Roles of Parallelizing Compilers for Low Power Manycores

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Green Computing Systems R&D Center built in Mar. 2011for low power many core hard , soft and applications,

Panel on Oct. 8, 2009, LCPC2009, at Univ. of Delaware

Needs of Parallelizing Compilers for Manycores

To improve effective performance, cost-performance and software productivity and reduce power for manycores and hetero-multicores

Multigrain Parallelization

Coarse-grain parallelism among loops and subroutines, near fine grain parallelism among statements in addition to loop parallelism

Data Localization

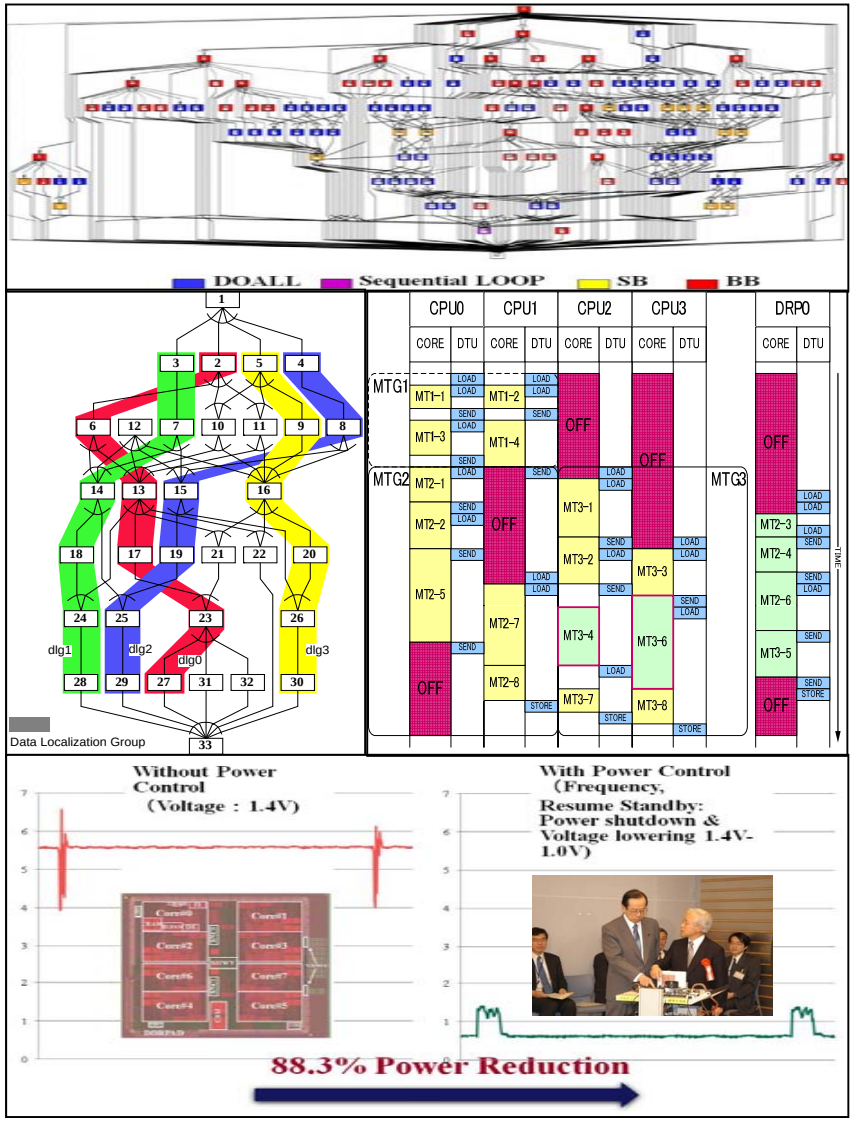
Automatic data management for distributed shared memory, cache and local memory

Data Transfer Overlapping

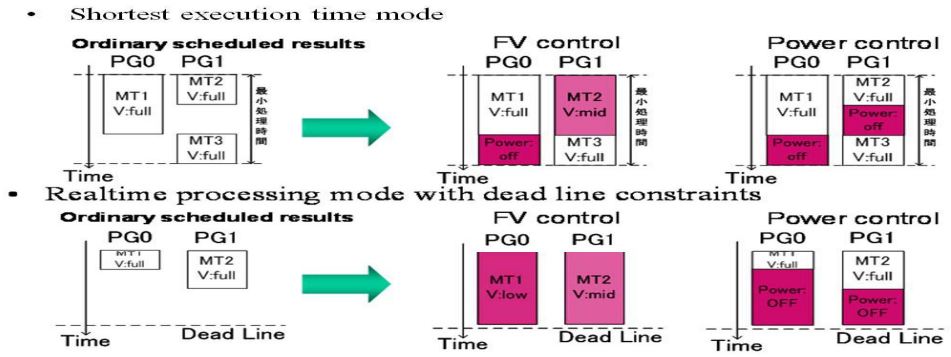
Data transfer overlapping using Data Transfer Controllers (DMAs)

Power Reduction

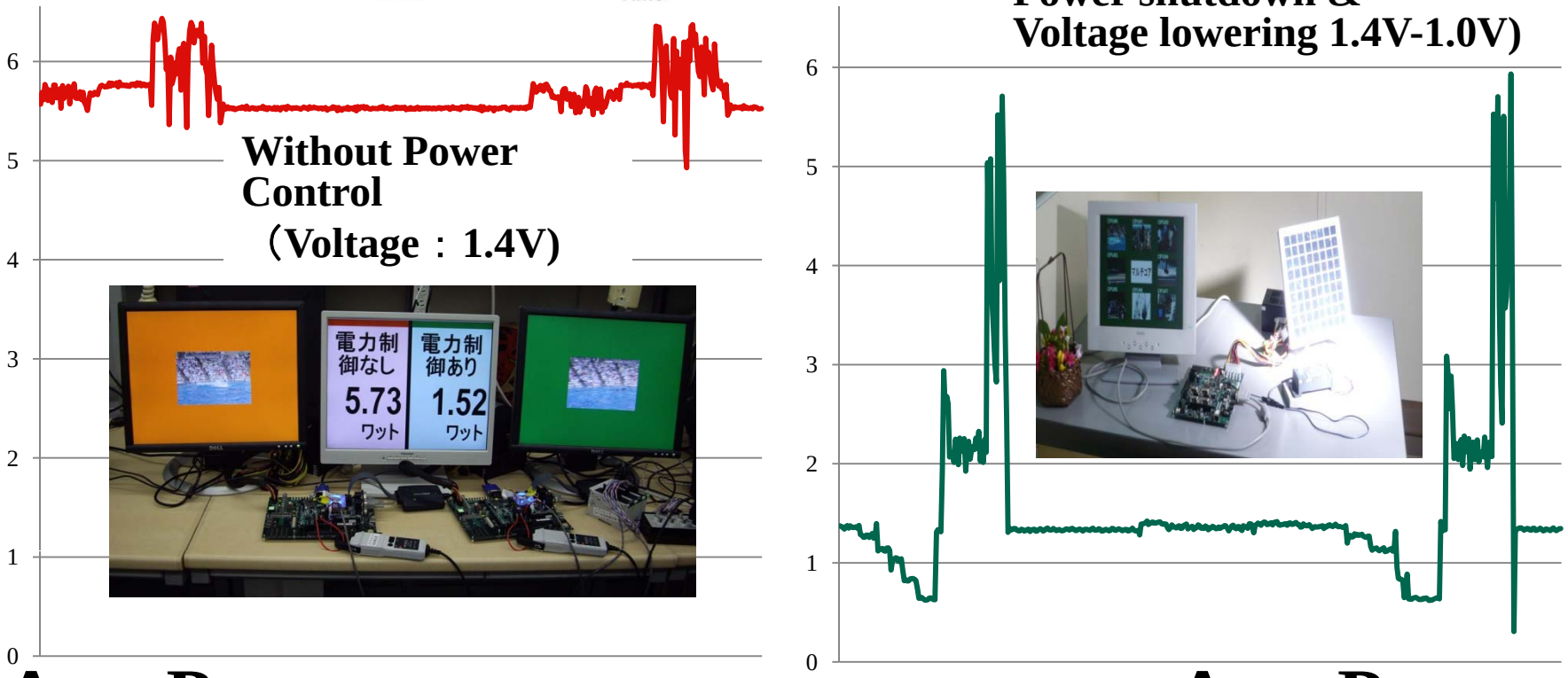
Reduction of consumed power by compiler control DVFS and Power gating with hardware supports.



Power Reduction by OSCAR Compiler for MPEG2 Decoding on 8 core chip



With Power Control
（Frequency,
Resume Standby:
Power shutdown &
Voltage lowering 1.4V-1.0V)



Without Power Control
（Voltage：1.4V)

Avg. Power 5.73 [W]

73.5% Power Reduction

Avg. Power 1.52 [W]

Compilation Flow Using OSCAR API

Application Program
Fortran or Parallelizable C
(Sequential program)

OSCAR API for Real-time Low Power High Performance Multicores
Directives for thread generation, memory, data transfer using DMA, power managements

Generation of parallel machine codes using sequential compilers

Waseda Univ. OSCAR Parallelizing Compiler

- Coarse grain task parallelization
- Global data Localization
- Data transfer overlapping using DMA
- Power reduction control using DVFS, Clock and Power gating

Parallelized Fortran or C program with APIl

Proc0
Code with directives
Thread 0

Proc1
Code with directives
Thread 1

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Backend compiler
API Analyzer
Existing sequential compiler

Backend compiler
API Analyzer
Existing sequential compiler

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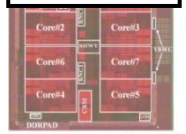
Backend compiler
OpenMP Compiler

Machine codes



Multicore from Vendor A

Machine codes

Multicore from Vendor B

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Shred memory servers

Executable on various multicores

Hitachi, Renesas, Fujitsu, Toshiba, Panasonic, NEC

OSCAR: Optimally Scheduled Advanced Multiprocessor
API : Application Program Interface