NSF Workshop on Science of Power Management

April 9 – 10, 2009
Westin Arlington
Purpose

Fundamental advances required to understand power/thermal issues from chips to large distributed computing ensembles and exploit them to maximize energy efficiency while meeting required performance/reliability constraints.
Organization & Funding

Organizing Committee
- Kirk Pruhs, University of Pittsburgh
- Kirk Cameron, Virginia Tech
- Partha Ranganathan, Hewlett-Packard
- Sandy Irani, University of California-Irvine
- David Brooks, Harvard University

Funding
- OCI, CISE/CNS, CISE/CCF
Agenda Overview

- Opening Remarks
  - Jeannette Wing (CISE Assistant Director, NSF)
  - Taieb Znati (CNS Division Director, NSF)
- Logistics
  - Expert Talks
  - Spotlight Talks
  - Breakout Session 1
- Dinner Reception at Rock Bottom Restaurant and Brewery
Logistics
(To be covered after Ty Znati’s intro)
Detailed Agenda (Day 1)

- Opening Remarks
- Expert Talks (Now thru 14:30 including breaks)
  - Larry Smarr (UCSD)
  - Partha Ranganathan (HP)
  - Dan Reed (Microsoft)
  - Rajesh Gupta (UCSD)
  - Kirk Pruhs (University of Pittsburgh)
- Selected Spotlight Talks (14:30 – 15:30)
  - 6 presentations
- Breakout Session 1 (16:00 – 18:30)
Detailed Agenda (Day 2)

- Continental Breakfast (8:15 – 8:45)
- Briefings by program directors (8:45 – 9:15)
- Breakout sessions
  - Breakout Session 2 (9:15 – 10:30)
  - Breakout Session 3 (11:00 – 12:00)
- Presentations by breakout leaders (12:00 – 13:00)
- Final remarks
Breakout Groups

- Groups based on 5 focus areas
  - Hardware & architecture
  - Software and middleware
  - Networking
  - Storage
  - Physicals

- Attendees ➔ groups based on expertise
  - Some load balancing
  - Let us know if we really goofed!

- Subgroups
  - 2-3 subgroups per group, mostly random
  - Each subgroup covers the same area (independent!)
  - Moderated by a leader
Breakout Logistics

Day 1
- Joint session at 16:00 (~20 mins)
  - Group objectives & expected outcomes
  - Breakup into subgroups
- Session 1 (until 18:30)
  - 11 subgroups meeting in EH1, EH2 & EH3

Day 2
- Joint session at 9:15 (~5 mins)
- Session 2 (individual subgroups)
- Session 3 (Joint group level)
- Presentations by group leaders
  - Both subgroup level and filtered group level
Dinner (04/09, 19:00)

Westin

Rock-Bottom Restaurant
Breakout Groups
(To be covered at 16:00 joint session)
Hardware Group

- Divided into 3 subgroups, each w/ 6-7 people.
- Focused on new science to address power/thermal design and corresponding performance and reliability tradeoffs from transistors to SMPs
- Potential areas to cover
  - Approaching the fundamental limits (switching speed, operating voltage, current densities, process control, etc.)
  - Low power architecture and technologies (including computation, interconnect & memory)
  - HW/FW level power/thermal management & their scalability challenges
  - Cross layer issues including HW-FW-SW interaction
SW/Middleware Group

- Divided into 3 subgroups, each w/ 5-6 people.
- Focused on new science to address intelligent power/thermal management from driver to distributed data center level.

Potential areas to cover

- Power/performance tradeoffs (including complexity and bounds).
- Coordinated multi-level power/thermal control
- Power/thermal metrics, measurement & control in large virtualized environments
- HW-MW and MW-physical’s interactions and smart power/cooling/load control.
Networking Group

Divided into 2 subgroups, each w/ 6-7 people.
Focused on new science to address power/thermal issues associated with communication medium from core interconnects to data center fabrics to Internet infrastructure.

Potential areas to cover
- Low power design and power/thermal management of intra-chip and inter-chip interconnects.
- Computation vs. communication & power vs. latency/performance tradeoffs
- Smart fabrics (data center, wireless, wired, …)
- New networking technologies & protocols
Storage Group

- Divided into 2 subgroups, each w/ 6-7 people.
- Focused on new science to address power/thermal issues associated with storage, file systems and databases.
- Potential areas to cover
  - Power/thermal management of storage devices and hierarchies (including tape, disk, NVRAM, …)
  - Low power file and database systems
  - Power related database tradeoffs (accuracy, precision, consistency, timeliness, …)
  - Novel storage & retrieval technologies
Physical Issues

- Divided into 2 subgroups, each w/ 4-5 people.
- Focused on new science to address intelligent management of power conversion, distribution and delivery, and cooling at all levels from chips to data center.

Potential areas to cover

- Power conversion and distribution issues at data center, rack, board and chip level including “smart” power supplies, VRs, etc.
- Smart cooling/thermal technologies and control from chip to data center level (including ambient, forced air & liquid cooling)
- Thermal enclosure design
- Power supply side issues from smart batteries to smart grid.
- Power/thermal/cooling faults (e.g., emergency rideout)
Outcomes

- Each subgroup generates a list of major outstanding issues and potential approaches.
- Multiple subgroups within a group may come up with different & sometimes conflicting items.
- Group level meetings expected to
  - Resolve conflicts (to the extent possible)
  - Bubble up most significant issues to the top