Global Positioning System (GPS)

Public Interface Control Working Group (ICWG) & Public Forum

October 26, 2022
0830-1600 PDT

United States Space Force
Space Systems Command
MILCOMM & PNT Directorate

Major Cobb Brandon
Mr. Dan Godwin
Captain Andrew Sweeten

Dial-in Information

LIVE MEETING LINK:
https://saicwebconferencing.zoomgov.com/j/1603353663

Meeting ID: 160 335 3663
Passcode: **621616**

DIAL IN:
Dial by your location
571 200 1700 US
Meeting ID: 160 335 3663
Passcode: 621616

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Alternate Meeting Application (only if needed)
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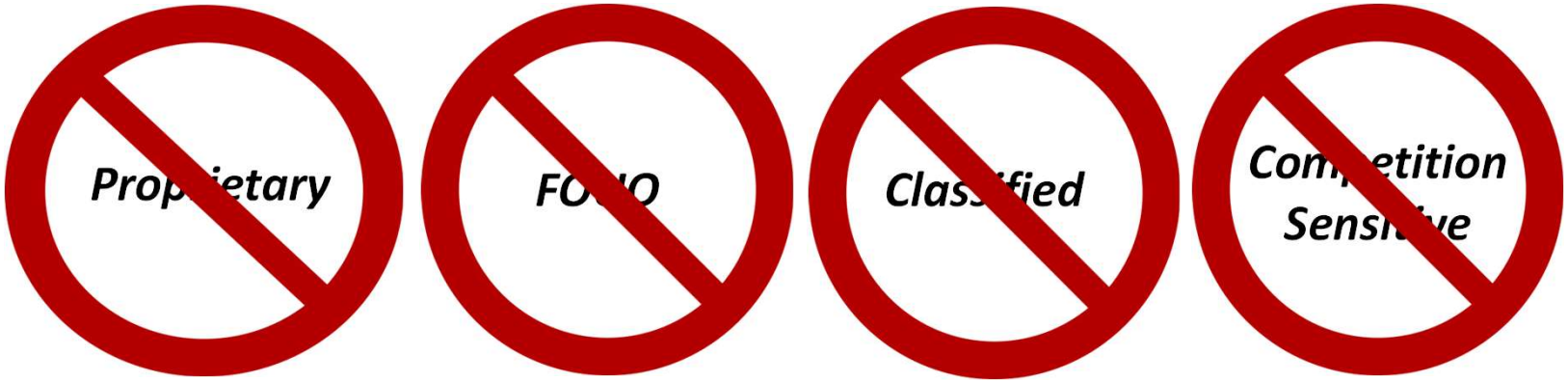
https://dod.teams.microsoft.us/l/meetup-join/19%3adod%3ameeting_c4dd5c38d0ae429191db25a307db6d5e%40thread.v2/0?context=%7b%22Tid%22%3a%228331b18d-2d87-48ef-a35f-ac8818ebf9b4%22%2c%22Oid%22%3a%2239eaebff-b71b-4aad-8a01-55fa5d59953e%22%7d

Toll number: +1 410-874-6740
Conference ID: 326 120 515#

Roll Call

Rules of Engagement

UNCLASSIFIED



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

Rules of Engagement (Cont'd)

- Please place your phones on mute when not speaking to minimize background noise
- For dial-in attendees, DO NOT take calls from phone while on telecom
- Comments against the topics listed on the official agenda will get priority during discussion
- Topics that warrant additional discussion may be side-barred
- Walk-on topics may be discussed during the open discussion
- Meeting minutes and final Proposed Changes Notices (PCNs) will be generated and distributed as a product of this meeting
- Please announce your name and organization before addressing the group

Rules of Engagement (Cont'd)

- Types of comments to be discussed/dispositioned:
  - Critical (C)
  - Substantive (S)
  - Rejected/Deferred Administrative (A)
- Comments are grouped by sub-topic rather than by comment type

Rules of Engagement (Cont'd)

The purpose of the meeting is to:

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

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

Agenda

Public ICWG (1st Half of Day)	Presenter	
GPS Public ICWG and Public Forum Meeting Overview and Roll Call, Rules of Engagement	Capt. Andrew Sweeten	8:30 8:45
Opening Remarks / GPS Overview	Maj. Stewart Brandon	8:45 9:05
2022 Public ICWG RFC Discussion		
• RFC-495 (2022 Proposed Changes to the Public Documents)	Tony Anthony	9:05 11:05
Break		11:05 11:10
• Open RFC Discussion Session / Action Items		11:10 11:30
Special Topics Presentations		
• Expected Almanac Behavior in OCX Era	Dr. Andrew Hansen	11:30 12:00
Action Item Review		12:00 12:10

Public Forum (2nd Half of Day)	Presenter	
Special Topics Presentations - Continued		
• Mitigate LNAV Default Nav Anomaly	Hamza Abusalam	13:00 13:20
• CNAV Message Schedules	Bert Hayden	13:20 13:40
• ISC and CEI Table	Karl Kovach	13:40 14:00
• Data ID Issue	Karl Kovach	14:00 14:20
Break		14:20 14:35
Walk-on Topics, Open Discussion		14:35 15:00
PRAT - Public Req. Accountability Tool	Tony Anthony	15:00 15:30
Action Item Review		15:30 16:00
Closing Remarks	Maj. Stewart Brandon	16:00 16:10
Hot Wash (internal)		16:10 16:40

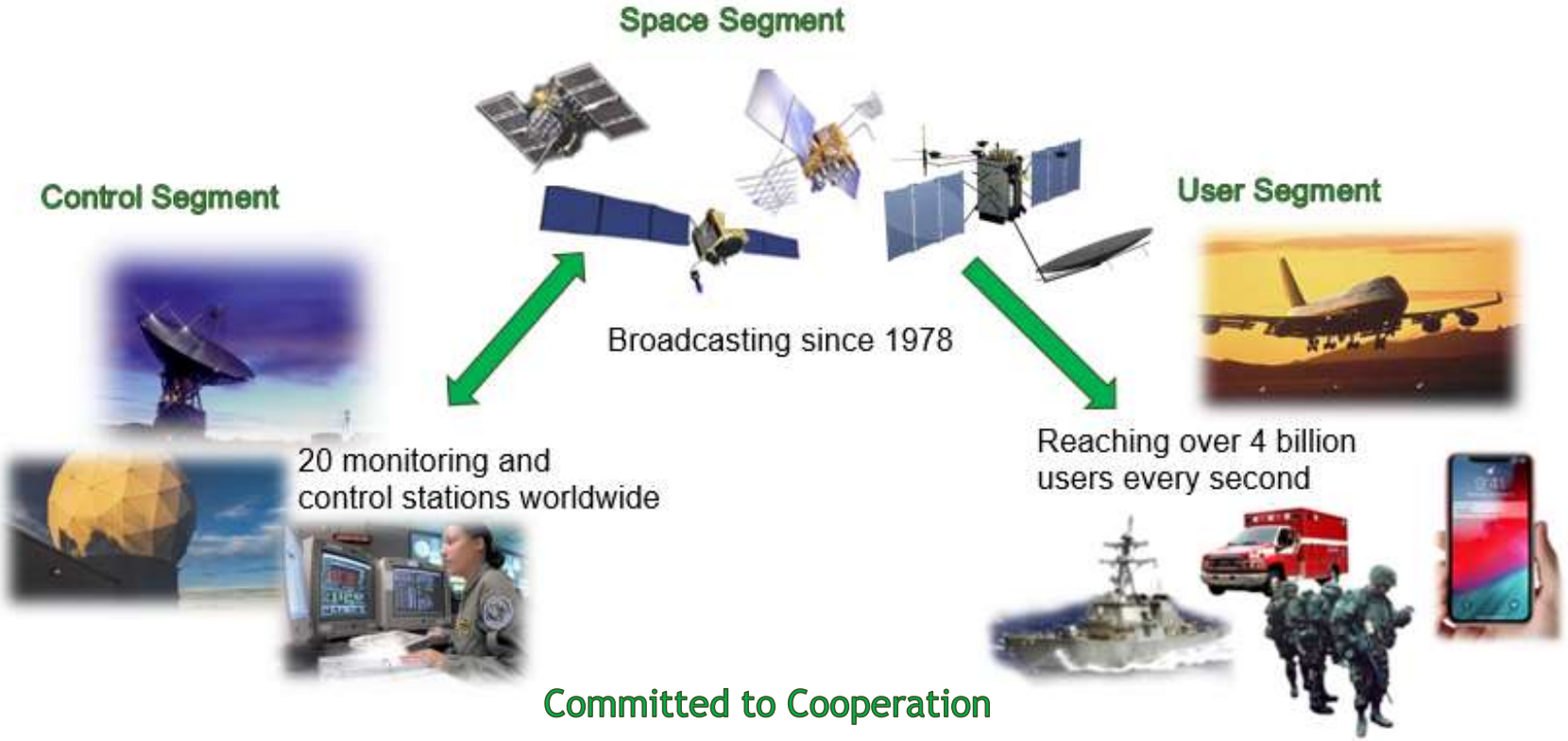
Opening Remarks

Position, Navigation, and Timing (PNT) Mission Area

October 26, 2022

Major Stewart C. Brandon
Chief, Positioning, Navigation and Timing
Requirements and Integration Branch

GPS Overview (DoD)



Committed to Cooperation

Department of Defense • Army • Navy • Air Force • Space Force • USMC • NGA • DISA • USNO • NSA • PNT EXCOM
National Nuclear Security Administration (NNSA) • Department of Transportation • Federal Aviation Administration
Department of Homeland Security • U.S. Coast Guard • International Civil Aviation Organization
Global Navigation Satellite Systems • Galileo • Beidou • GLONASS • QZSS • NAVIC
International Committee on GNSS • International Telecommunication Union

GPS Overview

Global Positioning Satellites: Encompassing the DoD and Civil Industry Partners

- **GPS is utilized across the world with**
- **6B+ users! GPS impacts almost every industry some of these industries include:**
  - **Agriculture**
  - **Maritime**
  - **Public Safety**
  - **Recreation**
  - **Space**
  - **Aviation**
  - **Finance**
  - **Telecommunications**
  - **Telematics**
  - **Oil/Gas**
- **GPS economic benefit ~$1.4 Trillion***

GPS consistently met all technical performance commitments: Accuracy, Integrity, Availability and Continuity Integrity, Availability and Continuity

GPS Constellation Status

37 Satellites • 31 Set Healthy
Baseline Constellation: 24 Satellites

Satellite Block	Quantity	Average Age (yrs)	Oldest
GPS IIR	12 (5*)	20.7	25.1
GPS IIR-M	8 (1*)	14.9	16.9
GPS IIF	12	8.6	12.3
GPS III	5	2.4	3.7

*Not set healthy

As of 27 Aug 22

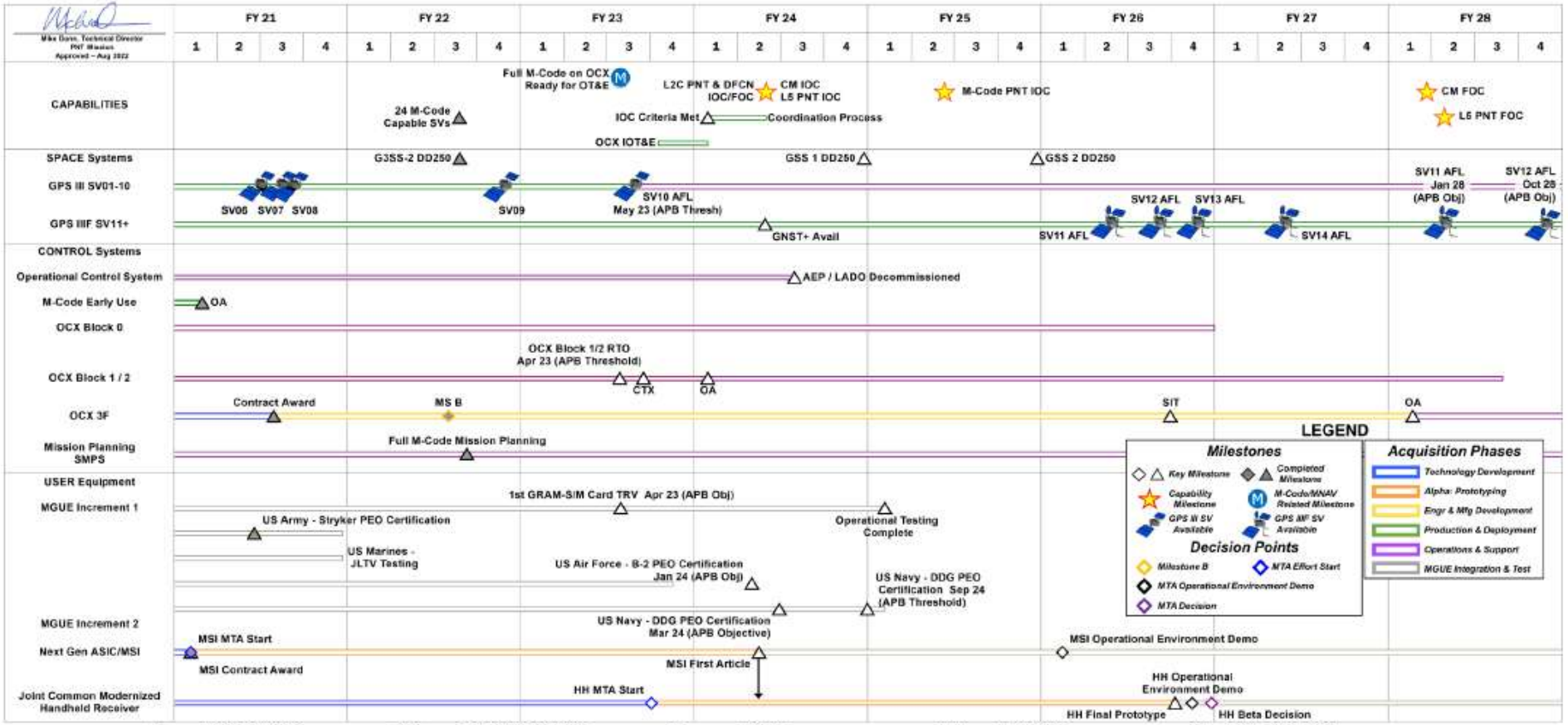
GPS Signal in Space (SIS) Performance

Week ending on 3 Sept 22

Average URE*	Best Day URE	Worst Day URE
49.1 cm	31.5 cm (20 Apr 21)	64.8 cm (20 May 22)

*All User Range Errors (UREs) are Root Mean Square values

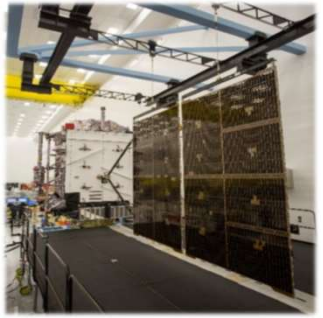
GPS Enterprise Roadmap



AEP	Architecture Evolution Plan	DFCN	Dual-Frequency Civil Navigation	HH	Handheld	MNAV	Military Navigation	PEO	Program Executive Officer
AFL	Available for Launch	FOC	Full Operational Capability	IOC	Initial Operating Capability	MS	Milestone	PNT	Positioning, Navigation & Timing
APB	Acquisition Program Baseline	GRAM-S/M	GPS Receiver Application Module – Standard Elec Module/Modernized	IOT&E	Initial Operational Test & Evaluation	MSI	Miniature Serial Interface	RTO	Ready for Transition to Ops
ASIC	Application-Specific Integrated Circuit			JLTV	Joint Light Tactical Vehicle	MTA	Middle Tier Acquisition	SMPS	SAASM Mission Planning System
CM	Constellation Management	G3SS	GPS III Satellite Simulator	LADO	Launch, Anomaly, and Disposal Operations	OA	Operational Acceptance	SIT	System Integration Test
CTX	Constellation Transfer	GNST+	GPS IIF Non-Flight Satellite Testbed	M-Code	Military Code	OCX	Next Gen Operational Control System	SV	Space Vehicle
DDG	Arleigh Burke Guided Missile Destroyer	GSS	GPS Satellite Simulator	MGUE	Military GPS User Equipment	OT&E	Operational Test and Evaluation	TRV	Technical Requirements Verification

GPS III

- SV01 Set healthy and available for use on 13 Jan 20
- SV02 Set healthy and available for use on 1 Apr 20
- SV03 Set healthy and available for use on 1 Oct 20
- SV04 Set healthy and available for use on 2 Dec 20
- SV05 Set healthy and available for use on 25 May 22
- SV06 Launch scheduled for 18 Jan 23
- SV07 in storage – AFL 20 May 21; TLD May 2024
- SV08 in storage – AFL 10 Jun 21; TLD FY25
- SV09 in storage – AFL 23 Aug 22; TLD FY26
- SV10 in production - TLD FY26



Five GPS III satellites declared operational

GPS III Follow-On (GPS IIIF)

- GPS IIIF additional features
  - Regional Military Protection (RMP) and redesigned Nuclear Detonation Detection System (NDS)
  - Search-and-Rescue (SAR) payload – faster detection and location of distress signals
  - Laser Retroreflector Array (LRA) – provides more precise ranging data
  - Partnering with Air Force Research Laboratory (AFRL) for future technology opportunities
    - Demo on Navigation Technology Satellite (NTS-3)
      - Digital Reprogrammable Payloads
      - Advanced Clocks
- Status: Milestone C Completed 13 Jul 20; SV11 launch forecasted for FY2027

Ensuring the Gold Standard today and into the future

Next Generation Operational Control System (OCX)

- Next-generation command, control and cyber-defense for GPS
  - Enhanced command and control capability
  - Modernized architecture
  - Robust information assurance and cyber security
- Incremental Development
  - OCX Block 0: Launch and Checkout System (LCS) for GPS III
  - OCX Blocks 1 and 2: Controls and manages all GPS IIR, GPS IIR-M, GPS IIF, and GPS III spacecraft; and controls all legacy and new GPS signals
  - OCX 3F: Adds support to OCX for GPS IIIF vehicle and new capabilities including Regional Military Protection
- Current Status
  - LCS successfully supported Launch and Checkout for GPS III SV01-SV05
  - OCX Block 1 completed factory integration and in Golden Dry Run for factory qualification
  - Constellation Transfer (CTX) 3QFY23; Operational Acceptance target 1QFY24

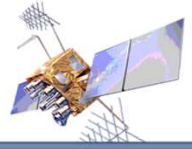
OCX program continues to execute and is nearing completion

GPS Modernization

SPACE SEGMENT (SATELLITES)

Legacy (GPS IIA/IIR)
- Basic GPS
- NUDET (Nuclear Detonation) Detection System (NDS)

GPS IIR-M
- 2nd Civil Signal (L2C)
- New Military Signal
- Increased Anti-Jam Power



GPS IIF
- 3rd Civil Signal (L5)
- Longer Life
- Better Clocks

GPS III (SV01-10)
- Accuracy & Power
- Increased Anti-Jam Power
- Inherent Signal Integrity
- 4th Civil Signal (L1C)
- Longer Life
- Improved Clocks

GPS IIIF (SV11-32)
- Unified S-Band Telemetry, Tracking, & Commanding
- Search & Rescue (SAR) Payload
- Laser Retroreflector Array
- Redesigned NDS Payload
- Regional Military Protect (RMP)

CONTROL SEGMENT (GROUND)

Legacy (OCS)
- Mainframe System
- Command & Control
- Signal Monitoring

Architecture Evolution Plan (AEP)
- Distributed Architecture
- Increased Signal Monitoring Coverage
- Security & Accuracy
- Launch And Disposal Operations

OCX Block 0
- GPS III Launch & Checkout

GPS III Contingency Ops (COps)
- GPS III Mission on AEP

M-Code Early Use (MCEU)
- Update OCS to operationalize Core M-Code on AEP

OCX Blocks 1 and 2
- Fly GPS IIR/-M, GPS IIF, GPS III
- Modernize Cyber Architecture
- Operationalize Civil Signals (L1C, L2C, L5)
- Full M-Code

OCX Block 3F
- Incorporates GPS IIIF Command & Control
- Integrates new capabilities

USER SEGMENT (RECEIVERS)

Legacy (PLGR/GAS-1/MAGR)
- First Generation System

Visit GPS.gov for more info

SAASM-era User Equipment
- Anti-Jam capability
- Electronic Protection

Military GPS User Equipment
- M-Code Receivers
- Common GPS Modules
- Increased Access Power w/ M-Code
- Increased Accuracy
- Increased Availability
- Increased Anti-Tamper Anti-Spoof
- Increased Acquisition in Jamming

GPS Requirements Management

October 26, 2022

Major Stewart Brandon

Chief, Positioning, Navigation, and Timing Requirements and Integration Branch

GPS Requirements Team

Space Force

- **Maj Stewart Brandon, Chief, PNT Requirements & Integration Branch**
- **Mr. Daniel Godwin, Chief, GPS Requirements Section**
- **Capt Adam Sweeten, GPS Requirements Action Officer**

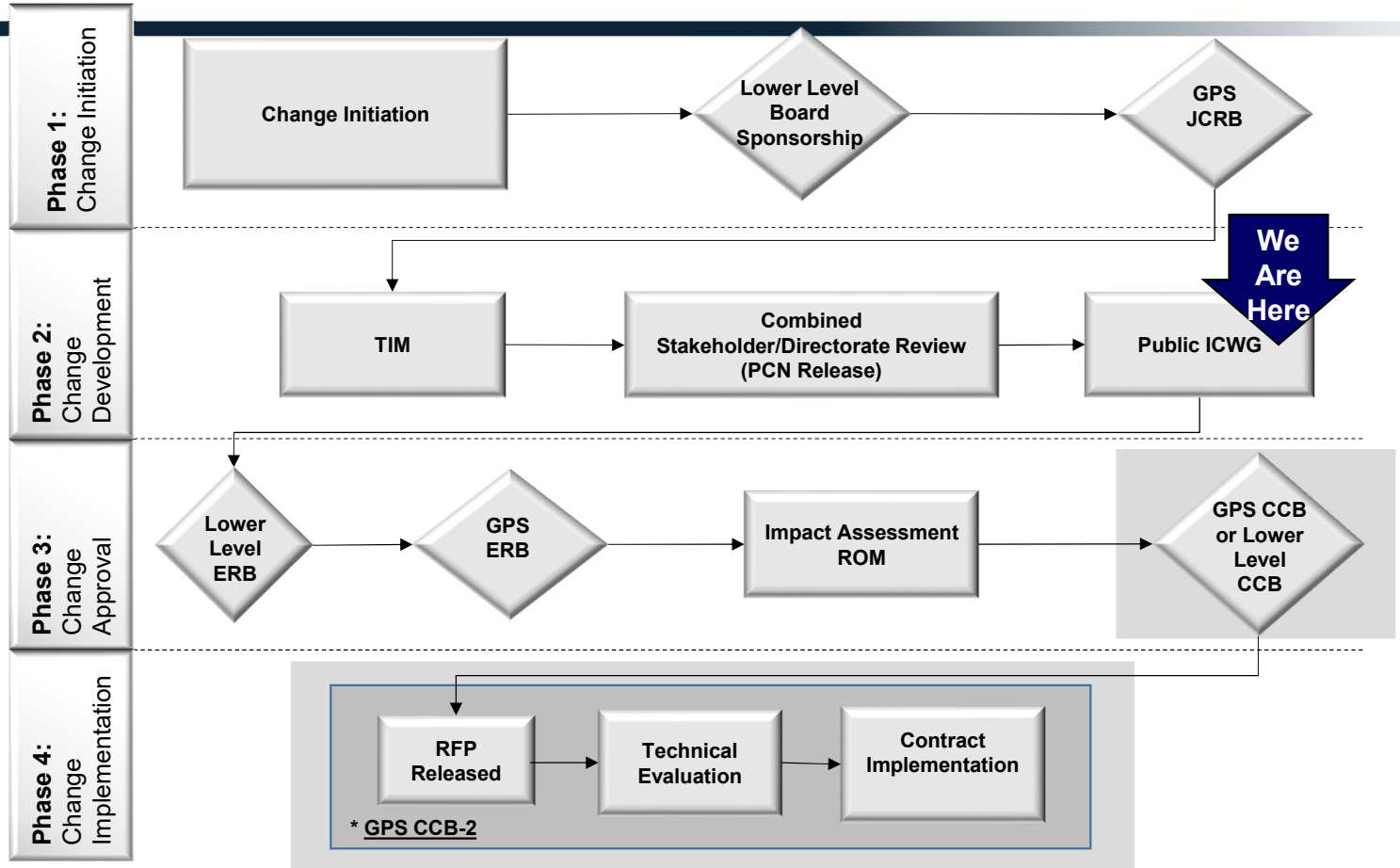
Aerospace

- **Dr. Rhonda Slattery, Enterprise Requirements Lead**
- **Mr. Karl Kovach, Civil Requirements Lead**
- **Mr. Bert Hayden, Senior Engineer Specialist**

Systems Engineering and Integration (SE&I)

- **Mr. Don Latterman, Senior Technical Advisor**
- **Mr. Tony Anthony, Responsible Engineer**

Technical Baseline Change Management Process Flow Chart



JCRB= Joint Change Review Board
ERB= Engineering Review Board
TIM= Technical Interchange Meeting
ROM= Rough Order of Magnitude
PCN= Proposed Change Notice
CCB= Configuration Control Board
ICWG= Interface Control Working Group
RFP= Request for Proposal

Action Items and Feedback

- We will record actions during the discussions and share during the Action Item agenda item
- If you have further actions or feedback after the 2022 PICWG please submit to smcgper@us.af.mil

QUESTIONS?

APPROVED FOR PUBLIC RELEASE

Positioning, Navigation, and Timing Mission Adjudication Working Group (AWG) Slides

PUBLIC-ICWG/AWG #2
26-OCT-2022

DOCUMENT CLASSIFICATION
Unclassified

REQUEST FOR CHANGE (RFC) NUMBER
RFC-495

RFC TITLE
2022 Proposed Changes to the Public Documents

GOVERNMENT POC
Capt. Andrew Sweeten SSC/CGES, 310.653.4549

SE&I POC
Tony Anthony, *SSC/ZACS-PNT/SE&I*, 310.418.7693X

CM POC
Veronica Quebedeaux, SSC/CGE/SE&I, 310.414.2856

RFC-495: 2022 Proposed Changes to the Public Documents

RFC CHANGE TYPE: Correction or Clarification to Baseline
1) PROBLEM STATEMENT:
1. **Change Pconst to Rconst and MFDconst in the CNAV and CNAV2 Integrity Support Message.** The rate of unalerted constellation failures (Rconst) and the mean duration of these failures (MFDconst) characterize such failures better than the probability of an unalerted constellation failure at any given time. (Pre-RFC-1200) 2. **Implement Administrative Fixes** needed on any document otherwise affected by any of the solutions to the above 5 problems.
2) SOLUTION:
1. Rework Pconst to Rconst and MFDconst in all affected documents 2. Provide clarity and clean up identified administrative changes in all affected documents IS-GPS-200, IS-GPS-705 and IS-GPS-800

RFC-495: 2022 Proposed Changes to the Public Documents

3) SPONSOR, DRIVER & IMPORTANT DATES:									**THIS RFC IS: ROUTINE**
Sponsor: ZACS-PNT				Lead Driver Event: ICAO State Letter Review			Lead Driver Event Date: ~~June 2023~~ Dec 2022		
JCRB	**TIM**	**Stakeholder Review**	**Comments Due**	**Resolve Comments**	**~~AWG~~**	**GPS ERB**	**Impact Assessment Period**	**LL CCB**	**CCB**
24 Jan 22	2 Feb 22 16 Feb 22 17 Feb 22	~~9 Jun 22~~ 15 Mar 22 (CSR) ~~15 Jun 22~~ 15 Jul 22 (Public Release)	~~25 Jul 22~~ 14 Apr 22 ~~30 Jul 22~~ 19 Sep 22	30 Apr 22 ~~15 Aug 22~~ 5 Oct 22	11 May 22 (govt AWG) ~~28 Sep 22~~ 26 Oct 22 (Public ICWG)	~~4 Jan 23~~ 7 Dec 22	TBD	~~12 Jan 23~~ 14 Dec 22	~~16 Jan 23~~ 19 Dec 22

4) APPROVAL AUTHORITY: (Select one)		
✓	Enterprise	Proposed Change (or Variance) affects multiple Segments' Technical Baseline(s), prime contractor documentation or external agencies outside of the GPS Directorate
	Lower Level	Proposed Change affects one Segments' Technical Baseline or prime contractor documentation

Stakeholder Review Status – Combined Stakeholder Review

15) REVIEW STATUS											
Office	**Response Required**	**No Impact**	**No Comments**	**Comments**	**No Response**	**EXTERNALSTAKEHOLDERS**	**Response Required**	**No Impact**	**No Comments**	**Comments**	**No Response**
PCA (GPA)	RR		X			**USSF, SpOC 2 SOPS (SPOC 2 SOPS)**	RR		X		
ZACS-Civil (GPC)	RR		X			**Space Delta 8 (was 50OG)**	RR		X		
ZACS-NGA (GPD)	RR		X			**PNT-MAT (was SpOC/S5M)**	RR		X		
ZACS-PNT (GPE)	RR		X			**National Security Agency**	RR		X		
PCET (GPEV)	RR				X	**NGA**	RR		X		
PCCC OCX 3F	RR			X		**PNT—PO (ADAP, MAGR, DAGR); EGI-M**	RR		X		
PCCC SMPS (GPGC)	RR	X				**AFLCMC/EBD**	RR				X
PCCX (GPGX)	RR			X		**SNL**		X			
PCCN (GPGN)	RR		X			**PRIME CONTRACTS**					
PCL (GPL)	RR	X				**IIR/IIR-M/III On Orbit Sust - LM**	RR			X	
ECPG (GPL)	RR			X		**IIA/IIF On-Orbit Sust - Boeing**	RR		X		
PCV (GPN; PCN)	RR			X		**GPS III - LM**	RR			X	
PCT (GPT)	RR				X	**GPS IIIF - LM**	RR			X	
PCU (GPU)	RR			X		**GCS II – Sust - LM**	RR	X			
PCM3 (GPV3)	RR			X		**OCX 1/2 - RTX**	RR				X
PCMF (GPV4)	RR			X		**OCX 3F - RTX**	RR				X
AEROSPACE	RR			X		**MGUE Inc 1 - KTR A**	RR		X		
MITRE	RR			X		**MGUE Inc 1 - KTR B**	RR			X	
SE&I	RR	X				**MGUE Inc 1 - KTR C**	RR			X	
EXTERNAL STAKEHOLDERS						**MGUE Inc 2 MSI - BAE**	RR			X	
PM-PNT (Army)	RR	See PCA (GPA) Response				**MGUE Inc 2 MSI - L3H**	RR		X		
NIWC PAC	RR	See PCV (GPN) Response				**MGUE Inc 2 MSI - RTX**	RR			X	
USNO	RR	See PCV (GPN) Response				**SMPS Development - BAH**	RR	X			
USMC	RR	See PCV (GPN) Response				**SMPS Sust - Lockheed Martin**	RR		X		
NAWCAD	RR	See PCV (GPN) Response				**USNDS Ground 6 / ICADS 7 - Sandia**	RR	X			

Public Review Comment Resolution Matrix (CRM) Status

CRM – COMBINED STAKEHOLDER/DIRECTORATE REVIEW STATUS:						
Disposition/Type	**Critical**	**Substantial**	**Administrative**	**Totals**	**Concurrence**	**Notes**
Accept		**35**	**1**	**36**		
Accept with Comment		**3**	**1**	**4**		
Reject	**2**	**3**		**5**		
Deferred		**1**		**1**		
Grand Totals:	**2**	**42**	**2**	**46**		

Industry Comment Decisions

CRM – COMBINED STAKEHOLDER/DIRECTORATE REVIEW STATUS:						
Disposition/Type	**Critical**	**Substantial**	**Administrative**	**Totals**	**Concurrence**	**Notes**
Accept		**9**		**9**		**Industry Comments** • Europa • Thales **FFRDC Comment** • Aerospace Corp
Accept with Comment		**3**	**1**	**4**		
Reject	**2**			**2**		
Deferred						
Grand Totals:	**2**	**12**	**1**	**15**		

Change Constellation Terminology

DOORS ID	IS200-2127, IS705-1741		
Paragraph	IS-GPS-200 30.3.3.10.1.8 IS-GPS-705 20.3.3.10.1.8	**Comment Number**	CRM #40, 41
	Substantive	**Disposition**	Accept
Comment Originator(s)	M. Mabilleau (Europa)		
Comment	The term "GNSS constellation" may be confusing as the ISM contain the parameter "GNSS ID". It is suggested to change "GNSS constellation" by "GNSS ID" or "constellation as per GNSS ID".		
Government Response	Agree		

Change Constellation Terminology

Paragraph	IS200-2127, IS705-1741
WAS	<INSERTED OBJECT>
Post AWG Proposed IS	Bits 78 through 81 of Message Type 40 shall provide the assumed mean duration of a satellite fault (MFD_{sat}) value for ARAIM at the current time for the associated GNSS constellation.
Newest Proposed IS	Bits 78 through 81 of Message Type 40 shall provide the assumed mean duration of a satellite fault (MFD_{sat}) value for ARAIM at the current time for the associated ~~GNSS~~ constellation as per GNSS ID.

Above The Allowed US Maximum Commitment

DOORS ID	IS200-1789, IS705-1633		
Paragraph	IS-GPS-200 30.3.3.10.1.9 IS-GPS-705 20.3.3.10.1.9	**Comment Number**	CRM #42, 43
	Substantive	**Disposition**	Reject
Comment Originator(s)	M. Mabilleau (Europa)		
Comment	The range of R_{const} goes above the maximum commitment provided by US in GPS SARPs. Combined with some values from MFD_{const}, it could lead to P_{const} above the US maximum commitment for P_{const} in GPS SARPs.		
Government Response	This is a generic bit definition applicable to more than GPS. The commenter did not provide a specific suggested note for us to consider		

Constellation Fault Probability

Paragraph	IS200-1789
Paragraph of Interest	The four bits are defined as follows: 0000 = 3.16 x 10^{-34} /hour 0001 = 1 x 10^{-34} /hour 0010 = 3.16 x 10^{-45} /hour 0011 = 1 x 10^{-45} /hour 0100 = 3.16 x 10^{-56} /hour 0101 = 1 x 10^{-56} /hour 0110 = 3.16 x 10^{-67} /hour 0111 = 1 x 10^{-67} /hour 1000 = 3.16 x 10^{-78} /hour 1001 = 1 x 10^{-78} /hour 1010 = 3.16 x 10^{-89} /hour 1011 = 1 x 10^{-89} /hour 1100 = 3.16 x 10^{-910} /hour 1101 = 1 x 10^{-910} /hour 1110 = 3.16 x 10^{-1011} /hour 1111 = RESERVED

Change Constellation Terminology

DOORS ID	IS200-1800, IS705-1647		
Paragraph	IS-GPS-200 30.3.3.10.1.10 (Corrected) IS-GPS-705 20.3.3.10.1.10	**Comment Number**	CRM #44, 46
	Substantive	**Disposition**	Accept
Comment Originator(s)	E. Canestri (Europa)		
Comment	The introduction of the notion of MFD_{const} instead of MFD, should be accompanied with a definition of what is meant by constellation fault. "Value for ARAIM" is not deemed sufficient to understand what it meant with this parameter. Add a note to clarify the MFDconst refers to the mean time between a fault exceeding the SPS SIS URE NTE tolerance from two or more satellites due to a common cause until the timely notification is issued to the user.		
Government Response	Agreed. SMEs provided language responding to this comment.		

Define MFD_{const}

Paragraph	IS200-1800
WAS	Bits 82 through 85 of Message Type 40 shall provide the assumed Mean Fault Duration (MFD) value for ARAIM at the current time for the associated GNSS constellation.
Post AWG Proposed Redlines	Bits ~~82~~86 through ~~85~~89 of Message Type 40 shall provide the assumed ~~Mean~~mean ~~Fault~~duration ~~Duration~~of a constellation fault (~~MFD~~MFDconst) value for ARAIM at the current time for the associated GNSS constellation.
Newest Proposed Redlines	Bits ~~82~~86 through ~~85~~89 of Message Type 40 shall provide the assumed ~~Mean~~mean ~~Fault~~duration ~~Duration~~of a constellation fault (~~MFD~~MFDconst) value for ARAIM at the current time for the associated GNSS constellation. MFD_{const} is the mean time the instantaneous URE of two or more satellites exceed, due to a common cause, 4.42 times the IAURA (or 5.73 times the IAURA when the conveying signal is provided with an enhanced level of integrity assurance) without a timely notification issued to the user.

Change Constellation Terminology

DOORS ID	IS200-1788, IS705-1632		
Paragraph	IS-GPS-200 30.3.3.10.1.9 IS-GPS-705 20.3.3.10.1.9	**Comment Number**	CRM #45, 47
	Substantive	**Disposition**	Accept
Comment Originator(s)	E. Canestri (Europa)		
Comment	The introduction of the notion of MFD_{const} instead of MFD, should be accompanied with a definition of what is meant by constellation fault. "Value for ARAIM" is not deemed sufficient to understand what it meant with this parameter. Add a note to clarify the MFDconst refers to the mean time between a fault exceeding the SPS SIS URE NTE tolerance from two or more satellites due to a common cause until the timely notification is issued to the user.		
Government Response	Agreed. SMEs provided language responding to this comment.		

Define R_{const}

Paragraph	IS200-1788
WAS	Bits 78 through 81 of Message Type 40 shall provide the assumed Constellation Fault Probability (P_{const}) value for ARAIM at the current time for the associated GNSS constellation
Post AWG Proposed Redlines	Bits ~~78~~82 through ~~81~~85 of Message Type 40 shall provide the assumed ~~Constellation~~constellation ~~Fault~~fault ~~Probability~~rate (~~P~~constR_{const}) value for ARAIM at the current time for the associated GNSS constellation.
Newest Proposed Redlines	Bits ~~78~~82 through ~~81~~85 of Message Type 40 shall provide the assumed ~~Constellation~~constellation ~~Fault~~fault ~~Probability~~rate (~~P~~constR_{const}) value for ARAIM at the current time for the associated GNSS constellation. R_{const} is the onset rate at which the instantaneous URE of two or more satellites exceed, due to a common cause, 4.42 times the IAURA (or 5.73 times the IAURA when the conveying signal is provided with an enhanced level of integrity assurance).

Define R_{sat} and MFD_{sat}

DOORS ID	IS200-1797, IS200-2127, IS705-1644, IS705-1741, IS800-1058, IS800-1064		
Paragraph	IS-GPS-200 30.3.3.10.1.7 IS-GPS-200 30.3.3.10.1.8	**Comment Number**	CRM #85
	Substantive	**Disposition**	Accept
Comment Originator(s)	Bert Hayden (Aerospace)		
Comment	While providing responses to Europa's comments (CRM #44, 45, 46, 47) to clarify/define Rconst and MFDconst, Aerospace provided definitions for Rsat and MFDsat. Completeness of parameter definitions.		
Government Response	Agreed. SMEs provided language responding beyond Europa's comments.		

Define R_{sat}

Paragraph	**IS200-1797**
WAS	Bits 74 through 77 of Message Type 40 shall provide the assumed Satellite Fault Rate (R_{sat}) value for ARAIM at the current time for the associated GNSS constellation.
Post AWG Proposed Redlines	Bits 74 through 77 of Message Type 40 shall provide the assumed ~~Satellite~~satellite ~~Fault~~fault ~~Rate~~rate (Rsat) value for ARAIM at the current time for the associated GNSS constellation.
Newest Proposed Redlines	Bits 74 through 77 of Message Type 40 shall provide the assumed ~~Satellite~~satellite ~~Fault~~fault ~~Rate~~rate (Rsat) value for ARAIM at the current time for the associated GNSS constellation. R_{sat} is the onset rate at which the instantaneous URE of any given satellite exceeds 4.42 times the IAURA (or 5.73 times the IAURA when the conveying signal is provided with an enhanced level of integrity assurance).

Define MFD_{sat}

Paragraph	**IS200-2127**
WAS	<INSERTED OBJECT>
Post AWG Proposed Redlines	Bits 78 through 81 of Message Type 40 shall provide the assumed mean duration of a satellite fault (MFDsat) value for ARAIM at the current time for the associated GNSS constellation
Newest Proposed Redlines	Bits 78 through 81 of Message Type 40 shall provide the assumed mean duration of a satellite fault (MFDsat) value for ARAIM at the current time for the associated GNSS constellation. MFD_{sat} is the mean time the instantaneous URE of any given satellite exceeds 4.42 times the IAURA (or 5.73 times the IAURA when the conveying signal is provided with an enhanced level of integrity assurance) without a timely notification issued to the user.

Data ID

	IS200-618, IS200-1371		
Paragraph	IS-GPS-200 20.3.3.5.1.1 IS-GPS-200 40.3.3.5.1.1	**Comment Number**	CRM #48
Comment Type	Substantive	**Disposition**	Accept With Comment
Comment Originator(s)	D. Bouvet (Thales)		
Comment	During 2021 public ICWG, the following action was taken: "The government will propose amendments to [IS-GPS-200] 20.3.3.5.1.1 and 40.3.3.5.1.1 to be reviewed at the 2022 Public ICWG that will specify the future use of the other Data IDs in LNAV transmissions. This proposal will preserve backward compatibility with all legacy receivers, whether or not they check the Data ID value." No change detected in IS-GPS-200N Section 20.3.3.5.1.1. Consider updating the paragraph according to the action taken last year.		
Government Response	This is the same as PRAT Item 2021-05 and will be addressed by a Special Topic by Karl Kovach. This Special Topic presentation may or may not close this PRAT Item, but it should advance the subject.		

Specific Alarm Condition c)

	IS200-1760		
Paragraph	IS-GPS-200 6.4.6.2.2	**Comment Number**	CRM #49
Comment Type	Substantive	**A**	Accept with Comments
Comment Originator(s)	D. Bouvet (Thales)		
Comment	Specific Alarm Condition c) says "The transmitted bits in words 3-10 in subframe 1, 2, or 3 are all set to 0's or all set to 1's." In the case of "all set to 1's", please clarify whether the two trailing bits 299 and 300 of the impacted subframe are also set to 1, or whether there are actually maintained to "00" (as it is the case for the default navigation data)?		
Government Response	Clarification wording found for this item and applied to the appropriate paragraph		

Specific Alarm Condition c)

Paragraph	IS200-1760
Proposed Redlines	C/A-Code or P(Y)-Code Signal (a) The failure of parity on 5 successive words of LNAV data (3 seconds) (see paragraphs 20.3.5 and 40.3.5). *(See Note 5)* (b) The broadcast IODE does not match the 8 LSBs of the broadcast IODC (excluding normal data set cutovers, see paragraph 20.3.3.4.1). (c) Bits 61 through 298 ~~The~~ transmitted ~~bits~~ in words 3-10 in subframe 1, 2, or 3 are all set to 0's or all set to 1's. (d) Default LNAV data is being transmitted in subframes 1, 2, or 3 (see paragraph 20.3.2). (e) The 8-bit preamble does not equal 10001011_2, decimal 139, or hexadecimal 8B (see paragraph 20.3.3). . . .

MT40 content only applicable GNSS ID For GPS?

DOORS ID	IS705-1611		
Paragraph	IS-GPS-705 20.3.3.10	**Comment Number**	CRM #50
Comment Type	Substantive	**Disposition**	Accept
Comment Originator(s)	D. Bouvet (Thales)		
Comment	The content of the ISM (MT40) seems appropriate to disseminate the Integrity Support Data of the GPS constellation, but not the ISD of the other constellations. A few examples: - Proposed values for Rsat and MFDsat do not allow to encode the Psat of $3x10^{-5}$ for the GAL constellation (the closest value would be 3.16x10-5); - Galileo will need to broadcast URA values through the ISM (not possible with the current format of MT40). It is suggested to clarify that the description of MT40 content is only applicable when the GNSS ID is equal to "0100" (GPS). For any other GNSS ID, manufacturers should consider the content of the message starting from bit 43 up to bit 276 as "Reserved".		
Government Response	We agree the proposed text is correct.		

MT40 content only applicable GNSS ID For GPS?

Paragraph	IS200-1611 20.3.3.10
Proposed Redlines	Figure 20-14a contains the structure of Message Type 40, Integrity Support Message (ISM) when the GNSS ID parameter is equal to "0100". When the GNSS ID parameter is different, bits 43 to 276 are reserved. The contents of Message Type 40 when the GNSS ID parameter is equal to "0100" are defined below, followed by material pertinent to the use of the ISM data. Users who implement Advanced Receiver Autonomous Integrity Monitoring (ARAIM) may use these parameters for the ARAIM algorithm as referenced in future TSO and MSO.

Simplify Table 20-XIc PRN Inclusion Mask Mapping

DOORS ID	IS705-1663		
Paragraph	IS-GPS-705 Table 20-XIc	**Comment Number**	CRM #51
Comment Type	Substantive	**Disposition**	Accept with Comments
Comment Originator(s)	D. Bouvet (Thales)		
Comment	For the PRN Mask, if it is accepted to limit the current definition of MT40 to GPS, then it is suggested to simplify Table 20-XIc "PRN Inclusion Mask Mapping" by keeping the GPS column only and deleting the other ones (MT40 format for other constellations could reduce the size of the PRN mask).		
Government Response	Decision is to keep GPS and SBAS columns Also affect IS-GPS-200 Table 30-XIc PRN Mapping Also affect IS-GPS-800 Table 3.5-11 PRN Mapping		

IS-GPS-705 Table 20-XIc

Paragraph IS705-1663

Proposed Redlines

Table 20-XIc PRN Mapping

Bits	~~Galileo~~	~~GLONASS~~	~~BeiDou~~	GPS	SBAS	~~QZSS~~	~~IRNSS~~
~~89~~93	~~SVID 1~~	~~Freq. 1~~	~~RCN 1~~	PRN 1	PRN 120	~~PRN 183~~	~~PRN ID 1~~
~~90~~94	~~SVID 2~~	~~Freq. 2~~	~~RCN 2~~	PRN 2	PRN 121	~~PRN 184~~	~~PRN ID 2~~
~~91~~95	~~SVID 3~~	~~Freq. 3~~	~~RCN 3~~	PRN 3	PRN 122	~~PRN 185~~	~~PRN ID 3~~
~~92~~96	~~SVID 4~~	~~Freq. 4~~	~~RCN 4~~	PRN 4	PRN 123	~~PRN 186~~	~~PRN ID 4~~
~~93~~97	~~SVID 5~~	~~Freq. 5~~	~~RCN 5~~	PRN 5	PRN 124	~~PRN 187~~	~~PRN ID 5~~
~~94~~98	~~SVID 6~~	~~Freq. 6~~	~~RCN 6~~	PRN 6	PRN 125	~~PRN 188~~	~~PRN ID 6~~
~~95~~99	~~SVID 7~~	~~Freq. 7~~	~~RCN 7~~	PRN 7	PRN 126	~~PRN 189~~	~~PRN ID 7~~
~~96~~100	~~SVID 8~~	~~Freq. 8~~	~~RCN 8~~	PRN 8	PRN 127	~~PRN 190~~	~~Reserved~~
~~97~~101	~~SVID 9~~	~~Freq. 9~~	~~RCN 9~~	PRN 9	PRN 128	~~PRN 191~~	~~Reserved~~
~~98~~102	~~SVID 10~~	~~Freq. 10~~	~~RCN 10~~	PRN 10	PRN 129	~~PRN 192~~	~~Reserved~~
~~99~~103	~~SVID 11~~	~~Freq. 11~~	~~RCN 11~~	PRN 11	PRN 130	~~PRN 193~~	~~Reserved~~
~~100~~104	~~SVID 12~~	~~Freq. 12~~	~~RCN 12~~	PRN 12	PRN 131	~~PRN 194~~	~~Reserved~~
~~101~~105	~~SVID 13~~	~~Freq. 13~~	~~RCN 13~~	PRN 13	PRN 132	~~PRN 195~~	~~Reserved~~
~~102~~106	~~SVID 14~~	~~Freq. 14~~	~~RCN 14~~	PRN 14	PRN 133	~~PRN 196~~	~~Reserved~~
~~103~~107	~~SVID 15~~	~~Freq. 15~~	~~RCN 15~~	PRN 15	PRN 134	~~PRN 197~~	~~Reserved~~
~~104~~108	~~SVID 16~~	~~Freq. 16~~	~~RCN 16~~	PRN 16	PRN 135	~~PRN 198~~	~~Reserved~~
~~105~~109	~~SVID 17~~	~~Freq. 17~~	~~RCN 17~~	PRN 17	PRN 136	~~PRN 199~~	~~Reserved~~
~~106~~110	~~SVID 18~~	~~Freq. 18~~	~~RCN 18~~	PRN 18	PRN 137	~~PRN 200~~	~~Reserved~~
~~107~~111	~~SVID 19~~	~~Freq. 19~~	~~RCN 19~~	PRN 19	PRN 138	~~PRN 201~~	~~Reserved~~
~~108~~112	~~SVID 20~~	~~Freq. 20~~	~~RCN 20~~	PRN 20	PRN 139	~~PRN 202~~	~~Reserved~~

Keeping SBAS as well.

b_nom and gamma_nom Clarification

	IS705-1649, IS705-1650, IS705-1653, IS200-1802, IS200-1803, IS200-1806, IS800-1051, IS800-1052, IS800-1055		
Paragraph	IS-GPS-705 20.3.3.10.1.5, 20.3.3.10.1.6 IS-GPS-200 30.3.3.10.1.5, 30.3.3.10.1.6 IS-GPS-800 3.5.4.7.1.5, 3.5.4.7.1.6	**Comment Number**	CRM #52
Comment Type	Substantive	**Disposition**	Accept
Comment Originator(s)	D. Bouvet (Thales)		
Comment	For the ARAIM, the Integrity Support Data (ISD) can include a nominal bias b_nom per satellite. MT40 transmits two values: b_nom and gamma_nom. Clarify whether the transmitted b_nom corresponds to the ISD b_nom, or whether the receiver has to process the transmitted b_nom and the gamma_nom parameters to obtain the ISD b_nom value. 1. If the first option is the correct one, consider explaining the foreseen use of gamma_nom in the ARAIM in section 20.3.3.10.1.6. 2. If the second option is the correct one, consider adding the equation(s) to compute the ISD b_nom from the transmitted b_nom and gamma_nom parameters.		
Government Response	• The second option and we are adding a formula as suggested (see slides for CRM #65 below). • Clarification has been added to the subject paragraphs as well (see next slide) • This response is modified by CRM #62 which has resulted in the term b_{nom} being changed to $ß_{nom}$ • The resolution here also applies to corresponding paragraphs in IS-GPS-200 and IS-GPS-800		

Sample Change for b_{nom} Clarification

Paragraph(s) of Interest	IS705-1650, IS705-1653
Proposed Redlines	**20.3.3.10.1.5 IAURA-IndependentAdditive Term for Nominal Pseudorange Error Bias** Bits 66 through 69 of Message Type 40 shall provide the assumed IAURA-Independent Additive Term (~~b~~β_{nom}) value for ARAIM at the current time for ~~the associated GNSS constellation~~the GPS satellites indicated in the PRN Inclusion Mask. The IAURA-Independent Additive Term (β_{nom}) bounds additive biases in the instantaneous URE that do not scale with IAURA, which is defined in section 30.3.3.1.1. **3.3.3.10.1.6 Scalar Term for Nominal Pseudorange Error Bias** Bits 70 through 73 of Message Type 40 shall provide the assumed Scalar Term(γ_{nom}) value for ARAIM at the current time for ~~the associated GNSS constellation~~the GPS satellites indicated in the PRN Inclusion Mask. The Scalar Term (γ_{nom}) bounds normalized additive biases in the instantaneous URE that scale with IAURA, which is defined in section 30.3.3.1.1.

Include RTCA/DO-246E Protocol

	IS200-1665		
Paragraph	IS-GPS-705 20.3.3.10.1.14 (Corrected)	**Comment Number**	CRM #53
Comment Type	Administrative	**Disposition**	Accept With Comments
Comment Originator(s)	D. Bouvet (Thales)		
Comment	Referring to a proprietary document (RTCA/DO-246E change 1) to define the protocol to process the ISM CRC may be a concern for end users. Consider replacing this reference by a "free of charge" document, or include the protocol in IS-GPS-705.		
Government Response	Decided to go a different direction. Rather than include the protocol from DO-246E in our documentation and open a sustainment issue, we are going to remove the reference to this document in this place. The applicable CRC will be in the future standard.		

RTCA/DO-246E Protocol Decision

Paragraph	IS-GPS-705 20.3.3.10.1.14
WAS	Bits 245 through 276 of MT-40 are a 32-bit Cyclic Redundancy Check (CRC) specific to the ISM parameters. The ISM CRC will cover only the ISM parameters in Message Type 40, (Bits 39 to 244). Refer to DO-246E-Change 1 document for more details on the ISM CRC.
Public-ICWG Proposed IS	Bits 245 through 276 of ~~MT~~ Message Type 40 are a 32-bit Cyclic Redundancy Check (CRC) specific to the ISM parameters. The ISM CRC will cover only the ISM parameters in Message Type 40~~,~~ (~~B~~bits 39 ~~to~~through 244). Refer to DO-246E-Change 1 document for more details on the ISM CRC.
Current Proposed IS	Bits 245 through 276 of ~~MT~~ Message Type 40 are a 32-bit Cyclic Redundancy Check (CRC) specific to the ISM parameters. The ISM CRC will cover only the ISM parameters in Message Type 40~~,~~ (~~B~~bits 39 ~~to~~through 244). ~~Refer to DO-246E-Change 1 document for more details on the ISM CRC.~~

Government Comments/Dispositions

CRM – COMBINED STAKEHOLDER/DIRECTORATE REVIEW STATUS:						
Disposition/Type	**Critical**	**Substantial**	**Administrative**	**Totals**	**Concurrence**	**Notes**
Accept		**26**	**1**	**27**		**Government Comments FAA**
Accept with Comment						
Reject		**3**		**3**		
Deferred		**1**		**1**		
Grand Totals:		**30**	**1**	**31**		

Limitations Of ASCII Characters For Civil Text Message

DOORS ID	IS200-2004, IS200-2115, IS800-282, IS800-1168		
Paragraph	IS-GPS-200 30.3.3.9 IS-GPS-800 3.5.4.5	**Comment Number**	CRM #54
Comment Type	Substantive (FAA)	**Disposition**	Accept
Comment Originator(s)	Jed Dennis		
Comment	Limitations of ASCII characters for civil text message is unnecessary and potentially limits usefulness of the message.		
Government Response	Agreed. Matching change to IS-GPS-800 has been added		

Message Types 36 and 15 Text Messages

Paragraph	IS200-2004, IS200-2115
Newly Proposed Redlines	**30.3.3.9 Message Types 36 and 15 Text Messages** Text messages are provided either in Message Type 36, Figure 30-9, or type 15, Figure 30-14. The specific contents of text message will be at the discretion of the Operating Command. Message Type 36 can accommodate the transmission of 18 eight-bit ~~ASCII~~ ISO 8859-1 characters. Message Type 15 can accommodate the transmission of 29 eight-bit ~~ASCII~~ ISO 8859-1 characters. The requisite bits shall occupy bits 39 through 274 of Message Type 15 and bits 128 through 275 of Message Type 36. Messages that include control and other undefined characters are for special uses. Such messages are valid, but may appear garbled if displayed. ~~The eight-bit ASCII characters shall be limited to the set described in paragraph 20.3.3.5.1.8.~~

CM-Code Signal Clarification

DOORS ID	IS200-1762		
Paragraph	IS-GPS-200 6.4.6.2.2	**Comment Number**	CRM #55
Comment Type	Substantive	**Disposition**	Accept
Comment Originator(s)	Jed Dennis (FAA)		
Comment	For CM-code signal, clarify that any of the MT-10, 11, 3xs are all 0's or all 1's, then this is an alert. As written, it requires all of these to be all 0's or all 1's to be considered an alert. . . (d) The transmitted bits (bits 39-276) in one or more of Message Types 10, 11 and/or 30's are all set to 0's or all set to 1's. . . .		
Government Response	Agreed		

Additional Guidance On Message Type 0

DOORS ID	IS200-1762		
Paragraph	IS-GPS-200 6.4.6.3	**Comment Number**	CRM #56
Comment Type	Substantive	**Disposition**	Accept
Comment Originator(s)	Jed Dennis (FAA)		
Comment	Is there additional guidance on how to apply this marginal criteria? While receiver might be able to confirm a MT-0, it is difficult to determine that it replaced one of these message types, especially if the receiver fails to correctly decode some messages. Are there other cases were an MT-0 might replace a MT-31 to MT-39 due to lack of information other than clock information?		
Government Response	Agreed		

Clarification on 6.4.6.3 Marginal Indications

Paragraph	IS200-1762
Newly Proposed Redlines	The health of the CM-code and CL-code signals is marginal when the signals would otherwise have been defined as healthy except that one or more of the following three warning conditions is or are present: 1. ~~Default CNAV data (i.e., Message Type 0) is being transmitted in lieu of Message Type 10, 11 and/or Message Type 30's on the CM-code signal (e.g., a current and consistent CEI data set is not available within the maximum broadcast interval defined in paragraph 30.3.4.1). See paragraph 30.3.3.~~ The satellite does not broadcast a current and consistent CEI data set within three times the maximum broadcast interval defined in paragraph 30.3.4.1. (Notes 1 and 2) 2. The URA alert flag is raised (i.e., bit 38 of each CNAV message is set to 1) and therefore the CM-code signal URA components do not apply to the CM-code and CL-code signals. This means the CM-code and CL-code signal URA may be worse than indicated by the URA index components transmitted in Message Type 10 and Message Type 30's. See paragraph 30.3.3. 3. Either or both the URAED index in Message Type 10 and the URANED0 index in Message Type 30's transmitted in the CM-code signal are equal to 15 or -16 ("N"=15 or "N"=-16). See paragraphs 30.3.3.1.1.4 and 30.3.3.2.4. Note 1: Default CNAV data (i.e. Message Type 0) may be transmitted in lieu of any message type when the correct data for the message type is unavailable or when no other message is scheduled. Note 2: UE might be unable to confirm the satellite broadcast of a consistent data set when local conditions prevent correctly receiving and decoding a continuous set of messages.

Remove PRN37 As An Alert Mechanism

DOORS ID	IS200-1335		
Paragraph	IS-GPS-200 6.4.3	**Comment Number**	CRM #57
Comment Type	Administrative	**Disposition**	Accept
Comment Originator(s)	Jed Dennis (FAA)		
Comment	Should remove PRN37 as an alert mechanism from SPS PS since not included as an alert in Section 6.4.6. Also, if PRN37 is not being used for SATZAP, then should remove reference in IS, although this is not critical. **6.4.3 PRNs 33 ~~and 37~~** PRN 33 should not be used by satellites because of its prior use in specialized ground applications. ~~PRN 37 should not be used by satellites until after PRN 37 is no longer needed for SATZAP purposes.~~		
Government Response	Agreed		

Add Wn_{op} to Table 6-I-1 CEI Data Set Parameters

DOORS ID	IS200-1639		
Paragraph	IS-GPS-200 Table 6-I-1	**Comment Number**	CRM #58
Comment Type	Substantive	**Disposition**	Accept
Comment Originator(s)	Jed Dennis (FAA)		
Comment	Table should include WNop. WNop is required in the calculation of IAURA.		
Government Response	Agreed		

Table 6-I-1

Paragraph	IS200-1639
Newly Proposed Redlines	

Symbol	Parameter Name	Subframe	Message
SV Health	SV Health (6 bits)	1	N/A
IODC	Issue of Data, Clock	1	N/A
URA	URA Index	1	N/A
WN	Data Sequence Propagation Week Number	1	10
T_{GD}	Group Delay Differential	1	30
a_{f0}	SV Clock Bias Correction Coefficient	1	30-37
a_{f1}	SV Clock Drift Correction Coefficient	1	30-37
a_{f2}	Drift Rate Correction Coefficient	1	30-37
t_{oc}	Time of Clock	1	30-37
WN_{op}	CEI Data Sequence Propagation Week Number	N/A	30-37
$\sqrt{A}$	Square Root of the Semi-Major Axis	2	N/A
. . .			

Type 30 Rate

DOORS ID	IS200-670		
Paragraph	IS-GPS-200 Table 30-XII	**Comment Number**	CRM #59
Comment Type	Substantive	**Disposition**	Defer
Comment Originator(s)	Jed Dennis (FAA)		
Comment	Type 30 should be at the same rate as Type 10, 11, as it has critical parameters like T_{gd}, ISC, and WN_{op}		
Government Response	This subject is related to Bert Hayden's Special Topic "CNAV Message Schedules CSOC IPT Recommendation". It is advisable to defer this comment for the moment and address it within the context of that Special Topic later in the day.		

Specific Alarm Indications Clarification

DOORS ID	IS200-1760		
Paragraph	IS-GPS-200 6.4.6.2.2 Specific Alarm Indications	**Comment Number**	CRM #60
Comment Type	Substantive	**Disposition**	Accept
Comment Originator(s)	Hamza Abduselam (FAA)		
Comment	Add a note to clarify that default LNAV data broadcast in Subframe 4 or in Subframe 5 does not constitute an alarm condition.		
Government Response	Agree. This added text is an extension to Note 5 in this paragraph		

6.4.6.2.2 Specific Alarm Indications

Paragraph	IS200-1760
Newly Proposed Redlines	5. An *alarm indication (see C/A-Code or P(Y)-Code Signal (a)) does not apply to the default navigation data described in paragraph 20.3.2, when in subframes 4 or 5. Application of the user parity algorithm at paragraph 20.3.5.2 will result in failed parity checks for words 3-10 because the default LNAV data pattern is applied to bits 61-298. According to a) and d) default LNAV data broadcast in subframe 4 or in subframe 5 will not be considered as a do-not-use condition, and the user equipment may continue using the GPS L1 measurement as healthy so long as none of the other conditions leading to a GPS UNHEALTHY determination are present.*

Change b_{nom_0} Value Range

DOORS ID	IS200-1804, IS705-1651, IS800-1053		
Paragraph	IS-GPS-200 30.3.3.10.1.5 IS-GPS-705 20.3.3.10.1.5 IS-GPS-800 3.5.4.7.1.5	**Comment Number**	CRM #61, 69, 77
Comment Type	Substantive	**Disposition**	Accept
Comment Originator(s)	Jed Dennis (FAA)		
Comment	Need to review Bnom,0 value ranges. Bnom,0 will be added with γnom*URA to achieve actual Bnom for the ARAIM algorithm. Current ranges seem higher than needed and approach value of the URA. Preliminary analysis reported by Stanford on current LNAV performance indicates a bias of about 0.15*URA, or roughly 0.36-m attributed to satellite position error bias. Analysis of signal deformation, code carrier covergence and other sources of bias has resulted in consideration of bias values in the 0.75 to 1.0-m range. Given that this directly inflates the protection level and is combined with gamma_nom * URA, it seems better to enable lower ranges in the messages.		
Government Response	Agreed. b_{nom} is now β_{nom} per CRM #62 (see below)		

30.3.3.10.1.5 Additive Term for Nominal Pseudorange Error Bias

Paragraph	IS200-1760	
	WAS	**Newly Proposed**
	The four bits are defined as follows: ~~0000 = 0.00 meters~~ ~~0001 = 0.13 meters~~ ~~0010 = 0.25 meters~~ ~~0011 = 0.38 meters~~ ~~0100 = 0.50 meters~~ ~~0101 = 0.63 meters~~ ~~0110 = 0.75 meters~~ ~~0111 = 0.88 meters~~ ~~1000 = 1.00 meter~~ ~~1001 = 1.13 meters~~ ~~1010 = 1.25 meters~~ ~~1011 = 1.38 meters~~ ~~1100 = 1.50 meters~~ ~~1101 = 1.63 meters~~ ~~1110 = 1.75 meters~~ ~~1111 = 2.00 meters~~	The four bits are defined as follows: 0000 = 0.00 meters 0001 = 0.10 meters 0010 = 0.20 meters 0011 = 0.30 meters 0100 = 0.40 meters 0101 = 0.50 meters 0110 = 0.60 meters 0111 = 0.70 meters 1000 = 0.80 meters 1001 = 0.90 meters 1010 = 1.00 meter 1011 = 1.10 meters 1100 = 1.20 meters 1101 = 1.30 meters 1110 = 1.40 meters 1111 = 1.50 meters

Nomenclature For B_{nom_0}

DOORS ID	IS200-1770, IS200-1803, IS200-1808, IS705-1618, IS705-1606, IS800-1040, IS800-1030		
Paragraph	IS-GPS-200 Table 30-XIa – ISM Parameters, 30.3.3.10.1.5, Figure 30-14a IS-GPS-705 Table 20-XIa – ISM Parameters, Figure 20-14a. Message Type 40 –ISM IS-GPS-800 Table 3.5-9 ISM Parameters, Figure 3.5-8a Subframe 3, Page 8, ISM	**Comment Number**	CRM #62, 63, 70, 71, 78, 79
Comment Type	Substantive	**Disposition**	Accept with Comments
Comment Originator(s)	Jed Dennis (FAA)		
Comment	62, 70, 78 Nomenclature for bnom,0 does not match planned nomenclature for MOPS and could cause confusion. (Later corrected to Update nomenclature to B_{nom_0}) (Even later b0)? 63 Update nomenclature for Bnom,0 in the Table 30-XIa – ISM Parameters 71 Update nomenclature for Bnom,0 in the Table 20-XIa – ISM Parameters 79 Update nomenclature for Bnom,0 in the Table 3.5-9 ISM Parameters		
Government Response	Agreement to change b_{nom} to β_{nom} (beta sub nom). Each document has various figures and tables to update.		

Table 30-XIa – ISM Parameters

Paragraph IS200-1760

Newly Proposed Redlines

Parameter	No. of Bits**	Scale Factor (LSB)	Valid Range**	Units
GNSS ID	4	See text		
WN_{ISM}	13	1	0 to 8191	weeks
TOW_{ISM}	6	4	0 to 164	hours
t_{correl}	4	~~0 to 12~~ See text		~~hours~~
~~b~~β_{nom}	4	~~0 to 2~~ See text		~~meters~~
γ_{nom}	4	~~0 to 2~~ See text		
R_{sat}	4	~~1x10^{-3} to 3.16x10^{-10}~~ See text		~~/hours~~
MFD_{sat}	4	See text		
~~P~~R_{const}	4	See text		
MFD_{const}	4	~~0.25 to 24~~ See text		~~hours~~
Service Level***	3	See text		
PRN Inclusion Mask ****	63	See text		

* See Figure 30-14a for complete bit allocation in Message Type 40

** Unless otherwise indicated in this column, valid range is the maximum range attainable with indicated bit allocation and scale factor

*** See Table 30-XIb for Service Level Descriptions

**** See Table 30-XI~~b~~c for PRN Inclusion Mask bit mapping

Name change is here

review γ_{nom} value ranges

DOORS ID	IS200-1807, IS705-1654, IS800-1056		
Paragraph	IS-GPS-200 30.3.3.10.1.6 IS-GPS-705 20.3.3.10.1.6 IS-GPS-800 3.5.4.7.1.6	**Comment Number**	CRM #64, 72, 80
Comment Type	Substantive	**Disposition**	Accept
Comment Originator(s)	Jed Dennis (FAA)		
Comment	Need to review γ_{nom} value ranges. Current range appears too high and only one or two values would ever be used. γ_{nom} should be a small percentage of URA. Preliminary analysis of data seems to suggests γ_{nom} values of 0.1, 0.15 or 0.2 are realistic. With a URA of 2.4, this results in a Bnom contribution of 0.36 for gamma_nom = 0.15. With a URA of 1.0, this can still be achieved with gamma_nom = 0.40. There appears to be margin for low URAs and provides better tuning if adjusted for large URAs. Better align parameter range with observations.		
Government Response	Agreed		

30.3.3.10.1.5 Additive Term for Nominal Pseudorange Error Bias

Paragraph	IS200-1807	
	WAS	**Newly Proposed**
	The four bits are defined as follows: ~~0000 = 0.00~~ ~~0001 = 0.13~~ ~~0010 = 0.25~~ ~~0011 = 0.38~~ ~~0100 = 0.50~~ ~~0101 = 0.63~~ ~~0110 = 0.75~~ ~~0111 = 0.88~~ ~~1000 = 1.00~~ ~~1001 = 1.13~~ ~~1010 = 1.25~~ ~~1011 = 1.38~~ ~~1100 = 1.50~~ ~~1101 = 1.63~~ ~~1110 = 1.75~~ ~~1111 = 2.00~~	The four bits are defined as follows: 0000 = 0.00 0001 = 0.05 0010 = 0.10 0011 = 0.15 0100 = 0.20 0101 = 0.25 0110 = 0.30 0111 = 0.35 1000 = 0.40 1001 = 0.45 1010 = 0.50 1011 = 0.55 1100 = 0.60 1101 = 0.65 1110 = 0.70 1111 = 0.75

Add section on protocols for B_{nom}

DOORS ID	After IS200-1765		
Paragraph	IS-GPS-200 30.3.3.10.2 IS-GPS-705 20.3.3.10.2 IS-GPS-800 3.5.4.7.2	**Comment Number**	CRM #65, 66, 67, 73, 74, 75, 81, 82, 83
Comment Type	Substantive	**Disposition**	Accept
Comment Originator(s)	Jed Dennis (FAA)		
Comment	Add section on protocols Add paragraph on calculation of Bnom Add equation for calculation of Bnom		
Government Response	b_{nom} is now β_{nom} per CRM #62 (see above)		

Proposed 30.3.3.10.2 Use of ISM Data

Paragraph	(Insert after IS200-1765)
Newly Proposed Insertion	

30.3.3.10.2 Use of ISM Data

To calculate the nominal pseudorange error bias (b_{nom}), use the following equation

$$b_{nom} = \beta_{nom} + \gamma_{nom} \, IAURA$$

IAURA is defined in section 30.3.3.1.1.

Satellite Fault Rate Values Range Too Extensive?

DOORS ID	IS200-1798, IS705-1645, IS800-1059		
Paragraph	IS-GPS-200 30.3.3.10.1.7 IS-GPS-705 20.3.3.10.1.7 IS-GPS-800 3.5.4.7.1.7	**Comment Number**	CRM #68, 76, 84
Comment Type	Substantive	**Disposition**	Reject
Comment Originator(s)	Jed Dennis (FAA)		
Comment	Range of values for Satellite Fault Rate seems to extensive. The large values are higher than any constellation's SARPs commitments (GLONASS $1e^{-4}$). The low values, with dynamic fault allocation, could result in ARAIM operating without checking single satellite faults. While we could revisit the entire range, at least should set the very optimistic values to "reserved" so that current generation equipment will continue to check single-fault modes, which could be satellite-induced or could be ionosphere, troposhere or Code-Noise multipath. There has been no discussion to provision equipment with the ability to operate with the higher-integrity URA that is included in the IS. Therefore these values will always need to be set for the current 4.42 integrity setting. Rationale: Safety		
Government Response	The argument is to leave as-is because the bit encoding applies to the interface and not just current GNSS systems		

30.3.3.10.1.7 Satellite Fault Rate

Paragraph	IS200-1807	
	WAS	**Newly Proposed (but Rejected)**
	The four bits are defined as follows: ~~0000 = 0.00 meters~~ ~~0001 = 0.13 meters~~ ~~0010 = 0.25 meters~~ ~~0011 = 0.38 meters~~ ~~0100 = 0.50 meters~~ ~~0101 = 0.63 meters~~ ~~0110 = 0.75 meters~~ ~~0111 = 0.88 meters~~ ~~1000 = 1.00 meter~~ ~~1001 = 1.13 meters~~ ~~1010 = 1.25 meters~~ ~~1011 = 1.38 meters~~ ~~1100 = 1.50 meters~~ ~~1101 = 1.63 meters~~ ~~1110 = 1.75 meters~~ ~~1111 = 2.00 meters~~	The four bits are defined as follows: 0000 = 0.00 meters 0001 = 0.10 meters 0010 = 0.20 meters 0011 = 0.30 meters 0100 = 0.40 meters 0101 = 0.50 meters 0110 = 0.60 meters 0111 = 0.70 meters 1000 = 0.80 meter 1001 = 0.90 meters 1010 = 1.00 meters 1011 = 1.10 meters 1100 = 1.20 meters 1101 = 1.30 meters 1110 = 1.40 meters 1111 = 1.50 meters

Open RFC-495 Discussion

QUESTIONS & COMMENTS?

Action Item Review

APPROVED FOR PUBLIC RELEASE

Global Positioning System (GPS)
Public Interface Control Working Group (ICWG)
& Public Forum Special Topic Briefings

October 26, 2022
0830-1600 PDT

United States Space Force
Positioning, Navigation, and Timing Mission Area

Expected Almanac Behavior in OCX Era

October 26, 2022

Dr. Andrew Hansen, DOT Volpe Center

Background and Motivation

- GPS almanac reference time (t_{oa}) is defined in the respective Interface Specifications for LNAV, CNAV, CNAV-2 messages
- In all cases it is the count of seconds into the applicable GPS almanac reference week number (WN_a)
- Operationally, t_{oa} is managed by the control segment to both
  - occur approximately 70 hours after first valid Signal in Space (SIS) transmission and
  - ensure that the difference between any active t_{oa} and GPS time (**t**) is less than 3.5 days
- This operational flexibility with the IS compliant definition leaves room for different t_{oa} generation

Time of Almanac (t_{oa}) Behavior Comparison

Operational Assignment of Time of Almanac ($\mathbf{t_{oa}}$) has flexibility

- AEP era control segment
  - Nominal almanac generation occurs daily at 2200 as a series of five fit intervals with the first fit starting at the 2200 epoch for the given day
  - Any off-nominal/contingent almanac generation also starts the first fit interval at the 2200 epoch of the given day even if that epoch is in the past
- OCX era control segment
  - Nominal almanac generation can occur once or twice a day as a series of five fit intervals
  - Off-nominal/contingent almanac generation produces five fit intervals
  - Regardless of which generation process occurs, the start time of the first fit interval is always the most recent zero-age-of-data epoch

There is Operational Flexibility in the Generation of Almanac Reference Time!

Example Almanac Intervals and t_{oa}

Almanac generated on the 2200 epoch

GPS time of predict (tgs)	Fit Duration (days)	AEP Fit start (tgs)	AEP toa Week (weeks)	AEP toa secondsOfWeek (sec)	OCX Fit start (tgs)	OCX toa Week (weeks)	OCX toa secondsOfWeek (sec)
984520800	6	984434400	1628	61440	984520800	1628	147456
984520800	6	984952800	1628	589824	985039200	1629	61440
984520800	6	985471200	1629	503808	985557600	1629	589824
984520800	32	985989600	1630	405504	986076000	1630	503808
984520800	32	988754400	1635	147456	988840800	1635	233472

Almanac NOT generated on the 2200 epoch

GPS time of predict (tgs)	Fit Duration (days)	AEP Fit start (tgs)	AEP toa Week (weeks)	AEP toa secondsOfWeek (sec)	OCX Fit start (tgs)	OCX toa Week (weeks)	OCX toa secondsOfWeek (sec)
984317400	6	984261600	1627	503808	984317400	1627	552960
984317400	6	984780000	1628	405504	984835800	1628	466944
984317400	6	985298400	1629	319488	985354200	1629	380928
984317400	32	985816800	1630	233472	985872600	1630	294912
984317400	32	988581600	1634	589824	988637400	1635	36864

t_{gs} units are total GPS seconds since the start of GPS time

Summary

- Both AEP and OCX produce IS-GPS-200/705/800 compliant almanacs
- Behavior between AEP and OCX will be slightly different from a user perspective
- After OCX becomes operational the users will see the following:
  - Nominally, $\mathbf{t_{oa}}$ values produced by OCX will be the same as AEP
  - However, $\mathbf{t_{oa}}$ will be as much as a day later than that from AEP for new uploads
  - And, when off-nominal/contingent almanacs are generated by OCX, the $\mathbf{t_{oa}}$ produced will be arbitrary with respect to the nominal almanacs (2200 epoch)

There is Operational Flexibility in the Generation of Almanac Reference Time!

QUESTIONS & COMMENTS?

APPROVED FOR PUBLIC RELEASE

Action Item Review

LUNCH BREAK

APPROVED FOR PUBLIC RELEASE

Mitigate LNAV Default Nav Anomaly

October 26, 2022

Hamza Abdulselam
Federal Aviation Administration

Mitigate LNAV Default Nav Anomaly

Objective: Mitigate the major hazard posed by a possible repeat of the 22 July 2020 broadcast of default navigation data (DND) in Subframe 4 page 17.

Owner: Hamza Abdulselam (FAA) and Bert Hayden (Aerospace)

Progress/Accomplishments: Assessed impact to aviation and made the necessary modifications at the interface, control segment and user equipment levels

✓ Interface Specification
- ✓ Held Special topic discussion on anomaly hazard at the GPS Public ICWG (Sep 2021)
- ✓ Added clarifying language at the Public ICWG

✓ Control Segment
- ✓ Installed AEP modification to prevent/eliminate 22 July 2020 root cause (April 2022)
- ✓ Estimated frequency of subframes 4/5 DND for healthy, operational satellites and found no other case (Feb 2022)
- Run a test during IST 3-1 Phase 1B, in Feb 2023, using the OCX simulators (TSTS) and develop a directive with expected data to replicate the event and assess the actual results and effects. – ECD Feb 2023

✓ User Equipment
- ✓ Assessed impact on current avionics with OEMs though RTCA – (May 2021)
- ✓ Validated aviation requirements through consultation with RTCA (Aug 2021)
- ✓ Updated language adapted in New draft MOPS (e.g. ED 259) – (March 2022)
  - Language clarifies that DND in subframe 4 and 5 by itself is not an alarm condition - Applies to future avionics
- ✓ Note to Manufacturers posted next to TSO-C145e and TSO-C196b - Advises manufacturers to apply the language adapted by the draft MOPS to their current design (May 2022)
  - This approach will only affect new avionics. Current thinking is to exempt default navigation data in Subframes 4 and 5 from the five successive parity failures test

QUESTIONS & COMMENTS?

APPROVED FOR PUBLIC RELEASE

CNAV Message Schedules

CSOC IPT Recommendation

October 26, 2022

Bert Hayden
The Aerospace Corp.
Karl Kovach
The Aerospace Corp.

✖ IIR-M ✖ IIF ✔ III/IIIF ✔ Works for Block ✖ Not Ideal for Block

Template A

Recommended Initial Schedule for GPS-III/IIIF

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
1	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
2	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
3	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
4	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	33	35
sec	*24*	*48*	*72*	*96*	*120*	*144*	*168*	*192*	*216*	*240*	*264*	*288*	*312*	*336*	*360*	*384*	*408*	*432*	*456*	*480*	*504*	*528*	*552*	*576*	*600*

	Content	Current L5 Specification	This Schedule
MT 10	Ephemeris 1	24 sec	24 sec
MT 11	Ephemeris 2	24 sec	24 sec
MT 3X	Clock Correction	24 sec	24 sec
MT 30	TGD/ISC/Ionosphere	144 sec	24 sec
MT 33	UTC	144 sec	600 sec
MT 35	GGTO *	144 sec	600 sec
MT 40	ISM *	144 sec	N/A
MT 32	EOP *	900 sec	600 sec
MT 37	Midi Almanac *	constellation in 60 min	126 PRNs in 60 min
MT 13 / 14	Differential Corrections *	constellation in 15 min	N/A
MT 15	Text Message *	none	600 sec

* “Optional” Messages

Prioritizes ISC and Almanac

✖ IIR-M ✔ IIF ✔ III/IIIF ✔ Works for Block ✖ Not Ideal for Block

Template B

Recommended Initial Schedule for GPS-IIF

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
1	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
2	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
3	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
4	33	35	33	35	33	35	33	35	33	35	33	35	33	35	33	35	33	35	33	35	33	35	33	35	33
sec	*24*	*48*	*72*	*96*	*120*	*144*	*168*	*192*	*216*	*240*	*264*	*288*	*312*	*336*	*360*	*384*	*408*	*432*	*456*	*480*	*504*	*528*	*552*	*576*	*600*

	Content	Current L5 Specification	This Schedule
MT 10	Ephemeris 1	24 sec	24 sec
MT 11	Ephemeris 2	24 sec	24 sec
MT 3X	Clock Correction	24 sec	24 sec
MT 30	TGD/ISC/Ionosphere	144 sec	24 sec
MT 33	UTC	144 sec	96 sec
MT 35	GGTO *	144 sec	96 sec
MT 40	ISM *	144 sec	N/A
MT 32	EOP *	900 sec	96 sec
MT 37	Midi Almanac *	constellation in 60 min	N/A
MT 13 / 14	Differential Corrections *	constellation in 15 min	N/A
MT 15	Text Message *	none	600 sec

* “Optional” Messages

✔ IIR-M ✔ IIF ✔ III/IIIF ✔ Works for Block ✖ Not Ideal for Block

Template C

Recommended Initial Schedule for GPS-IIR-M

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
2	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
3	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
4	33	35	33	35	33	35	33	35	33	35	33	35	33	35	33
sec	*24*	*48*	*72*	*96*	*120*	*144*	*168*	*192*	*216*	*240*	*264*	*288*	*312*	*336*	*360*

	Content	Current L5 Specification	This Schedule
MT 10	Ephemeris 1	24 sec	24 sec
MT 11	Ephemeris 2	24 sec	24 sec
MT 3X	Clock Correction	24 sec	24 sec
MT 30	TGD/ISC/Ionosphere	144 sec	24 sec
MT 33	UTC	144 sec	96 sec
MT 35	GGTO *	144 sec	96 sec
MT 40	ISM *	144 sec	N/A
MT 32	EOP *	900 sec	192 sec
MT 37	Midi Almanac *	constellation in 60 min	N/A
MT 13 / 14	Differential Corrections *	constellation in 15 min	N/A
MT 15	Text Message *	none	600 sec

* “Optional” Messages

ICD Recommendations

- Replace minimum broadcast intervals in public ICDs with general specifications
- Primary data (CEI) no less than every 30 seconds, 24 seconds nominal
- Secondary data every ten minutes from constellation (rather than a single SV)

QUESTIONS & COMMENTS?

APPROVED FOR PUBLIC RELEASE

ISC and CEI Table

October 26, 2022

Karl Kovach
The Aerospace Corp.

The Issue (1 of 3)

6.2.8 Clock, Ephemeris, Integrity (CEI) Data Set.

The Clock, Ephemeris, Integrity (CEI) data set is the collection of SV-specific clock correction polynomial parameters, ephemeris parameters, and related parameters (health flags, URA parameters, time tags, etc.) needed to use the SV's broadcast signal(s) in the positioning service. The parameters in the CEI data set are explicitly listed in Table 6-I-1. The entire CEI data set is needed for maximum accuracy. However, the core CEI data set (parameters without NOTE1 in Table 6-I-1) is sufficient for an initial position solution. The top term provides the epoch time of week of the state data utilized for the core CEI data set.

6.2.8.1 Core CEI Data Set.

A Core CEI Data Set are the CEI parameters necessary for a satellite to be used for a position solution (non-almanac); broadcast to users with the shortest broadcast interval -- see Table 20-XII. The top term provides the epoch time of week of the state data utilized for CEI data, except for parameters marked with a Note1 in Table 6-I-1.

The Issue (2 of 3)

Table 6-I-1. CEI Data Set Parameters

Symbol	Parameter Name	Message
$\dot{A}$	Change Rate in Semi-major Axis	10
ΔA	Semi-major Axis Difference at Reference Time	10
Δn_0	Mean Motion Difference from Computed Value at Reference Time	10
$\Delta \dot{n}_0$	Rate of Mean Motion Difference from Computed Value	10
ω	Argument of Perigee	10
e	Eccentricity	10
ISF	Integrity Status Flag NOTE1	10
(L1/L2/L5)	Signal Health (3 bits)	10
M_0	Mean Anomaly at Reference Time	10
URA_{ED}	Elevation Dependent User Range Accuracy	10
WN	Week Number	10
t_{oe}	Time of Ephemeris	10, 11
t_{oo}	CEI Data Sequence Propagation Time of Week	10, 30-37
$\dot{\Omega}$	Rate of Right Ascension	11
Ω_0	Longitude of Ascending Node of Orbit Plane at Weekly Epoch	11
C_{ic}	Amplitude of the Cosine Harmonic Correction Term to the Angle of Inclination	11
C_{is}	Amplitude of the Sine Harmonic Correction Term to the Angle of Inclination	11
C_{rc}	Amplitude of the Cosine Harmonic Correction Term to the Orbit Radius	11
C_{rs}	Amplitude of the Sine Correction Term to the Orbit Radius	11
C_{uc}	Amplitude of Cosine Harmonic Correction Term to the Argument of Latitude	11
C_{us}	Amplitude of Sine Harmonic Correction Term to the Argument of Latitude	11
i_0	Inclination Angle at Reference Time	11
$i_{0\text{-}n}$-DOT	Rate of Inclination Angle	11

The Issue (3 of 3)

$ISC_{L1C/A}$	Inter-signal Correction	30
ISC_{L2C}	Inter-signal Correction	30
ISC_{L5I5}	Inter-signal Correction	30
ISC_{L5Q5}	Inter-signal Correction	30
T_{GD}	Group Delay Differential	30
a_{f0}	SV Clock Bias Correction Coefficient	30-37
a_{f1}	SV Clock Drift Correction Coefficient	30-37
a_{f2}	Drift Rate Correction Coefficient Index	30-37
t_{oc}	Time of Clock	30-37
URA_{NED0}	NED Accuracy Index	30-37
URA_{NED1}	NED Accuracy Change Index	30-37
URA_{NED2}	NED Accuracy Change Rate Index	30-37
Alert	Alert Flag NOTE1	All

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}/t_{oc}. Any parameter marked with NOTE1 may be changed with or without a change in t_{oe}/t_{oc}.

Recommended Clarification

Should Be

IS-GPS-705H
23 Mar 2021

$ISC_{L1C/A}$	Inter-signal Correction NOTE1	30
ISC_{L2C}	Inter-signal Correction NOTE1	30
ISC_{L5I5}	Inter-signal Correction NOTE1	30
ISC_{L5Q5}	Inter-signal Correction NOTE1	30
T_{GD}	Group Delay Differential NOTE1	30
a_{f0}	SV Clock Bias Correction Coefficient	30-37
a_{f1}	SV Clock Drift Correction Coefficient	30-37
a_{f2}	Drift Rate Correction Coefficient Index	30-37
t_{oc}	Time of Clock	30-37
URA_{NED0}	NED Accuracy Index	30-37
URA_{NED1}	NED Accuracy Change Index	30-37
URA_{NED2}	NED Accuracy Change Rate Index	30-37
Alert	Alert Flag NOTE1	All

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}/t_{oc}. Any parameter marked with NOTE1 may be changed with or without a change in t_{oe}/t_{oc}.

Observations

- Historically, T_{GD} updated quarterly
  - Clearly not limited to 3-hour CNAV curve fit
  - T_{GD} changes very slowly
- Currently, ISCs updated approximately semi-annually
  - Clearly not limited to 3-hour CNAV curve fit
  - ISCs change very slowly
- In OCX era, ISCs likely ‘slightly updated’ daily
  - Clearly not limited to 3-hour CNAV curve fit

QUESTIONS & COMMENTS?

APPROVED FOR PUBLIC RELEASE

Data ID Issue

October 26, 2022

Bert Hayden
The Aerospace Corp.
Karl Kovach
The Aerospace Corp.

The Issue

20.1 Scope.

This appendix describes the specific legacy navigation (LNAV) data structure denoted by data ID number 2 for the lower set of PRN numbers (PRN 1-32). This data ID number, when transmitted as part of the LNAV data, shall be represented by the two-bit binary notation as 01. Data ID number 1 is no longer in use. The LNAV data structure for the lower set of PRN numbers is denoted as LNAV-L. The LNAV data structure for the upper set of PRN numbers (LNAV-U) is described in Appendix IV.

20.3.3.5.1.1 Data ID and SV ID.

The two MSBs of word three in each page shall contain data ID. Data ID number two (denoted by binary code 01) denotes the LNAV data structure of D(t) which is described in this Appendix and is the only valid value.

First Recommended Clarification

Currently Is

20.1 Scope.

This appendix describes the specific legacy navigation (LNAV) data structure denoted by data ID number 2 for the lower set of PRN numbers (PRN 1-32). This data ID number, when transmitted as part of the LNAV data, shall be represented by the two-bit binary notation as 01. Data ID number 1 is no longer in use. The LNAV data structure for the lower set of PRN numbers is denoted as LNAV-L. The LNAV data structure for the upper set of PRN numbers (LNAV-U) is described in Appendix IV.

Should Be

20.1 Scope.

This appendix describes the specific legacy navigation (LNAV) data structure denoted by data ID number 2 for the lower set of PRN numbers (PRN 1-32). This data ID number, when transmitted as part of the LNAV data, shall be represented by the two-bit binary notation as 01. Data ID numbers 0, 1, and 3 are not defined in this ISis no longer in use. The LNAV data structure for the lower set of PRN numbers is denoted as LNAV-L. The LNAV data structure for the upper set of PRN numbers (LNAV-U) is described in Appendix IV.

Same Clarification, Second Occurrence

Currently Is

40.1 Scope

This appendix describes the specific legacy navigation (LNAV) data structure denoted by data ID number 2 for the upper set of PRN numbers (PRN 33-63). This data ID number, when transmitted as part of the LNAV data, shall be represented by the two-bit binary notation as 01. Data ID number 1 is no longer in use. The LNAV data structure for the upper set of PRN numbers is denoted as LNAV-U. The LNAV data structure for the lower set of PRN numbers (LNAV-L) is described in Appendix II.

Should Be

40.1 Scope.

This appendix describes the specific legacy navigation (LNAV) data structure denoted by data ID number 2 for the upper set of PRN numbers (PRN 33-63). This data ID number, when transmitted as part of the LNAV data, shall be represented by the two-bit binary notation as 01. Data ID numbers 0, 1, and 3 are not defined in this IS ~~no longer in use~~. The LNAV data structure for the upper set of PRN numbers is denoted as LNAV-U. The LNAV data structure for the lower set of PRN numbers (LNAV-L) is described in Appendix II.

Second Recommended Clarification

Currently Is

20.3.3.5.1.1 Data ID and SV ID.

The two MSBs of word three in each page shall contain data ID. Data ID number two (denoted by binary code 01) denotes the LNAV data structure of D(t) which is described in this Appendix and is the only valid value.

Should Be

20.3.3.5.1.1 Data ID and SV ID.

The two MSBs of word three in each page shall contain data ID. Data ID number two (denoted by binary code 01) denotes the LNAV data structure of D(t) which is described in this Appendix and is the only valid value for this Appendix.

Same Clarification, Second Occurrence

Currently Is

40.3.3.5.1.1 Data ID and SV ID.

The two MSBs of word three in each page shall contain data ID. Data ID number two (denoted by binary code 01) denotes the LNAV data structure of D(t) which is described in this Appendix and is the only valid value.

Should Be

40.3.3.5.1.1 Data ID and SV ID.

The two MSBs of word three in each page shall contain data ID. Data ID number two (denoted by binary code 01) denotes the LNAV data structure of D(t) which is described in this Appendix and is the only valid value for this Appendix.

QUESTIONS & COMMENTS?

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Walk-on Topics

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Action Item Review

Closing Remarks

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Backup Slides

Acronyms

AFL	Available for Launch
ASIC	Application Specific Integrated Circuit
CDD	Capability Development Document
CDR	Critical Design Review
DAGR	Defense Advanced GPS Receiver
DDG	Arleigh Burke Guide Missile Destroyer
DT	Developmental Testing
FOT&E	Follow-on Operational Test and Evaluation
FQT	Formal Qualification Testing
FUE	Field User Evaluation
GNST+	GPS IIIF Non-flight Satellite Test Bed
GRAM–S/M	GPS Receiver Application Module – Standard Elec Module/Modernized
HH	Handheld
HPE	Hewlett Packard Enterprise
IBM	International Business Machines
IBR	Integrated Baseline Review
IDR	Implementation Design Review
JTLV	Joint Light Tactical Vehicle
LCS	Launch and Checkout System
MGUE	Military GPS User Equipment
MSI	Miniature Serial Interface
OCX	Operational Control System
OT	Operational Testing
PDR	Preliminary Design Review
PNT	Positioning, Navigation, and Timing
SIS	Signal in Space
TRV	Technical Requirements Verification
URE	User Range Error
USAF	United States Air Force
USMC	United States Marine Corps
USN	United States Navy