GPS calibration of LRTE, INMETRO and ONRJ equipment with respect to NIST G1 (1012-2020)

Summary

Over January-October 2020, the NIST conducted a trip to calibrate GPS equipment owned by the Laboratório de Referência de Tempo e Espaço (Brazil, UTC acronym LRTE), the National Institute for Metrology and Technology (Brazil, UTC acronym INXE) and the Observatório Nacional de Rio de Janeiro (Brazil, UTC acronym ONRJ). The trip started and finished at the NIST, providing closure with respect to NIST Group1 reference receivers NIST.

The operations and report of measurements are described in the report by NIST.

After examination of the report, the BIPM and NIST agreed that the results for some receivers could not be validated at this stage. If new information becomes available, a future version of the report may allow publication of new results in an update of this summary file.

- **Final results for the calibrated equipment**

The INTDLY values given in Table 1 have been computed by NIST using INTDLY values of NIST from the Group 1 trip 1001-2018. These INTDLY values should not be updated to reflect later changes in the conventional INTDLY values of NIST.

For a P3/PPP UTC link A-B involving any Group 1 and any receiver in this trip, the uncertainty resulting from the calibration, $U_B(A-B)$, is computed as

$$U_B(A-B) = (U_{CAL0}^2 + \Delta U_{CAL}(A)^2 + \Delta U_{CAL}(B)^2)^{1/2} \tag{1}$$

where U_{CAL0} = 2.5 ns at the time of calibration, as given conventionally to Group 2, and where ΔU_{CAL} (generally zero) is specified for each system.

For single frequency links, U_{CAL0} is 2.5 ns but should be complemented by an additional component to represent systematic errors in the ionospheric model.

Changes in the set-up of the receivers after the calibration must be accounted for as described in section A.3.6 of the most recent Calibration guidelines in https://webtai.bipm.org/ftp/pub/tai/publication/gnss-calibration/guidelines/.

Table 1. Final P1/P2/C1 INTDLY values from the 1012-2020 trip. Values of REFDLY with respect to UTC(k) and of CABDLY during the calibration are also indicated for reference. All values are in ns. "Meas. Date" refers to the first day of the differential calibration, to which the calibration results can be applied. "Impl. Date" is the MJD when the results should be implemented in the receiver.

System	BIPM	Meas. date	INTDLY P1	INTDLY P2	INTDLY C1	REF	REFDLY	CABDLY	Note	ΔU_{CAL}	Impl. date
NXRA	NXRA	2020/03/18	**41.6**	**49.3**	**43.1**	UTC(INXE)	211.9	124.9		0.0	59306
BAB5	NXRK	2020/03/18	**46.1**	**46.9**	**47.4**	UTC(INXE)	154.6	124.7		0.0	59306
OPTA	NXRL	2020/03/18	**45.9**	**52.0**	**47.4**	UTC(INXE)	211.1	70.2		0.0	59306
RJ03	RJ03	2020/06/01	**-1.0**	**-1.6**	**0.2**	UTC(ONRJ)	26.8	194.4	(1)	0.0	59306
RJ04	RJ04	2020/06/01	**-3.7**	**-9.2**	**-2.9**	UTC(ONRJ)	32.9	182.8	(1)	0.0	59306

Notes:
(1).The REFDLY value of RJ03 and RJ04 (Piktime TTS-5) may not havet been measured in full accordance with the Annex 1 of the calibration guidelines, see the report by NIST. Results are expressed as INTDLY for consistency with the CGGTTS V2 format but **new calibration should be performed if the set-up is**

changed: Only the "Total delay" (TOTDLY = INTDLY + CABDLY – REFDLY) is a strictly meaningful result.

Version history
V1.0 2021/03/30: Final results from Version 3 of the NIST Calibration report, to be implemented in G2 receivers.