Status report on NIMT time and frequency activities

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Abstract

Time and frequency laboratory at National Institute of Metrology Thailand (NIMT) is responsible of time and frequency metrology of Thailand. Main activities include time keeping and time dissemination. Cooperation with the Hydrographic Department, Royal Thai Navy is to disseminate time through the nation via internet network and speaking clock.

1. Introduction

NIMT Time and frequency laboratory is part of the electrical metrology department. Member of staff are Mr Thepbodin Borirak-arawin, Dr Thayathip Thongtan and Dr Piyaphat Phoonthong. Main functions are to maintain the local frequency standard and generating the UTC(NIMT), to provide calibration services to support the industries, to disseminate time of day to the public users as well as to provide strong educational supports in terms of research with universities.

2. Time and frequency keeping

Time keeping responsibilities consist of generating UTC(NIMT) by operating 3 Caesium frequency standards (5071A) with high performance tube. Frequency and phase offset generator (HROG-5) and time interval counter switching is applied to the NIMT timescale. UTC(NIMT) is kept link with the BIPM TAI time scale whereby, the differences of each of our clocks and GPS observations are measured daily by operating two timing receivers; Topcon Euro80 and Motorola Oncore, and CGGTTS data are sent to the BIPM for both UTC and UTCr. Time deviation is kept within 100 ns, where as frequency stability is maintained less than 5×10^{-14} [1].

3. Time disseminations

NIMT current time disseminations are through 4 main folds including: calibration services, time on internet network by applying the Network Time Protocol (NTP), time code via radio frequency via FM using the Radio Data System (RDS) and time information through telephone network.

4. Research

Dual Mixer Time Difference system for calibrating a high stability frequency source

Dual Mixer Time Difference (DMTD) is a method for measuring the time difference of the frequency source which can be implemented in many applications i.e. Time Scale system [2, 3] or Composite clock [4]. This document intends to simplify the DMTD system however the systematic noise [5] is still the prior consideration. The low-cost DMTD system, built at the Time and Frequency laboratory of NIMT, has much better stability than the conventional calibration system. Its stability strongly depends on the ambient temperature and the ratio of the reference frequency and the beat frequency.

The low-cost DMTD system, designed for the frequency up to 400 MHz, mainly consists of the Heterodyne circuit and the Zero Crossing Detector circuit. The whole system is shielded in the aluminum box to reduce the stray frequency noise. The Heterodyne circuit is equipped with the high reliability frequency mixer with shielded metal case. On the printed circuit board, the ground plate of the high and low frequency component is isolated to screen the high frequency noise. The series of filter are carefully designed and simulated to block any frequency noise above 100 kHz. Then, the Zero Crossing Detector circuit is utilized to amplify the signal by two inverting amplifier with the active low pass filter of 1100 Hz and 880 Hz respectively. Finally, the stability of the system for the variation of frequency is shown in the Fig. 1.

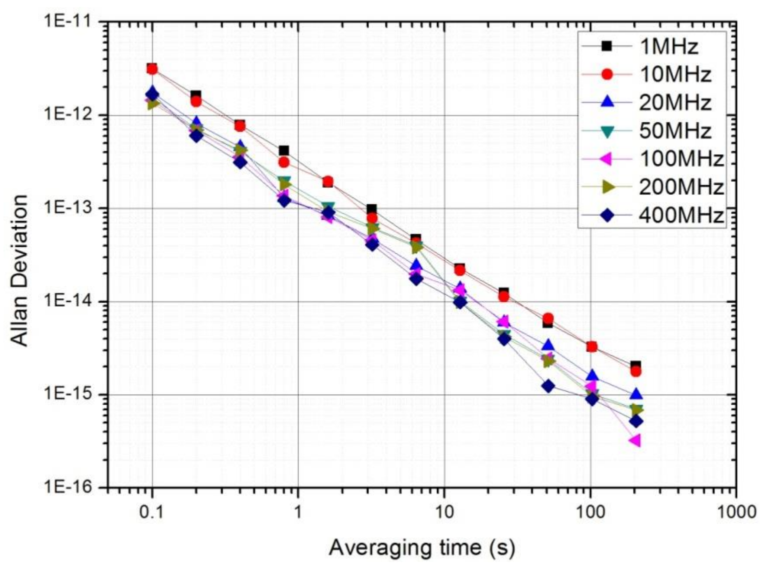

Fig. 1. The Allan deviation of the low-cost DMTD system for the different frequencies

The DMTD system is capable to measure the frequency source up to 400 MHz and its stability is lower than $5x10^{-13}$ for the averaging time of 1 s. This system will be implemented in the calibration system of the high stability frequency source and the development of the Thailand Time Scale

Frequency standard dissemination via Fiber optic

Internal frequency standard dissemination was through the coaxial cable (RG-58) which places together with an electrical cable. The AC line frequency, mainly 50 Hz, interfere with the frequency standard as a results the stability over the long distance is decreased. To overcome the situation, the fiber optic is replaced since the electromagnetic wave cannot interfere the signal. However the electrical to optical and optical to electrical conversion circuit need to be carefully designed to reduce the undesired noise.

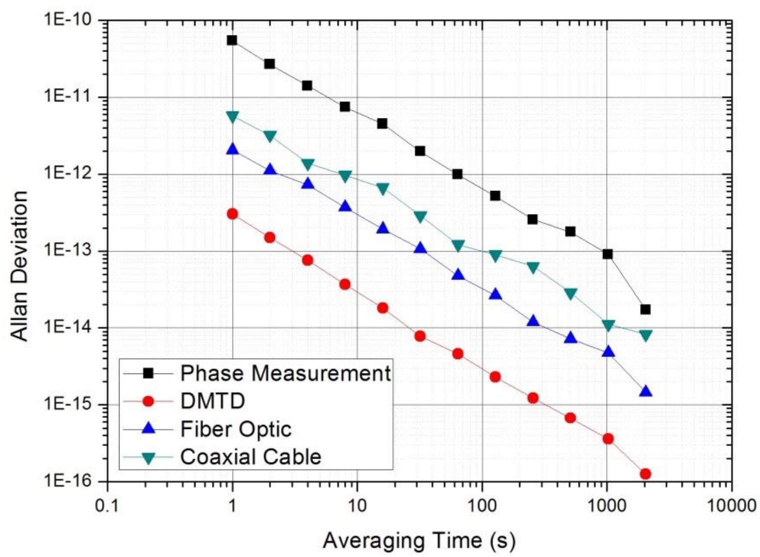

Fig. 2. The comparison of the Allan deviation for the frequency standard dissemination via fiber optic and coaxial cable

The stability result of the frequency standard dissemination via fiber optic is better than the coaxial cable for the distance over 30 m. For the shorter distance, the noise of the conversion circuit diminish the quality of the signal

5. Competence and developments

New calibration services submitted in August 2015 to be in the BIPM CMCs KCDB appendix c is the remote calibration services using the GPS common-view technique.

Further cooperation will be made with KRISS time and frequency division under the MoU signed in June 2014 on development of speed measurement calibration systems.

Time link of UTC(NIMT) with UTC will be done by contributing the RINEX data observation with the introduction of UTC(NIMT) timescale and applying GNSS time transfer technique of precise point positioning to this time link.

Clocks will be compared and audited with the Thailand Electronics Transactions Development Agency, ministry of information technologies; to provide Thailand standard time in electronic time stamping services.

References

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