| 05-6-1118-2014/2023 | | Priority: | 1 |
|---|---|---|---|
| | | Status: | In-progress |

# Information and Computing Infrastructure of JINR

**Leader:** V.V. Korenkov
**Deputy:** T.A. Strizh

## Participating Countries and International organizations:

Armenia, Azerbaijan, Belarus, Bulgaria, CERN, China, Czech Republic, Egypt, France, Georgia, Germany, Italy, Kazakhstan, Moldova, Mongolia, Poland, Romania, Russia, Slovakia, South Africa, Sweden, Taiwan, Ukraine, USA.

## Issues addressed and main goals of research:

The purpose of the theme is to develop the network, information and computing infrastructure of JINR for the research and production activities of the Institute and its Member States on the basis of state-of-the-art information technologies in accordance with the Seven-Year Plan for the development of JINR. A particular direction within the theme is the development of the JINR MLIT Multifunctional Information and Computing Complex (MICC) presented as a Project.

## Expected main results in the current year:

- Provision of the stable, safe and integral functioning of the JINR information and telecommunication network (backbone network (2x100 Gbps); transport network of the NICA megaproject (8x100 Gbps); MLIT mesh network (100 Gbps); telecommunication channels (3x100 Gbps); Wi-Fi network at the Institute's sites) for reliable data exchange between the Institute's subdivisions, the JINR Member States and international organizations collaborating with JINR.
  Provision of the full-scale and optimal operation of the guaranteed power supply and climate control systems of the MICC computing infrastructure. Implementation of the project on a new fire safety system of the MICC infrastructure.
  Expansion of the performance and storage system of the MICC basic grid component, i.e. the Tier1 center at JINR: processor capacities up to 300 kHS06, dCache storage systems on disks up to 13.1 PB.

  Enlargement of the computing resources and data storage systems as part of the Tier2/CICC integral component: processor capacities up to 150 kHS06, disk storages up to 6.5 PB.

  Expansion of the capacity of the MICC general distributed data storage and access system based on the EOS file system up to 30 PB. Support and maintenance of user work with the EOS system.

  Extension of a set of applied applications available to users in the cloud service for scientific and engineering computing (http://saas.jinr.ru). Optimization of the computing environment for neutrino experiments, i.e. the neutrino platform. Enlargement of the resources of the MICC cloud, including at the expense of the resources acquired by the Baikal-GVD, JUNO, NOvA/DUNE experiments, and their maintenance.

  Equipping of the hierarchical data processing and storage system of the "Govorun" supercomputer with an 8 PB warm layer based on the Ruler SSD. Creation of a polygon for quantum computing based on large-memory nodes. Creation of a polygon simulating the operation of the MPD detector based on the DAOS data reception and processing technology. Integration of the cold layer of the hierarchical data processing and storage system of the "Govorun" supercomputer under the EOS FS management with a common storage for the NICA experiments.

  Support and updates of grid middleware. Support and maintenance of the operation of the WLCG virtual organizations, the experiments NICA, COMPASS, NOvA, ILC, etc., local user groups on the MICC Tier1 and Tier2 resources. Maintenance of the unified system of access to the CVMFS software. Development of a prototype of the distributed data

processing system for the SPD experiment, which uses the MICC storage systems (tape and disk) and heterogeneous computing resources.
Further development of the distributed information and computing platform based on DIRAC integrating cloud resources of the organizations of the JINR Member States. Implementation of the system for monitoring the operability and performance of the resources integrated in DIRAC. Integration of new computing and storage resources.

Creation and testing of a set of services for the prototype of the MICC unified resource management system. Development of a concept and a work plan for the creation of a custom Big Data infrastructure to solve JINR's urgent tasks.

Expansion of the functions of the MICC monitoring system with additional accounting elements to track user actions over time. Update and support of the monitoring system, inclusion of monitoring the parameters of new MICC elements in the monitoring.

- Development and maintenance of the electronic document system EDS "Dubna", the project management system APT EVM for NICA, the systems ADB2, ISS, "Document Base", HR LHEP, CERNDB, EDS "Advance reports" at the request of end users and in accordance with the developed concept of the cloud SaaS platform of the unified administrative and business information system. Maintenance of the JINR Information System for Scientific Certification (ISSC).

  Trial operation of the server of scientific publications based on the Invenio-JOIN$^2$ software program, provision of interaction with the PIN IS at the level of bibliographic metadata. Development and commissioning of tools for integrating the PIN and JOIN$^2$ systems with the aim of transferring the publication data entry to the JOIN$^2$ system.

  Maintenance of the JINRLIB and MATHLIB program libraries. Replenishment of JINRLIB with computational physics programs. Update of mathematical program libraries, their integration with modern programming languages.

  Maintenance and modernization of central information servers, portals and databases for information support and software of the MLIT and JINR activity: development of the services of the "Visit Centre" portal; modernization and administration of the website of the PEPAN and "PEPAN Letters" journals; creation and support of websites of conferences, symposia at the request of the laboratories and other JINR subdivisions; organization of websites of the JINR subdivisions and conferences in a hosting mode.

  Implementation and maintenance of the web-based information and analytical system to automate the process of managing network and other types of software licenses.

  Development of the information and computing system for radiobiological studies, including the experimental data processing and storage system for analyzing behavioral and morphological changes in the central nervous system of laboratory animals.

  Implementation of the air quality management system (AQMS) and air quality modeling system (ADMoSS) into the MICC environment.

  Development of the project on a "Personal Account" system, which takes into account the peculiarities of working with personal information and simplifies access to the JINR information and computing resources.

- Organization and holding of special courses and tutorials on novel supercomputer technologies, technologies and tools for solving applied tasks on the basis of machine and deep learning methods. Conducting of special courses and tutorials in the JINR Member States in accordance with international cooperation programs. Organization of specialized courses on training IT specialists to solve tasks related to data processing and analysis for megascience experiments, including the NICA project.

Creation of an intelligent robotics laboratory for the development of cognitive control systems on the basis of the NICA accelerator complex and in other JINR laboratories, development of a laboratory workshop on robotics. Holding of schools on artificial intelligence and quantum computing.

## List of projects:

| | Project | Leader | Priority (period of realisation) |
|---|---|---|---|
| 1. | MICC | V.V. Korenkov | 1 (2017-2023) |

## List of Activities:

| | Activity or Experiment<br>Laboratory or other Division of JINR | Leaders<br>Main researchers |
|---|---|---|
| **1.** | **MICC Project** | **V.V. Korenkov**<br>**A.G. Dolbilov**<br>**V.V. Mitsyn**<br>**T.A. Strizh** |
| | MLIT | Eu.I. Aleksandrov, I.N. Aleksandrov, K.N. Angelov, A.S. Baginyan, A.I. Balandin, N.A. Balashov, A.V. Baranov, S.D. Belov, D.V. Belyakov, A.S. Bondyakov, Yu.A. Butenko, A.I. Churin, S.V. Chashchin, S.V. Gavrilov, A.P. Gavrish, T.M. Goloskokova, A.O. Golunov, E.N. Grafova, Eu.A. Grafov, Gromova, A.E. Gushchin, I.S. Kadochnikov, A.S. Kamensky, V.A. Kapitonov, I.A. Kashunin, A.O. Kondratiev, G.A. Korobova, E.Yu. Kulpin, N.A. Kutovskiy, A.A. Lavrentiev, S.B. Marchenko, M.A. Matveev, Ye. Mazhitova, S.V. Mitsyn, A.V. Nechaevsky, D.A. Oleynik, G.A. Ososkov, I.S. Pelevanyuk, A.Sh. Petrosyan, M.S. Plyashkevich, D.V. Podgainy, L.A. Popov, D.I. Pryakhina, Ya.I. Rozenberg, T.F. Sapozhnikova R.N. Semenov, M.L. Shishmakov, I.A. Sokolov, O.I. Streltsova, V.V. Trofimov, N.N. Voitishin, A.S. Vorontsov, A.V. Uzhinskiy, A.Yu. Zakomoldin, P.V. Zrelov, M.I. Zuev |
| ,, | VBLHEP | K.V. Gertsenberger, Yu.P. Minaev, A.N. Moshkin, O.V. Rogachevsky, B.G. Shchinov, S.V. Shmatov |
| | FLNP | G.A. Sukhomlinov |
| | LRB | V.N. Chausov |
| | FLNR | A.G. Polyakov, V.V. Sorokoumov |
| | DLNP | Yu.P. Ivanov |
| | BLTP | K.V. Kulikov, I.R. Rahmonov, A.A. Sazonov, Yu.M. Shukrinov |
| | UC | I.N. Semeniushkin |
| **2.** | **Information and software support of the research-and-production activity at JINR** | **P.V. Zrelov**<br>**V.V. Korenkov**<br>**I.A. Filozova** |
| | MLIT | N.A. Balashov, D.V. Belyakov, N.A. Davyudova, T.M. Goloskokova, D.S. Golub, P. Jancik, L.A. Kalmykova, A.A. Karlov, D.V. Kekelidze, D.I. Koshlan, S.A. Kretova, S.V. Kunyaev, N.A. Kutovskiy, G.G. Musulmanbekov, |

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|---|---|---|
| | | M.S. Plyashkevich, L.V. Popkova, A.V. Prikhodko, V.M. Pushkina, A.M. Raportirenko, T.F. Sapozhnikova, S.V. Semashko, R.N. Semenov, G.V. Shestakova, D.B. Stankus, V. Svozilik, T.S. Syresina, N.N. Vorobieva, A.V. Uzhinskiy, V.M. Yagafarova, A.G. Zaikina, T.N. Zaikina |
| | FLNP | I. Pavliková, M.V. Frontasyeva, W. Badawy, A. Yu. Dmitriev |
| | SOD | S.N. Nedelko |
| **3.** | **Development of the system for training and retraining of IT specialists based on the JINRMICC and its educational components** | **V.V. Korenkov**<br>**T.A. Strizh**<br>**O.I. Streltsova** |
| | MLIT | N.A. Balashov, S.D. Belov, V.V. Galaktionov, T.M. Goloskokova, N.I. Gromova, O.V. Ivantsova, I.S. Kadochnikov, M.H. Kirakosyan, N.A. Kutovskiy, V.V. Mitsyn, S.V. Mitsyn, I.K. Nekrasova, A.V. Nechaevsky, D.A. Oleynik, A.Sh. Petrosyan, D.V. Podgainy, A.G. Reshetnikov, T.F. Sapozhnikova, R.N. Semenov, Sh.G. Torosyan, V.V. Trofimov, S.V. Ulyanov, A.V. Uzhinskiy, M.I. Zuev |
| | UC | S.Z. Pakuliak |

## Collaboration

| Country or International Organization | City | Institute or laboratory |
|---|---|---|
| Armenia | Yerevan | IIAP NAS RA |
| Azerbaijan | Baku | ADA |
| | | IP ANAS |
| Belarus | Minsk | BSTU |
| | | INP BSU |
| | | JIPNR-Sosny NASB |
| | | UIIP NASB |
| Bulgaria | Sofia | INRNE BAS |
| | | SU |
| CERN | Geneva | CERN |
| China | Beijing | IHEP CAS |
| Czech Republic | Ostrava | VSB-TUO |
| | Prague | IP CAS |
| Egypt | Cairo | ASRT |
| | Giza | CU |
| France | Marseille | CPPM |
| Georgia | Tbilisi | GRENA |
| | | GTU |
| | | TSU |
| Germany | Darmstadt | GSI |
| | Frankfurt/Main | Univ. |
| | Hamburg | DESY |
| | Karlsruhe | KIT |
| | Zeuthen | DESY |
| Italy | Bologna | INFN |
| Kazakhstan | Almaty | INP |
| | Nur-Sultan | BA INP |
| Moldova | Chisinau | IMCS |
| | | MSU |

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|---|---|---|
| | | RENAM |
| Mongolia | Ulaanbaatar | NUM |
| Poland | Warsaw | IMGW-PIB |
| Romania | Bucharest | IFIN-HH |
| | Cluj-Napoca | INCDTIM |
| | Magurele | IFA |
| Russia | Chernogolovka | LITP RAS |
| | | SCC IPCP RAS |
| | Dubna | Dubna State Univ. |
| | | SCC "Dubna" |
| | | SEZ "Dubna" |
| | Gatchina | NRC KI PNPI |
| | Moscow | FRC IM RAS |
| | | IITP RAS |
| | | ISP RAS |
| | | ITEP |
| | | KIAM RAS |
| | | MPEI |
| | | MSK-IX |
| | | MSU |
| | | NRC KI |
| | | PRUE |
| | | RCC MSU |
| | | RSCC |
| | | SINP MSU |
| | Moscow, Troitsk | INR RAS |
| | Novosibirsk | BINP SB RAS |
| | | ICMMG SB RAS |
| | | SKIF |
| | Pereslavl-Zalesskiy | PSI RAS |
| | Protvino | IHEP |
| | Puschino | IMPB RAS |
| | Samara | SU |
| | St. Petersburg | FIP |
| | | ITMO Univ. |
| | | SPbSPU |
| | | SPbSU |
| | Vladikavkaz | NOSU |
| Slovakia | Kosice | IEP SAS |
| | Presov | PU |
| South Africa | Cape Town | UCT |
| Sweden | Lund | LU |
| Taiwan | Taipei | ASGCCA |
| Ukraine | Kharkov | NSC KIPT |
| | Kiev | BITP NASU |
| USA | Arlington, TX | UTA |
| | Batavia, IL | Fermilab |
| | Upton, NY | BNL |