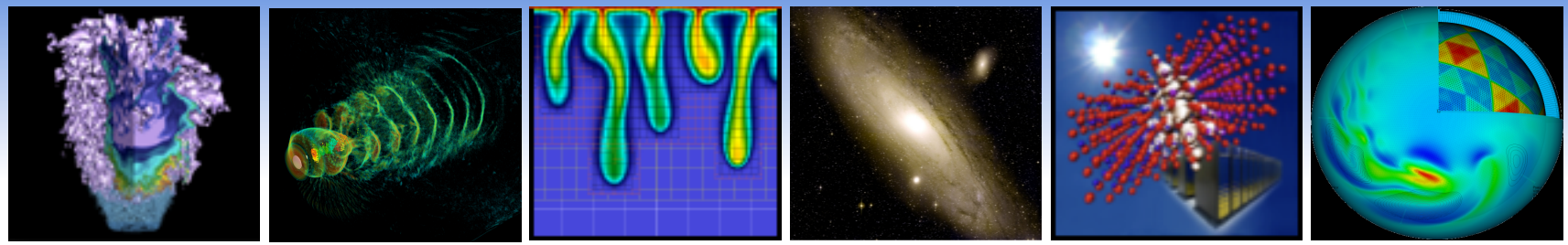


Magellan

A Test Bed to Explore Cloud Computing for Science

Shane Canon and Lavanya Ramakrishnan

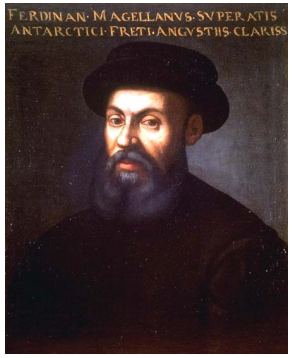
Cray XE6 Training

February 8, 2011

U.S. DEPARTMENT OF ENERGY | Office of Science

NERSC

Magellan – Exploring Cloud Computing



Co-located at two DOE-SC Facilities

- Argonne Leadership Computing Facility (ALCF)
- National Energy Research Scientific Computing Center (NERSC)
- Funded by DOE under the American Recovery and Reinvestment Act (ARRA)

RECOVERY.GOV

U.S. DEPARTMENT OF ENERGY | Office of Science

NERSC

Magellan Mission

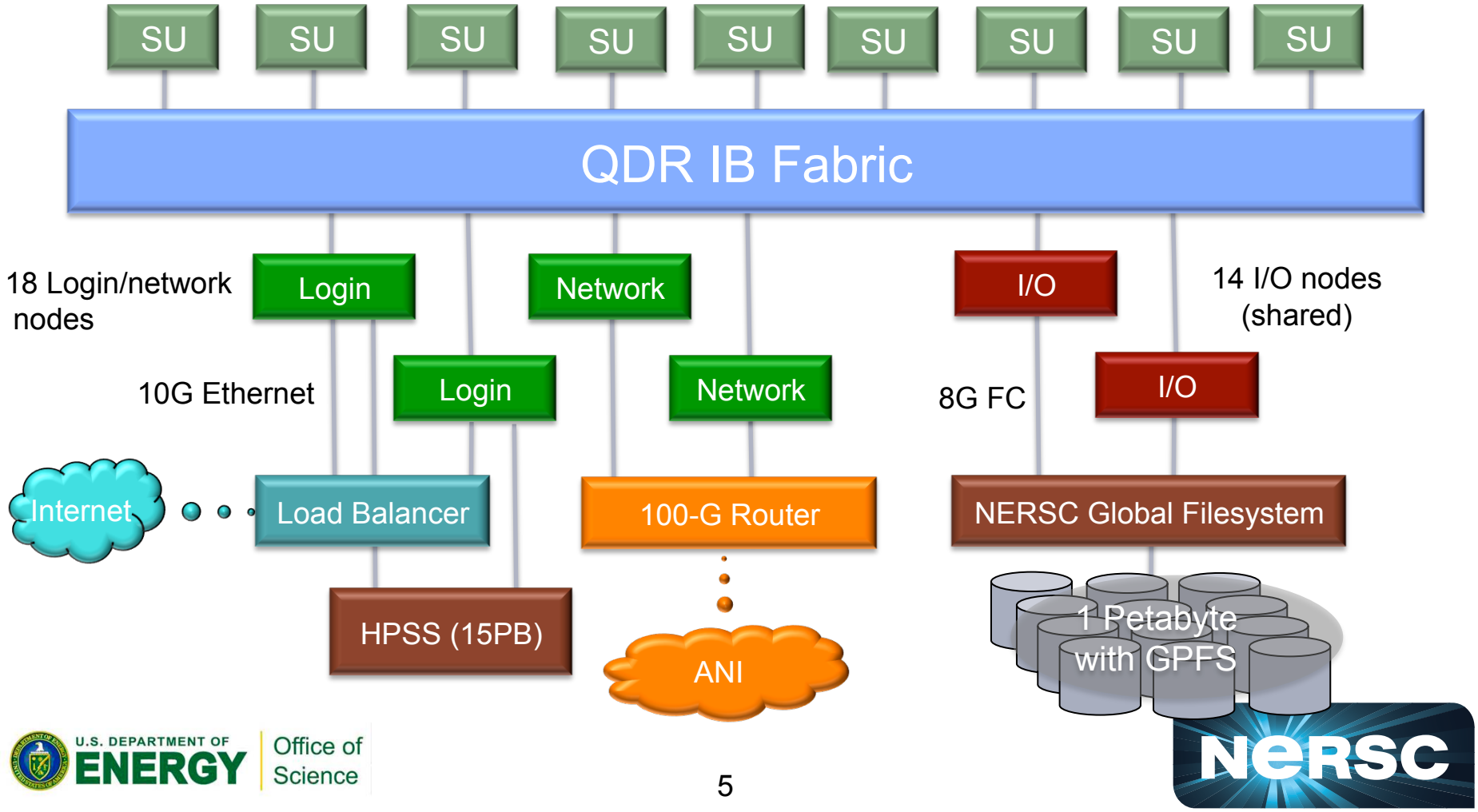
- Determine the appropriate role for commercial and/or private cloud computing for DOE/SC midrange workloads
- Deploy a test bed compute and data cloud to serve the needs of mid-range scientific computing.
- Evaluate the effectiveness of this test bed for a wide spectrum of DOE/SC applications in comparison with other platform models.

Magellan Research Agenda

- What are the unique needs and features of a science cloud?
- What applications can efficiently run on a cloud?
- Are cloud computing Programming Models such as Hadoop effective for scientific applications?
- Can scientific applications use a data-as-a-service or software-as-a-service model?
- What are the security implications of user-controlled cloud images?
- Is it practical to deploy a single logical cloud across multiple DOE sites?
- What is the cost and energy efficiency of clouds?

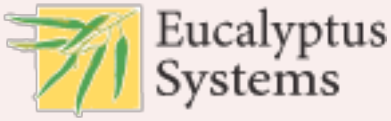
Magellan Test Bed at NERSC
Purpose-built for Science Applications

720 nodes, 5760 cores in 9 Scalable Units (SUs) ➔ 61.9 Teraflops
SU = IBM iDataplex rack with 640 Intel Nehalem cores



U.S. DEPARTMENT OF ENERGY | Office of Science

Current Magellan Node Allocation

Purpose	Nodes	Comments
	520 (Parallel) 40 (Serial)	Mix of node types and queues. Future: Dynamic provisioning and VMs
	40	Can expand based on demand. Supports: VMs, block storage
	40 (SATA) 40 (SSD)	MapReduce. Both configured with HDFS
	40	Testing provisioning, new cloud stacks

Magellan Allocations - IPM Study

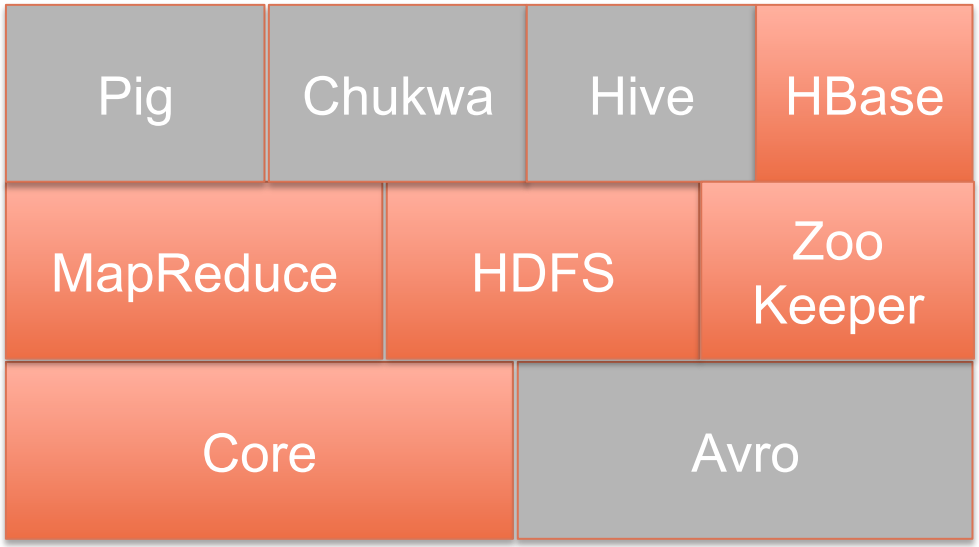
- **Profiling time is available to all MPP users as part of the Cloud Computing Performance Study**
  - **Separate allocation pool (NOT part of MPP allocation)**
  - **IPM will be turned on by default for all jobs**
  - **IPM will be used to collect several data points for each job (CPU Counters, time in MPI calls, IO)**
  - **Hope to develop "stop-light" chart of applications suitability for Cloud systems**

Eucalyptus

- **Open source Infrastructure as a Service implementation**
  - **API compatible with Amazon AWS**
  - **Virtual Machines, Object and Block Store**
- **Private virtual clusters**
  - **scripts to manage dynamic virtual clusters**
  - **NFS/Torque etc**
  - **Working on customized hooks for user/ community extensions**

Hadoop Stack

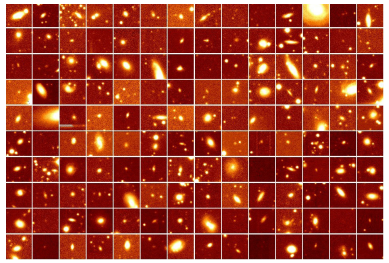
- **Open source reliable, scalable distributed computing**
  - **Implementation of MapReduce**
  - **HDFS distributed file system**
- **Number of applications**
  - **DeNovo Assembly, Kbase, large databases, image analysis, etc**
- ***Coming soon: Simple templates to plug in applications***

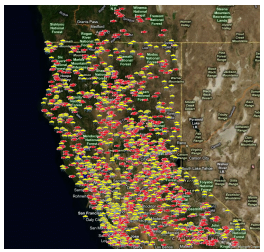


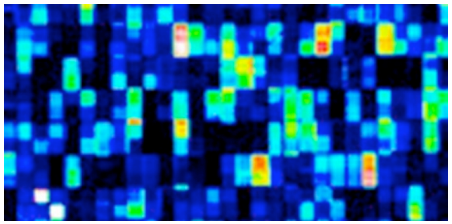
Source: Hadoop: The Definitive Guide

Attractive Features of the Cloud

- On-demand access to compute resources
  - Cycles from a credit card! Avoid lengthly procurements.
- Overflow capacity to supplement existing systems
  - Berkeley Water Center has analysis that far exceeds the capacity of desktops
- Customized and controlled environments
  - Supernova Factory codes have sensitivity to OS/compiler version
- Parallel programming models for data intensive science
  - Hadoop (data parallel, parametric runs)
- Science Gateways (Software as a Service)
  - Deep Sky provides an Astrophysics community data base

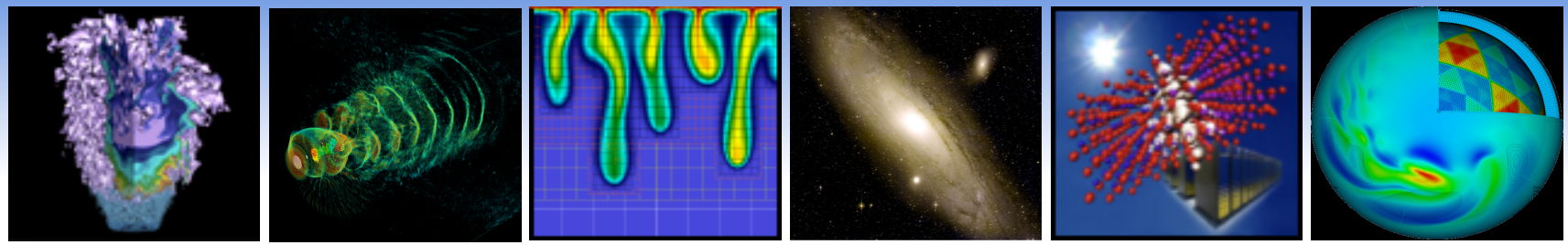






Dark Side of Clouds

- **Difficult to scale up HPC in the cloud**
  - Fine-grained / tightly-coupled MPI applications are a poor fit
  - Large scale jobs difficult to marshal
  - Long runs subject to node instability
- **Some assembly required**
  - Flexibility of Eucalyptus/EC2 comes with a price
  - Need mechanisms to distribute data and work (no batch, no parallel file system)
- **Frameworks like Hadoop can be difficult**
  - Designed to process large amount of unstructured data
  - Legacy apps can be difficult to convert
  - Not a replacement for most MPI-based algorithms



Thank you!

Contact Info:
Shane Canon
Scanon@lbl.gov
magellan.nersc.gov

U.S. DEPARTMENT OF ENERGY | Office of Science

NERSC