# Operation Center of the JINR Multifunctional Information and Computing Complex

*A.O. Golunov, A.G. Dolbilov, I.S. Kadochnikov, I.A. Kashunin, V.V. Korenkov, V.V. Mitsyn, I.S. Pelevanyk, T.A. Strizh.*
*Laboratory of Information Technologies (LIT), JINR*

The Multifunctional Information and Computing Complex (MICC) at the Laboratory of Information Technologies of the Joint Institute for Nuclear Research (LIT JINR) is a sophisticated multi-component hardware-software complex aimed at encompassing a wide range of tasks related to data processing, analysis and storage in order to ensure the scientific and productive activities of the Institute and its Member States. The main components of the MICC computing infrastructure are the Tier-1 and Tier-2 grid sites of the WLCG (Worldwide LHC Computing Grid) global grid infrastructure, created for processing data from experiments at the Large Hadron Collider, the JINR cloud infrastructure and the HybriLIT heterogeneous computing cluster. An important tool for providing the smooth operation of the computer systems of such a level in a 24/7 mode is comprehensive monitoring of all components and subsystems of the Complex. To ensure the operational control of the MICC components, the Operation Center (OC) of the Multifunctional Information and Computing Complex has been developed in the Laboratory of Information Technologies. The main function of the OC is the round-the-clock surveillance of the state of hardware components, services, the engineering and network infrastructure.

Figure 1. Photo of the MICC Operation Center

Monitoring data are collected by the Litmon monitoring system from a wide range of hardware and software related to Tiers and the local batch farm: cooling systems, temperature sensors, UPS, computing servers, disk arrays, managing services, L2 and L3 switches and routers, tape robot. This monitoring system aggregates information from four levels: engineering, network, hardware and software. It uses SNMP, IPMI or SSH protocols depending on the type of a monitored object. Monitoring results are displayed on the web page in the form of a dashboard (Fig. 3).

One of the crucial requirements to any monitoring or control system is its reliability. This can be satisfied by the system itself. But there is also another important requirement, i.e. availability. And to satisfy it, special arrangements are required to ensure stable access to the monitoring and control systems during power cuts, network failures or other emergencies. The MICC Operation Center is formed to provide 24x7 availability of the MICC systems. It is located in a special room for operators of the MICC. The Center is equipped with 6 big (55 inch in diagonal) screens for the monitoring information display (Fig. 1). Normally, these screens show information about all MICC components: Tier1 services, Tier-1 hardware, Tier-2 hardware, HybriLIT load, WLCG Google Earth Dashboard, JINR Cloud load. The OC has UPS (uninterruptable power supplies) to keep hardware operational up to 2 hours, 2 work stations for operators and 2 network links with the MICC (Fig. 2). This equipment together with the supported monitoring systems ensures the reliable and effective control of all MICC components under different critical conditions.

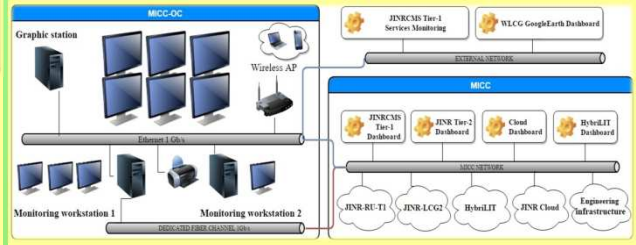


Figure 2. Network communications between the MICC OC and the MICC

The dashboard is divided into several areas to show various metrics of the MICC components (temperature, UPS load, network channels and switches load, status of work nodes and data storages, number of running/queued jobs, etc.). In case of any issue or emergency a sound alarm is played to draw an operator's attention.


Figure 3. MICC OC graphics station with several running Litmon dashboards and the WLCG Google Earth dashboard

An operator launches commands and scripts on the managing linux servers for the centralized management of services, the setting and configuration of the operating system.

The complex software OpenManage Essentials (OME) provided by the hardware manufacturer and including the OpenManage Server Administrator (OMSA) and Dell Licence Manager (DLM) components is used for the centralized management of the Dell server hardware (Fig. 4).

The complex software Supermicro Update Manager (SUM), Supermicro Server Manager (SSM) provided by the hardware manufacturer and the IPMI View utility are used for the centralized management of the SuperMicro server hardware (Fig. 5).

The software APC Struxureware Data Center Expert provided by the hardware manufacturer is used for the centralized management of the engineering infrastructure (Fig. 6).

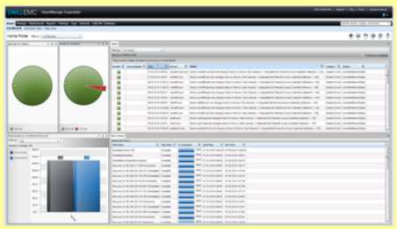

Figure 4. Dell OpenManage Essentials

Figure 5. SuperMicro IPMI View

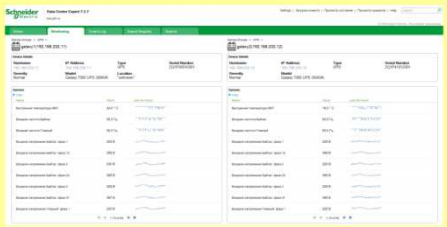

Figure 6. APC Struxureware Data Center Expert

1. Operation center of the JINR Multifunctional information and computing complex (Alexey Golunov, Andrei Dolbilov, Ivan Kadochnikov, Ivan Kashunin, Vladimir Korenkov, Valery Mitsyn, Igor Pelevanyk, Tatiana Strizh) CEUR Workshop Proceedings (CEUR-WS.org), ISSN:1613-0073, Publ.:RWTH Aachen University vol 1787, pp.235-240 http://ceur-ws.org/Vol-1787/235-240-paper-39.pdf (2016)

2. Multi-level monitoring system for the Multifunctional information and computing complex at JINR (Andrey Baginyan, Nikita Balashov, Alexandr Baranov, Sergey Belov, Dmitriy Belyakov, Yuriy Butenko, Andrey Dolbilov, Aleksei Golunov, Ivan Kadochnikov, Ivan Kashunin, Vladimir Korenkov, Nikolay Kutovskiy, Alexandr Mayorov, Valery Mitsyn, Igor Pelevenyuk, Roman Semenov, Tatyana Strizh, Vladimir Trofimov, Martin Vala) CEUR Workshop Proceedings (CEUR-WS.org), ISSN:1613-0073, Publ.:RWTH Aachen University vol 2023, pp.226-233 http://ceur-ws.org/Vol-2023/226-233-paper-36.pdf (2017)