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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
NVLAP - National Voluntary Laboratory Accreditation Program
NIST - National Institute of Standards and Technology
NOAA - National Oceanic and Atmospheric Administration
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			
NOV 2005	MJD	UT1-UTC(NIST) (±5 ms)	UTC(USNO,MC) - UTC(NIST) (±20 ns)
3	53677	-627 ms	1 ns
10	53684	-630 ms	3 ns
17	53691	-638 ms	4 ns
24	53698	-641 ms	5 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: A positive leap second will be added at the end of December 2005.

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, and 1998.

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 =
-0.2 s beginning 0000 UTC 14 February 2002
-0.3 s beginning 0000 UTC 24 October 2002
-0.4 s beginning 0000 UTC 03 April 2003
-0.5 s beginning 0000 UTC 29 April 2004
-0.6 s beginning 0000 UTC 17 March 2005

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
Oct. 26, 2005	53669	-9.7
Oct. 16, 2005	53659	-11.5
Oct. 06, 2005	53649	-12.2
Sep. 26, 2005	53639	-12.7
Sep. 16, 2005	53629	-12.6
Sep. 06, 2005	53619	-11.8
Aug. 27, 2005	53609	-11.6
Aug. 17, 205	53599	-10.3
Aug. 07, 2005	53589	-6.1
Jul. 28, 2005	53579	-1.9
Jul. 18, 2005	53569	4.3
Jul. 08, 2005	53559	8.4
Jun. 28, 2005	53549	10.5
Jun. 18, 2005	53539	15.6
Jun. 08, 2005	53529	14
May 29, 2005	53519	8.4
May 19, 2005	53509	5.7
May 09, 2005	53499	3.4
Apr. 29, 2005	53489	1.4
Apr. 19, 2005	53479	1.8
Apr. 09, 2005	53469	0.6
Mar. 30, 2005	53459	-1.1
Mar. 20, 2005	53449	-2.2
Mar. 10, 2005	53439	-3.6
Feb. 28, 2005	53429	-2.2
Feb. 18, 2005	53419	-1.8
Feb. 08, 2005	53409	-1.8
Jan. 29, 2005	53399	-1.7
Jan. 19, 2005	53389	0.8
Jan. 09, 2005	53379	1.3

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)
11/01/05	53675	5. 65	-73	-8
11/02/05	53676	5. 65	+108	+44
11/03/05	53677	5. 65	-31	-14
11/04/05	53678	5. 65	-20	+8
11/05/05	53679	5. 65	+66	+4
11/06/05	53680	5. 65	+100	-13
11/07/05	53681	5. 65	-56	-4
11/08/05	53682	5. 65	-2	+21
11/09/05	53683	5. 65	+72	+7
11/10/05	53684	5. 65	+32	+2
11/11/05	53685	5. 65	-70	-12
11/12/05	53686	5. 65	-12	-20
11/13/05	53687	5. 65	-143	+12
11/14/05	53688	5. 65	+17	-24
11/15/05	53689	5. 65	+112	+21
11/16/05	53690	5. 65	+18	-16
11/17/05	53691	5. 65	-170	+7
11/18/05	53692	5. 65	+103	-15
11/19/05	53693	5. 65	+108	+2
11/20/05	53694	5. 65	+17	+0
11/21/05	53695	5. 65	+18	-3
11/22/05	53696	5. 65	+15	+2
11/23/05	53697	5. 65	+64	-1
11/24/05	53698	5. 65	+30	+4
11/25/05	53699	5. 65	+11	+9
11/26/05	53700	5. 65	-56	-5
11/27/05	53701	5. 65	-107	+27
11/28/05	53702	5. 65	-31	-1
11/29/05	53703	5. 65	-20	-8
11/30/05	53704	5. 65	+76	+17

4. BROADCAST OUTAGES OVER FIVE MINUTES AND WWVB PHASE PERTURBATIONS

OUTAGES OF 5 MINUTES OR MORE							PHASE PERTURBATIONS 2 ms			
Station	NOV 2005	MJD	Began UTC	Ended UTC	Freq.		NOV 2005	MJD	Began UTC	End UTC
WWVB	11-19-05	53693	0121	0216	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.

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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)
Jan 06	-33	-287330.45	-39.1*	53736	53767
Dec 05	-32	-286118.35	-39.1	53705	53736*
Nov 05	-32	-284937.85	-39.35	53675	53705
Oct 05	-32	-284308.25	-39.35	53659	53675
Oct 05	-32	-283721.75	-39.1	53644	53659†
Sep 05	-32	-283017.95	-39.1	53626	53644
Sep 05	-32	-282549.95	-39	53614	53626†
Aug 05	-32	-282081.95	-39	53602	53614
Aug 05	-32	-281350.45	-38.5	53583	53602†
Jul 05	-32	-280156.95	-38.5	53552	53583
Jun 05	-32	-279617.95	-38.5	53538	53552
Jun 05	-32	-278993.95	-39.0	53522	53538†
May 05	-32	-277784.95	-39.0	53491	53522
Apr 05	-32	-277160.95	-39.0	53475	53491
Apr 05	-32	-276613.55	-39.1	53461	53475†
Mar 05	-32	-276066.15	-39.1	53447	53461
Mar 05	-32	-275403.5	-39.0	53430	53447†
Feb 05	-32	-274311.15	-39.0	53402	53430
Jan 05	-32	-273102.15	-39.0	53371	53402
Dec 04	-32	-272712.15	-39.0	53361	53371
Dec 04	-32	-271891.05	-39.1	53340	53361†

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