CONTROL SYSTEM OF VEPP-2000 COLLIDER (SOFTWARE, HARDWARE)

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Abstract

Electron-positron collider VEPP-2000 is under commissioning at Budker Institute of Nuclear Physics. The paper presents architecture, implementation and functionality of the software of the collider control system. The software according to hardware system consists of interacting subsystems responding on different acceleration facility parts. Control system software is based on several TCP/IP connected PC platforms working under operating system Linux and uses client-server techniques. The paper describes implementation, operating possibilities and perspectives of VEPP-2000 software.

The paper also presents structure, architecture and implementation of the hardware of the collider control system. The system consists of pulse-elements, steering coils power supplies, high-current main field power supply, RF subsystems and some other special subsystems (such as vacuum, temperature, etc.). The system is based on modern industrial protocol CAN-bus and specialized electronic BINP manufactured devices according the standard. The paper describes implementation of different subsystems based on CANbus devices, and operating characteristics and possibilities.

VEPP-2000 PROJECT

Since the end of 1974 the e+e- collider VEPP-2M in Novosibirsk has been successfully running in the c.m. energy range from threshold of hadron production up to 1.4 GeV. The integrated luminosity of about $74pb^{-1}$ was collected with two modern detectors SND and CMD-2 allowing precise measurements of most of the hadronic channels of e+e- annihilation. VEPP-2000 project is a further development of the facility dedicated to improve the luminosity and in the same time increase the maximum attainable energy up to 2GeV, that will significantly broaden the potential of experiments performed at the collider. Moreover this ring will allow to check the concept of round colliding beams [1].

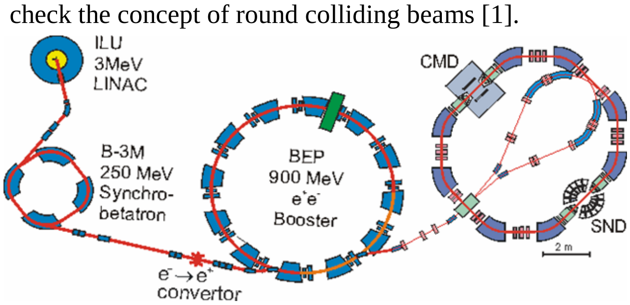

Figure 1: VEPP-2000 Complex layout.

VEPP-2000 HARDWARE

From the point of view of automation accelerator complex VEPP-2000 is a complicated system. Over than 500 control channels and 1000 monitoring channels and their joint usage apply rigid restriction on control system.

Acceleration complex VEPP-2000 consists of 5 subsystems: ILU and channel to B-3M, B-3M and channel to BEP, BEP ring, electron and positron channels from BEP to VEPP-2000, VEPP-2000 ring. Each of subsystems includes several sub subsystems: pulse elements, steady elements, RF-systems, and some additional systems like vacuum and temperature monitoring.

Control system of VEPP-2000 complex is based on several PC platforms under Linux operating system, connected into VEPP-2000 private net. Layout of automation system of VEPP-2000 collider is presented on Figure 2.

Table 1: Subsystems and channels

Subsystem	Sub subsystem	Protocol	N of channels
ILU & channel	Pulse Steady	CAMAC CANbus CANbus	50 40 30
B-3M & channel	Pulse Steady RF	CAMAC CANbus CANbus CANbus	50 40 40 20
BEP	Steady RF	CANbus CANbus	500 20
BEP–VEPP-2000 channels	Pulse Steady	CAMAC CANbus CANbus	30 100 50
VEPP-2000	Steady RF	CANbus CANbus	500 20
Common	Vacuum Temperature Cryogenics	CANbus CANbus CANBus	50 80 50

As it was mentioned above VEPP-2000 complex is a modernization of old VEPP-2M facility. This leads to necessity of taking into account a wealth of 20-year experience on the one hand and using modern automation solutions on the other hand.

On choice of hardware protocol one should be guided by capacity, support and standards. For automation system for VEPP-2000 facility two main protocols was chosen: well-known CAMAC and modern industrial protocol CANbus [2].

Table 1 specifiess subsystems and used protocols with approximate number of channels.

Control units used at VEPP-2000 complex are made in BINP [3,4]. CAMAC standard is used at the places where heavy traffic is needed (pickup stations) and also at the systems where migration on a new standards during modernization was considered inadequate (old systems like ILU, B-3M) which will be removed in future. CANbus protocol is used at the complex automation as a base protocol. It is very convenient for spatially distributed automation systems and allows reduce wire commutations significantly.

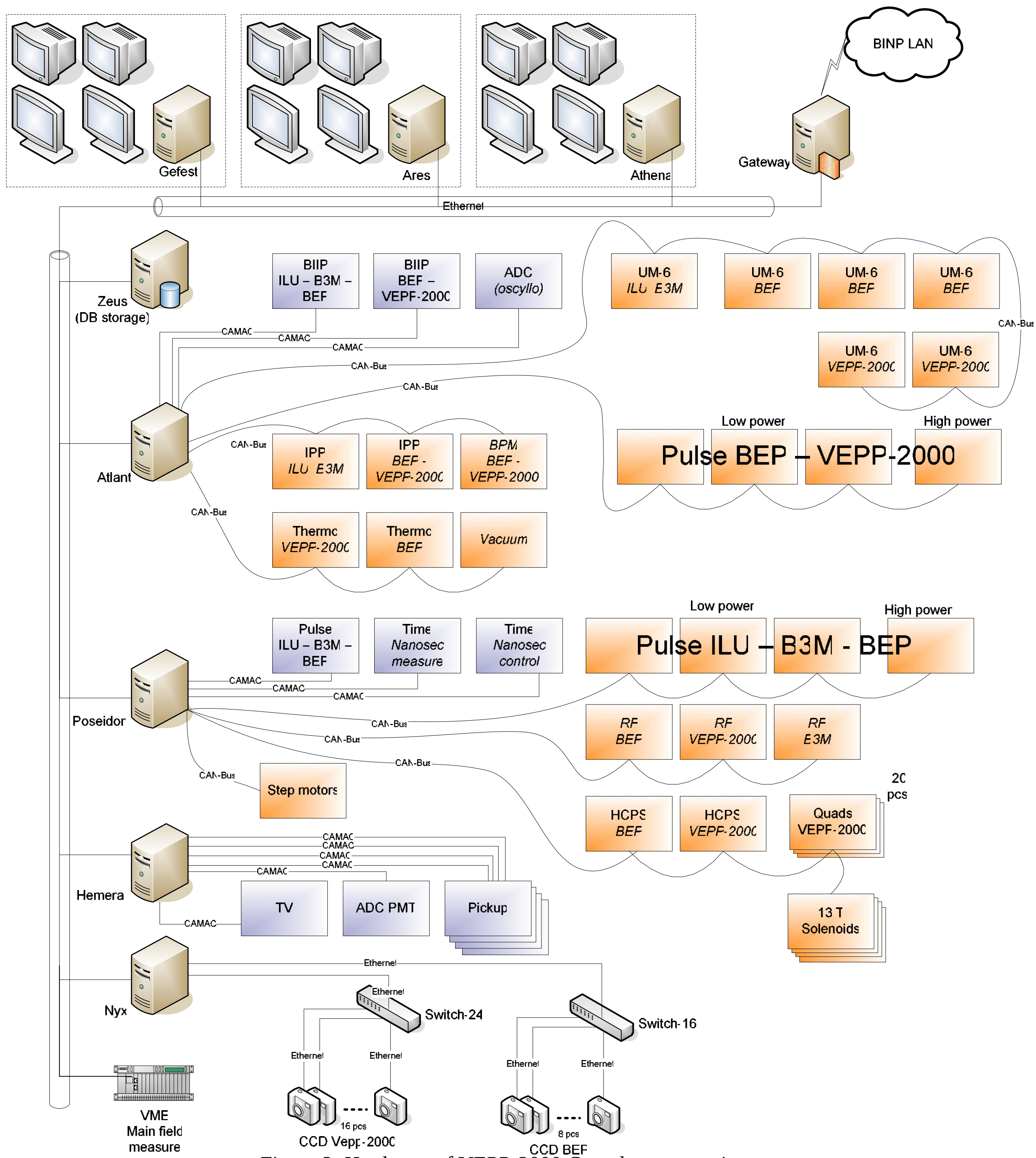

Figure 2: Hardware of VEPP-2000 Complex automation system

VEPP-2000 SOFTWARE ARCHITECTURE

Principles of software construction arose from hardware architecture. Specialized server controls one or several CAN or CAMAC buses and allows client applications to have access to hardware. The point is that several user-end applications working on special PC at the Main Control Room can control and monitor state and working of the hardware units. Applications can exchange messages about common system events (like injection or change energy or working regime) thru special message server. The second point is hiding from user details of hardware configuration and implementation of each server. All information about hardware configuration contains in special Data Bases, personal for each server. All foresaid is schematically shown on Figure 3.

Thus, software system allows user to manage and monitor different hardware subsystems sometimes very different from each other in one manner. Operator uses very similar applications GUI-styled as well as console-like to steer different parts of VEPP-2000 acceleration complex.

CONCLUSION

VEPP-2000 automation system is based on made in BINP (Novosibirsk) hardware in CAMAC and modern CANbus standards. Software system substantially corresponds to hardware system. It allows to operator independently steering of different VEPP-2000 subsystems like ILU, B-3M and BEP, VEPP-2000 and beam channels.

REFERENCES

[1] Yu. Shatunov, Status for VEPP-2000 Project, RUPAC-2006, Novosibirsk, 2006.

[2] http://www.can-cia.org

[3] http://www.inp.nsk.su/activity/automation/index.ru.shtml

[4] V.Kozak, at al., Embedded device set for control systems. Implementation and applications, RUPAC-2006, Novosibirsk, 2006.

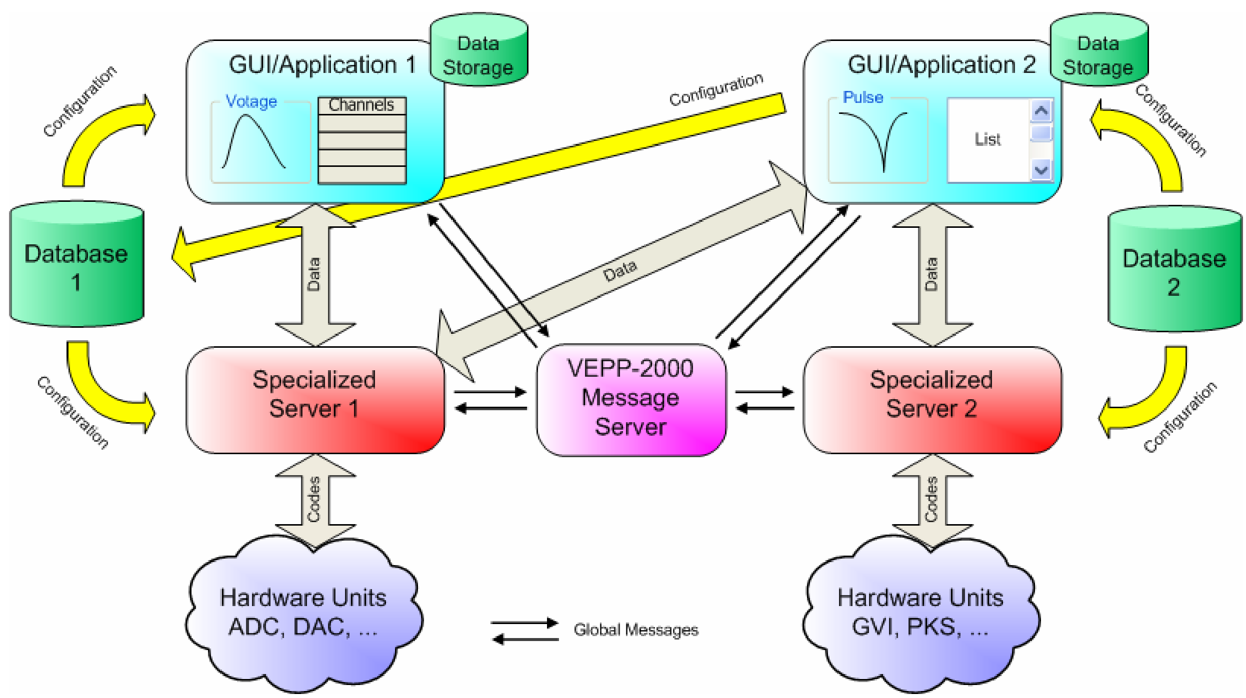

Figure 3: Principles of VEPP-2000 software construction