AP-10

INTERCOMPARISON BETWEEN VLBI FREQUENCY TRANSFER AND OTHER TECHNIQUES

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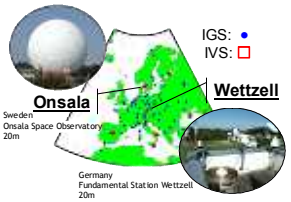
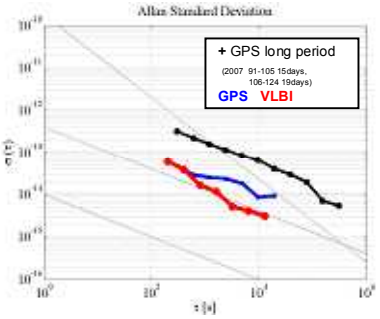
Introduction

As one of the new frequency transfer technique to compare the next highly stable frequency standards, we proposed the **geodetic VLBI technique**.

1. Developing a compact VLBI system
MARBLE SYSTEM
Multiple Antenna Radio-interferometry of Baseline Length Evaluation
2. Verifying the ability of VLBI frequency transfer
to show the capability of the current VLBI system
→ Intercomparison between VLBI and other techniques

Previous Study
Comparison between VLBI and GPS using IVS and IGS data





Onsala-Wettzell baseline
at each site
VLBI and GPS are *sharing* the H-maser

In general, the VLBI frequency transfer stability follows a $1/\tau$ law very close when averaging up to 10^4**s**.

The geodetic VLBI technique has the potential for precise frequency transfer

Development of a Compact VLBI System

We are developing a compact and transportable VLBI system to certificate the length of the reference baseline, based on a collaboration between Geospatial Information Authority of Japan and NICT.

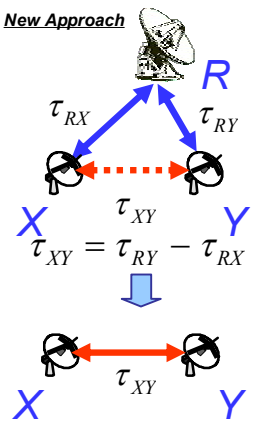

prototype #1
@KSRC, NICT


prototype #2
@GSI

MARBLE SYSTEM
(Multiple Antenna Radio-interferometer of Baseline Length Evaluation)
- Diameter **1.6m**
- S/X-band
- Front-fed paraboloidal reflector
- Az-El mounting
  Max speed AzEl **5 deg/sec**
- Transportable by **few person**

now under test experiment

New Approach

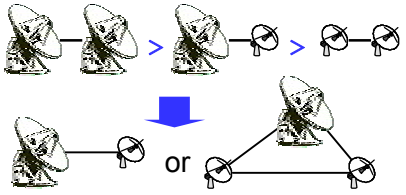


That is calculate the group delay of compact-compact antenna baseline from the two large-compact antenna baseline.

Basic Approach

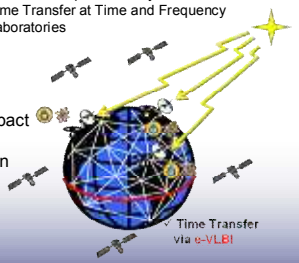
$$SNR \propto \frac{D_1 D_2}{\sqrt{T_1 T_2}} \qquad \sigma = \frac{1}{SNR}$$

SNR



Future image

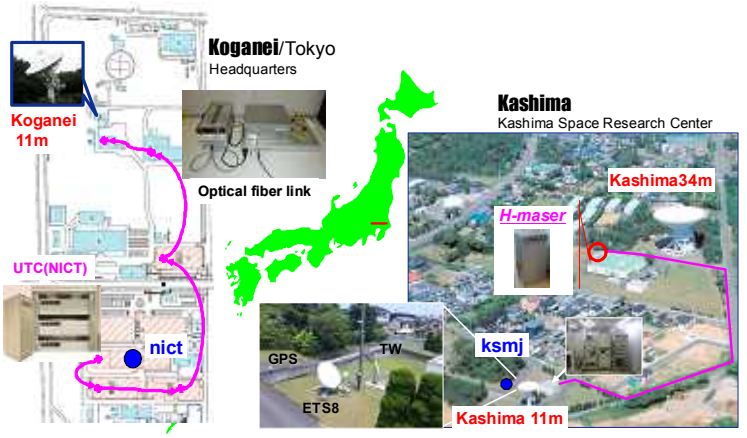
collocate compact VLBI systems for Time Transfer at Time and Frequency Laboratories



Advantages:
- could not consider the sensitivity of the compact-compact antenna baseline
- short integration time and increase the number of scan
- cancel the effects of the large antenna's problems (gravitational and thermal deformation)

Intercomparison between VLBI and Other Techniques

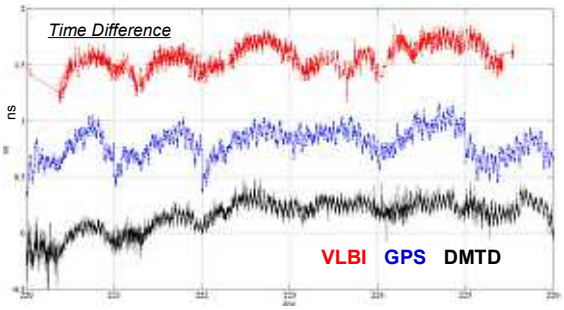
NICT has several T&F transfer techniques other than VLBI such as using GPS and telecommunication satellites at NICT Koganei Headquaters and Kashima Space Research Center.



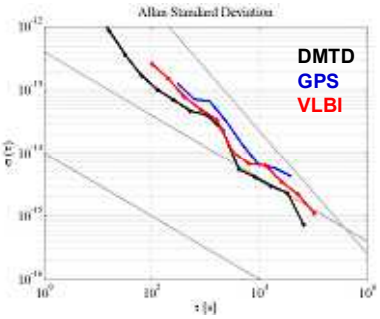
to show the capability of the current VLBI system
→ Intercomparison between VLBI and other techniques

Kashima 34m — Kashima 11m baseline

VLBI (multi channel sampling), GPS Carrier Phase, DMTD(Dual Mixer Time Difference)



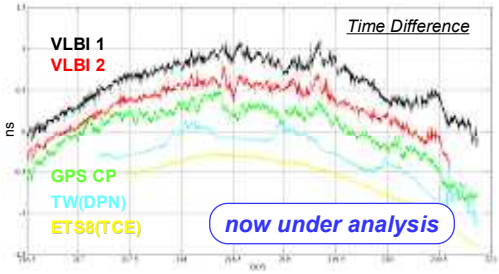
Frequency Stability



Summary
- Time differences
  VLBI vs. GPS and DMTD
  Good agreement : **±500ps**
- VLBI is more stable than GPS
  same baseline and same period
  over 10^3 averaging time
- VLBI stability : follows a $1/\tau$

Latest Observation

Kashima – Koganei baseline
VLBI 1(multi channel sampling), VLBI 2(wide band sampling), GPS Carrier Phase, TWSTFT (DPN: Dual Pseudo random Noises), ETS8 (TCE: Time Comparison Equipment)



About ETS8(TCE), please see the poser : AP-9 Nakagawa et al., "TIME AND FREQUENCY TRANSFER EXPERIMENTS BETWEEN TWO EARTH-BASED CLOCKS USING ETS-VIII SATELLITE"

References

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H. Takiguchi et al., Evaluation of the new approach to improving compact-compact antenna baseline in VLBI, JGU 2009 Abstract, D107-005, 2009.
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NiCT Kashima Space Research Center