Enabling Grids for E-science in Europe

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LCG-2 Middleware Tutorial:
Internals and APIs
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Grid Information System: Internals and APIs

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Contents

Enabling Grids for E-science in Europe

- The IS in EGEE/LCG
  - Components, Design, Infrastructure
- Available tools for retrieving information
  - as a user or Grid software developer
  - as a site manager
- A new era: R-GMA
- A quick summary for the hands-on session

Uses of the IS in EGEE/LCG

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If you are a user

Retrieve information of Grid resources and status

Get the information of your jobs status

If you are a middleware develop

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

Elements behind the IS

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```
*************************************************************************
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
```

`lcg-infosites` output
We will see it during the talk

- The general IS architecture has managed the information
- It has been provided by different providers and servers
- It follows the Glue Schema
- The LDAP Protocol has been used to access the information

General Elements

The Information System Elements

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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**

MDS is the EGEE/LCG Information System

Next slides

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First Block

- The LDAP Protocol: Generalities
- Its Data Model
- The EGEE/LCG Schema: The Glue Schema
- Current LDAP implementation

Second Block

- The providers and servers
- Local GRIIs, site GIISs and BDII
- Information transfer between these elements

The LDAP Protocol: Generalities

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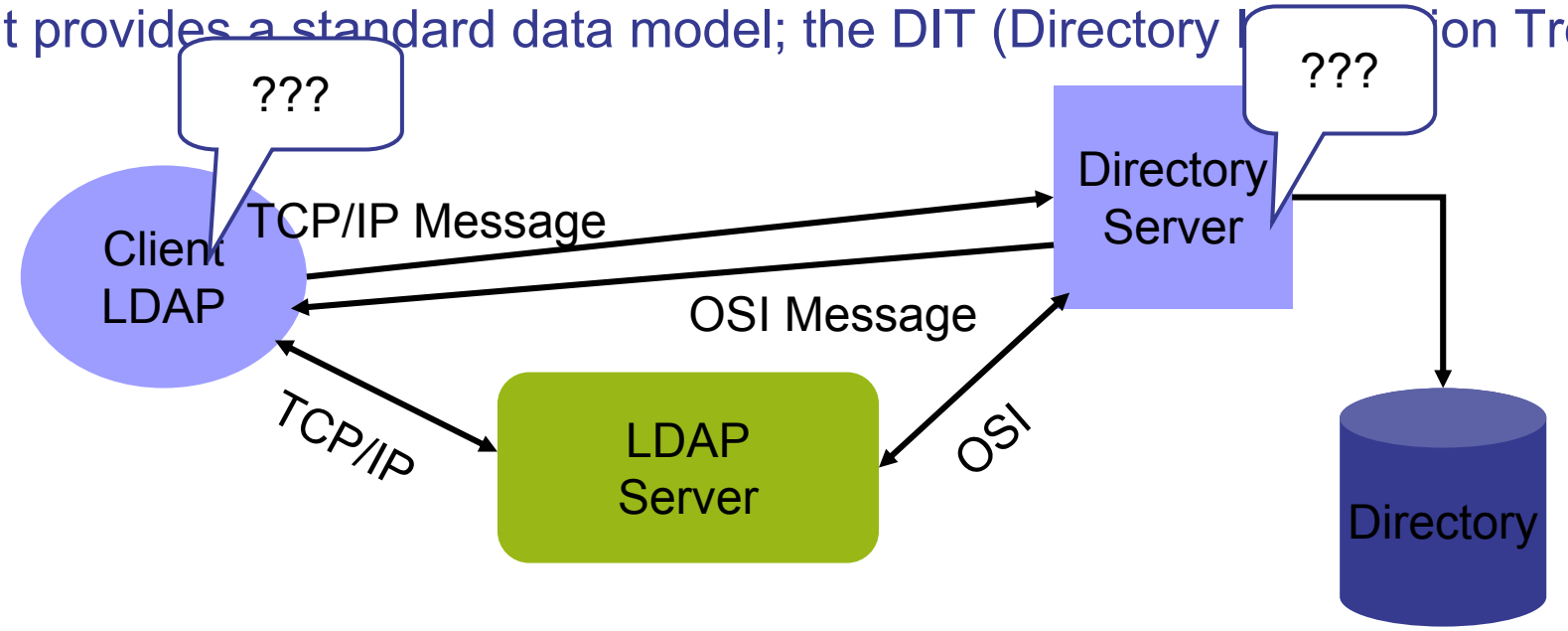
LDAP (Lightweight Directory Access Protocol)

It is the internal protocol used by the EGEE/LCG services to share information

√ It establishes the transport and format of the messages used by a client to access a directory

√ LDAP can be used as access protocol for a large number of databases

√ It provides a standard data model; the DIT (Directory I[illegible]on Tree)



The LDAP Protocol: The Data Model

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► The LDAP information model is based on **entries**

► These are **attribute** collections defined by a unique and global DN (Distinguished Name)

► Information is organized in a tree-like structure. A special attribute, **objectclass**, can be defined for each entry. It defines the classes tree corresponding to this entry. This attribute can be used to filter entries containing that object class

► The information is imported and exported from and to the LDAP server by **LDIF files** (LDAP Data Interchange Format)

```
dn: <distinguished name>
objectclass:<objectclassname>
<attributetype>:<attributevalue>
<attributetype>:<attributevalue>

dn: <distinguished name>
objectclass:<objectclassname>
<attributetype>:<attributevalue>
<attributetype>:<attributevalue>
```

► Those fields delimited by <> can be defined by the application following a certain **schema**

►The schema describes the attributes and the types associated with the data objects

The Glue Schema in EGEE/LCG: Design

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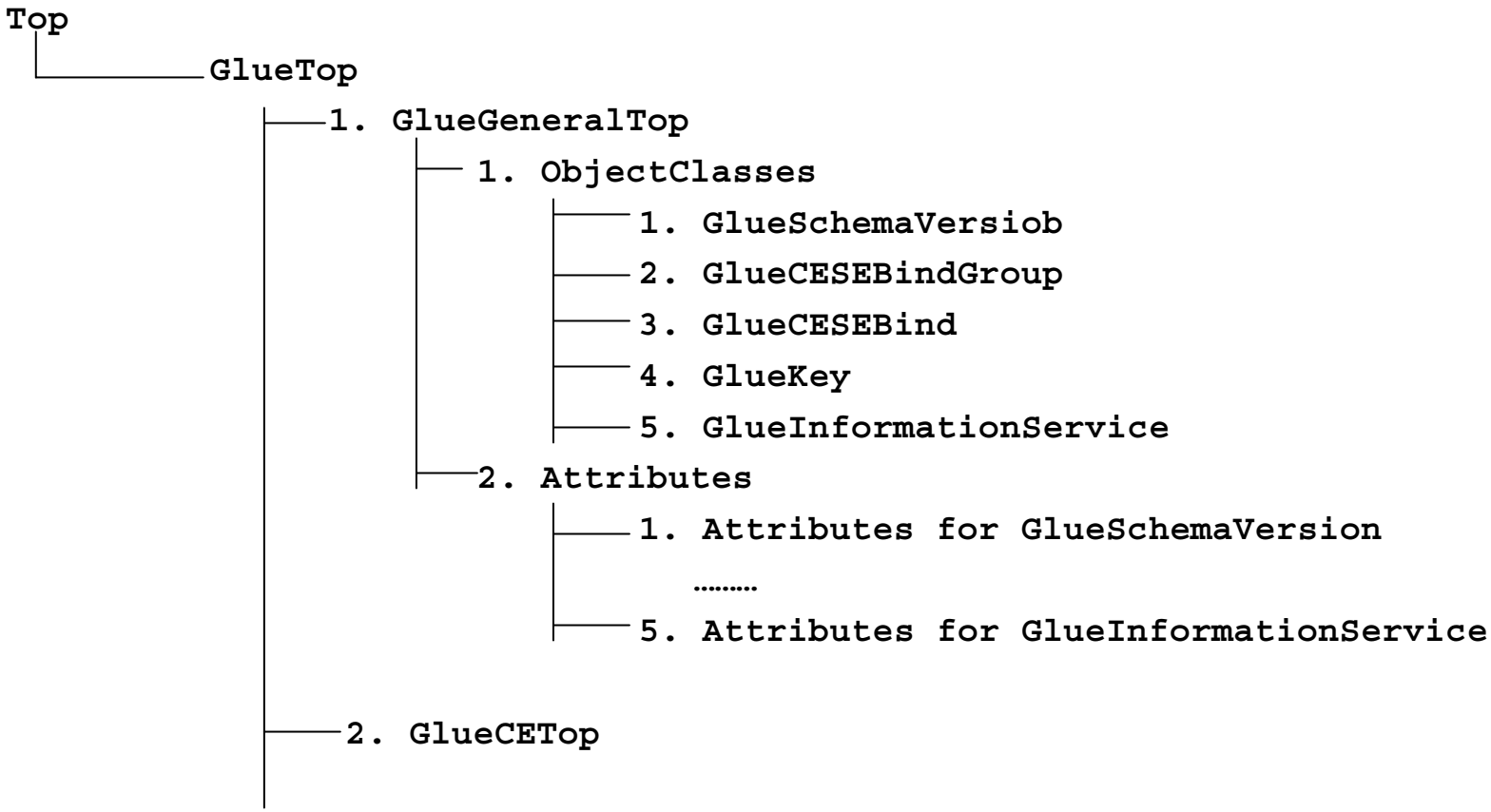
- ♠ It describes the Grid resources information stored by the IS
- ♠ It follows the DIT hierarchical structure for objectclasses and attributes:



Some examples of the Glue Schema (I)

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1. Some General Attributes:

- Base class (`objectclass: GlueTop`): No attributes
- Schema Version Number (`objectclass: GlueSchemaVersion`)
  - `GlueSchemaVersionMajor`: Major Schema Version Number
  - `GlueSchemaVersionMinor:` Minor Schema Version Number

2. Attributes for the CE

- Base Class for the CE information (`objectclass: GlueCETop`) : No attributes
- CE (`objectclass: GlueCE`)
  - `GlueCEUniqueID`: unique identifier for the CE
  - `GlueCEName:` human-readable name of the service
- CE Status (`objectclass: GlueCEState`)
  - `GlueCEStateRunningJobs:` number of running jobs
  - `GlueCEStateWaitingJobs:` number of jobs not running
  - `GlueCEStateTotalJobs:` total number of jobs (running + waiting)
  - `GlueCEStateStatus:` queue status: queueing (jobs accepted but not running), production (jobs accepted and run), closed (neither accepted nor run), draining (jobs not accepted but those already queued are running)
  - `GlueCEStateWorstResponseTime:` worst possible time between the submission of the job and the start of its execution

Some examples of the Glue Schema (II)

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3. Attributes for the SE

- Base Class (`objectclass: GlueSETop`) : No attributes
- Architecture (`objectclass: GlueSLArchitecture`)
  - `GlueSLArchitectureType:` type of storage hardware (disk, tape, etc)
- Storage Service Access Protocol (objectclass: GlueSEAccessProtocol)
  - `GlueSEAccessProtocolType:` protocol type to access or transfer files
  - `GlueSEAccessProtocolPort:` port number for the protocol
  - `GlueSEAccessProtocolVersion:` protocol version
  - `GlueSEAccessProtocolAccessTime:` time to access a file using this protocol

4. Mixed Attributes

- Association between one CE and one or more SEs (`objectclass: GlueCESEBindGroup`)
  - `GlueCESEBindGroupCEUniqueID:` unique ID for the CE
  - `GlueCESEBindGroupSEUniqueID`: unique ID for the SE

How to handle the Information in an LDAP server

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- OpenLDAP is an open source implementation of LDAP protocol
- It provides CLI and C/C++ APIs to search, add, remove, modify entries in the directory. Synchronous and asynchronous operations are allowed
- APIs description:
  http://www.openldap.org/software/man.cgi?query=ldap
- All these APIs have correspondent CLIs already included in the distribution
  - → ldapadd
  - → ldapdelete
  - → ldapmodify
  - → ldapsearch

  (Make a *"man"* to these commands to get more information)
- OpenLDAP includes also:
  - → JLDAP: LDAP class libraries for Java
  - → JDBC: LDAP-Java JDBC-LDAP Bridge Driver

The use of the command lines in LDAP

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♠ ldapsearch

Read port of the BDII

```
% ldapsearch \
   -x \                                          Simple authentication
   -H ldap://grid017.ct.infn.it:2170 \           Uniform resource identifier
   -b 'mds-vo-name=local,o=grid' \               Base DN for search
   '(objectclass=GlueSE)' \                      Filter
   GlueSEUniqueID \                              Attributes to be returned
```

(Make "man ldapsearch" to retrieve the whole set of options)

The ldapsearch Implementation in EGEE/LCG

Some wrappers of ldapsearch exist in LCG middleware, but they are not directly exposed to users

→ Part of the internal WMS software

→ Part of the Monitoring tools

ldapsearch example in LCG

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```
dn:GlueServiceURI=http://rlscert01.cern.ch:7777/cms/v.2.2/edg-local-replica-ca
  talog/services/edg-local-replica-catalog,mds-vo-name=local,o=grid
objectclass: GlueTop
objectClass: GlueService
objectClass: GlueSchemaVersion
GlueServiceURI: http://rlscert01.cern.ch:7777/cms/v2.2/edg-local-replica/catal
   og/services/edg-local-replica-catalog
GlueServiceType: edg-local-replica-catalog
GlueServicePrimaryOwnerName: LCG
GlueServicePrimaryOwnerContact: mailto:hep-project-grid-cern-testbed-managers@
  cern.ch
GlueServiceHostingOrganization: CERN
GlueServiceMajorversion: 1
GlueServiceMinorVersion: 0
GlueServicePatchVersion: 1
GlueServiceAccessControlRule: cms
GlueServiceInformationServiceURL: MDS2GRID:ldap://adc0002.cern.ch:2170/mds-vo-
   name=local,mds-vo-name=local,o=grid
GlueServiceStatus: running
GlueSchemaVersionMajor: 1
GlueSchemaVersionMinor: 1
```

Some tests

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If you are not very familiar with the CLI ldapsearch and with the command lcg-infosites, just play a bit before doing APIs

```
% ldapsearch -x -LLL -h grid017.ct.infn.it -p
2170 -b "o=grid"
```

```
% ldapsearch -x -LLL -h grid017.ct.infn.it -p
2170 -b "o=grid" '(objectclass=GlueSE)'
GlueSEName GlueSEPort
```

The use of the command lines in LDAP

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♠ ldapadd, ldapmodify, ldapdelete

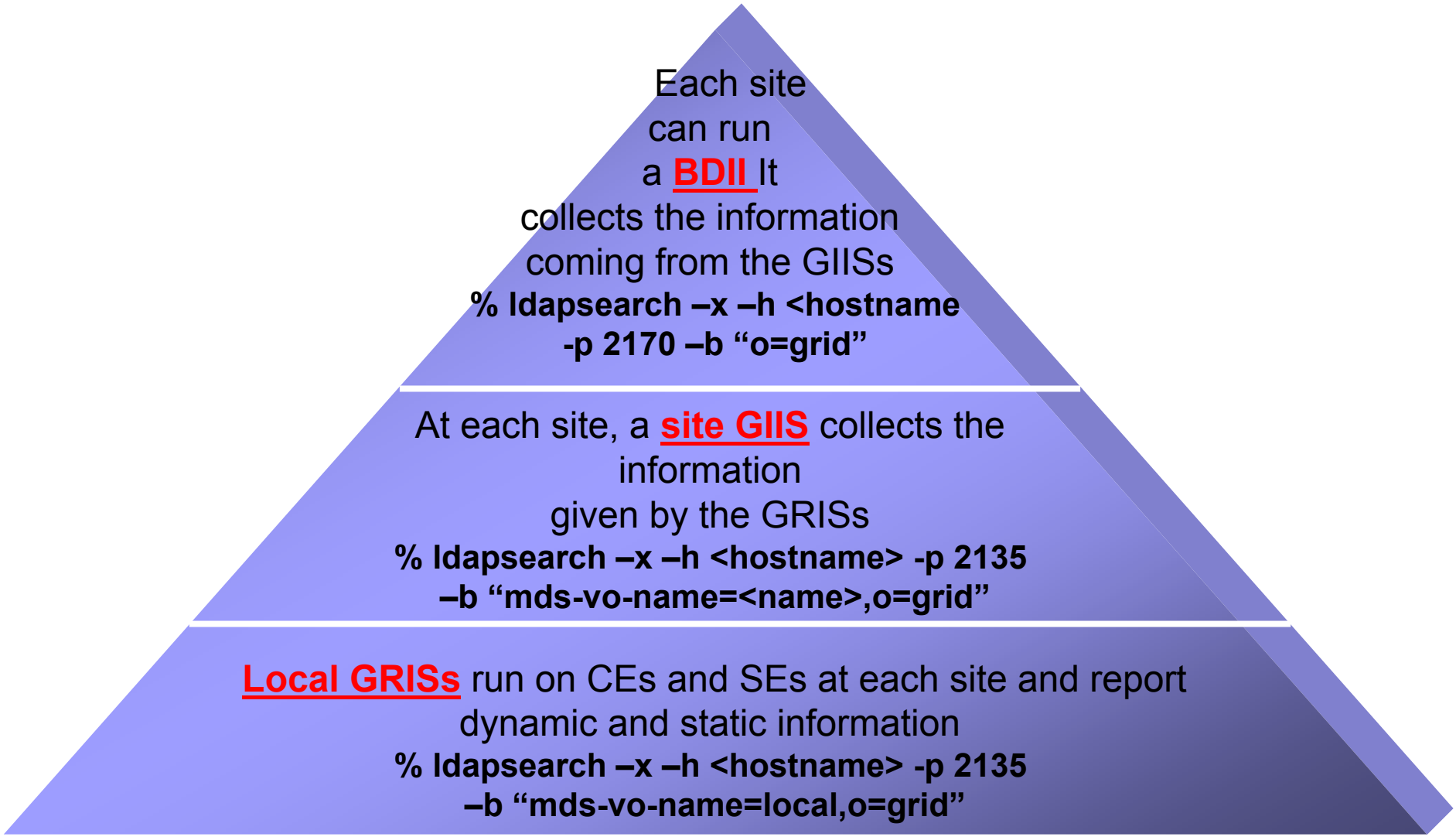
Write port of the BDII

```
% ldapadd \
  -x \                                          Simple authentication
  -H ldap://grid017.ct.infn.it:2171 \           Uniform resource identifier
  -D 'mds-vo-name=local,o=grid' \               DN binddn to bind to the
                                                  directory
  -f <your-file>                                File containing your new
                                                  entry
```

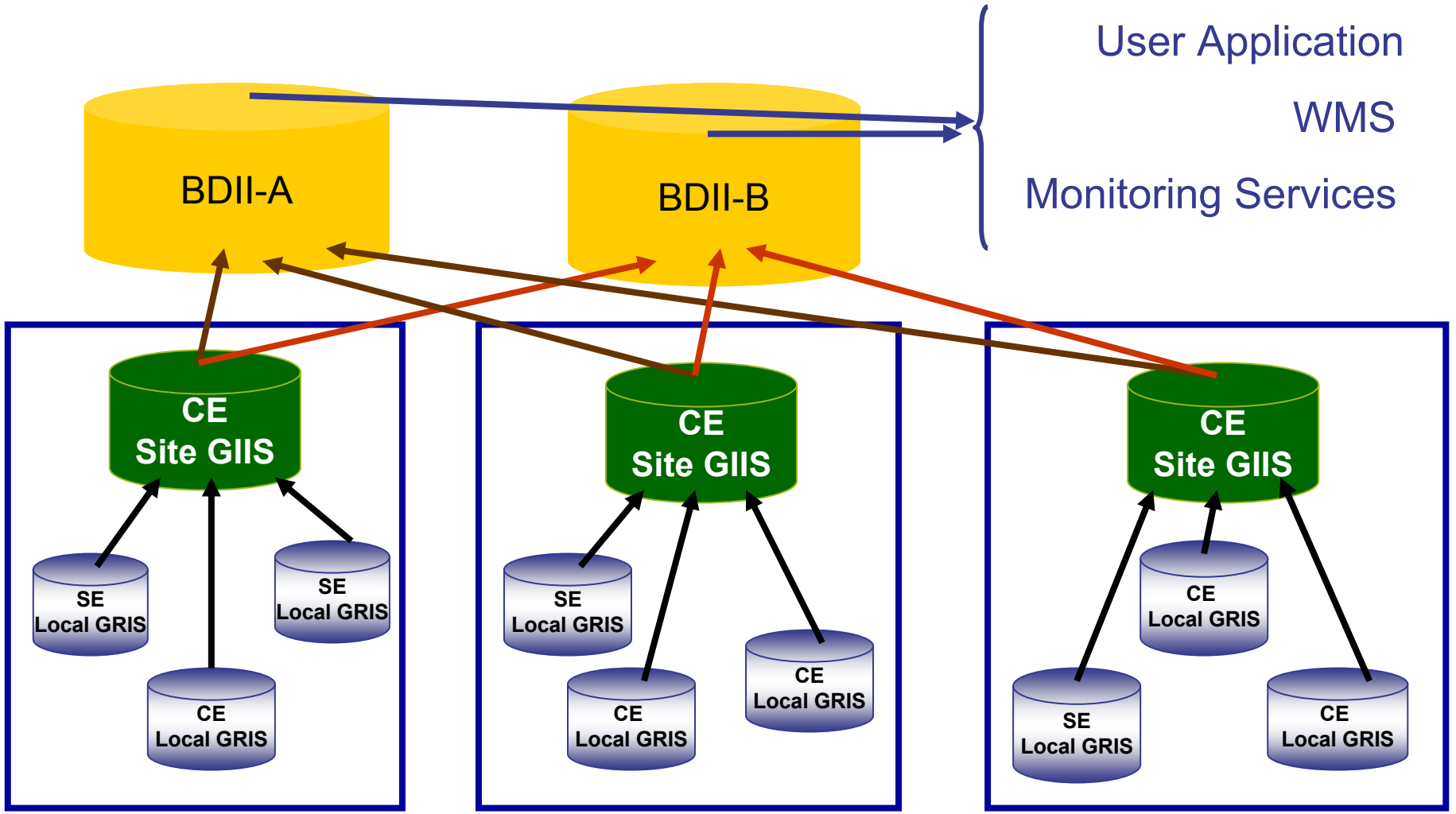
ldapadd, ldapmodify and ldapdelete in LCG-2

- LCG does NOT allow the use of these commands to create or modify information
- Several tools have been developed to include information in the servers
  - → They are not based on LDAP
  - → The query tools of LDAP can however retrieve this information

GRISs, GIISs and BDII



GRISs, GIISs and BDII (cont.)



The BDII

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This is the information server directly invoked by users and services

√ Because only those sites listed in the BDII really exist (it registers site GIISs)

√ Because it provides information to the RB (to find resources)

√ Because it is needed by the data management tools. The "`lcg-utils`" tools use it (see the Data Management talk)

√ Fundamental service to allow for stability (seen many times during the Alice DC for example). It is possible to define a hierarchy of Information Systems.

√ Because it can be configured by each VO following its needs using global production configuration file distributed by CERN via AFS.

`/afs/cern.ch/project/gd/www/gis/lcg2-bdii/<alice>`

→ The VOs members and the LCG group have access to these files

→ Each VO decides where jobs should be executed independently of the rest of the Grid

globus-mds: top responsible service

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► Lower level: GRIS

- Scripts and configuration files generate ldif files containing the information (for example, general information of the nodes)
- Other tools responsible of the dynamic information (for example, available and/or used space into a SE) – the so called information providers
- globus-mds runs such tools every few seconds. The system merges the dynamic information with the static one and register it to the local cache.

► Medium level: local GIIS

- Same procedure taking the information from the registered GRISs

► High level: BDII

- Publish the information of the site GIISs making a refresh every 2 minutes

► An example: the Resource Broker

- This is a Grid service and publishes its information and status to the information system as described above (it is a server)
- However it uses a BDII for matchmaking purposes (it is a client)

Next Slides: Tools based on the LDAP Protocol

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User privileges

- **`lcg-is-search:`** C++ executable
- **`lcg-infosites:`** Perl script. The next “edg-rm pi”
- Implementation in the experiment software

Software installation privileges

- **`lcg-ManageVOTag:`** Software tags publication

Site admin privileges

- **`lcg-user-configuration:`** Information generation

Information System Tools

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1. You are a user with no privileges

- Using LDAP you cannot generate but just retrieve information (ldapsearch)
- Some C++ APIs and scripts have been developed to make this job easier

♠ lcg-is-search

LDAP C++ API included in LCG-2 to retrieve information

☺ Why the need for this tool?

1. API allows users to interrogate the IS from any application or services
2. Better way of presenting the information (no way with ldapsearch)

☺ Which kind of tools are installed? (rpm: lcg-info-api-ldap-1.1-1.4 included in Gilda testbed)

1. A library: `/opt/lcg/lib/liblcg-info-api-ldap`
2. Headers: `/opt/lcg/include/lcg-info-api-ldap/`
3. Several handy executables: `lcg-is-search`, `lcg-infosites`, …

☺ Where do I find it?

WNs and UIs in `/opt/lcg/bin`

This will be tested during the hands-on session

lcg-is-search API

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`lcg-is-search` uses some ldapsearch wrappers designed by LCG

All of them can be found under: `/opt/lcg/include/lcg-info-api`

The following LCG wrappers are included in `lcg-is-search:`

- LDAPConnection (pure virtual class)
  - All kind of connections (sync. and async.) are derived from this class
  - It defines basic operations relative to a connection (open a connection, close it, checks whether a connection is established, etc)
- LDAPSynchConnection
  - It implements methods of LDAPConnection for a synchronous connection and implements the corresponding methods of LDAP
- LDAPQuery
  - It uses the LDAP Connection base class to query a database for information
- LDAPForwardIterator
  - It is a forward iterator for LDAP Objects
  - It apply to the LDAP query results a powerful means to iterate
- LDIFObject
  - Handles the attributes requested by the application

Some tests

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You can try the same queries you made with ldapsearch

```
% /opt/lcg/bin/lcg-is-search -f objectclass=GlueSE -a GlueSEName GlueSEPort
```

- You do not have additional information you did not ask for (the DNs)
- The lines are not cut at the end

Compare with ldapsearch

```
lcg-is-search -f objectclass=GlueTop -a'(& (GlueServiceType=edg-local-replica-
   catalog) (GlueServiceAccessControlRule))' GlueServiceAccessPointURL
```

First of all you do not care about hosts or ports. Just in the case you want an specific host, otherwise lcg-is-search looks at the one in default

```
ldapsearch -h grid017.ct.infn.it -p 2170 -x -LLL -b "o=grid"
   '(objectclass=GlueTop)' '(& (GlueServiceType=edg-local-replica-catalog)
   (GlueServiceAccessControlRule))' GlueServiceAccessPointURL
```

- You do not ask for the DN
- The lines are cut at the end of the buffer. It's very difficult to wrap this information into your code

Steps to follow and establish a connection using the LCG wrappers

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- An additional class (`InfoFromLDAP`) has been created to handle the LDAP wrappers in just one method able to:
  - establish the connection with a server
  - iterate through the whole buffer to find the information
  - retrieve the wished information
  - close the connection
  - everything just in one method called “query”
- Then `lcg-is-search` implements this class

```
LDAPConnection* connection = new LDAPSynchConnection(info_index, host, port, timeout);
connection-> open();
LDAPQuery query(connection,filter,attributes);
query.execute();
LDAPForwardIterator ldap_it(query.tuples() );
ldap_it.first();
while ( ldap_it. current() ){
        cout << (*ldap_it) << endl;
        ldap_it.next();
 }
connection->close();
```

Implementation of LDAP wrappers into the “query” method of the class InfoFromLDAP

LDAP implementation in the LCG wrappers (I)

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```
bool LDAPSynchConnection::open(){
bool result  = false;
close();
ldap* h_ldap = NULL;
if ((h_ldap = ldap_init(const_cast<char*>(source_name.c_str()),source_port))){
    ldap_set_option(h_ldap,LDAP_OPT_NETWORK_TIMEOUT,&timeout);
if((ldap_last_error = ldap_simple_bind_s(h_ldap,0,0)) ==LDAP_SUCCESS){
     handle = h_ldap;
     result = true;
     }
 }
else{
if (h_ldap){
  ldap_unbind(h_ldap);
   }
 }
  return result;
}
```

- **ldap_init:** allocates an LDAP structure. It does not open a connection to the server. This will occur when the 1st operation is attempted
- **ldap_set_option:** applies a value for a given option
- **ldap_simple_bind_s:** initiates a simple sync. bind operation to authenticate a client to an LDAP server
- **ldap_unbind:** used to unbind from the directory, terminate the current association and free the resources

The LDAP implementation is included only in LDAPSynchConnecti

LDAP Makefile

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The makefile should include the following packages:

```
BOOST_CFLAGS = -I/usr/include -I/opt/boots/gcc-3.2.2/include
BOOST_LIBS = -L/usr/lib -lpthread -L/opt/boost/gcc-
   3.2.2/lib/release -lboost_fs -lboost_thread -lboost_regex

DLOPEN_CFLAGS = -I/usr/share/libtool/libltdl
DLOPEN_LIBS = -L/usr/lib -lltdl

INCL_CFLAGS = -I/opt/edg/include -I/opt/lcg/include
CXX = /opt/gcc-3.2.2/bin/c++-3.2.2
CXXPP = /opt/gcc-3.2.2/bin/c++-3.2.2 -E

GLOBUS_THR_CFLAGS = -I/opt/globus/include/gcc32dbgpthr
GLOBUS_THR_LIBS = -L/opt/globus/lib -lldap_gcc32dbgpthr
```

(During the hands-on session you will have access to the Makefile)

Implementation of lcg_is_search in LCG-2

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experiment integration and support

♠ lcg-infosites

- This is a script which invokes lcg-is-search
- 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

```
> 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

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```
> 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
                     [... ... ... ... ...]
```

lcg-infosites

```
*************************************************************************
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
```

Seen in slide 4
It is using lcg-infosites with option “ce”

lcg-infosites

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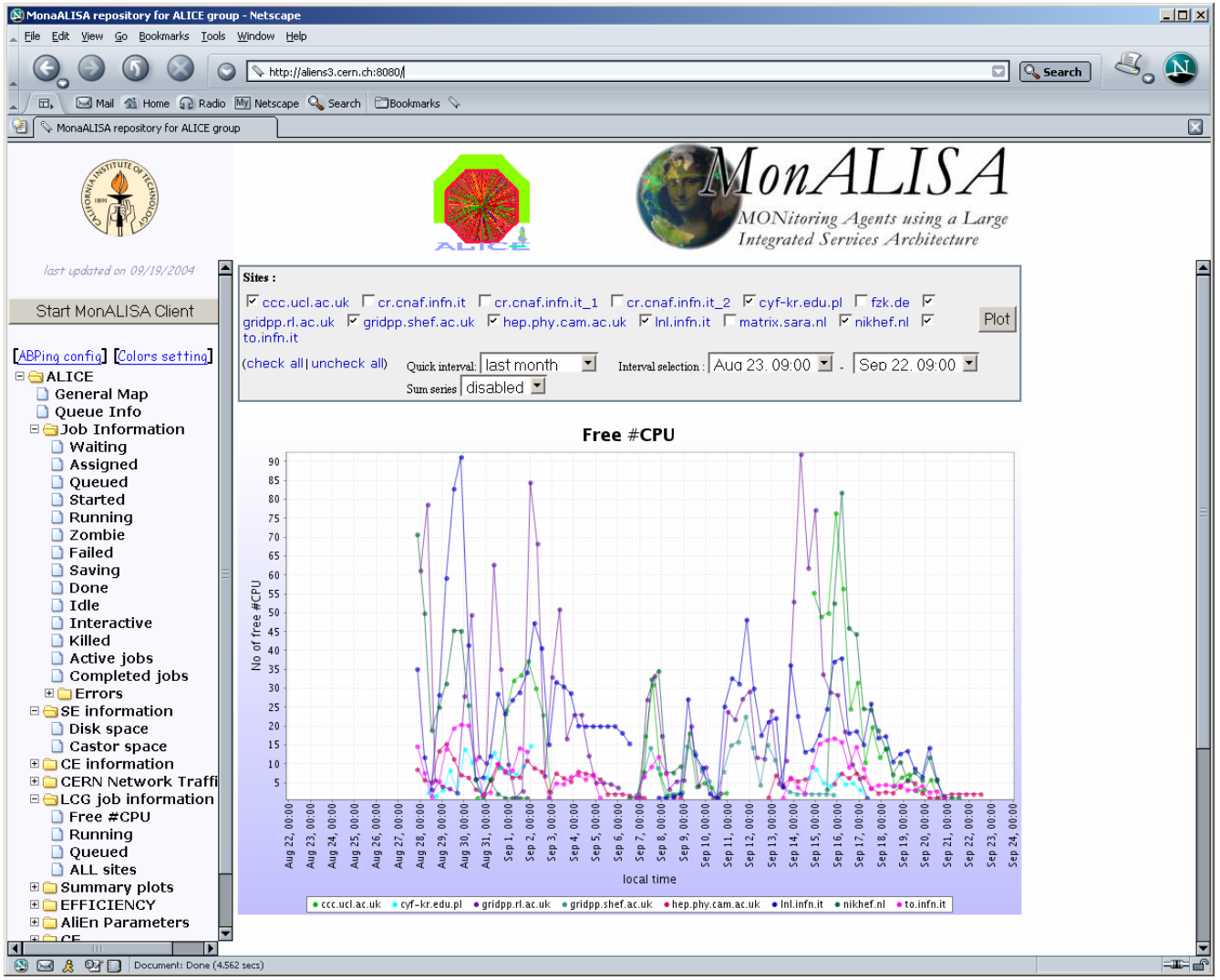
Implementation in MonALISA:

The monitoring service of the Alice Experiment



Some tests

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Test some lcg-infosites features:

```
%lcg-infosites -vo gilda ce

%lcg-infosites -vo gilda se

%lcg-infosites -vo gilda all

%lcg-infosites -vo gilda lrc

%lcg-infosites -vo gilda rmc
```

Information System Tools

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2. You have application software administrator privilege: You can publish application specific information

1. You can install the software of your VO

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♠ Through special Grid tools, an application software administrator can submit Grid requests for software installation and validation

♠ Once the software has been installed and validated, a tag specifying the software version can be published in the information system to announce software availability at a site

2. You can publish a software tag corresponding to the software you have installed

This will be tested duri
the hands-on sessior

♠ Via the script: `lcg-ManageVOTag` (UIs and WNs)

♠ The tag version is given as an argument to the script

♠ In case the user installs his software with his own tools, lcg-ManageVOtag can be independently used to publish the tag

Information System Tools

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♠ lcg-ManageVOTag

```
lcg-ManageVOTag -host <CE_host> -vo <your_vo> --feature -tag \
<your_tag>
```

Features:

√ **add** → It allows to join one or more tags each time (sgm privileges mandatory)

√ **remove** → any tag can be deleted (sgm privileges mandatory)

√ **list** → all tags included by the sgm can be visualized (all users from any VO can used this feature)

It's mandatory the tag follows the `VO-<voname>-<your-information>` syntax

```
> lcg-ManageVOTag -host lxb0706.cern.ch -vo dteam --add -tag VO-dteam-SFW1

lcg-ManageVOTag: VO-dteam-SFW1 submitted for addition by dteam to
GlueApplicationSoftwareRunTimeEnvironment
```

Glue Schema attribute which will be filled with the software tag

Information System Tools

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But… what is happening behind?

► The first time this command is used from the UI or the WN, globus-url-copy will be used to create a `/opt/edg/var/info/<VO>/<VO>.list` file including the first tag(s) you include

►The rest of the times the file will just the file will not be recreated and will just hold the new tags

►The **`edg-ce-all`** (info producer into the CE) will read the file and publish the info, setting the **`GlueApplicationSoftwareRunTimeEnvironment`** attribute value to the tags included in these files

Just interrogate the BDII or the GIIS:

```
ldapsearch -h lxb0705.cern.ch -p 2170 -x -b "o=grid" -LLL
objectclass=GlueSubCluster GlueApplicationSoftwareRunTimeEnvironment

dn: GlueSubClusterUniqueID=lxb0706.cern.ch,GlueClusterUniqueID=lxb0706.cern.ch

, Mds-Vo-name=eis,mds-vo-name=local,o=grid

GlueHostApplicationSoftwareRunTimeenvironment: VO-dteam-SFW1
```

Information System Tools

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3. You have administrator privileges: You can produce the information

☺ Now you can create easily static information via a interactive script included in the SEs and CEs:

`/opt/lcg/libexec/lcg-user-configuration`

experiment integration and support

```
**********************************************************************
DESCRIPTION
This script is intended to provide the user with a tool able to include
attribute values related to the GlueService. This script is interactive
and the required values will be passed by you through the screen.
WARNING: ALL VALUES ARE MANDATORY. Some fields must be integer values.
These are announced
**********************************************************************
Asking now for the values of the attributes:
Introduce the GlueServiceURI
(your value)
Introduce the GlueServiceType
(your value)
```

This will be tested during the hands-on session

Information System Tools

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Just wait maximal 2 minutes to refresh the BDII. Your entry is there

But… what has happened behind?

→ Under /opt/lcg/var a **GlueService.ldif$$** has just been created. It has already a ldif syntax and contains your new entry

```
dn: GlueServiceURI=<your_value>,Mds-Vo-name=local,o=grid
objectClass: GlueService
objectClass: GlueSchemaVersion
GlueServiceURI: <your_value>
GlueServiceAccessPointURL: <your_value>
GlueServiceType: <your_value>
GlueServicePrimaryOwnerName: <your_value>
GlueServicePrimaryOwnerContact: <your_value>
GlueServicePrimaryHostingOrganization: <your_value>
GlueServiceMajorVersion: <your_value>
GlueServiceMinorVersion: <your_value>
GlueServiceAccessControlRule: <your_value>
GlueServiceInformationServiceURL: <your_value>
GlueServiceStatus: <your_value>
GlueSchemaVersionMajor: <your_value>
GlueSchemaVersionMinor: <your_value>
```

Information System Tools

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¤ The file **/opt/lcg/var/lcg-info-generic-user.conf** has been modified to include just one line:

```
provider_script=/opt/lcg/libexec/lcg-info-user -file
/opt/lcg/var/GlueService.ldif$$
```

Cat $file

¤ The system script **/opt/lcg/sbin/lcg-info-generic-config** runs the new file **lcg-info-generic-user.conf**. This will include the new configuration

¤ The system script **/opt/lcg/libexec/lcg-info-wrapper** will run too

```
#!/bin/sh
/opt/lcg/libexec/lcg-info-generic /opt/lcg/var/lcg-info-generic-user.conf
/opt/lcg/libexec/lcg-info-user -file /opt/lcg/var/GlueService.ldif$$
```

New line

Always there

Next Slides: R-GMA

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A new era has already began in EGEE/LCG: R-GMA

- Presentation of R-GMA
  - Characteristics
  - Design
  - Architecture
- Tools
  - Browser
  - Virtual database
  - C++ APIs

R-GMA: New System

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Why a new system?

Disadvantages of the old system:

¤ LDAP does not allow to query information from different entries

¤ MDS is not flexible enough to allow for dynamic publication of data from user applications

Advantages of the new system:

¤ R-GMA is quite flexible and allows cross queries between different entries

¤ Anyone can introduce new information in the system in a very easy way

¤ It is quite dynamic with new Producers of information being notified by existing Consumers

R-GMA: Characteristics

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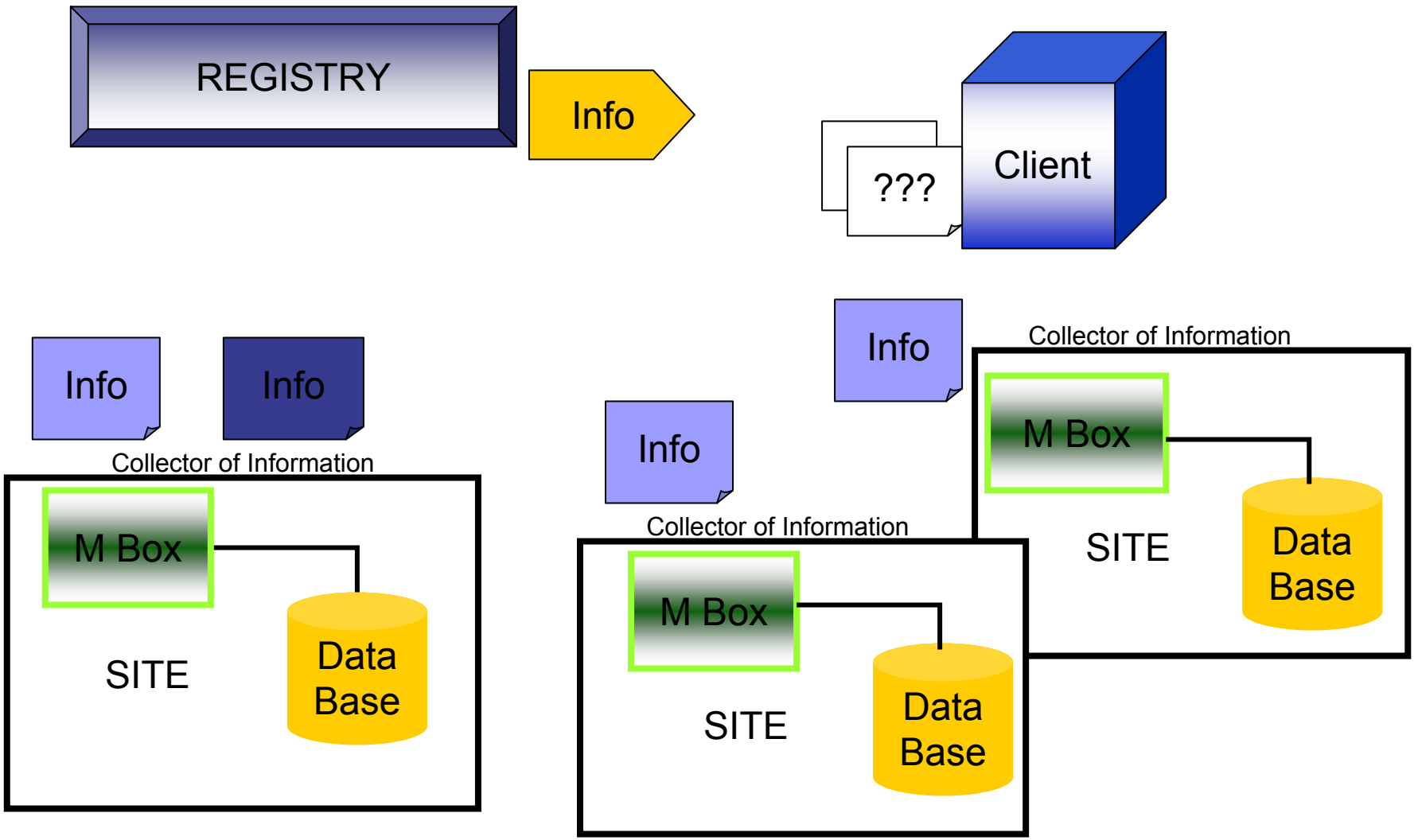
GMA (Grid Monitoring Architecture)

- From GGF (Global Grid Forum)
- Very simple; it does not define:
  - → Data model
  - → Data transfer mechanism
  - → Registry implementation

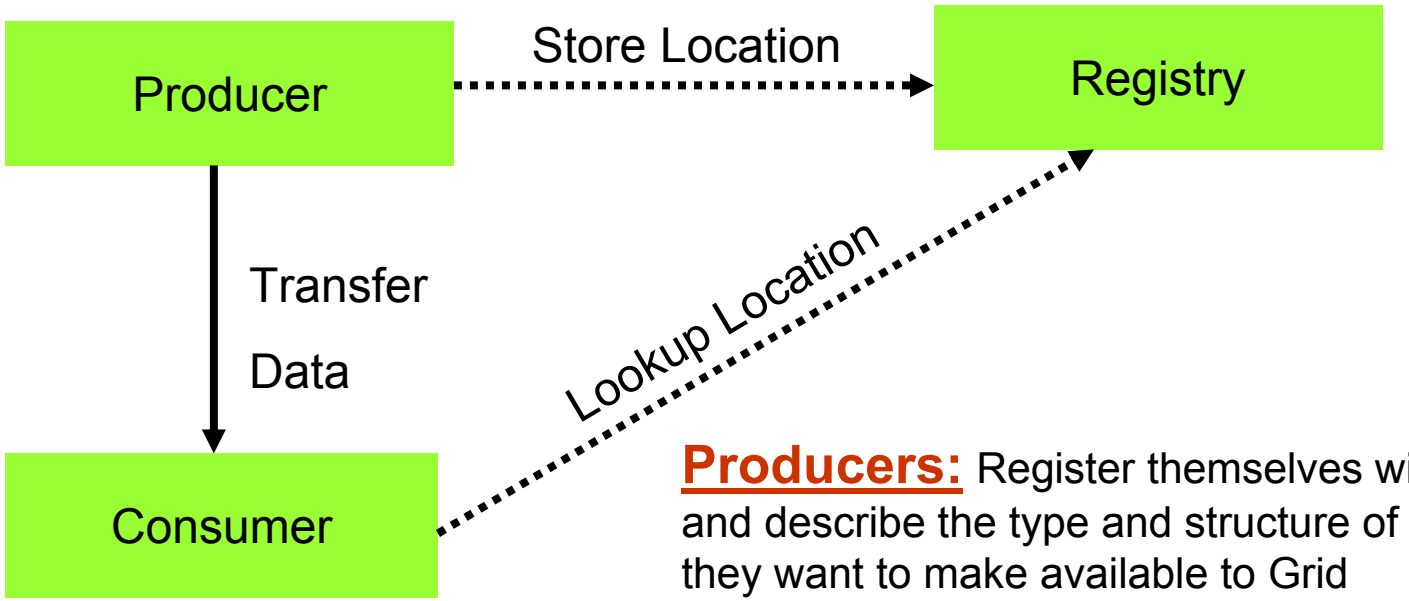
R-GMA (Relational GMA): Relational implementation

- Powerful data model and query language
- All data modeled as tables
- SQL as query language. It can express most queries in one expression
- You have a Relational DB for each VO

R-GMA: Design


REGISTRY
Info
???
Client
Info
Info
Collector of Information
M Box
SITE
Data Base
Info
Info
Collector of Information
M Box
SITE
Data Base
Info
Collector of Information
M Box
SITE
Data Base

R-GMA Architecture



Producers: Register themselves with the Registry and describe the type and structure of the information they want to make available to Grid

Consumers: Query the Registry to find out the information available and locate Producers which provide such information. They can connect directly the Producers

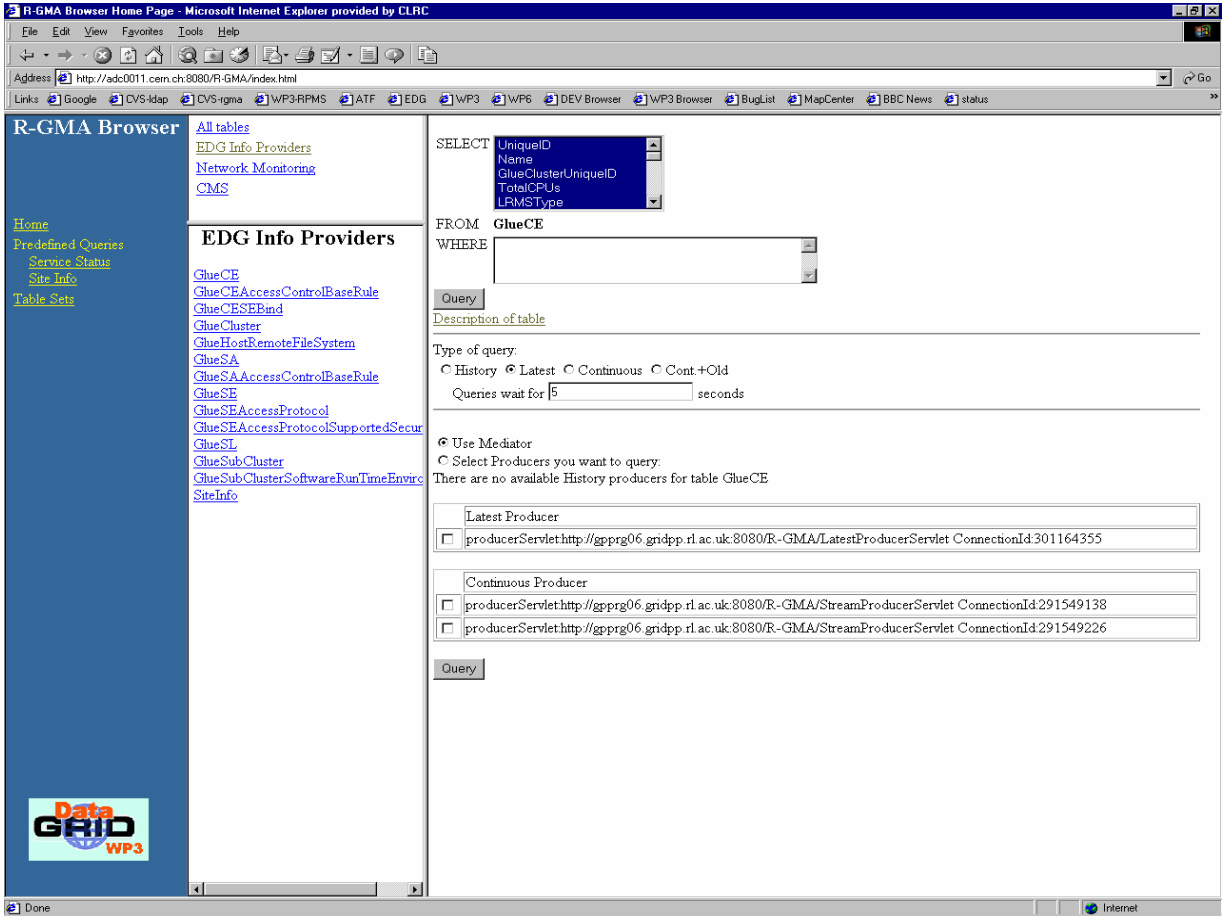
Registry: General collector, its arrow line represents the main flow of data

R-GMA tools: Browser

The user can retrieve the R-GMA information via the browser servlet

http://lcgic01.gridpp.rl.ac.uk:8080/R-GMA/index.html

It shows the schema, the registered producers and allows simple queries



edg-rgma: Virtual Database

- Recently set up in LCG-2/EGEE
- You can make with some of the APIs to produce or retrieve information
- Make `edg-rgma -c help` to retrieve more information

```
$ edg-rgma

rgma> latest select sitename,sysAdminContact from SiteInfo;

+----------------------+-------------------------------------------------+
| sitename             | sysAdminContact                                 |
+----------------------+-------------------------------------------------+
| IC-LCG2              | b.macevoy@imperial.ac.uk                        |
| LCGCERTTB4           | Piera.Bettini@cern.ch                           |
| Uni-Wuppertal        | lcg-admin@physik.uni-wuppertal.de               |
| RAL-LCG2             | lcg-support@gridpp.rl.ac.uk                     |
| nikhef.nl            | grid-support-admin@nikhef.nl                    |
+----------------------+-------------------------------------------------+
5 Rows in set
```

R-GMA: Classes

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- The headers are visible in your UI under:
  `/opt/edg/include/info`

- Those directly used in this tutorial are:
  - **Consumer.hh**
    - Executes a SQL query to return tuples to the user
    - Able to find the producers of information
  - **ResultSet.hh**
    - Handle the results strings
  - **StreamProducer.hh**
    - Register a table when it is created and subsequently to publish information

LCG APIS from R-GMA

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♠ **InfoFromRGMA (wrapper of R-GMA):**

Parallel development to `InfoFromLDAP`

```
> lcg-is-search-rgma  <your_request>
```

(lcg-is-search-rgma implements InfoFromRGMA)

♠ **InfoToRGMA (wrapper of R-GMA):**

You have the power, You create the information

experiment integration and support

```
> lcg-is-add-rgma  <your_input>
```

(lcg-is-add-rgma implements InfoToRGMA)

Our APIs based on LDAP use previous LDAP wrappers. In the case of R-GMA our APIs are directly the wrappers

How R-GMA classes are included in these classes

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InfoFromRGMA.cpp

Your request

type of query

```
Consumer myConsumer (os.str(), CONTINUOUS);
TimeInterval Timeout(60)
myConsumer.start(Timeout);
myConsumer.isExecuting()
```

Sends the Consumer query for executing

Returns all the available pieces of information

InfoToRGMA.cpp

Declares a table and creates it if needed

```
StreamProducer myProducer;
myProducer.declareTable(table," ");
myProducer.setTerminationInterval(TimeInterval(1200));
myProducer.setMinRetentionPeriod(TimeInterval(600));
myProducer.insert(your_request);
```

Inserts data into the producer

R-GMA Makefile

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The following inputs will be mandatory in the Makefile

```
BOOST_CFLAGS = -I/usr/include
BOOST_LIBS = -L/usr/lib/ -lpthread
DLOPEN_CFLAGS = -I/usr/share/libtool/libltdl
DLOPEN_LIBS = -L/usr/lib -lltdl
INCL_CFLAGS = -I/opt/edg/include -I/opt/lcg/include
INCL_LIBS = -L/opt/edg/lib -lrgma-cpp -lxerces-c1_7_0 -lssl
INCLUDES = -I/opt/edg/include/info
```

You will have access to the R-GMA makefiles during the hands-on session

The future in LCG-2

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LDAP can be considered the past in LCG

A new protocol has been deployed based on web services: **R-GMA**

Problem:

- Each protocol has its own schema, its own technology
- Users and developers have to adapt their software and applications to the new protocols

Questions:

- What to do with the already existing tools?
- What to do in the future to if a new protocol is arriving?

EIS experiment integration and support

Solution:

A new interface able to globalize all protocols with just one schema and just one query language

General Features of the Interface

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Characteristics:

1. The User Applications see just one interface
2. The query language and data model are included
4. The query and schema are syntactically and semantically translated internally in a transparent manner

User Requirements:

1. Perform the query via SQL
2. Configuration file to include the protocol and additional parameters mandatory for each protocol
3. Use the canonical schema

General Interface Tool

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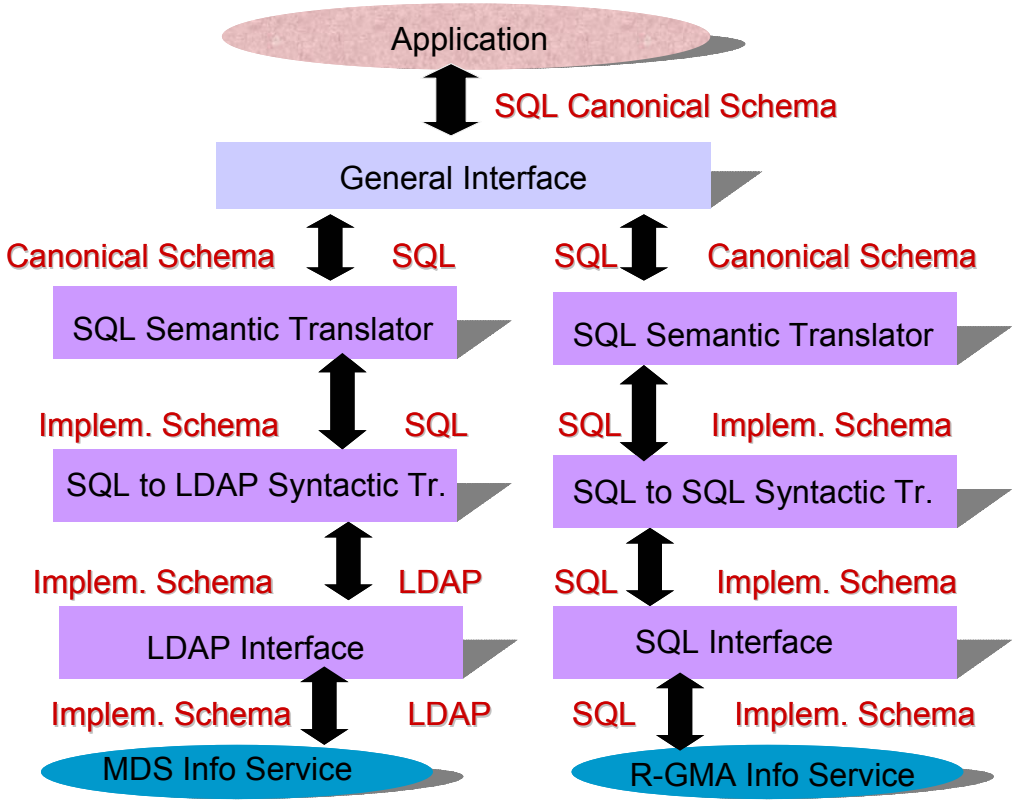
General schema of the API



Some examples

```
SELECT StorageServiceUniqueID
ComputingElementUniqueID FROM Glue.Bind

lxb0707.cern.ch
lxb0706.cern.ch:2119/jobmanager-pbs-long

lxb0710.cern.ch
lxb0706.cern.ch:2119/jobmanager-pbs-long

lxb0707.cern.ch
lxb0706.cern.ch:2119/jobmanager-pbs-short

lxb0710.cern.ch
lxb0706.cern.ch:2119/jobmanager-pbs-short

castorgridtest.cern.ch
lxb0706.cern.ch:2119/jobmanager-pbs-long

oplapro12.cern.ch
lxb0706.cern.ch:2119/jobmanager-pbs-long
```

Summary

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• Two main Information System technologies are used in LCG-2

→ **LDAP:** based on Globus

→ **R-GMA:** developed by the European DataGrid project

• Both technologies provide a data model:

→ **DIT:** In the case of LDAP

→ **SQL:** In the case of R-GMA

• The **GLUE** schema is used to describe Grid resource related information in both cases. Both technologies have implemented it depending on their data models

• Different tools to retry and produce information have been developed in LCG-2 based on both technologies. These APIs are available in C, C++ and Java.

• User tools (mostly Perl scripts) based on these APIs are already deployed and are being used to retry information (based right now in LDAP)

• These tools and APIs will be explained and tested during the hands-on session