Εισαγωγή στο Grid, EGEE και το HellasGrid

Introduction to Grid, EGEE and HellasGrid

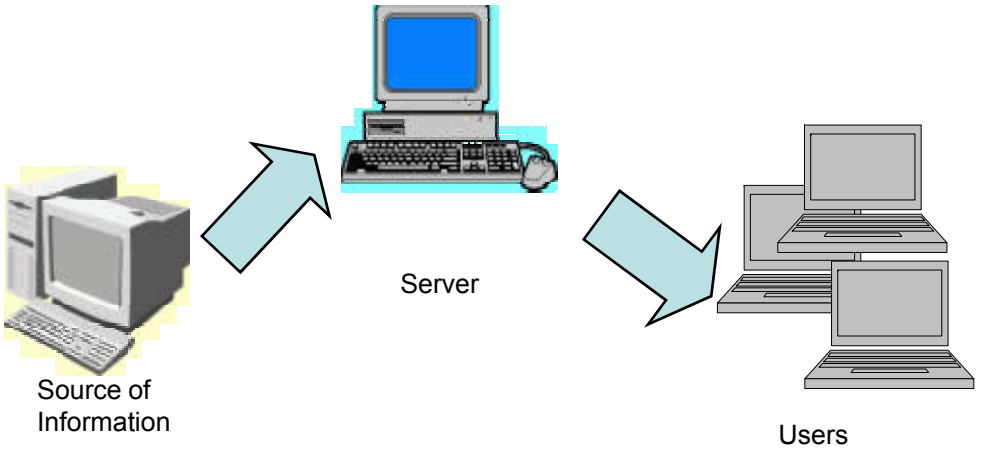
Athanasia Asiki
nasia@cslab.ece.ntua.gr
Computing Systems Laboratory,
National Technical University of Athens

Grid Technologies (Grids)

Contents

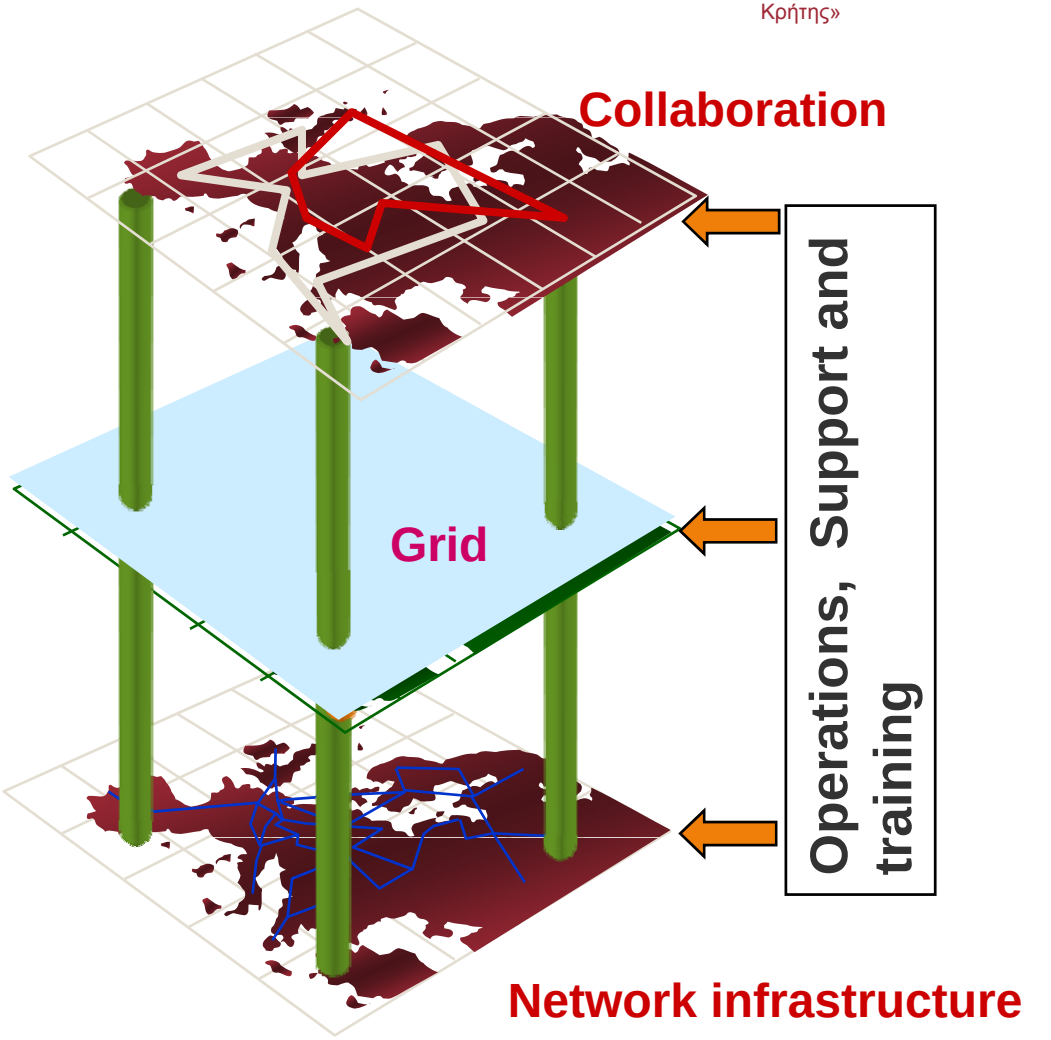
What is the Grid?

- The *World Wide Web* provides seamless access to information that is stored in many millions of different geographical locations



- The *Grid* is an emerging infrastructure that provides seamless access to computing power and data storage capacity distributed over the globe

The Grid


Collaboration
Grid
Operations, Support and training
Network infrastructure linking resource centres

Definition of Grid systems

- Collection of geographically distributed heterogeneous resources
  "Most generalized, globalized form of distributed computing"
- "An infrastructure that enables flexible, secure, coordinated resource sharing among dynamic collections of individuals, institutions and resources"
  Ian Foster and Carl Kesselman
- Offers access to a virtual and very powerful computing system
- A user does not care, in which resource his / her job / jobs is going to be executed

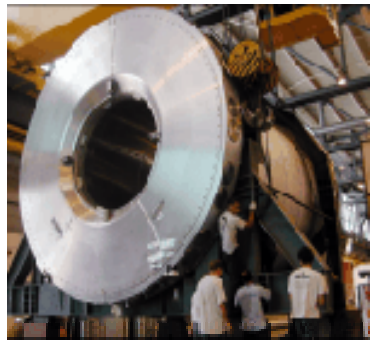
Defining the Grid

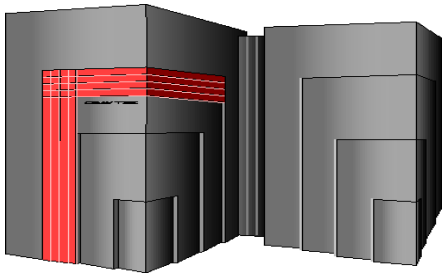
- A Grid is the combination of networked resources and the corresponding middleware, which provides services for the user.

Resources

- An entity that is going to be shared

  such as:
  - ✓ computational units
  - ✓ storage units
  - ✓ sensors
  - ✓ visualization tools
  - ✓ software



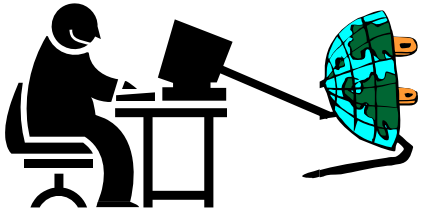


Principles of grid

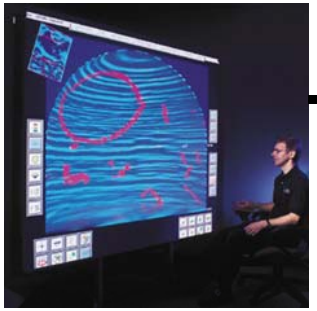
- Resource sharing
  - Geographically distributed resources offer computational power, storage capacity and bandwidth to the users
- Secure and reliable access
  - Authentication
  - Authorization
  - Access policy
- Open standards
- Co-operation among people belonging to different organizations, institutes, groups

Grid metaphorically …

Mobile Access

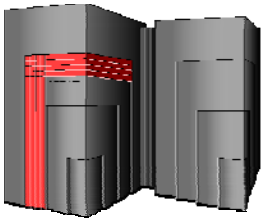


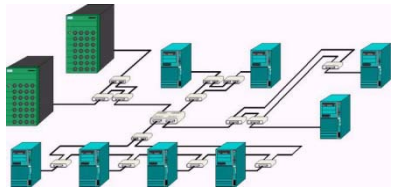
Workstation



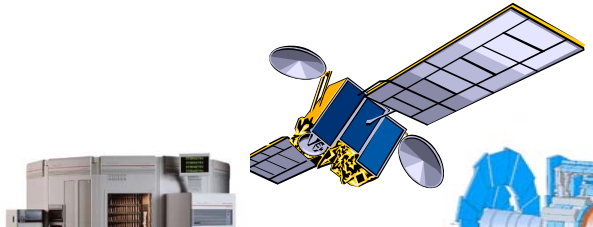
Visualising

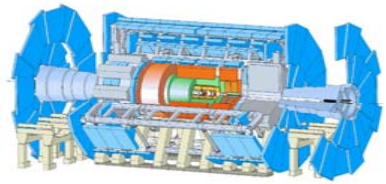
GRID MIDDLEWARE



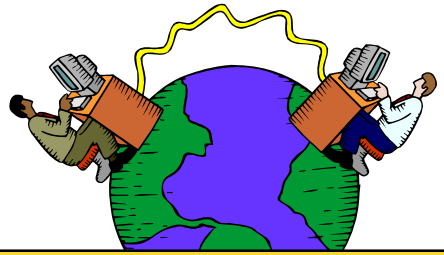


Supercomputer, PC-Cluster





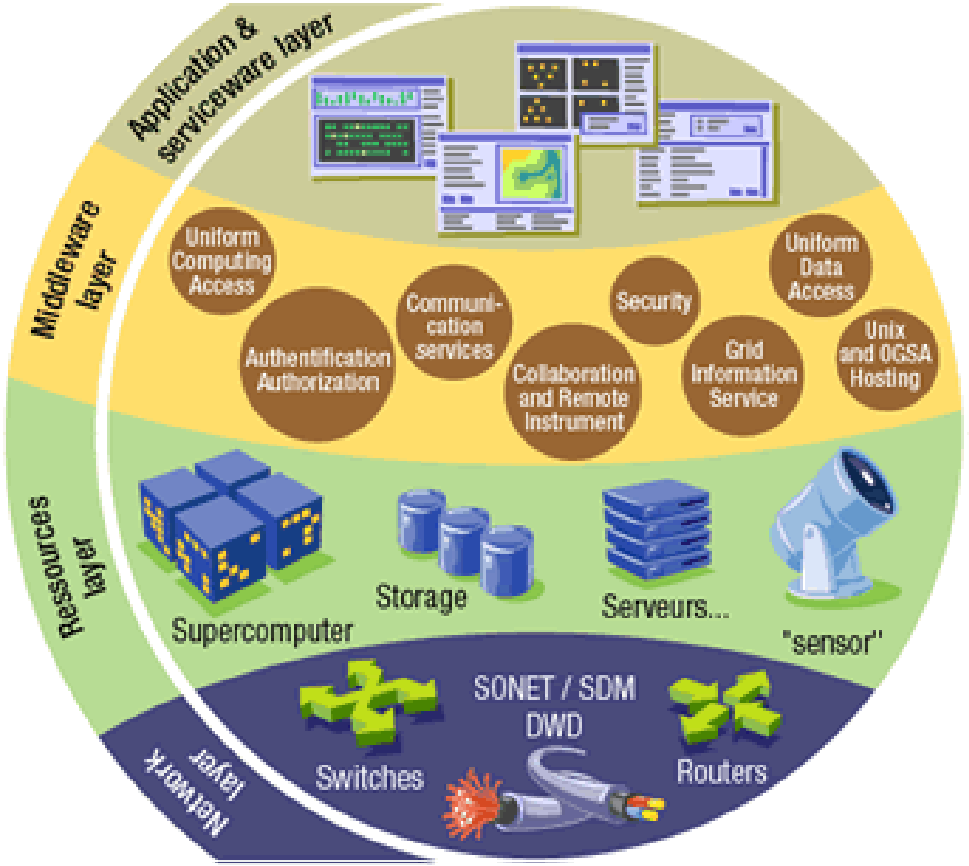
Data-storage, Sensors, Experiments



Internet, networks

Grid middleware

- The Grid relies on advanced softwa between resources and the applica
- The Grid middleware:
  - Basic services
    - Secure and effective access to resources
  - High level services
    - Optimal use of resources
    - Authentication to the different sites that are used
    - Job execution & monitoring of progress
    - Problem recovery
    - Transfer of results back to the user



Grid Middleware

- When using a PC or workstation you
  - Login with a username and password (“Authentication”)
  - Use rights given to you (“Authorisation”)
  - Run jobs
  - Manage files: create them, read/write, list directories
- Components are linked by local hardware
- Operating system
- One admin. domain

- **When using a Grid system**
  - Login with digital credentials – single sign-on (“Authentication”)
  - Use rights given you (“Authorisation”)
  - Run jobs
  - Manage files: create them, read/write, list directories
- **Services are linked by the Internet**
- **Middleware**
- **Many admin. domains**

Why now?

- Development of networking technology (doubling every nine months or so over the last years) and high-speed networks
  - ✓ widespread penetration of optical fibers
  - ✓ wireless connections
  - ✓ new Internet technologies (ADSL, WiMax)

- Moore's law everywhere
  - ✓ Instruments, detectors, sensors, scanners, …
    - ⇨ Organising their effective use is the challenge

- Applications require a huge amount of computations to be executed and the collaboration among scientists

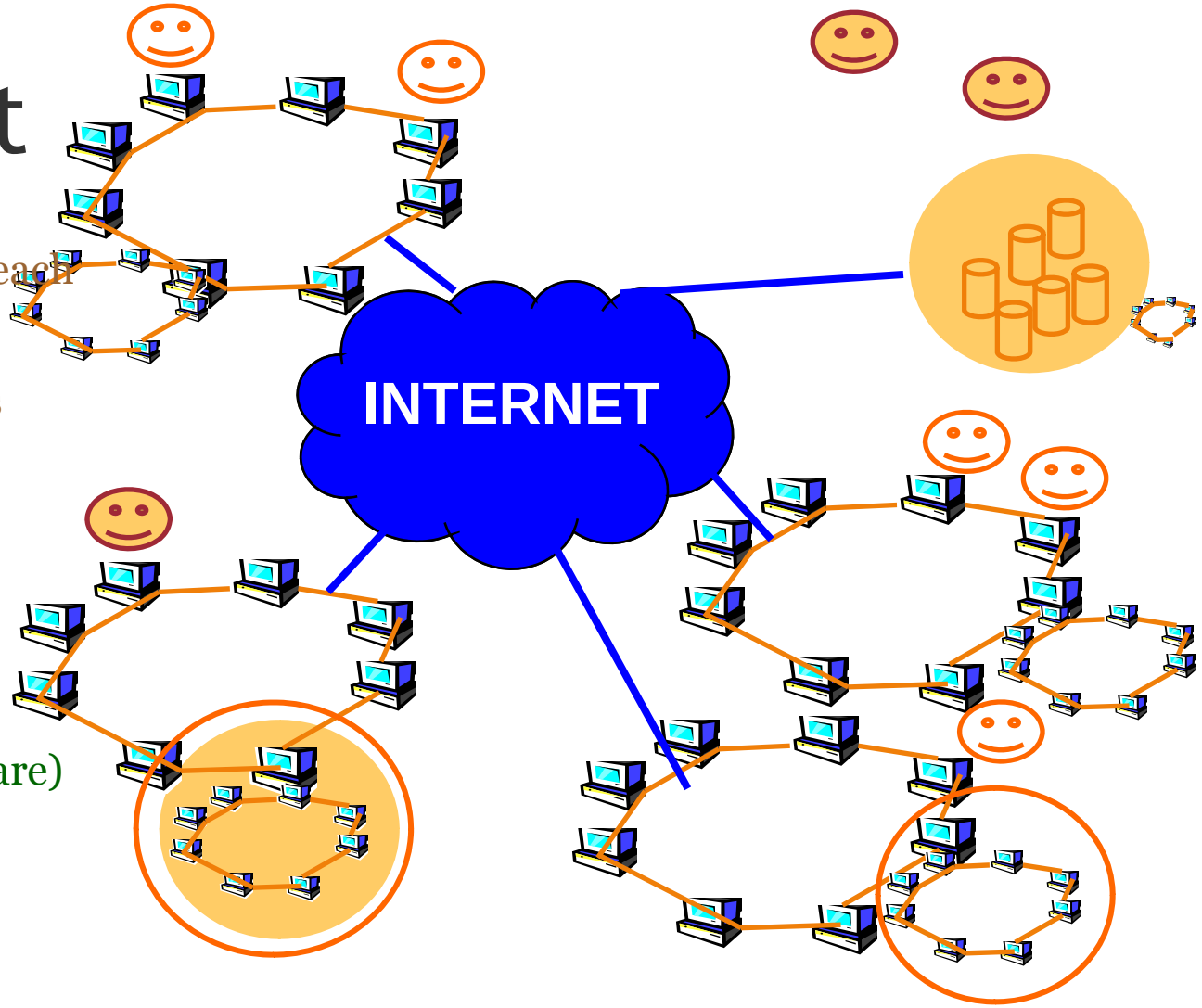
E-science

- Science that became feasible and promiscuous by resource sharing (sharing of data, scientific instruments, computational resources, colleagues) across the Internet

  ✓ Often very compute intensive
  ✓ Often very data intensive (both creating new data and accessing very large data collections) – data deluges from new technologies
  ✓ **Crosses organisational and administrative boundaries**

VO concept

- gLite middleware runs on each shared resource to provide
  - **Data services**
  - **Computation services**
  - **Security service**
- Resources and users form Virtual organisations: basis for collaboration
- Distributed services
- (both people and middleware) enable the grid



Virtual Organizations

- Virtual Organization

  "A set of individuals and / or institutions defined by highly controlled sharing rules, with resource providers and consumers defining clearly and carefully just what is shared, who is allowed to share and the conditions under which sharing occurs"

  Ian Foster

- Abstract entities grouping users, institutions and resources in the same administrative domain

What is going to be shared ?

- ✓ resources
- ✓ software
- ✓ special equipment
- ✓ licenses
- ✓ services
- ✓ Internet bandwidth

Virtual Organizations (VOs)

- Astrophysics, astro-particle physics
- Biomedical and Bioinformatic Applications
- Computational chemistry
- Earth sciences
- Finance
- Fusion
- Geophysics
- High-energy physics
- Infrastructure
- Other …

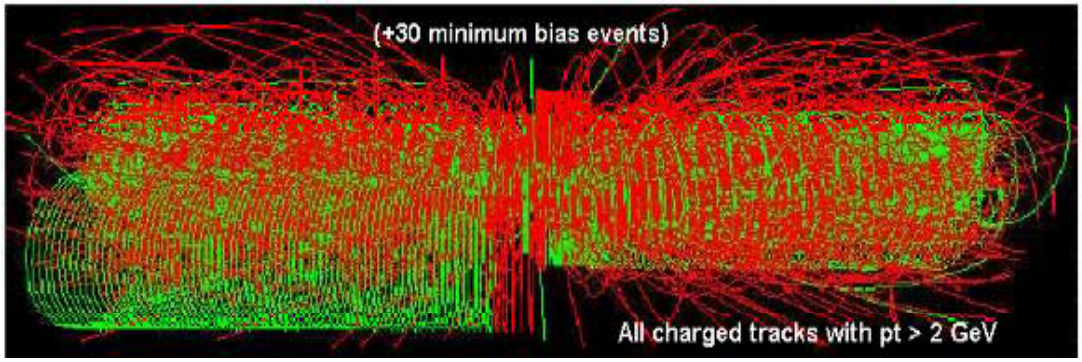
- Our regional VO: SEE
- VO for trainings : hgdemo

- List of existing VOs
  - http://cic.gridops.org/index.php?section=home&page=volist#1

Contents

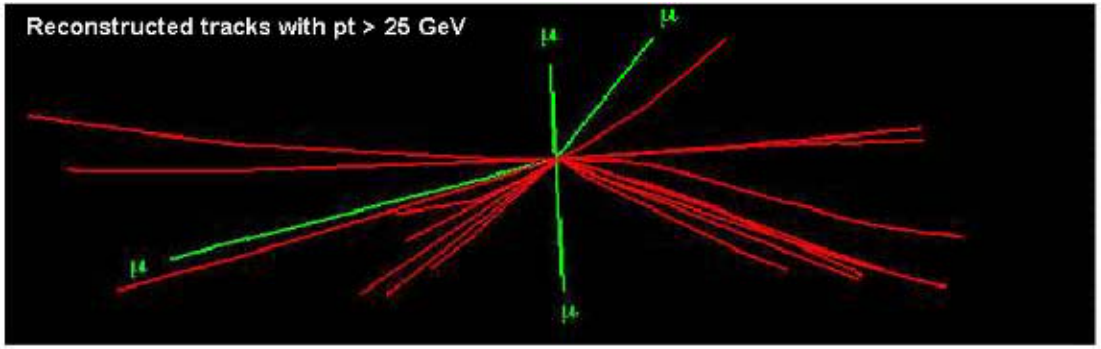
LHC Data Challenge

Starting from this event (particle collision) …



- ✓ Data Collection
- ✓ Data Storage
- ✓ Data Processing

You are looking for this "signature"…

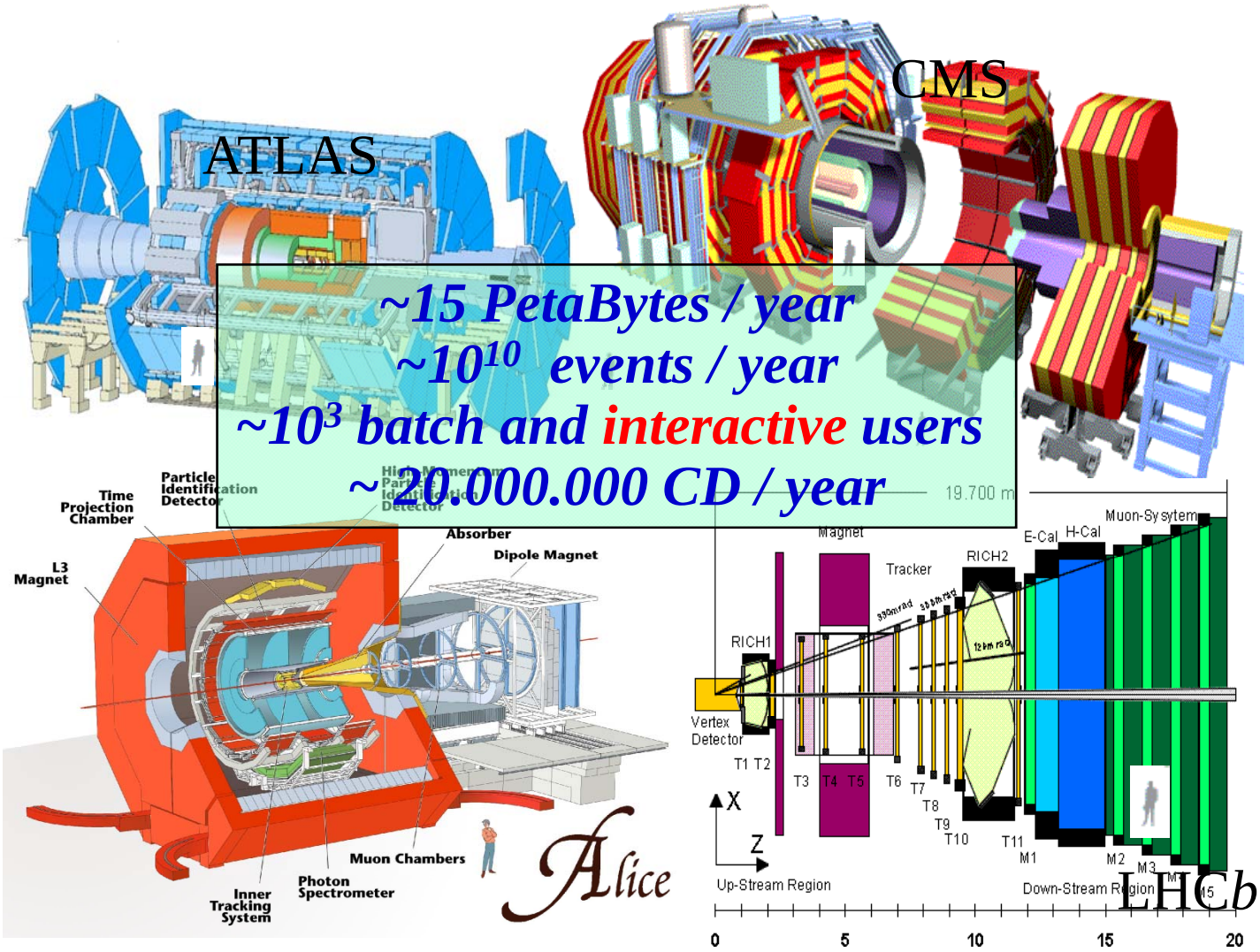


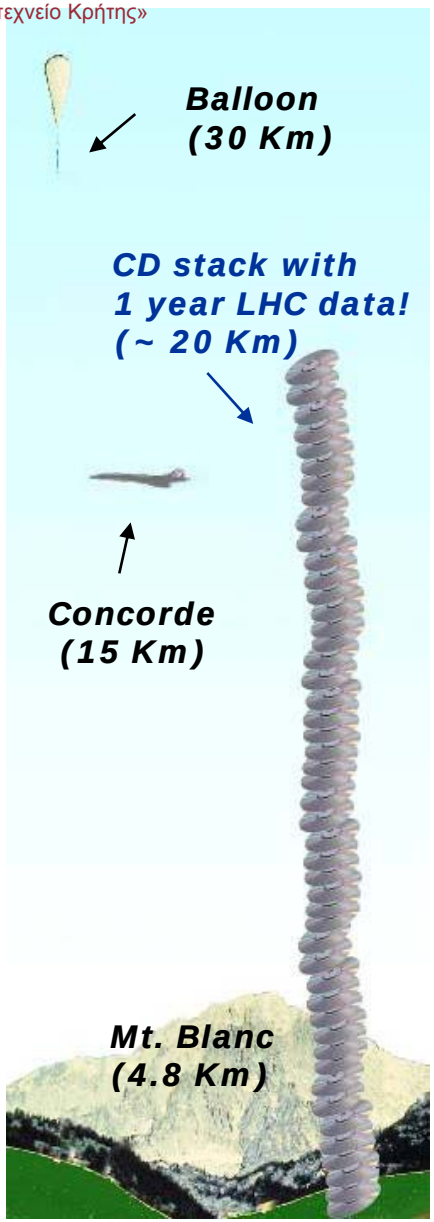
- ***Selectivity: 1 in 1013***

✓Like looking for 1 person in a thousand world populations!

✓Or for a needle in 20 million haystacks!

Amount of data from the LHC detectors





LHC Computing Grid

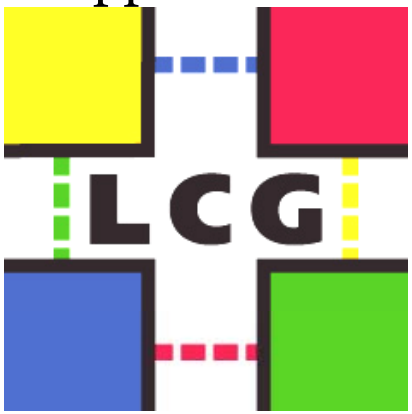
- The LHC Computing Grid Project (LCG) was born to prepare the computing infrastructure for the simulation, processing and analysis of the data of the Large Hadron Collider (LHC) experiments.

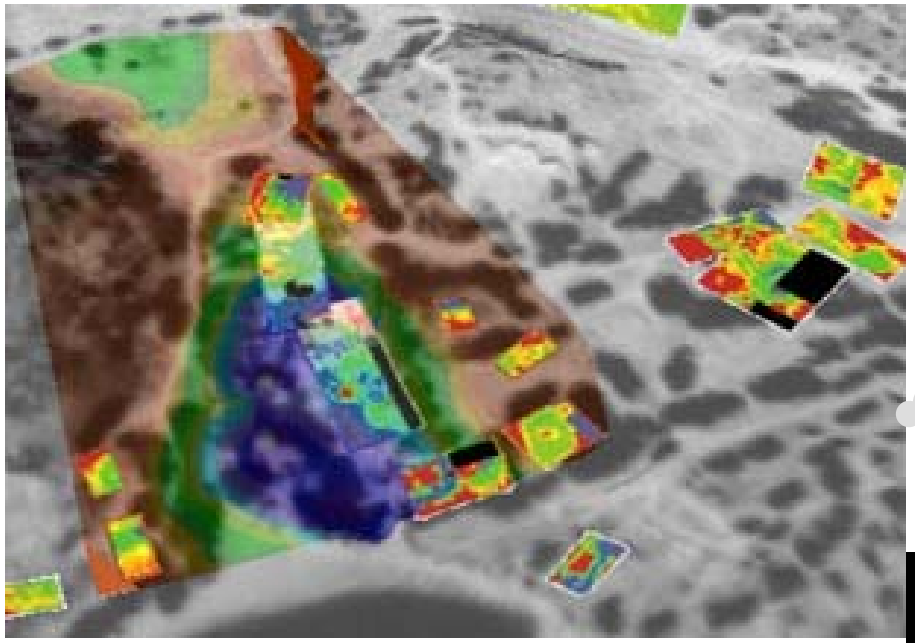
⇨ The processing of the enormous amount of data, that will be generated, will require large computational and storage resources and the associated human resources for operation and support.

⇨ Preparation of a common infrastructure of

- ✓ libraries
- ✓ tools
- ✓ frameworks

required to support the physics application software



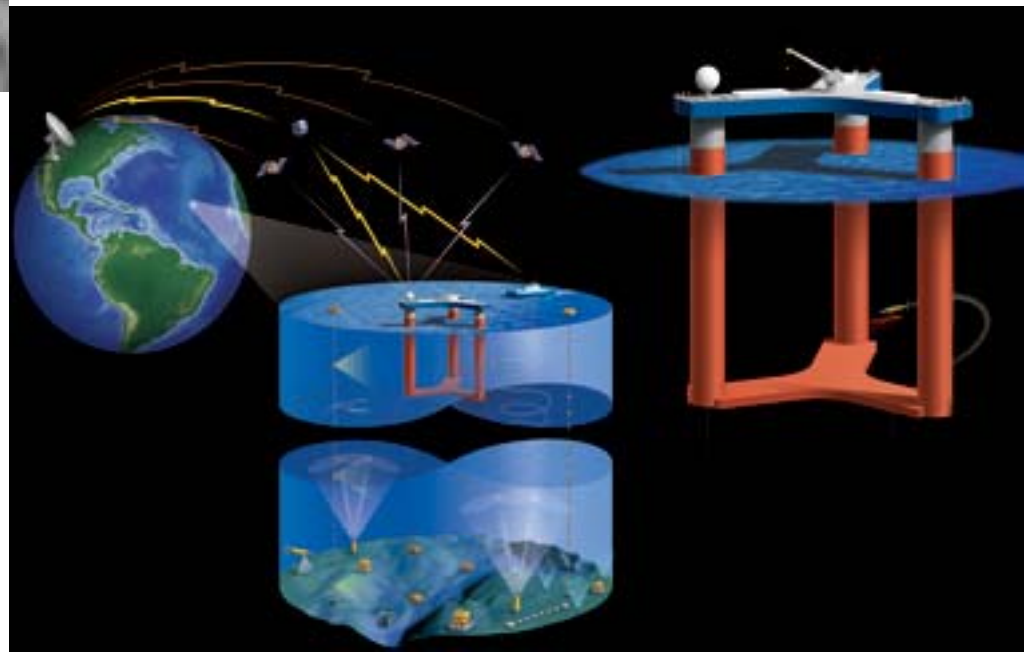


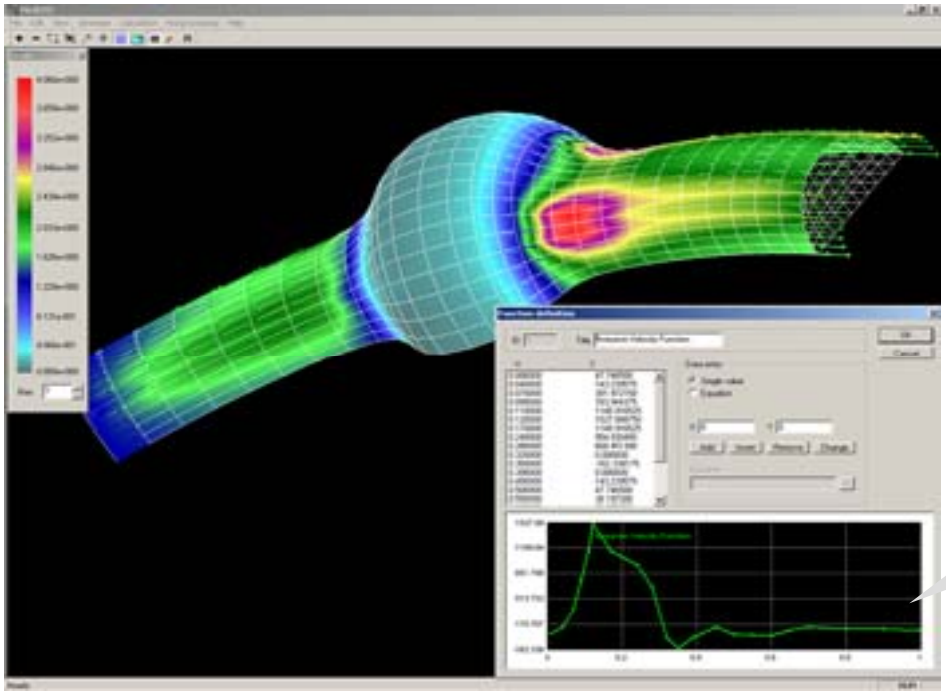
ArchaeoGrid

Create a computer model that weaves together data from many sources and predicts feedback interaction

LOOKING

Observe and analyze data streams in real time. A sensor grid with thousand of different sensors providing real time data and measurements from ocean-going researchers enabling an enormous data grid infrastructure.



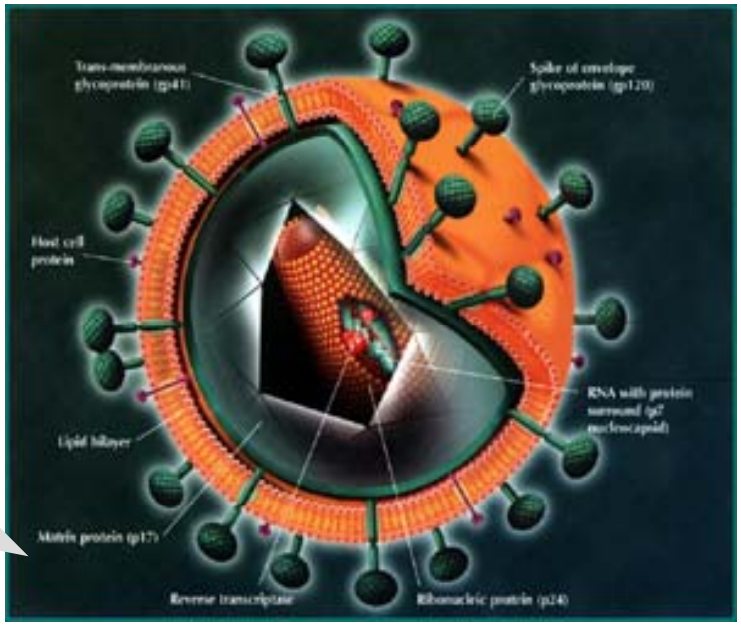


Parallel Blood Flow Simulation

Allows surgeons to perform virtual stent surgery until they get it just right. It combines parameters such as blood velocity and pressure with a series of medical images to automatically create a 3D computational model.

ViroLab

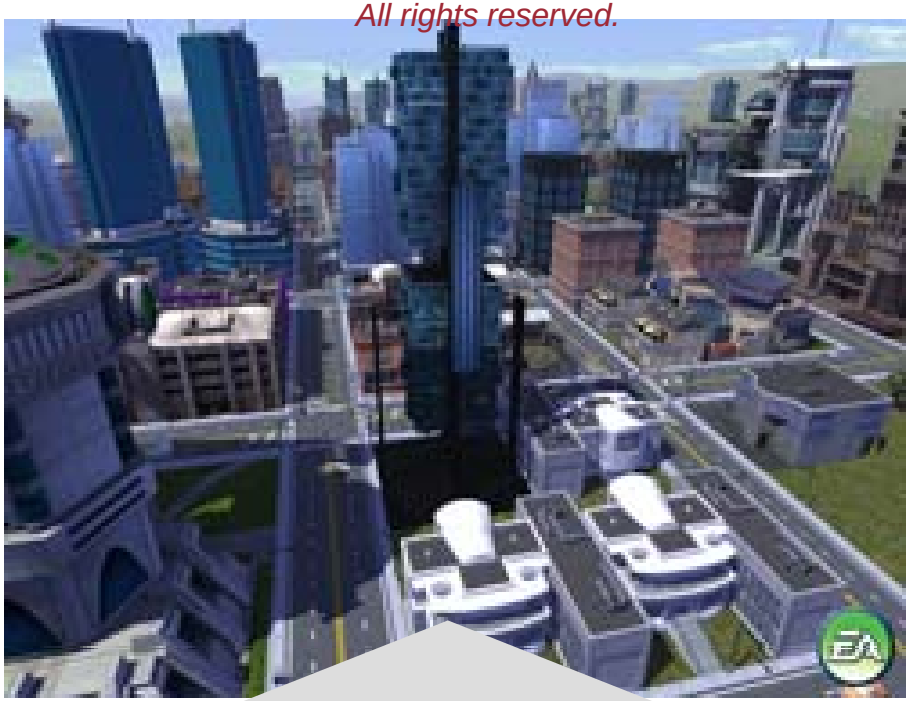
Aims to create a collaborative virtual labaratory for grid-based decision support for viral disease treatment. HIV treatment in the increasingly common case of HIV drug resistance is mainly studied. Virolab “vertically” integrates biomedical information relating to viruses, patients and literature resulting in a rule-based decision support system for drug ranking.



Some examples

Polar Grid

A planned project for an advance cyberinfrastructure, empowering smaller universities, and provide scientists with a gateway to teraflops of power: enough to drive new and improved high-performance simulations and enable measurement and prediction of ice sheet response to climate change and effect on ocean levels.



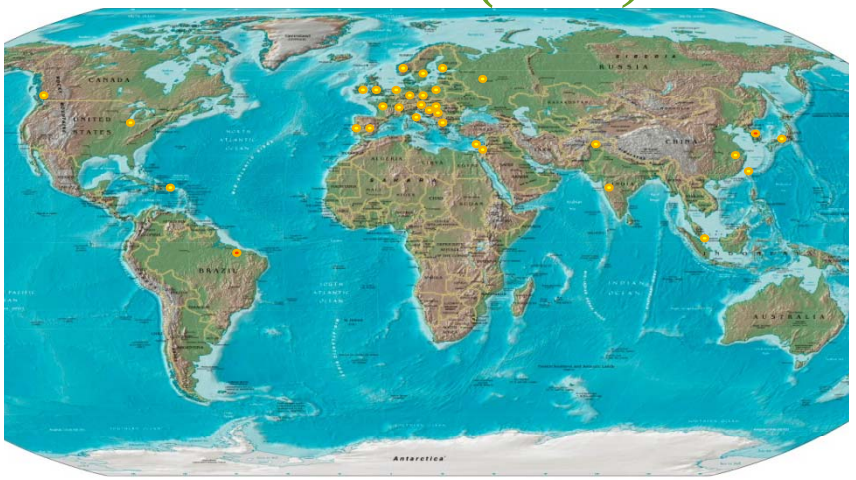
MoSES (Modelling and Simulation for e-Social Science)

Runs predictive models integrating real Census data, survey data, healthcare data of UK population. Determine the impact of different policy decisions and various social aspects like increasing life expectancy, immigration, aging population.

Contents

From EGEE to EGEE III

- EGEE objective:
  "to establish a seamless European Grid infrastructure for the support of the European Research Area (ERA)"



- EGEE:
  - Accomplished all of its objectives
  - Scope expanded beyond Europe

- EGEE II:
  →Full capacity from day one
  →Large-scale, production-quality infrastructure
  →Supporting a wide range of applications
  →Staff with extensive knowledge of Grid technology

EGEE
Enabling Grids for E-Science

- http://www.eu-egee.org/

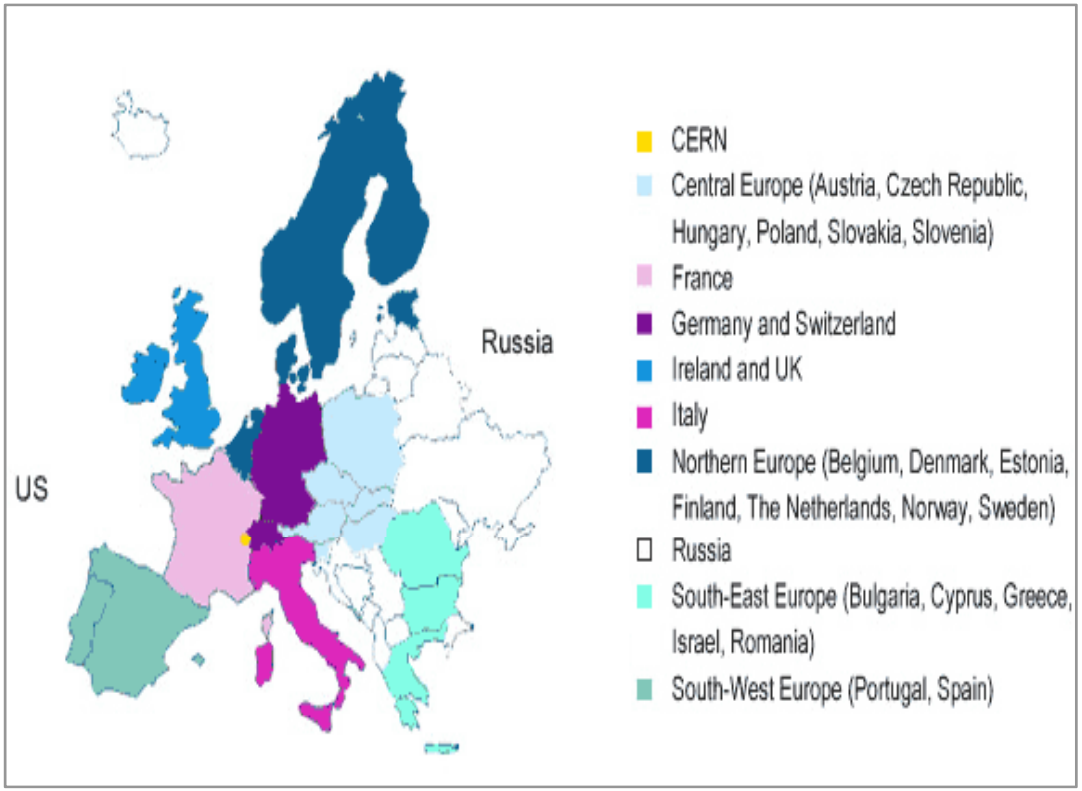
- EGEE-II aims to provide a production quality Grid infrastructure across the European Research Area and beyond.

- EGEE-III started on 1 April 2008

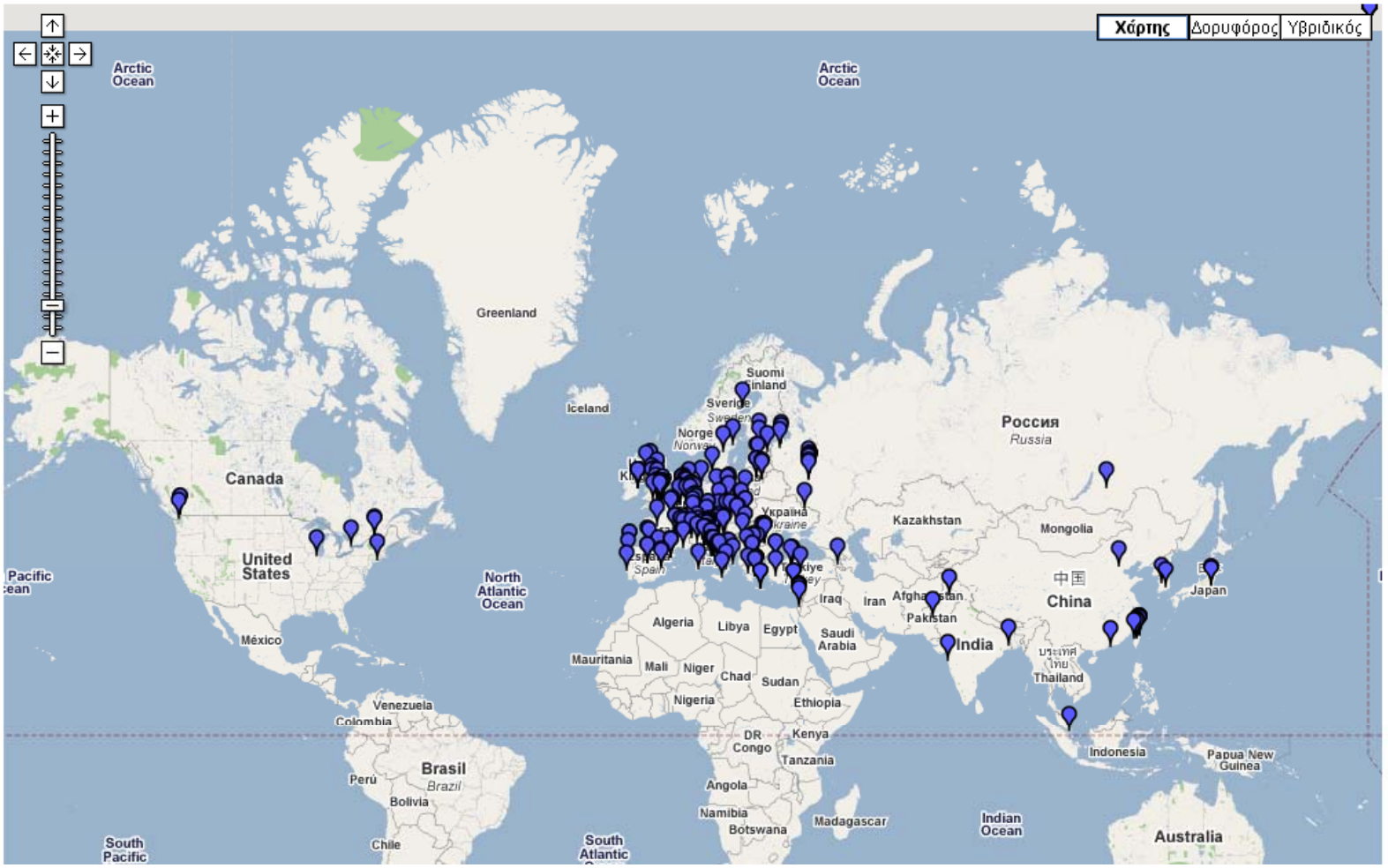
- Available infrastructure to the Research and Academic community 24 hours per day and 7 days per week

- Participants:
  - 240+ institutions
  - 45 countries

- Consists of:
  - 202 sites
  - ≈41.000 CPUs
  - ≈5 PB
  - ≈ 200 VOs
  - 100,000 concurrent jobs



Infrastructure of EGEE



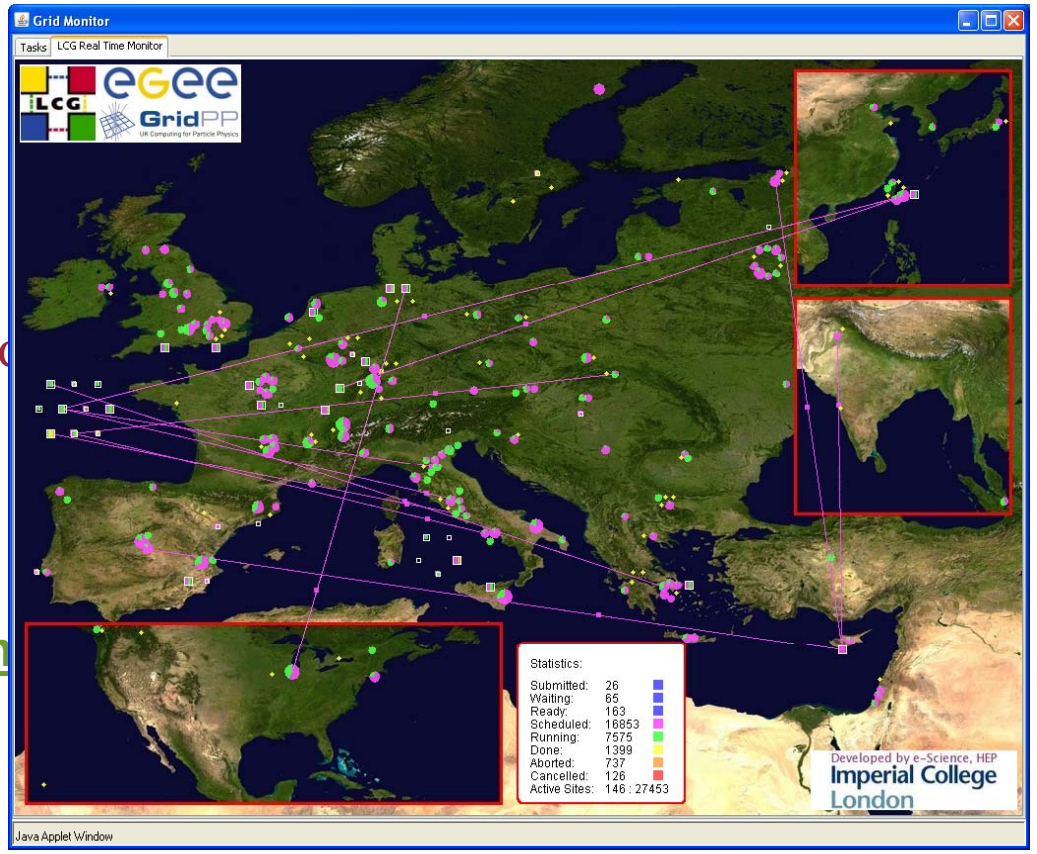
- Information about sites: http://goc.grid.sinica.edu.tw/gstat/

What is happening now?

Real Time Monitor

- Java tool
- Displays jobs running (submitted through RBs)
- Shows jobs moving around world map in real time, along with changes in status

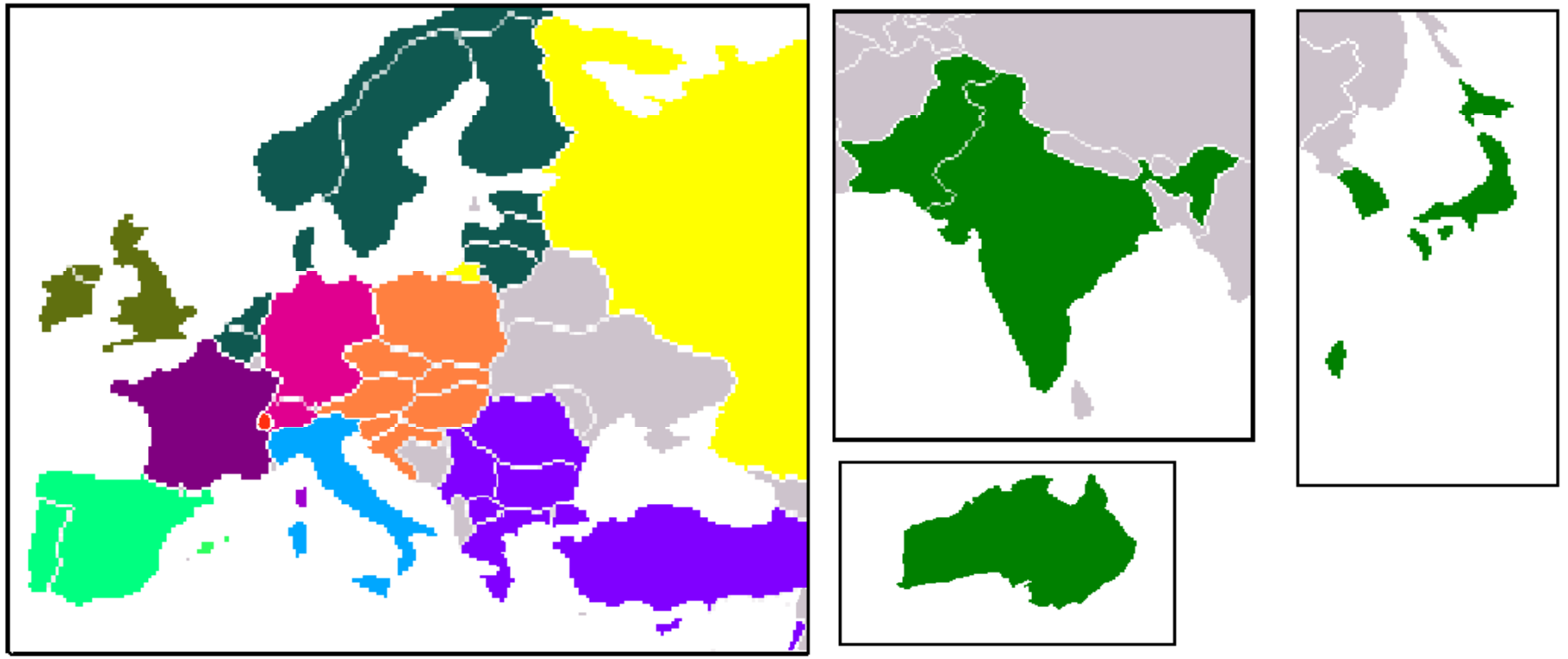
•http://gridportal.hep.ph.ic.ac.uk/rtm/



EGEE Mission

- ✓ Manage and operate production Grid infrastructure for the European Research Area
- ✓ Interoperate with e-Infrastructure projects around the globe (Open Standards-GGF) and Contribute to Grid standardisation efforts
- ✓ Incorporate new users from the industry and from the research community as well assuring the best possible training and support
- Support applications deployed from diverse scientific communities:
  - ✓ High Energy Physics
  - ✓ Earth Sciences
  - ✓ Computational Chemistry
  - ✓ **Fusion**
  - ✓ Biomedicine
  - ✓ Astrophysics
  - ✓ Finance, Multimedia
  - ✓ Geophysics
  - . . .
  - …
- Prepare for a permanent/sustainable European Grid Infrastructure (in a GÉANT2-like manner)

Operations centres in EGEE



Regional Operations Centres (ROC)

- Front-line support for user and operations issues
- Provide local knowledge and adaptations
- One in each region – many distributed

User Support Centre (GGUS)

- In FZK: provide single point of contact (service desk), portal

- https://gus.fzk.de/pages/home.php

EGEE Infrastructures

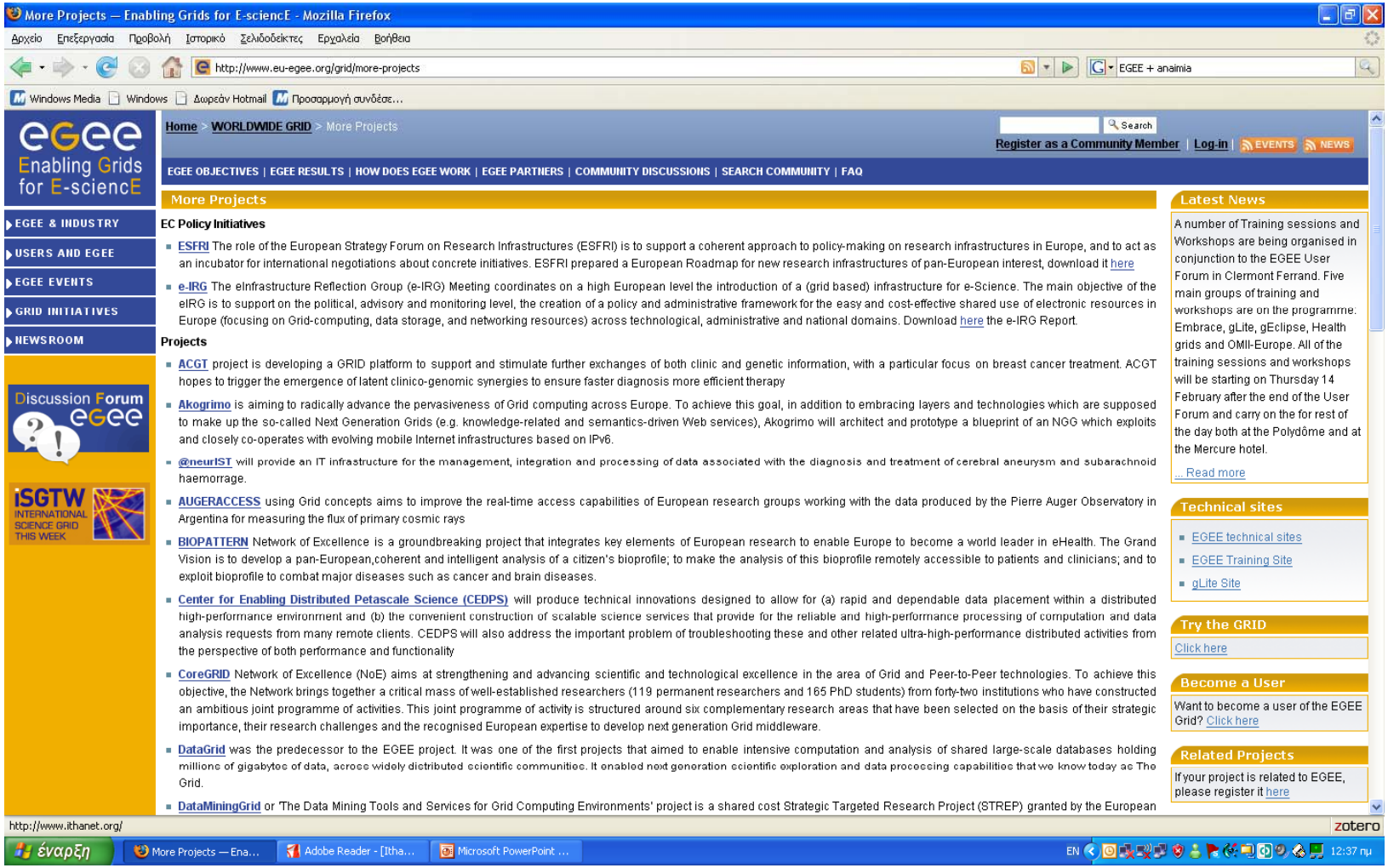
- Production service
  - Scaling up the infrastructure with resource centres around the globe
  - Running only well-tested and reliable middleware
  - Separated into ~200 Virtual Organizations
- Pre-production service
  - Run in parallel with the production service (restricted number of sites)
  - First deployment of new versions of the gLite middleware
- T-Infrastructure (Training & Education) - GILDA
  - Complete suite of Grid elements
  - Everyone can register and use GILDA for training and testing

gLite
Lightweight Middleware for Grid Computing

- Part of the EGEE project
- Next generation middleware for grid computing
- In its development participate from different academic and industrial European centers
- *Provides services for computing element, data management, accounting, logging and bookkeeping, information and monitoring, service discovery, security, workload management*

EGEE Related Projects

- http://www.eu-egee.org/grid/more-projects



Ποιοι έχουν δικαίωμα πρόσβασης

- Γενικά όλη η Ελληνική επιστημονική και ερευνητική κοινότητα:
  - Πανεπιστήμια
  - Ανώτατα Τεχνολογικά Εκπαιδευτικά Ιδρύματα
  - Ερευνητικά Κέντρα και Ινστιτούτα
- EGEE Access Users Policy (AUP):
  - Δικαίωμα πρόσβασης στην υποδομή του Grid έχουν:
    - Η ακαδημαϊκή ερευνητική και εκπαιδευτική κοινότητα.
    - Οργανισμοί χρηματοδοτούμενοι από το δημόσιο, ινστιτούτα και ερευνητικά εργαστήρια τα οποία σχετίζονται με την έρευνα και την εκπαίδευση.
    - Άλλου τύπου οργανισμοί, όπως για παράδειγμα εμπορικές εταιρίες, οι οποίες συνεργάζονται στον τομέα της ακαδημαϊκής έρευνας και εκπαίδευσης με τους παραπάνω οργανισμούς.

Categories of users

- New experimental users: want to port their applications in the Grid environment
- New production users: execute their applications on the production testbeds
- Experienced production users: their applications run on production infrastructures for long time (e.g. High Energy Physics, Bio- Medical)

European Network - GÉANT 2

European Commission
Information Society
and Media

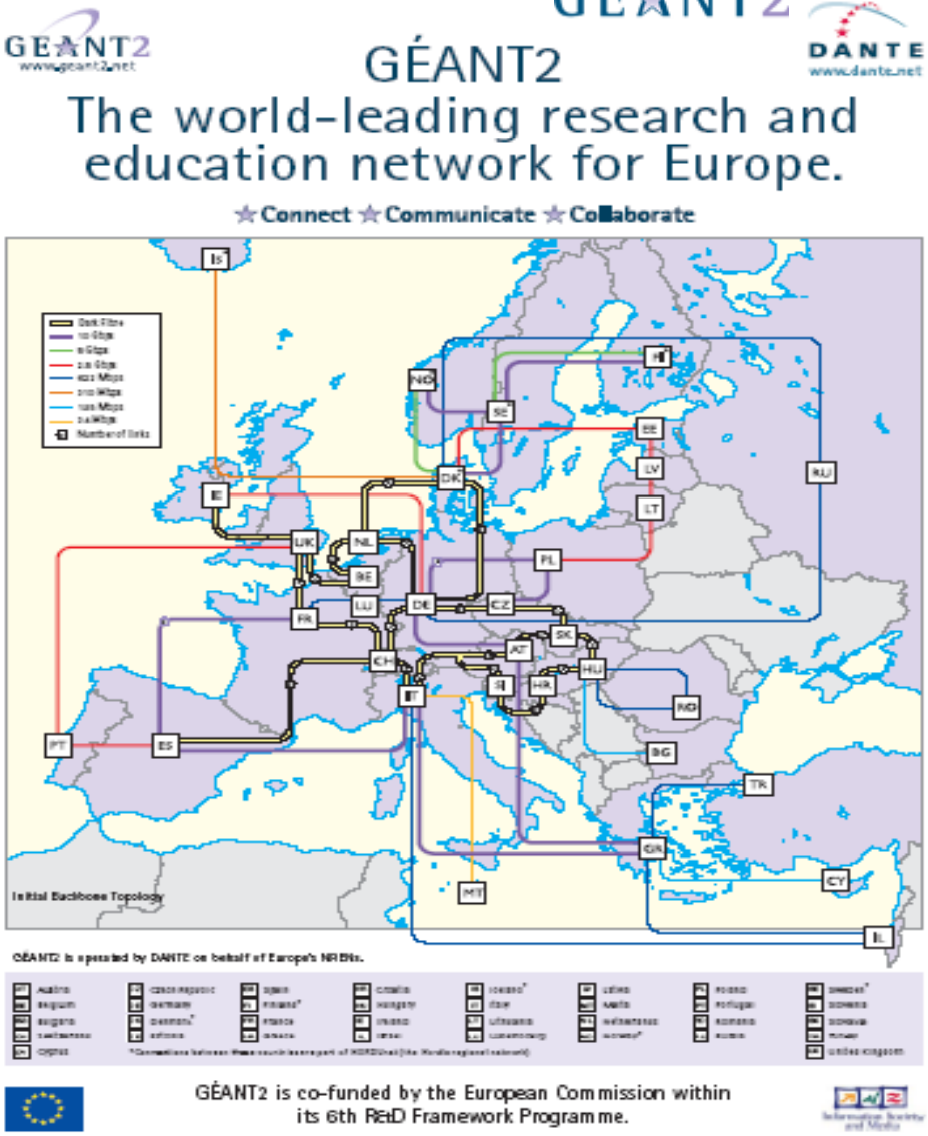
- "GÉANT2 is the seventh generation of pan-European research and education network, successor to the pan-European multi-gigabit research network GÉANT"

http://www.geant2.net/

- The project officially started on 1 September 2004 and will continue to take place for the next 4 years
- The project is supported by the European Committee and by 30 European National Research and Education Networks (NRENs) in 34 countries and is administrated by DANTE (*Delivery of Advanced Network Technology to Europe*).
- It provides services of high quality and readability in the European Education and Research community and connects all the National Research Networks of European Union, Centre and East Europe, Israel and Cyprus

GÉANT 2

- It provides:
  - Basic IPs services
  - Quality of service levels
- Two main services:
  - Routed (Internet) and switched (L1-L2)
- Backbone mixed:
  - Part of will be based on dark fiber
  - Part of it on leased services
- Greece interconnection:
  - 2 * 10Gbps lambdas



Software packages for Grid systems

- Operating system:
  - Linux (+GNU utilities), usually a RHEL3-like, for example Scientific Linux, Fedora Core, etc
- Middleware:
  - gLite v3.x (LCG)
- Libraries and Applications
  - Defined by the system and VOs administrators' foresight
  - The user can install and execute its own programmes

VOs software

Each VO according to its needs installs experimental software:

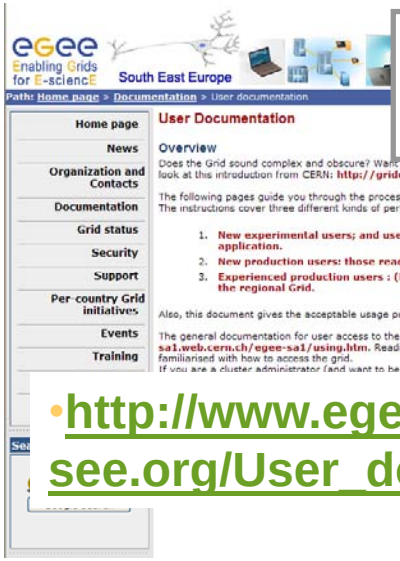
- ATLAS: atlas software (a big collection, v12.2.0 etc)
- CMS: cmkin, cobra, famos, geometry, ignominy, orca, oscar
- ALICE: alien, alice, root, proof
- LHCb: dirac, boole, DC, decfiles, gauss, paramfiles
- BIOMED: gate, cdss, gps@, gromacs, simri3d, gptm3d
- ESR: (earth science specific… eg, idl package)

- The users can negotiate with their VOs for the installation of needed software

Infrastructure Sites

- http://www.grid.auth.gr/pki/seegrid-ca/

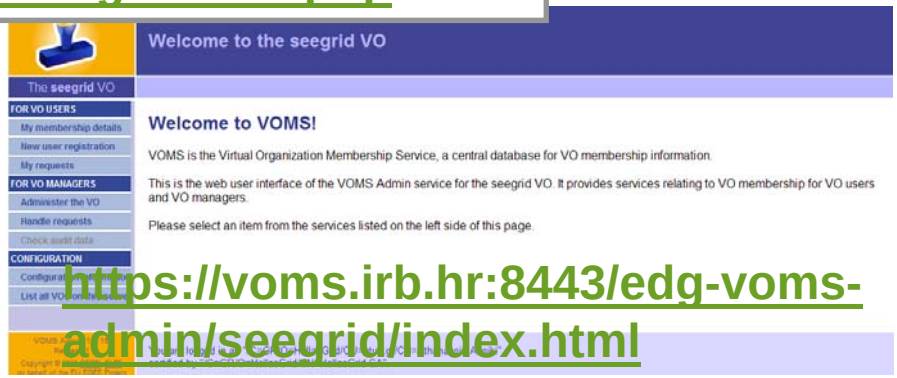
http://wiki.egee-see.org/index.php/SEE-GRID_Wiki



- **EGEE Helpdesk:**

https://helpdesk.egee-see.org/index2.php

- http://www.egee-see.org/User_documentation.php



https://voms.irb.hr:8443/edg-voms-admin/seegrid/index.html

Contents

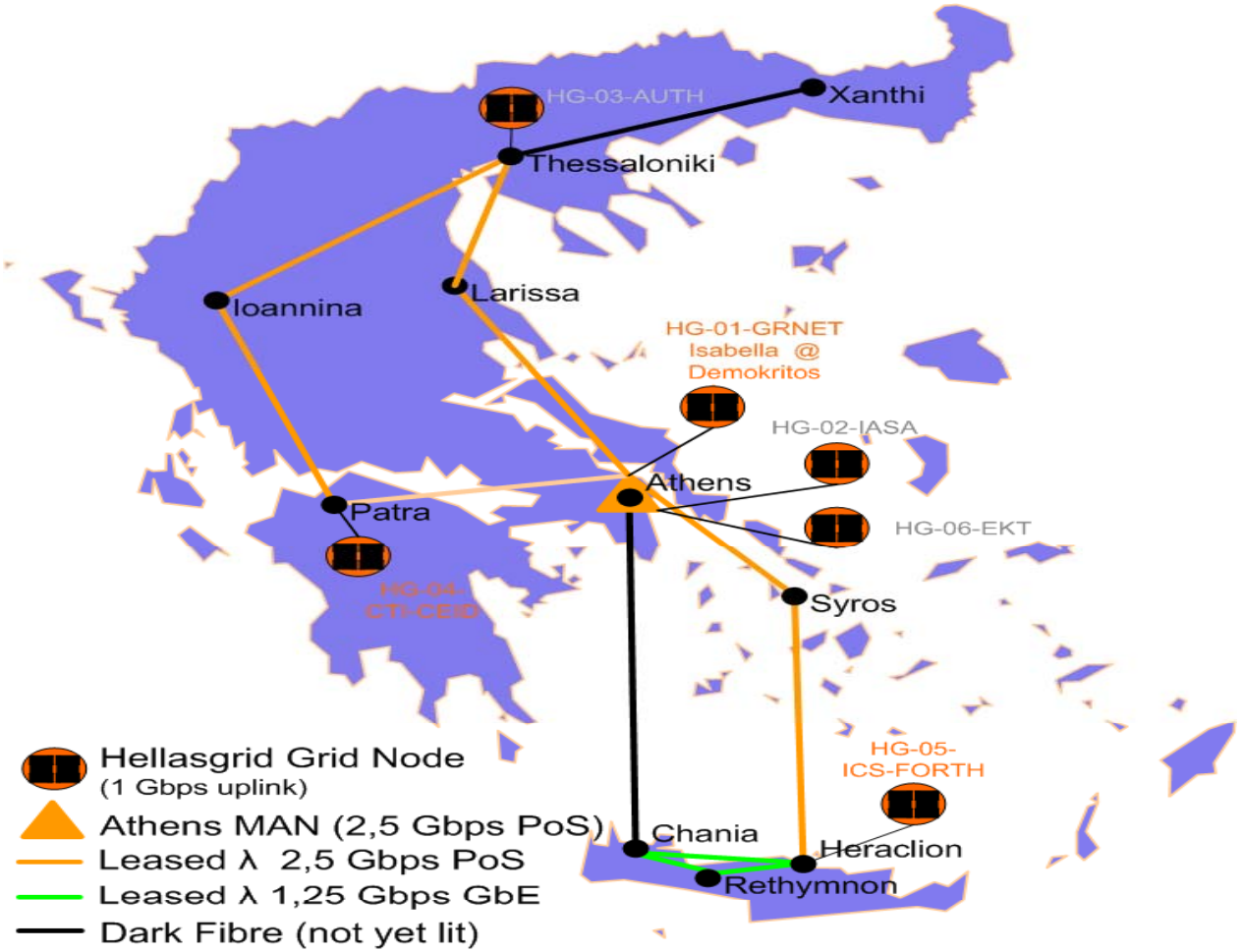
HellasGrid Infrastructure, Phase I & II

http://www.hellasgrid.gr/

- HellasGrid I
  - Located at N.C.S.R. Demokritos (a.k.a. Isabella)
  - 34 dual Intel **P4 Xeon @ 2.8GHz, 1GB RAM, 2x 70GB SCSI HDD**, 2x Gbit
  - IBM FAStT900 Storage Area Network
    - 2x Redundant Fiber Channel Controllers with 1Gbyte Cache each
    - 70x146.8GB= **10,276TB raw storage capability,** over 5 disk shelves
  - Tape Library ~30 TBytes, integrated monitoring
  - December 2004

- HellasGrid II
  - 5 sites: ΕΚΤ (>220), ΙΕΣΕ (48), ΑΠΘ (128), ΙΤΕ (128), ΙΤΥ (128)
  - ~700 CPUs **x86_64, 2 GB RAM, 1x 80GB SATA HDD**, 2x Gbit
  - ~20 TBytes storage space in SAN (5x 4TBs)
  - ~50 TBytes Tape Library in National Documentation Center

HellasGrid e-Infrastructure



HellasGrid structure

- Main site: HG-01-GRNET (Isabella, cslab@ICCS/NTUA)
- HG-02…HG-06 sites @ (NDC, IASA, AUTH, FORTH, CTI)
- Smaller sites (AUTH, UoM, FORTH, Demokritos, HEP-NTUA, IASA)

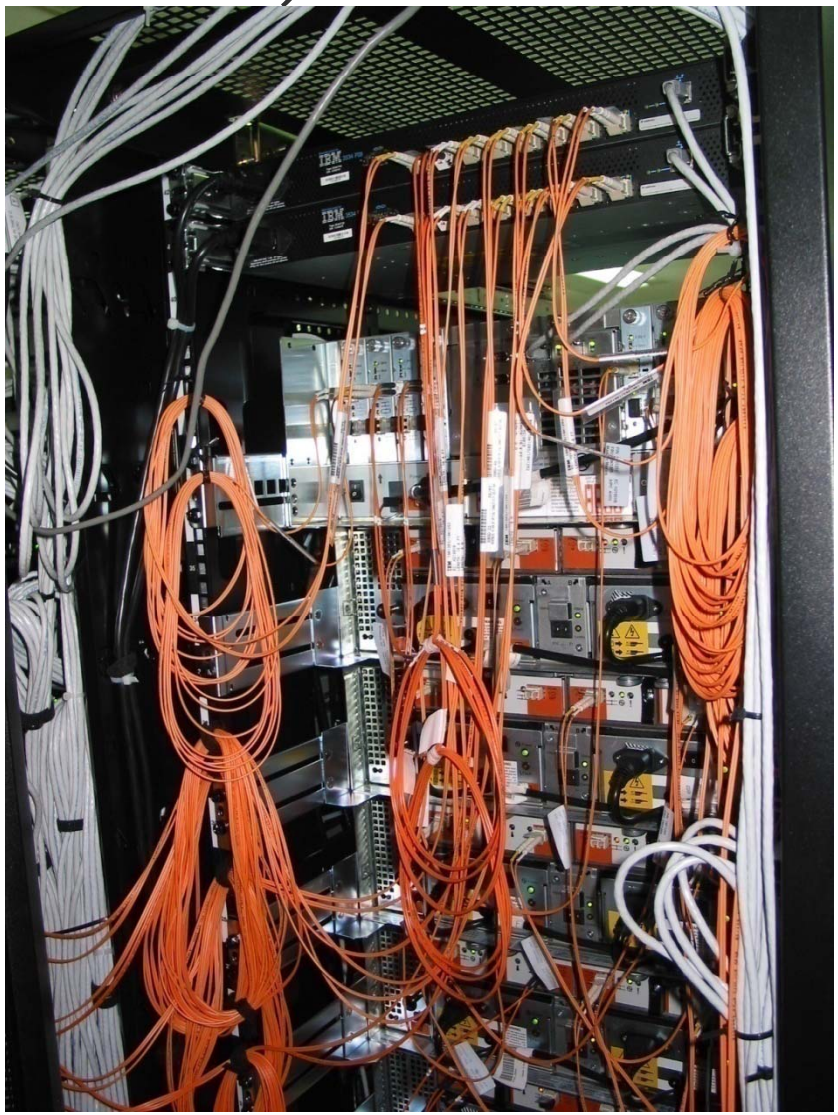
- HG CA and VOMS (AUTH):
  http://www.grid.auth.gr/pki/seegrid-ca/

- Helpdesk (CTI):
  user-support@hellasgrid.gr

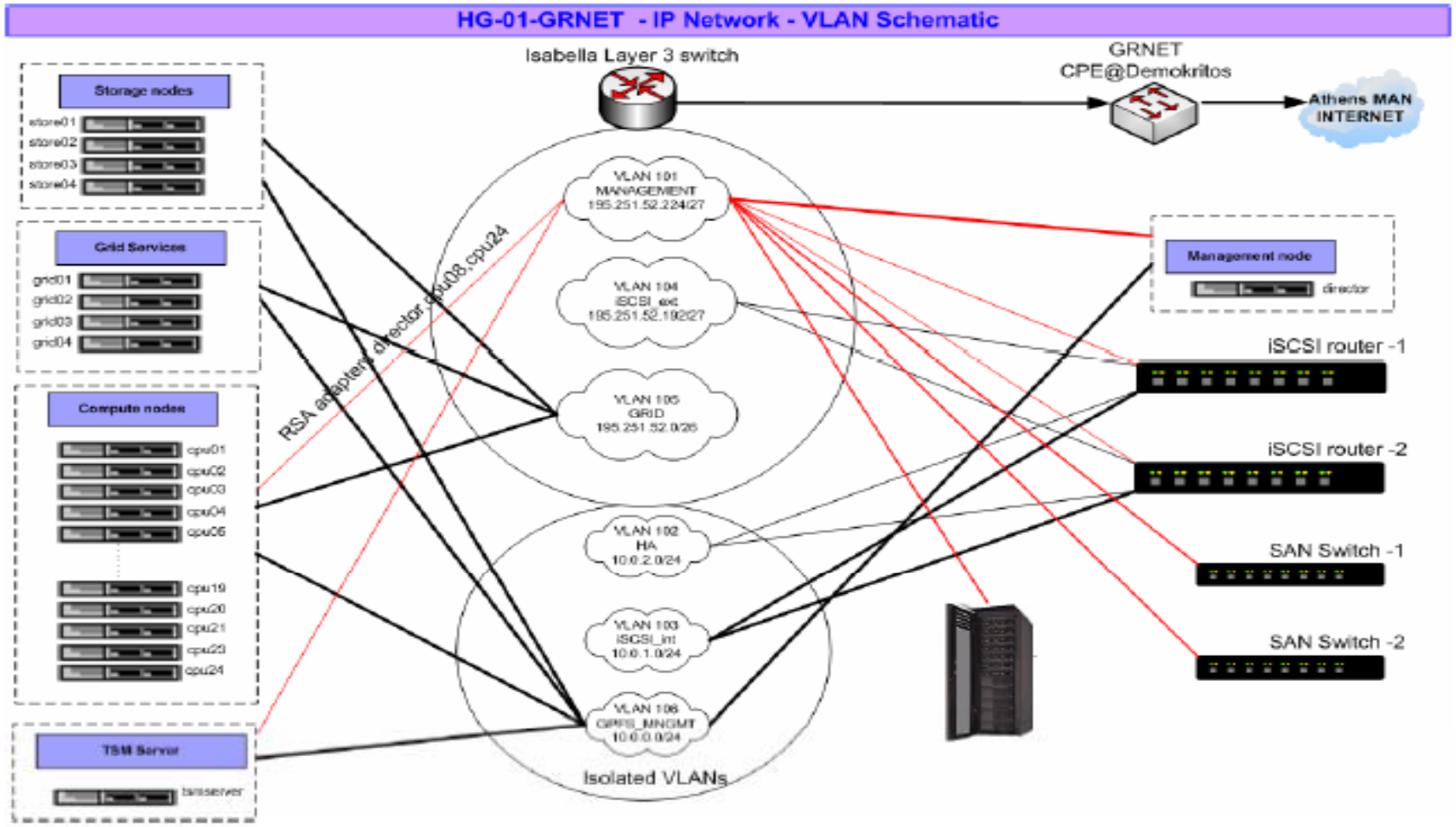
- Regional monitoring tools (FORTH):
  http://hellasgrid-ui.ics.forth.gr/acctROC/

- Apps support (IASA):
  application-support@hellasgrid.gr

HellasGrid I Infrastructure, Isabella



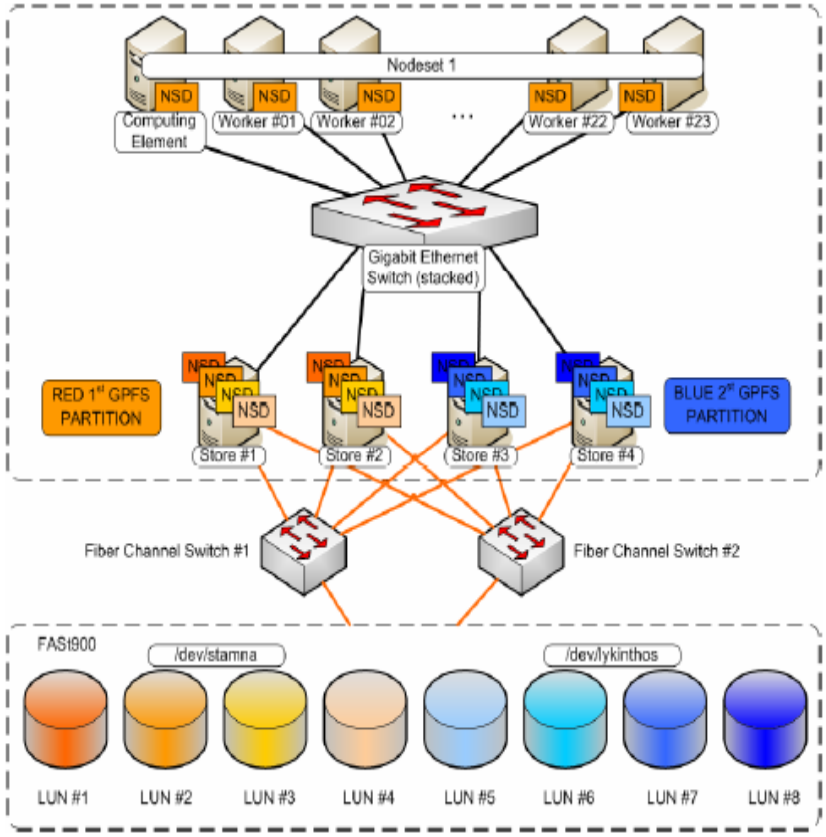
HellasGrid I, Isabella: Network



HellasGrid I, Isabella: Storage

- The first node of the Greek Grid Infrastructure, consisting a prototype for the next HellasGrid nodes
- Remarkable and innovative organization of SAN and filesystems

⇨ Scientific Linux, gLite 3.x, LCG, MPICH, CODESA3D-1.0, VO-alice, VO-atlas, VO-biomed, VO-dteam, VO-cms, VO-esr, VO-lhcb, VO-see (octave), VO-seegrid, …



Core Services (HG-01-GRNET)

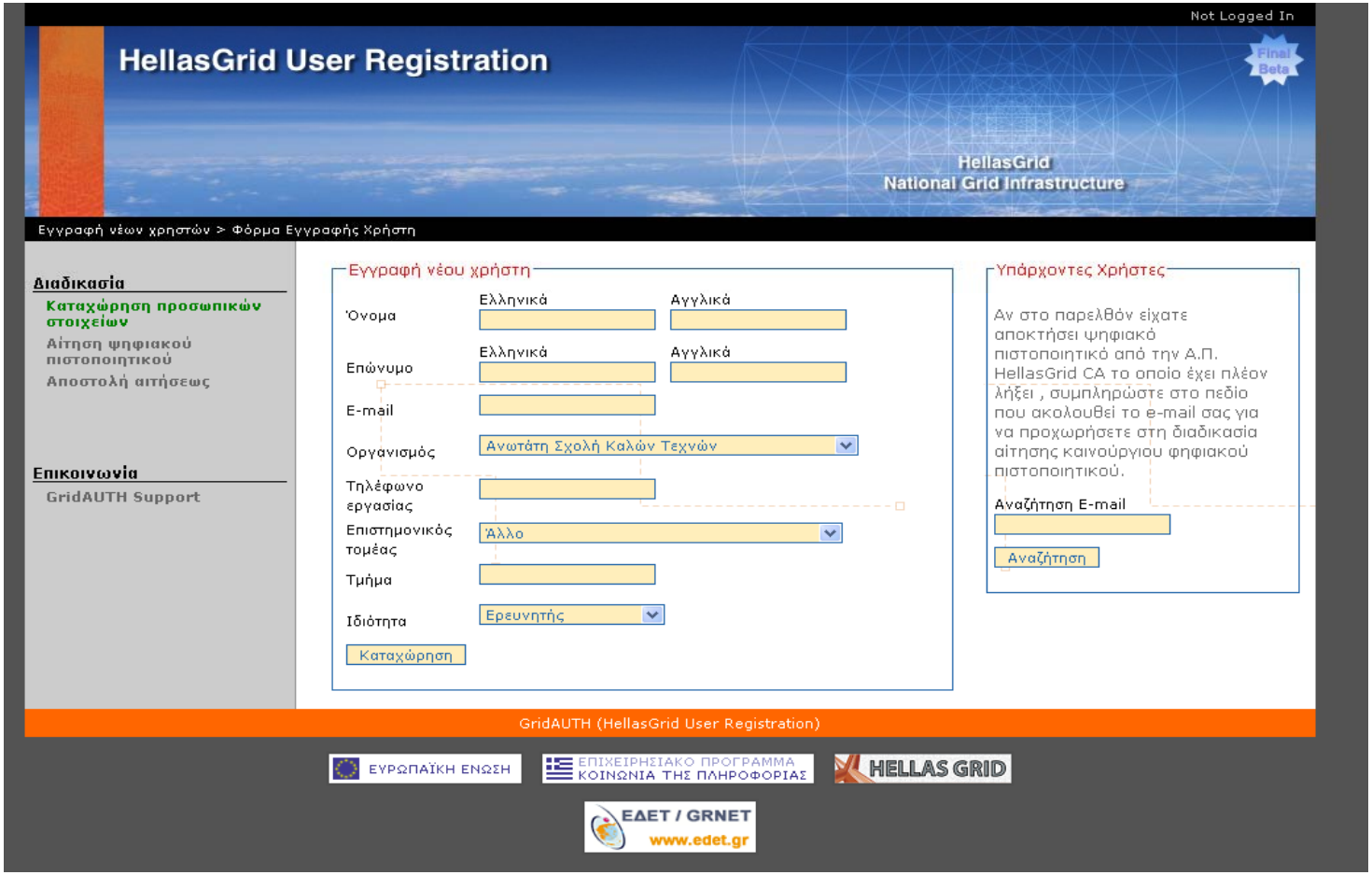
- Core Services
  - Central LCG File Catalog (LFC) for the users of the VOs:
    - eumed, hgdemo, see
  - Worklaod Management System and Information Index (BDII) which can be accessed by the users of the VOs:
    - atlas, alice, lhcb, cms, dteam, sixt, biomed, esr, magic, compchem, see, planck, hgdemo, eumed
  - Catch-All User Interface for HellasGrid
    - Registration is handled through the Hellasgrid User-Support Team
    - UI services are offered by all HG sites

- Certification Services for new sites (SFTs)
  - https://mon.isabella.grnet.gr/sft/lastreport.cgi (Needs a valid HellasGrid Certificate)

HellasGrid II Infrastructure

Registration to HellasGrid

https://access.hellasgrid.gr/register/registration_form



GridICE Monitoring

http://mon.egee-see.org

GridICE the eyes of the Grid

is monitoring eGee Enabling for E-sci

Geo view | Site view | VO view | Help | Abo

GridICE >> Site::ALL

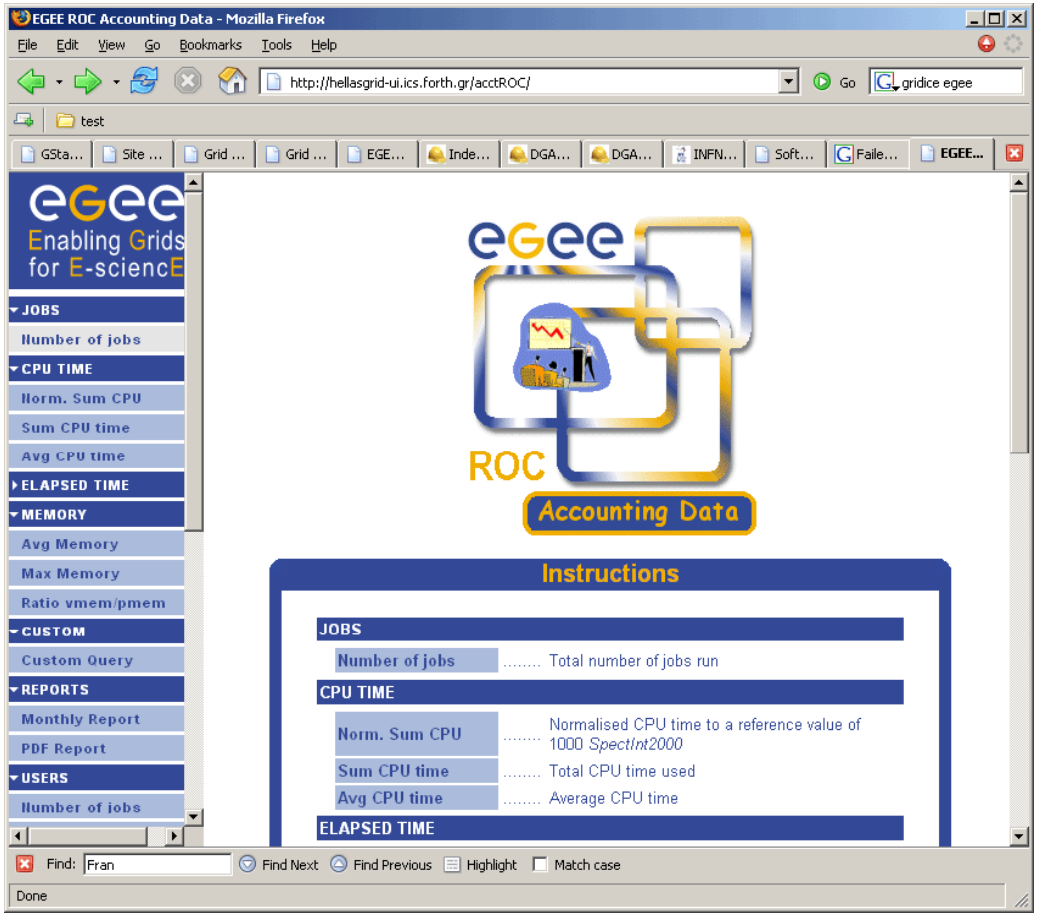
General | Gris | Host | Job | Charts | Network

Overview | Computing | Management

Site		Region	GK#	Q#	RunJob	WaitJob	Computing Resources: JobLoad	Power	WN#	CPU#	CPULoad	Storage Resources: Available	Total	%
AEGIS01-PHY-SCL		SEE	1	8	90	396	90%	95K	25	101	91%	-	-	-
BG-INRNE		SEE	-	-	-	-	16%	0	14	25	17%	-	-	-
BG01-IPP		SEE	2	22	12	954	64%	0	10	11	61%	916.2 GB	1 TB	11%
BG02-IM		SEE	1	6	2	22	100%	0	3	2	100%	15 GB	32.9 GB	54%
BG04-ACAD		SEE	1	12	54	241	98%	0	40	62	96%	24.8 GB	63.7 GB	61%
BG05-SUGrid		SEE	1	8	10	208	69%	0	5	16	38%	35.2 GB	83.5 GB	58%
CY-01-KIMON		SEE	1	10	37	11	5%	0	37	74	4%	-	-	-
GR-01-AUTH		SEE	1	12	10	341	92%	0	8	12	75%	165.2 GB	217.6 GB	24%
GR-03-HEPNTUA		SEE	-	-	-	-	10%	0	15	30	7%	-	-	-
GR-04-FORTH-ICS		SEE	1	10	2	429	100%	0	4	3	100%	-	-	-
GR-05-DEMOKRITOS		SEE	-	-	-	-	-	-	-	-	-	50.1 GB	67.7 GB	26%
GR-06-IASA		SEE	-	-	-	-	20%	0	10	20	0%	-	-	-
HG-01-GRNET		SEE	-	-	-	-	100%	0	23	64	68%	-	-	-
HG-02-IASA		SEE	-	-	-	-	7%	0	59	118	9%	-	-	-
HG-03-AUTH		SEE	1	16	92	463	97%	0	58	118	90%	2.5 TB	2.7 TB	9%
HG-04-CTI-CEID		SEE	1	15	113	71	97%	0	59	118	100%	2.3 TB	2.5 TB	6%
HG-05-FORTH		SEE	1	15	92	78	92%	0	59	118	100%	-	-	-
HG-06-EKT		SEE	1	17	225	280	100%	0	113	224	100%	-	-	-
HR-01-RBI		SEE	1	4	2	0	-	0	0	0	-	-	-	-
IL-BGU		SEE	1	2	0	8888	0%	0	5	5	5%	153.3 GB	154.9 GB	1%
LCG-IL-OU		SEE	-	-	-	-	100%	0	5	8	100%	-	-	-
MK-01-UKIM_II		SEE	1	5	9	197	-	-	-	-	-	-	-	-

Accounting statistics for the HellasGrid Infrastructure

http://hellasgrid-ui.ics.forth.gr/HG/



Q&A

Thank you!

Αναφορές

- Grid café:
  http://gridcafe.web.cern.ch/gridcafe
- Open Grid Forum:
  http://www.gridforum.org/
- HellasGrid Task Force
  http://www.hellasgrid.gr/
- EGEE (Enabling Grids for E-science)
  http://public.eu-egee.org/intro/
- The Globus Alliance
  http://www.globus.org/
- Worldwide LHC Computing Grid
  http://goc.grid.sinica.edu.tw/seegridwiki/
- Grid Operations Centre
  http://goc.grid-support.ac.uk/gridsite/gocmain/
- gLite UserGuide
  https://edms.cern.ch/file/722398//gLite-3-UserGuide.pdf

Χρήσιμα web links

- EGEE
  http://www.eu-egee.org/
- EGEE – South East Europe
  http://www.egee-see.org/
- SEE-GRID
  http://www.see-grid.org/
- Hellas Grid Task Force
  http://www.hellasgrid.gr/
- GRNET
  http://www.grnet.gr/
- gLite
  http://glite.web.cern.ch/glite/
- SEE-GRID Wiki
  http://goc.grid.sinica.edu.tw/seegridwiki/
- GOC Wiki
  http://goc.grid.sinica.edu.tw/gocwiki/
- SEEREN2
  http://www.seeren.org/