Network-Induced Memory Contention
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What is Network-Induced Memory Contention (NiMC)?
Out-of-band network operations, e.g. RDMA, that adds pressure to the memory subsystem

Exascale solutions increasingly rely on RDMA
- Asynchronous Many Task Applications
- Partitioned Global Address Space Applications
- Data Staging
- In-Situ Analytics

NiMC Performance Impact Case Studies

Single-node Study
- RDMA writes at 2-5 GBps
- Memory & cache contention observed on six of eight test platforms
- Worst impact on system with onload NICs

LAMMPS Multi-node Study
- 2X Sandybridge system with onload NICs
- 1 Sec. RDMA writes on a subset (0.2-0.5%) of nodes
- > 3X slowdown (LAMMPS)

Detection and Diagnosis

- Determining RDMA impact can be challenging:
  - Hard to determine traffic amount on target node
  - NiMC affects each workload differently
  - Machine learning correlates micro-performance to RDMA
- Evaluated 17 performance counters
- Importance of counter varies widely across workloads

Mitigation Strategies

Offload Network Cards
Impact of NiMC on LAMMPS w. Offload (64-Bk) (SandyBridge-X2-FDR-offload)
- Daly (med)
- Daly (min)
- No RDMA (min)

Offload cards can offer scalable solutions for modern CPUs at increased cost

Bandwidth Throttling
Impact of NiMC on STREAM w. Core Reserv. (SandyBridge-X2-onload)

Throttling below (500MBps) provides benefits vs. core reservation

Core Reservation
Impact of NiMC on LAMMPS w. Core Reserv. (64-Bk) (SandyBridge-X2-onload)

Core reservation provides a scalable solution when throttling is not enough

Machine learning shows five important L2 features for NiMC detection (LAMMPS)

Histograms across 3,200 processes, show outlier processes on far right