Grid infrastructures

FrontierScience05
Milano-Bicocca

Mirco Mazzucato
## Director of CNAF and INFN Grid project
mirco.mazzucato@pd.infn.it

Summary

- The e-Infrastructure evolution in the world
  - Some history (Biased and with an Italian and EU focus)
    - The national projects: INFN Grid, FIRB Grid.it,…..
    - The EU dimension
  - The current status
    - EGEE and LCG
    - Open Science Grid in US
    - APGrid Asia Pacific Acitvities
- Move towards standards
- The Future: EGEE-II, EGO
- The OMII UK and c-Omega consortia for open Middleware support and OMII EU proposal
- Conclusions
- Thanks to Fabrizio Gagliardi (CERN), Les Robertson (CERN), Rob Gardner (U. Chicago), Satoshi Matsuoka (JP), Satashi Sekiuchi (JP) for providing most of the material

The Grid precursor
INFN Condor Pool on WAN: checkpoint domains
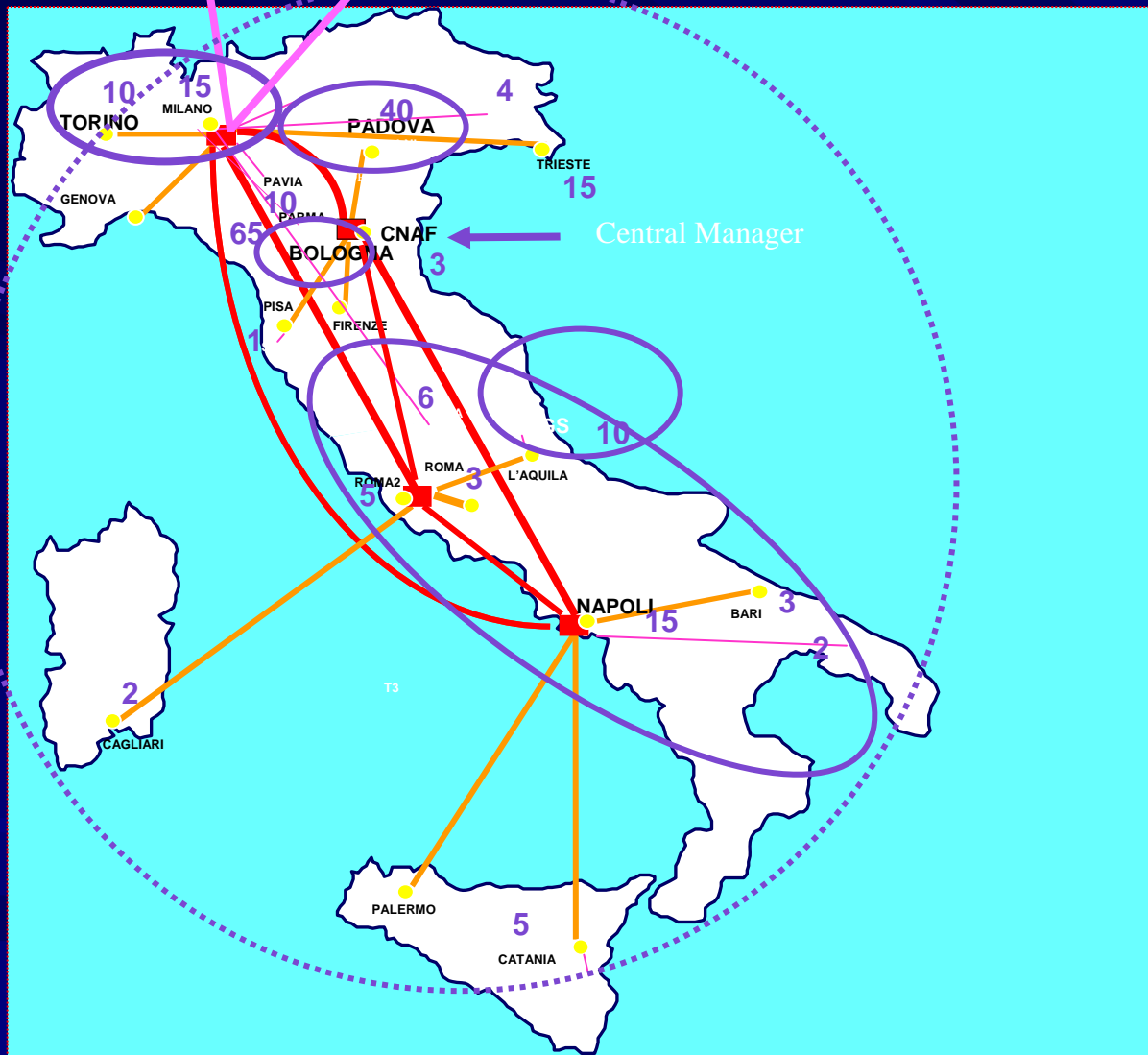
GARR-B Topology

Project started in 1996
155 Mbps ATM based
Network

access points (PoP)

● main transport nodes

■ CKPT domain
  # hosts

Default CKPT
domain @ Cnaf

~500 machines

6 ckpt servers

In production > '98

Lack of standards

Could not guarantee

effective international

resource sharing

26/01/2006   FrontierScience05   3

The INFN-GRID Project

- Spring 1999 : The Grid vision by Ian Foster and Carl Kesselmann
- February 2000: The Board of Directors approve the INFN Grid project
- Large size : 20 Italian Sites, ~100 people, ~ 50 FTE's
- Collaboration between physicists, sw engineers, computer professionals and computer scientists (CS Dep. of Universities of VE, PD, BO, CT, TO,…), CNR, and Industries
  - Datamat SPA and Nice major contributors of the joint developments
- Focused on the preparation of the INFN LHC comp. infrastructure
- …but with the goal of developing a new set of "standard" services and protocols to allow resource sharing in different administrative domains as the server Http and HTML are at basis of information sharing
- taking into account the requirements of other sciences
    - Biology (PD) and Earth Observation(Esrin-ESA-Frascati)
- INFN Grid has been and is the national container for INFN to coordinate the contribution to all EU and International Grid projects and to the GGF standardization
- Early R&D in Italy include work done in ISUFI (University of Lecce)
  - ->see S-PACI

The Grid activities in Italy: Some History

- INFN Grid is followed by an initial ~30M€ line of budget dedicated by MIUR to Grid R&D and related e-Infrastructures developments. Major projects funded:
  - Grid.IT, National project 3 years 12 M€ (2002-05)
    - R&D on next generation tools: Programming environ., Information Sys.
    - National production e-Infrastructure for Italian Science Institutions
  - S-PACI National project 3 years 4 M€ (2002-05)
    - The grid infrastructure in the South of Italy
  - Egrid National project 3 years 3 M€ (2003-06)
    - The Grid for finance
  - LIBI and LITBIO 3 years 7 M€ (2004-2007)
    - The Grid Laboratory for Bio-informatics
- Recently additional 32 M€ for Grids and Supercomp. in the South (PON) and other lines of budget (16 M€) for Open Source Support (FAR) etc.

The European dimension(1)

- **DATAGRID , EU project, Cern coord., 3 years, 10 MEuro (2001-3)**
  - European integration, new MW services for HEP, Biology, Earth Observation, first large EU e-Infrastructure
- **DataTAG, Progetto EU, Cern coord, 2 years, 4 Meuro (2002-03)**
  - Optical networking e Interoperability with US Grid, GLUE, VOMS
- **V EU Framework Program: 20 Grid projects, 50 M€, Italy: ~10%**
- **LHC Computing Grid (LCG) Progetto CERN (2002-05-08)' 60M€**
  - The construction of a World wide gri infratsructure for LHC with US, Japan, Canada', China, Taiwan
  - Phase I (2005) Prototype, Phase II (2008) Production Infrastructure
- **Rome 12/2003 EIRG, e-Infrastructure Reflection Group**
  - Italian Presidency initiative on "eInfrastructures (Internet and Grids) – The new foundation for knowledge-based Societies" Event organized by MIUR and INFN in collaboration with the EU Commission
  - EIRG representatives appointed by EU Ministers of Science
  - Policies and Roadmaps for the development of e-Infrastructures in EU

The European dimension (2)

- 2004 VI Framework Program > 250 M€ for Grids e testbeds
- 2004 EGEE: The project EU, coord. CERN: 32M€
  - 70 Istitutions, 25 countries organized in 9 Federations
  - The Italian Federation Italiana coordinata dall'INFN included ENEA, the 3 Universities of S-Paci, CNR, other Universities, Datamat SPA, Nice
  - Link through DEISA with CINECA and other Supercomputing Centers
- Other EU VI FP projects coordinated by Italian Organizations
  - Gridcc, Coord. INFN : grid for real time, remote control room, **4 M€**
  - Diligent, Coord. CNR: Digital Libraries in EGEE **6 M€**
  - GridCoord: Coord. Univer. Di Pisa coordination of nationa R&D on Grids
  - Recently: EUMED Grid, EU-China Grid,coord INFN, EGEE extensions
  - BionfoGrid, coord. CNR
- Important participation to many other FP VI projects
  - Universita' di Salerno in e-LEGI for e-Learning, Core-Grid……
- 2005: FP7 draft program
  - e-Infrastructures and National Grid integration explicitly mentioned between main objectives

The current status

The Grid in EGEE

- New computing infrastructure which provides seamless access to computing power and data distributed over different administrative domain in the globe
- A large set of interconnected, heterogeneous computing resources and their services
- Running, compatible with, and accessible from common middleware/Grid APIs (Standards)
- Integration of local policy in the deployment model
- Multi-VO supported for multi-science support
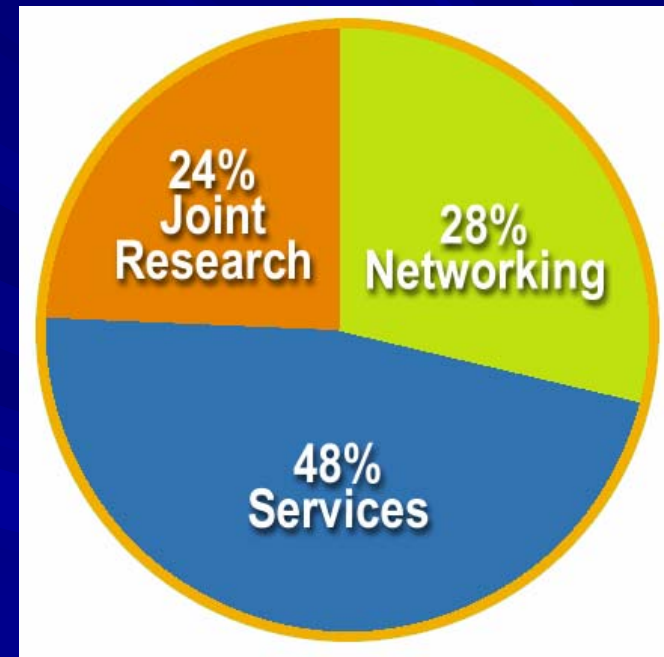- Establish a "common-market" computing environment

Why EGEE?

Build a large-scale production grid service to:

- Support science and technology worldwide
- Link with and build on national, regional and international initiatives
- Build the EU e-Infrastructure for Science
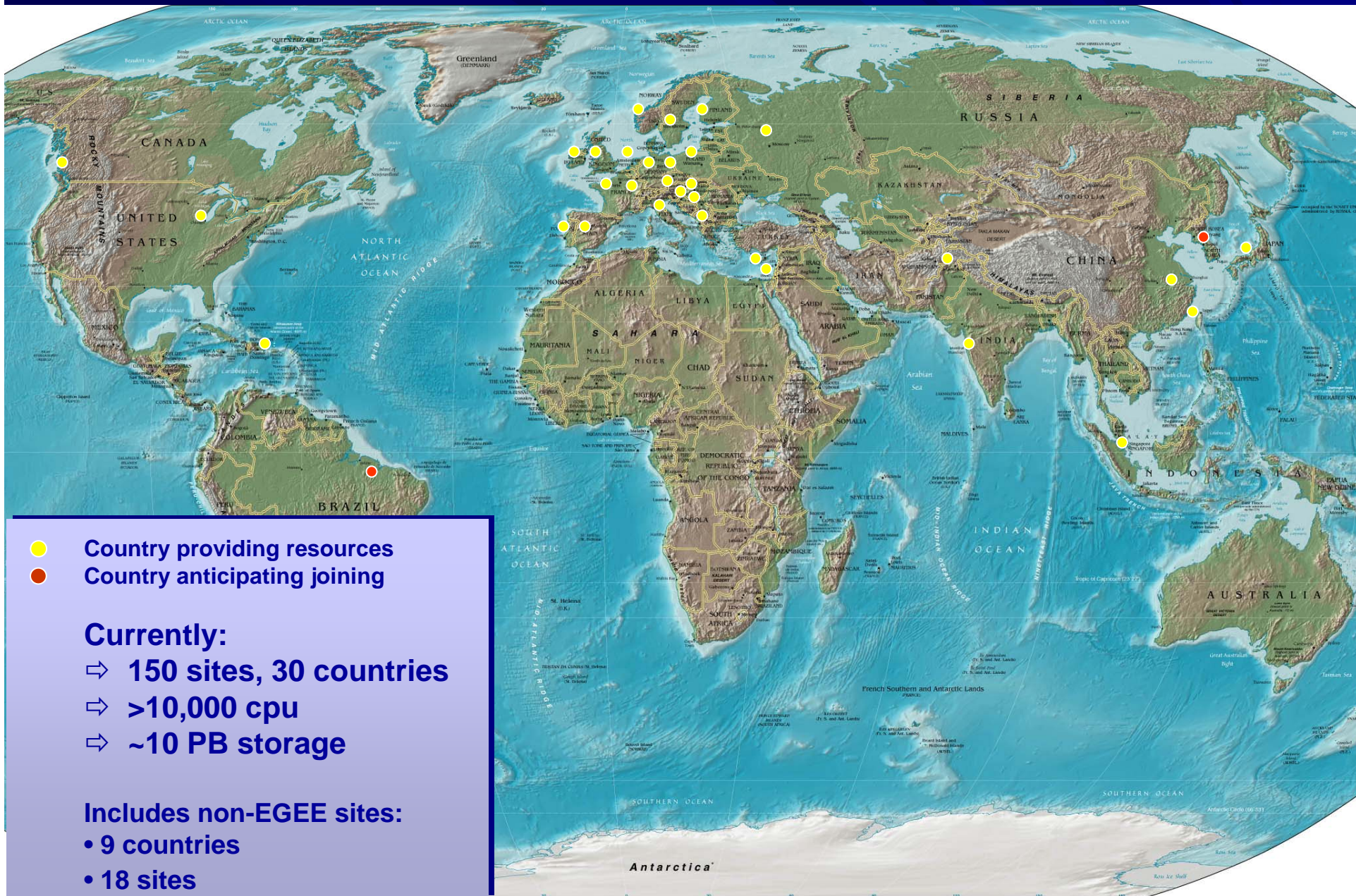- Foster international cooperation both in the creation and the use of the e-infrastructure

Collaborations

Grid infrastructure

Network

Operations, Support and training
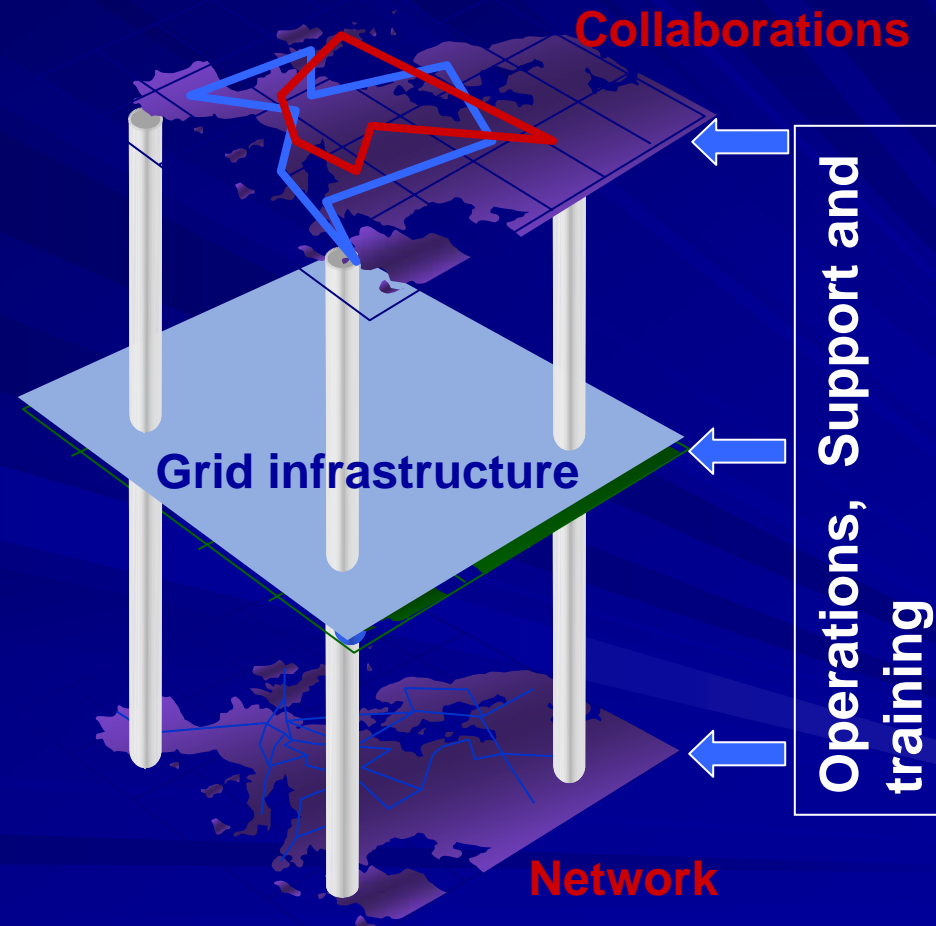
EGEE Activities

■ Emphasis on operating a production grid and supporting the end-users

■ 48 % service activities **(Grid Operations, Support and Management, Network Resource Provision)**

■ 24 % middleware re-engineering **(Quality Assurance, Security, Network Services Development)**

■ 28 % networking **(Management, Dissemination and Outreach, User Training and Education, Application Identification and Support, Policy and International Cooperation)**

Computing Resources: Feb 2005

- ● Country providing resources
- ● Country anticipating joining

Currently:
- ⇨ **150 sites, 30 countries**
- ⇨ **>10,000 cpu**
- ⇨ **~10 PB storage**

Includes non-EGEE sites:
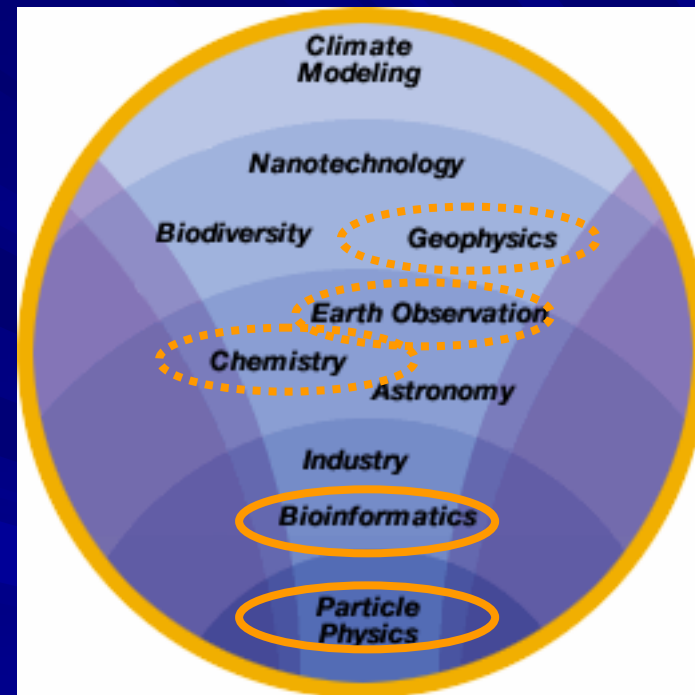- • **9 countries**
- • **18 sites**

The new Middleware: gLite

- Almost ready to replace LCG-2

- Started with existing components from EDG, VDT etc.

- Address many LCG-2 shortcoming and advanced needs from applications

- Initial web-services based Release 1 being tested in pre-production testbed with representatives from the application groups

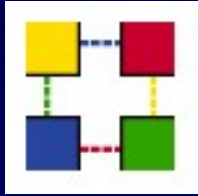- Will replace LCG-2 on production facility in 2006
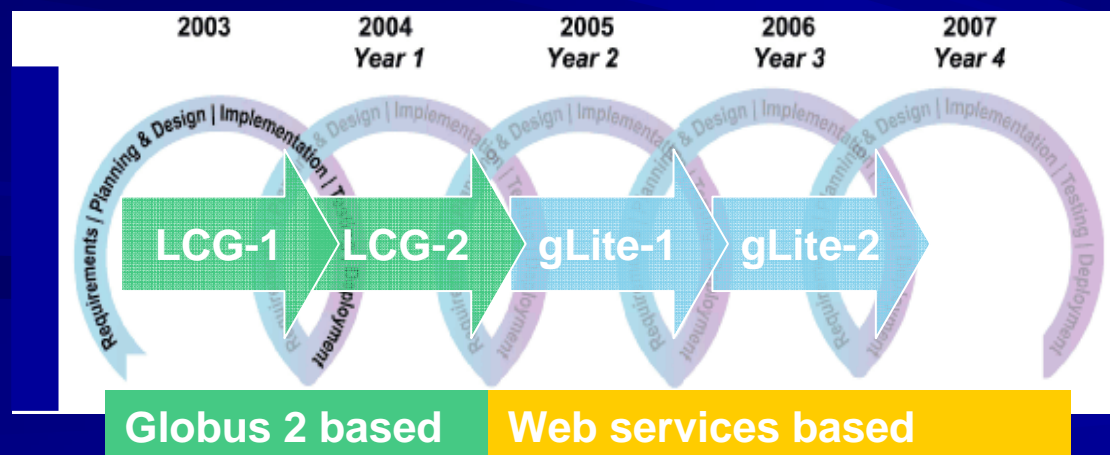
EGEE Applications

■ EGEE Scope : ALL-Inclusive for academic applications (open to industrial and socio-economic world as well)

■ Establish production quality sustained Grid services
  – 3000 users from at least 5 disciplines
  – over 50 sites
  – over 5 Petabytes (10^{15}) storage

■ Demonstrate a viable general process to **bring other scientific communities on board**

■ **Proposed a second phase** EGEE-II to take over EGEE in early 2006

Climate Modeling

Nanotechnology

Biodiversity   Geophysics

Earth Observation

Chemistry   Astronomy

Industry

Bioinformatics

Particle Physics

Pilot   New

LHC Computing Grid Project – LCG

The LCG Project status

LCG Service Hierarchy

Tier-0 – the accelerator centre
- Data acquisition & initial processing
- Long-term data curation
- Distribution of data → Tier-1 centres
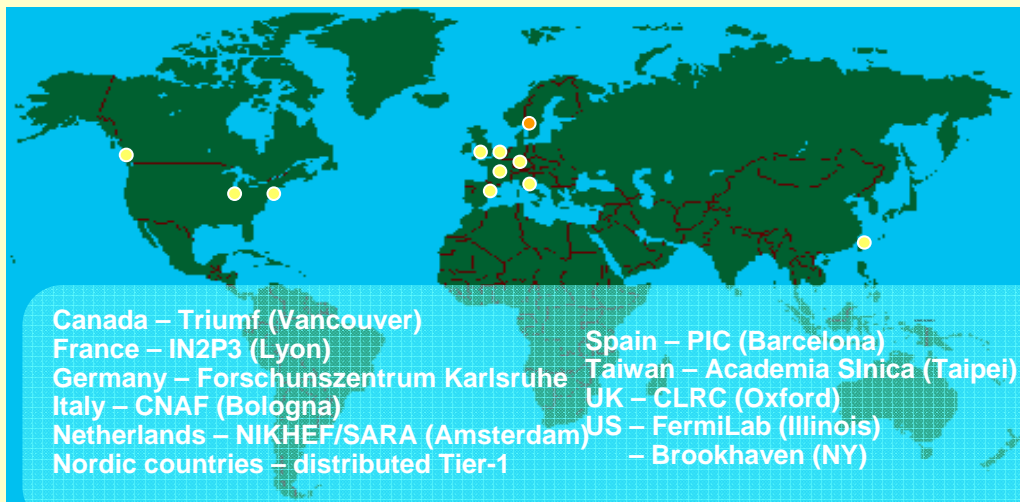
Tier-1 – "online" to the data acquisition process → high availability
- Managed Mass Storage – → grid-enabled data service
- Data-heavy analysis
- National, regional support

Canada – Triumf (Vancouver)
France – IN2P3 (Lyon)
Germany – Forschunszentrum Karlsruhe
Italy – CNAF (Bologna)
Netherlands – NIKHEF/SARA (Amsterdam)
Nordic countries – distributed Tier-1

Spain – PIC (Barcelona)
Taiwan – Academia SInica (Taipei)
UK – CLRC (Oxford)
US – FermiLab (Illinois)
– Brookhaven (NY)

Tier-2 – ~100 centres in ~40 countries
- Simulation
- End-user analysis – batch and interactive

LHC Computing Grid Project - a Collaboration

Building and operating the LHC Grid –
a global collaboration between

- The physicists and computing specialists from the LHC experiments
- The projects in Europe and the US that have been developing Grid middleware
- The regional and national computing centres that provide resources for LHC
- The research networks

Researchers

Computer Scientists & Software Engineers
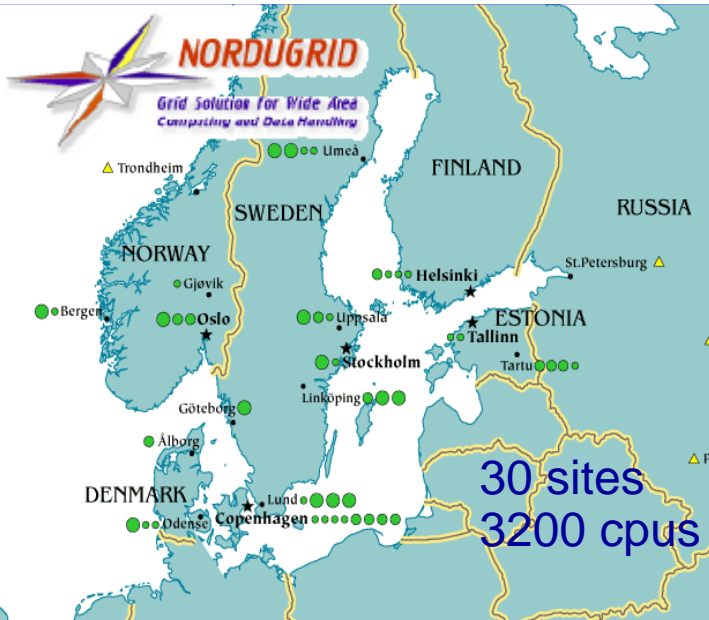
Service Providers

Including several national grid projects

Virtual Data Toolkit

30 sites
3200 cpus

Inter-operation with the Open Science Grid in the US and with NorduGrid:
→ Very early days for standards – still getting basic experience
→ Focus on baseline services to meet specific experiment requirements

May 2005

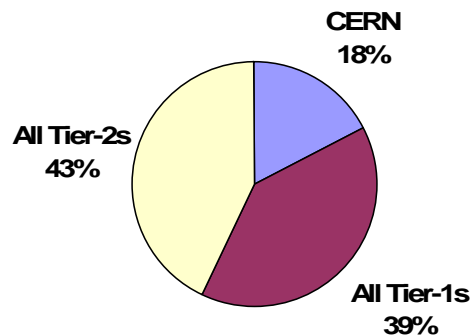**140 Grid sites**

34 countries

12,000 CPUs

8 PetaBytes

4 National Labs
2800 CPUs

Open Science Grid
Grid3

Summary of Computing Resource Requirements

All experiments - 2008

From LCG TDR - June 2005

	CERN	*All Tier-1s*	*All Tier-2s*	*Total*
CPU (MSPECint2000s)	25	56	61	142
Disk (PetaBytes)	7	31	19	57
Tape (PetaBytes)	18	35		53

CPU

CERN 18%
All Tier-2s 43%
All Tier-1s 39%

Disk

CERN 12%
All Tier-2s 33%
All Tier-1s 55%

Tape

CERN 34%
All Tier-1s 66%
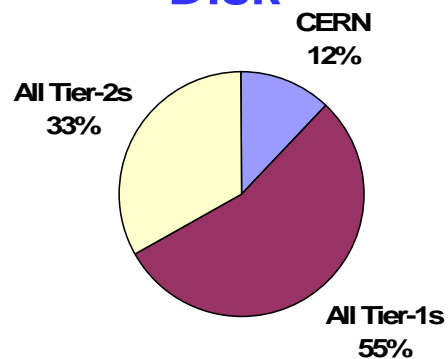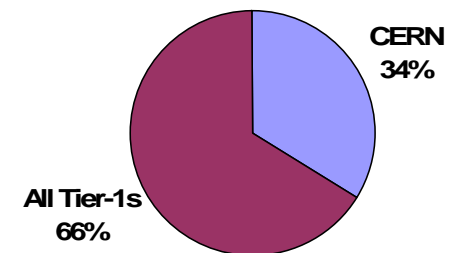
LCG Data Recording Challenge

Tape server throughput – 1-8 March 2005

- Simulated data acquisition system to tape at CERB
- In collaboration with ALICE – as part of their 450 M B/sec data challenge
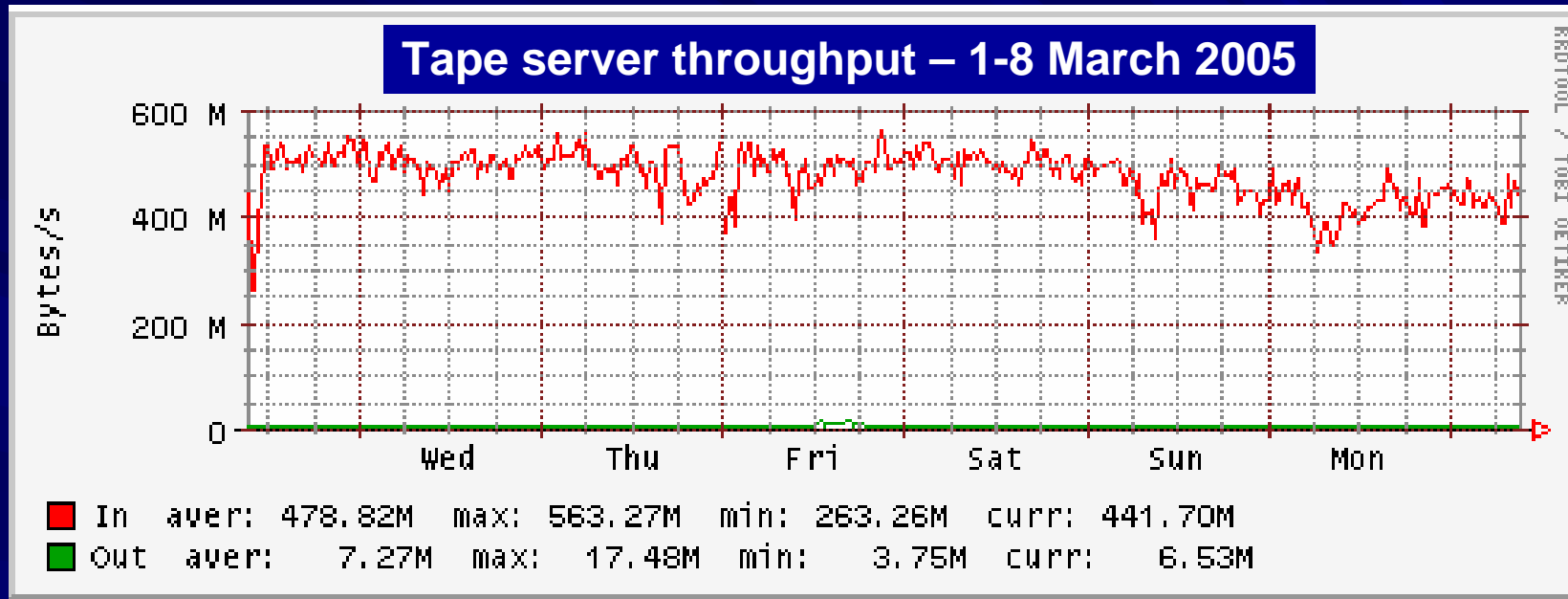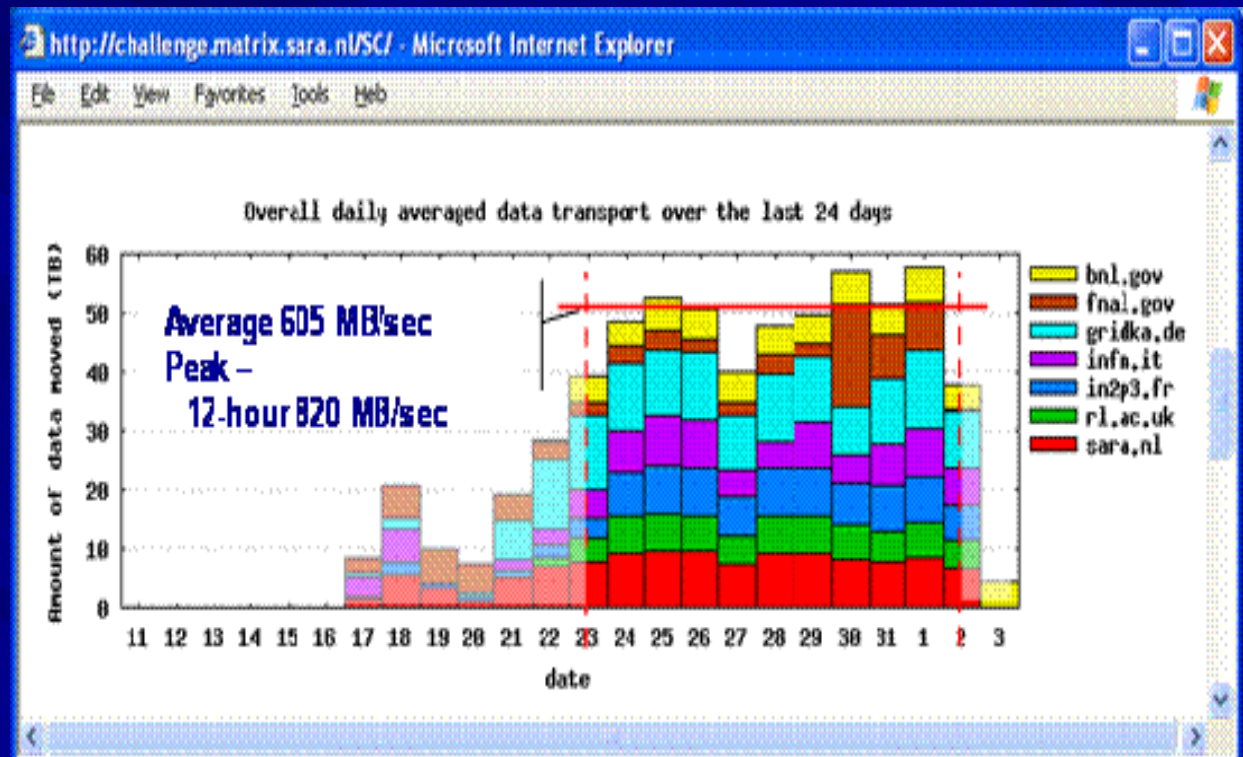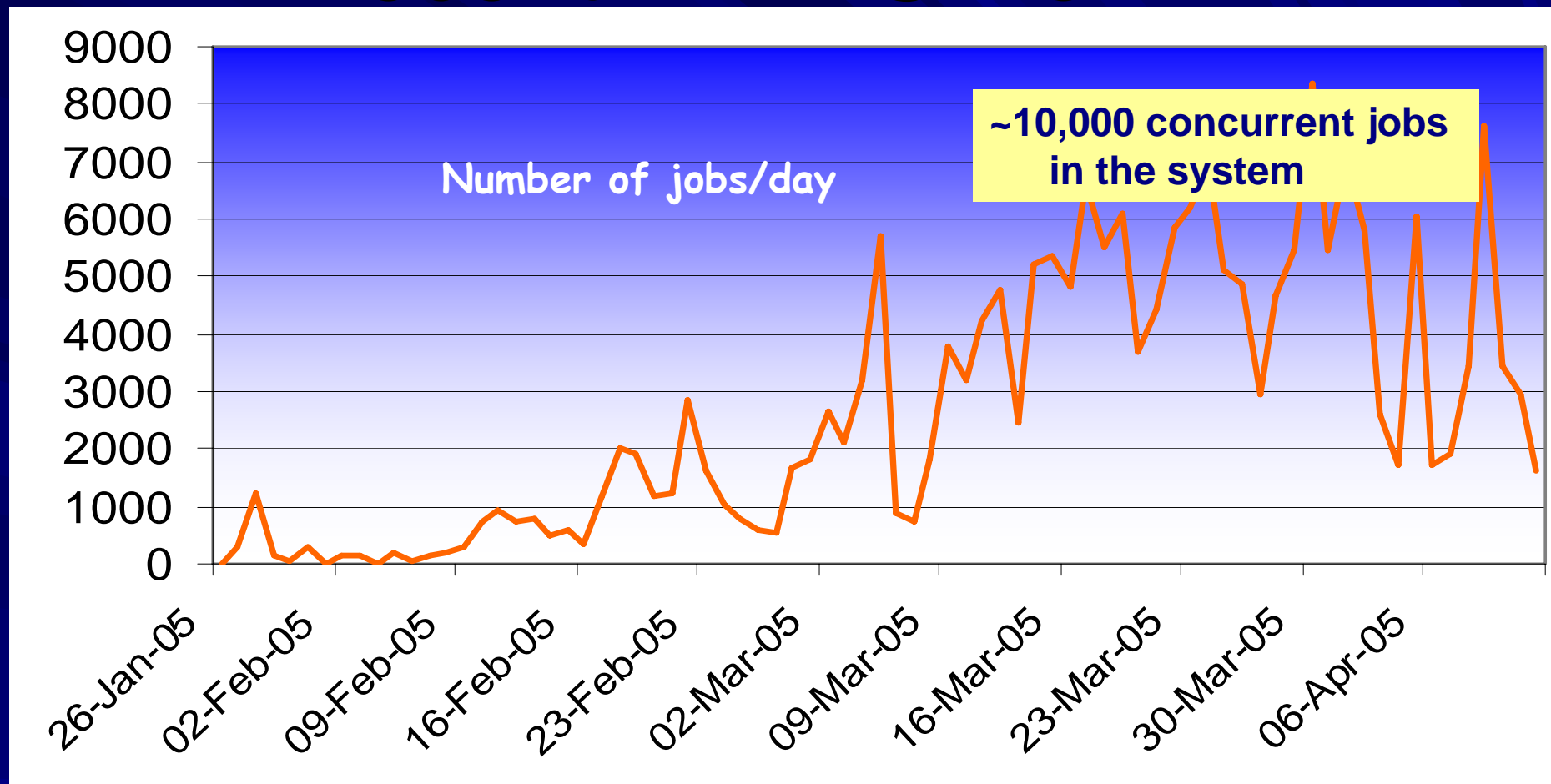- Target – one week sustained at 450 MB/sec – achieved 8 March

Service Challenge 2

- Data distribution from CERN to Tier-1 sites
- Original target – sustain daily average of 500 MByte/sec from CERN to at least 5 Tier-1 sites for one week by the end of April
- Target raised to include 7 sites and run for 10 days

- BNL, CCIN2P3, CNAF, FNAL, GridKa, RAL, NIKHEF/SARA
- Achieved on 2 April –
  -- average 600 MB/sec
  -- peak 820 MB/sec
- 500 MB/sec is 30% of the data distribution throughput required for LHC

Overall daily averaged data transport over the last 24 days

Average 605 MB/sec
Peak –
12-hour 820 MB/sec

bnl.gov
fnal.gov
gridka.de
infn.it
in2p3.fr
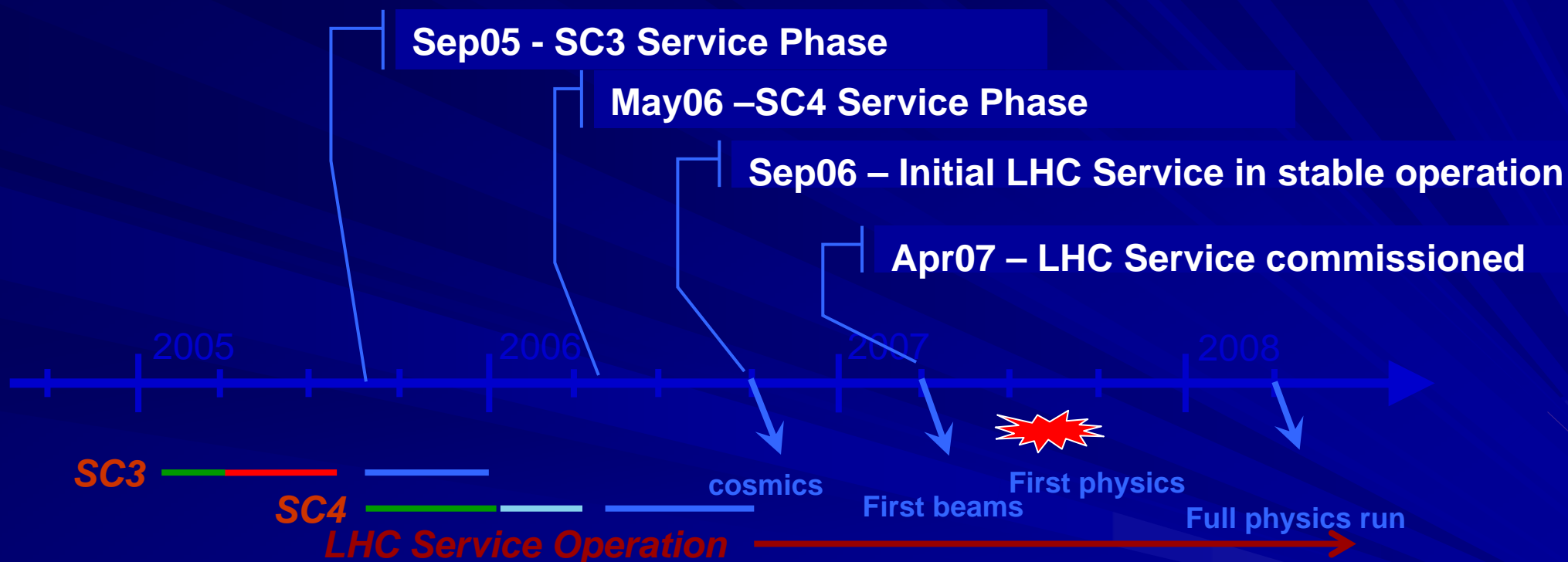rl.ac.uk
sara.nl

Recent ATLAS work

- ATLAS jobs in EGEE/LCG-2 in 2005
- In latest period up to 8K jobs/day
- Several times the current capacity for ATLAS at CERN alone – shows the reality of the grid solution

Ramping up to the LHC Service

- The services for Phase 2 will be ramped-up through two **Service Challenges** SC3 this year and SC4 next year
- These will include CERN, the Tier-1s and the major Tier-2s
- Each service Challenge includes –
  - -- a set-up period
    - check out the infrastructure/service to iron out the problems *before the experiments get fully involved*

    - schedule allows *time to provide permanent fixes* for problems encountered
    - A throughput test
  - -- followed by a long stable period for experiments to check out their computing model and software chain

Key dates for Service Preparation

Sep05 - SC3 Service Phase

May06 –SC4 Service Phase

Sep06 – Initial LHC Service in stable operation

Apr07 – LHC Service commissioned

2005   2006   2007   2008

SC3

SC4

LHC Service Operation

cosmics

First beams

First physics

Full physics run

- **SC3 – Reliable base service – most Tier-1s, some Tier-2s – basic experiment software chain – grid data throughput 1GB/sec, including mass storage 500 MB/sec (150 MB/sec & 60 MB/sec at Tier-1s)**
- **SC4 – All Tier-1s, major Tier-2s – capable of supporting full experiment software chain inc. analysis – sustain nominal final grid data throughput (~ 1.6 GB/sec mass storage throughput)**
- **LHC Service in Operation – September 2006 – ramp up to full operational capacity by April 2007 – capable of handling twice the nominal data throughput**

LCG Grid Status Summary

- May 2005 – running at ~15,000 jobs in the system
- The LCG/EGEE grid –
  - many more sites and processors than was anticipated at this stage
    - → ~140 sites, ~12,000 processors
      target for end 2004 was 20 sites, 2,000 processors
  - scalability is *already close to that needed for the full LHC grid*
  - Grid operation now working, sharing responsibility between operations centres in Taiwan, Italy, Germany, France, UK, Russia and CERN
  - Reliability is still a major issue - a focus for work this year
  - Middleware evolution → aim for a solid, though basic functionality by end 2005
- 34 countries working together in a consensus based organisation

The Open Science Grid Organization

Not a project but Management and Coordination of different projects

PPDG "Opportunity Flower"
R. Mount, CHEP 2001
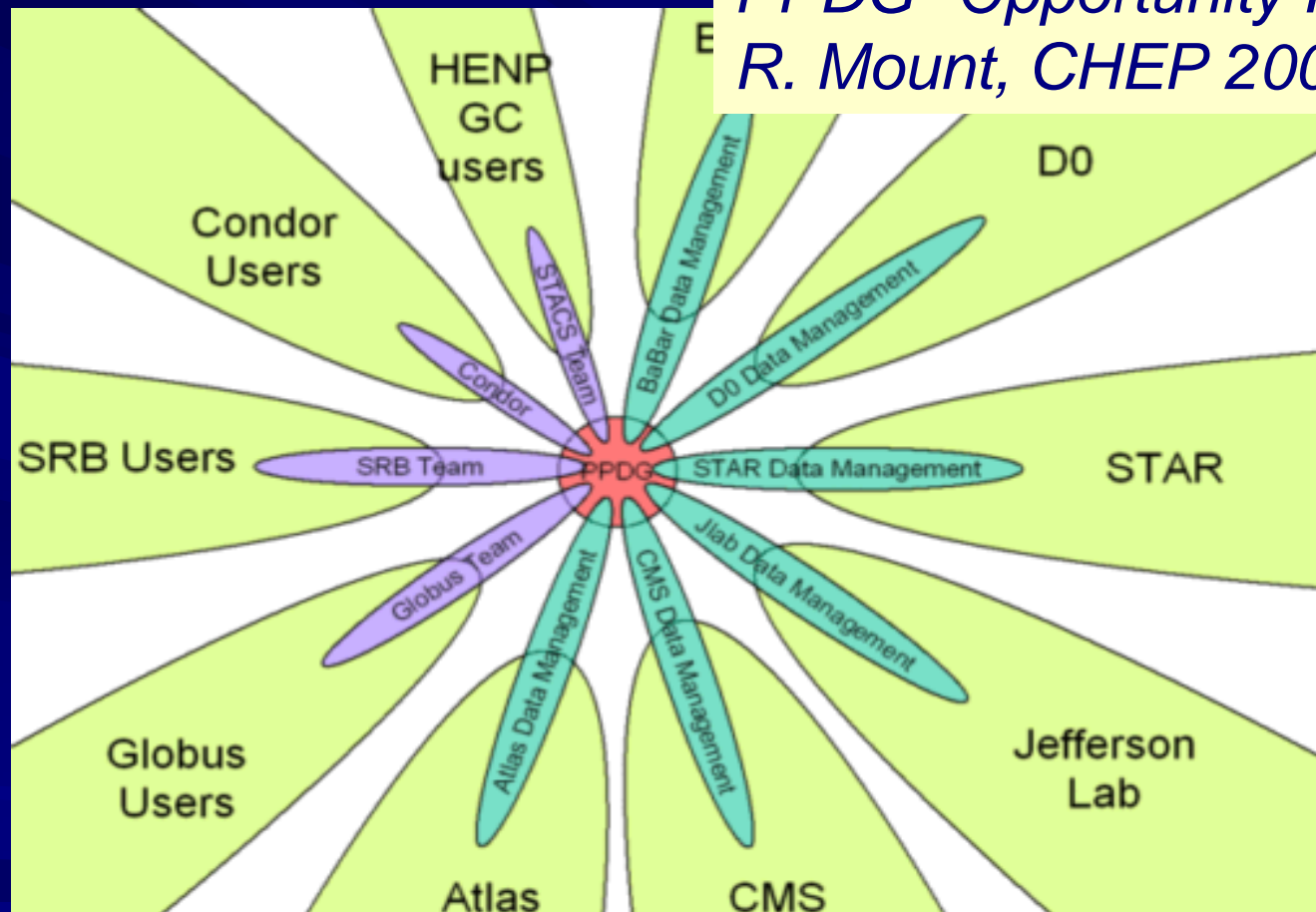
EARLY RECOGNITION OF THE COORDINATION CHALLENGE

Underlying Motivation and Principles

- Need: evolve the Grid3 to production scale distributed infrastructure.
- Recognized early that without a large, single source of project funding US would have to find a framework for collaboration that aligned stakeholder interests and maintained existing project management lines
- Rather than architecting a complete system, OSG derive principles based on working end-to-end requirements, and assemble teams with middleware and higher level service technology providers, VO-based project development teams, and applications integrators
  - These teams (Activities) would be formed on as add-needed basis

Basic OSG Entities

- **Technical Groups (7)**
  - Created from a need to separate long term technical oversight and strategic discussion from the day to day work
- **Activities (10)**
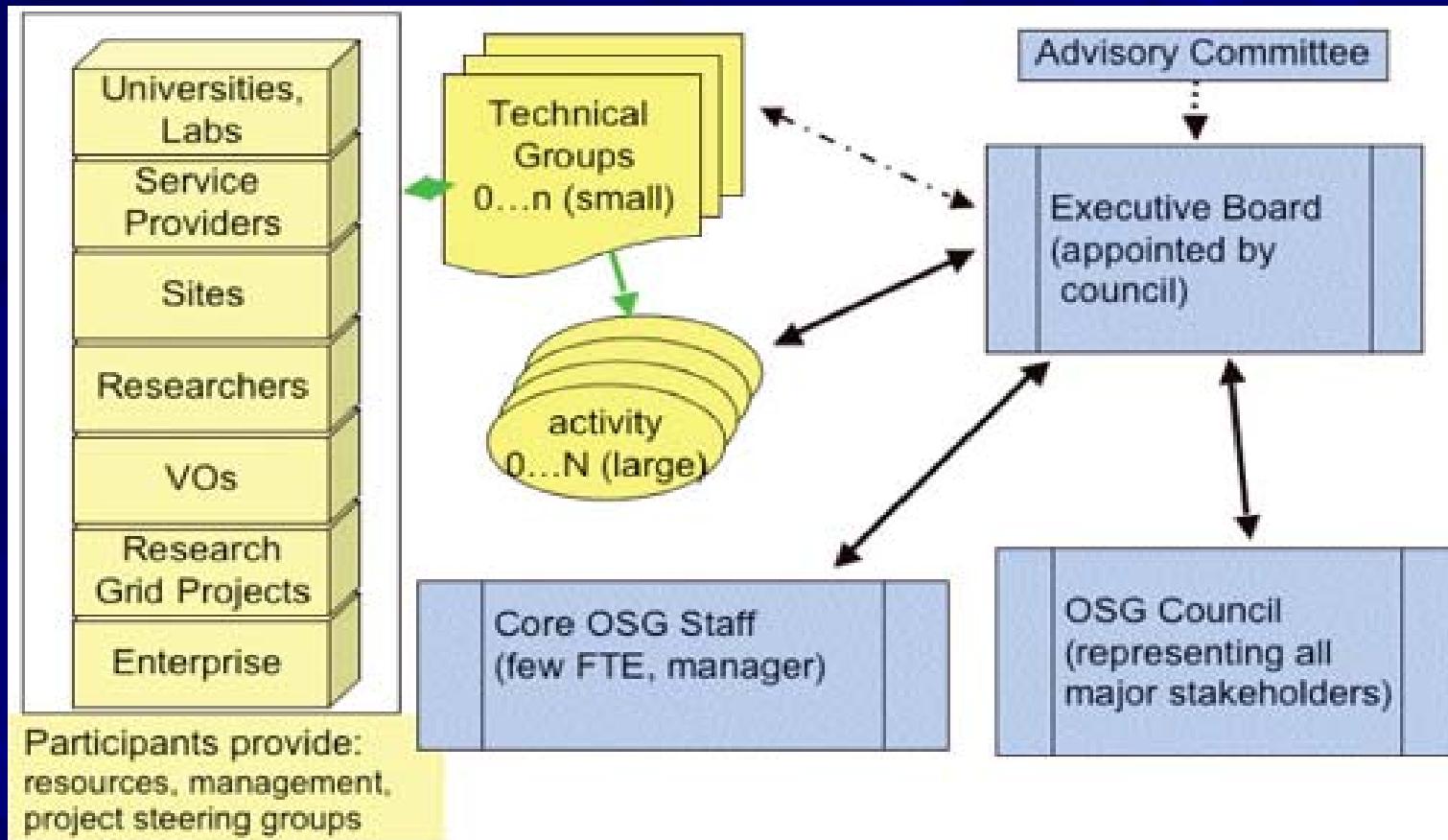 - Carriers of work in the OSG -- where participants plug directly in with effort and resources
  - Defined by a charge, scope, schedule (the usual components of a program of work)
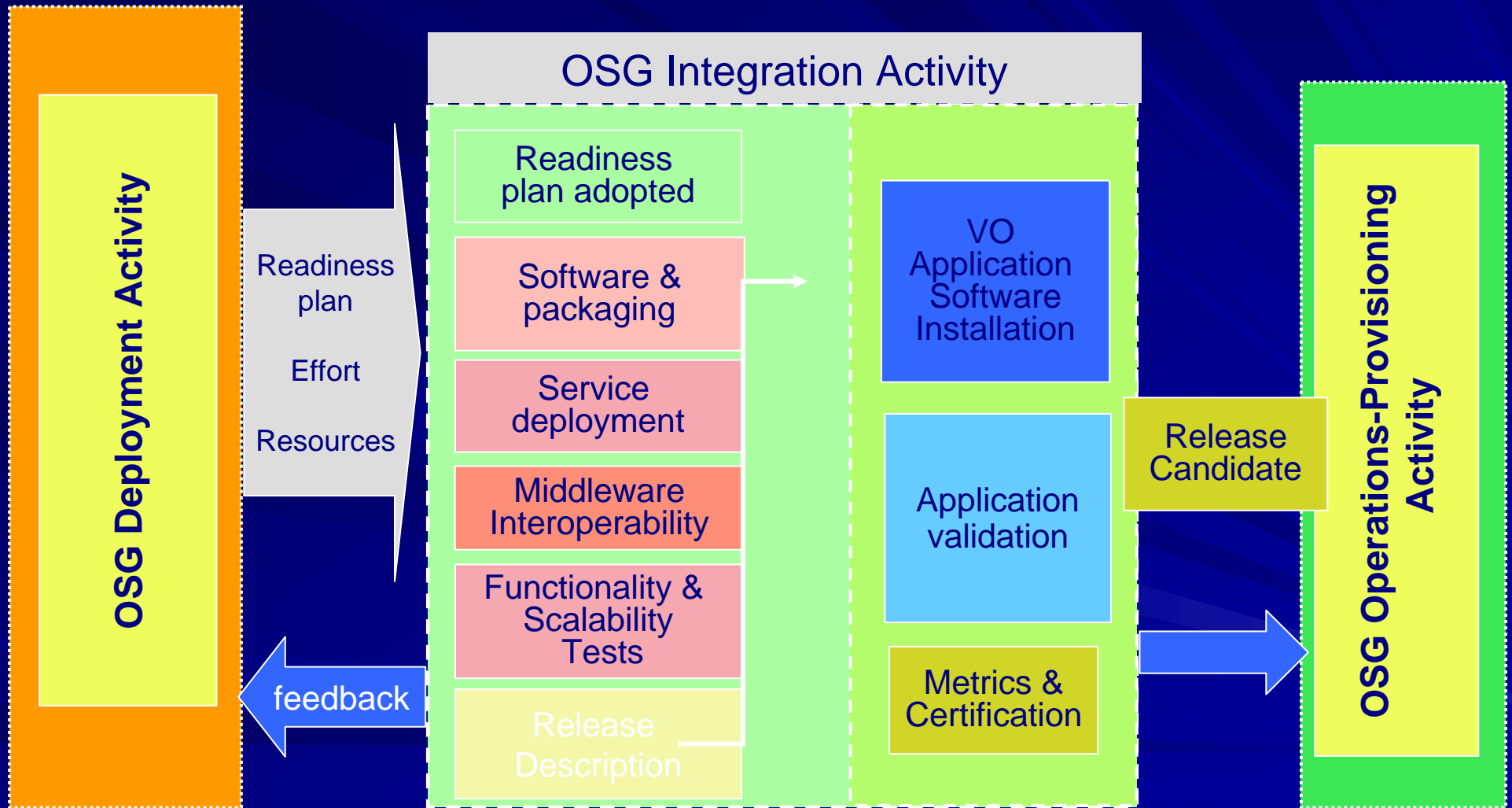- **Interim Executive Board and Council**
  - Provide the executive and governance functions, where stakeholder organizations interact programmatically

Consortium Architecture

Moving forward: path for new services into OSG

The OSG e-Infrastructure

25 Universities
4 National Labs
2800 CPUs

UWMilwaukee
UWMadison
FNAL_CMS
UM_ATLAS
UBuffalo-CCR
BU_ATLAS_Tier2
Purdue
UC_ATLAS_Tier2
BNL_ATLAS
IU_iuatlas
IU_ATLAS_Tier2
PSU_Grid3
ANL_Jazz
JHopkins
HU_HUATLAS
pdsf
Vanderbilt
Caltech-Grid3
Caltech-PG
UNM_HPC
OU_OSCER
OUHEP
UTA-DPCC
SMU_ATLAS
UCSanDiegoPG
UCSanDiego
Rice-Grid3
UFlorida-Grid3
UFlorida-PG
CHEPRIO_FIU
KNU
Open Science Grid
Grid3
South Korea

OSG Summary

- Consortium model of pulling together efforts from multiple projects & organizations working well so far
  - Deployment of multiple releases of production OSG this Spring, culminating in OSG 0.2
  - Sustainable framework for long term infrastructure
- Next up: introduction of next generation services for OSG 0.4

Asia Pacific Grid
APGrid

ApGrid: Asia Pacific Partnership for Grid Computing

- **Open community for Grid researchers in Asia Pacific**

- **First meeting and inaugural event**
  - Kick-off meeting: July, 2000
  - 1st ApGrid Workshop: Sep, 2001
- **ApGrid is**
  - A meeting point for all Grid researchers in Asia-Pacific
  - A communication channel to the GGF, and other grid communities
  - A pool for relating to international project partners

Participating Organizations

- **Australia**
  - APAC, ANU, Monash U, U. of Melbourne, Sydney VisLab, U. of Adelaide, Griffith U.
- **Canada**
  - National Research Council, CANARIE
- **China**
  - ICT/CAS, CNC/CAS, SDB/CAS
- **Hong Kong**
  - CS/HKU, CC/HKU
- **India**
  - CDAC, U. of Hyderabad
- **Japan**
  - AIST, TITECH, U. of Tsukuba, RIKEN, KDDI, Osaka U., NAIST, Doshisha U., KITECH, U. of Tokyo, Waseda U.
- **Malaysia**
  - USM, UTM

- **NewZealand**
  - U. of Otago
- **Philippines**
  - Ateneo de Manila U.
- **Singapore**
  - NGO, iHPC, NTU, NUS, SCS, APSTC
- **South Korea**
  - KISTI
- **Taiwan**
  - NCHC, ASCC
- **Thailand**
  - NECTEC, Kasetsart U., KMITNB
- **USA**
  - Indiana U., SDSC/UCSD, San Jose State U.
- **Viet Nam**
  - MOSTE, NCST

15 countries, 49 organizations

ApGrid/PRAGMA Testbed – unique features –

- **Truly (naturally) multi national/political/institutional VO beyond boundaries**
  - Not an application-dedicated testbed – general platform
  - Diversity of languages, culture, policy, interests, …
- **Grid BYO – Grass roots approach**
  - Each institution contributes his resources for sharing
  - Not a single source funded for the development
- **Physical resources**
  - Most contributed resources are small-scale clusters
  - Networking is there, however the bandwidth is not enough
- **Can**
  - have experiences on running international VO
  - verify the feasibility of this approach for the testbed development

言語と文字

サ ド シ

パठ ९ कल आपने क्या किया

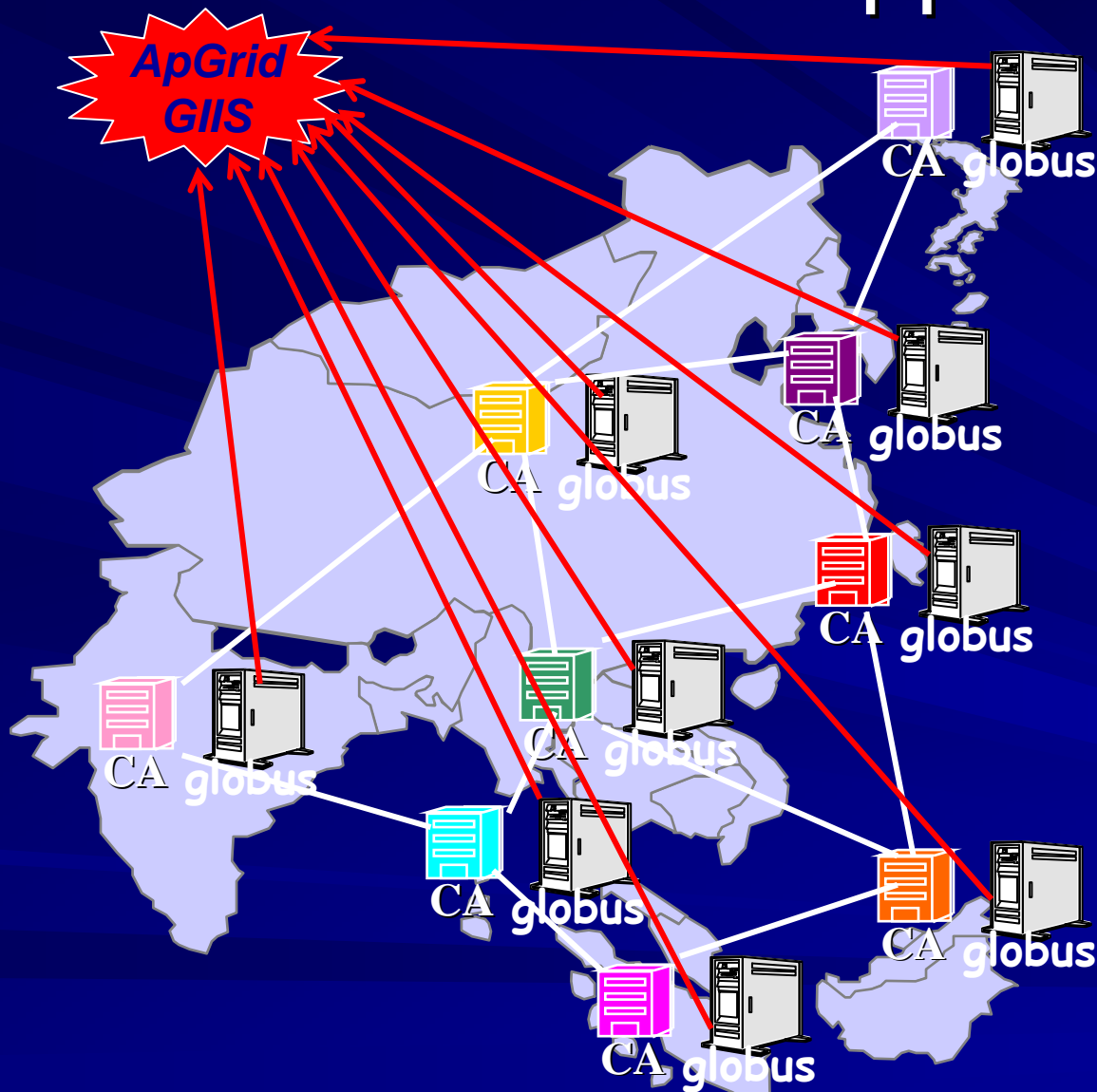互联网发展论坛

Selamat Datang!

Tin hằng ngày

Grass-roots Approach (strategy)

- **Assumption**
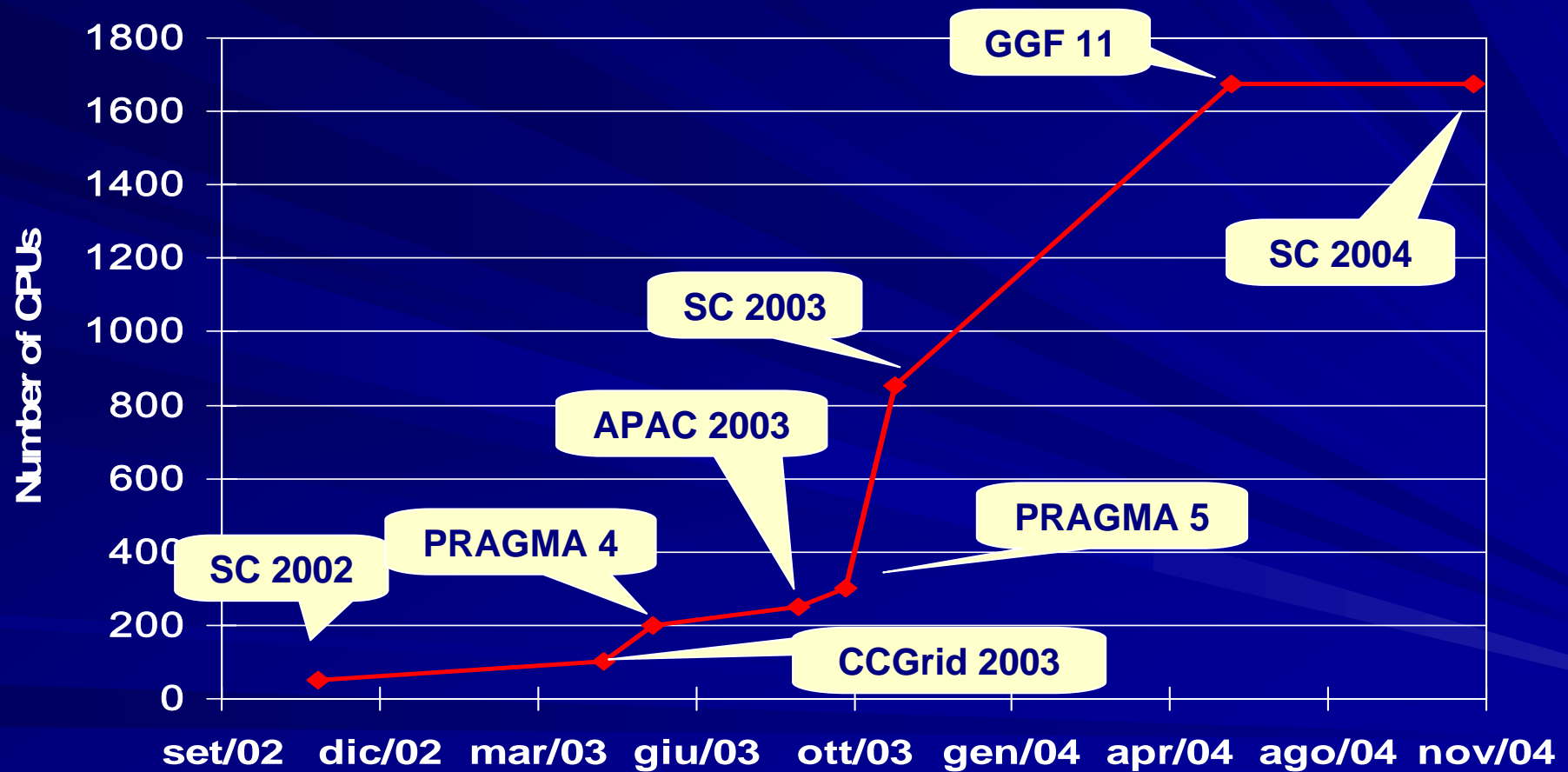 - Each institution has installed GT2
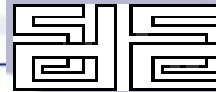
- **Necessary steps**
  - Gather and exchange trusted CA info. and trust with each other
  - Configure MDS to build an ApGrid MDS tree

- **For application use**
  - Install additional software in project-basis

Progress of the development

ApGrid Testbed

🌐 **Architecture, technology**
- ◆ **Based on GT2**
  - • **Allow multiple CAs**
  - • **Build MDS Tree**
- ◆ **Grid middleware/tools from Asia Pacific**
  - • **Ninf-G (GridRPC programming)**
  - • **Nimrod-G (parametric modeling system)**
  - • SCMSWeb (resource monitoring)
  - • Grid Data Farm (Grid File System), etc.

🌐 **Status**
- ◆ 22 organizations (10 countries)
- ◆ 23 clusters (1688 CPUs)

Success Stories

- Trans-Pacific Grid Datafarm won Distributed Infrastructure Award in the BWC'03
  - 7 sites at the US and Japan
  - Aggregated BW: 3.8Gbps

- Multi-Continental Telescience own Application Award in the BWC'03
  - telescience, microscopy, biomedical informatics, optical networking, next-generation protocols

- SARS Grid
  - Grid Community Pulls together to Battle SARS
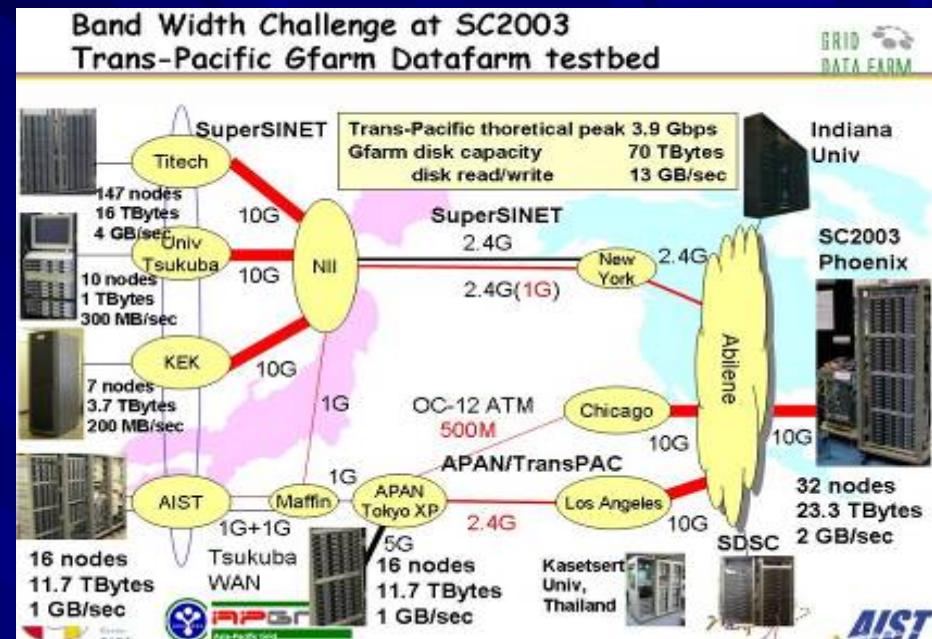
- Others
  - Encyclopedia of Life, Eco Grid, etc.

Climate simulation on ApGrid-TeraGrid @ SC2003

Severs
NCSA Cluster (225 CPU)

Forecasted Barotropic Height

Ensemble of predictions

1989/1/30/0
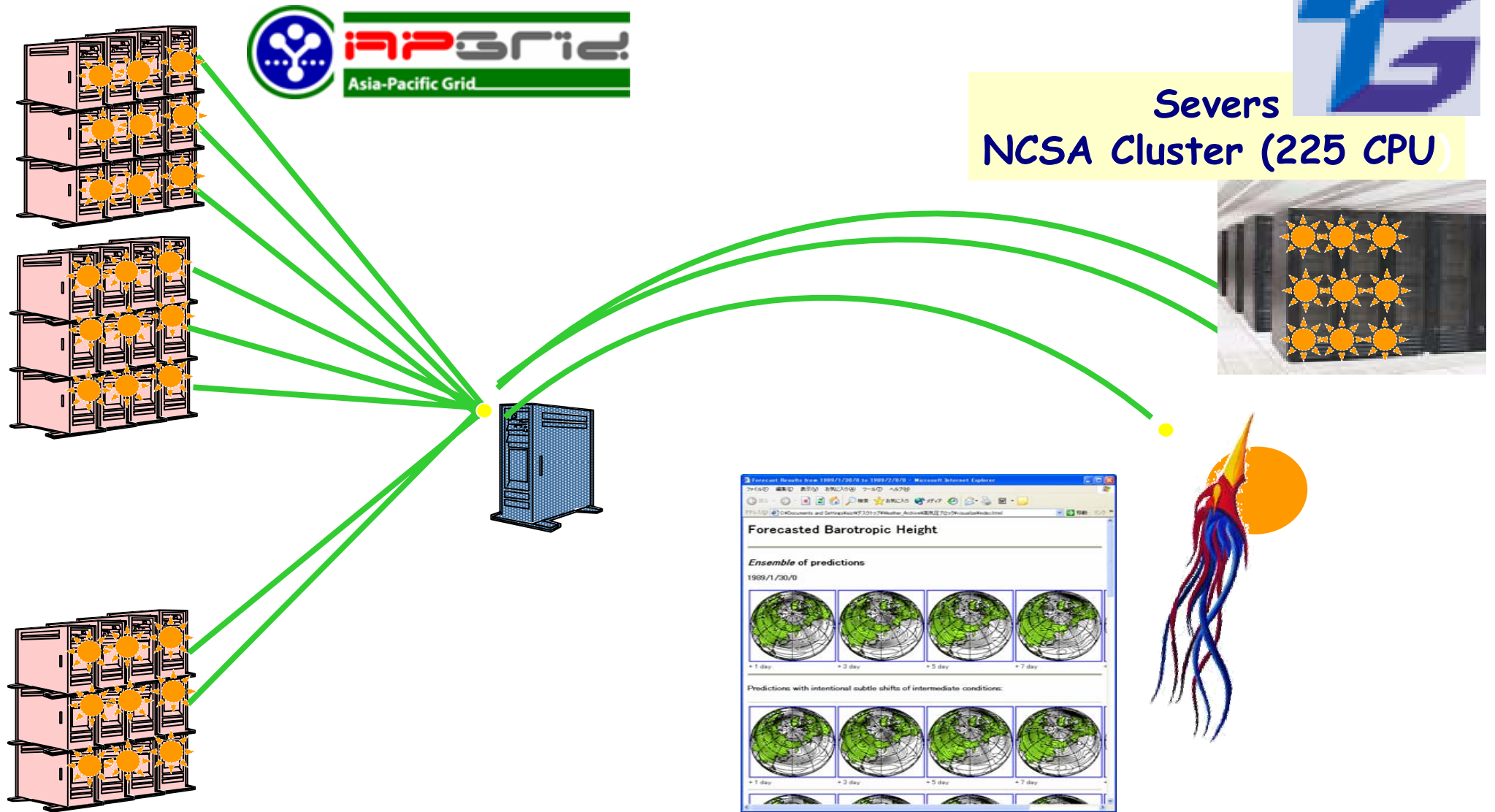
APGrid PMA: Asia Pacific Grid PMA

- **General Policy Management Authority in Asia Pacific**
  - Not specific for ApGrid, Not specific for PRAGMA…

- **Launched on June 1st, 2004**

- **Defines minimum CA requirements**

- **APGrid PMA accept two levels of CA:**
  - Experimental-level CA
    - Alternative of the Globus CA
    - Can be trusted within A-P communities
  - Production-level CA
    - Strict management is necessary
    - Expected to be trusted by international communities

Status of PMAs

- Currently, there are three regional PMAs
  - EUGrid PMA (established May 2004)
    - Former: EU EDG WP6 CA Coordination Group (started in 2002)
  - TAG PMA (going to be established)
    - Former: DOEGrid PMA (started in 2002)
  - APGrid PMA (established June 2004)
    - Unofficially started in 2003
- Each regional PMA is responsible for
  - coordination of CA policy within the region
  - coordination of CA policy with the other regional PMAs
- <u>Three PMAs are the founders of the International Grid Trust Federation (IGTF)</u>

The future: EGEE-II

- EGEE-II project proposal submitted on 8° September
- Goals
- EGEE has shown that reliable and effective production activities are possible (7-10 K Jobs concurrently running in top days)
- EGEE-II will focus in making services user friendly, easily installable, with increased performance, automatic handling of bulk operations, increse adherence to standards and interoperable (See also OMII Europe)

- Major testing and integration work now in separate activity : SA3
- Major effort in stengthening grid operations in Europe

- Grid economies, workflows and some inter-operability work will be performed outside EGEE (in related projects)
  – OMII Europe, Bioinfogrid etc.

The European Grid Organization (EGO)

- CERN ha recently proposed to EU parliament the the creation of EGO aiming at:
  - Providing long term support to the EU e-Infrastructure build by EGEE and DEISA (Supercomputing Centers) and by national Grid projects
  - Providing a coordinastion framework at EU level in line with what was peviosuly done for networking by Geant, DANTE and National Nrens like Garr
- EGO will be included between EGEE-II objectives

The national Grid.it e-Infrastructure

- Grid.it provide a national Grid Infrastructure and prototype a national Grid Operation Center (GOC)
  - The generalization of the infrastructure support to other Sciences from INFN is a model successfully established in the past with Garr
  - Resources are provided by INFN and major Italian Centers
  - The GOC support several Italian Sciences applications and the operation of the Italian infrastructure also in the context of the new European Infrastructure project EGEE
- The Italian eScience Grid.it e-infrastructure currently support:
  - Astrophysics
  - Biology
  - Computational Chemistry
  - Geophysics
  - Earth Observation
  - …….

Grid.IT Production Grid: 0perations Portal

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

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

INFN GRID

News

Organisation
- Deployment plan

Access to the grid
- Install your UI
- Get your certificate
- Register to a VO
- Submit a job

Manage your site
- Installation
- Upgrade
- Packages lists
- CVS repository

Grid status
- VO view
- Site view

Support
- Ticketing System
- Knowledge base

Search

Links

Site map

Welcome to the INFN Production Grid for Scientific Applications !

INFN-GRID is a research project which features solutions and innovations in methodologies and technologies for the implementation and widespread use of large-scale platforms and grids. We partecipate to several National and International research projects on Grid Computing:

We're coordinating our objectives with the strategies of the European Community to build the Next Generation Grid.

○ Grid.it
● INFNGrid

Our efforts are evaluated in terms of our grid capability to solve very critical, real problems in the medium-long term. The best standards in ICT are assumed as the technological starting point (e.g. OOP, Web services, Globus), over which new technologies are studied and built.

Read the latest *news* from *October 31, 2003*

Get your personal certificate

Access to the grid
Get your certificate

Step 2: Get your personal certificate

To access the GRID you need a Personal Certificate (released by a Certification Authority) to be installed in a User Interface where you got an account.

1. Install the **Certification Autority Certificate** on your browser 🌐
2. Identify yourself to the **Registration Authority** in your department and ask him for an ID 🌐
3. Ask for your **Personal Certificate** using the ID given to you by the RA 🌐
4. Install your **Personal Certificate** on your browser (the same browser of step 1). You have to wait for a couple of days to receive a mail with a web link to the page containing your certificate.
5. Export your **Personal Certificate** from your browser 🌐
6. Copy your **Personal Certificate** in your home directory of a User Interface where you got an account

All these steps are described in detail in the following document:

- INFN-GRID personal certificates howto - [PDF] - [TXT]

Go to: *Step 3: Register to a VO*

News

Organisation
▸ People & tasks
▸ Deployment

Access to the grid
▸ Install your UI
▸ Get your certificate
▸ Register to a VO
▸ Submit a job

Manage your site
▸ Installation
▸ Upgrade
▸ Testing
▸ Releases
▸ CVS Repository

Grid status
▸ Site view
▸ VO view
▸ Grid services

Support
▸ Ticketing System
▸ Knowledge base

Search

Links

Clear, simple and automated procedure to allow all Italian Institutions to set up a Registration Authority and get INFN CA Certificates

Developing Grid Standards

Increased functionality, standardization (vertical axis)

Research ➝ Managed shared virtual systems

Web services, etc. ➝ Open Grid Services Arch

Real standards (GGF: OGSI/WSRF, leveraging OASIS, W3C, IETF)
Multiple implementations

Internet standards ➝ Globus Toolkit

Defacto standard
Single implementation

Custom solutions

1990   1995   2000   2005   2010

11

From the source...

Source: Ian Foster - foster@mcs.anl.gov

Grid: towards "standard" services

Services corresponding to GGF or "de facto" Standards:

- Job Submission Description Language (JSDL)
- Storage Resource Manager (SRM GGF specification) for Storage
- GLUE Schema for Resource description
- Autentication and Authorization of users and resources: Globus GSI, Certficati X509, Trusted Certification Authorities
- Privacy in comunication: Gridftp..
- INFN VOMS for Authorization: INFN, EGEE, LCG, OSG (US)

- In progress:
- DGAS per accounting
- Information Systems
- Common Interface to Catalogs LFC,
- OGSA DAI for Databases

Main Issue: CE Standardization

- Initially Globus GRAM GT2 was the standard de-facto
- Not any more now
  - Globus GT4 CE, Condor based CE, Nordugrid CE, Unicore CE,EGEE CREAM, …
- Problem to grant interoperability between different grids
- Vaious activities to foster progress
  - CRM workshop: Roma, 17-18 February 2005
    - Partecipants: INFN-GRID, LCG, EGEE, Unicore, Condor, Globus, NorduGrid
    - Agreed to implement Job Submission Description Language
    - Standardization of the interface is the next step
- Addressed by new European Open Middleware Institute Initiative submitted to EU

Conclusions

- Grid infrastructures are taking over around the World to promote National, Regional and International collaboration in Science
- The LCG/EGEE grid has shown
  - May 2005 – capability of running at ~15,000 jobs in the system
  - many sites and processors
  - → ~140 sites, ~12,000 processor
  - scalability *already close to that needed for the full LHC grid*
- Slow but constant progress towards "standards"
  - Need to allow different experiences
  - TCP/IP will come but is not near the door
- See:http://grid.infn.it and links therein