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
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 $3 \times 10^{-15}$ 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