**VNET/P: Bridging the Cloud and High Performance Computing Through Fast Overlay Networking**


**VNET Model**
- VNET: A layer 2 virtual overlay network for the user’s virtual machines
  - Provide location independence to VMs
  - Carry VMs’ traffic via configurable overlay network
- Virtual machines on virtual networks as the abstraction for computing
- Virtual network as a fundamental layer for measurement and adaptation

**Bridge the Cloud and HPC**
- Adaptive cloud/HPC-spanning model: Seamlessly bridge distributed cloud and tightly-coupled resources
  - Applications can dynamically span to both environments
  - To provide effective on-demand resources for HPC
- Adaptive cloud/HPC-spanning model is currently limited by performance of virtual networking
  - How can we provide high performance inter-VM traffic while VMs are located on the same data center/cluster?

**Architecture of VNET/P**
- Move virtual networking directly into VMM
- Enable optimizations that can only happen inside VMM

**Optimizations**
- Guest-Driven
- VMM-Driven
- Dedicated Thread

**Future Work**
- Further performance improvement
  - Further performance optimizations (in submission)
  - Optimistic interrupts, Cut-through forwarding, Noise isolation
  - Move VNET up to guest through guest code injection (to appear in ICAC’12)
- An Ethernet abstraction for VMs on non-Ethernet interconnects (InfiniBand, SeaStar, etc)

**Conclusion**
- Extend virtual networking for VMs down to clusters and supercomputers
  - Such model is limited currently by virtual networking performance
- VNET/P: high performance virtual overlay networking for tightly-coupled parallel systems
  - Overlay networking directly implemented into VMM
  - High performance on 1Gb/10Gb networks
- Software-based overlay network can be extended into tightly-coupled environments

**Performance of VNET/P**
- VNET/P achieves native bandwidth on 1Gbps network
- VNET/P achieves native latency on 1Gbps network
- VNET/P achieves around 55%-70% of native bandwidth on 10Gbps network
- VNET/P achieves 3 times of native latency on 10Gbps network
- VNET/P achieves scalable bandwidth and latency on multiple nodes
- VNET/P achieves 95% of native performance on most of NAS application benchmarks