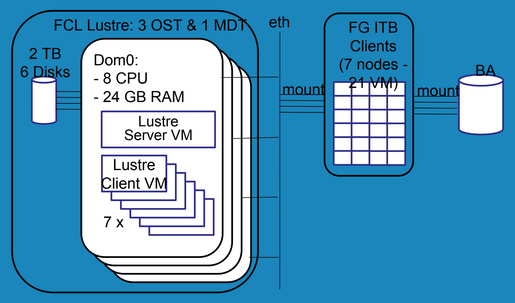
FermiCloud: A private cloud to support Fermilab Scientific Users

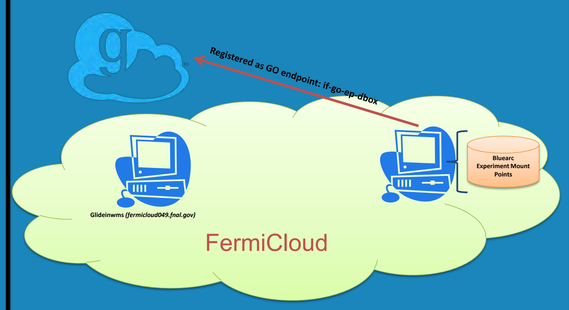
Intensity Frontier Storage

- FermiCloud configurable test bed, 10TB of storage per node, dedicated network
- Run real MINOS and NOVA user code on Lustre, Hadoop, OrangeFS



Intensity Frontier Data Transfer

- Flexible service deployments for several experiments
- Gridftp endpoint server hosted in FermiCloud
- Grid users can transfer output files back to experiment disk at Fermilab.
- Files have right user and group.

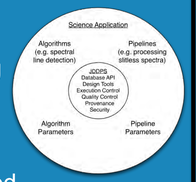


End-To-End Solution using Globus Online & GlideinWMS

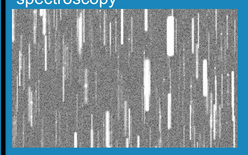
Cosmic Frontier

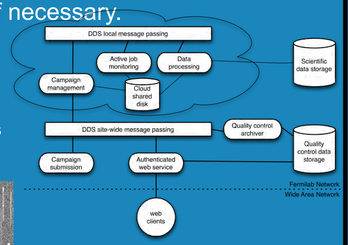
Fault-tolerance Development

- Demonstration Data Processing System
- Data Distribution Service with distributed message passing
- Cloud environment gives isolated private net, fault tolerance testing, interactive login if necessary.



Baryon acoustic oscillations simulation of slitless spectroscopy





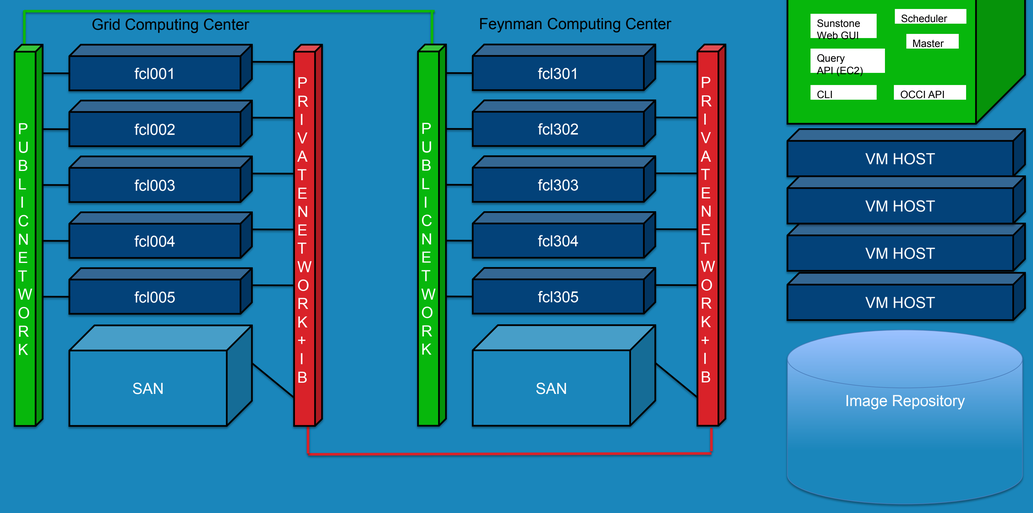
D0 SAMGRID Service Hosting

- Forwarding Node Servers divide a project into individual jobs and submit to the grid.
- Low CPU and network requirements, good candidate for virtualization.
- Increased hosting efficiency through multiple services on one physical node.

What is FermiCloud?

- Infrastructure-as-a-service private cloud for Fermilab Scientific Program.
- Integrated into Fermilab site security structure.
- Virtual machines have full access to existing Fermilab network and mass storage devices.
- Scientific stakeholders get on-demand access to virtual machines without system administrator intervention.
- Virtual machines created by users and destroyed or suspended when no longer needed.
- Testbed for developers and integrators to evaluate new grid and storage applications on behalf of scientific stakeholders.
- Ongoing project to build and expand the facility:
  I. Technology evaluation, requirements, deployment.
  II. Scalability, monitoring, performance improvement.
  III. High availability and reliability

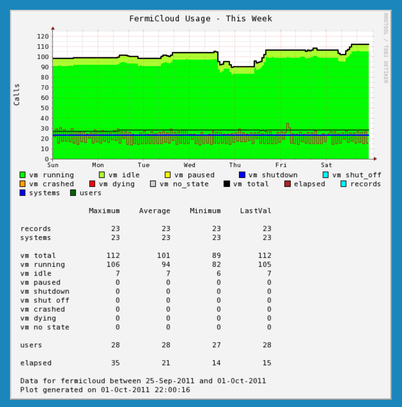
FermiCloud Architecture Diagrams



FermiCloud Operations

- Stock virtual machine images are provided for new users.
- Active virtual machines get security patches from site patching services.
- Dormant virtual machines get woken up periodically to get their patches.
- New virtual machines scanned by site anti-virus and vulnerability scanners, don't get network access until they pass.
- Three levels of service:
  - 24 by 7 high availability, can have fixed IP number,
  - 9 by 5 development/integration, use one of a pool of fixed IP's,
  - Opportunistic—Can be pre-empted if idle or if higher-priority users need cloud.

FermiCloud Metrics



In production for 1 year, number of VM's quadrupled during that time.

X.509 Authentication

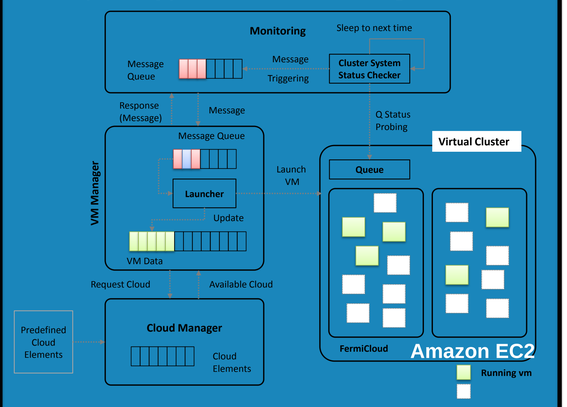
- Use OpenNebula Pluggable authentication feature.
- Wrote X.509 authentication plugin and contributed back to OpenNebula, included in OpenNebula 3.
- X.509 Authentication is integrated into command line tools, EC2 Query API, OCCI API, SunStone management GUI.
- Contributing to standards bodies to make authorization callout to external services, similar to Grid authentication.

Fabric Investigations

- Easily reconfigurable test bed to test new technologies and configurations
- Small MPI applications with Infiniband-enabled virtual machines. Collaboration with KISTI.
- Test bed for IPv6 investigations.
- SAN investigation for live migration and failover between buildings in case of a building failure.

On-demand Grid Cluster in Cloud

Increase utilization of physical resources with shared opportunistic grid jobs;
Also prototype for cloudbursting to EC2



Joint investigation with KISTI

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