GLONASS TIME SCALE DESCRIPTION

Definition of System

1. System timescale: GLONASS Time.

2. Generation of system timescale: on the basis of time scales of GLONASS Central Synchronizers (CS).

3. Is the timescale steered to a reference UTC timescale:

Yes.

a. To which reference timescale: UTC(SU), generated by State Time and Frequency Reference (STFR).

b. Whole second offset from reference timescale:

10800 s (03 hrs 00 min 00 s).

$t_{GLONASS} = UTC(SU) + 03$ hrs 00 min

c. Maximum offset (modulo 1s) from reference timescale:

660 ns (probability 0.95) – in 2014;

4 ns (probability 0.95) – in 2020.

4. Corrections to convert from satellite to system timescale:

SVs broadcast corrections $\tau_n(t_b)$ and $\gamma_n(t_b)$ in L1, L2 frequency bands for 30-minute segments of prediction interval.

a. Type of corrections given; include statement on relativistic corrections:

Linear coefficients broadcast in operative part of navigation message for each SV (in accordance with GLONASS ICD).

Periodic part of relativistic corrections taking into account the deviation of individual SVs orbits from GLONASS nominal orbits is incorporated in calculation of broadcast corrections to convert from satellite timescale to GLONASS Time.

b. Specified accuracy of corrections to system timescale:

The accuracy of calculated offset between SV timescale and GLONASS Time – 5,6 ns (rms).

c. Location of corrections in broadcast messages:

L1/L2

- $\tau_n(t_b)$ – line 4, bits 59 – 80 of navigation frame;

- $\gamma_n(t_b)$ - line 3, bits 69 – 79 of navigation frame.

d. Equation to correct satellite timescale to system timescale:

L1/L2

$$t_{GLONASS} = t + \tau_n(t_b) - \gamma_n(t_b)(t - t_b)$$

where t - satellite time;

$\tau_n(t_b)$, $\gamma_n(t_b)$ - coefficients of frequency/time correction;

t_b - time of locking frequency/time parameters.

5. Corrections to convert from GLONASS system time to reference UTC(SU) time:

SVs broadcast corrections τ_c in L1, L2 frequency bands for 30-minute segments of prediction interval.

a. Type of corrections given:

- τ_c – constant for 30-minute intervals.

b. Specified accuracy of corrections to reference timescale:

The accuracy of calculating GLONASS Time – UTC offset is

- below 40 ns – in 2014;

- below (1-2) ns – in 2020.

c. Location of corrections in broadcast messages:

L1/L2

- τ_c - line 5, bits 38 – 69 of navigation frame.

d. Equations to correct system timescale to reference timescale:

L1/L2

t_{UTC} + 03 hrs 00 min = $t_{GLONASS} + \tau_c$

6. Specified stability of system timescale:

Depends on CS characteristics.

7. Specified stability of reference timescale:

Depends on State Time and Frequency Reference (STFR) characteristics.

8. Specified stability of satellite clocks:

- $1 \cdot 10^{-13}$ (τ = 1 day)

9. Availability of System to GNSS Time Offset (GGTO):

a. Systems for which corrections are given?

GPS - correction τ_{GPS} broadcast by SVs.

b. Type of GGTO corrections given:

τ_{GPS} – fractional part of GPS-GLONASS Time offset (integer part is determined by user from GPS navigation message).

c. Stated accuracy of GGTO corrections given:

not worse than 30 ns (rms).

d. Location of corrections in broadcast messages:

τ_{GPS} - line 5, bits 10 – 31 of navigation frame.

e. Equation used for GGTO message:

$$T_{GPS} - T_{GL} = \Delta T + \tau_{GPS}$$

where ΔT - integer part of GPS-GLONASS Time offset;

τ_{GPS} - fractional part of the offsets.

Describe the details of the system, i.e. locations of system and reference timescale clocks, generation of timescales, and other details.

GLONASS Central Synchronizers are located at two sites of GLONASS Control Segment and include an ensemble of hydrogen frequency standards with daily frequency instability less than $2 \cdot 10^{-15}$. One of them is the Main CS, the other is Reserved CS.

GLONASS Time is generated on the basis of the Main CS timescale. The offset of Reserved CS timescale relative to the Main CS timescale is calculated with using the measurements provided by One-Way Measurement Facility and “all-in-view” method.

GLONASS reference timescale UTC(SU) is generated by STFR which includes cesium frequency standards, a group of hydrogen frequency standards, a TWSTFT link for synchronization to UTC.

Describe how the timescale transfers from the reference timescale to the system timescale and finally to the satellites. Include the nominal rate of SV updates.

The offsets of GLONASS Central Synchronizers timescales relative to UTC(SU) are controlled by “all-in-view” method with using SV signals. The data are transferred to GLONASS System Control Center where GLONASS Time and corrections for GLONASS Time–UTC(SU) offset are generated. The corrections are calculated and uploaded once per day.

If any other pertinent details exist concerning the generation and realization of system and/or reference time, include them as well.

GLONASS Time is corrected simultaneously with corrections of UTC in accordance with BIPM recommendations and, as a result, there is no whole second time offset between GLONASS Time and UTC(SU).