Change Topic: Public Signals-in-Space (SiS) Updates

This change package accommodates the text changes to support the proposed solution (see table below) within the public Signals-in-Space (SiS) documents. All comments must be submitted in Comments Resolution Matrix (CRM) form.

The columns in the WAS/IS table following this page are defined below:

Section Number: This number indicates the location of the text change within the document.

Proposed Heading: Contains existing and/or proposed changes to section titles and/or the titles to new sections

(WAS) <Document Title>: Contains the baseline text of the impacted document.

Proposed Object Text: Contains proposed changes to baseline text.

Proposed Rationale: Contains the supporting information to explain the reason for the proposed changes.

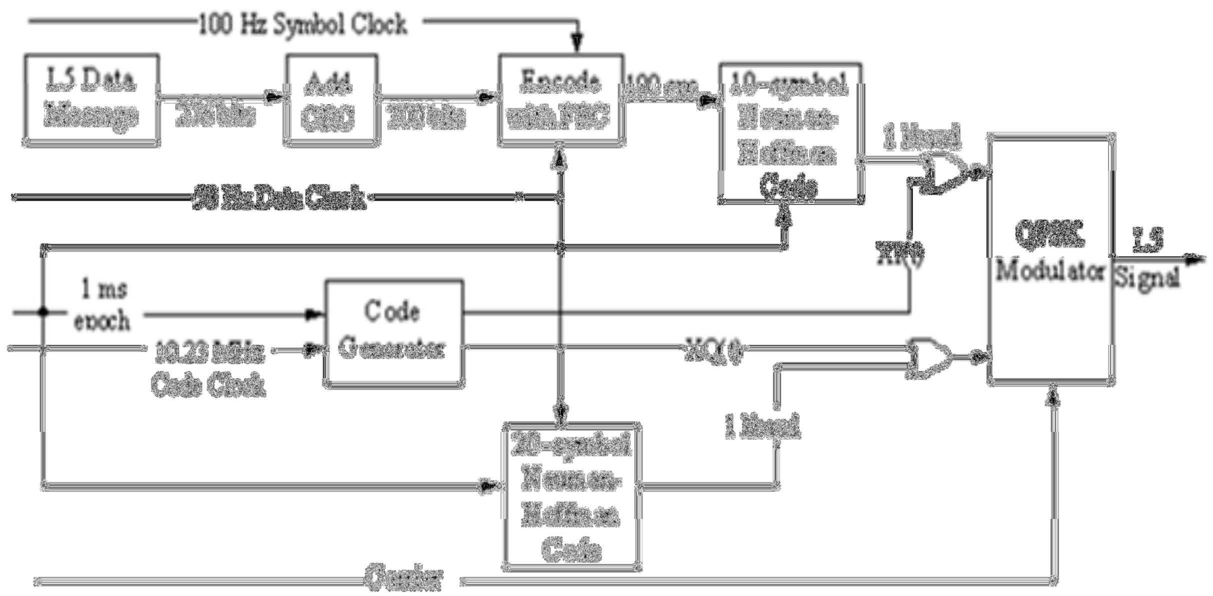
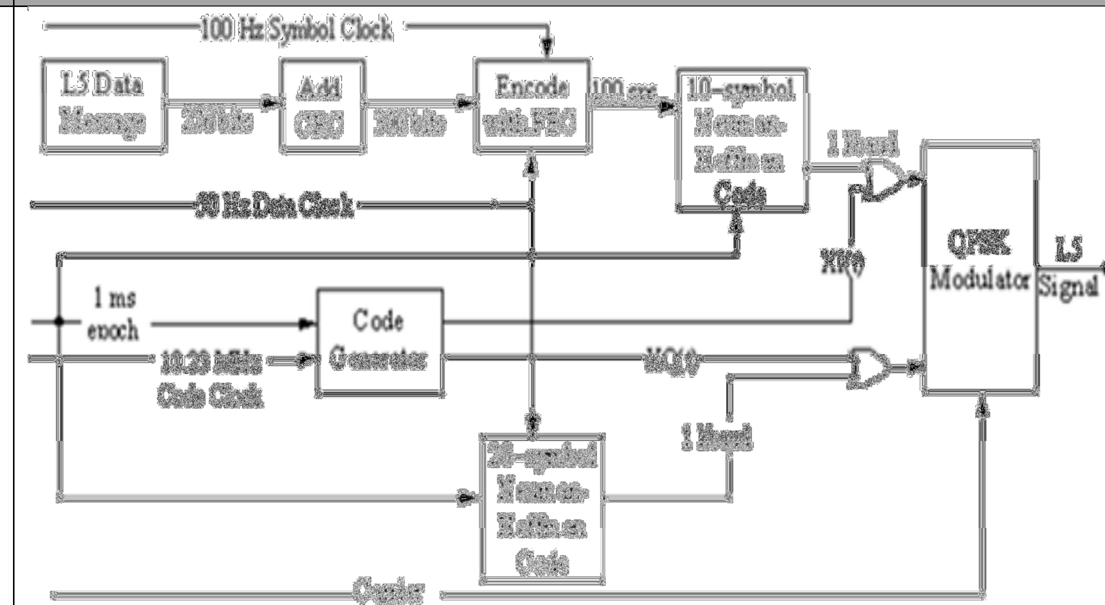
PROBLEM STATEMENT:
There are eight areas of obsolete/ambiguous language in the Signals-in-Space (SiS) specifications (mean anomaly equation, convolutional encoding, LNAV special messages reference, Universal Coordinated Time Offset Error (UTCOE), User Range Accuracy (URA) Note #3, Right Ascension Angle Language, and the signal health versus navigation data terminology, publication errors). If this language were interpreted incorrectly it could result in UE developers designing receivers that don't work.
SOLUTION: *(Proposed)*
Resolve the obsolete/ambiguous language in the areas above to avoid the potential for misinterpretation.
Note: For the changes with respect to IS-GPS-705B, IRN-001 there are ***<u>four</u>*** areas that are being amended: i. Coordinated Universal Coordinated Time Offset Error (UTCOE), (1 proposed change) ii. Signal health versus navigation data terminology) (1 proposed change) iii. Mean Anomaly equation (1 proposed change) iv. Publication Errors (32 proposed changes)

Start of WAS/IS for IS-GPS-705B, IRN-001 Changes

<table>
<tr><th>Section Number</th><th>IS-GPS-705 RevB IRN001 (17 Apr 2012) L5 SS and Nav User Segment Interfaces</th><th>Proposed Object Heading</th><th>Proposed Public Signals-in-Space (SiS) Updates Object Text</th><th>Proposed Rationale</th></tr>
<tr><td>2.2</td><td>Other Publications

International Earth Rotation and Reference Systems Service (IERS) Technical Note 36</td><td></td><td><u>Other Publications</u>

International Earth Rotation and Reference Systems Service (IERS) Technical Note 36</td><td>In order to be consistent with previous Revision, the term "Other Publications" should be underlined.</td></tr>
<tr><td>3.3.1.6</td><td><table>
<tr><th colspan="3">Table 3-III. Received Minimum RF Signal Strength</th></tr>
<tr><th rowspan="2">SV Blocks</th><th colspan="2">Signal</th></tr>
<tr><th>I5</th><th>Q5</th></tr>
<tr><td>IIF</td><td>-157.9 dBW</td><td>-157.9 dBW</td></tr>
<tr><td>III</td><td>-157.0 dBW</td><td>-157.0 dBW</td></tr>
</table></td><td></td><td><table>
<tr><th colspan="3">Table 3-III. Received Minimum RF Signal Strength</th></tr>
<tr><th rowspan="2">SV</th><th colspan="2">Signal</th></tr>
<tr><th>I5</th><th>Q5</th></tr>
<tr><td>Block IIF</td><td>-157.9 dBW</td><td>-157.9 dBW</td></tr>
<tr><td>GPS III</td><td>-157.0 dBW</td><td>-157.0 dBW</td></tr>
</table></td><td>Updated terminology to "SV", "Block IIF" and "GPS III" for consistency.</td></tr>
<tr><td>3.3.1.6.1</td><td><table>
<tr><th colspan="3">Table 3-IV. Space Service Volume (SSV) Received Minimum RF Signal Strength for GPS III and Subsequent Satellites over the Bandwidth Specified in 3.3.1.1 – GEO Based Antennas</th></tr>
<tr><th rowspan="2">SV Blocks</th><th colspan="2">Signal</th></tr>
<tr><th>I5</th><th>Q5</th></tr>
<tr><td>III and Subsequent</td><td>-182.0 dBW</td><td>-182.0 dBW</td></tr>
</table></td><td></td><td><table>
<tr><th colspan="3">Table 3-IV. Space Service Volume (SSV) Received Minimum RF Signal Strength for GPS III and Subsequent Satellites over the Bandwidth Specified in 3.3.1.1 – GEO Based Antennas</th></tr>
<tr><th rowspan="2">SV</th><th colspan="2">Signal</th></tr>
<tr><th>I5</th><th>Q5</th></tr>
<tr><td>GPS III and Subsequent Blocks</td><td>-182.0 dBW</td><td>-182.0 dBW</td></tr>
</table></td><td>Updated terminology to "SV", and "GPS III and Subsequent Blocks" for consistency.</td></tr>
</table>

Section Number	IS-GPS-705 RevB IRN001 (17 Apr 2012) L5 SS and Nav User Segment Interfaces	Proposed Object Heading	Proposed Public Signals-in-Space (SiS) Updates Object Text	Proposed Rationale
3.3.2.1	 Figure 3-3. Modulation of Signals		 Figure 3-3. Modulation of Signals	Publication error during Word export. Figure is now correct in Word/PDF. The quality of Figure 3-3 had degraded from Rev to Rev F and has now been restored.
3.3.2.3	In scenario b, the initial state of the XB sequence, B0, is greater than State 6151. Thus, the second natural XB sequence runs to completion and a third natural sequence starts (except when B0 is State 6152) prior to the next 1 ms epoch.		<DELETE>	This requirement is an identical requirement that has been erroneously duplicated into neighboring requirements. It should be deleted.
3.3.2.3	Each of the 1 ms Q5-code blocks is further encoded with a 20-bit Neuman-Hofman code. The 20 bits are modulo-2 added to the Q5 code chips at the PRN code epoch rate of 1 kHz. The code, nh20(t), starting coincident with the 20 ms data epoch on the I5 channel, is as follows:		Each of the 1 ms Q5-code blocks is further encoded with a 20-bit Neuman-Hofman code. The 20 bits are modulo-2 added to the Q5 code chips at the PRN code epoch rate of 1 kHz. The code, nh20(t), starting coincident with the 20 ms data epoch on the I5 channel, is as	The designations of '1st' and 'Last' should

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	1st Last nh20(t) = 0 0 0 0 0 1 0 0 1 1 0 1 0 1 0 0 1 1 1 0		follows: 1st Last nh20(t) = 0 0 0 0 0 1 0 0 1 1 0 1 0 1 0 0 1 1 1 0	be aligned properly to the bit stream.
3.3.4	The L5 CNAV data contains the requisite data for relating GPS time to UTC. The accuracy of this data during the transmission interval will be such that it relates GPS time to UTC (USNO) to within 90.0 nanoseconds (one sigma). This data is generated by the CS (or provided to the CS); therefore, the accuracy of these relationships may degrade if for some reason the CS is unable to upload data to an SV.		The L5 CNAV data contains the requisite data for relating GPS time to UTC. This data is generated by the CS (or provided to the CS); therefore, the accuracy of these relationships may degrade if for some reason the CS is unable to upload data to an SV.	The text "The accuracy of this data during the transmission interval shall be such that it relates GPS time (maintained by the MCS of the CS) to UTC (USNO) within 90 nanoseconds (one sigma)" has been deleted. The rationale is that the time accuracy stated (90ns-one sigma) is not aligned to the PPS PS and the SPS PS (40ns).

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6.2.2.2.1	Block IIA SVs	Block II SVs		Inserting Section 6.2.2.2.1 Block II SVs to maintain synchronization with IS-GPS-200.
6.2.2.2.1			See paragraph 6.2.2.2.1 of IS-GPS-200. These satellites do not broadcast the L5 signal.	Inserting Section 6.2.2.2.1 Block II SVs to maintain synchronization with IS-GPS-200.
6.2.2.2.2	Block IIR SVs.	Block IIA SVs.		Section 6.2.2.2.1 Block IIA SVs moved to Section 6.2.2.2.2. All associated text with 6.2.2.2.1 Block IIA SVs has also moved to Section 6.2.2.2.2.
6.2.2.2.3	Block IIR-M SVs.	Block IIR SVs.		Section 6.2.2.2.33Block IIR- SVs moved to Section

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				6.2.2.2.3. All associated text with 6.2.2.2.2 Block IIR SVs has also moved to Section 6.2.2.2.3.
6.2.2.2.4	Block IIF SVs.	Block IIR-M SVs.		Section 6.2.2.2.3 Block IIR-M SVs moved to Section 6.2.2.2.4. All associated text with 6.2.2.2.3 Block IIR M SVs has also moved to Section 6.2.2.2.4.
6.2.2.2.5	GPS III SVs	Block IIF SVs.		Section 6.2.2.2.4 Block IIF SVs moved to Section 6.2.2.2.5. All associated text with 6.2.2.2.4 Block IIR M SVs has also moved to Section

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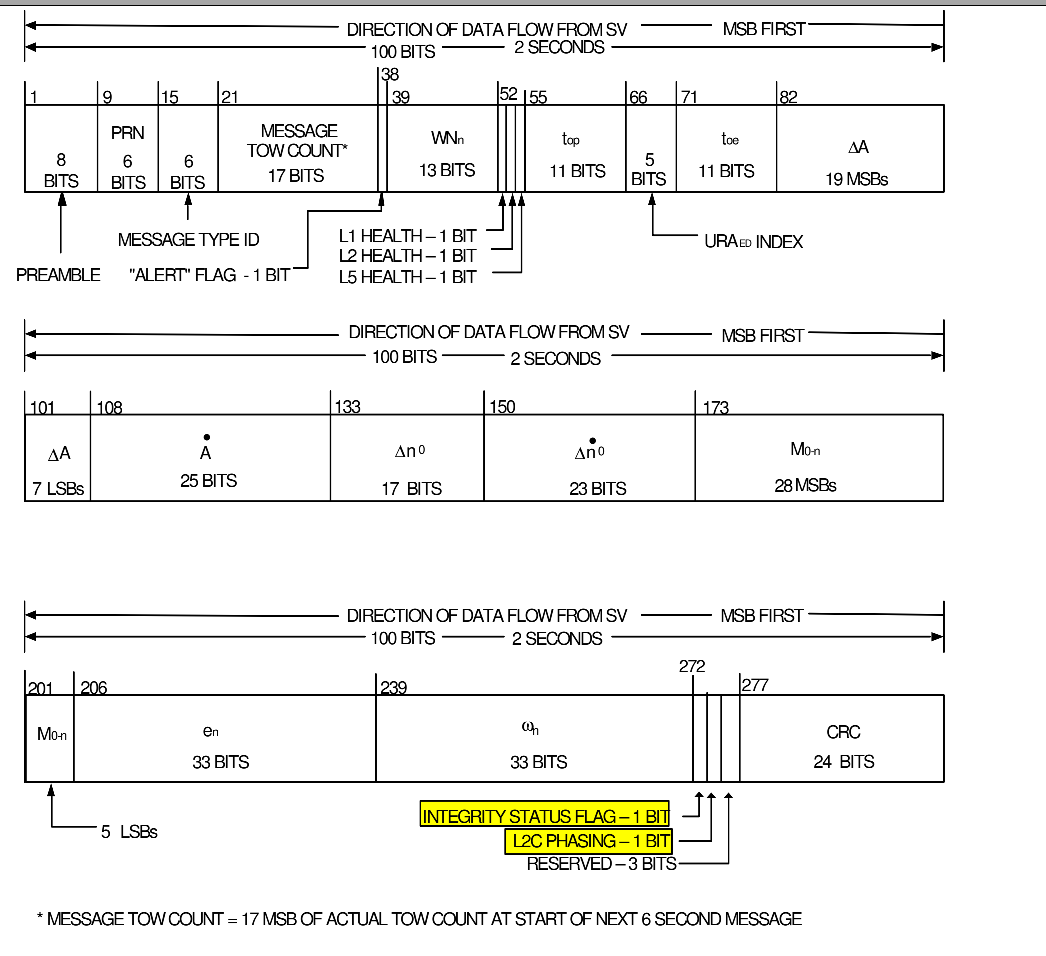
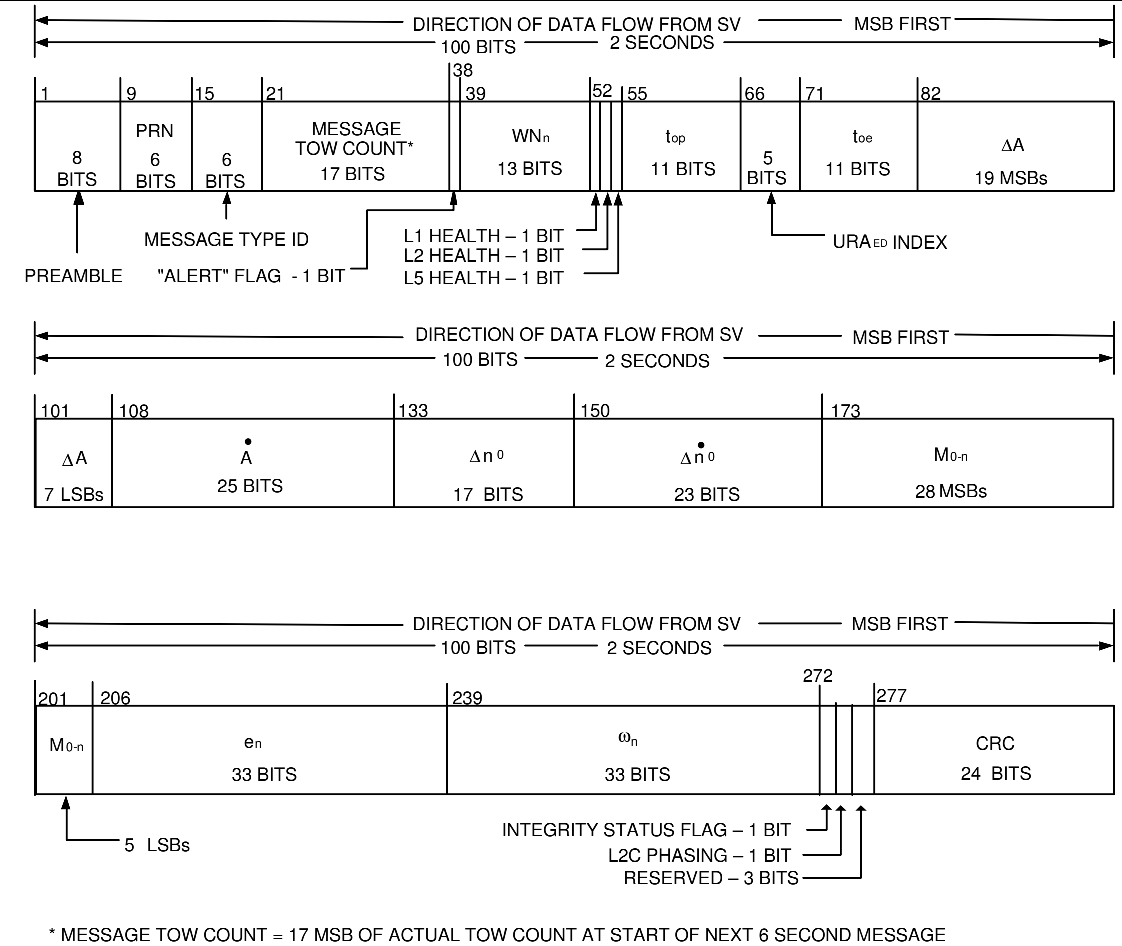
				6.2.2.2.5.
6.2.2.2.6		GPS III SVs		Section 6.2.2.2.6 GPS III SVs moved from Section 6.2.2.2.5 to remain synchronized with IS-GPS-200.
6.4.4	PRNs 33 and 63	PRNs 33 through 63		Fixed typo from "33 and 63" to "33 through 64"
10.3	Any letter of exception which is in force for the revision of the IS is depicted in Figure 10.3-1, 1-0.3-2, and 10.3-3.		Any letter of exception which is in force for the revision of the IS is depicted in Figure 10.3-1, 10.3-2, 10.3-3, and 10.3-4.	Fixed figure references. Also included reference to 10.3-4.

Section Number	IS-GPS-705 RevB IRN001 (17 Apr 2012) L5 SS and Nav User Segment Interfaces	Proposed Object Heading	Proposed Public Signals-in-Space (SiS) Updates Object Text	Proposed Rationale
20.3.3	 Figure 20-1. Message type 10 - Ephemeris 1		 Figure 20-1. Message type 10 - Ephemeris 1	Removing yellow highlighting from Figure 20-1. The highlighted bits were only differentiated for discussion purposes and removing the highlights have no technical impact.
20.3.3.1.1	The t_{oe} term shall provide the user with a convenient means for detecting any change in the ephemeris representation parameters. The t_{oe} is provided in both message type 10 and 11 for the purpose of comparison with the t_{oc} term in message type 30 - 37. Whenever these three terms do not match, a data set cutover has occurred and new data must be collected. The timing of the toe and constraints on the t_{oc} and toe are defined in paragraph 20.3.4.4.		The t_{oe} term shall provide the user with a convenient means for detecting any change in the ephemeris representation parameters. The t_{oe} is provided in both message type 10 and 11 for the purpose of comparison with the t_{oc} term in message type 30 - 37. Whenever these three terms do not match, a data set cutover has occurred and new data must be collected. The timing of the t_{oe} and constraints on the t_{oc} and t_{oe} are defined in paragraph 20.3.4.4.	The 't_{oe}' term in the last sentence should be subscripted to remain consistent

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				with the 't_{oe}' terms listed previously in the paragraph and throughout IS-GPS-705.
20.3.3.1.1	Any change in the message type 10 and 11 ephemeris data will be accomplished with a simultaneous change in the t_{oe} value. The CS will assure the t_{oe} value for Block IIR-M/IIF and SS will assure the toe value for GPS III, for at least the first data set transmitted by an SV after an upload, is different from that transmitted prior to the cutover. See Section 20.3.4.5 for additional information regarding t_{oe}.		Any change in the message type 10 and 11 ephemeris data will be accomplished with a simultaneous change in the t_{oe} value. The CS will assure the t_{oe} value for Block IIR-M/IIF and SS will assure the t_{oe} value for GPS III, for at least the first data set transmitted by an SV after an upload, is different from that transmitted prior to the cutover. See Section 20.3.4.5 for additional information regarding t_{oe}.	The 't_{oe}' term in the second sentence should be subscripted to remain consistent with the 't_{oe}' terms listed previously in the paragraph and throughout IS-GPS-705.
20.3.3.1.1.4	<u>URA_{ED} Index</u> <u>URA_{ED} (meters)</u> 15 6144.00 < URA_{ED} (or no accuracy prediction is available) 14 3072.00 < URA_{ED} ≤ 6144.00 13 1536.00 < URA_{ED} ≤ 3072.00 12 768.00 < URA_{ED} ≤ 1536.00 11 384.00 < URA_{ED} ≤ 768.00		The URA_{ED} index is a signed, two's complement integer in the range of +15 to -16 and has the following relationship to the ED URA: <u>URA_{ED} Index</u> <u>URA_{ED} (meters)</u> 15 6144.00 < URA_{ED} (or no accuracy prediction is available) 14 3072.00 < URA_{ED} ≤ 6144.00 13 1536.00 < URA_{ED} ≤ 3072.00 12 768.00 < URA_{ED} ≤ 1536.00	A descriptive sentence was erroneously dropped from this revision and now has been reinserted.

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	10 $192.00 < URA_{ED} \leq 384.00$		11 $384.00 < URA_{ED} \leq 768.00$	
	9 $96.00 < URA_{ED} \leq 192.00$		10 $192.00 < URA_{ED} \leq 384.00$	
	8 $48.00 < URA_{ED} \leq 96.00$		9 $96.00 < URA_{ED} \leq 192.00$	
	7 $24.00 < URA_{ED} \leq 48.00$		8 $48.00 < URA_{ED} \leq 96.00$	
	6 $13.65 < URA_{ED} \leq 24.00$		7 $24.00 < URA_{ED} \leq 48.00$	
	5 $9.65 < URA_{ED} \leq 13.65$		6 $13.65 < URA_{ED} \leq 24.00$	
	4 $6.85 < URA_{ED} \leq 9.65$		5 $9.65 < URA_{ED} \leq 13.65$	
	3 $4.85 < URA_{ED} \leq 6.85$		4 $6.85 < URA_{ED} \leq 9.65$	
	2 $3.40 < URA_{ED} \leq 4.85$		3 $4.85 < URA_{ED} \leq 6.85$	
	1 $2.40 < URA_{ED} \leq 3.40$		2 $3.40 < URA_{ED} \leq 4.85$	
	0 $1.70 < URA_{ED} \leq 2.40$		1 $2.40 < URA_{ED} \leq 3.40$	
	-1 $1.20 < URA_{ED} \leq 1.70$		0 $1.70 < URA_{ED} \leq 2.40$	
	-2 $0.85 < URA_{ED} \leq 1.20$		-1 $1.20 < URA_{ED} \leq 1.70$	
	-3 $0.60 < URA_{ED} \leq 0.85$		-2 $0.85 < URA_{ED} \leq 1.20$	
	-4 $0.43 < URA_{ED} \leq 0.60$		-3 $0.60 < URA_{ED} \leq 0.85$	
	-5 $0.30 < URA_{ED} \leq 0.43$		-4 $0.43 < URA_{ED} \leq 0.60$	
	-6 $0.21 < URA_{ED} \leq 0.30$		-5 $0.30 < URA_{ED} \leq 0.43$	

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	-7 0.15 < URA_{ED} ≤ 0.21 -8 0.11 < URA_{ED} ≤ 0.15 -9 0.08 < URA_{ED} ≤ 0.11 -10 0.06 < URA_{ED} ≤ 0.08 -11 0.04 < URA_{ED} ≤ 0.06 -12 0.03 < URA_{ED} ≤ 0.04 -13 0.02 < URA_{ED} ≤ 0.03 -14 0.01 < URA_{ED} ≤ 0.02 -15 URA_{ED} ≤ 0.01 -16 No accuracy prediction available-use at own risk For each URA index (N), users may compute a nominal URA value (X) as given by: • If the value of N is 6 or less, $X = 2^{(1 + N/2)}$, • If the value of N is 6 or more, but less than 15, $X = 2^{(N - 2)}$, • N = 15 shall indicate the absence of an accuracy prediction and shall advise the standard positioning service user to use that SV at his own risk. For N = 1, 3, and 5, X should be rounded to 2.8, 5.7, and 11.3 meters, respectively. The nominal URA_{ED} value (X) is suitable for use as a conservative prediction of the RMS ED range errors for accuracy-related purposes in the pseudorange domain (e.g., measurement de-weighting, RAIM, FOM computations). Integrity properties of the $IAURA_{ED}$ are specified with respect to the scaled		-6 0.21 < URA_{ED} ≤ 0.30 -7 0.15 < URA_{ED} ≤ 0.21 -8 0.11 < URA_{ED} ≤ 0.15 -9 0.08 < URA_{ED} ≤ 0.11 -10 0.06 < URA_{ED} ≤ 0.08 -11 0.04 < URA_{ED} ≤ 0.06 -12 0.03 < URA_{ED} ≤ 0.04 -13 0.02 < URA_{ED} ≤ 0.03 -14 0.01 < URA_{ED} ≤ 0.02 -15 URA_{ED} ≤ 0.01 -16 No accuracy prediction available-use at own risk For each URA index (N), users may compute a nominal URA value (X) as given by: • If the value of N is 6 or less, $X = 2^{(1 + N/2)}$, • If the value of N is 6 or more, but less than 15, $X = 2^{(N - 2)}$, • N = 15 shall indicate the absence of an accuracy prediction and shall advise the standard positioning service user to use that SV at his own risk. For N = 1, 3, and 5, X should be rounded to 2.8, 5.7, and 11.3 meters, respectively. The nominal URA_{ED} value (X) is suitable for use as a conservative prediction of the RMS ED range errors for accuracy-related purposes in the pseudorange domain (e.g., measurement de-weighting, RAIM, FOM computations). Integrity properties of the $IAURA_{ED}$ are specified with respect to the scaled (multiplied by either 4.42 or 5.73 as appropriate) upper bound	

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	(multiplied by either 4.42 or 5.73 as appropriate) upper bound values of the broadcast URA_{ED} index (see 20.3.3.1.1). For the nominal URA_{ED} value and the $IAURA_{ED}$ value, users may compute an adjusted URA_{ED} value as a function of SV elevation angle (E), for $E \geq 0$, as follows: Adjusted Nominal URA_{ED} = Nominal URA_{ED} (sin(E+90 degrees)) Adjusted $IAURA_{ED}$ = $IAURA_{ED}$ (sin(E+90 degrees)) URA_{ED} and $IAURA_{ED}$ account for SIS contributions to user range error which include, but are not limited to, the following: LSB representation/truncation error, alongtrack ephemeris errors, and crosstrack ephemeris errors. URA_{ED} and $IAURA_{ED}$ do not account for user range error contributions due to the inaccuracy of the broadcast ionospheric data parameters used in the single-frequency ionospheric model or for other atmospheric effects.		values of the broadcast URA_{ED} index (see 20.3.3.1.1). For the nominal URA_{ED} value and the $IAURA_{ED}$ value, users may compute an adjusted URA_{ED} value as a function of SV elevation angle (E), for $E \geq 0$, as follows: Adjusted Nominal URA_{ED} = Nominal URA_{ED} (sin(E+90 degrees)) Adjusted $IAURA_{ED}$ = $IAURA_{ED}$ (sin(E+90 degrees)) URA_{ED} and $IAURA_{ED}$ account for SIS contributions to user range error which include, but are not limited to, the following: LSB representation/truncation error, alongtrack ephemeris errors, and crosstrack ephemeris errors. URA_{ED} and $IAURA_{ED}$ do not account for user range error contributions due to the inaccuracy of the broadcast ionospheric data parameters used in the single-frequency ionospheric model or for other atmospheric effects.	

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<tr><td>20.3.3.1.3</td><td>
<table>
<tr><th colspan="6">Table 20-I. Message Types 10 and 11 Parameters (2 of 2)</th></tr>
<tr><th>Parameter Symbol</th><th>Parameter Description</th><th>No. of Bits**</th><th>Scale Factor (LSB)</th><th>Effective Range***</th><th>Units</th></tr>
<tr><td>t_{oe}</td><td>Ephemeris data reference time of week</td><td>11</td><td>300</td><td>604,500</td><td>seconds</td></tr>
<tr><td>Ω_{0-n}****</td><td>Reference right ascension angle</td><td>33*</td><td>2^{-32}</td><td></td><td>semi-circles</td></tr>
<tr><td>$\Delta\dot{\Omega}$ *****</td><td>Rate of right ascension difference</td><td>17*</td><td>2^{-44}</td><td></td><td>semi-circles/sec</td></tr>
<tr><td>i_{0-n}</td><td>Inclination angle at reference time</td><td>33*</td><td>2^{-32}</td><td></td><td>semi-circles</td></tr>
<tr><td>$\dot{i}_{0-n}$</td><td>Rate of inclination angle</td><td>15*</td><td>2^{-44}</td><td></td><td>semi-circles/sec</td></tr>
<tr><td>C_{is-n}</td><td>Amplitude of the sine harmonic correction term to the angle of inclination</td><td>16*</td><td>2^{-30}</td><td></td><td>radians</td></tr>
<tr><td>C_{ic-n}</td><td>Amplitude of the cosine harmonic correction term to the angle of inclination</td><td>16*</td><td>2^{-30}</td><td></td><td>radians</td></tr>
<tr><td>C_{rs-n}</td><td>Amplitude of the sine correction term to the orbit radius</td><td>24*</td><td>2^{-8}</td><td></td><td>meters</td></tr>
<tr><td>C_{rc-n}</td><td>Amplitude of the cosine correction term to the orbit radius</td><td>24*</td><td>2^{-8}</td><td></td><td>meters</td></tr>
<tr><td>C_{us-n}</td><td>Amplitude of the sine harmonic correction term to the argument of latitude</td><td>21*</td><td>2^{-30}</td><td></td><td>radians</td></tr>
<tr><td>C_{uc-n}</td><td>Amplitude of the sine harmonic correction term to the argument of latitude</td><td>21*</td><td>2^{-30}</td><td></td><td>radians</td></tr>
<tr><td colspan="6">* Parameters so indicated are two's complement, with the sign bit (+ or -) occupying the MSB;
** See Figure 20-1 and Figure 20-2 for complete bit allocation in message types 10 and 11;
*** Unless otherwise indicated in this column, effective range is the maximum range attainable with indicated bit allocation and scale factor.
**** Ω_{0-n} is the right ascension angle at the weekly epoch (Ω_{0-w}) propagated to the reference time at the rate of right ascension {$\dot{\Omega}_{REF}$ Table 20-II }.
***** Relative to $\dot{\Omega}_{REF}$ = -2.6 x 10^{-9} semi-circles/second.</td></tr>
</table>
</td><td></td><td>
<table>
<tr><th colspan="6">Table 20-I. Message Types 10 and 11 Parameters (2 of 2)</th></tr>
<tr><th>Parameter Symbol</th><th>Parameter Description</th><th>No. of Bits**</th><th>Scale Factor (LSB)</th><th>Effective Range***</th><th>Units</th></tr>
<tr><td>t_{oe}</td><td>Ephemeris data reference time of week</td><td>11</td><td>300</td><td>604,500</td><td>seconds</td></tr>
<tr><td>Ω_{0-n}</td><td>Longitude of Ascending Node of Orbit Plane at Weekly Epoch</td><td>33*</td><td>2^{-32}</td><td></td><td>semi-circles</td></tr>
<tr><td>$\Delta\dot{\Omega}$ ****</td><td>Rate of right ascension difference</td><td>17*</td><td>2^{-44}</td><td></td><td>semi-circles/sec</td></tr>
<tr><td>i_{0-n}</td><td>Inclination angle at reference time</td><td>33*</td><td>2^{-32}</td><td></td><td>semi-circles</td></tr>
<tr><td>$\dot{i}_{0-n}$</td><td>Rate of inclination angle</td><td>15*</td><td>2^{-44}</td><td></td><td>semi-circles/sec</td></tr>
<tr><td>C_{is-n}</td><td>Amplitude of the sine harmonic correction term to the angle of inclination</td><td>16*</td><td>2^{-30}</td><td></td><td>radians</td></tr>
<tr><td>C_{ic-n}</td><td>Amplitude of the cosine harmonic correction term to the angle of inclination</td><td>16*</td><td>2^{-30}</td><td></td><td>radians</td></tr>
<tr><td>C_{rs-n}</td><td>Amplitude of the sine correction term to the orbit radius</td><td>24*</td><td>2^{-8}</td><td></td><td>meters</td></tr>
<tr><td>C_{rc-n}</td><td>Amplitude of the cosine correction term to the orbit radius</td><td>24*</td><td>2^{-8}</td><td></td><td>meters</td></tr>
<tr><td>C_{us-n}</td><td>Amplitude of the sine harmonic correction term to the argument of latitude</td><td>21*</td><td>2^{-30}</td><td></td><td>radians</td></tr>
<tr><td>C_{uc-n}</td><td>Amplitude of the sine harmonic correction term to the argument of latitude</td><td>21*</td><td>2^{-30}</td><td></td><td>radians</td></tr>
<tr><td colspan="6">* Parameters so indicated are two's complement, with the sign bit (+ or -) occupying the MSB;
** See Figure 20-1 and Figure 20-2 for complete bit allocation in message types 10 and 11;
*** Unless otherwise indicated in this column, effective range is the maximum range attainable with indicated bit allocation and scale factor.
**** Relative to $\dot{\Omega}_{REF}$ = -2.6 x 10^{-9} semi-circles/second.</td></tr>
</table>
</td><td>The orbit parameter "Reference right ascension angle Ω_{O-N} **** in Table 20-I, is defined as Ω_{O-N} is the right ascension angle at the weekly epoch (Ω_{O-w}) propagated to the reference time at the rate of right ascension." This definition is consistent with the term used in IS-GPS-200 Table 20-II, but the name of the term is inconsistent- "Reference right ascension angle" in Table 20-I and "Longitude of</td></tr>
</table>

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				Ascending Node of Orbit Plane at Weekly Epoch" in IS-GPS-200 Table 20-II. Recommend that the identical terms be used since they are have identical definitions. Also recommending deleting the 4-star note, and thus renumbering the old 5-star note to a 4-star note.
20.3.3.2.4	The CS shall derive URA_{NED0}, URA_{NED1}, and URA_{NED2} indexes which, when used together in the above equations, results in the minimum $IAURA_{NED}$ that is greater than the predicted $IAURA_{NED}$ during the/ephemeris fit interval.		The CS shall derive URA_{NED0}, URA_{NED1}, and URA_{NED2} indexes that, when used together in the above equations, results in the minimum $IAURA_{NED}$ that is greater than the predicted $IAURA_{NED}$ during the ephemeris fit interval.	Corrected the grammar typo by changing "which, … results" to "that, …result" and corrected the typo by changing "the/ephemeris" to "the

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				ephemeris".
20.3.3.2.4	For each URA_{NED0} index (N), users may compute a nominal URA_{NED0} value (X) as given by: • If the value of N is 6 or less, but more than -16, X = $2^{(1 + N/2)}$, • If the value of N is 6 or more, but less than 15, X = $2^{(N - 2)}$, • N = -16 or N = 15 shall indicate the absence of an accuracy prediction and shall advise the standard positioning service user to use that SV at his own risk. For N = 1, 3, and 5, X should be rounded to 2.8, 5.7, and 11.3 meters, respectively. The nominal URA_{NED0} value (X) shall be suitable for use as a conservative prediction of the RMS NED range errors for accuracy-related purposes in the pseudorange domain (e.g., measurement de-weighting RAIM, FOM computations). Integrity properties of the $IAURA_{NED}$ are specified with respect to the scaled (multiplied by either 4.42 or 5.73 as appropriate) upper bound values of the URA_{NED0} index, URA_{NED1} index, and URA_{NED2} index (see 20.3.3.1.1). URA_{NED0} accounts for zeroth order SIS-contributions to user range error which include, but are not limited to, the following: LSB representation/truncation error; the net effect of clock correction polynomial error and code phase error in the transmitted signal for single-frequency L1C/A or single-frequency L2C users who correct the code phase as described in Section 20.3.3.3.1.1.1; the net effect of clock parameter, code phase, and inter-signal correction error for dual-frequency L1/L2 and L1/L5 users who correct for group delay and ionospheric effects as described in Section 20.3.3.3.1.1.2; radial ephemeris error; anisotropic antenna errors; and signal deformation error. URA_{NED} does not account for user range contributions due to the inaccuracy of the broadcast ionospheric data parameters used in the single-frequency ionospheric model or for other atmospheric effects. The transmitted URA_{NED1} index is an integer value in the range 0 to 7. The URA_{NED1} index has the following relationship to the URA_{NED1} value: $URA_{NED1} = \frac{1}{2^N}$ (meters/second) where		For each URA_{NED0} index (N), users may compute a nominal URA_{NED0} value (X) as given by: • If the value of N is 6 or less, but more than -16, X = $2^{(1 + N/2)}$, • If the value of N is 6 or more, but less than 15, X = $2^{(N - 2)}$, • N = -16 or N = 15 shall indicate the absence of an accuracy prediction and shall advise the standard positioning service user to use that SV at his own risk. For N = 1, 3, and 5, X should be rounded to 2.8, 5.7, and 11.3 meters, respectively. The nominal URA_{NED0} value (X) shall be suitable for use as a conservative prediction of the RMS NED range errors for accuracy-related purposes in the pseudorange domain (e.g., measurement de-weighting RAIM, FOM computations). Integrity properties of the $IAURA_{NED}$ are specified with respect to the scaled (multiplied by either 4.42 or 5.73 as appropriate) upper bound values of the URA_{NED0} index, URA_{NED1} index, and URA_{NED2} index (see 20.3.3.1.1). URA_{NED0} accounts for zeroth order SIS-contributions to user range error which include, but are not limited to, the following: LSB representation/truncation error; the net effect of clock correction polynomial error and code phase error in the transmitted signal for single-frequency L1C/A or single-frequency L2C users who correct the code phase as described in Section 20.3.3.3.1.1.1; the net effect of clock parameter, code phase, and inter-signal correction error for dual-frequency L1/L2 and L1/L5 users who correct for group delay and ionospheric effects as described in Section 20.3.3.3.1.1.2; radial ephemeris error; anisotropic antenna errors; and signal deformation error. URA_{NED} does not account for user range contributions due to the inaccuracy of the broadcast ionospheric data parameters used in the single-frequency ionospheric model or for other atmospheric effects. The transmitted URA_{NED1} index is an integer value in the range 0 to 7. The URA_{NED1} index has the following relationship to the URA_{NED1} value: $URA_{NED1} = \frac{1}{2^N}$ (meters/second) where	Changing: "The transmitted URA_{NED2} index is an integer value in the range 0 to 7. URA_{NED2} index has the following relationship to the URA_{oc2}:" to "The transmitted URA_{NED2} index is an integer value in the range 0 to 7. URA_{NED2} index has the following relationship to the URA_{NED2}:"

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	N = 14 + URA_{NED1} Index. The transmitted URA_{NED2} index is an integer value in the range 0 to 7. URA_{NED2} index has the following relationship to the URA_{oc2}: $URA_{NED2} = \frac{1}{2^N}$ (meters/second/second) where N = 28 + URA_{NED2} Index.		N = 14 + URA_{NED1} Index. The transmitted URA_{NED2} index is an integer value in the range 0 to 7. URA_{NED2} index has the following relationship to the URA_{NED2}: $URA_{NED2} = \frac{1}{2^N}$ (meters/second/second) where N = 28 + URA_{NED2} Index.	
20.3.3.4.4	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 signals of the SV whose PRN number is specified in the message or in the packet. For each health indicator, a “0” signifies that all navigation data are okay and “1” signifies that some or all navigation data are bad. The predicted health data will be updated at the time of upload when a new reduced almanac has been built by the CS. The transmitted health data may not correspond to the actual health of the transmitting SV or other SVs in the constellation.		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 signals of the SV whose PRN number is specified in the message or in the packet. For each health indicator, a “0” signifies that all signals on the associated frequency are okay and “1” signifies that some or all signals on the associated frequency are bad. The predicted health data will be updated at the time of upload when a new reduced almanac has been built by the CS. The transmitted health data may not correspond to the actual health of the transmitting SV or other SVs in the constellation.	The current language states that "For each health indicator, a “0” signifies that all navigation data are okay and “1” signifies that some or all navigation data are bad." This language is misleading

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				in that it implies that one bit designated with a "1" means that all navigation data (L1, L2, and L5) are bad, which may not be true. Recommended text clarifies that a "1" signifies that some or all signals on the associated frequency are bad.
20.3.3.4.6.1			A 6-bit value of "000000" in the PRN_a field shall indicate that no further Status Words are contained in the remainder of the data block. In this event, all subsequent bits in the data block field shall be filler bits, i.e., alternating ones and zeros beginning with one.	This language is being supplied so that users now know how to interpret dummy SVs for the L5 signal.

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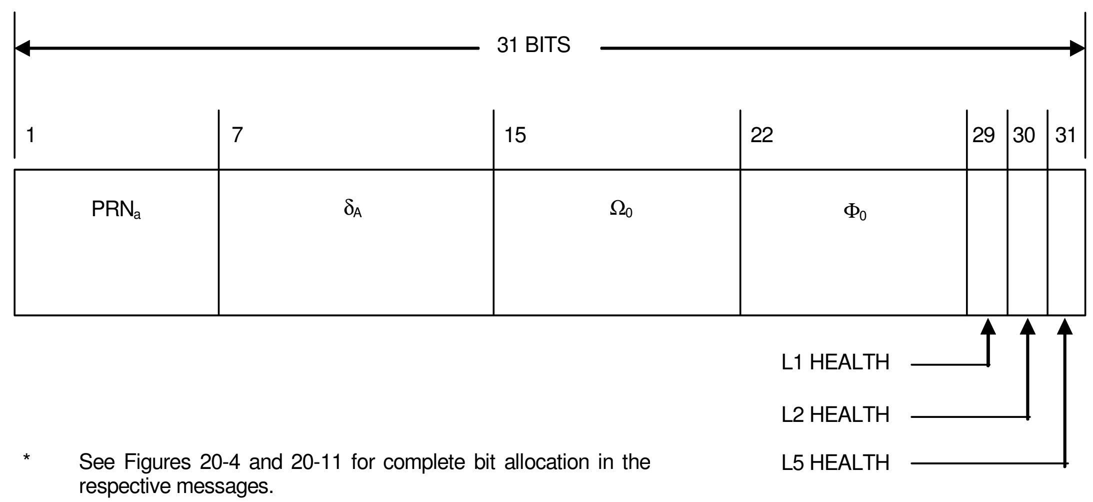
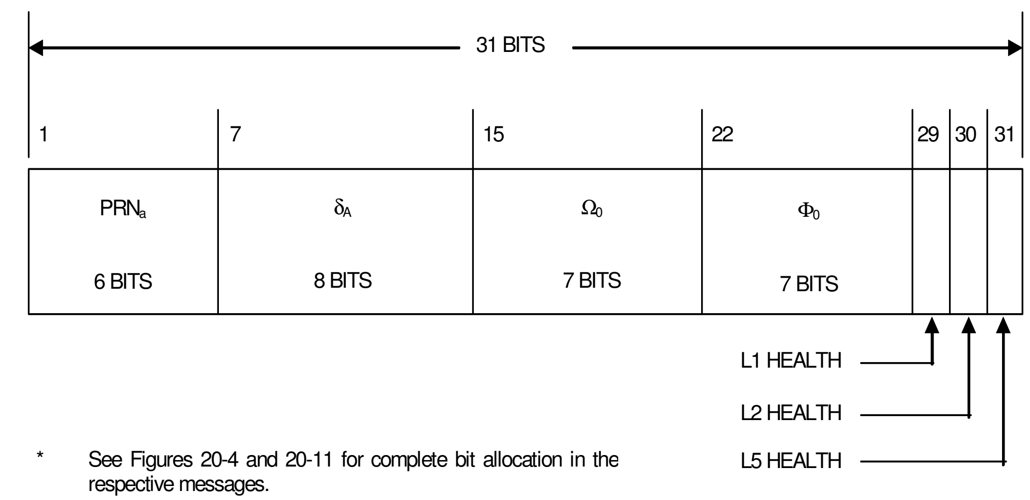
20.3.3.4.6.2.1	 Figure 20-16. Reduced Almanac Packet Content		 Figure 20-16. Reduced Almanac Packet Content	Publication error during Word export. Figure is now correct in Word/PDF. The bit counts for the data fields in the Reduced Almanac Packet diagram have been restored.
20.3.3.5.1	The EOP fields in the message type 32 contain the EOP data needed to construct the ECEF-to-ECI coordinate transformation. The user computes the ECEF position of the SV antenna phase center using the equations shown in Table 20-II. The full coordinate transformation for translating to the corresponding ECI SV antenna phase center position may be accomplished in accordance with the computations detailed in Chapter 5 of IERS Technical Note 36: IERS Conventions (2010) and equations for UT1, xp and yp as documented in Table 20-VIII. Figure 5.1 on page 73 of that document depicts the computational flow starting from GCRS (Geocentric Celestial Reference System) to ITRS (International Terrestrial Reference System). Ongoing WGS 84 re-adjustment at NGA and incorporating the 2010 IERS Conventions, are expected to bring Earth based coordinate agreement to within 2 cm. In the context of the Conventions, the user may as a matter of convenience choose to implement the transformation computations via either the Celestial Intermediate Origin (CIO) based approach" or the "Equinox based approach". The EOP parameters for ΔUT1 are to be applied within the "Rotation to terrestrial system" process, and the parameters for x_p and y_p are applied in the "Rotation for polar motion" process. Users are advised that the broadcast message type 32 EOP parameters already account for zonal, diurnal and semidiurnal effects (described in Chapter 8 of the IERS Conventions (2010)), so these effects should not be further applied by the user.		The EOP fields in the message type 32 contain the EOP data needed to construct the ECEF-to-ECI coordinate transformation. The user computes the ECEF position of the SV antenna phase center using the equations shown in Table 20-II. The full coordinate transformation for translating to the corresponding ECI SV antenna phase center position may be accomplished in accordance with the computations detailed in Chapter 5 of IERS Technical Note 36: IERS Conventions (2010) and equations for UT1, xp and yp as documented in Table 20-VIII. Figure 5.1 on page 73 of that document depicts the computational flow starting from GCRS (Geocentric Celestial Reference System) to ITRS (International Terrestrial Reference System). Ongoing WGS 84 re-adjustment at NGA and incorporating the 2010 IERS Conventions, are expected to bring Earth based coordinate agreement to within 2 cm. In the context of the Conventions, the user may as a matter of convenience choose to implement the transformation computations via either the "Celestial Intermediate Origin (CIO) based approach" or the "Equinox based approach". The EOP parameters for ΔUT1 are to be applied within the "Rotation to terrestrial system" process, and the parameters for x_p and y_p are applied in the "Rotation for polar motion" process. Users are advised that the broadcast message type 32 EOP parameters already account for zonal, diurnal and semidiurnal effects (described in Chapter 8 of the IERS Conventions (2010)), so	Added leading quotation so that the CIO based approach is within a pair of quotations: "Celestial Intermediate Origin (CIO) based approach".

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	The relevant computations utilize elementary rotation matrices $R_i(\alpha)$, where α is a positive rotation about the i^{th}-axis ordinate, as follows: $R_1(\alpha) = \begin{bmatrix} 1 & 0 & 0 \\ 0 & \cos(\alpha) & \sin(\alpha) \\ 0 & -\sin(\alpha) & \cos(\alpha) \end{bmatrix}$, $R_2(\alpha) = \begin{bmatrix} \cos(\alpha) & 0 & -\sin(\alpha) \\ 0 & 1 & 0 \\ \sin(\alpha) & 0 & \cos(\alpha) \end{bmatrix}$ $R_3(\alpha) = \begin{bmatrix} \cos(\alpha) & \sin(\alpha) & 0 \\ -\sin(\alpha) & \cos(\alpha) & 0 \\ 0 & 0 & 1 \end{bmatrix}$		these effects should not be further applied by the user. The relevant computations utilize elementary rotation matrices $R_i(\alpha)$, where α is a positive rotation about the i^{th}-axis ordinate, as follows: $R_1(\alpha) = \begin{bmatrix} 1 & 0 & 0 \\ 0 & \cos(\alpha) & \sin(\alpha) \\ 0 & -\sin(\alpha) & \cos(\alpha) \end{bmatrix}$, $R_2(\alpha) = \begin{bmatrix} \cos(\alpha) & 0 & -\sin(\alpha) \\ 0 & 1 & 0 \\ \sin(\alpha) & 0 & \cos(\alpha) \end{bmatrix}$ $R_3(\alpha) = \begin{bmatrix} \cos(\alpha) & \sin(\alpha) & 0 \\ -\sin(\alpha) & \cos(\alpha) & 0 \\ 0 & 0 & 1 \end{bmatrix}$	
20.3.3.7.2	Each DC data packet contains: corrections to SV clock polynomial coefficients provided in any one of the message types 30 to 37 of the corresponding SV; corrections to quasi-Keplerian elements referenced to t_{OD} of the corresponding SV; User Differential Range Accuracy (UDRA) and UDRA indices that enable users to estimate the accuracy obtained after corrections are applied. Each DC packet is made up of two different segments. The first segment contains 34 bits for the CDC parameters and the second segment contains 92 bits of EDC parameters totaling 126 bits. The CDC and EDC parameters form an indivisible pair and users must utilize CDC and EDC as a pair. Users must utilize CDC and EDC data pairs of the same $t_{op\text{-}D}$ ($t_{op\text{-}D}$ =DC data predict time of week) and of the same t_{OD}.		Each DC data packet contains: corrections to SV clock polynomial coefficients provided in any one of the message types 30 to 37 of the corresponding SV; corrections to quasi-Keplerian elements referenced to t_{OD} of the corresponding SV; User Differential Range Accuracy (UDRA) and $\dot{UDRA}$ indices that enable users to estimate the accuracy obtained after corrections are applied. Each DC packet is made up of two different segments. The first segment contains 34 bits for the CDC parameters and the second segment contains 92 bits of EDC parameters totaling 126 bits. The CDC and EDC parameters form an indivisible pair and users must utilize CDC and EDC as a pair. Users must utilize CDC and EDC data pairs of the same $t_{op\text{-}D}$ ($t_{op\text{-}D}$ =DC data predict time of week) and of the same t_{OD}.	Incorporated DOT over proper UDRA term.
20.3.3.7.4	The user will construct a set of initial (uncorrected) elements by: $A_i = A_0$ $e_i = e_n$ $i_i = i_{0\text{-}n}$ $\Omega_i = \Omega_{0\text{-}n}$ $\alpha_i = e_n \bullet \cos(\omega_n)$ $\beta_i = e_n \bullet \sin(\omega_n)$		The user will construct a set of initial (uncorrected) elements by: $A_i = A_0$ $e_i = e_n$ $i_i = i_{0\text{-}n}$ $\Omega_i = \Omega_{0\text{-}n}$ $\alpha_i = e_n \bullet \cos(\omega_n)$ $\beta_i = e_n \bullet \sin(\omega_n)$	The current mean anomaly equation, ΔM_0, yields a velocity component and is

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	$\gamma_i = M_{0-n} + \omega_n$ where A_0, e_n, i_{0-n}, Ω_{0-n}, ω_n and M_{0-n} are obtained from the applicable SV's message types 10 and 11 data. The terms α_i, β_i, and γ_i form a subset of stabilized ephemeris elements which are subsequently corrected by $\Delta\alpha$, $\Delta\beta$ and $\Delta\gamma$—the values of which are supplied in the message types 34 or 14-as follows: $\alpha_c = \alpha_i + \Delta\alpha$ $\beta_c = \beta_i + \Delta\beta$ $\gamma_c = \gamma_i + \Delta\gamma$ The quasi-Keplerian elements are then corrected by $A_c = A_i + \Delta A$ $e_c = (\alpha_c^2 + \beta_c^2)^{1/2}$ $i_c = i_i + \Delta i$ $\Omega_c = \Omega_i + \Delta\Omega$ $\omega_c = \tan^{-1}(\beta_c/\alpha_c)$ $M_{0\_c} = \gamma_c - \omega_c + \Delta M_0$ where ΔA, Δi and $\Delta\Omega$ are provided in the EDC data packet of the message type 34 or 14 and ΔM_0 is obtained from $\Delta M_0 = -3*(\mu^{1/2})/A_c^2*[(t_{oe}) - (t_{OD})]$. The corrected quasi-Keplerian elements above are applied to the user algorithm for determination of antenna phase center position in Section 20.3.3.1.3, Table 20-II.		$\gamma_i = M_{0-n} + \omega_n$ where A_0, e_n, i_{0-n}, Ω_{0-n}, ω_n and M_{0-n} are obtained from the applicable SV's message types 10 and 11 data. The terms α_i, β_i, and γ_i form a subset of stabilized ephemeris elements which are subsequently corrected by $\Delta\alpha$, $\Delta\beta$ and $\Delta\gamma$—the values of which are supplied in the message types 34 or 14-as follows: $\alpha_c = \alpha_i + \Delta\alpha$ $\beta_c = \beta_i + \Delta\beta$ $\gamma_c = \gamma_i + \Delta\gamma$ The quasi-Keplerian elements are then corrected by $A_c = A_i + \Delta A$ $e_c = (\alpha_c^2 + \beta_c^2)^{1/2}$ $i_c = i_i + \Delta i$ $\Omega_c = \Omega_i + \Delta\Omega$ $\omega_c = \tan^{-1}(\beta_c/\alpha_c)$ $M_{0\_c} = \gamma_c - \omega_c + \Delta M_0$ where ΔA, Δi and $\Delta\Omega$ are provided in the EDC data packet of the message type 34 or 14 and ΔM_0 is obtained from $\Delta M_0 = \frac{-3}{2}\left(\frac{\mu}{A_0{}^3}\right)^{\frac{1}{2}}\left(\frac{\Delta A_0}{A_0}\right)[(t_{oe} + WN_{oe} * 604{,}800) - (t_{OD} + WN * 604{,}800)]$ The corrected quasi-Keplerian elements above are applied to the user algorithm for determination of antenna phase center position in Section 20.3.3.1.3, Table 20-II.	incorrect. The mean anomaly equation should yield 'radians.'

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20.3.3.7.5	The $UDRA_{op-D}$ and UDRA shall give the differential user range accuracy for the SV. It must be noted that the two parameters provide estimated accuracy after both clock and ephemeris DC are applied. The $UDRA_{op-D}$ and UDRA indices are signed, two's complement integers in the range of +15 to -16 and have the following relationship:		The $UDRA_{op-D}$ and $U\dot{D}RA$ shall give the differential user range accuracy for the SV. It must be noted that the two parameters provide estimated accuracy after both clock and ephemeris DC are applied. The $UDRA_{op-D}$ and $U\dot{D}RA$ indices are signed, two's complement integers in the range of +15 to -16 and have the following relationship:	Incorporated DOT over proper UDRA terms.

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20.3.3.7.5	Index Value UDRA$_{op-D}$ (meters) UDRA (10^{-6} m/sec) 15 6144.00 < UDRA$_{op-D}$ 6144.00 14 3072.00 < UDRA$_{op-D}$ ≤ 6144.00 3072.00 13 1536.00 < UDRA$_{op-D}$ ≤ 3072.00 1536.00 12 768.00 < UDRA$_{op-D}$ ≤ 1536.00 768.00 11 384.00 < UDRA$_{op-D}$ ≤ 768.00 384.00 10 192.00 < UDRA$_{op-D}$ ≤ 384.00 192.00 9 96.00 < UDRA$_{op-D}$ ≤ 192.00 96.00 8 48.00 < UDRA$_{op-D}$ ≤ 96.00 48.00 7 24.00 < UDRA$_{op-D}$ ≤ 48.00 24.00 6 13.65 < UDRA$_{op-D}$ ≤ 24.00 13.65 5 9.65 < UDRA$_{op-D}$ ≤ 13.65 9.65 4 6.85 < UDRA$_{op-D}$ ≤ 9.65 6.85 3 4.85 < UDRA$_{op-D}$ ≤ 6.85 4.85 2 3.40 < UDRA$_{op-D}$ ≤ 4.85 3.40 1 2.40 < UDRA$_{op-D}$ ≤ 3.40 2.40 0 1.70 < UDRA$_{op-D}$ ≤ 2.40 1.70 -1 1.20 < UDRA$_{op-D}$ ≤ 1.70 1.20 -2 0.85 < UDRA$_{op-D}$ ≤ 1.20 0.85 -3 0.60 < UDRA$_{op-D}$ ≤ 0.85 0.60 -4 0.43 < UDRA$_{op-D}$ ≤ 0.60 0.43 -5 0.30 < UDRA$_{op-D}$ ≤ 0.43 0.30 -6 0.21 < UDRA$_{op-D}$ ≤ 0.30 0.21 -7 0.15 < UDRA$_{op-D}$ ≤ 0.21 0.15 -8 0.11 < UDRA$_{op-D}$ ≤ 0.15 0.11 -9 0.08 < UDRA$_{op-D}$ ≤ 0.11 0.08 -10 0.06 < UDRA$_{op-D}$ ≤ 0.08 0.06 -11 0.04 < UDRA$_{op-D}$ ≤ 0.06 0.04 -12 0.03 < UDRA$_{op-D}$ ≤ 0.04 0.03 -13 0.02 < UDRA$_{op-D}$ ≤ 0.03 0.02 -14 0.01 < UDRA$_{op-D}$ ≤ 0.02 0.01 -15 UDRA$_{op-D}$ ≤ 0.01 0.005 -16 No accuracy prediction available—use at own risk		Index Value UDRA$_{op-D}$ (meters) $\dot{UDRA}$ (10^{-6} m/sec) 15 6144.00 < UDRA$_{op-D}$ 6144.00 14 3072.00 < UDRA$_{op-D}$ ≤ 6144.00 3072.00 13 1536.00 < UDRA$_{op-D}$ ≤ 3072.00 1536.00 12 768.00 < UDRA$_{op-D}$ ≤ 1536.00 768.00 11 384.00 < UDRA$_{op-D}$ ≤ 768.00 384.00 10 192.00 < UDRA$_{op-D}$ ≤ 384.00 192.00 9 96.00 < UDRA$_{op-D}$ ≤ 192.00 96.00 8 48.00 < UDRA$_{op-D}$ ≤ 96.00 48.00 7 24.00 < UDRA$_{op-D}$ ≤ 48.00 24.00 6 13.65 < UDRA$_{op-D}$ ≤ 24.00 13.65 5 9.65 < UDRA$_{op-D}$ ≤ 13.65 9.65 4 6.85 < UDRA$_{op-D}$ ≤ 9.65 6.85 3 4.85 < UDRA$_{op-D}$ ≤ 6.85 4.85 2 3.40 < UDRA$_{op-D}$ ≤ 4.85 3.40 1 2.40 < UDRA$_{op-D}$ ≤ 3.40 2.40 0 1.70 < UDRA$_{op-D}$ ≤ 2.40 1.70 -1 1.20 < UDRA$_{op-D}$ ≤ 1.70 1.20 -2 0.85 < UDRA$_{op-D}$ ≤ 1.20 0.85	Incorporated DOT over proper UDRA terms.

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			-3 0.60 < $UDRA_{op-D}$ ≤ 0.85 0.60 -4 0.43 < $UDRA_{op-D}$ ≤ 0.60 0.43 -5 0.30 < $UDRA_{op-D}$ ≤ 0.43 0.30 -6 0.21 < $UDRA_{op-D}$ ≤ 0.30 0.21 -7 0.15 < $UDRA_{op-D}$ ≤ 0.21 0.15 -8 0.11 < $UDRA_{op-D}$ ≤ 0.15 0.11 -9 0.08 < $UDRA_{op-D}$ ≤ 0.11 0.08 -10 0.06 < $UDRA_{op-D}$ ≤ 0.08 0.06 -11 0.04 < $UDRA_{op-D}$ ≤ 0.06 0.04 -12 0.03 < $UDRA_{op-D}$ ≤ 0.04 0.03 -13 0.02 < $UDRA_{op-D}$ ≤ 0.03 0.02 -14 0.01 < $UDRA_{op-D}$ ≤ 0.02 0.01 -15 $UDRA_{op-D}$ ≤ 0.01 0.005 -16 No accuracy prediction available-use at own risk	
20.3.3.7.5	For any time, t_k, other than t_{op-D}, UDRA is found by, UDRA = $UDRA_{op-D}$ + UDRA (t_k - t_{op-D})		For any time, t_k, other than t_{op-D}, UDRA is found by, UDRA = $UDRA_{op-D} + \dot{UDRA} (t_k - t_{op-D})$	Incorporated DOT over proper UDRA term.

End of WAS/IS for IS-GPS-705B, IRN-001 Changes