High Energy Physics At OSCER

A User Perspective

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Considerations

- Why do we need OSCER?

- What will we do with OSCER?

- What we are now doing.

- Difficulties encountered using OSCER.

- Overcoming Problems.

- Summary

- See poster presentation for more background and detail.

Computing Challenges of HEP

- Huge Data Sets
  - DØ experiment running at the Fermilab Tevatron in Batavia, IL, USA is producing a petabyte of raw data to be analyzed
  - ATLAS experiment will run at CERN's LHC in Geneva, Switzerland and produce a few petabytes of raw data per year to be analyzed
  - To understand the physics large scale Monte Carlo simulations must produce an equally large amount of data and this has to be analyzed

Collaboratory Nature of HEP

- Huge Collaborations Provide Needed Resources
  - DØ has 700 physicists from 18 countries
  - ATLAS has 2000 physicists from 34 countries
- Huge Collaborations Create Challenges
  - Geographically disbursed – 6 continents
  - Collaborators need access to data and each other
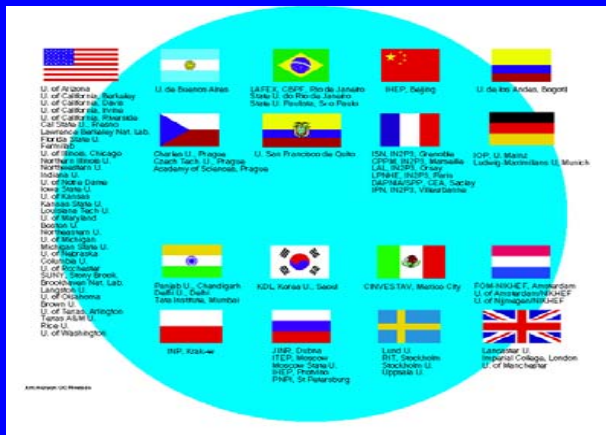
Why Do We Need OSCER?

- The massive computational resources needed can only be met by the distributed resources of the collaborators

- OSCER is a fine and powerful local computational resource for the OU/LU DØ and ATLAS collaborators.
  - Lots of CPU
  - Good network connectivity
  - Knowledgeable and helpful staff

What Will We Do With OSCER?

- Incorporate OSCER into the emerging Grid computing framework of the present and future HEP experiments.

- Near term plans are to use OSCER for Monte Carlo simulation production and analysis for DØ & ATLAS.

- In the longer term OSCER will be used for analysis of raw data.

How Will It Be Done?

- For efficiency and economy, will move on a large scale from a data production site centric model of organization to a hierarchal distributed model.

- Accomplish this by:
  - Developing and deploying Grid enabled tools and systems.
  - Organizing resources regionally.

Regional HEP Infrastructure

- DØ Southern Analysis Region
  - Provide GRID enabled software and computer resources to DØ collaboration
  - Provide regional technical support and coordination
- ATLAS Tier 2 Facility
  - Strong effort in progress to site such a facility in this region

Institutions Involved

- Cinvestav, Mexico
- Kansas State University
- Langston University
- Louisiana Tech University
- Rice University
- University of Arizona, Tucson, AZ
- Universidade Estadual Paulista, Brazil
- University of Kansas
- University of Oklahoma
- University of Texas at Arlington

DØ Remote Analysis Model

Central Analysis Center (CAC)

Fermilab

Regional Analysis Centers

RAC

RAC

Normal Interaction Communication Path

Occasional Interaction Communication Path

Institutional Analysis Centers

IAC

IAC

IAC

IAC

Desktop Analysis Stations

DAS

DAS

DAS

DAS

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Grid Hierarchy for LHC Experiments

Computing Hierarchy: The Tier Concept

The four experiments are committed to developing highly distributed data analysis infrastructures. These infrastructures are distributed both for technical reasons (e.g., to place computational and data resources near to demand) and for strategic reasons (e.g., to leverage existing technology investments). ATLAS and CMS are the most ambitious, anticipating a need for aggregate data rates of ~100 Gbytes/sec, around 60 TeraOps of fully utilized computing power, and the fastest feasible wide area networks, including several OC-48 links into CERN. Their hierarchical worldwide Data Grid system is organized in "Tiers," where Tier 0 is the central facility at CERN, Tier 1 is a national center, Tier 2 a center covering one region of a large country such as the US or a smaller country, Tier 3 a workgroup server, and Tier 4 the (thousands of) desktops (see figure).
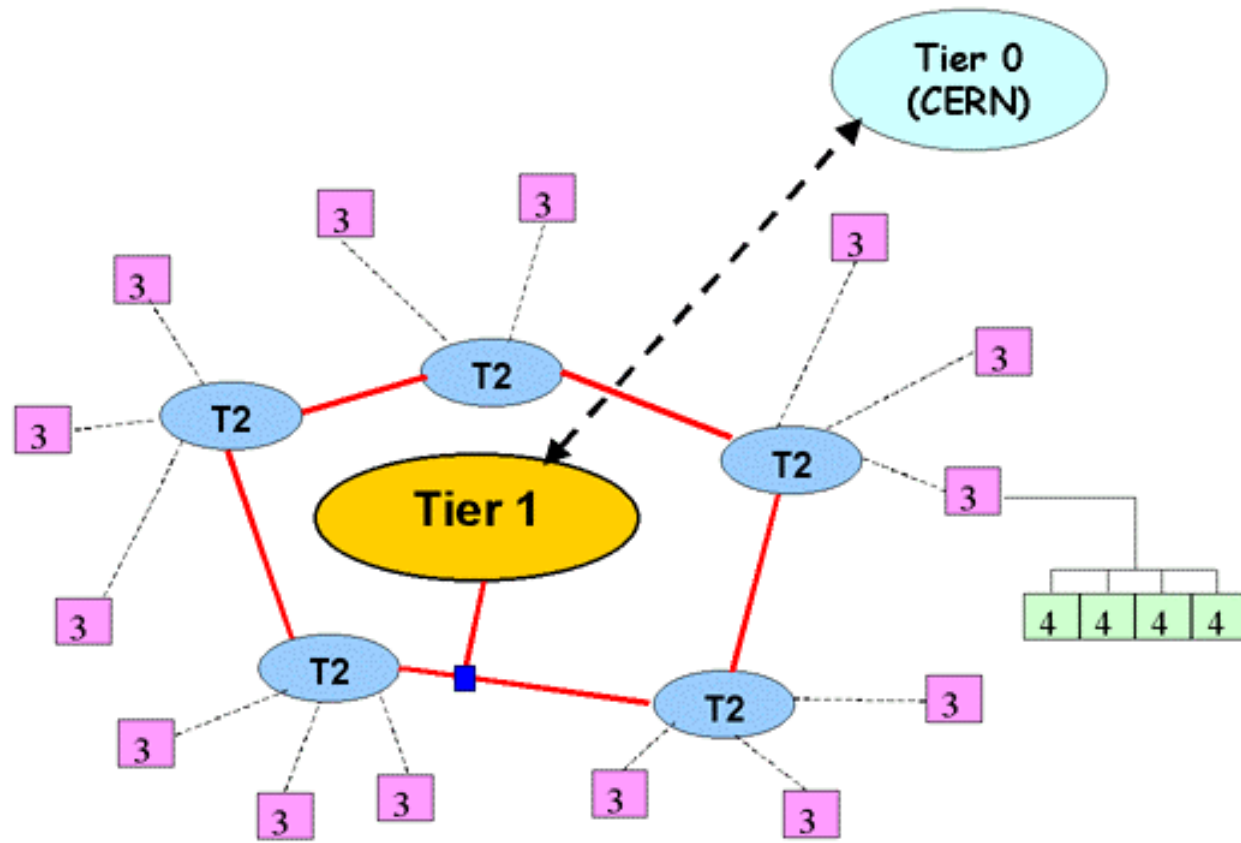

Figure 1: A hierarchical Grid for High Energy Physics. The hierarchy extends over 5 levels, from the central computing facilities at Tier 0 (CERN) to the Tier 4 desktops.

What We Are Now Doing

- Produce simulation data for DØ using:
  - Available Linux clusters at institutions (Not yet OSCER!)
  - Collaborator written code and standard HEP written libraries and packages
    - DØ code releases, mc_runjob, McFarm
- Store data and metadata in Fermilab's central data store via SAM over the network
  - **S**equential data **A**ccess via **M**eta-data
    - A file based data management and access layer between the Storage Management System and the data processing layers.
- While this a distributed computing model it is not multi-tiered and does not use standard Grid tools.

What We Are Now Doing

- Produce simulation data for ATLAS using:
  - Available Linux clusters at institutions (OSCER yes!)
  - Collaborator written code and standard HEP written libraries and packages.
    - Software system not yet as complicated and massive as DØ's.
- Job submission and data management done using standard Grid tools.
  - Globus, Condor-G
- Incomplete hierarchy, Tier 1 (BNL) and test sites.
- OUHEP assisted in the installation of Grid tools at OSCER to make this operational.

OSCER Deployment Difficulties

- DØ MC production not deployed on OSCER
  - High level McFarm management and bookkeeping system designed for dedicated cluster environment.
    - Root access for installation, running daemons for operations and external communications like SAM, limited to specific inter node communications protocols.
  - Not suited to OSCER's environment and purpose as a general purpose cluster.

Overcoming Deployment Problems

- Have SAM work with standard Grid tools.
  - SAMGrid software suite
    - Globus
    - Job and Information Management (JIM) broker
    - SAM
    - Condor/McFarm
- Have McFarm work on generic clusters.
  - Remove root dependencies, encapsulate daemon usage, allow flexible inter node communication.
  - Improve Grid interface.

Until Then…

- Work in progress to create a transitory McFarm environment within the confines of a PBS job on OSCER.

  - Testing inter node communication schemes allowable in OSCER for use with McFarm.

- Adapt McFarm in PBS environment to transfer data to the SAM station at OUHEP for conveyance to Fermilab.

Summary

- Large data sets and the need for massive computational resources make local resources like OSCER attractive to HEP.

- Successful production systems must be adapted to work on large generic clusters through standard Grid tools.

- OSCER staff and OU physicists working to bring OSCER online for DØ Monte Carlo production.

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