MODERNIZATION OF THE AUTOMATED CONTROL SYSTEM IN THE KURCHATOV SYNCHROTRON RADIATION SOURCE

E. Kaportsev, A. Valentinov, V. Dombrovsky, V. Korchuganov, Yu. Krylov, K. Moseev, N. Moseiko, Yu. Yupinov, RRC Kurchatov Institute, Moscow, Russia
Yu. Efimof, CJSC RTSoft, Moscow, Russia

Abstract

The running cycle of Kurchatov Synchrotron Radiation Source (KSRS) includes the injection of electrons with energy 80 MeV from the linear accelerator in the booster storage ring Siberia-1, the accumulation of a electron current up to 400 mA and, then, electron energy ramping up to 450 MeV with the subsequent extraction of electrons in the main ring, storage ring Siberia-2, and accumulation there up to 300 mA, and at last the energy ramping up to 2.5 GeV. [1]

The current automated control system (ACS) of KSRS «SIberia» – synchrotron radiation source and the center of communities, NRC Kurchatov institute, was founded over 20 years ago on the basis of control equipment in the CAMAC standard. It is physically and morally outdated and does not meet modern requirements for speed, accuracy and data transmission.

This paper presents some options for replacing the old control system of KSRS with modern components, high-speed CPUs, standard VME, and high-speed industrial network CAN.

OPERATIONAL MANAGEMENT OF THE COMPLEX

The network consists of a machine operator workstations running Windows, connected with the local network Ethernet. [2] Applications obtain the diagnostic information from the database server based on MS SQL Server, where it comes from the application server. The database server and application server are located within one computer. The ADC and DAC integrated into CAN-network. The application server executes the control program and collecting data from sensors and diagnostics. We have three servers: Canserver, CAMAC messaging server и Vacuum server. [3]

Canserver, used to control the DAC and ADC via CAN network. The application server runs specialized programs that support communication with the CAN-network actuators, K167 controllers, RF generators and power systems. [4]

Messaging Server CAMAC organizes communication with controllers that have not adapted to the standard CAN. [5]

The management server of the vacuum system is located directly in the vacuum console. It has its own database, which stores the archive of the currents of vacuum pumps. [6]

The most important disadvantage of the control system is outdated equipment, made on a hardware platform CAMAC. Currently, developed in BINP (Novosibirsk), controllers and control modules are Non-Repair, due to obsolete element base and removed from the production of most parts, which have no analogue in the free distribution. Due to the failure of most modules of the control system, there was an urgent need to replace outdated equipment with modern, easily upgradeable and scalable.

Canserver server used to control the DAC and ADC via the CAN network. On the application server run specialized programs, which support communication on CAN-network with executive devices, such as high-frequency generators and power of magnetic systems. [3]

Messaging Server CAMAC [4] organizes the exchange of data with CAMAC crate controller with CAN interface type of K167 [5].Through it passed all the information from the controllers and modules that have not yet adapted to the standard CAN.

Management server of vacuum system is directly in the vacuum control room. It has its own database that stores the archive currents of vacuum pumps. [6]

UPGRADED ACS

Upgraded ACS of KSRS (further - UACS) will be a multi-level structure, conventionally divided into upper and lower level, server level and peripherals (fig.1). UACS structurally divided into five branches of management: control of the injection part of the complex (linear accelerator and small storage ring “Siberia-1”), management of large storage ring (“Siberia-2”), diagnostic of beam in accelerators, vacuum control and temperature control.

Lower Level of UACS

Lower level of UACS must be made on the basis of bus-modular equipment in the standard VME and control equipment with embedded processors, running under operating systems like Lynxos. At this level should be gathered diagnostic information and perform control algorithm of the complex systems. This equipment is connected to a server level with Ethernet or CAN.

Server Level of UACS

Server level of UACS includes application servers and a database management system (DBMS). At this level, to be implemented:

- general algorithm for management and monitoring of the KSRS;
- communication with the VME standard CPUs;
- communication with the CAN-controller;

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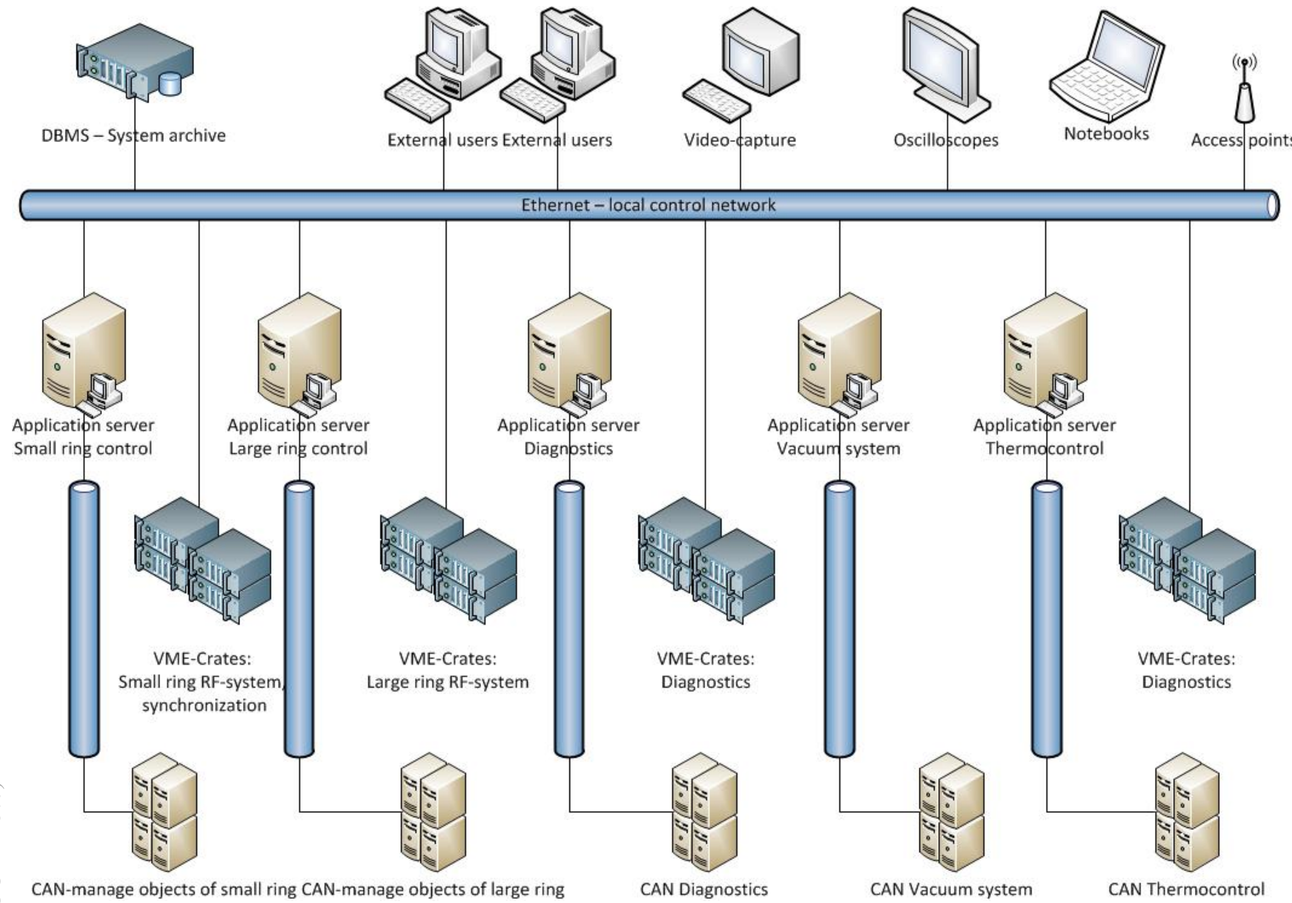

Fig.1. Structure of UACS.

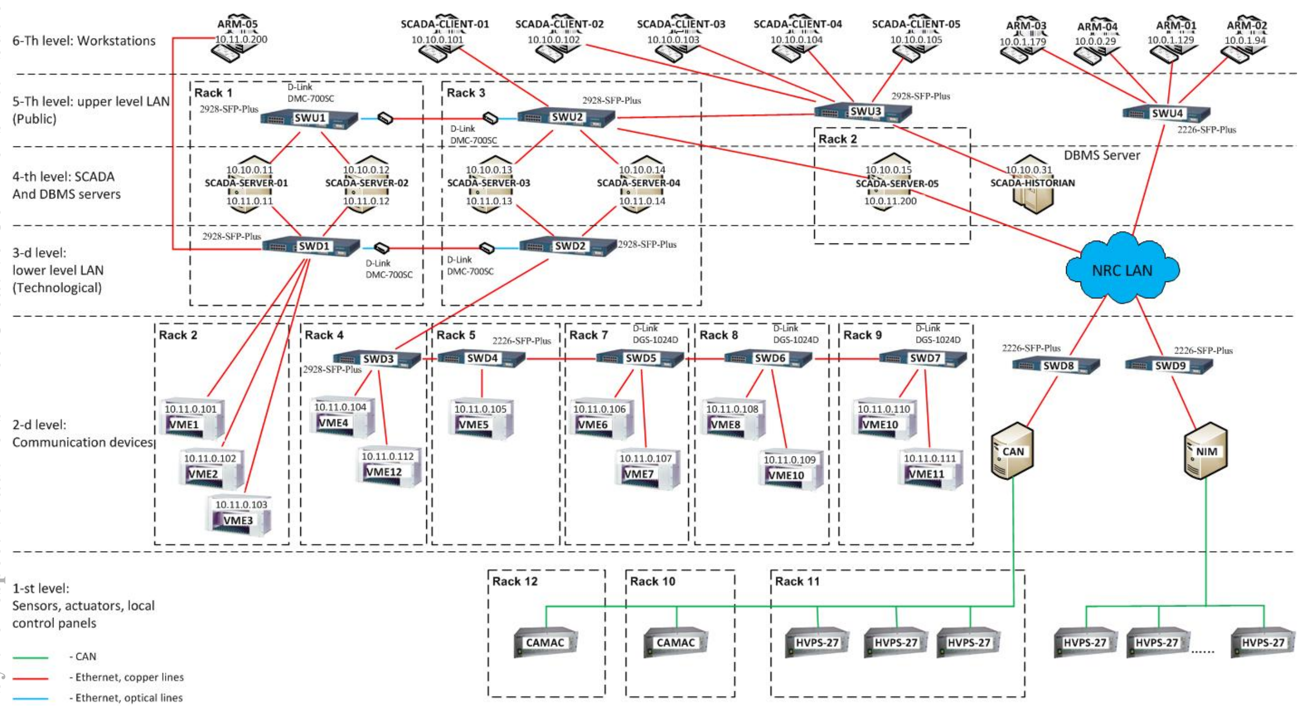

Fig.2. Block diagram of the TS.

- communication with the operator's workstations;
- operator's sessions logging;
- storage of information in the database;
- selection and provision of information to users' queries;
- diagnosis of software and hardware complex of UACS of KSRS (self-diagnostics).

Upper Level of UACS

The upper level includes the workstations of operators and other users of KSRSAt the top level must work full-featured system for monitoring and control - CitectSCADA.

CitectSCADA software enables: process visualization in graphic mode, management of workstations, tracking systems in real time in a graphical form and access to archived data, preparation of detailed reports, executing of subprogrammes, developed with CitectVBA and CiCode.

In the first phase of modernization was created test stand (TS), which is designed to develop and debug software for local UACS systems of KSRS. Block diagram of TS is shown in Fig. 2.

Functional structure of the TS is shown on Fig. 3. The functional structure of the TS has three levels of hierarchy:

On the 3rd level of the hierarchy are the operator's workstation (upper level);

At the 2nd level of the hierarchy are SCADA servers and database server (server level);

On the 1st level of the hierarchy are VME processor assembly and CAN-servers (lower level).

In conclusion, the new modernized system of automatic control of the complex will be run on modern hardware, provide operators and users with the necessary information in real time, provide the scientific community with sufficient historical data to allow further study of the physical processes.

REFERENCES

[1] V.Korchuganov et al., Kurchatov Synchrotron Radiation Source Facities Modernization. Proceedings of RuPAC XXII, Protvino, Russia, 2010.

[2] Yu.Krylov et al., Archiving and Monitoring of Status for KSRS. Proceedings of ICALEPCS 2005, Geneva, 2005.

[3] E.Kaportsev et al., The Expanded Program Tools for KSRS Operation with Archivation of Data. Proceedings of RuPAC XXII, Protvino, Russia, 2010.

[4] N.Moseiko et al., Intellectual Crate-controller K167. Proceedings of RuPAC XXI, Zvenigorod, Russia, 2008.

[5] E.Kaportsev et al., The Program Tools for KSRS Operation. Proceedings of RuPAC XXI, Zvenigorod, Russia, 2008.

[6] N.Moseiko et al., Modernization of the Vacuum System of Synchrotron Radiation Sources at the National Research Centre Kurchatov Institute. Physics of Particles and Nuclei Letters, 2012, vol.9, No.4-5, pp.456-460.

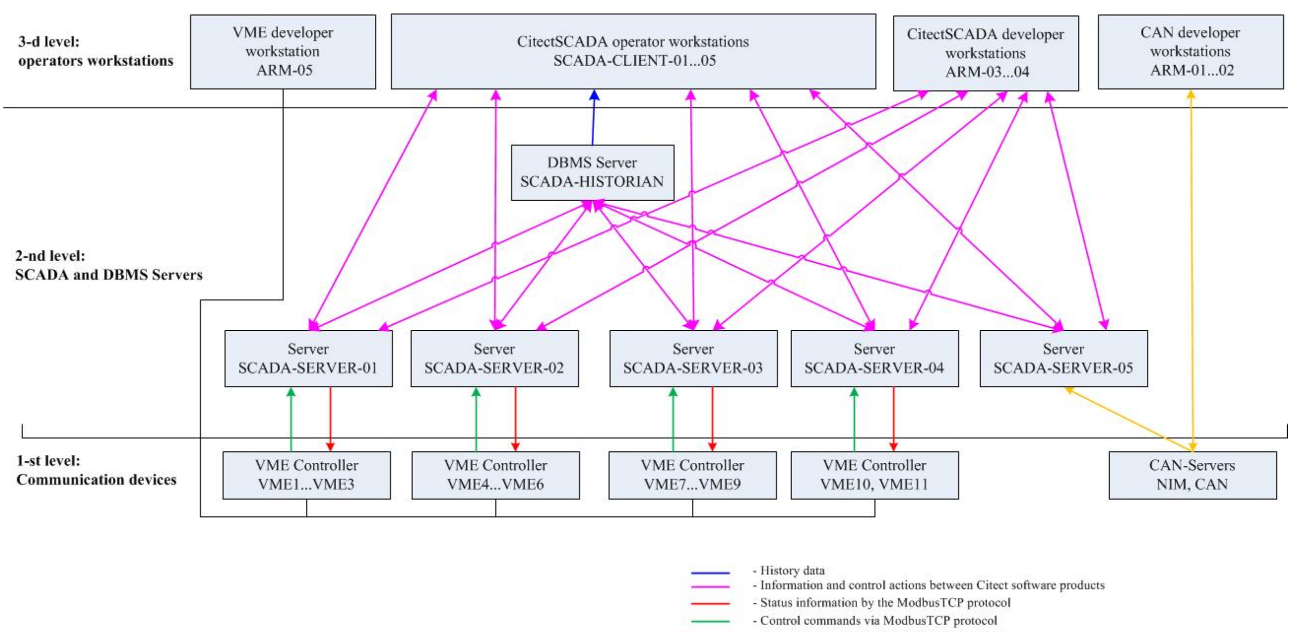

Fig.3. Functional structure of the TS.

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