

SYNCHRONIZED DATA DISTRIBUTION AND ACQUISITION SYSTEM USING REFLECTIVE MEMORY FOR J-PARC 3GEV RCS

H.Takahashi^{*,1)}, N.Hayashi¹⁾, M.Sugimoto²⁾

¹⁾J-PARC Accelerator Division, JAEA

Shirakata-Shirane 2-4, Tokai-mura, Naka-gun, Ibaraki, 319-1195, JAPAN

²⁾Mitsubishi Electric Control Software Co.,Ltd

1-1-2 Wadamisakichou, Hyougo-ku, Kobe-shi, Hyougo, 652-8555

Abstract

J-PARC 3GeV Rapid Cycling Synchrotron (RCS) inject the different parameter beam to each facility, which are Materials and Life Science Facility (MLF) and Main Ring (MR). Therefore, RCS Control System must realize the monitoring and the operation that are distinguished "MLF beams" and "MR beams". And, we have developed the data distribution and acquisition system for "synchronized data" which required the distinguished monitoring and operation.

Then, we have designed and developed distribution and acquisition system using Reflective Memory (RM) for BPM data, which is one of synchronized data. We have designed that RM have 54 virtual ring memories and buffer BPM data for a few seconds (at least 91 data per a BPM). And BPM data is written to virtual ring memory based on "RCS timing information", which is based on J-PARC scheduled timing system information. Thus "RCS timing information" is consistent with scheduled timing information. Thereby, data that written same virtual ring memory position become BPM data about identical beam.

The paper presents the current status of the synchronized data distribution and acquisition system using RM.

INTRODUCTION

The RCS injects each beam pulse of 25Hz into the MLF and the MR in respective demands. Therefore, all 25Hz beams which are injected different facilities must be controlled and monitored correctly. In order to realize this demand, synchronicity of data is indispensable.

Here, we describe the data which has synchronicity as "synchronized data" and classify "synchronized data" into "fast synchronized data" and "slow synchronized data". Then, about the synchronized data, we began to develop the data distribution and acquisition system based on "Reflective Memory (RM)" and "Wave Endless Recorder". Then, 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.

The system using RM is for "fast synchronized data" and another is for "slow synchronized data". Then, as "fast synchronized data", there is Beam Position Monitor

(BPM) data and etc. This BPM data is one of the most important data which is used from early commissioning phase. Therefore, we have designed and developed the synchronized data distribution and acquisition system using RM to meet the RCS commissioning start.

SYNCHRONIZED DATA

First, to collect and monitor the synchronized data, we decided that the data which required synchronicity is attached to the timing information. This timing information is common information in all of J-PARC facilities, such as Linac and RCS.

Then, by collecting and monitoring data based on timing information, it becomes possible to make synchronized data. These synchronized data that collected and monitored by this method have the synchronicity through all of J-PARC facilities. So, "synchronized data" may be become very significant.

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 used data distribution and acquisition system for fast synchronized data.

SYSTEM CONFIGURATION

Scheduled Timing System

As describe above, synchronized data is the data which is attached to the timing information. At J-PARC scheduled timing system, timing information is transmitted via RM. There are "trigger tag", "S tag", "MR cycle tag", "beam type" and etc in timing information. In this, "trigger tag" means number of trigger sent from timing system in an operation cycle which continued for 3 weeks, "S tag" means number of MR 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 timing information is common information in all of J-PARC facilities, such as Linac and RCS. This timing information image is shown Figure 1.

[#] takahashi.hiroki@jaea.go.jp

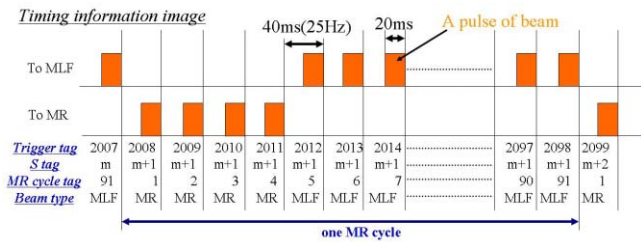


Figure 1: Timing information image

BPM System

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 2). Nine signal processing units are installed in three rooms (there are nine RM). A signal-processing board calculates beam positions every 1msec between acceleration times (20msec). This beam position data is expressed as $\{(x1, y1), (x2, y2), \dots, (x20, y20)\}$. And, BPM data is written on BPM system RM every beam pulse.

Configuration

Figure 3 shows the configuration of BPM data distribution and acquisition system. This system consists of "BPM system", "Scheduled Timing System", "RCS Tag Generation VME", "Data Distribution PC" and "Data Acquisition PC".

First, there are two RM loops, timing system loop and BPM system loop. The timing information, Look up table (LUT) and timing type are transmitted on the timing system RM loop. On the other hand, BPM data, BPM original waveform data and etc are transmitted on BPM system loop. Then, timing system and BPM system are

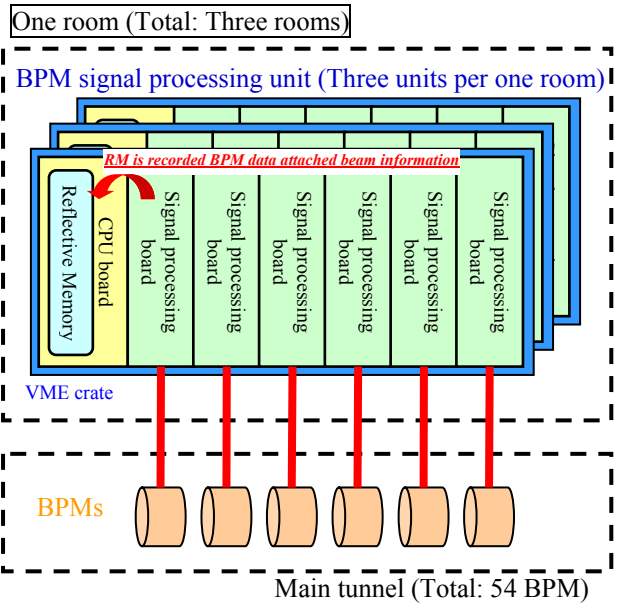


Figure 2: BPM system configuration.

not able to use same RM loop, because a large quality data is transmitted on each RM loop. But, BPM system must use timing information on timing system loop.

Therefore, RCS tag generation VME was developed. This VME is installed a CPU board, a trigger counter board and two RM boards which are timing system loop and BPM system loop.

Then, data distribution PC works on EPICS IOC and synchronized BPM data is distributed as waveform data which is compiled on 54 BPM data of same beam tag (RCS beam tag). And, data acquisition PC collects the bulk data which is compiled 54 BPM data during several seconds (at least 91 data). As a matter of course, this bulk data is compiled the same beam tag data.

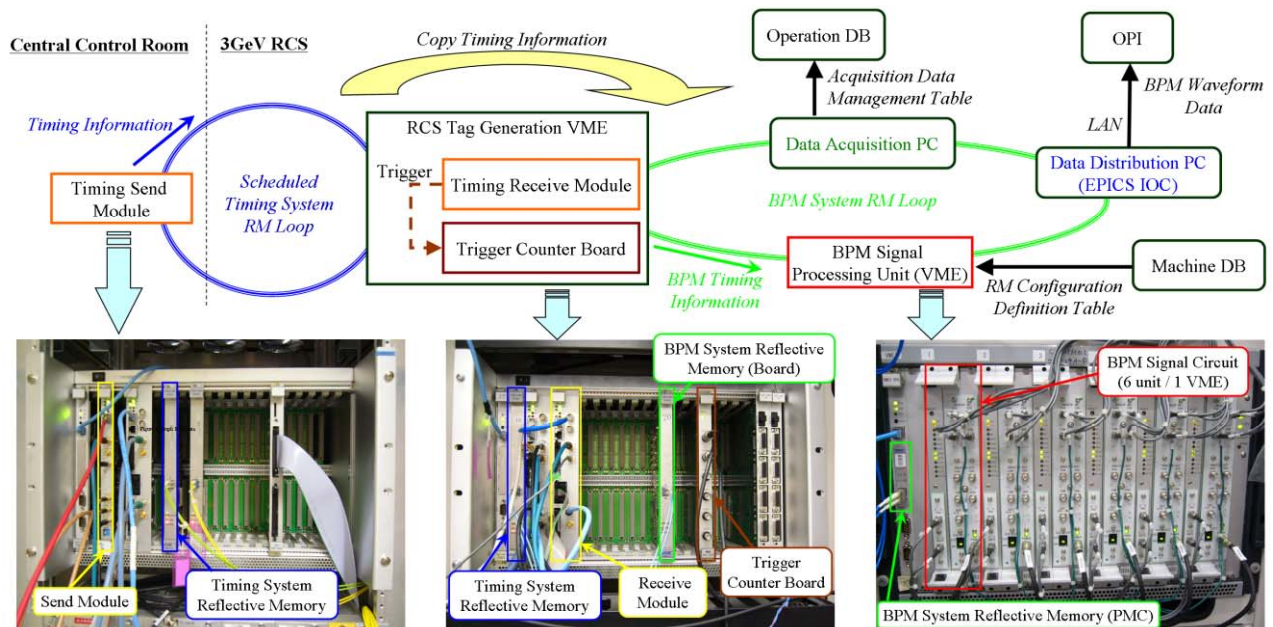


Figure 3: System configuration.

SYSTEM BEHAVIOR

About BPM system, to realize the synchronized data distribution and all 25Hz data acquisition, we have proposed that RM is used as ring memory and this system has been advanced development [2].

First, we defined "RCS tag" as the number of beam injected RCS in operation cycle. This tag is important to manage BPM data. RCS tag is generated a trigger counter board installed RCS tag generation VME. A trigger counter board counts the trigger from a receive module and set "RCS tag" this count value. BPM timing Information is made by merging "RCS tag" and Timing information", and written to BPM system RM. This structure is shown Table 1.

Table 1: Structure of BPM Timing Information

RCS Timing Information (Timing Information)	Trigger tag
	S tag (MR cycle number)
	MR cycle tag
	Beam type (MLF or MR)
RCS Timing Information (Generated by RCS tag VME)	RCS tag
	RCS type
	RCS tag update time (sec, msec)
	RM data tag (Ring memory position. Now, this is used "MR cycle tag")

Next, BPM signal processing unit calculates beam positions. This position data is attached RCS timing information. And this BPM data is written to assigned position by "RM data tag (MR cycle tag)" in ring memory every 40msec (25Hz) between non-accelerating times. A ring memory size for a BPM is about 0.6MB and total size (54 BPM) is defined about 33MB. On the other hand, BPM original waveform data, which is "single pulse mode data" or "waveform measurement mode data", is written the data shared memory area. This area is not used as ring memory, and the data is written out this area from BPM signal processing unit only when user requests the original BPM waveform data. A waveform data size is over 6MB, so the data shared memory area size is defined about 60MB. This area is able to be written 6 waveform

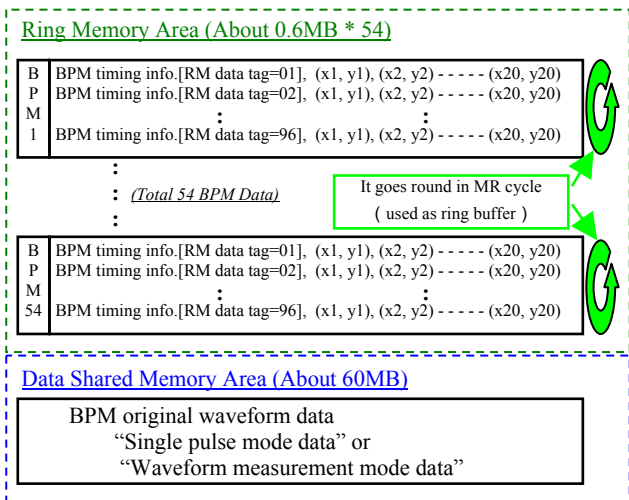


Figure 4: Data structure on BPM system RM.

data. Data structure on BPM system RM is shown Figure 4. It is possible that this data structure is changed a definition file which is created from Machine Database.

Then, data distribution PC collects 54 BPM data attached the latest timing information from RM ring memory and provides these data as an EPICS waveform. As a matter of course, data distribution PC collects and provides BPM data attached same beam type (MLF beam or MR beam). And data acquisition PC is possible to collect the 30 data about each 54 BPM that RCS tag is same. And these data (30 data / 1 BPM * 54 BPM) are able to be stored every 1 second [3]. However, about RCS commissioning, 25Hz operation has been almost never until now (main operation was 1Hz and single shot). Therefore, currently, BPM data is stored every 1 minute.

This system has been developed until RCS commissioning start and the synchronized BPM data is distributing now. Figure 5 is shown a example of BPM data. This synchronized BPM data is helped RCS commissioning.

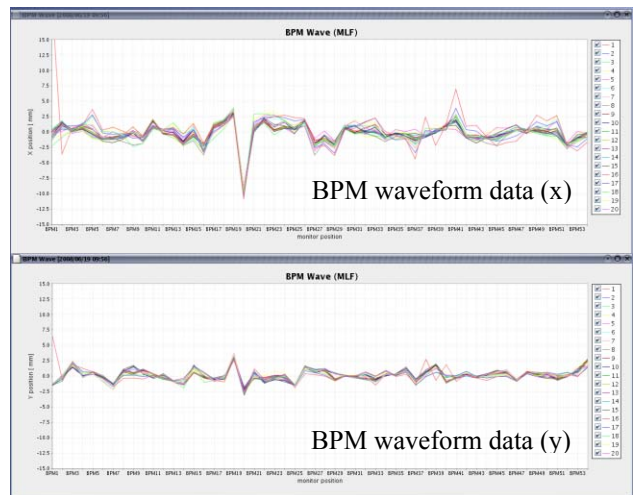


Figure 5: BPM data graph.

CONCLUSION

Status of synchronized data distribution and acquisition system is shown in this paper. Synchronized BPM data has been provided this system. And this BPM data is helped work of RCS commissioning. On the other hand, BPM data acquisition system is not effectively used, because RCS has been almost never operated at 25Hz until now (most operation was 1Hz or single shot). Then, the performance of synchronized data acquisition system will be confirmed at 25Hz operation in 2008.

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