Grid Computing at VECC-SINP for ALICE

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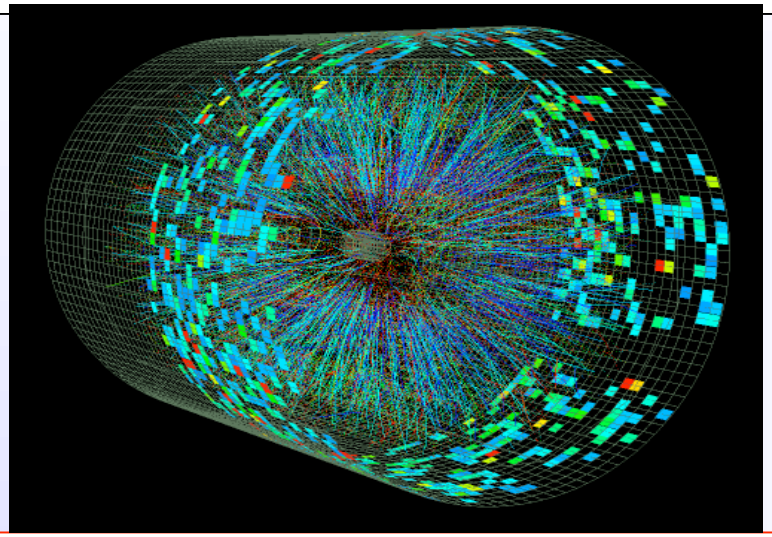
Future Outlook (STAR)



- **Rich physics still on tape: Half of year 4 Au+Au, 80% of year 5 Cu+Cu statistics still to be processed**
- Future runs:
  - Full EMC barrel installed and ready for use for triggered data over 2 units in h
  - Full barrel TOF upgrade for identified correlations, resonances, electrons
  - DAQ1000 upgrade of DAQ to remove deadtime, increase dataset size
  - Forward Meson Spectrometer upgrade for definitive measurements on CGC
  - Heavy Flavor Tracker for definitive measurements of open charm

What is Grid

In Layman language:-

Grid is a Mesh consists of different things. According to application things changes Like:-

For Power Grid : Things are Electrical Component

For Computer Grid: Things are Different Computer Equipment

In Computer Language:-

A “Grid” is a set of resources Computers, networks, storage devices, and others tied together by a common set of ubiquitous distributed services.

In Our (CERN) Language:-

Grid is a type of parallel and distributed system that enables the sharing, selection, and aggregation of geographically distributed "autonomous" resources dynamically at runtime depending on their availability, capability, performance, cost, and users' quality-of-service requirements.

Grid Computing: A Conceptual View

Difference between Grid and Cluster

Cluster

Local
Homogenous
Within Organization
Intranet Like

Grid

Global
Heterogeneous
Over Organizations
Internet Like

Grid is extension of Cluster

and logical extension to the web.

www(web) is accessing Information across the Globe whereas Grid is accessing Computing across the Globe

Broad Definition

Now we can say that:

The Grid is not only a computing infrastructure, for large applications, it is a technology that can bond and unify remote and diverse distributed resources ranging from meteorological sensors to data vaults, and from parallel supercomputers to personal digital organizers.

As such, it will provide services to all users that need them.

GRID APPLICATIONS

Scientific Applications

Distributed Supercomputing (Stellar Dynamics)
High-throughput Computing (Parametric Studies)
On-demand (Smart Instruments)
Data Intensive (Data mining)
Data Exploration
Collaborative Engineering (Collaborative Design)
High energy physics

Different Application:

Molecular modeling for drug design
Brain activity analysis
Analogous to electric power network(Grid)
Nuclear Simulations
Environmental Studies
Astrophysics etc

Why GRID for ALICE

What is GRID computing?

Grids enable the sharing, selection, and aggregation of a wide variety of geographically distributed computational resources (such as supercomputers, computing clusters, storage systems, data sources, instruments, people) and presents them as a single, unified resource for solving large-scale compute and data intensive computing applications.

The emphasis is on :

Distributed supercomputing
High throughput & data intensive applications.
Large scale storage
High speed network connectivity

Why ALICE is interested in GRID?

1 year of Pb-Pb running: 1 Pbytes of data
1 year of p-p running : 1 Pbytes of data
Simulations : 2 PBytes
Total Data storage: 4 Pbtyes/year

ALICE computing requirements:

Simulations, Data reconstruction & analysis will use about 10,000 PC-years.

Data GRID is the solution for ALICE

Connect high performance computers from all collaborating countries with a high speed secured network. Implement one virtual environment that is easy for the "end user''.

Data Grid

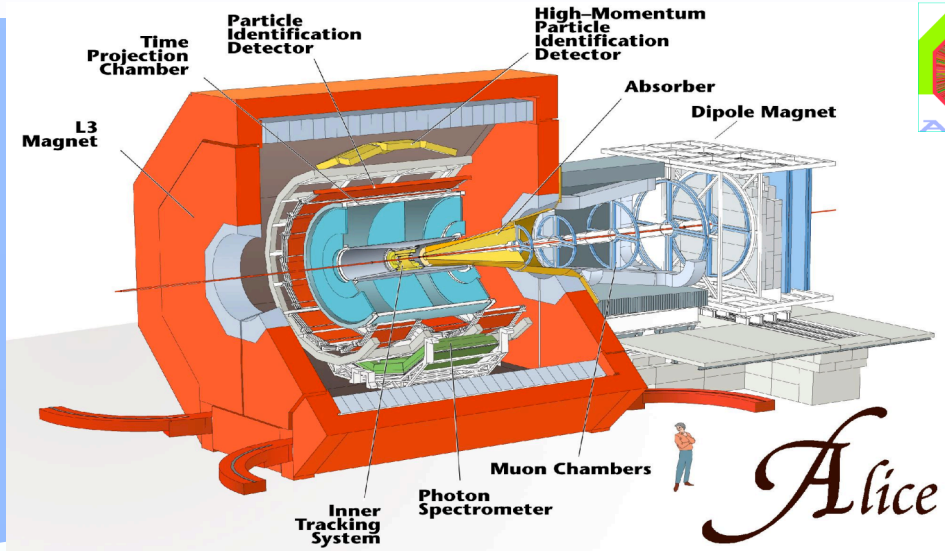
Data Grid is used for Applications which requires Data Intensive Computing and enable a Geographically distributed community to pool their resources to perform computationally intensive analyses on Petabytes (**10^{15}**) of data.

Current Data Grid Projects

	Project	Organization	Comment
1.	Earth System Grid	LLNL, ANL and NCAR	Climate Modeling
2.	European Data Grid	CERN	High Energy Physics Earth Observation
3.	GriPhyN (Grid Physics Network)	UCF and ANL	High Energy Physics
4.	PPDG Particle Physics Data Grid	Caltech and ANL	High Energy Physics
5.	HEPGrid Physics	Melbourne University	High Energy

Grid Project at ALICE

LHC Computing Model is Multi-Tier Hierarchical Model based on Data Grid technology.



ALICE Collaboration

- ~ 1/2 ATLAS, CMS, ~ 2x LHCb
- ~1000 people, 30 countries, ~ 80 Institutes

Total weight	**10,000t**
Overall diameter	**16.00m**
Overall length	**25m**
Magnetic Field	**0.4Tesla**

8 kHz (160 GB/sec)

level 0 - special hardware

200 Hz (4 GB/sec)

level 1 - embedded processors

30 Hz (2.5 GB/sec)

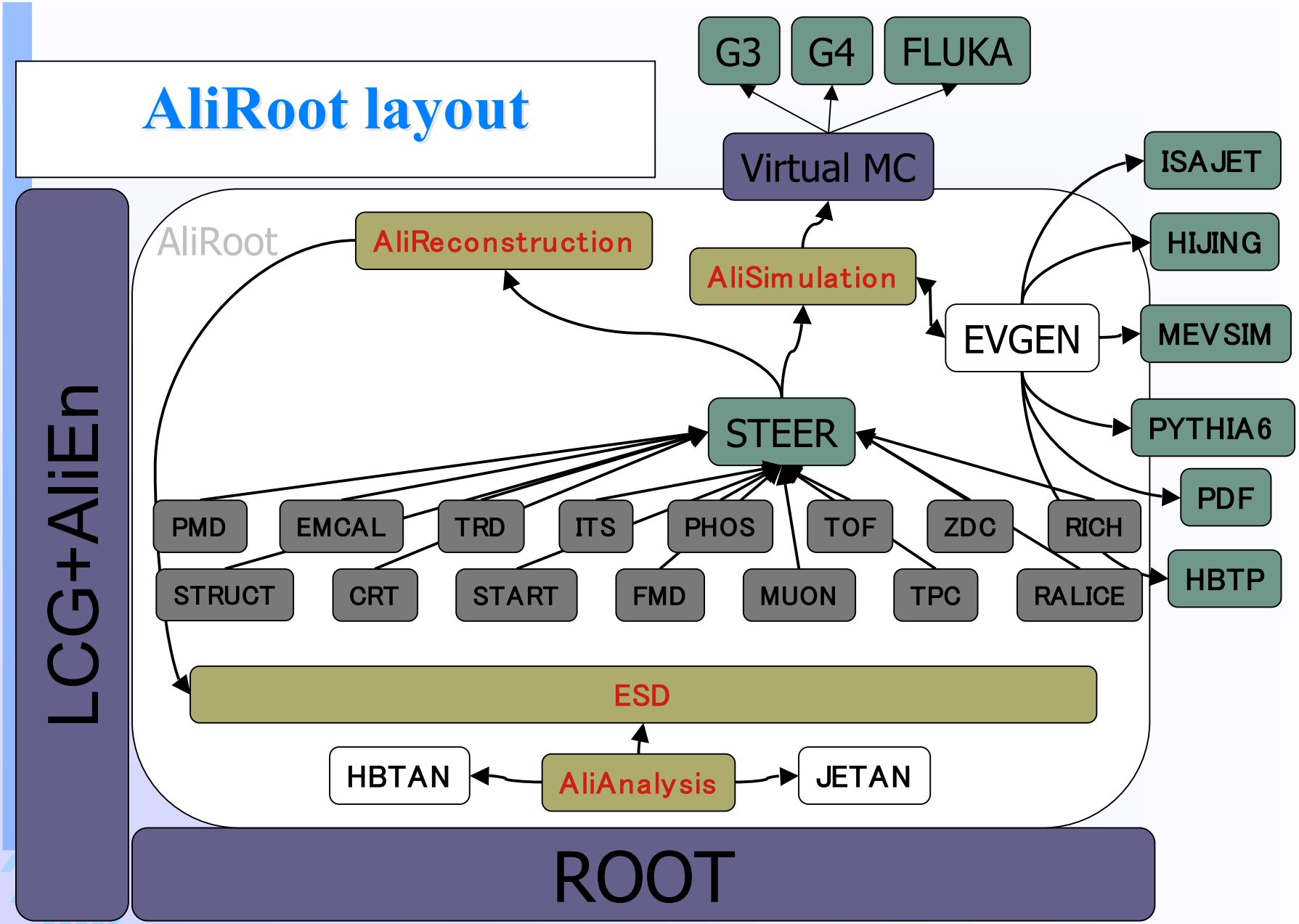
level 2 - PCs

30 Hz

(1.25 GB/sec)

data recording & offline analysis

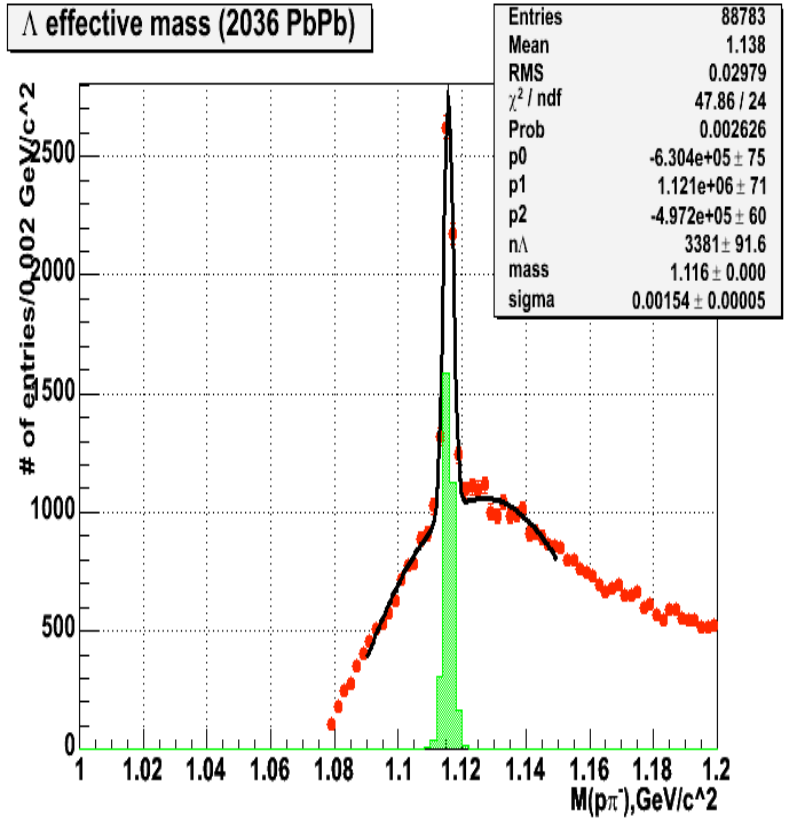
AliRoot layout

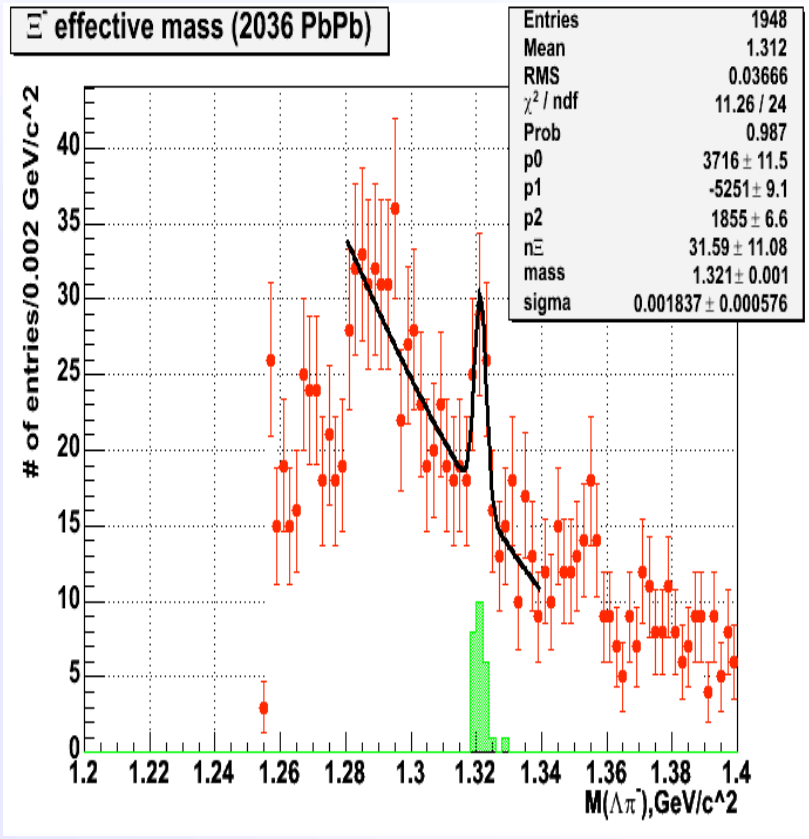


AliRoot: Current Status

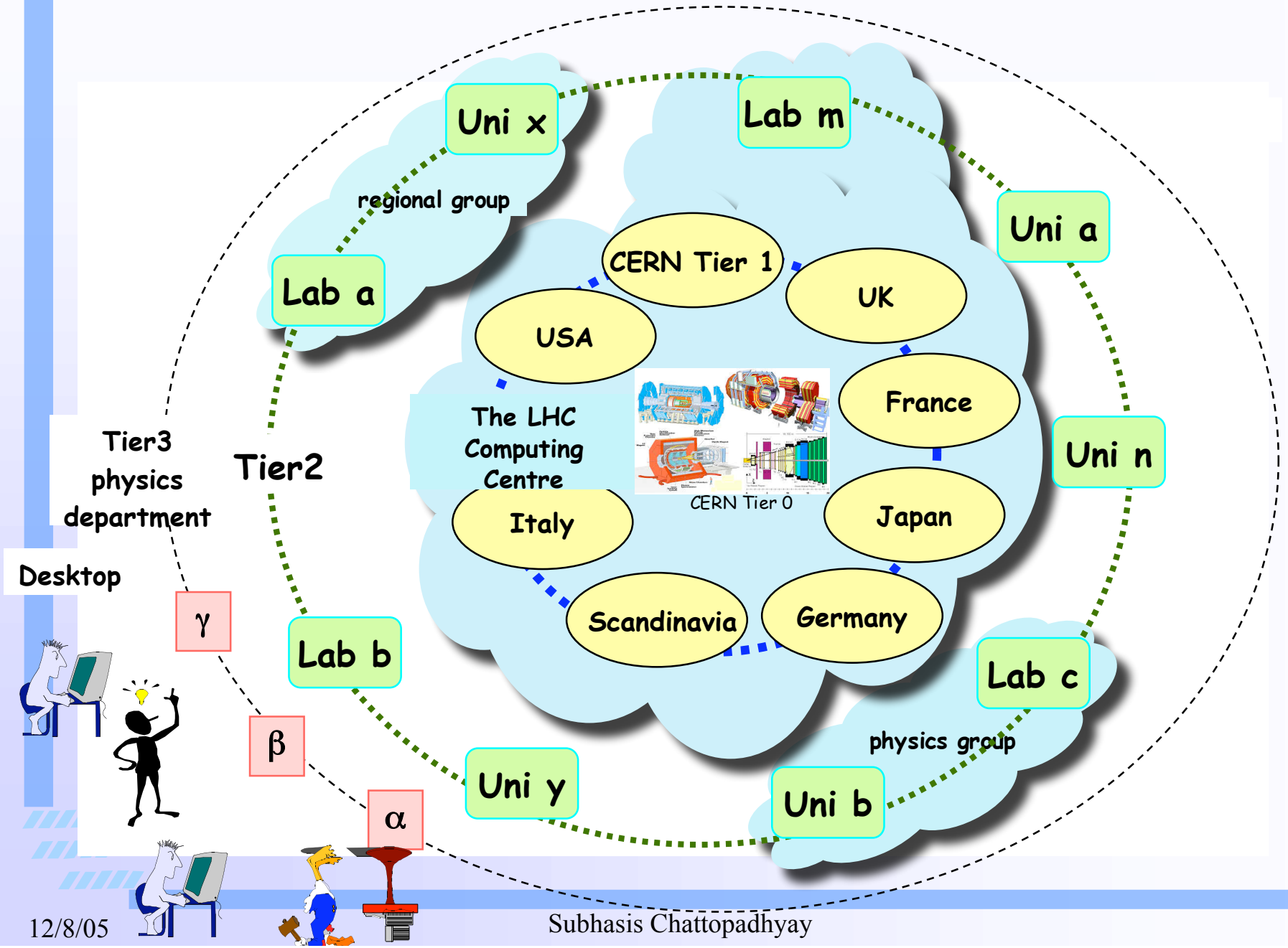
- Up-to-date description of ALICE detectors
  - TGeo
- Rich set of event generators, easily extensible
- Possibility to use different transport packages
  - VMC
- User friendly steering classes for simulation and reconstruction
- Efficient track reconstruction
- Combined PID based on Bayesian approach
- ESD classes for analysis and fine-tune calibration
- Analysis examples to explore wide spectrum of heavy-ion and pp physics

$\Xi \rightarrow \pi\Lambda \rightarrow p\pi$





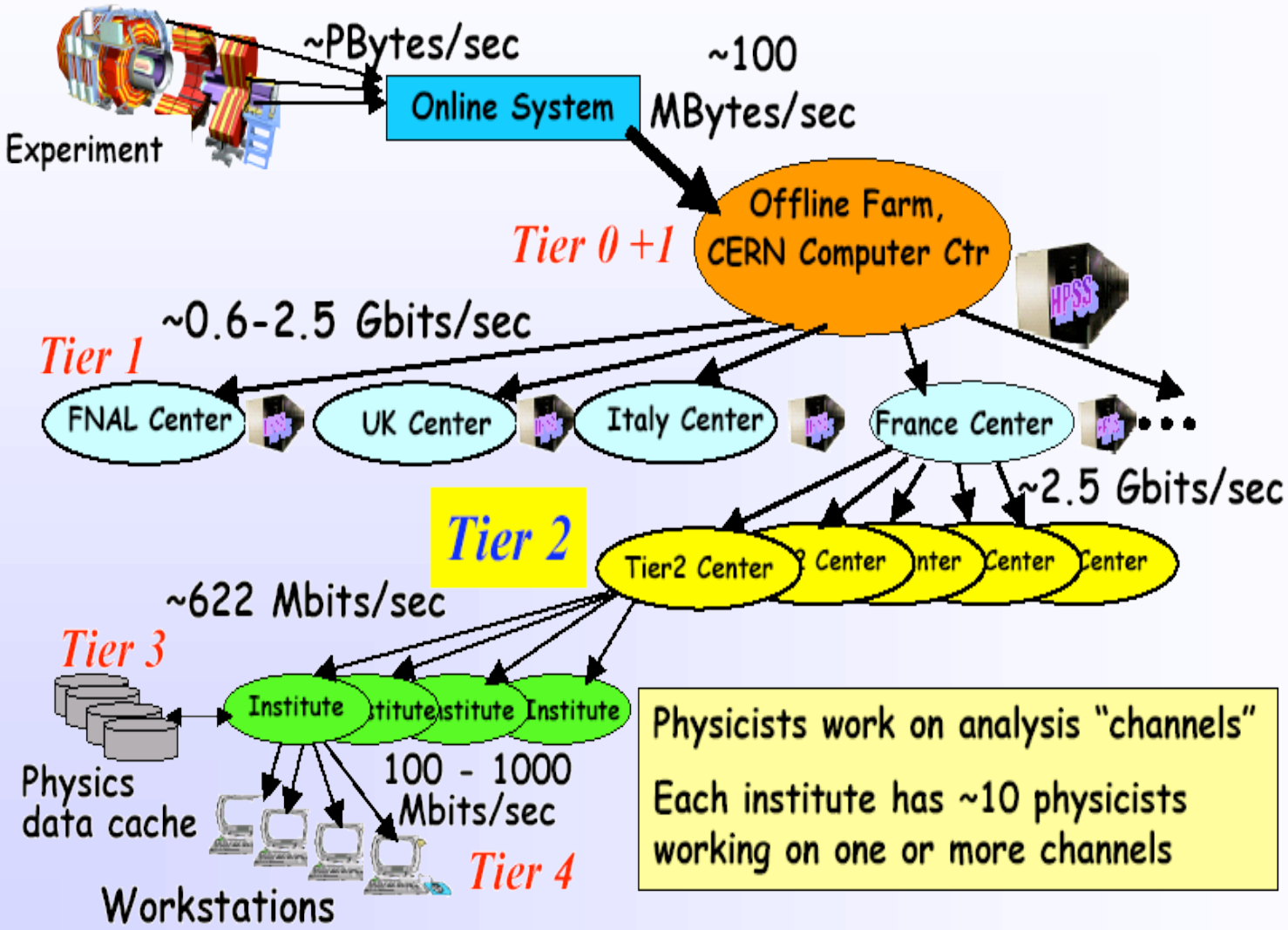
The Grid Computing Model

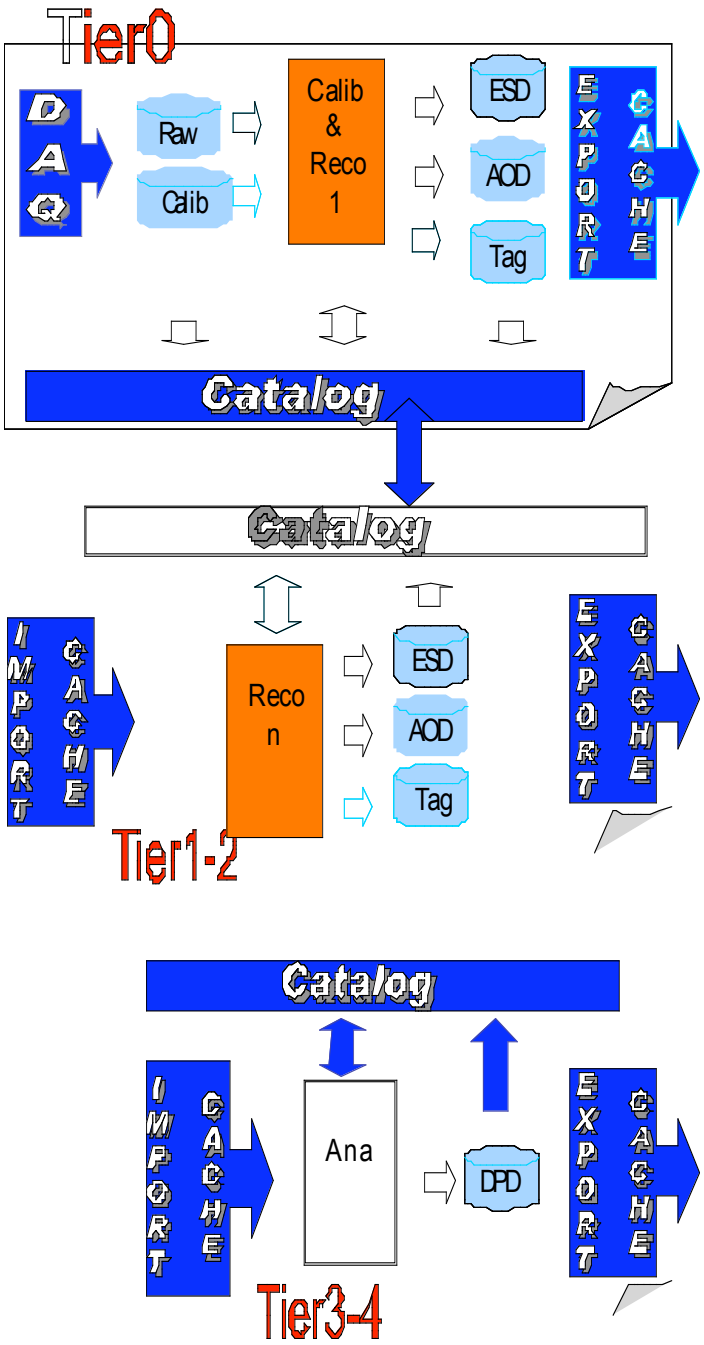


ALICE computing model

- pp
  - Quasi-online data distribution and first reconstruction at T0
  - Further reconstructions at T1's
  - 10 days' buffer
- AA
  - Calibration, alignment and pilot reconstructions during data taking
  - Data distribution and first reconstruction at T0 during four months after AA
  - Further reconstructions at T1's
  - One day's buffer
- One copy of RAW at T0 and one distributed at T1's

Data Grid Hierarchy





RAW data delivered by DAQ undergo Calibration and Reconstruction which produce for each event 3 kinds of objects:

1. ESD object
2. AOD object
3. Tag object

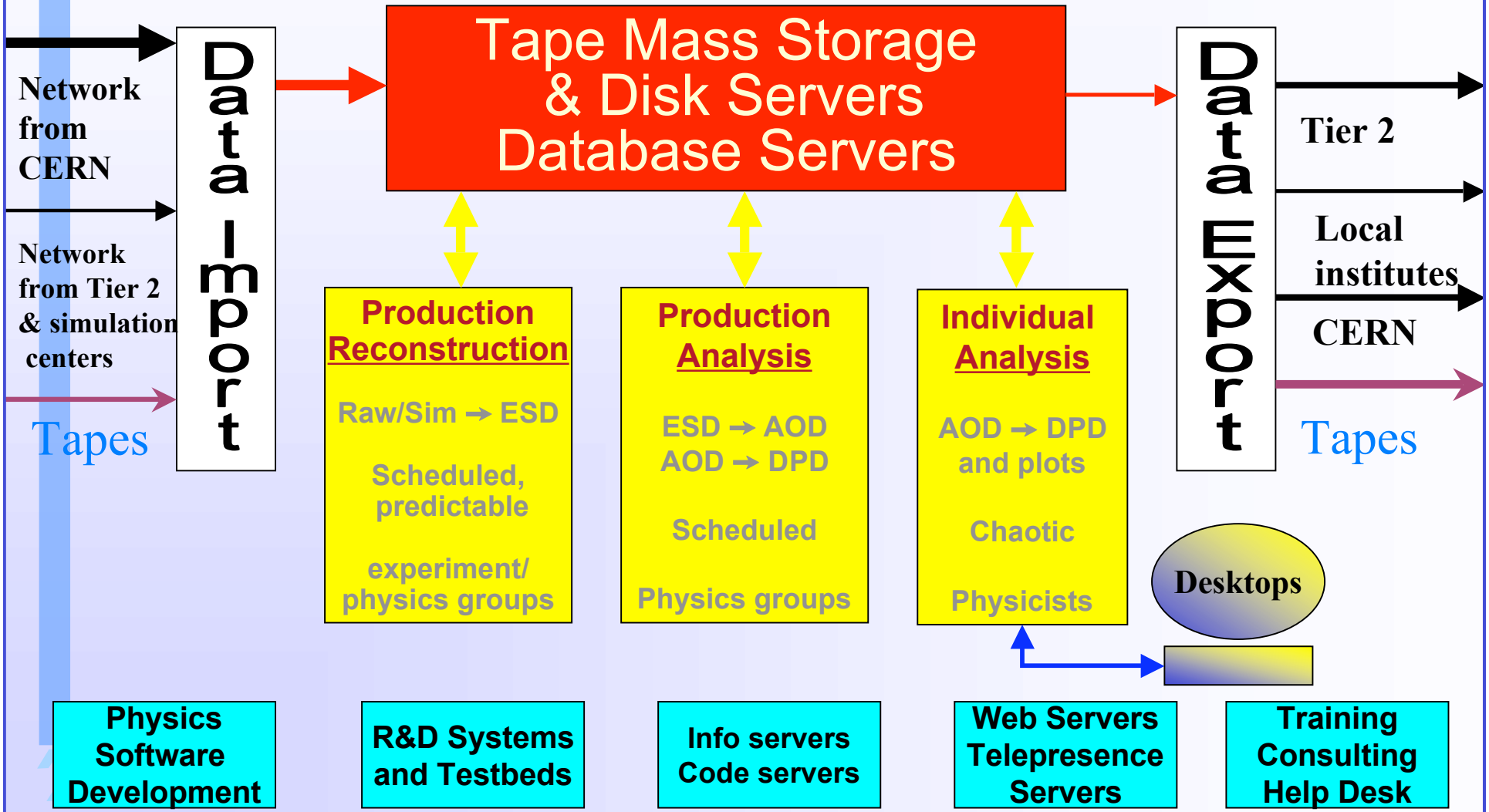
This is done in Tier-0 site.

Further reconstruction and calibration of RAW data will be done at Tier 1 and Tier 2.

The generation, reconstruction, storage and distribution of Monte-Carlo simulated data will be the main task of Tier 1 and Tier 2.

DPD (Derived Physics Data) objects will be Processed in Tier 3 and Tier 4.

Typical work flow at a Tier-1 & 2

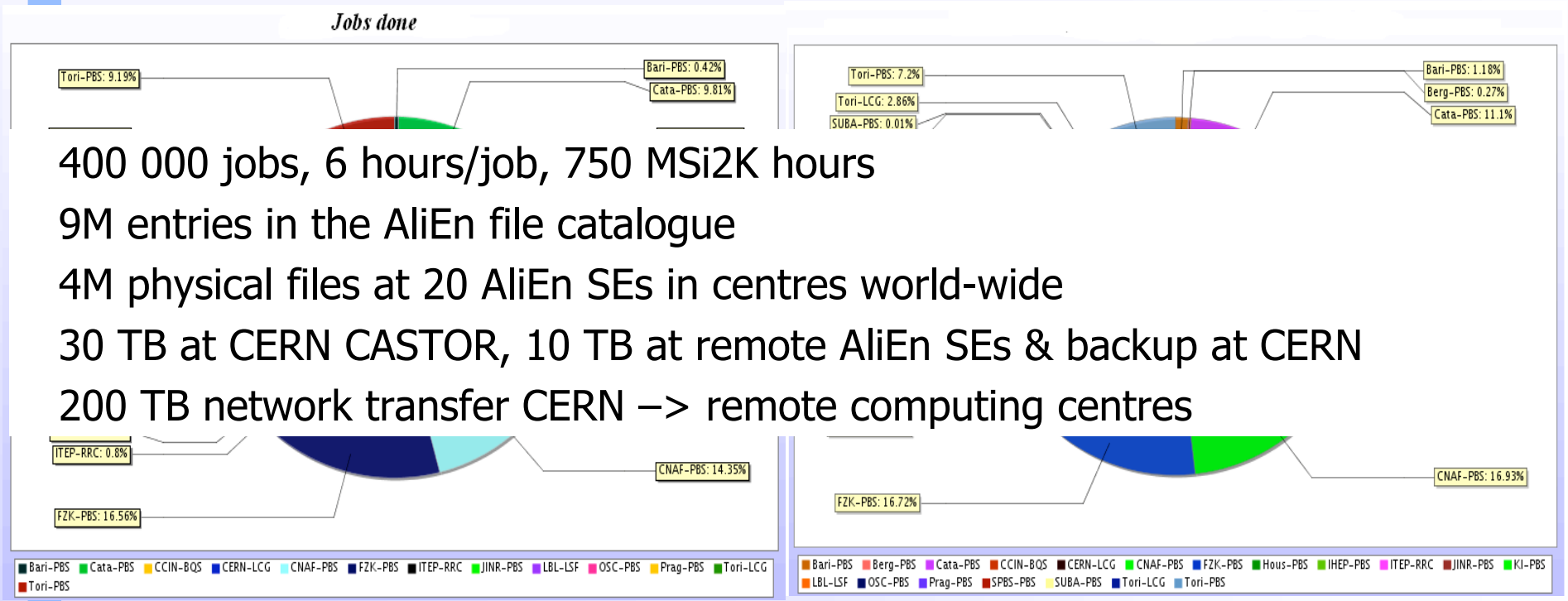


ALICE Analysis Basic Concepts

- Analysis Models
  - Prompt analysis at T0 using PROOF(+file catalogue) infrastructure
  - Batch Analysis using GRID infrastructure
  - Interactive Analysis using PROOF(+GRID) infrastructure
- User Interface
  - ALICE User access any GRID Infrastructure via AliEn or ROOT/PROOF UIs
- AliEn
  - Native and "GRID on a GRID" (LCG/EGEE, ARC, OSG)
  - integrate as much as possible common components
    - LFC, FTS, WMS, MonALISA ...
- PROOF/ROOT
  - single- + multitier static and dynamic PROOF cluster
  - GRID API class TGrid(virtual)->TAliEn(real)

PDC 04

- Jobs (AliEn/LCG)
- More operation sites added to the ALICE GRID as PDC progressed



400 000 jobs, 6 hours/job, 750 MSi2K hours

9M entries in the AliEn file catalogue

4M physical files at 20 AliEn SEs in centres world-wide

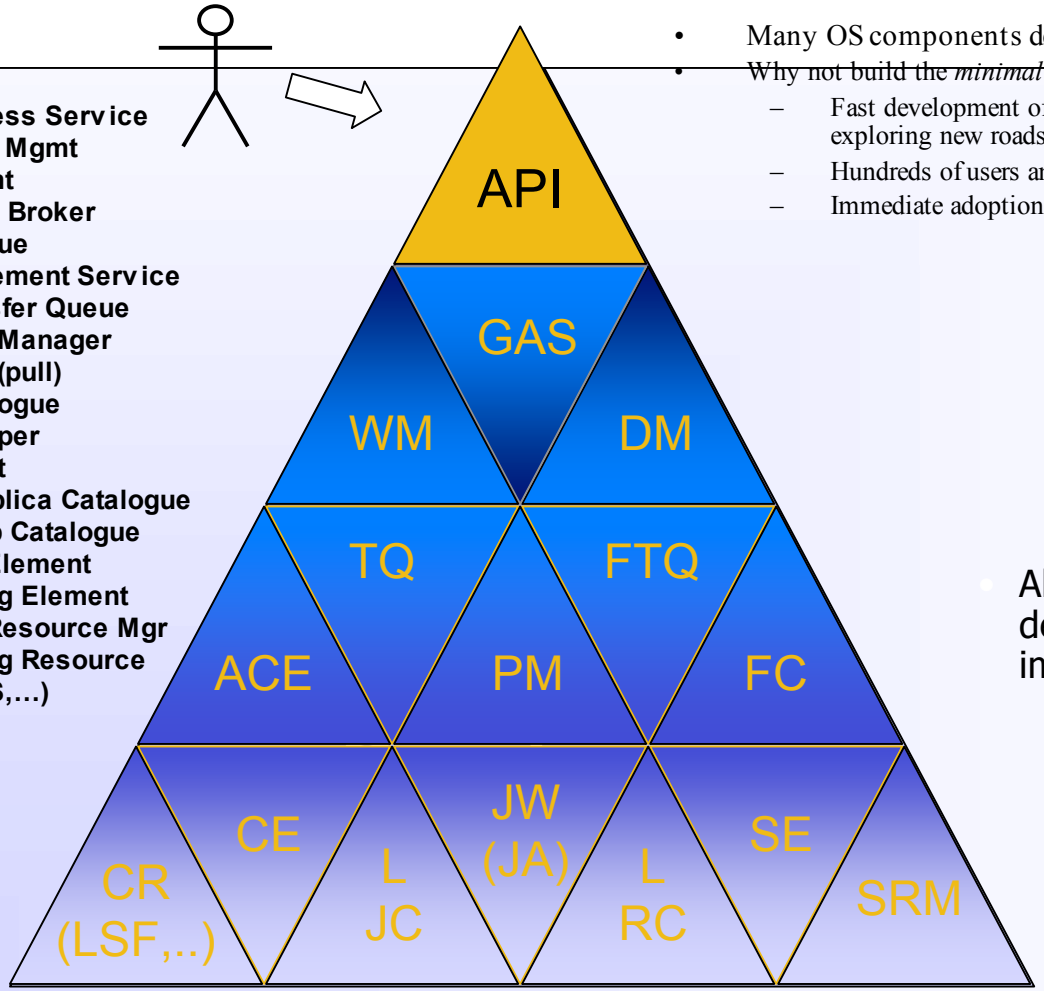
30 TB at CERN CASTOR, 10 TB at remote AliEn SEs & backup at CERN

200 TB network transfer CERN –> remote computing centres

- 17 permanent sites (33 total) under AliEn direct control and additional resources through GRID federation (LCG)

Middleware Services in AliEn

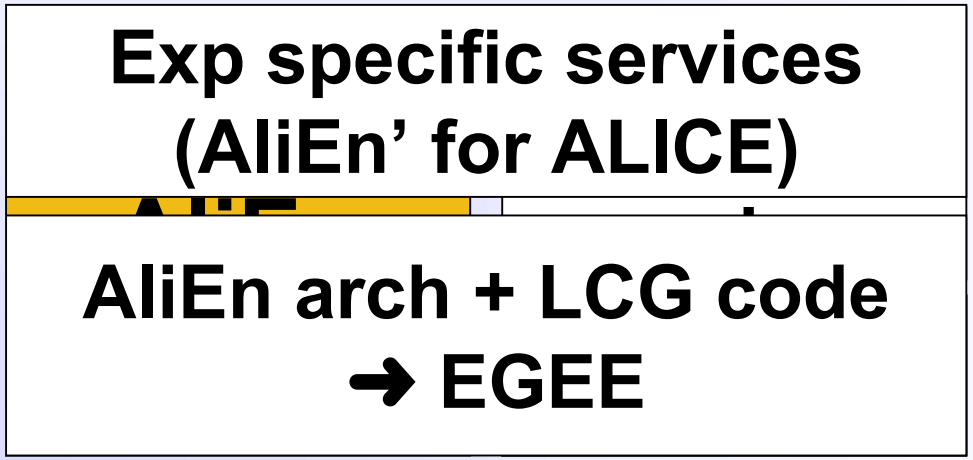
GAS	Grid Access Service
WM	Workload Mgmt
DM	Data Mgmt
RB	Resource Broker
TQ	Task Queue
FPS	File Placement Service
FQ	File Transfer Queue
PM	Package Manager
ACE	AliEn CE (pull)
FC	File Catalogue
JW	Job Wrapper
JA	Job Agent
LRC	Local Replica Catalogue
LJC	Local Job Catalogue
SE	Storage Element
CE	Computing Element
SRM	Storage Resource Mgr
CR	Computing Resource (LSF, PBS,...)



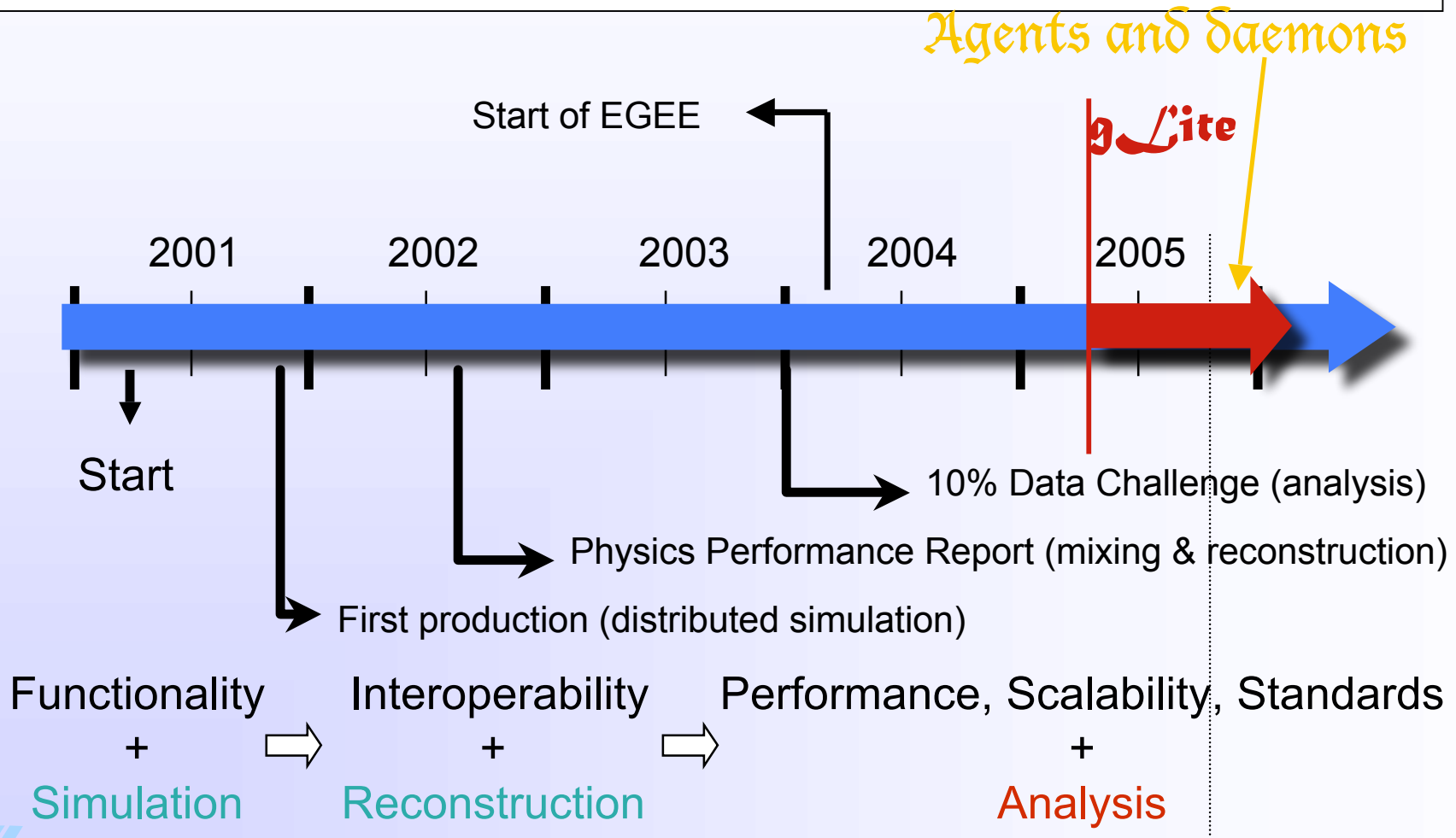
- Many OS components dealing with Grid issues
- Why not build the *minimal GRID* that *does the job*?
  - Fast development of a prototype, no problem in exploring new roads, restarting from scratch etc etc
  - Hundreds of users and developers for the modules
  - Immediate adoption of emerging standards

- AliEn (5% of code developed, 95% imported)

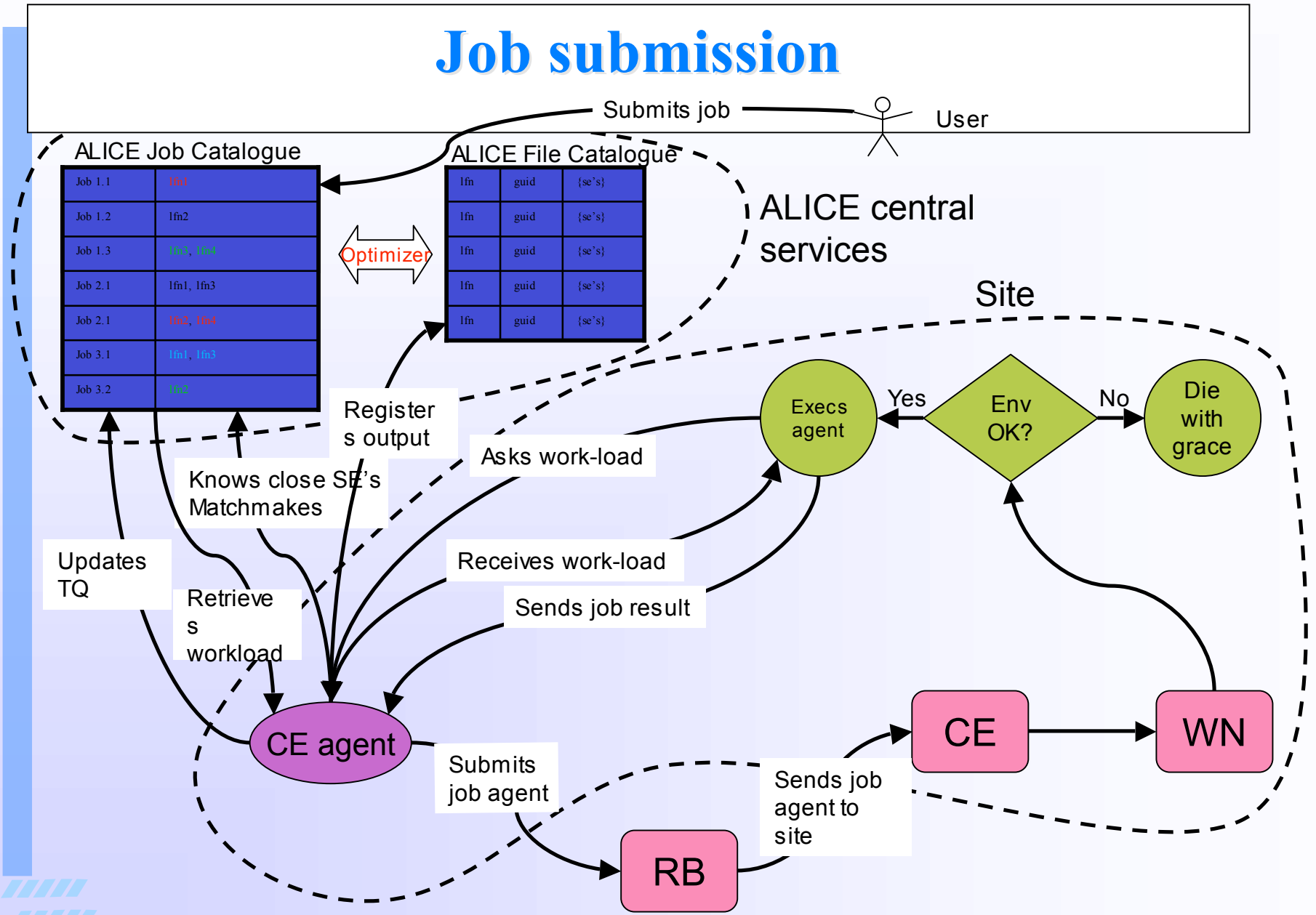
ALICE view on the current situation



The AliEn timeline



Job submission



Alice Grid at VECC-SINP

A tier-2 centre will be setup at VECC-SINP for Alice

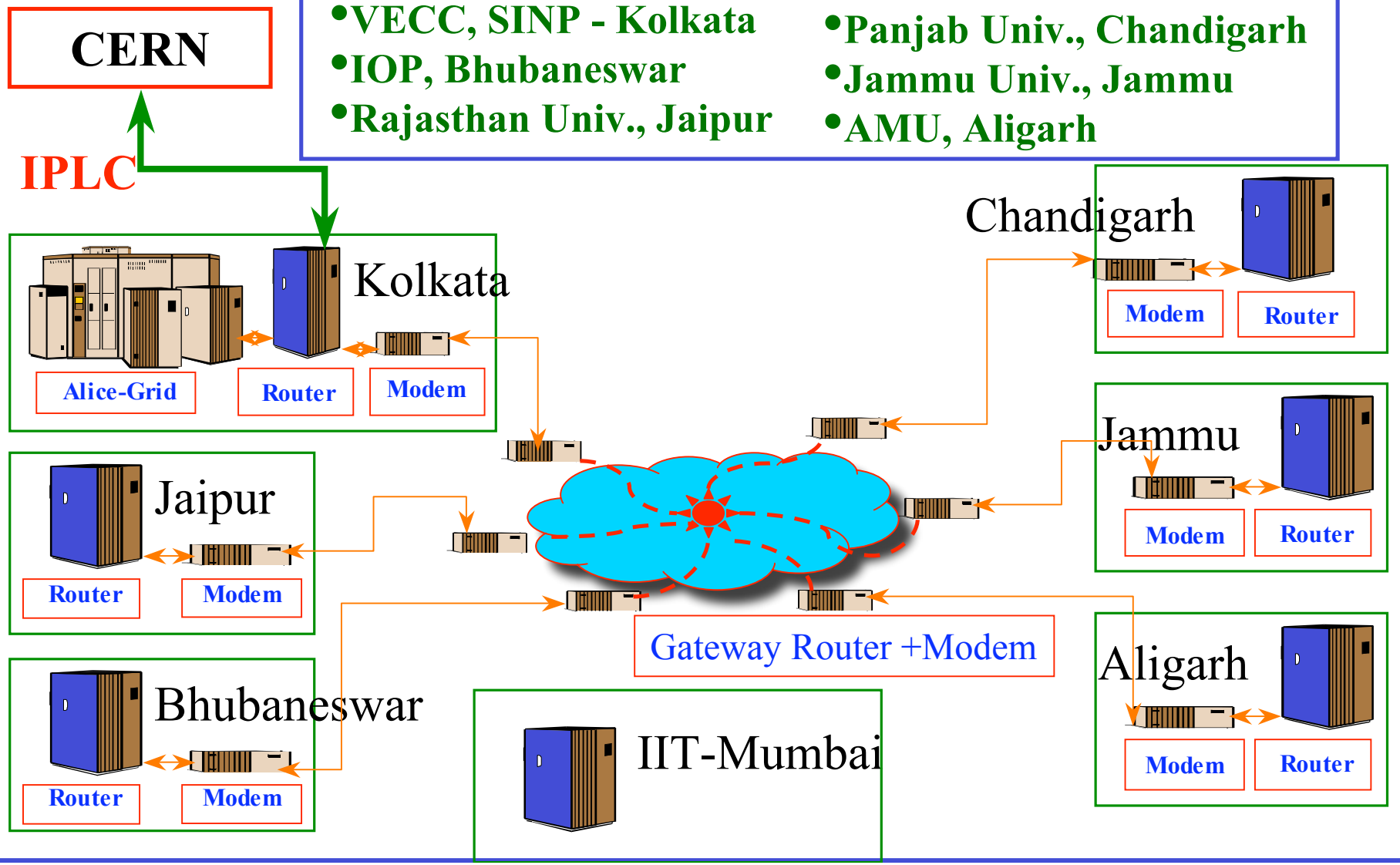
Why Tier 2 ?

1. Tier-2 is the lowest level to be accessible by the whole collaboration
2. Each sub-detector of ALICE has to be associated with minimum Tier 2 because of large volume of calibration and simulated data
3. PMD and Muon Chambers are the important sub-detectors of ALICE
   – VECC-SINP involve from conception to commissioning

Indian ALICE-GRID Project

Indian ALICE Collaborators

- VECC, SINP - Kolkata
- IOP, Bhubaneswar
- Rajasthan Univ., Jaipur
- Panjab Univ., Chandigarh
- Jammu Univ., Jammu
- AMU, Aligarh



Required Computing Resources for Tier 2

	# CPU (Intel P4)	Disk Space (TB)
Tier 0:	28800	1727
Tier 1 + 2	7200	838

Total 6 Tier 1 centers and for each Tier 1 there will be several (~ 5-6) Tier 2 Centers. Tier 2 centres should have the capacity roughly 30% of Tier1 + 2 capacity.

Resources required at VECC, Kolkata:

Total No. of CPUs - 200

Disk Storage - 50 TB

Network Bandwidth – 155 Mbps

Indian Alice grid: present status

- Approved project
- Rooms ready
- 16 nodes are ready as starting point
- Participated in MDC
- 4MBps BW is being installed as we speak
- Another 32 nodes will be installed very soon
- New clustering software (Quattor) installed
- New batch system software (Condor) installed
- Will add to Physics Data Challenge
- Similar system exists in SINP
- Will connect via fiber to integrate them

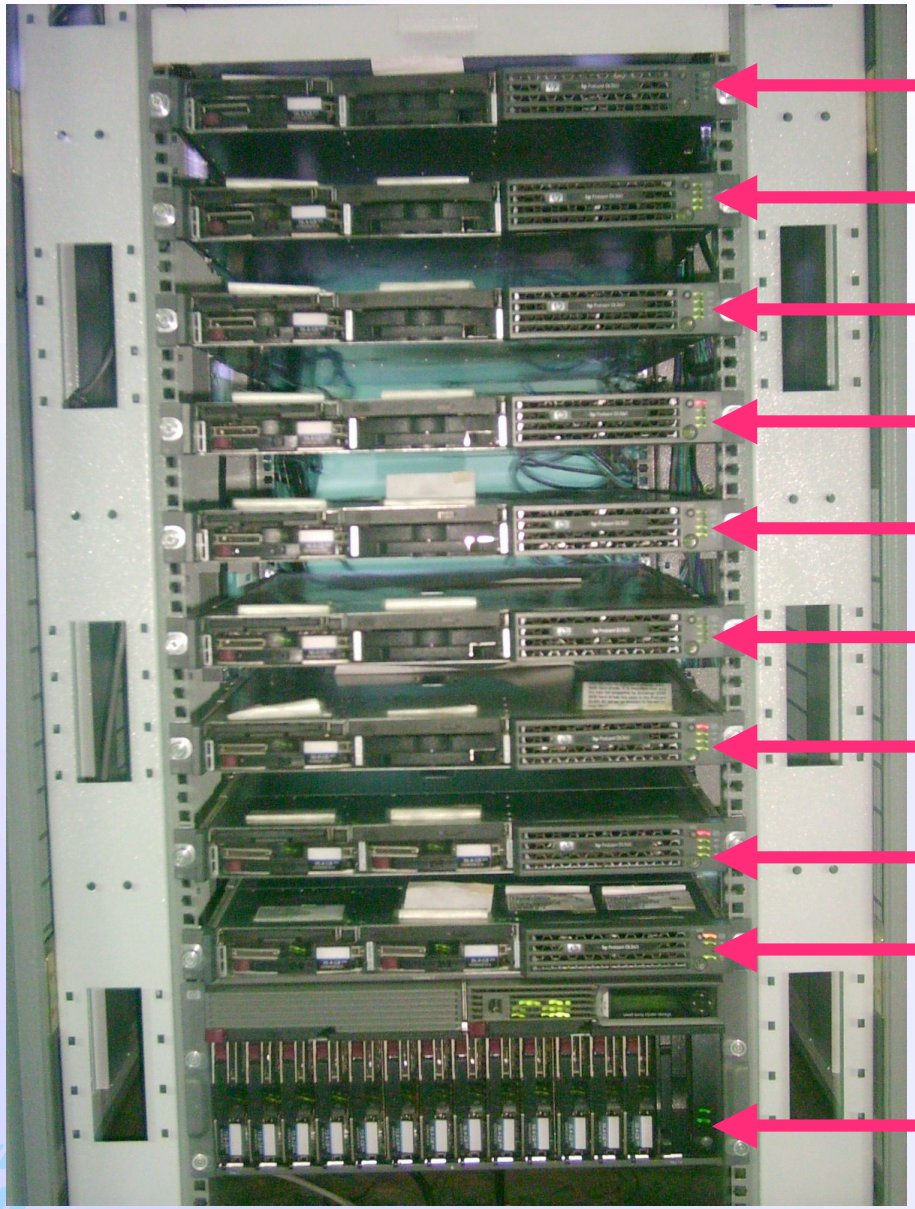
VECC Grid Computing Facility Room

View of VECC Cluster

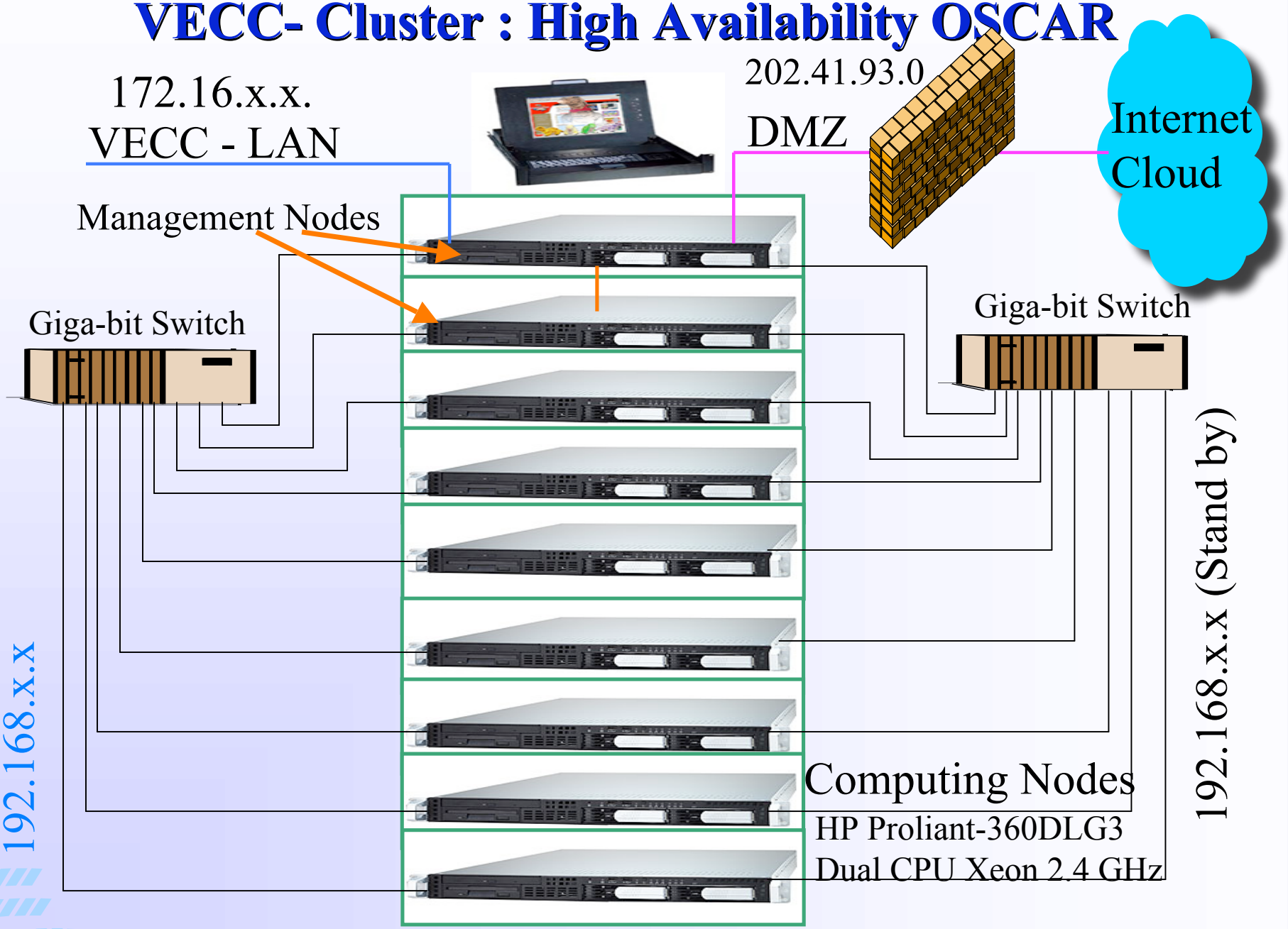
Full View

KVM Switch

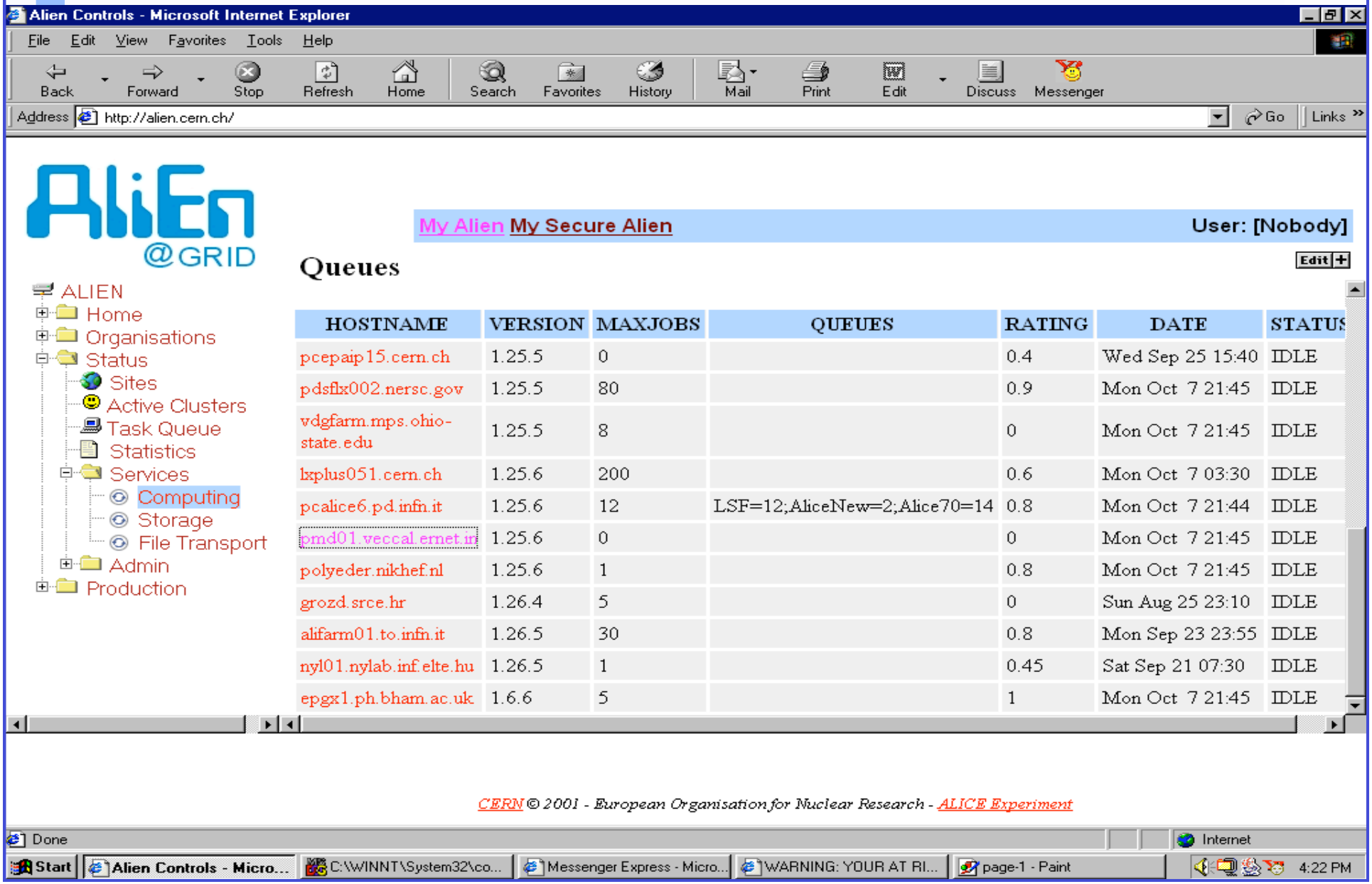
Different Part of VECC Cluster



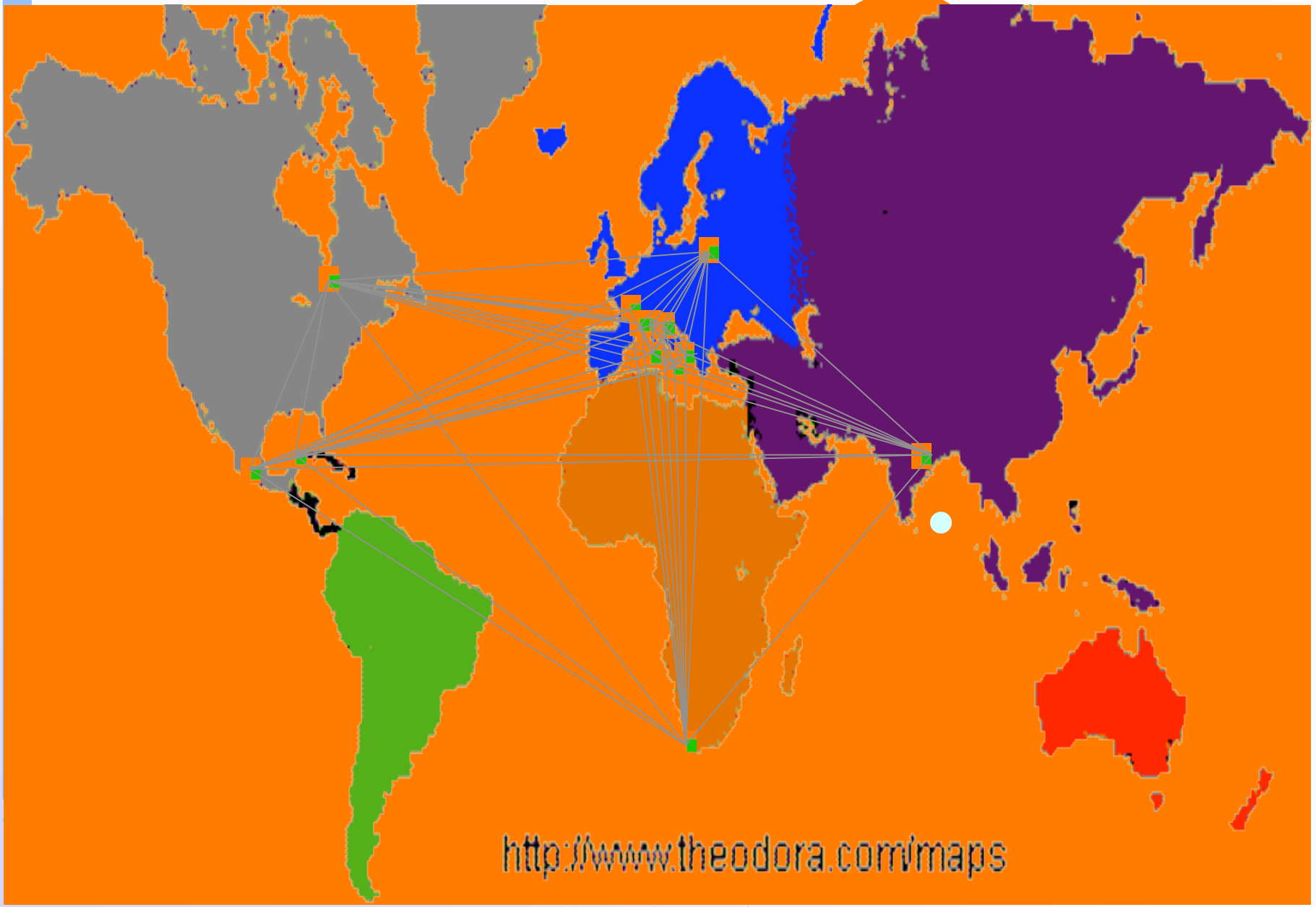
VECC- Cluster : High Availability OSCAR



VECC Cluster is visible form http://alien.cern.ch



The ALICE testbed for Phase II



Status and Plan

- Fully functional (partially occupied) tier-2 centre will be ready

  by March 2006.

Tier-3 centres:

BW:

procured at Jammu (2MBPS)

Work in progress at Jaipur and Chandigarh

Others will take up soon

HW:

Waiting for Alice to define functionalities more clearly.


"That's
all