



# GARUDA - The National Grid Computing Initiative of India

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## Outline

- **GARUDA Overview**
- **Communication Fabric**
- **Resources**
- **Partners**
- **Applications & User Groups**
- **Q & A**





## Motivation for GARUDA

- Sharing of high-end computational resources with the larger scientific and engineering community across the country
- Emerging High Performance Computing (HPC) applications require integration of geographically distributed resources
- Collaborative Framework for solving applications which are interdisciplinary requiring experts from multiple domains and distributed locations
- Universal (location-independence, ubiquitous) access to resources

**Computational Grids effectively address the above application requirements**





## Project Overview

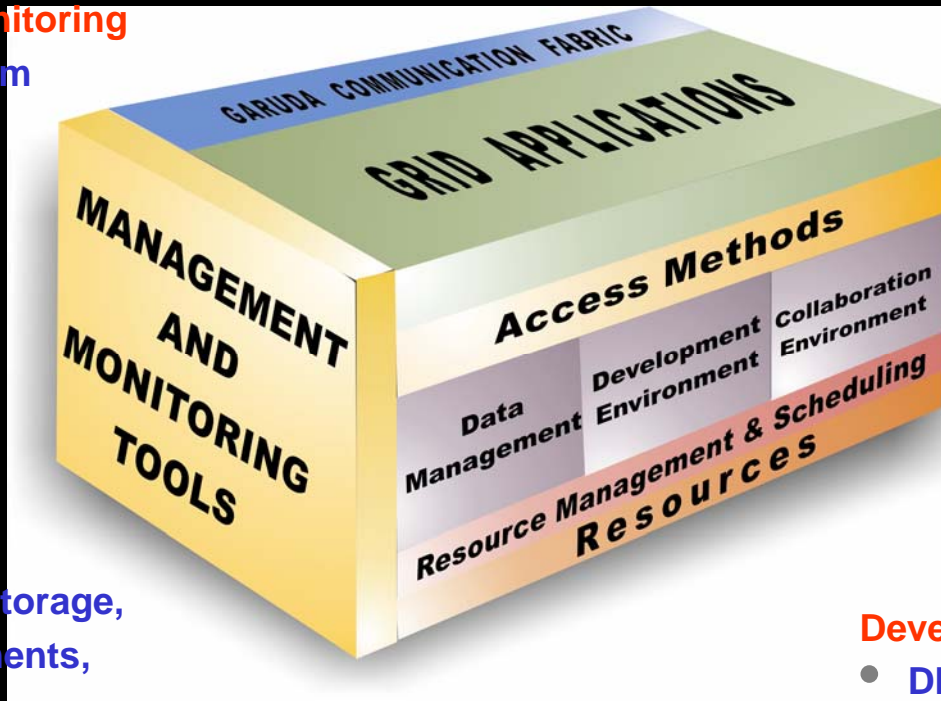
- Precursor to the National Grid Computing Initiative
  - Test Bed for grid technology/concepts and applications leading to the plan for the main grid initiative
- Project initiated by the Dept. of IT in November 2004
- Major Deliverables
  - Technologies, Architectures, Standards & Research Initiatives
  - Nation-wide high-speed communication fabric
  - Aggregation of Grid Resources
  - Deployment of Select applications of National Importance
  - Grid Strategic User Group
- High-speed Networking Component in collaboration with ERNET



# Garuda Component Architecture

### Management & Monitoring

- Paryaveekshanam



### Application (PoC)

- Disaster Management
- Bioinformatics

### Access Methods

- Access Portal
- Problem Solving Environments

### Data Management

- Storage Resource Broker

### Development Environment

- DIVIA for Grid

### Resources

- Compute, Data, Storage,
- Scientific Instruments,
- Softwares,...

### Resource Mgmt & Scheduling

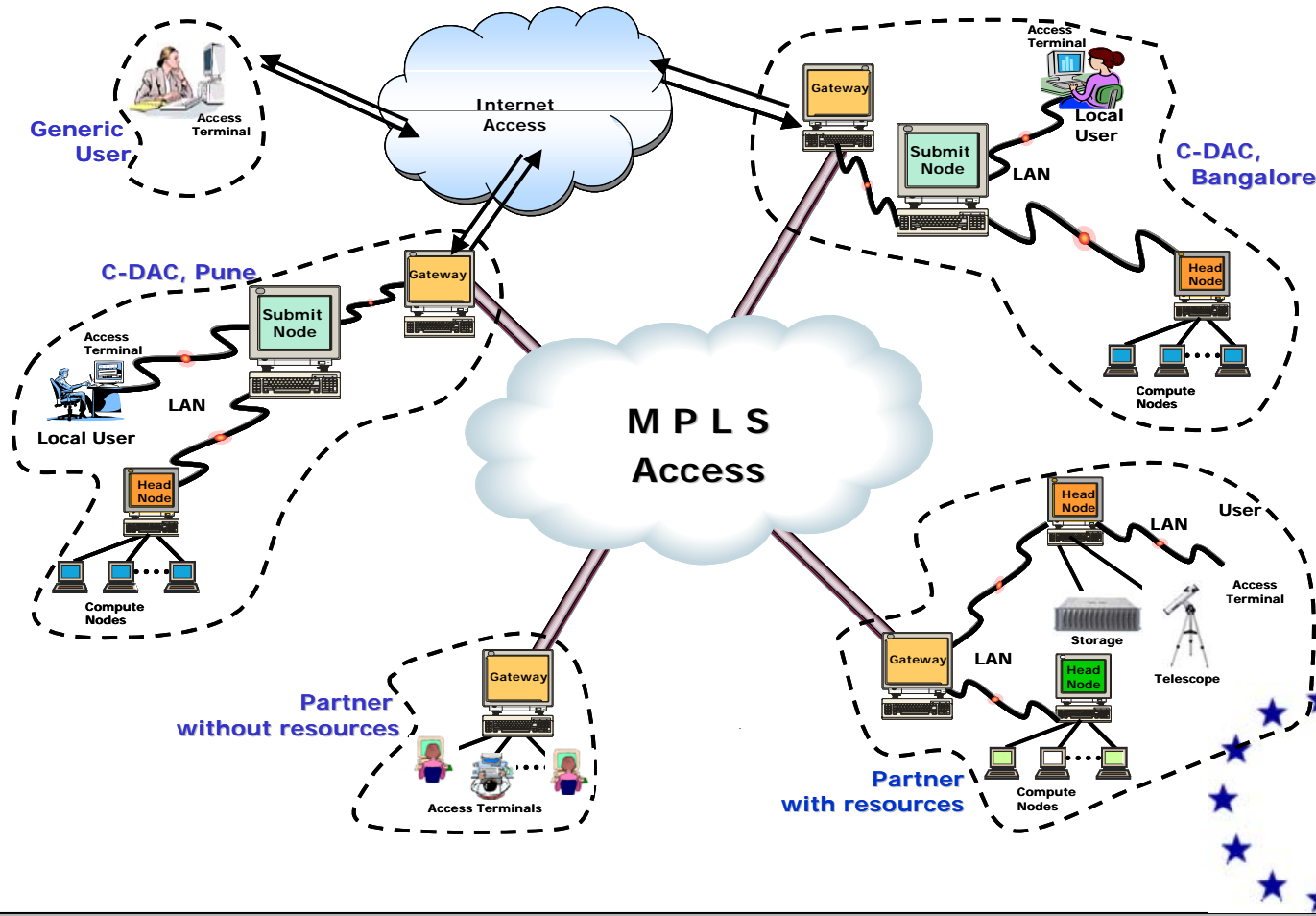
- Moab from Cluster Resources
- Load Leveler, Torque
- Globus 2.x

### Collaborative Environment

- Video Conferencing over IP
- Access Grid

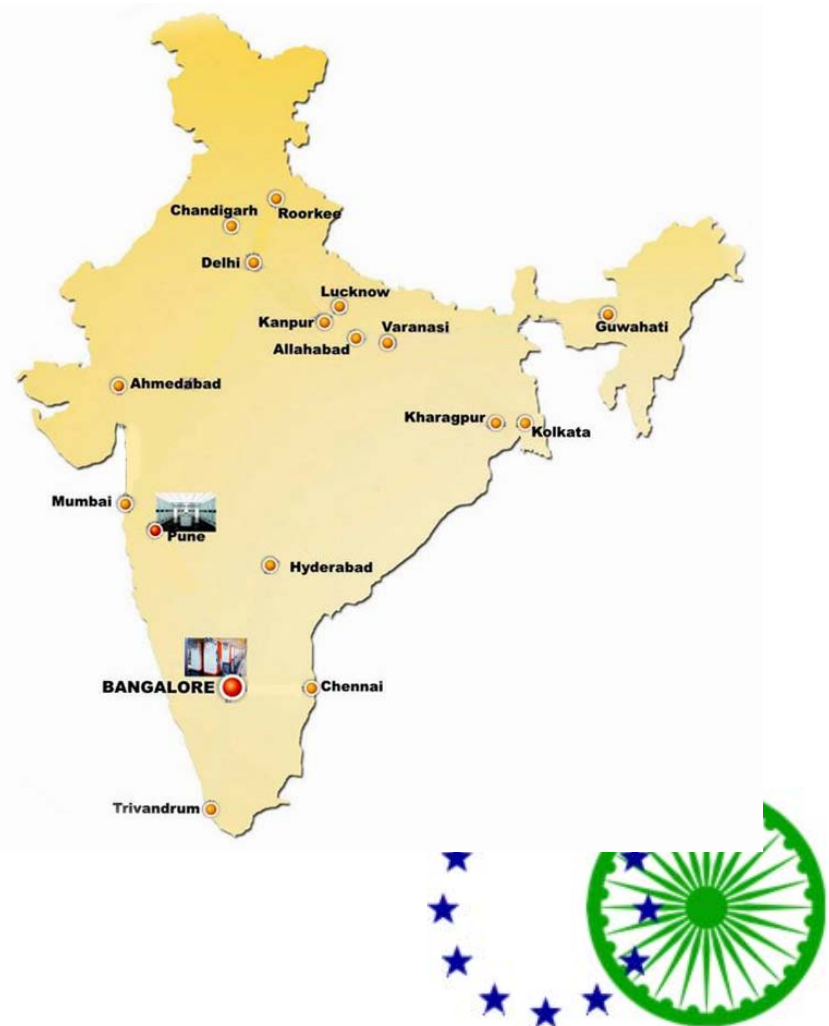


# GARUDA Component Deployment Scenario`



# euindiagrid इंडिया ग्रीड Cyber Infrastructure – Network Fabric

- 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



## Cyber Infrastructure – Resources

- In addition to PARAM Padma, Linux Clusters have been setup at Pune, Hyderabad & Chennai
- Grid Labs have been setup at Bangalore, Pune & Hyderabad
- Fourteen of the partner institutions are contributing resources including satellite terminals (compute aggregating to more than 300 CPUs)



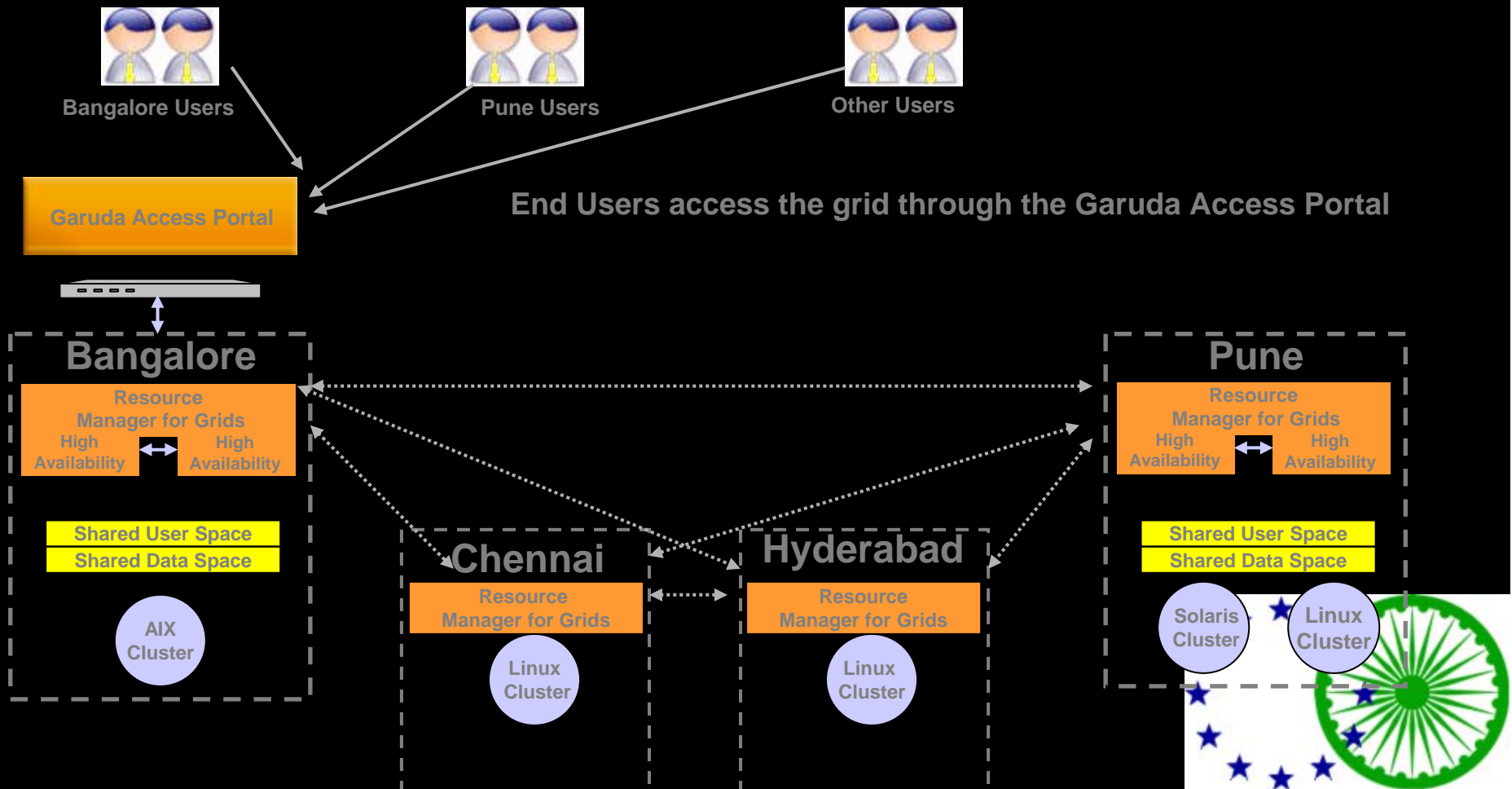


## Resource Details

- HPC Clusters from C-DAC
  - Bangalore :  
AIX Cluster
  - Pune, Chennai, Hyderabad :  
Linux Clusters
- Linux Clusters from
  - IISc & RRI, Bangalore
  - IMSc & MIT, Chennai
  - IIT, Guwahati
  - IIT, Kharagpur
- AIX SMP from University of Hyderabad
- SAC, Ahmedabad is contributing GSAT3 terminals (GSAT4 when launched) and Satellite bandwidth



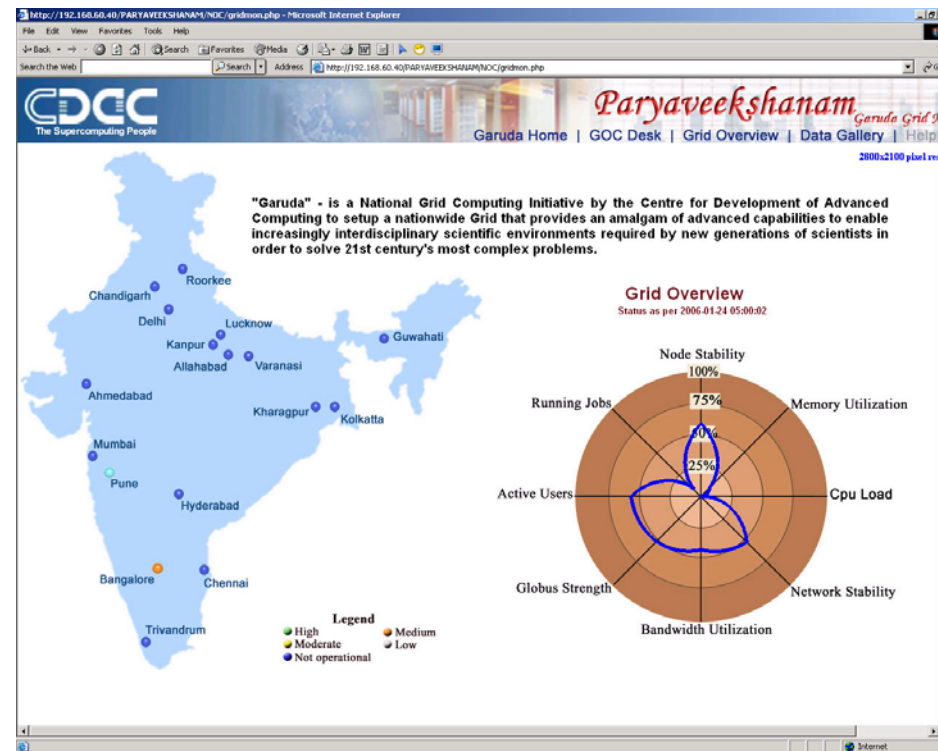
# Resources at C-DAC centres



# Grid Management & Monitoring Centre



- An integrated Resource Management & Monitoring Framework
- Network Traffic Analysis and Congestion Management
- Help desk for Grid Users



## GARUDA Partners

- Motivation
  - To Collaborate on Research and Engineering of Technologies, Architectures, Standards and Applications in Grid Computing
  - To Contribute to the aggregation of resources in the Grid
- Current Participation
  - 36 research & academic institutions in the 17 cities
  - ERNET-HQ in Delhi
  - 8 centres of C-DAC
  - Total of 45 institutions



Inter-University Centre for  
Astronomy and Astrophysics



IGOB  
INSTITUTE OF GENOMICS  
& INTEGRATIVE BIOLOGY  
Genomics Knowledge Partner



## GARUDA Partners (contd..)

### C-DAC Centres (8):

- Pune (2)
- Bangalore(2)
- Hyderabad
- Mumbai
- Chennai
- Thiruvananthapuram

### Government Collaborators

- ERNET India

### Academia

- Motilal Nehru National Institute of Technology, Allahabad
- Indian Institute of Science, Bangalore
- Punjab Engineering College, Chandigarh
- Madras Institute of Technology, Chennai
- Jawaharlal Nehru University, Delhi
- Guwahati University, Guwahati
- University of Hyderabad, Hyderabad
- Indian Institute of Technology at :
  - Chennai
  - Delhi
  - Guwahati
  - Kanpur
  - Kharagpur
  - Mumbai
  - Roorkee
- University of Pune, Pune
- Institute of Technology, Banaras Hindu University, Varanasi

## GARUDA Partners (contd..)

### Research Labs & Institutions

- Institute for Plasma Research, Ahmedabad
- Physical Research Laboratory, Ahmedabad
- Space Application Centre, Ahmedabad
- Harish Chandra Research Institute, Allahabad
- Indian Institute of Astrophysics, Bangalore
- National Centre for Biological Sciences, Bangalore
- Raman Research Institute, Bangalore
- Institute of Mathematical Sciences, Chennai
- Institute of Microbial Technology, Chandigarh
- Institute of Genomics and Integrative Biology, Delhi
- Centre for DNA fingerprinting and Diagnostics, Hyderabad
- Saha Institute of Nuclear Physics, Kolkatta
- Sanjay Gandhi Post Graduate Institute of Medical Sciences, Lucknow
- Bhabha Atomic Research Centre, Mumbai
- Tata Institute of Fundamental Research, Mumbai
- Inter-University Centre for Astronomy and Astrophysics, Pune
- National Chemical Laboratory, Pune
- National Centre for Radio Astrophysics, Pune
- Regional Cancer Centre, Thiruvananthapuram
- Vikram Sarabhai Space Centre, Thiruvananthapuram





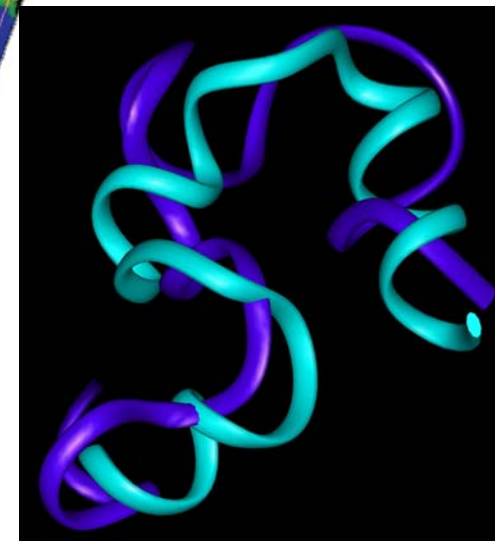
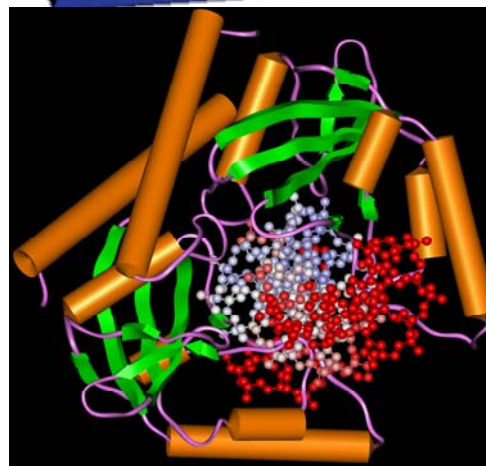
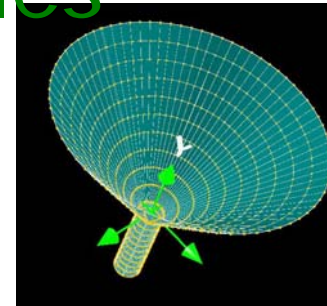
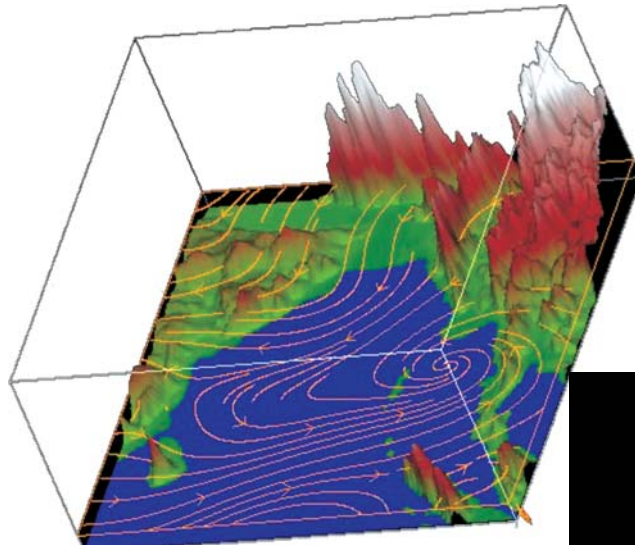
## Illustrative Applications



EU-IndiaGrid (RI-031834) is funded by the European Commission under the Research Infrastructure Programme  
[www.euindiagrid.eu](http://www.euindiagrid.eu)

## Objectives and Deliverables

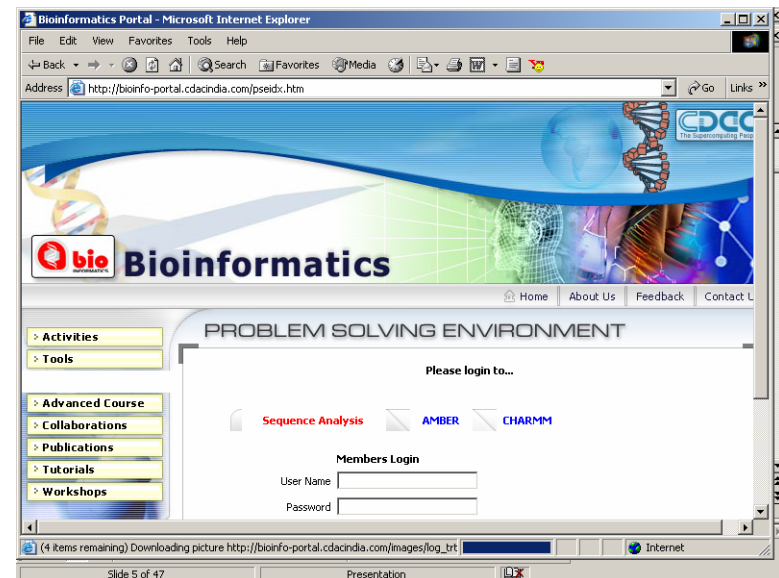
- Objectives
  - Enable applications of national importance requiring aggregation of geographically distributed resources
- Deliverables
  - Grid enablement of illustrative applications and some demonstrations such as
    - Bioinformatics
    - Disaster Management



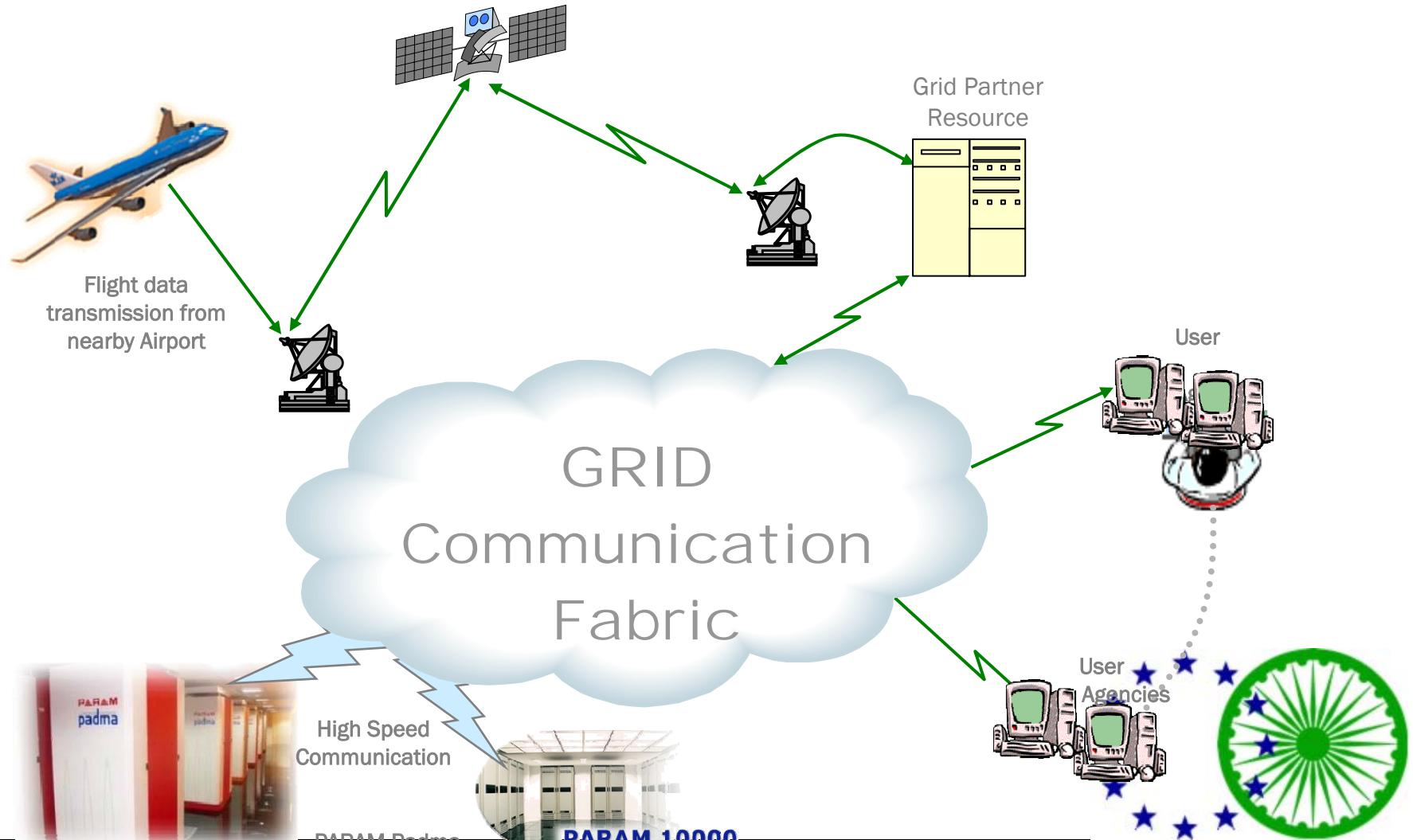


# euindiagrid इंडियाग्रीड Bioinformatics

- Bioinformatics Resources & Applications Facility (BRAf) on PARAM Padma
- Supports highly optimized Bioinformatics codes on the PARAM Padma
- Web computing portal providing all computational facility to solve related problems



# euindiagrid इंडियाग्रीड Disaster Management



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## Virtual User Community

- Astrophysics
- High Energy Physics & Astronomy
- Grid Technology
- Disaster Management
- Earth Science
- Bioinformatics (Genome)
- Network Technology



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Thank you!

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Advanced Computing For Human Advancement

