Introduction to Grids and the EGEE project

General presentation

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www.eu-egee.org

Information Society and Media

Lost in Definitions?

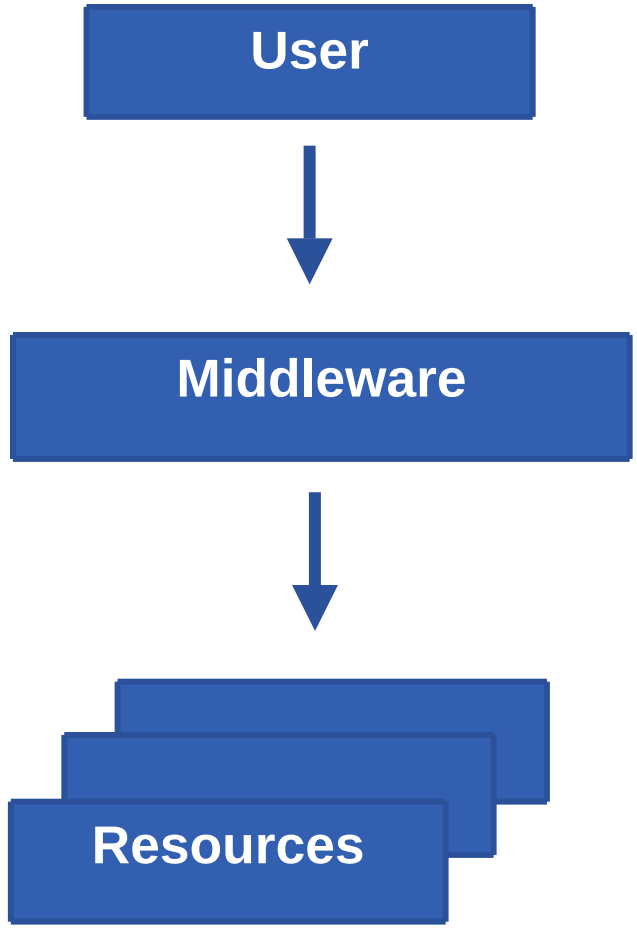
Defining the "Grid":

- Access to (high performance) computing power
- Distributed parallel computing
- Improved resource utilization through resource sharing
- Increased memory provision
- Controlled access to distributed memory
- Interconnection of arbitrary resources (sensors, instruments, …)
- Collaboration between users/resources
- Higher abstraction layer above network services
- Corresponding security
- …

Defining the Grid

- A Grid is the combination of networked resources and the corresponding Grid middleware, which provides Grid services for the user.
- This interconnection of users, resources, and services for jointly addressing dedicated tasks is called a virtual organization.
- Comparison between Grids and Networks:
  - Networks realize message exchange between endpoints
  - Grids realize services for the users

  ➔ higher level of abstraction



Grids vs. Distributed Computing

- **Distributed applications already exist, but they tend to be *specialized systems* intended for a single purpose or user group**

- **Grids go further and take into account:**
  - Different kinds of *resources*
    - Not always the same hardware, data and applications
  - Different kinds of *interactions*
    - User groups or applications want to interact with Grids in different ways
  - *Dynamic* nature
    - Resources and users added/removed/changed frequently

Grid and Virtualisation

- **Virtual Organisations (VO's)= Group of users, federating resources**
  - Heterogeneous: people from different organisations
  - Cooperation: common goals
  - For sharing: to solve problems by using common resources
- **Virtualised shared computing and data resources**
  - Access to resources outside their institute for members of VO's
  - Resource providers negotiate with VO not with individual members
- **Virtualisation and sharing also possible for :**
  - Instruments, sensors, people, etc.

Virtualisation of resources is needed to hide their heterogeneity and present a simple interface to users

Defining the Grid

A Grid is the combination
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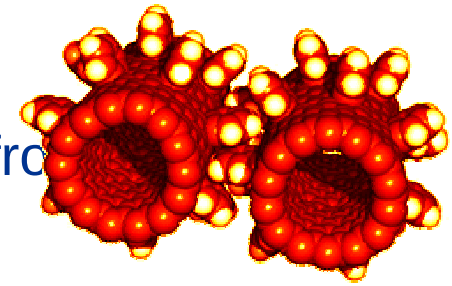
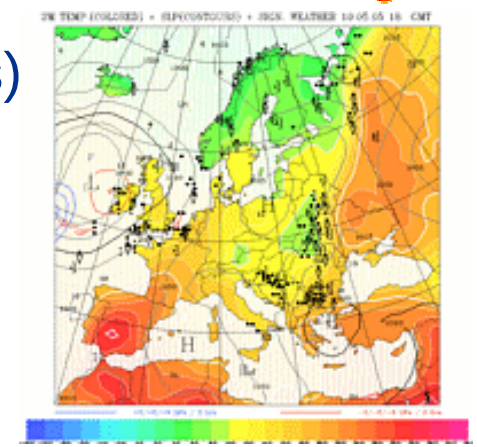
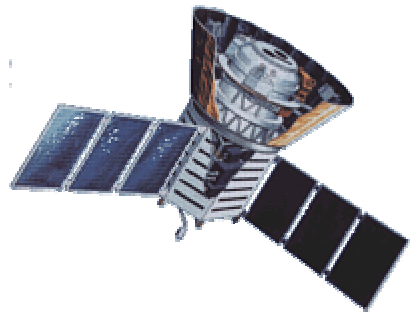
Why do we need a Grid?

- **Science is becoming increasingly digital and needs to deal with increasing amounts of data**
- **Simulations get ever more detailed**
  - e.g.Nanotechnology – design of new materials fro the molecular scale
  - Modelling and predicting complex systems (weather forecasting, river floods, earthquakes)
  - Decoding the human genome





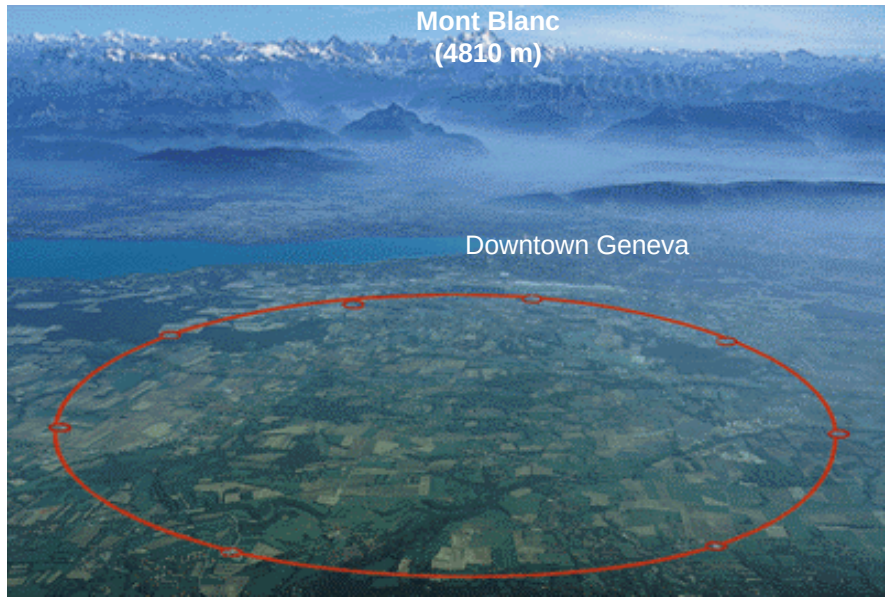
- **Experimental Science uses ever more sophisticated sensors to make precise measurements**
  - → Need high statistics
  - → Huge amounts of data
  - → Serves user communities around the world



The need for Grid in Particle Physics

- **CERN: the world's largest particle physics laboratory**
- **Particle physics requires special tools to create and study new particles: accelerators and detectors**

- **Large Hadron Collider (LHC):**
  - One of the most powerful instruments ever built to investigate matter
  - 4 experiments: ALICE, ATLAS, CMS, LHCb
  - 27 km circumference tunnel
  - Due to start up mid 2007



LHC Data

- 40 million collisions per second
- After filtering, 100 collisions of interest per second
- A Megabyte of data for each collision = recording rate of 0.1 Gigabytes/sec

- 10^{10} collisions recorded each year

  ⇨ When LHC starts operation:

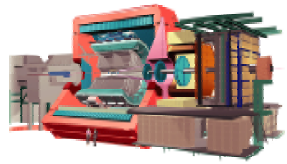
  will generate ~ 15 Petabytes/year of data*

*corresponding to more than 20 million CDs!

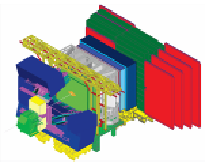
LHC Computing Grid

- **Aim: to develop, build and maintain a distributed computing environment for the storage and analysis of data from the four LHC experiments**
  - Ensure the computing service
  - … and common application libraries and tools

- **"Tier" infrastructure with Tier-0 at CERN, 11 Tier-1 centres and more than 100 Tier-2, and Tier-3 centres**
- **Phase I – 2002-05 – Development & planning**



- **Phase II – 2006-2008 – Deployment & commissioning of the initial services**



→ **LCG is not a development project – it relies on EGEE (and other Grid projects) for Grid middleware development, application support, Grid operation and deployment**

Service Challenges

- **Purpose**
  - Understand what it takes to operate a real Grid service
  - Trigger and verify Tier-1 & large Tier-2 planning and deployment – - tested with realistic usage patterns
  - Get the essential grid services ramped up to target levels of reliability, availability, scalability, end-to-end performance

- **Four progressive steps from October 2004 to September 2006**
  - End 2004 - SC1 – data transfer to subset of Tier-1s
  - Spring 2005 – SC2 – include mass storage, all Tier-1s, some Tier-2s
  - 2nd half 2005 – SC3 – Tier-1s, >20 Tier-2s –first set of baseline services
  - Jun-Sep 2006 – SC4 – pilot service

→ Autumn 2006 – LHC service in continuous operation
– ready for data taking in 2007

Collaboration with CERN openlab

- **CERN openlab**
  - Industry consortium for Grid-related technologies with common interests
  - Testbed for cutting-edge Grid software and hardware
  - Training ground for a new generation of engineers to learn about Grid

- **Partners in openlab (2003-2005)**
  - Enterasys, HP, IBM, Intel, Oracle

- **openlab-II (2006-2008)**
  - Platform Competence Centre
    - Platform virtualisation
    - Software and hardware optimisation
  - Grid Interoperability Centre – in collaboration with EGEE
    - Integration and certification of Grid middleware
    - Standardisation
  - Security activities

CERN openlab
for DataGrid applications

The EGEE project

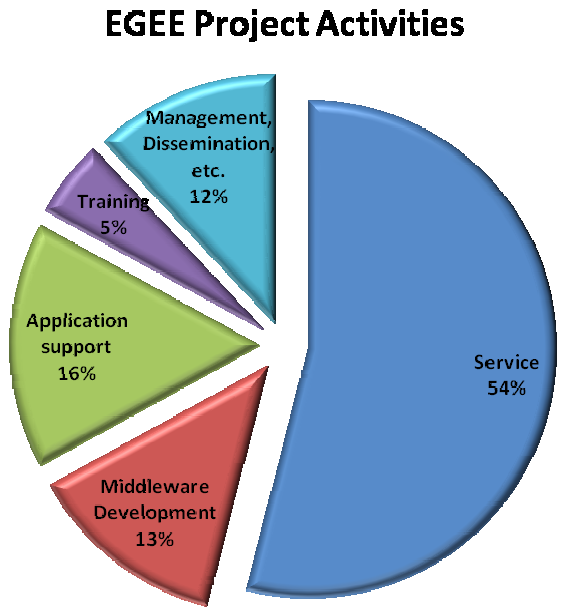
- **Flagship European grid infrastructure project, now in 2nd phase with 91 partners in 32 countries**

- **Objectives**
  - Large-scale, production-quality grid infrastructure for e-Science
  - Attracting new resources and users from industry as well as science
  - Maintain and further improve gLite Grid middleware

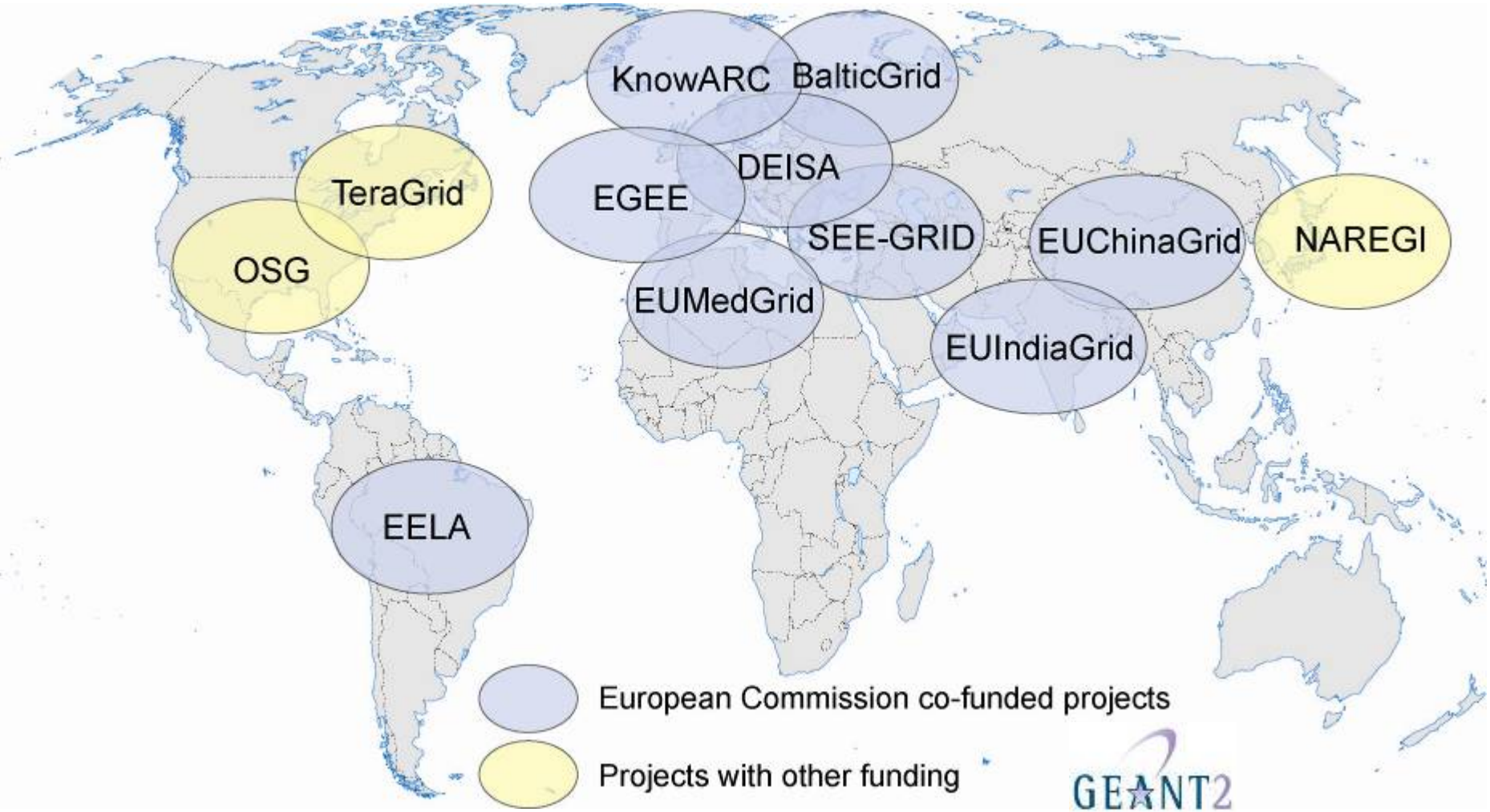
- **Structure**

  EGEE: 1 April 2004 – 31 March 2006

  EGEE-II: 1 April 2006 – 31 March 2008
  - Leveraging national and regional grid activities worldwide
  - Funded by the EC at a level of ~37 M Euros for 2 years
  - Support of related projects for infrastructure extension, application, specific services



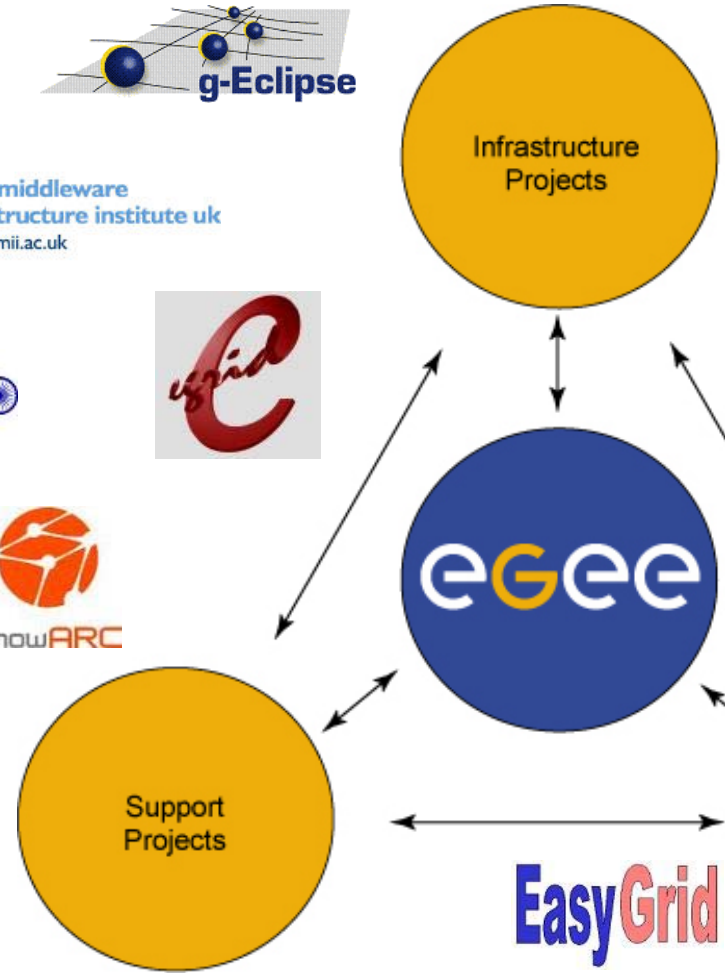
Collaborating e-Infrastructures



Potential for linking ~80 countries by 2008

Related projects

25 projects have registered as on May 2007: web page



BioinfoGRID
Bioinformatics Grid Application for life science

g-Eclipse

Baltic Grid

open middleware infrastructure institute uk
www.omii.ac.uk

GRIDCC

degree

CYCLOPS

int.eu.grid

assessGRID

eIndiaGrid

ISSeG
Integrated Site Security for Grids

KnowARC

ETICS

euchinagrid

omii europe
open middleware infrastructure institute

SEE-GRID

EasyGrid

Belief
Bringing Europe's eLectronic Infrastructures to Expanding Frontiers

Diligent
A DIgital Library Infrastructure on Grid ENabled Technology

EUMED Grid

ICEAGE

Achievements

- **Infrastructure**
  - ~ 240 sites
  - > 36 000 CPUs
  - > 5 PB storage
  - 98k jobs/day
  - > 200 Virtual Organisations

- **Middleware**
  - Now at gLite release 3.0
    - Focus on basic services, easy installation and management
    - Industry friendly open source license

- **Many applications from a growing number of doma**
  - Astronomy & Astrophysics
  - Civil Protection
  - Computational Chemistry
  - Comp. Fluid Dynamics
  - Computer Science/Tools
  - Condensed Matter Physics
  - Earth Sciences
  - Fusion
  - High-Energy Physics
  - Life Sciences

Grids in Europe

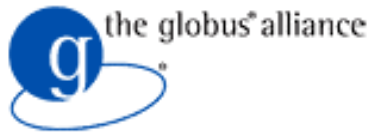
- **Great investment in developing Grid technology**
- **Sample of National Grid projects:**
  - Austrian Grid Initiative
  - Netherlands: DutchGrid
  - France: Grid'5000
  - Germany: D-Grid; Unicore
  - Greece: HellasGrid
  - Grid Ireland
  - Italy: INFNGrid; GRID.IT
  - NorduGrid
  - Swiss Grid
  - UK e-Science: National Grid Service; OMII; GridPP

- **EGEE provides a framework for national, regional and thematic Grids**

Projects Worldwide

- **Infrastructure projects**
  - OSG, Teragrid (US)
  - Naregi (Japan)
  - APAC (Australia)
  - and many more
  - …

- **Middleware projects**
  - Condor
  - Globus
  - Legion
  - and many more
  - …



→ **Collaboration with EGEE**

Standards are key

- **Need standards for the Grid to:**
  - Build confidence
  - Facilitate interoperability
  - Required for Business use

- **EGEE contributes to standards**
  - In OGF: contributes to 15 WGs and RGs, provides 2 Area Directors
  - Also work with IETF (Internet Engineering Task Force), OASIS (Organisation for the Advancement of Structured Information Standards) , e-IRG (e-Infrastructure Reflection Group) on standards
  - Common work with OSG, NAREGI, NORDUGRID/ARC, GIN (Grid Interoperation Now)

Summary

- **Grids represent a powerful new tool for science**

→Today we have a **window of opportunity** to move Grids from research prototypes to production systems (as networks did a few years ago)

- **EGEE offers:**
  - A mechanism for **linking** together **people**, **resources** and **data** for many scientific communities
  - A basic set of middleware for gridfiying applications, together with documentation, training and support
  - Regular forums to discuss with Grid experts, other communities and industry