Kashima 34-m Radio Telescope

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Abstract

The Kashima 34-m radio telescope has been continuously operated and maintained by the National Institute of Information and Communications Technology (NICT) as a facility of the Kashima Space Technology Center (KSTC) in Japan. This brief report summarizes the status of this telescope, the staff, and activities during 2012.

1. General Information

The Kashima 34-m radio telescope (Figure 1, left) was constructed as a main station of the "Western Pacific VLBI Network Project" in 1988. The telescope has been used not only for geodetic experiments but also for astronomical observations and spacecraft tracking under collaboration with National Astronomical Observatory of Japan (NAOJ), Kagoshima University, Institute of Space and Astronautical Science (ISAS), and other related institutes. The 34-m antenna was damaged by the big earthquake that occurred in north east Japan on March 11, 2011, and its operation was stopped for repair work until the end of March 2013.

The Kashima 34-m station is located about 100 km east of Tokyo in Japan. The Kashima 11-m radio telescope and the International GNSS Service station (KSMV) (Figure 1, right) are also co-located in the Kashima Space Technology Center. The station is maintained by the Space-Time Measurement Project of the Space-Time Standards Group, NICT.

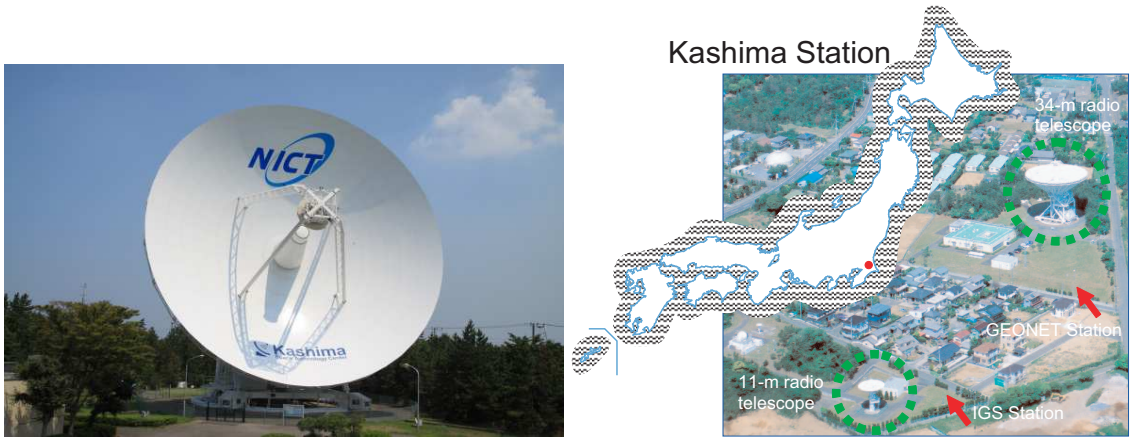

Figure 1. Left panel is a picture of the 34-m diameter radio telescope. Right panel indicates the location of Kashima KSTC in Japan and locations of 34-m antenna, 11-m antenna, and the GNSS station (KSMV) at the site.

2. Component Description

The receiver equipment of the Kashima 34-m radio telescope is summarized in Table 1 and Table 2. For radio frequency interference (RFI) mitigation, a high temperature superconductor

Table 1. Main specifications of the 34-m radio telescope.

Main reflector aperture	34 m
Latitude	N 35° 57' 21.27"
Longitude	E 140° 39' 36.33"
Height of AZ/EL intersection above sea level	43.7 m
Height of azimuth rail above sea level	26.9 m
Antenna design	Modified Cassegrain
Mount type	AZ-EL mount
Drive range azimuth	±270° from the North
Drive range elevation	7°-90°
Maximum speed azimuth	0.8°/sec
Maximum speed elevation	0.64°/sec
Maximum operation wind speed	13 m/s

Table 2. The receiver specifications of the 34-m radio telescope.

Band	frequency (MHz)	Trx (K)	Tsys (K)	Efficiency	SEFD (Jy)	Polarization
L	1405-1435	18	45	0.68	200	L/R
S	2193-2350	19	72	0.65	340	L/R
X-n (∗)	8180-9080	40	48	0.68	210	L/R
X-wL(#)	8180-9080	40	67	0.68	300	L/R
X-wH(#)	7860-8360	-	67	0.68	300	L/R
K	22000-24000	105	141	0.5	850	L
Ka	31700-33700	85	150	0.4	1100	R
Q	42300-44900	180	350	0.3	3500	– (†)

∗ : 8 GHz narrow band LNA . # : 8 GHz wide band LNA. † : No Polarizer

(HTS) band-pass filter (2193 - 2473 MHz) for S-band [1], and a conventional band-pass filter (1405 - 1435 MHz) for L-band have been used since 2008.

3. Staff

The engineering and technical staff of the Kashima Station are listed in Table 3.

4. Current Status and Activities

Recent status and activities related to the 34-m radio telescope in the NICT VLBI group are as follows:

Repair of Azimuth Wheel and Rail Cracking damage to the azimuth wheel, which is due to the big earthquake, was found in an inspection. Repair work to replace the azimuth wheels and rails is in progress and will finish at the end of March 2013.

Table 3. The engineering and technical staff of the Kashima station.

Name	**Responsibility**
KAWAI Eiji	Operations and maintenance.
SEKIDO Mamoru	Operations, maintenance, and coordination of development.
ICHIKAWA Ryuichi	Maintaining GNSS observation systems.
TAKEFUJI Kazuhiro	Development and experiments of wideband VLBI system.
UJIHARA Hideki	Designing of new wideband feed.
TSUTSUMI Masanori	Computer network and computer systems.
HASEGAWA Shingo	Computers for K5 system and supporting data conversion for e-transfer of IVS VLBI sessions.

IVS sessions The 34-m antenna could not participate in IVS sessions since 2011 because of the damages. In April 2013, the 34-m station will return to observing in the IVS sessions as it used to do.

Data transport of international and domestic VLBI observations has been made via e-transfer, rather than a physical shipping of recorded data disks. Depending on the request, Mark 5 data or K5 data are prepared and provided to IVS correlators from our data server, which is accessible from the Internet with a 1 Gbps connection.

Development of New Wideband Feed The main project of the VLBI group in NICT is a VLBI application for frequency comparison between distant atomic frequency standards. For pursuit of this project, a wideband observation system semi-compliant with a VLBI2010 system is under development. Due to some restriction, we decided to fix four observation frequency bands (3.2-4.2 GHz, 4.8-5.8 GHz, 9.6-10.6 GHz, and 12.8-13.8 GHz) for the new observation system. A new wideband feed system for this frequency selection is being designed. It will replace the original C-band receiver. The C-band receiver was already removed in June 2012, and the new wideband feed system will be installed in 2013.

5. Future Plans

The 34-m station will come back to operation after the first quarter in 2013. As mentioned in the former section, the new wideband feed is going to be installed, and a new optical wideband signal transmission system is to be installed for that. A new direct sampling system, which converts an analog RF signal to digital data without frequency conversion by taking advantages of the aliasing effect of sampling, is going to be employed experimentally for wideband observing. More details about technology development at NICT will be found in the NICT Technology Development Center Report, this volume.

References

[1] Kawai, E., J. Nakajima, H. Takeuchi, H. Kuboki, T. Kondo, M. Suzuki, K. Saito, RFI mitigation at a 2 GHz band by using a wide-band high-temperature superconductor filter, J. Geod. Soc. Jpn., Vol. 54, No. 1, pp. 31–37, 2008.

[2] Takefuji, K, and H. Ujihara, Technology Development Center at NICT, International VLBI Service for Geodesy and Astrometry 2012 Annual Report, edited by K. D. Baver and D. Behrend, this volume, 2013.