TECHNICAL SUMMARY REPORT

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INTRODUCTION

In ICALEPCS'03 held in Gyeongju, Korea, there were twelve sessions that control field should cover, and all oral presentations were reported in plenary sessions. For this reason, the participant could hear all sessions; it was possible to share the results of the conference to the maximum extent.

All oral presentations were made using PC. It was effective at the point of being able to show fruitful information by using a presentation tool, and using time efficiently. A speaker could display contents correctly with having checked the file in advance, and loss time was minimized. Moreover, the actual presentation manuscript was changed into PDF form from the original files remaining in a PC in the hall, and it is now opened to the public on the ICALEPCS'03 Web. It is worth considering the conference style as future reference.

STATUS REPORT

There was a report of J-PARC which is a large-scale proton accelerator under construction, and the high energy detectors used by LHC project of CERN, and three of eight talks were nuclear fusion-related reports. In J-PARC control, Ethernet was considered as Field-bus and the method of making network connection of measurement apparatus, the PLC, etc. was reported [1].

The number of nuclear fusion-related reports increased. As for the nuclear fusion control system, it was shown by these reports that accelerator control is not necessarily a different system. For example, the system of NIF is large-scale, needs to carry out an information share among many diagnostic processes [2]. It has become the design that requires the real time control characteristics for the realization of fast processing control or automatic control. And also there are many common features of accelerator controls, such as object-oriented architecture, CORBA middleware, Java programming, and a shared memory network, in the element technology of nuclear fusion control. A spread of control technology continues to increase by collaborating with nuclear fusion systems, and it will bring the wide variety of the systems to the ICALEPCS.

There were two reports from CERN/LHC about high energy detectors. The collaborators exceeding 2000 persons cause management difficulty, and it becomes important for the choice of methodology about the efficient system development to be carried out. In CERN, a JCOP team takes the overall coordination role [3]. The JCOP team is responsible for the design of software framework and coordinates four detector teams to perform smooth development. The method is in good shape and can avoid inefficient duplication of work.

PROJECT MANAGEMENT

In order to build the control system of large-scale equipment and to make a project successful, the amount of work has to be defined clearly, and divide to assign a group, then distribute and share information effectively and cooperatively. Project management becomes still more difficult, when project members are distributing all over the world and even their affiliation differ. The NIF, SNS, ALICE/LHC, and ALMA are all large-scale projects that need advanced project management. And, so the methodologies taken by them, the learned tips based on experience are very interesting.

The NIF is excellent in the examination methodology clearly defined as the quality control technique [4]. In NIF, the responsibility and management scheme for performing the examination, the quality assurance, test method, and the measurement technique are established very systematically. It seems that such a management technique is effective in leading a large-scale project to a success, and contributes to the early detection of a failure.

In the report of SNS that is the collaborative project of six research institutes, although the project proceeded by many research institutes is difficult too, it has found out that there is a method [5]. This is the method of characterizing a work and dividing into the constituent factor by the work breakdown structure (WBS). And although it is simple, telephone communication works fine at project in the test field.

International collaborative projects, such as development of four huge detectors of a CERN LHC experiment [3] and an ALMA radio telescope project [6], have a large geographical spread of a project member. The coordinate team that has responsibility in development of basic structures, such as the architecture and a framework, determines a whole frame. And also the team adjusts progress of a project and takes care of information sharing. Collaborating groups work for building-block pieces and their local applications by following the work breakdown form. The JCOP team in CERN and the ACS in ALMA are examples. At first, the whole system is divided into a framework and each part. Then, a higher level is designed by top-down, and a lower level is developed with prototyping by bottom-up, it can be called the standard procedure we should follow.

UPGRADE AND RE-ENGINEERING

Usually, many papers are reported in this session. Every laboratory faces the needs of upgrade the old

control system of accelerators in active service. There are restrictions, that is, a long shutdown period is not available, a new system should work immediately after the shutdown, and the system should be reliable as the same level of that of previous one. We have to consider, what is the requirements for a new system to realize, how the upgrade procedure minimizes the risk, and what is a new technology to achieve better performance etc. The Fermilab updates the system of the VAX base of 20 years ago [7]. The CERN/SPS also starts for renewal of CAMAC and NODAL system of 20 years ago [8]. The Fermilab takes the method that does not change the whole at a time but is updated to "piecewise." In software change, an old code is rewritten by Java, and web technology (Tomcat) is used. The CERN/SPS system is moving from "Function oriented hardware" to "Equipment oriented hardware" architecture. The new system is designed to ease maintenance and raise reliability of the system etc. The base technology such as Java (J2EE), Oracle, VME/LynxOS, and a PLC are chosen. Concerning the upgrade strategy of the system in a limited period with minimizing the risk, SPring-8 method is worth looking at [9]. In ESRF, previous system based on C/C++, RPC, Client/Server, X11/Motif, VME, and OS9 are replaced by Compact PCI, Linux, Windows PC, C++ / Java, Python and CORBA middleware [10]. The "Java-nizing" control is interesting in whether there is any advantage on what kind of equipment controls.

Now 140 or more organizations have adopted EPICS, and EPICS can not be an exception too. The renovation project, EPICS2010, has kicked off in order to meet the future. It has started asking an EPICS user for an opinion and an idea in order to fulfill the future control needs. It is interesting in what kind of definition will be made.

HARDWARE AND FRONT-END

The programmable logic devices showed its potential at this conference. A FPGA that can be programmed by VHDL or even in C language is very flexible, performance is excellent, and a chip count can also be reduced. Analog processing of RF signal becomes easier by using the FPGA. For example, an advanced BPM read-out circuit is realizable by performing processing which reduces a noise on an analog signal by high-speed ADC and FPGA, and performing preferable data reduction by DSP [11]. Such a system provides the performance that can fit to a high-speed feedback system. It is easy to change the data processing algorithm, and it would meet the demands flexibly enough, when BPM systems are changed in order to have advanced features. The FPGA will make a progress to be a System On Chip (SOC) by combining with CPU. And we can expect a spread of various kinds of control applications with FPGA/DSP/SOC micro-devices.

The shift from a crate direct-insertion type to a network connection type seems to accelerate from now on. The architecture is based on an idea of the "Beyond the crate" [12]. This is being able to create highly efficient systems inexpensively using FPGA or PC technology. The network type equipment is connecting to Ethernet or a Fiber channel network, and is fitting into the distributed control architecture [13]. By this decentralization, the VME itself can reduce a possibility of being the failure point, and it will raise the operational stability of a control system more. Moreover, wireless LAN technology will turn into indispensable technology of ubiquitous environment. If the wireless applications would be introduced to control with adequate security, it would realize an idea of "Beyond the cable".

SAFETY

Although the session of Safety was the subject presented for the first time, the interesting reports were made about establishment of the safety about the radiation resistance and reliability in CERN/LHC [14, 15]. If the proton beams of 7TeV in a LHC tunnel loses the control and hits even a beam pipe, accelerator damage would become catastrophic. The reliability of a monitor system, a surveillance system, and a dumping kicker system will be required to prevent damage at the high level. A PLC system is still holding the good position to prevent the failure firmly by active fail-safe HW/SW and passive fault-tolerant redundant HW. In order to avoid simultaneous fault, the safety architecture is designed not to use common technology between redundant systems. Although such reliability has a demand level far exceeding the reliability about old apparatus, PLC is chosen also for the safety field because of its established reliability. The safety system of a detector is also designed with autonomic and automatic control functionality.

The control system locating close to the LHC tunnel should have radiation hardness [16]. Every micro-device in a circuit board should be tested before the installation in order to guarantee the toughness against severe neutron radiation especially.

SOFTWARE ENGINEERING, MIDDLEWARE AND COMPONENTWARE

Many reports of Java were made in the software applications. Java/CORBA was chosen as the middleware, and the wave of paradigm shift to Java componentware was reported. Although componentware is a common production method in hardware manufacture, it means making a software system combining some component part, that is a cluster of functional objects. The improvement in software productivity was achieved by object-oriented programming, however code reusability was not satisfactory as much as it was expected before. The componentware accelerates software development by shifting from a white-box style to a black-box. The Java-based black-box-izing is expected to raise more productivity than simple OOP. The accelerator Control Middleware (CMW) of CERN corresponding to the LHC era realized this with the Java/CORBA base [17]. The

new 3-Tier structure middleware of CERN/SPS CESAR is created based on J2EE (Java to Enterprise Edition) as well [18]. The XML form is used as data expression. The proposal of the paradigm shift from an "object" to a "component" was made also from ESRF [19]. When the component-oriented software applications come to service, we will see what is the difference between simple object-oriented development and component-oriented development? And what kind of advantage does a spread of the middleware using Java technologies bring about? At the coming conference in 2005, the reports based on development experience will be presented.

INTERNET TECHNOLOGY & DISTRIBUTED KNOWLEDGE

A Java-based Web technology shows that Java is the key technology of the Internet. The server side applications of Web are created by Java enterprise edition. A data of Web application can be described in XML format. Apache/Tomcat is introduced into server engine, and dynamic creation of contents is performed on a server side. Web technology is indispensable keystone powerfully as a means of information sharing in the inter-laboratory projects. XML/XSL form is convenient in a share/exchange of information between laboratories. Java-based information system can be an application of "B2B solution (Business-to-business)" between research institutes.

The e-LogBook developed in DESY is a powerful tool for information sharing between collaborators or even laboratories [20]. Now, it is extended not only a HTML base but also a Java base. The e-LogBook use XML for data expression, Apache/Tomcat for service engine, and Oracle as a database server. Thus, J2EE, XML/XSL, Apache/Tomcat are base technology to realize the secure data sharing, information expression, and authentication. The Internet environment will become standard from now on by using Web technology as a core, and it will be an indispensable component technology of Global Accelerator Network (GAN) in a large-scale international collaboration project like a next-generation linear collider.

COMMENTS

At this conference, applications of the network connection type were reported. These are steps towards the realization of an idea of “Beyond the crate”. However, application to the control system of ubiquitous environment, such as wireless LAN that realizes “Beyond the cable”, or operation using a mobile terminal was not reported to the large extent. The crates and cables could be a boundary condition of the system design for the large-scale facilities. However, networking or wireless technology has the potential to be the solution. By virtue of proceeding information technology, many reports will be made at the next conference in 2005 at CERN.

CONCLUSIONS

It should be mentioned that ICALEPCS’03 was successful. Conference management was smooth, its performance was good, and the support staff's work was excellent and should be mentioned especially. We saw the heartfelt support here and there during the conference, and they led the conference to a success in historic beautiful place Gyeongju.

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