Internal delay calibration at NMIJ

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1 Introduction

NMIJ/AIST and NICT performed their first G2 calibration campaign with the NICT traveling receiver at NMIJ. The period of the calibration at NMIJ was from March 24, 2022 to June 8, 2022. Table 1 shows the receivers and antennas used for this calibration.

Table 1: List of receivers and antennas.

System	*Receiver*	*Antenna*	*Remark*
NC4S	Septentrio PolaRx4 TR Pro	AeroAntenna AT1675-120SW	Master
NC5S	Septentrio PolaRx5 TR	NovAtel GPS-703-GGG-MV	Backup
NC5C	Septentrio PolaRx5 TR	NovAtel GPS-703-GGG	Traveling
NM0D	Ashtexh Z12T	Ashtech ASH701945C	
NM0E	Septentrio PolaRx5 TR	Septentrio PolaNt-MF	

We performed a common clock measurement based on "BIPM guidelines for GNSS calibration" [1] and calculated the common clock differences (CCDs) from RINEX files. "concerto v4" (c4) was used as the analysis software [2], and "RTKLIB" software [3] was used to determinted the anntena positions of the traveling receiver.

The internal delays of the NICT reference receivers were calibrated by BIPM [4] as shown in Table 2.

Table 2: Internal delays of the reference receivers (all values in ns).

Sys.	*Date*	*REF*	*CAB*	*C1*	*P1*	*P2*	*E1*	*E5a*	U_{ref}
NC4S	2021.11	314.1	-	278.6	277.4	276.8	278.2	287.4	1.5
NC5S	2021.11	265.4	-	395.7	393.4	392.6	395.8	395.5	1.5

The internal delays of the NMIJ receivers with respect to the NICT reference receivers were calculated from the values in Tables 2, 10, and 11, as well as Table 3 shows the results of these

calculations. We estimated the uncertainty of this calibration using equation (1).

Table 3: Internal delays of the NMIJ receiver (all values in ns).

Sys.	*Ref.*	*REF*	*CAB*	*C1*	*P1*	*P2*	*E1*	*E5a*	U_{CAL}
NM0D	Ave.	50.6	234.1	**261.5**	**260.9**	**276.5**	-	-	2.3
	NC4S			261.33	260.73	276.42			
	NC5S			261.71	260.97	276.58			
NM0E	Ave.	23.8	281.1	**31.3**	**29.0**	**27.9**	**31.3**	**30.8**	2.3
	NC4S			31.14	28.87	27.86	31.19	30.97	
	NC5S			31.52	29.11	28.02	31.48	30.62	

$$U_{CAL} = \sqrt{U_{ref}^2 + U_{cal}^2} \tag{1}$$

Where U_{ref} is the uncertainty of the reference receiver, given in Table 2, and U_{cal} is the total uncertainty of this calibration, given in Table 12 and 13.

2 Results of raw data processing

Table 4 and 5 show the average CCDs between the traveling receiver and each reference or target receiver, and Figures 1 to 11 show raw plots and the time deviation of each CCD. We used single difference observations of each code (GPS C1, P1, P2, and Galileo E1, E5a) between receivers, and solved the receiver clock offsets of every observation epoch. The raw plots show the estimated CCDs as receiver clock offsets.

Table 4: Summary of the raw calibration results of GPS signals (all values in ns).

Pair	*Date*	*CCD (C1)*	U_a	*CCD (P1)*	U_a	*CCD (P2)*	U_a
NC5C - NC4S	59662 - 59675	-86.210	0.2	-87.215	0.2	-89.337	0.2
NC5C - NC5S	59662 - 59675	-251.647	0.1	-251.682	0.1	-253.767	0.2
NC5C - NM0D	59688 - 59716	-335.931	0.3	-337.529	0.3	-356.015	0.2
NC5C - NM0E	59688 - 59716	-179.546	0.2	-179.467	0.2	-181.254	0.2
NC5C - NC4S	59725 - 59738	-85.795	0.2	-86.774	0.2	-89.016	0.2
NC5C - NC5S	59725 - 59738	-251.495	0.1	-251.529	0.1	-253.601	0.2

Table 5: Summary of the raw calibration results of Galileo signals (all values in ns).

Pair	*Date*	*CCD (E1)*	U_a	*CCD (E5a)*	U_a
NC5C - NC4S	59662 - 59675	-85.715	0.2	-96.646	0.2
NC5C - NC5S	59662 - 59675	-251.773	0.1	-254.016	0.2
NC5C - NM0E	59688 - 59716	-179.507	0.2	-181.272	0.2
NC5C - NC4S	59725 - 59738	-83.315	0.2	-96.754	0.2
NC5C - NC5S	59725 - 59738	-251.579	0.1	-253.978	0.2

3 Calibration results

Table 6 and 7 show the ΔSYSDLY values for the traveling receiver with respect to the reference receivers. These values were calculated using equation (2).

$$\Delta\text{SYSDLY}_{A-B} = \text{CCD}_{A-B} + \text{REFDLY}_A - \text{REFDLY}_B \tag{2}$$

"No" in Table 6 and 7 indicates the measurement period at NICT, where No. 1 denotes

Table 6: Computed GPS ΔSYSDLY values for the traveling systems with respect to reference receivers. (all values in ns)

Pair	*No*	REF_T	REF_R	*C1 (ns)*		*P1 (ns)*		*P2 (ns)*	
				CCD	ΔSYS	*CCD*	ΔSYS	*CCD*	ΔSYS
NC5C - NC4S	1	311.7	315.6	-86.21	-90.11	-87.22	-91.12	-89.34	-93.24
NC5C - NC4S	2	311.6	315.5	-85.79	-89.69	-86.77	-90.67	-89.06	-92.96
		Misclosure			-0.42		-0.44		-0.28
		Mean			-89.90		-90.89		-93.10
NC5C - NC5S	1	311.7	266.7	-251.65	-206.65	-251.68	-206.68	-253.77	-208.77
NC5C - NC5S	2	311.6	266.7	-251.50	-206.60	-251.53	-206.63	-253.60	-208.70
		Misclosure			-0.05		-0.05		-0.07
		Mean			-206.62		-206.66		-208.73

preliminary measurements and No. 2 denotes closure measurements.

Table 8 and 9 show the ΔSYSDLY values for the NMIJ receivers with respect to the traveling receiver.

Table 10 and 11 show the ΔINTDLY values for the NMIJ receivers with respect to the reference receivers. ΔSYSDLY in Table 10 and 11 was obtained from equation (3) and ΔINTDLY was obtained from equation (4).

$$\Delta\text{SYSDLY}_{V-R} = \Delta\text{SYSDLY}_{T-R} - \Delta\text{SYSDLY}_{T-V} \tag{3}$$

$$\Delta\text{INTDLY}_{V-R} = \Delta\text{SYSDLY}_{V-R} - \text{CABDLY}_V + \text{CABDLY}_R + \Delta_T \tag{4}$$

Here Δ_T is the difference between the antenna cable delays of the traveling receiver at NICT (157.5 ns) and NMIJ (196.7 ns) because we used another antenna cable for the traveling receiver at NMIJ.

$$\Delta_T = \text{CABDLY}_T^{NMIJ} - \text{CABDLY}_T^{NICT} \tag{5}$$

Table 7: Computed Galileo ΔSYSDLY values for the traveling systems with respect to reference receivers. (all values in ns)

Pair	*No*	REF_T	REF_R	*E1 (ns)*		*E5a (ns)*	
				CCD	ΔSYS	*CCD*	ΔSYS
NC5C - NC4S	1	311.7	315.6	-85.71	-89.61	-96.65	-100.55
NC5C - NC4S	2	311.6	315.5	-85.31	-89.21	-96.75	-100.65
		Misclosure			-0.40		0.11
		Mean			-89.41		-100.60
NC5C - NC5S	1	311.7	266.7	-251.77	-206.77	-254.02	-209.02
NC5C - NC5S	2	311.6	266.7	-251.58	-206.68	-253.98	-209.08
		Misclosure			-0.09		0.06
		Mean			-206.73		-209.05

Table 8: Computed GPS ΔSYSDLY values for the visited systems with respect to the traveling system (all values in ns).

Pair	REF_T	REF_V	*C1 (ns)*		*P1 (ns)*		*P2 (ns)*	
			CCD	ΔSYS	*CCD*	ΔSYS	*CCD*	ΔSYS
NC5C - NM0D	119.0	50.6	-335.93	-267.53	-337.53	-269.13	-356.01	-287.61
NC5C - NM0E	119.0	23.8	-179.55	-84.35	-179.47	-84.27	-181.25	-86.05

Table 9: Computed Galileo ΔSYSDLY values for the visited systems with respect to the traveling system (all values in ns).

Pair	REF_T	REF_V	*E1 (ns)*		*E5a (ns)*	
			CCD	ΔSYS	*CCD*	ΔSYS
NC5C - NM0E	119.0	23.8	-179.51	-84.31	-181.27	-86.07

Table 10: Computed GPS ΔINTDLY values for the visited systems with respect to the reference receivers (all values in ns).

Pair	CAB_V	CAB_R	Δ_T	*C1 (ns)*		*P1 (ns)*		*P2 (ns)*	
				ΔSYS	ΔINT	ΔSYS	ΔINT	ΔSYS	ΔINT
NM0D - NC4S	234.1	0.0	39.2	177.63	-17.27	178.23	-16.67	194.52	-0.38
NM0E - NC4S	281.1	0.0	39.2	-5.56	-247.46	-6.63	-248.53	-7.04	-248.94
NM0D - NC5S	234.1	0.0	39.2	60.91	-133.99	62.47	-132.43	78.88	-116.02
NM0E - NC5S	281.1	0.0	39.2	-122.28	-364.18	-122.39	-364.29	-122.68	-364.58

Table 11: Computed Galileo ΔINTDLY values for the visited systems with respect to the reference receivers (all values in ns).

Pair	CAB_V	CAB_R	Δ_T	*E1 (ns)*		*E5a (ns)*	
				ΔSYS	ΔINT	ΔSYS	ΔINT
NM0E - NC4S	281.1	0.0	39.2	-5.11	-247.01	-14.53	-256.43
NM0E - NC5S	281.1	0.0	39.2	-122.42	-364.32	-122.98	-364.88

4 Uncertainty estimation

Table 12 and 13 show the uncertainty of the calibration. The method of estimating the uncertainty is the same as that in [5]. However, we append $u_{b,23}$ and $u_{b,24}$ as measurement errors of network analyzer for the antenna cable delay of the traveling receiver because we used different cables at the reference and visited laboratories.

Table 12: uncertainty GPS contributions.

Uncertainty	*Value C1/P1 (ns)*	*Value P2 (ns)*	*Value P1 - P2 (ns)*	*Value P3 (ns)*	*Description*
$u_a(T-R)$	0.20	0.20	0.28		CCD (traveling - reference)
$u_a(T-V)$	0.30	0.20	0.36		CCD (traveling - visited)
u_a	0.36	0.28	0.46	0.79	
Misclosure					
$u_{b,1}$	0.50	0.50	0.50		Observed misclosure
Systematic components related to CCD					
$u_{b,11}$	0.05	0.05	0.05		Position error at reference
$u_{b,12}$	0.05	0.05	0.05		Position error at visited
$u_{b,13}$	0.30	0.30	0.42		Multipath at reference
$u_{b,14}$	0.30	0.30	0.42		Multipath at visited
Link from the traveling system to the local UTC(k)					
$u_{b,21}$	0.50	0.50	0.00		REFDLY_T (at reference)
$u_{b,22}$	0.50	0.50	0.00		REFDLY_T (at visited)
$u_{b,23}$	0.50	0.50	0.00		CABDLY_T (at reference)
$u_{b,24}$	0.50	0.50	0.00		CABDLY_T (at visited)
$u_{b,TOT}$	1.09	1.09	0.60	1.43	
Link from the reference system to its local UTC(k)					
$u_{b,31}$	0.50	0.50	0.00		REFDLY_R
Link from the visited system to its local UTC(k)					
$u_{b,32}$	0.50	0.50	0.00		REFDLY_V
$u_{b,SYS}$	1.35	1.33	0.76	1.79	
u_{CAL}				1.79	

Revision history

Revision 0.1 Draft version.

Revision 1.0 Initial release. assigne cal-id.

Revision 1.1 Fix NM0E REFDLY due to the receiver setting.

Revision 1.2 Remove 1 PPS-in to internal reference of the NM0E receiver in Annex A.

Table 13: uncertainty Galileo contributions.

Uncertainty	*Value E1 (ns)*	*Value E5a (ns)*	*Value E1 - E5a (ns)*	*Value L3E (ns)*	*Description*
$u_a(T-R)$	0.20	0.20	0.28		CCD (traveling - reference)
$u_a(T-V)$	0.20	0.20	0.28		CCD (traveling - visited)
u_a	0.28	0.28	0.40	0.58	
Misclosure					
$u_{b,1}$	0.50	0.50	0.50		Observed misclosure
Systematic components related to CCD					
$u_{b,11}$	0.05	0.05	0.05		Position error at reference
$u_{b,12}$	0.05	0.05	0.05		Position error at visited
$u_{b,13}$	0.30	0.30	0.42		Multipath at reference
$u_{b,14}$	0.30	0.30	0.42		Multipath at visited
Link from the traveling system to the local UTC(k)					
$u_{b,21}$	0.50	0.50	0.00		REFDLY$_T$ (at reference)
$u_{b,22}$	0.50	0.50	0.00		REFDLY$_T$ (at visited)
$u_{b,23}$	0.50	0.50	0.00		CABDLY$_T$ (at reference)
$u_{b,24}$	0.50	0.50	0.00		CABDLY$_T$ (at visited)
$u_{b,TOT}$	1.09	1.09	0.60	1.33	
Link from the reference system to its local UTC(k)					
$u_{b,31}$	0.50	0.50	0.00		REFDLY$_R$
Link from the visited system to its local UTC(k)					
$u_{b,32}$	0.50	0.50	0.00		REFDLY$_V$
$u_{b,SYS}$	1.33	1.33	0.72	1.61	
u_{CAL}				1.61	

References

[1] BIPM guidelines for GNSS calibration V4.0 05/08/2021.

[2] T.Gotoh, et al, Proc. 21th EFTF and IFCS, pp.1188—1193, 2007.

[3] http://www.rtklib.com/, online

[4] 2020 Group 1 GNSS calibration trip (Cal_Id 1001-2020), v1.2, 2021

[5] "4.4 Uncertainty estimation", Annex 4 Template for the calibration report, BIPM Guidelines for GNSS equipment calibration.

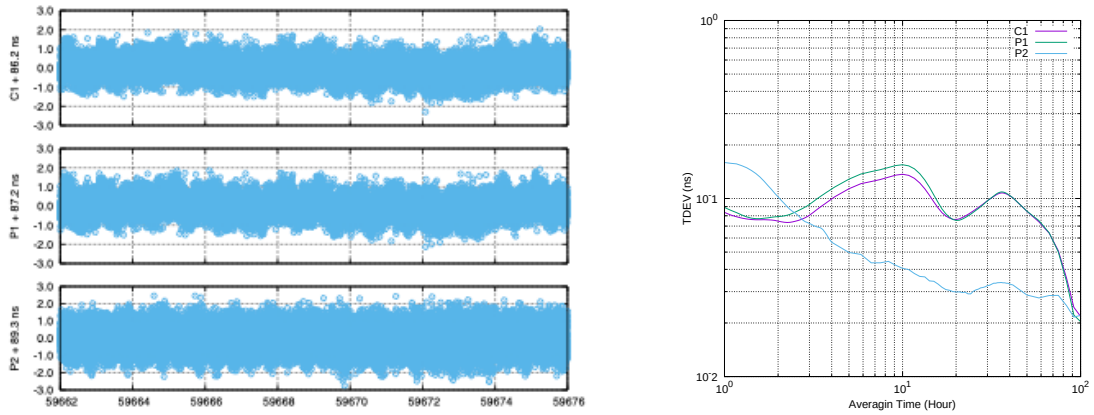


Figure 1: Common clock differences of GPS signals between NC5C and NC4S (preliminary).

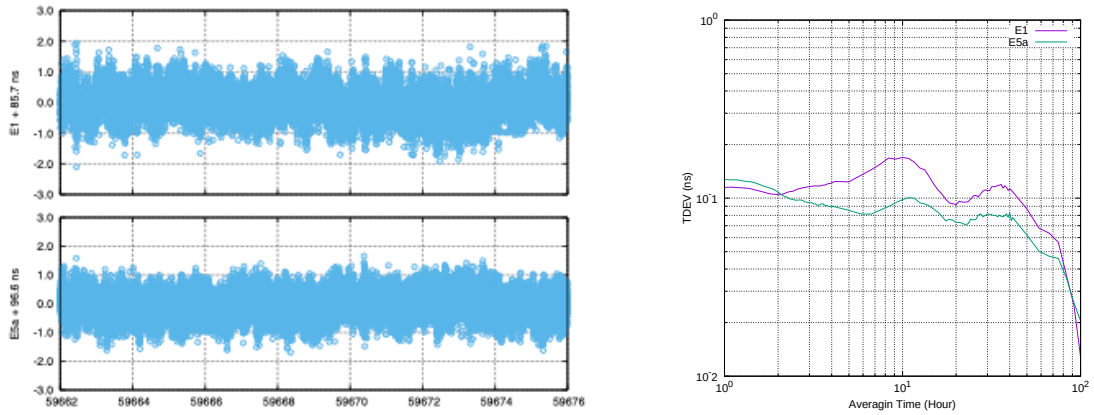


Figure 2: Common clock differences of Galileo signals between NC5C and NC4S (preliminary).

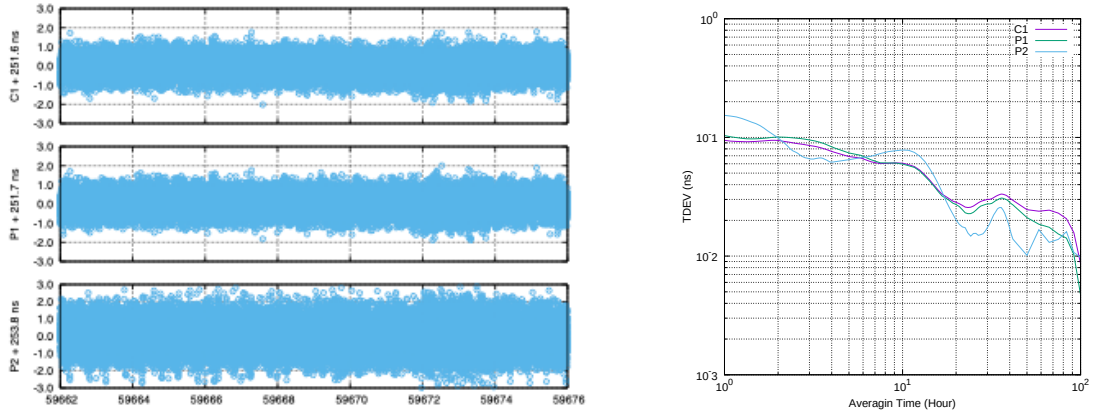


Figure 3: Common clock differences of GPS signals between NC5C and NC5S (preliminary).

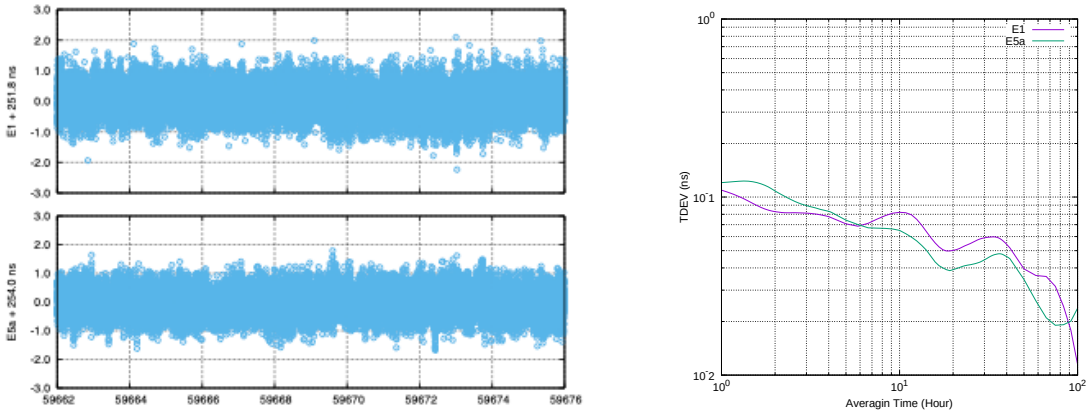


Figure 4: Common clock differences of Galileo signals between NC5C and NC5S (preliminary).

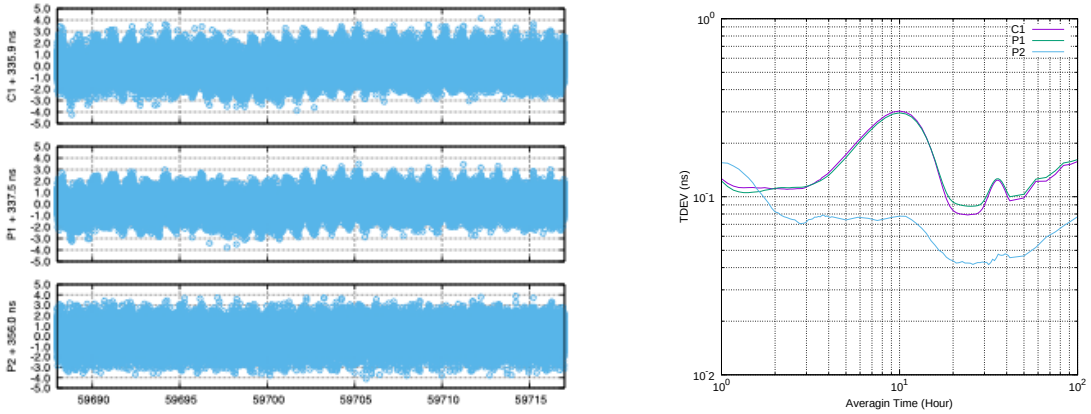


Figure 5: Common clock differences of GPS signals between NC5C and NM0D.

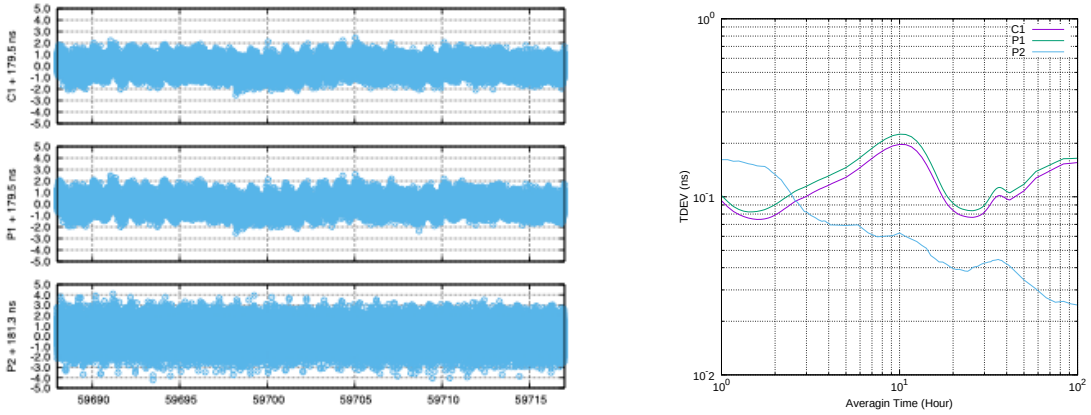


Figure 6: Common clock differences of GPS signals between NC5C and NM0E.

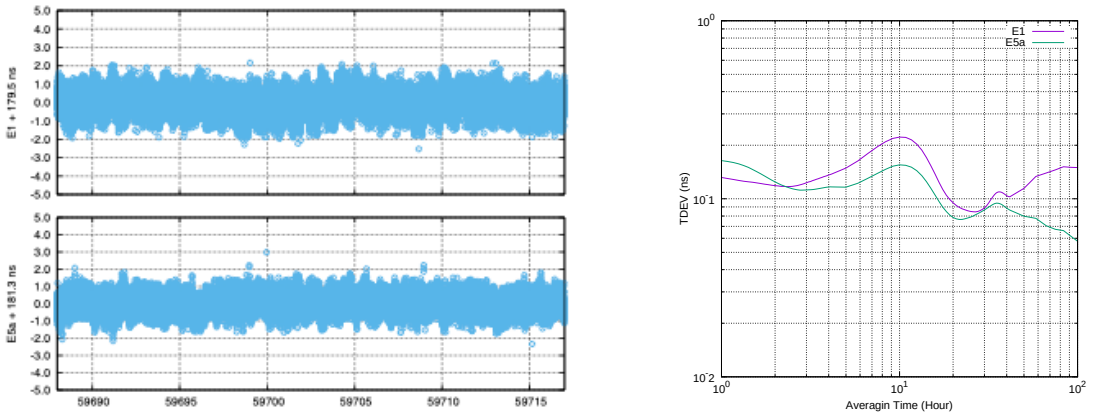


Figure 7: Common clock differences of Galileo signals between NC5C and NM0E.

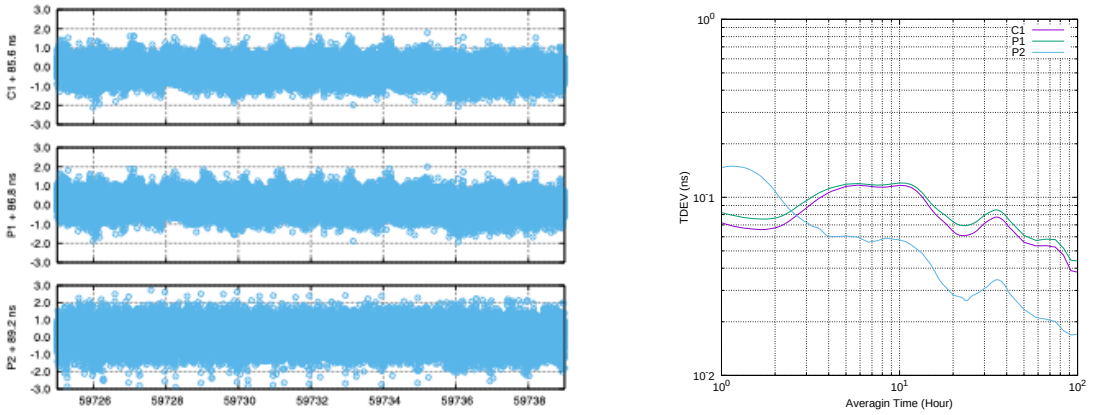


Figure 8: Common clock differences of GPS signals between NC5C and NC4S (closure).

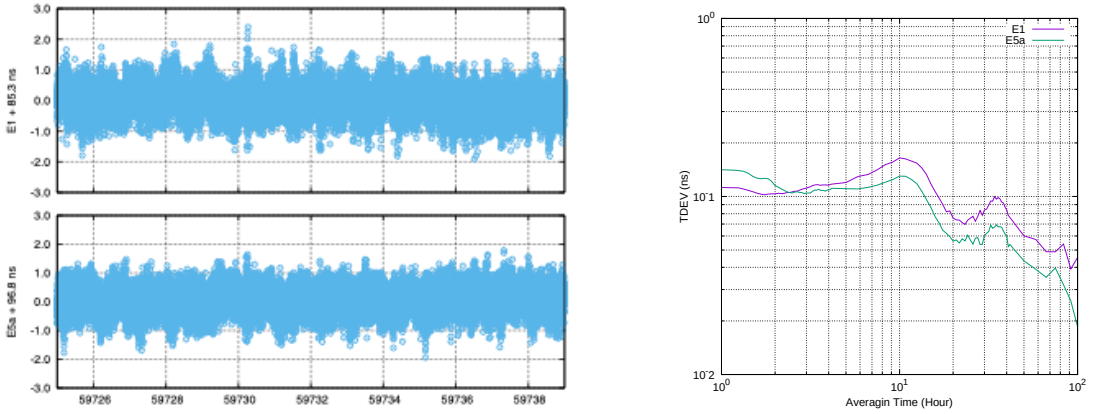


Figure 9: Common clock differences of Galileo signals between NC5C and NC4S (closure).

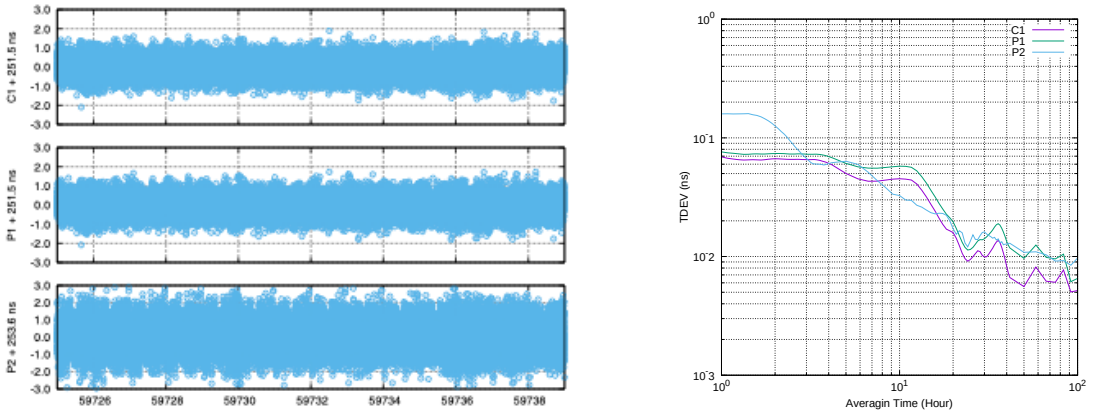


Figure 10: Common clock differences of GPS signals between NC5C and NC5S (closure).

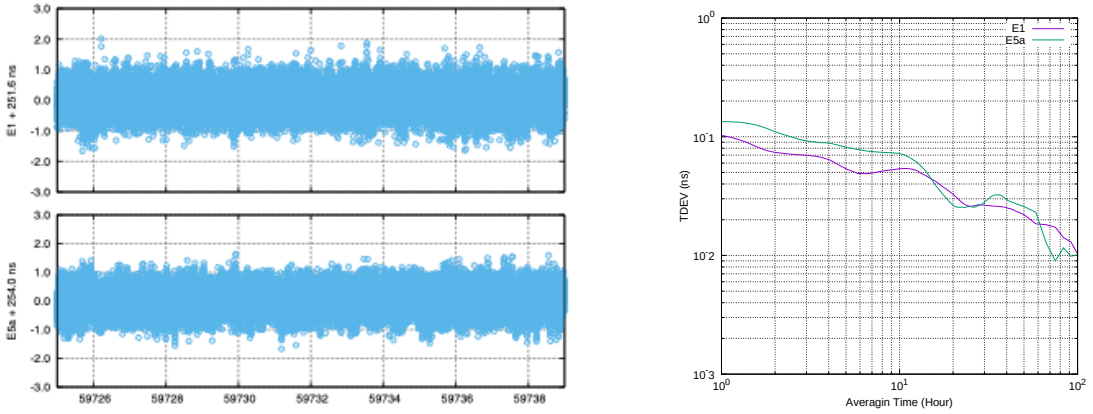


Figure 11: Common clock differences of Galileo signals between NC5C and NC5S (closure).

Annex A - Information Sheet

(to be repeated for each calibrated system)

Laboratory:	National Institute of Information and Communication Technology
Date and hour of the beginning of measurements:	**24/03/2022**
Date and hour of the end of measurements:	**06/04/2022**

Information on the system

	Local:	**Travelling:**
4-character BIPM code	NC4S	NC5C
• Receiver maker and type: Receiver serial number:	Septentrio PolaRx4 TR Pro S/N: 3102252	Septentrio PolaRx5 TR S/N: 4701466
1 PPS trigger level /V:		
• Antenna cable maker and type: Phase stabilised cable (Y/N):	FUJIKURA 8D-SFA-LITE Phase stabilized: No	FUJIKURA 5D-SFA-LITE Phase stabilized: No
Length outside the building /m:		
• Antenna maker and type: Antenna serial number:	AeroAntenna AT1675-120SW S/N: 5411	NovAtel GPS-703-GGG NEG14320005
Temperature (if stabilised) /°C		

Measured delays /ns

(if needed fill box "Additional Information" below)

	Local:	**Travelling:**
• Delay from local UTC to receiver 1 PPS-in:	167.5 ns	264.2 ns
Delay from 1 PPS-in to internal Reference (if different): (see section 2 for details)	148.1 ns (167.5 + 148.1 = 315.6 ns)	47.5 ns (264.2 + 47.5 = 311.7 ns)
• Antenna cable delay:		157.5 ns
Splitter delay (if any):		
Additional cable delay (if any):		

Data used for the generation of CGGTTS files

• INT DLY (GPS) /ns:	278.6 ns (C1), 277.4 ns (P1), 276.8 ns (P2)
• INT DLY (Galileo) /ns:	278.2 ns (E1), 278.4 ns (E5a)
• INT DLY (GLONASS) /ns:	
• CAB DLY /ns:	
• REF DLY /ns:	314.1 ns
• Coordinates reference frame:	
Latitude or X /m:	-3942091.42 m
Longitude or Y /m:	3368261.97 m
Height or Z /m:	3701993.35 m

General information

• Rise time of the local UTC pulse:	
• Is the laboratory air conditioned:	Yes
Set temperature value and uncertainty:	24 degree C
Set humidity value and uncertainty:	40 %

(1) For a trip with closure, not needed if the traveling equipment is used in the same set-up throughout.

Annex A - Information Sheet

(to be repeated for each calibrated system)

Laboratory:	National Institute of Information and Communication Technology
Date and hour of the beginning of measurements:	**24/03/2022**
Date and hour of the end of measurements:	**06/04/2022**

Information on the system

	Local:	**Travelling:**
4-character BIPM code	NC5S	NC5C
• Receiver maker and type: Receiver serial number:	Septentrio PolaRx5 TR S/N: 4701293	Septentrio PolaRx5 TR S/N: 4701466
1 PPS trigger level /V:		
• Antenna cable maker and type: Phase stabilised cable (Y/N):	FUJIKURA 8D-SFA-LITE Phase stabilized: No	FUJIKURA 5D-SFA-LITE Phase stabilized: No
Length outside the building /m:		
• Antenna maker and type: Antenna serial number:	NovAtel GPS-703-GGG-MV NMFV16270013R	NovAtel GPS-703-GGG NEG14320005
Temperature (if stabilised) /°C		

Measured delays /ns

(if needed fill box "Additional Information" below)

	Local:	**Travelling:**
• Delay from local UTC to receiver 1 PPS-in:	210.0 ns	264.2 ns
Delay from 1 PPS-in to internal Reference (if different): (see section 2 for details)	56.7 ns (210.0 + 56.7 = 266.7 ns)	47.5 ns (264.2 + 47.5 = 311.7 ns)
• Antenna cable delay:		157.5 ns
Splitter delay (if any):		
Additional cable delay (if any):		

Data used for the generation of CGGTTS files

• INT DLY (GPS) /ns:	395.7 ns (C1), 393.4 ns (P1), 392.6 ns (P2)
• INT DLY (Galileo) /ns:	395.8 ns (E1), 395.5 ns (E5a)
• INT DLY (GLONASS) /ns:	
• CAB DLY /ns:	
• REF DLY /ns:	265.4 ns
• Coordinates reference frame:	
Latitude or X /m:	-3942090.07 m
Longitude or Y /m:	3368263.35 m
Height or Z /m:	3701993.60 m

General information

• Rise time of the local UTC pulse:	
• Is the laboratory air conditioned:	Yes
Set temperature value and uncertainty:	24 degree C
Set humidity value and uncertainty:	40 %

(1) For a trip with closure, not needed if the traveling equipment is used in the same set-up throughout.

Annex A - Information Sheet

(to be repeated for each calibrated system)

Laboratory:	National Institute of Information and Communication Technology
Date and hour of the beginning of measurements:	**26/05/2022**
Date and hour of the end of measurements:	**08/06/2022**

Information on the system

	Local:	**Travelling:**
4-character BIPM code	NC4S	NC5C
• Receiver maker and type: Receiver serial number:	Septentrio PolaRx4 TR Pro S/N: 3102252	Septentrio PolaRx5 TR S/N: 4701466
1 PPS trigger level /V:		
• Antenna cable maker and type: Phase stabilised cable (Y/N):	FUJIKURA 8D-SFA-LITE Phase stabilized: No	FUJIKURA 5D-SFA-LITE Phase stabilized: No
Length outside the building /m:		
• Antenna maker and type: Antenna serial number:	AeroAntenna AT1675-120SW S/N: 5411	NovAtel GPS-703-GGG NEG14320005
Temperature (if stabilised) /°C		

Measured delays /ns

(if needed fill box "Additional Information" below)

	Local:	**Travelling:**
• Delay from local UTC to receiver 1 PPS-in:	167.5 ns	263.9 ns
Delay from 1 PPS-in to internal Reference (if different): (see section 2 for details)	148.0 ns (167.5 + 148.0 = 315.5 ns)	47.7 ns (263.9 + 47.7 = 311.6 ns)
• Antenna cable delay:		157.5 ns
Splitter delay (if any):		
Additional cable delay (if any):		

Data used for the generation of CGGTTS files

• INT DLY (GPS) /ns:	278.6 ns (C1), 277.4 ns (P1), 276.8 ns (P2)
• INT DLY (Galileo) /ns:	278.2 ns (E1), 278.4 ns (E5a)
• INT DLY (GLONASS) /ns:	
• CAB DLY /ns:	
• REF DLY /ns:	314.1 ns
• Coordinates reference frame:	
Latitude or X /m:	-3942091.42 m
Longitude or Y /m:	3368261.97 m
Height or Z /m:	3701993.35 m

General information

• Rise time of the local UTC pulse:	
• Is the laboratory air conditioned:	Yes
Set temperature value and uncertainty:	24 degree C
Set humidity value and uncertainty:	40 %

(1) For a trip with closure, not needed if the traveling equipment is used in the same set-up throughout.

Annex A - Information Sheet

(to be repeated for each calibrated system)

Laboratory:	National Institute of Information and Communication Technology
Date and hour of the beginning of measurements:	**26/05/2022**
Date and hour of the end of measurements:	**08/06/2022**

Information on the system

	Local:	**Travelling:**
4-character BIPM code	NC5S	NC5C
• Receiver maker and type: Receiver serial number:	Septentrio PolaRx5 TR S/N: 4701293	Septentrio PolaRx5 TR S/N: 4701466
1 PPS trigger level /V:		
• Antenna cable maker and type: Phase stabilised cable (Y/N):	FUJIKURA 8D-SFA-LITE Phase stabilized: No	FUJIKURA 5D-SFA-LITE Phase stabilized: No
Length outside the building /m:		
• Antenna maker and type: Antenna serial number:	NovAtel GPS-703-GGG-MV NMFV16270013R	NovAtel GPS-703-GGG NEG14320005
Temperature (if stabilised) /°C		

Measured delays /ns

(if needed fill box "Additional Information" below)

	Local:	**Travelling:**
• Delay from local UTC to receiver 1 PPS-in:	210.0 ns	263.9 ns
Delay from 1 PPS-in to internal Reference (if different): (see section 2 for details)	56.7 ns (210.0 + 56.7 = 266.7 ns)	47.7 ns (263.9 + 47.7 = 311.6 ns)
• Antenna cable delay:		157.5 ns
Splitter delay (if any):		
Additional cable delay (if any):		

Data used for the generation of CGGTTS files

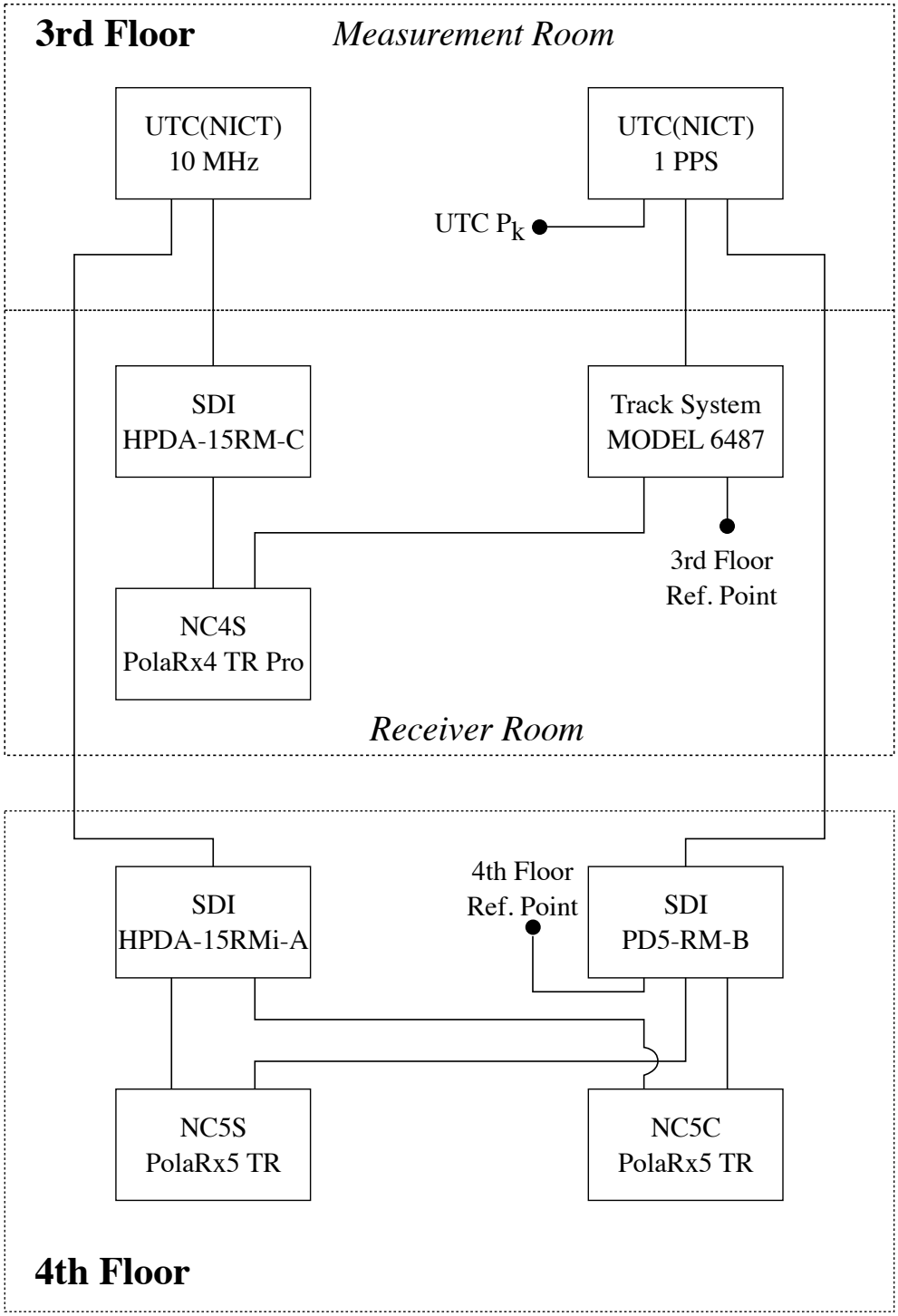
• INT DLY (GPS) /ns:	395.7 ns (C1), 393.4 ns (P1), 392.6 ns (P2)
• INT DLY (Galileo) /ns:	395.8 ns (E1), 395.5 ns (E5a)
• INT DLY (GLONASS) /ns:	
• CAB DLY /ns:	
• REF DLY /ns:	265.4 ns
• Coordinates reference frame:	
Latitude or X /m:	-3942090.07 m
Longitude or Y /m:	3368263.35 m
Height or Z /m:	3701993.60 m

General information

• Rise time of the local UTC pulse:	
• Is the laboratory air conditioned:	Yes
Set temperature value and uncertainty:	24 degree C
Set humidity value and uncertainty:	40 %

(1) For a trip with closure, not needed if the traveling equipment is used in the same set-up throughout.

Diagram of the experiment set-up:



Annex A - Information Sheet

(to be repeated for each calibrated system)

Laboratory:	National Metrology Institute of Japan
Date and hour of the beginning of measurements:	19/04/2022
Date and hour of the end of measurements:	17/05/2022

Information on the system

	Local:	**Travelling:**
4-character BIPM code	NM0D	NC5C
• Receiver maker and type: Receiver serial number:	Ashtech Z12T SN RT920030602	Septentrio PolaRx5 TR SN 4701466
1 PPS trigger level /V:		
• Antenna cable maker and type: Phase stabilised cable (Y/N):	 No	FUJIKURA 5D-SFA-LITE Phase stabilized: No
Length outside the building /m:	20 m	20 m
• Antenna maker and type: Antenna serial number:	Ashtech ASH701945C_M SCIS	NovAtel GPS-703-GGG NEG14320005
Temperature (if stabilised) /°C		

Measured delays /ns

(if needed fill box "Additional Information" below)

	Local:	**Travelling:**
• Delay from local UTC to receiver 1 PPS-in:	26.4 ns	59.2 ns
Delay from 1 PPS-in to internal Reference (if different): (see section 2 for details)	8.4 ns (26.4 + 8.4 + 15.8 = 50.6 ns)	59.8 ns (59.2 + 59.8 = 119.0 ns)
• Antenna cable delay:	234.1 ns	196.7 ns
Splitter delay (if any):		(1)
Additional cable delay (if any):		(1)

Data used for the generation of CGGTTS files

• INT DLY (GPS) /ns:	250.7 ns (GPS P1), 263.3 ns (GPS P2)
• INT DLY (Galileo) /ns:	-
• INT DLY (GLONASS) /ns:	-
• CAB DLY /ns:	234.1
• REF DLY /ns:	31.4
• Coordinates reference frame:	GRS80
Latitude or X /m:	36.0589844617 N (-3962293.74 m)
Longitude or Y /m:	140.134996611 E (3308881.72 m)
Height or Z /m:	79.088 m (3733527.60 m)

General information

• Rise time of the local UTC pulse:	-
• Is the laboratory air conditioned:	Yes
Set temperature value and uncertainty:	23 ± 1 ℃
Set humidity value and uncertainty:	55 ± 3 %

(1) For a trip with closure, not needed if the traveling equipment is used in the same set-up throughout.

Annex A - Information Sheet

(to be repeated for each calibrated system)

Laboratory:	National Metrology Institute of Japan
Date and hour of the beginning of measurements:	19/04/2022
Date and hour of the end of measurements:	17/05/2022

Information on the system

	Local:	**Travelling:**
4-character BIPM code	NM0E	NC5C
• Receiver maker and type: Receiver serial number:	Septentrio PolaRx5TR SN 4701201	Septentrio PolaRx5TR SN 4701466
1 PPS trigger level /V:		
• Antenna cable maker and type: Phase stabilised cable (Y/N):	 No	FUJIKURA 5D-SFA-LITE Phase stabilized: No
Length outside the building /m:	20 m	20 m
• Antenna maker and type: Antenna serial number:	Septentrio PolaNt-MF SN 11267	NovAtel GPS-703-GGG NEG14320005
Temperature (if stabilised) /°C		

Measured delays /ns

(if needed fill box "Additional Information" below)

	Local:	**Travelling:**
• Delay from local UTC to receiver 1 PPS-in:	23.8 ns	59.2 ns
Delay from 1 PPS-in to internal Reference (if different): (see section 2 for details)		59.8 ns (59.2 + 59.8 = 119.0 ns)
• Antenna cable delay:	281.1 ns	196.7 ns
Splitter delay (if any):		(1)
Additional cable delay (if any):		(1)

Data used for the generation of CGGTTS files

• INT DLY (GPS) /ns:	0.0 ns (GPS P1), 0.0 ns (GPS P2)
• INT DLY (Galileo) /ns:	-
• INT DLY (GLONASS) /ns:	-
• CAB DLY /ns:	281.1
• REF DLY /ns:	-16.1
• Coordinates reference frame:	GRS80
Latitude or X /m:	36.058984381 N (-3962300.46 m)
Longitude or Y /m:	140.135093405 E (3308875.97 m)
Height or Z /m:	84.122 m (3733534.13 m)

General information

• Rise time of the local UTC pulse:	-
• Is the laboratory air conditioned:	Yes
Set temperature value and uncertainty:	23 ± 1 °C
Set humidity value and uncertainty:	55 ± 3 %

(1) For a trip with closure, not needed if the traveling equipment is used in the same set-up throughout.

Diagram of the experiment set-up:

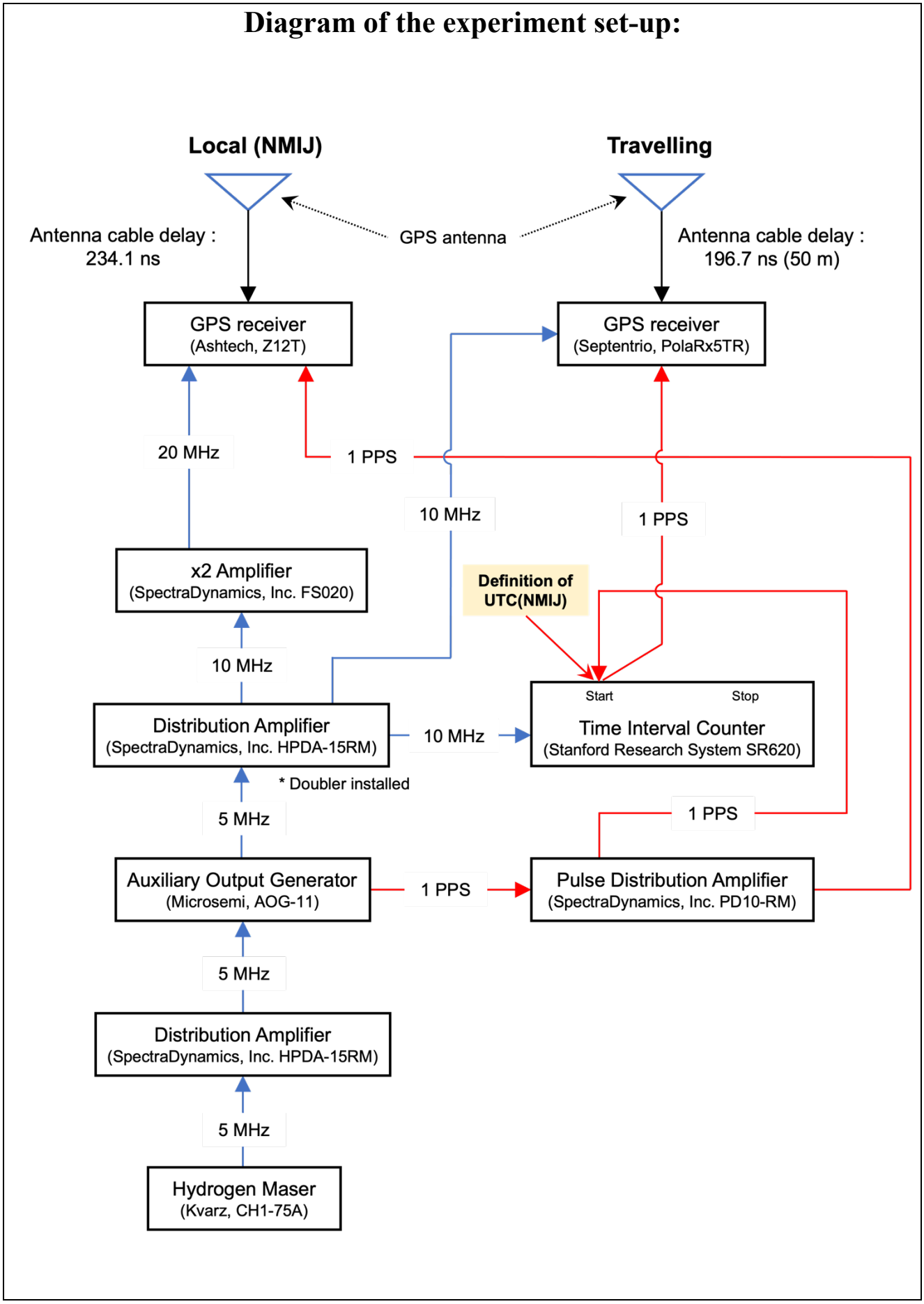
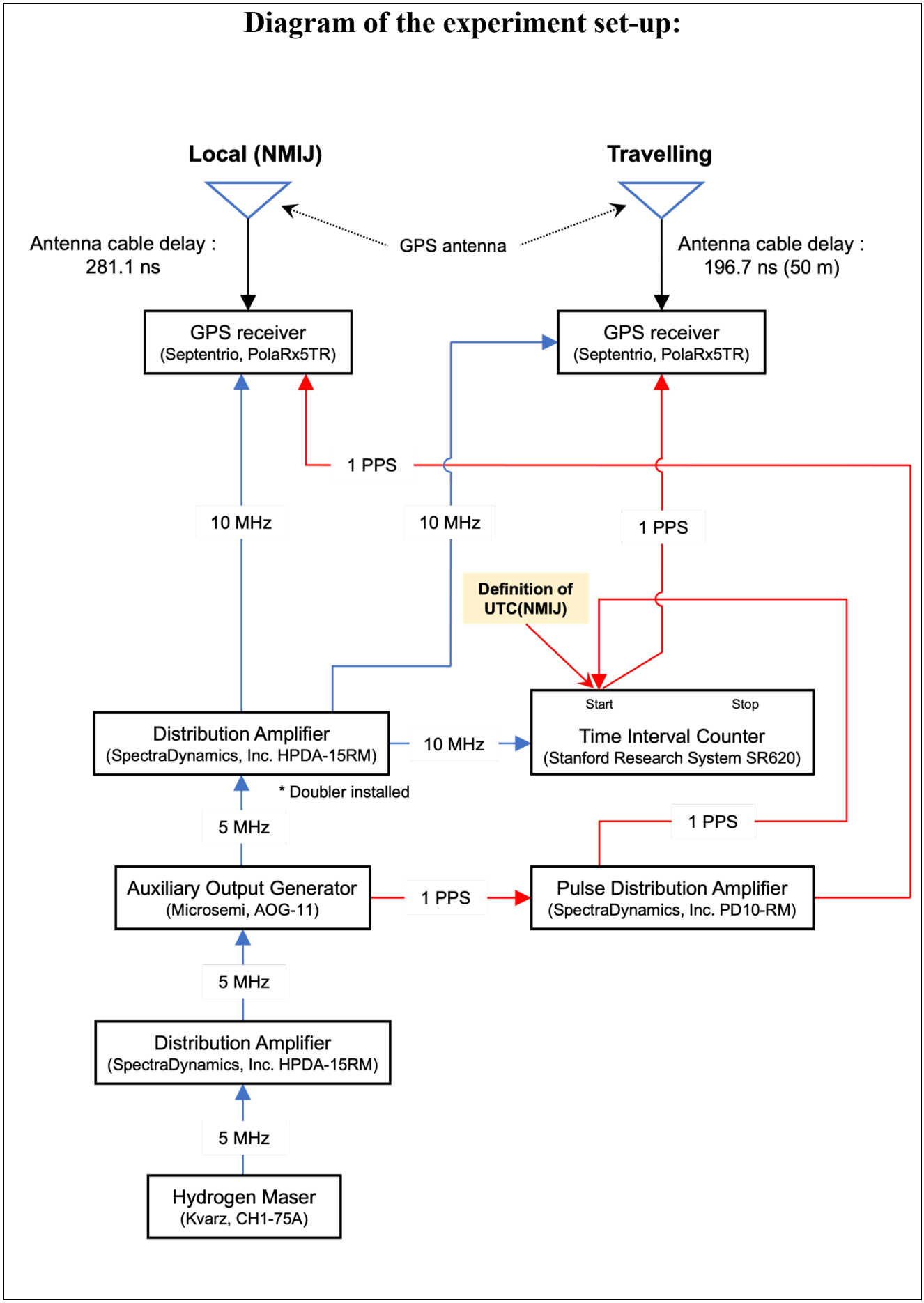


Diagram of the experiment set-up:



Log of Events / Additional Information :