Travelling securely on the Grid to the origin of the Universe

F-Secure SPECIES 2007 conference

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24 January 2007

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.
  - We try to understand the origin of the Universe.
- Provide a world-class laboratory to researchers in Europe and beyond
- New: Support world-wide computing using Grid technologies
- A few numbers …
  - 2500 employees: physicists, engineers, technicians, craftsmen, administrators, secretaries, …
  - 8000 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

What is the Grid?

GridCafé
www.gridcafe.org

What is the Grid?

*The **Grid** is **a service built on top of the Internet**, just like the Web. But the Grid goes one step futher...*

What is the Grid?

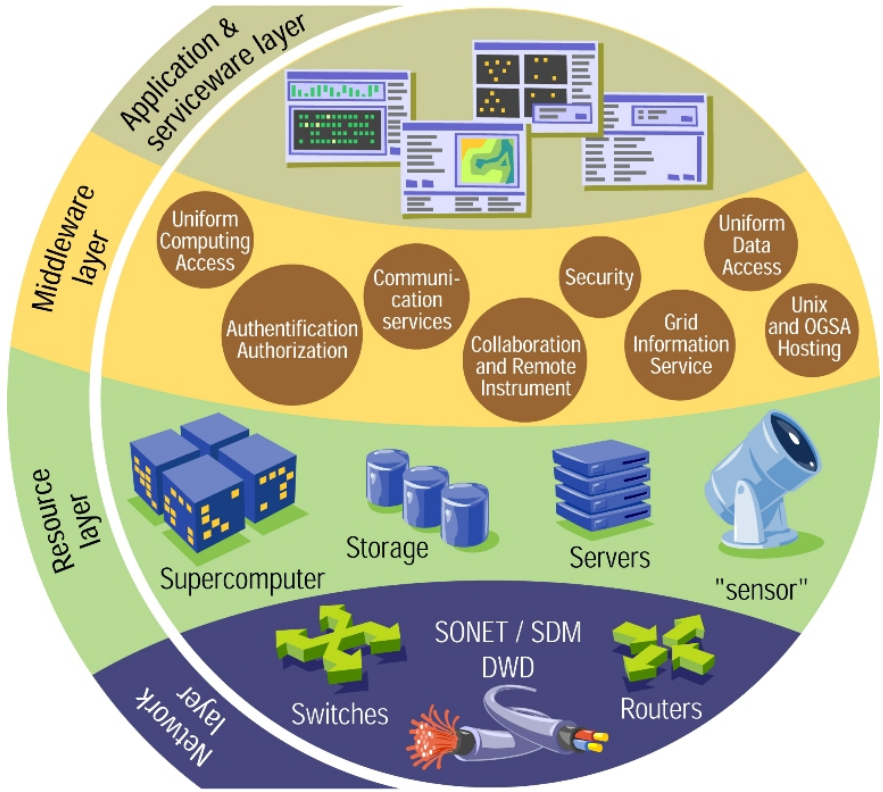
*Computers and instruments connected to the Grid share not **only** information ...*

What is the Grid?

... but also **computing power** and resources like **disk storage**, **databases** and **software applications.**

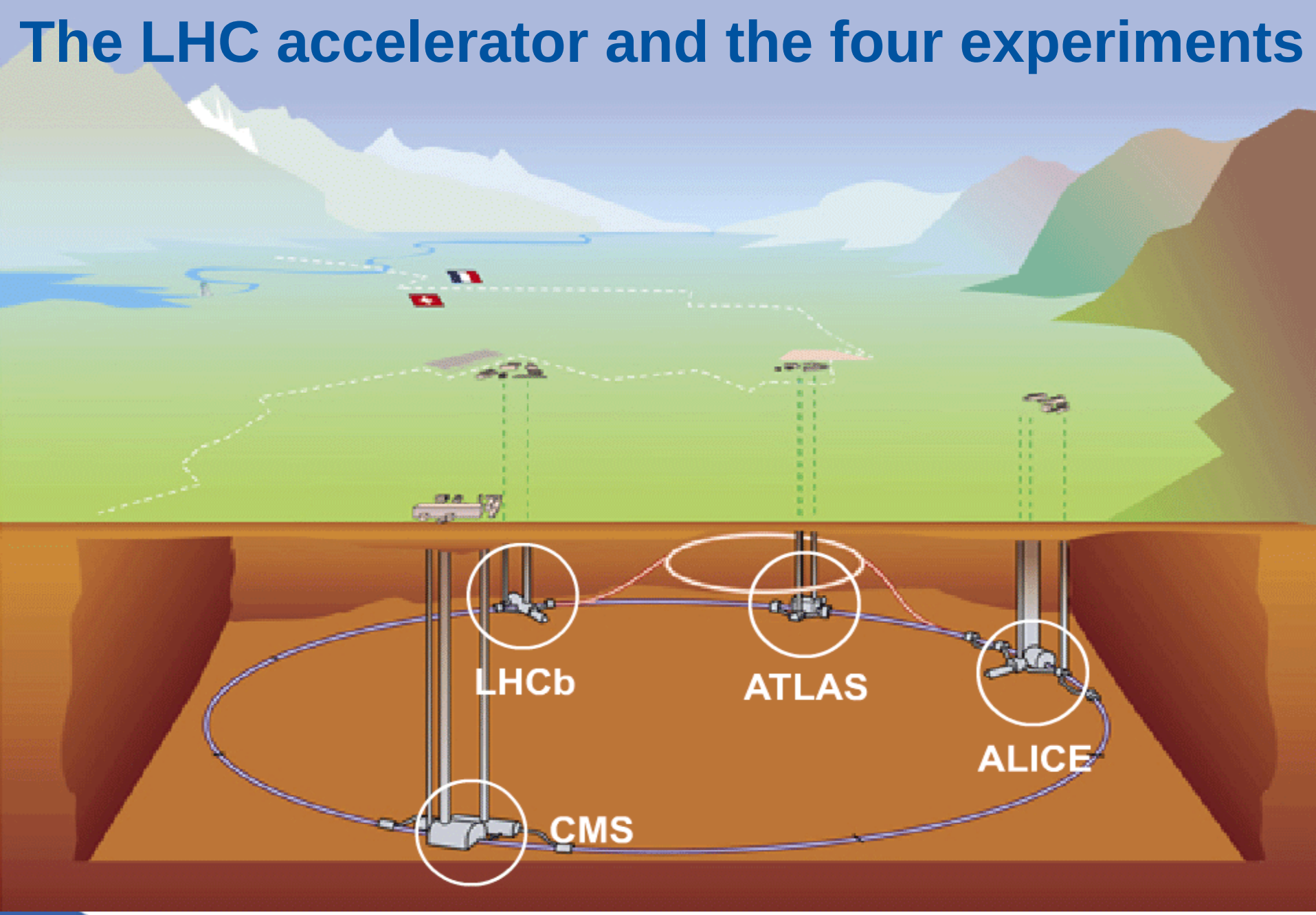
How does the Grid work?

- It relies on advanced software, called **middleware**.
- Middleware automatically finds the **data** the scientist needs, and the **computing power** to analyse it.
- Middleware balances the load on different resources. It also handles **security**, **accounting**, **monitoring** and much more.



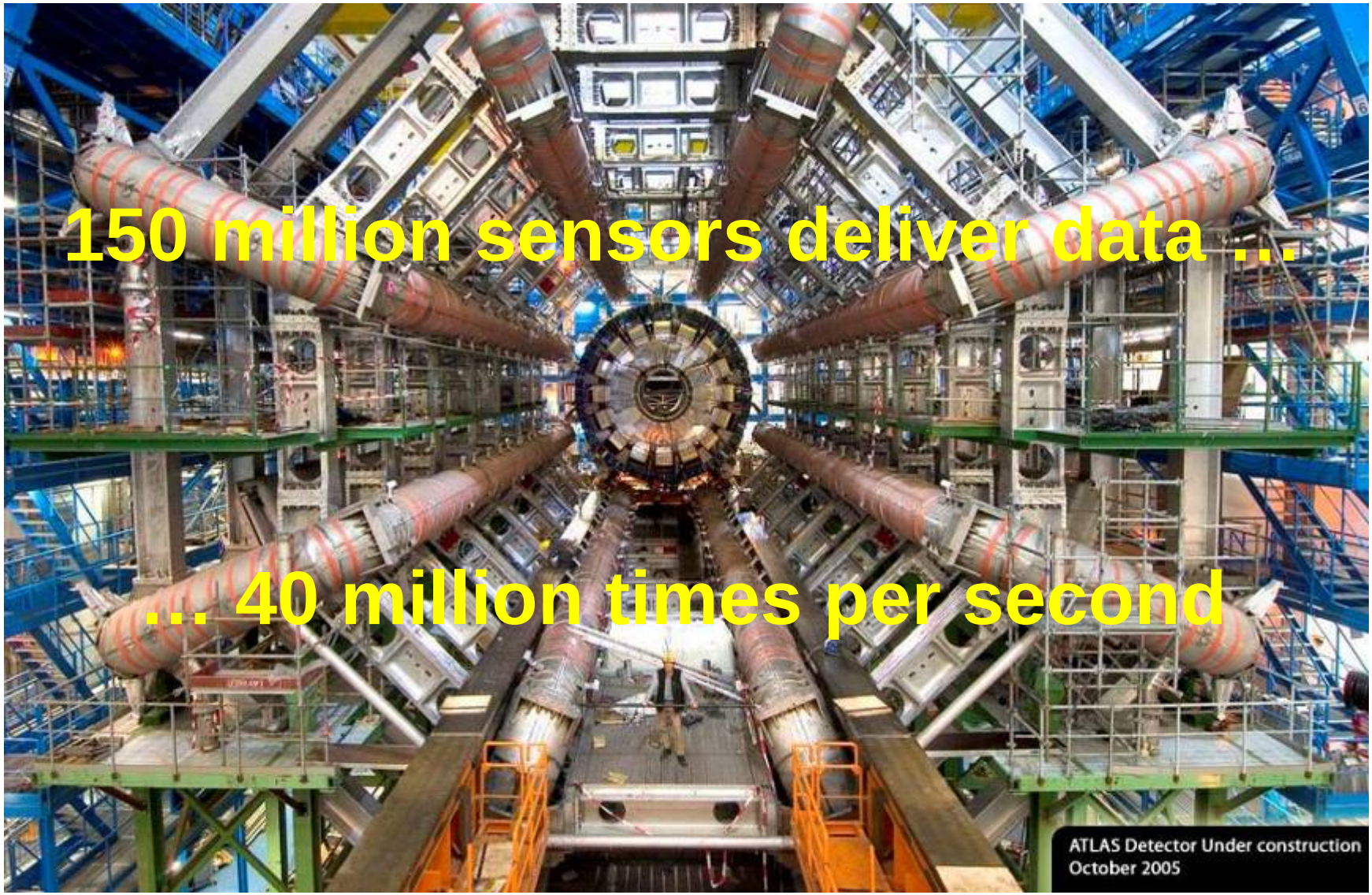
Why does CERN need the Grid?

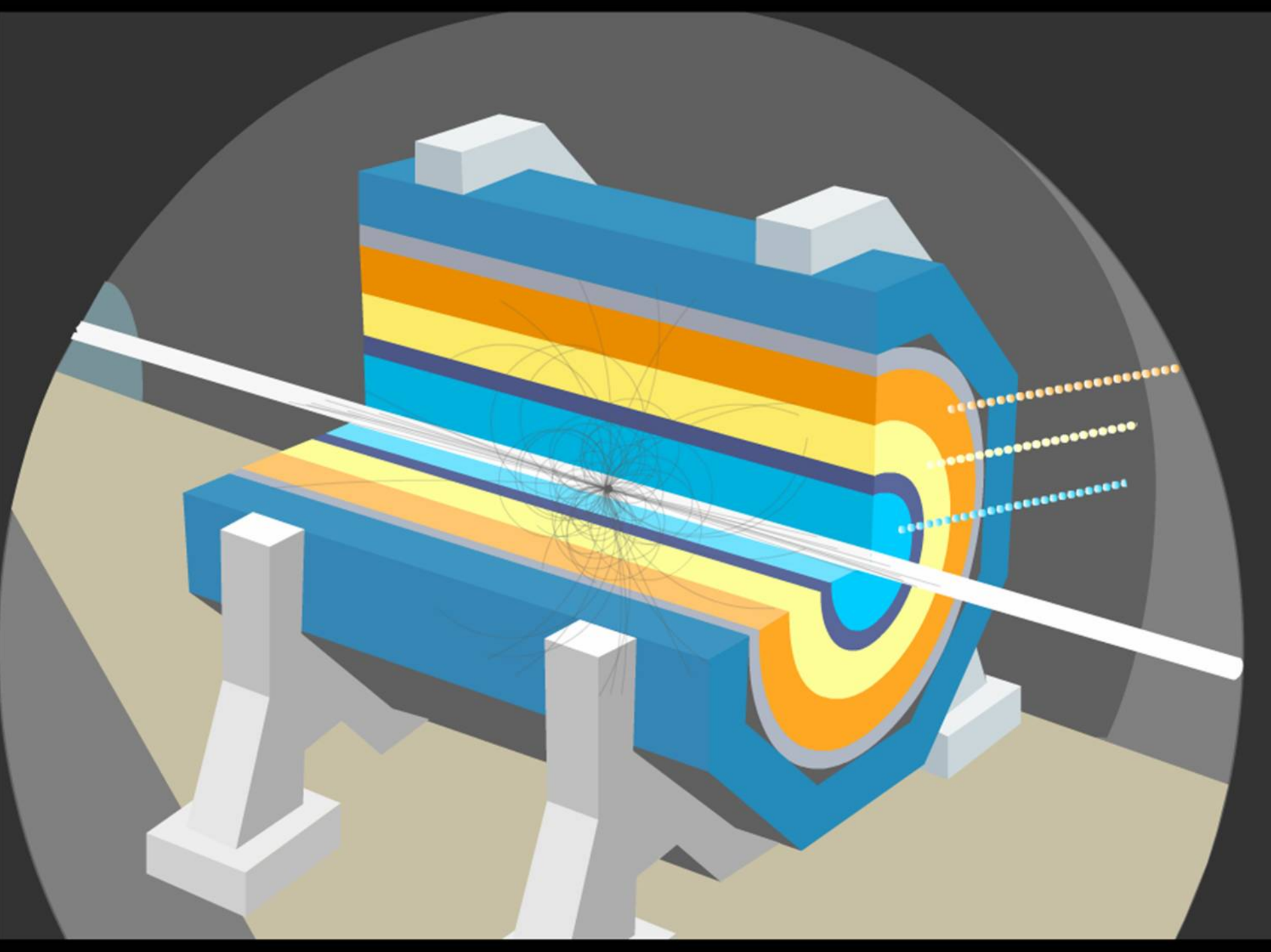
The LHC accelerator and the four experiments




View of the LHC tunnel

View of the ATLAS detector (under construction)



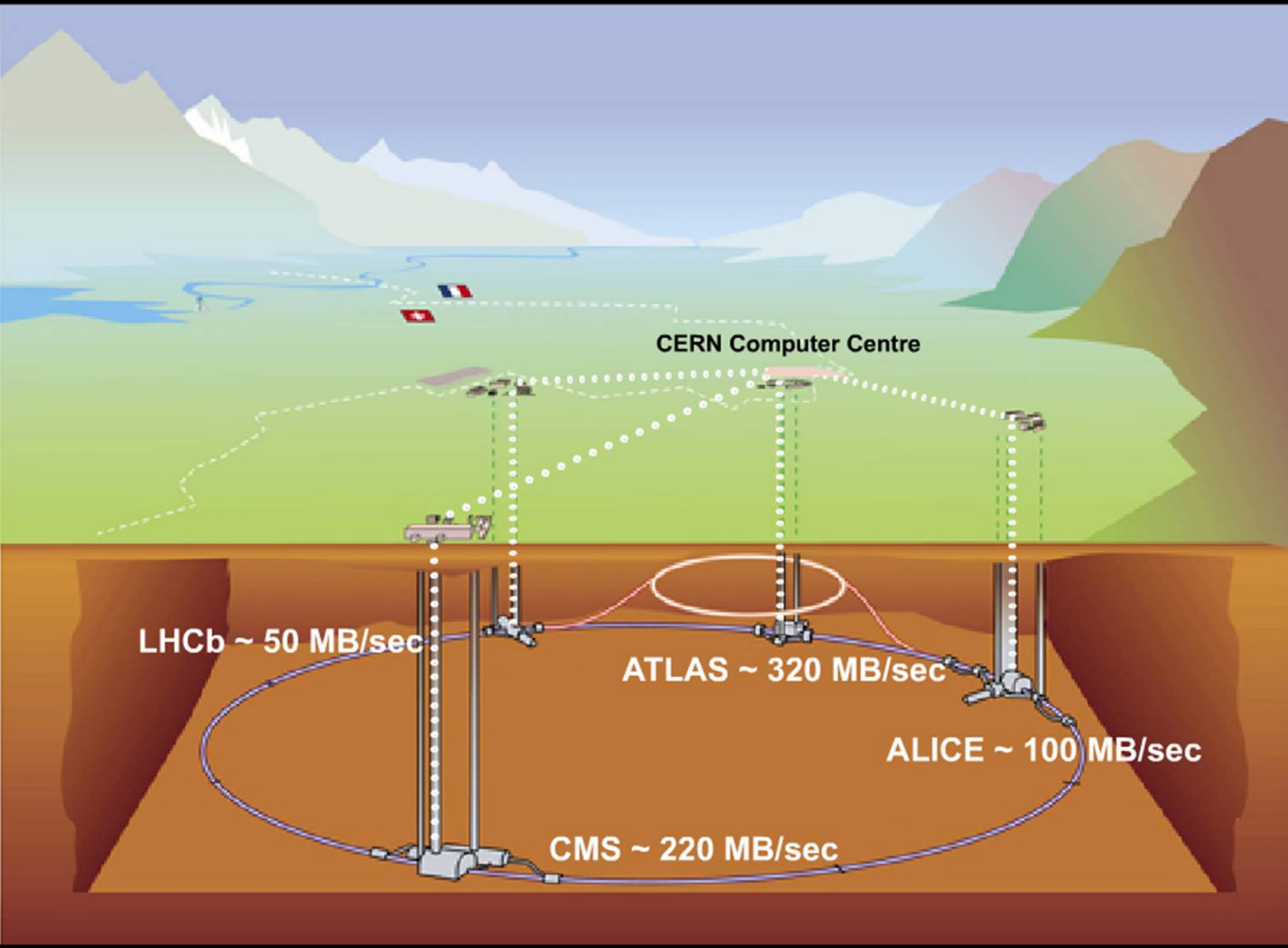


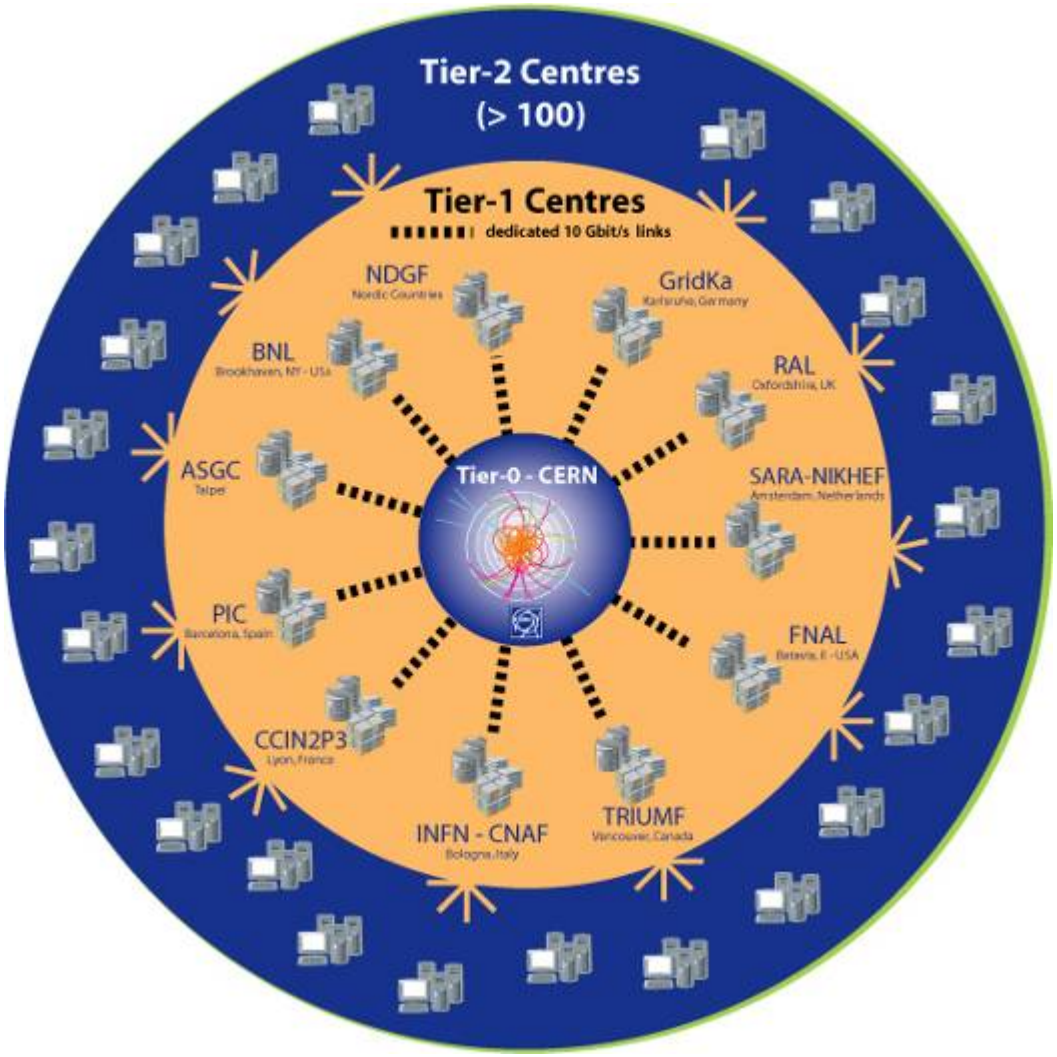
~ 300.000 MB/s
from all sub-detectors

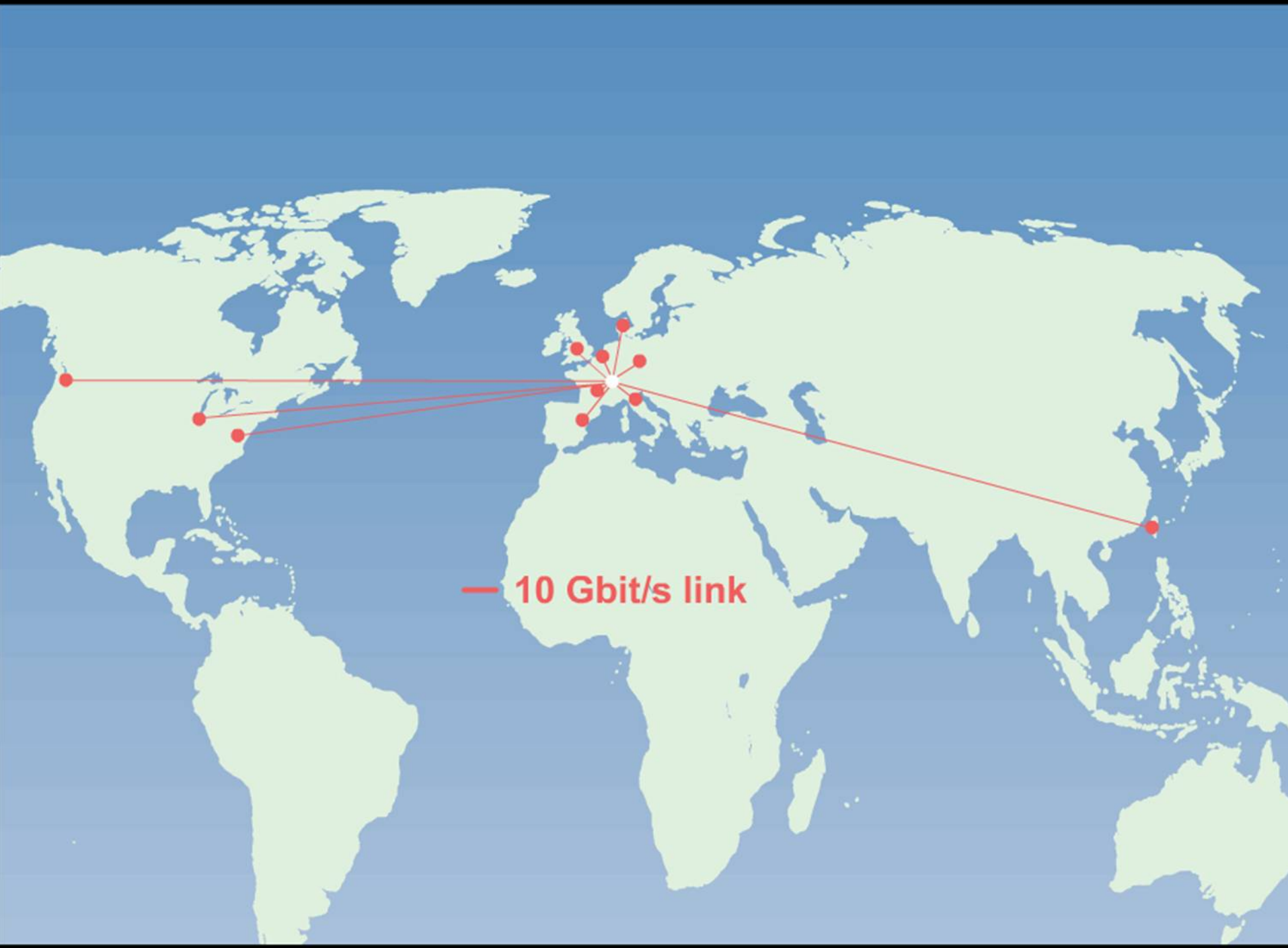
~ 300MB/s
Raw Data

Trigger and data acquisition

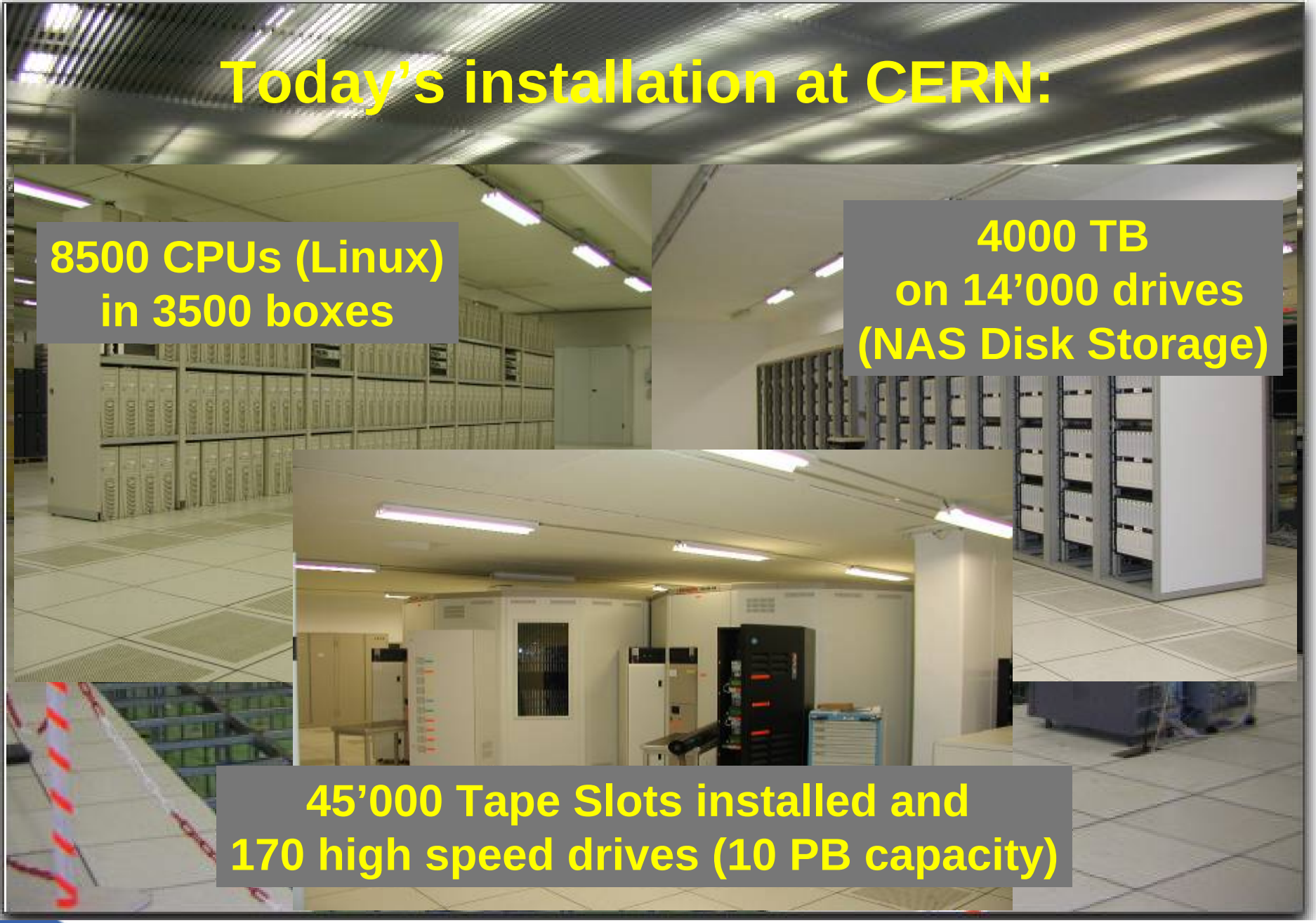
Event filter computer farm


CERN Computer Centre
LHCb ~ 50 MB/sec
ATLAS ~ 320 MB/sec
ALICE ~ 100 MB/sec
CMS ~ 220 MB/sec


Tier-2 Centres
(> 100)
Tier-1 Centres
dedicated 10 Gbit/s links
NDGF
Nordic Countries
GridKa
Karlsruhe, Germany
BNL
Brookhaven, NY - USA
RAL
Oxfordshire, UK
ASGC
Taipei
Tier-0 - CERN
SARA-NIKHEF
Amsterdam, Netherlands
PIC
Barcelona, Spain
FNAL
Batavia, IL - USA
CCIN2P3
Lyon, France
INFN - CNAF
Bologna, Italy
TRIUMF
Vancouver, Canada


10 Gbit/s link

Today's installation at CERN:



Massive ramp-up during 2006-08

Massive ramp-up during 2006-08

Massive ramp-up during 2006-08

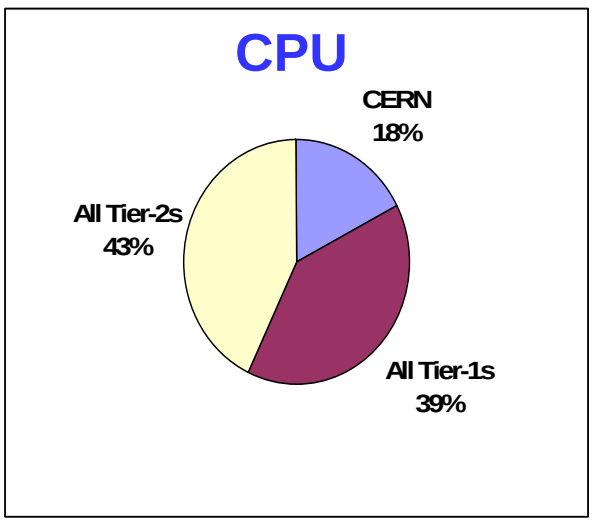
Distribution of Computing Services

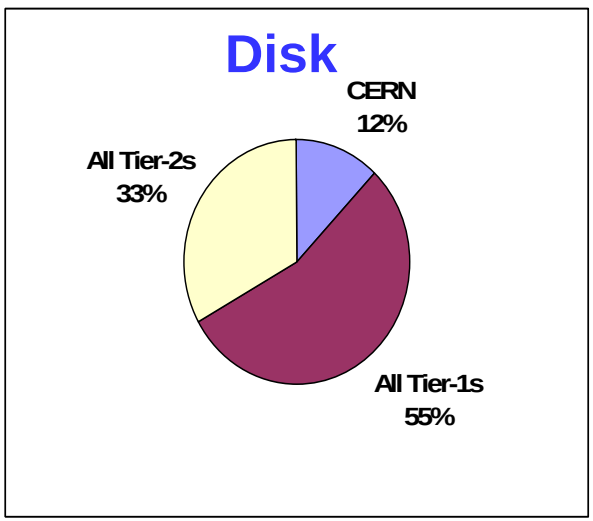
Summary of Computing Resource Requirements

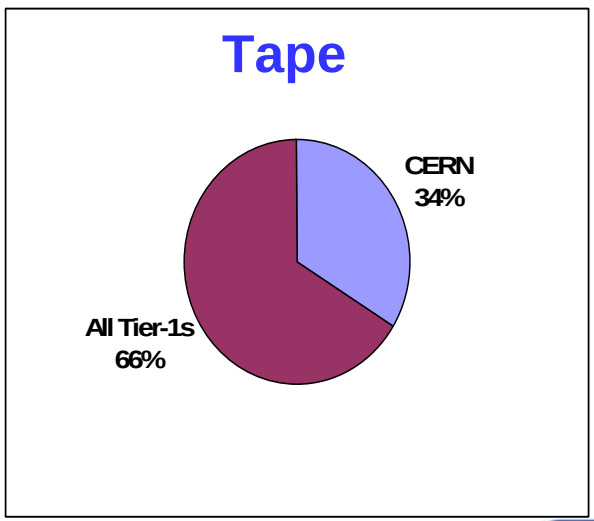
All experiments - 2008

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**

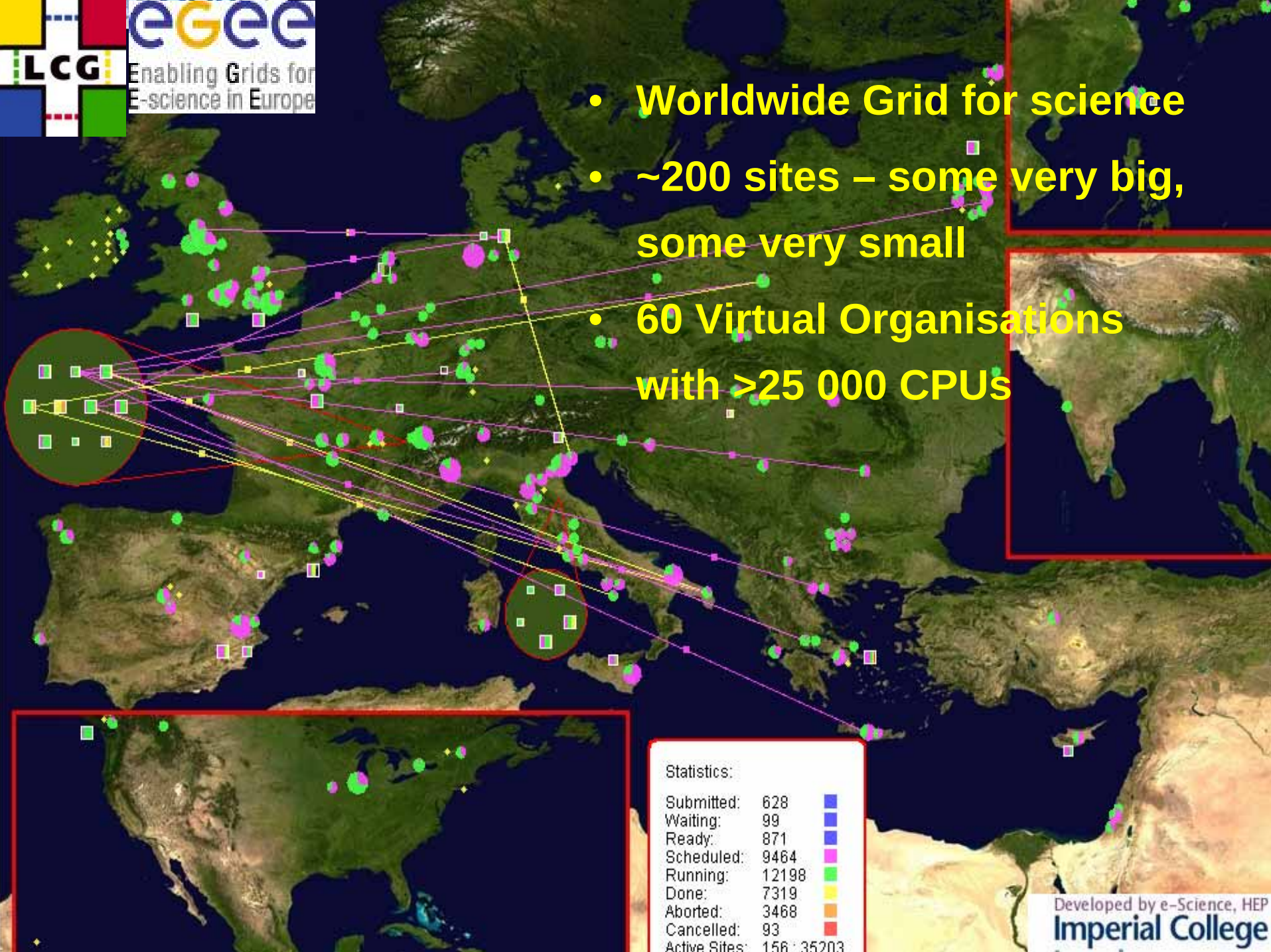






WLCG Collaboration

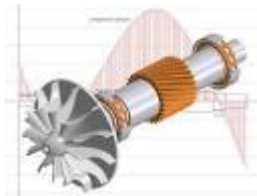
- The Collaboration
  - 4 LHC experiments
  - ~120 computing centres
  - 12 large centres (Tier-0, Tier-1)
  - 38 *federations* of smaller "Tier-2" centres
  - Growing to ~40 countries
- Memorandum of Understanding
  - Agreed in October 2005, now being signed
- Resources
  - Commitment made each October for the coming year
  - 5-year forward look

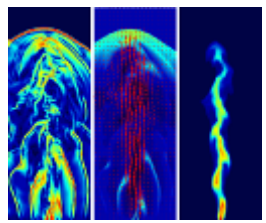

LCG
eGee
Enabling Grids for E-science in Europe
• Worldwide Grid for science
• ~200 sites – some very big, some very small
• 60 Virtual Organisations with >25 000 CPUs
Statistics:
Submitted: 628
Waiting: 99
Ready: 871
Scheduled: 9464
Running: 12198
Done: 7319
Aborted: 3468
Cancelled: 93
Developed by e-Science, HEP
Imperial College

The EGEE project

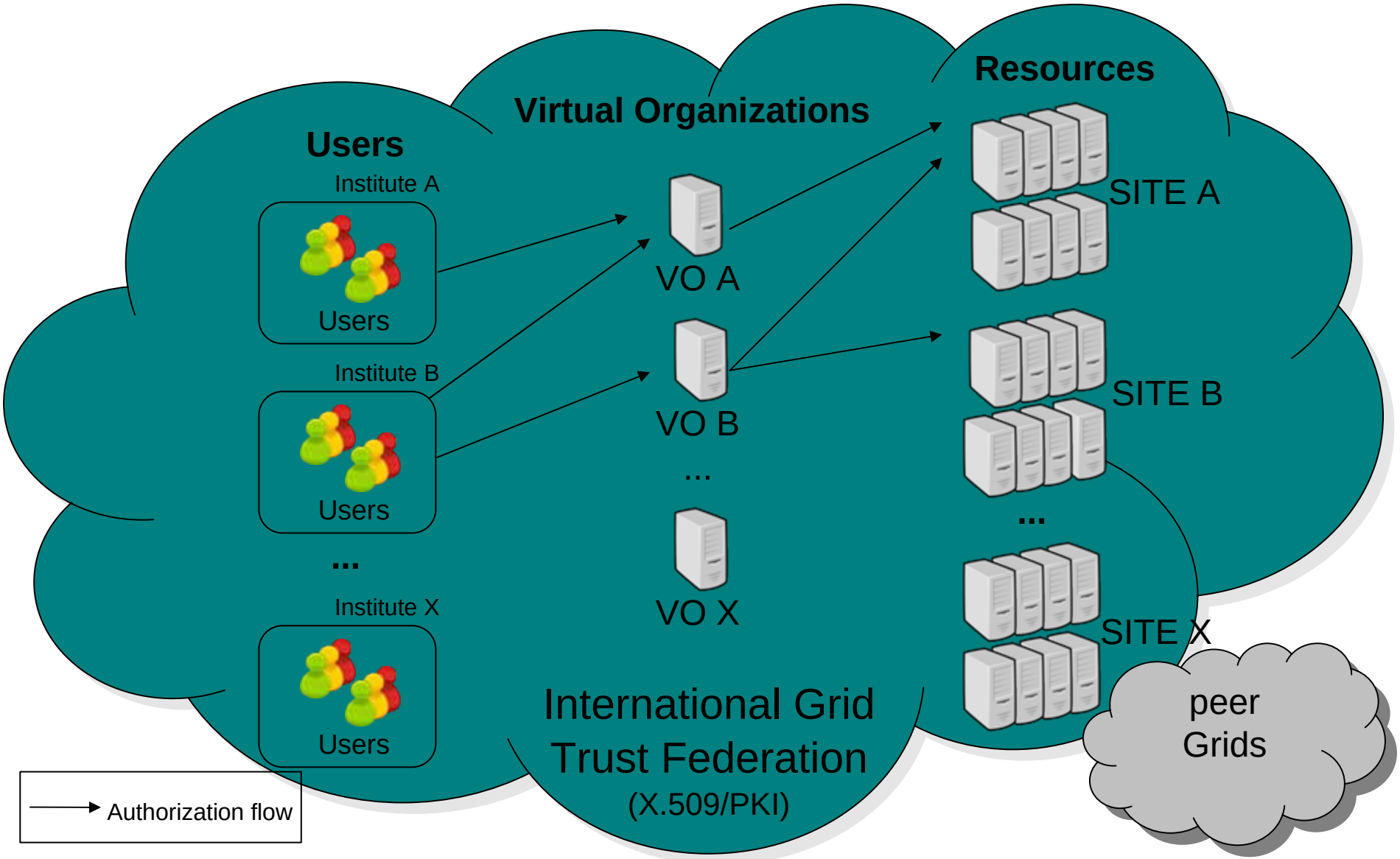
- **EGEE**
  - Started in April 2004
  - Now in 2nd phase with 91 partners in 32 countries

- **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
  - Improve Grid security





Entering the Grid



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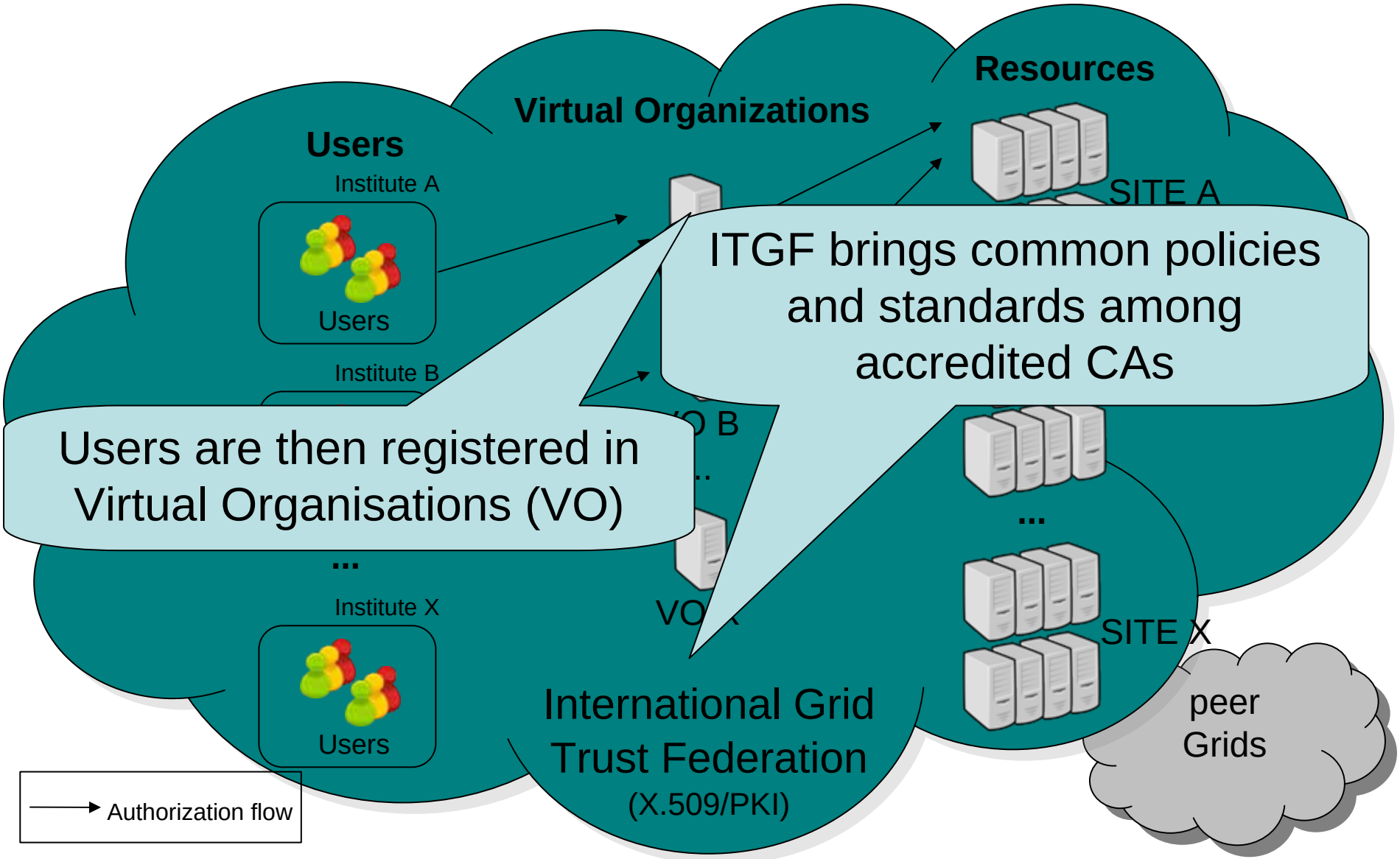
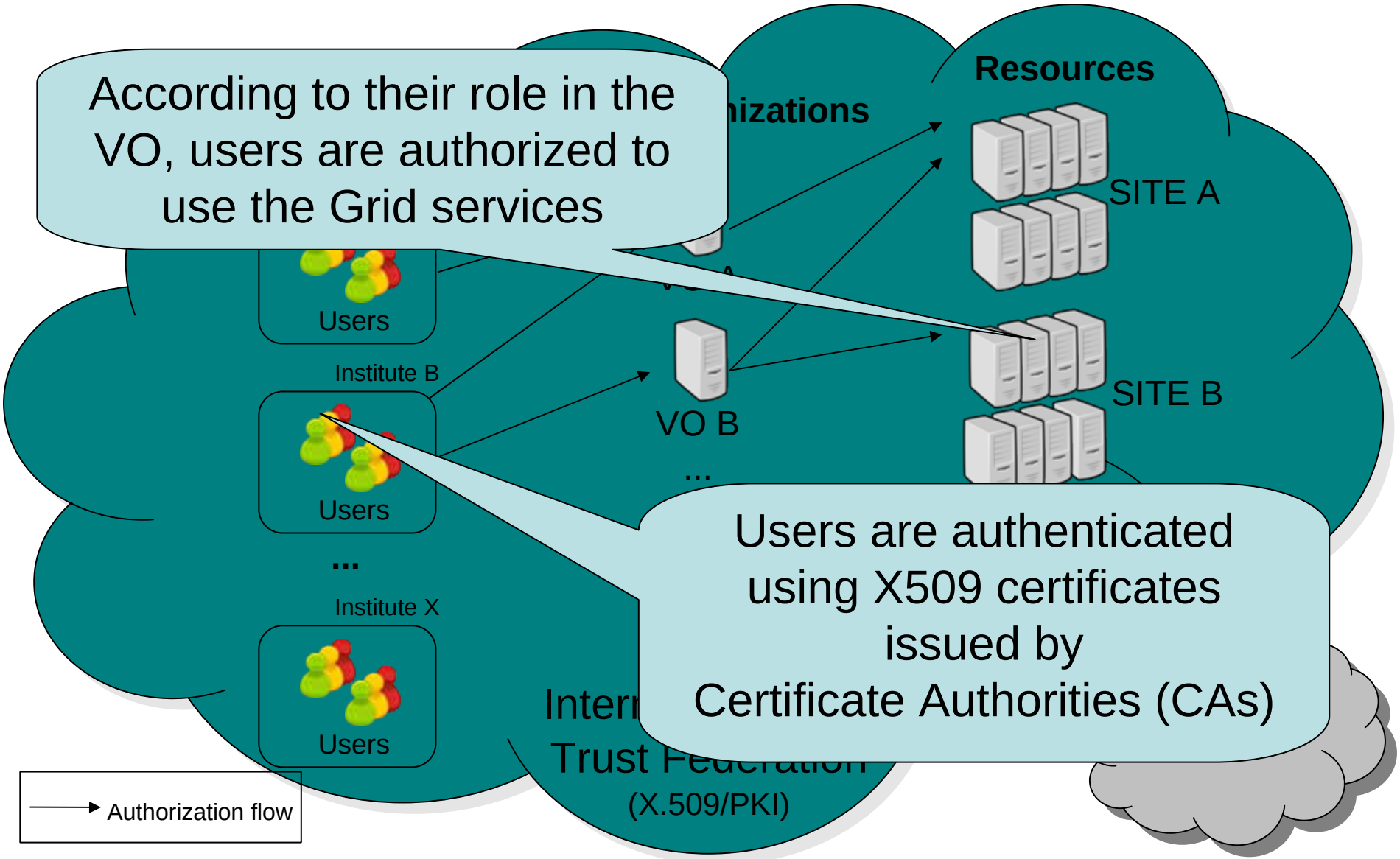
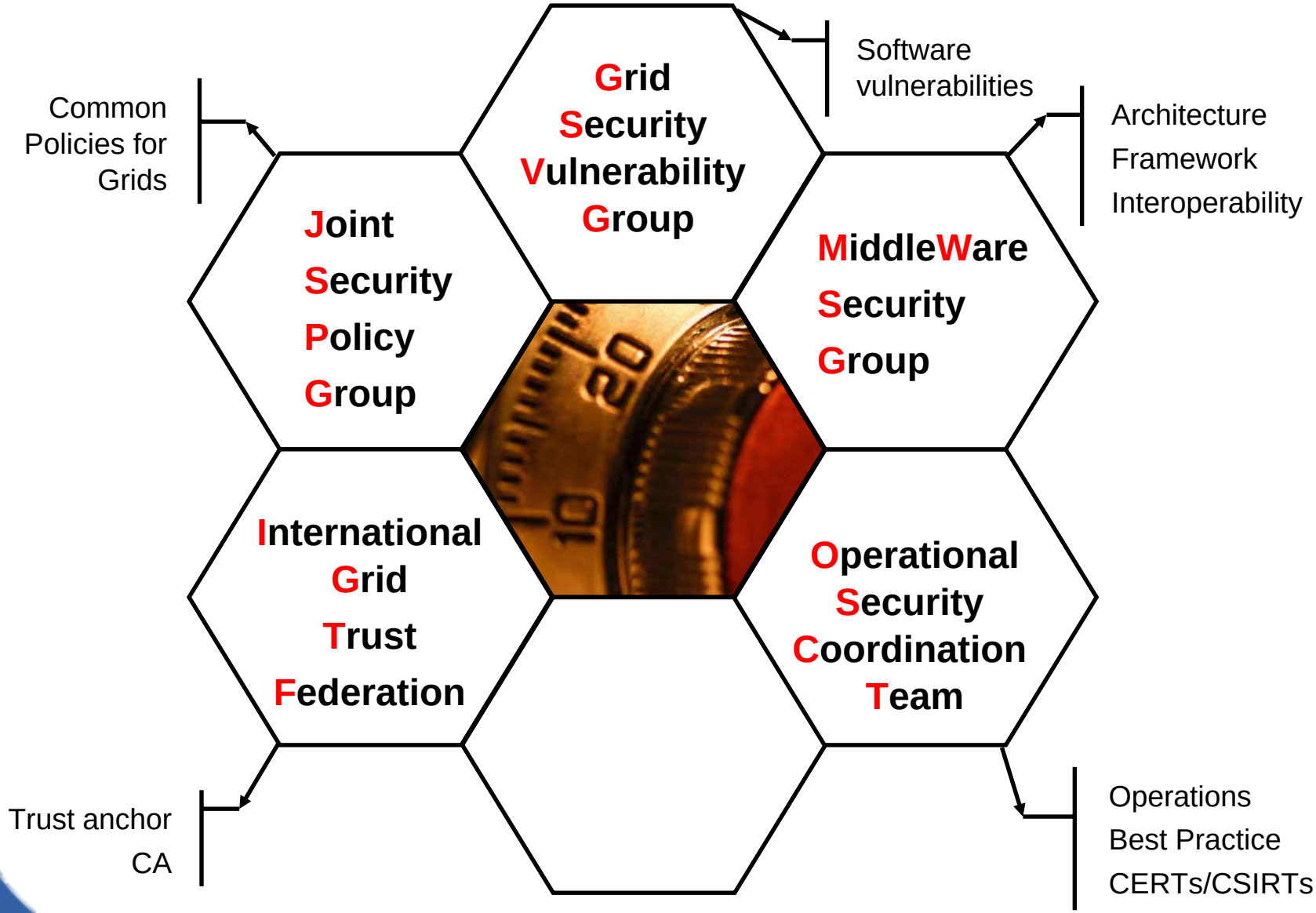


Entering the Grid

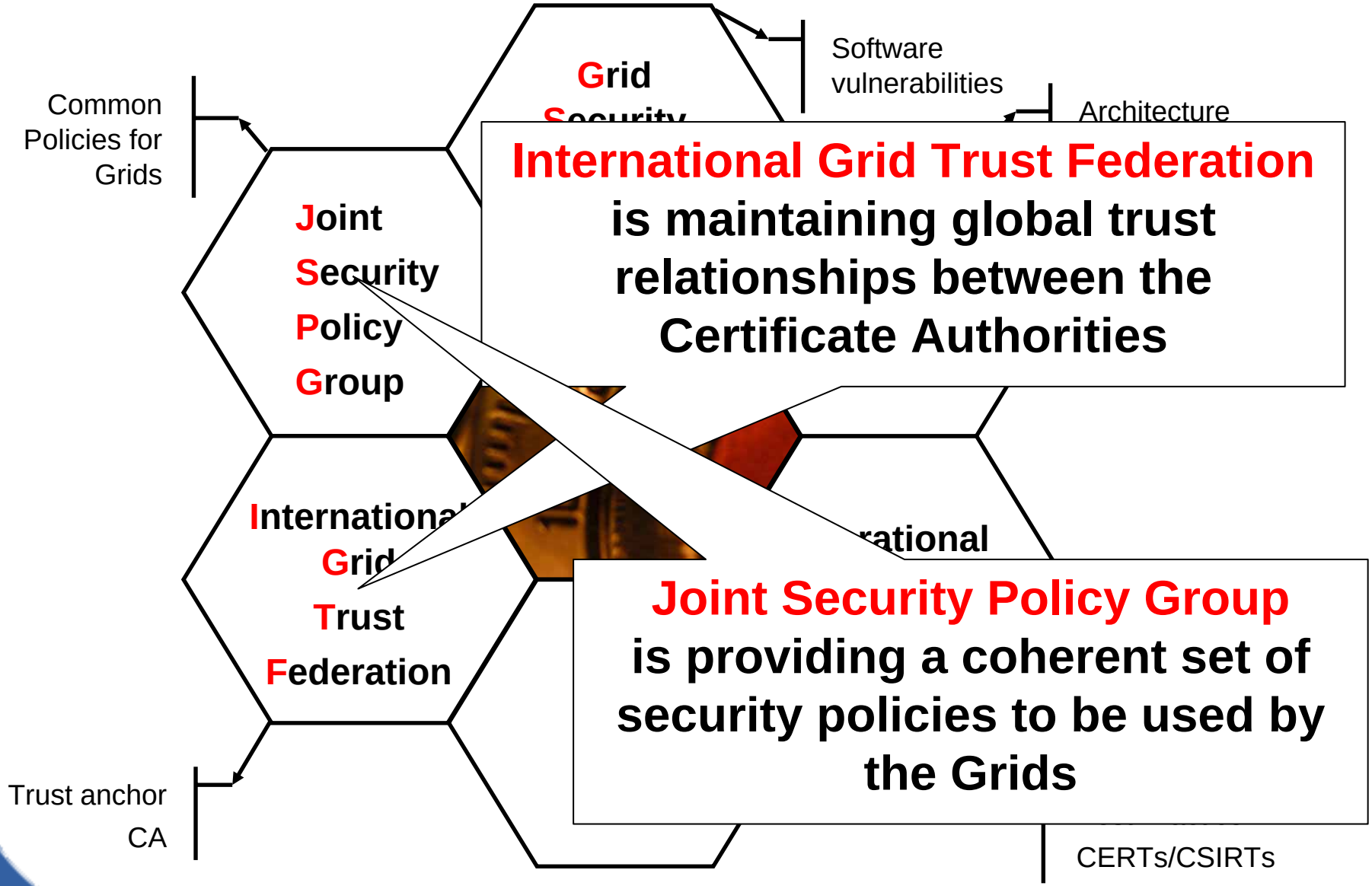


Security Collaboration in the LHC Grid



(Initial picture by Ake Edlund)

Security Collaboration in the LHC Grid



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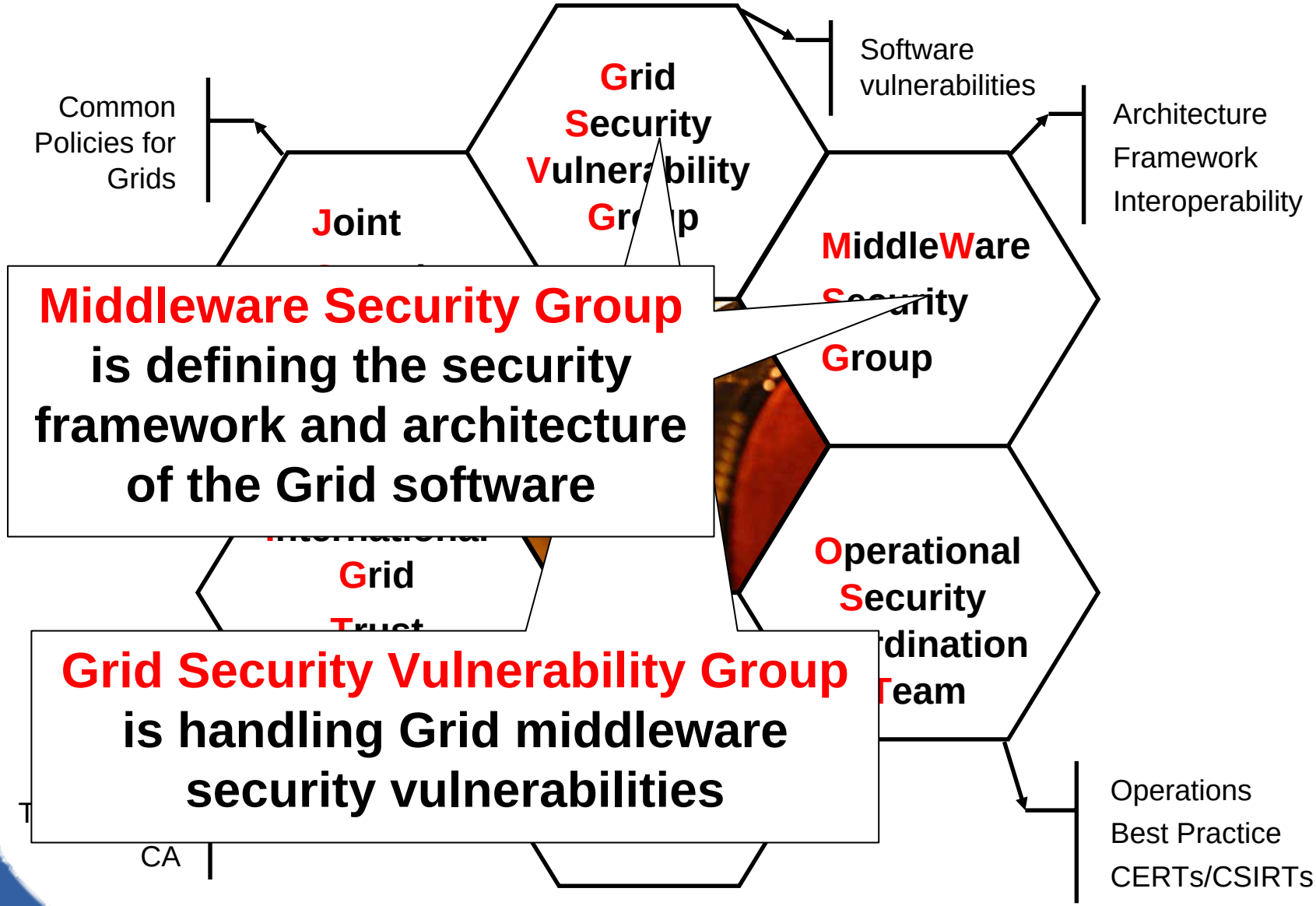
Security Collaboration in the LHC Grid

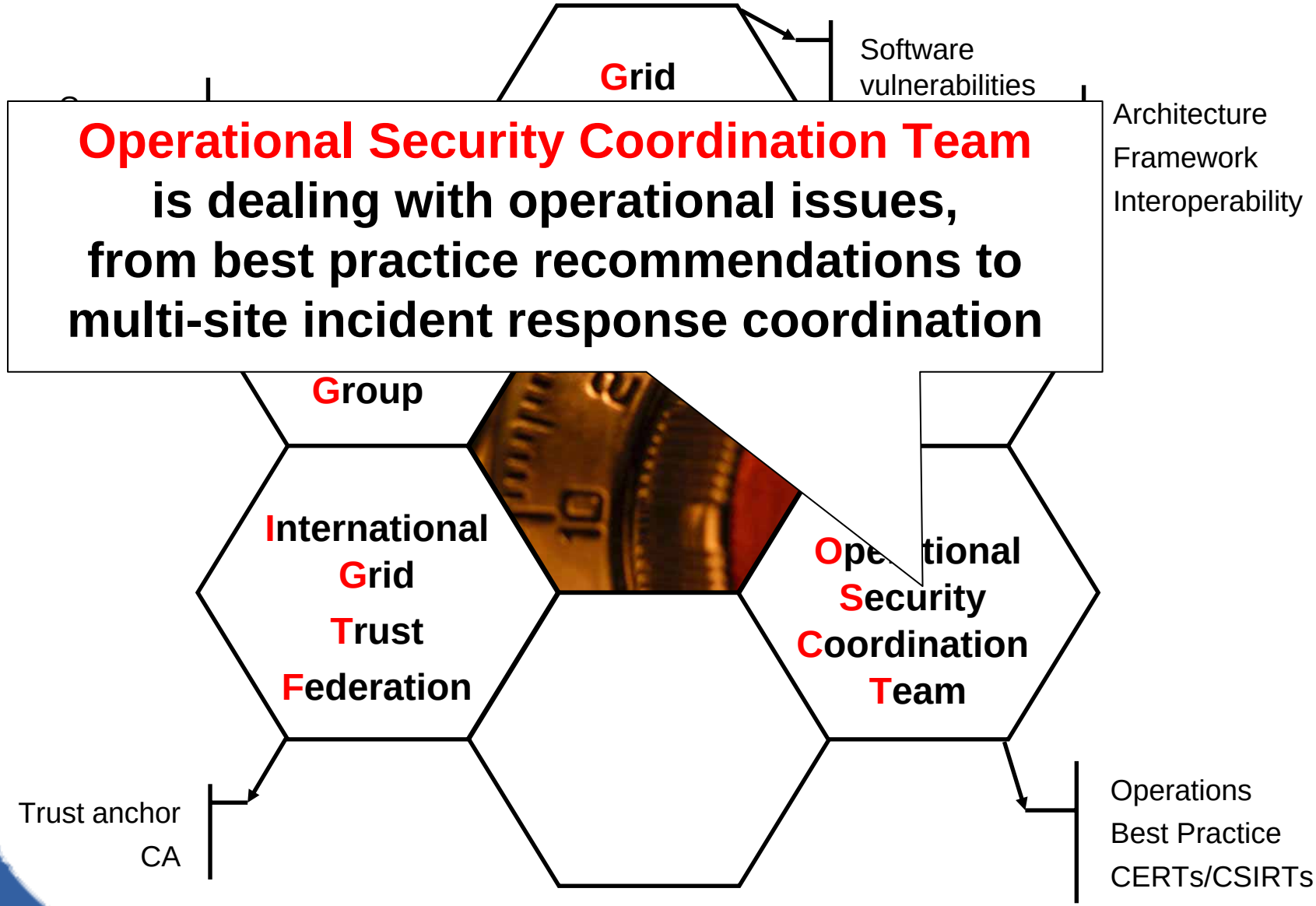


Middleware Security Group
is defining the security framework and architecture of the Grid software

Grid Security Vulnerability Group
is handling Grid middleware security vulnerabilities

(Initial picture by Ake Edlund)

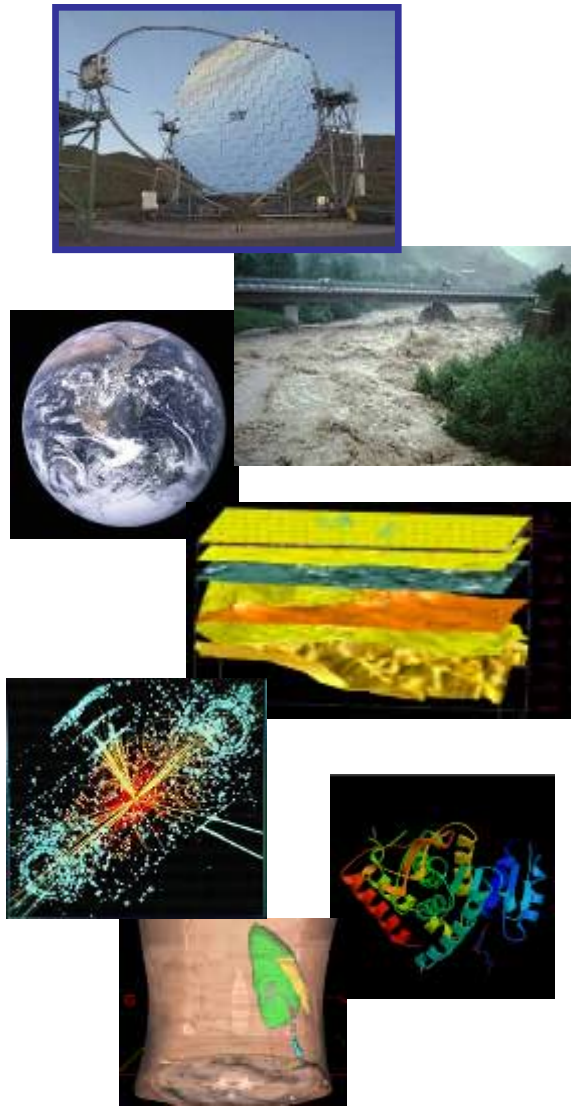
Security Collaboration in the LHC Grid



(Initial picture by Ake Edlund)

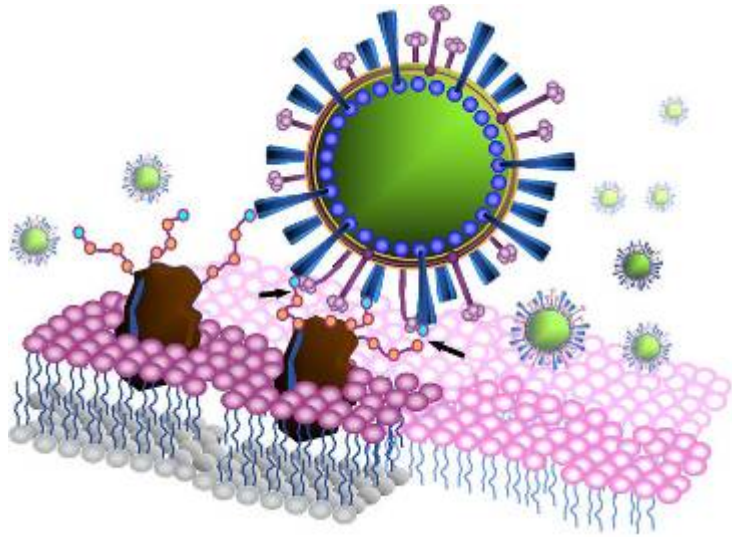
Applications on EGEE

- **More than 25 applications from an increasing number of domains**
  - Astrophysics
  - Computational Chemistry
  - Earth Sciences
  - Financial Simulation
  - Fusion
  - Geophysics
  - High Energy Physics
  - Life Sciences
  - Multimedia
  - Material Sciences
  - …..



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.**



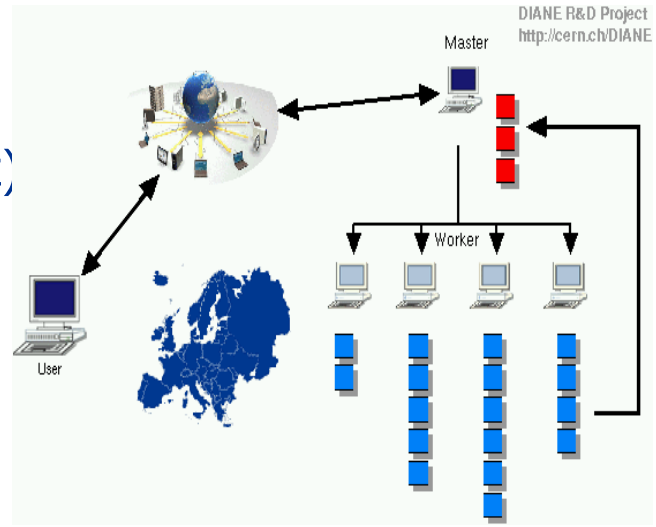
Neuraminidase, one of the two major surface proteins of influenza viruses, facilitating the release of virions from infected cells*. Image Courtesy Ying-Ta Wu, AcademiaSinica.*

Example: ITU Project

- **International Telecommunication Union**
  - ITU/BR: Radio-communication Sector
    - management of the radio-frequency spectrum and satellite orbits for fixed, mobile, broadcasting and other communication services

Figure 1
The extent of the planning area for the RRC-06

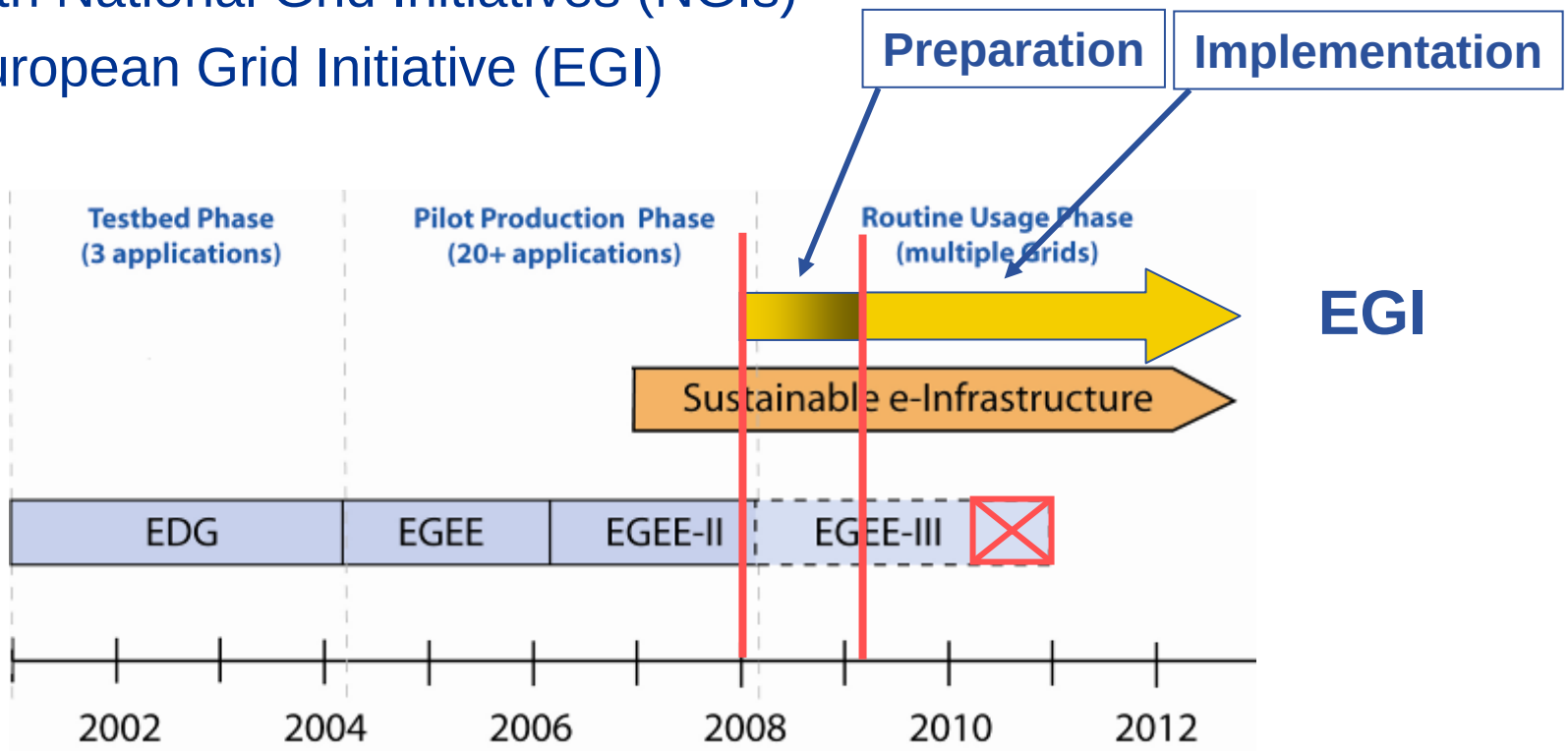
- **RRC-06 (15 May–16 June 2006)**
  - 120 countries negotiate the new frequency plan
  - introduction of digital broadcasting
    - UHF (470-862 Mhz) & VHF (174-230 Mhz)
  - Demanding computing problem with short-deadlines
  - Using EGEE grid were able to complete a cycle in less than 1 hour



Businesses @ EGEE06 Conference (Sep '06)


Sustainability

- **Need to prepare for permanent Grid infrastructure**
  - Ensure a high quality of service for all user communities
  - Independent of short project funding cycles
  - Infrastructure managed in collaboration with National Grid Initiatives (NGIs)
  - European Grid Initiative (EGI)



CERN openlab

- Industry partners provide state of the art technology, manpower
- CERN does test and validation in demanding Grid environment
- Platform competence centre
- Grid interoperability centre
- Security activities
- Joint events

www.cern.ch/openlab

PARTNERS

CONTRIBUTORS

STONESOFT

CERN and F-Secure partnership (1/2)

- The partnership brings together
  - F-Secure's computer security know-how, tools and products
  - CERN's expertise and complex infrastructure as a test bed
- Collaboration on desktop client security and malware detection within electronic mail transport. Focus on desktop and portable computers protection, email gateways (incoming and outgoing), email message stores
  - Antivirus, anti-spyware, anti-spam, anti-flood, anti-phishing
- Current areas of investigation
  - Automated installation of Antivirus client software to large number of computers (> 6000) with high reliability > 99.9 %
  - Detecting and stripping back-listed file extensions even when contained in compressed files on mail gateways
  - Regular expressions content filtering in mail gateways
  - Viewers and tools to analyze security log files

CERN and F-Secure partnership (2/2)

- Technical contact between F-Secure specialists and CERN mail and desktop security teams established with good and competent communication
  - All level of skills directly accessible: support, developers, product management, executives
- F-Secure products are excellent and we are collaborating to improve them further
- We aim to standardize CERN's infrastructure on F-Secure products

For more information about the Grid:

www.gridcafe.org

Thank you for your kind attention!