

Administration, Operation, and Planning of a Proof-of-Concept CMS Tier-2 Center

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1. Introduction

Two Linux cluster systems have been installed to serve as a research testbed for building a Tier-2^{1,2} Physics Grid center for Compact Muon Solenoid (CMS) collaboration at The University of Iowa.

One cluster (Table 1) consists of half terabyte SCSI Raid storage. Although the size of the cluster was targeted to be small for proof-of-concept research, the cluster was built as expandable as possible, especially regarding the amount of storage space and the number of compute nodes. The system has been installed with some Grid software and CMS software (see Appendix). For achieving high level of I/O performance between a server node and a disk array to meet the requirements of CMS simulation and analysis software, several vendors' solutions were evaluated before the system purchase:

- Advanced Clustering Technologies, Inc. -> <http://advancedclustering.com/>
 √ *Selected*
- Champaign Computer -> <http://www.c-computer.com/>
- Dell -> <http://www.dell.com>
- HP & Compaq -> <http://www.hp.com>
- Microway -> <http://www.microway.com/>
- Sun Microsystems -> <http://www.sun.com>
- Penguin Computing -> <http://www.penguincomputing.com/>
- QliTech Linux Computers -> <http://www.qlilinux.com/>

The other cluster consists of 32 Intel Pentium III @ 1.0 GHz Processors with total Memory of 16 GB, total Local disk of 640 GB, SCSI storage of 80 GB, and IDE storage of 80 GB. These two clusters are located at two different campus buildings and connected through campus fiber optical networks.

2. Administration and operation

The administration of two clusters is provided by the Research Services group of ITS. To operate these two clusters as physics Grid sites, the Athlon cluster plays the role of a Development Grid Testbed (DGT) on which both Grid software and CMS simulation and analysis software are installed and tested while the Pentium cluster is planned to be an

¹ <http://www.cacr.caltech.edu/projects/tier2-support/>

² <http://lcg.web.cern.ch/LCG/SC2/RTAG6/>

Integration Grid Testbed (IGT). Operation of the two Grid clusters includes the following tasks:

- 1.) To install, configure, and upgrade physics Grid software;
- 2.) To install, configure, and upgrade CMS simulation and analysis software;
- 3.) To support the research and development of CMS Grid monitoring tools and collaborative tools, and the testing of the tools;
- 4.) To learn administration and operation experiences from other tier centers and share our experiences with others;
- 5.) To participate in collaborative tests and data challenges with other tier centers.

Table 1. Hardware components of the Athlon cluster.

Athlon Cluster	Configurations	Additional Notes
1 server node	Dual Athlon 2200+ CPUs	
	2GB RAM	
	2 Ultra3, PCI SCSI RAID controllers	RAID0 and RAID5 must be supported
	150GB 10K RPM SCSI hard drive	
	Dual 64bit Gigabit NIC	
2 compute nodes , here lists the configuration for each node.	Dual Athlon 2200+ CPUs	
	1GB RAM	
	80GB 7200 RPM IDE hard drive	
	1 64bit Gigabit NIC	
Disk array	0.5TB SCSI disk array	Compatible with server SCSI controllers. The space of disk array is expandable
Switch	Non-blocking 8-port Gigabit switch	

3. Planning

Development of the proof-of-concept CMS Tier-2 center involves significant planning efforts in the following aspects:

- 1.) To keep track of cost/performance dynamics of computer hardware, and investigate and make decisions about hardware solutions;
- 2.) To upgrade the network connectivity between proof-of-concept Grid sites and their future network bandwidth to outside campus;
- 3.) To develop and strengthen Grid-based CMS collaboration with CMS Tier-1/Tier-2 centers and potential CMS Tier-3 centers;

- 4.) To seek resource sharing solutions (including external and internal grant applications) and investigate budget requirements of administering and operating a CMS Tier-2 center.

4. Concluding discussion

Our team for administering, operating, and planning the proof-of-concept CMS Tier-2 center has diversified and strong expertise in cluster and Grid computing (Yan Liu, Jun Ni, Anand Padmanabhan, Shaowen Wang), cluster and Grid system administration (Ransom Briggs, Shaowen Wang), central computing facility operation and management (Boyd Knosp, Jun Ni, Mike Noth, Shaowen Wang), and CMS experiments and analysis (Ugur Akgun, Ahmet Sedat Ayan, Alexi Mestvirishvili, Jonathan Olson, Yasar Onel). We wish to contribute to the development and operation of a successful CMS Grid system.

Appendix: Software installed on the CMS Tier-2 proof-of-concept system

1. Linux operating system

- a. RedHat7.3

2. Grid tools installed

- a. Globus
- b. VDT1.1.7
- c. WorldGrid
- d. LCG-0
- e. MPICH-G2

3. Current CMS applications

- a. HIJING (Heavy Ion Jet INteraction Generator)
- b. Pythia

4. CMS applications under testing

- a. CMSIM
- b. ORCA