Evaluation and Driving Applications for On-Chip Networks

Rajeev Balasubramaniam (Utah)
Angelos Bilas (Crete)
Jay Jayasimha (Intel)
Rich Oehler (AMD)
D K Panda (Ohio State)
Fabrizio Petrini (Pacific National Labs)
Drew Wingard (Sonics)
Workloads

- Environments: Traditional multi-core, SoC
- Apps
  - Running on desktops/laptops: traditional, gaming
  - HPC: real time simulation, bioinformatics, financial, other traditional apps
  - Datacenter: TPC, server consolidation
  - Recognition, Mining, Synthesis
  - Healthcare: MRI, etc.
  - Embedded (SoC-type): handheld games, medical
Architectural Characterization

- Access patterns: memory, I/O, streaming
- Sharing: read/write, read only, etc.
- Synchronization: fine/coarse grain, collective
- QoS, need for real time guarantees, performance isolation, isolation for security
- Programming models
  - Mixed mode (msg passing + coherence/shared memory)
  - Programming issues with new memory hierarchies being exposed to programmer
Network Requirements

- Support
  - granularity of data transfers
  - synchronization (multicast, etc.) and collective operations
  - Partitioning: QoS (virtual channels, partitioning), performance isolation, isolation for security

- Network interfaces for different protocols
Evaluation Metrics

- latency, b/w under different traffic classes
- power / energy thermal constrained?
- area, constrained
- real time deadlines, QoS (esp for SoC)
- standardization of metrics
- Monitoring/counters under constraints
Research Issues

- New programming models
  - performance aware constructs and annotations
- Limits to scalability of coherence protocols (enhanced support for barriers, multicast)
- Network support for classes of traffic
- New types of network services
  - isolation, security, partitioning, error recovery, power-aware decisions, reconfiguration, ...
- Models for RT guarantees (for SoC)
- Architectural benchmark suites & characterization
Tools/Methodology

- Tools and methodology
  - modeling
  - simulation: trace, execution, full-system simulation
  - emulation
  - prototyping