CCSDS NAVIGATION STANDARDS NORMATIVE ANNEXES

TIME SYSTEMS REGISTRY

**Policy:**  Expert Review

**Authority:**  CCSDS.MOIMS.NAV

**OID:**  1.3.112.4.X.1

**References:**

* [[ccsds-502.0-B-2]](https://public.ccsds.org/Pubs/502x0b2c1.pdf)
* [[ccsds-503.0-B-1]](https://public.ccsds.org/Pubs/503x0b1c1.pdf)
* [[ccsds-504.0-B-1]](https://public.ccsds.org/Pubs/504x0b1c1.pdf)

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| **Name** | **Description and Reference** | **Nomenclature** | **Default Units/Type** |
| BEIDOU | BeiDou Time (BDT) is a continuous time scale starting at 0000 UTC on January 1st, 2006 and is synchronized with UTC within 100 ns < (modulo one second). |  |  |
| ET | Ephemeris Time, (ET), the first dynamical time scale in history; it was defined by the International Astronomical Union in the 1950s and was superseded by Barycentric Dynamical Time in 1984. |  |  |
| GALILEO | Galileo System Time (GST) is a continuous time scale maintained by the Galileo Central Segment and synchronized with TAI with a nominal offset below 50 ns. The GST start epoch is 0000 UTC on Sunday, 22 August 1999 (midnight between 21 and 22 August). |  |  |
| GLONASS | GLONASS Time (GLONASST) is generated by the GLONASS Central Synchronizer and the difference between the UTC (SU) and GLONASST should not exceed 1 millisecond plus three hours [http://www.navipedia.net/index.php/Time\_References\_in\_GNSS - cite\_note-2](http://www.navipedia.net/index.php/Time_References_in_GNSS#cite_note-2) (the difference between Moscow Time and Greenwich Mean Time (GMT)), but http://www.navipedia.net/images/math/8/1/a/81a69207104f00baaabd6f84cafd15a0.png is typically better than 1 microsecond. Note: Unlike GPS, Galileo or BeiDou, GLONASS time scale implements leap seconds, like UTC. |  |  |
| GPS | Global Positioning System Time (GPS) is the continuous time scale for all GPS operations. It is maintained to be within one microsecond of UTC (Modulo one second). GPS time lags TAI by nineteen (19) seconds, i.e., GPS Time = TAI - 19 s. |  |  |
| GPSZ | GPS time expressed as relative (elapsed) time since the GPS epoch of 6 January 1980 0000 UTC. The elapsed time is presented in terms of Z counts (1.5 second increments) (578217609.333). In each satellite, an internally derived 1.5 second epoch provides a convenient unit for precisely counting and communicating time. Time stated in this manner is referred to as a Z-count. The Z-count is provided to the user as a 29-bit binary number consisting of two parts as follows:  a. The binary number represented by the 19 least significant bits of the Z-count is referred to as the time of week (TOW) count and is defined as being equal to the number of 1.5 second epochs that have occurred since the transition from the previous week. The count is shortcycled such that the range of the TOW-count is from 0 to 403,199 1.5 second epochs (equaling one week) and is reset to zero at the end of each week. The TOW-count's zero state is defined as that 1.5 second epoch which is coincident with the start of the present week. This epoch occurs at (approximately) midnight Saturday night-Sunday morning, where midnight is defined as 0000 hours on the Universal Coordinated Time (UTC) scale which is nominally referenced to the Greenwich Meridian. Over the years, the occurrence of the "zero state epoch" may differ by a few seconds from 0000 hours on the UTC scale, since UTC is periodically corrected with leap seconds while the TOW-count is continuous without such correction. A truncated version of the TOW-count, consisting of its 17 most significant bits, is contained in the hand-over word (HOW) of the L-Band downlink data stream.  b. The ten most significant bits of the Z-count are a binary representation of the sequential number assigned to the present GPS week (Modulo 1024). The range of this count is from 0 to 1023, with its zero state being defined as that week which starts with the 1.5 second epoch occurring at (approximately) midnight on the night of January 5, 1980/morning of January 6, 1980. At the expiration of GPS week number 1023, the GPS week number will rollover to zero (0). Users must account for the previous 1024 weeks in conversions from GPS time to a calendar date. |  | 1.5s increments |
| NAVIC | NAVIC (Navigation with Indian Constellation) is an autonomous regional [satellite navigation](https://en.wikipedia.org/wiki/Satellite_navigation) system in the Indian Regional Navigation Satellite System (IRNSS) that will provide accurate real-time positioning and timing services. The system is expected to be fully operational in 2018. |  |  |
| SCLK | Spacecraft Clock (receiver) (requires rules for interpretation in ICD) |  |  |
| TAI | International Atomic Time (TAI) is the practical realization of a uniform time scale based on atomic clocks and agrees with TT, except for a constant offset of 32.184s and the imperfections of existing clocks. The following relationships to other timescales are: TAI = TT - 32.184s  TAI = UTC + #leap\_seconds  TAI provides a physical time scale affected by the Earth's gravitational and rotational potential, and deduced from a weighted average of various international frequency standards. Relative weighting is based on the historical stability of the individual standards. TAI is maintained by the Bureau International des Poids et Mesures (BIPM) and is the basis of other time scales. |  |  |
| TCB | Barycentric Coordinate Time (TCB), where TCB is related to TT through a complex sequence of relativistic transformations. TCB - TDB ≈ 0.489 seconds/year \* (year-1977.0) Note: TCB is intended to be the time scale for ephemerides in the solar system. |  |  |
| TCG | Geocentric Coordinate Time is defined in the context of the [general theory of relativity](https://en.wikipedia.org/wiki/General_relativity). It is defined by a 1991 IAU resolution. |  |  |
| TDB | Barycentric Dynamical Time (TDB) is intended to serve as the independent argument of Barycentric ephemerides and equations of motion. It is defined as being linearly related to Barycentric Coordinate Time (TCB) The linear relationship between TDB and TCB is chosen such that the rate of TDB closely matches TT for the time span covered by the JPL Development Ephemerides. TDB is sometimes designated as Barycentric Ephemeris Time (Teph) when used as the time scale of the JPL ephemerides. |  |  |
| TT | Terrestrial Time (TT) is a theoretically ideal time at the Earth geoid. A practical realization is TT = TAI + 32.184 s. TT has also been known as Terrestrial Dynamical Time (TDT) when considered as a coordinate time for geocentric orbits. TT is the successor of pre-relativistic Ephemeris Time (ET). |  |  |
| UT1 | Universal Time (UT1) is the angular measure of Earth rotation inferred from observations. UT1 is the Earth-rotation angle determined by VLBI of selected radio point sources and interpolated by tracking of GPS satellites. UT1 provides a sequentially increasing continuum that is everlasting and widely apparent, and serves as the astronomical basis of civil time of day. The angular rate of modern-day UT1 has been defined to closely follow Newcomb's convention for mean solar time, based on the mean motion of the Sun reduced from 19th-century observations. |  |  |
| UTC | Coordinated Universal Time (UTC) is a broadcast time standard providing both astronomical time of day and atomic-time interval. UTC is kept within +/-0.9 s of UT1 by the introduction of leap seconds and is therefore a legally recognized proxy for Universal Time in most countries. UTC is always offset from TAI by an integer number of seconds, and is thus a carrier of precision frequency and time interval for broadcast standards based on the SI second. Note: Zulu time is synonymous with UTC. |  |  |