

InterOperability among Grids: A Case Study with GARUDA & EGEE Grids

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Outline

- Interoperability definition and needs
- Introduction to GARUDA
- Component comparisons: GARUDA Vs EGEE
- Interoperability frameworks
 - Security Interoperability
 - Information System Interoperability
 - Job Submission Interoperability
 - Data Management Interoperability
- Conclusion

Grid Interoperability

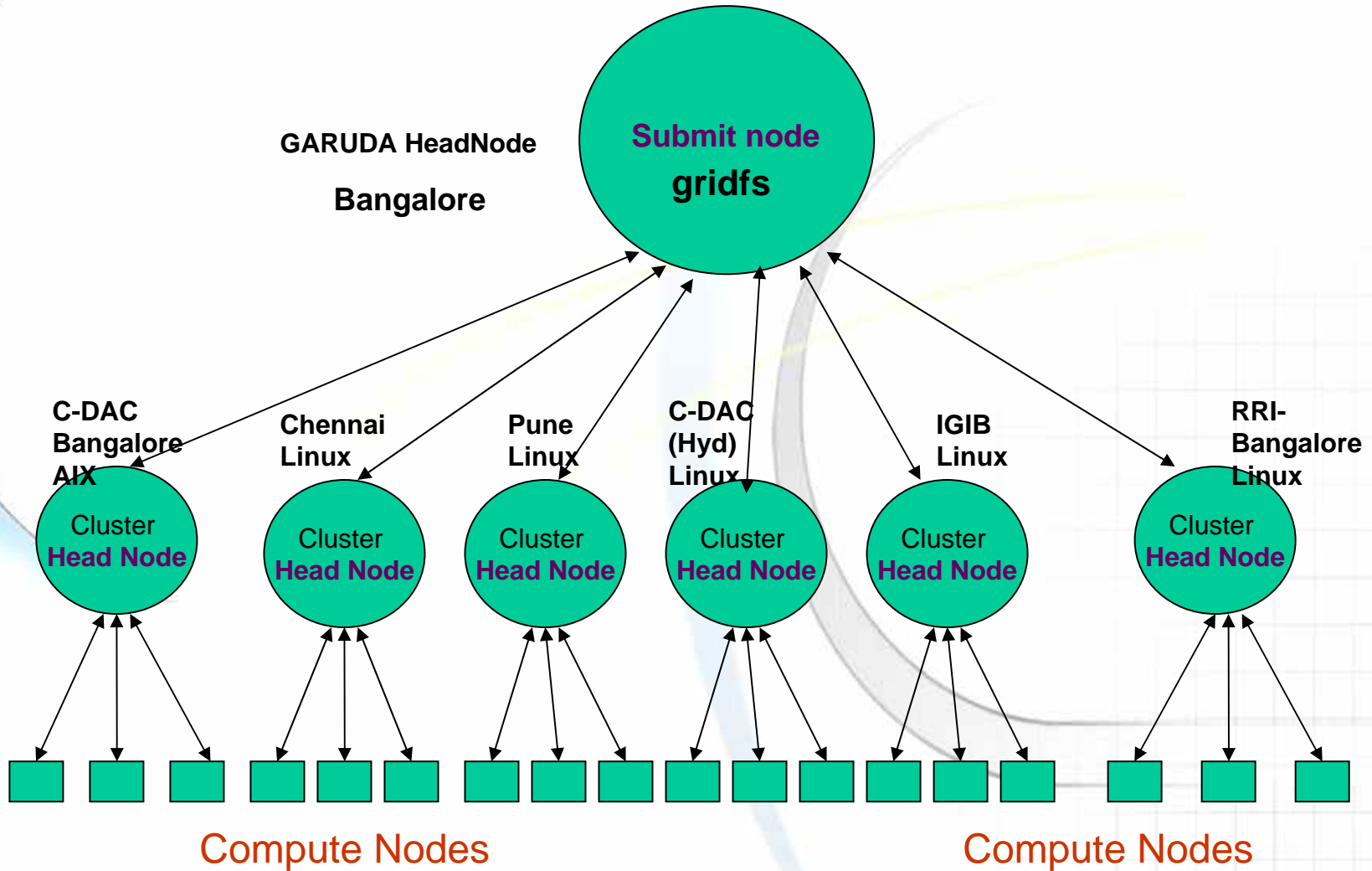
- Definition of Grid Interoperability
 - Ability of Components in a Grid to communicate and share, information and data to peer components in different Grids.
- Need for Grid Interoperability
 - Evolution of Customized Grid Middlewares
 - o Globus Toolkit
 - o Glite
 - o Unicore
 - o Gridbus
 - o Legion
 - Unifying Grids to address challenging scientific problems
 - o Particle analysis, Disaster management & Protein folding
 - Grid applications portability
 - o Enforcing common standards (OGF)

GARUDA Grid

GARUDA Overview

- National Grid Computing initiative by the Dept. of IT, Govt. of India in November 2004
- Objectives
 - Create a test bed for the research & engineering of technologies, architectures, standards and applications in Grid Computing
 - Bring together all potential research, development and user groups to develop a national Grid Computing Infrastructure
 - Create the foundation for the next generation grids by addressing long term research issues in grid computing
- GARUDA Resources & Connectivity
 - More than 400 CPUs and 13TB of storage
 - Connects 45 organizations across 17 cities
 - Provide seamless & high speed access to the compute, data & other resources on the Grid
 - Scalable, secure and reliable network private network

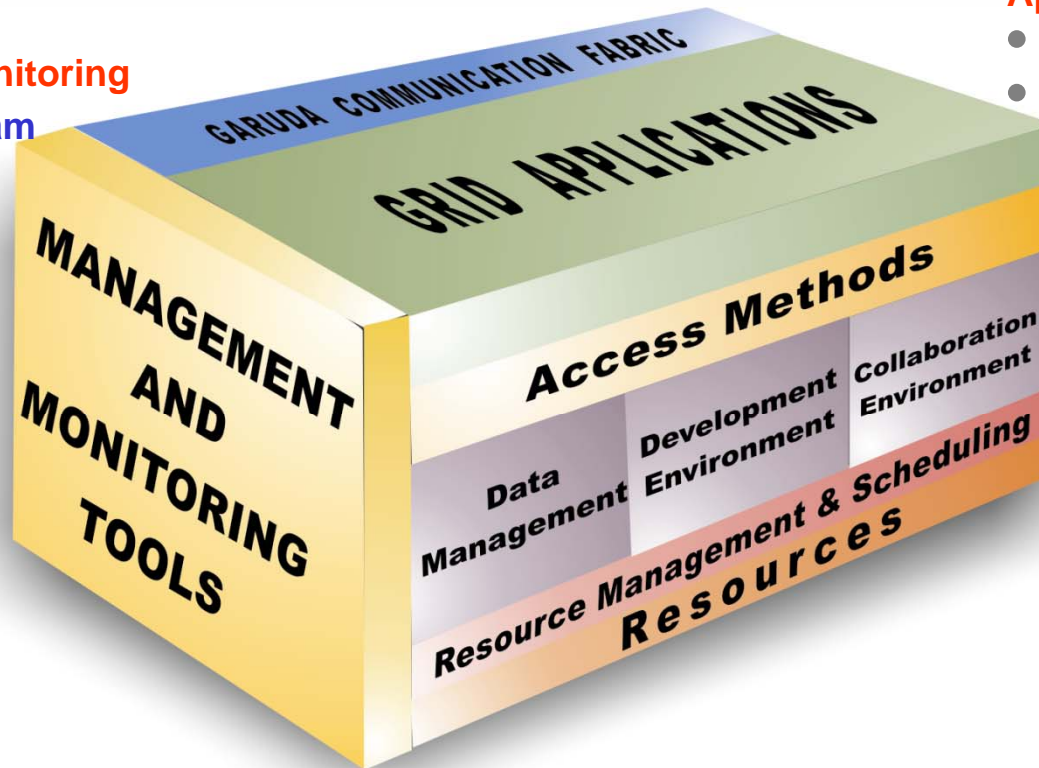
GARUDA Grid Architecture



GARUDA Components

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
- GridIDE

Resources

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

Resource Mgmt & Scheduling

- Moab from Cluster Resources
- Load Leveler, Torque, LSF, SGE
- Globus 2.4

GARUDA Access Methods

GARUDA Portal

- **User-friendly web portal for GARUDA**
- **Support submission of Jobs such as**
 - **Sequential Applications**
 - **Homogeneous Parallel Applications**
 - **Heterogeneous Parallel Applications**
- **Facilitate seamless integration of the Grid Meta Scheduler, Middleware, and Data Grid solutions**
- **Satellite & Terrestrial Grid Integration APIs**
- **Facilitate Semantic Search**

Tools Interface

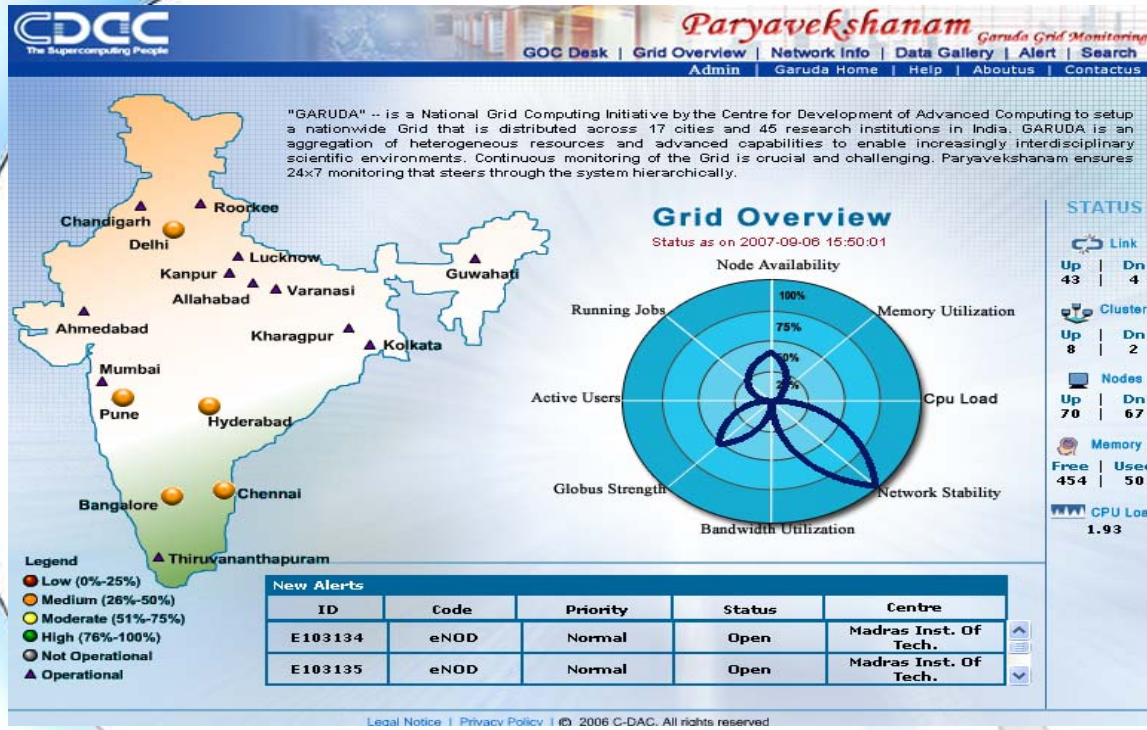
- **MOAB Grid Scheduler**
- **Globus Middleware**
- **Storage Resource Broker (SRB)**



Program Solving Environments

- **Supports the entire cycle of problem solving for specific application domains**
- **Currently Bio-informatics and Atmospheric Modelling PSEs**

Paryavekshanam – GARUDA Grid Monitoring Tool



Paryavekshanam Features

- Search facility for Resources & SW
- Parya Dashboard, Nodal, and Grid Overview pages
- GOC Desk page for the daily graphs
- Alert messages Gen for resource failure
- Addition of new sites is through web page
- Archival of Historical data
- Job monitoring & Accounting: jobs-running/cluster, job_id, job_name, state, Cpu_time, wall_time, memory used etc
- Archival of completed jobs
- SRB monitoring using APIs
- Home page with radar graph
- Nodal Information and grid overview page
- Network, data gallery, network monitoring

Objectives

- Monitor resources of GARUDA Grid & send alerts / notify for malfunctioning of resources.
- Resources are dynamic and critical in nature and
- Monitoring is an essential for heterogeneous distributed environment like GARUDA
- Paryavekshanam is a 24X7 grid-monitoring tool

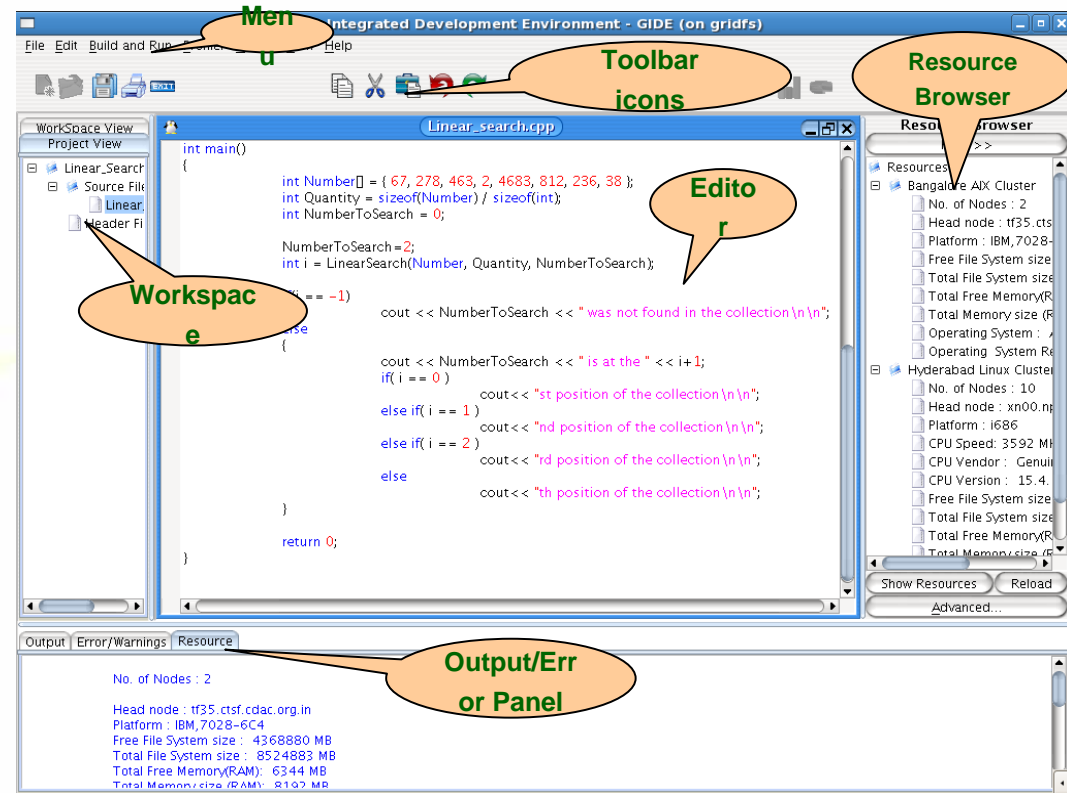
Grid Integrated Development Environment (GIDE)

Components of GridIDE

- Project Development and Management
- Resource Management
- Job Management
- Inbuilt source level Debugger
- Profiler
- Help

Features for next GridIDE

- Support web services
- Job submission through GARUDA Portal APIs
- Resource Management using GRIDMON database
- Accounting information



Applications Tested on GARUDA

- Disaster Management Application
 - Analyze disaster affected areas using SAR radar data, process it to take corrective actions.
 - Mosaic Data, and enable remote Visualization
- Bio-informatics Application
 - Smith-Waterman grid portal being deployed on GARUDA Grid
 - **Prototype tested across Bangalore, Pune, Hyderabad & Chennai Clusters**
 - Grid Enable popular applications like BLAST

GARUDA Grid Security

- **Authentication**
 - **GARUDA Certificate**
 - Subject Name
 - Public Key of the Subject
 - Identity of GARUDA CA
 - Digital Signature of GARUDA CA
 - **Adheres to GSI**
 - Credential Delegation
 - Single Sign-On
- **Authorization**
 - **User Mapping**
 - **DN to Pool of Unix accounts**
- **MOAB**
 - **Uses GSI FTP for data transfer**
- **SRB**
 - **Relies on separate SRB credential**
 - **Not integrated with GSI**
- **GARUDA CA**
 - **Managed by C-DAC Bangalore**
 - Key length 1024 bits
 - Not recognized by IGTF
 - Registration through PURSE
 - <http://gridfs.ctsf.cdac.org.in/purse/>
 - **Indian Grid CA**
 - Preliminary document is under review and will be submitted to APGrid PMA
 - Key length 2048 bits

GARUDA Information System (GIS)

- Depends on Globus MDS
- Easy querying & publishing
 - Hierarchical approach
 - GRIS : Resource level
 - GIIS : At site level and Grid level
- Follows MDS Core schema, can support GLUE Schema
- Integrated with Ganglia
 - Cluster level information
- GARUDA Grid Monitoring (Paryavekshanam)
 - Relies on data from MDS

GARUDA - Job Submission & Management

- Globus GRAM
 - Gatekeeper in GT 2.4
 - Supports Parallel MPI Jobs
 - DUROC Component
 - Integrates well with Torque, PBS
- Moab Workload Manager
 - A policy based job scheduler
 - Advanced Reservations
 - Uses GSI FTP : To support Data Transfers
- Local Schedulers-GARUDA
 - Torque - Linux Clusters
 - LSF - Linux clusters
 - Load Leveler- AIX Cluster
 - Torque-Aix Cluster (in progress)
 - SG Engine – Solaris Cluster

GARUDA - Data Grid Solutions

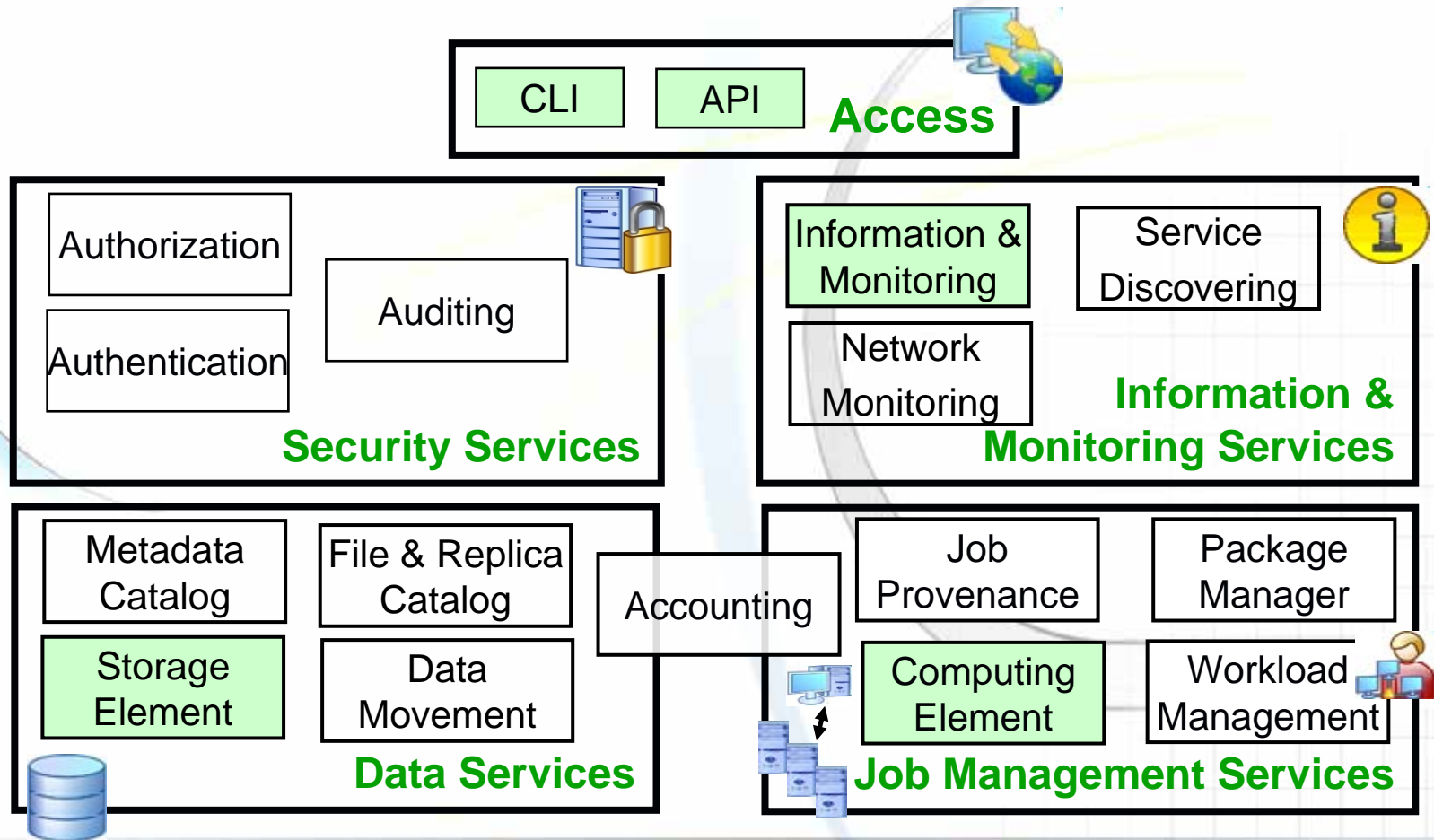
- Storage Resource Broker(SRB) -Data grid middleware
- SRB Components
 - MCAT server :
 - main repository of the information about the SRB federation
 - contains all the metadata about the all the SRB objects
 - SRB server (Agent) :
 - simple daemon running at each site and manages the local resources to present them to SRB federations
 - Agent can process the requests after getting metadata from the MCAT server.
 - SRB Clients :
 - Web and Java clients, APIs(C & Java) &Command line utilities(Scommands)
 - Gateways:
 - NFS Gateway
 - GridFtp Gateway
 - SRB API

GARUDA Vs EGEE

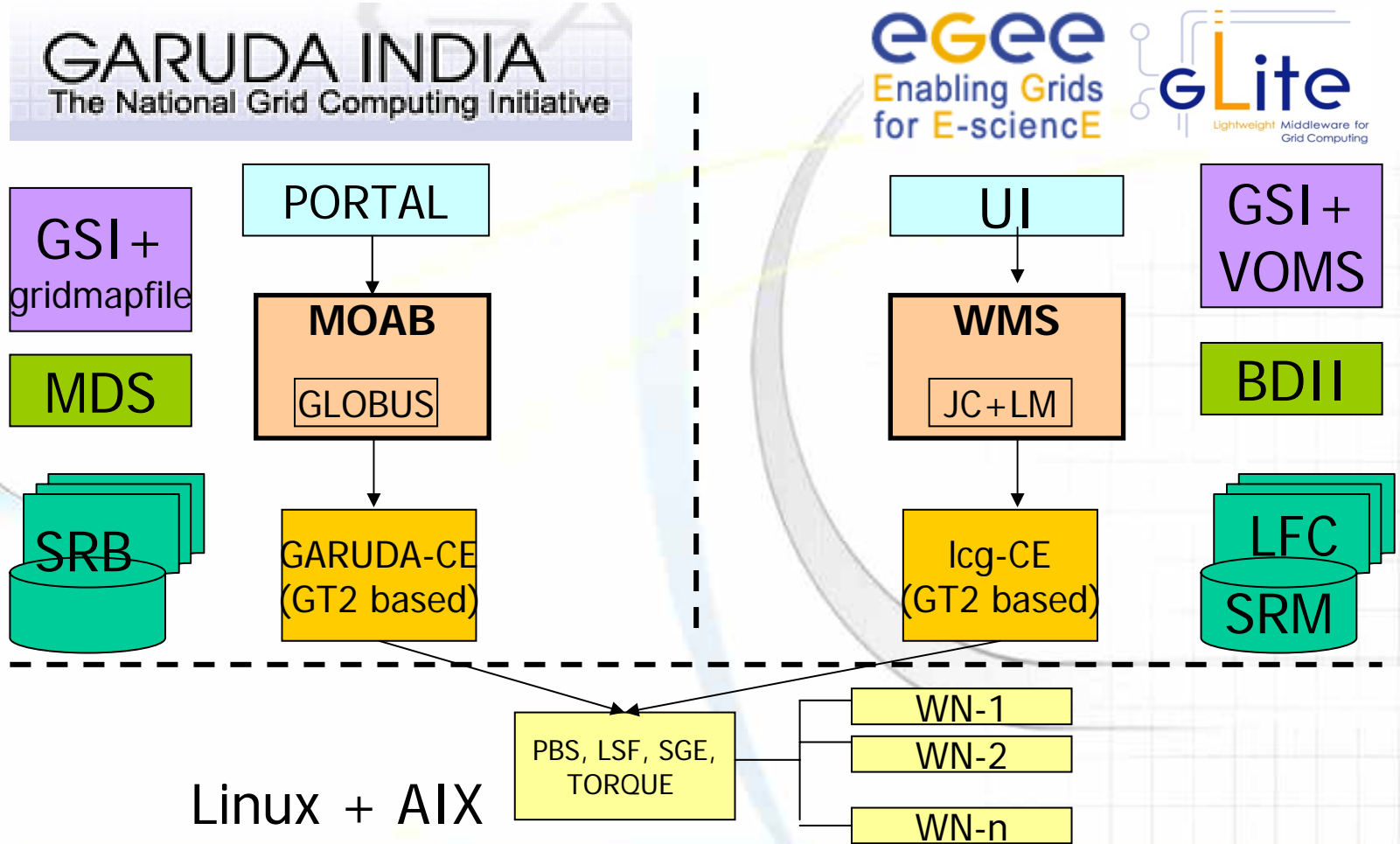
Overview of EGEE

- Project for **Enabling Grids for E-ScienceE**
 - Facilitate collaboration among research & engineering communities world wide
- Funded by European Commission
- Target applications
 - High energy physics, life science, Geology, computational chemistry etc.
- Based on **Glite** Middleware

Glite - Service Components



Middleware Components: GARUDA Vs EGEE



Security Components : GARUDA Vs EGEE

- GARUDA

- GSI for authentication
- Authorization based on Grid-map file
 - DN is mapped
- Key length is 1024
- CA not recognized internationally

- EGEE

- GSI & VOMS for authentication
- Authorization based on Grid-map file
 - VOMS Attrib is mapped
- Key length is 2048
- Recognized by IGTF

Access Methods: GARUDA Vs EGEE

- GARUDA

- Through GARUDA Access portal
- Job submission, monitoring and management interfaces
- Browse GARUDA resources
- Integrated with GARUDA Data Grid
- Integrated with GARUDA PSE

- EGEE

- Command line UI
- Exposes client APIs
- Support Grid Portals
 - GENIUS, P-GRADE
- Job submission, monitoring & management commands
- Commands to list & search resources
- Integrated with EGEE Data Grid

Meta Schedulers : GARUDA Vs EGEE

• GARUDA

- MOAB as the Meta Scheduler
- Resource Brokering & Scheduling
- Supported LRMS
 - PBS
 - Torque
 - Load Leveler
 - LSF
 - SGE
- Its own logging & book keeping

• EGEE

- WMS as the Meta Scheduler
- Resource Brokering & Matchmaking
- Supported LRMS
 - PBS
 - Torque
 - SGE
 - LSF
- Logging & Book keeping

Computing Elements: GARUDA Vs EGEE

- GARUDA

- Operating Systems
 - Linux (RHEL), AIX
- LRMS
 - PBS, Torque, Load Leveler, LSF, SGE
- LB Host – part of Moab
- Software installed are published into IS.

- EGEE

- Operating System
 - Scientific Linux
 - Initiatives to support to other OSs(Linux and non Linux)
- LRMS
 - PBS, Torque, SGE, LSF
- Software availability can be VO specific and advertised in IS

GARUDA Vs EGEE :Storage Element

- GARUDA

- Storage Resource Broker(SRB)
 - Provide a unified name space across the grid
 - Require SRB credentials
 - Web, Java Clients
 - Exposes API's (C, JAVA)
 - Command line interface
 - Supports file replication
- GridFTP can be used to transfer files

- EGEE

- Storage Resource Manager(SRM)
 - Shared storage resource allocation
 - Integrated with GSI
 - Command line interfaces
 - Supports file replication
 - Exposes API's (C,Perl)
- GridFTP is used to transfer files
- Namespace Management catalogs
 - LFC, AMGA

Information Service : GARUDA Vs EGEE

- GARUDA

- Based on Globus MDS 2
- GIIS at Site level & GRIS at resource level
- Hierarchical approach
- GLOBUS Schema, can support GLUE Schema v1.1
- MDS APIS

- EGEE

- Evolved version of Globus MDS
- GRIS at resource level & GIIS at site and higher levels implemented through BDIIs
- Hierarchical approach
- Follows GLUE Schema (v1.3)
- BDII APIs

InterOperability Frameworks: GARUDA & EGEE

A possible advanced scenario

Security Interoperability : GARUDA & EGEE

- Both Grids follow GSI for security
- GARUDA users get certificates from Internationally recognized CAs
- Authentication
 - GARUDA can trust certificates signed by EGEE CAs
 - Proxy credential in the VOMS proxy can be used for Authenticating EGEE users in GARUDA
 - EGEE can recognize Garuda users as VO users (euindia)
- Authorization
 - GARUDA relies on grid-mapfile for authorization
 - EGEE users DN will be mapped to local users in GARUDA resources
 - EGEE Grid should authorize GARUDA users based on their roles

Information Systems Interoperability: EGEE & GARUDA

- GARUDA tools have to validate & extract information from BDII
 - Information specified in Glue Schema
 - Adapter for fetching & processing information from BDII (TBD)
- EGEE needs Info Fetch interface to access GARUDA resource information from GIS
 - GIS is based on GIIS
 - GIIS Information is specified in Glue Schema
 - Info Fetch Interface (TBD)

Job Submission Interoperability : GARUDA to EGEE

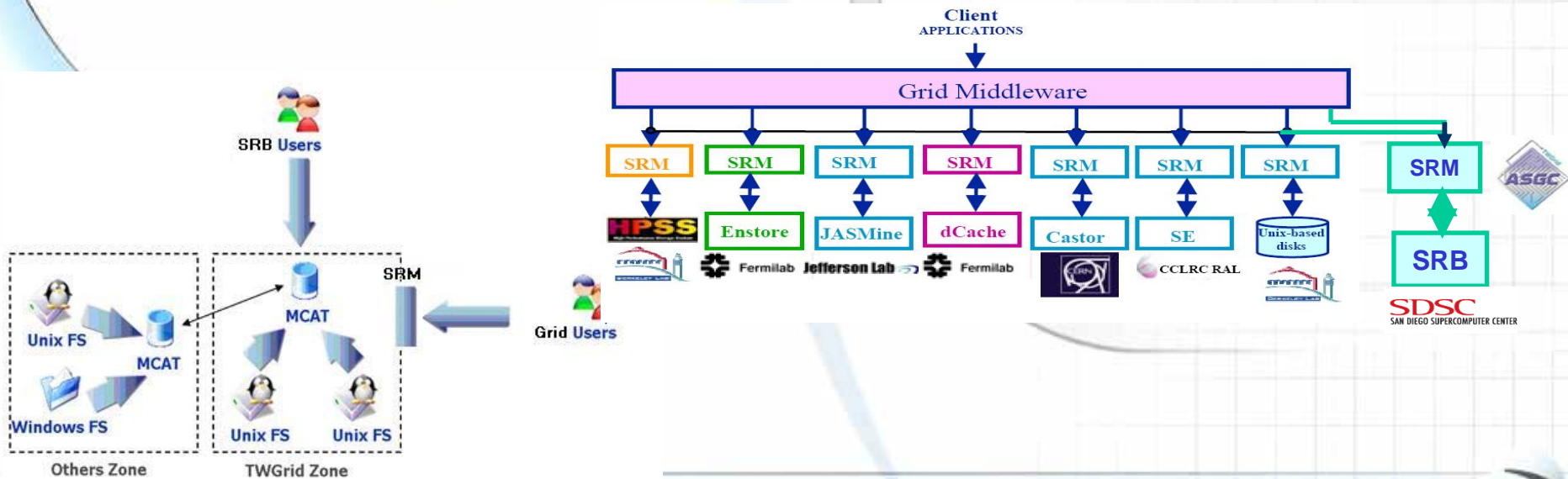
- Garuda users submit Job Request (JR) through Grid Portal.
- Grid Portal provide the JR to MOAB/GRAM.
- Match the JR to find suitable resources in EGEE.
 - **Information Adapter for Moab to query BDII (TBD)**
 - **Information Adapter for GRAM to query BDII (TBD)**
- Convert JR (with data staging information) to JDL.
 - MOAB/RSL script to JDL Adapter (JDLA-TBD)
- JDL Adapter submits JDL to WMS (TBD)
- Job identifier returned by WMS is taken to Grid Portal for:
 - Status-query and
 - Fetching Job output

Job Submission Interoperability: EGEE to GARUDA

- User makes job request (JR) through Glite UI
 - JDL Scripts
- Glite UI provides the JR to WMS
- WMS Match the JR to find suitable resources in GARUDA
 - Information Adapter for WMS + RB to query GARUDA Information System
- JDL to MOAB/RSL script converter : Generate MOAB/RSL script from JR with data staging information
 - JDL to MOAB/RSL Script Adapter (JMRS Adapter) need to be developed
- JMRS Adapter submits Job to MOAB/GRAM
- Job Details need to be updated in Logging & Book keeping

Data Management Interoperability: EGEE & GARUDA

- Data transfer using GridFTP
 - globus-url-copy gsiftp://<GARUDA Node>/file
 - gsiftp://<EGEE Node>/file
- Integrate Data Grids (SRB & SRM)
 - SRM interface to SRB (ASGC working)



Conclusion

- GARUDA & EGEE Adapt interOperability models based on OGF
- Adapters, and Converters for interoperability of GARUDA & EGEE (TBD)
 - Adapters for information fetching and converting job requirements
- Applications to be tried for demonstrating interoperability bet'n GARUDA & EGEE

THANK YOU

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