



# Global Positioning System (GPS)

## Public Interface Control Working Group (ICWG) & Public Forum

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29 September, 2021  
0830-1600 PDT

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



# Dial-in Information

## LIVE MEETING LINK:

Primary Screen URL -

<https://saicwebconferencing.zoomgov.com/j/1609131495?pwd=WTNkK01ES0pCc2NqR1VJdjhkd3NEQT09>

## DIAL IN:

Primary Dial In: 571-200-1700

Meeting ID: 160 913 1495

Password: 813441

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[https://dod.teams.microsoft.us/l/meetup-join/19%3adod%3ameeting\\_396b3961dfc744c58936d884c31f6f9f%40thread.v2/0?context=%7b%22Tid%22%3a%228331b18d-2d87-48ef-a35f-ac8818ebf9b4%22%2c%22Oid%22%3a%2239eabff-b71b-4aad-8a01-55fa5d59953e%22%7d](https://dod.teams.microsoft.us/l/meetup-join/19%3adod%3ameeting_396b3961dfc744c58936d884c31f6f9f%40thread.v2/0?context=%7b%22Tid%22%3a%228331b18d-2d87-48ef-a35f-ac8818ebf9b4%22%2c%22Oid%22%3a%2239eabff-b71b-4aad-8a01-55fa5d59953e%22%7d)



Public ICWG (1 <sup>st</sup> Half of Day)	Presenter
Opening Remarks	Maj Samuel Meyer
GPS Public ICWG and Public Forum Meeting Overview and Roll Call	Lt Adam Barnette
2021 Public ICWG RFC Discussion	
<ul style="list-style-type: none"> <li>RFC-467 (Proposed Changes to the Public Documents)</li> </ul>	Mr. Tony Anthony
<ul style="list-style-type: none"> <li>Open RFC Discussion Session</li> </ul>	
Action Item Review	

Public Forum (2 <sup>nd</sup> Half of Day)	Presenter
Roll Call, Rules of Engagement	
Special Topic Presentation	
<ul style="list-style-type: none"> <li>CNAV/CNAV2 Message Schedule and Broadcast Interval Working Group</li> <li>CNAV/CNAV-2 ISM Parameter</li> <li>Issue of Data, Clock (IODC) Brief</li> <li>AEP vs. OCX Almanac time of almanac (toa) Behavior</li> <li>GPS Non-Standard Codes</li> <li>Next Generation GPS – OCX Public Release Data Products</li> </ul>	Mr. Bert Hayden & Mr. Karl Kovach Dr. Andrew Hansen Maj Samuel Meyer Mr. Leif Knag  Mr. Karl Kovach Mr. Stephan Hillman
Walk-on Topics, Open Discussion	
Action Item Review	



# Overflow Agenda

- Overflow date **Thursday 9/30**

Public Forum (2 <sup>nd</sup> Half of Day)	Presenter
Roll Call, Rules of Engagement	
Special Topic Presentation	
<ul style="list-style-type: none"> <li>• CNAV/CNAV2 Message Schedule and Broadcast Interval Working Group</li> <li>• CNAV/CNAV-2 ISM Parameter</li> <li>• Issue of Data, Clock (IODC) Brief</li> <li>• AEP vs. OCX Almanac time of almanac (toa) Behavior</li> </ul>	<p>Mr. Bert Hayden &amp; Mr. Karl Kovach Dr. Andrew Hansen Maj Samuel Meyer Mr. Leif Knag</p>
<ul style="list-style-type: none"> <li>• GPS Non-Standard Codes</li> <li>• Next Generation GPS – OCX Public Release Data Projects</li> </ul>	<p>Mr. Karl Kovach Mr. Stephan Hillman</p>
Walk-on Topics, Open Discussion	
Action Item Review	



# Opening Remarks

## Global Positioning Systems (GPS) Position, Navigation, and Timing Mission Area

Maj Samuel Meyer

Chief, Positioning, Navigation and Timing  
Requirements and Integration Branch



**space control**

Broadcasting since 1978  
 17 Monitoring stations worldwide,  
 4 ground antennas, and 2 control stations  
 Reaching over 4 billion users every second

**user**

**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

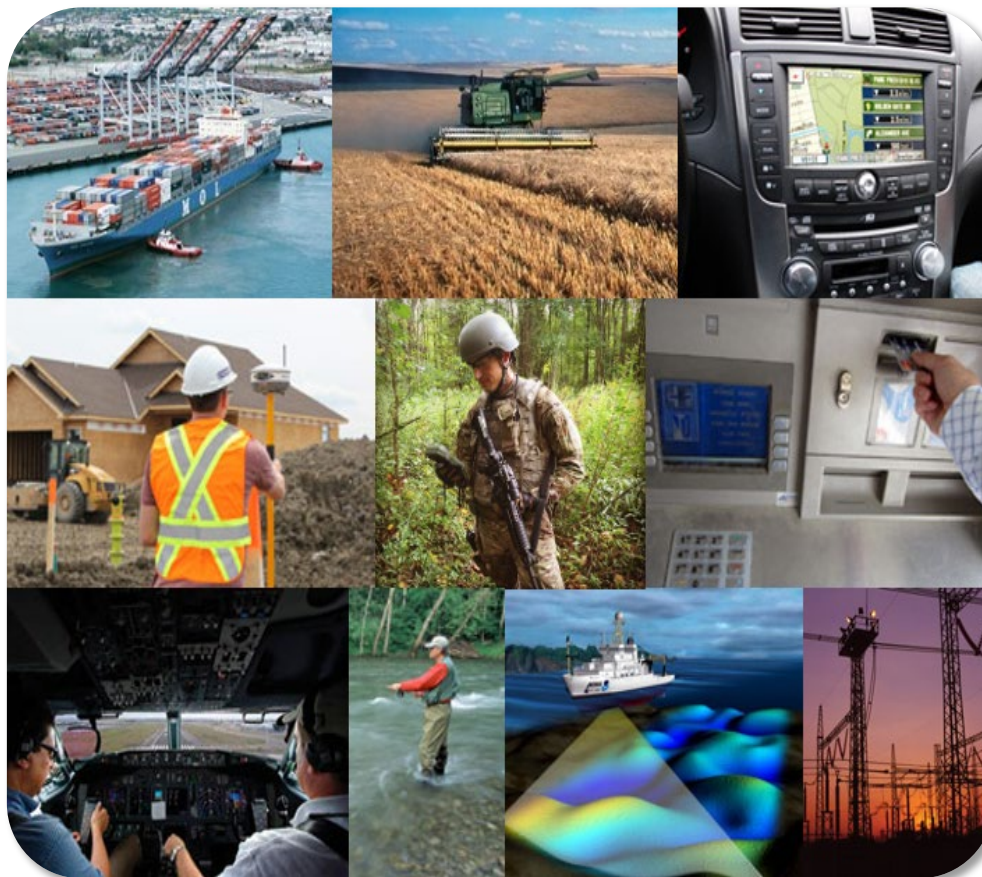


# Global Impact of GPS



- GPS is utilized across the world with +4B 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\*

\*<https://www.gps.gov/governance/advisory/meetings/2019-11/gallaher.pdf>



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



Unclassified

# GPS Constellation Status

**37 Satellites • 30 Set Healthy**  
**Baseline Constellation: 24 Satellites**



Satellite Block	Quantity	Average Age (yrs)	Oldest
GPS IIR	8 (4*)	19.6	24.1
GPS IIR-M	7 (1*)	13.9	15.9
GPS IIF	12	7.6	11.3
GPS III	4 (1*)	1.4	2.7

\*Not set healthy

As of 1 Sep 21

## GPS Signal in Space (SIS) Performance

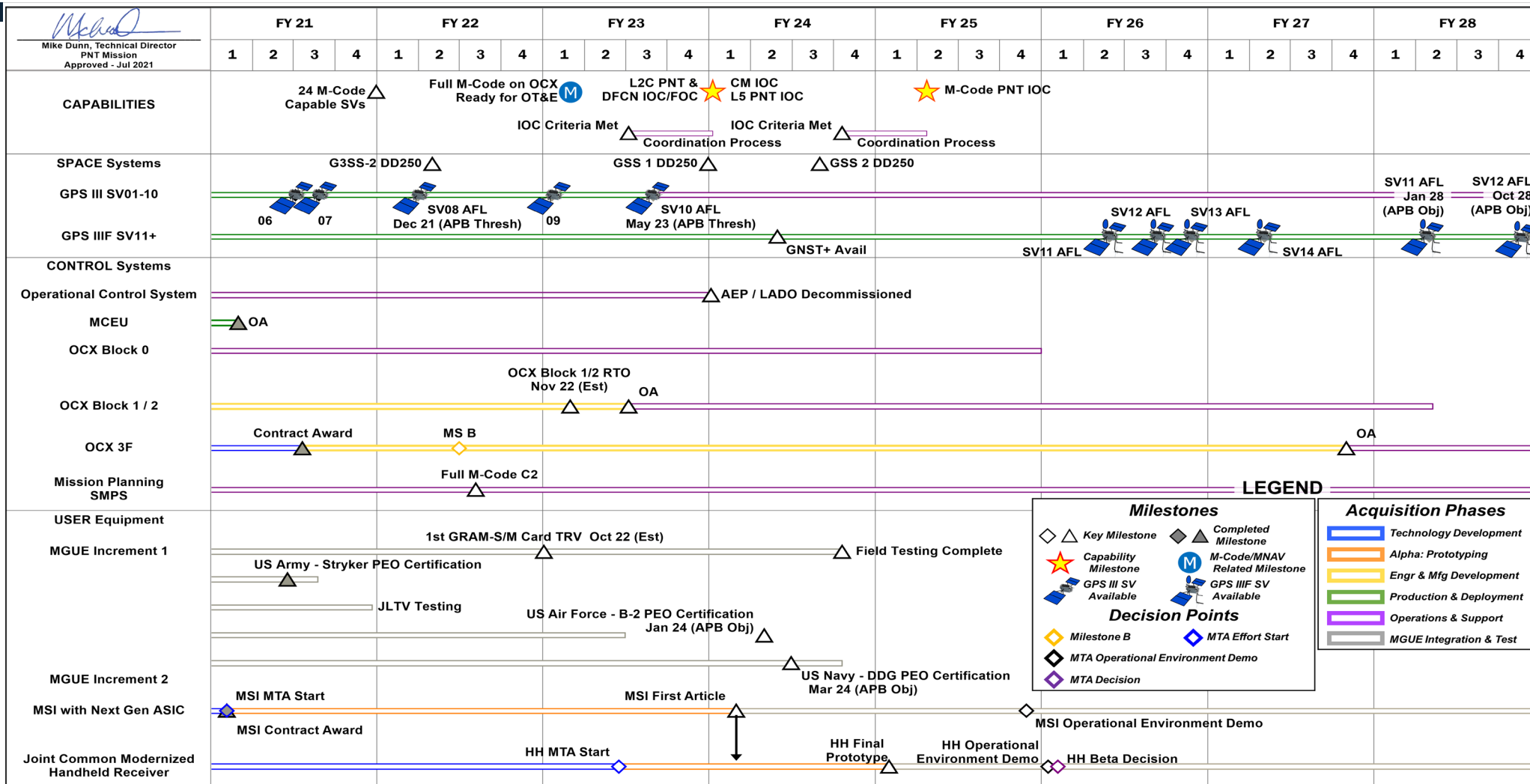
From 7 Aug 20 to 7 Aug 21

Average URE*	Best Day URE	Worst Day URE
50.0 cm	31.5 cm (20 Apr 21)	70.4 cm (13 Mar 21)

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



# GPS Enterprise Roadmap

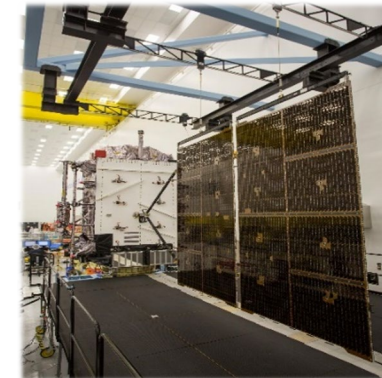


AEP	Architecture Evolution Plan	DFCN	Dual-Frequency Civil Navigation	GSS	GPS Satellite Simulator	MNAV	Military Navigation	OT&E	Operational Test and Evaluation
AFL	Available for Launch	Est	Forecast Estimate	HH	Handheld	MS	Milestone	PEO	Program Executive Officer
APB	Acquisition Program Baseline	FOC	Full Operational Capability	IOC	Initial Operating Capability	MSI	Miniature Serial Interface	PNT	Positioning, Navigation & Timing
ASIC	Application-Specific Integrated Circuit	GRAM-S/M	Standard Elec Module/Modernized	JLTV	Joint Light Tactical Vehicle	MTA	Middle Tier Acquisition	RTO	Ready for Transition to Ops
C2	Command & Control	G3SS	GPS III Satellite Simulator	LADO	Launch, Anomaly, and Disposal Operations	OA	Operational Acceptance	SMPS	SAASM Mission Planning System
CM	Constellation Management	GNST+	GPS IIF Non-Flight Satellite Testbed	MCEU	M-Code Early Use	Obj	Objective Date	SV	Space Vehicle
DDG	Arleigh Burke Guided Missile Destroyer			MGUE	Military GPS User Equipment	OCX	Next Gen Operational Control System	TRV	Technical Requirements Verification



# Global Positioning System (GPS) III

- Current Status
  - SV01 Operationally accepted on 2 Jan 20
  - SV02 Operationally accepted on 27 Mar 20
  - SV03 Operationally accepted on 27 Jul 20
  - SV04 Operationally accepted on 1 Dec 20
  - SV05 launched 17 Jun 21, Operationally accepted 29 Jun 21 and currently in test
  - SV06 Declared Available for Launch 5 Apr 21
  - SV07 Declared Available for Launch 20 May 21
  - SV08 Declared Available for Launch 10 Jun 21
  - SV09 System-level testing in progress
  - SV10 Component deliveries and installations in progress
- Upcoming Milestones
  - SV09 Thermal Vacuum testing planned for Fall 2021
  - SV10 Thermal Vacuum testing planned for Spring 2022





# GPS III Follow-On (GPS IIIF)

- Current Status

- Contract Awarded 26 Sep 18
- Critical Design Review (CDR) 2 Mar 20
- Milestone C 13 Jul 20
- SV13 & SV14 purchased Oct 2020
- Integrated Baseline Review (IBR) 6 May 21
- Implementation Design Review (IDR) 10 Dec 20
- Planned use of evolved/common bus on SV13+
- SV11 Available for Launch (AFL) 2QFY26
- SV12 AFL 3QFY26

- Upcoming Milestones

- GPS IIIF Non-Flight Satellite Testbed (GNST+) completion planned for Winter 2024
- SV11 Thermal Vacuum testing planned for Winter 2024





# Next Generation Operational Control System (OCX)

- Current Status
  - GPS III Launch & Checkout System (LCS) successfully supported launch of GPS III SV01-05 and transfer to 2SOPS
  - Addressed IBM obsolescence issue by awarding a modification to accelerate incorporation of Hewlett Packard Enterprise (HPE) replacement
  - Completed 17 of 17 Monitor Station installations (Jul 2021)
  - System integration and verification ongoing
- Upcoming Milestones
  - Next Generation Operational Control System (OCX) Certificate of Conformance Complete (Dec 2021)
  - Ready to Transition to Operations projected 4QCY22



*OCX program continues to execute within baseline*



# Next Generation Operational Control System (OCX) 3F

- Current Status
  - Awarded Next Generation Operational Control System (OCX) 3F Contract Award (\$283M, Apr 2021)
  - Startup Activities ongoing; program will modify adaptive architecture of OCX Blocks 1 and 2 software baseline to launch and control enhanced GPS IIF satellite capabilities
- Upcoming Milestones
  - Milestone B (1QCY22)
  - Handover to Sustainment (3QCY25)
  - Operational Acceptance (3QCY27)



*OCX 3F program continues to execute and meet schedule*



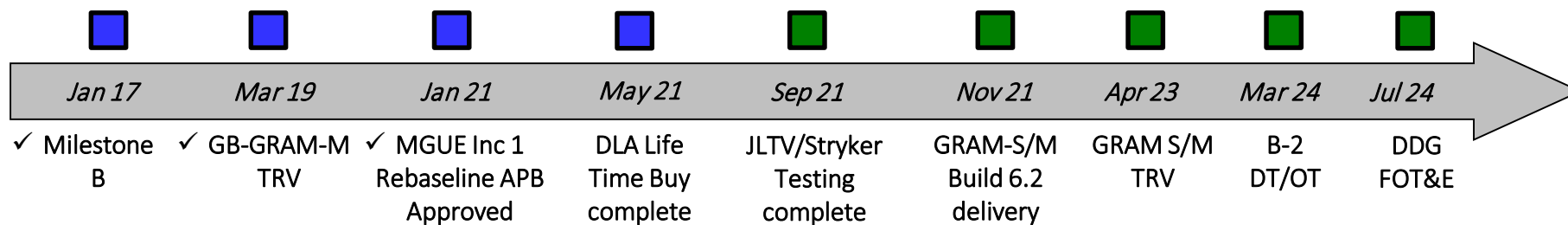
# Military GPS User Equipment (MGUE) Increment (Inc) 1



- **Current Status**

- MGUE Inc 1 provides warfighters with the M-Code capable GPS receivers required to access Modernized GPS improvements, primarily enhanced anti-jam and spoofing resistance
- MGUE Inc 1 develops and field-tests M-Code receiver-cards for Ground and Aviation/Maritime Lead Platforms. Services responsible for all receiver procurement
- Defense Logistics Agency (DLA) awarded ASIC Life Time Buy contracts to preserve \$1.2B investment in MGUE Inc 1 receivers—enables M-Code receiver production for next 8-9 years
- USMC Joint Light Tactical Vehicle (JLTV) Field User Evaluation (FUE) is scheduled to conclude on 14 Sep 21. US Army will leverage data from the JLTV FUE in lieu of a separate field test for their Mounted and Dismounted Assured PNT solutions
- USAF B-2 and USN Guided Missile Destroyer (DDG) testing currently scheduled to conclude by Fall 2024, completing MGUE Inc 1 field testing on all Lead Platforms

- **Upcoming Milestones**





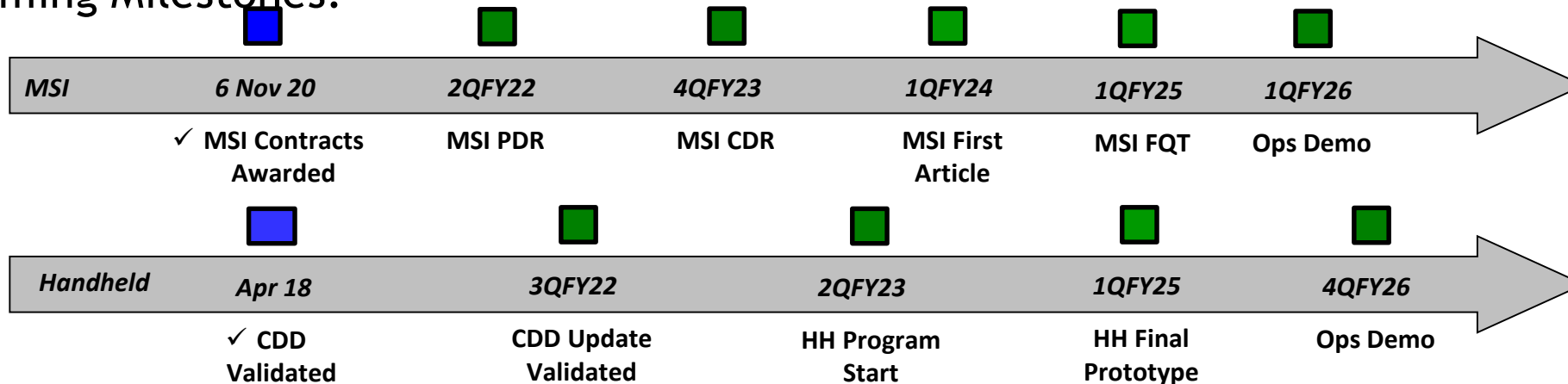


# Military GPS User Equipment (MGUE) Increment (Inc) 2

- Current Status

- MGUE Inc 2 matures the Next-Gen ASIC (NGA) technology required for all weapon system platforms to provide functionality & backwards compatibility
- MGUE Inc 2 will deliver a production-ready Miniature Serial Interface (MSI) Receiver Card in 1QFY26 to support Handheld (HH) and ground applications
- MGUE Inc 2 will deliver a Joint Common Handheld to replace the Defense Advanced GPS Receiver (DAGR)

- Upcoming Milestones:





# GPS Requirements Team



## Space Force

**Maj Samuel Meyer, Chief, Positioning, Navigation and Timing Integration**

**Lt Adam Barnette, GPS Ground and User Requirements Lead**

## Aerospace

**Dr. Rhonda Slattery, Enterprise Requirements Lead**

**Mr. Karl Kovach, Civil Requirements Lead**

## Systems Engineering and Integration (SE&I)

**Mr. Bert Hayden, Senior Technical Advisor**

**Mr. Tony Anthony, Responsible Engineer**

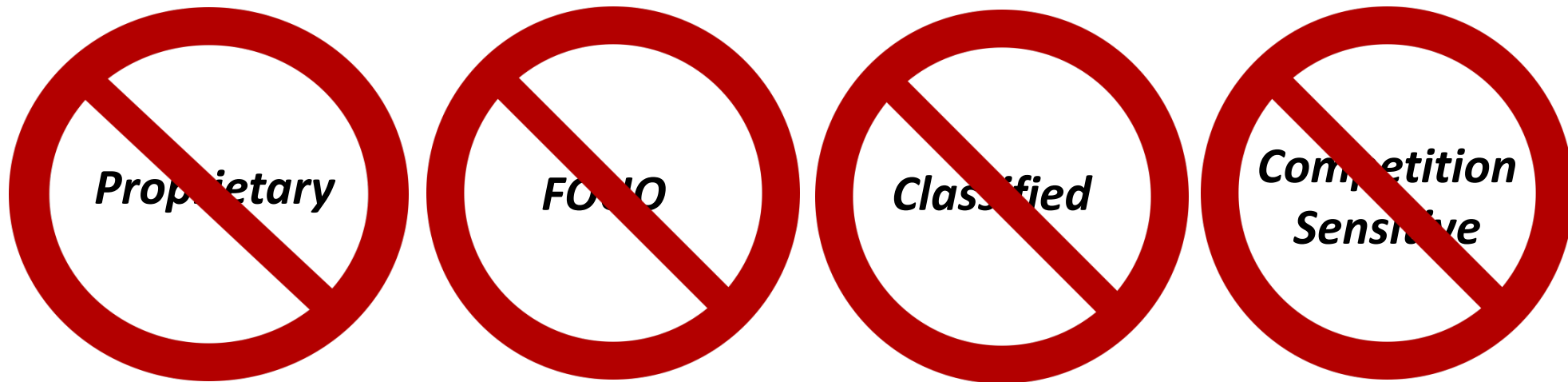
**Mr. Kevin Cano, Responsible Engineer**



# Roll Call



# 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



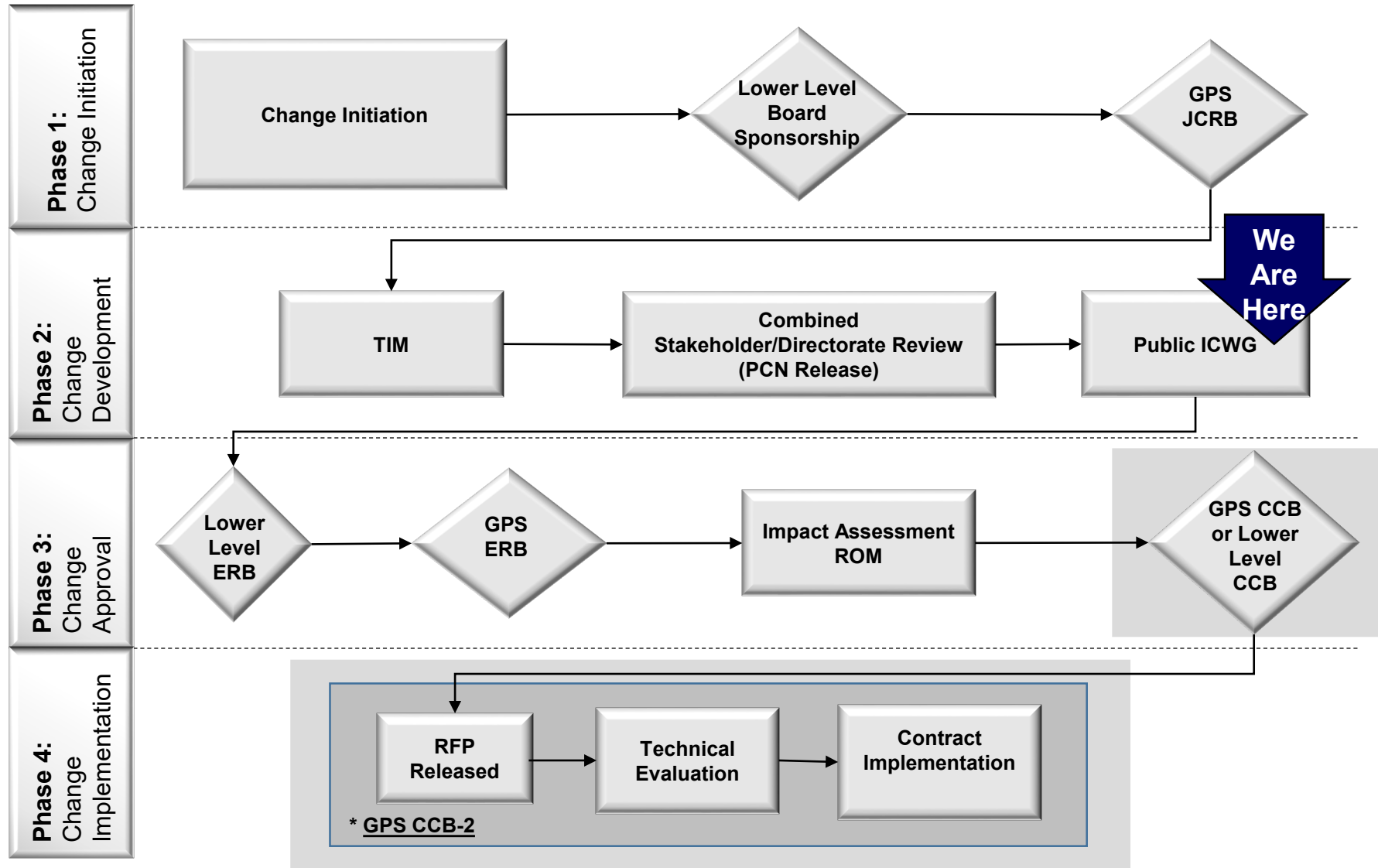
# Rules of Engagement (Cont'd)

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



# 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 Item / Concern Template

Submit GPS public document concerns and action items to [smcgper@us.af.mil](mailto:smcgper@us.af.mil)

Action Item / Concern			Date:
Originator	Organization	Phone No.	Email
Description			
Proposed Resolution			
Document(s) Impacted			



# 2021 RFC Discussion



# RFC 467: Proposed Changes to the Public Documents

Lt Adam Barnette, SSC  
Mr. Tony Anthony, SE&I





# RFC 467: Proposed Changes to the Public Documents

## ***Problem Statement:***

1. Reserved/spare bits in the CNAV are assumed to be a static bit pattern. With the current proposed implementation to fill those bits with a pseudorandom bit pattern, users are at risk of incorrectly using those bits for integrity checks.
2. The GPS IIF SV Configuration Code '101' confirms that the "alert" in HOW is still applicable. As such, one of the public stakeholder was requesting clarification to confirm if the "alert" in the HOW will also be applicable in the future undefined configuration codes. This is not sufficient for safety-of-life equipment that would need to have the confirmation because the alert is part of the "marginal" conditions leading to the selection/deselection of a satellite in a RAIM or ARAIM integrity context.
3. Current Issue of Data and Clock (IODC) requirement in IS-GPS-200 states that the IODC will be different from any value transmitted by the SV during the preceding 7-days. In certain occasions, current operations have shown not to follow that requirement.
4. The descriptions of how the navigation message changes with time (for example, transitions between data sets, or behavior under extended navigation) do not capture all the implementation differences between earlier SVs and GPS III/IIF.
5. Documents need clarification and clean-up, as identified in past Public ICWGs and as newly-identified changes of administrative nature.

## ***Impacted Documents:***

*IS-GPS-200, IS-GPS-705, IS-GPS-800*

# Stakeholder Review (CRM) Status



**16) CRM – COMBINED STAKEHOLDER/DIRECTORATE REVIEW STATUS:**

Disposition/Type	Critical	Substantial	Administrative	Totals	
Accept	0	48	41	89	
Accept with Comment	4	10	5	19	
Defer	1	10	0	11	
Reject	0	0	0	0	
<b>Grand Totals:</b>	<b>5</b>	<b>68</b>	<b>46</b>	<b>119</b>	



**16) CRM – COMBINED STAKEHOLDER/DIRECTORATE REVIEW STATUS:**

Disposition/Type	Critical	Substantial	Administrative	Totals	
Accept	0	48	41	89	<h1>Defers</h1>
Accept with Comment	4	10	5	19	
Defer	1	10	0	11	
Reject	0	0	0	0	
<b>Grand Totals:</b>	<b>5</b>	<b>68</b>	<b>46</b>	<b>119</b>	



<b>DOORS ID</b>	IS200-196, 6.3.1		
<b>Paragraph</b>	6.3.1 Received Signals	<b>Comment Number</b>	267
<b>Comment Type</b>	Substantive	<b>Disposition</b>	Defer
<b>Comment Originator(s)</b>	Rhonda Slattery (Aerospace)		
<b>Comment</b>	We should add a maximum power for GPS III/IIIF even if we don't have a separate figure example. This was discussed in an earlier RFC for 705 and 800, but seems to have been missed in 200.		
<b>Government Response</b>	More coordination work is needed with stakeholders Should be resolvable within the next year		

**Paragraph**

6.3.1 Received Signals

**Paragraph of Interest****6.3.1 Received Signals**

The guaranteed minimum user-received signal levels are defined in paragraph 3.3.1.6. As additional supporting material, Figure 6-1 illustrates an example variation in the minimum received power of the near-ground user-received L1 and L2 signals from Block IIR SVs as a function of SV elevation angle.



<b>DOORS ID</b>	IS800-1175		
<b>Paragraph</b>	New Table General - About Maximum Broadcast Interval	<b>Comment Number</b>	257 276 309
<b>Comment Type</b>	Substantive	<b>Disposition</b>	Defer
<b>Comment Originator(s)</b>	Bert Hayden (SE&I) Rhonda Slattery (Aerospace) Jeff Crum (LMCO)		
<b>Comment</b>	<p>257: The table as construed is misleading. Revise table ...                      (13) RATIONALE FOR CHANGE: Improve the clarity of the table.                      276: We should add additional information about the conditions for the various messages, and add caveats where appropriate                      309: Unless I've done my math incorrectly, I believe the consequence of this table is that you cannot broadcast CNAV-2 SF3PG5. Is that the planned CONOPS for CNAV-2 message broadcast?                      I believe that the required number of slots within the one-hour, 200-slot CNAV-2 BPE is as follows:                      PG1 entries required = 25 (1 msg every 144 sec)                      PG2 entries required = 25 (1 msg every 144 sec)                      PG3 entries required = 36 (6 msgs every 600 sec, assuming 32 SV constellation)                      PG4 entries required = 32 (32 msgs every 3600 sec, assuming 32 SV constellation)                      PG5 entries required = 128 (32 msgs every 900 sec, assuming 32 SV constellation)                      PG6 entries required = (optional)</p>		
<b>Government Response</b>	Needs more consultation with stakeholders (See <b>CNAV/CNAV2 Message Schedule and Broadcast Interval Working Group Discussion</b> )		





<b>DOORS ID</b>	IS200-670		
<b>Paragraph</b>	IS200-670 Table 30-XII IS705-371 Table 20-XII	<b>Comment Number</b>	255 256 304
<b>Comment Type</b>	Substantive	<b>Disposition</b>	Defer
<b>Comment Originator(s)</b>	Bert Hayden (SE&I) Jeff Crum (LMCO)		
<b>Comment</b>	255/256 The table as construed is misleading. Revise table .... Improve the clarity of the table. 304 Update table to IS200-670, specifically the asterisk annotation on the maximum broadcast interval for the Midi Almanac MT37. The 60 minutes should have both the 2-asterisk and 4-asterisk annotation, just like the Reduced Almanac in the row above.		
<b>Government Response</b>	Will be worked with the other similar issues		



<b>DOORS ID</b>	IS705-1632, IS200-1788		
<b>Paragraph</b>	IS-GPS-705, 20.3.3.10.1.8 Constellation Fault Probability	<b>Comment Number</b>	283
<b>Comment Type</b>	Substantive	<b>Disposition</b>	Defer
<b>Comment Originator(s)</b>	Denis Bouvet (Thales)		
<b>Comment</b>	<p>The fault probability and the fault rate are linked through the Mean Fault Duration. It could be more convenient to replace the constellation fault probability by a constellation fault rate, as an update of the MFD will cause an update of the Pconst if the Rconst is not modified.</p> <p>Current Rconst derived from SPS PS commitments would be 10<sup>-8</sup>/hr. If the Rconst remains constant in the future, but MFD is reduced, the resulting Pconst = Rconst * MFD to be broadcast in the ISM may not be encodable with the given format. For instance: if new MFD equals 0.5 hour, the Pconst should be equal to 5*10<sup>-9</sup>, and this value is not encodable in the ISM.</p> <p>There is no issue if the ISM broadcast R<sub>sat</sub>, Rconst and MFD instead of R<sub>sat</sub>, Pconst and MFD. If the analysis is confirmed, consider updating the ISM content, and replace the Pconst by Rconst, and change the units of the defined values (per hour).</p>		
<b>Government Response</b>	More coordination work is needed with stakeholders (See <b>CNAV/CNAV-2 ISM Parameter Discussion</b> )		



<b>Paragraph</b>	IS200-1788 20.3.3.10.1.8 and IS705-1632 20.3.3.10.1.8
<b>Paragraphs of Interest</b>	<p>IS-GPS-200  <b>30.3.3.10.1.8 Constellation Fault Probability</b></p> <p>Bits 78 through 81 of Message Type 40 shall provide the assumed Constellation Fault Probability (<math>P_{\text{const}}</math>) value for ARAIM at the current time for the associated GNSS constellation.</p> <p>IS-GPS-705  <b>20.3.3.10.1.8 Constellation Fault Probability</b></p> <p>Bits 78 through 81 of Message Type 40 shall provide the assumed Constellation Fault Probability (<math>P_{\text{const}}</math>) value for ARAIM at the current time for the associated GNSS constellation.</p>



<b>DOORS ID</b>	IS800-1040, IS705-1618, IS800-1040		
<b>Paragraph</b>	IS200-1770 30.3.3.10.1 ISM Parameter Content IS705-1618 20.3.3.10.1 ISM Parameter Content IS800-1040 3.5.4.7.1 ISM Parameter Content	<b>Comment Number</b>	272
<b>Comment Type</b>	Substantive	<b>Disposition</b>	Defer
<b>Comment Originator(s)</b>	Rhonda Slattery (Aerospace)		
<b>Comment</b>	We should change Pconst to Rconst and add MFDconst for more detailed information		
<b>Government Response</b>	More coordination work is needed with stakeholders Should be resolvable within the next year		



<b>DOORS ID</b>			
<b>Paragraph</b>	IS-GPS-200M, 20.3.3.5.1.1	<b>Comment Number</b>	281 313
<b>Comment Type</b>	Substantive/Critical	<b>Disposition</b>	Defer
<b>Comment Originator(s)</b>	Denis Bouvet (Thales) Yi Ding (CMC Electronics)		
<b>Comment</b>	<p>281 Following the PICWG 2015 meeting, and regarding a comment raised on Data ID interpretation, the minutes mention the following resolution: "The Government team will investigate the possibly of adding additional clarifications to IS-GPS-200 to address this [Backward compatibility] concern. While the Government still maintains the right to employ a Data ID different that "01", the group confirmed that users of the data structure corresponding to currently defined Data ID values will still be fully functional/compatible."</p> <p>313 We do not agree with the last sentence. Some certified and fielded receivers do check the Data ID coding to process the GPS LNAV data. Employing a Data ID different from "01" will create backward compatibility issue.</p>		
<b>Government Response</b>	The government will propose amendments to 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. (See next slide for sections of note)		



<b>Paragraph</b>	IS-GPS-200, 20.3.3.5.1.1 and 40.3.3.5.1.1
<b>Paragraph of Interest</b>	<p><b>20.3.3.5.1.1 Data ID and SV ID</b></p> <p>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.</p> <p>...</p> <p><b>40.3.3.5.1.1 Data ID and SV ID</b></p> <p>The two MSBs of word three in each page shall contain the 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.</p>



**16) CRM – COMBINED STAKEHOLDER/DIRECTORATE REVIEW STATUS:**

Disposition/Type	Critical	Substantial	Administrative	Totals	
Accept	0	48	41	89	<h1>Critical Accept With Comments</h1>
Accept with Comment	4	10	5	19	
Defer	1	10	0	11	
Reject	0	0	0	0	
<b>Grand Totals:</b>	<b>5</b>	<b>68</b>	<b>46</b>	<b>119</b>	



<b>DOORS ID</b>	IS200-1760, IS200-281		
<b>Paragraph</b>	IS-GPS-200, 6.4.6.2.2 Specific Alarm Indications	<b>Comment Number</b>	278 279 312
<b>Comment Type</b>	Critical	<b>Disposition</b>	Accept with Comments
<b>Comment Originator(s)</b>	John Foley (Garmin) Denis Bouvet (Thales) Yi Ding (CMC Electronics)		
<b>Comment</b>	<p>278... This proposed change is not backwards-compatible with some equipment designed in accordance with earlier versions of IS-GPS-200. ...</p> <p>279 ... The proposed change on the alarm condition related to the 5 parity checks will have an impact on airborne receivers that currently consider the satellite as 'GPS UNHEALTHY' as soon as 5 parity failures are detected, regardless of the processed LNAV subframe. Consider removing the proposed update</p> <p>312 The intent of the proposed change is for the airborne receiver to NOT consider default navigation data in subframe 4 or 5 as a failure condition. However, the actual wording in item (a) does not distinguish the parity errors due to Default Navigation Data (DND) or due to random erroneous bits. ...</p>		



**Government  
Response**

Original change is removed, but clarification for (a) is now in a new Note 5 which should satisfy the commenter's objections  
(see next two slides for proposed changes)



## Paragraph

## IS-GPS-200, 6.4.6.2.2

## Redlines

The following alarm indications are specific to the code signals listed below.

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).
- (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) 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<sub>2</sub>, decimal 139, or hexadecimal 8B (see paragraph 20.3.3).

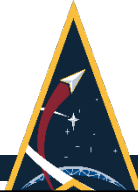
CM-Code Signal

- (a) The failure of the cyclic redundancy check (CRC) on 5 successive CNAV messages (60 seconds) (see paragraph 30.3.5).
- (b) The broadcast time of ephemeris (toe) is not current (i.e. not within the current curve-fit) or does not match the broadcast time of clock (toc) (excluding normal data set cutovers, see paragraphs 30.3.3.1.1 and 30.3.4.4).
- (c) The broadcast top is not consistent across the Message Types 10, 11 and Type 30's messages which comprise the current (i.e. not within the current curve-fit) CEI data set (excluding normal data set cutovers, see paragraph 30.3.4.4).
- (d) The transmitted bits (bits 39-276) in Message Types 10, 11 and Type 30's are all set to 0's or all set to 1's.
- (e) The 8-bit preamble does not equal 10001011<sub>2</sub>, decimal 139, or hexadecimal 8B (see paragraph 30.3.3).

*Notes:*

1. *A SIS alarm indication exists when the satellite is not trackable because it is not transmitting the standard PRN code modulation on the L-band carrier signal. These SIS alarm indications are specifically called out above because of their relatively high probability of occurrence.*
2. *The SIS alarm indications related to the LNAV and CNAV message data are considered "weak" indications since receivers do not necessarily continuously read each satellite's LNAV or CNAV message data either by design or by circumstance (e.g., radio-frequency interference [RFI] can prevent reading LNAV or CNAV message data). These weak SIS alarm indications are assumed to have a five-minute lag time before receivers take notice of them for alerting purposes.*
3. *The SIS alarm indications related to the LNAV or CNAV message data are indicative of a problem onboard the satellite. GPS receivers may perceive similar indications caused by local effects that are unrelated to the broadcast SIS.*
4. *In addition to SIS alarm indications, other conditions may also cause GPS signals to become temporarily untrackable, such as ionospheric signal fades, local signal masking, or local interference.*
5. *[Alarm indication \(a\) does not apply to the default navigation data described in paragraph 20.3.2. 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 61-300.](#)*

# CRM -278, 279, 312 Proposed Change (cont)



Paragraph	IS-GPS-200, IS200-281 , 20.3.2 Message Structure
Redlines	<p>(9<sup>th</sup> Paragraph)</p> <p><del>Block II and IIA SVs are designed with sufficient memory capacity for storing at least 60 days of uploaded LNAV data. However, the memory retention of these SVs will determine the duration of data transmission. The memory retentivity is guaranteed for at least 60 days for SVs subsequent to Block IIA. GPS III and GPS III-F</del> <u>All</u> SVs have the capability to support operation for at least 60 days without contact from the CS. <del>Alternating ones and zeros will be transmitted in words 3 through 10 in place of the normal LNAV data whenever</del> the SV cannot locate the requisite valid control or data element in its on-board computer memory, <u>the SV will transmit default LNAV data in the affected subframes. Default LNAV data is a sequence of alternating ones and zeros in bits 61 through 298, beginning with a one.</u> The following specifics apply to this default action:- (a) the <u>apparent</u> parity of the affected words will be invalid, (b) the two trailing bits of <u>word 10 the subframe (bits 299 and 300)</u> will be zeros (to allow the parity of subsequent subframes to be valid -- reference paragraph 20.3.5), (c) if the problem is the lack of a data element, only the directly related subframe(s) will be treated in this manner, <del>(d) if a control element cannot be located, this default action will be applied to all subframes and all subframes will indicate ID = 1 (Block II/IIA only) (i.e., an ID code of 001) in the HOW (reference paragraph 20.3.3.2) (Block IIR/IIR-M, IIF, and GPS III/III-F SVs indicate the proper subframe ID for all subframes).</del> Certain failures of control elements which may occur in the SV memory or during an upload will cause the SV to transmit in non-standard codes (NSC and NSY) which would preclude normal use by the US. Normal LNAV data transmission will be resumed by the SV whenever a valid set of elements becomes available.</p>
IS	<p>All SVs have the capability to support operation for at least 60 days without contact from the CS. Whenever the SV cannot locate the requisite valid control or data element in its on-board computer memory, the SV will transmit default LNAV data in the affected subframes. Default LNAV data is a sequence of alternating ones and zeros in bits 61 through 298, beginning with a one. The following specifics apply to this default action: (a) the apparent parity of the affected words will be invalid, (b) the two trailing bits of the subframe (bits 299 and 300) will be zeros (to allow the parity of subsequent subframes to be valid - reference paragraph 20.3.5), (c) if the problem is the lack of a data element, only the directly related subframe(s) will be treated in this manner. Certain failures of control elements which may occur in the SV memory or during an upload will cause the SV to transmit in non-standard codes (NSC and NSY) which would preclude normal use by the US. Normal LNAV data transmission will be resumed by the SV whenever a valid set of elements becomes available.</p>

Green text reflects recent changes



<b>DOORS ID</b>	IS200-462		
<b>Paragraph</b>	IS-GPS_200, 20.3.4.4.0-1	<b>Comment Number</b>	284 286
<b>Comment Type</b>	284 Substantive 286 Critical	<b>Disposition</b>	284 Accept 286 Accept with Comments
<b>Comment Originator(s)</b>	Jed Dennis (FAA) Mikael Mabileau (Europa)		
<b>Comment</b>	284 Dual-Frequency SBAS will use IODC. Can there be a constraint on IODC similar to IODE, since IODC inherently includes IODE? ... Statement about IODC based on inherent behavior of IODE 286 ... 1) Consider to modify the 7 days requirement for the IODC uniqueness by another time window requirement... 2) Bring a paper presenting the change of the IODC uniqueness requirement to the ICAO NSP		
<b>Government Response</b>	This change is not required since the IODE is a modulo representation of the IODC; however, it is correct and the added parenthetical phrase may help some readers		

**Paragraph**

IS200-462, 20.3.4.4.0-1

**Redlines**

The transmitted IODE [\(and therefore also the transmitted IODC\)](#) will be different from any value transmitted by the SV during the preceding six hours.



**16) CRM – COMBINED STAKEHOLDER/DIRECTORATE REVIEW STATUS:**

Disposition/Type	Critical	Substantial	Administrative	Totals	
Accept	0	48	41	89	<h1>Substantive Accept with Comments</h1>
Accept with Comment	4	10	5	19	
Defer	1	10	0	11	
Reject	0	0	0	0	
<b>Grand Totals:</b>	<b>5</b>	<b>68</b>	<b>46</b>	<b>119</b>	



<b>DOORS ID</b>	IS200-173		
<b>Paragraph</b>	6.2.2.2.2 Block IIA SVs.	<b>Comment Number</b>	200 249 263 291
<b>Comment Type</b>	Substantive/Administrative	<b>Disposition</b>	Accept
<b>Comment Originator(s)</b>	Jeff Stevens (MITRE) Anne Kastenholz (Boeing) Rhonda Slattery (Aerospace) Jeff Crum (LMCO)		
<b>Comment</b>	<ul style="list-style-type: none"> <li>• For consistency within section 6.2.2, remove the developer name for the Block IIA SVs.</li> <li>• Similar to the edit in IS200-171, remove the string "developed by Rockwell International".</li> <li>• Delete Rockwell here too (Or undelete it in 171)</li> <li>• If you are removing the developing contractor from other related objects, you should remove Rockwell International from this object, too.</li> </ul>		
<b>Government Response</b>	All Block II and IIA SVs have been decommissioned, so requirements about them have been removed from this document or rewritten to indicate they are decommissioned. (see next slide for proposed change)		



## Paragraph

IS200-170, IS200-171, IS200-172, IS200-173

## Redlines

**6.2.2.2.1 Block II SVs (Decommissioned)**

The first block of full scale operational SVs ~~developed by Rockwell International~~ are designated as SVNs 13-21 and are termed "Block II" SVs.- These SVs were designed to provide 14 days of positioning service without contact from the CS. These SVs transmitted a configuration code of 001 (reference paragraph 20.3.3.5.1.4). There are no longer any active Block II SVs in the GPS constellation.

**6.2.2.2.2 Block IIA SVs (Decommissioned)**

The second block of full scale operational SVs ~~developed by Rockwell International~~ are designated as SVNs 22-40 and are termed "Block IIA" SVs.- These SVs ~~are~~were capable of providing 60 days of positioning service without contact from the CS. These SVs transmitted a configuration code of 001 (reference paragraph 20.3.3.5.1.4). There are no longer any active Block IIA SVs in the GPS constellation.





<b>DOORS ID</b>	IS705-1494, IS705-1495		
<b>Paragraph</b>	6.2.2.2.2 Block IIA SVs	<b>Comment Number</b>	237 274 301 302
<b>Comment Type</b>	Substantive	<b>Disposition</b>	Accept with Comments
<b>Comment Originator(s)</b>	Jeff Stevens (MITRE) Rhonda Slattery (Aerospace) Jeff Crum (LMCO)		
<b>Comment</b>	237 For consistency with the deletion of Block II, the section for Block IIA SVs needs to be deleted. 274 Since these were left in 200, why not continue to reference to them? If you delete them here, you should delete them there too. 301 Object is missing from PCN but needs to be included. (Would change to) 6.2.2.2.2 RESERVED 302 Object is missing from PCN but needs to be included. (Would delete text under 6.2.2.2.2)		
<b>Government Response</b>	Keeping the paragraphs describing the SV blocks as decommissioned and refer to IS-GPS-200 to maintain consistency. (see next slide for proposed change)		

**Paragraph**

IS705-1494, IS705-1495, IS705-120, IS705-121

**Redlines****6.2.2.2.1 Block II SVs [\(Decommissioned\)](#)**

See paragraph 6.2.2.2.1 of IS-GPS-200. These satellites do not broadcast the L5 signal.

**6.2.2.2.2 Block IIA SVs [\(Decommissioned\)](#)**

See paragraph 6.2.2.2.2 of IS-GPS-200. These satellites do not broadcast the L5 signal.



<b>DOORS ID</b>	IS200-468		
<b>Paragraph</b>	Table 20-XII. IODC Values and Data Set Lengths (Block IIR/IIR-M/IIF & GPS III/ IIF)	<b>Comment Number</b>	213 285
<b>Comment Type</b>	Substantive	<b>Disposition</b>	213 Accept 285 Accept with Comments
<b>Comment Originator(s)</b>	Jeff Stevens (MITRE) Jed Dennis (FAA)		
<b>Comment</b>	<p>213 The proposed wording change is missing the cutover time constraint for transition between succeeding 24-hour CEI data sets. The final sentence should be deleted, consistent with the statement in the Rationale that there are no longer any CEI data sets transmitted for greater than 24 hours.</p> <p>285 What is the User Segment supposed to do with the information about the reserved IODC in Note 6? Should User Segment not use this satellite if these values are broadcast? Maybe better to delete if there is no action for the User Segment.</p>		
<b>Government Response</b>	(See next slide for proposed change)		



Paragraph  
Redlines

Table 20-XII. IODC Values and Data Set Lengths (Block IIR/IIR-M/IIF & GPS III/ IIIF)

Days Spanned	Transmission Interval (hours) (Note 5)	Curve Fit Interval (hours)	Fit Interval Flag	IODC Range <a href="#">(Note 6)</a>
1	2	4	0	(Note 2)
2-14	4	6	1	(Note 2)
15-16	6	8	1	240-247 (Note 1)
17-20	12	14	1	248-255, 496 (Note 1) (Note 3)
21-62	24	26	1	497-503, 1021-1023

Note 1: For transmission intervals of 6 and 12 hours, the IODC values shown will be transmitted in increasing order.

Note 2: IODC values for blocks with 2- or 4-hour transmission intervals (at least the first 14 days after a new CEI data sequence propagation) shall be any number in the range 0 to 1023 excluding those values of IODC [\(240-255, 496-511, 752-767 and 1008-1023\)](#) that correspond to IODE values in the range 240-255, subject to the constraints on re-transmission given in paragraph 20.3.4.4. The CS can define the GPS III and GPS IIIF SV time of transition from the 4 hour curve fits into extended navigation (beyond 4 hour curve fits). Following the transition time, the SV will follow the timeframes defined in the table, including appropriately setting IODC values.

Note 3: The ninth 12-hour data set may not be transmitted.

Note 4: Reserved

Note 5: The first CEI data set of a new CEI data sequence propagation may be cut-in at any time and therefore the transmission interval may be less than the specified value.

[Note 6: IODC values in the ranges 504-511, 752-767 and 1008-1020 are reserved](#)



<b>DOORS ID</b>	IS200-540		
<b>Paragraph</b>	30.3.3.1.1.2 Signal Health (L1/L2/L5).	<b>Comment Number</b>	219
<b>Comment Type</b>	Substantive	<b>Disposition</b>	Accept with Comments
<b>Comment Originator(s)</b>	Jeff Stevens (MITRE)		
<b>Comment</b>	The health bits in MT10 only convey information for the transmitting SV, so the addition of the phrase "or other SVs in the constellation" does not appear to be relevant here. Should this change have been applied instead to the MT37 / reduced almanac signal health description in section 30.3.3.4.4?		
<b>Government Response</b>	(See next slide for proposed change)		



## Paragraph

IS200-598 30.3.3.1.1.2 Signal Health (L1/L2/L5).

## Redlines

The three, one-bit, health indication in bits 155, 156, and 157 of Message Type 37 and bits 29, 30 and 31 of each packet of reduced almanac refers to the L1, L2, and L5 carrier of the SV whose PRN number is specified in the message or in the packet. These health indication bits only apply to codes and data as defined in IS-GPS-200, IS-GPS-705, and IS-GPS-800.

The health of each carrier is indicated by:

0 = Some or all codes and data on this carrier are OK,

1 = All codes and data on this carrier are bad or unavailable.

The health bit indication shall be given relative to the capabilities of each SV as designated by the configuration code in the LNAV message (see paragraph 20.3.3.5.1.4). Accordingly, the health bit for any SV which does not have a certain capability will be indicated as "healthy" if the lack of this capability is inherent in its design or if it has been configured into a mode which is normal from a user standpoint and does not require that capability; however, the Operating Command may choose to set the health bit "unhealthy" for an SV without a certain capability. Single-frequency L2C users or users who have not received or choose not to use configuration code should assume that every signal is available on every SV. The predicted health data will be updated at the time of upload when a new CEI data set has been built by the CS. Therefore, the transmitted health data may not correspond to the actual health of the ~~transmitting~~relevant SV. For more information about user protocol for interpreting health indications see paragraph 6.4.~~65~~.



<b>DOORS ID</b>	IS-464, IS200-1972, IS705-1675, IS800-1159		
<b>Paragraph</b>	IS200-1972, 30.3.4.4 Data Sets IS705-1675, 20.3.4.4 Data Sets	<b>Comment Number</b>	222 280 306
<b>Comment Type</b>	Substantive	<b>Disposition</b>	Accept/Accept with Comments
<b>Comment Originator(s)</b>	Jeff Stevens (MITRE) Denis Bouvet (Thales) Jeff Crum (LMCO)		
<b>Comment</b>	<p>222 Recommend changing the constraint on curve fit start times to be a 15-minute boundary, which is consistent with the CS and SV implementation, and may provide more helpful information to users that wish to identify the start and end times of the currently active curve fit interval. In the previous sentence, recommend using wording consistent with IS200-2121</p> <p>280 Is the following statement correct for all the CEI data set? In particular for the first CEI data set of a new CEI data sequence? "The start of the transmission interval for each CEI data set corresponds to the beginning of the curve fit interval for the CEI data set." If the answer is no, consider changing the sentence as follows: Except for the first CEI data set of a new CEI data sequence propagation, the start of the transmission interval for a CEI data set corresponds to the beginning of the curve fit interval for this CEI data set.</p> <p>306 This text is inconsistent with the equivalent text at the beginning of IS200-1972. Recommend making them consistent.</p>		
<b>Government Response</b>	(See next slides for proposed changes across three documents)		



## Paragraph

IS200-464, 20.3.4.4 Data Sets

## Redlines

Green Indicates Recent  
Change due to CRM #280

(4<sup>th</sup> Paragraph)

Except for the first CEI data set of a new CEI data sequence propagation, the start of the transmission interval for each CEI data set corresponds to the beginning of the curve fit interval for the CEI data set. Each CEI data set remains valid for the duration of its transmission interval, and nominally also remains valid for the duration of its curve fit interval. A CEI data set is rendered obsolete before the end of its curve fit interval when it is superseded by the SV cutting over to the first CEI data set of a new CEI data sequence propagation.





## Paragraph

IS200-1972, 30.3.4.4 Data Sets

## Redlines

Green Indicates Recent Change due to CRM #280

Except for the first CEI data set of a new CEI data sequence propagation, the start of the transmission interval for each CEI data set corresponds to the beginning of the curve fit interval for the CEI data set. Each CEI data set remains valid for the duration of its transmission interval, and nominally also remains valid for the duration of its curve fit interval. - A CEI data set ~~may be~~ is rendered obsolete before the end of its curve fit interval when it is superseded by the SV cutting over to the first CEI data set of a new CEI data sequence propagation.

The start time of the curve fit interval of the first CEI data set of a new CEI data sequence propagation may be later than the start time of the curve fit interval of the preceding CEI data set that was transmitted prior to the cutover. The beginning of the curve fit interval of the first CEI data set of a new CEI data sequence propagation will be a multiple of 900 seconds (15 minutes) relative to the start of week.



## Paragraph

IS705-1675, 20.3.4.4 Data Sets

## Redlines

Green Indicates Recent  
Change due to CRM #280

(5<sup>th</sup> Paragraph)

Except for the first CEI data set of a new CEI data sequence propagation, the start of the transmission interval for each CEI data set corresponds to the beginning of the curve fit interval for the CEI data set. Each CEI data set remains valid for the duration of its transmission interval, and nominally also remains valid for the duration of its curve fit interval. A CEI data set is rendered obsolete before the end of its curve fit interval when it is superseded by the SV cutting over to the first CEI data set of a new CEI data sequence propagation.



## Paragraph

IS800-1159, 3.5.5.2 Data Sets

## Redlines

Green Indicates Recent Change due to CRM #280

(3<sup>rd</sup> Paragraph)

Except for the first CEI data set of a new CEI data sequence propagation, the start of the transmission interval for each CEI data set corresponds to the beginning of the curve fit interval for the CEI data set. Each CEI data set remains valid for the duration of its transmission interval, and nominally also remains valid for the duration of its curve fit interval. A CEI data set is rendered obsolete before the end of its curve fit interval when it is superseded by the SV cutting over to the first CEI data set of a new CEI data sequence propagation.



<b>DOORS ID</b>	IS200-1438		
<b>Paragraph</b>	Figure 40-1 (sheet 10 of 11)	<b>Comment Number</b>	228 297
<b>Comment Type</b>	Substantive	<b>Disposition</b>	228 Accept 297 Accept with Comments
<b>Comment Originator(s)</b>	Jeff Stevens (MITRE) Jeff Crum (LMCO)		
<b>Comment</b>	<p>228 The proposed change appears to be replacing the format diagram for SF4:P13 with a duplicate of the format diagram for SF4:P14/15/17. This is incorrect; please see the next two CRM entries for the correct changes to Figure 40-1.</p> <p>297 Unclear what the PCN change is doing. Please explain. Improve PCN description of what is actually changing. The WAS, REDLINES, and IS don't seem to clearly depict what is changing.</p>		
<b>Government Response</b>	The change is an error and is being rescinded		



<b>DOORS ID</b>	IS200-1405		
<b>Paragraph</b>		<b>Comment Number</b>	265
<b>Comment Type</b>	Substantive	<b>Disposition</b>	Accept with Comments
<b>Comment Originator(s)</b>	Rhonda Slattery (Aerospace)		
<b>Comment</b>	Should we split the SV IDs into III and IIIF, like II and IIA in 171/173. Or maybe split IIIF into it's own paragraph or combine 171 and 173 for consistency.		
<b>Government Response</b>	Accept with Comments Already explained IIFs and an operational replenishment for IIIs. There is no IS-GPS-200 difference in III or IIIF.		



## Paragraph

IS200-1405

## Redlines

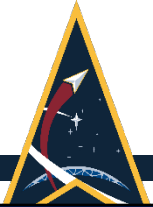
**6.2.2.2.6 GPS III and GPS IIF SVs**

The block of operational replenishment SVs are designated as SVNs 74-105. -This is the first block of operational SVs that transmit the L1C signal.- These SVs will provide at least 60 days of positioning service without contact from the CS.

The subset of operational replenishment SVs which are the “Follow-On” configuration of “GPS III” SVs are termed “GPS IIF”.



<b>DOORS ID</b>	IS200-2120 and IS200-2108		
<b>Paragraph</b>	IS200 Section 40.3.3.5.1.2.0-5 and 40.3.3.5.1.2.0-6 40.3.3.5.1.2 Almanac Data	<b>Comment Number</b>	300 234
<b>Comment Type</b>	Substantive	<b>Disposition</b>	300: Accept with Comments 234: Accept
<b>Comment Originator(s)</b>	300: Jeff Crum (LMCO) 234: Jeff Stevens (MITRE)		
<b>Comment</b>	300: With the addition of IS200-2120 (that has more details), does it make sense to have IS200-2108 remain in the document? Should IS200-2120 refer to IIR-M and IIF SVs in addition to the GPS III and IIF SVs? 234: The final paragraph that refers to Block IIR/IIR-M/IIF and GPS III/IIF should be deleted. Correct information for GPS III/IIF is now in the newly added paragraph IS200-2120, and LNAV-U does not apply to Block IIR/IIR-M/IIF.		
<b>Government Response</b>	While IS200-2120 should be kept as is, other adjustments have been made. (See next slide for current proposal)		



Paragraph	IS200 Section 40.3.3.5.1.2.0-5 and 40.3.3.5.1.2.0-6
<p>As Of May 21 IS200-2107 IS200-2120 IS200-2108</p>	<p><del>For Block IIA SVs, three sets of almanac shall be used to span at least 60 days. The first and second sets will be transmitted for up to six days each; the third set is intended to be transmitted for the remainder of the 60 days minimum, but the actual duration of transmission will depend on the individual SV's capability to retain data in memory. All three sets are based on six day curve fits that correspond to the first six days of the transmission interval.</del></p> <p>For GPS III and GPS IIF SVs, a minimum of five sets of almanac shall be used to span at least 60 days. The first, second, and third sets will be transmitted for up to six days each; the fourth and subsequent sets will be transmitted for up to 32 days each; with the final set transmitted for the remainder of the 60 days minimum. During the first 18 days after upload the sets are based on six day curve fits. Subsequent sets are based on 32 day curve fits.</p> <p>For Block IIR/IIR-M, IIF, GPS III, and GPS IIF SVs, multiple sets of almanac parameters shall be uploaded to span at least 60 days.</p>
<p>IS IS200-2107 <del>IS200-2120</del> <del>IS200-2108</del></p>	<p><del>For Block IIA SVs, three sets of almanac shall be used to span at least 60 days. The first and second sets will be transmitted for up to six days each; the third set is intended to be transmitted for the remainder of the 60 days minimum, but the actual duration of transmission will depend on the individual SV's capability to retain data in memory. All three sets are based on six day curve fits that correspond to the first six days of the transmission interval.</del></p> <p>For GPS III and GPS IIF SVs, a minimum of five sets of almanac shall be used to span at least 60 days. The first, second, and third sets will be transmitted for up to six days each; the fourth and subsequent sets will be transmitted for up to 32 days each; with the final set transmitted for the remainder of the 60 days minimum. During the first 18 days after upload the sets are based on six day curve fits. Subsequent sets are based on 32 day curve fits.</p> <p><del>For Block IIR/IIR-M, IIF, GPS III, and GPS IIF SVs, multiple sets of almanac parameters shall be uploaded to span at least 60 days.</del></p>

Green Indicates Recent Change





**16) CRM – COMBINED STAKEHOLDER/DIRECTORATE REVIEW STATUS:**

Disposition/Type	Critical	Substantial	Administrative	Totals	
Accept	0	48	41	89	<h1>Substantial Accepts</h1>
Accept with Comment	4	10	5	19	
Defer	1	10	0	11	
Reject	0	0	0	0	
<b>Grand Totals:</b>	<b>5</b>	<b>68</b>	<b>46</b>	<b>119</b>	



<b>DOORS ID</b>	IS200-2046:IS200-2049		
<b>Paragraph</b>	3.3.1.9 Signal Polarization.	<b>Comment Number</b>	196 261 288 289
<b>Comment Type</b>	Substantive	<b>Disposition</b>	Accept
<b>Comment Originator(s)</b>	Jeff Stevens (MITRE) Rhonda Slattery (Aerospace) Jeff Crum (LMCO) Jeff Crum (LMCO)		
<b>Comment</b>	196 The changes to the Signal Polarization section 3.3.1.9 appear to be introducing duplicated wording, for example "The transmitted signal shall be right-hand circularly polarized (RHCP)" is shown as being added in IS200-2047 and IS200-2049 when it already exists as the first paragraph in this section. 261 The first sentence added in 2047 already existed in 3.3.1.9 and wasn't deleted in 2046. It appears it's now in the paragraph twice? In 200L this is all one paragraph, so it's unclear how you are changing it in four objects. If it was broken up somewhere, that should show in the PCN 288/289 Object unnecessarily combines IS200-93 and IS200-2049 with IS200-2047. ...		
<b>Government Response</b>	Agree. The three requirements in -2047 will be distributed across -93, -2047 and -2049 (See next slide for proposed redlines)		



## Paragraph

## 3.3.1.9 Signal Polarization

## Redlines

IS200-93

The transmitted signal shall be right-hand circularly polarized (RHCP).

IS200-2047

~~For the angular range of  $\pm 13.8$  degrees from nadir, L1 ellipticity shall be no worse than 1.2 dB for Block IIA~~  
~~and~~ For the angular range of  $\pm 13.8$  degrees from nadir, L1 ellipticity shall be no worse than 1.8 dB for Block IIR/IIR-M/IIF/III/IIIF SVs. ~~L2 ellipticity shall be no worse than 3.2 dB for Block II/IIA SVs~~

IS200-2049

~~and~~ L2 ellipticity shall be no worse than 2.2 dB for Block IIR/IIR-M/IIF and GPS III/IIIF SVs over the angular range of  $\pm 13.8$  degrees from nadir.



<b>DOORS ID</b>			
<b>Paragraph</b>	6.2.2.1 Developmental SVs.	<b>Comment Number</b>	197
<b>Comment Type</b>	Substantive	<b>Disposition</b>	Accept
<b>Comment Originator(s)</b>	Jeff Stevens (MITRE)		
<b>Comment</b>	For consistency within section 6.2.2, remove the developer name for the Developmental SVs.		
<b>Government Response</b>	(See next slide for proposed change)		

**Paragraph****6.2.2.1 Developmental SVs.****Redlines**

The original concept validation satellites ~~developed by Rockwell International and~~ designated as satellite vehicle numbers (SVNs) 1-11 are termed "Block I" SVs. These SVs were designed to provide 3-4 days of positioning service without contact from the CS. These SVs transmitted a configuration code of 000 (reference paragraph 20.3.3.5.1.4). There are no longer any active Block I SVs in the GPS constellation. The last Block I SV was decommissioned in 1995.



<b>DOORS ID</b>	IS200-1639		
<b>Paragraph</b>	Table 6-I-1. CEI Data Set Parameters	<b>Comment Number</b>	204 266
<b>Comment Type</b>	Substantive	<b>Disposition</b>	Accept
<b>Comment Originator(s)</b>	Jeff Stevens (MITRE) Rhonda Slattery (Aerospace)		
<b>Comment</b>	<p>JS: The inter-signal correction parameters do not meet the definition of “core CEI” because they are not needed for an initial position solution, and they are not broadcast to users with the shortest broadcast interval. They should have a "NOTE1" to indicate that they are not considered "core CEI".</p> <p>RS: This is only showing part of the table. Shouldn't we be adding NOTE 1 to the ISCs also?</p>		
<b>Government Response</b>	(See next slide for proposed changes)		



Paragraph

Table 6-I-1. CEI Data Set Parameters

Redlines

Symbol	Parameter Name	Subframe	Message
SV Health	SV Health (6 bits)	1	N/A
...	...	...	...
$\dot{\Omega}$	Rate of Right Ascension	3	<del>±</del> N/A
$\Delta\dot{\Omega}$	<u>Rate of Right Ascension Difference</u>	<u>N/A</u>	<u>11</u>
$\Omega_0$	Longitude of Ascending Node of Orbit Plane at Weekly Epoch	3	11
...	...	...	...
URA <sub>ED</sub>	Elevation Dependent User Range Accuracy	N/A	10
ISC <sub>L1C/A</sub>	Inter-signal Correction <sup>NOTE1</sup>	N/A	30
ISC <sub>L1B/C</sub>	Inter-signal Correction <sup>NOTE1</sup>	N/A	30
ISC <sub>L1S1S</sub>	Inter-signal Correction <sup>NOTE1</sup>	N/A	30
ISC <sub>L1S/Q5</sub>	Inter-signal Correction <sup>NOTE1</sup>	N/A	30
...	...	...	...
Alert	Alert Flag <sup>NOTE1</sup>	All	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  $t_{oc}/t_{oe}$  for CNAV and  $t_{oc}/t_{oe}/IODC/IODE$  for LNAV. Any parameter marked with NOTE1 may be changed with or without a change in  $t_{oc}/t_{oe}/IODC/IODE$ .



<b>DOORS ID</b>	IS705		
<b>Paragraph</b>	Table 6-I-1. CEI Data Set Parameters	<b>Comment Number</b>	238 303
<b>Comment Type</b>	Substantive	<b>Disposition</b>	Accept
<b>Comment Originator(s)</b>	Jeff Stevens (MITRE) Jeff Crum (LMCO)		
<b>Comment</b>	238 The inter-signal correction parameters do not meet the definition of “core CEI” because they are not needed for an initial position solution, and they are not broadcast to users with the shortest broadcast interval. They should have a "NOTE1" to indicate that they are not considered "core CEI". 303 Object is missing from PCN but needs to be included. Update table to match the same RFC-467 change applied to IS200-1639		
<b>Government Response</b>	(See next slide for proposed changes)		





Paragraph

Table 6-I-1 CEI Data Set Parameters

Redlines

Symbol	Parameter Name	Message
.	.	.
$\Delta\dot{\Omega}$	Delta Rate of Right Ascension	11
.	.	.
$i_{0-n}$ -DOT	Rate of Inclination Angle	11
$ISC_{L1C/A}$	Inter-signal Correction <sup>NOTE1</sup>	30
$ISC_{L2C}$	Inter-signal Correction <sup>NOTE1</sup>	30
$ISC_{L5I5}$	Inter-signal Correction <sup>NOTE1</sup>	30
$ISC_{L5Q5}$	Inter-signal Correction <sup>NOTE1</sup>	30
.	.	.

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



<b>DOORS ID</b>	IS800-917		
<b>Paragraph</b>	Table 6.2-18	<b>Comment Number</b>	244
<b>Comment Type</b>	Substantive	<b>Disposition</b>	Accept
<b>Comment Originator(s)</b>	Jeff Stevens (MITRE)		
<b>Comment</b>	<p>The inter-signal correction parameters do not meet the definition of “core CEI” because they are not needed for an initial position solution, and they are not all broadcast to users with the shortest broadcast interval. They should have a "NOTE1" to indicate that they are not considered "core CEI".</p> <p><i>See Table 6.2-18.</i></p> <p><i>Add a superscripted “NOTE1” in the second column after the names of the following parameters: <math>ISC_{L1CP}</math>, <math>ISC_{L1CD}</math>, <math>ISC_{L1CA}</math>, <math>ISC_{L2C}</math>, <math>ISC_{L5I5}</math>, <math>ISC_{L5Q5}</math></i></p> <p>(13) RATIONALE FOR CHANGE: Consistency with CS/SV implementation</p>		
<b>Government Response</b>	(See next slide for proposed changes)		



Paragraph  
Redlines

IS800-917, Table 6.2-18

Symbol	Parameter Name	Subframe
...		
$i_0$	Inclination Angle at Reference Time	2
$i_{0-n}$ -DOT	Rate of Inclination Angle	2
$ISC_{L1CP}$	Inter-signal Correction <a href="#">NOTE1</a>	2
$ISC_{L1CD}$	Inter-signal Correction <a href="#">NOTE1</a>	2
$ISC_{L1CA}$	Inter-signal Correction <a href="#">NOTE1</a>	3
$ISC_{L2C}$	Inter-signal Correction <a href="#">NOTE1</a>	3
$ISC_{L5I5}$	Inter-signal Correction <a href="#">NOTE1</a>	3
$ISC_{L5Q5}$	Inter-signal Correction <a href="#">NOTE1</a>	3
ISF	Integrity Status Flag <sup>NOTE1</sup>	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  $t_{oe}$ .



<b>DOORS ID</b>	6.3.2		
<b>Paragraph</b>	6.3.2 Extended Navigation Mode	<b>Comment Number</b>	205
<b>Comment Type</b>	Substantive	<b>Disposition</b>	Accept
<b>Comment Originator(s)</b>	Jeff Stevens (MITRE)		
<b>Comment</b>	Since this section is being changed to be a generic description of extended operations, the final paragraph (following IS200-201) needs to be updated to remove the direct linkage with short-term and long-term extended operations since those behaviors are SV block and code specific		
<b>Government Response</b>	(See next slide for proposed changes)		



## Paragraph

## 6.3.2 Extended Navigation Mode

## Redlines

If the CS is unable to upload the SVs (the CS is unavailable or the SV is unable to accept and process the upload),  
~~During short-term and long-term extended operations (approximately day 2 through day 62 after an upload),~~  
the almanac data, UTC parameters and ionospheric data will not be maintained current and will degrade in accuracy from the time of last upload.



<b>DOORS ID</b>	6.3.4		
<b>Paragraph</b>	6.3.4 Extended Navigation Mode (GPS III).	<b>Comment Number</b>	206 207
<b>Comment Type</b>	Substantive	<b>Disposition</b>	Accept
<b>Comment Originator(s)</b>	206: Jeff Stevens (MITRE) 207: Jeff Stevens (MITRE)		
<b>Comment</b>	206: Section title needs updating to add GPS IIIIF. 207: The GPS III/IIIIF extended navigation description needs updating to reflect the fact that these SVs will nominally maintain 4-hour curve fits with 2-hour cutovers if contact with the CS has been lost.		
<b>Government Response</b>	(See next slide for proposed changes)		



## Paragraph

6.3.4 Extended Navigation Mode (GPS III).

## Redlines

**6.3.4 Extended Navigation Mode (GPS III and GPS III F).**

(2<sup>nd</sup> Paragraph)

If the CS is unable to upload the SVs (the CS is unavailable or the SV is unable to accept and process the upload), ~~each~~the user range error (URE) of the SV will increase as time from upload continues, causing a positioning service accuracy degradation. Each SV shall continue to maintain normal operations during a period that will nominally extend to at least 60 days from upload but may be shorter. Any SV that enters extended navigation following this normal operations period shall individually transition to short-term extended operations and ~~eventually~~subsequently to long-term extended operations (based on time from ~~each~~the SV's last upload) as defined in paragraph 6.2.3.2 and 6.2.3.3, and as further described throughout this IS. ~~As time from upload continues through these three operational intervals, the user range error (URE) of the SV will increase, causing a positioning service accuracy degradation.~~



<b>DOORS ID</b>	IS200-2073		
<b>Paragraph</b>	20.3.3.5.1.4 Anti-Spoof (A-S) Flags and SV Configurations.	<b>Comment Number</b>	208 209 269
<b>Comment Type</b>	Substantive/Administrative	<b>Disposition</b>	Accept
<b>Comment Originator(s)</b>	Jeff Stevens (MITRE) Rhonda Slattery (Aerospace)		
<b>Comment</b>	<p>208 Recommend removing the language about "system backward compatibility requirements" to simplify the final paragraph. To be consistent with the details that are being removed from the individual SV configuration code descriptions, the information in the HOW should be described as "flags".</p> <p>209 The "IS" wording contains unnecessary underlining.</p> <p>269 The II/IIA stuff was deleted from 20.3.2, so this is no longer accurate for 001 - maybe just delete II/IIA here too?</p>		
<b>Government Response</b>	(See next slide for proposed changes)		





**Paragraph** IS200-2073 20.3.3.5.1.4 Anti-Spoof (A-S) Flags and SV Configurations

Redlines	<u>Code</u> <u>SV Configuration</u>
	000            No Information is available
	001 — <del>A-S capability, plus flags for A-S and "alert" in HOW; memory</del> <u>Memory</u> capacity as described in paragraph 20.3.2 (e.g. <del>Block</del> <u>Block</u> <del>HA</del> /IIR SV).
	010 — <del>A-S capability, plus flags for A-S and "alert" in HOW; memory</del> <u>Memory</u> capacity as described in paragraph 20.3.2, M-code signal capability, L2C signal capability (e.g., Block IIR-M SV).
	011 — <del>A-S capability, plus flags for A-S and "alert" in HOW; memory</del> <u>Memory</u> capacity as described in paragraph 20.3.2, M-code capability, L2C signal capability, L5 signal capability (e.g., Block IIF SV).
	100 — <del>A-S capability, plus flags for A-S and "alert" in HOW; memory</del> <u>Memory</u> capacity as described in paragraph 20.3.2, M-code capability, L1C signal capability, L2C signal capability, L5 signal capability, no SA capability (e.g., GPS III SVs).
	101 <del>A-S capability, plus flags for A-S and "alert" in HOW; memory</del> <u>Memory</u> capacity as described in paragraph 20.3.2, M-code capability, Regional Military Protection capability, L1C signal capability, L2C signal capability, L5 signal capability, no SA capability (e.g., GPS III SVs).
	110, 111 — <u>Reserved</u> in order to preserve future use of these values in a future revision of this IS. Until such a revision, the User Segment developing to this version of this IS should interpret these values as indicating that no information in this data field is presently usable as a means to identify the actual SV configuration.
	<u>To comply with system backward compatibility requirements, all present and future satellites that transmit the C/A and P(Y) ranging codes will have A-S capability, and A-S and "alert" in HOW.</u>
	<u>All present and future satellites that transmit the C/A and P(Y) ranging codes will have A-S capability, and flags for A-S and "alert" in HOW.</u>

Green Indicates Recent Change



<b>DOORS ID</b>	IS200-463/2091/2121		
<b>Paragraph</b>	20.3.4.4 Data Sets.	<b>Comment Number</b>	210/211/212
<b>Comment Type</b>	Substantive	<b>Disposition</b>	Accept
<b>Comment Originator(s)</b>	Jeff Stevens (MITRE)		
<b>Comment</b>	<p>210: The proposed wording change has inadvertently modified one occurrence of the phrase "CEI data sets" to the less specific "sets" (IS200-463).</p> <p>211: The proposed wording change is missing the cutover time constraint for transition between succeeding 24-hour CEI data sets. The final sentence should be deleted, consistent with the statement in the Rationale that there are no longer any CEI data sets transmitted for greater than 24 hours (IS200-2091).</p> <p>212: Recommend changing the constraint on curve fit start times to be a 15-minute boundary, which is consistent with the CS and SV implementation, and may provide more helpful information to users that wish to identify the start and end times of the currently active curve fit interval (IS200-2121).</p>		
<b>Government Response</b>	(See next slide for proposed changes)		



Paragraph	20.3.4.4 Data Sets.
Redlines	<p>IS200-463                      Cutovers to new CEI data sets will occur only on <u>two</u>-hour boundaries except for the first CEI data set of a new CEI data sequence propagation. The first CEI data set may be cut-in (reference paragraph 20.3.4.1) at any time during the <del>hour</del><u>two hours</u> and therefore may be transmitted by the SV for less than <del>one two hour</del><u>hours</u>. <u>Upon</u> <del>During</del><u>transition to</u> short-term operations, cutover <del>to from</del> <u>4</u><del>these 2-hour sets and CEI subsequent data</del> <u>sets</u> to <del>succeeding</del> <u>4-hour</u> CEI data sets <del>will always occur modulo 4 and hours subsequent relative cutovers</del> to <del>end/start of week</del>. <del>Cutover from succeeding 4-hour CEI data sets to 6-hour CEI data sets shall occur modulo 12</del><u>4</u> hours relative to end/start of week.</p> <p>IS200-2091  <u>Upon transition to long-term operations, cutover from 4-hour CEI data sets to 6-hour CEI data sets shall occur modulo 12 hours relative to end/start of week. Subsequent cutovers to succeeding 6-hour CEI data sets shall occur modulo 6 hours relative to end/start of week. Cutover from 6-hour CEI data sets to 12-hour CEI data sets and subsequent cutovers to 24 succeeding 12-hour CEI data sets shall occur modulo 24</u><del>12</del> hours relative to end/start of week. <del>Cutover from a 12-hour CEI data sets transmitted to 24-hour hours CEI or data more sets occurs and on subsequent a cutovers modulo to succeeding 24-hour boundary CEI data sets shall occur modulo 24 hours relative to end/start of week.</del></p>
<p><b>Green Indicates Recent Change</b></p>	<p>IS200-464                      The start of the transmission interval for each CEI data set corresponds to the beginning of the curve fit interval for the CEI data set. Each CEI data set <u>remains valid for the duration of its transmission interval, and</u> nominally <u>also</u> remains valid for the duration of its curve fit interval. <del>-</del> A CEI data set <del>may be</del><u>is</u> rendered obsolete before the end of its curve fit interval when it is superseded by the SV cutting over to <u>the first CEI data set of a new CEI data sequence propagation</u>.</p> <p>IS200-2121  <u>The start time of the curve fit interval of the first CEI data set of a new CEI data sequence propagation may be later than the start time of the curve fit interval of the preceding CEI data set that was transmitted prior to the cutover. The beginning of the curve fit interval of the first CEI data set of a new CEI data sequence propagation will be a multiple of 300</u><del>900</del> seconds (<u>5</u><del>15</del> minutes) relative to the start of week.</p>



<b>DOORS ID</b>	IS200-472		
<b>Paragraph</b>	20.3.4.5 Reference Times.	<b>Comment Number</b>	215
<b>Comment Type</b>	Substantive	<b>Disposition</b>	Accept
<b>Comment Originator(s)</b>	Jeff Stevens (MITRE)		
<b>Comment</b>	The "Rationale" wording includes inappropriate references.		
<b>Government Response</b>	(See next slide for proposed Rationale)		



## Paragraph

## 20.3.4.5 Reference Times.

## Redlines

(5<sup>th</sup> Paragraph)

For each parameter, Table 20-XIII describes specifies the fit interval, the nominal transmission interval, and the nominal selection of the fit point (which will be expressed as an epoch time modulo 604,800 seconds in the Navigation Message). Where applicable, the week number associated with the epoch time is also provided in the Navigation Message.

...

...

Rationale (now reads)

The week number should be listed in addition to the reference time epoch for each of the time-dependent parameters.



<b>DOORS ID</b>	IS200-1498		
<b>Paragraph</b>	30.3.3.5 Message Type 32 Earth Orientation Parameters (EOP).	<b>Comment Number</b>	226 298
<b>Comment Type</b>	Substantive	<b>Disposition</b>	Accept
<b>Comment Originator(s)</b>	Jeff Stevens (MITRE) Jeff Crum (LMCO)		
<b>Comment</b>	226 Table and paragraph references in the final paragraph are incorrect for IS-GPS-200. 298 The table and section cross-references don't appear to be accurate. <ul style="list-style-type: none"> <li>• (Table 20-XV) -&gt; (Table 30-XIII)</li> <li>• §20.3.4.7.1 and §20.3.4.6.1 -&gt; §30.3.3.1.3 and §20.3.3.3.3.1.</li> </ul>		
<b>Government Response</b>	(See next slide for proposed changes)		



## Paragraph

## 30.3.4.5 Reference Times

## Redlines

(10<sup>th</sup> Paragraph)

A change from the broadcast reference time immediately prior to cutover is used to indicate a change of values in the CEI data set. For CNAV data, the user may use the following example algorithm to detect the occurrence of a new CEI data sequence propagation cutover:

$$\text{DEV} = t_{\text{oe}} \text{ [modulo 7200]}$$

If  $\text{DEV} \neq 5400$ , then a new CEI data sequence propagation cutover has occurred within the past 4 hours.

When  $\text{DEV} = 5400$ , the broadcast  $t_{\text{oe}}$  and  $t_{\text{oc}}$  correspond to the midpoint of the curve fit interval for that CEI data set (Table 30-~~V~~XIII). When  $\text{DEV} \neq 5400$ , the broadcast  $t_{\text{oe}}$  and  $t_{\text{oc}}$  are offset values representing a time that is a minimum of 300 seconds prior to the midpoint of the curve fit interval for that CEI data set. These offsets are accounted for in the generation of the time-dependent coefficients in the CEI data set, such that the user may directly apply the broadcast  $t_{\text{oe}}$  and  $t_{\text{oc}}$  in the algorithms of paragraphs ~~20.3.4.7.1~~30.3.3.1.3 and ~~20.3.4.6.1~~20.3.3.3.1.

Green Indicates  
Recent Change



<b>DOORS ID</b>	Figure 40-1 (sheet 4 of 11)		
<b>Paragraph</b>	Figure 40-1 (sheet 4 of 11)	<b>Comment Number</b>	229
<b>Comment Type</b>	Substantive	<b>Disposition</b>	Accept
<b>Comment Originator(s)</b>	Jeff Stevens (MITRE)		
<b>Comment</b>	Because SF4:P10 is not used for almanac in the LNAV-U data structure, it should be removed from sheet 4 that depicts the format of the almanac pages.		
<b>Government Response</b>	(See next slide for proposed changes)		

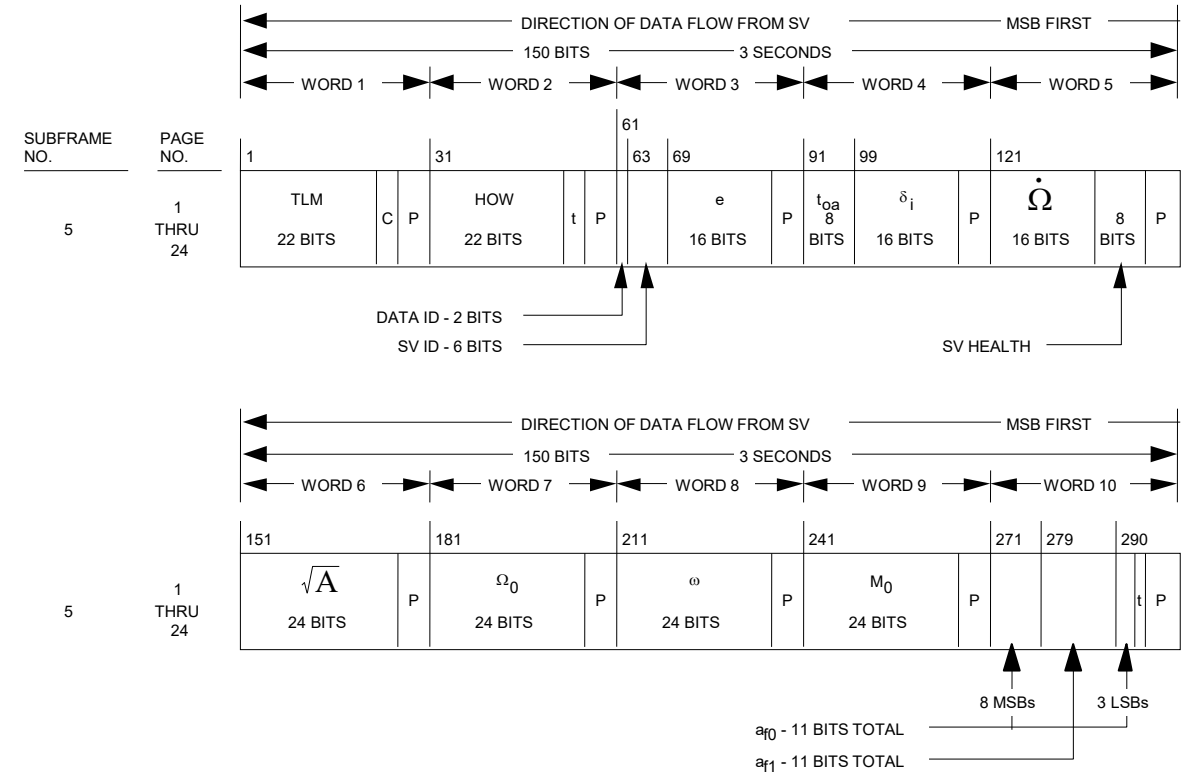




**Paragraph**  
**Redlines**

Figure 40-1 (sheet 4 of 11)

In the NOTE below the figure, change "... PAGES 2, 3, 4, 5, 7, 8, 9 & 10 OF SUBFRAME 4 ..." to "... PAGES 2, 3, 4, 5, 7, 8 & 9 OF SUBFRAME 4 ..."



P = 6 PARITY BITS  
 t = 2 NONINFORMATION BEARING BITS USED FOR PARITY COMPUTATION (SEE PARAGRAPH 20.3.5)  
 C = TLM BITS 23 AND 24. BIT 23 IS THE INTEGRITY STATUS FLAG AND BIT 24 IS RESERVED  
 NOTE: PAGES 2, 3, 4, 5, 7, 8, & 9 OF SUBFRAME 4 HAVE THE SAME FORMAT AS PAGES 1 THROUGH 24 OF SUBFRAME 5



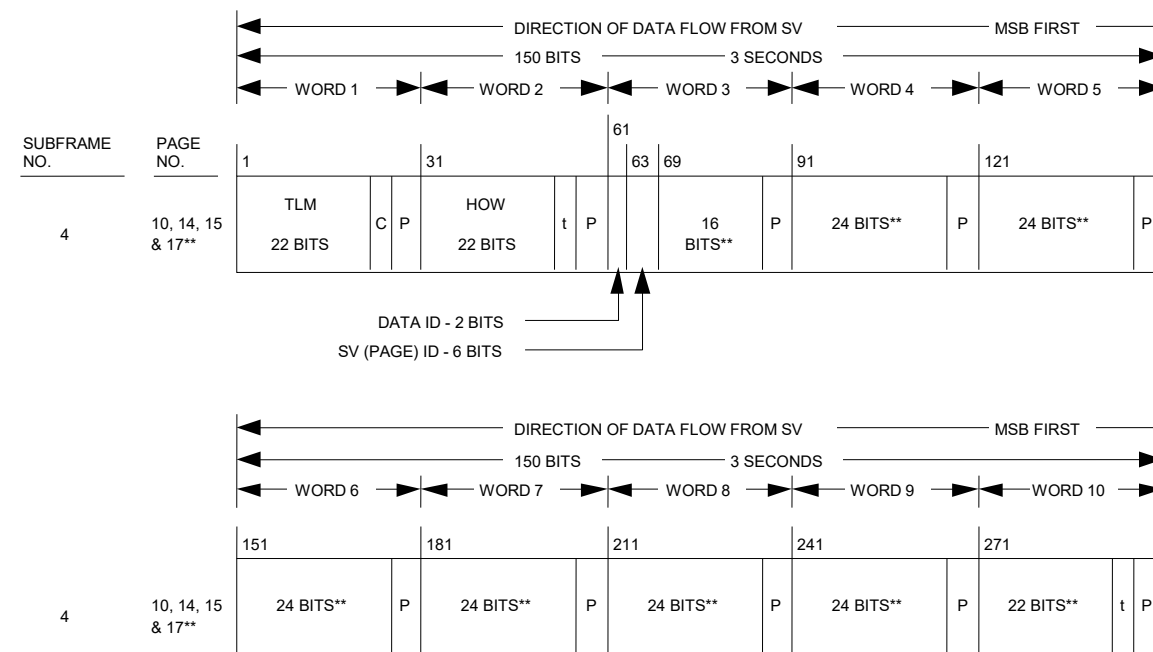
<b>DOORS ID</b>			
<b>Paragraph</b>	Figure 40-1 (sheet 11 of 11)	<b>Comment Number</b>	230
<b>Comment Type</b>	Substantive	<b>Disposition</b>	Accept
<b>Comment Originator(s)</b>	Jeff Stevens (MITRE)		
<b>Comment</b>	Because SF4:P10 is not used for almanac in the LNAV-U data structure, it should be added to sheet 11 that depicts the format of the "reserved and special messages" SF4 pages.		
<b>Government Response</b>	(See next slide for proposed changes)		



**Paragraph**  
**Redlines**

Figure 40-1 (sheet 11 of 11)

Under "PAGE NO" , change both occurrences of "14, 15 & 17\*\*" to "10, 14, 15 & 17\*\*".  
 In the double asterisk footnote below the figure, change "... OF PAGES 14 AND 15 ARE RESERVED FOR SYSTEM USE ..." to "... OF PAGES 10, 14 AND 15 ARE RESERVED FOR SYSTEM USE ...".



\*\* THE INDICATED PORTIONS OF WORDS 3 THROUGH 10 OF PAGES 10, 14 AND 15 ARE RESERVED FOR SYSTEM USE, WHILE THOSE OF PAGE 17 ARE RESERVED FOR SPECIAL MESSAGES PER PARAGRAPH 20.3.3.5.1.8  
 P = 6 PARITY BITS  
 t = 2 NONINFORMATION BEARING BITS USED FOR PARITY COMPUTATION (SEE PARAGRAPH 20.3.5)  
 C = TLM BITS 23 AND 24. BIT 23 IS THE INTEGRITY STATUS FLAG AND BIT 24 IS RESERVED



<b>DOORS ID</b>	IS200-1372		
<b>Paragraph</b>	Table 40-V. Data IDs and SV IDs in Subframes 4 and 5	<b>Comment Number</b>	231 232 270 298
<b>Comment Type</b>	Substantive/Administrative	<b>Disposition</b>	Accept
<b>Comment Originator(s)</b>	Jeff Stevens (MITRE) Rhonda Slattery (Aerospace) Jeff Crum (LMCO)		
<b>Comment</b>	<p>231 Because SF4:P10 is not used for almanac in the LNAV-U data structure and does not have an assigned SV ID, it should be indicated as "Reserved" in the table.</p> <p>232 The "Redlines" incorrectly shows the "(Note 4)" in the headings for the two SV ID columns as deleted, instead of being replaced with "(Note 3)"</p> <p>270 It appears you didn't correctly apply the notes. Note 4, now note 3, should apply to the entire column, and Note 3 was deleted, but is still referenced in specific cells</p> <p>298 The REDLINES don't match the IS so it's hard to tell what the real change is. It looks like the "IS" has the correct info so the REDLINES needs to be fixed. Improve PCN depiction of the REDLINES to match the "IS" object which appears to be correct.</p>		
<b>Government Response</b>	(See next slide for proposed changes)		



Paragraph  
Redlines

IS200-1372, Table 40-V.

Data IDs and SV IDs in Subframes 4 and 5

Page	Subframe 4		Subframe 5	
	Data ID	SV ID* (Note 43)	Data ID	SV ID* (Note 43)
1	Note(2)	121	Note(1)	65
2	Note(1)	89	Note(1)	66
3	Note(1)	90	Note(1)	67
4	Note(1)	91	Note(1)	68
5	Note(1)	92	Note(1)	69
6	Note(2)	121	Note(1)	70
7	Note(1)	93	Note(1)	71
8	Note(1)	94	Note(1)	72
9	Note(1)	95	Note(1)	73
10	Note(2)	0 Reserved	Note(1)	74
11	Note(2)	121	Note(1)	75
12	Note(2)	126	Note(1)	76
13	Note(2)	116	Note(1)	77
14	Note(2)	117	Note(1)	78
15	Note(2)	118	Note(1)	79
16	Note(2)	121	Note(1)	80
17	Note(2)	119	Note(1)	81
18	Note(2)	120	Note(1)	82
19	Note(2)	122 Note(3)	Note(1)	83
20	Note(2)	123 Note(3)	Note(1)	84
21	Note(2)	121	Note(1)	85
22	Note(2)	124 Note(3)	Note(1)	86
23	Note(2)	125 Note(3)	Note(1)	87
24	Note(2)	126	Note(1)	88
25	Note(2)	127	Note(2)	115

\* Use "0" to indicate "dummy" SV. When using "0" to indicate dummy SV, use the data ID of the transmitting SV.

Note 1: Data ID of that SV whose SV ID appears in that page

Note 2: Data ID of transmitting SV

Note 3: SV ID may vary (except for IIR/IIR-M/IF/GPS-III/GPS-III-F SVs).

Note 4: For almanac data pages, the SV ID relationship to PRN ID is defined in Table 3-1a and Table 3-1b



<b>DOORS ID</b>	IS200-2105		
<b>Paragraph</b>	40.3.3.5.1.2 Almanac Data	<b>Comment Number</b>	233
<b>Comment Type</b>	Substantive	<b>Disposition</b>	Accept
<b>Comment Originator(s)</b>	Jeff Stevens (MITRE)		
<b>Comment</b>	For consistency with LNAV-L section 20.3.3.5.1.2, the caution about attempting to track a dummy SV should be added to this section for LNAV-U.		
<b>Government Response</b>	(See next slide for proposed changes)		

**Paragraph**

## 40.3.3.5.1.2 Almanac Data

**Redlines**

The almanac message [\(174 almanac data bits and 8 SV health bits\)](#) for any dummy SVs shall contain alternating ones and zeros with valid parity. [Users are cautioned against attempting to track a dummy SV since the results are unpredictable.](#)



<b>DOORS ID</b>			
<b>Paragraph</b>	20.3.3.3.1.3 Ionospheric Data.	<b>Comment Number</b>	239
<b>Comment Type</b>	Substantive	<b>Disposition</b>	Accept
<b>Comment Originator(s)</b>	Jeff Stevens (MITRE)		
<b>Comment</b>	Extended operations are not applicable to CNAV and so the wording may be simplified.		
<b>Government Response</b>	(See next slide for proposed changes)		





## Paragraph

20.3.3.3.1.3 Ionospheric Data

## Redlines

...

...

The ionospheric data shall be updated by the CS at least once every six days while the CS is able to upload the SVs. If the CS is unable to upload the SVs, the ionospheric data transmitted by the SVs may not be accurate. ~~During extended operations, if the CS is unable to upload the SVs,~~ and the use of this model will yield unpredictable results.



<b>DOORS ID</b>	IS705		
<b>Paragraph</b>	20.3.4.4 Data Sets	<b>Comment Number</b>	240
<b>Comment Type</b>	Substantive	<b>Disposition</b>	Accept
<b>Comment Originator(s)</b>	Jeff Stevens (MITRE)		
<b>Comment</b>	This paragraph is erroneously being replaced with a duplicate copy of the newly added paragraph IS705-1736.		
<b>Government Response</b>	(See next slide for proposed changes)		

**Paragraph****20.3.4.4 CEI Data Sets****Redlines**

Except for the first CEI data set of a new CEI data sequence propagation, the start of the transmission interval for each CEI data set corresponds to the beginning of the curve fit interval for the CEI data set. Each CEI data set remains valid for the duration of its transmission interval, and nominally also remains valid for the duration of its curve fit interval. A CEI data set is rendered obsolete before the end of its curve fit interval when it is superseded by the SV cutting over to the first CEI data set of a new CEI data sequence propagation.



<b>DOORS ID</b>	IS705-1736		
<b>Paragraph</b>	20.3.4.4	<b>Comment Number</b>	241
<b>Comment Type</b>	Substantive	<b>Disposition</b>	Accept
<b>Comment Originator(s)</b>	Jeff Stevens (MITRE)		
<b>Comment</b>	<p>Recommend changing the constraint on curve fit start times to be a 15-minute boundary, which is consistent with the CS and SV implementation, and may provide more helpful information to users that wish to identify the start and end times of the currently active curve fit interval. In the first sentence, recommend using wording consistent with IS200-2121.</p> <p>(13) RATIONALE FOR CHANGE: Consistency with CS/SV implementation</p>		
<b>Government Response</b>	(See next slide for proposed changes)		



## Paragraph

IS705-1736, 20.3.4.4

## Redlines

The **start time of the** curve fit interval of the first CEI data set of a new CEI data sequence propagation may ~~have a be~~ later **than** the start time ~~than~~ of the curve fit interval of the preceding CEI data set that was transmitted prior to the cutover. The beginning of the curve fit interval of the first CEI data set of a new CEI data sequence propagation will be a multiple of ~~300~~ **900** seconds (~~5~~ **15** minutes) relative to the start of week.

Green Indicates  
Recent Change



<b>DOORS ID</b>	IS800-140, IS800-1174		
<b>Paragraph</b>	Multiple	<b>Comment Number</b>	242
<b>Comment Type</b>	Substantive	<b>Disposition</b>	Accept
<b>Comment Originator(s)</b>	Jeff Stevens (MITRE)		
<b>Comment</b>	<p>Table 3.5-9 is already in use in IS-GPS-800; see IRN-IS-800G-002 from RFC-413.                  Assign a new table number to Table 3.5-9 Maximum Repetition Rates and Maximum Broadcast Periods.                  (13) RATIONALE FOR CHANGE: Consistency</p>		
<b>Government Response</b>	<p>Will convert to Table 3.5-2a                  (See next slide for proposed changes)</p>		



Paragraph

IS800-140, IS800-1174, Multiple paragraphs

Redlines

Subframe 3 provides other navigation data which is commutated over multiple pages. -Each page of subframe 3 provides different data as shown in Figures 3.5-2 through 3.5-~~8a~~88a.- Additional subframe 3 pages may be defined in the future.- It shall be noted that the broadcast sequence of subframe 3 pages is variable-~~and,~~ as The such, maximum users repetition must rates not and expect broadcast a periods fixed are pattern given of in page Table sequence 3.5-92a in paragraph 3.5.4. Subframe 3 provides an 8-bit PRN number of the transmitting SV with a range of 0 (00000000) to 255 (11111111).

Table 3.5-92a Maximum Repetition Rates and Maximum Broadcast Intervals ~~Periods~~.

Green Indicates Recent Change

Page Data	Page Number	Maximum Broadcast Intervals †
UTC, IONO and ISC	1	144 sec
GGTO and EOP	2	144 sec ***
Reduced Almanac	3	10 min *,***
Midi Almanac	4	60 min *
Differential Corrections	5	15 min **,***
Text Message	6	As Needed
SV Configuration	7	12.5 min
Integrity Support Message	8	144 sec

\* Complete set of SVs in the constellation.  
 \*\* When Differential Corrections are available.  
 \*\*\* Optional (interval applies if/when broadcast).  
 † The intervals specified are maximum. As such, the broadcast intervals may be shorter than the specified value.



<b>DOORS ID</b>	IS800-1172		
<b>Paragraph</b>	3.5.5.2	<b>Comment Number</b>	243
<b>Comment Type</b>	Substantive	<b>Disposition</b>	Accept
<b>Comment Originator(s)</b>	Jeff Stevens (MITRE)		
<b>Comment</b>	<p>Recommend changing the constraint on curve fit start times to be a 15-minute boundary, which is consistent with the CS and SV implementation, and may provide more helpful information to users that wish to identify the start and end times of the currently active curve fit interval.</p> <p>(13) RATIONALE FOR CHANGE: Consistency with CS/SV implementation</p>		
<b>Government Response</b>	(See next slide for proposed changes)		



**Paragraph**

IS800-1172, 3.5.5.2

**Redlines**

The start time of the curve fit interval of the first CEI data set of a new CEI data sequence propagation may be later than the start time of the curve fit interval of the preceding CEI data set that was transmitted prior to the cutover. The beginning of the curve fit interval of the first CEI data set of a new CEI data sequence propagation will be a multiple of ~~300~~ 900 seconds (~~5~~ 15 minutes) relative to the start of week



<b>DOORS ID</b>	IS-GPS-705, Modifies IS705-1521 and IS705-275		
<b>Paragraph</b>	Table 6-I-1 Table 20-IV Table 30-IV	<b>Comment Number</b>	253 254
<b>Comment Type</b>	Substantive	<b>Disposition</b>	Accept
<b>Comment Originator(s)</b>	Brent Renfro (ARL UT)		
<b>Comment</b>	<p>Table 20-IV does not remove the note '**** The bit string of "100000000000" will indicate that the group delay value is not available.'</p> <p>Table 30-IV does not remove the note '**** The bit string of "100000000000" will indicate that the group delay value is not available.'</p> <p>(13) RATIONALE FOR CHANGE: This note should have been removed in RFC 442.</p>		
<b>Government Response</b>	(See next two slides for proposed changes)		



Paragraph  
Redlines

IS-GPS-705, IS705-275 Table 20-IV, Group Delay Differential Parameters

Table 20-IV. Group Delay Differential Parameters\*\*\*

Parameter	No. of Bits**	Scale Factor (LSB)	Valid Range***	Units
T <sub>GD</sub>	13*	2 <sup>-35</sup>		seconds
ISC <sub>L1C/A</sub>	13*	2 <sup>-35</sup>		seconds
ISC <sub>L2C</sub>	13*	2 <sup>-35</sup>		seconds
ISC <sub>L5I5</sub>	13*	2 <sup>-35</sup>		seconds
ISC <sub>L5Q5</sub>	13*	2 <sup>-35</sup>		seconds

\* Parameters so indicated are two's complement with the sign bit (+ or -) occupying the MSB;  
 \*\* See Figure 20-3 for complete bit allocation in message type 30;  
 \*\*\* Valid range is the maximum range attainable with indicated bit allocation and scale factor;  
 \*\*\*\* ~~The bit string of "100000000000" will indicate that the group delay value is not available.~~



Paragraph  
Redlines

IS-GPS-200, IS200-1614 and IS200-582, Table 30-IV Group Delay Differential Parameters

**Table 30-IV. Group Delay Differential Parameters** ~~\*\*\*\*~~

Parameter	No. of Bits**	Scale Factor (LSB)	Valid Range***	Units
T <sub>GD</sub>	13*	2 <sup>-35</sup>		seconds
ISC <sub>L1C/A</sub>	13*	2 <sup>-35</sup>		seconds
ISC <sub>L2C</sub>	13*	2 <sup>-35</sup>		seconds
ISC <sub>L5I</sub>	13*	2 <sup>-35</sup>		seconds
ISC <sub>L5Q5</sub>	13*	2 <sup>-35</sup>		seconds

\* Parameters so indicated are two's complement with the sign bit (+ or -) occupying the MSB;  
 \*\* See Figure 30-3 for complete bit allocation in Message Type 30;  
 \*\*\* Valid range is the maximum range attainable with indicated bit allocation and scale factor  
~~\*\*\*\* The bit string of "100000000000" will indicate that the group delay value is not available~~



<b>DOORS ID</b>	IS200-1292		
<b>Paragraph</b>	6.2.1.1 Note 3	<b>Comment Number</b>	262
<b>Comment Type</b>	Substantive	<b>Disposition</b>	Accept
<b>Comment Originator(s)</b>	Rhonda Slattery (Aerospace)		
<b>Comment</b>	If you are deleting all references to integrity status flag being off or on, you left out Note 3.		
<b>Government Response</b>	Convert off and on to 0 and 1 (See next slide for proposed changes)		

**Paragraph**

IS200-1292, 6.2.1.1 Note 3

**Redlines**

Note #3: The URA is not required to bound the instantaneous URE when: (a) an alert is issued to the users before the instantaneous URE exceeds either of the scaled URA bounds; or (b) if the integrity status flag is '~~off~~0', an alert is issued to the users no more than 8.0 seconds after the instantaneous URE exceeds the 4.42 times URA bound; or (c) if the integrity status flag is '~~on~~1', an alert is issued to the users no more than 8.0 seconds after the instantaneous URE exceeds the 4.42 times URA bound; or (d) if the integrity status flag is '~~on~~1', an alert is issued to users no more than 5.2 seconds after the instantaneous URE exceeds the 5.73 times URA bound. In this context, an "alert" is defined as any indication or characteristic of the conveying signal, as specified elsewhere in this document, which signifies to users that the conveying signal may be invalid or should not be used, such as the health bits not indicating operational-healthy, broadcasting non-standard code, parity error, etc.



<b>DOORS ID</b>	IS200-175, IS200-207		
<b>Paragraph</b>	6.2.2.2.3 Block IIR SVs 6.3.3.1 Extended Navigation Mode (Block IIR/IIR-M)	<b>Comment Number</b>	264
<b>Comment Type</b>	Substantive	<b>Disposition</b>	Accept
<b>Comment Originator(s)</b>	Rhonda Slattery (Aerospace)		
<b>Comment</b>	After 14 days they will broadcast incorrect data? I think this is not true. The accuracy will degrade, but the data is required to be "correct". Can we come up with a better phrase or just delete this sentence?		
<b>Government Response</b>	Removed the statements about "Contractual requirements...". An Interface Specification should generally restrict itself to engineering intent. (See next slide for proposed changes)		

**Paragraph**

IS200-175, IS200-207

**Redlines****6.2.2.2.3 Block IIR SV**

The block of operational replenishment SVs developed by Lockheed Martin are designated as SVNs 41-61 and are termed "Block IIR" SVs. These SVs have the capability of storing at least 60 days of navigation data with current memory margins, while operating in a IIA mode, to provide positioning service without contact from the CS for that period. ~~(Contractual requirements for these SVs specify transmission of correct data for only 14 days to support short-term extended operations while in IIA mode.)~~

**6.3.3.1 Extended Navigation Mode (Block IIR/IIR-M)**

The Block IIR/IIR-M SVs, ~~when operating in the Block IIA mode, will perform similarly to the Block IIA SVs~~ **and** have the capability of storing at least 60 days of navigation data, with current memory margins, to provide positioning service without contact from the CS for that period (through short-term and long-term extended operations). ~~(Contractual requirements for these SVs specify transmission of correct data for only 14 days to support short-term extended operations while in IIA mode.)~~ Under normal conditions, the CS will provide daily uploads to each SV, which will allow the SV to maintain normal operations as defined in paragraph 6.2.3.1 and described within this IS.





<b>DOORS ID</b>	IS200-431		
<b>Paragraph</b>		<b>Comment Number</b>	268
<b>Comment Type</b>	Substantive	<b>Disposition</b>	Accept
<b>Comment Originator(s)</b>	Rhonda Slattery (Aerospace)		
<b>Comment</b>	Why doesn't this apply to GPS III? The data is calculated the same for all the SVs. I would revert to the original language		
<b>Government Response</b>	Reverting to original. Since GPS III/IIIF SVs may not transition to short- or long-term extended operations, but the URE will still increase with time since last upload, the URE estimates for each operational interval in the table in 20.3.3.5.2.1 may not be applicable to GPS III/IIIF. (See next slide for proposed changes)		



<b>Paragraph</b>	IS200-431
<b>IS in May 2021</b>	<p>The user is cautioned that the sensitivity to small perturbations in the parameters is even greater for the almanac than for the ephemeris, with the sensitivity of the angular rate terms over the interval of applicability on the order of <math>10^{14}</math> meters/(semicircle/second). An indication of the URE provided by a given almanac during each of the operational intervals <a href="#">on Block IIR/IIR-M/IIF SVs</a> is as follows:</p>
<b>WAS at RFC origination and NOW</b>	<p>The user is cautioned that the sensitivity to small perturbations in the parameters is even greater for the almanac than for the ephemeris, with the sensitivity of the angular rate terms over the interval of applicability on the order of <math>10^{14}</math> meters/(semicircle/second). An indication of the URE provided by a given almanac during each of the operational intervals is as follows:</p>



<b>DOORS ID</b>	IS800-1174, IS800-1175		
<b>Paragraph</b>		<b>Comment Number</b>	275
<b>Comment Type</b>	Substantive	<b>Disposition</b>	Accept
<b>Comment Originator(s)</b>	Rhonda Slattery (Aerospace)		
<b>Comment</b>	I think this is in 3.5.5. To be parallel to 200 and 705, it should be after 3.5.5.1 and referenced in there.		
<b>Government Response</b>	Accept Moved to location after IS800-288. (See next slide for proposed changes)		



**Paragraph**

**Redlines**

IS800-287, ID800-288, IS800-1174, IS800-1175

**3.5.5.1 Paging and Cutovers**

Broadcast sequence of subframe 3 pages is completely arbitrary and, as such, users must not expect a fixed pattern of page sequence.

Table 3.5-2a. Maximum Repetition Rates and Maximum Broadcast Intervals

Page Data	Page Number	Defined Repetition Interval †	Maximum Broadcast Interval
UTC, IONO and ISC	1	144 sec	Not Applicable
GGTO and EOP	2	144 sec ***	Not Applicable
Reduced Almanac	3	Not Applicable	10 min ***
Midi Almanac	4	Not Applicable	60 min ***
Differential Corrections	5	Not Applicable	15 min **,***
Text Message	6	As Needed	Variable
SV Configuration	7	12 min	Not Applicable
Integrity Support Message	8	144 sec	Variable

\* Complete set of SVs in the constellation  
 \*\* When Differential Corrections are available  
 \*\*\* Optional (interval applies if/when broadcast)  
 † The intervals specified are maximum. As such, the broadcast intervals may be shorter than the specified value.



<b>DOORS ID</b>	IS800-140		
<b>Paragraph</b>	IS800 Section 3.5.1.0-3	<b>Comment Number</b>	307
<b>Comment Type</b>	Substantive	<b>Disposition</b>	Accept
<b>Comment Originator(s)</b>	Jeff Crum		
<b>Comment</b>	Text is incorrectly modified to remove Figure 3.5-8a. That figure needs to be cited because it was added to IS800 via RFC-413 and is part of the baseline IS-GPS-800H.		
<b>Government Response</b>	Include Figure 3.5-8a because it was added in RFC-413. (See next slide for proposed changes)		



## Paragraph

IS800 Section 3.5.1 Message Content

## Redlines

(3<sup>rd</sup> Paragraph)

Subframe 3 provides other navigation data which is commutated over multiple pages. -Each page of subframe 3 provides different data as shown in Figures 3.5-2 through 3.5-~~8a~~8a.- Additional subframe 3 pages may be defined in the future.- It shall be noted that the broadcast sequence of subframe 3 pages is variable-~~and, as~~The such, maximum users repetition mu~~strates~~notand expect broadcast a periods fixed are pattern given of in page Table sequence~~3.-5-2a~~. Subframe 3 provides an 8-bit PRN number of the transmitting SV with a range of 0 (00000000) to 255 (11111111).



<b>DOORS ID</b>	IS800-1174		
<b>Paragraph</b>	IS800 Section 3.5.4.0-3	<b>Comment Number</b>	308
<b>Comment Type</b>	Substantive	<b>Disposition</b>	Accept
<b>Comment Originator(s)</b>	Jeff Crum		
<b>Comment</b>	Modify Table Caption/Title to be consistent with similar tables from IS200 and IS705.		
<b>Government Response</b>	(See next slide for proposed changes)		



Paragraph

IS800 Section 3.5.4.0-3

Redlines

[Table 3.5-2a. Maximum Repetition Rates and Maximum Broadcast Intervals](#)

*Object Type:* [Table Caption](#)



# Open RFC Discussion



- **Address Questions or comments**



# Action Item Review



# Global Positioning System (GPS)

## Public Interface Control Working Group (ICWG) & Public Forum Special Topics Briefing

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29 September, 2021  
0830-1630 PDT

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



# CNAV/CNAV2 Message Schedule and Broadcast Interval Working Group

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29 September 2021

Bert Hayden, SAIC  
Karl Kovach, Aerospace



# CNAV/CNAV2 Message Schedule and Broadcast Interval Working Group

- Working group to discuss scheduling issues
  - CNAV message schedules
  - CNAV2 subframe-3 page schedules
  - Maximum broadcast interval tables
    - Midi-Almanac, Differential Corrections, ARAIM ISM, GGTO
  - Single-frequency vs. dual-frequency operations
- For more information or to register to participate please email
  - SSC GPER Workflow [smcgper@us.af.mil](mailto:smcgper@us.af.mil)
  - Bert Hayden (SE&I) [albert.h.hayden@saic.com](mailto:albert.h.hayden@saic.com)
  - Karl Kovach (Aerospace) [karl.i.kovach@aero.org](mailto:karl.i.kovach@aero.org)



*QUESTIONS?*



# CNAV/CNAV-2 ISM Parameter

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29 September 2021

ZACS Civil/Andrew Hansen  
CAO



# Current CNAV/CNAV-2 ISM Parameters

- IS-GPS-200M/705H/800H Define Message Type 40 (ISM for ARAIM)

Content	Field	Bits	Cum.
GNSS ID	1	4	4
WN <sub>ISM</sub>	2	13	17
TOW <sub>ISM</sub>	3	6	23
t_correl	4	4	27
b_nom	5	4	31
γ_nom	6	4	35

Content	Field	Bits	Cum.
R_sat	7	4	39
P_const	8	4	43
MFD	9	4	47
Service Level	10	3	50
Mask	11	63	113
ISM CRC	12	32	145

These three parameters were addressed by SARPS/MOPS work on ARAIM.







# Proposed ISM Parameter Update

- ICAO SARPS & RTCA/EUROCAE MOPS Community request  
Treat constellation fault in the same manner as satellite fault, i.e. rate & mean fault duration, for improved performance of ARAIM formulation

Content	Field	Bits	Cum.
GNSS ID	1	4	4
WN <sub>ISM</sub>	2	13	17
TOW <sub>ISM</sub>	3	6	23
t <sub>correl</sub>	4	4	27
b <sub>nom</sub>	5	4	31
γ <sub>nom</sub>	6	4	35

Content	Field	Bits	Cum.
R <sub>sat</sub>	7	4	39
MFD <sub>sat</sub>	8	4	47
R <sub>const</sub>	9	4	43
MFD <sub>const</sub>	10	4	51
Service Level	11	3	54
Mask	12	63	117
ISM CRC	13	32	149

Propose changing  $P_{const}$  to  $R_{const}$  and add an  $MFD_{const}$  for constellation faults



Proposed  $MFD_{const}$  values, in hours, of [0.25 0.5 1 2 4 6 8 10 12 16 20 24 30 36 42 48]



*QUESTIONS?*



# Issue of Data, Clock (IODC) Brief

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29 September 2021

Maj Sam Meyer  
Chief, ZACS-PNT R & I



- GPS IODC/IODE Concern
- Background
- Way Forward



# GPS IODC/IODE Concern

- Issue of Data, Clock (IODC) a value of 0-1023; used to identify updated GPS clock data
- Issue of Data, Ephemeris (IODE) a value of 0-255; used to identify updated GPS Ephemeris data
- Per IS-GPS-200, IODE must match corresponding portion of IODC in broadcast and values may not repeat within 6 days
- Concern is repetition (or mismatch) of IODC/IODE
  - ICD non-compliance may cause calculation errors with user equipment affecting PNT data between the two
  - Potential for safety-of-life event; none reported to date
  - Approximately 137 IODC repetition violations since 2007

*IS-GPS-200 has always specified IODC values of 0-1023*



# Background

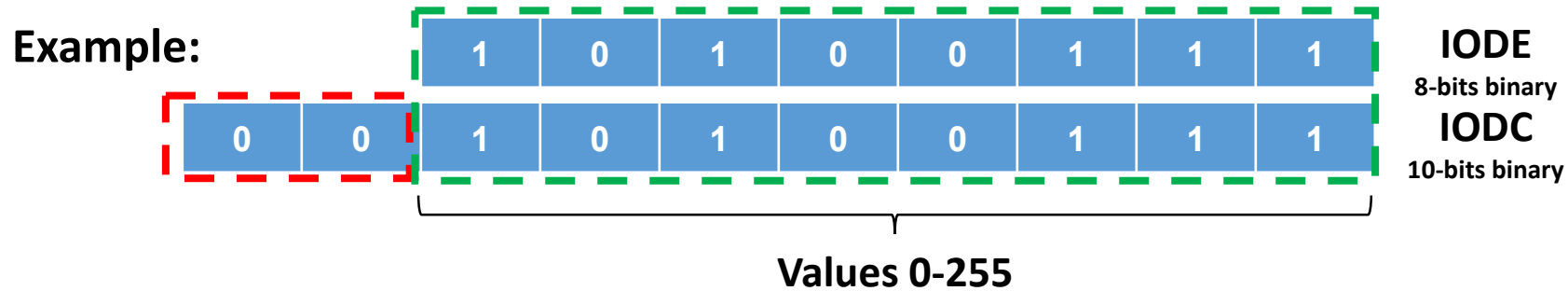
- Legacy GPS control system used IODC range 0-1023 until Architecture Evolution Program (AEP) IOC in Sep 2007; AEP's IODC range is 0-255
- AEP 7.1.0 fielded Sep 2017; AEP's IODC algorithm updated to use full ICD range 0-1023

*In resolving a known issue on GPS that could impact compliant receiver/user equipment, we uncovered an issue with non-compliant chipsets*



# Background, cont

- Incoming reports indicated this change affected millions of GPS receivers which were non-compliant with ICD
- AEP 7.1.0 released IODC algorithm to use range 0-1023; added resiliency to operations. Resulting in roughly 2 million GPS receiver chipsets negatively affected
- AEP 7.1.1 removed IODC due to the affected GPS receivers



*SMC/GP and 50 SW/CC issued joint memo Dec 2017; stated intention to re-deploy no earlier than Mar 2018*



# Way Forward

- Implement full IODC range in AEP
- ECPG implement with “toggle on/off” capability
- 2 SOPS issue Notice Advisory to NAVSTAR Users (NANU) to notify users of IODC expansion activation date (ie - “toggle on” date)





*QUESTIONS?*



# AEP vs. OCX Almanac time of almanac (toa) Behavior

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29 September 2021

Leif Knag  
Raytheon/L3 Harris



# AEP vs. OCX toa Behavior

- AEP nominally generates almanacs on a daily basis with a series of 5 almanac fit intervals that start at 22:00 of a given day
  - Even when almanacs are not generated at the normal time of day, they still go back to the last 22:00 epoch for the start of the first fit interval
  - An almanac generated exactly at 22:00 will go back to the previous 22:00 epoch for the start of the first fit even though the most recent K-point will be used for propagations
  - Nominal toa values are in bold and other allowable off-nominal toa values are described below from the AEP OPS Tech Order:

## NOTE

The following are the Time of Almanac (TOAs, in seconds from the beginning of the GPS week) for the corresponding 24-hour almanac interval\*:

(SUNDAY/2200 - MONDAY/2200): 307200, **319488**  
 (MONDAY/2200 - TUESDAY/2200): 393216, **405504**  
 (TUESDAY/2200 - WEDNESDAY/2200): 479232, 491520, **503808**  
 (WEDNESDAY/2200 - THURSDAY/2200): 565248, 577536, **589824**  
 (THURSDAY/2200 - FRIDAY/2200): 36864, 49152, **61440**  
 (FRIDAY/2200 - SATURDAY/2200): 122880, 135168, **147456**  
 (SATURDAY/2200 - SUNDAY/2200): 208896, 221184, **233472**

\* All times are GPS time. Nominal values are displayed as bold; other values are possible given almanac adjusts.

- OCX also generates almanacs on a daily basis (1 or 2 times a day) using 5 fit intervals, with the nominal configuration being once a day at the 22:00 epoch. However, the time of the start of the first fit is always the time of the most recent ZAOD (K-point)
  - When a manually generated almanac is generated, it will not go back to the last 22:00 epoch for the start of the first fit, but will use the most recent ZAOD as the time of the start of the first fit.



# Example Almanac Fit Intervals and toa

- The following are examples of different almanac generations between AEP and OCX
- Here, tgs units are total GPS seconds since the start of GPS time

## Example of generation of an almanac on a 22:00 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

## Example of generation of an almanac NOT on a 22:00 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



# The Differences for Users

- Both AEP and OCX are providing almanacs in a way that is compliant with IS-GPS-200, but the behavior will be slightly different from a user perspective
- After OCX becomes operational the users will see the following:
  - The toa will be as much as a day later for new uploads
  - Nominally, the toa values used by OCX will be the same as AEP
    - OCX almanacs are generated at 22:00 each day and AEP/OCX both use the same logic for determining the toa when the fit intervals are aligned
  - When an off-nominal manual OCX almanac is generated, it will have an arbitrary toa value based on the time that the almanac is generated. This allows an almanac to be generated with any possible toa value.
    - This is different from AEP, which goes back to the last 22:00 epoch to calculate the first toa (with other possible toa values listed on the previous chart)
    - If a receiver is expecting the nominal time of almanac values that AEP has used for the past 14 years, they may be impacted by this change
- Though the differences are minor and in compliance with IS-GPS-200 (as well as other navigation data types), we felt it would be prudent to make the user community aware of the changes



*QUESTIONS?*



# GPS Non-Standard Codes

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29 September 2021

Karl Kovach  
The Aerospace Corp.



- **Reasons for Non-Standard Codes (NSCs)**
  - For integrity and robustness in safety-critical applications
- **Important NSC Characteristics**
  - A warning that is <sup>①</sup>timely, <sup>②</sup>clear, and <sup>③</sup>unambiguous
- **Tour of the Seven (7) GPS NSCs\***
  - Non-Standard C/A-code (NSCA)
  - Non-Standard CM-code (NSCM)
  - Non-Standard CL-code (NSCL)
  - Non-Standard I5-code (NSI5)
  - Non-Standard Q5-code (NSQ5)
  - Non-Standard L1C<sub>D</sub>-code (NSCD)
  - Non-Standard L1C<sub>P</sub>-code (NSCP)

*\* Most have never seen these recipes before...*





- **From International Civil Aviation Organization (ICAO)**
  - International Standards and Recommended Practices (SARPs)
    - Annex 10 to the Convention on International Civil Aviation
      - Volume 1, Radio Navigation Aids
        - 3.7 Requirements for the Global Navigation Satellite System (GNSS)
          - 3.7.1 Definitions...

***Integrity.*** A measure of the trust that can be placed in the correctness of the information supplied by the total system. Integrity includes the ability of a system to provide timely and valid warnings to the user (alerts).



# Important (Required) Characteristic ①

***Integrity.*** A measure of the trust that can be placed in the correctness of the information supplied by the total system. Integrity includes the ability of a system to provide **timely** and valid **warnings** to the user (alerts).

- **For integrity use, NSCs must be timely warnings**
  - ① “Timely” = on the order of 10 seconds or so
    - Range of 6 seconds to 5 minutes for the various phases of flight
      - 6 s = Category I precision approach (e.g.)
      - 10 s = initial approach, non-precision approach, departure, etc.
      - 15 s = en route navigation (terminal)
      - 5 min = en route navigation (oceanic)



# GPS Timely Warnings ①

- **Pre-Planned Warnings**
  - Such as for scheduled satellite maintenance activities
  - ➔ Health flags in the broadcast navigation (NAV) message
    - Well-defined in GPS Interface Control Documents (ICDs)
- **Close to Real-Time Warnings**
  - Such as for surprise satellite failures or upload failures
  - ➔ Ground-issued SatZap command (PRN-37 or NSC)
    - Less risky for satellite hardware than amplifier power-off
- **Effectively Real-Time Warnings**
  - Such as for satellite on-board detection of potential failures
  - ➔ Satellite autonomous initiation of NSC transmissions
    - Ground can still track NSC to troubleshoot the symptoms



# Important (Required) Characteristics ②③

**Integrity.** A measure of the trust that can be placed in the correctness of the information supplied by the total system. Integrity includes the ability of a system to provide timely and **valid warnings** to the user (alerts).

- For integrity use, NSCs must be valid warnings
  - “Valid” = ②clear and ③unambiguous
  - Received correlation power drop >20 dB (>99%) is ②clear
    - Doesn’t even require receiver to continuously demod NAV data
  - Received correlation power drop >20 dB (>99%) is ③**ambiguous**
    - Power drop could be due to signal obscuration (e.g., wing shadowing)
    - Sometimes receivers will still track even with a >20 dB power drop

*“Valid” also includes false alert (false warning) considerations*



# Important (Required) Characteristics ②③

**Integrity.** A measure of the trust that can be placed in the correctness of the information supplied by the total system. Integrity includes the ability of a system to provide timely and **valid warnings** to the user (alerts).

- **For integrity use, NSCs must be valid warnings**
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      - Doesn’t even require receiver to continuously demod NAV data
    - Received correlation power drop >20 dB (>99%) is ③**ambiguous**
      - Power drop could be due to signal obscuration (e.g., wing shadowing)
      - Sometimes receivers will still track even with a >20 dB power drop
  - ➡ Publishing the NSC definitions makes them ③**unambiguous**

*Hence the rationale for this paper...*



# >20 dB Drop on One Signal is a Sign

- **>20 dB Drop on Just One Signal is Ambiguous Sign**
  - Tracking multipath signal when direct signal blocked
  - Tracking NSC when standard code signal replaced
- **Either Way, Integrity-Conscious Receiver will Heed Sign**
  - Publishing NSC sequences lets receiver distinguish which
    - If NSC, then warned to NOT USE the measurements
    - If multipath, then probably ought not use the measurements
- **Integrity-Oblivious Receiver may Simply Ignore Sign**
  - Can lead a receiver designer to knowledge...
    - But can't make them think!



# Tour of the Seven (7) GPS NSCs

- Non-Standard C/A-code (NSCA)
- Non-Standard CM-code (NSCM)
- Non-Standard CL-code (NSCL)
- Non-Standard I5-code (NSI5)
- Non-Standard Q5-code (NSQ5)
- Non-Standard L1C<sub>D</sub>-code (NSCD)
- Non-Standard L1C<sub>P</sub>-code (NSCP)



# Non-Standard C/A-code (NSCA)

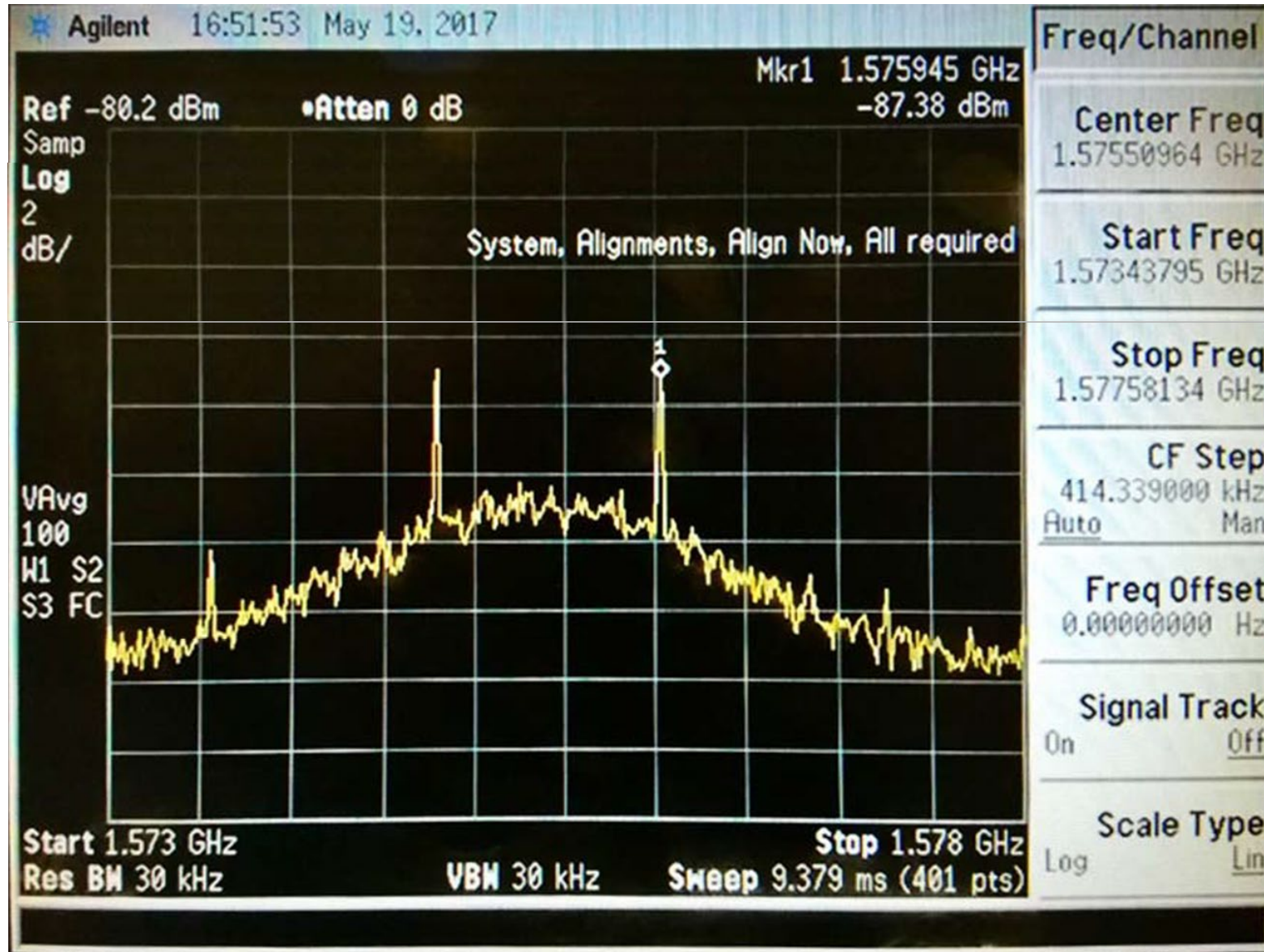
- **BOC[0.5,0.00005] Signal**
  - Baseline established with ICD-GPS-200, 25 Jan 83
  - GPS's first BOC signal (quarter century before M-code)
  - Binary sequence not published in ICD-GPS-200 however

**3.2.1.4 Non-standard Codes. The NSC and NSY codes, used to protect the user from a malfunction in the SV's reference frequency system (reference paragraph 3.2.1) are not for utilization by the user and, therefore, are not defined in this document.**



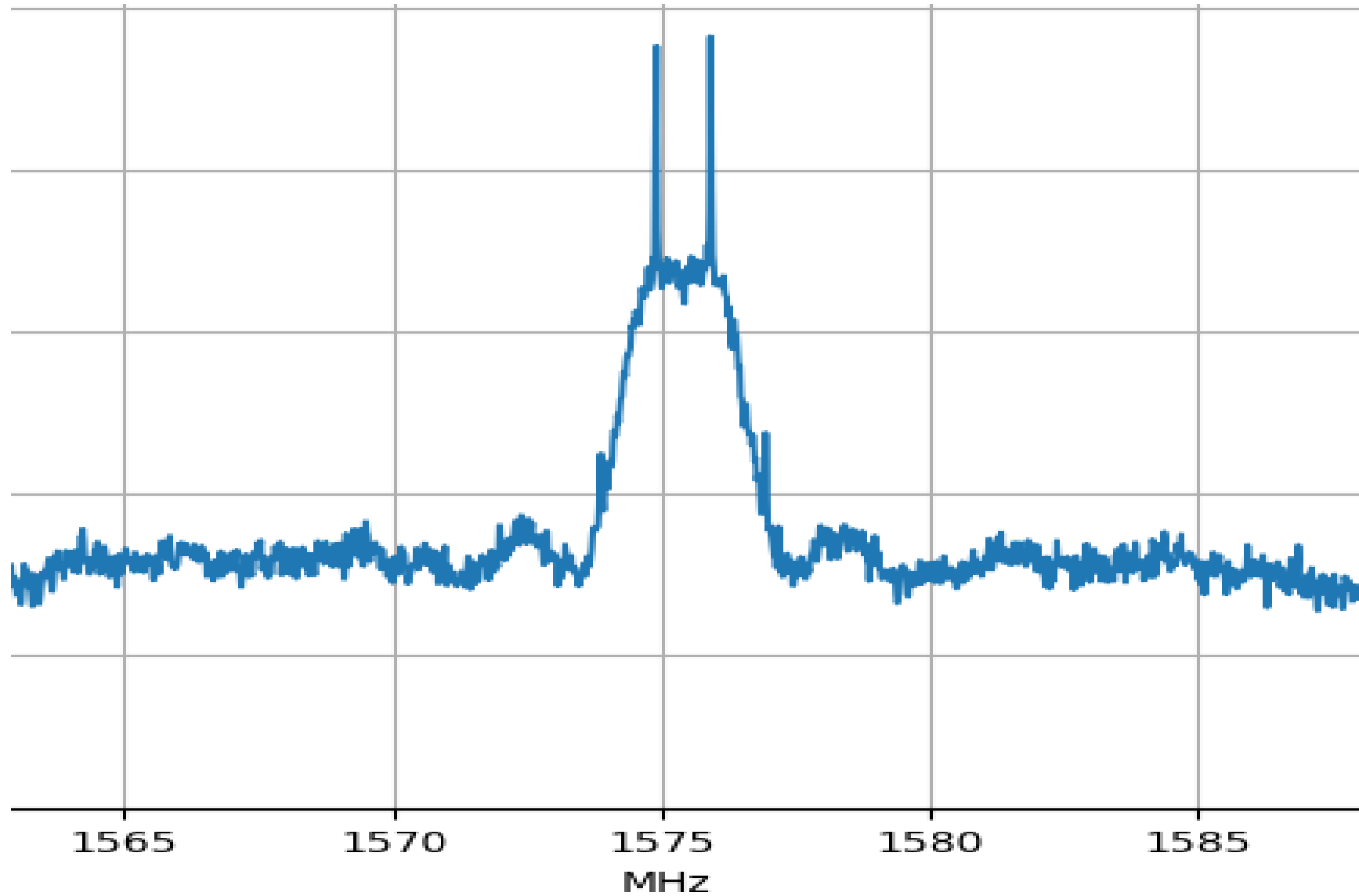


# NSCA, aka "Horns of the Devil"





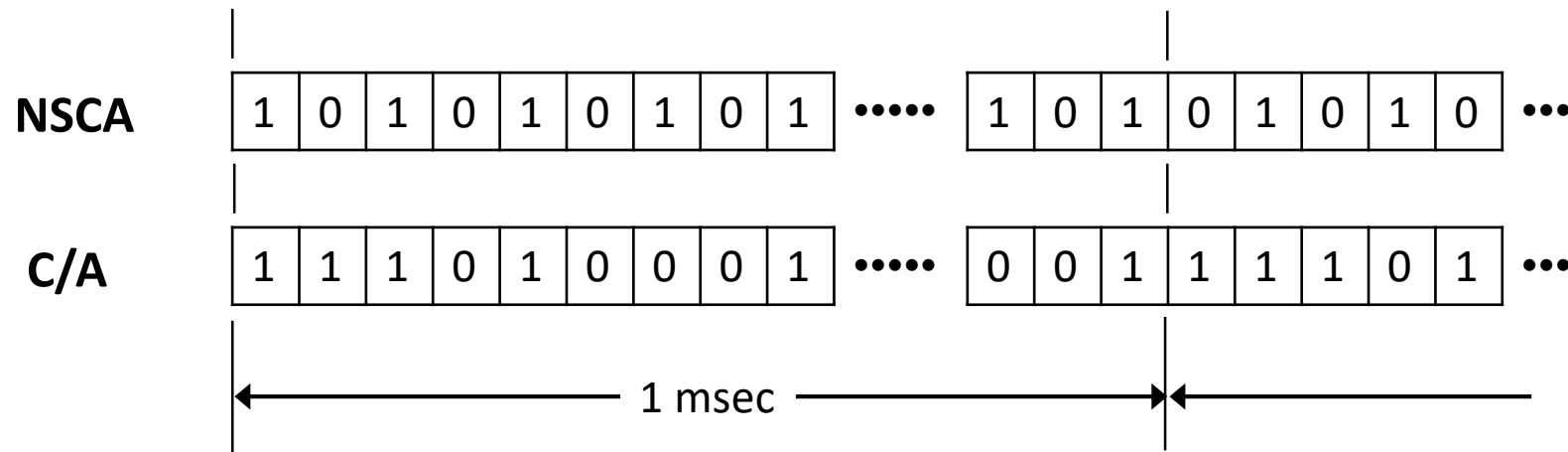
# NSCA, aka "Horns of the Devil"





# NSCA has Special Properties

- **Over any Multiple of 2 msec Integration Interval**
  - Cross-correlation with C/A-code is zero at zero  $\Delta$ -Doppler
  - $\gg 20$  dB correlation power drop

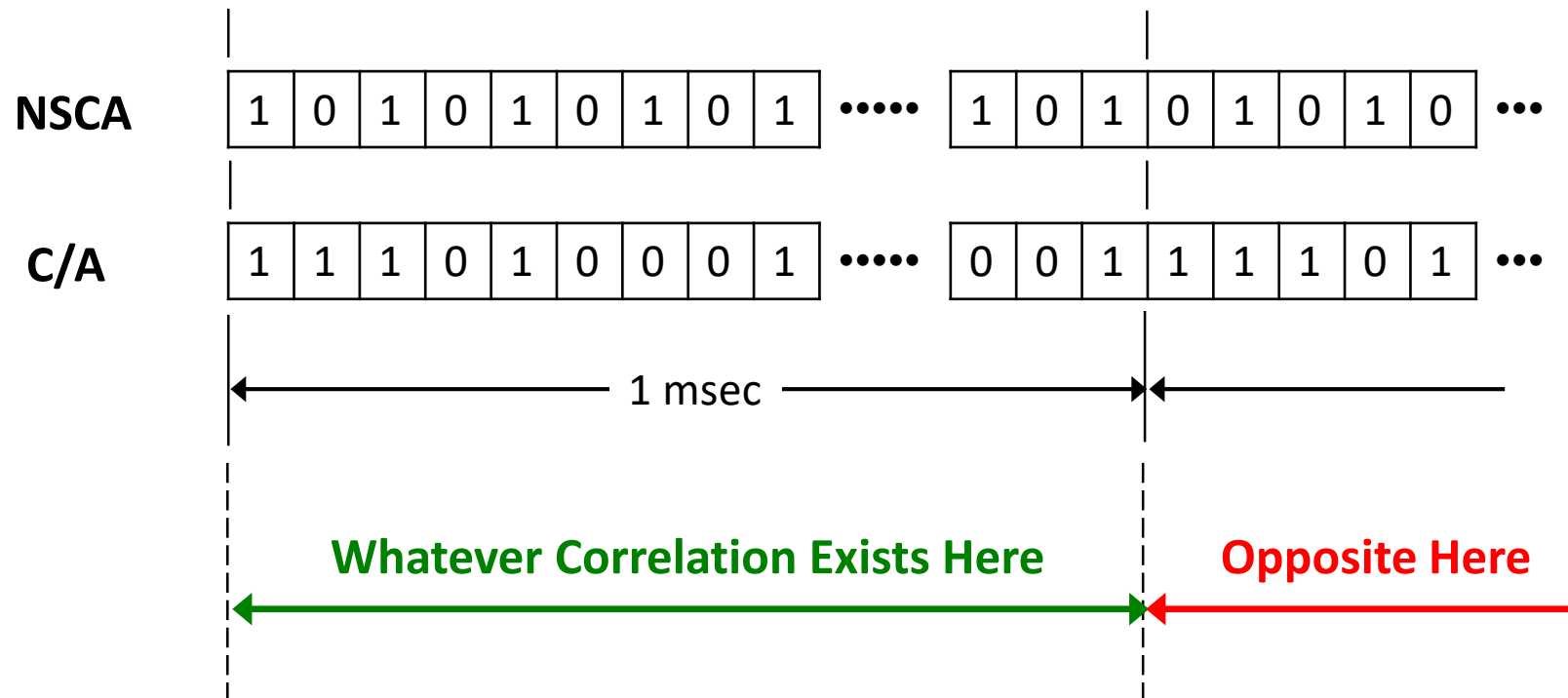


- NSC repeats every 2 msec (2046 chips)
- C/A repeats every 1 msec (1023 chips)



# NSCA has Special Properties

- Over any Multiple of 2 msec Integration Interval
  - Cross-correlation with C/A-code is zero at zero  $\Delta$ -Doppler
  - $\gg 20$  dB correlation power drop





# Integrity Warning!



**DO NOT USE any of these NSC recipes for Position, Navigation, or Timing (PNT) purposes other than to confirm the transmission of NSC signals and thereby preclude inadvertent use of NSC signal information.**



- **NSCM (L2C Moderate Length Code) is Not Special**
  - Just a previously unpublished L2CM code (20 msec long)

NSCM Initial Shift Register State (Octal)

437607611

Chipping rate of 511.15 kbps

Short cycled period = 10230

- **NSCL (L2C Long Length Code) is Not Special**
  - Just a previously unpublished L2CL code (1500 msec long)

NSCL Initial Shift Register State (Octal)

100726411

Chipping rate of 511.15 kbps

Short cycled period = 767250

- **NSCM & NSCL Correlation Power Drops Not Special**
  - Same as cross-correlation between standard L2CM & L2CL codes



# Remaining Four (4) GPS NSCs

- Same 'Not Special' Design Choice for other NSCs
  - Non-Standard I5-code (NSI5)
  - Non-Standard Q5-code (NSQ5)
  - Non-Standard L1C<sub>D</sub>-code (NSCD)
  - Non-Standard L1C<sub>P</sub>-code (NSCP)
- Unpublished Codes from the Same Code Families
  - Recipes are in the paper
  - NSC correlation power drops not special
    - Same as cross-correlations between standard codes



# Summary of the GPS NSCs

Non-Standard Code	Special	Correlation Power Drop
NSCA	Y	$> \sim \infty$ dB
NSCM	N	$> \sim 25.1$ dB
NSCL	N	$> \sim 43.9$ dB
NSI5	N	$> \sim 27.7$ dB
NSQ5	N	$> \sim 27.9$ dB
NSCD	N	$> \sim 26.9$ dB
NSCP	N	$> \sim 28.7$ dB





- **GPS NSCs are Robust Integrity Warnings**
  - ① **Timely** for satellite on-board fault detection alerting
  - ② **Clear** even in poor signal conditions when NAV data unreliable
  - ③ **Ambiguous** for some receivers under excellent signal conditions
- **Tour of the Seven (7) GPS NSCs**
  - NSCA is special and ③ **unambiguous** for signal tracking operation
  - Other NSCs only offer >100-fold drop in correlation power (>20 dB)
- **Recommendations**
  - Focus on presence/absence of C/A-code for integrity warning
  - If monitoring C/A-code is impossible/impractical for some reason...
    - If care about integrity and if receiver will use >20 dB weaker tracking...
      - Then use NSC recipes in this paper to check for presence of NSC



*QUESTIONS?*

# Next Generation GPS - OCX Public Release Data Products

---

29 September 2021



Presenters  
*Stephan M Hillman*  
*The Aerospace Corporation*

*Claudia Vinnedge*  
*The Raytheon Corporation*



# Background

GPS Control Segment (CS) currently distributes four data products as defined in ICD-GPS-240 via the USCG Navigation Center:

- Notice Advisory to Navstar Users (NANU)
- Operational Advisory (OA)
- Almanac (SEM & YUMA)
- Satellite Outage File (SOF)
- See: <https://www.navcen.uscg.gov/?pageName=gpsAlmanacs>

The 2d Space Operations Squadron (2SOPS) also makes these products available as well as the Anti-Spoof (A-S) file.

- See: <https://gps.afspc.af.mil/gps/conststatus.html>

In the OCX era, all five data products will be consolidated into four schema-based XML products defined in ICD-GPS-870 and distributed via the USCG Navigation Center:

- GPS Advisory (equivalent NANU content)
- GPS Advisory Collection (equivalent SOF content)
- Ops Status (equivalent Ops Advisory content)
- Public Common Almanac (equivalent SEM, YUMA, and A-S content)

# OCX-Era Product Design



The OCX-era products were designed to be compliant with the National Information Exchange Model (NIEM)

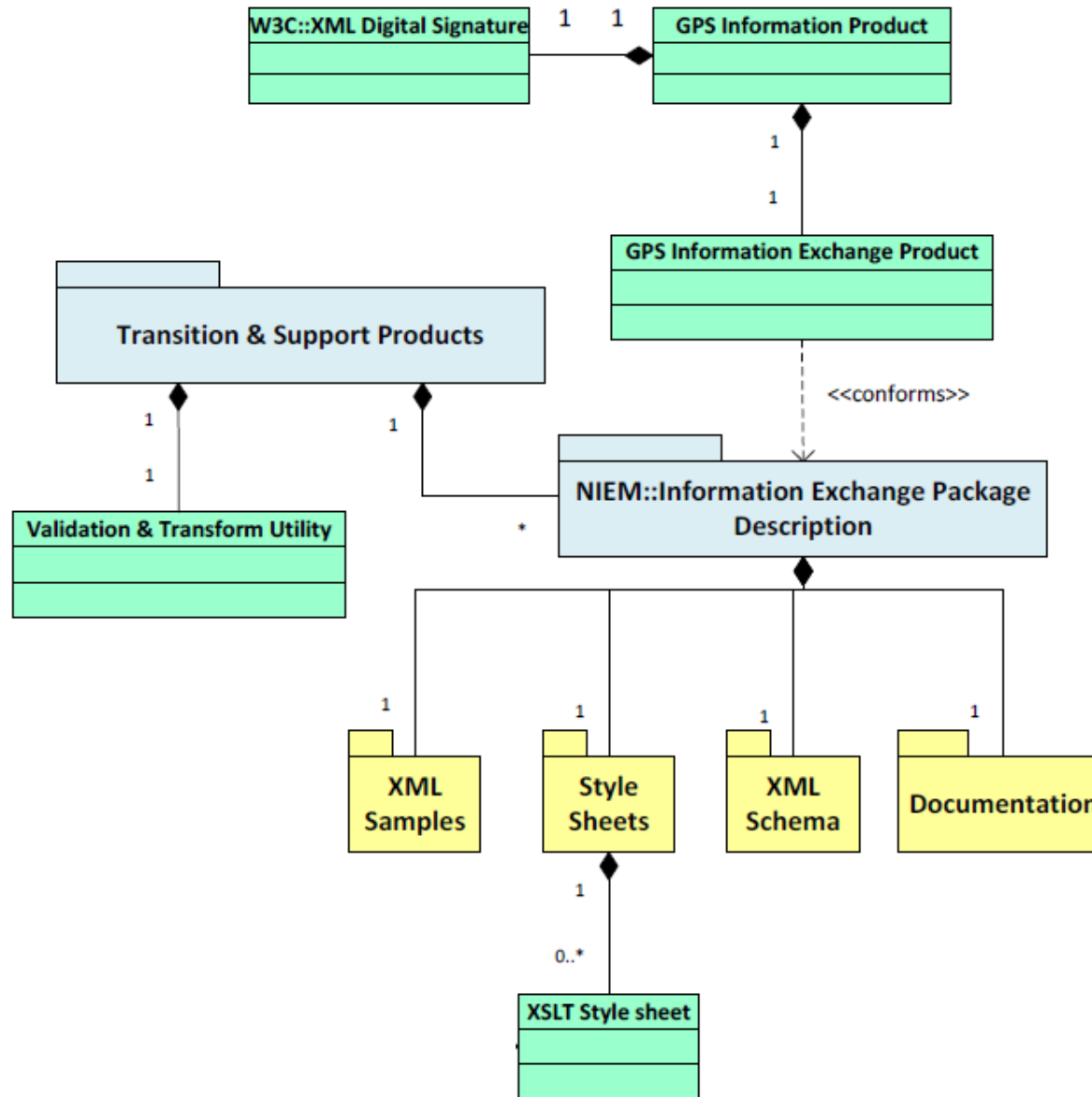
- “NIEM is a common vocabulary that enables efficient information exchange across diverse public and private organizations”
- The OCX-era products are compliant with NIEM Version 2.1
- See: <https://www.niem.gov/>

IAW NIEM, each OCX-era product has an associated Information Exchange Package Documentation (IEPD)

- “A NIEM IEPD is a package that describes the construction and content of a NIEM information exchange”
- For the OCX-era products, each IEPD will be provided in the form of a digitally signed zip file containing a pre-defined directory structure with:
  - XML Schema
  - XML Sample Product/s
  - XSLT Stylesheet/s
  - Legacy (AEP-era) Sample Product/s
  - Documentation

All OCX-era products will be digitally signed using DoD PKI

# OCX-Era Product High Level Ontology



# Backwards Compatibility Approach



For systems that cannot or will not be updated to process the directly-distributed XML files after OCX transition, XSLT Stylesheets are provided for each IEPD that has one or more corresponding AEP-era product

- The Stylesheets conform to W3C standards and allow for transformation of the directly-distributed XML products into the AEP-era ASCII text formats
  - Or DTD XML format in the case of the SOF file

For those users without the knowledge or resources to directly utilize the XSLT Stylesheets, GPS will provide a downloadable utility which will ingest an XML product and relevant XSLT Stylesheet, and then output the desired AEP-era formatted file

- The Validate and Transform Utility (VATU) is a stand-alone application that can be installed and used on local workstations
- Java must be installed on the subject workstation

The tool and all IEPDs will be posted to the USCG NAVCEN public web site



Ops Status IEPD is the first of three IEPDs that will be released to the public for socialization over the coming months

- The remaining two IEPDs will be the GPS Advisory IEPD and the Public Common Almanac IEPD
  - The GPS Advisory IEPD is used for both the GPS Advisory (NANU) and the GPS Advisory Collection (SOF) products
- All of the IEPDs follow the same basic structure and conform to the same standards

The Ops Status product provides the same information as found in the AEP-era Operational Advisory (OA) product, per the definition found in ICD-GPS-870 Rev E, Appendix 2





# Ops Status Product 2 of 8

The files and folders shown in Figure 1 will be visible under the main directory of the zipped IEPD:

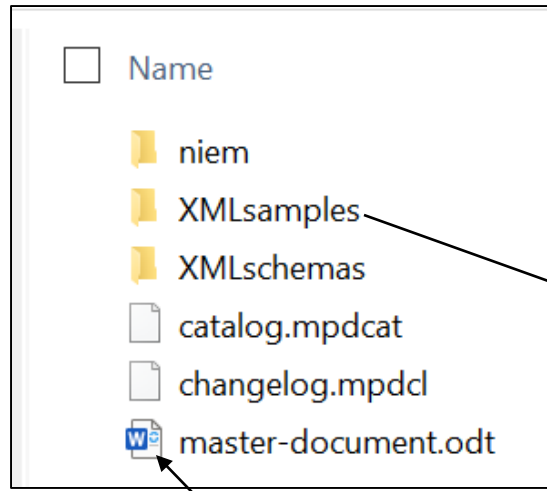


Figure 1

Provides a list of artifacts, schemas, definitions, business rules, and other information found in the IEPD

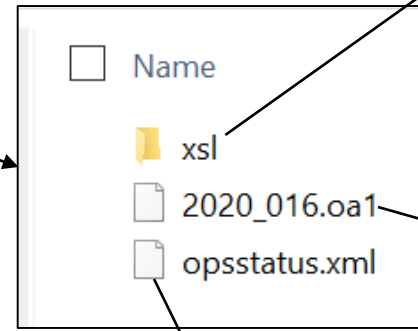


Figure 2

Sample of the directly distributed, NIEM-compliant XML product

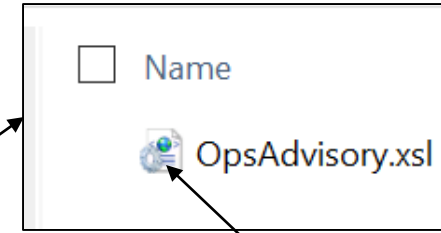


Figure 3

Sample of the legacy text formatted product, generated via the provided XSLT Stylesheet



Schema is provided to simplify adoption of the NIEM-compliant XML products

Mapping from NIEM-compliant XML data elements to the legacy text product can be found in the XSLT Stylesheet

The GPS program acknowledges not all users will be familiar with schema or XSLT standards, so the previously mentioned Validate and Transform Utility (VATU) is provided and will be demonstrated at this time



# Ops Status Product 4 of 8

The NIEM-compliant XML content maps to the legacy text Sections as follows:

- Section 1 – Plane, Slot, & AFS Assignment
  - This data is grouped under the “opsstatus:Constellation” element within individual SpaceVehicle records for each PRN as follows:

```
<gpspub:SpaceVehicle xsi:type="gpspub:GPSSpaceVehicleType"
s:id="vehref27">
  <gpspub:PseudoRandomNoiseID>27</gpspub:PseudoRandomNoiseID>
  <gpspub:SlotNumeric>3</gpspub:SlotNumeric>
  <gpspub:PlaneText>F</gpspub:PlaneText>
  <gpspub:SVBlockCode>IIR</gpspub:SVBlockCode>
  <gpspub:NavigationPayload>
    <gpspub:Clock>
      <gpspub:AtomicClockKindCode>rubidium</gpspub:AtomicClockKindCode>
    </gpspub:Clock>
  </gpspub:NavigationPayload>
</gpspub:SpaceVehicle>
```



- Section 2 – Current and recent advisories, forecasts, and general text NANUs
  - This data is grouped within individual SpaceEvent records for each PRN as follows:

```

<opsstatus:GPSSpaceEvent>
  <gpspub:SpaceEventKindCode>Launch</gpspub:SpaceEventKindCode>
  <gpspub:GPSSpaceVehicleReference s:ref="vehref15"/>
  <opsstatus:GPSMetadata>
    <nc:EffectiveDate>
      <nc:DateTime>2009-01-01T11:05:00.000Z</nc:DateTime>
    </nc:EffectiveDate>
    <nc:ReportedDate>
      <nc:DateTime>2009-01-01T11:05:00.000Z</nc:DateTime>
    </nc:ReportedDate>
    <gpspub:DESVersionNumeric>9</gpspub:DESVersionNumeric>
    <gpspub:NtkDESVersionNumeric>7</gpspub:NtkDESVersionNumeric>
    <gpspub:ResourceElementIndicator>>false</gpspub:ResourceElementIndicator>
    <gpspub:CreateDate>2020-01-16T16:31:09.000Z</gpspub:CreateDate>
    <gpspub:IdentifierValueText>2009001</gpspub:IdentifierValueText>
  </opsstatus:GPSMetadata>
</opsstatus:GPSSpaceEvent>

```



# Ops Status Product 6 of 8

- Section 2 – Continued
  - The following provides a basic mapping between key data elements within the GPSSpaceEvent element and the legacy Ops Advisory format:
    - **SpaceEventKindCode** – NANU Type
      - Enumerations are fully spelled out rather than abbreviations
      - Ex, ForecastDeltaV instead of FCSTDV
    - **GPSSpaceVehicleReference** – PRN
    - **EffectiveDate** = **ReportedDate** – MSG DATE/TIME
    - **ActivityDate** – Event Start/Stop time as seen in the SUMMARY column
      - This is an optional element and may not be present if the NANU has no start/stop time information
      - **ActivityDateRange** will be used if the event has both start and stop DTG, with the start and stop DTG contained within the **StartDate** and **EndDate** elements
    - **CreatedDate** – The creation DTG of the Ops Status product



# Ops Status Product 7 of 8

- Section 3 – Point of Contact Information as well as the publication date from the SUBJ line of the Ops Advisory
  - This data is grouped under the “opsstatus:Constellation” element within the GPSMetadata record
    - Three Date-Time Groups (DTG) are listed within the GPSMetadata record, but only one directly relates to the legacy Ops Advisory format
      - **CreatedDate**: DTG of product creation
        - used to populate the publish date found in the SUBJ line of the legacy Ops Advisory
      - **ReportedDate**: defaults to same DTG as CreatedDate
      - **EffectiveDate**: the DTG when OCX’s internal processes pulled the raw data used to construct the product



# Ops Status Product 8 of 8

- Section 3 – Continued
  - Individual PointOfContact records are provided for each POC

```
<gpspub:PointOfContact>
  <nc:OrganizationName>NAVCEN</nc:OrganizationName>
  <nc:OrganizationPrimaryContactInformation>
    <nc:ContactTelephoneNumber>
      <nc:NANPTelephoneNumber>

<nc:TelephoneAreaCodeID>703</nc:TelephoneAreaCodeID>

<nc:TelephoneExchangeID>313</nc:TelephoneExchangeID>
  <nc:TelephoneLineID>5900</nc:TelephoneLineID>
  <nc:TelephoneSuffixID xsi:nil="true"/>
  </nc:NANPTelephoneNumber>
  </nc:ContactTelephoneNumber>
  <nc:ContactWebsiteURI> HTTPS://WWW.NAVCEN.USCG.GOV
  </nc:ContactWebsiteURI>
</nc:OrganizationPrimaryContactInformation>
<gpspub:PointOfContactCategoryCode> CIVIL NON-AVIATION
</gpspub:PointOfContactCategoryCode>
</gpspub:PointOfContact>
```



*QUESTIONS?*





# Backup



# Opening Remarks

## Global Positioning Systems (GPS) Position, Navigation, and Timing Mission Area

Major Meyer  
Chief, Positioning, Navigation and Timing

Back Up Slides

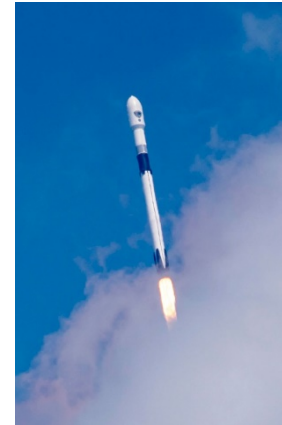


AFL	Available for Launch	IBR	Integrated Baseline Review
ASIC	Application Specific Integrated Circuit	IDR	Implementation Design Review
CDD	Capability Development Document	JTLV	Joint Light Tactical Vehicle
CDR	Critical Design Review	LCS	Launch and Checkout System
DAGR	Defense Advanced GPS Receiver	MGUE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

# PNT Enterprise 2020 achievements (Satellite Segment)



- **GPS III**
  - GPS III SV01 launched 23 Dec 18, Operationally Acceptance (OA) 2 Jan 20, "Set healthy" in operational constellation 13 Jan 20
  - GPS III SV02 launched 22 Aug 19, OA 27 Mar 20
  - GPS III SV03 launched 30 Jun 20, OA 27 Jul 20
  - GPS III SV04 launched 5 Nov 20, OA 1 Dec 20
  
- **GPS IIIF**
  - Completed Milestone C on 14 Jul 20
  - Awarded SV13/14 on 6 Oct 20 for \$510.9M - anticipate \$116M savings with alternate buy strategy



GPS III SV03 Launch



GPS III SV04 Launch



# PNT Enterprise 2020 achievements (Ground Segment)



- GPS III Contingency Operations (COps)
  - OA 27 Mar 20
- Next Generation Operational Control (OCX)
  - 8/17 monitor station installations complete
- OCX 3F
  - RFP release Sept 2020
- Military-Code Early Use (MCEU)
  - OA completed on 18 Nov 20; MCEU now installed and operational on 2 SOPS ops floor
  - IST 2-6 Phase 2 Developmental Testing complete 30 Sep 20
  - OUE Completed 30 Oct 20
  - HQ SpOC/S3/6 Operationally Accepted MCEU on 18 Nov 20
  - All 6 M-MSTIC installs completed 30 Jul 20; spares on site



# PNT Enterprise 2020 Achievements (User Equipment)

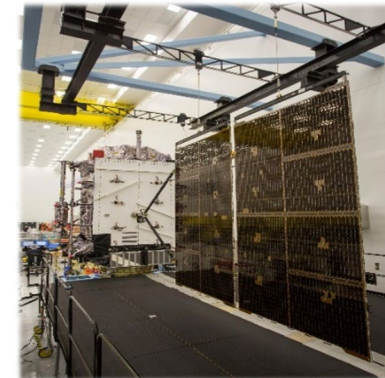


- MGUE Inc 1
  - Card-Level PEO Cert for JLTV (1st Lead Platform): Completed, 26 Jun 20
  - Completed Stryker Development Testings on 15 Aug 20
  - Restructure MGUE Inc 1, including conversion to FFP - ADM was approved on 23 Aug 20
- MGUE Inc 2
  - MSI awarded 6 Nov 20 and met 1QFY21 target
  - Handheld conducting ongoing phased prototype demos with users prior to completion of MSI development





- SV01 Set healthy and available for use on 13 Jan 20
- SV02 Set healthy and available for use on 1 Apr 20
- SV03 Operationally accepted 27 Jul 20
- SV04 launched 5 Nov 20; Operationally accepted 1 Dec 20
  - Second(First??) NSSL mission on a recoverable Falcon 9
- SV05 launched on 17 Jun 21; Operationally accepted 29 Jun
  - SCA transfer, and OA completed in 12 days!
  - Fastest turnover to Ops for a GPS III spacecraft
  - First NSSL reuse of launch vehicle (booster from SV04)
- SV06 Declared Available for Launch 5 Apr 21
- SV07 Declared Available for Launch 20 May 21
- SV08 Declared Available for Launch 10 Jun 21
- SV09 10 Component deliveries in progress







# GPS III Follow-On (GPS IIIF)

- GPS IIIF additional features:
  - Regional Military Protection (RMP)
  - New 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) and industry for future technology opportunities
  - Digital Reprogrammable Payloads
  - Near Real-Time Commanding/Crosslinks
  - Demo on Navigation Technology Satellite (NTS-3)
- Status: Design Completed 13 Jul 20; SV11 launch forecast for 2026



*Ensuring the Gold Standard today and into the future*



# Next Generation Operational Control System (OCX)



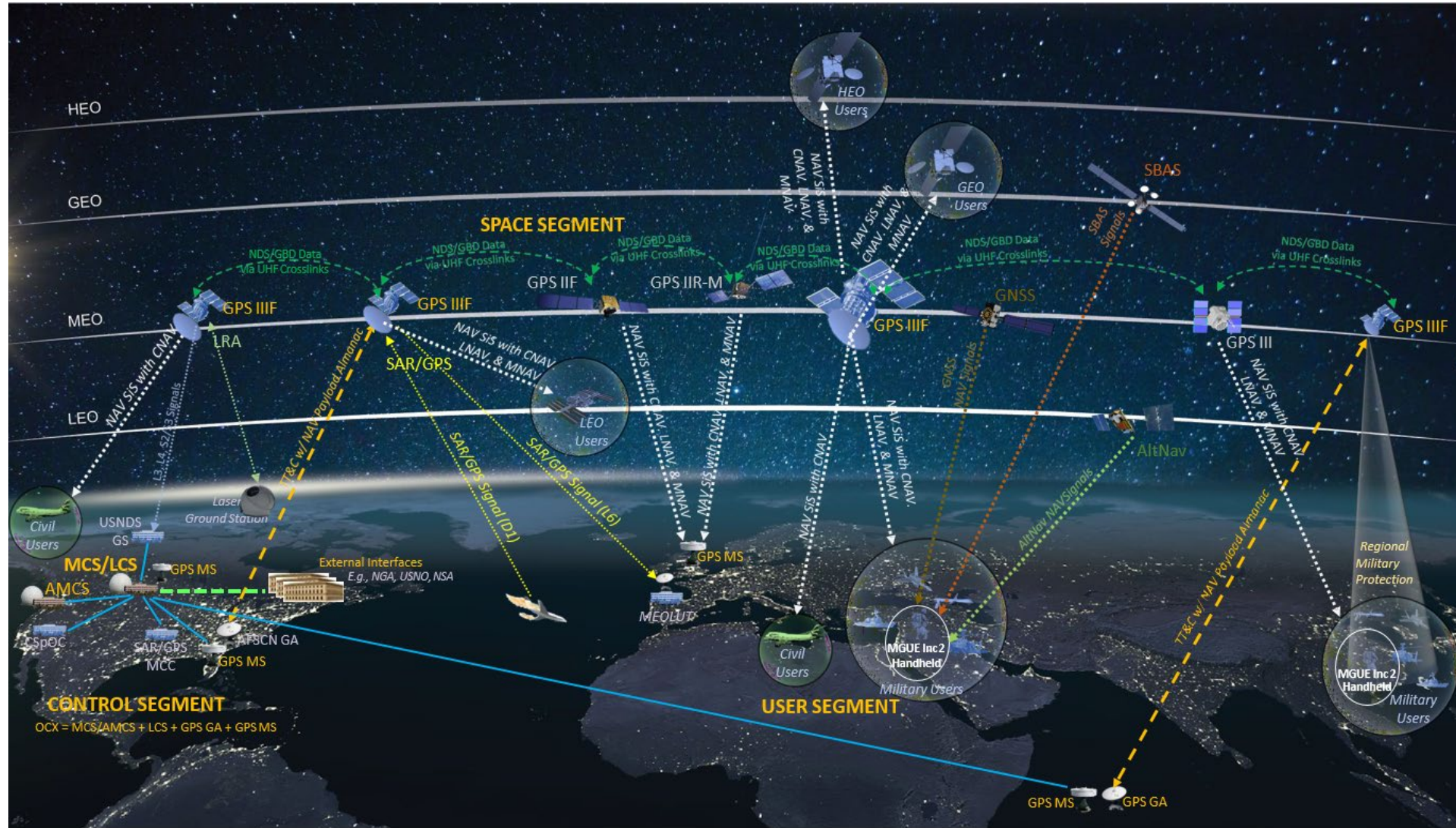
- Next-generation command, control and cyber-defense for GPS
  - Enhanced command and control capability
  - Modernized architecture robust cyber security
- Incremental Development
  - OCX Block 0: GPS III Launch & Checkout System (LCS)
  - OCX Blocks 1 and 2: Controls and manages all GPS IIR, GPS IIR-M, GPS IIF, and GPS III spacecraft; and controls all legacy and new GPS signals
- Current Status
  - LCS successfully supported GPS III SV01- SV05 Launches
  - Completed 17 Monitor station integrations Jul 2021
  - OCX Block 1 software coding complete 12 Aug 19
  - System integration and verification ongoing
  - Ready to Transition to Operations: 4QCY22

*OCX program continues to execute and meet schedule*



Unclassified

# GPS Operational Overview

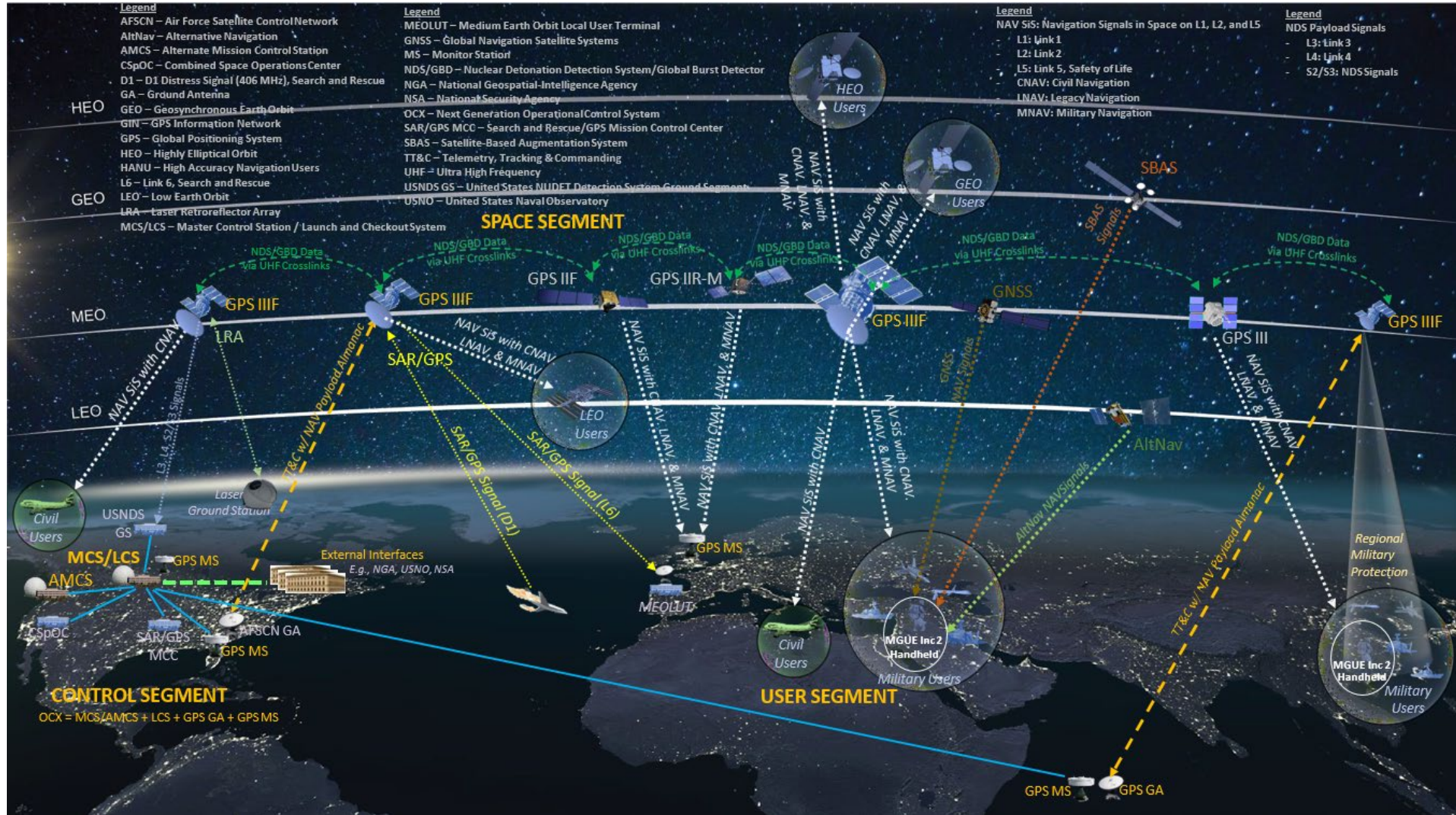



Unclassified





# GPS Operational Overview w/Acronyms



The background of the slide is a composite image. On the left, a rocket is launching, with a large plume of white smoke and fire. In the center, a satellite is shown in orbit above the Earth. On the right, a large satellite dish is visible on the ground, pointing towards the sky. The overall color scheme is blue and white, with a dark blue border at the top.

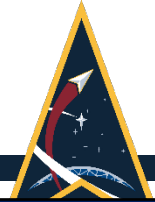
**Global Utility**  
**Uninterrupted Service**  
**Strength through Partnership**  
**Gold Standard**

**GPS**



## **CRM Details when extra room is needed**





Paragraph	CRM #278 (Garmin)		
Comment	Comment (10)	Suggested Change (12)	Rationale (13)
	<p>PCN-IS-200L_RFC467_20210513 change number IS200-1760 proposes amending C/A-code alarm condition a) to limit the applicability of the failure of parity on 5 successive words of LNAV data to only subframes 1, 2, or 3. The rationale provided for this comment is “Added subframes”.</p> <p>This proposed change is not backwards-compatible with some equipment designed in accordance with earlier versions of IS-GPS-200. Specifically, design standards for airborne GPS receivers going as far back as 1996 (TSO-C129a) have included requirements to reject satellites for the failure of parity on 5 successive words of LNAV data, regardless of subframe.</p> <p>The backwards compatibility concern is related to the following scenario:</p> <ul style="list-style-type: none"> <li>• Satellites broadcasting invalid parity in subframes 4 or 5 are supposed to be considered healthy and are required to fulfill the performance defined in the GPS SPS Performance Standards. Default navigation data broadcast in subframes 4 or 5 could trigger an invalid parity condition.</li> <li>• Airborne GPS receivers designed to reject satellites for parity failures on 5 successive words of LNAV data, regardless of subframe, will momentarily reject these satellites and will be unable to obtain the performance level specified in the SPS Performance Standards. This could result in reduced availability/continuity of airborne operations dependent upon GPS.</li> </ul> <p>If a large portion of the deployed constellation were to broadcast default navigation data on subframes 4 and 5 on a regular basis, it could have significant operational impacts on airborne GPS receivers designed to reject satellites for the failure of parity on 5 successive words of LNAV data on subframes 4 and 5. Prior to this proposed ICD change, it was assumed that the likelihood of this condition was low enough that it would still fall within Continuity and Availability commitments specified in the GPS SPS Performance standard.</p>	<p>No specific change to the text is requested. However, the Garmin comment can be resolved by ensuring that satellites broadcasting invalid parity (or default navigation data) on subframes 4 and 5 are not counted as healthy satellites for the purposes of meeting GPS SPS Performance Standard Continuity and Availability commitments. The 5th Edition of the GPS SPS Performance Standard still defines failure of parity on any 5 successive words as an alert condition, irrespective of the subframe (section 2.3.4). Additionally, information regarding the expected frequency and duration of satellites broadcasting invalid parity or default navigation data on subframes 4 and 5 would help determine the operational impact on airborne GPS receivers designed to reject such satellite signals.</p>	<p>Refer to Comment and Proposed resolution.</p>



Paragraph	CRM #279 (Thales)			
Comment	Comment (10)	Original Text (11)	Suggested Change (12)	Rationale (13)
	<p>The proposed change on the alarm condition related to the 5 parity checks will have an impact on airborne receivers that currently consider the satellite as 'GPS UNHEALTHY' as soon as 5 parity failures are detected, regardless of the processed LNAV subframe.</p> <p>In addition, this modification seems inconsistent with the commitments provided in the ICAO SARPs for the GPS constellation, where the HEALTHY designation refers to the SPS PS (2008 version in Amendment 92), in which the failure of parity on 5 successive words of NAV data is described as one of the 9 alarm indications designating an unhealthy signal, and where NAV data are not limited to subframes 1, 2 and 3 (they designate the data modulo-2 added to the ranging code, as per section 1.6.1).</p>		<p>Consider removing the proposed update of the alarm condition (a)</p>	



Paragraph	CRM #281 (Thales)		
Comment	Comment (10)	Suggested Change (12)	Rationale (13)
	<p>Following the PICWG 2015 meeting, and regarding a comment raised on Data ID interpretation, the minutes mention the following resolution:</p> <p>"The Government team will investigate the possibly of adding additional clarifications to IS-GPS-200 to address this [Backward compatibility] concern. While the Government still maintains the right to employ a Data ID different that "01", the group confirmed that users of the data structure corresponding to currently defined Data ID values will still be fully functional/compatible."</p> <p>So far, the use of the Data ID for the user equipment has not been clarified in the following revisions of IS-GPS-200. Consider updating IS-GPS-200 by</p> <ul style="list-style-type: none"> <li>a) either providing the elements defining the expected behavior of a user equipment designed w.r.t. IS-GPS-200M when receiving a data ID different from "01";</li> <li>b) or confirming that equipment processing LNAV data from a given satellite (at the minimum assigned to the lower set of PRN numbers 1 to 32), as defined by IS-GPS-200M, will remain fully functional, even if a data ID different from "01" is broadcast for this satellite.</li> </ul>		





Paragraph	CRM #286 CMC Electronics		
Comment	Comment (10)	Suggested Change (12)	Rationale (13)
	<p>Comment on PCN-IS-200L_RFC467:                      The link between the GPS clock/ephemeris and the associated SBAS correction in the DFMC SBAS standard is managed by mapping the IODN broadcast in the SBAS MT32 (providing SBAS correction) with the IODC associated to the GPS clock/ephemeris set. This link was validated at ICAO level based on the unicity requirement of the IODC over 7 days. SBAS has to monitor the IODC unicity when augmenting GPS under the DFMC SBAS standard. Removing such requirement is impacting DFMC SBAS as it becomes unclear how the unicity of the IODC should be monitored at the ground level and how/when to react from SBAS side.</p> <p>This change of the ICD is not in line with the latest GPS SARPs modifications approved in November 2020. NSP6 WP1 contains a requirement on the unicity of the IODC over 7 days (see section 3.1.1.1.3.1.4). The removal of such commitment may have impact on operational systems using GPS such as the one identified above for DFMC SBAS.</p> <p>For DFMC SBAS, a time windows, over which the IODC remains unique, needs to be defined. There is no operational needs to keep it set to 7 days but this time windows for a unique IODC on broadcast needs to be defined to set properly SBAS ground monitors when augmenting GPS. Focusing on SBAS, this time windows could be defined considering the maximum 3 clock/ephemeris sets stored in the airborne receiver for use (see MOPS ED-259A DMS:042).</p>	<p>1) Consider to modify the 7 days requirement for the IODC uniqueness by another time window requirement to fulfill the need of the DFMC SBAS standard considering the DFMC SBAS MOPS requirement on GPS clock/ephemeris storage (ED-259A DMS:042).</p> <p>2) Bring a paper presenting the change of the IODC uniqueness requirement to the ICAO NSP to discuss the impact on augmentation systems (SBAS/GBAS) and to discuss modification of the GPS SARPs in view of this change of the GPS LNAV ICD.</p>	<p>Compatibility with ICAO SARPs and RTCA/EUROCAE MOPS</p>



Paragraph	CRM #312 CMC Electronics			
Comment	Comment (10)	Original Text (11)	Suggested Change (12)	Rationale (13)
	<p>The intent of the proposed change is for the airborne receiver to NOT consider default navigation data in subframe 4 or 5 as a failure condition. However, the actual wording in item (a) does not distinguish the parity errors due to Default Navigation Data (DND) or due to random erroneous bits. In the latter case, the airborne receiver should consider the satellite as "bad" (i.e. not usable), regardless of subframes.</p> <p>The expected behavior is summarized as the following:</p> <ul style="list-style-type: none"> <li>1) DND in subframe 1, 2, or 3 =&gt; this is an alarm condition</li> <li>2) DND in subframe 4 or 5 =&gt; this is not an alarm condition</li> <li>3) 5 successive parity errors (not due to DND) in any subframe =&gt; this is an alarm condition</li> </ul> <p>The proposed change by adding "in subframe 1, 2, or 3" in item (a) does not solve the problem. It only covers the case the parity errors are due to DND and does not cover the case the parity errors are due to random erroneous bits.</p>	<p>(a) The failure of parity on 5 successive words of LNAV data (3 seconds) (see paragraphs 20.3.5 and 40.3.5).</p>	<p>(a) The failure of parity on 5 successive words of LNAV data (3 seconds) not due to default LNAV data in any subframe (see paragraphs 20.3.5 and 40.3.5).</p>	<p>The suggested change in column L covers the expected behavior item 3) of column (10).</p> <p>The existing item (d) of the ICD covers the expected behavior item 1) of column (10).</p> <p>The expected behavior item 2) of column J is automatically covered because no alarm condition is specified for that scenario.</p>



Paragraph	CRM #313 (CMC Electronics)			
Comment	Comment (10)	Original Text (11)	Suggested Change (12)	Rationale (13)
	<p>This comment is related to the following meeting minute of the PICWG meeting in 2015:</p> <p>"The Government team will investigate the possibly of adding additional clarifications to IS-GPS-200 to address this concern. While the Government still maintains the right to employ a Data ID different that "01", the group confirmed that users of the data structure corresponding to currently defined Data ID values will still be fully functional/compatible."</p> <p>We do not agree with the last sentence. Some certified and fielded receivers do check the Data ID coding to process the GPS LNAV data. Employing a Data ID different from "01" will create backward compatibility issue.</p>		<p>Consider adding the following sentence in IS-GPS-200 (Section 20.1 is probably a good place; may consider section 40.1 as well for upper set PRNs):</p> <p>GPS LNAV message will maintain the encoding of Data ID to "01" to keep backward compatibility with existing equipments.</p>	



# Issue of Data, Clock (IODC) Brief

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29 September 2021

## Back Up Slides

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# IODC Usage Data

