

Recommendation for Committee Decision

Prepared by: Working Groups B, S, and D

(Working Group, or individual Members or Associate Members)

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Issue Title: On the use of the broadcast prediction of UTC to determine the offsets between GNSS times for non-space-based users.

Background/Brief Description of the Issue:

Multi-GNSS is more and more used in a variety of applications. Multi-GNSS users need to know the timing offsets between the individual GNSS, also called inter-system timing biases.

In ICG 2017, a discussion was raised on the possibility to use a pivot time scale as reference to estimate the different GNSS time offsets, so that each GNSS would need to broadcast only one parameter. In recent years, the use of the prediction of UTC already broadcast by the GNSS as this pivot has proved to be a viable solution, without the need to create a new time scale. On this topic the Consultative Committee for Time and Frequency of the BIPM issued a Recommendation in 2021 “On the use of existing time scales to generate GNSS inter-system information” recommending to avoid the proliferation of unnecessary time scales.

Discussion/Analyses:

The inter-system time biases can be determined by three different approaches:

- determination at user level when a sufficient number of GNSS satellites are in view
- use of direct broadcast information (GNSS-to-GNSS time offset) when available
- use of the prediction of UTC (called $bUTC_{GNSS}$) that each GNSS currently broadcasts through the message ($GNSS_{time} - bUTC_{GNSS}$) as a pivot to determine related inter-system time biases

Even if the $bUTC_{GNSS}$ is not the same for the different GNSS (different UTC(k) are used by the GNSS as intermediate references), they are sufficiently close to one another for that purpose. Recent studies have confirmed that with the current differences between the $bUTC_{GNSS}$ broadcast by the different GNSS, the resulting error on the inter-system time bias has no significant impact on positioning and timing in situations where non-space-based mass-market receivers cannot determine the inter-system bias directly from the measurements.

The prediction of UTC broadcast by the GNSS is expected to improve in the future, which will improve GNSS interoperability and time dissemination accuracy.

The feasibility/performance of the three approaches depend on many factors such as the number of GNSS satellites in view, the noise level of the receiver and the accuracy of the broadcast messages.

Continuous effort in monitoring and validating all GNSS-to-GNSS time offset is to be pursued also promoting the collaboration among the different involved groups.

The needs of space users may lead to different conclusions that may require revisiting this recommendation.

Recommendation of Committee Action:

1. In the case a common pivot method is chosen to provide the user with GNSS inter-system time biases, multi-GNSS receiver manufacturers consider the benefit of using the common pivot $bUTC_{GNSS}$ contained in the GNSS navigation message. This approach comes in addition to the two other existing methods (estimation at user level or use of broadcast GNSS-to-GNSS time offset). For mass-market non-space-based users, this eliminates the need to create an ad hoc time scale as a common pivot.

2. GNSS providers continue their efforts to improve the prediction of UTC broadcast in the navigation message with the help of time laboratories, with the aim to improve their time dissemination service.