Welcome: Intel Multicore Research Conference

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Intel Introduction

- R&D at 75 WW Labs, with 7K people
  - Budget $6B ~ 15% Revenue
- Software importance growing
  - 3K people in Software & Solutions Group
  - Corp Technology Group: SW, …
  - Some say 10K SW overall: 10% of employees
- SW: widely used products … innovative R&D
  - Compilers, libraries, Vtune performance
  - Threading and Cluster Tools
    - Program expression, correctness, performance
  - BIOS, OS, middleware, management
  - ISV and user communities are the targets

Intel Hardware

- Intel HW manufacturing
  - 1+ M chips per day, 15 Fabs WW
- Revenue sources
  - Pentium, Itanium, IXA, Xscale, ….
  - Chipsets, white boxes, …
- Architectures
  - Moore's Law continues, but
    - Clock gains → Cores/ chip
  - 2 core chips now, 4 soon, …
  - Digital home, office, servers, … , petaflops

Multicore State Today

- "Two for the price of one"
  - Works for a while, e.g. virus checking + computing
- Multicore demands ISV development shift
  - ISVs have come to expect clock gains
    - "Free" performance gains drove functionality gains
    - Some differentiation energy going to parallelism now
- Intel academic relations
  - Many styles, project-team relations best
  - 2006: New Intel program for joint multicore R&D

Big Parallelism Questions

A. How to get **parallelism into applications**
B. How to **deliver performance at runtime**

- **A. Requirements for Parallel Applications @ ISVs**
  - Best algorithms expressed as usable libraries
    - Adaptive, scalable libraries based on best algorithms
    - Much broader coverage than currently available
  - Rest of code expressed in flexible languages
    - Threads cause too many bugs and perf anomalies
    - OMP well structured but confining → TBB, others
    - Correctness and performance tools
  - Applications prototypes as demonstrations
    - Need to develop prototypes with ISVs/ users
    - Characterize these for analysis/simulation

Big Parallelism Questions

■ B. Realities of Runtime Parallel Performance
  – Single program running at maximum rate
  – Multiple programs running simultaneously
    ■ One-user multiprog. client or many users on servers
  – OS scheduling of jobs
    ■ Linux and Windows relationships with applications
  – HW/SW latencies and effective BW
    ■ Cache hierarchy
    ■ Interconnects and coherence – intra and inter-node
    ■ Atomicity of memory accesses → transactions

Parallelism Challenges

- All of the above questions are important
  - Any one issue can ruin overall performance
- Demands vary across applications
  - Program structure, data sizes
- Single platform/system can't satisfy everyone
  - "Customizable COTS" possible now, may grow
  - Clusters, interconnects, chipsets, processor types
  - SW variations

Intel focusing on platforms, software, and systems

Conclusion

- Conference goals: inform academia,
  solicit help
  - Innovative applications areas
  - Development SW
  - RT support SW
- Successful projects will match Intel teams with academic groups
  - Joint activities for long-term success
  - Ideas flow both ways