



# The AMGA metadata catalog

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- ▶ Background and Motivation for AMGA
- ▶ Interface, Architecture and Implementation
- ▶ Metadata Replication on AMGA
- ▶ Use cases



- ▶ Metadata is **data about data**
- ▶ On the Grid: **information about files**
  - Describe files
  - Locate files based on their contents
- ▶ But also **makes DB access a simple task on the Grid**
  - Many Grid applications need structured data
  - Many applications require only simple schemas
    - Can be modelled as metadata
  - Main advantage: better integration with the Grid environment
    - Metadata Service is a Grid component
    - **Grid security**
    - Hide DB heterogeneity



# ARDA/gLite Metadata Interface

BioinfoGRID

- ▶ 2004 - ARDA evaluated existing Metadata Services from HEP experiments
  - AMI (ATLAS), RefDB (CMS), Alien Metadata Catalogue (ALICE)
  - Similar goals, similar concepts
  - Each designed for a particular application domain
    - Reuse outside intended domain difficult
  - Several technical limitations: **large answers, scalability, speed, lack of flexibility**
- ▶ ARDA proposed an **interface for Metadata access on the GRID**
  - Based on requirements of LHC experiments
  - But generic - not bound to a particular application domain
  - Designed jointly with the gLite/EGEE team
  - Incorporates feedback from GridPP
- ▶ Adopted as the **official EGEE Metadata Interface**
  - Endorsed by PTF (Project Technical Forum of EGEE)



- ▶ ARDA developed a **P**roject **T**ask **F**orce in order to develop:
  - AMGA – ARDA Metadata Grid Application
- ▶ Began as **prototype** to evaluate the Metadata Interface
  - Evaluated by community since the beginning:
    - LHCb and Ganga were early testers (more on this later)
  - Matured quickly thanks to users feedback
- ▶ Now is **part of the gLite middleware**
  - Official Metadata Service for EGEE
  - First release with gLite 1.5
  - Also available as standalone component
- ▶ It is expanding to other user communities:
  - HEP, Biomed, UNOSAT...



## ► Some Concepts:

- **Metadata** - List of attributes associated with **entries**
- **Attribute** – key/value pair with type information
  - **Type** – The type (int, float, string,...)
  - **Name/Key** – The name of the attribute
  - **Value** - Value of an entry's attribute
- **Schema** – A set of attributes
- **Collection** – A set of entries associated with a schema
- Think of schemas as tables, attributes as columns, entries as rows



## ▶ Dynamic Schemas

- Schemas can be modified at runtime by client
  - Create, delete schemas
  - Add, remove attributes

## ▶ Metadata organised as an **hierarchy**

- Collections can contain sub-collections
- Analogy to file system:
  - Collection ⇔ Directory; Entry ⇔ File

## ▶ Flexible Queries

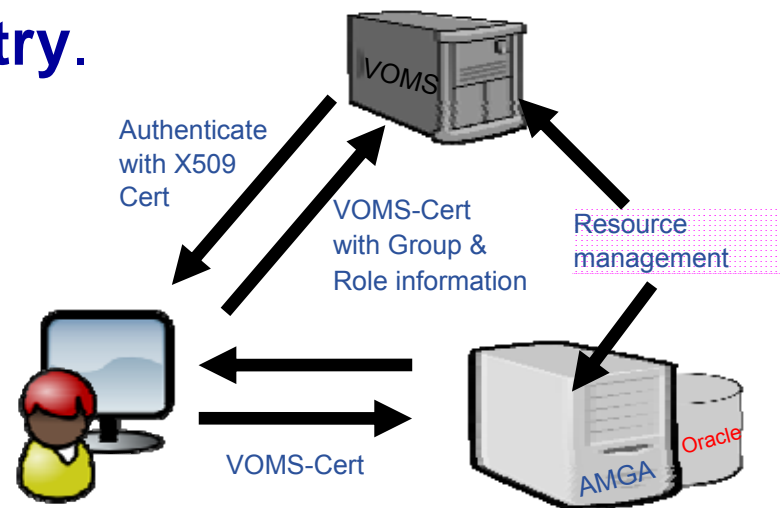
- SQL-like query language
- Joins between schemas
- Example

### QUERY EXAMPLE:

```
selectattr /gLibrary:FileName \  
          /gLibrary:Author \  
          `/gLibrary:FILE=/gLAudio:FILE \  
          and \  
          like(/gLibrary:FileName, "%mp3")`
```



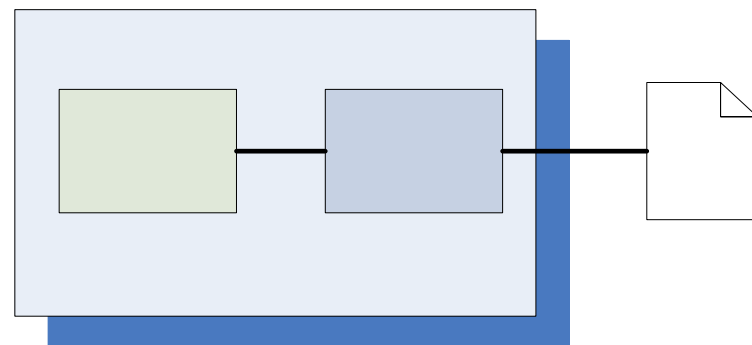
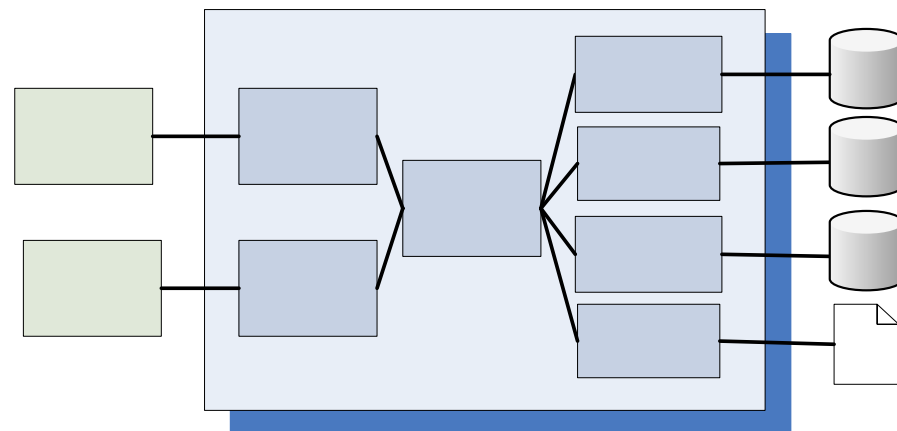
- ▶ Unix style permissions
- ▶ ACLs – **per-collection** or **per-entry**.
- ▶ Secure connections – **SSL**
- ▶ Client Authentication based on
  - Username/password
  - General X509 certificates
  - Grid-proxy certificates
- ▶ Access control via a Virtual Organization Management System (VOMS)





# AMGA Implementation

- ▶ C++ multiprocess server
  - Runs on any Linux flavour
- ▶ Backends
  - Oracle, MySQL, PostgreSQL, SQLite
- ▶ Two frontends
  - TCP Streaming
    - High performance
    - Client API for: **C++**, **Java**, **Python**, **Perl**, **Ruby**
  - SOAP
    - Interoperability
- ▶ Also implemented as standalone Python library
  - Data stored on filesystem





## ► Motivation

- **Scalability** – Support hundreds/thousands of concurrent users
- **Geographical distribution** – Hide network latency
- **Reliability** – No single point of failure
- **DB Independent replication** – Heterogeneous DB systems
- **Disconnected computing** – Off-line access (laptops)

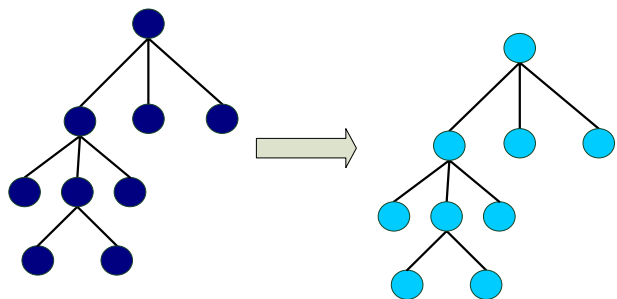
## ► Architecture

- Asynchronous replication
- Master-slave – Writes only allowed on the master
- Replication at the application level
  - Replicate Metadata commands, not SQL → DB independence
- Partial replication – supports replication of only sub-trees of the metadata hierarchy

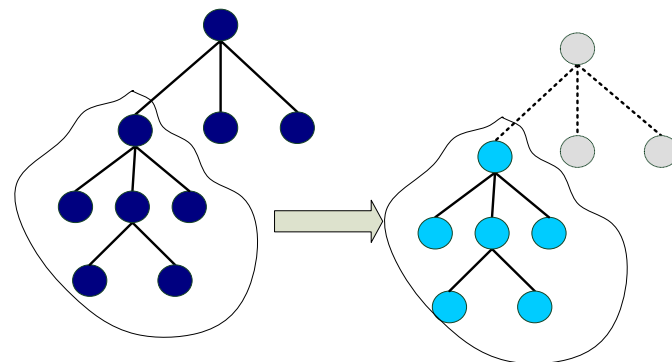


# Metadata Replication 2/2

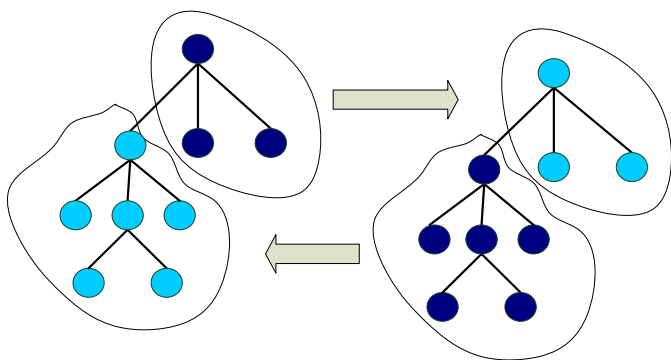
Full replication



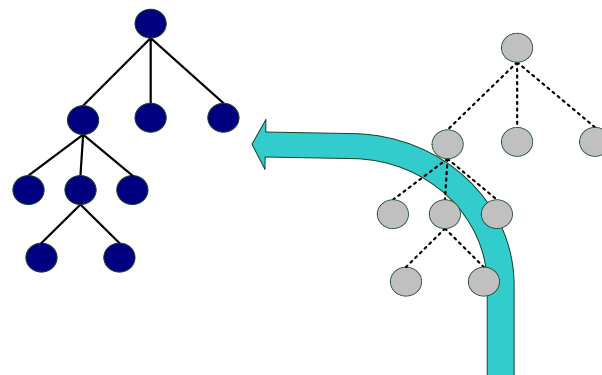
Partial replication



Federation



Proxy





- ▶ **LHCb-bookkeeping** (keep additional information from executed jobs)
  - Migrated bookkeeping metadata to ARDA prototype
    - 20M entries, 15 GB
    - Large amount of static metadata
  - Feedback valuable in improving interface and fixing bugs
  - AMGA showing good scalability
- ▶ **Ganga**
  - Job management system
    - Developed jointly by Atlas and LHCb
  - Uses AMGA for storing information about job status
    - Small amount of highly dynamic metadata



## ▶ TCP Streaming Front-end

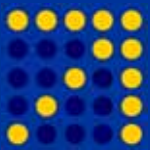
- mdcli & mdclient and C++ API (md\_cli.h, MD\_Client.h)
- Java Client API and command line mdjavaclient.sh & mdjavacli.sh (also under Windows)
- Python Client API

## ▶ SOAP Frontend (WSDL)

- C++ gSOAP
- AXIS (Java)
- ZSI (Python)



- ▶ AMGA – Metadata Service of gLite
  - Part of gLite (but still not certified in gLite 3.0. it will be done with 3.1 release)
  - Useful for simplified DB access
  - Integrated on the Grid environment (Security)
- ▶ Replication/Federation features
- ▶ Tests show good performance/scalability
- ▶ Already deployed by several Grid Applications
  - LHCb, ATLAS, Biomed, ...
- ▶ AMGA Web Site
  - <http://project-arda-dev.web.cern.ch/project-arda-dev/metadata/>



## ▶ Biomed: Medical Data Manager

- Deployed on EGEE production grid

## ▶ gMOD

- Deployed on GILDA



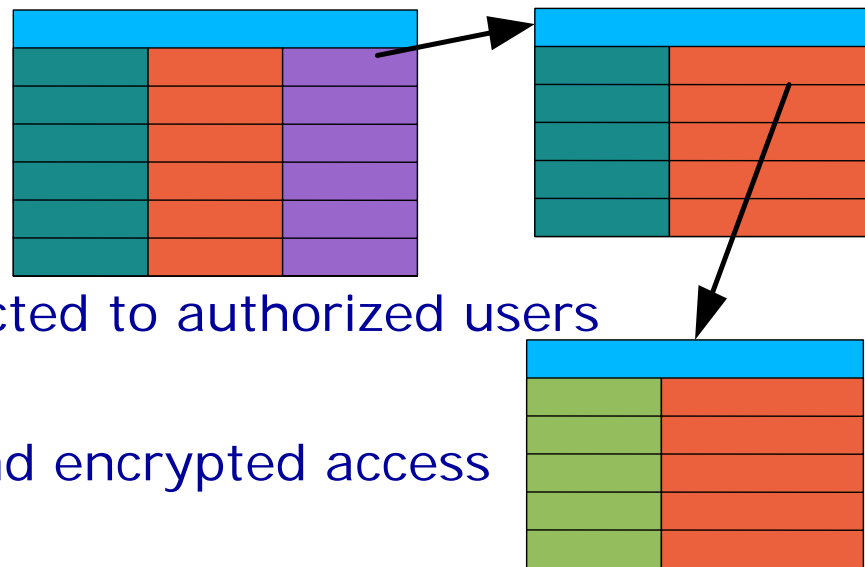
# Biomed: Medical Data Manager

Store and access medical images exploiting metadata on the Grid

Built on top of gLite data management system

Demonstrated at EGEE conference

- ▶ Strong security requirements
  - Patient data is sensitive
  - Data must be encrypted
  - Metadata access must be restricted to authorized users
- ▶ AMGA used as metadata server
  - Demonstrates authentication and encrypted access
  - Used as a simplified DB
- ▶ More details at:
  - <http://www.i3s.unice.fr/~johan/mdm/mdm-051013.pdf>





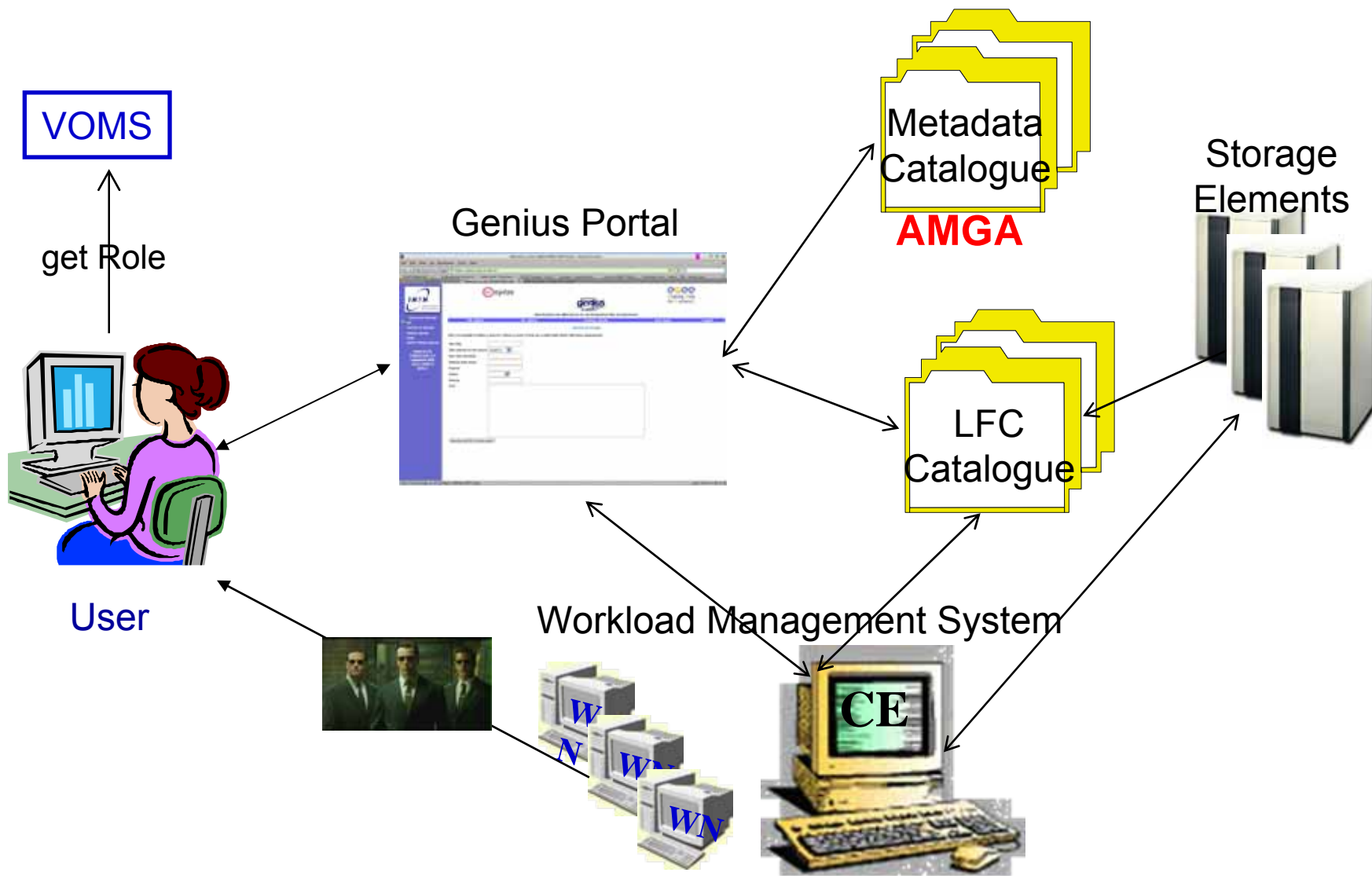
# gMOD: grid Movie On Demand

BioinfoGRID

- ▶ gMOD provides a Video-On-Demand service
- ▶ User chooses among a list of video and the chosen one is streamed in real time to the video client of the user's workstation
- ▶ For each movie a lot of details (Title, Runtime, Country, Release Date, Genre, Director, Case, Plot Outline) are stored and users can search a particular movie querying on one or more attributes
- ▶ Two kind of users can interact with gMOD: **TrailersManagers** that can administer the db of movies (uploading new ones and attaching metadata to them); **GILDA VO users (guest)** can browse, search and choose a movie to be streamed.



- ▶ Built on top of gLite services + GENIUS web portal:
- ▶ **Storage Elements**, sited in different places, physically contain the movie files
- ▶ **LFC**, the File Catalogue, keeps track in which Storage Element a particular movie is located
- ▶ **AMGA** is the repository of the detailed information for each movie, and makes possible queries on them
- ▶ The **Virtual Organization Membership Service (VOMS)** is used to assign the right role to the different users
- ▶ The **Workload Management System (WMS)** is responsible to retrieve the chosen movie from the right Storage Element and stream it over the network down to the user's desktop or laptop





gMOD is accesible through the Genius Portal (<https://glite-tutor.ct.infn.it>)  
Selecting from left side menu: VO Services/gMOD

The screenshot shows the gMOD interface within the Genius Portal. At the top, there are logos for INFN, egee, GENIUS, and NICE. Below the logos is a navigation bar with the text "Welcome brunor" and "Resource Broker: gilda-lcg Virtual Organization: gilda LFC Host: Your Data Logout".

On the left side, there is a "gMOD Services" menu with the following items: Search & Stream, Search & Stream, Select & Stream (highlighted), Videos Queue, Logs, Clean Videos Queue, Add Trailer & Metadata, Edit/Remove Metadata, and Back home.

The main content area is titled "Select & Stream" and contains the following text: "With this service it is possible to select a trailer and submit on the grid to stream on your client."

Below this text is a "Trailer List" with the following items: Amelie of Montmartre, American Pie 2, Batman Begins, The Fast and The Furious, **Madagascar** (highlighted), The Matrix, Spider Man, The Alien, The Pink Panther, Inside Man, and star trek.

To the right of the trailer list is a form for "Madagascar" with the following fields:

- Title: Madagascar
- Run Time: 86
- Release Date: 2005
- Country: USA
- Genre: Action
- Director: Eric Darnell
- Cast: Ben Stiller .... Alex (voice) Chris Rock .... Marty (voice) David Schwimmer .... Melman (voice) Jada Pinkett Smith .... Gloria (voice)
- Outline: At New York's Central Park Zoo, a lion (Stiller), a zebra (Rock), a giraffe (Schwimmer), and a hippo (Smith) are best friends and stars of the show.

At the bottom left of the form is a "Submit trailer" button. To the right of the form is a small image of the Madagascar movie poster.

