

When databases meet the Grid

A New Data Source Oriented CE for GRID

Giuliano Taffoni & Claudio Vuerli

INAF – OATs and INAF – SI

- **What is a G-DSE**
- **An overview of the G-DSE**
- **Some practice**
- **A use case: the AstroDB**

People:

- ✓ Edgardo Amborsi
- ✓ Giuliano Taffoni
- ✓ Andrea Barisani
- ✓ Claudio Vuerli
- ✓ Antonia Ghiselli

- I have a DB and I want to **USE** it from my **GRID**.
- I have a number of DBs and I want to **USE** all of them.
- Move the execution to the data and not data to the code.
- Fully compliant with (LCG) GLite.
- No space for WS (Web Services).

- **The Grid limit: it is able to execute binary code or shell scripts and to store files.**
- **DB in the Grid? Extension of the existing Resource Manager of Globus for providing transparent access to heterogeneous DS and DSE.**

- Until now, only **two types of computational resources**, the hardware machines and batch queuing system, have been taken into account as valid Resource Framework Layer instances.
- **Different types of virtual computing machines exist** such as Java Virtual Machine, Parallel Virtual Machine and Data Source Engine.
- The **Grid Information System and Data Model** have been used to represent hardware computing machines only; a software computational machine resource however can also be represented.

- We extend the **Grid Resource Framework Layer, Information System and Data Model** so that a software virtual machine as a Data Source Engine becomes a valid instance for a Grid computing model.
- We define therefore a **new Grid component (G-DSE)** that enables the access to a Data Source Engine and Data Source, totally integrated with the Grid Monitoring and Discovery System and Resource Broker.
- The new **Grid Element**, finally, can be built on top of the G-DSE component.

the Query Element

- **May exist** a pool of Data Sources on which USERS' Query/Transaction can be processed through some Engine (DSE)
- **May be possible** a Mapping for Query/Transaction on more LOCAL DSE to a Data Source
- **Must be possible** to Grant/Revoke all LOCAL DSEs needed for a mapped Query/Transaction
- **Must be possible** to enter Query/Transaction running state with specialized mechanisms
- **Must be possible** to Grant/Revoke additional DSE resources request based on DATA SET, TABLE SPACE, etc., at run time
- **May be possible** a Query/Transaction Spawning for JOIN intra/inter G-DSEs
- **Must be possible** to Send Query/Transaction on a DSE
- **Must be possible** to Receive Query/Transaction from a DSE
- **Must be possible** to enter Termination requests for cancelling Query/Transaction
- **Must be possible** to make Query/Transaction Match-Making based on specific Knowledge Base of DSE and DS

- **Provide a proper extension of the Grid to take care of a new resource**
- **Security GSI: no need to extend but to use!**
- **First theory (Grid Abstract State Machine), then...application.**

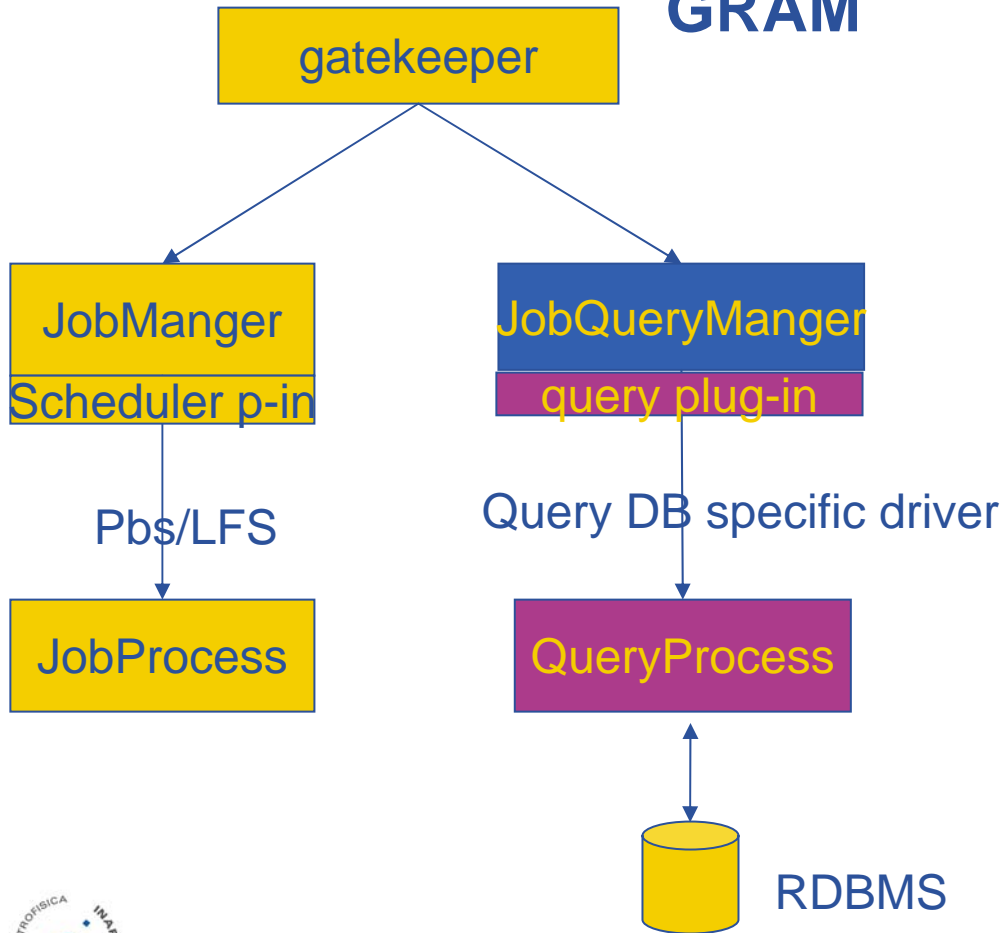
“A Formal Framework for Defining Grid Systems”

Zsolt N. Nemeth & Vaidy Sunderam

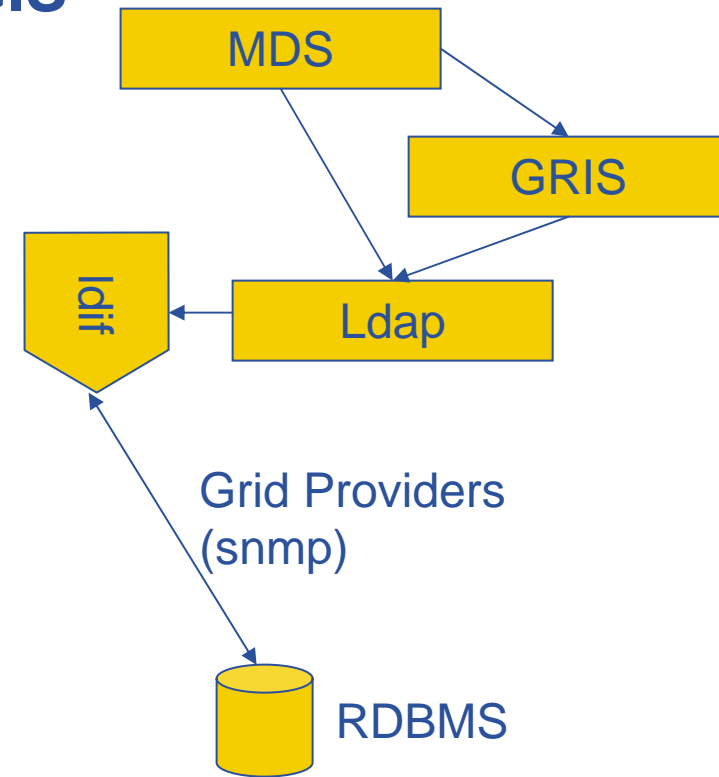
2nd IEEE/ACM (CCGRID'02)

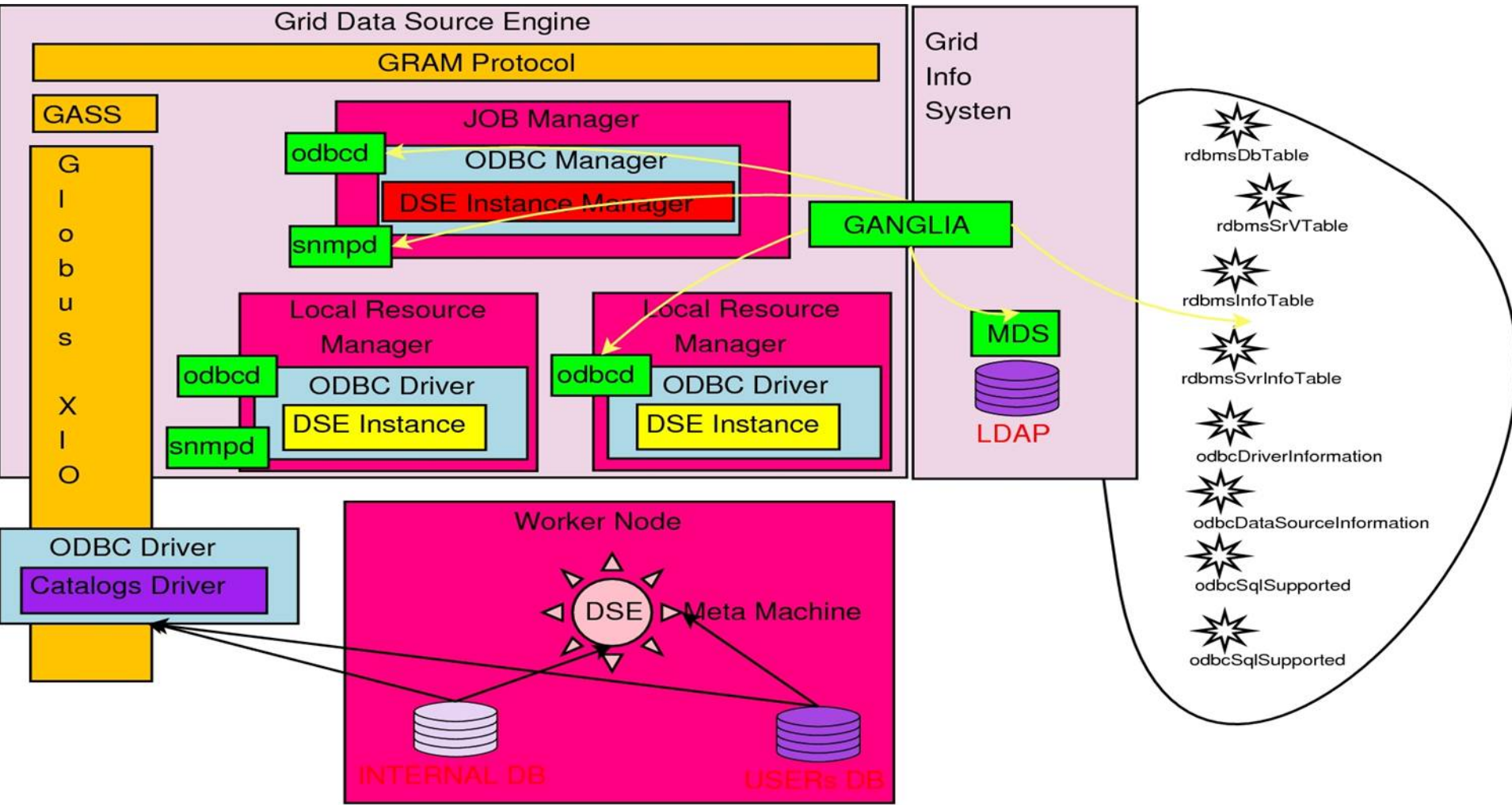
- **No access to astronomical databases from the Grid middleware chosen for the GRID.IT project**
- **Some possible solutions evaluated (Spitfire, OGSA-DAI)**
- **A tight correlation between data access/management and computation is of paramount importance within the Astronomical Community**

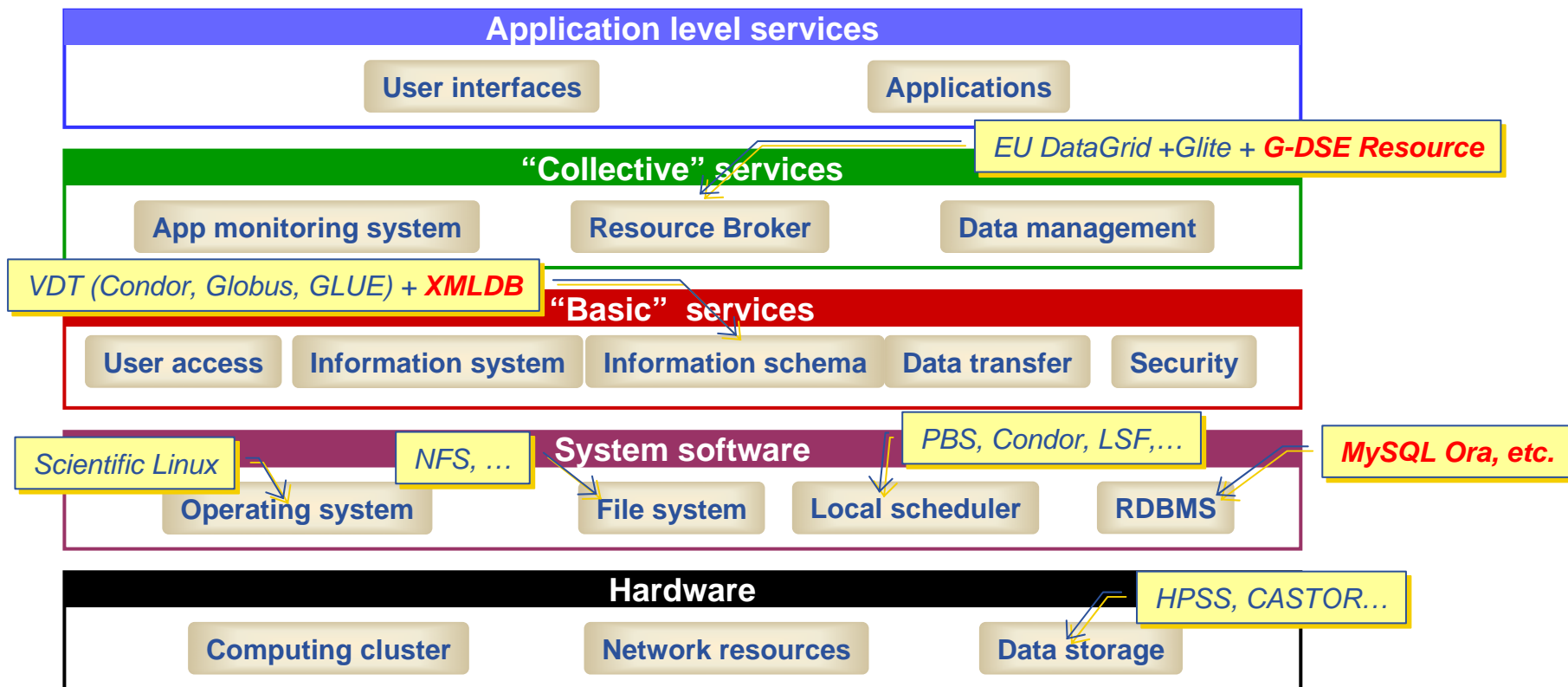
GRAM



GIS

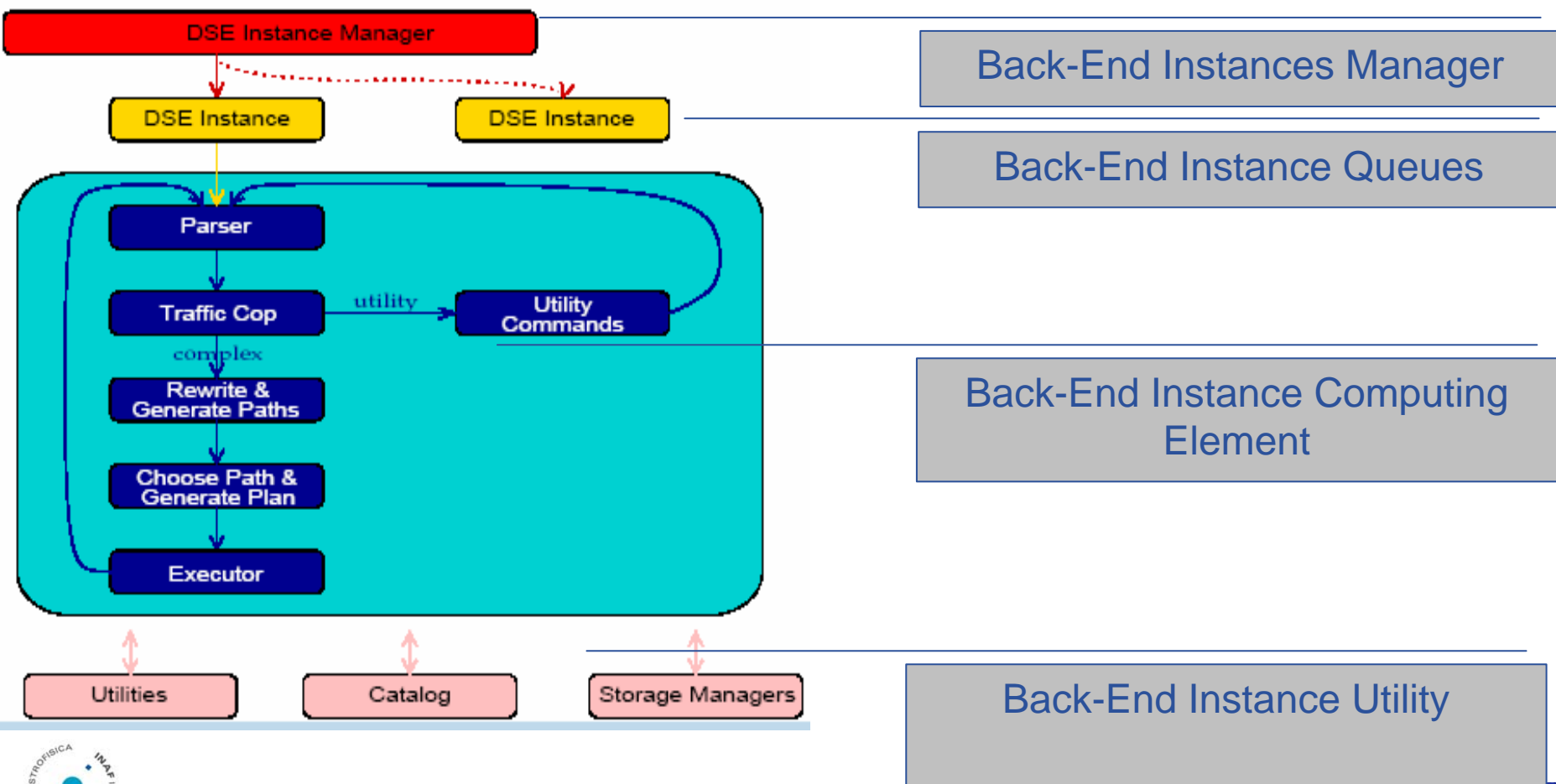




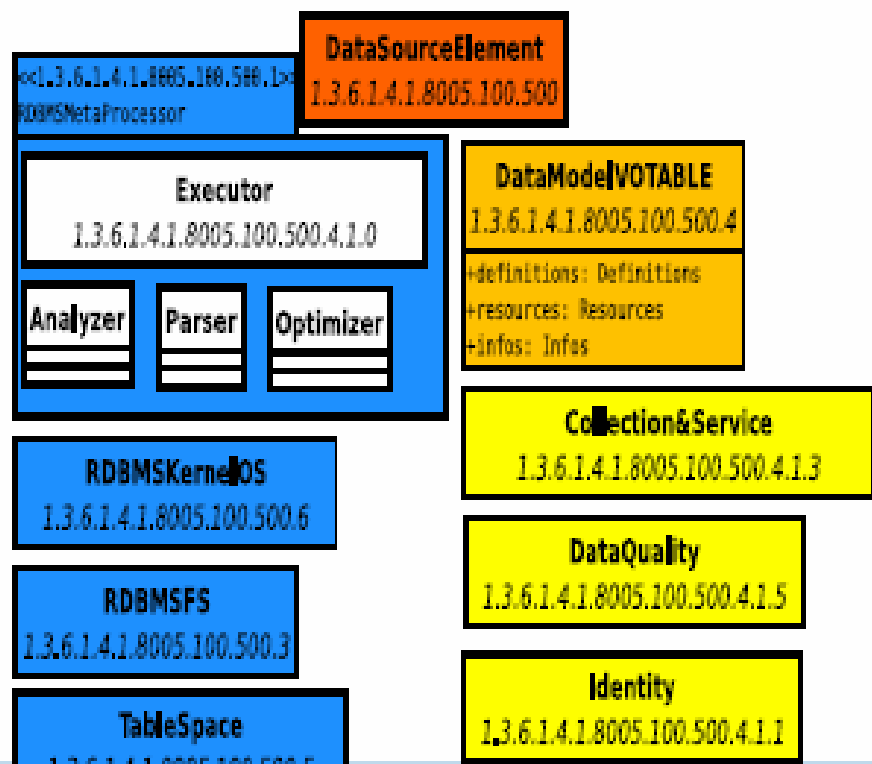


- **Architectural Analysis of GRID software, its workflow, its programming language, internal mechanism, and its functionality;**
- **Architectural Analysis of a DSE, its workflow, its programming language, internal mechanism, and its functionality;**
- **Conceptual mapping between DSEs and GRFL, trying to represent a DSE through the grid resource abstraction, i.e. the GACM (Grid Abstract Computing Machine);**
- **Globus XIO integration with I/O ODBC Driver;**

- **Transparent mechanisms: QueryJobManager component, LocalQueryJobManager component, Distribution QueryJob Framework over G-DSE;**
- **Interfacing the Grid Resource Information Index Backend with the G-DSE Information Provider;**
- **Enhancement of the Grid Resource Specification Language (RSL) for DSE;**
- **Adoption of standards, such as ODBC, JDBC, SNMP, MIB (Management Information Base), GLOBUS, EDG and VOMS.**



GlueSchema Extended for DataSourceEngine and for MetaDataModel FileSystem

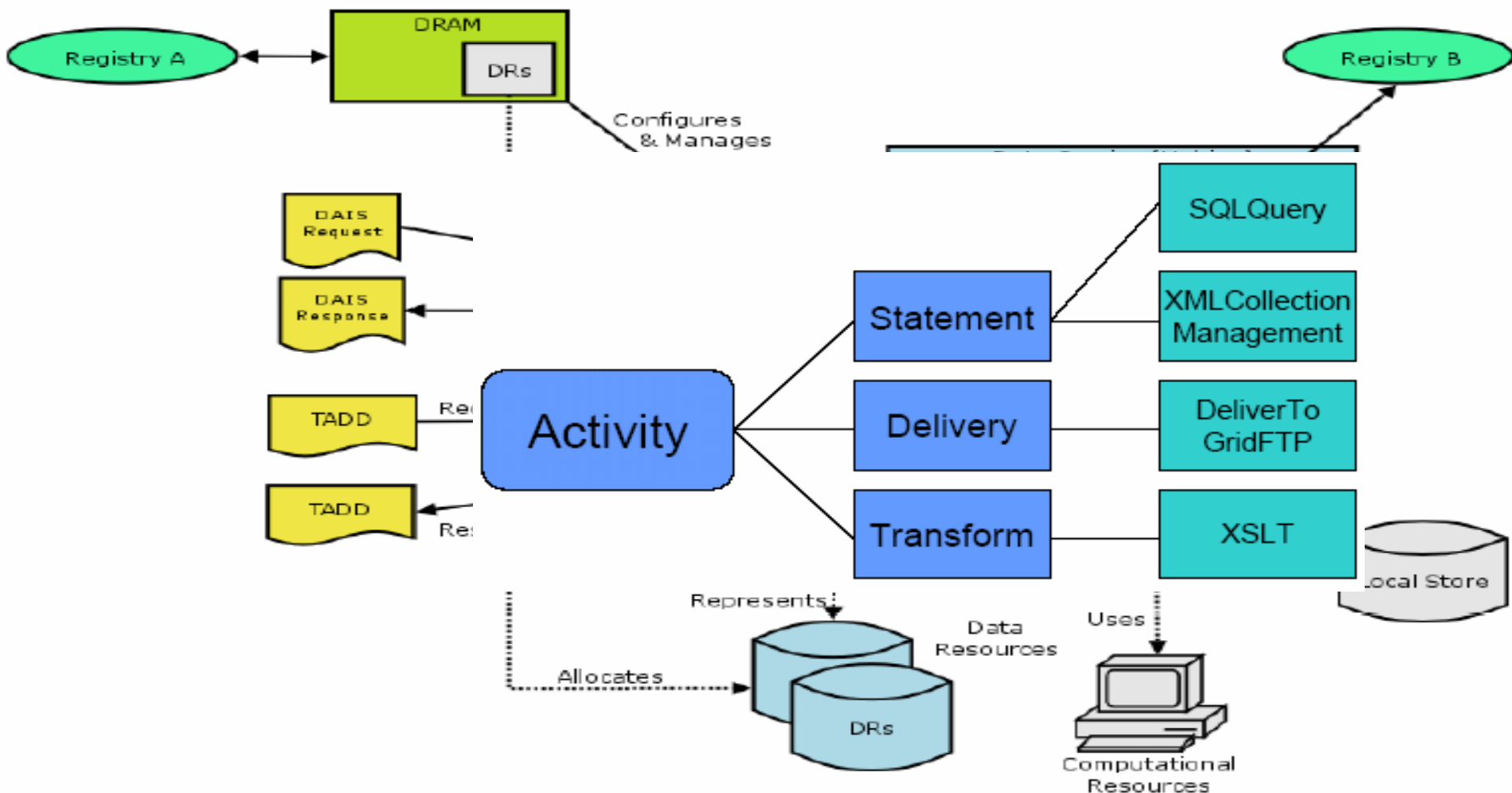


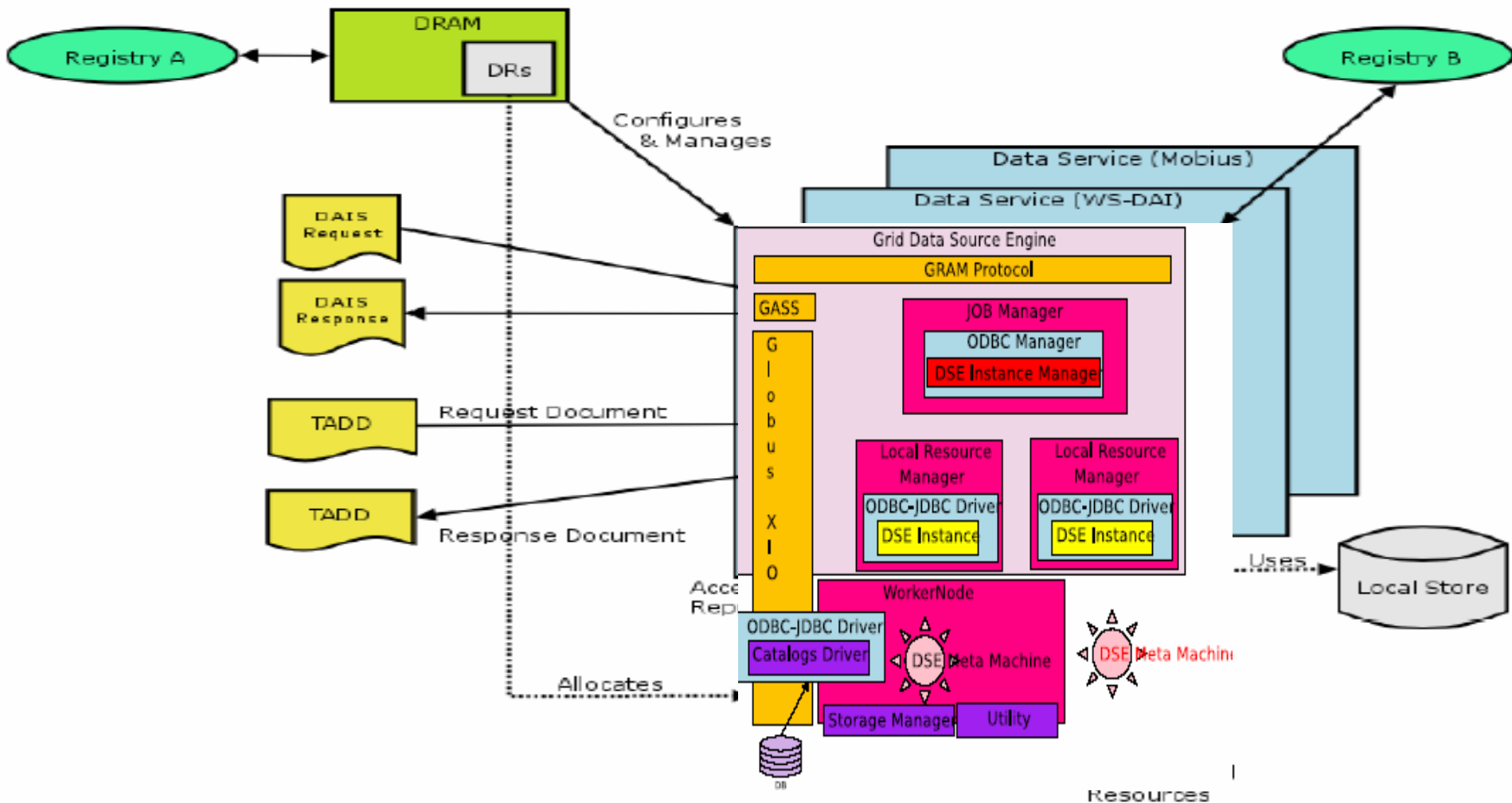
Provided 250 MIB-RDBMS and ODBC information parameters.

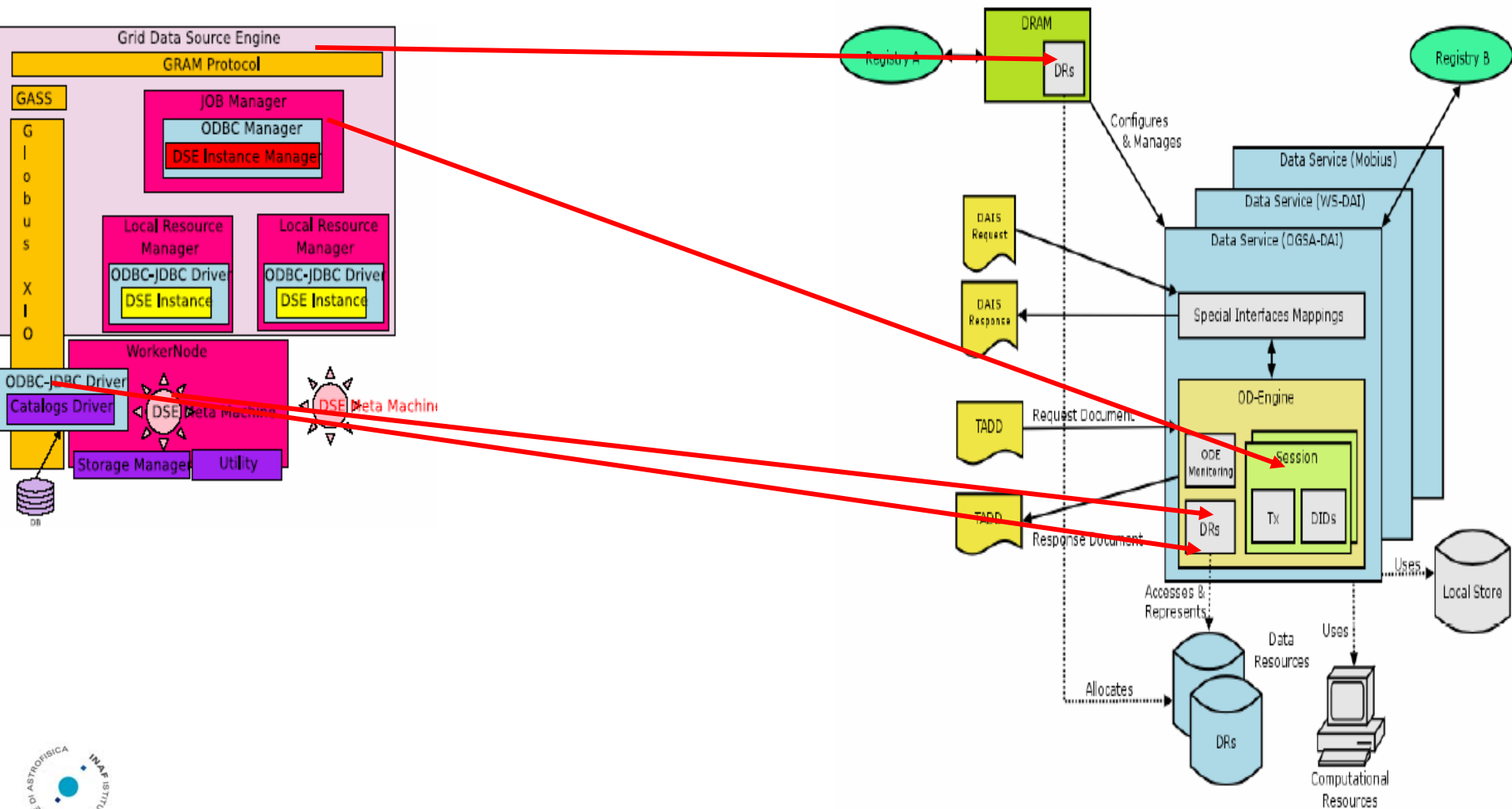
Some of them are:

- Requesting Transactions
- Executing Transactions
- Handling Transactions
- Committing Transactions
- Rolling Back Transactions
- SQL capability of DSE;
- Scientific Functions provided by DSE;

- The *Data Resource Access Manger* (DRAM) supports data service (re)configuration, monitoring, management and recovery.
- The core of *Data Services* (DS) is the *OGSA-DAI Engine* (ODE) that provides a framework for activity and task management.
- A *Task And Data Document* (TADD) permits a number of tasks to be specified, together with their parameters, inputs, outputs and control flow.
- The response to a request is generated by the ODE within a *Session*, which may also be a *Transaction* (Tx). The ODE analyses incoming TADDs, conducts authentication and authorisation, and then constructs an optimised execution graph.
- A DRAM will monitor a DS's status digest produced by its internal monitor.
- The ODE is being designed to support dynamic configuration, sessions, transactions, recovery and concurrency.

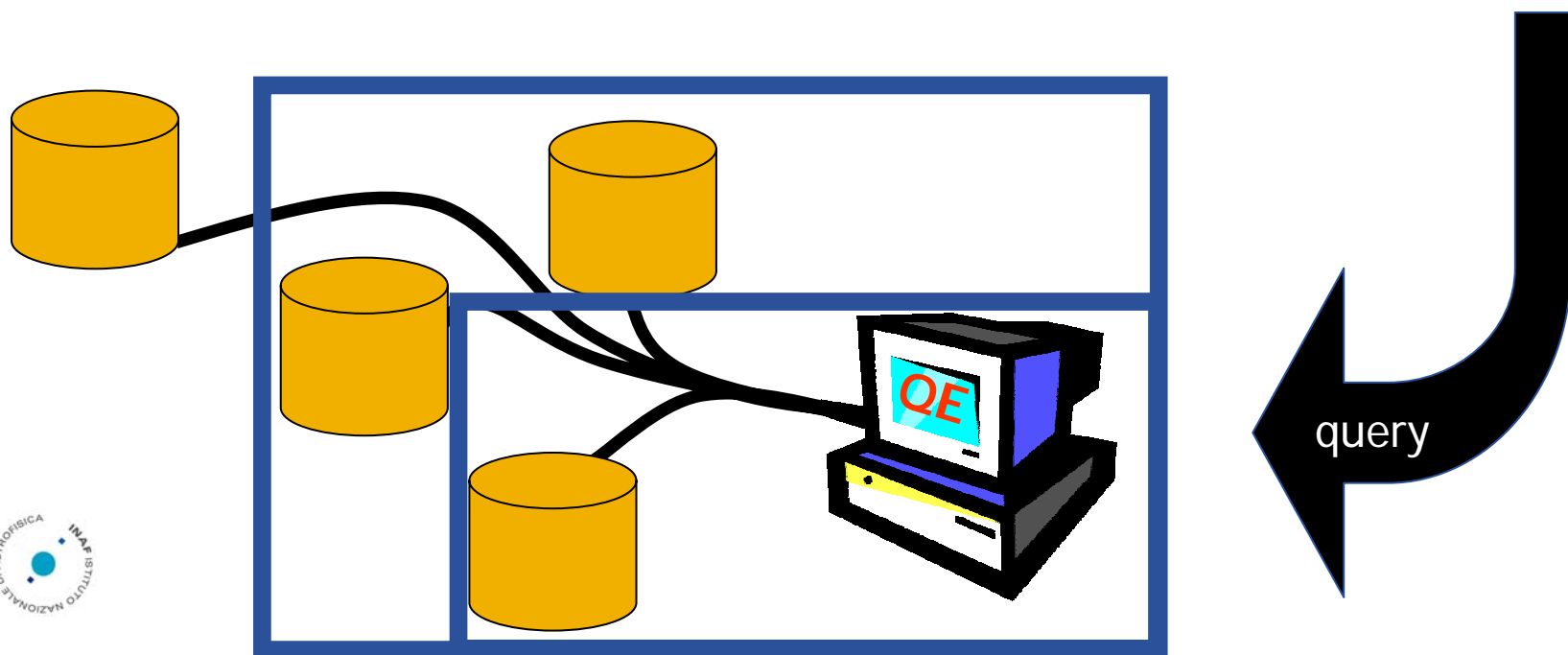
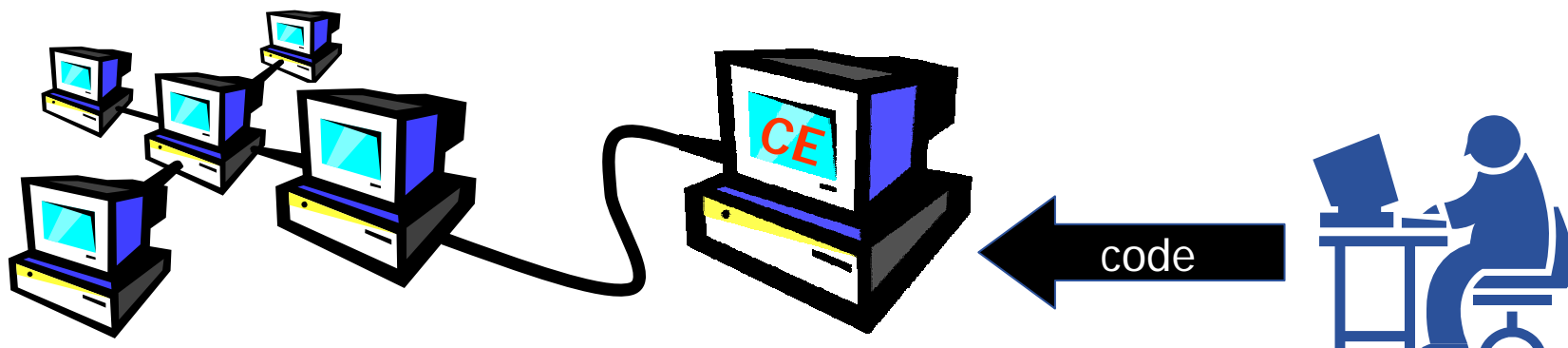






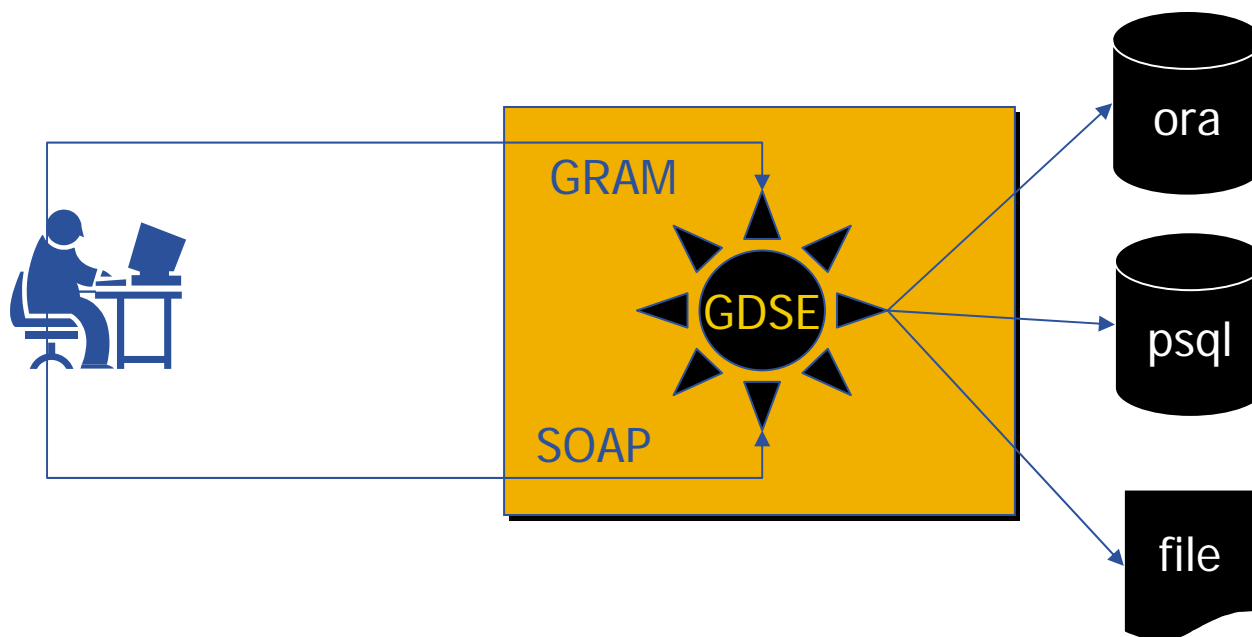
- New **Grid component**:
 - Integrated within the Grid Information System
 - May be integrated in the WMS
- New **Grid Element** on top of the G-DSE component

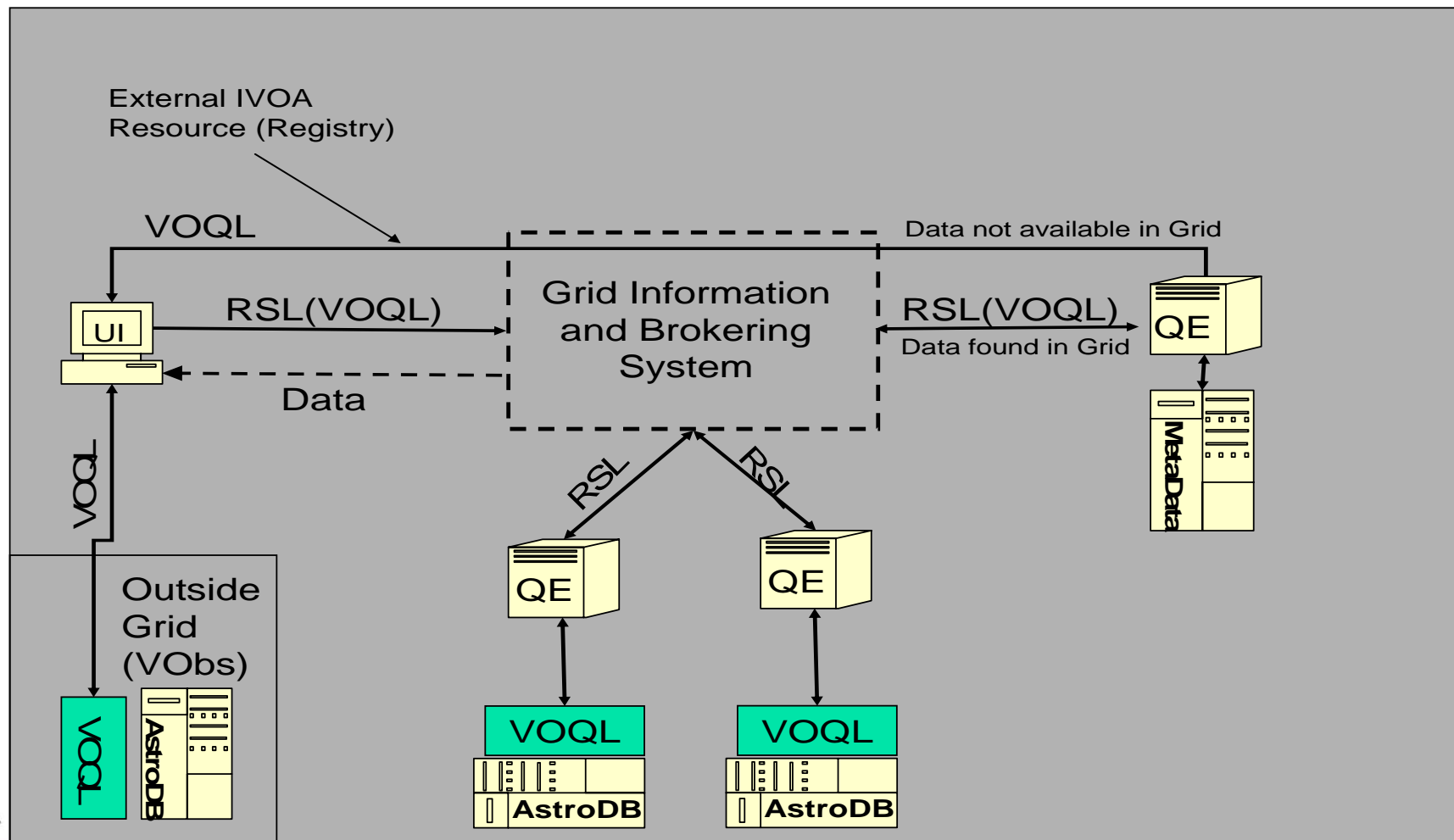
the Query Element



- With the “G-DSE enabled” collective and resource Grid layers, the new QE (Query Element) Grid Element is built
- QE is a CE able to manage Queries and to connect RDBMS resources via Grid
- It speaks RSL to interact with Grid services, VOQL when exchanging data with RDBMS resources and processing query requests coming from Uls (Users)

- Runs on any linux/unix flavour: GT \geq 2.4.3
- Backends: any DB vendor (MySQL, Oracle, PostgreSQL etc...) + flat files
- Two protocols: GRAM or WS
- API: C, C++, python, java, perl





- **Access control using GSI and VOMS**
 - The certificate + roles identify the user permissions on DB



Super user: create, modify, admin, grant and revoke users.... ANYTHING!!!



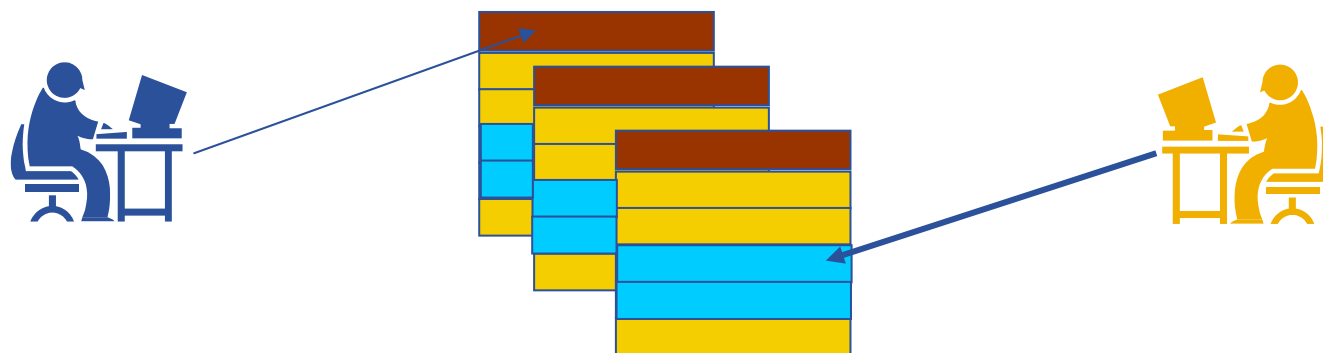
Standard user: select + insert



Simple user: select

And so on...

- **Granularity access control:**
 - Permissions on whole DB, on one table, on one row;
 - “rw” or “ro” or “rwx” etc...
 - “delegation”



The super user from a UI can modify the acl or delegate a new user to do it.

- **The present**

- Interactive query
- Off line access
- **Parallel sql** to many DSE:
 - SIMD (Single Instruction Multiple Data)
 - MIMD (Multiple Instruction Multiple Data)
- Redirect output to a SE
- Discovery system: BDII integrated.

- **The future**

- XIO (distributed join)
- Automatic intra-GDSE parallel access
- WMS integration
- Workflow implementation

- UI/QE interactions through a STANDARD LANGUAGE
- RSL (SQL)

```
> globus-job-run g.dse.host/dbmanager-ODBC -queue PSQL1 "select
a,b from table;"
```

```
-----
| a      | b      |
|-----|-----|
| Uno    | 001    |
| Due    | 002    |
| Tre    | 003    |
|-----|-----|
```

Off line access

```
> globus-job-submit g.dse.host/dbmanager-ODBC -queue PSQL1
"select a,b from table;"
https://g.dse.host/20001/23297/113699980234
>globus-job-status https://g.dse.host/20001/23297/113699980234
DONE
>globus-job-get-output https://g.dse.host/20001/23297/113699...
```

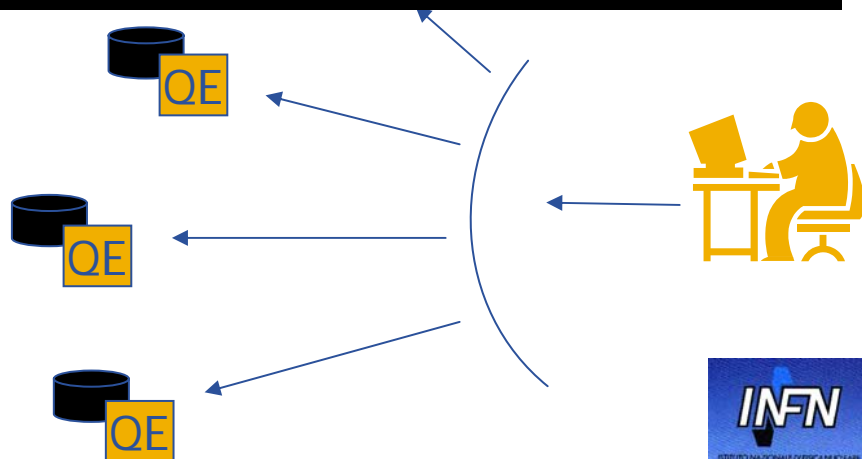
```
-----
| a      | b      |
|-----|-----|
| Uno    | 001    |
| Due    | 002    |
| Tre    | 003    |
|-----|-----|
```

• UI implementation

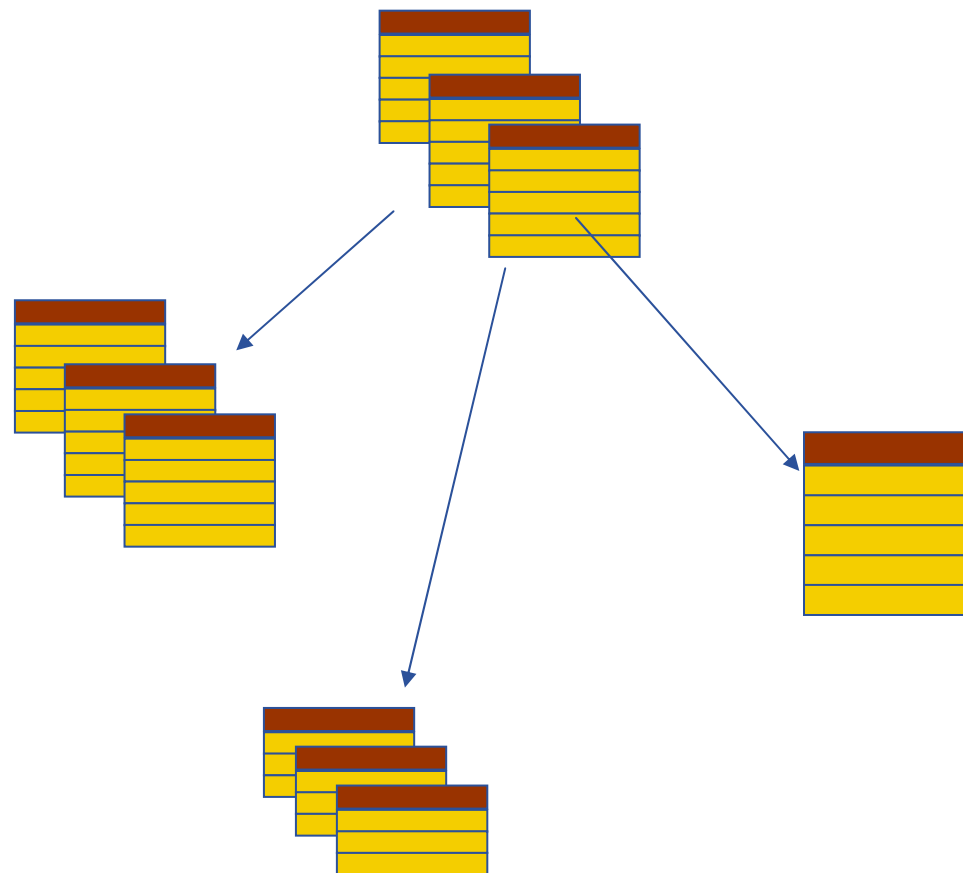
- `glite-query-submit -h g.dse.name -sql "select a from onetable where.. ;"` `-o gsiftp://se.name/tmp/out.dat`
- `glite-query -h g.dse.name`
 - > interactive usage.

- **Co-allocator: concurrently allocates more than one G-DSE**
- **Single SQL on multiple data**
- **Multiple SQL on same data**

```
> globus-job-submit -: g.dse.host/dbmanager-ODBC -queue PSQL.1
> globus-job-submit -: g.dse.host/dbmanager-ODBC -queue PSQL
"select a,b from table where a < 10;" -: g.dse2.host/dbmanager-
ODBC -queue PSQL "select a,b from table where a between 10 and
20;" -: g.dse.host3/dbmanager-ODBC -queue PSQL "select a,b from
table where a > 20;"
```



- **Scalability**
- **Reliability**
- **Two implementations:**
 - DB replica
 - Data replica
- **Performances**
 - SIMD
 - MIMD
- **Partial replica**



[Home page](#)



Web [Immagini](#) [Gruppi](#) [Directory](#) [News](#) [altro »](#)

My resource is an Astro DB

Cerca con Google

Mi sento fortunato

[Ricerca avanzata](#)

[Preferenze](#)

[Strumenti per le lingue](#)

Cerca: ☒ il Web ☐ pagine in Italiano ☐ pagine provenienti da: Italia

[Pubblicità](#) - [Soluzioni Aziendali](#) - [Tutto su Google](#) - [Google.com in English](#)

©2006 Google

Root

branch

branch

value
value
value

branch

value
value

branch

value

etc...



br

value
value
value

branch

value
value

branch

value

```
> ldapsearch -LLL -x -H g.dse.host -b "mds-vo-
name=site,o=grid"
```

```
dn:GlueDSEUniqueID=g.dse.host:2119/dbmanager-ODBC, mds-vo-
name=local,o=grid
```

```
objectClass: GlueCETop
```

```
objectClass: GlueCE
```

```
objectClass: GlueDSE
```

```
objectClass: GlueDSETop
```

```
objectClass: GlueKey
```

```
GlueDSEName: TESTDB
```

```
GlueDSEStateStatus: Production
```

```
GlueDSEInfoLRMSType: Postgresql
```

```
GlueDSEInfoLRMSVersion:7.3
```

- G-DSE supports Data Source (DS) and DSE indexing, monitoring, management and recovery through a rich set of Meta-Data bound to standard GIS.
- DS have their core engine into G-DSE, that provides a framework for activity and task management.
- A RSL/JDL Transaction/Query permits a number of tasks to be specified, together with their parameters, inputs, outputs and control flow.
- The response to a request is generated by the G-DSE within a JobQueryManager *Session*. The G-DSE analyses incoming Task and conducts authentication and authorisation
- The standard Grid WorkLoad Manager constructs an optimised execution graph.
- GIS will monitor a DS's and DSE's status digest produced by its internal monitor.
- The G-DSE has been designed to support dynamic configuration, sessions, transactions, recovery and concurrency.

Biomed	
Private	medinfo
Code	Code
Family_name	Occupation
Name	disease
Address	Hospital
Telephone	

```
> voms-proxy-init -voms gilda:/gilda/Role=gildaDBAdmin
Your Identity ...

> globus-job-run g.dse.host/dbmanager-ODBC -queue PSQL1 \
"CREATE TABLE Private (
    Code            integer    NOT NULL,
    FamilyName      char(10)   NOT NULL,
    Name            char(10)   NOT NULL,
    Address          varchar(20) DEFAULT 'unknown',
    Telephone        varchar(20),
    PRIMARY KEY (Code) );"

> globus-job-run g.dse.host/dbmanager-ODBC -queue PSQL1 \
"CREATE TABLE medinf (
    Code            integer    NOT NULL,
    Occupation       varchar(20),
    Disease          varchar(20) NOT NULL,
    Hospital         varchar(20) NOT NULL);"
```

```
> globus-job-run g.dse.host/dbmanager-ODBC -queue PSQL1 \
  "INSERT INTO Private VALUES (...);
...
> globus-job-run g.dse.host/dbmanager-ODBC -queue PSQL1 \
  "SELECT Private.familyname, Private.name,
medinfo.occupations, medinfo.disease FROM Private , medinfo
WHERE Private.code = medinfo.code ... ;"
```

```
-----
| Family Name | Name   | Work           | Disease |
-----
| Rossi       | Ugo   | Ricercatore   | gastrite |
| etc ..     |       |               |         |
-----
```



```
> globus-job-run g.dse.host/dbmanager-ODBC -queue PSQL1 \  
"GRANT SELECT on medinfo to inafdbuser";
```

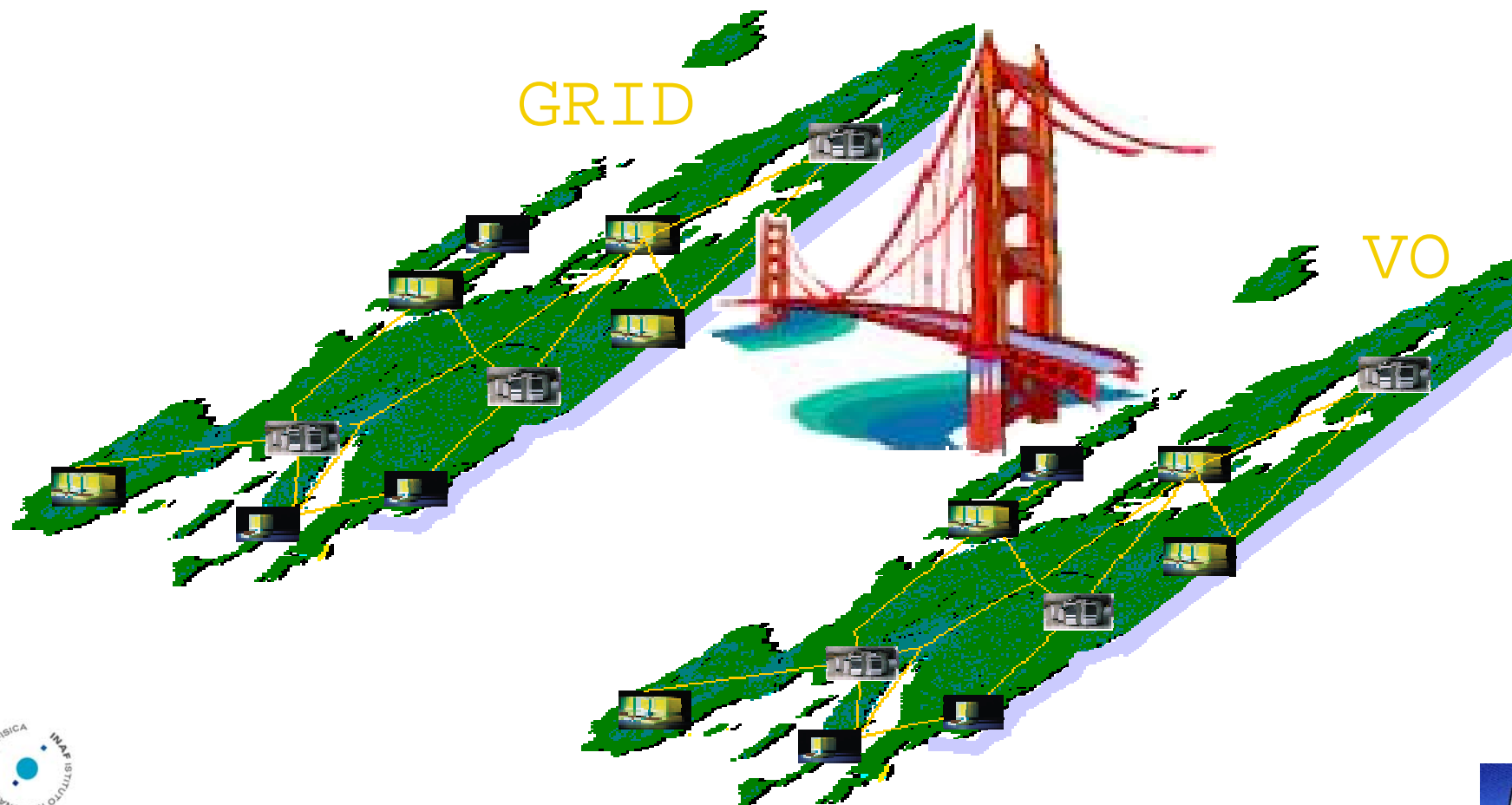
```
> globus-job-run g.dse.host/dbmanager-ODBC -queue PSQL1 \  
"CREATE VIEW flue AS SELECT Private.name, Private.Telephone  
WHERE medinfo.disease = 'flue';  
SELECT name from flue;  
START TRANSACTION; INSERT INTO Private VALUES (...); INSERT  
INTO medinfo VALUES (...); COMMIT;"
```

	Name

	Bianchi
	Rossi
	Neri

The International Virtual Observatory Alliance (IVOA) was formed in June 2002 with a mission to *facilitate the international coordination and collaboration necessary for the development and deployment of the tools, systems and organizational structures necessary to enable the international utilization of astronomical archives as an integrated and interoperating virtual observatory.*





- **Astronomical Resources**
 - Catalogues & Archives structured in DB
 - Complex DBs
- **Astronomical Standards**
 - VOResource
 - VOTable
 - VOQL
 - SOAP
- **Computational Operations, statistical analysis etc. on DataBases**
 - Ex. exploring the values at the extreme of some distribution can take 2 hours

- Any Astronomical DB is a Resource

```

<resource>
  <description>
  <info>
  <coosys>
  <param>
  <link>
  <table>
  <DATA>
</resource>
  
```

→

```

<instrument>
<coverage>
  <spatial>
  <spectral>
    <bandpass>
    <central Wlength>
    <min Wlength>
    <max Wlength>
  </spectral>
</coverage>
<resolution> ...
  
```

- **Verify the ability of the GIS to act as VOTable;**
- **Astronomical Resource XSD (eXtensible Schema Definition) => Astronomical Resource GLUE;**
- **BDII ~= Registry;**
- **VOQL (XML) query;**

BDII DB status

host/2119:dbmanager-ODBC-Lotar

branch

branch

value

value

value

branch

value

value

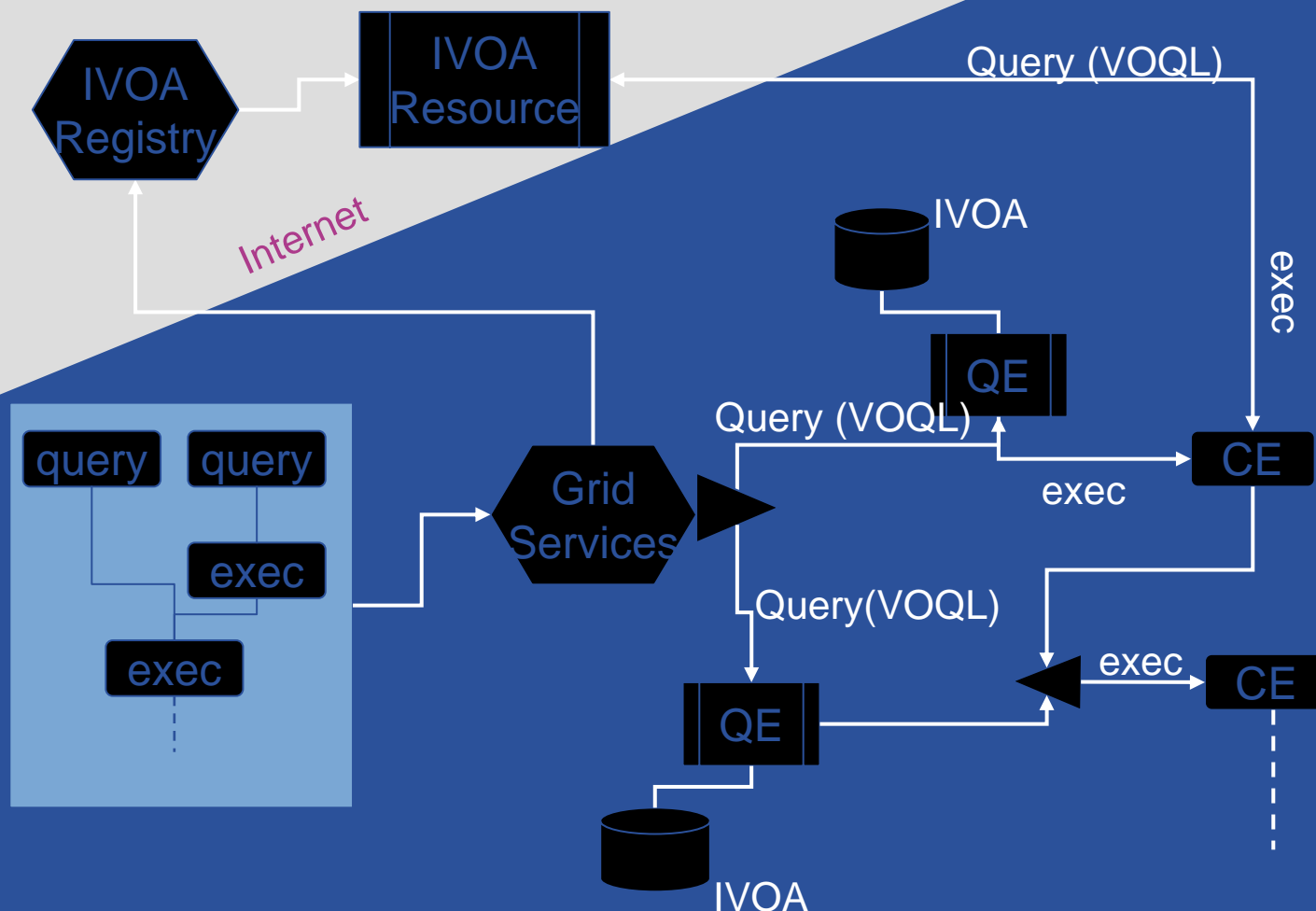
branch

value

etc...

GlueIVOAContactName=host/2119
 GlueIVOAResourceTitle=
 GlueIVOAResourceShortName=
 GlueIVOAResourceCoverage=
 GlueIVOAResourceCoverageSpectral=
 ...

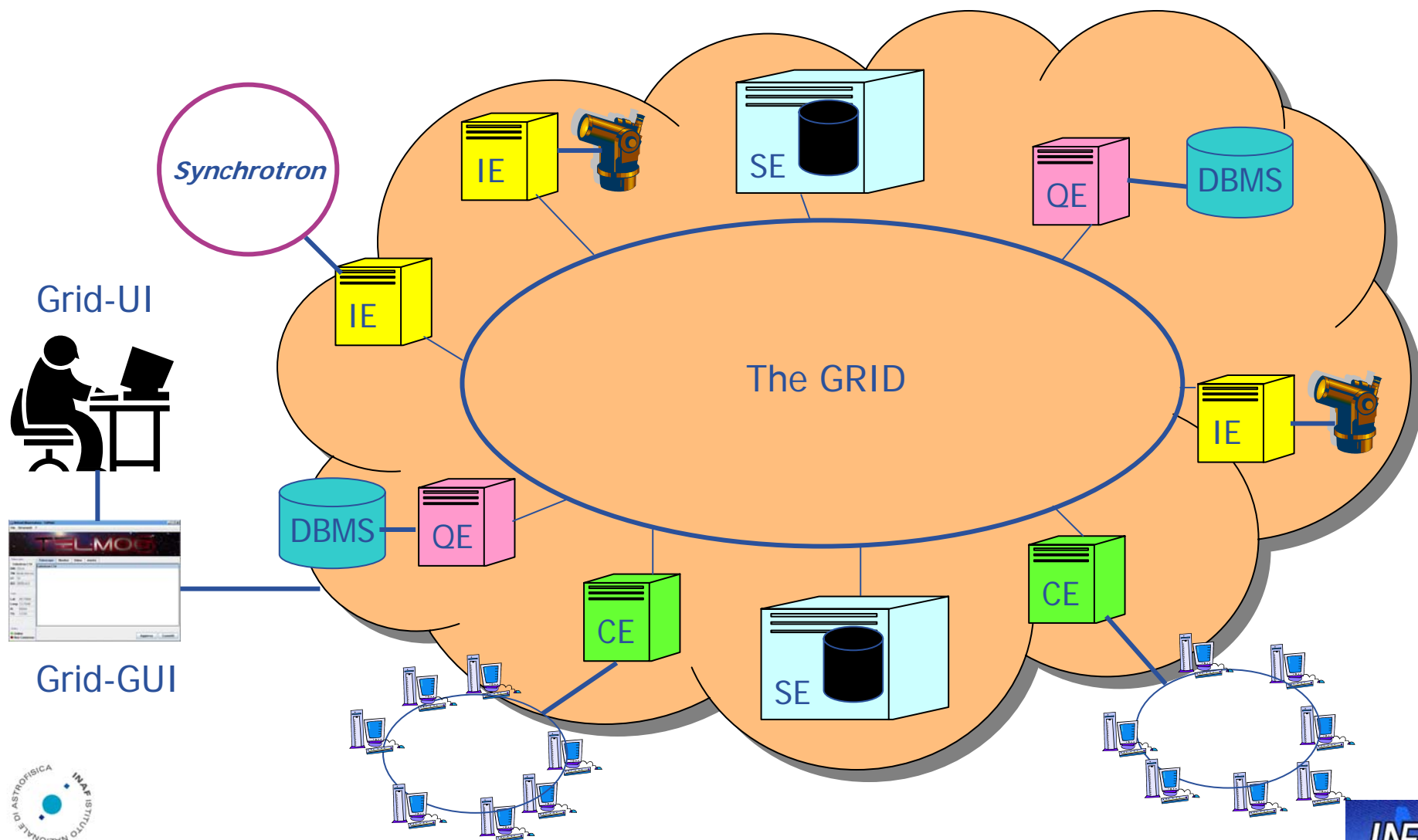
Joining VO and Grid: from the Grid to VO.



API for applications: work in progress.

- **New Grid services (R-GMA,...)**
- **New Features on G-DSE**
- **May be integrated in the WMS**
- **G-DSE is going now to be installed in all sites within the VO INAF (extended tests of G-DSE within that VO in a short time).**
- **Bioinformatics**
- **ArcheoGrid**
- **G-DSE as FileStorage (some tests done...)**
- **Instruments...**

- Provide a suitable formal definition of a Grid Abstract Computing Machine using Formal specification language
- Review the architectural definition of a Data Source Engine (DSE), to build an Instrument Control System
- Provide ICS integrated in the existing Grid Resource Framework Layer (G-ICS)
- Extend GIS capabilities to understand and handle monitoring and control requests to ICS
- Extend GIS capabilities to describe ICS Resources
- Provide a new Manager for ICS integrated in Globus
- Extend semantic and provide it to RSL to use G-ICS
- Etc...



End of Presentation

Thank you for your attention