



Enabling Grids for E-science

The EGEE middleware (and the GILDA t-Infrastructure)

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www.eu-egee.org



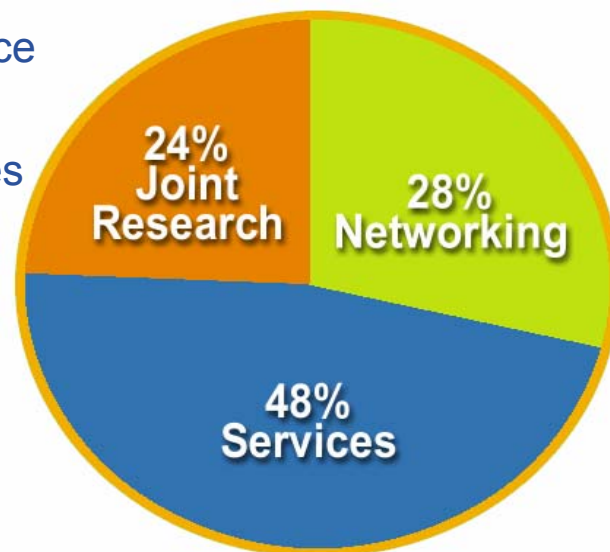
24% Joint Research

JRA1: Middleware Engineering and Integration

JRA2: Quality Assurance

JRA3: Security

JRA4: Network Services Development



48% Services

SA1: Grid Operations, Support and Management

SA2: Network Resource Provision

28% Networking

NA1: Management

NA2: Dissemination and Outreach

NA3: User Training and Education

NA4: Application Identification and Support

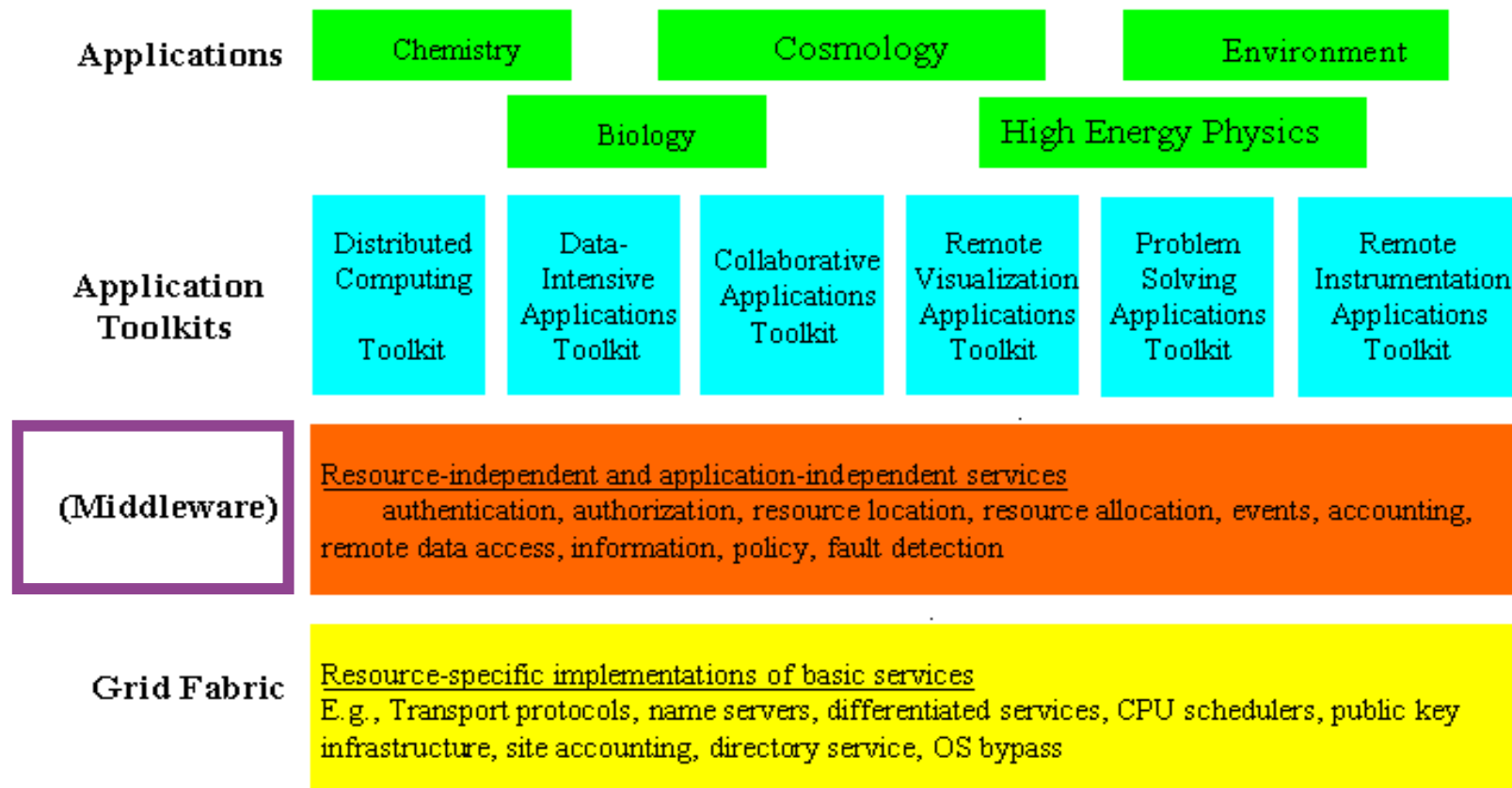
NA5: Policy and International Cooperation

Emphasis in EGEE is on operating a *production Grid* and on supporting the end-users.

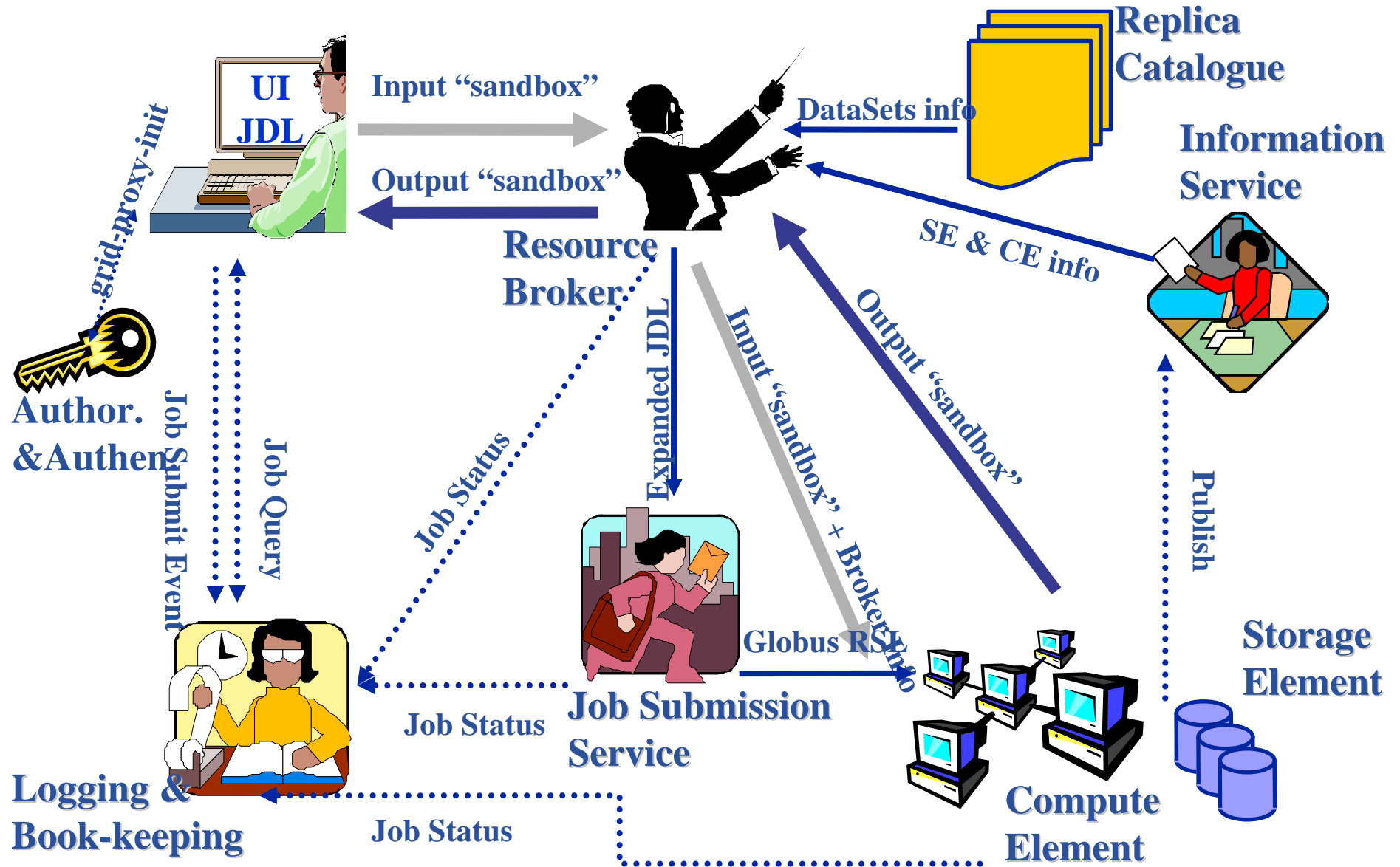
- **Generalities**
- **Security System**
 - GSI
 - VOMS
 - MyProxy
- **Information System**
 - lcg-infosites
 - R-GMA
- **Workload Management System**
- **Data Management System**
 - LFC
 - FiReMan
- **The GILDA t-Infrastructure**
 - services
 - tools
 - applications
 - tutorial lay-out
- **Summary and conclusions**

Generalities

The Grid from a Services View



A typical job workflow



LCG (the present)

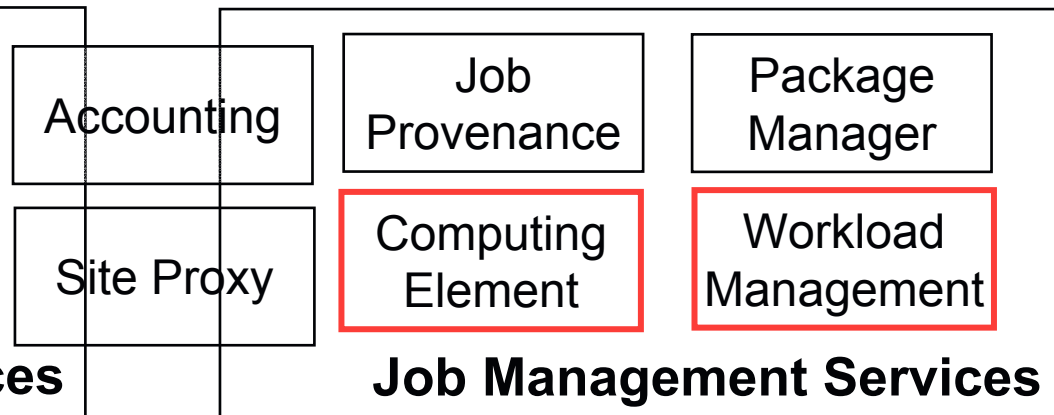
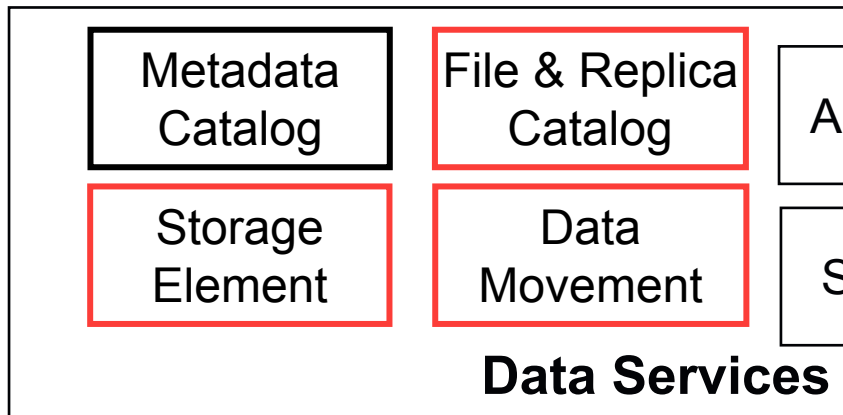
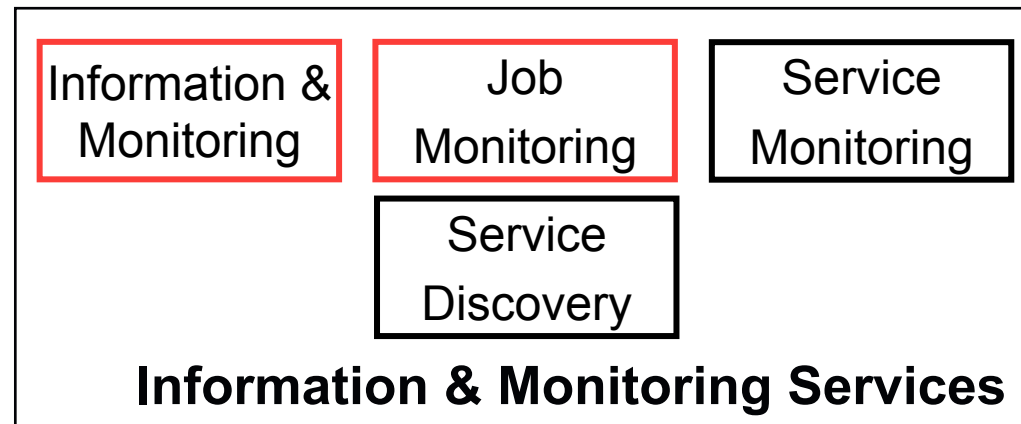
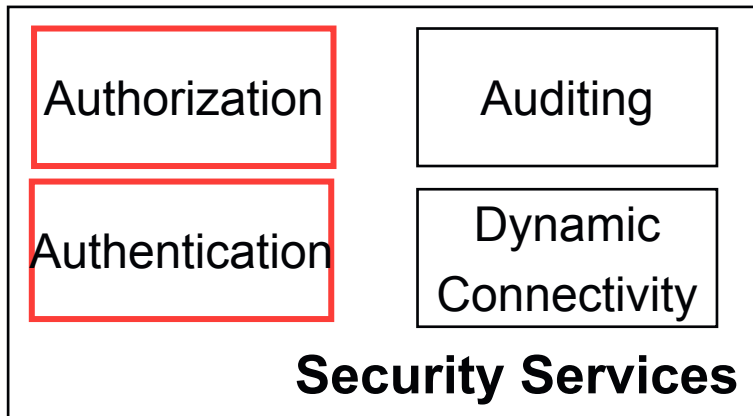
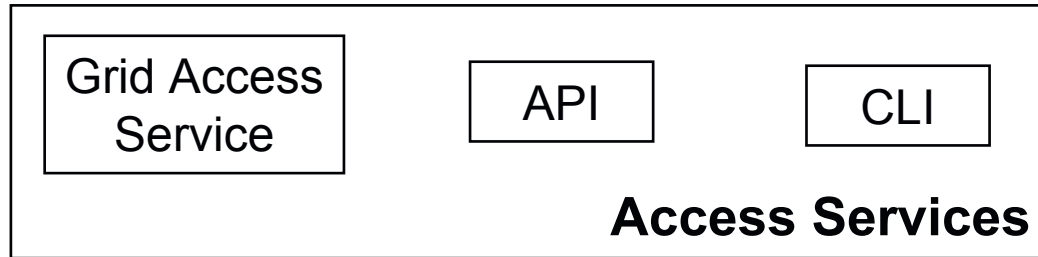
- **Security**
 - GSI
- **Job Management**
 - Condor + Globus
 - CE, WN
 - Logging & Bookkeeping
- **Data Management**
 - LCG services
- **Information & Monitoring**
 - BDII (evolution of MDS)
- **Grid Access**
 - CLI + API

gLite (the future)

- **Security**
 - GSI and VOMS
- **Job Management**
 - Condor+ Globus + blahp
 - CE, WN
 - Logging & Bookkeeping
 - Job Provenance
 - Package management
- **Data Management**
 - LFC
 - gLite-I/O + FiReMan
- **Information & Monitoring**
 - BDII
 - R-GMA + Service Discovery
- **Grid Access**
 - CLI + API + Web Services

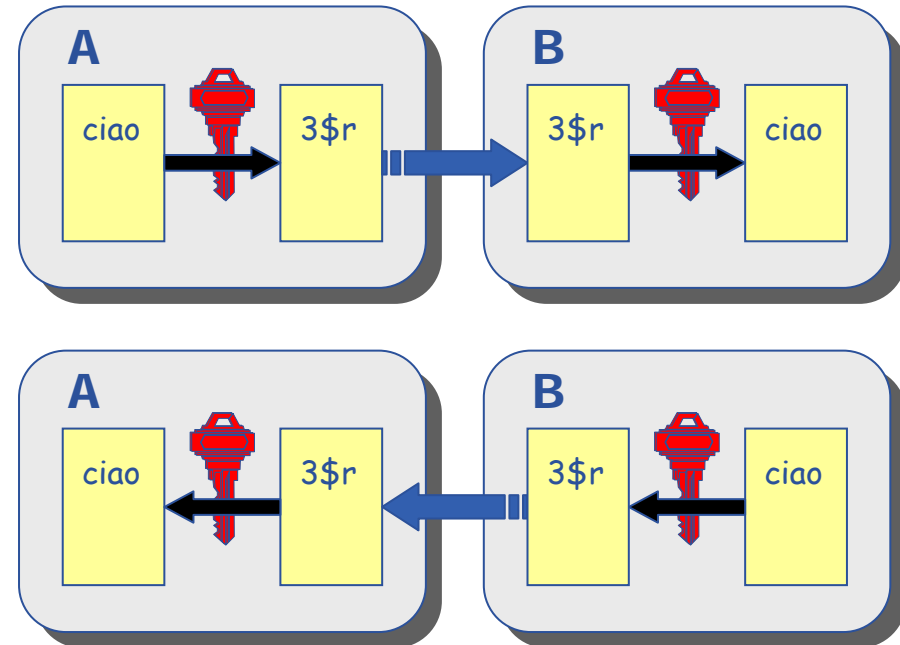
- The gLite Grid services follow a *Service Oriented Architecture*
 - **facilitate interoperability among Grid services**
 - **allow easier compliance with upcoming standards**
- Architecture is not bound to specific implementations
 - **services are expected to work together**
 - **services can be deployed and used independently**
- The gLite service decomposition has been largely influenced by the work performed in the LCG project

gLite components overview

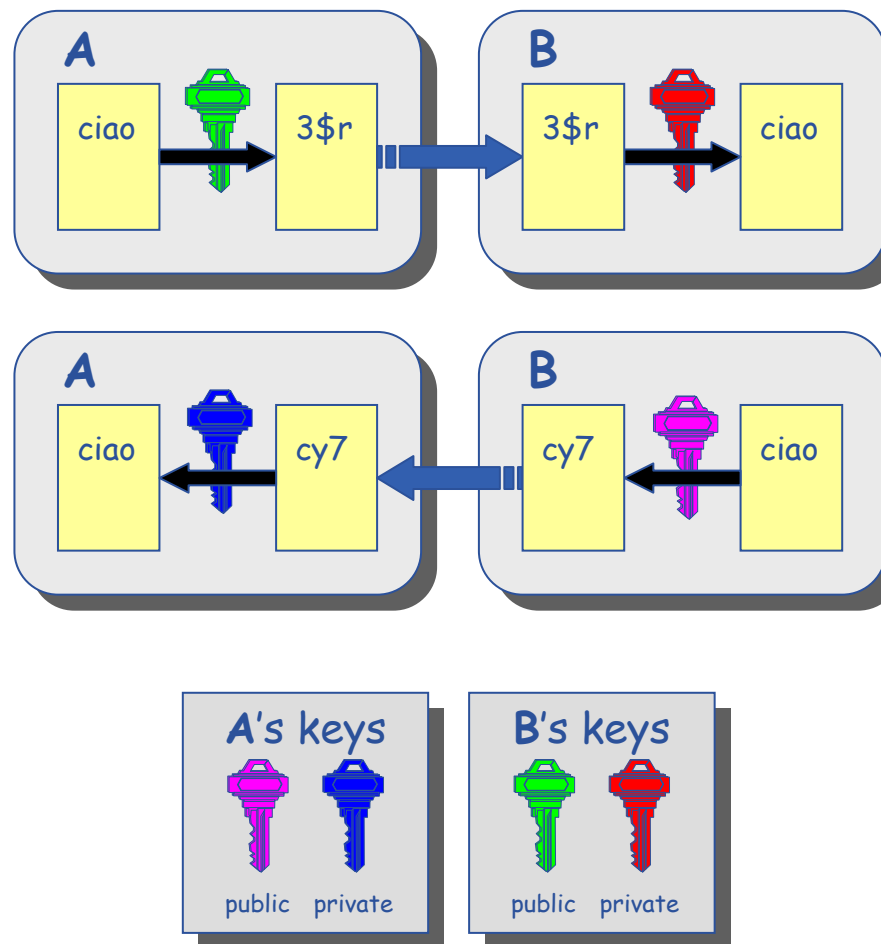


Security System (GSI, VOMS, and MyProxy)

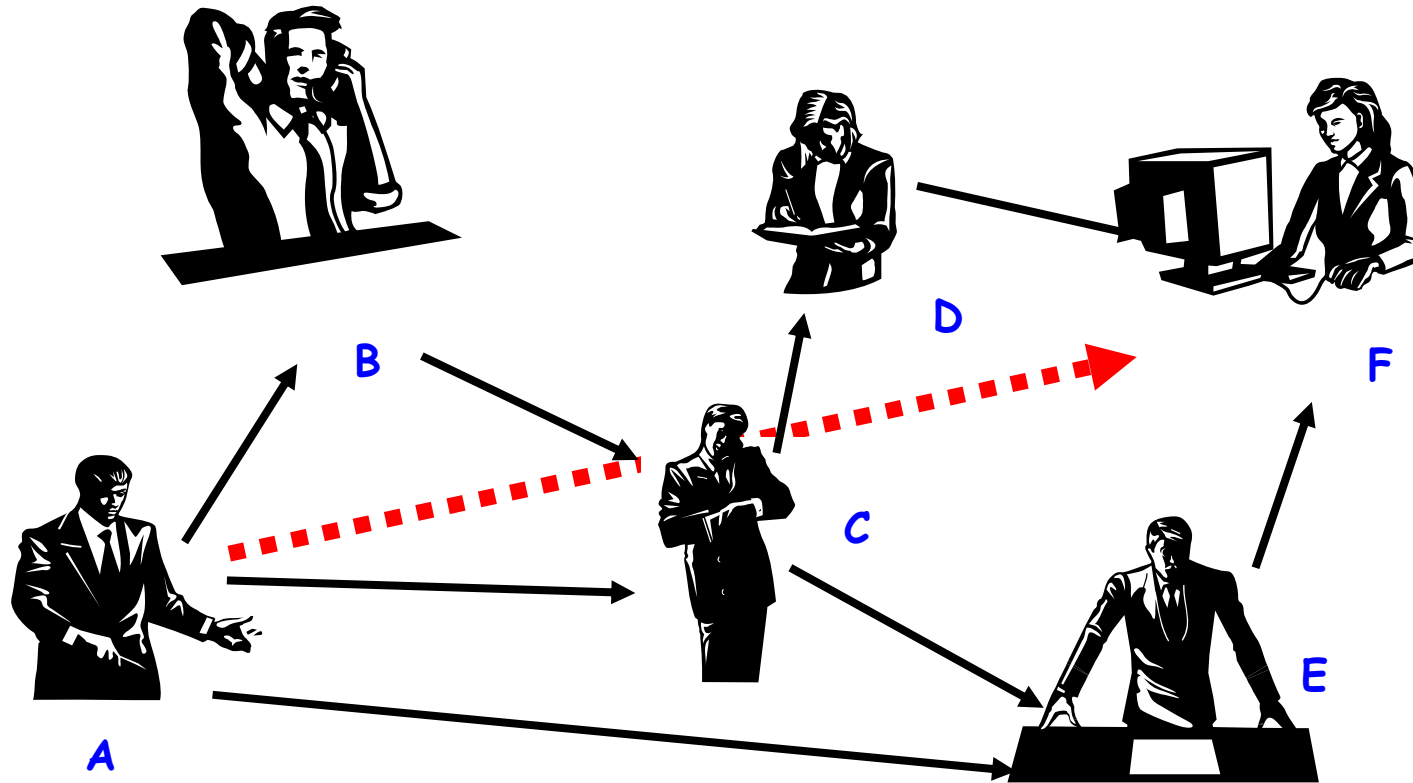
- The same key is used for encryption and decryption
- Advantages:
 - Fast
- Disadvantages:
 - how to distribute the keys?
 - the number of keys is $O(n^2)$
- Examples:
 - DES
 - 3DES
 - Rijndael (AES)
 - Blowfish
 - Kerberos



- Every user has two keys: one *private* and one *public*:
 - it is *impossible* to derive the private key from the public one;
 - a message encrypted by one key can be decrypted **only** by the other one.
- No exchange of secrets is necessary
 - the sender cyphers using the *public* key of the receiver;
 - the receiver decrpts using his *private* key;
 - the number of keys is $O(n)$.
- Examples:
 - Diffie-Hellmann (1977)
 - RSA (1978)



- **A's digital signature is safe if:**
 1. A's private key is not compromised
 2. B knows A's public key
- **How can B be sure that A's public key is really A's public key and not someone else's?**
 - A *third party* guarantees the correspondence between public key and owner's identity, by signing a document which contains the owner's identity and his public key (**Digital Certificate**)
 - Both A and B must trust this third party
- **Two models:**
 - PGP: "web of trust";
 - X.509: hierarchical organization.



- F knows D and E, who knows A and C, who knows A and B.
- F is reasonably sure that the key from A is really from A.

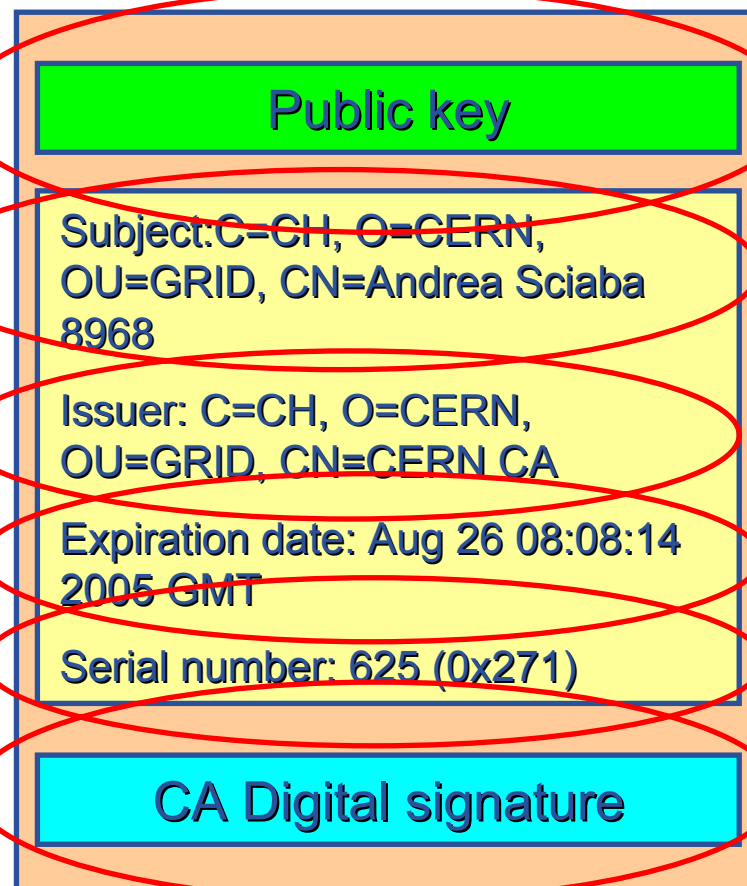
The “third party” is called Certification Authority (CA).

- Issue certificates for users, programs and machines
- Check the identity and the personal data of the requestor
 - Registration Authorities (RAs) do the actual validation
- CA’s periodically publish a list of compromised certificates
 - **Certificate Revocation Lists (CRL)**
 - They contain all the revoked certificates yet to expire
 - **Online Certificate Status Protocol (OCSP).**
- CA certificates are **self-signed**

- An X.509 Certificate contains:

- owner's public key;
- identity of the owner;
- info on the CA;
- time of validity;
- Serial number;
- digital signature of the CA

Structure of a X.509 certificate



Based on X.509 PKI:

- every user has a certificate
- certificates are stored in the local file system
- every Grid user authenticates himself

1. A sends a challenge to B
2. B verifies the challenge
3. B sends a response to A
4. A encrypts the response with his private key
5. A sends the encrypted response to B
6. B uses A's public key to decrypt the response
7. B compares the decrypted string with the original challenge
8. If they match, B verified A's identity and A can not repudiate it.



- Virtual Organization Membership Service (VOMS) is a service that keeps track of the members of a VO and grants users authorization to access the resource at VO level, providing support for group membership, roles (e.g. administrator, software manager, student) and capabilities.
- Support for it is integrated in most of the grid services.
- Provide a secure system for VO to organize the user in groups and/or roles and to disseminate this information
- User should be able to decide which information wants to publish
- Compatibility with Globus Toolkit
- Each VO has its own server(s) containing groups membership, roles and capabilities information for each member
- User contacts the server requesting his authorization info
- The server sends the authorization info to the client
- The client includes it in a proxy certificate

- **single login using voms-proxy-init only at the beginning of the session (was grid-proxy-init)**
- **backward compatibility: the extra VO related information is in the user's proxy certificate, which can be still used with non VOMS-aware services**
- **multiple VOs: the user may "log-in" into multiple VOs and create an aggregate proxy certificate, which enables her to access resources in any of them**

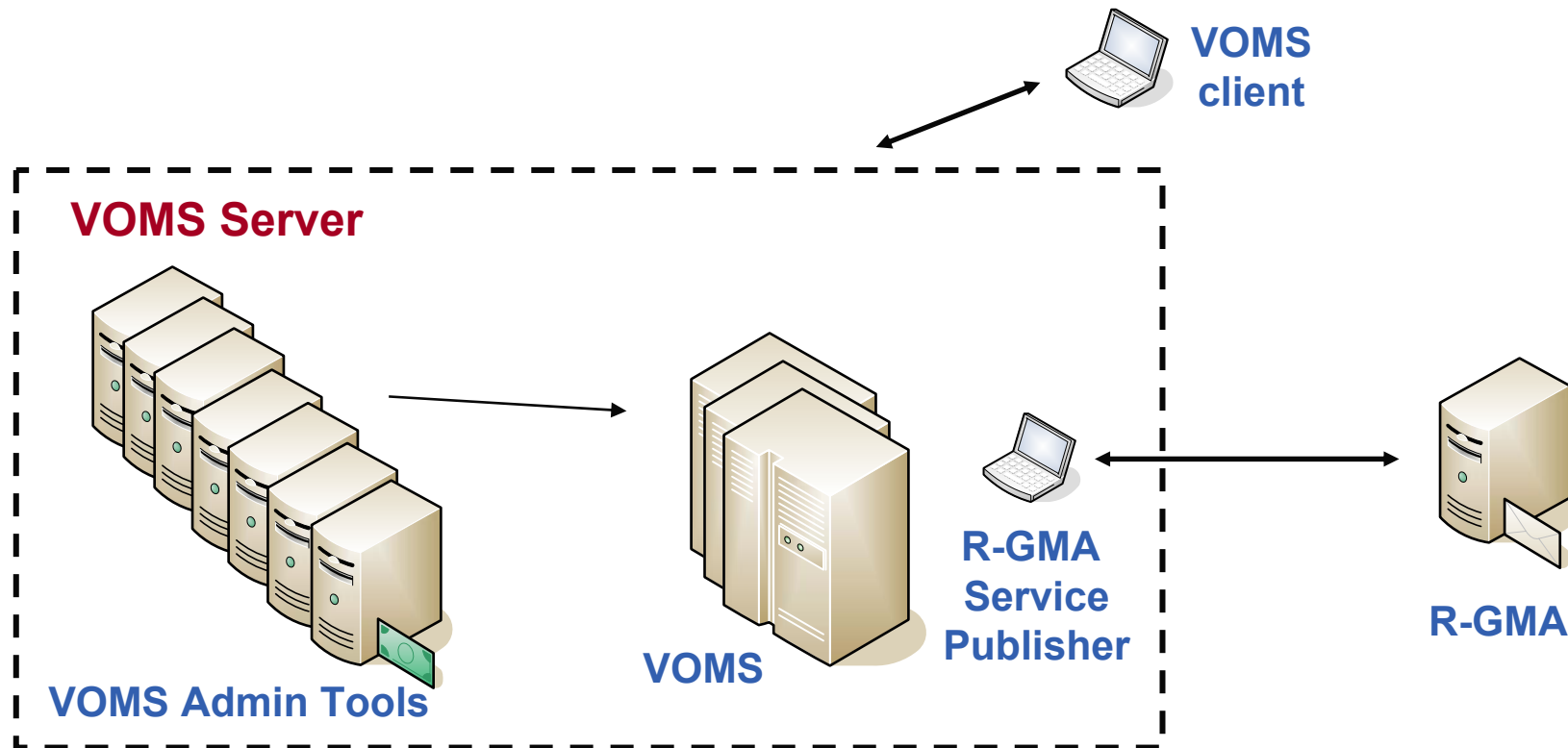
- **VOMS Features**

- Single login using (proxy-init) only at the beginning of a session
 - Attaches VOMS certificate to user proxy
- Expiration time
 - The authorization information is only valid for a limited period of the time as the proxy certificate itself
- Multiple VO
 - User may log-in into multiple VOs and create an aggregate proxy certificate, which enables him/her to access resources in any one of them
- Backward compatibility
 - The extra VO related information is in the user's proxy certificate
 - User's proxy certificate can be still used with non VOMS-aware service
- Security
 - All client-server communications are secured and authenticated

- **Virtual Organization Membership Service (VOMS)**
 - Account Database
 - Serving information in a special format (VOMS credentials)
 - Can be administered via command line & via web interface
 - Provides information on the user's relationship with his/her Virtual Organization (VO)
 - Membership
 - Group membership
 - Roles of user

VOMS Server key components

- Set of services required to run VOMS Server
 - VOMS Server (configured one instance per VO)
 - VOMS Admin Management front-end
 - R-GMA Service Publisher



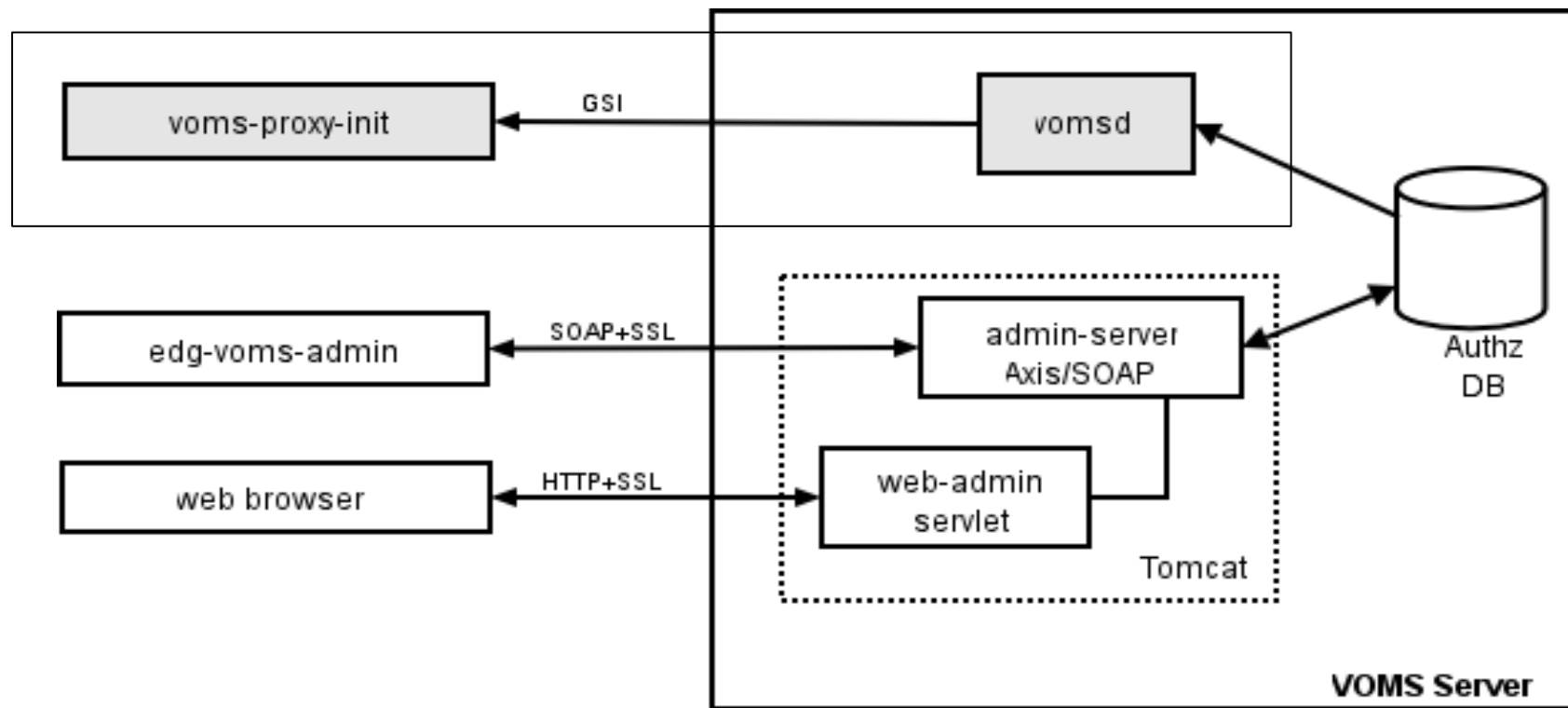
- **The number of users of a VO can be very high:**
 - E.g. the experiment ATLAS has 2000 members
- **Make VO manageable by organizing users in groups:**
 - VO BIOMED-FRANCE
 - Group Paris
 - *Sorbonne University*
 - Group Prof. de Gaulle
 - *Central University*
 - Group Lyon
 - Group Marseille
- **Groups can have a hierarchical structure**
- **Group membership is added automatically to your proxy when doing a *voms-proxy-init***

- **Assign rights to certain members of the groups**
 - using Access Control Lists (ACL) like in a file system
 - Allow / Deny
 - *Create user*
 - *Delete user*
 - *Get ACL*
 - *Set ACL*
 - *List user*
 - *Remove ACL*
 - Specifying unit for entry:
 - The local database administrator
 - A specific user (not necessarily a member of this VO)
 - Anyone who has a specific VOMS attribute FQAN
 - Anyone who presents a certificate issued by a known CA (Including host and service certificates)
 - Absolutely anyone, even unauthenticated clients

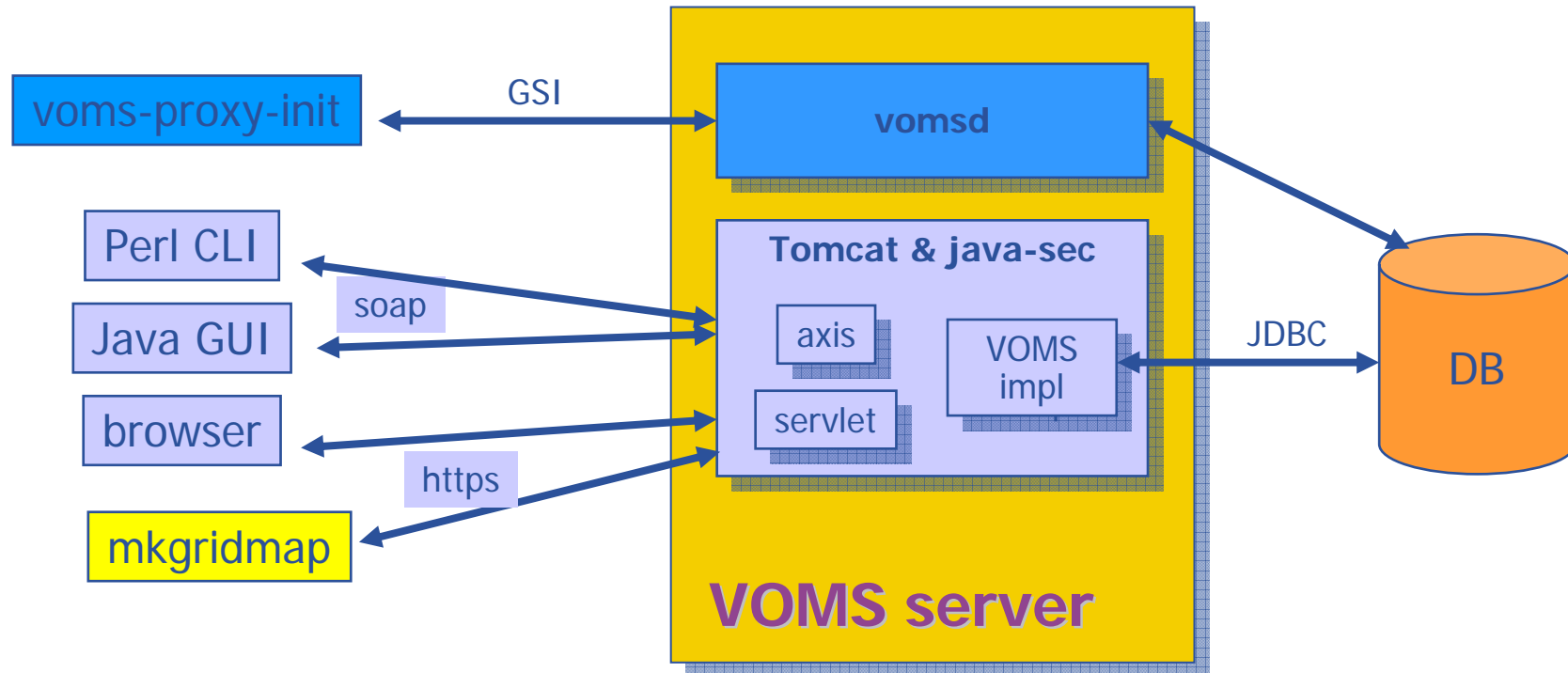
- **Roles are specific roles a user has and that distinguishes him from others in his group:**
 - Software manager
 - Administrator
 - Manager

- **Difference between roles and groups:**
 - Roles have no hierarchical structure – there is no sub-role
 - Roles are not used in ‘normal operation’
 - They are not added to the proxy by default when running *voms-proxy-init*
 - But they can be added to the proxy for special purposes when running *voms-proxy-init*

- **Example:**
 - User Yannick has the following membership
 - VO=BIOMED-FRANCE, Group=Paris, Role=SoftwareManager
 - During normal operation the role is not taken into account, e.g. Yannick can work as a normal user
 - For special things he can obtain the role “Software Manager”



Authz DB is a RDBMS (both MySQL and Oracle are currently supported).



- VOMS
 - Available at <http://inf Forge.cnaf.infn.it/voms/>
 - Alfieri, Cecchini, Ciaschini, Spataro, dell'Agnello, Fronher, Lorente y, From gridmap-file to VOMS: managing Authorization in a Grid environment
 - Vincenzo Ciaschini, A VOMS Attribute Certificate Profile for Authorization
- GSI
 - Available at www.globus.org
 - A Security Architecture for Computational Grids. I. Foster, C. Kesselman, G. Tsudik, S. Tuecke. *Proc. 5th ACM Conference on Computer and Communications Security Conference*, pp. 83-92, 1998.
 - A National-Scale Authentication Infrastructure. R. Butler, D. Engert, I. Foster, C. Kesselman, S. Tuecke, J. Volmer, V. Welch. *IEEE Computer*, 33(12):60-66, 2000.
- RFC
 - S.Farrell, R.Housley, An internet Attribute Certificate Profile for Authorization, RFC 3281

Consists of a server and a set of client tools that can be used to delegate and retrieve credentials to and from a server.

MyProxy Client commands:

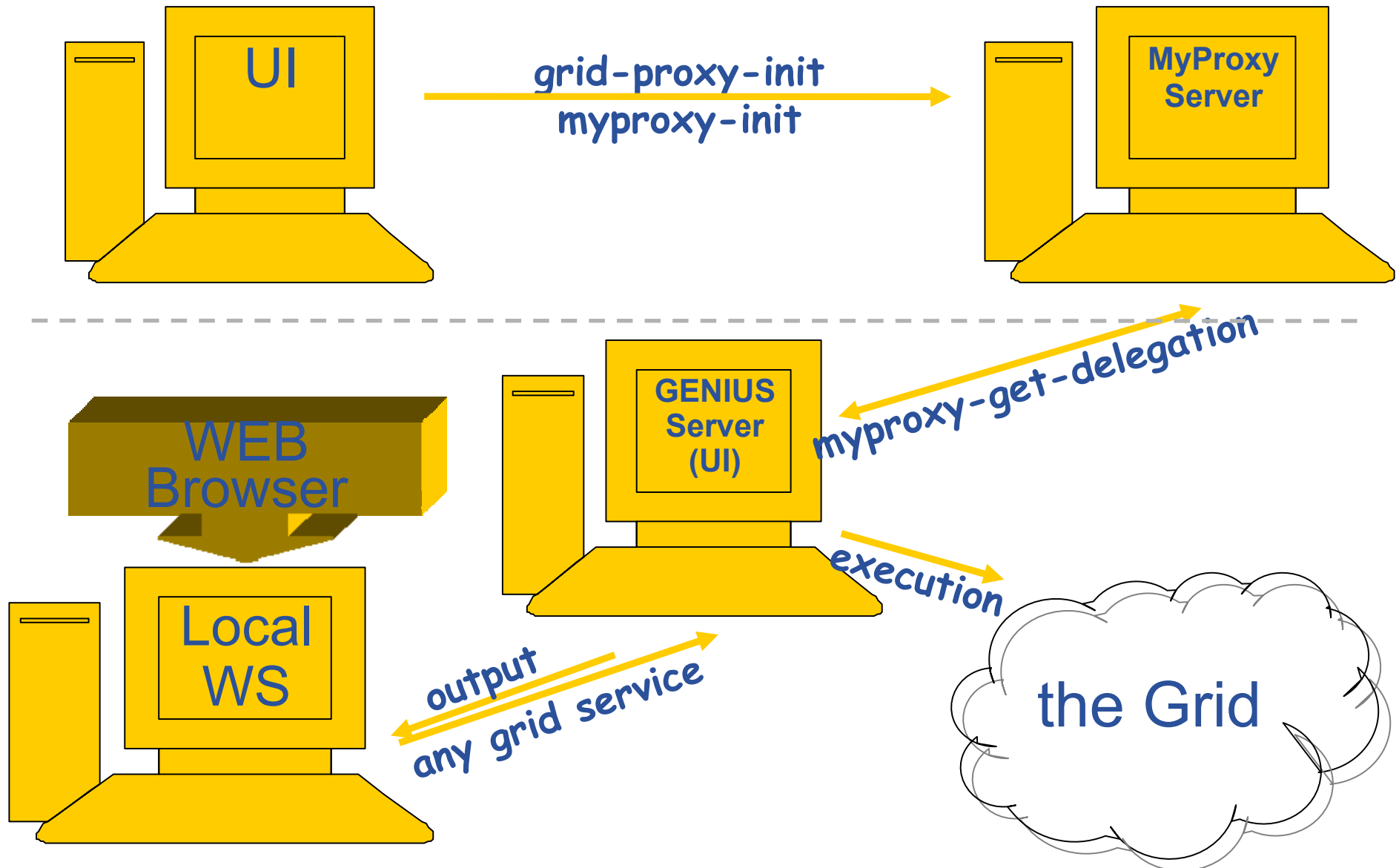
- *myproxy-init*
- *myproxy-info* // `myproxy-info -s <host name> -d`
- *myproxy-destroy*
- *myproxy-get-delegation* // `myproxy-get-delegation -s <host name> -d`
 `-t <hours> -o <output file> -a <user proxy>`
- *myproxy-change-pass-phrase*

The ***myproxy-init*** command allows you to create and send a delegated proxy to a MyProxy server for later retrieval; in order to launch it you have to assure you're able to execute the `grid-proxy-init` or `vomsproxy-init` command.

```
myproxy-init -s <host name> -t <hours> -d -n
```

The `myproxy-init` command stores a user proxy in the repository specified by `<host name>` (the `-s` option). Default lifetime of proxies retrieved from the repository will be set to `<hours>` (see `-t`) and no password authorization is permitted when fetching the proxy from the repository (the `-n` option). The proxy is stored under the same user-name as is your subject in your certificate (`-d`).

Grid authentication with MyProxy



Information System (lcg-infosites, R-GMA, DGAS, GridICE)

lcg-infosites (the present)

If you are a user

Retrieve information of Grid resources and status

Get the information of your jobs status

If you are a middleware developer

Workload Management System:
Matching job requirements and Grid resources

Monitoring Services:
Retrieving information of Grid Resources status and availability

If you are site manager or service

You “generate” the information for example relative to your site or to a given service

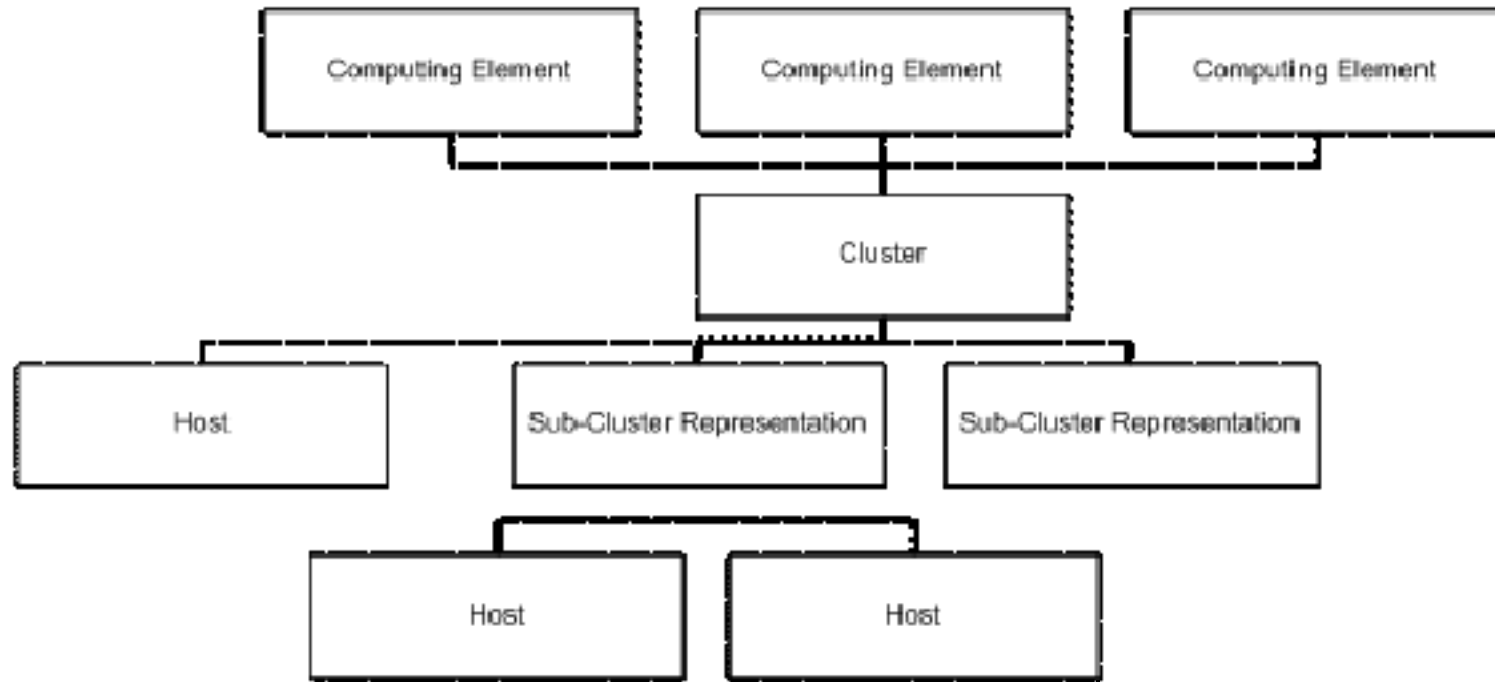
```

*****
These are the data for alice: (in terms of CPUs)
*****
#CPU  Free   Total Jobs   Running   Waiting   Computing Element
-----
52     51     0             0          0    ce.prd.hp.com:2119/jobmanager-lcgpbs-long
16     14     3             2          1    lcg06.sinp.msu.ru:2119/jobmanager-lcgpbs-long
[.....]
The total values are:
-----
10347  5565     2717     924     1793
    
```



- ✘ Something has managed this information: (General IS architecture)
 - ✘ Something has provided it: (Providers, Servers)
 - ✘ It is following a certain "schema": (GLUE Schema)
 - ✘ And she has accessed it following a protocol: (Access Protocol: LDAP)
- She will use some EGEE/LCG tools and after few moments...

- **Developed within High Energy Physics (HEP) community**
 - DataGrid / EGEE
 - DataTAG
 - Globus
- **Currently defines CEs and SEs**
- **Entire R-GMA Schema (not only GLUE):**
 - For service discovery and monitoring
 - <http://hepunix.rl.ac.uk/egee/jra1-uk/glite-r1/schema/index.html>



Computing Element

Glue Schema - Computing Element
 Namespace: Glue
 vers. 1.1 - 08/04/2003

| Info |
|--------------------------|
| -LRMSType : string |
| -LRMSVersion : string |
| -GRAMVersion : string |
| -HostName : string |
| -GatekeeperPort : string |
| -TotalCPUs : int |

| State |
|------------------------------|
| -Status : string |
| -TotalJobs : int |
| -RunningJobs : int |
| -WaitingJobs : int |
| -WorstResponseTime : int |
| -EstimatedResponseTime : int |
| -FreeCPUs : int |

| Policy |
|-------------------------|
| -MaxWallClockTime : int |
| -MaxCPUTime : int |
| -MaxTotalJobs : int |
| -MaxRunningJobs : int |
| -Priority : int |

| Job |
|-----------------------------|
| -GlobalID : string |
| -LocalID : string |
| -LocalOwner : string |
| -GlobalOwner : string |
| -Status : string |
| -SchedulerSpecific : string |

| AccessControlBase |
|-----------------------|
| -Rule : string [0..*] |

| ComputingElement |
|---------------------------------|
| -Name : string |
| -UniqueID : string [key] |
| -InformationServiceURL : string |

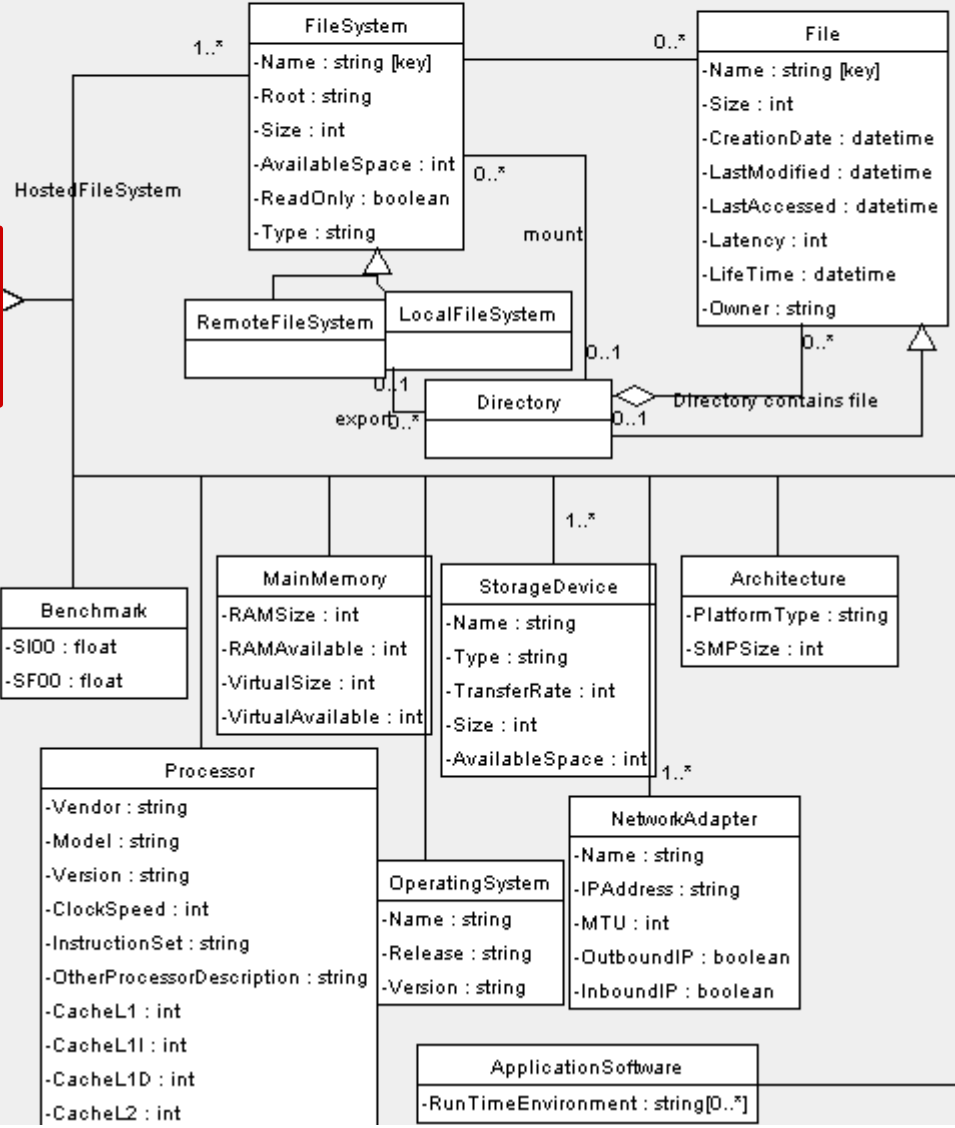
| Cluster |
|---------------------------------|
| -Name : string |
| -UniqueID : string [key] |
| -InformationServiceURL : string |

| SubCluster |
|---------------------------------|
| -Name : string |
| -UniqueID : string [key] |
| -InformationServiceURL : string |

| Host |
|------|
|------|

| SMPLoad |
|------------------|
| -Last1Min : int |
| -Last5Min : int |
| -Last15Min : int |

| ProcessorLoad |
|------------------|
| -Last1Min : int |
| -Last5Min : int |
| -Last15Min : int |



MDS: Monitoring and Discovery Service

- ▶ Adopted from Globus
- ▶ It is the general architecture of EGEE/LCG to manage Grid information

General steps:

- 1st. At each site **providers** report static and dynamic service status to **servers**
- 2nd. A **central system** queries these servers and stores the retrieved information in a database
- 3rd. This information will be accessed through a given **access protocol**
- 4th. The central system provides the information in a **given schema**

BDII (a MDS evolution) is the current EGEE/LCG Information System and it is based on LDAP

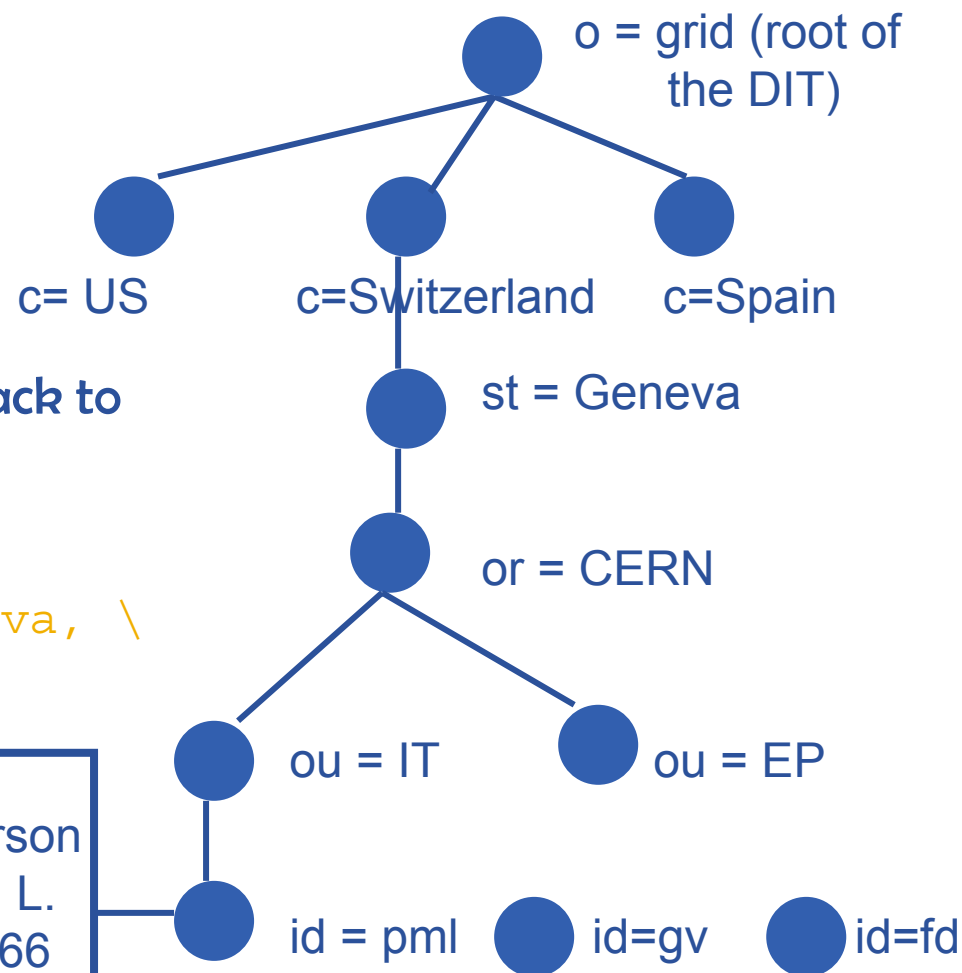
▶ LDAP structures data as a tree

▶ The values of each entry are uniquely named

▶ Following a path from the node back to the root of the DIT, a unique name is built (the DN):

`"id=pml,ou=IT,or=CERN,st=Geneva, \ c=Switzerland,o=grid"`

objectClass:person
 cn: Patricia M. L.
 phone: 5555666
 office: 28-r019



♠ lcg-infosites

- Already deployed in LCG-2 in the last release
- It is intended to be the most complete information retriever for the user:
 - ✓ Once he arrives at the Grid (on UIs)
 - ✓ To be used by the user applications (on WNs)
- Several versions of this script have been included in the software packages of ATLAS and the monitoring services of Alice (MonAlisa)
- You do not need a proxy



*This will be tested during
the hands-on session*

> `lcg-infosites --vo <your_vo> feature --is <your_bdii>`

- It's mandatory to include the **vo** and the **feature**
- The **-is** option means the BDII you want to query. If not supplied, the BDII defined into the **LCG_GFAL_INFOSYS** will be interrogated

Features and descriptions:

| | |
|------------------|--|
| closeSE | Names of the CEs where the user's VO is allowed to run together with their corresponding closest SEs |
| ce | Number of CPUs, running and waiting jobs and names of the CEs |
| se | SEs names together with the available and used space |
| lrc (rmc) | Name of the lrc (rmc) for the user's VO |
| all | It groups all the features just described |
| help | Description of the script |

> `lcg-infosites --vo alice se --is lxb2006.cern.ch`

```

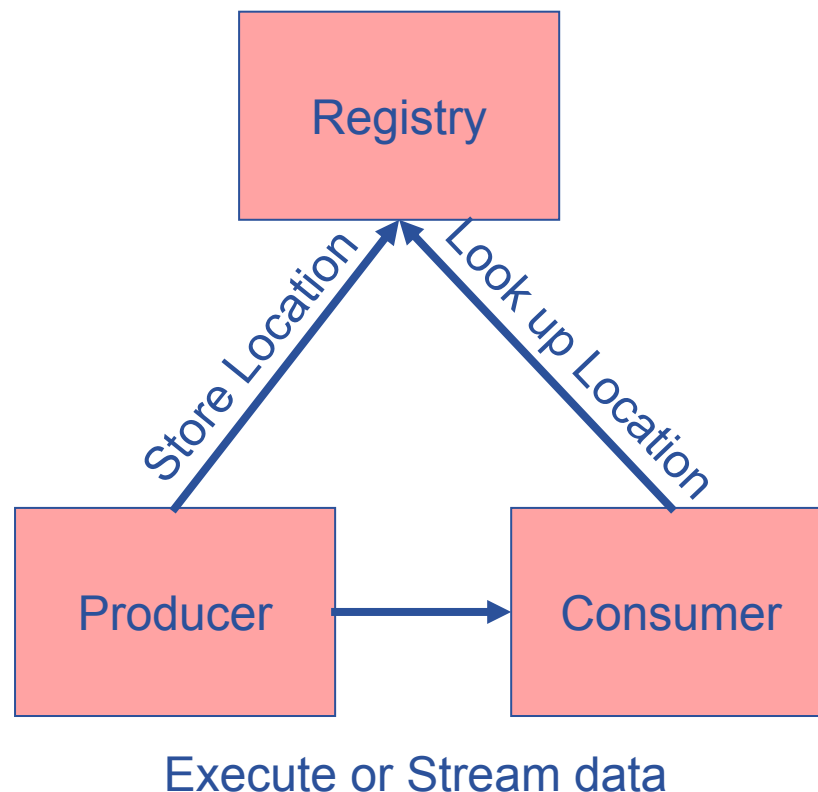
*****
These are the data for alice: (in terms of SE)
*****
Avail Space (Kb)          Used Space (Kb)          SEs
-----
33948480                  2024792                  se.prd.hp.com
506234244                 62466684                 teras.sara.nl
1576747008                3439903232               gridkap02.fzk.de
1000000000000             500000000000            castorgrid.cern.ch
304813432                 133280412                gw38.hep.ph.ic.ac.uk
651617160                 205343480                mu2.matrix.sara.nl
1000000000000             1000000000               lcgads01.gridpp.rl.ac.uk
415789676                 242584960                cclcgseli01.in2p3.fr
264925500                 271929024                se-a.ccc.ucl.ac.uk
668247380                 5573396                  seitep.itep.ru
766258312                 681359036                t2-se-02.lnl.infn.it
660325800                 1162928716               tbn17.nikhef.nl
1000000000000             1000000000000           castorftp.cnaf.infn.it
14031532                  58352476                 lcgse01.gridpp.rl.ac.uk
1113085032                1034242456               zeus03.cyf-kr.edu.pl
[... ..]

```

R-GMA (the future)

- **Relational Grid Monitoring Architecture (R-GMA)**
 - Developed as part of the EuropeanDataGrid Project (EDG)
 - Now as part of the EGEE project.
 - Based the Grid Monitoring Architecture (GMA) from the Global Grid Forum (GGF).
- **Uses a relational data model.**
 - Data is viewed as a table.
 - Data structure defined by the columns.
 - Each entry is a row (tuple).
 - Queried using Structured Query Language (SQL).

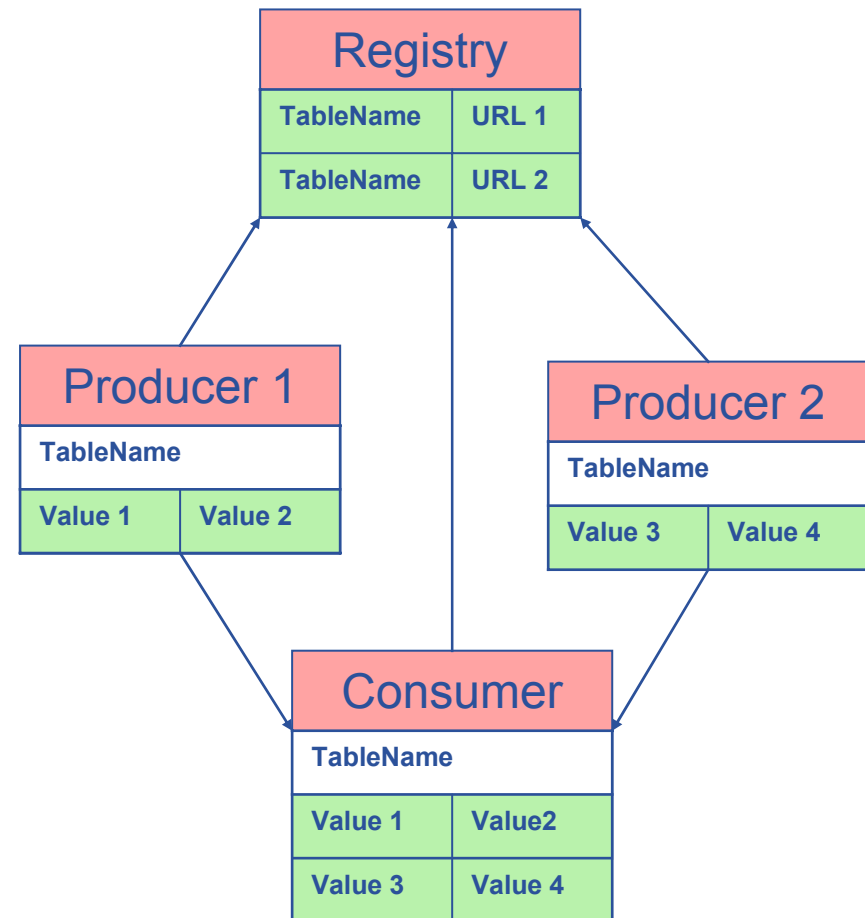
- The Producer stores its location (URL) in the Registry.
- The Consumer looks up producer URLs in the Registry.
- The Consumer contacts the Producer to get all the data.
- Or the Consumer can listen to the Producer for new data.



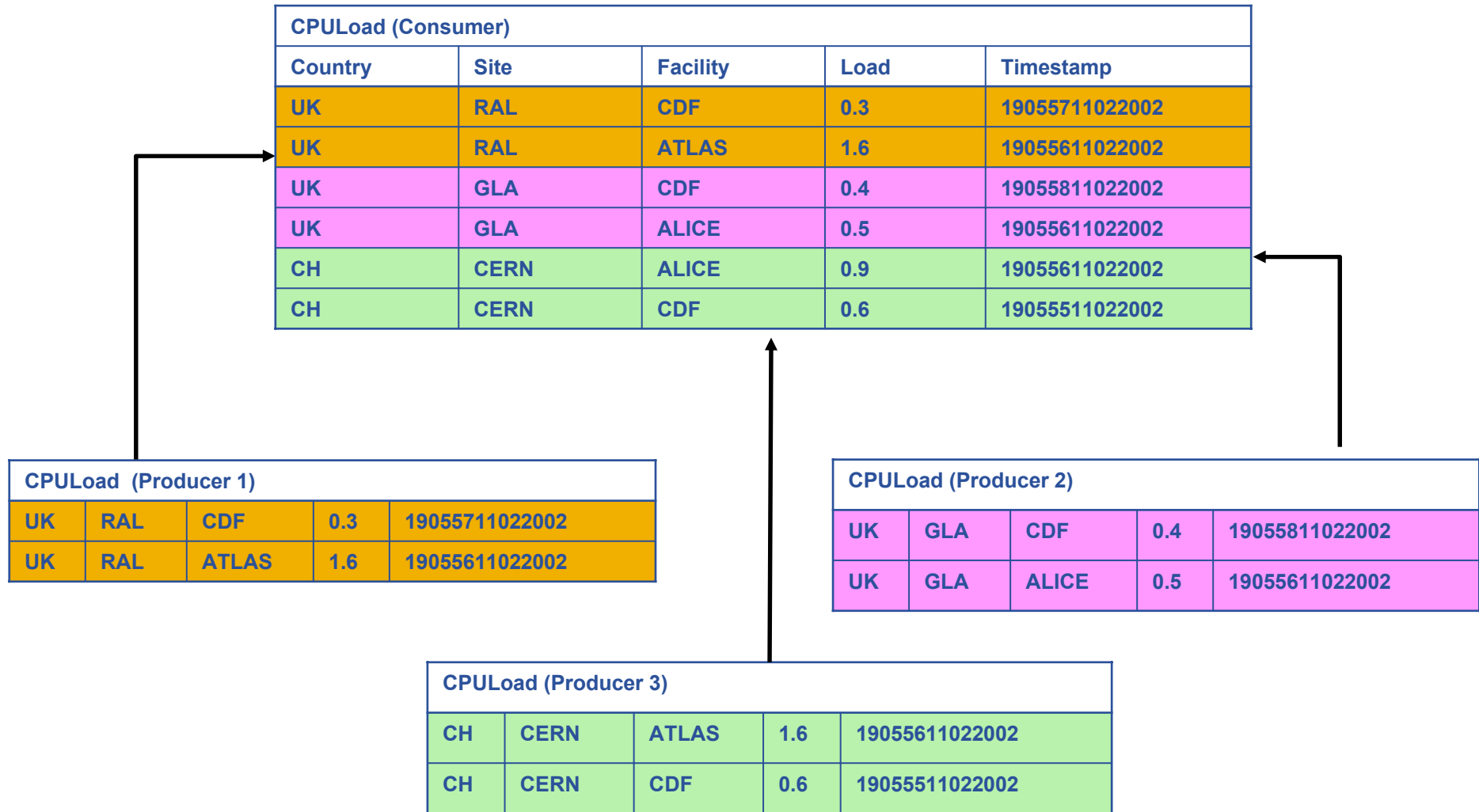
| name | ID | birth | Group |
|------|----|------------|-------|
| Tom | 4 | 1977-08-20 | HR |

`SELECT * FROM people WHERE group='HR'`

- The Consumer will get all the URLs that could satisfy the query.
- The Consumer will connect to all the Producers.
- Producers that can satisfy the query will send the tuples to the Consumer.
- The Consumer will merge these tuples to form one result set.

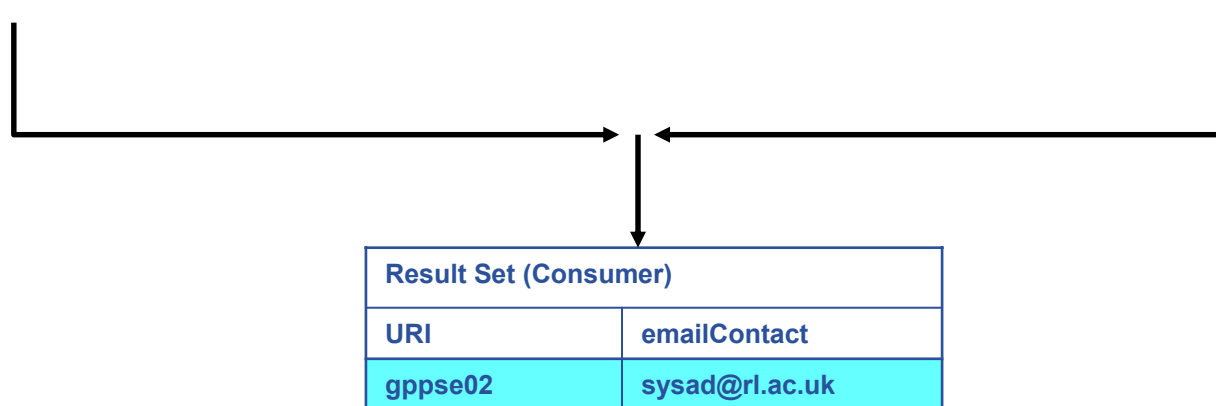


Select * from CPUload



| Service | | | | |
|-------------|-------|------|----------------|------|
| URI | VO | type | emailContact | site |
| gppse01 | alice | SE | sysad@rl.ac.uk | RAL |
| gppse01 | atlas | SE | sysad@rl.ac.uk | RAL |
| gppse02 | cms | SE | sysad@rl.ac.uk | RAL |
| lxshare0404 | alice | SE | sysad@cern.ch | CERN |
| lxshare0404 | atlas | SE | sysad@cern.ch | CERN |

| ServiceStatus | | | | |
|---------------|-------|------|----|---------------|
| URI | VO | type | up | status |
| gppse01 | alice | SE | y | SE is running |
| gppse01 | atlas | SE | y | SE is running |
| gppse02 | cms | SE | n | SE ERROR 101 |
| lxshare0404 | alice | SE | y | SE is running |
| lxshare0404 | atlas | SE | y | SE is running |



SELECT Service.URI Service.emailContact FROM Service S, ServiceStatus SS
WHERE (S.URI= SS.URI and SS.up='n')

- **The easiest way to try out R-GMA.**
 - It is installed on the machine running the Registry and Schema:
<https://rgmasrv.ct.infn.it:8443/R-GMA>
 - You can also install it along with the Producer and Consumer Servlets.
- **Using the Browser you can do the following.**
 - Browse the tables in the schema.
 - Look at the table definitions.
 - See all the available producers for a table.
 - Query a table.
 - Query only selected producers.

R-GMA Browser Home Page - Mozilla

File Edit View Go Bookmarks Tools Window Help

https://rgmasrv.ct.infn.it:8443/R-GMA/ Go Search


Home Bookmarks Webmail Missioni Offerte Ordini FastWeb Mozilla.org

R-GMA Browser

Home

Predefined:

- [Services](#)
- [Site](#)
- [Table Sets](#)



Enabling Grids For E-science

[All tables](#)

- [GLUE Info Providers](#)
- [Network Monitoring](#)
- [Service Discovery](#)
- [CMS](#)
- [GlueSA](#)
- [GlueSAAccessControlBaseRule](#)
- [GlueSE](#)
- [GlueSEAccessProtocol](#)
- [GlueSEAccessProtocolSupportedSec](#)
- [GlueSL](#)
- [GlueService](#)
- [GlueServiceAccessControlRule](#)
- [GlueSubCluster](#)
- [GlueSubClusterSoftwareRunTimeEnv](#)
- [GlueVO](#)
- [JobMonitor](#)
- [NetworkFileTransferThroughput](#)
- [NetworkICMPPacketLoss](#)
- [NetworkOneWayIPDV](#)
- [NetworkRTT](#)
- [NetworkTCPThroughput](#)
- [NetworkUDPPacketLoss](#)
- [NetworkUDPThroughput](#)
- [Service](#)
- [ServiceAssociation](#)
- [ServiceData](#)
- [ServiceStatus](#)
- [Site](#)
- [UserTable](#)

Query: `SELECT Name, Endpoint, Type, MajorVersion, MinorVersion, PatchVersion, Site_Name, WSDL, Semantics, MeasurementDate, MeasurementTime FROM Service`

| Name | Endpoint |
|--|--|
| https://rgmasrv.ct.infn.it:8443/R-GMA/ArchiverServlet | https://rgmasrv.ct.infn.it:8443/R-GM |
| https://rgmasrv.ct.infn.it:8443/R-GMA/ConsumerServlet | https://rgmasrv.ct.infn.it:8443/R-GM |
| https://rgmasrv.ct.infn.it:8443/R-GMA/DBProducerServlet | https://rgmasrv.ct.infn.it:8443/R-GM |
| https://rgmasrv.ct.infn.it:8443/R-GMA/BrowserServlet | https://rgmasrv.ct.infn.it:8443/R-GM |
| https://rgmasrv.ct.infn.it:8443/R-GMA/SchemaServlet | https://rgmasrv.ct.infn.it:8443/R-GM |
| https://rgmasrv.ct.infn.it:8443/R-GMA/LatestProducerServlet | https://rgmasrv.ct.infn.it:8443/R-GM |
| https://rgmasrv.ct.infn.it:8443/R-GMA/CanonicalProducerServlet | https://rgmasrv.ct.infn.it:8443/R-GM |
| https://rgmasrv.ct.infn.it:8443/R-GMA/StreamProducerServlet | https://rgmasrv.ct.infn.it:8443/R-GM |
| https://rgmasrv.ct.infn.it:8443/R-GMA/RegistryServlet | https://rgmasrv.ct.infn.it:8443/R-GM |
| glite-rb.ct.infn.it_Logging_Bookkeeping_Server | http://glite-rb.ct.infn.it/LB/LBServer |

Number of rows: 10

- **APIs exist in Java, C, C++, Python.**
 - For clients (servlets contacted behind the scenes)
- **They include methods for...**
 - Creating consumers
 - Creating primary and secondary producers
 - Setting type of queries, type of produces, retention periods, time outs...
 - Retrieving tuples, inserting data
 - ...
- **You can create your own Producer or Consumer.**

- **R-GMA overview page.**
 - <http://www.r-gma.org/>
- **R-GMA in EGEE**
 - <http://hepunx.rl.ac.uk/egee/jra1-uk/>
- **R-GMA Documentation**
 - <http://hepunx.rl.ac.uk/egee/jra1-uk/LCG/doc/>

A generic Grid accounting process involves many subsequent phases that can be divided in:

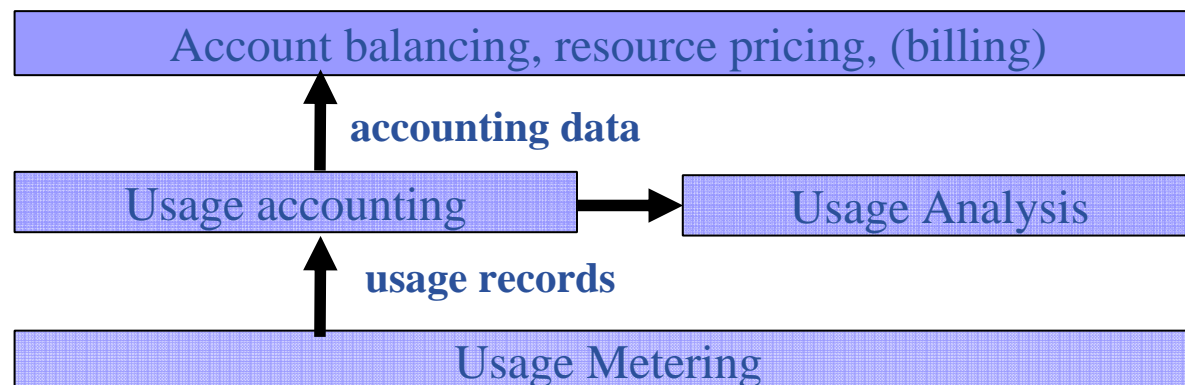
- **Metering:** collection of usage metrics on computational resources.
- **Accounting:** storage of such metrics for further analysis.
- **Usage Analysis:** Production of reports from the available records.
- **Pricing:** Assign and manage prices for computational resources.
- **Billing:** Assign a cost to user operations on the Grid and charge them.

In this presentation we briefly describe these steps and give a quick overview of DGAS, the accounting middleware of the EGEE project.

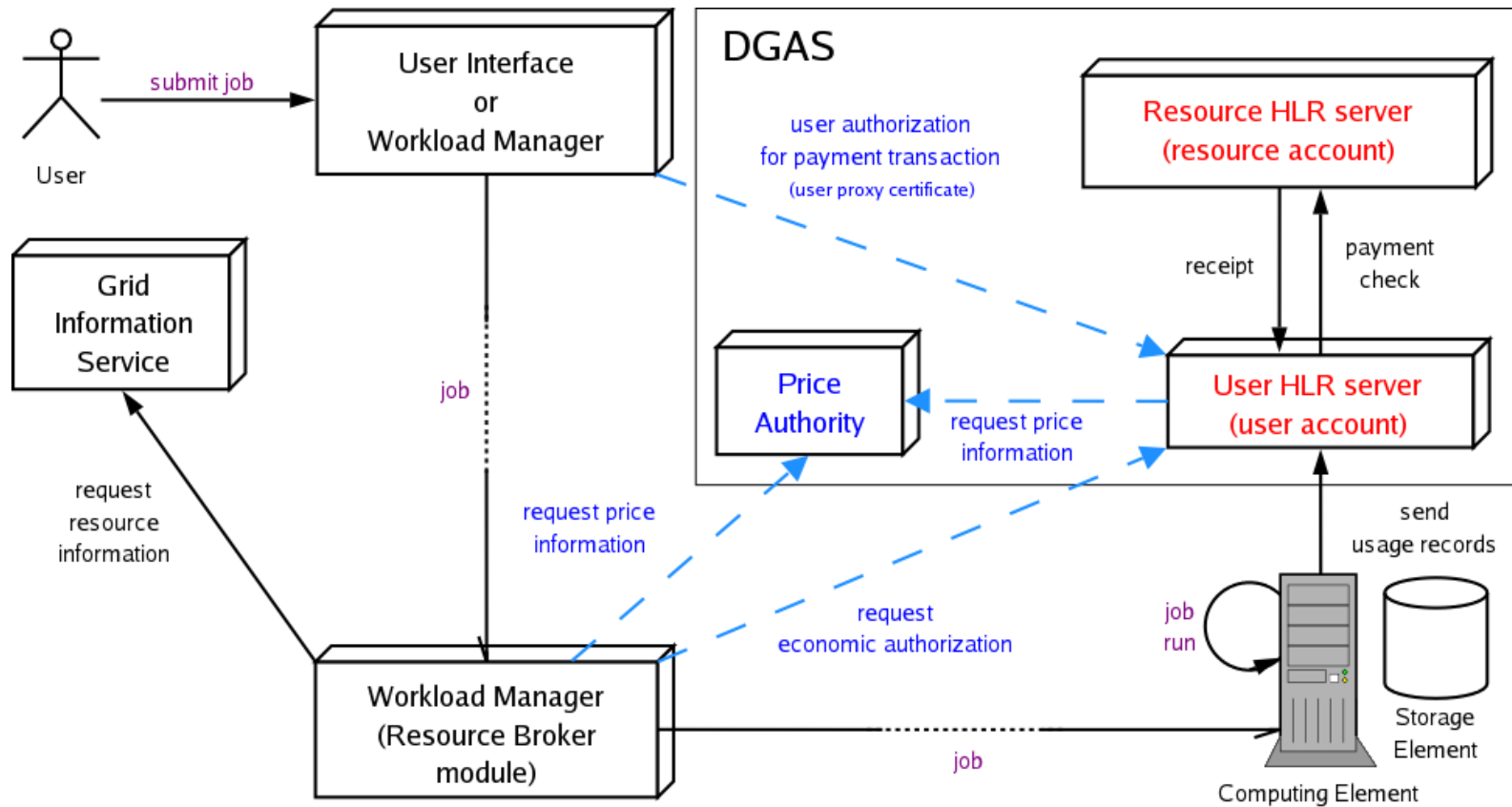
The *Data Grid Accounting System* was originally developed within the EU Datagrid Project and is now being maintained and re-engineered within the EU EGEE Project.

The Purpose of *DGAS* is to implement *Resource Usage Metering, Accounting and Account Balancing* (through *resource pricing*) in a fully distributed Grid environment. It is conceived to be distributed, secure and extensible.

The system is designed in order for Usage Metering, Accounting and Account Balancing (through resource pricing) to be independent layers.



A simplified view of DGAS within the WMS context.



Usage Metering on Computing Elements is done by lightweight sensors installed on the Computing Elements. These sensors parse PBS/LSF/Torque event logs to build Usage Records that can be passed to the accounting layer.

For a reliable accounting of resource usage (essential for billing) it is important that the collected data is *unequivocally* associated to the unique grid ID of the user (certificate subject/DN), the resource (CE ID) as well as the job (global job ID).

A process, completely transparent to the Grid User collects the necessary information needed by the Accounting. These, and the corresponding metrics are sent via an *encrypted* channel to the Accounting System *signed with the user credentials*.

The usage of *Grid Resources* by *Grid Users* is registered in appropriate servers, called Home Location Registers (HLRs) where both users and resources are registered.

In order to achieve scalability, accounting records can be stored on an arbitrary number of independent HLRs. At least one HLR per VO is foreseen, although a finer granularity is possible.

Each HLR keeps the records of all grid jobs submitted or executed by each of its registered users or resources, thus being able to furnish usage information with many granularity levels:

Per user or resource,
per group of users or resources,
per VO.

Accounting requires usage metering, but not necessarily resource pricing and billing.

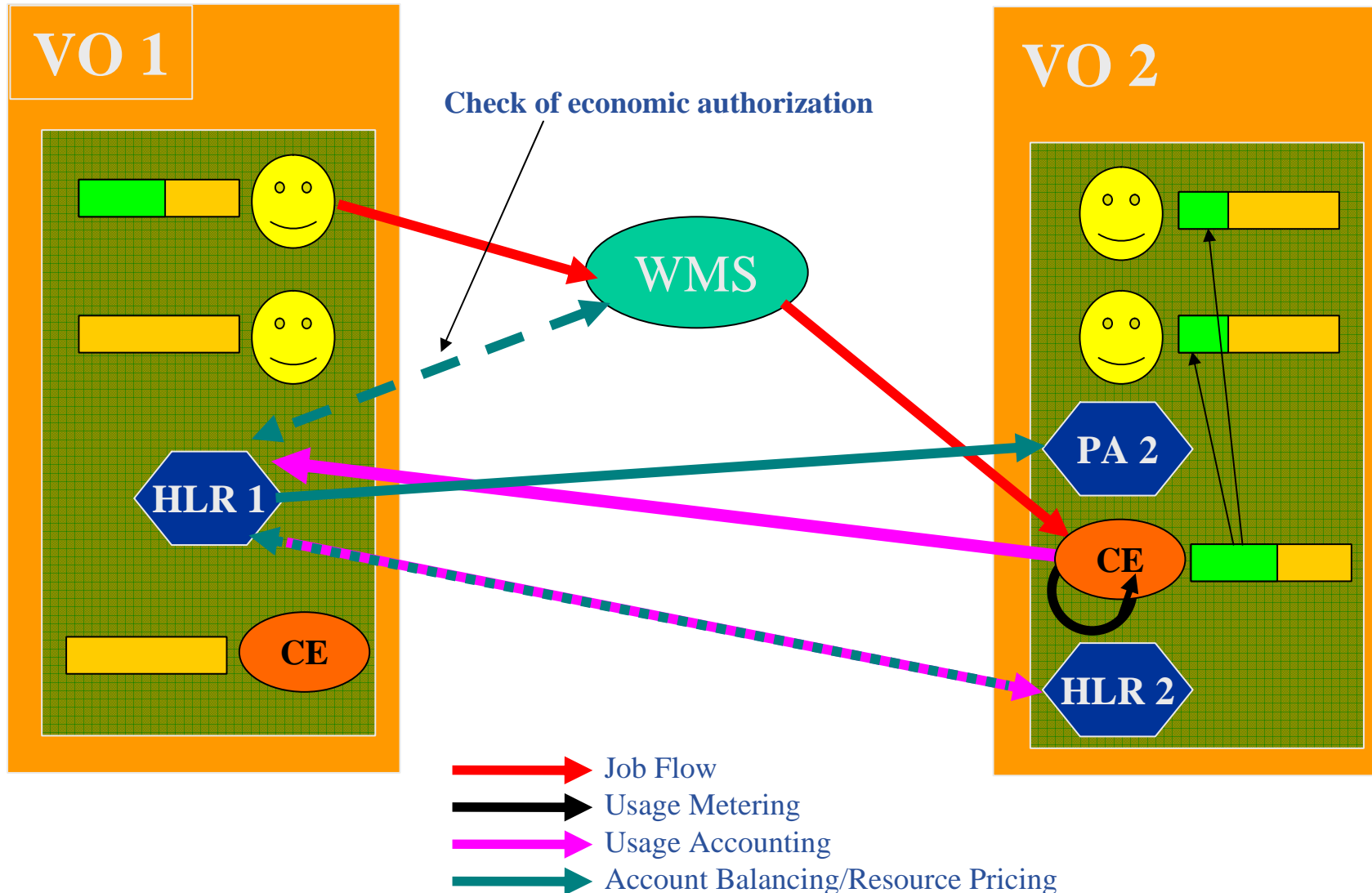
Resource pricing is done by dedicated Price Authorities (PAs) that may use different pricing algorithms: manual setting of fixed prices, dynamical determination of prices according to the state of a resource.

In order to achieve scalability, prices can be established by an arbitrary number of independent PAs. At least one PA per VO is foreseen (VOs will want to retain control on the pricing of their resources).

Price algorithms are dynamically linked by the PA server and can be re-implemented according to the resource owners' needs.

The job cost is determined (by the HLR service) from *resource prices* and *usage records*.

Account balancing is done by exchanging virtual credits between the *User HLR* and the *Resource HLR*.

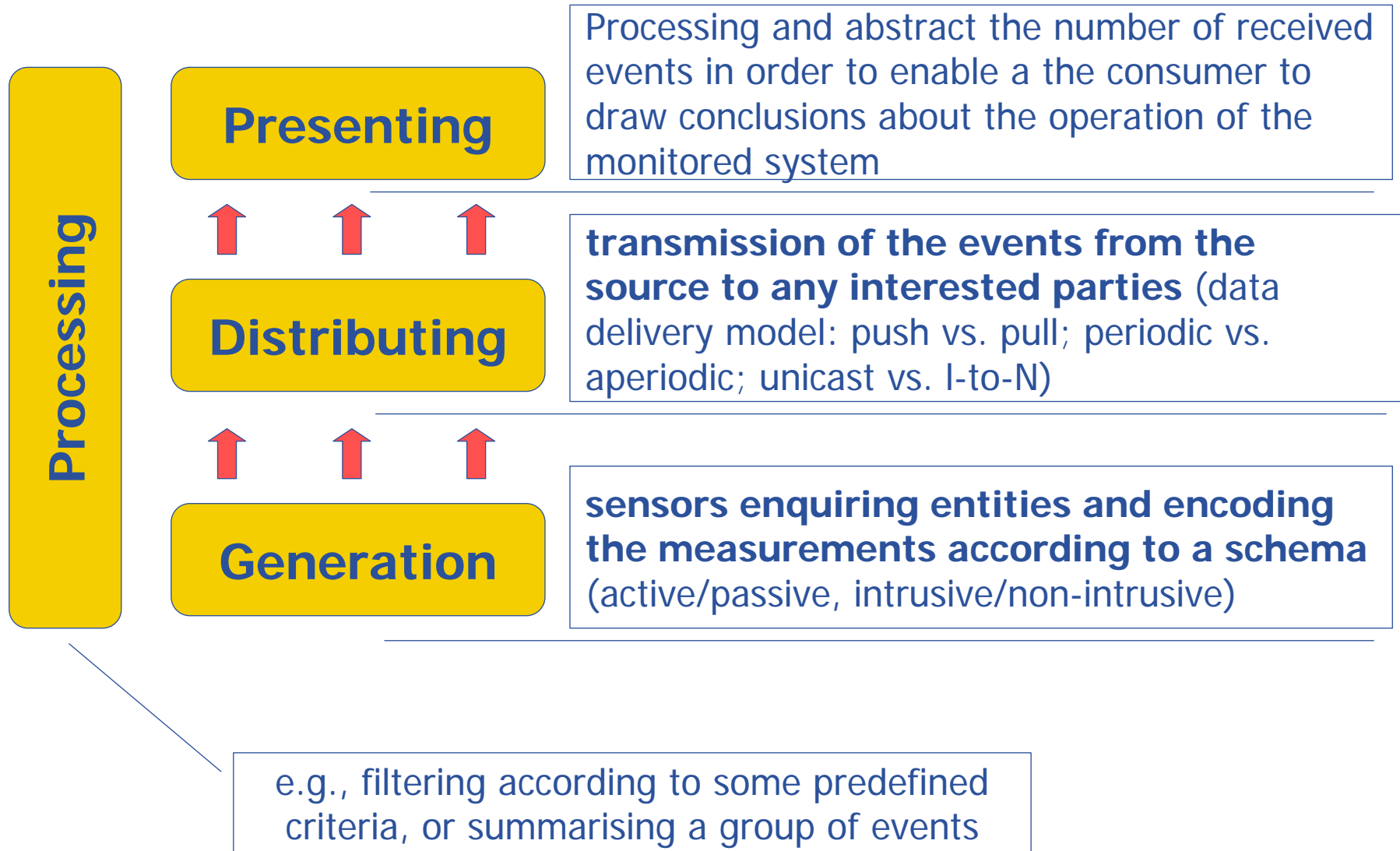


- ***Further information and documentation about DGAS can be found at:***
<http://www.to.infn.it/grid/accounting>

- **Grid Monitoring**
 - the activity of **measuring** significant **grid resources related parameters**
 - in order to
 - **analyze usage, behavior and performance of the grid**
 - **detect and notify**
 - *fault situations*
 - *contract violations (SLA)*
 - *user-defined events*

- **Measurement:** the process by which numbers or symbols are assigned to feature of an entity in order to describe them according to clearly defined rules
- **Event:** collection of timestamped data associated with the attribute of an entity [2]
- **Event schema** (or simply schema): defines the typed structure and semantics of all events so that, given an event type, one can find the structure and interpret the semantics of the corresponding event [2]

The four main phases of monitoring



- Virtual Organization:
 1. visualize at various aggregation levels the actual set of resources accessible to its members;
 2. Assess how Grid mapping functionalities from virtual to physical resources and users meet the members' demands
 3. analyze data retrospectively to understand how to improve the effectiveness of VO applications running in a Grid, as the target machine for different executions of the same application can vary over time

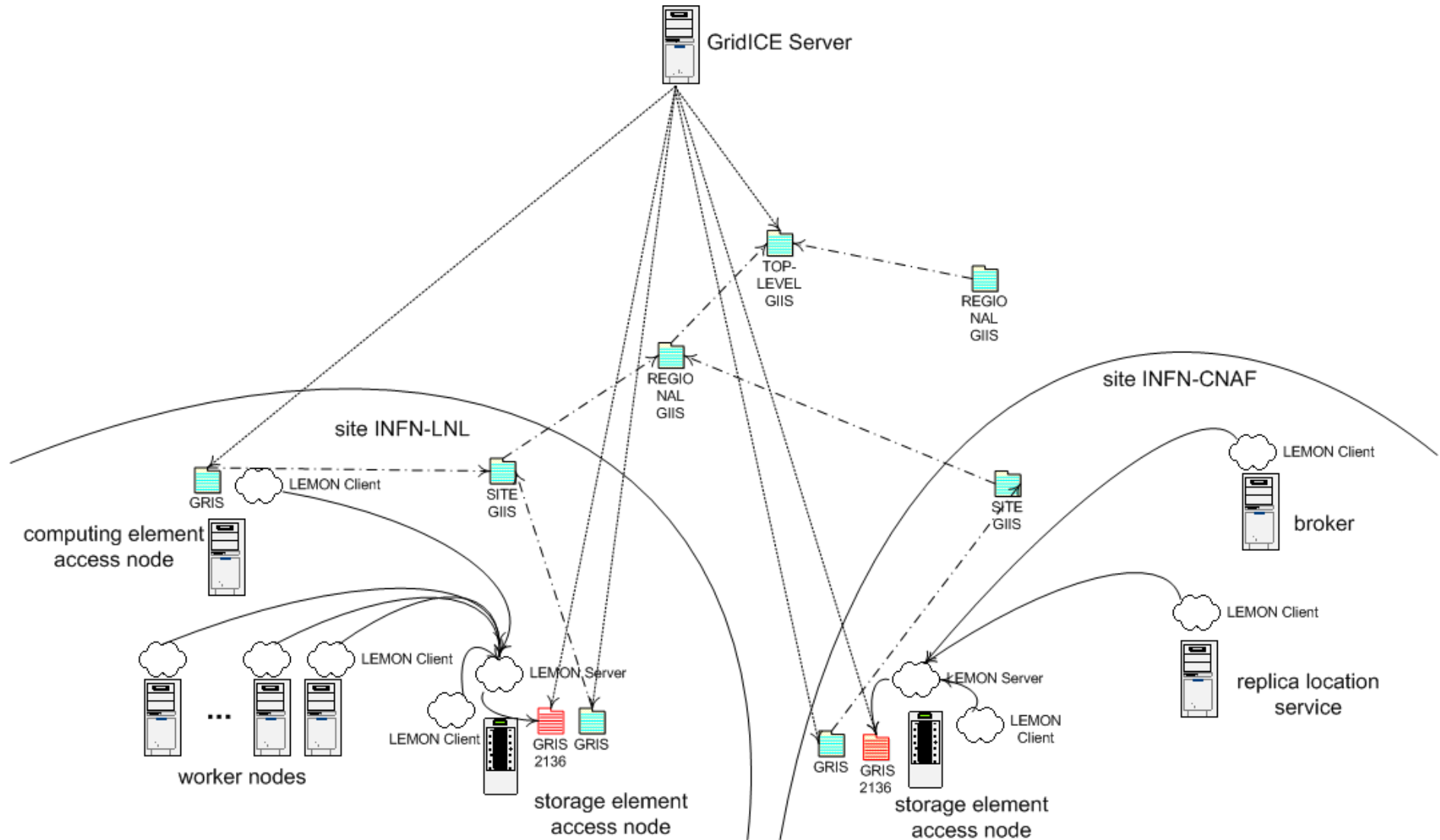
- Site Administrator:
 - Visualize the managed Grid services in order to see how they are being used/performing (possibly divided by VO)
- User:
 - Is my job “working” (e.g., consuming CPU?)
- Grid Operation Center:
 - Status of Grid services (e.g., WMS, Service Discovery, CE, SE)
 - Free/busy resources per site/per VO at a given time
 - Timely notification about fault situations

GridICE: architectural insight

- *generation* of events:
 - Sensors: typically perl scripts or C programs
 - Schema:
 - GLUE Schema v.1.2 + GridICE extension
 - *System related (e.g., CPU load, CPU Type, Memory size)*
 - *Grid service related (e.g., CE ID, queued jobs)*
 - *Network related (e.g., Packet loss)*
 - *Job usage (e.g., CPU Time, Wall Time)*
 - All sensors are executed in a periodic fashion

- *distribution* of events:
 - Hierarchical model
 - **Intra-site**: by means of the local monitoring service
 - *default choice, LEMON (<http://www.cern.ch/lemon>)*
 - **Inter-site**: by offering data through the Grid Information Service
 - **Final Consumer**: depending on the client application
 - Mixed data delivery model
 - **Intra-site**: depending on the local monitoring service (push for lemon)
 - **Inter-site**: depending on the GIS (current choice, MDS 2.x, pull)
 - **Final consumer**: pull (browser/application), push (publish/subscribe notification service)

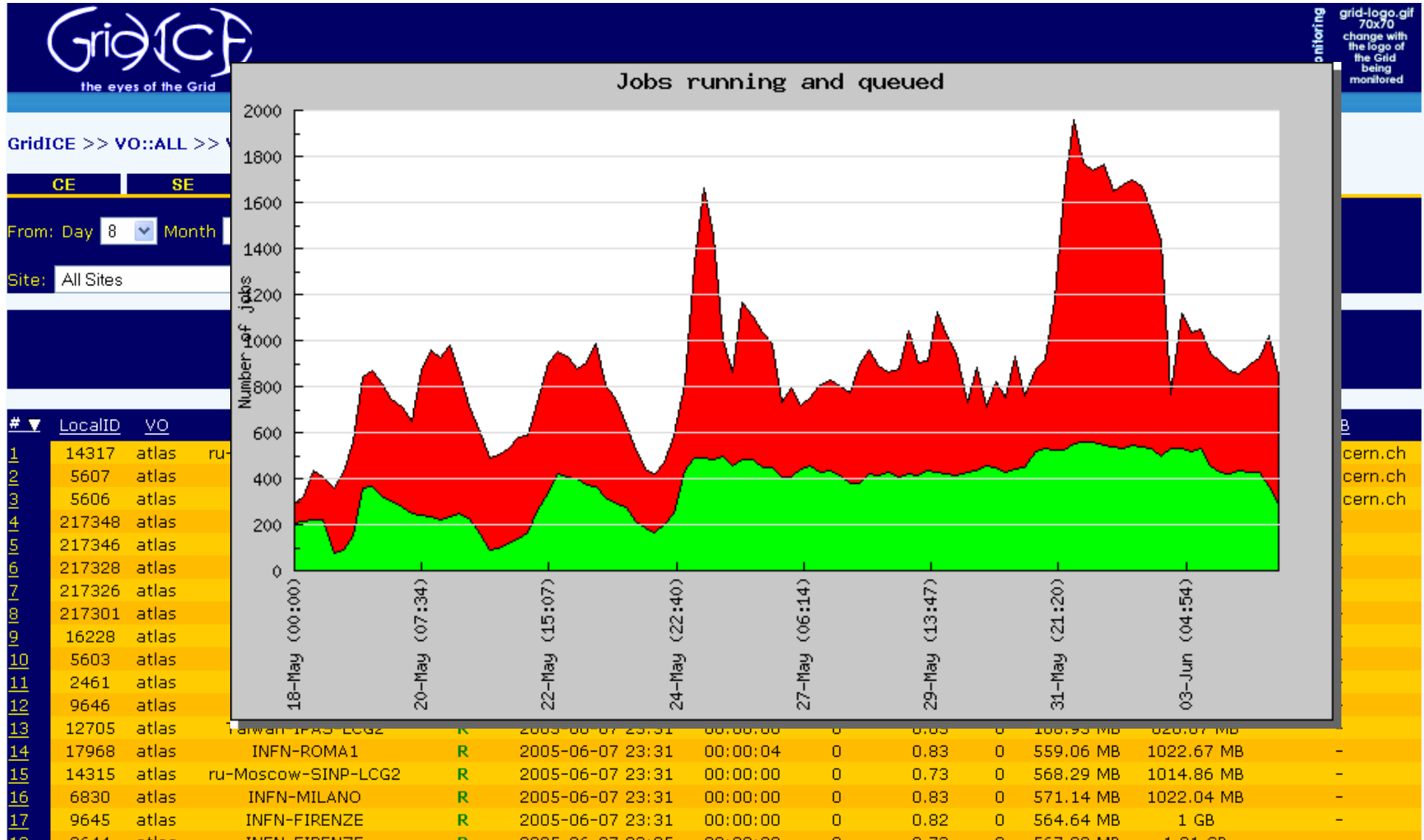
Example deployment in LCG2



| Site | Domain | Computing Resources | | | | | | Storage Resources | | | | | |
|------------------------|--------------------|---------------------|----|--------|---------|----------|-------|-------------------|------|---------|-----------|----------|-----|
| | | GK# | Q# | RunJob | WaitJob | SlotLoad | Power | WN# | CPU# | CPUload | Available | Total | % |
| INFN-PISA2 | pi.infn.it | 1 | 7 | 4 | 0 | 100% | 13K | 2 | 4 | 100% | 3.5 TB | 3.5 TB | 0% |
| INFN-ROMA1 | roma1.infn.it | 1 | 2 | 2 | 7 | 5% | 235K | 21 | 42 | 2% | 31.1 GB | 33.9 GB | 8% |
| INFN-Roma1-CMS | roma1.infn.it | 1 | 2 | 0 | 0 | 0% | 48K | 5 | 11 | 0% | 63.2 GB | 65.9 GB | 4% |
| INFN-ROMA1-VIRGO | roma1.infn.it | 1 | 2 | 6 | 0 | 86% | 45K | 7 | 14 | 29% | 28.4 GB | 31.2 GB | 9% |
| INFN-ROMA2 | roma2.infn.it | 1 | 6 | 1 | 0 | 10% | 86K | 5 | 18 | 5% | 1.1 TB | 1.1 TB | 3% |
| INFN-ROMA3 | roma3.infn.it | 1 | 3 | 0 | 0 | 0% | 38K | 4 | 8 | 0% | 956.7 GB | 956.7 GB | 0% |
| INFN-TORINO | to.infn.it | 1 | 8 | 56 | 29 | 100% | 297K | 28 | 56 | 93% | 420.6 GB | 1.9 TB | 79% |
| NA-ICAR-CNR | dma.unina.it | 1 | 6 | 3 | 16 | 100% | 8K | 3 | 3 | 100% | - | - | - |
| SNS | sns.it | 1 | 7 | 1 | 0 | 8% | 24K | 3 | 6 | 0% | 64.6 GB | 67.7 GB | 5% |
| SPACI-LECCE | egee.unile.it | 1 | 6 | 0 | 7 | 0% | 6K | 1 | 1 | 0% | - | - | - |
| TOKYO-LCG2 | icepp.jp | 1 | 2 | 0 | 0 | 0% | - | - | - | - | 896.8 GB | 1.8 TB | 51% |
| LCG_KNU | knu.ac.kr | 1 | 5 | 5 | 484 | 100% | - | - | - | - | 59 GB | 61.6 GB | 4% |
| NIKHEF-ELPROD | nikhef.nl | 1 | 6 | 205 | 53 | 94% | - | - | - | - | 895.2 GB | 1.7 TB | 8% |
| saralcg2 | matrix.sara.nl | 1 | 16 | 42 | 11 | 92% | - | - | - | - | 90.6 GB | 104.4 GB | 13% |
| NCP-LCG2 | ncp.edu.pk | 1 | 6 | 0 | 0 | 0% | - | - | - | - | 42.3 GB | 44.1 GB | 4% |
| PAKGRID-LCG2 | pakgrid.org.pk | 1 | 6 | 0 | 0 | 0% | - | - | - | - | 59.5 GB | 60.3 GB | 1% |
| CYFRONET-LCG2 | cyf-kr.edu.pl | 1 | 9 | 55 | 179 | 92% | - | - | - | - | 865 GB | 2 TB | 58% |
| egee.man.poznan.pl | egee.man.poznan.pl | 1 | 5 | 0 | 0 | 0% | - | - | - | - | 255.4 GB | 255.6 GB | 0% |
| WARSAW-LCG2 | fuw.edu.pl | 1 | 3 | 0 | 0 | 7% | - | - | - | - | 348.1 GB | 348.1 GB | 0% |
| LIP-LCG2 | lip.pt | 1 | 4 | 12 | 10 | 3% | 113K | 7 | 23 | 14% | 346 GB | 696.9 GB | 51% |
| ROGRID-ICI | grid.ici.ro | 1 | 6 | 7 | 7 | 78% | 76K | 5 | 16 | 54% | 138.2 GB | 141.6 GB | 2% |
| ITEP | itep.ru | 1 | 7 | 2 | 0 | 5% | - | - | - | - | 63.3 GB | 68.6 GB | 8% |
| JINR-LCG2 | jlnr.ru | 1 | 5 | 2 | 0 | 10% | - | - | - | - | 1.7 TB | 1.7 TB | 1% |
| RRC-KI | grid.kiae.ru | 1 | 5 | 1 | 0 | 5% | - | - | - | - | 762.5 GB | 766.3 GB | 0% |
| ru-Moscow-GCRAS-LCG2 | wdcb.ru | 1 | 3 | 0 | 0 | 0% | - | - | - | - | - | - | - |
| RU-Moscow-KIAM-LCG2 | keldysh.ru | 1 | 4 | 1 | 0 | 13% | - | - | - | - | 97.4 GB | 102.5 GB | 5% |
| ru-Moscow-SINP-LCG2 | sinp.msu.ru | 1 | 9 | 33 | 1 | 69% | - | - | - | - | 87.3 GB | 104.9 GB | 17% |
| ru-Novgorod-NOVSU-LCG2 | novsu.ac.ru | 1 | 5 | 0 | 0 | 0% | - | - | - | - | 23.2 GB | 23.4 GB | 0% |
| ru-PNPI-LCG2 | pnpi.nw.ru | 1 | 1 | 58 | 28 | 100% | - | - | - | - | - | - | - |
| ru-PSN-LCG2 | psn.ru | 1 | 2 | 22 | 29 | 100% | - | - | - | - | 167.8 GB | 172.3 GB | 3% |
| HPC2N | hpc2n.umu.se | 1 | 1 | 50 | 75 | 54% | - | - | - | - | 929.1 GB | 934.9 GB | 1% |
| NSC | nsc.liu.se | 1 | 6 | 4 | 1 | 17% | - | - | - | - | 59.4 GB | 66.9 GB | 11% |
| GOG-Singapore | ngpp.ngp.org.sg | 1 | 3 | 0 | 0 | 3% | - | - | - | - | - | - | - |

| Site | Total | All | | Broker | | BDII | | CE | | SE | | GC | | Others | | | | | |
|-------------------|-------|-----|-------------|--------|---|------|---|----|---|----|---|----|---|--------|---|---|----|---|----|
| | | ✘ | ⚠ | ✘ | ⚠ | ✘ | ⚠ | ✘ | ⚠ | ✘ | ⚠ | ✘ | ⚠ | ✘ | ⚠ | | | | |
| CERN-CIC | 3 | - | Disappeared | - | - | - | - | 1 | - | - | 1 | - | - | 1 | - | - | - | - | - |
| CNAF-T1 | 29 | 1 | 11 | - | - | 6 | 1 | 4 | - | - | 1 | - | - | 2 | - | - | 5 | - | - |
| ESA-ESRIN | 9 | 6 | - | - | - | - | - | 1 | - | - | 1 | - | - | 1 | - | - | 6 | 6 | - |
| HPCC-UNILE | 2 | - | - | - | - | - | - | 1 | - | - | - | - | - | - | - | - | 1 | - | - |
| ifae | 83 | 4 | 11 | 1 | - | - | - | 1 | - | - | 5 | 4 | - | - | - | - | 76 | - | 11 |
| INAF-TRIESTE | 1 | - | - | - | - | - | - | - | - | - | 1 | - | - | - | - | - | - | - | - |
| INFN-BARI | 27 | 1 | - | - | - | - | - | 1 | - | - | 1 | - | - | 1 | - | - | 24 | 1 | - |
| infn-bologna | 5 | - | - | - | - | - | - | 1 | - | - | 1 | - | - | 1 | - | - | 2 | - | - |
| INFN-BOLOGNA-CMS | 15 | 2 | 1 | - | - | - | - | 2 | 1 | - | 1 | - | - | - | - | - | 12 | 1 | 1 |
| INFN-CAGLIARI | 10 | - | 2 | - | - | - | - | 2 | - | 1 | 1 | - | - | 1 | - | - | 6 | - | 1 |
| INFN-CATANIA | 4 | - | - | 1 | - | - | - | 1 | - | - | 1 | - | - | 1 | - | - | - | - | - |
| INFN-FERRARA | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| INFN-FIRENZE | 19 | - | - | - | - | - | - | 1 | - | - | 1 | - | - | 1 | - | - | 16 | - | - |
| INFN-FRASCATI | 9 | - | 4 | - | - | - | - | 2 | - | 1 | 2 | - | 2 | 2 | - | 1 | 3 | - | - |
| INFN-LECCE | 3 | - | - | - | - | - | - | 1 | - | - | 1 | - | - | - | - | - | 1 | - | - |
| INFN-LNL-2 | 17 | 1 | - | - | - | - | - | 1 | 1 | - | 1 | - | - | 1 | - | - | 14 | - | - |
| INFN-LNL-LCG | 94 | - | 12 | - | - | - | - | 1 | - | - | 1 | - | - | - | - | - | 92 | - | 12 |
| INFN-MILANO | 33 | - | 7 | - | - | - | - | 1 | - | - | 2 | - | 1 | 2 | - | 1 | 28 | - | 5 |
| INFN-NAPOLI-ATLAS | 21 | - | 1 | - | - | - | - | 2 | - | - | 1 | - | 1 | 1 | - | - | 17 | - | - |
| INFN-PADOVA | 64 | - | 6 | 7 | - | 1 | - | 1 | - | - | 4 | - | - | 1 | - | - | 50 | - | 6 |
| INFN-PERUGIA | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| INFN-PISA | 17 | - | 1 | - | - | - | - | 1 | - | - | 3 | - | - | - | - | - | 13 | - | 1 |
| INFN-PISA2 | 5 | - | 1 | - | - | - | - | 1 | - | - | 1 | - | 1 | 1 | - | - | 2 | - | - |
| INFN-ROMA1 | 24 | - | - | - | - | - | - | 1 | - | - | 1 | - | - | 1 | - | - | 21 | - | - |
| INFN-Roma1-CMS | 7 | - | - | - | - | - | - | 1 | - | - | - | - | - | 1 | - | - | 5 | - | - |
| INFN-ROMA1-VIRGO | 9 | - | - | - | - | - | - | 1 | - | - | - | - | - | 1 | - | - | 7 | - | - |
| INFN-ROMA2 | 9 | - | 2 | - | - | - | - | 1 | - | - | 1 | - | - | 1 | - | 1 | 6 | - | 1 |
| INFN-ROMA3 | 6 | - | - | - | - | - | - | 1 | - | - | - | - | - | 1 | - | - | 4 | - | - |
| INFN-TORINO | 30 | - | - | - | - | - | - | 1 | - | - | - | - | - | 1 | - | - | 28 | - | - |
| INFN-TRIESTE | 3 | - | 3 | - | - | - | - | 1 | - | 1 | 1 | - | 1 | - | - | - | 1 | - | 1 |
| [mi.infn.it] | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| NA-ICAR-CNR | 5 | - | - | - | - | - | - | 1 | - | - | - | - | - | 1 | - | - | 3 | - | - |

Running/waiting jobs for a VO

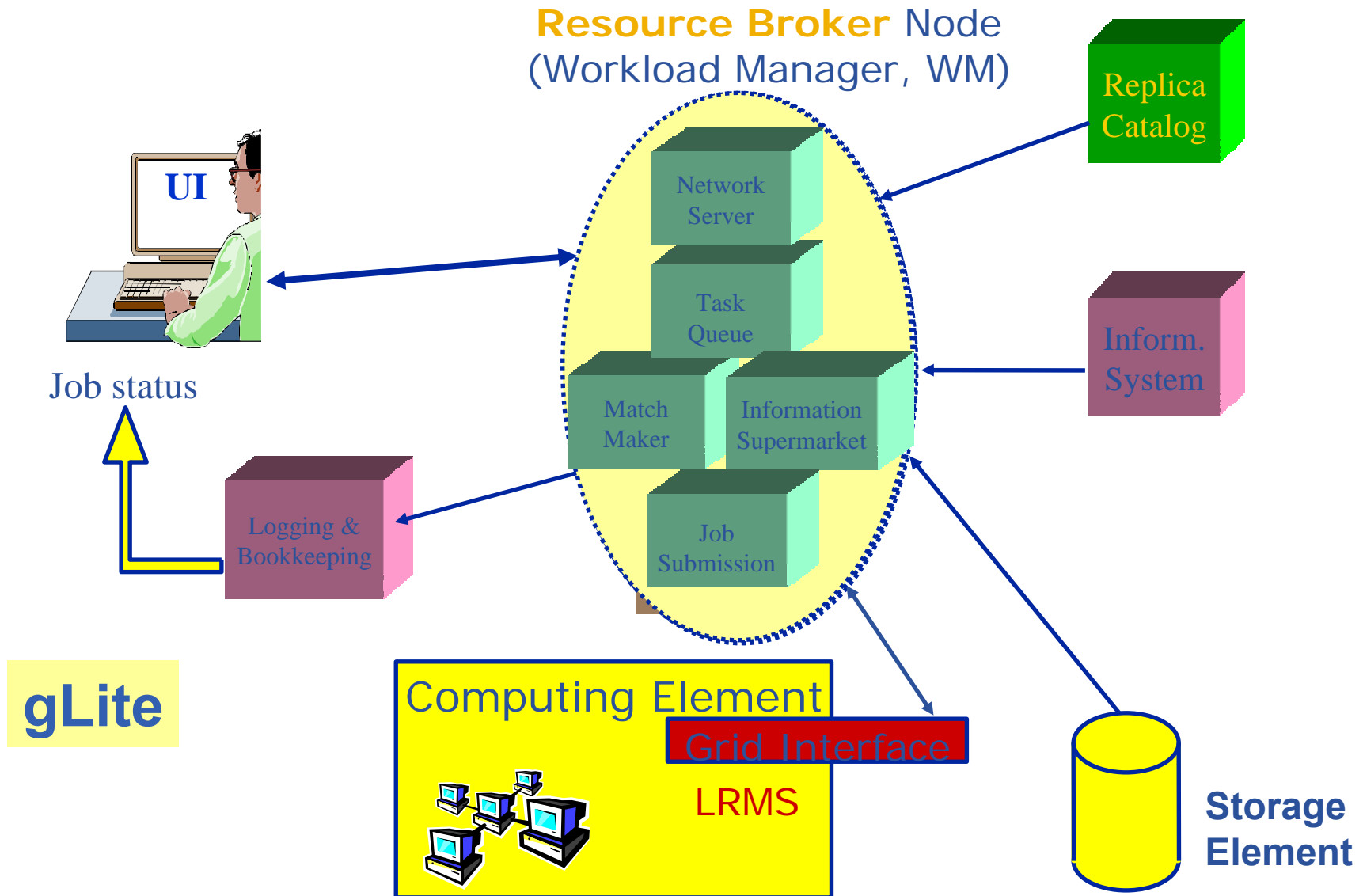


Home page: <http://grid.infn.it/gridice>

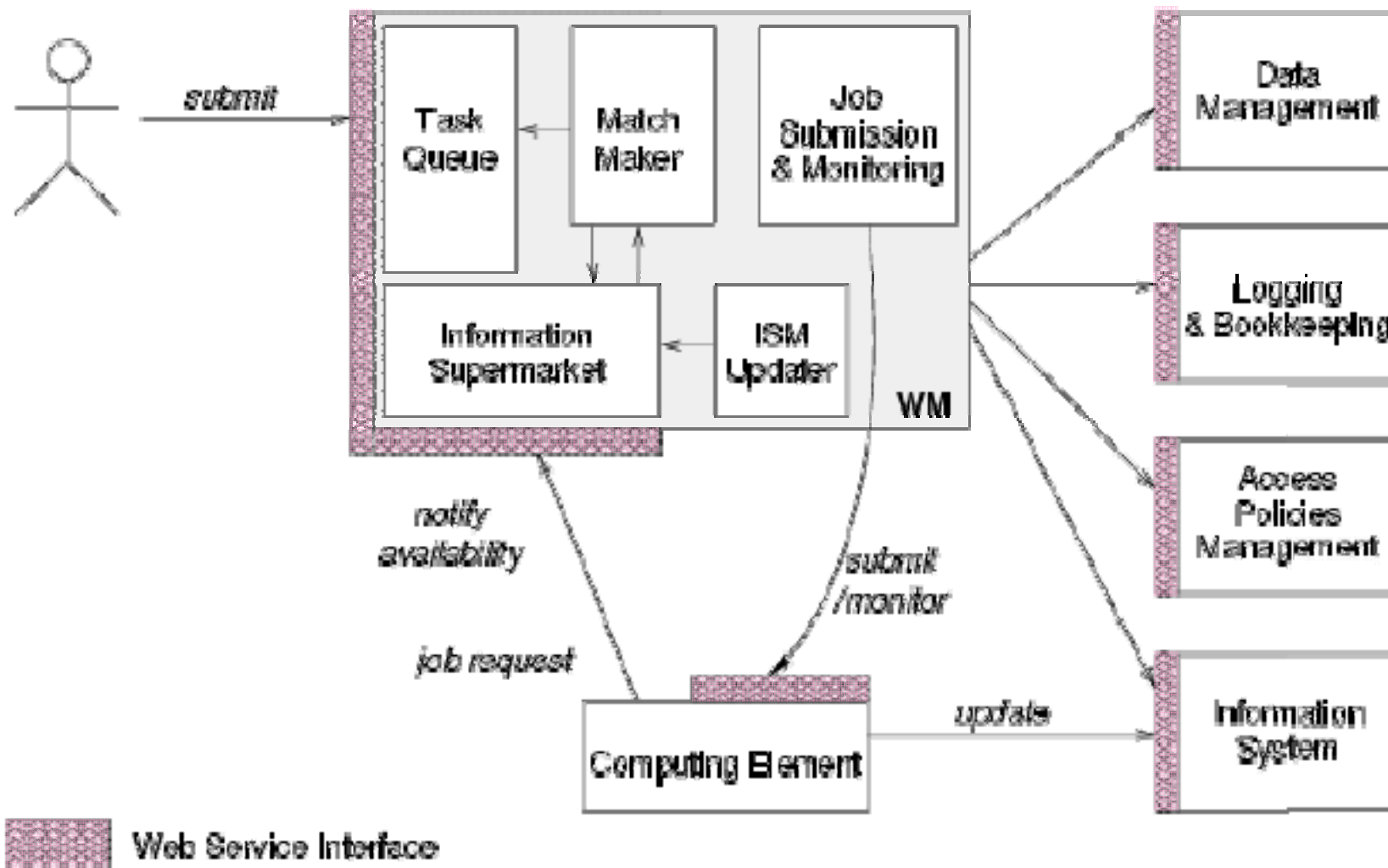
- [1] S. Andreatta, N. De Bortoli, S. Fantinel, A. Ghiselli, G. L. Rubini, G. Tortone, M. C. Vistoli **GridICE: a monitoring service for Grid systems**, Future Generation Computer System 21 (2005) 559–571
- [2] B. Tierney, R. Aydt, D. Gunter, W. Smith, M. Swamy, V. Taylor, R. Wolski, **A Grid Monitoring Architecture**, GFD-I.7
- [3] S. Zaniolas, R. Sakellariou, **A taxonomy of grid monitoring systems**, Future Generation Computer Systems 21 (2005) 163–188
- [4] M. Franklin, S. Zdonik, **“Data In Your Face”: Push Technology in Perspective**, ACM SIGMOD '98, Seattle, WA, USA
- [5] S. Andreatta, A. Ciuffoletti, A. Ghiselli, C. Vistoli. **Monitoring the connectivity of a Grid**. Proceedings of the 2nd International Workshop on Middleware for Grid Computing (MGC 2004) in conjunction with the 5th ACM/IFIP/USENIX International Middleware Conference, Toronto, Canada, October 2004.
- [6] S. Andreatta, N. De Bortoli, S. Fantinel, G.L. Rubini, G. Tortone. ***Design and Implementation of a Notification Model for Grid Monitoring Events***. CHEP04, Interlaken (CH), Sep 2004

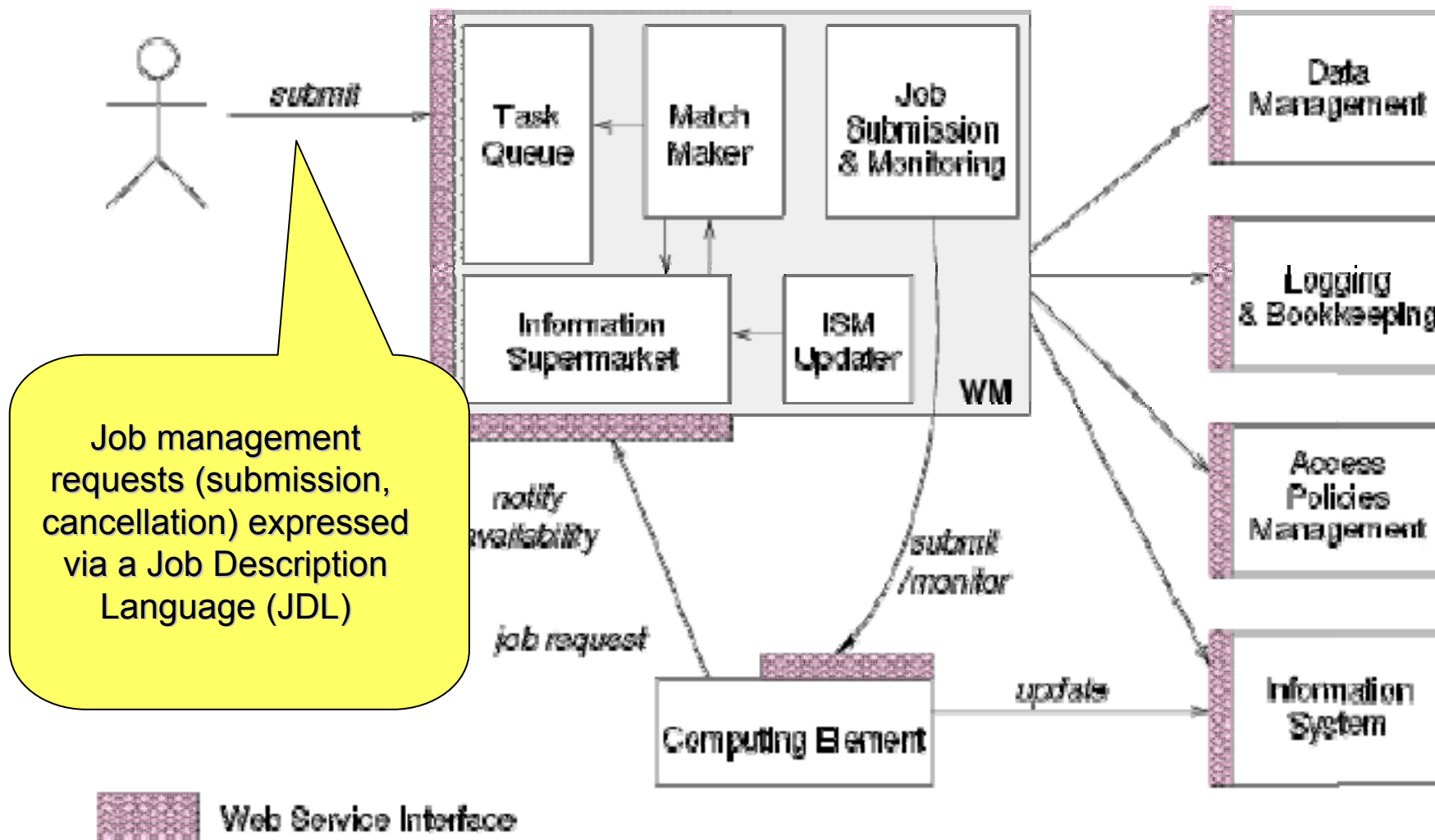
Workload Management System

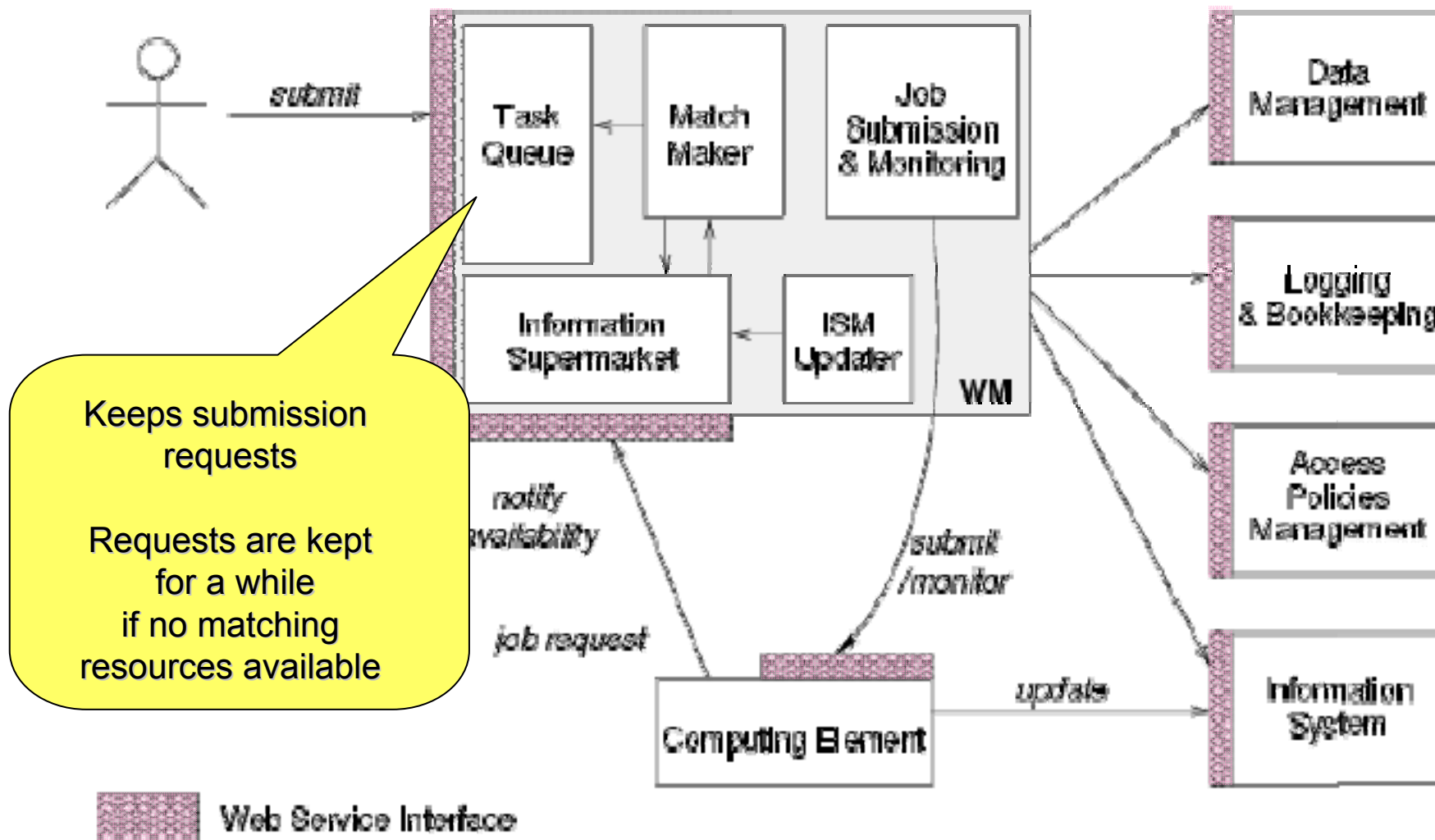
- **Job Management Services**
 - **main services related to job management/execution are**
 - **computing element**
 - *job management (job submission, job control, etc.), but it must also provide*
 - *provision of information about its characteristics and status*
 - **workload management**
 - *core component discussed in details*
 - **accounting**
 - *special case as it will eventually take into account*
 - computing, storage and network resources
 - **job provenance**
 - *keep track of the definition of submitted jobs, execution conditions and environment, and important points of the job life cycle for a long period*
 - debugging, post-mortem analysis, comparison of job execution
 - **package manager**
 - *automates the process of installing, upgrading, configuring, and removing software packages from a shared area on a grid site.*
 - extension of a traditional package management system to a Grid



- WM can adopt
 - **eager scheduling (“push” model)**
 - a job is bound to a resource as soon as possible and, once the decision has been taken, the job is passed to the selected resource for execution
 - **lazy scheduling (“pull” model)**
 - foresees that the job is held by the WM until a resource becomes available, at which point that resource is matched against the submitted jobs
 - *the job that fits best is passed to the resource for immediate execution.*
- Varying degrees of eagerness (or laziness) are applicable
 - **match-making level**
 - **eager scheduling**
 - *implies matching a job against multiple resources*
 - **lazy scheduling**
 - *implies matching a resource against multiple jobs*

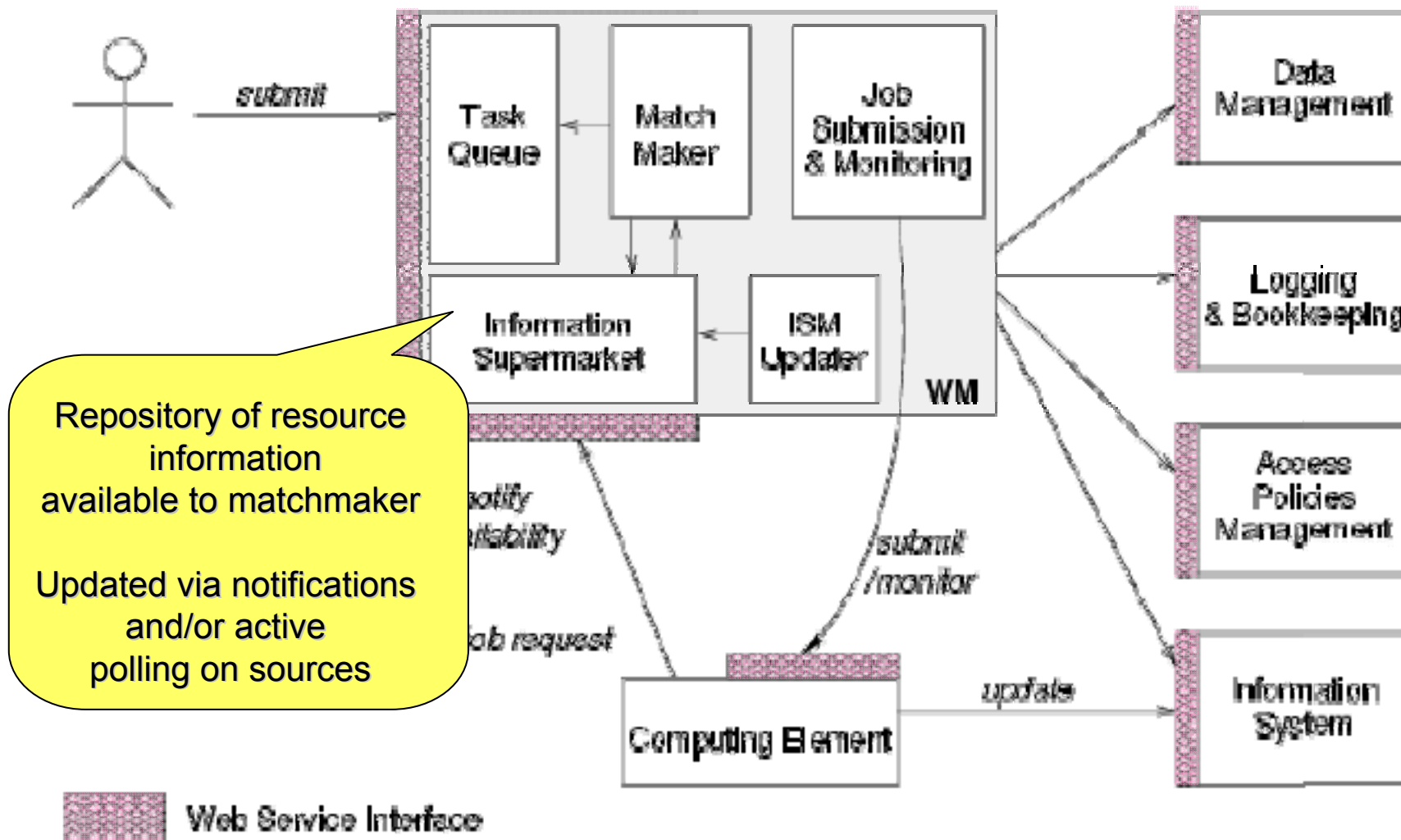


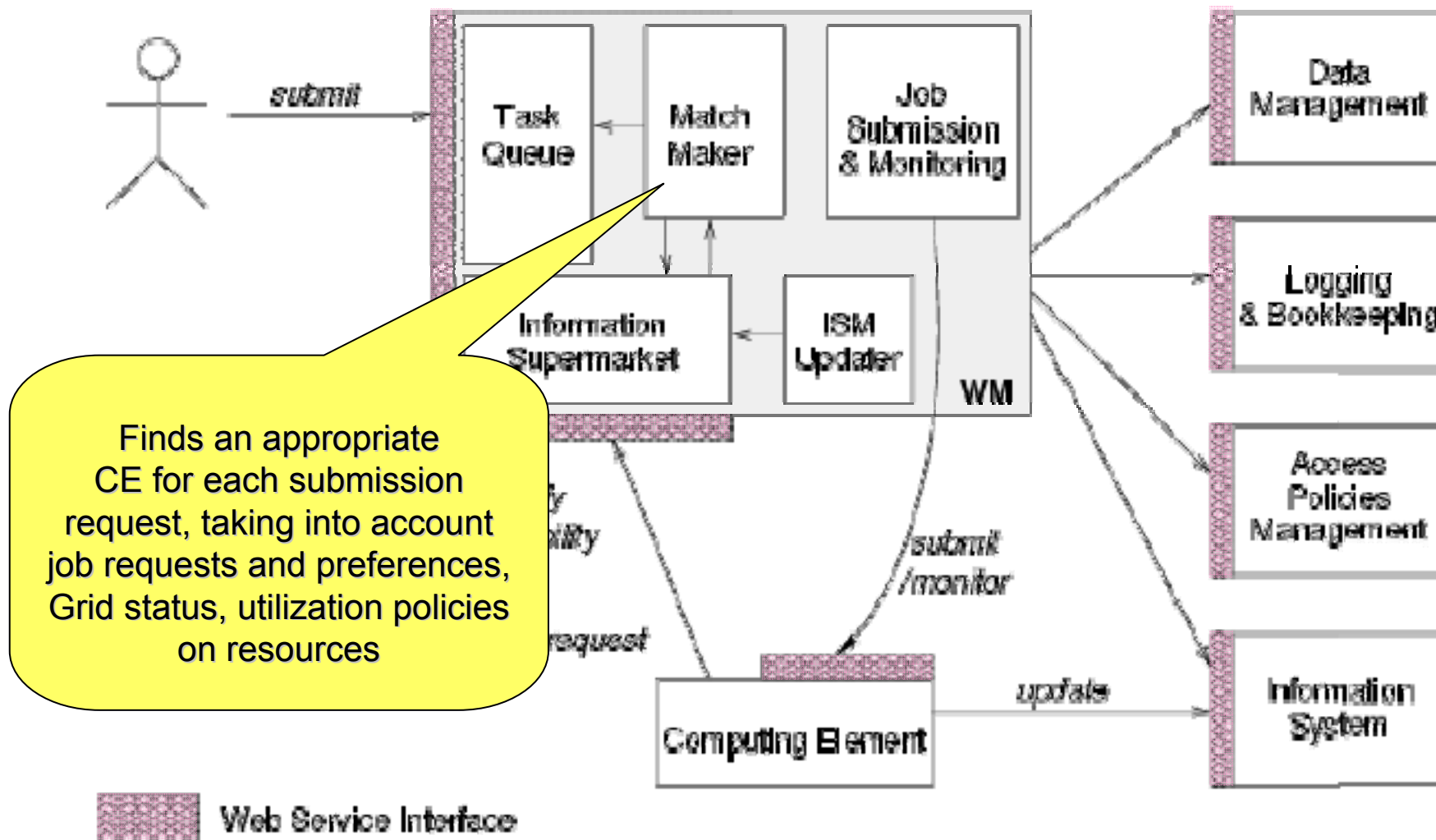


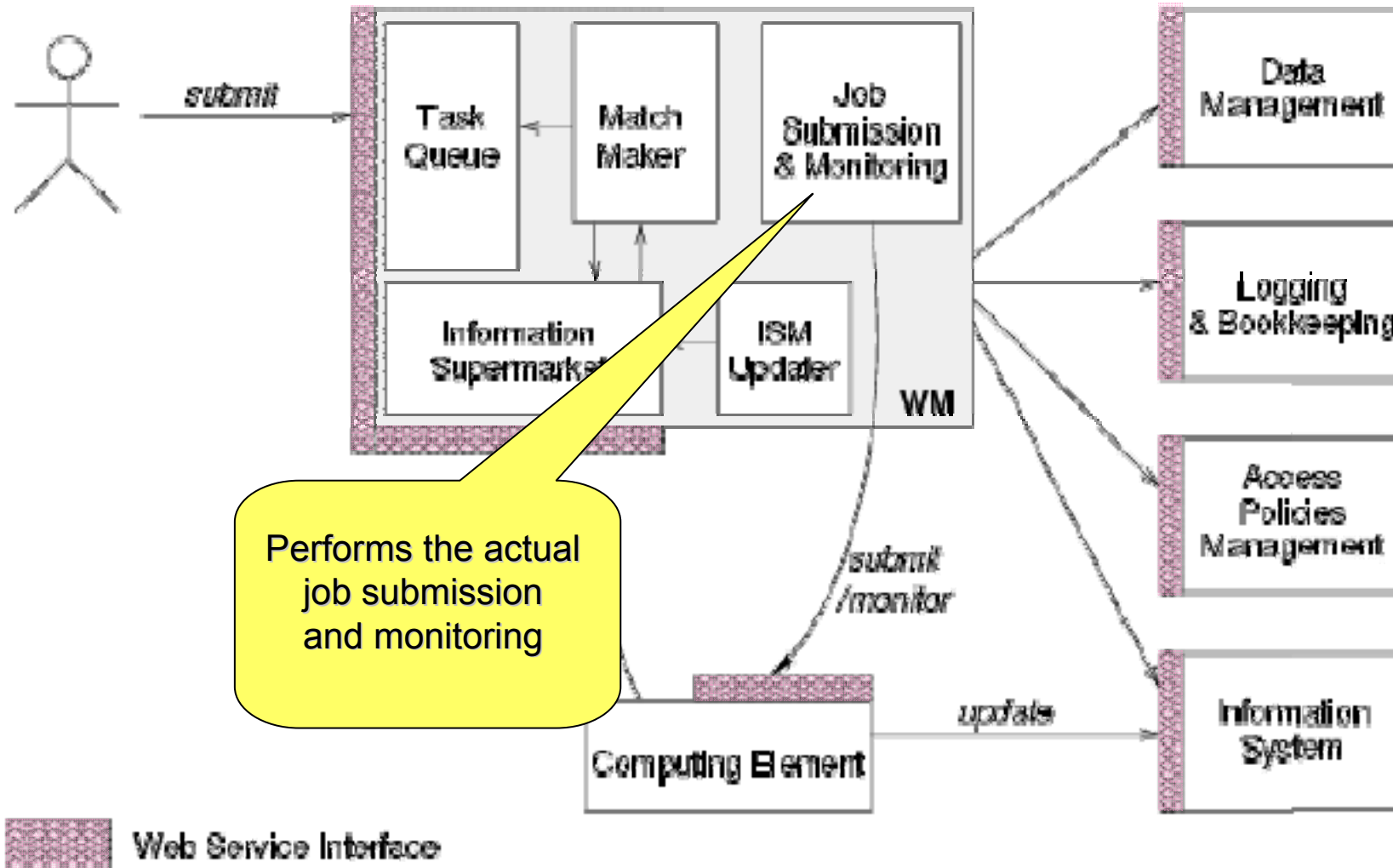


Keeps submission requests

Requests are kept for a while if no matching resources available







- ISM represents one of the most notable improvements in the WM as inherited from the EU DataGrid (EDG) project
 - **decoupling between the collection of information concerning resources and its use**
 - **allows flexible application of different policies**
- The ISM basically consists of a repository of resource information that is available in read only mode to the matchmaking engine
 - **the update is the result of**
 - **the arrival of notifications**
 - **active polling of resources**
 - **some arbitrary combination of both**
 - **can be configured so that certain notifications can trigger the matchmaking engine**
 - **improve the modularity of the software**
 - **support the implementation of lazy scheduling policies**

- The Task Queue represents the second most notable improvement in the WM internal design
 - **possibility to keep a submission request for a while if no resources are immediately available that match the job requirements**
 - technique used by the AliEn and Condor systems
- Non-matching requests
 - **will be retried either periodically**
 - eager scheduling approach
 - **or as soon as notifications of available resources appear in the ISM**
 - lazy scheduling approach

- L&B tracks jobs in terms of *events*
 - **important points of job life**
 - **submission, finding a matching CE, starting execution etc**
 - *gathered from various WMS components*
- The events are passed to a physically close component of the L&B infrastructure
 - **locallogger**
 - **avoid network problems**
 - *stores them in a local disk file and takes over the responsibility to deliver them further*
- The destination of an event is one of *bookkeeping servers*
 - **assigned statically to a job upon its submission**
 - **processes the incoming events to give a higher level view on the job states**
 - Submitted, Running, Done
 - **various recorded attributes**
 - *JDL, destination CE name, job exit code*
- Retrieval of both job states and raw events is available via legacy (EDG) and WS querying interfaces
 - **user may also register for receiving notifications on particular job state changes**

WMS components handling the job during its lifetime and performing the submission

- **Job Adapter**
 - **is responsible for**
 - making the final touches to the JDL expression for a job, before it is passed to CondorC for the actual submission
 - creating the job wrapper script that creates the appropriate execution environment in the CE worker node
 - *transfer of the input and of the output sandboxes*
- **CondorC**
 - **responsible for**
 - performing the actual job management operations
 - *job submission, job removal*
- **DAGMan**
 - **meta-scheduler**
 - purpose is to navigate the graph
 - determine which nodes are free of dependencies
 - follow the execution of the corresponding jobs.
 - **instance is spawned by CondorC for each handled DAG**
- **Log Monitor**
 - **is responsible for**
 - watching the CondorC log file
 - intercepting interesting events concerning active jobs
 - *events affecting the job state machine*
 - triggering appropriate actions.

- **Information to be specified when a job has to be submitted:**
 - Job characteristics
 - Job requirements and preferences on the computing resources
 - Also including software dependencies
 - Job data requirements
- **Information specified using a Job Description Language (JDL)**
 - Based upon **Condor's CLASSified ADvertisement language (ClassAd)**
 - Fully extensible language
 - A ClassAd
 - *Constructed with the classad construction operator []*
 - *It is a sequence of attributes separated by semi-colons.*
 - *An attribute is a pair (key, value), where value can be a Boolean, an Integer, a list of strings, ...*
 - `<attribute> = <value>;`

- **The supported attributes are grouped into two categories:**
 - **Job Attributes**
 - Define the job itself
 - **Resources**
 - Taken into account by the Workload Manager for carrying out the matchmaking algorithm (to choose the “best” resource where to submit the job)
 - **Computing Resource**
 - *Used to build expressions of Requirements and/or Rank attributes by the user*
 - *Have to be prefixed with “other.”*
 - **Data and Storage resources**
 - *Input data to process, Storage Element (SE) where to store output data, protocols spoken by application when accessing SEs*

- JobType
 - *Normal* (simple, sequential job), *DAG*, *Interactive*, *MPICH*, *Checkpointable*
- Executable (**mandatory**)
 - The command name
- Arguments (**optional**)
 - Job command line arguments
- StdInput, StdOutput, StdError (**optional**)
 - Standard input/output/error of the job
- Environment
 - List of environment settings
- InputSandbox (**optional**)
 - List of files on the UI's local disk needed by the job for running
 - The listed files will be staged automatically to the remote resource
- OutputSandbox (**optional**)
 - List of files, generated by the job, which have to be retrieved

- Requirements
 - Job **requirements on computing resources**
 - Specified using attributes of resources published in the Information Service
 - If not specified, default value defined in UI configuration file is considered
 - Default: *other.GlueCEStateStatus* == "Production" (the resource has to be able to accept jobs and dispatch them on WNs)

- Rank
 - **Expresses preference** (how to rank resources that have already met the Requirements expression)
 - Specified using attributes of resources published in the Information Service
 - If not specified, default value defined in the UI configuration file is considered
 - Default: - *other.GlueCEStateEstimatedResponseTime* (the lowest estimated traversal time)
 - Default: *other.GlueCEStateFreeCPUs* (the highest number of free CPUs) for parallel jobs (see later)

- **InputData**

- Refers to data used as input by the job: these data are published in the Replica Catalog and stored in the Storage Elements)
- LFNs and/or GUIDs

Details in Data Management lecture

- **InputSandbox**

- Executable, files etc. that are sent to the job

- **DataAccessProtocol** (mandatory if **InputData** has been specified)

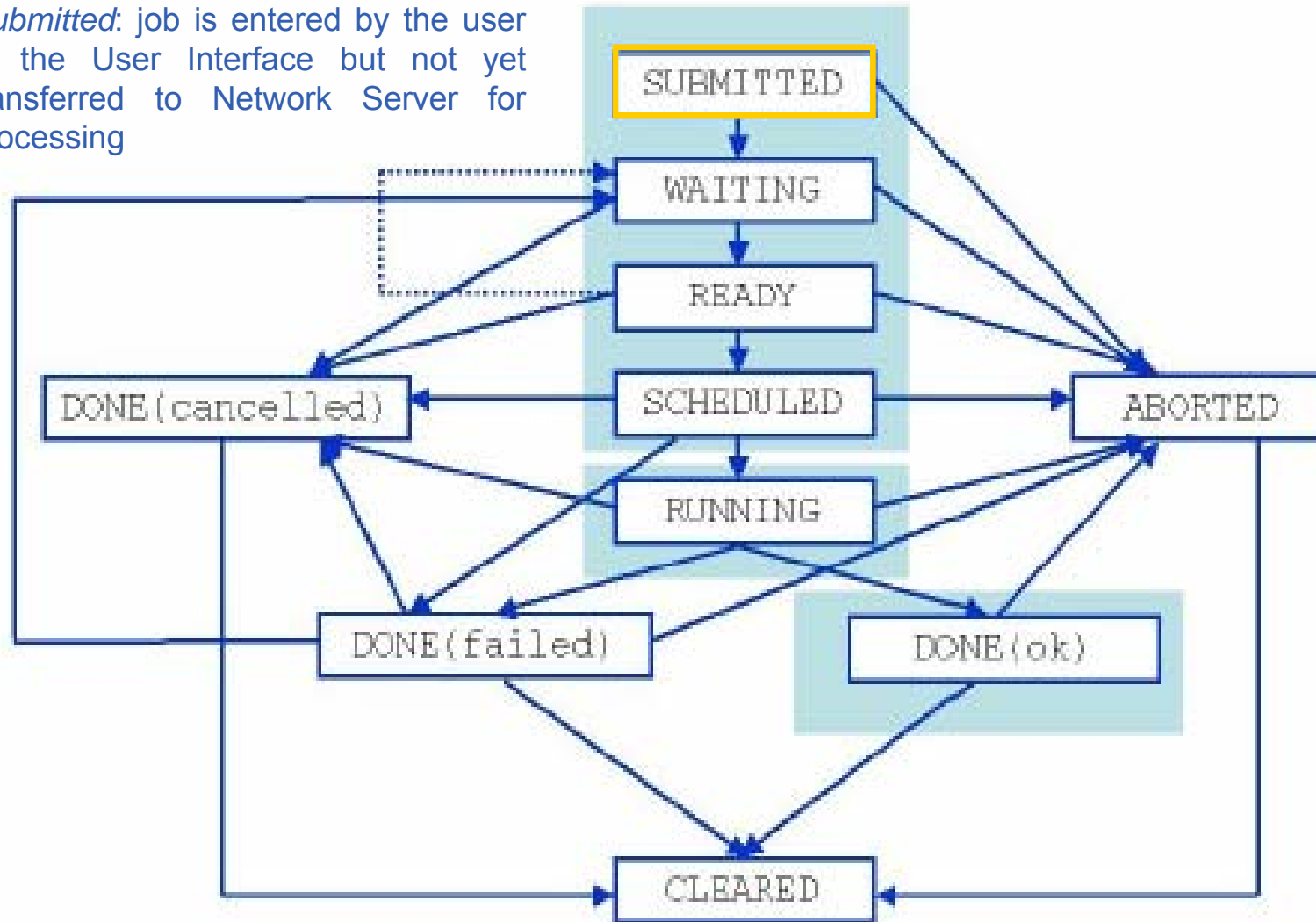
- The protocol or the list of protocols which the application is able to speak with for accessing *InputData* on a given Storage Element

- **OutputSE**

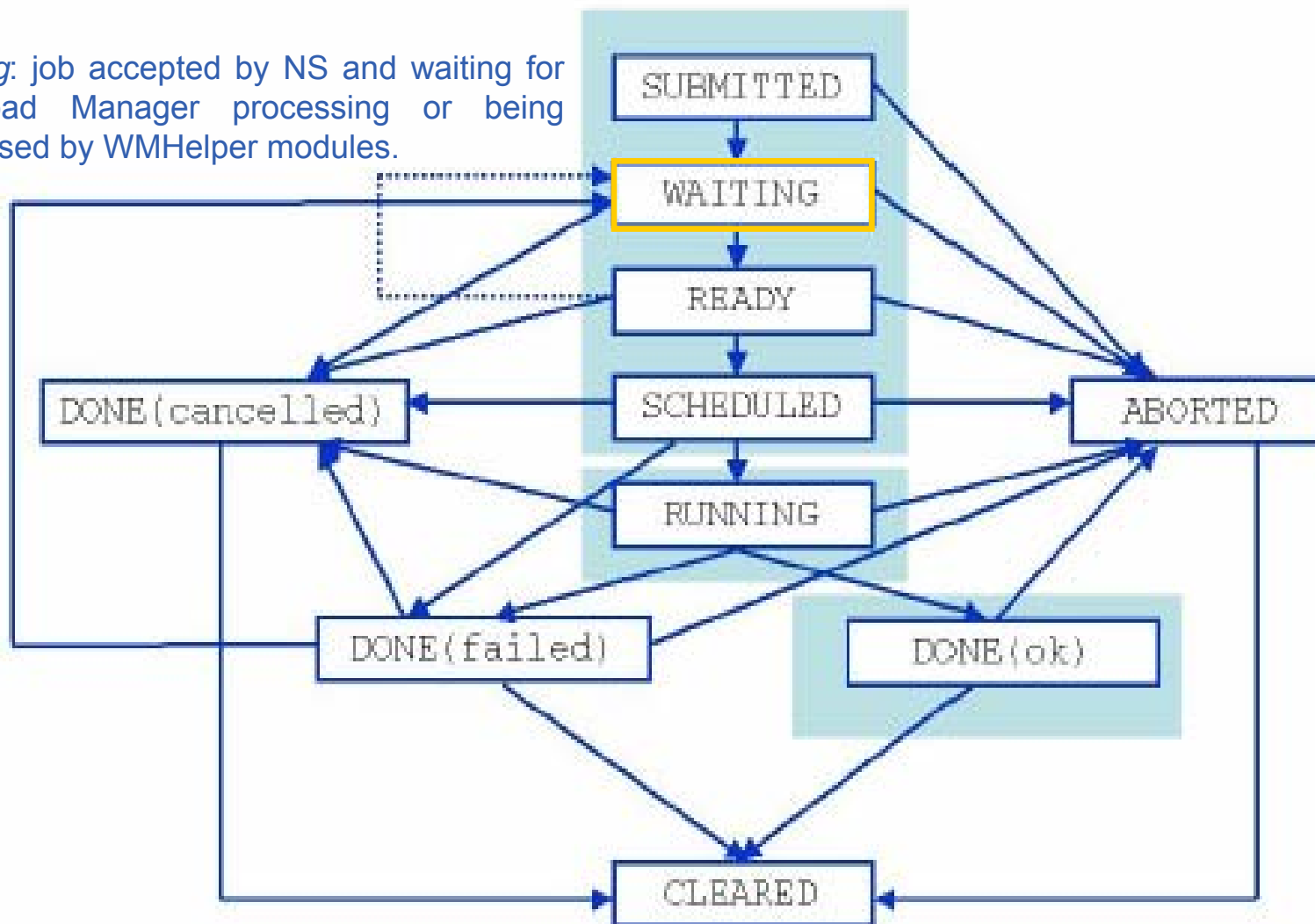
- The Uniform Resource Identifier of the output Storage Element
- RB uses it to choose a Computing Element that is compatible with the job and is close to Storage Element

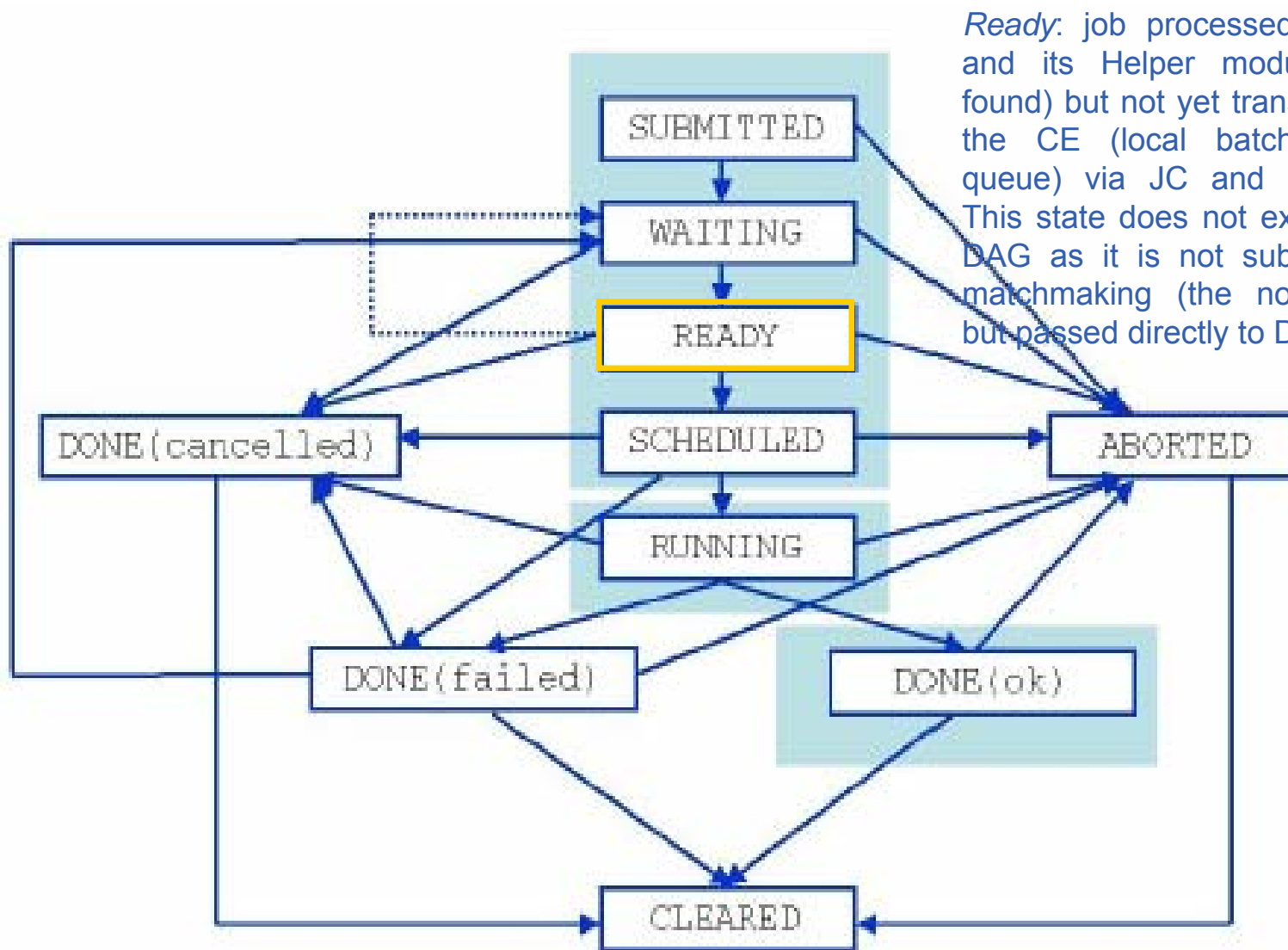
```
[
JobType="Normal" ;
Executable = "gridTest" ;
StdError = "stderr.log" ;
StdOutput = "stdout.log" ;
InputSandbox = { "/home/mydir/test/gridTest" };
OutputSandbox = { "stderr.log", "stdout.log" };
InputData = { "lfn:/glite/myvo/mylfn" };
DataAccessProtocol = "gridftp" ;
Requirements = other.GlueHostOperatingSystemNameOpSys
    == "LINUX"
        && other.GlueCEStateFreeCPUs >= 4 ;
Rank = other.GlueCEPolicyMaxCPUtime ;
]
```

Submitted: job is entered by the user to the User Interface but not yet transferred to Network Server for processing

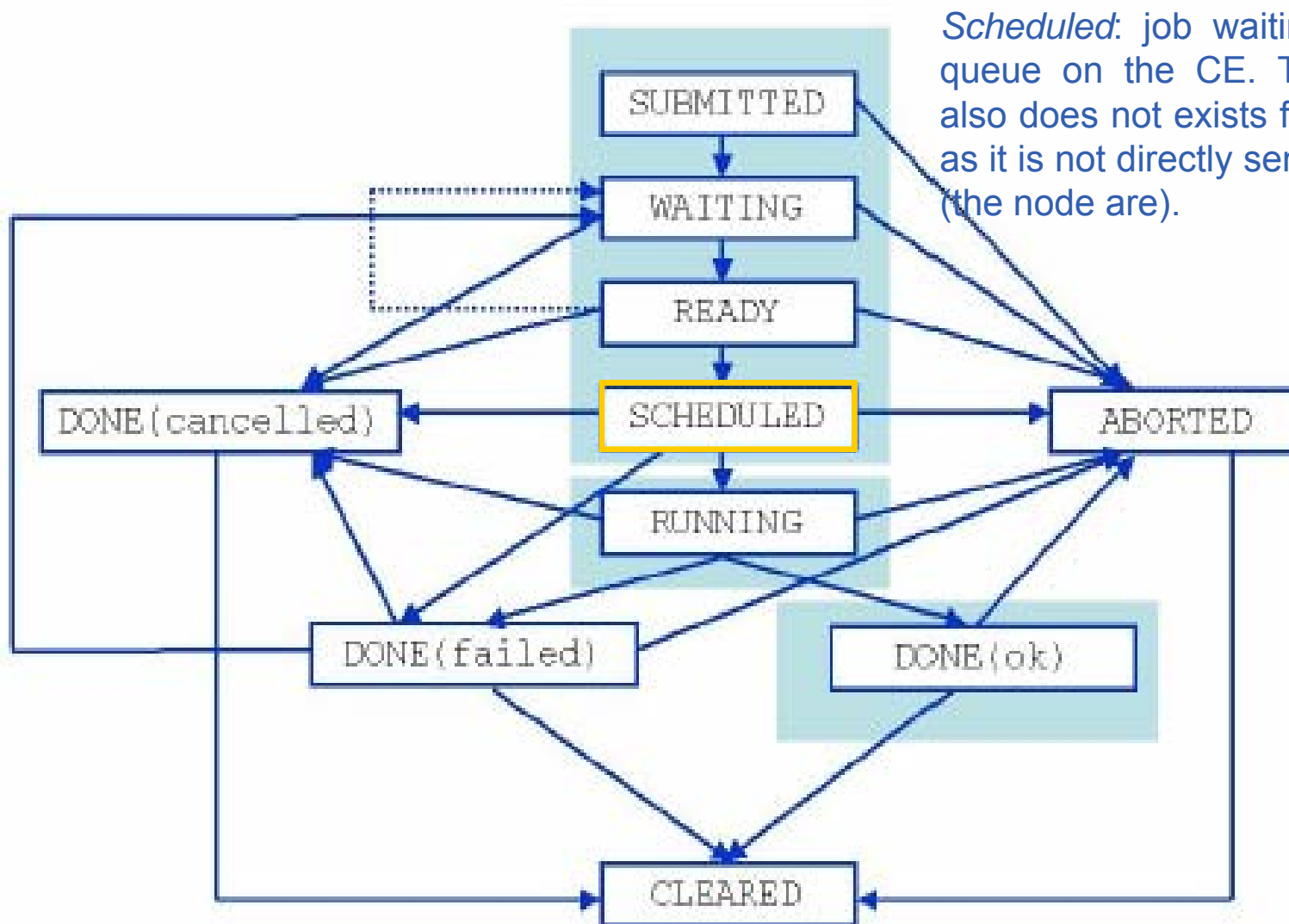


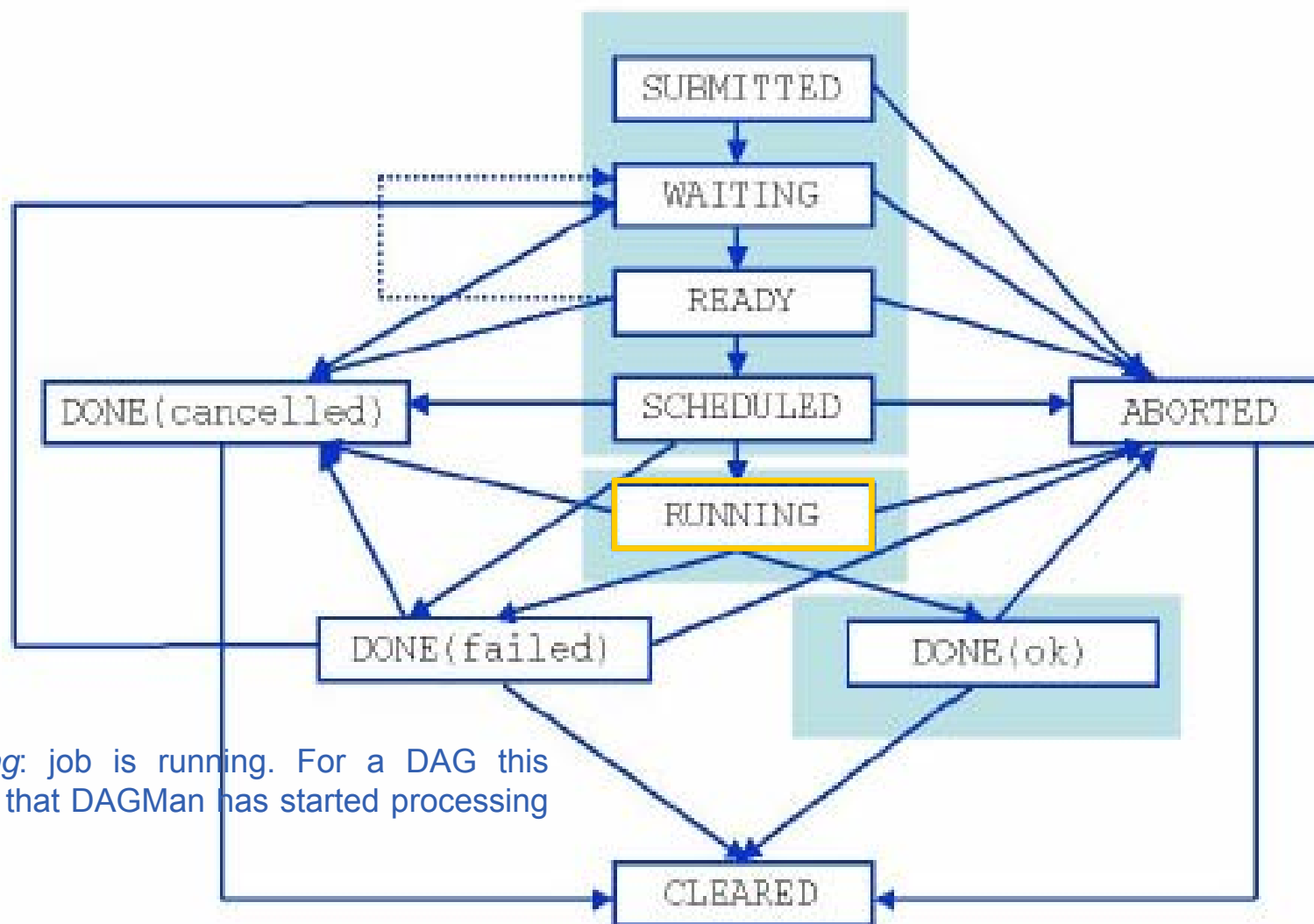
Waiting: job accepted by NS and waiting for Workload Manager processing or being processed by WMHelper modules.



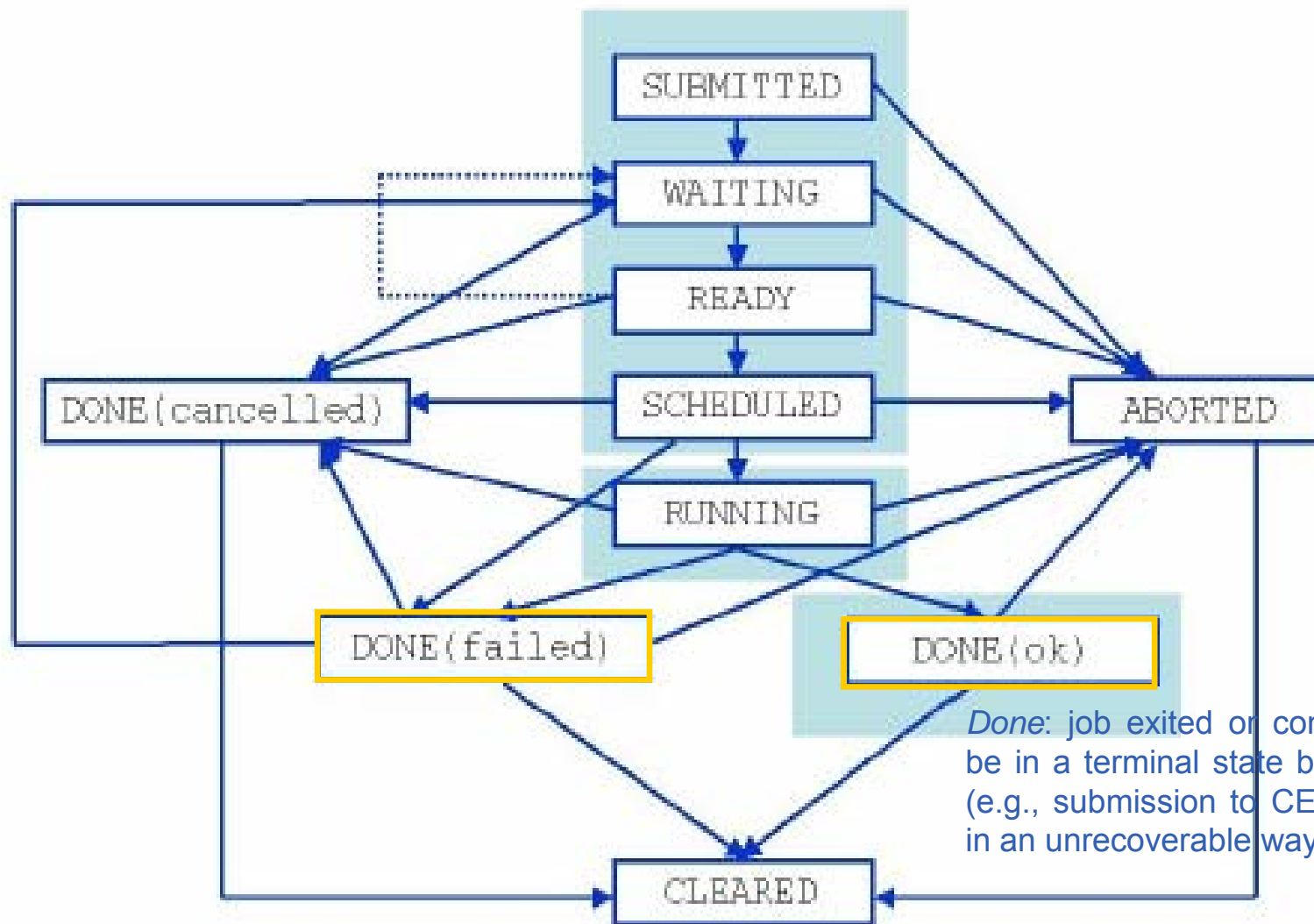


Ready: job processed by WM and its Helper modules (CE found) but not yet transferred to the CE (local batch system queue) via JC and CondorC. This state does not exist for a DAG as it is not subjected to matchmaking (the nodes are) but passed directly to DAGMan.

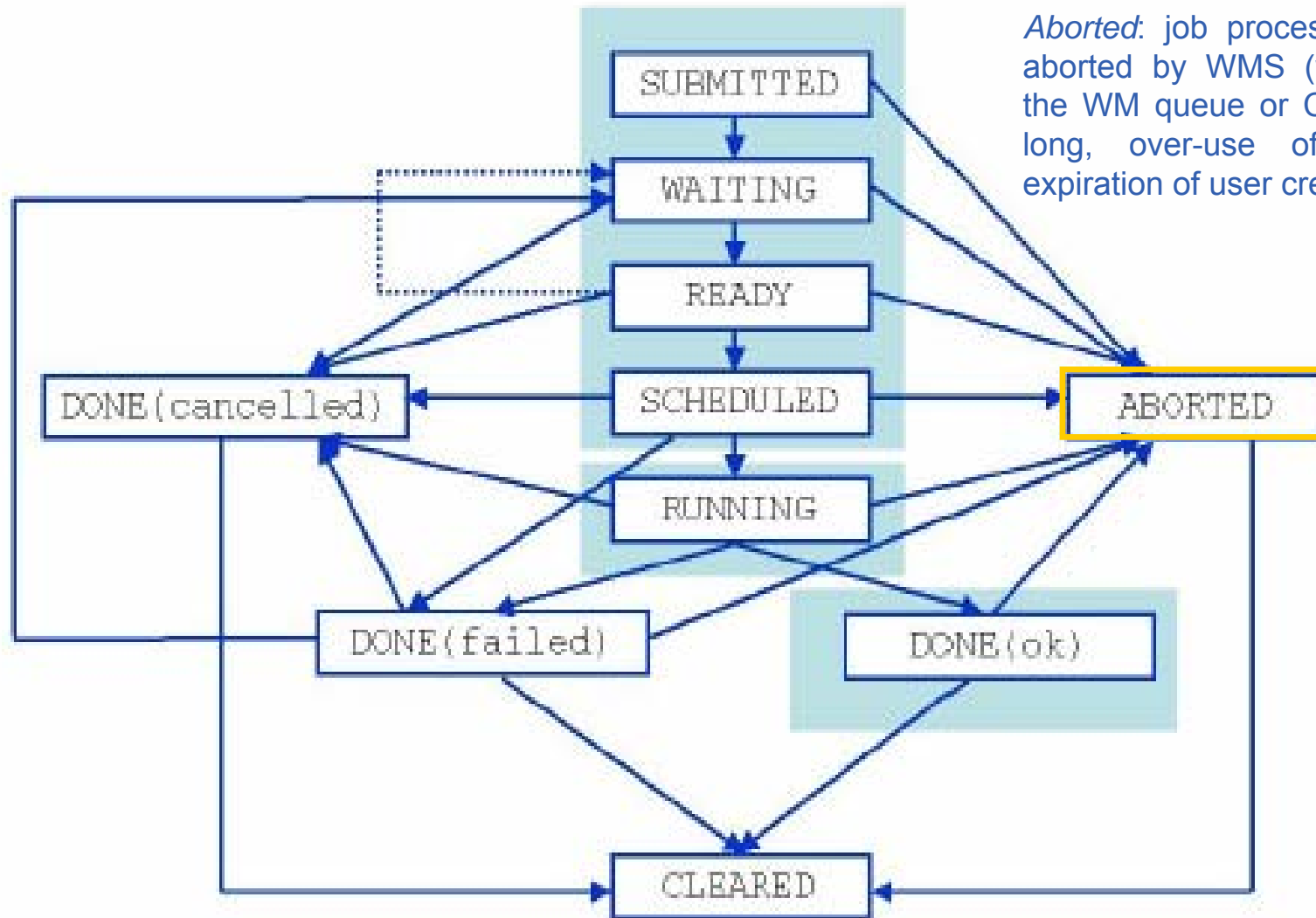


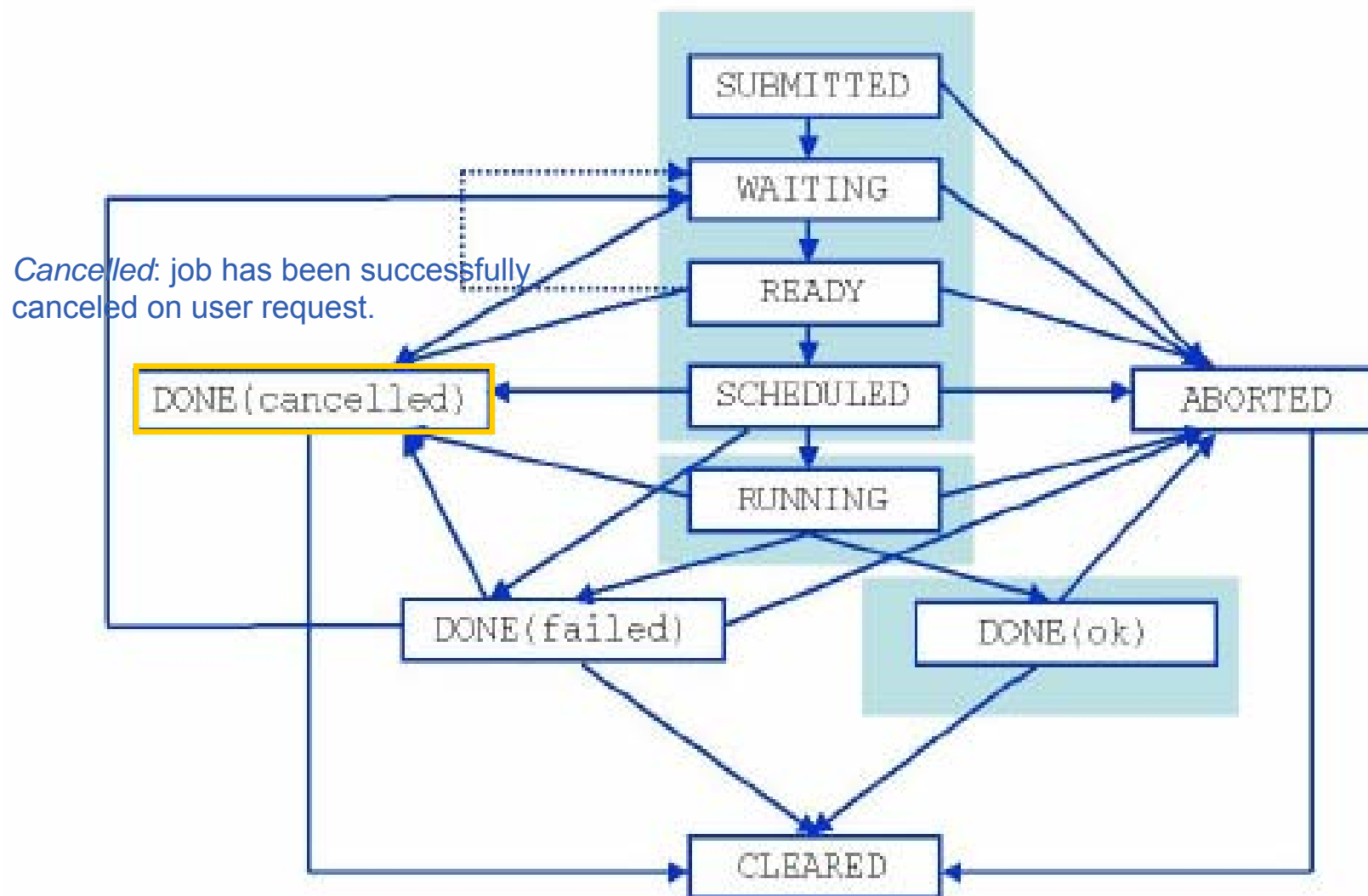


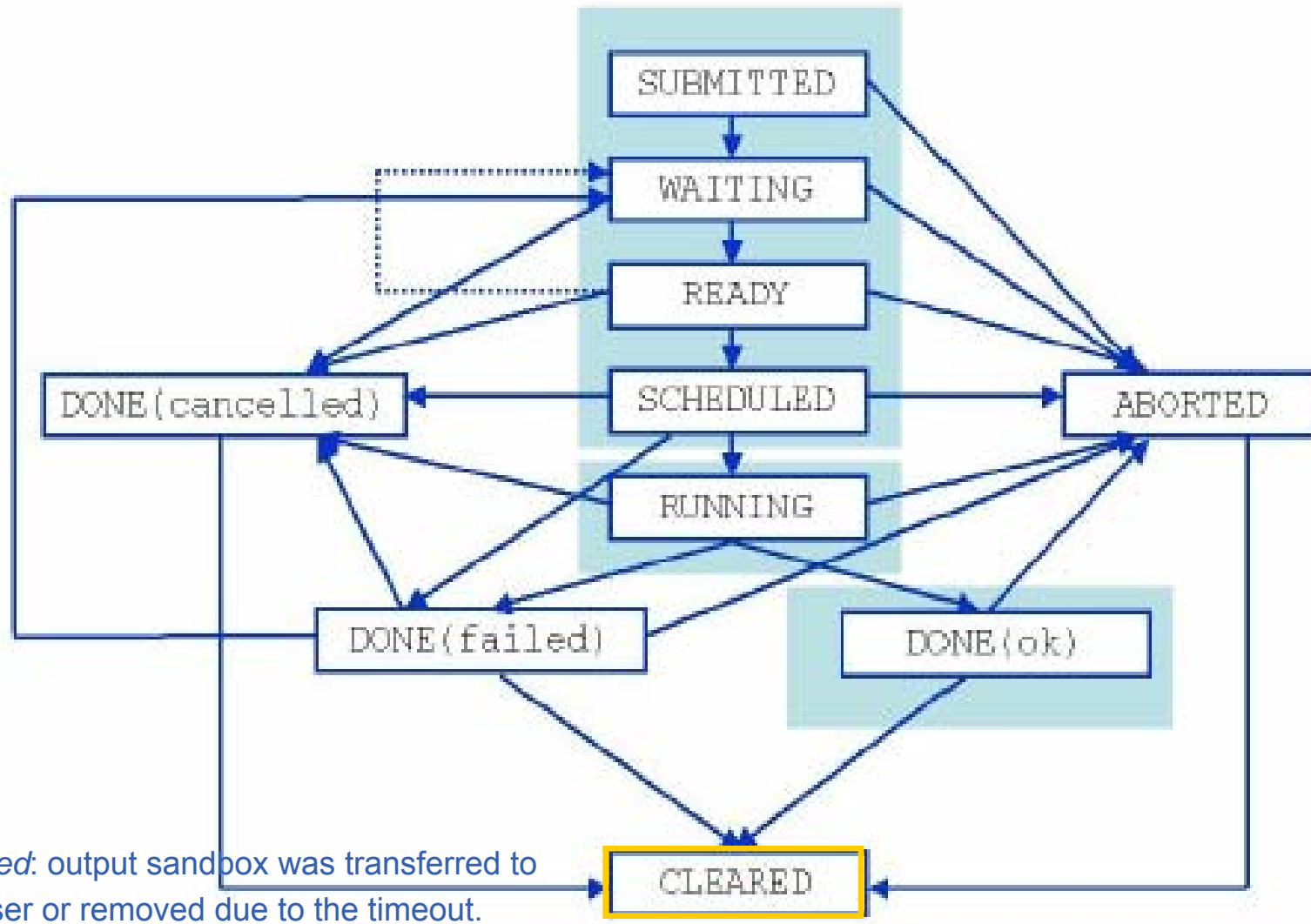
Running: job is running. For a DAG this means that DAGMan has started processing it.



Done: job exited or considered to be in a terminal state by CondorC (e.g., submission to CE has failed in an unrecoverable way).



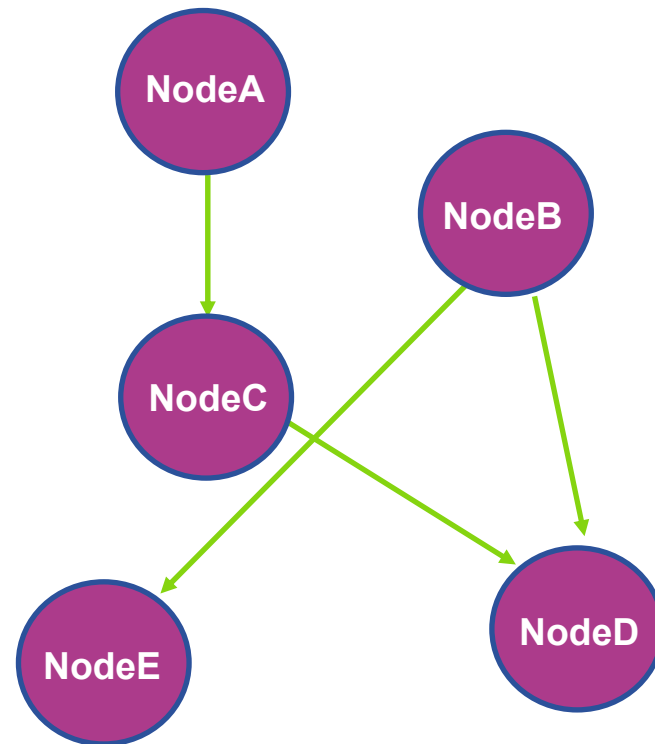
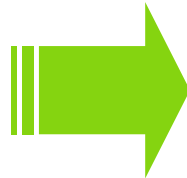
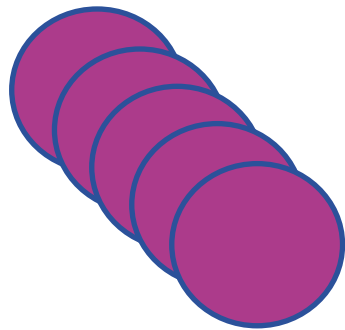












- A DAG represents a set of jobs:

Nodes = Jobs

Edges = Dependencies



- Type = "DAG"  *Mandatory*
- VirtualOrganisation = "yourVO"  *Mandatory*
- Max_Nodes_Running = int >0  *Optional*
- MyProxyServer = "... "  *Optional*
- Requirements = "... "  *Optional*
- Rank = "... "  *Optional*
- InputSandbox =  more later!  *Optional*
- ~~• OutSandbox = "... "~~
- Nodes = nodeX  more later!  *Mandatory*
- Dependencies  more later!  *Mandatory*

The *Nodes* attribute is the core of the DAG description;

```
....
Nodes = [ nodefilename1 = [...]
          nodefilename2 = [...]
          .....
          dependencies = ...
        ]
```



```
Nodefilename1 = [ file = "foo.jdl"; ]
Nodefilename2 =
  [ file = "/home/vardizzo/test.jdl";
    retry = 2;      ]
```



```
Nodefilename1 = [
  description = [ JobType = "Normal";
                 Executable = "abc.exe";
                 Arguments = "1 2 3";
                 OutputSandbox = [...];
                 InputSandbox = [...];
                 ..... ]
  retry = 2;
  ]
```

- It is a list of lists representing the dependencies between the nodes of the DAG.

```
....
Nodes = [ nodefilename1 = [...]
          nodefilename2 = [...]
          .....
          dependencies = ...
        ]
```



```
dependencies =
    {nodefilename1, nodefilename2}
```



MANDATORY : YES!

```
dependencies = {};
```

```
{ nodefilename1, nodefilename2 }
```

```
{ { nodefilename1, nodefilename2 }, nodefilename3 }
```

```
{ { { nodefilename1, nodefilename2 }, nodefilename3 }, nodefilename4 }
```

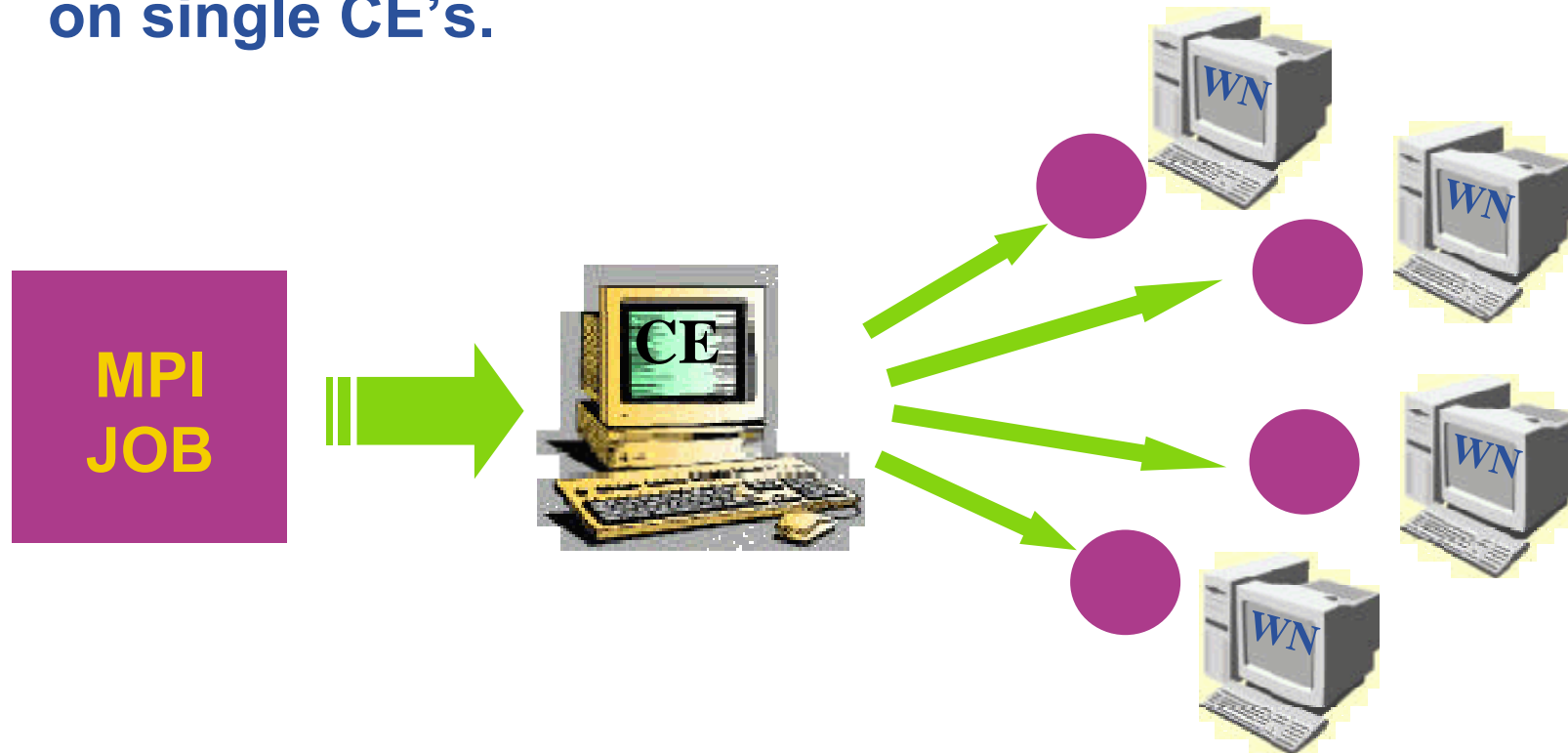
- All nodes inherit the value of the attributes from the one specified for the DAG.

- Nodes without any InputSandbox values, have to contain in their description an empty list:

InputSandbox = { };

```
NodeA= [
  description = [
    JobType = "Normal";
    Executable = "abc.exe";
    OutputSandbox = {"myout.txt"};
    InputSandbox = {
      "/home/vardizzo/myfile.txt",
      root.InputSandbox; };
  ]
]
```

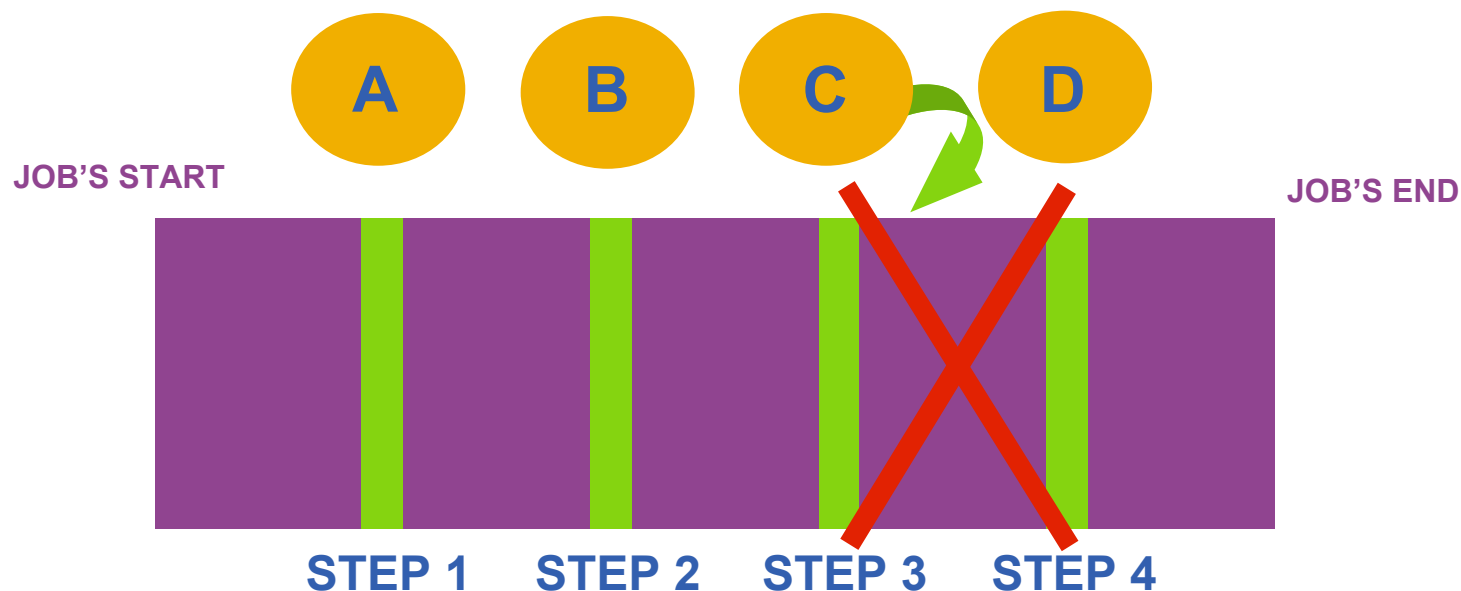
- The MPI job is run in parallel on several processors.
- Libraries supported for parallel jobs: MPICH.
- Currently, execution of parallel jobs is supported only on single CE's.











- `Type = "job";` ➔ *Mandatory*
- `JobType = "MPICH";` ➔ *Mandatory*
- `Executable = "...";` ➔ *Mandatory*
- `NodeNumber = "int > 1";` ➔ *Mandatory*
- `Argument = "...";` ➔ *Optional*
- `Requirements =` ➔ *Mandatory*
`Member("MpiCH", other.GlueHostApplicationSoftwareRunTimeEnvironment)`
`&& other.GlueCEInfoTotalCPUs >= NodeNumber ;`

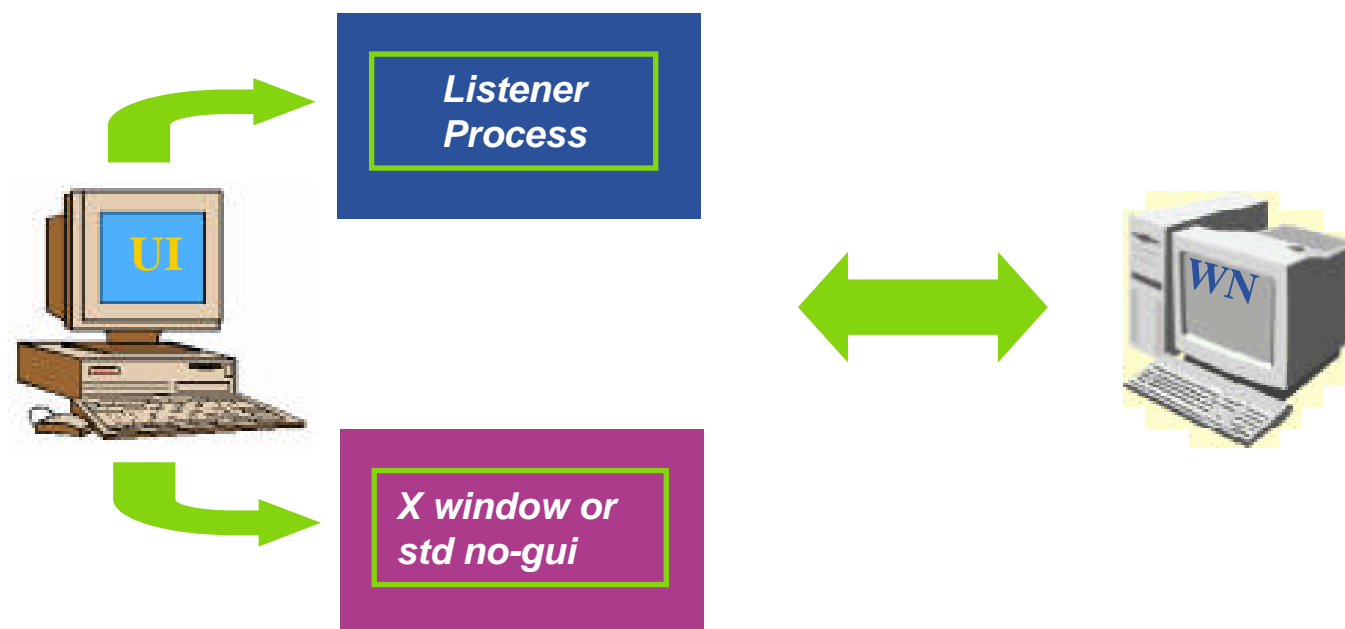
- `Rank = other.GlueCEStateFreeCPUs;` ➔ *Mandatory*

- It is a job that can be decomposed in several steps;
- In every step the job state can be saved in the LB and retrieved later in case of failures;
- The job can start running from a previously saved state instead from the beginning again.



- `Type = "job";`  *Mandatory*
- `JobType = "checkpointable";`  *Mandatory*
- `Executable = "...";`  *Mandatory*
- `JobSteps = "list int | list string";`  *Mandatory*
- `CurrentStep = "int >= 0";`  *Mandatory*
- `Argument = "...";`  *Optional*
- `Requirements = "...";`  *Optional*
- `Rank = "";`  *Optional*

- It is a job whose standard streams are forwarded to the submitting client.
- The `DISPLAY` environment variable has to be set correctly, because an X window is open.



- Specified setting **JobType = “Interactive”** in JDL
- When an interactive job is executed, a window for the stdin, stdout, stderr streams is opened
 - Possibility to send the stdin to
 - the job
 - Possibility to have the stderr
 - and stdout of the job when it
 - is running
- Possibility to start a window for
- the standard streams for a
- previously submitted interactive
- job with command **glite-job-attach**



- Type = "job";
- JobType = "interactive";
- Executable = "...";
- Argument = "...";
- ListenerPort = "int > 0";
- OutputSandbox = "";
- Requirements = "...";
- Rank = "";

- ➔ *Mandatory*
- ➔ *Mandatory*
- ➔ *Mandatory*
- ➔ *Optional*
- ➔ *Optional*
- ➔ *Optional*
- ➔ *Mandatory*
- ➔ *Mandatory*

gLite Commands:

glite-job-attach [options] <jobID>

- **JDL Submission:**

`glite-job-submit -o guidfile jobCheck.jdl`

- **JDL Status:**

`glite-job-status -i guidfile`

- **JDL Output:**

`glite-job-output -i guidfile`

- **Get Latest Job State:**

`glite-job-get-chkpt -o statefile -i guidfile`

- **Submit a JDL from a state:**

`glite-job-submit -chkpt statefile -o guidfile jobCheck.jdl`

- **See also [options] typing `-help` after the commands.**

- **gLite WMS's User Guide**
 - <https://edms.cern.ch/document/572489/1>
- **EGEE Middleware Architecture DJRA1.1**
 - <https://edms.cern.ch/document/476451/>
- **Practical approaches to Grid workload management in the EGEE project – CHEP 2004**
 - <https://edms.cern.ch/document/503558>
- **Grid accounting in EGEE, current practices – Terena Network Conference 2005**
 - http://www.terena.nl/conferences/tnc2005/programme/presentations/show.php?pres_id=107

Data Management System

- **User and programs produce and require data**
- **Data may be stored in Grid datasets (files)**
 - Located in Storage Elements (**SEs**)
 - Several replicas of one file in different sites
 - Accessible by Grid users and applications from “everywhere”
 - Locatable by the WMS (data requirements in JDL)
- **Also...**
 - Resource Broker can send (small amounts of) data to/from jobs:
Input and Output Sandbox
 - Data may be copied from/to local filesystems (WNs, UIs) to the Grid

- **File Management**
 - Storage
 - Access
 - Placement
 - Cataloguing
 - Security
- **Metadata Management**
 - Secure database access
 - Schema management
 - File-based metadata
 - Generic metadata

- **What does “Data Management” mean ?**
 - Users and applications produce and require data
 - Data may be stored in Grid files
 - Granularity is at the “file” level (no data “structures”)
 - Users and applications need to handle files on the Grid
- **Files are stored in appropriate permanent resources called “Storage Elements” (SE)**
 - Present almost at every site together with computing resources
 - We will treat a storage element as a “black box” where we can store data
 - Appropriate data management utilities/services hide internal structure of SE
 - Appropriate data management utilities/services hide details on transfer protocols

- **Storage Element**

- Storage Resource Manager
- POSIX-I/O
- Access protocols

gsiftp, https, rfio, file, ...

- **Catalogs**

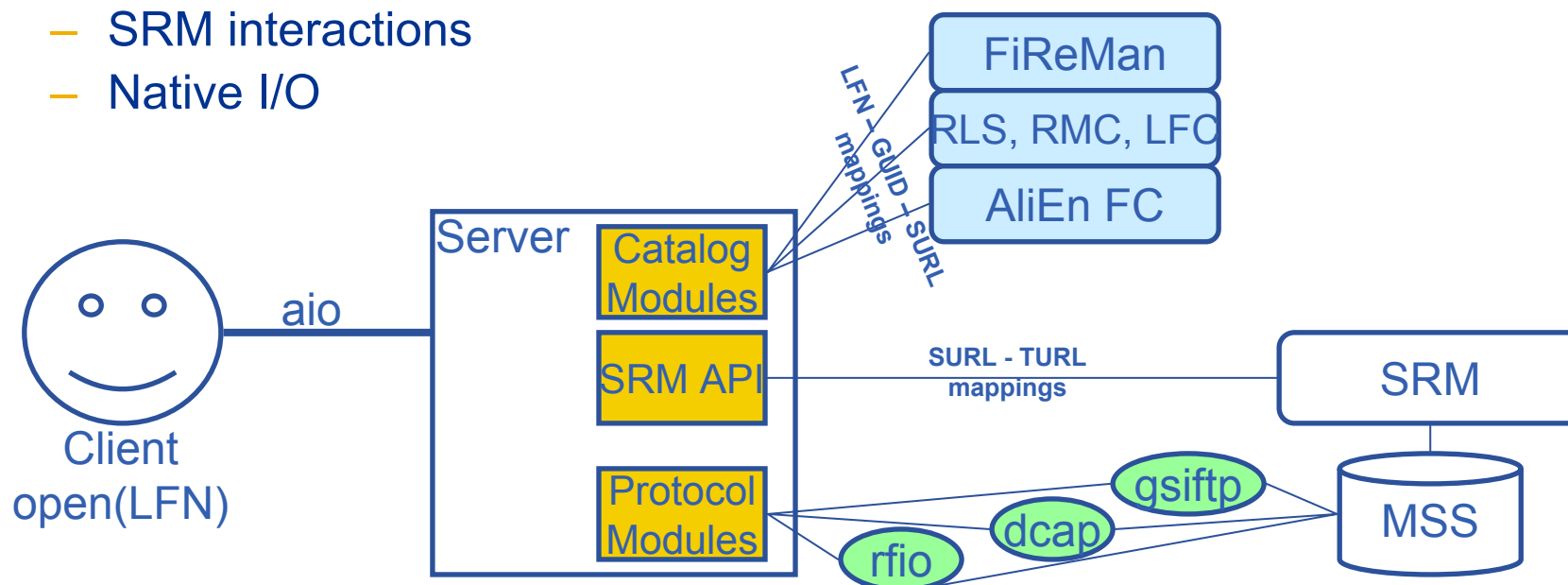
- File Catalog
- Replica Catalog
- File Authorization Service
- Metadata Catalog

- **File Transfer**

- File Transfer Service
- File Placement Service

- File Storage
 - **Storage Elements** with **SRM** (Storage Resource Manager) interface
 - Posix I/O interface through **glite-io**
 - Supports transfer protocols (bbftp, https, ftp, **gsiftp**, **rfio**, **dcap**, ...)
- Catalogs
 - **File and Replica Catalog**
 - **File Authorization Service**
 - **Metadata Catalog**
 - Distribution of catalogs, conflicts resolution (**messaging**)
- Transfer
 - Top-level **Data Scheduler** as global entry point (there may be many).
 - Site **File Placement Service** managing transfers and catalog interactions
 - Site **File Transfer Service** managing incoming transfers (the network resource)

- **Client only sees a simple API library and a Command Line Interface**
 - GUID or LFN can be used, i.e. `open("/grid/myFile")`
- **GSI Delegation to gLite I/O Server**
- **Server performs all operations on User's behalf**
 - Resolve LFN/GUID into SURL and TURL
- **Operations are pluggable**
 - Catalog interactions
 - SRM interactions
 - Native I/O



- **gLite IO server relies against a Mass Storage System implementing SRM interface**
- **gLite IO server communicates with MSS through SRM**
- **SRM is not provided by gLite !**
- **Tested MSS are, till now, CASTOR and dCache**
- **Full support to functionalities depending also from MSS**
- **Installing and configuring MSS is apart from gLite issues**
- **How to and guides to do so**

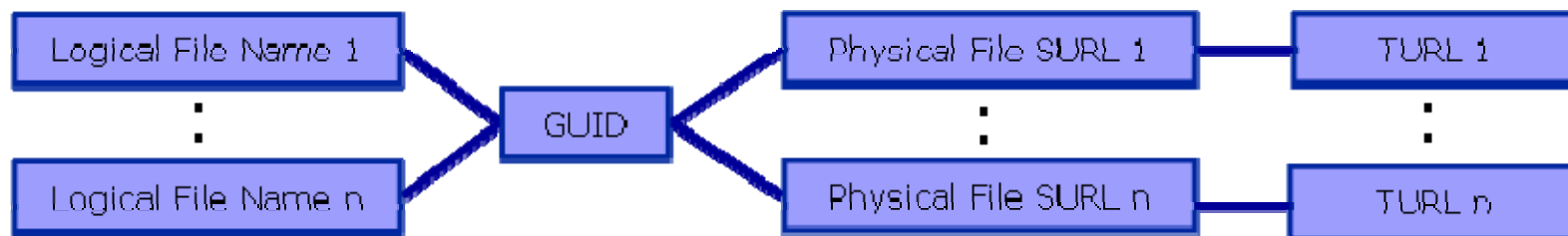
http://egee-na4.ct.infn.it/wiki/out_pages/dCache-SRM.html

<http://storage.esc.rl.ac.uk/documentation/html/D-Cache-Howto>

- **Data movements capability (should be...) provided by**
 - Data scheduler (DS) (top-level)
 - File Placements Services (FPS) (local)
 - Transfer Agent (FTA) (local)
 - File Transfer Library (low level, called by applications)
- **DS keeps track of data movement request submitted by clients**
- **FPS pools DS fetching transfers with local site as destination, updating catalog**
- **FTA maintains state of transfers and manages FTA**
- **Data scheduler has not been released with gLite 1.1**
 - So actually no replica can be performed with gLite DMS

LCG File Catalog (LFC)

- **Logical File Name (LFN)**
 - An alias created by a user to refer to some item of data, e.g. “lfn:cms/20030203/run2/track1”
- **Globally Unique Identifier (GUID)**
 - A non-human-readable unique identifier for an item of data, e.g. “guid:f81d4fae-7dec-11d0-a765-00a0c91e6bf6”
- **Site URL (SURL) (or Physical File Name (PFN) or Site FN)**
 - The location of an actual piece of data on a storage system, e.g. “srm://pcrd24.cern.ch/flatfiles/cms/output10_1” (SRM)
“sfn://lxshare0209.cern.ch/data/alice/ntuples.dat” (Classic SE)
- **Transport URL (TURL)**
 - Temporary locator of a replica + access protocol: understood by a SE, e.g. “rfio://lxshare0209.cern.ch//data/alice/ntuples.dat”



- **File catalogs in LCG:**

- They keep track of the location of copies (replicas) of Grid files
- The DM tools and APIs and the WMS interact with them

- **EDG's Replica Location Service (RLS, "old!")**

- Catalogs in use in LCG-2
- Replica Metadata Catalog (**RMC**) + Local Replica Catalog (**LRC**)
- Some performance problems detected during Data Challenges

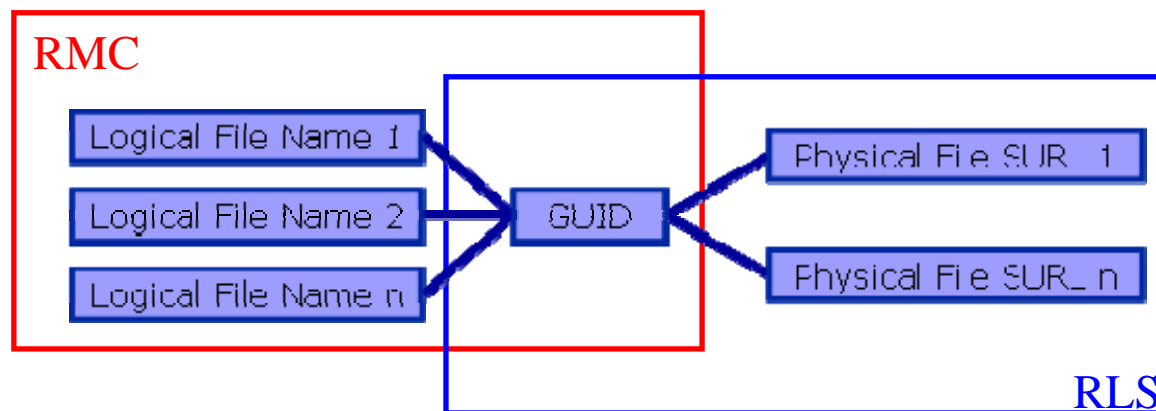
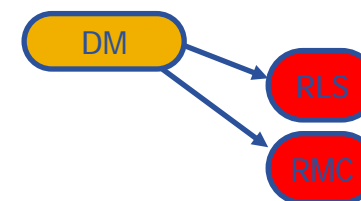
- **New LCG File Catalog (LFC, "current!")**

- In production in next LCG release; deployment in January 2005
- Coexistence with RLS; migration tools provided:

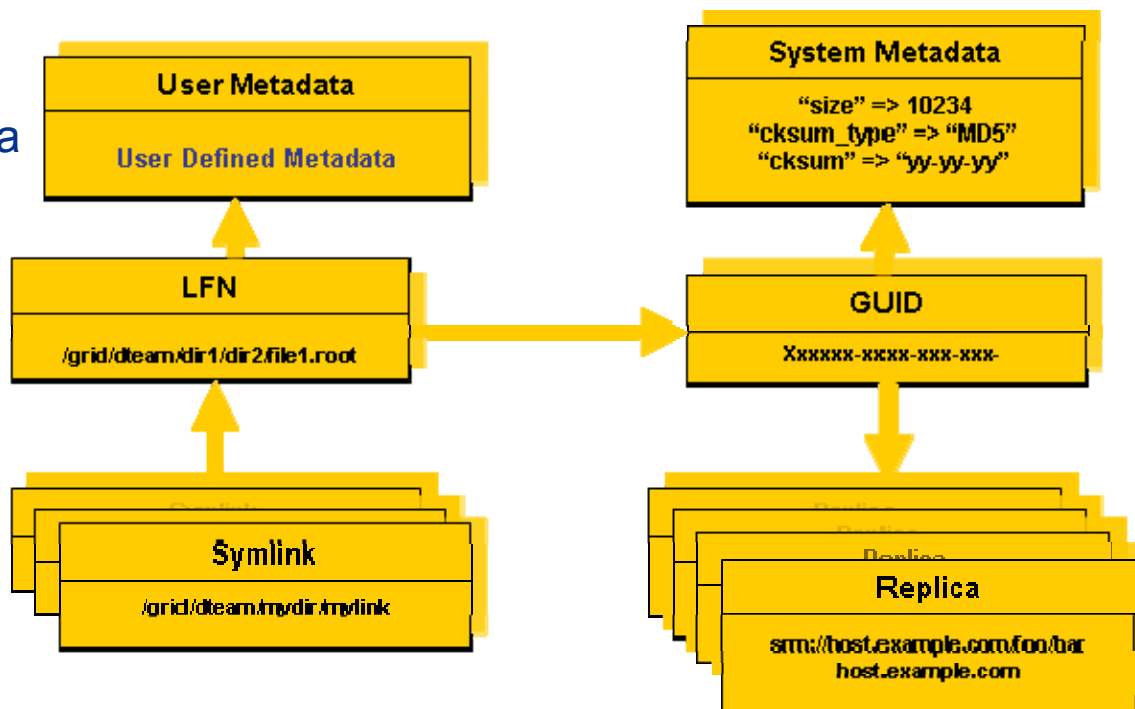
[http://goc.grid.sinica.edu.tw/gocwiki/How to migrate the RLS entries into the LCG File Catalog %28LFC%29](http://goc.grid.sinica.edu.tw/gocwiki/How%20to%20migrate%20the%20RLS%20entries%20into%20the%20LCG%20File%20Catalog%20%28LFC%29)

- Accessible by defining: \$LCG_CATALOG_TYPE=lfc and \$LFC_HOST
- Better performance and scalability
- Provides new features: security, hierarchical namespace, transactions...

- **RMC:**
 - Stores LFN-GUID mappings
 - Accessible by edg-rmc CLI + API
- **RLS:**
 - Stores GUID-SURL mappings
 - Accessible by edg-lrc CLI + API
- **Main weaknesses:**
 - Insecure (anyone can delete catalog entries)
 - Bad performance (java clients...)



- One single catalog
- LFN acts as main key in the database. It has:
 - Symbolic links to it (additional LFNs)
 - Unique Identifier (GUID)
 - System metadata
 - Information on replicas
 - One field of user metadata



- **Fixes EDG catalogs performance and scalability problems**
 - Cursors for large queries
 - Timeouts and retries from the client
- **Provides more features than the EDG Catalogs**
 - User exposed transaction API (+ auto rollback on failure)
 - Hierarchical namespace and namespace operations (for LFNs)
 - Integrated GSI Authentication + Authorization
 - Access Control Lists (Unix Permissions and POSIX ACLs)
 - Checksums
- **New features will be added soon (requests welcome!)**
 - Integration with VOMS, FiReMan
 - POOL Integration is in progress
 - Sessions
 - Bulk operations

- **LFC client commands**
 - Provide administrative functionality
 - Unix-like
 - LFNs seen as a Unix filesystem (/grid/<VO>/ ...)

- **LFC C API**
 - Alternative way to administer the catalog
 - Python wrapper provided

- **Integration with GFAL and lcg_util APIs complete**
 - lcg-utils access the catalog in a transparent way

- **Integration with the WMS completed**
 - The RB can locate Grid files: allows for data based match-making
 - Using the Data Location Interface
 - Not yet tested in production

- **lcg_utils: lcg-* commands + lcg_* API calls**
 - Provide (all) the functionality needed by the LCG user
 - Transparent interaction with file catalogs and storage interfaces when needed
 - Abstraction from technology of specific implementations
- **Grid File Access Library (GFAL): API**
 - Adds file I/O and explicit catalog interaction functionality
 - Still provides the abstraction and transparency of lcg_utils
- **edg-gridftp tools: CLI**
 - Complete the lcg_utils with low level GridFTP operations
 - Functionality available as API in GFAL
 - May be generalized as lcg-* commands

Replica Management

| | |
|----------------|---|
| lcg-cp | Copies a grid file to a local destination |
| lcg-cr | Copies a file to a SE and registers the file in the catalog |
| lcg-del | Delete one file |
| lcg-rep | Replication between SEs and registration of the replica |
| lcg-gt | Gets the TURL for a given SURL and transfer protocol |
| lcg-sd | Sets file status to “Done” for a given SURL in a SRM request |

File Catalog Interaction

| | |
|---------------|---|
| lcg-aa | Add an alias in LFC for a given GUID |
| lcg-ra | Remove an alias in LFC for a given GUID |
| lcg-rf | Registers in LFC a file placed in a SE |
| lcg-uf | Unregisters in LFC a file placed in a SE |
| lcg-la | Lists the alias for a given SURL, GUID or LFN |
| lcg-lg | Get the GUID for a given LFN or SURL |
| lcg-lr | Lists the replicas for a given GUID, SURL or LFN |

Low level methods (many POSIX-like):

| | | | |
|----------------|-----------------|-----------------|----------------|
| lfc_access | lfc_deleteclass | lfc_listreplica | lfc_setacl |
| lfc_aborttrans | lfc_delreplica | lfc_lstat | lfc_setatime |
| lfc_addreplica | lfc_endtrans | lfc_mkdir | lfc_setcomment |
| lfc_apiinit | lfc_enterclass | lfc_modifyclass | lfc_seterrbuf |
| lfc_chclass | lfc_errmsg | lfc_opendir | lfc_setsize |
| lfc_chdir | lfc_getacl | lfc_queryclass | lfc_starttrans |
| lfc_chmod | lfc_getcomment | lfc_readdir | lfc_stat |
| lfc_chown | lfc_getcwd | lfc_readlink | lfc_symlink |
| lfc_closedir | lfc_getpath | lfc_rename | lfc_umask |
| lfc_creat | lfc_lchown | lfc_rewind | lfc_undelete |
| lfc_delcomment | lfc_listclass | lfc_rmdir | lfc_unlink |
| lfc_delete | lfc_listlinks | lfc_selectsrvr | lfc_utime |
| | | | send2lfc |

Summary of the LFC Catalog 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 |

Managing ownership and permissions:

lfc-chmod

lfc-chown

Managing ACLs:

lfc-getacl

lfc-setacl

Remember that per user mapping can change in every session.

The default is for LFNs and directories to be VO-wide readable.

Consistent user mapping will be added soon.

Renaming:

lfc-rename

An LFN can only be removed if it has no SURLs associated.

Removing:

lfc-rm

LFNs should be removed by lcg-del, rather than lfc-rm.

- Information on the file catalogs
 - LFC, gfal, lcg-utils:
 - “Evolution of LCG-2 Data Management (J-P Baud, J. Casey)”
 - <http://indico.cern.ch/contributionDisplay.py?contribId=278&sessionId=7&confId=0>
 - LFC installation, administration, migration from RLS:
 - Wiki entries indicated through the presentation:
 - http://goc.grid.sinica.edu.tw/gocwiki/How_to_set_up_an_LFC_service
 - http://goc.grid.sinica.edu.tw/gocwiki/How_to_migrate_the_RLS_entries_into_the_LCG_File_Catalog_%28LFC%29
 - LFC contacts:
 - Jean-Philippe.Baud@cern.ch
 - Sophie.Lemaitre@cern.ch

File and Replica Management catalog (FiReMan) (the future)

- **Storage Element**
 - gLite **defines** the SE to have 3 interfaces:
 - Storage Resource Management (SRM) interface
 - Gridftp interface
 - Native I/O interface (rfio, dcap, nfs, ..)
 - LCG only requires the gridftp interface (“classic SE”)
- **gLite: SRM is mandatory for each SE**
- **POSIX-like I/O:**

GFAL:

- client-side interaction with the SRM, storage and catalogs
- user certificate is used
- no atomicity guarantee

gLite – I/O:

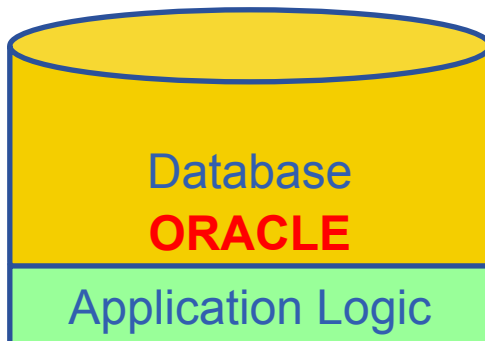
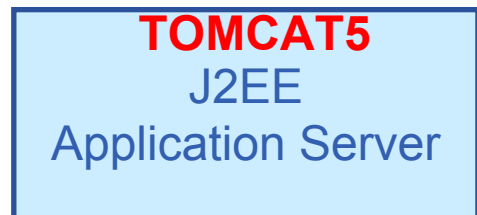
- provides a server to process SRM, native I/O and catalog interactions
- client delegates user credential to glite I/O server
- glite I/O **owns** files on SE

- **Managed File Transfer**
- **LCG provides command-line utilities through lcg-util to move data. All the operations are performed on the client.**
 - Blocking operation – client has to wait until the copy/replication is done
 - Scaling and Network resource management issue – if every job issues wide-area file movement operations from the worker nodes in a cluster, this will easily clog up the network
- **gLite provides services for asynchronous and bulk data movement**
 - File Transfer
 - File Placement (transfer including catalog registration)

- 2 independent implementations exist

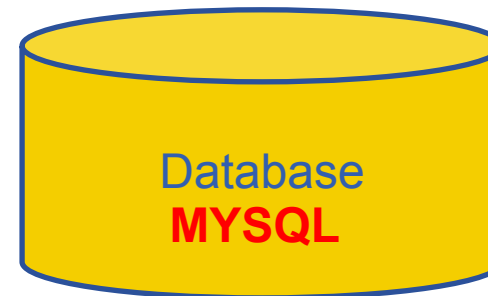
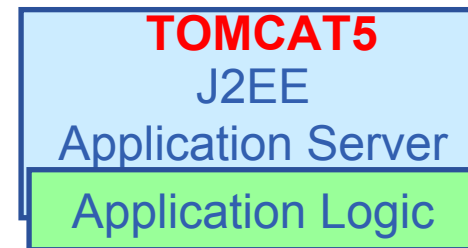
Oracle Implementation

- Catalog Logic lives inside Oracle as Stored Procedures
- Tomcat parses credential only, passes operations through to DB




MySQL Implementation

- Simple Table Structure using InnoDB tables
- Credential parsing and all of the logic is in Tomcat



- **Storage Element – common interface to storage**
 - Storage Resource Manager Castor, dCache, DPM, ...
 - POSIX-I/O gLite-I/O, rfio, dcap, xrootd
 - Access protocols gsiftp, https, rfio, ...

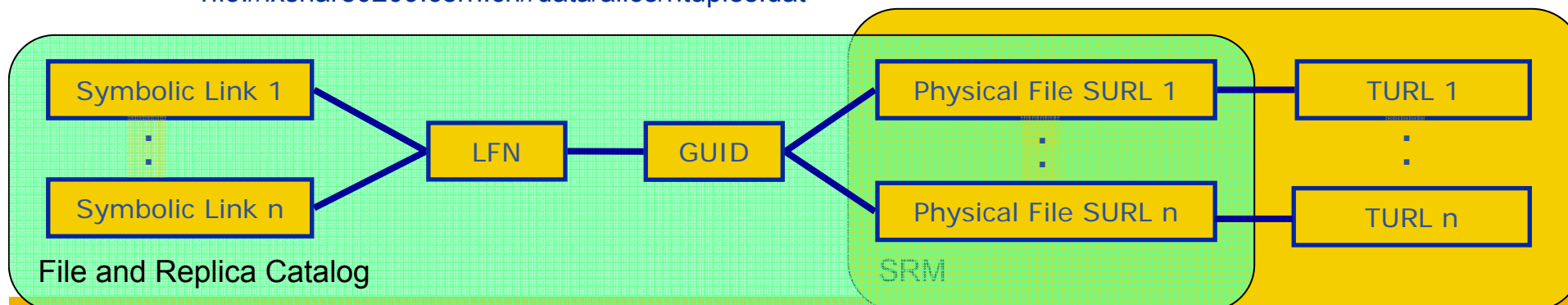
- **Catalogs – keep track where data is stored**
 - File Catalog
 - Replica Catalog
 - File Authorization Service
 - Metadata Catalog


 - gLite File and Replica Catalog
 - Globus RLS
 - Application specific catalogs

- **File Transfer – scheduled reliable file transfer**
 - Data Scheduler (only designs exist so far)
 - File Transfer Service gLite FTS and glite-url-copy;
(manages physical transfer) Globus RFT, Stork
 - File Placement Service gLite FPS
(FTS and catalog interaction in a transactional way)



- **Symbolic Link** in logical filename space
- **Logical File Name (LFN)**
 - An alias created by a user to refer to some item of data, e.g. “lfn:cms/20030203/run2/track1”
- **Globally Unique Identifier (GUID)**
 - A non-human-readable unique identifier for an item of data, e.g. “guid:f81d4fae-7dec-11d0-a765-00a0c91e6bf6”
- **Site URL (SURL) (or Physical File Name (PFN) or Site FN)**
 - The location of an actual piece of data on a storage system, e.g.
 - “srm://pcrd24.cern.ch/flatfiles/cms/output10_1” (SRM)
 - “sfn://lxshare0209.cern.ch/data/alice/ntuples.dat” (Classic SE)
- **Transport URL (TURL)**
 - Temporary locator of a replica + access protocol: understood by a SE, e.g. “rfio://lxshare0209.cern.ch//data/alice/ntuples.dat”



- **Web-services interface:** Guarantees client support on many platforms and many languages.
- **Standardization effort ongoing.** It is being managed through the EGEE PTF. Are provided:
 - **Linux Command Line tools**
 - **C/C++ API**
 - **Java API**
 - **Perl modules**
 - **JavaScript (for web clients)**
 - **gLite integrated bash (glitesh) – prototype**
- **Security:** Fine-grained ACL support with minimal performance penalty.
 - DNs own the files
 - VOMS group support
 - Basic Unix security (ugo rwx)
 - Additional ACLs for setPermission, list, remove, setMetadata, getMetadata

Summary of the Fireman Catalog commands

| | |
|--|--|
| <p>glite-catalog-chmod glite-catalog-setacl glite-catalog-setdefacl glite-catalog-setdefperm</p> | <p>Change access mode of the Fireman file/directory. Set the ACL, the default ACL and the default permission</p> |
| <p>glite-catalog-stat glite-catalog-getguid</p> | <p>List the details of a file – all attributes, replicas. Or just the associated GUID.</p> |
| <p>glite-catalog-setattr glite-catalog-getattr glite-catalog-setschema</p> | <p>Set/get metadata attribute and set the metadata schema of a given directory</p> |
| <p>glite-catalog-getacl glite-catalog-getdefacl</p> | <p>Get file/directory access control lists and default ACL</p> |
| <p>glite-catalog-symlink</p> | <p>Make a symbolic link to a file. Directory symlinks are not supported by design.</p> |

Summary of the Fireman Catalog commands

| | |
|---|---|
| glite-catalog-ls | List file/directory entries in a directory |
| glite-catalog-mkdir | Create a directory |
| glite-catalog-mv | Rename a file/directory |
| glite-catalog-rm glite-catalog-rmdir | Remove a file/directory |
| glite-catalog-getreplica | Get all replicas associated with a file/GUID |
| glite-catalog-touch glite-catalog-create | Create a new entry in the catalog/update the modification time |
| glite-catalog-find | Find entries based on their name pattern |
| glite-seindex-list | List all SEs having a replica of the given files |

API level methods:

| | |
|------------------------------------|---------------------------------------|
| glite_catalog_free | glite_catalog_guidstat_new |
| glite_catalog_get_endpoint | glite_catalog_guidstat_setchecksum |
| glite_catalog_get_errclass | glite_catalog_lfnstat_clone |
| glite_catalog_get_error | glite_catalog_lfnstat_copy |
| glite_catalog_new | glite_catalog_lfnstat_free |
| glite_catalog_set_default_perm | glite_catalog_lfnstat_freearray |
| glite_catalog_set_error | glite_catalog_lfnstat_new |
| glite_catalog_get_verror | glite_catalog_permission_addaclentry |
| glite_catalog_aclentry_clone | glite_catalog_permission_clone |
| glite_catalog_aclentry_free | glite_catalog_permission_deaclentry |
| glite_catalog_aclentry_freearray | glite_catalog_permission_free |
| glite_catalog_aclentry_new | glite_catalog_permission_freearray |
| glite_catalog_attribute_clone | glite_catalog_permission_new |
| glite_catalog_attribute_free | glite_catalog_permission_setgroupname |
| glite_catalog_attribute_freearray | glite_catalog_permission_setusername |
| glite_catalog_attribute_new | glite_catalog_rcentry_addsurl |
| glite_catalog_fcentry_clone | glite_catalog_rcentry_clone |
| glite_catalog_fcentry_free | glite_catalog_rcentry_free |
| glite_catalog_fcentry_freearray | glite_catalog_rcentry_freearray |
| glite_catalog_fcentry_new | glite_catalog_rcentry_new |
| glite_catalog_fcentry_setguid | glite_catalog_rcentry_setchecksum |
| glite_catalog_fcentry_update | glite_catalog_stat_clone |
| glite_catalog_fcentry_addsurl | glite_catalog_stat_free |
| glite_catalog_frcentry_clone | glite_catalog_stat_freearray |
| glite_catalog_frcentry_free | glite_catalog_stat_new |
| glite_catalog_frcentry_freearray | glite_catalog_surlentry_clone |
| glite_catalog_frcentry_new | glite_catalog_surlentry_free |
| glite_catalog_frcentry_setchecksum | glite_catalog_surlentry_freearray |
| glite_catalog_frcentry_setguid | glite_catalog_surlentry_new |
| glite_catalog_guidstat_clone | glite_fireman_expand_path |
| glite_catalog_guidstat_copy | glite_fireman_get_locate_limit |
| glite_catalog_guidstat_free | glite_fireman_get_query_limit |
| glite_catalog_guidstat_freearray | glite_fireman_get_readdir_limit |

| | |
|--|---|
| glite_fireman_getinterfaceversion | glite_fireman_setattributes |
| glite_fireman_getschemaversion | glite_fireman_setdefaultglobalpermission |
| glite_fireman_getservicemetadata | glite_fireman_setdefaultprincipalpermission |
| glite_fireman_getversion | glite_fireman_setmasterreplica |
| glite_fireman_checkpermission | glite_fireman_updateguidstat |
| glite_fireman_getpermission | glite_fireman_updatestatus |
| glite_fireman_setpermission | glite_fireman_updatesurlstat |
| glite_fireman_createfile | glite_fireman_addreplica |
| glite_fireman_getfilecatalogentry | glite_fireman_associatedirwithschema |
| glite_fireman_getguidforlfn | glite_fireman_create |
| glite_fireman_getlfnforguid | glite_fireman_getstat |
| glite_fireman_locate | glite_fireman_listlfn |
| glite_fireman_mkdir | glite_fireman_listreplicas |
| glite_fireman_mv | glite_fireman_remove |
| glite_fireman_readdir | glite_fireman_remove replica |
| glite_fireman_rmdir | glite_seindex_getinterfaceversion |
| glite_fireman_symlink | glite_seindex_getschemaversion |
| glite_fireman_unlink | glite_seindex_getversion |
| glite_fireman_updatemodifytime | glite_seindex_listsebyguid |
| glite_fireman_updatevaliditytime | glite_seindex_listsebylfn |
| glite_fireman_addguidreplica | glite_conf_value |
| glite_fireman_clearattributes | glite_config_file |
| glite_fireman_createguid | glite_discover_endpoint |
| glite_fireman_getattributes | glite_freestringarray |
| glite_fireman_getdefaultglobalpermission | glite_location |
| glite_fireman_getdefaultprincipalpermission | glite_location_log |
| glite_fireman_getguidforsurl | glite_location_var |
| glite_fireman_getguidstat | glite_pkg_var |
| glite_fireman_getmasterreplica | glite_tmp |
| glite_fireman_getsurlstat | glite_uri_free |
| glite_fireman_hasguid | glite_uri_new |
| glite_fireman_listattributes | |
| glite_fireman_listreplicasbyguid | |
| glite_fireman_listsurlsbyguid | |
| glite_fireman_query | |
| glite_fireman_removeguid | |
| glite_fireman_removeguidreplica | |

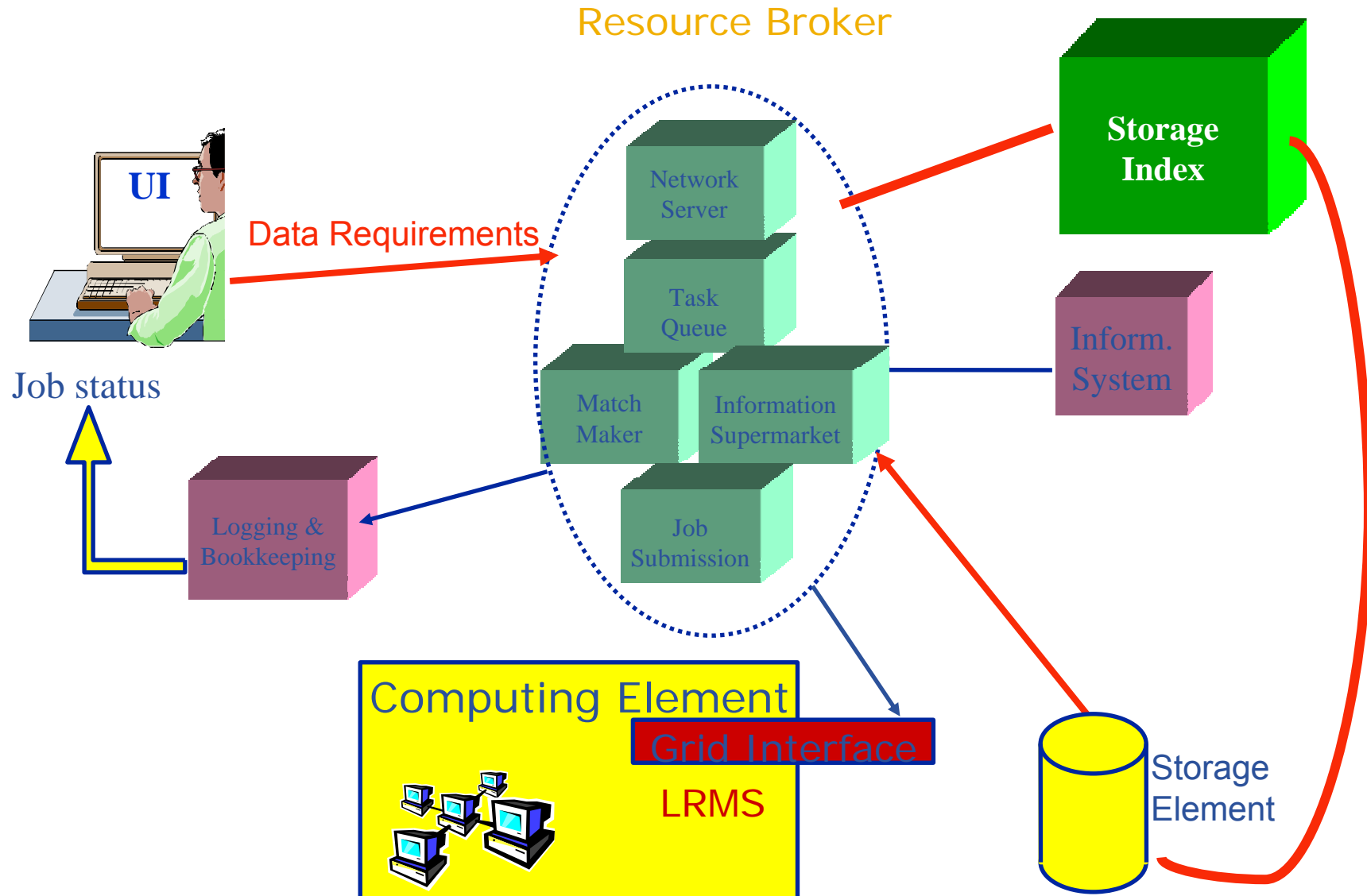
RED methods also have bulk versions

Summary of the gLite I/O command line tools

| | |
|------------------------|--|
| <code>glite-get</code> | Retrieve a file from the Grid using LFN or GUID |
| <code>glite-put</code> | Put a local file into the Grid, assigning LFN |
| <code>glite-rm</code> | Remove a file (replica!) from the Grid using LFN or GUID |

Summary of the gLite I/O API calls (C only)

| | |
|-----------------------------|---------------------------------|
| <code>glite_open</code> | <code>glite_posix_open</code> |
| <code>glite_read</code> | <code>glite_posix_read</code> |
| <code>glite_write</code> | <code>glite_posix_write</code> |
| <code>glite_creat</code> | <code>glite_posix_creat</code> |
| <code>glite_fstat</code> | <code>glite_posix_fstat</code> |
| <code>glite_lseek</code> | <code>glite_posix_lseek</code> |
| <code>glite_close</code> | <code>glite_posix_close</code> |
| <code>glite_unlink</code> | <code>glite_posix_unlink</code> |
| <code>glite_error</code> | <code>glite_filehandle</code> |
| <code>glite_strerror</code> | |



```
[
Executable = "helloCSC.sh";
StdOutput = "Message.txt";
StdError = "stderr.log";
StorageIndex = "http://lxb2028.cern.ch:8080/EGEE/glite-data-
catalog-service-fr/services/SEIndex";
InputData = "lfn:///tmp/testCSC";
DataAccessProtocol = "gridftp,gliteio";
InputSandbox = {"helloGet.sh"},
OutputSandbox = {"Message.txt", "stderr.log", "testfile.txt"};
]
```

Endpoint of the Catalog
(StorageIndex interface)

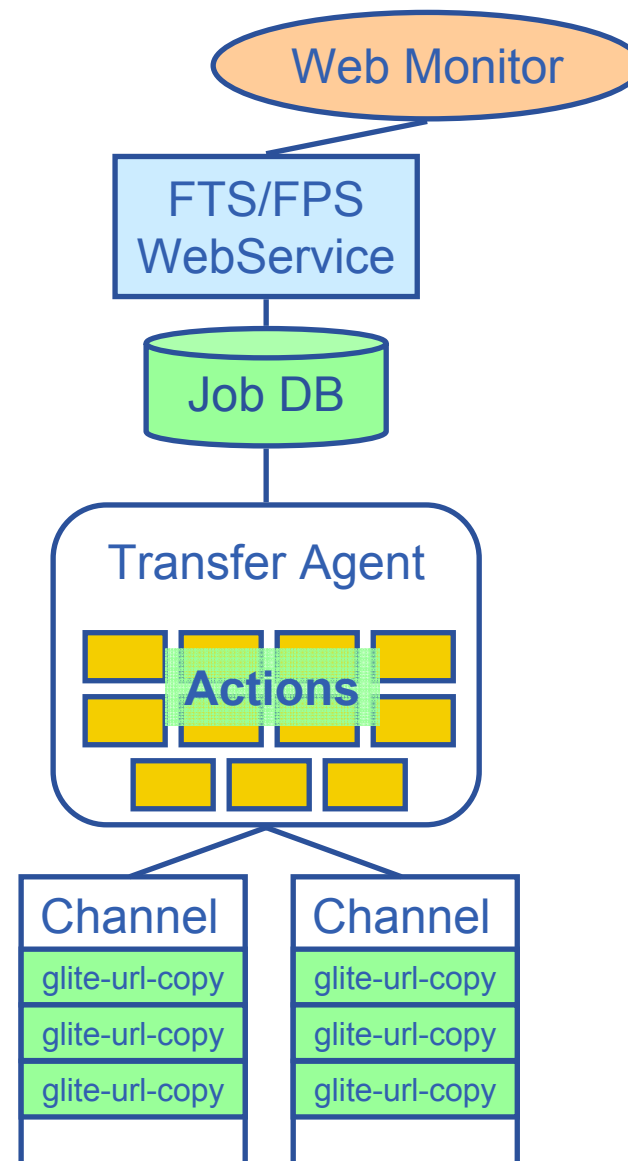
LFN of the file needed

Access protocol used

- Many Grid applications will distribute a LOT of data across the Grid sites
- Need efficient and easy to manage File movement service
- **gLite File Transfer Service FTS**
 - Manage the network and the storage at both ends
 - Define the concept of a CHANNEL: a link between two SEs
 - Channels can be managed by the channel administrators, i.e. the people responsible for the network link and storage systems
 - These are potentially different people for different channels
 - Optimize channel bandwidth usage – lots of parameters that can be tuned by the administrator
 - VOs using the channel can apply their own internal policies for queue ordering (i.e. professor's transfer jobs are more important than student's)
- **gLite File Placement Service**
 - It **IS** an FTS with the additional catalog lookup and registration steps, i.e. LFNs and GUIDs can be used to perform replication. Could've been called File Replication Service. (**replica = managed/catalogued copy**)

- **GridFTP is the basis of most transfer systems**
- **Retry functionality is limited**
 - Only retries in case of network problems; no possibility to recover from GridFTP a server crash
- **GridFTP handles one transfer at a time**
 - No possibility to do bulk optimization
 - No possibility to schedule parallel transfers
- **Need a layer on top of GridFTP that provides reliable scheduled file transfer**
 - FTS/FPS
 - Globus RFT (layer on top of single gridftp server)
 - Condor Stork

- **File Transfer/Placement Service (FTS,FPS)**
 - Transfer Job Database
 - Exposes the Transfer Web Service Interface to which user clients talk (submit, cancel, status capability)
 - Has a Web Interface
 - Manages Catalog updates if necessary
- **Transfer Agent**
 - Basic Actions
 - Get transfer jobs from Transfer Job Database
 - Manages transfer over many channels
 - Monitors transfer status and updates Transfer Job Database
 - Extensible with user-defined custom actions
 - Retry Policy
- **Transfer Service (glite-url-copy)**
 - Actually performs transfer: SRM – SRM, gsiftp – SRM, gsiftp – gsiftp
 - Monitor capability, including gsiftp performance markers

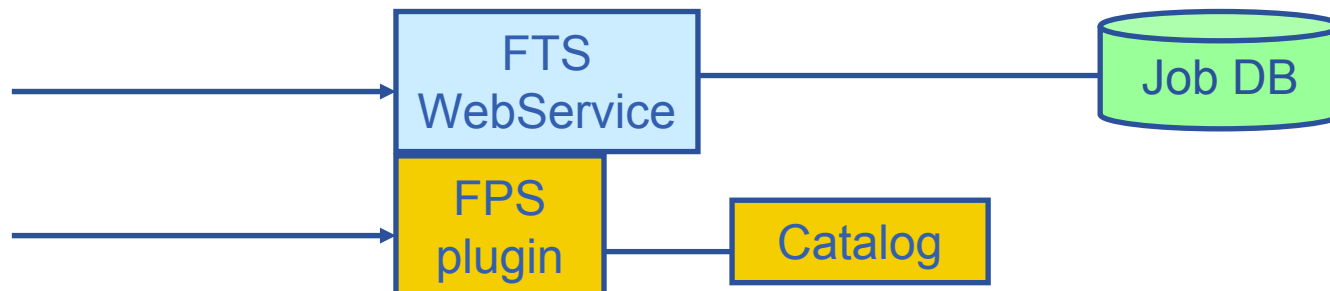


- **File Transfer Service (FTS)**

- Acts only on SRM SURLs or gsiftp URLs
- `submit(source-SURL, destination-SURL)`

- **File Placement Service (FPS)**

- A plug-in into the File Transfer that allows to act on logical file names (LFNs)
- Interacts with replica catalogs (similar to gLite-I/O)
- Registers replicas in the catalog
- `submit(transferJobs)` (`transferJob = sourceLFN, destinationSE`)



Summary of the FTS/FPS commands

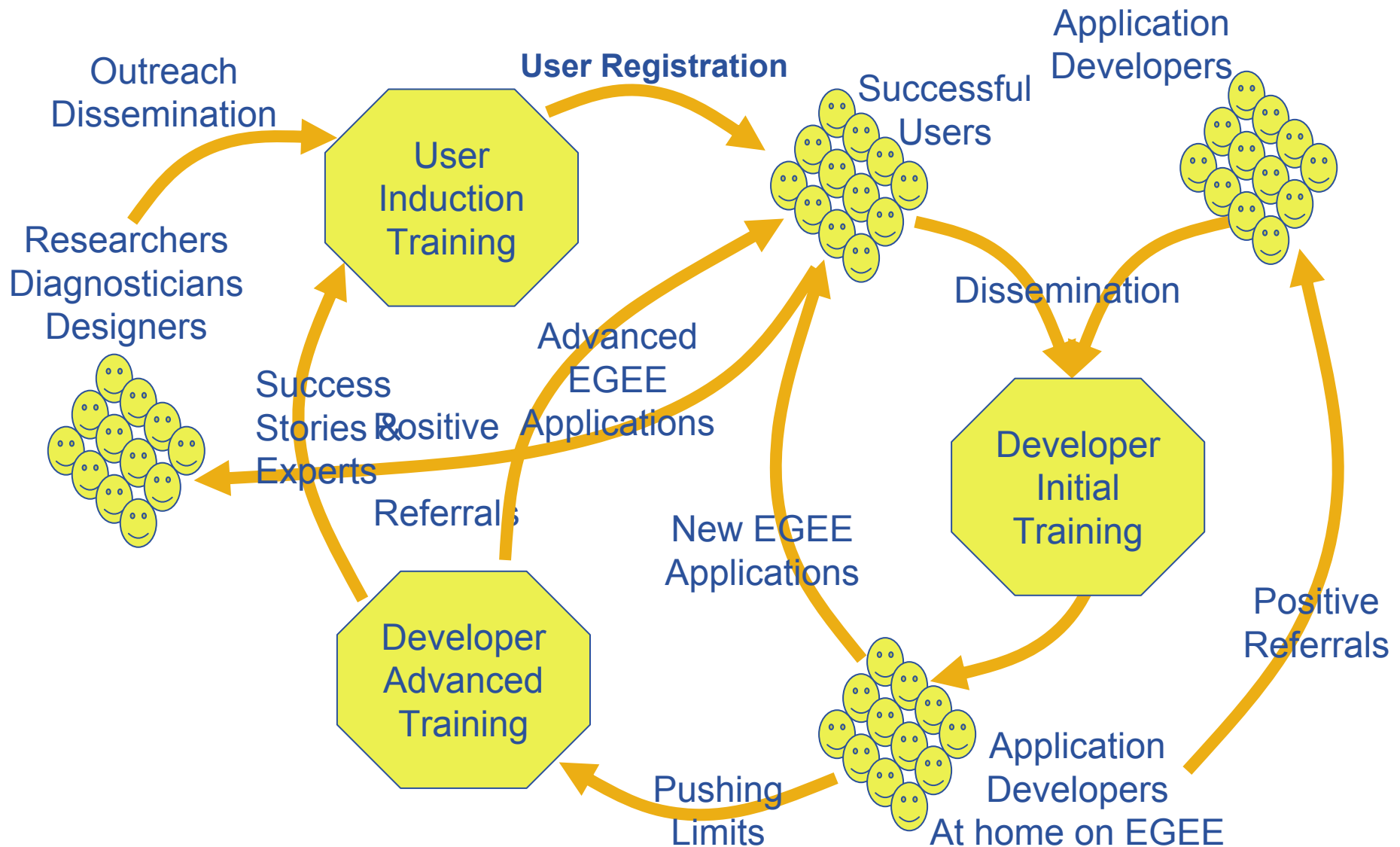
| | |
|---|---|
| glite-transfer-submit | Submit a transfer job, consisting of source/target pairs. |
| glite-transfer-cancel | Cancel an existing job |
| glite-transfer-status | Retrieve the status of a transfer job |
| glite-transfer-list | List jobs |
| glite-transfer-channel | Get all replicas associated with a file/GUID |
| glite-catalog-touch glite-catalog-create | Create a new entry in the catalog/update the modification time |
| glite-catalog-find | Find entries based on their name pattern |
| glite-seindex-list | List all SEs having a replica of the given files |

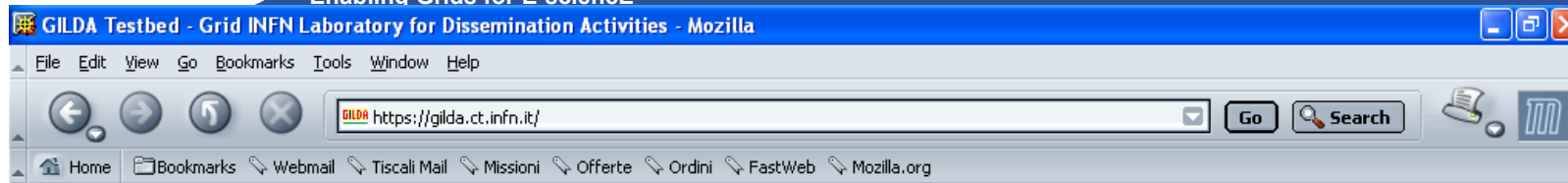
API is also available in C and Java (WSDL-autogenerated)

- **Using the File Transfer Service (FTS)**
 - Lookup source SURL in replica catalog
 - Initiate and monitor transfer
 - After successful transfer register new replica in the catalog
- **Using the File Placement Service (FPS)**
 - Initiate and monitor transfer
 - Plugin takes care of catalog interactions
- **FTS and FPS offer the same interface**
 - Difference only in input parameters to the submit command
 - SURLs vs. LFNs
 - Different configuration
 - FPS requires catalog endpoint

- **gLite homepage**
 - <http://www.glite.org>
- **DM subsystem documentation**
 - <http://egee-jra1-dm.web.cern.ch/egee-jra1-dm/doc.htm>
- **FiReMan catalog user guide**
 - <https://edms.cern.ch/file/570780/1/EGEE-TECH-570780-v1.0.pdf>
- **gLite-I/O user guide**
 - <https://edms.cern.ch/file/570771/1.1/EGEE-TECH-570771-v1.1.pdf>
- **FTS/FPS user guide**
 - <https://edms.cern.ch/file/591792/1/EGEE-TECH-591792-Transfer-CLI-v1.0.pdf>

The GILDA t-Infrastructure






GILDA (G rid I nfn L aboratory for D issemination A ctivities)

is a virtual laboratory to demonstrate/disseminate the strong capabilities of grid computing.

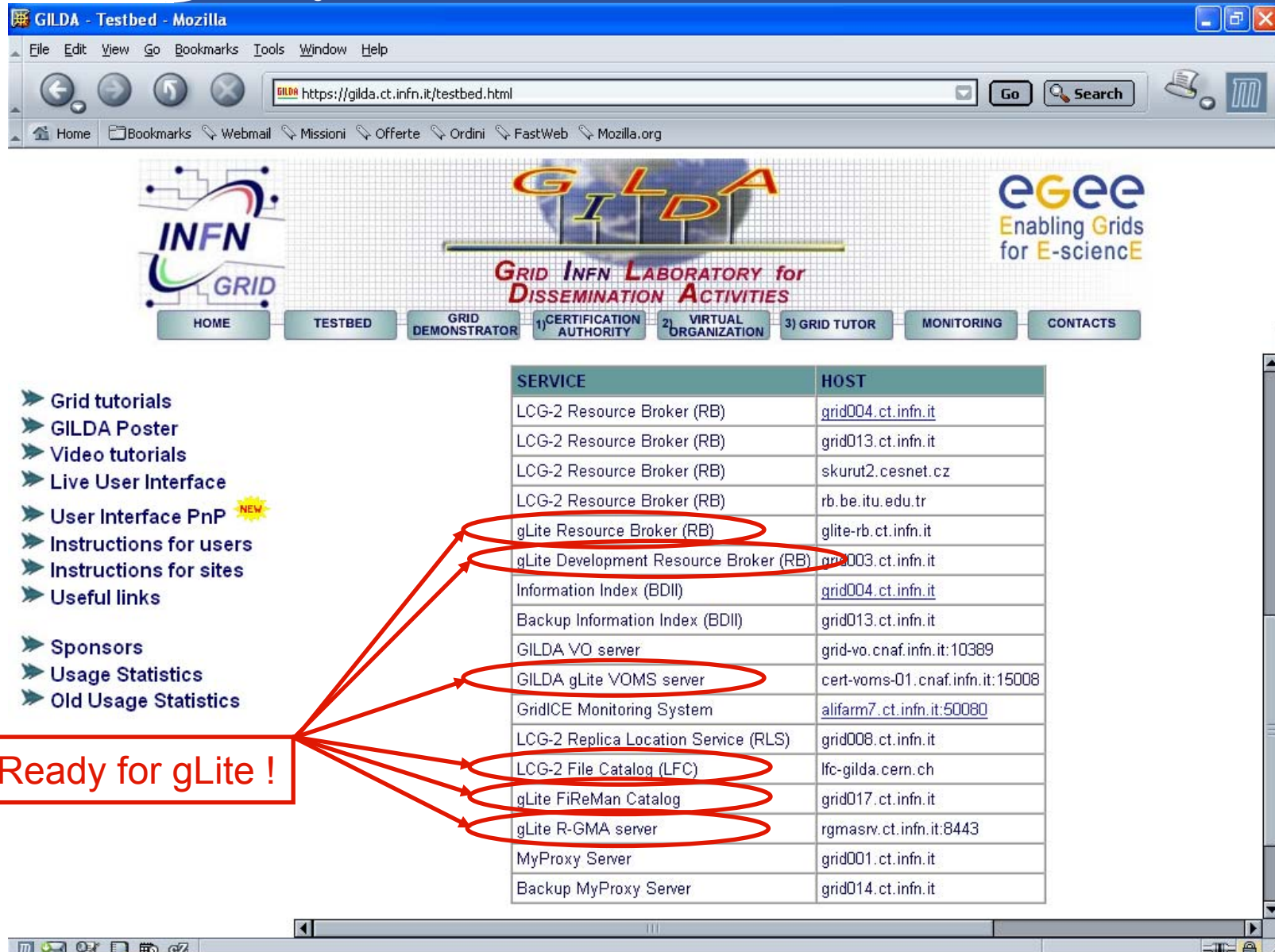
GILDA consists of the following elements:

- Grid tutorials
- GILDA Poster
- Video tutorials
- Live User Interface
- User Interface PnP 
- Instructions for users
- Instructions for sites
- Useful links
- Sponsors
- Usage Statistics
- Old Usage Statistics

- **the GILDA Testbed:** a series of sites and services (Resource Broker, Information Index, Data Managers, Monitoring tool, Computing Elements, and Storage Elements) spread all over Italy and the rest of the world on which the latest version of both the [INFN Grid](#) middle-ware (fully compatible with [LCG](#) middle-ware) and the [gLite](#)  middle-ware are installed;
- **the Grid Demonstrator:** a customized version of the full [GENIUS web portal](#), jointly developed by INFN and [NICE](#), from where **everybody** can submit a pre-defined set of applications to the GILDA Testbed;
- **the GILDA Certification Authority:** a fully functional Certification Authority which issues 14-days X.509 certificates to everybody wanting to experience grid computing on the GILDA Testbed;
- **the GILDA Virtual Organization:** a Virtual Organization gathering all people wanting to experience grid computing on the GILDA Testbed; GILDA also runs the [Virtual Organization Membership Service](#) (VOMS) developed by INFN;
- **the Grid Tutor:** based on a full version of the [GENIUS web portal](#), to be used only during [grid tutorials](#);
- **the monitoring system:** a versatile monitoring system completely based on [GridICE](#), the grid monitoring tool developed by INFN;
- **the GILDA mailing list:** gilda@infn.it, also archived on the web [here](#).



~15 sites in 3 continents !

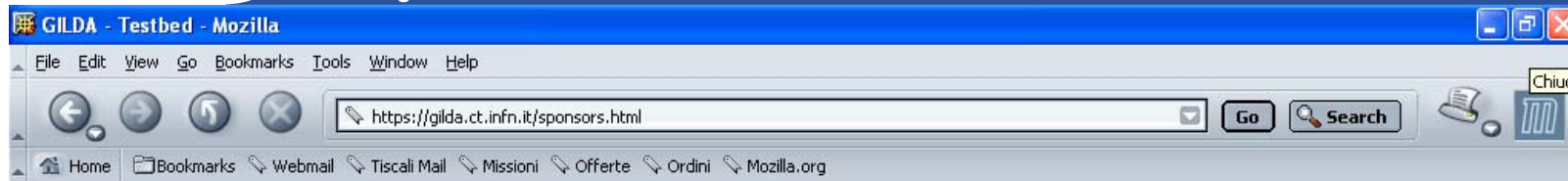


[HOME](#)
[TESTBED](#)
[GRID DEMONSTRATOR](#)
[1\) CERTIFICATION AUTHORITY](#)
[2\) VIRTUAL ORGANIZATION](#)
[3\) GRID TUTOR](#)
[MONITORING](#)
[CONTACTS](#)

- Grid tutorials
- GILDA Poster
- Video tutorials
- Live User Interface
- User Interface PnP ★ NEW
- Instructions for users
- Instructions for sites
- Useful links
- Sponsors
- Usage Statistics
- Old Usage Statistics

| SERVICE | HOST |
|--|---|
| LCG-2 Resource Broker (RB) | grid004.ct.infn.it |
| LCG-2 Resource Broker (RB) | grid013.ct.infn.it |
| LCG-2 Resource Broker (RB) | skurut2.cesnet.cz |
| LCG-2 Resource Broker (RB) | rb.be.itu.edu.tr |
| gLite Resource Broker (RB) | glite-rb.ct.infn.it |
| gLite Development Resource Broker (RB) | grid003.ct.infn.it |
| Information Index (BDII) | grid004.ct.infn.it |
| Backup Information Index (BDII) | grid013.ct.infn.it |
| GILDA VO server | grid-vo.cnaf.infn.it:10389 |
| GILDA gLite VOMS server | cert-voms-01.cnaf.infn.it:15008 |
| GridICE Monitoring System | alifarm7.ct.infn.it:50080 |
| LCG-2 Replica Location Service (RLS) | grid008.ct.infn.it |
| LCG-2 File Catalog (LFC) | lfc-gilda.cern.ch |
| gLite FiReMan Catalog | grid017.ct.infn.it |
| gLite R-GMA server | rgmasrv.ct.infn.it:8443 |
| MyProxy Server | grid001.ct.infn.it |
| Backup MyProxy Server | grid014.ct.infn.it |

Ready for gLite !



GILDA is sponsored by:





The GILDA Certification Authority

GRID INFN LABORATORY for DISSEMINATION ACTIVITIES

- [General information](#)
- [GILDA CA certificate](#)
- [Request a personal certificate](#)
- [Request an account](#)
- [Request a host certificate](#)
- [Renew a certificate](#)
- [Check a personal certificate](#)
- [Certificate Revocation List](#)

The **GILDA Certification Authority** (GILDA CA) issues temporary (two weeks) personal public key certificates (compliant with the X.509 standard) in order to access the GILDA Testbed.

Absolutely no identity check is going to be performed on the requester, so the personal certificates issued by the GILDA CA have absolutely no value on any real production Grid Infrastructure.

The **GILDA Certification Authority** is managed by:

Giuseppe Platania
INFN Catania
Via S. Sofia, 64
I-95123 Catania
ITALY

e-mail: gilda-ca@ct.infn.it
Tel: +39 095 378 5469
Fax: +39 095 378 5231

In order to inspect the GILDA CA certificate and/or save it in your web browser (necessary to validate your personal certificate) click on **GILDA CA certificate** in the left part of this page.

In order to request a certificate, click on **Request a personal certificate** in the left part of this page.

If you already have a trusted personal certificate, click on **Request an account**, in the left part of this page, to request an account. Your personal certificate must be included in your browser before doing this.

In order to request a host certificate, click on **Request a host certificate** in the left part of this page.



The GILDA Certification Authority

Enabling Grids for E-science

Request a GILDA CA personal certificate - Mozilla

File Edit View Go Bookmarks Tools Window Help

https://gilda.ct.infn.it/CA/mgt/restricted/ucert.php

Home Bookmarks mozilla.org mozillaZine mozdev.org

- Request an account
- Request a host certificate
- Check a personal certificate
- Certificate Revocation List

In order to correctly generate a request it is mandatory to fill **all** fields in the form below. Please, double check the correctness of the e-mail address that you are going to provide since **no verification** will be performed by the server.

The password you are prompted about in the form below is the password of your personal account on the **GENIUS Portal** from where you will access the GILDA Testbed and it is **NOT** the passphrase of your personal certificate.

When the certificate will be signed by the GILDA CA manager you will be notified by e-mail with the instructions to download your GILDA CA personal certificate and access the GILDA Testbed.



| | |
|---|--|
| Institute/University/Company: | <input type="text"/> |
| First name and last name: | <input type="text"/> |
| Account username (max 8 characters; only not-accented letters and digits are allowed, both lowercase and uppercase): | <input type="text"/> |
| Account password (only not-accented letters and digits are allowed, both lowercase and uppercase): | <input type="password"/> |
| Confirm account password (only not-accented letters and digits are allowed, both lowercase and uppercase): | <input type="password"/> |
| E-mail: | <input type="text"/> |
| KeySize: | 2048 (High Grade) <input type="button" value="v"/> |

GILDA Testbed - Grid INFN Laboratory for Dissemination Activities - Mozilla

File Edit View Go Bookmarks Tools Window Help

https://gilda.ct.infn.it/ Go Search


Home Bookmarks Webmail Tiscali Mail Missioni Offerte Ordini Mozilla.org

GRID INFN LABORATORY for DISSEMINATION ACTIVITIES

HOME TESTBED GRID DEMONSTRATOR 1) CERTIFICATION AUTHORITY 2) VIRTUAL ORGANIZATION 3) GRID TUTOR MONITORING CONTACTS

- Grid tutorials
- GILDA Poster
- Video tutorials **NEW**
- Live User Interface
- User Interface PnP **NEW**
- Instructions for users
- Instructions for sites
- Useful links
- Sponsors
- Usage Statistics
- Old Usage Statistics



[Registration Form](#)

Nome e cognome / First name and family name:

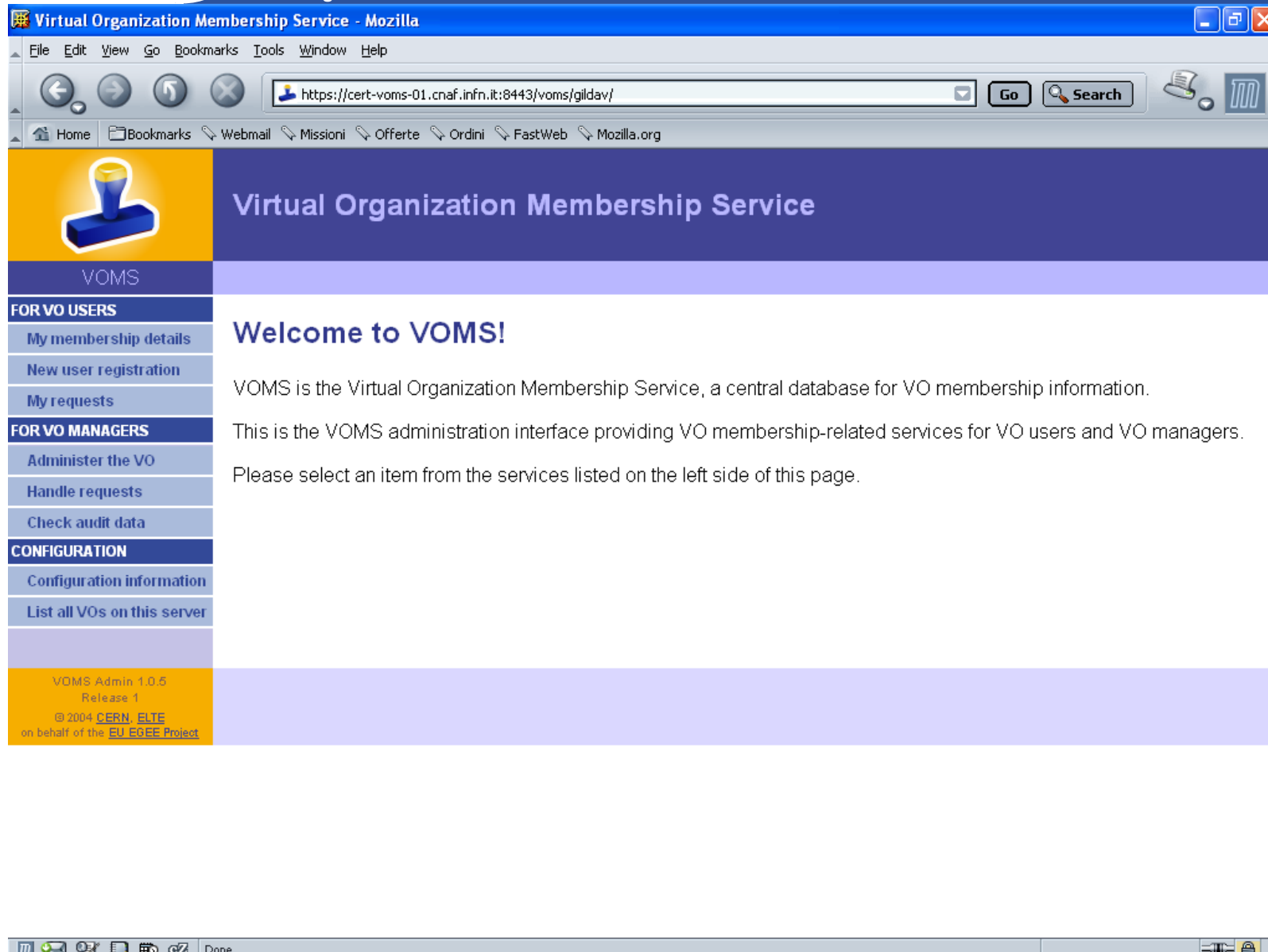
Istituto/Institute:

Telefono/Phone number:

E-mail:

Selezione VO / VO choice:

La sottomissione della domanda implica l'obbligo ad un corretto uso delle risorse messe a disposizione dell'utente.



Virtual Organization Membership Service

VOMS

FOR VO USERS

- My membership details
- New user registration
- My requests

FOR VO MANAGERS

- Administer the VO
- Handle requests
- Check audit data

CONFIGURATION

- Configuration information
- List all VOs on this server

Welcome to VOMS!

VOMS is the Virtual Organization Membership Service, a central database for VO membership information.

This is the VOMS administration interface providing VO membership-related services for VO users and VO managers.

Please select an item from the services listed on the left side of this page.

VOMS Admin 1.0.5
Release 1
© 2004 CERN, ELTE
on behalf of the EU EGEE Project



Enabling Grids for E-science

The GILDA Monitoring System (http://alifarm7.ct.infn.it:50080/gridice)

GILDA - GridICE - Grid Monitoring Service - Mozilla

http://alifarm7.ct.infn.it:50080/gridice/site.php

Site view VO view Job Monitoring Geo view Gris view

Site view::ALL >> Summary

| Site | GK# | CE# | RunJob | WaitJob | JobLoad | SlotLoad | Power | WN# | CPU# | CPUload | Available |
|---------------|-----------|-----------|----------|-----------|------------|------------|------------|-----------|-----------|------------|---------------|
| be.itu.edu.tr | 1 | 3 | 3 | 0 | 100% | 100% | - | - | - | - | 139.2 Gb |
| cesnet.cz | 1 | 1 | 0 | 0 | - | - | - | - | - | - | 3 Tb |
| cnaf.infn.it | 1 | 4 | 0 | 1 | 0% | 0% | 6K | 1 | 2 | 0% | 13.4 Gb |
| ct.astro.it | 1 | 4 | 0 | 17 | 0% | 0% | 4K | 1 | 1 | 0% | 104.5 Gb |
| ct.infn.it | 2 | 7 | 0 | 0 | 0% | 0% | - | - | - | - | 1.4 Tb |
| grid.unipg.it | 1 | 3 | 0 | 0 | 0% | 0% | 20K | 8 | 10 | 3% | 7.3 Gb |
| na.astro.it | 1 | 4 | 0 | 0 | 0% | 0% | - | - | - | - | 213.8 Gb |
| pd.infn.it | 1 | 4 | 2 | 6 | 20% | 0% | 8K | 2 | 4 | 5% | 498.6 Gb |
| ui.savba.sk | 1 | 4 | 0 | 0 | 0% | 0% | 19K | 4 | 4 | 0% | 68.5 Gb |
| TOTAL | 10 | 34 | 5 | 24 | 15% | 12% | 56K | 16 | 21 | 18% | 5.4 Tb |

Generated: Fri, 6 May 2005 12:28:49 +0200

GILDA - GridICE - Grid Monitoring Service - Mozilla

http://alifarm7.ct.infn.it:50080/gridice/vo_details.php?voName=gilda&visi

Site view VO view Job Monitoring Geo view Gris view

VO view::gilda >> Core Services >> Computing Resources

Computing Resources Storage Resources

| Computing Element ID | Site | Free Slots | Total Slots |
|--|---------------|------------|-------------|
| cn01.be.itu.edu.tr:2119/jobmanager-lcglsf-infinite | be.itu.edu.tr | 0 | 2 |
| cn01.be.itu.edu.tr:2119/jobmanager-lcglsf-long | be.itu.edu.tr | 0 | 2 |
| cn01.be.itu.edu.tr:2119/jobmanager-lcglsf-short | be.itu.edu.tr | 0 | 2 |
| skurut1.cesnet.cz:2119/jobmanager-lcgpbs-gilda | cesnet.cz | 0 | 0 |
| grid011f.cnaf.infn.it:2119/jobmanager-lcgpbs-cert | cnaf.infn.it | 2 | 2 |
| grid011f.cnaf.infn.it:2119/jobmanager-lcgpbs-infinite | cnaf.infn.it | 2 | 2 |
| grid011f.cnaf.infn.it:2119/jobmanager-lcgpbs-long | cnaf.infn.it | 2 | 2 |
| grid011f.cnaf.infn.it:2119/jobmanager-lcgpbs-short | cnaf.infn.it | 2 | 2 |
| gildace.ct.astro.it:2119/jobmanager-lcgpbs-infinite | ct.astro.it | 1 | 1 |
| gildace.ct.astro.it:2119/jobmanager-lcgpbs-long | ct.astro.it | 1 | 1 |
| gildace.ct.astro.it:2119/jobmanager-lcgpbs-short | ct.astro.it | 1 | 1 |
| ce-test.ct.infn.it:2119/jobmanager-lcglsf-infinite | ct.infn.it | 8 | 8 |
| ce-test.ct.infn.it:2119/jobmanager-lcglsf-long | ct.infn.it | 8 | 8 |
| ce-test.ct.infn.it:2119/jobmanager-lcglsf-short | ct.infn.it | 8 | 8 |
| grid010.ct.infn.it:2119/jobmanager-lcgpbs-infinite | ct.infn.it | 19 | 19 |
| grid010.ct.infn.it:2119/jobmanager-lcgpbs-long | ct.infn.it | 19 | 19 |
| grid010.ct.infn.it:2119/jobmanager-lcgpbs-short | ct.infn.it | 19 | 19 |
| ce.grid.unipg.it:2119/jobmanager-lcgpbs-infinite | grid.unipg.it | 16 | 16 |
| ce.grid.unipg.it:2119/jobmanager-lcgpbs-long | grid.unipg.it | 16 | 16 |
| ce.grid.unipg.it:2119/jobmanager-lcgpbs-short | grid.unipg.it | 16 | 16 |
| grid4.na.astro.it:2119/jobmanager-lcgpbs-cert | na.astro.it | 7 | 7 |
| grid4.na.astro.it:2119/jobmanager-lcgpbs-infinite | na.astro.it | 7 | 7 |
| grid4.na.astro.it:2119/jobmanager-lcgpbs-long | na.astro.it | 7 | 7 |
| grid4.na.astro.it:2119/jobmanager-lcgpbs-short | na.astro.it | 7 | 7 |
| gilda-ce-01.pd.infn.it:2119/jobmanager-lcgpbs-infinite | pd.infn.it | 2 | 2 |

Computing Resources Storage Resources

| Storage Element ID | Storage Space ID | Site | Free Space | Used Space |
|-------------------------|------------------|---------------|------------|------------|
| cn02.be.itu.edu.tr | gilda:gilda | be.itu.edu.tr | 139.22 Gb | 32 Mb |
| testbed005.cnaf.infn.it | gilda:gilda | cnaf.infn.it | 13.44 Gb | 1.89 Gb |
| gildase.ct.astro.it | gilda:gilda | ct.astro.it | 104.54 Gb | 1.92 Gb |
| grid009.ct.infn.it | gilda:gilda | ct.infn.it | 1.38 Tb | 638.26 Gb |
| alifarm12.ct.infn.it | gilda:gilda | ct.infn.it | 22.19 Gb | 2.68 Gb |
| se.grid.unipg.it | gilda:gilda | grid.unipg.it | 7.33 Gb | 1.79 Gb |
| grid3.na.astro.it | gilda:gilda | na.astro.it | 213.79 Gb | 3.23 Gb |
| gilda-se-01.pd.infn.it | gilda:gilda | pd.infn.it | 498.59 Gb | 727 Mb |
| dgt02.ui.savba.sk | gilda:gilda | ui.savba.sk | 68.54 Gb | 145 Mb |

Generated: Fri, 6 May 2005 12:49:01 +0200

GridICE Homepage



The Grid Tutor

(<https://grid-tutor.ct.infn.it>, <https://glite-tutor.ct.infn.it>)




Enabling Grids for E-science

Welcome to the GENIUS INFN GRID Portal - Mozilla

File Edit View Go Bookmarks Tools Window Help

https://grid-tutor.ct.infn.it/

Home Bookmarks Webmail Tiscali Mail Missioni Offerte Ordini FastWeb Mozilla.org

Grid Enabled web eNvironment for site Independent User job Submission

Welcome to GENIUS

[Important Notice](#)
[GENIUS User's Guide \(pdf\)](#)
[New Grid Authentication with MyProxy](#)
[GENIUS MyProxy Server Installation](#)
[GENIUS CVS Available](#)
[GENIUS Mailing List](#)
[GENIUS Mailing Archive \(Help on Majordomo Commands\)](#)
[GRID MOVIE](#)
[Useful Links](#)
[Credits](#)

This portal is best viewed with Mozilla 1.6.
 Netscape (4.79, 4.80, 6 and higher) and Internet Explorer (5 or higher) can also be used.
 The use of any other web browsers could induce some visualization mismatches and is not currently suggested.
 GENIUS is based on Apache 1.3.31 and OpenSSL 0.9.7d.
 Last update: Tue 12 April 2005

powered by
[EnginFrame 3.2](#)
 compliant with
[LCG-2 GRID.IT](#)
[gLite-1](#)

frn.it/

Offerte Ordini FastWeb Mozilla.org



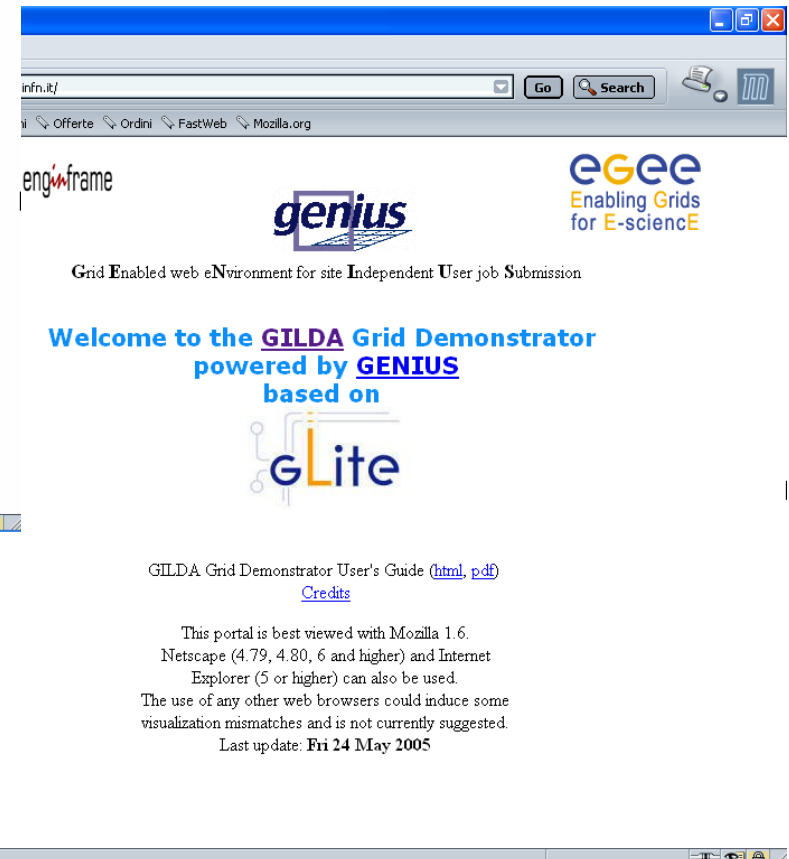
Grid Enabled web eNvironment for site Independent User job Submission

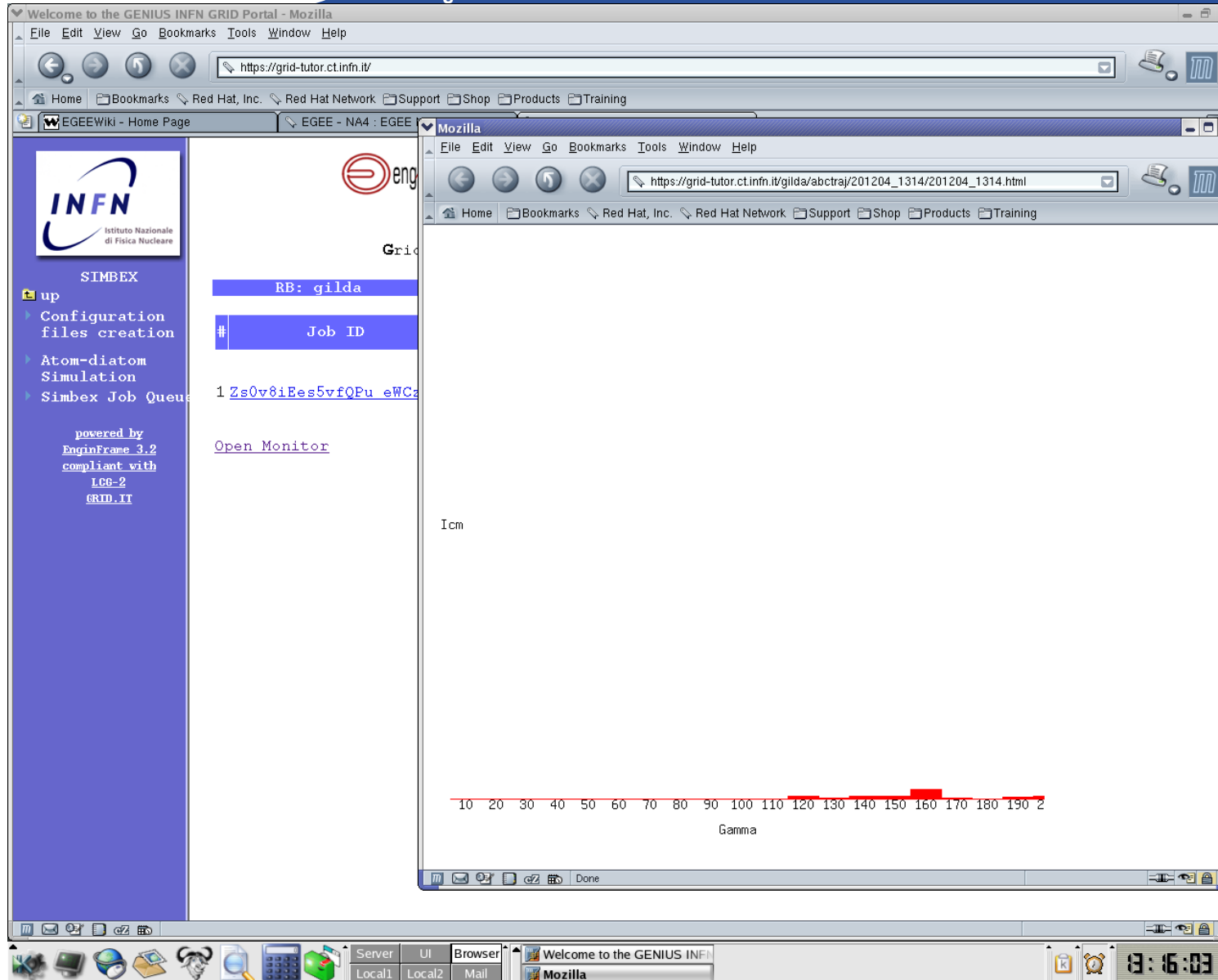
Welcome to GENIUS based on



[Important Notice](#)
[GENIUS User's Guide \(pdf\)](#)
[New Grid Authentication with MyProxy](#)
[GENIUS MyProxy Server Installation](#)
[GENIUS CVS Available](#)
[GENIUS Mailing List](#)
[GENIUS Mailing Archive \(Help on Majordomo Commands\)](#)
[GRID MOVIE](#)
[Useful Links](#)
[Credits](#)

This portal is best viewed with Mozilla 1.6.
 Netscape (4.79, 4.80, 6 and higher) and Internet Explorer (5 or higher) can also be used.
 The use of any other web browsers could induce some visualization mismatches and is not currently suggested.





The screenshot shows a Mozilla browser window displaying the GENIUS INFN GRID Portal. The page includes a sidebar with navigation links, a main content area with a table of job IDs, and a plot of Gamma values.

| RB: | Job ID |
|-------|------------------------|
| gilda | |
| # | |
| | 1 Zs0v8iEes5vfQPu_eWCz |

Open Monitor

Icm

Gamma

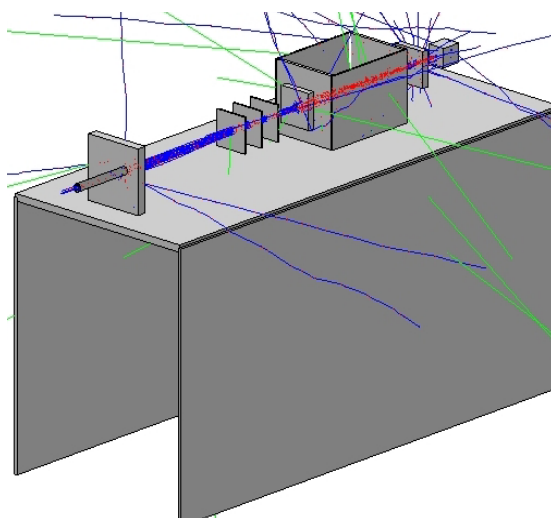
10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 2

Interactive
MPI jobs !

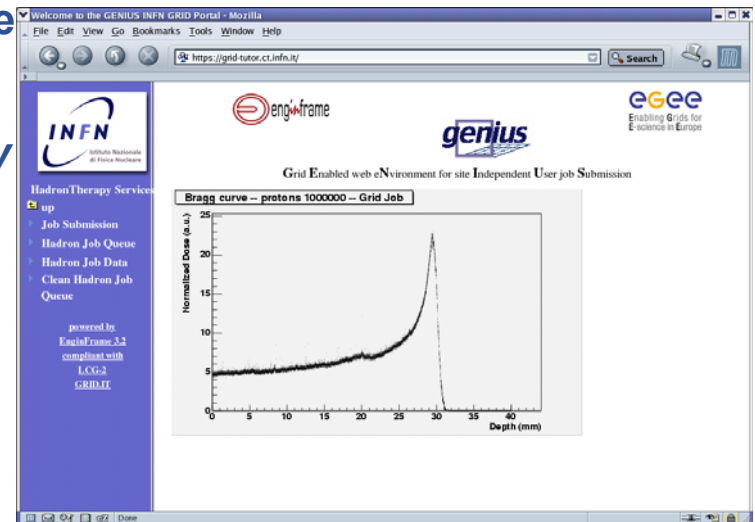
CATANA beam line in reality



hadronTherapy in GENIUS



CATANA beam line simulated by hadronTherapy




Welcome to the GENIUS INFN GRID Portal - Mozilla


File Edit View Go Bookmarks Tools Window Help


https://grid-tutor.ct.infn.it/


Home Bookmarks Red Hat, Inc. Red Hat Network Support Shop Products Training



Istituto Nazionale di Fisica Nucleare







Enabling Grids for E-science in Europe

Grid Enabled web eNvironment for site Independent User job Submission

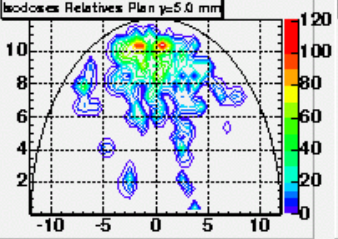
| | | | | |
|-----------|-----------|------------|-----------|--------|
| RB: gilda | VO: gilda | RLS: GILDA | Your Data | Logout |
|-----------|-----------|------------|-----------|--------|

Directory contents - tmp1100001761583.ef/gate_job_list_20041109_123955

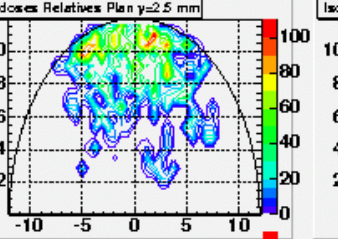
RelDoseTree.gif (GIF Image, 606x302 pixels) - Mozilla

https://grid-tutor.ct.infn.it/ef/download/RelDoseTree.gif

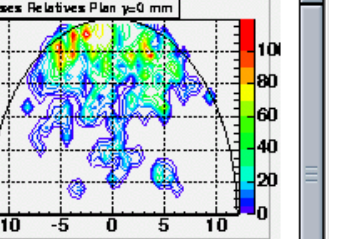
Isodoses Relatives Plan y=5.0 mm



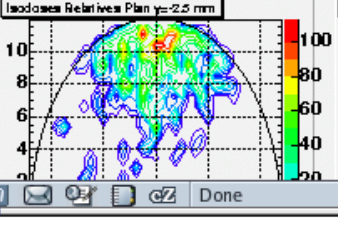
Isodoses Relatives Plan y=2.5 mm



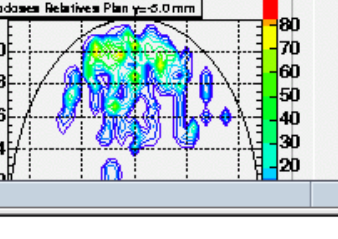
Isodoses Relatives Plan y=0 mm




Isodoses Relatives Plan y=-2.5 mm



Isodoses Relatives Plan y=-5.0 mm





Done



GILDA PnP
GILDA User Interfaces Plug & Play

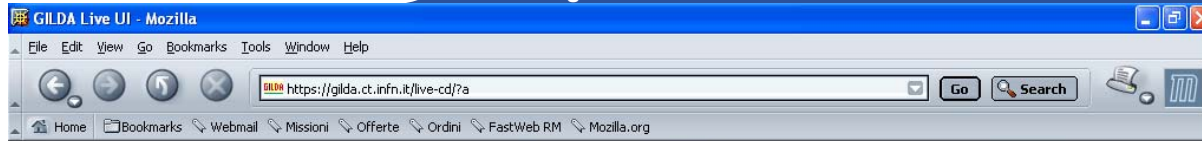
GILDA USER INTERFACE PLUG & PLAY COMBINED (LCG AND GLITE)

The *GILDA User Interface Plug & Play* tarball contains all the necessary software to seamlessly turn your Linux PC into a machine from you can access and use the *GILDA* dissemination grid realized in the context of both the Italian *INFN Grid Project* and the European *EGEE Project*. The installation procedure installs the User Interface in the user directory so no root privilege is required. This User Interface is based both on *INFN Grid 2.4.0* (fully compatible with *LCG 2.4.0*) and *gLite 1.1*.

- Grid tutorials
- GILDA Poster
- Video tutorials
- Live User Interface
- User Interface PnP **NEW**
- Instructions for users
- Instructions for sites
- Useful links
- Sponsors
- Usage Statistics
- Old Usage Statistics

GILDA User Interface Plug & Play

- Introduction
- Use
- Download
- Useful links & info
- Contacts & acknowledgments



- Grid tutorials
- GILDA Poster
- Video tutorials
- Live User Interface NEW
- User Interface PnP
- Instructions for users
- Instructions for sites
- Useful links

- Sponsors
- Usage Statistics
- Old Usage Statistics



GILDA LIVE USER INTERFACE

The *GILDA Live User Interface* DVD contains all the necessary software and use the [GILDA](#) dissemination grid realized in the context of the [INFN Grid Project](#) and the European [EGEE Project](#). *GILDA Live User Interface* is based both on [INFN Grid 2.4.0](#) (fully compliant with [LCG 2.4.0](#)) and [gLite 1.1](#) on [Knoppix 3.6](#).

SYSTEM REQUIREMENTS

The Grid middleware installed on the GILDA testbed and, then, on

GILDA Live
User
Interface



GILDA User Interface
gLite 1.1 and LCG 2.4



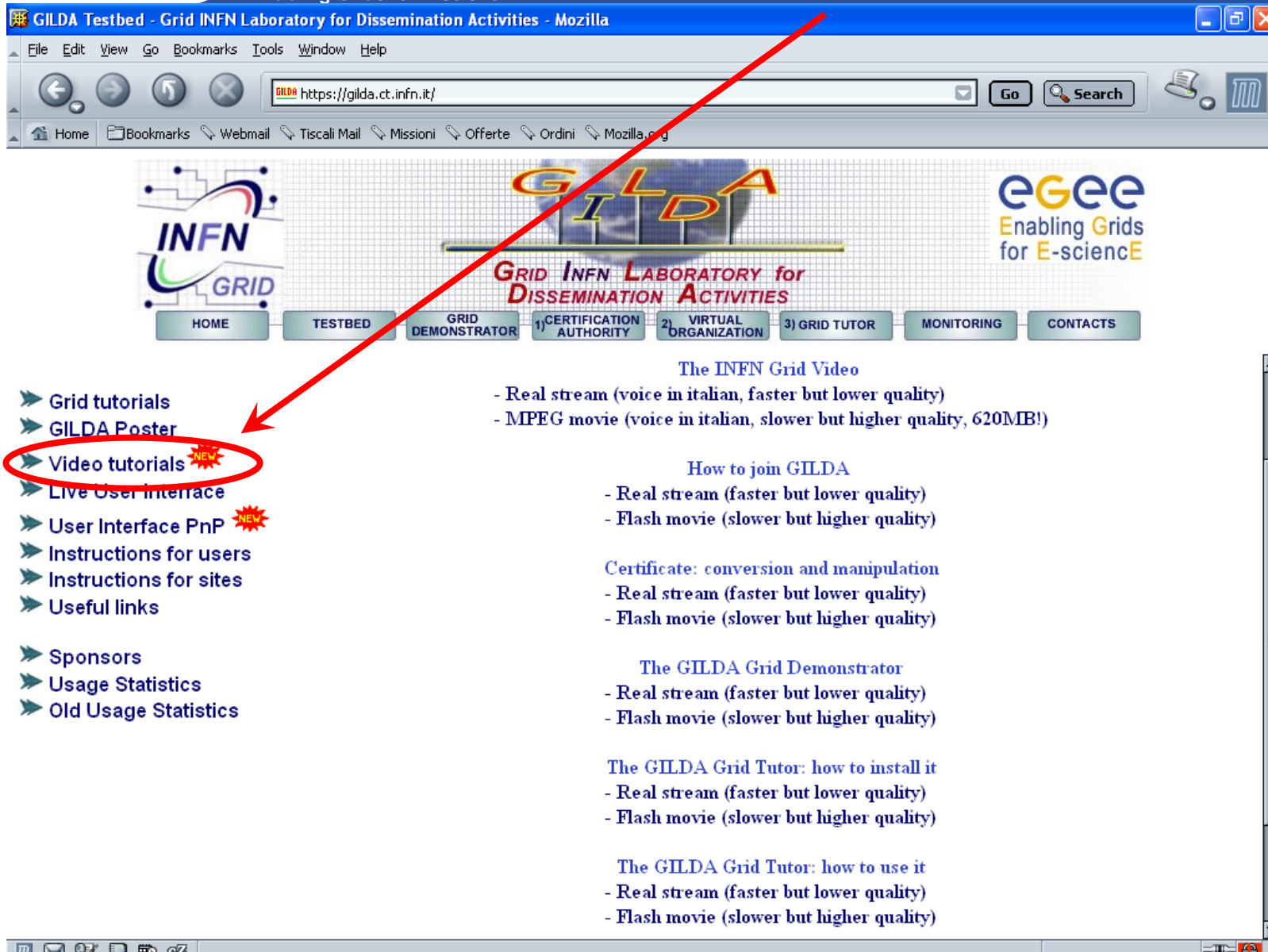
2004

Edinburgh, 7 April 2004, [slides](#), [pictures](#)
 Tunis, 22-23 April 2004, [pictures](#)
 Edinburgh, 26-28 April 2004, [slides](#), [pictures](#)
 CERN, 17-19 May 2004, [pictures](#)
 Catania, 24-25 May 2004, [home page](#), [pictures](#)
 Dubna, 29 June - 2 July 2004, [agenda](#)
 Edinburgh, 6 July 2004, [home page](#)
 Catania, 14-16 July 2004, [home page](#), [pictures](#)
 Vico Equense, 19 July 2004, [slides](#), [pictures](#)
 Vico Equense, 6-10 September 2004, [home page](#)
 Catania, 4-8 October 2004, [home page](#), [agenda](#)
 Vilnius, 5-6 October 2004, [agenda](#)
 London, 6 October 2004
 Madrid, 6-7 October 2004, [agenda](#)
 Heidelberg, 11-14 October 2004
 CERN, 16 October 2004
 Prague, 26 October 2004, [home page](#)
 Warsaw, 4-6 November 2004, [home page](#), [agenda](#)
 Lyon, 9-10 November 2004, [agenda](#)
 The Hague, 15-17 November 2004, [pictures](#)
 Merida, 15-20 November 2004, [home page](#), [agenda](#),
[slides](#), [pictures](#)
 Tunis, 20 November 2004
 Rio de Janeiro, 22-23 November 2004, [home page](#),
[agenda](#), [pictures](#)
 The Hague, 24 November 2004, [agenda](#)
 CERN, 29-30 November 2004, [agenda](#)
 Kosice, 30 November - 1 December 2004, [agenda](#)
 Tunis, 6-7 December 2004
 Bochum, 7-10 December 2004, [home page](#), [agenda](#)
 Edinburgh, 8 December 2004, [home page](#)
 Istanbul, 9-10 December 2004, [agenda](#), [slides](#), [pictures](#)
 Shanghai, 9-10 December 2004, [agenda](#)
 Aurillac, 13-14 December 2004
 Prague, 16 December 2004, [home page](#), [pictures](#)
 Tel Aviv, 22-23 December 2004, [agenda](#), [pictures](#)

2005

CERN, 13 January 2005, [agenda](#)
 Torino, 18-19 January 2005, [home page](#), [agenda](#)
 CERN, 20 January 2005, [agenda](#)
 CERN, 2-4 February 2005, [agenda](#)
 Roma, 3 February 2005, [home page](#), [agenda](#), [pictures](#)
 Sydney, 3-4 February 2005, [home page](#)
 CERN, 9-11 February 2005, [agenda](#)
 Amsterdam, 14-16 February 2005, [home page](#)
 Trento, 23-25 February 2005, [home page](#), [agenda](#)
 Amsterdam, 28 February - 1 March 2005, [home page](#)
 Julich, 9 March 2005,
 Clermont-Ferrand, 9-31 March 2005, [agenda](#)
 Vienna, March-August 2005
 Hamburg, 23-24 March 2005, [home page](#), [agenda](#)
 Ula-Merida, 31 March-1 April 2005, [agenda](#)
 Zilina, 4 April 2005, [home page](#) and [agenda](#)
 Edinburgh, 9-13 May 2005, [home page](#) and [agenda](#)
 St. Augustin, 25 May 2005, [home page](#) and [agenda](#)
 Catania, 13-15 June 2005, [home page](#), [agenda](#), [pictures](#)
 Valencia, 14-16 June 2005, [home page](#), [agenda](#)
 Lyon, 17 June 2005, [home page](#) and [agenda](#)
 Bratislava, 27-30 June 2005, [agenda](#)
 Karlsruhe, 8 July 2005, [home page](#) and [agenda](#)
 Vico Equense, 10-22 July 2005, [home page](#), [agenda](#)
 Budapest, 11-16 July 2005, [home page](#), [agenda](#)
 Clermont-Ferrand, 25-27 July 2005, [home page](#), [agenda](#)
 Madrid, 26-27 July 2005, [home page](#), [agenda](#)
 Swansea, 6 August 2005, [home page](#) and [agenda](#)
 Taipei, 22-23 August 2005, [home page](#) and [agenda](#)
 CERN, 24 August 2005, [home page](#) and [agenda](#)
 Tokyo, 25-26 August 2005, [home page](#) and [agenda](#)
 Seoul, 29-30 August 2005, [home page](#) and [agenda](#)
 Clermont-Ferrand, 05-07 September 2005, [home page](#),
[agenda](#)
 Lausanne, 5-9 September 2005, [home page](#) and [agenda](#)
 Saint-Malo, 12-15 September 2005, [home page](#), [agenda](#)
 Karlsruhe, 26-30 September 2005, [home page](#), [agenda](#)
 Raanana, 28-29 September 2005, [home page](#), [agenda](#)
 London, 6 October 2005, [home page](#) and [agenda](#)
 Sophia Antipolis, 10-14 October 2005, [home page](#),
[agenda](#)





Grid tutorials

- Grid tutorials
- GILDA Poster
- Video tutorials** NEW
- Live User Interface
- User Interface PnP NEW
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- Instructions for sites
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- Usage Statistics
- Old Usage Statistics

The INFN Grid Video

- Real stream (voice in italian, faster but lower quality)
- MPEG movie (voice in italian, slower but higher quality, 620MB!)

How to join GILDA

- Real stream (faster but lower quality)
- Flash movie (slower but higher quality)

Certificate: conversion and manipulation

- Real stream (faster but lower quality)
- Flash movie (slower but higher quality)

The GILDA Grid Demonstrator

- Real stream (faster but lower quality)
- Flash movie (slower but higher quality)

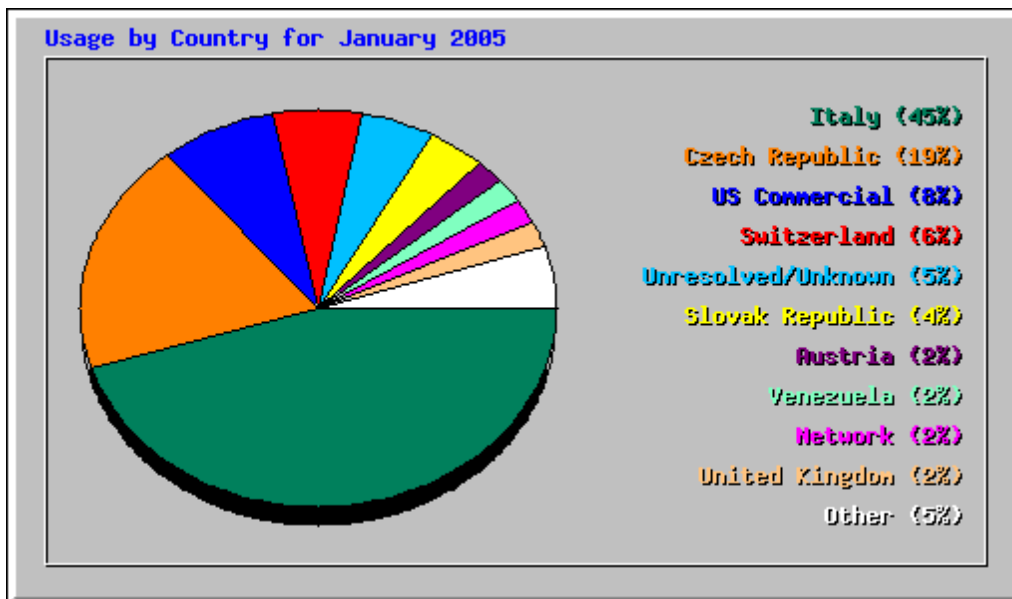
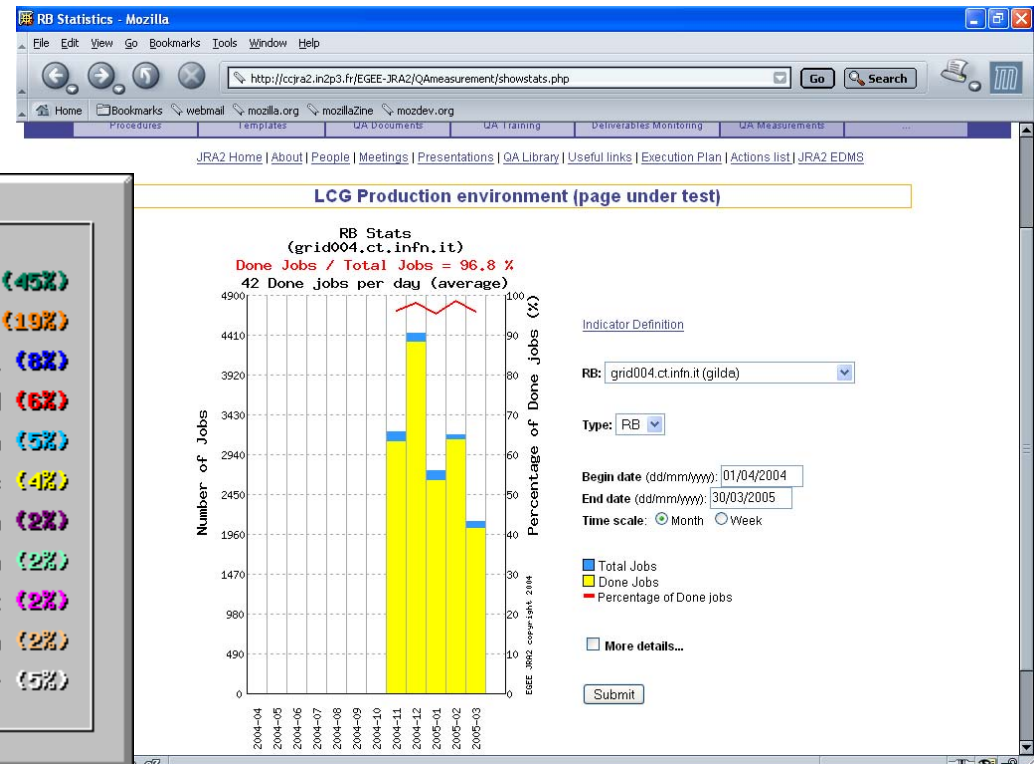
The GILDA Grid Tutor: how to install it

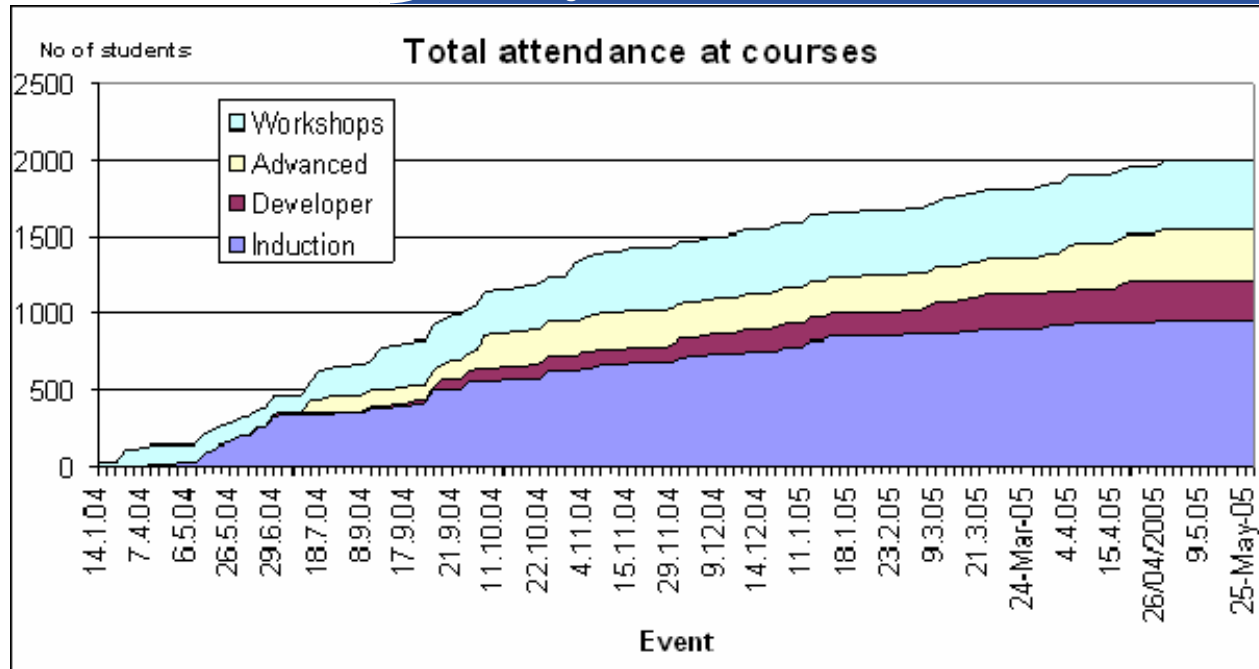
- Real stream (faster but lower quality)
- Flash movie (slower but higher quality)

The GILDA Grid Tutor: how to use it

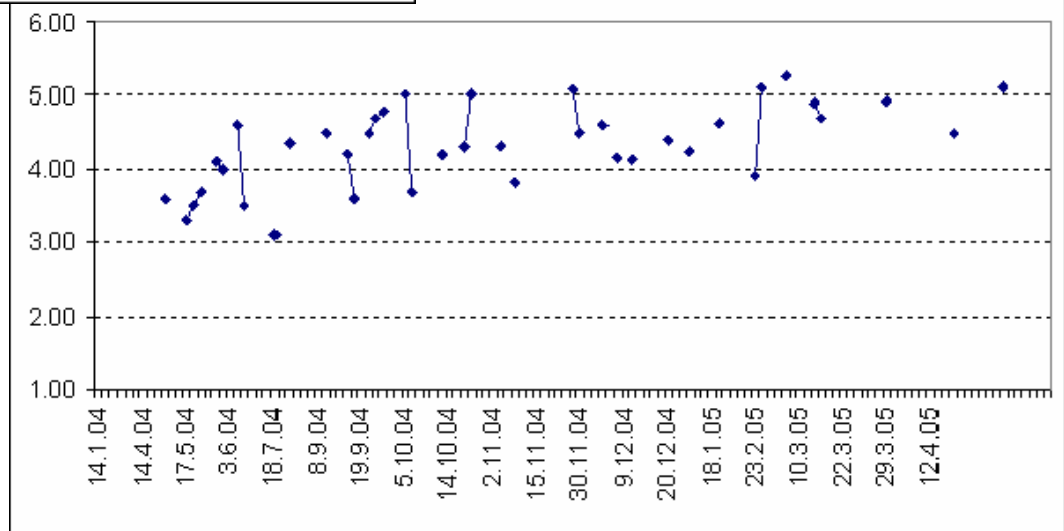
- Real stream (faster but lower quality)
- Flash movie (slower but higher quality)

- 15 sites in 3 continents
- > 2000 certificates issued, 15% renewed at least once
- > 50 tutorials and demos performed in 15 months
- > 50 jobs/day on the average
- Job success rate above 80%
- > 750,000 hits (> 40,000 visits) on (of) the web site from 10's of different countries
- > 0.5 TB of videos and UI's downloaded from the web site





Overall Feedback



- **7 Virtual Organizations supported:**
 - Biomedicine (Biomed)
 - Earth Science Academy (ESR)
 - Earth Science Industry (CGG)
 - Astroparticle Physics (MAGIC)
 - Computational Chemistry (GEMS)
 - Grid Search Engines (GRACE)
 - Astrophysics (PLANCK)
- **Development of complete interfaces with GENIUS for 3 Biomed Applications: GATE, hadronTherapy, and Friction/Arlecione**
- **Development of complete interfaces with GENIUS for 4 Generic Applications: EGEODE (CGG), MAGIC, GEMS, and CODESA-3D (ESR) (successful demos of EGEODE and GEMS at EGEE review)**
- **Development of complete interfaces with GENIUS for 16 demonstrative applications available on the GILDA Grid Demonstrator (<https://grid-demo.ct.infn.it>)**
- **Development of complete interface with CLI for NEMO**

- **The EGEE middleware:**
 - Is exiting prototyping phase and entering real production phase (LHC first real data are only 2 years away from now!)
 - Implements a full and complete stack of grid services that can be used all together or separately at user's discretion
 - Closely follow the standardization process going in GGF and other for a
- **GILDA is a real virtual laboratory for dissemination of grid computing:**
 - It is a “de facto” standard t-Infrastructure adopted both by EGEE and some forthcoming EU-FP6 projects (EELA, EUCHINAGRID, EUMEDGRID, **ICEAGE**)
 - It is a complete suite of grid elements (test-bed, CA, VO, monitoring system, web portal, **live user interface, user interface plug&play**) and applications fully dedicated to dissemination purposes and pre-orting of new applications to EGEE Infrastructure
 - GILDA runs latest production (stable) version of both the LCG grid middleware but it is also early adopting gLite in order to make the transition to the new middleware smoother and easier