Εισαγωγή στο EGEE και το HellasGrid

Introduction to EGEE and HellasGrid

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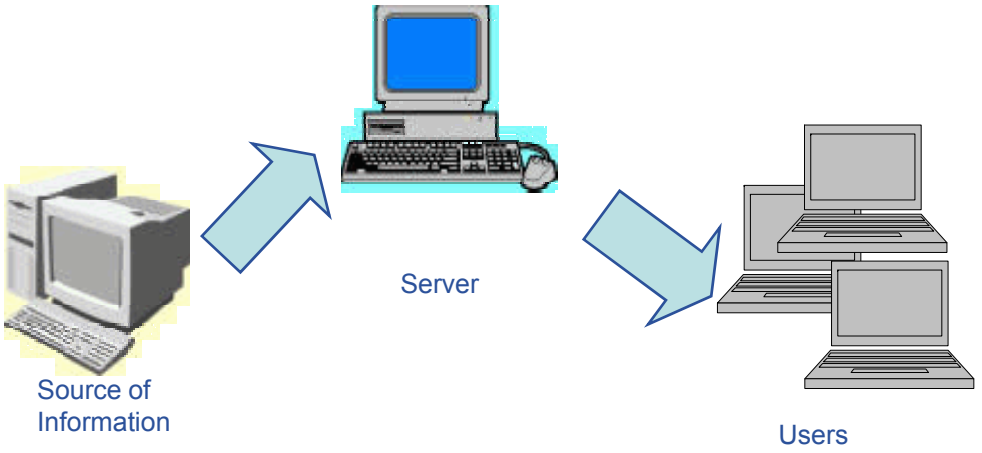
Grid Technologies (Grids)

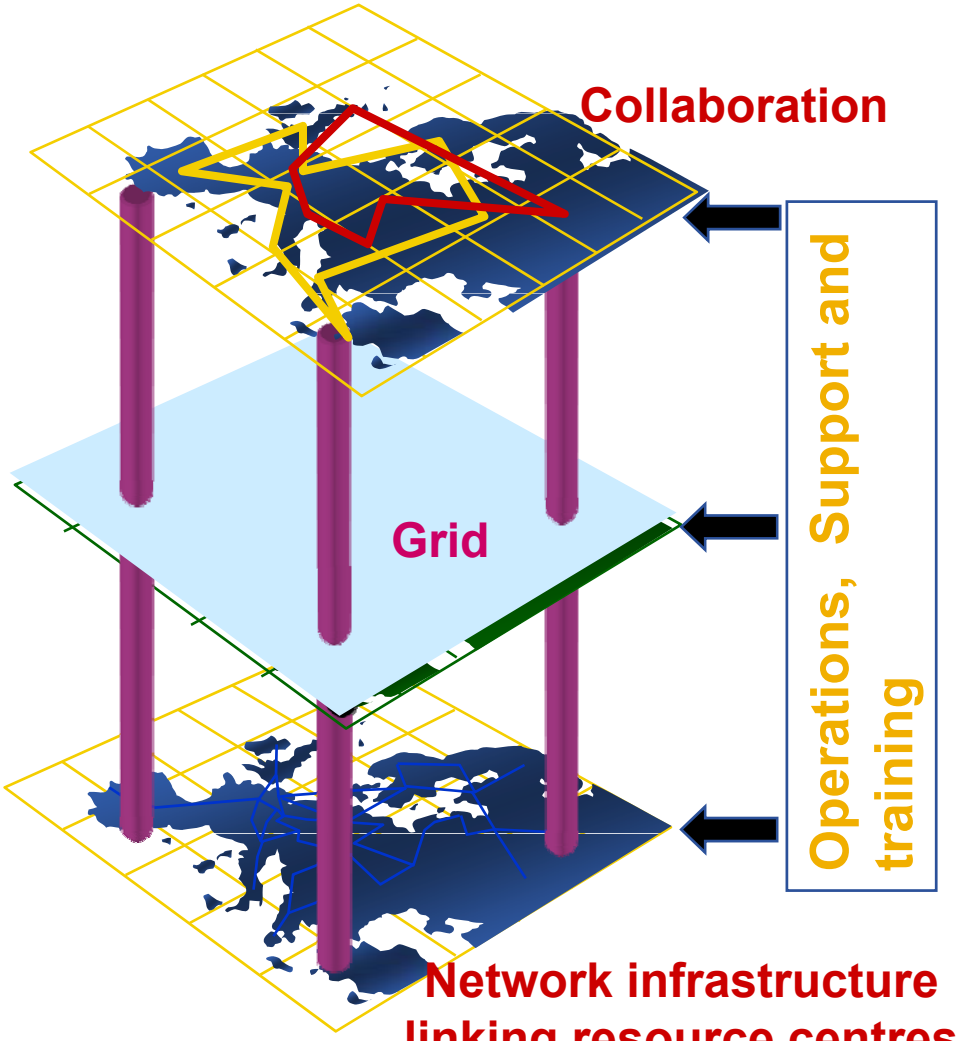
What is the Grid?

- **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

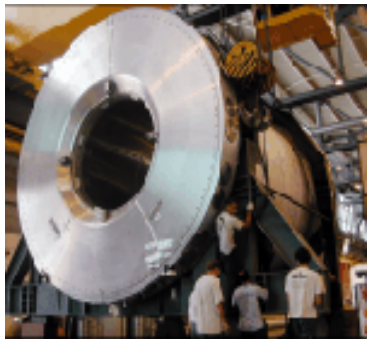
Definition of Grid systems

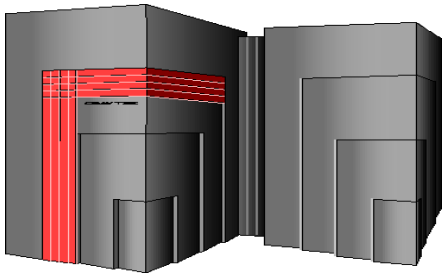
- **Collection of geographically distributed heterogeneous resources**
  "Most generalized, globalized form of distributed computing"
- "An infrastructure that enables flexible, secure, coordinated resource sharing among dynamic collections of individuals, institutions and resources"
  Ian Foster and 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**

Resource

- **An entity that is going to be shared**

  such as:
  - ✓ **Computational units**
  - ✓ **Storage units**
  - ✓ **Software**

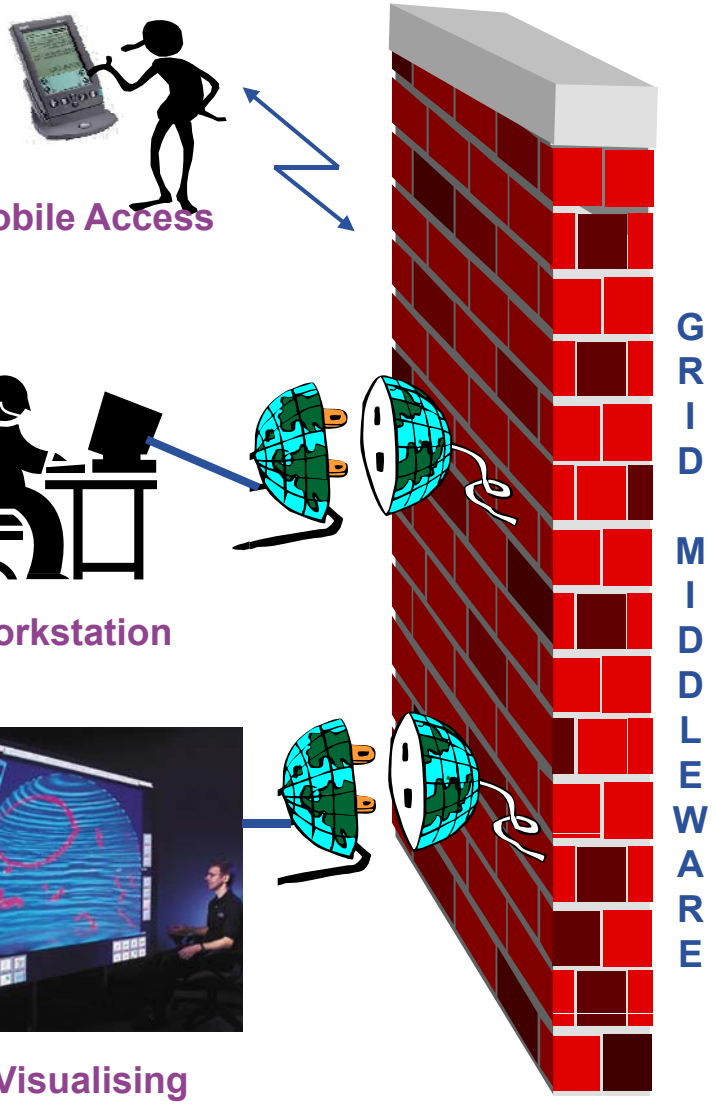


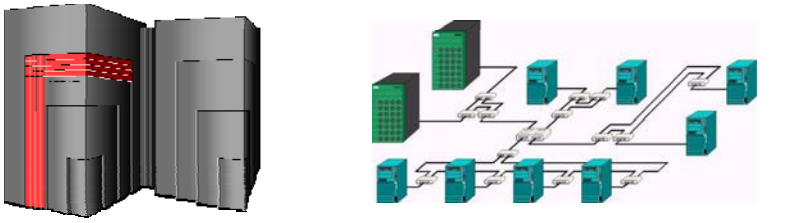


Principles of grid

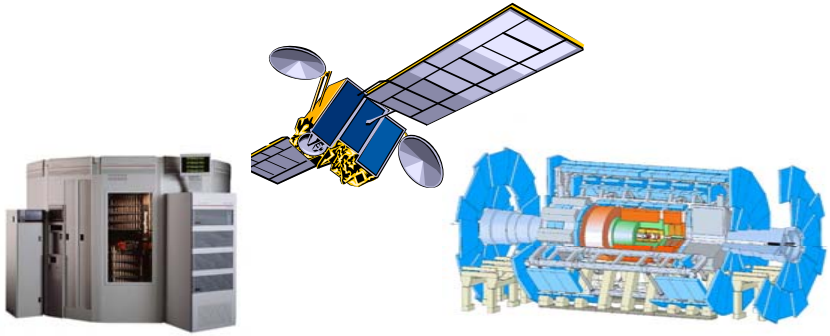
- **Resource sharing**
  - Geographically distributed resources offer computational power, storage capacity and bandwidth to the users
- **Secure and reliable access**
  - Authentication
  - Authorization
  - Access policy
- **Open standards**
- **Co-operation among people belonging to different organizations,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

Grid metaphorically …

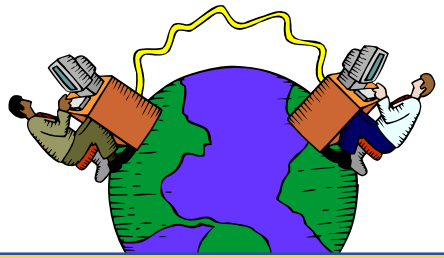




Supercomputer, PC-Cluster



Data-storage, Sensors, Experiments



Internet, networks

Why now?

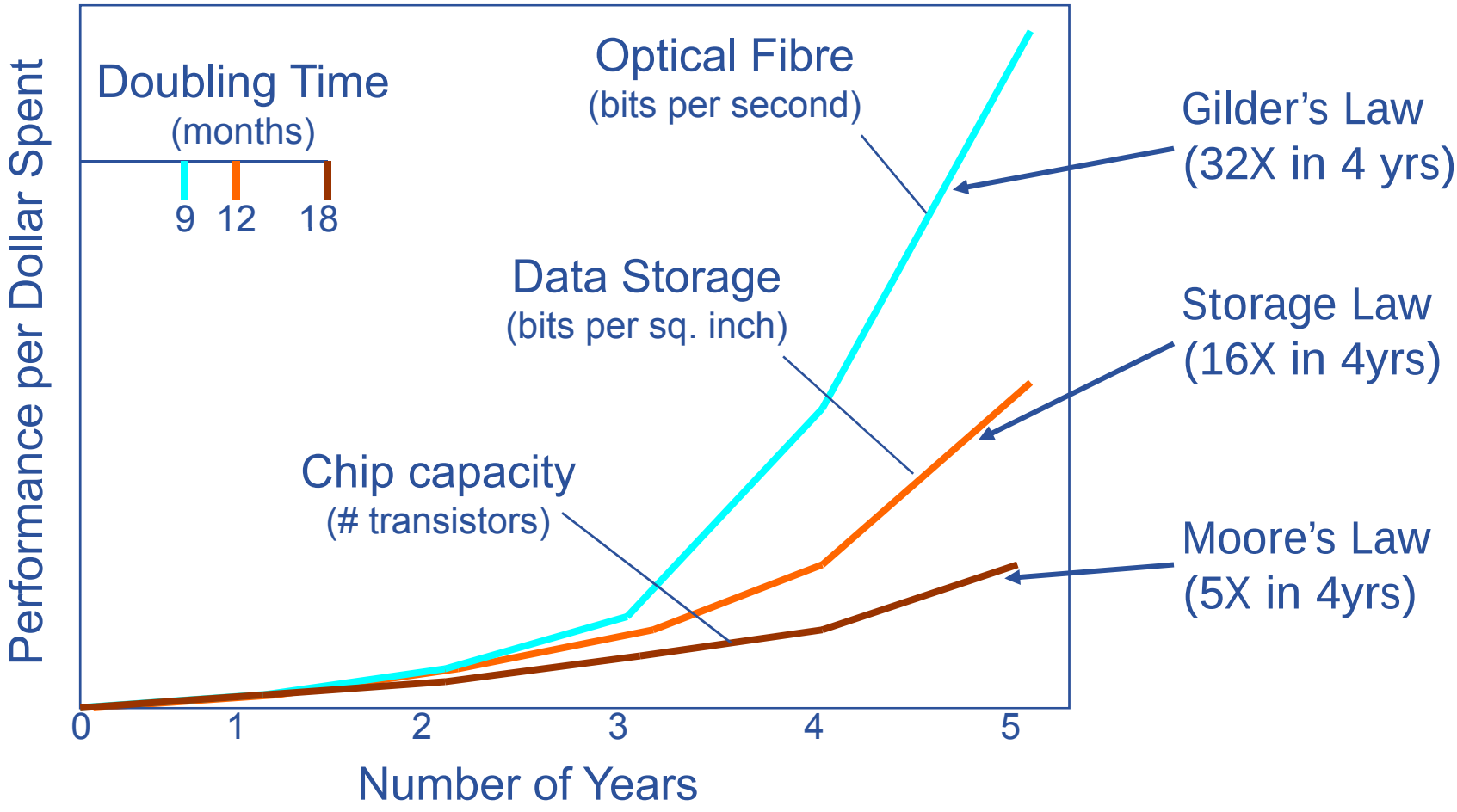
- **Development of networking technology (doubling every nine months or so over the last years) and high-speed networks**
  - ✓ **widespread penetration of optical fibers**
  - ✓ **wireless connections**
  - ✓ **new Internet technologies (ADSL, WiMax)**

- **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**

Exponential Growth



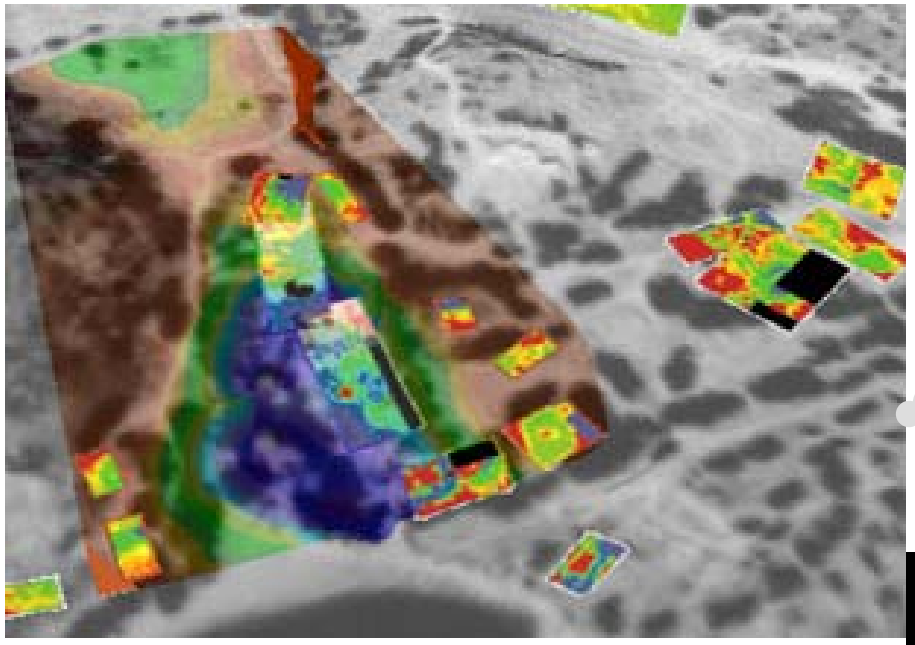
Triumph of Light – *Scientific American*. George Stix, January 2001

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**

Some examples

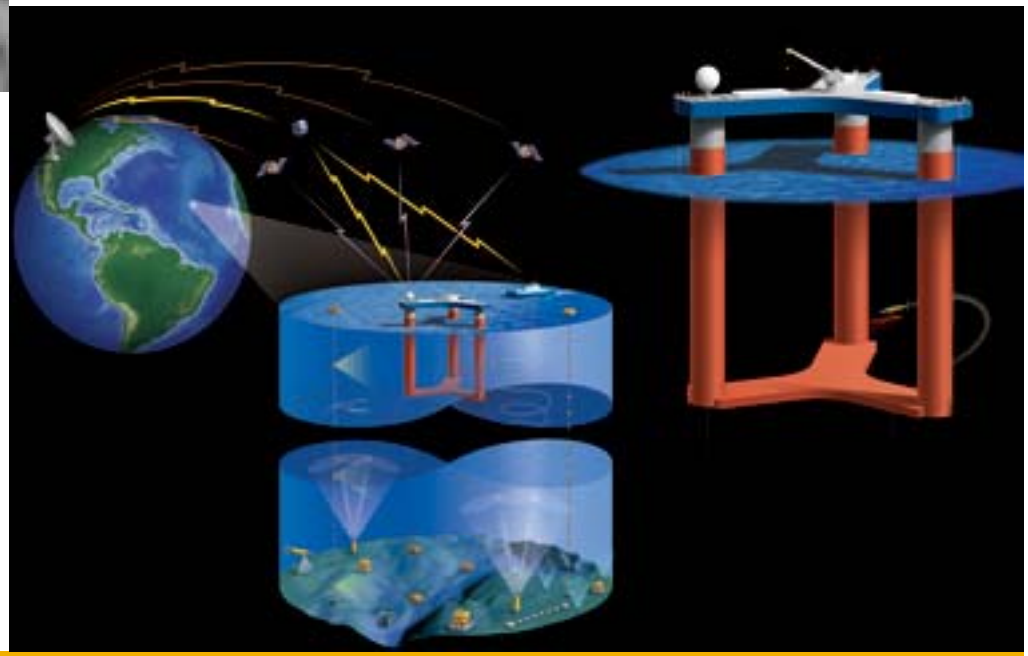


ArchaeoGrid

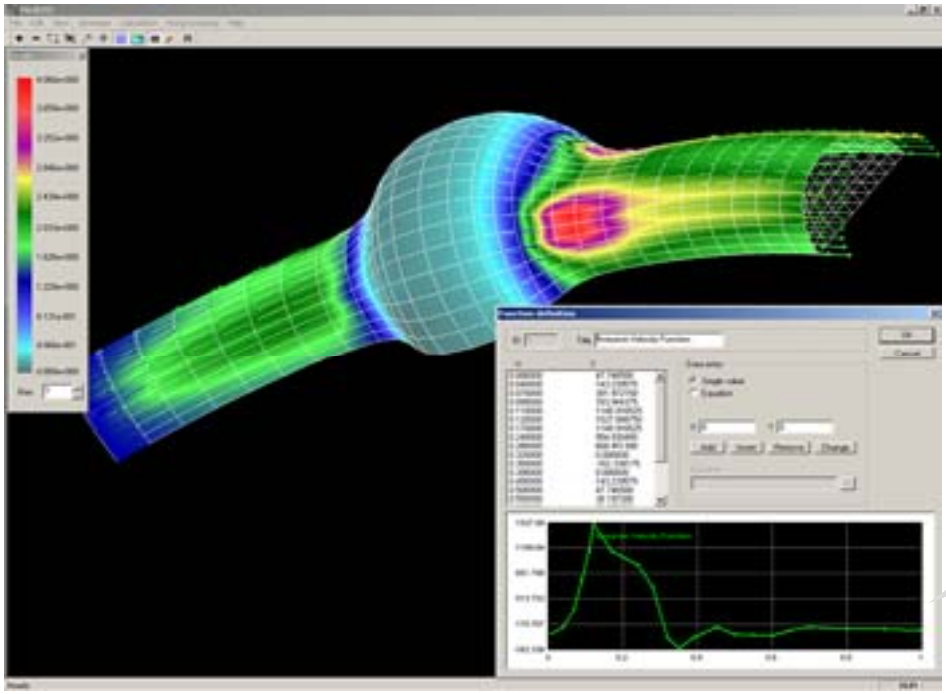
Create a computer model that weaves together data from many sources and predicts feedback interaction

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.



Some examples

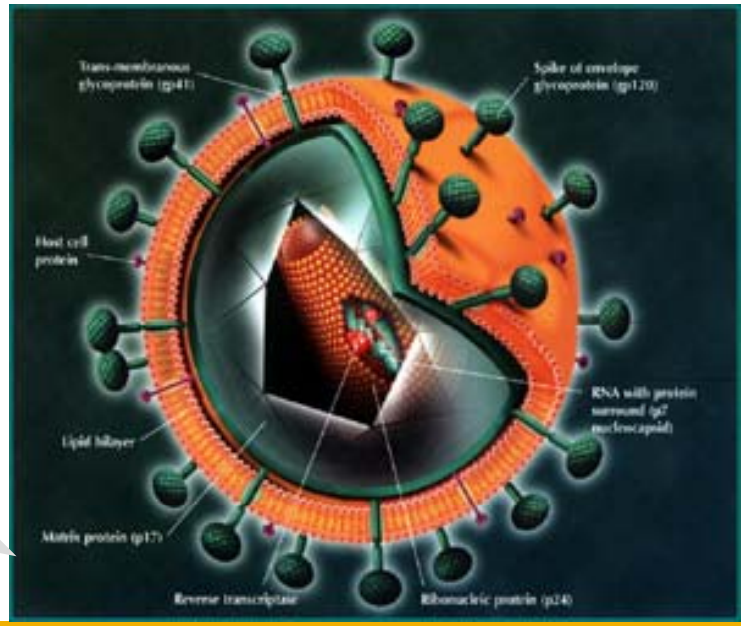


Parallel Blood Flow Simulation

Allows surgeons to perform virtual 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.

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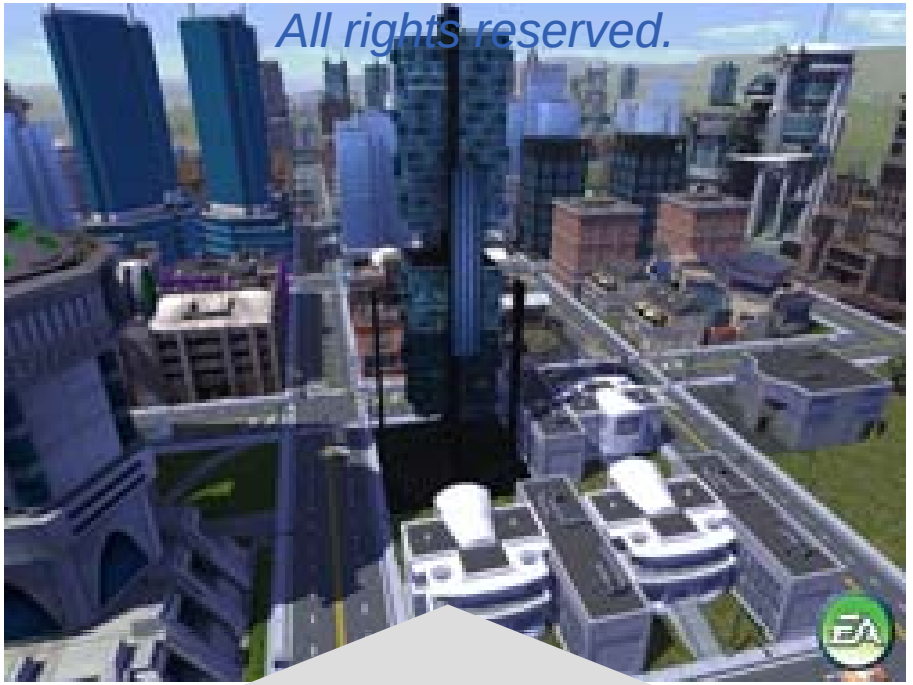


MoSES (Modelling and Simulation for e-Social Science)

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.

The European Network

Budget: 178.643.730 €
Duration: 4 years

GÉANT 2

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

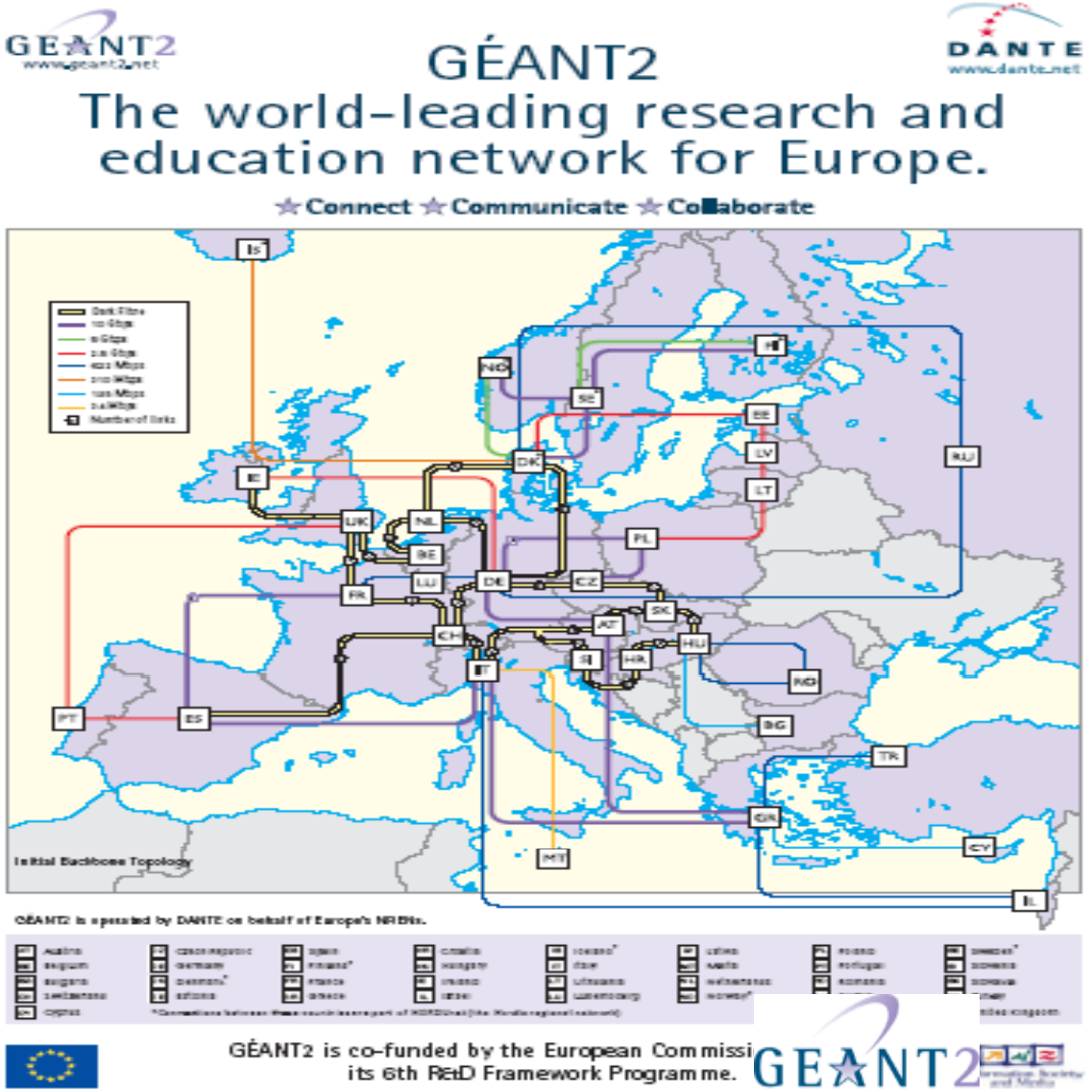
European Commission
Information Society
and Media

http://www.geant2.net/

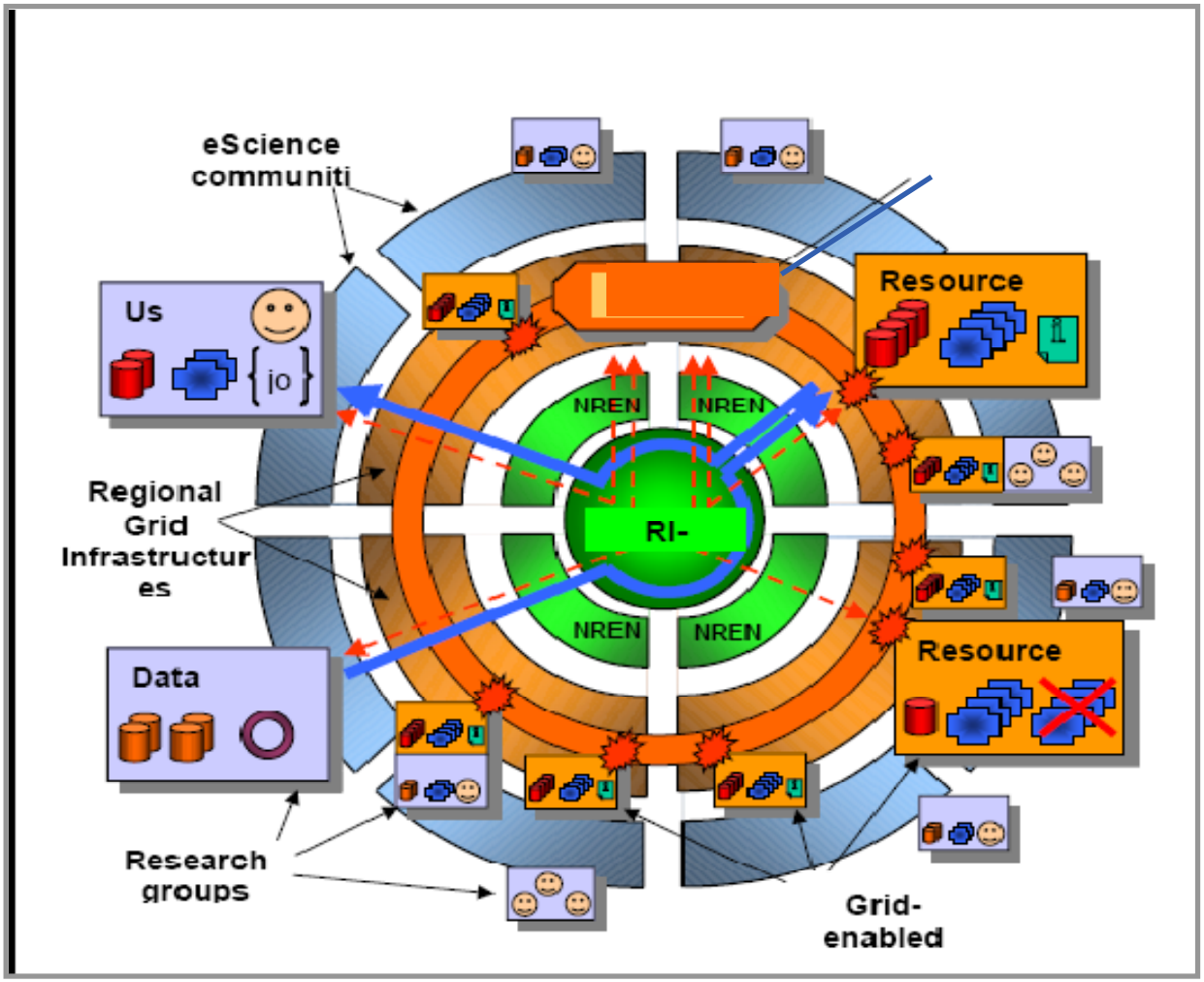
- The project officially started on 1 September 2004 and will continue to take place for the next 4 years
- The project is supported by the European Committee and by 30 European National Research and Education Networks (NRENs) in 34 countries and is administrated by DANTE (*Delivery of Advanced Network 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

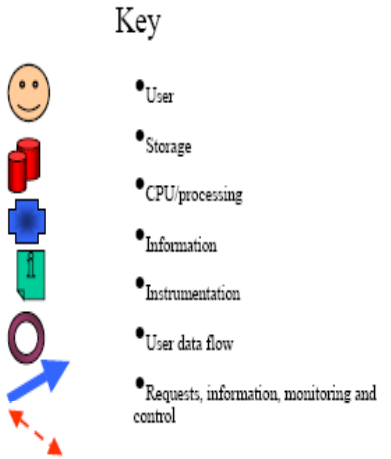
GÉANT 2

- **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

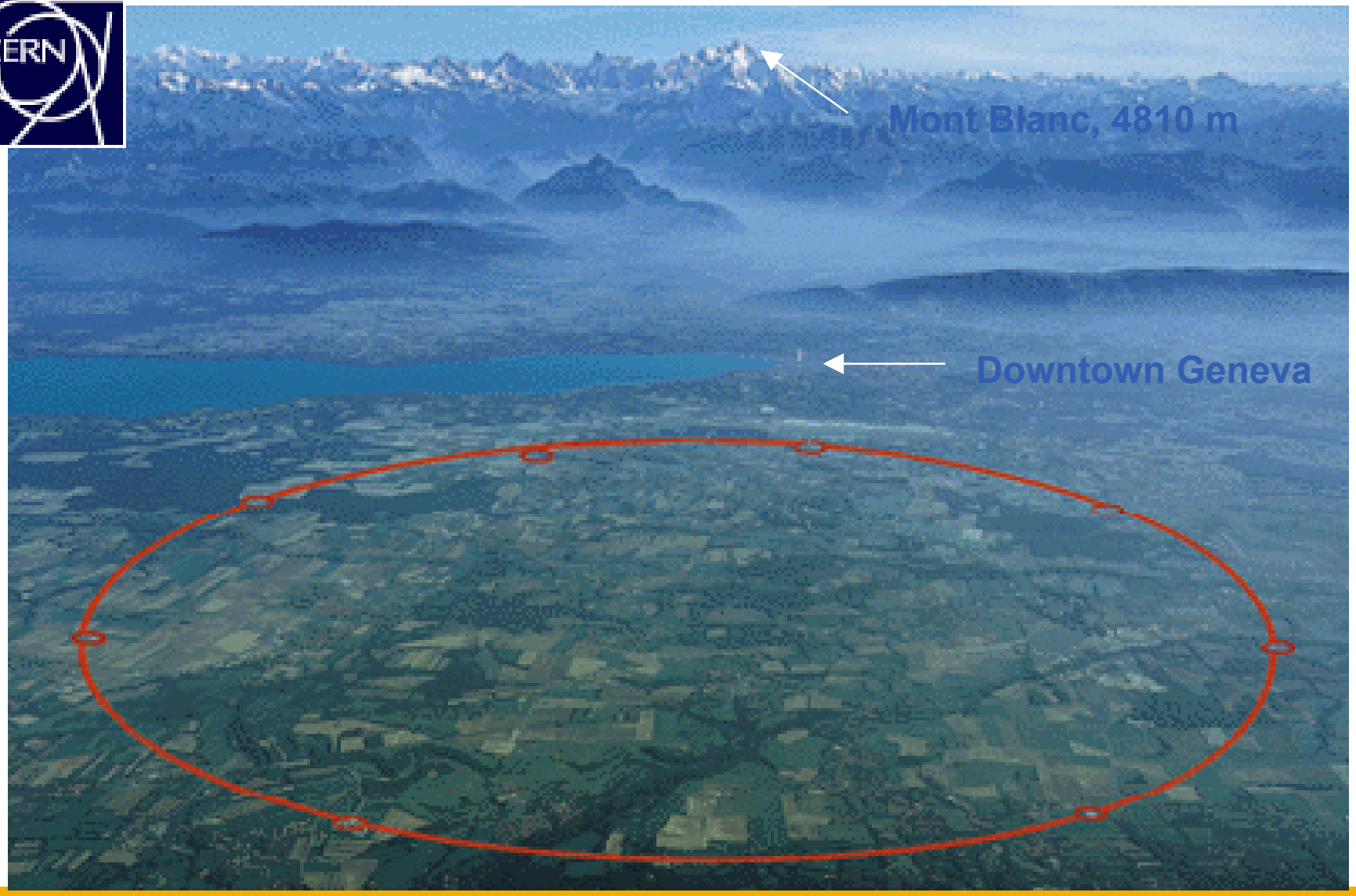


GEANT, NRENs και GRIDs





CERN



LHC (Large Hadron Collider)

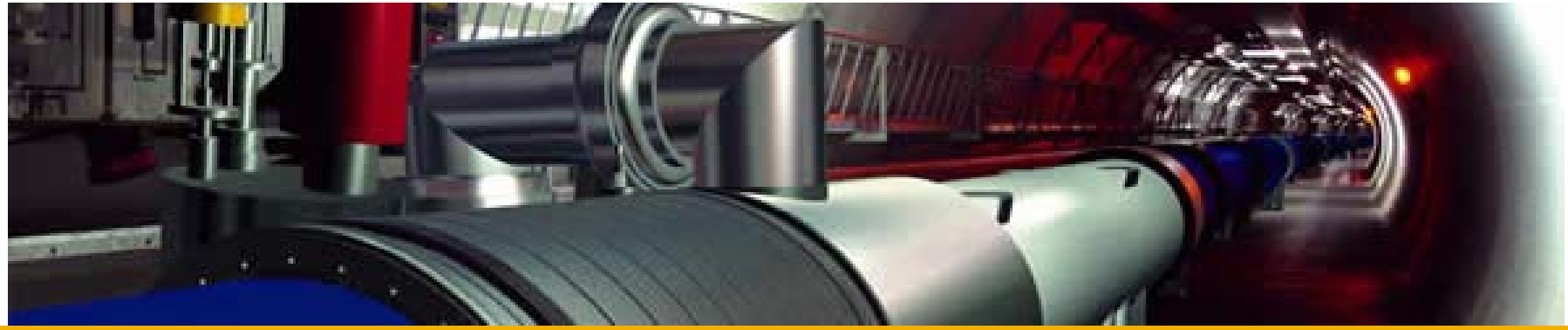
- **LHC will collide beams of protons at an energy of 14 TeV**
- **If the Higgs boson exists, the LHC will almost certainly find it!**
- ***Four experiments, with detectors:***

ALICE

ATLAS

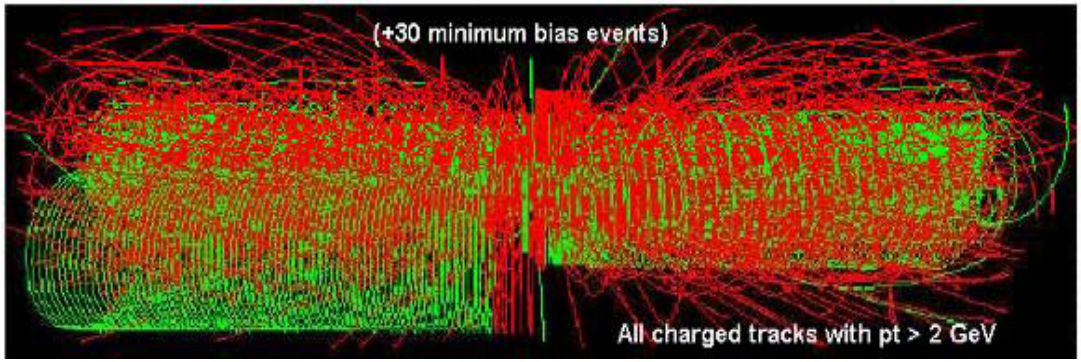
CMS

LHCB



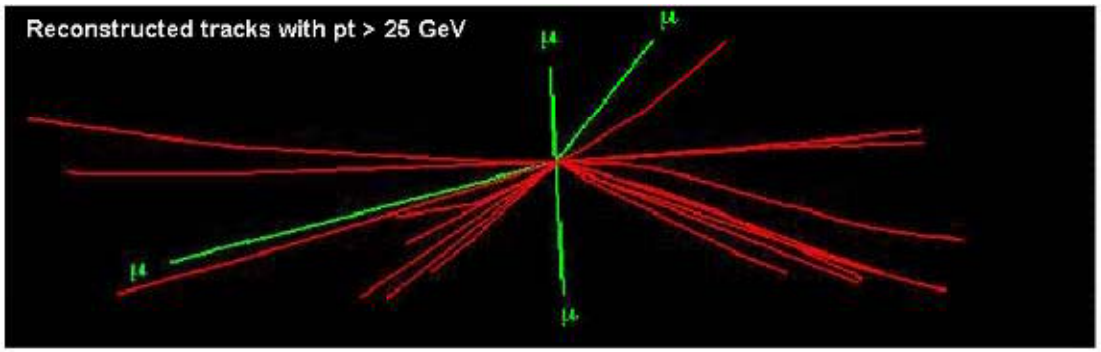
LHC Data Challenge

Starting from this event (particle collision) …



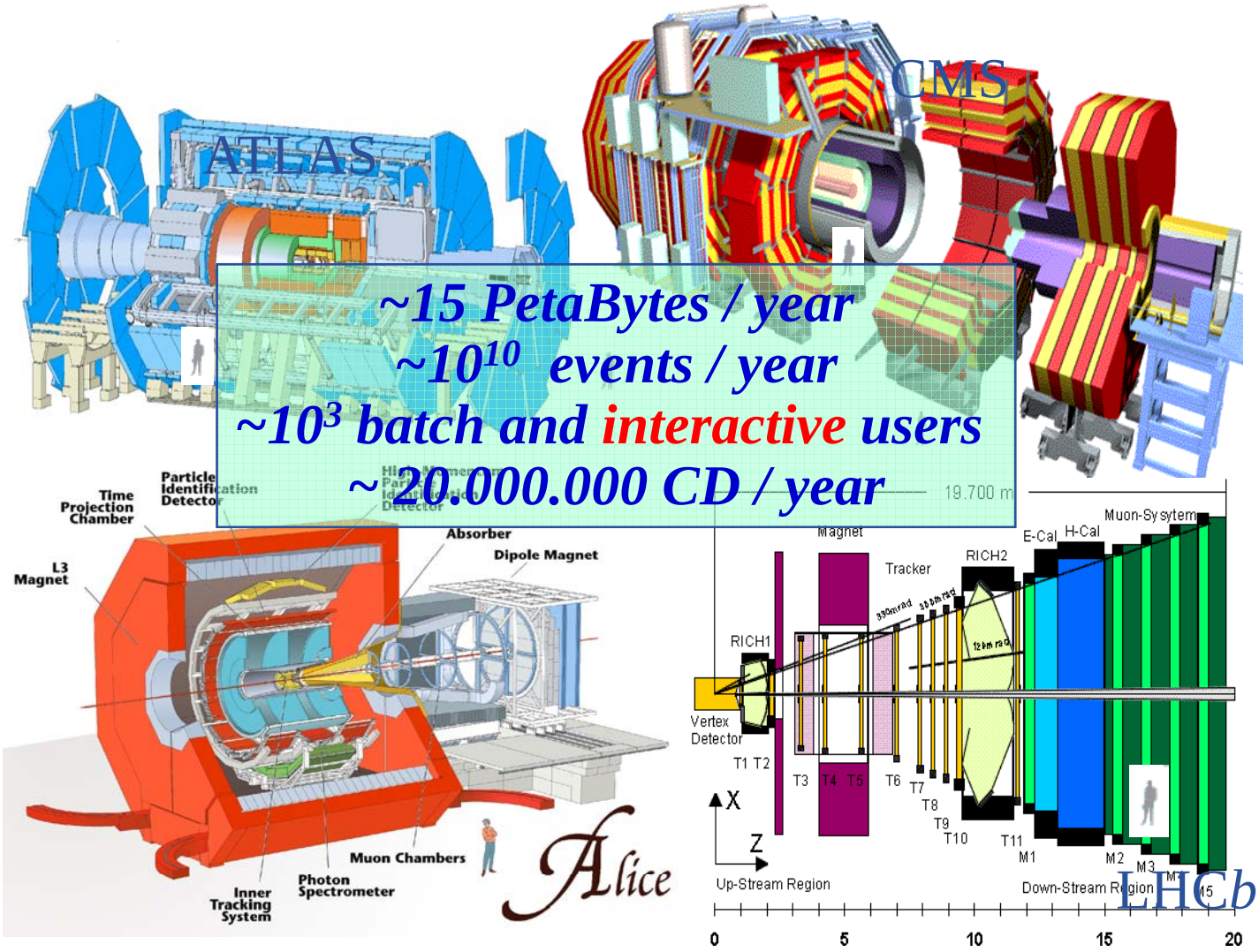
- ✓ Data Collection
- ✓ Data Storage
- ✓ Data Processing

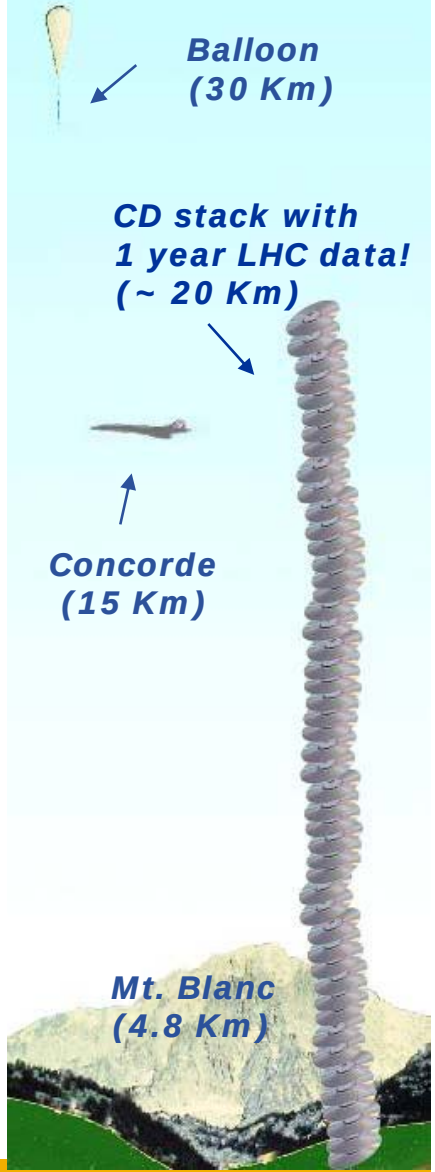
You are looking for this "signature"…



- *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

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**

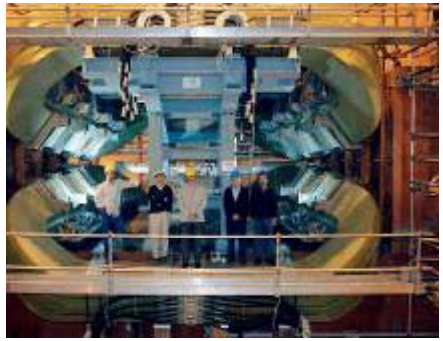
- **What is going to be shared ?**
  - ✓ resources
  - ✓ software
  - ✓ special equipment
  - ✓ licenses
  - ✓ services
  - ✓ Internet bandwidth

Virtual Organizations (VOs)

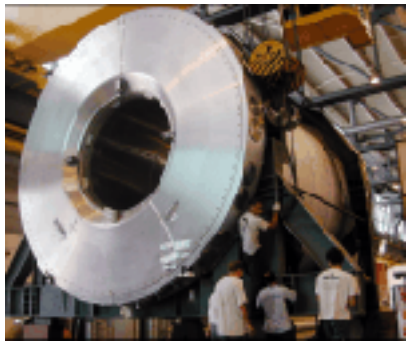
- **Associated with LHC experiment**
  - ALICE ⇨ ALICE experiment
  - ATLAS ⇨ ATLAS experiment
  - CMS ⇨ CMS experiment
  - DTEAM ⇨ Grid (LCG) Deployment Group
  - LHCB ⇨ LHCB experiment
  - SixTrack ⇨ Single Particle Tracking Code

CMS

LHCb



ATLAS



ALICE

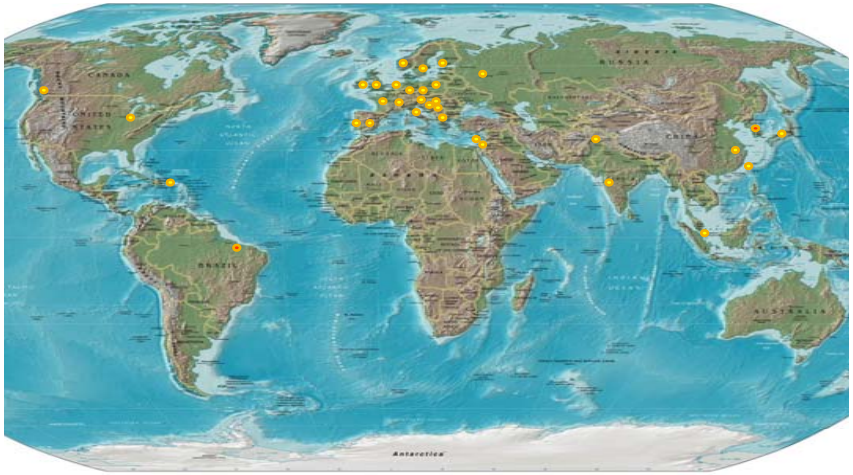
Virtual Organizations (VOs)

- **Not associated with LHC experiment**
  - Babar ⇨ Babar experiment
  - D0 ⇨ D0 experiment
  - H1 ⇨ H1 experiment
  - Zeus ⇨ Zeus experiment
  - ILC ⇨ ILC Community
  - Biomed ⇨ EGEE Biomedical Activity
  - ESR ⇨ Earth Science Research
  - EGEODE ⇨ Expanding GEOsciences on Demand
  - PhenoGrid ⇨ Particle Physics Phenomenology
  - CompChem ⇨ Computational Chemistry
  - SEE-VO ⇨ South Eastern Europe VO
  - Hgdemo ⇨ Training events
- **List of existing VOs**
  - https://lcg-registrar.cern.ch/virtual_organization.html

From EGEE to EGEE II

- **EGEE objective:**

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

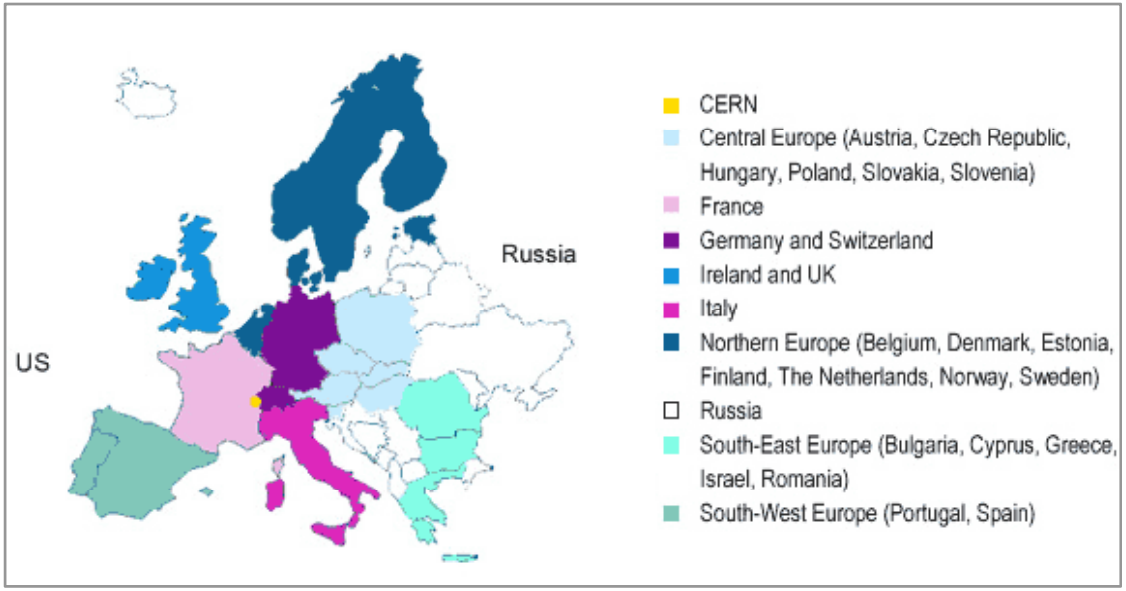


- **EGEE:**
  - Accomplished all of its objectives
  - Scope expanded beyond Europe

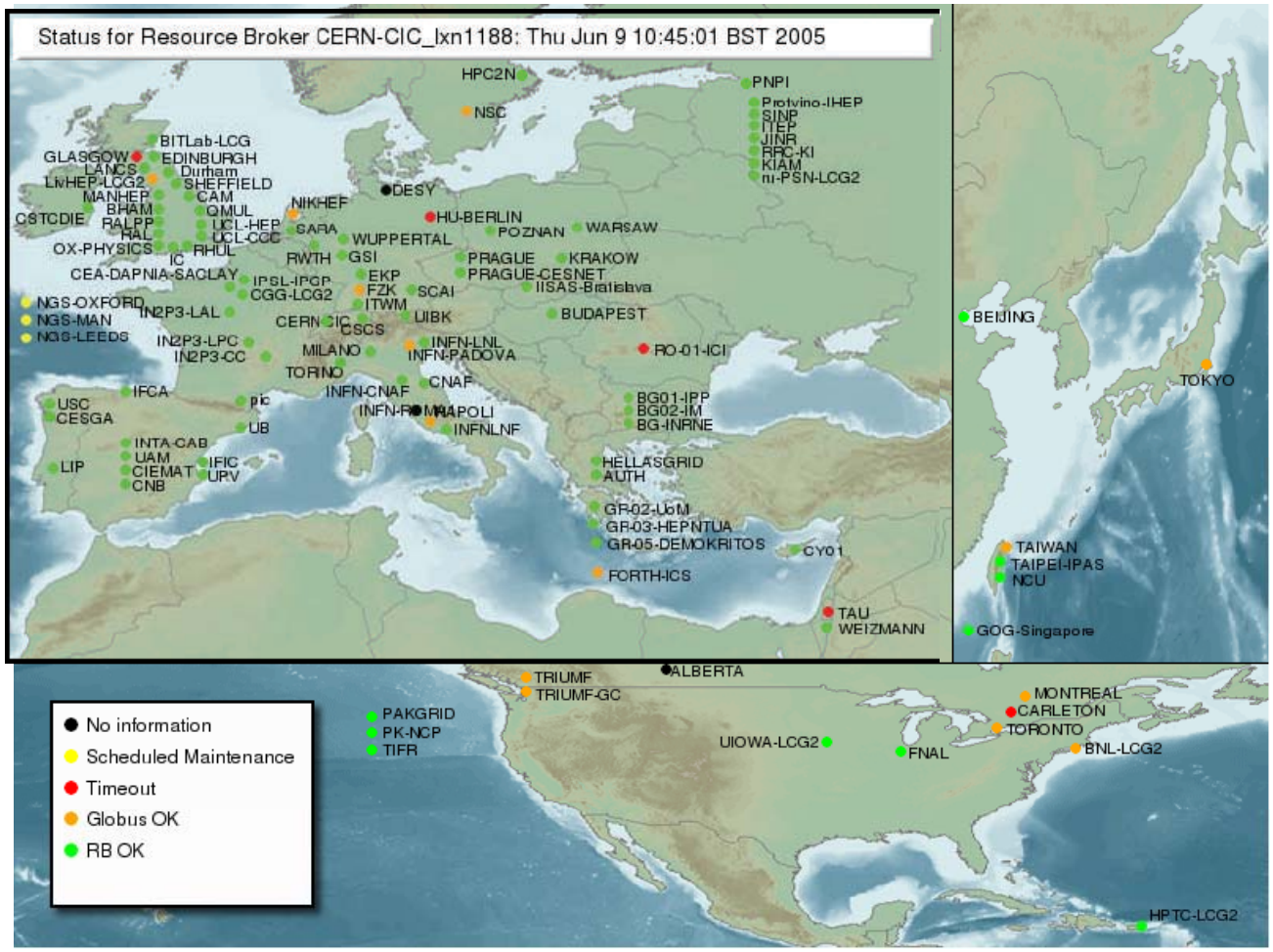
- **EGEE-II start:**
  - → Full capacity from day one
  - → Large-scale, production-quality infrastructure
  - → Supporting a wide range of applications
  - → Staff with extensive knowledge of Grid technology

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

- Started on 1 April 2006
- Available infrastructure to the Research and Academic community 24 hours per day and 7 days per week
- Participants:
  - ✓ 90+ institutions
  - ✓ 46 countries
- Consists of:
  - ✓ 202 sites
  - ✓ ≈30.000 CPUs
  - ✓ ≈12.500TB



Infrastructure of LCG/EGEE



EGEE-II Mission

- ***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)**

Project activities Activities

- **Networking activities**

  Include NA1 (Project Management), NA2 (Dissemination, Outreach and Communication), NA3 (User Training and Induction), NA4 (Application Identification and Support), and NA5 (Policy and International Cooperation)

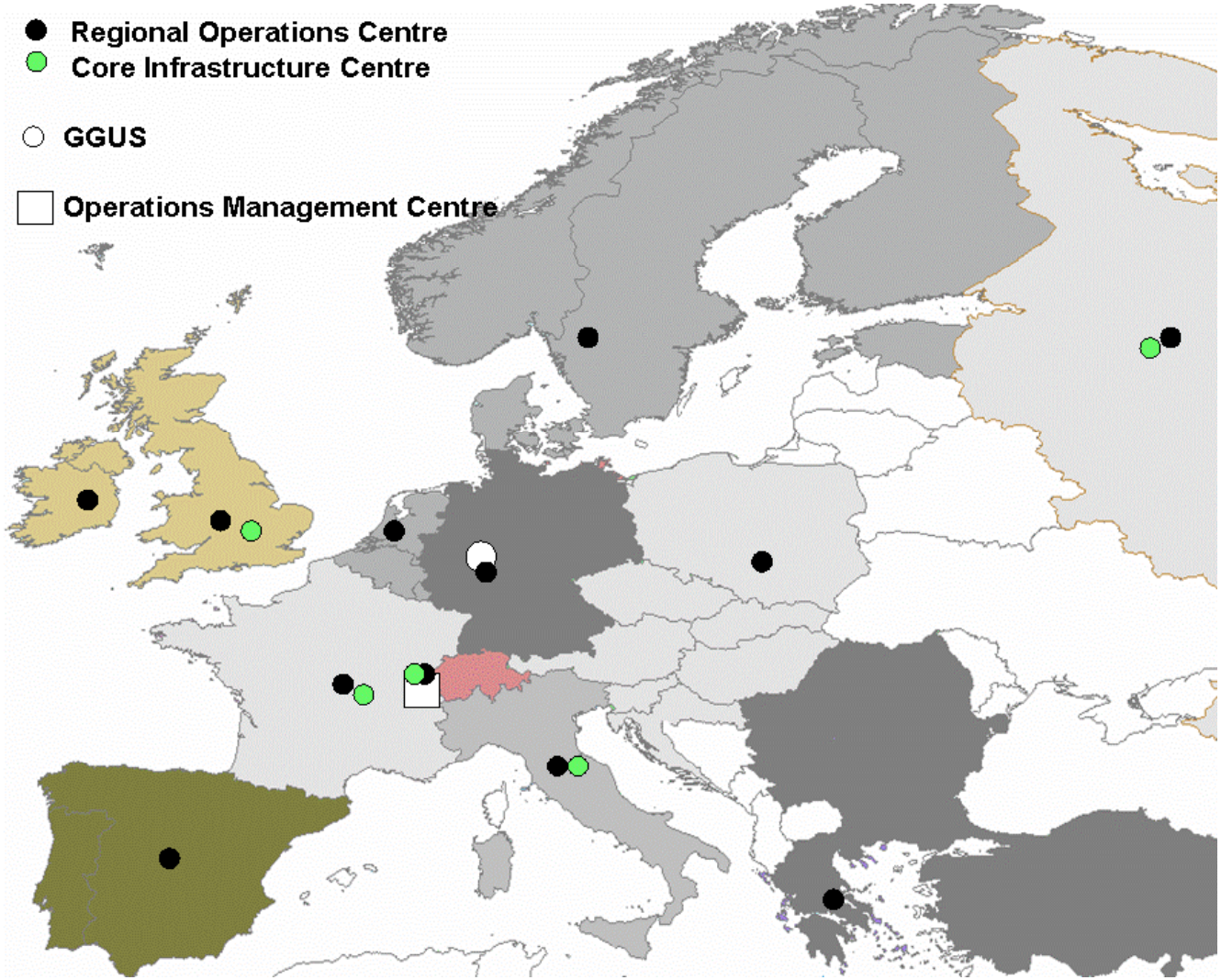
- **Service activities**

  Consist of SA1 (European Grid Operations, Support and Management), SA2 (Networking Support) and SA3 (Middleware Integration, Testing and Certification) combing software elements from a variety of sources to provide integrated releases for deployment on the infrastructure

- **Joint Research activities**

  JRA1 (Middleware Re-Engineering) will continue to develop and support the gLite middleware and JRA2 (Quality Assurance) will manage quality throughout the project, including overall security and coordination.

Operations centres in EGEE



Operations Management Centre (OMC)

- At CERN – mainly

Core Infrastructure Centres (CIC)

- Administration of daily grid operations – oversight, troubleshooting
  - "Operator on Duty"
- Deployment of infrastructure services
- 2nd level support στα ROCs
- UK/I, Fr, It, CERN, Russia, Taipei

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

gLite
Lightweight Middleware for Grid Computing

- **Part of the EGEE project**
- **Next generation middleware for grid computing**
- **In its development participate 80 programmers from 12 different academic and industrial European centers**
- *Provides services for computing element, data management, accounting, logging and bookeping, information and monitoring, service discovery, security, workload management*

Grid systems' related software

- **Operating system:**
  - Linux (+GNU utilities), usually a RHEL3-like,
    for example Scientific Linux 3.0.7, Fedora Core 3, etc
- **Middleware:**
  - gLite v3.0 (LCG)
- **Libraries and Applications**
  - Defined by the system and VOs administrators' foresight
  - The user can install and execute its own programms

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

GridICE Monitoring for SEE

http://mon.egee-see.org

Site	Region	GK#	Q#	RunJob	WaitJob	JobLoad	Power	WN#	CPU#	CPULoad	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	-	-	-	-	-	-	-	-

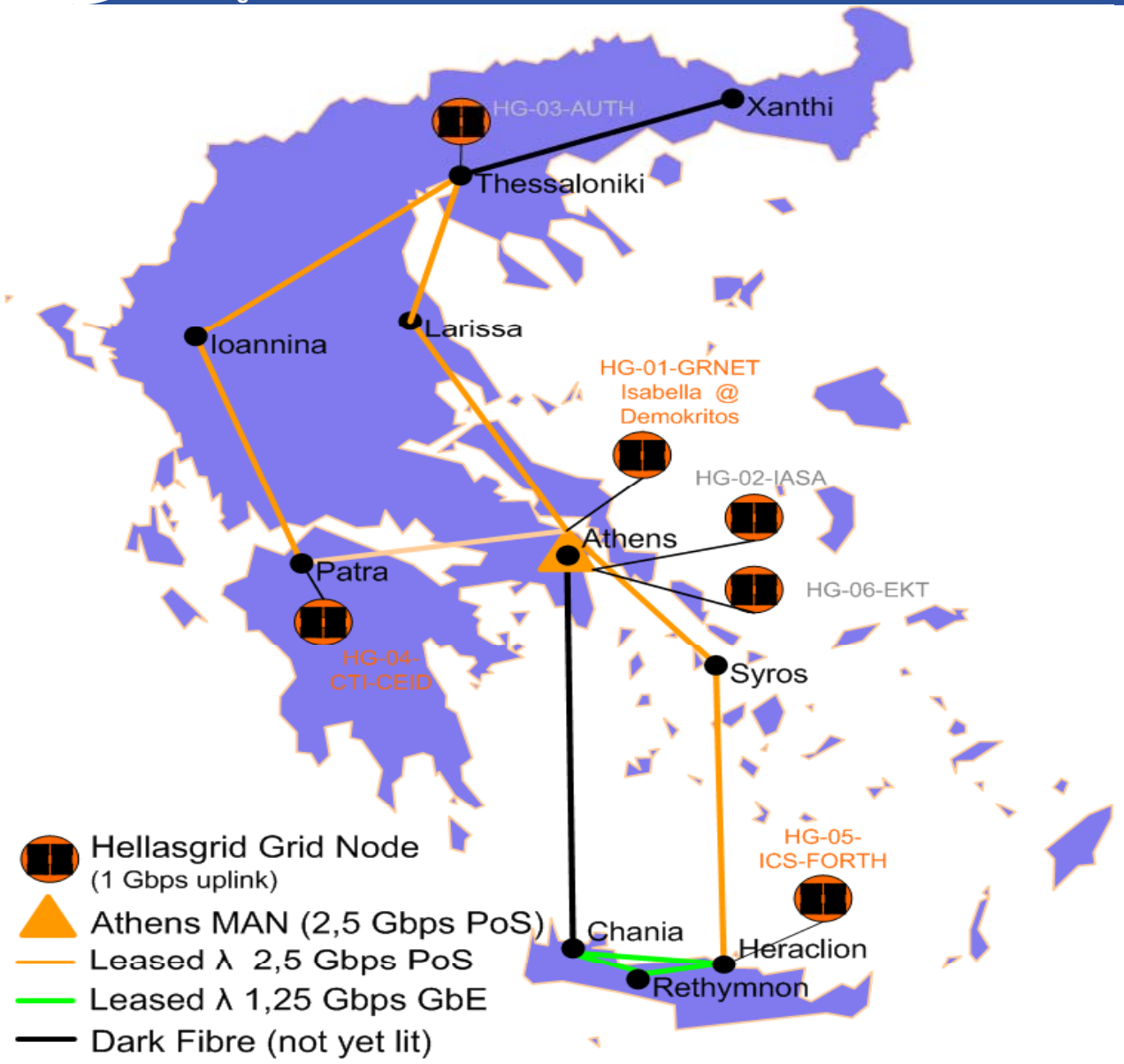
HellasGrid Infrastructure, Phase I & II

- **HellasGrid I (500.000 €)**
  - Βρίσκεται στον Δημόκριτο, Αγία Παρασκευή (a.k.a. Isabella)
  - 34 dual Intel **P4 Xeon @ 2.8GHz, 1GB RAM, 2x 70GB SCSI HDD**, 2x Gbit
  - IBM FAStT900 Storage Area Network, ολοκληρωμένο σύστημα
    - 2x Redundant Fiber Channel Controllers with 1Gbyte Cache each
    - 70x146.8GB= **10,276TB raw storage capability,** over 5 disk shelves
  - Tape Library με δυνατότητα έως ~30 TBytes, integrated monitoring
  - Παραδόθηκε στο ΕΔΕΤ από την IBM κατά τον Δεκέμβριο του 2004

- **HellasGrid II (1.000.000 €)**
  - 5 φυσικοί κόμβοι: ΕΚΤ (>220), ΙΕΣΕ (48), ΑΠΘ (128), ΙΤΕ (128), ΙΤΥ (128)
  - ~700 Επεξεργαστές **x86_64, 2 GB RAM, 1x 80GB SATA HDD**, 2x Gbit
  - ~20 TBytes συνολικός αποθηκευτικός χώρος σε τεχνολογία SAN (5x 4TBs)
  - ~50 TBytes Tape Library, το οποίο έχει εγκατασταθεί στο ΕΚΤ

http://www.hellasgrid.gr/

HellasGrid e-Infrastructure



HellasGrid structure

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

- HG CA and VOMS : GridAUTH, Dept. of Physics, AUTH
- Helpdesk : ITY (CTI)

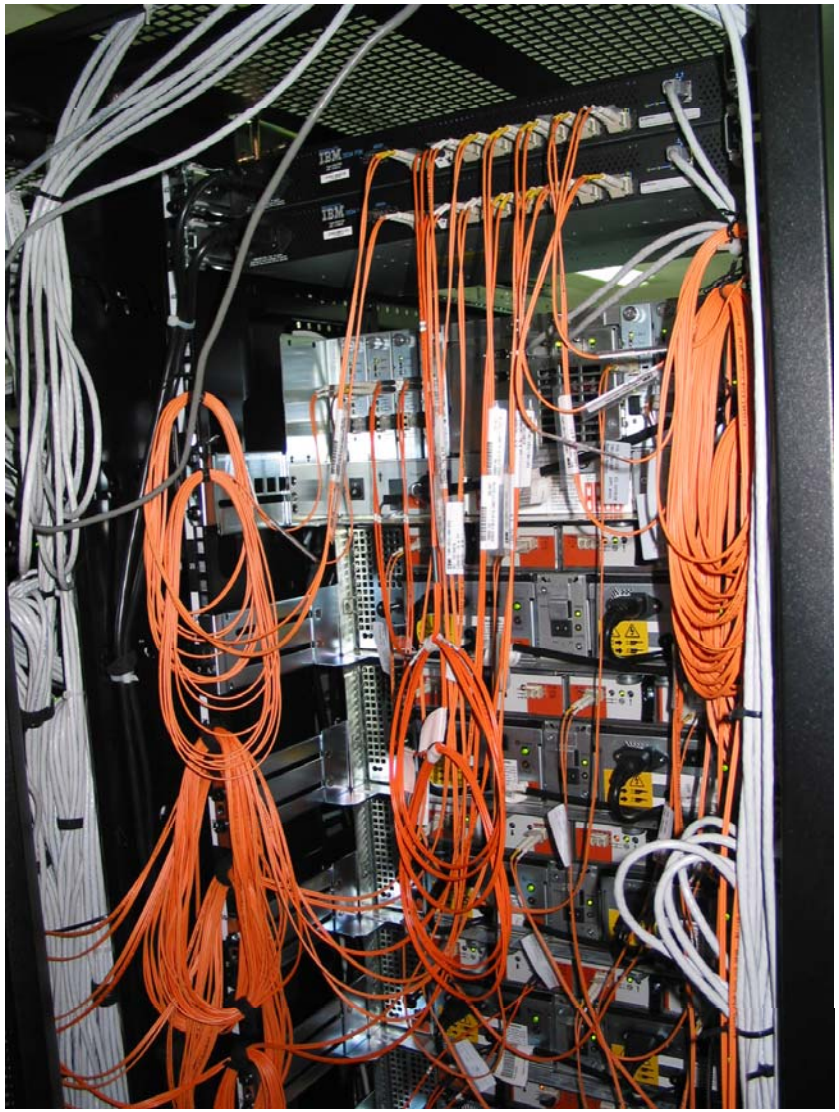
  user-support@hellasgrid.gr

- Regional monitoring tools : ΙΤΕ-Ι.Π. (FORTH)

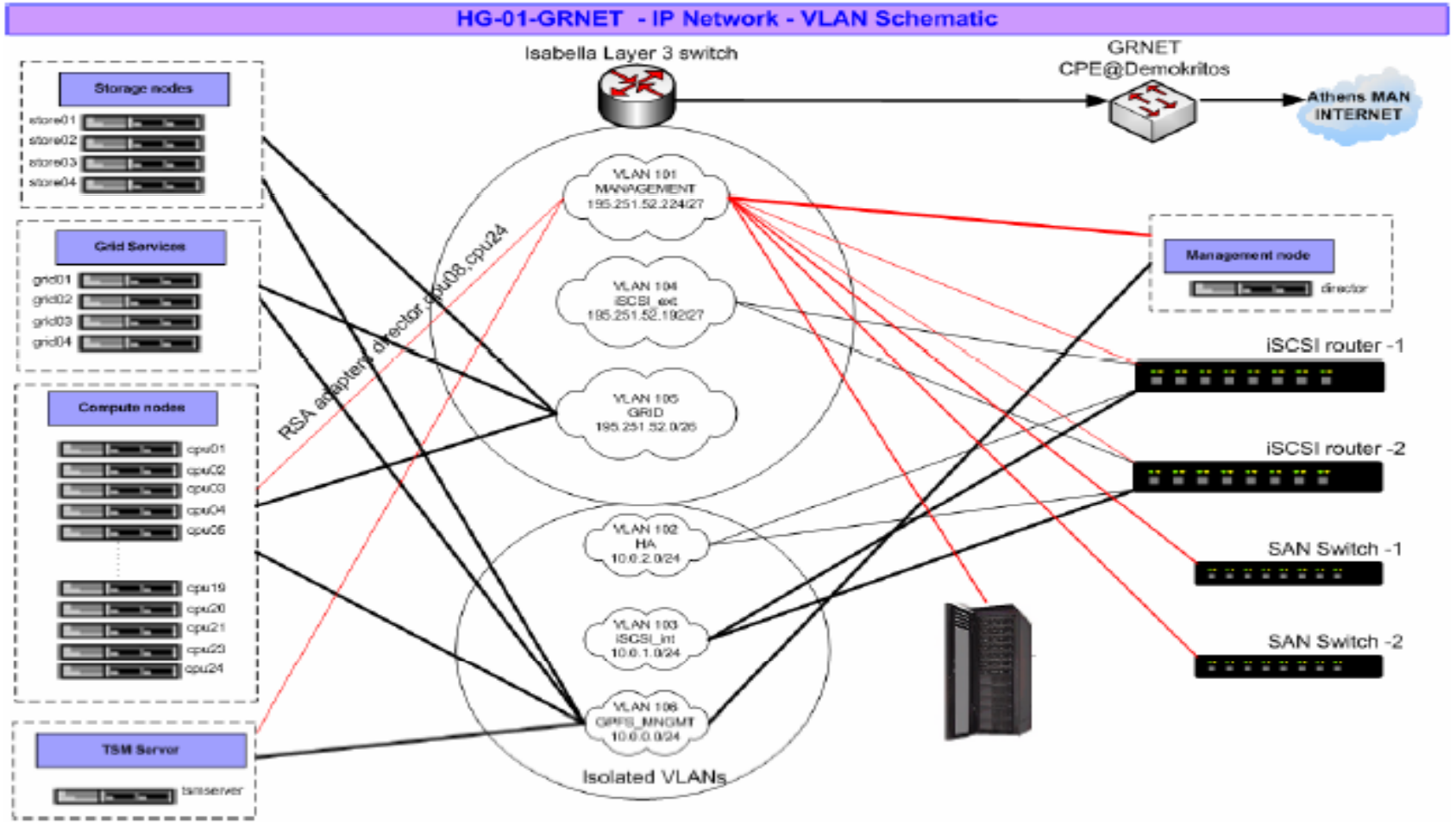
- Apps support : Ε.Κ.Ε.Φ.Ε Δημόκριτος + όλες οι ομάδες των sites

  application-support@hellasgrid.gr

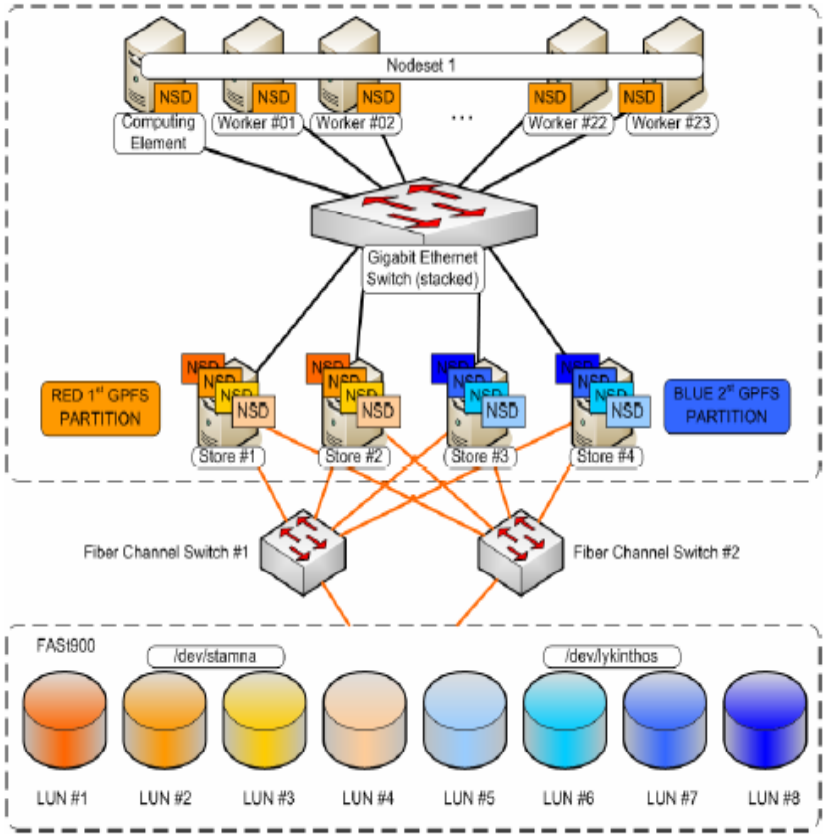
HellasGrid I Infrastructure, Isabella



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 3.0._, 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
  - Resource Broker 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

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

HellasGrid II Infrastructure

In more details …

- **HG-02-IASA** (Ινστιτούτο Επιταχυντικών Συστημάτων και Εφαρμογών (ΙΕΣΕ) - Εθνικό Καποδιστριακό Πανεπιστήμιο Αθηνών):
  - ✓ Συστοιχία με 66 Dual CPUs, 4,2 TB SAN Storage
  - ✓ Scientific Linux, gLite 3.0._, LCG, VO_atlas, VO_cms, VO_lhcb

- **HG-03-AUTH** (Στο Αριστοτέλειο Πανεπιστήμιο Θεσσαλονίκης):
  - ✓ Συστοιχία με 64 Dual CPUs, 4 TB SAN Storage
  - ✓ Scientific Linux, gLite 3.0._, LCG, MPICH, VO_atlas, VO_lhcb

- **HG-04-CTI-CEID** (Ερευνητικό Ακαδημαϊκό Ινστιτούτο Τεχνολογίας Υπολογιστών (ΕΑ-ΙΤΥ) στην Πάτρα)
  - ✓ Συστοιχία με 64 Dual CPUs, 4 TB SAN Storage
  - ✓ Scientific Linux, gLite 3.0._, LCG, MPICH, VO_atlas, VO-biomed, VO_cms, VO_lhcb,

In more details …

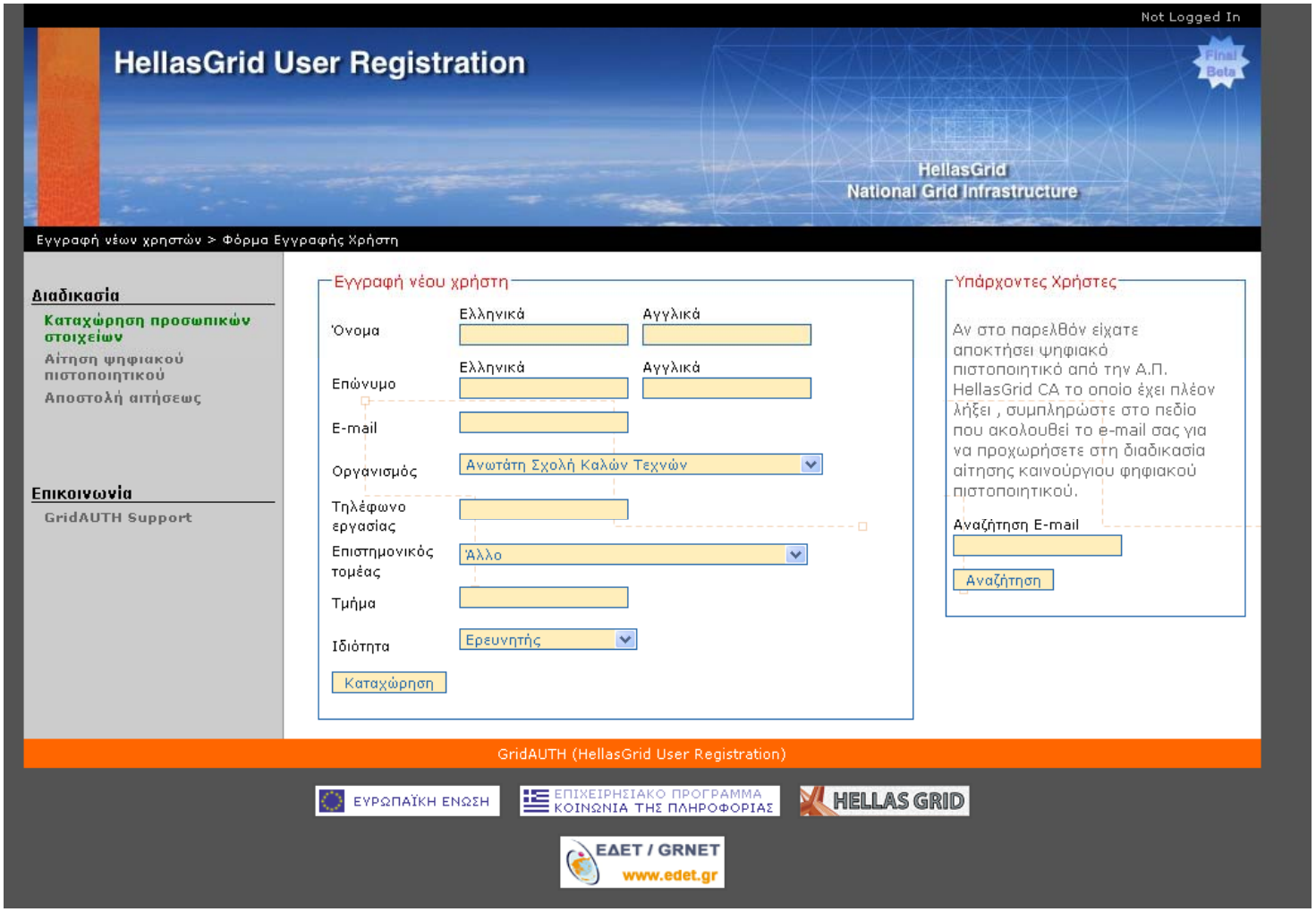
- **HG-05-FORTH** (Ίδρυμα Τεχνολογίας και Έρευνας στο Ηράκλειο Κρήτης):
  - ✓ Συστοιχία με 64 Dual CPUs (3.4GHz), 4,2 TB SAN Storage
  - ✓ Scientific Linux, gLite 3.0._, LCG, VO_atlas, VO-biomed, VO_cms, VO_lhcb,

- **HG-06-EKT** (Στο Εθνικό Κέντρο Τεκμηρίωσης):
  - ✓ Συστοιχία με 64 Dual CPUs, 4 TB SAN Storage
  - ✓ Scientific Linux, gLite 3.0._, LCG, VO_atlas, VO_biomed, VO_lhcb

- Πληροφορίες: http://goc.grid.sinica.edu.tw/gstat/

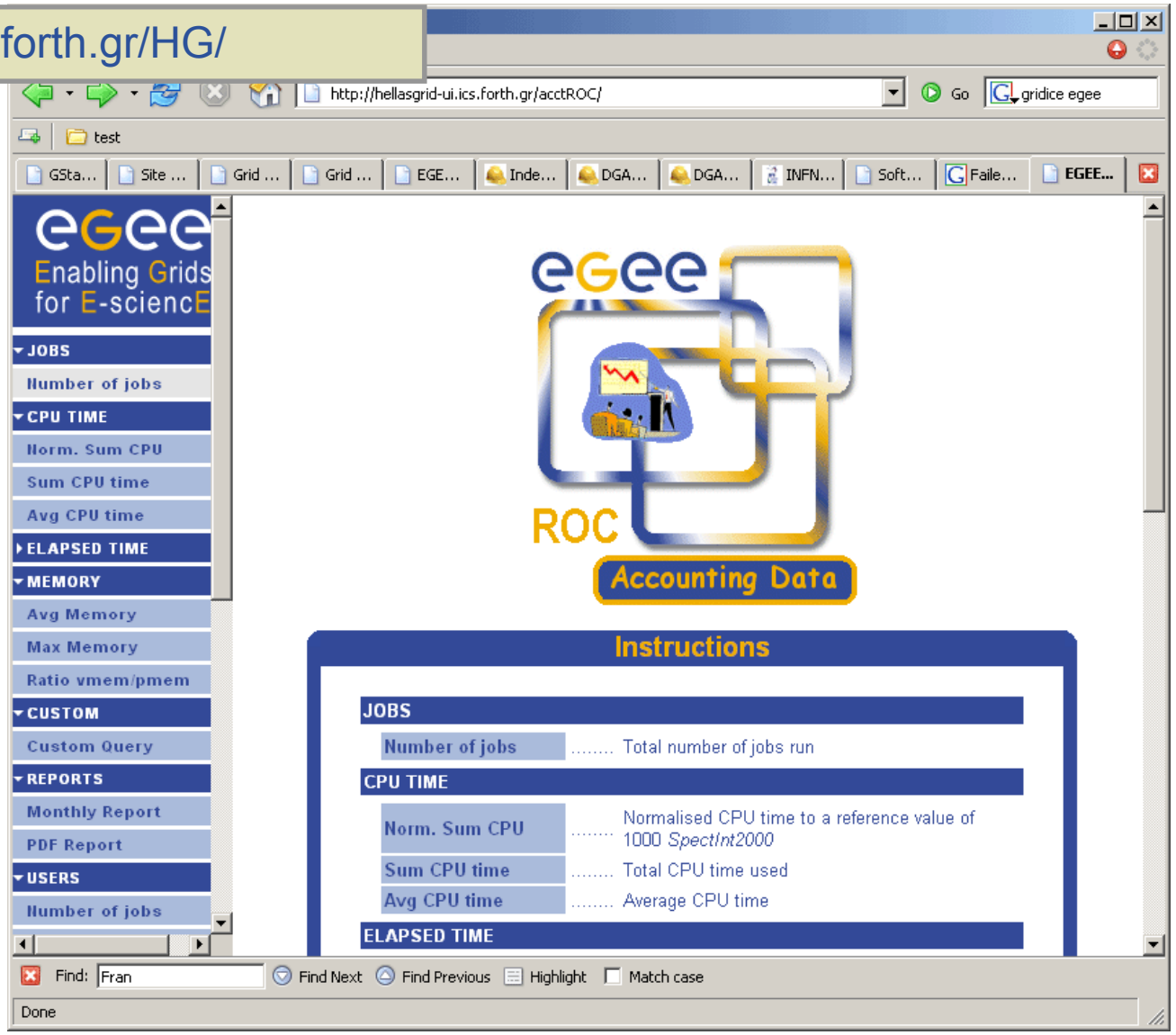
Registration to HellasGrid

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



Accounting statistics for the HellasGrid Infrastructure

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



Training events

- http://www.egee-see.org/training/
- http://indico.cern.ch/conferenceDisplay.py?confId=23475

Q&A

Thank you!

Αναφορές

- ✓ **Grid café:**
  http://gridcafe.web.cern.ch/gridcafe
- ✓ Global Grid Forum:
  http://www.gridforum.org/
- ✓ Gridtoday:
  http://www.gridtoday.com/gridtoday.html
- ✓ Grid Computing
  http://en.wikipedia.org/wiki/Grid_computing
- ✓ Distributed Computing
  http://en.wikipedia.org/wiki/Distributed_systems
- ✓ Supercomputing
  http://en.wikipedia.org/wiki/Supercomputing
- ✓ LCG-2 User Guide
  http://egee.itep.ru/User_Guide.html
- ✓ EGEE (Enabling Grids for E-science)
  http://public.eu-egee.org/intro/

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/

Χρήσιμα web links

- **Global Grid Forum**
  http://www.ggf.org
- **GRID today**
  http://www.gridtoday.com/gridtoday.html
- **Grid Computing Planet**
  http://www.gridcomputingplanet.com/
- **Enter the Grid Magazine**
  http://enterthegrid.com/
- **Enterprise Grid Alliance**
  http://www.gridalliance.org/en/index.asp
- **Grid Operations Centre**
  http://goc.grid-support.ac.uk/gridsite/gocmain/
- **gLite UserGuide**
  https://edms.cern.ch/file/722398//gLite-3-UserGuide.pdf
- **The Globus Alliance**
  http://www.globus.org/
- **Worldwide LHC Computing Grid**
  http://goc.grid.sinica.edu.tw/seegridwiki/