

20th BIPM TWSTFT Report

To: TWSTFT Participating Stations

Copy:

Prof. J. Kovalevsky, President of the CIPM

Prof. S. Leschiutta, President of the CCTF

Dr W.J. Klepczynski, Chairman of the CCTF WG on TWSTFT

Dr T. J. Quinn, Director of the BIPM

Dear Colleagues,

**Introduction into TAI
of the four new TWSTFT links, three in the Pacific Rim and one in Europe**

This is the 20th BIPM TWSTFT Report. Please note that on 5 January 2002 three TWSTFT links in the Pacific Rim, NTSC/CRL, NMIJ/CRL and TL/CRL, and one in Europe, ROA/PTB, were introduced into the computation of TAI, after calibration by *Circular T*. The NIST/PTB TWSTFT link was also reintroduced into the computation. For all these links the GPS data are computed in parallel and kept as back-up.

This report covers the data for transatlantic and European links from November 2001 to January 2002. All TWSTFT links reported here are computed and compared with GPS C/A-code common-view data. Section IV presents an updated summary of the international time links.

The replacement of the INTELSAT 307° E transponders in late February and March 2001 caused time steps in the transatlantic TWSTFT links, which thus required a new calibration. The USNO/NPL and NIST/PTB links have been recalibrated and the USNO/PTB link is awaiting calibration.

Please note that the BIPM TWSTFT Reports are available by ftp (62.161.69.5, see the directory /Publication/), and via the BIPM web site http://www.bipm.fr/enus/5_Scientific/c_time/time_ftp.shtml. Computer-readable data for all the TWSTFT links published in these reports are available from the same address. Reports of the two most recent meetings of the CCTF WG on TWSTFT can be found at http://www.bipm.org/pdf/cctf/wg_twstft.html.

Sincerely yours,

Jacques Azoubib and Włodzimierz Lewandowski

20th BIPM TWSTFT Report

Table of Contents

Section I: Comparison of TWSTFT and GPS CV links computed at the BIPM

Section II: Frequency stabilities of the TWSTFT and GPS CV links reported in Section I

Section III: A brief description of the hardware equipment of the participating laboratories

Section IV: Summary of the international time links

Section I

Comparison of TWSTFT and GPS CV links computed at the BIPM

Results of the computation for twelve time links are given in Tables 1 to 12. Plots showing the differences between the TWSTFT results and the GPS results are given in Figures 1 to 12.

- TWSTFT links

Because the TWSTFT data are unevenly spaced by intervals of 2, 3 or 4 days, they are linearly interpolated to give the data for the TAI standard dates at intervals of 5 days.

When TWSTFT sessions are missing and data are interpolated between TWSTFT sessions more than 5 days apart, results are printed in bold characters. The upper limit for interpolation is 10 days.

- GPS C/A-code common-view links

GPS C/A-code common-view links are computed using IGS precise ephemerides and IGS ionosphere maps.

Table 1. NIST/PTB link through INTELSAT 307° E

Date 2001 (MJD)	[UTC(NIST) – UTC(PTB)] /ns		(TWSTFT – GPS) /ns
	TWSTFT	GPS (<i>Circular T</i>)	
1 November (52214)	–49	–56	7
6 November (52219)	–47	–52	5
11 November (52224)	–48	–52	4
16 November (52229)	–48	–55	7
21 November (52234)	–46	–51	5
26 November (52239)	–43	–49	6
1 December (52244)	–39	–48	9
6 December (52249)	–36	–43	7
11 December (52254)	–30	–39	9
16 December (52259)	–24	–30	6
21 December (52264)	–20	–25	5
26 December (52269)	–15	–22	7
31 December (52274)	–17	–17	0

Reintroduction of NIST/PTB TWSTFT link into TAI

Date 2002 (MJD)	[UTC(NIST) – UTC(PTB)] /ns		(TWSTFT – GPS) /ns
	TWSTFT (<i>Circular T</i>)	GPS	
5 January (52279)	–16	–19	3
10 January (52284)	–12	–12	0
15 January (52289)	–8	–10	2
20 January (52294)	–1	0	–1
25 January (52299)	2	1	1
30 January (52304)	3	2	1

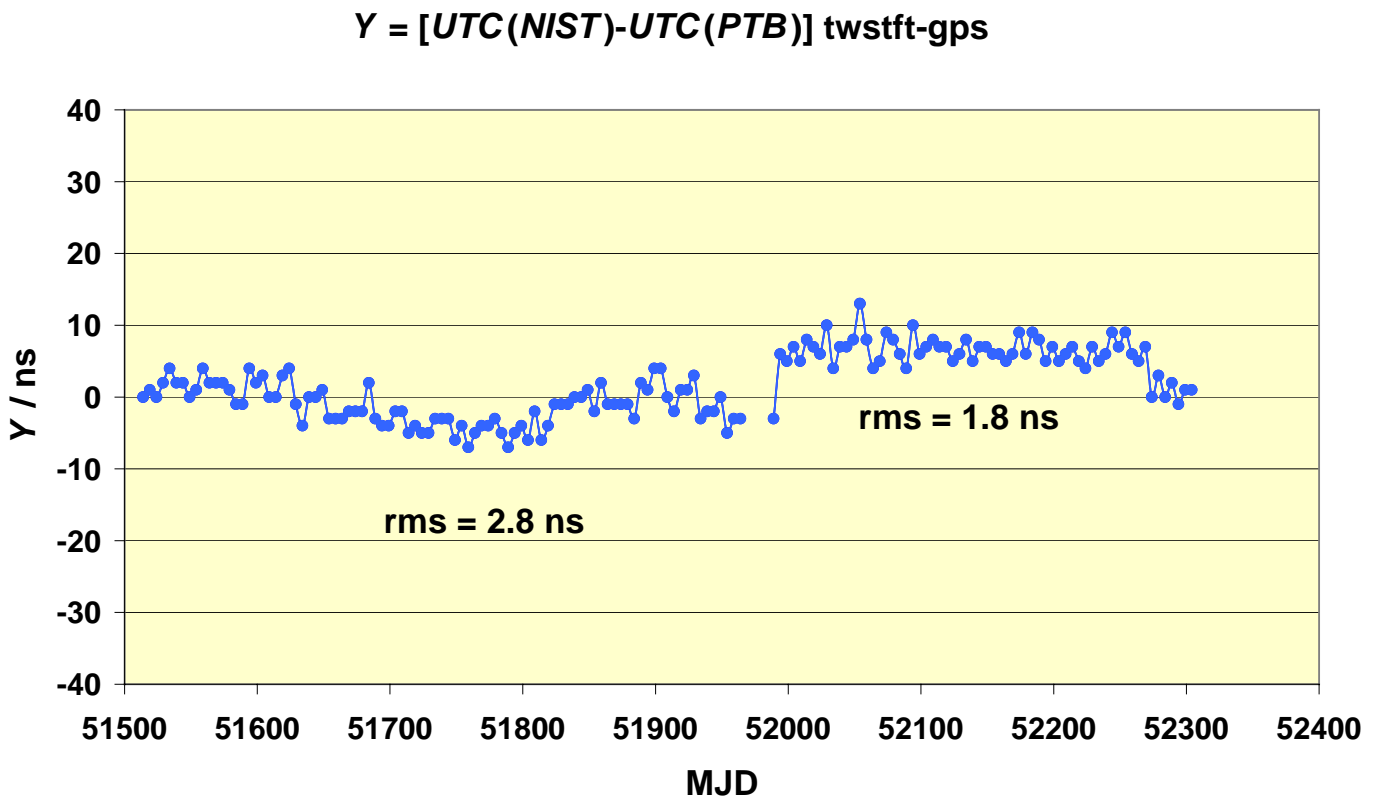


Figure 1. Differences between TWSTFT and GPS C/A-code common-view for NIST/PTB link.

Notes: After changes of INTELSAT 307° E transponders from 25 February to 17 March 2001 (MJD 51965 – 51985) causing time steps, a new calibration of the NIST/PTB TWSTFT link derived from *Circular T* was applied starting from 31 December 2001 (MJD 52274).

Since 5 January 2002 (MJD 52279) the TWSTFT data are used again for the computation of TAI and the corresponding GPS data are computed in parallel and kept as back-up.

Several changes in PTB earth station hardware in March 2001 ending on 28 March 2001 (MJD 51996).

Table 2. USNO/NPL link with NPL TWSTFT Station 02 through INTELSAT 307° E

Date 2001/2002 (MJD)	$[UTC(USNO) - UTC(NPL)] / ns$		(TWSTFT-GPS)/ns
	TWSTFT (<i>Circular T</i>)	GPS	
1 November (52214)	15	4	11
6 November (52219)	17	7	10
11 November (52224)	21	9	12
16 November (52229)	23	12	11
21 November (52234)	27	15	12
26 November (52239)	31	20	11
1 December (52244)	35	23	12
6 December (52249)	37	28	9
11 December (52254)	38	27	11
16 December (52259)	34	24	10
21 December (52264)	31	20	11
26 December (52269)	29	18	11
31 December (52274)	27	18	9
5 January (52279)	25	14	11
10 January (52284)	22	12	10
15 January (52289)	20	8	12
20 January (52294)	18	7	11
25 January (52299)	17	6	11

$$Y = [UTC(USNO) - UTC(NPL)] \text{ twstft-gps (NPL2)}$$

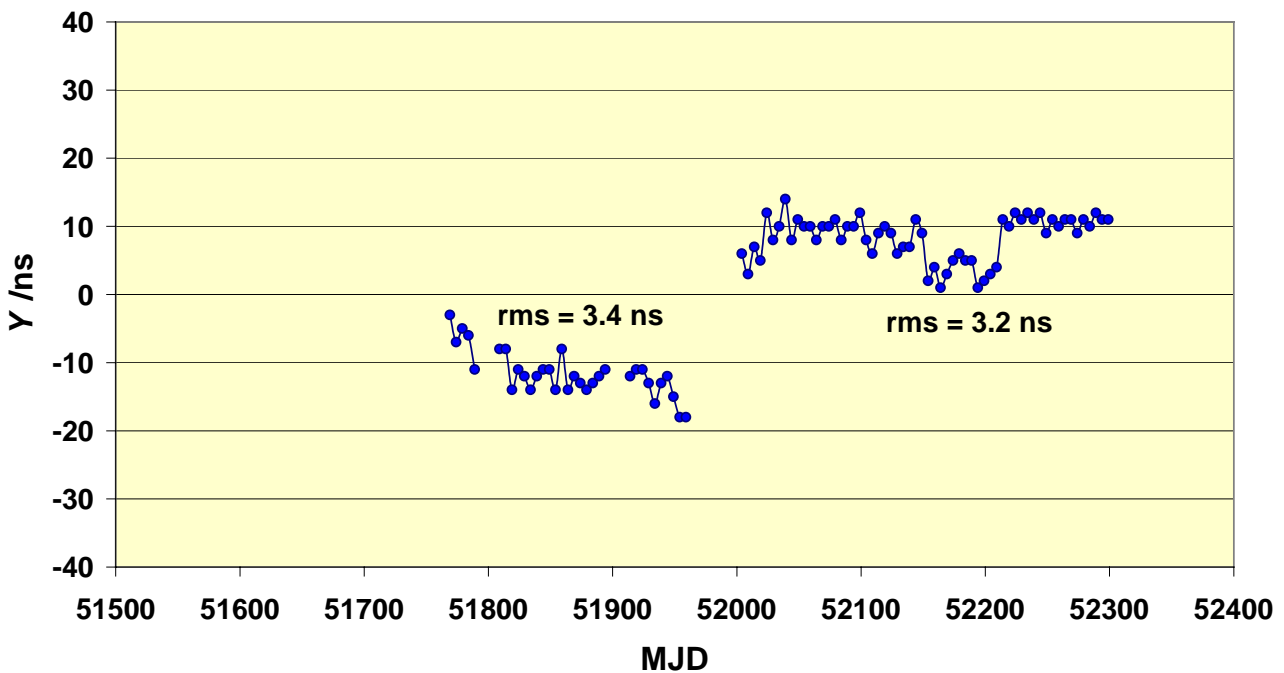


Figure 2. Differences between TWSTFT (NPL station 02) and GPS C/A-code common-view for USNO/NPL link.

Notes: Changes of INTELSAT 307° E transponders from 25 February to 17 March 2001 (MJD 51965-51985) causing time steps.

A new calibration of the USNO/NPL02 TWSTFT Ku-band link by the USNO portable X-band station link was applied starting from 19 March 2001 (MJD 51987).

Change of GPS receiver at the USNO from single-channel to multi-channel on 1 April 2001 (MJD 52000).

Change of USNO modem from Mitrex to Satre on 4 May 2001 (MJD 52033).

Change of GPS receiver at the NPL at the beginning of September 2001 (about MJD 52154).

The USNO/NPL TWSTFT link with NPL TWSTFT Station 02 is used for the computation of TAI. The corresponding GPS multi-channel data are computed in parallel and kept as back-up.

Table 3. USNO/PTB link through INTELSAT 307° E

Date 2001/2002 (MJD)	[UTC(USNO) – UTC(PTB)] /ns		(TWSTFT – GPS)/ns
	TWSTFT	GPS	
1 November (52214)	-9	-34	25
6 November (52219)	-8	-30	22
11 November (52224)	-10	-34	24
16 November (52229)	-11	-37	26
21 November (52234)	-12	-36	24
26 November (52239)	-10	-34	24
1 December (52244)	-12	-37	25
6 December (52249)	-10	-35	25
11 December (52254)	-9	-34	25
16 December (52259)	-6	-29	23
21 December (52264)	-9	-29	20
26 December (52269)	-8	-30	22
31 December (52274)	-6	-30	24
5 January (52279)	-9	-33	24
10 January (52284)	-11	-34	23
15 January (52289)	-11	-35	24
20 January (52294)	-8	-31	23
25 January (52299)	-3	-26	23
30 January (52304)	1	-24	25

$$Y = [UTC(USNO) - UTC(PTB)]_{\text{twstft-gps}}$$

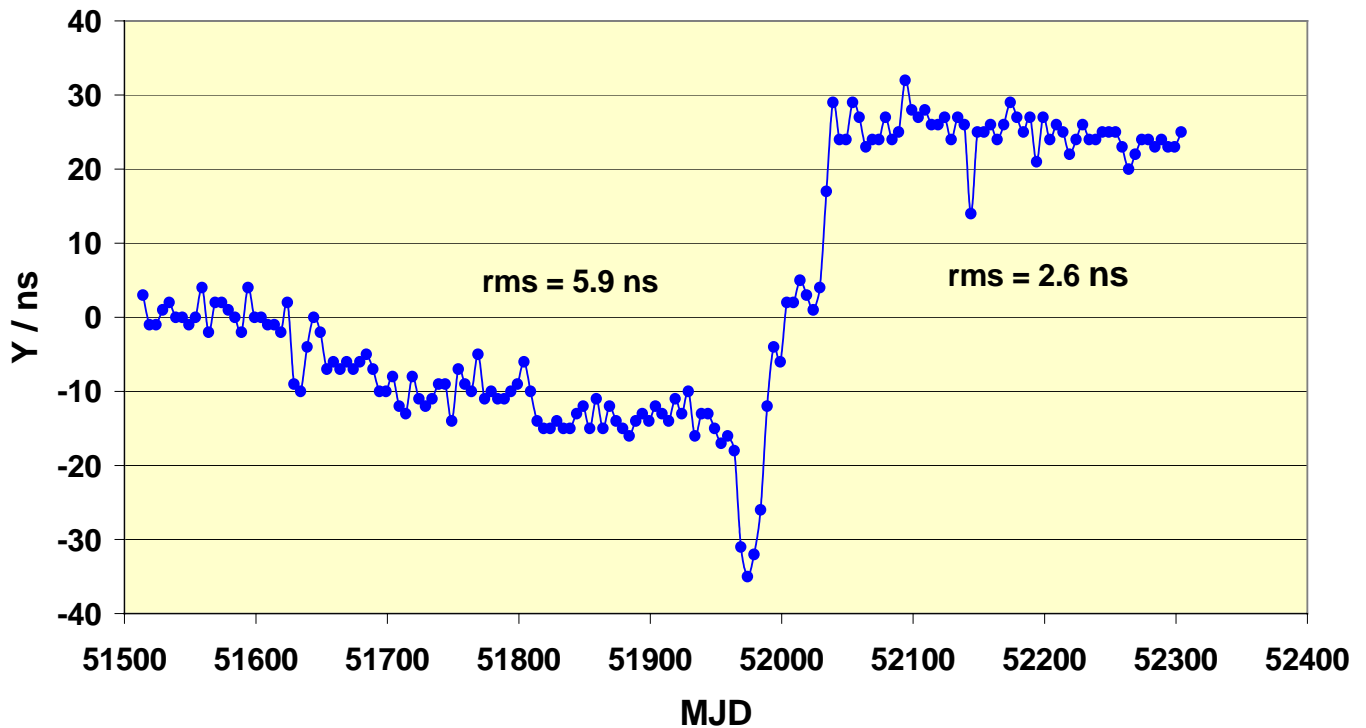


Table 3. Differences between TWSTFT and GPS C/A-code common-view for USNO/PTB link

Note: A calibration of the USNO/PTB TWSTFT link derived from *Circular T* values from July 1999 was applied starting from 29 November 1999 (MJD = 51511).

Changes of INTELSAT 307° E transponders from 25 February to 17 March 2001 (MJD 51965-51985) causing time steps.

Several changes in PTB earth station hardware in March 2001 ending on 28 March 2001 (MJD 51996).

Change of GPS receiver at the USNO from single-channel to multi-channel on 1 April 2001 (MJD 52000).

Change of USNO modem from Mitrex to Satre on 4 May 2001 (MJD 52033).

Table 4. VSL/PTB link through INTELSAT 307° E

Date 2001/2002 (MJD)	[UTC(VSL) – UTC(PTB)] /ns		(TWSTFT – GPS) /ns
	TWSTFT (<i>Circular T</i>)	GPS	
1 November (52214)	17	15	2
6 November (52219)	16	13	3
11 November (52224)	18	14	4
16 November (52229)	19	13	6
21 November (52234)	25	23	2
26 November (52239)	24	20	4
1 December (52244)	12	8	4
6 December (52249)	12	8	4
11 December (52254)	6	0	6
16 December (52259)	9	2	7
21 December (52264)	9	5	4
26 December (52269)	0	-2	2
31 December (52274)	-12	-15	3
5 January (52279)	-12	-15	3
10 January (52284)	-17	-24	7
15 January (52289)	-28	-32	4
20 January (52294)	-17	-20	3
25 January (52299)	-1	-4	3
30 January (52304)	4	-2	6

$$Y = [UTC(VSL) - UTC(PTB)] \text{ twstft-gps}$$

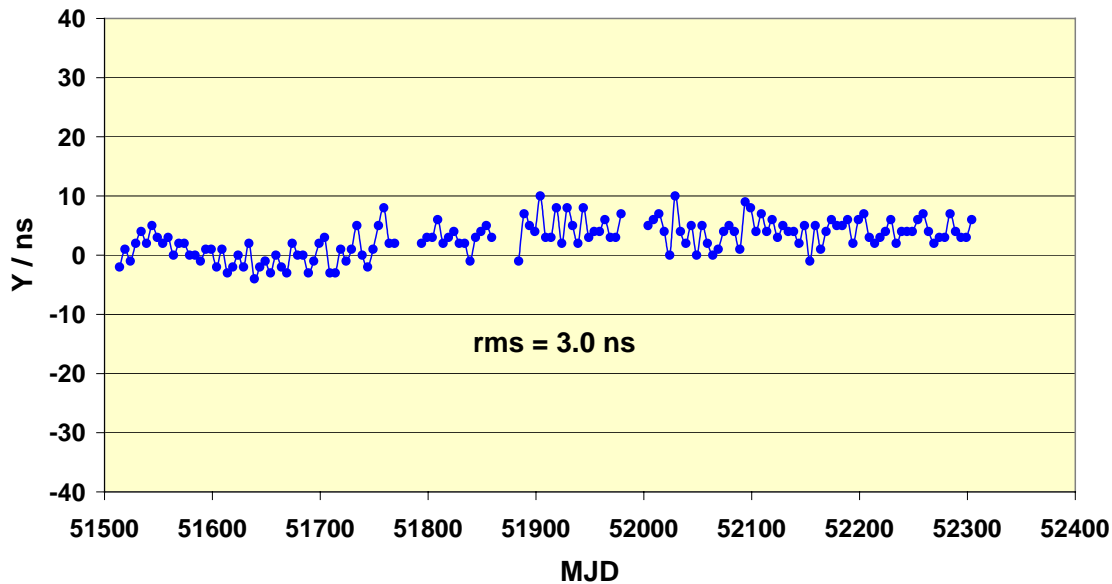


Figure 4. Differences between TWSTFT and GPS C/A-code common-view for VSL/PTB link

Notes: The VSL/PTB TWSTFT link was calibrated by *Circular T*.

The VSL/PTB TWSTFT link has been included in the computation of TAI since 1 January 2000 (MJD = 51544).

Several changes in PTB earth station hardware in March 2001 ending on 28 March 2001 (MJD 51996).

Table 5. NPL/PTB link with NPL TWSTFT Station 01 through INTELSAT 307° E

Date 2001/2002 (MJD)	[UTC(NPL) – UTC(PTB)] /ns		(TWSTFT–GPS)/ns
	TWSTFT (<i>Circular T</i>)	GPS	
1 November (52214)	–40	–40	0
6 November (52219)	–43	–42	–1
11 November (52224)	–49	–48	–1
16 November (52229)	–52	–54	2
21 November (52234)	–56	–55	–1
26 November (52239)	–58	–58	0
1 December (52244)	–63	–64	1
6 December (52249)	–68	–67	–1
11 December (52254)	–64	–66	2
16 December (52259)	–57	–59	2
21 December (52264)	–55	–58	3
26 December (52269)	–52	–54	2
31 December (52274)	–50	–53	3
5 January (52279)	–51	–51	0
10 January (52284)	–50	–50	0
15 January (52289)	–48	–48	0
20 January (52294)	–44	–42	–2
25 January (52299)	–36	–37	1
30 January (52304)	–32	–34	2

$$Y = [UTC(NPL) - UTC(PTB)]_{twstft-gps}$$

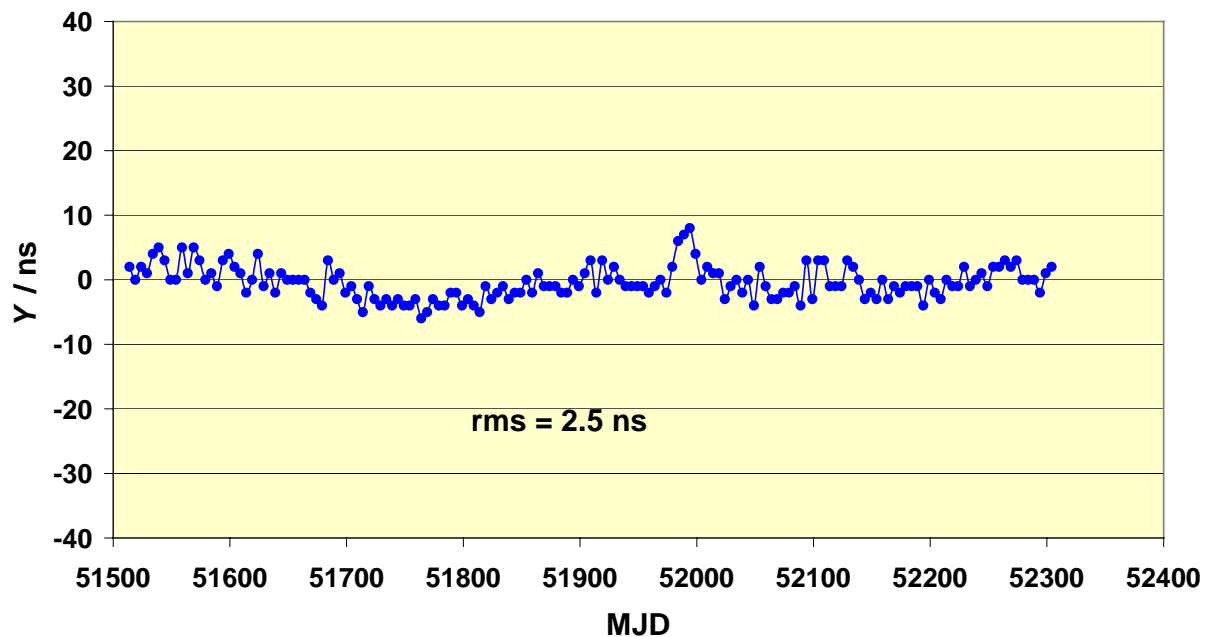


Figure 5. Differences between TWSTFT (NPL station 01) and GPS C/A-code common-view for NPL/PTB link.

Notes: A new calibration of the NPL/PTB TWSTFT link using *Circular T* was applied on 29 November 1999 (MJD 51511).

The NPL/PTB TWSTFT link has been included in the computation of TAI since 4 July 2000 (MJD 51729).

Several changes in PTB earth station hardware in March 2001 ending on 28 March 2001 (MJD 51996).

Change of GPS receiver at the NPL at the beginning of September 2001 (about MJD 52154).

Table 6. NPL/VSL link with NPL TWSTFT Station 01 through INTELSAT 307° E

Date 2001/2002 (MJD)	[UTC(NPL) – UTC(VSL)] /ns		(TWSTFT – GPS)/ns
	TWSTFT	GPS	
1 November (52214)	-58	-55	-3
6 November (52219)	-60	-55	-5
11 November (52224)	-66	-62	-4
16 November (52229)	-73	-67	-6
21 November (52234)	-81	-78	-3
26 November (52239)	-82	-79	-3
1 December (52244)	-76	-71	-5
6 December (52249)	-79	-76	-3
11 December (52254)	-71	-67	-4
16 December (52259)	-67	-62	-5
21 December (52264)	-65	-63	-2
26 December (52269)	-54	-52	-2
31 December (52274)	-39	-38	-1
5 January (52279)	-39	-36	-3
10 January (52284)	-34	-27	-7
15 January (52289)	-21	-17	-4
20 January (52294)	-27	-22	-5
25 January (52299)	-37	-34	-3
30 January (52304)	-37	-32	-5

$$Y = [UTC(NPL) - UTC(VSL)]_{\text{twstft-gps}}$$

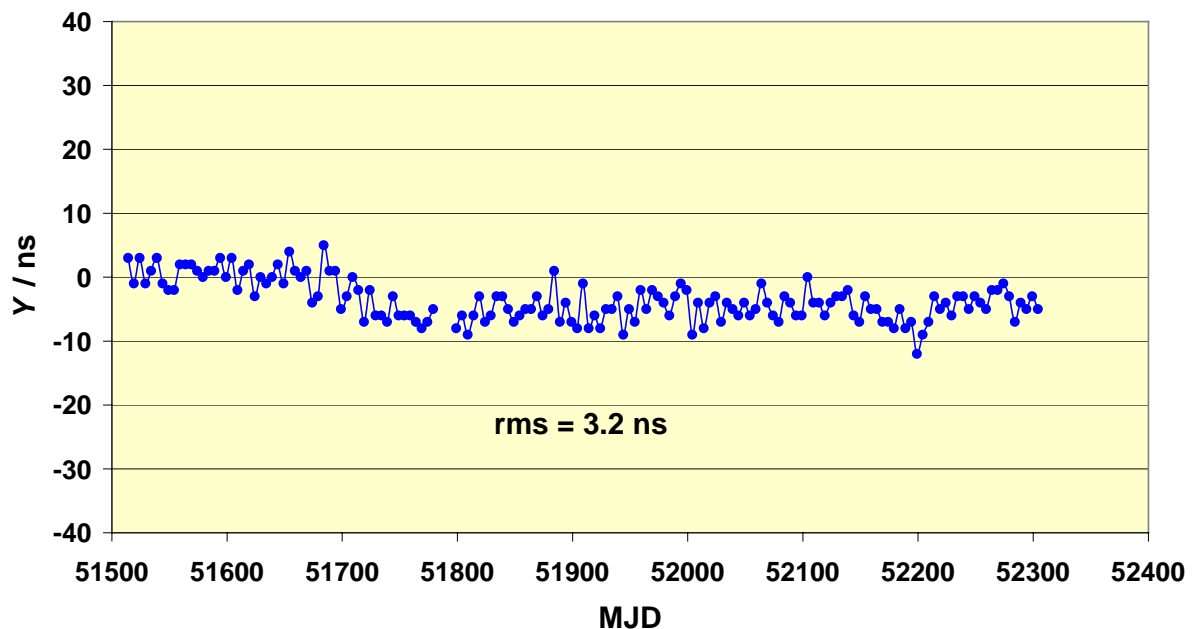


Figure 6. Differences between TWSTFT (NPL station 01) and GPS C/A-code common-view for NPL/VSL link

Note: A new calibration of the NPL/VSL TWSTFT link using *Circular T* was applied on 29 November 1999 (MJD = 51511).

Change of GPS receiver at the NPL at the beginning of September 2001 (about MJD 52154).

Table 7. IEN/PTB link through INTELSAT 307° E

Date 2001/2002 (MJD)	[UTC(IEN) – UTC(PTB)] /ns		(TWSTFT – GPS) /ns
	TWSTFT	GPS (Circular T)	
1 November (52214)	190	–48	238
6 November (52219)	192	–46	238
11 November (52224)	199	–40	239
16 November (52229)	208	–31	239
21 November (52234)	213	–22	235
26 November (52239)	215	–22	237
1 December (52244)	208	–30	238
6 December (52249)	213	–24	237
11 December (52254)	211	–26	237
16 December (52259)	214	–26	240
21 December (52264)	219	–14	233
26 December (52269)	226	–10	236
31 December (52274)	226	–11	237
5 January (52279)	220	–20	240
10 January (52284)	230	–8	238
15 January (52289)	231	–8	239
20 January (52294)	227	–9	236
25 January (52299)	227	–12	239
30 January (52304)	237	–1	238

$$Y = UTC(IEN) - UTC(PTB) - twstft - gps$$

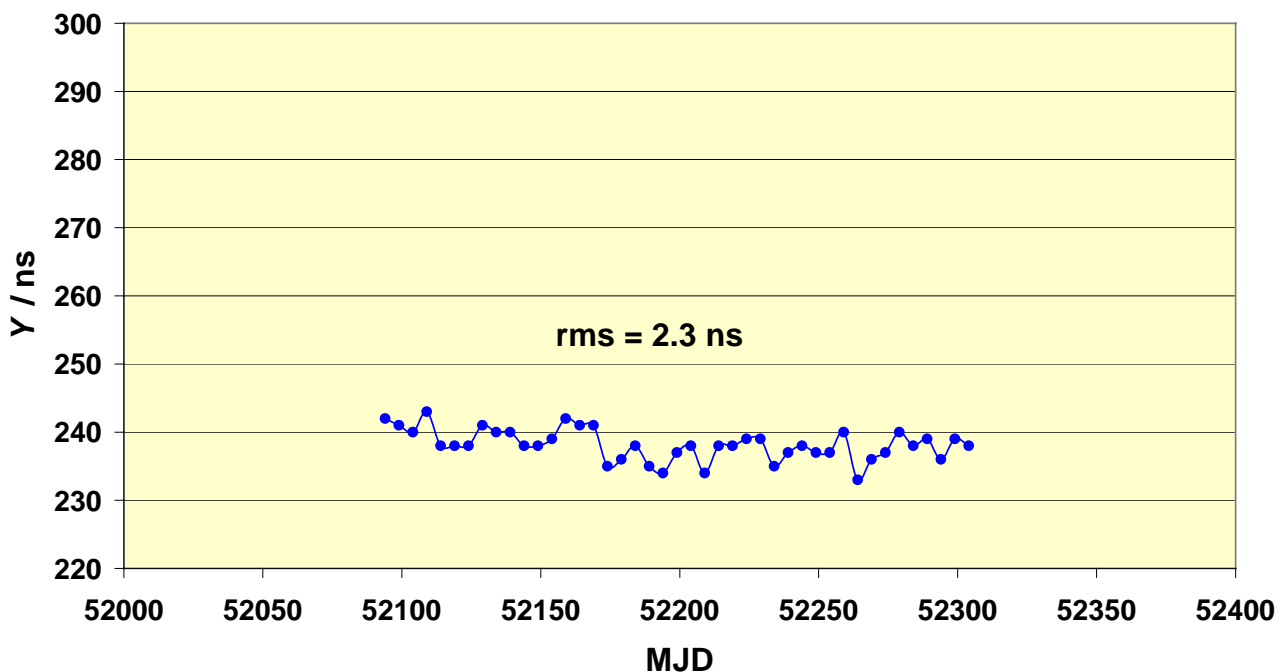


Figure 7. Differences between TWSTFT and GPS C/A-code common-view for IEN/PTB link.

Note: TWSTFT is not calibrated.

Table 8. ROA/PTB link through INTELSAT 307° E

Introduction of ROA/PTB TWSTFT link into TAI

Date 2002 (MJD)	[UTC(ROA)– UTC(PTB)] /ns		(TWSTFT – GPS)/ns
	TWSTFT (<i>Circular T</i>)	GPS	
5 January (52279)	31	26	5
10 January (52284)	32	31	1
15 January (52289)	21	18	3
20 January (52294)	15	7	8
25 January (52299)	28	28	0
30 January (52304)	23	19	4

Note: A calibration of the ROA/PTB TWSTFT link derived from *Circular T* values is applied starting from 31 December 2001 (MJD = 52274).

ROA/PTB TWSTFT link is used for the TAI computation since 5 January 2002 (MJD 52279)

Table 9. PTB/OCA link through INTELSAT 307° E

Date 2001/2002 (MJD)	[UTC(PTB) – OCA clock] /ns		(TWSTFT – GPS)/ns
	TWSTFT	GPS	
1 November (52214)	3186	3121	65
6 November (52219)	3116	3053	63
11 November (52224)	3043	2985	58
16 November (52229)	2970	2908	62
21 November (52234)	2887	2832	55
26 November (52239)	2806	2750	56
1 December (52244)	2739	2683	56
6 December (52249)	2654	2586	68
11 December (52254)	2575	2513	62
16 December (52259)	2493	2435	58
21 December (52264)	2413	2350	63
26 December (52269)	2333	2268	65
31 December (52274)	2254	2181	73
5 January (52279)	2177	2101	76
10 January (52284)	2103	2036	67
15 January (52289)	2021	1955	66
20 January (52294)	1942	1874	68
25 January (52299)	1862	1790	72
30 January (52304)	1780	1700	80

$$Y = [UTC(PTB) - OCA\ clock]_{twstft-gps}$$

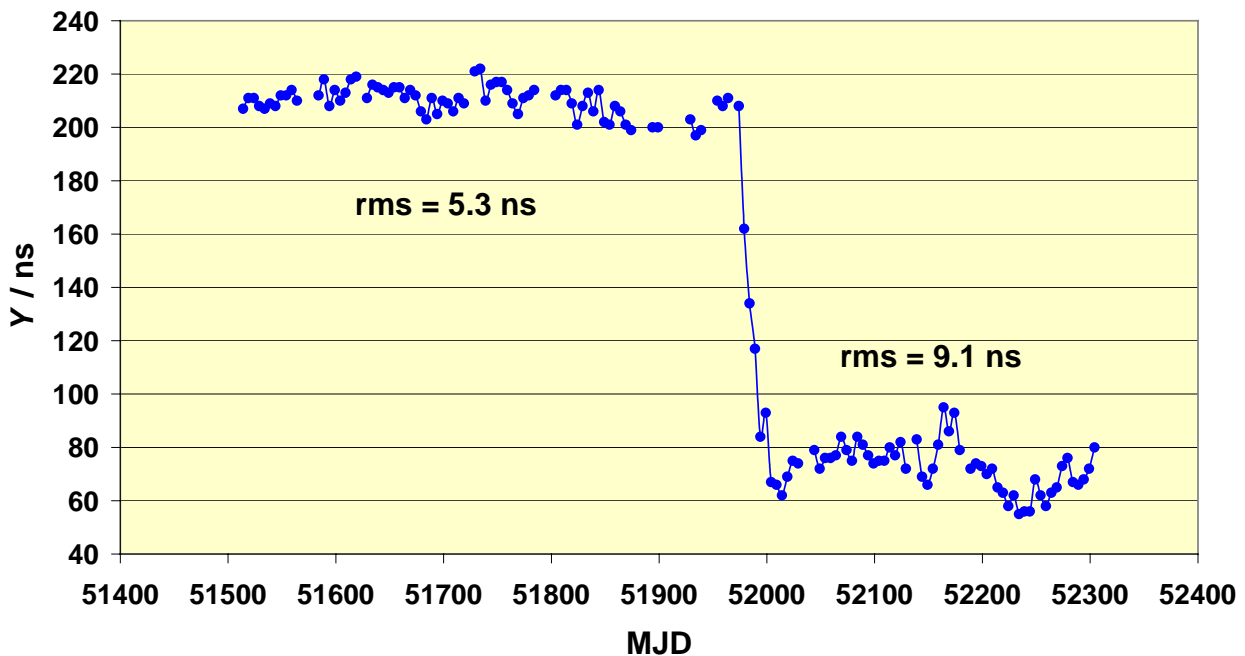


Figure 9. Differences between TWSTFT and GPS C/A-code common-view for PTB/OCA link. TWSTFT is not calibrated.

Note: Several changes in PTB earth station hardware in March 2001 ending on 28 March 2001 (MJD 51996).

Table 10. NML/CRL link through INTELSAT 176° E

Date 2001 (MJD)	$[UTC(NML) - UTC(CRL)] / ns$		(TWSTFT - GPS)/ns
	TWSTFT	GPS (<i>Circular T</i>)	
1 November (52214)	31	3	28
6 November (52219)	49	19	30
11 November (52224)	56	28	28
16 November (52229)	48	23	25
21 November (52234)	62	35	27
26 November (52239)	61	38	23
1 December (52244)	76	43	33
6 December (52249)	91	65	26
11 December (52254)	110	85	25

$$Y = UTC(NML) - UTC(CRL) - twstft - gps$$

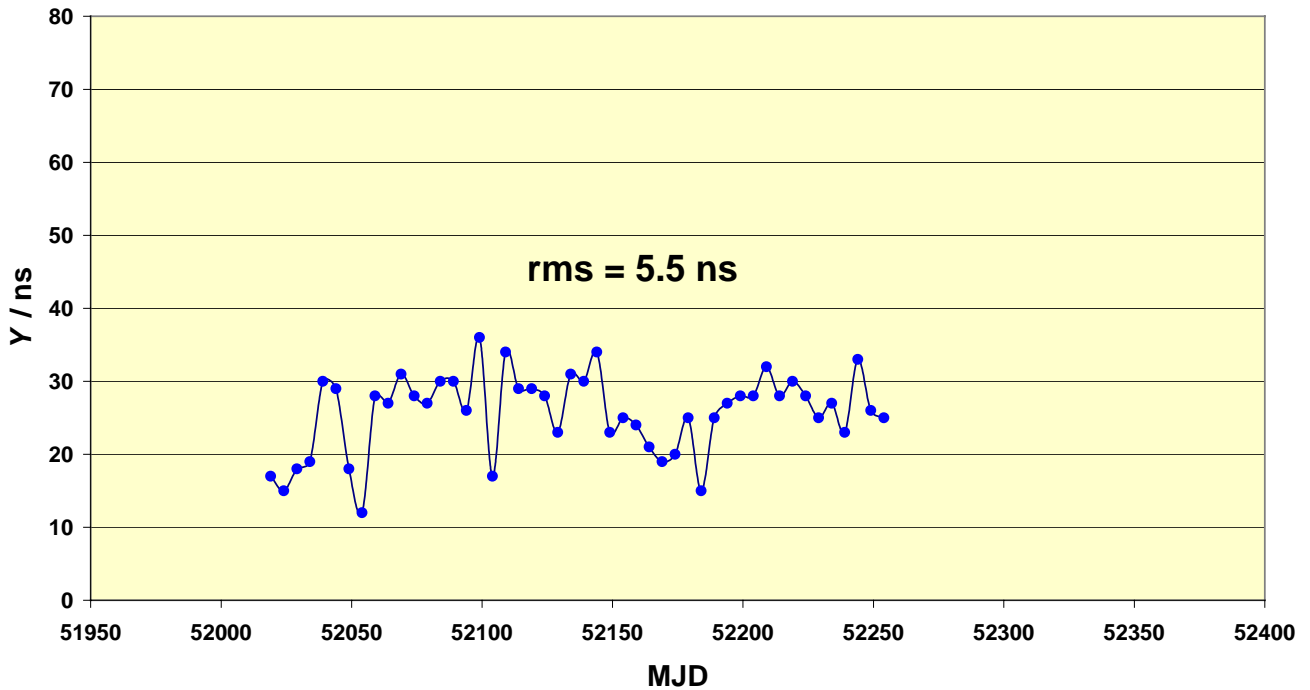


Figure 10. Differences between TWSTFT and GPS C/A-code common-view for NML/CRL link.

Note: TWSTFT is not calibrated.

Table 11. NTSC*/CRL link through JCSAT-1B at 150° E

Date 2001 (MJD)	[UTC(NTSC) – UTC(CRL)] /ns		(TWSTFT – GPS)/ns
	TWSTFT	GPS (<i>Circular T</i>)	
1 November (52214)	30	2	28
6 November (52219)	24	–5	29
11 November (52224)	18	–13	31
16 November (52229)	9	–16	25
21 November (52234)	17	–9	26
26 November (52239)	18	–1	19
1 December (52244)	42	10	32
6 December (52249)	52	22	30
11 December (52254)	68	41	27
16 December (52259)	57	30	27
21 December (52264)	36	3	33
26 December (52269)	26	–2	28
31 December (52274)	–19	–19	24

Introduction of NTSC/CRL TWSTFT link into TAI

Date 2002 (MJD)	[UTC(NTSC) – UTC(CRL)] /ns		(TWSTFT – GPS)/ns
	TWSTFT (<i>Circular T</i>)	GPS	
5 January (52279)	–8	–16	8
10 January (52284)	–13	–14	1
15 January (52289)	6	–4	10
20 January (52294)	9	8	1
25 January (52299)	27	20	7
30 January (52304)	46	35	11

$$Y = UTC(NTSC) - UTC(CRL) - \text{twstft} - \text{gps}$$

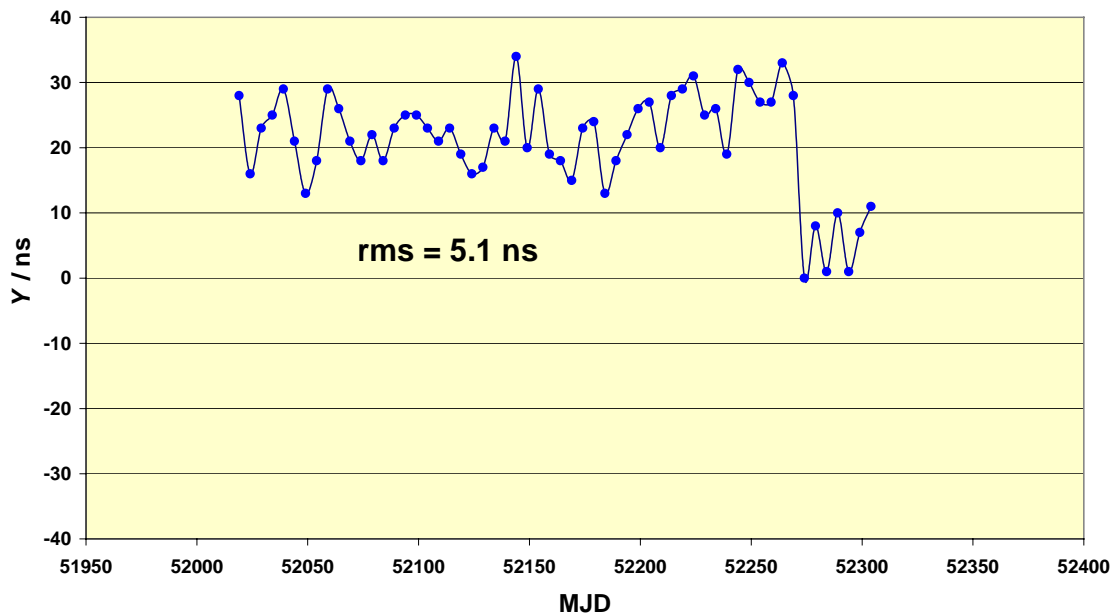


Figure 11. Differences between TWSTFT and GPS C/A-code common-view for NTSC/CRL link.

Notes: *NTSC. National Time Service Center, formerly CSAO.

A calibration of the NTSC/CRL TWSTFT link derived from *Circular T* values is applied starting from 31 December 2001 (MJD 52274).

NTSC/CRL TWSTFT link is used for the TAI computation since 5 January 2002 (MJD 52279).

Table 12. NMIJ/CRL link through JCSAT-1B at 150° E

Date 2001 (MJD)	[UTC(NMIJ) – UTC(CRL)] /ns		(TWSTFT – GPS)/ns
	TWSTFT	GPS (<i>Circular T</i>)	
1 November (52214)	208	118	90
6 November (52219)	204	112	92
11 November (52224)	207	110	97
16 November (52229)	205	111	94
21 November (52234)	208	116	92
26 November (52239)	206	116	90
1 December (52244)	223	124	99
6 December (52249)	230	133	97
11 December (52254)	241	145	96
16 December (52259)	242	146	96
21 December (52264)	239	144	95
26 December (52269)	246	149	97
31 December (52274)	149	149	0

Introduction of NMIJ/CRL TWSTFT link into TAI

Date 2002 (MJD)	[UTC(NMIJ) – UTC(CRL)] /ns		(TWSTFT – GPS)/ns
	TWSTFT (<i>Circular T</i>)	GPS (<i>Circular T</i>)	
5 January (52279)	152	156	–4
10 January (52284)	149	158	–9
15 January (52289)	170	171	–1
20 January (52294)	161	176	–15
25 January (52299)	173*	170	3
30 January (52304)	188	190	–2

$$Y = UTC(NMIJ) - UTC(CRL) - twstft - gps$$

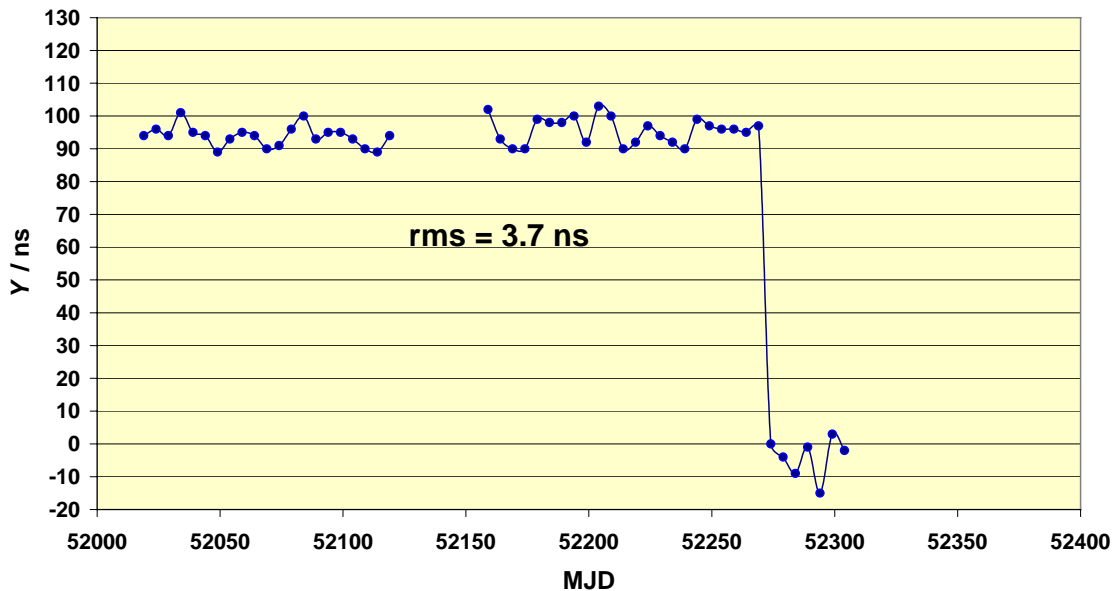


Figure 12. Differences between TWSTFT and GPS C/A-code common-view for NMIJ/CRL link.

Notes: A calibration of the NMIJ/CRL TWSTFT link derived from *Circular T* values is applied starting from 31 December 2001 (MJD 52274).

NMIJ/CRL TWSTFT link is used for the TAI computation since 5 January 2002 (MJD 52279).

Table 13. TL/CRL link through JCSAT-1B at 150° E

Date 2001 (MJD)	[UTC(TL) – UTC(CRL)] /ns		(TWSTFT – GPS)/ns
	TWSTFT	GPS (<i>Circular T</i>)	
1 November (52214)	83	17	66
6 November (52219)	79	11	68
11 November (52224)	83	18	65
16 November (52229)	93	34	59
21 November (52234)	89	27	62
26 November (52239)	86	28	58
1 December (52244)	91	32	59
6 December (52249)	97	29	68
11 December (52254)	108	46	62
16 December (52259)	109	41	68
21 December (52264)	104	46	58
26 December (52269)	110	49	61
31 December (52274)	41	41	0

Introduction of TL/CRL TWSTFT link into TAI

Date 2002 (MJD)	[UTC(TL) – UTC(CRL)] /ns		(TWSTFT – GPS)/ns
	TWSTFT(<i>Circular T</i>)	GPS (<i>Circular T</i>)	
5 January (52279)	47	49	-2
10 January (52284)	49	50	-1
15 January (52289)	55	58	-3
20 January (52294)	52	62	-10
25 January (52299)	55	53	2
30 January (52304)	61	59	2

$$Y = UTC(TL) - UTC(CRL) - \text{twstft} - \text{gps}$$

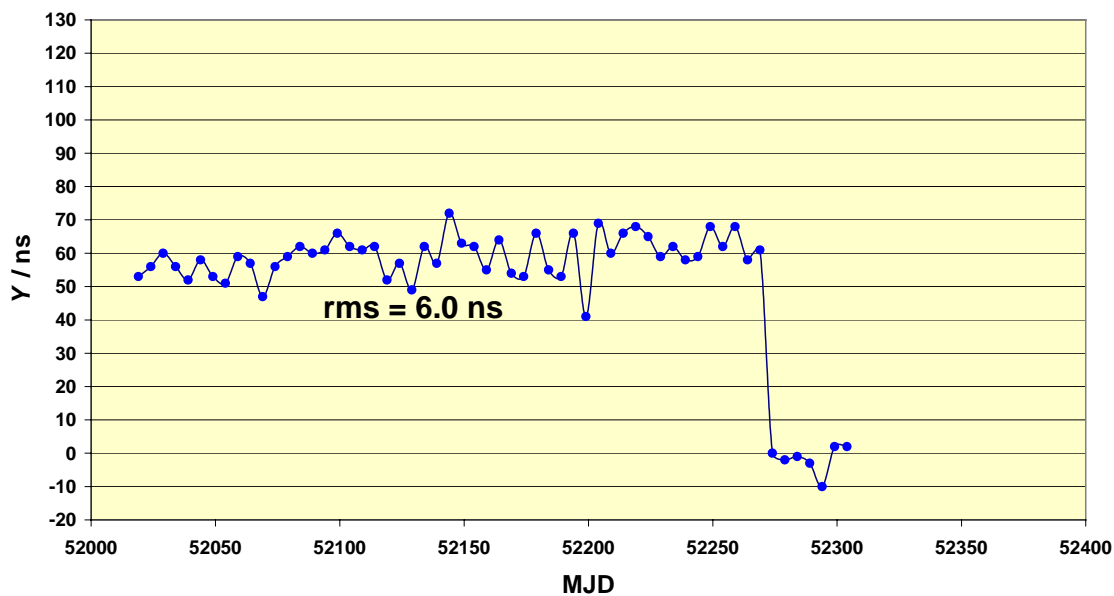


Figure 13. Differences between TWSTFT and GPS C/A-code common-view for TL/CRL link.

Notes: A calibration of the TL/CRL TWSTFT link derived from *Circular T* values is applied starting from 31 December 2001 (MJD 52274).

TL/CRL TWSTFT link is used for the TAI computation since 5 January 2002 (MJD 52279).

Section II

Frequency stability of some TWSTFT and GPS CV links
reported in Section I

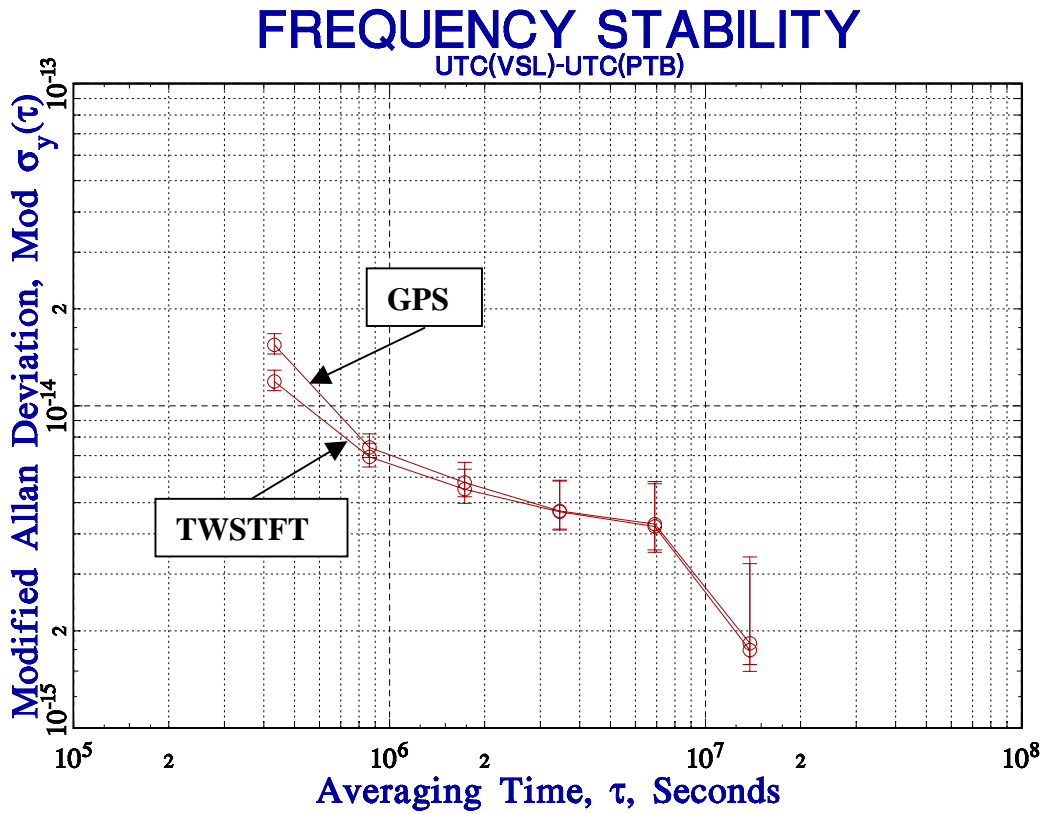


Figure 1. Frequency stability of [UTC(VSL) – UTC(PTB)] by GPS CV and by TWSTFT for the MJD period 51269 - 52304.

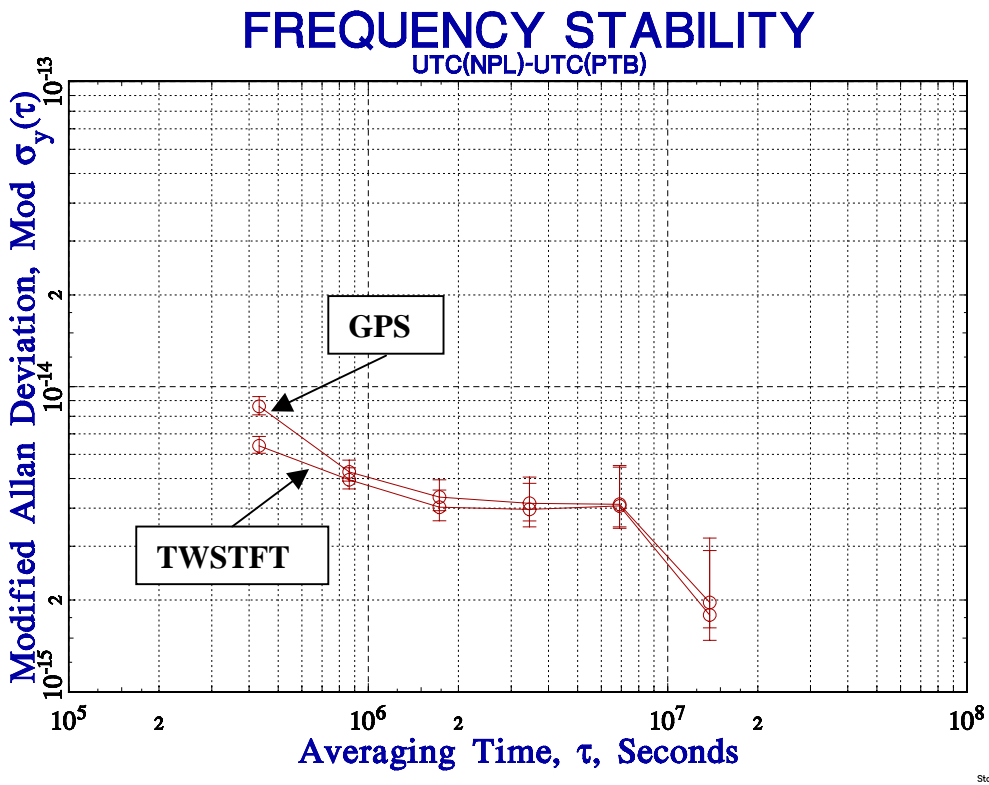


Figure 2. Frequency stability of [UTC(NPL) – UTC(PTB)] by GPS CV and by TWSTFT for the MJD period 51269 - 52304.

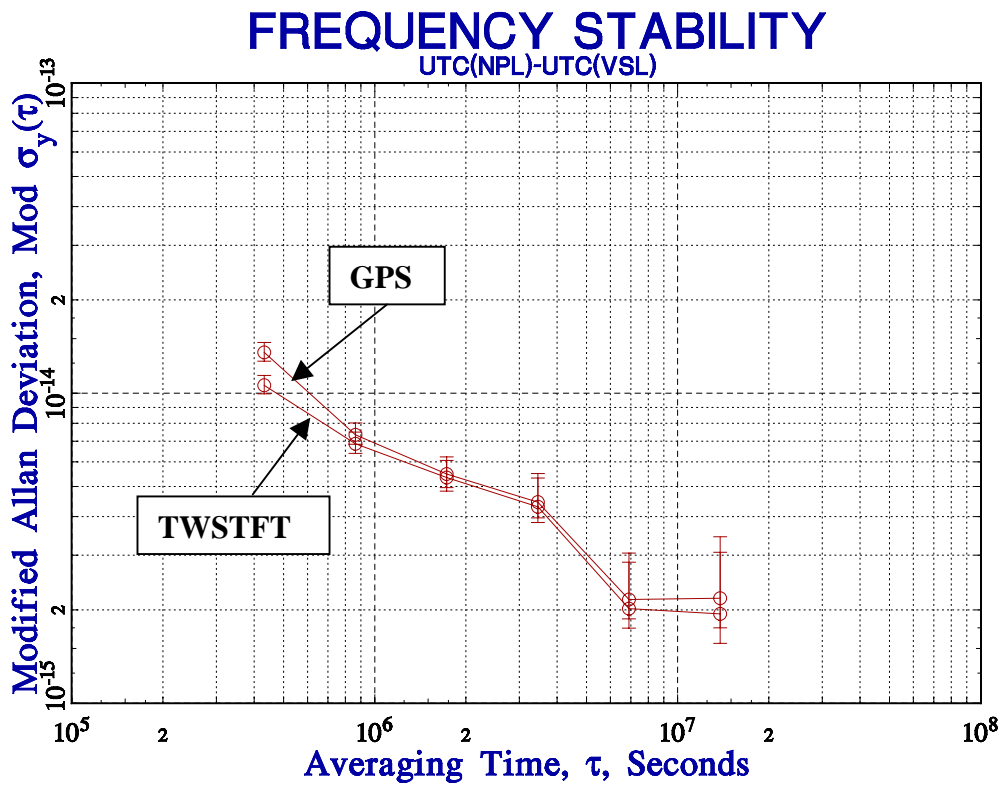


Figure 3. Frequency stability of $[UTC(NPL) - UTC(VSL)]$ by GPS CV and by TWSTFT. for the MJD period 51269 - 52209.

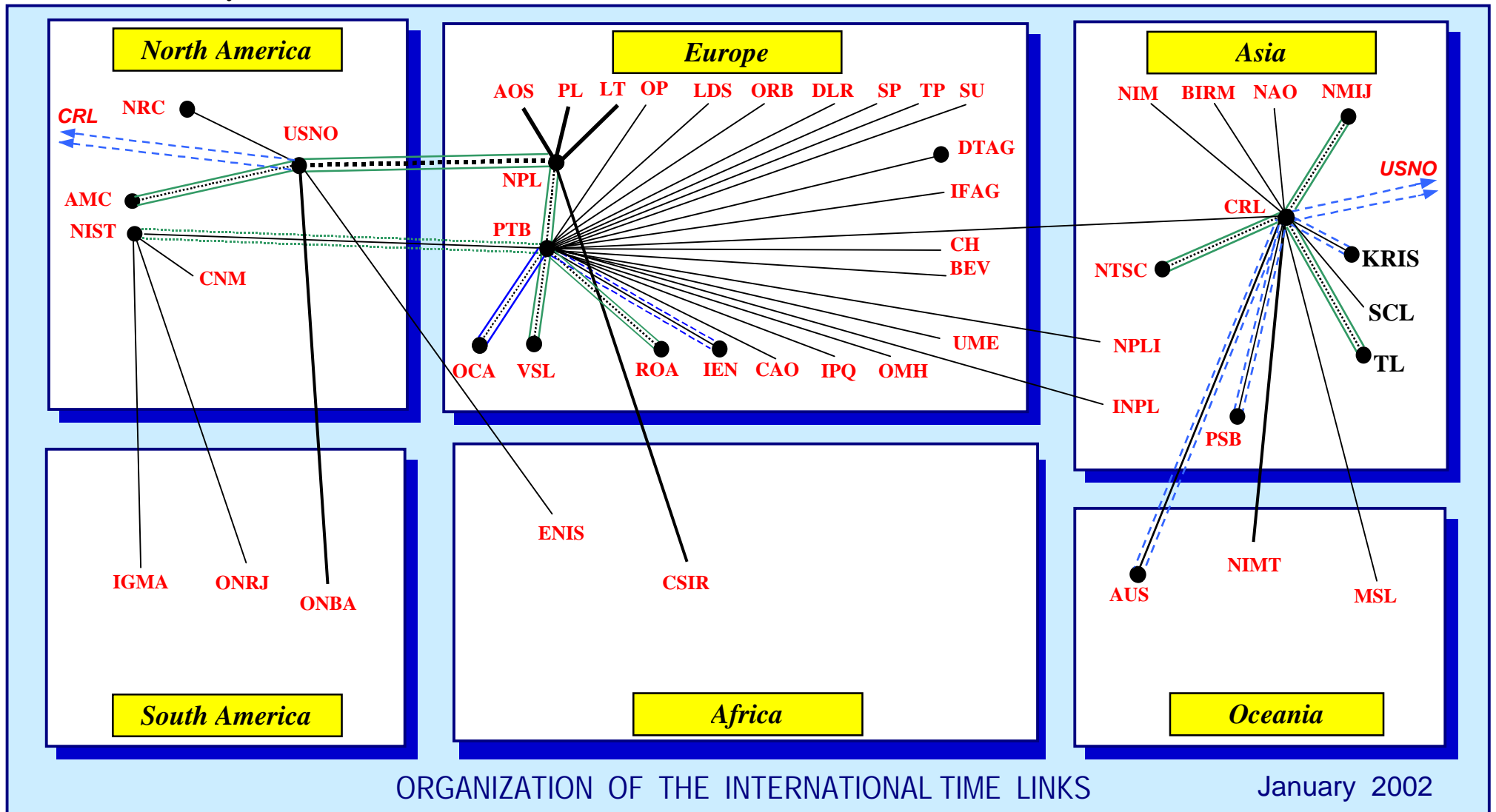
Section III: Description of some equipment providing data for this report.

Lab.	GPS CV	TWSTFT (through INTELSAT 307° E)
NIST	Receiver type: NBS/TTR5 Receiver serial no: 010 Internal delay: 53.0 ns Reference name: UTC(NIST) Reference type: ensemble of 4 Cs + 5 H-masers	Modem type: University of Stuttgart/MITREX 2500 Modem serial no: Antenna: 3.7 m – steerable Degree of automation: 85 % Reference name: UTC(NIST) Reference type: ensemble of 4 Cs + 5 H-masers
OCA	Receiver type: AOA/TTR5 Receiver serial No: Internal delay: Reference name: OCA clock Reference type: 1 Cs	Modem type: University of Stuttgart/MITREX 2500 Modem serial no: Antenna: 1.8 m – VSAT Andrew Degree of automation: Reference name: OCA clock Reference type: 1 Cs
NPL *	Receiver type: AOA/TTR5A Receiver serial No: 276 Internal delay: 68.5 ns Reference name: UTC(NPL) Reference type: 1 H-maser	Modem type: TimeTech/SATRE (carrier-phase option) Modem serial no: 038 Antenna: 2.4 m – VSAT Degree of automation: Reference name: UTC(NPL) Reference type: 1 H-maser
PTB	Receiver type: Rockwell Collins/TTR5 Receiver serial No: Internal delay: 77 ns Reference name: UTC(PTB) Reference type: 1 Lab. Cs	Modem type: TimeTech/SATRE (carrier-phase option) Modem serial no: 037 Antenna: 1.8 m – VSAT Degree of automation: Reference name: UTC(PTB) Reference type: 1 Lab. Cs
USNO *	Receiver type: AOA/TTR6 Receiver serial no: 440 Internal delay: Reference name: UTC(USNO MC) Reference type: 1 H-maser + freq. syntent.	Modem type: University of Stuttgart/MITREX 2500 Modem serial no: 85006 From 4 May 2001: TimeTech/SATRE Antenna: 4.6 m – steerable Degree of automation: Reference name: UTC(USNO MC) Reference type: 1 H-maser + freq. syntent.
VSL	Receiver type: VSL/TTR5 Receiver serial no: VSL01 Internal delay: 63.9 ns Reference name: UTC(VSL) Reference type: 1 Cs + micro-phase-stepper	Modem type: University of Stuttgart/MITREX 2500 Modem serial no: 85008 Antenna: 3 m – steerable Degree of automation: Reference name: UTC(VSL) Reference type: 1 Cs + micro-phase-stepper

Notes

* The NPL and USNO are also equipped with TWSTFT back-up stations.

Section IV: Summary of the international time links.



ORGANIZATION OF THE INTERNATIONAL TIME LINKS

January 2002

- | | | | |
|--|--|--|------------------------------------|
| | TWSTFT | | GPS CV single-channel |
| | TWSTFT back-up link | | GPS CV single-channel back-up link |
| | TWSTFT link in preparation | | GPS CV multi-channel |
| | OCA/PTB link not used for computation of TAI | | GPS CV multi-channel back-up link |
| | Laboratory equipped with TWSTFT | | |

