

First Prototype of the CrossGrid Testbed

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The CrossGrid international distributed testbed will share resources across fifteen European sites, to run interactive applications, and is one of the challenging points of the CrossGrid project.

The sites list ranges from relatively small computing facilities in universities, to large computing centers, so offering an ideal mixture to test the possibilities of the Grid framework. National research networks and the high-performance European network, Géant, will assure the interconnectivity of all sites.

The figure 1 below shows the geographical map for the different nodes, including the major "network" links. This includes usually three steps: the local step (typically inside a University or Research Center, via Fast or Gigabit Ethernet), the jump via the national network provider (at speeds that will range from 34 Mbits/s to 622 Mbits/s or even Gigabit) to the national node, and finally the link to the Geant network (155 Mbits/s to 2.5 Gbits/s).

The CrossGrid testbed largely benefits from the DataGrid experience on testbed setup: since the CrossGrid middleware is being developed it was decided that the initial testbed middleware would have to be based entirely in DataGrid (EDG) and Globus middleware distributions. The efforts to establish an inte-

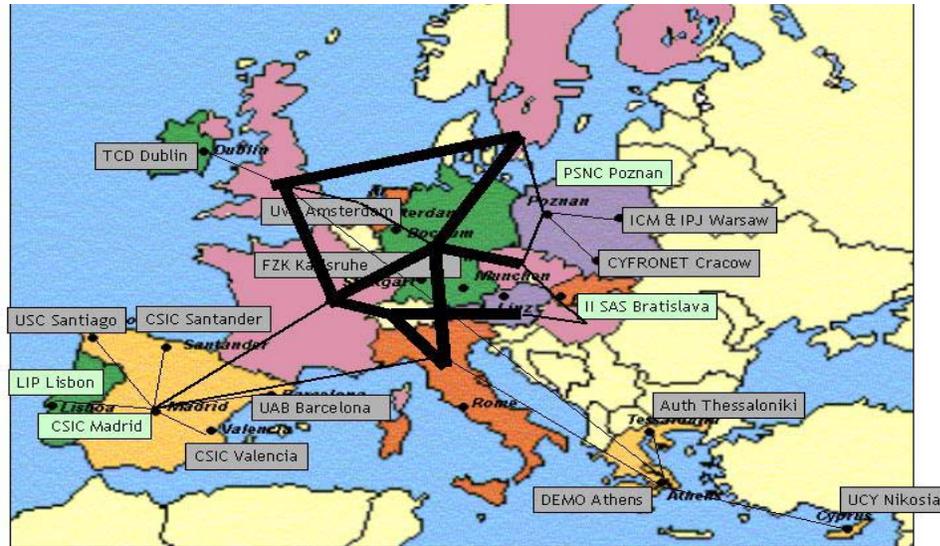


Fig. 1. CrossGrid testbed map.

grated CrossGrid testbed started with the release of EDG 1.2, however several problems were found in the first installed sites. The EDG release 1.2.2 with improved stability has allowed more sites to join in spite of some serious middleware limitations. Currently EDG 1.2.2 and 1.2.3 is deployed and new version 1.4.0 is being tested at several sites; it is expected that it will overcome many of the major limitations of the previous versions and will allow the interconnection of both CrossGrid and DataGrid testbeds.

At least 16 sites are foreseen to be included in the CrossGrid testbed, this number may be increased with the addition of more sites interested in the technologies and applications being developed by CrossGrid, and with the addition of more sites belonging to CrossGrid partners. These 16 sites are being deployed and registered into the CrossGrid Resource Broker (RB).

According with the CrossGrid testbed architecture and minimum hardware requirements each site must have at least five system components:

Gatekeeper: is the system that provides the gateway through which Jobs are submitted to local farm nodes.

Worker Node (WN): is a local farm-computing node where jobs are actually executed. Jobs arrive to the WN through the local batch scheduling system. Many worker nodes can exist behind a single Gatekeeper.

Storage Element (SE): is the generic name for any storage resource that includes a Grid interface ranging from large Hierarchical Storage Management Systems to disk pools.

User Interface (UI): is used by end-users to submit jobs to the grid testbed through the resource broker.

LCFG installation server: is used to install, configure and maintain the above systems from a single management system. The installation server is required for the proper installation of the EDG middleware.

Although we talk about a generic CrossGrid testbed, in fact several “testbeds” will co-exist to support different efforts, from pure development, to production after validation:

Development testbed: new middleware or application software development will require a dedicated small but well maintained testbed, to allow its test in a Grid aware framework. The testbed setup will include a dedicated minimal configuration, and the flexibility to adapt to the required changes in the external software packages (like for example migrating from Globus 2.0 to Globus 3, or from RH6.2 to RH7.2, etc).

Test and Validation testbed: each new software release will require a complete test process. The dedicated testbed supports this effort, and is be offered by LIP, FZK, CSIC(IFIC), USC(CESGA) and DEMO.

Finally the **Production testbed** will be used to run the applications, showing the Grid potential. It will be extended over all testbed sites: CYFRONET, ICM, INS, UvA, IISAS, FZK, PSNC, UCY, TCD, CSIC, UAB, USC, DEMO, AUTH, and LIP.

The current “test and validation” testbed for CrossGrid, managed by the LIP group, has been very successful: external sites resources have been included in the corresponding Resource Broker and users joined to the Virtual Organizations. Jobs have been successfully submitted through User Interface nodes at each testbed site.

Basic tests covering the Globus and EDG middleware functionalities have been performed using the testbed. These tests cover the job submission through Globus, job submission through the EDG RB, file transfer with GSI ftp, file replication with GDMP, file replication with the Replica Manager, the VO server and the MDS information system.

Three CrossGrid sites (FZK, IFIC and LIP) have participated at the IST 2002 demonstration event showing the interoperation of the CrossGrid sites with other testbeds. During the demonstration several jobs have been successfully executed in the three participating CrossGrid sites.

In addition the first tests with MPI in the testbed have been performed. Since the EDG RB doesn’t support parallel applications the program executions have been performed using the Globus job submission capabilities directly. The MPI package used for the tests was MPICH-G2 a variant of the MPICH implementation using Globus IO for inter-process communication and Globus DUROC for resource co-allocation. In the same context tests were performed on how to start the parallel applications. MPICH provides its own program start-up command named `mpirun`, the MPICH-G2 `mpirun` command has some limitations.

At the same time, first CrossGrid software prototypes are being developed. A prototype of the HEP application has been released, requiring MPI and very low latency. Tests aiming to validate the prototype architecture and the testbed middleware with a real CrossGrid application are being conducted in the testbed.

The basic collaborative tools are the WP4 web pages (that can be found at <http://grid.ifca.unican.es/crossgrid/wp4>) and the videoconference system VRVS (<http://vrvs.org>): thanks to it, coordination meetings take place regularly with the participation of all sites (14 meetings in 9 months). Web pages containing information about the central testbed services are available at the LIP web server. The main link for these pages is <http://www.lip.pt/computing/cg-services>. These web pages also contain pointers to usage statistics and information on how to configure the testbed sites to use the central services. Useful information on how to diagnose problems and a list of common configuration problems is also provided. The pages are both a central place to find updated information about the testbed and a first level user support tool where users can cross check their site configurations and obtain helpful hints on how to solve common problems.

One of the most important central services is the Virtual Organizations server that contains the CrossGrid VO. To use the CrossGrid VO for authentication configuration changes have to be made in all testbed systems. The support for VO site configuration is provided through the central services web pages at <http://www.lip.pt/computing/cg-services>. Users wishing to join the CrossGrid VO send their request by Email with an explanation of their participation in the project and containing the X.509 user certificate.

Users and site administrators can obtain information about the testbed status from the mapcenter web pages available at <http://mapcenter.lip.pt>. Mapcenter is an important tool for testbed support since it provides quick global view of the testbed status and also historical data can be used to identify the origin of problems occurred in the past. The mapcenter web pages are extremely important for site administrators since they allow them to check the site services connectivity.

Regarding the software repository, the Savannah software package has been installed on <http://gridportal.fzk.de>. It is a web-portal-application based on a MySQL database and php/perl scripts based on Sourceforge. It provides the central software download repository for CrossGrid. Furthermore Mailinglist-Forums, BugTrackers and CVS services are offered for developer and user communication.

The User Help Desk is the main tool of the User Support Team and this specific development has been done taking into account the guidelines for the unification of the DataGrid and the CrossGrid Helpdesk. User Help Desk infrastructure allows all CrossGrid testbed users to get support for encountered problems or questions and access to the CrossGrid user documentation. A user could be a scientist using the CrossGrid or a local system administrator of a CrossGrid testbed site. Users can ask all kind of questions related to the CrossGrid Testbed; i.e. certificate, installation questions, network security, resource broker, etc. The Help Desk Database administrator takes care of the utility and will control the efficiency of the method trying to improve it if it is possible. The CrossGrid HelpDesk is a Web based helpdesk system incorporating PHP, Javascript and MySQL, customized from the OneOrZero initiative.