Korea Geodetic VLBI Station, Sejong

Yunmo Sung, Kiduk Ahn, Sangoh Yi, Hongjong Oh, Sangcheol Han, Eunjin Kim

Abstract This report briefly introduces the activities carried out at the Sejong VLBI station during 2014. The Sejong antenna can only perform S/X VLBI observing in Korea. Sejong station began to participate in IVS VLBI IVS-R1 sessions in the latter half of 2014. The geodesy division in NGII (National Geographic Information Institute) manages the Sejong station, and NGII has a plan to use the K- and Q-bands for geodetic VLBI observations with the KVN (Korean VLBI Network of KASI) in the future.

1 General Information

The Sejong station is the first geodetic VLBI station in the Republic of Korea which is dedicated to geodetic purposes. The station is located about 120 km south of Seoul at longitude 127°18′12″E, latitude 36°31′12″N, and 153 meters in height in the middle of Sejong city, which serves as a new administrative capital. The Sejong antenna is 22 meters in diameter, and multi frequency bands (S, X, K, and Q) are available at the same time.

The staff at Sejong station consists of six people including a new site director, Ahn Ki Duk, who began work in December 2014. Mr. Yi Sang Oh is responsible for planning of annual VLBI observing, both international and domestic. Mr. Oh Hong Jong is responsible for RFI monitoring and co-location for space geodetic techniques. Mr. Han Sang Cheol is responsible for antenna maintenance. The Sejong station has a VLBI antenna, an IGS station (SEJN), four pillars for co-location, and a mobile SLR system (40 cm in diameter) which is already developed by KASI and will be relocated. Three space techniques (VLBI, GNSS, and SLR) are directly measurable by electric survey instrument. And an MR (Microwave Radiometer) will be installed on the roof of the main observation building. Dr. Jung Ho Cho of KASI is the person in charge of the MR, and NGII and KASI are expecting to use it to calibrate for the water vapor effect on VLBI and GNSS.

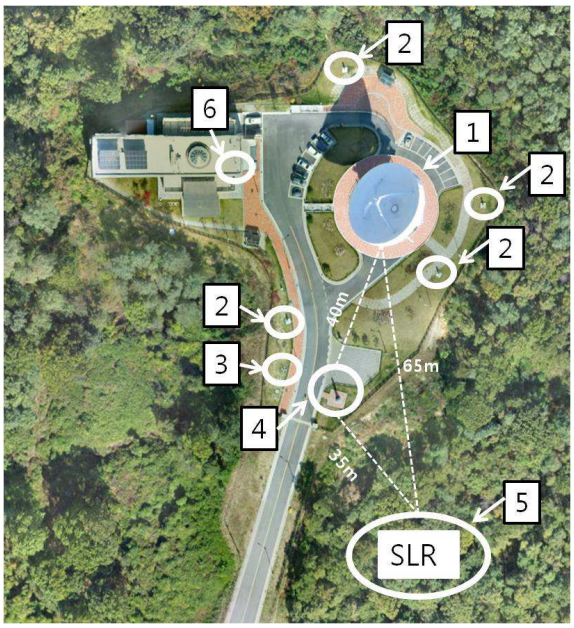

Fig. 1 Layout of Sejong station: 1. VLBI antenna 2. pillar for co-location 3. UTP(Unified control Point) 4. IGS station (SEJN) 5. (Under construction) SLR site of KASI 6. (Under installation) MR(Microwave Radiometer) of KASI.

National Geographic Information Institute

Sejong Network Station

Table 1 Staff members of the Sejong station.

Name	Responsibility	e-mail
Ki Duk Ahn	Site Director	akd8@korea.kr
Sangoh Yi	Analysis	sangoh.yi@korea.kr
Hongjong Oh	Analysis	stockoh11@korea.kr
Sangcheol Han	VLBI maintenance	hsc4907@korea.kr
Eunjin Kim	Operator	vikisio1015@gmail.com
Sangwon Lee	Operator	lsw860210@gmail.com

2 Sejong VLBI System

The Sejong VLBI configuration is listed in Table 2.

The S and X SEFDs were about 2,000 — 3,000 Jy. The reason why they have high SEFDs is that we used coaxial cable (length is about 30 cm) to connect from the feed to the cryogenic chamber. We have a plan to improve it in the future. The K- and Q-band receiver systems are still not ready to be operated. Because Sejong antenna was designed to use the multi-frequency receiving system, in order to work it properly, the lower frequency system (that is S/X) must be completed in the first place. S/X system was completed in the middle of 2014. We expect that the K and Q systems will be completed within 2015. The Sejong site uses the Field system (FS 9.10.4) and the K5 data recorder. To send VLBI data to a correlator, we use data format converter (k5tom5b) software developed by NICT.

Table 2 Sejong Antenna parameters.

Parameters	Sejong VLBI
IVS letter codes	Sejong (Kv)
CDP number	7368
DOMES number	23907S001
Location	Lat.: 36°31′N, Long.: 127°18′E
Elevation	177 m
Diameter of main reflector	22 m
Antenna type	Shaped Cassegrain
Aperture efficiency	about 60%
Pointing accuracy	0.0131°
Reflector surface accuracy	100 μm
Operation range	AZ: $\pm$270° EL: 0 $\sim$ 90°
Slew speed	5°/sec (AZ and EL)
FS Version	9.10.4
Data acquisition Recorder	K5

Table 3 Receiving system of the Sejong VLBI system.

Bands	S	X	K	Q
Freq. [GHz]	2.1–2.6	8.0–9.0	21–23	42–44
Receiver noise temp.	$<$ 20K	$<$ 30K	$<$ 50K	$<$ 80K
Polarization	R,L	R,L	R,L	R,L
SEFD	3,000	3,000	–	–
Aperture efficiency	0.6	0.6	0.6	0.6

3 Activities in 2014

3.1 VLBI Observations

In early 2014, we prepared to join IVS regular sessions by doing several fringe tests with the Tsukuba (GSI) and Kashima (NICT) antennas. We appreciate their help. In August, the IVS managed the fringe test for the Sejong antenna to verify its performance. Thankfully, three antennas (Sejong, Shanghai, and Hobart) were involved in the fringe tests. Finally, the IVS finally accepted Sejong to join the IVS regular sessions. Beginning with session IVS-R1655, we are consistently participating in IVS-R1 observations. In December, we successfully obtained the first light at Q-band. The Sejong staff and the KVN members managed this fringe test together. We used single dish observations and used auto correlation modules to find fringes.

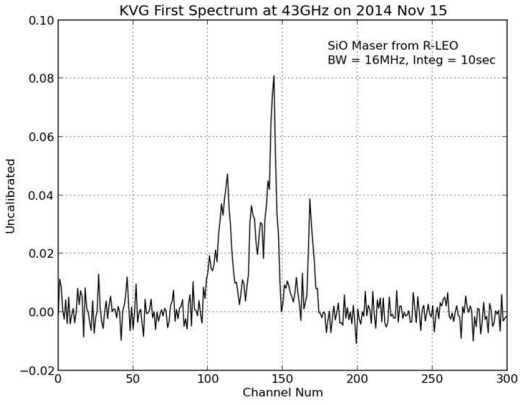

Fig. 2 Facilities for local-ties in the Sejong station.

Table 4 Activities for VLBI observations. [NGII: National Geographic Information Institute, KVN: Korean VLBI Network, KJCC: Korea-Japan Correlation Center, GSI: Geospatial Information Authority of Japan, NICT: National Institute of Information and Communications Technology.]

No.	session	SKED	Corr.	Freq.	Remarks
1	t2095	GSI	NGII	S/X	ant. performance test
2	f14071	KVN	KJCC	X	ant. performance test
3	s14073	GSI	NGII	S/X	ant. performance test
4	r1633	GSI	NGII	S/X	ant. performance test
5	s14108	GSI	NGII	S/X	ant. performance test
6	c1415	NICT	NGII	S/X	ant. performance test
7	f14141	NICT	NGII	S/X	ant. performance test
8	jd1405	GSI	NGII	S/X	ant. performance test
9	a14147a	KVN	KJCC	X	ant. performance test
10	kvnfrg	IVS	HAYSTACK	S/X	ant. performance test
11	kvwfrg	IVS	HAYSTACK	S/X	ant. performance test
12	r1655	IVS	NGII-KASI	X	regular observing
13	f14293a	KVN	NGII-KASI	X	fringe test
14	r1658	IVS	NGII-KASI	X	regular observing
15	–	KVN	KJCC	Q	fringe test
16	r1666	IVS	KJCC	S/X	regular observing
17	f4c18a	CVN	CVN	X	fringe test
18	f14352a	KVN	KJCC	X	fringe test
19	r1667	IVS	KJCC	S/X	regular observing
20	f14358a	KVN	KJCC	X	fringe test
21	r1668	IVS	KJCC	S/X	regular observing

3.2 S/X Receiving System Improvement Work

In early 2013, the S/X SEFDs showed ranges between 30,000 Jy and 80,000 Jy which is higher than we expected. The main problem was an S/X dual feed. We separated the two feeds to improve the SEFDs to 1,500 — 2,000 Jy. We obtained these SEFD results by using standard sources such as Cas A, Taurus A, and Cygnus A. We will keep working on the improvement of the antenna performances.

3.3 Joining the AOV (Asia-Oceania VLBI Group)

The Sejong station joined the AOV group that was discussed at the IVS 8th GM in Shanghai, China. In 2015, Sejong will participate in AOV VLBI observations about less than ten times due to the installation of the K- and Q-band system. But we will actively work with them as far as possible.

3.4 SLR Site Construction

KASI began constructing the mobile SLR site in October. The diameter of the SLR is 40 cm, and the construction will be completed in the middle of 2015. The Sejong station is providing support for construction.

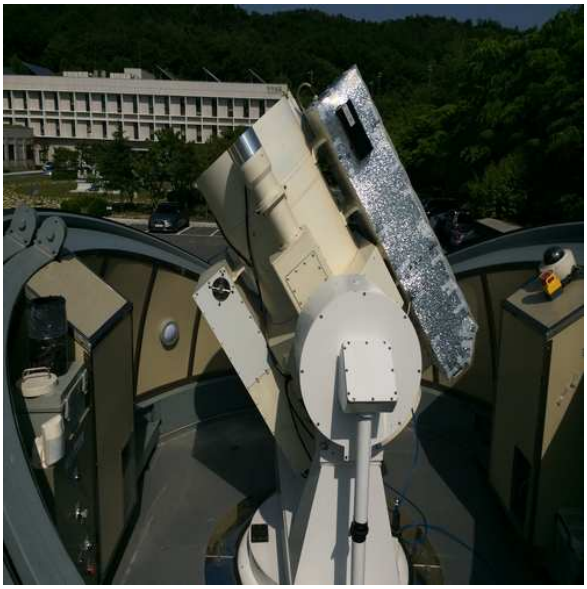

Fig. 3 Mobile SLR system developed by KASI.

4 Future Plans

We will take on the following activities in 2015: 1) participating in IVS-R1 sessions and the AOV, 2) improvement of S/X performance, 3) Korean VLBI observations (X, K, and Q) with KVN, 4) completion of SLR site and installation of Microwave Radiometer, 5) five local tie surveys, and 6) maintenance of VLBI system.