SYNCHRONIZED DATA MONITORING AND ACQUISITION SYSTEM FOR J-PARC RCS

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Abstract

J-PARC 3GeV RCS (Rapid Cycling Synchrotron) is a proton synchrotron with an extreme high power of 1MW, and delicate care must be taken to suppress radiation due to beam loss. The RCS injects each beam pulse of 25 Hz into the MLF (Material and Life Science Facility) and the MR (50GeV Main Ring) in a predefined order. Furthermore, the different beam control parameters are required for the MLF and the MR.

Therefore, in order to reduce beam loss, synchronicity of data is indispensable. For this reason, control data monitoring and acquisition must be made separately for each beam pulse, distinguishing the destination in the control system. The data, which require synchronicity monitoring and acquisition, are such as beam position data [BPM (Beam Position Monitor) data]. We select mainly these data, and we are developing the synchronized data monitoring and acquisition system based on RM (Reflective Memory), WER (Wave Endless Recorder).

The status of development and some test results for this system will be presented in this report.

INTRODUCTION

Since different beam control parameters are required for the MR and the MLF, data monitoring and acquisition must be made distinct for each beam pulse. In order to realize this demand, synchronicity of data is indispensable. However, it is not necessarily mean that all data have to be synchronized. Because, there also are data which required no synchronicity, such as the status data of power supply.

Then, we mainly classified into two kinds of data which should be collected, "synchronized data" and "standard data". Furthermore we classified "synchronized data" into "fast synchronized data" and "slow synchronized data". And we have designed and developed RCS control system in response to each data.

And, about the synchronized data, we are developing monitoring and acquisition system based on RM and WER.

SYNCHRONIZED DATA

The data which has synchronicity is called "synchronized data".

First, to collect and monitor the synchronized data, we decided that the data which required synchronicity is attached to the beam information. There is "trigger tag", "beam tag", "beam type", "MR cycle tag" and so on in "beam information". In this, "trigger tag" means number of trigger sent from Timing System in an operation cycle which continued for 3 weeks, "beam tag" means number of beams in an operation cycle, "beam type" means about destination of beam and "MR cycle tag" means trigger tag which is reset for every acceleration cycle of MR[1]. This beam information is common information in all of J-PARC facilities, such as Linac and RCS. This beam information image is shown Figure 1.

Then, by collecting and monitoring data based on beam information, it becomes possible to make synchronized data. These synchronized data that collected and monitored by this method have the synchronicity through

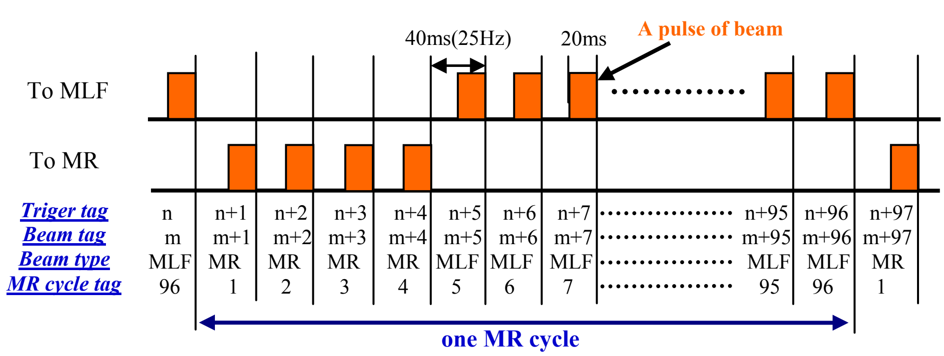

Figure 1: Beam information image attached synchronized data

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all of J-PARC facilities. So, "synchronized data" may be become very significant.

Next, we classified "synchronized data" into "fast synchronized data" and "slow synchronized data".

FAST SYNCHRONIZED DATA

Fast synchronized data is required to collect all of 25Hz data. Moreover, it is required to monitor in distinction to MLF or MR. As "fast synchronized data", there is Beam Position Monitor (BPM) data, Beam Loss Monitor (BLM) data and etc.

But, if the synchronized data will be organized after collection, it takes time to data processing. This isn't going to work for always monitoring. Then, we decided that RM is adopted in monitoring and acquisition system for fast synchronized data.

Configuration

RM is an optical ring-based, ultrahigh-speed shared memory network solution. It allows a distributed network to share real-time data at a deterministic rate, regardless of bus structures and operating systems. Now, monitoring and acquisition system for fast synchronized data can be realized mostly, by adopting RM as a system configuration. Here, it takes RCS BPM data as an example and the overview of this system is shown in Figure 2.

BPM system consists of a BPM and a BPM signal-processing board. The signal-processing board is composed on a VME crate. The signal processing unit consists of a CPU board installed the RM and six signal-processing boards. Thereby, six BPMs are connected to a signal processing unit (Figure 3). Nine signal processing units are installed in three rooms (there are nine RM). Then, there are two PC installed RM, Interface PC and Data Server for RM (DSR). Interface PC supplies BPM data on RM to Human Machine Interface (HMI) which is not installed RM. DSR collects and stores all of 25Hz BPM data.

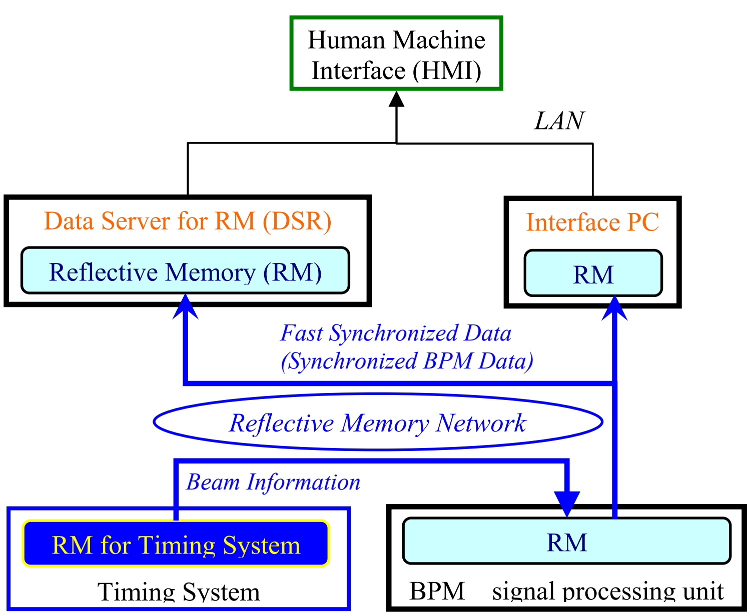


Figure 2: BPM data collection system configure

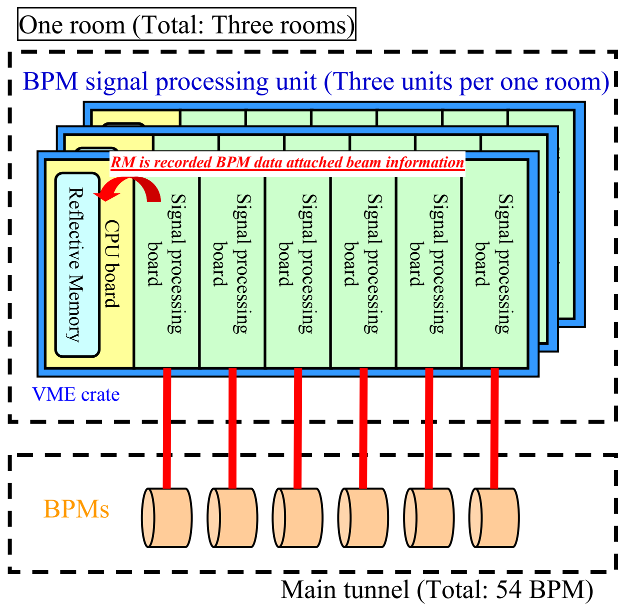


Figure 3: Outline of BPM system configuration.

Monitoring and Acquisition

A signal-processing board calculates beam positions every 1msec between acceleration times (20msec). This beam position data is expressed as {(x1, y1), (x2, y2), -----(x20, y20)}. After, beam position data is attached beam information (we called this BPM data), BPM data records on RM every 40msec (25Hz) between non-accelerating times.

Then, we decided RM is used as a ring memory, in order to store BPM data for several seconds (about 96 data) on memory space of RM. For monitoring BPM data, Interface PC collects BPM data attached latest beam tag out of data stored on ring memory, and supplies these data to HMI. As a matter of course, Interface PC collects and supplies BPM data attached same beam type. On the other hand, for acquisition BPM data, DSR collects and stores BPM data for 30 beam tag every 1 second [2].

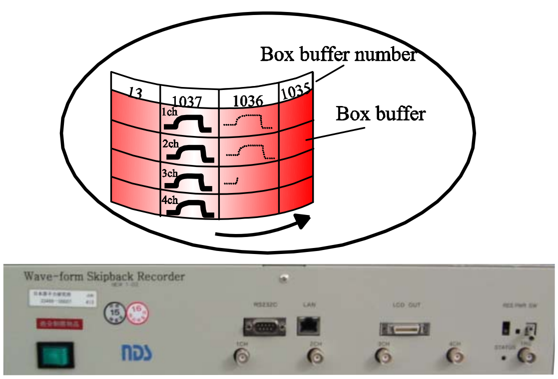
We have just started to test at actual signal processing unit. We tested monitoring and acquisition about four week, between May 25 to June 16, 2006. The result of this test, we think that our proposed system have satisfying capability for online monitoring and collection all of 25Hz BPM data.

SLOW SYNCHRONIZED DATA

Slow synchronized data is required to monitor at intervals of a few seconds. Either, this is required to collect when operator commanded such as after accident. Therefore, it is not required collecting all of 25Hz data. As "slow synchronized data", there is output voltage data at pattern power supply and etc.

Configuration

WER is designed with a circular-buffer and LAN. A circular buffer is divided to the beam size, called the circular box buffer. The box shifts by the beam trigger, and the trigger number (beam tag) is allocated to the box. To collect the synchronized data, the Data Server for WER (DSW) can get "slow synchronized data" easily, since the data is managed by the beam tag. The beam tag may not coincide among measuring instruments because we used a lot of WER. Therefore, the beam tags in all WER are made to coincide by the mechanism like NTP (Network Time Protocol) [3]. Figure 4 shows the hardware image of WER.



Memory: 32MB
1024 (Box buffer)
* 8k (B/Box buffer) *4ch
ADC: 12bit (isolated) * 4ch,
10MS/s, differential input

Figure 4: Hardware image of WER

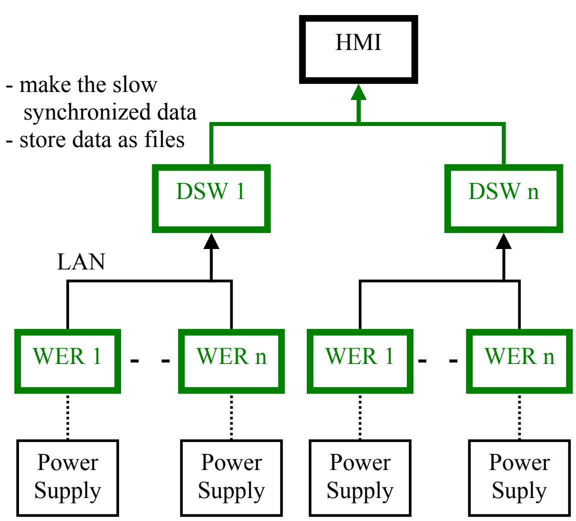


Figure 5: Configure of slow synchronized data monitoring and acquisition system

The overview of this system is shown in Figure 5. This system consists of some DSW and many WER. We have an assumption that WER of about ten maximum per a DSW. DSW collects data which have same beam tag from many WER. In this way, DSW can collect "slow synchronized data" easily. Then, DSW stores "slow synchronized data" and also supplies this to HMI.

We configure this system consists of one DSW and 13 WER. And we tested monitoring and acquisition for slow synchronized data. The result of this test, we confirmed that our proposed system have satisfying capability.

CONCLUSION

In this paper, we showed status of synchronized data monitoring and acquisition system. We are developing this system by classifying "synchronized data" into "fast synchronized data" and "slow synchronized data".

For "first synchronized data", RM is adopted this system. Now, we have just started to test at actual signal processing unit. The latest result of this test, we think that our proposed system has satisfying capability. Furthermore, we will continue a test, and confirm this system capability.

For "slow synchronized data", WER is adopted this system. In the case of one DSW, we confirmed this system have satisfying capability. Next, in the case of same DSW, we will design, develop and test.

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