Introduction Data Management

Jan Just Keijser
Nikhef
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vl·e virtual laboratory for e·science

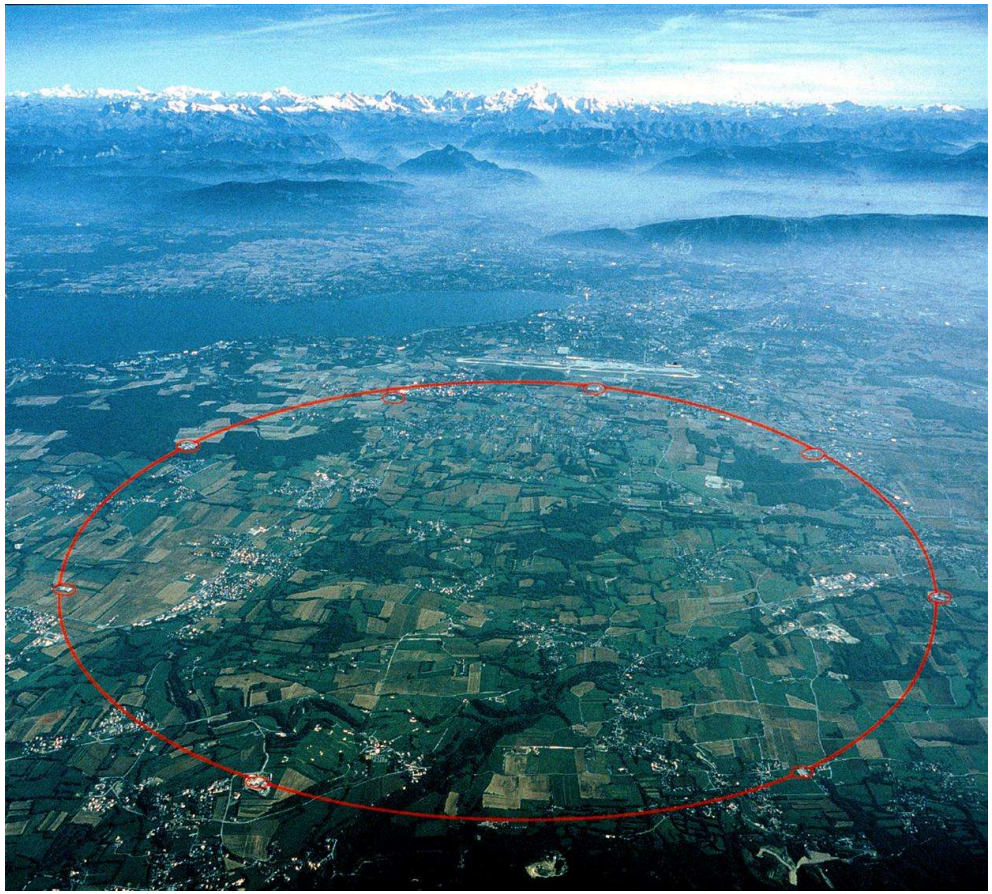
Outline

- Introduction
- SRM
- Storage Elements in gLite
- LCG File Catalog (LFC)
- Information System

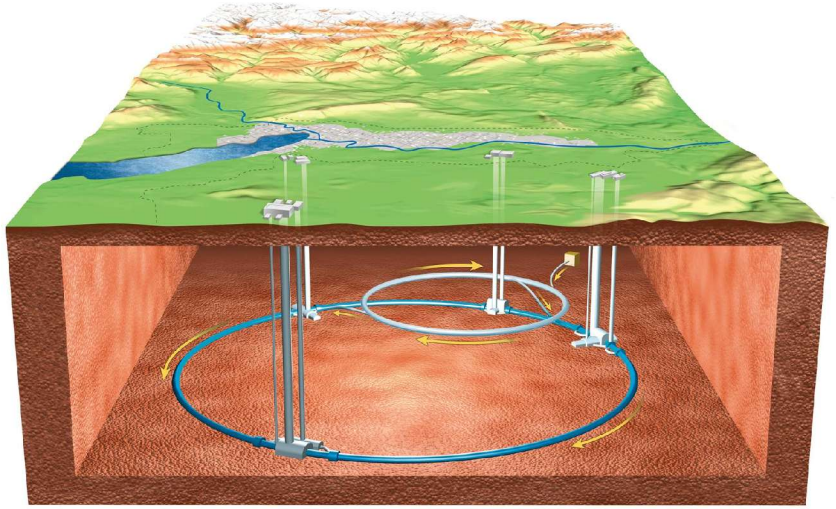
Introduction

- Grid infrastructures are usually used for analysing and manipulating large amounts of data coming from scientific instruments and other sources
- Example: LOFAR, MAGIC,…..

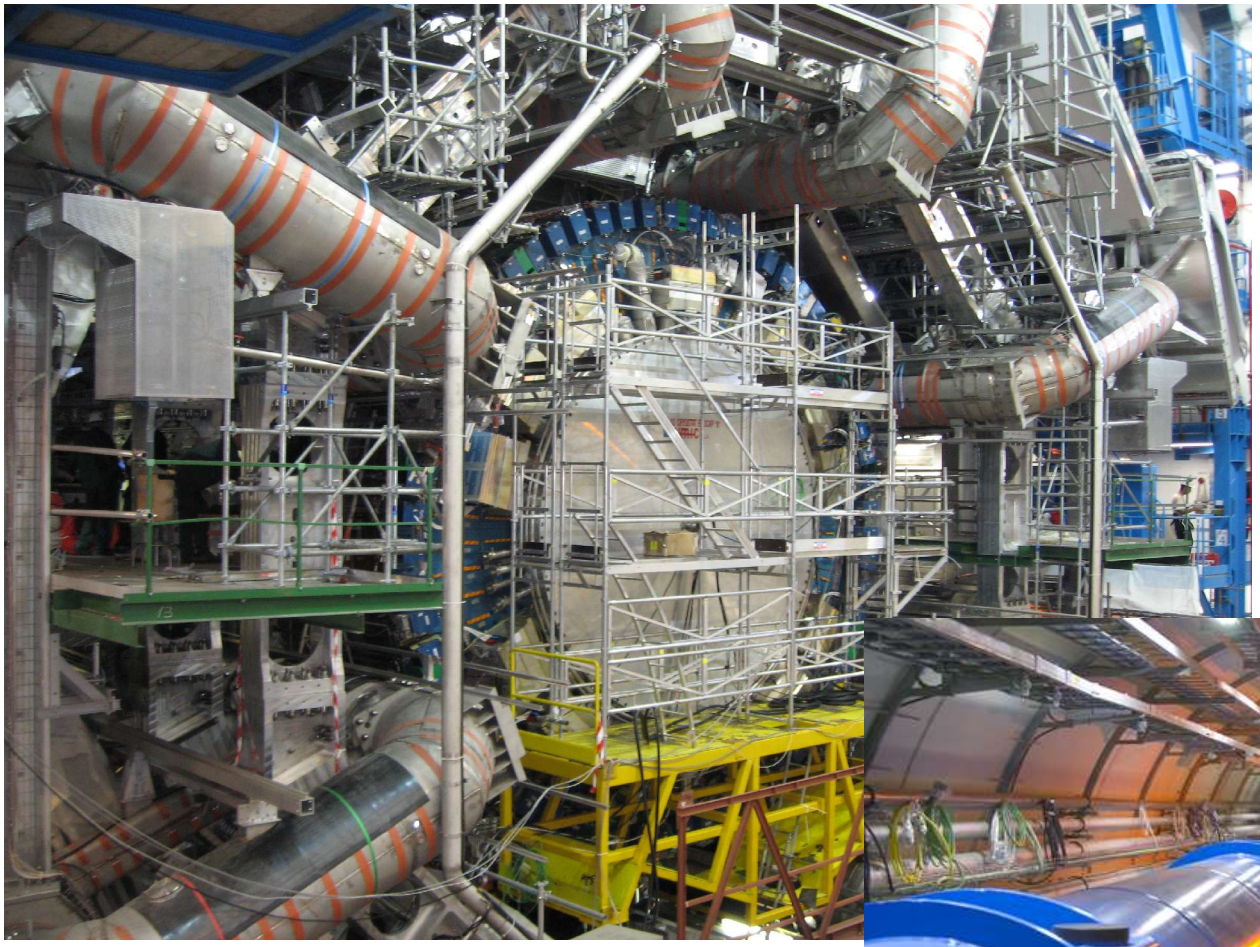
Example: Large Hadron Collider



- Produces ~15 PByte/year
- Grid computing for data storage and processing
- Depends on EGEE and OSG infrastructure



Introduction



- Data is stored at CERN and 11 other (tier1) sites
- Data is processed at CERN, the 11 tier1 sites and ~100 tier2 sites

Introduction

- Data management tools enables the usage and sharing data in a grid environment

Introduction

- **Storage Infrastructures**
  - Disk
  - Hierarchical Storage Management (HSM)
    - The hierarchy consists of different types of storage media, such as disks systems or tape, each type representing a different level of cost and speed of retrieval
    - policy-based management of file backup and archiving without the user needing to be aware of when files are being retrieved from or stored on backup storage media.

      Example: files that have not been used for some time are automatically migrated from disk to tape
    - HSM Software: TSM, DMF, CASTOR, Enstore, HPSS,…

Introduction

How do we link users, user programs and the data given the fact that data is distributed over different storage systems?

Introduction

Data management in the Grid environment needs:

- A system which keeps track of the location of all files and copies of those files
- A uniform interface for all storage systems

SRM

- **Uniform access to heterogeneous storage resources on the Grid: SRM**

- **Storage Resource Managers**
  - SRM is a control protocol for:
    - Space reservation
    - File management
    - Replication
    - Protocol negotiation

SRM

- **SRM implementation**
  - SRM I/F is implemented as a web service
  - Implementations for dCache, DPM, SRB, ….
- **SRM Examples**
  - srmLs
  - srmPrepareToPut
  - srmBringOnline
  - srmCopy
  - srmGetTransferProtocols

The user never gets to see this, since SRM is hidden by the gLite client software ☺

Storage Elements in gLite

- **DPM**
  - SRM
  - Data Transfer protocols: gridftp, secure rfio
  - Storage type: disk
- **dCache**
  - SRM
  - Data Transfer protocols: gridftp, gsidcap, xrootd
  - Storage type: disk, HSM
- **StoRM**
  - SRM
  - Data Transfer protocols: gridftp, rfio
  - Storage type: disk

LFC

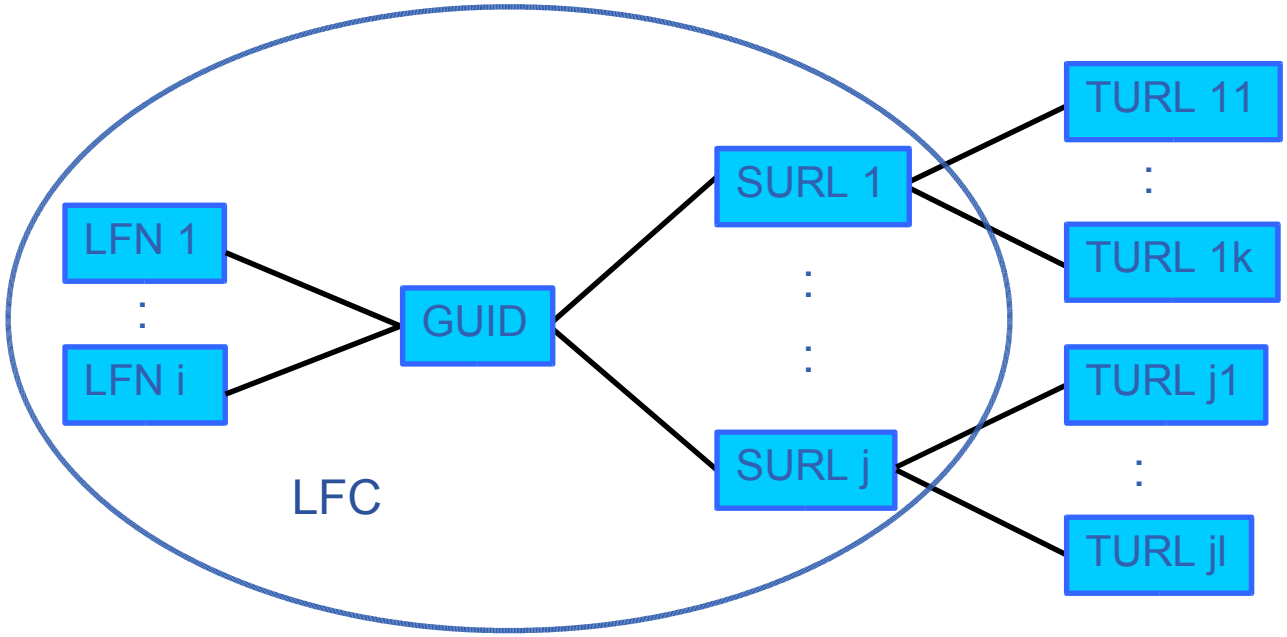
- **LFC**
  - Keeps track of the location of copies (replicas) of files on the Grid

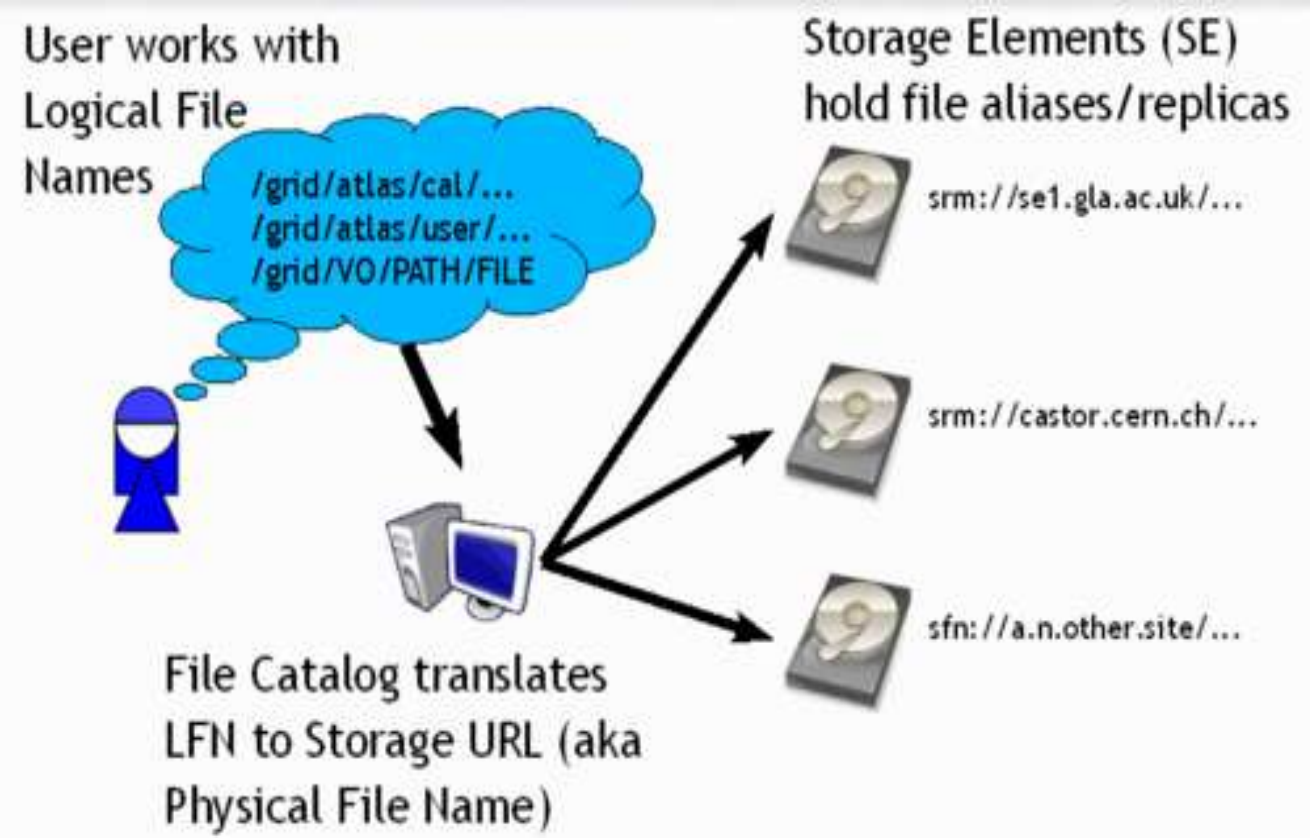
Name conventions

- **Logical File Name (LFN)**
  - An alias created by a user to refer to some item of data, e.g. "lfn:/grid/tutor/mydir/myfile"
  - Unix-like namespace
- **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)**
  - The location of an actual piece of data on a storage system, e.g. "srm://pcrd24.cern.ch/flatfiles/cms/output10_1"
- **Transport URL (TURL)**
  - Locator of a replica + access protocol: understood by a SE, e.g. "rfio://lxshare0209.cern.ch//data/alice/ntuples.dat"

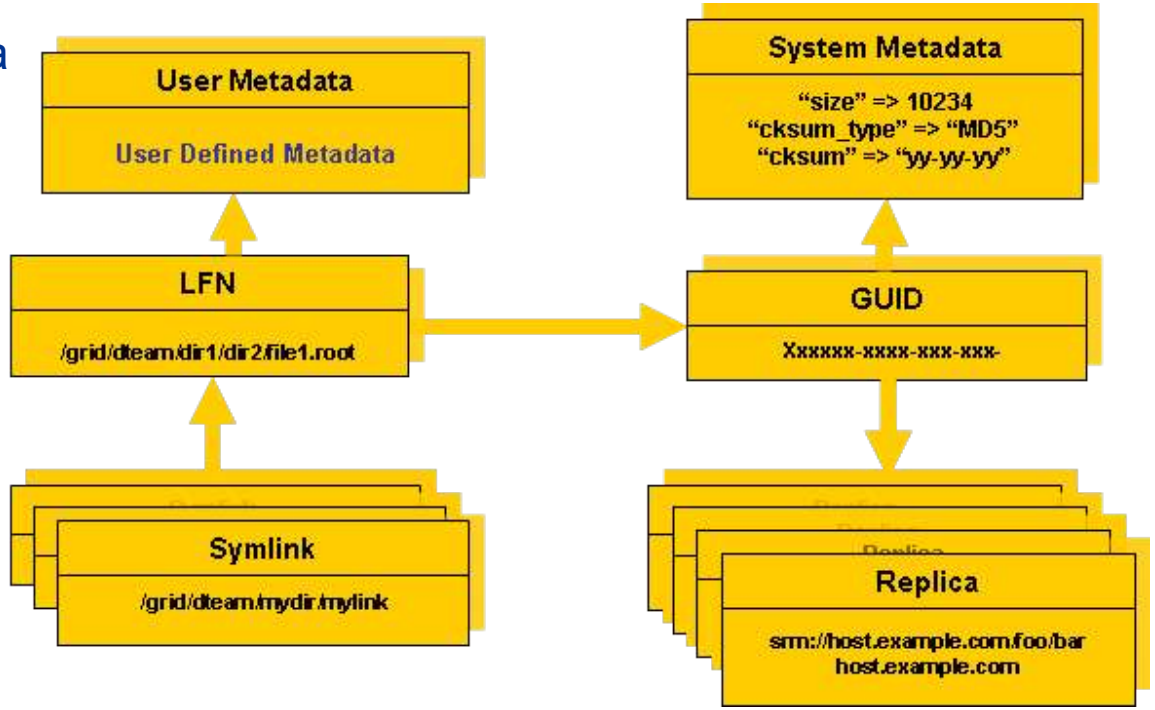
Naming conventions

- **How do they fit together?**
  - LFC holds the mapping LFN-GUID-SURL




User works with
Logical File
Names
/grid/atlas/cal/...
/grid/atlas/user/...
/grid/VO/PATH/FILE
Storage Elements (SE)
hold file aliases/replicas
srm://se1.gla.ac.uk/...
srm://castor.cern.ch/...
sfn://a.n.other.site/...
File Catalog translates
LFN to Storage URL (aka
Physical File Name)

- **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



- **Two kinds of LFC**
  - Central LFC
    For each VO, one site on the grid will publish a global catalog. This will record entries (file replicas or dataset entities) across the whole of the grid.
  - Local LFC
    Local catalogs record the file replicas stored at that site's SEs only.

LFC

- Integrated GSI Authentication + Authorization
- Access Control Lists (Unix Permissions and POSIX ACLs)
- Sessions (multiple operations inside a single transaction)
- Bulk operations (inside transactions)

LFC interfaces

- **Interaction with the WMS(RB)**
  - The InputSandbox and OutputSandbox should only be used for small amounts of data. Large files should be on SEs
  - The RB can locate Grid files: allows for data-based match-making
  - Jdl file:
    - InputData = "lfn:/grid/tutor/MyFile";
      - The lfn's / guid's needed by the job as an input to the process
      - Tells RB to schedule job on CE close to SE holding the file
      - glite-brokerinfo getInputData returns list of files in InputData attribute
    - OutputSE=srm.grid.sara.nl";
      - location of a SE where the output data will be stored
    - DataAccessProtocol="gsiftp";
      - The list of protocols that the application is able to "speak" for accessing files listed in the InputData

- **LFC interfaces**
  - Commandline interface and C/C++/Python api
  - Lcg_utils commandline tools and API
    - Combined operations on LFC and data
  - GFAL
    - Provides a Posix-like interface for File I/O Operation

More to come in the next talk!

Information system

Finding out where to put your data:

- **BDII**
  - BDII collects information of all nodes running grid services in the EGEE infrastructure.
  - Based on ldap
- **Need to set environment variable LCG_GFAL_INFOSYS**
  - Needs to be set to a BDII. Example: bdii.grid.sara.nl:2170

Information system

- **lcg-infosites**
  - Example: finding an SE:

> lcg-infosites --vo tutor se

```
        Avail Space(Kb) Used Space(Kb)  Type    SEs
        ----------------------------------------------------------
        1320000000      n.a             n.a     gb-se-ams.els.sara.nl
        1320000000      n.a             n.a     gb-se-wur.els.sara.nl
        536868064       2848            n.a     se.grid.rug.nl
        104856555       1044            n.a     srm.grid.sara.nl
```

  - Example: finding an LFC

> lcg-infosites --vo tutor lfc

```
        lfc.grid.sara.nl
```

Information system

- **lcg-info**

For more advanced searches:

For example, finding out where to put your files

>lcg-info --vo tutor --list-se --query='SE=srm.grid.sara.nl' --attrs=Path

- SE: srm.grid.sara.nl
  - Path /pnfs/grid.sara.nl/data/tutor

Links

- **gLite User Guide: https://edms.cern.ch/file/722398//gLite-3-UserGuide.html**

Questions?