

Information Technologies

An important task for the next seven-year period of activity is the formation of a unified Grid environment of the JINR Member States in which three main levels can be distinguished. The **network level** comprises high-speed backbones and telecommunication links. The **resource level** is formed by highly efficient computing clusters, supercomputers, and data storage systems joined into a unified Grid environment. The **applied level** encompasses sets of research topics the solutions of which have been adapted to the Grid environment and within the framework of corresponding virtual organizations.

The elaboration of the network level of the JINR Grid infrastructure includes development and upgrade of the JINR telecommunication links and local network. In particular, it is planned to increase the bandwidth of the **JINR–Moscow channel** in total up to 720 Gbps. JINR is actively involved in the development of an international segment within the GEANT project that will foster an increase in the bandwidth of the international channels up to 10 Gbps in 2009, with further growth in 2010–2016. The integration of the Grid infrastructures of JINR and its Member States is planned through the high-speed European network GEANT. The development plan for the JINR Local Network (LAN) in the projected period foresees an upgrade of the JINR backbone to a data transfer rate of 10 Gbps, connection to this backbone of all the JINR laboratories, an increase in the performance of the LAN central telecommunication node kernel, an increase of the data transfer rate at the level of the Institute subdivisions up to 1 Gbps and an increase of the LAN protection at the hardware level, etc.

Resource level components	2010	2011	2012	2013	2014	2015	2016
Growth of CICC computing capacity: CPUkSI2K	2 500	4 000	4 000	7 000	7 000	10 000	10 000
Disk storage increase (TB)	1 200	2 000	2 000	4 000	4 000	8 000	8 000
Increase of mass memory (TB)	500	2 000	2 000	5 000	5 000	10 000	10 000
Setting up of CPGS	Preparation of technical requirements and purchase of equipment	Realization	Maintenance and upgrade				
Primary, information, and application software	Maintenance and upgrade						
Licensing of services, office software	Realization			Maintenance and upgrade			

The kernel of the **resource level** of the JINR information infrastructure consists of the high-efficiency **computing clusters** and of the **data storage systems** of the Central Information and Computing Complex (CICC). The requirements for the LHC experimental data processing and analysis stimulate further increase in the CICC performance and disk space. In order to manage the joint Grid infrastructure, it is planned to set up a **centre of primary Grid services**

(CPGS) that will provide coordinated functioning of geographically distributed resource centres. Specific work to set up CPGS includes preparation of hardware and software basis of CPGS, development of tools for service development, execution of CPGS basic services, standardization of the service of information attendance, opening of a certification centre, connection of resource units of the JINR participating countries, etc. The development of **information and primary software support** of the research and production activity of the Institute to achieve a unified information environment of JINR and its Member States is an indispensable condition.

The **applied level of the JINR Grid-environment** covers the user applications working in a **virtual organization** (VO) environment which comprises both users and owners of computing resources. The virtual organization is a flexible structure that can be formed dynamically and may have a limited lifetime. Instances of VOs working within the WLCG project are those that are involved in the LHC experiments ATLAS, CMS, ALICE, being carried out with the direct participation of JINR. The development of new VOs becomes necessary under maturation of the development of **mathematical methods and tools**. In 2010–2016, work will be continued on the development of mathematical methods for modeling physical processes and analysis of experimental data, on the development of software and computer complexes, etc. Research in the field of quantum information technology is also planned.

The seven-year expenses are given in the table. The funding will be carried out both from the JINR budget resources and under special-purpose financing from the JINR Member States.

Funding (k\$)

Activities	2010	2011	2012	2013	2014	2015	2016
External communication links	165	65	85	85	135	135	185
LAN	125	125	225	125	205	205	225
CICC and Grid infrastructure	260	460	390	490	650	670	790
Licensed software	80	80	80	80	100	100	100
Service acquisition and other expenses	17	20	20	40	43	53	64
Total	647	750	800	820	1 133	1 163	1 364