National Grid Initiatives in Italy
INFN Grid and Grid.it
IGI and c-OMEGA

ICFA Workshop
DDW'06 Cracow, Poland
9-11 October 2006

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Summary

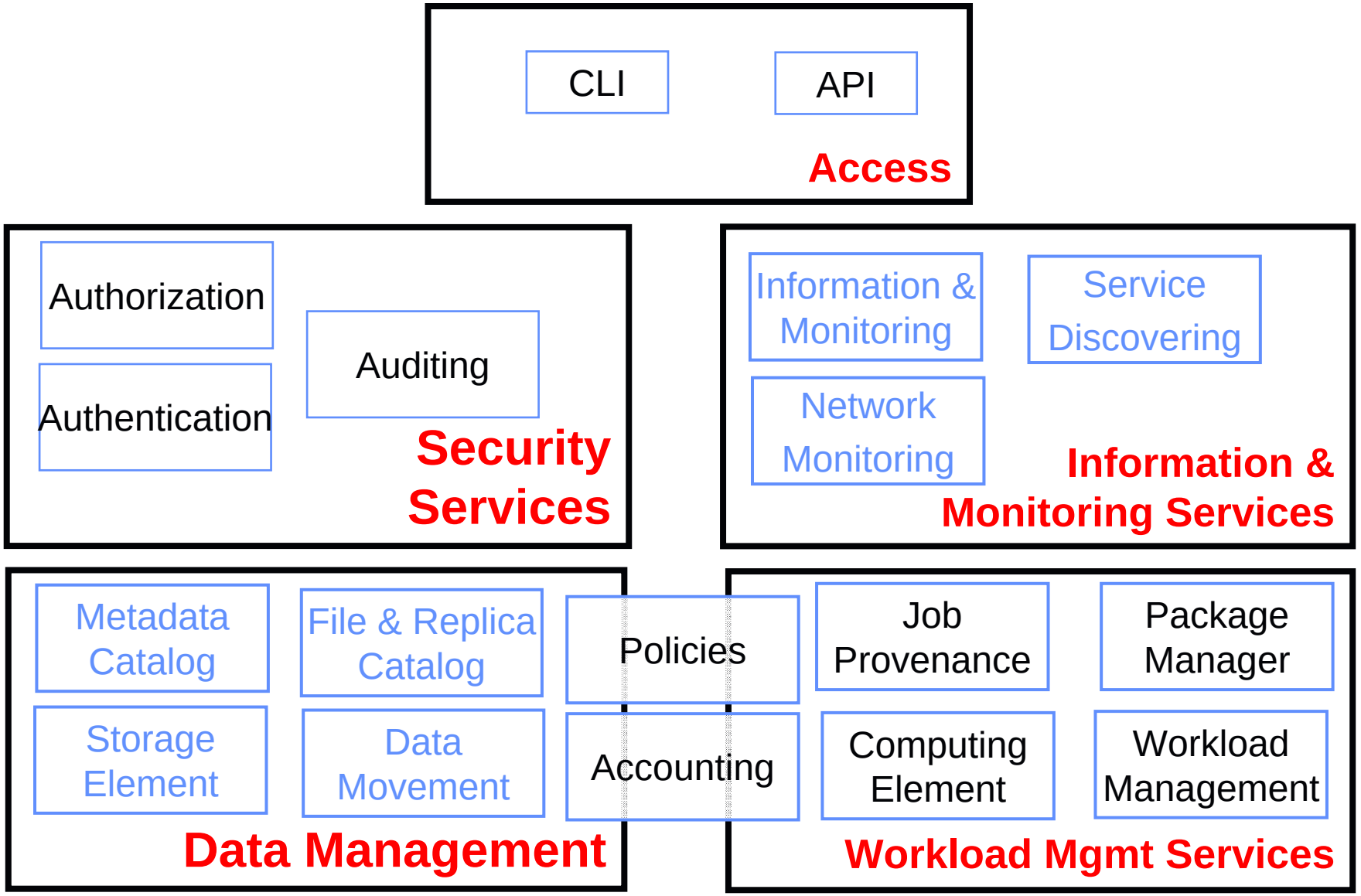
- Grids in Italy
  - The Middleware developments
- The Italian e-Infrastructure
  - The national projects:
    - INFN Grid, FIRB Grid.it,.....
- The Italian Production Grid
- The Italian Grid Infrastructure (IGI) Association
- The c-Omega consortium for Open Middleware support in commercial take up
- Conclusions

The current strategy/challenges for Grid M/W

(Refer mainly to INFN Grid results but include some other Italian Grid projects: SPACI, ENEA, Egrid)

- **Focus:** Get developed and deployed a layered SOA with baseline services, as conceived since the beginning, being of general use and having to satisfy the requirements of many Italian sciences
  - HEP, Biology, Astrophysics, Earth Observation (Esrin-ESA-Frascati), Comp. Chem…….
- -> based on standard specification, GGF…
  - Still open for CE after 6 years…..JSDL, BES??
  - Just at the beginning for SE: SRM V2.2
    - **Italy: Storm ->** SRM V2.2 over GPFS
- Avoid divergencies and entropy: Keep strong integration/coordination between the National and EU M/W developments (EDG, EGEE/LCG, EGEE-II, OMII EU).
  - "Same" baseline M/W, integrated operation and management. Avoid proliferation of private baseline VOboxes !
  - National development of complementary high level or missing services well integrated in gLite M/W Service Oriented Architecture

The Reference Service Stack is EGEE gLite
(INFN coordinates MW developments in EGEE II)



Middleware issues for production grids currently tackled by INFN

- **Improve functionalities according to application requirements**
  - E.g. Full attributes for user Authorizations Management. **VOMS**
- **Provide new services for Grid management**
  - New framework to enforce VO policies grid wide: **G-PBOX**
  - Grid wide user level account: **DGAS ->**
  - **-> now in INFN production Grid**
- **Guarantee robustness and performance**
  - Keep SLAs Grid-wide:. **GridICE** Monitoring and notification service
  - Continuous improvements of the EGEE Workload Management System (WMS)
    - Number of jobs/sec handled, Job cluster…..
- **Interoperation and standards**
  - **CREAM CE**

Developments

- Middle term (New functionalities within EGEE)
  - Add functionality to create a proxy to C/C++ API
  - Homogeneous replica management: badly needed as users increase
- Longer term (Move towards standards within OMII-EU)
  - Full Attribute Authority
    - Support for generic attributes in both core and admin components (not just group/role) , compliant to RFC 3281
    - Examples:
      - HLR to contact (DGAS)
      - User Identification (LHCb)
      - Home Institution (Shib)
  - Easier deployment schema for VOMS certificates
    - Issue connected to short life (tipically 1 year) VOMS server certificates
  - Use of SAML for OGSA Authorisation
    - Definition and implementation of a web service compliant with the SAML Authorization model
    - Development of a wrapper around the VOMS server in order to issue SAML credentials

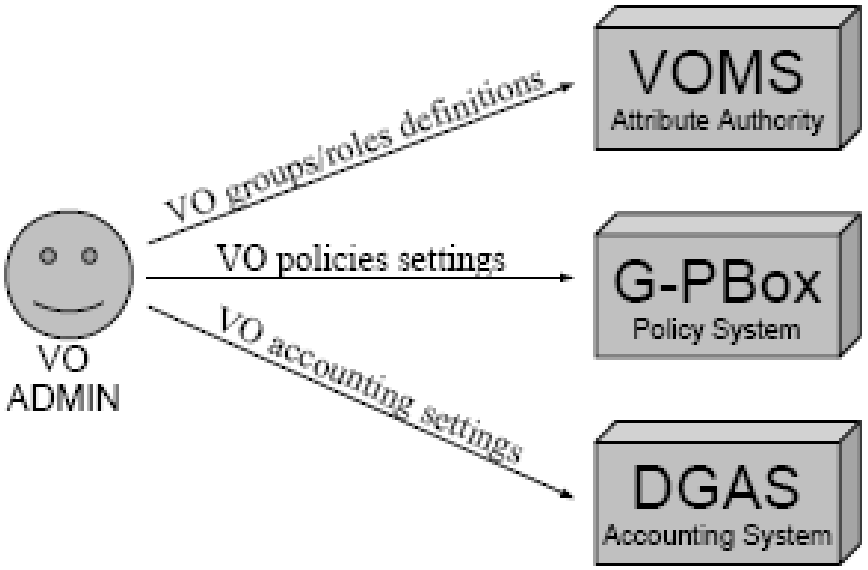
Policy Management: G-PBox

- **Description** :
  - G-PBox is a new VO-oriented Grid policy service allowing the enforcement of policies agreed between the VO and the resource owners on grid services
  - WMS: interoperability is supported for policy-aware job scheduling.
  - CE (LCG): a CE PEP querying G-PBox is already available.
  - gLite/CREAM: an interface to G-Pbox is available
  - SE/StoRM: the list of attributes is defined.
- **Framework**: Grid.it, and EGEE II
- **Task-force including developers, certification and HEP + Bio applications groups has established after a long debate the requirements**

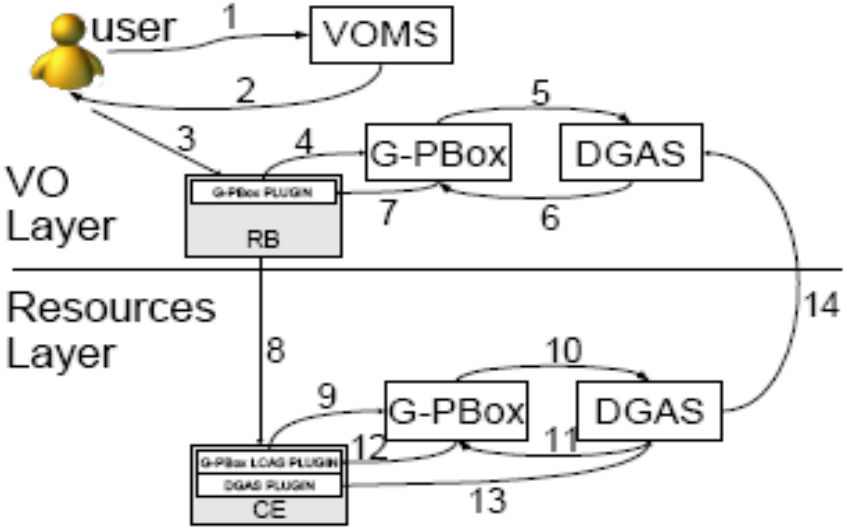
G-PBox: the overall Grid scenario

VO services operate in two different phases:

- Administration Phase:
  - the definition of the groups/roles, policies and accounting parameters by the VO administrator,
  - GPBox, as VOMS and DGAS services, allow to propagate such decisions in order to define VO-Grid wide policies and permissions for the VO's users
- Execution phase: job submission, interaction between the VO users and the Grid Services regulated by VOMS, GPBox and DGAS



1st phase - VO administrator tasks



2nd phase – User job submission

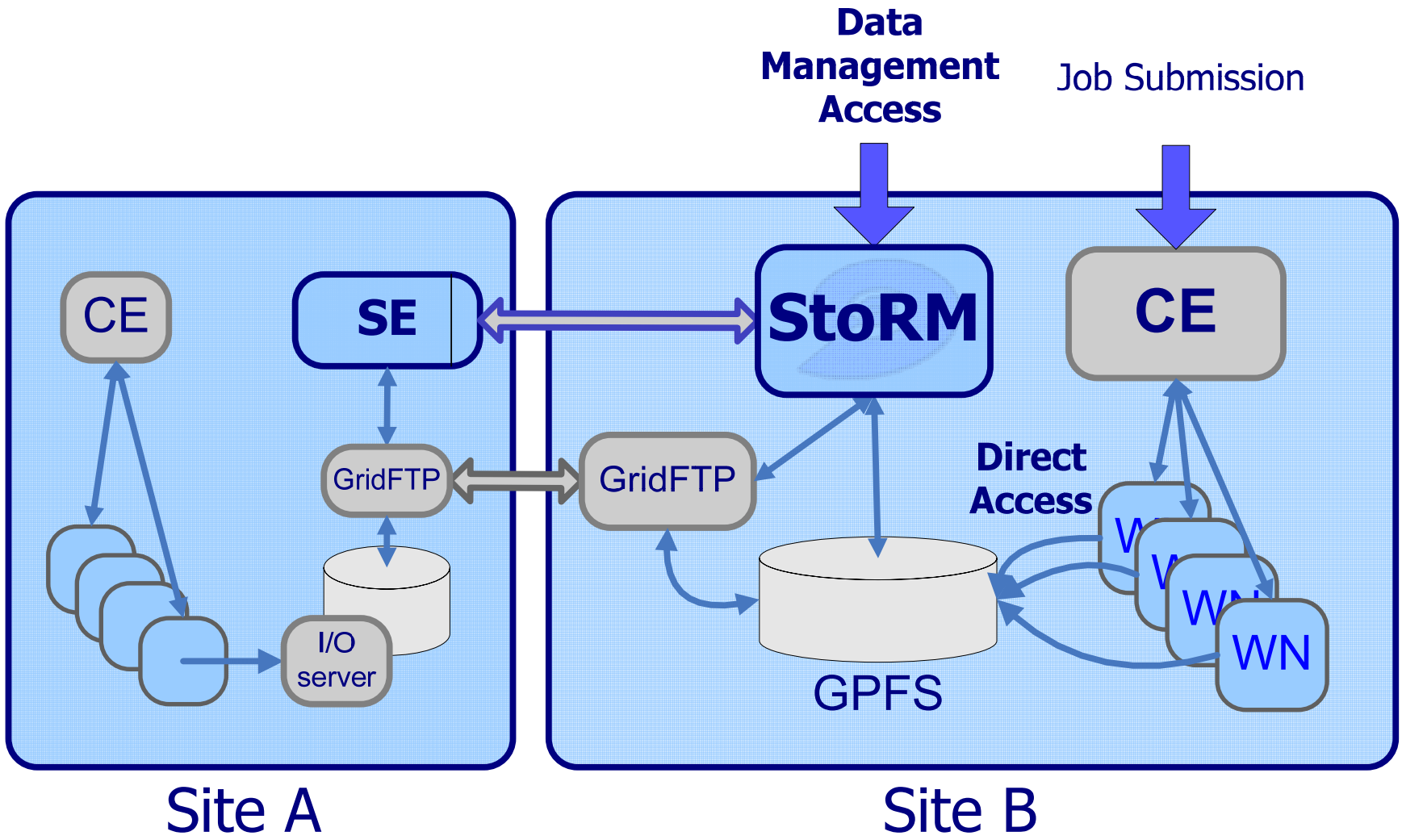
G-PBox Release 1: description (Glite 3.1)

- G-PBox Server to propagate policies on main services
- Simple G-PBox Server Admin Interface (PBoxGUI)
- PEP(Policy Enforcement Plug-in) for WMS and CE
- Policies implemented (based on VOMS groups and roles):
  - job submission policies based on queue priority flags published by CEs
    - VO administrators can change internal group and role priorities on CE VO queues grid wide
    - Sites Admin keep full control
  - ban policies (VO manager can define a list of CEs banned to a set of users)
- Present status
  - Deployment on the INFN certification testbed within gLite 3.0..x, integrated with pre-production infrastructure
  - Integration testing for gLite 3.1 deployment ongoing

StoRM : Storage Resource Manager (INFN and ICTP (EGrid))

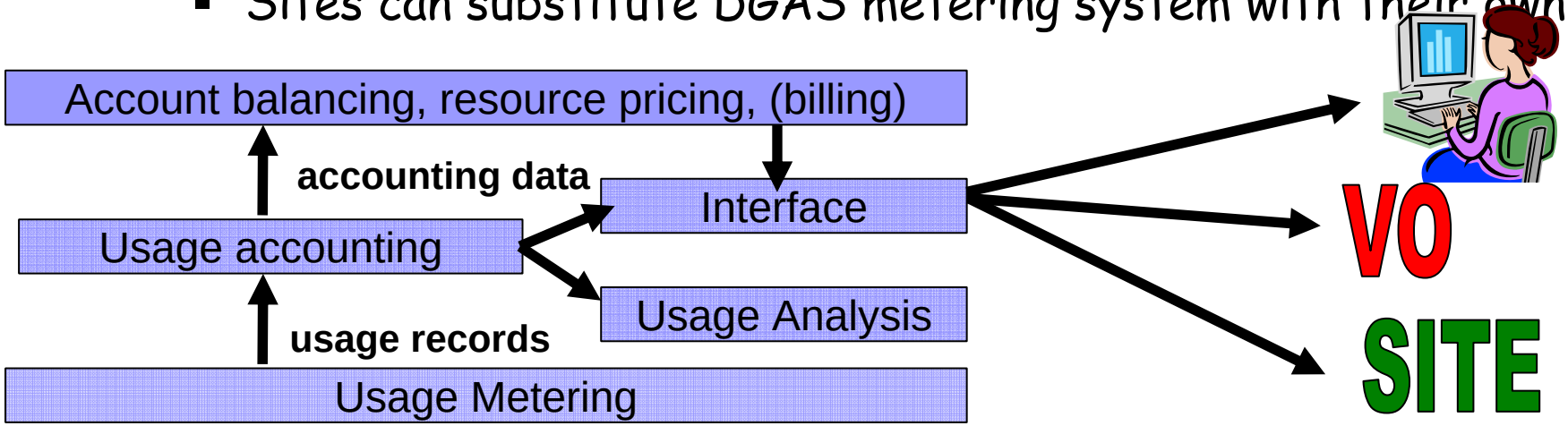
- **Description** : StoRM is a **disk** based storage resource manager which
  - implements SRM v.2.1.1
  - is designed to support guaranteed space reservation and direct access (native posix I/O calls)
  - takes advantage of high performance PARALLEL file systems such as GPFS. Other posix file systems are or will be supported (e.g.,Lustre, ext3)
  - Authentication and Authorization are based on VOMS certificates
- **Framework**: Grid.it/FIRB (WP5) and EGrid project
- **Status**: In pre-production at CNAF for GPFS

StoRM - Grid scenario

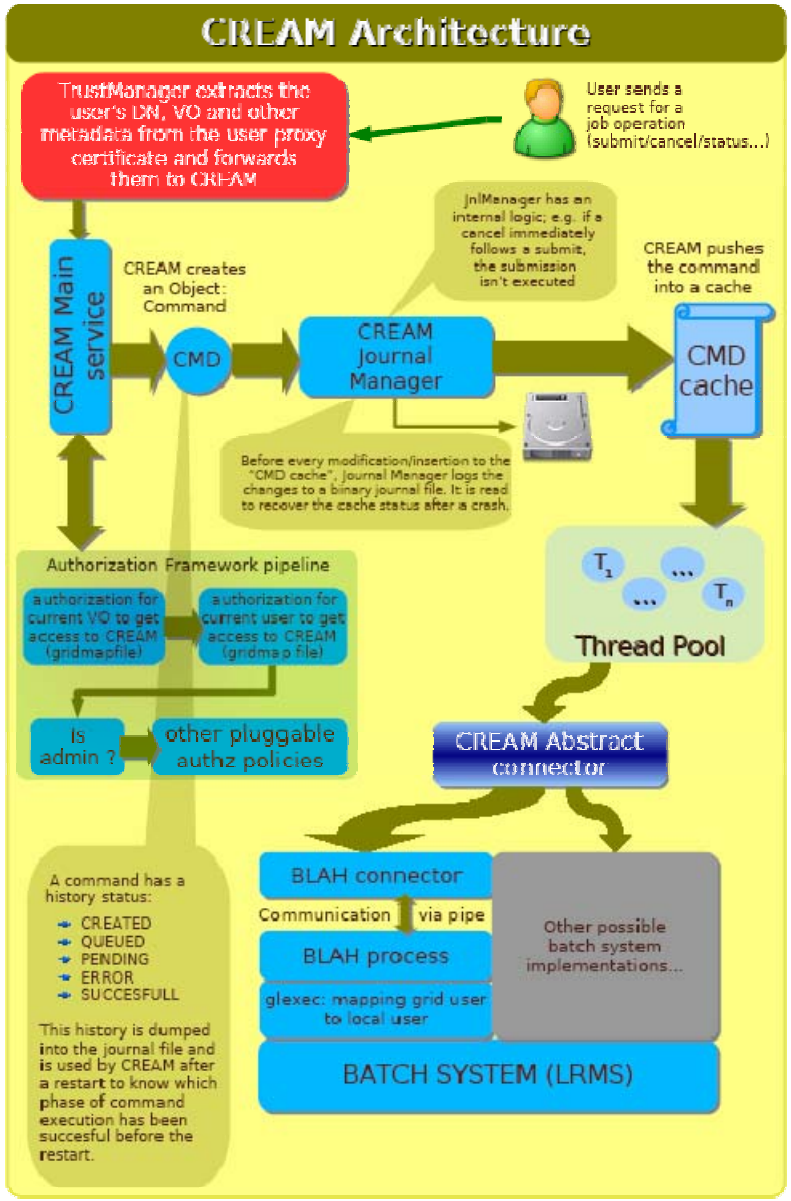


Accounting - DGAS

- DGAS: accumulates Grid accounting information
  - ***User, JobId**, user VO, VOMS FQAN(role,capabilities), SI2K, SF2K, system usage (cpuTime, wallTime…),…*
  - allows billing and scheduling policies
  - levels of granularity: from single jobs to VO or grid aggregations
  - Privacy: only the user or VO manager can access information
    - site managers can keep accounting information available just for site internal analysis
  - Sites can substitute DGAS metering system with their own



gLite CE is evolving towards ICE-CREAM



- CREAM: Lightweight web service Computing Element
  - Cream WSDL allows defining custom user interface
  - C++ CLI interface allows direct submission
- Fast notification of job status changes
  - via CEMon
- Improved security
  - no "fork-scheduler"
- Will support for bulk jobs on the CE
  - optimization of staging of input sandboxes for jobs with shared files
- WMS Interface to Cream Environment
  - being integrated in WMS for submissions to CREAM
- Incorporating JSDL and strongly encouraging and waiting BES specs

GridICE Monitoring and Notification for self repairing grids

Site ▼	GK#	Q#	RunJob	WaitJob	SlotLoad	MH#	Power	WN#	CPU#	CPULoad	Available	Total	%
CNR-ILC-PISA	1	6	0	0	0%	4	18K	2	4	0%	379.7 GB	381.6 GB	1%
ENEA-INFO	2	6	0	26664	-	4	10K	2	2	51%	29 GB	36.5 GB	20%
ESA-ESRIN	1	4	0	0	0%	2	-	-	-	-	414.4 GB	870.3 GB	52%
INAF-Trieste	1	4	3	0	11%	16	106K	15	38	7%	1.1 TB	1.5 TB	24%
INFN-BARI	1	4	127	65	96%	27	209K	18	36	44%	3.5 TB	6.2 TB	43%
INFN-BOLOGNA	1	6	11	18	92%	8	122K	6	20	38%	26.6 GB	71.3 GB	63%
INFN-BOLOGNA-CMS	1	2	4	58	80%	5	23K	3	6	67%	907 GB	1.7 TB	46%
INFN-CAGLIARI	1	6	0	38	0%	15	105K	12	24	0%	902.1 GB	938.1 GB	4%
INFN-CATANIA	1	6	195	74	95%	90	1M	85	238	47%	2.7 TB	3.5 TB	23%
INFN-CNAF	1	8	0	0	100%	21	48K	5	10	31%	897.5 GB	1.8 TB	51%
INFN-FERRARA	1	4	1	0	0%	17	160K	13	36	8%	978.1 GB	1006 GB	3%
INFN-FIRENZE	1	6	78	68	100%	19	389K	17	68	5%	503 GB	722.1 GB	30%
INFN-FRASCATI	1	3	5	41	83%	5	34K	3	6	68%	879.8 GB	1.2 TB	30%
INFN-GENOVA	1	4	0	0	0%	5	38K	3	6	0%	337.9 GB	341.7 GB	1%
INFN-LECCE	1	3	0	0	0%	4	11K	2	4	0%	15 GB	17.9 GB	16%
INFN-LNL-2	1	6	155	99	100%	87	872K	75	162	25%	723.4 GB	2 TB	64%
INFN-LNS	1	5	29	29	100%	6	90K	4	16	0%	473 GB	476.2 GB	1%
INFN-MILANO	1	13	4	0	3%	27	243K	24	48	0%	1 GB	169.1 GB	99%
INFN-NAPOLI	1	6	31	158	91%	20	182K	18	36	72%	105.8 GB	870.3 GB	88%
INFN-NAPOLI-ATLAS	1	7	32	96	100%	18	164K	16	32	84%	2.5 TB	2.5 TB	1%
INFN-NAPOLI-CMS	1	6	0	0	0%	8	59K	6	12	0%	153.8 GB	417.8 GB	63%
INFN-NAPOLI-VIRGO	1	7	0	0	-	3	5K	1	2	17%	6.5 GB	14.1 GB	54%
INFN-PADOVA	2	25	26	275	99%	65	488K	47	94	24%	9.1 TB	10.8 TB	16%
INFN-PARMA	1	2	5	2	83%	5	29K	3	6	83%	126.1 GB	139.7 GB	10%
INFN-PERUGIA	1	6	24	9	100%	47	402K	45	90	75%	200 GB	216.5 GB	8%
INFN-PISA	1	6	37	45	92%	24	134K	20	36	84%	1.2 TB	4.5 TB	73%
INFN-RISA2	1	6	0	0	-	-	-	-	-	-	-	-	-

GILDA:The Laboratory to try out Grid.it and EGEE Grid

MW summary

- Constant efforts have been put on general production grid services to be able to:
  - Routinely support running of thousands of jobs with efficiencies >= 99%
  - Keep sustainable data transfer rates at Gbps in many site; thanks to large WLCG efforts
    - Autodiscovery and correction of faulty components
    - Fast Monitoring and Notification services
  - Guarantee time perfomance
    - E.g. WMS and CE bulk job submission
  - Guarantee Grid wide VO policies enforcement
  - Guarantee robust user level accounting
  - Attract new user comunities

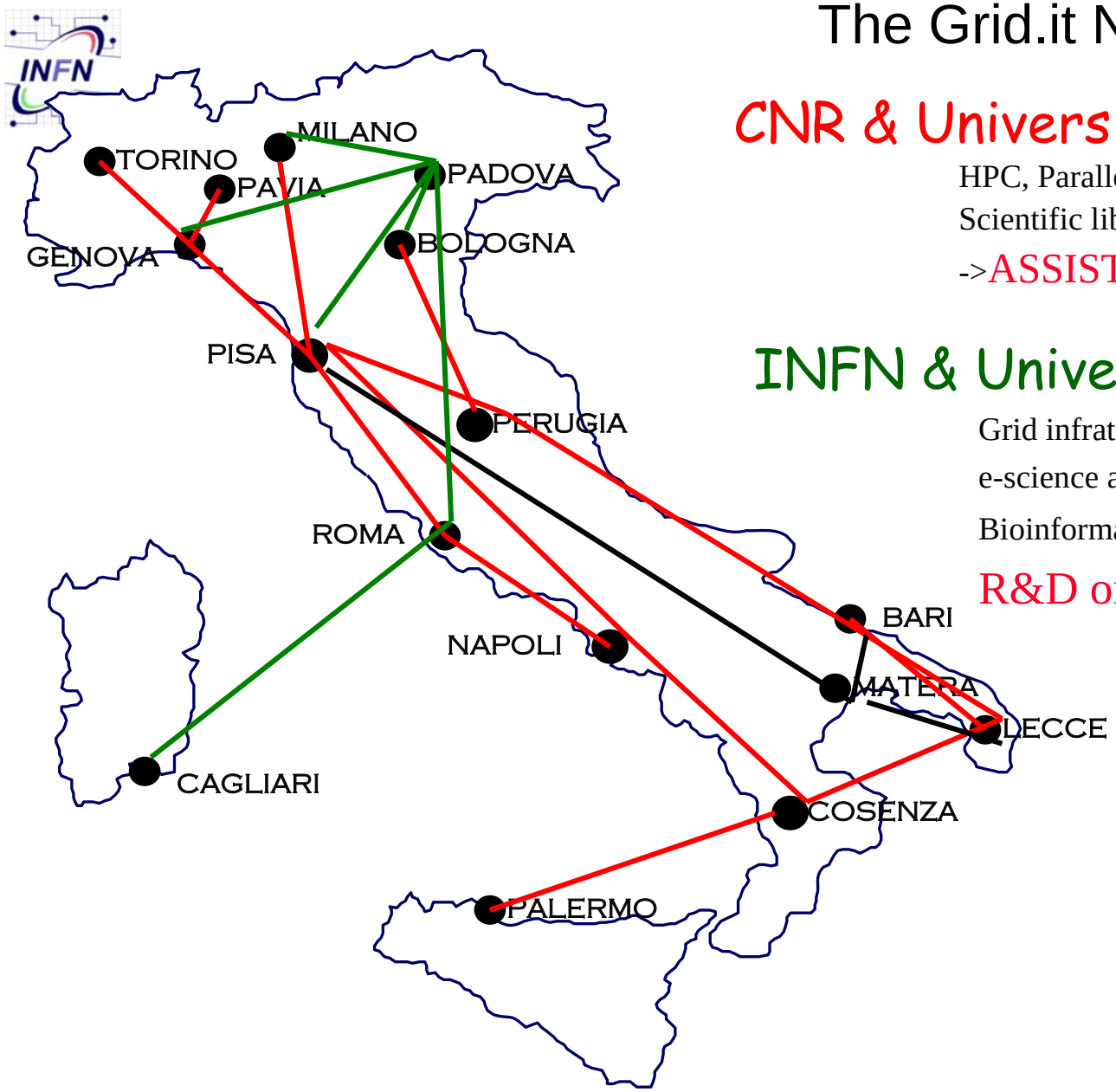
The Italian Grid infrastructure:

The FIRB Grid.it Project

launched in 2002 within

FIRB: Government Fund for the Investments in the Basic Research (Ministry of Education, University and Research (MIUR))

The Grid.it National Project



CNR & University

HPC, Parallel Programming, Grid computing,
Scientific libraries, Data base and knowledge discovery,
->ASSIST

INFN & University

Grid infratsructure(INFN-Grid, DataGrid, DataTag) ,
e-science applications: Astrophysics,
Bioinformatics, Geophysics, …

R&D on National eInfrastructure

ASI

Applications of
Earth Observation

CNIT

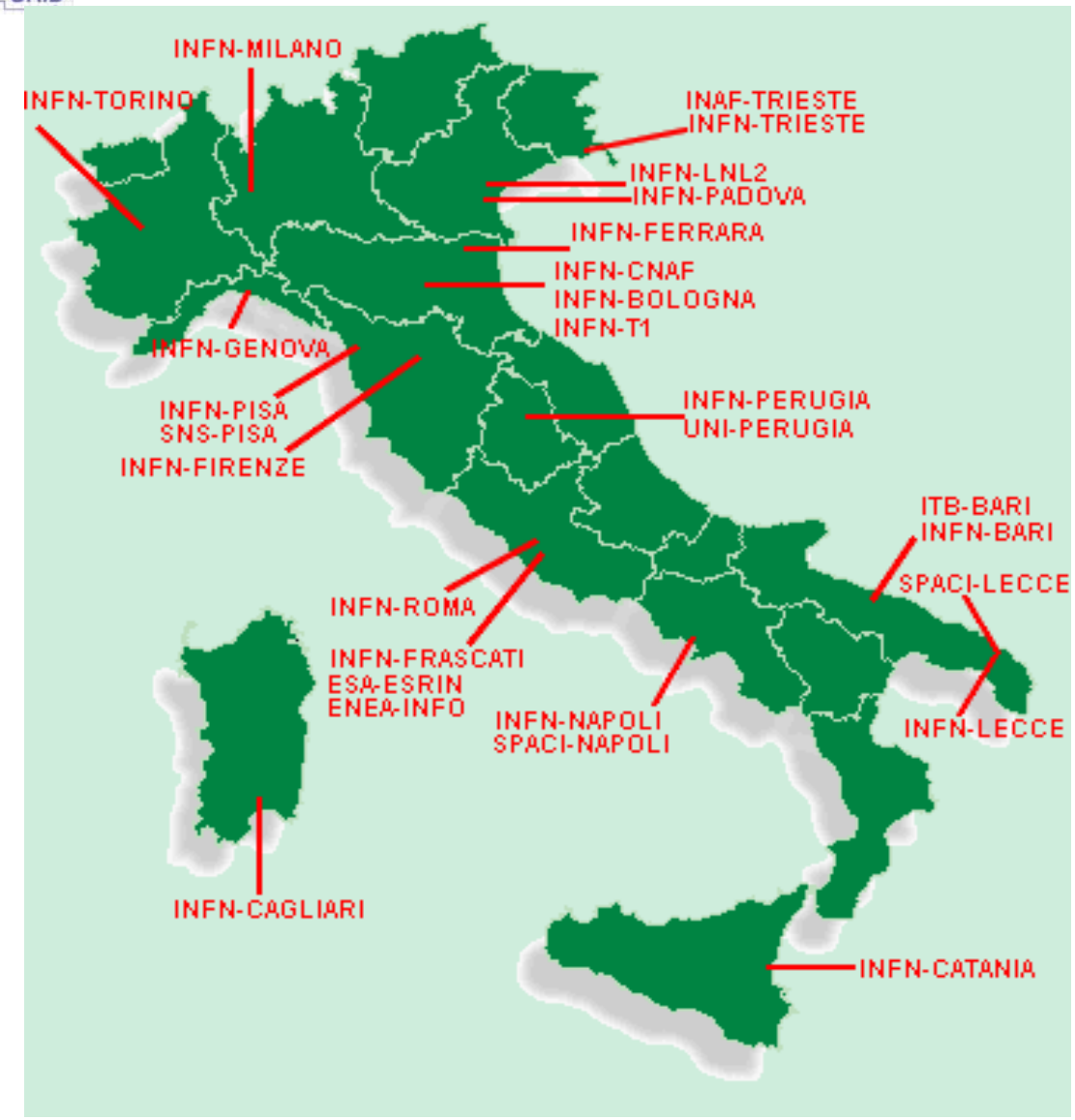
R&D on optical networking

End :November 2006

The Grid.it e-Infrastructure

- Grid.it has completed the R&D phase for the National Grid Infrastructure operation and for studying and prototyping the services required by a national Grid Operation Center (GOC) (integrated with the EU Regional Operation Center (ROC))
  - Located at CNAF (Bologna) but leveraging contributions from other Italian centers
- Has generalized the infrastructure support from INFN to other Sciences
- The Italian GOC/ROC currently support several Italian Research Communities application and the operation of the Italian e-Infrastructure also as part of WLCG/EGEE II

The Italian Production Grid: a sum of grids



http://grid-it.cnaf.infn.it

3000 CPUs, 500TB

37 ‘resource centers’:

All centers are accessible through Resouce Brokers and registered in the grid.it Information System

25 sites are registered also in the EGEE/LCG infrastructure
12 sites are accessible through the italian Grid services and the italian top level BDII

INFN Grid, SPACI, ENEA, ESA-ESRIN and PONs provide different CPU architectures

The Italian Grid: the SPACI Consortium:

a flexible, robust, secure and scalable IT infrastructure

Southern Partnership for Advanced Computational Infrastructure

3 MEuro startup funds by MIUR

1.4 Tflops

SPACI infrastructure part of the EGEE production Grid

ISUFI/CACT

Center for Advanced Computing Technologies
University of Lecce
Director: Prof. Giovanni Aloisio

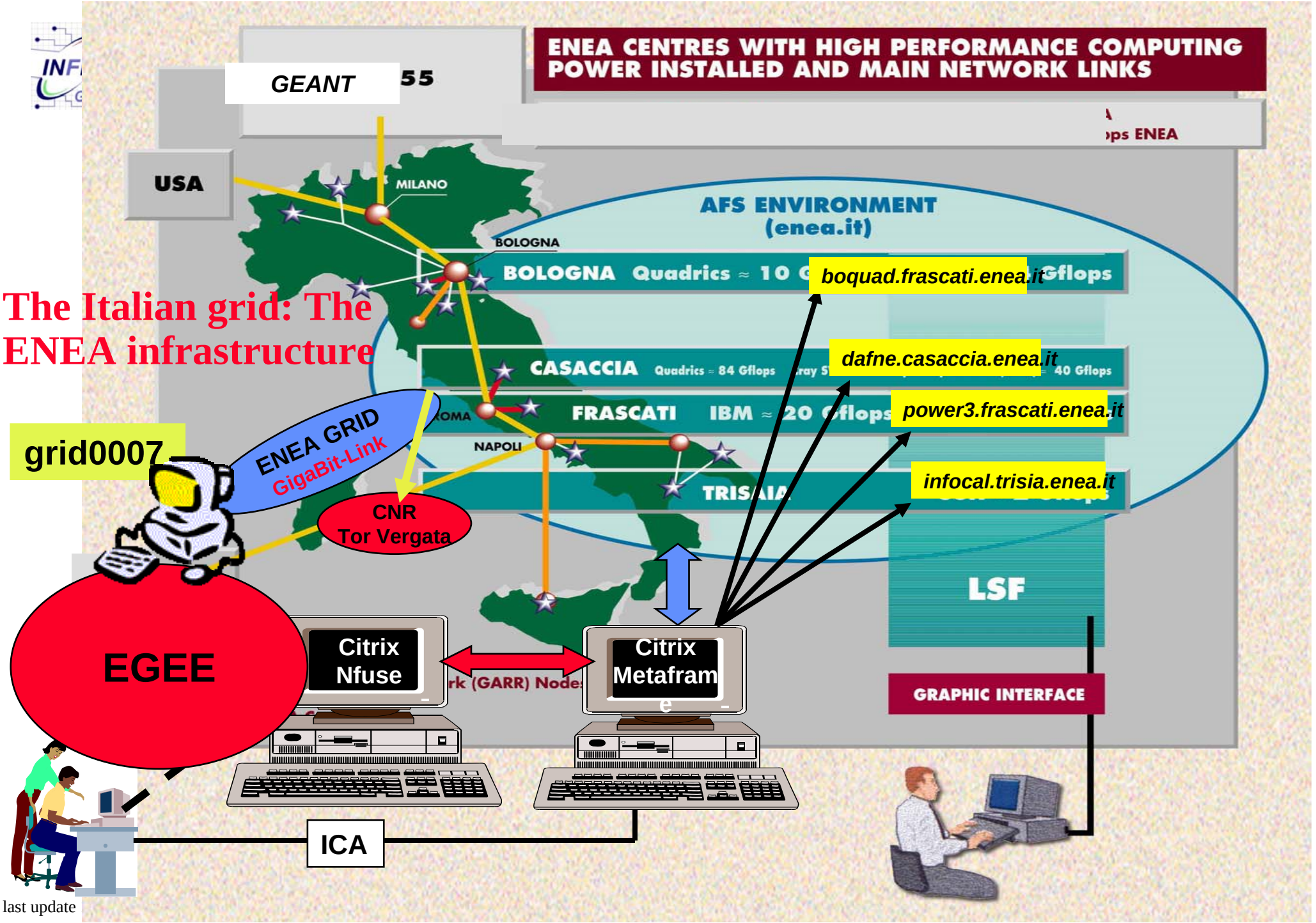
DMA/ICAR

Dept. of Mathematics and Applications
University of Naples "Federico II" & ICAR (Section of Naples)
Director: Prof. Almerico Murli

MIUR/HPCC

Center of Excellence for High Perfomance Computing
University of Calabria
Director: Prof. Lucio Grandinetti

The Italian grid: The ENEA infrastructure



last update

The Italian Regional Operation Center (ROC)

- Grid.it GOC achievements and tools provide the foundation of the Italian ROC activities
- Italian GOC and EGEE ROC are now unified to provide
- First level support to Italy
  - Geographically based local front line support to Virtual Organization, Users and Resources Centres
  - Through daily shifts covering working hours(8.30-19.30)
  - Shifters from CNAF(Bologna) and major Italian Centers (SPACI)
  - Check list to be covered during the shift
    - Experts on call
  - Periodic (every 15 days) phone conference
    - ROC teams and site managers
  - ROC report to EGEE and leverage from activities of the Italian Production Grid Central Management Team (CMT)
- Second level support to EU
  - Operation of the EU e-Infrastructure
  - Italian ROC guarantee the EGEE weekly shifts rotating between major EU Centers

The Central Management Team (CMT)

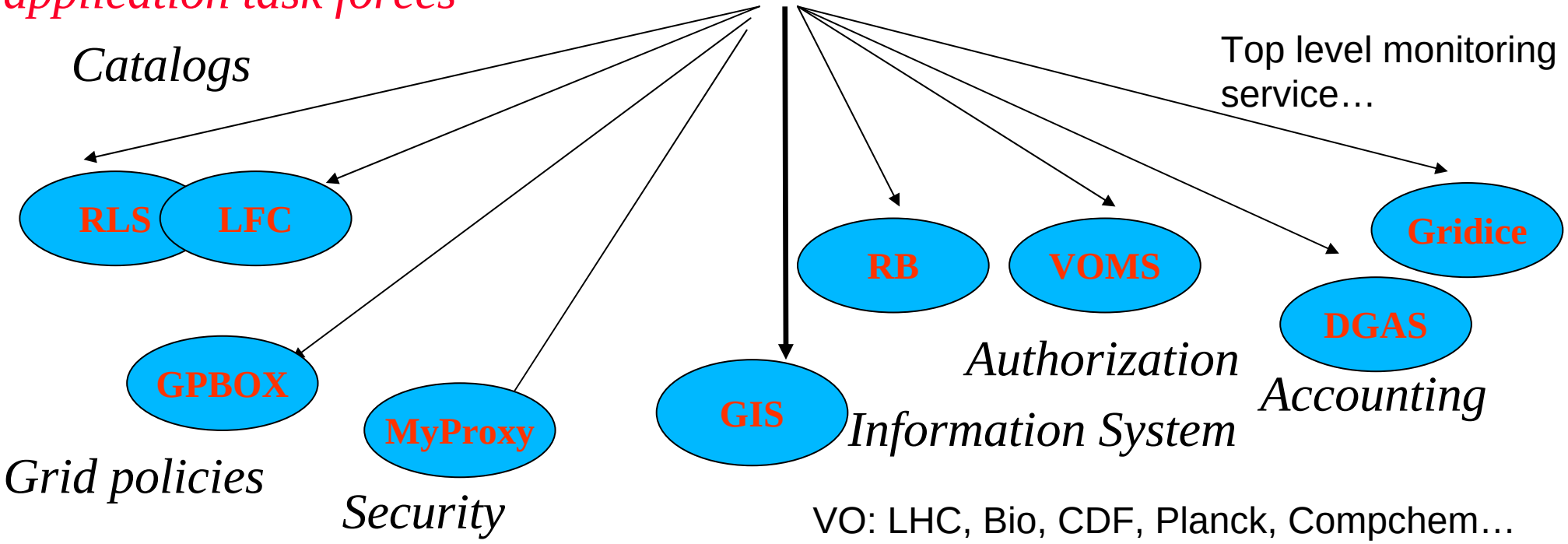
- Guarantee Release Distribution and Site Certification in Italy
- The CMT is responsible of the certification: dynamically checking the functionalities and configuration of a site services before including it in the Italian production grid.
- In particular checks:
  - Information System data consistence
  - Local jobs submission (LRMS)
  - Grid submission with Globus (globus-job-run)
  - Grid submission with the EGEE Resorce Broker
  - ReplicaManager functionalities
- To certificate a site the CMT uses dedicated grid services located at CNAF
- In this way only certified sites are dynamically included in the production grid to guarantee robust operations

The INFNGRID-3.0 release = gLite 3.0 + DGAS + GPBOX
Managed Core SERVICES

EGEE gLite 3.0 RCn
in pre-production
gLite 3.1
in certification
Tested by
application task forces

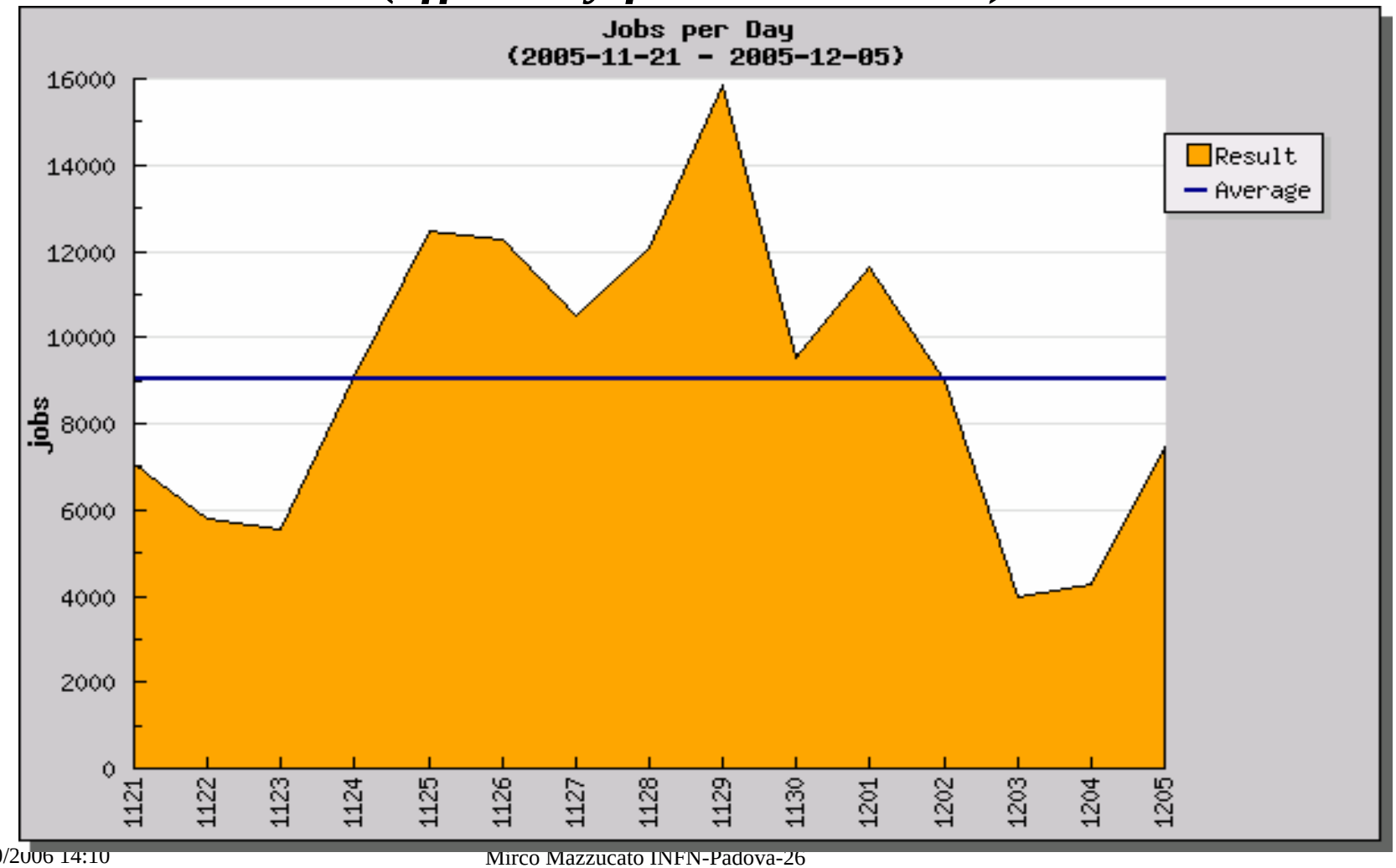
Grid.it Production Grid: INFNGRID 3.0
On
SCIENTIFIC LINUX 3.05

Catalogs
RB and VOMS:
One for each VO



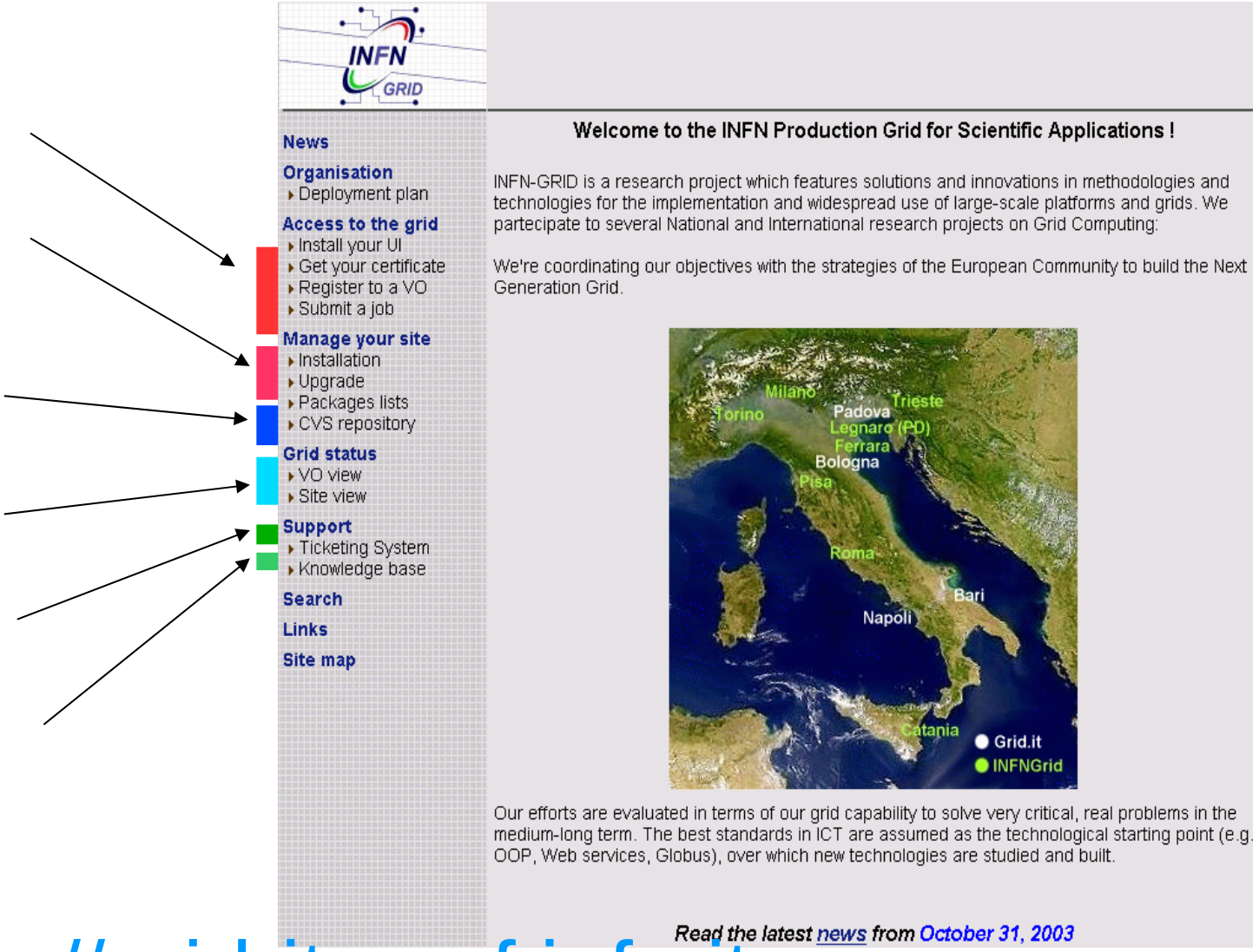
Job report in Grid.it

Average of 9000 Jobs/day submitted and completed in Grid.it via grid (efficiency from 80 to 100%)



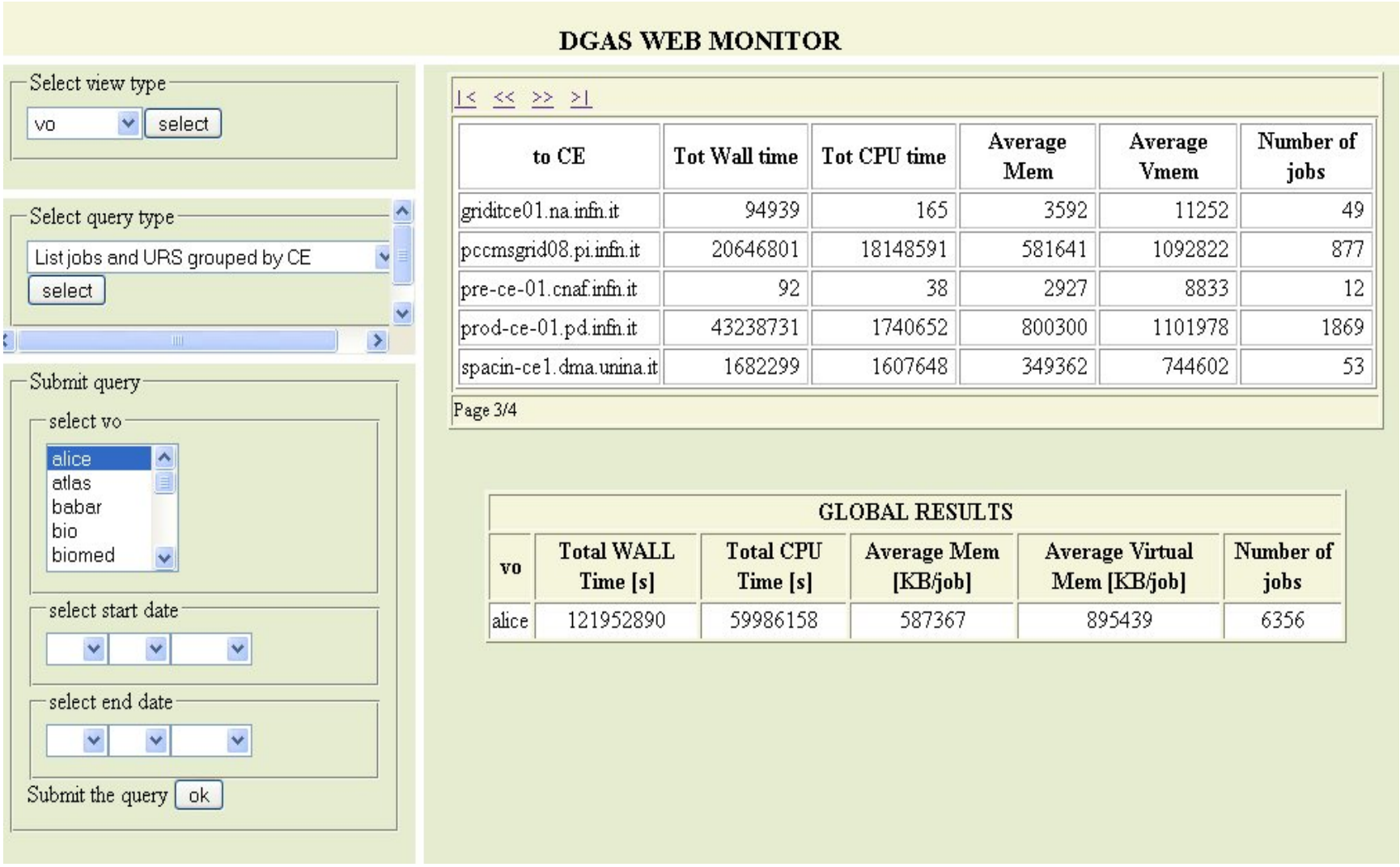
Grid.IT Production Grid: Operations Portal

- User documentation
- site managers documentation
- Software repository
- Monitoring
- Trouble tickets system
- Knowledge base



http://grid-it.cnaf.infn.it

A new key Service: The DGAS Accounting



DGAS WEB MONITOR

Select view type

vo select

Select query type

List jobs and URS grouped by CE

select

Submit query

select vo

alice
atlas
babar
bio
biomed

select start date

select end date

Submit the query ok

|< << >> >|

to CE	Tot Wall time	Tot CPU time	Average Mem	Average Vmem	Number of jobs
griditce01.na.infn.it	94939	165	3592	11252	49
pccmsgrid08.pi.infn.it	20646801	18148591	581641	1092822	877
pre-ce-01.cnaf.infn.it	92	38	2927	8833	12
prod-ce-01.pd.infn.it	43238731	1740652	800300	1101978	1869
spacin-ce1.dma.unina.it	1682299	1607648	349362	744602	53

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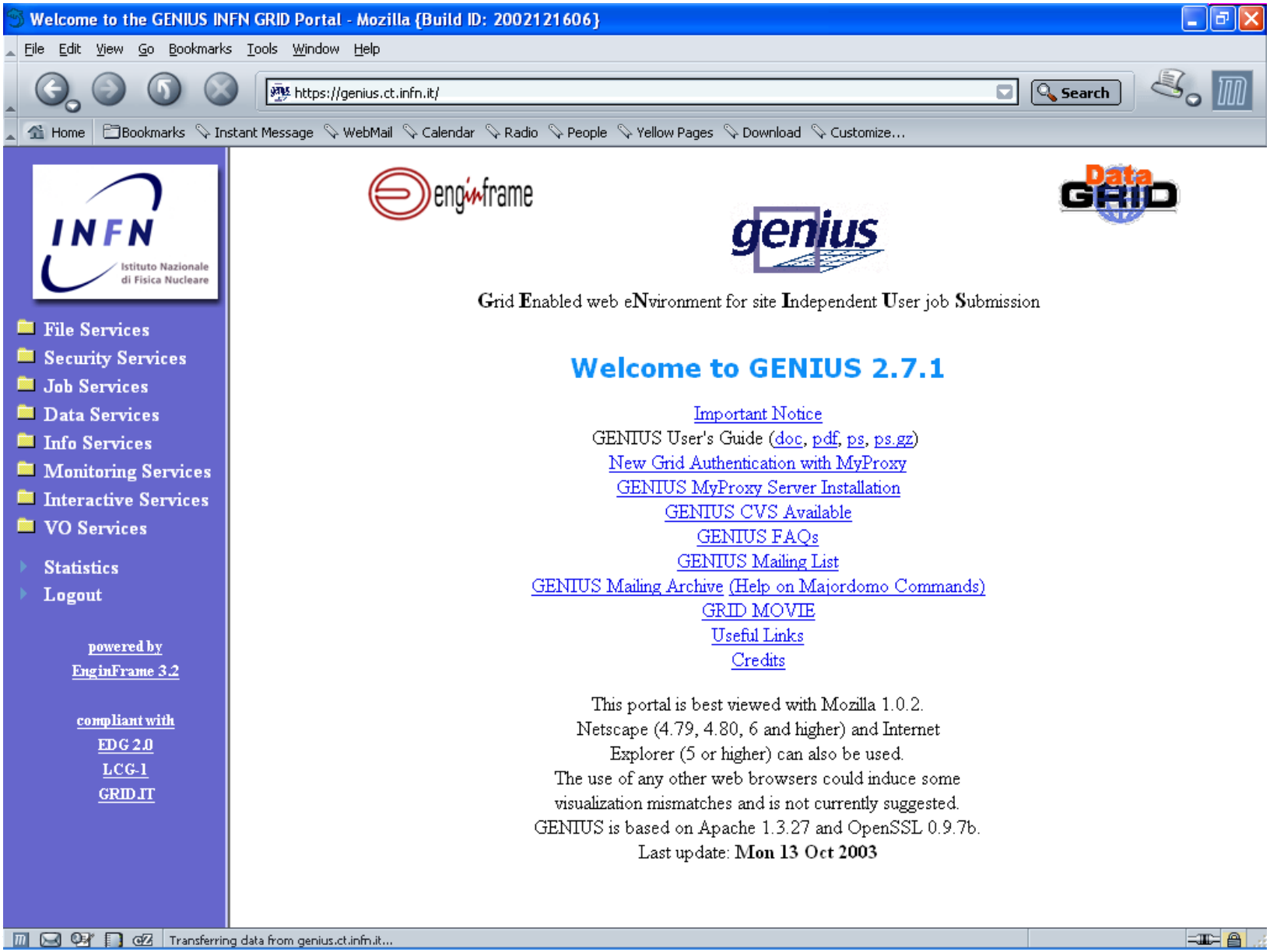
GLOBAL RESULTS

vo	Total WALL Time [s]	Total CPU Time [s]	Average Mem [KB/job]	Average Virtual Mem [KB/job]	Number of jobs
alice	121952890	59986158	587367	895439	6356

GENIUS Portal: interfaced to~100 Grid services



The long term sustainability of the Italian Grid

- Grid.it end in 2006 and need to be replaced by a more long term organization to guarantee the sustainability of the current Italian Grid infrastructure and its connection to EU level
- The proposal for the future:
- The Association for the Italian Grid Infrastructure (IGI)
  - Originally conceived to provide national coordination of the different pieces of the national e-Infrastructure present in EGEE II
  - Supported by MIUR
- Quite consensus for the expansion of IGI scope to include all Institutions involved in e-Infrastructure projects in Italy e.g. Supercomputing Centers as CILEA, CASPUR and new PON projects infrastructure in view of the set up of the European Grid Initiative
- Constitutional document in final approval phase by involved institutions

The strategy for IGI and objectives

- Start from a core Scientific Institution already involved in Grid e-Infrastructure projects at EU (EGEE, DEISA..) or at national level (PON)
- Include enlargement and representation within the scope
- Focus on setting up and operate a common e-Infrastructure for the Italian Science, including main public resources providers: INFN, SPACI, ENEA, ICTP, INAF, Supercomputing Centers, new PON Consortia, Regional Initiatives….and Users CNR,INAF, INGV, ….
  - Industry as advisors
  - Initial phase should allow different grid M/W (EGEE, UNICORE, GLOBUS…) to cohexist and interoperate
- IGI should provide a consistent/coordinated Italian interface and strategy towards
  - EU Grid infrastructure projects, eIRG and ESFRI, EU EGI
  - International activities
- Support actvities of a vaste range of Scientific disciplines: Physics, Astrophysics, Biology, Health, Chemics, Geophysics, Economy, Finance, and possibile extensions to other sectors as Civil Protection (GMES), e-Learning, dissemination in Universities and secondary school
  - Provide the best value for the available money for computing

The EU sustainability after EGEE-II and DEISA-II

- General agreement on the urgent need to prepare for a permanent Grid infrastructure at EU level
  - Infrastructure managed centrally in collaboration with national bodies (e.g.IGI)
- Support to the proposal of European Grid Organisation (EGI) and its general objectives
  - Provide long term foundation for the operation of production Grid infrastructures for all sciences in Europe in coordination with national initiatives
  - Integrate, test, validate and package Grid middleware for distribution
  - Provide advice, training and support to new user communities
  - Support industrial up taking
- …but grids technology is still in an early stage. Need to complete its evolution to meet very general user community requirements and standards

The strategy towards innovation and general Grid exploitation:C-OMEGA

- Focus: Exploit Italian and general achievements in global Science Grids for early grid exploitation in Industry
  - Releasing and supporting in Italy and Europe a platform of selected and coherent Grid Services Open Source obeying to International Standards
  - Supporting pilot exploitation by Industry, Business and Services
- Leveraging from the large development and standardization effort of international and national research projects like EDG, LCG, EGEE, Grid.it…
- A common set of Services, as the WEB and TCP/IP for
  - eSience Institutions
  - Early commercial adopter
- Should guarantee evolution and adherence to international standards
  - Close collaboration with similar initiatives at EU level: OMII Europe
- The Italian solution:
- The Consortium for the Open M/W Enabling Grid Applications (C-OMEGA)

C-OMEGA: Objectives

- Objectives
- Be the national reference organization, also for activities at EU and International level, aiming at developing, support, diffuse and exploit a platform of Open Source components derived by current Grid projects components and increasingly obeying to international standards
  - No "standards" no large industrial exploitation
- Favor synergy between the Research and Academia with the industrial world, in particular PMI, the pubblic Services (Health, Administration..) etc.
- Support with formation and dissemination activities and pilot projects the early commercial adoption of grids to increase Italian and EU competitiveness
- Profit of recent funds (PNR) made available by MIUR for Joint Research and Innovation projects between Science and Industry
- 2 proposal accepted (~29 M€):
- PRISMA: Grid exploitation in collaborative Engineering (Finmeccanica)
- EGG: Grids for public administration
- c-OMEGA being financed as the foundation of those two projects

The C-Omega partners

- 2005: Proposal submitted to MIUR for the launch of c-OMEGA with FIRB Pnr funds
- Partners involved:
- Public Research Institutions: INFN, CNR, INAF, ICTP,Universities
- Computing Consortia: SPACI….,
- Large end-user companies: Elasis FIAT, RAI
- International IT industries: Oracle…
- National IT companies: Datamat, Engineering SPA, Avanade
- SMEs: Nice, Eurix, Create-Net, Exadron, Synapsis, K-Solutions, Flextel …..
- Public Consortia: ECT(Tn), Pisa Ricerche, ITC IRST (Tn), CEFRIEL (Mi)
- Services: Societa' Italiana per la Telemedicina @TIM

C-OMEGA and OMII Europe

- INFN and the Open Middleware Institute Initiative (OMII) UK have put the c-OMEGA vision at the foundation of the new OMII Europe proposal
  - In final phase of negotiations
- Main goal of OMII-EU is in making available a platform of Grid Services within a Service Oriented Architecture focusing on the "Standardization" of
  - Quality Assurance for software re-engineering process adopted in grid M/W developments
  - Grid Services interface specification
- EGEE-II, DEISA-II etc keep focusing on functionalities
- Leveraging and providing return to current major implementation deployed in large e-Infrastructures
- Key partners include all major M/W developers world-wide
  - INFN representing EGEE
  - Fujitsu and Juelich representing UNICORE and DEISA MW
  - Globus and Condor for US M/W

Conclusions

- First generation of Grid services in LCG/EGEE, DEISA production Grid are currently in use in Italy
- They are fast evolving for more functionalities, robustness and security
  - Application as HEp and Biomed indicate clear directions for the evolution to satisfy those communities
- Some needed services are still new or missing and very important functionalities are required by user communities
- Standards specs are still badly missing for many baseline services, see BES
- However LHC experiments (~10K people), as other Sciences, need to have a fully efficient infrastructure in place as soon as possible. Europe need to provide what is required in time to avoid multiplication of efforts:
  - Unsustainable grid infrastrctures for each VO
- Together with other National Initiatives and CERN IGI need to address the long term sustainability
  - EGI should be finalised after an in depth debate in all countries
- The Consortium c-OMEGA in collaboration with OMII-EU will favor the transfer of Science Grid achievements to Industry and society and will guarantee sustainability and evolution towards standards