Overview of the EU Data Grid Project

The European DataGrid Project Team

http://www.eu-datagrid.org

The EU DataGrid (EDG) Project

- 9.8 M Euros EU (IST) funding over 3 years
- Three year phased developments & demos (2001-2003)
- Project objectives:
  - Middleware for fabric & Grid management (mostly funded by the EU)
  - Large scale testbed (mostly funded by the partners)
  - Production quality demonstrations (partially funded by the EU)
  - To collaborate with and complement other European and US projects
  - Contribute to Open Standards and international bodies:
    - Co-founder of Global Grid Forum and host of GGF1 and GGF3
    - Industry and Research Forum for dissemination of project results
- Total of 21 partners
  - Research and Academic institutes as well as industrial companies
- Main partners:

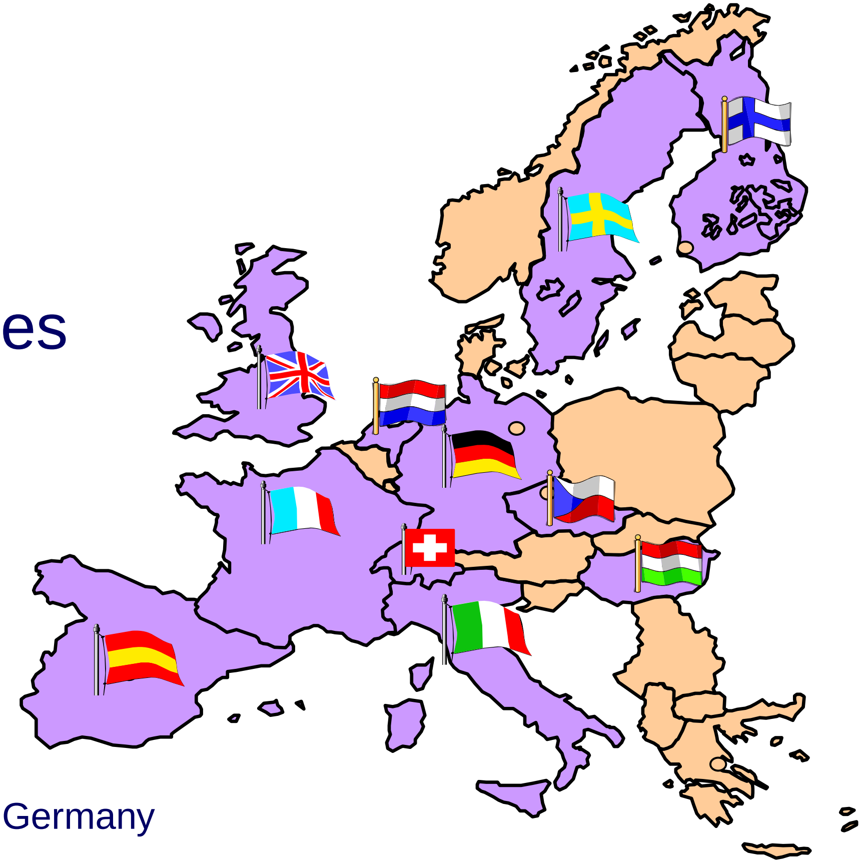
EDG Assistant Partners

Industrial Partners

- •Datamat (Italy)
- •IBM-UK (UK)
- •CS-SI (France)

Research and Academic Institutes

- •CESNET (Czech Republic)
- •Commissariat à l'énergie atomique (CEA) – France
- •Computer and Automation Research Institute, Hungarian Academy of Sciences (MTA SZTAKI)
- •Consiglio Nazionale delle Ricerche (Italy)
- •Helsinki Institute of Physics – Finland
- •Institut de Fisica d'Altes Energies (IFAE) - Spain
- •Istituto Trentino di Cultura (IRST) – Italy
- •Konrad-Zuse-Zentrum für Informationstechnik Berlin - Germany
- •Royal Netherlands Meteorological Institute (KNMI)
- •Ruprecht-Karls-Universität Heidelberg - Germany
- •Stichting Academisch Rekencentrum Amsterdam (SARA) – Netherlands
- •Swedish Research Council - Sweden



EDG structure : work packages

- The EDG collaboration is structured in 12 Work Packages:

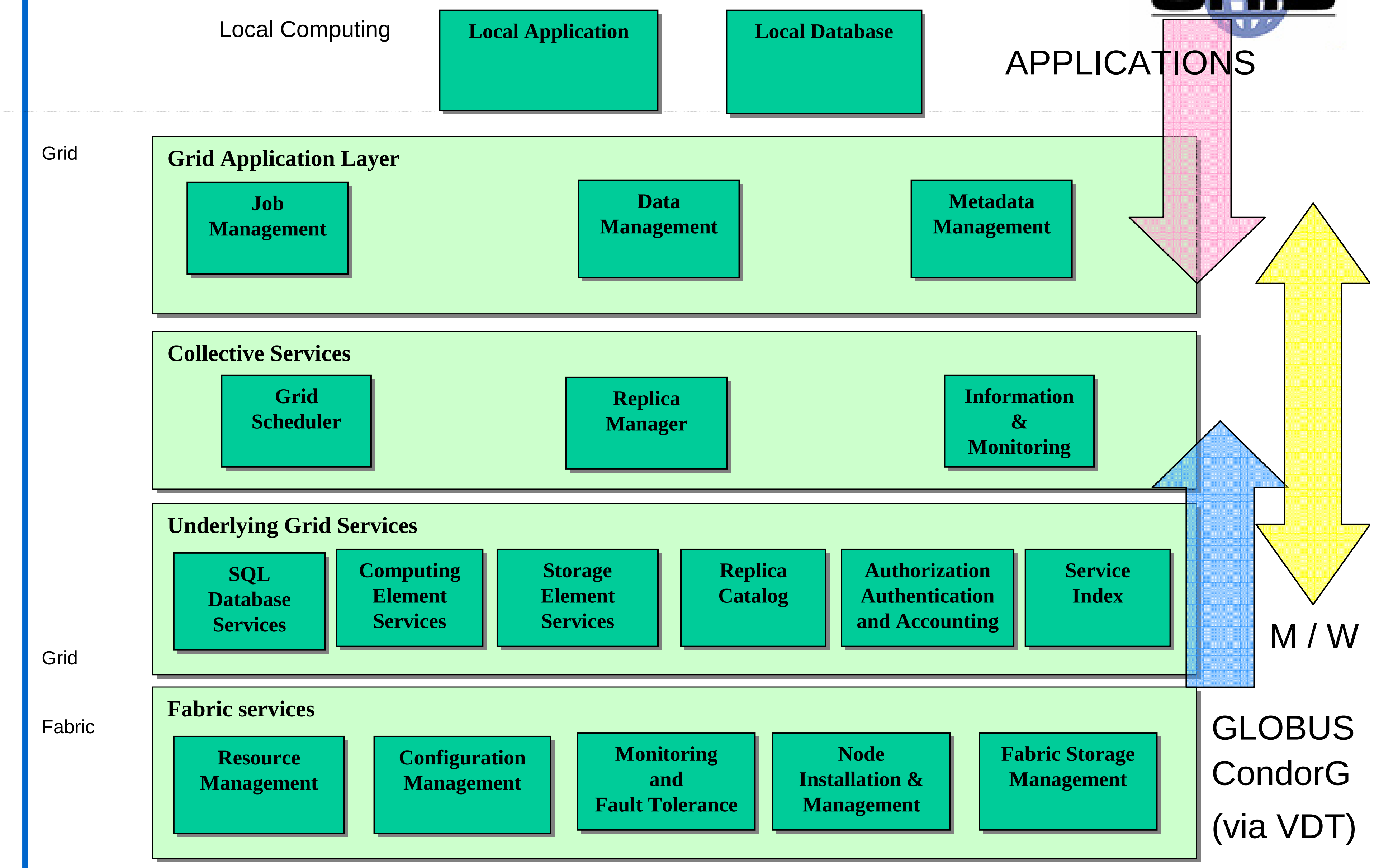
  - WP1: Work Load Management System
  - WP2: Data Management
  - WP3: Grid Monitoring / Grid Information Systems
  - WP4: Fabric Management
  - WP5: Storage Element
  - WP6: *Testbed and demonstrators*
  - WP7: Network Monitoring
  - WP8: High Energy Physics Applications
  - WP9: Earth Observation
  - WP10: Biology
  - WP11: Dissemination
  - WP12: Management

} **Applications**

Project Schedule

- Project started on 1/Jan/2001
- Testbed 0 (early 2001)
  - International test bed 0 infrastructure deployed
    - Globus 1 only - no EDG middleware
- Testbed 1 (2002)
  - First release of EU DataGrid software to defined users within the project:
    - HEP experiments (WP 8), Earth Observation (WP 9), Biomedical applications (WP 10)
- Testbed 2 (End 2002)
  - Builds on Testbed 1 to extend facilities of DataGrid
  - Focus on stability
- EDG very successfully passed its 2nd annual EU review on February 4-5 2003
- Testbed 3 (2003)
  - Advanced functionality; currently being deployed.
- Project stops on 31/Dec/2003

EDG Middleware Architecture



Local Computing

Local Application

Local Database

APPLICATIONS

Grid

Grid Application Layer

Job Management

Data Management

Metadata Management

Collective Services

Grid Scheduler

Replica Manager

Information & Monitoring

Underlying Grid Services

SQL Database Services

Computing Element Services

Storage Element Services

Replica Catalog

Authorization Authentication and Accounting

Service Index

M / W

Grid

Fabric

Fabric services

Resource Management

Configuration Management

Monitoring and Fault Tolerance

Node Installation & Management

Fabric Storage Management

GLOBUS

CondorG

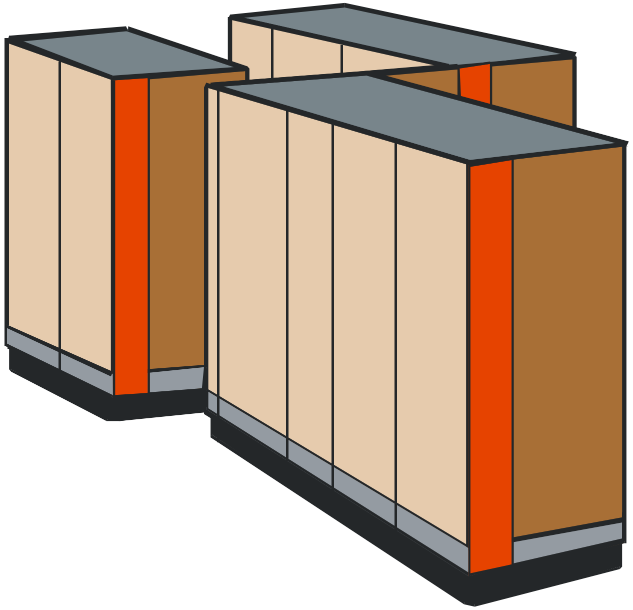
(via VDT)

The EDG WMS (WP1)

- The user interacts with Grid via a **Workload Management System** (WMS)
- The Goal of WMS is the **distributed scheduling and resource management in a Grid environment**.
- What does it allow Grid users to do?
  - To submit their jobs
  - To execute them on the "best resources"
    - The WMS tries to optimize the usage of resources
  - To get information about their status
  - To retrieve their output

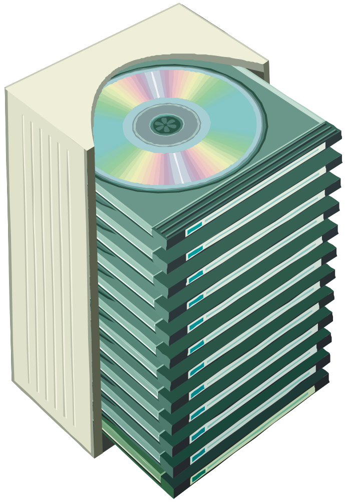
Computing Element (WP4)

- Is a Grid Job Queue
  - Publishes information about itself
  - Checks the job is permitted
  - Sends it to an an appropriate internal queue



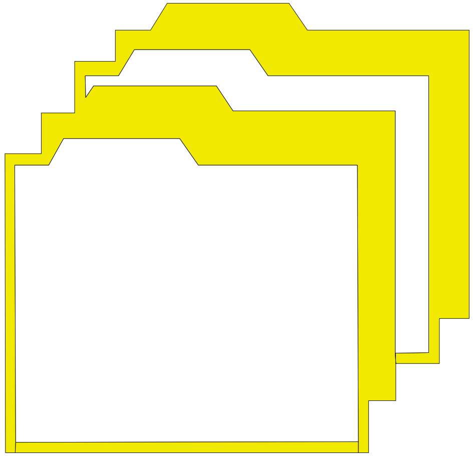
SRM: Storage Resource Manager (WP5)

- SRM subset implementation
  - A defacto international standard for Storage Resource Management
- Web service uses Java AXIS and EDG security
- Supports multiple VOs
- Functions
  - Writing a file
  - Reading a file



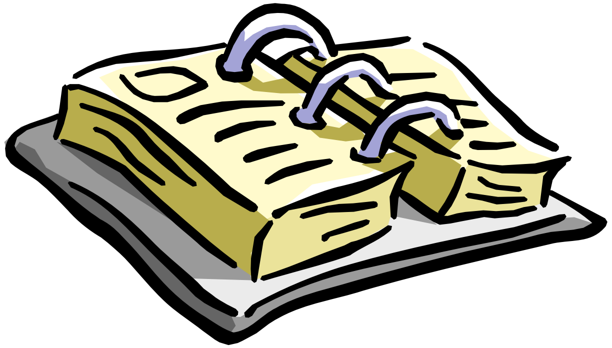
Replica Manager (WP2)

- High level data management on the Grid
  - Location of data
  - Replication of data
  - Efficient access to data
- Hides the SRM
- Coordinates use of
  - Replica Location Service
  - Replica Metadata Catalog
  - Replica Optimization Service



Information & Monitoring (WP3)
R-GMA

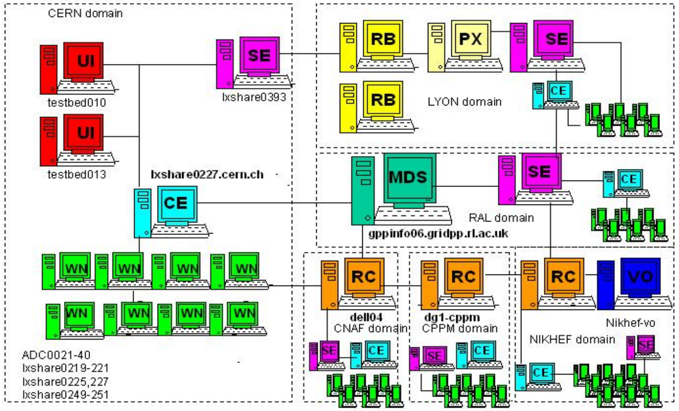
- Relational implementation of GMA from GGF
- Makes use of GLUE schema
- Interoperable with MDS
- Deals with information on
  - The Grid itself
    - Resources and Services (for which the Globus MDS is a common solution)
    - Job status information
  - Grid applications
    - This is information published by user jobs.



TestBed Integration (WP6)

- Exact definition of RPM lists (components) for the various testbed machine profiles (CE, RB, UI,, WN, IC etc.) – check dependencies
- Perform preliminary centrally (CERN) managed tests on EDG m/w before green light for spread EDG testbed sites deployment
- Provide, update end user documentation for installers/site managers, developers and end users
- Define EDG release policies, coordinate the integration team staff with the various WorkPackage managers – keep high inter-coordination.
- Set up the Authorization Working Group to manage authorization policies on the testbed

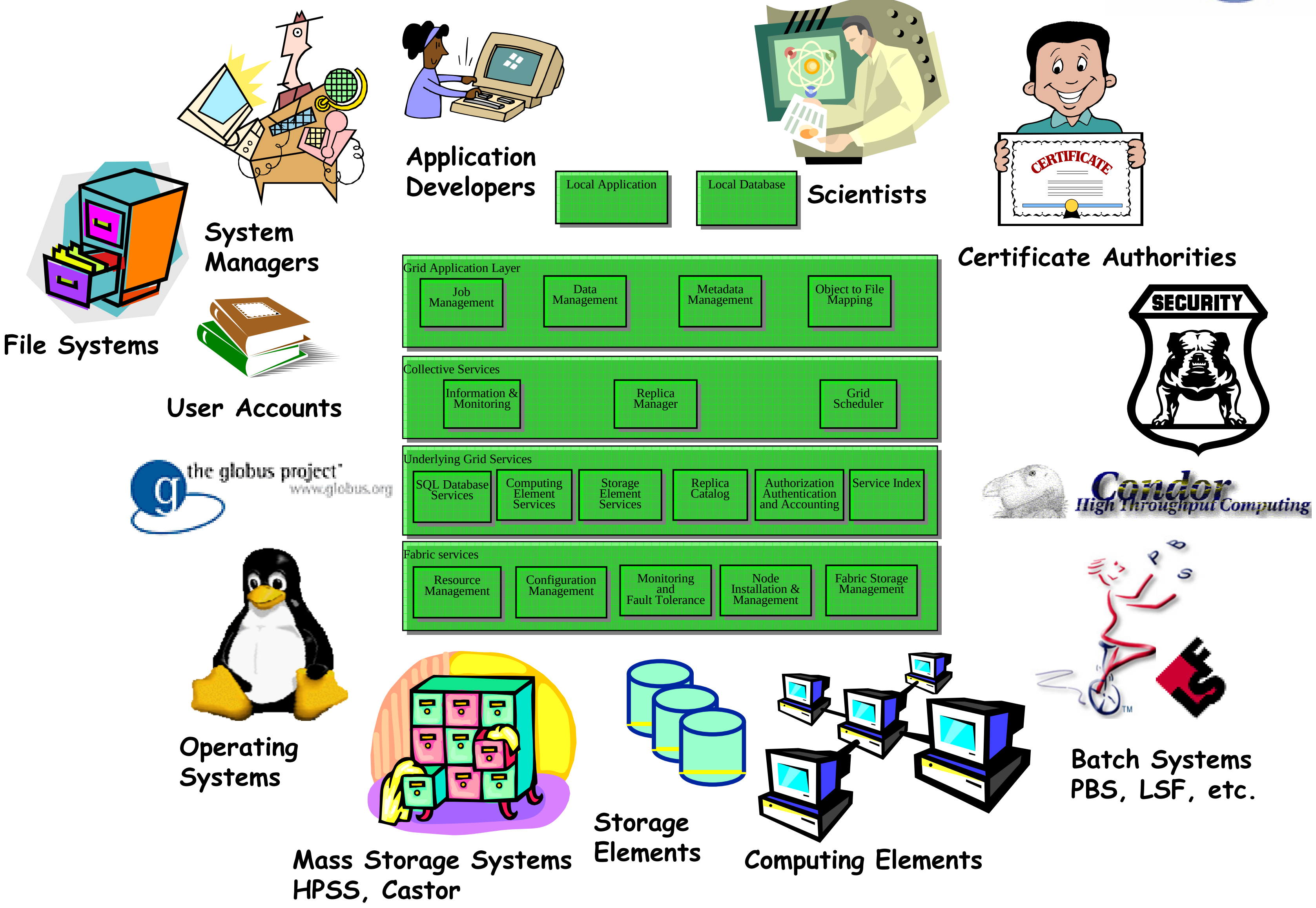
EDG production testbed EDG Release EDG 1.4.7
CERN Computing Element site and corresponding spread GRID services



Grid aspects covered by EDG

VOMS	Provides certificate with VOs, groups and roles	**RGMA: Information & Monitoring**	Provides info on resource utilization & performance
User Interface	Submit & monitor jobs, retrieve output	**Grid Fabric Management**	Configure, installs & maintains grid sw packages and environ.
Workload Management System	Manages submission of jobs to Res. Broker, obtains information and retrieves output	**Network performance**	Provides efficient network transport, bandwidth monitoring
Computing Element	Gatekeeper to a grid computing resource	**Testbed admin.**	Certificate auth.,user reg., usage policy etc.
Storage Resource Manager	Grid-aware storage area	**Applications**	HEP, EO, Biology
Replica Manager	Replicates and locates data		

EDG Interfaces



System Managers

Application Developers

Local Application

Local Database

Scientists

Certificate Authorities

File Systems

User Accounts

Grid Application Layer

- Job Management
- Data Management
- Metadata Management
- Object to File Mapping

Collective Services

- Information & Monitoring
- Replica Manager
- Grid Scheduler

Underlying Grid Services

- SQL Database Services
- Computing Element Services
- Storage Element Services
- Replica Catalog
- Authorization Authentication and Accounting
- Service Index

Fabric services

- Resource Management
- Configuration Management
- Monitoring and Fault Tolerance
- Node Installation & Management
- Fabric Storage Management

Operating Systems

Mass Storage Systems HPSS, Castor

Storage Elements

Computing Elements

Batch Systems PBS, LSF, etc.

DataGrid in Numbers (as of Feb. 2003)

People

>350 registered users

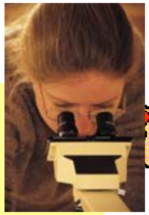
12 Virtual Organisations

16 Certificate Authorities

>200 people trained

278 man-years of effort

100 years funded



Testbeds

>15 regular sites

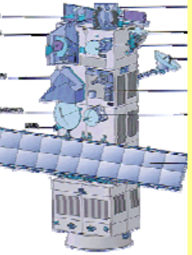
>40 sites using EDG sw

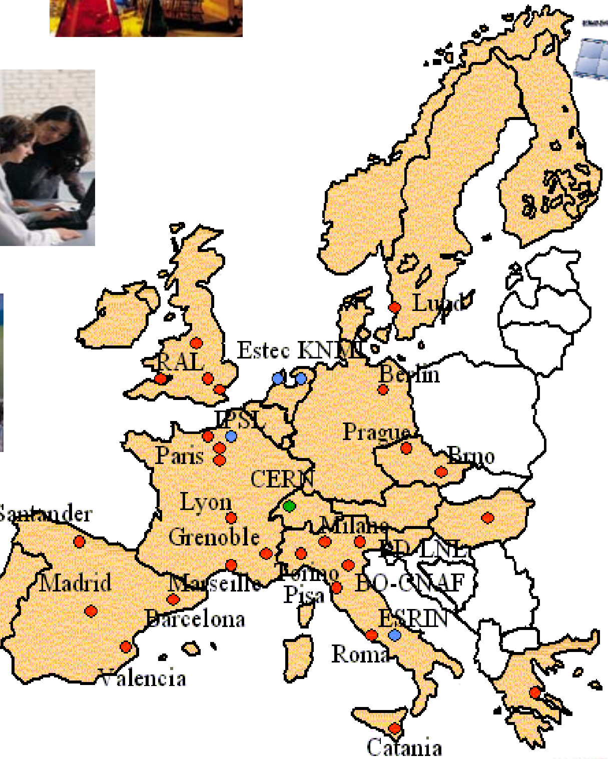
>10'000s jobs submitted

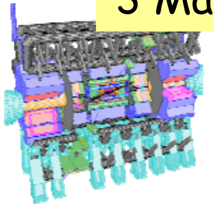
>1000 CPUs

>15 TeraBytes disk

3 Mass Storage Systems







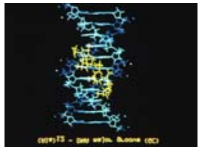
Software

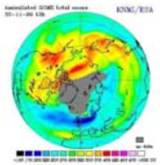
50 use cases

18 software releases

Current release 1.4

>300K lines of code





GEANT

Scientific applications

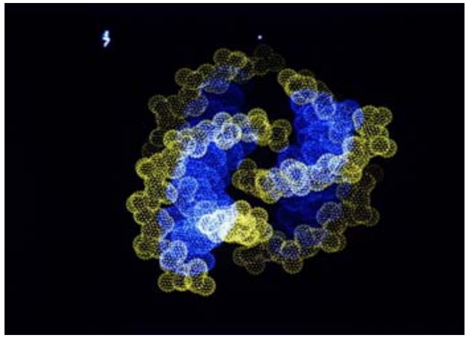
5 Earth Obs institutes

9 bio-informatics apps

6 HEP experiments

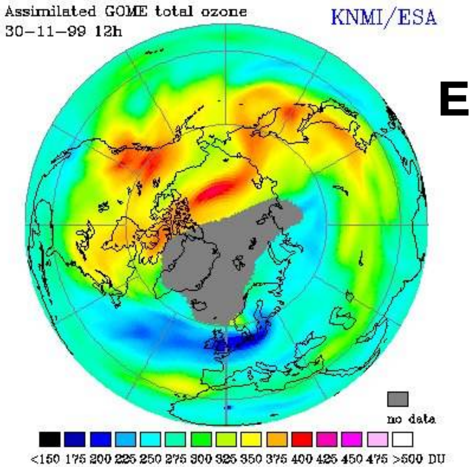
DataGrid Scientific Applications

Developing grid middleware to enable large-scale usage by scientific applications



Bio-informatics

- Data mining on genomic databases (exponential growth)
- Indexing of medical databases (Tb/hospital/year)



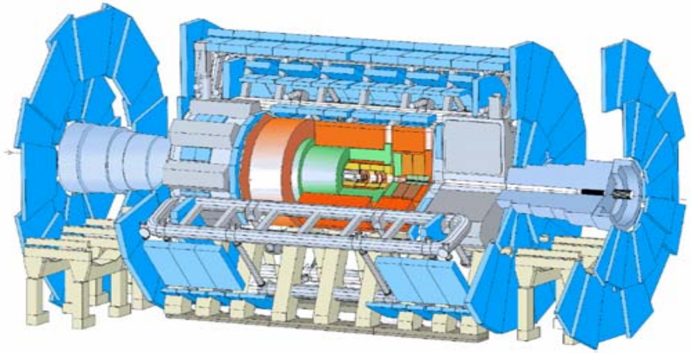
Assimilated GOME total ozone
30-11-99 12h
KNMI/ESA
no data
<150 175 200 225 250 275 300 325 350 375 400 425 450 475 >500 DU

Earth Observation

- about 100 Gbytes of data per day (ERS 1/2)
- 500 Gbytes, for the ENVISAT mission

Particle Physics

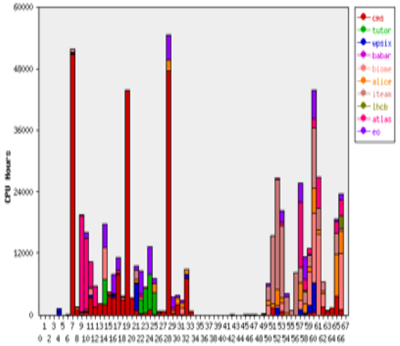
- Simulate and reconstruct complex physics phenomena millions of times
- LHC experiments will generate 6-8 PetaBytes/year

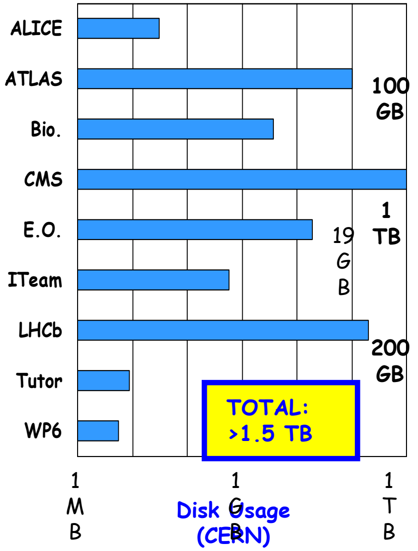


Application Usage of Release 1.4

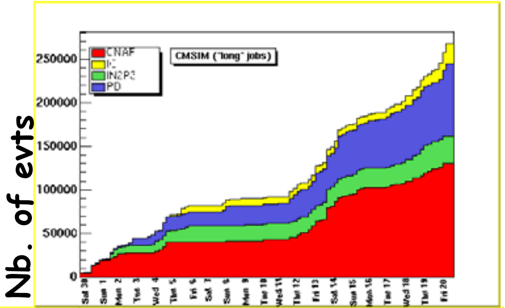
EDG 1.4 evaluated for review in Feb. 2003

CPU Usage



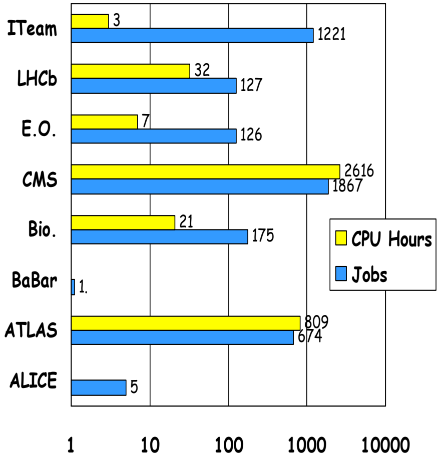


HEP Simulation

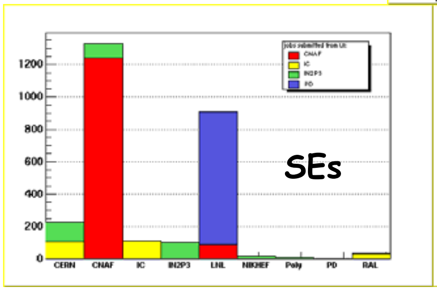


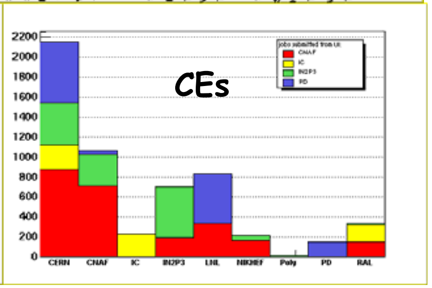
Positive Signs:

- Large increase in users.
- Many sites interested in joining.
- Pushing real jobs through system.



Disk Usage





Release 2.0

- Major new developments in all middleware areas
- Addre
  - WMS ored
  - Rep
  - Data ed
  - Info
    scal
  - Unif
  - Fabr
- Provid
- Upgrade underlying software

Being deployed on Application TB now

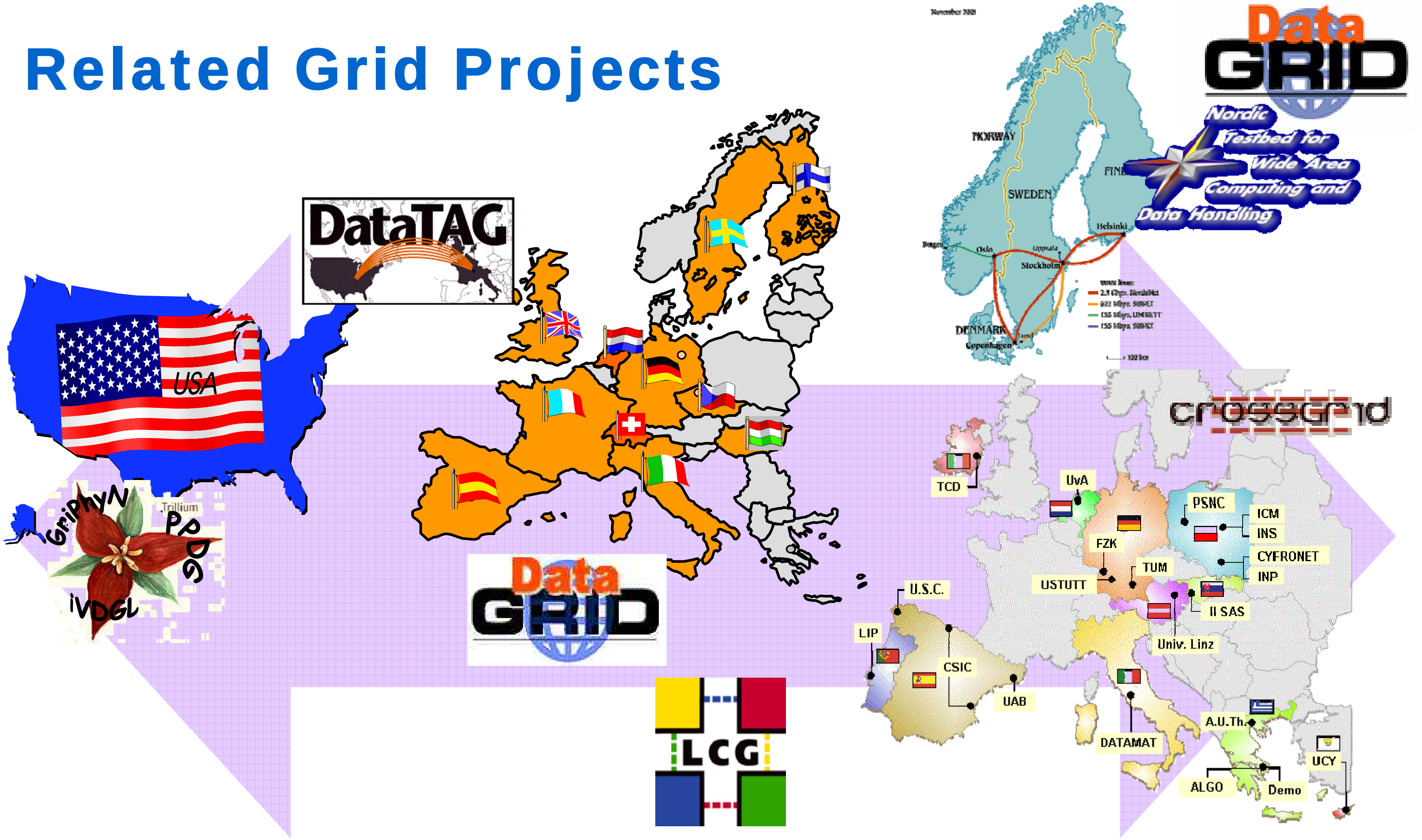
Tutorial will use 1.4 the first day

- Job submission
- Data management

2.0 will be used second day

- new job submission features
- new data mgmt features
- R-GMA

Related Grid Projects

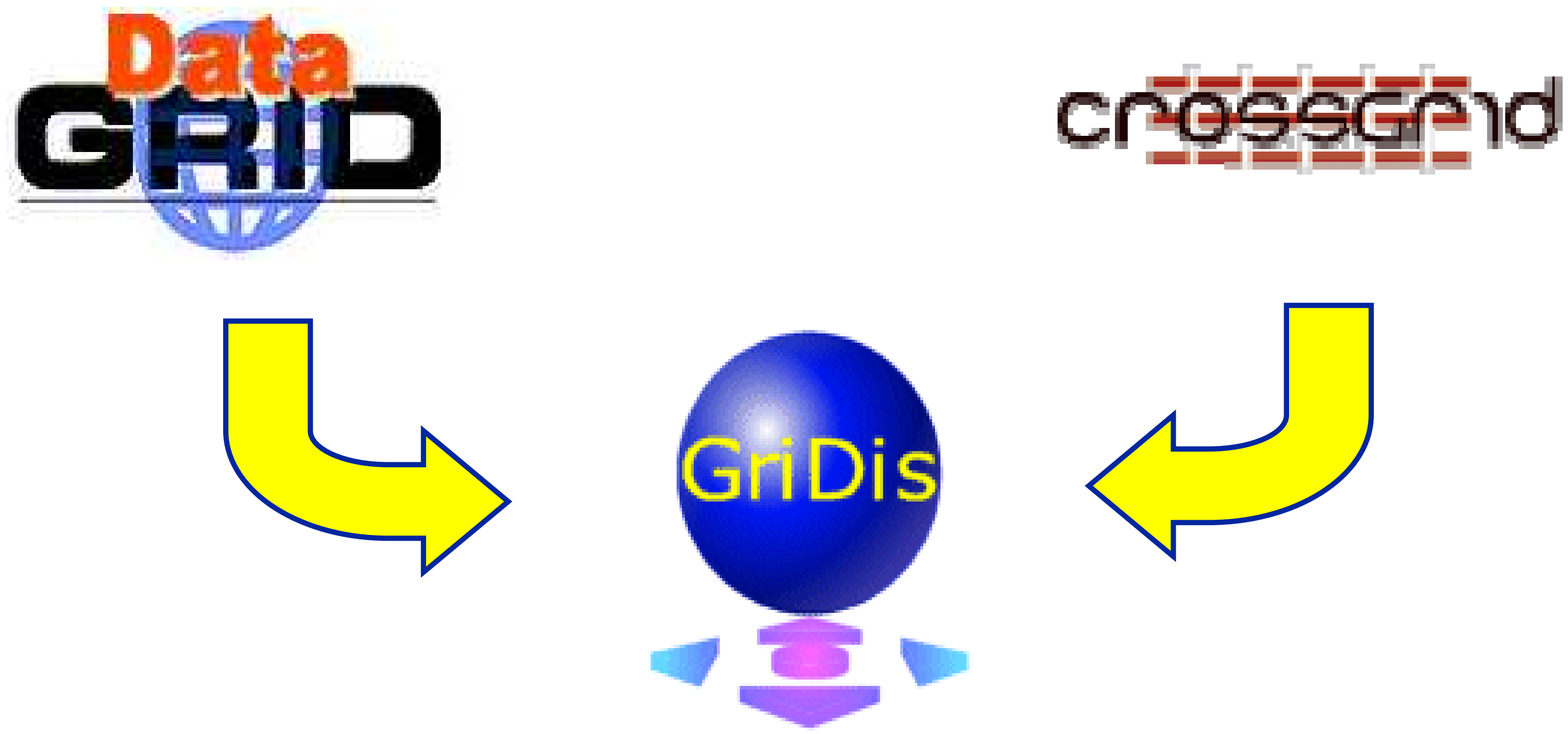


Through links with sister projects, there is the potential for a truly global scientific applications grid

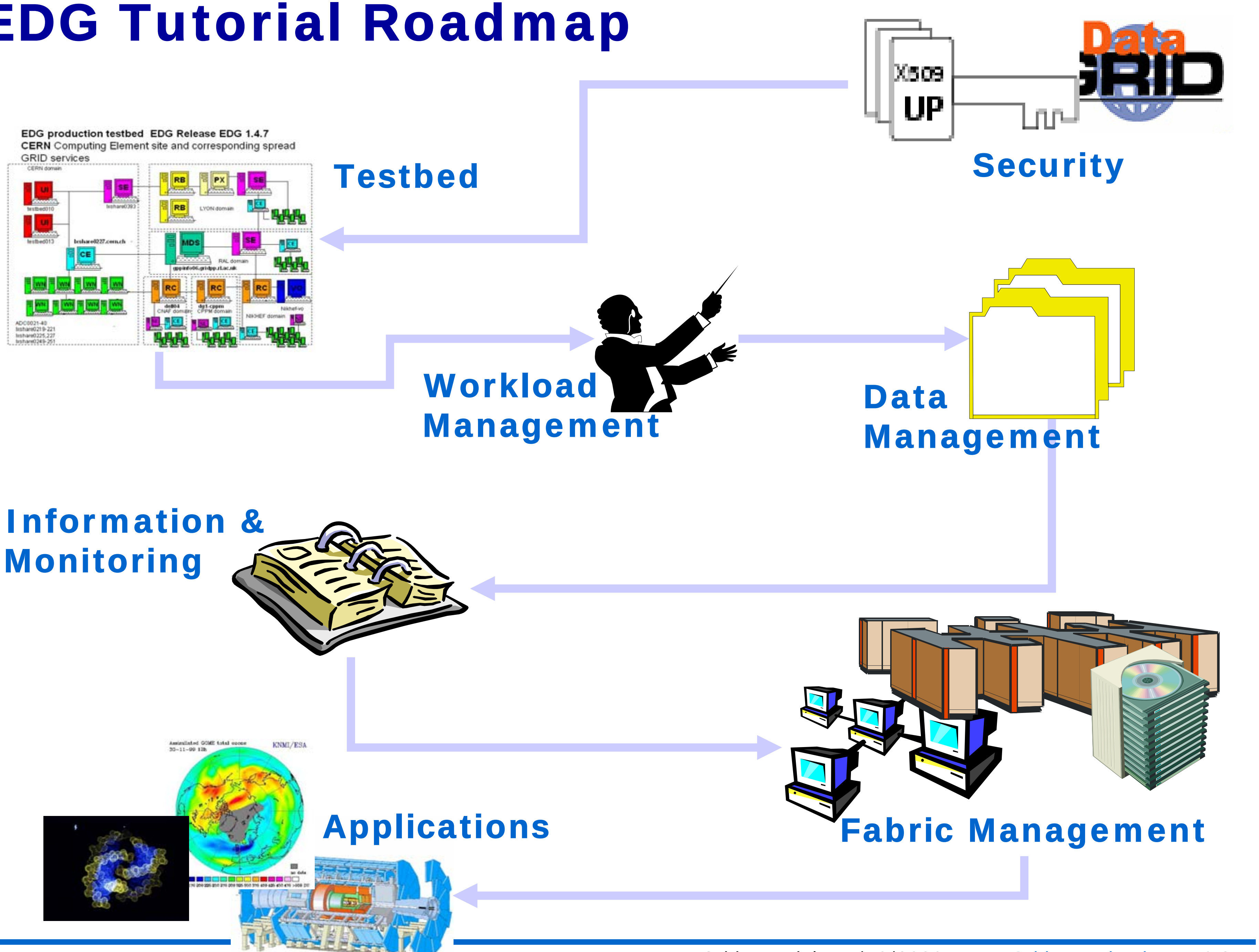
Demonstrated at IST2002 and SC2002 in November

Tutorial Testbed

- EDG dissemination testbed (GriDis)
- Resources from EDG and Crossgrid



EDG Tutorial Roadmap



Testbed

Security

Workload Management

Data Management

Information & Monitoring

Fabric Management

Applications

EDG : reference web sites

- EDG web site
  - http://www.edg.org
- Source for all required software :
  - http://datagrid.in2p3.fr
- EDG testbed web site
  - http://marianne.in2p3.fr
- Dissemination Testbed (GriDis)
  - **http://web.datagrid.cnr.it/GriDis/GriDisWP1.html**
- EDG users guide
  - http://marianne.in2p3.fr/datagrid/documentation/EDG-Users-Guide.html
- EDG tutorials web site
  - http://cern.ch/edg-tutorials