§3. Verification of Analyses of Helical and Tokamak Plasmas Using Broad Band Network toward Building of the Nuclear Fusion Research Grid

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1. Background

Intensification of the IT communication environment in large fusion facilities, such as JT-60U/SA, LHD, and ITER, accelerates collaborative researches with some research institutes. The amount of the handling experimental data increases year by year. Also, it is important to make the back-up data or the mirror data of valuable experiments in a remote collaboration area. Therefore the development of the technology of long-distance and broadband transmission is required. The technology of the broadband transmission in a long-distance is investigated here using SINET3.

2. Issues of long-distance and broadband data transfer

Use of TCP protocols prevents experimental data from lacking during data transfer. Although TCP protocols guarantee to transfer data to destination hosts, a variety of properties, acknowledgement, transfer limitation with window size and congestion control, results in low throughput in broadband network. Dr. Hiraki solved this problem by developing Comet-TCP 1). Long-distance and broadband data transfer demands to relax limits on traffic under a high-latency environment and to use network bandwidth efficiently. Gateway which includes Comet-TCP protocol is set up in the middle of computers that send and receive data. Although usual TCP protocols are used between a computer and a gateway, Long Fat Tunnel (LFT) protocols 2) are used between gateways. Consequently, issue of long-distance and broadband data transfer is solved.

3. Experiment and results of long distance and broadband data transfer

Throughput was determined with SNET between Japan Atomic Energy Agency Naka Fusion Institute and Kyusyu University Advanced Fusion Research Center (Figure 1). Methods, devices and network environments of determination are as follows. Network bandwidth is 100Mbps. Round Trip Time (RTT) is 40ms. Each operating system of two computers is Windows XP SP3 and Windows 2008 server. Each computer is connected WANDIRECTOR A100 which includes Comet-TCP, made by Fujitsu Co., Ltd. Results are as follows.

i) File transfer using FTP protocols (File size is 50MB. Average value of three trials)
   Case of connection to WANDIRECTOR: 66.67Mbps
   Case of no connection to WANDIRECTOR: 1.48Mbps
ii) Network benchmark test using Netperf (Average value of three trials)
   Case of connection to WANDIRECTOR: 82.0Mbps
   Case of no connection to WANDIRECTOR: 11.71Mbps

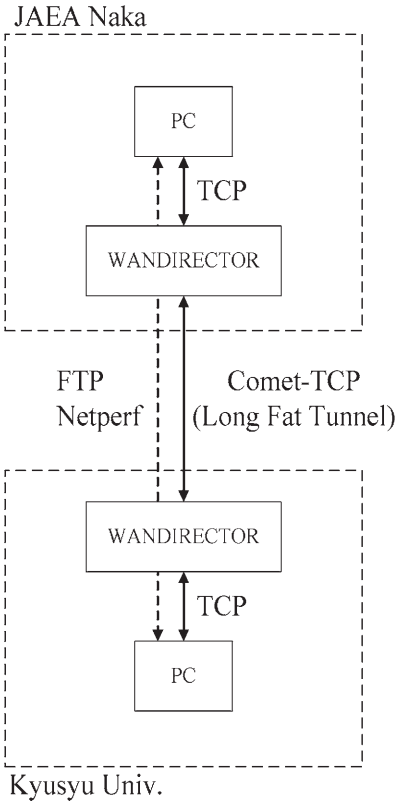

Fig.1. Experiment of data transfer and netperf

4. Discussion

RTT of 40 ms has throughput of 12.8 Mbps in theory because general window size of Windows is 64KB. Connection of WANDIRECTOR provides with more than five times theoretical throughput. This shows Comet-TCP is effective in file transfer under the high-latency and broadband networks.

Different value of FTP and netperf results from recording technique. FTP records telecommunication data in a hard disk drive. On the other hand, netperf records it in a main memory. In general, hard disk recording is 100 times slower than main memory recording. Therefore slowness of hard disk recording affects throughput.

5. Future plan

Although broadband data transfer was tested on this occasion, file size and limitation of transfer time were not set up. Therefore restraint condition which experiment was predicted requires more verification.

In addition, remote access test is not conducted to any computers. Remote computer access is easily affected by network latency. We need to verify whether WANDIRECTOR can deny influence of network latency or not.

1) Jinzaki, A.: Stream Processor Comet, in JSPP2000, IPSJ Symposium Series Vol. 2000, No.6 (in Japanese). IPSJ, 2000, pp. 205–212.
2) Nakamura, M., et al.: End-node transmission rate control kind to intermediate routers - towards 10 Gbps era, PFLDnet, 2004