

Multi-Purpose Network of Distributed Computing “Dubna-Grid”¹

A.N. Antonov², D.V. Belyakov¹, D.V. Chkhaberidze¹, E.N. Cheremisina²,
D.C. Golub¹, S.N. Dobromyslov³, A.G. Dolbilov¹, V.V. Ivanov¹,
Val.V. Ivanov¹, L.A. Kalmikova¹, V.V. Korenkov¹, Yu.A. Kryukov²,
V.V. Mitsyn¹, L.A. Popov¹, A.A. Rats³, E.B. Ryabov³, Yu.S. Smirnov^{1,4},
O.G. Smirnova⁵, T.A. Strizh¹, P.V. Zrelov¹

¹ *Laboratory of Information Technologies,
Joint Institute for Nuclear Research, 141980, Dubna, Russia*

² *University “DUBNA”, 141980, Dubna, Russia*

³ *Administration of Dubna, 141980, Dubna, Russia*

⁴ *Chicago University, USA*

⁵ *Lund University, Sweden*

1. Introduction

The “Dubna-Grid” Project [1] is aimed at the creation of a distributed meta-computing environment on the basis of vacant computing resources of “office” computers. The project foresees creation of a common pool of accessible nodes of more than 1000 units. The Project is based on an Agreement between Administration of Dubna, Joint Institute for Nuclear Research and University “Dubna” for creation of a city-wide multi-purpose new generation informational infrastructure based on the Grid technologies.

2. The aims of the Project

Implementation of the project will allow one:

- to create a consolidated computing environment (meta-cluster) of the city of Dubna on the basis of the resources of scientific, research and educational institutions, in particular, JINR subdivisions, University “Dubna”, secondary schools and other organizations concerned;
- to create a segment of the international Grid infrastructure, operating in frames of various Grid systems (LGG/EGEE, NorduGrid and OSG);
- to perform research in the areas of control, security and stability within the Grid environment;
- to provide execution of large-scale computing tasks of JINR and other enterprises of Dubna scientific-industrial complex and other organizations concerned;
- to share experience in creation of a city segment of the Grid infrastructure in order to create similar systems in other Russian cities.

3. Motivation of the participants

- The Joint Institute for Nuclear Research is interested to attract additional computing resources in order to conduct research work in frames of both the current experiments and the experiments that are being prepared at the LHC accelerator at CERN – ATLAS, ALICE, CMS.

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- The University “Dubna” has an extensive program of the development of the educational process and the training of specialists for work with advanced information technologies. In addition, the University is interested in developing a scientific-research program with participation of students and post-graduates of both the university “Dubna” and the JINR University Center on the issues related to information technologies.
- The city of Dubna as a City of Science, is interested in creation of informational-computational infrastructure for high-technology production and scientific research as well as using the information technologies for solving tasks in various spheres of the city life.

4. Responsibility and basic arrangements

The regulation of the activities of the parties participating in the Project requires taking into account their specific nature:

1. Administration of the city of Dubna: provides an informational-educational network with a total number of computers of almost 500 units (shared with the original owners); provides a municipal data link; modernizes the computers operating within the Project; takes part in funding the creation of the 1 Gbps Internet communication link Moscow-Dubna.
2. Joint Institute for Nuclear Research: develops and sets up a test-bed: the infrastructure that allows studies of scaling and replication; provides certification (obtaining host certificates for the equipment and personal certificates for the main performers of the work) for work in the international Grid systems; installs various Grid systems on the test-bed sites; establishes a united Grid laboratory for research in the field of Grid technologies and organization of training specialists of the corresponding profile; purchases equipment required for creation of a managing servers pool; sets up the 1 Gbps Moscow-Dubna data link.
3. University “Dubna”: provides creation of a server center for the maintenance of the University segment of the Grid infrastructure; provides 500 computers from the University network (shared with the original owners); takes part in developing the Grid technologies course and in training specialists in the framework of the joint Grid laboratory; develops new information-retrieval systems based on the Grid technologies for electronic libraries of Dubna and Moscow region.

5. Project resources

The creation of the Grid-segment is realized on the basis of the available network, information and computing resources of the city of Dubna and other scientific and educational institutions.

5.1 Network resources

- 100 Mbps JINR-University channel.
- 100 Mbps University-schools channels.
- Bridges and gates in the University and the city network structure.

5.2 Hardware resources

- Server for maintenance of the meta-cluster infrastructure.

- Program bridge (server) for separation of the networks of the Project “Dubna-Grid”, schools and classes of the University.
- Computing nodes (146 units at the moment) in the computer classes of the University and city schools.

5.3 Software resources

- OS “Scientific Linux CERN”, current version – on servers and virtual machines of the computing nodes.
- Software for support of the virtual machines.
- Cluster environment – a modified variant of “Warewulf Cluster Toolkit”, current version – 2.2.3.
- Grid Software (has not been installed yet).

5.4 Web resources

- Web-site of the Project can be found at <http://dubna-grid.jinr.ru>. It contains sections with common information about the Project, a frequently updated news section and information about the partners.
- Monitoring system has been developed, and the information on the current state of the meta-cluster Dubna-Grid is available at <http://dgrsrv.jinr.ru/ganglia/>.

6. Grid laboratory

The test complex is created in the framework of the joint Grid laboratory organized at LIT JINR. The test-bed is required in order to stress-test automatic scaling capabilities of the cluster nodes, validate and test new versions of the software for nodes and servers of the meta-cluster, development of a system of measuring the meta-cluster performance. Main tasks of this test-bed are:

- Installation of software analogous to that installed in the computer classes of the city schools and in the University “Dubna” in the framework of the “Dubna-Grid” Project.
- Installation of software LCG and OSG and integration with the JINR University Center test infrastructure (NordGrid).
- Working out regulations on the structure and the rules of operating the Grid laboratory.
- Grid student laboratory.

7. Project parameters in 2007

Main parameters of the “Dubna-Grid” meta-cluster to be reached in the year 2007 are given below.

- Total performance of the city meta-cluster – 2 Teraflops.
- A number of the meta-cluster nodes – 1500 units.
- Length of the city network highway – 32 km.
- Total memory on hard disks – 30 Tbytes (server disk array), 30 Tbytes (distributed disk array).
- RAM of one Grid node – 1 Gbyte.

8. Current status

Current state of “Dubna-Grid” meta-cluster:

- 2 servers for the maintenance of meta-cluster infrastructure are installed;
- 146 PC have been configured;
- the software of the meta-cluster has been debugged and tested using real computational tasks;
- the network infrastructure has been debugged and now it is maintaining successfully the virtual network of the meta-cluster;
- a system for the detailed monitoring of the most important parameters of the meta-cluster has been successfully installed; a project web-page has been created;
- maximal filling of the cluster is 40 PC;
- for the debugging of new components of the main meta-cluster, a test-bed is being created at LIT JINR.

9. Project Milestones

- installation of a pool of computing nodes which are under a unified administration in the common address space;
- development of technologies on realization of a separate administration of office computers and nodes of the Grid infrastructure on the basis of virtual machines;
- creation of a meta-cluster prototype integrating resources of various organizations;
- development of mass installation technologies and spreading software to all accessible nodes of the city infrastructure;
- installation of various Grid systems at the meta-cluster nodes and put these resources to the disposal of the users of other Grid projects such as LCG/EGEE, NorduGrid, OSG etc.;
- training of specialists in the field of Grid technologies, holding seminars, giving lectures and demonstrations.

References

- [1] P.V. Zrelov, V.V. Ivanov, Val.V. Ivanov, V.V. Korenkov, Yu.A. Kryukov, A.A. Rats A.A., E.B. Ryabov, Yu.S. Smirnov, O.G. Smirnova, T.A. Strizh: *Project “Dubna-Grid”*. In: Proc. of Int. conference “Distributed Computing and Grid-Technologies in Science and Education”, June 29 – July 2, 2004, Dubna, Russia, pp. 48 – 53 (in Russian).