§25. Intelligent Data Migration Scheme in *"LABCOM/X"* Multi-Tier Distributed Storage

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Recent "data explosion" induces the demand for high capability of storage distribution and dynamic migration among them. The data volume of LHD plasma diagnostics has grown 4.6 times bigger than that of three years before (Fig. 1). Under such existing condition, frequent migration or replication between plenty of distributed storage becomes mandatory, and thus increases the human operational costs.

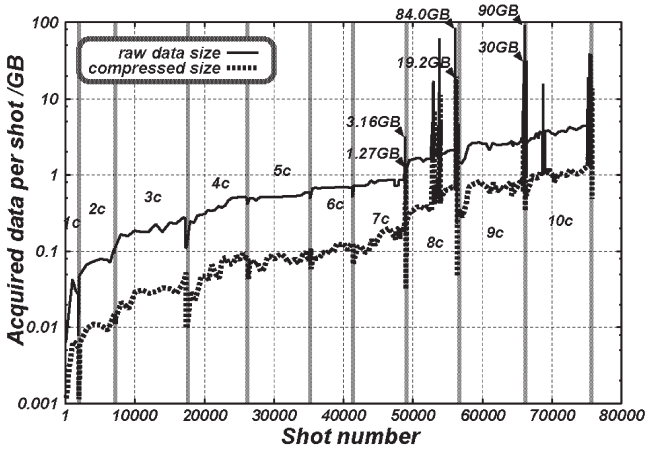

Fig. 1. Growth of shot-by-shot acquisition data amount in LABCOM system: At the end of 10th campaign, LHD short-pulse experiments acquired about 4.6 GB/shot plasma diagnostic raw data, with having about 170 shots everyday [1) 2)].

To reduce them computationally, a new adaptive data migration scheme has been developed on LHD's multi-tier distributed storage [3)]. So-called the HSM (Hierarchical Storage Management) software usually adopts a low-level cache mechanism or simple watermarks for triggering the data stage-in and out between two storage devices. However, the new scheme can deal with a number of distributed storage by the facilitator database that manages the whole data locations with their access histories and retrieval priority. Not only the inter-tier migration but also the intra-tier replication or data moving is even manageable so that it can be a big help in extending or replacing storage equipment.

The access history of each data object is also utilized to optimize the volume size of fast and costly RAID, in addition to a normal cache mechanism for frequently retrieved data. These new schemes have demonstrated their effectiveness on the LHD multi-tier distributed storage for further expandability (Fig. 2).

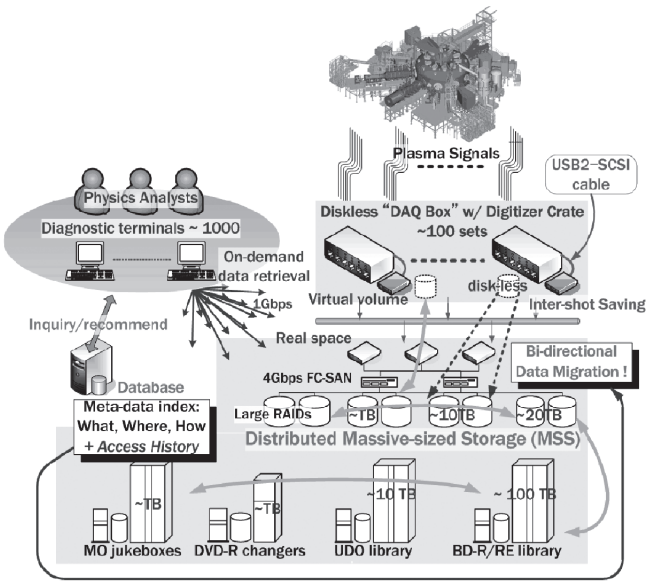

Fig. 2. Schematic view of adaptive data migration in *"LABCOM/X"* multi-tier distributed storage: The 1st layer of diskless "DAQ Box" should save its volatile memory data into RAID just after the acquisition ends. Indexing meta-database should trigger the data recall back from libraries into RAID for faster access.

Start of New "DAQ Box" Operation

Since 2005, we have entirely re-designed our data acquisition (DAQ) front-end computer to be a low-cost and maintenance-free "DAQ Box". As it has no magnetic parts at all, it could be installed near the magnetic field coils in LHD main-body room. It also involves that the first-tier data storage, i.e. local HDD, becomes extinct, and thus could reduce human cost and time for data migration.

In order to enable us to operate such the remote DAQ unit, some additional peripherals should be accompanied together. For digitizer operation, timing unit is always mandatory, and the whole DAQ unit must be remotely controlled with switching electricity (Fig. 3).

Fig. 3 New FPGA-based timing demodulator (left) and remote power controller (right) boxes: From the 10th LHD campaign, they have been ready for distribution. They can help us to reduce both the new installation and human maintenance costs for plasma diagnostics.

References
1)Nakanishi, H. et al.: J. Plasma Fusion Res. **82** (2006) 171.
2)Ohsuna, M. and Nakanishi, H. et al.: Fusion Eng. Des. **81** (2006) 1753.
3)Nakanishi, H. et al.: J. Plasma Fusion Res. SERIES, **7** (2006) 361.