

Development of VLBI in Japan

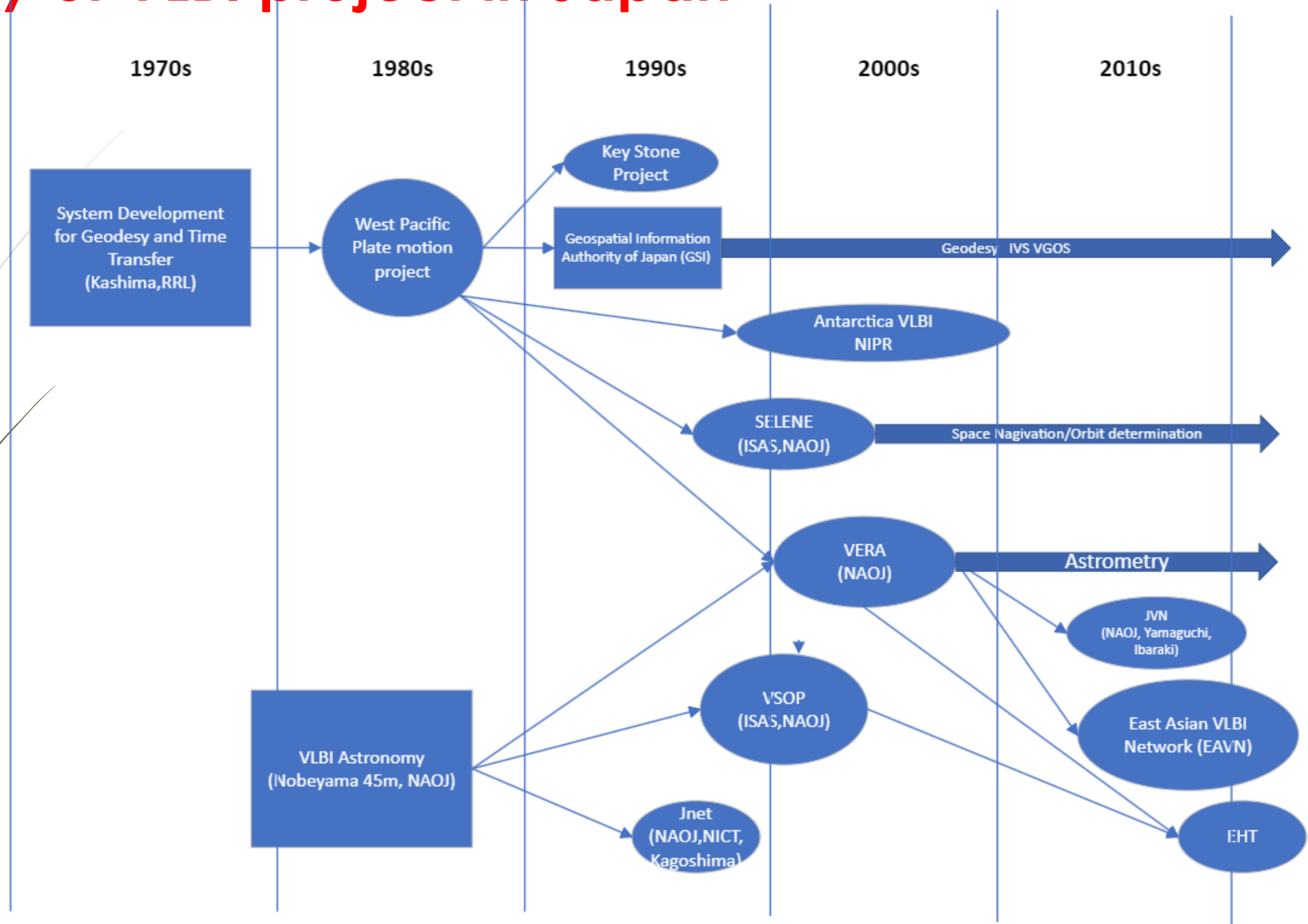
Hideyuki Kobayashi

(National Astronomical Observatory of Japan)

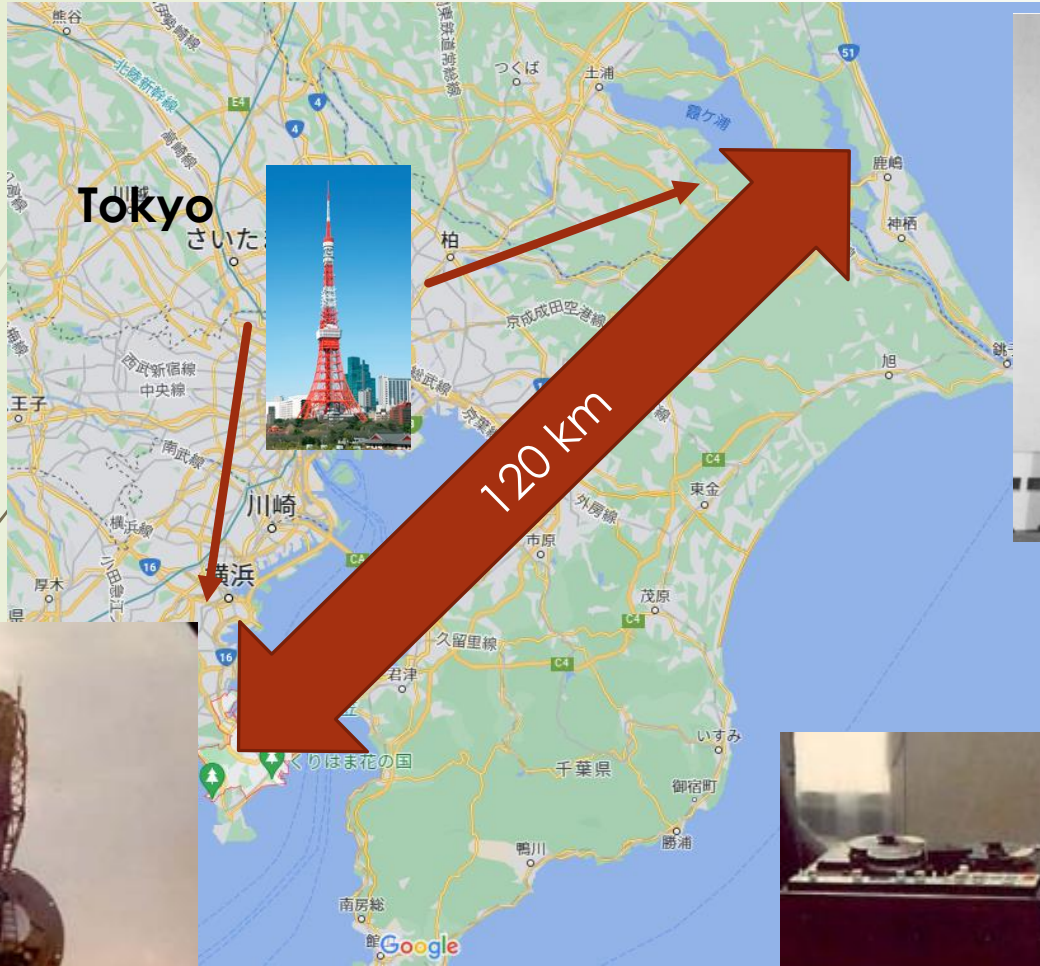
XXXI IAU GA, DIVISION B, Session 2B: History of Radio Astronomy in Eastern Asia

August 5, 2022, BUSAN, Korea

History of VLBI project in Japan



First VLBI Experiment in Japan in 1977



Kashima 26m

Kashima 26m and Yokosuka 12.8m were used at Feb. 1977.

Cs clock as reference

TV broadcast signal for time synchronization

K-1 recorder

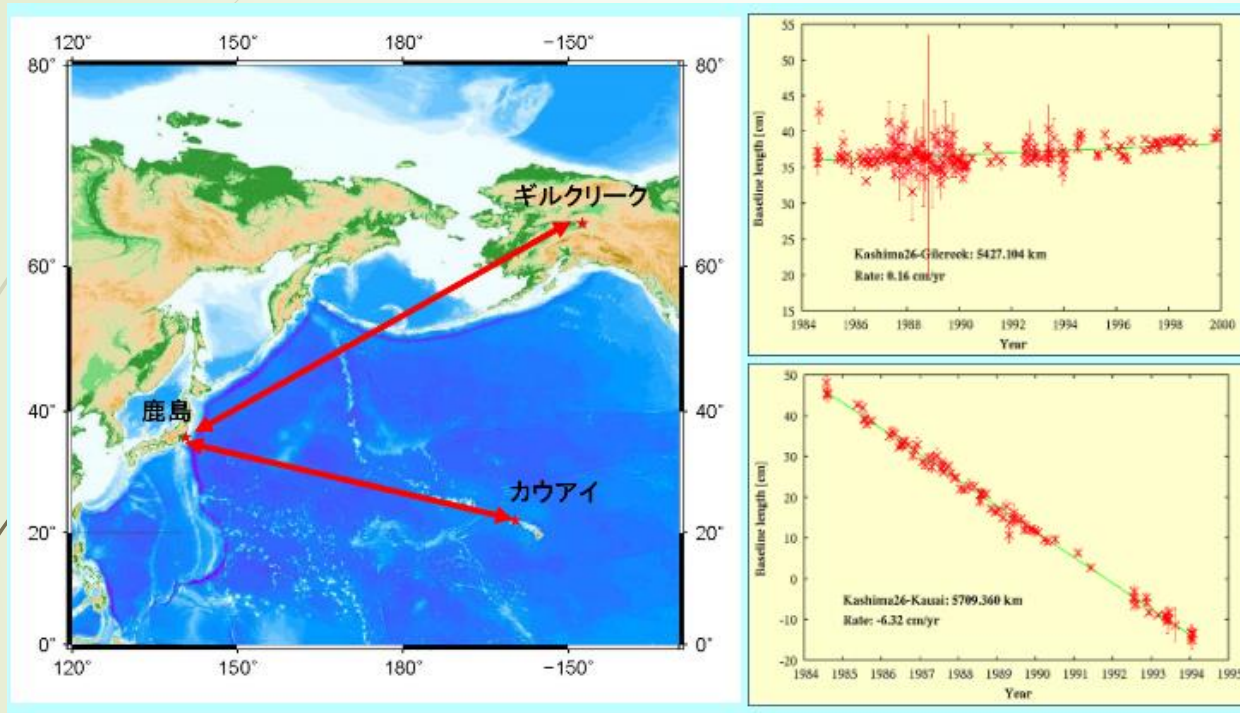
- **4Mbps**
- **Correlation by computer**



Yokosuka 12.8m



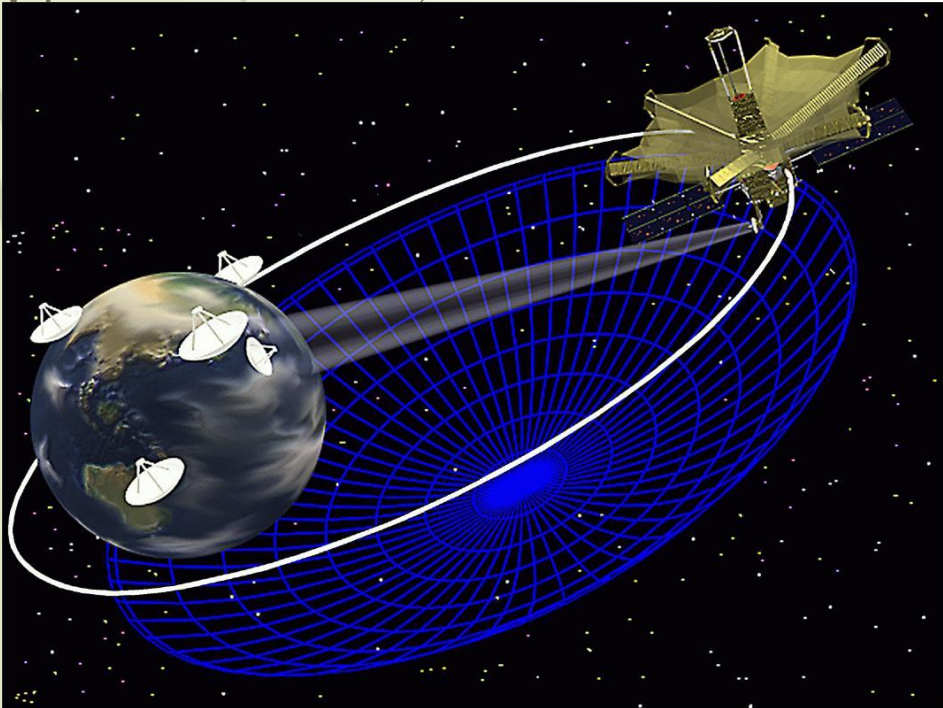
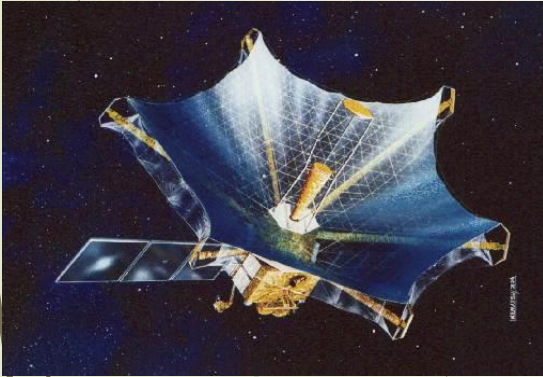
West Pacific Plate motion Project (NASA Crustal Dynamics Project: CDP)



- Detection of on-going motion of the Pacific Plate
- K3 system, equivalent for the Mk3 system, was developed and applied.
- First measurement of the Pacific plate at 1983.

VSOP

<https://darts.isas.jaxa.jp/astro/halca/vsop/index.html.en>

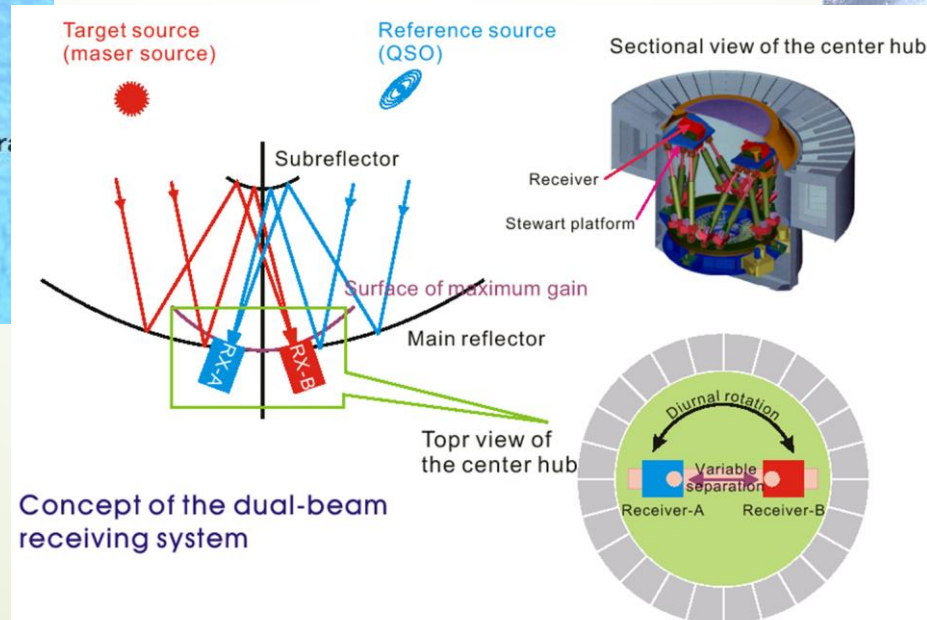
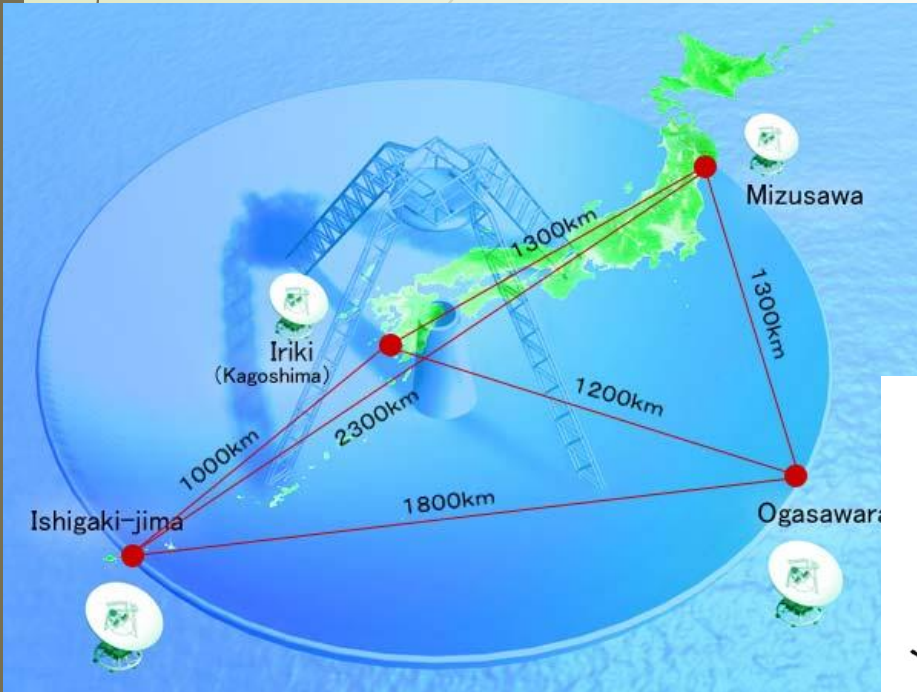
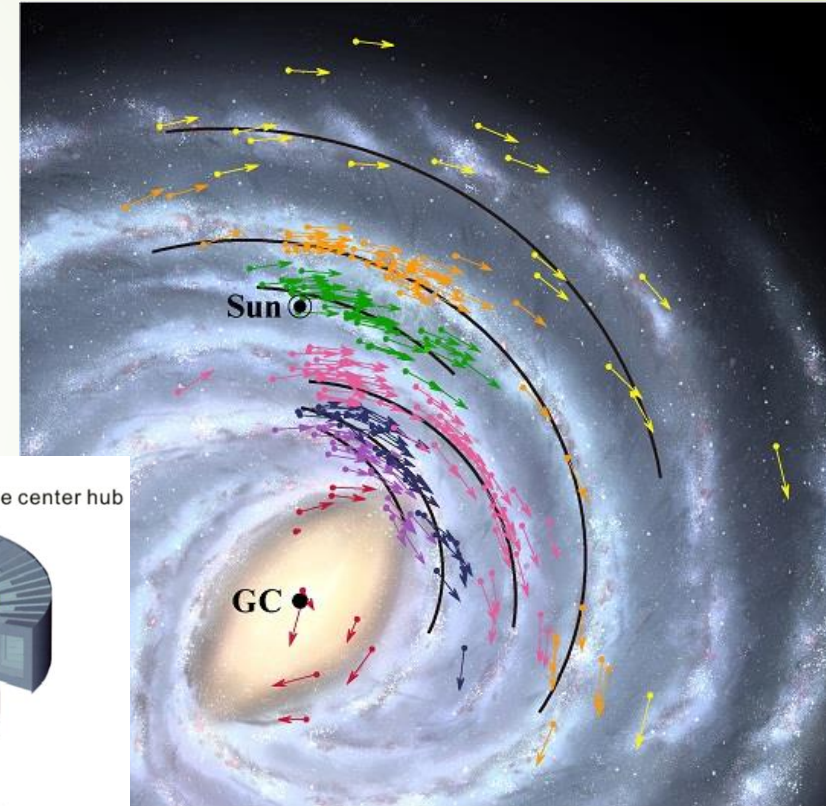


- ▶ Launched in 1997 and Ceased operation in 2005
- ▶ 7-m Diameter on-board deployment telescope operated at 18, 6, and 1.3 cm wavelength
- ▶ Talk by Hirabayashi-san

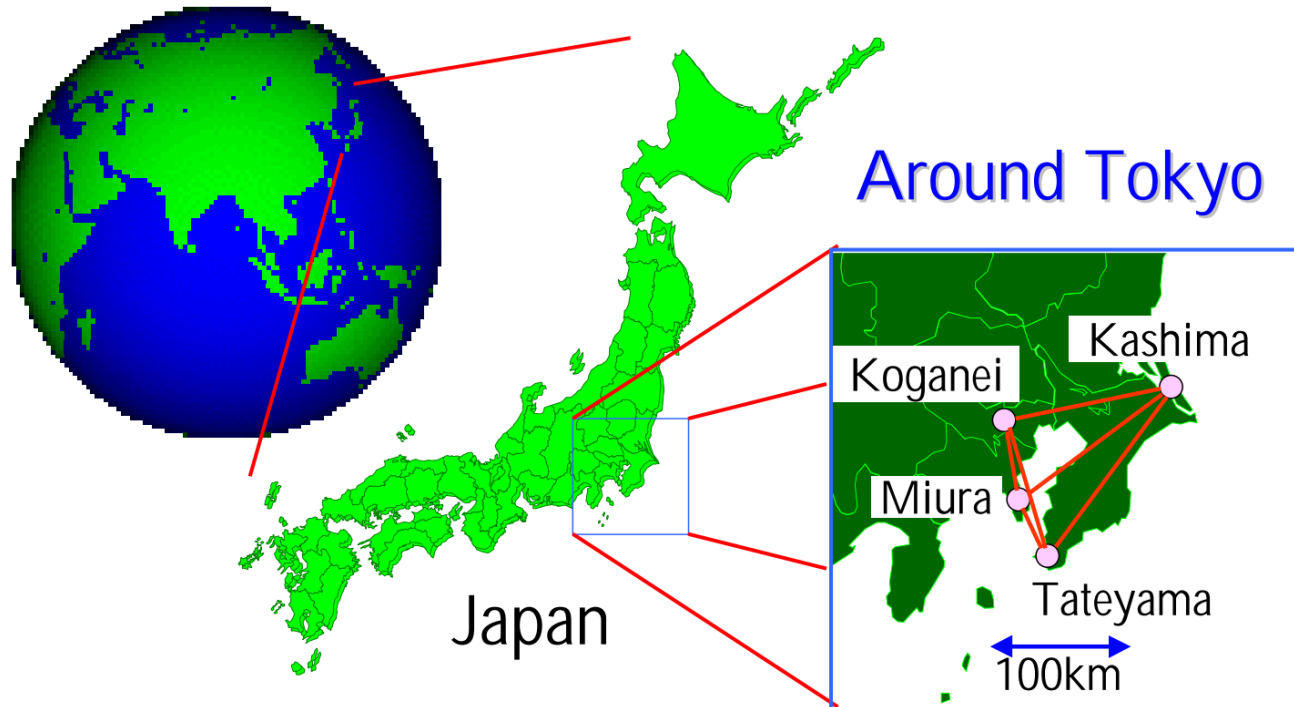
VERA

<https://www.miz.nao.ac.jp/veraserver/>

- Phase referencing VLBI for Galactic Astrometry
- 1999-2021
- Continued in EAVN as general VLBI stations

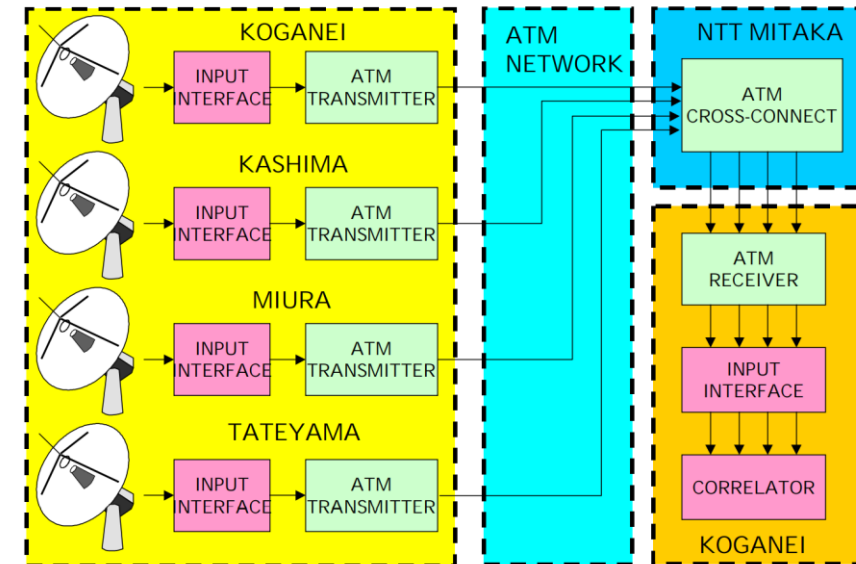


Key Stone Project



- Four 11-m telescope was distributed around Tokyo to monitor the crustal deformation in real-time.
- 1995-2000

Real-Time VLBI System

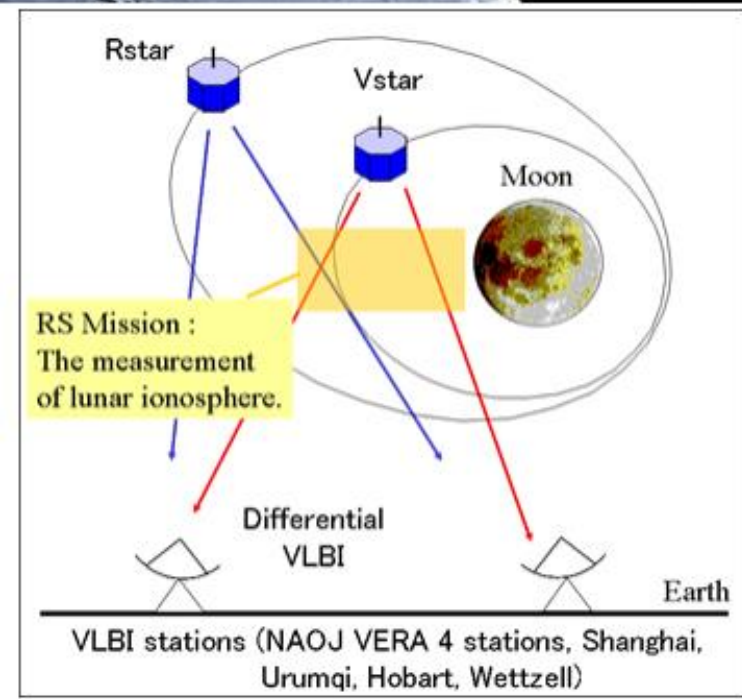


SELENE

https://www.kaguya.jaxa.jp/index_e.htm

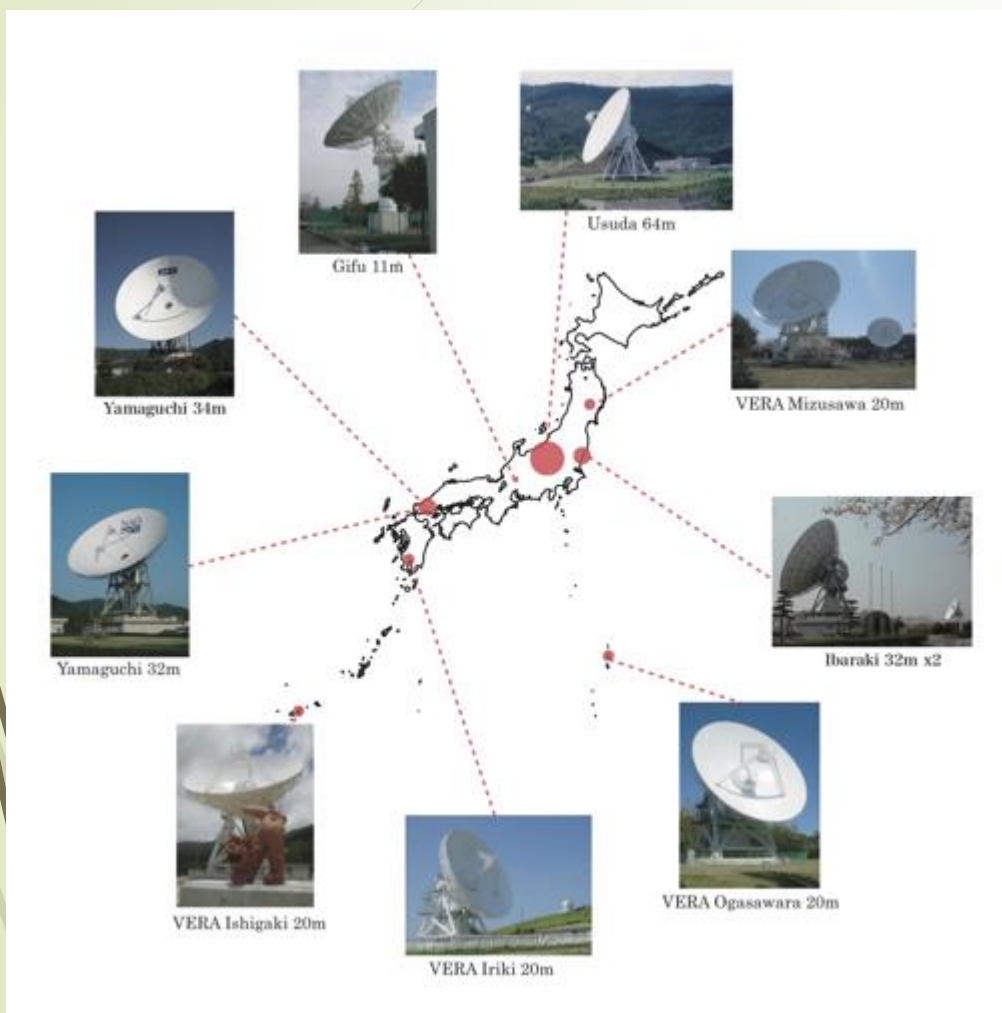


- Japanese Lunar mission
 - HDTV camera for Lunar surface mapping
 - Laser Altimeter
 - VLBI radio source (Vstart, Rstar)
 - others
- 2007-2009
- Continued to apply for orbit determination of Hayabusa, Hayabusa-2 and others



JVN

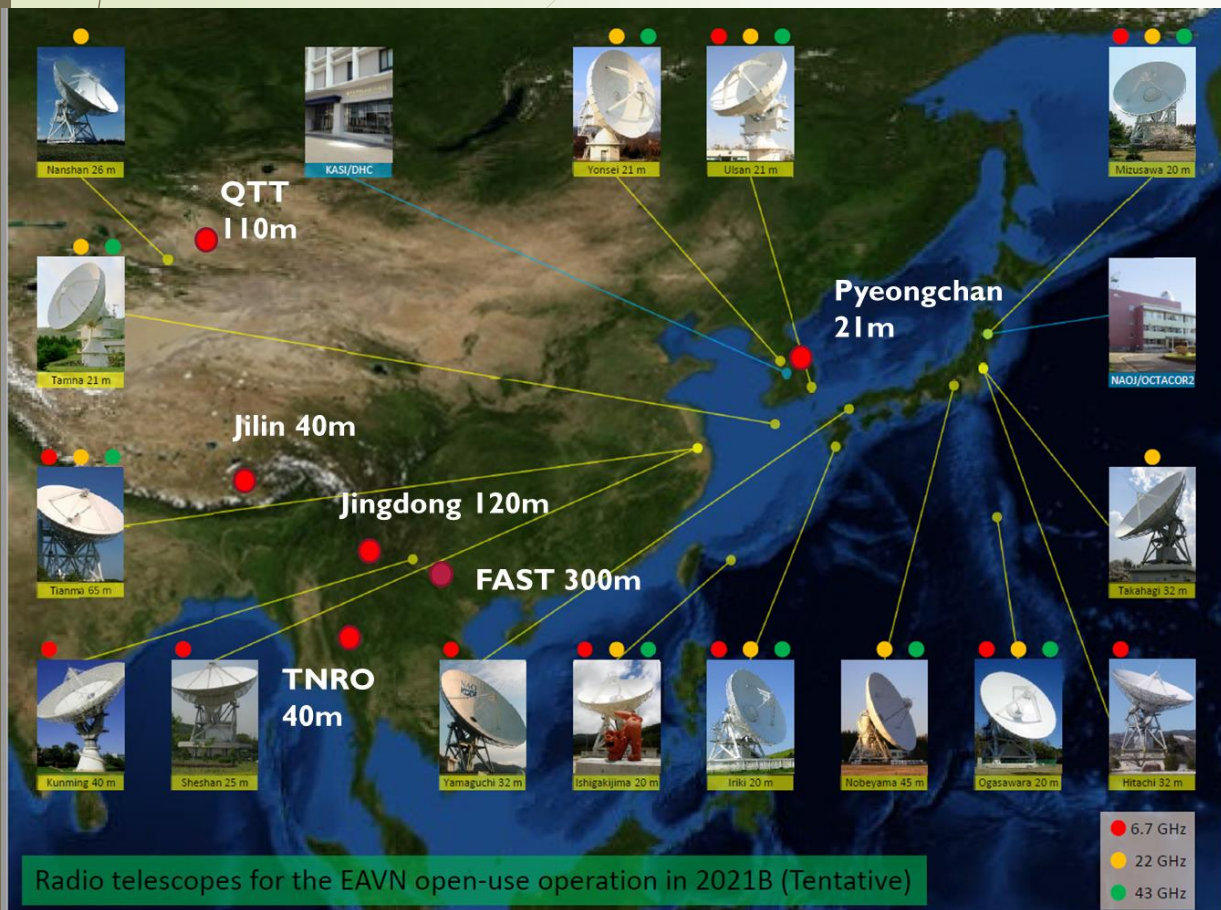
<http://astro.sci.yamaguchi-u.ac.jp/jvn/index.html>



- Japanese VLBI network
- University association and VERA
 - Ibaraki, Yamaguchi, Gifu, Osaka Metropolitan, and Kagoshima Universities
- Mainly operated at 6.7 GHz (Methanol maser monitoring)

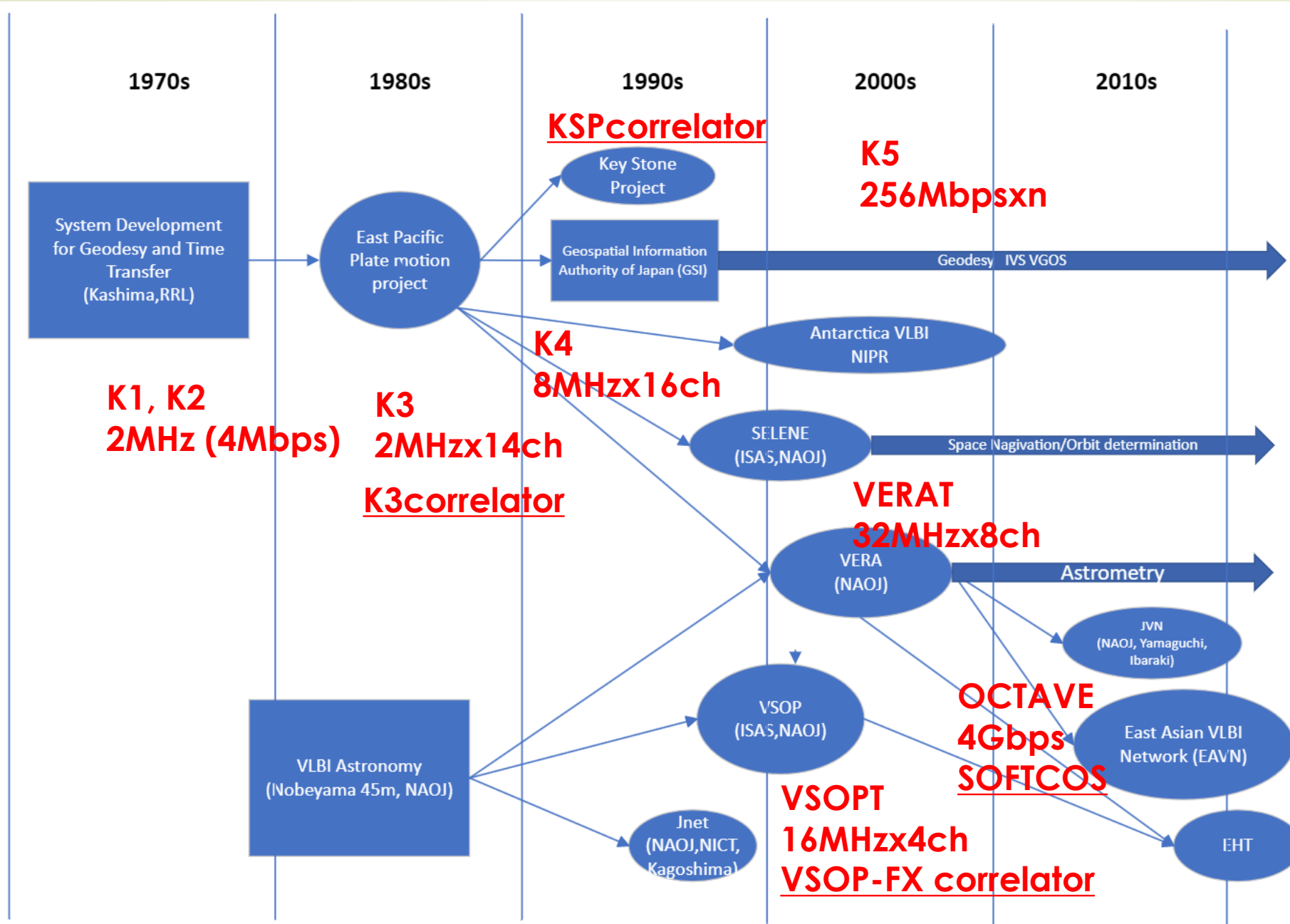
EAVN

https://radio.kasi.re.kr/eavn/main_eavn.php



- Open use observation was started from 2018.
- Operation at 6.7, 22, and 43 GHz
- Current organized telescopes
 - 14 (Korea 3, Japan 8, China 3)
- Recording rate: 1 Gbps usually 4Gbps possibly
- Correlator
 - KASI KJCC correlator
 - SHAO DiFX
 - NAOJ Softcos

Terminal and Correlator Development in Japan





Summary

- Development of VLBI in Japan was initiated at Kashima for the geodesy application from early 1970s, which was just after the first VLBI experiments.
- Astronomy of VLBI was started from Nobeyama 45-m and extended to VSOP, VERA, and EAVN.
- Geodesy VLBI was expanded to GSI and space application like SELENE and orbit determination like Hayabusa-2.
- Domestic VLBI network is kept by the university association.