Web to Cloud !!!

Prabhakar Dhekne

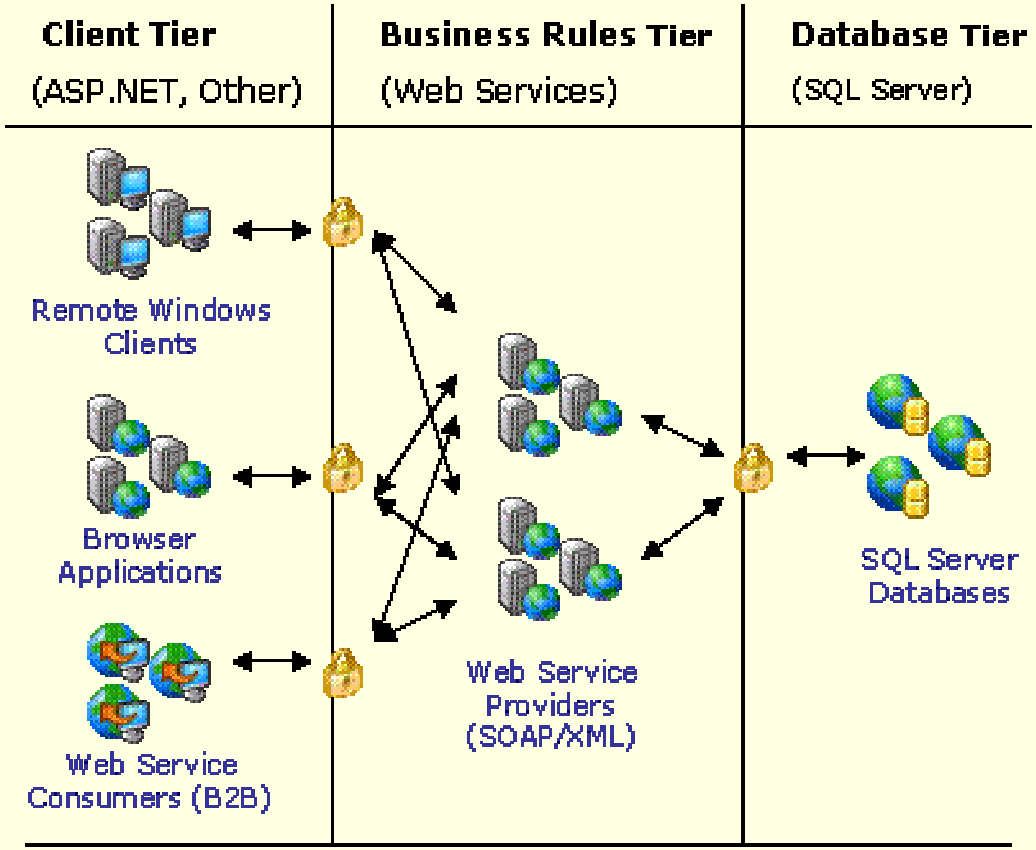
Scientific Consultant to Principal Scientific Adviser to GOI, Raja Ramanna Fellow, BARC

Physics and the Web

- Tim Berners-Lee developed the Web at CERN as a tool for exchanging information between the partners in physics collaborations
- It was the international particle physics community who first embraced the Web
  - ‘Killer’ application for the Internet
  - Transformed modern world – academia, business and leisure

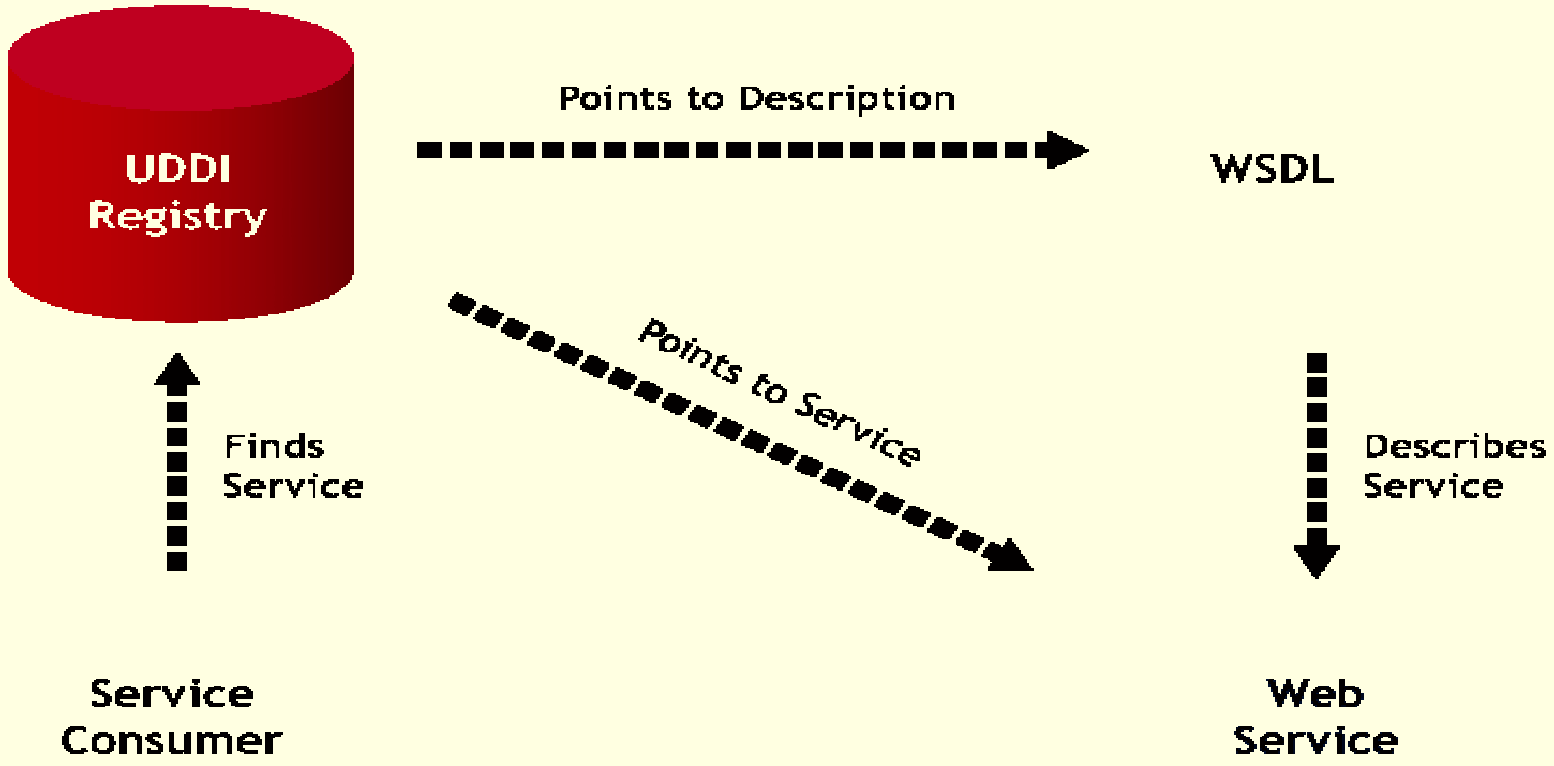
Service Oriented Architecture (SOA)

Service oriented architectures are not a new thing. The first service oriented architecture for many people in the past was with the use DCOM or Object Request Brokers (ORBs) based on the CORBA specification.



A service-oriented architecture is essentially a collection of services. These services communicate with each other. The communication can involve either simple data passing or it could involve two or more services coordinating some activity. A means of connecting services to each other is also needed.

Using Web Services



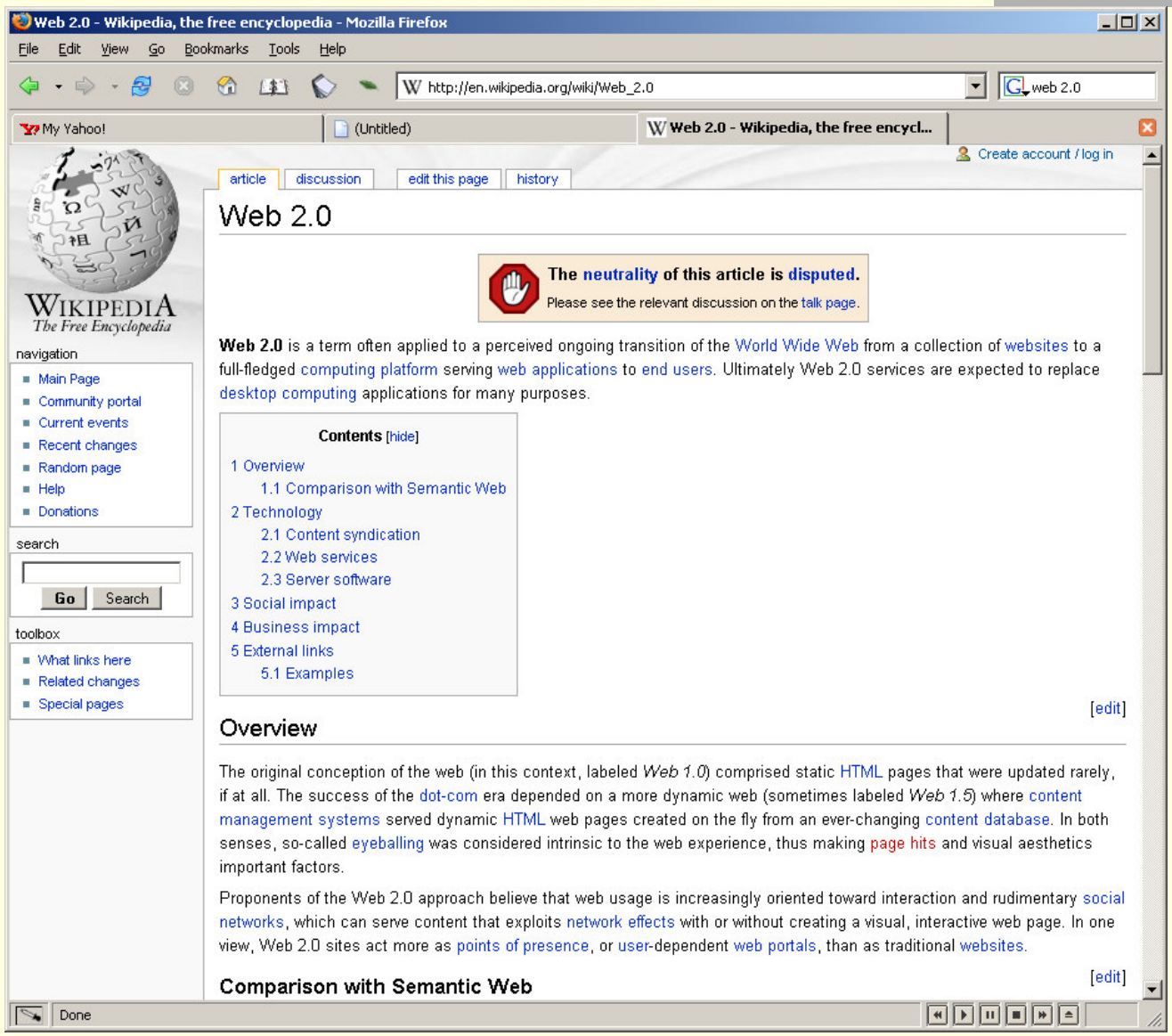
Internet as a ICT backbone

- Use of Internet as backbone e-infrastructure is very attractive (Yahoo, Google, Microsoft, You tube: Movie/AV/Images)
  - Increasing bandwidth – 10 Gbits/Sec
- Advances in storage capacity (Email Servers, Blogs, Orkut etc)
  - Terabytes, petabytes per site
- Advanced applications (SETHI@Home)
  - Simulation based design, sharing of advanced instruments
- Increased availability of compute resources (TFLOPS)
  - Data Centres, Clusters, Web farms, Grids : Cloud Computing

Google's Computing Infrastructure

- Google have created a new class of large-scale computer systems to support Internet search
  - ~ 3 million processors in clusters of ~2000 processors each
  - Commodity parts
    - x86 processors, IDE disks, Ethernet communications
    - Gain reliability through redundancy & software management
  - Partitioned workload
    - Data: Web pages, indices distributed across processors
    - Function: crawling, index generation, index search, document retrieval, Ad placement
- A Data-Intensive Super Computer (DISC)
  - Large-scale computer centered around data
    - Collecting, maintaining, indexing, computing
  - Similar systems at Microsoft & Yahoo

Wikipedia is a Collaborative Dictionary Being Edited in Realtime by Anyone



India and the LHC

- **India's collaboration with CERN currently involves some 130 people.**
- **Indian engineers are playing a key role in LHC magnet testing.**
- **Indian industry is delivering state-of-the-art equipment.**
- **Indian scientists are participating in the CMS and ALICE detectors.**
- **India is a partner in developing a global Grid for the LHC and has set up regional WLCG in India**

India's kind contribution is over 60 MCHF

May 25th, 2005 Visit of Dr Avul Pakir Jainulabdeen Abdul Kalam - President of India

LHC: Large Hadron Collider

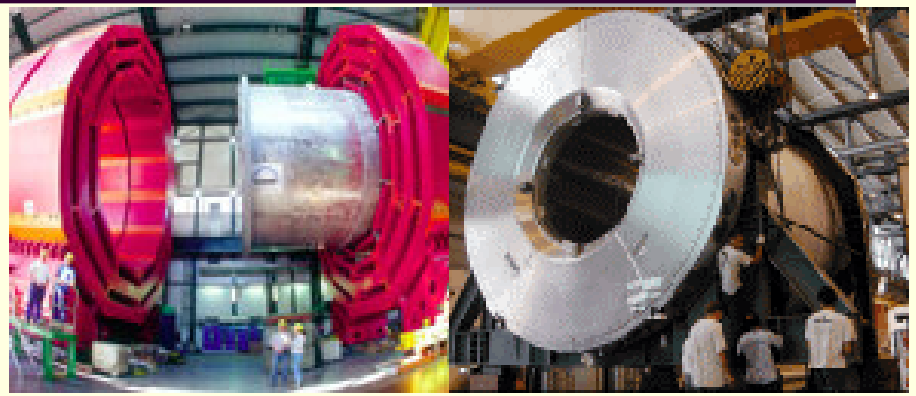
Largest particle accelerator

International research on particle

100m below CERN, near Geneva, Swiss

Indian collaboration

Petabytes data/experiment



Construction of CMS & ALICE Experiment Devices

Inside LHC Tunnel

source: http://lhc.web.cern.ch/lhc/

CERN

The LHC Data Challenge

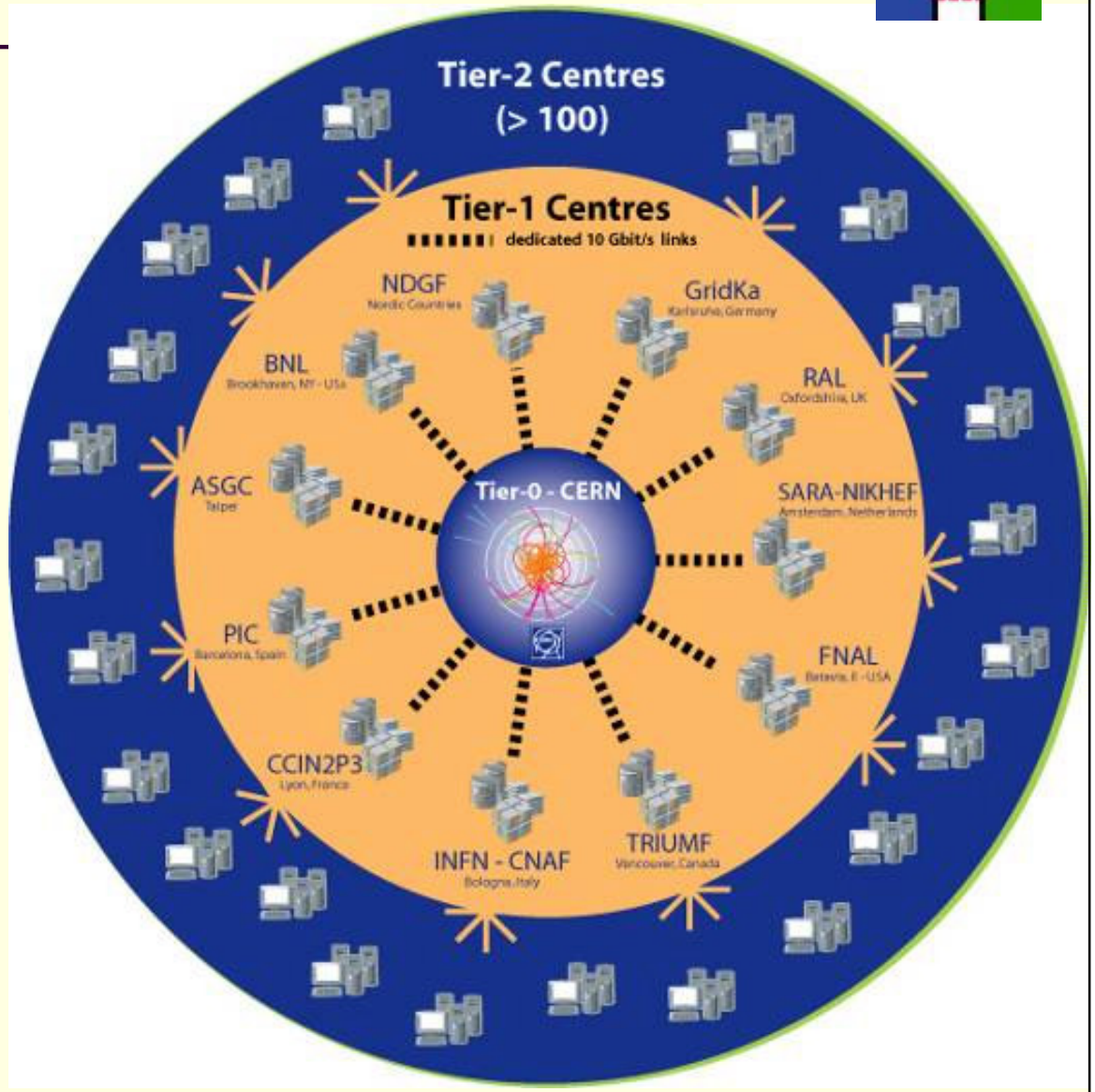
- LHC experiments will produce **10-15 million Gigabytes** of data each year (about 20 million CDs!)
- LHC data analysis requires a computing power equivalent to **~ 100,000 of today's fastest PC processors**.
- Requires many cooperating computer centres, CERN proving only ~20% of the CPU power

Beyond the Web?

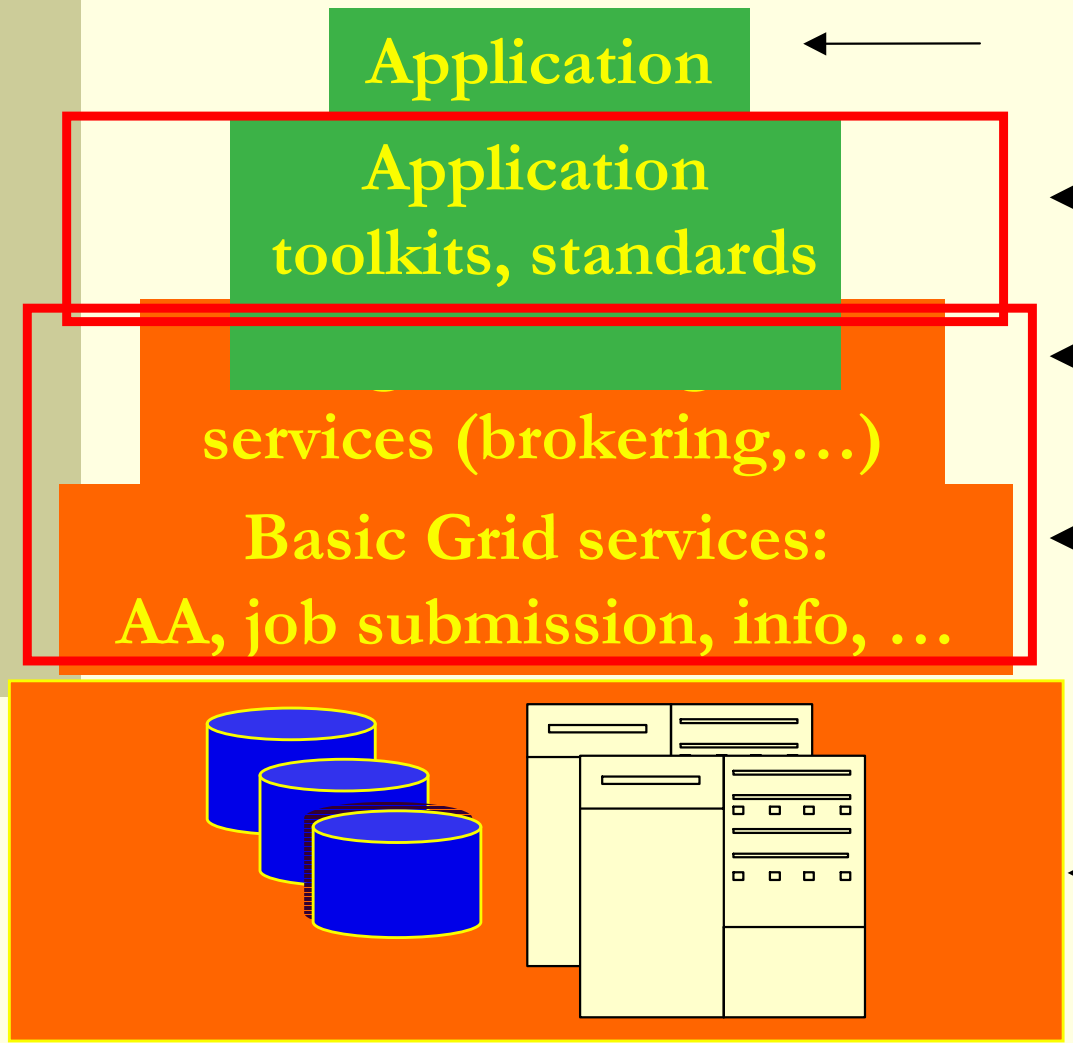
- Scientists developing collaboration technologies that go far beyond the capabilities of the Web
  - To use remote computing resources
  - To integrate, federate and analyse information from many disparate, distributed, data resources
  - To access and control remote experimental equipment
- Capability to access, move, manipulate and mine data is the central requirement of these new collaborative science applications
  - Data held in file or database repositories
  - Data generated by accelerator or telescopes
  - Data gathered from mobile sensor networks

LHC Computing Grid project (LCG)

- More than 140 computing centres
- 12 large centres for primary data management: CERN (Tier-0) and eleven Tier-1s
- 38 federations of smaller Tier-2 centres
- India – BARC, TIFR, VECC
- Relies on EGEE and OSG Grids



Context



Graphical interface

Portal and

Command line tools

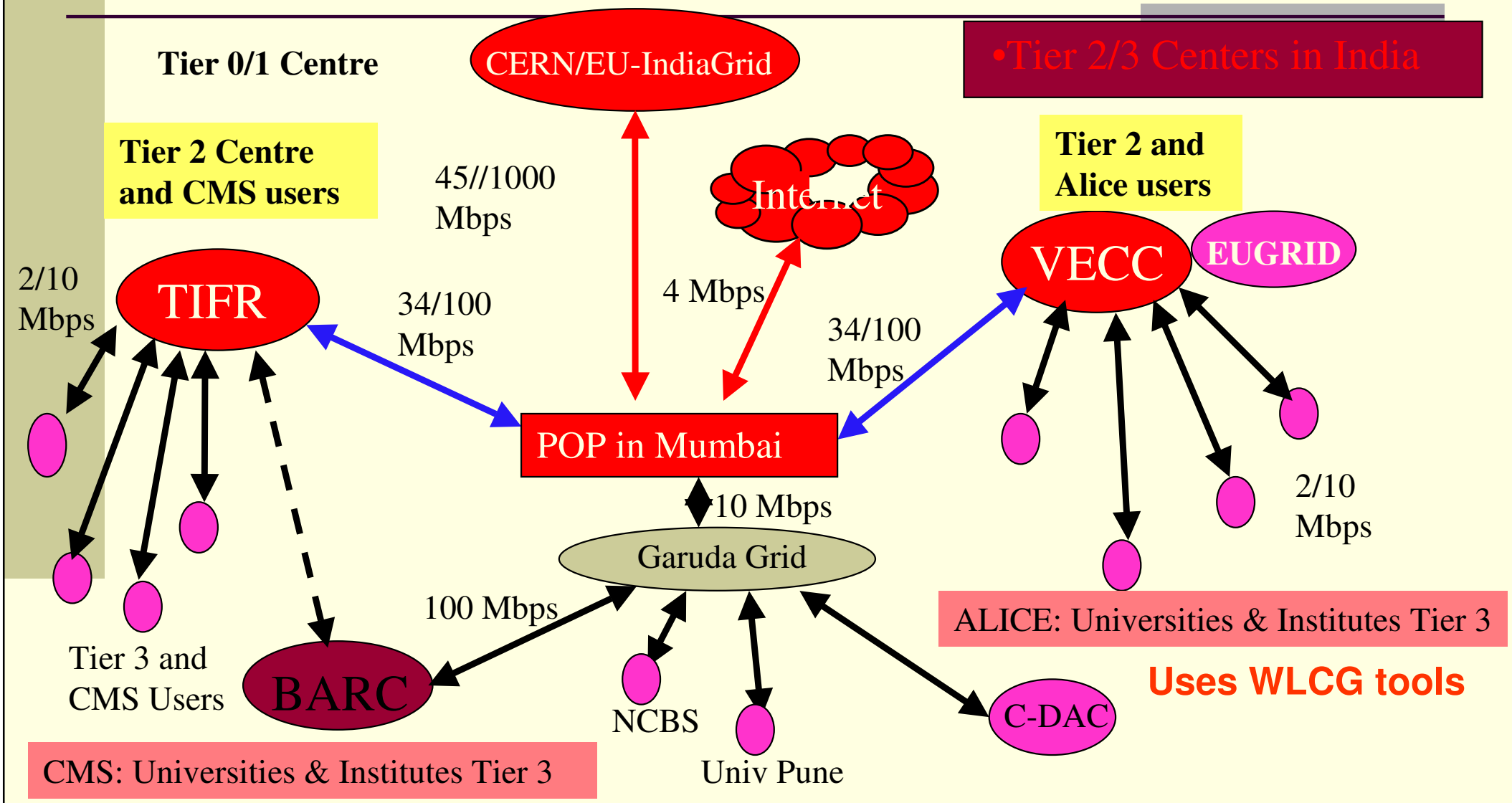
Grid middleware
LCG: gLite

Fabric

Contributions in LHC Grid

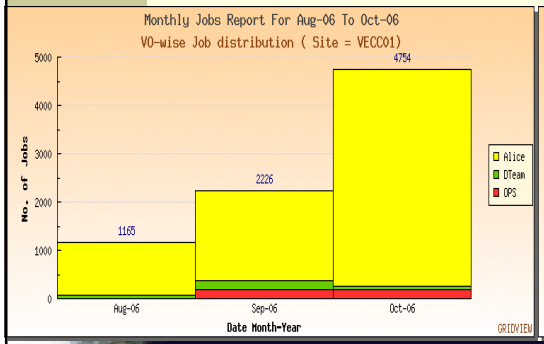
- DAE in collaboration with IT Division CERN is developing global Grid components & tools for the WLCG & Operations support (till now over 750 man-month). From 2010 onwards contributions are in the area of virtualization and cloud computing.
- Indian scientists are participating in the CMS and ALICE experiment & detector development
- India has operational ALICE (Kolkata) and CMS (TIFR) Tier II regional centres of WLCG network in India connected to DAE (BARC, IOPB, SINP) Institutes and 14 Universities.
- Contribution as 2 FTE per year for LCG operation, also developed diagnostics software

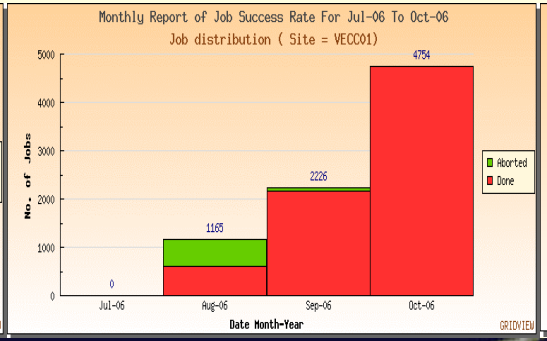
DAE-WLCG & EU-IndiaGrid

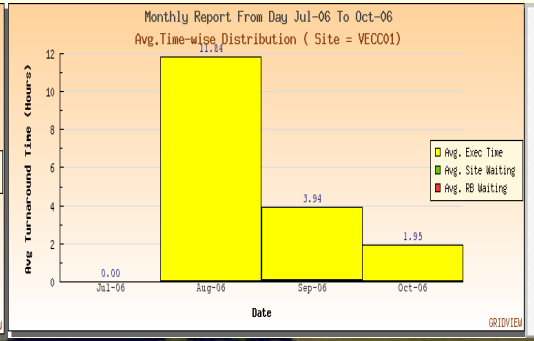


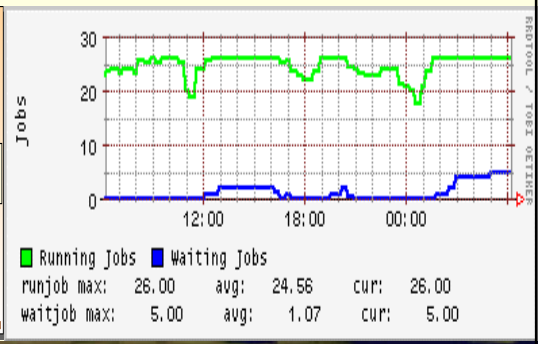
DAE/DST/ERNET: Geant link operational since August 2006 and EU-IndiaGrid since Jan 2007

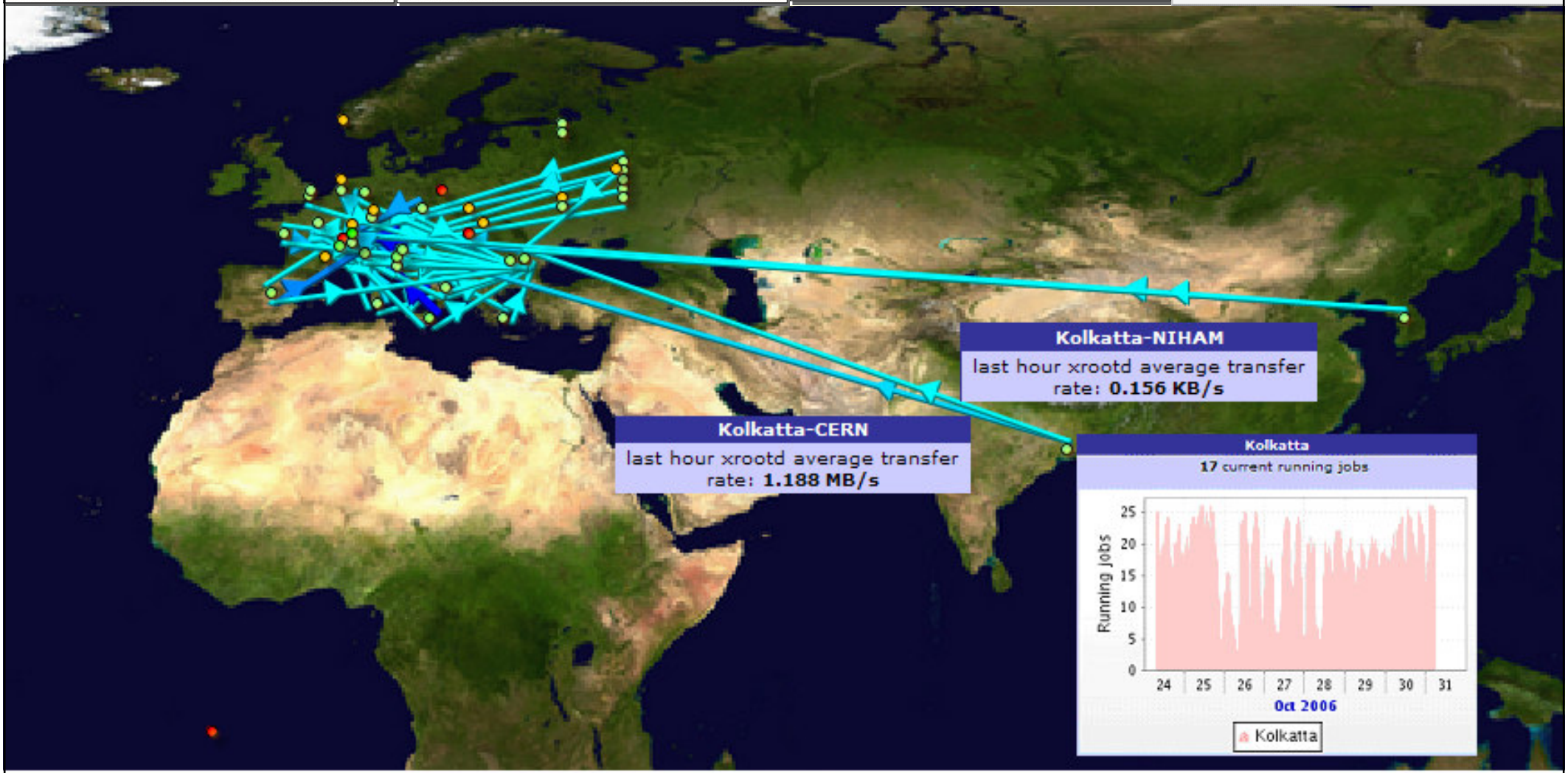
PDC-06 Status





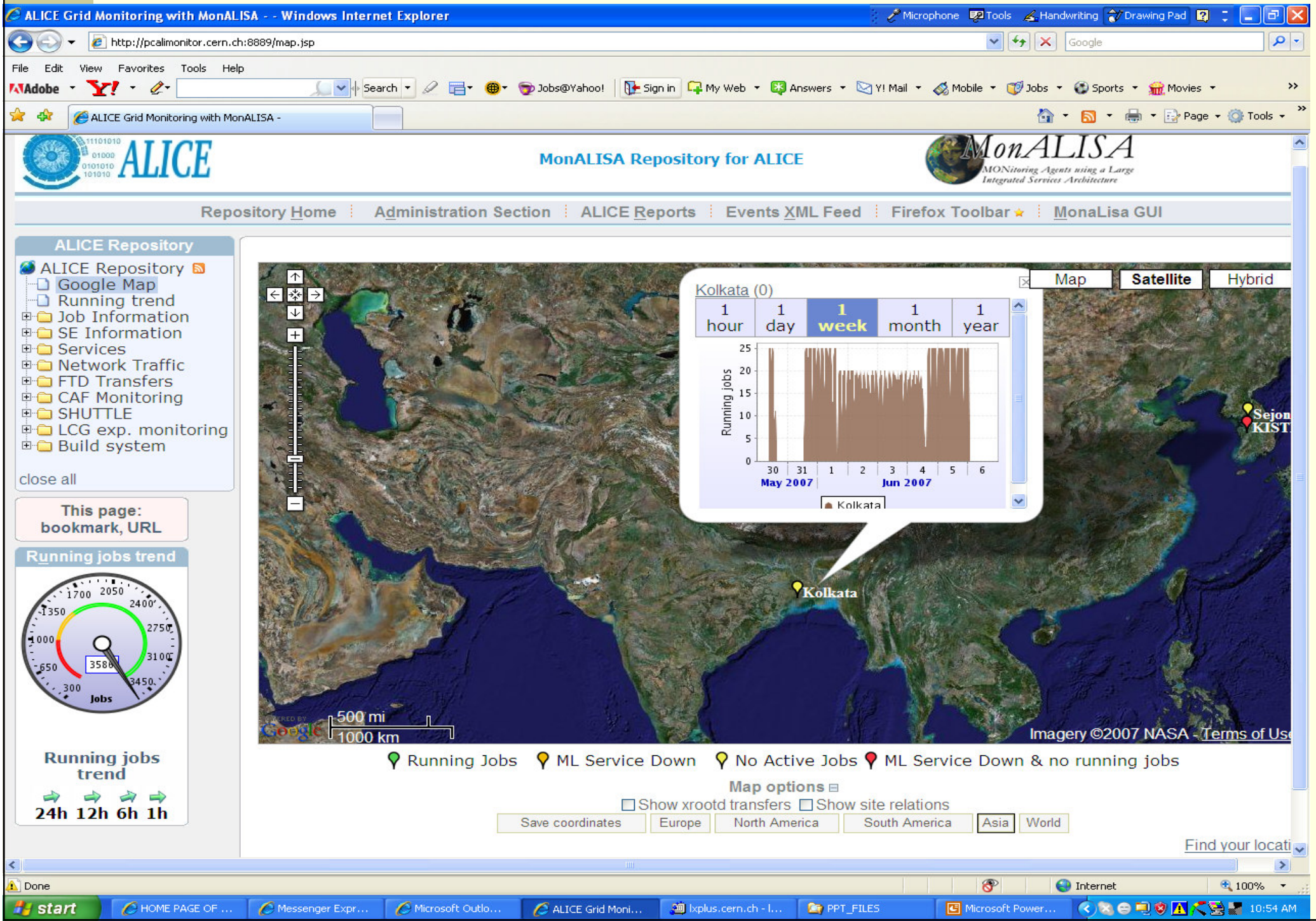




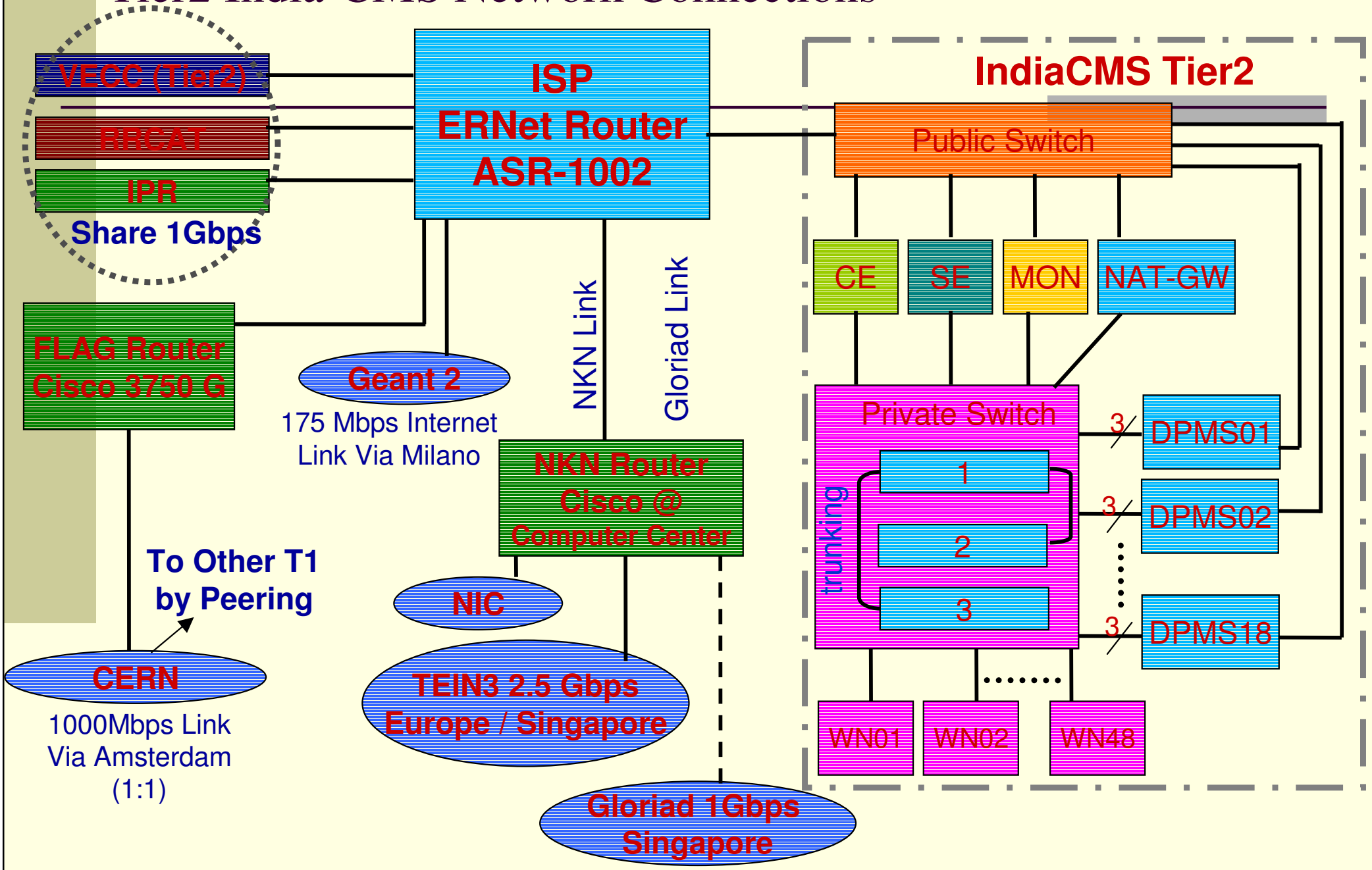


Running Jobs Zombie Jobs No Active Jobs ML Service Down

PDC-07 Status



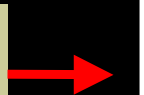
Tier2 India-CMS Network Connections



Participated in

- Data Challenges PDC 06, PDC07,
- Calibration Challenges
- Live surgery for TMH

Indian Tier II Sites



Tier-2 Availability and Reliability Report

Federation Summary - Sorted by Name — March 2008

Critical SAM Tests - http://sam-docs.web.cern.ch/sam-docs/docs/htmldocs/MANUserManual/node22.html

Availability = % of successful tests
Reliability = Availability / Scheduled Availability
Reliability and Availability for federation - average of all sites in the federation

Colour coding : < 30% | < 60% | < 90% | >= 90%

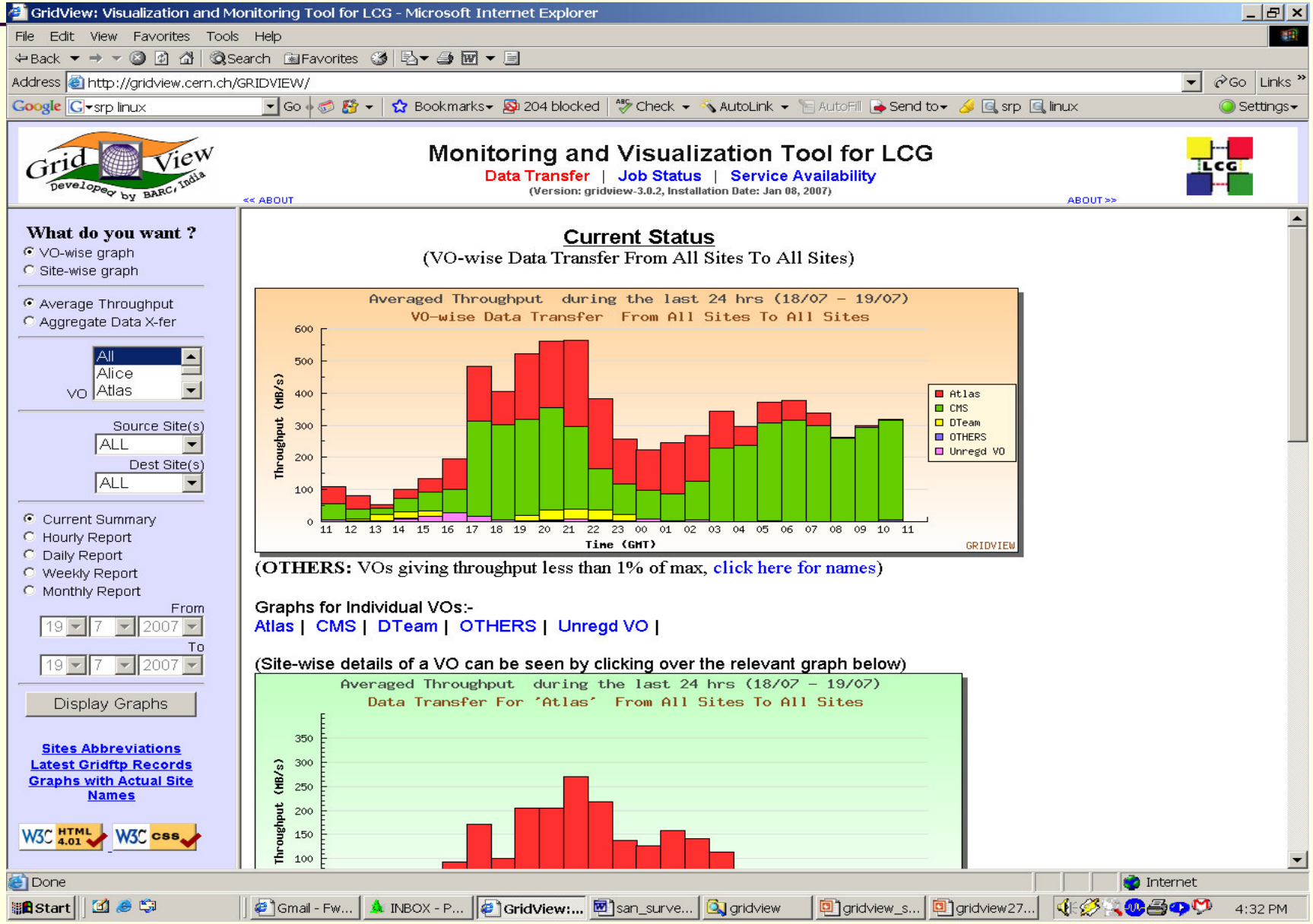
Federation	Reli-ability	Avail-ability
AT-HEPHY-VIENNA-UIBK	99 %	92 %
AU-ATLAS	43 %	46 %
BE-TIER2	89 %	89 %
CH-CHIPP-CSCS	87 %	88 %
CN-IHEP	71 %	65 %
CZ-Prague-T2	96 %	95 %
DE-DESY-LHCb-T2	98 %	98 %
DE-DESY-RWTH-CMS-T2	86 %	87 %
DE-FREIBURGWUPPERTAL	89 %	88 %
DE-GSI	88 %	89 %
DE-MCAT	84 %	82 %
ES-ATLAS-T2	91 %	86 %
ES-CMS-T2	92 %	90 %
ES-LHCb-T2	83 %	77 %
FR-GRIF	97 %	96 %
FR-IN2P3-CC-T2	96 %	89 %
FR-IN2P3-LAPP	87 %	88 %
FR-IN2P3-LPC	100 %	100 %
FR-IN2P3-SUBATECH	99 %	99 %
HU-HGCC-T2	89 %	89 %
IL-HEPTier-2	54 %	57 %
IN-DAE-KOLKATA-TIER2	93 %	93 %
IN-INDIACMS-TIFR	53 %	53 %
IT-ALICE-federation	82 %	77 %
IT-ATLAS-federation	82 %	77 %
IT-CMS-federation	82 %	77 %

Federation	Reli-ability	Avail-ability
IT-LHCb-federation	82 %	77 %
JP-Tokyo-ATLAS-T2	97 %	95 %
PK-CMS-T2	73 %	62 %
PL-TIER2-WLCG	89 %	81 %
PT-LIP-LCG-Tier2	73 %	75 %
RO-LCG	83 %	74 %
RU-RDIG	84 %	83 %
SI-SiGNET	93 %	93 %
T2_US_Caltech	0 %	46 %
T2_US_Florida	0 %	46 %
T2_US_MIT	0 %	46 %
T2_US_Nebraska	0 %	45 %
T2_US_Purdue	0 %	31 %
T2_US_UCSD	0 %	46 %
TR-Tier2-federation	90 %	91 %
TW-FTT-T2	86 %	87 %
UK-London-Tier2	85 %	58 %
UK-NorthGrid	89 %	87 %
UK-ScotGrid	91 %	86 %
UK-SouthGrid	95 %	93 %
US-AGLT2	8 %	11 %
US-MWT2	68 %	70 %
US-NET2		100 %
US-SWT2		100 %
US-WT2	0 %	7 %

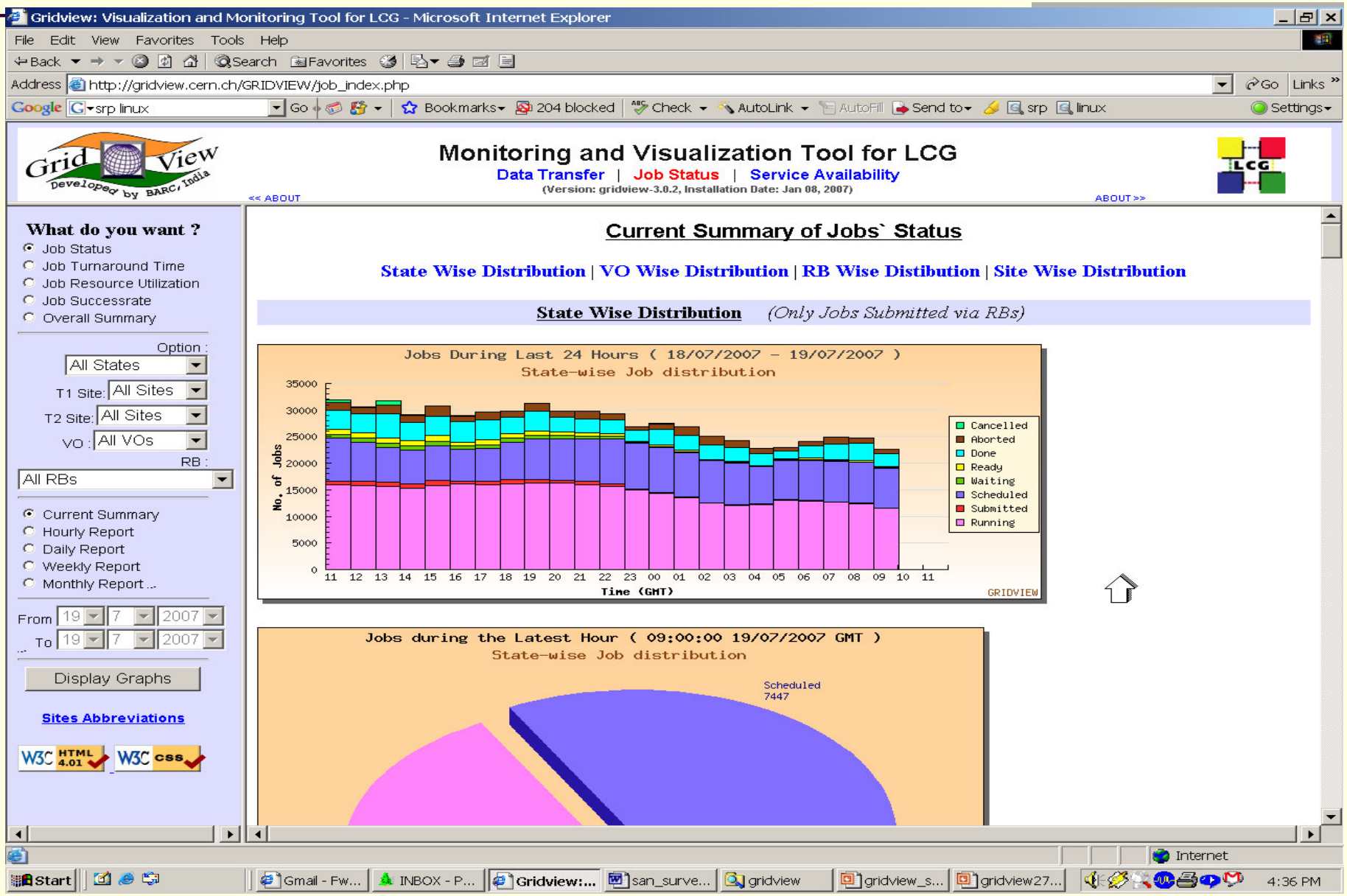
* US sites in OSG are not yet included in the critical test system

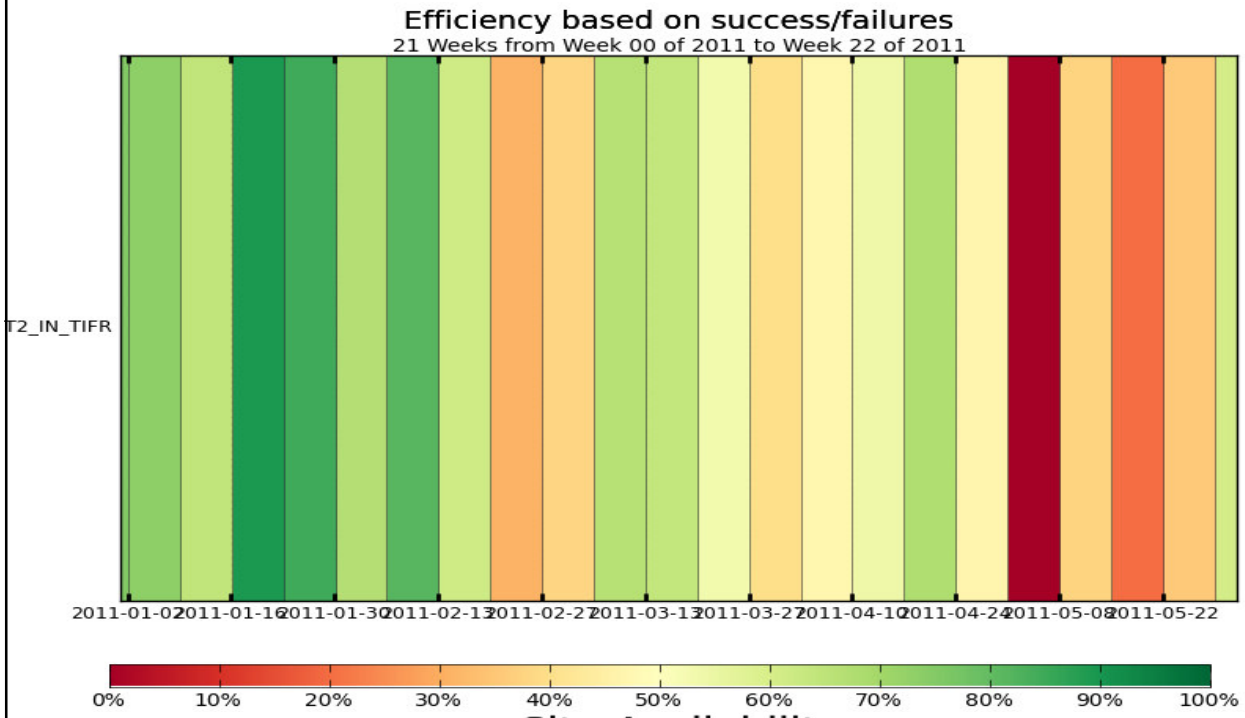
Large number of ALICE & CMS Jobs Submitted

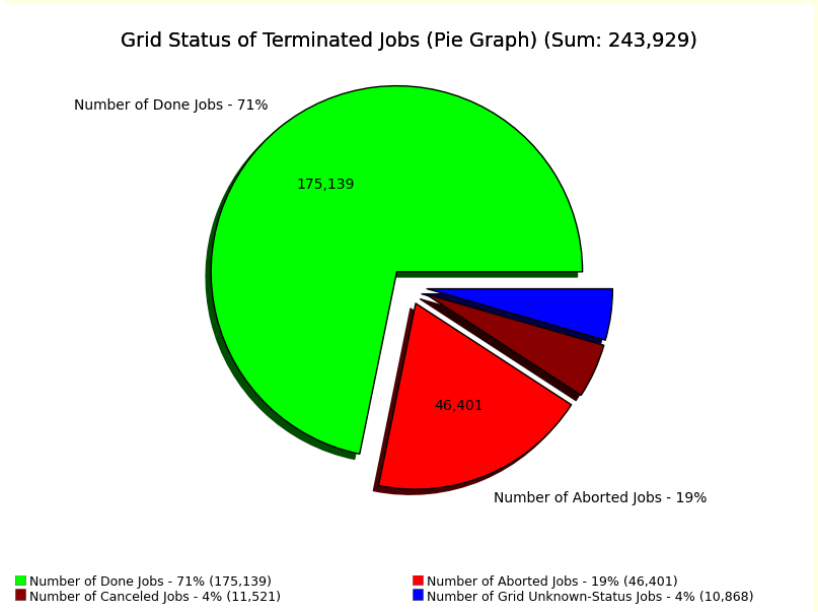
VO-wise Data Transfer

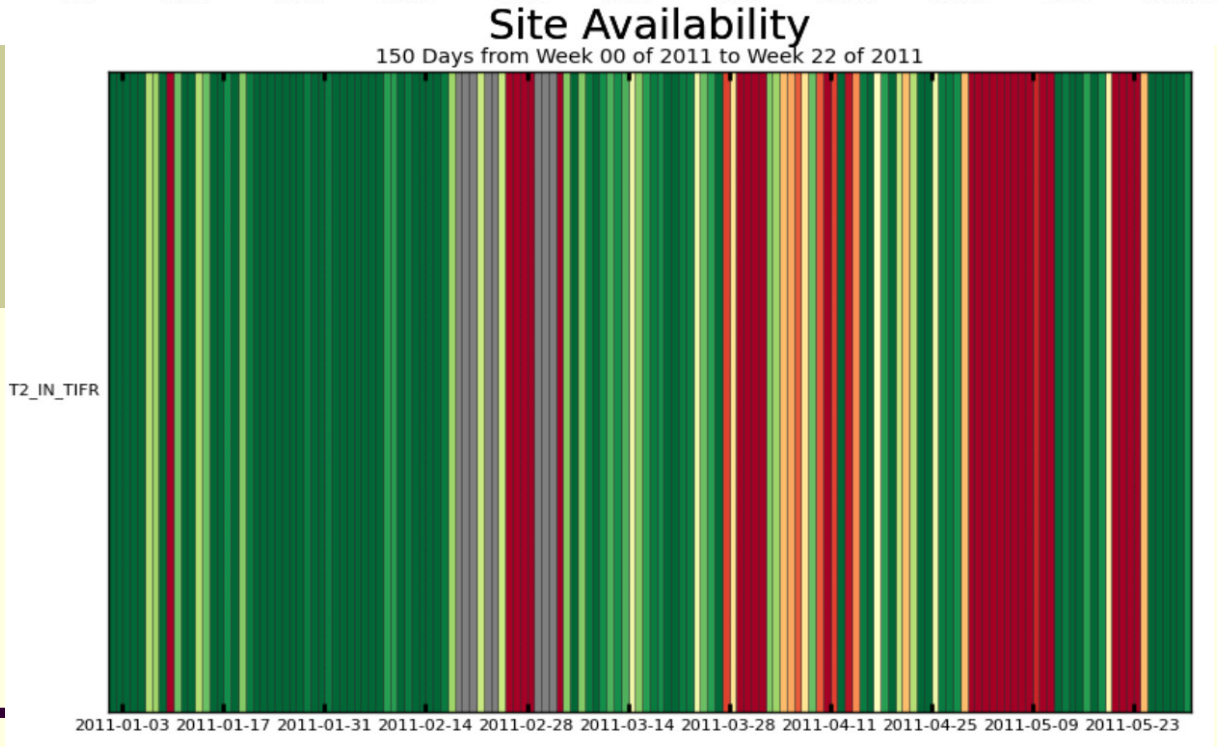


Job Status


Gridview: Visualization and Monitoring Tool for LCG - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Address http://gridview.cern.ch/GRIDVIEW/job_index.php
Monitoring and Visualization Tool for LCG
Data Transfer | Job Status | Service Availability
(Version: gridview-3.0.2, Installation Date: Jan 08, 2007)
<< ABOUT
ABOUT >>
What do you want ?
Job Status
Job Turnaround Time
Job Resource Utilization
Job Successrate
Overall Summary
Option :
All States
T1 Site: All Sites
T2 Site: All Sites
VO : All VOs
RB :
All RBs
Current Summary
Hourly Report
Daily Report
Weekly Report
Monthly Report ..
From 19 7 2007
To 19 7 2007
Display Graphs
Sites Abbreviations
Current Summary of Jobs` Status
State Wise Distribution | VO Wise Distribution | RB Wise Distibution | Site Wise Distribution
State Wise Distribution (Only Jobs Submitted via RBs)
Jobs During Last 24 Hours (18/07/2007 - 19/07/2007)
State-wise Job distribution
No. of Jobs
Time (GMT)
Cancelled
Aborted
Done
Ready
Waiting
Scheduled
Submitted
Running
GRIDVIEW
Jobs during the Latest Hour (09:00:00 19/07/2007 GMT)
State-wise Job distribution
Scheduled
7447
Start
4:36 PM



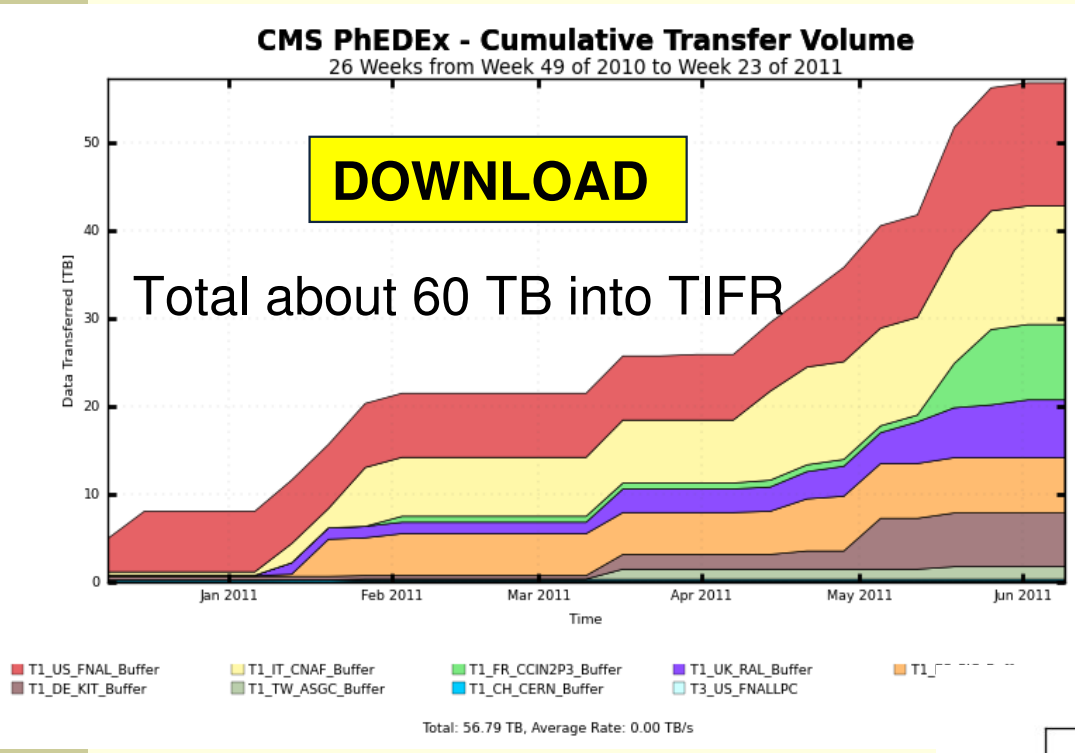




About 65% on average

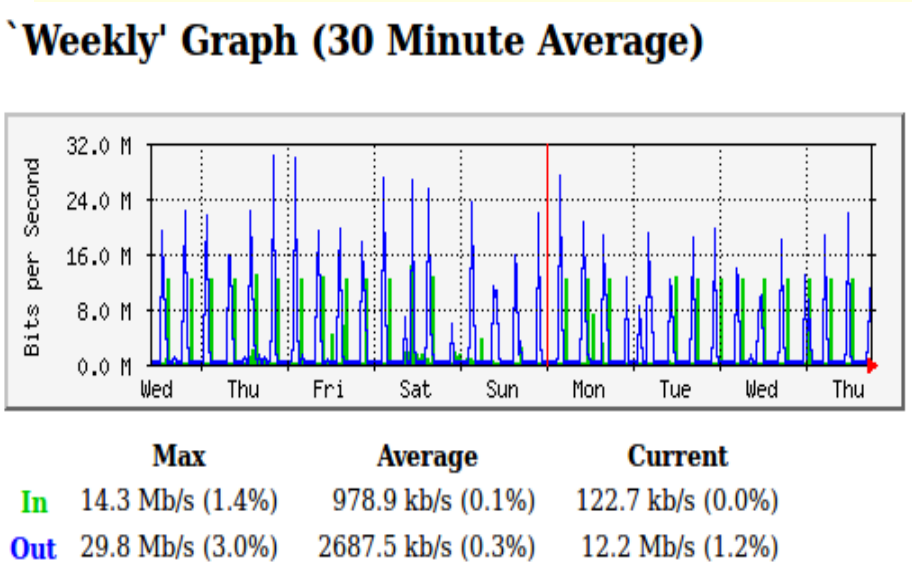
360 cores Quad core dual Intel 5355 and 485 TB storage

Transfers of Monte-Carlo production data



DOWNLOAD

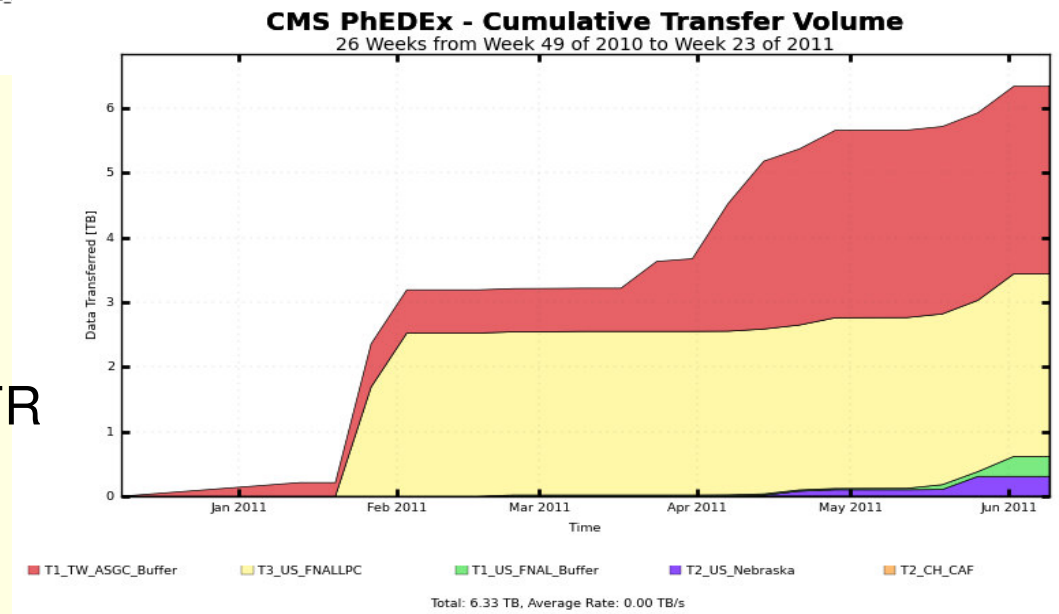
Total about 60 TB into TIFR



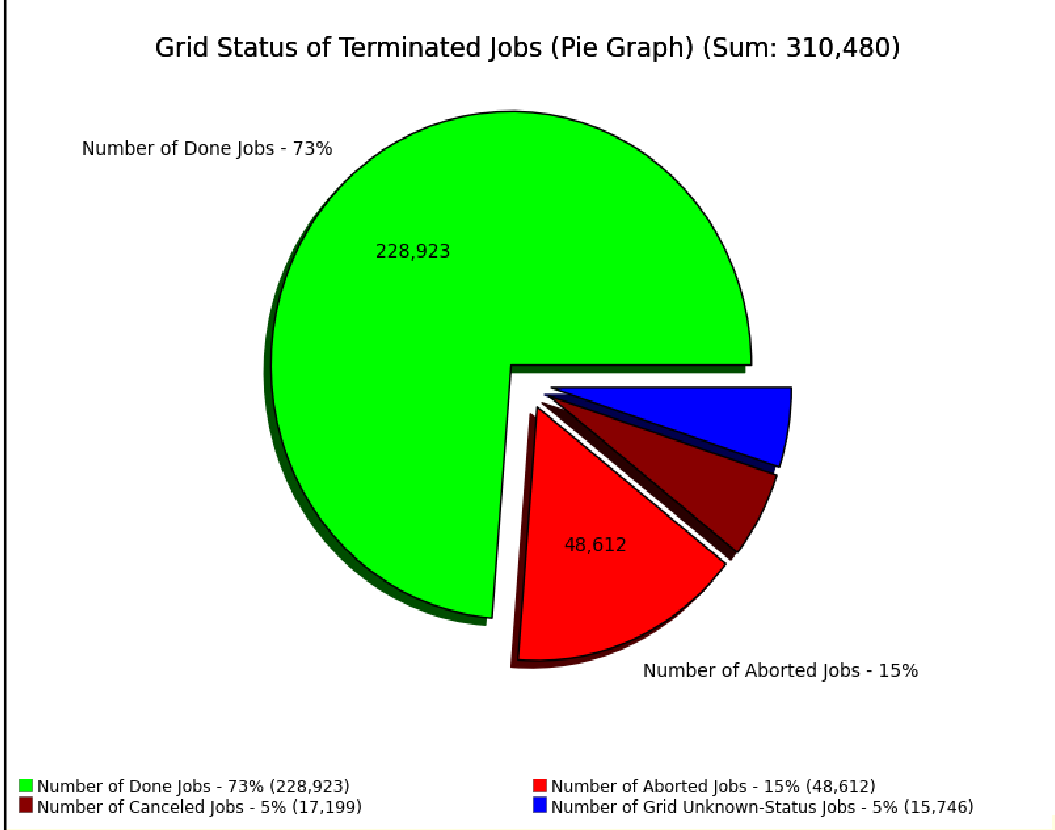
	Max	Average	Current
In	14.3 Mb/s (1.4%)	978.9 kb/s (0.1%)	122.7 kb/s (0.0%)
Out	29.8 Mb/s (3.0%)	2687.5 kb/s (0.3%)	12.2 Mb/s (1.2%)

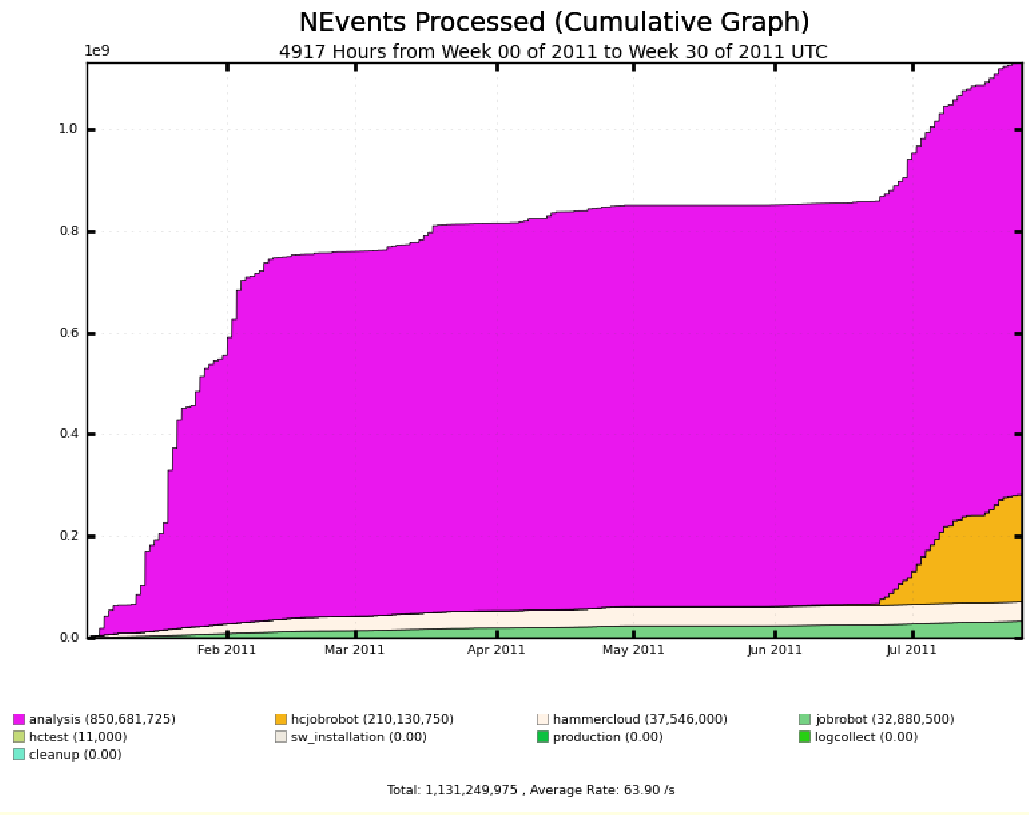
UPLOAD

Total about 6.5 TB from TIFR



Jobs @ T2-IN-TIFR





- Almost 10 Billion events have been processed at our T2 since beginning of this year.
- HCJobRobot and JobRobot's were passing successfully.

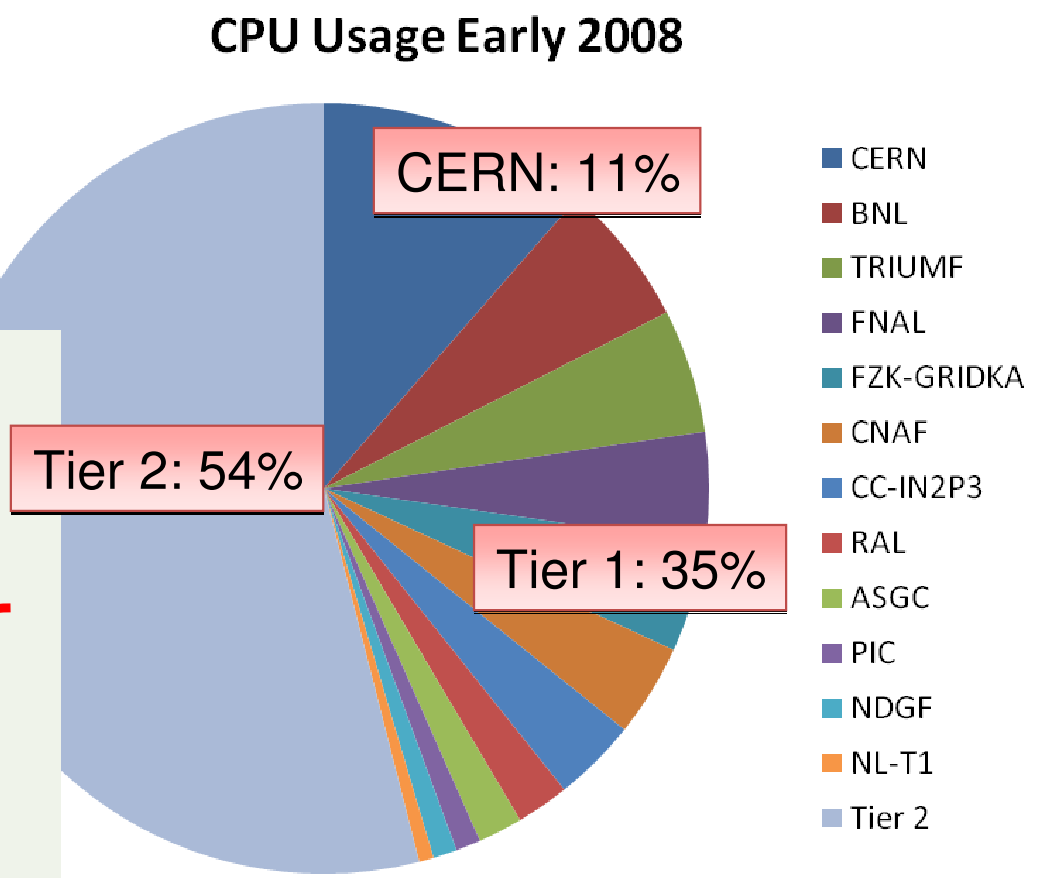
LHC Grid Fest

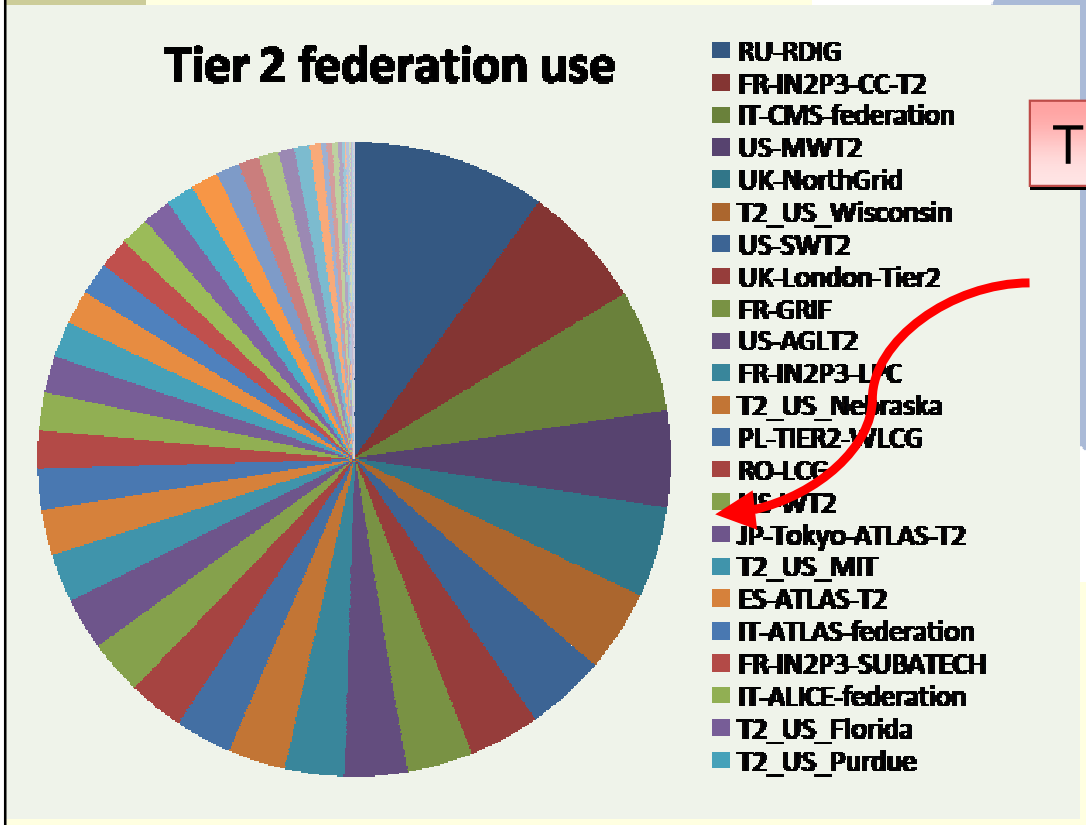
On 3rd October, the Worldwide Large Hadron Collider Computing Grid consortium announce the readiness of the Worlwide LHC Computing Grid (WLCG), an e-infrastructure conceived and designed to support this data challenge, and with it the research of more than 9000 physicists around the globe.

We are invited to participate in a Grid Fest an event celebrated at CERN to mark the operation of production level of WLCG, through Video conference **(only Tier I's are invited)**

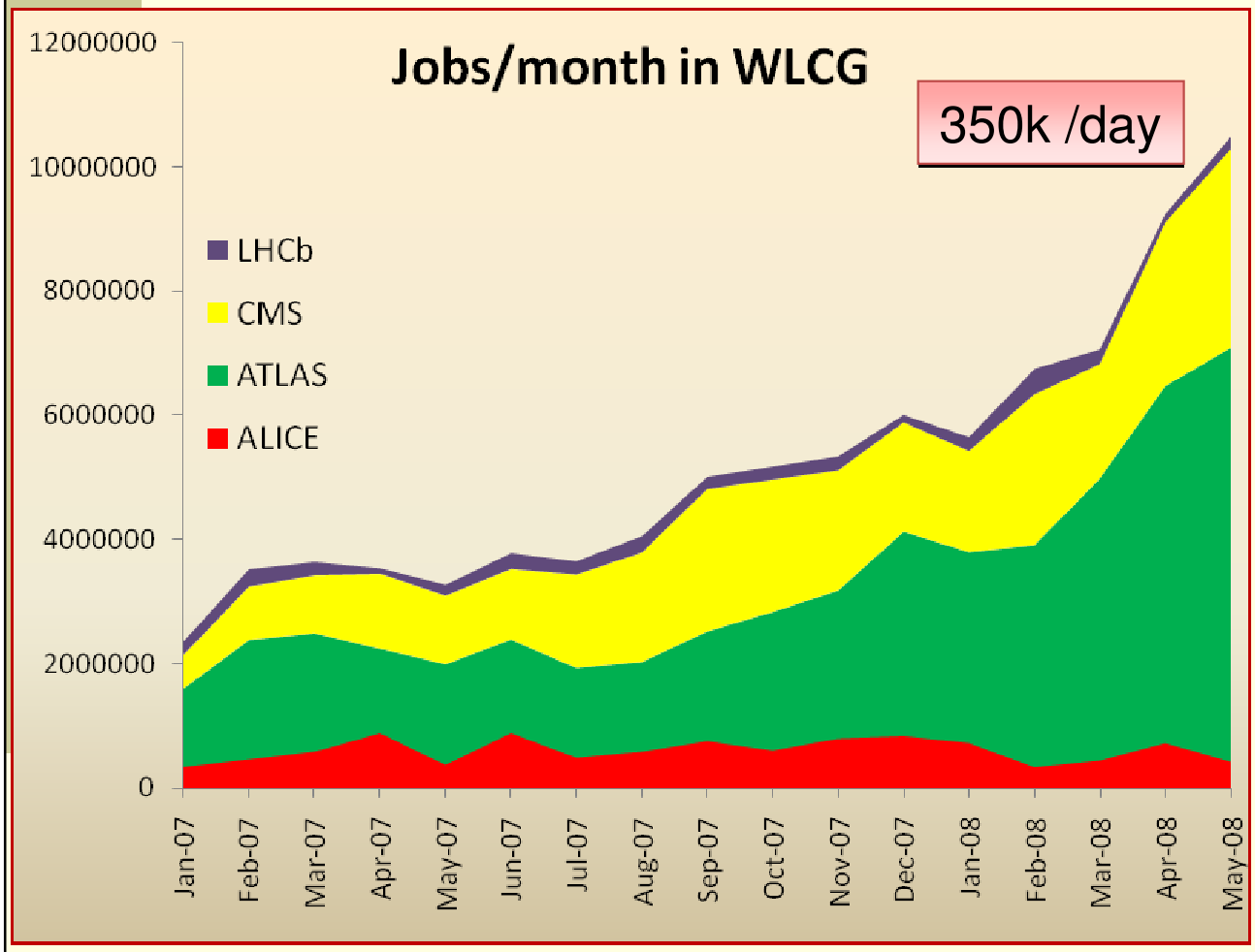
Recent grid use

- The grid concept really works – all contributions – large & small contribute to the overall effort!
- A worldwide collaboration in action !





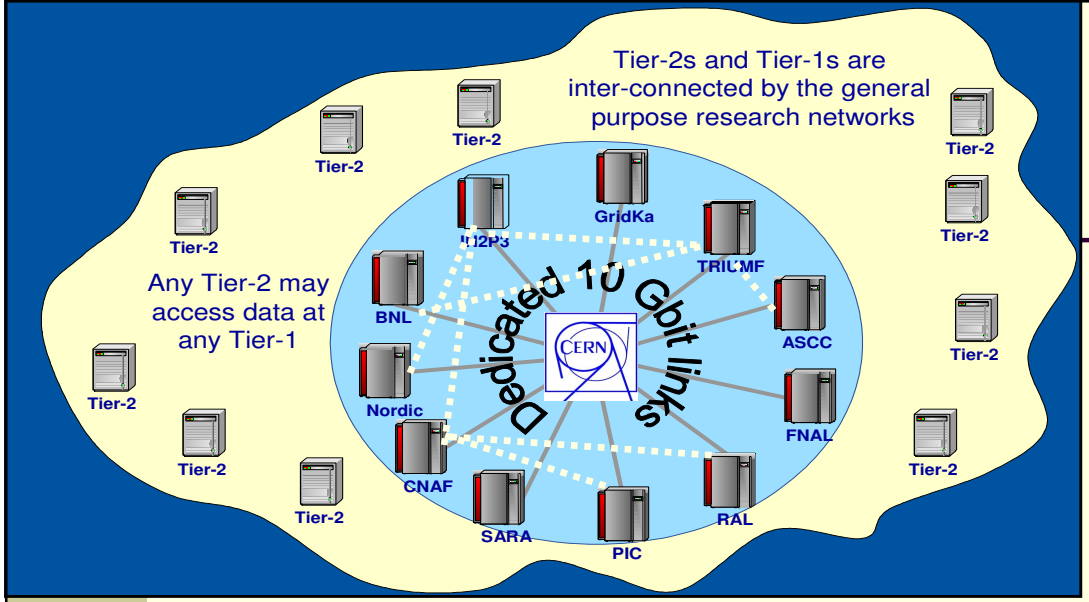
Recent grid activity

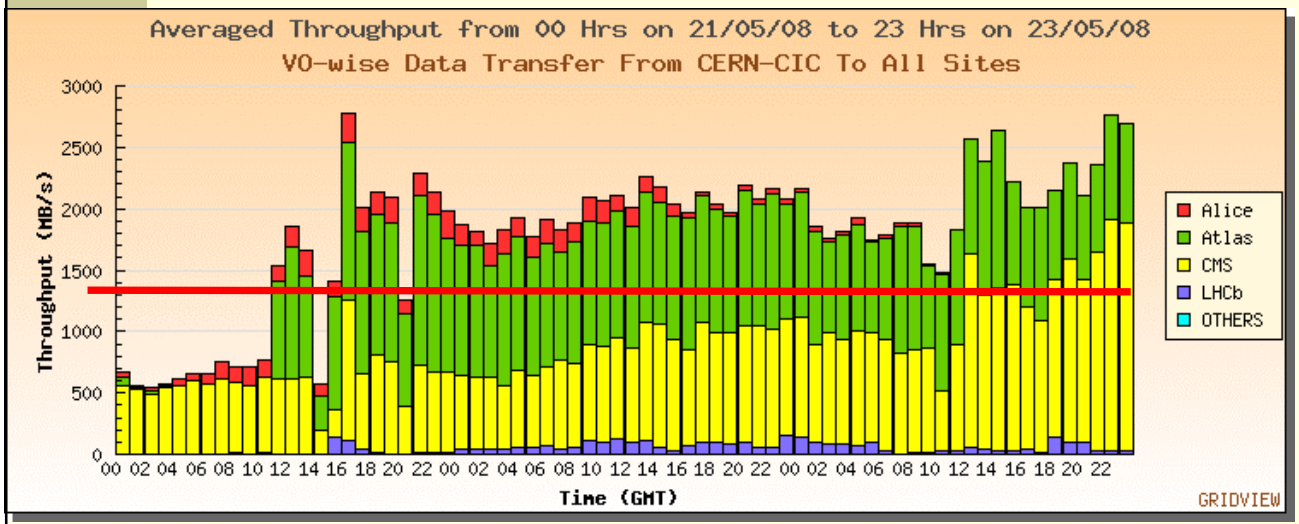


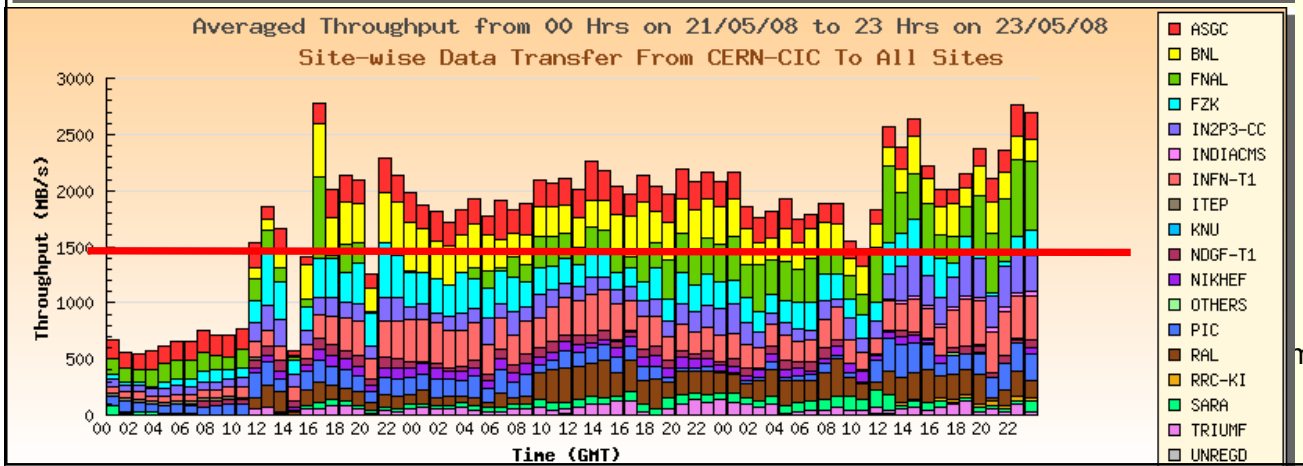
- WLCG ran 44M jobs in 2007
- In readiness testing during 2008, WLCG ran more than10 million jobs /month
- (1 job is ~ 8 hours use of a single processor)

These workloads are at the level anticipated for 2009 data

Data transfer out of Tier 0







- Full experiment rate needed is 650 MB/s
- Desire capability to sustain twice that to allow for Tier 1 sites to shutdown and recover
- Have demonstrated far in excess of that
- All experiments exceeded required rates for extended periods, & simultaneously
- All Tier 1s achieved (or exceeded) their target acceptance rates

Enabling Grids for E-SciencE - EGEE

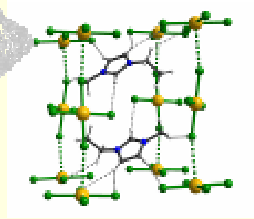
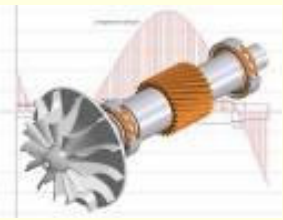
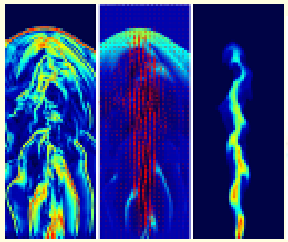
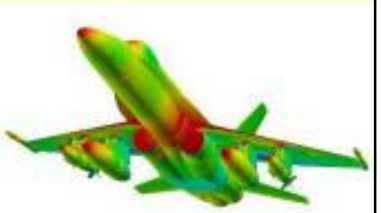
- EU supported project
- Develop and operate a multi-science grid
- Assist scientific communities to embrace grid technology
- First phase concentrated on operations and technology
- Second phase (2006-08)
  Emphasis on extending the scientific, geographical and industrial scope

→ world-wide Grid infrastructure

→ international collaboration

→ In phase 2 will have
  > 90 partners in 32 countries
  (incl. USA, Russia, Korea and Taiwan)



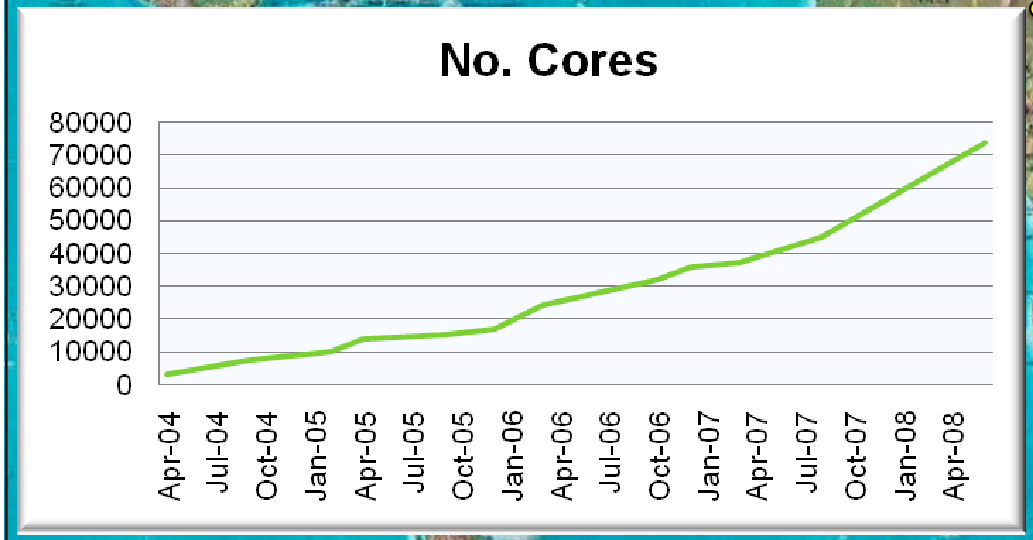





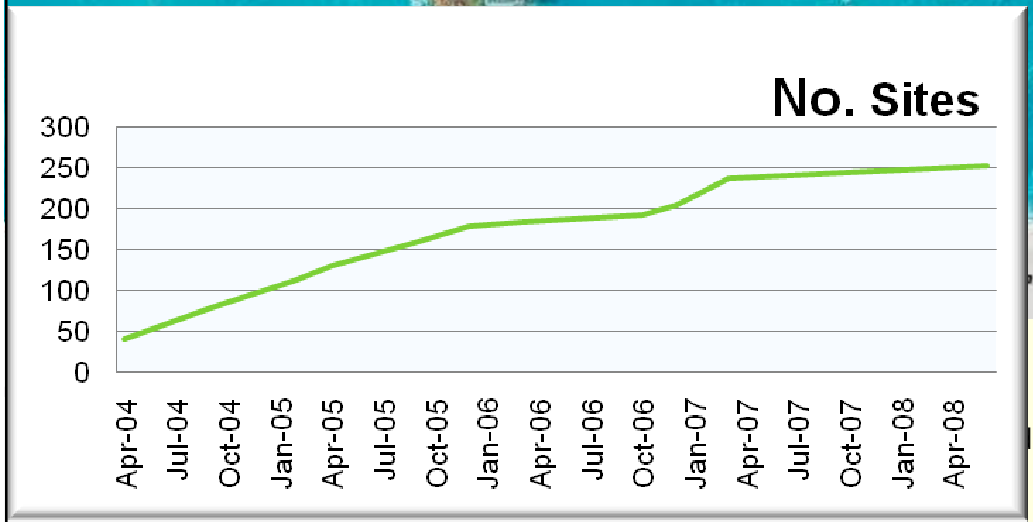

EGEE Achievements - Infrastructure

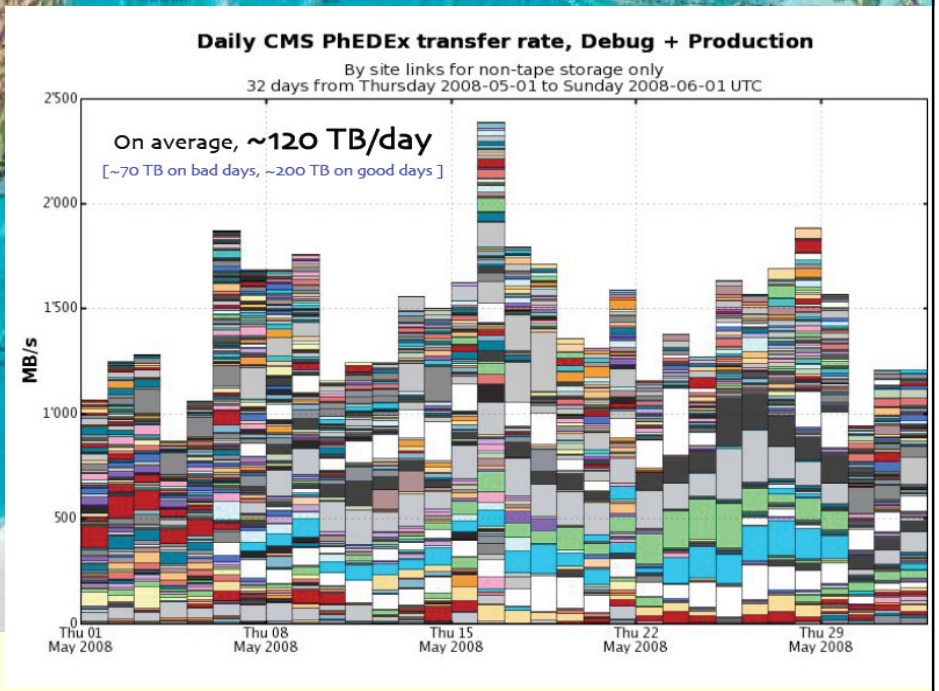
EGEE Production Grid Infrastructure

Steady growth over the lifetime of the project

Improved reliability

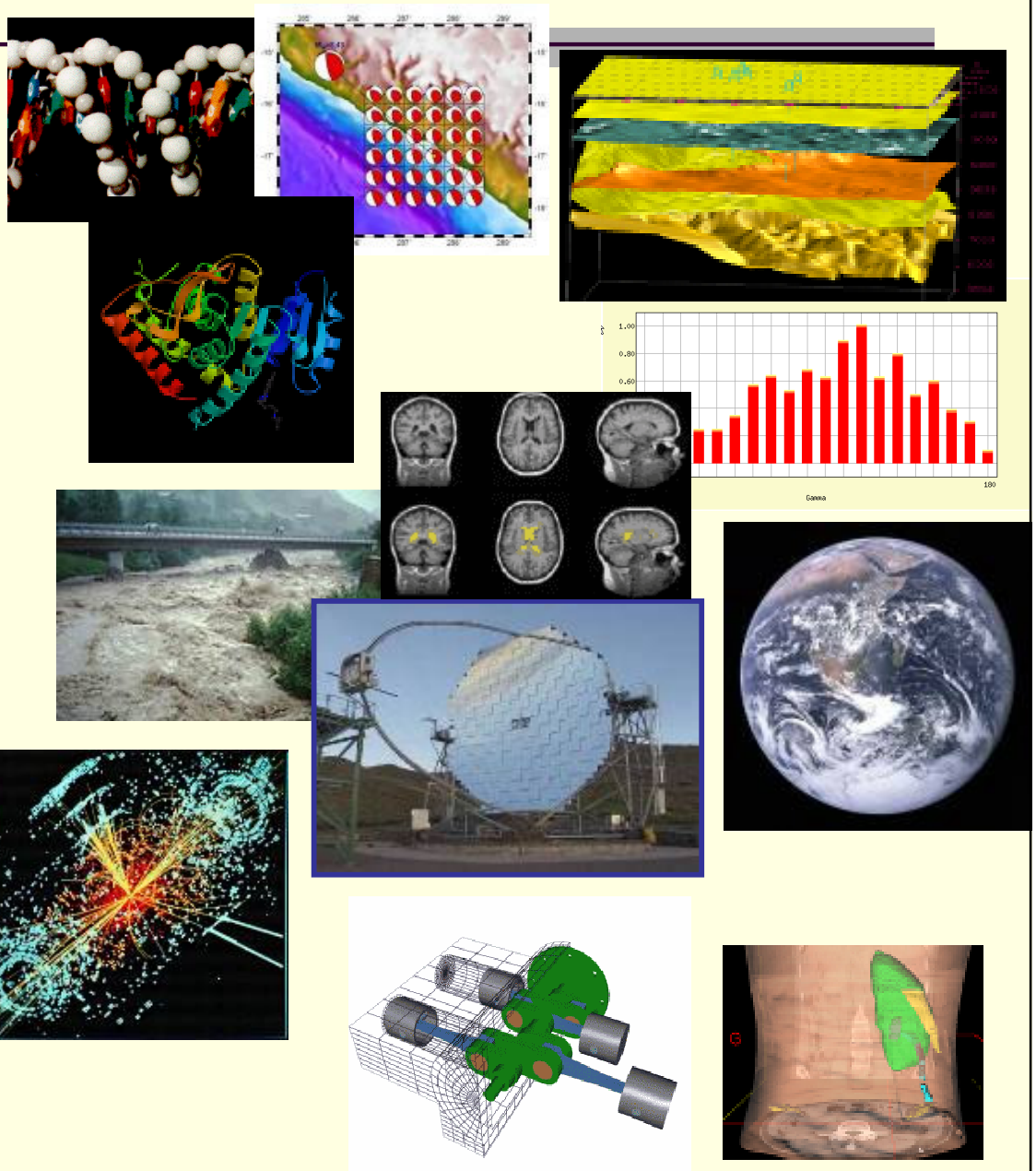






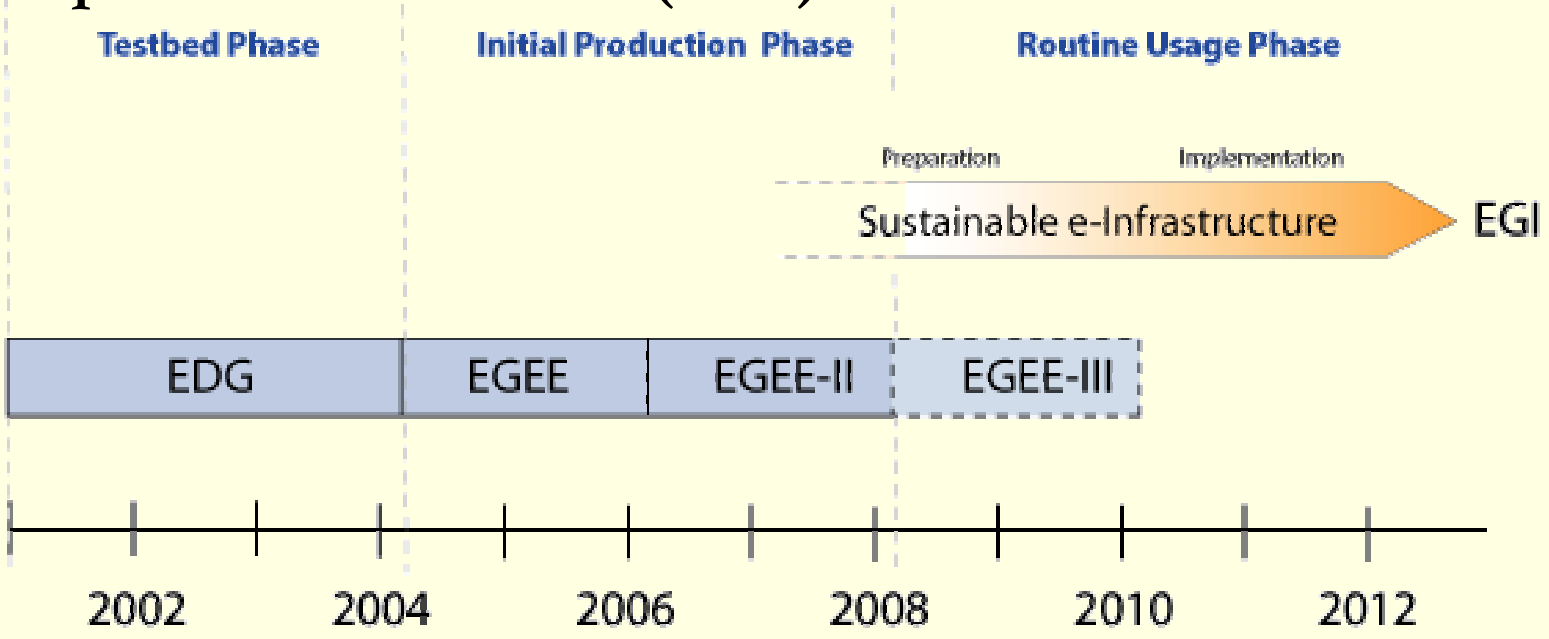
EGEE Achievements - Applications

- >270 VOs from several scientific domains
  - Astronomy & Astrophysics
  - Civil Protection
  - Computational Chemistry
  - Comp. Fluid Dynamics
  - Computer Science/Tools
  - Condensed Matter Physics
  - Earth Sciences
  - Fusion
  - High Energy Physics
  - Life Sciences



Sustainability

- Need to prepare for permanent Grid infrastructure
- Ensure a high quality of service for all user communities
- Independent of short project funding cycles
- Infrastructure managed in collaboration with National Grid Initiatives (NGIs)
- European Grid Initiative (EGI)



EUROPEAN GRIDS

- India has close relationship with European Commission via an associate project EUIndiaGrid phase I and II
  - WLCG: World-wide LHC Computing Grid Collaboration
  - EGEE: Enabling Grid for E-sciencE project for all sciences
  - EGI: European Grid Initiative
    - Middleware gLite Open Source Software

The Grid computing groups

- The Globus Alliance (www.globus.org) GT2, GT4
  - OGSA/I standards initially proposed by the Globus Group
  - Middleware GT
- The Global Grid Forum (www.ggf.org)
  - Meets three times annually
  - Solicits involvement from industry, research groups, and academics
- The CERN Group WLCG
  - Middleware gLite 3.0
- The European Group (EGEE - EGI)

Collaborations with Europe

Many Indian researchers have multi-national research collaborations & projects such as EU-IndiaGrid, FAIR, STAR, PHENIX, Climate/Weather etc. all of which would require high bandwidth connectivity to Europe & beyond.

India is effectively participating in the major international experimental programmes in Europe such as Large Hadron Collider (LHC), ITER, and others. Participation in the European Framework Programmes has been very fruitful and has enables Indian scientists to collaborate in frontier research activities with European colleagues. The **EU-IndiaGrid** project, which has allowed Indian scientists to access major European and Indian Grid infrastructures exposing them to the grid technology, made significant progress in last two years.

EU-IndiaGrid project

- The first phase was started in Oct 2008 and made significant progress by connecting European grid infrastructures to Indian Grids, even exceeding initial goals.
- This has encouraged European Union to initiate EU-IndiaGrid2
- Organizations working on Grid enabled applications: The partners of the project are both European (INFN,) and Indian (Pune University, C-DAC, ERNET, NIC, BARC, TIFR, SINP, VECC, IISC, IITD).

EU-IndiaGrid project Achievements so far....

Building an e-Science community

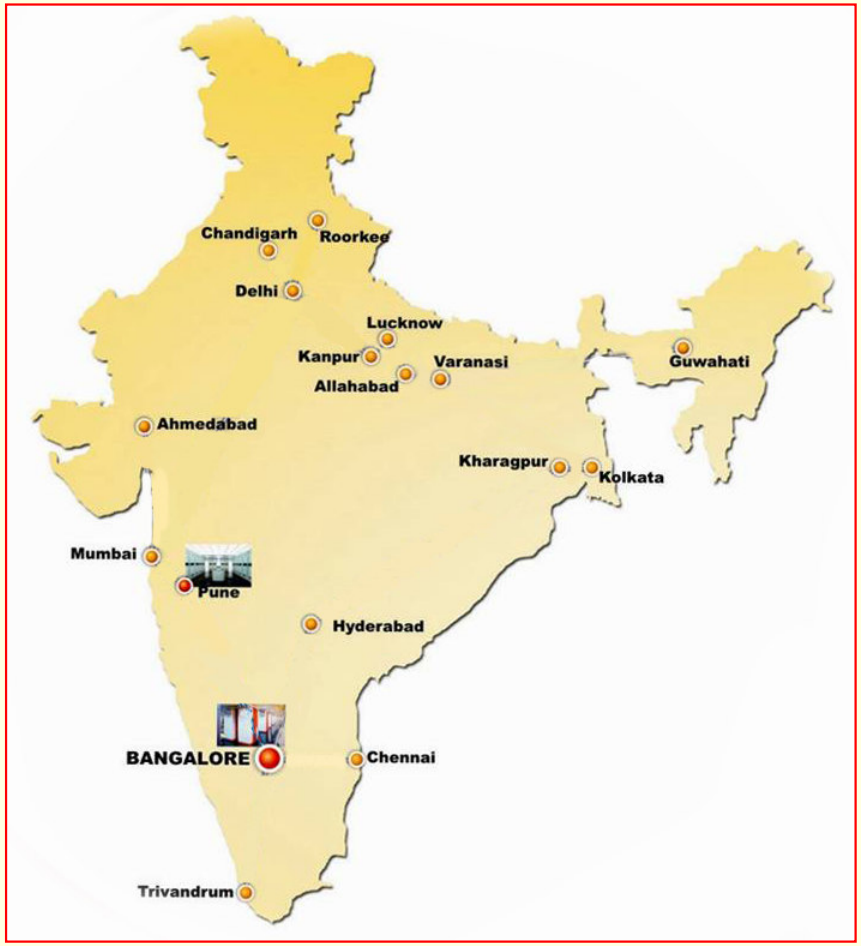
Establishing collaborations and synergies with related applications and initiatives between European & Indian users

Identifying researchers interested in Grid infrastructures or in e-Science based on Grid infrastructures

Bridging e-Infrastructures within Europe & India

National Grid: Garuda by C-DAC

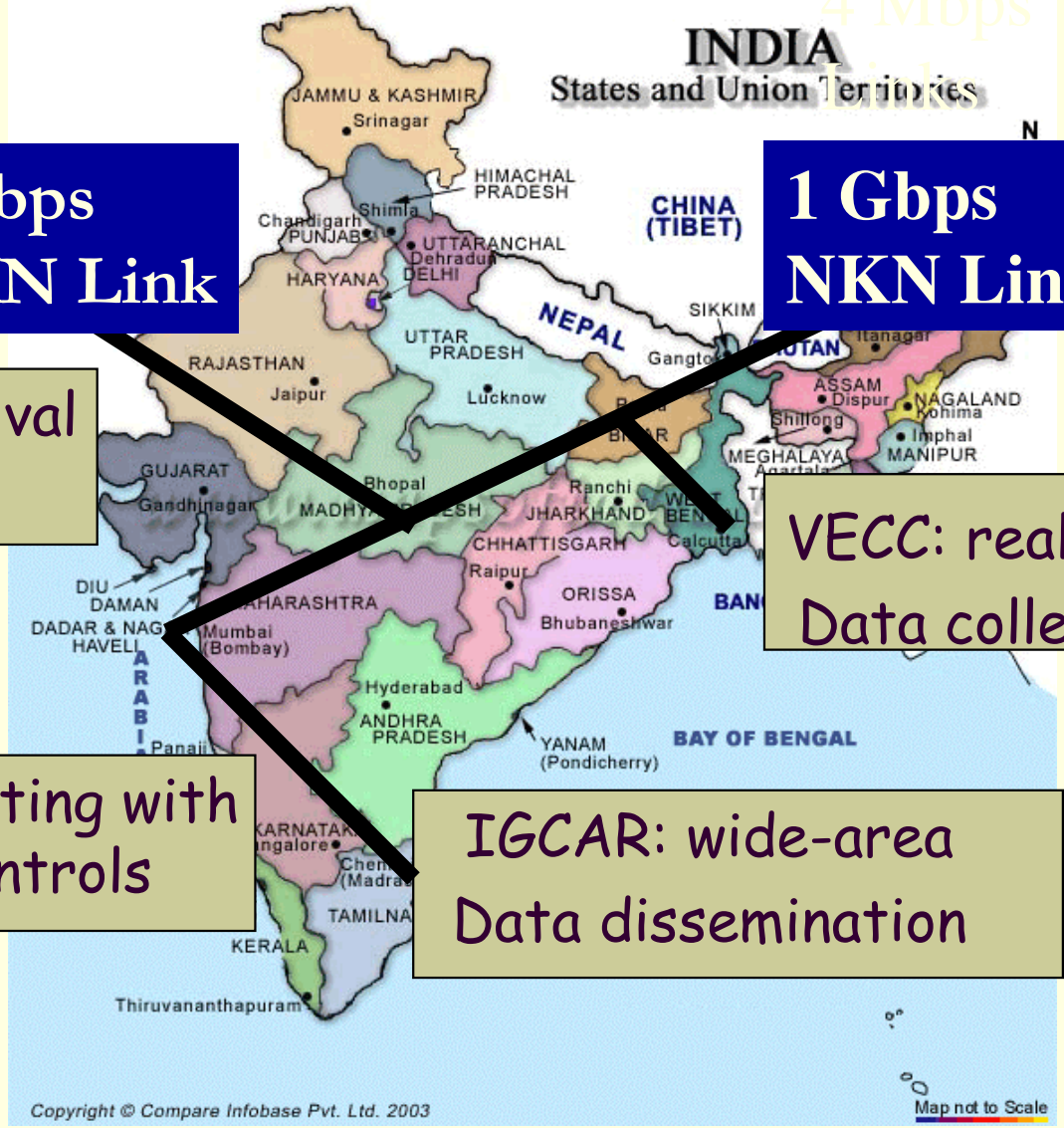
- The Proof of Concept network has been established in collaboration with ERNET
- The MPLS Virtual Private Network (VPN) connects 22 institutions at 100 Mbps and 23 institutions at 10 Mbps across 17 Indian cities with SLA agreements
- Collaborative environment enabled through Video Conferencing over IP at the following centres of C-DAC : Bangalore, Pune, Chennai, Hyderabad, Mumbai and Trivandrum
- Uses GT2, MOB scheduler, monitoring tools



New Projects with Europe

- The EU-IndiaGrid project fully achieved its objectives and technical goals and even exceeded expectations
- As a results of excellent achievements, two year second phase Eu-IndiaGrid2 project - Sustainable e-Infrastructures across Europe and India, funded by EC, was approval, with start date 1/1/2010
- New proposal for Co-ordination and Harmonization of Advanced e-INfrastructures (CHAIN) is expected to reinforce coherent synergy between India & Europe and would help in consolidating India's multi-gigabit, low latency, e-infrastructure: National Knowledge Network (NKN).

DAE Grid (Private)



1 Gbps NKN Link

1 Gbps NKN Link

CAT: archival storage

VECC: real-time Data collection

BARC: Computing with shared controls

IGCAR: wide-area Data dissemination

Resource sharing and coordinated problem solving in dynamic, multiple R&D units

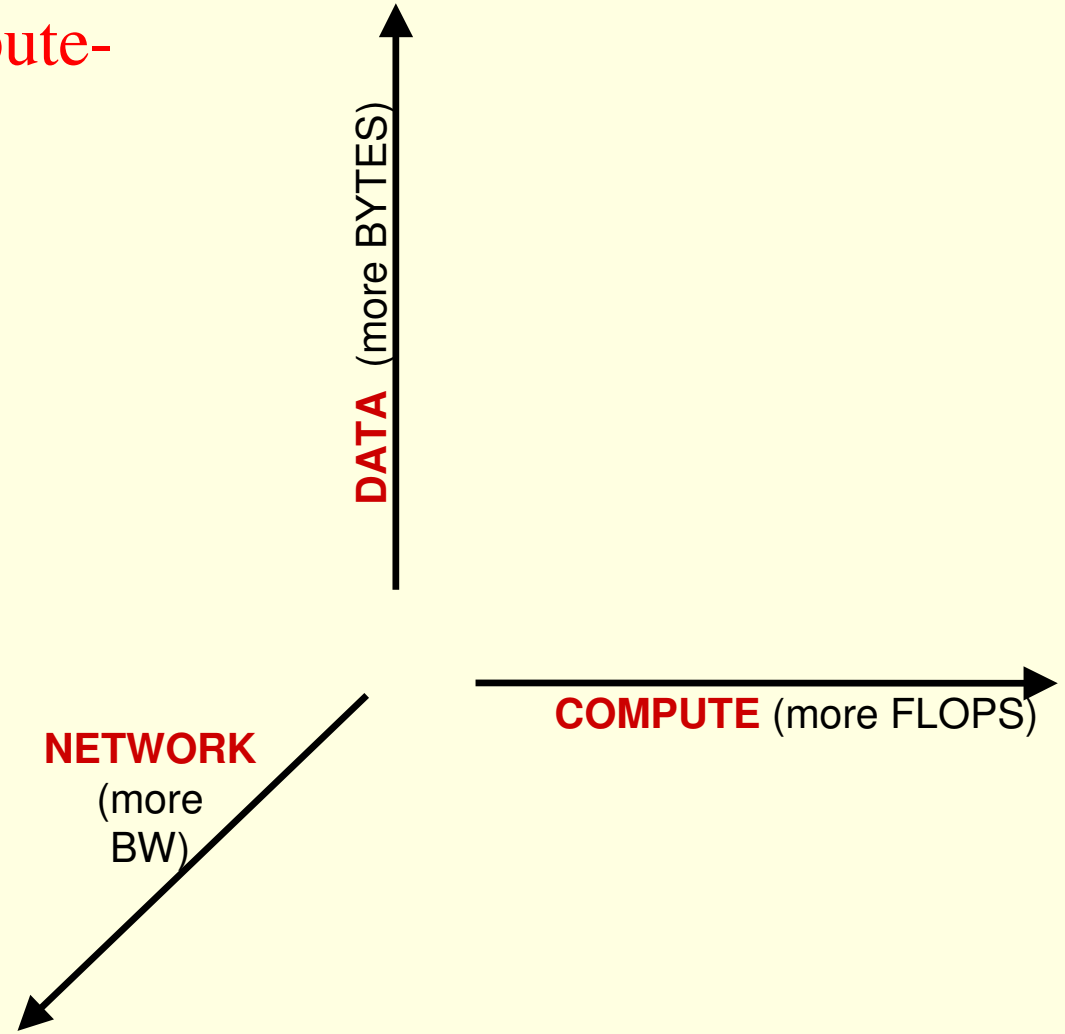
gLite, GridView

Today's Applications

These applications, are both data-intensive and compute-intensive.

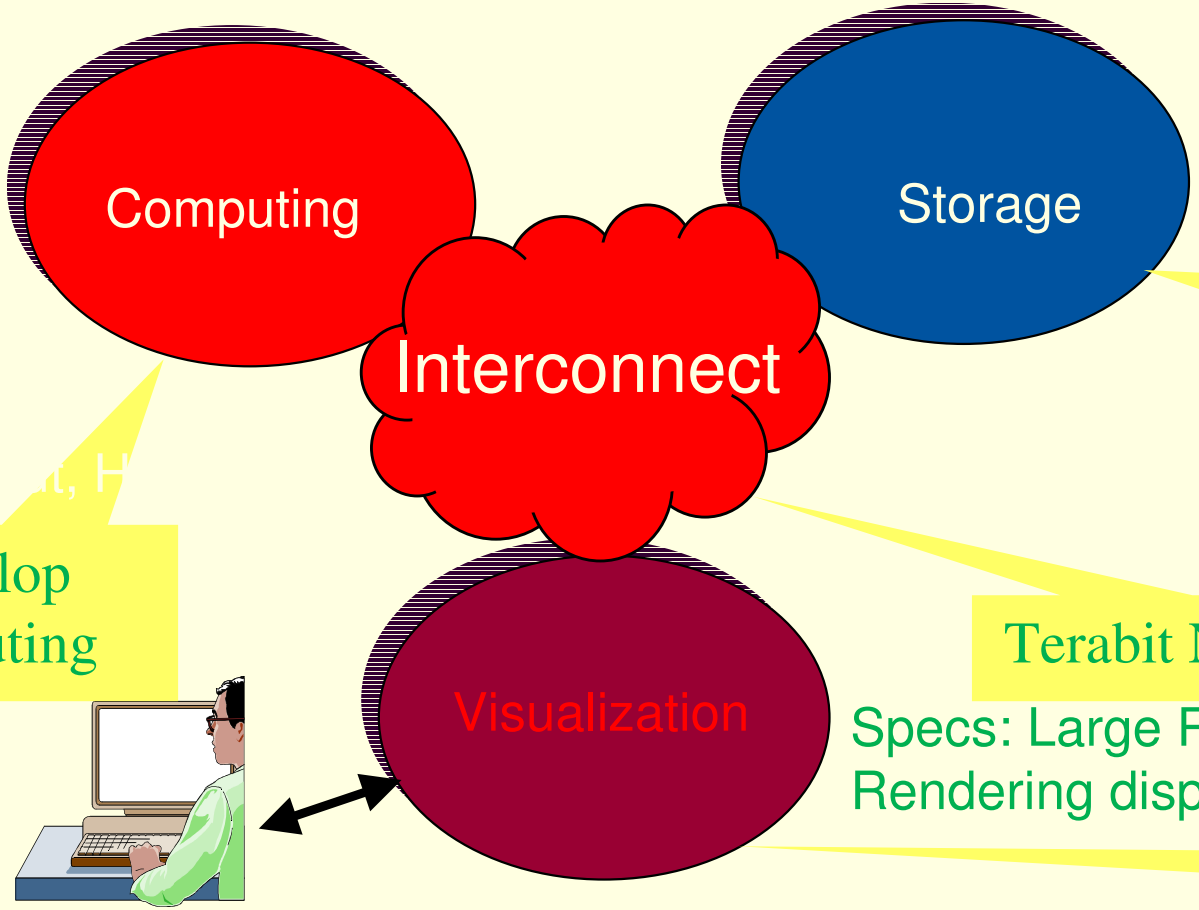
Data and High Performance Computing

Data and Cyberinfrastructure Services



Trends: Computing

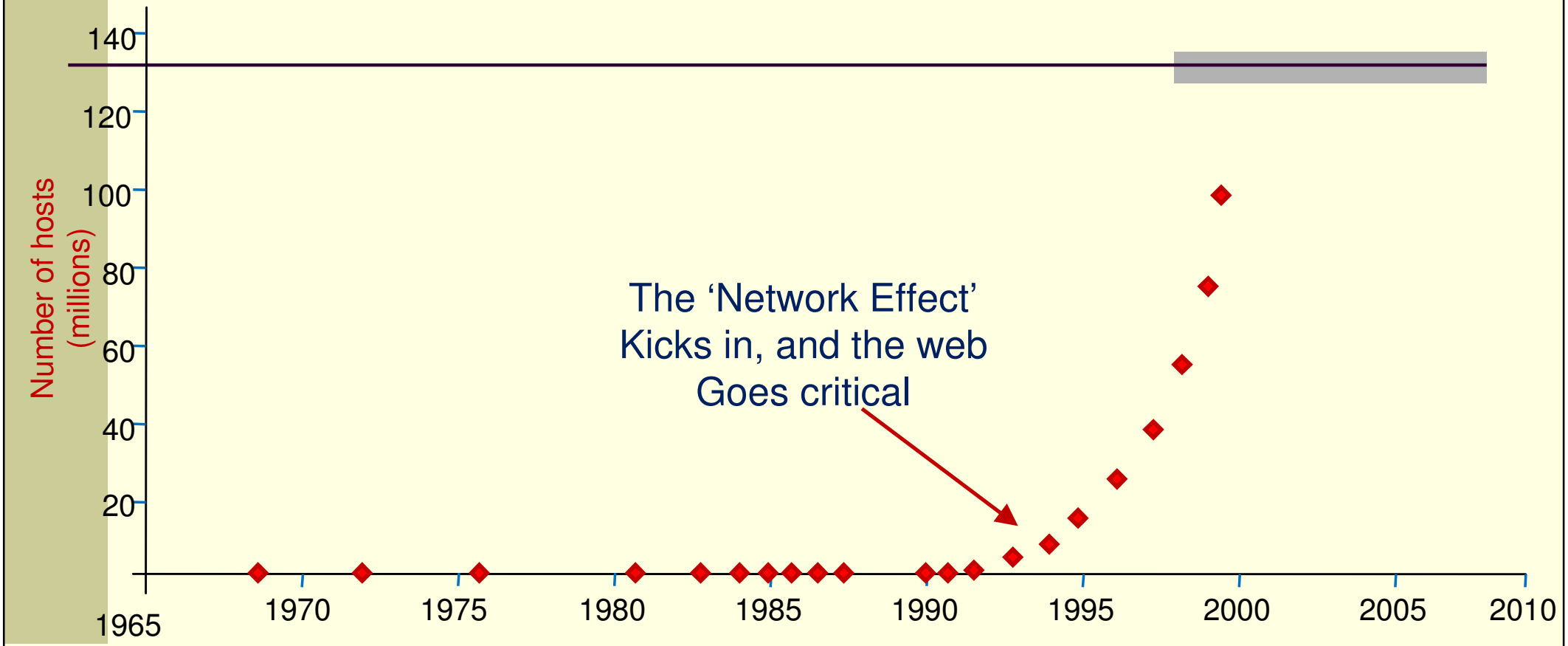
Given sufficient budget one can build, by sheer brute force, very powerful supercomputer (Peta or Exa scale range) with commodity components integrated using open source software



Green Computing Initiative

- Almost half of recurring expenses on data centres come from power bills (24/7 operation; example EKA)
- Measures like consolidation and virtualization are used to achieve optimal utilization of IT infrastructure (Grids)
- Green Computing Initiatives and energy efficient technologies (reduce emissions& increase cooling efficiency)
- Data centres are being redesigned to go green business processes (Use of energy efficient technology like blade servers, thin client, LCD's etc; Global warming culprits)
- Only 20% computing resources come from Tier o centre at CERN and rest come from collaborators (methods to improve operational efficiencies)

Important Milestones in Network Revolution



PHASE 1.Packet Switching Networks

- 1969: 4 US Universities linked to form ARPANET
- 1972: First e-mail program created
- 1976: Robert Metcalfe develops Ethernet

2. The Internet is Born

TCP/IP becomes Standard
DNS created
IETF created (1986)

3. The World Wide Web

HTML Created
CERN launches WWW
NCSA launches Mosaic

4.With XML

5.The GRID

Networks became affordable !!!

OFC based Networks

- Today's science is based on worldwide collaborations by sharing computations, data, expensive equipments, information, knowledge, wisdom across the Internet
- Researchers need more accurate & precise solutions to their problems (from 1D to 3D) in shortest possible time

- Many countries today have deployed Lambda Network Facility "e-infrastructure": OFC based high bandwidth network to handle large volume data traffic requirements of advanced applications
- Success in e-infrastructure is a precursor to success in Grid Computing

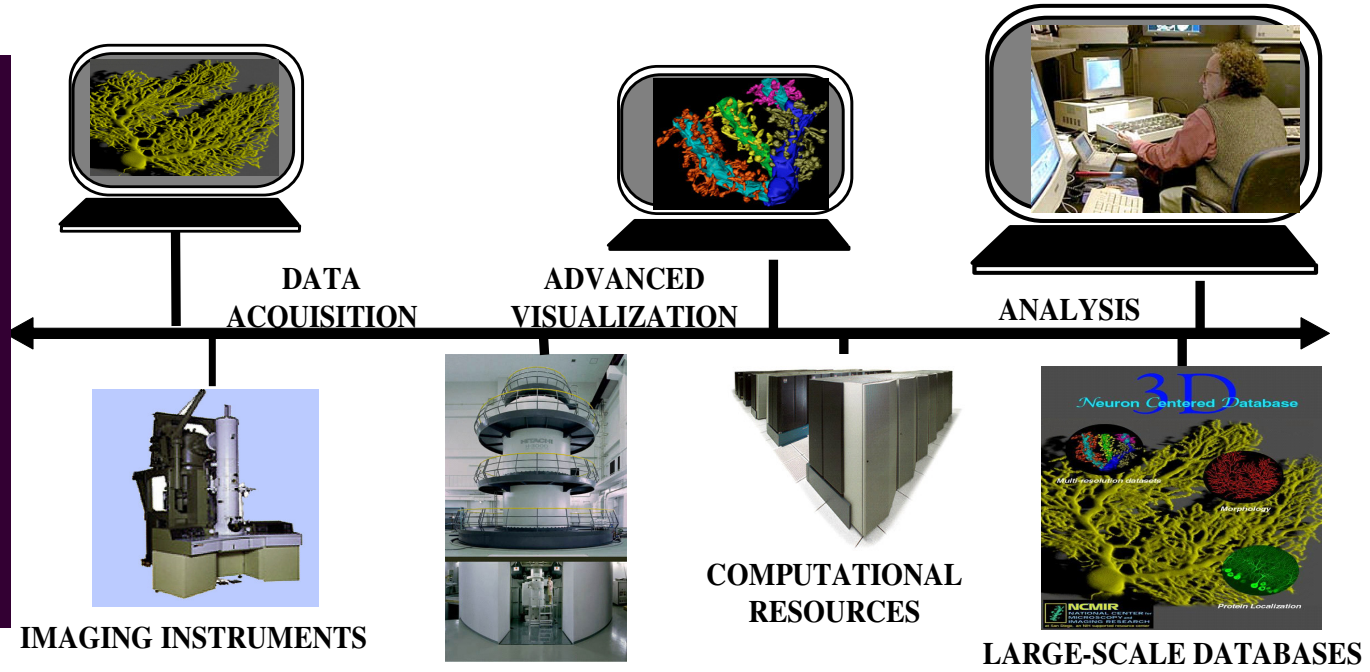
What is e-Science?

- ‘e-Science is about global collaboration in key areas of science, and the next generation of infrastructure that will enable it.’ John Taylor
- Purpose of e-Science initiative is to allow scientists to do ‘faster, better or different’ research
- Design, develop and implement an advanced infrastructure to support real-time processing, interpretation, integration, visualization and mining of vast amounts of time critical data generated by high throughput devices.

e-Science" and "e-Research

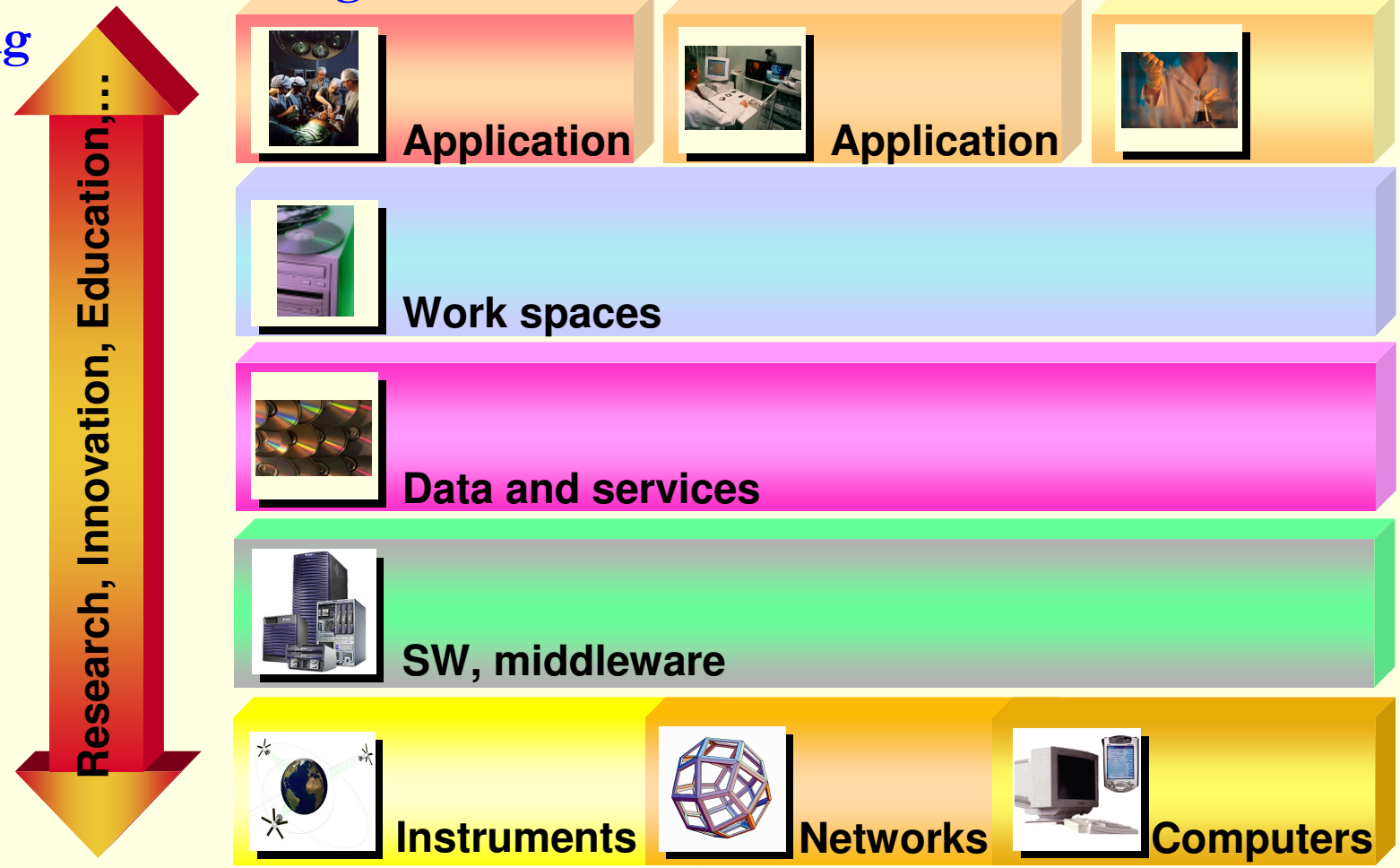
- e-Science is about global collaboration in key areas of science, and the next generation of infrastructure "e-Infrastructure" that will enable it
- e-Science reflects growing importance of international laboratories, satellites and sensors and their integrated analysis by distributed teams

Grid Technology supports e-Science and e-Infrastructure
It is software (middeleware) built on top of networks



e-Infrastructures

Domain-independent ICT-based RIs designed to support research; they integrate in a seamless way networks, computers, SW, data resources, experimental and training facilities to enable collaborative science and engineering



Networking Scenario in INDIA

High speed links which are needed to set up for such network are still very expensive in India and in particular International Leased lines. We have very primitive network infrastructure.

Large number of networking initiatives with limited scope in each sector

- NICNET (Government Information)
- ERNET (Education)
- ANUNET, SPACENET, CSIRNET…(Specific Departments)
- SWANs (35 in number)
- GARUDA, WLCG, EU-IndiaGrid (Grid Computing)

In India, scenario has changed recently. Today, Private companies are laying fiber all over India.

The National Knowledge Network (NKN)

- GOI approved the ten-year project to be implemented by National Informatics Centre (NIC).

Objectives:

- NKN project is aimed at establishing a strong and robust internal Indian network which will be capable of providing secure and reliable connectivity.
- To bring together all the stakeholders from Higher Education, Science, Technology, Healthcare, Agriculture GRID Computing, e-governance.

- The inauguration of initial phase of the NKN with about 60 institute connections by the President of India on 9th April, 2009.
- The leading agencies in research & education are the first major organizations to be connected through this network.
- NKN Web site & Logo launching by Mr. Kapil Sibal, Union Minister for Communication and Information Technology and Minister of Human Resource Development on Feb. 5, 2011.

Understanding Human Welfare and Development by Bringing together Education and Research in Health and Agriculture in India

NKN Design Philosophy

- To build a scalable network, which can expand both in the Reach (spread in the country) and Speed.
- To be a common Network Backbone like national highway, wherein different categories of users shall be supported.

Objective of NKN

- Interconnect all National Education & Research Institutes, Leading National Labs, Colleges etc
- Connect more than 5000 sites across the country
- Serve millions of end-users + eScience Projects
- 3-tier Architecture, partially subsidized by National funds:Links national, regional and international initiatives
  - The Campus Network
  - The NREN
  - The International connectivity

Features NKN

High Capacity, Highly Scalable Backbone

Support for Quality of Service (QoS) and Security

Common Standard Platform

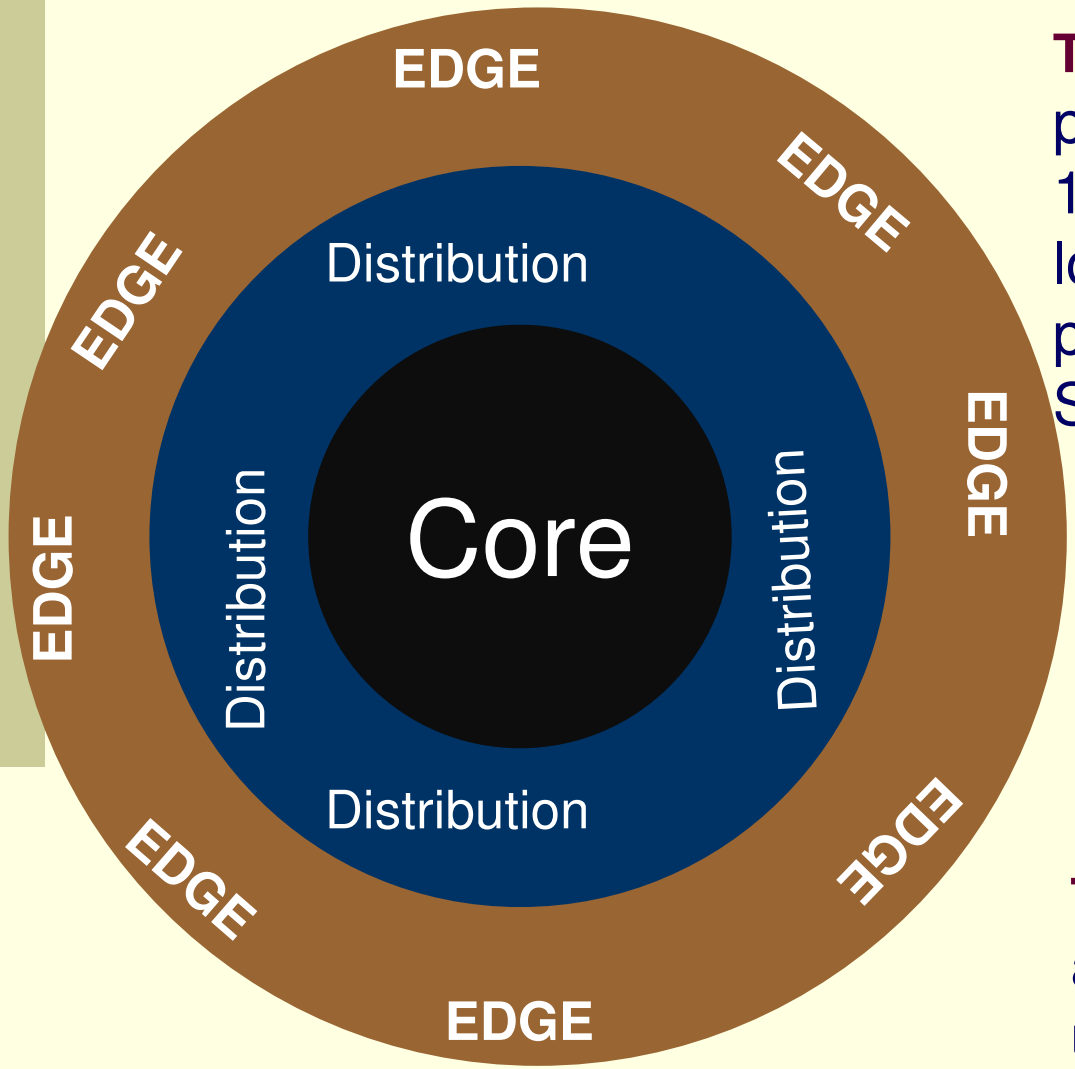
Bandwidth from Many NLD's

Highly Reliable & Available by Design

Test beds (for various implementation)

Dedicated and Owned

NKN Topology



The Core: 7 Supercore locations pan India with fully meshed Multi-10 Gbps connectivity and 26 Core locations having Multi-10 Gbps partially meshed connectivity with Supercore locations.

The distribution layer connects to the core of the network using multiple links at speeds of 2.5 / 10 Gbps.

The Edge networks are having connectivity at upto a speed of 1 Gbps.

Introduction: Key Highlights of NKN

NKN is a state-of-the-art multi-gigabit pan-India network

Idea of setting NKN was finalized at the Office of PSA & NKC.

NIC working as the Project Execution Agency

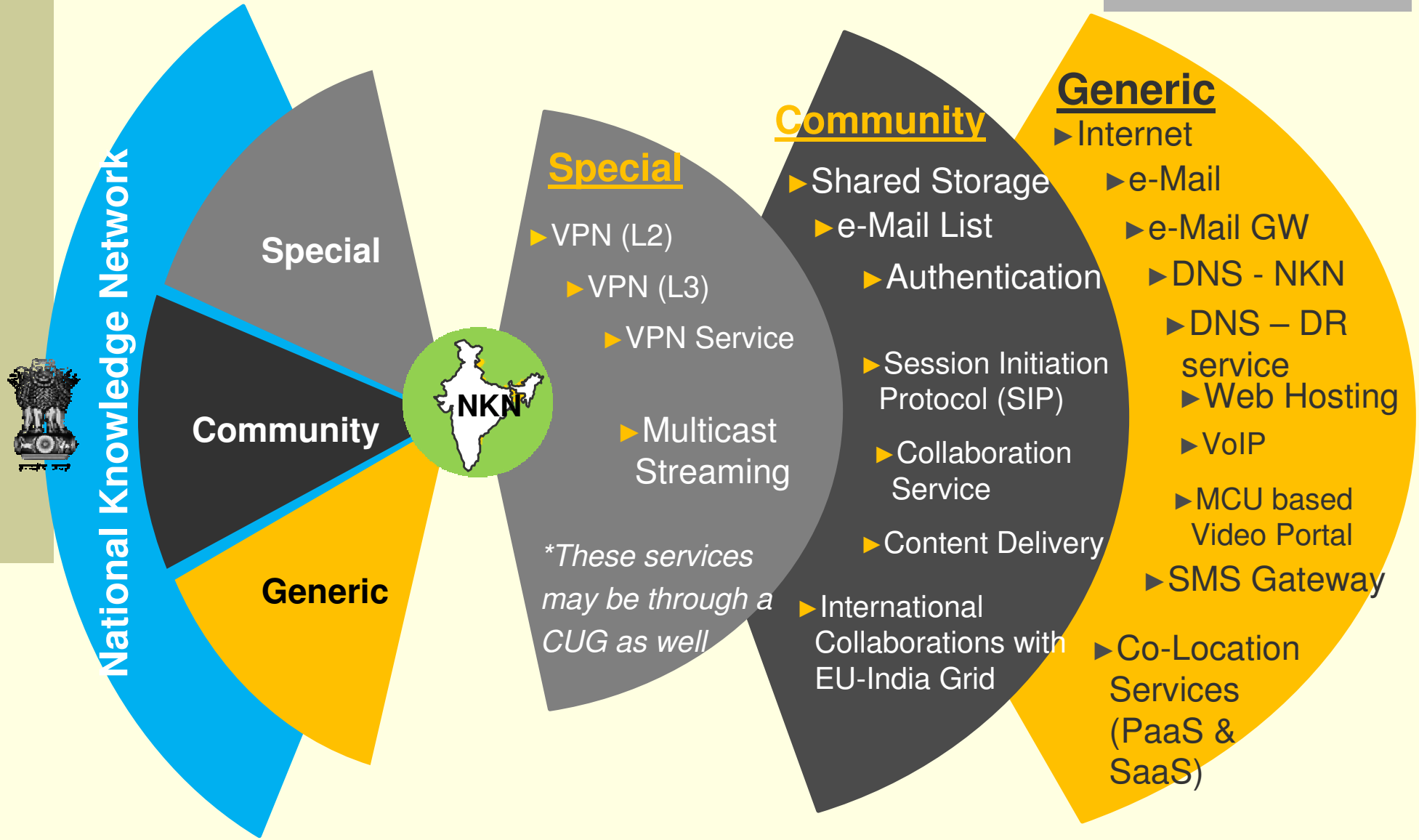
57+ Institutes in Initial Phase & 1500+ institutes in final phase

Connect R & D, educational, health, agri, labs institutes etc..

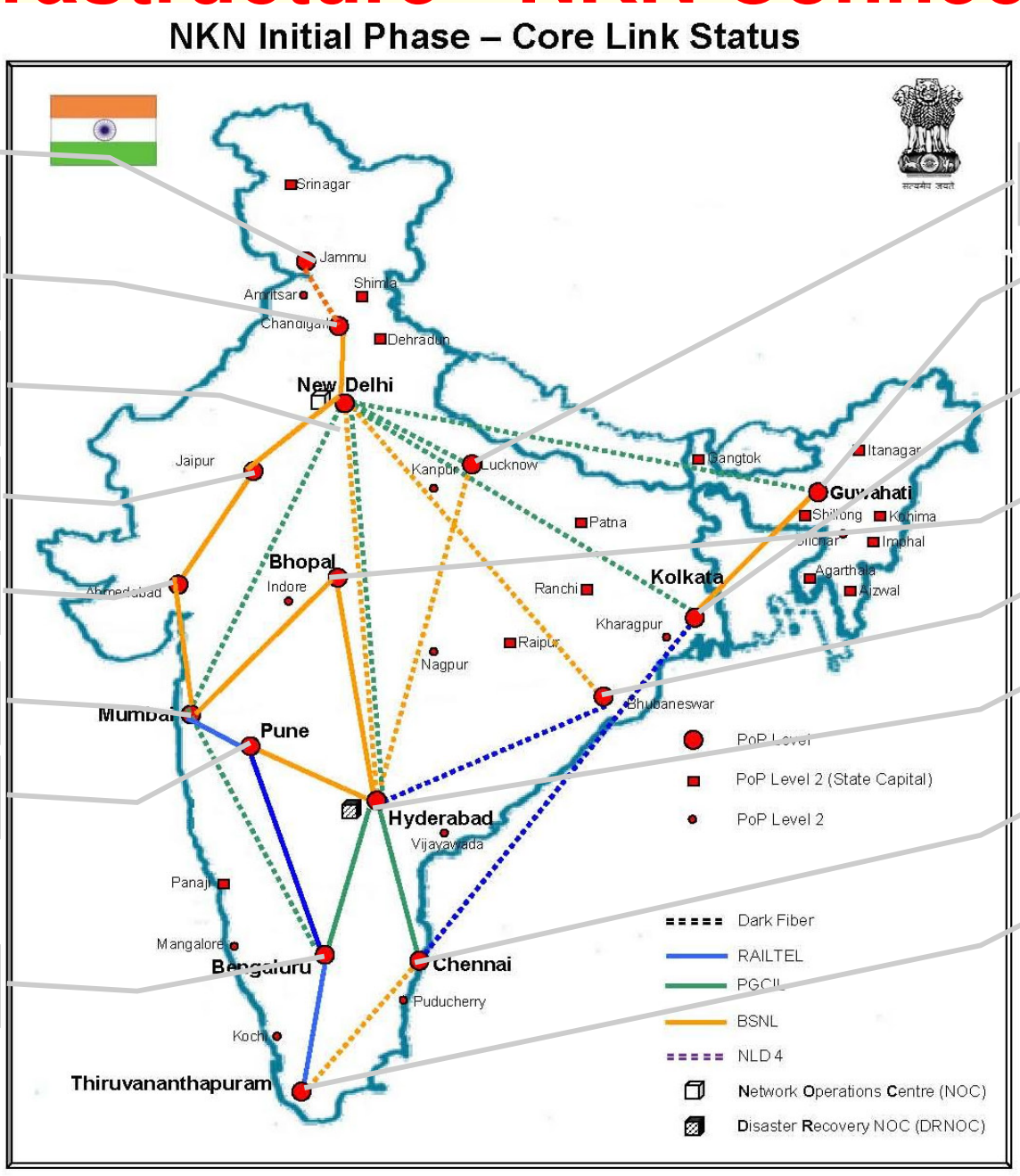
GoI approved a budget of INR 5990 crores for NKN in March, 2010

- **9th April 2009:** Inaugurated the NKN Project.
  - 16 PoP
  - 26 Backbone Links
  - 57 Edge Links
- **5th March, 2011:** Launched the Logo & Website of NKN
  - 27 PoP
  - 76 Backbone Links
  - 216 Edge Links

National Knowledge Network
Key Services



E-Infrastructure - NKN Connected Sites



Jammu University

IMTECH IIT-ropar, PU

IIT-D, IIT-R, JNU,DU,AMU, CSIR, IGIB-N, IGIB-O, NDRI, RML, NSIT, IIITD

Raj Univ

IIT-Gnr, AAU, SAC

BARC, TIFR,CDAC,IIT-B, Anushakti Ngr

NCRA,IITM,CDAC-P, IUCAA , Uni pune,

IISC, RRI,CDAC-KP, CDAC-Elec, IIAP, TIFR-bangalore

CDRI, BA-univ, IIT-K, CSAU

AAU, IIT-G, ICAR-S, univ-G,

SAHA, VECC, IIT-P, IIT-KGP ICAR-P,

JNKVV, RRCAT

IOP, IIT-BHU

IIT-H, CADC-H, AMD, DNA, AGRANGA Univ,

IIT-M, CDAC-M, IGCAR, Anna Univ, IIMSc, SNEYE

VSSC, CDAC-T, RCC

Health
Universit
ICAR
CDAC
CSIR
IIT. IISC
DAE

connected 364 no's

NKN update

- Full financial sanction for NKN received in March 2010
- Initial phase with 15 cores having multiple 2.5 Gbps (26 fiber links) connecting over 60 institutes with 1 Gbps has been completed in 2009
- Virtual class rooms, Garuda and DAE Grid operation and Collab-CAD are running on NKN
- Open Drug Discovery project of CSIR running over NKN
- 364 institutes connected till now and remaining 400 institutes will be connected by March 2012

NKN an integral part of e-science Infrastructure

- Earliest use was to establish Virtual classrooms in IITs (NKN is a high-speed, low-latency network)
- Tele-Medicine
- Grid for LHC Grid, Climate Science, Cancer Grid, Brain Grid,…
- ESRF – Remote access to Synchrotron Beam line at Grenoble, France (BARC)
- Open Source Drug Discovery (CSIR)
- Research Collaboration(National and International)

National Knowledge Network

Creation of Virtual Classrooms (VCR)

- A total of 66 Virtual Classrooms (VCR) are being created under this project. *(38 VCR at IITs, 23 VCRs at NITs, IISc, IIESR & 5 VCRs at NIC)*

National Knowledge Network - Connecting Knowledge Institutions - Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://www.nkn.in/photogallery.php

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National Knowledge Network...

Skip to Main Content | Skip to Navigation | Text Size A A A

National Knowledge Network

Connecting Knowledge Institutions

सत्यमेव जयते

Member Corner

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- Services
- Applications
- Design and Architecture
- Connected Institutions
- NKN News and Announcements
- Media Gallery
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National Knowledge Network

Photo Gallery

IIT-Mumbai Virtual Classroom running on NKN

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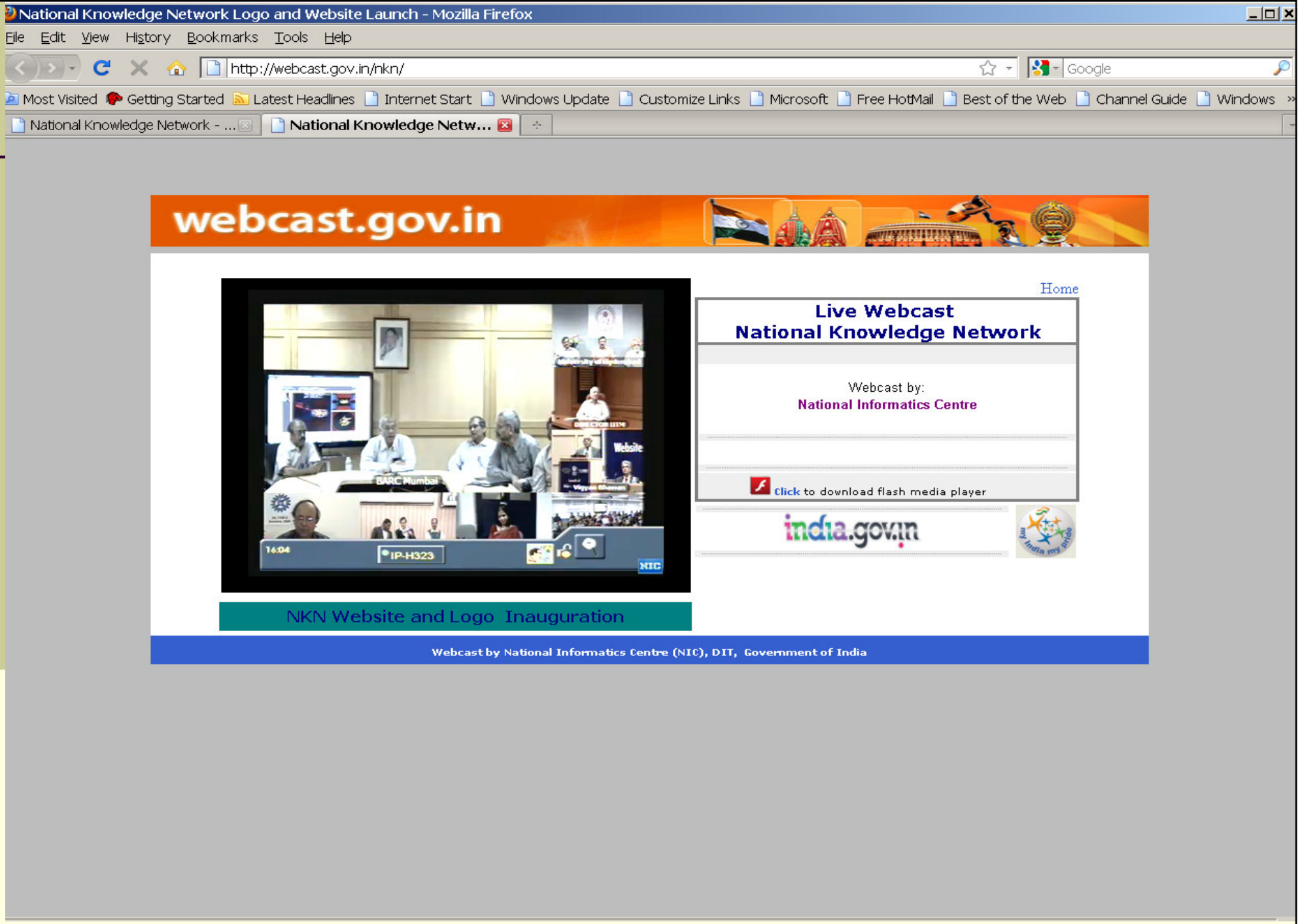
Site Owned & Maintained by
NKN Programme and Implementation Unit

NIC Website designed & hosted by
National Informatics Centre.

Transferring data from www.nkn.in...


National Knowledge Network Logo and Website Launch - Mozilla Firefox
File Edit View History Bookmarks Tools Help
http://webcast.gov.in/nkn/
Google
Most Visited Getting Started Latest Headlines Internet Start Windows Update Customize Links Microsoft Free HotMail Best of the Web Channel Guide Windows
National Knowledge Network - ...
National Knowledge Netw...
webcast.gov.in
Home
Live Webcast
National Knowledge Network
Webcast by:
National Informatics Centre
Click to download flash media player
india.gov.in
BARC Mumbai
Website
16:04
IP-H323
NIC
NKN Website and Logo Inauguration
Webcast by National Informatics Centre (NIC), DIT, Government of India

Collaborative design of reactor components
Credits : IGCAR, Kalpakkam, NIC-Delhi, Comp Divn, BARC

FIP Experimental Set-up (*French beamline for Investigation of Proteins*) IBS/CEA, Grenoble, France

Located on a Bending Magnet section (*BM30A*) of ESRF.

It is specially dedicated to crystallography of biological macromolecules.

This beam-line will be used either for normal diffraction or for multi-wavelength diffraction, using anomalous dispersion.

Its optics delivers a focused beam on a fixed sample position, with a relatively high energy resolution of about $1e^{-3}$ to $1e^{-4}$ and a large accessible energy range (7-18 keV). The beam height and focusing distance are fixed.

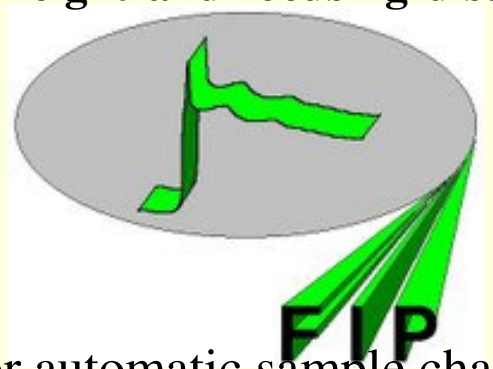
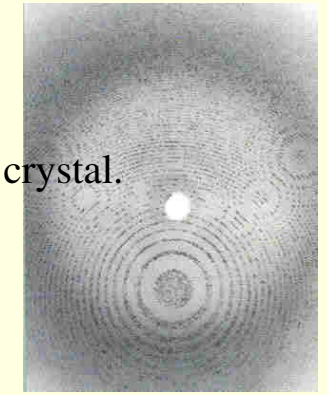
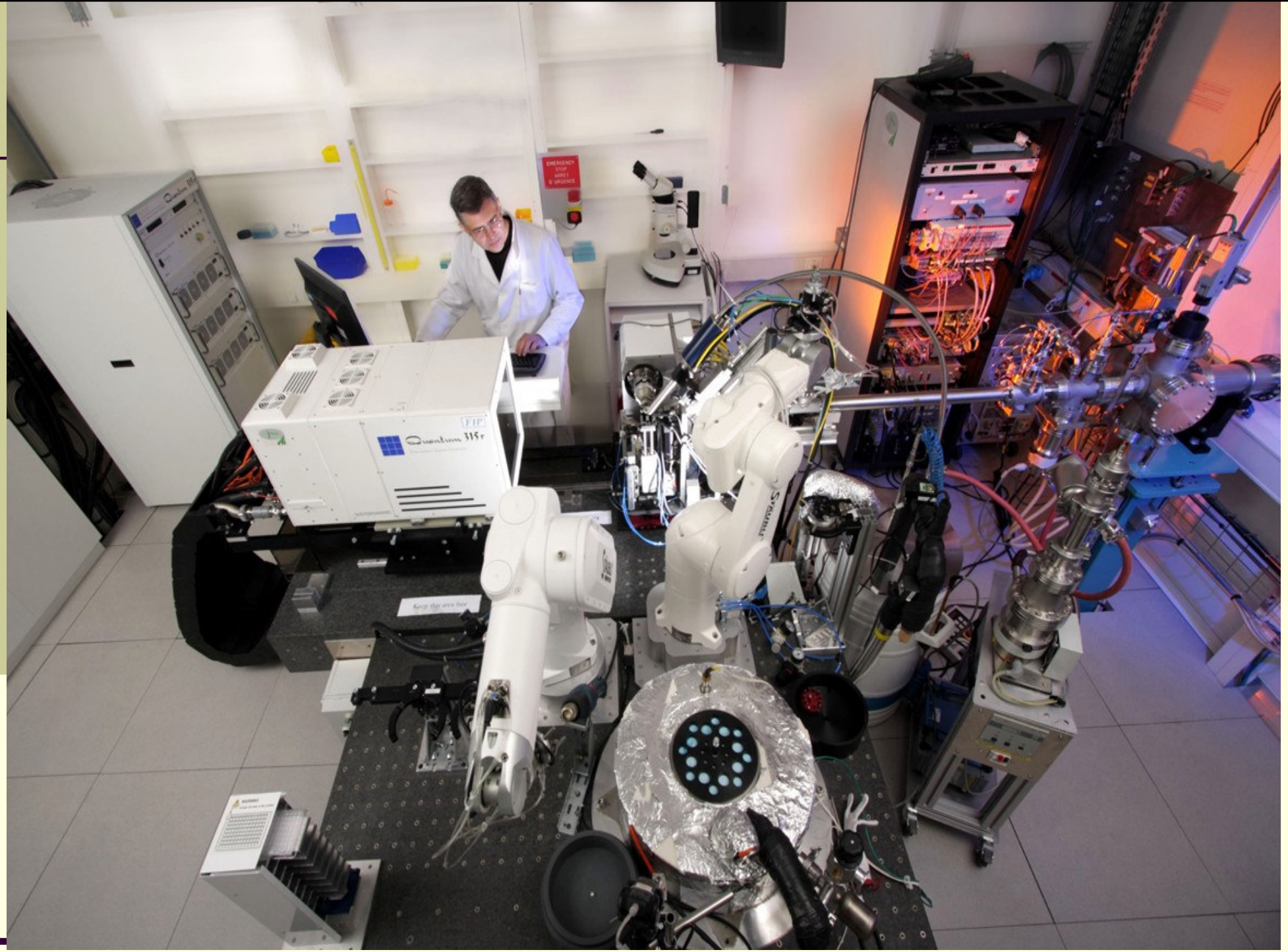
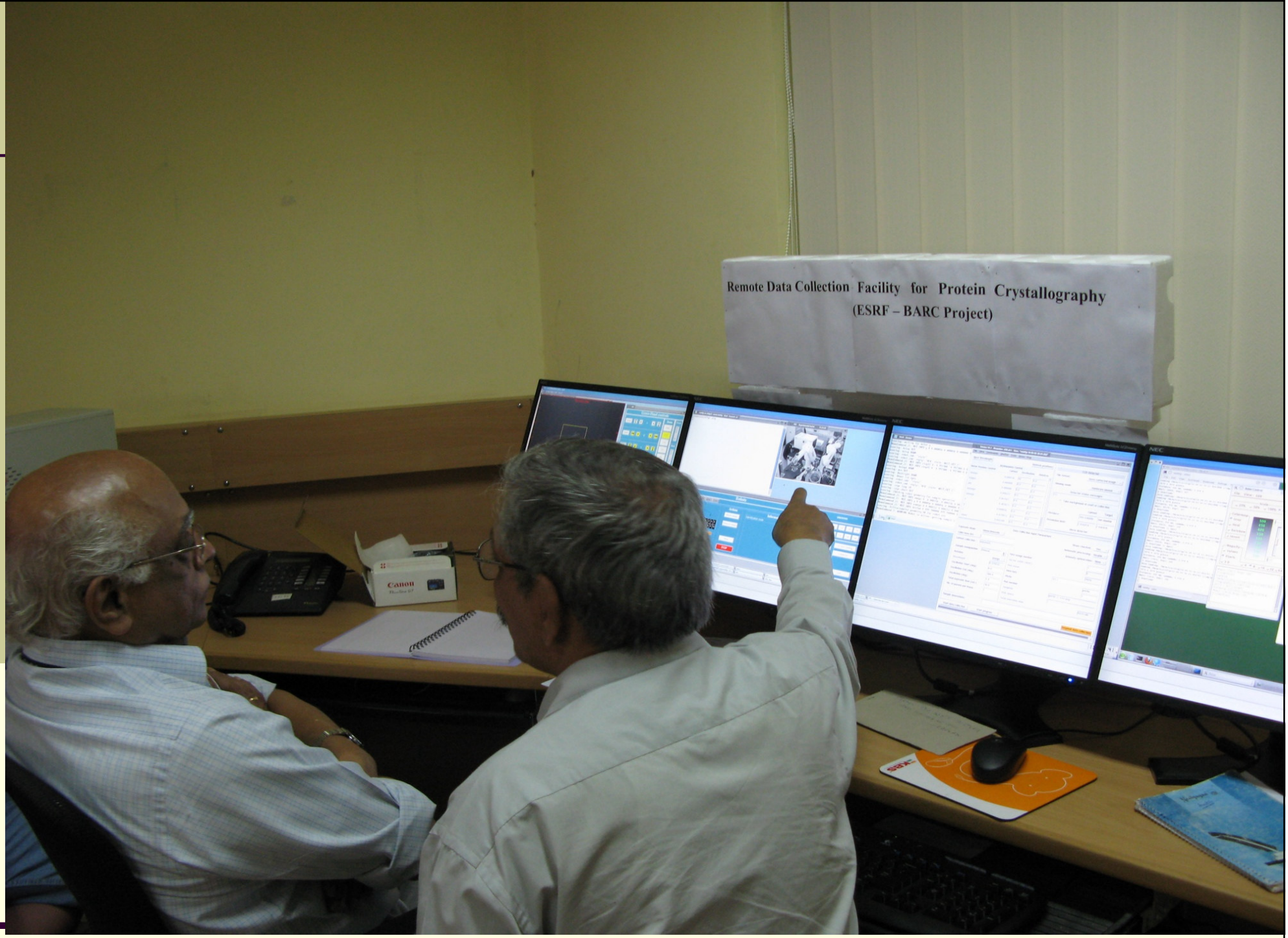


Plate size 225mm * 225mm
Pixel size 75 – 150 microns
Many such frames constitute one data set for a crystal.
Typically 360 frames.
Size of one frame file = 18MB
Four wave length data sets.
Total size 1440 * 18 MB per protein crystal

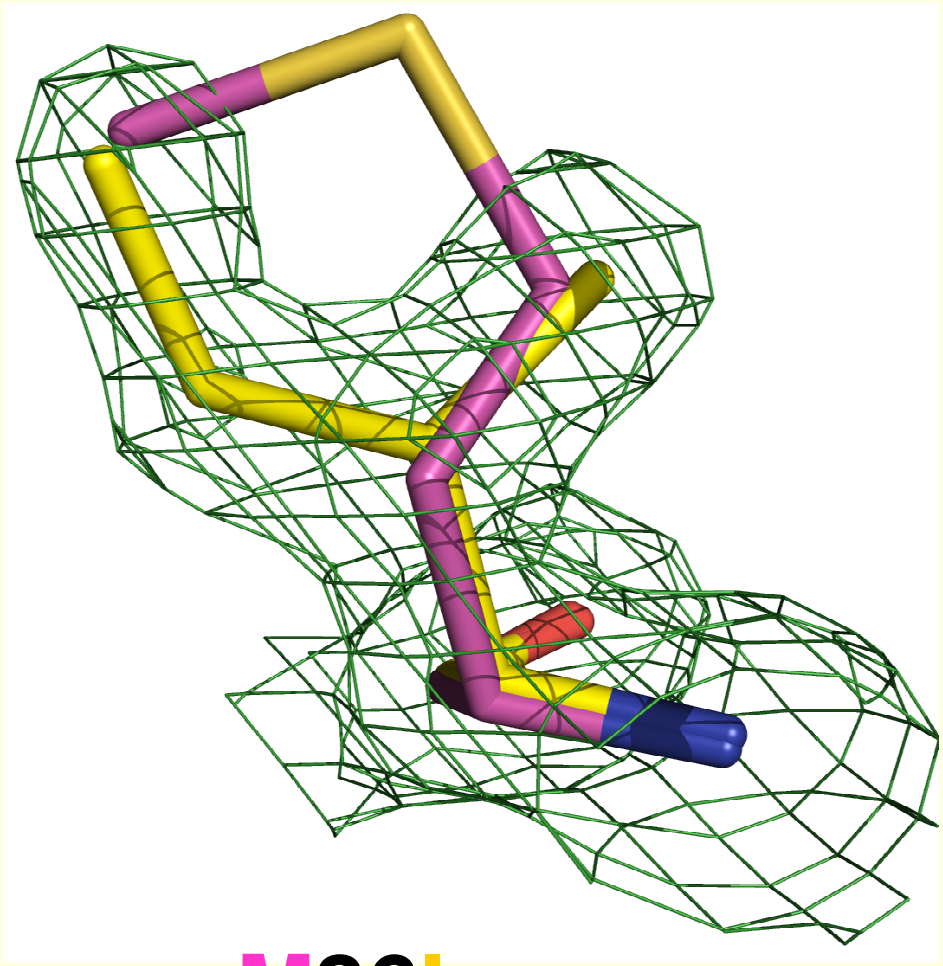


Robot for automatic sample change under cryo-conditions


EMERGENCY
STOP
ARRET
D'URGENCE
Quantum 116
FIP
Keep the area free


Remote Data Collection Facility for Protein Crystallography
(ESRF – BARC Project)

Drug-resistant HIV-1 protease enzyme



M36I

Good quality data collected by operating FIP beamline from India. Resolution 1.6 Å. Structure refined to Rf = 16.2%

SA-OMIT map clearly shows electron density appropriate for the mutation M36I.

The original amino acid M (shown in purple carbons) doesn't fit density.

The changed amino acid I (shown in yellow carbons) fits the density perfectly.

DAE-wide Applications on NKN

- DAE-Grid : Grid resources at BARC, IGCAR, RRCAT and VECC
- ANUNET and WLCG and GARUDA Grid migration
- Videoconferencing: with NIC, IITs, IISc
- Collab-CAD : Collaborative design of sub assembly of the prototype 500 MW Fast Breeder Reactor from NIC, BARC & IGCAR
- Remote classrooms : Among Training schools

Regional WLCG Tier II Grid in India

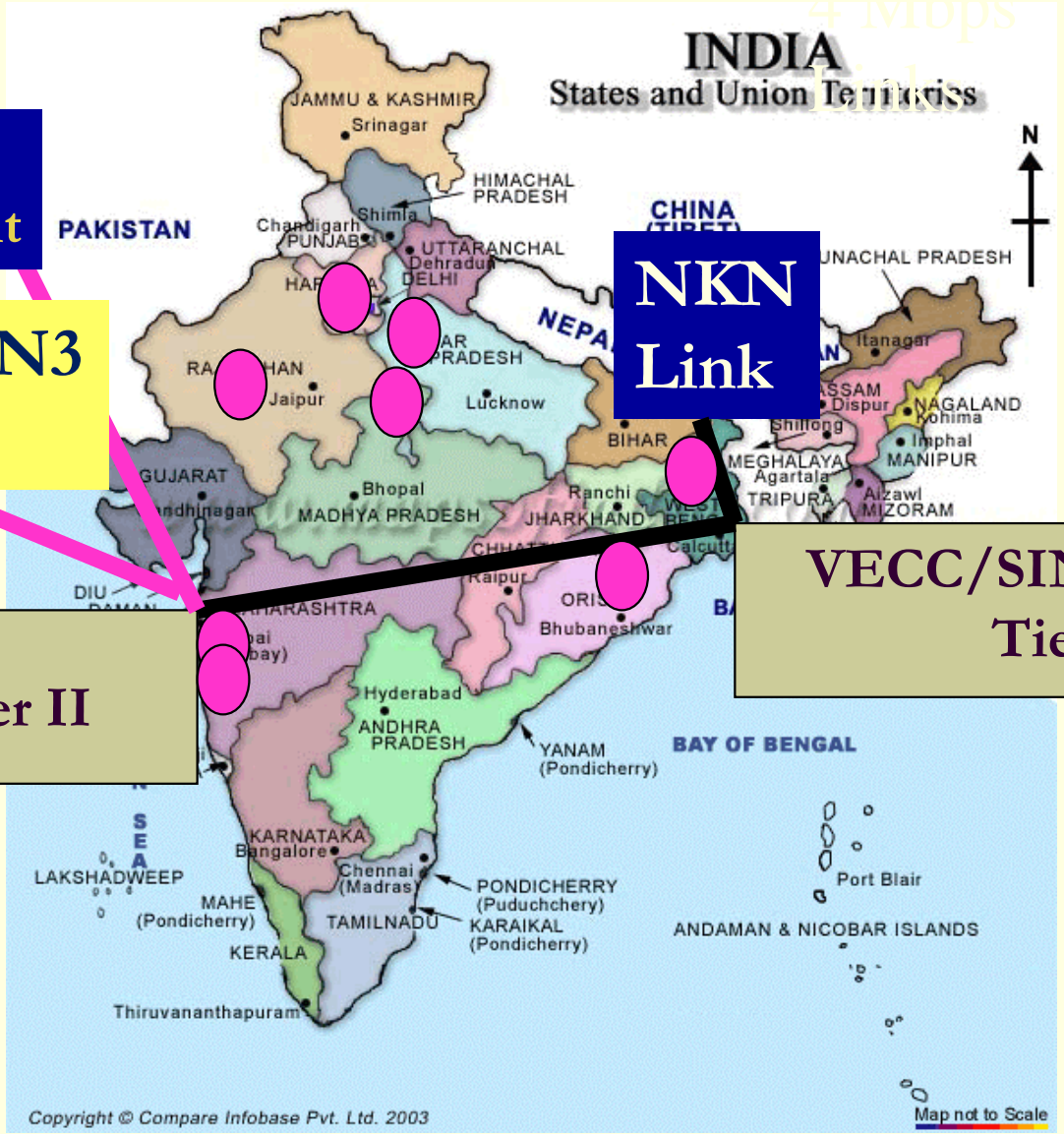
1 Gbps link to CERN/Geant

2.5 Gbps TEIN3 Link to Geant

NKN Link

TIFR : CMS Tier II

VECC/SINP: ALICE Tier II



Tier III NKN link

IPLC

NKN

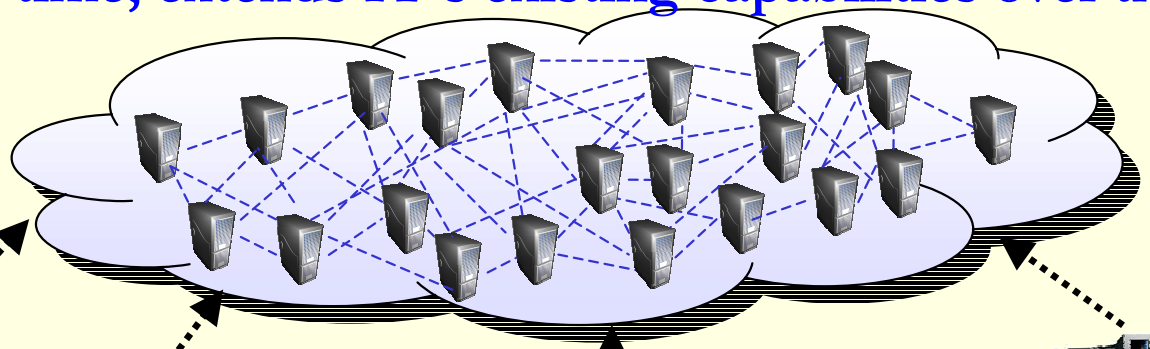
BARC, IOPB and 14 Universities have been operational since 2007

Virtualization?

- The key term is “virtualization” (encapsulation behind a common interface of diverse implementations) to create a virtual resource market to allocate resources based on business demand.
- Virtualization introduces a layer of abstraction: instead of having to snoop out what resources are available and try to adapt a problem to use them, a user can describe a resource environment (virtual workspace). The mapping between the physical resources and the virtual workspace will be handled using virtual machines, virtual appliances, distributed storage facilities and network overlays.

What is Cloud Computing?

An emerging computing paradigm where data and services reside in massively scalable data centers that can be ubiquitously accessed from any connected devices over the Internet. The cloud – a service oriented business/ software/hardware platform on the Internet -- rather than from a specific identifiable device -- aims to deliver supercomputing power over the Internet -- any subscription-based or pay-per-use service that in real time, extends IT's existing capabilities over the Internet



4+ billion phones *by 2010 [Source: Nokia]*

Web 2.0-enabled PCs, TVs, etc.

Businesses, from startups to enterprises

Benefits of Cloud Computing

- Cloud computing providing unlimited infrastructure to store and execute customer data and program. As customers you do not need to own the infrastructure, they are merely accessing or renting, they can forego capital expenditure and consume resources as a service, paying instead for what they use.

Benefits of Cloud Computing :

- Minimized Capital expenditure
- Location and Device independence
- Utilization and efficiency improvement
- Very high Scalability (expand on-the-fly as needed)
- High Computing power

Pricing on GoGrid

CPU	RAM	Disk Space	Cost per Hour *
1 x Core	0.5 GB	30 GB	as low as $0.04
1 x Core	1 GB	60 GB	as low as $0.08
1 x Core	2 GB	120 GB	as low as $0.19
3 x Core	4 GB	240 GB	as low as $0.36
6 x Core	8 GB	480 GB	as low as $0.76

Cloud Storage

- **FREE 10GB per month**
- **$0.15 per GB per month (in excess of 10GB)**

Data Transfer **

- **Outbound: as low as $0.17 / GB**
- **Inbound: FREE**

*** Cloud Server Pricing based on Enterprise Cloud Plan**

**** Outbound Data Transfer Pricing based on 6TB Data Transfer plan**

Cloud Server Pricing

With our Pay-as-you-go Plan, Server RAM hours are billed at $0.19 per GB of deployed RAM per Hour. Per server, that breaks down to:

CPU	RAM	Disk Size	Cost per Hour
1 x Xeon	0.5 GB	30 GB	$0.095
1 x Xeon	1 GB	60 GB	$0.19
1 x Xeon	2 GB	120 GB	$0.38
3 x Xeon	4 GB	240 GB	$0.76
6 x Xeon	8 GB	480 GB	$1.52

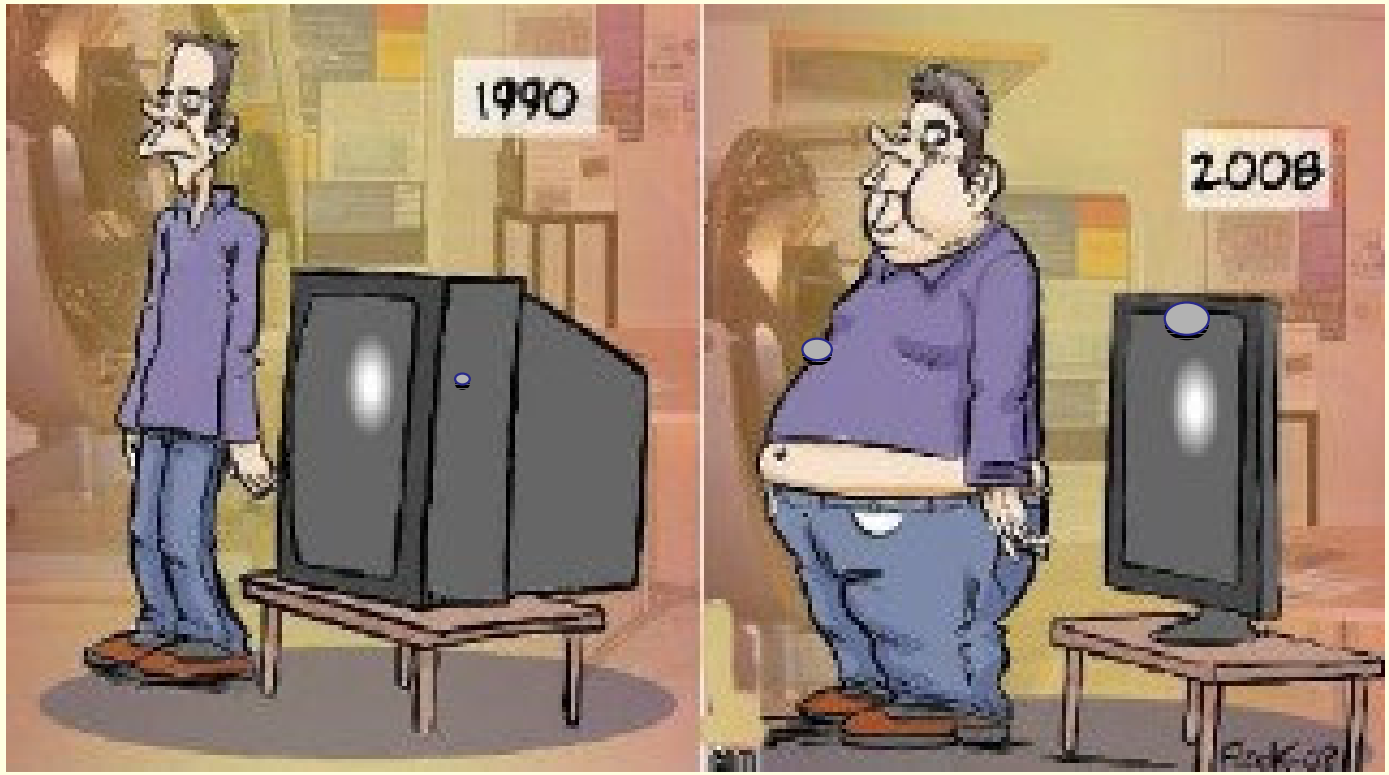
Concerns about Cloud Computing

- Performance, reliability, and SLAs,
- Control of data, and service parameters,
- Application features and choices,
- Interaction between Cloud providers,
- No standard APIs – mix of SOAP and REST!
- Privacy, security, compliance, trust…

Conclusions

- e-Science has the potential to transform the way the university community pursues research
- Open access to publicly funded research results and data is now becoming a reality
- Institutional Repositories will be important elements of the national information infrastructure
- Institutional repositories will need to address data issues as well as research publications
- University libraries will need to provide advice and data curation services for scientists

Relax !!!



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