OSU INAM: A Profiling and Visualization Tool for Scalable and In-Depth Analysis HPC Clusters

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Overview

- Profiling tool challenges
- Usage case
- Overview of OSU INAM
- Current OSU INAM features
- Demo
Profiling Tools Perspective and Challenges

• There are 30+ profiling for HPC systems
• System level vs User level  
  – User level novelty
• Different types of Users have different needs  
  – HPC administrators  
  – HPC Software developers  
  – Domain scientists
• Different HPC layers to profile  
  – How to correlate them?
Use Case: domain scientist

• You are a domain scientist running your application
  – Expecting getting better results, you get performance degradation
  – Where is the source of degradation in HPC system?

• How can a domain scientist get a holistic view of the HPC ecosystem?
  – Integration with job scheduler, MPI library, and fabric
  – In-depth performance monitoring

• High productivity tools perspective for HPC users

• Capable to reuse the stored data from OSU INAM daemon
Overview of OSU INAM

- A network monitoring and analysis tool that is capable of analyzing traffic on the InfiniBand network with inputs from the MPI runtime
- Remotely monitors IB clusters in real time by querying various subnet management entities and gathering input from the MPI runtimes
- Capability to analyze and profile node-level, job-level and process-level activities for MPI communication
  - Point-to-Point, Collectives and RMA
- Ability to filter data based on type of counters using “drop down” list
- Remotely monitor various metrics of MPI processes at user specified granularity
- "Job Page" to display jobs in ascending/descending order of various performance metrics in conjunction with MVAPICH2-X
- Visualize the data transfer happening in a “live” or “historical” fashion for entire network, job or set of nodes
- Fabric discovery in less than 10 mins for ~2000 nodes
- Sub-second IB port inquiry for ~2000 nodes
  - Enhanced fault tolerance for database operations
    - Thanks to Trey Dockendorf @ OSC for the feedback
  - OpenMP-based multi-threaded designs to handle database purge, read, and insert operations simultaneously
  - Improved database purging time by using bulk deletes
  - Tune database timeouts to handle very long database operations
  - Improved debugging support by introducing several debugging levels
OSU INAM Features

Comet@SDSC --- Clustered View
(1,879 nodes, 212 switches, 4,377 network links)

- Show network topology of large clusters
- Visualize job topology in the network
- Visualize traffic pattern on different links
- Quickly identify congested links/links in error state
- See the history unfold – play back historical state of the network

Finding Routes Between Nodes
OSU INAM Features (Cont.)

- **Job level view**
  - Show different network metrics (load, error, etc.) for any live job
  - Play back historical data for completed jobs to identify bottlenecks
- **Node level view - details per process or per node**
  - CPU and memory utilization for each rank/node
  - Bytes sent/received for MPI operations (pt-to-pt, collective, RMA)
  - Network metrics (e.g. XmitDiscard, RcvError) per rank/node

**Visualizing a Job (5 Nodes)**

**Estimated Process Level Link Utilization**

- **Estimated Link Utilization view**
  - Classify data flowing over a network link at different granularity in conjunction with MVAPICH2-X 2.2rc1
    - Job level and
    - Process level

More Details in Tutorial/Demo
Live Demo at OSC and OSU clusters