Rapport BIPM-2002/02

BUREAU INTERNATIONAL DES POIDS ET MESURES

DETERMINATION OF THE DIFFERENTIAL TIME CORRECTIONS FOR GPS TIME EQUIPMENT LOCATED AT THE OP, IEN, ROA, PTB, NIST AND USNO

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Abstract

Following a suggestion at the 4th meeting of the CCTF Working Group on Two-Way Satellite Time Transfer (TWSTFT), the BIPM is conducting a series of differential calibrations of GPS equipment located in time laboratories equipped with two-way stations. This report details measurements which took place from 26 December 2001 to 27 May 2002, involving GPS time equipment located at the Observatoire de Paris (OP), Paris, France, the Istituto Elettrotechnico Nazionale Galileo Ferraris (IEN), Turin, Italy, the Real Instituto Observatorio de la Armada (ROA), San Fernando, Spain, the Physikalisch-Technische Bundesanstalt (PTB), Braunschweig, Germany, the United States Naval Observatory (USNO), Washington DC, USA, and the National Institute of Standards and Technology (NIST), Boulder, Colorado, USA. However

INTRODUCTION

Following a suggestion at the 4th meeting of the CCDS Working Group on TWSTFT [1], the BIPM is conducting a series of differential calibrations of GPS equipment located in time laboratories equipped with two-way stations [2, 3].

As for previous trips the GPS time equipment located at the OP was chosen as reference: to check the reproducibility of the measurements, the calibrations were organized as round trips beginning and ending at the OP. Although the OP is not yet equipped with a TWSTFT station, it has often served in the past as reference laboratory for GPS calibrations. Over the last twenty years its GPS time receiver has been compared several times with the NIST absolutely-calibrated reference GPS time receiver. The difference between these two has never exceeded a few nanoseconds.

Repeated determinations of the differential time corrections for the GPS time equipment located in the various laboratories should:

- improve the accuracy of the access to UTC of participating laboratories,
- provide valuable information about the stability of GPS time equipment,
- serve as provisional differential calibrations of the two-way equipment.

This report details an exercise which took place from 26 December 2001 to 27 May 2002. Succeeding visits are scheduled to take place at four to five month intervals.

EQUIPMENT

All the receivers involved in this comparison are C/A code, 0.5 V trigger level, but not all of them use the same software. Their principal characteristics are provided in Table 1. Detailed information on the set-up of equipment at each location is provided in Appendix I.

Table 1. GPS equipment involved in this comparison.

Laboratory	Receiver Maker	Receiver Type	Receiver Ser. No
OP	AOA	TTR-5	NBS051
IEN	NBS	TTR-5	NBS031
ROA	AOA	TTR-6	253
PTB	Rockwell-Collins	NBS	PTB01
USNO	AOS	TTS-2	014
NIST	NBS	TTR-5	NBS10
BIPM Portable receiver	AOS	TTS-2	020

The portable BIPM H receiver is equipped with a Cable C101. Its delay measured at the BIPM is: 184.34 ns ± 0.4 ns (1σ).

The delay of the cable C101 was measured at the BIPM using a double-weight pulse method with a time interval counter steered by an external frequency source, an HP 5071A clock. We measured at the very beginning of the linear part of the rising pulse at each end of the cable using a 0.5 V trigger level [4].

The delay of this cable was also measured at the visited laboratories. The results are reported in Appendix II.

CONDITIONS OF COMPARISON

For the present comparison, the portable equipment comprised a form of the receiver, its antenna and a calibrated antenna cable. The laboratories visited supplied (a) a 10 MHz reference signal, (b) a series of 1 s pulses from the local reference, UTC(*k*), via a cable of known delay. In each laboratory the portable receiver was connected to the same clock as the local receiver and the antenna of the portable receiver was placed close to the local antenna. The differential coordinates of the antenna phase centres were known at each site with uncertainties of a few centimetres.

RESULTS

The processing of the comparison data obtained in laboratory *k* consists first of computing, for each track *i*, the time differences:

$$dt_{k,i} = [UTC(k) - GPS\ time]_{\mathrm{BIPMH},i} - [UTC(\mathrm{k}) - GPS\ time]_{k,i}\ .$$

The noise exhibited by the time series dt_k is then analysed, for each of the laboratories visited, by use of the modified Allan variance. In each case, this exhibits white phase noise up to an averaging interval of about one day. We illustrate this in Figure 1.

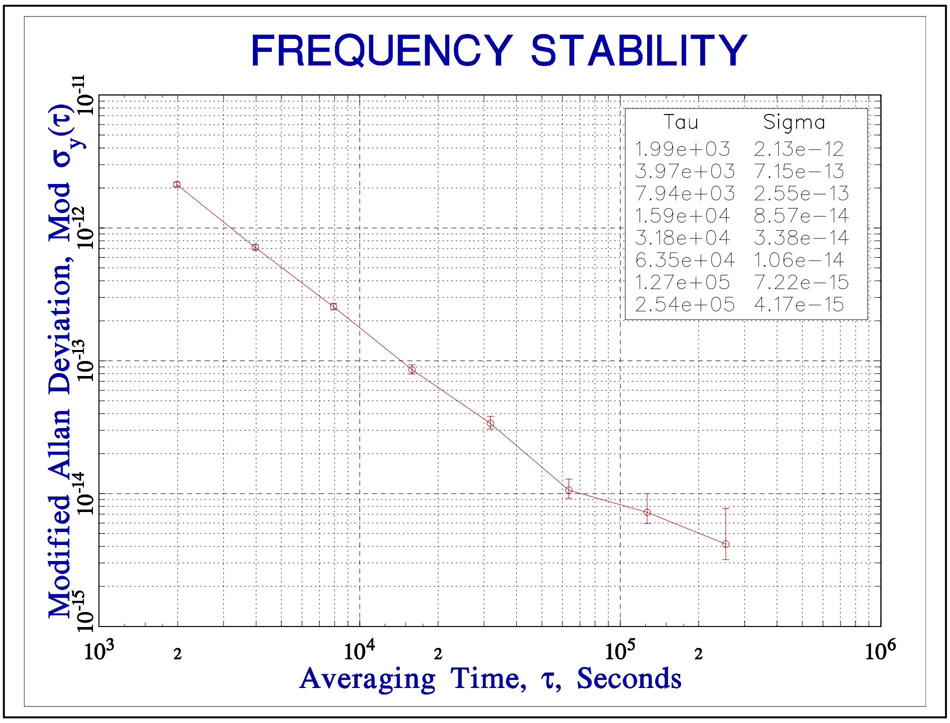

Figure 1. Square root of the modified Allan variance of the time series dt_{OP} for the period: 26 December 2001 – 08 January 2002.

The one-day averages are reported in Figure 2 and Appendix III. The level of noise for one-day averaging period is reported in Table 2.

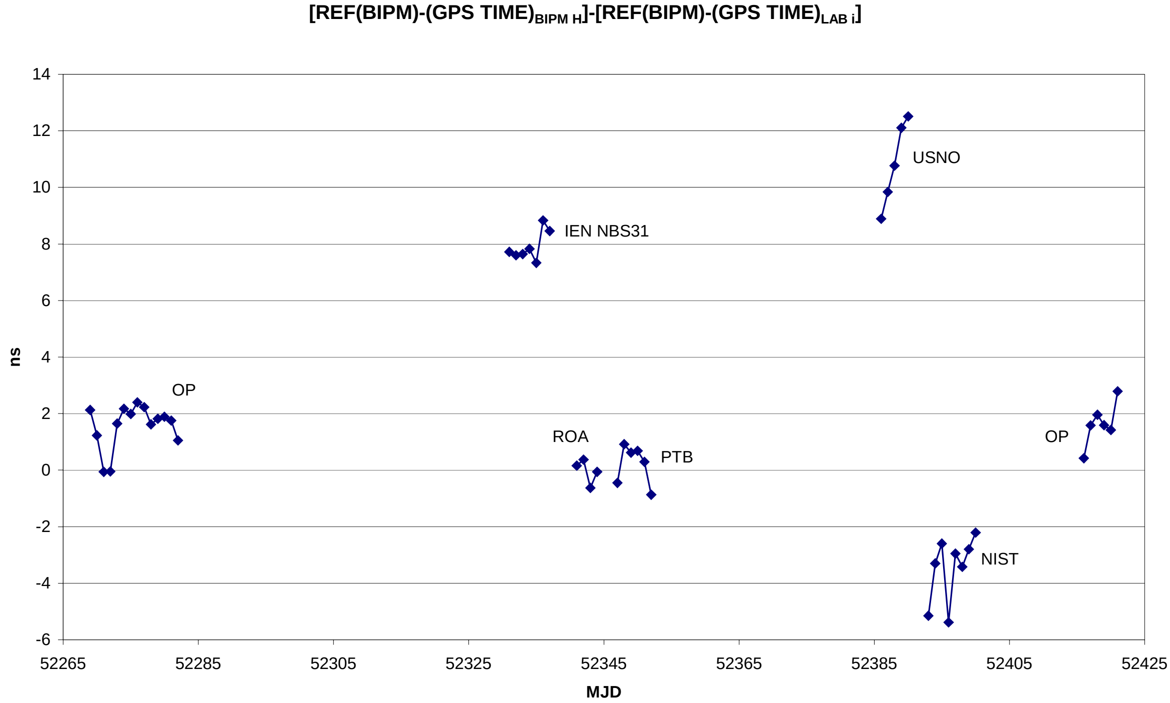

Figure 2. Daily averages of d$t_{k,i}$ for each laboratory.

Next, we computed mean offsets for the full duration of comparison at each location, and the corresponding standard deviations of individual common view (see Table 2).

Table 2. Mean offsets for the full duration of comparison at each location.

Lab	Period 2001/2002	Total number of common views	Mean offset /ns	Standard deviation of individual common view /ns	Level of noise for 1 day /ns	Dispersion of daily mean /ns
OP	26 Dec – 8 Jan	557	1.5	2.5	0.5	0.7
IEN	26 Feb – 4 Mar	236	7.9	3.8	0.5	0.5
ROA	8 - 11 Mar	96	0.0	3.7	1.0	0.4
PTB	14 - 19 Mar	183	0.5	3.2	0.3	0.7
USNO	16 – 22 Apr	1120	10.8	3.3	0.7	1.5
NIST	29 Apr - 6 May	139	–3.5	2.9	1.2	1.2
OP	22 – 27 May	213	1.6	2.7	0.5	0.8

From the preceding table, after averaging the two measurements at the OP, we derived differential time corrections which should be added to the values derived during the GPS comparisons of the time scales kept by the laboratories visited. These are reported in Table 3.

Table 3. Differential time correction d to be added to$[UTC(\mathrm{k}_1) - UTC(\mathrm{k}_2)]$, and its estimated uncertainty $u(d)$ for the period of comparison (1σ).

$[UTC(\mathrm{k}_1)\text{-}UTC(\mathrm{k}_2)]$	d	$u(d)$
[*UTC*(IEN)-*UTC*(OP)]	6	3
[*UTC*(ROA)-*UTC*(OP)]	–2	3
[*UTC*(PTB)-*UTC*(OP)]	–1	3
[*UTC*(USNO)-*UTC*(OP)]	9	3
[*UTC*(NIST)-*UTC*(OP)]	–5	3

The uncertainties given in this table are conservative. They are mainly driven by the uncertainty due to the 'round-trip' reproducibility at the OP.

For information we provide in Table 4 results of some past calibrations between NIST and OP.

Table 4. Some past calibrations between NIST and OP: d are differential time corrections to be added to [*UTC*(NIST)-*UTC*(OP)], and $u(d)$ are estimated uncertainties for the periods of comparisons.

Date	d/ns	$u(d)$/ns	Reference
July 1983	0.0	2.0	[11]
January 1985	–7.0#	13.0	[12]
September 1986	0.7*	2.0	[13]
October 1986	–1.4*	2.0	[13]
January 1988	–3.8*	3.0	[14]
April 1988	0.6*	3.0	[15]
March 1994	2.6*	1.5	[16]
March 1995	–3.7*	1.0	[17]
May 1996	–0.7*	1.5	[18]
May 2002	–5.0*	3.0	[19]

NBS03 receiver at NIST
* NBS10 receiver at NIST

CONCLUSION

These measurements are part of a series of differential calibrations of GPS equipment located in time laboratories equipped with TWSTFT stations. They provide an independent calibration of TWSTFT equipment and also improve accuracy of the access to UTC of participating laboratories.

The present measurements were performed under good conditions with excellent closure of travelling equipment at the OP. The GPS time equipment of most of participating laboratories agrees within a few nanoseconds with reference equipment at the NIST and the OP. Only at the IEN and the USNO does the difference with the NIST exceed 10 ns. In these two laboratories readjustment of the delays of GPS time equipment might be considered. It should be stressed, however, that the IEN and the USNO are linked to the UTC system through TWSTFT links. The IEN TWSTFT link to the PTB was calibrated by GPS, and the USNO TWSTFT link to the NPL was calibrated using a TWSTFT X-band portable station. The GPS common-view for these links is used as a back-up technique.

The GPS time equipment located at the NIST and the OP are excellent references for GPS calibration trips. This equipment was compared several times during the past two decades. The differences between them have never exceeded a few nanoseconds (see Table 4).

The next trip involving the same laboratories is scheduled for autumn 2002.

Acknowledgements

The authors wish to express their gratitude to their colleagues for unreserved collaboration they received. Without this, the work could not have been accomplished.

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[18] M.A. Weiss, Personal communication, 1996.

[19] This report.

Appendix I

Set-ups of local and portable equipment at each location (forms filled at laboratories)

BIPM GPS calibration information sheet

Laboratory:	BNM – SYRTE, Observatoire de Paris
Date and hour of the beginning of measurements:	10 December 2001 (52253) 16h22
Date and hour of the end of measurements:	08 January 2002 (52282) 08h02

Receiver setup information

	Local: NBS 51	**Portable: BIPM H**
• Maker:	Allen Osborne Associates	AOS
• Type:	TTR-5	TTS-2
• Serial number:	051	020
• Receiver internal delay :	54 ns	-19,36 ns
• Antenna cable identification:	505 IF	C101
Corresponding cable delay :	168 ns ± 0,3 ns	184,3 ns ± 0,4 ns
• UTC cable identification:	503	497
Corresponding cable delay :	/	/
Delay to local UTC :	304 ns	306 ns
• Receiver trigger level:	0.5 V	0.5 V
• Coordinates reference frame:	ITRF	ITRF
Latitude:	4 202 780,30 m	4 202 781,970 m
Longitude:	171 370,03 m	171 364,125 m
Height:	4 778 660,12 m	4 778 658,526 m

Antenna information

	Local:	**Portable:**
• Maker:	A.O.A.	Matsushita elec. works
• Type:	/	GPS
• Serial number:	/	0709 AU 53022
If the antenna is temperature stabilised		
• Set temperature value :	/	

Local antenna cable information

• Maker:	/
• Type:	RG-58
• Is it a phase stabilised cable:	No
• Length of cable outside the building :	Approximately 6 meters

General information

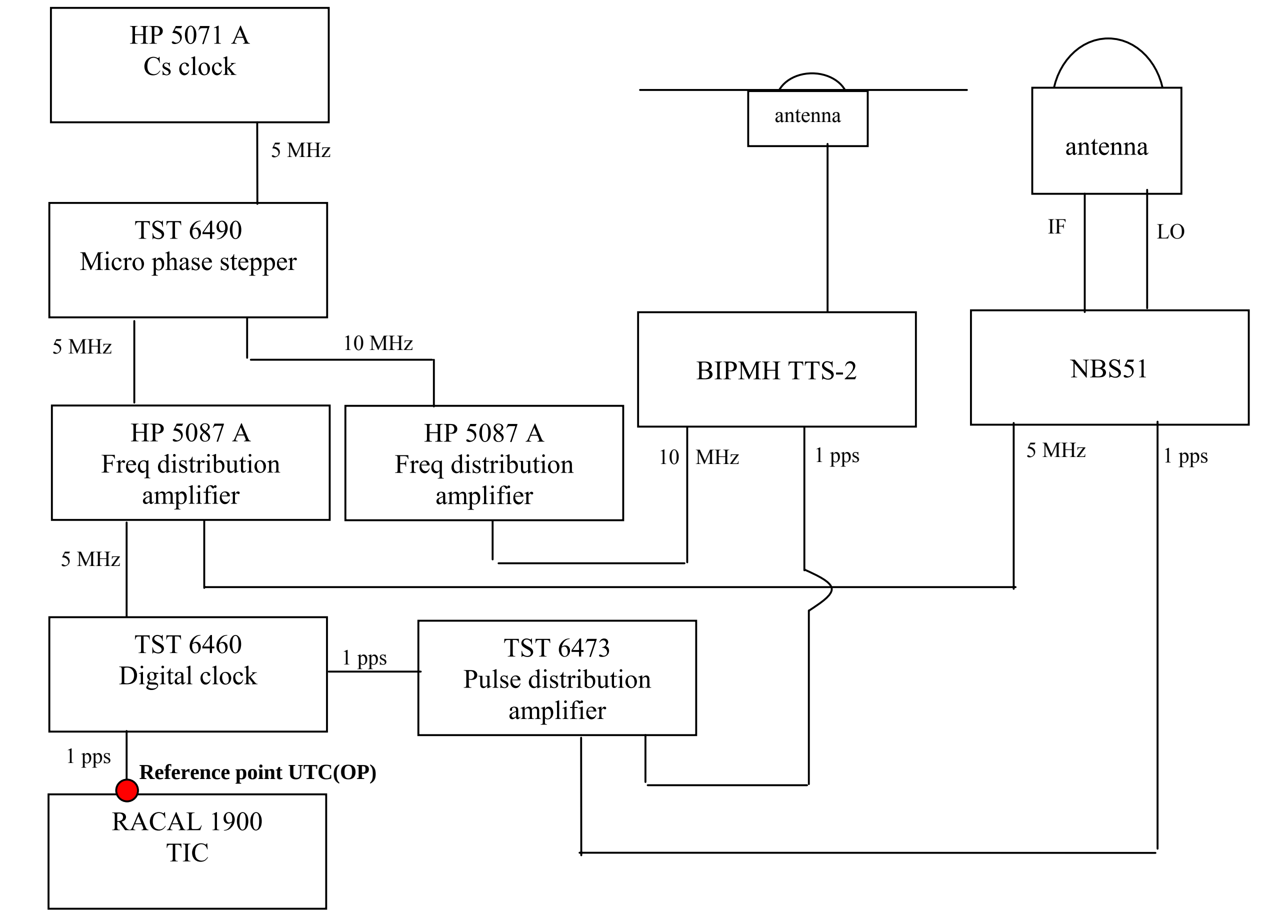
• Rise time of the local UTC pulse:	4 ns
• Is the laboratory air conditioned:	Yes
• Set temperature value and uncertainty :	(21,5 ± 2) °C
• Set humidity value and uncertainty :	/

Cable delay control

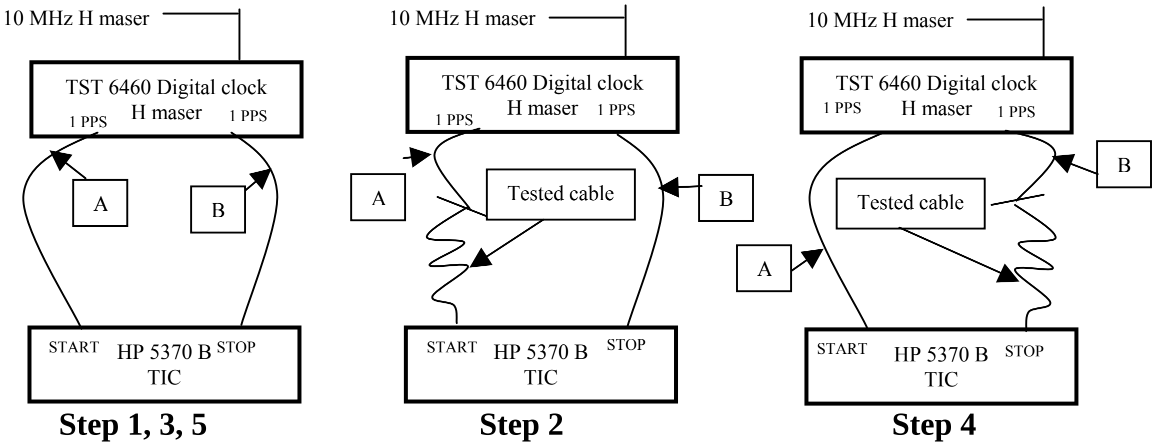
Cable identification	delay measured by BIPM	Delay measured by local method
BIPM C101	184,3 ns ± 0,4 ns	184,6 ns ± 0,3 ns

Plot of the experiment set-up:

Link to the local UTC of both receivers and Antenna positions



Description of the local method of cable delay measurement:



The method used to calibrate the cables is a double wheight method in five steps as shown above.
At each step (i) the TIC gives the result (R_i)of 100 measurments.
The test cable delay is then obtained by the following formula:

$$\text{Delay} = \frac{R_2 - \left(\frac{R_1 + R_3}{2}\right) + \left(\frac{R_3 + R_5}{2}\right) - R_4}{2} + \text{corrections}$$

The corrections are the estimated delay introduced by adaptators : - 0,1 ns / adaptator

BIPM GPS calibration information sheet

Laboratory:	IEN G. Ferraris – Torino (Italy)
Date and hour of the beginning of measurements:	2002-02-26 (MJD: 52331) - 11:30 UTC
Date and hour of the end of measurements:	2002-03-04 (MJD: 52337) - 07:30 UTC

Receiver setup information

	Local: IEN 31	Local: 3SN	Portable: BIPM H
• Maker:	NBS	3S Navigation	AOS
• Type:	TTR-5	GNSS-300T	TTS-2
• Serial number:	31	1003	020
• Receiver internal delay (GPS) : (*) comprehensive of the antenna cable delay	253,0 ns (*) (receiver + cable)	1693,0 ns (*) (receiver + cable)	-19,36 ns
• Receiver internal delay (GLO) :	-	3600,0 ns	-
• Antenna cable identification:	-	-	C101
Corresponding cable delay :	not available (*)	Not available (*)	(184,3 ± 0,4) ns
• UTC cable identification:	1PPS(IEN31)	1PPS(3SN)	1PPS(BIPH)
Corresponding cable delay :	not available	not available	not available
Delay to local UTC :	(4,9 ± 0,1) ns	(6,7 ± 0,1) ns	(151,1 ± 0,1) ns
• Receiver trigger level:	0,5 V	0,5 V	0,5 V
• Coordinates reference frame:	ITRF 88	ITRF 88	ITRF 88
Latitude or X m	45 00 54,048 N	45 00 53,987	45 00 53,979 N
Longitude or Y m	007 38 20,709 E	007 38 20,686	007 38 20,752 E
Height or Z m	306.64 m	306,64 m	304,85 m

Antenna information

	Local: IEN31		Portable:
• Maker:	NBS	3S navigation	Matsushita elec. works
• Type:	NBS	-	GPS
• Serial number:	31	-	0709 AU 53022
If the antenna is temperature stabilised			
• Set temperature value :	-	-	-

Local antenna cable information

• Maker:	Mantovani & Serazzi - Italy
• Type:	RG 58 Cu
• Is it a phase stabilised cable:	no
• Length of cable outside the building :	5 m

General information

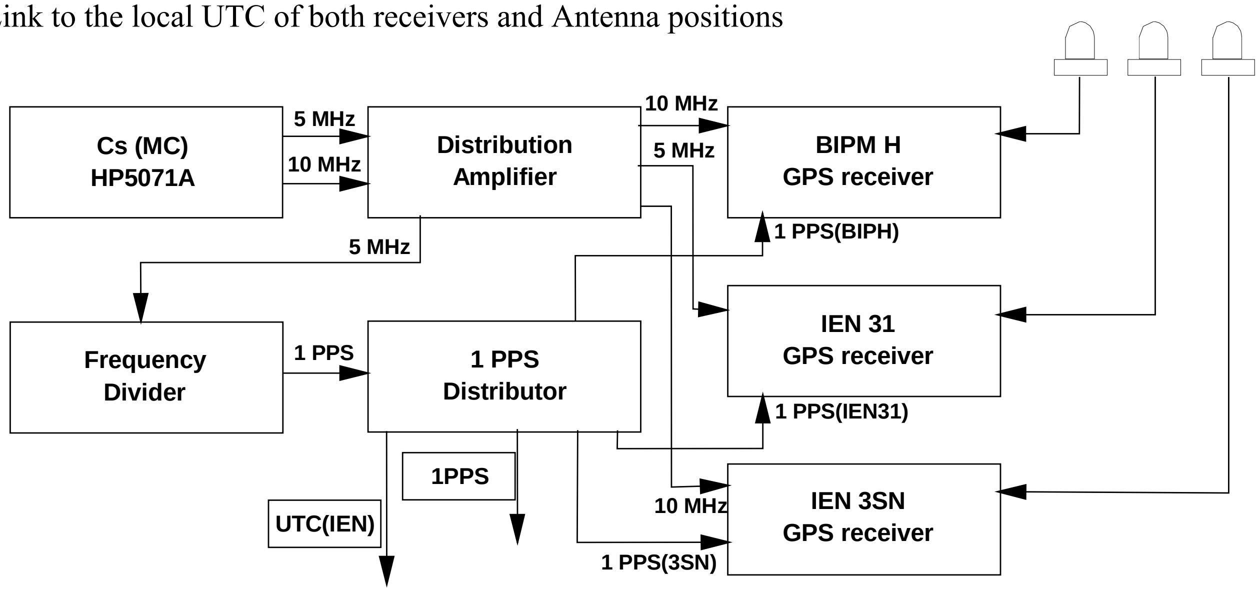
• Rise time of the local UTC pulse:	15 ns
• Is the laboratory air conditioned:	yes
• Set temperature value and uncertainty :	(23 ± 1) °C
• Set humidity value and uncertainty :	(30 ± 10) %

Cable delay control

Cable identification	delay measured by BIPM	Delay measured by local method
BIPM C101	184,34 ns ± 0,4 ns	(185,6 ± 0,1) ns

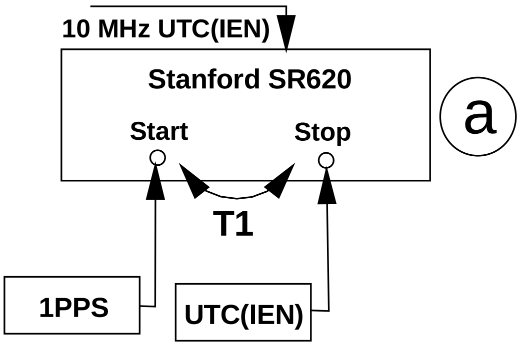
Plot of the experiment set-up:

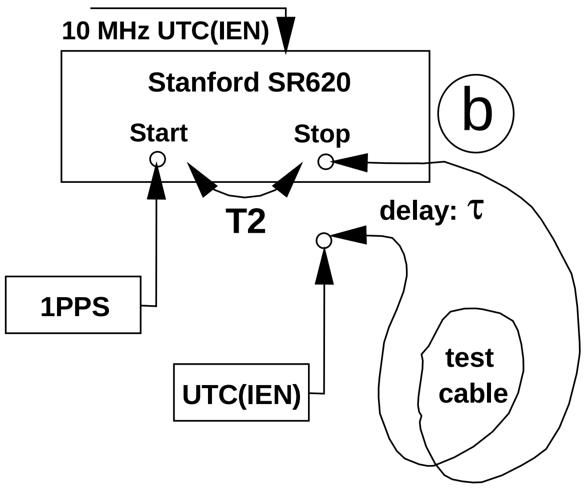
Link to the local UTC of both receivers and Antenna positions



Measured delays: UTC(IEN) – 1PPS(BIPH), UTC(IEN) – 1PPS(IEN31), UTC(IEN) – 1PPS(3SN)

Description of the local method of cable delay measurement:





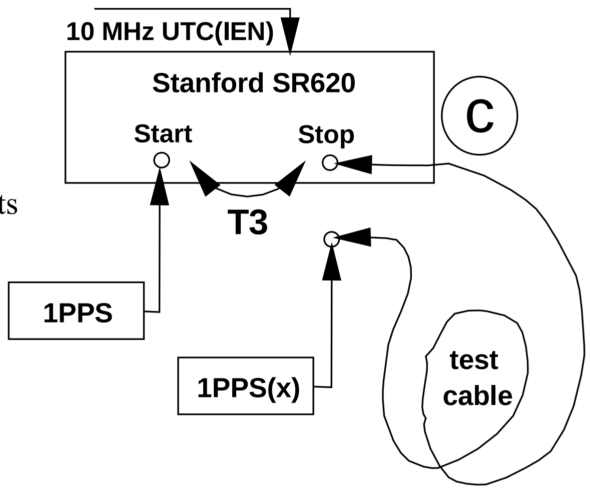
Delay measurements: differential method to compensate for the counter asymmetry.

1PPS: auxiliary UTC(IEN) time reference.

1PPS(x): 1PPS(BIPH) or 1PPS(IEN31) or 1PPS(3SN)

T1, T2 and T3: mean value of 20 delay measurements (with estimation of the standard deviation).

τ: delay of an auxiliary cable (test cable) or of the BIPM antenna cable.



τ = T2 – T1

UTC(IEN) – 1PPS(x) = T3 – T2

BIPM GPS calibration information sheet

Laboratory:	Real Observatorio de la Armada
Date and hour of the beginning of measurements:	08-March-2002:
Date and hour of the end of measurements:	11-March-2002:

Receiver setup information

	Local:	Portable: BIPM H
• Maker:	Allen Osborne Ass.	AOS
• Type:	TTR-6	TTS-2
• Serial number:	253	020
• Receiver internal delay (GPS) :	50.0 ns	-19,36 ns
• Receiver internal delay (GLO) :		
• Antenna cable identification:	IF	C101
Corresponding cable delay :	234.0 ns	184,3 ns ± 0,4 ns
• UTC cable identification:	ROA	ROA
Corresponding cable delay :	-	-
Delay to local UTC :	0.0 ns	0.0 ns
• Receiver trigger level:	0.5 V	0.5 V
• Coordinates reference frame:	ITRF	ITRF
Latitude or X m	+5105512.30 m	+5105512.30 m
Longitude or Y m	-555º90.96 m	-555º90.96 m
Height or Z m	+3769792.05 m	+3769792.05 m

Antenna information

	Local:	Portable:
• Maker:	Allen Osborne	Matsushita elec. works
• Type:		GPS
• Serial number:	575	0709 AU 53022
If the antenna is temperature stabilised		
• Set temperature value :		

Local antenna cable information

• Maker:	
• Type:	RG- 58
• Is it a phase stabilised cable:	NO
• Length of cable outside the building :	42 m

General information

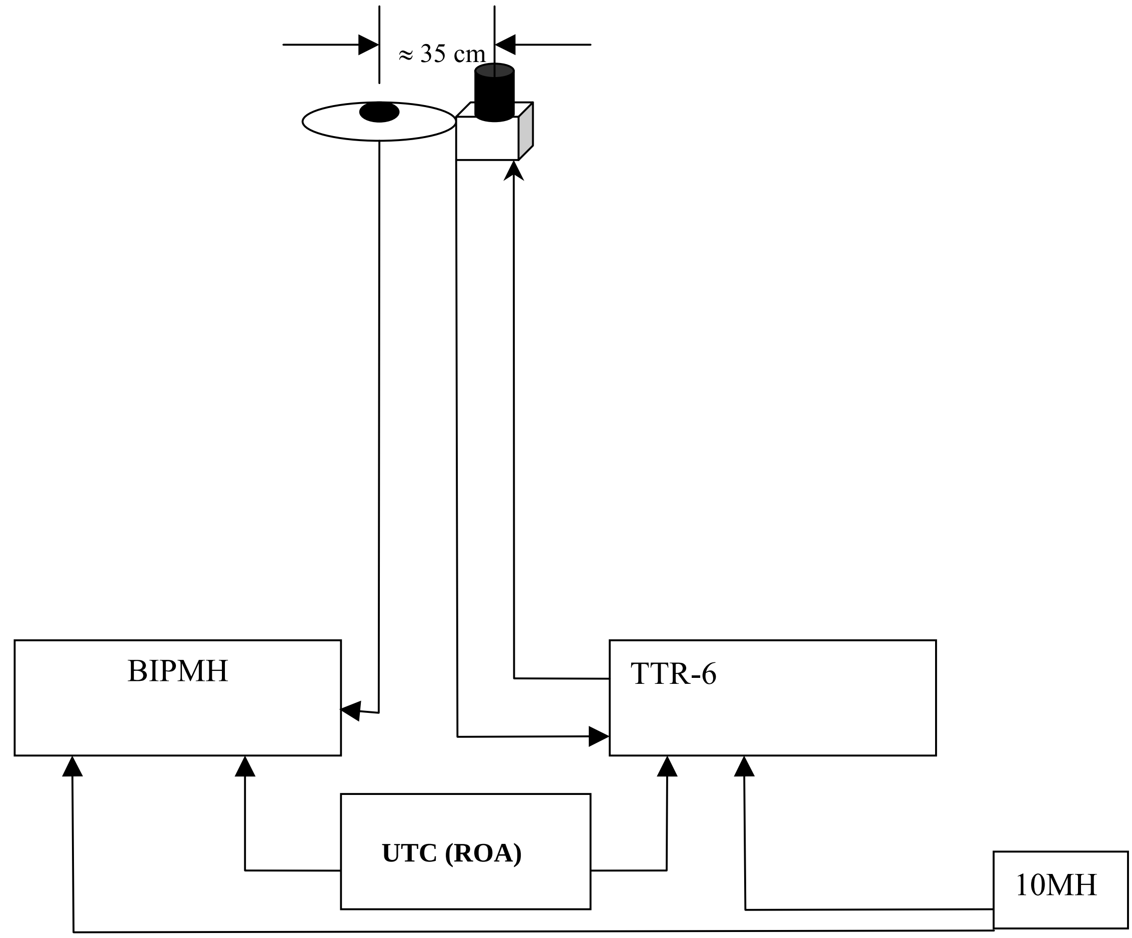
• Rise time of the local UTC pulse:	≤ 2.2 ns / Volt
• Is the laboratory air conditioned:	Yes
• Set temperature value and uncertainty :	23 ºC ± 1ºC
• Set humidity value and uncertainty :	40% ± 5%

Cable delay control

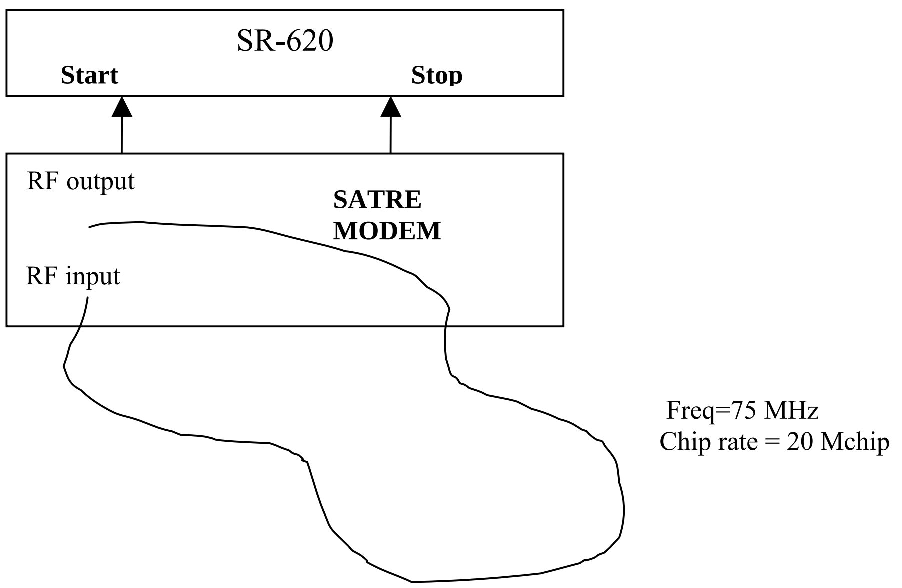
Cable identification	delay measured by BIPM	Delay measured by local method
BIPM C101	184,34 ns ± 0,4 ns	186.21±0.01 ns (k=2, N=60)

Plot of the experiment set-up:

Link to the local UTC of both receivers and Antenna positions



Description of the local method of cable delay measurement:



BIPM GPS calibration information sheet

Laboratory:	PTB
Date and hour of the beginning of measurements:	MJD 52347, 2002-03-14, 13:35 UTC
Date and hour of the end of measurements:	MJD 52352, 2002-03-19, 05:56 UTC

Receiver setup information

	Local:	**Portable: BIPM H**
• Maker:	Rockwell-Collins	AOS
• Type:	original NIST-Type	TTS-2
• Serial number:	PTB01	020
• Receiver internal delay (GPS) :	70,0 ns	-19,36 ns
• Receiver internal delay (GLO) :		
• Antenna cable identification:	IF Input / AT 06	C101
Corresponding cable delay :	626 ns (entered (626+21) ns)	184,3 ns ± 0,4 ns
• UTC cable identification:	1PPS REF/ (PTB01)	
Corresponding cable delay :		
Delay to local UTC :	-21 ns (entered 0 ns)	
• Receiver trigger level:	0,5 V	0.5 V
• Coordinates reference frame:	ITRF	ITRF
Latitude or X m	3844103,15	3844064,783
Longitude or Y m	0709758,73	0709657,373
Height or Z m	5023116,37	5023126,386

Antenna information

	Local:	**Portable:**
• Maker:	AOA	Matsushita elec. works
• Type:	NIST – Type	GPS
• Serial number:	?	0709 AU 53022

If the antenna is temperature stabilised

• Set temperature value :		

Local antenna cable information

• Maker:	?
• Type:	Air Dielectric Cable
• Is it a phase stabilised cable:	no
• Length of cable outside the building :	about 30 m

General information

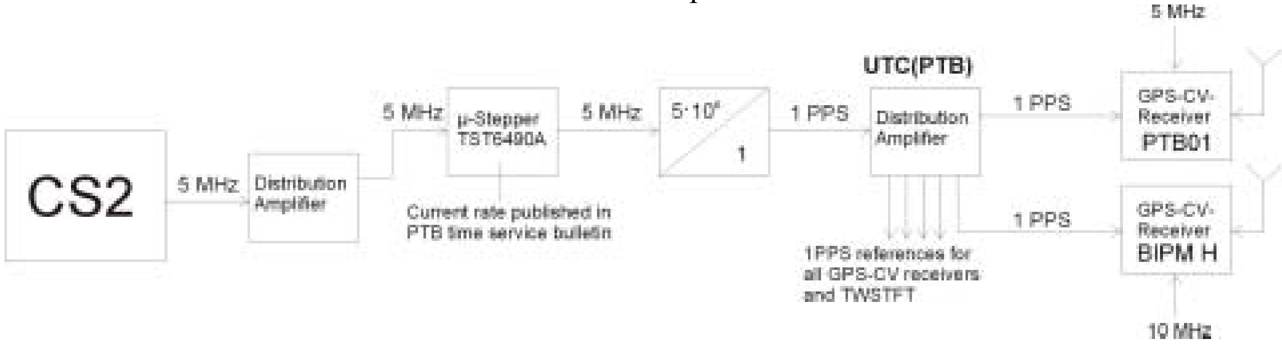
• Rise time of the local UTC pulse:	5 ns
• Is the laboratory air conditioned:	Atomic clocks: yes / GPS receivers: no
• Set temperature value and uncertainty :	(22 ± 2) °C
• Set humidity value and uncertainty :	

Cable delay control

Cable identification	delay measured by BIPM	Delay measured by local method
BIPM C101	184,34 ns ± 0,4 ns	**by Mitrex-Modem:182,8 ns ± 0,5 ns** **by TI – Counter: 183,8 ns ± 0,5 ns**

Plot of the experiment set-up:

Link to the local UTC of both receivers and Antenna positions



Description of the local method of cable delay measurement:

1. TI - method with counter:
   a) TI - measurement between two pulses from the same source.
   b) TI - measurement as a) with cable under test in Stop-Input of the Time-Interval- Counter.
   c) Difference of counter readings gives cable delay.

2. TI - method with counter and Mitrex- modem:
   a) Measurement of 1PPS/TX - 1PPS/RX with short cable in station-loop operation.
   b) Measurement as a) with short cable plus cable under test in station-loop operation.
   c) Difference of counter readings gives cable delay.

BIPM GPS calibration information sheet

Laboratory:	USNO
Date and hour of the beginning of measurements:	04/16/02, MJD 52386, 1214 UT
Date and hour of the end of measurements:	04/22/02, MJD 52390, 1246 UT

Receiver setup information

	Local: MOT1	**Portable: BIPM H**
• Maker:	AOS SRC	AOS
• Type:	TTS-2	TTS-2
• Serial number:	014	020
• Receiver internal delay (GPS) :	-47.9	-19,36 ns
• Receiver internal delay (GLO) :		
• Antenna cable identification:	SPS	C101
Corresponding cable delay :	172.06* ns TSA antenna = 31.68 ns Antenna cable = 122.2 ns, FSS-1-5/12V , port 1 = 11.7 ns, splitter/rcvr cable=6.48 ns	184,3 ns ± 0,4 ns
• UTC cable identification:	A10	E2
Corresponding cable delay :		
Delay to local UTC :	0.0 ns	-0.13 ns
• Receiver trigger level:	0.5 V	0.5 V
• Coordinates reference frame:	WGS-84	WGS-84
Latitude or X m	+1112161.10 m	+1112167.38 m
Longitude or Y m	-4842855.43 m	-4842851.90 m
Height or Z m	+3985494.36 m	+3985493.66 m

Antenna information

	Local:	**Portable:**
• Maker:	3S Navigation	Matsushita elec. works
• Type:	Dorne Margolin/TSA 100	GPS
• Serial number:	12	0709 AU 53022
If the antenna is temperature stabilised		
• Set temperature value :	105 F	

Local antenna cable information

• Maker:	Andrews
• Type:	FSJ1-50A
• Is it a phase stabilised cable:	yes
• Length of cable outside the building :	6 meters

General information

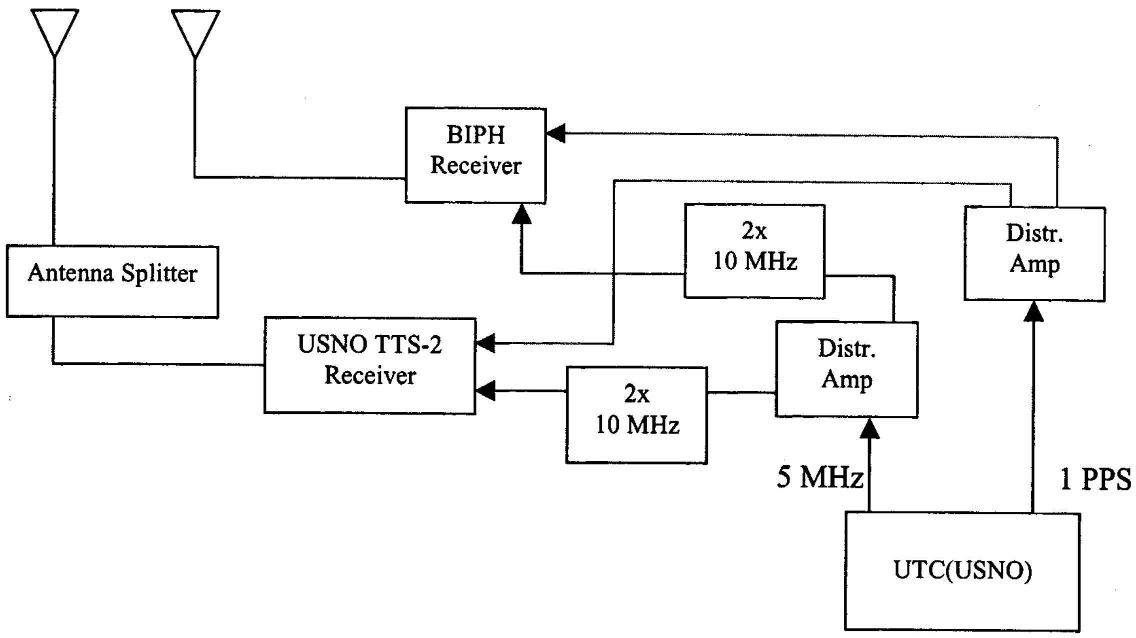
• Rise time of the local UTC pulse:	4.1 ns (10%-90%) pulse height 5 volt DC
• Is the laboratory air conditioned:	yes
• Set temperature value and uncertainty :	22C +/-1^{o}C
• Set humidity value and uncertainty :	N/A

Cable delay control

Cable identification	delay measured by BIPM	Delay measured by local method
BIPM C101	184,34 ns ± 0,4 ns	184.06 ns +/-0.250 ns

Plot of the experiment set-up:

Link to the local UTC of both receivers and Antenna positions



Description of the local method of cable delay measurement:

BIPM GPS calibration information sheet

Laboratory:	NIST
Date and hour of the beginning of measurements:	**April 29, 2002 (MJD 52393) 21:38:00**
Date and hour of the end of measurements:	**May 6, 2002 (MJD 52400) 14:46:00**

Receiver setup information

	Local:	Portable: BIPM H
• Maker:	NIST	AOS
• Type:	NBS (TTR-5)	TTS-2
• Serial number:	NBS10	020
• Receiver internal delay (GPS) :	53.0ns	-19,36 ns
• Receiver internal delay (GLO) :	N/A	N/A
• Antenna cable identification:	None	C101
Corresponding cable delay :	199.9ns	184,3 ns ± 0,4 ns
• UTC cable identification:	None	None
Corresponding cable delay :	66.7ns	681.0ns
Delay to local UTC :	0ns	0ns
• Receiver trigger level:	0.5V	0.5 V
• Coordinates reference frame:	WGS84	ITRF
Latitude or X m	-1288398.27 m	-1288352.03 m
Longitude or Y m	-4721698.10 m	-4721662.20 m
Height or Z m	+4078625.68 m	4078674.59 m

Antenna information

	Local:	Portable:
• Maker:	NIST	Matsushita elec. works
• Type:	GPS	GPS
• Serial number:	NBS10	0709 AU 53022
If the antenna is temperature stabilised		
• Set temperature value :	N/A	N/A

Local antenna cable information

• Maker:	Andrew
• Type:	FSJ1-50A
• Is it a phase stabilised cable:	YES
• Length of cable outside the building :	~30 m

General information

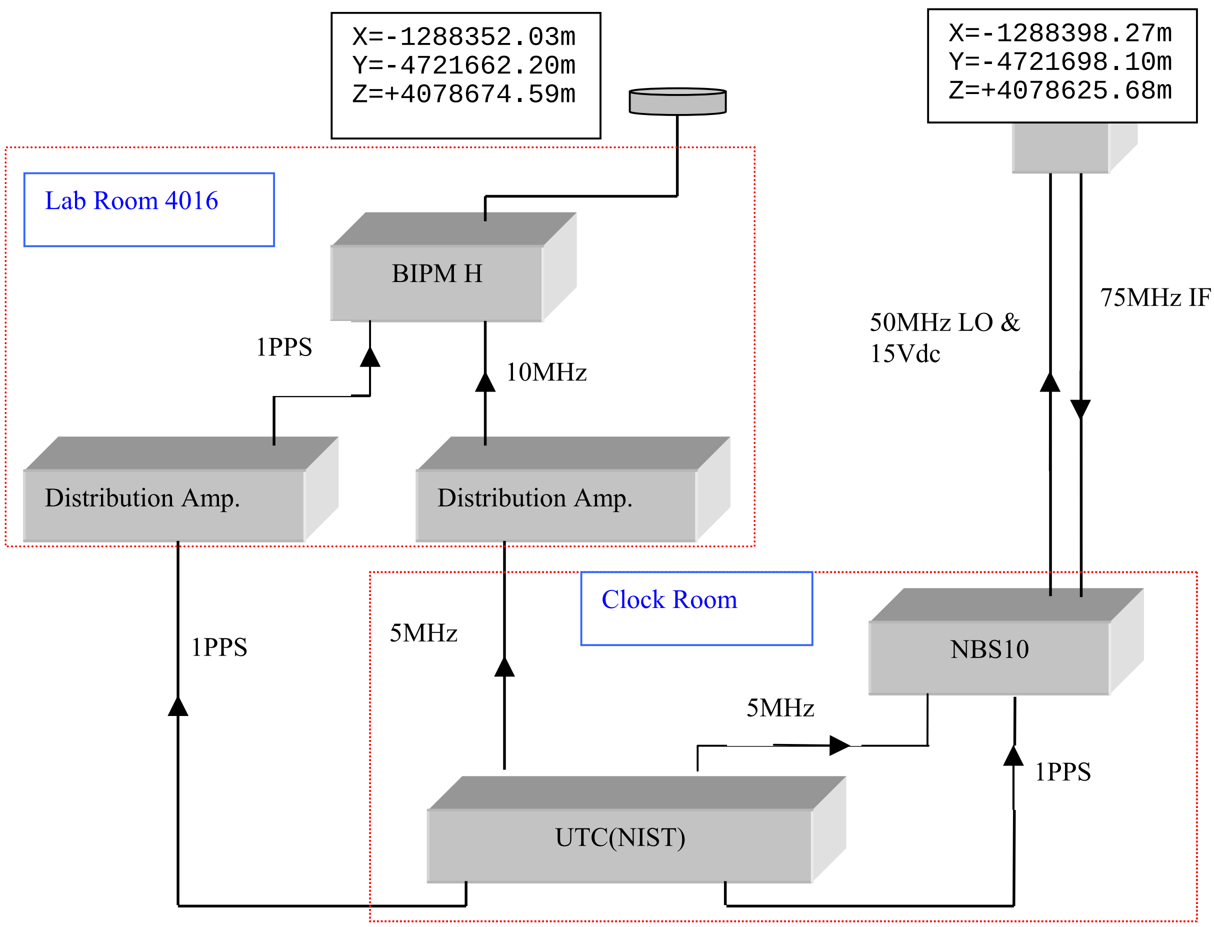
• Rise time of the local UTC pulse:	~1.5 ns (from 0Vdc to 0.5Vdc)
• Is the laboratory air conditioned:	YES
• Set temperature value and uncertainty :	Local: 23±1°c, Portable: 20±2°c
• Set humidity value and uncertainty :	9% to 32%

Cable delay control

Cable identification	delay measured by BIPM	Delay measured by local method
BIPM C101	184,34 ns ± 0,4 ns	183.0ns±0.5ns

Plot of the experiment set-up:

Link to the local UTC of both receivers and Antenna positions



Description of the local method of cable delay measurement:

Measure the cable's group delay at 1575.42MHz ± 10MHz with a HP network analyzer.

Appendix II

Measurement of portable cables at the visited laboratories

Laboratory	BIPM C101 cable /ns	Measurement method
BIPM	184.34 ± 0.4	double Weight Pulse method
OP (before trip)	184.6 ± 0.3	Dual weighing method
IEN	185.6 ± 0.1	Pulse method
ROA	186.21 ± 0.01	Sartre Modem
PTB	182.8 ± 0.5 183.8 ± 0.5	Mitrex Modem Pulse method
USNO	184.06 ± 0.25	
NIST	183.0 ± 0.5	Network analyzer
OP (after trip)	184.6 ± 0.3	Dual weighing method

Appendix III

Daily results of the comparisons

LAB	MJD	Mean offset /ns	Standard deviation of individual common view /ns	Standard deviation of the mean /ns	Number of individual common views
OP	52269	2.13	2.27	0.45	25
	52270	1.23	1.95	0.29	46
	52271	-0.06	2.59	0.39	45
	52272	-0.05	2.51	0.37	45
	52273	1.65	2.7	0.4	46
	52274	2.17	2.63	0.39	46
	52275	1.99	1.87	0.29	41
	52276	2.4	2.74	0.42	43
	52277	2.23	1.96	0.3	42
	52278	1.62	2.11	0.33	40
	52279	1.82	2.74	0.42	42
	52280	1.89	2.43	0.37	43
	52281	1.75	2.22	0.35	41
	52282	1.05	2.36	0.65	13
IEN	52331	7.72	3.86	0.79	24
	52332	7.6	3.43	0.53	42
	52333	7.64	2.82	0.46	37
	52334	7.83	2.54	0.41	38
	52335	7.33	4.69	0.72	42
	52336	8.83	5	0.78	41
	52337	8.46	1.57	0.44	13
ROA	52341	0.16	2.79	0.72	15
	52342	0.37	3.26	0.59	31
	52343	-0.63	3.68	0.66	31
	52344	-0.06	5.62	1.26	20
PTB	52347	-0.45	2.6	0.63	17
	52348	0.92	3.35	0.54	39
	52349	0.62	2.84	0.46	38
	52350	0.68	3.28	0.52	39
	52351	0.29	3.92	0.63	39
	52352	-0.87	3.31	0.96	12
USNO	52386	8.89	2.93	0.27	114
	52387	9.84	3.14	0.19	284
	52388	10.77	3.58	0.21	298
	52389	12.11	3.32	0.2	277
	52390	12.51	3.65	0.29	161

LAB	MJD	Mean offset /ns	Standard deviation of individual common view /ns	Standard deviation of the mean /ns	Number of individual common views
NIST	52393	-5.15	1.34	0.95	2
	52394	-3.3	2.31	0.5	21
	52395	-2.6	2.57	0.58	20
	52396	-5.38	4.83	1.05	21
	52397	-2.95	3.52	0.77	21
	52398	-3.42	2.23	0.49	21
	52399	-2.8	2.84	0.62	21
	52400	-2.21	3.68	0.98	14
OP	52416	0.42	2.84	0.65	19
	52417	1.58	3.38	0.5	45
	52418	1.96	2.51	0.39	42
	52419	1.59	2.57	0.38	46
	52420	1.42	2.36	0.35	45
	52421	2.79	2.16	0.54	16