The Grid Services of Consorzio COMETA for Industry

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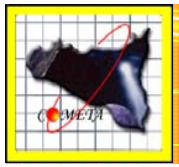
Istanbul, 22.09.2008



Outline

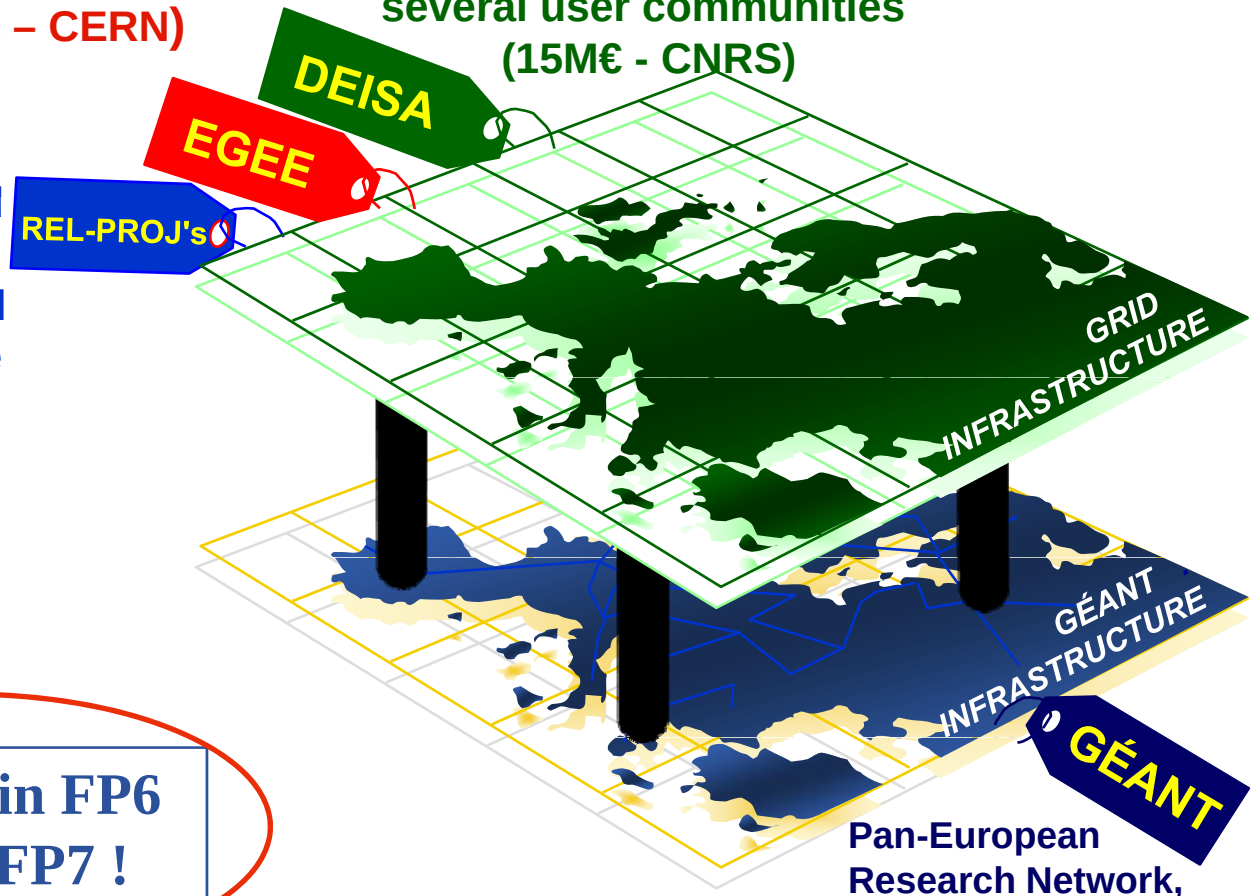
- Grid & Industry
- The Sicilian e-Infrastructure and its Grid services
- Examples of industrial/commercial applications
- Summary and conclusions

The European e-Infrastructure today…

Production quality Grid, HEP, Biomed..., int. links (67M€ – CERN)

Grid of EU supercomputers networked at Gbps, focus on global filing systems,>40 Tflop/s, several user communities (15M€ - CNRS)

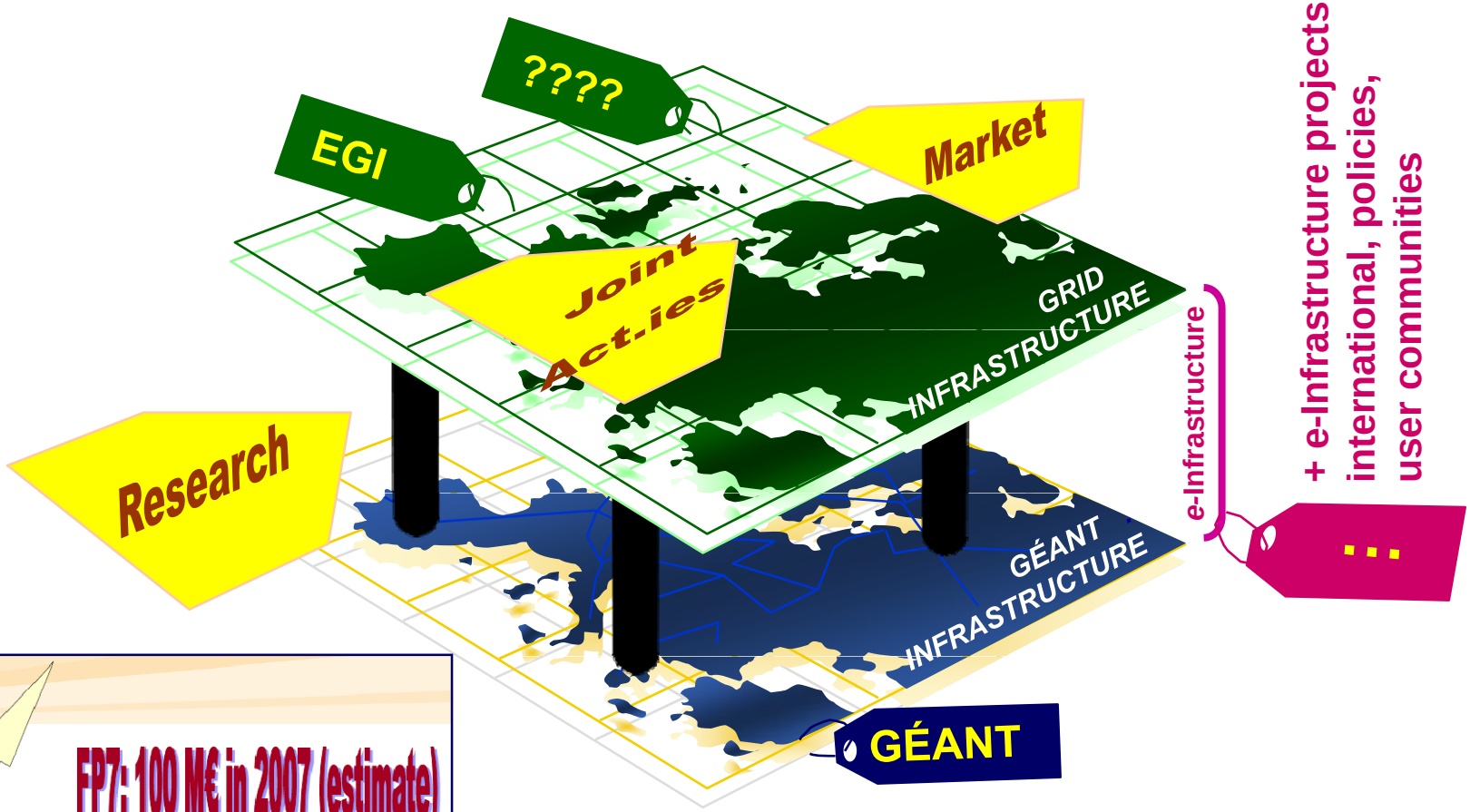
EGEE Related projects co-vering several regions of the world

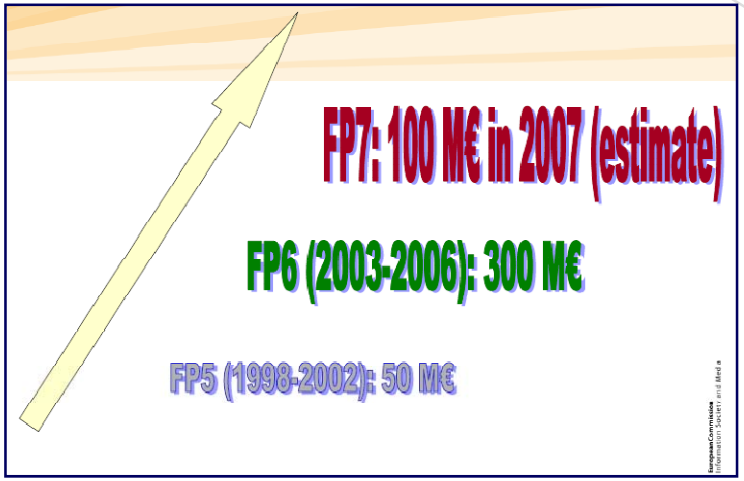


- 300 M€ in FP6
- 4 G€ in FP7 !

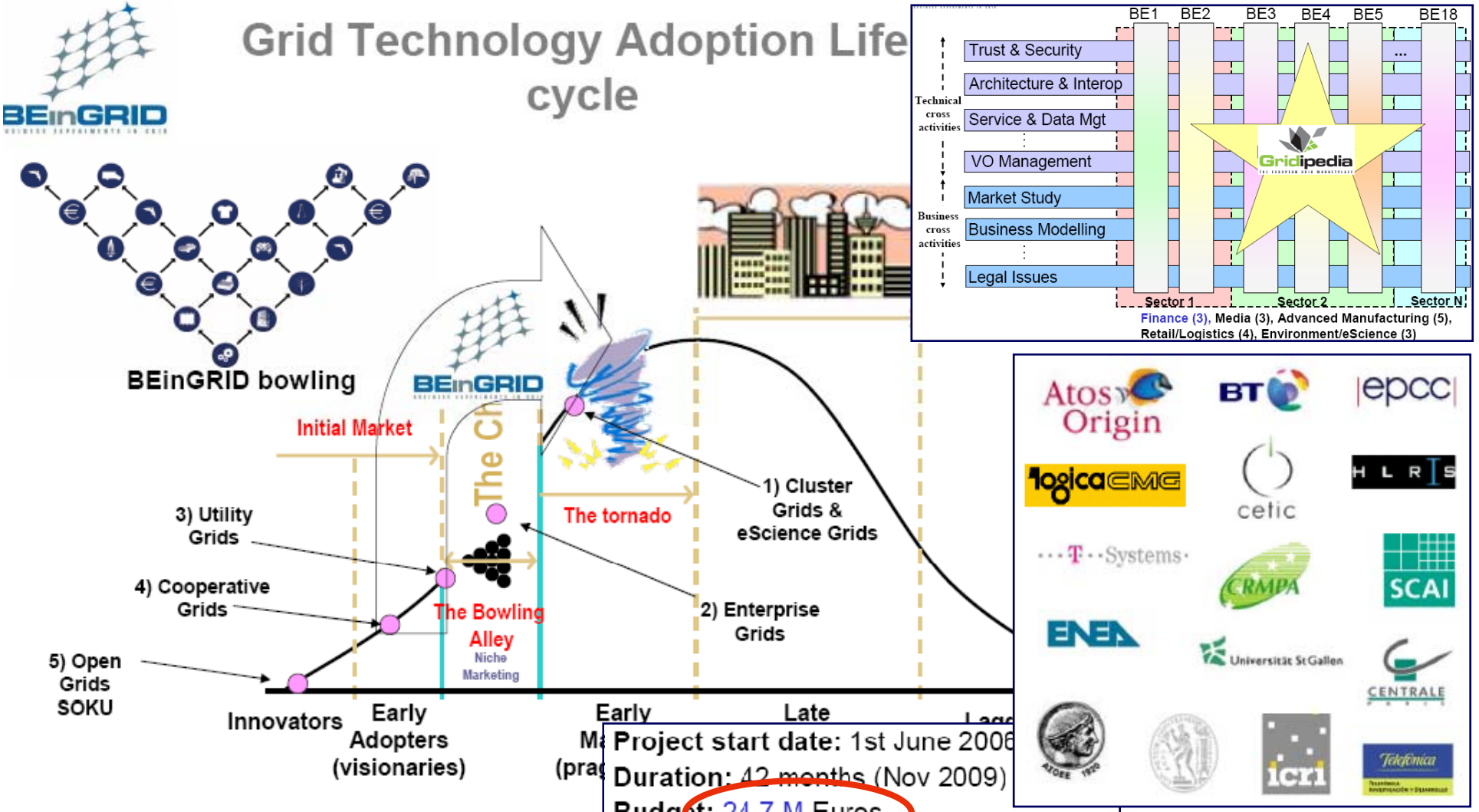
Pan-European Research Network, 3900 inst., 30+ million users, 40+ countries (~100 M€ - DANTE)

...and tomorrow ?



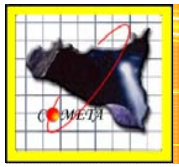


Grid & Industry: a concrete example



Project start date: 1st June 2006
Duration: 42 months (Nov 2009)
Budget: 24.7 M Euros
Max EC contribution: 15.7 M euros
Effort: 2713 PM (226 PY, 65 P, 360.000h)
Consortium: 77 partners (+10 additional)
Website: www.beingrid.eu

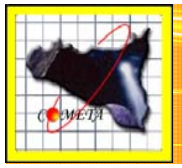
Coordinator: Atos Origin



Things are however not so easy...

- **The adoption of Grid technology by Industry is slower than it could be (and than what happened with the web 15 years ago)**

- **Recent surveys (conducted also by EGEE) confirm that the most important "brakes" are:**
  - **Security**
    - Strict ACLs and strong "privacy" rules for sensible data;
  - **Standards**
    - Their adoption would encourage long term investments
  - **Training**
    - Need of a formative offer "tailored" for the business world
  - **Management of commercial software licences**
    - Usage control and protection of revenues of commercial software providers



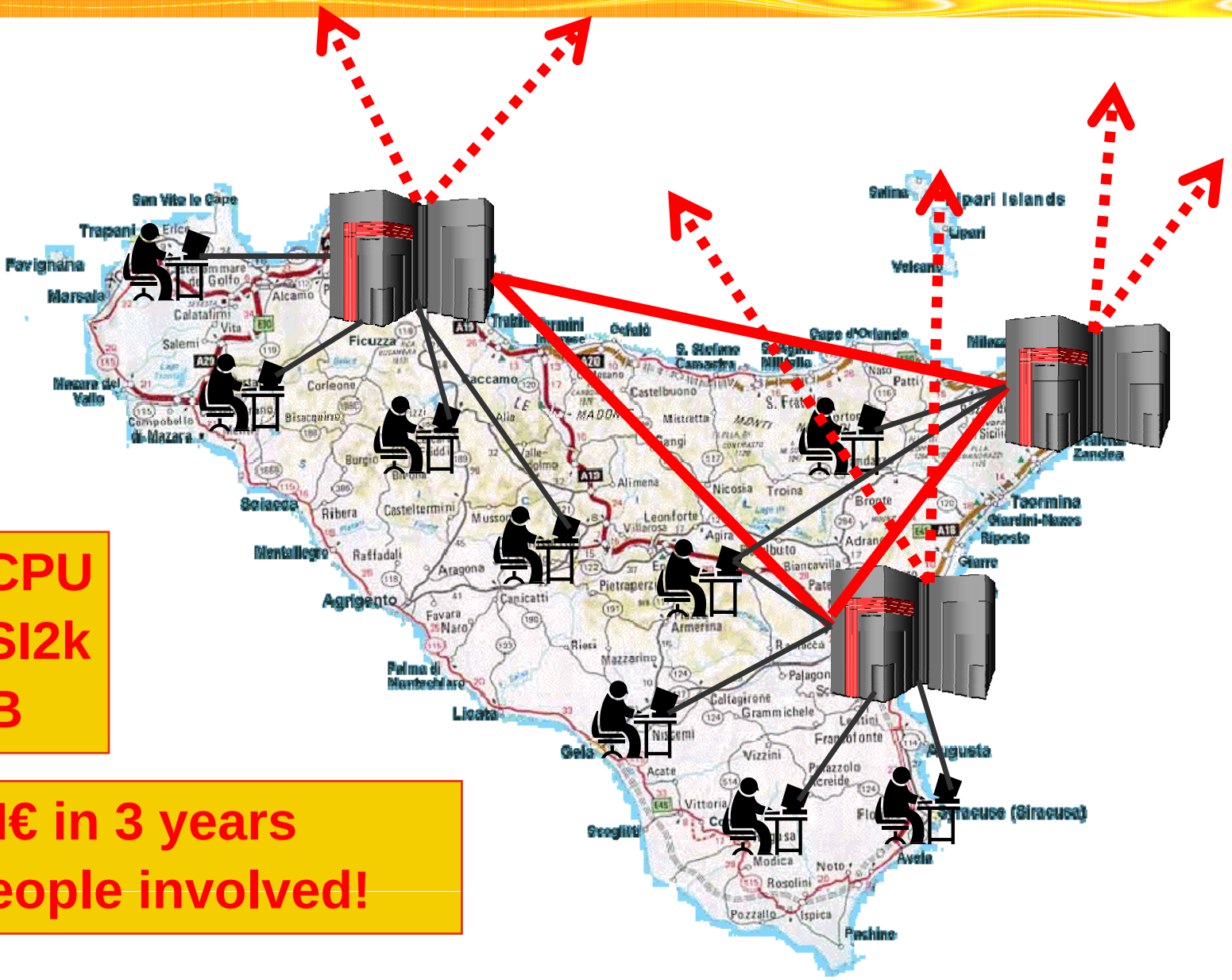
Objectives of an e-Infrastructure in Sicily

- Create a Virtual Laboratory in Sicily, both for scientific and industrial applications, built on top of a Grid infrastructure and with a special support for HPC
- Connect the Sicilian e-Infrastructure to those already existing in Italy, in Europe, and in the rest of the world improving the scientific collaboration and increasing the "competitiveness" of e-Science and e-Industry *"made in Sicily"*
- Disseminate the *"grid paradigm"* through the organization of dedicated events and training courses
- Trigger/foster the creation of spin-offs in the ICT area in order to reduce the *"brain drain"* of brilliant young people to other parts of Italy and beyond

The COMETA Consortium

(www.consorzio-cometa.it)

The Sicilian Grid in one slide…



~2000 CPU
~3.2 MSI2k
~250 TB

~11.3 M€ in 3 years
>270 people involved!

The Sicilian e-Infrastructure (1/2)

The Sicilian e-Infrastructure (2/2)

Computing and Storage resources available

1. ~2000 cores AMD Opteron 2218 rev. F
2. 2 GB of RAM per core
3. Commercial LRMS (LSF)
4. Infiniband-4X (for MPI applications)

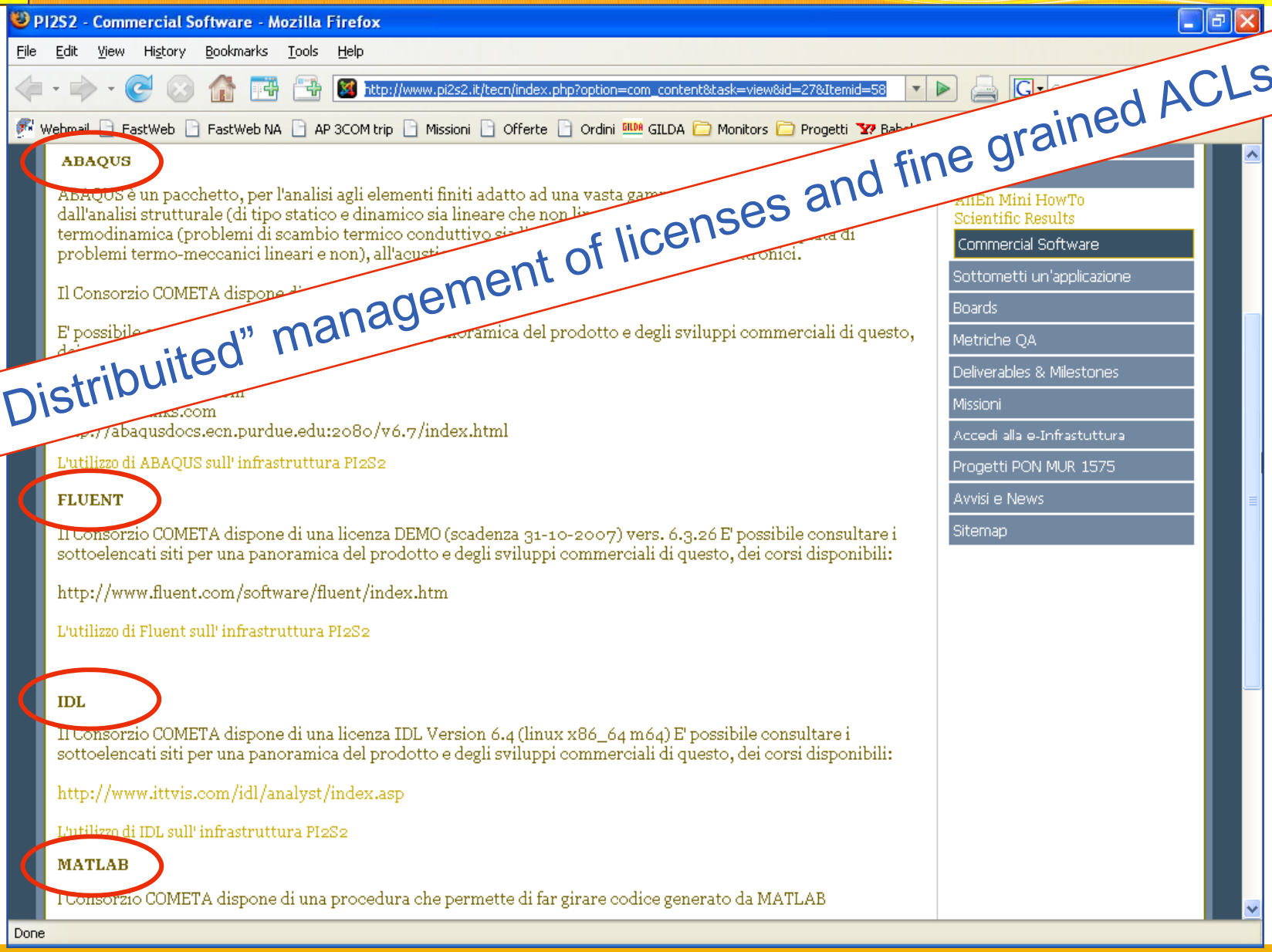
gLite 3.1 as Grid middleware everywhere.
A deliberate investment on a "de facto" standard.
Vendors taught to install and configure it.

1. ~250+ TB of storage
2. Distributed parallel filesystem (GPFS)

Usage of the Sicilian e-Infrastructure

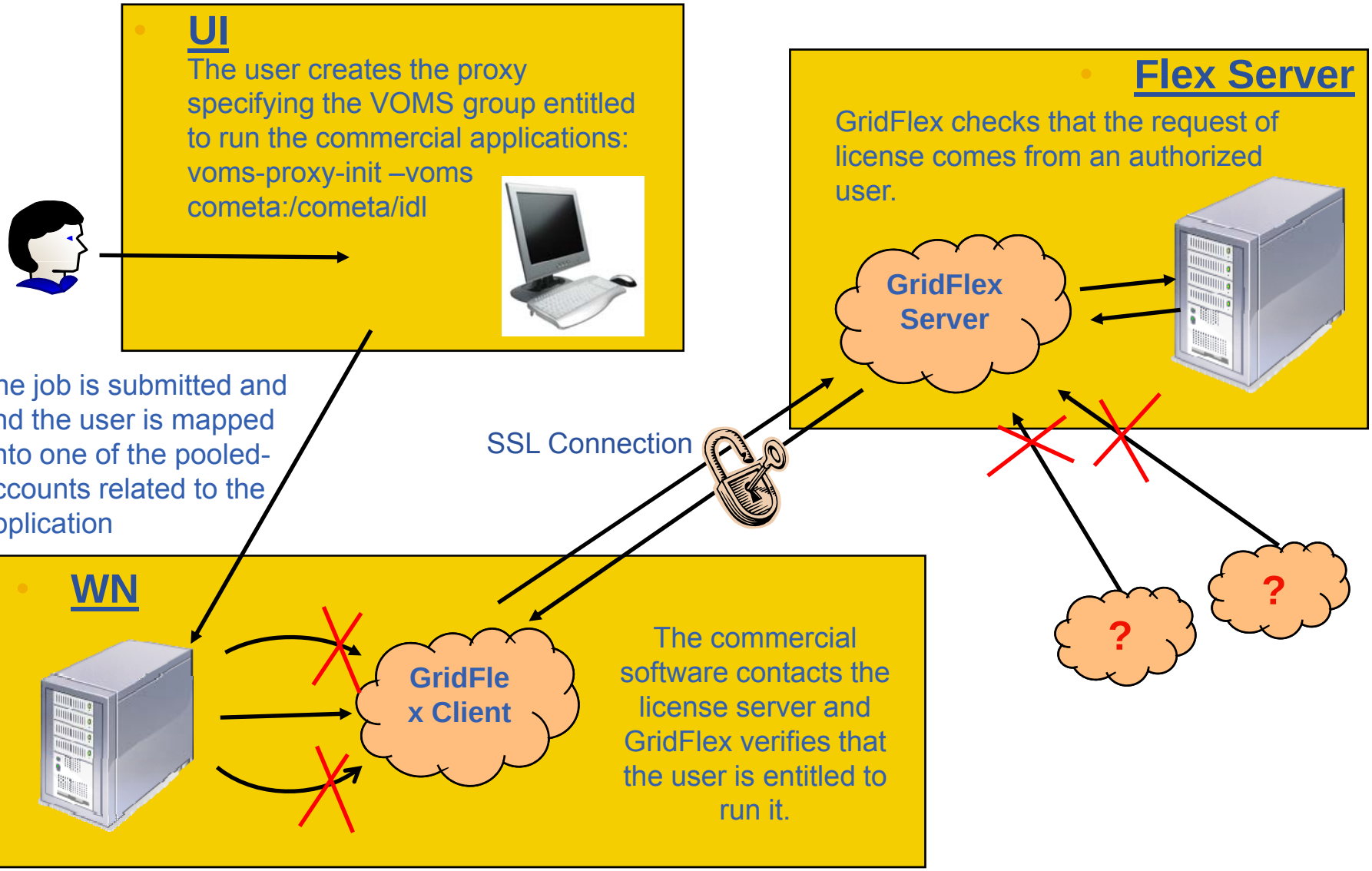
Commercial Software Available

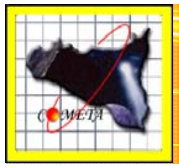
(www.pi2s2.it/tecn/index.php?option=com_content&task=view&id=27&Itemid=58)



"Distributed" management of licenses and fine grained ACLs

GridFlex (1/2)


UI
The user creates the proxy specifying the VOMS group entitled to run the commercial applications:
voms-proxy-init –voms cometa:/cometa/idl
Flex Server
GridFlex checks that the request of license comes from an authorized user.
GridFlex Server
The job is submitted and and the user is mapped onto one of the pooled-accounts related to the application
SSL Connection
WN
GridFle x Client
The commercial software contacts the license server and GridFlex verifies that the user is entitled to run it.
?
?



GridFlex (2/2)

1. **What is it ? What is it not ?**
   GridFlex is NOT a license manager but a tool that implements a license server (e.g. Flexlm) with the Grid Security Infrastructure (certificates, proxies, etc.) and the VOMS extensions (groups, roles, etc.);

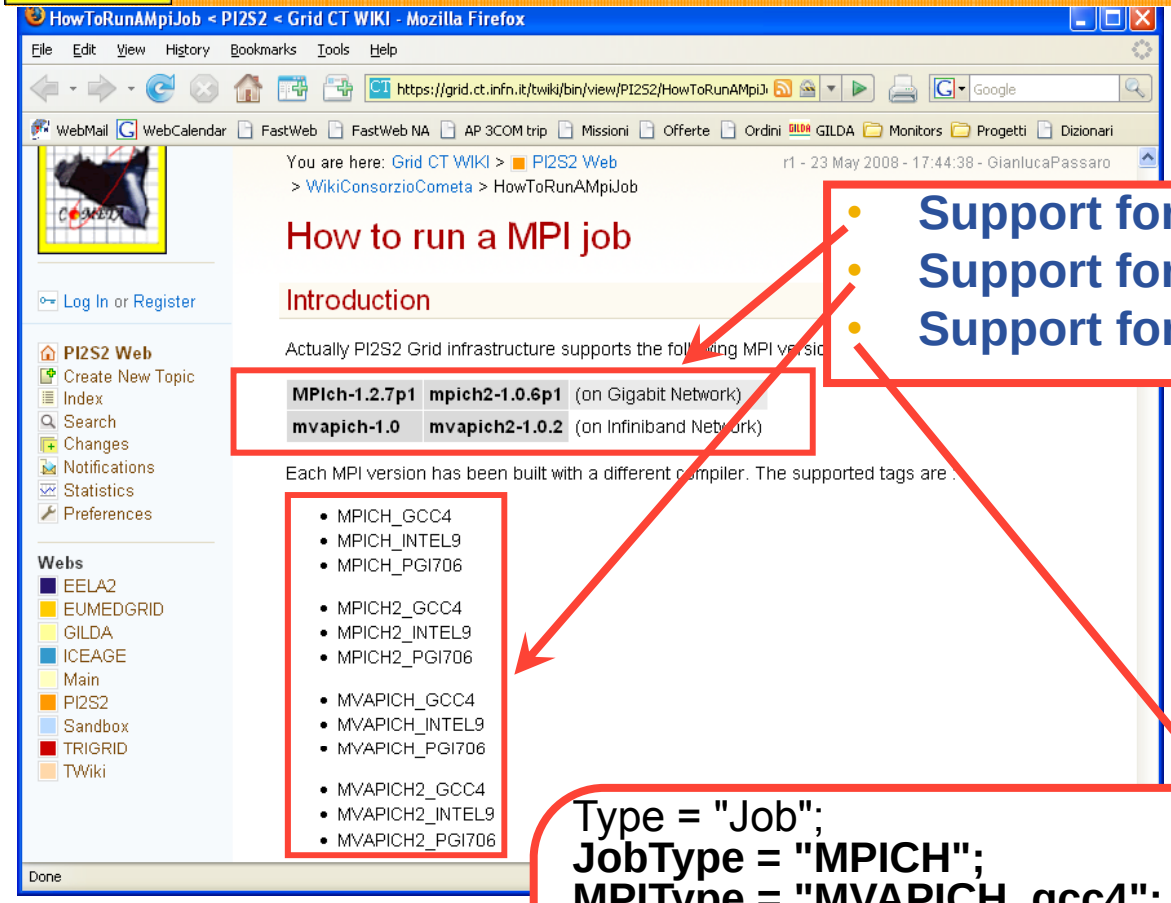
2. **Why to use it ?**
   Because the actual license servers can not be used in a Grid environment. GridFlex opens e-Infrastructures to commercial software and allows external users to use their own licenses “on demand” on business-oriented e-Infrastructures.

Other Grid Services available on the Sicilian Grid

1. Full support for MPI-1 and MPI-2 applications;
2. Transactional frameworks for the creation and management of digital repositories;
3. Grid portals for “clouds”;
4. QoS and SLA in Grid
   (see A. Puliafito talk tomorrow afternoon in the session “Business models and Grid environments – SME perspectives”);
5. Porting of gLite to MS Windows;
6. Secure Storage (encrypted);
7. Storage accounting

Grid & HPC in COMETA (1/2)

(grid.ct.infn.it/twiki/bin/view/PI2S2/HowToRunAMpiJob)

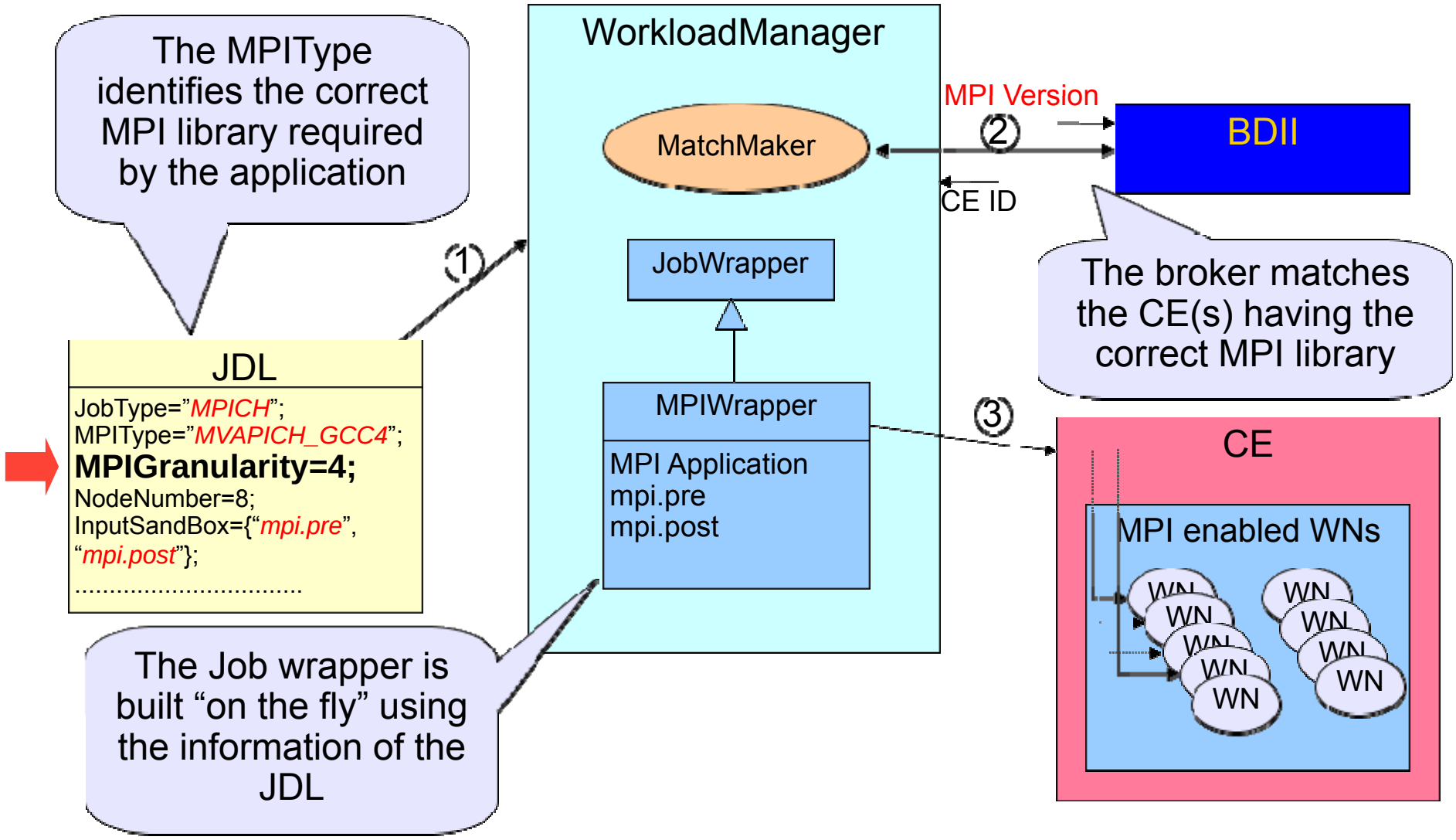


- **Support for Gigabit and Infiniband networks**
- **Support for GCC, Intel and PGI compilers**
- **Support for gLite 3.1**

```
Type = "Job";
JobType = "MPICH";
MPIType = "MVAPICH_gcc4";
NodeNumber = 12;
Executable = "mergesort-ib1-gcc4";
StdOutput = "mpi.out";
StdError = "mpi.err";
InputSandbox = {"mergesort-ib1-gcc4","mpi.pre.sh","mpi.post.sh"};
OutputSandbox = {"mpi.err","mpi.out"};
RetryCount = 1;
```

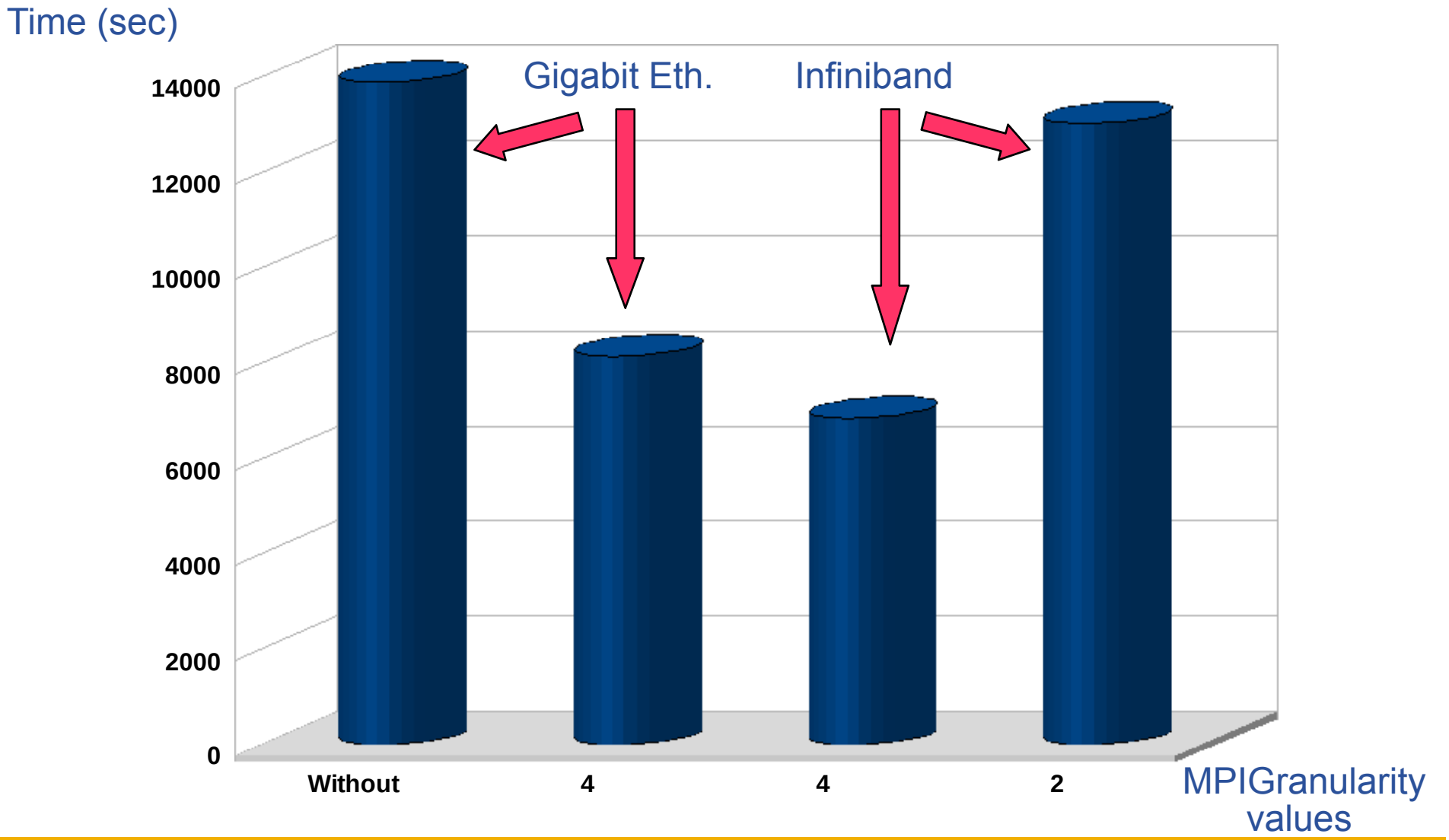
gLite 3.1

Grid & HPC in COMETA (2/2)
(The Architecture)

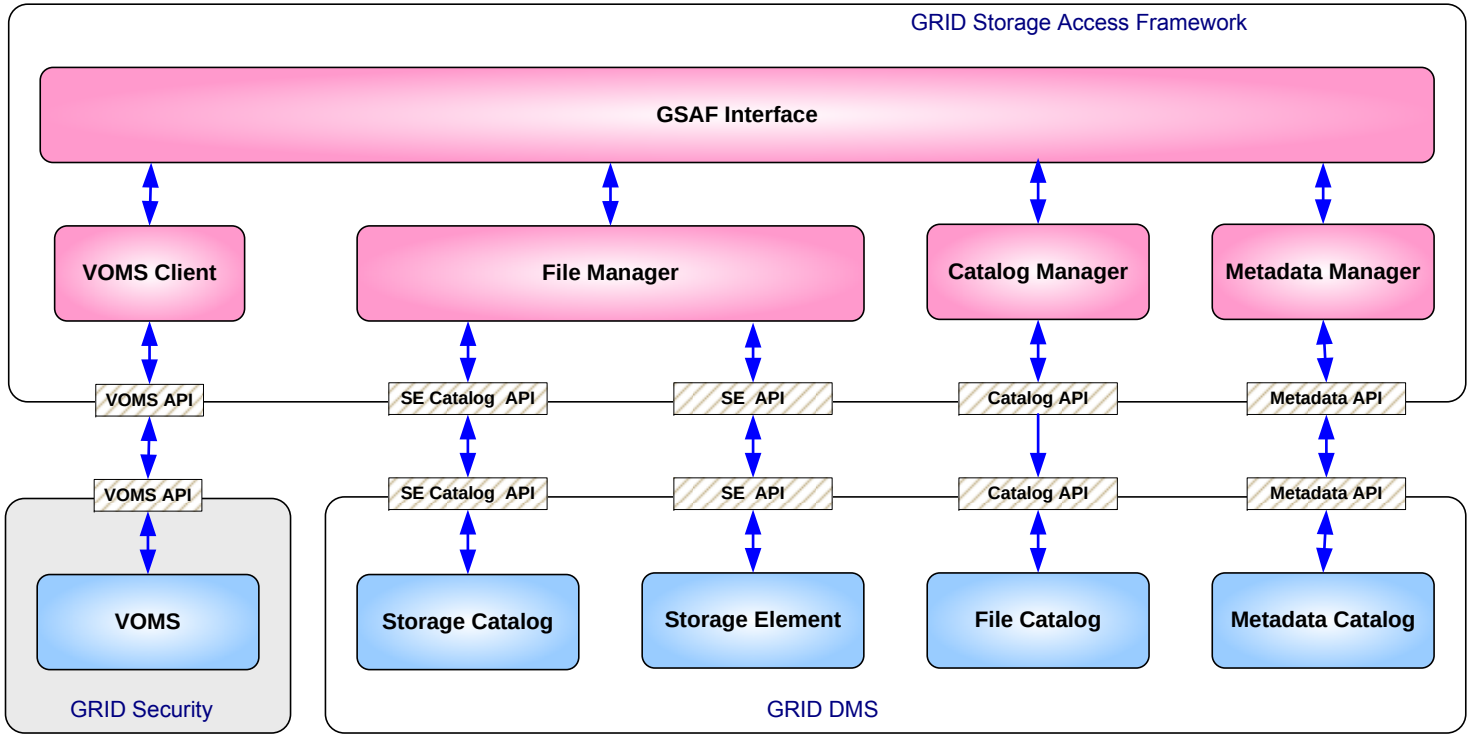


Effect of MPIGranularity

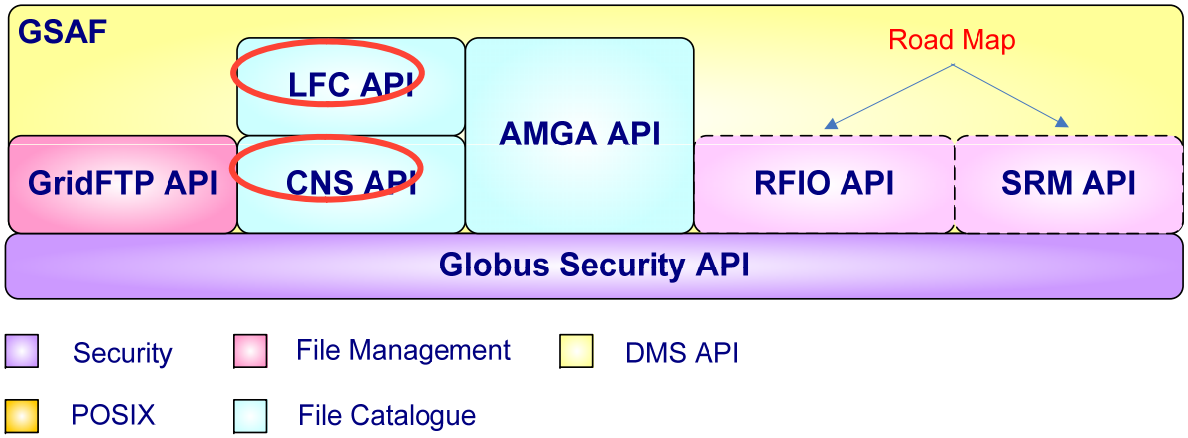
Execution of Fluent on the COMETA infrastructure



Grid Storage Access Framework - (1/3) The Logical Architecture

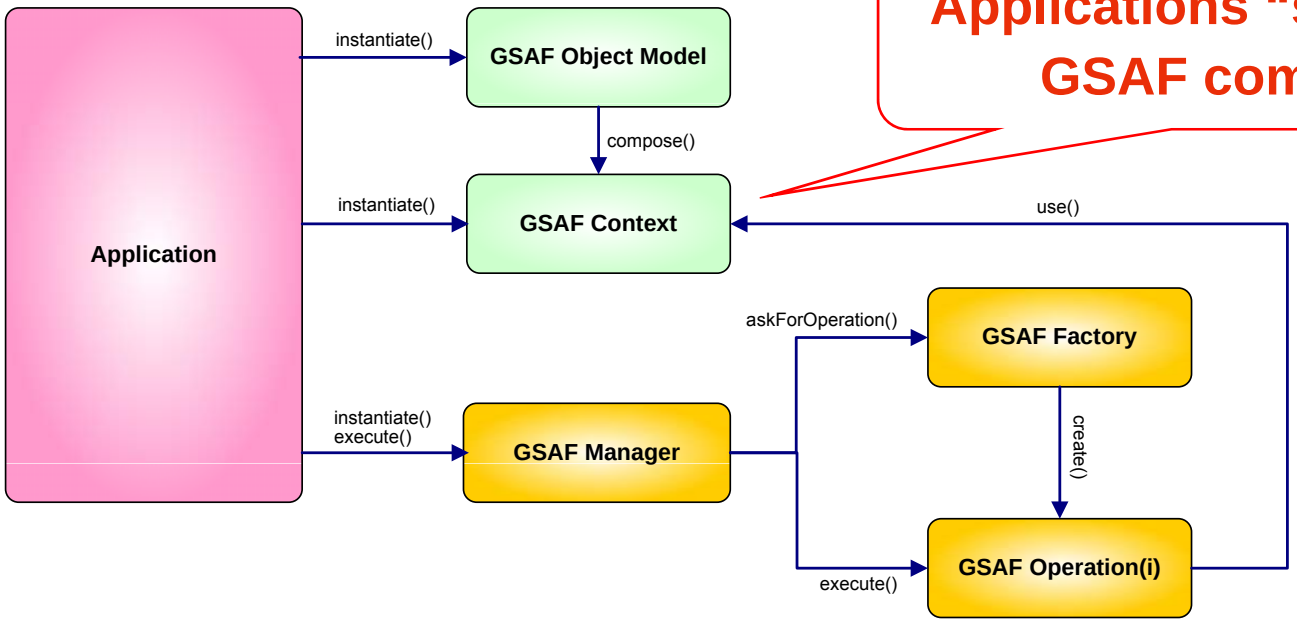


Pure Java implementation

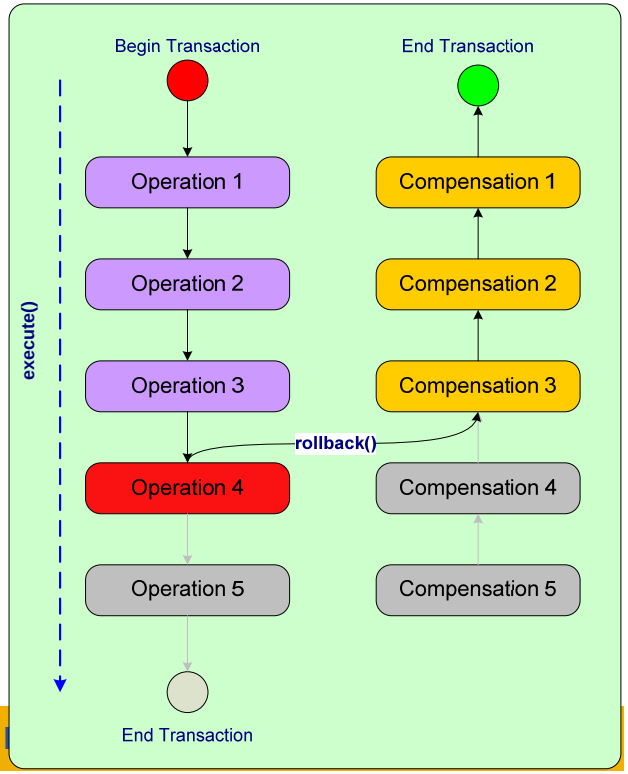


Grid Storage Access Framework - (2/2) Software Model and Transactionality

Applications "see" only GSAF components

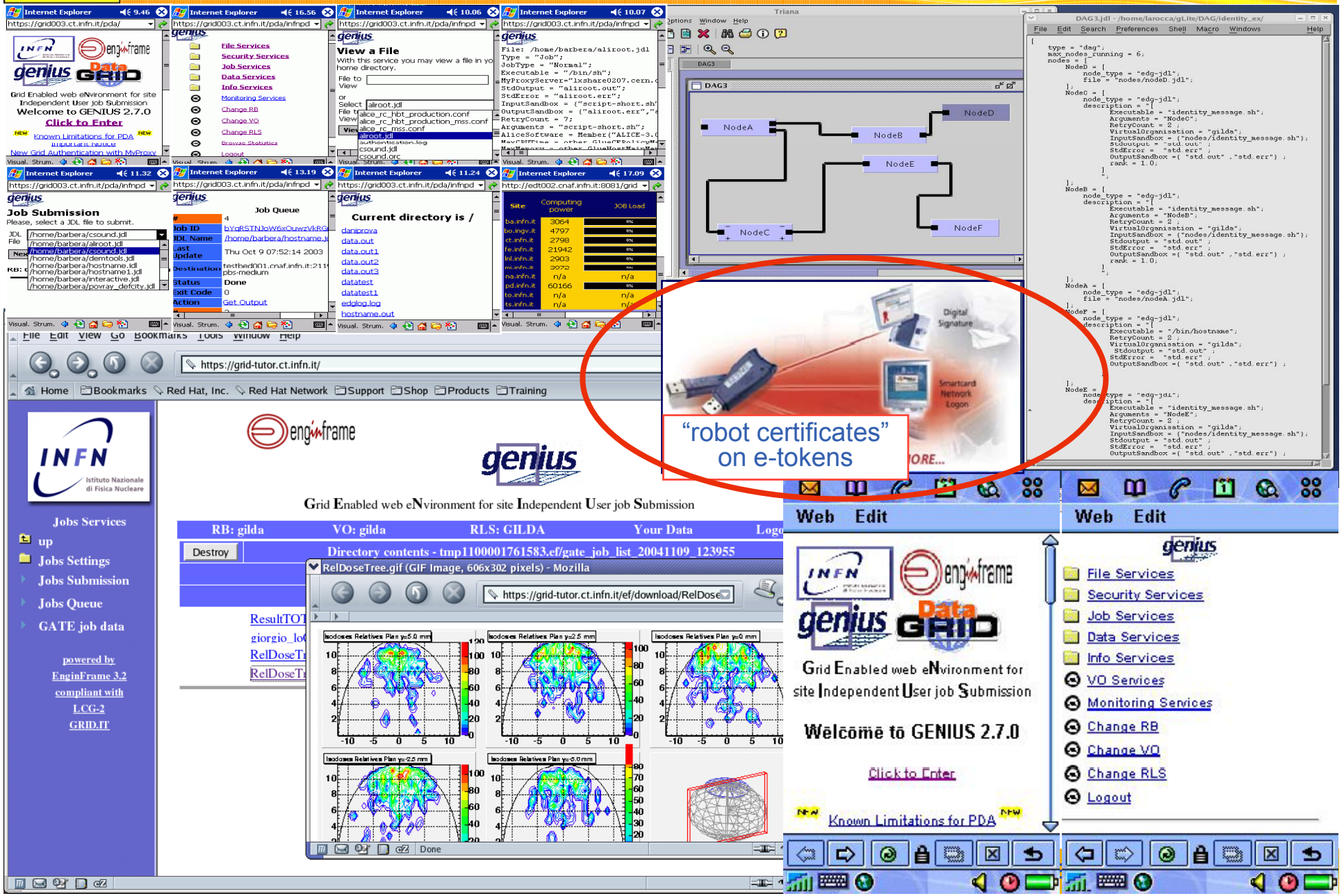


SAGAS Transaction Model with Compensations

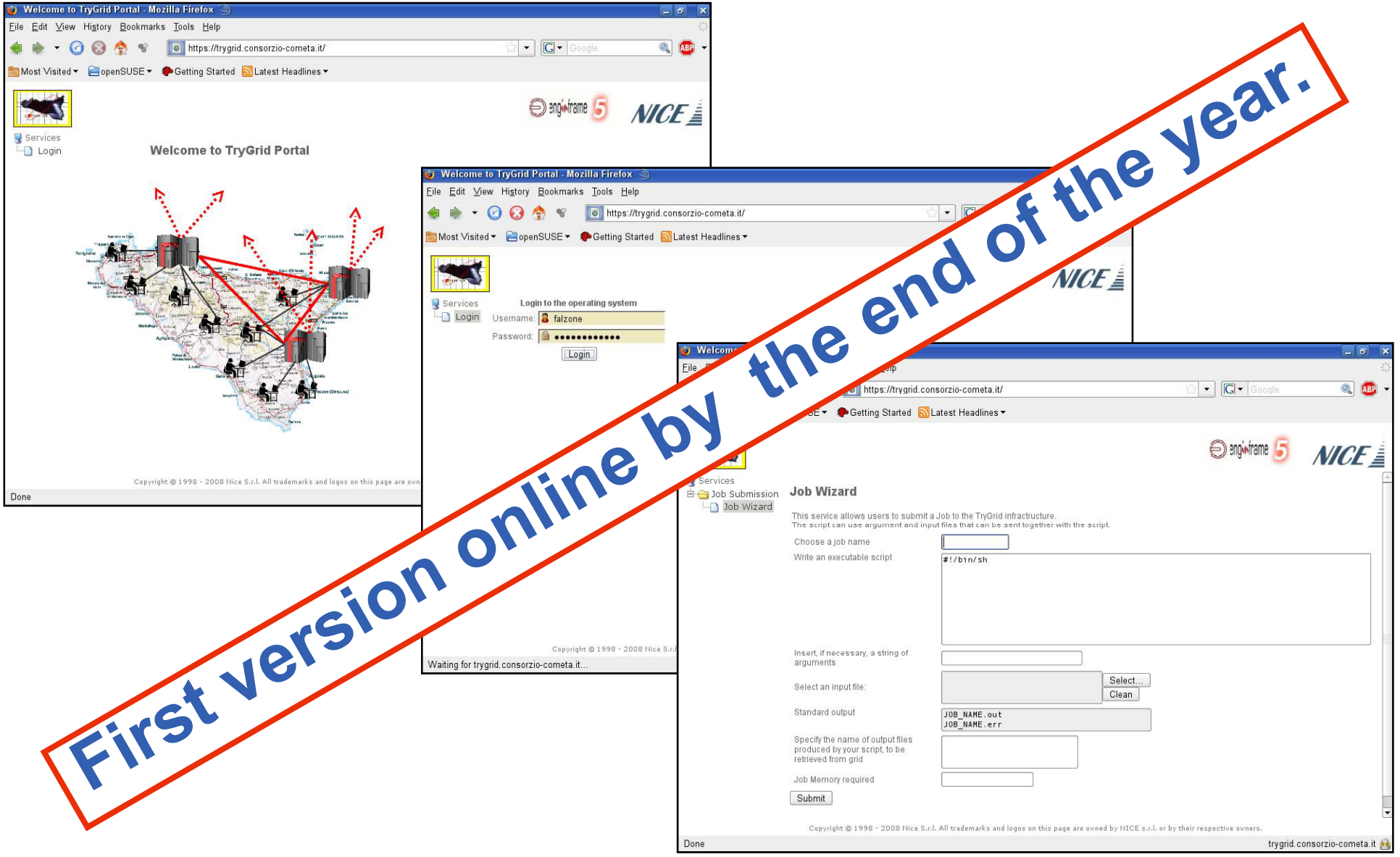


The “new”GENIUS Grid Portal

(COMETA-INFN-NICE collaboration)



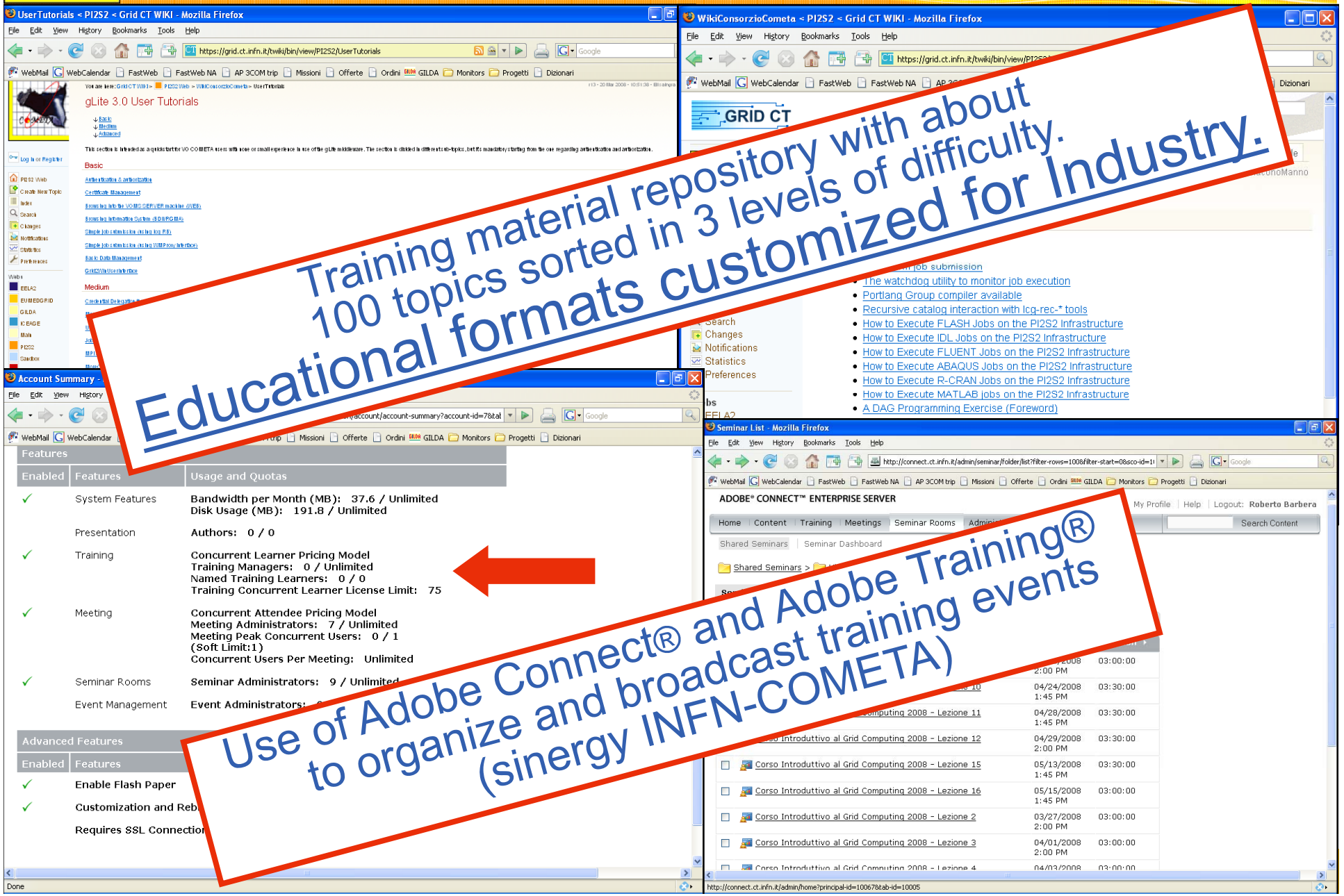
TryGrid:
Cloud Computing with gLite at Consorzio COMETA



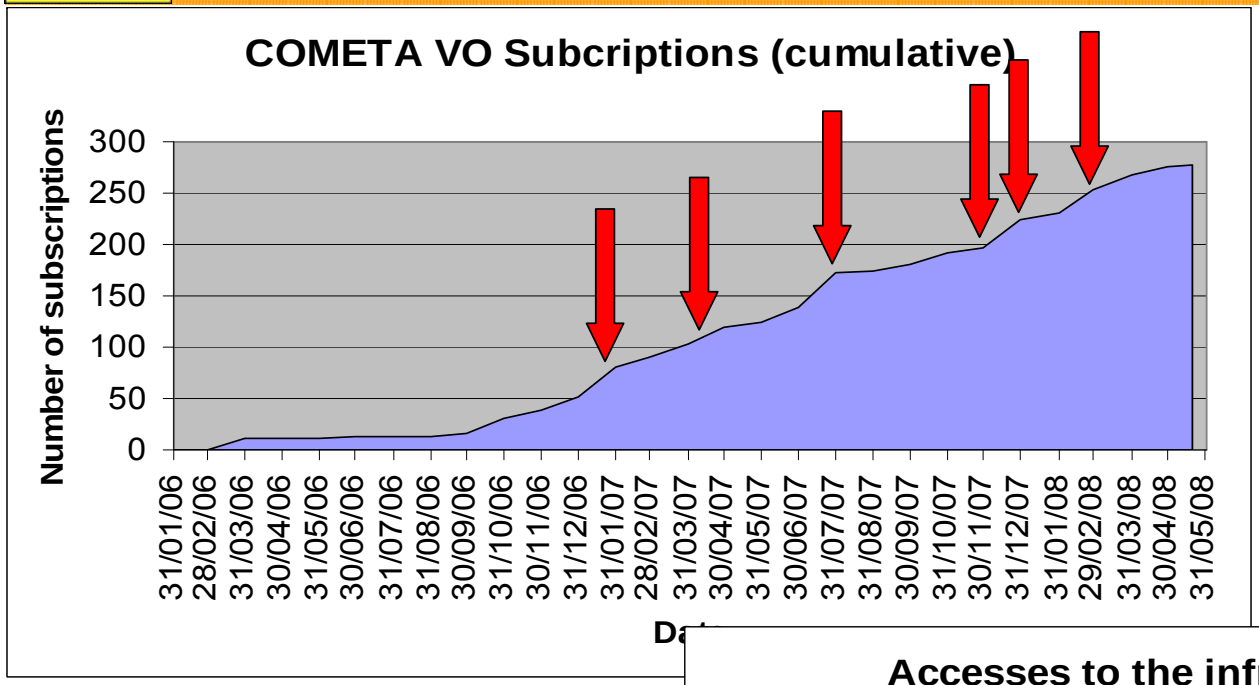
H/W Infrastructures for Training

3 classrooms available for a total of ~100 seats

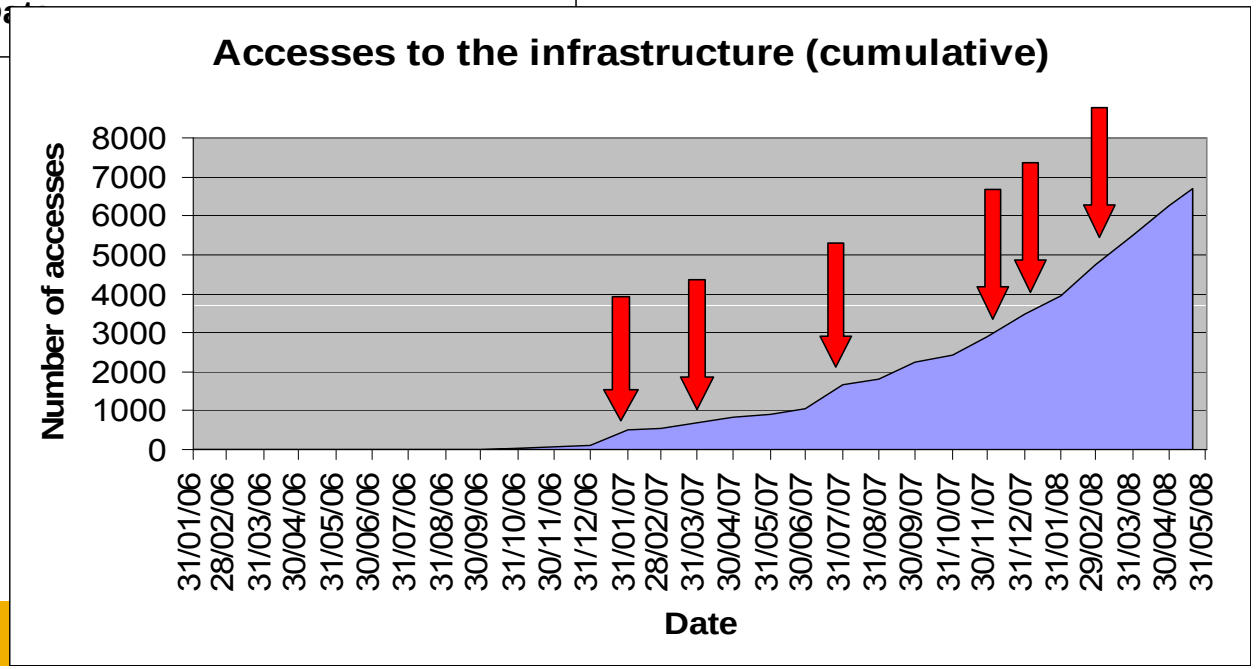
S/W Infrastructures for Training



Quality metrics: VO subscriptions and accesses to the infrastructure



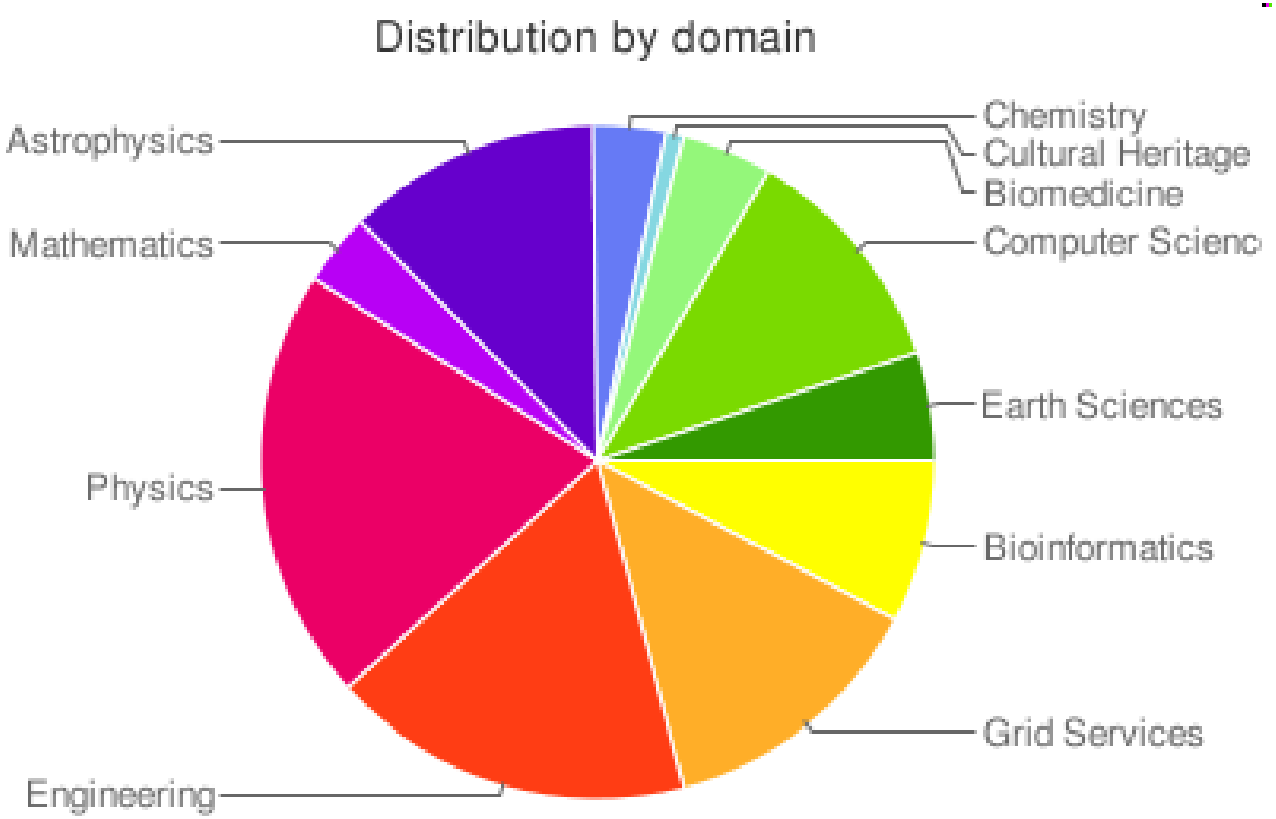
Direct correlation between training and usage of the infrastructure



Arrows indicate Tutorials and Grid Open Days

The Applications of COMETA

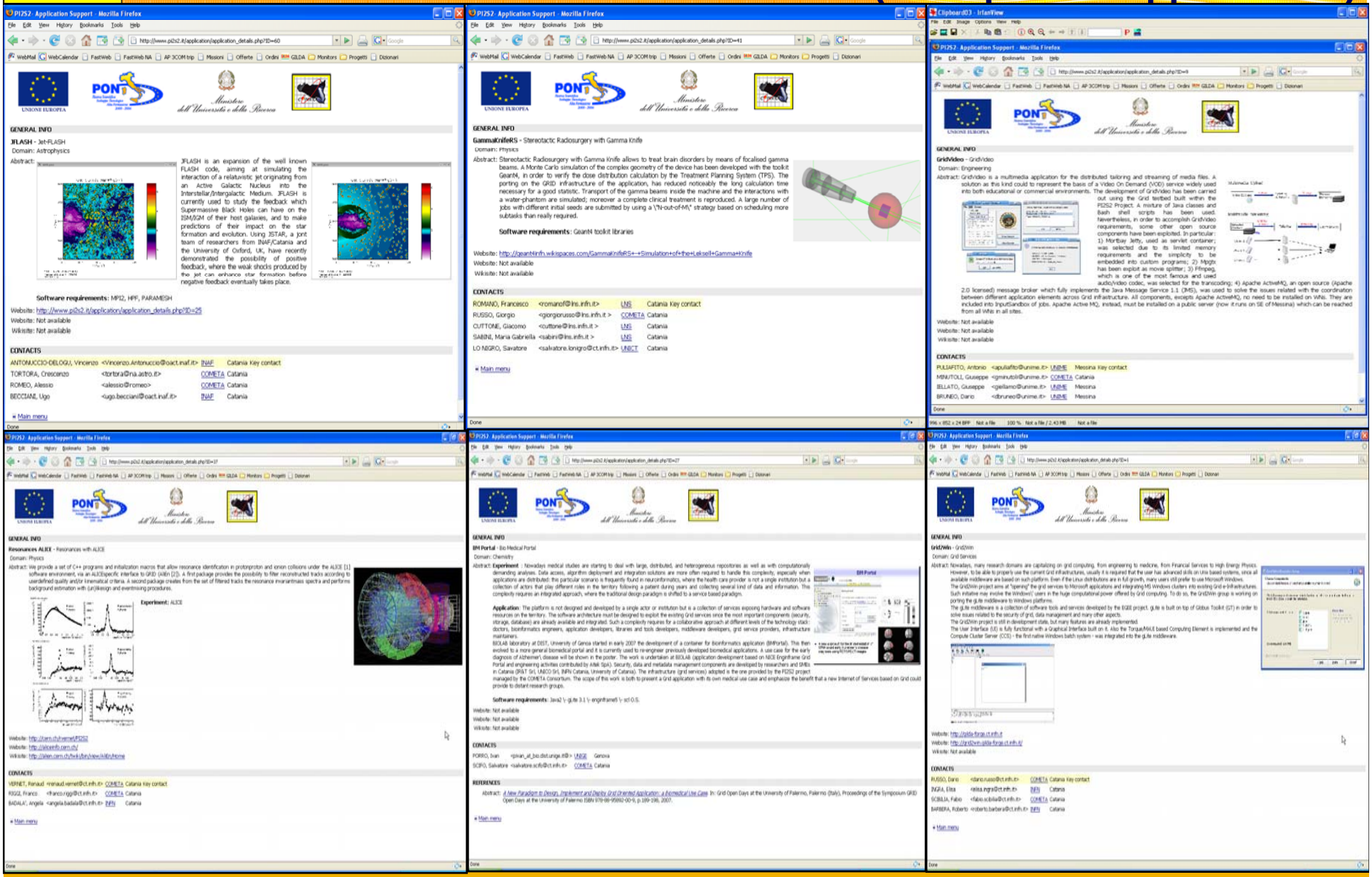
- **A comprehensive database is available at:**
  - www.pi2s2.it/applications (**116** entries as of today)



- **A volume edited by COMETA is also available at:**
  - indico.ct.infn.it/materialDisplay.py?materialId=12&confId=24

Some examples…

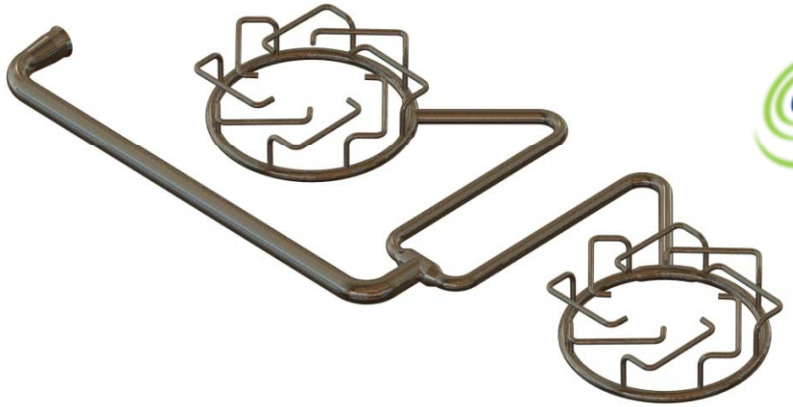
(www.pi2s2.it/applications)



Industrial/Commercial Use Cases (1/4)

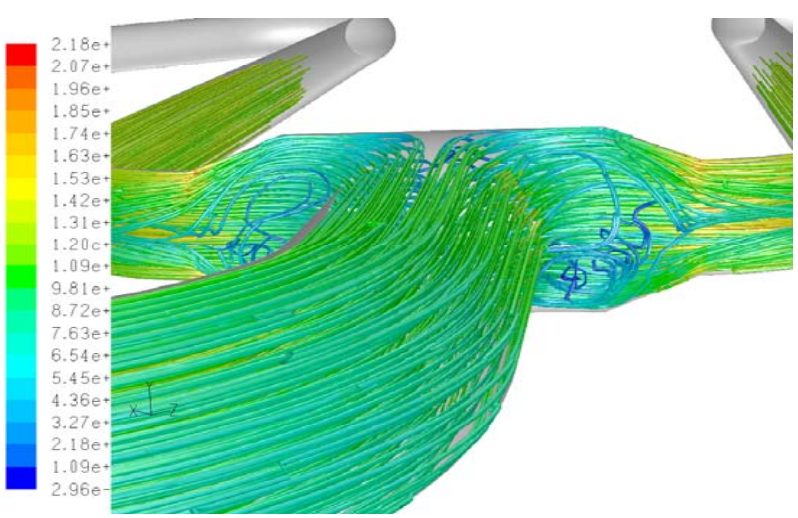
- Study of the syngas adduction system to check out the fluid-dynamics of the inlet of the Siemens V94.2K turbine, the “topper” of the IGCC ISAB Energy plant.

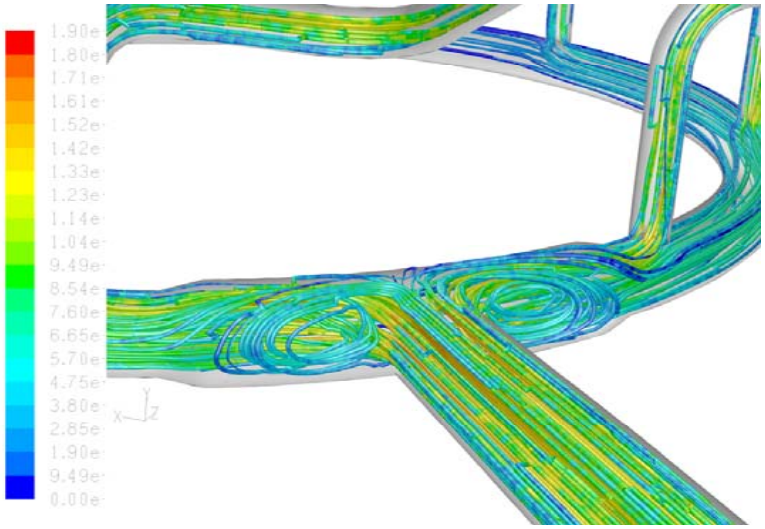
(Courtesy: Prof. R. Lanzafame, UNICT)



ERG

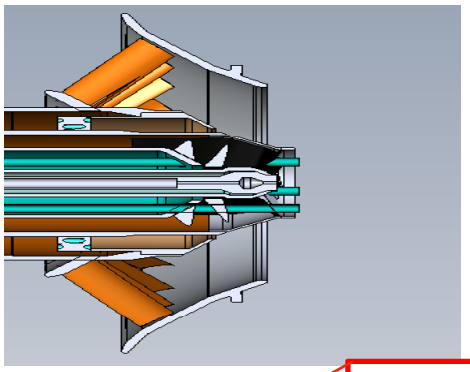
ISABEnergy

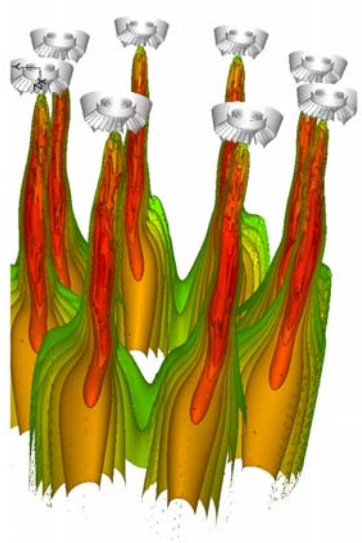


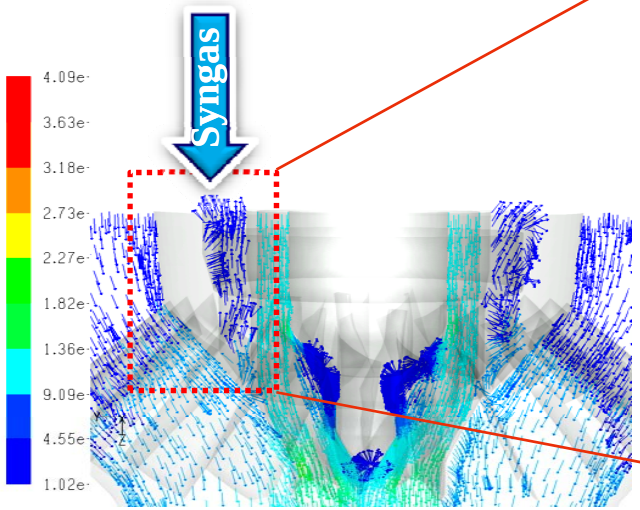


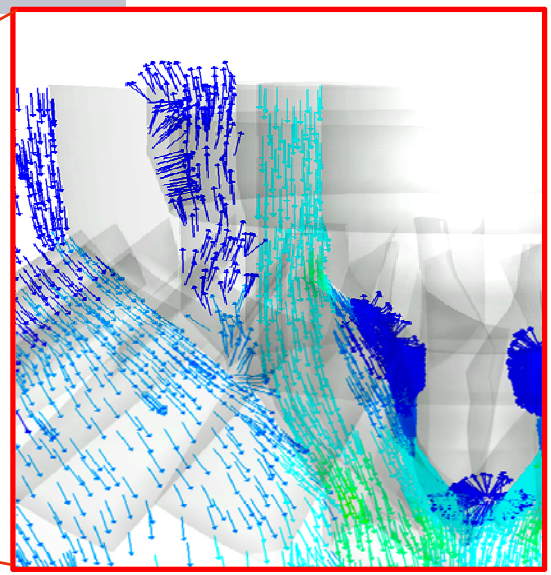
- Fluid-dynamics study of the hybrid burning in the Siemens V94.2K turbine, “topper” of the IGCC ISAB Energy plant.

(Courtesy: Prof. R. Lanzafame, UNICT)







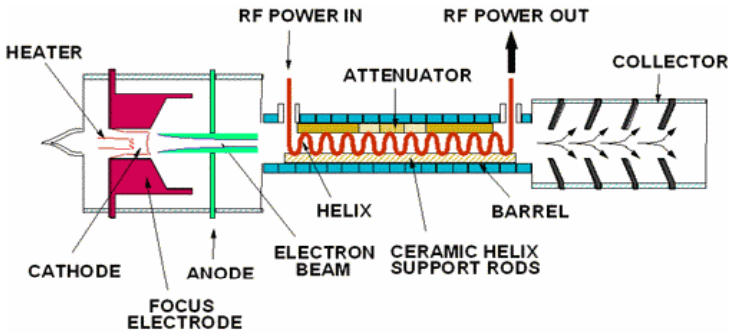


Hot air flow in the synga pipe

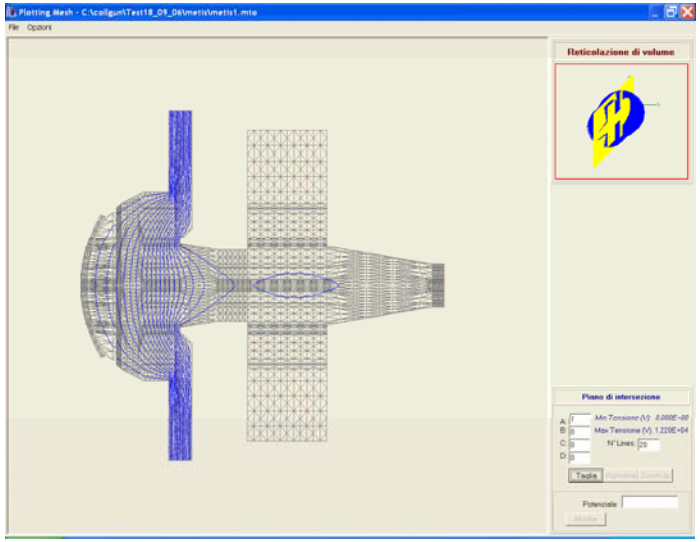
Industrial/Commercial Use Cases (3/4)

- Electromagnetic Analysis of Progressive Wave Tubes.

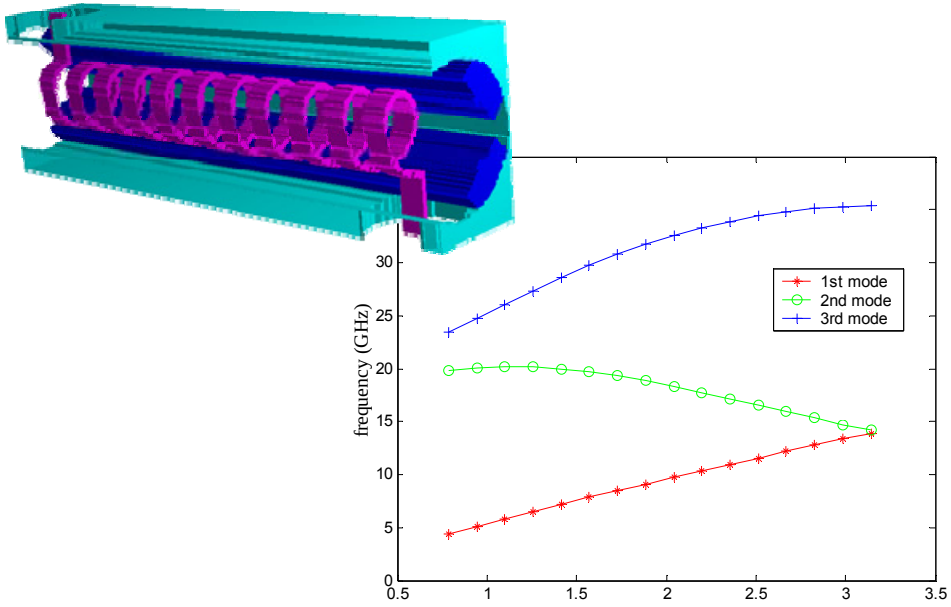
(Courtesy: Dr. G. Pollicino, UNICT)



Galileo Avionica



Simulation time on 1 PC: 400 min.
Simulation time on Grid: 30 min.

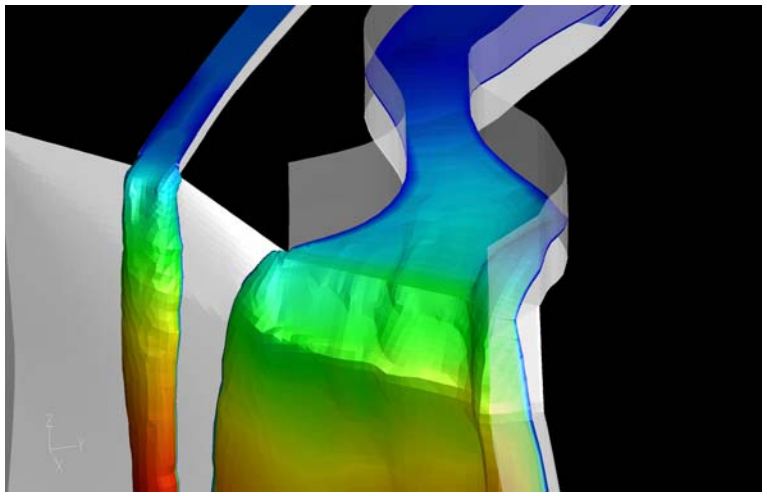


Simulation time on 1 PC: 8 h.
Simulation time on Grid: 45 min.

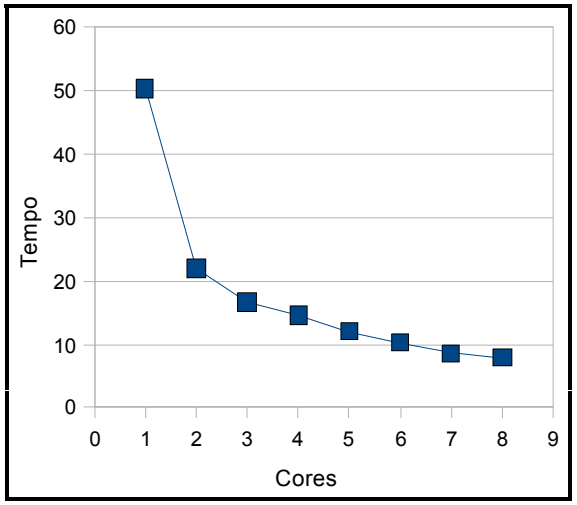
Industrial/Commercial Use Cases (4/4)

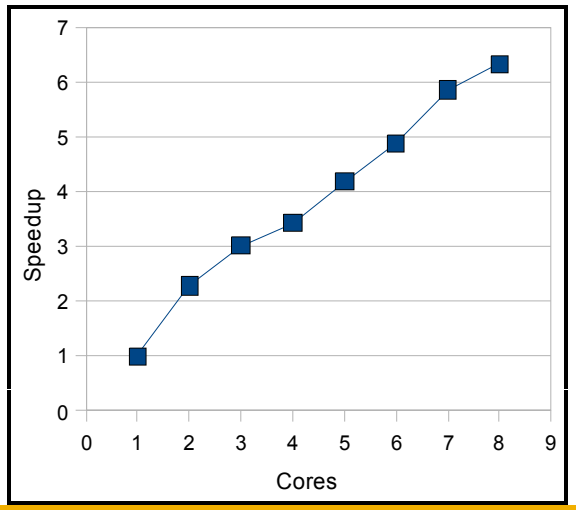
(Courtesy: Dr. E. Leggio, COMETA – Dr. M. Testa, Numidia)

- Fluid-dynamics simulation of the “Le Marmore” falls to determine the critical points of the path in various conditions of flow.



Numidia srl





3.1 millions of volumes

Summary and conclusions

- The Consorzio COMETA and the PI2S2 project have changed the perspective of scientific computing in Sicily, conjugating in a unique way Grid and HPC;
- The gLite middleware has been extended with new services thought, since the beginning, with the needs of Industrial applications in mind;
- Training material has been developed along with educative formats customized for the world of industry and business;
- More than 115 applications and services have been developed and deployes; several of them have industrial/ commercial interest;
- The Sicilian e-Infrastructure is open to all Industrial subjects interested in using it and/or establishing partnerships with COMETA. Feel free to contact me.

Thank you for your kind attention !

Any questions ?