



Enabling Grids for E-science

AMGA Metadata Service

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- **This presentation primarily consists in slides from:**
 - Tony Calanducci
 - Third EELA Tutorial for Managers and Users
 - Rio de Janeiro, 26-30 June 2006
 - Nuno Santos, Birger Koblitz
 - 20 June 2006
 - Workshop on Next-Generation Distributed Data Management
 - Patricia Méndez Lorenzo: UNOSAT application using AMGA
 - User Forum
 - CERN, 1st March 2006
 - <http://indico.cern.ch/materialDisplay.py?contribId=23&sessionId=11&materialId=slides&confId=286>

- **Background and Motivation for AMGA**
- **Examples**
- **Interface, Architecture and Implementation**
- **Metadata Replication on AMGA**
- **Further information**

- Metadata is **data about data**
- On the Grid: **information about files**
 - Describes files
 - Locate files based on their metadata

- **AMGA – ARDA Metadata Grid Application**
 - ARDA: A Realisation of Distributed Analysis for LHC
- **Now part of gLite middleware**
 - Official Metadata Service for EGEE
 - Also available as standalone component
- **Expanding user community**
 - HEP, Biomed, UNOSAT...
 - More on this later

- **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

- **gLibrary**
 - Files are saved on SEs and registered into LFC file catalogues
 - The AMGA Metadata Catalogue is used to archive and organize metadata and to answer users' queries.
- **LHCb-bookkeeping**
 - 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

- **gLibrary is built using the following AMGA collections:**
 - /gLibrary contains generic metadata for each entry
 - /gLAudio, /gLImage, /gLVideo, /gLPPT, /EGEEPPT, /gLDoc, ... are examples of collections of “additional features” (shown later)
 - /gLTypes
 - keeps the associations between document types and the names of the collection that contains the “additional features”
 - is used by gLibrary to find out where it has to look when new document types are added into the system (extensibility)
 - /gLKeys is used to store Decryption Keys

Collection		/gLibrary		
Entry Names	Attributes			
	FileName	PathName	Type	Submitter
4ffaafc8-26e7-4826-b460-3d5bf08081a4	DedicatoAte.mp3	/grid/gilda/calanducci	Audio	Tony Calanducci
00454dca-a269-4b93-8a45-c4012af05600	ardizzonelarocca_is_231005.ppt.gpg	/grid/gilda/calanducci/EGEE	EGEEDOC	Tony Calanducci

/gLibrary (continuum)

Attributes				
SubmissionDate	Encryption	Description	Keywords	CreationDate
2006-01-05 00:00:00	false	Canzone delle vibrazioni che ha ricevuto un enorme successo tra i teenagers nel 2003	Vibrazioni	2004-02-05 00:00:00
2005-01-05 16:44:22	true	gLite Information System	R-GMA, RGMA, BDII, IS	2005-10-05 23:40

Initialize your VOMS proxy asking to be member of the gilda VO

Edit your `.mdclient.config` setting `Login=NULL` (user will be retrieved from your proxy extensions)

Log into AMGA

```
$ voms-proxy-init --voms gilda
$ voms-proxy-info -fqan
/gilda/Role=NULL/Capability=NULL
$ grep Login .mdclient.config
Login = NULL
```

Suppose we want to look for all contents about VOMS

```
Query> whoami
>> gilda
Query> selectattr /gLibrary:FILE /gLibrary:FileName /gLibrary:Type
'like(/gLibrary:Keywords, "%VOMS%")'
>> 1f6e9ac6-5c86-4599-b03b-560e0e7ea38a
>> VOMS_server_Installation.ppt.gpg
>> EGEEEDOC
```

Now let's find out in which collection EGEEEDOC attributes are stored

```
Query> getattr /gLTypes/EGEEEDOC Path
>> EGEEEDOC
>> /EGEEPPT
```

- **Medical Data Manager – MDM**

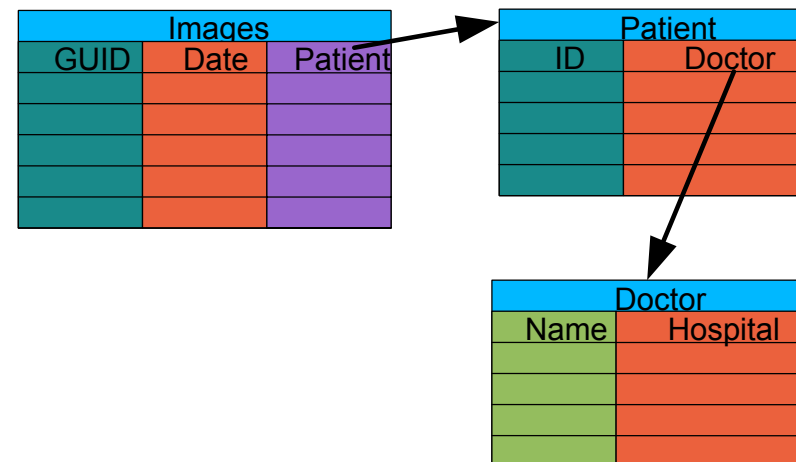
- Store and access medical images and associated metadata on the Grid
- Built on top of gLite 1.5 data management system
- Demonstrated at last EGEE conference (October 05, Pisa)

- **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**

- <https://uimon.cern.ch/twiki/bin/view/EGEE/DMEncryptedStorage>

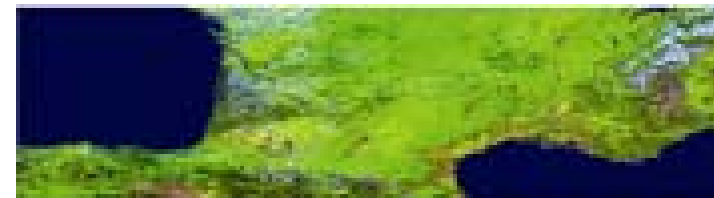
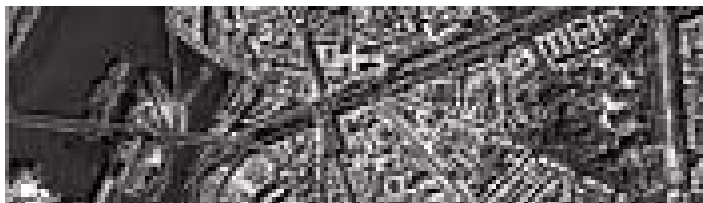
UNOSAT is a United Nations Initiative

Objectives

- Provide the humanitarian community with access to satellite imagery and Geographic Information System services
 - ▶ Reduce disasters and plan sustainable development
- Ensure cost-effective and timely products

Core Services

- Humanitarian Mapping
- Image Processing



VEGETATION – 1 Km

IKONOS – 1m

- Potential Bottlenecks:

- UNOSAT beginning to suffer from limited capacity and processing power
 - Multiple satellites being launched
 - Larger and larger storage capacity needed

- In summer 2005 we have provided a whole structure at CERN for UNOSAT

- UNOSAT Virtual Organization (VO)
 - 3.5TB in CASTOR
 - Computing Elements, Resource Brokers
 - Collaboration with ARDA group
 - AFS area of 5GB

We have provided
the whole GRID
infrastructure
At CERN

- We have run some UNOSAT tests (images compression) inside the GRID environment (quite successful)

- The framework developed for in principle for Geant4 (See Alberto Ribon's presentation [49]) has been adapted for UNOSAT needs

- UNOSAT provided us with a set of images for testing
- Associated to each image a metadata file was included
File name, directory path, geographical coordinates

■ Steps:

STORAGE LEVEL

- Copy and registration of the images in Castor@CERN
 - ▶ Use of the LFC Catalog
- Parse the metadata files to extract the different metadata
- Use of the AMGA tool to parse metadata to location of the files

COMPUTING LEVEL

- Use of compression tools to compress images inside LCG resources
- Use of the general submission tool adapted to UNOSAT needs

☐ LFC Catalogue

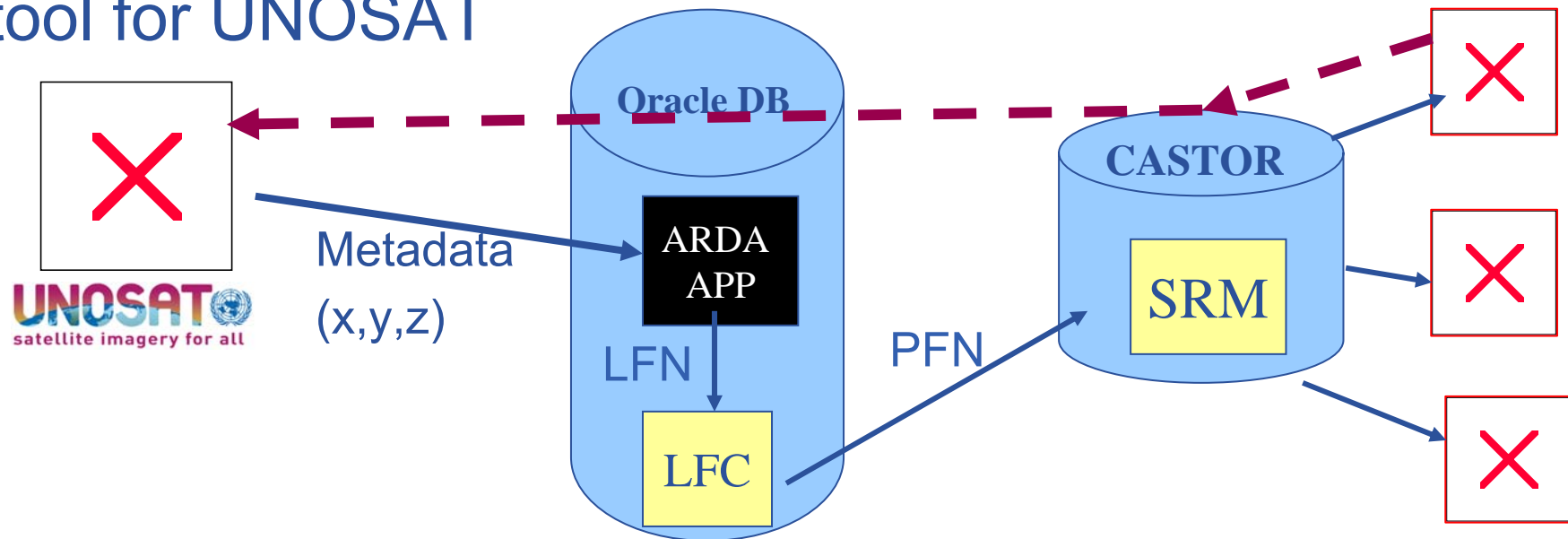
➔ Mapping of LFN to PFN

☐ UNOSAT requires

➔ User will give as input data certain coordinates

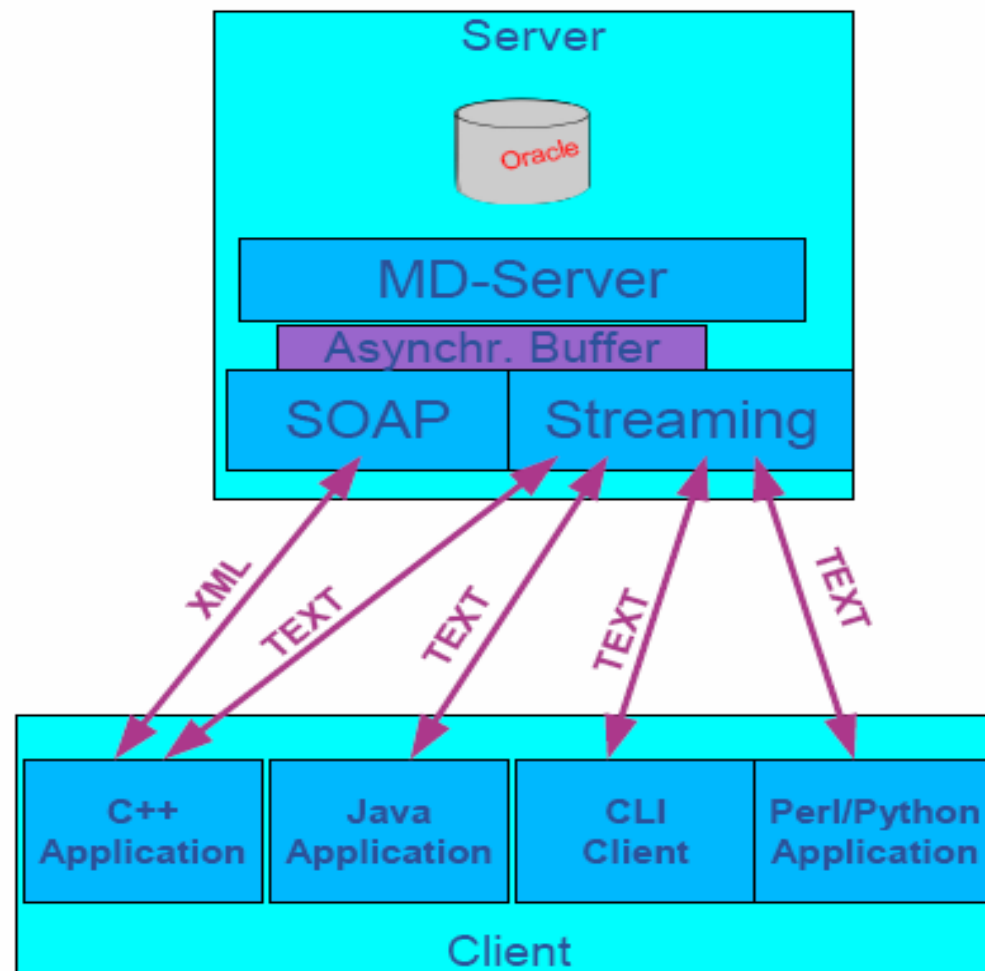
➔ As output, want the PFN for downloading

☐ The ARDA Group assists us setting up the AMGA tool for UNOSAT



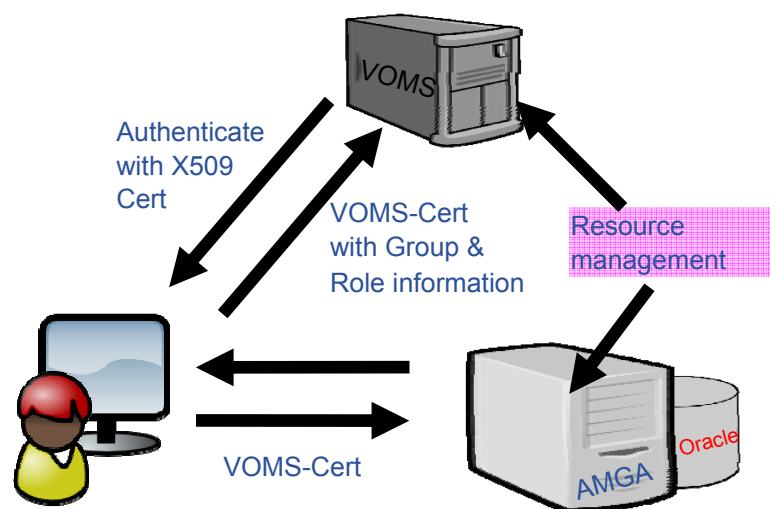
- **AMGA Implementation:**

- SOAP and Text frontends
- Streamed Bulk Operations
- Supports single calls, sessions & connections
- SSL security with grid certs (negotiated by client)
- Own User & Group management + VOMS
- PostgreSQL, Oracle, MySQL, SQLite backends
- Works alongside LFC
- C++, Java, Perl, Python clients



- **Dynamic Schemas**
 - Schemas can be modified at runtime by client
 - Create, delete schemas
 - Add, remove attributes
- **Metadata organised as an hierarchy**
 - Schemas can contain sub-schemas
 - Analogy to file system:
 - Schema ↔ Directory; Entry ↔ File
- **Flexible Queries**
 - SQL-like query language
 - Joins between schemas

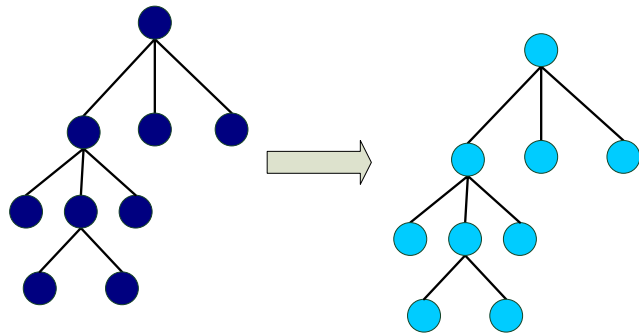
- **Unix style permissions**
- **ACLs – Per-collection or per-entry.**
- **Secure connections – SSL**
- **Client Authentication based on**
 - Username/password
 - General X509 certificates
 - Grid-proxy certificates
- **Access control via a Virtual Organization Management System (VOMS):**



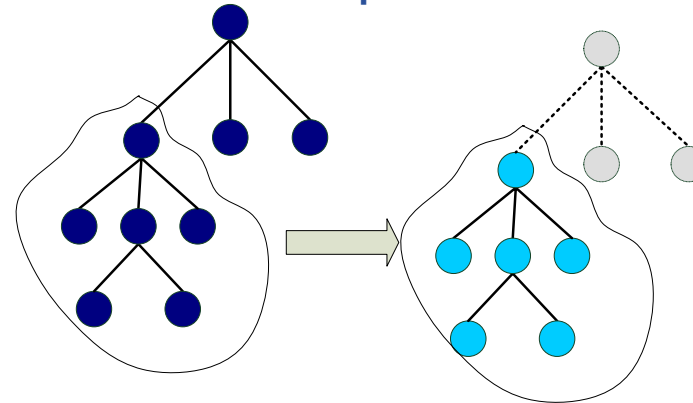
- Currently working on **replication/federation** mechanisms for AMGA
- **Motivation**
 - **Scalability** – Support hundreds/thousands of concurrent users
 - **Geographical distribution** – Hide network latency
 - **Reliability** – No single point of failure
 - **DB Independent replication** – Heterogeneous 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
- <http://amga.web.cern.ch/amga/publications/nsantos2006AMGAReplication.pdf>

Some use cases

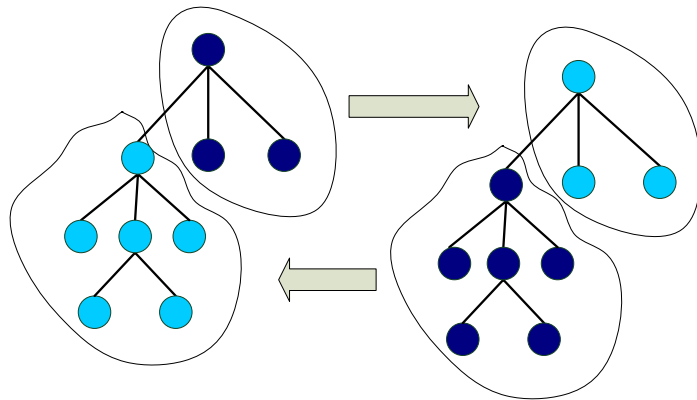
Full replication



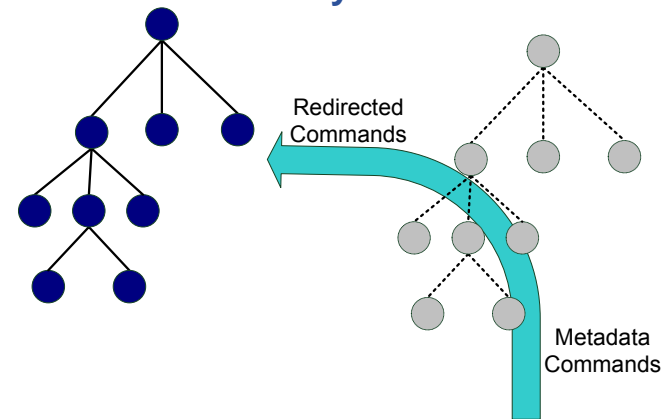
Partial replication



Federation



Proxy



- **But also....**

- **simplified DB access 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

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Collection	/gLTypes
Entry names	Attributes
	Path (<i>refers to a collection</i>)
Audio	/gLAudio
Image	/gLImage
Video	/gLVideo
Documents	/gLDOC
PowerPoint	/gLPPPT
EGEEDOC	/EGEEPPT

Collection	/gLKeys
Entry names	Attributes
	Passphrase
00454dca-a269-4b93-8a45-c4012af05600	ardizzo

“additional features”

Collection	/EGEEPPT							
Entry names	Attributes							
	Title	Runtime	Author	Type	Date	Event	Speaker	Topic
00454dca-a269-4b93-8a45-c4012af05600	Information Systems	00:30:00	Valeria Ardizzone, Giuseppe La Rocca	Theoretical	2005-10-23	4 th EGEE Conference	Giuseppe La Rocca, Valeria Ardizzone	R-GMA, BDII

Collection	/gLAudio					
Entry names	Attributes					
	SongTitle	Duration	Album	Genre	Singer	Format
4ffaafc8-26e7-4826-b460-3d5bf08081a4	Dedicato A Te	00:03:27	Dedicato A Te	Pop	Le Vibrazioni	MP3

- **User Requirements:**
 - a valid proxy with VOMS extensions
 - VOMS Role and Group needed to be recognized by gLibrary as a contents manager.
- **3 kinds of users:**
 - **gLibraryManager:** (s)he can create new content type and allows a generic VO user to become gLibrarySubmitter
 - **gLibrarySubmitters:** they can add new entries and define access rights on the entries they create.
 - Fine-grained permission (reading, writing, listing, decrypting) settings on each entry: whole VO members, VO groups, list of DNs
 - **generic VO users:** browse and make queries (on entries they have access to)
- **Basic level of cryptography:**
 - New files saved on SEs can be encrypted beforehand with a symmetric passphrase that will be saved in /gLKeys. Only selected users (that have a specific DN in the subject of their VOMS proxy) can access the passphrase and decrypt the file.

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```

Now let's find out in which collection EGEEEDOC attributes are stored

```
Query> getattr /gLTypes/EGEEEDOC Path
>> EGEEEDOC
>> /EGEEPPT
```

Now we can make a JOIN between the 2 tables to extract all the information we like

```
Query> selectattr /gLibrary:FILE /gLibrary:FileName /gLibrary:Description
/EGEEPPT:Author /EGEEPPT:Title /EGEEPPT:Event '/gLibrary:FILE=/EGEEPPT:FILE and
like(/gLibrary:Keywords, "%VOMS%") `
>> 1f6e9ac6-5c86-4599-b03b-560e0e7ea38a
>> VOMS_server_Installation.ppt.gpg
>> VOMS Server installation tutorial done in Venezuela
>> ziggy, Giorgio
>> Installing a gLite VOMS Server
>> First Latin American Workshop for Grid Administrators
```

Let's see where the passphrase to decrypt the file is stored

```
Query> selectattr /gLibrary:FILE DecryptKeyDir 'FILE="1f6e9ac6-5c86-4599-b03b-
560e0e7ea38a" '
>> 1f6e9ac6-5c86-4599-b03b-560e0e7ea38a
>> /DLKeys/gildateam
```

But ...

```
Query> getattr /gLKeys/gildateam/1f6e9ac6-5c86-4599-b03b-560e0e7ea38a
Passphrase
Error 4: Permission denied
```

Because gilda is not a member of the gildateam group

- **on AMGA and gLibrary:**

- <http://indico.eu-eela.org/conferenceTimeTable.py?confId=37>
- (go to day 3 for the AMGA tutorial)

- **AMGA Web Site**

<http://project-arda-dev.web.cern.ch/project-arda-dev/metadata/>

- **AMGA – Metadata Service of gLite**
 - Useful for simplified DB access
 - Integrated in the Grid environment (Security)
- **Replication/Federation under development**
- **Tests show good performance/scalability**
- **Already deployed by several Grid Applications**
 - LHCb, ATLAS, Biomed, ...
 - DLibrary