Global Positioning Systems (GPS) Directorate
2019 Virtual Public Interface Control Working Group (ICWG) Meeting Minutes
Date: 7 May 2019
Meeting Time: 0830 – 1030 HRS (Pacific Time)
Location: Virtual (dial-in)
Dial-In: 1-310-653-2663; Meeting ID: 6729512 Passcode: 123456
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Meeting started: 0830 HRS (Pacific Time)
Meeting ended: 0930 HRS (Pacific Time)
Links: https://www.gps.gov/technical/icwg/meetings/2019/
Agenda:
Public ICWG – 0830 – 0930 HRS (Pacific Time)

> Introduction
> Rules of Engagement
> GPS Technical Baseline Configuration Management Process
> RFC-400 (Leap Second and Earth Orientation Parameters)
> Open RFC Discussion Session
> Action Item Review
> Adjourn

Name	Organization	Online
Amirian, Caaren	SE&I	X
Berg, John	Aerospace	X
Bolger, Jason	SE&I	X
Czopek, Frank	Microcosm	X
Fabian, Frank	MITRE	X
Fischer, John	Orolia	X
Flores, Anthony	SE&I	X
Ford, Cheryl	PNT-PO	X
Godwin, Dan	SMC/GPE	X
Goff, Stan	Chicago Inside GNSS	X
Hegarty, Chris	MITRE	X
Hilario, Ramon	SMC/GPN	X
Hillman, Stephan	Aerospace	X
Hutsell, Steven	2SOPS	X
Kawakami, Todd	NGA	X
Kirpes, Roger	Collins Aerospace	X
Kovach, Karl	Aerospace	X
Kwan, Philip	SE&I	X
Lemus, Jennifer	SE&I	X
McCarthy, Dennis	USNO	X
Min, Jason	Sandia National Laboratories	X
Naick, Purvis	SMC/GPC	X
Nguyen, Ha	FAA	X
Pi, Kevin	Raytheon	X
Rose, Michael Maj	19SOPS	X
Ruch, Rebecca CWO	USCG NAVCEN	X
Semler, Jim	L3	X
Shook, Garrett	SMC/GPN	X
Sinnokrak, Nicholas CDR	Navy	X
Slattery, Rhonda	Aerospace	X
Stamatakos, Nicholas	USNO	X
Telcide, Michael Capt	Aerospace	X

<u>Introduction</u>

Capt Michael Telcide (GPS Program Office) addressed the public with opening remarks, team introductions, rules of engagement, and technical baseline configuration management process.

<u>RFC-400 – Leap Second and Earth Orientation Parameters</u>

A. Capt Telcide provided a brief overview of the history of the RFC – that it was last briefed at the 2018 Public ICWG and the solution has been re-worked in preparation for today's meeting.

>   **Problem Statement:** As currently documented in the technical baseline for Earth Orientation Parameters (EOP) data and applications, Civil Navigation (CNAV) and CNAV-2 users may calculate the wrong UT1 time immediately following a leap second change, as the linkage between Coordinated Universal Time (UTC) and UT1 time is not properly captured.

>   **Solution Statement:** Re-define the EOPs such that UT1 is calculated with respect to GPS time instead of UTC time. Therefore, since GPS time does not utilize leap seconds, there is no leap second problem for users when they calculate UT1.

B. Following the overview, Philip Kwan briefed the specifics:

>   **Problem** – How the current UTC to UT1 relationship is depicted will result in a one-second discontinuity in the event of a leap second. The ΔUT1 term is meant to account for the one-second discontinuity, but the user may not receive it until a period of time after the leap second event because the Control Segment (CS) needs to update the EOP message. Therefore, the user may calculate UT1 that is one second off until they receive the updated message.

>   **Solution** – Redefine ΔUT1 and ΔU̇T1 to ΔUTGPS and ΔU̇TGPS respectively. ΔUTGPS is the relationship between UT1 time and GPS time. ΔU̇TGPS is the drift rate of the ΔUTGPS term with respect to time. This redefinition removes the leap second problem, but it also puts UT terms on equal footing with the polar motion terms, which are expressed with respect to GPS time.

>   **Additional Changes (1 - 6)**

>> 1. ΔUTGPS scale factor change from 2^{-24} to 2^{-23} because deriving the UTC-GPS time offset from the current bit allocation and scale factor for ΔUTGPS and UT1-UTC (constrained within 0.9s) will result in a valid range that is less than half of what is provided in the UTC parameters. Example: Δt_{LS} (leap second count) in the UTC message has twice the valid range of the derived UTC-GPS time offset but permits the UTC-GPS time offset to have the valid range of at least the Δt_{LS}. Given this, the derived UTC-GPS time offset will go outside the valid range sooner than permitted and result in GPS lifespan issues and/or rollover issues. Solution will double the valid range to be more aligned, and preliminary analysis does not conclude substantial error due to increased granularity from scale factor doubling. Please refer to slides for specific details.
>> 2. Made changes in the table to incorporate EOP changes (please refer to changes A through F in the slides).

<ol type="a">
<li start="1">Action #1: Minor error (typo) in part E in the notes – 64800 should be corrected to 86400 for the seconds in a day.

<ol start="3">
Add statements to couple the UTC and EOP messages in order for the user to use a week number for the EOP data.
<ol type="a">
The EOP messages do not contain a reference week number
UTC is paired with EOP with the requirement that consistent message pairs have t_{EOP} set to t_{ot}
Conclusion: Define criteria for the user.
<ol type="i">
CNAV: 1. $t_{EOP} = t_{ot}$; 2. t_{op} in EOP message = t_{op} in UTC message
CNAV-2: 1. $t_{EOP} = t_{ot}$; 2. EOP message and UTC message were transmitted within 4 hours of each other

Add a statement that the user may calculate the original ΔUT1 (UT1-UTC offset) term from the UT1-GPS time offset and the GPS-UTC time offset
Add language so the user knows:
<ol type="a">
Which tides are already applied to the EOPs
That the tides do not need to be further applied

Add requirement for the Control Segment to update EOP data every 3 days, and if not, the accuracy of the EOP data will degrade over time.
<ol type="a">
Addressed in the public comments – rework

<ol type="C" start="3">
Public Comment Discussion

There were 4 comments submitted by the public: one substantive and three administrative comments. All were discussed.

Steven Hutsell, 2SOPS, commented that the language provided in #6 above is not clear. Propose to make the text vague.
<ol type="a">
Discussed using "refreshed" but that term isn't used in the document.
"Updated" was unclear, but discussion cleared up the meaning of update. Even if the CS is not receiving a new NGA bulletin on the EOPs, they will still conduct an update for the EOPs.
Recommend using "updated". Received concurrence from reviewers based on the discussion.
Action #2: Update "uploaded" to "updated" in the slides and PIRNs.

Nick Stamatakos, USNO, commented that "EOP parameters" as written is redundant and may be read as "Earth Orientation Parameters parameters." Comment is accepted.
<ol type="a">
Discussed "EOPP" which stands for Earth Orientation Parameter Predictions
Removing the redundancy will ensure that the reader does not confuse with the acronym in (a)
Received a comment saying that EOP(s) should not have the parentheses surrounding the (s)
Action #3: Make the slides clear between singular and plural.
<ol type="i">
Earth Orientation Parameters = EOPs

  ii. Earth Orientation Parameter = EOP
3. Dennis McCarthy, USNO, commented that the "Celestial Ephemeris Pole" term should be updated to the more up-to-date "Celestial Intermediate Pole" as depicted in the International Earth Rotation and Reference Systems Service (IERS) Technical Note 36.
4. Steven Brown, Lockheed Martin, commented on the appearance of the EOP message definition in IS-GPS-800 (Figure 3.5-3). The arrows should be fixed.
  a. Frank Czopek: Put "DIRECTION OF DATA FLOW FROM SV" closer to "MSB FIRST", so that it reads: "DIRECTION OF DATA FLOW FROM SV (MSB FIRST)"
    i. Mr. Czopek will submit a comment to be discussed in the September 2019 Public ICWG (global fix)
    ii. It looks like the document calls out two separate fields but in reality it should inform the reader the direction of data being sent and what bit is sent first
  b. Frank Czopek: Put more space between "DIRECTION OF DATA FLOW FROM SV" and "MSB FIRST"
    i. **Action #4: Fix this in the PIRN and slides.**

Discussion of the 4 comments concluded.

Open RFC Discussion

The floor was opened for any RFC discussion; no additional comments.

Action Item Review

Reviewed the four actions that were captured in the meeting.

There will be an announcement as to when EOPs with the newly updated definitions will be broadcast.

Closing Statements

Capt Telcide gave closing statements, describing when the minutes, updated PIRNs, and final IRNs will be released. He announced the PICWG, tentatively scheduled for Wednesday, September 25, 2019, to discuss RFC-395 (2019 Public Document Proposed Changes) and RFC-403 (Health Bit Clarification)

Adjourn

Meeting was adjourned at 0930 Pacific.

Action Item Review Table: Year	Action Item #	Short Title	Status	Comments	Remaining Actions
2019	1	Fix "64800" typo in Public ICWG slide deck to be "86400"	In Work	To be incorporated prior to final review of the Public ICWG slides and RFC-400 PIRNs	
	2	Clarify that the EOP accuracy degradation statement is for the CS updating the EOPs, not the CS uploading the EOPs	In Work	To be incorporated prior to final review of the Public ICWG slides and RFC-400 PIRNs	
	3	Make distinctions between singular and plural updates of "EOP Parameter(s) to EOP(s)"in the Public ICWG slide deck	In Work	To be incorporated prior to final review of the Public ICWG slides and RFC-400 PIRNs	
	4	Spacing between "DIRECTION OF DATA FLOW FROM SV" and "MSB FIRST"	In Work	To be incorporated prior to final review of the Public ICWG slides and RFC-400 PIRNs	