Physical System Simulation and Verification

Combining Pre- and Post- Silicon Verification

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Physical System Simulation

In the future, deep design exploration will need to occur on actual parts.

- The number of configurations is growing exponentially.
  - Simulators will not scale with design complexity.
  - To “warm up” the state, will require trillions of steps.

- Can we perform design exploration from specific reached states?
  - Pre- and post-silicon verification approaches need to be combined.
  - We need on-chip mechanisms to enable physical co-simulation with symbolic simulation.
Future Systems (e.g., UT TRIPS Architecture)
Combined Power & Functional Specifications

- The power density of microprocessors (as well as ASICs, FPGAs) is now first-order problem.

- There are ways to trade power for performance.
  - Equivalent circuits that require different numbers of clock cycles
  - Different circuits can be selected based on the current voltage.

- Future HDLs must combine functional and power specifications into a single language.

- Future functional verification will require knowing circuit parameters, such voltages, as well as the netlist.

Source: F. Pollack, Intel, New Microprocessor Challenges in Coming Generations of CMOS Technologies, Micro32
Our Vision

We would like computing systems to be specified by a *formula manual*, a complete precise set of formulas that exactly specifies computing systems (whether hardware, software, or both).

- A formula manual unambiguously describes the functionality being offered.
- A formula manual defines the abstract specification for its concrete implementation.
- A formula manual can be used as the concrete specification for something built on top of it.

We want mathematically specified, mechanically checked computing systems.

- This is a long-term and evolving goal.
  - Systems are increasing in complexity faster than our ability to manage them or control them.
  - If we are aggressive, maybe we can achieve this vision on small commercial designs, e.g., cell telephones, pagers, routers, etc.
- Our ability to field secure systems is based on our ability to specify and validate our computing, networking, and control systems.