Expected Physicists' Usage of CMS Tier 3

Christopher D Jones
Cornell University

Overview

Physicist's Activities

Tier Strengths

Activities at Tier 3s

- Coding
- Testing
- Small Batch Jobs
- Grid Submissions
- Interactive Usage

Physicists' Activities

Code Development

Done for analysis, reconstruction, calibration, simulation,etc.
Easiest if have full CMS software release available

Monte Carlo Studies

Test code using small samples
Generate small samples to test for correct generation
Generate large samples
Read and skim large samples
Iteratively examine skimmed samples
Possibly re-skim to get additional information

Data Analysis

Test code using small samples
Read and skim large samples
Iteratively examine skimmed samples
Possibly re-skim to get additional information

Systematic Studies

Iteratively examine skimmed samples
Possibly re-skim to get additional information

Tier Strengths

T0

CERN
First to process the data

T1

USA = FNAL
Lots of CPU power and storage
Partial copy of the 'raw' detector data
Full copy of the 'analysis level' (AOD) data
Archive of T2 produced MC

T2

San Diego, Caltech, Nebraska, Wisconsin, Purdue, MIT, University of Florida
In total will have lots of CPU power
Individually will hold 'analysis level' (AOD) data of interest to particular groups
Generate lots of MC

T3

Computing resources dedicated to specific group
Quick response to physicist's activities

Coding

All coding tasks require a CMSSW software release

At the moment, the ability to read a particular file can depend on the software release used to create that file

Physicists usually stay with one software release for a long time

several releases will probably have to be available at a site to accommodate all physicists

A new major release is made about every month

This rate will decrease but probably not until a year after initial data taking

Will want to have the code installed locally

It is possible to remotely build over afs but it is 'beyond painful'

Useful resources

One release takes about 1.5GB of disk space + ~1 GB for externals shared by releases

A fast multi-CPU compilation machine with the releases on its local disk

compilation time is usually dominated by I/O

Running Locally

For some cases, running a job at T3 may give faster results

- Testing or debugging
- Local copy of skimmed data
- Interactive

Requires full installation of CMSSW software release

Useful to have dedicated machine(s) for short jobs

- typically no longer than 5 minutes
- need good network connectivity to software release disk
  - cmsRun dynamically loads shared libraries and load time is dominate startup cost of jobs

PhEDEx can be used to retrieve data from T1/T2

Local batch queue useful for longer jobs

- Condor is the queue of choice for the US grid

NOTE: if data is available at T2 and jobs take longer than an hour, better to submit jobs to the grid.

Grid Submission

MC and data will be on T1 and T2

- Physics groups will request large MC sample generation and prepare standard data skims
  - All of these will be in the CMSSW EDM ROOT format used by cmsRun
- Physicist's find data using the Database Bookeeping System (DBS)
  - Physicist just use a web browser to lookup the data
- Physicists will want to process these samples

CRAB is CMS physicists' grid submission tool

- Need to install CRAB (separate from CMSSW) and a grid user interface (UI)
- http://uscms.org/SoftwareComputing/UserComputing/Tutorials/Crab.html

Once job is finished, physicists will want to transfer resulting skims back to T3

- Present
  - Large files (>100MB) need to be written to a grid 'storage element'
  - Physicists need write permission to a T1 or T2 storage system
  - Use 'srmcp' to copy data from the storage system to T3
- Future
  - Physicist's jobs will write into CMS' storage space (i.e. namespace)
  - Data will be visible to DBS
  - Use PhedEx to transfer data back to T3

Interactive

Files used by CMSSW are intended for direct use in ROOT

Bare ROOT

- Can do simple 'TBrowser' plots in ROOT without having libraries

FWLite

- Automatically load libraries with proper object 'dictionaries'
- Give full ROOT macro (or python) access to data
- Also works for compiled code (dictionaries set how to read data from file)

TFWLiteSelector

- TSelector is ROOT's 'modular' processing system
- TFWLiteSelector lets you get data from a edm::Event just like in cmsRun

Amount of data needed by an analysis will probably exceed the ability to interactively plot quantities using only one machine

Groups in CMS are exploring use of PROOF

PROOF is ROOT's distributed computing environment

- Allows one Root application to use multiple machines in a local cluster to process physicist's data in parallel
- Only works with TSelector

CMS Week on December 2006 had a session on progress

- http://indico.cern.ch/conferenceDisplay.py?confId=8814#18

Getting this to work is a priority of the Physics Tools group

- I'd take a 'wait till problems worked out' approach

Conclusions

T3s are likely to be the main 'gateway' to CMS for most physicists

T3s ability to quickly respond to physicists activities is their greatest strength

- Quick compilation/debugging of code
- Ability to test by running very short jobs
- Local batch jobs for processing small amounts of data quickly
- Support for interactive data exploration