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 increased gradually, and the related infrastructure upgrades were carried out in 2022.

In contrast to SACLA, we foresee a significant increase in the data generation rate at SPring-8 following the upgrade of the beamlines, which will be 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 of 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 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 those of 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.

2. Construction of SPring-8 Data Center

In 2022, we installed a new computer room for the SPring-8 data center at the Accelerator and Beamline R&D Facility. We installed a computer system in the room in March 2023. The system consists of 64 CPU nodes (4k CPU cores), 16 GPU nodes (1k CPU cores and 111k CUDA cores), and 20-PB disk storage. The system is being commissioned and will be open to users in the summer of 2023.

3. Consideration of data management infrastructure at SPring-8 data center

We plan to connect the SPring-8 data center with GakuNin RDM [4] provided by the National Institute for Informatics (NII), so that users can manage not only SPring-8 data but also other data obtained from laboratory instruments and other facilities. Users will be able to access data in the SPring-8 data center via GakuNin RDM.

We have started the development of the SPring-8 dataflow service for the purpose of effective sharing of experimental data. Users will be able to use the service through the portal system of the SPring-8 data center. To upload data, users need a json file describing the metadata of the experiment as well as the experimental data.

4. Upgrade of network Infrastructure at SPring-8

In FY2020, we started to build a new network infrastructure for upgrading SPring-8 beamlines. In FY2022, we upgraded the bandwidth of the backbone network to 100 G and introduced the network branches to BL13XU, BL35XU, and

BL46XU.

5. Installation of a shared cache storage system at SACLA

We previously operated four high-speed cache storage systems for BL1, BL2, BL3, and User-LAN at SACLA. In the summer of 2022, by introducing a single cache storage system that handles the functions of these four systems, we achieved load distribution for capacity and improved performance. The new cache storage system has a capacity of 2.4 PB and a total I/O performance of 30 GB/s or more.

6. Development of BL-774 system

We have been developing a beamline control, data acquisition, and online analysis platform, BL-774 [5]. BL-774 achieves robustness and flexibility by incorporating two-phase development with rapid application development (RAD) and web-based graphical user interfaces (GUIs). The web-based GUIs also provide functionality for configuration management.

In FY2022, we introduced BL-774 to the optics and experimental hutches at BL13XU and BL46XU. We have started the development of a method of controlling the front-end system using BL-774.

7. Automation of data analysis for X-ray CT data at BL28B2

We have started the development of a data analysis system that automatically transfers the data acquired by the automatic X-ray CT measurement system installed at BL28B2 to the SPring-8 data center and automatically performs the 3D reconstruction of X-ray CT data. Users will be able to download the analyzed data through the portal system of the SPring-8 data center.

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