



Recommendation ITU-R TF.686-3
(12/2013)

**Glossary and definitions of time and
frequency terms**

TF Series
Time signals and frequency standards emissions



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Foreword

The role of the Radiocommunication Sector is to ensure the rational, equitable, efficient and economical use of the radio-frequency spectrum by all radiocommunication services, including satellite services, and carry out studies without limit of frequency range on the basis of which Recommendations are adopted.

The regulatory and policy functions of the Radiocommunication Sector are performed by World and Regional Radiocommunication Conferences and Radiocommunication Assemblies supported by Study Groups.

Policy on Intellectual Property Right (IPR)

ITU-R policy on IPR is described in the Common Patent Policy for ITU-T/ITU-R/ISO/IEC referenced in Annex 1 of Resolution ITU-R 1. Forms to be used for the submission of patent statements and licensing declarations by patent holders are available from <http://www.itu.int/ITU-R/go/patents/en> where the Guidelines for Implementation of the Common Patent Policy for ITU-T/ITU-R/ISO/IEC and the ITU-R patent information database can also be found.

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Series	Title
BO	Satellite delivery
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P	Radiowave propagation
RA	Radio astronomy
RS	Remote sensing systems
S	Fixed-satellite service
SA	Space applications and meteorology
SF	Frequency sharing and coordination between fixed-satellite and fixed service systems
SM	Spectrum management
SNG	Satellite news gathering
TF	Time signals and frequency standards emissions
V	Vocabulary and related subjects

Note: This ITU-R Recommendation was approved in English under the procedure detailed in Resolution ITU-R 1.

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RECOMMENDATION ITU-R TF.686-3*

Glossary and definitions of time and frequency terms

(1990-1997-2002-2013)

Scope

The terms listed in Annex 1 are taken from relevant ITU-R and ITU-T Recommendations, ITU-R Handbooks, the International Vocabulary of basic and general terms in Metrology (VIM) published by International Organization for Standardization (ISO), the Glossary of Time and Frequency Terms of the National Institute of Standards and Technology (NIST), and other noted references. Annex 1 also includes a number of related telecommunication terms in general usage in the field of frequency and time. Two types of terms are presented; those typically used within the standard-frequency and time-signal services and those in more general use, but specifically applicable to this field.

The ITU Radiocommunication Assembly,

considering

- a) that it is essential for the work of the ITU that terms should be used in a clearly defined and uniform manner;
- b) that there is a need for a common terminology for the unambiguous specification and description of frequency and time standard systems;
- c) that there is a need to promote a consistent use of terminology across the growing community of users of frequency and time standard systems,

recommends

- 1 that Annex 1 be used as a glossary and as definitions of time and frequency terms for the users of standard-frequency and time-signal services.

References**ITU-R Recommendations**

- TF.457: Use of the modified Julian date by the standard-frequency and time-signal services
- TF.460: Standard-frequency and time-signal emissions
- TF.538: Measures for random instabilities in frequency and time (phase)
- TF.768: Standard frequencies and time signals
- TF.1010: Relativistic effects in a coordinate time system in the vicinity of the Earth
- TF.1153: The operational use of two-way satellite time and frequency transfer employing pseudorandom noise codes
- TF.2018: Relativistic time transfer in the vicinity of the Earth and in the solar system.

* This Recommendation should be brought to the attention of the Telecommunication Standardization Bureau (TSB) and the International Organization for Standardization (ISO).

ITU-R Handbooks

Selection and use of precise frequency and time systems

Satellite time and frequency transfer and dissemination.

ITU Radio Regulations**ITU-T Recommendations**

G.810: Definitions and terminology for synchronization networks

G.811: Timing characteristics of primary reference clocks.

Other references

IEV: International electrotechnical vocabulary

ISO 8601: Representation of dates and times

NIST: Glossary of Time and Frequency Terms

NTP: Network time protocol (www.ntp.org)

PTP: Precision time protocol – IEEE 1588 Standard for a precision clock synchronization protocol for networked measurement and control systems

ANSI: American National Standards Institute

BIPM: VIM JCGM 200: 2012

BIPM: GUM – Guide to the expression of uncertainty in measurement JCGM100: 2008

BIPM: SI Brochure.

Annex 1**Glossary and definition of time and frequency terms****accuracy; exactitude; exactitud**

Closeness of the agreement between the result of a measurement and the true value of the measurand. See GUM, VIM.

active frequency standard; étalon de fréquence actif; patrón de frecuencia activo

An atomic oscillator whose output signal is derived from the radiation emitted by the atomic species providing the atomic reference transition. The electronic system detects the transition, and servo controls the phase and frequency of a quartz oscillator on the received frequency. The most prominent example is the hydrogen maser. See Hydrogen Maser frequency standard.

ageing; vieillissement; envejecimiento

The systematic change in frequency with time due to internal changes in the oscillator.

NOTE 1 – It is the frequency change with time when factors external to the oscillator (environment, power supply, etc.) are kept constant.

Allan variance (AVAR)/Allan deviation (ADEV); *variance d'Allan (AVAR)/écart type d'Allan (ADEV); varianza/desviación típica de Allan (AVAR/ADEV)*

A standard method of characterizing the frequency instability of oscillators in the time domain, both short term and long term. See “two-sample deviation/variance”.

all-in-view GNSS time transfer; *transfert de signaux horaires à partir de tous les satellites GNSS visibles; transferencia de señales horarias de todos los GNSS a la vista*

In this technique, data is collected from all GNSS satellites in view during a specified time interval to establish the offset of a local clock to each of the observed satellite clocks. The local clock offset to IGST can then be computed by using IGS precise satellite orbits and clock offset products. Then any two local clocks can be compared at any distance by a simple difference, with an uncertainty which is largely independent of the distance. This technique provides significant improvement in measurement precision over common view time transfer in case of baselines > 1 000 km.

atomic clock/frequency standard; *étalon de fréquence/horloge atomique; reloj atómico/patrón de frecuencia*

An atomic clock keeps time using an oscillator based on an electronic transition frequency in the microwave, optical or ultraviolet region of the electromagnetic spectrum of atoms.

atomic time-scale; *échelle de temps atomique; escala de tiempo atómico*

A time-scale based on atomic or molecular resonance phenomena. Elapsed time is measured by counting cycles of a frequency locked to an atomic or molecular transition.

bandwidth; *largeur de bande; anchura de banda*

Absolute value of the difference between the limiting frequencies of a frequency band.

beat frequency; *fréquence de battement; frecuencia de batido*

The interference between two different frequencies that results in a periodic variation in frequency whose rate is the difference between the two input frequencies.

bias; *biais; error sistemático*

Estimate of a systematic measurement error/uncertainty. See GUM.

Caesium beam frequency standard; *étalon de fréquence à jet de césium; patrón de frecuencia de haz de cesio*

An atomic frequency standard that is based on the ground state hyperfine transition in Cs133 atoms. It is a prominent example of a passive frequency standard.

calibration; *étalonnage; calibración*

The process of identifying and measuring offsets between the indicated value and the value of a reference standard used as the test object to some determined level of uncertainty.

NOTE 1 – In many cases, e.g. in a frequency generator, the calibration is related to the stability of the device and therefore its result is a function of time and of the measurement averaging time.

carrier frequency; *fréquence porteuse; frecuencia portadora*

The frequency of a signal upon which information (modulation) is impressed.

carrier phase measurements; *mesures de phase de la porteuse; mediciones de la fase de la portadora*

GNSS systems provide two types of direct measurements – code based pseudorange and the carrier phase. Due to their low noise, carrier phase measurements can be used for smoothing pseudoranges and in high precision positioning applications. Carrier phase measurements are ambiguous by an

unknown integer number of cycles presenting a problem that requires additional time and processing to solve.

clock; *horloge; reloj*

A device for time measurement and/or time display.

clock ensemble; *ensemble d'horloge, conjunto de relojes*

A collection of clocks, not necessarily in the same physical location, operated together in a coordinated way either for mutual control of their individual properties or to maximize the performance (time accuracy and frequency stability) and availability of a time-scale derived from the ensemble.

clock time difference; *différence entre temps d'horloge; diferencia de tiempo de reloj*

The difference between the readings of two clocks at the same instant.

NOTE 1 – To avoid confusion in sign, algebraic quantities should be given, applying the following convention. At a time T of a reference time-scale, let a denote the reading of clock A, and b the reading of clock B. The clock time difference is expressed by $A - B = a - b$ at the instant T . There is no universally accepted convention for the significance of the sign. If $A - B$ is measured electrically, a positive value usually implies that a given tick from clock A arrives before the corresponding tick from clock B, whereas, the reverse is usually true if A and B are calendar dates read from the two clocks.

NOTE 2 – In some situations relativistic effects can be significant and must be accounted for. See Recommendation ITU-R TF.2018.

coherence of frequency; *cohérence de fréquence; coherencia de frecuencia*

Same as coherence of phase (phase coherence).

coherence of phase; *cohérence de phase; coherencia de fase*

See “phase coherence”.

common-view (CV) time-transfer; *transfert de signaux horaires à partir de vues simultanées; transferencia con visión común (VC) de señales horarias*

Allows the direct comparison of two clocks at remote locations. In this technique, two stations, A and B, receive simultaneous one-way signals simultaneously from a single GNSS satellite and measure the time difference between the satellite clock and their own local clock. The time difference between clocks A and B is calculated by taking the difference between the simultaneous clock difference measurements, in which any error in the satellite clock is cancelled. In addition, some error sources such as orbit error and ionospheric error that are correlated with link geometry are reduced in CV time transfer. The CV technique thus performs quite well when the two stations are separated by short distances but the uncertainty gets larger as the distance increases (less cancellation of errors, less common visibility) until the point where common view observation is no longer possible.

coordinated clock; *horloge coordonnée; reloj coordinado*

A clock synchronized within stated limits to a reference clock that is spatially separated.

coordinate time; *temps-coordonnée; tiempo-coordenada*

The concept of time in a specific coordinate frame, valid over a spatial region with varying gravitational potential.

NOTE 1 – TAI is a coordinate time-scale defined in a geocentric reference frame. See International atomic time and terrestrial time.