CCS Overview

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Why Is CCS Needed?

- History:
  - Three delay numbers: slow, typ, fast
    - Just too inaccurate
  - Linear delay: f(cap)
    - What about slew rates?
  - NLDM: table f(cap, slew), interpolate between points
    - Which table? How many points?
    - Multiple voltage support complicated
    - Where next?

Library Characterization History

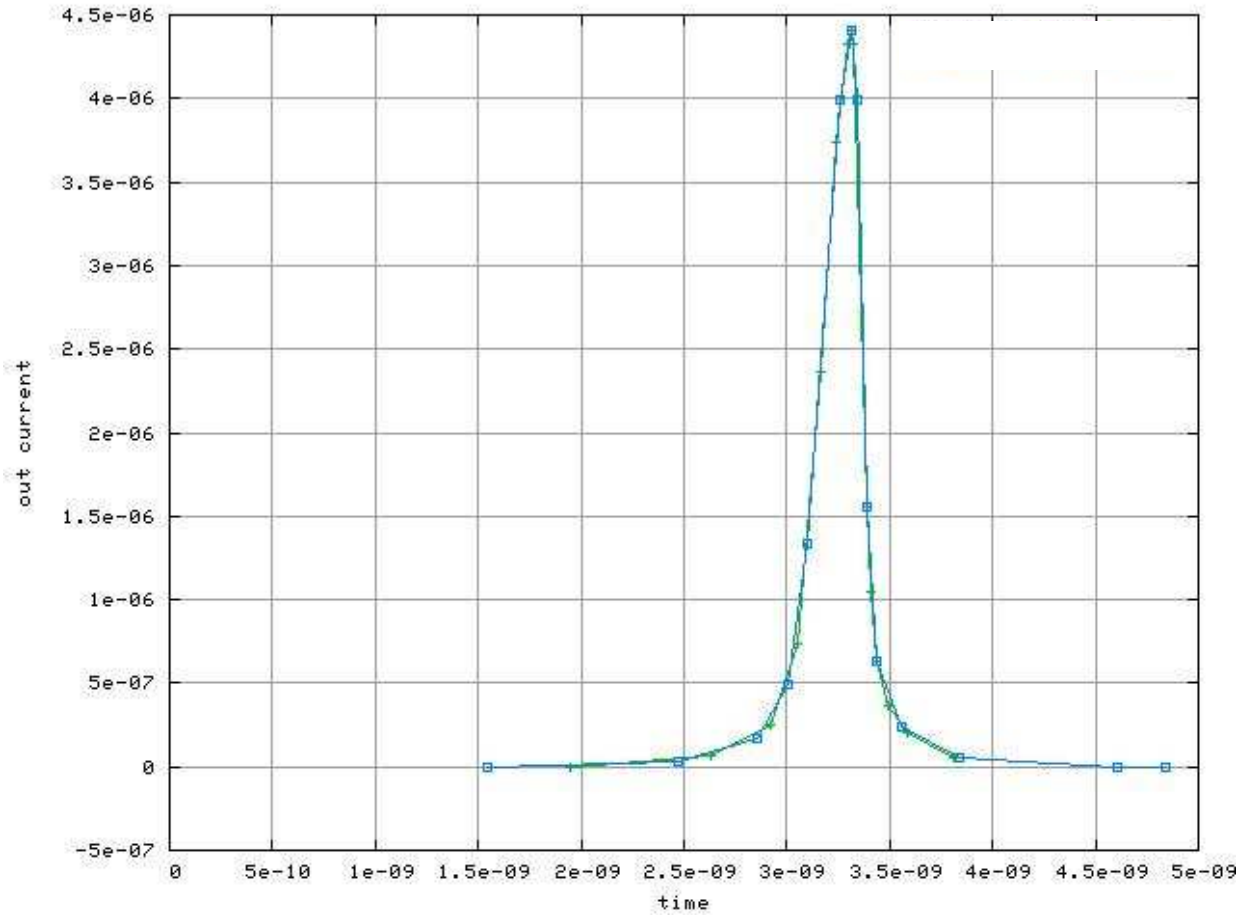
- 1991:
  - Design flow: synthesis getting off the ground
  - Characterization: lots of circuit simulation
- 1998: Artisan IPO
  - Design flow: static timing analysis becoming important
  - Characterization: lots of circuit simulation
- 2001: Tech bust
  - Design flow: Physical synthesis becoming mainstream
  - Characterization: lots of circuit simulation
- 2004: Artisan becomes part of ARM
  - Design flow: System level languages, flows
  - Characterization: lots of circuit simulation

IP Suppliers and Data Models

- IP companies will provide whatever data is needed by tools
- Models designed for maximum accuracy
- NLDM example:
  - Each entry is the result of a simulation
- CCS example:
  - Each entry is the result of a simulation

Partial I-V Curve

- Computed as part of characterization process



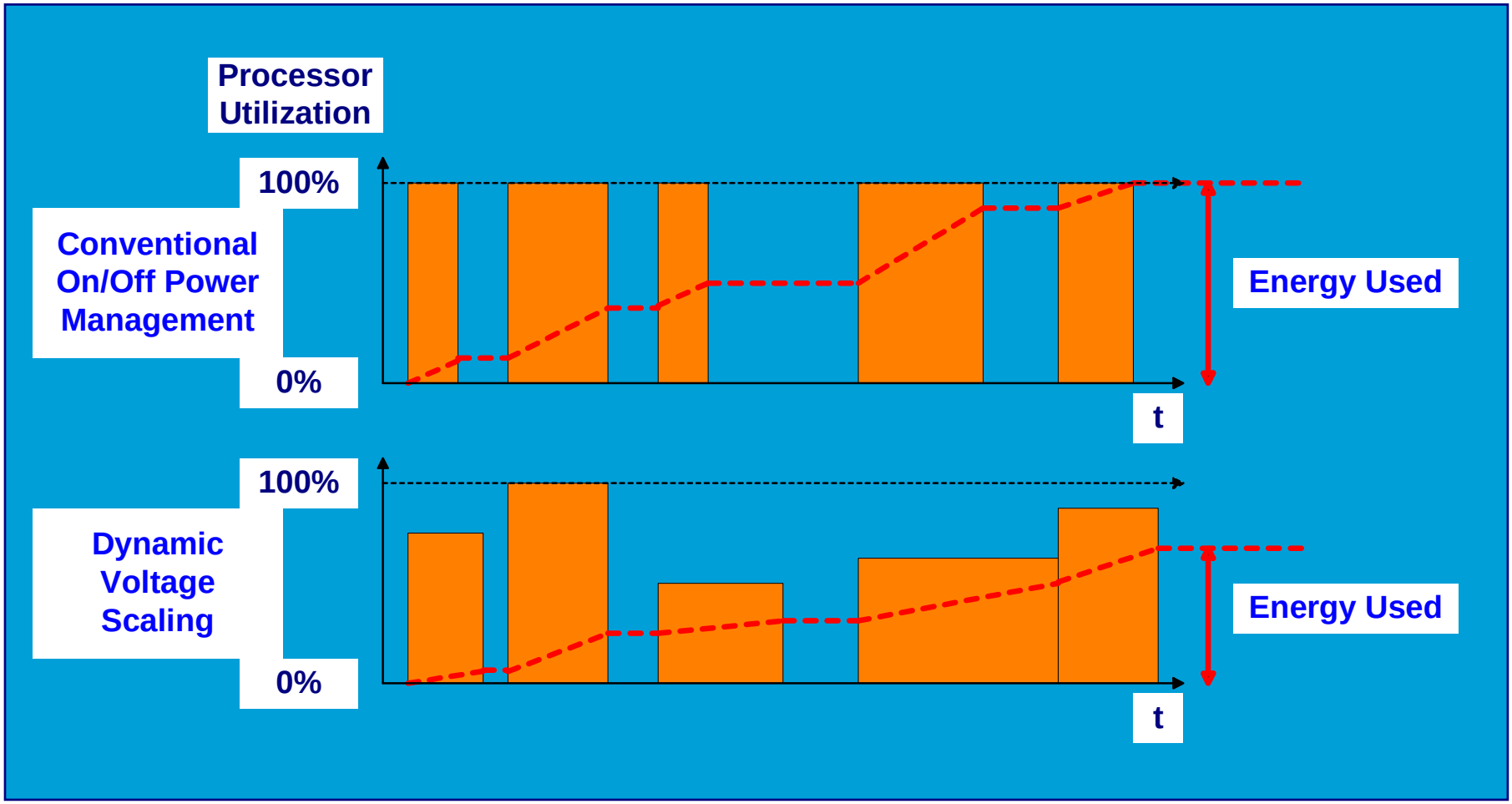
What It Takes to Characterize CCS

- Working closely with Synopsys CCS team
- Two stage input capacitance model (Miller effect)
- Current waveform used
  - Characterized on a per timing arc, input slew, and output load basis
- Input slew/output load characterized
- Result: comparable effort to NLDM characterization
  - Increased disk usage internally to store waveform data

Application Using Dynamic Voltage Scaling

- Intelligent Energy Management for ARM CPUs
- Idle and sleep modes
  - Conventional power management technique
  - Optimizes power consumption ONLY when there is nothing to be done
- Frequency scaling
  - Turning down the frequency of the processor
  - Reduces average power consumption
  - BUT does not reduce total energy used
- Dynamic Voltage Scaling (DVS)
  - Turn down the voltage fed to the processor
  - Requires a reduction in processor frequency
  - DVS is the only technique to reduce energy used

Intelligent Energy Management



Conclusions

- “Models are to be used, but never to be believed”
  - Henri Thiel
- Accuracy to SPICE is important, but SPICE accuracy has limits
  - Silicon will vary at low voltages
  - Closed loop system has benefits
- CCS should provide good accuracy across a wide range of voltages
- Beta release now, full release coming soon