CHANGE NOTICE

Affected Document: IS-GPS-800 Rev G	**IRN/SCN Number** IRN-IS-800G-001	**Date:** 30-SEP-2020
Authority: RFC-00442	**Proposed Change Notice** PCN-IS-800F_RFC442	**Date:** 07-APR -2020

CLASSIFIED BY: N/A
DECLASSIFY ON: N/A

Document Title: NAVSTAR GPS Space Segment / User Segment L1C Interface

RFC Title: 2020 Public Document Proposed Changes

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

1. The public user community has expressed interest in adding a new clock error rate equation that aids in their calculations.
2. User equations involving time calculations need to be clarified.
3. To improve consistency in IS-GPS-200, clarify that a LNAV T_{GD} value of '10000000' means that the group delay value is unavailable, which aligns with the clarification of CNAV T_{GD}.
4. Administrative clarification and clean-up, identified in past Public ICWGs and as newly-identified changes of administrative nature.

Description of Change:

1. Recommend new SV Clock Relativistic Correction rate equation.
2. Clarify equations by recommending examples or clarifying instructions.
3. Add a statement that clarifies whether a LNAV T_{GD} value of '10000000' indicates that the group delay value in unavailable.
4. Provide clarity and clean up identified administrative changes in all public documents.

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AUTHORIZED SIGNATURES	REPRESENTING	DATE
	PNT Capability Area Integration, Portfolio Architect, Space and Missile Systems Center - LAAFB	

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IS800-161 :

Section Number :
3.5.3.0-12

WAS :

Parameter		No. of Bits**	Scale Factor (LSB)	Valid Range***	Units
URA_{NED0} Index	NED Accuracy Index	5*			(see text)
URA_{NED1} Index	NED Accuracy Change Index	3			(see text)
URA_{NED2} Index	NED Accuracy Change Rate Index	3			(see text)
a_{f2-n}	SV Clock Drift Rate Correction Coefficient	10*	2^{-60}		sec/sec^2
a_{f1-n}	SV Clock Drift Correction Coefficient	20*	2^{-48}		sec/sec
a_{f0-n}	SV Clock Bias Correction Coefficient	26*	2^{-35}		seconds
T_{GD}****	Inter-Signal Correction for L1 or L2 P(Y)	13*	2^{-35}		seconds
ISC_{L1CP}****	Inter-Signal Correction for $L1C_P$	13*	2^{-35}		seconds
ISC_{L1CD}****	Inter-Signal Correction for $L1C_D$	13*	2^{-35}		seconds
WN_{op}	CEI Data Sequence Propagation Week Number	8	1		weeks

* Parameters so indicated are in two's complement notation;

** See Figure 3.5-1 for complete bit allocation in Subframe 2;

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

**** The bit string of "1000000000000" will indicate that the group delay value is not available.

Redlines :

Table 3.5-1. Subframe 2 Parameters (3 of 3)

Parameter		No. of Bits**	Scale Factor (LSB)	Valid Range***	Units
URA_{NED0} Index	NED Accuracy Index	5*			(see text)
URA_{NED1} Index	NED Accuracy Change Index	3			(see text)
URA_{NED2} Index	NED Accuracy Change Rate Index	3			(see text)
a_{f2-n}	SV Clock Drift Rate Correction Coefficient	10*	2^{-60}		sec/sec^2
a_{f1-n}	SV Clock Drift Correction Coefficient	20*	2^{-48}		sec/sec
a_{f0-n}	SV Clock Bias Correction Coefficient	26*	2^{-35}		seconds
T_{GD}****	Inter-Signal Correction for L1 or L2 P(Y)	13*	2^{-35}		seconds
ISC_{L1CP}****	Inter-Signal Correction for $L1C_P$	13*	2^{-35}		seconds
ISC_{L1CD}****	Inter-Signal Correction for $L1C_D$	13*	2^{-35}		seconds
WN_{op}	CEI Data Sequence Propagation Week Number	8	1		weeks

* Parameters so indicated are in two's complement notation;

** See Figure 3.5-1 for complete bit allocation in Subframe 2;

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

~~**** The bit string of "1000000000000" will indicate that the group delay value is not available.~~

IS :

Parameter		No. of Bits**	Scale Factor (LSB)	Valid Range***	Units
URA_{NED0} Index	NED Accuracy Index	5*			(see text)
URA_{NED1} Index	NED Accuracy Change Index	3			(see text)
URA_{NED2} Index	NED Accuracy Change Rate Index	3			(see text)
a_{f2-n}	SV Clock Drift Rate Correction Coefficient	10*	2^{-60}		sec/sec^2
a_{f1-n}	SV Clock Drift Correction Coefficient	20*	2^{-48}		sec/sec
a_{f0-n}	SV Clock Bias Correction Coefficient	26*	2^{-35}		seconds
T_{GD}****	Inter-Signal Correction for L1 or L2 P(Y)	13*	2^{-35}		seconds
ISC_{L1CP}****	Inter-Signal Correction for $L1C_P$	13*	2^{-35}		seconds
ISC_{L1CD}****	Inter-Signal Correction for $L1C_D$	13*	2^{-35}		seconds
WN_{op}	CEI Data Sequence Propagation Week Number	8	1		weeks

* Parameters so indicated are in two's complement notation;

** See Figure 3.5-1 for complete bit allocation in Subframe 2;

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

IS800-1011 :

Section Number :
3.5.3.6.1.0-9

WAS :
Table 3.5-2. Part 3

Element/Equation	Description
SV Velocity	
$\dot{E}_k = n / (1 - e \cos E_k)$	Eccentric Anomaly Rate
$\dot{v}_k = \dot{E}_k \sqrt{1-e^2} / (1 - e \cos E_k)$	True Anomaly Rate
$(di_k / dt) = (\text{IDOT}) + 2\, \dot{v}_k (c_{is} \cos 2\phi_k - c_{ic} \sin 2\phi_k)$	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
$\dot{r}_k = eA\dot{E}_k \sin Ek + 2\dot{v}_k (c_{rs} \cos 2\phi_k - c_{rc} \sin 2\phi_k)$	Corrected Radius Rate
$\dot{\Omega}_k = \dot{\Omega} - \dot{\Omega}_e$	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
$\dot{x}_k = -x'_k\, \dot{\Omega}_k \sin \Omega_k + \dot{x}'_k \cos \Omega_k - \dot{y}'_k \sin \Omega_k \cos i_k - y'_k(\dot{\Omega}_k \cos \Omega_k \cos i_k - (di_k / dt) \sin \Omega_k \sin i_k)$	Earth- Fixed *x* velocity (m/s)
$\dot{y}_k = x'_k\, \dot{\Omega}_k \cos \Omega_k + \dot{x}'_k \sin \Omega_k + \dot{y}'_k \cos \Omega_k \cos i_k - y'_k(\dot{\Omega}_k \sin \Omega_k \cos i_k + (di_k / dt) \cos \Omega_k \sin i_k)$	Earth- Fixed *y* velocity (m/s)
$\dot{z}_k = \dot{y}'_k \sin i_k + y'_k\, (di_k / dt) \cos i_k$	Earth- Fixed *z* velocity (m/s)

Redlines :
Table 3.5-2. Part 3

Element/Equation	Description
SV Velocity	
$\dot{E}_k = n / (1 - e \cos E_k)$	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
~~$\dot{r}_k = eA\dot{E}_k \sin E_k + 2\dot{v}_k (c_{rs} \cos 2\phi_k - c_{rc} \sin 2\phi_k)$~~	~~Corrected Radius Rate~~
$\dot{r}_k = \dot{A}(1 - e \cos(E_k)) + A\, e \sin(E_k)\, \dot{E}_k + 2(c_{rs} \cos(2\phi_k) - c_{rc} \sin(2\phi_k))\, \dot{v}_k$	Corrected Radius Rate for CNAV-2
$\dot{\Omega}_k = \dot{\Omega} - \dot{\Omega}_e$	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
$\dot{x}_k = -x'_k \dot{\Omega}_k \sin \Omega_k + \dot{x}'_k \cos \Omega_k - \dot{y}'_k \sin \Omega_k \cos i_k - y'_k(\dot{\Omega}_k \cos \Omega_k \cos i_k - (di_k / dt) \sin \Omega_k \sin i_k)$	Earth- Fixed *x* velocity (m/s)
$\dot{y}_k = x'_k \dot{\Omega}_k \cos \Omega_k + \dot{x}'_k \sin \Omega_k + \dot{y}'_k \cos \Omega_k \cos i_k - y'_k(\dot{\Omega}_k \sin \Omega_k \cos i_k + (di_k / dt) \cos \Omega_k \sin i_k)$	Earth- Fixed *y* velocity (m/s)
$\dot{z}_k = \dot{y}'_k \sin i_k + y'_k\, (di_k / dt) \cos i_k$	Earth- Fixed *z* velocity (m/s)

IS :

Table 30-II. Part 3

Element/Equation	Description
SV Velocity	
$\dot{E}_k = n / (1 - e \cos E_k)$	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 Rat
$\dot{r}_k = \dot{A}(1 - e \cos(E_k)) + A\, e \sin(E_k)\, \dot{E}_k + 2(c_{rs} \cos(2\phi_k) - c_{rc} \sin(2\phi_k))\, \dot{v}_k$	Corrected Radius Rate for CNAV-2
$\dot{\Omega}_k = \dot{\Omega} - \dot{\Omega}_e$	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
$\dot{x}_k = -x'_k \dot{\Omega}_k \sin \Omega_k + \dot{x}'_k \cos \Omega_k - \dot{y}'_k \sin \Omega_k \cos i_k - y'_k(\dot{\Omega}_k \cos \Omega_k \cos i_k - (di_k / dt) \sin \Omega_k \sin i_k)$	Earth- Fixed *x* velocity (m/s)
$\dot{y}_k = x'_k \dot{\Omega}_k \cos \Omega_k + \dot{x}'_k \sin \Omega_k + \dot{y}'_k \cos \Omega_k \cos i_k - y'_k(\dot{\Omega}_k \sin \Omega_k \cos i_k + (di_k / dt) \cos \Omega_k \sin i_k)$	Earth- Fixed *y* velocity (m/s)
$\dot{z}_k = \dot{y}'_k \sin i_k + y'_k (di_k / dt) \cos i_k$	Earth- Fixed *z* velocity (m/s)

IS800-186 :

Section Number :
3.5.3.7.1.0-1

WAS :
The algorithms defined in paragraph 20.3.3.3.3.1 of IS-GPS-200 allow all users to correct the code phase time received from the SV with respect to both SV code phase offset and relativistic effects. 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 P(Y) and L2 P(Y) code measurements, the single-frequency (L1) user and the dual-frequency (L1/L2 and L1/L5) user must apply additional terms to the SV clock correction equations. These terms are described in paragraph 3.5.3.9. In addition, users shall use t_{oe}, provided in bits 39 through 49 of subframe 2, to replace t_{oc} in the algorithms in paragraph 20.3.3.3.3.1 of IS-GPS-200.

Redlines :
The algorithms defined in paragraph 20.3.3.3.3.1 of IS-GPS-200 allow all users to correct the code phase time received from the SV with respect to both SV code phase offset and relativistic effects. 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 P(Y) and L2 P(Y) code measurements, the single-frequency (L1) user and the dual-frequency (L1/L2 and L1/L5) user must apply additional terms to the SV clock correction equations. These terms are described in paragraph 3.5.3.9. In addition, users shall use t_{oe}, provided in bits 39 through 49 of subframe 2, to replace t_{oc} in the algorithms in paragraph 20.3.3.3.3.1 of IS-GPS-200. Refer to IS-GPS-200, Section 20.3.3.3.3.1.0-2.1 for optional first and second derivative of the SV clock correction equation.

IS :
The algorithms defined in paragraph 20.3.3.3.3.1 of IS-GPS-200 allow all users to correct the code phase time received from the SV with respect to both SV code phase offset and relativistic effects. 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 P(Y) and L2 P(Y) code measurements, the single-frequency (L1) user and the dual-frequency (L1/L2 and L1/L5) user must apply additional terms to the SV clock correction equations. These terms are described in paragraph 3.5.3.9. In addition, users shall use t_{oe}, provided in bits 39 through 49 of subframe 2, to replace t_{oc} in the algorithms in paragraph 20.3.3.3.3.1 of IS-GPS-200. Refer to IS-GPS-200, Section 20.3.3.3.3.1.0-2.1 for optional first and second derivative of the SV clock correction equation.

IS800-654 :

Section Number :
3.5.3.9.0-2

WAS :
The bit string of “1000000000000” shall indicate that the group delay value is not available. The related algorithm is given in paragraphs 3.5.3.9.1 and 3.5.3.9.2.

Redlines :
The ~~bit string of “1000000000000” shall indicate that the group delay value is not available. The~~ related algorithm is given in paragraphs 3.5.3.9.1 and 3.5.3.9.2.

IS :
The related algorithm is given in paragraphs 3.5.3.9.1 and 3.5.3.9.2.

IS800-223 :

Section Number :
3.5.4.1.1.1.0-1

WAS :
Subframe 3, page 1 includes: (1) the parameters needed to relate GPS Time to UTC (USNO), and (2) notice to the user regarding the scheduled future or recent past (relative to navigation message upload) value of the delta time due to leap seconds (Δt_{LSF}), together with the week number (WN_{LSF}) and the day number (DN) at the end of which the leap second becomes effective. Information required to use these parameters to calculate t_{UTC} is in paragraph 20.3.3.5.2.4 of IS-GPS-200 except the following definition of Δt_{UTC} shall be used:

$$\Delta t_{UTC} = \Delta t_{LS} + A_{0\text{-}n} + A_{1\text{-}n} (t_E - t_{ot} + 604800 (WN - WN_{ot})) + A_{2\text{-}n} (t_E - t_{ot} + 604800 (WN - WN_{ot}))^2 \text{ seconds.}$$

Redlines :
UTC and GPS Time Subframe 3, page 1 includes:~~-~~ (1) the parameters needed to relate GPS Time to UTC (USNO), and (2) notice to the user regarding the scheduled future or recent past (relative to navigation message upload) value of the delta time due to leap seconds (Δt_{LSF}), together with the GPS week number (WN_{LSF}) and the GPS day number (DN) ~~at~~near the end of which ~~the leap second~~Δt_{LSF} becomes effective.~~-~~ Information required to use these parameters to calculate tUTC is in paragraph 20.3.3.5.2.4 of IS-GPS-200 except the following definition of Δt_{UTC} shall be used:

$$\Delta t_{UTC} = \Delta t_{LS} + A_{0\text{-}n} + A_{1\text{-}n} (t_E - t_{ot} + 604800 (WN - WN_{ot})) + A_{2\text{-}n} (t_E - t_{ot} + 604800 (WN - WN_{ot}))^2 \text{ seconds.}$$

IS :

UTC and GPS Time Subframe 3, page 1 includes: (1) the parameters needed to relate GPS Time to UTC (USNO), and (2) notice to the user regarding the scheduled future or recent past (relative to navigation message upload) value of the delta time due to leap seconds (Δt_{LSF}), together with the GPS week number (WN_{LSF}) and the GPS day number (DN) near the end of which Δt_{LSF} becomes effective. Information required to use these parameters to calculate t_{UTC} is in paragraph 20.3.3.5.2.4 of IS-GPS-200 except the following definition of Δt_{UTC} shall be used:

$$\Delta t_{UTC} = \Delta t_{LS} + A_{0\text{-}n} + A_{1\text{-}n} (t_E - t_{ot} + 604800 (WN - WN_{ot})) + A_{2\text{-}n} (t_E - t_{ot} + 604800 (WN - WN_{ot}))^2 \text{ seconds.}$$
