



GARUDA - The National Grid Computing Initiative of India

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Outline

- **GARUDA Overview**
- **Architecture & Network**
- **Resources**
- **Partners**
- **Applications for PoC**
- **Interoperability**





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

Resources

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

Development Environment

- DIVIA for Grid

Resource Mgmt & Scheduling

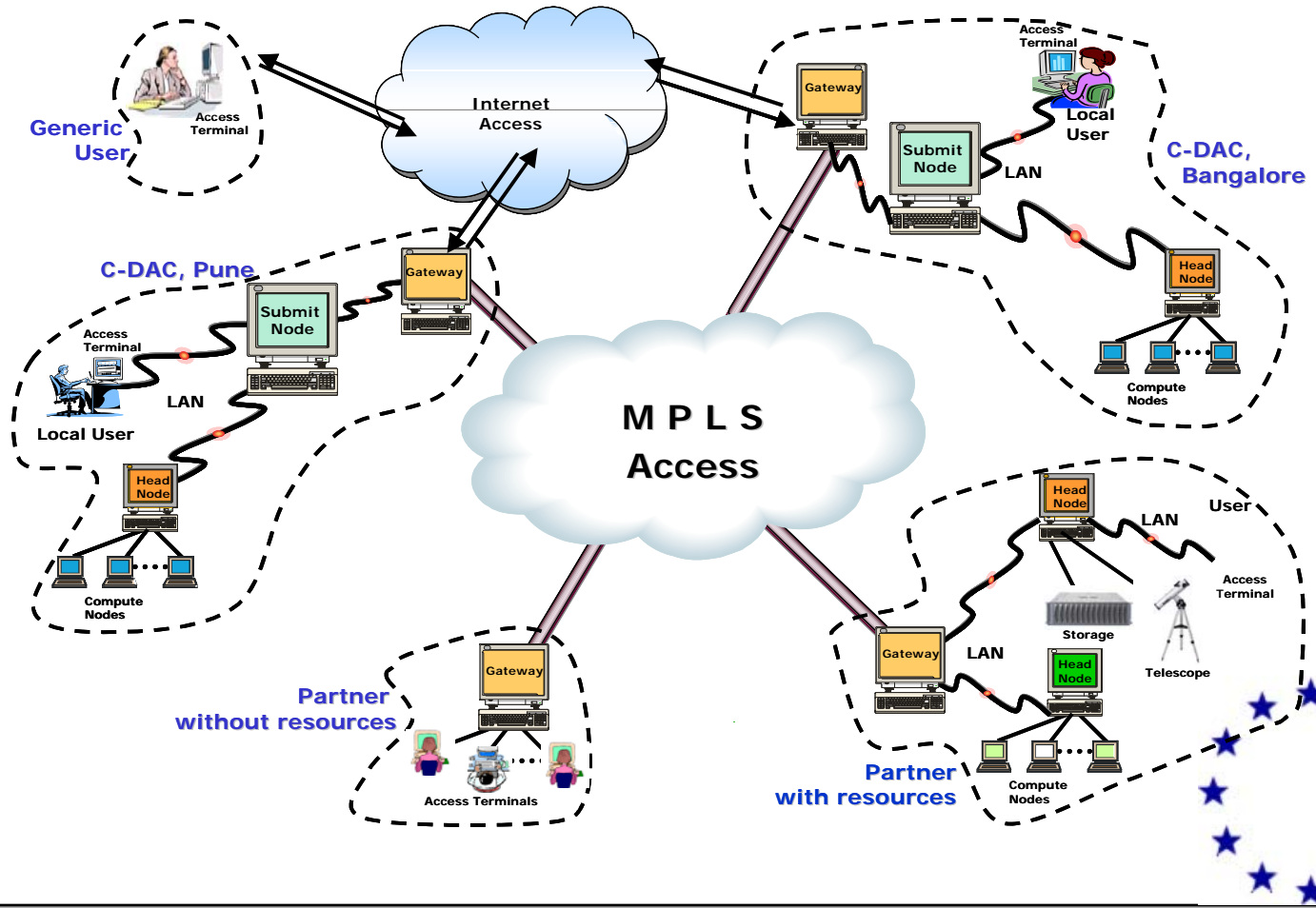
- Moab from Cluster Resources
- Load Leveler, Torque
- Globus 2.x

Collaborative Environment

- Video Conferencing over IP
- Access Grid



GARUDA Component Deployment Scenario`



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)

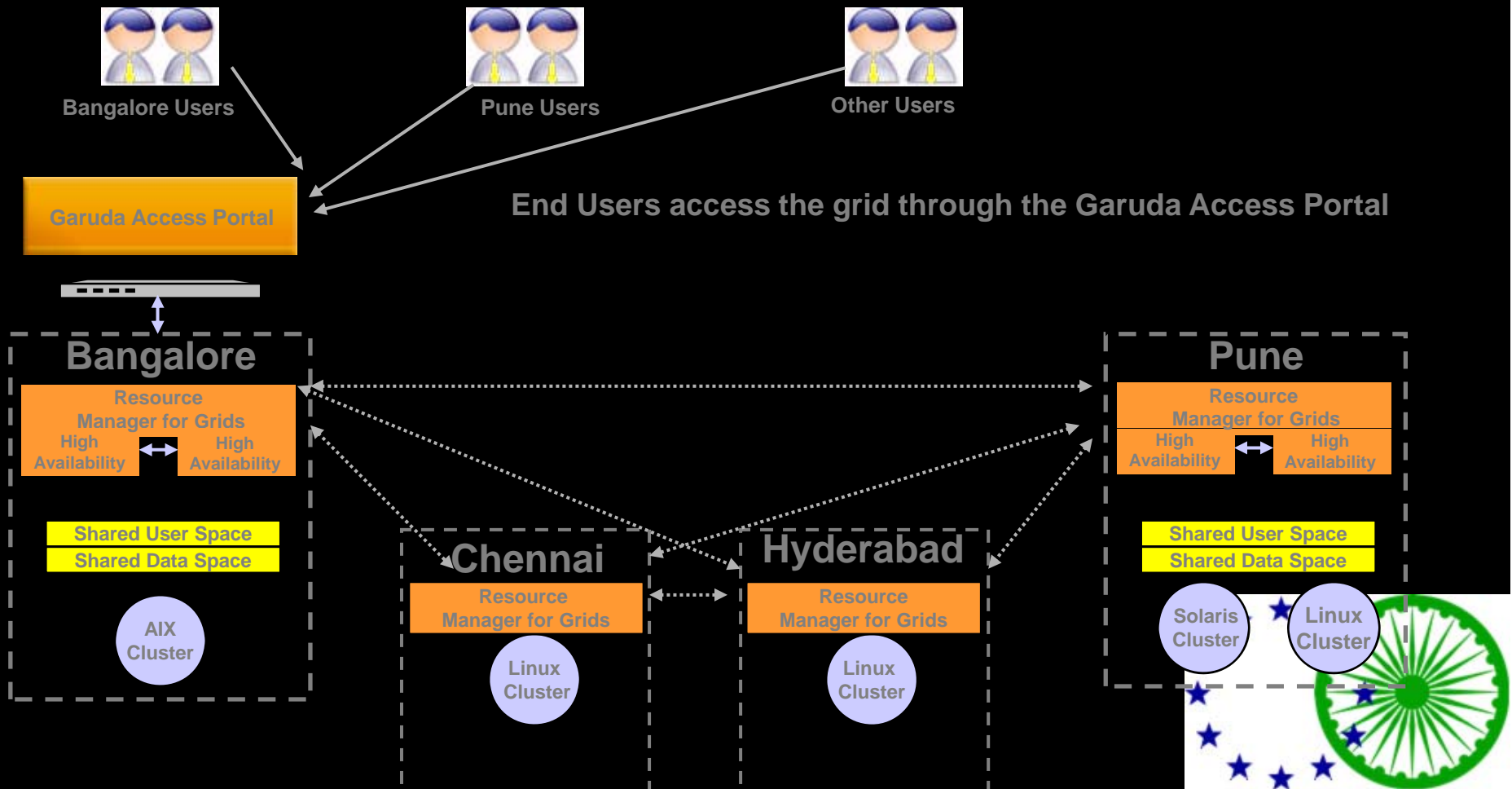


Resource Details

- 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



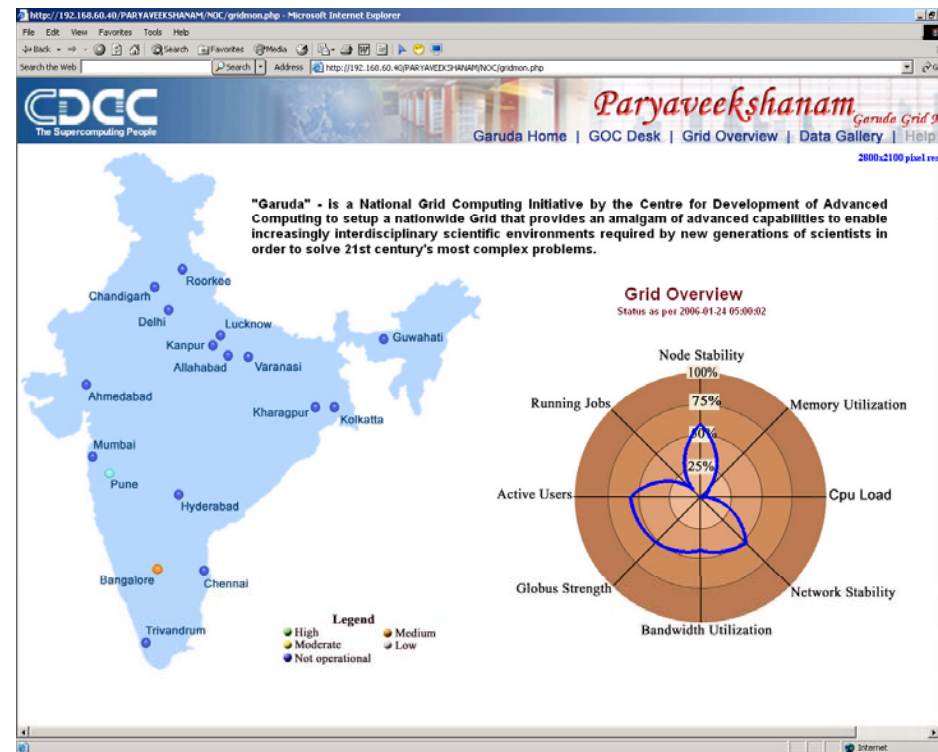
Job submission flow



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



IGIB
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





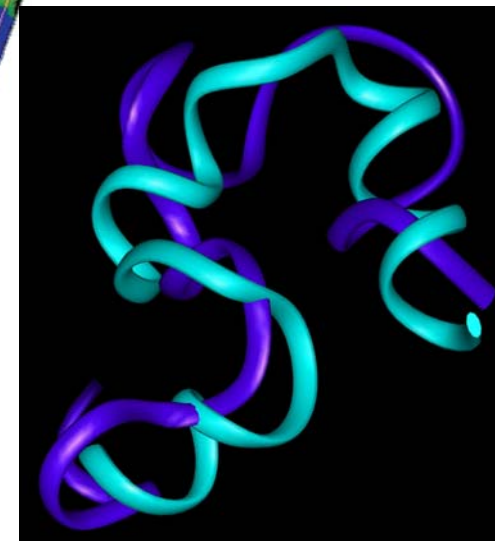
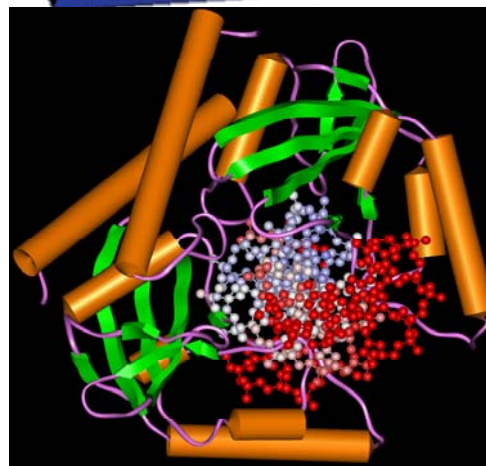
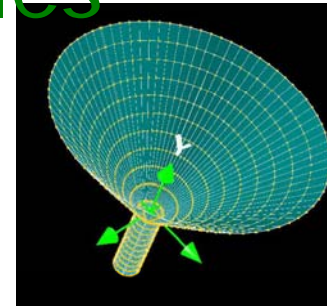
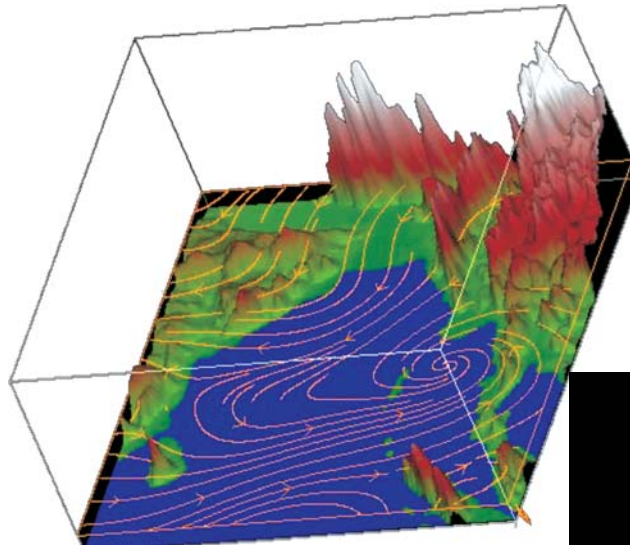
Illustrative Applications



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

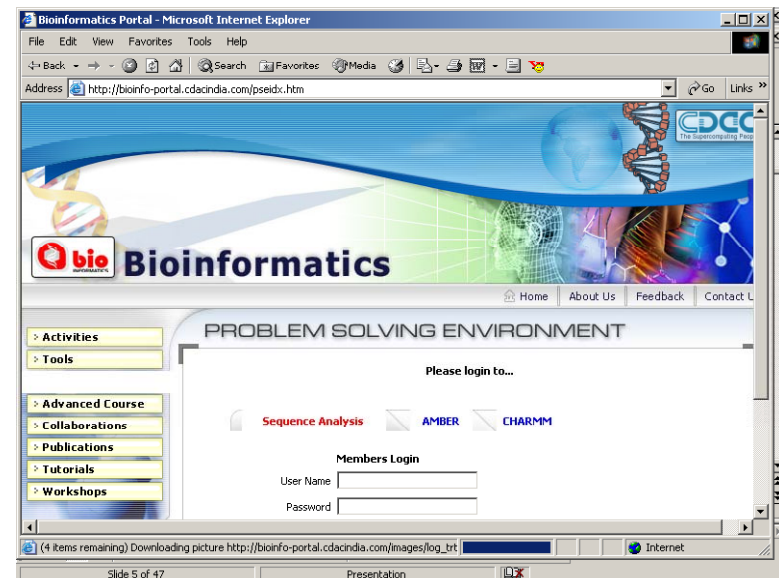
Objectives and Deliverables

- 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

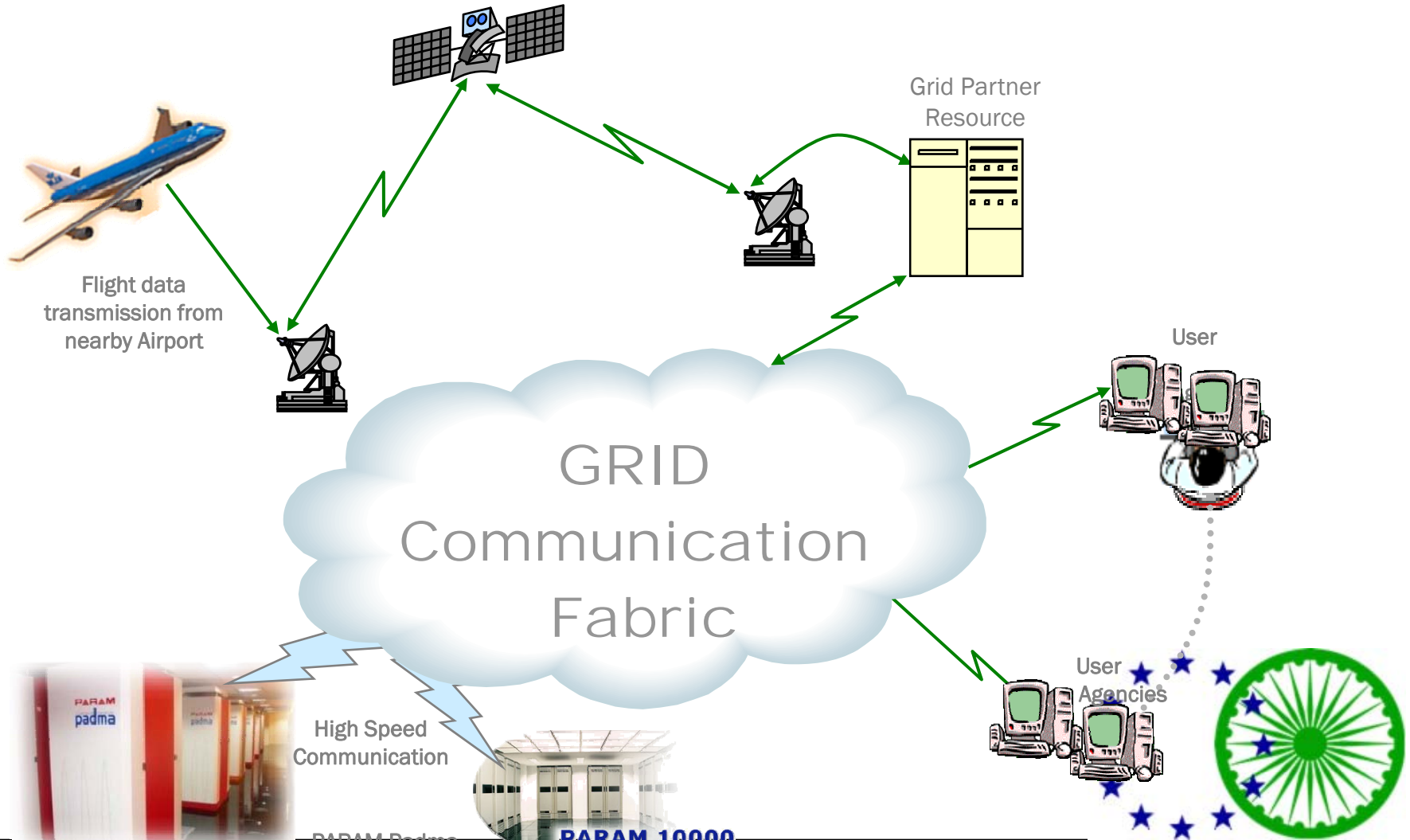


euindiagrid इंडियाग्रीड Bioinformatics

- 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



euindia grid
इंडिया ग्रीड
Disaster Management





Virtual User Community

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

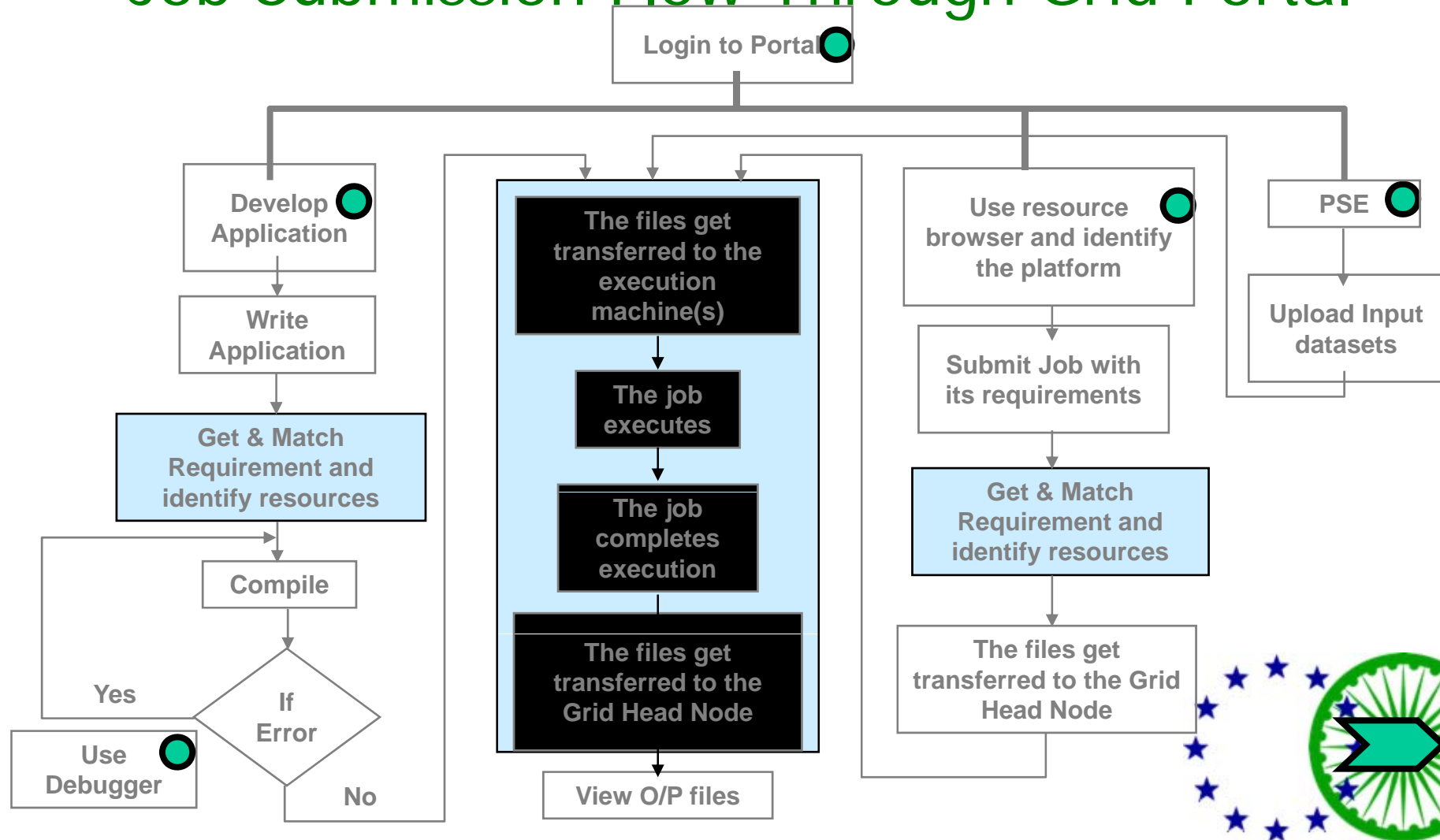


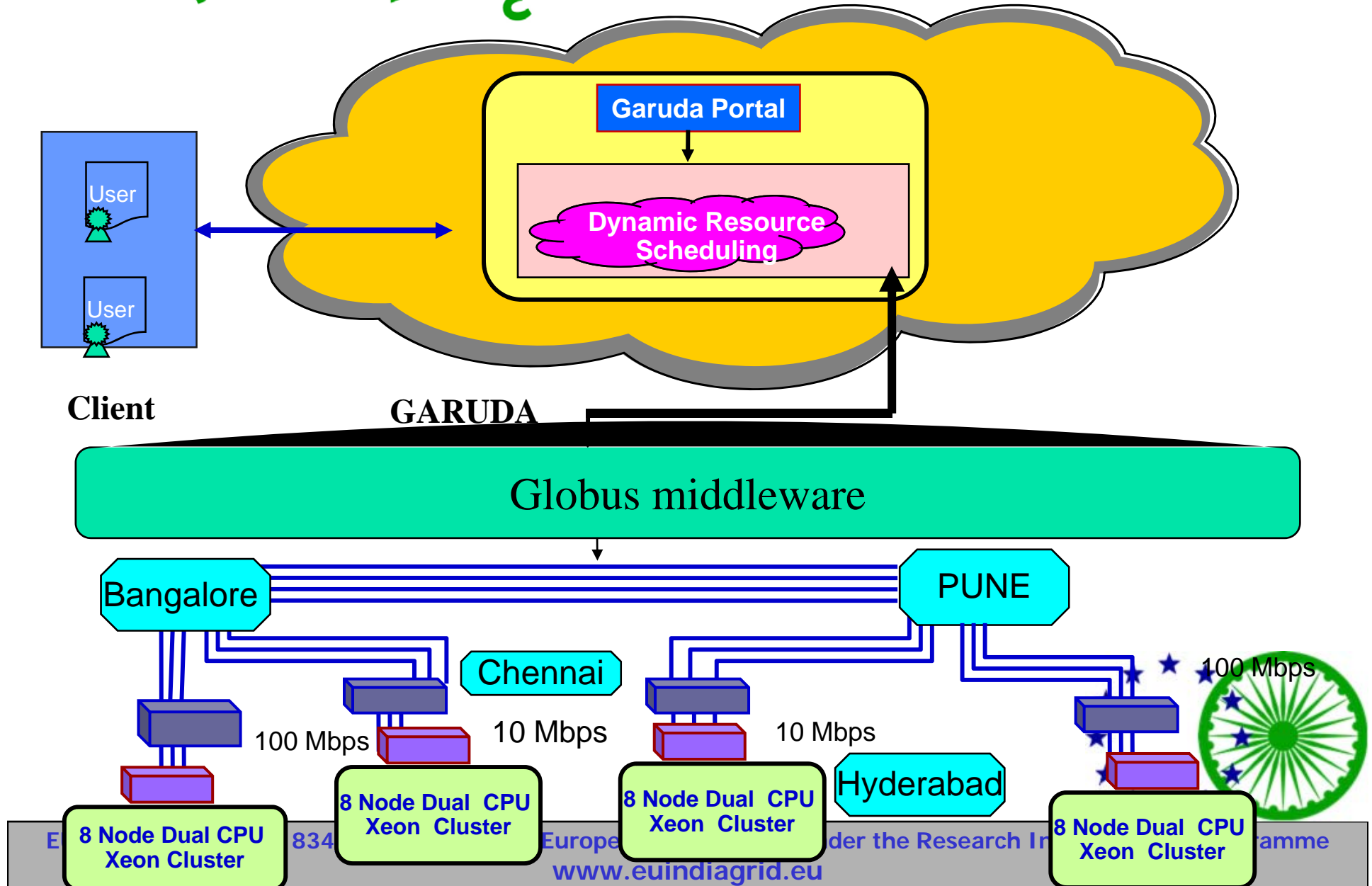
Garuda – EGEE Interoperability

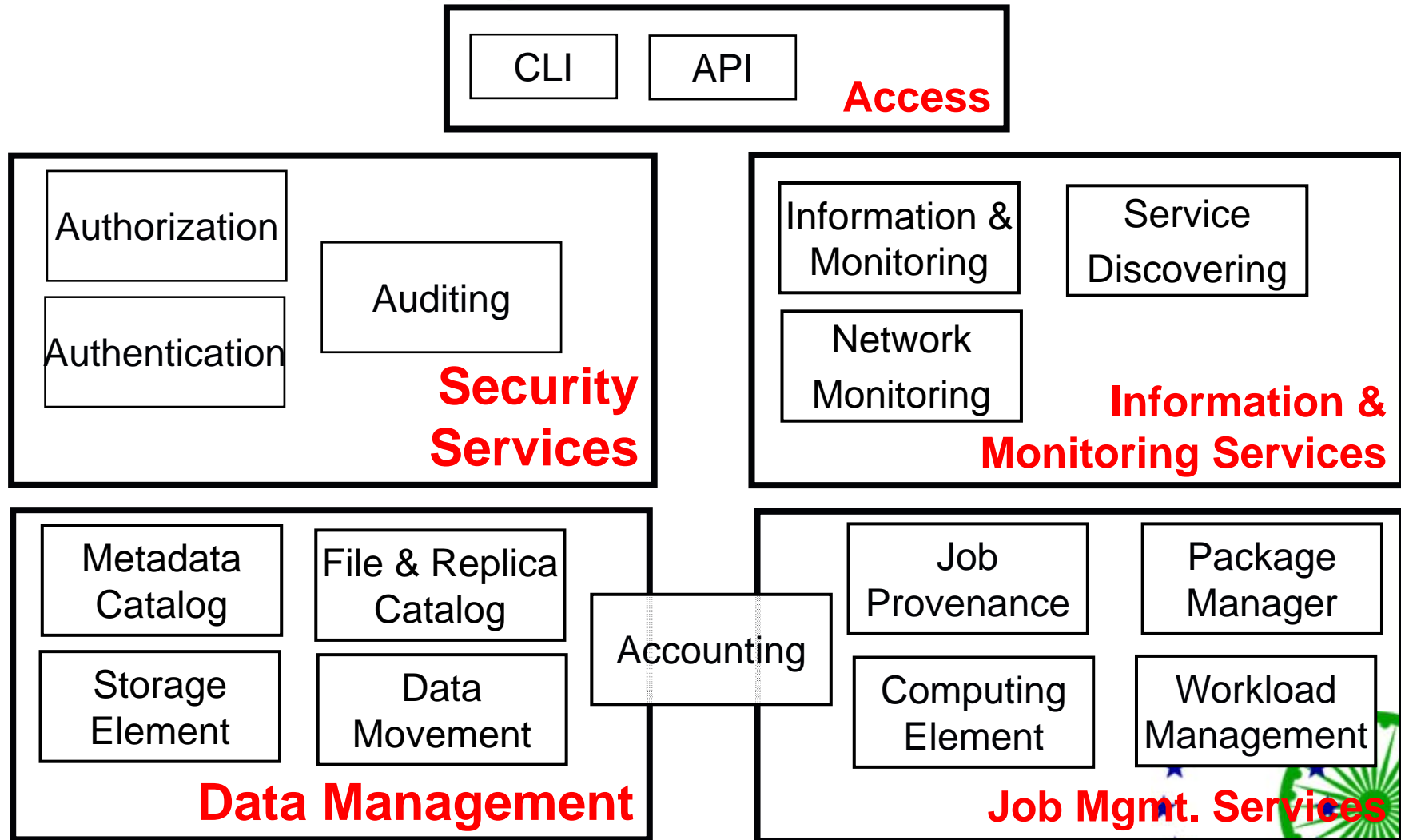
- Garuda components
- EGEE components
- Options for interoperability
- Discussion



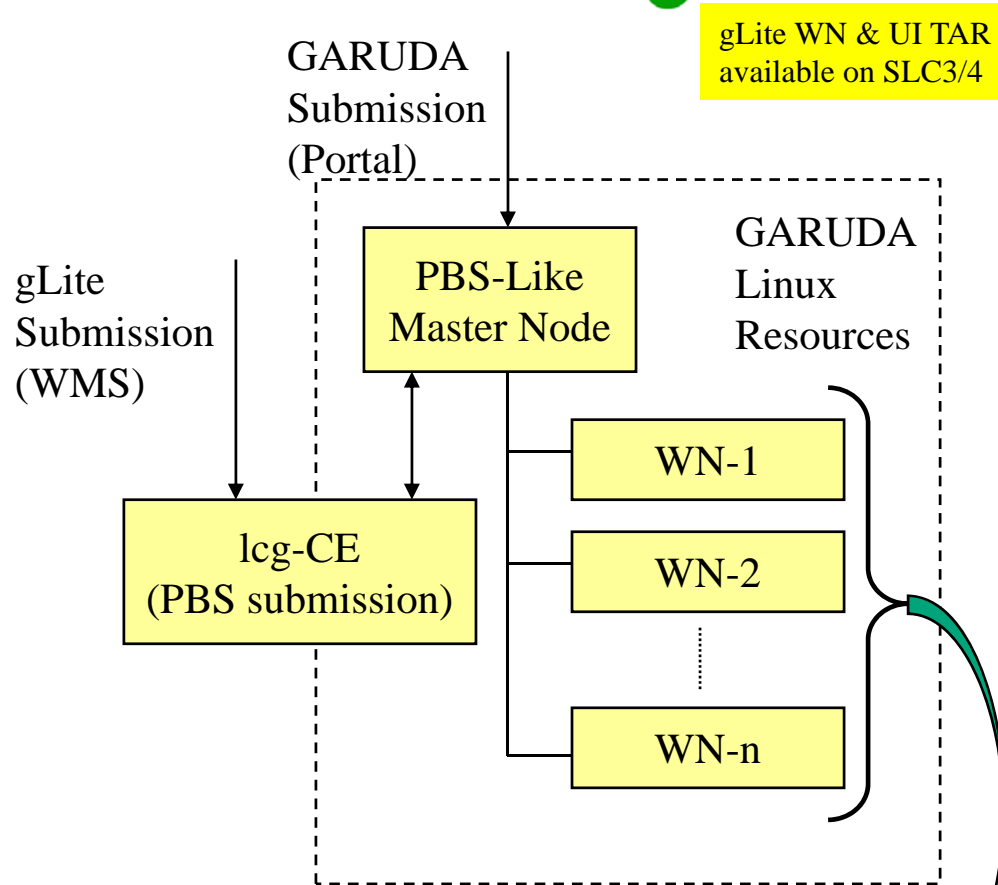
Job Submission Flow Through Grid Portal





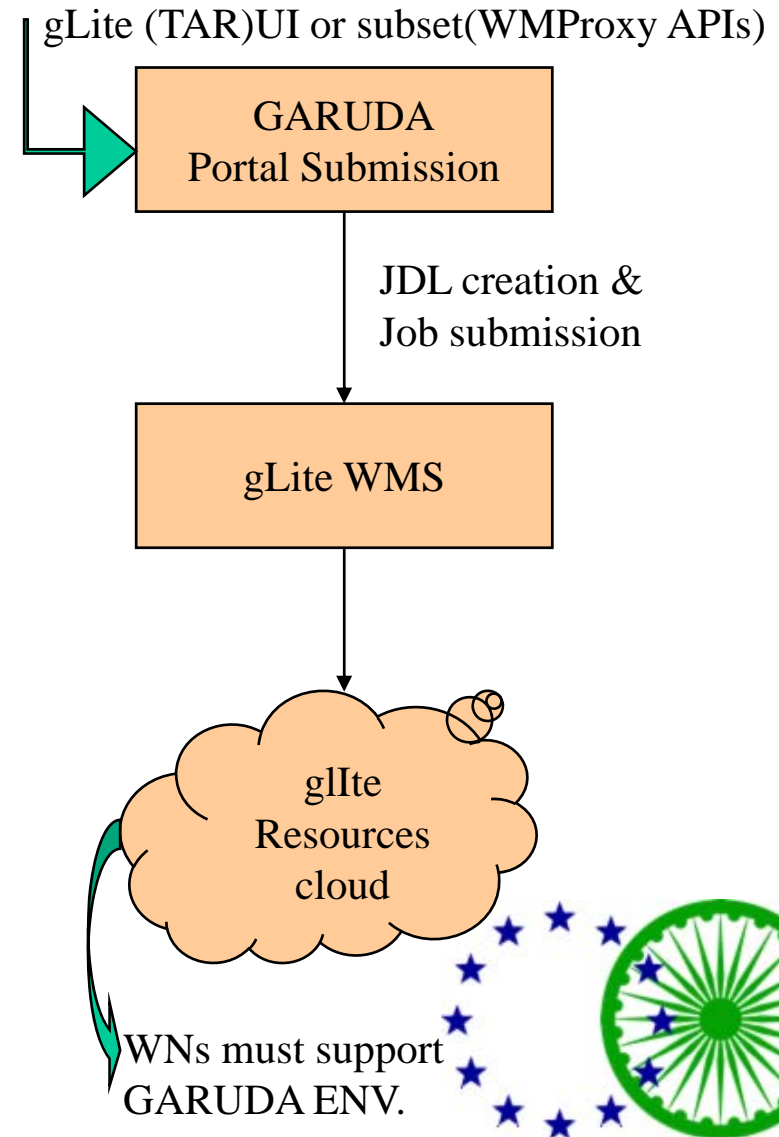


Basic Interop. Job submission



In case of AIX sys. could be evaluated AIX-ENEA solution

Mixed WN: GARUDA + gLite TAR-WN



Job Submission Flow for EGEE Grid User

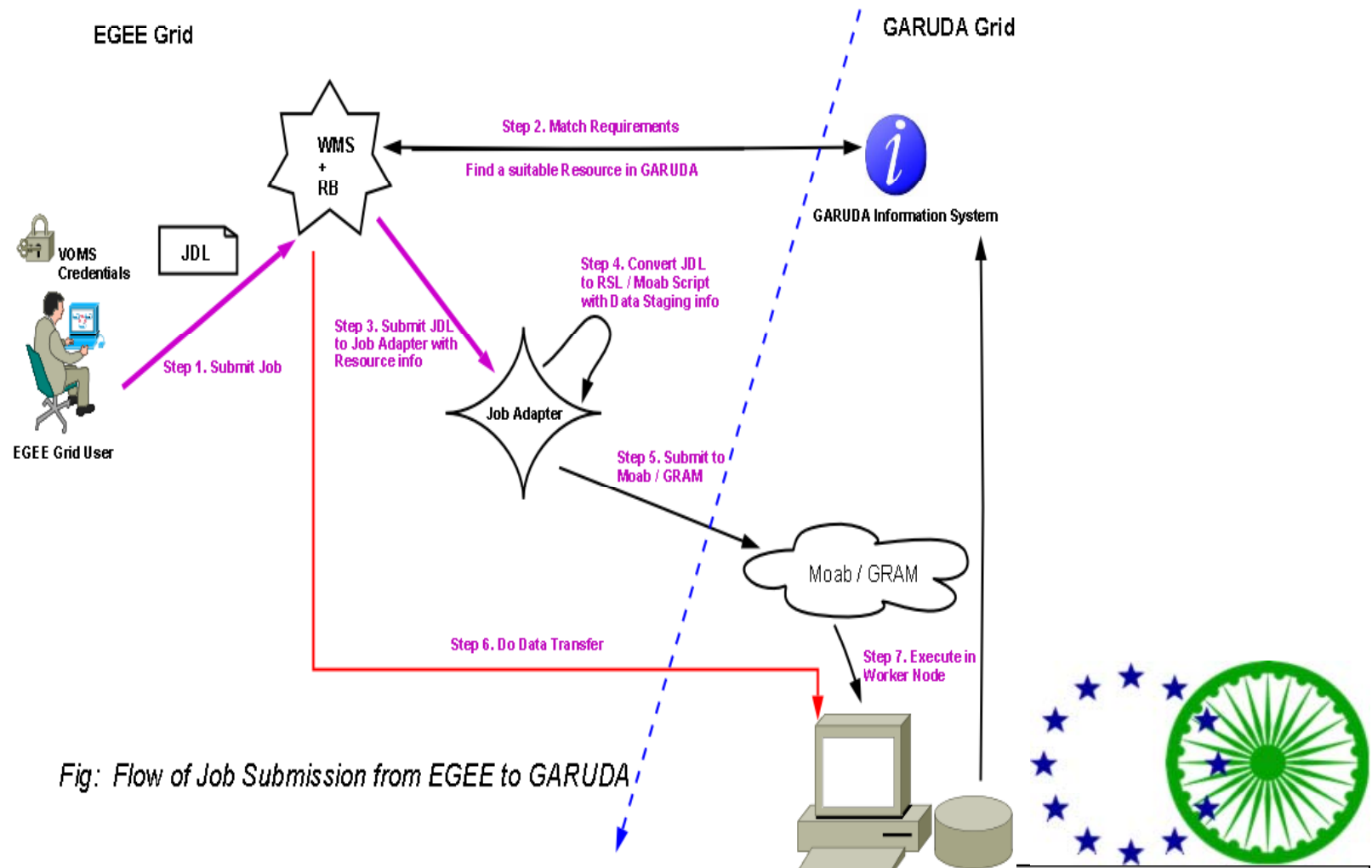
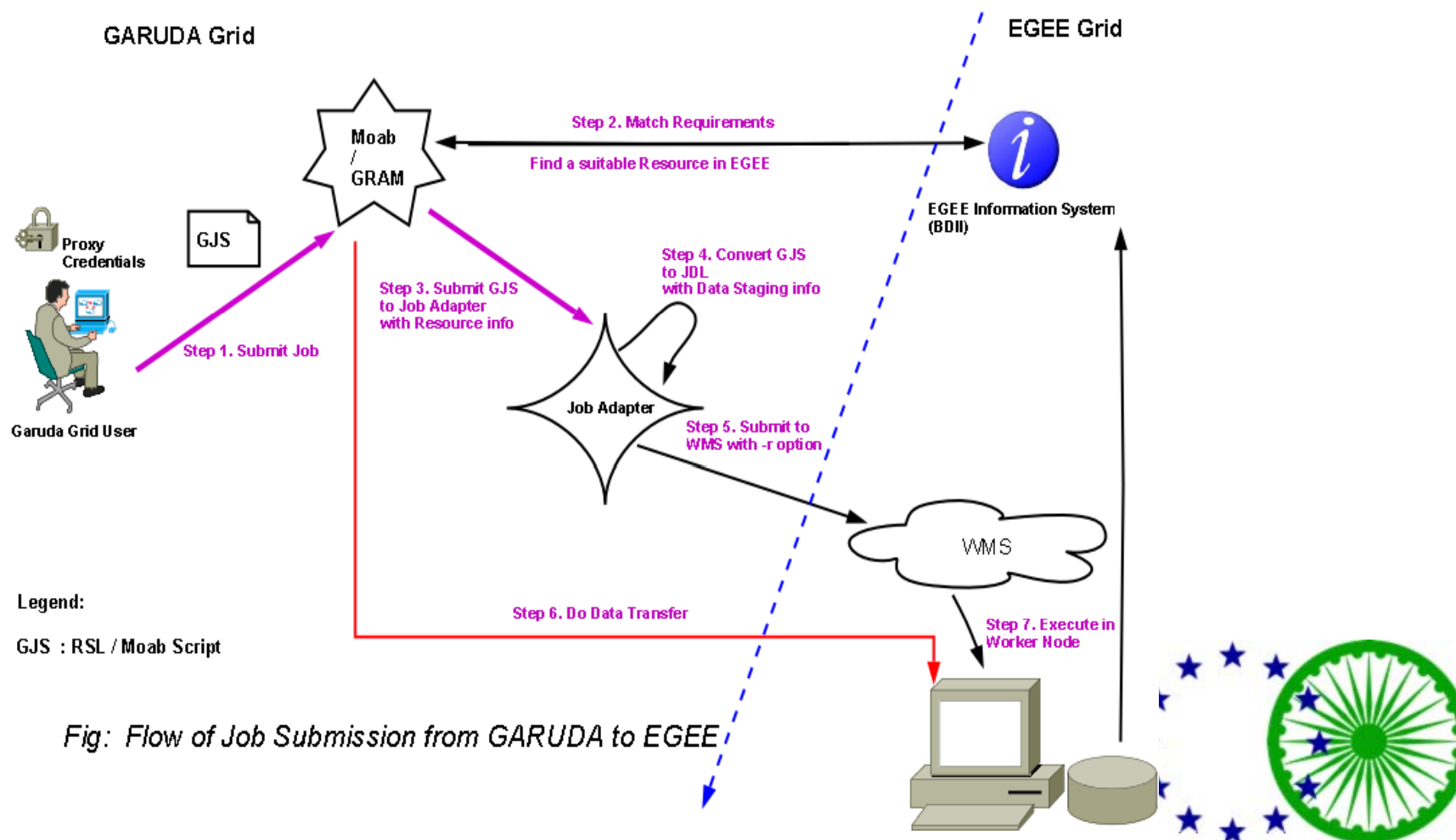


Fig: Flow of Job Submission from EGEE to GARUDA

Job Submission Flow for GARUDA Grid User





Challenges !

- Multiple components – evolving
- User authentication mechanisms
- Complexity and stability
- Open source and commercial license
- Accounting



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Thank you!

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