Correlation Processing in NICT Kashima

Mamoru Sekido, Kazuhiro Takefuji, Masanori Tsutsumi

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 the fast wideband correlator called 'GICO3'. These correlators are used for processing of VLBI observations conducted for R&D experiments. This paper reports the activities of the correlation center in NICT.

1 General Information

Software correlator has become popular at recent VLBI correlation centers. This trend was driven by the rapid increase of processing capabilities of computer technologies and the increase of hard disk drive capacity. VLBI group of NICT Kashima has played the leading role in the 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 fields of geodesy, astronomy, and space science. The 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. The correlation system is located in the Kashima Space Technology Center (KSTC), although correlation processing is performed by sharing data with the network file system (NFS) over the local area network (LAN) spanning between the NICT headquarters in Tokyo and KSTC.

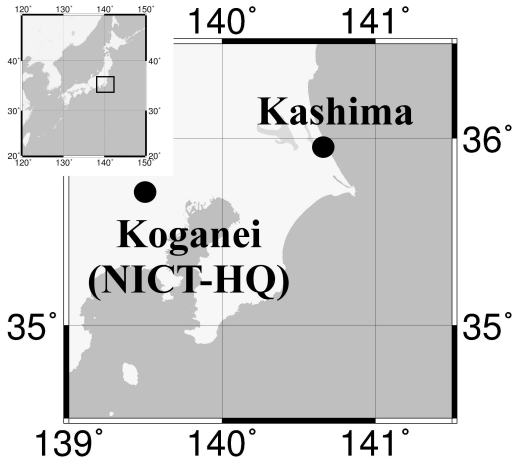

Fig. 1 Location of the NICT-Koganei Headquarters and Kashima.

2 Component Description

The correlation system is composed of high performance computer servers and a data recording system with a RAID disk system. They are not always stored in the same racks in the computer room but are located separately and 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 channel geodetic VLBI observation data is processed with the K5/VSSP software correlator, which was developed by T. Kondo [1]. A typical processing time for 256-Mbps (32-Mbps x 16-channels) observations for the correlation of one baseline takes about two times the 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 at 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 been peformed with servers C and D in Table 1. The processing time for 2-Gbps mode (2048-Msps x 1-bit x 2-ch) for one baseline (Kashima 34-m - Koganei 11-m) takes aproximately five times the real data acquisition rate at present. Its rate is thought to be limited by the 1-Gbps network speed at the Koganei 11-m station.

2.3 Network Connection

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

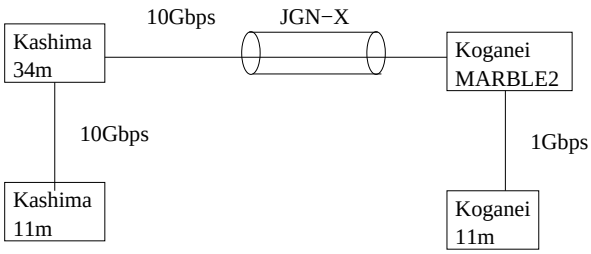

Fig. 2 Network speed between the Kashima and Konganei sites.

3 Staff

Tsutsumi Masanori: In charge of maintenance of data processing servers and data acquisition RAID systems.

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

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

4 Current Status and Activities

The VLBI group of NICT Kashima has been conducting R&D VLBI observations for technology development. The current mission of our group is development of a 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, R&D observing for the Gala-V project has been performed with a single channel in 2013, and that data processing was performed with the GICO3 software correlator.

Fig. 3 Servers used for corelation processing.

5 Future Plans

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

Acknowledgements

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

References

1. T. Kondo, et al., 'Development of the new real-time VLBI technique using the Internet Protocol', IVS CRL-TDC News No. 17, pp.22-24, 2000.
2. Hiro Osaki, Tetsuro Kondo, and Moritaka Kimura, 'Development of Versatile Scientific Sampling Processor (VSSP)-A Practical Approach', IVS CRL-TDC News, No.20, pp.7-9, 2002.
3. M. Kimura, and J. Nakajima, 'The implementation of the PC based Giga bit VLBI system', IVS CRL-TDC News No.21, pp.31-33, 2002.