New Control System for the RIKEN Ring Cyclotron Using EPICS

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Abstract

The control system of the RIKEN Ring Cyclotron (RRC) has been replaced to the new system using the Experimental Physics and Industrial Control System (EPICS)[1] since this April. The status of the system and its extension plan to the RIKEN Linear Accelerator (RILAC) control will be reported in this paper.

1 Introduction

The project of renewing the RRC control system has been started since three years before. One reason for the necessity of the system replacement was some operational problems mainly occurring around the touch panel, man-machine interface, and the other reason was the request to expand the system to achieve compatibility with the RIKEN RI Beam Factory (RIBF) project.[2] The former one is due to the oldness of the system; the last control system had kept working for more than 13 years till this March. To maintain compatibility between the old and the new control system, a partial system replacement plan was investigated, and finally, we employed the EPICS as the next control system. Considering the fact that the RRC is constantly in operation, the system replacement must be carried out in stages. Under the present condition of the RRC operation, we cannot take a sufficiently long period at any one time to replace the large quantity of low level control parts. Therefore, we are attempting to replace only the high level control parts of the system, including the touch panel as the first stage, and the low level control parts are being left as they are. However, by this replacement method, the maximum control ability of the present equipment is expected to be realized.

The preliminary system which controlled some kind of devices of the RRC was tested two years ago, and we obtained results which indicated that the fundamental operations could be performed using EPICS.[3] Therefore, we extended the system to be able to control all the accelerator devices which were controlled by the CAMAC-CIM/DIM system. The outline of the RRC control system is shown in the following section.

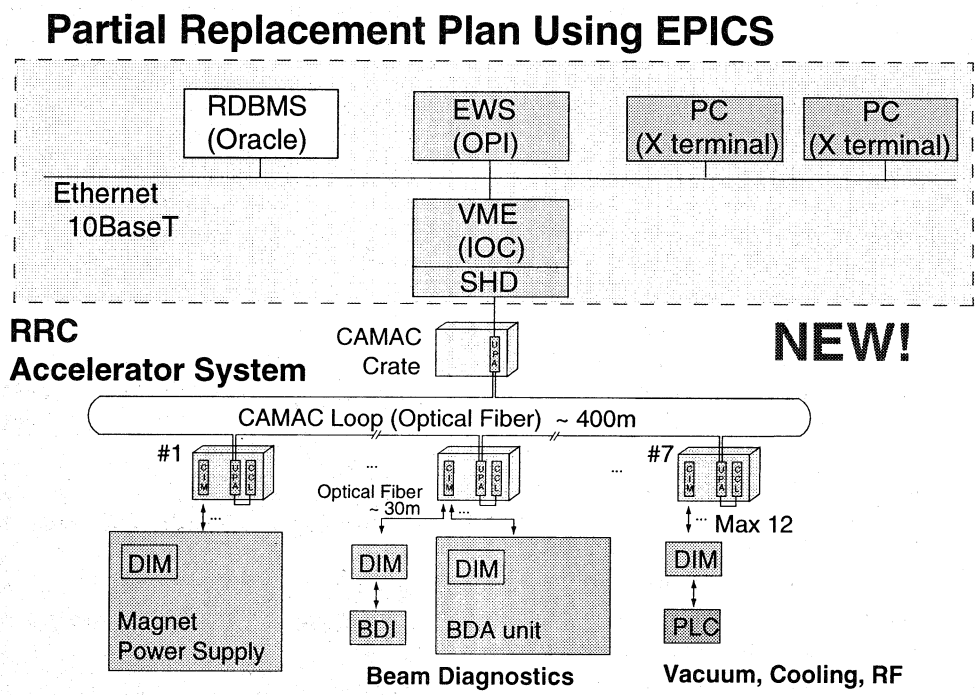

Fig.1 New control system using the EPICS.

2 New control system and its status

2.1 The control system of the RRC and its status

In Fig.1, the part surrounded by the dashed line is newly introduced to the system to replace the mini-computer, Mitsubishi M60/AR, which is the host computer in the last system. Our system is based on a CAMAC serial crate network and is supported by two types of modules, communication interface modules (CIMs) and device interface modules (DIMs). These modules were originally developed by RIKEN in order to assist the main computer in its tasks. Almost all magnet power supplies and beam diagnostic devices such as beam profile monitors, beam baffles, beam slits, main differential probes and Faraday cups are controlled by them.

As mentioned in the last section, only high level control parts are replaced in the first stage of the system replacement. This means that the low level control parts including a CAMAC loop are left as they are and they must be controlled by EPICS. One of the advantages of using EPICS is many hardwares are already supported by EPICS Collaboration. For example, the CAMAC system supported in EPICS. Therefore, we developed the device supports to control the CIM/DIM system using CAMAC library in EPICS.

On the other hand, we created graphic user interfaces (GUIs) for operation on the EPICS workstation which were used as the operator interface. Another advantage of using EPICS is that many standard host softwares are prepared by EPICS Collaboration such as Motif-based Editor / Display Manager (MEDM) and so on. The GUIs were created by using MEDM / DM2K if our objective operations were realized using the objects prepared in them (DM2K is the upgraded version of MEDM, which was developed by BESSY[4]). When we required more complex functions on GUI, we had to create them by writing programs in C. In the new system, we prepared programs to show the graph of data measured by a profile monitor, a Faraday cup and a main differential probe. Though DM2K has a graph object, it has functions which are too simple for our requirements. However, for the present, almost all operation windows were created by DM2K. Figure 2 is a sample GUI created by DM2K for the control of beam attenuaters.

In our system, one HP-UX 10.20 machine works as a server and two Windows machines work as clients. All EPICS database and EPICS sequencers which are written in the state notation language for sequential operations are loaded on one VME computer from the server computer. An operator connects his Windows machine to the HP-UX server machine, and controls devices by communication with objected EPICS records on the VME computer. There are more than 20,000 EPICS records on the VME computer now. This number is too big in comparison with the control system of KEK-B, for example. However, it is difficult to separate these records and to load them to plural VME computers, because it is difficult to divide the CAMAC control loop in two. Therefore, we are using the VME CPU module which mounts 128 MByte memory to make operation without resource troubles. About 50% of memory is used in constant, and we can do beam operation smoothly. Figure 3 shows the PC structure for EPICS at the control room. We use only the two Windows machines shown in the left part of the figure now. However the system shown in the right part, which has same ability as the left part, will be introduced within this year for another mode of beam operation.

At the present, almost all RRC devices connected to the CAMAC-CIM/DIM system can be controlled by EPICS. Beam operation is done by using each GUIs and the condition of the magnet power supplies is watched every 10 seconds using one of the standard EPICS host tool, Alarm Handler (ALH). It tells us an unexpected accident on the power supplies by beeping. Further, the beam intensity is measured by a Faraday cup every 200 msec and always shown on the trend graph on the Windows machine at the control desk.

2.2 Extension of the system to the RILAC control

The present RILAC control system consists of some different systems; the system controlled by a mini-computer as well as the RRC control system, the system controlled by a PC, the devices controlled through the hard wire directly and so on. Since the system replace of the RRC was succeeded, we started to replace the high level control part of the RILAC control system using mini-computer by using EPICS as well as the RRC. In the system, the mini-computer, Mitsubishi M60/500, is used in the same position as in the RRC system. It is older model of M60/AR, but there is no difference between them in a strict sense for the actual control. Therefore, the control of the devices in the RILAC system will be made possible only by adding the operational data into the Oracle database. However, it is available only for the devices controlled by the CAMAC-CIM/DIM system. The RILAC has a more complex control system than the RRC because of its longer history. Some devices are controlled by the CAMAC-CIM/DIM system as

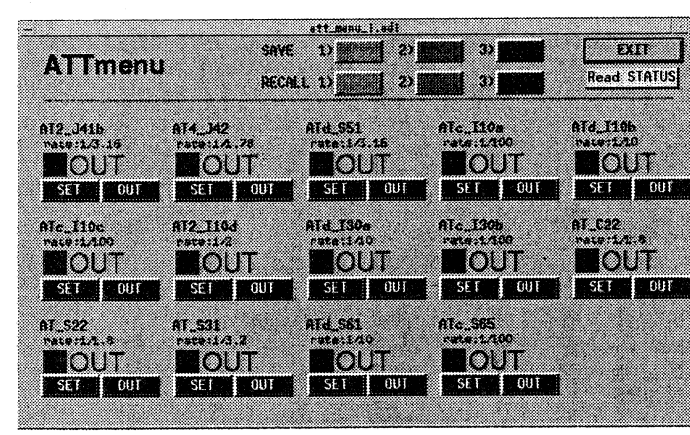

Fig. 2 Sample of GUI created by using DM2K.

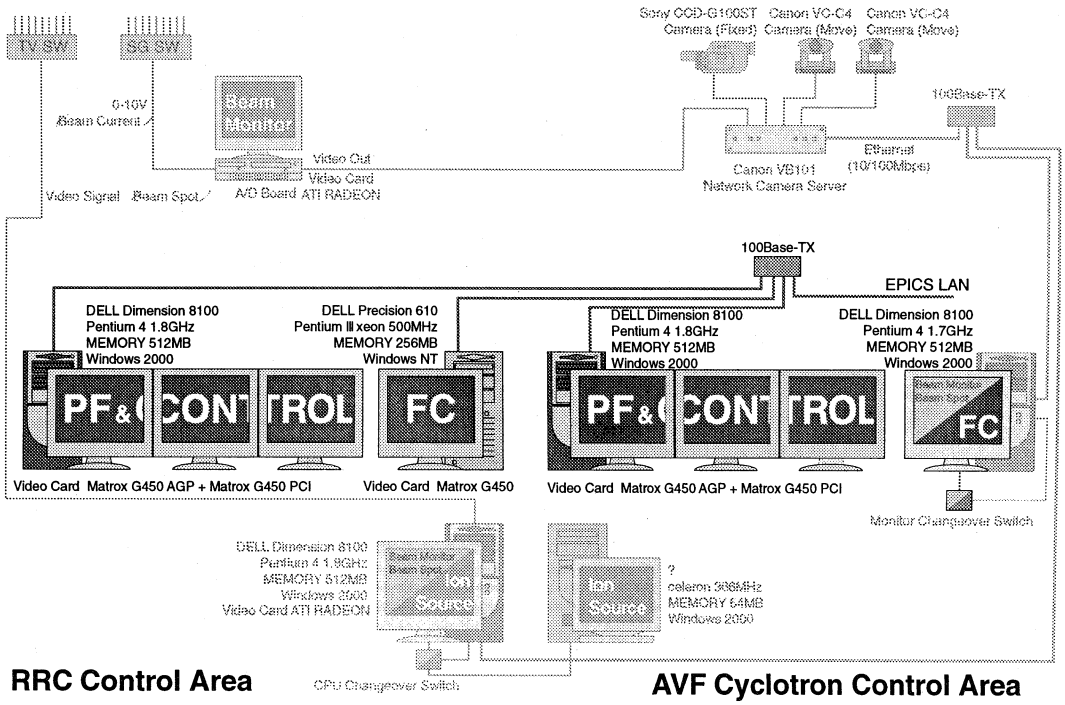

Fig.3 PC structure for EPICS at the RRC control room.

well as the RRC system, while others are controlled by a GP-IB. The CAMAC-CIM/DIM system controls some magnet power supplies and some beam diagnostic devices, and GP-IB controls some power supplies for the magnets and for the rf systems of the RILAC. However, there are no significant differences in the construction of the EPICS database between a CAMAC-CIM/DIM system and a GP-IB. The device support for the GP-IB device was developed in the same way as the device supports for the CIM/DIM. Their operation was tested by using the same kind of GUIs as the CAMAC system and it was succeeded in this summer.

Furthermore, a network I/O (NIO) system[5] was newly introduced to control the new power supplies in the RILAC system. The device supports for NIO were also developed, and we succeeded the operation of the magnet power supplies controlled by NIO in this spring.

Now we has started to control the magnet power supplies and beam diagnostic devices controlled by CAMAC-CIM/DIM system and the magnet power supplies controlled by NIO by EPICS since this spring. We are to replace the M60/500 system to the EPICS within this year.

3 Summary

The RRC and a part of RILAC system have replaced to the new system since this spring. We are to go on this system replacement in stages, and aim to control all beam devices which consist in the RRC and the RILAC system by EPICS in the future. For this, there is a renewal plan of the HP-UX server machine to more powerful one at the beginning of this October supported by Mitsubishi Electric Corporation. We continue the investigation of the RILAC control system as well as the RRC control system.

References

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[5] http://elc.aska.or.jp/denshi/system/kasokuki/