6. Data/Network

1. Introduction

We operate and upgrade data and network infrastructure (both hardware and software) to advance experimental control, data acquisition, and data analysis at SACLA and SPring-8. At SACLA, we built the SACLA data center for data acquisition and analysis and have operated it since the first user beamtime in 2012. It can reliably store data with a maximum data rate of 6 Gbps and perform the associated data analysis with a typical data size of a few tens of TB per experiment [1,2]. Data generation will increase gradually, and the related infrastructure upgrades were carried out in 2021 and will be completed in 2022. In contrast to SACLA, we foresee a significant increase in data generation rate at SPring-8 following the upgrade of the beamlines, which are equipped with higher speed and higher pixel count detectors. In addition to the significant data size increase, we see other demands, such as remote access to the beamlines and upgrading the beamline control software.

To cope with these requirements, we have started conceptualizing a new data and network infrastructure for SPring-8 with the data center at its core. The multiple data systems that spread over the beamlines now under operation will be merged into one centralized SPring-8 data center by implementing these upgrades. Our estimation indicates that computation demands are intermittent and have a peak comparable to dedicated supercomputer centers. To meet these requirements efficiently, the SPring-8 data center will be connected to the High-Performance Computing Infrastructure (HPCI) [3] system, including the supercomputer Fugaku, and private cloud operators. This year, we finalized the conceptual design and named it “SPring-8 Data-Center Initiative”.

2. SPring-8 Data-Center Initiative

We plan to start user services at the SPring-8 data center in the summer of 2023. In FY2021, three SPring-8 data workshops were held to discuss the SPring-8 Data-Center Initiative with users [4]. At the first workshop, we discussed expanding large-scale data analysis capabilities. At the second workshop, we discussed collaboration with the material digital transformation (MDX) platform regarding sharing, publishing, and reusing experimental data. At the third workshop, we discussed data-related projects other than MDX, standardization activity on the data structure by the Japanese Society for Synchrotron Radiation Research (JSSRR), and the needs of the users from private companies regarding sharing, publishing, and reusing experimental data.

From the discussion at the data workshops, we considered the specifications of the computer system of the SPring-8 data center and user service for data flow in the data center. We have also conducted technical studies on S3-compatible services for data delivery from the data center to the users’ institutions.

3. Upgrade of network infrastructure at SPring-8

In FY2020, we started to build a new network infrastructure for upgrading SPring-8 beamlines. In FY2021, we introduced the new network to BL13XU, BL28B2, and BL29XU.

4. Development of BL-774 system

We have been developing BL-774, a beamline control, data acquisition, and online analysis platform [5]. BL-774 achieves robustness and flexibility by incorporating two-phase development with rapid application development and Web-based graphical user interfaces (GUIs). The Web-based GUIs also provide functionality for configuration management. In FY2021, we introduced BL-774 to the optics and experimental hutches at BL09XU and to the optics hutch at BL20B2.

5. Remote experiment applications [6]

We have established an application procedure for remote experiments at SPring-8 and SACLA, which are in increased demand owing to the COVID-19 pandemic. The process consists of four types of application: remote experiment apparatus application, remote experiment beamtime application, remote experiment viewing application, and remote equipment maintenance application.

6. Development of a remote-operating system at SACLA

We have developed a remote-operating system at SACLA, which allows users to control experimental instruments outside the facility. In FY2021, we introduced the system at BL2 EH6 and BL3 EH5. A user experiment using the system was conducted in November 2021 at BL2 EH6.

7. SPring-8 Data and Network Committee

The SPring-8 Data Network Committee [7] was established in 2019. The third committee meeting was held online on Dec. 1, 2021. The committee discussed and formulated the remote access to experimental control terminals at SPring-8 and SACLA and the rules for using the SPring-8 and SACLA data center.

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