A short introduction to glite middleware

Stefano Cozzini

INFM/CNR Democritos

The EU-IndiaGrid project, RI-031834, is funded by the European Commission, DG INFSO under the Research Infrastructures Programme

European Commission Information Society and Media

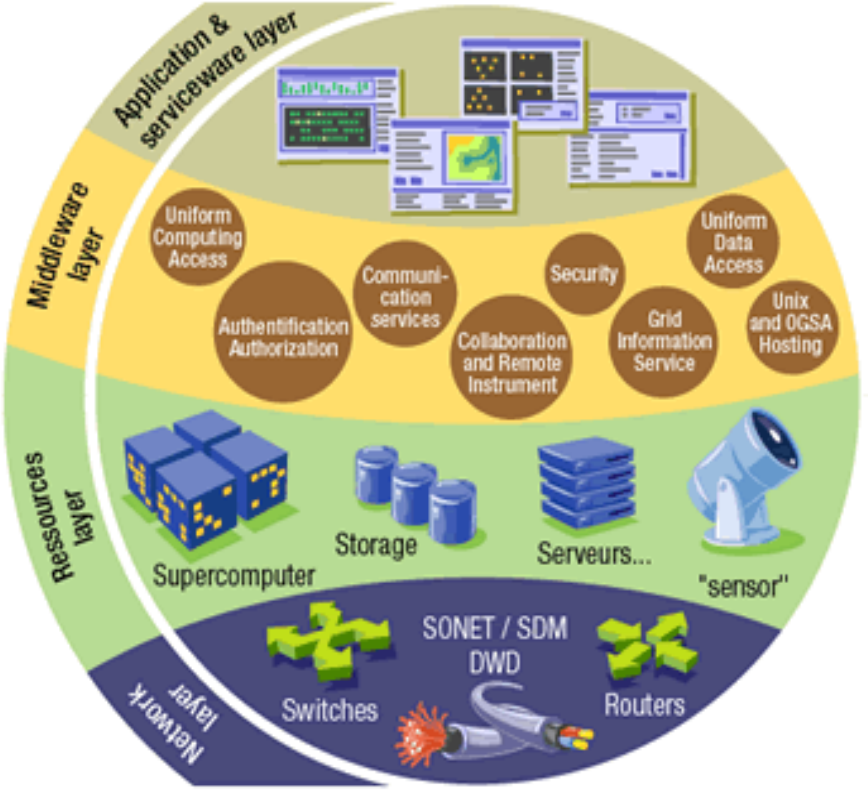
gLite – Overview

- gLite
  - Developed within the EGEE project (European Flagship project for Grid computing)
  - First release 2005 (currently gLite 3.1)
  - Developed from existing components (globus, condor, edg etc..)
  - Intended to replace present middleware with production quality services
  - Interoperability & Co-existence with deployed infrastructure
  - Open Source license

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

gLite – Grid middleware

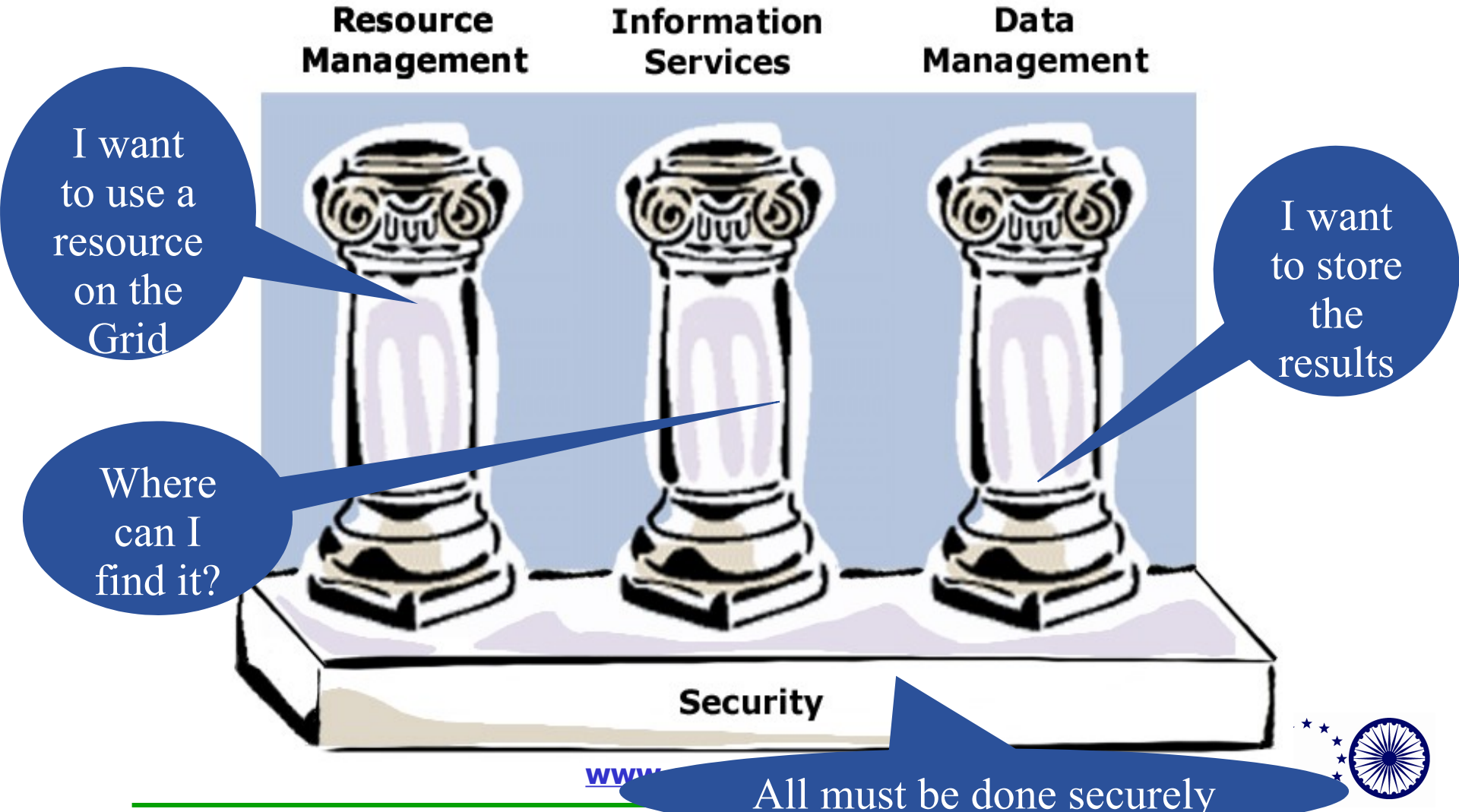
- The Grid relies on advanced software – the middleware - which interfaces between resources and the applications
- The GRID middleware
  - Finds convenient places for the application to be executed
  - Optimizes use of resources
  - Organizes efficient access to data
  - Deals with authentication to the different sites that are used
  - Run the job & monitors progress
  - Transfers the result back to the users



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

Grid foundations

- Defined by the Globus (http://globus.org) (Globus Toolkit)



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

Authorisation, Authentication

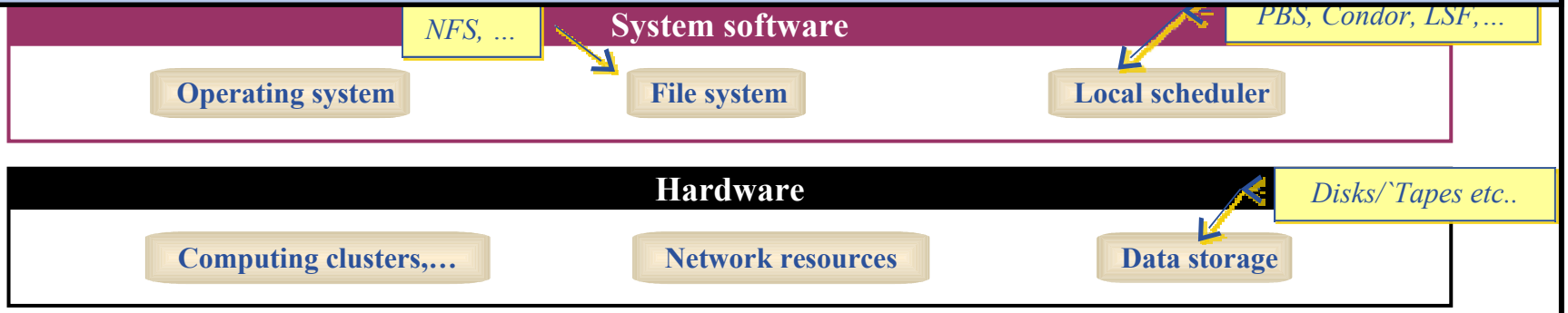
Users in many locations and organisations

Access services (“user interface”) :
logon, upload credentials, run m/w commands

GRID SERVICES

Build on Grid Security Infrastructure

“Gate keeping”:
map user’s credential to local user id / account



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

Basic job submission

How do I run a job on a compute element (CE) ? (CE =batch queue)

Tools that:

- copy files to and between CE's and data storage
- Submit job to a CE
- Monitor job
- Get output

www.euindiagrid.eu

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

Information service (IS)

How do I know which CE could run my job?

Which is free?

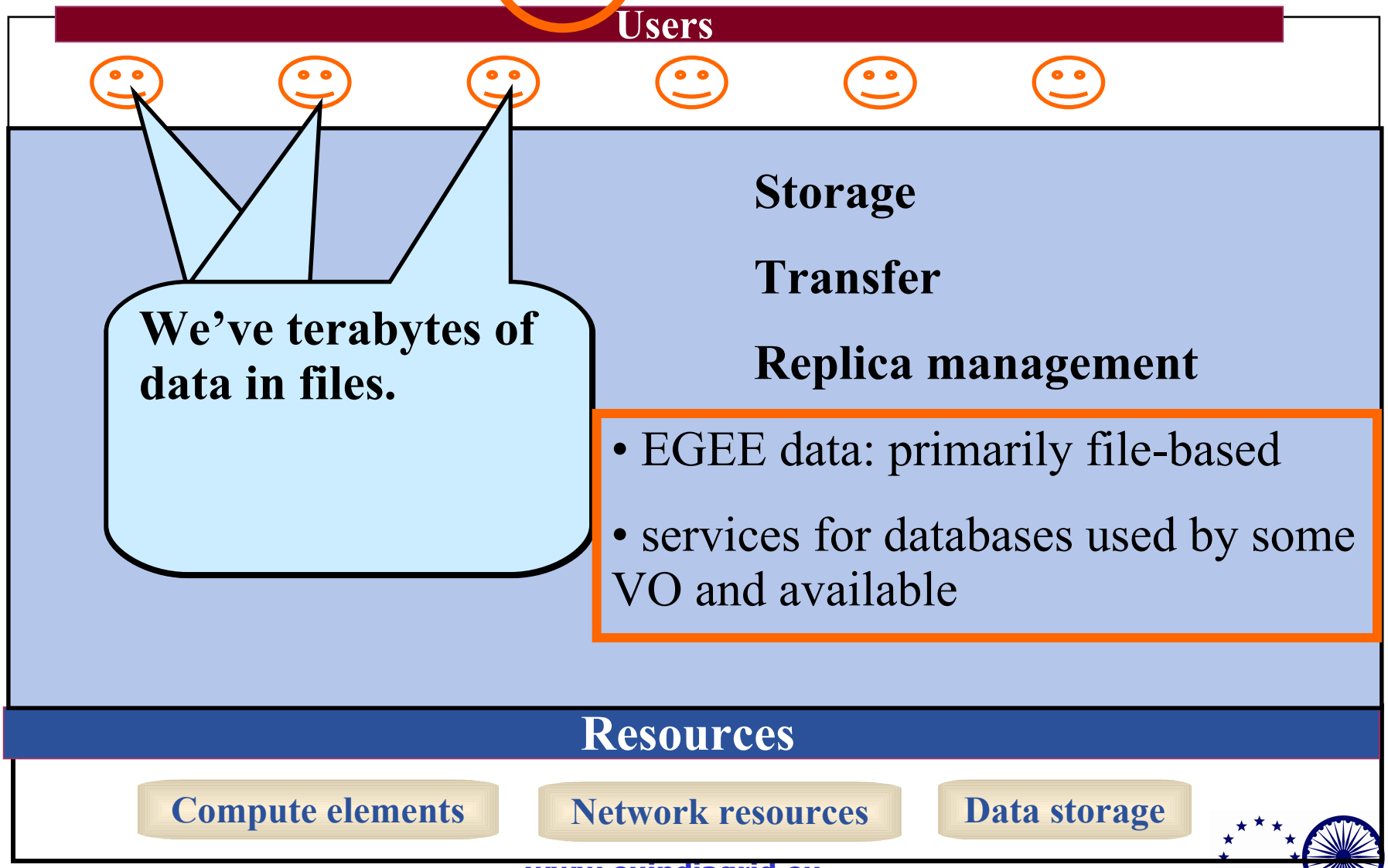
Information Service (IS):

- Resources send updates to IS
- Grid services query IS before running jobs

www.euindiagrid.eu

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

File management



www.euindiagrid.eu

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

Workflow on the GRID..

WMS: the heart of the grid. Sends the jobs on the grid and keeps track of them

BDII: LDAP database with info on resources (CE+SE)

UI: local machine on which the user defines his jobs. All commands to the grid are issued from a UI

LB: a SQL database in which each changing of status of a job is registered

CE: the server of a LRMS (LSF, PBS, Torque…)

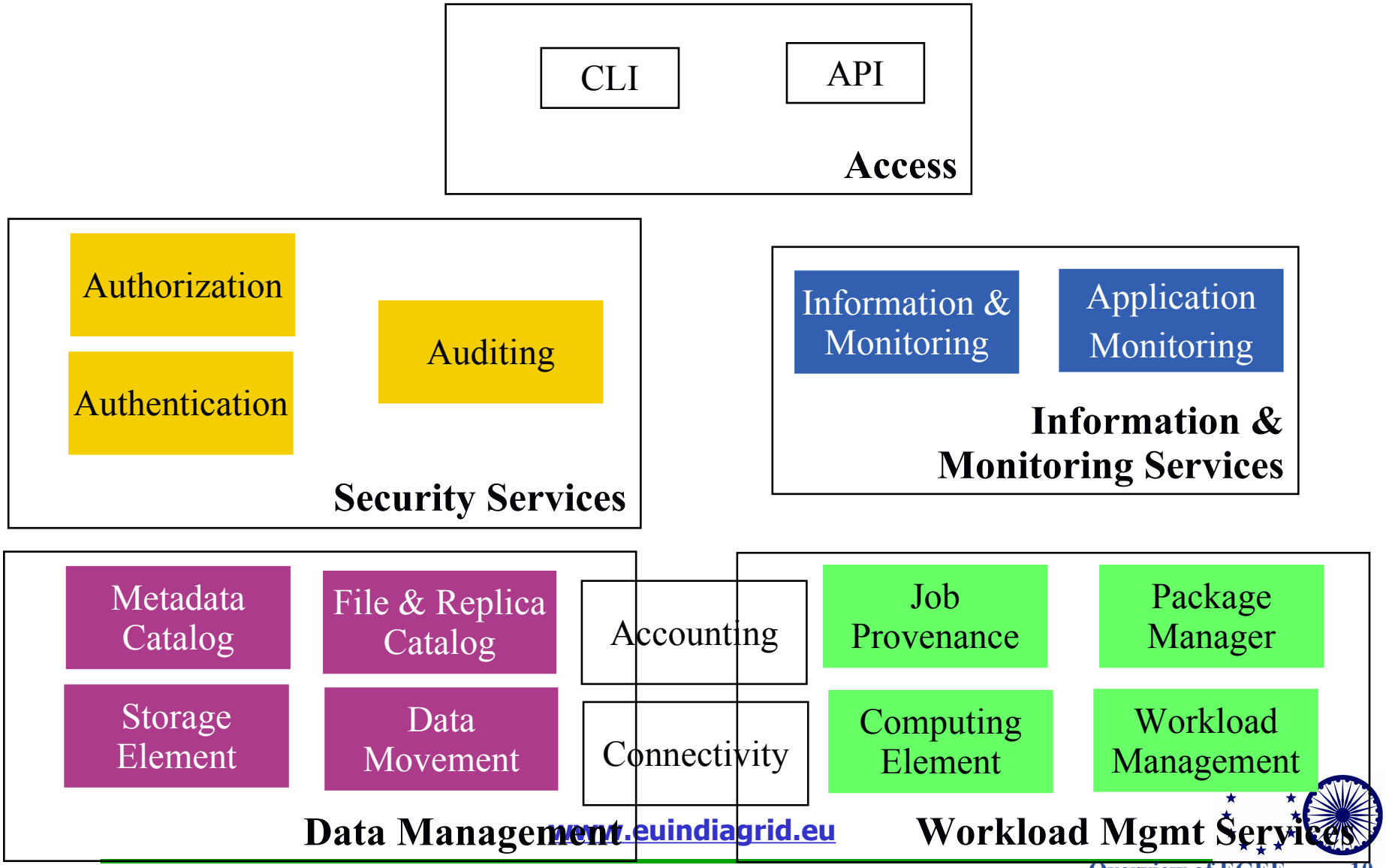
LFC: files stored on a SE are registered in the catalog

WN: CPUs that actually execute the jobs

SE: output files are written on storage resources throughout the grid

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

gLite Grid Middleware Services



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

Access Services

- Glite User Interface
  - A dedicated machine with all the command to interface with GRID
  - Your laptop/desktop cannot be used as official UI.
  - For this tutorial: portal.grid.sissa.it
- Portals
  - Browser based user interface for accessing grid and other services
  - "Live" dynamic pages available to authenticated, authorized users.
  - Manage credentials, launch jobs, manage files, etc.
  - Hide Grid complexities like batch job submission with RSL
  - Can run from anywhere
  - Unlike user desktop clients, connections go through portal server, so overcome firewall/NAT issues
  - Ex. Genius Portal

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

Milu

- Miramare Lightweight User Interface: a re-packaging of the gLite UI software version 3.1 intended to be portable/easy to install/ easy to remove and lightweited.
- Evolution of the Egrid-UI (R. Murri EGRID project) and ICTP-UI (R.Murri A. Terpin EU-IndiaGrid project)
- Now a collaboration among Sissa/eLab and ICTP EU-IndiaGrid: [maintainer Tyanko Aleksiev]
- It has been tested on several GNU/Linux distributions, including:
  - Scientific Linux 4.7
  - Fedora 8
  - Ubuntu 7.10/8.04
- http://www.democritos.it/cluster-wiki/index.php/Milu

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

Security

- Basic security:
  - **Authentication:** Who we are on the Grid?
  - **Authorization:** Do we have access to a resource/service?
  - **Protection:** Data integrity and confidentiality
- but, there are thousands of resources over different administration domains...:
  - **Single sign-on**, i.e. give a password once, and be able to access all resources (to which we have access)
- Grid Security Infrastructure (GSI):
  - **Grid credentials:** digital certificate and private key
    - Based on Public Key Infrastructure (PKI). X.509 standard
    - Certification Authority (CA) signs certificates. Trust relationship
  - **Proxy certificates:** Temporary self-signed certs, allowing single sign-on: ***Proxy delegation***

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

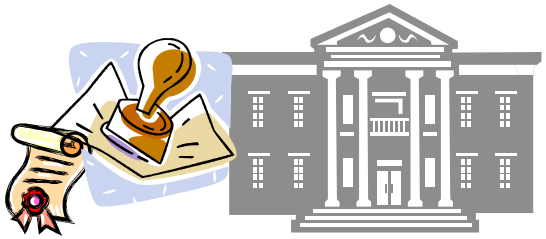
Conventional grid security

Bob

Cert request

Certification Authority (CA)

Bob´s Grid certificate



Single sign-on
Delegation through proxy certificate

User Interface (UI)

Proxy

grid-proxy-init

Grid resources (B)

Sysadmin B :
- Create user “user001“
- Map Bob´s certificate to “user001“

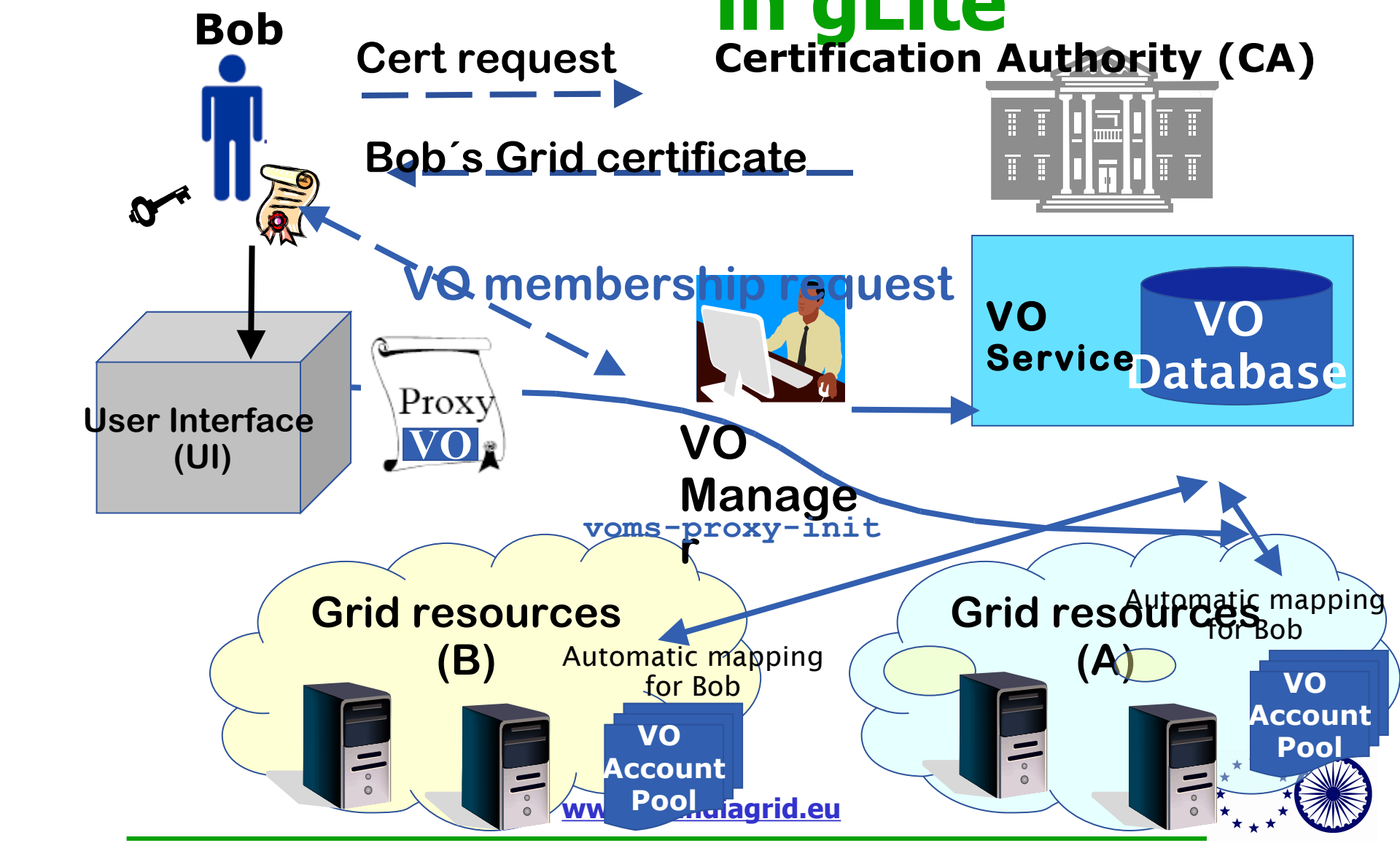
Grid resources

Sysadmin A :
- Create user “grid1“
- Map Bob´s certificate to “grid01“

- Manual user "mapping"
- No info about VOs

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

gLite – Enhanced security in gLite



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

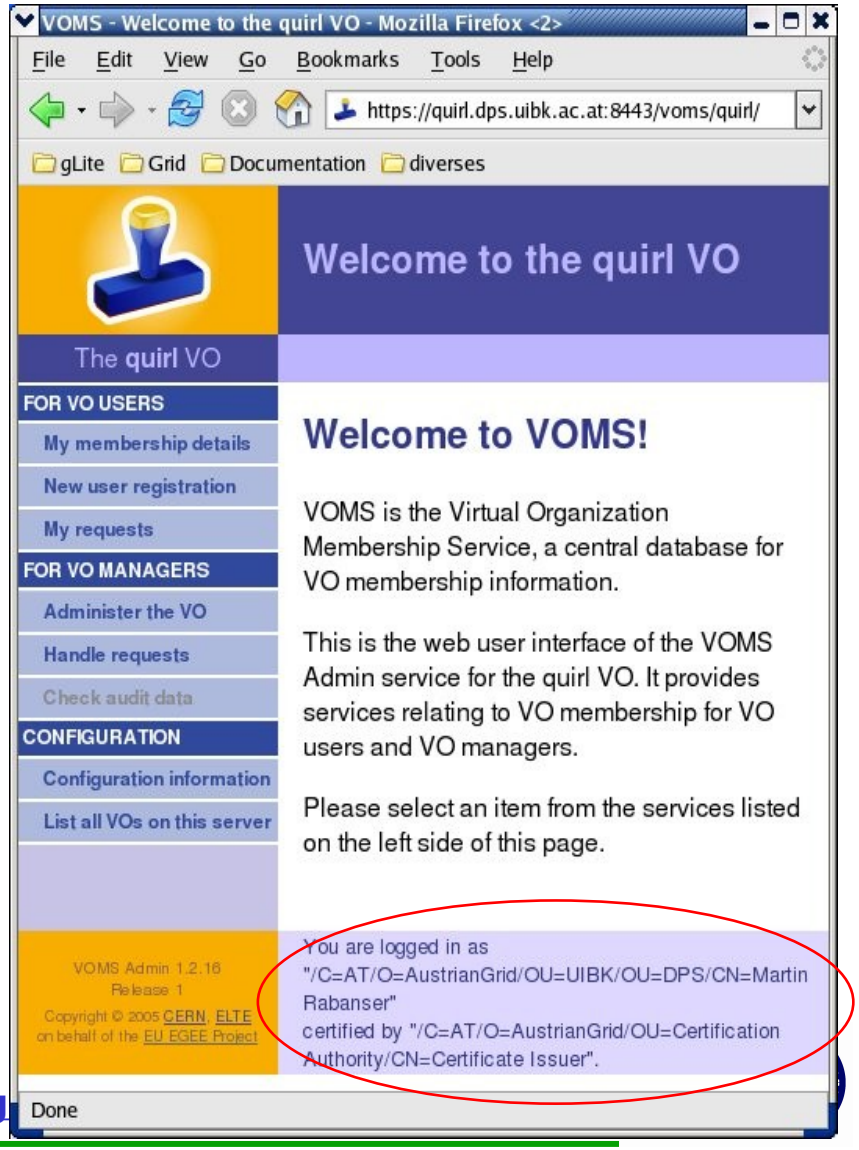
gLite: VOMS

- Virtual Organization Membership Service (VOMS)
  - EGEE/gLite enhancement for VO management
  - Provides information on user's relationship with Virtual Organization (VO)
    - Membership
    - Group membership
    - Roles of user
- Multiple VO
  - User can register to multiple VOs and create an aggregate proxy
  - Access ressources in every registered VO
- Backward compatibility
  - Extra VO related information in users proxy certificate
  - Users proxy can still be used with non VOMS-aware services

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

VOMS - **Web interface**

- Requires a valid certificate from a recognized CA imported on the browser
- VO user can
  - Query membership details
  - Register himself in the VO
    - Needs a valid certificate
  - Track his requests
- VO manager can
  - Handle requests from users
  - Administer the VO
- Everybody can
  - Get information about the VO

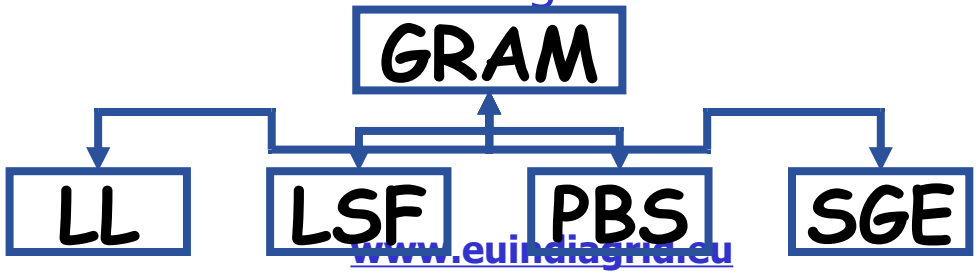


www.euindiag

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

Resource Management

- Everything (or anything) is a resource
  - Physical or logical (single computer, cluster, parallel, data storage, an application...)
  - Defined in terms of **interfaces**, not devices
- Each site must be autonomous (local system administration policy)
- Grid Resource Allocation Manager (GRAM)
  - Defines resource layer protocols and APIs that enable clients to **securely instantiate a Grid computational task** (i.e. a job)
  - Secure remote job submissions
  - Relies on local resource management interfaces



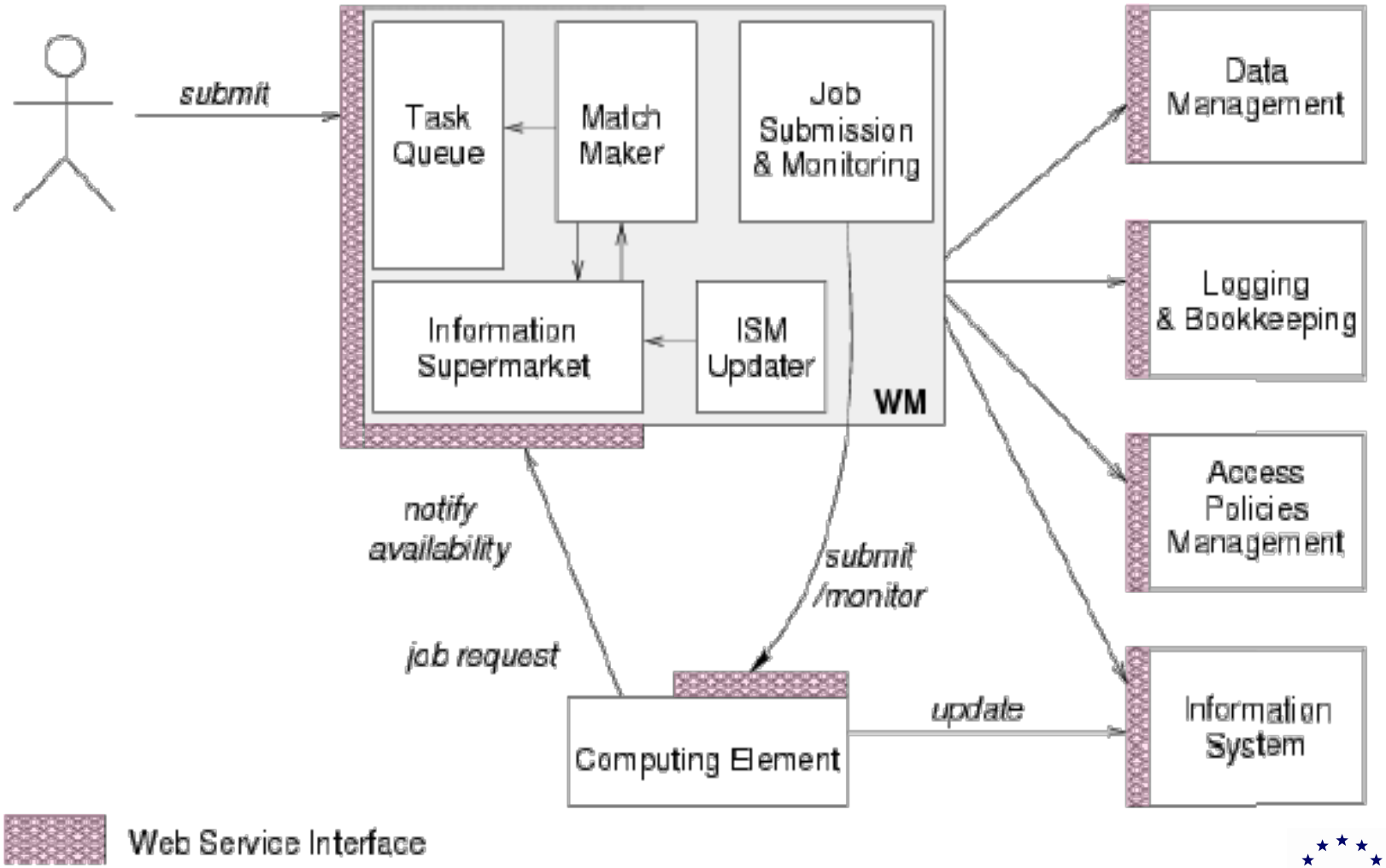
EU-IndiaGrid (RI-031834) is funded by the European Commission under the Research Infrastructure Programme

gLite: Workload Management System (WMS)

- Job Management Services related to job management/execution
  - Computing Element
    - job management (submission, control, ...)
    - information about characteristics and status
    - Actual execution is done in a Worker Node (WN)
  - Workload Management
    - core component: it orchestrates all the business
  - Job Provenance
    - keeps track of job definition, execution conditions, environment
    - important points of the job life cycle
      - debugging, post-mortem analysis, comparision of job execution
  - Package Manager
    - extension of a traditional package management system to a grid
      - automates the process of installing, upgrading, configuring and removing software packages from a shared area on a grid site

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

WMS architecture



www.euindiagrid.eu

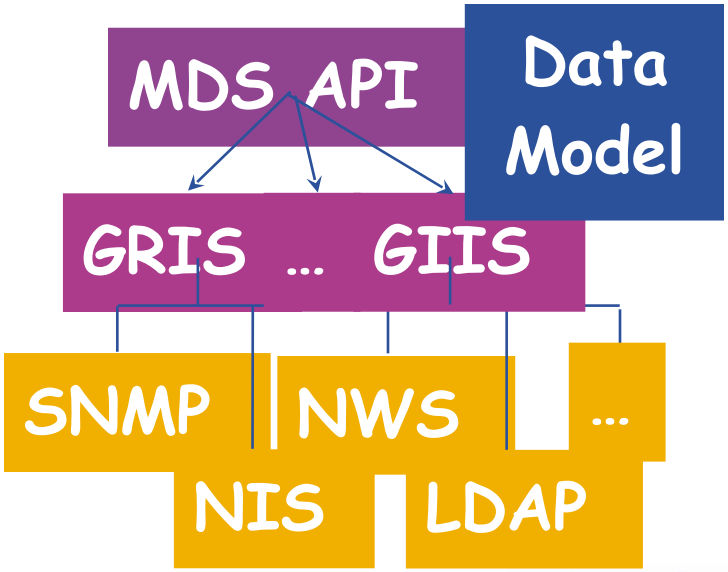
EU-IndiaGrid (RI-031834) is funded by the European Commission under the Research Infrastructure Programme

Information Services

- Maintains information about hardware, software, services and people participating in a Virtual Organization
  - Should scale with the Grid´s growth

"Find a computer with at least 2 free CPUs and with 10GB of free disk space..."

- Globus MDS (Metacomputing Directory Service)
  - Hierarchical, push based (pull based)
    ➔ showed limitations



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

gLite IS: - **BDII**

- Berkely Database Information Index (BDII)
  - A Monitoring and Discovery Service (MDS) **evolution**
  - Based on LDAP (Lightweight Directory Access Protocol)
  - Central system
    - Queries servers/providers about status
    - Stores the retrieved information in a database
    - Provides the information following the GLUE Schema
- Commands
  - lcg-infosites –vo <your_vo> all l ce l se l lfc l lfcLocal l –is <your_bdii>

```
[gliteui] /home/martin > lcg-infosites --vo dpsgltb all –is glitece.dps.uibk.ac.at
#CPU    Free    Total Jobs      Running Waiting ComputingElement
----------------------------------------------------------
  2      2      0               0       0    glitece.dps.uibk.ac.at:2119/blah-pbs-dpsgltb
Avail Space(Kb) Used Space(Kb)  Type    SEs
----------------------------------------------------------
3172384         4664832         n.a     gliteio.dps.uibk.ac.at
```


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

Data management - **Overview**

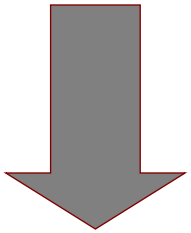
- User and programs produce and require data
  - WMS can send data from/to jobs
    - Input/Output Sandboxes are limited to 10 MB
    - Data has to be copied from/to local filesystems to the Grid (UI, WN)
- Solution
  - Storing data in Grid datasets
    - Located in Storage Elements (SE)
    - Several replicas of one file in different sites
    - Accessible by Grid users and applications from "everywhere"
    - Locatable by the WMS (data requirements in JDL)

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

Data Management Services

Grid Data Management Services enable users to:

- move files in and out of the Grid
- Replicate files on different SE's
- Locate files on various SE's

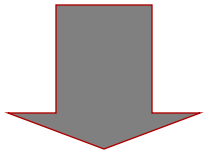


Data Management means movement and replication of files on grid elements

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

Data Management Services(2

- Data transfer is done by a number of protocols (gsiftp, rfio, file, etc..)
- Usage of a central file catalogue



By using high level data management tools which enable transparency of the transport layer details (protocols) , storage location and the internal structure of the SE's

The SE is a "black box"

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

Files : name conventions

- Logical File Name (LFN)
  - An alias created by the user to refer to some file
  - A LFN is of the form: lfn:/grid/<MyVO>/<MyDir>/<MyFile>
  - Example: lfn:/grid/gridbox/importantResults/Test1240.dat
- Globally Unique Identifier (GUID)
  - A file can always be identified by its GUID (based on UUID)
  - A GUID is of the form: guid:<unique_string>
  - All replicas of a file will share the same GUID
  - Example: guid:f81d4fae-7dec-11d0-a765-00a0c91e6bf6

both lfn's and guid's refer to **files** (**not replicas**)

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

Replicas : name convention

Storage URL (SURL) (AKA: Physical/Storage File Name (PFN/ SFN))

- Used by the RMS to find where the replica is physically stored
- A SURL is of the form: sfn://<SE_hostname>/<VO_path>/<file_name>
- Example: sfn://tbed1.cern.ch/flatfiles/SE00/gilda/project1/testSUTL.dat

Transport URL (TURL)

- Temporary locator of a physical replica including the access protocol understood by a SE
- A TURL is of the form: <protocol>://<SE_hostname>/<VO_path>/ <filename>
- Example: gsiftp://tbed1.cern.ch/gilda/project1/testTURL.dat

Both SURL and TURL 's refer to **replicas**

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

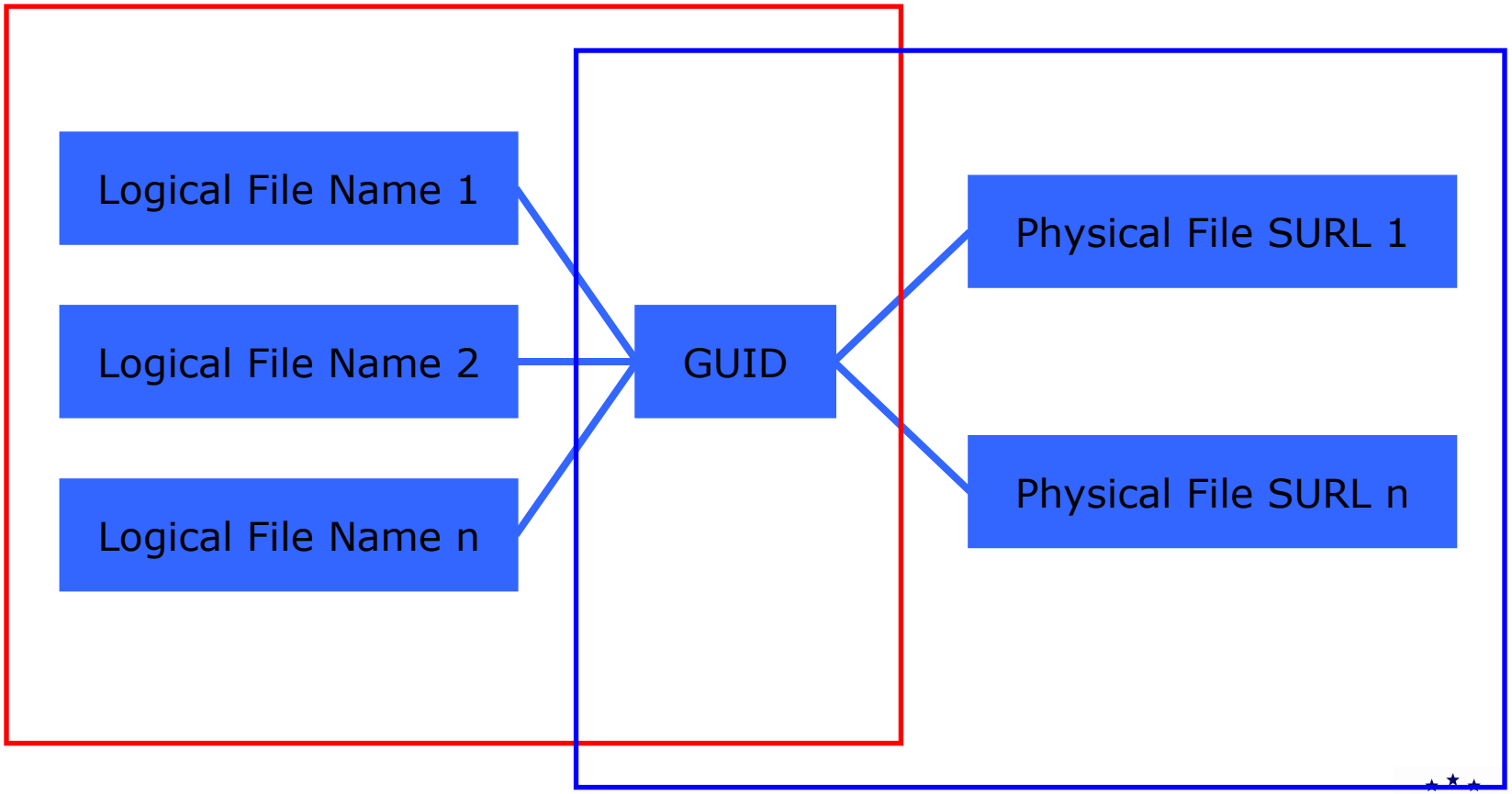
File Catalogs

- How do I keep track of all of the files I have on the Grid ?
- Even if I remember all the lfn's of my files, what about someone else's files ?
- How does the Grid keep track of lfn-guid-surl associations ?
- Well… for that we have a FILE CATALOG

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

File Catalogs – cont'd

RMC =Replica Management System

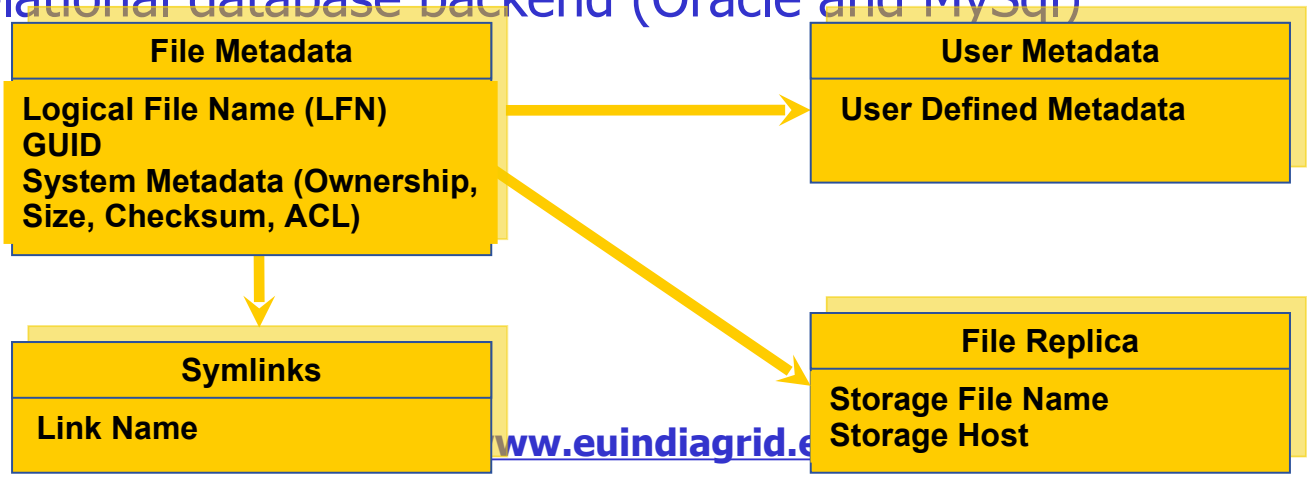


RLS – Replica Location Service

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

Data management - **LFC**

- LCG File Catalog
  - Unique Identifier (GUID)
  - One single catalog with LFN-> GUID -> SFN mapping
  - All entities are treated/replicated like files in a UNIX filesystem
  - Hierarchical namespace
  - System attributes stored as metadata on the GUID (1 field of user metadata
  - Transactions, timeoutes, retries
  - Relational database backend (Oracle and MySql)



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

gLite: LFC commands

lfc-chmod	Change access mode of the LFC file/directory
lfc-chown	Change owner and group of the LFC file-directory
lfc-delcomment	Delete the comment associated with the file/directory
lfc-getacl	Get file/directory access control lists
lfc-ln	Make a symbolic link to a file/directory
lfc-ls	List file/directory entries in a directory
lfc-mkdir	Create a directory
lfc-rename	Rename a file/directory
lfc-rm	Remove a file/directory
lfc-setacl	Set file/directory access control lists
lfc-setcomment	Add/replace a comment

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

Time to work:

- Tools:
  - GRIDSEED

http://www.democritos.it/cluster-wiki/index.php/Gridseed%40elab

http://www.democritos.it/cluster-wiki/index.php/Getting_Started_with_GridSeed_and_gLite_middleware

  - MILU

http://www.democritos.it/cluster-wiki/index.php/Milu

  - SISSA official User-Interface

ssh portal.grid.sissa.it

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

How to work

- I propose to work in different groups for this first hands on session:
  - People with little or no knowledge about grid computing can follow the gridseed tutorial to get acquainted with gLite middleware:
  - People with gLite experience and certificate can setup their own environment on our portal machine and check out the Milu user-interface..
  - People interested in Sys. Adm side can play with the Gridseed infrastructure

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

Technical details

- ICTP accounts should allow you to log on the Eklund machines:
  - Read your email/browse internet etc.. etc..
- The same username is available on portal.grid.sissa.it, the official eLab/Sissa UserInterface
  - Ssh username@portal.grid.sissa.it
- From portal you can reach the gridseed user-interfaces with the following sequence of commands:
  - Tunnel-ui[1,2]-on : open the connection
  - ui-1 ; to connect
  - No password are required !

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

First exercise:

- Change the password on portal !
- Make your login from ictp to sissa passwordless
  - check out this page:
  - http://www.democritos.it/cluster-wiki/index.php/AUTHENTICATION

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