§3. Technical Demonstration of 10 Gbps SINET-based High-bandwidth Data Transfer for Remote Experiments

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i) Introduction

The primary objective of this collaborative study is making technical demonstrations of the long-distance data transfer and the remote archiving which are required for the remote participation in fusion experiments. At the collaborative three sites of NIFS Toki, NII Tokyo, and IFERC Rokkasho having 10 Gbps uplink to SINET backbone, we have installed the 10 Gbps test PC servers to have some verification tests between them for both fast data transfer algorithm and the effective throughputs. Those network tests have been done by means of standard Layer-3 (L3) Internet connections and also by the Layer-2 virtual private network (L2VPN) dedicated for this collaboration test study.

## ii) Test Results

To compare the L2VPN to the standard L3 Internet, the dedicated L2VPN circuit has been built on the SINET4 infrastructure, as shown in Fig. 1. The MMCFTP is used as the high speed file transferring algorithm<sup>1)</sup>.



Fig. 1. Network configuration for the high speed data transfer tests: 10 Gbps L3 Internet and L2VPN connections were used on SINET4 across the NIFS, NII, and IFERC sites.

Table I. Test results on standard L3 Internet data transfer
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MTU	IPS	NII to IFERC	IFERC to NII
1500 Byte	on	0.8 Gbps	1.8 Gbps
1500 Byte	off	2 Gbps	3 Gbps
9000 Byte	off	2-6 Gbps	4 Gbps

Table I shows the test results of the standard L3 Internet data transfers. Changing the Ethernet frame size from the standard 1500 bytes to the so-called jumbo frame of 9000 bytes, turning off the intrusion prevention system of the firewall, or other systematic tunings could not overcome the throughput limit of 4 Gbps between NII and IFERC. We found it is the maximum packet forwarding rate of the IFERC firewall equipment.

On the other hand, the L2VPN tests between NIFS and IFERC showed more than 8 Gbps throughput very stably  $^{2)}$ , as shown in Fig. 2. At the SC15 conference, we also demonstrated 15 Gbps transfer rate on dual 10 Gbps links between Tokyo and Austin, USA  $^{3)}$ . Consequently, we can conclude that L2VPN is the promising methods for the next-generation long-distance remote participations.

## iii) Summary and Future Plans

Since April 2016, the new SINET5 has 100 Gbps full meshed backbones, and the oversea links are 100 Gbps for US and additional 20 Gbps for EU (See Fig. 3). To fully utilize this upgrade benefits, we plan to make oversea tests for the technical demonstration using actual fusion data.

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- Nakanishi, H., Yamanaka, K., *et al.*; "Test and Verification of Fast Data Transfer methods for ITER-REC", 32<sup>nd</sup> JSPF Annual Meeting, 24–27 Nov. 2015, Nagoya, Japan (2015) 24pD51P.
- K. Yamanaka, "MMCFTP: A New Fast FTP", SC15 Exhibition, Austin, Texas, 16–19 Nov. 2015.



Fig. 2. L2VPN tests show 8.5 Gbps stable throughput over 100 s. Its performance is far beyond the L3 Internet transfers passing through firewalls.



Fig. 3. New SINET5 oversea structure (since April 2016).