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A data transfer method for physics data of experimental fusion reactors using virtual disks

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Analyzing physics data from experimental fusion reactors is important for R&D of demonstration reactors. The Japanese fusion community is planning to transfer all ITER's raw data near-real time to the Remote Experiment Centre (REC) in Japan and provide it, along with a supercomputer to domestic researchers so that they can freely analyze ITER data. "Near real-time" transfer means that the transfer of one shot data is completed before the start of the next shot.

The generation rate of measured data in ITER is assumed to be 2 GB/s in the initial phase and 50 GB/s in the mature phase. For near real-time data transfer from ITER to REC, speeds equal to or greater than these are desirable. The duration of one shot in the initial phase is expected to be 500 seconds, and the amount of data will be 2 GB x 500 sec = 1TB.

If the transfer target is a single large file, the file transfer tool MMCFTP [1] can be used to transfer the file between Europe and Japan at a speed of about 100 Gbps. However, the physics data of experimental fusion reactors is a collection of files of various sizes from a large number of sensors. It is difficult to read, write, and transfer many small files at high speed. This is called the Lots of Small Files (LOSF) Problem.

In this presentation, we evaluate a method using virtual disks to achieve near real-time transfer from ITER to REC. A virtual disk is mainly used as storage for a virtual machine (VM), and is a file system on the VM, but a single file on the VM host. The acquired data is stored to the virtual disk on the VM, and then the virtual disk file is transferred at high speed to the REC by the VM host. After the transfer is completed, the virtual disk is attached to the VM on the REC, and the ITER data can be used for analysis.

We installed one server each at QST REC in Rokkasho and NII in Tokyo, and prepared a virtual machine for ITER's Codac Core System v7 on each. There are two L2VPN connections between REC and NII, one of which goes through Amsterdam, New York, and Los Angeles, and the round trip time (RTT) is about 374ms. Since the RTT between ITER and REC is about 250ms, we conducted the experiment in a more difficult transfer environment. A portion of the NIFS's LHD data, approximately 1 TB, was used for the transfer data. There are various formats of virtual disks and various file transfer tools. We compared these combinations and evaluated them from the viewpoint of whether near real-time transfer is possible.
In this presentation, we will report the results of this experiment and briefly introduce some topics including Japanese academic network update.

References
[1] K.Yamanaka, S.Urushidani, H.Nakanishi, et.al. "A TCP/IP-based constant-bit-rate file transfer protocol and its extension to multipoint data delivery", FED Vol.89 No.5 770-774 (2014)

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