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Radiocommunication Study Group 7

DRAFT REVISION OF RECOMMENDATION ITU-R TF.460-6

Standard-frequency and time-signal emissions

Summary of revisions

This modification of the Recommendation eliminates the procedure for adjustment of UTC by insertion of leap seconds. The elimination of the leap second adjustments is recommended to be effective on 1 January five years after approval of this Recommendation.

DRAFT REVISION OF RECOMMENDATION ITU-R TF.460-6*

Standard-frequency and time-signal emissions

(Question ITU-R 102/7)

(1970-1974-1978-1982-1986-1997-2002)

Scope

This Recommendation defines the implementation of Coordinated Universal Time (UTC) without leap second adjustments. UTC serves as the time and frequency reference of standard-frequency and time-signal emissions.

The ITU Radiocommunication Assembly,

considering

a) that ~~the World Administrative Radio Conference, Geneva, 1979, allocated the~~Article 5 of the Radio Regulations allocates bands of frequencies ~~20 kHz ± 0.05 kHz, 2.5 MHz ± 5 kHz (2.5 MHz ± 2 kHz in Region 1), 5 MHz ± 5 kHz, 10 MHz ± 5 kHz, 15 MHz ± 10 kHz, 20 MHz ± 10 kHz and 25 MHz ± 10 kHz~~ to the standard-frequency and time-signal service;

~~*b)* that additional standard frequencies and time signals are emitted in other frequency bands;~~

~~*c*~~*b)* the provisions of Article 26 of the Radio Regulations;

~~*d*~~*c)* the continuing need for close cooperation between Radiocommunication Study Group 7 and the International Maritime Organization (IMO), the International Civil Aviation Organization (ICAO), the General Conference of Weights and Measures (CGPM), the Consultative Committee for Time and Frequency (CCTF), the Bureau International des Poids et Mesures (BIPM), the International Earth Rotation and Reference Systems Service (IERS) and the concerned Unions of the International Council of Scientific Unions (ICSU);

~~*e*~~*d)* the ~~desirability~~importance of maintaining worldwide coordination of standard-frequency and time-signal emissions;

~~*f*~~*e)* the need to disseminate standard frequencies and time signals in conformity with the SI (International System of Units) second as defined by the ~~13th General Conference of Weights and Measures (1967)~~CGPM;

~~*g)* the continuing need to make universal time (UT) immediately available to an uncertainty of one-tenth of a second,~~

f) that in 1975 the CGPM recommended the use of UTC as the basis of civil time;

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* This Recommendation should be brought to the attention of the International Maritime Organization (IMO), the International Civil Aviation Organization (ICAO), the General Conference of Weights and Measures (CGPM), the Consultative Committee for Time and Frequency (CCTF), the Bureau International des Poids et Mesures (BIPM), the International Earth Rotation and Reference Systems Service (IERS), the International Union of Geodesy and Geophysics (IUGG), the International Union of Radio Science (URSI), the International Organization for Standardization (ISO) and the International Astronomical Union (IAU).

g) that other scientific organizations, particularly the International Astronomical Union (IAU) and the International Union of Radio Science (URSI), have recommended the general use of UTC;

h) the importance of monitoring the difference between the UTC time-scale and the time defined by the rotation of the Earth (UT1) and maintaining the respective knowledge-base;

j) that the IERS provides updated daily data relating the UT1 to UTC to users;

k) that the IERS provides predictions of the difference between UT1 and UTC at different delays, which allow real-time access to UT1, and which will on average over a two-year period provide a more accurate knowledge of UT1 than does UTC with leap seconds,

noting

that Recommendation ITU-R TF.460-6 is incorporated by reference in the Radio Regulations, and that the revised Recommendation ITU-R TF.460 will become effective only after the date of entry into force established by the appropriate World Radiocommunication Conference,

recognizing

1 that the World Administrative Radio Conference (Geneva, 1979) (WARC-79) has decided that UTC shall be used in all international radiocommunication activities;

2 that according to Recommendation ITU-R TF.536 and in accordance with the recommendation of the CGPM the designation of UTC is to be used in all languages;

3 that the UTC system with leap seconds was essentially introduced to provide a common standard for broadcast time and frequency signals generated from the UTC(k) physical representations and give ready access to low-precision UT1 from these broadcast times and frequency signals maintained within the necessary approximation for celestial navigation;

4 that an increasing number of applications require traceability to a continuous international time-scale;

5 that time references other than UTC that are proliferating do not offer the reliability, accessibility, or metrological quality of the international reference UTC;

6 that celestial navigation is no longer a primary means of navigation;

7 that users can easily access UT1 information by means other than radio transmissions,

recommends

1 ~~that all standard-frequency and time-signal emissions conform as closely as possible to coordinated universal time (UTC) (see Annex 1); that the time~~that UTC as defined in Annex 1 should be used to designate the time in all international telecommunication activities and in all official documents of ITU;

2 that the application of leap second adjustments to UTC should cease on 1 January five years after approval by the appropriate World Radiocommunication Conference;

3 that the UTC frequency should be used as the ultimate reference for standard-frequency emissions;

4 that the transmission of time signals should not deviate from UTC by more than ~~1 ms~~100 microseconds;

5 that the emitted standard frequencies should not deviate by more than 1 part in ~~10^{10}, and~~ 10^{11} from the UTC frequency;

6 that the time signals emitted from each transmitting station should bear a known relation to the phase of the carrier~~;~~,

~~2 that standard-frequency and time-signal emissions, and other time-signal emissions intended for scientific applications (with the possible exception of those dedicated to special systems) should contain information on UT1 – UTC and TAI – UTC (see Annex 1).~~

invites

the IERS and the service providers of Global Navigation Satellite Systems to offer convenient access to values of UT1−UTC so that users have access to UT1.

ANNEX 1

Time and ~~T~~time ~~-~~scales

A Universal time (UT1)

~~Universal time (UT) is the general designation of time scales based on the rotation of the Earth.~~

~~In applications in which an imprecision of a few hundredths of a second cannot be tolerated, it is necessary to specify the form of UT which should be used:~~

~~UT0 is the mean solar time of the prime meridian obtained from direct astronomical observation;~~

~~UT1 is UT0 corrected for the effects of small movements of the Earth relative to the axis of rotation (polar variation);~~

~~UT2 is UT1 corrected for the effects of a small seasonal fluctuation in the rate of rotation of the Earth;~~

~~UT1 is used in this Recommendation, since it corresponds directly with the angular position of the Earth around its axis of diurnal rotation.~~

~~Concise definitions of the above terms~~UT1 is the time determined from astronomical observations of the rotation of the Earth with respect to the International Celestial Reference System. A technical description and the concepts involved are available in the publications of the IERS ~~(Paris, France)~~.

B International atomic time (TAI)

The international ~~reference scale of~~ atomic time (TAI), based on the SI second ~~(SI)~~, as realized on the rotating geoid, is formed by the BIPM on the basis of clock data supplied by cooperating establishments. It is in the form of a continuous ~~scale~~time, e.g. in days, hours, minutes and seconds from the origin 1 January 1958 (adopted by the CGPM 1971). TAI is not physically realized and consequently is not suitable for time dissemination.

C Coordinated universal time (UTC)

UTC is the time-scale maintained by the BIPM~~, with assistance from the IERS,~~ which forms the basis of a coordinated dissemination of standard frequencies and time signals. It corresponds exactly in rate with TAI but differs from it by an ~~integer~~integral number of seconds.

~~The UTC scale is adjusted by the insertion or deletion of seconds (positive or negative leap-seconds) to ensure approximate agreement with UT1.~~

~~D DUT1~~

~~The value of the predicted difference UT1 – UTC, as disseminated with the time signals is denoted DUT1; thus DUT1 ≈ UT1 – UTC. DUT1~~

NOTE 1 – The value UT1−UTC, either observed or predicted, is determined by the IERS and disseminated by multiple sources. It may increase or decrease without limit. It may be regarded as a correction to be added to UTC to obtain ~~a better approximation to~~ UT1.

NOTE 2 – The dissemination of the previously coded~~The~~ values of UT1–UTC will be discontinued~~DUT1 are given by the IERS in multiples of 0.1 s~~.

~~The following operational rules apply:~~

~~1 Tolerances~~

~~**1.1** The magnitude of DUT1 should not exceed 0.8 s.~~

~~**1.2** The departure of UTC from UT1 should not exceed ±0.9 s (see Note 1).~~

~~**1.3** The deviation of (UTC plus DUT1) should not exceed ±0.1 s.~~

~~NOTE 1 – The difference between the maximum value of DUT1 and the maximum departure of UTC from UT1 represents the allowable deviation of (UTC + DUT1) from UT1 and is a safeguard for the IERS against unpredictable changes in the rate of rotation of the Earth.~~

~~2 Leap-seconds~~

~~**2.1** A positive or negative leap-second should be the last second of a UTC month, but first preference should be given to the end of December and June, and second preference to the end of March and September.~~

~~**2.2** A positive leap-second begins at 23h 59m 60s and ends at 0h 0m 0s of the first day of the following month. In the case of a negative leap-second, 23h 59m 58s will be followed one second later by 0h 0m 0s of the first day of the following month (see Annex 3).~~

~~**2.3** The IERS should decide upon and announce the introduction of a leap-second, such an announcement to be made at least eight weeks in advance.~~

~~3 Value of DUT1~~

~~**3.1** The IERS is requested to decide upon the value of DUT1 and its date of introduction and to circulate this information one month in advance. In exceptional cases of sudden change in the rate of rotation of the Earth, the IERS may issue a correction not later than two weeks in advance of the date of its introduction.~~

~~**3.2** Administrations and organizations should use the IERS value of DUT1 for standard-frequency and time-signal emissions, and are requested to circulate the information as widely as possible in periodicals, bulletins, etc.~~

~~**3.3** Where DUT1 is disseminated by code, the code should be in accordance with the following principles (except § 3.4 below):~~

– the magnitude of DUT1 is specified by the number of emphasized second markers and the sign of DUT1 is specified by the position of the emphasized second markers with respect to the minute marker. The absence of emphasized markers indicates DUT1 = 0;

– the coded information should be emitted after each identified minute if this is compatible with the format of the emission. Alternatively the coded information should be emitted, as an absolute minimum, after each of the first five identified minutes in each hour.

Full details of the code are given in Annex 2.

3.4 DUT1 information primarily designed for, and used with, automatic decoding equipment may follow a different code but should be emitted after each identified minute if this is compatible with the format of the emission. Alternatively, the coded information should be emitted, as an absolute minimum, after each of the first five identified minutes in each hour.

3.5 Other information which may be emitted in that part of the time-signal emission designated in § 3.3 and 3.4 for coded information on DUT1 should be of a sufficiently different format that it will not be confused with DUT1.

3.6 In addition, UT1 – UTC may be given to the same or higher precision by other means, for example, by messages associated with maritime bulletins, weather forecasts, etc.; announcements of forthcoming leap seconds may also be made by these methods.

3.7 The IERS is requested to continue to publish, in arrears, definitive values of the differences UT1 – UTC and UT2 – UTC.

E DTAI

The value of the difference TAI – UTC, as disseminated with time signals, shall be denoted DTAI. DTAI = TAI – UTC may be regarded as a correction to be added to UTC to obtain TAI.

The TAI – UTC values are published in the BIPM Circular T. The IERS should announce the value of DTAI in integer multiples of one second in the same announcement as the introduction of a leap second (see § D.2).

ANNEX 2

Code for the transmission of DUT1

A positive value of DUT1 will be indicated by emphasizing a number, *n*, of consecutive second markers following the minute marker from second marker one to second marker, *n*, inclusive; *n* being an integer from 1 to 8 inclusive.

$$DUT1 = (n \times 0.1)\ s$$

A negative value of DUT1 will be indicated by emphasizing a number, *m*, of consecutive second markers following the minute marker from second marker nine to second marker (8 + *m*) inclusive, *m* being an integer from 1 to 8 inclusive.

$$DUT1 = -(m \times 0.1)\ s$$

A zero value of DUT1 will be indicated by the absence of emphasized second markers.

~~The appropriate second markers may be emphasized, for example, by lengthening, doubling, splitting or tone modulation of the normal second markers.~~

~~*Examples*:~~

FIGURE 1

DUT1 = + 0.5 s

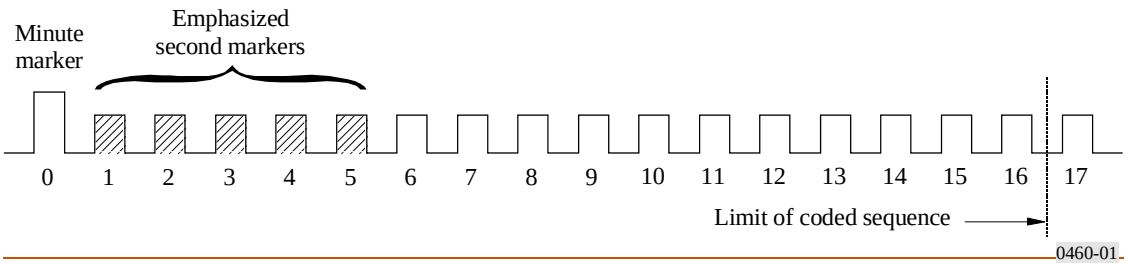
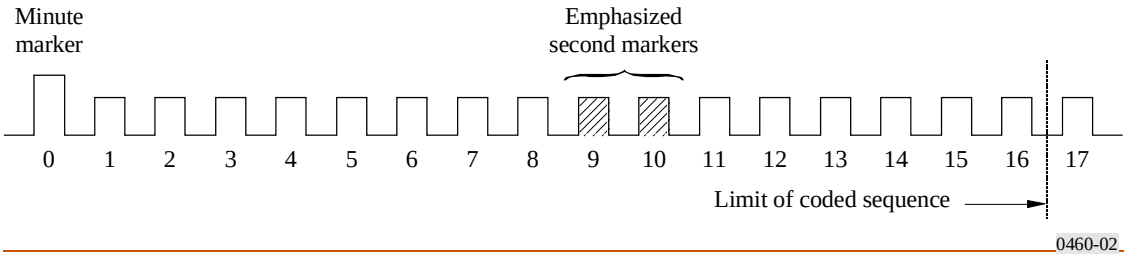


FIGURE 2

DUT1 = – 0.2 s



~~ANNEX 3~~

~~**Dating of events in the vicinity of a leap-second**~~

~~The dating of events in the vicinity of a leap-second shall be effected in the manner indicated in the following Figures:~~

FIGURE 3

Positive leap-second

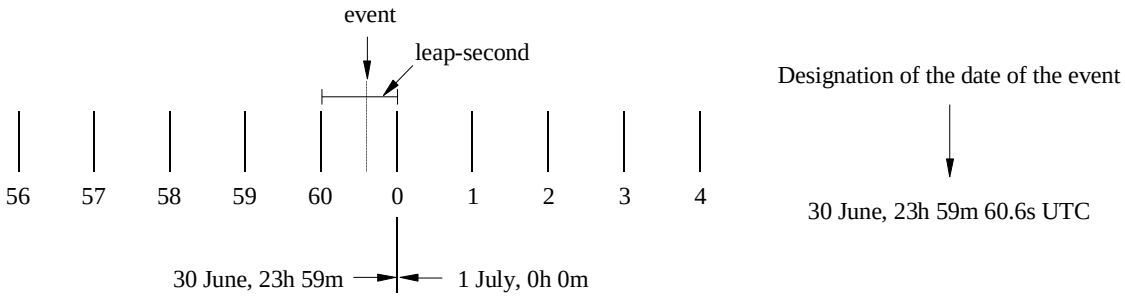


FIGURE 4

Negative leap-second