§22. Video Delivery System for LHD Experiment Remote Participation

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Because LHD is a cooperative experiment being operated by NIFS and other universities, a lot of researchers around Japan are engaging in this experiment. Because they are remote from the NIFS, the remote participation facilities are helpful to promote closed relationship for fusion research. In order to provide efficient remote participation environment, we have been developing the remote collaboration systems using the Internet. Using this system, they can retrieve the latest data and control their instruments even from their room far away from NIFS. The video streaming system is one of them. During LHD experiments, the researchers in the central control system can see the summary graphs of the latest short and the plasma video images displayed on the panel at the front. This information is useful for the researchers to provide for the next shot by adjusting their instruments. Shoji developed the video demanding system [1] to broadcast plasma images using the network. However, this system converts the original images into MPEG format. Because MPEG format is lossy format, and they lose the original information. Therefore, the researchers can't use them for further analysis. In order to solve this problem, the authors developed another system. This system [2] enables the remote participants to see the same images from their institutes like the researchers in the control room. This system captures the video image projected into the screen, and provides these images for the researchers using Super SINET [3].

However, this system converts the original images into the NTSC video format, and it deteriorates the quality of the images. For example, the letters of the latest shot summary graph are hardly readable. To solve this problem, the new system has been developed. Fig.1 shows the overview of the system. The video output signal is split in front of the projector, and the divided signal is inputted into the Server through the down converter. The main difference from the former one is to use another video capture card that can handle RGB signal directly. The maximum acceptable resolution is UXGA(1600x1200), and the resolutions of source signals are SXGA(1280x1200) or lower. Therefore, the deterioration of the image can be reduced. However, because the board cannot accept higher refreshing rate faster than 60Hz at the SXGA or higher resolution, we use the down converter to decrease the frequency. The captured images are sent to the remote sites using Super SINET. Therefore, the system can supply the higher quality images than before, and it helps the remote researchers participating in the experiment. Because the capture driver is provided only for Windows operating system, the new system is running on Windows 2003 server while the former system is running on Linux.

The maximum capturing ratio at the SXGA resolution is 12 frames / sec, and the total data amounts to 45MB/sec. In order to reduce the traffic of the network, each frame is compressed by JPEG format. However, because JPEG compression is lossy format, it might cause the problem. Therefore, the compression algorithms are modulated and can be replaced by another one easily. We are now developing lossless compression algorithm, and have a plan to replace the compression codes.

	Server (Old)	Server (new)	Client
CPU	Xeon 2GHz x 2	Xeon 2GHz x 2	Pentium 4 2GHz
Memory	1GB	1GB	1GB
OS	Linux Kernel 2.4	Windows 2003 Server	Windows 2000 Professional
Capture card	BtB 878 based	VisionRGB	
NIC	1000Base-SX	1000Base-SX	1000Base-T

Table I: The specifications of the servers and clients

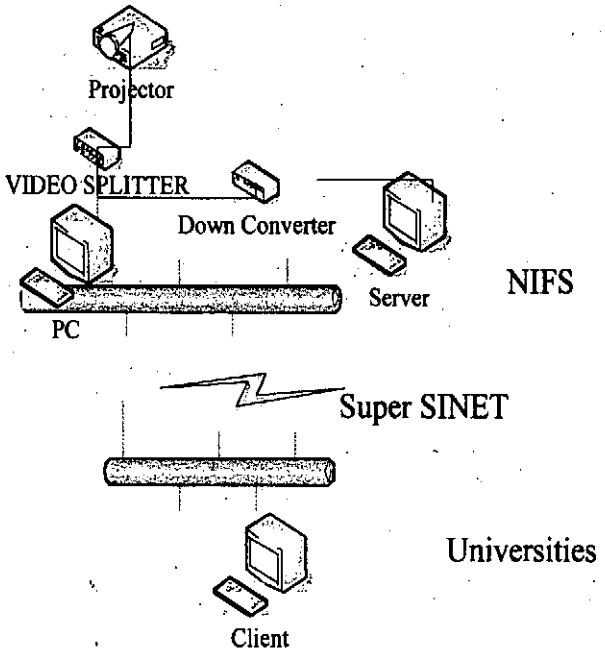

Fig1. The overview of the system.

References

1) Emoto, M., et. al., Rev. Sci. Inst., 74,(2003), pp.1766
2) Shoji, M., et. al, PCaPAC2000, Hamburg, Oct. 2000
3) http://www.sinet.ad.jp/