INSTALLING AND OPERATING A GRID INFRASTRUCTURE AT DESY

Andreas Gellrich for the DESY IT Group * at CHEP2004, Interlaken, Switzerland

The Role of DESY in the Grid

DESY is one of the world-wide leading centers for research with particle accelerators and synchrotron light. The hadron-electron collider HERA houses 3 experiments which have been taking data for more than a decade and are planning to continue running until 2007.
The role of DESY for the HERA experiments is as Tier-0 and Tier-1 centre for data recording and production and as analysis centre. For the HERA-II program it is essential to use Grid resources at remote sites, starting with Monte Carlo production, where the applications are ready to use the Grid infrastructure. For the Hamburg University DESY is the footprint in the LHC Grid for CMS.
http://www.desy.de/

Grid Activities at DESY

DESY started Grid activities with the installation of an EDG1.4 based Grid testbed in 2003. In April 2004 a second Grid testbed was set up, exploiting LCG-2 middleware. As a consequence DESY joined a number of national and international Grid projects.
Since August 2004 a production-grade Grid is being operated using the most recent LCG-2_2_0 middleware version. The *DESY Production Grid* is part of the LCG TestZone. It supports the LCG VOs *'cms'* and *'dteam'* and supports and manages VOs for the DESY experiments and groups, among them: *'hone'* and *'zeus'* for the HERA experiments H1 and ZEUS, *'ildg'* for the LatticeQCD community, and *'ilc'* for the international linear collider detector groups.
http://grid.desy.de/

Grid Projects at DESY

EGEE@DESY

DESY is participating in the EU-project *Enabling E-SciencE (EGEE) and is member of the* German/Switzerland federation.
EGEE started on April 1st, 2004 for a first two-year period of a four-year programme. It aims on building a Grid infrastructure in Europe which is made available to scientists of various areas. Two pilot application domains have been selected. One is HEP with LCG in particular. DESY participates in the Service Area (SA1) and will bring in its experience and know-how in computing infrastructure with elaborated data management and analysis functionality.

http://www.eu-egee.org/

D-GRID@DESY

DESY is a founding member of the German D-GRID initiative.
The D-GRID project will start on January 1st, 2005. Exploiting the experiences and know-how in data management, DESY will play a leading role in the *HEP-Community Projects* as well as in the *Integration Project*.
For the HEP-community DESY manages and supports a German-wide catch-all VO and provides core services. It is planned to organize the universities and institutes in a German Grid for High Energy Physics (GHEP) and set up a Virtual Organization *'ghep'* for this purpose.

http://d-grid.de/

ILDG@DESY

The International Lattice DataGrid (ILDG) was started with the aim of making gauge field configurations available to an international group of scientists using Grid technologies. Each configuration submitted to ILDG will consist of a set of meta-data and a set of binary files.
In the context of the German *Lattice Forum* (LATFOR), DESY is setting up a Data Grid testbed, exploiting the DESY Grid infrastructure, in particular the catalog services.

http://www-zeuthen.desy.de/latfor/
http://www.lqcd.org/ildg/

LCG@DESY

The Experimental Physics Institute of the U Hamburg, located on the DESY site, participates in the CMS Collaboration at the Large Hadron Collider (LHC) at CERN. DESY supports the U Hamburg in installing and operating a Grid infrastructure for the LHC Computing Grid (LCG).
The CMS Grid activities are incorporated in the LCG-2 based Grid infrastructure at DESY. The DESY Grid computing resources, including computers of the U Hamburg, are part of the LCG TestZone.

http://cern.ch/lcg/

Grid Infrastructure at DESY

Grid Infrastructure

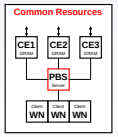
The Grid Infrastructure at DESY is based on the most recent LCG-2 middleware, currently LCG-2_2_0. It contains all elements to make up a complete Grid, including a Resource Broker (RB) with Information Index (BDII) and Proxy Server (PXY), catalog services such as a Local Replica Catalog (LRC) and a Meta Data Catalog (MDC), the management of Virtual Organizations (VO), User Interfaces (UI), Computing Elements (CE) with Worker Nodes (WN), and a dCache-bases Storage Element (SE) as a back-end to the mass storage facilities. DESY has a 1Gbit/s WAN connection.

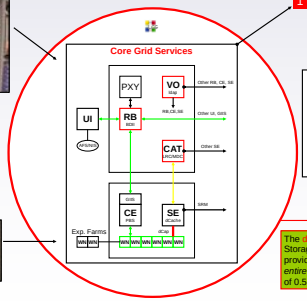
Operational Aspects

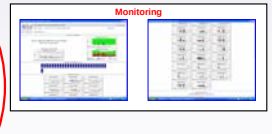
The installation and operation of a Grid infrastructure in a global context puts special demands to institution in charge. Due to the global dependencies and the outside visibility, a new level of quality in providing services must be achieved. But also within an institution the circumstances change, since traditionally independent experimental groups start to share services and resources locally and globally.
In addition to the well-known core Grid services, the following aspects must be considered:

- Installation services (LCFGng)
- AFS and NIS/YP on the UIs
- Ganglia/Nagios for monitoring
- Backup for mission critical components
- Around the clock services

The concept of incorporating computing resources of the various groups into a common homogenous system can be realized by way of separate CEs which submit jobs to a central batch (PBS) server.







The dCache-based Storage Element (SE) provides access to the *entire* DESY data space of 0.5 PB

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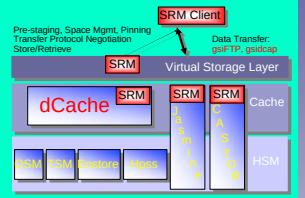
Grid Developments at DESY

Components

dCache

The goal of the dCache project, a joint effort between DESY and FermiLab, is to provide a system for storing and retrieving huge amounts of data, distributed among a large number of heterogeneous server nodes, under a single virtual file system tree with a variety of standard access methods. Depending on the Persistency Model, dCache provides methods for exchanging data with backend (tertiary) Storage Systems as well as space management, pool attraction, dataset replication, hot spot determination and recovery from disk or node failures. Connected to a tertiary storage system, the cache simulates unlimited direct access storage space. Data exchanges to and from the underlying HSM are performed automatically and invisibly to the user. File system namespace operations may be performed through a standard *nfs(2)* interface.
http://www.dcache.org/

Storage System Abstraction



Grid Applications at DESY

The H1 Collaboration

H1 is currently incorporating their various MC production sites outside DESY into a common Grid framework.

Monte Carlo Production at DESY

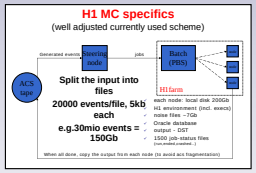
The HERA experiments H1 and ZEUS started to adapt their *Monte Carlo* production schemes to the Grid. The DESY Grid infrastructure supports the Virtual Organizations (VO) *'hone'* and *'zeus'* which are also supported by other collaborators world-wide. Other collaborations and groups will follow. The physics output of HERA-II is the driving force for an increasing demand for MC production. While the paradigms of resource sharing are changing, Grid technologies are applied to account for the demand.

The ZEUS Collaboration

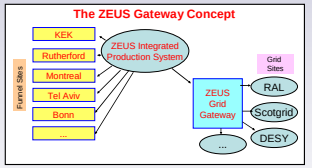
ZEUS has been using a tool called *Funnel* for a decade now to use idle CPU cycles in their partner institutes. Their so-called ZEUS Gateway Concept is now being adapted to the Grid. Approximately 1% of the overall Monte Carlo production is currently carried out using Grid resources, but the fraction is constantly growing as more and more partners apply Grid technologies.
Using the DESY Production Grid with the connected partners a few hundred thousand MC events have already been produced.

H1 MC specifics

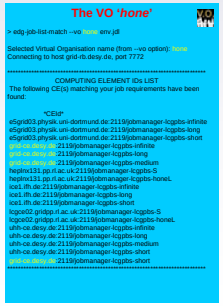
(well adjusted currently used scheme)



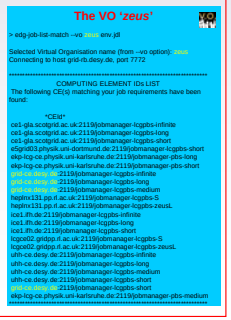
The ZEUS Gateway Concept



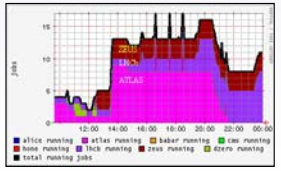
The VO *'hone'*



The VO *'zeus'*



Runnning jobs RAL on September 21st, 2004.
The jobs of the VO *'zeus'* consume roughly a quarter of the computing resources and co-exist with the LHC VOs *'atlas'* and *'lhcb'*.
RAL is one of the first ZEUS collaborators to support the DESY VOs *'hone'* and *'zeus'* in addition to the LHC VOs.



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