2. Control System

1. Status

In FY2019, we have started to control the SPring-8 and the SACLA seamlessly [1]. The SACLA is used for SACLA user experiments and the injector for SPring-8 in parallel. We must control the beam energy and peak current on a bunch-by-bunch basis [2]. For this purpose, we designed and developed the control system with the reflective memory.

Several components of the control system and network were replaced, including a beam position monitor, a screen monitor [3], a top-up interlock module to fit the beam injection from SACLA to SPring-8, and the safety interlock system for SACLA. The functions of the emergency stop button on the SACLA accelerator safety interlock system were changed so that the SACLA and SPring-8 accelerator safety interlocks work in the same way.

We renewed the server computers for the beamline control system with blade-type computers as the virtual host service to provide more than 40 beamline workstations. A new type of in-vacuum undulator (ID10) is controlled with next-generation system where the pulse motor controller for the gap between magnets is controlled via the EtherCAT protocol [4].

2. Development of the framework for the accelerator control system

The new control system is working well, but several parts need further modification:

- Bunch-by-bunch beam control in SACLA
- Management of the signal registration of the parameter database
- Integration of one- and two-dimensional data with the MDAQ data acquisition scheme

For bunch-by-bunch beam control, a system with the reflective memory is under development. A master controller stores all patterns of the required parameters for the low-level RF controllers. Each pattern consists of 60 rows, which correspond to the parameters for 1 sec with a beam reputation rate of 60 Hz. A pattern can be selected every second on demand. The system will be introduced to the bunching section such as the gun, beam deflector, prebuncher, booster, L-band correction, L-band, C-band correction, S-band, and 12 units of the C-band. It will be installed in the kicker magnet power supply.

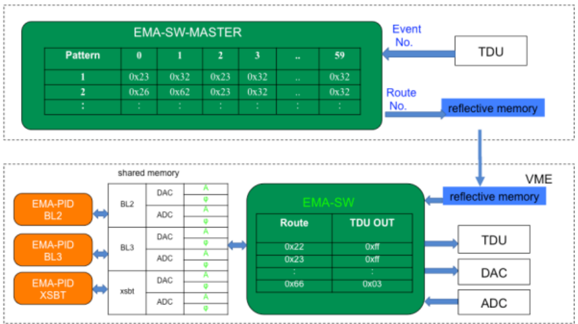

Fig. 1. Schematic of bunch-by-bunch parameter control

Figure 1 overviews this system. The master sends the past, present, and future beam parameters to the RF system. Regarding the data acquisition timing of the pulsed machine linac, the digitizer must convert the data after the trigger. This means that the data obtained just after the trigger is related to the previous shot. Because the settling time is needed for the parameter setting of the RF system, we must set the data prior to the target bunch.

Consequently, the RF system must receive past, present, and future parameters to operate the bunch-by-bunch control.

We developed a web interface to manage the signal registration of the parameter database. One function is to manage the signal registration workflow. The signal registration involves several steps:

1. User upload of SVOC files
2. Execution of SVOC syntax check for the uploaded files
3. Registration of the signal to the test DB
4. Registration of the signal to the operational DB

When the parameter is registered, a rollback procedure is also created.

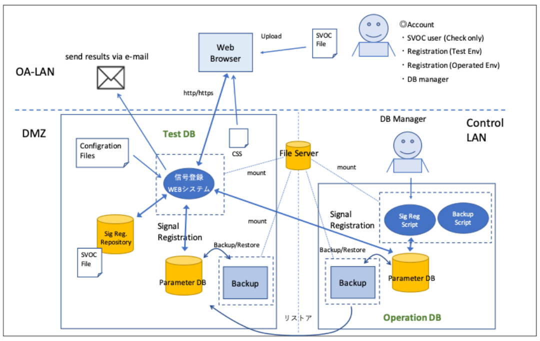

Fig. 2. Schematic of the signal registration for the parameter database.

For data acquisition, we are preparing three types of processes:

- Point data acquired with a fixed interval by polling
- Point data acquired by a triggered event
- One- or two-dimensional array data

In FY2018, point data were acquired to the online DB with the MDAQ scheme. However, the waveform (one-dimensional data) and a screen image (two-dimensional data) were handled with separates systems. In FY2019, one system was developed to manage one- and two-dimensional data with the MDAQ scheme. This system manages large data stored in the file server, and an attribute of the file is stored in the online DB. Hence, all types of data can be accessed seamlessly.

3. Beamline interlock system

The BL05XU beamline system was upgraded, and the beamline interlock system was modified to accommodate the change. To improve the convenience of beamline users, we added a new user-specific operation screen to the touch panel for several beamlines. This screen makes it easier for users to recognize the beamline equipment status.

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