Meeting of the CCTF GNSS Working group
Zoom, June 23, 2021 12h00 UTC

The meeting was held as a videoconference.
These minutes and all material presented during the meeting are available at https://www.bipm.org/en/committees/cc/cctf/wg/cctf-wggnss/2021-06-23.

Pascale Defraigne, chair of the WG, opened the meeting reminding that it is devoted to the topic of calibration and presented the agenda.

1. G1 and G2 calibration status

G. Petit (GP) presented the status of the Group 1 calibrations, reminding that the 2020 trip was started in June 2020 and the APMP leg was completed in January 2021. The EURAMET G1 leg has just been completed and results show good consistency with 2018[1] so that the G1 reference does not need to be changed and remains realized by the BIPM reference BP21. The G1 legs for SIM and COOMET are in preparation with two parallel trips. A significant change of about 2 ns is observed for the PTB station PT13, due to a new measurement of the REFDEL, it is clarified that this has no impact on the previous calibrations provided by PTB to G2 labs.

P. Defraigne (PD) presented the status of Group 2 calibration. She updated the study on the consistency between successive G2 calibration trips for new results obtained since the last meeting (5 receivers) confirming that the results are well in line with standard uncertainty used for G2 links in UTC.
On the other hand, as a side effect of the COVID crisis, not many G2 calibrations took place so that a majority of laboratories now have a calibration older than 4 years.

Representatives of the G1 laboratories presented a summary of their activities.

- P. Uhrich (PU) reported a trip to CNES and ILNAS and foresees a trip linked to Galileo TSP that is also useful for G2. One of the two OP traveling receivers failed during the CNES/ILNAS trip.
- A. Bauch (AB) for PTB reported on a sucessful campaign visiting INRiM, but a problem with the traveling receiver in the most recent trip to UFE, waiting for clarification.
- H. Esteban (HE) for ROA reported on a calibration at IPQ in progress, plus one scheduled trip to NPL. He furthermore showed a quantification of different cable delay measurements
- PD reported that A. Karaush for SU could not attend the meeting but indicated by mail that the visit to BY is in preparation and the paperwork is done.
- B. Patla for NIST reported that a trip to Argentina is just starting with visits to four laboratories.
- There was no report for USNO. Questioned by M. Gertsvolf (MG) and GP on possible G2 calibrations, P. Koppang indicated that there was no status update and no scheduled calibration trip at this time
- Z. Yang for NIM indicated that he recently took over the responsibility after the departure of K. Liang and committed to continue the G2 trips.

[1] H. Esteban noted a mistake in the presentation concerning one of ROA's receivers and this has been corrected.

- R. Ichikawa for NICT indicated that a trip to NMIJ is planned.
- There was no report for TL.

2. Absolute calibration

P. Waller (PW) presented recent results of absolute calibration of BDS3 delays for some receivers. He outlined the interest of BDS3 signals (e.g. same frequencies and codes as Galileo) and reported that the calibration equipment and procedures have been updated to cover BDS3 codes. He reminded the techniques and uncertainty budgets of receiver absolute calibration at ESTEC and presented results for two PolaRx5: GOLD from ESTEC and BP27 from the BIPM. He noted that the firmware upgrade from version 5.2.0 to 5.4.0 necessary to acquire BDS3 signals on BP27 caused an apparent shift of order 0.3 ns in receiver delays, a fact he had previously seen in some cases (also noted by PU).

GP presented an update on the absolute calibration of BIPM stations. Three BIPM receivers have now been absolutely calibrated in one or two occasions and they provide i. a direct source of information to compare absolute calibrations and ii. a method to transfer absolute calibration to the G1 laboratories through the G1 calibration trips. It is planned to maintain a list of such comparisons as envisioned in the CCTF 2021 Recommendation. MG asked whether the uncertainties in Circular T accounted for the absolute calibration uncertainty and GP clarified that it is not needed in section 1 for [UTC-UTC(k)] but it is needed in section 4 for [UTC-UTC_GNSS].

From the following discussion, it comes out to recommend that:

- The time laboratories, when upgrading the receiver firmware, monitor the stability of the HW delays using the common clock difference with a separate station, and avoid upgrading several stations at the same time.
- The labs, and in particular the G1 labs, upgrade their equipment to record all BeiDou-3 signals so that the calibration can be propagated from the BIPM to the labs and the links based on BeiDou-3 can start to be computed
- ORB delivers the new version of the R2CGGTTS providing CGGTTS results for BeiDou-3 satellites and signals

3. Discussion on the CCTF Questionnaire and suggested actions for improvement

PD presented a summary of the CCTF questionnaire related to the user comments on the G1/G2 calibration scheme for UTC. The main motives of concern were
1. Problems with getting calibration e.g. from absence of G1 labs in some RMOs (GULFMET and AFRIMET) or insufficient devoted resources (SIM).
2. Technical demands, e.g. procedure in case of new receiver or what kind of calibrations are recognized.
To answer the first series of concerns, it is envisioned that RMOs (notably SIM) could review and update the list of G1 labs, possibly considering adding one G1 lab. Also, it was recalled that it is not mandatory to have a TW station to act as G1 lab, separate GNSS stations connected to UTC(k) can be sufficient. Alternatively, any laboratory can perform calibrations if being recognized “authorized

third party" after agreement by the BIPM. Such calibrations provide higher uncertainty than the regular G2. Also, laboratories needing calibration and having no access to a RMO with G1 labs, should contact the BIPM that will transmit the requests.
To answer the second series of concerns, it is planned to prepare a "synthetic document" summarizing the procedures to get calibration and the available techniques.

A series of action items were noted:
The WG will prepare the "synthetic document" as noted above.
The BIPM will contact the RMOs' TCTFs in order for the RMOs to review and possibly update the list of G1 labs.
The BIPM will contact all laboratories with calibration older than 4 years and send the "synthetic document" to indicate how to get calibration. For the labs having no calibration at all, will be furthermore communicated the future mention "uncalibrated" in the Circular T in place of the current arbitrary "20 ns" attributed to these stations.
The BIPM will maintain a list of requested calibrations for laboratories without a direct access to G1 labs and will update the G1 labs about the requests.

The meeting was closed at 14h UTC.

Published 09 July 2021 (P. Defraigne, G. Petit)

List of participants

Pascale Defraigne	Chair, ORB
Gérard Petit	Secretary, BIPM

WG Members

Group 1 representatives:

Andreas Bauch	PTB
Pierre Uhrich	OP
Hector Esteban	ROA
Ryuichi Ichikawa	NICT
Zhiqiang Yang	NIM
Bijunath Patla	NIST
James Hanssen	USNO (by phone)

Giancarlo Cerretto	INRIM
Johann Furthner	DLR
Michael Wouters	NMIA
Paul Koppang	USNO
Wenjun Wu	NTSC
Marina Gertsvolf	NRC
Judah Levine	NIST
Pierre Waller	ESTEC

Invited

Giovanna Signorile	INRIM
Bin Jian	NRC
Dong Guo	NTSC
Kun Liang	BJTU
Frédéric Meynadier	BIPM

Excused

A. Karaush	VNIIFTRI
D. Rovera	OP