Global Positioning Systems (GPS) Public Interface Control Working Group and Public Forum

6 - 7 September 2017
0830 – 1630 hrs PST

United States Air Force GPS Directorate
Phone Number: 1-310-653-2663 Meeting ID: 7536629 Passcode: 000001
DCS Website: https://conference.apps.mil/webconf/gpspublicmeeting

Opening Remarks

Global Positioning Systems (GPS) Directorate Space and Missile Systems Center

Roll Call

Agenda – Day 1 (Public ICWG)

Opening Remarks

Roll Call

Agenda Overview

Meeting Logistics / Rules of Engagement

Meeting Purpose

RFC-349: 2017 Public Document Clean-Up

RFC-351: ICD-GPS-240/ICD-GPS-870 Admin Changes

RFC-352: Update ICD-GPS-240 and ICD-GPS-870 for NANU Issuance

RFC-354: Leap Second and EOP (Earth Orientation Parameters) Synchronization

BREAK

Action Item Review

2017

Past years

Adjourn

Agenda – Day 2 (Public Forum)

Reconvene

Roll Call

Action Item Review Continued (if necessary)

Special Topic Presentations

Delta from 2016 PICWG RFC-312, Definition Clarification for Time of Predict

GPS IIR-M and IIF L2C Phase Noise Plot Addition to IS-GPS-200 as References

IS-GPS-200H URA Wording Clarification (briefed by Aerospace Corp.)

Open Discussion Session

Action Item Review

Adjourn

GPS Requirements Team

Air Force

James Horejsi, GPS Chief Engineer

Daniel Godwin, GPS Requirements Section Chief

Maj Jenny Ji, GPS Requirements Section Deputy

Lt Irvin Vazquez, GPS Ground/User Requirements Lead

Capt Robert Van Roekel, GPS Requirements IMA

Aerospace Corporation

Dr. Rhonda Slattery

Karl Kovach

Systems Engineering and Integration (SE&I)

Liberty Alversado

Perry Chang

Amit Patel

John Kasper

Huey Nguyenhuu

Meeting Logistics

- Parking (Bldg. 200, 18th floor for parking validation)
- Restrooms
- Emergency Exits
- Refreshments
- Lunch
- Wi-Fi
- Additional Meeting Space
- Meeting Minutes

Rules of Engagement

UNCLASSIFIED

ABSOLUTELY NO PROPRIETARY, CLASSIFIED, OR COMPETITION SENSITIVE INFORMATION IS TO BE DISCUSSED DURING THIS MEETING.

Rules of Engagement

- Please place your phones on mute when not speaking to minimize background noise
- Comments against the topics listed on the official agenda will get priority during discussion
- Topics that warrant additional discussion may be side-barred
- Ad-hoc topics may be discussed during the open discussion on 7 Sep 17
- Meeting minutes and final IRNs will be generated and distributed as a product of this meeting
- Please announce your name and organization before addressing the group
- Day 2 may be rolled into Day 1, time permitting

Meeting Purpose

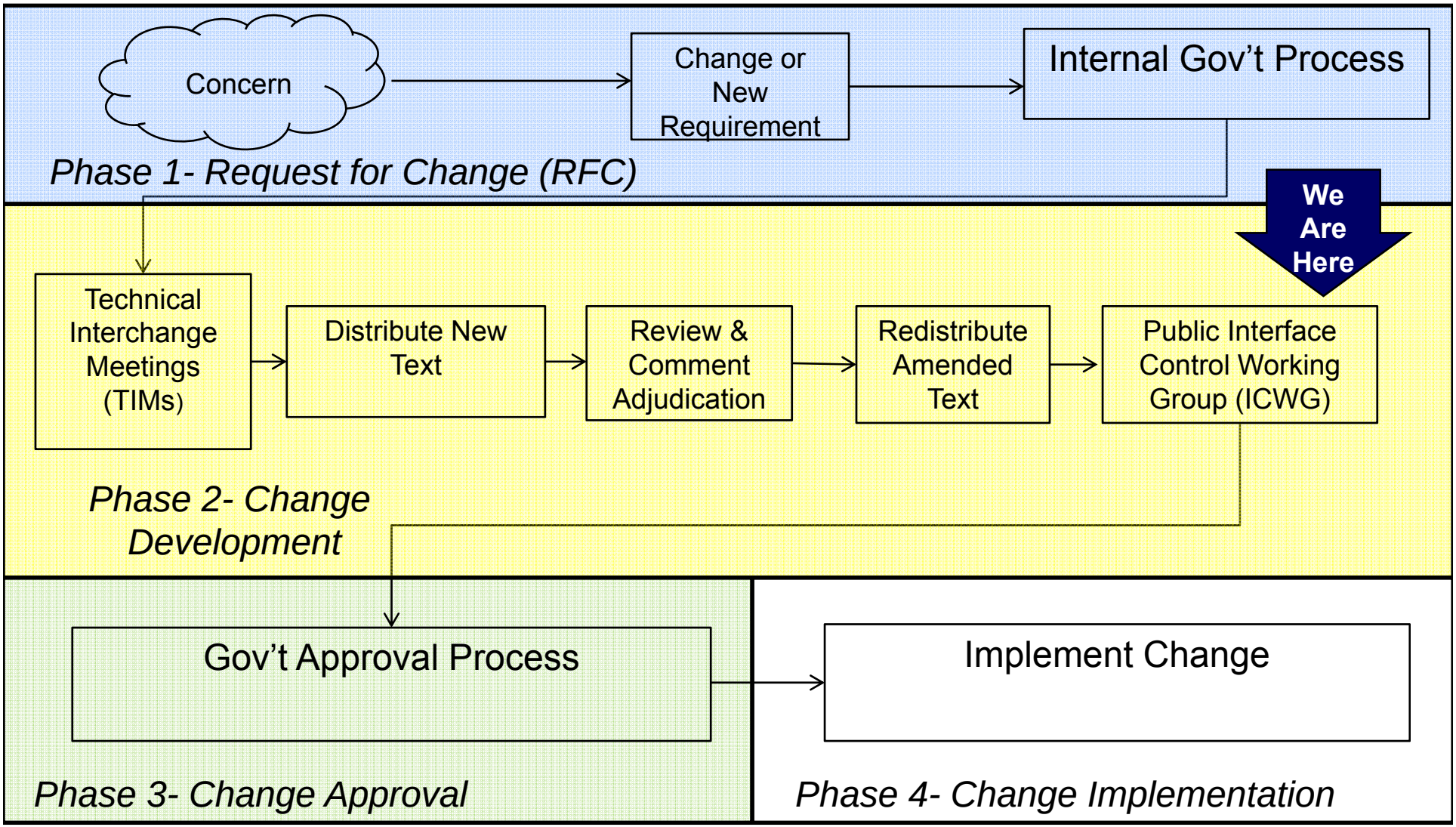
- The purpose of the meeting is to:

1) Obtain ICWG approval on the proposed language generated for the enterprise RFCs that may impact the public documents

2) Discuss any new open forum items against the Public Signals in Space documents

Comments received will be vetted per the standard change management process

Change Management High Level Process Flow



2017 PUBLIC INTERFACE CONTROL WORKING GROUP

ICWG Introduction

Ground Rules

- Please begin each comment by stating your name and organization
- Keep your comments within the scope of the proposed changes
- Any additional, out-of-scope changes can be submitted to the GPS directorate via the provided pre-RFC submission forms
- The proposed changes reflect updates to the CCB-approved version of the public documents, which served as the baseline (i.e., WAS) for the reviewed materials
- These presentations contain all submitted comments that are:
    - Critical (all)
    - Substantive (all)
    - Any Rejected Administrative Comment
- Additional concerns can be submitted via concern forms or emailed to smcgper@us.af.mil

Updates to the Change Review Process

- The GPS Directorate has received numerous comments highlighting the cumbersome nature of reviewing proposed interface revision notices (PIRNs)
- The SE&I team is working tirelessly to update the process used to release PIRNs so materials are presented in an efficient, readable manner
- Periodic updates will be provided to technical baseline change review stakeholders on progress with this effort
- Any further discussions on this topic will be deferred and additional comments can be submitted to the GPS Directorate via smcgper@us.af.mil

{TEMPLATE for CRM Status}

CRM – COMBINED STAKEHOLDER/DIRECTORATE REVIEW STATUS					
Disposition/Type	**Critical**	**Substantial**	**Administrative**	**Totals**	**Concurrence**
Accept	##	##	##	##	##
Accept with Comment	##	##	##	##	##
Reject	##	##	##	##	##
Defer	##	##	##	##	##
Grand Totals:	##	##	##	##	##

Affected Document(s)	{List document(s)}	**DOORS ID**	{DOORS ID}
Paragraph	{Insert text here}	**Comment Number**	{from CRM}
Comment Type	{Critical/Substantive/Admin}	**Disposition**	{Accept/Accept w/ Comment/Reject/Defer}
Comment Originator(s)	Commenter Name (Commenter Organization)		
Comment	{What was submitted by the commenter in the CRM}		
Directorate Response	{Text describing the rationale of the disposition}		

BASELINE TEXT (WAS)	PIRN TEXT (IS)	PROPOSED TEXT
{Text shown in current version of CCB-approved interface revision notice}	{Text from PIRN}	{Proposed text received by the commenter during the PIRN review, and/or proposed text by the government to adjudicate the subject comment}

{TEMPLATE for Comment Adjudication}

2017 Public Document Clean-Up Government Only Non-Public ICWG

Lt Irvin Vazquez-Calderon
Huey Nguyenhuu

RFC-349
2017 Public Document Clean-Up

Problem Statement:
Some ambiguous, insufficient, or missing editorial or administrative information exist within the descriptive texts, phrases, and/or references in the public documents.
Proposed Solution:
Modify public documents to clarify some ambiguous, insufficient, or missing editorial or administrative information to enhance the public document quality (clear and concise communication) as suggested by Public Interface Control Working Group (ICWG) participants, stakeholders, and key members.
Impacted Documents:
IS-GPS-200 and IS-GPS-705

CRM Status

CRM – COMBINED STAKEHOLDER/DIRECTORATE REVIEW STATUS					
Disposition/Type	**Critical**	**Substantial**	**Administrative**	**Totals**	**Concurrence**
Accept	0	0	0	0	0
Accept with Comment	0	1	0	1	0
Reject	0	0	0	0	0
Defer	0	0	0	0	0
Grand Totals:	0	1	0	1	1

Critical Comments (0)

Substantive Comments

Rejected Administrative Comments

Critical Comments

Substantive Comments (1)

Rejected Administrative Comments

DOORS ID	IS705-265		
Paragraph	**20.3.3.2.4.0-6**	**Comment Number**	**25**
Comment Type	Substantial	**Disposition**	**Accept with comment**
Comment Originator(s)	Denis Bouvet (Thales)		
Comment	This comment applies to section 20.3.3.2.4. Clarify to which users the IURA$_{NED}$ is applicable. Add "for single-frequency L1 C/A users who correct the code phase as described in section 20.3.3.3.1.1.1, for single-frequency L5 users who correct the code phase as described in section 20.3.3.3.1.2.1 and for dual-frequency L1/L5 users who correct the group delay and ionospheric effects as described in section 20.3.3.3.1.1.2." to the end of the current sentence after "fit interval".		
Directorate Response	Accept with comment. Add L5 reference as noted in the proposed text below		

BASELINE TEXT (WAS)	PIRN TEXT (IS)	PROPOSED TEXT
URA$_{NED0}$ accounts for zeroth order SIS contributions to user range error which include, but are not limited to, the following: LSB representation/truncation error; the net effect of clock correction polynomial error and code phase error in the transmitted signal for single-frequency L1C/A or single-frequency L2C users who correct the code phase as described in Section 20.3.3.3.1.1.1; the net effect of clock parameter, code phase, and inter-signal correction error for dual-frequency L1/L2 and L1/L5 users who correct for group delay and ionospheric effects as described in Section 20.3.3.3.1.1.2; radial ephemeris error; anisotropic antenna errors; and signal deformation error. URA$_{NED}$ does not account for user range contributions due to the inaccuracy of the broadcast ionospheric data parameters used in the single-frequency ionospheric model or for other atmospheric effects.	URA$_{NED0}$ accounts for zeroth order SIS-contributions to user range error which include, but are not limited to, the following: LSB representation/truncation error; the net effect of clock correction polynomial error and code phase error in the transmitted signal for single-frequency L1C/A or single-frequency L2C users who correct the code phase as described in Section 20.3.3.3.1.1.1 and for single-frequency L5 users who correct the code phase as described in section 20.3.3.3.1.2.1; the net effect of clock parameter, code phase, and inter-signal correction error for dual-frequency L1/L2 and L1/L5 users who correct for group delay and ionospheric effects as described in Section ~~20.3.3.3.1.1.2~~ 20.3.3.3.1.2; radial ephemeris error; anisotropic antenna errors; and signal deformation error. URA$_{NED}$ does not account for user range contributions due to the inaccuracy of the broadcast ionospheric data parameters used in the single-frequency ionospheric model or for other atmospheric effects.	URA$_{NED0}$ accounts for zeroth order SIS-contributions to user range error which include, but are not limited to, the following: LSB representation/truncation error; the net effect of clock correction polynomial error and code phase error in the transmitted signal for single-frequency L1~~C~~/L2/L5~~A or single-frequency L2C~~ users who correct the code phase as described in Section 20.3.3.3.1.1.1 ~~and for single-frequency L5 users who correct the code phase as described in section 20.3.3.3.1.2.1~~; the net effect of clock parameter, code phase, and inter-signal correction error for dual-frequency L1/L2 and L1/L5 users who correct for group delay and ionospheric effects as described in Section ~~20.3.3.3.1.1.2~~ 20.3.3.3.1.2; radial ephemeris error; anisotropic antenna errors; and signal deformation error. URA$_{NED}$ does not account for user range contributions due to the inaccuracy of the broadcast ionospheric data parameters used in the single-frequency ionospheric model or for other atmospheric effects.

BASELINE TEXT (WAS)

URA_{NED0} accounts for zeroth order SIS-contributions to user range error which include, but are not limited to, the following: LSB representation/truncation error; the net effect of clock correction polynomial error and code phase error in the transmitted signal for single-frequency L1C/A or single-frequency L2C users who correct the code phase as described in Section 20.3.3.3.1.1.1; the net effect of clock parameter, code phase, and inter-signal correction error for dual-frequency L1/L2 and L1/L5 users who correct for group delay and ionospheric effects as described in Section 20.3.3.3.1.1.2; radial ephemeris error; anisotropic antenna errors; and signal deformation error. URA_{NED} does not account for user range contributions due to the inaccuracy of the broadcast ionospheric data parameters used in the single-frequency ionospheric model or for other atmospheric effects.

PIRN TEXT (IS)

URA_{NED0} accounts for zeroth order SIS-contributions to user range error which include, but are not limited to, the following: LSB representation/truncation error; the net effect of clock correction polynomial error and code phase error in the transmitted signal for single-frequency L1C/A or single-frequency L2C users who correct the code phase as described in Section 20.3.3.3.1.1.1 and for single-frequency L5 users who correct the code phase as described in section 20.3.3.3.1.2.1; the net effect of clock parameter, code phase, and inter-signal correction error for dual-frequency L1/L2 and L1/L5 users who correct for group delay and ionospheric effects as described in Section ~~20.3.3.3.1.1.2~~ 20.3.3.3.1.2; radial ephemeris error; anisotropic antenna errors; and signal deformation error. URA_{NED} does not account for user range contributions due to the inaccuracy of the broadcast ionospheric data parameters used in the single-frequency ionospheric model or for other atmospheric effects.

PROPOSED TEXT

URA$_{NED0}$ accounts for zeroth order SIS-contributions to user range error which include, but are not limited to, the following: LSB representation/truncation error; the net effect of clock correction polynomial error and code phase error in the transmitted signal for single-frequency L1~~C~~/L2/L5~~A or single-frequency L2C~~ users who correct the code phase as described in Section 20.3.3.3.1.1.1 ~~and for single-frequency L5 users who correct the code phase as described in section 20.3.3.3.1.2.1~~; the net effect of clock parameter, code phase, and inter-signal correction error for dual-frequency L1/L2 and L1/L5 users who correct for group delay and ionospheric effects as described in Section ~~20.3.3.3.1.1.2~~ 20.3.3.3.1.2; radial ephemeris error; anisotropic antenna errors; and signal deformation error. URA$_{NED}$ does not account for user range contributions due to the inaccuracy of the broadcast ionospheric data parameters used in the single-frequency ionospheric model or for other atmospheric effects.

DOORS ID	**IS705-271**		
Paragraph	**20.3.3.3.1.1.1**	**Comment Number**	**25 (Cont.)**
Comment Type	**Substantial**	**Disposition**	**Accept with comment**
Comment Originator(s)	Denis Bouvet (Thales)		
Comment	This comment applies to section 20.3.3.2.4. Clarify to which users the IURANED is applicable. Add “for single-frequency L1 C/A users who correct the code phase as described in section 20.3.3.3.1.1.1, for single-frequency L5 users who correct the code phase as described in section 20.3.3.3.1.2.1 and for dual-frequency L1/L5 users who correct the group delay and ionospheric effects as described in section 20.3.3.3.1.1.2.” to the end of the current sentence after “fit interval”.		
Directorate Response	Accept with comments. Change the section 20.3.3.3.1.1.1 Title to reflect the L5 reference.		

BASELINE TEXT (WAS)	PIRN TEXT (IS)	PROPOSED TEXT
20.3.3.3.1.1.1 L1/L2 Inter-Signal Group Delay Differential Correction	None	20.3.3.3.1.1.1 L1/L2/L5 Inter-Signal Group Delay Differential Correction

RFC-349
2017 Public Document Clean-Up

Critical Comments

Substantive Comments

Rejected Administrative Comments (0)

ICD-GPS-240/ICD-GPS-870 Admin Changes

Major Jenny Ji
Amit Patel

RFC-351
ICD-GPS-240/ICD-GPS-870 Admin Changes

Problem Statement:
Currently the Operational Advisories (OA) that are published and archived contain plane/slot descriptions that are not in agreement with the constellation definition provided to the public in the Standard Positioning Service Performance Standard (SPSPS). The OA does not have the capability to correctly publish information regarding fore/aft position since moving to the 24+3 constellation with three expanded slots.
Proposed Solution:
~~Modify public documents to rectify OA discrepancy as suggested by Public Interface Control Working Group (ICWG) participants, stakeholders, and key members.~~ *GPS directorate is proposing to remove OA section 1, Satellites, Planes, and Clocks (CS=Cesium RB=Rubidium) in ICD-GPS-870 for Public ICWG 2018. RFC-351 will just be addressing United States Coast Guard (USCG)/Admin comments (mostly to update POC contact info).*
Impacted Documents:
ICD-GPS-240, ICD-GPS-870

Background

- The OA message is defined in
  - ICD-GPS-240
  - ICD-GPS-870
- Quote from ICD-GPS-240, Section 20.1

  "The Operational Advisory (OA) message provides a summary of the satellite constellation status."

- The OA consists of
  - Header
  - Section one – satellites, planes, and clocks
  - Section two – current and recent advisories
  - Section three – points of contact for support and additional info.

Example of An Operational Advisory Message

```
UNCLASSIFIED
GPS OPERATIONAL ADVISORY        209.OA1
SUBJ: GPS STATUS      27 JUL 2016

1. SATELLITES, PLANES, AND CLOCKS (CS=CESIUM RB=RUBIDIUM):
A. BLOCK I : NONE
B. BLOCK II: PRNS  1,  2,  3,  5,  6,  7,  8,  9, 10, 11, 12, 13, 14, 15
   PLANE   : SLOT D2, D1, E1, E3, D4, A4, C3, F3, E2, D5, B4, F6, F1, F2
   CLOCK   :      RB, RB, RB, RB, RB, RB, RB, RB, RB, RB, RB, RB, RB, RB
   BLOCK II: PRNS 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29
   PLANE   : SLOT B1, C4, E4, C5, B6, D3, E6, F4, A1, B2, B5, C2, B3, C1
   CLOCK   :      RB, RB, RB, RB, RB, RB, RB, RB, CS, RB, RB, RB, RB, RB
   BLOCK II: PRNS 30, 31, 32
   PLANE   : SLOT A3, A2, F5
   CLOCK   :      RB, RB, RB
2. CURRENT ADVISORIES AND FORECASTS :
A. FORECASTS:           FOR SEVEN DAYS AFTER EVENT CONCLUDES.
NANU          MSG DATE/TIME       PRN  TYPE         SUMMARY (JDAY/ZULU
TIME START - STOP)

2016043       151521Z JUL 2016    26   FCSTDV       204/0820-204/2020
<Records omitted to reduce size>
B. ADVISORIES:
NANU          MSG DATE/TIME       PRN  TYPE         SUMMARY (JDAY/ZULU
TIME START - STOP)

C. GENERAL:
NANU          MSG DATE/TIME       PRN  TYPE         SUMMARY (JDAY/ZULU
TIME START - STOP)
<Records omitted to reduce size>

3. REMARKS:
A. THE POINT OF CONTACT FOR GPS MILITARY OPERATIONAL SUPPORT IS THE GPS
OPERATIONS CENTER AT 719-567-2541 OR DSN 560-2541.
B. CIVILIAN:  FOR INFORMATION, CONTACT US COAST GUARD NAVCEN AT
COMMERCIAL 703-313-5900 24 HOURS DAILY AND INTERNET
HTTP://WWW.NAVCEN.USCG.GOV
C. MILITARY SUPPORT WEBPAGES CAN BE FOUND AT THE FOLLOWING
HTTPS://GPS.AFSPC.AF.MIL/GPS OR HTTPS://GPS.AFSPC.AF.MIL/GPSOC
```

GPE to remove in Public ICWG 2018

Problems With Section 1 of the Operational Advisory Messages

- Format limitations
  - Persistent problem since we moved to expanded slot constellation
  - This is a text file, so any changes to the layout will most likely impact existing text parsers
- Inaccuracies
  - The current format cannot show Fore and Aft slot positions, nor can it show if an SV is not currently in an assigned slot (during re-phasing for example).
- Limitations in source of OA data
  - Problem whenever more than 4 SVs in a plane
  - This data is manually input by operators, so it is only as current as the last time an operator went into the GPS User Support System (GUSS) and updated the plane/slot assignments.
- Concern – Publishing and archiving incorrect information reduces trust in the product

RFC-351 Course of Action (COA)

1. Take no action against the OA message at this year **(New COA – Recommended by GPE)**
   - Section 1 of the OA does not accurately represent the constellation status but USCG Navigation Center (NAVCEN) has the correct information on the NAVCEN's GPS Constellation Status Page: http://www.navcen.uscg.gov/?Do=constellationStatus
   - Announce plan that proposes to sunset current OA product at transition to Operational Control System – Next Generation (OCX). Based on community reaction, open new RFC against ICD-GPS-870 (OCX) to either remove or update OCX OA as appropriate.
   - Investigate options to remove from publication in ICD-GPS-240
2. Remove the entire OA from both documents, ICD-GPS-240 and ICD-GPS-870 **(Reflected in current 08022017 PIRNs on GPS.GOV)**
   - This may cause certain public users to object
   - The Satellite Outage File (currently distributed to USCG but not yet distributed to public) and the GPS Advisory Collection planned for OCX contain all of the information provided in section 2 of the OA.
3. Continue with the original proposed modification of the OA in the 04262017 PIRNs **(Reflected in first set)**
   - This solution only partially resolves originators & SME concern
   - The OA will still not accurately represent the constellation status
   - Duplication of effort given NAVCEN's publication of the constellation of status

PIRN Release Schedule

- Two sets of PIRNs were released to GPS.GOV for review. The first set proposed to modify the OA to increase clarity. The second and currently released set proposed to remove the OA.
- The IRNs will be released post public ICWG in which the OA will not be affected and only USCG/admin comments will be addressed per GPE direction.

CRM Status

CRM – COMBINED STAKEHOLDER/DIRECTORATE REVIEW STATUS					
Disposition/Type	**Critical**	**Substantial**	**Administrative**	**Totals**	**Concurrence**
Accept	**0**	**2**	**8**	**10**	**10**
Accept with Comment	**0**	**0**	**2**	**2**	**2**
Reject	**0**	**0**	**0**	**0**	**0**
Defer	**0**	**0**	**0**	**0**	**0**
Grand Totals:	**0**	**2**	**10**	**12**	**12/12**

Critical Comments (8) (All OBE given change in COA)

Substantive Comments

Rejected Administrative Comments

Critical Comments

Substantive Comments (4) (Only 2 addressed the ICD redlines, 2 were CM related)

Rejected Administrative Comments

DOORS ID	ICD240-294		
Paragraph	30 Appendix 3: Satellite Outage File (SOF)	**Comment Number**	21
Comment Type	Substantive	**Disposition**	***Accept***
Comment Originator(s)	Lynde Parker (AFSPC/A2/3/6SP)		
Comment	GPSISFILE may not be the end solution for public availability		
Directorate Response	This allows for future flexibility in the file name if another entity generates the file.		

BASELINE TEXT (WAS)	PIRN TEXT (IS)	PROPOSED TEXT
A sample SOF with an internal DTD is as follows:	A sample SOF with an internal DTD is as follows (NOTE: if GPSIS is no longer used to generate the file, the file source tag "GPSISFILE" may be changed):	A sample SOF with an internal DTD is as follows (NOTE: if GPSIS is no longer used to generate the file, the file source tag "GPSISFILE" may be changed):

DTD: Data Transfer Device
GPSIS: GPS Information System

DOORS ID	ICD240-294		
Paragraph	30 Appendix 3: Satellite Outage File (SOF)	**Comment Number**	22
Comment Type	Substantive	**Disposition**	***Accept***
Comment Originator(s)	Capt R.E. Holmes (USCG Navigation Center)		
Comment	The GPSOC maintains a Web site accessible to unclassified military users worldwide. The current SOF is posted at a conspicuous spot on this Web site for download. All other worldwide, civil users may download the SOF from the U.S. Coast Guard Navigation Center Web site.		
Directorate Response	The additional text clarifies the location where other worldwide, civil users can download the SOF.		

BASELINE TEXT (WAS)	PIRN TEXT (IS)	PROPOSED TEXT
Unclassified Web Site. The GPSOC maintains a Web site accessible to unclassified users worldwide. The current SOF is posted at a conspicuous spot on this Web site for download.	Unclassified Web Sites. The GPSOC maintains a Web site accessible to unclassified military users worldwide. The current SOF is posted at a conspicuous spot on this Web site for download. All other worldwide, civil users may download the SOF from the U.S Coast Guard Navigation Center Web site.	Unclassified Web Sites. The GPSOC maintains a Web site accessible to unclassified military users worldwide. The current SOF is posted at a conspicuous spot on this Web site for download. All other worldwide, civil users may download the SOF from the U.S Coast Guard Navigation Center Web site.

GPSOC: GPS Operations Center
SOF: Satellite Outage File

Critical Comments

Substantive Comments

Rejected Administrative Comments (0)

- **BACKUP**

Format Limitations

- GPS has been operated as a 24+3 constellation with three expanded slots since 2011
  - AF press release on June 15, 2011 announced completion of transition
- SPS PS constellation definition
  - The three expanded slots have “fore” and “aft” positions
  - These are denoted by F/A in the SPS PS: e.g., B1F, F2A
  - Operators use this definition also
- OA definition does not support fore/aft nomenclature
  - Definition limited to one letter (plane) and one number (slot)
  - As a result, “aft” is shown as the base slot and “fore” is shown as slot 5
    - For example, F2A shows up as F2, F2F shows up as F5
  - The workaround is documented on the NAVCEN’s GPS Constellation Status Page: http://www.navcen.uscg.gov/?Do=constellationStatus
  - Note: the workaround does not provide any way to distinguish between a slot that has been collapsed vs. a slot with the “fore” position empty
    - This already happened in slot B1F from March 2013 – April 2015.

Definition of 24+3 Constellation from SPS PS

Table A.2-2. Expandable 24-Slot Constellation Almanac, at Epoch of 00:00:00 on 1 Jul 93

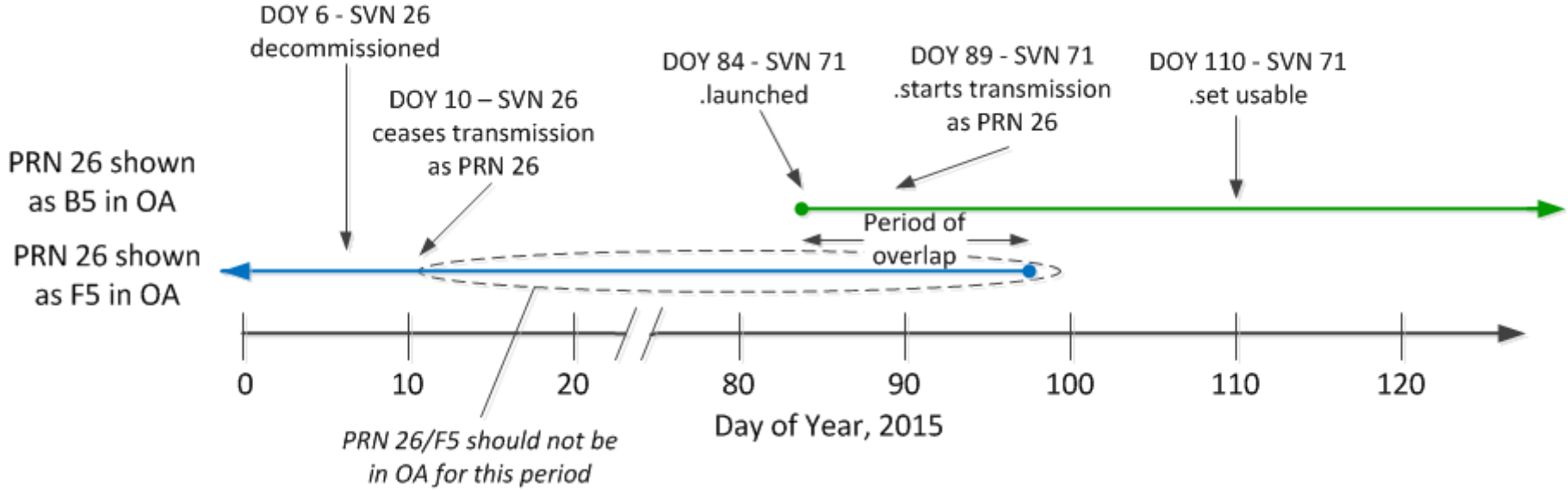
Slot ID	e (unit less)	δ_i (degrees)	OMEGADOT (deg/sec)	A (meters)	$OMEGA_0$ (degrees)	ω (degrees)	M_0 (degrees)
A1	0.000	1.000	-4.4874E-7	26,559,710	357.734	0.000	268.126
A2	0.000	1.000	-4.4874E-7	26,559,710	357.734	0.000	161.786
A3	0.000	1.000	-4.4874E-7	26,559,710	357.734	0.000	11.676
A4	0.000	1.000	-4.4874E-7	26,559,710	357.734	0.000	41.806
B1F	0.000	1.000	-4.4874E-7	26,559,710	57.734	0.000	94.916
B1A	0.000	1.000	-4.4874E-7	26,559,710	57.734	0.000	66.356
B2	0.000	1.000	-4.4874E-7	26,559,710	57.734	0.000	173.336
B3	0.000	1.000	-4.4874E-7	26,559,710	57.734	0.000	309.976
B4	0.000	1.000	-4.4874E-7	26,559,710	57.734	0.000	204.376
C1	0.000	1.000	-4.4874E-7	26,559,710	117.734	0.000	111.876
C2	0.000	1.000	-4.4874E-7	26,559,710	117.734	0.000	11.796
C3	0.000	1.000	-4.4874E-7	26,559,710	117.734	0.000	339.666
C4	0.000	1.000	-4.4874E-7	26,559,710	117.734	0.000	241.556
D1	0.000	1.000	-4.4874E-7	26,559,710	177.734	0.000	135.226
D2F	0.000	1.000	-4.4874E-7	26,559,710	177.734	0.000	282.676
D2A	0.000	1.000	-4.4874E-7	26,559,710	177.734	0.000	257.976
D3	0.000	1.000	-4.4874E-7	26,559,710	177.734	0.000	35.156
D4	0.000	1.000	-4.4874E-7	26,559,710	177.734	0.000	167.356
E1	0.000	1.000	-4.4874E-7	26,559,710	237.734	0.000	197.046
E2	0.000	1.000	-4.4874E-7	26,559,710	237.734	0.000	302.596
E3	0.000	1.000	-4.4874E-7	26,559,710	237.734	0.000	66.066
E4	0.000	1.000	-4.4874E-7	26,559,710	237.734	0.000	333.686
F1	0.000	1.000	-4.4874E-7	26,559,710	297.734	0.000	238.886
F2F	0.000	1.000	-4.4874E-7	26,559,710	297.734	0.000	0.456
F2A	0.000	1.000	-4.4874E-7	26,559,710	297.734	0.000	334.016
F3	0.000	1.000	-4.4874E-7	26,559,710	297.734	0.000	105.206
F4	0.000	1.000	-4.4874E-7	26,559,710	297.734	0.000	135.346

expanded slots

Example of An OA Inaccuracy

- PRN 26 listed in both F5 (F2F) and B5 (B1F) for DOY 84-98, 2015
- Up through DOY 6, PRN 26 assigned to SVN 26
  - SVN 26 had occupied slot F2F. SVN 43/PRN 13 took over that responsibility
  - DECOM NANU 2015005. Transmission from SVN 26 as PRN 26 ceased DOY 10
- PRN 26 next assigned to SVN 71
  - SVN 71 launched on DOY 84 (NANU 2015019) into slot B1F (B5 by OA)
  - SVN 71 began transmission (unhealthy) on DOY 89
    - initially usable on DOY 110 (NANU 2015028)
- PRN 26 incorrectly appeared in OA as F5 (F2F) from DOY 11-98
  - PRN 26 should have been entirely missing for OA for DOY 11-83
- PRN 26 correctly appeared in OA as B5 (B1F) starting DOY 84
- Not only were we providing inaccurate information at the time, the problem persists in the historical record
  - Review of NANUs clears up the issues, but requires time and some level of expertise

Example of an OA Inaccuracy – Time-History Plot



Excerpt from OA for Day 85, 2015

```
UNCLASSIFIED
GPS OPERATIONAL ADVISORY        085.OA1
SUBJ: GPS STATUS       26 MAR 2015

1. SATELLITES, PLANES, AND CLOCKS (CS=CESIUM RB=RUBIDIUM):
A. BLOCK I : NONE
B. BLOCK II: PRNS  1,  2,  3,  4,  5,  6,  7,  8,  9, 10, 11, 12, 13, 14
   PLANE    : SLOT D2, D1, B6, D6, E3, D4, A4, A6, F3, E6, D5, B4, F6, F1
   CLOCK    :      RB, RB, RB, RB, RB, RB, RB, CS, RB, CS, RB, RB, RB, RB
   BLOCK II: PRNS 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 26, 27
   PLANE    : SLOT F2, B1, C4, E4, C3, E1, D3, E2, F4, A1, B2, B5, F5, C2
   CLOCK    :      RB, RB, RB, RB, RB, RB, RB, RB, RB, CS, RB, RB, CS, RB
   BLOCK II: PRNS 28, 29, 30, 31, 32
   PLANE    : SLOT B3, C1, A3, A2, E5
   CLOCK    :      RB, RB, RB, RB, RB
```

Limitations in Source Data – The SV That Changed Planes

- OA shows SVN 51/PRN 20 assigned to E1 through DOY 110 of 2015
- OA designation for PRN 20 changes to B6 on DOY 111
  - PRN remains in this state up to this writing
  - DOY 111 corresponds to the day SVN 69/PRN 3 transitioned to E1
- From other sources, I believe the operators regard SVN 51/PRN 20 as being in E7
- Multiple sources tell me that there is a “six SV per plane” limit somewhere in the process. Therefore if there are more than six SVs in a plane, some are “administratively moved” to other planes for purposes of the OA
- If correct, this limitation leads to publication of inaccurate data
  - These data are being retained in the NAVCEN archives

Update ICD-GPS-240 and ICD-GPS-870 for NANU Issuance

Lt Irvin Vazquez-Calderon
John A. Kasper

RFC-352 Update ICD-GPS-240 and ICD-GPS-870 for NANU Issuance

Problem Statement:
Aerospace Corporation has expressed concern about the potential for differences of interpretation of the Notice Advisory to Navstar Users (NANU) issuance guidance in the GPS Standard Positioning Service Performance Standard (SPSPS) Plan, the GPS Precise Positioning Service Performance Standard (PPSPS), and the NANU Notification times requirements in ICD-GPS-240 and ICD-GPS-870.
Proposed Solution:
Update ICD-GPS-240 and ICD-GPS-870, Section 10.2 NANU Notification Times, in order to provide clarification of the requirement and to mitigate any potential delays of the SPSPS and PPSPS for NANU issuance.
Impacted Documents:
ICD-GPS-240 and ICD-GPS-870

CRM Status

CRM – COMBINED STAKEHOLDER/DIRECTORATE REVIEW STATUS					
Disposition/Type	**Critical**	**Substantial**	**Administrative**	**Totals**	**Concurrence**
Accept	**0**	**14**	**3**	**17**	**17**
Accept with Comment	**0**	**0**	**0**	**0**	**0**
Reject	**0**	**2**	**1**	**3**	**0**
Defer	**0**	**0**	**0**	**0**	**0**
Grand Totals:	**0**	**16**	**4**	**20**	**17/20**

Critical Comments (0)

Substantive Comments

Rejected Administrative Comments

Critical Comments

Substantive Comments (16)

Rejected Administrative Comments

DOORS ID	N/A		
Paragraph	N/A	**Comment Number**	1
Comment Type	Substantive	**Disposition**	***Accept***
Comment Originator(s)	Steven Hutsell (2 SOPS)		
Comment	As indicated during the teleconference, we respectfully NON-concur with the [Reason For Change (Driver)]. If the intent is to try "to align ICD-GPS-240 with [text from an external document, whether the SPSPS, PPSPS, or otherwise]", I'd recommend simply stating such instead of "Fix 2SOPS violations…..", which comes across besmirching an Operations Squadron for otherwise innocently following orders from HHQ that were otherwise legally in compliance with the document applicable to the interface in question (ICD-GPS-240).		
Directorate Response	Understand the concern. Language has been modified to remove any specific or unwarranted blame as the rationale.		

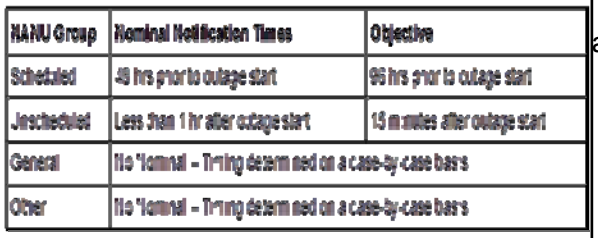
BASELINE TEXT (WAS)	PIRN TEXT (IS)	PROPOSED TEXT
Fix 2SOPS violations of the SPS PS for NANU issuance.	~~Fix 2SOPS violations of the SPS PS for NANU issuance.~~ Clarify SPS PS derived requirements for NANU issuance.	Clarify SPSPS derived requirements for NANU issuance

HHQ: Higher Headquarters
SOPS: Space Operations Squadron

DOORS ID	ICD240-120 and ICD870-139		
Paragraph	10.2 NANU Notification Times	**Comment Number**	2 and 10/11
Comment Type	Substantive	**Disposition**	***Accept***
Comment Originator(s)	2) Steven Hutsell (2 SOPS) and 10/11) Mr. Daniel O'Laughlin (Mitre)		
Comment	2) We respectfully don't see the need for the proposed change on the second page of the attached document ("The status and problem reporting….."). Rationale: ICD-GPS-240 defines thresholds pertaining to interaction between the GPS CS and GUSS, the GPS CS and NAVCEN, and the GPS CS and military users. The injection of SPSPS and/or PPSPS education is not of immediate concern to the factions executing the interface. Additionally, the "…..are applicable requirements for DoD…..", while of good intent I trust, may also unfortunately be asking for some legal consternation, given how the [Capital R] Requirements communities, who operate from their own sets of documents, might see this statement as blurring lanes of responsibility. ICD-GPS-240 already has enough drama of its own without having to contend with external document applicability wrangling. 10/11) In the NANU Notification Table (in both, PIRN-870B-002/PIRN-240-003) the proposed change changes the heading of one column of the table from "Objective" to "Threshold". However, the text that reference the table still refers to it as an "Objective". (i.e., they state: Nominal and objective NANU notification times for the four NANU groups are summarized in Table 10-IV.)		
Directorate Response	2) Understand the concern. Will remove the last sentence from the "IS" text and move it to a rationale section in the DOORS database. 10/11) Understand the concern. Since "Objective" was changed in Table-IV to "Threshold", verbiage in subject paragraph should be consistent as well.		

BASELINE TEXT (WAS)	PIRN TEXT (IS)	PROPOSED TEXT
NANU messages announcing scheduled events are normally distributed to the user community prior to the event. NANU messages announcing unscheduled events are normally distributed to the user community as soon as practical after the event. However, mission critical problems have priority over user notification and therefore may delay normal NANU distribution. NANU notification times typically vary by NANU group. Nominal and objective NANU notification times for the four NANU groups are summarized in Table 10-IV. .	NANU messages announcing scheduled events are normally distributed to the user community prior to the event. NANU messages announcing unscheduled events are normally distributed to the user community as soon as practical after the event. However, mission critical problems have priority over user notification and therefore may delay normal NANU distribution. NANU notification times typically vary by NANU group. Nominal and ~~objective~~ threshold NANU notification times for the four NANU groups are summarized in Table 10-IV. The status and problem reporting standards given in the current editions of the GPS Precise Positioning Service Performance Standard (PPSPS) and GPS Standard Positioning Service Performance Standard (SPSPS) are applicable requirements for DoD.	NANU messages announcing scheduled events are normally distributed to the user community prior to the event. NANU messages announcing unscheduled events are normally distributed to the user community as soon as practical after the event. However, mission critical problems have priority over user notification and therefore may delay normal NANU distribution. NANU notification times typically vary by NANU group. Nominal and threshold NANU notification times for the four NANU groups are summarized in Table 10-IV. *(Note: The suggested change text [in blue of the "IS" text] will be moved to the rationale section of the document in the DOORS database.)*

DOORS ID	ICD870-141		
Paragraph	Table 10-IV NANU Notification Times	**Comment Number**	8 (GPGX-01)
Comment Type	Substantive	**Disposition**	***Reject***
Comment Originator(s)	Mr. David Hoki (Mitre)		
Comment	Language for scheduled "nominal notification times" is "NLT 48 hrs & NET 96 hrs prior to outage start". NLT (No later than) and NET (No earlier than) are confusing as a nominal time. The entry should be changed to "96 hours" which is what the 2008 SPS PS states multiple times. A note about the Loss of continuity metric for NANUs issued with less than 48 hours of interruption should be added as a note, but 48 hours is not the nominal time the SPS says OCS should post scheduled NANUs for. Additionally, the next update of the SPS PS should remove the statement "at least 96 hours in advance". It is 96 hours nominally, not at least 96 hours. OCS may give more than 96 hours notice but the nominal commitment is 96 hours. If that is not the intent of the SPS, then the SPS needs to be reworded to state consistent intent.		
Directorate Response	Understand the concern; however, comment is based upon an outdated/obsolete PIRN. Current PIRN no longer contains the language specified in comment.		

BASELINE TEXT (WAS)	PIRN TEXT (IS)	PROPOSED TEXT
	See the proposed change in Comment No. 7,14 and 18, 19 & 20	See the proposed change in Comment No. 7,14 and 18, 19 & 20

NANU Group	Nominal Notification Times	Objective
Scheduled	48 hrs prior to outage start	96 hrs prior to outage start
Unscheduled	Less than 1 hr after outage start	15 minutes after outage start
General	No "nominal – Timing determined on a case-by-case basis	
Other	No "nominal – Timing determined on a case-by-case basis	

NET: No-earlier than.
NLT: No-later than

DOORS ID	ICD870-141		
Paragraph	Table 10-IV NANU Notification Times	**Comment Number**	7,14 and 18, 19 & 20
Comment Type	Substantive	**Disposition**	***Accept***
Comment Originator(s)	Lt. Jared Pilcher (MCEU) & Steve Hutsell (2SOPS)		
Comment	#7: Clarify intent of proposed Note 1 to state that the threshold will not be met. #14: Changing the Objective column to Threshold creates an issue with the Unscheduled row. "15 minutes after outage start" is an Objective metric but with the proposed changes would be listed under the Threshold column. #18: Intuitively, why would a "Threshold" value be tighter (less than) a "Nominal" value. Rationale for the question: Intuitively, if (less than 1 hour but greater than 15 minutes) is in excess of "Threshold", how can it be considered "Nominal"? #19 Nominal is redundant under the "Nominal Notification Times" column, "Scheduled" row. Suggest removing it. #20: "No Nominal" is inaccurate under the "Nominal Notification Times" column, "General" and "Other" row. Suggest putting "None" instead.		
Directorate Response	Understand the concerns. To alleviate concern and remove any confusion, the two row columns (Unscheduled row) under Nominal Notification Time and Threshold were switched. May was changed to "will" in Note 1.		

BASELINE TEXT (WAS)

NANU Group	Nominal Notification Times	Objective
Scheduled	48 hrs prior to outage start	96 hrs prior to outage start
Unscheduled	Less than 1 hr after outage start	15 minutes after outage start
General	No Nominal – Timing determined on a case-by-case basis	
Other	No Nominal – Timing determined on a case-by-case basis	

PIRN TEXT (IS)

NANU Group	Nominal Notification Times	Threshold
Scheduled	Nominally 96 hours prior to outage start.	NLT 48 hrs prior to outage start per the performance standards (see note #1)
Unscheduled	Less than 1 hr after outage start	15 minutes after outage start
General	No Nominal - Timing determined on a case-by-case basis	
Other	No Nominal - Timing determined on a case-by-case basis	
NOTE 1: If the need for a planned outage is determined less than 48 hours prior to the start time of the outage, the associated Forecast NANU may not meet the Scheduled outage Threshold.		

PROPOSED TEXT

NANU Group	Nominal Notification Times	~~Objective~~ Threshold
Scheduled	~~48 hrs prior to outage start~~ ~~Nominally~~ 96 hours prior to outage start.	NLT 48 ~~96~~ hrs prior to outage start ~~per the performance standards~~ (see note #1)
Unscheduled	~~Less than 1 hr after outage start~~ 15 minutes after outage start	~~15 minutes after outage start~~ Less than 1 hr after outage start
General	~~No Nominal~~ None – Timing determined on a case-by-case basis	
Other	~~No Nominal~~ None – Timing determined on a case-by-case basis	
NOTE 1: If the need for a planned outage is determined less than 48 hours prior to the start time of the outage, the associated Forecast NANU ~~may~~ will not meet the Scheduled outage Threshold.		

BASELINE TEXT (WAS)

NANU Group	Nominal Notification Times	Objective
Scheduled	48 hrs prior to outage start	96 hrs prior to outage start
Unscheduled	Less than 1 hr after outage start	15 minutes after outage start
General	No Nominal – Timing determined on a case-by-case basis	
Other	No Nominal – Timing determined on a case-by-case basis	

PIRN TEXT (IS)

NANU Group	Nominal Notification Times	Threshold
Scheduled	Nominally 96 hours prior to outage start.	NLT 48 hrs prior to outage start per the performance standards (see note #1)
Unscheduled	Less than 1 hr after outage start	15 minutes after outage start
General	No Nominal - Timing determined on a case-by-case basis	
Other	No Nominal - Timing determined on a case-by-case basis	
NOTE 1: If the need for a planned outage is determined less than 48 hours prior to the start time of the outage, the associated Forecast NANU may not meet the Scheduled outage Threshold.		

PROPOSED TEXT

NANU Group	Nominal Notification Times	~~Objective~~ Threshold
Scheduled	~~48 hrs prior to outage start~~ ~~Nominally~~ 96 hours prior to outage start.	NLT 48 ~~96~~ hrs prior to outage start ~~per the performance standards~~ (see note #1)
Unscheduled	~~Less than 1 hr after outage start~~ 15 minutes after outage start	~~15 minutes after outage start~~ Less than 1 hr after outage start
General	~~No Nominal~~ None – Timing determined on a case-by-case basis	
Other	~~No Nominal~~ None – Timing determined on a case-by-case basis	

NOTE 1: If the need for a planned outage is determined less than 48 hours prior to the start time of the outage, the associated Forecast NANU ~~may~~ will not meet the Scheduled outage Threshold.

DOORS ID	ICD240-122		
Paragraph	Table 10-IV NANU Notification Times	**Comment Number**	9 (GPGX-02)
Comment Type	Substantive	**Disposition**	***Reject***
Comment Originator(s)	Mr. David Hoki (Mitre)		
Comment	WAS/IS language for unscheduled objective [notification time] is "15 minutes after outage start". This conflicts with higher precedence document SS-CS-800 CS3194 which says "...generate digital NANUs and make them available within 2 minutes from the time the status changed...". The ICD objective time should be as tight or tighter than the CS800 objective time. Recommend changing ICD870-141 IS language for unscheduled objective [notification time] to " within 2 minutes from the time the status changed until upload connection to USNO initiated" to be consistent with CS800. also recommend unscheduled nominal language to be "within 60 minutes from the time the status changed until upload connection to USNO initiated"		
Directorate Response	Understand the concern. However, the comment is against a non-validated requirement, and requirements for Effectivity 30 have not been ascertained at present. Also, nothing is fixed until a new Capability Description Document is published.		

BASELINE TEXT (WAS)	PIRN TEXT (IS)	PROPOSED TEXT
	See the proposed change in Comment No. 6,13 and 15, 16, & 17	See the proposed change in Comment No. 6,13 and 15, 16, & 17

NANU Group	Nominal Notification Times		Objective
Scheduled	96 hrs prior to outage start	1 hr after outage start	7 days prior to outage start
Unscheduled	Less than 1 hr after outage start		15 minutes after outage start
General	No Nominal – Timing determined on a case-by-case basis		
Other	No Nominal – Timing determined on a case-by-case basis		

USNO: United States Naval Observatory

DOORS ID	ICD240-122		
Paragraph	Table 10-IV NANU Notification Times	**Comment Number**	6,13 and 15, 16, & 17
Comment Type	Substantive	**Disposition**	***Accept***
Comment Originator(s)	Lt. Jared Pilcher (MCEU) and Steve Hutsell (2SOPS)		
Comment	#6: Clarify intent of proposed Note 1 to state that the threshold will not be met. #13: Changing the Objective column to Threshold creates an issue with the Unscheduled row. "15 minutes after outage start" is an Objective metric but with the proposed changes would be listed under the Threshold column. #15: Intuitively, why would a "Threshold" value be tighter (less than) a "Nominal" value. Rationale for the question: Intuitively, if (less than 1 hour but greater than 15 minutes) is in excess of "Threshold", how can it be considered "Nominal"? #16: Nominal is redundant under the "Nominal Notification Times" column, "Scheduled" row. Suggest removing it. #17: "No Nominal" is inaccurate under the "Nominal Notification Times" column, "General" and "Other" row. Suggest putting "None" instead.		
Directorate Response	Understand the concerns. To alleviate concern and remove any confusion, the two row columns (Unscheduled row) under Nominal Notification Time and Threshold were switched and implemented suggestions of comments #16 & 17. May was changed to "will" in Note 1.		

BASELINE TEXT (WAS)

NANU Group	Nominal Notification Times		Objective
Scheduled	96 hrs prior to outage start	1 hr after outage start	7 days prior to outage start
Unscheduled	Less than 1 hr after outage start		15 minutes after outage start
General	No Nominal – Timing determined on a case-by-case basis		
Other	No Nominal – Timing determined on a case-by-case basis		

PIRN TEXT (IS)

NANU Group	Nominal Notification Times	Threshold
Scheduled	Nominally 96 hours prior to outage start.	NLT 48 hrs prior to outage start per the performance standards (see note #1)
Unscheduled	Less than 1 hr after outage start	15 minutes after outage start
General	No Nominal - Timing determined on a case-by-case basis	
Other	No Nominal - Timing determined on a case-by-case basis	

NOTE 1: If the need for a planned outage is determined less than 48 hours prior to the start time of the outage, the associated Forecast NANU ~~may~~will not meet the Scheduled outage Threshold.

PROPOSED TEXT

NANU Group	Nominal Notification Times		~~Objective~~ Threshold
Scheduled	~~96 hrs prior to outage start~~	~~1hr after outage start~~	NLT 48 ~~96~~ hrs prior to outage start ~~per the performance standards~~ (see note #1)
	~~Nominally~~ 96 hours prior to outage start.		
Unscheduled	~~Less than 1 hr after outage start~~ 15 minutes after outage start		~~15 minutes after outage start~~ Less than 1 hr after outage start
General	~~No Nominal~~ None – Timing determined on a case-by-case basis		
Other	~~No Nominal~~ None – Timing determined on a case-by-case basis		

NOTE 1: If the need for a planned outage is determined less than 48 hours prior to the start time of the outage, the associated Forecast NANU ~~may~~ will not meet the Scheduled outage Threshold.

BASELINE TEXT (WAS)

NANU Group	Nominal Notification Times		Objective
Scheduled	96 hrs prior to outage start	1 hr after outage start	7 days prior to outage start
Unscheduled	Less than 1 hr after outage start		15 minutes after outage start
General	No Nominal – Timing determined on a case-by-case basis		
Other	No Nominal – Timing determined on a case-by-case basis		

PIRN TEXT (IS)

NANU Group	Nominal Notification Times	Threshold
Scheduled	Nominally 96 hours prior to outage start.	NLT 48 hrs prior to outage start per the performance standards (see note #1)
Unscheduled	Less than 1 hr after outage start	15 minutes after outage start
General	No Nominal - Timing determined on a case-by-case basis	
Other	No Nominal - Timing determined on a case-by-case basis	
NOTE 1: If the need for a planned outage is determined less than 48 hours prior to the start time of the outage, the associated Forecast NANU ~~may~~will not meet the Scheduled outage Threshold.		

PROPOSED TEXT

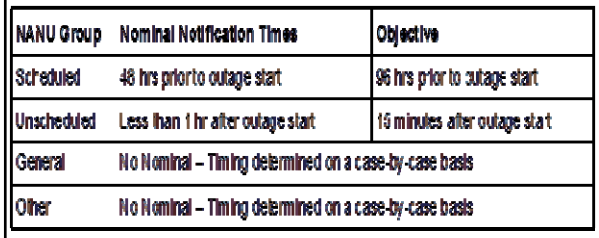
NANU Group	Nominal Notification Times		~~Objective~~ Threshold
Scheduled	~~96 hrs prior to outage start~~	~~1hr after outage start~~	NLT 48 ~~96~~ hrs prior to outage start ~~per the performance standards~~ (see note #1)
	~~Nominally~~ 96 hours prior to outage start.		
Unscheduled	~~Less than 1 hr after outage start~~ 15 minutes after outage start		~~15 minutes after outage start~~ Less than 1 hr after outage start
General	~~No Nominal~~ None – Timing determined on a case-by-case basis		
Other	~~No Nominal~~ None – Timing determined on a case-by-case basis		
NOTE 1: If the need for a planned outage is determined less than 48 hours prior to the start time of the outage, the associated Forecast NANU ~~may~~ will not meet the Scheduled outage Threshold.			

Critical Comments

Substantive Comments

Rejected Administrative Comments (1)

DOORS ID	ICD870-141		
Paragraph	Table 10-IV NANU Notification Times	**Comment Number**	12
Comment Type	Administrative	**Disposition**	***Reject***
Comment Originator(s)	Alex Synder (Raytheon)		
Comment	The use of threshold instead of objective is a bit confusing. The use of objective in requirements definition tends to be used as a "hard requirement" (critical performance) as supposed to 'good enough' effort -threshold. Suggest switching back to objective		
Directorate Response	Understand the concern. A TIM held, post JCRB-2, 11Apr17, made real-time changes to the table in question, and they made the determination to change “Objective” to “Threshold”.		

BASELINE TEXT (WAS)	PIRN TEXT (IS)	PROPOSED TEXT
	See the proposed change in Comment No. 7,14 and 18, 19 & 20	See the proposed change in Comment No. 7,14 and 18, 19 & 20

NANU Group	Nominal Notification Times	Objective
Scheduled	48 hrs prior to outage start	96 hrs prior to outage start
Unscheduled	Less than 1 hr after outage start	15 minutes after outage start
General	No Nominal – Timing determined on a case-by-case basis	
Other	No Nominal – Timing determined on a case-by-case basis	

Leap Second and EOP (Earth Orientation Parameters) Synchronization

Lt Vazquez-Calderon
Perry Chang

RFC-354
Leap Second and EOP (Earth Orientation Parameters) Synchronization

Problem Statement:
The linkage between different timing systems is not properly captured in the current technical baseline. Using the existing IS-GPS-200 & IS-GPS-705 documentation, CNAV users will calculate the wrong Universal Time 1 (UT1) immediately following a leap second change. As a result, user applications that require high precision pointing will cause the pointing to be in error. Possible users may include any systems that require high precision pointing.
Proposed Solution:
The proposed changes to the impacted technical baseline documents would correctly calculate UT1 during a leap second transition.
Impacted Documents:
IS-GPS-200, IS-GPS-705

CRM Status

CRM –COMBINED STAKEHOLDER/DIRECTORATE REVIEW STATUS					
Disposition/Type	**Critical**	**Substantial**	**Administrative**	**Totals**	**Concurrence**
Accept	**0**	**8**	**3**	**11**	**0**
Accept with Comment	**0**	**2**	**7**	**9**	**0**
Reject	**0**	**0**	**0**	**0**	**0**
Defer	**0**	**1**	**0**	**1**	**0**
Grand Totals:	**0**	**11**	**10**	**21**	**0**

Critical Comments (0)

Substantive Comments

Rejected Administrative Comments

Critical Comments

Substantive Comments (11)

Rejected Administrative Comments

DOORS ID	IS200-1658		
Paragraph	30.3.3.5.1.1 User Algorithm for Application of the EOP	**Comment Number**	3
Comment Type	Substantive	**Disposition**	***Accept with Comments***
Comment Originator(s)	Kevin Pi (Raytheon)		
Comment	Recommend re-writing the texts in this object to break down compound shall statements for better clarity. Recommend using the exact same terminology in Table 30-VIII and the descriptive text right after - use instead of ΔUT1(dot) delta t (UTC-EOP) equation does not seem to be correct - changed 64800 to 604800 There is an extra " at the end of the sentence		
Directorate Response	Accepted and modified the recommended text		

BASELINE TEXT (WAS)	PIRN TEXT (IS)	PROPOSED TEXT
New Object	When implementing the first equation in Table 30-VIII, $t_{UTC-EOP}$ shall be derived from data contained in message type 33 (see Section 30.3.3.6). For a given upload, the Control Segment shall ensure the ΔUT1 and ΔUT1(dot) values in message type 32 shall be consistent with the UTC parameters (A_{0-n}, A_{1-n}, A_{2-n}, and Δt_{LS}) in the message type 33 and that the t_{EOP} in message type 32 shall be identical to the t_{ot} in message type 33. When calculating $t_{UTC-EOP}$ for Table 30-VIII the user shall only use data from a message type 33 with the same t_{ot} as the t_{EOP} of the message type 32 containing ΔUT1 and ΔUT1(dot). The following definition of $t_{UTC-EOP}$ shall be used. $t_{UTC-EOP}$ = (t - $\Delta t_{UTC-EOP}$) [modulo 86400 seconds] where $\Delta t_{UTC-EOP} = \Delta t_{LS} + A_{0-n} + A_{1-n}(t-t_{ot} + 64800(WN-WN_{ot})) + A_{2-n}(t-t_{ot}+604800(WN-WN_{ot}))^2$ To avoid discontinuities in UT1 across leap seconds, the value of Δt_{LS} must be used in the calculation of $t_{UTC-EOP}$ regardless of whether a leap second has occurred. This accounts for the continuous nature of UT1 until a new upload after the leap second provides an update value for ΔUT1 that is consistent with the new Δt_{LS}."	When implementing the first equation in Table 30-VIII, t_{UTC_EOP} ~~shall be~~ is derived from data contained in message type 33 (see Section 20.3.3.6). For a given upload, the Control Segment shall ensure the ΔUT1 and ~~ΔUT1(dot)~~ $\dot{\Delta UT1}$ values in message type 32 ~~shall be~~ are consistent with the UTC parameters (A_{0-n}, A_{1-n}, A_{2-n}, and Δt_{LS}) in the message type 33, and ~~that~~ the t_{EOP} in message type 32 shall be identical to the t_{ot} in message type 33. When calculating t_{UTC_EOP} for Table 30-VIII the user shall only use data from a message type 33 with the same t_{ot} as the t_{EOP} of the message type 32 containing ΔUT1 and ~~ΔUT1(dot)~~ $\dot{\Delta UT1}$. The following definition of t_{UTC_EOP} shall be used. t_{UTC_EOP} = (t - Δt_{UTC_EOP}) [modulo 86400 seconds] where $\Delta t_{UTC\_EOP} = \Delta t_{LS} + A_{0-n} + A_{1-n}(t-t_{ot} + 604800(WN-WN_{ot})) + A_{2-n}(t-t_{ot}+604800(WN-WN_{ot}))^2$ To avoid discontinuities in UT1 across leap seconds, the value of Δt_{LS} must be used in the calculation of t_{UTC_EOP} regardless of whether a leap second has occurred. This accounts for the continuous nature of UT1 until a new upload after the leap second provides an update value for ΔUT1 that is consistent with the new Δt_{LS}.~~"~~

DOORS ID	IS705-1525		
Paragraph	20.3.3.5.1.1 User Algorithm for Application of the EOP	**Comment Number**	5
Comment Type	Substantive	**Disposition**	***Accept with Comments***
Comment Originator(s)	Kevin Pi (Raytheon)		
Comment	Recommend re-writing the texts in this object to break down compound shall statements for better clarity. Recommend using the exact same terminology in Table 30-VIII and the descriptive text right after - use instead of ΔUT1(dot) delta t (UTC-EOP) equation does not seem to be correct - changed 64800 to 604800 There is an extra " at the end of the sentence		
Directorate Response	Accepted and modified the recommended text		

BASELINE TEXT (WAS)	PIRN TEXT (IS)	PROPOSED TEXT
New Object	When implementing the first equation in Table 20-VIII, $t_{UTC-EOP}$ shall be derived from data contained in message type 33 (see Section 20.3.3.6). For a given upload, the Control Segment shall ensure the ΔUT1 and ΔUT1(dot) values in message type 32 shall be consistent with the UTC parameters (A_{0-n}, A_{1-n}, A_{2-n}, and Δt_{LS}) in the message type 33 and that the t_{EOP} in message type 32 shall be identical to the t_{ot} in message type 33. When calculating $t_{UTC-EOP}$ for Table 20-VIII the user shall only use data from a message type 33 with the same t_{ot} as the t_{EOP} of the message type 32 containing ΔUT1 and ΔUT1(dot). The following definition of $t_{UTC-EOP}$ shall be used. $t_{UTC-EOP}$ = (t - $\Delta t_{UTC-EOP}$) [modulo 86400 seconds] where $\Delta t_{UTC-EOP} = \Delta t_{LS} + A_{0-n} + A_{1-n}(t-t_{ot} + 64800(WN-WN_{ot})) + A_{2-n}(t-t_{ot}+604800(WN-WN_{ot}))^2$ To avoid discontinuities in UT1 across leap seconds, the value of Δt_{LS} must be used in the calculation of $t_{UTC-EOP}$ regardless of whether a leap second has occurred. This accounts for the continuous nature of UT1 until a new upload after the leap second provides an update value for ΔUT1 that is consistent with the new Δt_{LS}."	When implementing the first equation in Table 20-VIII, t_{UTC_EOP} ~~shall be~~ is derived from data contained in message type 33 (see Section 20.3.3.6). For a given upload, the Control Segment shall ensure the ΔUT1 and ~~ΔUT1(dot)~~ $\dot{\Delta UT1}$ values in message type 32 ~~shall be~~ are consistent with the UTC parameters (A_{0-n}, A_{1-n}, A_{2-n}, and Δt_{LS}) in the message type 33, and ~~that~~ the t_{EOP} in message type 32 shall be identical to the t_{ot} in message type 33. When calculating t_{UTC_EOP} for Table 20-VIII the user shall only use data from a message type 33 with the same t_{ot} as the t_{EOP} of the message type 32 containing ΔUT1 and ~~ΔUT1(dot)~~ $\dot{\Delta UT1}$. The following definition of t_{UTC_EOP} shall be used. t_{UTC_EOP} = (t - Δt_{UTC_EOP}) [modulo 86400 seconds] where $\Delta t_{UTC\_EOP} = \Delta t_{LS} + A_{0-n} + A_{1-n}(t-t_{ot} + 604800(WN-WN_{ot})) + A_{2-n}(t-t_{ot}+604800(WN-WN_{ot}))^2$ To avoid discontinuities in UT1 across leap seconds, the value of Δt_{LS} must be used in the calculation of t_{UTC_EOP} regardless of whether a leap second has occurred. This accounts for the continuous nature of UT1 until a new upload after the leap second provides an update value for ΔUT1 that is consistent with the new Δt_{LS}.~~"~~

PIRN TEXT (IS)

When implementing the first equation in Table 20-VIII, $t_{UTC-EOP}$ shall be derived from data contained in message type 33 (see Section 20.3.3.6). For a given upload, the Control Segment shall ensure the ΔUT1 and ΔUT1(dot) values in message type 32 shall be consistent with the UTC parameters (A_{0-n}, A_{1-n}, A_{2-n}, and Δt_{LS}) in the message type 33 and that the t_{EOP} in message type 32 shall be identical to the t_{ot} in message type 33.

When calculating $t_{UTC-EOP}$ for Table 20-VIII the user shall only use data from a message type 33 with the same t_{ot} as the t_{EOP} of the message type 32 containing ΔUT1 and ΔUT1(dot). The following definition of $t_{UTC-EOP}$ shall be used.

$t_{UTC-EOP} = (t - \Delta t_{UTC-EOP})$ [modulo 86400 seconds]

where

$\Delta t_{UTC-EOP} = \Delta t_{LS} + A_{0-n} + A_{1-n} (t-t_{ot} + 64800(WN-WN_{ot})) + A_{2-n} (t-t_{ot}+604800 (WN-WN_{ot}))^2$

To avoid discontinuities in UT1 across leap seconds, the value of Δt_{LS} must be used in the calculation of $t_{UTC-EOP}$ regardless of whether a leap second has occurred. This accounts for the continuous nature of UT1 until a new upload after the leap second provides an update value for ΔUT1 that is consistent with the new Δt_{LS}."

PROPOSED TEXT

When implementing the first equation in Table 20-VIII, t_{UTC_EOP} ~~shall be~~ is derived from data contained in message type 33 (see Section 20.3.3.6). For a given upload, the Control Segment shall ensure the ΔUT1 and ~~ΔUT1(dot)~~ $\Delta\dot{U}T1$ values in message type 32 ~~shall be~~ are consistent with the UTC parameters (A_{0-n}, A_{1-n}, A_{2-n}, and Δt_{LS}) in the message type 33, and ~~that~~ the t_{EOP} in message type 32 shall be identical to the t_{ot} in message type 33.

When calculating t_{UTC_EOP} for Table 20-VIII the user shall only use data from a message type 33 with the same t_{ot} as the t_{EOP} of the message type 32 containing ΔUT1 and ~~ΔUT1(dot)~~ $\Delta\dot{U}T1$. The following definition of t_{UTC_EOP} shall be used.

$t_{UTC\_EOP} = (t - \Delta t_{UTC\_EOP})$ [modulo 86400 seconds]

where

$\Delta t_{UTC\_EOP} = \Delta t_{LS} + A_{0-n} + A_{1-n}(t-t_{ot} + 604800(WN-WN_{ot})) + A_{2-n}(t-t_{ot}+604800(WN-WN_{ot}))^2$

To avoid discontinuities in UT1 across leap seconds, the value of Δt_{LS} must be used in the calculation of t_{UTC_EOP} regardless of whether a leap second has occurred. This accounts for the continuous nature of UT1 until a new upload after the leap second provides an update value for ΔUT1 that is consistent with the new Δt_{LS}.~~"~~

DOORS ID	IS200-1658		
Paragraph	30.3.3.5.1.1 User Algorithm for Application of the EOP	**Comment Number**	6
Comment Type	Substantive	**Disposition**	***Defer***
Comment Originator(s)	Stephan Hillman		
Comment	The use of $A_{0\text{-}n}$, $A_{1\text{-}n}$, and $A_{2\text{-}n}$ in Appendix III of IS200 is not consistent with identical terms in IS705 and ICD700, and it is not consistent with the same terms used elsewhere in IS200. Recommend updating this object and others in Appendix III to make them consistent with the other references (A_0, A_1, A_2).		
Directorate Response	Per confirmation with Karl Kovach, there is no history to the use of $A_{\#\text{-}n}$, thus we are free to change to $A_{\#}$ to match other documentation. However, because this change will also introduce new changes to other parts of documents, we will defer this update to the next year PICWG.		

BASELINE TEXT (WAS)	**PIRN TEXT (IS)**	**PROPOSED TEXT**
New Object	When implementing the first equation in Table 30-VIII, $t_{UTC\text{-}EOP}$ shall be derived from data contained in message type 33 (see Section 30.3.3.6). For a given upload, the Control Segment shall ensure the ΔUT1 and ΔUT1(dot) values in message type 32 shall be consistent with the UTC parameters ($\mathbf{A_{0\text{-}n}}$, $\mathbf{A_{1\text{-}n}}$, $\mathbf{A_{2\text{-}n}}$, and Δt_{LS}) in the message type 33 and that the t_{EOP} in message type 32 shall be identical to the t_{ot} in message type 33. When calculating $t_{UTC\text{-}EOP}$ for Table 30-VIII the user shall only use data from a message type 33 with the same t_{ot} as the t_{EOP} of the message type 32 containing ΔUT1 and ΔUT1(dot). The following definition of $t_{UTC\text{-}EOP}$ shall be used. $t_{UTC\text{-}EOP} = (t - \Delta t_{UTC\text{-}EOP})$ [modulo 86400 seconds] where $\Delta t_{UTC\text{-}EOP} = \Delta t_{LS} + \mathbf{A_{0\text{-}n}} + \mathbf{A_{1\text{-}n}} (t\text{-}t_{ot} + 64800(WN\text{-}WN_{ot})) + \mathbf{A_{2\text{-}n}} (t\text{-}t_{ot}+604800 (WN\text{-}WN_{ot}))^2$ To avoid discontinuities in UT1 across leap seconds, the value of Δt_{LS} must be used in the calculation of $t_{UTC\text{-}EOP}$ regardless of whether a leap second has occurred. This accounts for the continuous nature of UT1 until a new upload after the leap second provides an update value for ΔUT1 that is consistent with the new Δt_{LS}.”	Will defer the change to next year PICWG

DOORS ID	IS200-1658, IS705-1525		
Paragraph	20.3.3.5.1.1 & 30.3.3.5.1.1 User Algorithm for Application of the EOP	**Comment Number**	7
Comment Type	Substantive	**Disposition**	***Accept***
Comment Originator(s)	Mike Thielen (Raytheon)		
Comment	The calculations in all three changes for ΔtUTC-EOP contain a number, 64800, in the A1-n term that is believed to be a typographical error.		
Directorate Response	Changes are applied		

BASELINE TEXT (WAS)	**PIRN TEXT (IS)**	**PROPOSED TEXT**
New Object	$t_{UTC-EOP} = (t - \Delta t_{UTC-EOP})$ [modulo 86400 seconds] where $\Delta t_{UTC-EOP} = \Delta t_{LS} + A_{0-n} + A_{1-n}(t-t_{ot} + 64800(WN-WN_{ot})) + A_{2-n}(t-t_{ot}+604800(WN-WN_{ot}))^2$	$t_{UTC-EOP} = (t - \Delta t_{UTC-EOP})$ [modulo 86400 seconds] where $\Delta t_{UTC-EOP} = \Delta t_{LS} + A_{0-n} + A_{1-n}(t-t_{ot} + 604800(WN-WN_{ot})) + A_{2-n}(t-t_{ot}+604800(WN-WN_{ot}))^2$

DOORS ID	IS200-623&1658, IS705-324&1525		
Paragraph	20.3.3.5.1.1 & 30.3.3.5.1.1 User Algorithm for Application of the EOP	**Comment Number**	8, 12, 16, 17, 19
Comment Type	Substantive	**Disposition**	***Accept***
Comment Originator(s)	Brent Renfro (University of Texas) & Steven Hutsell (2SOPS)		
Comment	Using a hyphen to separate UTC and EOP in the t(sub) UTC-EOP is probably a mistake. It could be confused for a minus sign. Using an underscore avoids this problem and is also consistent with other named quantities in this section. Change needs to be applied throughout		
Directorate Response	Changes are applied		

BASELINE TEXT (WAS)	PIRN TEXT (IS)	PROPOSED TEXT
New object	$t_{UTC-EOP}$	t_{UTC-_EOP}

DOORS ID	IS200-623, IS705-324		
Paragraph	20.3.3.5.1.1 & 30.3.3.5.1.1 User Algorithm for Application of the EOP	**Comment Number**	9 & 13
Comment Type	Substantive	**Disposition**	***Accept***
Comment Originator(s)	Brent Renfro (University of Texas)		
Comment	Note at end of table contains misleading information. Transit time doesn't enter into this calculation, so the existing note is misleading.		
Directorate Response	Transit time is removed from the table		

BASELINE TEXT (WAS)	**PIRN TEXT (IS)**	**PROPOSED TEXT**
See subsequent slides	See subsequent slides	See subsequent slides

Comment 9 – Transit Time
Brent Renfro (Univ. of Texas)

- Baseline Text (WAS): IS705-324

Table 20-VIII. Application of EOP Parameters

Element/Equation	Description
$UT1 = UTC + \Delta UT1 + \dot{\Delta UT1}\ (t - t_{EOP})$	Compute Universal Time at time t
$x_p = PM\_X + \dot{PM\ X}\ (t - t_{EOP})$	Polar Motion in the x-axis
$y_p = PM\_Y + \dot{PM\ Y}\ (t - t_{EOP})$	Polar Motion in the y-axis
t is GPS system time at time of transmission, i.e., GPS time corrected for transit time (range/speed of light).	

Comment 9 – Transit Time
Brent Renfro (Univ. of Texas)

- PIRN Text (IS): IS705-324

Table 20-VIII. Application of EOP Parameters	
Element/Equation	Description
$UT1 = t_{UTC-EOP} + \Delta UT1 + \Delta \dot{UT1} \ (t - t_{EOP})$	Compute Universal Time at time t
$x_p = PM\_X + PM\dot{X} \ (t - t_{EOP})$	Polar Motion in the x-axis
$y_p = PM\_Y + PM\dot{Y} \ (t - t_{EOP})$	Polar Motion in the y-axis
t is GPS system time at time of transmission, i.e., GPS time corrected for transit time (range/speed of light).	

Comment 9 – Transit Time
Brent Renfro (Univ. of Texas)

- PROPOSED Text (IS): IS705-324

Table 20-VIII. Application of EOP Parameters

Element/Equation	Description
$UT1 = t_{UTC\_EOP} + \Delta UT1 + \Delta \dot{UT1} \ (t - t_{EOP})$	Compute Universal Time at time t
$x_p = PM\_X + PM\dot{X} \ (t - t_{EOP})$	Polar Motion in the x-axis
$y_p = PM\_Y + PM\dot{Y} \ (t - t_{EOP})$	Polar Motion in the y-axis

t is GPS system time at time of transmission~~, i.e., GPS time corrected for transit time (range/speed of light).~~

Comment 13 – Transit Time
Brent Renfro (Univ. of Texas)

- Baseline Text (WAS): IS200-623

Table 30-VIII. Application of EOP Parameters

Element/Equation	Description
$UT1 = UTC + \Delta UT1 + \dot{\Delta UT1}\ (t - t_{EOP})$ *	Compute Universal Time at time t
$x_p = PM\_X + \dot{PM\_X}\ (t - t_{EOP})$ *	Polar Motion in the x-axis
$y_p = PM\_Y + \dot{PM\_Y}\ (t - t_{EOP})$ *	Polar Motion in the y-axis

*t is GPS system time at time of transmission, i.e., GPS time corrected for transit time (range/speed of light). Furthermore, the quantity ($t-t_{EOP}$) shall be the actual total time difference between the time t and the epoch time t_{EOP}, and must account for beginning or end of week crossovers. That is, if ($t-t_{EOP}$) is greater than 302,400 seconds, subtract 604,800 seconds from ($t-t_{EOP}$). If ($t-t_{EOP}$) is less than -302,400 seconds, add 604,800 seconds to ($t-t_{EOP}$).

Comment 13 – Transit Time
Brent Renfro (Univ. of Texas)

- PIRN Text (IS): IS200-623

Table 30-VIII. Application of EOP Parameters

Element/Equation	Description
$UT1 = t_{UTC-EOP} + \Delta UT1 + \Delta \dot{UT1} \ (t - t_{EOP})$ *	Compute Universal Time at time t
$x_p = PM\_X + PM\dot{X} \ (t - t_{EOP})$ *	Polar Motion in the x-axis
$y_p = PM\_Y + PM\dot{Y} \ (t - t_{EOP})$ *	Polar Motion in the y-axis

*t is GPS system time at time of transmission, i.e., GPS time corrected for transit time (range/speed of light). Furthermore, the quantity ($t-t_{EOP}$) shall be the actual total time difference between the time t and the epoch time t_{EOP}, and must account for beginning or end of week crossovers. That is, if ($t-t_{EOP}$) is greater than 302,400 seconds, subtract 604,800 seconds from ($t-t_{EOP}$). If ($t-t_{EOP}$) is less than -302,400 seconds, add 604,800 seconds to ($t-t_{EOP}$).

Comment 13 – Transit Time
Brent Renfro (Univ. of Texas)

- PROPOSED Text (IS): IS200-623

Table 30-VIII. Application of EOP Parameters

Element/Equation	Description
$UT1 = t_{UTC\_EOP} + \Delta UT1 + \Delta \dot{UT1} \ (t - t_{EOP})$ *	Compute Universal Time at time t
$x_p = PM\_X + PM\dot{X} \ (t - t_{EOP})$ *	Polar Motion in the x-axis
$y_p = PM\_Y + PM\dot{Y} \ (t - t_{EOP})$ *	Polar Motion in the y-axis

*t is GPS system time at time of transmission, ~~i.e., GPS time corrected for transit time (range/speed of light).~~ Furthermore, the quantity ($t-t_{EOP}$) shall be the actual total time difference between the time t and the epoch time t_{EOP}, and must account for beginning or end of week crossovers. That is, if ($t-t_{EOP}$) is greater than 302,400 seconds, subtract 604,800 seconds from ($t-t_{EOP}$). If ($t-t_{EOP}$) is less than -302,400 seconds, add 604,800 seconds to ($t-t_{EOP}$).

RFC-354 Leap Second and EOP (Earth Orientation Parameters) Synchronization

Critical Comments

Substantive Comments

Rejected Administrative Comments (0)

ACTION ITEM REVIEW
2017
Past Years

CLOSING COMMENTS
(For the 1st Day)

THANK YOU

The meeting will reconvene tomorrow at 0830 hrs PDT.

Global Positioning Systems (GPS) Public Interface Control Working Group and Public Forum

6 -7 September 2017
0830 – 1630 hrs PST

United States Air Force GPS Directorate
Phone Number: 1-310-653-2663 Meeting ID: 7536629 Passcode: 000001
DCS Website: https://conference.apps.mil/webconf/gpspublicmeeting

Roll Call

Rules of Engagement

UNCLASSIFIED

ABSOLUTELY NO PROPRIETARY, CLASSIFIED, OR COMPETITION SENSITIVE INFORMATION IS TO BE DISCUSSED DURING THIS MEETING.

Rules of Engagement

- Please place your phones on mute when not speaking to minimize background noise
- Comments against the topics listed on the official agenda will get priority during discussion, all others will be addressed during the open discussion
- Topics that warrant additional discussion may be side-barred
- Meeting minutes and final IRNs will be generated and distributed as a product of this meeting
- Please announce your name and organization before addressing the group

Meeting Purpose

- The purpose of the meeting is to:

1) Obtain ICWG approval on the proposed language generated for the enterprise RFCs that may impact the public documents

2) Discuss any new open forum items against the Public Signals in Space documents

Comments received will be vetted per the standard change management process

Agenda – Day 2 (Public Forum)

Reconvene

Roll Call

Action Item Review Continued (if necessary)

Special Topic Presentations

Delta from 2016 PICWG RFC-312, Definition Clarification for Time of Predict

GPS IIR-M and IIF L2C Phase Noise Plot Addition to IS-GPS-200 as References

IS-GPS-200H URA Wording Clarification (briefed by Aerospace Corp.)

Open Discussion Session

Action Item Review

Adjourn

ACTION ITEM REVIEW (Cont.)

2017 PUBLIC FORUM

Delta from PICWG 2016 Definition Clarification for Time of Predict

Maj Jenny Ji
Amit Patel

Definition Clarification for Time of Predict RFC-312 Special Topic

Problem Statement:
To remove ambiguity in contractor interpretation, the definition of the parameter Time of Predict (T_{op}) and other timing parameters must be clarified in the GPS technical baseline documentation.
Proposed Solution:
Create an RFC to process the proposed changes with the correct stakeholders and update applicable documents for accurate implementation. Introduced Clock, Ephemeris, Integrity (CEI) Date Set to signal to user equipment that there is new navigation data. Clarified the relationship between health bits and Toe/Toc/IODE/IODC to ensure the integrity of the signal in space. Ensure user equipment integrity & backward compatibility with existing user equipment.
Impacted Documents:
Public Documents : IS-GPS-200, IS-GPS-705, IS-GPS-800

RFC-312 Special Topic

- RFC-312 is an RFC from 2016 PICWG. It has been CCB approved as of 12 June 2017. This RFC proposed some additional changes to the impacted documents since 2016 PICWG. The additional changes are:

  - Removal of the 15-Minute Cutover Boundary limitation on the first data set of newly uploaded data

  - The addition of the Clock, Ephemeris, Integrity (CEI) Data Set Parameters

RFC-312 Special Topic

- Removal of the 15-Minute Cutover Boundary limitation on the first data set of newly uploaded data:
  - Redlines:
    - Cutovers of subframe 2 data to new CEI data sets will nominally occur on hour boundaries except for the first CEI data set of a new ~~upload. The first data set of newly uploaded~~CEI data ~~will cutover on 15 minute~~sequence ~~boundaries~~propagation.
  - IS:
    - Cutovers of subframe 2 data to new CEI data sets will nominally occur on hour boundaries except for the first CEI data set of a new CEI data sequence propagation.

RFC-312 Special Topic

- The addition of the Clock, Ephemeris, Integrity (CEI) Data Set Parameters (1/2)

Symbol	Parameter Name	Subframe
$\dot{A}$	Change Rate in Semi-major Axis	2
ΔA	Semi-major Axis Difference at Reference Time	2
Δn_0	Mean Motion Difference from Computed Value at Reference Time	2
$\Delta \dot{n}_0$	Rate of Mean Motion Difference from Computed Value	2
Ω_0	Longitude of Ascending Node of Orbit Plane at Weekly Epoch	2
$\Delta \dot{\Omega}$	Rate of Right Ascension Difference	2
ω	Argument of Perigee	2
a_{f0}	SV Clock Bias Correction Coefficient	2
a_{f1}	SV Clock Drift Correction Coefficient	2
a_{f2}	Drift Rate Correction Coefficient Index	2
C_{ic}	Amplitude of the Cosine Harmonic Correction Term to the Angle of Inclination	2
C_{is}	Amplitude of the Sine Harmonic Correction Term to the Angle of Inclination	2
C_{rc}	Amplitude of the Cosine Harmonic Correction Term to the Orbit Radius	2
C_{rs}	Amplitude of the Sine Correction Term to the Orbit Radius	2
C_{uc}	Amplitude of Cosine Harmonic Correction Term to the Argument of Latitude	2

RFC-312 Special Topic

The addition of the Clock, Ephemeris, Integrity (CEI) Data Set Parameters (2/2)

C_{us}	Amplitude of Sine Harmonic Correction Term to the Argument of Latitude	2
e	Eccentricity	2
i_0	Inclination Angle at Reference Time	2
$i_{0\text{-}n}$-DOT	Rate of Inclination Angle	2
ISC_{L1CP}	Inter-signal Correction	2
ISC_{L1CD}	Inter-signal Correction	2
ISC_{L1CA}	Inter-signal Correction	3
ISC_{L2C}	Inter-signal Correction	3
ISC_{L5I5}	Inter-signal Correction	3
ISC_{L5Q5}	Inter-signal Correction	3
ISF	Integrity Status Flag NOTE1	2
ITOW	Interval Time of Week	2
L1C	Signal Health (1 bits)	2
M_0	Mean Anomaly at Reference Time	2
T_{GD}	Group Delay Differential	2
t_{oe}	Time of Ephemeris	2
t_{op}	CEI Data Sequence Propagation Time of Week	2
URA_{ED} Index	Elevation Dependent User Range Accuracy, URA_{ED} Index	2
URA_{NED0} Index	NED Accuracy Index	2
URA_{NED1} Index	NED Accuracy Change Index	2
URA_{NED2} Index	NED Accuracy Change Rate Index	2
WN	Data Sequence Propagation Week Number	2

NOTE1: Parameters so indicated are for CEI Refinement – not limited to curve fit. Parameters not indicated are needed for/limited to curve fit.
Updates to parameters in table shall prompt changes in t_{oe}. Any parameter marked with NOTE1 may be changed with or without a change in t_{oe}.

GPS IIR-M and IIF L2C Phase Noise Plot Addition to IS-GPS-200 as References

Lt Irvin Vazquez-Calderon
Huey Nguyenhuu

Background Information

- **Concern**: A plot of typical GPS III phase noise spectral density is currently TBD in IS-GPS-705 and IS-GPS-800. A plot of L5 IIF data is provided in IS-GPS-705. Since these are provided for user reference and do not drive design, they do not belong in interface specifications.

- **Actions Taken by RFC-267**:
  - Civil community rejected the recommendation to remove the typical noise plots. In fact, they would like to see GPS III L5 and L1C spectral phase noise plots to be added in IS-GPS-705 and IS-GPS-800, respectively.
  - The typical GPS III L5 and L1C spectral phase noise plots were added to IS-GPS-705 and IS-GPS-800 respectively by RFC-267, CCB approved Mar 24, 2016.

Final Decision

- **Mar 24th 2016 CCB inquiry**:
  - Explore the possibility to include GPS IIR-M and IIF L2C phase noise plots as user references in IS-GPS-200 for completeness.

- **Follow-on Activities:**
  - GPS IIR-M Data are not readily available.
  - 2016 Public ICWG discussion: Recalled that the people who could use the data thought there would be quite a bit of variance from one SV to another. So "typical" charts wouldn't provide the fidelity needed. They also thought that anyone who really needed the data would also have the means to generate them; therefore, by putting these "typical plots" into a document would have little, if any, value.

Final decision: "NOT to include GPS IIR-M and IIF L2C phase noise plots as user references in IS-GPS-200 since there is no value added"

Back-Up

GPS IIR-M and IIF L2C Phase Noise Plots
2017-Special Topic

IS-GPS-705 Navstar GPS Space Segment/User Segment L5 Interface

6.3 Supporting Material

6.3.2 Integrated Phase Noise Characteristics.

As an aid to user equipment receiver designers, plots are provided (Figure 6-1 and Figure 6-2) of a typical GPS Block IIF and GPS III phase noise spectral density for the un-modulated L5 carrier.

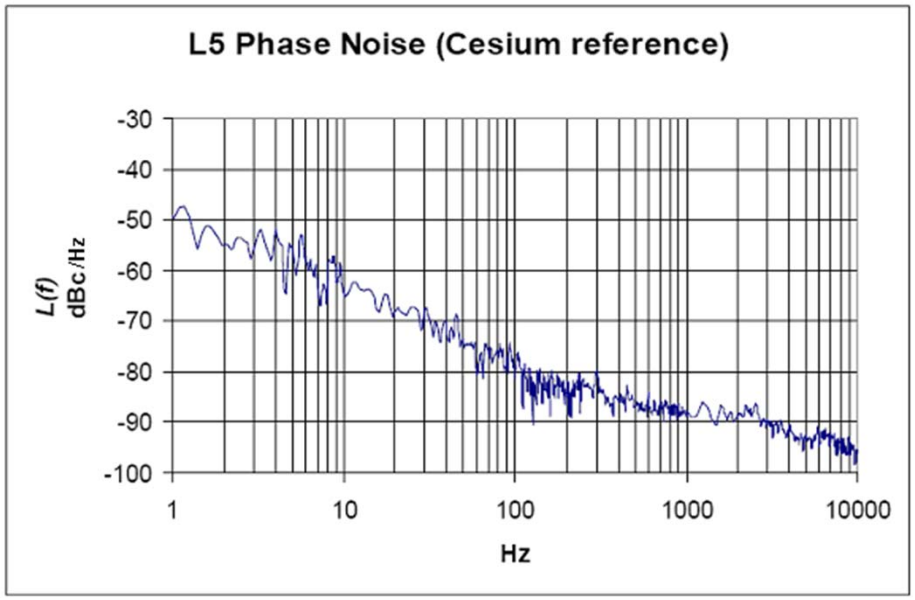


Figure 6-1. Typical GPS IIF L5 Carrier Phase Noise Spectral Density

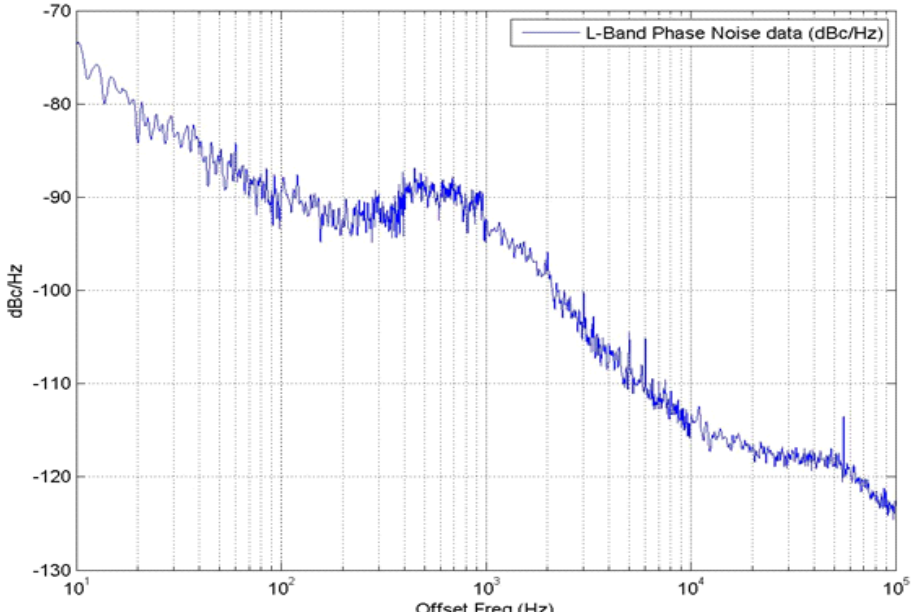


Figure 6-2 Typical GPS III L5 Carrier Phase Noise Spectral Density

- WAS: TBD
- Added by RFC-267, IRN-IS-705D-001

GPS IIR-M and IIF L2C Phase Noise Plots
2017-Special Topic

IS-GPS-800 Navstar GPS Space Segment/User Segment L1C Interface

6.3 Supporting Material

6.3.2 Integrated Phase Noise Characteristics.

As an aid to user equipment receiver designers, a plot is provided (Figure 6-1) of a typical GPS III phase noise spectral density for the un-modulated L1C carrier.

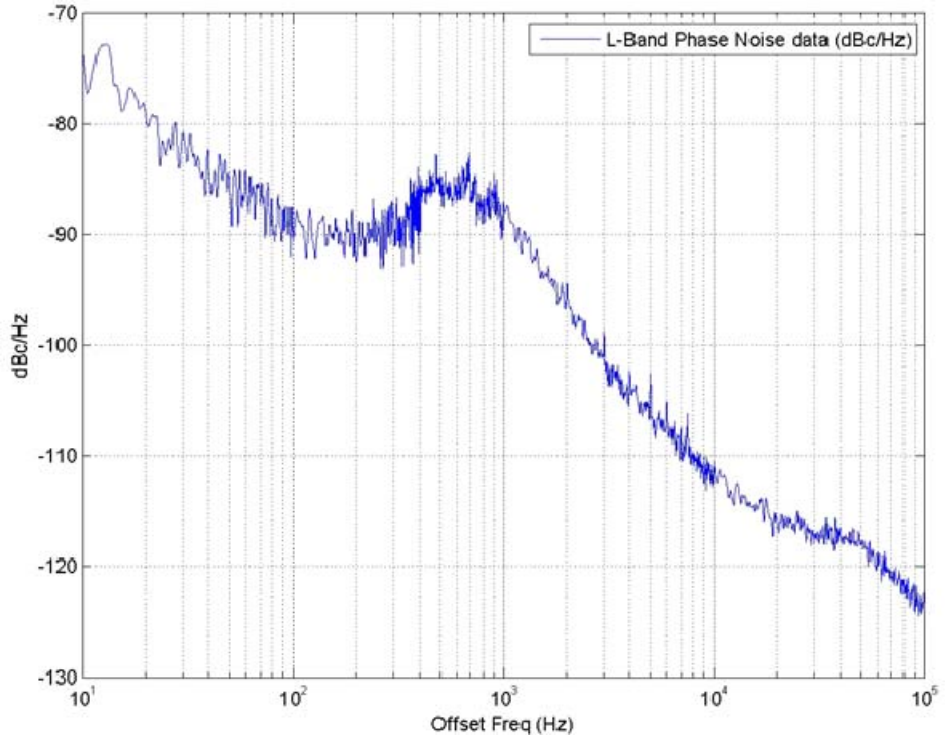


Figure 6-1 Typical GPS III L1C Carrier Phase Noise Spectral Density

- WAS: Reserved for L1C Phase Noise Plot
- Added by RFC-267, IRN-IS-800D-001

Special Topic

WALK-ON (?)

D. Spinden (Rockwell Collins)

OPEN DISCUSSION

ACTION ITEM REVIEW

Closing Remarks

James Horejsi

Chief Engineer, Global Positioning Systems (GPS) Directorate Space and Missile Systems Center

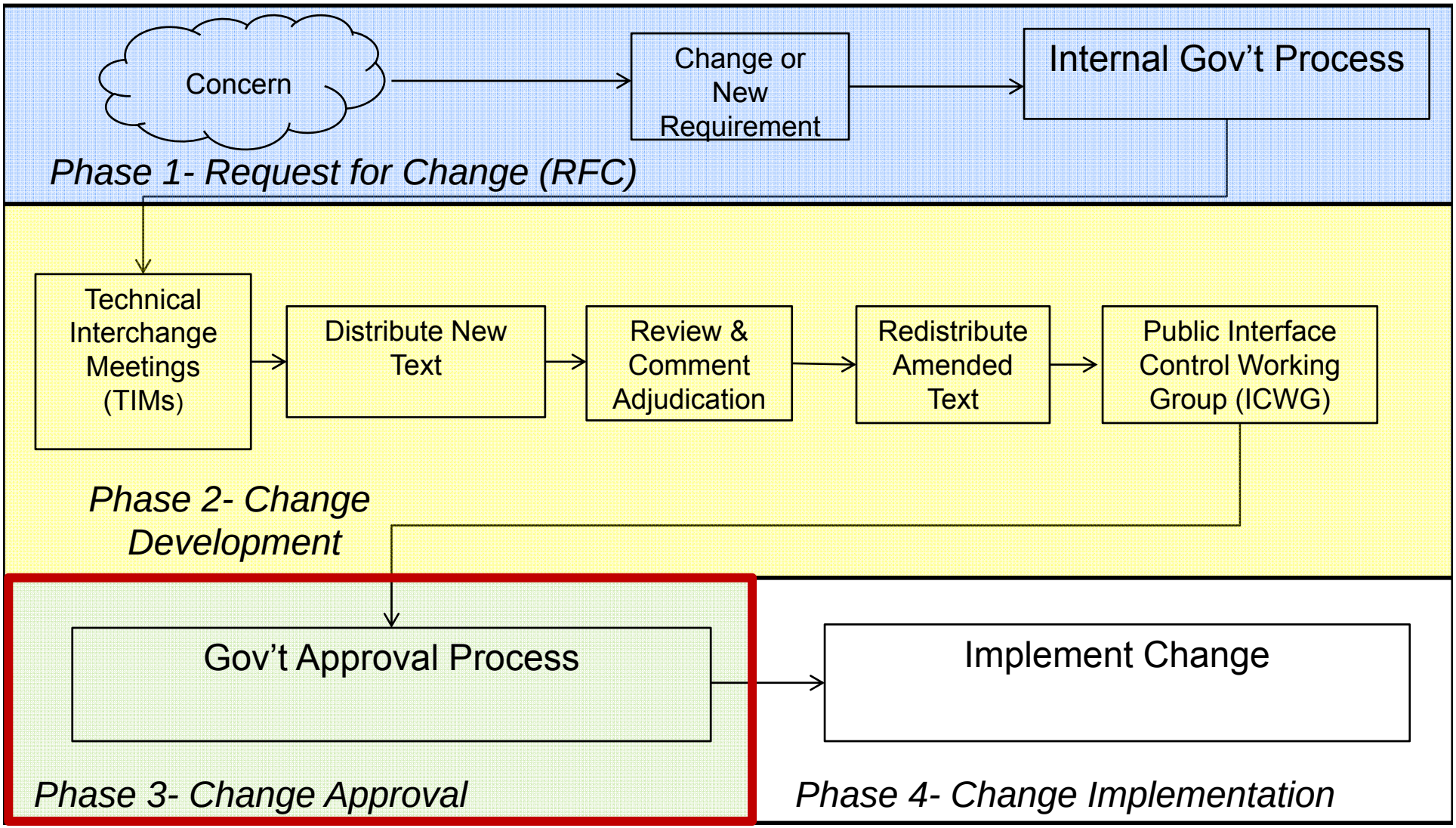
Closing Comments

- 2018 meetings for the GPS public documents are tentatively scheduled for September
  - Submit any GPS Public Document Concerns to the government workflow identified above. For consideration in the 2018 Public ICWG, the government requests any Concern submissions be sent NLT **28 Feb 18**
- Direct any follow-up communication related to this meeting to smcgper@us.af.mil
- Final updates to the public documents will be available on GPS.gov following approval by the Configuration Control Board
- Please provide feedback to the GPS requirements team to enable the continual improvement of this meeting

Concern Template

Concern			
Originator	**Organization**	**Phone No.**	**Email**
Description			
Proposed Resolution			
Document (s) Impacted			
Date			
Remark			

Change Management High Level Process Flow



Thank You