NICT Correlation Center 2017-2018 Biennial Report

Mamoru Sekido [1] , Kazuhiro Takefuji [1], and Masanori Tsutsumi [1]

Abstract This report describes the NICT Correlation center and its activities.

1 General Information

VLBI Correlation center of NICT is operated by Space-Time Standards Laboratory of NICT/Applied Electromagnetic Research Institute, and located in the Kashima Space Technology Center. Development of broadband VLBI technology for application to precise frequency comparison between atomic clocks is primary mission of our group. VLBI experiments for this project have been conducted, and have been processed.

2 Component Description

VLBI system 'GALA-V' is broadband VLBI system composed of two small diameter antennas and Kashima 34m diameter VLBI station. Upgrading of receiver system[1] and development of wide-band bandwidth synthesis technique[2] have been performed by using these stations. Small (2.4m) diameter stations have been installed at headquarter (HQ) of NICT in Tokyo and National Metrology Institute of Japan (NMIJ) in Tsukuba, respectively. Both institutes are in charge of keeping time series

Fig. 1 Cluster computer of correlators system by using GICO3 Software correlator at NICT/Kashima.

UTC(NICT) and UTC(NMIJ), thus time difference with respect to UTC is regularly monitored by using GPS-link. This environment was suitable for evaluation of frequency-link by VLBI.

A series of VLBI experiments for clock comparison had been conducted in 2017 and 2018[3]. In March 2018, VLBI station at NMIJ was moved to Kashima, then it was exported to Medicina in Italy for intercontinental VLBI experiment. Installation of the small VLBI station to Medicina observatory has been made at the end of July 2018. After initial testing, a series of VLBI experiment has been conducted from Oct. 2018.

Data acquisition has been made by RF-Direct sampler K6/GALAS[4] and K6 recording system. The observation mode was 2048-Msps/1-bit/4-ch. Total data rate is 8192-Mbps per station. Correlation processing of Kashima -Koganei, and Kashima - Tsukuba, or Kashima - Medicina baselines are performed with GICO3 software correlator[5]. Fig. 1 shows the cluster computer for correlation processing with GICO3 software correlator. Specification of cluster computers for

1. Kashima Space Technology Center, National Institute of Information and Communications Technology

Table 1 Specifications of cluster computers for correlation processing.

Machine	CPU	Memory	RAID
A	Intel i7-3960x v2 6-Core 3.3GHz	64 GB	
B	Xeon E5-2680 v2 20Core 2.8GHz (Dual CPU)	64 GB	Areca ARC-1882ix-24
C	Xeon E5-2680 v2 20Core 2.8GHz (Dual CPU)	64 GB	Areca ARC-1883ix-24
D	Xeon E5-2687 v2 16Core 3.4GHz (Dual CPU)	64 GB	Areca ARC-1882ix-24

correlation processing is summarized in Table 1.

About 30 TB of data is acquired per a day per station. One session of GALA-V experiment continues 2-3 days.

Observed data at NMIJ had been collected by physical transportation of disk set. In case of VLBI experiment between Medicina-Kashima baseline, observed data has been transferred over high speed network. VLBI stations between Medicina, NICT/Kashima, and Koganei are connected by 10-Gbps network. Available data transfer rate is around 5Gbps from Medicina to Kashima. This is realized by the support of high-speed research network of GARR in Italy, GEANT in Europe, Internet2 and TransPAC in USA, and JGN in Japan. The data processing takes 1-2 times of the data acquisition rate. Thus, it takes about four days for correlation processing total 150-200 TB of observation data.

3 Staff

Members who are contributing to the Correlation Center of NICT are listed below (in alphabetical order):

- KONDO Tetsuro: Development of wideband bandwidth synthesis software.
- SEKIDO Mamoru: Coordinating of VLBI observation and making data analysis with CALC/SOLVE.
- TAKEFUJI Kazuhiro: Operating correlation processing for broadband data.
- TSUTSUMI Masanori: Maintaining the computer servers of K6 VLBI recording system and cluster computers for correlation process.

Acknowledgement

High speed network environment is provided by high speed R&D network testbed JGN[1]. Especially, we appreciate Takatoshi Ikeda of JGN, Kunitaka Namba, and Yoshihiro Okamoto of the Information System Section of NICT for supporting this project.

[1] https://www.jgn.nict.go.jp/index.html

References

1. Kazuhiro Takefuji, Hideki Ujihara, and Tetsuro Kondo, “NICT Technology Development Center 2015+2016 Biennial Report”, International VLBI Service for Geodesy and Astrometry 2015+2016 Biennial Report, edited by K. D. Baver, D. Behrend, and K. L. Armstrong, NASA/TP-2017-219021, 2017.
2. Kondo, T. and K. Takefuji, ”An algorithm of wideband bandwidth synthesis for geodetic VLBI”, Radio Sci., 51, doi:10.1002/2016RS006070, 2017.
3. Sekido, M., “NICT VLBI Analysis Center Report for 2017-2018”, International VLBI Service for Geodesy and Astrometry 2017+2018 Biennial Report, edited by K. D. Baver, D. Behrend, and K. L. Armstrong, NASA/TP-2018-??????, 2018.
4. Sekido, M., TOW 2015 Lecture Note https://ivscc.gsfc.nasa.gov/meetings/tow2015/Sekido.Lec.pdf, @2015.
5. Kimura, M., ”Development of the software correlator for the VERA system II”, IVS NICT-TDC News 35, pp.22-25, 2007. http://www2.nict.go.jp/sts/stmg/ivstdc/news_28/pdf/tdcnews_28.pdf