Virtual workspace as basis of supercomputer center

Agenda

- Introduction
- Cluster configuration
- Virtual workspace approach
- Virtual machines
- Benefits
- Examples
- Conclusion
Resource Center Computational Center

- was founded in 1996
- provides university members with HPC services
- offers distributed computing software licenses
- develops new ways of provisioning computational resources
## Cluster configuration

<table>
<thead>
<tr>
<th></th>
<th>T-Platform cluster T-EDGE96 HPC-0011828-001</th>
<th>SMP cluster, HP Proliant DL980</th>
<th>Hybrid cluster, HP SL390s G7</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CPU</strong></td>
<td>2x Intel E5335 2.0 GHz</td>
<td>8x Intel X7560 2.2 GHz</td>
<td>2x Intel X5650 2.67 GHz</td>
</tr>
<tr>
<td><strong>Commutator</strong></td>
<td></td>
<td>Infiniband 20 Gb/s</td>
<td></td>
</tr>
<tr>
<td><strong>HDD</strong></td>
<td>160 GB</td>
<td>2 TB</td>
<td>120 GB</td>
</tr>
<tr>
<td><strong>GPU</strong></td>
<td>-</td>
<td>-</td>
<td>3x (8x) NVIDIA Tesla M2050</td>
</tr>
<tr>
<td><strong>RAM</strong></td>
<td>16 GB</td>
<td>0.5-2 TB</td>
<td>96 GB</td>
</tr>
<tr>
<td><strong>Total RAM</strong></td>
<td>768 TB</td>
<td>3 TB</td>
<td>2.3 TB</td>
</tr>
<tr>
<td><strong>Total characteristics</strong></td>
<td>48 nodes, 384 cores</td>
<td>3 nodes, 192 cores</td>
<td>24 nodes, 288 cores, 112 GPUs</td>
</tr>
<tr>
<td><strong>Peak performance</strong></td>
<td><strong>3.07 TFLOPS</strong></td>
<td><strong>1.7 TFLOPS</strong></td>
<td><strong>59.6 TFLOPS</strong></td>
</tr>
</tbody>
</table>
Conventional clusters

- managed by CentOS
- utilized by issuing PBS command or running user-friendly script to submit job
- have user's home directory mounted on each node prior to running a job
Virtual workspace approach

Users need a way to access cluster resources:

• they want it to be easy
• they want it to be secure
• they want to store experiment's data safely and have universal access to it
• they want to customize their working environments
Each user is provided with private virtual machine which enables
• access to clusters via PBS
• access to licensed software repository
• storage for user's data
Virtual workspace approach

There is a separate cluster of virtual machines managed by VMWare.

Cluster specifications:
• 60 Blade servers HP BL460G7
  - 2x Intel Xeon X5670
  - 96GB RAM
  - 2x 10GbE, 2x QDR IB
• Storage system: StorageWorks P4500 G2 (240 TB)
• Commutators: 48x 1GbE и 4x 10GbE
• Peak performance: 8.6 TFLOPS
Virtual machine can be used for:

- data pre- and post-processing
- application development
- data storage
- other routine tasks
VM characteristics can be customized to suit user's needs (CPUs, RAM, storage, operating system)
Access to virtual machine

- LDAP single sign on
- Logging via SSH (Linux) or RDP (Windows)
- Optional VPN
- User is free to install additional software for remote access (VNC, FreeNX, etc.)
User's benefits

- Customized environment
- Root privileges in virtual machine (sudo)
- Universal access to computational and storage resources
- Virtual machine backup (regular snapshots)
- Possibility to create virtual private clusters
Examples

T-Platform cluster

- Ideal
- Pcystal
- MPPcrystal

Speedup vs. Cores graph:
- Ideal curve
- Pcystal curve
- MPPcrystal curve
Examples

SMP cluster

Ideal
Pcrystal
MPPcrystal

Speedup vs Cores graph
Conclusion

- Virtual workspace streamlines scientific research work flow
- Consolidates experiment's data
- Can be extended to virtual private cluster
Questions?
Thank you!