NICT Correlation Center 2017–2018 Biennial Report

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

1 General Information

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

2 Component Description

The VLBI system 'GALA-V' is a broadband VLBI system composed of two small diameter antennas and the Kashima 34-m diameter VLBI station. The upgrading of the receiver system [1] and development of wideband bandwidth synthesis techniques [2] have been performed by using these stations. Small (2.4-m) diameter stations were installed at the headquarters (HQ) of NICT in Tokyo and the National Metrology Institute of Japan (NMIJ) in Tsukuba, respectively. Both institutes are in charge of keeping time series UTC (NICT) and UTC (NMIJ); thus, the time difference with respect to UTC is regularly monitored by using GPS-link. This environment was suitable for frequency-link evaluation by VLBI.

Fig. 1 The cluster computer of the correlator system using the GICO3 Software correlator at NICT/Kashima.

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

Data acquisition has been made by the RF-Direct sampler K6/GALAS [4] and the K6 recording system. The observation mode was 2,048-Msps/1-bit/4-ch. The total data rate is 8,192-Mbps per station. Correlation processing of the Kashima–Koganei, Kashima–Tsukuba, or Kashima–Medicina baselines is performed with the GICO3 software correlator [5]. Figure 1 shows the cluster computer for correlation processing with the GICO3 software correlator.

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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

Specifications of the cluster computers for correlation processing are summarized in Table 1.

About 30 TB of data is acquired per day per station. One session of the GALA-V experiment continues for two to three days.

Observed data at NMIJ was collected by the physical transportation of a disk set. In the case of VLBI experiments with the Medicina–Kashima baseline, observed data was transferred over high speed network. VLBI stations between Medicina, NICT/Kashima, and Koganei are connected by 10-Gbps network. The available data transfer rate is around 5 Gbps from Medicina to Kashima. This is realized by the support of the high-speed research network of GARR in Italy, GEANT in Europe, Internet2 and TransPAC in USA, and JGN in Japan. The data processing takes one to two times the data acquisition rate. Thus, it takes about four days for correlation processing, totaling 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 observations and making data analysis with CALC/SOLVE.
- TAKEFUJI Kazuhiro: Performing correlation processing for broadband data.
- TSUTSUMI Masanori: Maintaining the computer servers of the K6 VLBI recording system and cluster computers for the correlation process.

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