

Recent Developments in Grid Computing & e-infrastructures in India

Presented jointly by
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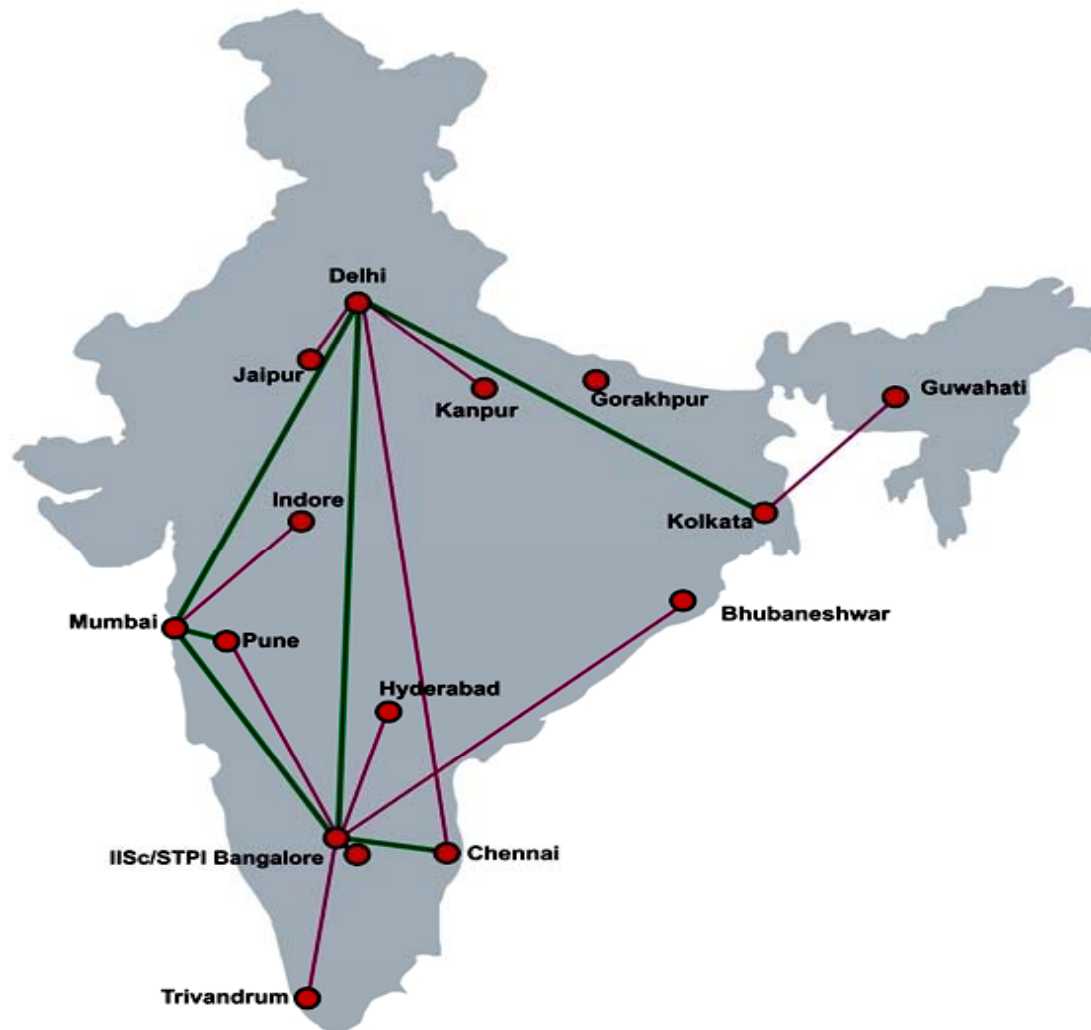
Outline of Talk

- About ERNET India
- Setting up Grid Networks
 - LHC and Regional WLCG in India
 - Indian Grid Computing Initiative- GARUDA
 - EU-IndiaGrid
- National Knowledge Network(NKN)
- India Grid Certification Authority
- International Connectivity
- Summary

ERNET

- **ERNET India is a non-profit making autonomous organization under Department of IT, Government of India**
- **ERNET is NREN for India**
- **15 Point of Presence (PoPs) at premier E&R institutions in the country**
 - **User base is over 1300 institutions. Connected over terrestrial links and Satellite – VSAT**
- **Dual stacked(IPv4 & IPv6), MPLS enabled Backbone**
- **430 Mbps Commodity Internet bandwidth**
- **Provides connectivity to global research network**

ERNET Backbone



April 22, 2009

Recent developments in Grid Computing & e-infrastructures
in India

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 established regional WLCG two Tier II's in India

India's kind
contribution
is over 60
MCHF

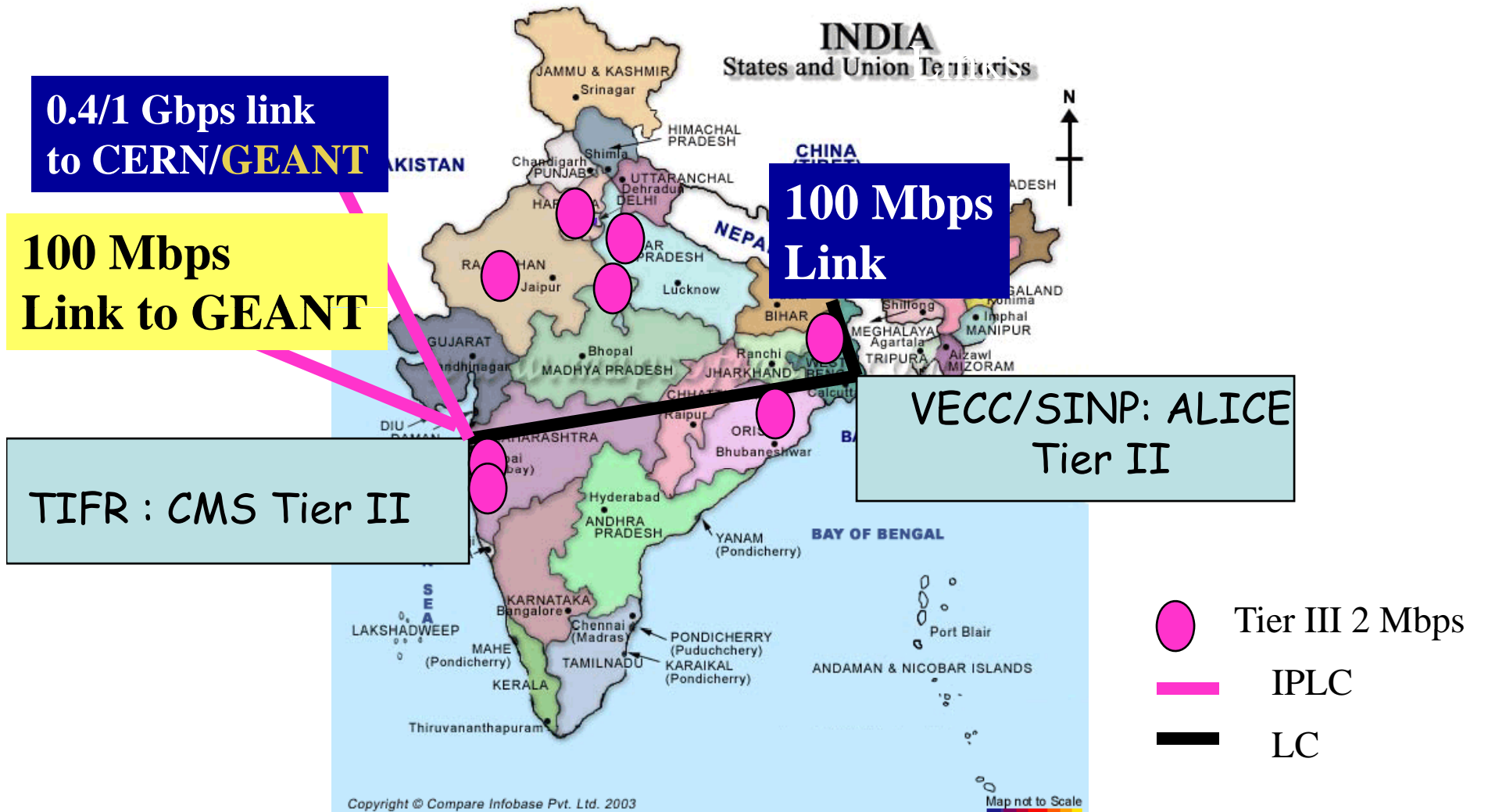


May 25th, 2005 Visit of Dr A. P. J. Abdul Kalam - President of India

Network Scenario in India

- In India, 10-15 years ago, we had very primitive network infrastructure
- Today, scenario has changed. Private companies are laying fiber all over 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 (10 to 12 times expensive than other countries)
- The DAE/DST has committed to set up a regional Tier II network in India to support CMS & ALICE users
- ERNET was entrusted the responsibility to set up the network: MOU agreement with TIFR (DAE) and DST

Regional WLCG Tier II Grid in India



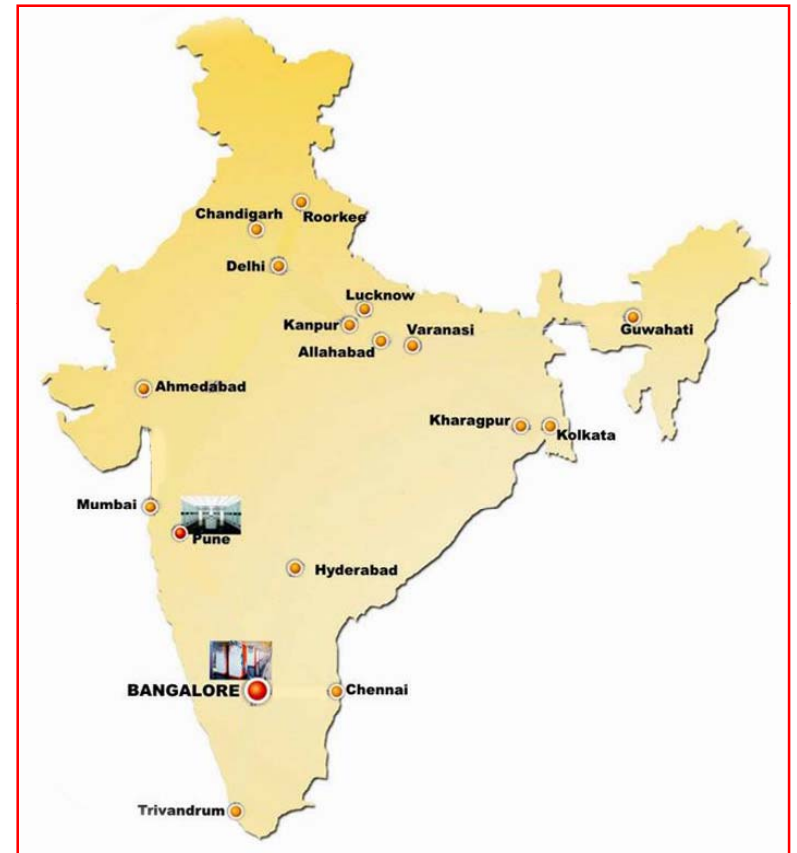
Original Network started operating since 2007 and upgraded on regular basis

GEANT peering on TIFR-CERN link

- **GEANT Peering to DAE for TIFR-CERN 1 Gbps/400 Mbps line**
- **This was first discussed at Bled, Slovenia, early March 2008, with EC officials**
- **Meeting with EC delegation at Delhi at end-January 2009**
- **The peering actually got successfully implemented by 11 February 09**
- **In CMS computing model, a Tier-2 has to be connected with at least 4 down links and 2 up links to CMS Tier-1s**
 - **3 down links commissioned CERN, FNAL and ASGC**
 - **2 up links commissioned CERN and ASGC**
- **100 Mbps link established between TIFR & IPR, Ahmedabad for ITER experiment to share TIFR-CERN link**

National Grid Computing Initiative: GARUDA

- The Proof of Concept network has been established
- The MPLS Virtual Private Network (VPN) connects 22 institutions at 100 Mbps and 23 institutions at 10 Mbps across 17 Indian cities; implemented by ERNET
- 2.4 Gbps backbone bandwidth
- Computing and Storage resources made available in Garuda grid

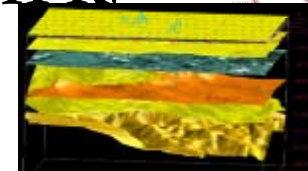
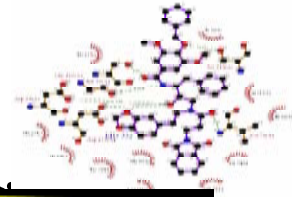
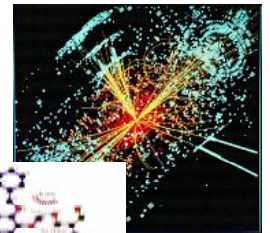


The EU-IndiaGrid Project Joining European and Indian grids for e-science

- To support the interconnection and interoperability of the prominent European Grid infrastructure (EGEE) with the Indian Grid infrastructure for the benefit of eScience applications
- Two year project started from Oct 2006 with BUDGET of 1208K Euro total fund out of which 1015.9K Euro from European Commission (5 European & 8 Indian partners)
- Person months
 - 353.3 PM total
 - 226.4 PM funded from European Commission

EU-IndiaGrid Mission

- **Quickly set up Grid Infrastructure**
 - Use production Grid-WLC and connect GARUDA
 - Interoperate with EGEE Euro-Grids
 - Contribute to Grid standardisation efforts
 - **Support applications from diverse communities**
 - High Energy Physics..... DAE units
 - Condense Matter Physics ...Pune Univ, TIFR
 - Bio-Sciences..... NCBS
 - Climate/Earth Sciences MOES
- + Disseminate knowledge about the Grid through training
- + Prepare for sustainable European Grid Infrastructure



Excellent grading received in final EC review held in March 2009

Constraints & Realities

- No Single NLD is covering throughout the country
- Reliability demands links be from two or more NLDs
- QoS across NLDs still an unresolved issue
- QoS across MPLS clouds across ISPs is still an unresolved issue
- Strategic Control
- High cost

National Knowledge Network(NKN)

- **NKN** an e-infrastructure project : a multi 10 Gbps network of High Speed Computing & Communication system, implemented by the Department of Information Technology, GOI, under supervision from the High Level Committee chaired by Dr. Chidambaram, Principal Scientific Advisor to GOI
- It aims to facilitate access & exchange of knowledge in a cost effective manner and interlink about 5000 Govt. Labs, IIT's, Universities & Colleges

Objective of NKN

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

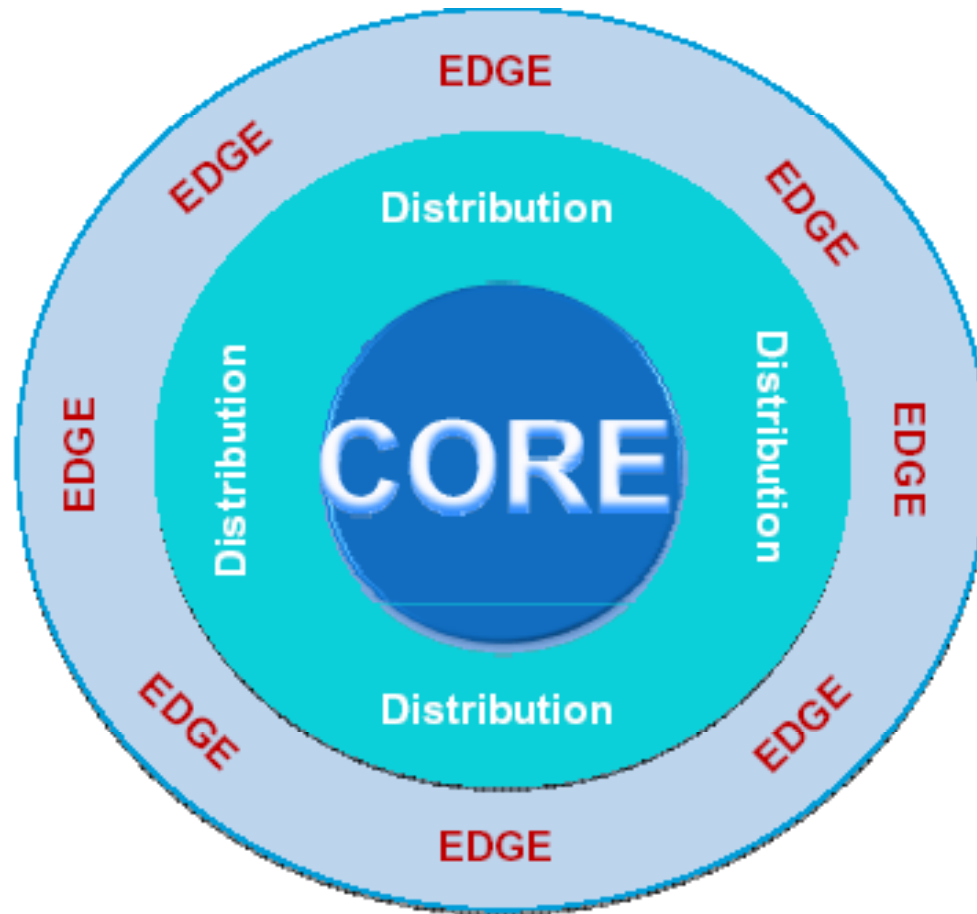
NKN Design Philosophy

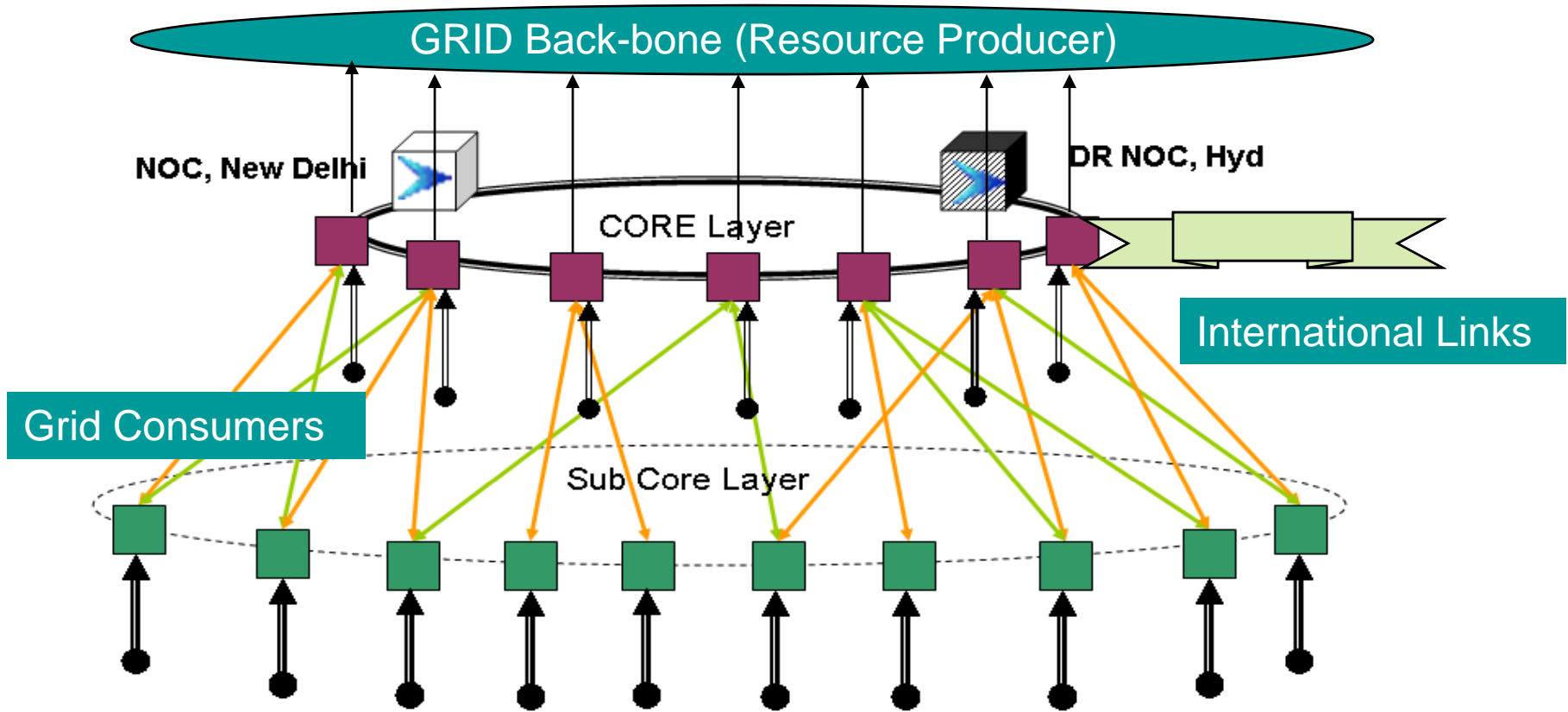
- **Common National e-infrastructure like national highway, wherein different categories of users shall be supported**
- **To build a scalable network, which can expand both in Reach (spread across the entire country) and Speed (capacity)**

NKN Features

- High Capacity, Highly Scalable Backbone
- Provide Quality of Service (QoS) and Security
- Wide Geographical Coverage
- Bandwidth from many NLD's
- Highly Reliable & Available by Design
- Test beds (for various implementation)
- Dedicated and Owned.
- Connectivity for International & other global R&D Networks

NKN of INDIA





Grid Consumers

International Links

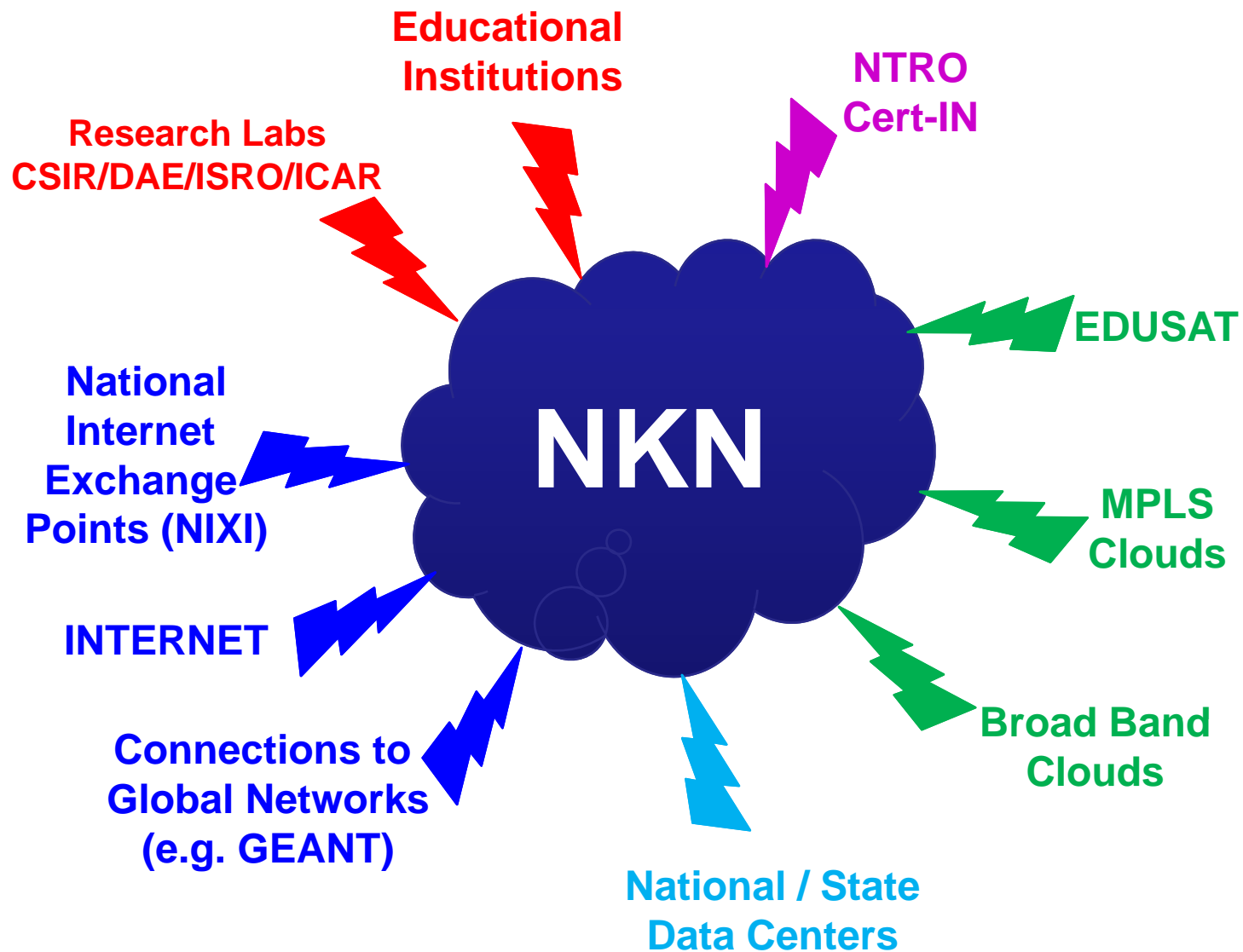
Grid Consumers

Core & Distribution Backbone- NKN

LEGEND

- Core Layer PoP
- Distribution Layer PoP
- Multiple Institutes connecting to PoP
- Core to Distribution Links

NKN Topology



Implementation Strategy

- Being implemented in two phases: initial & final
- Initially the PoPs are co-located in National Informatics Centre(NIC) state center by upgrading the existing infrastructure and with the bandwidth provided by the NLDs
- ERNET locations will be upgraded by NKN and become NKN PoPs.
- New PoPs will be created - called the NKN PoPs
- Agreement with PSU's (BSNL/PGCIL/Railtel) for supporting fiber for 10 years

Initial Phase of NKN

CORE is ready

- CORE at 15 locations operational with multi 2.5 Gbps since 20 Dec 2008 to be enhanced to 10 Gbps

End Nodes for Initial Phase

57 End Point Connectivity (Initial Period)

57 User Nodes (Education, National R&D Labs)

- End Node Infrastructure
 - HD quality VC/ Router/Laptops/UPS/AC/ Minor works
- User Training workshop held at BARC on NOV 10-11, 08
- Application training planned in June 09 first week

Inaugurated by the President of India on April 9, 2009

Applications to show cased

- **Education & Research**
 - **Countrywide Real Time Classroom (IITs)**
 - **GRID Applications**
- **Agriculture**
- **Health Care**
- **Industry**
 - **e-governance**
 - **Knowledge content creation**

Grid Computing using NKN core

- Climate change modeling application considered as a grand challenge national problem
- Main applications planned for initial phase are:
 - Climate change Modeling (MOES)
 - HEP of LHC (WLCG network in India; gLite) (DAE)
 - EU-IndiaGrid linking Garuda (GTK), WLCG & EGEE
 - Computing Grid of DAE (gLite)
 - Open Source Drug Discovery (CSIR)
- Application of Collab_CAD (NIC/BARC/VSSC/IGCAR)

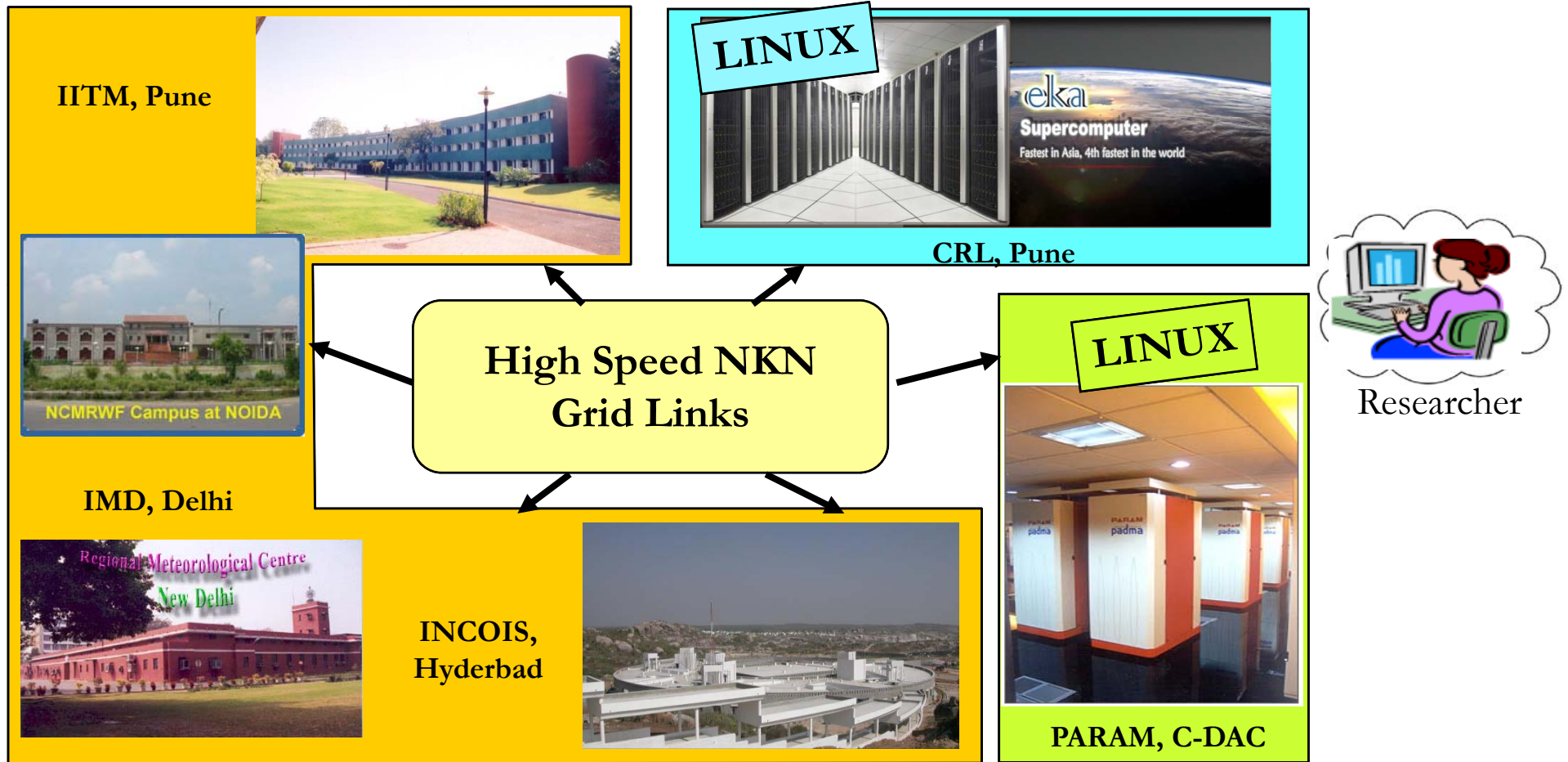
Indian Grid Certification Authority

- ASGC played the role of Grid CA for India till recently
- First Grid CA in India was established at C-DAC, Bangalore; Indian Grid Certification Authority (IGCA) accredited by APGridPMA
- C-DAC presented IGCA in APGridPMA Face to Face meeting on 16th Sep 2008 @ OGF24, Singapore.
 - Reference: <http://www.ogf.org/OGF24>
<http://www.apgridpma.org/meetings/index.html>
- IGCA formally inaugurated on Jan 14, 2009 by Dr. R Chidambaram , PSA to Govt. of India and presided by Secretary, DIT
- IGCA is fully operational now and issuing user and host certificates

Migrating present Grids to NKN

- **LHC regional Grid (DAE/DST)**
 - 2 x Tier II CMS & ALICE and 14 Universities
- **GARUDA Grid (C-DAC/DIT)**
 - 45 institutes in 17 Cities; partially using NKN
- **EU-IndiaGrid (European Grid)**
 - 9 Indian partners and 5 European
- **DAE Grid (DAE private Grid)**
 - Operational with NKN backbone

NKN Grid brings together major supercomputers for Climate Change research



SN - EYE CARE

- **Tele Medicine**
 - Diabetic Retinopathy
 - Glaucoma
- **Tele Education**
 - Training of Surgeons, Nurses
 - Sharing of PubMed Database
 - Current areas of Research Interest
- **Sankar Nethralaya(SN) will act as a Nodal Agency**

International Connectivity

- **Current status**

- TIFR-CERN link (0.4/1Gbps)
- ERNET-GEANT link(100 Mbps)

- **Participation in TEIN3**

- From India, ERNET was nominated to participate in South Asia Feasibility Study(SAFS) meetings of TEIN3.
- SAFS report accepted by EC
- During SAFS meeting, we had projected 2.5 Gbps connectivity to India toward GEANT PoP in Europe and toward East Asia PoP of TEIN3
- We are going to participate in network procurement phase of TEIN3 for South Asia

- **Connectivity to Internet2**

- To connect to TEIN3 PoP at Singapore at 622 Mbps from India

- **Proposal from ASGC for PoP in Chennai**

Summary

- **Key concepts for NKN**
 - High bandwidth, low latency nationwide network
 - Production quality ICT infrastructure
 - Sustainability – planning for the long-term
 - Expandability in Reach and Speed
 - Security and ... many other
- **Creating the “grid layer” in e-Infrastructure**
- **International Connectivity to Europe, USA and Japan/Singapore**
- **Multiple applications shared on a single backbone**

**THANKS FOR YOUR
ATTENTION**