UPGRADE OF THE PLS LINAC CONTROL SYSTEM

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ABSTRACT

The old 2Gev Linac Control system with three-layered architecture was developed by in-house members in early 1993. In the new system, EPICS, a non-commercial toolkit, replaces RTworks, a commercial SCADA software Toolkit. This paper describes the old RTworks based system and the new EPICS based control system for PLS Linac.

INTRODUCTION

The PLS linac control system has not performed adequately for beam physicists and operators because the old PLS Control system is out of date and the application software has increased. After the evaluation of possible accelerator control systems, we selected the de facto standard EPICS Toolkit in the second quarter of 2001[1].The EPICS project for the PLS control system including linac and storage ring started simultaneously in the third quarter of 2001. Since then, the linac control system was converted to EPICS in the MPS, Modulator and Beam Loss monitor step by step. First, these systems affect the beam operation and a vacuum control system was excluded from the project. Because we worked on the EPICS project while maintaining high beam availability for beam users, the control system was thoroughly examined step-by-step for six months prior to the field installation. The developed EPICS system controls magnetic power supplies, modulators/klystrons, and IPAs. The Junction Box was developed and installed along with the previous items for the convenience of maintenances and repairs. In addition, we installed a network device to monitor the system status and to command remotely in the EPICS control system. Before installation to the linac field, the original VME system by Eltec had been operated under OS/9. EPICS IOC, VxWorks O/S hardware system of Motorola, replaced this system. The EPICS control system was installed around PreInjector, Linac and BTL in linac gallery. Table 1 and Figure 1 compare the old and new systems.

	Old system	Upgraded system
S/W Toolkit	RTworks	EPICS
Architecture	3 Layer	2 Layer
Network	10base2	100 base TX/FX
IOC Platform	M68K VME/OS-9	VME/VxWorks PC/Windows,Linux
Core S/W	Homemade S/W	EPICSBase3.14
Device Intf.	Direct I/O	Serial, Ethernet

Table 1: Comparison of systems

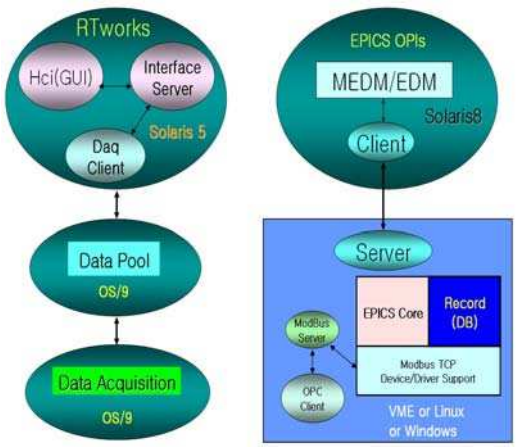

Fig 1: S/W Structure of systems

OPERATOR INTERFACE

The old system used RTworks software package by Talarian as the OPI the development tool. RTdaq was mainly used to handle the data coming from the VME system installed in Realtime device level. The Control Panel could be graphically built using RTdraw. In addition, the communication with the VME System that was run in a low-level system could smoothly interface the components provided by RTWorks.

However, RTdaq provided at present was able to run only under VxWorks. Since the VME System, old Front-end computer for PLS linac control, can run in OS/9, the user defined communication software module is configured to indirectly interface with RTdaq. The software structure in Fig.1 could not show the original performance of RTworks. Therefore, we chose EPICS, Control System Toolkit proven in the accelerator control field and is free of charge.

DATA ARCHIVING

A Data Archiving System has a purpose to classify and saves necessary data extracted from a database. The old control system was very poor in the saving data. The PLS RTworks-based system did not have saving tools but temporarily saved the data in the shared memory as shown in Fig. 2. The system simply saved files that were indexed in a sequence with key signals by each system.

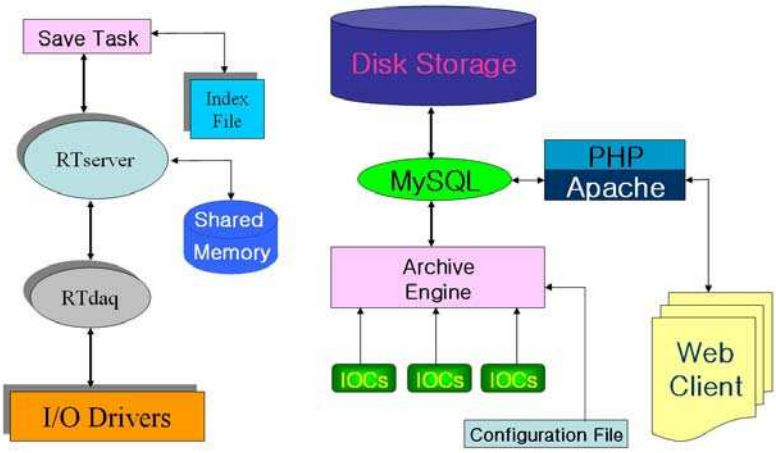

Fig.2: Software structure of the old and new systems for data archiving

Thus, the data disappeared after the power-off. In addition, as the amount of the data increases, the speed of saving and searching the data decreases remarkably. Due to this problem, an upgrade in the data archiving system is required. Thus, we selected and used temporarily My-SQL Database which was free of charge. Our decision was based on the fact that consuming less computer resource and easy understanding lead to less time and effort. Now it is possible to save and control much more data by selecting My-SQL. The change leads to more efficiency in the data control. The Data Archive System can not only save but also monitor necessary data graphically on a web browser. In addition, users are able to search and modify data on a web browser.

CONTROL NETWORK

The network of the old linac control system physically shared the same routers with an office network. IP addresses registered in the same routers are distinguished by an access list.

In such an environment, due to network traffic caused by increasing the number of computers and excessive use of the internet, the control system network was in trouble and response time was delayed. During this summer shutdown period, the office subnet and the control system network installed each router separated physically (Fig. 3). Only the node permitted by the control network router may be used.

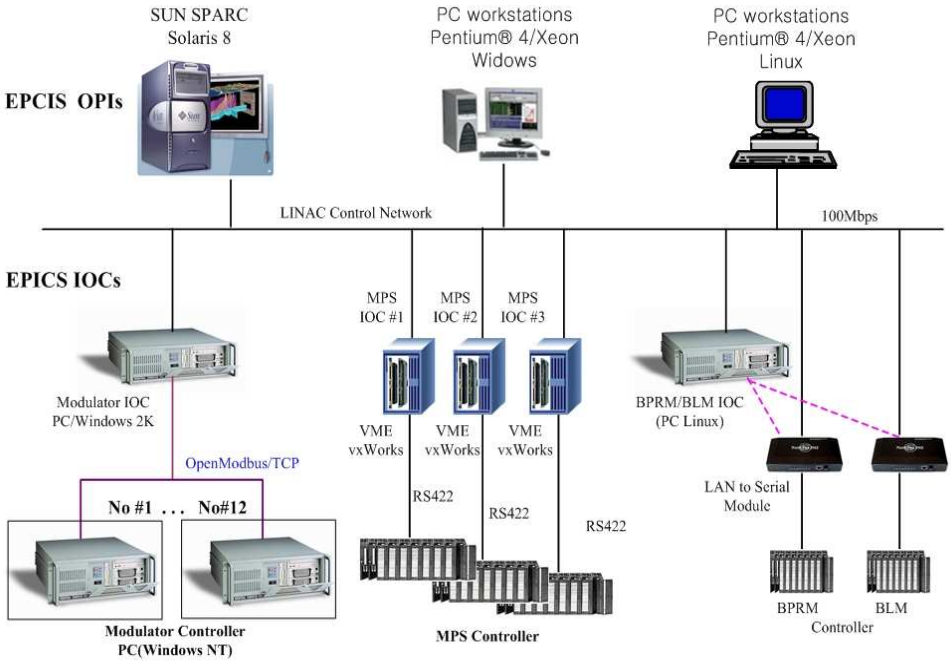

Fig.3: The architecture of the developed EPICS control system for PLS Linac

CONTROL SYSTEM FOR MAGNET POWER SUPPLY

There are 100 power supplies for various magnets and solenoids in the linac and BTL. This system replaced the old VME 68K CPU boards with OS-9 to a new Power CPU. (Fig.3)

EPICS IOCs are implemented in a VME bus system with MVME5100 CPU running the VxWorks real-time operating system. We selected the VME system under VxWorks to preserve our investment in hardware and to make the use of the existing EPICS resources for VME I/O boards. To interface the MPS interface controller with the serial interface, serial PMC module (TPMC866) with 8 channels on the PowerPC CPU Board is used [2].

DATA ACQUISITION AND MONITORING OF KlYSTRON /MODULATOR SYSTEM

12 klystrons and 12 modulators are installed in the klystron gallery. In the 12 modulators, the VME

system is assigned to control each modulator. Data Logging necessary for beam operation is important and the absence of a self-diagnostic function in modulators has been a problem. Moreover, VME-OS9 was difficult for modulator device experts who were familiar with PCs to use. Thus, the development of the control system called new modulator controller based on industrial PCs that can satisfy insufficient conditions mentioned above is promoted. Electronic signals for access to modulator devices are categorized by the analog monitor and the control signal, the digital monitor and the control signal, and the trigger signal. Two Printed Circuit Boards, namely Interlock Signal Condition Module and Fast Pulse Signal Conditioning Module that can access the signals mentioned above were developed and built in the industrial PC platform installed in a 19 inch Rack module. An Event Driven Method under Borland C++ builder 5.0 was used for the Data Acquisition software of this system [5]. Modulator controllers installed in each of 12 modulators are networked to the Modulator IOC mentioned above through Ethernet. ModBus TCP/IP protocol using Ethernet is popular among accelerators and industries as the Field Bus of current control networks. Also, ModBus device support software module is already developed and works well in the EPICS environment.

CAMERA CONTROL AND MONITORING OF BEAM LOSS DATA

There are two BM (Beam Monitoring) stations; one for the linac and one for the BTL. Out of 14 beam profile monitors (BPRM), 4 units are located in the linac, three units for BAS, and 7 units in the BTL. There are also 42 beam loss monitors (BLM) in the linac and 15 units in the BTL and BAS. In each BM station, the camera controller and the BLM Controller are installed [3]. This controller has an intelligent CPU and a serial network function. In the old system, traditional VME CPU Board and a serial interface board were used. This system is replaced with an industrial PC system and LAN to Converter module that is cost effective. Although there are various products internationally, we used the LAN to Converter I/O module, NetEye, proven in many domestic industrial sites [6]. We installed and configured this hardware module with Async, Device Support facility provided by EPICS [4].

SUMMARY AND FUTURE PLAN

The EPICS control system installed in the linac field has operated successfully so far. Especially, the EPICS system for MPS has proven very reliable showing no system downtime. Soon we will add the BCM and Vacuum EPICS control system in the near future.

ACKNOWLEDGEMENTS

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REFERENCES

[1] J. H. Kim, K. M. Ha, J. M. Kim, I. S. Ko, et al., “Development Status of EPICS Application for PLS Computer Control System,” ICALEPS2001, San Jose, USA (2001).

[2] J. H. Kim, J. M. Kim, J. W. Oh, I.S. Ko, et al, “Upgrade of the MPS Control System for PLS Linac,” LINAC2002, Gyeongju, Korea (2002).

[3] I. S. Ko, J. H. Kim, J. Choi, and W. Namkung, “Control System of PLS 2-GeV Electron Linac,” IEEE Trans. Nulc. Sci., 43, 25 (1996).

[4] http://www.aps.anl.gov/epics

[5] S. C. Kim, S. S. Park, S. H. Kim, Y. J. Han and S. H. Nam, “New Modulator controller of the PLS Linac,” EPAC2002, Paris, France (2002).

[6] http://www.smic.co.kr