GNSS Timescale Description Template

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GNSS Timescale Description

GPS

Definition of System

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

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)

- **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.

- **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.

- **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

- **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