

IAA Working Group

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

Technical	Probability (Risk)			Impact		
	High	Medium	Low	High	Medium	Low
Building a validated useful simulator	X			X		
Composable	X			X		
New methodologies for building simulators	X			X		
Accuracy	X			X		
Exascale Calibrated models	X			X		
Methodologies for constructing Exascale calibrated models		X			X	
Performance	X				X	
Parallelism	X			(capacity)	X	
Multiscale		X			X	
Hardware acceleration	X				X	
Power and thermal models			X	X		
Ease of use		X			X	
Visualization		X			X	
Automation		X			X	
Documentation & deployability	X			X		

- **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

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