

Current status of TAI

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6th meeting of laboratories
contributing to TAI
31 March 2004, BIPM

Stability of EAL, accuracy of TAI

- Stability (20 to 40 days)
 - 0.6×10^{-15}
- BIPM evaluation of d $+5.0 \times 10^{-15}$ to $+11.9 \times 10^{-15}$
 - $u = 2.0 \times 10^{-15}$



Clocks participating in TAI



53 contributing laboratories

250 - 300 clocks

- HP5071A 68%
- H masers 16%
- Other 16%



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Clock weighting



stability

- independent clocks,
- **relative weights,**
- upper limit to clock weights,
- **weight of a clock remains constant on the 30 days of the interval of computation,**
- iterative process based on the previous interval to predict the clock frequencies on the following interval (random walk frequency modulation...),
- **weight determination based on 12 intervals of computation (one year)**
 - deweighting (annual frequency variations, long term drifts),
 - **detection of abnormal behavior**

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Clock comparison

- GPS (...)
- TWSTFT

- GPS schedules for single channel receivers
- GLONASS schedules

TAI accuracy

- Primary frequency standards

- NIST-F1

- IEN-CSF1

- PTB-CSF1

- SYRTE-FOM

- SYRTE-FO2

- PTB-CS1, PTB-CS2

- CRL-O1

- SYRTE-JPO

} caesium fountains

- BIPM evaluation of d $+5.0 \times 10^{-15}$ to $+11.9 \times 10^{-15}$
 $u = 2.0 \times 10^{-15}$



Calculation of Circular T

- Automated procedure (T-Soft, Z. Jiang)
- Shorter delay in the publication of Circular T
 - ~ 12th of the month
- More reliability

- Standard file names
- Standard formats (clocks and clock comparison)
- Respect of deadlines for data submission

Circular T

- Distribution:
 - E-mail (all correspondents)
 - BIPM web site - Time section ftp server
 - surface mail (~20)
 - ascii / pdf versions
- April 2003
 - [UTC - UTC(k)], [TAI - TA(k)] published to 0.1ns
 - access to GPS time and GLONASS time in the same table
 - new section 6
 - time links used in the calculation
 - uncertainties (January 2004)
 - calibration equipment / link (January 2004)
- new format

1 - Coordinated Universal Time UTC and its local realizations UTC(k). Computed values of $[UTC-UTC(k)]$.
From 1999 January 1, 0h UTC, $TAI-UTC = 32$ s.

Date 2004	0h UTC	JAN 30	FEB 4	FEB 9	FEB 14	FEB 19	FEB 24	FEB 29
MJD		53034	53039	53044	53049	53054	53059	53064
Laboratory k		$[UTC-UTC(k)]/ns$						
AOS (Borowiec)		-27.0	-35.2	-35.0	-28.8	-26.2	-25.2	-23.5
APL (Laurel)		-208.1	-194.7	-176.7	-146.6	-121.6	-103.3	-90.0
AUS (Sydney)		-461.1	-449.1	-452.4	-456.3	-447.0	-445.0	-454.5
BEV (Wien)		27.0	37.2	40.1	48.1	54.7	61.1	69.7
BIRM (Beijing)		1671.5	1687.6	1703.8	1713.8	1736.0	1755.7	1765.7
CAO (Cagliari)		-4073.7	-4066.4	-4055.1	-4043.2	-4031.8	-4019.3	-4026.6
CH (Bern)		-1.8	-0.5	-4.6	-2.1	2.4	4.9	5.5
CNM (Queretaro)		1.9	-5.0	-0.6	-3.9	4.4	1.2	1.2
CNMP (Panama)		-2217.8	-2286.6	-2345.4	-2432.6	-2473.3	-2535.6	-2603.2
CRL (Tokyo)		-12.8	-8.5	-10.4	-9.2	-7.3	-5.6	-6.1
CSIR (Pretoria)		2947.5	2886.1	2817.6	2760.6	2686.4	2614.3	2539.0
DLR (Oberpfaffenhofen)		17.0	10.2	13.3	13.3	18.3	29.9	31.4
DTAG (Darmstadt)		221.6	230.3	236.7	222.6	226.9	223.3	222.3
IEN (Torino)		-26.9	-22.0	-15.1	-12.5	-18.9	-15.1	-23.3
IFAG (Wetzell)		-2658.1	-2680.2	-2692.4	-2703.4	-2718.5	-2738.7	-2751.9
IGMA (Buenos Aires)		-83.6	-81.4	-86.7	-86.2	-77.3	-81.2	-92.3
INPL (Jerusalem)		-9348.9	-9391.6	-9433.0	-9450.8	-9484.9	-9510.4	-9533.8
JATC (Lintong)		-11080.5	-11065.6	-11061.6	-11063.2	-11057.8	-11049.7	-11039.0
JV (Kjeller)		-9864.9	-9852.0	-9808.6	-9762.2	-9745.8	-9687.1	-9616.8
KRIS (Daejeon)		18.0	11.0	13.9	8.3	1.5	0.6	0.2
LDS (Leeds)		4893.2	4929.4	4962.6	5006.2	5021.4	5034.9	5051.4
LT (Vilnius)		124.7	130.6	122.3	122.2	137.9	142.9	134.3
MSL (Lower Hutt)		-80.8	-96.9	-68.2	-33.5	-14.4	-13.5	-7.7
NAO (Mizusawa)		-30.1	-35.8	-34.3	-55.2	-69.7	-72.4	-79.7
NIM (Beijing)		-2658.1	-2648.6	-2655.6	-2652.6	-2647.3	-2652.5	-2657.6
NIMB (Bucharest)		-324.1	-312.4	-305.1	-299.2	-291.8	-282.6	-294.8
NIMT (Bangkok)		-882.4	-902.2	-914.4	-936.9	-952.3	-973.6	-990.3
NIST (Boulder)		-3.1	-4.5	-1.5	-2.0	-0.5	1.2	1.1
NMC (Sofiya)		-3584.3	-3595.5	-3601.7	-3606.8	-3631.3	-3663.2	-3667.4
NMIJ (Tsukuba)		88.7	97.3	98.9	102.5	105.6	110.0	112.9

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6 - Time links used for the computation of TAI and their uncertainties.

The time links used in the elaboration of this *Circular T* are listed in this section. The technique for the link is indicated as follows: GPS SC for GPS common-view single-channel C/A data; GPS MC for GPS common-view multi-channel C/A data; GPS P3 for GPS common-view multi-channel dual-frequency P code data; GPS GT for 'GPS time' observations; INT LK for internal cable link and TWSTFT for two-way satellite time and frequency transfer data.

For each link, the following uncertainties are provided: u_A is the statistical uncertainty evaluated by taking into account the level of phase noise in the raw data, the interpolation interval between data points and the effects with typical duration between 5 and 30 days. u_B is the uncertainty on the calibration, estimated by the BIPM.

The calibration type of the link is indicated as: GPS EC for GPS equipment calibration; TW EC for two-way equipment calibration; LC (technique) for a link calibrated using 'technique'; BC (technique) for a link calibrated using 'technique' to transfer a past equipment calibration through a discontinuity of link operation.

The calibration dates indicate: the most recent calibration results for the two laboratories in the case of EC and the most recent calibration of the link in the case of LC and BC, NA stands for not available, in this case estimated values are provided

Link	Type	u_A /ns	u_B /ns	Calibration Type	Calibration Dates
AOS /PTB	GPS MC	1.5	5.0	GPS EC /GPS EC	2001 Oct/2003 Aug
APL /USNO	GPS MC	1.5	20.0	NA /GPS EC	NA /2002 Apr
AUS /CRL	GPS MC	3.0	5.0	GPS EC/GPS EC	2002 Sep/2002 Aug
BEV /PTB	GPS MC	1.5	5.0	GPS EC/GPS EC	2001 Dec/2003 Aug
BIRM/CRL	GPS MC	2.5	20.0	NA /GPS EC	NA /2002 Aug
CAO /PTB	GPS SC	7.0	20.0	NA /GPS EC	NA /2003 Aug
CH /PTB	GPS SC	2.5	20.0	NA /GPS EC	NA /2003 Aug
CNM /NIST	GPS SC	5.0	20.0	NA /GPS EC	NA /2003 Jul
CNMP/USNO	GPS MC	4.0	7.0	GPS EC/GPS EC	2002 Oct/2002 Apr
CRL /PTB	GPS MC	2.0	5.0	GPS EC/GPS EC	2003 Oct/2003 Aug
CSIR/PTB	GPS MC	3.0	20.0	NA /GPS EC	NA /2003 Aug
DLR /PTB	GPS P3	0.7	5.0	GPS EC/GPS EC	2003 Apr/2003 Aug
DTAG/PTB	GPS SC	3.0	10.0	GPS EC/GPS EC	1998 May/2003 Aug
IEN /PTB	TWSTFT	1.0	5.0	LC (GPS SC)	2002 Feb
IFAG/PTB	GPS P3	0.7	5.0	GPS EC/GPS EC	2003 Jun/2003 Aug
IGMA/NIST	GPS GT	5.0	20.0	NA /GPS EC	NA /2003 Jul
INPL/PTB	GPS SC	4.0	10.0	GPS EC/GPS EC	1987 Jun/2003 Jun
JATC/NTSC	INT LK	0.2	20.0	NA	NA
JV /PTB	GPS GT	5.0	20.0	NA /GPS EC	NA /2003 Jun
KRIS/CRL	GPS MC	2.5	20.0	NA /GPS EC	NA /2002 Aug

