



GNSS Timescale Description Template



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Heading

GNSS Timescale Description

GPS

Definition of System

- ▶ Introductory text, defines the document, the name of the system and the header for the numbered questions



Basics

1. **System timescale: GPS Time**

2. **Generation of system timescale:**

- ▶ Covers the basics:

- ▶ The name of the system timescale

- ▶ The generation of the timescale, which for GPS is a clock ensemble of various station and GPS clocks



Steering

- ▶ **3. Is system timescale steered to a reference UTC timescale?**
 - ▶ a. **To which reference timescale: UTC(USNO)**
 - ▶ b. **Whole second offset from reference timescale?**
Yes, 15 seconds ahead of UTC as of 07/2010, with changes corresponding to the addition/subtraction of leap seconds
 - ▶ c. **Maximum offset (modulo 1s) from reference timescale?**
1 microsecond, typically within 10 nanoseconds

- ▶ Covers information on the steering of the GNSS Timescale to a reference laboratory timescale
- ▶ Includes statement of any offsets and maximum offset modulo one second
- ▶ GPS Time is steered to UTC (USNO)



From Satellite Time to System Time

- ▶ **4. Corrections to convert from satellite to system timescale?**
 - ▶ a. Type of corrections given; include statement on relativistic corrections
 - ▶ b. Specified accuracy of corrections to system timescale
 - ▶ c. Location of corrections in broadcast messages
 - ▶ d. Equations to correct satellite timescale to system timescale

- ▶ This section covers the conversion of satellite timescale to system timescale.
- ▶ GPS almanac and ephemeris information is referenced to GPS Time, so this conversion is necessary.
- ▶ GPS includes a statement on the particular anomalies for which the given relativistic correction accounts and the given, typical accuracies.



From System Time to Reference UTC Time

- ▶ **5. Corrections to convert from system to reference UTC timescale? If yes:**
 - ▶ a. Type of corrections given
 - ▶ b. Specified accuracy of corrections to reference timescale
 - ▶ c. Location of corrections in broadcast messages
 - ▶ d. Equations to correct system timescale to reference timescale

- ▶ This section concerns the conversion of GNSS system time to a reference UTC, and the accuracy associated with the conversion.

- ▶ GPS includes the equations to convert from GPS Time to UTC as realized by USNO, and the stated and typical accuracy.



Stability

▶ **6. Specified stability of system timescale**

Not specified

▶ **7. Specified stability of reference timescale**

UTC(USNO) stability of 3×10^{-15} per day

▶ **8. Specified stability of satellite clocks**

Not published, stability depends on block of satellite

▶ These sections are about timescale stability.

▶ GPS does not publish much information on this, other than the minimum stated stability of USNO.



System to GNSS Time Offset (GGTO)

- ▶ **9. Availability of System to GNSS Time Offset (GGTO)**
 - ▶ a. Systems for which corrections are given?
 - ▶ b. Type of GGTO corrections given
 - ▶ c. Stated accuracy of GGTO correction, if available
 - ▶ d. Location of corrections in broadcast messages
 - ▶ e. Equations used for GGTO message

- ▶ GPS plans to broadcast GGTO corrections for up to 7 GNSS systems
- ▶ GPS has a stated goal of 5 ns (95%) for a GPS to Galileo time offset.
- ▶ Accuracies to other systems depend largely on each system's time scale predictability.



Additional Information

- ▶ **Describe the details of the system, i.e. locations of system and reference timescale clocks, generation of timescales, and other details.**
- ▶ GPS includes information on the GPS Master Control Station location and more on the computation of GPS Time, among other topics.
- ▶ Also present is a section about the tuning of oscillator frequencies of the clocks onboard GPS Satellites to account for special and general relativistic effects to ground-based observers



Additional Information

- ▶ **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.**
- ▶ USNO monitors the offset of GPS Time to UTC as realized by USNO and reports this data to GPS Operations
- ▶ GPS satellites are nominally updated at least once per day



Additional Information

- ▶ **If any other pertinent details exist concerning the generation and realization of system and/or reference time, include them as well.**
- ▶ GPS includes a statement on the signal types used to realize GPS time

