6. SNET Collaborative Research

SNET has been operating dedicated to the fusion research collaborations, *i.e.*, the Fusion Virtual Laboratory (FVL) in Japan. SNET consists of a cluster of layer-2 and layer-3 virtual private network (L2/L3-VPN) circuits which inter-connect the collaborative universities and institutes via the national academic network backbone SINET5 operated by National Institute of Informatics (NII). Since 2017, SNET has given the priority to the bilateral collaborations on remote data acquisition and archiving because other remote accesses are already served by SSL–VPN. In 2018 fiscal year (FY), the fusion experiments of three Japanese universities, QUEST in Kyushu University, GAMMA10/PDX in University of Tsukuba, and TST-2 in University of Tokyo, are connected via SNET to share the LHD data storage.

The TST-2 experiment remotely acquires the MIR data synchronously with its operational sequence, whose amount was 86.6 GB on 960 plasma discharges in 2018 FY. Figure 1 shows a typical result of the MIR data analysis on the TST-2 ohmic plasma. Two-dimensional fluctuations of equal density surface just before, in the middle, and just after the internal magnetic reconnections happened were observed by using 6 × 6 array.

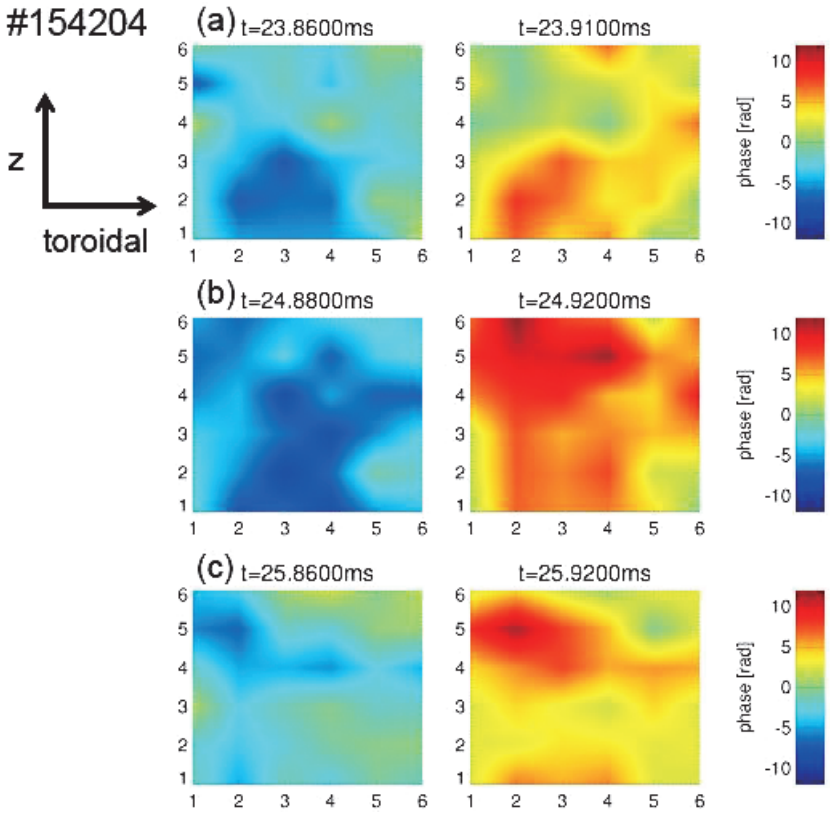

Fig. 1 Two-dimensional phase images where (a) t_{sp} ~ –1.08 ms, (b) t_{sp} ~ –0.08 ms, and (c) t_{sp} ~ +0.92 ms, respectively. X and Y axes show the channel nos. whose intervals are approximately 27 mm. Left and right images show the phases in the fluctuation's bottom and top time, respectively.

Research highlights

One of the important objectives of the SNET collaboration is to execute the feasibility study on the real-time replication between multiple data repository sites by using 10 Gbps and higher bandwidth long-distance network, such as SINET. For the multi-point date replication, two possible approaches can be considered, daisy-chain and parallel transfers. The most effective solution would probably be the combination use of these two methods. National Institute of Informatics (NII), National Institutes for Quantum and Radiological Science and Technology (QST), and NIFS have been collaborating to conduct some performance comparison tests across those three sites by using the real LHD data of the 20th campaign.

The uplink bandwidth of each site is 20 Gbps (NIFS), 40 Gbps (NII), and 10 Gbps (QST), respectively. Thus, the transfer tests were made under the traffic limitations of 16 Gbps between NIFS and NII, and 8 Gbps to QST. Figure 2 shows the traffic results made by the daisy-chain and parallel transfer tests. The whole LHD data of the day were always able to be replicated to the other two sites within 40 minutes. By changing the applied transfer method, we have successfully compared the characteristic differences and also the overall throughputs between these two methods. Through the verification tests, the daisy-chain transfer can been found to be faster in total replication time than the parallel one with the following conditions:

i. The network bandwidth at the source site is insufficient for performing parallel transfers to all the destination sites at once
ii. A destination site has a higher bandwidth than the source site
iii. The empty time after completing the transfer to the relay site could be used effectively.

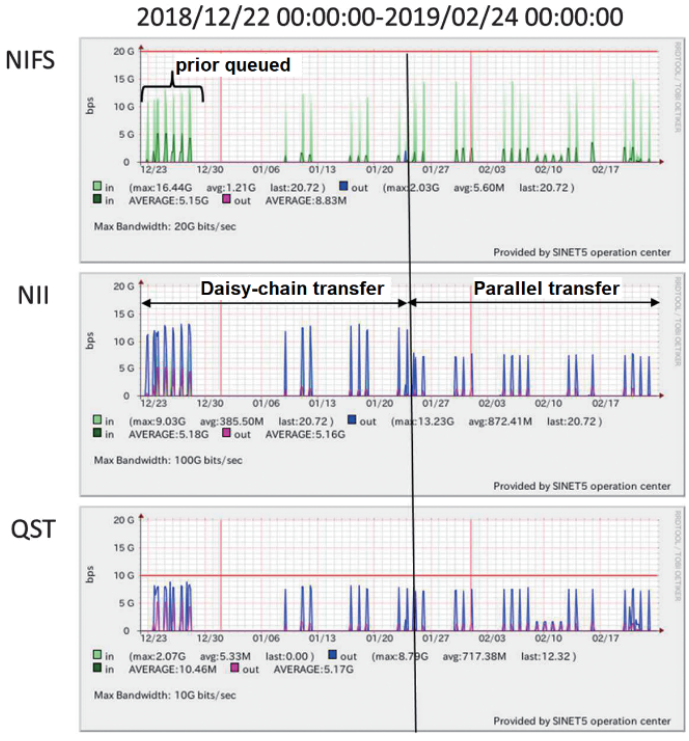

Fig. 2 Observed traffic at sender (NIFS), relaying (NII), and receiver nodes (QST), in both daisy-chain and parallel transfer tests.

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