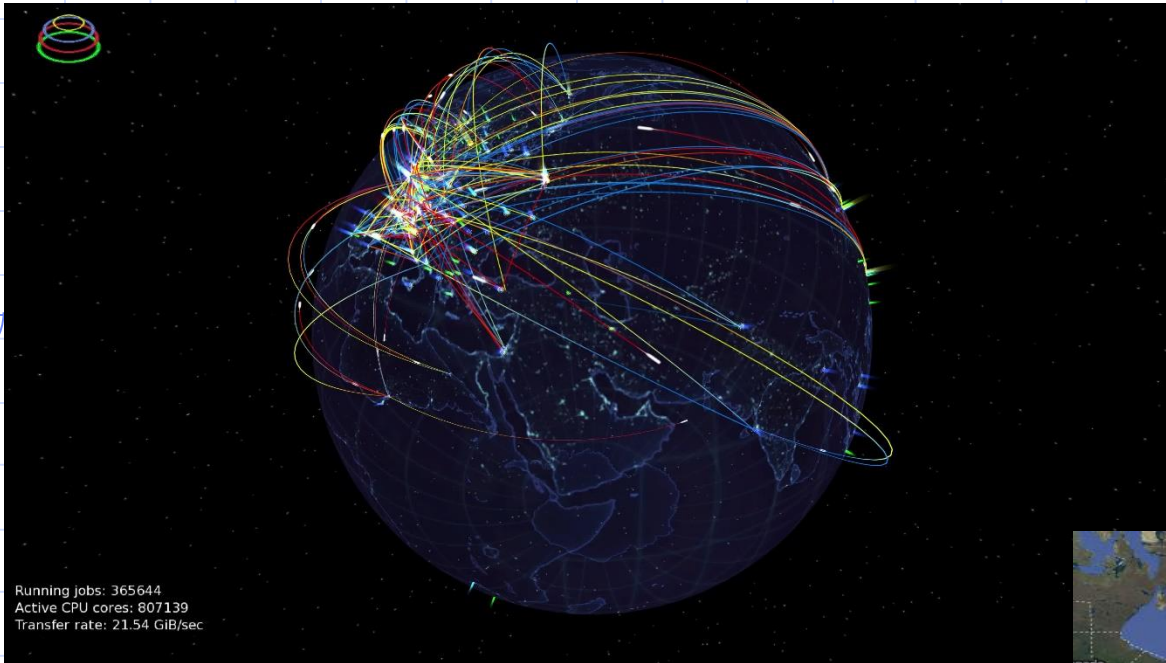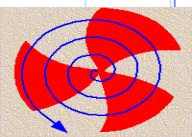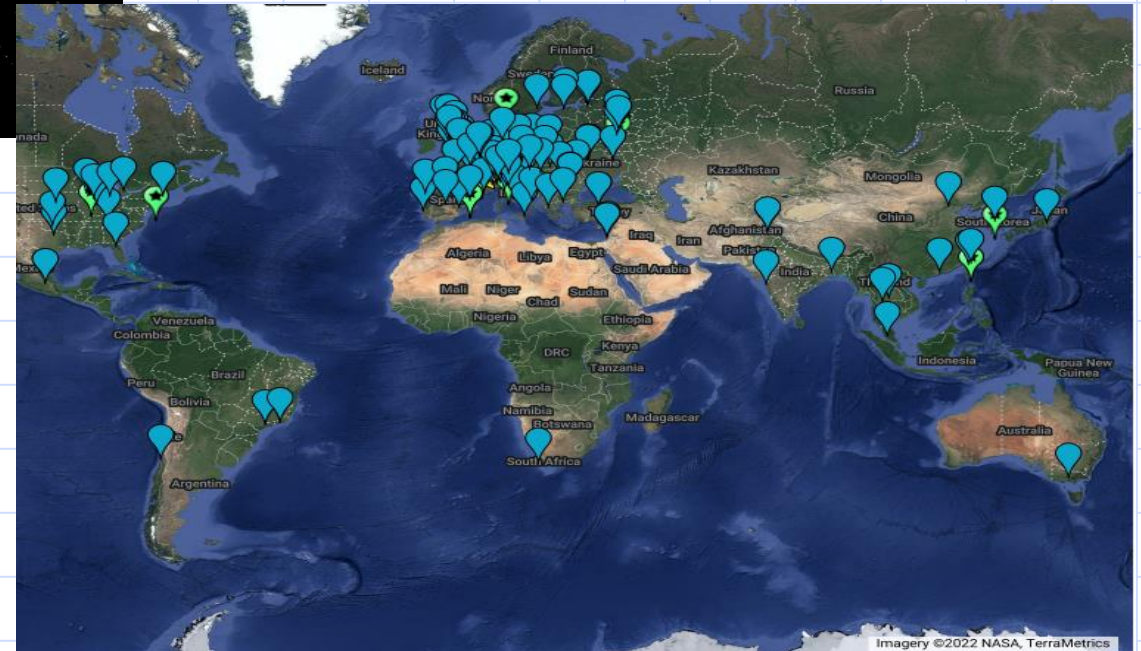# India @ WLCG

- **Two Tier-2s**
  - **VECC Kolkata for ALICE**
  - **TIFR Mumbai for CMS**
  - **Software Work**

- ✓ **Active for 2 decades,**
- ✓ **Resources as per M&O-A share,**
- ✓ **Network from NKN (MOU between DAE & NKN)**

Vikas Singhal, VECC Kolkata India

Software Development @ BARC

DAE-CERN Protocol agreement on Grid computing for software development for WLCG.

- ➢ More than 11M CHF in-kind contribution,
- ➢ More than a decade of active software development (2003 –2012),
- ➢ Contribution of 1000 Person-months,

DAE developed software is deployed at WLCG, CERN

- ➢ GRIDVIEW :
   A Grid Monitoring and Visualization Tool for LCG
- ➢ SHIVA: Problem Tracking System,
- ➢ Co-relation Engine, Fabric management,
- ➢ Quattor toolkit enhancements,
- ➢ ALICE VOBOX Monitoring,
- ➢ Enhancements for Cloud Management at CERN
- ➢ TIFR is participating in CMS software.
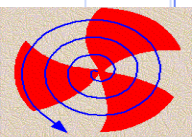
Kolkata Tier II

Who We Are

VECC → Variable Energy Cyclotron Centre,
DAE → Department of Atomic Energy. Govt of India.

Tier-2 Site for the WLCG (World Wide Computing Grid)
Kolkata Tier-2 For ALICE GRID
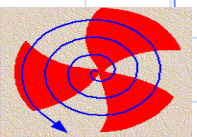GOCDB Name:- IN-DAE-VECC-02

Team:-
Subhasis Chattopadhyay : Mentor
Vikas Singhal
Prasun Singh Roy
+ 2 casual staff (changing)

Tapas K. Samanta and Sushant K. Pal helped in establishing the centre in the initial years.

From where we started

Started in 2002

CERN

128Kbps Ethernet Bandwidth

- ◉ **Operating System**
  - › Scientific Linux 3.05
- ◉ **Middleware**
  - › Alice Environment with PBS as batch system
- ◉ **Hardware (CPU, Disk)**
  - › 1xDuel Xeon,4GB Compute Node
  - › 2xDuel Xeon,2GB WNs
  - › 2x80GB Disk Space
- ◉ **Bandwidth**
  - › **512Kbps Shared**

S. K. Pal & T. Samanta
Started in 2002.
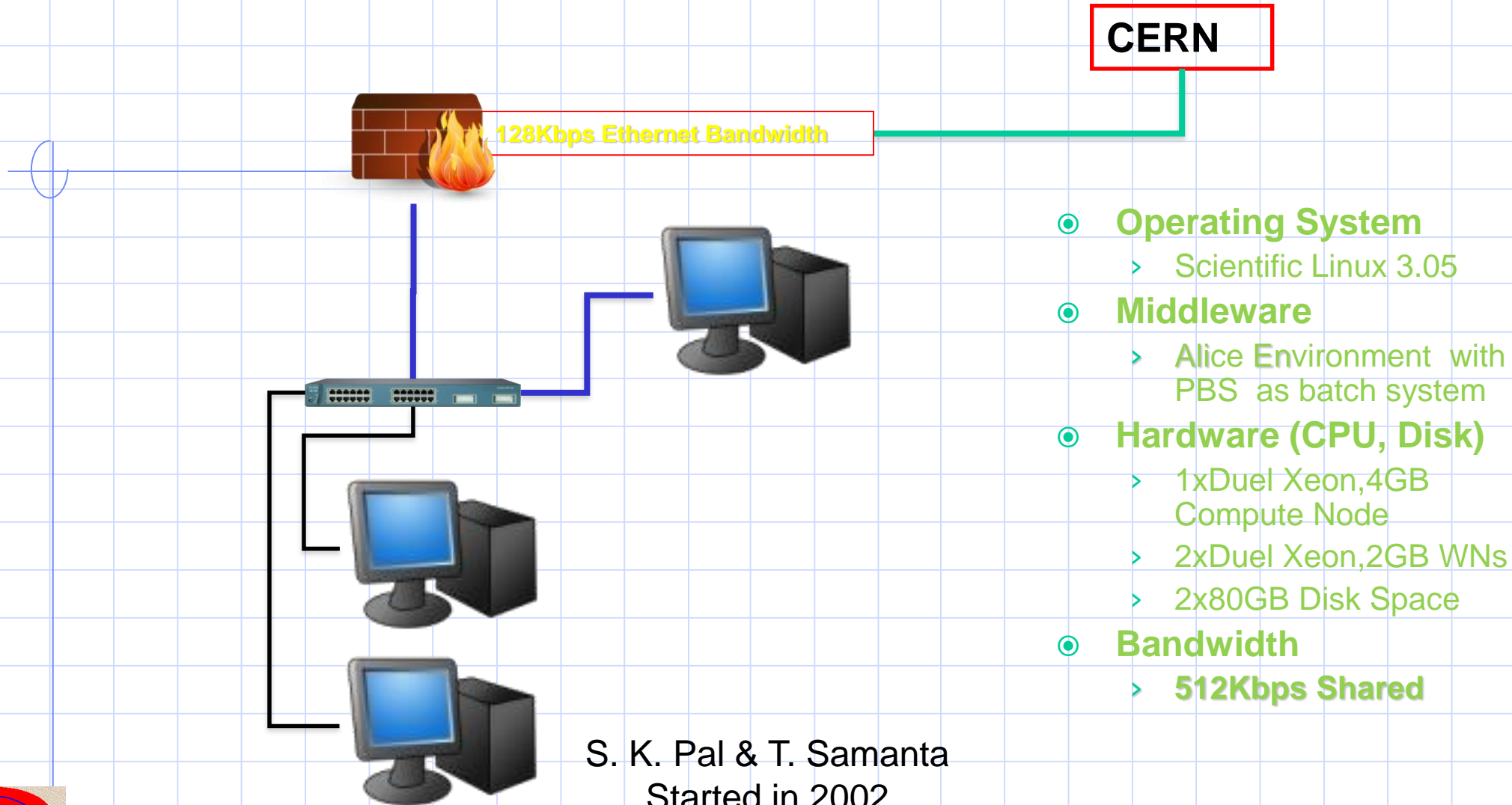
From 2 Core to 5000 Cores

Started with

----2 Desktop Machine	2002
----2 Tower Like Servers	2003
----9 HP 1U Servers	2004
----17 Wipro 1U Servers Single Core	2006
----40 HP Blades Dual Core	2008
----8 HP Blades Quad Core	2009
----32 Dell Blade Dual Processor Dual Core	2011
----GPU Server with Tesla 2070 with 448Cores	2012
----2* Intel Xeon Phi Co-processor 244 core	2016
----48 Node Cluster 2688 core	2017
----16 DELL Node Cluster	2020

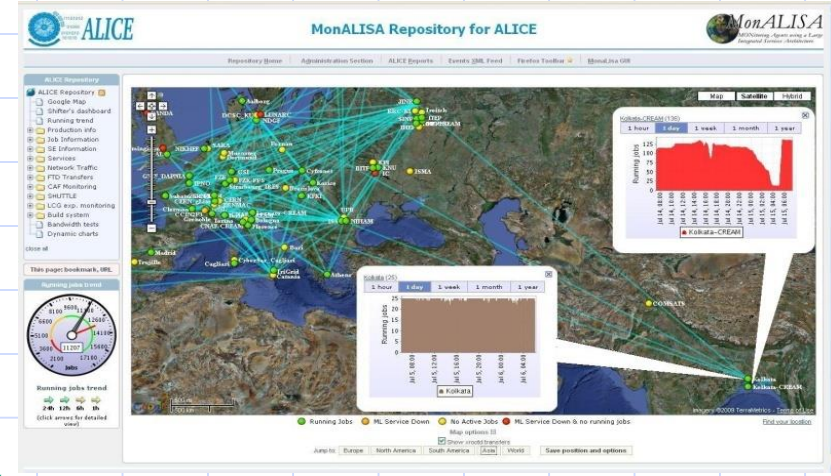These resources are total for the facility not only for Tier-2.

Kolkata Tier2 on Monalisa
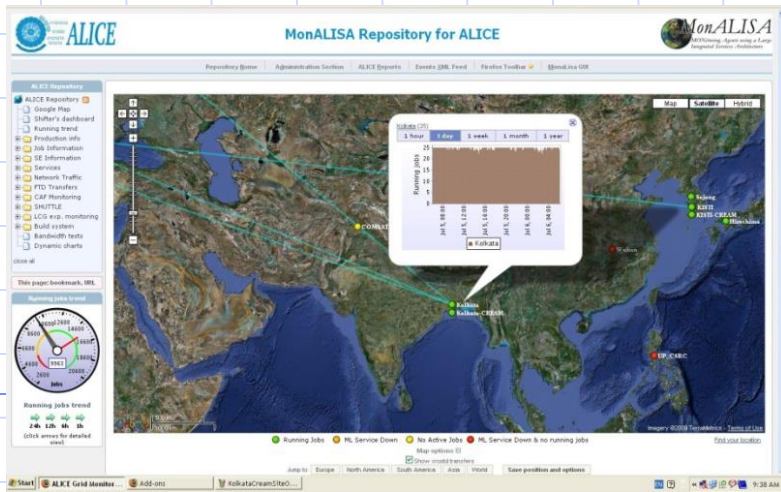
2007

2011

2015
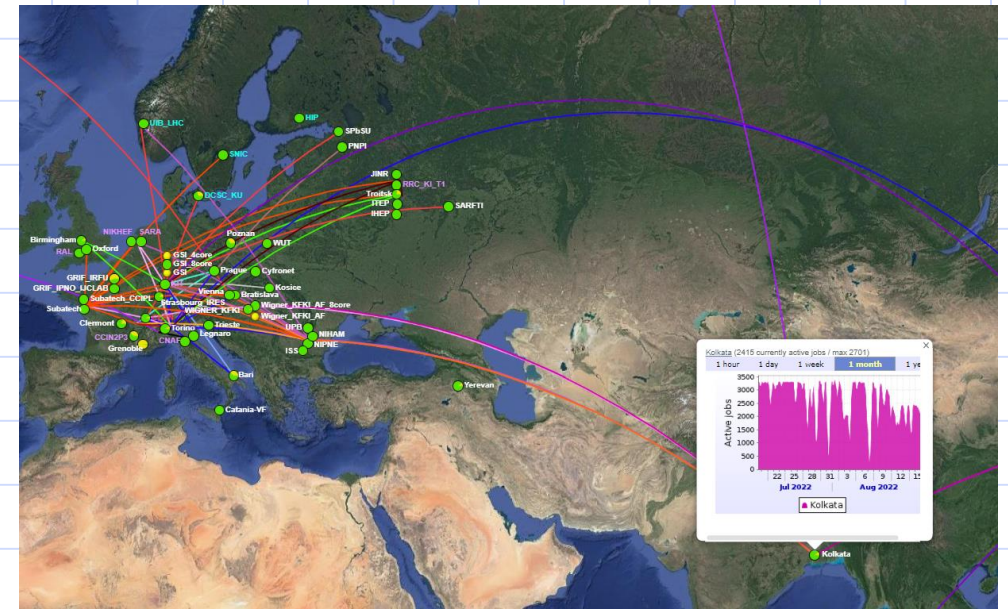
2022

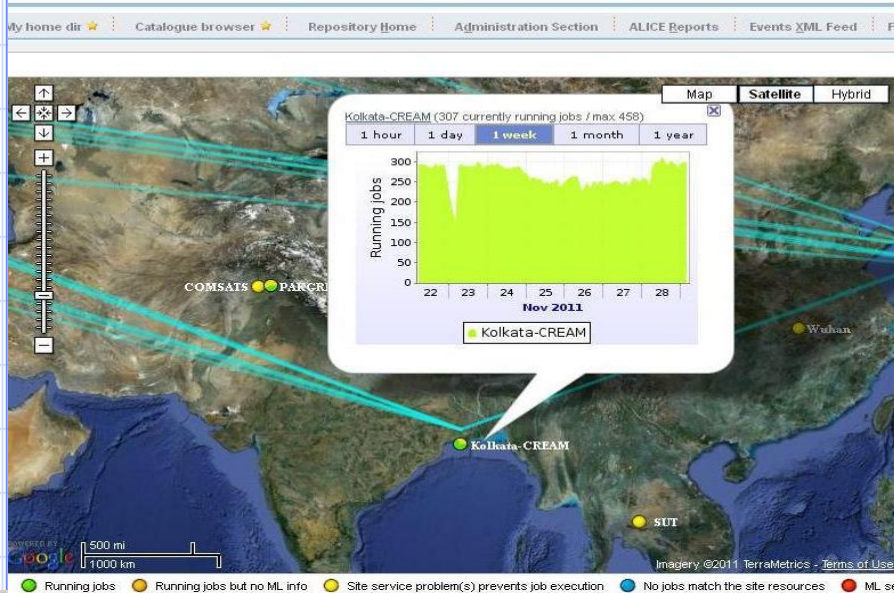# From 512MB Disk to 5000TB Disk

Started with

----512MB in Desktop Machine	2002
----40GB in Tower Like Servers as DAS	2003
----400GB in HP MSA 500	2004
----2TB Wipro NAS	2006
----108TB HP EVA SAN	2008
---- 25 TB i-scsi	2009
----200TB IBM DS 5100	2011
----2TB Hard disk in GPU Server	2012
----3*48 TB (12*4TB) Disk Servers	2015
----7*160 TB (16*10TB) Disk Servers	2018
----8* 192 TB (16*12TB) Disk Servers (EOS RAIN-6)	2020

It shows piece by piece evolved and gathered all kind of infrastructure.

Evolution of Infrastructure

2006
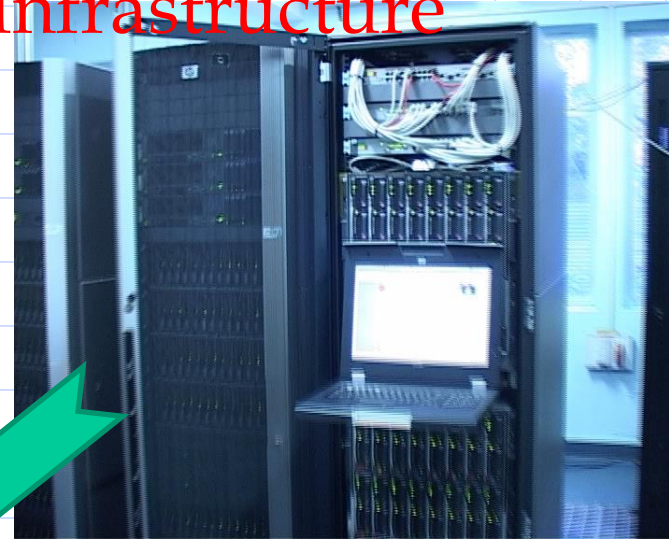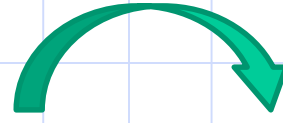
2008
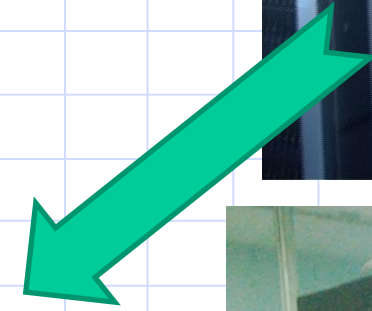
2010
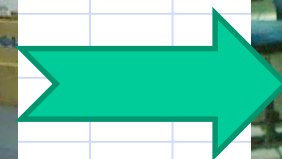
2012
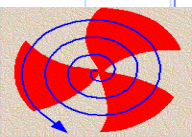
Implemented Efficient Cooling Solution
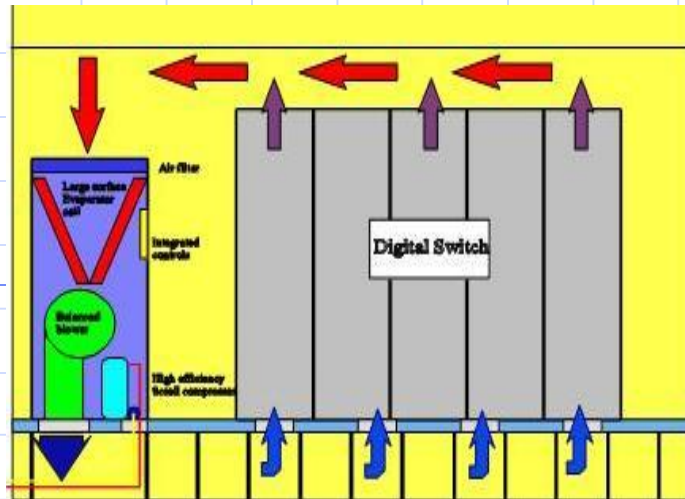
> Hot and Cool Air is separated using Cold Air Containment which is least accessible Area.

> All the management and monitoring of the server, storage is from outside Cold Aisle Containment.

> Temperature gradient between Cold and Hot zone is 5^oC.

➢Power usage effectiveness (PUE)

      =Total Facility Power/
        IT Equipment Power
      = 1200Units / 816Unit per Day
      = 1.47

➢New Cooling solution reduced cooling power consumption by half.

➢Earlier PUE factor was ~ 2.

From 128Kbps to 10+ Gbps Network

Started with

----128Kbps   shared link   2002

----512Kbps   2003

----2Mbps Dedicated Link   2004

----4Mbps from Bharti   2006

----30Mbps from Reliance   2008

----100Mbps from VSNL (ERNET)   2009

----300 Mbps (NKN Took over)   2011

----Upgraded with 1Gbps   2012

---- 10Gbps   2017

---- *Upgraded to 16Gbps (Mumbai-CERN)   2022

* Will be upgraded upto Kolkata if more 70% utilization of existing 10Gb.

Vikas Singhal, VECC Kolkata India
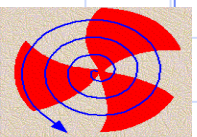
Status and Achievements

16.5 M* ALICE jobs completed, at Kolkata Tier-2 during past 15 years.

For last 5 years, every day 7000 jobs successfully completed (each job is 12 Hrs long).

HTCondor Kolkata

24x7 Operation, >90% availability, No AMC.
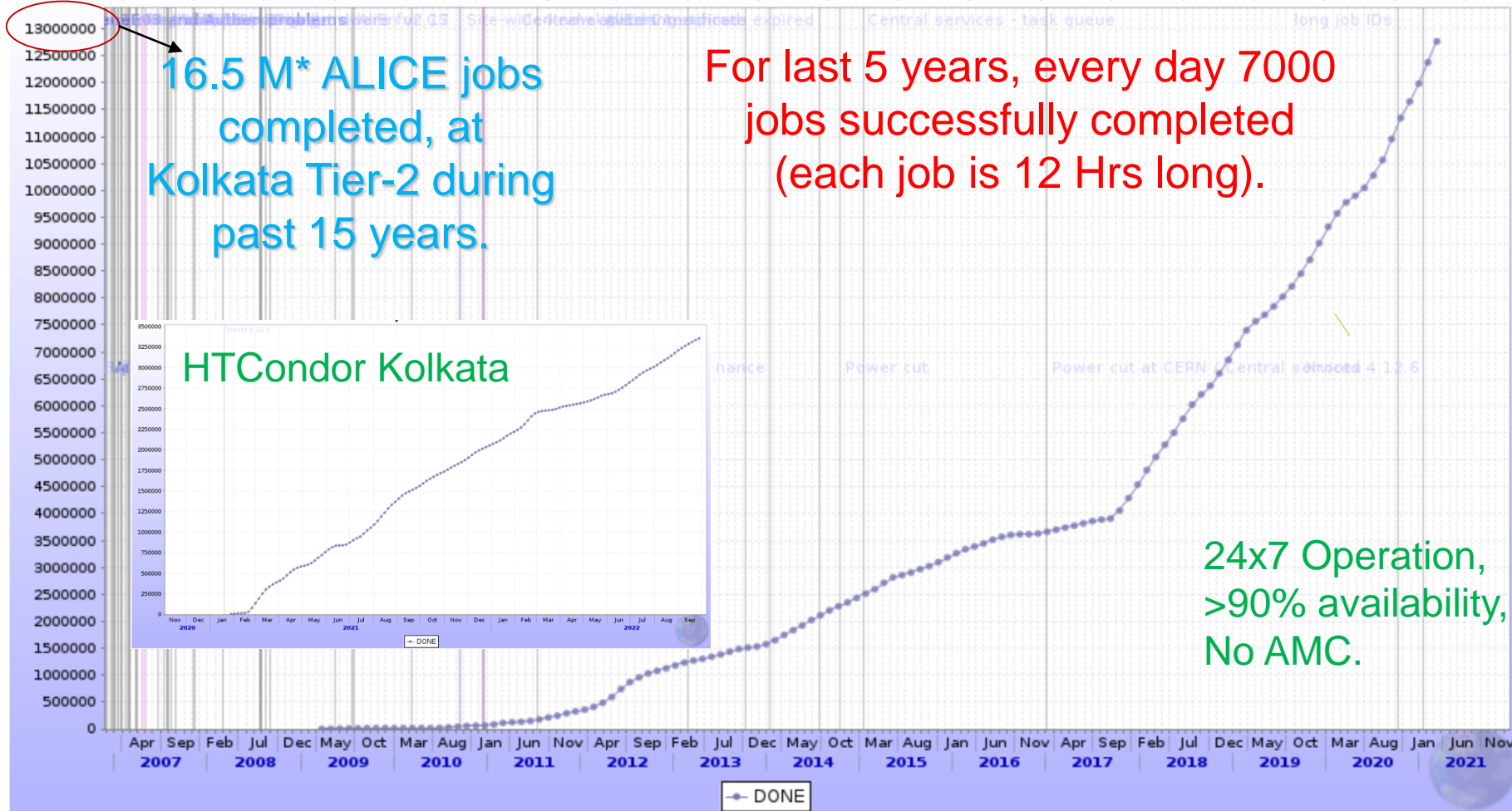
ALICE MonaLISA Monitoring Page

- Since March 2021 switched on to HT Condor based cluster.
- 3.5M Jobs are added which completed on HTC Kolkata.

Vikas Singhal, VECC Kolkata India

12

Kolkata on MonaLisa
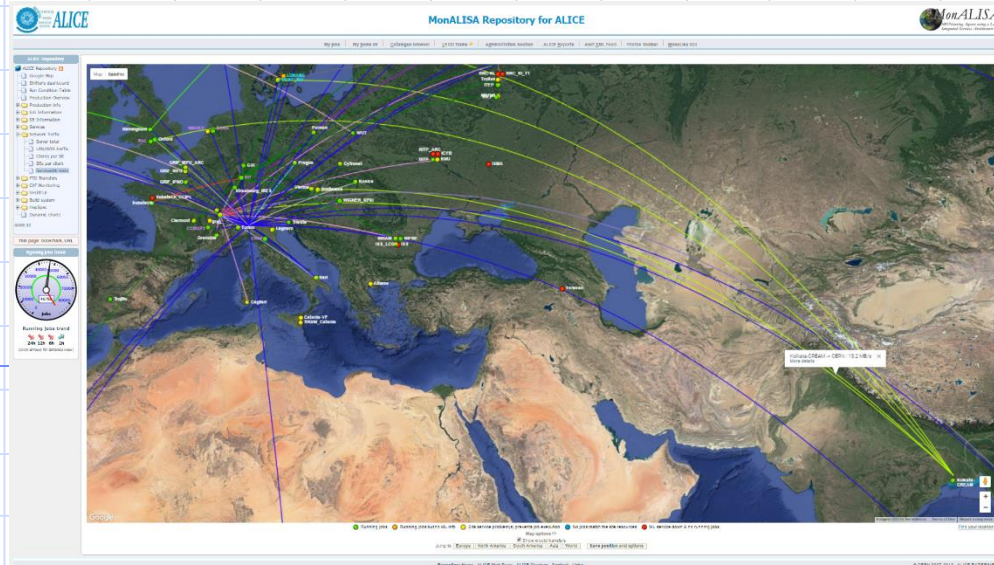
Data transfer between Kolkata and rest of the world

VECC Tier-2 Resources:-

Computing :- ~ 3500 cores
(cooling need to upgraded)

Storage :- ~ 1.3 PB

Network:- ~ 16 Gbps (8+8 WAN)

Recently ungraded from 10 Gbps.

Connectivity between Asian Tiers

From last 6 years started Networking between ASIAN Sites.

Initiative by ATCF.

TIFR hosted ATCF-5 Meeting in 2019.

Connectivity increasing day by day.
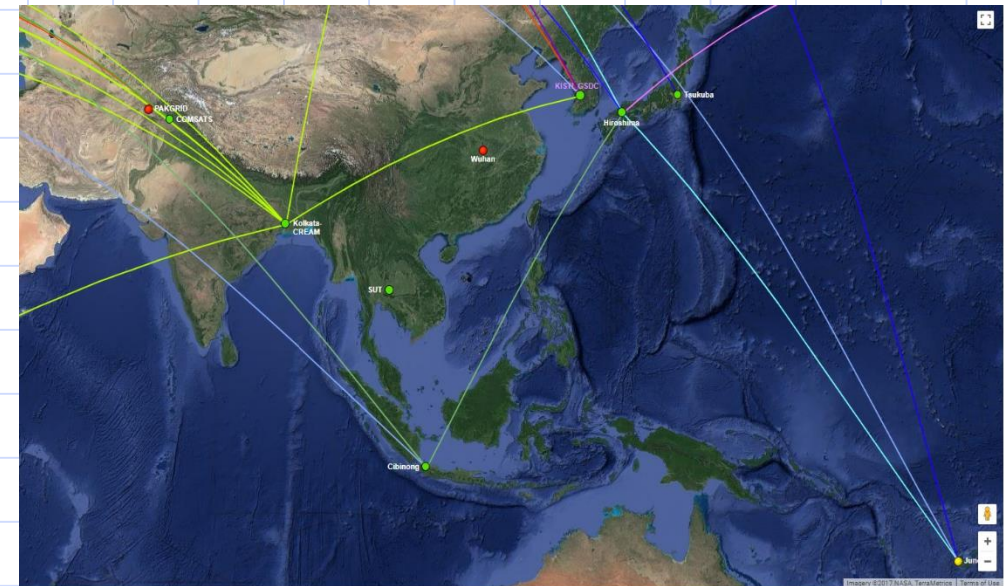
In TopSuperComputers India List

Listed in TopSuperComputers India list

48 Nodes Cluster
Commissioned Q4-2017

Theoretical Peak Performance
Rpeak = 1.0752 Tflops /Server
Rpeak = 51.6 Tflops Cluster
Linpack Benchmark performance
Rmax = 43.0471 Tflops.

http://topsc.cdacb.in/

Top Super Computers in India is list of the most powerful supercomputers in India and it is maintained by C-DAC Bangalore. Earlier it was maintained by IISc Banglore since its inception in 2009.

Kolkata Tier-2 Cluster is still on the list.

Evolution of Grid Computing Facility at VECC (2002-now)

2002
- 2 Desktop Machine
- 512MB HD in Desktop Machine
- 128Kbps network shared link

2003
- 2 Tower Like Servers
- 40GB as DAS
- 512Kbps Network

2004
- 9 HP 1U Servers
- 400GB in HP MSA 500
- 2Mbps Dedicated Link

2009
- 8 Quad Core HP Blades
- 25 TB i-SCSI storage
- 100Mbps from VSNL (ERNET)

2008
- 40 Dual Core HP Blades
- 108TB HP EVA SAN storage
- 30Mbps WAN from Reliance

2006
- 17 Wipro 1U Servers Single Core
- 2TB Wipro NAS storage
- 4Mbps WAN Network from Bharti

2010 - 2012
- 32 Dual Processor Blades
- 200TB IBM DS 5100 storage
- 300 Mbps WAN from NKN
- Cold aisle cooling solution
- Efficient cooling (1.47 PUE)

2012 -2016
- Accelerated computing with Tesla 2075 GPU
- Heterogeneous computing for CBM via GPU
- 1Gbps NKN WAN under LHCONE
- 148 TB of disk based storage
- Intel Xeon-phi co-processor for computing

2017-2022
- More than100 nos of servers
- More than 80 TFlops of computing
- 10Gbps WAN network and 40 Gbps intranet.
- 16.5 Million ALICE Jobs completed.
- More than 3 PB disk servers
- Low cost storage solution via EOS RAIN-6

15

What we achieved

➢ **India's Two Tier-2s. One for CMS and another for ALICE since 2002 and have operational expertise for GRID deployment .**

➢ **Providing resource to CMS and ALICE Community.**

➢ **Procured and commissioned resource as per M&O-A share for ALICE and CMS.**

➢ **Commissioned Green and Efficient cooling solution at VECC which reduced power requirement by half.**

➢ Consistently and continuously **running with more than 90% uptime for the last 20 years.**
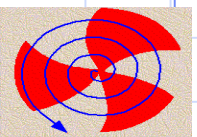
What we achieved cont…

➢ **Maintaining a reasonable Tier-3` infrastructures both at TIFR and VECC for all our Indian collaborators.**

➢ **Providing computing support for all the major projects like CMS, STAR, ALICE, CBM, Medical Imaging, etc. (and local users.)**

➢ **Birth of IGCA :- Indian Grid Certification Authority. (Thanks to Subrata Chattopadhyay and his team at CDAC B'lore.)**

➢ **High Speed Network from Europe through the (NKN) PoP established at CERN, Geneva,**

➢ **Open Source Software and support for the high end operating systems, software like EOS (low cost disk based storage solution), Vidyo (Video Conferencing Tool) etc.**

➢ **Asian Tier Centre Forum (ATCF).`**
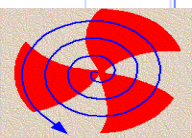
Network Connectivity MOU between DAE and NIC

MoU for Peer to Peer High Bandwidth connectivity between CERN-GENEVA and TIFR-Mumbai for WLCG project.

Department of Atomic Energy
And
National Informatics Centre

Salient Features:-
- Started 17/03/2020 for 5 years

- NKN will not charge.

- Two committees :-
    - The WLCG Management Committee
    - The regional WLCG Monitoring Committee

- Round the clock Network Operations.

- Availability of Network (99% for every calendar month.)

- Presently 14 institutes included and expansion going on.

How we achieved

- Dedication and hard work is only the KEY.

- It is a LONG Journey, every day few steps walked.

- Started with zero resources and Less Man Power as we are outside the COMPUTER Division, VECC.

- Procured the each and every piece of resource to build the CENTRE.

- Efficiently purchasing and managing the resources, bit by bit procured the resources by following all RULEs and regulation.

- Working with CASUAL STAFF for last 8 years.
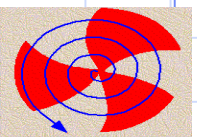
Grid Site As per WLCG & Experiment Requirement

WMS
MyProxy
VOMS….

Site BDII

CE
Now HTCondor-CE
Earlier Cream-
CE,LCG-CE

WNs
(More and
More WNs)

SE
(PureXrootD)

LCG-UI

Disks
(More and
More
Disks)
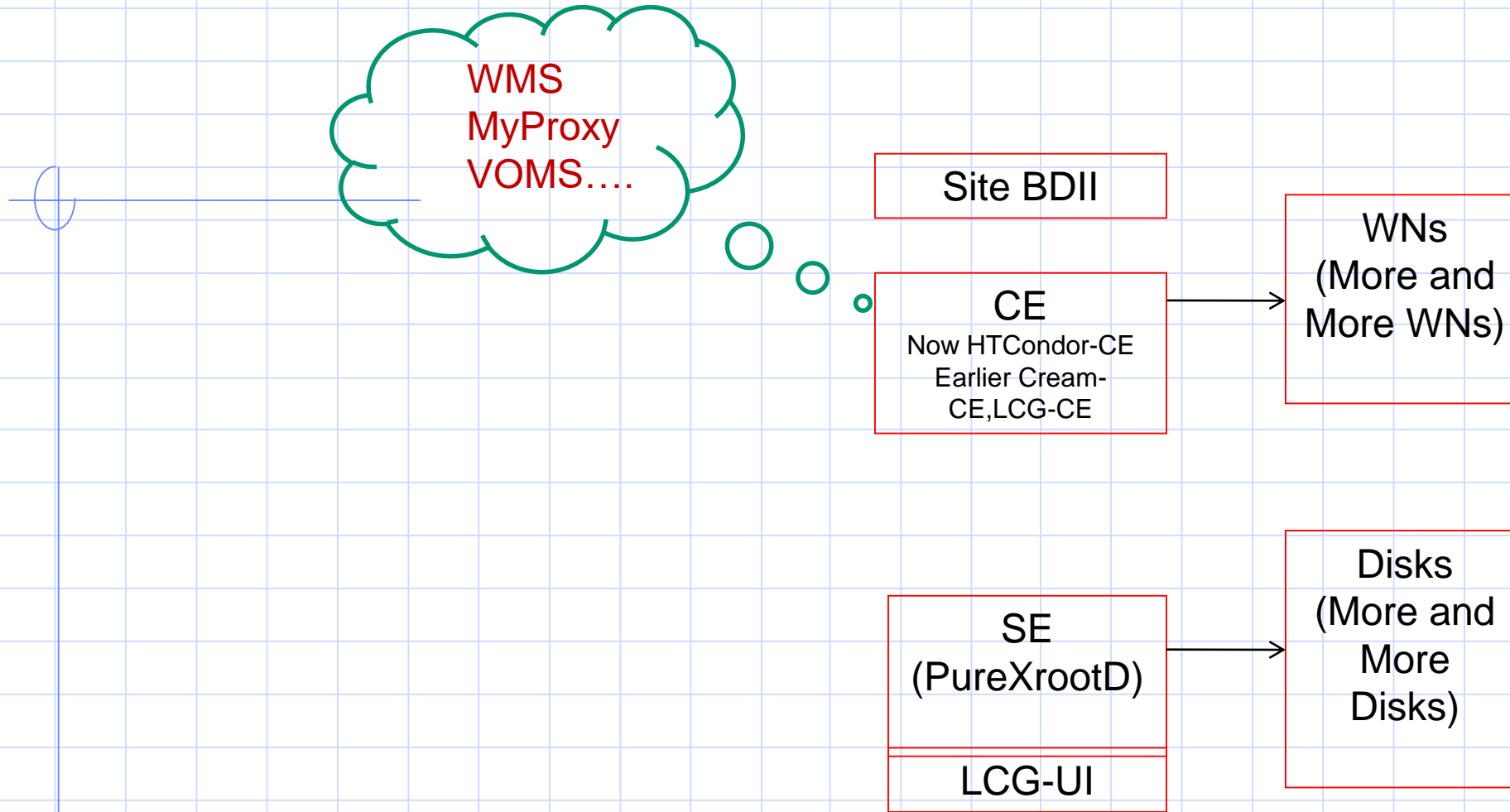
KOLKATA Site Components

Central
Services
WMS
MyProxy

VO-BOX

Cooling, UPS
Fire Alarm,
Access Control
etc…

|		
Site BDII	NFS SERVER	Blade 64 bit Servers With Blade Enclosures
CREAM-CE	PBS SERVER	HP DELL IBM Etc…
EOS	DNS SERVER	32or64bit Servers
PureXrootD	UI SERVER	1U & 2U Servers
XrootD Redirector	Tier3 Management Server and cluster	New SAN Box
XrootD Disk Server		Old NAS
		Older NAS
	HA SERVER	Even Older DAS
Monitoring Server		Few Tower Servers
Installation,DHCP Server etc..		Disks Arrays (More and More Arrays)

Current Status and Recent Upgradation

Upgradation of HTCondor-CE (v4.5.2 to v5.1.6) and HTCondor (v8.8.17 to v9.0.17)

✓ GGUS Ticket Generated on 2022-06-01 (**Ticket-ID: 157563**)

✓ Planned Upgradation during First Week of November 2022.

✓ Implementation start on : 03/11/2022 and end on : 16/11/2022. Took little longer due to the dependencies of HT Condor-CE for CentOS Stream – 8.

✓ Site is up on 16/11/2022

Upgradation Steps:

➢ made condor peaceful offline and one by one switched off the worker nodes.

➢ Installed CentOS Stream 8 and HTCondor (v9.0.17) – execute role and all meta-packages required by WLCG/ALICE on WNs.

➢ Switched off the CE and CM (taken a backup of config files).

➢ Installed CentOS Stream 8 and HTCondor (v9.0.17) - -- central-manager and submitter role and all meta-packages required by WLCG/ALICE on CM and CE.

➢ Copied the Token file from CM to all execute nodes and submitter.

➢ HTCondor cluster is ready but not communication with VOBOX
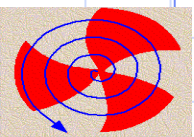
Enabling of HTCondor-Cluster for WLCG

Upgradation Steps continue… :

➢ Due to the dependencies like apel-lib, apel-parsers, apel-ssm, python-ldap =<3.4.0; python-dirq, MySQL-python, could not install htcondor-ce-apel with CentOS Stream 8. EGI's UMD middleware is not supported with CentOS Stream 8. Till now could not resolve.

➢ Again installed CentOS 7 and HTCondor v9 and HTCondor-CE v5 with WLCG/ALICE meta packages and Host-Certificate are installed.

➢ Followed the document : https://twiki.cern.ch/twiki/bin/view/LCG/MiniHTCsetup

➢ VOBOX → htcondor-ce : Could not connect due to wrong GSI Mapping (GSS_ASSIST_GRIDMAP). (Maarten Litmaath helped to resolve the issue.)

PROBLEM to check :-

==============================
condor_ping –verbose –name Kolkata-condor-ce.tier2-kol.res.in –pool Kolkata-condor-ce.tier2-kol.res.in:9619 WRITE
WRITE failed!
SECMAN:2010:Received "DENIED" from server for user gsi@unmapped using method GSI.

==============================

SOLUTION
Differences of condor_mapfile in HTCondor-CE v8
/etc/condor-ce/condor_mapfile and write the mapping as
GSI   ".*,\/foo\/Role=NULL\/Capability=NULL"   foousr001.

Condor v9 version, condor_mapfile
/etc/condor-ce/mapfiles.d/11-gsi.conf
GSI   /.*,\/foo\/Role=NULL\/Capability=NULL/   foousr001
(The enclosing characters for the regex to be changed from " to perl-flavoured / .)
And comment below lines
#GSI (.*) GSS_ASSIST_GRIDMAP
#GSI "(/CN=[-.A-Za-z0-9/=]+)" \1@unmapped.htcondor.org
#CLAIMTOBE .* anonymous@claimtobe
#FS (.*) \1

SUCCESSFUL Output VOBOX – HTCondor-CE

==============================
condor_ping -verbose -name kolkata-condor-ce.tier2-kol.res.in -pool kolkata-condor-ce.tier2-kol.res.in:9619 WRITE
Remote Version: $CondorVersion: 9.0.17 Sep 29 2022 BuildID: 607845
PackageID: 9.0.17-1 $
Local Version: $CondorVersion: 8.8.17 Mar 11 2022 BuildID: 577936
PackageID: 8.8.17-1 $
Session ID: kolkata-condor-ce:21777:1668591813:492
Instruction: WRITE
Command: 60021
Encryption: none
Integrity: MD5
Authenticated using: GSI
All authentication methods: FS,GSI
Remote Mapping: alicesgm@users.htcondor.org
Authorized: TRUE
==============================

Grid-Peer Tier3 Cluster Status

Grid-Peer Head Node CM-ldap

Interactive Nodes

Non-interactive Nodes

Storage

- Total 624 Threads (48 Threads/server).
- Extensively used by VECC users and ALICE INDIA/CBM INDIA Collaborators. 75+ active users (across India)
- Grid-Peer: Head Node/ HTCondor Submitter.
- CM-ldap: Ldap Authentication Server + HT Condor CM
- Interactive Nodes (Grid-peer) : 4 Nos. @48 threads & 128GB RAM.
- Non-interactive Nodes(HT-Condor Execute Nodes): 9 Nos. @48 threads & 128GB RAM.
- Network Connected : 10G Fibre.
- OS debian 11.3 (64bit).
- Two factor authentication Login (1-Key-Based Authentication, 2-PasswordAuthentication,).
- Access to Grid-Peer Head-Node by using LAN & WAN(IPv4).
- gcc version 10.2.1 20210110 & condor version 9.12.0-1.1

Storage:

- Glusterfs Storage: 129 TB Usable Space. (Replica-2 Type)
- Total space 216TB (18Hard disk) 15 hard disk usable and 3 Global hot spare and Configuring RAID 5
- Glusterfs Storage are installed with Centos Stream 8.
- Users home directory of interactive nodes are mounted by NFS through Glusterfs storages.

Monitoring under development

Network is provided

by NKN India.

Thank You