

Recommendation for Committee Decision

Prepared by : Working Group D

Date of Submission : 24 October 2025.

Issue Title : Continuous GNSS Time Transfer across Day Boundaries using IGS Products

Background/Brief Description of the Issue :

The GNSS/RNSS time dissemination service and time comparison techniques based on GNSS are the main techniques nowadays used to compare clocks at distance and it is the backbone of the synchronization of national infrastructures.

GNSS time transfer using post-processed precise orbit and clock products is currently one of the most accurate methods for comparing remote clocks and frequency standards worldwide. Precise Point Positioning (PPP) time transfer, for instance, is intensely used for the computation of the Coordinated Universal Time UTC.

Over the past decade, extremely accurate optical frequency standards (OFS) have been developed in several laboratories around the world. These standards have achieved unprecedented frequency stability (10^{-18} in relative value), allowing significant advances in frequency-based measurements and is leading toward a redefinition of the second. The applications of such high accuracy measurements are rapidly developing and commercially available OFS are appearing on the market.

These clocks challenge the performance limits of GNSS-based time transfer, even averaging over multiple days is still insufficient to reach the stability levels needed for OFS comparisons.

Precise Point Positioning (PPP) time transfer with ambiguity resolution has demonstrated significant improvement over classical PPP techniques, which is essential for the aforementioned OFS time frequency transfer. However, this approach requires dedicated products and continuity of phase measurements to achieve optimal results, which will ultimately benefit UTC and the high accuracy comparison based on optical frequency standards.

Discussion/Analyses :

Most precise GNSS orbit, clock, and bias products are currently computed by IGS Analysis Centers in daily batches, with each file typically covering a 24-hour interval. This segmentation introduces discontinuities in the clock and phase bias products at day boundaries, complicating continuous timing analyses spanning multiple days.

Some Analysis Centers already provide continuous clock solutions, ensuring phase continuity across day boundaries or including small overlaps between consecutive days to recover the transition. However, this practice is not yet applied consistently across all centers and product types. Furthermore, a combination across such clock solutions from various Analysis Centers would improve the robustness of consecutiveness across day boundaries.

Ensuring clock continuity between daily solutions would improve interoperability among Analysis Centers, facilitate long-term clock performance evaluation, and enhance the overall reliability and precision of GNSS-based timing services.

In this frame, the ICG should promote the widest possible use of GNSS in particular for metrological and science purposes, underpinning national and international synchronization. This also considering that there are mutual benefits between improving UTC, the next generation clocks, and the GNSS services

Recommendation of Committee Action :

The ICG WG-D recommends

- *The IGS considers to encourage its Analysis Centers to implement and distribute daily clock products that maintain temporal continuity across day boundaries, avoiding discontinuities in the clock and phase bias solutions, or provide the necessary information to recover such continuity.*
- *ICG members who operate an IGS Analysis Center to also consider adopting a similar strategy for their precise products.*

Members Consensus Reached _____ **; No Consensus Reached** _____

Chairperson Signature: _____ **Date:** _____