A Plan of a new Control System for the RIKEN Ring Cyclotron Using EPICS System

Masahiro KAJI*, Misaki KOBAYASHI**, Makoto NAGASE**, Ichiro YOKOYAMA**, Toshiya TANABE**
Masayuki KASE**, Makoto SUGIMOTO***

* Mitsubishi Electric Corporation
2-2-1, Yaesu, Chuo-ku, Tokyo 104-0028, Japan
** The Institute of Physical and Chemical Research (RIKEN)
2-1, Hirosawa, Wako-shi, Saitama 351-0198, Japan
*** Mitsubishi Electric Control Software Corporation
6-1-2, Hamayama-dori, Hyogo-ku, Kobe, Hyogo 654-0871, Japan

Abstract

It has been more than 10 years since the present control system of the RIKEN Ring Cyclotron (RRC) started its operation. It is necessary to expand the present system to suit for the RIBF project [1], however extending with the present system is not desirable, considering that the composition parts become old and its maintenance cost is high.

A plan of alternative new control system of the RRC by using EPICS [2] system has been proposed since last year, and we employed a part of the system for some preliminary tests this spring. The total plan of the system and the obtained result will be reported in this paper.

1 Introduction

Figure 1 shows the block diagram of the present control system of the RRC. The characteristics of this system are as follows:

(1) The computer network consists of three mini-computers (Mitsubishi M60/500) which are linked with one another through the optical fiber loops.
(2) A CAMAC serial network and a GP-IB are used for the control of the accelerator devices.
(3) Microprocessors are used for the interface between CAMAC modules and controlled devices.
(4) The operating system OS60/UMX is a combination of a real-time and UNIX system.
(5) Most operations are performed by the touch panels.

Adding to (3), two types of intelligent modules are used; one is a CAMAC module called as CIM (Communication Interface Module), and the other is a terminal module for high-speed local control of the accelerator devices called as DIM (Device Interface Module). The details of the system were mentioned in Ref. [3] [4].

2 Plan of the new System

The present control system has some problem shown below.

(1) Maintenance

The host computers of the present system are mini-

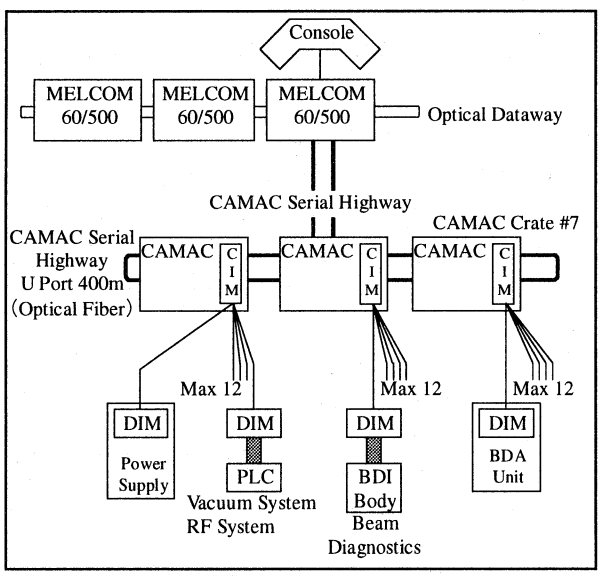

Fig. 1 The present control system of the RRC.

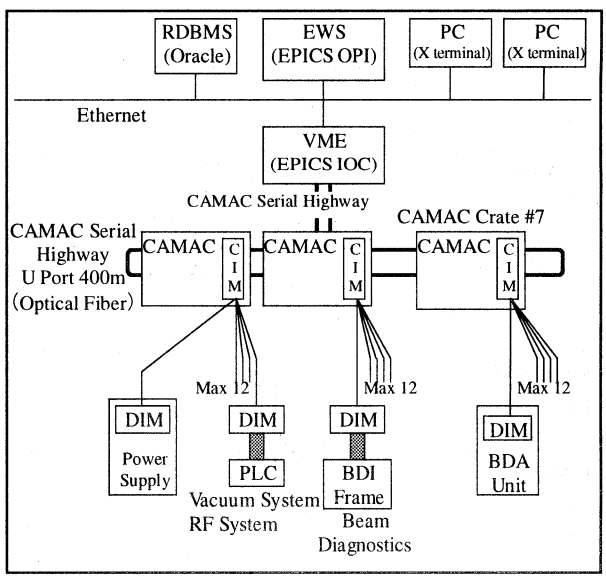

Fig. 2 The new control system using EPICS.

computers, of which maintenance cost is comparatively high. Furthermore, the touch panels for accelerator operation become old. Replacing the panels to new ones requires developing new applications for it.

(2) Mixture of control data and logic

The current control system has not achieved a separation of control data and logic. The data for control is embedded in each Fortran source code as "DATA" statements. It is a possible source to cause some problems. For example, it may have inconsistency since several application programs have data of the meaning same in each source code.

In order to solve these problems, the replacement plan is proposed. (Fig. 2) The new plan is that the M60 computer system should be removed, and VME computers and engineering workstations also should be introduced. Software on M60 is replaced by EPICS and Oracle based software system.

We tested a preliminary system of the new plan last summer. Table.1 shows comparison between the present system and new system.

3 EPICS Control System

EPICS is a distributed control system that is developed by EPICS collaboration. In an EPICS control system, VME single board computers are used as IOCs (Input / Output Controllers), which work as distributed servers of EPICS. Real-time operating system VxWorks, which is developed by Wind River Systems Inc., runs on the VME computers. EPICS IOC applications consist of IOC Core, Record support, Device support, and Driver support. When using the hardware currently not supported by EPICS, a hardware driver and/or a device support routine need to be created.

Moreover, EWSs are used as OPIs (Operator Interface). EPICS protocol between IOC and OPI is called CA (Channel Access) protocol. The CA client applications such as MEDM (Motif-based Editor / Display Manager), ALH (Alarm Handler) and AR (Archiver: EPICS logging tool) run on OPI. Using these basic EPICS applications, user can create a basic control system without programming.

4 Accelerator Database System

In the new control system, we planned to concentrate all data of the accelerator system on the relational database management system. It brings sharing of data between users and prevents dual keeping of the control data.

Oracle runs on a Linux server computer. This database manages the property of the control devices such as a name of device, a control address, and a specification.

Table 1 Comparison between M60 system and EPICS system

• **Hardware**	**Present System**	**New EPICS System**
Computer	Mini computers M60 CAMAC Crate Controllers	VME Computers (For I/O Controller) EWS's (For Operator Interface) CAMAC Crate Controllers
Network	CAMAC Serial Highway (UDP Optical Fiber)	CAMAC Serial Highway (UDP Optical Fiber) Ethernet (between EWS and VME)
Operational Screen	Character-based Touch Panels	Graphic User Interface (Motif Based Windows)

• **Software**	**Present System**	**New EPICS System**
OS	M60: OS60/UMX	VME: VxWorks 5.2 (included by Tornado 1.0) EWS: HP-UX 10.20
Middleware	*None*	EPICS R3.13, Oracle Workgroup Server 8.0
Data for Control	Built in Fortran Program as "Data" Statements	Managed by RDBMS (Oracle 8.0)
Control Logic	Fortran Programs	EPICS Device/Driver Supports (Low Level) EPICS Database designed on CAD tool "CapFast" (Middle Level) EPICS Client Applications (High Level)
GUI	Fortran Programs	EPICS MEDM and its configuration
Data Logging	Fortran Programs	EPICS Archiver and its configuration
Alarm System	Fortran Programs	EPICS ALH and its configuration

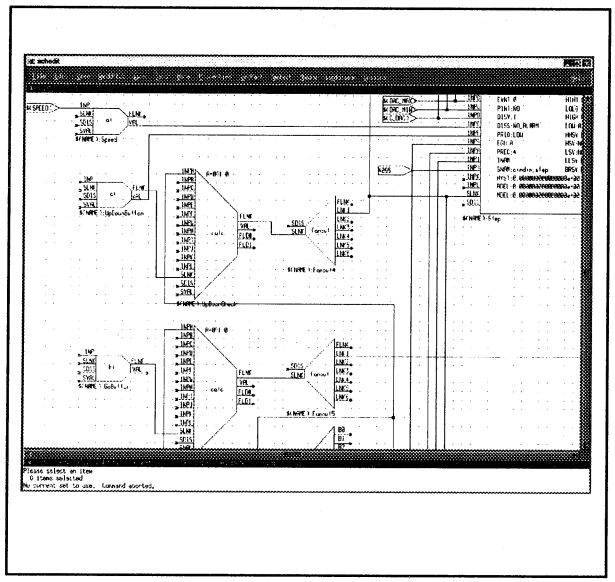

Fig. 3 Sample of EPICS record

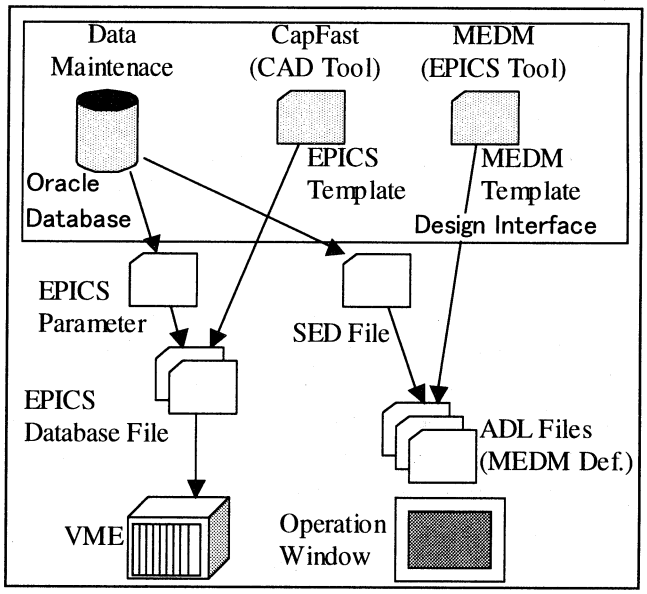

Fig. 4 EPICS configuration generate

5 Linkage of EPICS and Oracle

EPICS applications such as IOC core, MEDM, ALH require each configuration files. These configuration files are almost text-based files. Therefore it is possible to generate these files automatically from Oracle Database.

Generally, there are a number control devices of same type in the control system. Therefore, it is efficient to expand one template of control logic to many actual control devices.

In the preliminary EPICS system, the scheme in which EPICS database files and MEDM definition files are automatically generated, is developed. (Fig. 4)

5.1 EPICS database

"EPICS database file" is a configuration file of the real-time process database on IOC Core. The file is generated by dbLoadTemplate (EPICS tool) from EPICS template file and EPICS parameter file.

The EPICS Template file has the control logic for specific type of equipment such as a magnet power supply, profile monitor. The template file is designed on CapFast CAD Tool (Fig. 3).

The EPICS parameter file has a set of parameters for each existing device. The parameters in this file are required by its related EPICS template file.

5.2 Operational Window (MEDM)

The configuration files of operation windows on MEDM are also automatically generated using the data on the database system. The MEDM template file is created on the editor function of MEDM. The UNIX "SED" command file that is produced from the database system, automatically generates a number of operation screens from a template MEDM file.

6 Conclusion

We have tested the preliminary system to control power supplies and profile monitors of the Ring Cyclotron Accelerator. It has been verified that fundamental operation could be performed through the preliminary system. From now on, the development of the software replacement is in progress and the work for actual replacement will be performed.

References

[1] T.Yano, A.Goto et al, Paper presented at Cyclotrons and their Applications 98, Caen 14-19 June 1998, p696.

[2] L. R. Dalesio et al., Proc. of International Conference on Accelerator and Large Experimental Physics Control Systems (ICALEPCS' 93) Berlin, 1993, p179.

[3] T.Wada et al, Proc. of 11th International Conference on Cyclotrons and their Applications. Tokyo 1987, p407.

[4] T.Wada et al, IEEE Transactions on Nuclear Science, Vol. NS-32 No.5 October 1984, p2095.