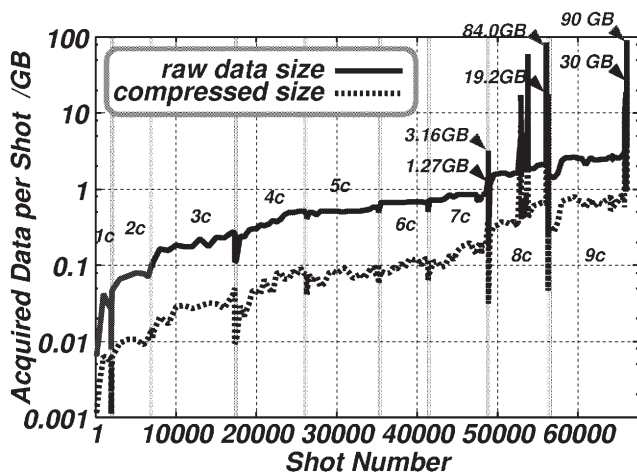


## §22. Framework Remodeling of LABCOM Data Acquisition System for the Next-Generation “LABCOM/X” Project

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The LABCOM data acquisition system (DAQ) has been operated for the LHD plasma diagnostics for nine years. It has set up a new world record of acquired data amount of 90 GB/shot in 2005-2006 campaign (Fig. 1). Its ultrawide-band DAQ based on the CompactPCI digitizers has enabled about 80 MB/s real-time data acquisition for each plasma measurement<sup>1)</sup>. Actually proved 80 MB/s bandwidth could easily satisfy the requirement for the advanced, large-scale fusion experiments, such as LHD and ITER. The basic performance of our DAQ unit has enough capability, but the subsidiary tools are not fully developed<sup>2)</sup>.



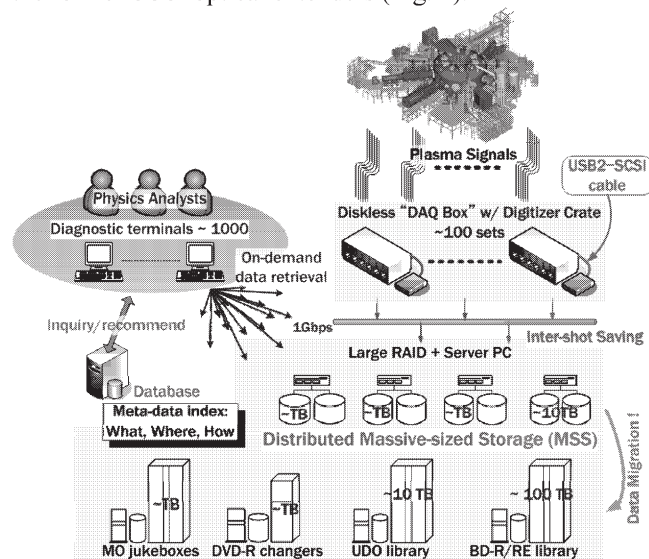
**Fig. 1.** Growth of shot-by-shot acquisition data amount in LABCOM system: At the end of 9<sup>th</sup> campaign, we had 170 shot/day, and produced about 3.0 GB/shot.

### “DAQ Box” Development

LHD already had over sixty DAQs in the 9<sup>th</sup> campaign, and its increase has made the operational and maintaining burden quite heavy. The data migration procedures between multi-tier distributed storages also need much closer attention. Therefore, “more distributed acquisition and centralized operations” would be indispensable to cope with both high-efficiency I/O throughputs and much enlarged data volume. In this study, DAQ front-end that consists of some digitizer chassis and an acquisition computer has been entirely re-designed to realize a low-cost and maintenance-free “DAQ Box” for fusion plasma measurements.

To satisfy those necessary conditions, Linux OS and its free drivers for digitizers, such as CAMAC and CompactPCI, have been adopted. Network-bootable diskless computers are desirable for reducing the possibility of hardware troubles in the bad noise environment. To wire it

adjacently to the digitizer controller could get rid of the cost for electrically isolating uplinks. Our inspection revealed that SCSI-USB2.0 conversion cables are the most promising in both transferring speed and the cost to replace the former SCSI optical extenders (Fig. 2).



**Fig. 2.** Revised diagram of LABCOM DAQ and multi-tier storage system: As the 1<sup>st</sup> layer “DAQ Box” keeps raw data only on its volatile memory, they must be saved to RAID just after the acquisition is finished.

It also means that the first-tier data storage becomes extinct, and thus could reduce the migration cost and time.

### Development of New FPGA-based Timing Demodulator

For replacing the costly VME-based timing demodulator, we have newly developed its FPGA version. It adopts the embedded device “Suzaku” that combines the Spartan-3E FPGA and MicroBrazz Linux software processor. Original logics have been newly rewritten by VHDL and C (ONC RPC on Linux). Its cost is almost one-tenth of the previous VME one.

### Multi-site Abstraction and DAQ Logical Extension

Another functional extension is to cope with multiple sites and experiments, in which remote participation mechanisms and utilities would be essential. The introduction of so-called “DataGrid” technology, which will be provided by the specific middleware such as Globus toolkit or ITBL (IT-based laboratory), seems to be a shorter way for revising the LABCOM data system.

This conceptual re-design for the DAQ framework would provide universal data accessing environments logically. Simultaneously, users could obtain the proper access controlling functionality for data and system security. For advancing necessary R&D, we have some discussion with JAEA (JT-60) and All-Japan ST research groups.

### References

- 1)Nakanishi, H. et al.: J. Plasma Fusion Res. **82** (2006) 171.
- 2)Nakanishi, H. and Okumura, H.: J. Plasma Fusion Res. **81** (2005) 112.