Three Challenges
in the Area of Thermal Issues

Josep Torrellas

University of Illinois
http://iacoma.cs.uiuc.edu

Accuracy

- Convince ourselves that our models are acceptably accurate:
  - Modeling at what level of detail? (e.g., control logic blocks, clock network)
  - Take into account local, rather than average global quantitites? (e.g., voltage, leakage power)
  - How to model power delivery accurately?
  - How can we design and experiment with better sensors (IBM Power 5)?

  Why? Because we are less able to use
  "intuititon sanity check" to validate our conclusions

Scope

- Undestand the division of labor between microarchitecture/compiler/OS
  - Temperature variations are slow (e.g. for a power density of 1 W/mm2, T changes 0.1 degrees in about 25-100 usec)*
  - Microarchitecture responds quickly, has low overhead, but adds complication
  - Software is typically the opposite, plus it may have future knowledge

  Why? In the T world, things take longer to occur than in the hardware microarchitecture world

  * David Skadron, ISCA 2004 tutorial

Different Mindset

- Often key is rate of change of events rather than absolute number of events
  - DI/dt
  - Cooling rate
- Inter-dependences between different problems:
  - Power control schemes introduce I spikes, which affects voltage

  Why? We come from simpler, more static environments: increase performance