

Grid Computing – a new tool for science

- presented at the ITU RRC-06 conference -



CERN, the European Organization for Nuclear Research

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CERN stands for over 50 years of

- fundamental research and discoveries
- technological innovation
- training and education
- bringing the world together



1954 Rebuilding Europe
First meeting of the
CERN Council



1980 East meets West
Visit of a delegation from Beijing



2004 Global Collaboration
The Large Hadron Collider
involves over 80 countries

CERN's mission in Science

- Understand the fundamental laws of nature
 - We accelerate elementary particles and make them collide.
 - We observe the results and compare them with the theory.
- Provide a world-class laboratory to researchers in Europe and beyond
- A few numbers ...
 - 2500 employees: physicists, engineers, technicians, craftsmen, administrators, secretaries, ...
 - 6500 visiting scientists (half of the world's particle physicists), representing 500 universities and over 80 nationalities
 - Budget: ~1 Billion Swiss Francs per year
 - Additional contributions by participating institutes

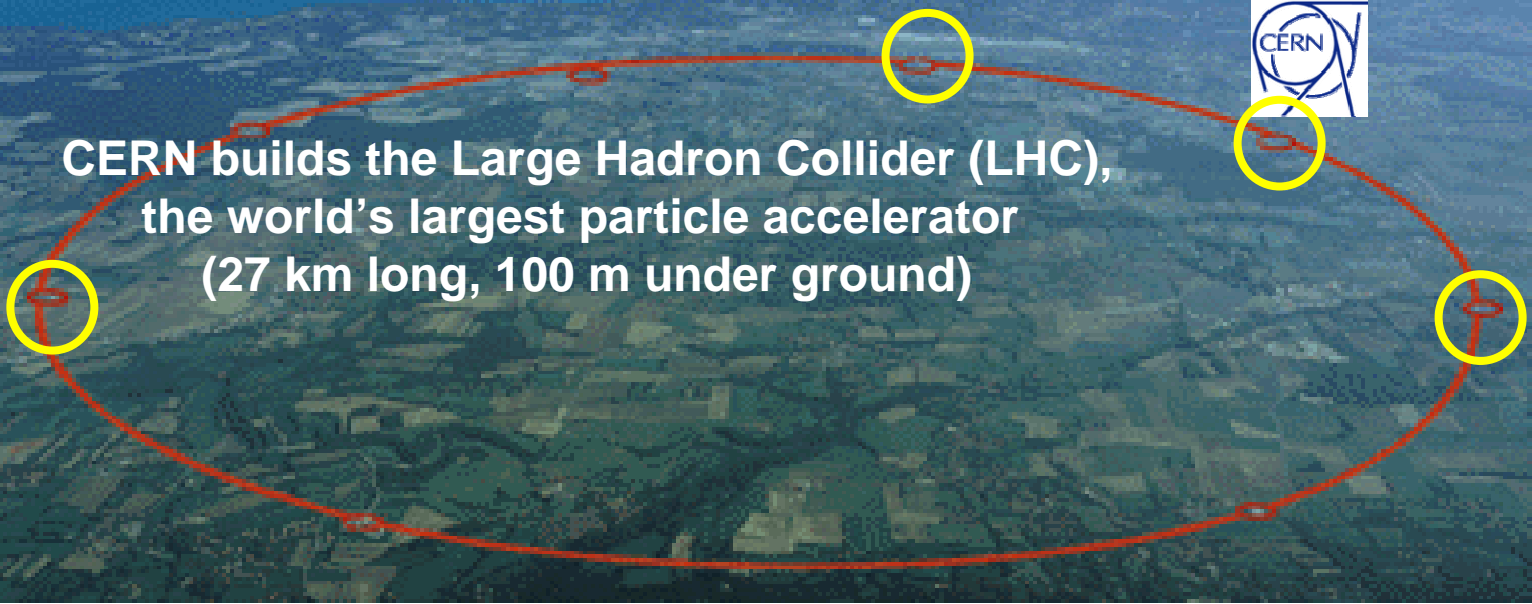
The CERN site near Geneva

Collaborators from around the world build four huge experiments to observe the collisions

Geneva



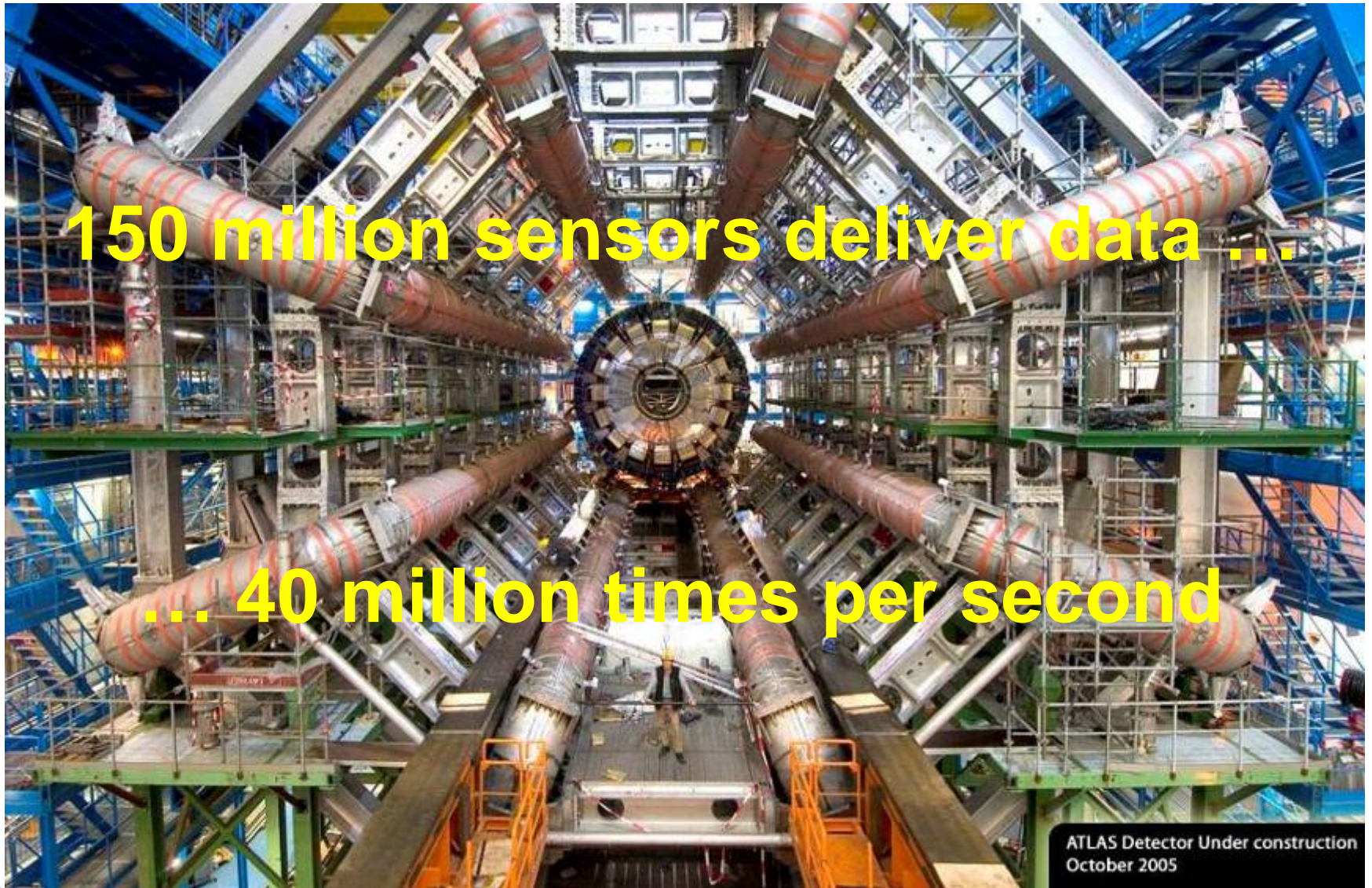
CERN builds the Large Hadron Collider (LHC),
the world's largest particle accelerator
(27 km long, 100 m under ground)





View of the LHC tunnel

View of the ATLAS detector (under construction)



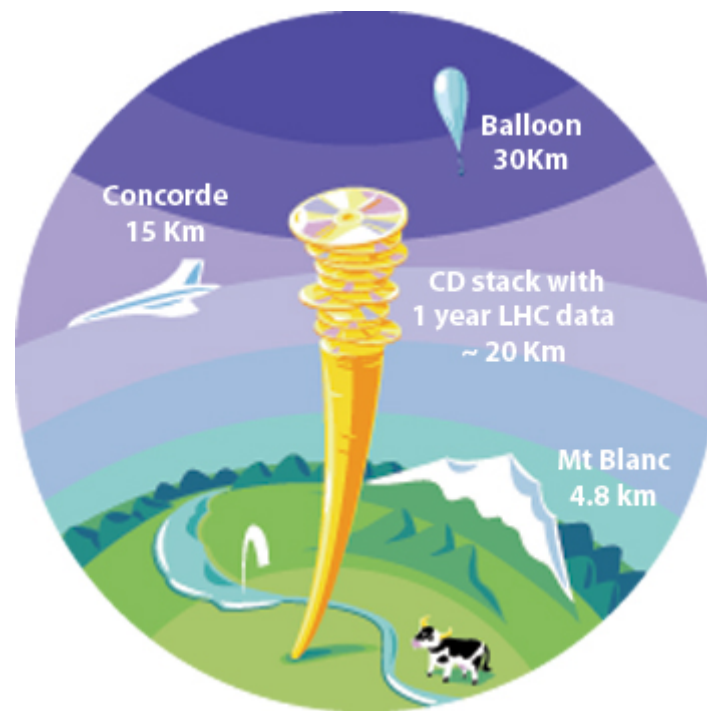
150 million sensors deliver data ...

... 40 million times per second

ATLAS Detector Under construction
October 2005

The Data Challenge

- The accelerator will be completed in 2007 and run for 10-15 years.
- Experiments will produce about **15 Million Gigabytes** of data each year (about 20 million CDs!) .
- LHC data analysis requires a computing power equivalent to **~100,000 of today's fastest PC processors.**
- Requires many cooperating computer centres, as CERN can only provide ~20% of the capacity.



Therefore, we build a Computing Grid

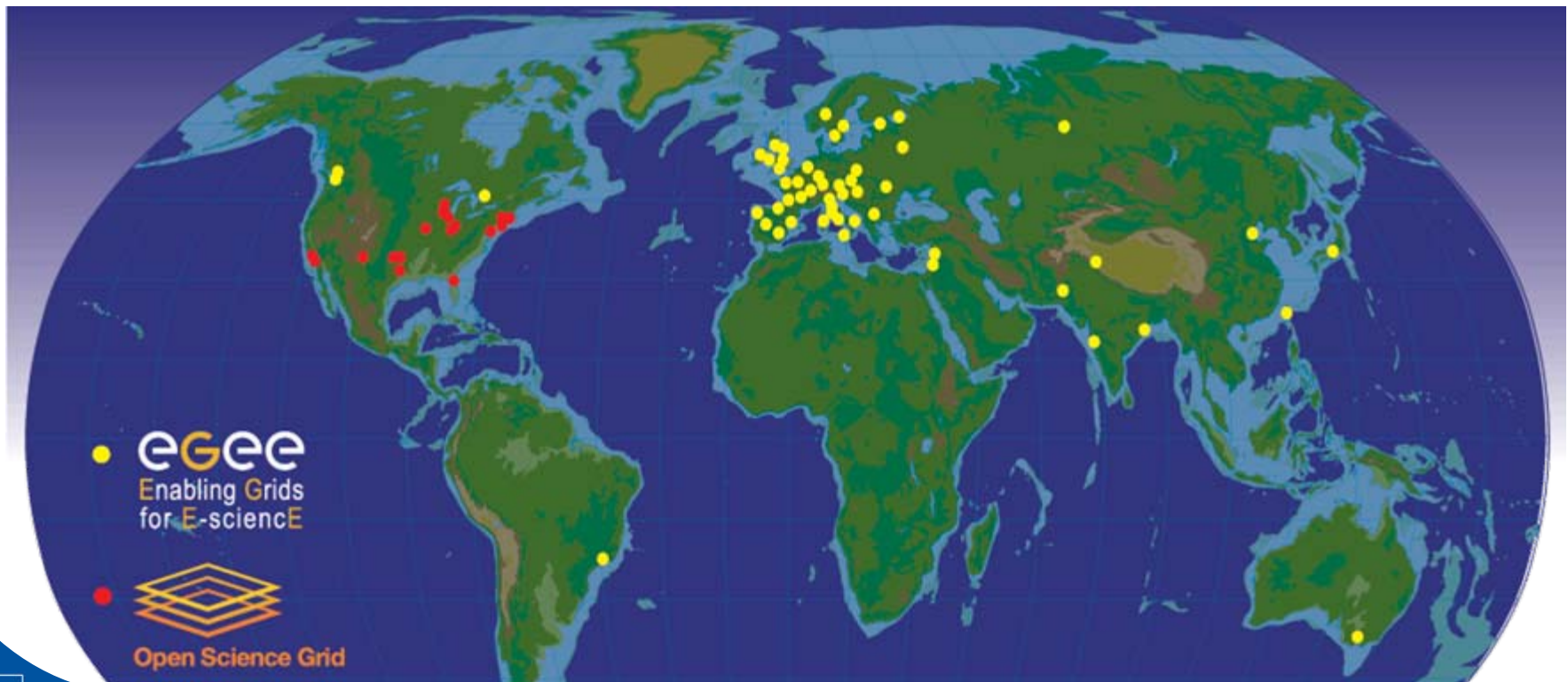
The Grid connects Instruments, Computer Centres and Scientists



The Web, invented at CERN, shares information
The Grid shares computing power and storage

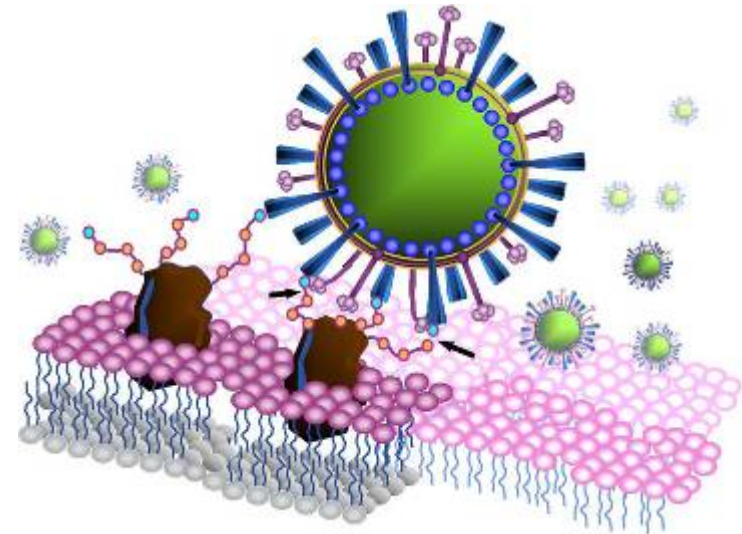
The Grid used by CERN and its partners

- Today: >200 sites in 30 countries with >22,000 PCs
- The **EGEE** and **OSG** projects are the basis
- Over 25 applications in nine scientific domains



Recent example: EGEE Attacks Avian Flu

- EGEE used to analyse 300,000 possible potential drug compounds against bird flu virus, H5N1.
- 2000 computers at 60 computer centres in Europe, Russia, Asia and Middle East ran during four weeks in April - the equivalent of 100 years on a single computer.
- Potential drug compounds now being identified and ranked.

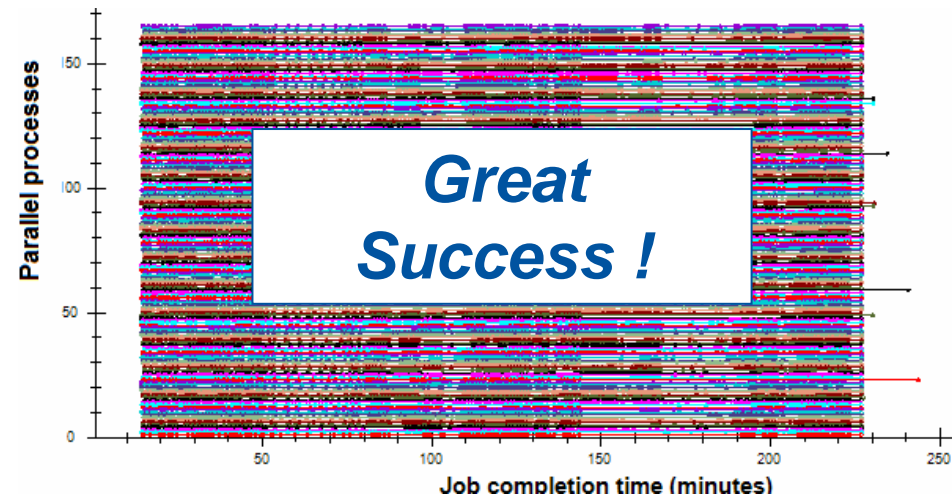


Neuraminidase, one of the two major surface proteins of influenza viruses, facilitating the release of virions from infected cells. Image Courtesy Ying-Ta Wu, AcademiaSinica.

ITU-BR system for RRC 2006



- ITU-BR developed a system for RRC 2006
 - Run compatibility and complementary analysis
 - 84 PCs executing 168 parallel tasks
 - Compatibility analysis < 4h



- ITU-BR wanted to be sure and do even better
 - Provide more CPU power
 - Reduce risks by providing a supplementary system
 - Gain experience on how to access large and reliable computing resources 'on demand'

Use of EGEE technology and infrastructure

- First contact with CERN established last year
- CERN interested in applying Grid experience to ITU's computing challenge
- Re-used technologies developed for High-Energy Physics, but applicable to many other fields
- ITU's programmes ported to EGEE environment
- Added optimisation to achieve fast turn-around
- Monitoring of large distributed computing infrastructures (thanks to Caltech-developed product MonALISA)



Contributing EGEE Computer Centres



RunID: ALL-it_20060519-102



CERN
INFN-CNAF Bologna
(+several sites of the Italian GridIT infrastructure)
PIC Barcelona
CNB Madrid
DESY (Hamburg and Zeuthen)
Cyfronet Krakow
Moscow State University

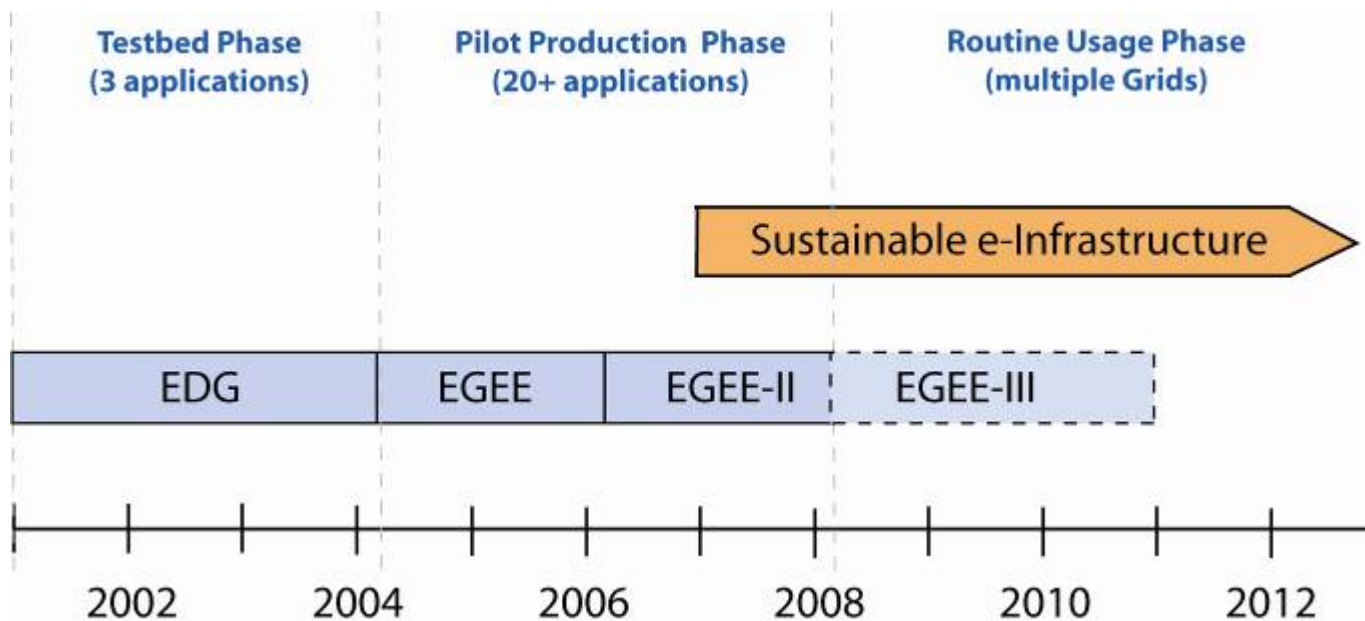


Results

- EGEE used a subset of its Grid for RRC 2006
 - Over 400 PCs
 - Compatibility analysis < 1h
- Porting of ITU analysis program was easy
- Happy to have contributed to the success of such an important event
- Another powerful demonstration of the potential of the Grid...
- A very pleasant human experience as well

Towards a European Grid Infrastructure

- Europe is in a leading position in scientific Grids thanks to EGEE
- Must ensure transition from projects to a sustainable e-infrastructure
- Requires creation of National Grid Infrastructures
- Requires coordination by a new European Organization (FP7)
- Requires the support of European Governments



In Summary

- Grid Computing is a new technology providing unprecedented capabilities for science and industry.
- CERN and its partners are the major drivers due to the computing needs created by the LHC project.
- A global and sustainable Grid infrastructure is required.
- In Europe, we propose to establish National Grid Infrastructures, coordinated by a European Organization.
- We work towards interoperation with similar projects around the world.