CCSDS Time Definitions

CCSDS Time BoF

January 2019

# Introduction

This document serves as a glossary of technical timing definitions used for reference for the CCSDS Time BoF. The terminology represents the agreement of CCSDS Time BoF participating agencies.

# Definitions:

## Clock

A device that generates periodic, accurately spaced signals for local timekeeping applications.

A clock consists of at least three parts: an oscillator, a device that counts the oscillations and converts them to units of time interval (such as seconds, minutes, hours, and days), and a means of displaying or recording the results.

## Time unit

The reference Time unit is a second, which is defined as the duration of 9 192 631 770 periods of the radiation corresponding to the transition between the two hyperfine levels of the ground state of the caesium 133 atom.  [BIPM]

https://www.bipm.org/en/bipm-services/timescales/tai.html

## Time scale

An agreed upon system for timekeeping.

All time scales use a frequency source to define the length of the one second time unit, which is the standard unit of time interval. All of the following commonly used time scales reference the same one second time unit as measured by BIPM on the surface of the Earth:

* TAI: a continuous time scale calculated at the BIPM using data from some four hundred atomic clocks in over eighty national laboratories.
* **[Coordinated Universal Time (UTC)](https://www.bipm.org/en/bipm-services/timescales/time-ftp/Circular-T.html)**, the atomic time scale that forms the basis for the coordinated dissemination of standard frequencies and time signals; UTC is identical with TAI except that from time to time a [leap second](https://www.bipm.org/en/bipm-services/timescales/leap-second.html) is added to ensure that, when averaged over a year, the Sun crosses the Greenwich meridian at noon UTC to within 0.9 s.
* Global Navigation Satellite Systems (GNSS)

Sun barycenter

Relativistic time

## Time

Time is the marking of an event with respect to a reference origin, nominally TAI.

## Time interval

The elapsed time between two events.

In time and frequency metrology, time interval is usually measured in small fractions of a [second](https://www.nist.gov/time-and-frequency-services/time-and-frequency-z-s-so#second), such as [milliseconds](https://www.nist.gov/time-and-frequency-services/time-and-frequency-z-m#millisecond), [microseconds](https://www.nist.gov/time-and-frequency-services/time-and-frequency-z-m#microsecond), or [nanoseconds](https://www.nist.gov/time-and-frequency-services/time-and-frequency-z-n-o#nanosecond).

## Time transfer

Time transfer is a mechanism used to compare Time or frequency measurements from one location to another.

Commonly used time transfer methods are:

* one-way
* common-mode, common-view transfer
* two-way methods

## Clock synchronization/correlation

Time correlation is ''the determination of the variance and time offset of two continuous timescales" provided by two different clock-ensemble. this procedure require the knowledge of clock parameters (stability, drift,...) and also propagation delay of the time transfer. 

## Time synchronization

Synchronization is the process of setting a clock-ensemble to the same time.

# References

<https://www.nist.gov/pml/time-and-frequency-division/popular-links/time-frequency-z/time-and-frequency-z-z-index>

https://www.bipm.org/en/bipm-services/timescales/tai.html