Performance Prediction and Simulation for Exascale Interconnection Networks

Working Group
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Performance Prediction and Simulation Goals

- Application developers want to understand the performance bottlenecks
  - Parameter studies: processor, network, memory
  - Feedback for application tuning

- DoE/DoD/NSF
  - Procurement decisions based on application performance: execution and power

- System Design Research
  - Industry and academia
Current Status

- No neutral ground
- Tools are largely inaccessible to application developers
  - Even when accessible are not in form that is immediately usable
- Islands of simulation artifacts
- Microarchitecture simulation speeds
  - 1-5KIPs for Intel/AMD and 200 KIPs for Power4
- Simulations now limited in practice to 64-128 cores
- System software cannot support larger systems
  - For example due to BIOS limitations
- Storage system simulations lag processor and interconnect simulation technologies
  - SAN configurations
Challenges

- Cost building a validated useful simulator
  - Composable
  - New methodologies for building simulators
- Accuracy
  - Calibrated models
  - Methodologies for constructing calibrated models
- Performance
  - Parallelism
  - Multiscale
  - Hardware acceleration
- Power and thermal models
- Ease of use
  - Visualization
  - Automation
  - Documentation & deployability
# Challenges

- **Impact** is redefined as impacting the efficiency of an Exascale system
- **NRE Costs:**
  - Significantly less than custom hardware or systems
  - Ongoing maintenance and evolution cost across system generations

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<tr>
<th>Technical</th>
<th>Probability (Risk)</th>
<th>Impact</th>
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<td>Accuracy</td>
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<td>Exascale Calibrated models</td>
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<td>Methodologies for constructing Exascale calibrated models</td>
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<td>Performance</td>
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Non-Technical Strategic Issues

- Demonstrable value
- Integration with Devices. Memory and Algorithms tracks
- Neutral simulation environment for competing organizations to provide models
  - 80/20 rule applies?
  - Encourage industry involvement through procurement incentives
  - Encourage academic involvement through procurement/publication incentives
- Fund organizations to use the tools