§49. Progress of Fusion Virtual Laboratory in Japan

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The data acquisition and access platform developed in LHD is named *LABCOM/X system* that can be applied for multiple remote sites operating their own fusion experimental devices. The fusion-dedicated virtual private network, named *SNET*, is virtually formed on the academic information backbone SINET in order to provide long-distance communication links among many fusion sites. The end-to-end links have at least 1 Gbps bandwidth and the backbones which are the real platform of VPNs have more than 10 Gbps. As a center of SNET, NIFS has four 1 Gbps uplinks in parallel.

The SINET carrier, National Institute for Informatics (NII), has announced that they will upgrade the present SINET3 to SINET 4 in March 2011. Then, the SNET NIFS uplink will become wider to be 10 Gbps, which must be utilized mainly by the remote data exchange among SNET collaboration sites. So, we started the preparation to use 10 Gbps directly by connecting the 10 Gbps network storage to SNET, as described below.

Remote Data Acquisitions in QUEST, Kyushu Univ.

QUEST remote data acquisition system has been operating between Kyushu Univ. and NIFS since the beginning of its operation in June 2008[1)]. Through it began with only one data acquisition (DAQ) node, the number of DAQs gradually increased up to six at present. Three remote DAQs, namely 'QUEST-Primary', 'QUEST-HX', and 'QUEST-GigE1' are already running since last year. In 2009, three new DAQs have been additionally installed, whose names are 'QUEST-Flux', QUEST-Ha', and 'QUEST-Density'. They are prepared to measure the magnetic fluxes, H-alpha line emissions, and the plasma densities, respectively.

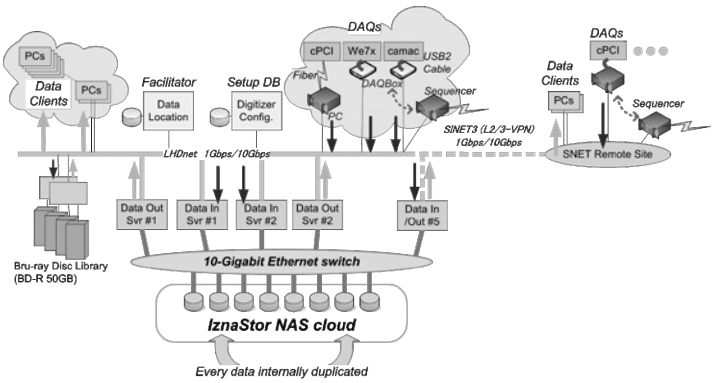

Fig. 1. Structure of *LABCOM/X* distributed data system with the extension for SNET remote sites. The present remote sites are QUEST in Kyushu Univ. and GAMMA10 in Univ. of Tsukuba.

For the QUEST remote data acquisition, we first introduced the *GigE Vision* high bandwidth digital camera system, *Basler scout scA640-70gc*, for plasma monitoring. As its video streaming output is 45.6 MB/s continuously, about a half of the present SNET uplink of 1 Gbps will be occupied by this camera measurement. It may affect other DAQs in transferring raw data to the remote storage at NIFS, and therefore, we plan to upgrade the SNET uplinks into 2 or 4 Gbps very soon. When it will be successfully upgraded, another *GigE Vision* camera of higher framing rate about a few 100/s will be installed in addition.

New Remote DAQ in GAMMA10, Univ. of Tsukuba

By applying the same scheme as the QUEST remote data acquisition, the remote data sharing of the GAMMA10 experimental data has started since last year[1)]. Many data transforming scripts have been developed to register them into NIFS data repository to be shared on SNET, and finally the whole data of 2008 campaign have been successfully migrated to be sharable on SNET.

In addition to share the already acquired data, a new remote DAQ node has been installed at GAMMA10 to measure four channels of floating voltages of the plasma end plate. The essential information of experiment operation, the sequence timings and the shot number, are given by the GAMMA10 experiment control system through the hard wires and the http network communication, respectively. The new DAQ is named as "G10-PXI" because it uses PXI 6133 digitizer.

Upgrade to 10 Gbps "Cloud" Storage at NIFS

The LABCOM/X data system is now operating many DAQs among three fusion experiments; LHD, QUEST, and GAMMA10. In order to increase the capacity and improve the reliability at once, the prior 4 Gbps FibreChannel (FC)-based cluster storage having 8 RAIDs[2)] will be replaced with the network-attached storage (NAS) linked by 10 Gbps Ethernet. The new NAS system is called "*IznaStor*", whose schematic view is shown in Fig. 1.

The previous FC storage cluster had a single point of failure (SPOF) in primary writable RAID. The new system, however, has a completely symmetric structure in which all the NAS nodes are hot swappable and the input/output (I/O) will be then altered into another node automatically. Automatic file replication is also made from the primary node to another, and free capacities are balanced among all the nodes.

Taking the increasing use of SNET remote DAQs into account, the NAS-based cloud storage is more suitable especially in upgrading the I/O throughput. Another big advantage exists in the fact that NAS is cost effective than expensive FC-based RAID. For the backend 'near-line' archiving storage, we also increased the capacity by adding another BD-R disc library. The total capacity of four BD-R libraries is now 0.22 peta-bytes.

1) Nakanishi, H. *et al.*: NIFS Annual Report (2009) 519.
2) Nakanishi, H. *et al.*: NIFS Annual Report (2009) 159.