Technical Summary Report

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1 Introduction

First of all, I like to express my sincere thanks to Dr. Axel Daneels and Dr. Jijiu Zhao for inviting me as a final speaker to make the summary talk of ICALEPCS97. Also, many thanks go to all member of technical staff working at the computer room for their helps on making the final presentation electronically.

Before I try to attempt to make a summary, I have to confess that I am not a control specialist. I am mere an accelerator physics who once accidentally had been in charge to develop the control system of the Pohang Light Source. So, my summary is basically the collection of highlights and issues made throughout the ICALEPCS97.

2 Review by subject

There are more than 200 papers presented at ICALEPCS97. About three quarters of the papers presented are from the discipline of accelerator and its application. However, there are still significant contributions from the field of astrophysics observation, fusion science, and the high energy physics experiment.

2.1 Status report

One of the interesting point of this conference is that there are several status reports from various fields. There are three reports of promising accelerators: SPring-8, RHIC, and KEKB. Control systems for VLT and LHD are also introduced. The Spring-8 is the latest but largest third-generation synchrotron radiation source. Its quick and successful commissioning shows the key role of the control system.

Not only SPring-8 but recently completed accelerators such as most third-generation light sources and CEBAF at TJNAF show that their commissioning has been completed smoothly within short period of time. One can think that there are several reasons for the success such as better accelerator design codes, higher precision manufacturing, better quality assurance, and finer alignment. However, one cannot deny the importance and the key role of the well-developed control system *in advance*.

In this conference, we hear that the success of modern control system for large experimental device is based on the well-organised project management during the development stage. For SPring-8 [1], the control system developers follow the standard model with spiral prototyping. For VLT system [2], the developer sets up frequent deadlines and S/W reporting system to integrate complicated work done by many collaborators. They also learn what other people had made before.

We also hear the negative feeling on the possibility of turnkey system. Even though there is only one report on this matter for ESRF RF control system [3], it is certain that there are many unreported systems facing such troubles. It seems a common feeling that the turnkey control system is extremely difficult to upgrade or expand the system after it has once been installed. This limitation is serious drawback when the hardware and software are changing very rapidly.

2.2 Hardware development

We hear that the DSP technology is widely applied to various systems. Particularly, there are several applications for the fast orbit correction [4,5]. Clearly the DSP applica-tion will be expand to more sophisticated system such as longitudinal feedback system to allow the bunch-by-bunch beam manipulation in the near future. Because of cheaper cost of DSP chips and better development tools, the DSP application will expand very rapidly to various fields in the accelerator and other large experimental devices.

For the new fieldbus system, there are three strong protocols: CAN, PROFIBUS, and WORLDFIP [6]. They will be used for next generation control system by fulfilling the maximum capacity of real-time control. So far, the VME system is dominant in the current control system. However, there are still a significant number of CAMAC systems being used.

In my point of view, one of the key issues in the hardware development is the expansion of PLC system into the main accelerator control system. This progress is clearly marked by the two-decade-long experience of PLC installation at CERN [7]. By followed its industrial origin, PLCs were used various auxiliary systems such as utility control or fire alarm. Since then, their usage becomes expanded to the front-end level such as power conversion system and even to the control room level. For example, PLCs have become widely used in the interlock system or machine access control system for many accelerators. It is because that the PLC has an industrial robustness and it is easy to make a simple logic flow. Now, one can forecast that the PLC will be integrated into the communication level by using Ethernet.

2.3 Software development

During the conference, we can see the trend of software development. One of the key issues at the last conference

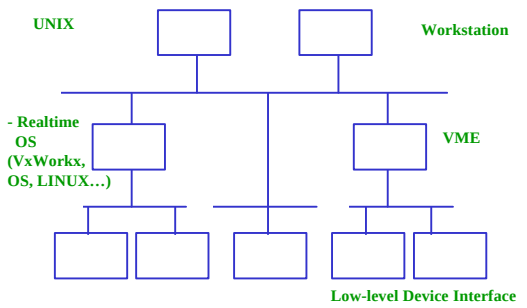

Fig. 1: Standard Model.

was the collaboration of software development and software sharing. The introduction of EPICS followed by its growing user group is still a good example of this demand. However, there are still obstacles in sharing software such as different type of computers and their operating systems.

After JAVA language was introduced about 850 days ago (as we heard at the last invited talk on Friday made by a representative of SUN company), we become free to write an application software from the computer to be used. Even though the full sharing of JAVA applications for the console computers between different accelerators will take significant time and efforts to achieve, it is simple and easy to share small applets for icons, markers, and plot routines in the design of the man-machine interface layer.

The trend for platform-independent control system can be further achievable by adapting CORBA. This kind of effort is already started between KEK and DESY [8]. Their ultimate target is one high-level application applying to different accelerators or other large-scale experimental devices -- not only different locations placed but also different platforms used. Since this kind of control demand is unique, it seems quite difficult for the industry to develop such applications. I am sure that this is the challenging point for the control system developer in the field of accelerators and large physical device.

Internet and WWW are ever growing topics in various fields and the accelerator. Definitely, large experimental physics devices are big customers for these. Up to now, there are many attempts to use Internet and WWW in the control system. So far, some data displays and monitoring routines can be sent via Internet and WWW. JAVA will also be played a key role in the Webification of the control system.

2.4 Inexpensive systems

Even though the advanced technology is applied to large experimental devices, there are still many small-scale systems that are mostly required small budget and limited man-power for the construction and the normal operations. For this kind of demand, PCs and Windows/NT become a good solution. Nowadays, the performance of PCs becomes more and more powerful, so the boundary between PCs and workstations becomes fuzzy. There are also many development tools available for application programs. Visual Basic and C/C++ are widely used by many developers. Labview is also popular for small-sized machine control system. We can design the control console with MMI objects for distributed system by adopting Windows/NT [9]. One can clearly see this trend when we hear that even EPICS becomes available on PC and Window environment.

This trend is actually not limited to small scale control system. There is an increasing number of PCs available at the main control room for large accelerator and other experimental devices. DESY is one of such large accelerator using many PCs in the control room for a long time [10]. Their experience shows that PCs provide very reliable operation statistics. Of course, due to its structural limit, there are still several problems to be solved such as I/Os and interrupt sequences. However, one can not deny the increasing potential of PCs for the large control system.

2.5 Standard model: can we keep it?

Most of the large control system is following so-called standard model as shown in Fig. 1. It has an upper layer with workstations with UNIX system. Usually, a VME system with realtime OS such as VxWorks or OS-9 is used in the middle layer. The lower layer is a set of electronics and communication channel to send data to upper layer and to execute commands from the upper layer. However, due to the ever-growing PCs and PLCs, we are faced to rethink this standard model as shown in Fig. 2.

First, we may not need to maintain the structural symmetry. So far, the hierarchical tree maintains its symmetry for different target systems such as DC power supplies, diagnostic devices, and feedback systems. Let's think about the following case. DC power supplies for various magnets must be set before the beam operation. This requirement is clearly different from diagnostic devices that require constant data collections during the accelerator operation. In this case, such slow and sequential operating target may not require fast realtime control. Instead, PCs and PLCs nowadays can play a key role for this system. This fact is also important to build a low-cost control system.

We are also facing to develop better use of DSP applications for fast responding system. We need more study to achieve the best performance of newly introduced DSP applications in the large control system.

2.6 System upgrade

In this conference, we hear many new control systems for newly built accelerators, telescopes, and fusion devices. This new system is already incorporated current hardware and software technology. However, the rapid development of technology makes the life-cycle of products shorter. So, the new system will become obsolete soon. This is even severe problem for existing control system that is based on a decade old technology. There is no clear way how to upgrade the existing control system with rapidly changing technology. We need to share our experiences on this matter.

3 Conclusions

While we stayed at the heart of Beijing, we enjoyed real Chinese hospitality. For those who visited the Great Wall and the Ming tombs on Thursday excursion, they will not forget the police escort to come back to the banquet hall on time. Banquet was also superb and we really enjoyed famous Chinese cuisine. We thank to Hewlett-Packard China for the banquet. We also remember the local organisation committee and young IHEP members who spent their effort to make the smooth operation of the conference. I would like to express my sincere thanks to Prof. Jijiu Zhao and her superb team, who made ICALEPCS97 successful.

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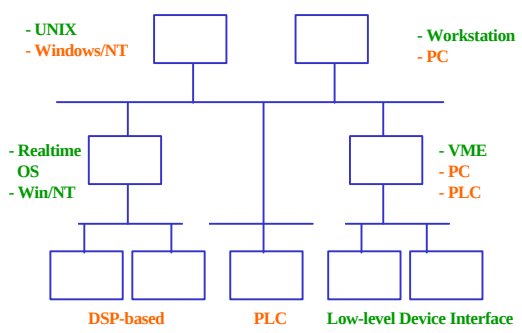

Fig. 2: Rethinking Standard Model.