

Long Term Comparison of Timescale Systems using Independent Time Transfer Methods

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Precise Timing Facility (PTF) is an important element of the NavIC ground segment responsible for generating and disseminating NavIC System Time. The system time is generated using an ensemble of highly stable atomic clocks and is continuously steered to Indian Standard Time (IST) being generated at NPL, India. In order to steer the NavIC System Time to IST, it is required to estimate the phase and frequency offsets between the NavIC System Time and IST.

Satellite based time transfer is one of the most prevalent methods to compute the difference between two geographically separated timescales. To realize time transfer, the two facilities are equipped with the time transfer infrastructure required for Two-Way Satellite Time and Frequency Transfer (TWSTFT) and GNSS All-In-View (AV) time transfer [1, 2]. Recently, the timing facilities have been augmented with the precisely calibrated NavIC time transfer receivers also. NavIC based common view provides an alternate and independent method to compare the remotely located timescales systems. The TWSTFT terminals, GNSS time transfer receivers and NavIC time transfer receivers are calibrated precisely. Figure 1 shows the established time transfer systems for NavIC AV, GNSS AV and TWSTFT at NavIC PTF. The algorithms required for processing the raw measurements generated by the Satre modem for computing time offset using TWSTFT, for processing the raw measurements from GNSS and NavIC receiver for obtaining time offset using GNSS/NavIC AV methods have been developed and implemented. Data using the three techniques have been processed and evaluated for long term duration. The offsets computed using NavIC AV reconciles with the offsets computed using other two methods. Figure 2 shows the offset between NavIC System Time and IST computed using the three methods. The time transfer operations using the three independent methods are now operational for computing the time offset between two precise timing facilities.

This paper presents the long term results of computed time offset between NavIC System Time and IST using NavIC AV, GNSS AV and TWSTFT methods. The results obtained using the three independent methods converge to each other within 3 ns.



Figure 1. NavIC receiver, GNSS receiver and TWSTFT modem operational at PTF

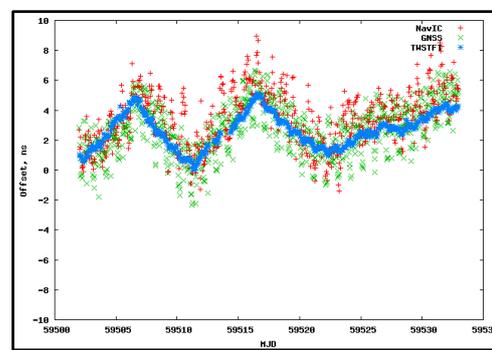


Figure 2. Time offset between NavIC System Time and Indian Standard Time using three methods

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