CMS Computing at FNAL

Hans Wenzel Fermilab

- Introduction
- CMS: What's on the floor, How we got there.
- Near term plans.

Introduction

- CMS is an experiment in construction for the LHC, first data expected in 2006
- Until then computing at FNAL provides:
- Monte Carlo Production (Trigger + physics TDR) in distributed evironment.
- Host and serve the data
- Provide computing and development platform for physicist (code, disk .....)

Our Web sites

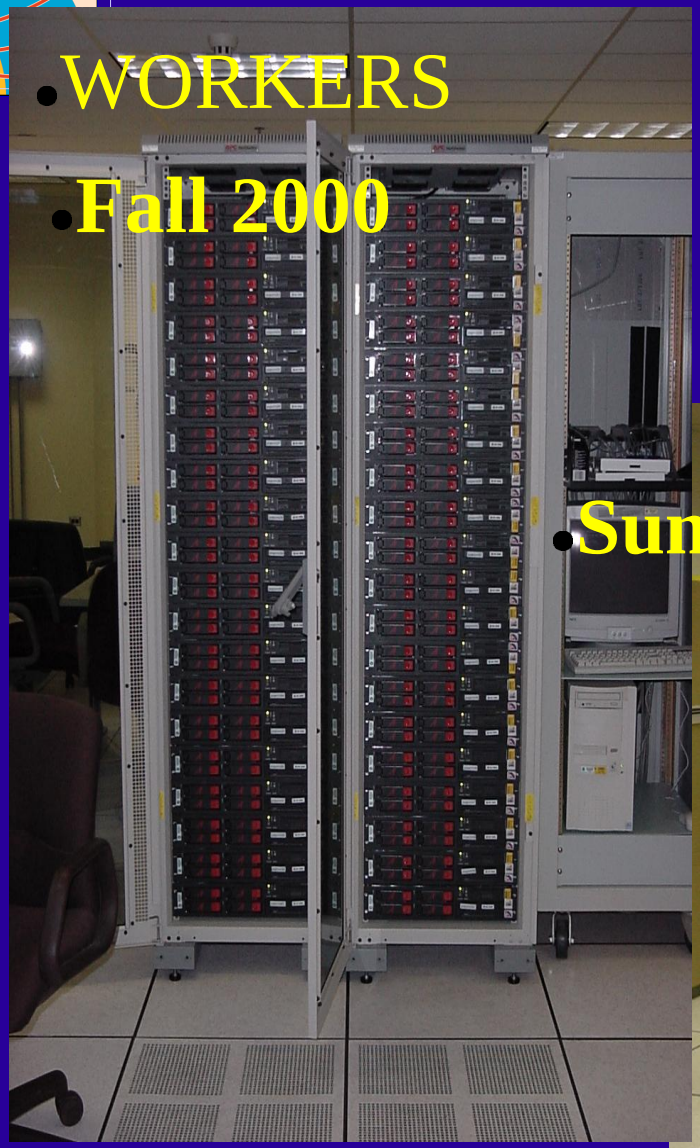
- Monitoring page, links to tools and scripts
  http://computing.fnal.gov/cms/Monitor/cms_production.html
- **Department web site:** http://computing.fnal.gov/cms

The CMS dpartment

- New department, most people hired over the last 18month
- Same is true for the hardware I will give an historical overview

+ the desktop PC's:

- WORKERS
- **Fall 2000**

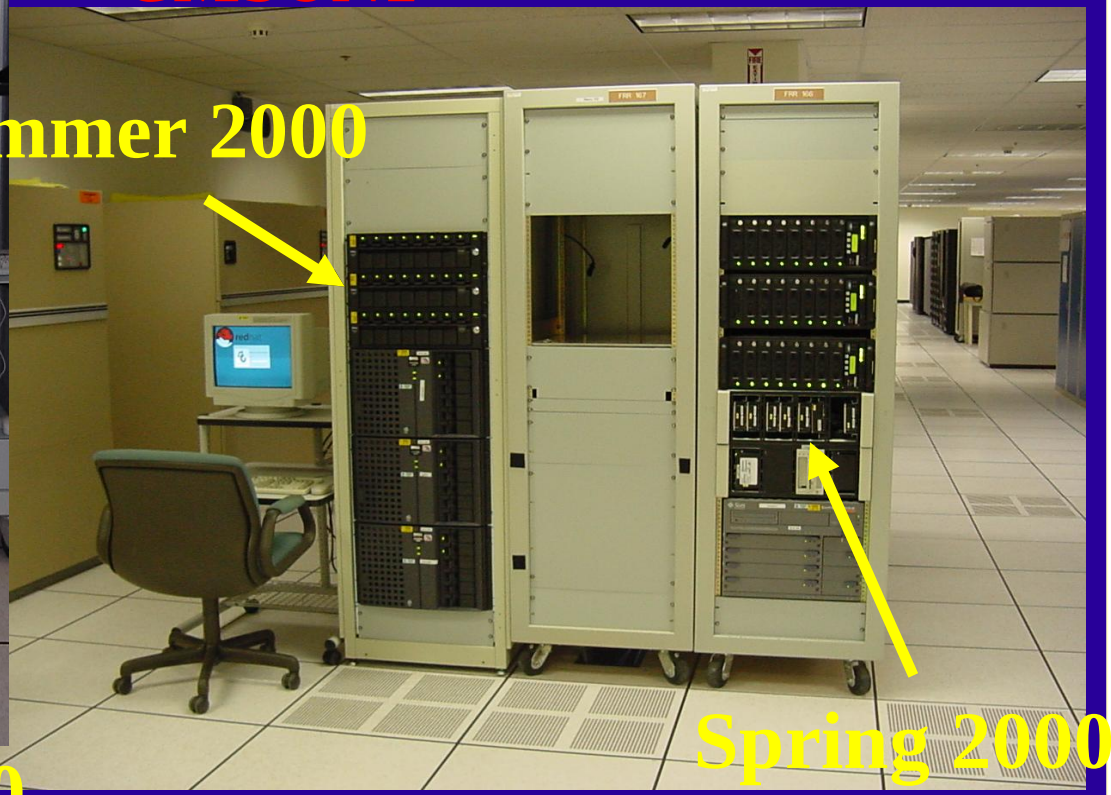


Popcrn01 – popcrn40

SERVERS:

GALLO,WONDER,VELVEETA, CMSUN1

- **Summer 2000**



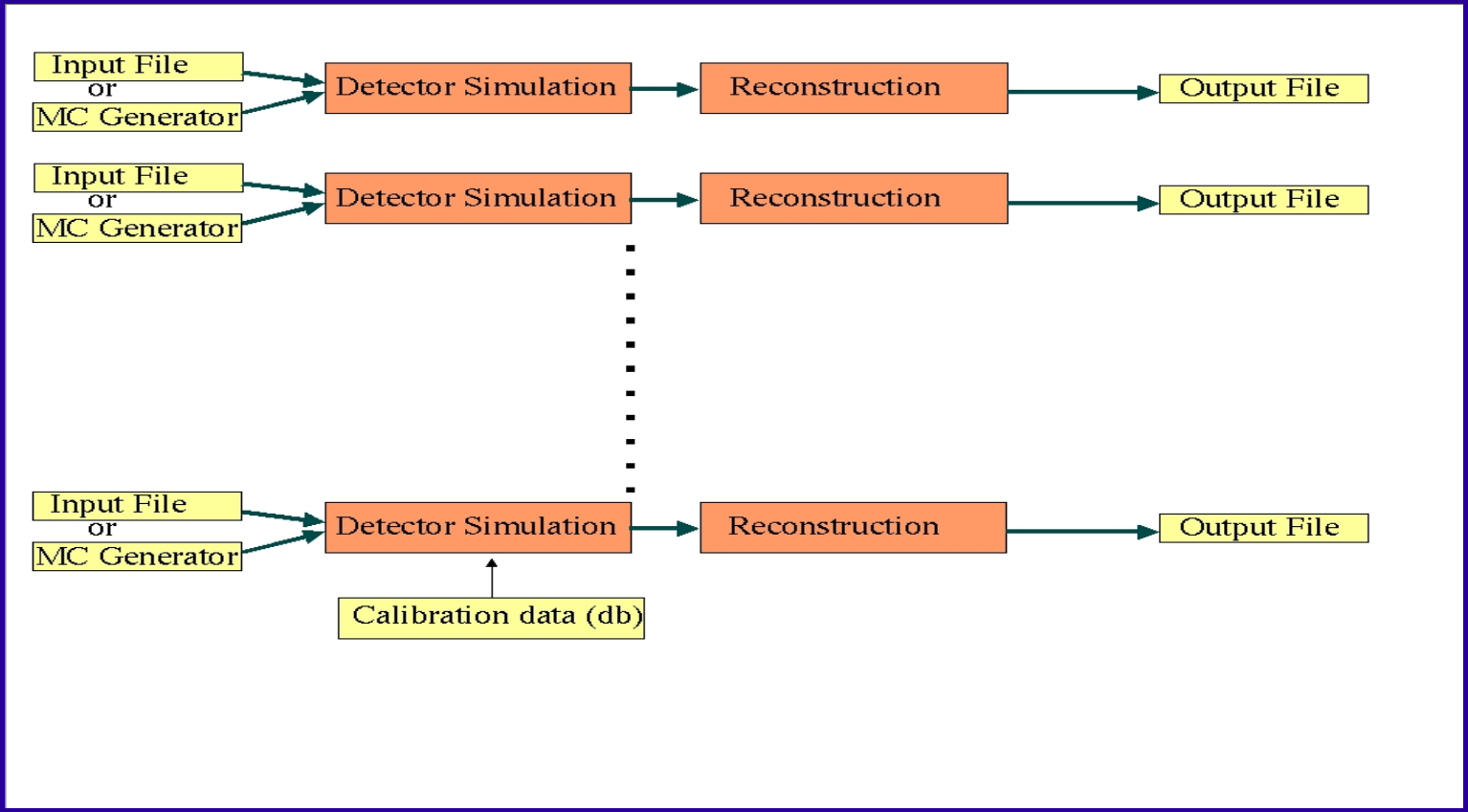
Spring 2000

Hardware and software used in Production

- 2 Dell Servers with 4 Pentium CPU's. GALLO is the IO node of the FARM and VELVEETA is the Objectivity Database host. Each has > 200 Gbyte raid attached.
- 40 dual CPU (popcrn01−popcrn40). For Digis production 10 are used as pile up server leaving the other 30 (60 CPU's) as worker nodes. Currently we have a sample of 500 000 minimum bias events.
- STK robot (enstore)−−> tapes are made by the devil (pure evil)
- FBSNG batch system −−> can only recommend

Think about production!

Classic way:



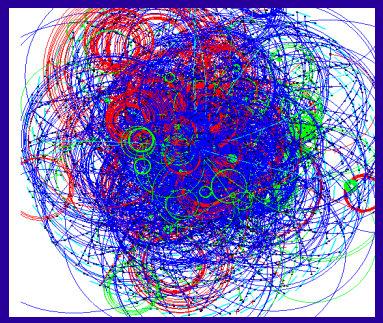
easy to do: linux farm with batch system,
very robust the processes don't care about each other, if the node or the process dies you run it again!

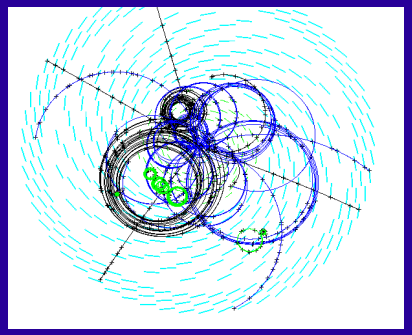
CMS Major Challenge: Pile up

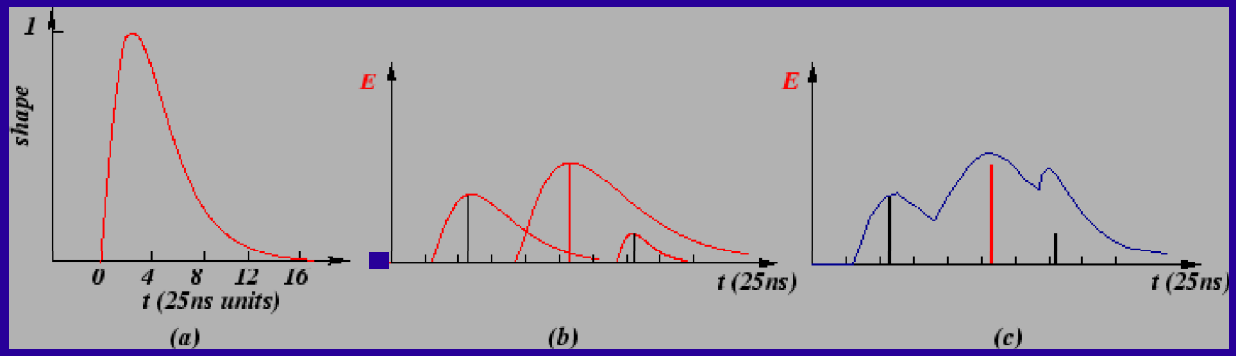
- Events are big (raw event is 2MB)
- Detector digitization has to take into account multiple crossings
  - ➔Pileup: @ 10^{34} = 17 minimum bias events/crossing
  - ➔Calorimetry needs -5 to +3 crossings
  - ➔Muon DT ought to have +- 10 crossings
  - ➔Tracker loopers can persist for many crossings
  - ➔Typically need information from ~200 mb events for each signal event
- Study at different luminosities infers different pileup
  - ➔Therefore not sensible to include pileup in simulation but in digitization (front end of reconstruction)
- Track finding in very complex environment
- High magnetic field and ~1 rad length of tracker material:
  - ➔Lots of bremstrahlung for the electrons,
  - ➔TK-ECAL matching non-trivial

Digitisation and Pileup

- High luminosity -> 17 minimum bias events in one bunchcrossing
- Overlay crossings -5 to +3
- 200 min.bias for 1 signal event
- ”recycle” min.bias events







Pileup

- Solution is to sample a finite number pseudo−randomly
- Problems can come when one single mb event by itself would trigger the detector
  - You would get this trigger many many times
  - Filter the minimum bias events, but remember to take into account the removed events
  - must sample from full range of mb events to ensure patterns do not repeat too often
- If you need 1 Million Signal events you would need 200 million minimum bias events
  - Impossible with current CPU, storage etc
- 200mb events = 70MB
  - massive data movement problem

OODigis

Currently

OOHit Data

GALLO

VELVEETA

Pile up

Popcr31

Popcrn32

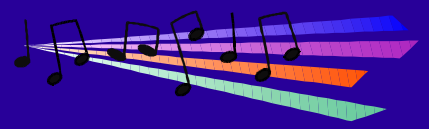
Popcrn01

Popcrn40

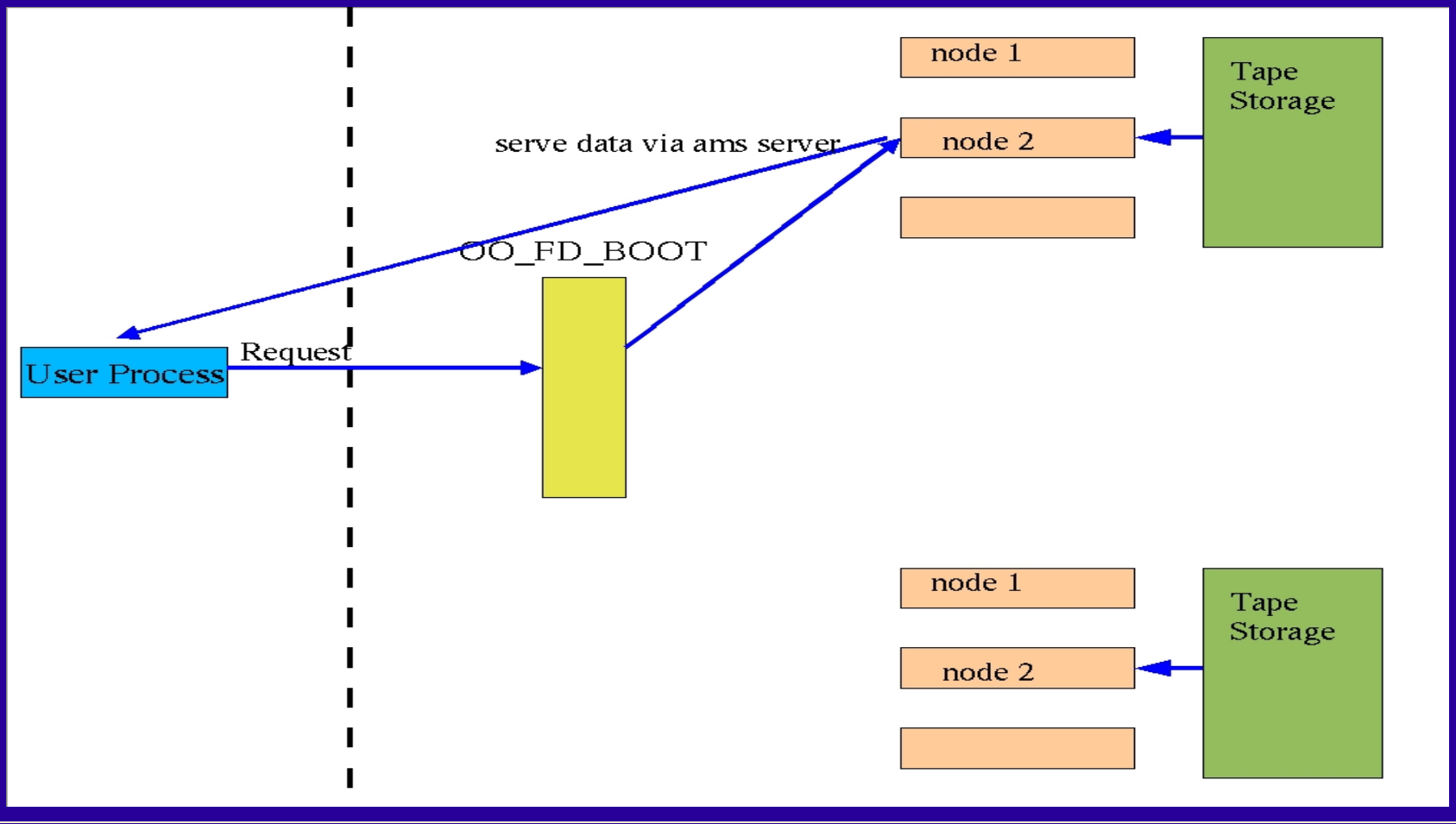
Popcrn30

AMS Servers on
popcrn31−popcrn40
(pile up servers)
GALLO (data server)
VELVEETA (DB host)

Every one talks to everyone



User access to the data in Objectivity



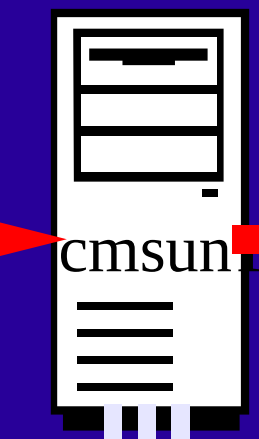
User access to FNAL Objectivity data:

AMD server
AMD/Enstore interface

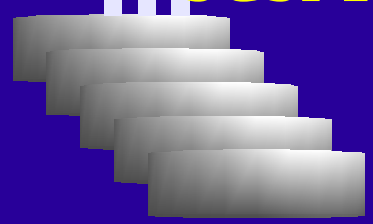
Enstore
STKEN
Silo

> 10 TB

No disk cache (yet)



SCSI 160



RAID 250 GB

Network

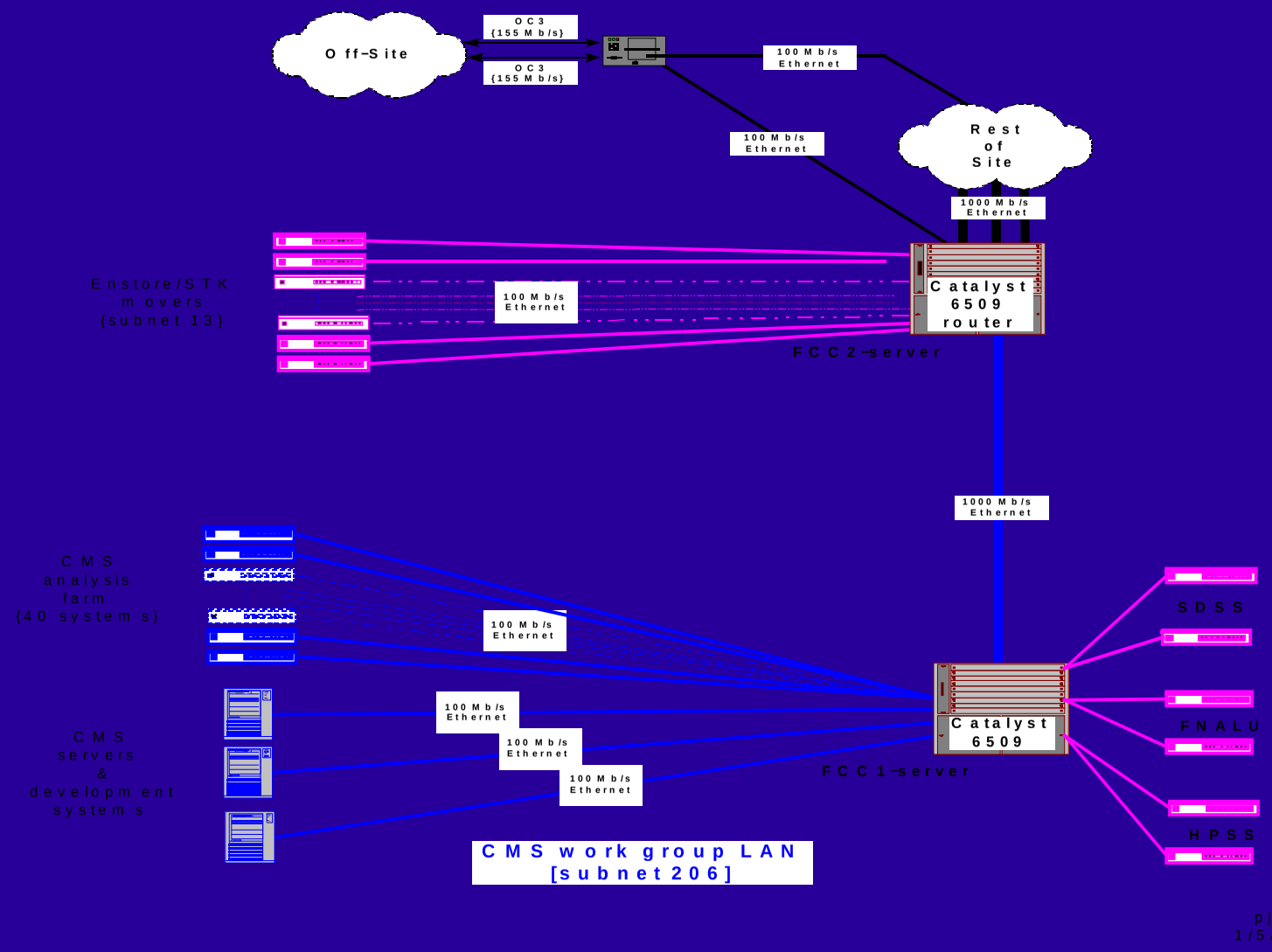
Objects

Users in:
Wisconsin
CERN
FNAL
Texas

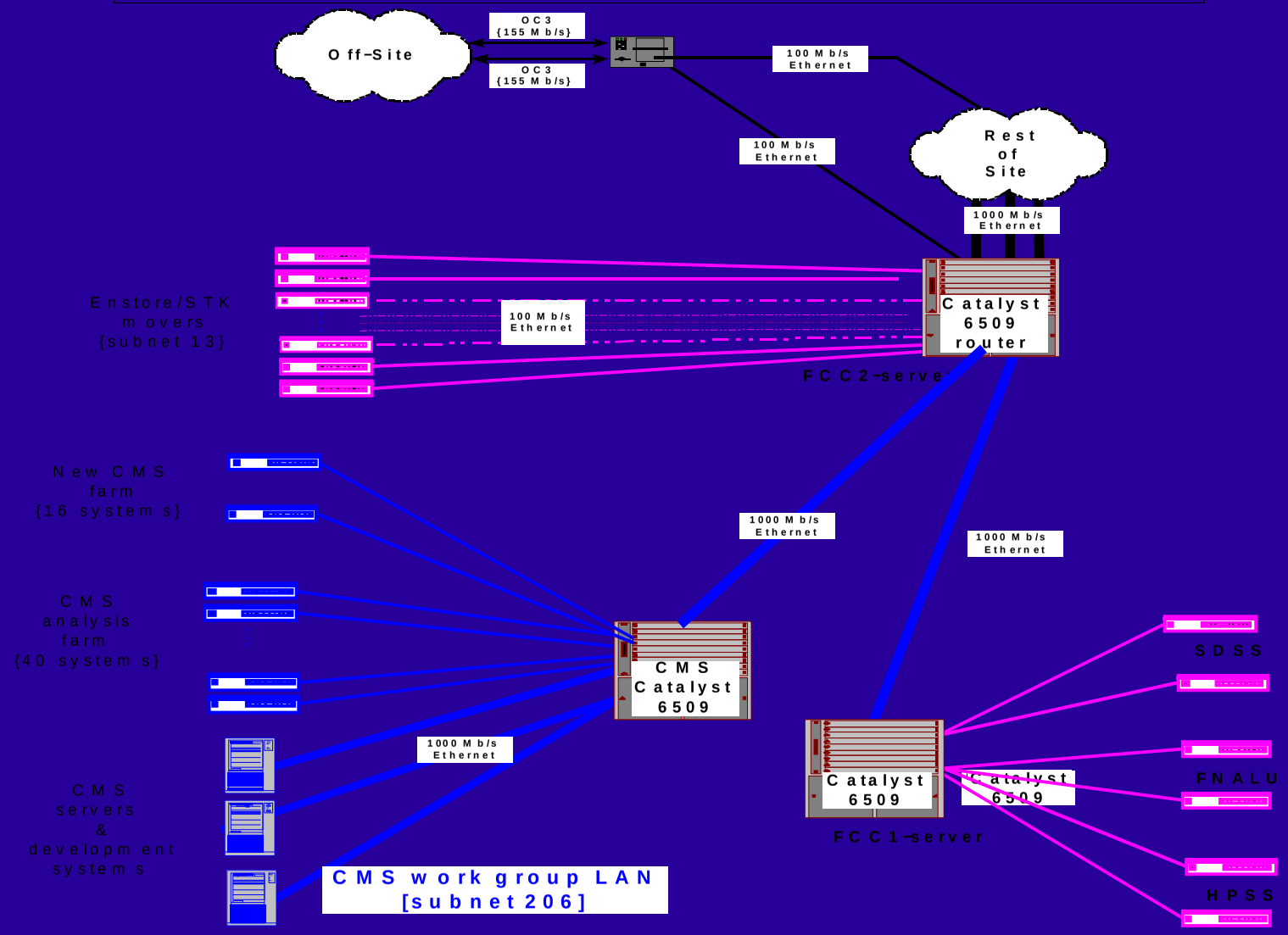
Host redirection protocol allows to add more servers
−−> scaling+ load balancing

Upgrades in 2001

Current Networking



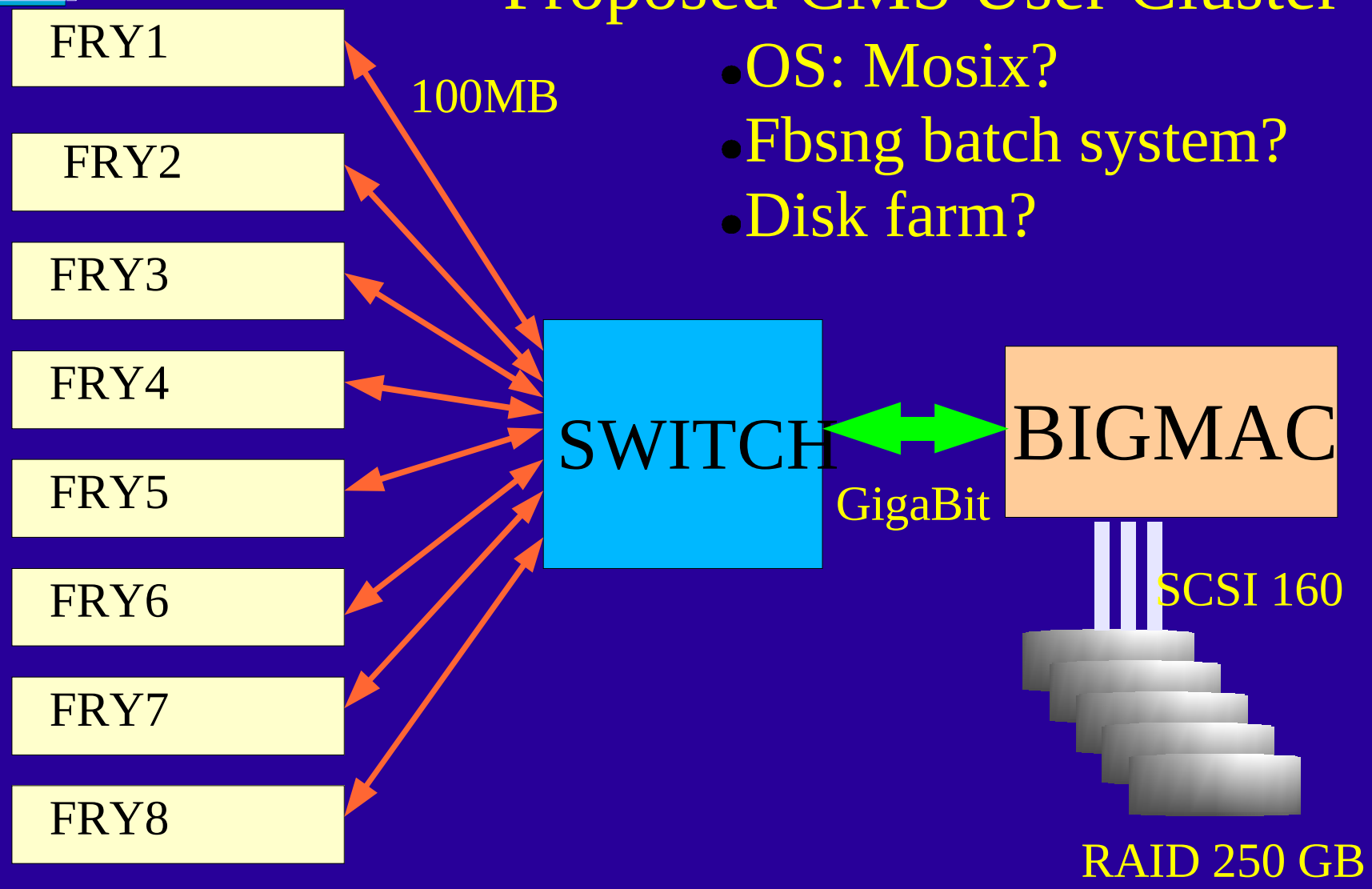
Upgraded Networking



Fall 2001

Near term plan

- Testing and benchmarking of raid arrays
- Build up a User analysis cluster:
  - load balancing
  - cheap
  - expendable
  - easy central login
  - transparent access to disks
  - make plenty of local disks globally available.....

Proposed CMS User Cluster

- OS: Mosix?
- Fbsng batch system?
- Disk farm?