GRIDPP – AN OPERATIONAL GRID

Dr D. J. Colling (Imperial College), on behalf of the GridPP Collaboration

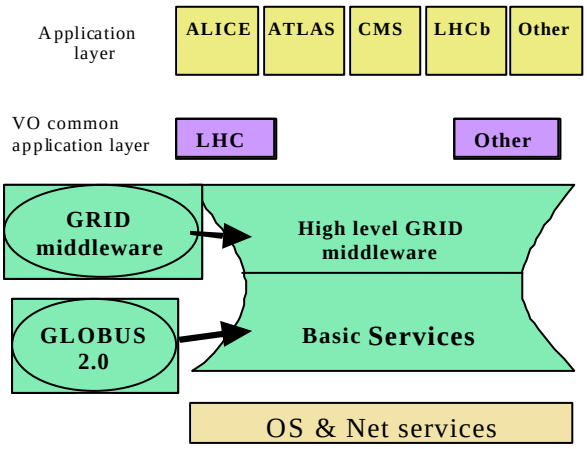
Key words to describe the work: EU DataGrid, SAM, Particle Physics, HEP, Job Submission, Data management.

Key Results: Contributions to EU DataGrid and US-based (SAM) middleware. Rapid deployment of a testbed within the UK using EU DataGrid tools. Adaptation and interfaces to a range of particle physics applications.

Motivation (problems addressed): LHC Computing Challenge and the requirements of existing US-based particle physics experiments to harness distributed CPU and storage on an unprecedented scale.

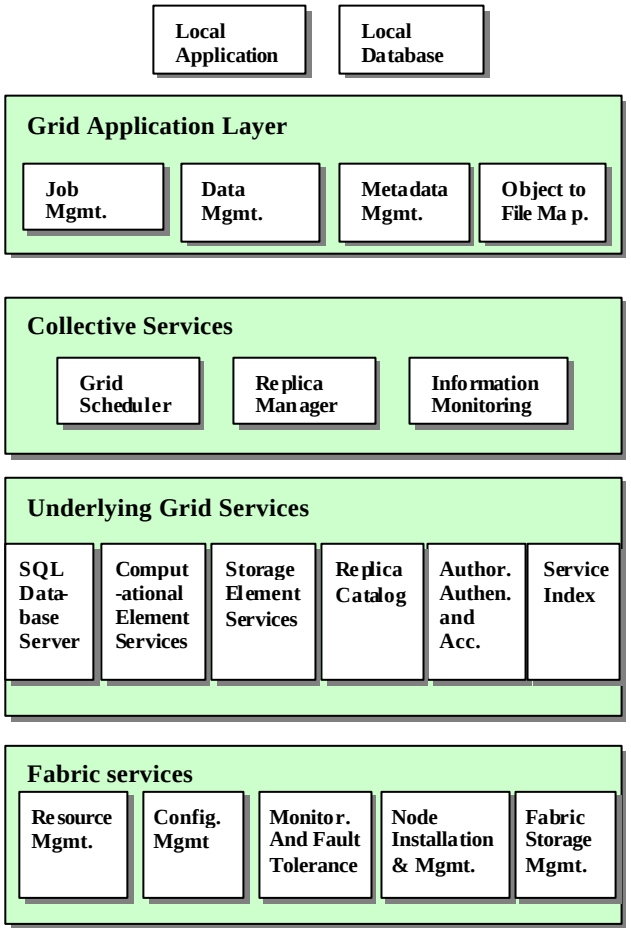
UK Physicists are currently preparing for the turn on of the Large Hadron Collider [1] (LHC) at CERN [2] in 2007 that will produce an enormous stream of data (millions of GigaBytes per year) to be stored and processed (using up to one hundred thousand processors). No single computer centre will be able to provide these resources and the distribution of computation and data via the Grid are essential. The UK expects to play a major role in the analysis of data from the LHC and the exciting discoveries that are anticipated. At present, simulated data are required to understand the problems of triggering, detector performance and data reconstruction. The volume of simulated data required is large and provides an immediate requirement for Grid-like computing. In addition, currently running the US-based experiments are producing increasingly large amounts of data that already start to challenge traditional computing paradigms. To address these immediate and future needs, GridPP is developing an operational Grid; a Grid that must function incrementally as it develops to address the current needs of the HEP community. GridPP works both within the EDG [3] framework and with tools developed in the US.

The EDG architecture is based on that proposed by Ian Foster and Carl Kesselman with a reduced number of implemented services:



Schematic EDG architecture: The GLOBUS hourglass

Sixteen services have been implemented by the middleware developers, based on original coding for some services and on the usage of the Globus-2 [4] toolkit for basic Grid infrastructure services: authentication (GSI), secure file transfer (GridFTP), information systems (MDS), job submission (GRAM) and the Globus Replica Catalogue. In addition the job submission system uses software from the Condor-G [5] project. The middleware also relies on general open source software such as OpenLDAP.

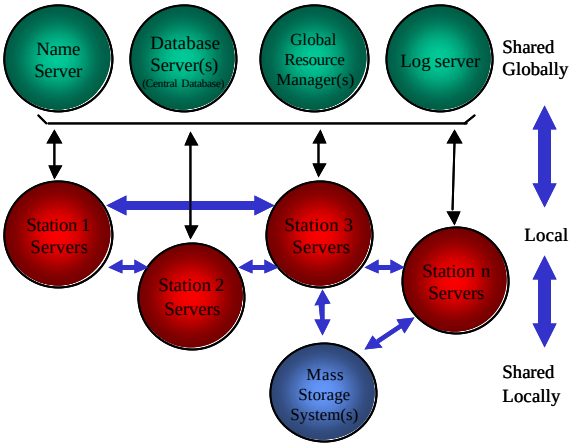


The multi-layered EDG GRID architecture

EDG middleware development is divided into six functional areas: Workload management, data management, Grid monitoring and information systems, fabric management, mass storage, and network monitoring. A number of key elements are operational in the UK and have been tested and, indeed, used in anger by the BaBar and UKDMC experiments and by the QCDGRID project. The CMS experiment has also used some components and hopes to have production quality applications soon that make full use of these Grid tools. In particular, at least in rudimentary form, the following elements are operational in the UK:

- **User Interface** (UI): This is the access point where a Grid-user defines a job using a Job Description Language (JDL) that specifies input data files, the code, the software environment and the outputs. The user also specifies the way in which the broker chooses the resources. Graphical interfaces are being developed.
- **Resource Broker** (RB): Currently running at ICSTM and serving the UK community, the RB performs the match-making between the requirements of the job and the available resources, and attempts to schedule the job in an optimal way. Ultimately, it will query a replica catalogue to find the physical location of particular files and the scheduling and match-making algorithms employed by the RB will determine the ultimate efficiency of the Grid.
- **Job Submission System** (JSS): This is a wrapper for Condor-G, interfacing the Grid to the local batch systems such as PBS, LSF or BQS. Condor-G is a joint Condor-Globus project that combines the inter-domain resource management protocols of the Globus toolkit with the intra-domain resource and job management methods of Condor.
- **Replica Catalogue** (RC): The replica catalogue translates logical file names to one or more physical file names (if duplicate exist). Currently running at Bristol to serve the UK community, it is implemented using Globus software by means of a single LDAP server. A more distributed system may be developed in the future that will decouple the transport protocol, query mechanism, and database technology to allow maximum flexibility.
- **GDMP**: This client-server software system is a generic file replication tool that replicates files securely and efficiently from one site to another using several Globus tools. In addition, it manages replica catalogue entries associated with its operations.

In addition to the EDG work, GridPP is contributing to the development of the SAM system developed by



The Distributed SAM System

the D0 experiment and recently adopted by the CDF experiment at Fermilab, Chicago. The SAM system is Grid-like in many respects and has been recently interfaced to Condor in the UK. Key developments in the future are designed to make it truly Grid-like by including the ability to move jobs to the data in addition to the current philosophy of moving the data to the job.

1. The Large Hadron Collider: http://user.web.cern.ch/user/Index/LHC.html
2. CERN Laboratory: http://www.cern.ch
3. DataGrid: http://eu-datagrid.web.cern.ch/eu-datagrid
4. Globus: http://www.globus.org
5. Condor: http://www.cs.wisc.edu/condor/