VEPP-4 Control System Upgrade

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Abstract

VEPP-4 control system requires an upgrade to support the system functions. The existing control system is based on CAMAC embedded 24-bit computers. An upgrade would allow us to use PC-based application programming.

In the paper we will describe an approach which allows us to integrate the existing control system as a real-time process level into a three-layer architecture which resembles the standard model (Fig.1)’:

- PCs on an operator level,
- existing computers on the process level,
- microprocessor-based front-end electronics on the equipment level.

We are to use a data flow server to link the operator and process levels, to fit net protocols and data format, and to reduce a number of connections between the levels. This server includes dynamic database with values of all control and measurement data. Both networks between the levels are based on Ethernet.

The access from the operator level to the process level is provided by home developed applications. The operator level network is private and separated from the BINP public network by a bridge.

1 Introduction

VEPP-4 facility was commissioned in the end of 1970 s as a facility for providing experiments with colliding electron-positron beams. The first version of VEPP-4 control system was based on ODRA-1300 24-bit computers (analogous to ICL-1900 series). In the early 1980’ a necessity for the control system upgrade became obvious for the following:

- existing electronics became obsolete, but a full range of custom-made CAMAC electronics for automation (different types of DACs, ADCs, multiplexers, switches, etc) was developed in BINP,
- in 1983-1985 an autonomous crate controller emulating instructions set of ODRA-1300 was designed,
- existing ODRA-1300 computers became obsolete and unsupported.

This upgrade was completed in the end of 1980 . s

Now the control system has a star architecture of Intelligent Crate Controllers (ICCs) with a central node supporting a boot of peripheral computers, intercomputer communications and file server functions. A set of Passive CAMAC Crates (PCCs) with front-end electronics is

2 Upgrade requirements

Possibilities of the existing control system have become non adequate for a great number of control needs, especially for feedbacks and graphics. The upgrading of VEPP-4 control system would be done in two stages. We split the upgrade in to two stages because a long period of time is needed to develop new application programs for the operator level of a new system.

The goals of the first stage of the upgrade are:

- to replace a large number of interface types for intercomputer communications with one custom-made CAMAC-embedded Ethernet-CAMAC adapter,
- to eliminate obsolete system modules and devices that are not manufactured or soon will be,
- to eliminate home developed file system on existing hard disks (total 40 Mbytes) by PC file system; at the first stage of upgrading this PC provides functions of the existing central node (network connections, a file server and a bootable computer).

The main requirement for the first stage of the upgrade is to preserve the developed application software.

At the second stage of the upgrade PCs will be used as operators and graphical consoles. At the second stage, the central PC becomes DataBase and Transmit Server (DBTS) and additionally provides the next functions: fitting of net protocols and data format, reducing data flow between the operator level and the process level, providing dynamic database and proxy server functions.

Fig.1 shows a simplified scheme of new VEPP-4 control system.

3 The first stage of upgrade developments

The next developments are included into the first stage of the VEPP-4 control system upgrade:

- Virtual Terminal Process (VTP) in existing ICCs and PCs, such a process which provides in PCs a virtual terminal for running applications in ICCs,
- Ethernet-CAMAC Adapter (ECA): 2M CAMAC-module includes commercial Ethernet-for-PC board and firmware realized packet driver,
- multiprocess server on PC under MS DOS; now it has a full acceptable performance for file accessesconnected in a star configuration via serial data links to
  each ICC [1].

and intercomputer communications about 100 - 200 Kbytes/s.

As all new system implementations are additional to existing system software, the change of interfaces will not affect the existing applications

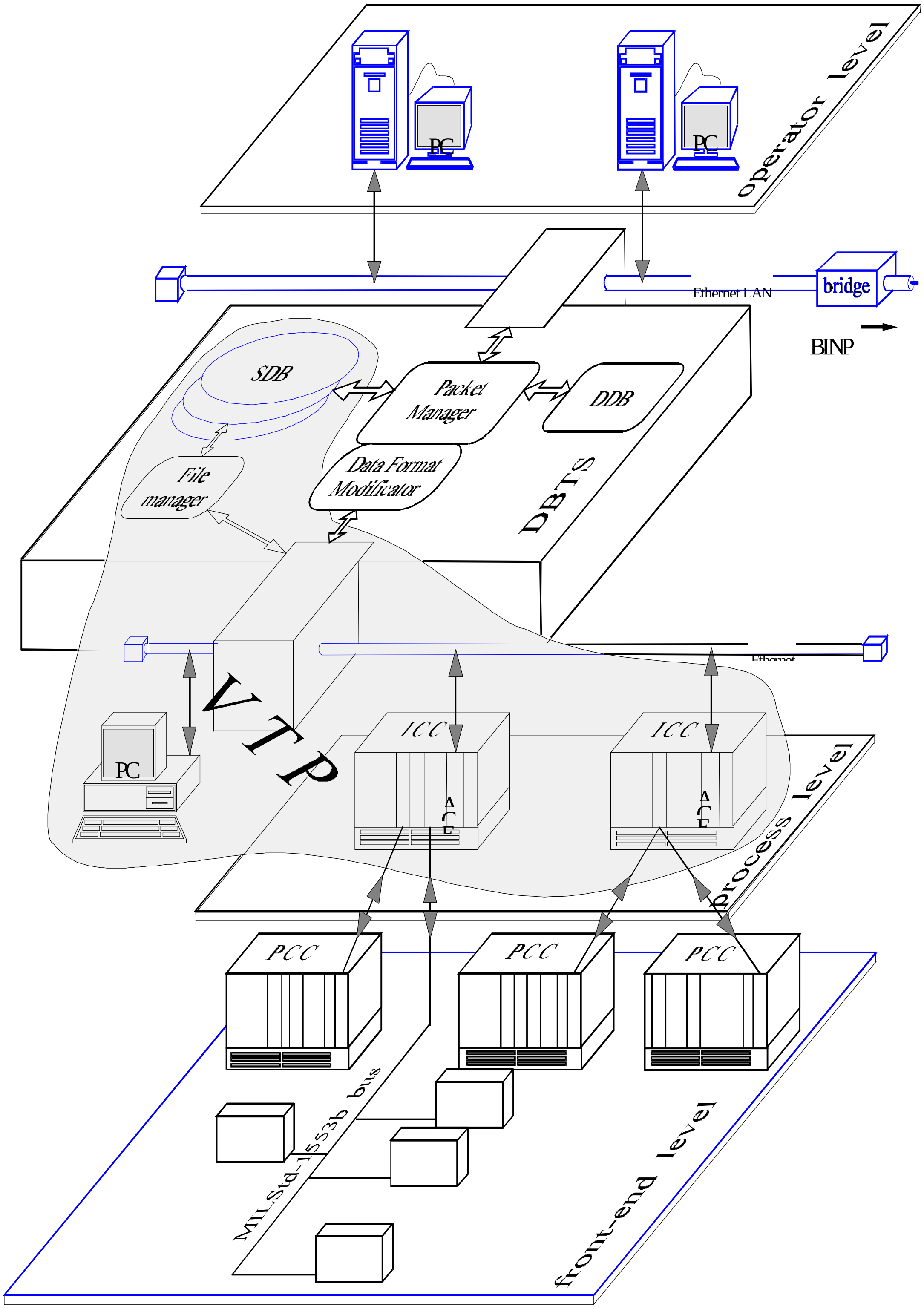

Figure 1 Scheme of the VEPP-4 control system upgrade

4 DataBase and Transmit Server

4.1 Dynamic DataBase

Dynamic DataBase (DDB) is arranged in memory of DBTS and includes:

- values of all control and measurement channels (coil currents, voltages, temperature, vacuum, etc.),
- beams parameters (values of beams currents,
- status information (polarity (electrons or positrons) and readiness of the systems, particles energy, etc.)

The ICCs run local programs that periodically read and control modules on their local CAMAC serial highways. For example, all the data in ICCs controlling pulsed systems are updated at a 1 Hz rate. The ICCs only send data packet through the network to DDB for the parameters that have changed. Operator level program sends control packet through DBTS to ICC to perform control or measuring act. After the act has been performed, ICC returns new data to DDB and sends the answer to the initial operator program.

4.2 Types of Interchanging Data Packets

The next types of interchanging data packets are allowed for DBTS:

- between the operator level and the process level without modification,
- between the operator level and the process level with data format modification (24-bit word ⇔ 32-bit word),
- between DBTS and ICC,
- between DBTS and an operator application,
- from one ICC to another.

4.3 Static DataBase

A Static DataBase (SDB) is arranged on DBTS disk and consists of three parts. The first part of SDB includes a full description of the control electronics configuration: addresses of crates, types and positions of modules, etc. The second part includes the description of control channels: records of text, integer and real variables. The third part of SDB includes files, which are sets of operating data values for different parts of the facility.

5 Conclusion

The first stage of the control system upgrade would be completed by the end of the summer next year. Now we have developed most of the system implementations (VTP, software for the PC-server) and have completed a design of ECA. Hereafter a realization of the first stage will allow us to extend a function range of the server and to integrate operator level applications while keeping the operated control system available. It is important for us to make the second stage at the same time, when VEPP-4 facility runs into operation.

6 References

[1] A.Aleshaev, et.al. VEPP-4 Control System, ICALEPCS'95, Chicago, USA, p.799, F-PO-2.