2020 Group 1 GNSS calibration trip

Summary

The 2020 visit to Group 1 laboratories is the fourth Group 1 trip and started in June 2020.
The trip is decomposed into several phases, each enclosed with closure at the BIPM. Some phases may be run in parallel.

- Phase 1 (June-December 2020). BIPM-NICT-TL-BIPM with the traveling receivers BP1J and BP25;
- Phase 1b (June-December 2020). BIPM-NIM-BIPM with the traveling receivers TS03 and TS04;
- Phase 2 (to be continued)

Due to the COVID situation, restrictions in shipping made it imposible to carry out Phase 1 with the three APMP laboratorios in the same trip. Taking advantage of the presence of two NIM receivers at the BIPM, a specific trip was organized, described under Phase 1b.
Since phase 3 of the 2018 Group 1 trip, results are provided for the GPS codes P1, P2 and C1 and the Galileo E1 and E5a codes.
This report provides intermediate results which are determined with respect to one BIPM receiver.
Final results for all Group 1 receivers are determined in a separate document BIPM Technical Memorandum 266.

Trip 1001-2020: Report of phase 1

1. Description of equipment and operations

1.1 Traveling equipment

- Traveling systems:

Two systems are included in the BIPM traveling calibrator: BP1J and BP25, see Table 1 and the report of operations 1001-2020-phase1-cv.pdf.

- Other traveling equipment:

See Annex 1 of the Guidelines.

1.2 Visited equipment

See a summary in Table 1. The detailed information on the set-up and the measurements performed is in the report of operations 1001-2020-phase1-cv.pdf.
The receiver BP21 from the BIPM serves as a reference for the closure, with the receiver BP1K included as a backup system.

Table 1. Summary information on phase 1 of the calibration trip 1001-2020

Institute	Status of equipment	Dates of measurement	BIPM code	RINEX name	Receiver type
BIPM	Traveling		BP1J	BP1J	Septentrio PolaRx4TR
BIPM	Traveling		BP25	BP25	Mesit GTR55
BIPM	BIPM reference	59024-59029	BP21	BP21	Septentrio PolaRx5TR (AC On) (2)
BIPM	BIPM backup	59024-59029	BP1K	BP1K	PikTime TTS4
NICT	G1 backup	59079-59102	NC5S	NC5S	Septentrio PolaRx5TR (AC Off) (2)
NICT	G1 backup	59079-59102	NC5G	NC5G	Dicom GTR50
NICT	G1 reference	59079-59102	NC4S	NC4S	Septentrio PolaRx4 TR
TL	G1 backup	59153-59165	TLT0	TWTF	Septentrio PolaRx4TR
TL	G1 reference	59153-59165	TLT1	TLT1	Ashtech Z12T (1)
TL	G1 backup	59153-59165	TLT3	TLT3	Dicom GTR50
TL	G1 backup	59153-59165	TLT5	TLT5	Septentrio PolaRx5TR (AC On) (2)
BIPM	BIPM reference	59192-59198	BP21	BP21	Septentrio PolaRx5TR
BIPM	BIPM backup	59192-59198	BP1K	BP1K	PikTime TTS4

(1) TLT1 is a modified Z12T which internal reference is the 1PPS-in, see 1001-2020-phase1-cv.pdf
(2) Because it is estimated that the Auto-compensation mode of the Septentrio PolaRx5 impacts its INTDLY value at the level of 0.5 ns, the mode is indicated in Table 1.

2. Data used

Rinex files have been obtained from all receivers participating to this trip.

3. Results of raw data processing

- The raw code differences have been generated by the DCLRINEX procedure (see Guidelines Annex 3). Each run for a pair of stations generates 3 files (summary .sum, data .dif, plot .pdf). Summary files and plots are available in 1001-2020-phase1-cv.pdf. All code measurements are indicated with 2 digits numeric precision in order to minimize rounding errors in computing iono-free linear combination values.

- For each pair (traveling – visited) or (traveling – reference):
  - Plots of the data differences and of the statistical analysis (Tdev) are in the report of operations 1001-2020-phase1-cv.pdf ;
  - For each code, the inferred RAWDIF(code) are taken as the median of the raw differences. The associated uncertainties are taken as the floor of the Tdev values, with a minimum of 0.1 ns.

- Summary tables.

For this report, the BIPM system BP21 is considered to be the reference. However another system (BP1K) is used as backup and is listed in Tables 2.1.

Table 2.1 Raw differential results for all pairs (Traveling – Reference) (ns) at the BIPM. Measurements for the local backup BP1K are also included.

Labo	Date	Pair	RDIF(P1)	Unc	RDIF(P2)	Unc	RDIF(C1)	Unc	RDIF(E1)	Unc	RDIF(E5a)	Unc
BIPM	59024-59029	BP1J-BP21	-34.29	0.1	-33.36	0.1	-35.12	0.1	-35.76	0.1	-26.10	0.1
BIPM	59192-59198	BP1J-BP21	-34.48	0.1	-33.45	0.1	-35.29	0.1	-35.93	0.1	-26.51	0.1
BIPM	59024-59029	BP25-BP21	11.86	0.1	17.55	0.1	10.40	0.1	10.08	0.1	16.15	0.1
BIPM	59192-59198	BP25-BP21	11.89	0.1	17.24	0.1	10.49	0.1	10.11	0.1	16.47	0.1
BIPM	59024-59029	BP1K-BP21	8.48	0.1	9.63	0.1	7.85	0.1	8.06	0.1	5.53	0.1
BIPM	59192-59198	BP1K-BP21	8.53	0.1	9.76	0.1	7.91	0.1	8.15	0.1	5.61	0.1

Table 2.2 Raw differential results for all pairs (Traveling – Visited) (ns)

Labo	Date	Pair	RDIF(P1)	Unc	RDIF(P2)	Unc	RDIF(C1)	Unc	RDIF(E1)	Unc	RDIF(E5a)	Unc
NICT	59079-59102	BP1J-NC5S	-243.09	0.1	-242.39	0.1	-244.02	0.1	-244.64	0.1	-234.47	0.1
NICT	59079-59102	BP25-NC5S	-190.97	0.1	-185.64	0.1	-192.34	0.1	-192.87	0.1	-186.29	0.1
NICT	59079-59102	BP1J-NC5G	-116.43	0.1	-116.41	0.1	-115.05	0.1				
NICT	59079-59102	BP25-NC5G	-64.27	0.1	-59.67	0.1	-63.37	0.1				
NICT	59079-59102	BP1J-NC4S	-78.13	0.1	-77.76	0.1	-78.08	0.1	-78.12	0.1	-77.41	0.1
NICT	59079-59102	BP25-NC4S	-25.99	0.1	-21.02	0.1	-26.40	0.1	-26.34	0.1	-29.25	0.1
TL	59153-59165	BP1J-TLT0	72.17	0.1	69.78	0.1	72.22	0.1	71.90	0.1	N/A (1)	
TL	59153-59165	BP25-TLT0	115.56	0.1	117.70	0.1	115.09	0.1	114.92	0.1	N/A (1)	
TL	59153-59165	BP1J-TLT1	-320.53	0.1	-329.48	0.1	-318.88	0.1				
TL	59153-59165	BP25-TLT1	-277.14	0.1	-281.59	0.1	-276.01	0.1				
TL	59153-59165	BP1J-TLT3	12.34	0.1	8.58	0.1	12.57	0.1				
TL	59153-59165	BP25-TLT3	55.72	0.1	56.44	0.1	55.44	0.1				
TL	59153-59165	BP1J-TLT5	-109.50	0.1	-108.54	0.1	-110.36	0.1	-110.96	0.1	-98.83	0.1
TL	59153-59165	BP25-TLT5	-66.13	0.1	-60.64	0.1	-67.46	0.1	-67.94	0.1	-59.61	0.1

(1) The antenna of TLT0 is not adapted to the reception of the L5 frequency.

4. Calibration results

In the first step, one computes **ΔSYSDLY,** the differences of SYSDLY for all pairs (Traveling-Reference) and (Traveling-Visited), from

$$\Delta SYSDLY_{A\text{-}B}(Code) = RAWDIF_{A\text{-}B}(Code) + REFDLY_A - REFDLY_B \quad (1)$$

where RAWDIF(Code) is read in Table 2 and where the values REFDLY are in the report of operations 1001-2020-phase1-cv.pdf.

The **ΔSYSDLY** values are reported in Table 3 for the pairs Traveling-Reference (section 4.1) and in Table 4 for the pairs Traveling-Visited (section 4.2).

In the second step one computes **ΔSYSDLY** (Visited-Reference) for all visited systems.

$$\Delta SYSDLY_{V\text{-}R} = \Delta SYSDLY_{T\text{-}R} - \Delta SYSDLY_{T\text{-}V.} \quad (2)$$

One can then compute **ΔINTDLY** (Visited-Reference) for all visited systems.

$$\Delta INTDLY_{V\text{-}R} = \Delta SYSDLY_{V\text{-}R} - CABDLY_V + CABDLY_R \quad (3)$$

where the values CABDLY are taken from the report of operations 1001-2020-phase1-cv.pdf;
Tables 5 reports the $\mathbf{\Delta INTDLY_{V\text{-}R}}$ results for the pairs Visited-Reference (section 4.3).
Using assumed $\mathbf{INTDLY_R}$ values for the Reference system, Table 6 then reports $\mathbf{INTDLY_V}$ for all visited systems (section 4.4).

4.1 Traveling system with respect to the reference system

REFDLY values are available from the report of operations 1001-2020-phase1-cv.pdf.

Table 3.1. Computed ΔSYSDLY values for the traveling systems with respect to BP1J used as a reference. The misclosures are also indicated. (all values in ns).

Pair	Date	$REFDLY_T$	$REFDLY_R$	Note	P1 (ns)		P2 (ns)		C1 (ns)		E1 (ns)		E5a (ns)	
					RAWDIF	ΔSYSDLY	RAWDIF	ΔSYSDLY	RAWDIF	ΔSYSDLY	RAWDIF	ΔSYSDLY	RAWDIF	ΔSYSDLY
BP1J-BP21	59024-59029	195.7	43.3		-34.29	118.15	-33.36	119.08	-35.12	117.32	-35.76	116.68	-26.10	126.34
BP1J-BP21	59192-59198	195.7	43.3		-34.48	117.95	-33.45	118.98	-35.29	117.14	-35.93	116.50	-26.51	125.92
		Misclos.				0.20		0.10		0.18		0.18		0.42
BP1J-BP21		Mean				118.05		119.03		117.23		116.59		126.13
BP25-BP21	59024-59029	53.5	43.3		11.86	22.12	17.55	27.81	10.40	20.66	10.08	20.34	16.15	26.41
BP25-BP21	59192-59198	53.4	43.3		11.89	22.03	17.24	27.38	10.49	20.63	10.11	20.25	16.47	26.61
		Misclos.				0.09		0.43		0.03		0.09		0.20
BP25-BP21		Mean				22.08		27.60		20.65		20.30		26.51

Results for the traveling systems are reported in Table 3.1.

Results for the local backup BP1K vs. BP21 are shown in Table 3.2. The misclosure for this pair is an indicator of the relative instabilities of the two stationary receivers.

Table 3.2. Computed ΔSYSDLY values for the local backup BP21 with respect to BP1J used as a reference. All values in ns

Pair	Date	$REFDLY_T$	$REFDLY_R$	Note	P1 (ns)		P2 (ns)		C1 (ns)		E1 (ns)		E5a (ns)	
					RAWDIF	ΔSYSDLY	RAWDIF	ΔSYSDLY	RAWDIF	ΔSYSDLY	RAWDIF	ΔSYSDLY	RAWDIF	ΔSYSDLY
BP1K-BP21	59024-59029	-32.2	43.3		8.48	-66.92	9.63	-65.77	7.85	-67.55	8.06	-67.34	5.53	-69.87
BP1K-BP21	59192-59198	-32.2	43.3		8.53	-66.88	9.76	-65.65	7.91	-67.50	8.15	-67.26	5.61	-69.80
		Misclos.				0.04		0.12		0.05		0.08		0.07
BP1K-BP21		Mean				-66.90		-65.71		-67.53		-67.30		-69.84

4.2 Traveling system with respect to the visited systems

REFDLY values are available from the report of operations 1001-2020-phase1-cv.pdf.

Table 4. Traveling vs. Visited systems (all values in ns)

Pair	Date	$REFDLY_T$	$REFDLY_V$	Note	P1 (ns)		P2 (ns)		C1 (ns)		E1 (ns)		E5a (ns)	
					RAWDIF	ΔSYSDLY	RAWDIF	ΔSYSDLY	RAWDIF	ΔSYSDLY	RAWDIF	ΔSYSDLY	RAWDIF	ΔSYSDLY
BP1J-NC5S	59079-59102	403.7	266.8		-243.09	-106.17	-242.39	-105.47	-244.02	-107.10	-244.64	-107.72	-234.47	-97.55
BP25-NC5S	59079-59102	255.6	266.8		-190.97	-202.16	-185.64	-196.83	-192.34	-203.53	-192.87	-204.06	-186.29	-197.48
BP1J-NC5G	59079-59102	403.7	171.3		-116.43	115.99	-116.41	116.01	-115.05	117.37				
BP25-NC5G	59079-59102	255.6	171.3		-64.27	20.04	-59.67	24.64	-63.37	20.94				
BP1J-NC4S	59079-59102	403.7	315.7		-78.13	9.89	-77.76	10.26	-78.08	9.94	-78.12	9.90	-77.41	10.61
BP25-NC4S	59079-59102	255.6	315.7		-25.99	-86.08	-21.02	-81.11	-26.40	-86.49	-26.34	-86.43	-29.25	-89.34
BP1J-TLT0	59153-59165	192.7	157.9		72.17	106.95	69.78	104.56	72.22	107.00	71.90	106.68	N/A	N/A
BP25-TLT0	59153-59165	53.5	157.9		115.56	11.15	117.70	13.29	115.09	10.68	114.92	10.51	N/A	N/A
BP1J-TLT1	59153-59165	192.7	0.0	(1)	-320.53	-127.83	-329.48	-136.78	-318.88	-126.18				
BP25-TLT1	59153-59165	53.5	0.0	(1)	-277.14	-223.63	-281.59	-228.08	-276.01	-222.50				
BP1J-TLT3	59153-59165	192.7	25.6		12.34	179.40	8.58	175.64	12.57	179.63				
BP25-TLT3	59153-59165	53.5	25.6		55.72	83.59	56.44	84.31	55.44	83.31				
BP1J-TLT5	59153-59165	192.7	0.0	(1)	-109.50	83.20	-108.54	84.16	-110.36	82.34	-110.96	81.74	-98.83	93.87
BP25-TLT5	59153-59165	53.5	0.0	(1)	-66.13	-12.62	-60.64	-7.13	-67.46	-13.95	-67.94	-14.43	-59.61	-6.10

(1) **$REFDLY_V$** value not available.

4.3 Visited systems with respect to reference system

The Table 5 provides the values obtained by differencing Table 3.1 (BP21 reference) and Table 4. CABDLY values are taken from the report of operations 1001-2020-phase1-cv.pdf and have not been measured during this calibration.

Table 5. Visited vs. BP21 Reference (all values in ns)

Pair	Date	$CABDLY_V$	$CABDLY_R$	Note	P1 (ns)		P2 (ns)		C1 (ns)		E1 (ns)		E5a (ns)	
					ΔSYSDLY	ΔINTDLY	ΔSYSDLY	ΔINTDLY	ΔINTDLY	ΔINTDLY	ΔINTDLY	ΔINTDLY	ΔSYSDLY	ΔINTDLY
NC5S-BP21 via BP1J	2020.7	0.0	140.8	(1)	224.22	365.02	224.50	365.30	224.33	365.13	224.31	365.11	223.68	364.48
NC5S-BP21 via BP25	2020.7	0.0	140.8	(1)	224.24	365.04	224.43	365.23	224.18	364.98	320.65	461.45	323.61	464.41
NC5G-BP21 via BP1J	2020.7	268.7	140.8		2.06	-125.84	3.02	-124.88	-0.14	-128.04				
NC5G-BP21 via BP25	2020.7	268.7	140.8		2.03	-125.87	2.96	-124.95	-0.29	-128.20				
NC4S-BP21 via BP1J	2020.7	0.0	140.8	(1)	108.16	248.96	108.77	249.57	107.29	248.09	106.69	247.49	115.52	256.32
NC4S-BP21 via BP25	2020.7	0.0	140.8	(1)	108.16	248.96	108.71	249.51	107.14	247.94	203.02	343.82	215.47	356.27
TLT0-BP21 via BP1J	2020.9	119.8	140.8		11.10	32.10	14.47	35.47	10.23	31.23	9.91	30.91	N/A	N/A
TLT0-BP21 via BP25	2020.9	119.8	140.8		10.93	31.93	14.31	35.31	9.96	30.97	106.08	127.08	N/A	N/A
TLT1-BP21 via BP1J	2020.9	0.0	140.8	(1)	245.88	386.68	255.81	396.61	243.41	384.21				
TLT1-BP21 via BP25	2020.9	0.0	140.8	(1)	245.71	386.51	255.68	396.48	243.15	383.95				
TLT3-BP21 via BP1J	2020.9	143.6	140.8		-61.35	-64.15	-56.61	-59.41	-62.40	-65.20				
TLT3-BP21 via BP25	2020.9	143.6	140.8		-61.52	-64.32	-56.72	-59.52	-62.67	-65.47				
TLT5-BP21 via BP1J	2020.9	0.0	140.8	(1)	34.85	175.65	34.87	175.67	34.89	175.69	34.85	175.65	32.26	173.06
TLT5-BP21 via BP25	2020.9	0.0	140.8	(1)	34.70	175.50	34.73	175.53	34.60	175.40	34.73	175.53	32.61	173.41

(1) **$CABDLY_V$** value not available.

4.4 Provisional INTDLY values of visited systems

Table 6 lists INTDLY values of the visited systems.
These values are provisional and based on INTDLY values for BP21 (P1=28.4 ns; P2=27.3 ns; C1=30.6 ns, E1=30.7 ns, E5a=30.9 ns) from 1001-2018, as described in BIPM Technical Memorandum 266. Final INTDLY values will be based on minimizing changes between 1001-2018 and 1001-2020, as described in BIPM Technical Memorandum 266, and will be reported in the global report of the trip 1001-2020 available here. Since two results can be computed from Table 5, using either BP1J or BP25 as traveling system, the values in Table 6 are the average of the two results, and the difference between the two is indicated. We note that the difference Δ(BP1J-BP25) is typically of order 0.2 ns. It is taken into account in component $u_{b,1}$ of the uncertainty budget in Tables 7 and 8.

Table 6. Provisional INTDLY values of Visited systems using 1001-2018 reference values for the reference systems BP21 (all values in ns).

Pair	Date	Note	P1	P2	C1	E1	E5
			$INTDLY_V$	$INTDLY_V$	$INTDLY_V$	$INTDLY_V$	$INTDLY_V$
NC5S vs BP21	2020.7	(1)	393.43	392.56	395.65	395.83	395.54
Δ(BP1J-BP25)			-0.01	0.07	0.15	-0.04	-0.31
NC5G vs BP21	2020.7	(2)	1.05	0.89	0.98		
Δ(BP1J-BP25)			0.03	0.06	0.16		
NC4S vs BP21	2020.7	(1)	277.36	276.84	278.61	278.21	287.39
Δ(BP1J-BP25)			0.00	0.06	0.15	-0.03	-0.33
TLT0 vs. BP21	2020.9		60.41	62.69	61.70	61.55	N/A
Δ(BP1J-BP25)			0.17	0.16	0.27	0.12	N/A
TLT1 vs. BP21	2020.9	(3)	414.99	423.84	414.68		
Δ(BP1J-BP25)			0.18	0.13	0.26		
TLT3 vs. BP21	2020.9		-35.83	-32.16	-34.73		
Δ(BP1J-BP25)			0.17	0.11	0.26		
TLT5 vs. BP21	2020.9	(3)	203.97	202.90	206.14	206.29	204.14
Δ(BP1J-BP25)			0.16	0.14	0.30	0.13	-0.35

(1) Results are System Delay values (SYSDLY)
(2) NC5G is a GTR50: Results are changes with respect to values entered in the receiver (-30.9 ns P1, -19.0 ns P2, -38.5 ns C1).
(3) Results are Total Delay values (TOTDLY)

5 Uncertainty estimation

In this section, we determine the uncertainty of the differential calibration process i.e. we estimate all components that can affect the accuracy. We determine a value U_{CAL0} that is to be used as the accuracy of all P3/PPP links (Visited – Reference) at the epoch of calibration.

$$u_{CAL0} = \sqrt{u_a^2 + u_b^2}$$

with the statistical uncertainty u_a and the systematic uncertainty u_b. (all are 1-sigma).
The statistical uncertainty u_a originates from RAWDIF (see section 3) and is given by the statistical analysis of the raw code differences for (Traveling-Reference) and (Traveling-Visited).

The systematic uncertainty is given by $u_B = \sqrt{\sum_n u_{b,n}^2}$

where all possible terms to be considered in the sum are listed in Table 7 for GPS and Table 8 for Galileo and some detail on their estimation is provided at the end of this section. Values appear separately for each code and for the difference of the two codes (e.g. P1, P2 and P1-P2 for GPS) so as to compute a value u_{CAL} applicable to P3 links.
We choose to compute U_{CAL} using for u_b the uncertainty u_{bSYS} of $\Delta SYSDLY_{V-R}$ from equation (2)[1]
Table 7 presents all components of the uncertainty budget along with the uncertainty u_{bSYS} of $\Delta SYSDLY_{V-R}$ from equation (2) and the resulting uncertainty value U_{CAL}.

The value u_{CAL} =1.3 ns from Tables 7 and 8 is applicable to dual-frequency code or PPP links. The value u_{CAL} =1.1 ns is applicable to C1/E1 links. Final values of u_{CAL} are consistent with the conventional value of 1.5 ns for dual-frequency links between G1 laboratories, as used in UTC computation.

Table 7. Uncertainty contributions. For all components of u_b, the P3 values are computed as P1 + 1.545x(P1-P2)

Unc.	Value C1/P1 (ns)	Value P2 (ns)	Value P1-P2 (ns)	Value P3 (ns)	Description
u_a (T-V)	0.1	0.1			RAWDIF (traveling-visited)
u_a (T-R)	0.1	0.1			RAWDIF (traveling-reference)
u_a	0.15	0.15		0.4	See text below
"Misclosure"					
$u_{b,1}$	0.3	0.3	0.3		observed mis-closure
Systematic components related to RAWDIF					
$u_{b,11}$	0.1	0.1	0.1		Position error at reference
$u_{b,12}$	0.1	0.1	0.1		Position error at visited
$u_{b,13}$	0.2	0.2	0.3		Multipaths at reference
$u_{b,14}$	0.2	0.2	0.3		Multipaths at visited
Link of the Traveling system to the local UTC(k)					
$u_{b,21}$	0.5	0.5	0		$REFDLY_T$ (at ref lab)
$u_{b,22}$	0.5	0.5	0		$REFDLY_T$ (at visited lab)
$u_{b,TOT}$	0.8	0.8	0.5	1.0	
Link of the Reference system to its local UTC(k)					
$u_{b,31}$	0.5	0.5	0		$REFDLY_R$ (at ref lab)
Link of the Visited system to its local UTC(k)					
$u_{b,32}$	0.5	0.5	0		$REFDLY_V$ (at visited lab)
$u_{b,SYS}$	1.1	1.1	0.5	1.2	Components of equation (2)
u_{CAL}	1.1			1.3	Composed of u_a and $u_{b,SYS}$

[1] It is somewhat arbitrary to choose SYSDLY to estimate the link accuracy. This reflects the fact that the REFDLY is subject to change e.g. with change of reference clock and that its uncertainty should better be taken into account.

Table 8. Galileo uncertainty contributions. For all components of u_b, the E3 values are computed as E1 + 1.261x(E1-E5)

Unc.	Value E1 (ns)	Value E5 (ns)	Value E1-E5 (ns)	Value E3 (ns)	Description
u_a (T-V)	0.1	0.1			RAWDIF (traveling-visited)
u_a (T-R)	0.1	0.1			RAWDIF (traveling-reference)
u_a	0.15	0.15		0.4	See text below
"Misclosure"					
$u_{b,1}$	0.3	0.3	0.3		observed mis-closure
Systematic components related to RAWDIF					
$u_{b,11}$	0.1	0.1	0.1		Position error at reference
$u_{b,12}$	0.1	0.1	0.1		Position error at visited
$u_{b,13}$	0.2	0.2	0.3		Multipaths at reference
$u_{b,14}$	0.2	0.2	0.3		Multipaths at visited
Link of the Traveling system to the local UTC(k)					
$u_{b,21}$	0.5	0.5	0		$REFDLY_T$ (at ref lab)
$u_{b,22}$	0.5	0.5	0		$REFDLY_T$ (at visited lab)
$u_{b,TOT}$	0.8	0.8	0.5	1.0	
Link of the Reference system to its local UTC(k)					
$u_{b,31}$	0.5	0.5	0		$REFDLY_R$ (at ref lab)
Link of the Visited system to its local UTC(k)					
$u_{b,32}$	0.5	0.5	0		$REFDLY_V$ (at visited lab)
$u_{b,SYS}$	1.1	1.1	0.5	1.2	Components of equation (2)
u_{CAL}	1.1			1.3	Composed of u_a and $u_{b,SYS}$

The components in Tables 7 and 8 are separated in several categories:

- The u_a value for P3 is conservatively estimated from the linear combination of P1 and P2 values. Lower values would be obtained from a statistical analysis of P3 RAWDIF.
- $u_{b,1}$ accounts for possible variations of the delays of the traveling systems during the trip. This is evaluated on the one hand by the observed misclosure (~ 0.2 ns average for each code, see Table 3.1), on the other hand by the observed discrepancies between the results of the two traveling receivers (~0.2 ns for each code, see Table 6).
- $u_{b,11}$ and $u_{b,12}$ account for errors in the differential position (Travel – Local). They are conservatively estimated to be 3 cm (100 ps) to account for possible sub-nominal behavior of the baseline determination occasionally observed in the DCLRINEX software. The L5 baseline used for Galileo processing is determined from L5 data.
- $u_{b,13}$ and $u_{b,14}$ account for multipaths. This is difficult to estimate and 0.2 ns is conventionally used, following a discussion in the CCTF working group on GNSS in 2017.
- $u_{b,21}$ and $u_{b,22}$ account for the measurement between the reference point of the traveling system and the local UTC(k). They include at least one measurement with a TIC and are taken to be 0.5 ns. Note that lower uncertainties may be reported by the participating laboratories, about 0.1 ns at TL.
- $u_{b,31}$ and $u_{b,32}$ account similarly for the measurement between the reference point of the local system and the local UTC(k). They include at least one measurement with a TIC and are taken to be 0.5 ns. Note that lower uncertainties may be reported by the participating laboratories, e.g. of order 0.1 ns at TL for TLT0 and TLT5.

Version history

V1.0 2021/01/29: Draft report of phase 1.