Grid Tests and Developments

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The DataGrid project

The computing model for the storage, management, simulation, reconstruction, distribution, and analysis of the data of the four LHC experiments (ALICE, ATLAS, CMS, and LHCb) consists of two key elements[1]:

- A multi-tier hierarchical model of regional centres developed by the MONARC (Models of Networked Analysis at Regional Centres for LHC experiments) group [2].
- Grid[3] software will be used as flexible middleware for the secure, coordinated access to the resources distributed worldwide.

After an about one year preparation phase, the EU funded DataGrid project[4] started in January 2001: A three year development and test phase to demonstrate the feasibility of the grid approach to the LHC computing challenge. The major development projects are:

- Data grid services to provide workload management, scheduling, and data movement as well as monitoring services across institutional boundaries.
- Fabric management including network infrastructure, cluster and mass storage management.
- A production quality test bed using scientific applications from high energy physics, earth observation, and biology.

Globus Installation

To explore grid tools and to be ready to use the first test bed of the DataGrid project, release 1.1.3 of the Globus Toolkit[5] has been installed on the central Linux and AIX clusters of GSI. Globus offers the basic protocols, services, and APIs (application programmer interfaces) to use geographically and organizationally dispersed computing resources:

- GRAM: The Globus Resource Allocation Manager. It units grid machines, providing a common user interface to the different batch systems.
- GIS: The Grid Information Service. It provides a common interface to discover the properties of grid resources.
- GSI: The Grid Security Infrastructure, a library for providing generic security services for applications that will be run on the grid.

Users on all central Linux and AIX machines at GSI can use the Globus services to submit processes to other grid sites. The main advantage is a single worldwide Globus user id. A test machine has been configured as gatekeeper to our local batch system LSF.

A major computational challenge for the ALICE collaboration during 2001 will be the simulation for the physics performance report. After successful explorations between different centres, it is planed to use Globus tools for parts of these massive productions.

ROOT and Grid

AliRoot, the ALICE off-line framework for simulation, reconstruction, and analysis is built on ROOT[6], a set of OO frameworks widely used in high energy and nuclear physics to build data acquisition, simulation, and analysis systems. The main features of ROOT are:

- The ability to handle and analyse large amounts of data in an efficient way.
- The built-in CINT C++ interpreter, which allows for a fast prototyping, since the command language, scripting language, and the implementation language are all C++.
- A rich set of classes including histogramming, fitting, and visualization.

To build the basic infrastructure for one of the long term use cases of ALICE - interactive distributed analysis on the grid – we started to interface two Globus APIs to ROOT.

PROOF, the Parallel ROOT Facility, allows to send work via wide area networks to a master server which distributes it to slave servers, collects the results, and sends the results back to the client. A prototype of using the grid security infrastructure to authenticate the client to the servers has been developed. It will be put into the ROOT distribution soon. The same mechanism can be used for remote file access via TNetFile and rootd or for the coming TFtp class.

Wide area distributed analysis requires careful selection of the resources used, based on available CPUs, network bandwidth, and load as well as data location. Neither manual configuration nor defaults are acceptable. Manual configuration requires deep knowledge of the remote system that an average user does not posses. Even the best defaults cannot fit to the ever changing resources. Decisions should be made at run-time based on the structure and state of the computing environment as well as the needed resources. Therefore the second Globus API we want to use in ROOT is the grid information service. The basic protocol for this information service is LDAP (Lightweight Directory Access Protocol)[7]. We developed a small C++ layer on top of the LDAP C API. The next step is to integrate it in ROOT along the lines of the SQL interface classes.

References

[1] Report of the Steering Group of the LHC Computing Review, CERN/LHCC/2001-004.

[2] MONARC Phase 2 report, CERN/LCB/2000-001.

[3] Ian Forster, Carl Kesselman, Steven Tuecke: The Anatomy of the Grid, Enabling Scalable Virtual Organizations, to appear: Int. J. Supercomputer Applications, 2001.

[4] http://www.datagrid.cnr.it/.

[5] Ian Foster, Carl Kesselman, Globus: A Toolkit-Based Grid Architecture. In: Ian Forster, Carl Kesselman (Eds), The GRID: Blueprint for a new Computing Infrastructure, (1999) pages 259-278. See also http://www.globus.org.

[6] Rene Brun and Fons Rademakers, *ROOT - An Object Oriented Data Analysis Framework*, NIM A389 (1997) 81-86. See also http://root.cern.ch/.

[7] RFC 1823: The LDAP Application Programming Interface.