Examples of use of e-Infrastructures for Art and Cultural Heritage

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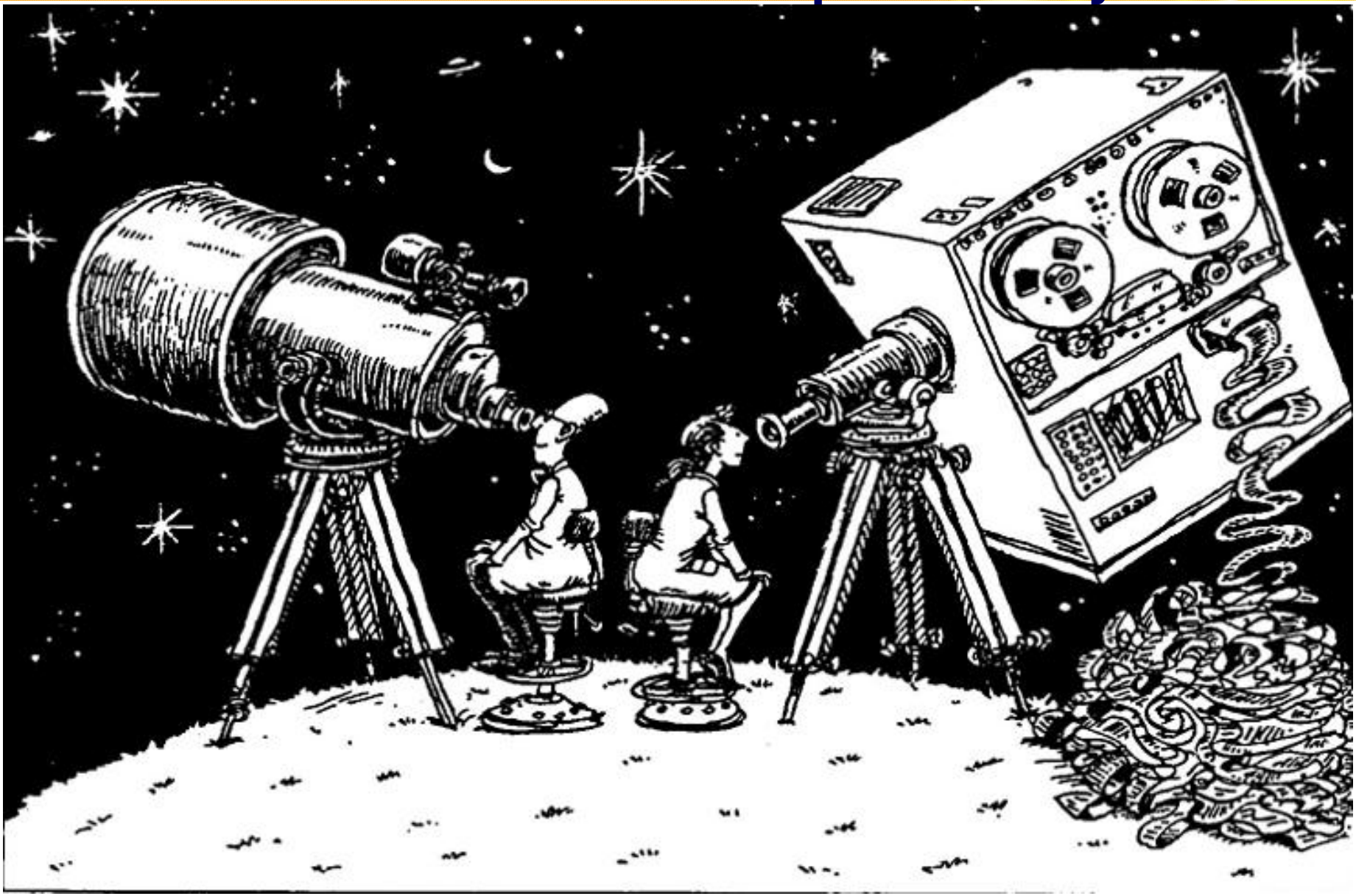
Digital Cultural Heritage e_Infrastructure Workshop
Barcelona, 14.06.2011

Outline

- **e-Infrastructure and e-Science concepts;**
- **Why Grids for Arts and Humanities ?**
- **Use Cases:**
  - The ASTRA project;
  - The Data Sonification technique;
  - The Cultural Heritage Digital Repositories;
- **Summary and Conclusions.**

21st Century Research is becoming more and more computationally intensive



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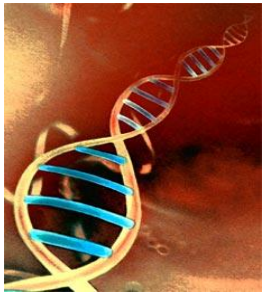
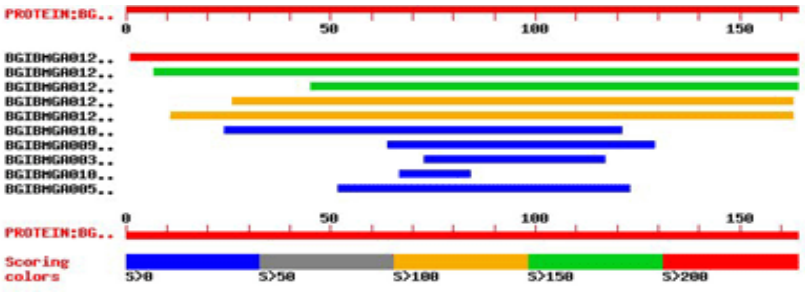
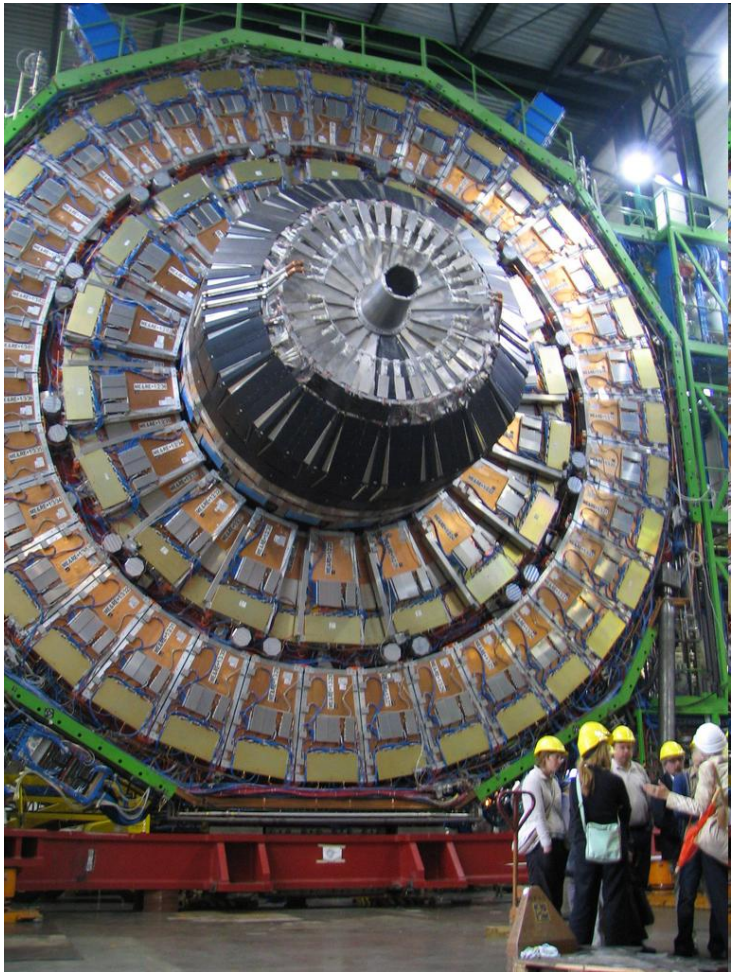
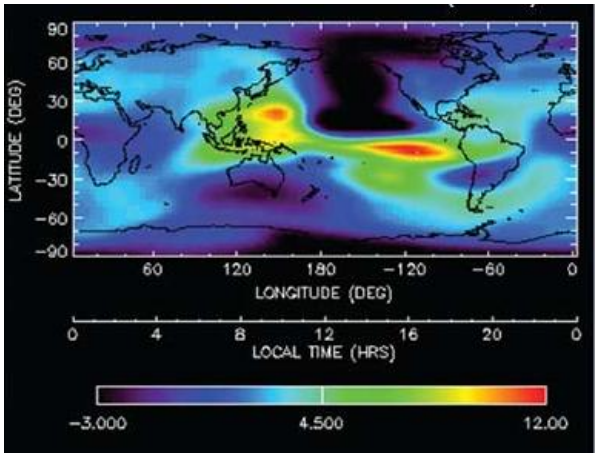
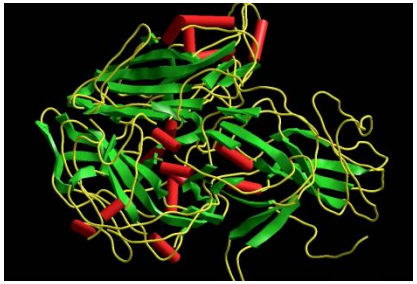
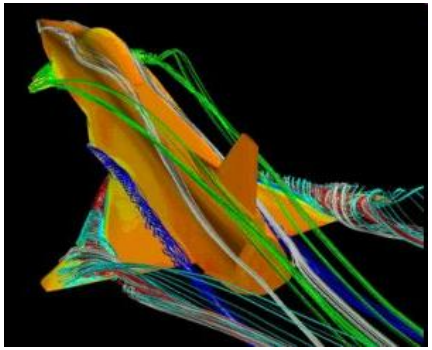








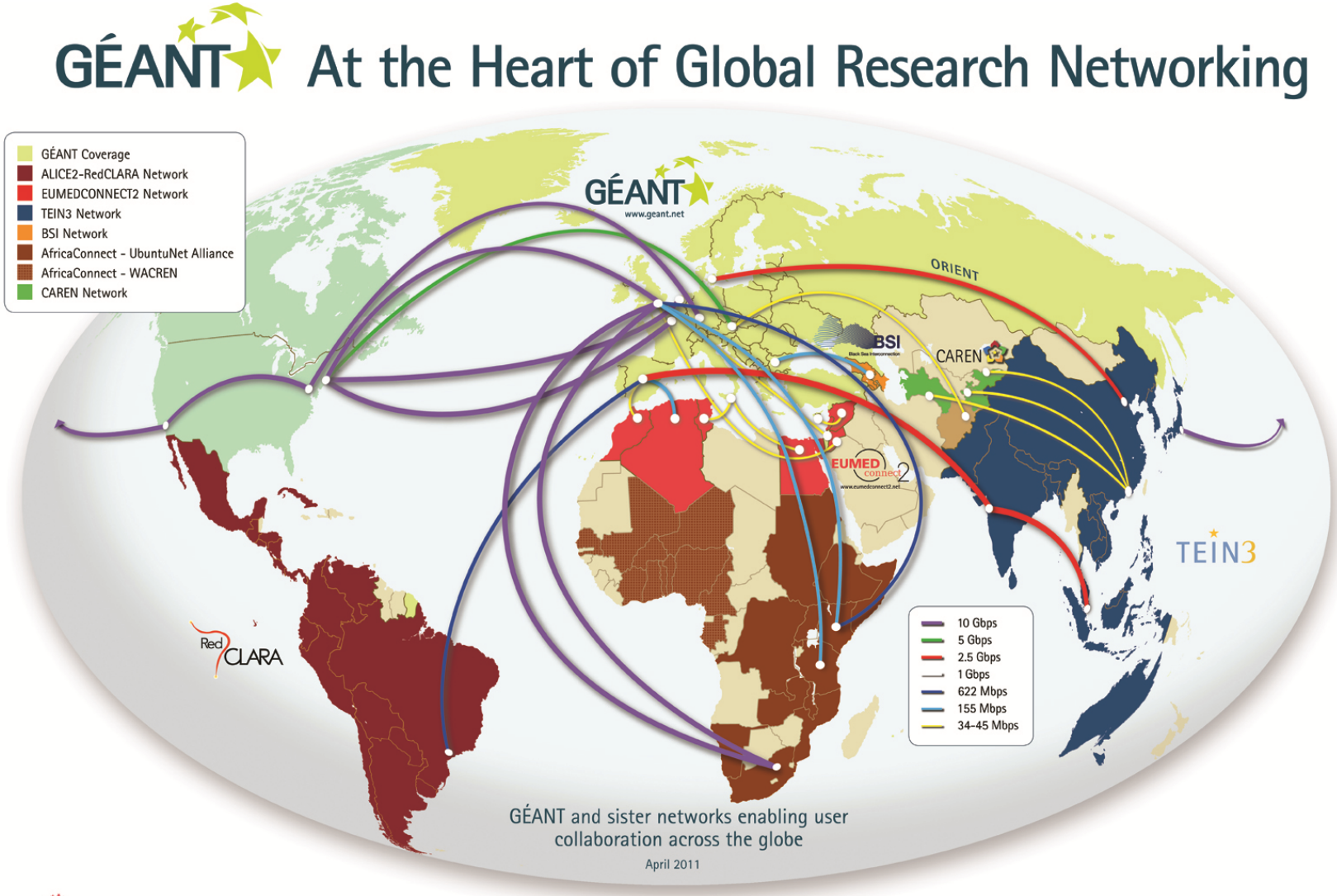




e-Science

- Virtual Organisations
- e-Infrastructure
- Applications
- Data
- Instruments

Research networks at «global» scale



DANTE www.dante.net GÉANT www.geant.net

connect • communicate • collaborate

GÉANT is co-funded by the European Commission within its 7th R&D Framework Programme.
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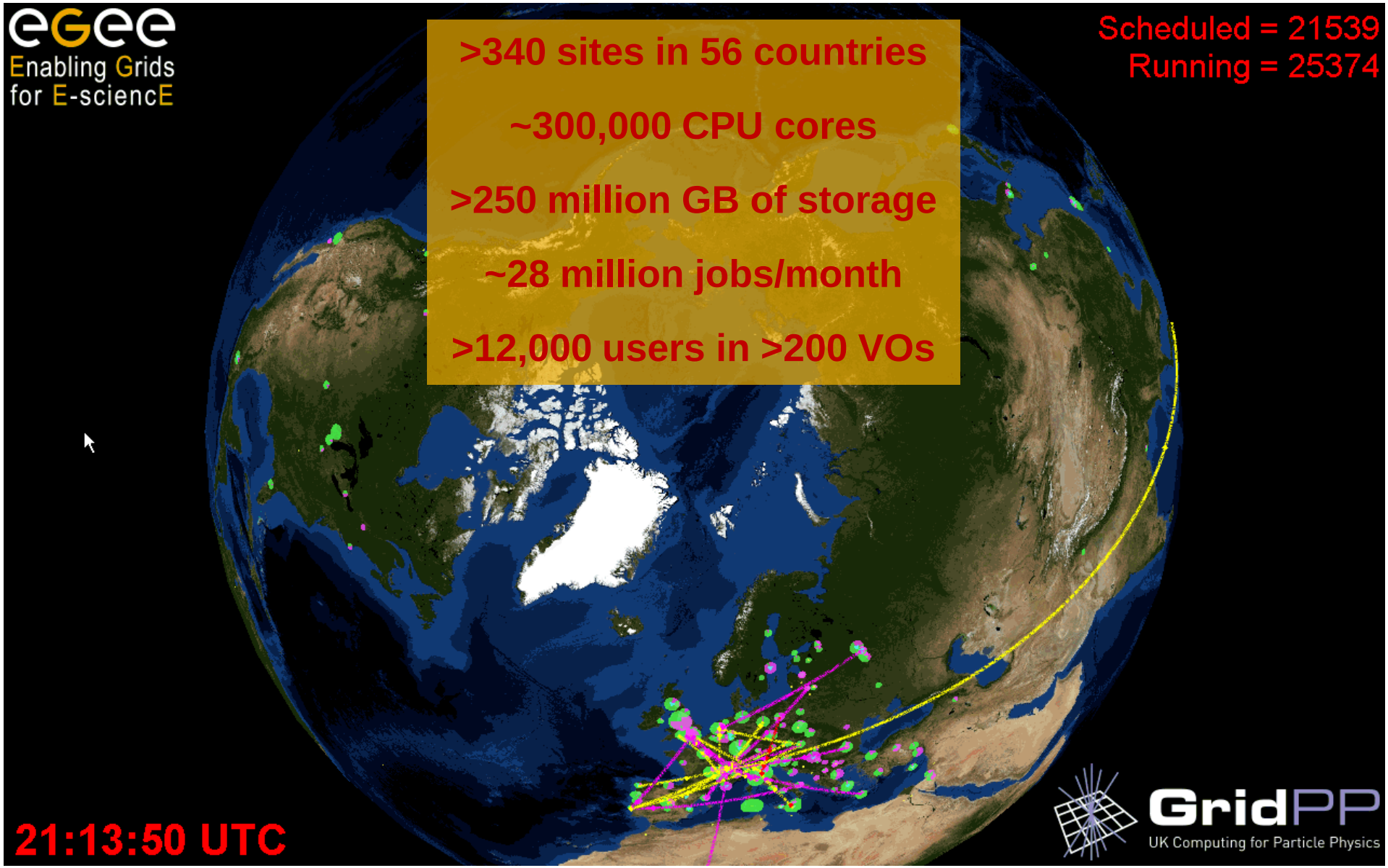
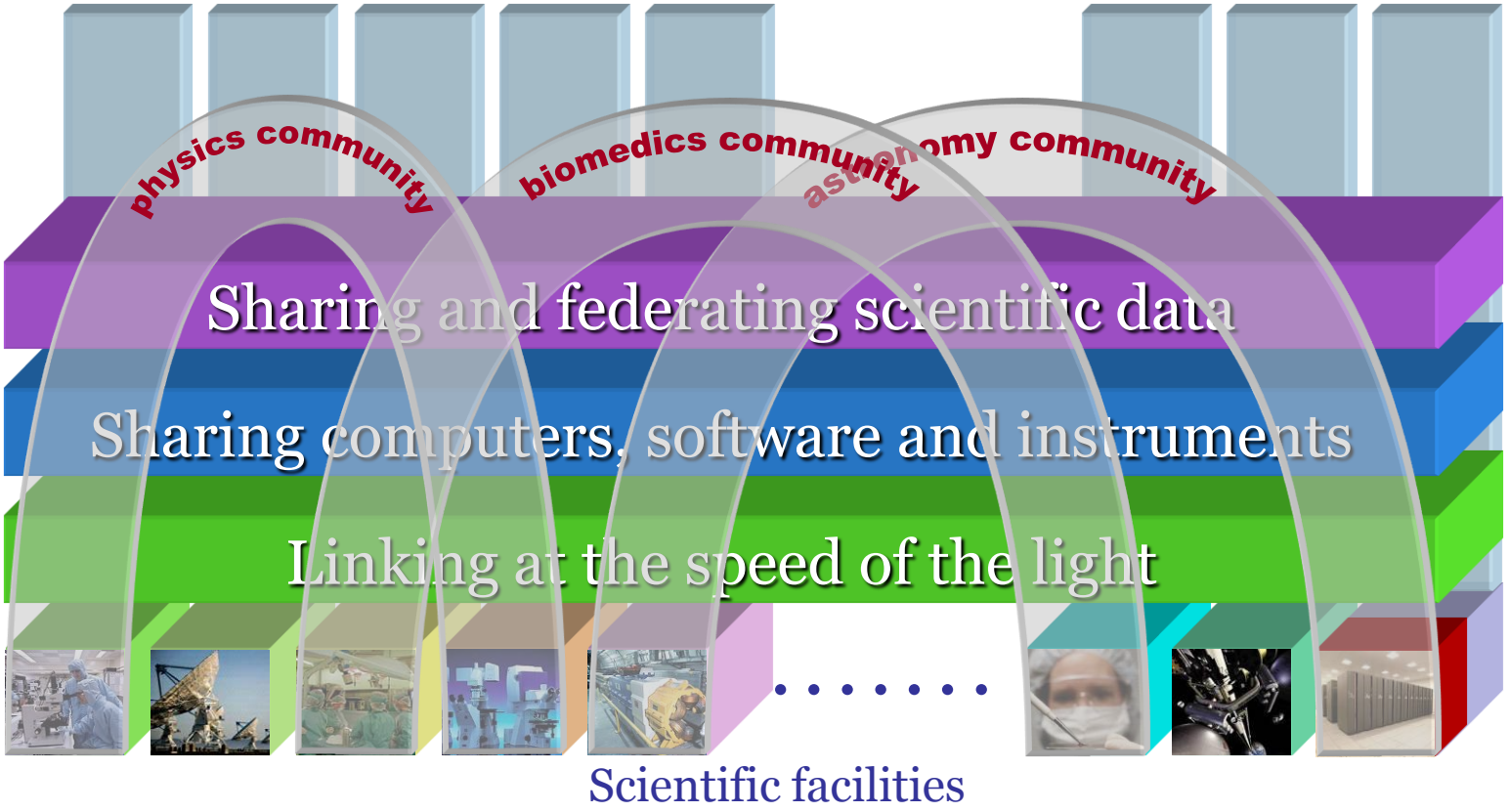
European Commission Information Society and Media

Grids at «global» scale



e-Infrastructures for Science

…ubiquitous research environments for accessing and sharing resources and tools…



Slide by Kostas Glinos (EC DG-INFSO)

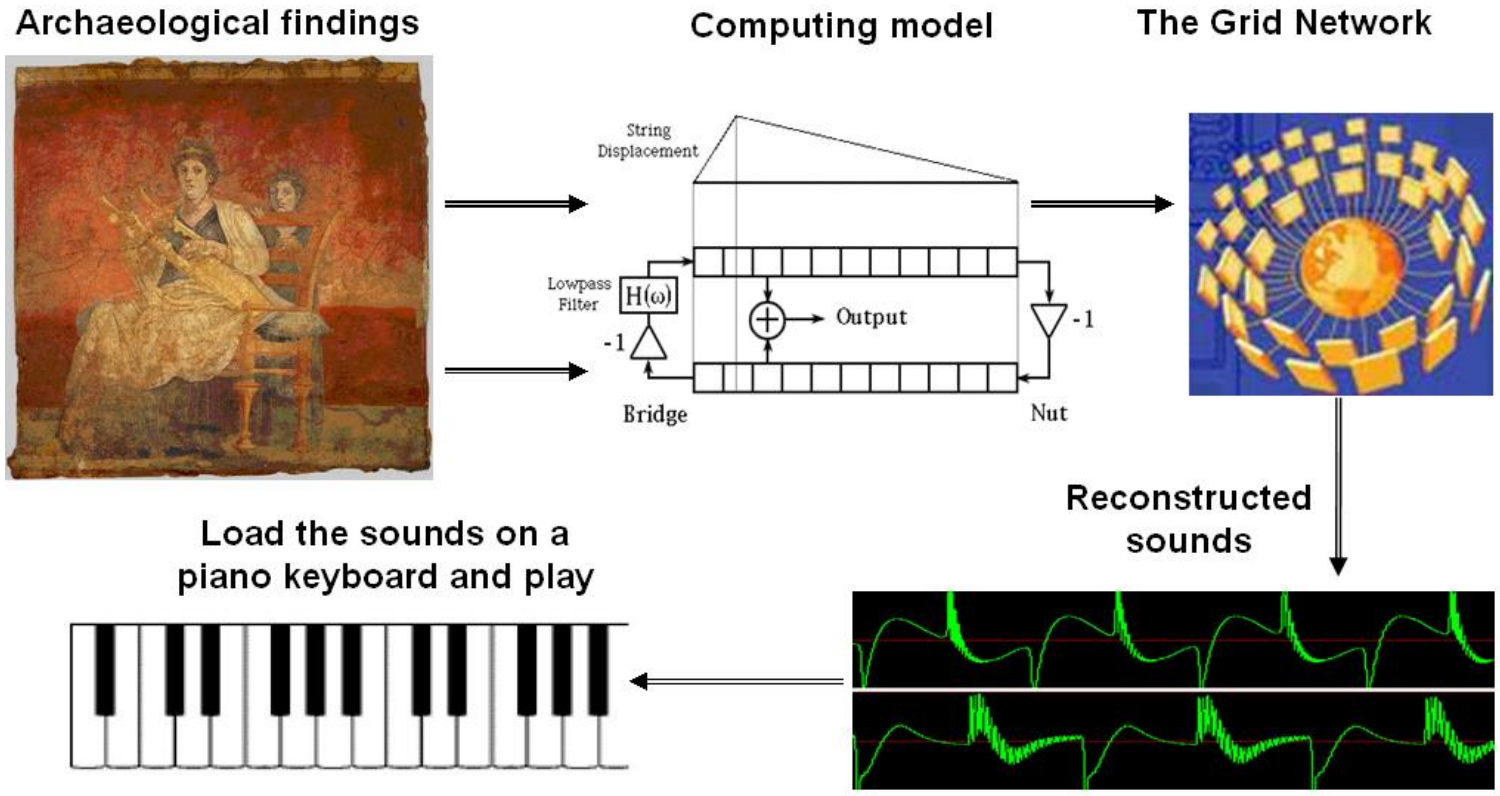
European Commission
Information Society and Media

Why e-Infrastructures also for Arts and Humanities?

- **High performance/throughput computing systems:**
  - Large scale, computationally intensive, problems can be tackled, e.g. “ab initio” sound creation, document/image digital restoration, etc.;
- **High performance storage systems:**
  - Geographically distributed replicas of files
    - Fault-tolerant digital preservation;
- **Simplified authentication systems:**
  - Single Sign-On (SSO); support of Federations of Identity Providers
- **Fine-grained authorization systems:**
  - Allow to precisely define “who”:
    - Individual user(s), group(s), organization(s), the whole world;
  - And “what”:
    - Read/edit/delete data and metadata;
    - Search, browse;
    - Creation of new repositories;
    - Role assignments, etc.

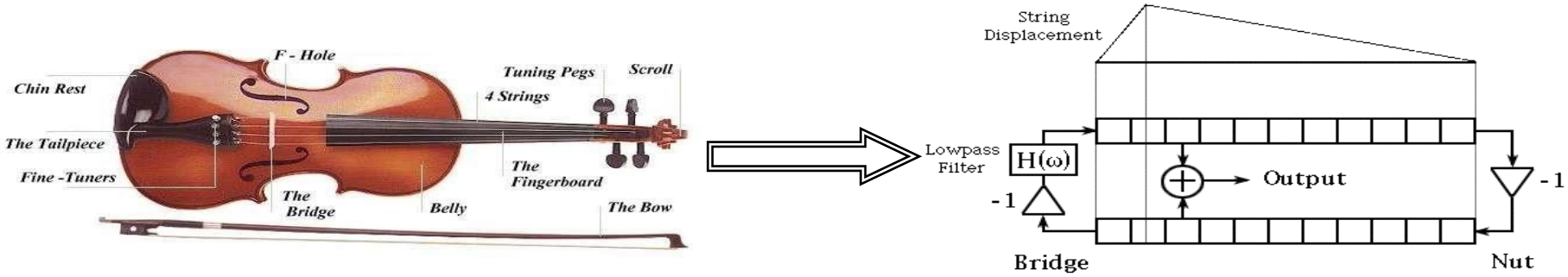
1st Use Case: ASTRA (www.astraproject.org)

- **The ASTRA (*Ancient instrument Sound/Timbre Reconstruction Application*) project aims at reconstructing the sound or timbre of ancient instruments using archaeological data as fragments from excavations, written descriptions, pictures, etc.**



The Physical Modeling Synthesis

- The technique used is the Physical Modeling Synthesis (PMS), a complex digital audio rendering technique which allows to recreate a model of the musical instrument and produce the sound by simulating its behavior as a mechanical system.



- The PMS offers great potentialities both to:
  - musicians searching for the most convincing real-world sound emulations;
  - musicians searching for unique, never-heard-before sounds by changing the instrument geometry.

- The model allows to capture accidents during the performance, such as: squeaks, mode locking and multi-phonics.

Why does ASTRA need e-Infrastructures ?

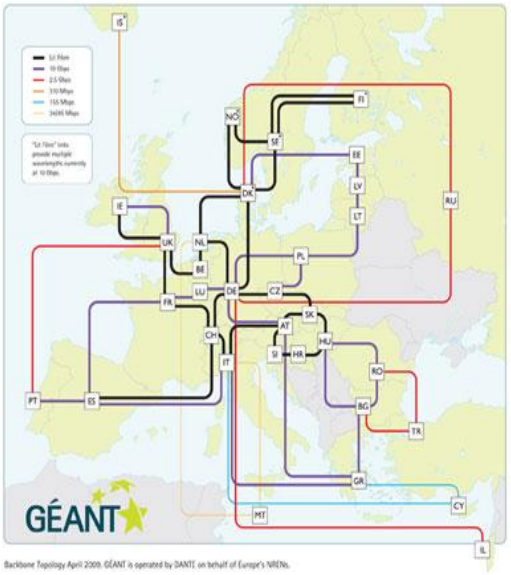
- **ASTRA project heavily exploits Research Networks and Grid infrastructures:**

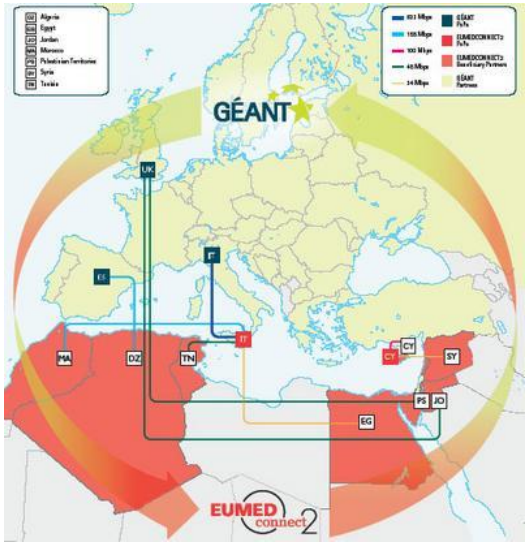
– Thanks to the Grid and the network, many simulations can be performed in parallel on different computers at different locations.

30 s of reconstructed sound need ~ 90 min on a 3.73 Ghz CPU with 2 GB RAM

GEANT and EUMEDCONNECT2 provide the needed network infrastructures to speed up the overall computation time.

ASTRA can count on more than 500 CPU cores and the support of more than 20 Grid sites both in the GILDA (a part of EGI) and EUMEDGRID infrastructures.



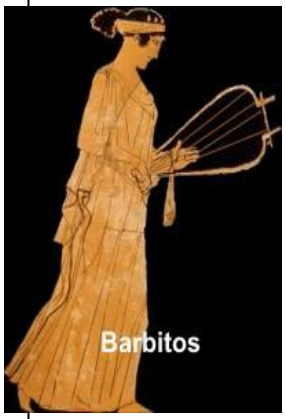


ASTRA main achievements

In Dec. 2008, a unique concert was staged using the digitally reconstructed sounds of the Epigonion alongside the Sonora Netwok Ensemble's performance of the Czech composer Jan Dismas Zelenka's Psalm "Laetatus sum".
To watch an excerpt of the concert, click here.

In Dec. 2009, the sound of the Barbitos, an ancient Greek instrument similar to the double bass, was also reconstructed.

The music was sent across GEANT and TEIN3 networks 9,300 km far from the venue in Stockholm to let dancers from the Arts Exchange of Asia dance in real time in Kuala Lumpur (Malaysia).
To watch the video, click here.



- **The Lost Sounds Orchestra is the ASTRA project orchestra:**
  - It is a unique ensemble all made of reconstructed ancient instruments coming from the ASTRA research activities;
  - It is the first orchestra in the world composed only by reconstructed instruments;
  - It plays sounds being lost in time due to instruments too complex both to build and play;
- **The Lost Sounds Orchestra is currently supported by the following sponsors:**

blue sky

powered by GRISBY MUSIC

Meyer Sound

Focusrite

Bricasti Design

- **The ASTRA project is currently finishing modeling other ancient instruments: the *Chitara*, the *Salpinx* and the *Lyra*.**

2nd Use Case: Data Sonification

- **Data sonification is the representation of data sets by sound signals:**
  - It can be considered as the acoustic counterpart of data visualization;
- **Data sonification is currently used in several fields, for different purposes:**
  - science and engineering;
  - education and training;
- **Although most data analysis techniques are exclusively visual in nature, data presentation and exploration systems could greatly benefit from sonification technique:**
  - Studies have shown that people are quite more confident in recognizing patterns audibly rather than visually.

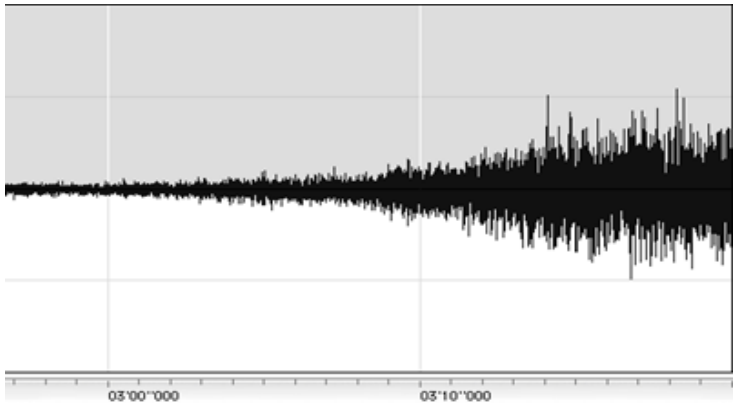
Advantages of Data Sonification

- **Sonic representations are particularly useful when dealing with complex, high-dimensional data, or in data monitoring/pattern recognition tasks where it is practically impossible to use the visual inspection:**
  - It is quite impossible to distinguish a blinking light flashing 100 times a second from another one flashing 200, 1000, or 10000 times a second;
  - It is much easier to recognize and differentiate periodic signals from 20 Hz to (almost) 20000 Hz;

- **Sound can immediately make clear and recognizable transitions between random states and periodic phenomena.**

From theory to practice: sonification of volcanic seismograms

- **Currently, no definitive method to predict volcanic eruptions has either been discovered or implemented;**
- **Data sonification of seismic data aims at:**
  - Discovering a sort of “signature tune” of an imminent eruption:
    - By the identification of musical patterns that might indicate the preparation of an eruption; it would then be possible to implement civil protection measures, hours of even days before the event.



Why does Data Sonification need e-Infrastructures ?

- Converting seismic data into sound waves, through the sonification process, involves substantial computer processing:
  - 1 second long seismic sample generates 120 MB of data, filling a CD in just 6 seconds and a DVD in 40 seconds;
- This amount of information, combined with the complexity of the sonification process, requires dedicated high bandwidth and capacity research networks and advanced Grid infrastructures.

Data Melodisation

- **The melodisation of a data set allows to convert into aural signals almost any kind of information;**
  - Starting from a list of **"m"** elements to be sonified the process provides a list of notes chosen among a set of **"n"** notes;
  - The standard **(Musical Instrument Digital Interface) MIDI** code has been adopted to convert data in notes:

    "C" note corresponds to integer 60;
    "C#" note corresponds to integer 61;
    and so on...
  - The lowest acceptable MIDI value is **0** and the highest is **127**;
  - The number of possible notes is then 128: $\mathbb{Z}_m \longrightarrow \mathbb{Z}_{128}$

«Melodisation» of Mt. Tungurahua

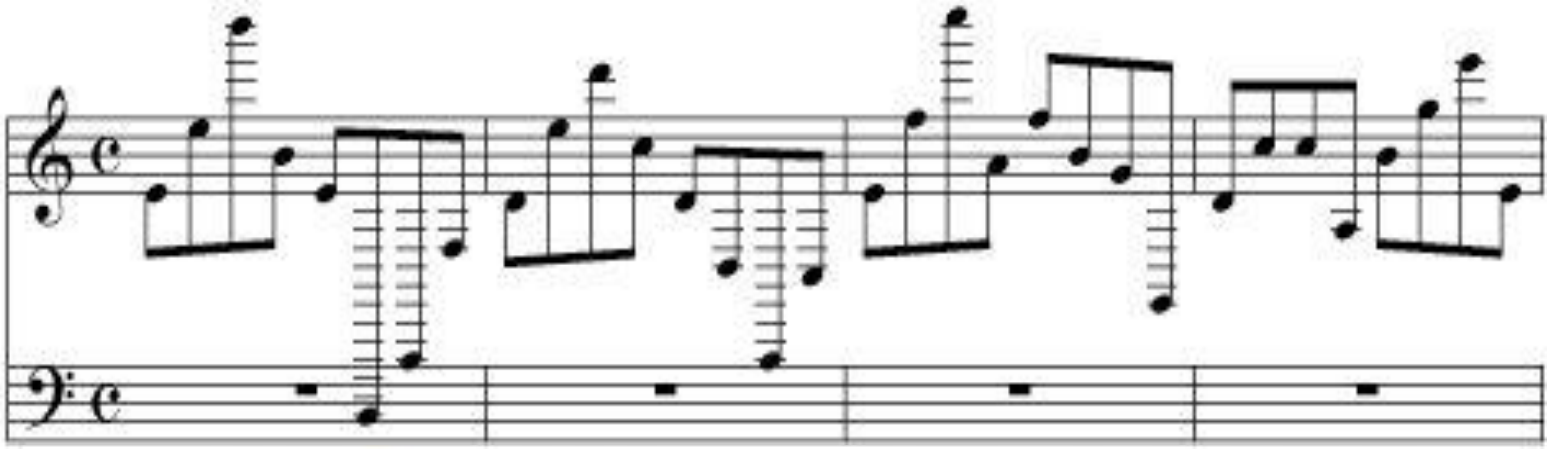
Start from an empty score;

Put a seismogram on it…;

Draw the notes in the pentagram;

… and you get the score!

Have you ever heard a volcano playing a piano ?

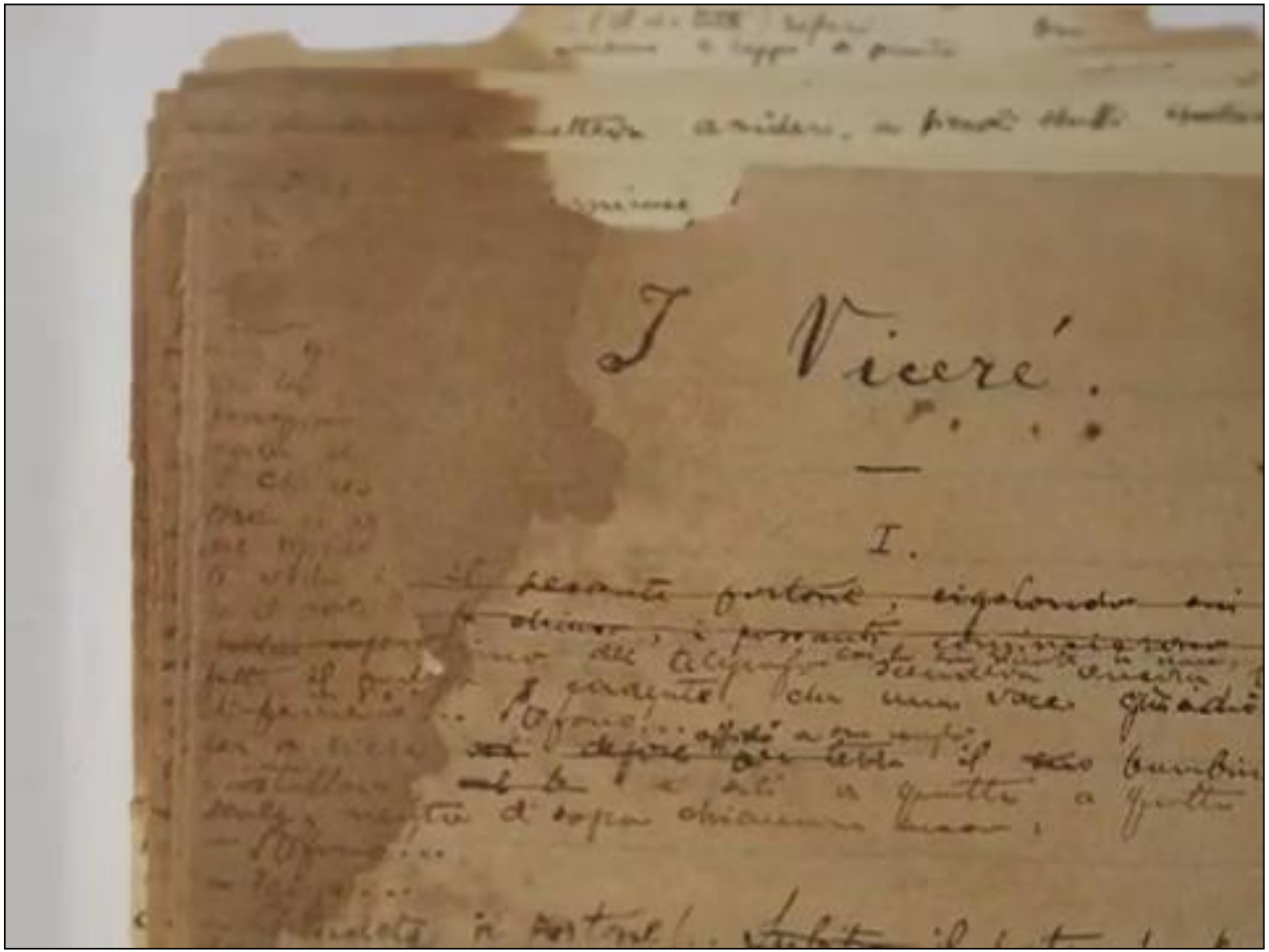


e-Science and Art

- **On the 14th of March 2009 a modern dance company, choreographed by Jason Garcia Ignacio, performed in the US to music generated from seismic data recorded from four different volcanoes belonging to three continents.**

For a short video of the performance click here.

3rd Use Case: Federico De Roberto works



Digitisation phase @ University of Catania

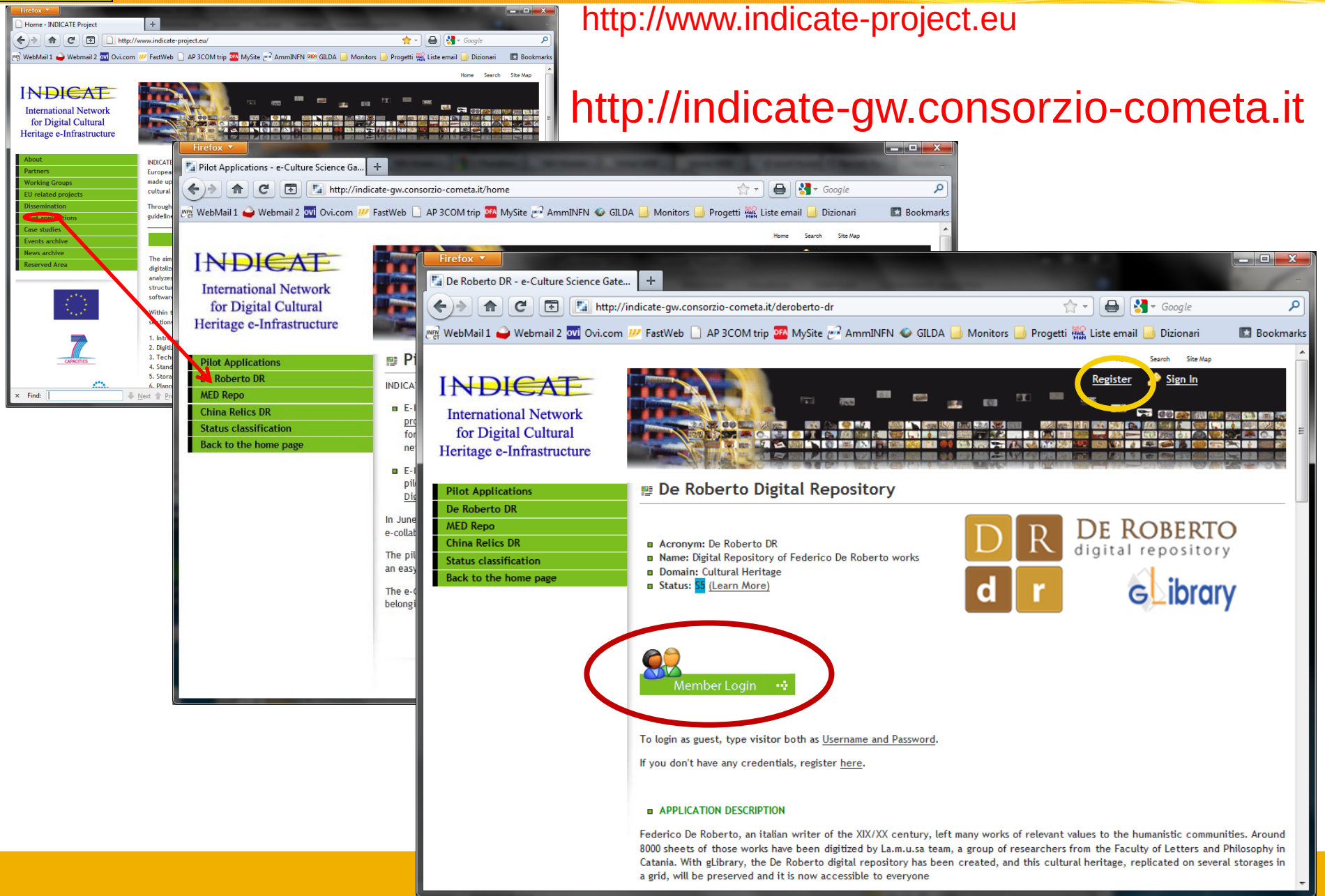
The gLibrary framework
(http://glibrary.ct.infn.it)

- **gLibrary is the INFN/COMETA platform that provides a simple yet powerful system to store, organize, search and retrieve "digital assets" in repositories built on e-Infrastructures**
  - hides the underlying technical details to the users
- **What we mean by "digital asset":**
  - data + metadata

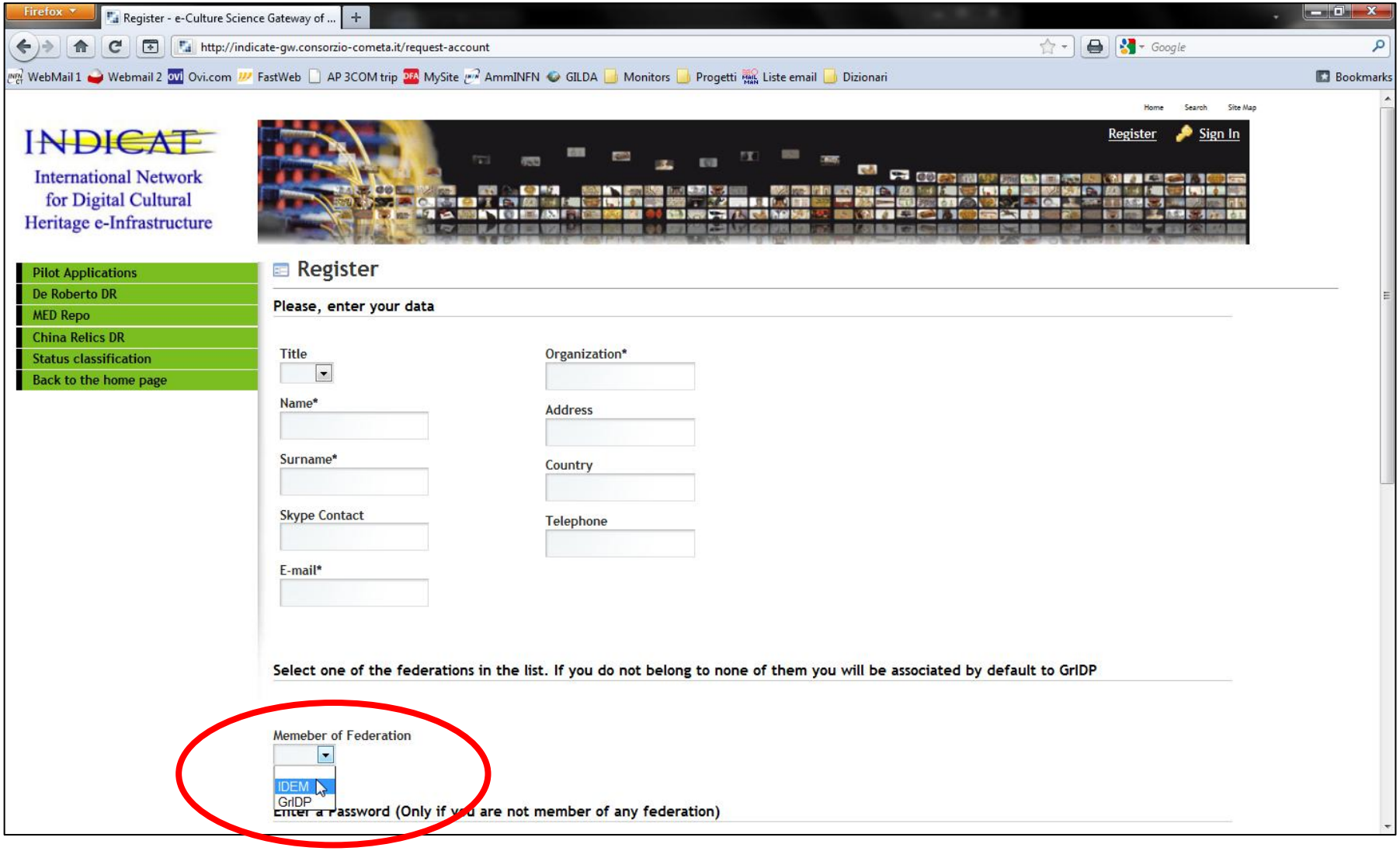
The INDICATE e-Culture Science Gateway (1/7)

http://www.indicate-project.eu

http://indicate-gw.consorzio-cometa.it



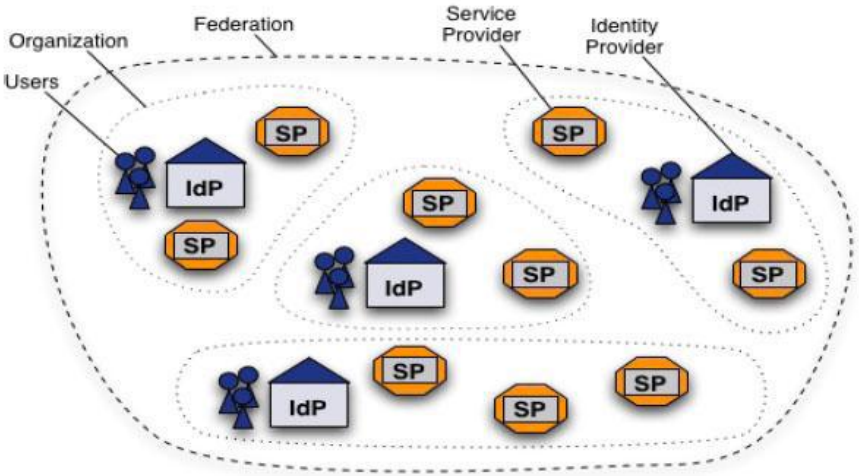
The INDICATE e-Culture Science Gateway (2/7)

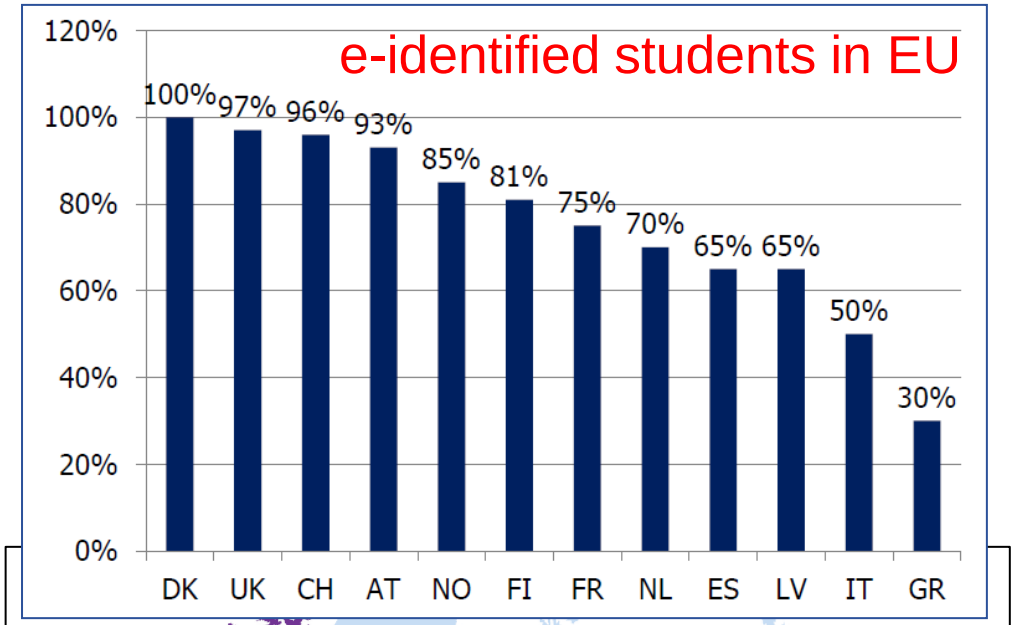


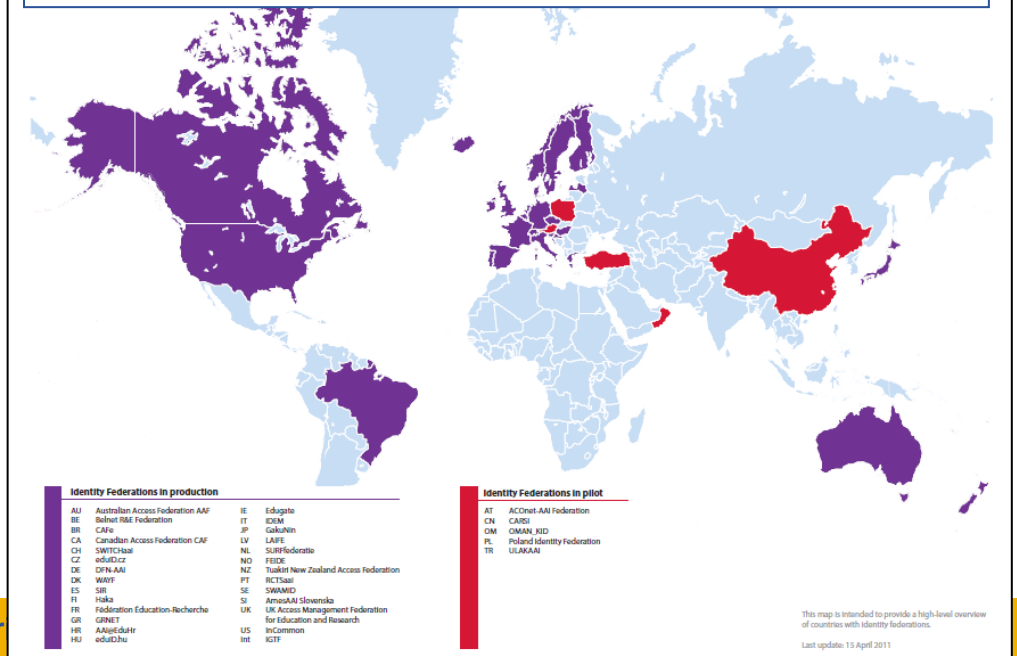
The GARR-IDEM Identity Federation (www.idem.garr.it)

IDEM figures:

- 45 IDentity Providers:
  - 31 in production;
  - 14 in test;
- >2,700,000 end users (as of October 2010);
- ~50% of the Italian higher education & research community







The INDICATE e-Culture Science Gateway

Select an Identity Provider

Shibboleth

Identity Federations' discovery service

The service you are trying to reach requires that you get authenticated. Please, choose from the list below the Federatio
and the Organisation you belong to.

Federation	Organisation
GARR-IDEM	CASPUR
GrIDP	CILEA
All Sites	CINECA
	Consortium GARR sede di Firenze
	Fondazione IRCCS Policlinico San Matteo
	GARR FI idp2
	GARR FI idp21b
	http://fed.amm.unibs.it/fed/idp
	https://idp-shib.unisannio.it/idp/shibboleth
	https://idp.unipi.it/idp/shibboleth

Select | Remember for session

In case of problems, please send an email to *credentials-admin_AT_ct.infn.it* with their description.

Do not bookmark this page!

After login you will be redirected to the web page conta

Identity Provider Catania

INFN IGI

«catch-all» Identity Provider

Login Page

In order to use this service of the portal https://indicate-gw.consorzio-cometa.it, please enter below the credentials provided to you by the IDPCT Identity Provider:

User barbera

Password •••••••

Login

Lost/forgotten Credentials

If you have lost or forgotten your credentials, please send an email to *credentials-admin_AT_ct.infn.it*

Do not bookmark this page!

After login you will be redirected to the web page containing the service of the portal you wanted to use.

Shibboleth

Shibboleth Identity Provider Login to Service Provider https://indicate-gw.consorzio-cometa.it /shibboleth

Existing Session: false
Requested Authentication Methods: []
Attempting Authentication Method: urn:oasis:names:tc:SAML:2.0:ac:classes:PasswordProtectedTransport
Is Forced Authentication: false

Username: test1

Password: •••••

Login

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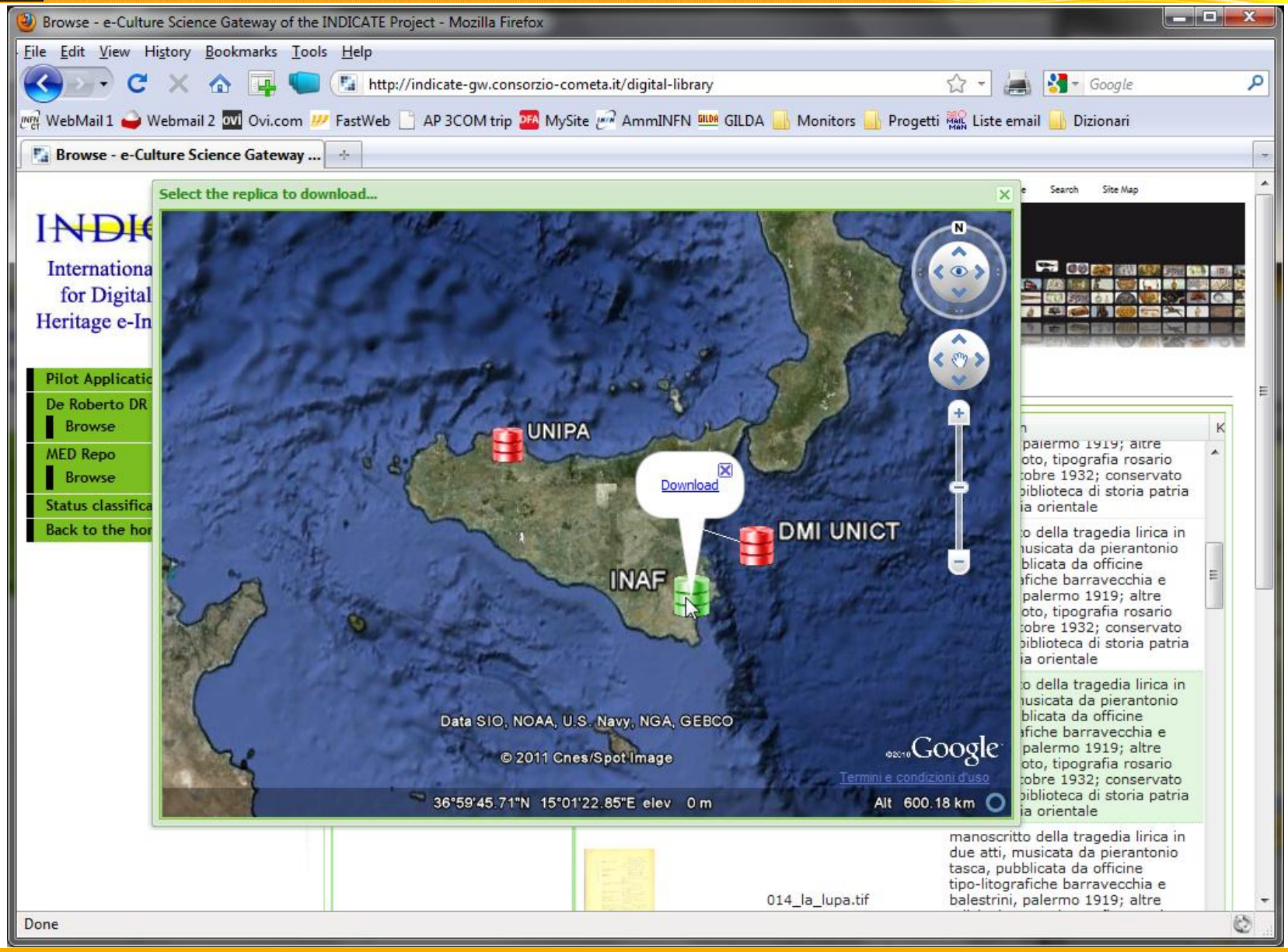
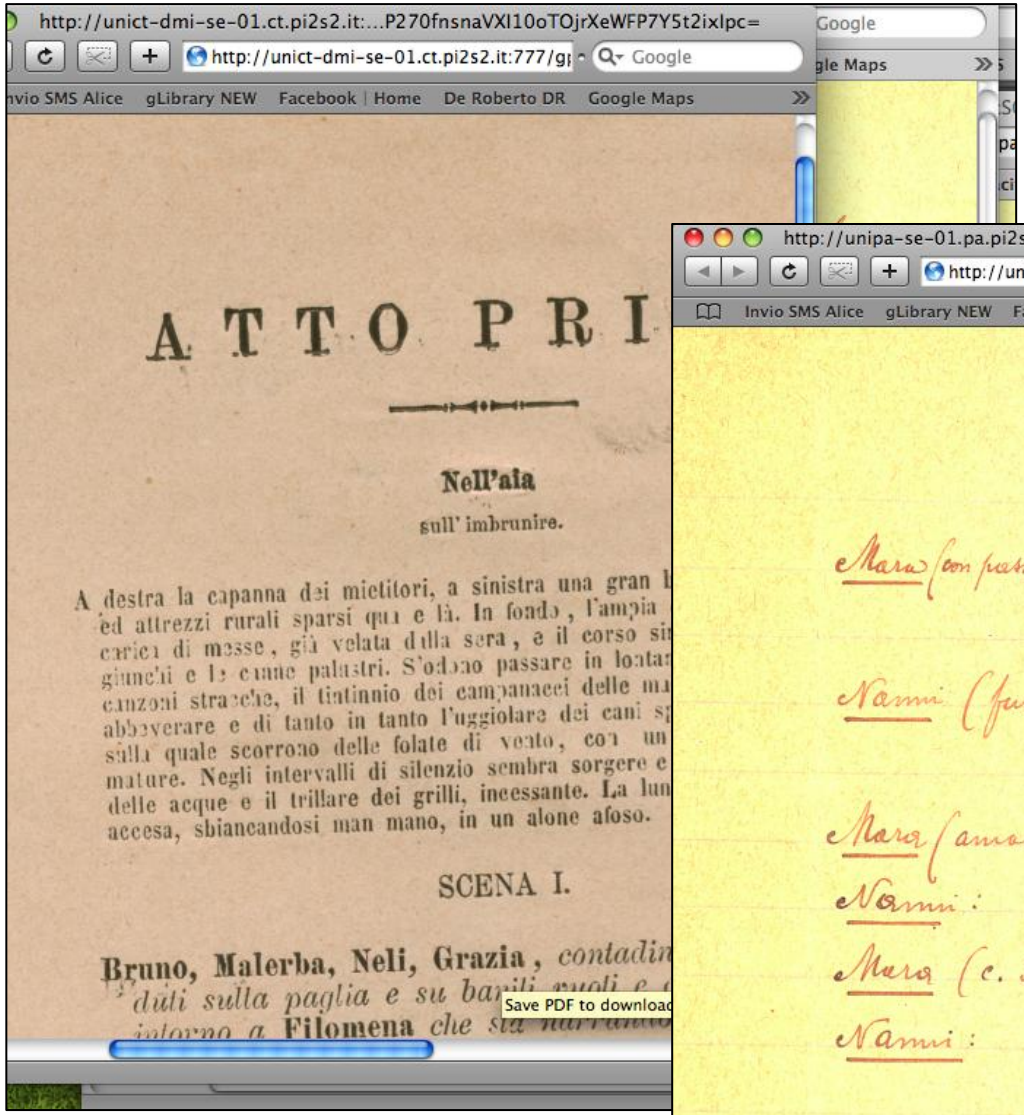
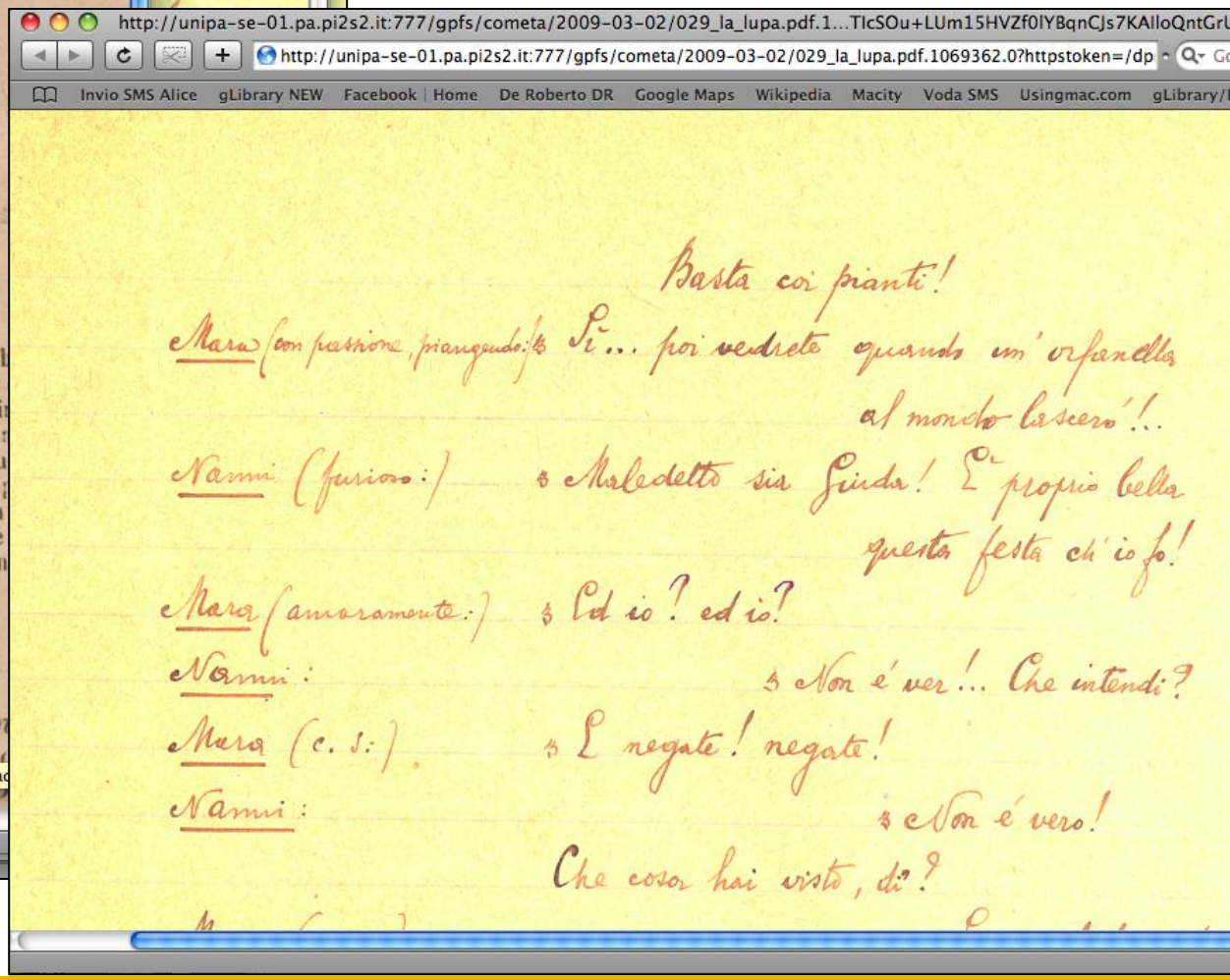
The INDICATE e-Culture Science Gateway (4/7)

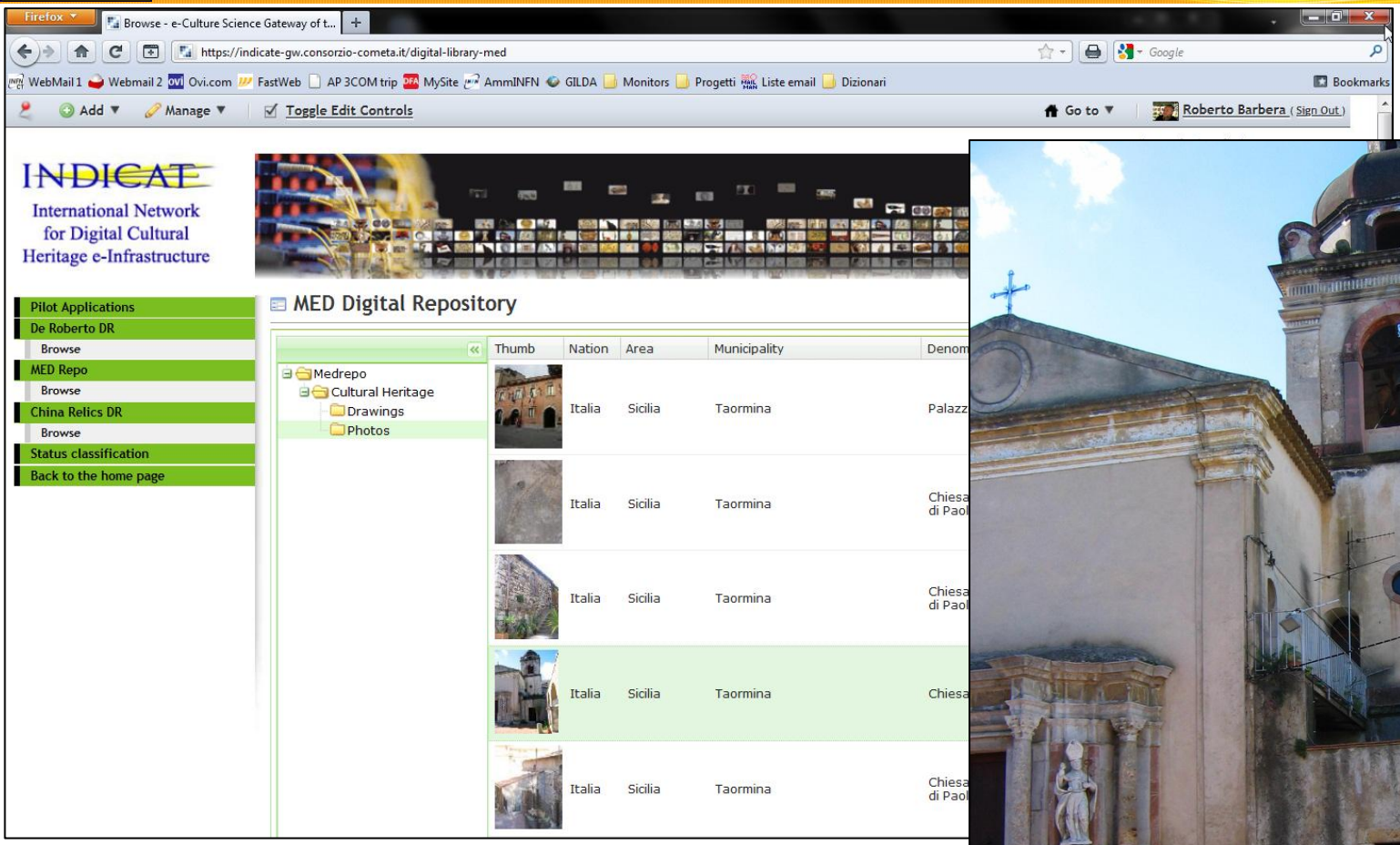


The INDICATE e-Culture Science Gateway (5/7)





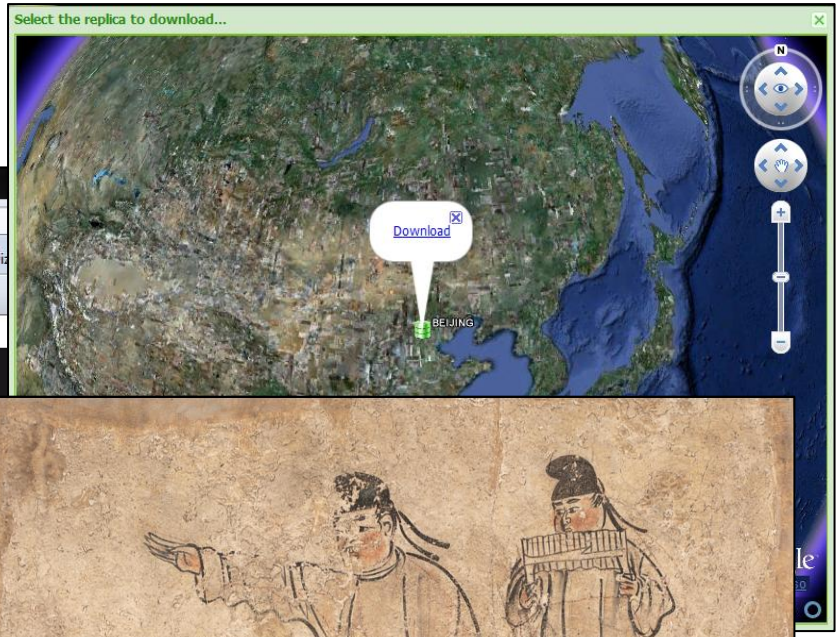
The INDICATE e-Culture Science Gateway (6/7)



The INDICATE e-Culture Science Gateway (7/7)

Thanks to the collaboration with

EPIKH



Firefox | Browse - e-Culture Science Gateway of t... | https://indicate-gw.consorzio-cometa.it/digital-library-chinarelics

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INDICATE
International Network for Digital Cultural Heritage e-Infrastructure

- Pilot Applications
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- China Relics DR
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- Status classification
- Back to the home page

China Relics Digital Repository

China Relics
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  - 壁画

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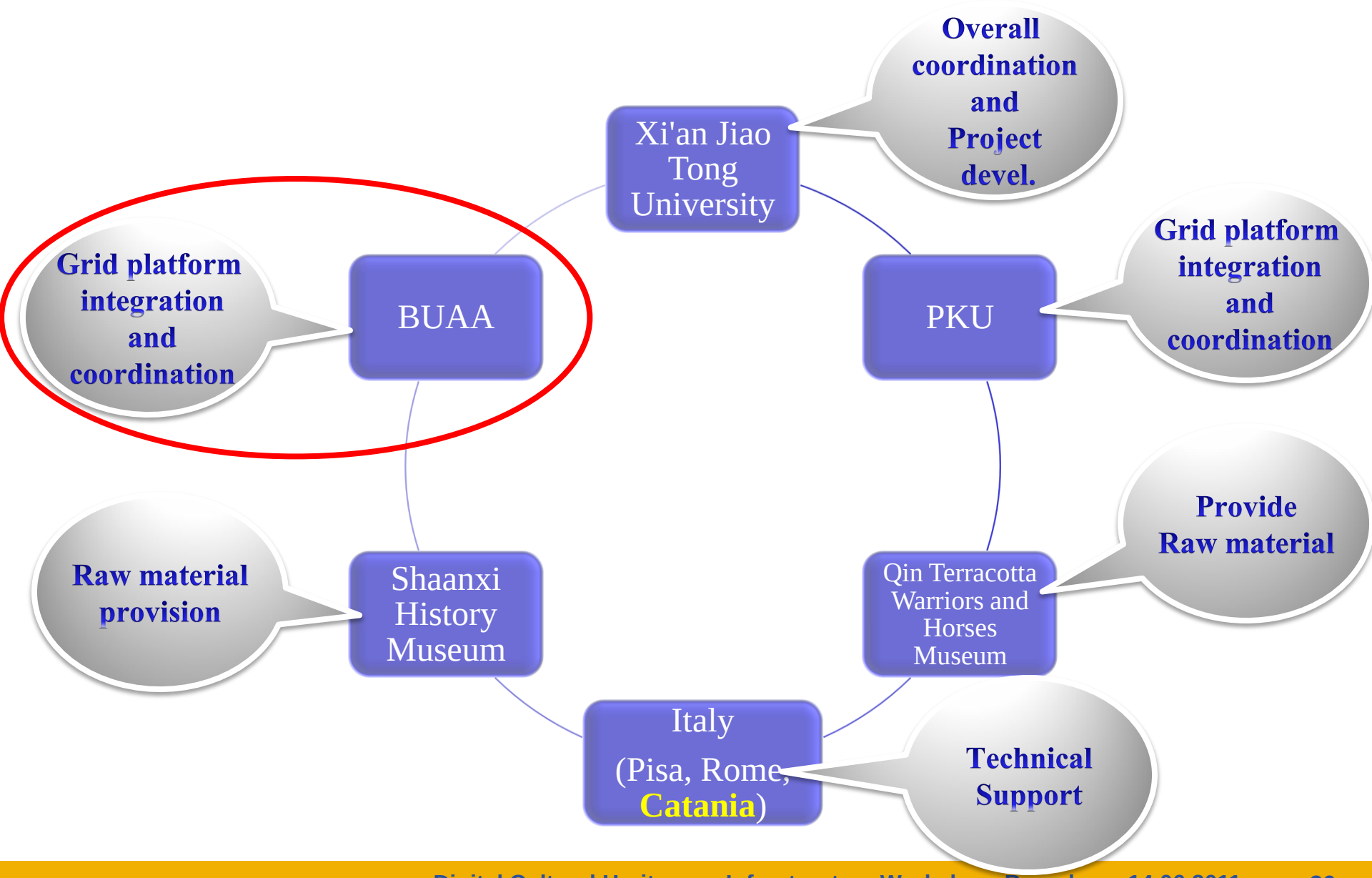
	2	唐安公主墓男侍图
	3	苏思勖墓舞蹈图
	4	马球图
	5	李凤墓侍女图

Partners of the Joint Chinese-Italian Research Infrastructure for Cultural Heritage



- **Mobile interface to access Grid Digital Libraries:**
  - *iPhone, iPod Touch, iPad;*
- **Advantages:**
  - provides an extremely intuitive and touch-based user interface to Grid storage elements and metadata, especially for non-expert users;
  - (to do) automatic selection of the closest replica, according to the user physical location retrieved by the integrated GPS;
  - offline access to the assets already downloaded.

(In collaboration with Dr. C. Pistagna, Univ. of Catania)

Some s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Summary and Conclusions

- e-Infrastructures are key enablers of the e-Science done by multi-disciplinary collaborations referred to as Virtual Organisations or Virtual Research Communities;

- They can be very beneficial platforms for Arts, Digital Cultural Heritage and Humanities in general;

- If any of you is interested in the tools/activities described in this presentation, I would be very happy to discuss possible collaborations.

Thank you for your kind attention !

Any questions ?

References (1/2)

- **The ASTRA Project**
  - Download examples
- **The Physical Modeling Synthesis**
- **The Research Networks:**
  - GEANT
  - EUMEDCONNECT2
- **The Grid Infrastructures:**
  - EUMEDGRID
  - GILDA
- **Etna Sonification website**
  - Download examples
- **CityDance Ensemble**
- **MIDI Toolbox manual**

References (2/2)

- **gLibrary contacts:**
  - antonio.calanducci@ct.infn.it, glibrary@ct.infn.it
- **Federico De Roberto repository:**
  - https://glibrary.ct.infn.it/
- **Videos:**
  - http://www.youtube.com/watch?v=VNN3OnpmUUU
  - http://www.youtube.com/watch?v=IhFFjHD8IsI
- **Publications:**
  - A.Calanducci, R.Barbera, J.Sevilla, A. De Filippo, M.Saso, S. Iannizzotto, F. De Mattia, F.Vicinanza. "Data Grids for Conservation of Cultural Inheritance", 1st International Workshop on Data Grids for e-Science (DaGreS09) at ACM International Conference on Computing Frontiers, May 18-20, 2009 (http://www.computingfrontiers.org/2009/)
    - https://glibrary.ct.infn.it/m/DaGRes-editor.pdf
  - A. Calanducci, C. Cherubino, L. N. Ciuffo, D. Scardaci, "A Digital Library Management System for the Grid", Fourth International Workshop on Emerging Technologies for Next-generation GRID (ETNGRID 2007) at 16th IEEE International Workshops on Enabling Technologies: Infrastructures for Collaborative Enterprises (WETICE-2007), GET/INT Paris, France, June 18-20, 2007 (http://etngrid.diit.unict.it/2007/index.html).
    - https://glibrary.ct.infn.it/glibrary/downloads/gLibrary_paper_v2.pdf