

# JINR Participation in the LCG/WLCG and EGEE Projects

S.D. Belov, V.V. Galaktionov, V.V. Korenkov, N.A. Kutovsky, V.V. Mitsyn,  
D.A. Oleynik, T.A. Strizh, E.A. Tikhonenko, I.M. Tkachev, V.E. Zhiltsov

*Laboratory of Information Technologies, JINR*

**G.S. Shabratova**

*Veksler and Baldin Laboratory of High Energies, JINR*

The Joint Institute for Nuclear Research takes an active part in two large-scale worldwide grid projects: LHC Computing Grid (LCG) (since 2003) and Enabling Grids for E-science (EGEE) (since 2004) [1, 2].

The mission of the LHC Computing Grid Project [from 2005, the Worldwide LHC Computing Grid (WLCG)] is to build and maintain the data storage and analysis infrastructure for the entire high energy physics community that will use the LHC (<http://lcg.web.cern.ch/LCG/>) [3]. The modern grid technologies are the basis of the infrastructure building. The JINR staff members participate in three LHC experiments (ALICE, ATLAS and CMS) and it is very important to provide the proper conditions for the full-scale participation of the JINR physicists to the experiments at the LHC running phase. The JINR participates in the LCG project in accordance with the Protocol signed and adopted in 2003 by CERN, Russia and JINR. The following directions of the activities were defined:

- creation and support of the LCG infrastructure at the JINR;
- testing of various new grid software to be deployed in the LCG;
- evaluation of the grid technologies in the context of their usage in the LCG: in particular, the Globus toolkit (<http://www.globus.org/>) or grid software from the industry (<http://gridcafe.web.cern.ch/gridcafe/gridprojects/industry.html>);
- development and support of the Monte-Carlo generator repository and data base (*MCDB*) (<http://mcdm.cern.ch>);
- support and development of Castor system (*CERN Advanced STORAGE manager* <http://castor.web.cern.ch/castor/>);
- participation in ARDA project (*A Realization of Distributed Analysis for LHC* <http://lcg.web.cern.ch/LCG/activities/arda/arda.html>).

The EGEE project (<http://www.eu-egee.org>) has been conceived to provide a global infrastructure for the scientific activity, with financial support from the European Community. The JINR and a number of Russian institutes successfully participating in the EU DataGrid (<http://www.eu-datagrid.org>) and LCG projects have been invited by the European partners to join the EGEE project. The aim of the EGEE project is to gather all current national, regional and application grid developments into a common grid-infrastructure for the scientific research. The EGEE project infrastructure provides 24-hour a-day access to the most high-performance computing resources independently of their geographical location. The world-wide distributed scientific communities can use this infrastructure in accordance with the common access rules. Nowadays, the EGEE project brings together scientists and engineers from more than 240 institutions in 45 countries world-wide and the EGEE Grid consists of 41,000 CPU, about 5 PB (5 million Gigabytes) disk and tape MSS of storage and maintains 100,000 concurrent jobs. As the EGEE project started in fact with the LCG global infrastructure, the EGEE and LCG projects infrastructures are considered as a common LCG/EGEE infrastructure.

The JINR and Russian institutes participating in the EGEE project founded the Russian Data Intensive Grid consortium (RDIG) with the aim to jointly accomplish the works in the EGEE project, to develop the EGEE infrastructure in Russia and to involve other Russian organizations from different scientific, educational and industry spheres (see the RDIG consortium map in the Fig.1). The RDIG EGEE creation was fixed in an official document named the

Memorandum on grid infrastructure creation in Russia signed in the 2003 year by the directors of nine institutes, including the JINR. Now the RDIG EGEE is a part of the global LCG/EGEE infrastructure and its infrastructure comprises 15 Resource Centers with about 2000 CPU and more 650 TB of disk storage. During 2006-2007 year the JINR participated in the following EGEE activities: SA1 – grid infrastructure support, NA2 – dissemination and outreach [4], NA3 – training and induction [5], NA4 – application identification and support [6].

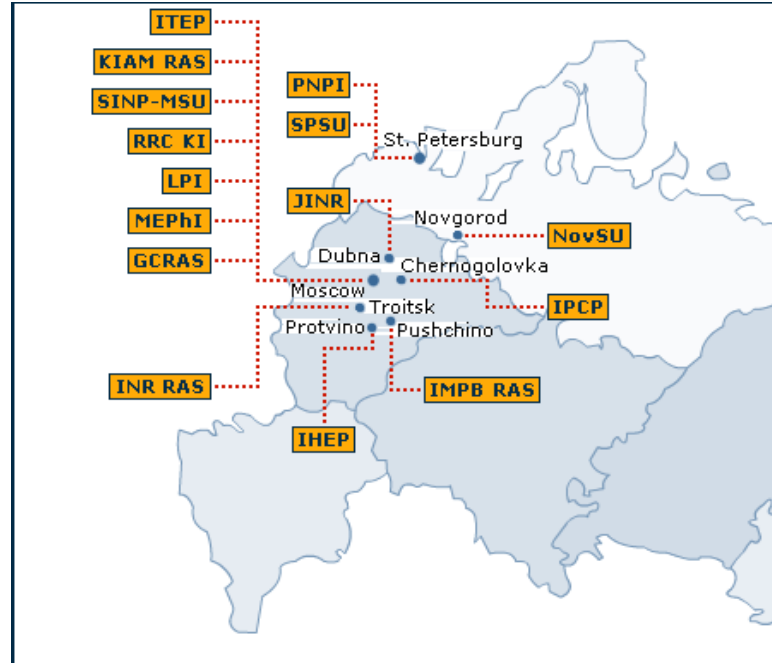


Fig. 1: Russian Data Intensive Grid Consortium

By the middle of the 2004 year, the creation of the LCG/EGEE infrastructure has reached the first noticeable results at the JINR. This infrastructure is a part of the JINR Central Information and Computing Center (CICC). To follow the requirements of the global grid projects, all the elements of the JINR telecommunication, network and information infrastructure should be provided at predefined target levels. Specifically, these concern the high-throughput telecommunication data links, the JINR local area network (LAN) backbone, the central computer complex and grid segment, the software support for the physical experiments using grid.

The JINR LCG/EGEE farm consists of a complex of special servers providing proper grid services and 250 computing nodes. In 2006, the migration from the LCG middleware environment to the gLite new generation middleware has been done (the current version is gLite-3.1.0) [7]. Also the Scientific Linux 3 operational system has been updated to Scientific Linux 4. Users can access the LCG/EGEE resources via the User Interface (UI) service installed at one of the interactive computers of the JINR CICC (*lxpub04.jinr.ru*). The following basic and special grid services are also provided at the JINR:

- Storage Element (SE) service (32 TB dCache disk storage, 20 machines);
- Computing Element (CE) service as grid batch queue enabling access for nine Virtual Organizations (VO) including ALICE, ATLAS, CMS, HONE (H1 experiment at DESY) with JINR scientists participation;
- Resource Broker service (RB);
- Information Service (BDII- Berkley DB Information Index);
- Proxy service (PX), the advanced service for access to the LCG/EGEE resources (MyProxy);
- Workload Management System + Logging&Bookkeeping Service (WMS+LB);
- RGMA-based monitoring system collector service (MON-box);

- LCG File Catalog (LFC) service;
- VO boxes special services for ALICE and CMS;
- BATCH server machine;
- NFS server for VO's software;
- NorduGrid monitor machine.

The software required for Virtual Organizations is currently installing at the JINR LCG site including dCache xrootd door, AliROOT, ROOT, GEANT packages for ALICE; ATLAS packages; CMSSW packages for CMS, DaVinci and Gauss packages for LHCb. A special server

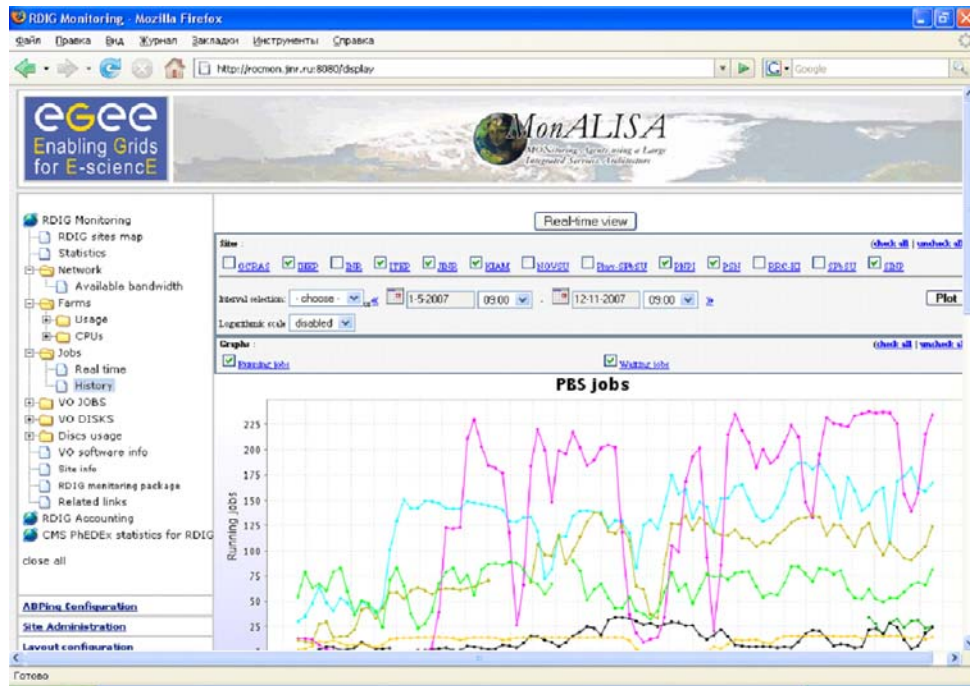


Fig. 2: Example of RDIG monitoring data visualization (<http://rocmon.jinr.ru:8080>)

has been installed and supported at the JINR to provide the RDIG LCG sites monitoring based on the MonALISA system [8]. The monitoring system developed several years ago was extended by the accounting system storing the data on resource utilization on the RDIG sites by virtual organizations and single users. The RDIG monitoring and accounting system is accessible at the <http://rocmon.jinr.ru:8080>. Monitoring is provided for CPU number (total, working, down, free, and busy), number of running and waiting jobs, storage space (used and available) and current state of network bandwidth (see Fig.2 with an instance of monitoring results) for each RDIG partners and for each VO registered at RDIG.

The accounting system provides information on the number of submitted jobs, total and normalized CPU time used, average time per job, waiting job time, average ratio waiting/used CPU time per job and other information (Fig. 3).

Also a special web-page on RDMS CMS PhEDEx transfer statistics has been developed (<http://rocmon.jinr.ru/scripts/phedex>) (see Fig.1 in [9]) with information on the data transfer rates and the amount of data transferred during different time periods (hours and days).

In the frames of the participation in the WLCG, EGEE and ARDA projects the following work has been done in cooperation with Russian and foreign colleagues:

- support and development of the JINR LCG-segment within the global LCG infrastructure;
- participation in Service and Data Challenges for CMS, ATLAS and ALICE [9,10,11];
- ALICE software support at 12 Russian LCG-sites;
- grid-monitoring and accounting system of Russian LCG/EGEE infrastructure;

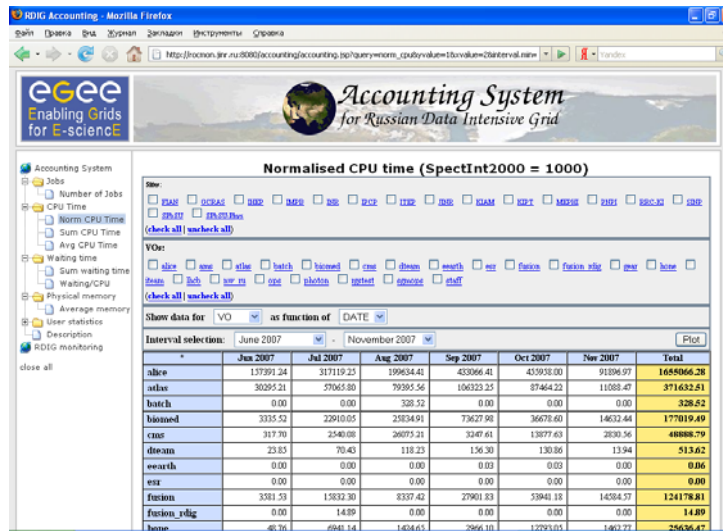


Fig. 3: Accounting System web-page for Normalized CPU time

- evaluation of new Grid technologies (Open Middleware Infrastructure Institute (OMII), Globus Toolkit 3&4);
- gLite middleware testing/evaluation – testing of gLite AMGA metadata service [12], Metadata catalog, Fireman catalog, gridFTP and VOMS (Virtual Organization Membership Service) testing;
- participation in ARDA activities in coordination with experiments (CMS Dashboard development including monitoring of errors and condor-G monitoring [13], ATLAS Commander development);
- File Transfer Service (FTS) monitoring and testing. Since February 2007, the CERN FTS channels monitoring is performed by the JINR specialists providing Daily logs with tracking of current problems and open issues (<https://twiki.cern.ch/twiki/bin/view/LCG/TransferOperations>). Weekly report for the Joint Operation Meeting at CERN and Weekly Castor Summary of issues noticed on the Castor Tier-0 service. Daily logs are kept in the Daily log archive representing the channel status history;
- development of the MCDB system (LCG Monte-Carlo physical events data base) – creation of a set of basic modules; web-interface development; access to MCDB from CMSSW package (<http://mcdm.cerb.ch>) [14,15];
- dCache usage/development;
- participation in CASTOR2 system development;
- testbed infrastructure for testing the gLite3.X environment was installed at JINR local nodes;
- courses for Grid administrators and users.

A striking example of our activities in gLite middleware testing is the participation in the development of certification tests for VOMS. A number of 32 programs aimed at testing the operations of the administration of virtual organization (*voms-admin* operation), both with the use of a WEB interface and the use of CLI (Command Language Interface) and 28 programs testing *voms-proxy-init* user command (generation of proxy certificate) were developed. All these programs have been integrated into the automated system SAM (Service Ability Monitor) and are in regular use in the EGEE.

We work in close cooperation and provide support to our partners in Ukraine, Belarus, Czech Republic, Romania, Germany, South Africa, Bulgaria, paying special attention to the grid administration and development. During a week in February-March, 2006, training courses

for grid system administrators and ALICE users from Ukraine were held at the JINR. Within the Hulubei-Meshcheryakov programme involving LIT and Romanian scientists, a fruitful workshop and grid tutorials for Romanian system administrators (grid administration, ALICE and ATLAS in grid) were organized at the JINR in March-April, 2007. Moreover, expertise developed at LIT was successfully implemented at the Magurele Campus near Bucharest both as it concerns general grid system administration (at IFIN-HH) and ALICE grid (at ISS). A special agreement on cooperation in grid activities was agreed during a visit of Wroclaw University colleagues to the JINR in August, 2007.

A global coordination of the NA2 activity in the RDIG EGEE consortium is secured [5]. The RDIG-EGEE informational web-portal (<http://www.egee-rdig.ru>) has been developed and is supported. The portal is realized on the Apache 2 web-server with the usage of ORACLE DBMS and php-Personal Home Page (see the RDIG-EGEE portal information pages in Fig. 4).

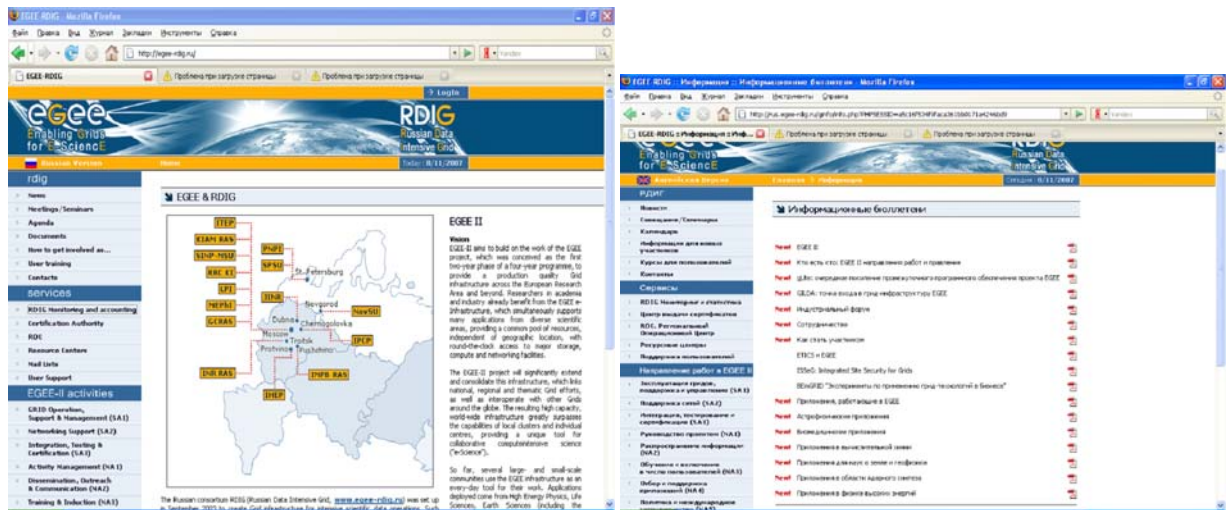


Fig. 4: The RDIG-EGEE web-portal (<http://www.egee-rdig.ru>)

All EGEE Info sheets and EGEE news releases are regularly translated into Russian and they are accessible at the RDIG-EGEE portal. The video-clip “JINR participation in EGEE” was created. A special presentation was prepared for the International Economic Forum in St. Petersburg (June 2007). JINR organized in Dubna the first “Grid Industry day” in Russia, which attracted a large number of industry organizations and companies interested in the deployment and usage of modern grid technologies. Special illustrative materials on grid in JINR (poster and info pages) were prepared and presented on the occasion of the visit in Dubna of the First Deputy Chairman of the Government of the Russian Federation, S.B. Ivanov.

The 2<sup>nd</sup> international conference “Distributed computing and Grid-technologies in science and education” (GRID-2006) was organized and hosted by JINR (<http://grid2006.jinr.ru>). GRID-2006 gathered more than 200 scientists from Russia and Member States countries. It is the only conference in the Russian Federation specially devoted to modern grid technologies. At this conference LIT specialists presented several reports on their achievements in the WLCG and EGEE projects.

As a result of JINR participation in the WLCG and EGEE projects, the JINR LCG/EGEE site is fully integrated into the worldwide LCG/EGEE grid infrastructure. It provides all the necessary resources, services and software, for the participation of JINR specialists in ALICE, ATLAS and CMS experiments just from the beginning of the LHC start, expected in 2008 year. We plan to continue our participation in the WLCG project to support and develop the JINR LCG/EGEE site at the running phase of the LHC experiments. Further JINR activities in

the WLCG project are based on the Memorandum on Understanding signed in September, 2007 by Russia, JINR and CERN. This agreement provides the legal and financial basis to the participation of Russia and JINR in the WLCG project, subsequently to the LHC start. We shall continue our activities at the next stage of the EGEE project as well, taking into account that these two global grid projects are being developed in a close cooperation.

The results of JINR activities in the WLCG and EGEE projects have been presented at several international conferences (“Distributed Computing and Grid-technologies in Science and Education”, Dubna, Russia, 2006; ACAT 2007, Amsterdam, 2007; OGF20/EGEE User Forum, 2007, Manchester, UK; NEC’2007, Varna, Bulgaria, 2007; “Physics at the Future Colliders”, Tbilisi, 2007), ICFA Workshop on Grid Activities within Large Scale International Collaborations (Sinaia, Romania, 2006) and the EGEE conferences (Geneva, 2006; Budapest, 2007) [16].

## References

- [1] S.D.Belov, V.V.Galaktionov, V.V.Korenkov, N.A.Kutovsky, V.V.Mitsyn, E.G.Nikonov, E.G.Oleynik, V.D.Pose, G.S.Shabratova, T.A.Strizh, E.A.Tikhonenko, I.M.Tkachev, N.S.Zaikin, V.E.Zhiltsov, *JINR Participation in the LCG and EGEE Projects* (in Russian), LIT JINR Scientific Report 2004-2005, JINR, 2005, pp.40-45.
- [2] V.Korenkov, *JINR Participation in the LCG and EGEE Projects*, NEC’2005 Proceedings, JINR, 2006, pp.170-173.
- [3] *LHC Computing Grid Technical Design Report*, LCG-TDR-00, CERN-LHC-2005-024, CERN, Geneva, 20 June 2005, available at <http://cern.ch/lcg/tdr>
- [4] A.Kryukov, A.Demichev, V.Kovalenko, V.Mitsyn, *Migration of basic RDIG-EGEE grid service to gLite new generation middleware* (in Russian), in Proc. of the 2<sup>nd</sup> Int. Conference “Distributed Computing and Grid-technologies in Science and Education”, JINR, 2006, pp.343-345.
- [5] T.A.Strizh, *Grid Awareness Dissemination and Outreach Activities in Russian Federation*, NEC’2005 Proceedings, JINR, 2006, pp.260-263.
- [6] V.Korenkov, N.Kutovskiy, I.Tkachev, *Experience of Grid Infrastructure Installation, User and Administrator Training in Grid*, in Proc. of the 2<sup>nd</sup> Int. Conference “Distributed Computing and Grid-technologies in Science and Education”, JINR, 2006, pp.96-98.
- [7] E.Tikhonenko, *Application Identification and Support (NA4) Activities in the RDIG-EGEE consortium*, in Proc. of the XXth Int. Symposium on Nuclear Electronics and Computing, JINR, 2006, pp.264-266.
- [8] S.D.Belov, I.M.Tkachev, *RDIG monitoring and accounting*, in Proc. of the 2<sup>nd</sup> Int. Conference “Distributed Computing and Grid-technologies in Science and Education”, JINR, 2006, pp.26-27.
- [9] V.V.Ivanov, N.I.Gromova, V.V.Korenkov, N.A.Kutovsky, V.V.Mitsyn, E.A.Tikhonenko, P.V.Zrellov, *LHC Computing Organization and Support at the Joint Institute for Nuclear Research*, this volume, pp.38-42.
- [10] E.Slabositskaya, L.Stepanova, Y.Lyublev, N.Kutovsky, V.Mitsyn, G.Shabratova, E.Ryabinkin, A.Kiryanov, N.Kruglov, S.Zotkin, A.Zarochentsev, *Distributed Computing Environment of ALICE in 2006 Data and Service Challenges at RDIG Sites*, in Proc. of the 2<sup>nd</sup> Int. Conference “Distributed Computing and Grid-technologies in Science and Education”, JINR, 2006, pp.147-154.
- [11] V.Gavrilov, I.Golutvin, V.Ilyin, O.Kodolova, V.Korenkov, S.Shmatov, E.Tikhonenko, *RDMS CMS Computing*, in the Proceedings of the 2<sup>nd</sup> Int. Conference “Distributed Computing and GRID-technologies in Science and Education”, JINR, 2006, pp.61-65.
- [12] V.Pose, B.Koblitz, *Testing of the gLite-AMGA Metadata Service*, in Procs. of the 2<sup>nd</sup> Int. Conference “Distributed Computing and Grid-technologies in Science and Education”, JINR, 2006, pp.128-133.
- [13] J.Andreeva, S.Belov,..., I.Sidorova,..., E.Tikhonenko et al., *Dashboard for the LHC Experiments*, to be published in Journal of Physics: Conference Series – CHEP’2007 Proceedings.
- [14] P.Bartalini, S.Belov et al., *LCG Generator*, in the Proceedings of the International Conference on Computing in High-Energy Physics: CHEP’04, Interlaken, Switzerland, 2004, vol.2, pp.83-186; L. Dudko et al., hep-ph/0404241.
- [15] S.Belov et al., *LCG MCDB – a Knowledge base of Monte-Carlo Simultaneous Events*, to be published in CPC (<http://www.nikhef.nl/acat07/talks/Belov.pdf>).
- [16] <http://grid2006.jinr.ru>; <http://nec2007.jinr.ru/program.asp>; <http://www.hepi.edu.ge/conferences/talks.html>; <http://www.nikhef.nl/acat07/talks>.