

Key Stone Project VLBI Stations (Kashima, Koganei, Miura, and Tateyama)

Yasuhiro Koyama

Abstract

Key Stone Project Network consists of four space geodetic observation sites around Tokyo, Japan. The overview of the four sites will be described in this report.

1. Introduction

Communications Research Laboratory (CRL) has been establishing a compact space geodetic observation network around Tokyo, Japan under a project which was named as Key Stone Project [1]. The Key Stone Project network consists of four observation sites at Koganei (Tokyo), Kashima (Ibaraki), Miura (Kanagawa), and Tateyama (Chiba). The geographic locations of these four sites are shown in Figure 1. Table 1 shows the latitudes, longitudes and mailing addresses of the four sites.

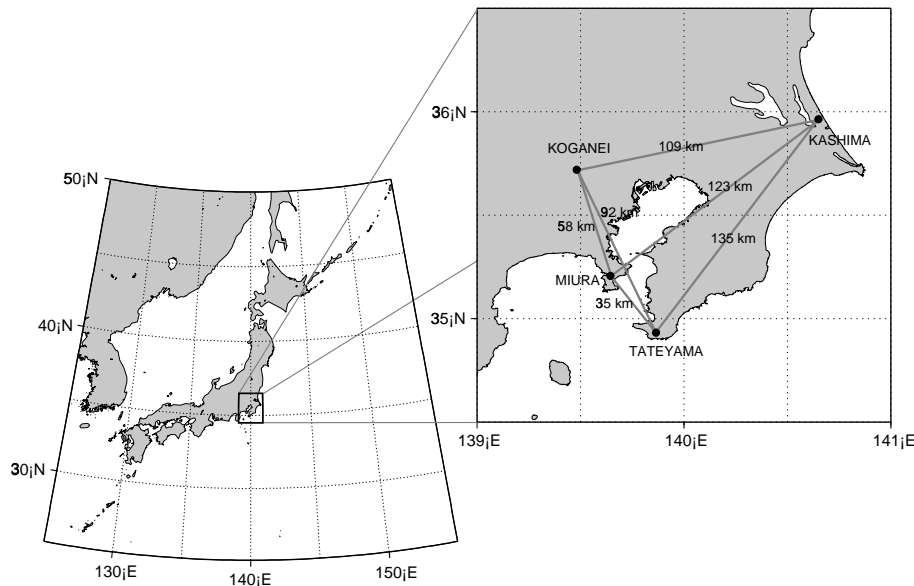


Figure 1. Geographic locations of four Key Stone Project network sites.

At each site, observation facilities of three space geodetic techniques, Very Long Baseline Interferometry (VLBI), Satellite Laser Ranging (SLR) and Global Positioning System (GPS), are collocated. An 11 m diameter fully steerable cassegrain antenna for VLBI observations, an optical telescope with an aperture of 75 cm in diameter for SLR observations, and a GPS antenna mounted on top of a stable pillar are placed within about 100 m from each other. While the Kashima and Koganei stations are located where research members of CRL are working, there are no dedicated personnel at Miura and Tateyama stations. The observation system is therefore automated as

Table 1. Locations and addresses of the Key Stone Project observation sites.

Station	Latitude	Longitude	Mail address
Koganei	35°42.6'	139°29.3'	4-2-1 Nukui-kita, Koganei, Tokyo 184-8795
Kashima	35°57.3'	140°39.4'	893-1 Hirai, Kashima, Ibaraki 314-0012
Miura	35°12.4'	139°39.0'	1691 Koenbo, Hasse, Miura, Kanagawa 238-0115
Tateyama	34°56.2'	139°50.9'	1397 Kitatsuka, Inuishi, Tateyama, Chiba 294-0226

much as possible and regular VLBI observations at four stations can be performed without any human interactions in principle [2].

Daily VLBI observations began in January 1995 with a single baseline between Koganei and Kashima, and the full network observations with four stations began in September 1996. As of March 1999, a four station VLBI experiment is performed once every two days with a duration of about 24 hours. High speed Asynchronous Transfer Mode (ATM) communication network connecting the four sites have been established under the collaboration between CRL and the Telecommunication Network Laboratory Group of Nippon Telegraph and Telephone Corporation (NTT). The observed and formatted signals are transferred to the correlator facility at Koganei and processed in real-time. Observations and data analysis of VLBI measurements are fully automated and the analysis results are produced shortly after all observations of an experiment session finished. GPS observations at four sites began in July 1997 and the regular SLR observations began in September 1998.

2. Technical Characteristics

The design of the antenna system at four sites are identical in design except that the Koganei VLBI antenna has a taller pedestal than the other three sites in order to maintain clear sky view as much as possible since the antenna is surrounded by tall woods. The antennas are 11-m diameter cassegrain system with S-band and X-band receivers (Figure 2). The low noise amplifiers are located at room temperature but the performance of the receivers is not so bad, as shown in Table 2 [3].

Table 2. Performance of the antenna (Koganei).

	S-band (7700-8600MHz)	X-band (2100-2500MHz)
Aperture Efficiency	81 %	67 %
System noise temperature	76 K	95 K
SEFD	3030 Jy	6180 Jy

Structure of the antennas is Azimuth-Elevation mount with the ranges of 0° – 540° in azimuth and 5° – 88° in elevation. The maximum slewing speed is 3°/sec in both axes. The antenna and other observation systems are controlled from a Unix workstation with observation control software developed by CRL. The data acquisition system is KSP (K4) VLBI data acquisition system [4].



Figure 2. 11 meter VLBI antenna at Kashima. A GPS antenna is mounted on top of the pillar (right).

3. Technical Staff for the KSP VLBI stations

Technical staff members who are contributing observations and operations of the Key Stone Project VLBI stations are listed below. In principle, no operations are necessary for the regular VLBI observations, but the status monitoring and remote operations are performed from Koganei station where at least one operator is on duty during the daytime period.

- Tetsuro Kondo, Responsible for overall operations and performances.
- Taizoh Yoshino, Leader of the Key Stone Project team in CRL.
- Yasuhiro Koyama, Development of operation and monitoring software.
- Ryuichi Ichikawa, Responsible for Kashima and Tateyama stations.
- Jun Amagai and Kouichi Sebata, Responsible for Koganei and Miura stations.
- Naoki Goto and Muneo Takeda, Operator at Koganei station, Space Engineering Development Co., Ltd.

4. Current Status and Future Plans

Regular VLBI observations at the data rate of 256 Mbps are currently performed once every two days. Unfortunately, the ATM network for the Miura station will be terminated in May 1999, and the regular once-in-two-days experiments will be performed with Kashima, Koganei, and Tateyama stations afterwards. Tape-based VLBI observations at all of four stations will be performed instead once every six days.

The Key Stone Project ATM network was connected with the OLIVE network which is connecting Usuda (64 m antenna operated by Institute of Space and Astronautical Science) and Nobeyama (45 m antenna operated by Nobeyama Radio Observatory). The first successful real-time VLBI observations with the Key Stone Project VLBI stations and Usuda was performed in November

1998. The first successful 1 Gbps VLBI observations were also performed by using the Key Stone Project VLBI sites at Kashima and Koganei in July 1998. Two sets of Giga-bit VLBI system which has been in development by CRL were used and the data were correlated by using the Giga-bit VLBI correlator system at Kashima. The Key Stone Project VLBI stations will be used for such a technical test-bed of the new observation systems developed by CRL.

Seven geodetic VLBI experiments have been performed with the 34 m antenna station at Kashima and the Key Stone Project VLBI stations to make a precise tie of the network to the global terrestrial reference frame. A further tie experiment was performed in January 1999 with the 34 m antenna station at Kashima and Gilmore Creek Geophysical Observatory at Fairbanks and such an experiment was repeated in March 1999. Experiments with Wettzell and Urumqi stations are planned in the future to improve the accuracy of the tie. Ground survey measurements between VLBI, GPS, and SLR reference points at four Key Stone Project observation sites were performed in 1996, 1997, and 1998. These efforts are expected to contribute to a detailed study of the collocation of VLBI, GPS, and SLR.

References

- [1] Taizoh Yoshino: Overview of the Key Stone Project, J. Commun. Res. Lab., Vol. 46, No. 1, pp.3-6, March 1999
- [2] Yasuhiro Koyama, Takahiro Iwata, and Hiroshi Takaba: KSP VLBI System; Observation and System Management Software, J. Commun. Res. Lab., Vol. 46, No. 1, pp.33-38, March 1999
- [3] Noriyuki Kurihara, Hiroshi Takaba, Akihiro Kaneko, and Kouichi Sebata: KSP VLBI System; Antenna and Receiver System, J. Commun. Res. Lab., Vol. 46, No. 1, pp.7-13, March 1999
- [4] Hitoshi Kiuchi, Jun Amagai, Shin'ichi Hama, and Michito Imae: KSP VLBI System; KSP Data-Acquisition System, J. Commun. Res. Lab., Vol. 46, No. 1, pp.25-32, March 1999