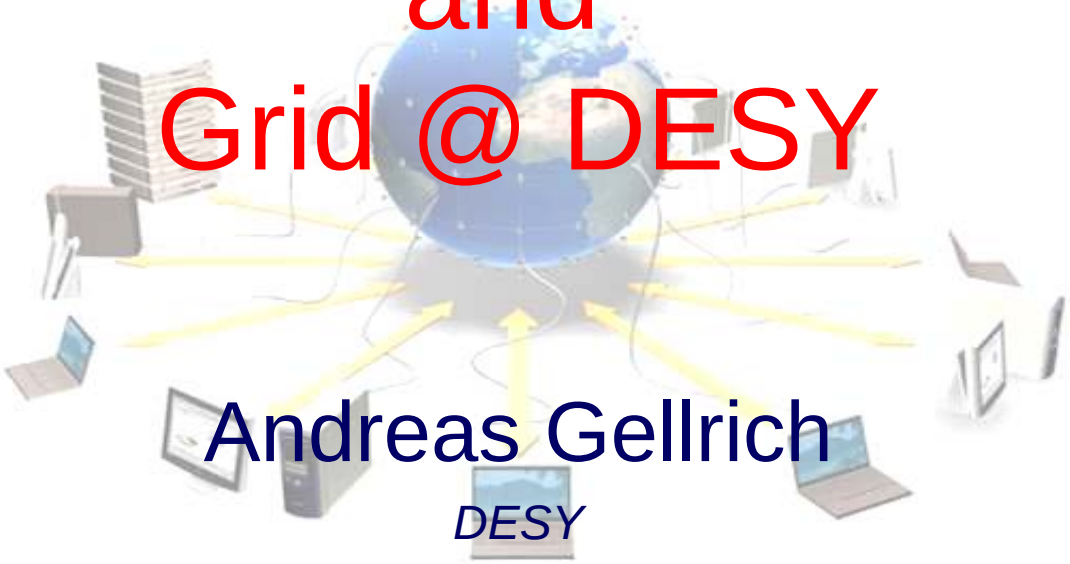
Introduction to the Grid and Grid @ DESY



Andreas Gellrich
DESY

Synchrotron Grid Workshop
ESRF, Grenoble, France
08.12.2008

Contents

- *Introduction*
- The Grid
- Grid @ DESY
- Practical `'xray'`
- *Summary*

Legacy …

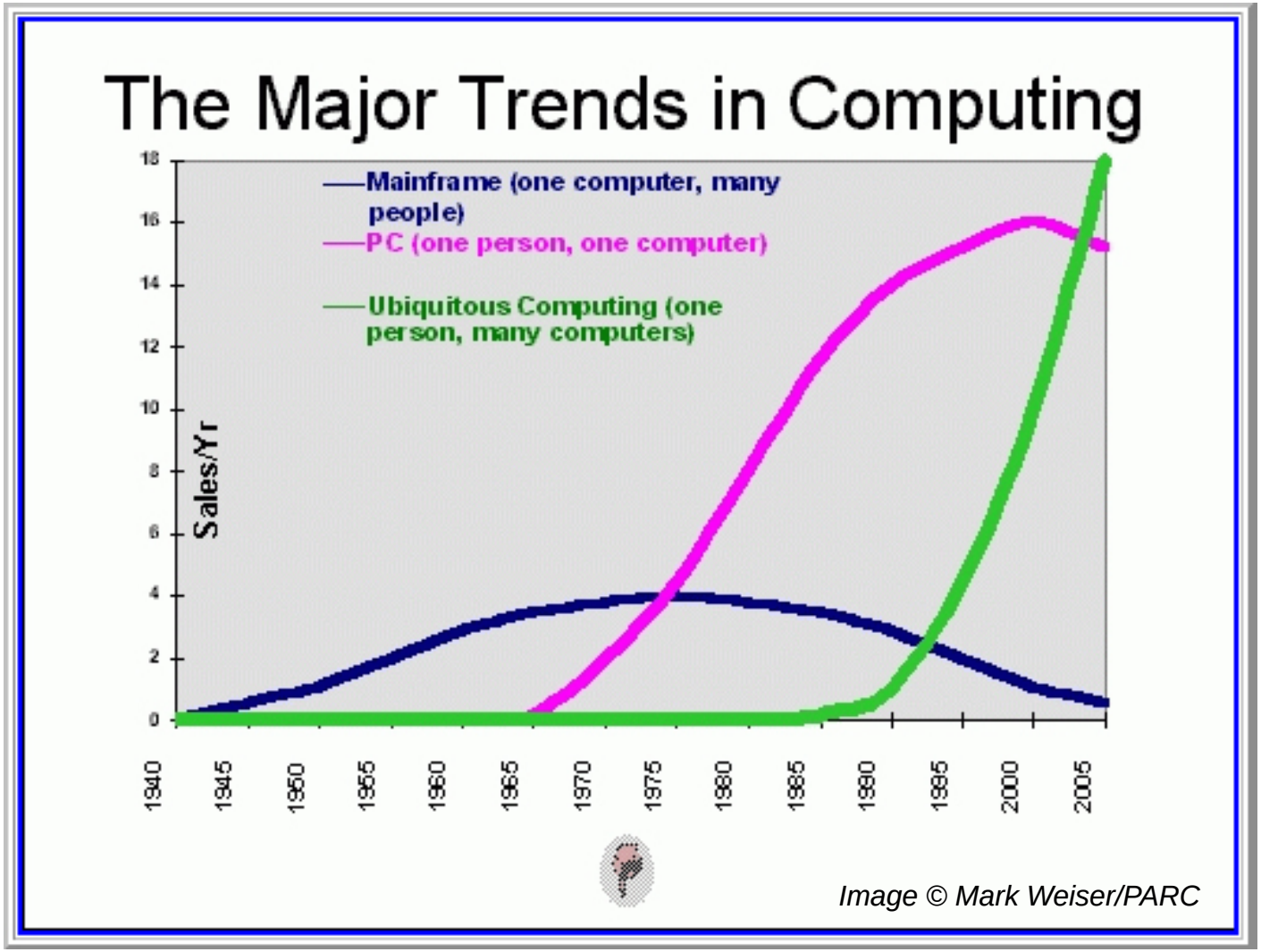
- Trivially, computing requirements must always be related to the technical abilities at a certain time …

- Until not long ago: (at least in HEP …)
  - Computing was a pure *offline* task:
    "Let's first take data and then see how we handle them."
  - Necessary resources could be provided *locally*
  - In HEP, people have always been used to *global* approaches

- Nowadays: (LHC, ILC, …)
  - Computing is treated like a detector component
  - Necessary resources cannot be provided locally anymore
  - Larger amounts of resources are not provided locally

  - The paradigm changed from *local* to *global*

… Legacy …


The Major Trends in Computing
Mainframe (one computer, many people)
PC (one person, one computer)
Ubiquitous Computing (one person, many computers)
Sales/Yr
0
2
4
6
8
10
12
14
16
18
1940
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
Image © Mark Weiser/PARC

... Legacy ...

... Legacy ...

… Legacy

„We will probably see the spread of ´computer utilities‘, which, like present electric and telephone utilities, will service individual homes and offices across the country.“ Len Kleinrock (1969)

„A computational grid is a hardware and software infrastructure that provides dependable, consistent, pervasive, and inexpensive access to high-end computational capabilities.“ I. Foster, C. Kesselmann (1998)

„The sharing that we are concerned with is not primarily file exchange but rather direct access to computers, software, data, and other resources, as is required by a range of collaborative problem-solving and resource brokering strategies emerging in industry, science, and engineering. The sharing is, necessarily, highly controlled, with resources providers and consumers defining clearly and carefully just what is shared, who is allowed to share, and the conditions under which sharing occurs. A set of individuals and/or institutions defined by such sharing rules what we call a virtual organization.“ I. Foster, C. Kesselmann, S. Tuecke (2000)

The Grid

“Sharing resources within Virtual Organizations in a global world.”

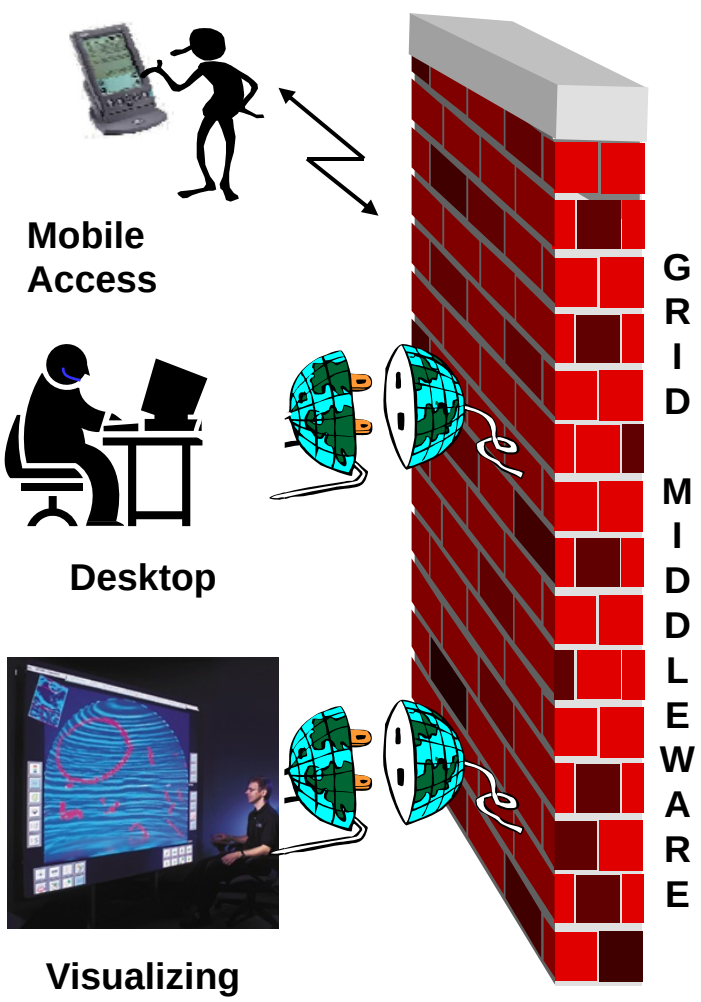
Power Grid

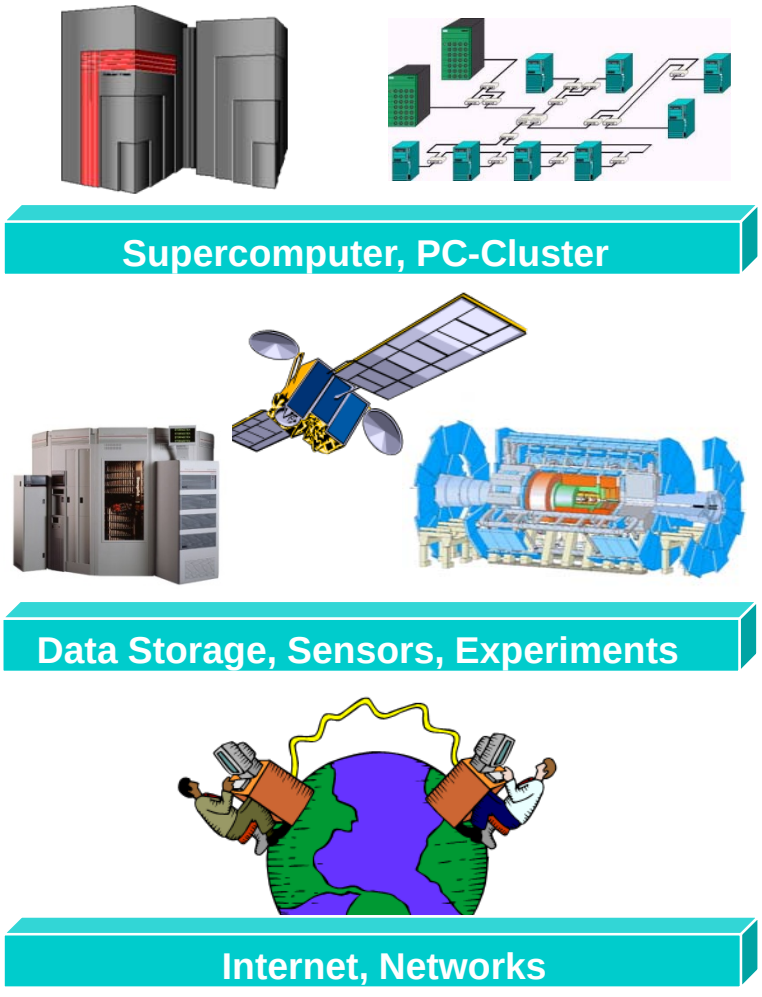
Sources

Infrastructure

Users

Grid Dream

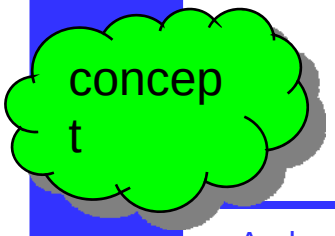

Mobile Access
Desktop
Visualizing
GRID MIDDLEWARE


Supercomputer, PC-Cluster
Data Storage, Sensors, Experiments
Internet, Networks

Grid Computing

Grid Computing is about *virtualization* of *global* resources.

- It is about *transparent* access to globally distributed resources such as data and compute cycles
- A Grid infrastructure consists of *services* to access resources and (of course) of the *resources* itself
  - Opposite to *distributed computing*, Grid resources are *not centrally controlled*
  - Hence it is mandatory to use *standard, open, general-purpose protocols and interfaces*
  - A Grid must *deliver nontrivial qualities of services*
- In general Grid infrastructures are *generic*; without any dependencies of the applications / experiments



Grid Types

- Data Grids:
  - Provisioning of transparent access to data which can be physically distributed within *Virtual Organizations* (VO)
- Computational Grids:
  - allow for large-scale compute resource sharing within Virtual Organizations (VO)
- (Information Grids):
  - Provisioning of information and data exchange, using well defined standards and web services

Jobs are *transient*; data is *persistent.*

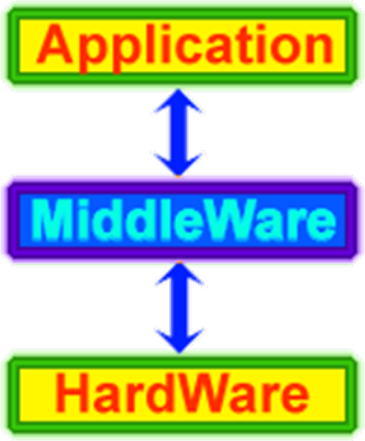
Grid Building Blocks …

concep
t

A *Virtual Organization* (VO) is a *dynamic collection of individuals, institutions, and resources* which is defined by certain *sharing rules*.

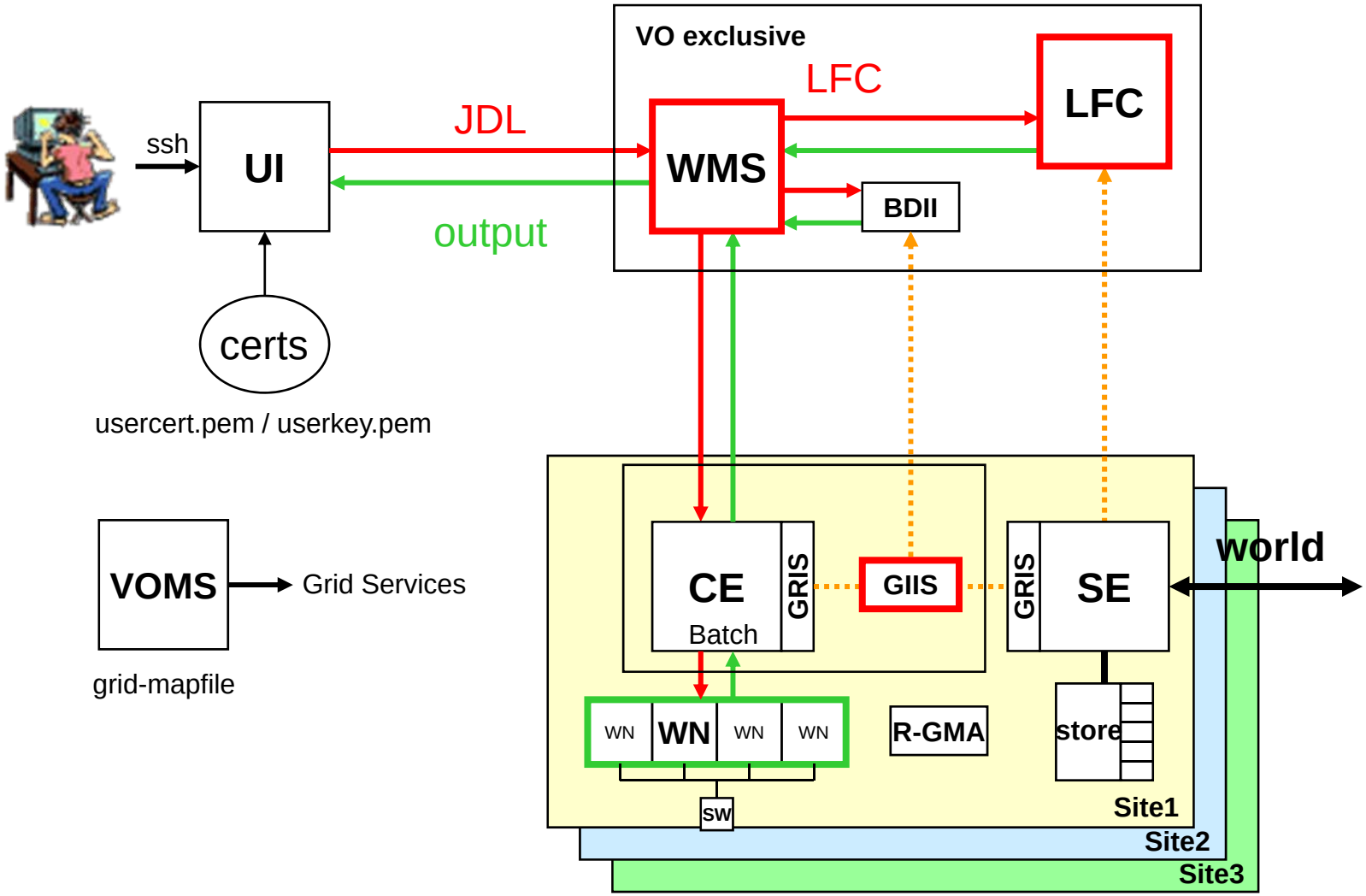
- A VO represents a collaboration
- Users *authenticate* with personal certificates (*Authentication*)
- Users are members of a certain VO (*Authorization*)
- Certificates are *issued* by a *Certification Authority* (CA)

- Grid Infrastructure
  - Core Services (mandatory per VO)
    - VO Membership Services
    - Grid Information Services
    - Workload Management System
  - Resources (brought in by partners (*Grid sites*))

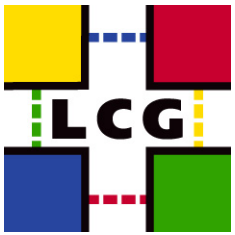


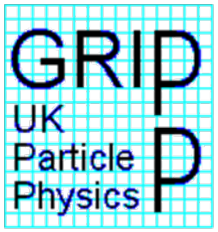
… Grid Building Blocks ...

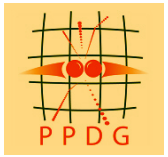
… Grid Building Blocks



Grid Projects







EGEE …

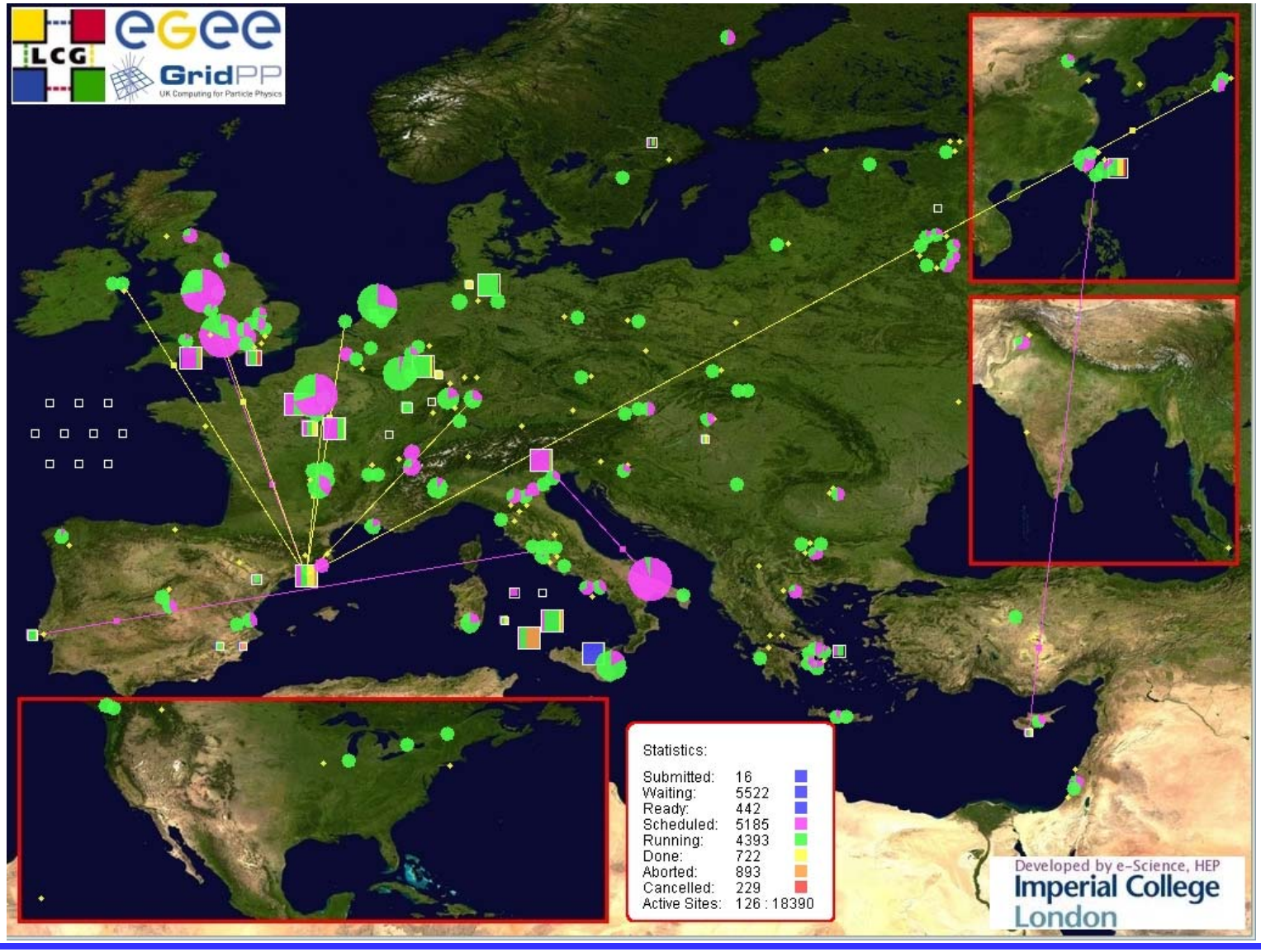
Objectives:

The EGEE project brings together experts from more than 50 countries with the common aim of building on recent advances in Grid technology and developing a service Grid infrastructure which is available to scientists 24 hours-a-day.

The project provides researchers in academia and business with access to a production level Grid infrastructure, independent of their geographic location. The EGEE project also focuses on attracting a wide range of new users to the Grid.

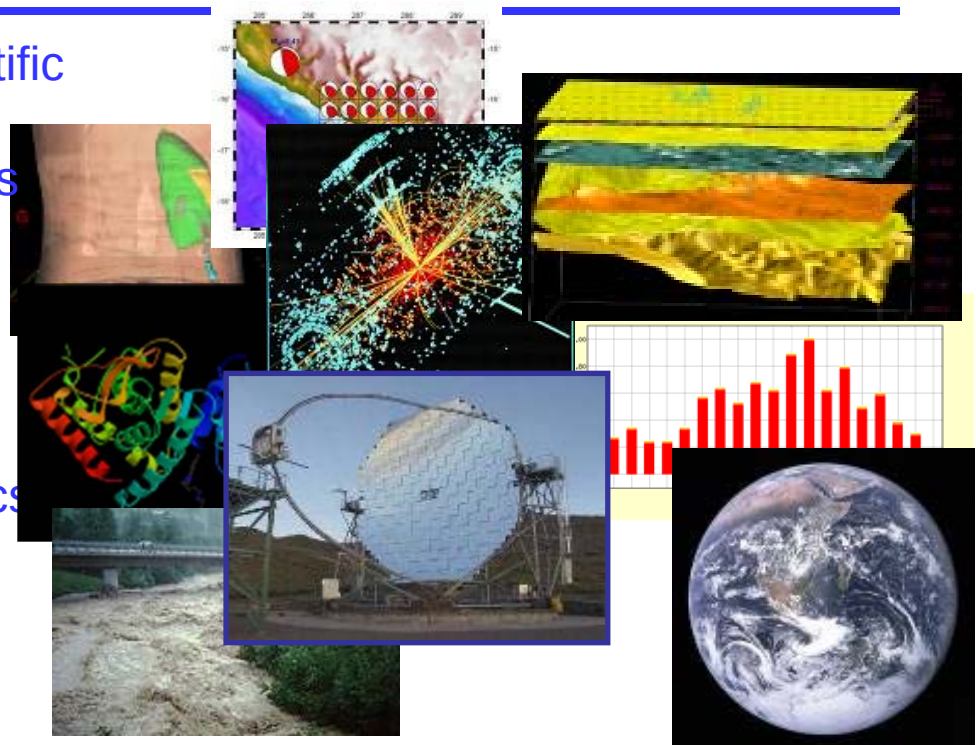
Because of its needs and its tradition and because of its **simple** use cases, HEP has become the pilot application for the Grid (in EGEE).

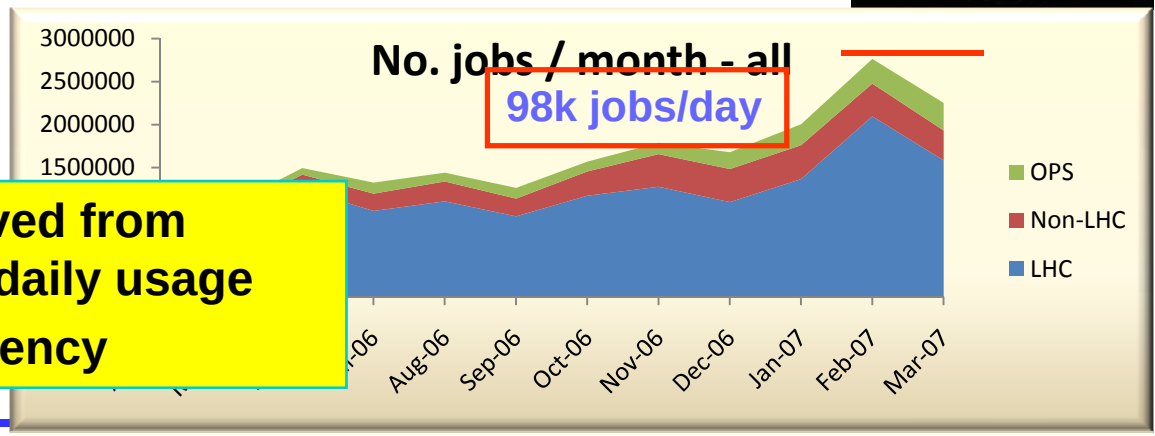
… EGEE …


LCG
eGee
GridPP
UK Computing for Particle Physics
Statistics:
Submitted: 16
Waiting: 5522
Ready: 442
Scheduled: 5185
Running: 4393
Done: 722
Aborted: 893
Cancelled: 229
Active Sites: 126 : 18390
Developed by e-Science, HEP
Imperial College
London

Highlights from EGEE 2

- >200 VOs from several scientific domains
  - Astronomy & Astrophysics
  - Civil Protection
  - Computational Chemistry
  - Comp. Fluid Dynamics
  - Computer Science/Tools
  - Condensed Matter Physics
  - Earth Sciences
  - Fusion
  - High Energy Physics
  - Life Sciences
- Further applications under evaluation





Applications have moved from testing to routine and daily usage

~80-90% efficiency

Grid Issues

- The Grid provides almost *infinite* resources to a single user on the price of a certain overhead
- Grid computing requires a new view to computing
- Even the *local* resources appear as *remote* for the user (jobs are attracted by the data)

- Data management: How to keep data consistent …

- Security:

- Support is one of the first things that does not scale and is constantly underestimated …

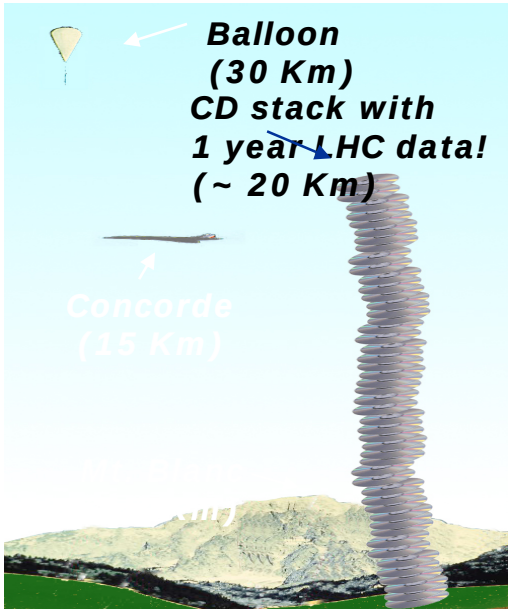
… Grid Issues …

- Data is *persistent* whereas jobs are *transient*
- As soon as data is stored *homogeneity* is broken

- Original idea: VO is based on common sharing rules
- All users w/i VO are equal
- Storage: VO vs. single user

- Data consistency

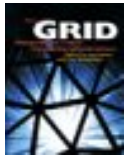
- SE implementations
- SRM, gridFTP
- dCache, castor, DPM, StoRM



Grid Literature

Books:

- Foster, C. Kesselmann: *The Grid: Blueprint for a New Computing Infrastructure*, Morgan Kaufmann Publisher Inc. (1999)
- F. Berman, G. Fox, T. Hey: *Grid Computing: Making The Global Infrastructure a Reality*, John Wiley & Sons (2003)



Articles:

- I. Foster, C. Kesselmann, S. Tuecke: *The Anatomy of the Grid* (2000)
- I. Foster, C. Kesselmann, J.M. Nick, S. Tuecke: *The Physiology of the Grid* (2002)
- I. Foster: *What is the Grid? A Three Point Checklist* (2002)

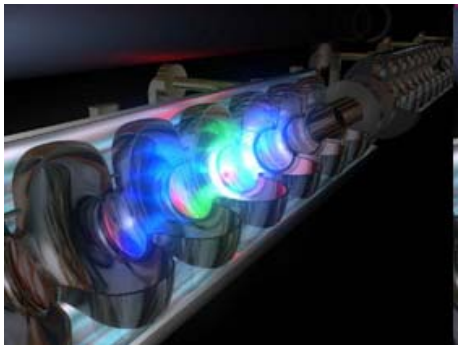
Grid @ DESY

“The future of scientific computing …”

DESY ...

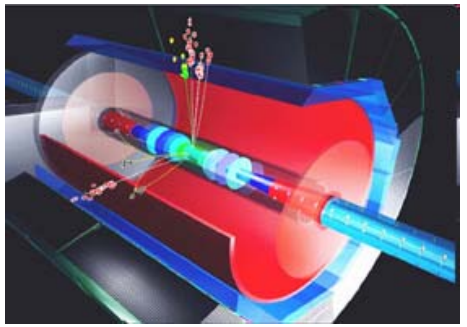
"DESY conducts basic research in the natural sciences with special emphasis upon accelerators, photon science and particle physics."

http:///www.desy.de/
http://www.xfel.eu/



Accellerators
Petra III
XFEL
ILC

Photon Science
FLASH
Petra III
CFEL
XFEL



HEP
H1,HERMES,ZEUS
ATLAS,CMS
ILC
IceCube
Theory

… DESY …

… DESY

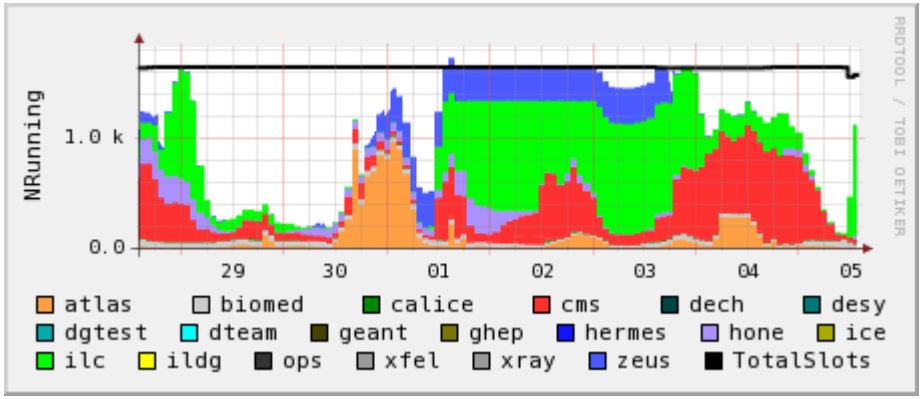
- DESY operates a Grid infrastructure as a partner in the German/Swiss federation (DECH) of the EU project *Enabling Grids for E-sciencE* (EGEE) deploying the middleware *gLite*.
- DESY provides Grid services and Grid resources to a number of VOs of *various* disciplines
- DESY provides a *data repository* for ILC testbeam and *Monte Carlo* data accessible via the Grid
- DESY is part of the *World-wide LHC Computing Grid* (WLCG) as a Tier-2 centre

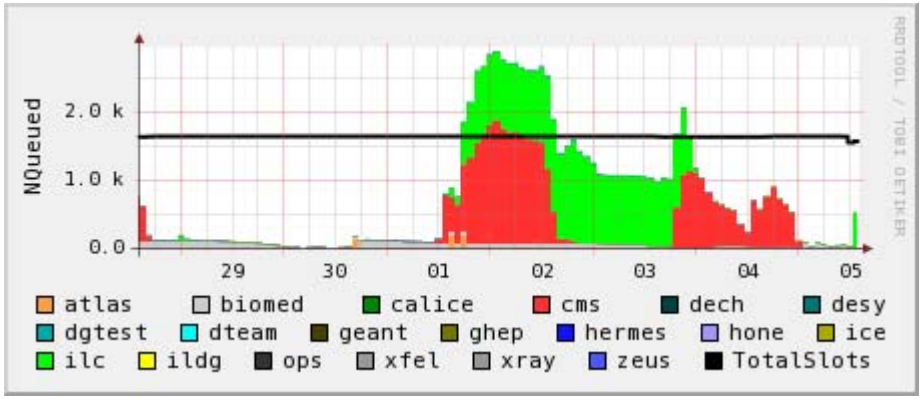
Grid @ DESY ...

- VOs hosted at DESY:
  - Global: '*hone*', '*ilc*', '*xfel.eu*', '*zeus*'
  - Regional: '*calice*', '*ildg*'
  - Local: '*desy*', '*hermes*', '*icecube*'
- VOs supported at DESY:
  - Global: '*atlas*', '*biomed*', '*cms*', '*lhcb*', '*dteam*', '*ops*'
  - Regional: '*dech*', '*xray.vo.egee-eu.org*'
- Grid Core Services:
  - VOMS, LFC, BDII, 11 WMS
- Grid Computing Resources at DESY: (CE)
  - `grid-ce3.desy.de` 1646 slots @ 309 hosts (all)
  - `hera-ce0.desy.de` 292 slots @ 82 hosts (HERA)
- Grid Storage Resources at DESY: (SE)
  - `dcache-se-atlas.desy.de` O(100 TB) w/ tape backend
  - `dcache-se-cms.desy.de` O(100 TB) w/ tape backend
  - `dcache-se-desy.desy.de` O(100 TB) w/ tape backend

… Grid @ DESY

Jobs at DESY-HH November/December 2008





DESY Issues

- The *local* installation is operated in a *global* environment
  - There is always day light somewhere on the globe
  - Core Grid services are used everywhere (VOMS, LFC)

- One *common* infrastructure for *multiple* VOs of multiple disciplines
  - Different groups want different things
  - Computing models differ fundamentally
  - Use and user patterns differ
  - Software requirements differ

- User support is a big issue
  - Not scalable
  - Underestimated
  - Has a huge social factor

Practical '*xray*'

"What can we gain …"

The VO '*xray*'

- ESRF initiated a project to study '*Grid for Synchrotron*'
- ESRF founded the VO '*xray.vo.eu-egee.org*'
- By now 2 sites support '*xray*': ESRF and DESY-HH
- All necessary core services are available:
  - VOMS: `grid-voms.esrf.eu`
  - LFC: `grid-lfc.desy.de`
  - WMS: `xray-wms.desy.de`
    `wms1.egee.fr.cgg.com`
  - AMGA: `grid-amga0.desy.de`

'*xray*' Issues …

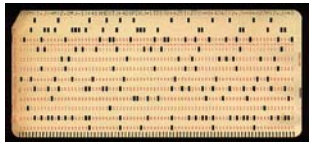
- In HEP(-like) institutes the usage of the EGEE Grid infrastructure is straight forward – with a lot of room for improvements though
- Management of data (files) might be the main use case of '*xray*'?

  (G. Foerstner ESRF/DESY)
  - AMGA
- Does the GUI *g-eclipse* help to ease access

  (G. Foerstner, F. Schluenzen, K. Wrona, DESY)
- What else is available?

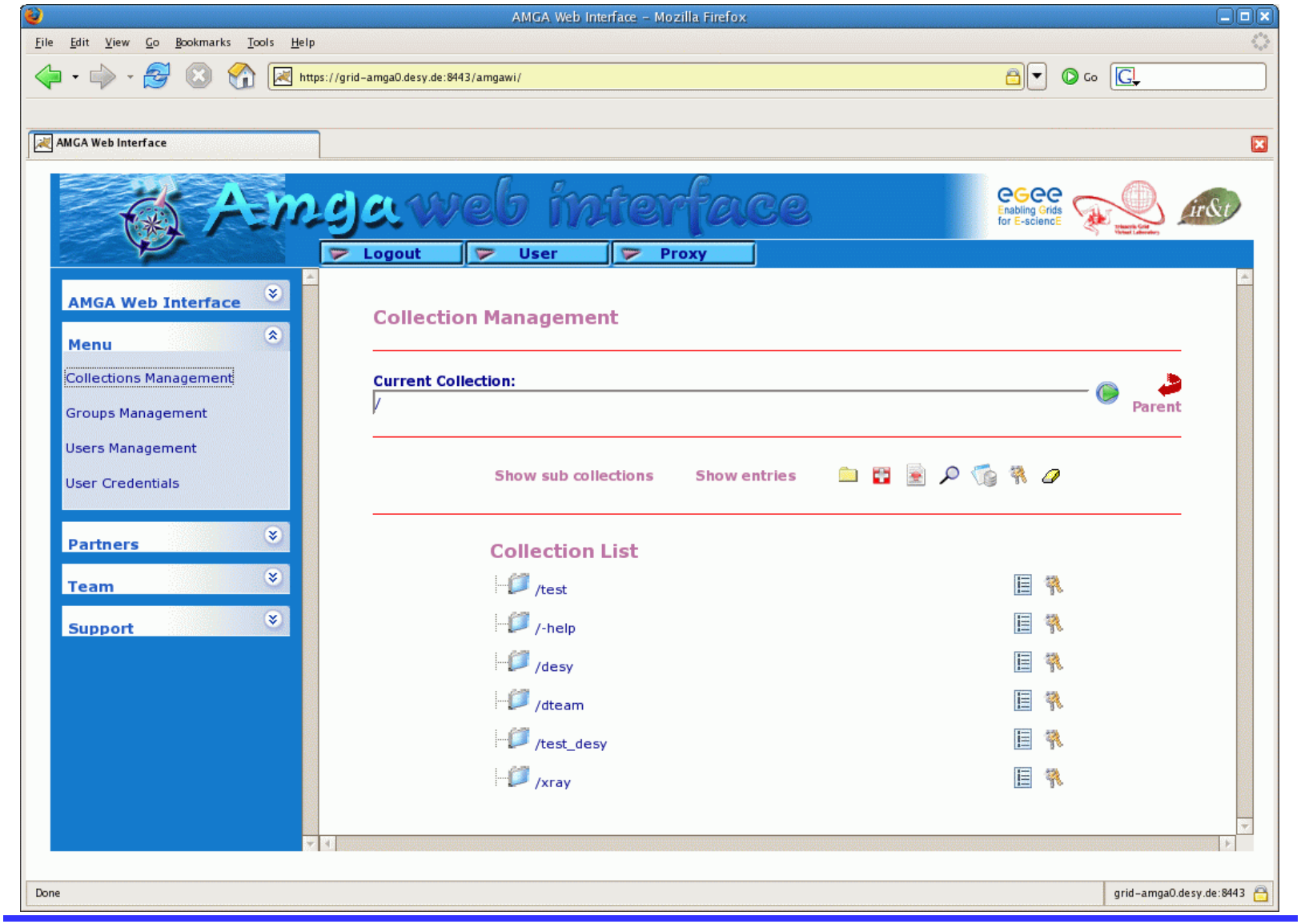
… '*xray*' Issues

- Do the Grid and the Synchrotron Light Computing needs match?
  - The Grid runs Linux (SL4/5) …
  - HEP uses a file-oriented data model with atomic data structures (*events*) which can be processes (trivially) parallel
- What about software?

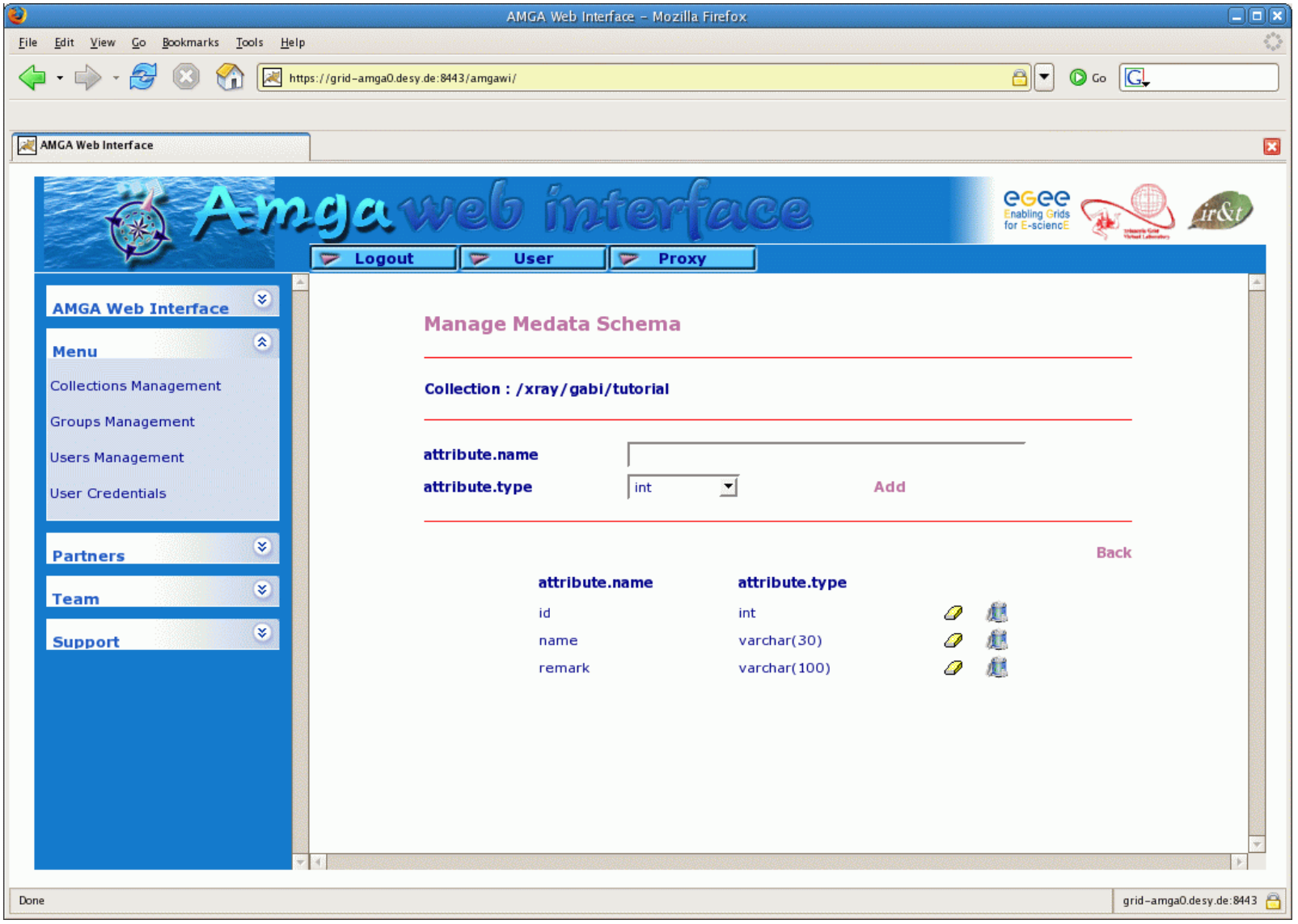


- Some VOs (HONE, ZEUS, …) just rely on very basic things a bring the needed software with the job …
- Other VOs (LHC,…) rely on VO-specific centrally VO-managed software installation per site …

‘*xray*’: Amga …


AMGA Web Interface – Mozilla Firefox
File Edit View Go Bookmarks Tools Help
https://grid-amga0.desy.de:8443/amgawi/
AMGA Web Interface
Amga web interface
Enabling Grids for E-sciencE
Logout
User
Proxy
AMGA Web Interface
Menu
Collections Management
Groups Management
Users Management
User Credentials
Partners
Team
Support
Collection Management
Current Collection:
/
Parent
Show sub collections
Show entries
Collection List
/test
/-help
/desy
/dteam
/test_desy
/xray
Done
grid-amga0.desy.de:8443

… ‘*xray*’: Amga …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Users Management
User Credentials
Partners
Team
Support
Manage Medata Schema
Collection : /xray/gabi/tutorial
attribute.name
attribute.type
int
Add
Back
attribute.name
attribute.type
id
int
name
varchar(30)
remark
varchar(100)
Done
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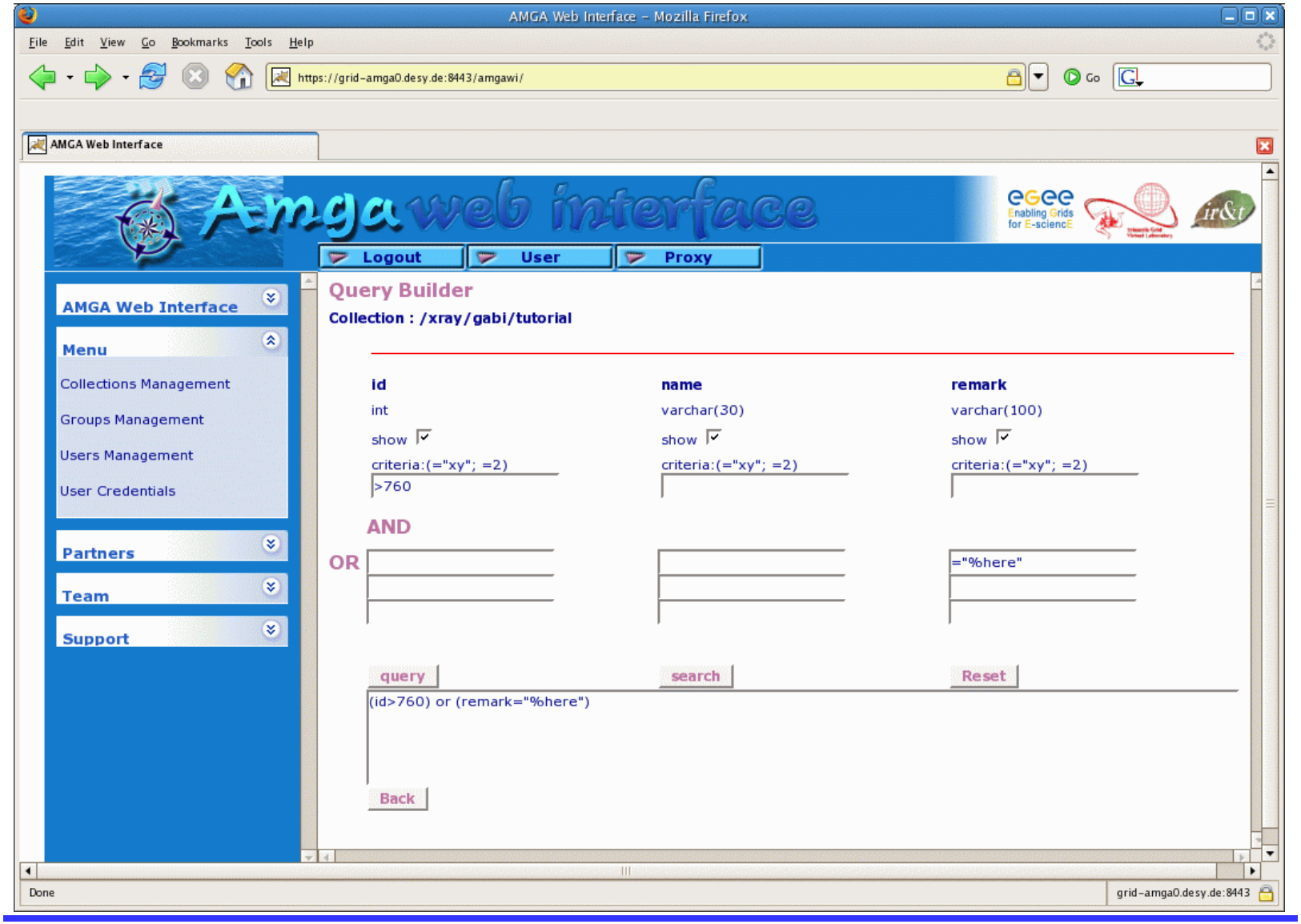
… ‘*xray*’: Amga …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AMGA Web Interface
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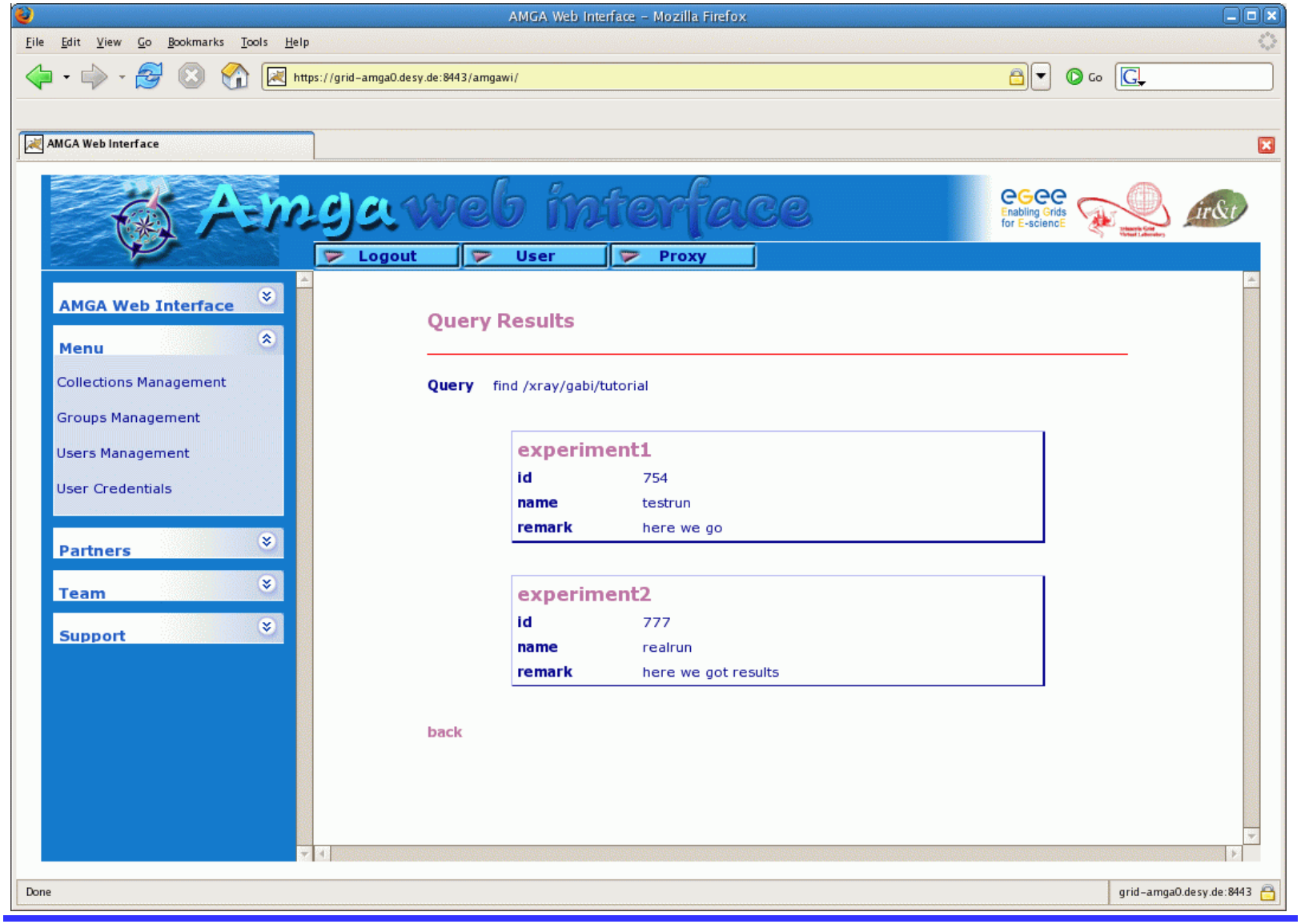
Groups Management
Users Management
User Credentials
Partners
Team
Support
Query Builder
Collection : /xray/gabi/tutorial
id
int
show
criteria:(="xy"; =2)
>760
name
varchar(30)
show
criteria:(="xy"; =2)
remark
varchar(100)
show
criteria:(="xy"; =2)
AND
OR
="%here"
query
search
Reset
(id>760) or (remark="%here")
Back
Done
grid-amga0.desy.de:8443

… '*xray*': Amga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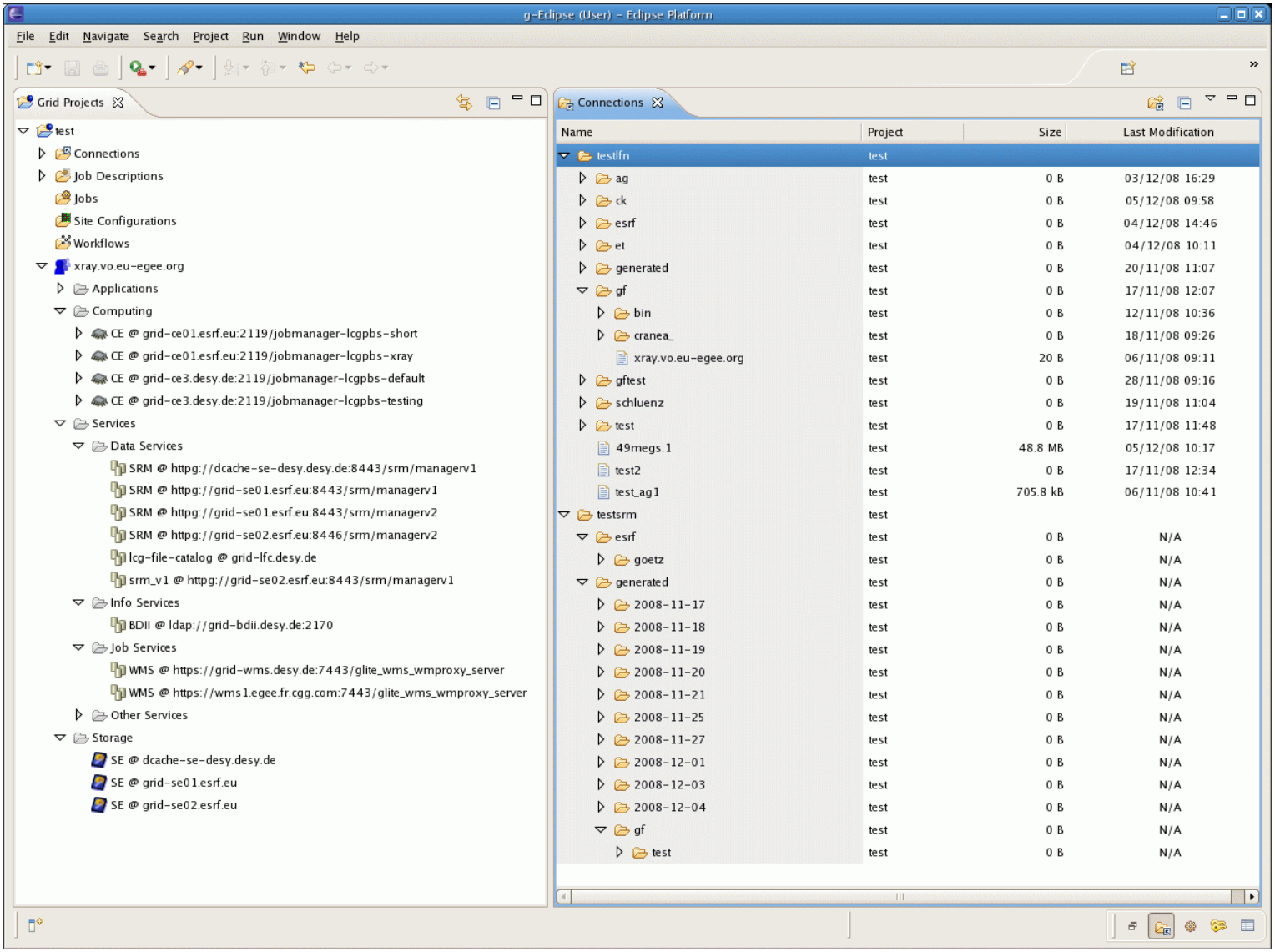
Amga web interface
Enabling Grids for E-sciencE
Logout
User
Proxy
AMGA Web Interface
Menu
Collections Management
Groups Management
Users Management
User Credentials
Partners
Team
Support
Query Results
Query find /xray/gabi/tutorial
experiment1
id 754
name testrun
remark here we go
experiment2
id 777
name realrun
remark here we got results
back
Done
grid-amga0.desy.de:8443

‘*xray*’: g-Eclipse



Summary

- Grid has grown from an idea to reality; it is there!
- Grid computing has already become a key technology in e-Science
- Resources are hardly available outside the Grid in many fields
- Massive efforts have been going into the Grid, e.g. EGEE
- LHC relies on the Grid!
- Become a member of '*xray.vo.eu-egee.org*' and try out!