Emerging Opportunities in HPC Cloud & Collocation Services

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Agenda

• About the NSI @ Switch
• Computing Challenges
  • Spotlight on Research
  • Other Research Areas that Benefit from HPC
• Next Steps
About the NSI

**Full-service** supercomputing facility

**Mission** for excellence in education and research in supercomputing and its applications

**Provides** supercomputing training and services to academic and research institutions, government and private industry

**Supports** energy, the environment, medical informatics and health care

**Serves** researchers at the University of Nevada Las Vegas and other statewide, nationwide and global research
NSI @ Switch

• 2014 - UNLV moved its NSCEE facilities to Switch facility in Las Vegas

• Hosted on Cherry Creek system – large Intel system for scientific and economic R&D

• > 26,000 compute cores

• Intel Xeon E5-2697v2 12C 2.700GHz, Intel Truscale, Intel Xeon Phi 7120P

• Dedicated Research Network (DMZ) with 200Gb/s potential
Cloud & Collocation
NSI Computing Challenges

Numerous and complex workloads
  • Hundreds of projects
  • Highly compute-intensive research

Massive data needs
  • Users must access massive data remotely to do their work

Time-sensitive projects
  • Many NSI projects have critical governmental and environmental significance, so timely and reliable performance is a key requirement

Powerful and reliable infrastructure is mandatory!
Spotlight: Alzheimer’s Research

The need for innovation

- Alzheimer’s Disease continue to cause tremendous family, social, and economic burdens to modern society
- Despite substantial progress, existing treatment approaches are limited – so new therapeutic approaches are desperately needed

The NSI project

- NSI works with researchers to compare genomes of Alzheimer's patient with normal patients
- **Challenge**: Researchers wanted to enhance the statistical power of previous analyses by including more than 10,000 additional patients (and thus genomic data sets) in the study – **meaning a massive leap in computational requirements**
Alzheimer’s Project Results

• Reduced overall runtimes for processing workload
  • Decreased processing time by more than 50% using PBS Professional in conjunction with Rocks and an improved system with shared memory compute node
  • 3 hours instead of the 8+ hours to process a genome

• Fast, easy implementation

• Powerful, flexible customization capabilities -- can be easily extended by adding site-specific processing plugins/hooks

• Improved system manageability and extensibility:
  • Lightweight solution
  • Very easy to manage
  • Not dependent on any specific operating system
Other NSI Research that Benefits from HPC…

Quantum Dynamics of Chemical Reactions
- HPC dramatically improves ability to understand how atoms and molecules interact and the chemical reactions that occur in different environments
- Researchers use complex theoretical calculations to explore how molecules behave at absolute zero temperatures and other conditions

Fracking
- Hydraulic fracturing often takes place >1 mile below groundwater supplies
- Mechanical engineers use sophisticated numerical models to more accurately predict prime locations for extraction and assess possible contamination associated with the process

Magnetically Dominated Jets in Gamma-Ray Burst
- Gamma-ray bursts are the most luminous, and violent, explosions in the universe -- they signify the deaths, collisions or swallowing up of stars
- Astrophysicists’ computational research advances our understanding of the physical mechanisms behind GRBs and other high-energy astrophysical phenomena
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Thank you for your attention!

Questions?

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