Presentation of the results of differential calibration of geodetic-type receivers

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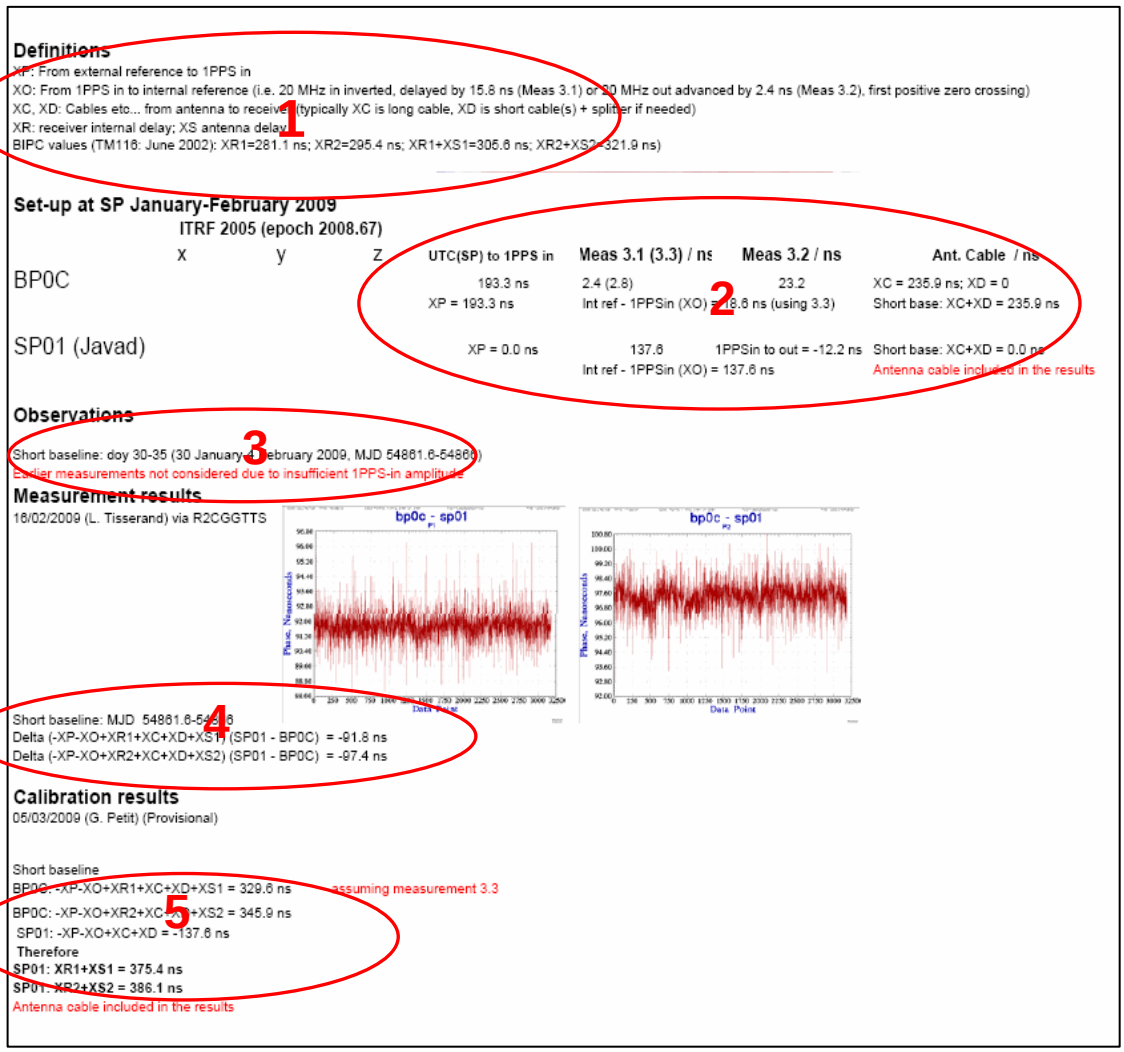
Calibration results are provided with a computation sheet (example below) that contains a summary of the different steps of the computation procedure. This document gives some information on the computation sheet.



The sheet is divided into 5 parts which contain numerical information, as detailed below.

Part 1: Definitions

We use conventional notations for the different hardware delays that intervene in the set-up. They are briefly commented in the highlighted area and described in more detail below (see also Petit G. et al., “Progresses in the calibration of geodetic like GPS receivers for accurate time comparisons”, Proc. 15th EFTF, 164, 2001). We also indicate here the relation to the calibration information in the CGGTTS format.

- XR and XS which form the “INT DLY” part of the CGGTTS format

XR represents the receiver hardware delay, between a reference point which definition depends on the receiver and the internal time reference of the measurements. XS represents the antenna delay, between the phase center and the cable connexion. It had initially been envisioned that XR and XS could be calibrated independently but we presently always consider only the sum XR+XS for a given system. For a geodetic-type receiver, XR1+XS1 corresponds to P1 measurements and XR2+XS2 to P2 measurements.

- XC and XD which form the “CAB DLY” part of the CGGTTS format

XC corresponds to the delay of the long cable from the antenna to the laboratory. If a splitter is installed, XD corresponds to the delay of the splitter and small cable. For a simple set-up with just an antenna cable, XD = 0.

- XP and XO which form the "REF DLY" part of the CGGTTS format

XP corresponds to the delay of the 1PPS-in of the receiver *vs* the laboratory reference.
XO corresponds to the delay of the receiver reference *vs* the 1PPS-in. The definition of the receiver reference depends on the receiver type:

- For Ashtech Z12-T: The first positive zero crossing of the inverted 20MHz-in following the 1PPS-in, delayed by 15.8 ns.
- For Septentrio PolaRx: The 1PPS-out, delayed by 8.7 ns.
- For Dicom GTR50: The 1PPS-in, i.e. XO = 0.
- For Javad/Topcon: The first positive zero crossing of the 5/10MHz-in following the 1PPS-in.

Procedures to measure these values are described in the Calibration guidelines available here.

The conventional values of XRi+XSi (I = 1 or 2) for the reference receiver are also indicated in this part.

Part 2: Experimental set-up

In this part, one finds the results of the measurements that allow computing XP and XO, as well as the values of XP, XO, XC and XD (from left to right in the highlighted area). Values appear first for the reference receiver, then for all the receivers under calibration. All values are obtained from the laboratory report.
If several set-ups have been used, they will be distinguished by some identification (e.g. set-up 1, 2, etc…) that will be also found in the following parts. The identification "short base" or "short baseline" is often used to identify the standard set-up where the two systems are operated in parallel.

Part 3: Observations

This part contains a simple list of the different periods of observations. In general, only one period is present, except when different set-ups have been used.

Part 4: Measurements results

In this part, the results of the comparison of the Rinex files are presented.
The computation is usually carried out by the BIPM using the R2CGGTTS program to transform Rinex files to CGGTTS, then an ad-hoc program to obtain the average values X1/X2 of the differences of REFGPS(P1) / REFGPS(P2) from the two CGGTTS files. A plot of the P1 / P2 differences is also provided.

Part 5: Calibration results

We have the following relation between the measurements Xi (i=1/2) (from Part 3) and the different delays XP/O/C/D/R/Si (from Part 2) for the receiver under calibration (cal_rec) and the reference receiver (ref_rec):

Xi = (XRi+XSi+XCi+XDi-XPi-XOi)(cal_rec) - (XRi+XSi+XCi+XDi-XPi-XOi)(ref_rec)

so that **(XRi+XSi)(cal_rec)** may be computed as

(XRi+XSi)(cal_rec) = Xi + (XRi+XSi+XCi+XDi-XPi-XOi)(ref_rec) - (XCi+XDi-XPi-XOi)(cal_rec) (1)

In the first lines of the highlighted area, values of XPi, XOi, XCi, XDi from Part 2 and (XRi+XSi) for the reference receiver from Part 1 are summed to obtained the intermediate results to be used in equation (1).
In the last lines of the highlighted area the final results for **(XRi+XSi)(cal_rec)**, from equation (1), are presented.