§16. Steady-state Operation Methods of LHD Data Acquisition System

Nakanishi, H., Kojima, M., Ohsuna, M., Nonomura, M.,
LABCOM Group,
Yoshida, M., Imazu, S. (CTC)

In case of the recent quasi-steady-state fusion devices, the non-stop real-time operation becomes indispensable to the data acquisition system, which was not significant in conventional short-pulse experiments. The newest fusion devices applying the super-conducting magnets, such as LHD (Large Helical Device) and Wenderstein 7-X, usually plan to hold a quasi-steady-state experiment with over ten minutes plasma duration. In such cases, the data acquisition system also has to run in real-time so that it can display the transient behaviors in accordance with the plasma discharge going on.

The LHD diagnostics have over 30 kinds of plasma measurement devices and their total number of CAMAC modules and channels are about 300 and 2000, respectively. In the 2001 campaign, their acquisition data makes up to 620 MB/shot in 150 shot/day usual operation [1]. Under those situations, the effective utilization method of existing digitizer resources, such as CAMAC and VMEbus modules, also becomes an important subject. It also sustains this subject that in short duration CAMAC modules still have enough capabilities to digitize any transient plasma phenomena.

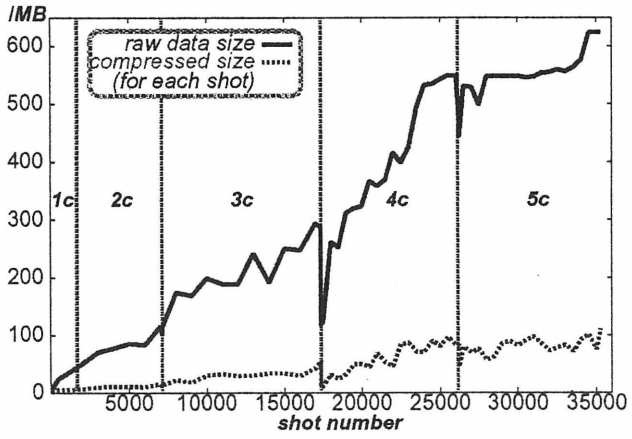

Fig.1. Growth of shot-by-shot data size acquired by LABCOM CAMAC system: The growth rate of the raw data slows down comparing to the previous cycles, however it still keeps growing.

In this study, 3 minutes cyclic operation scheme of the CAMAC-based data acquisition system has been developed toward the LHD long-pulse experiment, which succeeded to demonstrate the synchronized digitizer operations repeatedly. As there are too many signal channels in LHD to enable the 2-way alternating and break-less operation, additional diagnostics timing modules (VME) and wired-logic handling PLCs have been installed to generate/distribute the sub-structured control sequences within the master one.

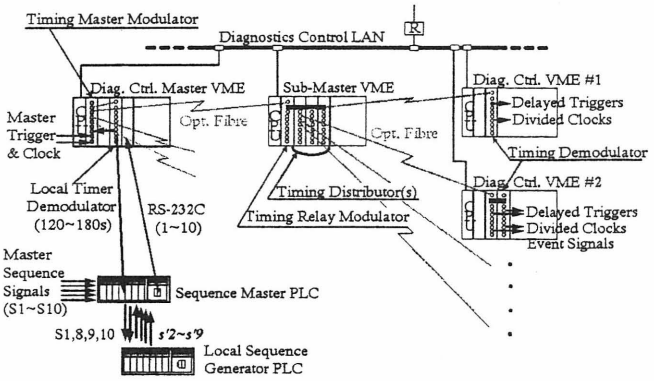

Fig.2. Sub-sequence generation and distribution circuit using a set of DTS and PLC

Sub-sequences will be practically recognized as a series of the short-pulse operation sequences so that all the acquisition instruments will run synchronously on them.

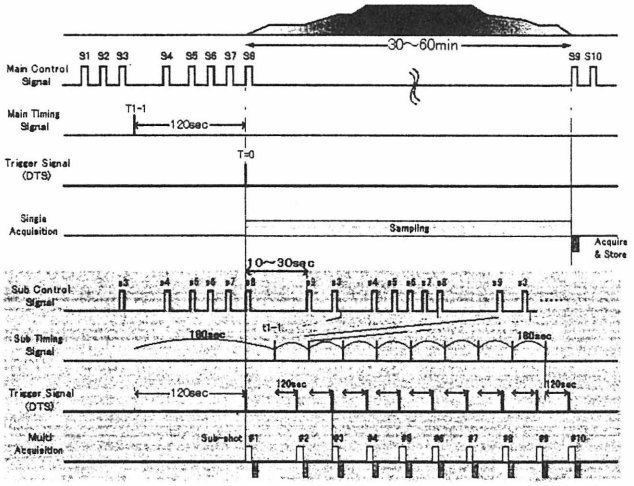

Fig.3. Long pulse operation sequence of the conventional CAMAC data acquisition system

New Trial for Real-time Data Acquisition System

To complement the intermittent operation of the CAMAC digitizers in the long-pulse experiment, R&D for the wide-bandwidth real-time digitizer front-end (DFE) system has been preceded simultaneously [2]. For that purpose, the CompactPCI standards can smoothly replace the CAMAC digitizers because of its popularity and low price by the PCI compliance. As a preliminary result, the prototype system has achieved its continuous data acquisition and transfer performance up to 80MB/s in one DFE. Such fast steaming transfer of the massively sized LHD physics data has proved its instrumental wide possibility.

The CompactPCI standard has an affinity with the PCI bus so that it will be also quite applicable for the PC-cluster or PC-based distributed system, especially in construction of a new data acquisition system. Its complementarity with the conventional CAMAC and VMEbus based system has been successfully verified in LHD.

References

1) Nakanishi, H. et al.: Fusion Eng. Des. **48** (2000) 135
2) Nakanishi, H. et al.: Fusion Eng. Des. **56-57** (2001) 1011