

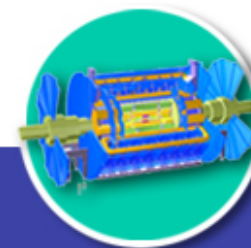
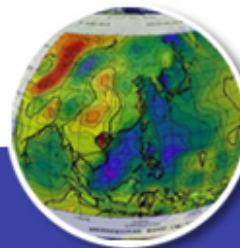


The gLite Data Management System

Giuseppe LA ROCCA

INFN Catania 

giuseppe.larocca@ct.infn.it





Outline

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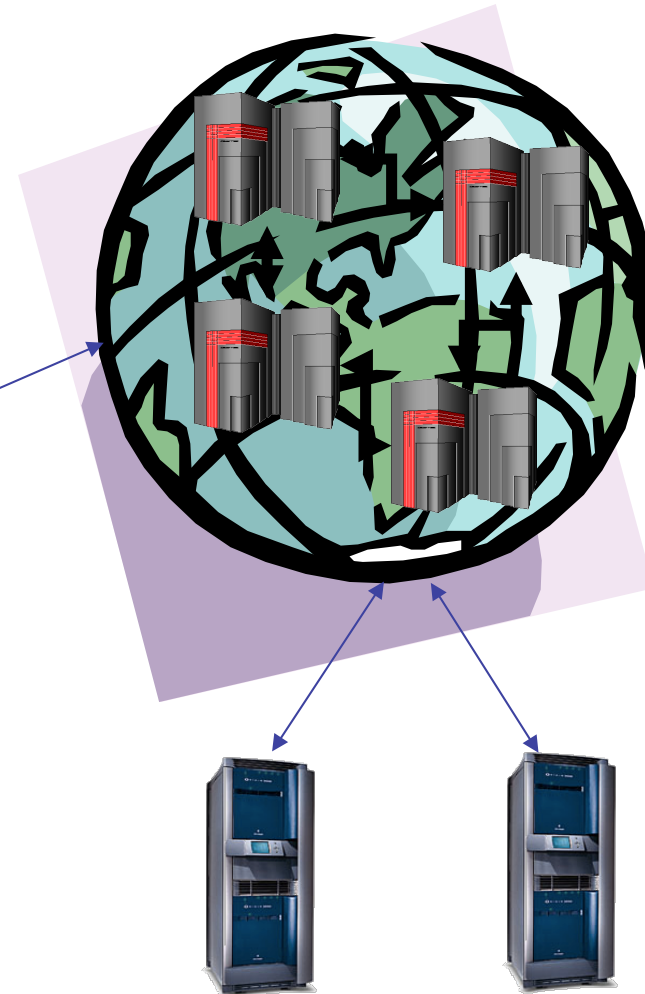
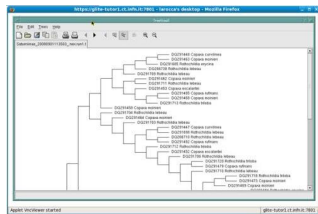
- **Storage & Protocols**
 - **Types of Storage**
- **The Storage Resource Manager (SRM)**
- **Grid file referencing schemes**
- **LFC File Catalogue**
 - **Architecture**
 - **LFC commands**
- **File & Replica Management Client Tools**
- **File Transfer Service (FTS)**
- **References**
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The overall goal of this presentation

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I need to collect data from the GRID Storage Elements to run my application. How can I do ?



Storage Elements & protocols

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- The **Storage Element** is the service which allows a user or an application to store data for future retrieval.
- All data in a SE must be considered **read-only** and therefore can not be changed unless physically removed and replaced.

Protocol	Type	GSI secure	Description	Optional
GSIFTP	File Transfer	Yes	FTP-like	No
gsidcap	File I/O	Yes	Remote file access	Yes
insecure RFIO	File I/O	No	Remote file access	Yes
secure RFIO (gsirfio)	File I/O	Yes	Remote file access	Yes

- The **GSIFTP** protocol offers the functionalities of FTP, but with support for GSI. It is responsible for secure, fast and efficient file transfers to/from Storage Elements.
- **RFIO** was developed to access tape archiving systems, such as **CASTOR** (CERN Advanced STORAge manager) and it comes in a secure and an insecure version.
- The **gsidcap** protocol is the GSI enabled version of the **dCache** native access protocol, dcap.

Types of Storage Elements /1

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- In WLCG/EGEE, different types of Storage Elements are available:
- **CASTOR.** It consists in a disk buffer frontend to a tape mass storage system. A virtual file system (namespace) shields the user from the complexities of the disk and tape underlying setup. File migration between disk and tape is managed by a process called "stager". The native storage protocol, the insecure RFIO, allows access of files in the SE. Since the protocol is not GSI-enabled, only RFIO access from a location in the same LAN of the SE is allowed. With the proper modifications, the CASTOR disk buffer can be used also as disk-only storage system.

Types of Storage Elements /2

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- **StoRM**. It has been designed to support *space reservation* and *direct access* (native POSIX I/O call), as well as other standard libraries (like RFIO).
- **StoRM** takes advantage from high performance parallel file systems like **GPFS** (from IBM).
 - In addition, standard POSIX file systems are supported (XFS from SGI and ext3).
- **StoRM** takes advantage of **ACL** support provided by the underlying file systems to implement the security models

Types of Storage Elements /3

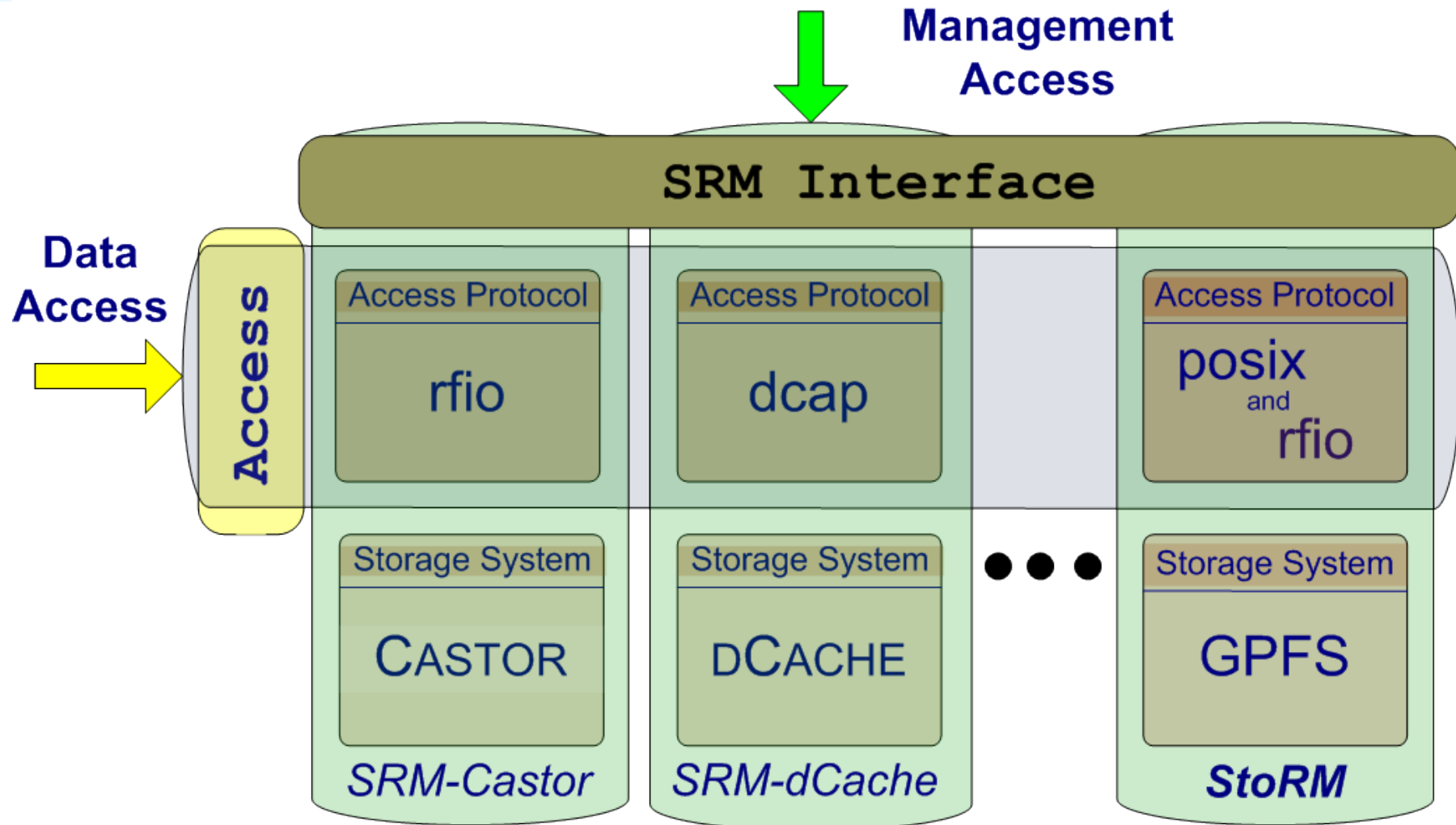
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- **dCache.** It consists of a server and one or more pool nodes. The server represents the single point of access to the SE and presents files in the pool disks under a single virtual file system tree. Nodes can be dynamically added to the pool. The native gsidcap protocol allows POSIX-like data access. dCache is widely employed as disk buffer frontend to many mass storage systems, like HPSS and Enstore, as well as a disk-only storage system.
- **LCG Disk pool manager.** It's a lightweight disk pool manager, suitable for relatively small sites (max 10 TB of total space). Disks can be added dynamically to the pool at any time. Like in dCache and CASTOR, a virtual file system hides the complexity of the disk pool architecture. The secure RFIO protocol allows file access from the WAN.

The Storage Resource Manager

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The Storage Resource Manager

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The *Storage Resource Manager (SRM)* has been designed to be the single interface for the management of disk and tape storage resources.

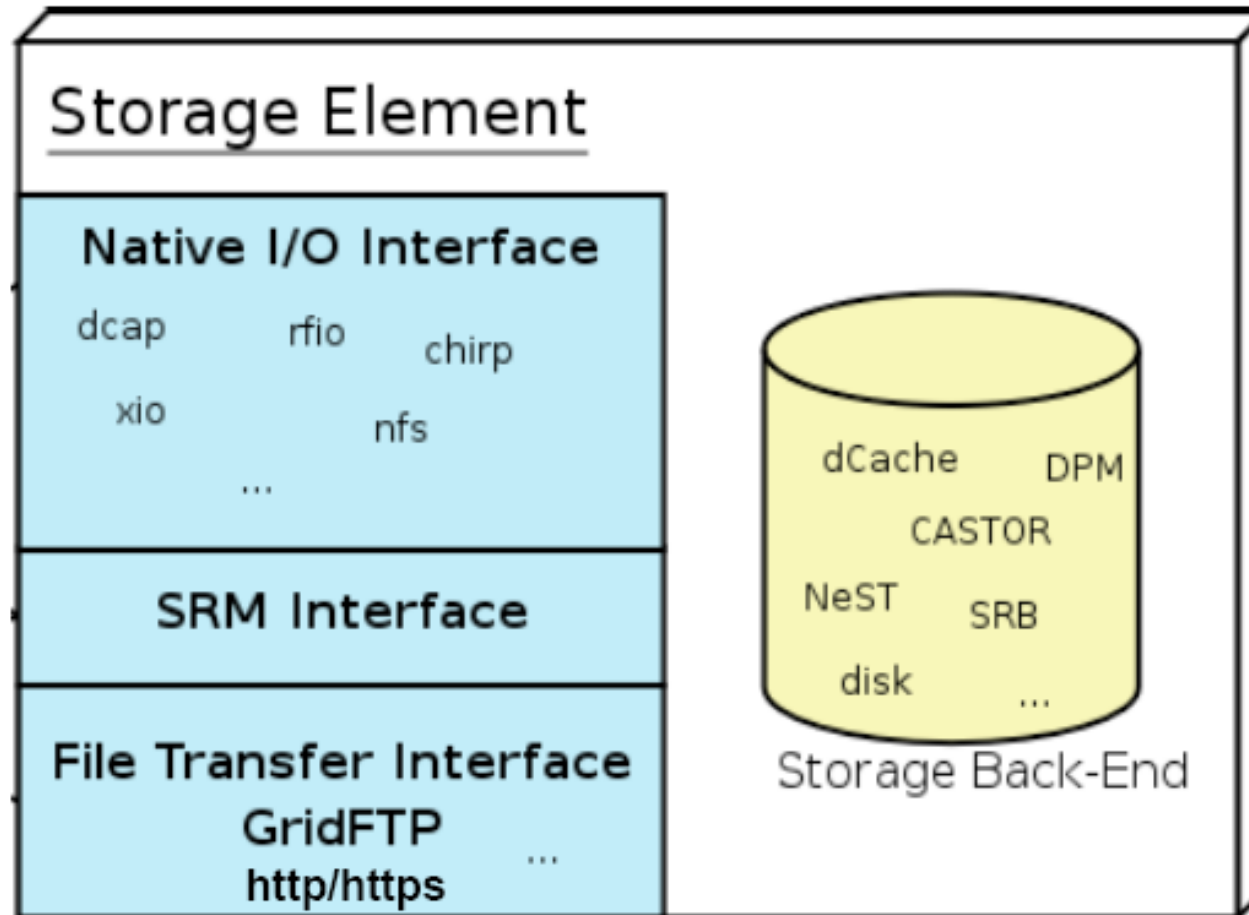
Any type of Storage Element in WLCG/EGEE offers an SRM interface except for the Classic SE, which is being phased out.

SRM hides the complexity of the resources setup behind it and allows the user to request files, keep them on a disk buffer for a specified lifetime, reserve space for new entries, and so on.

- In gLite, interactions with the SRM is hidden by high level services (DM tools and APIs)**

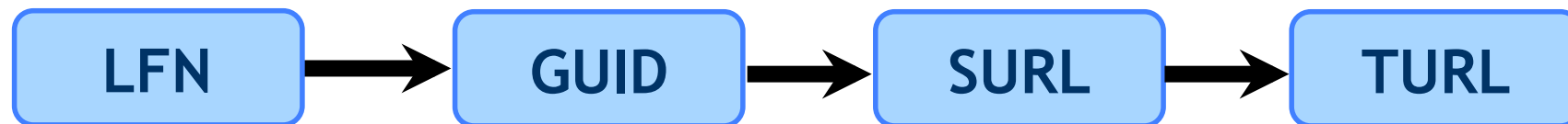
The gLite Storage Element

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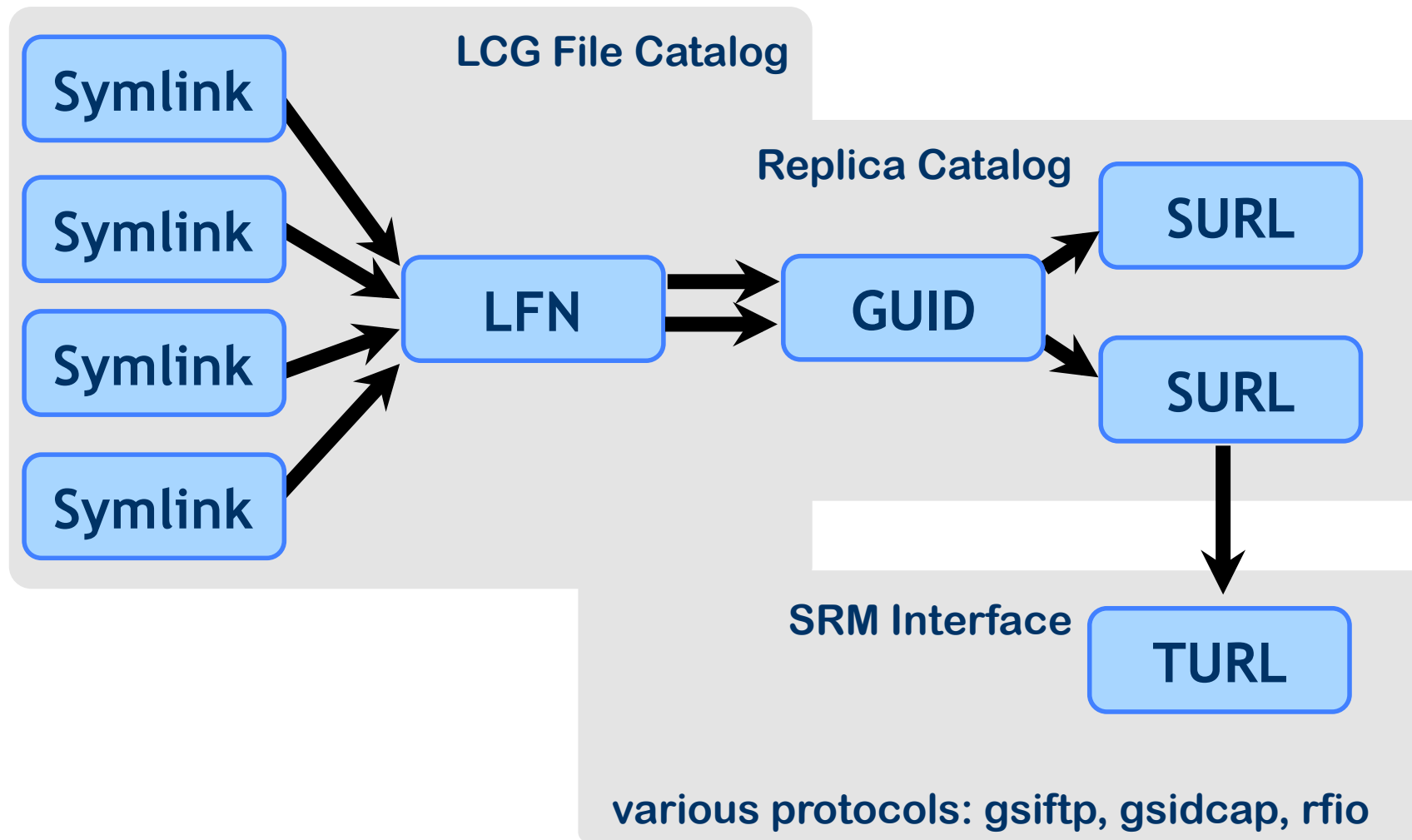


Grid file referencing schemes

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- Logical File Name (LFN)
 - **lfn:/grid/gilda/input-file**
- Grid Unique IDentifier (GUID)
 - **guid:4d57edef-fa5c-4512-a345-1c838916b357**
- Storage URL (for a specific replica, on a specific Storage Element)
 - **srm://aliserv6.ct.infn.it/gilda/generated/2007-11-13/fileb366f371-b2c0-485d-b12c-c114edaf4db4**
 - **sfn://se01.athena.hellasgrid.gr/data/dteam/doe/file1**
- Transport URL (for a specific replica, on an SE, with a specific protocol)
 - **gsiftp://aliserv6.ct.infn.it/gilda/generated/2007-11-13/fileb366f371-b2c0-485d-b12c-c114edaf4db4**

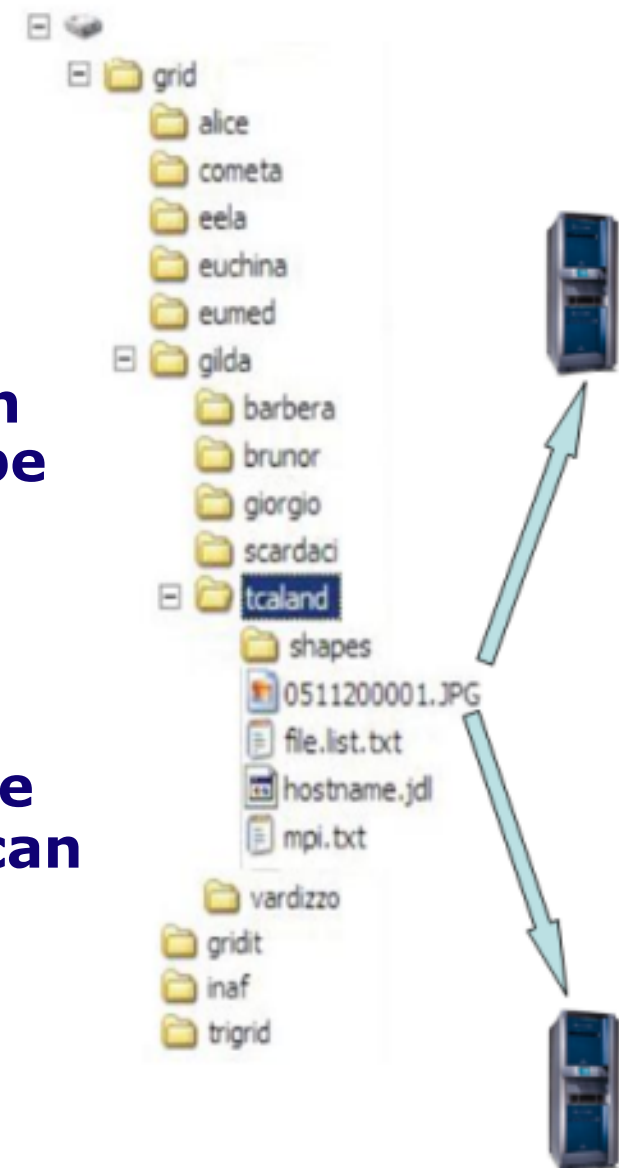


LFC File Catalogue

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- **Users and applications need to locate files (or replicas) on the Grid. The **LCG File Catalogue** is the service which maintains mappings between LFN(s), GUID and SURL(s).**
- **The catalogue publishes its endpoint in the Information Service so that it can be discovered by Data Management tools and other services (the WMS for example).**
- **It consists of a unique catalogue, where the LFN is the main key. Further LFNs can be added as symlinks to the main LFN.**
 - **System metadata are supported, while for user metadata only a single string entry is available**



Architecture of the LFC Catalogue

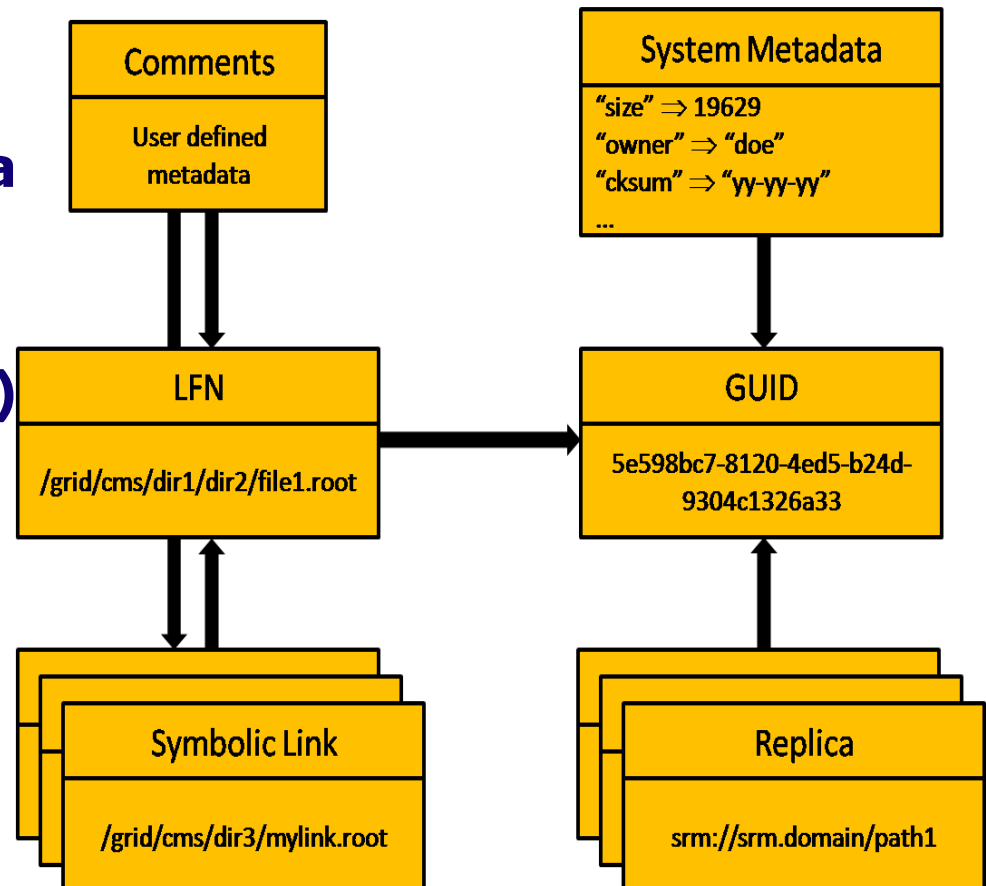
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- **LFN acts as main key in the database.**

It has:

- **Symbolic links to it (additional LFNs)**
- **System metadata**
- **Information on replicas**
- **One field of user metadata**
- **Access Control Lists**
- **Integration with VOMS (VirtualID and VirtualGID)**
- **C API language**





LFC Commands

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- **User can interact with the file catalogue through CLIs and C APIs.**
 - **The environment variable `LFC_HOST` (e.g.: `LFC_HOST=gilda-lfc.ct.infn.it`) must contains the host name of the LFC server to be used.**
- **The directory structure of the LFC namespace has the form: `/grid/<VO>/<subpaths>`**
 - **Users of a given VO will have read and write permissions only under the corresponding `<VO>` subdirectory.**

LFC Commands

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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

- **Listing the entries of a LFC directory**

- **lfc-ls** [-cdiLIRTu] [--class] [--comment] [--deleted] [--display_side] [--ds] path...
- where **path** specifies the LFN pathname (mandatory)
- Remember that LFC has a directory tree structure
- **/grid/<VO_name>/<you create it>**



- All members of a VO have read-write permissions under their directory
- You can set **LFC_HOME** to use relative paths

```
lfc-ls /grid/gilda/tutorials/taipei02
export LFC_HOME=/grid/gilda/tutorials
lfc-ls -l taipei02
lfc-ls -l -R /grid
```

- **Creating directories in the LFC**
 - **lfc-mkdir [-m mode] [-p] path...**
- **Where path specifies the LFC pathname**
- **Remember that while registering a new file (using lcg-cr, for example) the corresponding destination directory must be created in the catalog beforehand.**
- **Examples:**

```
lfc-mkdir /grid/gilda/<YOUR_DIRECTORY>
```



Created by the user

- **Creating a symbolic link**

- **lfc-ln -s file linkname**
- **lfc-ln -s directory linkname**

- **Create a link to the specified *file* or *directory* with linkname**

Examples:

```
– lfc-ln -s /grid/gilda/test /grid/gilda/aLink
```

Original File

Symbolic Link

Let's check the link using lfc-ls with long listing

```
– lfc-ls -l aLink  
lrwxrwxrwx 1 19122 1077 0 Jun 14 11:58 aLink -  
> /grid/gilda/test
```



Access Control List (ACL)

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- LFC allows to attach to a file or directory an access control list (ACL), a list of permissions which specify who is allowed to access or modify it. The permissions are very much like those of a UNIX file system: read (**r**), write (**w**) and execute (**x**).
- In LFC, users and groups are internally identified as **numerical virtual uids** and **virtual gids**, which are virtual in the sense that they exist only in the LFC namespace.
 - A user can be specified as a name, as a virtual uid or as a DN.
 - A group can be specified as name, as a virtual gid or as a VOMS FQAN.
- A directory in LFC has also a **default ACL** (which is the ACL associated to any file or directory being created under that directory). After creation, the ACLs can be freely changed.
 - When creating a sub-directory, its default ACL is inherited from the parent directory

Print the ACL of a directory

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```
$ lfc-getacl /grid/gilda/tutorials/test-acl
```

```
# file: /grid/gilda/tutorials/test-acl
```

```
# owner: /C=IT/O=INFN/OU=Personal Certificate/L=Catania/  
CN=Giuseppe La Rocca/Email=giuseppe.larocca@ct.infn.it
```

```
# group: gilda
```

```
user::rwx
```

```
group::rwx #effective:rwx
```

```
other::r-x
```

```
default:user::rwx
```

```
default:group::rwx
```

```
default:other::r-x
```

In this example, the owner and all users in the `gilda` group have full privileges to the directory, while other users cannot write into it.

Modify the ACL

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```
lfc-setacl [-d] [-m] [-s] acl_entries path
```

The **-m** option means that we are modifying the existing ACL. Other options of `lfc-setacl` are **-d** to remove ACL entries, and **-s** to replace the complete set of ACL entries.

acl_entries is a coma separated list of **entries**. Each entry has colon separated fields: ACL type, id (uid or gid), permission. Only directories can have default ACL entries!

The **entries** look like:

```
user::perm  
user:uid:perm  
group:perm  
group:gid:perm  
mask:perm  
other:perm
```

```
default::user:perm  
default::user:uid:perm  
default::group:perm  
default::group:gid:perm  
default::mask:perm  
deafult::other:perm
```

Modify the ACL of a directory

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Lets's change default ACL, with read/write permission for user and group, and no privileges for others.

- The syntax we apply here is modify (-m) default (d:) for user (u:), and the same of course for group and others.**

```
$ lfc-setacl -m d::u:6,d::g:6,d::o:0 \  
$LFC_HOME/test-acl/
```

Adding metadata information

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The **lfc-setcomment** and **lfc-delcomment** commands allow the user to associate a comment with a catalogue entry and delete such comment. This is the only user-defined metadata that can be associated with catalogue entries.

The comments for the files may be listed using the **--comment** option of the **lfc-ls** command. This is shown in the following example:

```
$ lfc-setcomment /grid/gilda/file1 "My metadata"
```

```
$ lfc-ls --comment /grid/gilda/file1  
/grid/gilda/file1 My metadata
```


LCG Data Management Client Tools

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- The LCG Data Management tools allow users to copy files between UI, WN and a SE, to register entries in the file catalogue and replicate files between SEs.

lcg-cp	Copies a Grid file to a local destination
lcg-cr	Copies a file to a SE and registers it in the catalogue
lcg-del	Deletes one file (either one replica or all the replicas)
lcg-rep	Copies a file from one SE to another SE and registers it in the catalogue
lcg-gt	Gets the TURL for a given SURL and transfer protocol
lcg-aa	Adds an alias in the catalogue for a given GUID
lcg-ra	Removes an alias in the catalogue for a given GUID
lcg-rf	Registers in the catalogue a file residing on a SE
lcg-uf	Unregisters in the catalogue a file residing on a SE
lcg-la	Lists the aliases for a given LFN, GUID or SURL
lcg-lg	Gets the GUID for a given LFN or SURL
lcg-lr	Lists the replicas for a given LFN, GUID or SURL

- The **--vo <vo name>** option, to specify the virtual organisation of the user, is present in all commands, except for **lcg-gt**. Its usage is mandatory unless the variable **LCG_GFAL_VO** is set (e.g.: **export LCG_GFAL_VO=gilda**)

Timeouts

The commands **lcg-cr**, **lcg-del**, **lcg-gt**, **lcg-rf**, **lcg-sd** and **lcg-rep** all have timeouts implemented.

By using the option **-t**, the user can specify a number of seconds for the timeout.

The default is 0 seconds, that is no timeout.

If we got a times out during the performing of an operation, all actions performed till that moment are rolled back, so no broken files are left on a SE and no existing files are not registered in the catalogues.

- For all **lcg-*** commands to work, the environment variable **LCG_GFAL_INFOSYS** must be set to point to a top BDII in the format **<hostname>:<port>**, so that the commands can retrieve the necessary information

```
export LCG_GFAL_INFOSYS=gilda-bdii.ct.infn.it:2170
```

- The **VO_<VO>_DEFAULT_SE** variable specifies the default SE for the VO.

Uploading a file to the Grid /1

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```
$ lcg-cr --vo gilda -d aliserv6.ct.infn.it \  
file:/home/larocca/file1
```

```
guid:6ac491ea-684c-11d8-8f12-9c97cebf582a
```

where the only argument is the local file to be uploaded and the **-d <destination>** option indicates the SE used as the destination for the file. The command returns the file **GUID**.

If no destination is given, the SE specified by the **VO_<VO>_DEFAULT_SE** environmental variable is taken.

The **-P** option allows the user to specify a relative path name for the file in the SE. If no **-P** option is given, the relative path is automatically generated.

Uploading a file to the Grid /2

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The following are examples of the different ways to specify a destination:

```
-d aliserv6.ct.infn.it  
-d srm://aliserv6.ct.infn.it/data/gilda/my_file  
-d aliserv6.ct.infn.it -P my_dir/my_file
```

The `-l <lfn>` option can be used to specify a LFN:

```
$ lcg-cr --vo gilda -d aliserv6.ct.infn.it \  
-l lfn:/grid/gilda/myalias1 \  
file:/home/larocca/file1
```

```
guid:db7ddbc5-613e-423f-9501-3c0c00a0ae24
```

Uploading a file to the Grid /3

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The **-g** option allows to specify a **GUID** (otherwise automatically created):

```
$ lcg-cr --vo gilda -d aliserv6.ct.infn.it \  
-g guid:baddb707-0cb5-4d9a-8141-a046659d243b \  
file: `pwd`/file2
```

```
guid:baddb707-0cb5-4d9a-8141-a046659d243b
```



Attention!

This option should not be used except for expert users and in very particular cases. Because the specification of an existing GUID is also allowed, a misuse of the tool may end up in a corrupted GRID file in which replicas of the same file are in fact different from each other.

Replicating a file

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```
$ lcg-rep -v --vo gilda -d <SECOND_SE> \  
guid:db7ddbc5-613e-423f-9501-3c0c00a0ae24
```

Source URL:

```
sfn://aliserv6.ct.infn.it/data/gilda/larocca/file1
```

File size: 30

Destination specified: <SECOND_SE>

Source URL for copy:

```
gsiftp://aliserv6.ct.infn.it/data/gilda/larocca/file1
```

Destination URL for copy:

```
gsiftp://<SECOND_SE>/data/gilda/generated/2004-07-09/  
file50c0752c-f61f-4bc3-b48e-af3f22924b57
```

streams: 1

Transfer took 2040 ms

```
Destination URL registered in LRC: srm://<SECOND_SE>/  
data/gilda/generated/2004-07-09/file50c0752c-  
f61f-4bc3-b48e-af3f22924b57
```

Listing replicas, GUIDs and aliases /1

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```
$ lcg-lr --vo gilda \  
  lfn:/grid/gilda/tutorials/larocca/my_alias1  
  
  srm://aliserv6.ct.infn.it/data/gilda/generated/  
  2004-07-09/file79aee616-6cd7-4b75-8848-f091  
  srm://<SECOND_SE>/data/gilda/generated/2004-07-08/  
  file0dcabb46-2214-4db8-9ee8-2930
```

Again, a LFN, the GUID or a SURL can be used to specify the file.

The lcg-lg command returns the GUID associated with a specified LFN or SURL.

```
$ lcg-lg --vo gilda lfn:/grid/gilda/test.txt  
  guid:cf93526e-807a-43a6-9262-f55a3989623c
```


The `lcg-la` command can be used to list the LFNs associated with a particular file, which can be identified by its GUID, any of its LFNs, or the SURL of one of its replicas:

```
$ lcg-la --vo gilda \  
guid:cf93526e-807a-43a6-f55a3989623c  
  
lfn:/grid/gilda/test.txt
```

Managing aliases

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The `lcg-aa` (*add alias*) command allows the user to add a new LFN to an existing GUID:

```
$ lcg-aa --vo gilda \  
guid:baddb707-0cb5-4d9a-8141-a046659d243b lfn:/  
grid/gilda/new_alias
```

The `lcg-ra` (*remove alias*) command allows a user to remove an LFN from an existing GUID:

```
$ lcg-ra --vo gilda \  
guid:baddb707-0cb5-4d9a-8141-a046659d243b lfn:/  
grid/gilda/my_alias1
```

Copying files out the Grid

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```
$ lcg-cp --vo gilda -t 100 -v lfn:/grid/gilda/  
tutorials/pippo.txt file:/tmp/pippo.txt
```

```
Source URL: lfn:/grid/gilda/pippo.txt
```

```
File size: 104857600
```

```
Source URL for copy:
```

```
gsiftp://aliserv6.ct.infn.it:/storage/gilda/2007-07-06/  
input2.dat.10.0
```

```
Destination URL: file:///tmp/myfile
```

```
# streams: 1
```

```
# set timeout to 100 (seconds)
```

```
85983232 bytes 8396.77 KB/sec avg 9216.11
```

```
Transfer took 12040 ms
```

Deleting replicas /1

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A file stored on a SE and registered in LFC can be deleted using the lcg-del command.

- **If a SURL is provided as argument, then that particular replica will be deleted.**
- **If a LFN or GUID is given instead then the `-s <SE>` option must be used to indicate which one of the replicas must be erased**

```
$ lcg-del --vo gilda -s aliserv6.ct.infn.it \
  guid:91b89dfe-ff95-4614-bad2-c538bfa28fac
```

Deleting replicas /2

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- If the **-a** option is used, all the replicas of the given file will be deleted and unregistered from the catalog.

```
$ lcg-del --vo gilda -a \  
guid:91b89dfe-ff95-4614-bad2-c538bfa28fac
```

Registering Grid files

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The `lcg-rf` command allows to register a file physically present in a SE, creating a **GUID-SURL** mapping in the catalogue.

The `-g <GUID>` option allows to specify a **GUID** (otherwise automatically created).

```
$ lcg-rf --vo gilda \  
-g guid:baddb707-0cb5-4d9a-8141-a046659d243b \ srm://  
aliserv6.ct.infn.it/data/gilda/generated/2004-07 08/  
file0dcabb46-2214-4db8-9ee8-2930de1
```

```
guid:baddb707-0cb5-4d9a-8141-a046659d243b
```

Unregistering Grid files

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lcg-uf allows to delete a GUID-SURL mapping (respectively the first and second argument of the command) from the catalogue:

```
$ lcg-uf --vo gilda \  
guid:baddb707-0cb5-4d9a-8141-a046659d243b \  
srm://aliserv6.ct.infn.it/data/gilda/generated/  
2004-07 08/file0dcabb46-2214-4db8-9ee8-2930de1
```

If the last replica of a file is unregistered, the corresponding GUID-LFN mapping is also removed.



Attention!

lcg-uf just removes entries from the catalogue.

It does not remove any physical replica from the SE.



File Transfer Service

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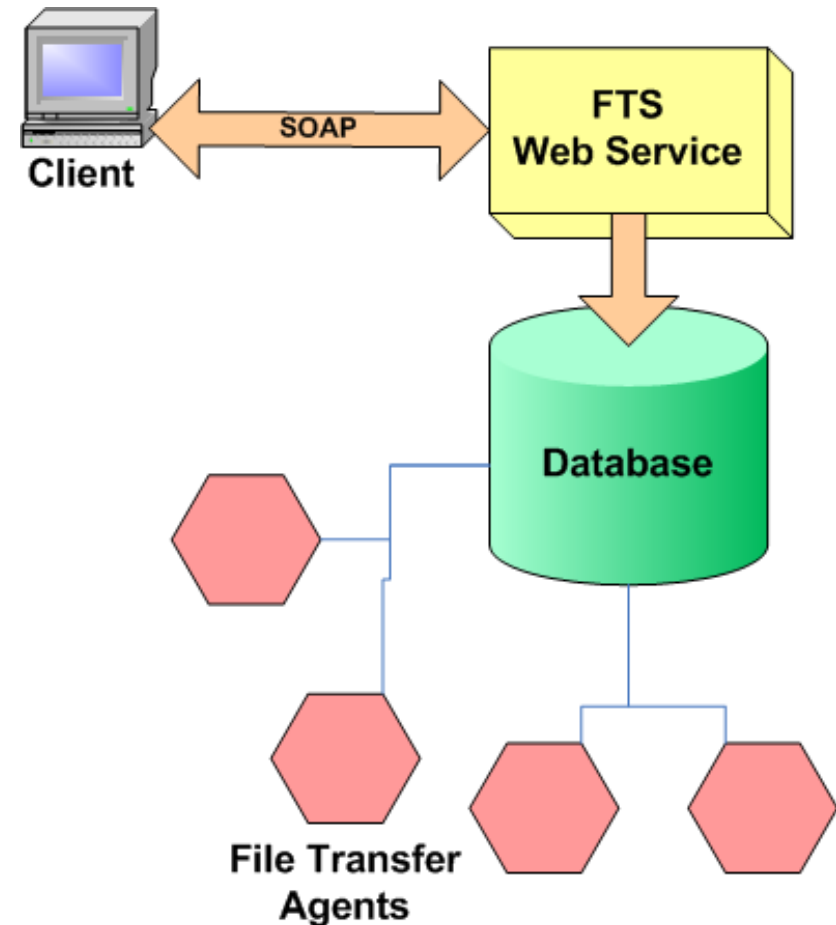
- **The File Transfer Service (FTS) is the lowest-level data movement service defined in gLite.**
 - It is responsible for moving sets of files from one site to another.
 - It is designed for point to point movement of physical files (no file routing via intermediate storage).
 - The FTS has dedicated interfaces for managing the network resource and to display statistics of ongoing transfers.
 - The FTS handles internally the SRM negotiation between the source and destination SEs and the management of the underlying GridFTP transfers.

FTS Architecture

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- **The clients.** The FTS client libraries or command line tools are used by the applications to communicate with the FTS.
- **The FTS Web Service.** The web service component is implemented as a Tomcat web application. This is a proper web service that implements the WSDL as defined by the FTS interface. Based on the Web Service Description Language document, anyone can build their own clients in their own preferred language. The web service connects to the database through JDBC using a Tomcat database connection pool.
- **The FTS Database.** There is a MySQL and an Oracle implementation of the FTS schema. This is the only persistency point in the system and it scales only as well as the corresponding backend allows (Oracle scales better than MySQL, obviously). There can be only a single instance of this database for a given FTS instance.
- **The File Transfer Agents.** It is an agent that actually performs the file transfers on the channels that the FTS manages.



Basic Concepts /1

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- **Transfer Job:** a set of files to be transferred in a source/destination pair format;
- **File:** a source/destination SURL pair to be transferred;
- **Job State:** a function of the individual file states constituting the Job;
- **File State:** the state of an individual file transfer;
- **Channel:** a specific network pipe used for file transfers.
 - **Production channels** are high bandwidth, dedicated network pipe between Tier-0, Tier-1's and other major Tier-2's centers.
 - **Non-production channels** are assigned typically to open networks and do not guarantee a minimum throughput as production channels do.

Basic Concepts /2

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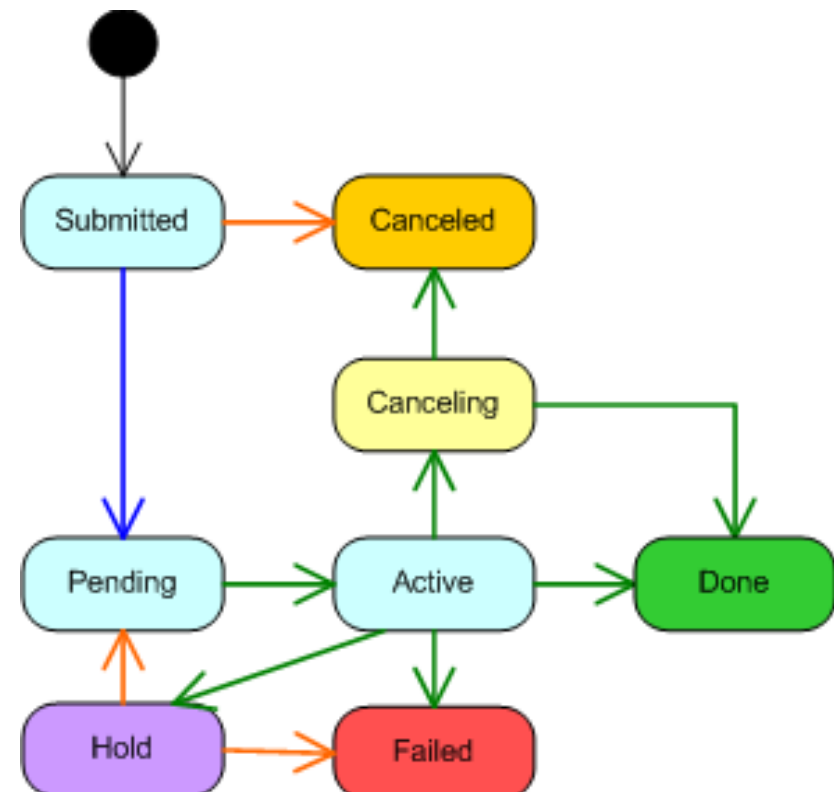
- The transfer jobs are processed asynchronously (batch mode). Upon submission, a **job identifier** is returned to the user.
- This identifier can be used to query the status of the job as it progresses through the system or cancel the job.
- Once a job has been submitted to the system it is assigned to a *transfer channel* based on the SEs containing the source and the destination.

Transfer job states

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- **Submitted:** the job has been submitted to FTS but not yet assigned to a channel
- **Pending:** the job has been assigned to a channel and files are waiting for being transferred
- **Active:** the transfer for some of the job's files is ongoing
- **Canceling:** the job is being canceled
- **Canceled:** the job has been canceled
- **Done:** all files in a job were successfully transferred
- **Failed:** some file transfers in a job have failed
- **Hold:** the job has aborted and requires manual interventions (moving it to **Pending** or **Failed**)



FTS Commands /1

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- Before submitting a job, the user is expected to upload an appropriate password-protected long-term proxy to the MyProxy server used by FTS.

The following user-level commands for submitting, querying and canceling jobs are described here:

glite-transfer-submit

Submits a transfer job

glite-transfer-status

Displays the status of an ongoing transfer job

glite-transfer-list

Lists all submitted transfer jobs owned by the user

glite-transfer-cancel

Cancel a transfer job

FTS Commands /2

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- Some additional administrative commands are described here

`glite-transfer-channel-add`

FTS

Create a new channel with defined parameters on

`glite-transfer-channel-list`

Displays details of the given channel defined on FTS

`glite-transfer-channel-set`

Allows administrator to set a channel 'Active' or 'Inactive'

Submitting a job to FTS

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- Once a user has successfully registered a long-term proxy to a MyProxy server, he can submit a transfer job. He can do it either by specifying the source-destination pair in the command line:

```
$ myproxy-init -s myproxy-fts.cern.ch -d
```

```
$ glite-transfer-submit -m myproxy-fts.cern.ch \  
-s https://w-fts.grid.sinica.edu.tw:8443/sc3/glite-data-  
transfer-fts/services/FileTransfer \  

```

```
srm://srm.sara.nl/pnfs/srm.sara.nl/data/source_file \  
srm://srm.cnaf.infn.it/castor/cnaf.infn.it/grid/destination
```

```
Enter MyProxy password:
```

```
Enter MyProxy password again:
```

```
c2e2cdb1-a145-11da-954d-944f2354a08b
```

Querying the job status

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- The following example shows a query to FTS to infer information about the state of a transfer job:

```
$ glite-transfer-status \  
-s https://w-fts.grid.sinica.edu.tw:8443/sc3/glite-data-  
transfer-fts/services/FileTransfer \  
-l c2e2cdb1-a145-11da-954d-944f2354a08b  
  
Source: srm://srm.grid.sara.nl/pnfs/grid.sara.nl/data/  
source_file  
Destination: srm://sc.cr.cnaf.infn.it/castor/cnaf.infn.it/  
grid/destination  
  
State: Pending  
Retries: 0  
Reason: (null)  
Duration: 0
```


Listing and Canceling data transfer

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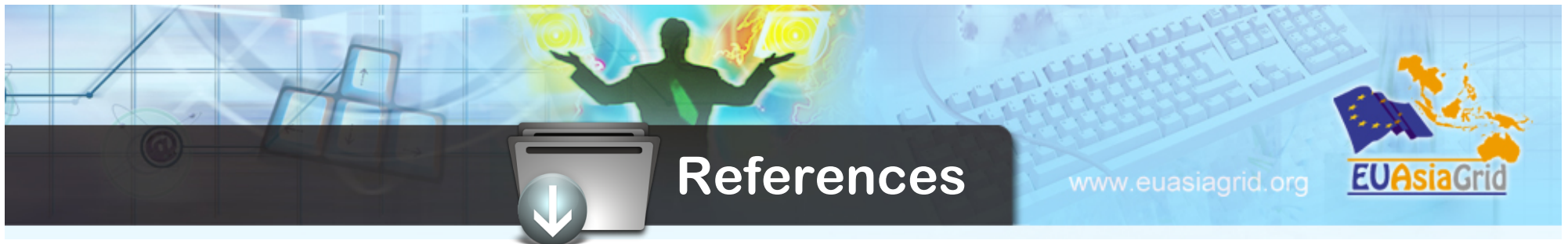


- **Listing..**

```
$ glite-transfer-list \  
-s https://w-fts.grid.sinica.edu.tw:8443/sc3/glite-data-  
transfer-fts/services/FileTransfer  
...  
c2e2cdb1-a145-11da-954d-944f2354a08b Pending
```

- **Cancelling..**

```
$ glite-transfer-cancel \  
-s https://w-fts.grid.sinica.edu.tw:8443/sc3/glite-data-  
transfer-fts/services/FileTransfer \  
c2e2cdb1-a145-11da-954d-944f2354a08b
```



- **gLite 3 User Guide – Manual Series**

- <https://edms.cern.ch/file/722398/1.2/gLite-3-UserGuide.pdf>

- **gLite Documentation homepage**

- <http://glite.web.cern.ch/glite/documentation/default.asp>

- **DM subsystem documentation**

- <http://egee-jra1-dm.web.cern.ch/egee-jra1-dm/doc.htm>

- **File Transfer Services**

- <http://cern.ch/egee-jra1-dm/FTS/default.htm>

- **LFC and DPM documentation**

- <https://uimon.cern.ch/twiki/bin/view/LCG/DataManagementDocumentation>



Hands-on

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- **Connect to the training infrastructure using the information reported in the tutorial sheet**
- **Run the hands-on available in this web link:**
- **http://www.euasiagrid.org/wiki/index.php/Data_Management**
- **Enjoy!**