Steering a Rubidium clock to ± 1 ns with respect to UTC(NPLI)

Mohammad Aslam[1], Sonali[1], Vattikonda Bharath[*1,2], Ashish Agarwal[1,2], Amitava SenGupta[3]

[1]*Time & Frequency Metrology, National Physical Laboratory, New Delhi, India*. e-mail: mohammadaslam380@gmail.com, bharath.v@nplindia.org, ashish@nplindia.org
[2]Academy of Scientific and Innovative Research (AcSIR), Ghaziabad- 201002, India
[3]NorthCap University, Gurgaon. e-mail: sengupta53@yahoo.com

Atomic steering is a mechanism through which a clock is being corrected periodically, with respect to its reference to maintain its timing accuracy within the set limits. Steering an atomic clock with respect to a time scale depends on the Time Interval difference Measurement (TIM) capability between them and the resolution of frequency corrections that can be applied to the clock. Generally correcting the time output from a clock is avoided as it reflects direct jump in the time for the user. Frequency corrections are generally preferred as they impart time corrections slowly over a specified time duration called phase time constant.

In this paper two Rubidium (Rb) frequency standards are characterised for free run and then steered with respect to UTC(NPLI). Frequency corrections are applied based on the algorithm developed to maintain the output of the Rb with in specified limits.

The free run performance of the two Rb standards i.e., Rb Miniaturised Atomic Clock (MAC) of Microchip and Rb frequency Standard of Morion will be discussed (frequency stability, phase noise, Time DEViation) with respect to UTC(NPLI). The two clocks have a frequency corrections resolution of ±1E-6 Hz/Hz and ±1E-7 Hz/Hz respectively. The steered output performance of these two Rb clocks which are collocated with UTC(NPLI) shall be compared and presented in detail. The steering mechanism and the algorithm developed to automatically measure and impart the frequency corrections shall be presented.

References:

1. A NIST Disciplined Oscillator, Michael Lombardi, NCSL International Workshop and Symposium, 2010.
2. Disciplined Oscillator system by UTC(NIM) for Remote Time and Frequency traceability, Liang Kun et.al., IEEE Xplore, Proceedings 2014.