Indian Network Perspectives

Presented by :
Savita Utreja, ERNET India
savita@eis.ernet.in

Presentation Outline

- ERNET India – Introduction
- Networks established by ERNET India
  - ERNET
  - Network for Indian Grid – GARUDA
  - Network DAE - LHC grid
  - Network Overlays
- International Connectivity
- International Collaborations in Networking
- Research in Networking
- Integrated National Knowledge Network
- Government Networks
- Industrial & Private networks

ERNET India

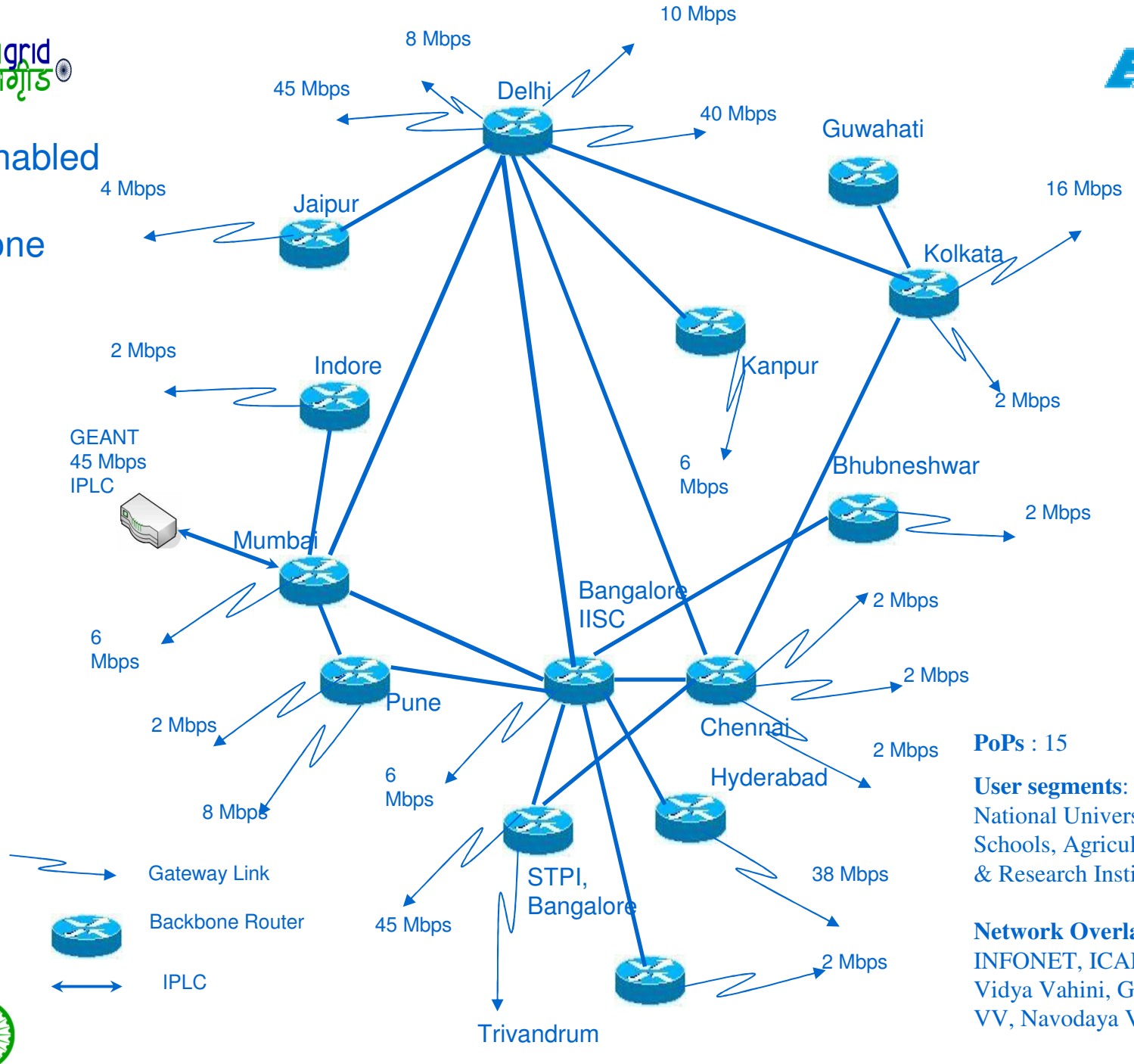
- Main Objectives
  - Network for Educational and Research Community (NREN).
  - R&D in area of Data Communications and its applications.
  - Training and consultancy.
  - Hosting of educational Content.
  - Domain Registrar for ac.in, res.in and edu.in
- Collaboration with academic and research Institutes

Networks established by ERNET

ERNET

- Terrestrial Backbone
  - **IPv6** and **MPLS** enabled Backbone
  - Topology with redundant Channels at Nodes
- International Connectivity through GEANT for connectivity with other NRENs
- Commodity Internet bandwidth through multiple Service Providers
- VSAT based Satellite Network in C-band with hub at Bangalore
  - Beaming 3 Transponders of 36 MHz
  - Channel for Distance Learning / Video Multicasting
- Seamless Connectivity of Satellite and Terrestrial links
- 15 POPs located at E&R Institutions
- User base 1200 institutions
  - Universities, Research institutes, Colleges & Schools
  - More than 200 Mbps Internet bandwidth

IPv6 Enabled MPLS Backbone



PoPs : 15

User segments:
National Universities, Colleges Schools, Agricultural Institutions & Research Institutions

Network Overlays : UGC-INFONET, ICAR Net, AICTE , Vidya Vahini, Gyan Vahini, CIC-VV, Navodaya Vidyalaya Samiti

The Indian Network Grid - GARUDA

Based on ERNET's competence in high speed networking, DIT directed ERNET to design, deploy and operate the pan-Indian high-speed network for the proof of concept phase of GARUDA project of CDAC.

Features

- Ethernet based with aggregate bandwidth capacity of 2.4 Gbps
- Scalable , resilient and secure
- High levels of reliability
- Effective Network Management

Deliverables & Status

•High-speed Communication Fabric connecting 45 institutions (22 institutes at 100Mbps and 23 at 10 Mbps)

Network DAE-LHC Grid

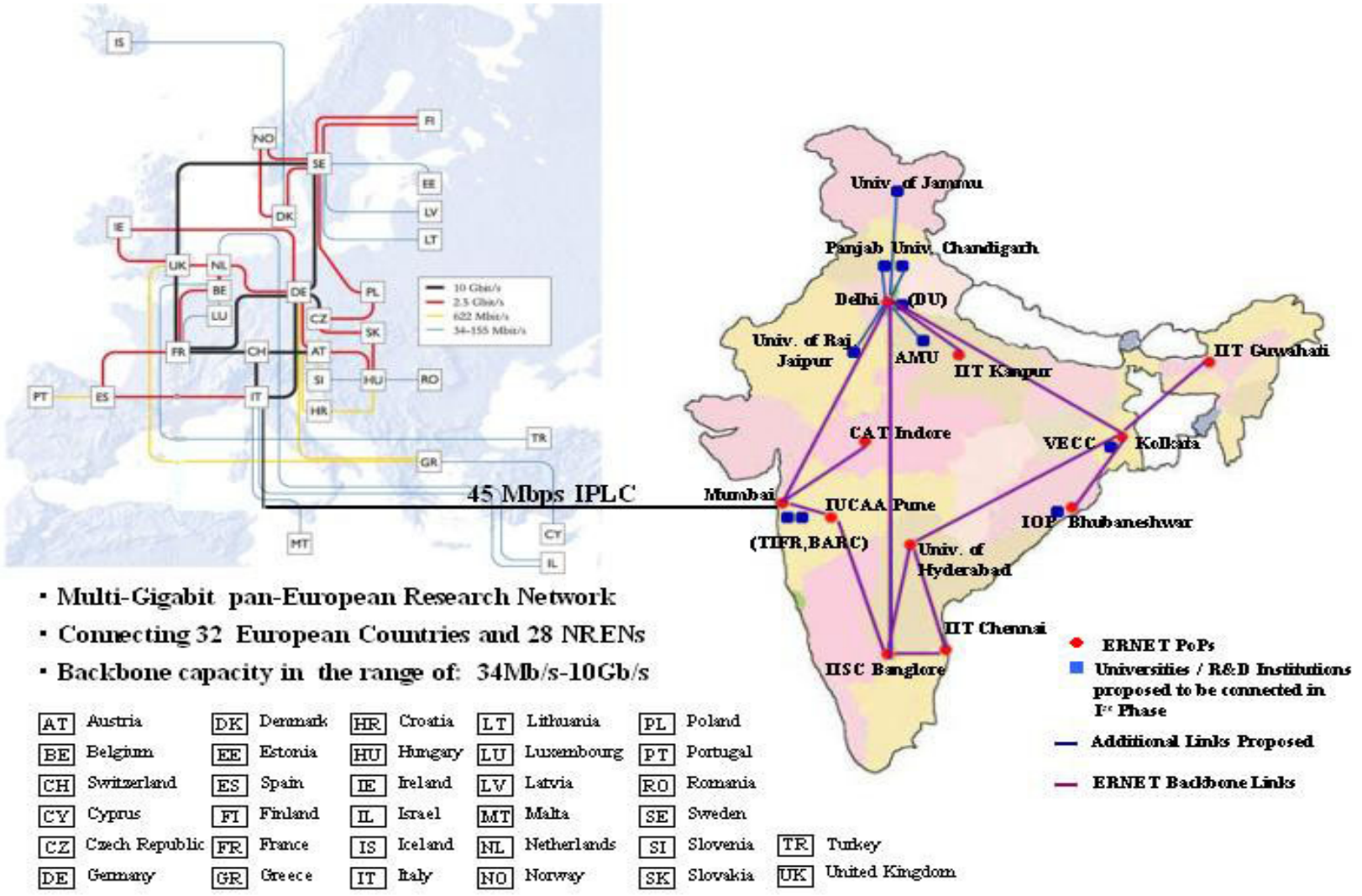
- ERNET has provided bandwidth to different Tier II & Tier III centres of LHC gird institutes and universities for accessing the GEANT, the pan European network by setting up a separate network for these institutes.

- 45 Mbps IPLC connectivity between ERNET and GEANT is used by these LHC grid users in India to share resources and collaborate with their counterparts in Europe.

Connectivity of ERNET with European Research Network GEANT

- ERNET has been connected with European Research and Education Network GEANT through 45 Mbps international private leased circuit (IPLC).
- Link is used by Indian Scientists for collaborative research in high end physics with their counterparts in Europe.
- This link provides gateway for other research network such as Internet2, Canarie & APAN.
- Being upgraded to 100Mbps. Scaling up to 1Gbps through TEIN3 collaboration.

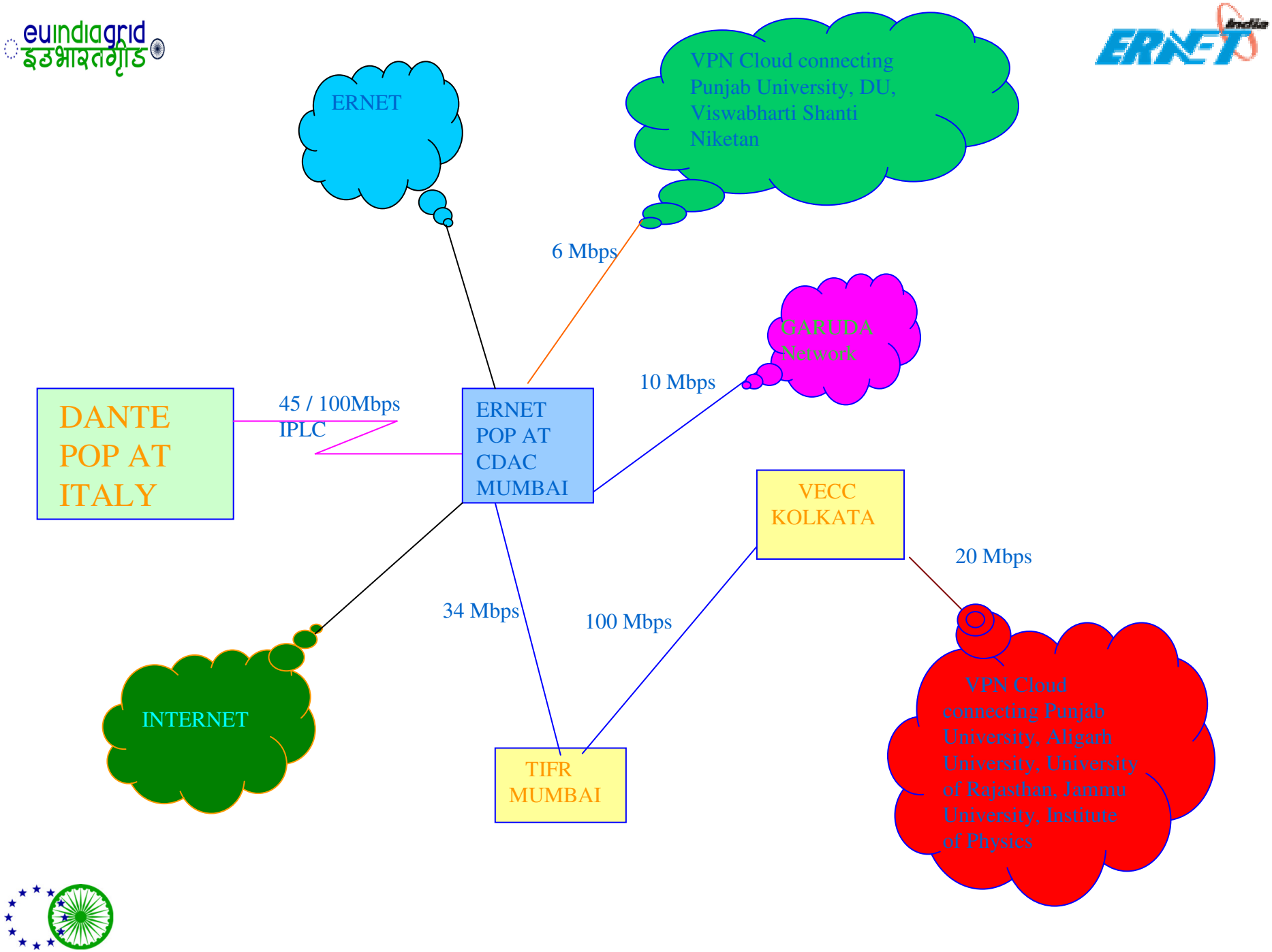
GEANT – ERNET Connectivity



- Multi-Gigabit pan-European Research Network
- Connecting 32 European Countries and 28 NRENs
- Backbone capacity in the range of: 34Mb/s-10Gb/s

AT	Austria	DK	Denmark	HR	Croatia	LT	Lithuania	PL	Poland
BE	Belgium	EE	Estonia	HU	Hungary	LU	Luxembourg	PT	Portugal
CH	Switzerland	ES	Spain	IE	Ireland	LV	Latvia	RO	Romania
CY	Cyprus	FI	Finland	IL	Israel	MT	Malta	SE	Sweden
CZ	Czech Republic	FR	France	IS	Iceland	NL	Netherlands	SI	Slovenia
DE	Germany	GR	Greece	IT	Italy	NO	Norway	SK	Slovakia

TR	Turkey
UK	United Kingdom


ERNET
VPN Cloud connecting Punjab University, DU, Viswabharti Shanti Niketan
6 Mbps
GARUDA Network
10 Mbps
DANTE POP AT ITALY
45 / 100Mbps IPLC
ERNET POP AT CDAC MUMBAI
VECC KOLKATA
20 Mbps
34 Mbps
100 Mbps
INTERNET
TIFR MUMBAI
VPN Cloud connecting Punjab University, Aligarh University, University of Rajasthan, Jammu University, Institute of Physics

Demo through ERNET-GEANT link

- Live relay of surgery from Seoul Korea to Tata Memorial Hospital, Mumbai in Jan'07 using Digital video Transport System (DVTS) consuming 30 Mbps bandwidth.
- 2.1 TB of data related with Sloan Digital Sky Survey (SDSS) was downloaded using the link in 3 weeks by IUCAA Pune.
- Teleconference on Tsunami on 29th August'07 with APAN meeting at Xi'an China.
- BITS Pilani & IIT Guwahati going to use the link for IPv6 project Tiny6 with INRIA France.
- Demonstration of live surgery cum teleconference form Kyushu University, Japan to Tata Memorial Hospital was done in April '08 using 30 Mbps bandwidth end to end.

Trans Eurasia Information Network (TEIN 3)

- TEIN3 will provide connectivity to National Research & Education networks (NRENs) in South Asian countries with pan – European Research Network GEANT2 and thus to Internet2.
- TEIN2 is operational and DANTE has taken initiative to extend reachability of TEIN to South Asian countries.
- DANTE is conducting feasibility study for connecting South Asian Countries like India, Nepal, Bangladesh, Pakistan, Bhutan and Sri Lanka on European Commission funded network called TEIN3.
- ERNET participated in TEIN3 feasibility Study and submitted the desired inputs in April 2008.

Expectations from TEIN3

- High capacity link between GEANT & ERNET
  - 1Gbps in 2008 to start with
  - 2.5 Gbps in 2009
  - 10 Gbps in 2010
- Redundancy in connectivity with link to Singapore or Hongkong POP of TEIN2.
- Provide direct connectivity to APAN.

International Collaborations in Networking

ERNET's Role in EU-India Grid

- Analyze the present network connectivity plan between Europe and India and promote improvements in terms of bandwidth and network services.
  - 45 Mbps ERNET- GEANT link between India grid & EU grid
  - Bandwidth being upgraded
- Interoperability
  - Interoperability between GARUDA and EU grid.

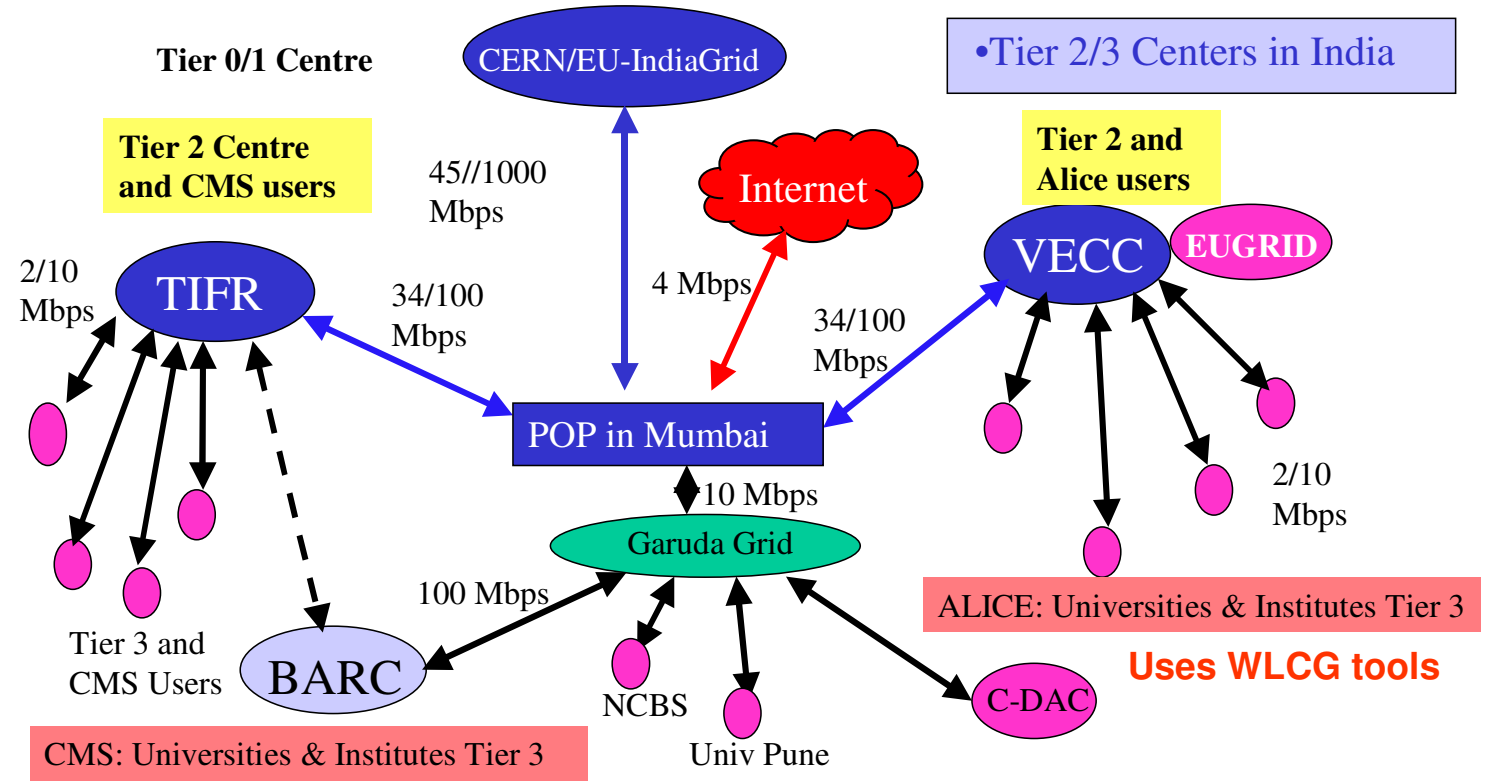
Challenges in Interoperability

- GARUDA a closed user group network
- No external connectivity envisaged
- Private addressing scheme

Interoperability

- Private Addresses of EU-India grid partners were changed to Public Addresses
- CDAC Mumbai common point & hence point of interconnectivity
- Networks learned from GEANT injected into GARUDA network
- GARUDA IP address advertised to GEANT
- Change in network architecture at partner institute
- The Interoperability was established in January 2007

DAE/DST-WLCG & EU-IndiaGrid



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

International Collaborations in Networking

(contd..)

- **BELIEF (Bringing Europe's eLectronic Infrastructures to Expanding Frontiers)**
  - aims to develop synergy between researcher communities and on-going e-infrastructure initiatives .
  - Implemented by consortium of EU partners, ERNET India, Brazil and US.
  - Relies on the local support of Indian and Latin American partners: ERNET & Brazil to ensure increased visibility as well as the participation of high-profile industrial and scientific communities in these locations.

International Collaborations in Networking

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6Choice

- Supports cooperation between ERNET, European GEANT and Grid network through joint networks interconnection, service planning and experiments with the middleware jointly developed in the project.

- Complement the implementation of the e-infrastructures framework across Europe and India for future community research and technological development, policy activities including monitoring and assessment activities.

Research in Networking

Quality of Service (QoS)

- ERNET in association with institutions including IITs (DELHI, MUMBAI, KHARAGPUR, MADRAS) , CDAC PUNE & IISC BANGALORE has taken up a project to setup National Quality of Service Test bed.
- Aims to provide QoS assurances to applications requiring assured bandwidth from end-to-end, communication privacy, minimal round time for packet delivery,regularity of the data flow.
- Associated with analyzing Qos related issues for IP networking including those of multimedia applications like VoIP, Video conferencing and other real time applications like distance learning and digital library.
- This testbed will be interconnected with the local testbed at other locations in the country.

Research in Networking

(contd..)

IPv6

- ERNET India & IIT Kanpur had taken initiative to implement IPv6 on ERNET backbone and test some IPv6 features like auto configuration, IPv6 multicast, DNS, E-Mail etc.

- ERNET backbone has been upgraded to provide dual stack access of IPv6 and IPv4 to its users to develop, test and implement IPv6 based mail, DNS, web applications and products.

India requires High Speed Network

For learning & knowledge sharing, Education Research sector requires following applications:

- e-learning
- Multimedia Conferencing
- E-access
- Telemedicine for Health
- Video Conference for Telemedicine
- Distance Education
- Text communication
- Video streaming
- E-books
- e-labs
- Research

Integrated National Knowledge Network (iNKN)

- Multi Gigabit Integrated National Knowledge Network (iNKN) has been proposed as absolute necessity for development of the nation.
- The proposed network will enable researchers and academia from different background and diverse geographies to work closely for development in critical and emerging areas. It will allow them to share and transfer knowledge at ease.
- The expert group set up by Department of Information Technology(DIT) submitted blue print for setting up of integrated National Knowledge Network (iNKN).
- Government of India has allocated Rs. 100 crores for the current year 2008-09 for iNKN.

GOVERNMENT NETWORKS

NICNET

- Provides network backbone and e-Governance support to Central Government, State Governments, UT Administrations, Districts and other Government bodies
- A high speed NICNET is combination of Terrestrial and satellite based networks
- NICNET facility has been established in all Central Government departments, 35 States/UTs and over 600 District centers to facilitate informatics development for decision support and information exchange.

GOVERNMENT NETWORKS

(contd..)

Software Technology Parks Of India (STPI)

- An autonomous organization under Ministry of Communications and Information Technology,Govt.of India.
- Has 21 Centres across the country,major ones at Bangalore, Noida, Chennai, Hyderabad and Pune.
- STPI services
  - IPLC Circuit for the International Sites.
  - Broadband Internet services
  - Internet Leased Line services

Industrial & Private Networks -Major Players

- Bharat Sanchar Nigam Ltd(BSNL)
- Reliance Infrastructure Ltd
- Bharti Airtel Ltd
- Tata Communications(VSNL)
- Power Grid Corporation Ltd(PGCIL)
- Railtel Corporation
- Sify
- Tulip IT
- Vodafone

Thank You