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NIST TIME AND FREQUENCY BULLETIN
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The difference between UTC(NIST) and UTC has been within ±100 ns since July 6, 1994. The table below shows values of UTC - UTC(NIST) as supplied by the BIPM in their *Circular T* publication for the most recent 310-day period in which data are available. Data are given at ten-day intervals. Five-day interval data are available in *Circular T* .

0000 Hours Coordinated Universal Time		
DATE	**MJD**	**UTC-UTC(NIST), ns**
Apr. 26, 2017	**57869**	**0.5**
Apr. 16, 2017	**57859**	**6.9**
Apr. 6, 2017	**57849**	**10**
Mar. 27, 2017	**57839**	**5.5**
Mar. 17, 2017	**37829**	**-4.9**
Mar. 7, 2017	**37819**	**-6.6**
Feb. 25, 2017	**57809**	**-5.1**
Feb. 15, 2017	**57799**	**-2**
Feb. 5, 2017	**57789**	**-0.6**
Jan. 26, 2017	**57779**	**-0.6**
Jan. 16, 2017	**57769**	**-1.2**
Jan. 6, 2017	**57759**	**-1.4**
Dec. 27, 2016	**57749**	**-1.2**
Dec. 17, 2016	**57739**	**-2.6**
Dec. 7, 2016	**57729**	**-1.3**
Nov. 27, 2016	**57719**	**0.9**
Nov. 17, 2016	**57709**	**1.6**
Nov. 7, 2016	**57699**	**1.2**
Oct. 28, 2016	**57689**	**1.8**
Oct. 18, 2016	**57679**	**4.5**
Oct. 8, 2016	**57669**	**5.5**
Sep. 28, 2016	**57659**	**4.1**
Sep. 18, 2016	**57649**	**1.3**
Sep. 8,2016	**57639**	**0.4**
Aug. 29, 2016	**57629**	**-1.6**
Aug. 19, 2016	**57619**	**-4.7**
Aug. 9, 2016	**57609**	**-4.2**
Jul. 30, 2016	**57599**	**-4.1**
Jul. 20, 2016	**57589**	**-2.0**
Jul. 10, 2016	**57579**	**-0.3**
Jun. 30, 2016	**57569**	**0.7**
Jun. 20, 2016	**57559**	**1.1**
Jun. 10, 2016	**57549**	**0.9**
May 31, 2016	**57539**	**0.4**

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3. BROADCAST OUTAGES OVER FIVE MINUTES AND WWVB PHASE PERTURBATIONS

OUTAGES OF 5 MINUTES OR MORE						PHASE PERTURBATIONS 2 ms			
Station	Apr 2017	MJD	Began UTC	Ended UTC	Freq.	Apr 2017	MJD	Began UTC	End UTC
WWVB	4-20-17	57863	0053	0104	60 kHz	None			
WWV	None					None			
WWVH	None					None			

4. NOTES ON NIST TIME SCALES AND PRIMARY STANDARDS

Primary frequency standards developed and operated by NIST are used to provide accuracy (rate) input to the BIPM and to provide the best possible realization of the SI second. NIST-F1 and NIST F-2, cold-atom cesium fountain frequency standards, have served as the U.S. primary standards of time and frequency since 1999. The uncertainty of NIST-F2 is currently about 1 part in 10^{16}.

The AT1 scale is run in real-time by use of data from an ensemble of cesium standards and hydrogen masers. It is a free-running scale whose frequency is maintained as nearly constant as possible by choosing the optimum weight for each clock that contributes to the computation.

UTC(NIST) is generated as an offset from our real-time scale AT1. It is steered in frequency towards UTC by use of data published by the BIPM in its *Circular T*. Changes in the steering frequency will be made, if necessary, at 0000 UTC on the first day of the month, and occasionally at mid-month. A change in frequency is limited to no more than ±2 ns/day. The frequency of UTC(NIST) is kept as stable as possible at other times.

UTC is generated at the BIPM by use of a post-processed time-scale algorithm and is not available in real-time. The parameters that we use to generate UTC(NIST) in real-time are therefore based on an extrapolation of UTC from the most recent available data.

References:

Allan, D.W.; Hellwig, H.; and Glaze, D.J., "An accuracy algorithm for an atomic time scale," Metrologia, Vol.11, No.3, pp. 133-138 (1975).

Allan, D.W.; Davis, D.D.; Weiss, M.A.; Clements, A.; Guinot, B.; Granveaud, M.; Dorenwendt, K.; Fischer, B.; Hetzel, P.; Aoki, S.; Fujimoto, M.; Charron, L.; and Ashby, N., “Accuracy of international time and frequency comparisons via global positioning system satellites in common-view,” IEEE Transactions on Instrumentation and Measurement, Vol. IM-34, pp.118-125 (1985).

Heavner, T.P.; Jefferts, S.R.; Donley; E.A.; Shirley, J.H. and Parker, T.E., “NIST F1; recent improvements and accuracy evaluations,” Metrologia, Vol. 42, pp. 411-422 (2005).

Jefferts, S.R.; Shirley, J.; Parker, T.E.; Heavner, T.P.; Meekhof, D.M.; Nelson, C., Levi, F.; Costanza, G.; De Marchi, A.; Drullinger, R.; Hollberg, L.; Lee, W.D.; and Walls, F.L., “Accuracy evaluation of NIST-F1,” Metrologia, Vol. 39, pp. 321-336 (2002).

Lewandowski, W. and Thomas, C., “GPS Time transfer,” Proceedings of the IEEE, Vol. 79, pp. 991-1000 (1991).

Parker, T.E.; Jefferts, S.R.; Heavner, T.P.; and Donley, E.A., “Operation of the NIST-F1 caesium fountain primary frequency standard with a maser ensemble, including the impact of frequency transfer noise,” Metrologia, Vol. 42, pp. 423-430 (2005).

Weiss, M.A.; Allan, D.W., “An NBS Calibration Procedure for Providing Time and Frequency at a Remote Site by Weighting and Smoothing of GPS Common View Data,” IEEE Transactions on Instrumentation and Measurement, Vol. IM-36, pp. 572-578 (1987).

5. UTC(NIST) – AT1 PARAMETERS

The table below lists parameters that are used to define UTC(NIST) with respect to our real-time scale AT1. To find the value of UTC(NIST) - AT1 at any time T (expressed as a Modified Julian Date, including a fraction if needed), the appropriate equation to use is the one for which the desired T is greater than or equal to the entry in the T_0 column and less than the entry in the last column. The values of x_{ls}, x, and y for that month are then used in the equation below to find the desired value. The parameters x and y represent the offsets in time and frequency, respectively, between UTC(NIST) and AT1; the parameter x_{ls} is the number of leap seconds applied to both UTC(NIST) and UTC, as specified by the IERS. Leap seconds are not applied to AT1.

UTC(NIST) - AT1 = $x_{ls} + x + y(T - T_0)$					
Month	x_{ls} (s)	x (ns)	y (ns/d)	T_0 (MJD)	Valid until 0000 on: (MJD)
Jun 17	-37	-445488.75	-37.15*	57905	57935
May 17	-37	-444448.55	-37.15	57877	57905*
May 17	-37	-444338	-36.85	57874	57877†
Apr 17	-37	-44190.6	-36.85	57870	57874
Apr 17	-37	-443935.45	-36.45	57863	57874†
Apr 17	-37	-443418.15	-36.95	57849	57863†
Apr 17	-37	-443231.4	-37.35	57844	57849†
Mar 17	-37	-443156.7	-37.35	57842	57844
Mar 17	-37	-442621.2	-38.25	57828	57842†
Mar 17	-37	-442099.7	-37.25	57814	57828†
Mar 17	-37	-442062.85	-36.85	57813	57814†
Feb 17	-37	-441325.85	-36.85	57793	57813
Feb 17	-37	-441029.45	-37.05	57785	57813†
Jan 17	-37	-439880.9	-37.05	57754	57785
Dec 16	-36	-439547.45	-37.05	57745	57754
Dec 16	-36	-439287.05	-37.2	57738	57745†
Dec 16	-36	-438770.45	-36.90	57724	57738†
Dec 16	-36	-438733.45	-37.00	57723	57754†
Nov 16	-36	-437694.75	-37.00	57704	57723
Nov 16	-36	-437694.75	-37.30	57695	57704†
Nov 16	-36	-437620.95	-36.90	57693	57695†
Oct 16	-36	-436956.75	-36.90	57675	57693
Oct 16	-36	-436510.35	-37.20	57663	57675†
Oct 16	-36	-436472.9	-37.50	57662	57663†
Sep 16	-36	-435910.4	-37.50	57647	57662
Sep 16	-36	-435350.9	-37.30	57632	57647†
Aug 16	-36	-434936.7	-37.65	57621	57632
Aug 16	-36	-434191.7	-37.25	57601	57621†
Jul 16	-36	-434079.95	-37.25	57598	57601
Jul 16	-36	-433041.2	-37.10	57570	57598†
Jun 16	-36	-431923.7	-37.25	57540	57570†
May 16	-36	-431476.7	-37.25	57528	57540
May 16	-36	-430771.8	-37.1	57509	57528†
Apr 16	-36	-430697.6	-37.1	57507	57509

† Rate change in mid-month

***Provisional value**

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