

## Relations of UTC and TAI with GPS time, GLONASS time, UTC(USNO)\_GPS and UTC(SU)\_GLONASS

(File available at <ftp://ftp2.bipm.org/pub/tai/other-products/utcgncss/utc-gncss> )

### [TAI - GPS time] and [UTC - GPS time]

The GPS satellites disseminate a common time scale designated 'GPS time'. The relation between GPS time and TAI is:

$$[TAI - GPS\ time] = 19\ s + C_0,$$

where the time difference of 19 seconds is kept constant and  $C_0$  is a quantity of the order of tens of nanoseconds, varying with time.

The relation between GPS time and UTC involves a variable number of seconds as a consequence of the leap seconds of the UTC system and is as follows:

From 1 January 2017, 0 h UTC, until further notice,  $[UTC - GPS\ time] = -18\ s + C_0$ ,

Here  $C_0$  is given at 0 h UTC every day.

$C_0$  is computed as follows. The GPS data recorded at the Paris Observatory for highest-elevation satellites are first corrected for precise satellite ephemerides and for ionospheric delays derived from IGS maps, and then smoothed to obtain daily values of  $[UTC(OP) - GPS\ time]$  at 0 h UTC. Daily values of  $C_0$  are then derived by linear interpolation of  $[UTC - UTC(OP)]$ .

The standard deviation  $\sigma_0$  characterizes the dispersion of individual measurements for a month. The actual uncertainty of user's access to GPS time may differ from these values.  $N_0$  is the number of measurements.

### [TAI - UTC(USNO)\_GPS] and [UTC - UTC(USNO)\_GPS]

The GPS satellites broadcast a prediction of UTC(USNO) calculated at the USNO, indicated by UTC(USNO)\_GPS. The relation between UTC(USNO)\_GPS and TAI involves a variable number of seconds as a consequence of the leap seconds of the UTC system, and is as follows:

From 1 January 2017, 0 h UTC, until further notice,  $[TAI - UTC(USNO)_GPS] = 37\ s + C_0'$

Here  $C_0'$  is given at 0 h UTC every day.

$C_0'$  is computed using the values of  $[UTC - UTC(OP)]$  similarly than the computation of  $C_0$ .

The relation between UTC(USNO)\_GPS and UTC is  $[UTC - UTC(USNO)_GPS] = 0\ s + C_0'$

The standard deviation  $\sigma_0'$  characterizes the dispersion of individual measurements for a month. The actual uncertainty of user's access to UTC(USNO)\_GPS may differ from these values.  $N_0'$  is the number of measurements.

## Relations of UTC and TAI with GPS time, GLONASS time, UTC(USNO)\_GPS and UTC(SU)\_GLONASS (Cont.)

(File available at <ftp://ftp2.bipm.org/pub/tai/other-products/utcgns/utc-gnss> )

### [UTC - GLONASS time] and [TAI - GLONASS time]

The GLONASS satellites disseminate a common time scale designated 'GLONASS time'. The relationship between GLONASS time and UTC is

$$[UTC - GLONASS \text{ time}] = 0 \text{ s} + C_1,$$

where the time difference 0 s is kept constant by the application of leap seconds so that GLONASS time follows the UTC system, and  $C_1$  is a quantity of the order of tens of nanoseconds (tens of microseconds until 1 July 1997), which varies with time.

The relation between GLONASS time and TAI involves a variable number of seconds and is as follows:

From 1 January 2017, 0 h UTC, until further notice,  $[TAI - GLONASS \text{ time}] = 37 \text{ s} + C_1$ .

Here  $C_1$  is given at 0 h UTC every day.

$C_1$  is computed as follows. The GLONASS data recorded at the Astrodynamical Observatory, Borowiec, Poland for the highest-elevation satellites are smoothed to obtain daily values of  $[UTC(AOS) - GLONASS \text{ time}]$  at 0 h UTC. Daily values of  $C_1$  are then derived by linear interpolation of  $[UTC - UTC(AOS)]$ .

To ensure the continuity of  $C_1$  estimates, the following corrections are applied:

- +1285 ns from 1 January 1997 (MJD 50449) to 22 March 1999 (MJD 51259)
- +107 ns for 23 March 1999 and 24 March (MJD 51260 and MJD 51261)
- 0 ns since 25 March 1999, (MJD 51262).

The standard deviation  $\sigma_1$  characterizes the dispersion of individual measurements for a month. The actual uncertainty of user's access to GLONASS time may differ from these values.  $N_1$  is the number of measurements.

### [TAI - UTC(SU)\_GLONASS] and [UTC - UTC(SU)\_GLONASS]

The satellites broadcast a prediction of UTC(SU) calculated at the SU, indicated by UTC(SU)\_GLONASS. The relation between UTC(SU)\_GLONASS and TAI involves a variable number of seconds as a consequence of the leap seconds of the UTC system, and is as follows:

From 1 January 2017, 0 h UTC, until further notice,  $[TAI - UTC(SU)_GLONASS] = 37 \text{ s} + C_1'$

Here  $C_1'$  is given at 0 h UTC every day.

$C_1'$  is computed using the values of  $[UTC - UTC(AOS)]$  similarly than the computation of  $C_1$ .

The relation between UTC(SU)\_GLONASS and UTC is  $[UTC - UTC(SU)_GLONASS] = 0 \text{ s} + C_1'$

The standard deviation  $\sigma_1'$  characterizes the dispersion of individual measurements for a month. The actual uncertainty of user's access to UTC(SU)\_GPS may differ from these values.  $N_1'$  is the number of measurements.