Encrypted Data Storage.

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www.eu-egee.org

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Background

- In some research and user communities data security is imperative.
  - Medical data
  - Financial data
  - Personal data
- eg. **In the medical research field:**
  - Data files should be anonymized.
  - Data files should be encrypted:
    - On storage elements.
    - During transfer.
  - Metadata and Data files controlled by ACLs.
  - These files should be protected from “local attack” also.

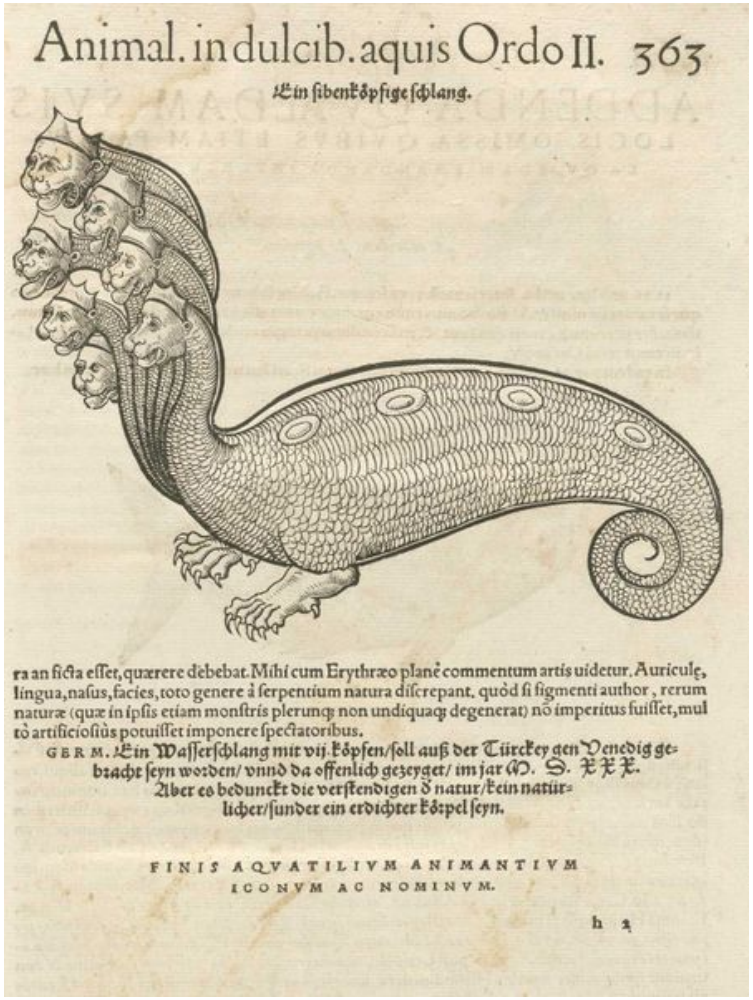
Encryption

- Strong encryption of files gives more flexibility:
  - Unauthorized access to the encrypted file is not catastrophic.
- But how to encrypt?
  - Decryption a requirement:
    - By the owner.
    - By a group defined at file-level granularity.
- Authentication certificates are not suitable for long-term.
  - Renewal each year → files lost?
  - Revocation or lost pass phrase → files lost?
  - No group access.
- Symmetric keys can be hard to manage
  - Large number of keys needed for high granularity.
  - User-managed keys → lost keys → lost files.

Key Management

- Central key storage is not so good.
  - All eggs in one basket.
  - Single security breach gives away all keys.
  - Rogue root-privilege user could access every key (file).
- Distributed key storage a better strategy.
  - Secret is shared across separate keystores (DB or other).
  - Ideally on administratively different heterogeneous servers.
  - Not enough to hack one server.
  - Coordinated attack needed to access the keys.

Hydra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Ein ſibenköpfige ſchlang.
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Aber es beduncket die verſtendigen d natur/ ein natürlicher/ ſunder ein erdichter köpel ſeyn.
FINIS AQVATILIVM ANIMANTIVM ICONVM AC NOMINVM.
h 2

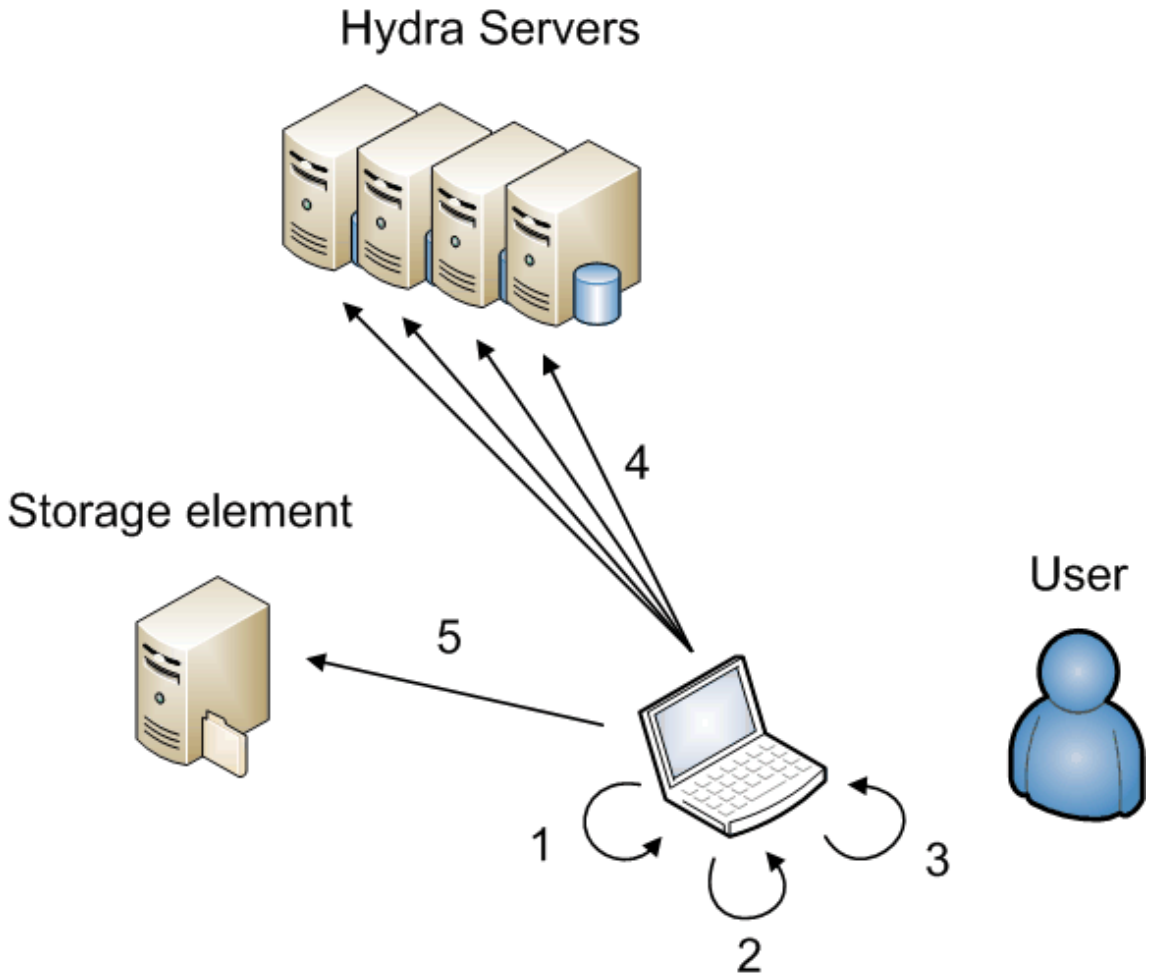
Hydra is a distributed key storage solution.

- File encryption key generated, split and distributed to keystores (databases)
- Splitting based on **Shamir Secret Sharing Scheme**.
  - (m, n) threshold scheme. With $n > m$.
  - $m - 1$ degree polynomial with n points calculated.
  - Need m points to reconstruct the polynomial.
  - $m - 1$ fragments do not help to determine the constant, which is the secret.
- This scheme provides:
  - Security: m fragments required to reconstruct key.
  - Fault Tolerance: $m - n$ keystores unavailable: key recoverable.
  - eg. Splitting key using $(3, 5)$ scheme:
    Key "lost" if 3 servers attacked.
    Any 2 servers may be offline.

Hydra

- A key per file:
  - Distributed to *n* (preferably) geographically and managerially separated servers.
  - Key fragment access controlled with access control list.
  - Access for only owner or list of users.
  - Access to list of groups (VOMS).
- **Caveats:**
  - **Still vulnerable to user credential compromise.**
    - Proxies are in many places.
    - Secure token service could help.
  - **Decrypted files eventually are used:**
    - A WN will have access with user credentials when computing, thus a compromise there reveals the contents.

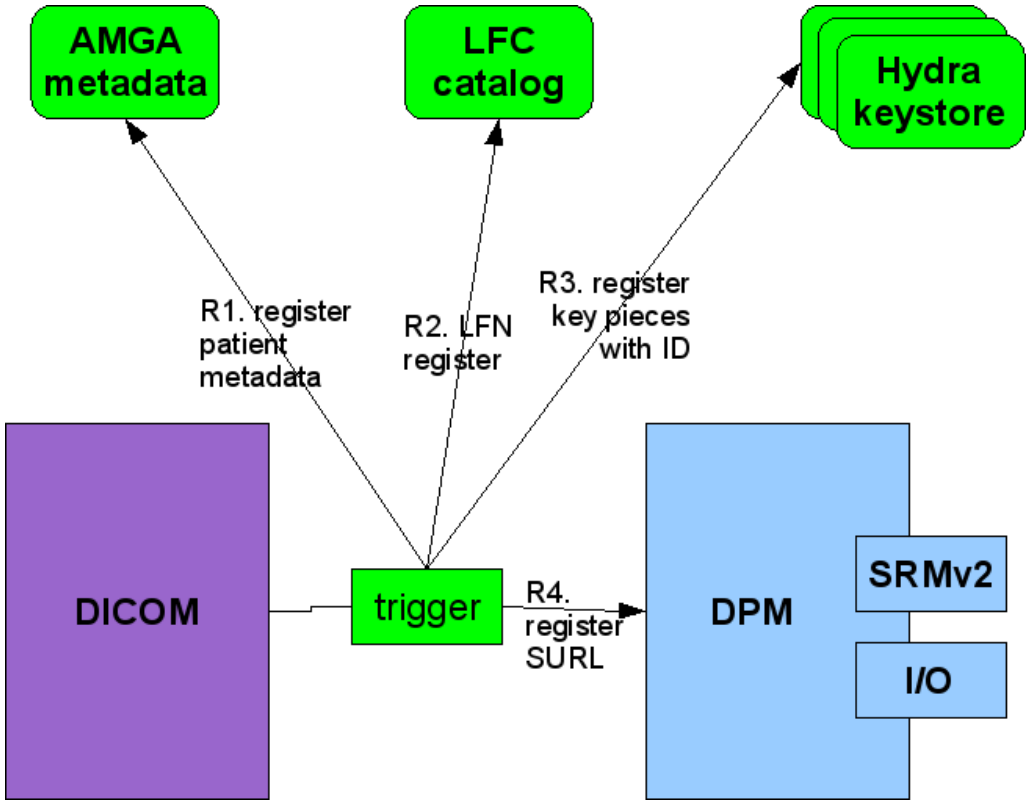
Hydra



Hydra in EGEE/gLite

- Hydra integrated to produce **Medical Data Manager** (MDM).
- Medical data: Managed by DICOM storage.
  - **D**igital **I**maging and **Co**mmunications in **M**edicine (**DICOM**): standard.
  - DICOM designed for internal hospital usage.
  - Should not be exposed to general Grid environment.
- EGEE solution: extension of Data Management tools.
  - DICOM to DPM trigger.
  - Encryption/decryption of data on the fly.
  - Metadata registration of metadata to catalog (AMGA), file logical info to LFC
  - Storage of key fragments to Hydra using LFC GUID.
  - SRMv2, GFAL, gridFTP for SURLs, TURLs and transfers.

File Registration



- DPM-DICOM trigger:
  - Registered to AMGA, LFC.
  - Uses LFC (or DICOM) GUID for ID.
  - Registers keys under ID to Hydra.
  - Stores encrypted file to DPM.
- GUID important (retrieval).

```
dpm-dicom-trigger <DICOM file name>

MDM-register <DICOM file name>
```

Status and Deployment.

- Installation/Documentation/Notes continuous updating:
  - To be updated with more focus on end-user tasks.
  - Technical/development details to be (re)moved.
- Certified for SL4. SL5/Debian ongoing.
  - Hydra clients in the general gLite UI.
  - Hydra service released separately (client wishes).
- Security Audit:
  - Done. Code review issues raised.
  - Code being updated.
- **Future work depends on the needs of clients.**

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- **Hydra part of EMI. Continued HIP support.**
- **Under discussions with external company.**
  - Front end for generic cloud storage.
  - Prototype Java interface. .NET integration after.

`https://twiki.cern.ch/twiki/bin/view/EGEE/DMEDS`

Questions?

p.s. There's a LaTeX template available:

https://edms.cern.ch/document/964536/1