Tools and Techniques for Managing Clusters for SciDAC Lattice QCD at Fermilab

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FNAL SciDAC Lattice QCD clusters

80 node Pentium III cluster

176 node Xeon cluster
Introduction

- **Tools**
  - for hardware management tasks.
  - for OS installation/upgrade and reloading BIOS/firmware.
  - tools that work in conjunction with the PBS batch queue system.
- Integration of tools for remote administration.
Remote node management

- serial links to each worker node.
- BIOS/console redirection.
- support both IPMI 0.9 and 1.5 versions.
- IPMI – remote power on, power off, reset.
Super Micro’s IPMI View – GUI based management Interface over LAN
Network boot

- PXE (Pre-boot Execution Environment)

<table>
<thead>
<tr>
<th>PXE loads</th>
<th>OS Install</th>
<th>BIOS/Firmware Install</th>
</tr>
</thead>
<tbody>
<tr>
<td>PXE loads</td>
<td>bootloader <strong>pxelinux</strong></td>
<td>bootloader <strong>pxegrub</strong></td>
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<tr>
<td>bootloader loads</td>
<td>linux kernel image + initrd. Launches kernel bootstrap</td>
<td>mknbi (from etherboot) DOS image. Launches DOS bootstrap</td>
</tr>
<tr>
<td>install</td>
<td>via init/rc.d, brings in install script, which -partitions disk -makes file system -rcp’s tar files -explodes file system -does host IP config -rsh’s to bootp server to comment itself out under bootptab. reboot.</td>
<td>autoexec.bat executes -does firmware/BIOS upgrade/install -using bootp discovers host IP -ftp’s stdout/stderr to bootp server. -rsh’s to bootp server to comment itself out under bootptab. reboot.</td>
</tr>
</tbody>
</table>
Fermi Tools

rgang – (milc - minimum level of complexity) execute the same command on all of the nodes. Coded in python.

- two modes:
  - command mode.
  - copy mode.
- n-way option.
- rgang can be used to install itself.

n-way = 0 (default)  n-way = 3

```
startnode
```
```
startnode
```

w101
w102
w103
w104
w105
w106
w107
w108
w109
w110
w101
w102
w103
w104
w105
w106
w107
w108
w109
w110
Fermi Tools

- **fermistat** - list cluster resource usage by users and running jobs. Works in conjunction with PBS batch queue system.
- **fermitrack** – poor man’s project accounting. Works in conjunction with PBS batch queue accounting system.

```bash
> qsub -A "myproject" -l nodes=n mypbsscript
```

Diagram:
- `fermitrack`
  - `accounting file`
  - `project file`
- PBS server updates accounting file at the start and end of each job
- `qsub` (submit pbs job) refers project file to check for account validity
Integration - How it all comes together.

- **Head node** checks worker node health data & resource usage are within safe limits.
- **fermitrack** uses PBS accounting to check per project resource usage.
- Each worker node collects health data issuing IPMI commands to the BMC interface at set intervals.
- Health data transferred over to head node over **syslog udp socket**.
- Head node **rgang’s** to all worker nodes to check resource usage.
- Head node checks worker node health data & resource usage are within safe limits.

**worker nodes**
### All Health Statistics

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<th>Proc Tmp1</th>
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</table>
Example

fermistat –l <jobid> | rgang – <command>

fermistat –l 8345.job | rgang – uptime

- - - - - - - - - - - - - - w605 - - - - - - - - - - - - - -

rsh w605 'uptime'
2:21pm up 9 days, 2:02, 0 users, load average: 1.99, 1.97, 1.91

- - - - - - - - - - - - - - w606 - - - - - - - - - - - - - -

rsh w606 'uptime'
2:21pm up 9 days, 2:03, 0 users, load average: 1.99, 1.97, 1.91

- - - - - - - - - - - - - - w607 - - - - - - - - - - - - - -

rsh w607 'uptime'
2:21pm up 9 days, 2:02, 0 users, load average: 1.99, 1.97, 1.91

- - - - - - - - - - - - - - w608 - - - - - - - - - - - - - -

rsh w608 'uptime'
2:21pm up 9 days, 2:02, 0 users, load average: 2.00, 1.97, 1.91
Example

fermistat –c <rgang style list-of-nodes>
fermistat -c w1{01-04}
pbsnodes -c w101
pbsnodes -c w102
pbsnodes -c w103
pbsnodes -c w104

fermistat –l <jobid> | fermistat -o –
fermistat -l 8345.job | fermistat -o -
pbsnodes -o w605
pbsnodes -o w606
pbsnodes -o w607
pbsnodes -o w608
Conclusion

It works . . . .

http://qcdhome.fnal.gov - 80 node Pentium III cluster
http://lqcd.fnal.gov - 176 node Xeon cluster
http://fermitools.fnal.gov - rgang and other tools

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