CHANGE NOTICE

Affected Document:	IRN/SCN Number	Date:
IS-GPS-705 Rev E	IRN-IS-705E-001	28-NOV-2018
Authority:	**Proposed Change Notice**	**Date:**
RFC-00374	IS705E_RFC374	28-SEP-2018

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

Document Title: NAVSTAR GPS Space Segment / User Segment L5 Interface

RFC Title: 2018 Proposed Changes to the Public Documents

Reason For Change (Driver):

The following topic was deferred from the 2017 Public ICWG and will now be resolved by this RFC.

1. Currently the Operational Advisories (OAs) that are published and archived contain plane/slot descriptions that are not in the constellation definition provided to the public in the Standard Positioning Service (SPS) Performance Standard (PS). The OA does not have the capability to correctly publish information regarding fore/aft position since moving to the 24+3 constellation with three expanded slots. In addition, the Points of Contact of the OA are not represented in a way that allows for efficient updates. This is a follow-up to RFC-351, which was CCB-approved on 8-Jan-2018.

The following topic resolves 3 document clean-up related activities:

2. a) Signal-in-space topics need clarification, as identified by the public in past Public ICWGs. b) There were some administrative errors found during the UpRev process of the public documents. c) Contractor signatories are required for government-controlled documents.

(Pre-RFCs 819, 861)

Description of Change:

1. Modify the OA as agreed to in ICD-GPS-240 and ICD-GPS-870.
2. a) Provide clarity for the list of signal-in-space topics identified by the public. b) Clean up identified administrative changes in all public documents. c) Remove required contractor signatories from government-controlled documents.

Authored By: Philip Kwan **Checked By: Jennifer Lemus**

AUTHORIZED SIGNATURES	REPRESENTING	DATE
[signature]	GPS Directorate Space & Missile Systems Center (SMC) – LAAFB	4 MAR 19

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Clean-Up and Clarification Proposed Changes

IS705-25 :

Section Number :
3.2.1.0-1

WAS :
Two PRN ranging codes are transmitted on L5: the in-phase code (denoted as the I5-code); and the quadraphase code (denoted as the Q5-code). Code-division-multiple-access techniques allow differentiating between the SVs even though they may transmit at the same L5 frequency. The SVs shall transmit intentionally "incorrect" versions of the I5 and the Q5-codes when needed to protect the users from receiving and utilizing anomalous NAV signals. These two "incorrect" codes are termed non-standard I5 (NSI5) and non-standard Q5 (NSQ5) codes.

Redlines :
Two PRN ranging codes are transmitted on L5: the in-phase code (denoted as the I5-code); and the quadraphase code (denoted as the Q5-code). Code-division-multiple-access techniques allow differentiating between the SVs even though they may transmit at the same L5 frequency. The SVs shall transmit intentionally "incorrect" versions of the I5 and the Q5-codes when needed to protect the users from receiving and utilizing anomalous ~~NAV~~CNAV signals. These two "incorrect" codes are termed non-standard I5 (NSI5) and non-standard Q5 (NSQ5) codes.

IS :
Two PRN ranging codes are transmitted on L5: the in-phase code (denoted as the I5-code); and the quadraphase code (denoted as the Q5-code). Code-division-multiple-access techniques allow differentiating between the SVs even though they may transmit at the same L5 frequency. The SVs shall transmit intentionally "incorrect" versions of the I5 and the Q5-codes when needed to protect the users from receiving and utilizing anomalous CNAV signals. These two "incorrect" codes are termed non-standard I5 (NSI5) and non-standard Q5 (NSQ5) codes.

IS705-31 :

Section Number :
3.2.2

WAS :
NAV Data.

Redlines :
~~NAV~~L5 CNAV Data.

IS :
L5 CNAV Data.

IS705-37 :

Section Number :
3.2.3.0-1

WAS :
The L5 consists of two carrier components that are in phase quadrature with each other. Each carrier component is bi-phase shift key (BPSK) modulated by a separate bit train. One bit train is the modulo-2 sum of the I5-code, NAV data, and synchronization sequence while the other is the Q5-code with no NAV data, but with another synchronization sequence. For a particular SV, all transmitted signal elements (carriers, codes, synchronization sequences, and data) are coherently derived from the same on-board frequency source.

Redlines :
The L5 consists of two carrier components that are in phase quadrature with each other. Each carrier component is bi-phase shift key (BPSK) modulated by a separate bit train. One bit train is the modulo-2 sum of the I5-code, ~~NAV~~CNAV data, and synchronization sequence while the other is the Q5-code with no ~~NAV~~CNAV data, but with another synchronization sequence. For a particular SV, all transmitted signal elements (carriers, codes, synchronization sequences, and data) are coherently derived from the same on-board frequency source.

IS :
The L5 consists of two carrier components that are in phase quadrature with each other. Each carrier component is bi-phase shift key (BPSK) modulated by a separate bit train. One bit train is the modulo-2 sum of the I5-code, CNAV data, and synchronization sequence while the other is the Q5-code with no CNAV data, but with another synchronization sequence. For a particular SV, all transmitted signal elements (carriers, codes, synchronization sequences, and data) are coherently derived from the same on-board frequency source.

IS705-61 :

Section Number :
3.3.1.7.0-1

WAS :
Equipment group delay is defined as the delay between the signal radiated output of a specific SV (measured at the antenna phase center) and the output of that SV's on-board frequency source; the delay consists of a bias term and an uncertainty. The bias term on L1/L2 P(Y) is of no concern to users since it is included in the clock correction parameters relayed in the NAV data, and is therefore accounted for by user computations of system time (reference paragraphs 20.3.3.2.3, 20.3.3.3.2.3 and 20.3.3.3.2.4). The uncertainty (variation) of these delays as well as the group delay differential between the signals of L1, L2, and L5 are defined in the following.

Redlines :
Equipment group delay is defined as the delay between the signal radiated output of a specific SV (measured at the antenna phase center) and the output of that SV's on-board frequency source; the delay consists of a bias term and an uncertainty. The bias term on L1/L2 P(Y) is of no concern to users since it is included in the clock correction parameters relayed in the ~~NAV~~CNAV data, and is therefore accounted for by user computations of system time (reference paragraphs 20.3.3.2.3, 20.3.3.3.2.3 and 20.3.3.3.2.4). The uncertainty (variation) of these delays as well as the group delay differential between the signals of L1, L2, and L5 are defined in the following.

IS :
Equipment group delay is defined as the delay between the signal radiated output of a specific SV (measured at the antenna phase center) and the output of that SV's on-board frequency source; the delay consists of a bias term and an uncertainty. The bias term on L1/L2 P(Y) is of no concern to users since it is included in the clock correction parameters relayed in the CNAV data, and is therefore accounted for by user computations of system time (reference paragraphs 20.3.3.2.3, 20.3.3.3.2.3 and 20.3.3.3.2.4). The uncertainty (variation) of these delays as well as the group delay differential between the signals of L1, L2, and L5 are defined in the following.

IS705-65 :

Section Number :
3.3.1.7.2.0-1

WAS :
The group delay differential between the radiated L1 and L5 signals (i.e. L1 P(Y) and L5 I5; and L1 P(Y) and L5 Q5) is specified as consisting of random plus bias components. The mean differential is defined as the bias component and will be either positive or negative. For a given navigation payload redundancy configuration, the absolute value of the mean differential delay shall not exceed 30.0 nanoseconds. The random plus non-random variations about the mean shall not exceed 3.0 nanoseconds (95% probability), when including consideration of the temperature and antenna effects during a vehicle orbital revolution. L1 and L2 group delay differential is described in 3.3.1.7.2 of IS-GPS-200. Corrections for the bias components of the group delay differential are provided to the users in the NAV message using parameters designated as T_{GD} (reference paragraph 20.3.3.3.3.2 of IS-GPS-200) and Inter-Signal Correction (ISC) (reference paragraph 20.3.3.3.1.2).

Redlines :
The group delay differential between the radiated L1 and L5 signals (i.e. L1 P(Y) and L5 I5; and L1 P(Y) and L5 Q5) is specified as consisting of random plus bias components. The mean differential is defined as the bias component and will be either positive or negative. For a given navigation payload redundancy configuration, the absolute value of the mean differential delay shall not exceed 30.0 nanoseconds. The random plus non-random variations about the mean shall not exceed 3.0 nanoseconds (95% probability), when including consideration of the temperature and antenna effects during a vehicle orbital revolution. L1 and L2 group delay differential is described in 3.3.1.7.2 of IS-GPS-200. Corrections for the bias components of the group delay differential are provided to the users in the ~~NAV~~CNAV message using parameters designated as T_{GD} (reference paragraph 20.3.3.3.3.2 of IS-GPS-200) and Inter-Signal Correction (ISC) (reference paragraph 20.3.3.3.1.2).

IS :
The group delay differential between the radiated L1 and L5 signals (i.e. L1 P(Y) and L5 I5; and L1 P(Y) and L5 Q5) is specified as consisting of random plus bias components. The mean differential is defined as the bias component and will be either positive or negative. For a given navigation payload redundancy configuration, the absolute value of the mean differential delay shall not exceed 30.0 nanoseconds. The random plus non-random variations about the mean shall not exceed 3.0 nanoseconds (95% probability), when including consideration of the temperature and antenna effects during a vehicle orbital revolution. L1 and L2 group delay differential is described in 3.3.1.7.2 of IS-GPS-200. Corrections for the bias components of the group delay differential are provided to the users in the CNAV message using parameters designated as T_{GD} (reference paragraph 20.3.3.3.3.2 of IS-GPS-200) and Inter-Signal Correction (ISC) (reference paragraph 20.3.3.3.1.2).

IS705-73 :

Section Number :
3.3.2.0-1

WAS :
The characteristics of the I5-codes and the Q5-codes are defined below in terms of their structure and the basic method used for generating them. Figures 3-2 and 3-3 depict simplified block diagrams of the scheme for generating the 10.23 Mbps $I5_i(t)$ and $Q5_i(t)$ patterns, and for modulo-2 summing the I5 patterns with the NAV bit train, $D_5(t)$, which is rate 1/2 encoded and clocked at 100 sps. In addition, the 100 sps are modulated with a 10-bit Neuman-Hofman code that is clocked at 1 kHz. The resultant composite bit trains are then used to modulate the L5 in-phase carrier. The Q5-code is modulated with a 20-bit Neuman-Hofman code that is also clocked at 1 kHz.

Redlines :
The characteristics of the I5-codes and the Q5-codes are defined below in terms of their structure and the basic method used for generating them. Figures 3-2 and 3-3 depict simplified block diagrams of the scheme for generating the 10.23 Mbps $I5_i(t)$ and $Q5_i(t)$ patterns, and for modulo-2 summing the I5 patterns with the ~~NAV~~CNAV bit train, $D_5(t)$, which is rate 1/2 encoded and clocked at 100 sps. In addition, the 100 sps are modulated with a 10-bit Neuman-Hofman code that is clocked at 1 kHz. The resultant composite bit trains are then used to modulate the L5 in-phase carrier. The Q5-code is modulated with a 20-bit Neuman-Hofman code that is also clocked at 1 kHz.

IS :
The characteristics of the I5-codes and the Q5-codes are defined below in terms of their structure and the basic method used for generating them. Figures 3-2 and 3-3 depict simplified block diagrams of the scheme for generating the 10.23 Mbps $I5_i(t)$ and $Q5_i(t)$ patterns, and for modulo-2 summing the I5 patterns with the CNAV bit train, $D_5(t)$, which is rate 1/2 encoded and clocked at 100 sps. In addition, the 100 sps are modulated with a 10-bit Neuman-Hofman code that is clocked at 1 kHz. The resultant composite bit trains are then used to modulate the L5 in-phase carrier. The Q5-code is modulated with a 20-bit Neuman-Hofman code that is also clocked at 1 kHz.

IS705-1496 :

Section Number :

6.1.0-1

WAS :

AFMC	-	Air Force Materiel Command
AFSPC	-	Air Force Space Command
ASCII	-	American Standard Code for Information Interchange
bps	-	bits per second
BPSK	-	Bi-Phase Shift Key
C/A	-	Course/Acquisition
CDC	-	Clock Differential Correction
CEI	-	Clock, Ephemeris, Integrity
CNAV	-	Civil Navigation
CRC	-	Cyclic Redundancy Check
CS	-	Control Segment
dB	-	Decibel
dBc	-	Power ratio of a signal to a (unmodulated) carrier signal, expressed in decibels
dBi	-	Decibels with respect to isotropic antenna
dBW	-	Decibels with respect to 1 Watt
DC	-	Differential Correction
DoD	-	Department of Defense
ECEF	-	Earth-Centered, Earth-Fixed
ECI	-	Earth Centered Inertial
EDC	-	Ephemeris Differential Correction
EOL	-	End of Life
FEC	-	Forward Error Correction
GGTO	-	GPS/GNSS Time Offset
GNSS	-	Global Navigation Satellite System
GPS	-	Global Positioning System
GPSW	-	Global Positioning System Wing
Hz	-	Hertz
I5	-	In-phase Code on L5 Signal

ICC	-	Interface Control Contractor
ID	-	Identification
IODC	-	Issue of Data, Clock
IS	-	Interface Specification
ISC	-	Inter-Signal Correction
LSB	-	Least Significant Bit
MSB	-	Most Significant Bit
NAV	-	Navigation
NSI5	-	Non-Standard I-Code
NSQ5	-	Non-Standard Q-Code
OCS	-	Operational Control System
PIRN	-	Proposed Interface Revision Notice
PRN	-	Pseudo-Random Noise
P(Y)	-	Precise (Anti-Spoof) Code
Q5	-	Quadraphase code on L5 Signal
RF	-	Radio Frequency
RHCP	-	Right Hand Circular Polarization
RMS	-	Root Mean Square
SBAS	-	Satellite Based Augmentation System
sps	-	Symbols per Second.
SIS	-	Signal In Space
SS	-	Space Segment
SSV	-	Space Service Volume
SV	-	Space Vehicle
TBD	-	To Be Determined
TBS	-	To Be Supplied
TOW	-	Time Of Week
URA	-	User Range Accuracy
US	-	User Segment
USNO	-	US Naval Observatory
UTC	-	Coordinated Universal Time
WGS 84	-	World Geodetic System 1984

WN	-	Data Sequence Propagation Week Number
WN_e	-	Extended Week Number

Redlines :

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TOW	-	Time Of Week
URA	-	User Range Accuracy

US	-	User Segment
USNO	-	US Naval Observatory
UTC	-	Coordinated Universal Time
WGS 84	-	World Geodetic System 1984
WN	-	Data Sequence Propagation Week Number
WN_e	-	Extended Week Number

IS705-1519 :

Section Number :
6.3.5.0-1

WAS :
Before any new signal or group of signals (e.g., L2C, L5, M, L1C, etcetera) is declared operational, the availability of and/or the configuration of the broadcast signal or group of signals may not comply with all requirements of the relevant IS or ICD. For example, the pre-operational broadcast of L2C signals from the IIR-M satellites did not include any NAV or CNAV data as required by IS-GPS-200. Pre-operational use of any new signal or group of signals is at the users own risk.

Redlines :
Before any new signal or group of signals (e.g., L2C, L5, M, L1C, etcetera) is declared operational, the availability of and/or the configuration of the broadcast signal or group of signals may not comply with all requirements of the relevant IS or ICD. For example, the pre-operational broadcast of L2C signals from the IIR-M satellites did not include any ~~NAV~~LNAV or CNAV data as required by IS-GPS-200. Pre-operational use of any new signal or group of signals is at the users own risk.

IS :
Before any new signal or group of signals (e.g., L2C, L5, M, L1C, etcetera) is declared operational, the availability of and/or the configuration of the broadcast signal or group of signals may not comply with all requirements of the relevant IS or ICD. For example, the pre-operational broadcast of L2C signals from the IIR-M satellites did not include any LNAV or CNAV data as required by IS-GPS-200. Pre-operational use of any new signal or group of signals is at the users own risk.

IS705-241 :

Section Number :
20.3.3.1.3.0-4

WAS :

Table 20-I. Message Types 10 and 11 Parameters (1 of 2)

Parameter Symbol	Parameter Description	No. of Bits**	Scale Factor (LSB)	Valid Range***	Units
WN	Data Sequence Propagation Week Number	13	1		weeks
URA_{ED} INDEX	ED accuracy	5*			(see text)
Signal health (L1/L2/L5)		3	1		(see text)
t_{op}	CEI Data sequence propagation time of week	11	300	0 to 604,500	seconds
ΔA ****	Semi-major axis difference at reference time	26*	2^{-9}		meters
$\dot{A}$	Change rate in semi-major axis	25*	2^{-21}		meters/sec
Δn_0	Mean Motion difference from computed value at reference time	17*	2^{-44}		semi-circles/sec
$\Delta \dot{n}_0$	Rate of mean motion difference from computed value	23*	2^{-57}		semi-circles/sec^2
M_{0-n}	Mean anomaly at reference time	33*	2^{-32}		semi-circles
e_n	Eccentricity	33	2^{-34}	0.0 to 0.03	dimensionless
ω_n	Argument of perigee	33*	2^{-32}		semi-circles

* Parameters so indicated are two's complement, with the sign bit (+ or -) occupying the MSB;

** See Figure 20-1 for complete bit allocation in message type 10;

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

**** Relative to A_{REF} = 26,559,710 meters.

Redlines :

Table 20-I. Message Types 10 and 11 Parameters (1 of 2)

Parameter Symbol	Parameter Description	No. of Bits**	Scale Factor (LSB)	Valid Range***	Units
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* 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, valid range is the maximum range attainable with indicated bit allocation and scale factor.

**** Relative to A_{REF} = 26,559,710 meters.

Table 20-I. Message Types 10 and 11 Parameters (1 of 2)

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$\dot{A}$	Change rate in semi-major axis	25*	2^{-21}		meters/sec
Δn_0	Mean Motion difference from computed value at reference time	17*	2^{-44}		semi-circles/sec
$\Delta \dot{n}_0$	Rate of mean motion difference from computed value	23*	2^{-57}		semi-circles/sec^2
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e_n	Eccentricity	33	2^{-34}	0.0 to 0.03	dimensionless
ω_n	Argument of perigee	33*	2^{-32}		semi-circles

* 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, valid range is the maximum range attainable with indicated bit allocation and scale factor.

**** Relative to A_{REF} = 26,559,710 meters.

IS705-265 :

Section Number :
20.3.3.2.4.0-6

WAS :
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 L1/L2/L5 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 20.3.3.3.1.2; 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:

$$URA_{NED1} = \frac{1}{2^N} \text{ (meters/second)}$$

where

$$N = 14 + URA_{NED1} \text{ Index.}$$

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}:

$$URA_{NED2} = \frac{1}{2^N} \text{ (meters/second/second)}$$

where

$N = 28 + URA_{NED2}$ Index.

Redlines :

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 ~~L1/L2/~~L5 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 C/A/L~~2~~5 and L~~1~~2C/L5 users who correct for group delay and ionospheric effects as described in Section 20.3.3.3.1.2; 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:

$$URA_{NED1} = \frac{1}{2^N} \text{ (meters/second)}$$

where

$N = 14 + URA_{NED1}$ 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}:

$$URA_{NED2} = \frac{1}{2^N} \text{ (meters/second/second)}$$

where

N = 28 + URA_{NED2} Index.

IS :

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 L5 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 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; 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:

$$URA_{NED1} = \frac{1}{2^N} \text{ (meters/second)}$$

where

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}:

$$URA_{NED2} = \frac{1}{2^N} \text{ (meters/second/second)}$$

where

N = 28 + URA_{NED2} Index.

IS705-271 :

Section Number :
20.3.3.3.1.1.1

WAS :
L1/L2/L5 Inter-Signal Group Delay Differential Correction.

Redlines :
L1/L2~~/L5~~ Inter-Signal Group Delay Differential Correction.

IS :
L1/L2 Inter-Signal Group Delay Differential Correction.

IS705-280 :

Section Number :
20.3.3.3.1.2.2.0-1

WAS :
The two frequency (L1 C/A and L5 I5) user shall correct for the group delay and ionospheric effects by applying the relationship:

$$PR = \frac{(PR_{L5I5} - \gamma_{15} PR_{L1C/A}) + c(ISC_{L5I5} - \gamma_{15} ISC_{L1C/A})}{1 - \gamma_{15}} - cT_{GD}$$

Redlines :
The ~~two~~ dual-frequency (L1 C/A and L5 I5) user shall correct for the group delay and ionospheric effects by applying the relationship:

$$PR = \frac{(PR_{L5I5} - \gamma_{15} PR_{L1C/A}) + c(ISC_{L5I5} - \gamma_{15} ISC_{L1C/A})}{1 - \gamma_{15}} - cT_{GD}$$

IS :
The dual-frequency (L1 C/A and L5 I5) user shall correct for the group delay and ionospheric effects by applying the relationship:

$$PR = \frac{(PR_{L5I5} - \gamma_{15} PR_{L1C/A}) + c(ISC_{L5I5} - \gamma_{15} ISC_{L1C/A})}{1 - \gamma_{15}} - cT_{GD}$$

IS705-281 :

Section Number :
20.3.3.3.1.2.2.0-2

WAS :
The two frequency (L1 C/A and L5 Q5) user shall correct for the group delay and ionospheric effects by applying the relationship:

$$PR = \frac{(PR_{L5Q5} - \gamma_{15} PR_{L1C/A}) + c(ISC_{L5Q5} - \gamma_{15} ISC_{L1C/A})}{1 - \gamma_{15}} - cT_{GD}$$

where

PR = pseudorange corrected for ionospheric effects,
PR_i = pseudorange measured on the channel indicated by the subscript;
ISC_i = inter-signal correction for the channel indicated by the subscript (see paragraph 20.3.3.3.1.2),

T_{GD} = see paragraph 20.3.3.3.3.2 of IS-GPS-200,
c = speed of light (see paragraph 20.3.4.3),

and where, denoting the nominal center frequencies of L1 and L5 as f_{L1} and f_{L5} respectively,

$\gamma_{15} = (f_{L1}/f_{L5})^2 = (1575.42/1176.45)^2 = (154/115)^2$.

Redlines :

The ~~two~~ dual-frequency (L1 C/A and L5 Q5) user shall correct for the group delay and ionospheric effects by applying the relationship:

$$PR = \frac{(PR_{L5Q5} - \gamma_{15} PR_{L1C/A}) + c(ISC_{L5Q5} - \gamma_{15} ISC_{L1C/A})}{1 - \gamma_{15}} - cT_{GD}$$

where

PR = pseudorange corrected for ionospheric effects,

PR_i = pseudorange measured on the channel indicated by the subscript;

ISC_i = inter-signal correction for the channel indicated by the subscript (see paragraph 20.3.3.3.1.2),

T_{GD} = see paragraph 20.3.3.3.3.2 of IS-GPS-200,

c = speed of light (see paragraph 20.3.4.3),

and where, denoting the nominal center frequencies of L1 and L5 as f_{L1} and f_{L5} respectively,

$\gamma_{15} = (f_{L1}/f_{L5})^2 = (1575.42/1176.45)^2 = (154/115)^2$.

IS :

The dual-frequency (L1 C/A and L5 Q5) user shall correct for the group delay and ionospheric effects by applying the relationship:

$$PR = \frac{(PR_{L5Q5} - \gamma_{15} PR_{L1C/A}) + c(ISC_{L5Q5} - \gamma_{15} ISC_{L1C/A})}{1 - \gamma_{15}} - cT_{GD}$$

where

PR = pseudorange corrected for ionospheric effects,

PR_i = pseudorange measured on the channel indicated by the subscript;

ISC_i = inter-signal correction for the channel indicated by the subscript (see paragraph 20.3.3.3.1.2),

T_{GD} = see paragraph 20.3.3.3.3.2 of IS-GPS-200,

c = speed of light (see paragraph 20.3.4.3),

and where, denoting the nominal center frequencies of L1 and L5 as f_{L1} and f_{L5} respectively,

$\gamma_{15} = (f_{L1}/f_{L5})^2 = (1575.42/1176.45)^2 = (154/115)^2$.

IS705-283 :

Section Number :
20.3.3.3.1.2.3.0-1

WAS :
The two frequency (L2 C and L5 I5) user shall correct for the group delay and ionospheric effects by applying the relationship:

$$PR = \frac{(PR_{L5I5} - \gamma_{25} PR_{L2C}) + c(ISC_{L5I5} - \gamma_{25} ISC_{L2C})}{1 - \gamma_{25}} - cT_{GD}$$

Redlines :
The ~~two~~ dual-frequency (L2 C and L5 I5) user shall correct for the group delay and ionospheric effects by applying the relationship:

$$PR = \frac{(PR_{L5I5} - \gamma_{25} PR_{L2C}) + c(ISC_{L5I5} - \gamma_{25} ISC_{L2C})}{1 - \gamma_{25}} - cT_{GD}$$

IS :
The dual-frequency (L2 C and L5 I5) user shall correct for the group delay and ionospheric effects by applying the relationship:

$$PR = \frac{(PR_{L5I5} - \gamma_{25} PR_{L2C}) + c(ISC_{L5I5} - \gamma_{25} ISC_{L2C})}{1 - \gamma_{25}} - cT_{GD}$$

IS705-284 :

Section Number :
20.3.3.3.1.2.3.0-2

WAS :
The two frequency (L2 C and L5 Q5) user shall correct for the group delay and ionospheric effects by applying the relationship:

$$PR = \frac{(PR_{L5Q5} - \gamma_{25} PR_{L2C}) + c(ISC_{L5Q5} - \gamma_{25} ISC_{L2C})}{1 - \gamma_{25}} - cT_{GD}$$

where

PR = pseudorange corrected for ionospheric effects,
PR_i = pseudorange measured on the channel indicated by the subscript,
ISC_i = inter-signal correction for the channel indicated by the subscript (see paragraph 20.3.3.3.1.2),

T_{GD} = see paragraph 20.3.3.3.3.2 of IS-GPS-200,
c = speed of light (see paragraph 20.3.4.3).

and where, denoting the nominal center frequencies of L2 and L5 as f_{L2} and f_{L5} respectively.

$\gamma_{25} = (f_{L2}/f_{L5})^2 = (1227.6/1176.45)^2 = (24/23)^2$

Redlines :
The ~~two~~ dual-frequency (L2 C and L5 Q5) user shall correct for the group delay and ionospheric effects by applying the relationship:

$$PR = \frac{(PR_{L5Q5} - \gamma_{25} PR_{L2C}) + c(ISC_{L5Q5} - \gamma_{25} ISC_{L2C})}{1 - \gamma_{25}} - cT_{GD}$$

where

PR = pseudorange corrected for ionospheric effects,
PR_i = pseudorange measured on the channel indicated by the subscript,
ISC_i = inter-signal correction for the channel indicated by the subscript (see paragraph 20.3.3.3.1.2),

T_{GD} = see paragraph 20.3.3.3.3.2 of IS-GPS-200,
c = speed of light (see paragraph 20.3.4.3).

and where, denoting the nominal center frequencies of L2 and L5 as f_{L2} and f_{L5} respectively.

$\gamma_{25} = (f_{L2}/f_{L5})^2 = (1227.6/1176.45)^2 = (24/23)^2$

IS :
The dual-frequency (L2 C and L5 Q5) user shall correct for the group delay and ionospheric effects by applying the relationship:

$$PR = \frac{(PR_{L5Q5} - \gamma_{25} PR_{L2C}) + c(ISC_{L5Q5} - \gamma_{25} ISC_{L2C})}{1 - \gamma_{25}} - cT_{GD}$$

where

PR = pseudorange corrected for ionospheric effects,
PR_i = pseudorange measured on the channel indicated by the subscript,
ISC_i = inter-signal correction for the channel indicated by the subscript (see paragraph 20.3.3.3.1.2),

T_{GD} = see paragraph 20.3.3.3.3.2 of IS-GPS-200,
c = speed of light (see paragraph 20.3.4.3).

and where, denoting the nominal center frequencies of L2 and L5 as f_{L2} and f_{L5} respectively.

$\gamma_{25} = (f_{L2}/f_{L5})^2 = (1227.6/1176.45)^2 = (24/23)^2$

IS705-286 :

Section Number :
20.3.3.3.1.3.0-1

WAS :
The ionospheric parameters which allow the "L5 only" user to utilize the ionospheric model for computation of the ionospheric delay are contained in message type 30. The "one frequency" user should use the model given in Figure 20-4 of IS-GPS-200 to make this correction. The calculated value of T_{iono} (T_{iono} = ionospheric correction parameter) in the model is referred to the L1 frequency; if the user is operating on the L5 frequency, the correction term must be multiplied by γ15 (reference paragraph 20.3.3.3.1.2.2). It is estimated that the use of this model will provide at least a 50 percent reduction in the single-frequency user's RMS error due to ionospheric propagation effects. The bit lengths, scale factors, ranges, and units of these parameters are given in Table 20-X of IS-GPS-200 (See Figure 20-3 for complete ionospheric bit allocation).

Redlines :
The ionospheric parameters which allow the "L5 only" user to utilize the ionospheric model for computation of the ionospheric delay are contained in message type 30. The "~~one~~ single-frequency" user should use the model given in Figure 20-4 of IS-GPS-200 to make this correction. The calculated value of T_{iono} (T_{iono} = ionospheric correction parameter) in the model is referred to the L1 frequency; if the user is operating on the L5 frequency, the correction term must be multiplied by γ15 (reference paragraph 20.3.3.3.1.2.2). It is estimated that the use of this model will provide at least a 50 percent reduction in the single-frequency user's RMS error due to ionospheric propagation effects. The bit lengths, scale factors, ranges, and units of these parameters are given in Table 20-X of IS-GPS-200 (See Figure 20-3 for complete ionospheric bit allocation).

IS :
The ionospheric parameters which allow the "L5 only" user to utilize the ionospheric model for computation of the ionospheric delay are contained in message type 30. The "single-frequency" user should use the model given in Figure 20-4 of IS-GPS-200 to make this correction. The calculated value of T_{iono} (T_{iono} = ionospheric correction parameter) in the model is referred to the L1 frequency; if the user is operating on the L5 frequency, the correction term must be multiplied by γ15 (reference paragraph 20.3.3.3.1.2.2). It is estimated that the use of this model will provide at least a 50 percent reduction in the single-frequency user's RMS error due to ionospheric propagation effects. The bit lengths, scale factors, ranges, and units of these parameters are given in Table 20-X of IS-GPS-200 (See Figure 20-3 for complete ionospheric bit allocation).

IS705-299 :

Section Number :
20.3.3.4.4.0-1

WAS :
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.

Redlines :
The three, one-bit, health indication in bits 155, 156 and 157 of message type 37 and bits 29, 30 and 31 of each packet of reduced almanac refers to the L1, L2, and L5 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 midi almanac or 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.

IS :
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 midi almanac or 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.

IS705-331 :

Section Number :
20.3.3.6.2.0-1

WAS :
Message type 33 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 NAV 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 (and define) 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.

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

Redlines :

Message type 33 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 ~~NAV~~CNAV 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 (and define) 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.

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

IS :
Message type 33 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 CNAV 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 (and define) 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.

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

IS705-336 :

Section Number :
20.3.3.7.1.0-1

WAS :
Message type 34 provides SV clock correction parameters (ref. Section 20.3.3.2) and also, shall contain DC parameters that apply to the clock and ephemeris data transmitted by another SV. One message type 34, Figure 20-7, shall contain 34 bits of clock differential correction (CDC) parameters and 92 bits of ephemeris differential correction (EDC) parameters for one SV other than the transmitting SV. Bit 150 of message type 34 shall be a DC Data Type indicator that indicates the data type for which the DC parameters apply. Zero (0) signifies that the corrections apply to L5 CNAV data, $D_5(t)$, and one (1) signifies that the corrections apply to NAV data, D(t), described in Appendix II of IS-GPS-200.

Redlines :
Message type 34 provides SV clock correction parameters (ref. Section 20.3.3.2) and also, shall contain DC parameters that apply to the clock and ephemeris data transmitted by another SV. One message type 34, Figure 20-7, shall contain 34 bits of clock differential correction (CDC) parameters and 92 bits of ephemeris differential correction (EDC) parameters for one SV other than the transmitting SV. Bit 150 of message type 34 shall be a DC Data Type indicator that indicates the data type for which the DC parameters apply. Zero (0) signifies that the corrections apply to L5 CNAV data, $D_5(t)$, and one (1) signifies that the corrections apply to ~~NAV~~LNAV data, D(t), described in Appendix II of IS-GPS-200.

IS :
Message type 34 provides SV clock correction parameters (ref. Section 20.3.3.2) and also, shall contain DC parameters that apply to the clock and ephemeris data transmitted by another SV. One message type 34, Figure 20-7, shall contain 34 bits of clock differential correction (CDC) parameters and 92 bits of ephemeris differential correction (EDC) parameters for one SV other than the transmitting SV. Bit 150 of message type 34 shall be a DC Data Type indicator that indicates the data type for which the DC parameters apply. Zero (0) signifies that the corrections apply to L5 CNAV data, $D_5(t)$, and one (1) signifies that the corrections apply to LNAV data, D(t), described in Appendix II of IS-GPS-200.

IS705-373 :

Section Number :
20.3.4.2.0-1

WAS :
In controlling the SVs and uploading of data, the CS shall allow for the following timing relationships:

a. Each SV operates on its own SV time;
b. All time-related data (TOW) in the messages shall be in SV-time;
c. All other data in the NAV message shall be relative to GPS time;
d. The acts of transmitting the NAV messages shall be executed by the SV on SV time.

Redlines :
In controlling the SVs and uploading of data, the CS shall allow for the following timing relationships:

a. Each SV operates on its own SV time;

b. All time-related data (TOW) in the messages shall be in SV-time;

c. All other data in the ~~NAV~~CNAV message shall be relative to GPS time;

d. The acts of transmitting the ~~NAV~~CNAV messages shall be executed by the SV on SV time.

IS :
In controlling the SVs and uploading of data, the CS shall allow for the following timing relationships:

a. Each SV operates on its own SV time;
b. All time-related data (TOW) in the messages shall be in SV-time;
c. All other data in the CNAV message shall be relative to GPS time;
d. The acts of transmitting the CNAV messages shall be executed by the SV on SV time.

IS705-1477 :

Section Number :
20.3.4.4.0-1

WAS :
The t_{oe} shall be equal to the t_{oc} of the same CNAV CEI data set. t_{op} does not have to match t_{oe}/ t_{oc}. As a redundant check, t_{op} in message type 10 will match with the t_{op} term in message type 30-37 for a valid CEI data set. The following rule governs the transmission of t_{oe} and t_{oc} values in different CEI data sets: The transmitted $t_{oe/}t_{oc}$ will be different from any value transmitted by the SV during the preceding six hours.

Cutovers to new CEI data sets will occur only on hour boundaries except for the first CEI data set of a new CEI data sequence propagation. The first CEI data set may be cut-in (reference paragraph 20.3.4.1) at any time during the hour and therefore may be transmitted by the SV for less than one hour.

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

Normal Operations. The message type 10, 11, and 30-37 CEI data sets are transmitted by the SV for periods of two hours. The corresponding curve fit interval is three hours.

Redlines :
The t_{oe} shall be equal to the t_{oc} of the same CNAV CEI data set. t_{op} does not have to match t_{oe}/ t_{oc}. As a redundant check, t_{op} in message type 10 will match with the t_{op} term in message type 30-37 for a valid CEI data set. The following rule governs the transmission of t_{oe} and t_{oc} values in different CEI data sets: The transmitted $t_{oe/}t_{oc}$ will be different from any value transmitted by the SV during the preceding six hours.

Cutovers to new CEI data sets will occur only on hour boundaries except for the first CEI data set of a new CEI data sequence propagation. The first CEI data set may be cut-in (reference paragraph 20.3.4.1) at any time during the hour and therefore may be transmitted by the SV for less than one hour.

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

Normal Operations. The message type 10, 11, and 30-37 CEI data sets are transmitted by the SV for periods of two hours. The corresponding curve fit interval is three hours.

IS :
The t_{oe} shall be equal to the t_{oc} of the same CNAV CEI data set. t_{op} does not have to match t_{oe}/ t_{oc}. As a redundant check, t_{op} in message type 10 will match with the t_{op} term in message type 30-37 for a valid CEI data set. The following rule governs the transmission of t_{oe} and t_{oc} values in different CEI data sets: The transmitted t_{oe}/t_{oc} will be different from any value transmitted by the SV during the preceding six hours.

Cutovers to new CEI data sets will occur only on hour boundaries except for the first CEI data set of a new CEI data sequence propagation. The first CEI data set may be cut-in (reference paragraph 20.3.4.1) at any time during the hour and therefore may be transmitted by the SV for less than one hour.

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

Normal Operations. The message type 10, 11, and 30-37 CEI data sets are transmitted by the SV for periods of two hours. The corresponding curve fit interval is three hours.