TWSTFT calibration campaign 2023 – Analysis of results

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Introduction - This work presents the analysis of the results of the European two-way satellite time and frequency transfer (TWSTFT) calibration campaign organized in 2023. The measurements for this calibration campaign lasted for approximately 4 months, from August 2023 to November 2023. TWSTFT is still one of the most important techniques for time scale comparisons contributing to the realization of the coordinated universal time, UTC. For maintaining the accuracy of TWSTFT at the typical level of about 1 ns, a periodic calibration of the delay asymmetry of each TW-station is required.

The campaign - 11 European time laboratories equipped with 12 TWSTFT stations participated in this calibration campaign. The participants are: TIM, PL, PTB, VSL, LTFB, ROA, OP, NPL, RISE, INRIM and METAS. From 8 stations, data was reported from two receiver channels of the SATRE modem. 4 stations reported data from only one receiver channel of the SATRE modem. 8 stations also reported data from a software defined receiver (SDR). This is the first time that so many receiver channels were involved in a single calibration campaign.

Like in previous calibration campaigns, a mobile TWSTFT station (MOB), of which the internal delay asymmetry is considered to be constant, is used as a means to compare the fixed stations at the participating laboratories. This calibration approach allows the determination of the TW link delay asymmetry expressed as CALR values and provides the-state-of-the-art lowest level of measurement uncertainty between each pair of TW stations.

Analysis - The measurement data from the SATRE modems was analyzed by two different methods: the site-based method and the baseline-based method. The data from the SDR receivers was analyzed only by the site-based method.

Conclusions - Preliminary results show a good agreement of the computed CALR values from both methods, and taking into account all known changes (ESDVAR) in the stations after the previous calibration campaign, the agreement with the previous CALR values is well within the estimated uncertainties. The uncertainties of the new CALR are typically less than 0.8 ns (k = 1). Full results will be presented at the conference.

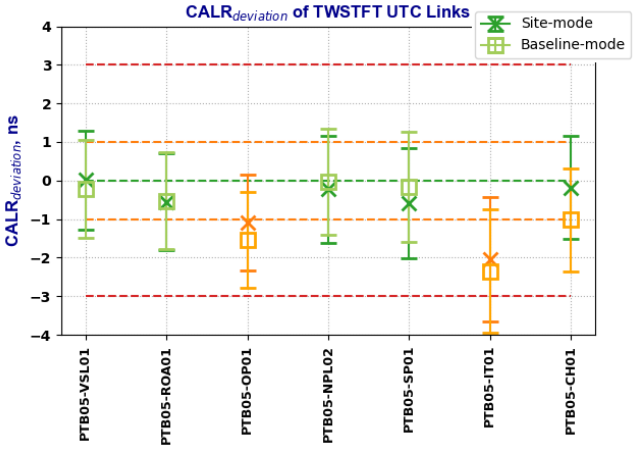

Fig. 1: Preliminary results of the difference between new CALR values and previous CALR values corrected by ESDVAR values.