

# 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. Previously, we evaluated the ability of VLBI frequency transfer by comparison with GPS carrier phase frequency transfer using data from the International VLBI Service for Geodesy and Astrometry and the International GNSS Service. We achieved the frequency stability of  $2 \times 10^{-11}$  at an averaging time of 1 sec which has a  $1/\tau$  trend. Over the averaging time of 1000 sec, it surpassed the frequency stability of typical atomic fountain. These results showed that geodetic VLBI technique has the potential for precise frequency transfer [2]. Furthermore, to show the capability of VLBI, we perform the intercomparison experiments between VLBI and other techniques using our facilities Kashima and Koganei antennas [4].

## 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 [1]. We named this system "Multiple Antenna Radio-interferometer for Baseline Length Evaluation (MARBLE)". We are planning to deploy it at global time and frequency laboratories and use it for T&F transfer with high speed networks. And also, we are planning the unique concept for VLBI experiment using two MARBLEs and one large antenna [3]. This concept has many advantages compared to normal VLBI frequency transfer. Currently, we have completed two prototypes of MARBLE. So, we are preparing the VLBI frequency transfer experiment using MARBLE.

## 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 Headquarters. We set up the TWSTFT (Two-Way Satellite Time and Frequency Transfer) antenna at NICT Kashima Space Research Center (KSRC). KSRC has GPS and VLBI station including MARBLE first prototype. We finished the preparations for exact intercomparison between VLBI and other techniques on the Kashima-Koganei baseline. In near future, we are going to set up the second prototype of MARBLE at Koganei and carry out the intercomparison experiments.

We will present the details of this study, based on these findings.

## References

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