1 Introduction

The aim of this project is to design and implement a scalable and resilient infrastructure for CERN High Energy Physics (HEP) data analysis. The infrastructure is based on OpenStack components for structuring a private Cloud with Gluster File System. Our test results show that the adopted approach provides a scalable and resilient solution for managing resources.

2 Architecture

- Computational resources
  - Dell PowerEdge, 2 quad core Intel Xeon
  - 32GB (8 x 4GB) RAM
  - 4 x 10GbE Broadcom 57718 network
- Gluster File System servers
  - Dell PowerEdge servers
  - 512GB LUN attached to each
- OpenStack Controller
  - Dell PowerEdge servers

Virtual Machines (QOCO2 Images)

<table>
<thead>
<tr>
<th>Type</th>
<th>Nodes</th>
<th>Cores</th>
<th>Memory</th>
</tr>
</thead>
<tbody>
<tr>
<td>WN</td>
<td>25</td>
<td>4</td>
<td>14</td>
</tr>
<tr>
<td>CE</td>
<td>1</td>
<td>4</td>
<td>14</td>
</tr>
<tr>
<td>GlusterFS</td>
<td>2</td>
<td>4</td>
<td>14</td>
</tr>
</tbody>
</table>

3 System Components

- OpenStack Cloud (Grizzly release)
- Gluster File System
- Advanced Resource Connector middleware
- CERN Virtual Machine File System

4 GlusterFS IO

- GlusterFS is used
  - inside the Cloud to provide shared area (Brick 1 & 2, 2TB)
  - outside for Glance and Nova repositories (Brick 3 & 4, 1TB)

5 System Stability

- The evaluation is based on the CMS Dashboard together with CSC and NDGF accounting and monitoring systems
- More than 65k jobs have been processed, including CMS production and analysis jobs
- Example of a specific user
  - Run 400 analysis jobs with 74 walltime days and 85% CPU efficiency

6 Performance Analysis

- 4% performance loss evaluated with the HEPSPEC-2006 benchmark
- Burst mode VM boot requests based on Local and GlusterFS based setups
- Uniform boot response with GlusterFS

7 Live Migration

- Experiments with different kinds of instances
  - Minimal VM of Ubuntu m1.small took 6 sec
  - Worker node VM with full configuration took 43 sec
- Experienced random failures in higher number of live migration requests

8 Conclusion

We have demonstrated:
- More flexible system/user management through the virtualized environment;
- Efficient addition/removal of virtual resources;
- Scalability with an acceptable performance loss;
- A seamless view of our site through ARC middleware.

9 Acknowledgements

- This project is funded by Academy of Finland (AoF)
- Thanks to Ulf Tigerstedt, CSC for help with HEPSPEC tests
- The CMS collaboration for sending production jobs to process