

Kashima and Koganei 11-m VLBI Stations

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Abstract The Kashima and Koganei 11-m stations are used for geodetic and astronomical monitoring observations and for an R&D test bed of VLBI technology.

1 General Information

A pair of 11-m diameter antennas are 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 in Kashima Space Technology Center (KSTC), on the east coast of the Japanese main island. The Koganei 11-m antenna is located in the headquarters of the NICT in Tokyo (Figure 1). The 11-m VLBI antennas at Kashima and Koganei (Figure 2) were established and have been operating for the monitoring of crustal deformation of the Tokyo metropolitan area (Key Stone Project) since 1995 [1]. After regular VLBI observations, the KSP VLBI Network terminated in 2001. Since then, the 11-m VLBI stations at Kashima and Koganei have mainly been used for research and technology developments. After the “Tohoku earthquake” that occurred in March 2011, the Kashima and Koganei 11-m stations participated in IVS-R1, T2, and APSG sessions.

NICT Space-Time Standards Laboratory/Kashima Space Technology Center

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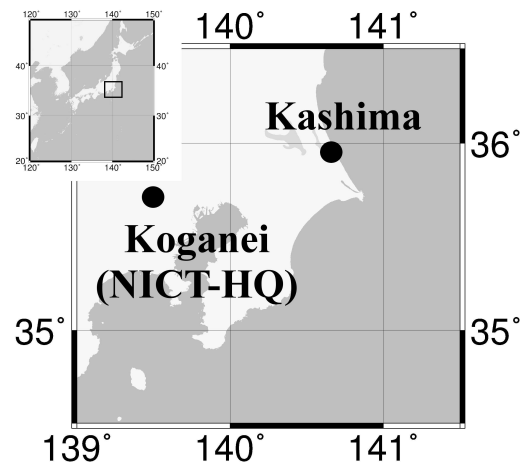


Fig. 1 Location of NICT-Koganei Headquarters and Kashima.

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 Kashima and Koganei stations have been different by 80 MHz.

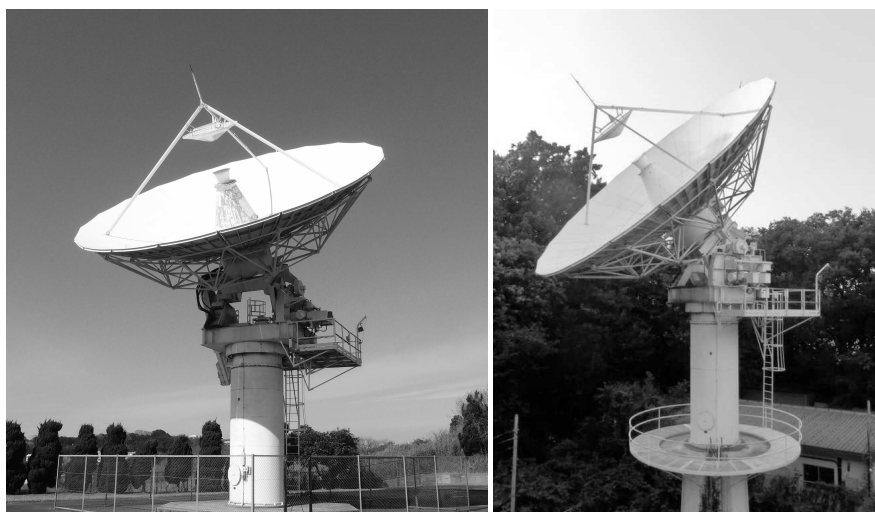


Fig. 2 11-m VLBI antennas at Kashima (left panel) and Koganei (right panel).

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

		Kashima	Koganei
Antenna Type		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
Rx Freq. [MHz]	S band	2212 ~ 2360	2212 ~ 2360
	X Low band	7700 ~ 8200	7700 ~ 8200
	X High band	8180 ~ 8680	8100 ~ 8600
Local Freq. [MHz]	S band	3000	3000
	X Low band	7200	7200
	X High band	7680	7600
SEFD [Jy]	X-band	5700	9500
	S-band	3300	5500

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 inputs. This system is constantly used for geodetic VLBI observations including IVS sessions. This sampler has digital filter functionality in it. 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 format¹. Data format conversion from K5/VSSP32 to Mark IV, VLBA, and Mark 5B are available with conversion tools².

Another sampler, ADS3000+ [3], has digital base-band conversion (DBBC) function. Several kinds of data acquisition modes (personalities) are switched by exchanging an FPGA program. The DBBC mode enables flexible selection of 16 video frequency channels with any of 4/8/16/32 MHz bandwidth. Therefore this can be compatible with conventional 16 channels of geodetic VLBI observations. Another data acquisition mode (8bit-128MHz-1ch) was used for astronomical observations requiring higher dynamic range observations. Other modes (1bit-1024MHz-1ch, 2bit-1024MHz-1ch, and 1bit-2048MHz-1ch) were used for broadband VLBI observations for geodesy and time and frequency transfer. Figure 3 shows the data acquisition terminal of K5/VSSP32 and K5/VS1.

2.3 Upgrading Network Speed

The local area network (LAN) connection speed connecting the Kashima 34-m antenna site, the Kashima 11-m, and the Koganei 11-m stations were upgraded

¹ Please see http://ryuu.nict.go.jp/stmg/K5/VSSP/vsspALL_header_format-e.pdf

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

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

System	K5/VSSP32 (4 units)	ADS3000+(K5/VSI)
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 [Msps]	0.04,0.1,0.2,0.5,1, 2,4,8,16,32,64	128, 256, 1024, 2048,4096
Quantization bit	1,2,4,8 bit	
Max. data rate [Mbps]	256 /unit x 4	4096
Output Interface	USB 2.0	VSI-H

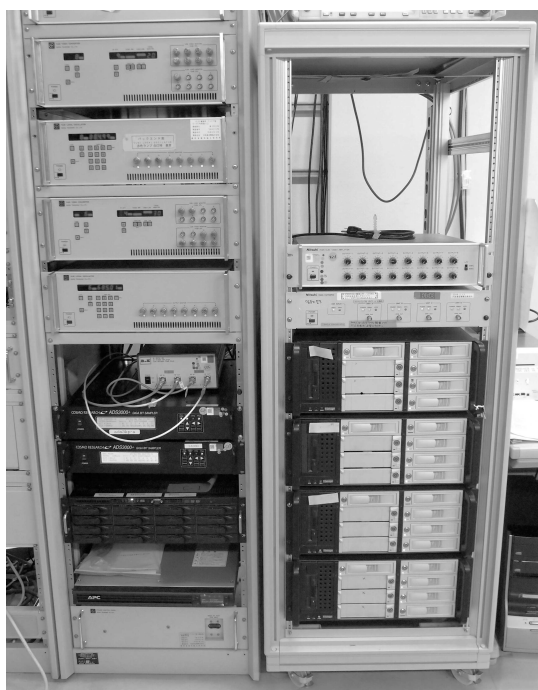


Fig. 3 Data acquisition terminal (K5/VSSP and K5/VSI) at the Kashima 11-m station.

to 10 Gbps in 2014. The high speed network connection is provided by collaboration with the JGN-X (Next generation Network Testbed). The 10G-LAN connection is used for sharing the data and correlation processing. In the case of IVS sessions, the VLBI data of these stations are collected, format converted, and put on external servers for e-transfer to correlators.

Not only the internal LAN, but also the outreach network, were upgraded to 10 Gbps by the support of JGN-X in this year. Then data transfers (e-transfer)

speed up to 10 Gbps became available through the JGN-X and APAN network.

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 an International GNSS Service (IGS) Data Center. Figure 4 shows the KSMV station at the Kashima 11-m antenna site. A local survey was performed in 2014 at Koganei. The survey results may be used for a local tie at Koganei between VLBI and GPS.



Fig. 4 GNSS receiver pillar at the Kashima 11-m site registered as KSMV of the IGS tracking station.

3 Staff

Kawai Eiji: In charge of station maintenance and IVS observations.

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

Ichikawa Ryuuchi: In charge of GNSS station care and GNSS observations.

Sekido Mamoru: In charge of overall activities of the Kashima and Koganei VLBI stations.

4 Current Status

The Kashima and the Koganei 11-m stations are participating in geodetic VLBI sessions IVS-T2, APSG, and JADE, 14 sessions a year in total. In addition, these two stations are used as a test bed for R&D experiments including time and frequency transfer.

The problem of tearing of cables (coaxial cables and status-control lines), which happened at the Kashima 11-m antenna in October 2013, was fixed in March 2014. Both stations have been normally operating since April.

The Koganei 11-m antenna is jointly operated by two groups in the NICT: the STSL and the Space Weather and Environment Informatics Laboratory (SWEIL). When the antenna is not used for VLBI observations by STSL, down linked observations from the STEREO satellite³ have been provided by the SWEIL until October 2014. This STEREO satellite downlink has been suspended since October 10, 2014.

Pointing (antenna axis parameter) observation was made in January 2015 in order to monitor the antenna status. The last update of the axis parameters was made in April 2014 for Kashima 11 m, and in April 2013 for Koganei 11 m. The drift of the mean azimuth and elevation offsets were (0.004, 0.001) and (-0.006, -0.004) in degrees for the Kashima 11-m and Koganei 11-m antennas. The root mean square (RMS) scatter of the deviation for the azimuth and elevation angles were (0.006, 0.009) and (0.014, 0.011) for Kashima 11 m and Koganei 11 m. The degradation of the parameters was within the RMS deviation of the offset; thus the parameters were retained.

Acknowledgements

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References

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³ http://www.nasa.gov/mission_pages/stereo/main/index.html