



Clarifying the Continuity of GPS Time

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Motivation

- The GPS interface specifications contain a lot of verbiage that address week number (WN) and second of week (SOW)
 - The information is scattered throughout the IS series
 - WN/SOW math is correct, but not necessarily consistent
- The IS implicitly encourages users to implement complex WN/SOW math to difference two times
 - Algebraically, using “seconds since beginning of GPS Epoch” is much simpler
- The ICWG process spends inordinate amounts of time reviewing, correcting the “time math” in the IS text



Proposal

- Define two representations of GPS time (GPST)
 - Weeks (WN) and seconds of week (SOW) = GPST(WN+SOW)
 - Two values; for example, Week 2063, SOW 213030.25
 - Elapsed integer and fractional seconds = GPST(sec)
 - A single value; for example, 1247915430.25 seconds
 - Both referenced to beginning of GPS time (6 Jan 1980)
- Establish approach
 - GPST(WN+SOW) used in navigation message
 - GPST(sec) to be used in calculations
- Define how navigation message quantities are converted from GPST(WN+SOW) to corresponding GPST(sec)
 - Do this in a dedicated section of each IS so information is consolidated
- Express all time calculations in terms of GPST(sec)
 - No more week rollover math in equations!



Implementation Details

- Add material to IS-GPS-200, Section 3.3.4 GPS Time and SV Z-Count
 - 3.3.4.1 GPST Representation
 - Define concept of GPST(WN+SOW) and GPST(sec)
 - 3.3.4.2 Converting Between GPST Representations
 - Define GPS Epochs (10-bit and 13-bit week rollovers)
 - Define how each GPST(WN+SOW) is converted to GPST(sec)
 - 3.3.4.3 Relating GPST to UTC
 - Existing text from 3.3.4
 - 3.3.4.4 Z-Count Time
 - Existing text from 3.3.4

DETAILS IN MEMO





Scope of the Changes

- The following sections in IS-GPS-200 contain “time math” that would be changed by this proposal
 - 22 sections listed in the table
- Similar tables need to be developed for IS-GPS-705, IS-GPS-800

Section#	Title	Section#	Title
3.3.4	GPS Time and SV Z-Count	30.3.3.1.3	User Algorithm for Determination of SV Position
6.1	Acronyms	30.3.3.2.1.1	SV Clock Correction
		30.3.3.2.1.2	Data Predict Time of Week
20.3.3.3.3.1	User Algorithm for SV Clock Correction	30.3.3.2.4	NED Accuracy Estimates
20.3.3.4.3	User Algorithm for SV Ephemeris Determination	30.3.3.3.1.3	Data Predict Week Number
20.3.3.4.3.4	Geometric Range	30.3.3.4.1	Almanac Reference Week
20.3.3.4.4	NMCT Validity Time	30.3.3.5.1.1	User Algorithm for Application of the EOP
20.3.3.5.1.5	Almanac Reference Week	30.3.3.6.2	UTC and GPS Time
20.3.3.5.2.2	Almanac Reference Time	30.3.3.7.2.1	DC Data Predict Time of Week
20.3.3.5.2.3	Almanac Time Parameters	30.3.3.7.3	Application of Clock-Related DC Data
20.3.3.5.2.4	Coordinated Universal Time (UTC)	30.3.3.7.4	Application of Orbit-Related DC Data
		30.3.3.8.2	GPS and GNSS Time



Summary of Benefits

- Complexities of GPST(WN+SOW) and week rollover handling will be “packaged” in one location
- As explicit discussion of navigation message week number limitations and the need for external provision of GPS Epoch will be added
- “Time math” equations throughout the document will become much simpler

- The cost is the effort associated with a significant modification to the IS series



Conclusion

- GPS time is already continuous
 - No leap seconds or other discontinuities
- Let's take advantage of that
 - Define separation between
 - Navigation message representation
 - Equations associated with “time math”
 - Simplify the “time math”, improve clarity