

DEVELOPMENT STATUS OF EPICS APPLICATION FOR PLS COMPUTER CONTROL SYSTEM

J. H. Kim, K. M. Ha, J. M. Kim, K. H. Kim, E. H. Lee, J. C. Yoon,
J. W. Lee, J. Choi, S. H. Nam, J. Y. Huang and I. S. Ko
Pohang Accelerator Laboratory, POSTECH, Pohang 790-784, Korea

Abstract

The control system for Pohang Light Source (PLS) was designed about twelve years ago and has been working without serious problem so far. However, as the demand for the application programs for accelerator physics and data analysis increases, the present control system shows the lack of flexibility and control speed. To have faster and more flexible performance, we have decided to convert the current control system into an EPICS-based one on the two-layered hierarchical Ethernet network. EPICS Toolkit will be applied to our system while preserving our investment in most hardware. All EPICS system will be replaced to ensure homogeneous layout for PLS linac and storage ring. This paper presents the status of the application development with EPICS on a test bed system and the future plans.

1 INTRODUCTION

A basic function of the control system for the accelerator is to operate various subsystems remotely in real time manner and to archive necessary data for the operators and users. In this sense, the current control system for the PLS satisfies the basic function in a daily operation [1-3]. However, this custom-built, twelve-years-old system is facing difficulties to catch up the growing number of beam lines last decade from two to almost twenty and many insertion devices. Moreover, fast changing technologies in this field make the routine maintenance difficult because of short lifetime of hardware and software. For example, some VME boards are no more in the market since long time, so the replacement is simply impossible. We are now facing to adopt rapidly growing information, telecommunication, networking, and computer technologies into our new accelerator control system. This system should provide not only fast and reliable performances, but also various advanced services such as modeling and simulation for the operators, accelerator physicists, and beam line users. A short list below shows the reason why we need to upgrade the current PLS control system (or replace the current system to new one in a sense):

- Replace obsolete subsystems to worth new ones
- Adopt current technology development in IT/Control system
- Getting better reliability in system
- Easy and quick maintenance capability
- More flexibility to adopt ever growing demands from users
- Easy use of operation data by accelerator physicists
- Provide good data handling tools for beam line users
- Maintain the system configuration within industrial, international, and de facto standards

2 COMPARISON BETWEEN THE CURRENT SYSTEM TO NEW ONE

The design of the current control system was finished in 1990 and completed by in-house members of PLS in 1994. It has three layers of hierarchical structure. The VME data acquisition system was very similar to Elettra (Trieste, Italy) control system, and the upper layer in Unix was adopted from the concept of SPEAR (SLAC, USA) control system. This system, especially hardware platform, has been used until now with good reliability and acceptable performance. However, the rapidly expanding beamlines and the new insertion devices, increasing the control points, produce serious problems to this system. This difficulty is enhanced by the poor structure of database. Because of this, developments of various application programs for accelerator operators, physicists, and users are limited.

In the current control system [1-3], the data or the control/monitoring commands are delivered through three layers of hierarchical (and physical) structure that means three different computers. Due to this, the response time takes longer and it has higher chance of failure in the data delivery. Also, there are two databases: one in Unix layer (or operator interface layer) and another in VME layer (or data process layer) which functions as a supervisory control computer. Even though the original aim was to organize handling of data in each layer, this actually gives data handling more complex, longer data handling time, and waste of resources. For the operators and accelerator physicists,

it is not easy to make their own application program because of complex database and lack of utility tools. From a hardware point of view, MIL-STD-1553B channel and 10 Mbps Ethernet were the top of the line products when they were chosen, but not any more. This network is too slow to handle large image data.

By counting various aspects, we have decided to build new control system for PLS with replacing necessary hardware and network to new ones, and intensive use of EPICS in the software development [4-6]. The new control system has two layers of hierarchical structure and a centralized database. This gives the fast response in the system and the effective use of resources. Accelerator operators and physicists can build their own application, such as alarm handler (AR) easily by using simplified database and tools that EPICS provides. Since this upgrade or replacement requires a lot of efforts and experienced manpower, we decide to build a test bed that is a scaled version of one full system [7].

3 TESTBED FOR PLS CONTROL SYSTEM UPGRADE

Figure 1 shows the schematic structure of the test bed for PLS control system upgrade, and Table 1 lists the hardware used in the test bed. The current status of the test bed is following:

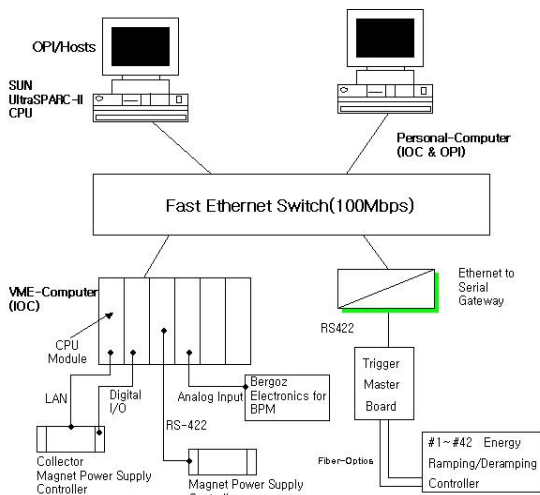


Figure 1: Schematic structure of test bed control system.

3.1 Host

Most of EPICS extension tools are successfully installed. As an example of the PLS main control screen, the control/monitoring window for the magnet power supplies (MPS) is completed as shown in Fig. 2 with MEDM tool. A test of channel access with IOC

has been completed. There is also a panel for energy ramping control in Fig. 3 by LookOut (NI product) under Windows 2000 environment. This LookOut is connected to IOC via channel access client.

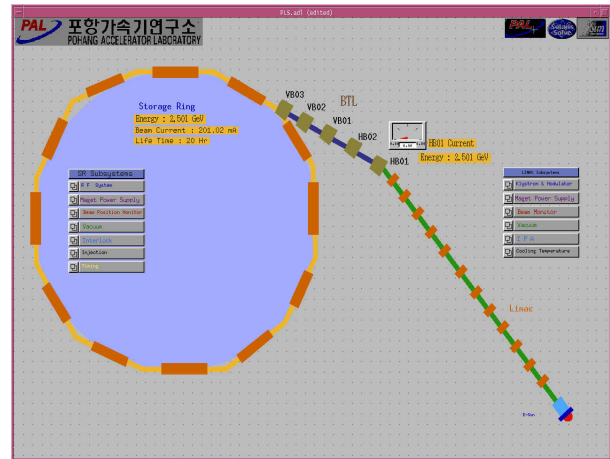


Figure 2: PLS main control screen

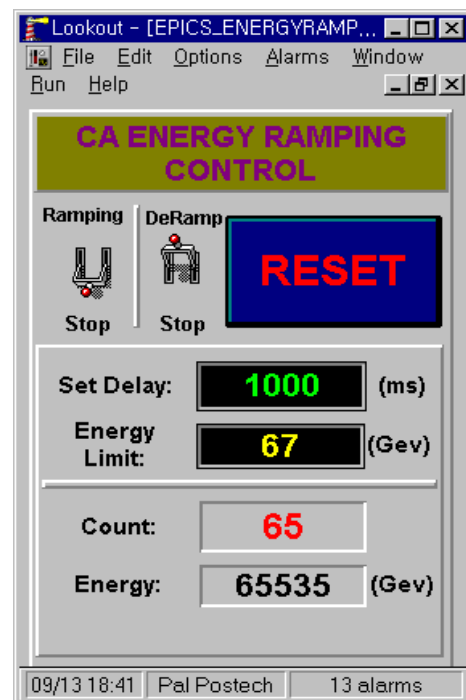


Figure 3: Ramping /Deramping Control panel

3.2 IOC

There are two IOC hardware platforms (VME, PC) to satisfy the current PLS control system installed in the field. Therefore, the test bed has independent development environment for VME and PC IOC. In a VME crate under vxWorks, PowerPC SBC (MVME 5100) and M68K SBC (MVME147) are used along with I/O boards connected to MPS controllers, BPM

electronics, and ramping controller as listed in Table 1. For this system, EPICS Base R3.13.5 is used. At present, device access tests are being carried out by using records supported by EPICS. We are now testing the several I/O boards to select the optimum interface so that our machine controller can work in the lower level. Also, under Windows NT and 2000 environments, EPICS R13.14.alpha2 version is used to connect for PC IOC. Record supports are obtained by producing threads from EPICS standard aiRecord and aoRecord. The Capfast and VDCT are used as a data configuration tool.

3.3 Local Controller

The new controllers are being developed for the corrector magnet power supply and the linac modulator control with EPICS architecture concept. To support the existing and EPICS control system hardware interface, these controllers have two independent data channels to connect the IOC within controllers. Especially, the MPS corrector controller is designed to have Ethernet controller chip with TCP/MODBUS communication protocol [8]. The prototype modulator controller based on the industrial PC is changed from having simple functions for Linac modulator and klystron to adopting the EPICS IOC function.

Table 1: Hardware list used test bed control system.

Hardware	Specification	Purpose
SUN ULTRA 80	Two UltraSPARC-II 450MHz CPU	SUN WS Host
MVME5100	PowerPC SBC	VME IOC CPU B'D
MVME147	M68K SBC	VME IOC CPU B'D
Pentium_III PC	Pentium_III MotherBoard	PC IOC/Host CPU B'D
TSVME500	4 Ch. Serial RS422	MPS controller-1
TPMC866	8 Ch. Serial RS422	MPS controller-2
VMIVME-3122-331	64Ch. ADC Board	BPM Electronic intf.
ADAM-4572	Ethernet to Serial Controller	Ramping Magnet
CES VMDIS 8003	VME Bus monitor	VME bus debugging
Home made Corrector MPS Controller	One chip intelligent controller board with Open Modbus/Tcp intf.	Corrector MPS Control/monitor
Home made MPS Controller	One chip intelligent controller board with serial interface	Linac MPS Control/monitor

4 FUTURE PLANS

Even though this test bed project is limited in size, this is a good opportunity to educate EPICS to software engineers, operators, and others who have interests in learning how to use EPICS in PLS [9]. We will continue to work on this test bed by increasing the number of IOCs by early 2002. After we have satisfying results, we will expand the test bed to one full cell out of 12 cells in the Winter 2002 maintenance period. A complete upgrade of PLS control system is expected by 2003.

ACKNOWLEDGMENT

This work is supported by Pohang Iron & Steel Co. and Ministry of Science and Technology, Korea.

REFERENCES

- [1] 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).
- [2] I. S. Ko, Jin W. Lee, Jong C. Yun, Eun H. Lee and Byum R. Park, "Computer Control System of PLS 2-GeV Storage ring," IEEE Trans. Nucl. Sci., 45, 2012 (1998).
- [3] I. S. Ko, J. H. Kim, S. C. Kim, "Test Bed of Control System Using Multimedia Technology at PLS," IEEE Trans. Nulc. Sci., 45, 2016 (1998).
- [4] <http://www.aps.anl.gov/epics>
- [5] <http://mesa53.lanl.gov/lansce8/Epics/epics.htm>
- [6] http://csg.lbl.gov/EPICS_collaboration.html
- [7] J. H. Kim, K. M. Ha, J. M. Kim, S. H. Nam, J. Y. Huang, I. S. Ko, "EPICS based upgrade plan for PLS control system," Korean Physical Society 2001 Fall Meeting, Kwang-ju, Korea (2001).
- [8] OPEN MODBUS/TCP SPECIFICATION Release 1.0, 29 March 1999
- [9] K. H. Kim, J. Choi, T. Y. Lee, G. N. Kim, M. H. Cho, W. Namkung, and I. S. Ko, "Development of the Simulator for the Global Orbit Feedback System using EPICS," in these proceedings