Roles of Parallelizing Compilers for Low Power Manycores

Hironori Kasahara
Professor
Department of Computer Science & Engineering
Director
Advanced Multicore Processor Research Institute
Waseda University, Tokyo, Japan
IEEE Computer Society Board of Governor
http://www.kasahara.cs.waseda.ac.jp

Green Computing Systems R&D Center built in Mar. 2011 for 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

- Shortest execution time mode
- Realtime processing mode with deadline constraints

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)

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OSCAR
Parallelizing Compiler

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

Hitachi, Renesas, Fujitsu, Toshiba, Panasonic, NEC

OSCAR: Optimally Scheduled Advanced Multiprocessor
API: Application Program Interface

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

Parallelized Fortran or C program with API

Backend compiler

Machine codes

Multicore from Vendor A

Multicore from Vendor B

Executable on various multicores

OpenMP Compiler

Proc0
Code with directives
Thread 0

Proc1
Code with directives
Thread 1

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