   Dead Line

Evaluation Results of the Power Reduction on ARM

Power Consumption of H.264 Decoder

■ W/O Power Control   ■ W/ Power Control

Average Power Consumption [W]

- 1 core: W/O = 1.07, W/ = 0.79
- 2 cores: W/O = 1.69, W/ = 0.57
- 3 cores: W/O = 2.45, W/ = 0.51

# of Cores

- ☐ Reduced 79% of power consumption compared with the original multicore execution
- ☐ Reduced 52% of power consumption compared with the original sequential execution

Devirtualization Features

- Function pointer call statements are hard to analyze by the compiler statically
  - There are non-deterministic function call
- OSCAR compiler replaces the function pointer call with the set of the simple function call and pointer comparison
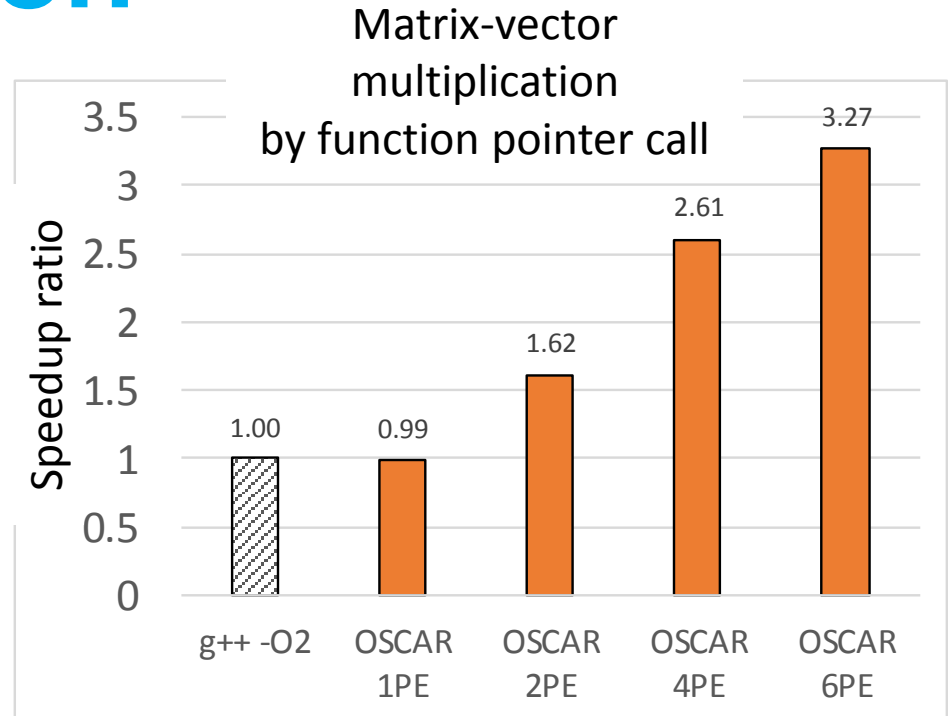 - Short example

```
void vcaller(A *x){
    x->sub();
}
```
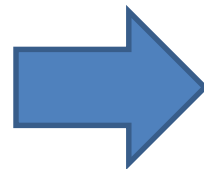
```
void vcaller(A *x){
    if(x->sub == A_sub){
        A_sub();
    }else if(x->sub == B_sub){
        B_sub();
    }
}
```

Evaluation Results of the Devirtualization

□ 3.27 times speedup compared with the sequential execution

Matrix-vector multiplication by function pointer call

Intel Xeon X5670
2.93GHz 6 core SMP

Summary

- Features of OSCAR compiler
  - Multigrain parallelization
    - 55 times speedup by 64 processors
  - Power reduction
    - Reduced 79% of power consumption
  - Devirtualization
    - 3.27 times speedup by 6 processors