§20. Progress of LABCOM Data System at LHD

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The LABCOM data acquisition and management system has been operating for LHD since 1998. In the 14th campaign, the total number of the data acquisition (DAQ) nodes went up to 90, and more than half of them are steady-state operable by using Yokogawa WE7x and NI PXI digitizers.

Fig. 1 shows the history of data growth happened at LHD. In short-pulse experiments of less than 10-second plasma duration, ~11 GB/shot raw data are acquired. For more than ten years, the data growth very well follows the famous Moore's law that predicts the data size to be double in every 18 months. It corresponds 100 times growth for 10 years, which can be observed well in Fig. 1 (left). As a result, the total amount of the cumulated data is increasing exponentially up to > 0.33 PB.

Continuous Monitoring for Device and Environment

In addition to the sequential data acquisition and storing during experiments, we have newly installed 24/7 non-stop signal monitoring DAQs for device status and environmental radiation dose monitoring.

The so-called control device monitoring one named "CDP" carries out continuous 1 kHz digitizing on every 540 analog signals. They are mainly used for the cryogenics and temperature monitoring by thermocouples. CDP uses 7 of 80-channel multiplexed 16-bit ADC module, NI PXI-6225, contained in a PXI chassis. The raw data production rate will be
$560 * 2 * 10^3 * 3600 * 24 * 7 = 0.677*10^{12}$ byte/week, and thus >16 TB will be acquired in one annual campaign.

For better accessibility of those trend data, 1 Hz thinned "CDPslow" and its day-long one "CDPslowL" are also made by smoothing the original signals. The both CDP and CDPslow data can be retrieved with the same manner for usual plasma diagnostic data except that their shot and sub-shot numbers are the date and time in digits, like 20110628 and 1827, respectively.

Verification Tests on New "Cloud" Storage

Since last year, we have introduced a new "cloud" storage system, named *"IznaStor"*[1]. It applies cost effective 10 GbE NAS (network attached storage) and provides some good functionalities of automatic internal file replication, load balancing, SPOF (single point of failure)-free high availability, anonymous hot plug-and-play nodes, and so on. See Table I.

Table II shows the performance improvements by the cloud storage, which basically provides 4 or 6 times faster speed than 4 Gbps FC-based cluster storage. When it is used by means of FUSE (file-system in user-space) for the data server's compatibility, the protocol conversion may cause some overheads to reduce the throughput. As newly acquired raw data are migrated through FTP client/server codes in LABCOM system, we will have to modify them to directly access the native functions of *"IznaStor"*.

Table I. Functional comparison between FC-based cluster file-system (GFS2), IP-based iSCSI one, and the new cloud storage *"IznaStor"*

	GFS2/FC	GFS2/iSCSI	IznaStor
Cost	+/–	++	++
Speed	+/–	++	++
Scale out	+/–	+/–	++
Load balance	––	––	++
Availability	+/–	+/–	++
Fault tolerance	––	––	++

Table II. Throughput comparison between old GFS2 cluster storage vs. new *"IznaStor"* cloud one

Storage device / File-system	I/O speed (MB/s)
4 Gbps FC-RAID/RH-GFS2	107
10 GbE IznaStor/FUSE vfs	172
10 GbE IznaStor/native put - get	403 - 620

1) Nakanishi, H. *et al.*: NIFS Annual Report (2010) 181.

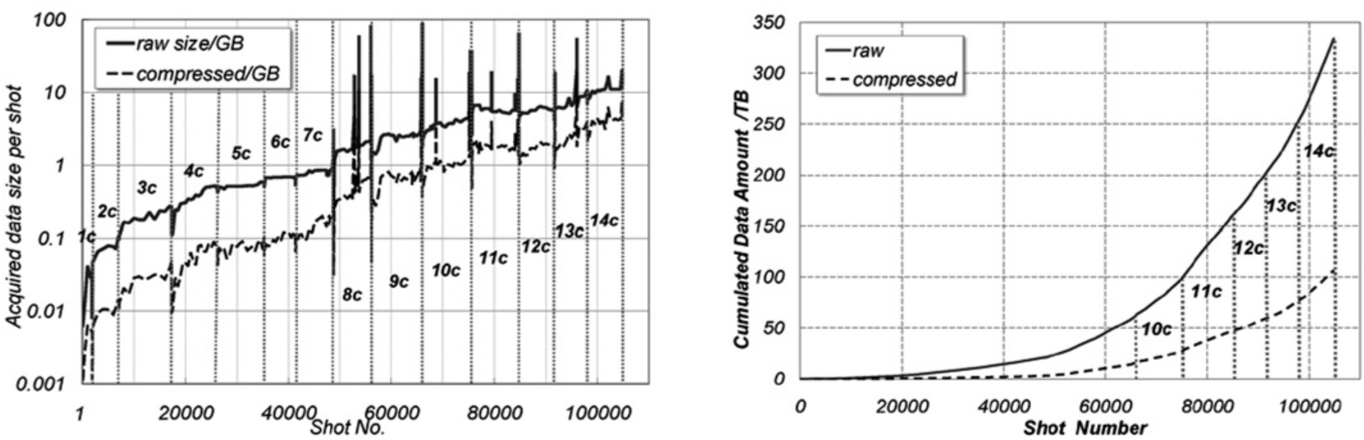

Fig. 1. Data growth in LHD: Acquired raw data size per shot (left) and the cumulated amount (right).