Reduced latency GNSS comparison of optical clocks and timescales

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Optical clocks are now contributing regularly to TAI calibrations[1] and have recently begun contributing to the steering of local realizations of UTC. This increased responsibility comes with concerns about ensuring a consistent frequency. BIPM's monthly Circular T provides a convenient source of comparisons with clocks operated at other institutes, but its publication schedule increases the latency from when the measurement is taken, to the time that data is available. To react quickly to any unforeseen problems, it is valuable to reduce this delay as much as possible.

We will present results of a collaboration for regular data exchange and frequency comparison between KRISS in Korea, and NMIJ and NICT in Japan. It aims to organize data collection and evaluation such that the results are made available regularly and with minimized delay. Comparisons between the institutes employ the satellite comparison technique of PPP-AR[2], provided by NRCan[3] based on weekly updated IGS information. For intermittently operating clocks like NICT-Sr1, we consider optimized scheduling to make the best use of the satellite links.

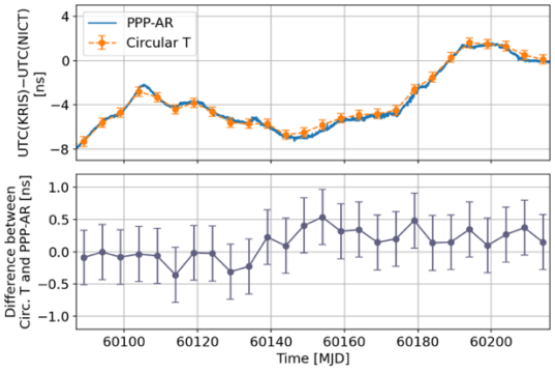

Fig. 1: Top: Time difference between two local timescales, determined through PPP-AR and Circular T. Bottom: The difference between the two evaluations falls within statistical expectations.

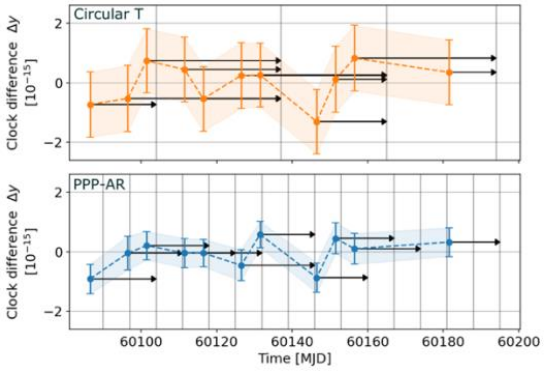

Fig. 2: Comparison of two optical clocks via Circular T (top), and direct data exchange, using NRCan PPP-AR for the long-distance link (bottom). Vertical lines indicate publishing dates of data, arrows show the delay until data is available.

[1] https://webtai.bipm.org/database/show_psfs.html

[2] B. Jian *et al*, "GPS PPP-AR frequency transfer and its application for comparing atomic fountain primary frequency standards between NRC and PTB", Metrologia, vol. 60, 065002, 2023

[3] https://webapp.csrs-scrs.nrcan-rncan.gc.ca/geod/tools-outils/ppp.php