# Kashima 11m and Koganei 11 m VLBI Stations

M. Sekido, E. Kawai

**Abstract** The Kashima and Koganei 11 m stations have been used for paticipating T2, CRF, and APSG sessions conducted by the IVS and AOV sessions organized in Asia-Oseania region.

## **1** General Information

A pair of 11 m diameter antennas have been operated by the VLBI group of the Space-Time Standard Laboratory (STSL) of the National Institute of Information and Communications Technology (NICT). The Kashima 11 m antenna is located at Kashima Space Technology Center (KSTC), on the east coast of the Japanese main island. The Koganei 11 m antenna is located at the headquarters of the NICT in Tokyo (Figure 1). The 11 m VLBI antennas at Kashima and Koganei (Figure 2) have been regularly operated with other two stations for the monitoring of crustal deformation of the Tokyo metropolitan area (Key Stone Project) since 1995 [1]. After the KSP project has terminated in 2001, two 11m diameter antennas were transferred to Gifu Univ. and Hokkaido Univ. Kashima and Koganei 11 m stations remained and have been used for research and technology developments by NICT.

These two stations had not participated international geodetic observations until 2011. After the "Tohoku earthquake" occurred in March 2011, the Kashima and Koganei stations have been participating

NICT Space-Time Standards Laboratory/Kashima Space Technology Center

NICT KSP Network Station

IVS 2015+2016 Biennial Report



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

to international IVS-R1, T2, APSG, and AOV sessions.

## 2 Component Description

### 2.1 Antenna

The antenna parameters of Kashima-11 and Koganei-11 are summarized in Table 1. The band-pass filters for S-band (2212-2360 MHz) were installed in 2010 at both stations for mitigation of radio frequency interference from cell phone stations. The local oscillator frequency of XH-band at the Kashima 11 m station has been changed from 7600 MHz to 7680 MHz since 2008, and since then, the observation bands of the



Fig. 2 11 m VLBI antennas at Kashima (left panel) and Koganei (right panel).

**Table 1** The antenna parameters of the 11 m antennas.

		Kashima	Koganei	
Antenna Typ	pe	Cassegrain type		
Diameter		11 m		
Mount Style	•	Az El mount		
Latitude		N 35° 57' 19.46"	N 35° 42' 37".89	
Longitude		E 140° 39' 26.86"	E 139° 29' 17".06	
Altitude		62.4 m	125.4 m	
	S band	$2212 \sim 2360$	$2212\sim2360$	
Rx Freq.	X Low band	$7700 \sim 8200$	$7700 \sim 8200$	
[ MHz ]	X High band	$8180\sim 8680$	$8100\sim8600$	
	S band	3000	3000	
Local Freq.	X Low band	7200	7200	
[ MHz ]	X High band	7680	7600	
SEFD [ Jy ]	X-band	5700	9500	
	S-band	3300	5500	

Kashima and Koganei stations have been different by 80 MHz.

## 2.2 Data Acquisition Systems

Two kinds of samplers are available at both stations as summarized in Table 2. The K5/VSSP32 [2] has four channels of video band signal input per unit. Four units of K5/VSSP32 constitute one geodetic VLBI terminal with 16 video channels. This system is constantly used for geodetic VLBI observations including IVS sessions. This K5/VSSP32 sampler has digital filter functionality inside. The input video signal is digitized with 8-bit quantization with 64 MHz sampling. Then the frequency bandwidth is shaped by digital filter and output by specified data rate. The output data is written to a standard Linux file system in K5/VSSP32 format <sup>1</sup>. Data format conversion from K5/VSSP32 to Mark IV, VLBA, and Mark-5B are available with conversion tools <sup>2</sup>.

Another sampler ADS3000+[3, 4] and PC-VSI data recording system are available at both stations. ADS3000+ sampler has digital baseband conversion (DBBC) function, which enables flexible selection of 16 video frequency channels with any of 4/8/16/32 MHz bandwidth. Thus, this is compatible with conventional 16 channels of geodetic VLBI. Geodetic VLBI observation has been made by using K5/VSSP32 and ADS3000+ DAS are not used at 11m stations yet.

## 2.3 Network for e-Transfer

All of the data observed by VLBI stations of NICT are provided to correlation center by e-transfer. Acquired VLBI data format is converted to Mark5B if necessary,

<sup>1</sup> Please see http://www2.nict.go.jp/sts/stmg/ K5/VSSP/vssp32\_format.pdf

<sup>&</sup>lt;sup>2</sup> Observation and data conversion software for K5/VSSP are freely available from http://www2.nict.go.jp/sts/ stmg/K5/VSSP/index-e.html

[Msps]

Quantization bit

Max. data rate [Mbps]

Kashima 11 m and Koganei 11 m stations.					
System		K5/VSSP32	ADS3000+(K5/VSI)		
		(4 units)			
	Video Converter	K4/KSP 16ch	not necessary		
	# of Input Channels	4 /unit x 4 units	1 or 2		
	# of Output Channels	16	1, 2, 16		
	Input Freq. Range	0 - 300 MHz	0 - 2 GHz		
	Sampling Rate	0.04,0.1,0.2,0.5,1,	128, 256, 1024,		

2,4,8,16,32,64

256/unit x 4

2048,4096

4096

1.2.4.8 bit

 Table 2 VLBI data sampler/DAS systems equipped at the Kashima 11 m and Koganei 11 m stations.



Fig. 3 Data acquisition terminal (K5/VSSP and K5/VSI) at the Kashima 11 m station.

and they are put on external servers for e-transfer to correlator. The local area network (LAN) speed connecting among the Kashima 34 m, the Kashima 11 m, and the Koganei 11 m stations has been upgraded to 10 Gbps in 2014. The high speed network connection is provided by collaboration with the Research Network Testbed JGN. Figure 4 shows schematic diagram of local network connection and outbound network.



Fig. 4 Network environment of VLBI station in NICT (Kashima 11 m, Kashima 34 m, and Koganei 11 m). Network speed of 10 Gbps is available internally, and for e-Transfer of VLBI data to correlation center.

## 2.4 GNSS Site

Both Kashima 11 m and Koganei 11 m have GNSS observation sites — named KSMV and KGNI, respectively. Their data is regularly uploaded to the International GNSS Service (IGS) Data Center. Figure 5 shows the KSMV station at the Kashima 11 m antenna site. A local survey was performed in 2014 at Koganei.



**Fig. 5** The Kashima 11 m antenna and GNSS receiver pillar of the IGS tracking station KSMV.

## 3 Staff

Following staffs (alphabetical order) are contributing to run Kashima 11 m and Koganei 11m stations.

Hasegawa Shingo: Supporting staff for IVS observation, operation of data conversion and maintenance of file servers for e-transfer.

- Ichikawa Ryuichi: In charge of GNSS station care and GNSS observations.
- Kawai Eiji: In charge of station keeping maintenance.
- Kondo Tetsuro: Contributing to implementation of ADS3000+ control by FS9. Maintaining K5/VSSP software package, which is used for data acquisition and conversion.
- Miyauchi Yuka: In charge of data acquisiton software with PC-VSI and VDIF data stream.
- Sekido Mamoru: In charge of observation operation and overall activities of the Kashima and Koganei VLBI stations.
- Tsutsumi Masanori: In charge of network security and maintenance of data acquisition computers.

## 4 Current Status and Activities during the Past Year

The Kashima and the Koganei 11 m stations are participating in geodetic VLBI sessions IVS-T2, APSG, CRF. and AOV sessions. Because of system crash at antenna control computer at Kashima 11 in 2016, some IVS sessions were partially failed once. Except for that trouble two stations are working stably.

The Koganei 11 m antenna has been operated by time sharing with the Space Environment Laboratory (SPEL). Our group have higher priority of to use the antenna for VLBI observation. When the antenna is free from VLBI observation, it is used for receiving down-link signal from the STEREO satellite <sup>3</sup> by the SPEL.

Last pointing observation for upgrading antenna axis parameter was made in January 2015.

### Acknowledgements

We thank the research testbed network JGN and the Information System Section of NICT for supporting the high speed network environment.

## References

- Special issue for the Key Stone Project, J. Commun. Res. Lab., Vol. 46, No. 1, pp.1-221, 1999.
- Kondo, T., Y. Koyama, R. Ichikawa, M. Sekido, E. Kawai, and M. Kimura, Development of the K5/VSSP System, J. Geod, Soc. Japan, Vol. 54, No 4, pp. 233-248, 2008.
- Takefuji, et al., "Next-generation A/D Sampler ADS3000+ for VLBI2010", in VLBI2010: From Vision to Reality, Proceedings from the Sixth IVS General Meeting, edited by D. Behrend and K.D. Baver. NASA/CP-2010-215864, p.378-382, 2010.
- Sekido, M., K.Takefuji, M. Tsutsumi, "Broadband VLBI Data Acquisition System for GALA-V", IVS NICT-TDC News No. 35, pp. 7-11, 2015.

<sup>&</sup>lt;sup>3</sup> http://www.nasa.gov/mission\_pages/stereo/main/index.html