Correlation Processing in NICT Kashima

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Abstract Correlation processing of VLBI observation data has been performed by two sorts of software correlation systems in NICT. One is the multi-channel 'K5/VSSP software correlator' and the other one is fast wideband correlator called 'GICO3'. These correlators are used for processing of VLBI observation conducted for R&D experiments. This paper reports the activities of correlation center in NICT.

1 General Information

Software correlator has become popular in recent VLBI correlation centers. This trend was driven by rapid increase of processing capabilities of computer technologies and increase of hard disk drive capacity. VLBI group of NICT Kashima has played the leading role in development of operational software correlator from early 2000[1, 2]. VLBI group of Space-Time Standard Laboratory (STSL) of the National Institute of Information and Communications Technology (NICT) has been working on VLBI technology development in collaboration with domestic institutes and universities in the field of geodesy, astronomy, and space science. Current mission of our group is precise frequency comparison between atomic standards at distant locations. In this development, VLBI experiments have been conducted for research and development (R&D) purposes and the data have been processed by our own software correlation systems. Correlation system is located in the Kashima Space Technology Center (KSTC), though correlation processing is performed with sharing data with the network file system (NFS) over the local area network (LAN) spanning between NICT headquarter in Tokyo and KSTC.

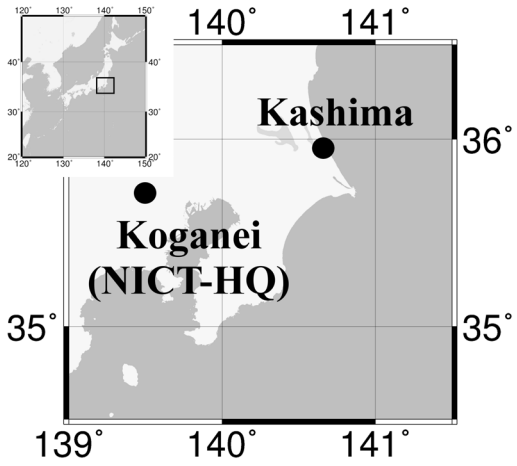

Fig. 1 Location of NICT-Koganei Headquarters, and Kashima

2 Component Description

The correlation system is composed of high performance computer servers and data recording system with RAID disk system. They are not always stored in the same racks in the computer room, but located separately and has been connected via 1000BASE-T network.

NICT Space-Time Standards Laboratory/Kashima Space Technology Center

NICT Correlator

IVS 2013 Annual Report

2.1 K5/VSSP correlator

Conventional 16 channels of geodetic VLBI observation data is processed with K5/VSSP software correlator, which was developed by T.Kondo[1]. A typical processing time for 256-Mbps (32-Mbps x 16-channels) observation for 1 baseline correlation takes about 2 times of real observation scan lengths when 16 cores of the servers A and B in table 1 are used.

Table 1 CPU Servers used for correlation processing.

Servers	CPU type and Core	CPU clock	Memory Size
A	Intel Corei7 8 cores	3.0 GHz	16 GBytes
B	Intel Corei7 8 cores	1.6 GHz	12 GBytes
C	Xeon E5-2680 40 cores	1.2 GHz	66 GBytes
D	Intel Corei7-3960X 12 cores	1.2GHz	66 GBytes

2.2 GICO3 Correlator

Fast wideband correlation software written by M.Kimura[3] has been used with Giga-bit data acquisition system (ADS1000, ADS3000/ADS3000+). The data acquired of 512-MHz or 1024-MHz bandwidth (1024-Msps or 2048-Msps x 1 or 2-bit sampling = 1024-Mbps or 2048-Mbps) are processed with GICO3. Correlation processing has bee peformed with sever C and D in table 1. Processing time for 2-Gbps mode (2048-Msps x 1-bit x 2-ch) for 1 baseline (Kashima 34-m - Koganei 11-m) takes aproximately 5 times of real data acquisition rate at present. Its rate is thought to be limited by the 1-Gbps network speed at Koganei 11m station.

2.3 Network Connection

Kashima 34-m antenna site and Kashima 11 m station is connected via 10-Gbps LAN. The network speed between Kashima and Koganei 11-m is 1 Gbps at present (Fig. 2), but this will be upgraded to 10-Gbps soon. The 10-Gbps network connection between KSTC and NICT Koganei Headquarter suported by research network JGN-X (Next Generation Network Test bed). For correlation processing of Kashima - Koganei baseline, the observation data are not transferred before processing, but shared with network file system (NFS) over the LAN. Thus data processing can be started just after the observation and that is quite useful for quick fringe check and performance test.

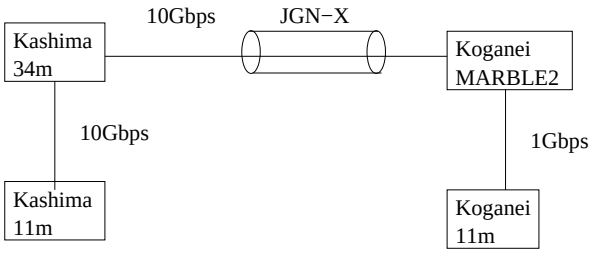

Fig. 2 Network speed between Kashima and Konganei site.

3 Staff

Tsutsumi Masanori: He is in charge of maintenance of data processing servers and data acquisition RAID systems.

Takefuji Kazuhiro: he uses GICO3 correlator for R&D VLBI experiments.

Sekido Mamoru: He uses K5/VSSP correlator for conventional VLBI observations and is in charge of overall activities.

4 Current Status and Activities

VLBI group of NICT Kashima has been conducting R&D VLBI observations for technology development. Current mission of our group is development of wideband VLBI observation system (named Gala-V) for precise frequency comparison between newly developed atomic standards. The Gala-V system employs similar radio frequency coverage (3-14 GHz) with VGOS but acquires data of four 1 GHz bandwidth signals. Currently observation of R&D experiment for Gala-V project has been performed with single channel in 2013, and that data processing has been performed with GICO3 software correlator.

Fig. 3 Servers used for corelation processing.

5 Future Plans

VLBI correlator NICT has been used for R&D experiments conducted by NICT itself. Following to the progress of the Gala-V project, load for data processing will increase. Thus increase of processing capacity and more systematic configuration of the system are to be considered.

Acknowledgments

We thanks to research network JGN-X and Information System Section of NICT for supporting the network environment for e-VLBI.

References

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