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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	ns	- nanosecond
SI	- International System of Units	μs	- microsecond
TA	- Atomic Time	ms	- millisecond
TAI	- International Atomic Time	s	- second
USNO	- United States Naval Observatory	min	- minute
UTC	- Coordinated Universal Time		

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			
DEC 2007	MJD	UT1-UTC(NIST) (±5 ms)	UTC(USNO,MC) - UTC(NIST) (±20 ns)
6	54440	-253 ms	6 ns
13	54447	-255 ms	5 ns
20	54454	-263 ms	5 ns
27	54461	-268 ms	4 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 was added at the end of December 2007.

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.

DUT1 = UT1 - UTC =
-0.3 s beginning 0000 UTC 29 November 2007
+0.1 s beginning 0000 UTC 28 September 2006
+0.0 s beginning 0000 UTC 22 December 2006
-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
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
Aug. 27, 2007	54339	-3.0
Aug. 17, 2007	54329	-2.3
Aug. 07, 2007	54319	-2.4
Jul. 28, 2007	54309	-1.8
Jul. 18, 2007	54299	-2.8
Jul. 08, 2007	54289	-1.7
Jun. 28, 2007	54279	-0.2
Jun. 18, 2007	54269	2.6
Jun. 08, 2007	54259	2.1
May 29, 2007	54249	5.4
May 19, 2007	54239	7.9
May 09, 2007	54229	9.4
Apr. 29, 2007	54219	11.2
Apr. 19, 2007	54209	10.4
Apr. 09, 2007	54199	11.4
Mar. 30, 2007	54189	12.5
Mar. 20, 2007	54179	13.6
Mar. 10, 2007	54169	15.2

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)	
DATE	MJD	ANTENNA PHASE (μs)	LORAN-C (BAUDETTE) (8970)	LORAN-C (BOISE CITY) (9610)
12/01/2007	54435	5. 65	-36	-10
12/02/2007	54436	5. 65	-7	-13
12/03/2007	54437	5. 65	-9	-24
12/04/2007	54438	5. 65	+2	-11
12/05/2007	54439	5. 65	-9	+22
12/06/2007	54440	5. 65	-1	-1
12/07/2007	54441	5. 65	-3	-13
12/08/2007	54442	5. 65	+103	+94
12/09/2007	54443	5. 65	+64	+79
12/10/2007	54444	5. 65	-148	-137
12/11/2007	54445	5. 65	+41	+34
12/12/2007	54446	5. 65	-33	-6
12/13/2007	54447	5. 65	+50	-10
12/14/2007	54448	5. 65	+78	+73
12/15/2007	54449	5. 65	-71	-77
12/16/2007	54450	5. 65	-28	-16
12/17/2007	54451	5. 65	-21	-14
12/18/2007	54452	5. 65	+1	-18
12/19/2007	54453	5. 65	-8	+24
12/20/2007	54454	5. 65	+8	-11
12/21/2007	54455	5. 65	+23	+33
12/22/2007	54456	5. 65	+18	+6
12/23/2007	54457	5. 65	-22	-22
12/24/2007	54458	5. 65	-7	-15
12/25/2007	54459	5. 65	+20	+29
12/26/2007	54460	5. 65	+10	+0
12/27/2007	54461	5. 65	-11	+35
12/28/2007	54462	5. 65	+21	-19
12/29/2007	54463	5. 65	-17	-11
12/30/2007	54464	5. 65	-26	-23
12/31/2007	54465	5. 65	+27	+23

4. BROADCAST OUTAGES OVER FIVE MINUTES AND WWVB PHASE PERTURBATIONS

OUTAGES OF 5 MINUTES OR MORE							PHASE PERTURBATIONS 2 ms			
Station	Dec 2007	MJD	Began UTC	Ended UTC	Freq.		Dec 2007	MJD	Began UTC	End UTC
WWVB	12-05-07	54439	0336	0433	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)
Feb 08	-33	-316580.4	-37.9*	54497	54526
Jan 08	-33	-315405.5	-37.9	54466	54497*
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†
May 07	-33	-306738.7	-37.9	54238	54252
May 07	-33	-306091.0	-38.1	54221	54238†
Apr 07	-33	-304951.6	-38.3	54191	54221
Mar 07	-33	-304262.2	-38.1	54173	54191
Mar 07	-33	-303764.3	-38.3	54160	54173†
Feb 07	-33	-302691.9	-38.3	54132	54160
Jan 07	-33	-302079.1	-38.3	54116	54132
Jan 07	-33	-301501.6	-38.5	54101	54116†

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