

LHC at CERN - Geneva, Switzerland

Fermilab - Batavia, Illinois

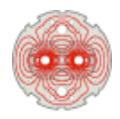
Plans for the US-CMS Remote Operations Center

LHC@FNAL

Erik Gottschalk Fermilab



Overview



- Remote operations for CMS & LHC
- What is LHC@FNAL?
- Planning
- Status
- Needs
- Summary

LHC@FNAL website:

http://cd-amr.fnal.gov/remop/remop.html



Goals for Joint CMS & LHC Remote Operations



- Build a dedicated remote operations center to support both CMS and LHC commissioning and operations.
 - Remote shifts for CMS
 - Enable CMS and LHC experts to access information in real time
 - Participate remotely in studies, commissioning, and operations
 - Training for CMS & LARP (LHC Accelerator Research Program)
- 2. Facilitate communication with CMS and LHC control rooms.
 - Call center in the US to help contact experts, answer questions.
 - Test collaboration tools to improve communication
- 3. Take advantage of a unique opportunity to have detector and accelerator experts working together to solve problems.
- 4. The *principal goal* is to enable people to participate in commissioning & operations when they are unable to travel (cost, family, visa issues, etc.).

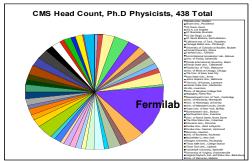


Remote Operations for US-CMS



The remote operations center will serve the US-CMS community.





There are nearly 50 US institutions in CMS and approximately 600 signing physicists/engineers/guest scientists in the US.

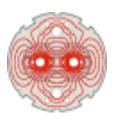
The LHC Physics Center (LPC) will provide a place in the US for physics/analysis discussions and meetings.

The LHC@FNAL remote operations center will provide a US hub for operations activities.

The goal is to provide a facility that will enable CMS collaborators to take remote shifts (for example, data-quality monitoring)



Remote operations for LHC



Remote operations center for LHC:

- provide training before going to CERN
- support LHC components built in US
- participate remotely in LHC studies
- access monitoring information
- develop software for LHC

LARP: The US LHC Accelerator Research Program (LARP) consists of four US laboratories, BNL, FNAL, LBNL and SLAC, who collaborate with CERN on the Large Hadron Collider (LHC).

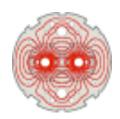
The LARP program enables U.S. accelerator specialists to take an active role in the LHC accelerator during its commissioning and operations, and to be a major collaborator in LHC performance upgrades.

CCC at CERN





What is LHC@FNAL?



A Place

- That provides access to information in a manner that is similar to what is available in control rooms at CERN
- Where members of the LHC community can participate remotely in LHC and CMS activities

A Communications Conduit

 Between CERN and members of the LHC community located in North America

An Outreach tool

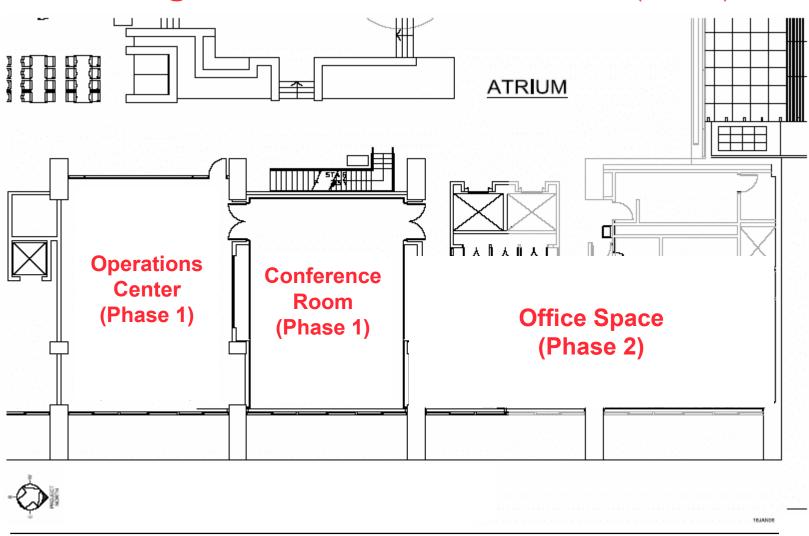
- Visitors will be able to see current LHC activities
- Visitors will be able to see how future international projects in particle physics (such as the ILC) can benefit from active participation in projects at remote locations.



LHC@FNAL Location & Layout



LHC@FNAL is located in Fermilab's Wilson Hall (1st floor)





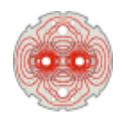
LHC@FNAL Construction Status







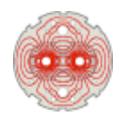
Planning for LHC@FNAL



- We formed a task force with members from all Fermilab divisions, university groups,
 CMS, LARP, and LHC. The advisory board had an even broader base.
- The LHC@FNAL task force developed a plan with input from many sources including CMS, LHC, CDF, D0, MINOS, MiniBoone and Fusion Energy Sciences (FES).
- We worked with CMS and US-CMS management, as well as members of LARP and the LHC machine group at all steps in the process.
- A detailed requirements document for LHC@FNAL was prepared and reviewed in 2005.
- We visited 9 sites (e.g. Hubble, NIF, ESOC) to find out how other projects build control rooms and do remote operations.
- We have a Collaboration Agreement between CERN and FNAL to work on LHC software development.
- We are engaged in construction, integration, software development and outreach activities. The CMS Remote Operations Center (ROC) is already in operation.
- The goal is to have LHC@FNAL ready for detector commissioning and startup of beam in 2007.
- We plan to work with the ILC controls group to develop plans for ILC remote operations.
- We hope to collaborate with the Fusion community (FES) to develop collaborative tools.
 Together we are exploring connections to OSG and other GRID projects.



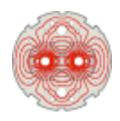
Current Status of LHC@FNAL



- Construction of a joint CMS and LHC remote operations center (LHC@FNAL) is nearing completion - Spring 2007
- LHC@FNAL Software (LAFS) development effort for LHC accelerator software has been successfully launched. This is a collaboration between CERN and Fermilab.
- Software development for LHC, CMS, ILC:
 - 1. Role Based Access for LHC (RBA)
 - 2. LHC Sequencer
 - 3. Sequenced Data Acquisition (SDA)
 - 4. Screen Snapshot Service (SSS)
 - 5. Identity Database (IDDB)
 - 6. LHC Beam Instrumentation Software
 - 7. Electronic Logbook for ILC



Role Based Access (RBA)



An approach to restrict system access to authorized users.

What is a ROLE?

- A role is a job function within an organization.
- Examples: LHC Operator, SPS Operator, RF Expert, PC Expert, Developer, ...
- A role is a set of access permissions for a device class/property group
- · Roles are defined by the security policy
- A user may assume several roles

What is being ACCESSED?

- Physical devices (power converters, collimators, quadrupoles, etc.)
- Logical devices (emittance, state variable)

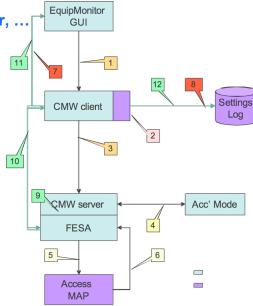
What type of ACCESS?

- · Read: the value of a device once
- Monitor: the device continuously
- · Write/set: the value of a device

Requirements have been written

- Authentication
- Authorization

Status: Code development in progress

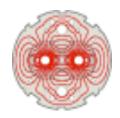


The software infrastructure for RBA is <u>crucial</u> for remote operations. Permissions can be setup to allow experts outside the control room to <u>read or monitor a device safely</u>.

This is a CERN/Fermilab collaboration working on RBA for the LHC control system.



Screen Snapshot Service (SSS)



An approach to provide a snapshot of a graphical interface to remote users.

What is a snapshot?

- An image copy of a graphical user interface at a particular instance in time.
- Examples: DAQ system buffer display, operator control program, ...
- · A view-only image, so there is no danger of accidental user input.
- Initially envisioned for application GUIs but could be expanded to desktops.

What is the role of the service?

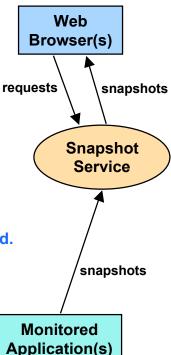
- Receives and tracks the snapshots from the monitored applications.
- Caches the snapshots for short periods of time.
- Serves the snapshots to requesting applications/users.
- Prevents access from unauthorized applications/users.
- Acts as a gateway to private network applications for public network users.

How will this work?

- Applications capture and send snapshots to the service provider in the background.
- · Users would access snapshots using a web browser.

Status:

- The capturing of snapshots from Java applications has been demonstrated.
- The transfer of snapshots is being investigated.



SSS is being developed at Fermilab for CMS, and may be applicable to the LHC.



Future Capabilities for HEP



Although we are making good progress on the development of remote operations capabilities for high-energy physics (HEP), there is <u>room for improvement</u>. Better collaborative tools will contribute significantly to our ability to participate in LHC, and plan for the International Linear Collider (ILC).

We can benefit from improved communications tools by

- exploiting convergence of telecom and internet technologies (e.g. SIP),
- deploying integrated communications (voice, video, messaging, email, data)
- and advanced directory services for identification, location and scheduling.

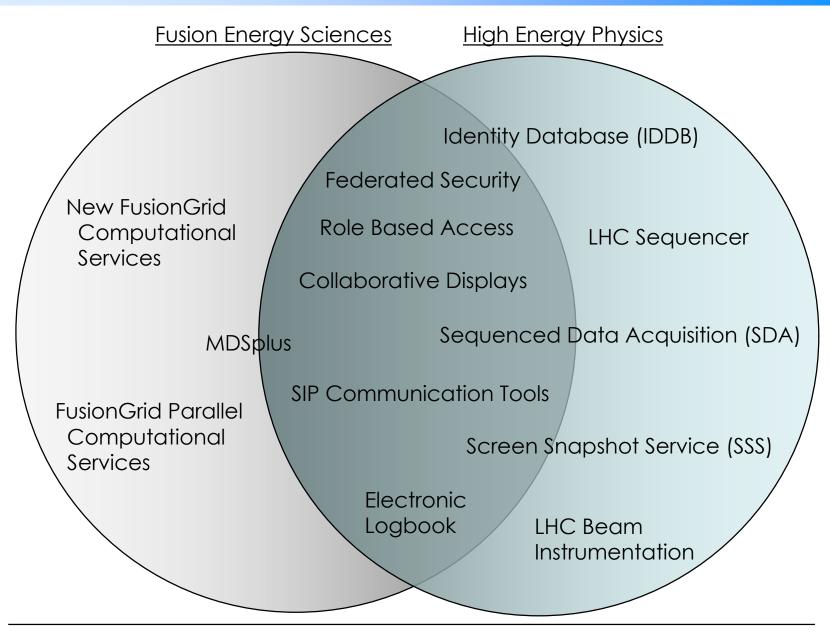
We can benefit from a true collaborative control room by

deploying distributed, shared display walls for remote collaborative visualization.

We can benefit from security enhancements (role-aware & easier-to-use security).

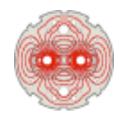
Some of these needs are already being addressed by Fusion (FES) community.

Substantial Overlap Between FES and HEP Needs





Summary



- The goals of LHC@FNAL are to support both CMS and LHC commissioning and operations, and to take advantage of an opportunity to have detector and accelerator experts work together.
- The LHC@FNAL remote operations center is under construction, and will be completed by Spring 2007.
- A collaborative effort between CERN and Fermilab to develop LHC accelerator software has been successfully launched.
- There is an urgent need for better collaborative tools to improve our ability to work on the LHC.
- There is substantial overlap between the needs for High Energy Physics (HEP) and Fusion Energy Sciences (FES) for collaborative tools.



Additional Slides





Site Visits



- Technology Research, Education, and Commercialization Center (TRECC) West Chicago, Illinois (Aug. 25, 2005)
- Gemini Project remote control room Hilo, Hawaii (Sept. 20, 2005)
 - http://docdb.fnal.gov/CMS-public/DocDB/ShowDocument?docid=425
- Jefferson Lab control room Newport News, Virginia (Sept. 27, 2005)
 - http://docdb.fnal.gov/CMS-public/DocDB/ShowDocument?docid=505
- Hubble Space Telescope & STScl Baltimore, Maryland (Oct. 25, 2005)
- National Ignition Facility Livermore, California (Oct. 27, 2005)
 - http://docdb.fnal.gov/CMS-public/DocDB/ShowDocument?docid=532
- General Atomics San Diego, California (Oct. 28, 2005)
- Spallation Neutron Source Oak Ridge, Tennessee (Nov. 15, 2005)
 - http://docdb.fnal.gov/CMS-public/DocDB/ShowDocument?docid=570
- Advanced Photon Source Argonne, Illinois (Nov. 17, 2005)
- European Space Operations Centre Darmstadt, Germany (Dec. 7, 2005)
 - http://docdb.fnal.gov/CMS-public/DocDB/ShowDocument?docid=622



LHC Sequencer



Automates the very complex sequence of operations required to operate the LHC.

Typical commands

- Set, get, check devices
- Wait for conditions
- Execute more complex operations
- Start regular programs
- Start plots
- Send data to shot log

Step through commands

- Stops on error
- Allow restart at failed command

Sequencer is used for:

- Normal operations
- Studies or special cases

Working with CERN on requirements

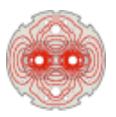
- Explore existing implementations:
 FNAL, LEP, RHIC, NIF, HERA, SMI++
- http://cd-amr.fnal.gov/remop/Sequencer.htm

LHC State Diagram Stable Beams Pre-Injection Sudden degradation Rampdown OP request / PELP all PCS OP mode change Unstable Beams Slow degradation Injection Plateau -No beam Adjust Recover OP request OP request Ready for Pilot beam Saueeze Injection request OP request Beam Dump Warning Flat Top Circulating Pilot End Ramp Ready For Ramping Intermediate Injection request Send Ramp Timing Cimulating Readvito NB: All transitions to "Beam Dump Fired" Intermediate ramp supressed for the sake of clarity. Can clear go there from anywhere. Prepare Ready For Nominal ramp Injection Sequence Filling nominal Reinject Pilot for Circulating Nominal **Nominal**

This is a CERN/Fermilab collaboration working on the LHC Sequencer.



Sequenced Data Acquisition (SDA)



SDA is a software system for collecting, storing and analyzing data in terms of the stages of a complex process.

SDA₁

- 1st version of SDA developed for FNAL Run II
- Provides consistent and accurate data from the Fermilab accelerator complex
- Used by operators, physicists, engineers, DOE

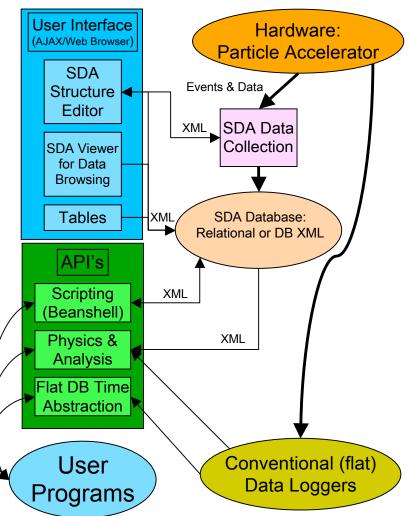
SDA₂

- 2nd version of SDA being developed
- Improved SDA for FNAL
- Development is ~90% completed

SDA 2 for LHC

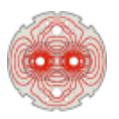
- Need to establish requirements for LHC with CERN
- "SDA Workshop" on Nov. 16 at CERN

This is a CERN/Fermilab collaboration.





Identity Database (IDDB)



A lightweight user authentication framework.

Motivation

In order to enable access control in software applications, users need to be properly authenticated. This requires a security infrastructure that maintains user accounts, permissions, and has access to log files. A typical developer usually does not have enough time and expertise to implement and maintain a security infrastructure.

Identity Database

A solution that targets small- and medium-scale applications, both standalone and web-based, such as programs for data analysis, web portals, and electronic logbooks.

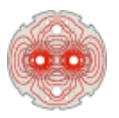
Features

- Includes database, application programming interface (API), and web-based user interface for management.
- A single IDDB instance can be shared by multiple programs/systems.
- A single user can be identified by several different types of credentials: username + password, Kerberos, X.509 certificates, IP address
- Access permissions are described by roles, and roles are assigned to users.
- Each application can have its own set of roles, which are managed independently.

IDDB is being developed at Fermilab for an electronic logbook for ILC.



LHC Beam Instrumentation Software



Dedicated applications for LHC beam instrumentation need to be written.

- Tune measurement (including coupling, chromaticity, etc.)
- · Wire scanners, synchrotron radiation monitors, etc.

The LHC@FNAL Software (LAFS) team will begin by writing the high-level application software for the LHC tune measurement system by providing panels for device configuration/setup and measurement displays:

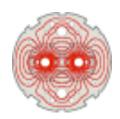
- FFT measurement
- Continuous FFT
- Tune PLL
- · Chromaticity measurement
- Tune feedback
- Coupling feedback



This is a CERN/Fermilab collaboration working on LHC beam instrumentation software.



Some assumptions (CMS operations)



For CMS

- CMS will have a shift schedule, a run plan, and a protocol that defines responsibilities and roles of shift personnel. We assume that a shift leader is responsible for CMS shift activities.
- LHC@FNAL will have shift operators who will be able to assist US-CMS collaborators with CMS activities during commissioning and operations.
- LHC@FNAL will participate in CMS shifts. Neither the duration nor the frequency of the LHC@FNAL shifts
 has been determined.
- The CMS Collaboration will have a protocol for access to the CMS control system (PVSS), and a policy for how access to the control system will vary depending on the physical location of an individual user.
- The CMS Collaboration will have a policy that defines how DAQ resources are allocated. This includes allocation of DAQ resources to various detector groups for calibration and testing.
- The CMS Collaboration will have a protocol that defines how on-demand video conferencing will be used in CMS control rooms and LHC@FNAL.
- The CMS Collaboration will provide web access to electronic logbook and monitoring information to collaborators worldwide
- The CMS Collaboration will maintain a call tree that lists on-call experts worldwide for each CMS subsystem during commissioning and operations

For both CMS & LHC

LHC@FNAL will comply with all CERN and Fermilab safety and security standards.