

# ***Space and Missile Systems Center***

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## **Global Positioning Systems (GPS)**

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



**United States Space Force  
Position, Navigation, and Timing Mission Area  
Wednesday, 30 September 2020, 0830-1630 PDT**



# *Dial-in Information*

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## **PRIMARY**

Dial-in: +1 646-828-7666 or 833-568-8864 (Toll Free)

Meeting ID: 161 1734 2565

Password: 12345

Screen Share:

<https://saicwebconferencing.zoomgov.com/j/16117342565?pwd=Njg5TVBTbXpKMVVndzNoL0pPMkhTZz09>

## **BACKUP**

Dial In: 410-874-6300 DSN: 312-874-6300

Conference Number: 380008635

Screen Share:

<https://conference.apps.mil/webconf/gpspublicmeeting2020>

**SLIDE LINK:** <https://www.gps.gov/technical/icwg/meetings/2020/>



# Agenda

Public ICWG (1 <sup>st</sup> Half of Day)	Presenter
Opening Remarks	Maj Van Roekel
GPS Public ICWG and Public Forum Meeting Overview and Roll Call	Lt Julia Corton
2020 Public ICWG RFC Discussion	
<ul style="list-style-type: none"> <li>RFC-413 (Integrity Support Messages)</li> </ul>	Anthony Flores (SE&I)
<ul style="list-style-type: none"> <li>RFC-442 (2020 Proposed Changes to the Public Documents)</li> </ul>	Dylan Nicholas (SE&I)
<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>Eliminate 7-Day Non-Repeat Rule for Issue of Data, Clock (IODC)</li> </ul>	Karl Kovach (Aerospace Corp)
Walk-on Topics, Open Discussion	
Action Item Review	



# *Opening Remarks*

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

**Major Robert B. Van Roekel**

**Deputy Chief, Positioning, Navigation and  
Timing Integration**



# GPS Overview

## Space Segment



Broadcasting since 1978

## Control Segment



20 monitoring and control stations worldwide

## User Segment



Reaching over 4 billion users every second



## Committed to Cooperation

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



# GPS Modernization

## Space Segment

*SV families provide L-Band broadcast to User Segment*

### GPS IIA/IIR

- Basic GPS
- Nuclear Detonation Detection System (NDS)

### GPS IIR-M

- 2<sup>nd</sup> Civil Signal (L2C)
- New Military Signal
- Increased Anti-Jam Power

### GPS IIF

- 3<sup>rd</sup> Civil Signal (L5)
- Longer Life
- Better Clocks

### GPS III (SV01-10)

- Accuracy & Power
- Increased Anti-Jam Power
- Inherent Signal Integrity
- 4<sup>th</sup> Civil Signal (L1C)
- Longer Life
- Better Clocks

### GPS IIIF (SV11-32)

- Unified S-Band Telemetry, Tracking & Commanding
- Search & Rescue (SAR) Payload
- Laser Retroreflector Array
- Redesigned NDS Payload

## Control Segment

*TT&C of Space Segment assets & distribution of data to user interfaces*

### Legacy (OCS)

- Mainframe System
- Command & Control
- Signal Monitoring

### Architecture Evolution

- Plan (AEP)
- Distributed Architecture
- Increased Signal Monitoring Coverage
- Security
- Accuracy

### OCX Block 0

- GPS III Launch & Checkout System
- GPS III Contingency Ops (COps)
- GPS III Mission on AEP
- M-Code Early Use (MCEU)
- Update OCS to operationalize Core M-Code

### OCX Block 1/2

- Fly Constellation & GPS III
- Begin New Signal Control
- Upgraded Information Assurance

### OCX Block 2+

- Control all signals
- Capability On-Ramps
- GPS IIIF Evolution

## User Segment

*Applies Space and Control Segment data for PNT applications*

Continued support to an ever-growing number of applications

- Annual Public Interface Control Working Group (ICWG)
- Standard Positioning Service (SPS) Performance Standard Updates
- Precise Positioning Service (PPS) Enhancements
- Sustained commitment to transparency
- Visit [GPS.gov](http://GPS.gov) for more info

Modernized Civil Signals

- L2C (Various commercial applications)
- L5 (Safety-of-life, frequency band protected)
- L1C (Multi-GNSS interoperability)



# GPS Constellation Status

**35 Satellites • 31 Set Healthy**  
**Baseline Constellation: 24 Satellites**



Satellite Block	Quantity	Average Age (yrs)	Oldest
GPS IIR	9 (2*)	18.6	23.1
GPS IIR-M	7 (1*)	12.9	14.9
GPS IIF	12	6.6	10.2
GPS III	2 (1*)	0.9	1.7

\*Ops capable; not set healthy

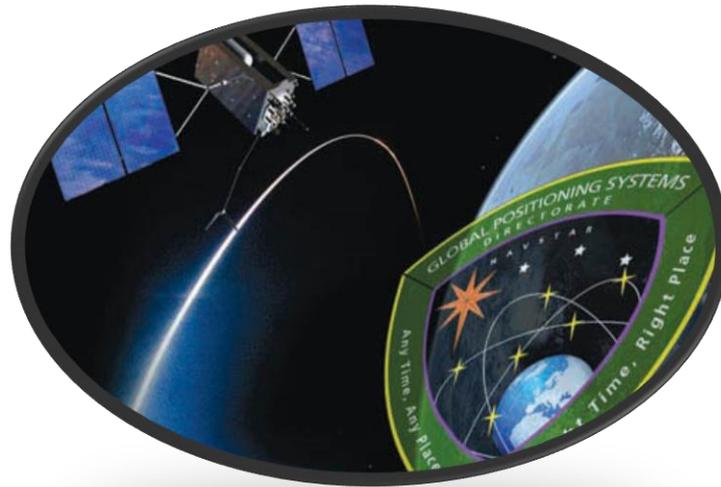
As of 22 Aug 20

## GPS Signal in Space (SIS) Performance

From 18 Aug 19 to 15 Aug 20

Average URE*	Best Day URE	Worst Day URE
52.2 cm	38.5 cm (1 Jun 20)	90.2 cm (26 Jul 20)

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



## GPS continues the Global Utility

- “The Gold Standard”
- Committed to maintaining uninterrupted service
- Committed to maintaining domestic and international partnerships



# ***GPS Requirements Team***

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## **Air Force**

**Maj Van Roekel, Deputy Chief, Positioning, Navigation and Timing Integration**

**Mr. Daniel Godwin, Requirements Section Chief**

**Lt Julia Corton, Systems and Integration Requirements Lead**

**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. Anthony Flores, Responsible Engineer**

**Mr. Albert Hayden, System Engineer**

**Mr. Dylan Nicholas, Responsible Engineer**

**Mr. Kevin Cano, Responsible Engineer**



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# Roll Call



# *Rules of Engagement*

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# UNCLASSIFIED



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



# *Rules of Engagement (Cont'd)*

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- **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)*

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- **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**



# *Meeting Purpose*

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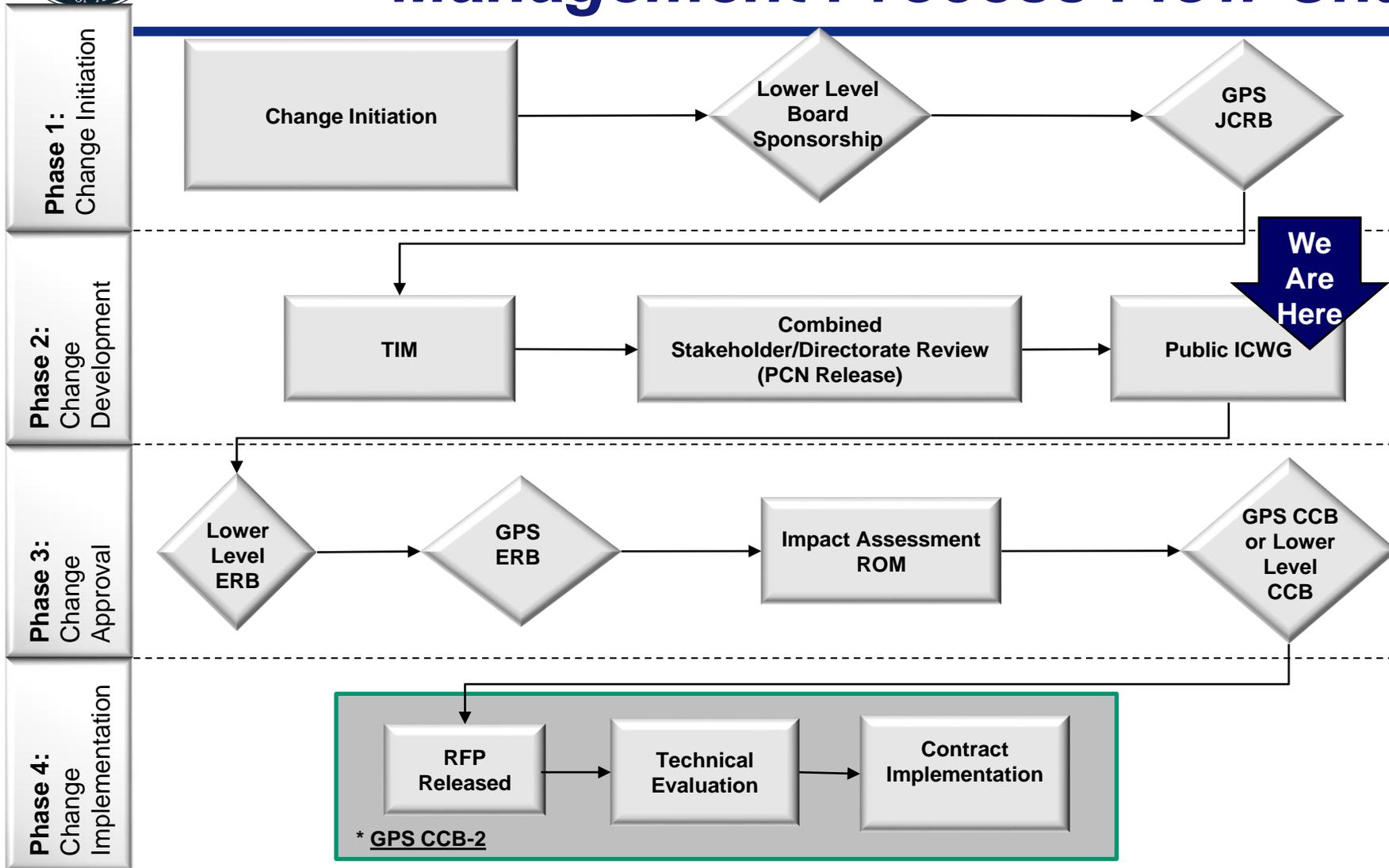
- The purpose of the meeting is to:

**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				



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# 2020 RFC Discussion



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# RFC-413: Integrity Support Messages

**Dr. Andrew Hansen, Volpe/FAA**

**Mr. Karl Kovach, Aerospace Corp**

**Mr. Anthony Flores, SE&I**

**Mr. Albert Hayden, SE&I**

**PCNs:** <https://www.gps.gov/technical/icwg/meetings/2020/>



# ***RFC-413: Integrity Support Messages***

## ***Problem Statement:***

Navigation integrity for Global Navigation Satellite Systems (GNSS) including GPS has, to date, been codified in performance standard(s) documentation. The implication is that receiver manufacturers must extract information manually and encode it into GNSS receivers. This has two negative effects: 1) operational receivers cannot be modified without a maintenance cycle when updated standards are released; 2) for other-than-GPS systems, receiver manufacturer reliance on documentation produced by foreign entities.

## ***Proposed Solution:***

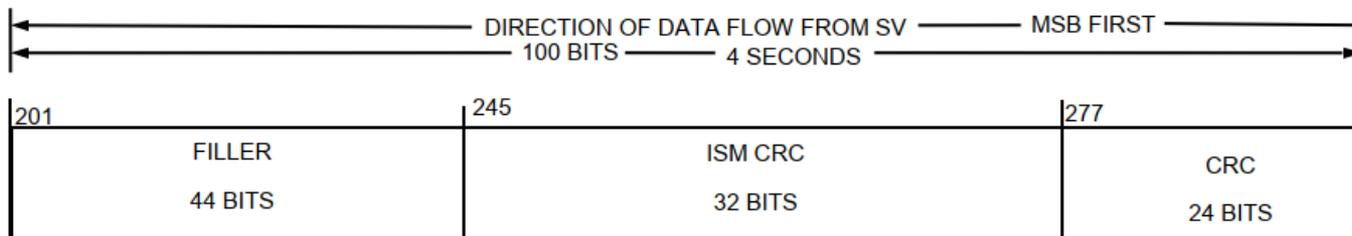
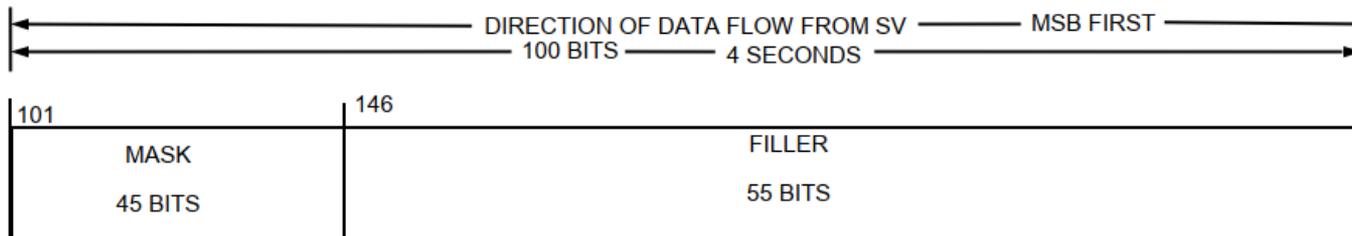
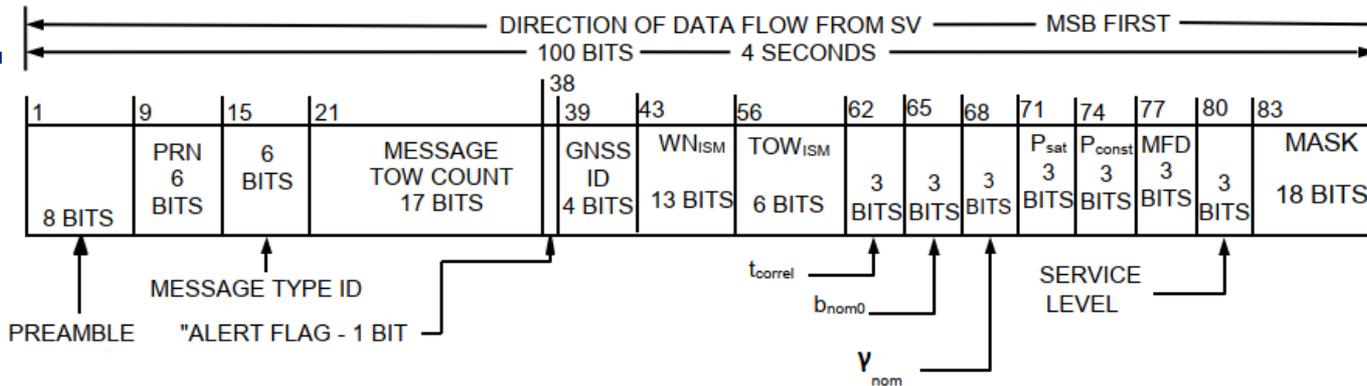
Define an Integrity Support Message (ISM) that contains pertinent integrity information about GNSS constellations including, and that are compatible with, GPS and broadcast the Integrity Support Message (ISM) via Civil Navigation (CNAV) (L2C & L5) and CNAV-2 (L1C). These messages enable the end user to perform Advanced Receiver Autonomous Integrity Monitoring (ARAIM).

## ***Impacted Documents:***

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



# RFC Summary of Changes



\* MESSAGE TOW COUNT = 17 MSBs OF ACTUAL TOW COUNT AT START OF NEXT 12-SECOND MESSAGE

Introduced CNAV Message Type (MT) 40 and Subframe 3, Page 8 for ISMs. Similar message was added to IS-GPS-200, IS-GPS-705, and IS-GPS-800. More information on each parameter can be found in the PCNs



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# *Comment Review*



# RFC-413 Comments Resolution Matrix (CRM) Status

<b>CRM – COMBINED REVIEW STATUS</b>				
<b>Disposition/Type</b>	<b>Critical</b>	<b>Substantive</b>	<b>Administrative</b>	<b>Totals</b>
<b>Accept</b>		4	16	20
<b>Accept with Comment</b>	1	9	2	12
<b>Reject</b>			17	17
<b>Defer</b>				
<b>Grand Totals:</b>	1	13	35	49

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

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

<b>DOORS ID</b>	IS200-1774, IS705-1657, and IS800-1070		
<b>Paragraph</b>	IS200 30.3.3.10.1.10 IS705 20.3.3.10.1.10 IS800 3.5.4.7.1.10	<b>Comment Number</b>	6
<b>Comment Type</b>	Critical	<b>Disposition</b>	Accept with Comments
<b>Comment Originator(s)</b>	Denis Bouvet (Thales)		
<b>Comment</b>	<p>Service Level 3 and 4 values associate safety of life criticality with the use of ISM parameters in Horizontal ARAIM (H-ARAIM) or Vertical ARAIM (V-ARAIM) algorithm.</p> <p>This is not understood: for some lateral navigation operations (based on a solution monitored by H-ARAIM), the integrity failure can be considered as Hazardous, not Major. In addition, the current GPS Satellite Fault Probability (<math>P_{sat}</math>) and Constellation Fault Probability (<math>P_{const}</math>) values (<math>10^{-5}</math> and <math>10^{-8}</math>) used in RAIM are defined regardless of the operation. Can this classification be clarified?</p>		
<b>Government Response</b>	<p>The ISM parameter will be validated with respect to a RAIM service and NOT a safety criticality level. The TSO will go into more depth on safety criticality levels. Revising the Service Level based off comment (see next slides)</p>		



## PCN TEXT (IS)

IS-GPS-200: Table 30-XIb- Service Levels

<b>Service Level</b>	<b>Severity</b>	<b>Description</b>
Level 1	No Data Available	Service Level indicates that users may resort to the Performance Values for integrity solutions instead of the ISM. Users should not use ISM
Level 2	Non-Safety of Life Use (Minor)	Uncertified ARAIM
Level 3	Safety of Life Use (Major)	Service Level indicates that the user should only use these parameters for the applications requiring integrity less than or equivalent to H-ARAIM solutions.
Level 4	Safety of Life Use (Hazardous)	Service Level indicates that the user should only use these parameters for the applications requiring integrity less than or equivalent to V-ARAIM solutions.



## PROPOSED TEXT

IS-GPS-200: Table 30-XIb- Service Levels

Service Level	Severity	Description
Level 1	No Data Available	Service Level indicates that users may resort to the Performance Values for integrity solutions instead of the ISM. Users should not use ISM
Level 2	Non-Safety of Life Use ( <del>Minor</del> )	Uncertified ARAIM
Level 3	Safety of Life Use ( <del>Major</del> Horizontal)	Service Level indicates that the user should only use these parameters for the applications requiring integrity less than or equivalent to H-ARAIM solutions.
Level 4	Safety of Life Use ( <del>Hazardous</del> Vertical)	Service Level indicates that the user should only use these parameters for the applications requiring integrity less than or equivalent to V-ARAIM solutions.

<b>DOORS ID</b>	IS705-1615, IS200-1768, IS800-1037		
<b>Paragraph</b>	20.3.3.10.1.2 30.3.3.10.1 3.5.4.7.1	<b>Comment Number</b>	1
<b>Comment Type</b>	Substantive	<b>Disposition</b>	Accept with Comments
<b>Comment Originator(s)</b>	Denis Bouvet (Thales)		
<b>Comment</b>	<p>The start of the time of validity for a given ISM data issue is given by ISM Effectivity Time Stamp Week Number (WN_ISM) and ISM Effectivity Time Stamp Time of Week (TOW_ISM). However, there is no indication about the length of the validity period of this ISM.</p> <p>Can it be clarified in IS-GPS-705?</p>		
<b>Government Response</b>	The IS does not have an expiration date. The UE would just use the latest available ISM. A statement can be added.		



## PCN TEXT (IS)

## PROPOSED TEXT

None

*Inserted after IS705-1615:*

The CS shall upload the current ISM parameters, when necessary, to the SVs.

Users shall use the ISM message with the latest WN\_ISM and TOW\_ISM time stamp.



<b>DOORS ID</b>	IS200, IS705, and IS800		
<b>Paragraph</b>	IS200 30.3.3.10.1.2.0-1	<b>Comment Number</b>	19
<b>Comment Type</b>	Substantive	<b>Disposition</b>	Accept with comments
<b>Comment Originator(s)</b>	Steven Brown (Lockheed Martin)		
<b>Comment</b>	Based on this definition for ISM Week Number, can the timestamp be a time in the future, if not, that constraint should be stated. If so, how does the user react to a future time? What happens if two different SVs transmit different ISMs at the different timestamps?		
<b>Government Response</b>	No, the time stamp cannot be in the future. User will use the latest ISM with the latest WN and TOW time stamp. (See Comment #1 for revised text)		



<b>DOORS ID</b>	IS705-1634		
<b>Paragraph</b>	20.3.3.10.1.4	<b>Comment Number</b>	2
<b>Comment Type</b>	Substantive	<b>Disposition</b>	Accept with Comments
<b>Comment Originator(s)</b>	Denis Bouvet (Thales)		
<b>Comment</b>	The current ARAIM algorithm definition provided by Working Group- C (WG-C) does not use nor describe the "Correlation Time Constant" parameter. Can it be detailed here?		
<b>Government Response</b>	Our priority is to finalize the IS first prior to going back to Working Group-C with the updates. It is sufficient details for the IS. We have text that tells the user to look at the Military Standard Order (MSO) and Technical Standard Order (TSO) for further details on the parameters. See IS705-1611 in the PCN for the statement that points to the new documents. See backup slides for detailed definitions from the future documents.		



<b>DOORS ID</b>	IS705-1649		
<b>Paragraph</b>	20.3.3.10.1.5	<b>Comment Number</b>	3
<b>Comment Type</b>	Substantive	<b>Disposition</b>	Accept with Comments
<b>Comment Originator(s)</b>	Denis Bouvet (Thales)		
<b>Comment</b>	<p>The current ARAIM algorithm definition provided by WG-C uses one parameter named "<math>b_{nom}</math>".</p> <p>Can IS-GPS-705 detail how <math>b_{nom}</math> is computed, based on the Additive Term <math>b_{nom}</math> and Scalar Term <math>\gamma_{nom0}</math>?</p>		
<b>Government Response</b>	<p>Our priority is to finalize the IS first prior to going back to Working Group-C with the updates. It is sufficient details for the IS. We have text that tells the user to look at the MSO and TSO for further details on the parameters. See IS705-1611 in the PCN for the statement that points to the new documents. See backup slides for detailed definitions from the future documents.</p>		



<b>DOORS ID</b>	IS705-1643		
<b>Paragraph</b>	20.3.3.10.1.7	<b>Comment Number</b>	7
<b>Comment Type</b>	Substantive	<b>Disposition</b>	Accept With Comments
<b>Comment Originator(s)</b>	Denis Bouvet (Thales)		
<b>Comment</b>	<p>The content of the ISM does not seem compatible with the binary definition of the Integrity Support Flag (ISF).          What is going to be the value of the ISF when <math>P_{sat}</math> is less than <math>10^{-5}</math> but higher than <math>10^{-8}</math>? or when the nominal bias <math>b_{nom}</math> is different from 0?          Can it be clarified that the ISF is not for use in safety of life applications?</p>		
<b>Government Response</b>	<p>When <math>P_{SAT}</math> is greater than <math>10^{-8}</math> the ISF will be set to 0. When less than <math>10^{-8}</math>, the ISF will be set to 1. The ISF is a short summary but not as detailed. Both the ISM and ISF are applicable for safety of life.</p>		



<b>DOORS ID</b>	IS-GPS-705		
<b>Paragraph</b>	20.3.3.10.1.7	<b>Comment Number</b>	8
<b>Comment Type</b>	Substantive	<b>Disposition</b>	Accept with Comments
<b>Comment Originator(s)</b>	Denis Bouvet (Thales)		
<b>Comment</b>	<p>Civil aviation dual-frequency receivers are meant to process L1 C/A code and L5 signals. Therefore, only the ISM broadcast in L5 CNAV message is going to be processed.</p> <p>Can IS-GPS-705 clarify that the <math>P_{sat}</math>, <math>P_{const}</math> and <math>b_{nom}</math> values broadcast in the L5 CNAV ISM are also usable when the equipment is using Legacy Navigation (LNAV) data? (in a fallback L1 only mode, in case of interference in the L5 band).</p>		
<b>Government Response</b>	<p>The information that is in the ISM can be used in LNAV L1C/A. Details on how that can be used will be detailed in the TSO.</p>		



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<b>DOORS ID</b>	IS800-1030		
<b>Paragraph</b>	3.5.2.0-19	<b>Comment Number</b>	10
<b>Comment Type</b>	Substantive	<b>Disposition</b>	Accept
<b>Comment Originator(s)</b>	Jeff Crum (Lockheed Martin)		
<b>Comment</b>	Picture has error. The last 21 bits of the mask should span bits 101-121 and the filler should start at bit 122, not bit 164.		
<b>Government Response</b>	Agree		

# PCN TEXT (IS)

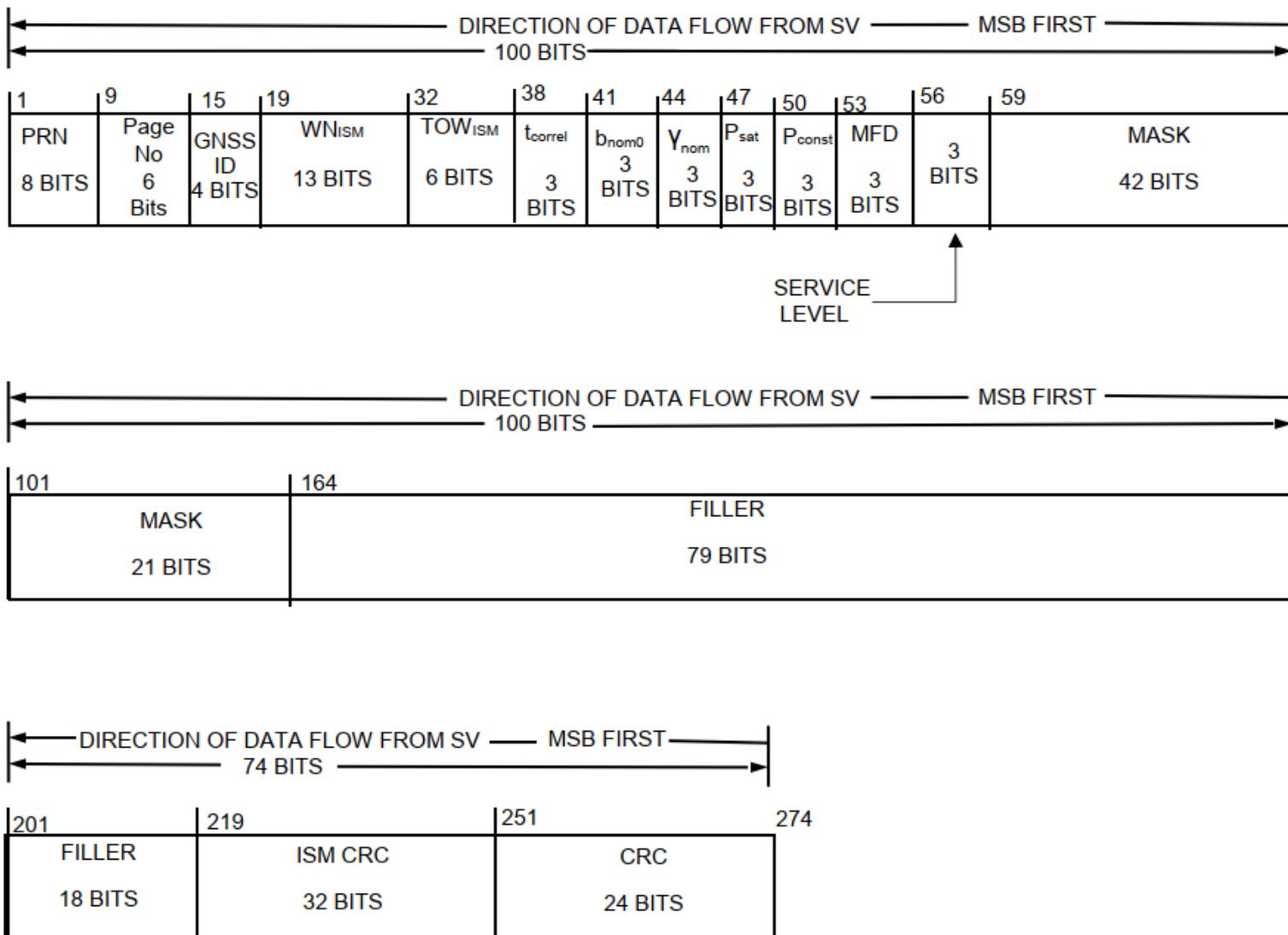


Figure 3.5-8a Subframe 3, Page 8, Integrity Support Message

# PROPOSED TEXT

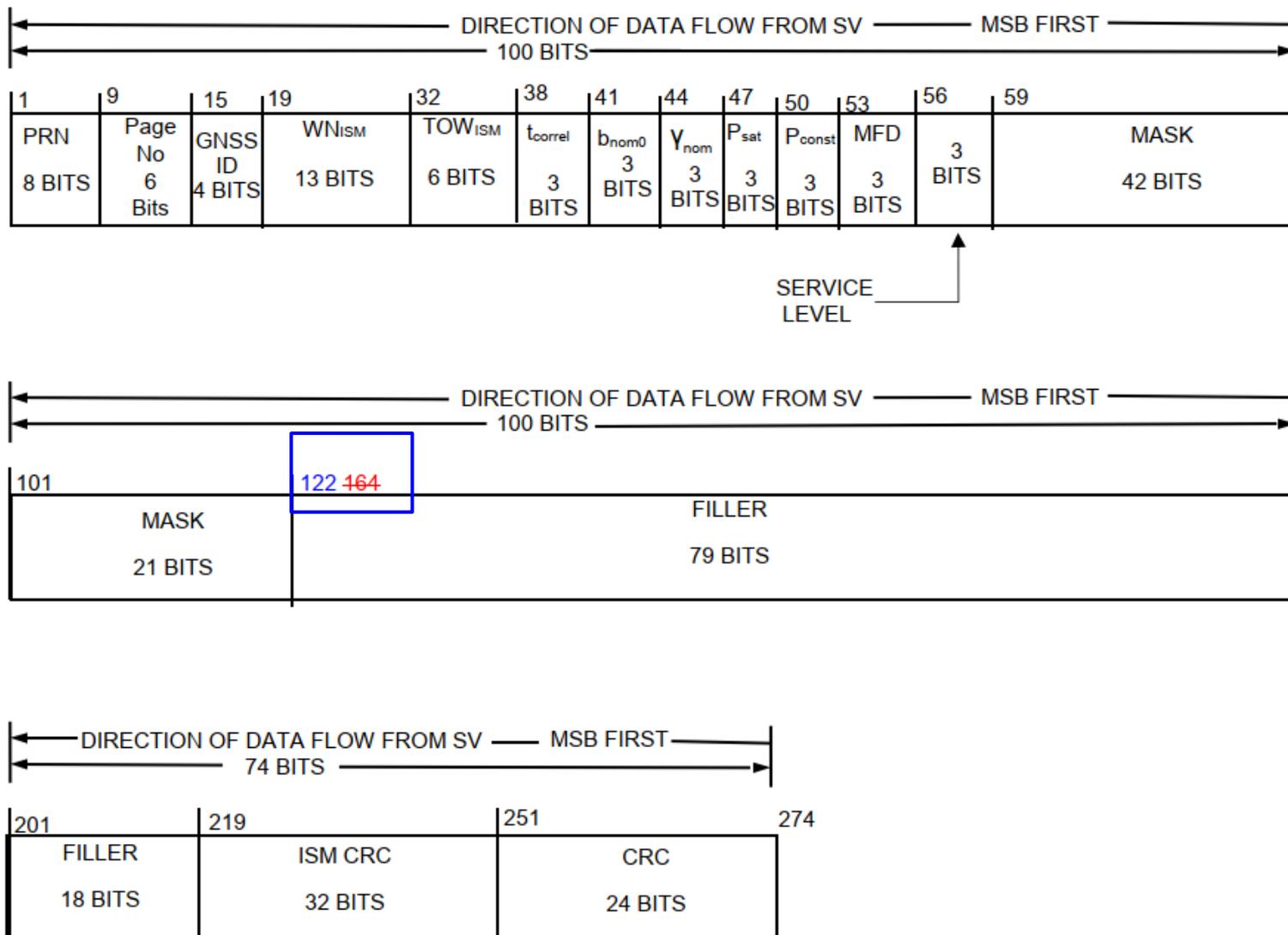


Figure 3.5-8a Subframe 3, Page 8, Integrity Support Message

<b>DOORS ID</b>	IS800-1080		
<b>Paragraph</b>	3.5.4.7.1.12.0-1	<b>Comment Number</b>	18
<b>Comment Type</b>	Substantive	<b>Disposition</b>	Accept
<b>Comment Originator(s)</b>	Jeff Crum (Lockheed Martin)		
<b>Comment</b>	Text has MT40 instead of Subframe 3, Page 8 (SF3PG8) in IS800.		
<b>Government Response</b>	Agree		

<b>PCN TEXT (IS)</b>	<b>PROPOSED TEXT</b>
<p>Bits 219 through 250 of MT-40 are a 32-bit Cyclic Redundancy Check (CRC) specific to the ISM parameters. The ISM CRC will cover only the ISM parameters in Message Type 40, (Bits 15 to 218). Refer to GNSS-Based Precision Approach Local Area Augmentation System (LAAS) Signal-in-Space Interface Control Document for more details on the ISM CRC.</p>	<p>Bits 219 through 250 of <del>MT-40</del> <a href="#">Subframe 3, Page 8</a> are a 32-bit Cyclic Redundancy Check (CRC) specific to the ISM parameters. The ISM CRC will cover only the ISM parameters in <del>Message Type 40</del> <a href="#">Subframe 3, Page 8</a>, (Bits 15 to 218). Refer to GNSS-Based Precision Approach Local Area Augmentation System (LAAS) Signal-in-Space Interface Control Document for more details on the ISM CRC.</p>



<b>DOORS ID</b>	IS200-1770, IS705-1618, And IS800-1040		
<b>Paragraph</b>	IS200 30.3.3.10.1.0-7 IS705 20.3.3.10.1.0-7 IS800 3.5.4.7.1.0-6	<b>Comment Number</b>	25, 32, and 42
<b>Comment Type</b>	Substantive	<b>Disposition</b>	Accept with comments
<b>Comment Originator(s)</b>	Jim Selmer (L3 Harris)		
<b>Comment</b>	The way the probabilities are shown here is misleading. For example the value shown as $1e^{-5}$ would less confusingly be rendered as $1 \times 10^{-5}$ , as we do not mean to raise e to the -5th power here. And, the probabilities are on a per-hour basis, so the notation should include "/hour" at the end.		
<b>Government Response</b>	Commentator is correct will go with the suggested changes. Additionally, We took a note that the document is not consistent when it comes to expressing scientific notation. There's cases where it's $x10^{-1}$ and case where it's $1E^{-1}$ . A new PRAT Action Item will be opened to explore the idea of making the rest of the documents consistent with the changes.		



# PCN TEXT (IS)

IS-GPS-200: Table 30-XIa- ISM Parameters

Parameter	No. of Bits**	Scale Factor (LSB)	Valid Range***	Units
GNSS ID	4			
WN <sub>ISM</sub>	13	1		week
TOW <sub>ISM</sub>	6	4	0 to 164	hours
$t_{\text{correl}}$	3		0 to 12	hours
$b_{\text{nom0}}$	3		0 to 2	meter
$\gamma_{\text{nom}}$	3		0 to 2	
$P_{\text{sat}}$	3		$1e^{-3}$ to $1e^{-9}$	
$P_{\text{const}}$	3		$1e^{-3}$ to $1e^{-9}$	
MFD	3		0.25 to 24	hours
Service Level*	3			
Mask****	63			

\* See Table 30-XIb for Service Level Descriptions  
 \*\* See Figure 30-14a for complete bit allocation in Message Type 40  
 \*\*\* Unless otherwise indicated in this column, valid range is the maximum range attainable with indicated bit allocation and scale factor  
 \*\*\*\* See Table 30-XIb for Mask bit mapping



# PROPOSED TEXT

IS-GPS-200: Table 30-XIa- ISM Parameters

Parameter	No. of Bits**	Scale Factor (LSB)	Valid Range***	Units
GNSS ID	4			
WN <sub>ISM</sub>	13	1		week
TOW <sub>ISM</sub>	6	4	0 to 164	hours
$t_{\text{correl}}$	3		0 to 12	hours
$b_{\text{nom0}}$	3		0 to 2	meter
$\gamma_{\text{nom}}$	3		0 to 2	
$P_{\text{sat}}$	3		$1e^{-3} \times 10^{-3}$ to $1e^{-9} \times 10^{-9}$	/hours
$P_{\text{const}}$	3		$1e^{-3} \times 10^{-3}$ to $1e^{-9} \times 10^{-9}$	/hours
MFD	3		0.25 to 24	hours
Service Level*	3			
Mask****	63			

\* See Table 30-XIb for Service Level Descriptions

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

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

\*\*\*\* See Table 30-XIb for Mask bit mapping

<b>DOORS ID</b>	IS200-670 and IS705-371		
<b>Paragraph</b>	30.3.4.1 and 20.3.4.1.0-3	<b>Comment Number</b>	28 and 38
<b>Comment Type</b>	Substantive	<b>Disposition</b>	Accept with Comments
<b>Comment Originator(s)</b>	Jim Selmer (L3 Harris)		
<b>Comment</b>	<p>The sentence "Users are not required to collect them all, but may need to" does not add clarity. For user equipment vendors, there is no practical distinction between being required to do something and needing to do it. The sentence effectively says "users do not have to collect all the messages unless they have to." Please provide clearer criteria for when user equipment shall collect more than one ISM. If this is not feasible, and it is thought that the user equipment specifications are better places to capture specific requirements, then replace the sentence with "User equipment shall comply with the ISM collection requirements of the governing specification."</p>		
<b>Government Response</b>	See revised wording in next slides.		

# BASELINE TEXT (WAS)

IS-GPS-200 Table 30-XII. Message Broadcast Intervals

Message Data	Message Type Number	Maximum Broadcast Intervals †
Ephemeris	10 & 11	48 sec
Clock	Type 30's	48 sec
ISC, IONO	30*	288 sec
Reduced Almanac	31* or 12	20 min**,****
Midi Almanac	37*	120 min**,****
EOP	32*	30 min****
UTC	33*	288 sec
Diff Correction	34* or 13 & 14	30 min***,****
GGTO	35*	288 sec****
Text	36* or 15	As needed****
<p>* Also contains SV clock correction parameters.  ** Complete set of SVs in the constellation.  *** When Differential Corrections are available.  **** Optional (interval applies if/when broadcast).</p> <p>† The intervals specified are maximum. As such, the broadcast intervals may be shorter than the specified value.</p>		

# PCN TEXT (IS)

IS-GPS-200 Table 30-XII. Message Broadcast Intervals

Message Data	Message Type Number	Maximum Broadcast Intervals †
Ephemeris	10 & 11	48 sec
Clock	Type 30's	48 sec
ISC, IONO	30*	288 sec
Reduced Almanac	31* or 12	20 min**,****
Midi Almanac	37*	120 min**,****
EOP	32*	30 min****
UTC	33*	288 sec
Diff Correction	34* or 13 & 14	30 min***,****
GGTO	35*	288 sec****
Text	36* or 15	As needed****
Integrity Support Message+	40	288 sec ****
<p>* Also contains SV clock correction parameters.  ** Complete set of SVs in the constellation.  *** When Differential Corrections are available.  **** Optional (interval applies if/when broadcast).  + One ISM per maximum broadcast interval; However, users can accept multiple ISMs from any SVs. Users are not required to collect them all, but may need to.  † The intervals specified are maximum. As such, the broadcast intervals may be shorter than the specified value.</p>		

# PROPOSED TEXT

IS-GPS-200 Table 30-XII. Message Broadcast Intervals

Message Data	Message Type Number	Maximum Broadcast Intervals †
Ephemeris	10 & 11	48 sec
Clock	Type 30's	48 sec
ISC, IONO	30*	288 sec
Reduced Almanac	31* or 12	20 min**,****
Midi Almanac	37*	120 min**,****
EOP	32*	30 min****
UTC	33*	288 sec
Diff Correction	34* or 13 & 14	30 min***,****
GGTO	35*	288 sec****
Text	36* or 15	As needed****
Integrity Support Message+	40	288 sec ****
<p>* Also contains SV clock correction parameters.  ** Complete set of SVs in the constellation.  *** When Differential Corrections are available.  **** Optional (interval applies if/when broadcast).  + One ISM per maximum broadcast interval; However, users are not required but can accept multiple ISMs from any SVs. Users can refer to the TSO and MSO for further details Users are not required to collect them all, but may need to.  † The intervals specified are maximum. As such, the broadcast intervals may be shorter than the specified value.</p>		



<b>DOORS ID</b>	IS200-1798, 1804, 1801, IS705-1660, 1651, 1645, 1633, 1648 IS800-1050, 1053, 1056, 1059, 1065, 1061		
<b>Paragraph</b>	30.3.3.10.1.7.0-2	<b>Comment Number</b>	23, 26, 27, 33, 34, 35, 36, 37, 43, 44, 45, 46, 47, 48
<b>Comment Type</b>	Administrative	<b>Disposition</b>	Reject
<b>Comment Originator(s)</b>	Jim Selmer (L3 Harris)		
<b>Comment</b>	Shouldn't "hours" be "hour" for these data items for Satellite Fault Probability? Change "meters" to "meter" for values 1.0 m or less.		
<b>Government Response</b>	Units for decimal are either plural or singular. Leave as is		



<b>DOORS ID</b>	IS200-1764, IS705-1611, IS800-1034		
<b>Paragraph</b>	IS200 30.3.3.10.0-1 IS705 20.3.3.10.0-1 IS800 3.5.4.7.0-1	<b>Comment Number</b>	24, 31, 41
<b>Comment Type</b>	Administrative	<b>Disposition</b>	Reject
<b>Comment Originator(s)</b>	Jim Selmer (L3 Harris)		
<b>Comment</b>	Shouldn't "TSO and MSO" be "TSOs and MSOs?"		
<b>Government Response</b>	It is just one TSO and one MSO. So it would be singular and not plural		



UNCLASSIFIED

# *Open RFC Discussion*

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- **Questions/comments?**



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# **RFC-442: 2020 Public Document Proposed Changes**

**Lt Julia Corton, SMC/ZAC**

**Mr. Karl Kovach, Aerospace**

**Mr. Dylan Nicholas, SE&I**

**Mr. Kevin Cano, SE&I**

**Mr. Albert Hayden, SE&I**

**PCNs:** <https://www.gps.gov/technical/icwg/meetings/2020/>



# ***RFC-442: 2020 Public Document Proposed Changes***

## ***Problem Statement:***

For the upcoming 2020 Public ICWG, there is an opportunity to clarify the documents for better understanding such as:

1. Optional Clock Error Rate Equation
2. UTC Leap Second Schedule Announcement Alignment
3. LNAV vs CNAV Group Delay Differential ( $T_{GD}$ ) Value
4. Administrative clarification and clean-up

## ***Proposed Solution:***

1. Recommend new SV Clock Relativistic Correction rate equation.
2. Clarify equations by recommending examples or clarifying instructions.
3. Remove statement that on CNAV telling the user that a  $T_{GD}$  value of '10000000' indicates that the group delay value is unavailable.
4. Provide clarity and cleaned up identified administrative changes in all public documents.

## ***Impacted Documents:***

*IS-GPS-200, IS-GPS-705, IS-GPS-800, ICD-GPS-240*



# RFC Summary of Changes

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## 1. Optional Clock Error Rate Equation

**WAS :**

<INSERTED OBJECT>

**Redlines :**

<INSERTED OBJECT>

**IS :**

$$\Delta \dot{t}_{SV} = a_{f1} + 2 a_{f2} (t - t_{oc}) + \frac{nFe\sqrt{A} \cos E}{1 - e \cos E} \frac{Sec}{Sec}$$

$$\Delta \ddot{t}_{SV} = 2 a_{f2} - \frac{n^2 Fe \sqrt{A} \sin E}{(1 - e \cos E)^3} \frac{sec}{sec^2}$$

Affected documents:

IS-GPS-200, paragraph 20.3.3.3.3.1.0-4



# RFC Summary of Changes

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## 1. Optional Clock Error Rate Equation

### WAS :

Any one of Message Types 30 through 37, Figure 30-3 through Figure 30-10, contains the parameters needed by the users for apparent SV clock correction. Bits 61 to 71 contain  $t_{oc}$ , clock data reference time of week. Bits 72 to 127 contain SV clock correction coefficients. The related algorithm is given in paragraph 20.3.3.3.3.1.

### Redlines :

Any one of Message Types 30 through 37, Figure 30-3 through Figure 30-10, contains the parameters needed by the users for apparent SV clock correction. Bits 61 to 71 contain  $t_{oc}$ , clock data reference time of week. Bits 72 to 127 contain SV clock correction coefficients. The related algorithm is given in paragraph 20.3.3.3.3.1. [Refer to Section 20.3.3.3.3.1 for optional first and second derivative of the SV clock correction equation.](#)

### Affected documents:

IS-GPS-200, paragraph 30.3.3.2.1.1

IS-GPS-705, paragraph 20.3.3.2.3.0-1

IS-GPS-800, paragraph 3.5.3.7.1.0-1



# RFC Summary of Changes

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## 2. UTC Leap Second Schedule Announcement Alignment

### Redlines :

Page 18 of subframe 4 includes: -(1) the parameters needed to relate GPS time to UTC, and (2) notice to the user regarding the scheduled future or recent past (relative to LNAV message upload) value of the delta time due to leap seconds ( $\Delta t_{LSF}$ ), together with the [GPS](#) week number ( $WN_{LSF}$ ) and the [GPS](#) day number (DN) [at near](#) the end of which ~~the leap second~~  $\Delta t_{LSF}$  becomes effective. "Day one" is the first day relative to the end/start of week and the  $WN_{LSF}$  value consists of eight bits which shall be a modulo 256 binary representation of the GPS week number (see paragraph 6.2.4) to which the DN is referenced. The user must account for the truncated nature of this parameter as well as truncation of  $WN$ ,  $WN_t$ , and  $WN_{LSF}$  due to rollover of full week number (see paragraph 3.3.4(b)). The CS shall manage these parameters such that, when  $\Delta t_{LS}$  and  $\Delta t_{LSF}$  differ, the absolute value of the difference between the untruncated  $WN$  and  $WN_{LSF}$  values shall not exceed 127.

### Affected documents:

- IS-GPS-200, paragraph 20.3.3.5.2.4.0-1
- IS-GPS-705, paragraph 20.3.3.6.2
- IS-GPS-800, paragraph 3.5.4.1.1.1



# RFC Summary of Changes

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## 2. UTC Leap Second Schedule Announcement Alignment

### Redlines :

Depending upon the relationship of the effectivity date to the user's current GPS time, the following three different UTC/GPS-time relationships exist:

NOTE: Whenever ( $\Delta t_{LS} = \Delta t_{LSF}$ ), the determination of an effectivity time of  $\Delta t_{LSF}$ , as indicated by the  $WN_{LSF}$  and the DN, is not necessary, and in such a circumstance the user may assume a UTC/GPS-time relationship given by 20.3.3.5.2.4.a, below.

a. Whenever either:

(1) ( $\Delta t_{LS} = \Delta t_{LSF}$ ), or

(2) the effectivity time indicated by the  $WN_{LSF}$  and the DN values is not in the past (relative to the user's present time), and the user's present time does not fall in the time span which starts at six hours prior to the effectivity time and ends at six hours after the effectivity time, the UTC/GPS-time relationship is given by

Affected documents:  
IS-GPS-200, paragraph 20.3.3.5.2.4.0-4



# RFC Summary of Changes

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## 3. LNAV vs CNAV $T_{GD}$ Value

### Redlines :

The group delay differential correction terms,  $T_{GD}$ ,  $ISC_{L1C/A}$ ,  $ISC_{L2C}$  for the benefit of single frequency L1 P, L1 C/A, L2 P, L2C users and dual frequency L1/L2 users are contained in bits 128 through 166 of Message Type 30 (see Figure 30-3 for complete bit allocation). The bit length, scale factors, ranges, and units of these parameters are given in Table 30-IV. ~~The bit string of "1000000000000" shall indicate that the group delay value is not available.~~ The related algorithm is given in paragraphs 30.3.3.3.1.1.1 and 30.3.3.3.1.1.2.

### Affected documents:

IS-GPS-200, paragraph 30.3.3.3.1.1.0-1

IS-GPS-705, paragraph 20.3.3.3.3.1

IS-GPS-800, paragraph 3.5.3.9.0-2



# RFC Summary of Changes

## 4. Administrative clarification and clean-up

Redlines :

Table 30-II. Part 3

Element/Equation	Description
<b>SV Velocity</b>	
$\dot{E}_k = n / (1 - e \cos E_k)$	Eccentric Anomaly Rate
$\dot{v}_k = \dot{E}_k \sqrt{1 - e^2} / (1 - e \cos E_k)$	True Anomaly Rate
$(di_k / dt) = (IDOT) + 2 \dot{v}_k (c_{is} \cos 2\phi_k - c_{ic} \sin 2\phi_k)$	Corrected Inclination Angle Rate
$\dot{u}_k = \dot{v}_k + 2\dot{v}_k (c_{us} \cos 2\phi_k - c_{uc} \sin 2\phi_k)$	Corrected Argument of Latitude Rate
<del><math>\dot{r}_k = -eA\dot{E}_k \sin E_k + 2\dot{v}_k (c_{rs} \cos 2\phi_k - c_{rc} \sin 2\phi_k)</math></del>	<del>Corrected Radius Rate</del>
$\dot{r}_k = \dot{A}(1 - e \cos(E_k)) + A e \sin(E_k) \dot{E}_k + 2(c_{rs} \cos(2\phi_k) - c_{rc} \sin(2\phi_k)) \dot{v}_k$	<u>Corrected Radius Rate for CNAV</u>
$\dot{\Omega}_k = \dot{\Omega} - \dot{\Omega}_e$	Longitude of Ascending Node Rate
$\dot{x}'_k = \dot{r}_k \cos u_k - r_k \dot{u}_k \sin u_k$	In- plane x velocity
$\dot{y}'_k = \dot{r}_k \sin u_k + r_k \dot{u}_k \cos u_k$	In- plane y velocity
$\dot{x}_k = -x'_k \dot{\Omega}_k \sin \Omega_k + \dot{x}'_k \cos \Omega_k - \dot{y}'_k \sin \Omega_k \cos i_k - \dot{y}'_k (\dot{\Omega}_k \cos \Omega_k \cos i_k - (di_k / dt) \sin \Omega_k \sin i_k)$	Earth- Fixed x velocity (m/s)
$\dot{y}_k = x'_k \dot{\Omega}_k \cos \Omega_k + \dot{x}'_k \sin \Omega_k + \dot{y}'_k \cos \Omega_k \cos i_k - \dot{y}'_k (\dot{\Omega}_k \sin \Omega_k \cos i_k + (di_k / dt) \cos \Omega_k \sin i_k)$	Earth- Fixed y velocity (m/s)
$\dot{z}_k = \dot{y}'_k \sin i_k + \dot{y}'_k (di_k / dt) \cos i_k$	Earth- Fixed z velocity (m/s)

Affected documents:

- IS-GPS-200, paragraph 30.3.3.1.3.1-11
- IS-GPS-705, paragraph 20.3.3.1.3.0-13
- IS-GPS-800, paragraph 3.5.3.6.1.1-7



# *RFC Summary of Changes*

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## 4. Administrative clarification and clean-up

### **Redlines :**

Parameters used in the YUMA format are not the same as used in the SEM format. -The SEM parameters are the same as defined in IS-GPS-200 and broadcast from an SV. -The YUMA angular units are in radians whereas the SEM angular units are in semicircles. In addition, the YUMA Orbital Inclination is a direct measure of inclination angle (approximately 55 degrees), whereas the SEM Inclination Offset is relative to 0.30 semicircles (54 degrees). -The parameters of the YUMA almanac are identified within the message structure. - Figure 40-2 illustrates one record ~~of 28~~ in a sample YUMA almanac file. - Line one of each record identifies the week in which the file was generated as well as the PRN number of the subject SV.

Affected documents:

ICD-GPS-240, paragraph 40.5.0-1

Note: Removing 28 since the Figure 40-2 applies to more than 28 SVs and that number may vary in the future.



# RFC Summary of Changes

## 4. Administrative clarification and clean-up

IS :

```
***** Week 59 almanac for PRN-01 *****
ID:                                01
Health:                             000
Eccentricity:                       0.9913444519E-002
Time of Applicability(s):           503808.0000
Orbital Inclination(rad):           0.9805097338
Rate of Right Ascen(r/s):           -0.7943188009E-008
SQRT(A) (m 1/2):                    5153.577637
Right Ascen at Week(rad):           0.3072393117E+001
Argument of Perigee(rad):           0.782072915
Mean Anom(rad):                     0.1774841613E+001
Af0(s):                              -0.3862380981E-003
Af1(s/s):                           -0.3637978807E-011
week:                                59
```

Affected documents:  
ICD-GPS-240, paragraph 40.5.0-2



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# *Comment Review*



# RFC-442 Comments Resolution Matrix (CRM) Status

<b>CRM – COMBINED REVIEW STATUS</b>				
<b>Disposition/Type</b>	<b>Critical</b>	<b>Substantive</b>	<b>Administrative</b>	<b>Totals</b>
<b>Accept</b>		<b>3</b>	<b>2</b>	<b>5</b>
<b>Accept with Comment</b>		<b>4</b>	<b>1</b>	<b>5</b>
<b>Reject</b>			<b>1</b>	<b>1</b>
<b>Defer</b>		<b>1</b>		<b>1</b>
<b>Grand Totals:</b>		<b>8</b>	<b>4</b>	<b>12</b>

<b>DOORS ID</b>	IS200-1761		
<b>Paragraph</b>	6.4.6.3	<b>Comment Number</b>	2
<b>Comment Type</b>	Substantive	<b>Disposition</b>	Accept with Comments
<b>Comment Originator(s)</b>	Denis Bouvet (Thales)		
<b>Comment</b>	<p>Condition #3 of the Marginal indications defined in IS-GPS-200L is not consistent with the marginal conditions defined in the SPS PS 2020. IS-GPS-200L mentions URA = 15 as the only criterion, while Standard Positioning Service Performance Standard (SPS PS) 2020 considers URA &gt;= 8 as a marginal condition. This new marginal condition defined in IS-GPS-200L is different from what is currently assumed in civil aviation receivers (compliant with DO-229 MOPS).</p> <p>In addition, as mentioned in SPS PS 2020 section 2.1, in case of conflict between the SPS and the IS, one should defer to the IS. Meaning that URA index comprised between 8 and 14 now designates a satellite as "Healthy". Can you confirm that this interpretation is correct? If not, it is suggested to define the same criteria as in the SPS PS. If the interpretation is correct, is it possible to have the rationale for relaxing the "marginal" indications constraints?</p>		



## Government Response

The clarification below will be added to the “Marginal Indications” sections in -200, -705, and -800.

(e.g., in Section 6.4.6.2 in -200) will read:

“More restrictive ‘marginal indications’ (e.g., the transmitted URA index in subframe 1 greater than or equal to 8) may apply in the context of specified minimum performance standards such as are given in the *GPS Standard Positioning Service Performance Standard* (SPS PS).”



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<b>DOORS ID</b>	IS200-1761		
<b>Paragraph</b>	6.4.6.3	<b>Comment Number</b>	3
<b>Comment Type</b>	Substantive	<b>Disposition</b>	Accept with Comments
<b>Comment Originator(s)</b>	Denis Bouvet (Thales)		
<b>Comment</b>	If the interpretation is correct, is it possible to have the rationale for relaxing the "marginal" indications constraints?		
<b>Government Response</b>	No further clarification is needed.		



<b>DOORS ID</b>	IS-GPS-705 For Review Purposes Only Up Rev Version		
<b>Paragraph</b>	7.4.5.2	<b>Comment Number</b>	5
<b>Comment Type</b>	Substantive	<b>Disposition</b>	Accept with Comments
<b>Comment Originator(s)</b>	Denis Bouvet (Thales)		
<b>Comment</b>	<p>"Marginal" indication #3 is not consistent with SPS PS 2020 Marginal criteria.</p> <p>Considering that IS-GPS supersedes SPS PS content, is it confirmed that CNAV URANED0 and URAED indices greater than or equal to 8 but less than 15 are not anymore seen as indications of "marginal" status?</p>		
<b>Government Response</b>	<p>The IS does not supersede the SPS PS. The intention was to make the constraints in the specification less restrictive. If a user wishes their receiver to be SPS PS guaranteed then the users should follow what's in the SPS.</p>		

<b>DOORS ID</b>	IS200-407		
<b>Paragraph</b>	20.3.3.5.1.2	<b>Comment Number</b>	4
<b>Comment Type</b>	Substantive	<b>Disposition</b>	Defer
<b>Comment Originator(s)</b>	Denis Bouvet (Thales)		
<b>Comment</b>	<p>The new code value '101' associated with block III F satellites confirms that the "alert" in HOW is still applicable. This is however not sufficient for safety-of-life equipment that would need to have the confirmation that future generations of GPS satellites will also implement the "alert" in Handover Word (HOW) functionality.</p> <p>Otherwise, these receivers designed w.r.t IS-GPS-200L will have to discard satellites with codes 110 and 111, because there is currently no guarantee that the alert in the HOW will be implemented and broadcast, and because this alert is part of the "marginal" conditions leading to the selection/deselection of a satellite in a RAIM or ARAIM integrity context.</p> <p>It is therefore suggested that even if the signals and functions cannot be fully detailed for codes 110 and 111 satellites, the IS clarifies at least that the "alert" in HOW function will be implemented.</p>		



## **Government Response**

We recognize that this is a subject for misinterpretation and we will come up with a proposed solution for next year's Public ICWG.

## 20.3.3.5.1.4 Anti-Spoof (A-S) Flags and SV Configurations.

...

### Code SV Configuration

000 No Information is available

001 A-S capability, plus flags for A-S and "alert" in HOW; memory capacity as described in paragraph 20.3.2 (e.g. Block II/Block IIA/IIR SV).

010 A-S capability, plus flags for A-S and "alert" in HOW; memory capacity as described in paragraph 20.3.2, M-code signal capability, L2C signal capability (e.g., Block IIR-M SV).

011 A-S capability, plus flags for A-S and "alert" in HOW; memory capacity as described in paragraph 20.3.2, M-code capability, L2C signal capability, L5 signal capability (e.g., Block IIF SV).

100 A-S capability, plus flags for A-S and "alert" in HOW; memory 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 A-S capability, plus flags for A-S and "alert" in HOW; memory 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 F SVs).

110, 111 Reserved 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 in



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<b>DOORS ID</b>	IS705-256		
<b>Paragraph</b>	20.3.3.2.3	<b>Comment Number</b>	6
<b>Comment Type</b>	Substantive	<b>Disposition</b>	Accept
<b>Comment Originator(s)</b>	James P. Fernow (MITRE)		
<b>Comment</b>	For consistency with the 2020 GPS SPS Performance Standard, eliminate statements about L2/L5 dual-frequency measurement combinations.		
<b>Government Response</b>	Agree		



BASELINE TEXT (WAS)	PROPOSED TEXT (IS)	PROPOSED TEXT
<p>However, since the SV clock corrections of equations in paragraph 20.3.3.3.3.1 of IS-GPS-200 are estimated by the CS using dual frequency L1 and L2 P(Y) code measurements, the single-frequency L5 user and the dual-frequency L1 and L5, and L2 and L5 users must apply additional terms to the SV clock corrections equations.</p>	<p>N/A</p>	<p>However, since the SV clock corrections of equations in paragraph 20.3.3.3.3.1 of IS-GPS-200 are estimated by the CS using dual frequency L1 and L2 P(Y) code measurements, the single-frequency L5 user and the dual-frequency L1 and L5, <del>L2 and L5</del> users must apply additional terms to the SV clock corrections equations.</p>

<b>DOORS ID</b>	IS705-265		
<b>Paragraph</b>	20.3.3.2.4	<b>Comment Number</b>	7
<b>Comment Type</b>	Substantive	<b>Disposition</b>	Accept
<b>Comment Originator(s)</b>	James P. Fernow (MITRE)		
<b>Comment</b>	For consistency with the 2020 GPS SPS Performance Standard, eliminate statements about L2/L5 dual-frequency measurement combinations.		
<b>Government Response</b>	Agree		

<b>BASELINE TEXT (WAS)</b>	<b>PCN TEXT (IS)</b>	<b>PROPOSED TEXT</b>
the net effect of clock parameter, code phase, and inter-signal correction error for dual-frequency L1 C/A/L5 and L2C/L5 users who correct for group delay and ionospheric effects as described in Section 20.3.3.3.1.2	N/A	the net effect of clock parameter, code phase, and inter-signal correction error for dual-frequency L1 C/A/L5 <del>and L2C/L5</del> users who correct for group delay and ionospheric effects as described in Section 20.3.3.3.1.2



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<b>DOORS ID</b>	IS705		
<b>Paragraph</b>	20.3.3.3.1.4 (Figure 20.15)	<b>Comment Number</b>	8
<b>Comment Type</b>	Substantive	<b>Disposition</b>	Accept
<b>Comment Originator(s)</b>	James P. Fernow (MITRE)		
<b>Comment</b>	For consistency with the 2020 GPS SPS Performance Standard, eliminate statements about L2/L5 dual-frequency measurement combinations.		
<b>Government Response</b>	Agree		

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# PCN TEXT (IS)

# PROPOSED TEXT

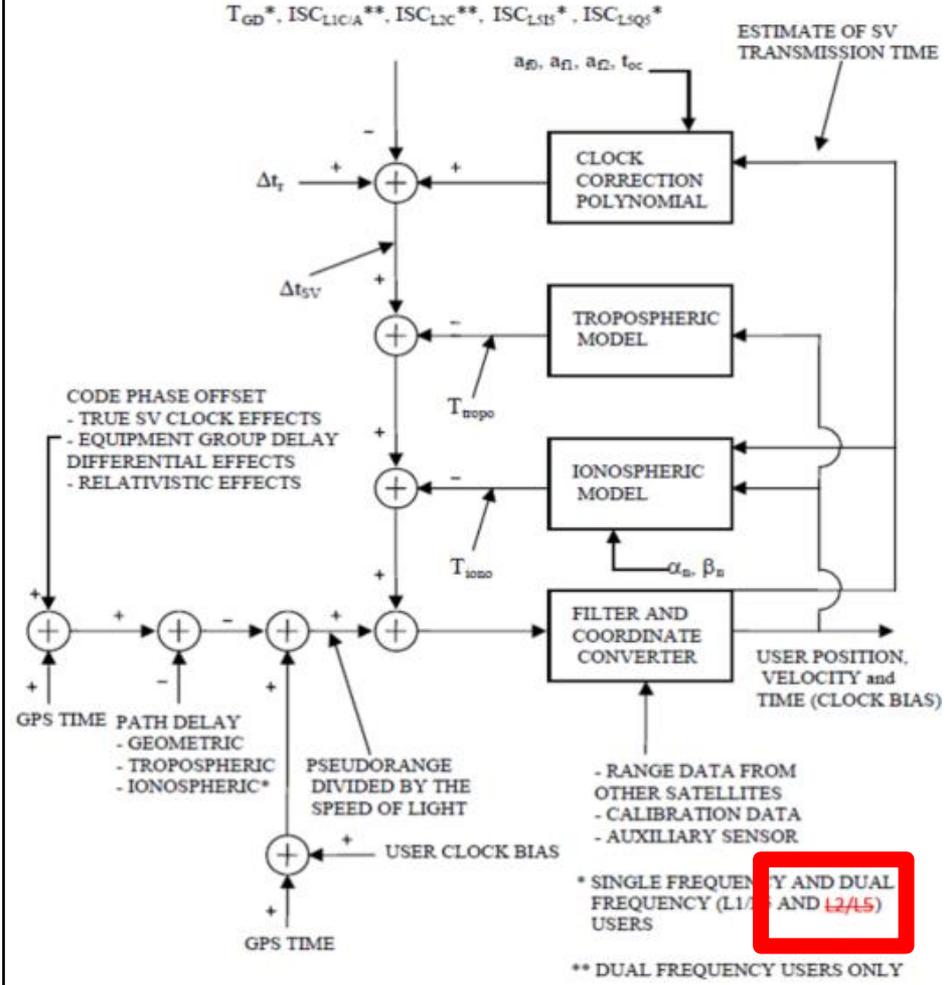
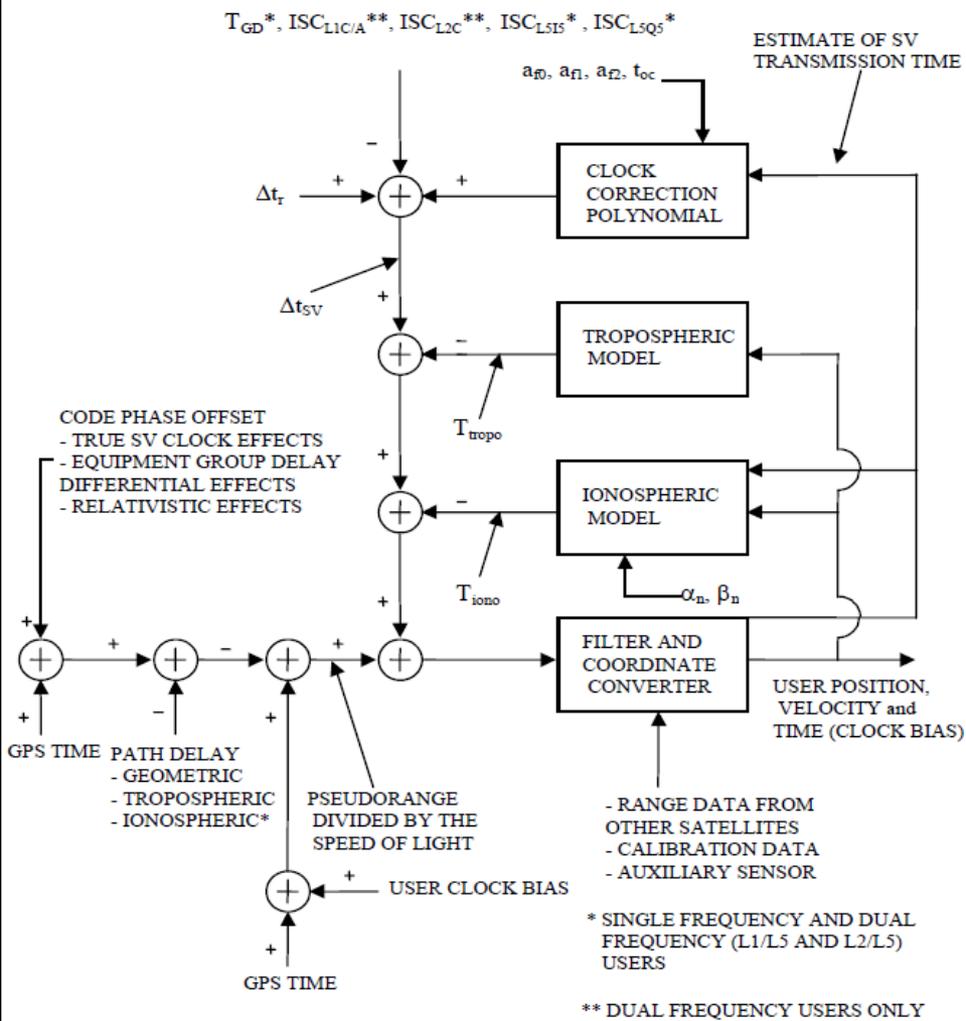


Figure 20-15: Sample Application of Correction Parameters

Figure 20-15: Sample Application of Correction Parameters



<b>DOORS ID</b>	IS200-441		
<b>Paragraph</b>	20.3.3.5.2.4.0-4	<b>Comment Number</b>	12
<b>Comment Type</b>	Substantive	<b>Disposition</b>	Accept with Comment
<b>Comment Originator(s)</b>	Steven Brown(LM)		
<b>Comment</b>	<p>If the intention is to change how the GPS Enterprise does leap second from current operations for the past 40 years, this new comment in the PCN does not make the severity of changes clear. Does this comment direct the every 6 month update even if no leap second is changed?</p>		
<b>Directorate Response</b>	<p>This change will not affect current operations. It clarifies to users that the value of the effectivity time parameters (<math>WN_{LSF}</math> and <math>DN</math>) are not strictly relevant to the conversion of GPS time to UTC if <math>\Delta t_{LS}</math> and <math>\Delta t_{LSF}</math> have the same value. The change will therefore be kept since it does not cause any change to operations.</p> <p>Additional changes will be made to non-public documents, see Action Item 2019-06.</p>		



UNCLASSIFIED

# *Open RFC Discussion*

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- Questions/comments?



UNCLASSIFIED

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# Action Item Review



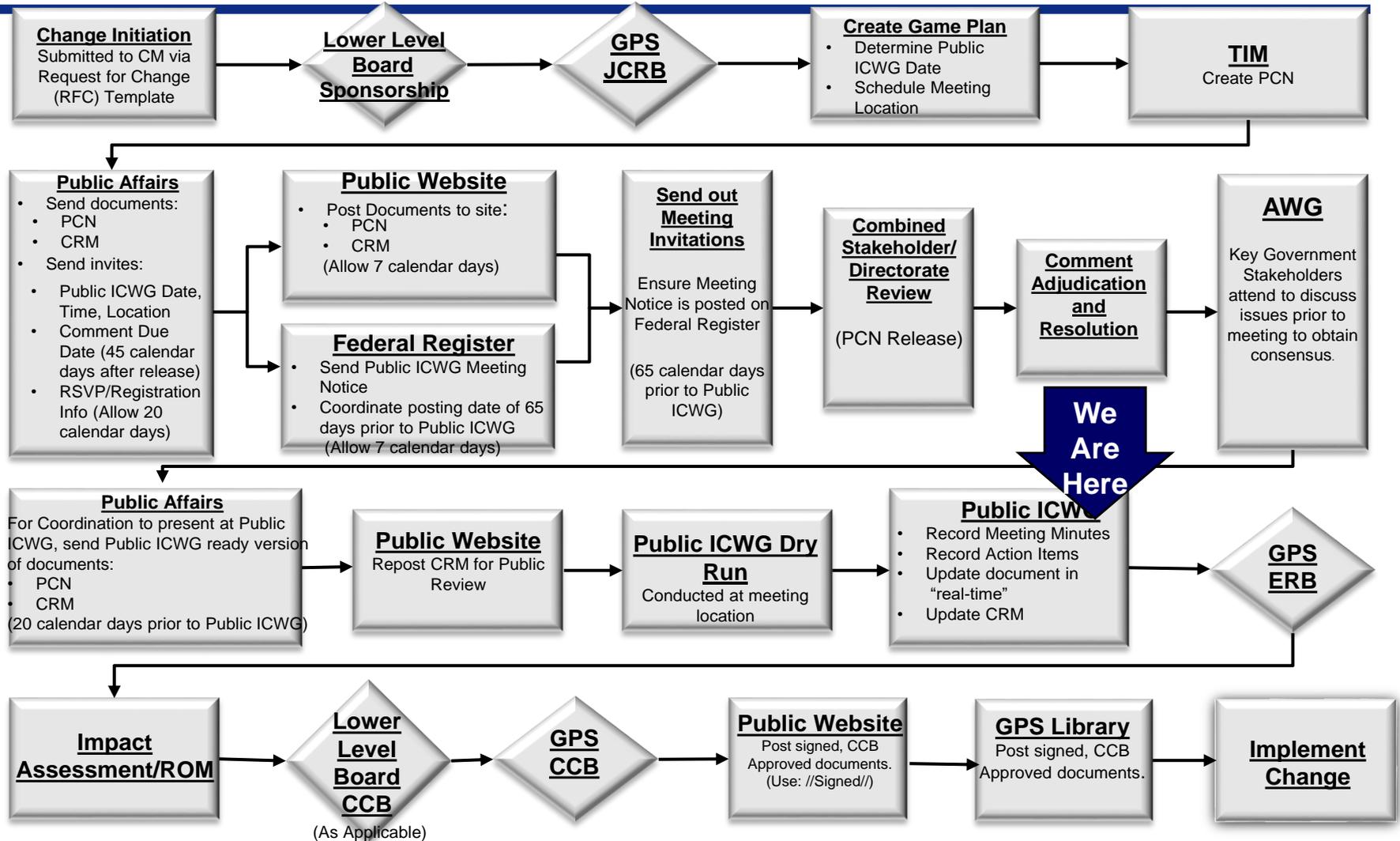
UNCLASSIFIED

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# BACKUP



# Technical Baseline Change Management Process – GPS Public Changes





# Parameter Definitions

- $t_{\text{correl}}$  The correlation time for the signal-in-space (SIS) user range error (URE). When RAIM was originally developed, the correlation time for the SIS URE was assumed to be two minutes due to the GPS use of selective availability (SA) to degrade the SIS URE for civil users. [Reference: Lee, Van Dyke, Decléene, Studenny, Beckman; *“Summary of RTCA SC-159 GPS Integrity Working Group Activities”*; Institute of Navigation; Papers published in Navigation; Volume V, 1998.] The  $t_{\text{correl}}$  parameter is used in setting the RAIM detection thresholds as a function of the false alert rate.
- $b_{\text{nom}}$  The nominal pseudorange bias error (unsigned) which is assumed to affect all receivers when tracking a satellite signal. [Reference: Working Group C, ARAIM Technical Subgroup; *“Interim Report, Issue 1”*; EU-U.S. Cooperation on Satellite Navigation; 19 December 2012.] It is primarily the result of SIS malformations interacting with the receiver’s radio frequency (RF) bandwidth (BW) and the correlation method used for tracking the satellite SIS, but it may also account for other additive bias-like pseudorange errors. While each satellite SIS and each receiver’s RF BW and correlation method has its own unique bias error (signed), the  $b_{\text{nom}}$  parameter is used to conservatively account for effect of the actual bias errors on a receiver position solution over the span of malformations affecting the particular class of satellites and over the allowed combinations of receiver RF BWs and correlation methods.
- gamma The gamma multiplier accounts for potential bias-like errors that may vary as a function the broadcast user range accuracy (URA) value. The existence of these bias-like errors which vary with the broadcast URA value is still hypothetical. [Reference: Walter, T.; *“Bounding SIS Errors with the ISM Parameter”*; EU-U.S. Cooperation on Satellite Navigation, Working Group C meeting; October 2019.] The gamma parameter is used for inflating the  $b_{\text{nom}}$  value used in the ARAIM algorithm as a function the URA value currently broadcast by each satellite.

# ***Space and Missile Systems Center***

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## **Global Positioning Systems (GPS)**

### **Public Forum**



**United States Space Force  
Position, Navigation, and Timing Mission Area  
Wednesday, 30 September 2020, 0830-1630 PDT**



# *Dial-in Information*

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## **PRIMARY**

Dial-in: +1 646-828-7666 or 833-568-8864 (Toll Free)

Meeting ID: 161 1734 2565

Password: 12345

Screen Share:

<https://saicwebconferencing.zoomgov.com/j/16117342565?pwd=Njg5TVBTbXpKMVVndzNoL0pPMkhTZz09>

## **BACKUP**

Dial In: 410-874-6300 DSN: 312-874-6300

Conference Number: 380008635

Screen Share:

<https://conference.apps.mil/webconf/gpspublicmeeting2020>

**SLIDE LINK:** <https://www.gps.gov/technical/icwg/meetings/2020/>



# Agenda

Public ICWG (1 <sup>st</sup> Half of Day)	Presenter
Opening Remarks	Major Van Roekel
GPS Public ICWG and Public Forum Meeting Overview and Roll Call	Lt Julia Corton
2020 Public ICWG RFC Discussion	
<ul style="list-style-type: none"> <li>RFC-413 (Integrity Support Messages)</li> </ul>	Anthony Flores (SE&I)
<ul style="list-style-type: none"> <li>RFC-442 (2020 Proposed Changes to the Public Documents)</li> </ul>	Dylan Nicholas (SE&I)
<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>Eliminate 7-Day Non-Repeat Rule for Issue of Data, Clock (IODC)</li> </ul>	Karl Kovach
Walk-on Topics, Open Discussion	
Action Item Review	



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# Roll Call



# *Rules of Engagement*

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# UNCLASSIFIED



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



# *Rules of Engagement (Cont'd)*

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- **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**



# *Meeting Purpose*

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- 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**

# *Space and Missile Systems Center*

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## **Special Topic: Eliminate 7-Day Non-Repeat Rule for Issue of Data, Clock (IODC)**



**Karl Kovach  
Aerospace Corps  
30 Sep 20**



# Overview

- **Proposal to eliminate the 7-day non-repeat rule for IODC**
- **7-day non-repeat rule currently serves no useful purpose**
  - **It used to be useful in old days when IODC was AODC**
    - **'Old days' = Phase 1 Control Segment**
    - **AODC = "Age of Data, Clock"**
  - **Now it is just an opportunity for an "ICD Violation"**
    - **We do violate the 7-day non-repeat rule occasionally**
    - **CNES does good job reporting when we violate our ICDs**
- **Eliminating the rule eliminates potential for ICD Violation**
  - **Has no down-side impact**



## **20.3.4.4 Data Sets.**

The IODE is an 8 bit number equal to the 8 LSBs of the 10 bit IODC of the same CEI data set. The following rules govern the transmission of IODC and IODE values in different CEI data sets: (1) The transmitted IODC will be different from any value transmitted by the SV during the preceding seven days; (2) The transmitted IODE will be different from any value transmitted by the SV during the preceding six hours. The range of IODC will be as given in Table 20-XI for Block II/IIA SVs and Table 20-XII for Block IIR/IIR-M/IIF and GPS III SVs.



## 20.3.4.4 Data Sets.

The IODE is an 8 bit number equal to the 8 LSBs of the 10 bit IODC of the same CEI data set. The following rules govern the transmission of IODC and IODE values in different CEI data sets: (1) **Reserved** ~~The transmitted IODC will be different from any value transmitted by the SV during the preceding seven days~~; (2) The transmitted IODE will be different from any value transmitted by the SV during the preceding six hours. The range of IODC will be as given in Table 20-XI for Block II/IIA SVs and Table 20-XII for Block IIR/IIR-M/IIF and GPS III SVs.



# *Impact Assessment*

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- **Control Systems = No Impact**
  - They can keep doing what they do now
- **Satellites = No Impact**
  - They can keep doing what they do now
- **GPS Receivers = No Impact**
  - They can keep doing what they do now
- **External Monitor Networks = Small Impact**
  - They can still operate the same way they do now
  - Won't be able to report 7-day rule violations any more



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# Back Up Material



# *IODC Was AODC*

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## **ICD-GPS-200, 25 Jan 83**

### **20.3.3.3.1.5 Age of Data, Clock (AODC).**

Bits 23 and 24 of word three shall be the two MSBs of the ten-bit AODC term; bits one through eight of word eight in subframe 1 shall contain the eight LSBs of the AODC. The AODC indicates the approximate GPS time-of-week for which the correction parameters were estimated and thereby provides the user with a confidence level in the SV clock correction. The algorithms related to SV clock correction are given in Section 20.3.3.3.3; the identity between the AODC and age of data for ephemeris (AODE) is defined in Section 20.3.4.4.

## **IS-GPS-200K, 4 Mar 19**

### **20.3.3.3.1.5 Issue of Data, Clock (IODC).**

Bits 23 and 24 of word three in subframe 1 shall be the two MSBs of the ten-bit IODC term; bits one through eight of word eight in subframe 1 shall contain the eight LSBs of the IODC. The IODC indicates the issue number of the data set and thereby provides the user with a convenient means of detecting any change in the subframe 1 core CEI data. Constraints on the IODC as well as the relationship between the IODC and the IODE (issue of data, ephemeris) terms are defined in paragraph 20.3.4.4.



# WALK-ON



# *Open Forum Discussion*

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- **Questions/comments?**



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# ACTION ITEM REVIEW



# *Closing Remarks*

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- **Next steps**
- **Public ICWG Minutes will be posted on GPS.gov**
- **RFC 413 and 442 will proceed to the Engineering Review Board (ERB)**
- **Public inputs may be provided to: [smcgper@us.af.mil](mailto:smcgper@us.af.mil)**



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**Thank You**  
**for attending the**  
**2020 Public ICWG!**