General rules of operation for GNSS calibrations

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The BIPM Time department is operating a GNSS calibration scheme as described in the "Guidelines for GNSS equipment calibration" available at https://webtai.bipm.org/ftp/pub/tai/publication/gnss-calibration/guidelines/. This TM describes the general rules of operation which, as of Version 2, are only defined for GPS and Galileo.

- Each calibration exercise is identified by a calibration identifier (Cal_Id), see section 1.
- Results of calibration exercises are made available by the Time Department, see section 2.
- The page https://webtai.bipm.org/ftp/pub/tai/publication/gnss-calibration/ allows access to all files associated with GNSS calibrations. See section 3.
- New calibration exercises are handled as described in section 4.
- Changes affecting systems between calibrations are handled as described in section 5.

1. The calibration identifier (Cal_Id)

The Cal_Id format is znnn-YYYY where
- z identifies the type of calibration;
- nnn is a number assigned by the BIPM;
- YYYY indicates the year (typically the start of the calibration exercise).

The types of calibration z can be (non-GNSS calibration types are not included here):
- z = 1: For GNSS calibration campaigns referenced to a station in the BIPM scheme, under the supervision of the BIPM; nnn then identifies a report corresponding to a calibration exercise
  - o 000 to 009 for Group 1 trips
  - o 011 to 099 for Group 2 trips
  - o 101 to 199 for "Direct calibration" without closure by RMOs/labs/BIPM
  - o 201 to 999 for other exercises by RMOs/labs/BIPM
- z = 2: For GNSS stations, calibrated with other techniques (e.g. manufacturer calibration, absolute calibration, or transfer using a calibrated link); nnn then identifies a report and is a sequential number within the year.

Once a GNSS station has been calibrated, the calibration results should be used to generate the CGGTTS data files and the Cal_Id identifying the calibration exercise should be reported with the data. If changes occur to a calibrated system, see section 5.

2. Availability of the results of time calibrations

After validation of the results of a calibration exercise, a summary report should be added as a pdf file in the directory https://webtai.bipm.org/ftp/pub/tai/publication/time-calibration/Current/. This concerns all techniques, however only GNSS is detailed here.

For GNSS calibrations, the name of the pdf file is Cal-Id_TTT_Other-info_Vx-y where
- Cal-Id is the calibration identifier as described in section 1;
- TTT is the Type of calibration (free format, usually indicates the calibrated codes e.g. GPSP3, GPSP3C1, GALE3);
- Other-info is free format; It is recommended to indicate the list of the labs involved;

- Vx-y is a version number to keep track of updates in the calibration report.

The pdf file contains a short (typically 1-page) summary report written by the BIPM to summarize the results. It contains at least:
- the list of the calibrated stations and the numerical results;
- the standard uncertainty U_{CAL0} that is to be assigned to UTC links with the calibrated stations;
- hypertext links to the file(s) which contain more detailed information (typically the full report written by the party in charge of the calibration exercise).
- an "introduction date" agreed with the participants to use the results in producing the data files.

See examples of such reports in the web page https://webtai.bipm.org/ftp/pub/tai/publication/time-calibration/Current/ .

Calibrations results are also available through other accesses in the Time department database:
- https://webtai.bipm.org/database/calib.html: The list of all GNSS calibration results, listed for each GNSS. Can be searched by Cal_Id, by laboratory or by receiver;
- https://webtai.bipm.org/database/calid_gnss.html: The list of all Cal_Id with general information on each trip, also including trips not yet completed.
- https://webtai.bipm.org/database/gnss.html: The GNSS equipment page gives access to the latest calibration identifier relative to all selected receivers (by default all receivers in the database). When only one receiver is selected, its complete history of calibrations is displayed.

3. Organization of the page https://webtai.bipm.org/ftp/pub/tai/publication/gnss-calibration/

The directory structure :

```
  readme.pdf          : This file

—Group1               : Group1 trips (by the BIPM)
   |
   |—1001-2014         : Files associated to initial Group1 trip
   |—1001-2016
   ├─ … …

—Group2               : Trips for Group 2 labs (by RMOs and other)
   |
   |—2014              : results for 2014
   |—2015              : results for 2015
      |—1101-2015      : Files associated with calibration 1101-2015
      ├─ … …

   ├─ … …

—Other                : Other calibrations (Cal-Id starting with 2)
   |
   |—2014              : results for 2014
   |—2015              : results for 2015
   ├─ … …

   ——Guidelines        : Latest version of the Guidelines
     |—Archive         : Earlier versions

   ——Doc-Soft          : Software and other documentation for calibrations

  ——Absolute           : Repository of absolute calibration reports (in building)
```

Pending the validation of the results by the BIPM and the installation of the files in the public ftp structure, the files are hosted on the Time department internal server G:\calib\Results in a similar directory structure as indicated above.

4. Procedure for handling new calibrations

UTC(k) laboratories seeking GNSS calibration should refer to the following information document: https://webtai.bipm.org/ftp/pub/tai/publication/gnss-calibration/guidelines/How-to-get-calibration-July2021.pdf

Once a calibration exercise is planned, the typical procedure is as follows:

- The organizers of the calibration exercise should notice the BIPM Time department (gpetit@bipm.org with copy to tai@bipm.org), indicating at least: A responsible person and lab, the type of calibration, the list of labs, the planned time period of the exercise.
- The BIPM assigns a Cal_Id and enters the a priori information in the Time department database. The information is then visible at https://webtai.bipm.org/database/calid_gnss.html .
- The BIPM creates the directories in the ftp and on G:\calib\.
- After reception of the report, the BIPM checks it for general consistency with the expected content as described in the Guidelines Annex 4.
- After validation of the report, the BIPM will
  o Write the 1-page summary (section 2) and agree with the participants of an "introduction date" for the results ;
  o Update the Time Calibrations web page (section 2), the GNSS Calibrations web page (section 3) and the Time department database;
  o Inform the participants
    ▪ that the results are published;
    ▪ that they should use the results and include the Cal_Id in the reported data files at the agreed "introduction date".

5. Changes affecting systems between calibrations

The procedure in case of changes is described in the latest version of the Guidelines, available at https://webtai.bipm.org/ftp/pub/tai/publication/gnss-calibration/guidelines/, section A.3.6.

A brief summary:

If the calibration results are expressed as INTDLY or SYSDLY and if the changes only affect the REFDLY value, no change is required to the Cal_id and associated reports. It is expected that the REFDLY measurement uncertainty is accounted for in the standard calibration uncertainty.

All other cases are considered as 'transfer of calibration'. This corresponds either to changes in receiver (e.g. firmware) or in the antenna or antenna cable implying a new determination of INTDLY or SYSDLY values, or to a true transfer of calibration from a previously calibrated system to a new system. In all such cases, a report of operations should be transmitted to the BIPM for validation. If the transfer of calibration implies new INTDLY/SYSDLY values for an existing receiver, a new Cal_Id will be assigned with its own summary report. In all other cases, the original Cal_Id is kept and the summary report of the Cal_Id is updated to include the new results (see last main bullet of section 4).