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1. GENERAL BACKGROUND INFORMATION

ACRONYMS AND ABBREVIATIONS USED IN THIS BULLETIN

ACTS	-	Automated Computer Time Service
BIPM	-	Bureau International des Poids et Mesures
CS	-	Cesium Standard
GPS	-	Global Positioning System
IERS	-	International Earth Rotation Service
LORAN	-	Long Range Navigation
MC	-	Master Clock
MJD	-	Modified Julian Date
NIST	-	National Institute of Standards and Technology
NOAA	-	National Oceanic and Atmospheric Administration
NVLAP	-	National Voluntary Laboratory Accreditation Program
SI	-	International System of Units
TA	-	Atomic Time
TAI	-	International Atomic Time
USNO	-	United States Naval Observatory
UTC	-	Coordinated Universal Time

ns	-	nanosecond
μs	-	microsecond
ms	-	millisecond
s	-	second
min	-	minute

2. TIME SCALE INFORMATION

The values listed below are based on data from the IERS, the USNO, and NIST. The UTC(USNO,MC) - UTC(NIST) values are averaged measurements from all available common-view GPS satellites (see bibliography on page 5). **UTC - UTC(NIST) data are on page 3.**

0000 HOURS COORDINATED UNIVERSAL TIME			
JUN 2008	MJD	UT1-UTC(NIST) (±5 ms)	UTC(USNO,MC) - UTC(NIST) (±20 ns)
5	54622	-431 ms	-8 ns
12	54629	-436 ms	-7 ns
19	54636	-438 ms	-7 ns
26	54643	-441 ms	-3 ns

The master clock pulses used by the WWV, WWVH, and WWVB time-code transmissions are referenced to the UTC(NIST) time scale. Occasionally, 1 s is added to the UTC time scale. This second is called a leap second. Its purpose is to keep the UTC time scale within ±0.9 s of the UT1 astronomical time scale, which changes slightly due to variations in the Earth's rotation.

NOTE: No leap second will be added at the end of June 2008.

Positive leap seconds, beginning at 23 h 59 min 60 s UTC and ending at 0 h 0 min 0 s UTC, were inserted in the UTC timescale on 30 June 1972, 1981-1983, 1985, 1992, 1993, 1994, and 1997, and on 31 December 1972-1979, 1987, 1989, 1990,1995, 1998, and 2005.

The use of leap seconds ensures that UT1 - UTC will always be held within ±0.9 s. The current value of UT1 - UTC is called the DUT1 correction. DUT1 corrections are broadcast by WWV, WWVH, WWVB, and ACTS and are printed below. These corrections may be added to received UTC time signals in order to obtain UT1.

	-0.4 s beginning 0000 UTC 13 March 2008
	-0.3 s beginning 0000 UTC 29 November 2007
DUT1 = UT1 - UTC =	-0.2 s beginning 0000 UTC 14 June 2007
	-0.1 s beginning 0000 UTC 15 March 2007

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 10-day intervals. Five day interval data are available in Circular T.

0000 Hours Coordinated Universal Time

DATE	MJD	UTC-UTC(NIST) ns
May 23, 2008	54609	-7.8
May 13, 2008	54599	-8.4
May 03, 2008	54589	-10.2
Apr. 23, 2008	54579	-10.1
Apr. 13, 2008	54569	-12.8
Apr. 03, 2008	54559	-12.5
Mar. 24, 2008	54549	-12.6
Mar. 14, 2008	54539	-13.0
Mar. 04, 2008	54529	-9.9
Feb. 23, 2008	54519	-6.7
Feb. 13, 2008	54509	-5.1
Feb. 03, 2008	54499	-3.8
Jan. 24, 2008	54489	-1.2
Jan. 14, 2008	54479	-0.9
Jan. 04, 2008	54469	1.3
Dec. 25, 2007	54459	3.0
Dec. 15, 2007	54449	5.2
Dec. 05, 2007	54439	5.1
Nov. 25, 2007	54429	7.1
Nov. 15, 2007	54419	5.6
Nov. 05, 2007	54409	5.8
Oct. 26, 2007	54399	4.5
Oct. 16, 2007	54389	2.3
Oct. 06, 2007	54379	1.7
Sep. 26, 2007	54369	1.2
Sep. 16, 2007	54359	0.0
Sep. 06, 2007	54349	-2.1

3. PHASE DEVIATIONS FOR WWVB AND LORAN-C

WWVB - The values shown for WWVB are the time differences between the time markers of the UTC(NIST) time scale and the first positive-going zero voltage crossover measured at the transmitting antenna. The uncertainty of the individual measurements is ±0.5 μs. The values listed are for 1300 UTC.

LORAN-C - The values shown for Loran-C represent the daily accumulated phase shift. The phase shift is measured by comparing the output of a Loran receiver to the UTC(NIST) time scale for a period of 24 h. If data were not recorded on a particular day, the symbol (-) is printed. The stations monitored are Baudette, Minnesota (8970) and Boise City, Oklahoma (9610). The monitoring is done from the NIST laboratories in Boulder, Colorado.

Note: The values shown for Loran-C are in nanoseconds.

		UTC(NIST)-WWVB (60 kHz)	UTC(NIST) - LORAN PHASE (ns)	
		ANTENNA PHASE	LORAN-C (BAUDETTE)	LORAN-C (BOISE CITY)
DATE	MJD	(μs)	(8970)	(9610)
06/01/2008	54618	5. 65	-41	+7
06/02/2008	54619	5. 65	-16	+4
06/03/2008	54620	5. 65	+24	-10
06/04/2008	54621	5. 65	+43	+5
06/05/2008	54622	5. 65	+74	-12
06/06/2008	54623	5. 65	+39	+12
06/07/2008	54624	5. 65	-22	+4
06/08/2008	54625	5. 65	+98	-11
06/09/2008	54626	5. 65	+22	+7
06/10/2008	54627	5. 65	+163	+15
06/11/2008	54628	5. 65	-27	-25
06/12/2008	54629	5. 65	-23	-15
06/13/2008	54630	5. 65	+39	+20
06/14/2008	54631	5. 65	+5	+15
06/15/2008	54632	5. 65	-10	-10
06/16/2008	54633	5. 65	-2	-27
06/17/2008	54634	5. 65	+100	+25
06/18/2008	54635	5. 65	-163	-5
06/19/2008	54636	5. 65	+152	-20
06/20/2008	54637	5. 65	+79	+8
06/21/2008	54638	5. 65	-63	+21
06/22/2008	54639	5. 65	-36	-19
06/23/2008	54640	5. 65	-48	-4
06/24/2008	54641	5. 65	+52	+7
06/25/2008	54642	5. 65	-10	+13
06/26/2008	54643	5. 65	-10	+9
06/27/2008	54644	5. 65	+108	-3
06/28/2008	54645	5. 65	-16	-34
06/29/2008	54646	5. 65	+59	+33
06/30/2008	54647	5. 65	-38	+24

4. BROADCAST OUTAGES OVER FIVE MINUTES AND WWVB PHASE PERTURBATIONS

OUTAGES OF 5 MINUTES OR MORE							PHASE PERTURBATIONS 2 ms			
Station	June 2008	MJD	Began UTC	Ended UTC	Freq.		June 2008	MJD	Began UTC	End UTC
WWVB	06-30-08	54647	0938	1053	60 kHz					
WWVB	06-25-08	54642	----	0018	60 kHz					
WWVB	06-24-08	54641	2327	----	60 kHz					
WWVB	06-01-08	54618	1244	1335	60 kHz					
WWV										
WWVH										

5. 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. NIST-F1, a cold-atom cesium fountain frequency standard, has served as the U.S. primary time and frequency standard since 1999. The uncertainty of NIST-F1 is currently about 5 parts 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 using 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.

6. BIBLIOGRAPHY

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Table 7.1 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 Day, 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 offset in time and in 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.

Table 7.1

$$UTC(NIST) - AT1 = x_{ls} + x + y*(T - T_0)$$

Month	x_{ls} (s)	x (ns)	y (ns/d)	T_0 (MJD)	Valid until 0000 on: (MJD)
Aug 08	-33	-322560.3	-38.4*	54679	54710
Jul 08	-33	-322369.9	-38.4	54648	54679*
Jun 08	-33	-321211.9	-38.6	54618	54648
May 08	-33	-320594.3	-38.6	54602	54618
May 08	-33	-320018.3	-38.4	54587	54602†
Apr 08	-33	-319288.7	-38.4	54568	54587
Apr 08	-33	-318867.4	-38.3	54557	54568†
Mar 08	-33	-318178.0	-38.3	54539	54557
Mar 08	-33	-317684.0	-38.0	54526	54539†
Feb 08	-33	-316582.0	-38.0	54497	54526
Jan 08	-33	-315974.0	-38.0	54481	54497
Jan 08	-33	-315405.5	-37.9	54466	54481†
Dec 07	-33	-314230.6	-37.9	54424	54466
Nov 07	-33	-313813.7	-37.9	54435	54424
Nov 07	-33	-313091.7	-38.0	54405	54435†
Oct 07	-33	-312635.7	-38.0	54393	54405
Oct 07	-33	-311911.8	-38.1	54374	54393†
Sep 07	-33	-310768.8	-38.1	54344	54374
Aug 07	-33	-309587.7	-38.1	54313	54344
Jul 07	-33	-308940.0	-38.1	54296	54313
Jul 07	-33	-308408.0	-38.0	54282	54296†
Jun 07	-33	-307762.0	-38.0	54265	54282
Jun 07	-33	-30726.3	-37.9	54252	54265†

† Rate change in mid-month
†† Rate change one day early
***Provisional value**