§17. Development of an IP Multicast-based Real-time Monitoring System for Long-pulse Operations

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Introduction

Short pulse operations are popular for nuclear fusion experiments. For example, LHD experiments in NIFS are usually consecutive short pulse (~10 s) plasma discharge experiments for every three minutes. However, operations that are no shorter than one hour are needed for use in practical generators, and the study of long-pulse operations is therefore becoming important. For this reason, NIFS has begun to test longer pulse experiments, and achieved 100 seconds' discharge in 2002. Because the main target of the current data acquisition systems is short pulse operation, these systems are not yet suitable for long-pulse operation. These systems are batch systems, and they acquire data during plasma discharges and transfer them to the storages until next discharge. Therefore, the researchers cannot see the acquired data during long-pulse discharges.

System Overview

In order to monitor continuous long-pulse operation, the authors developed the real-time monitoring system. The main characteristic of this system is to use IP multicast. Because the IP multicast packets are only sent to the sub-net in which the clients want to receive, the network load and server load will be reduced comparing to the one-to-one connection. Kariya demonstrated that the flexible monitoring system can be built using the IP multicast [1]. The authors used this idea and enhanced it. When the multicast server receives the IP multicast packet, it calls the filter program. Because these programs can be written by the end user, the system becomes more flexible.

The Figure 1 shows the overview of this system. The system can be divided into two parts, the plasma monitoring part and the LHD monitoring part. The target of the plasma monitoring part is to monitor the plasma specific data. This data is acquired by PC Linux servers. These servers use the PCI and CompactPCI based A/D board. Because the CompactPCI is more reliable than PCI, the CompactPCI based system is used in the shield room which is near the LHD. They acquire data at the frequency of 1 kHz. They average acquired data, and send them by IP multicast at the frequency of 1Hz. The LHD monitoring part receives data from the LHD real-time monitoring system [2]. Because the LHD real-time monitoring system is located on the network that is isolated from other system, the other users cannot access to the network. The LHD monitoring part retrieves the data from the LHD real-time monitoring system, and sends the data using IP multicast every second.

To visualize the received packet, NIFScope [3], a house made visualization tool, is used. Because NIFScope incorporates Ruby interpreter in it, the users can display not only the raw signals but also the physical data calculated by the Ruby program. Fig. 2 shows NIFScope window displaying the graph of the 100 s' discharge.

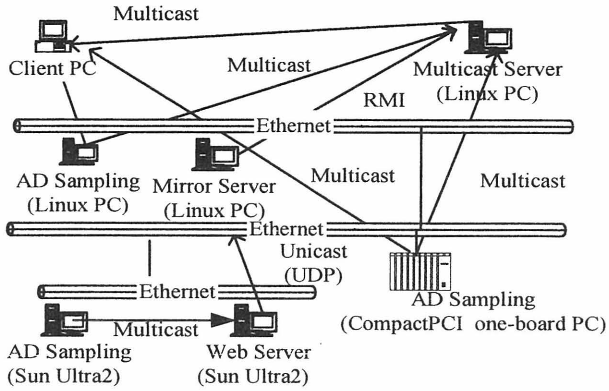

Fig. 1 System Overview

The multicast daemon retrieves data acquired by the LHD monitoring system from the mirror server, and sends them as IP multicast packets. The data acquired by CompactPCI and the PCI system are sent directly by IP multicast, and some are relayed by the multicast daemon.

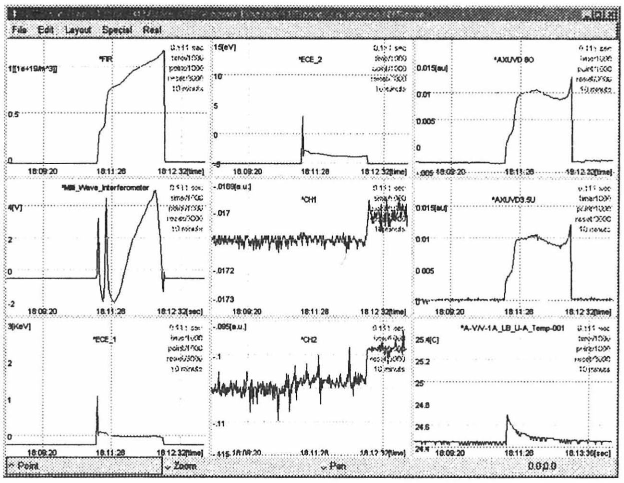

Fig.2 The real-time graph of NIFScope

The graph plots acquired data during the long pulse discharge of 100s.

Reference

1) J.Kariya, etl. al., **74** (1998) 67
2) S.Yamaguchi, et. al., Fus. Eng. Des., **48** (2000) 9
3) M.Emoto, et. al., Fus. Eng. Des.,**60** (2002) 367