PROPOSED CHANGE NOTICE

Affected Document:	IRN/SCN Number	Date:
IS-GPS-705E	XXX-XXXX-XXX	DD-MMM-YYYY
Authority:	**Proposed Change Notice**	**Date:**
RFC-00374	IS705E_RFC374	01-MAY-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 2 topics were deferred from the 2017 Public ICWG and will now be resolved by this RFC.

1. Currently the OAs that are published and archived contain plane/slot descriptions that are not in the constellation definition provided to the public in the SPS Performance Standard. 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 continuation of RFC-351, which was CCB-approved on 8-Jan-2018.
2. The linkage between different timing systems is not properly captured in the current technical baseline. With the current documentation, MNAV and CNAV users will calculate the wrong UT1 time immediately following a leap second change. This affects user applications that require high precision pointing, which may include optical telescopes or any military system with this requirement. Documents affected: IS-GPS-200, IS-GPS-705, and IS-GPS-800. The topic was part of RFC-354, which will be superseded due to the inclusion of this topic in this RFC.

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

3. a) Signal-in-space topics need clarification, as identified by the public in past Public ICWGs. Documents affected: IS-GPS-200 and IS-GPS-705. 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 718, 819, 861)

Description of Change:

1. Modify the OA as agreed to in ICD-GPS-240 and ICD-GPS-870.
2. The proposed changes to the impacted technical baseline documents would correctly calculate UT1 during a leap second transition.
3. a) Provide clarity for the list of signal-in-space topics identified by the public in documents IS-GPS-200 and IS-GPS-705. 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: Perry Chang, Philip Kwan, Amit Patel**

AUTHORIZED SIGNATURES	REPRESENTING	DATE
	GPS Directorate Space & Missile Systems Center (SMC) – LAAFB	

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El Segundo, CA 90245

CODE IDENT 66RP1

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Note: Repeat this Signature Page for each document signatory.

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APPROVED BY:

With Comments: Yes ☐ No ☐

With Exceptions: Yes ☐ No ☐

_____	_____	_____
Name of Approving Organization	Authorized Signature	Date

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CODE IDENT 66RP1

RFC-374 Leap Second and Earth Orientation Parameters Proposed Changes

IS705-322 :

Section Number :
20.3.3.5.1.1-3

WAS :

Table 20-VII. Earth Orientation Parameters

Parameter Symbol	Parameter Description	No. of Bits**	Scale Factor (LSB)	Valid Range***	Units
t_{EOP}	EOP Data Reference Time	16	2^{4}	0 to 604,784	seconds
PM_X †	X-Axis Polar Motion Value at Reference Time.	21*	2^{-20}		arc-seconds
$\dot{PM}$_X	X-Axis Polar Motion Drift at Reference Time.	15*	2^{-21}		arc-seconds/day
PM_Y ††	Y-Axis Polar Motion Value at Reference Time.	21*	2^{-20}		arc-seconds
$\dot{PM}$_Y	Y-Axis Polar Motion Drift at Reference Time.	15*	2^{-21}		arc-seconds/day
ΔUT1 †††	UT1-UTC Difference at Reference Time.	31*	2^{-24}		seconds
$\dot{\Delta UT1}$ †††	Rate of UT1-UTC Difference at Reference Time	19*	2^{-25}		seconds/day

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

** See Figure 20-5 for complete bit allocation in message type 32;

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

† Represents the predicted angular displacement of instantaneous Celestial Ephemeris Pole with respect to semi-minor axis of the reference ellipsoid along Greenwich meridian.

†† Represents the predicted angular displacement of instantaneous Celestial Ephemeris Pole with respect to semi-minor axis of the reference ellipsoid on a line directed 90° west of Greenwich meridian.

††† With zonal tides restored.

Redlines :

Table 20-VII. Earth Orientation Parameters

Parameter Symbol	Parameter Description	No. of Bits**	Scale Factor (LSB)	Valid Range***	Units
t_{EOP}	EOP Data Reference Time	16	2^{4}	0 to 604,784	seconds
PM_X †	X-Axis Polar Motion Value at Reference Time.	21*	2^{-20}		arc-seconds
PMẊ	X-Axis Polar Motion Drift at Reference Time.	15*	2^{-21}		arc-seconds/day
PM_Y ††	Y-Axis Polar Motion Value at Reference Time.	21*	2^{-20}		arc-seconds
PMẎ	Y-Axis Polar Motion Drift at Reference Time.	15*	2^{-21}		arc-seconds/day
ΔUT1 †††	UT1-UTC Difference at Reference Time.	31*	2^{-24}		seconds
ΔU̇T1 †††	Rate of UT1-UTC Difference at Reference Time	19*	2^{-25}		seconds/day

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

** See Figure 20-5 for complete bit allocation in message type 32;

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

† Represents the predicted angular displacement of instantaneous Celestial Ephemeris Pole with respect to semi-minor axis of the reference ellipsoid along Greenwich meridian.

†† Represents the predicted angular displacement of instantaneous Celestial Ephemeris Pole with respect to semi-minor axis of the reference ellipsoid on a line directed 90° west of Greenwich meridian.

††† With zonal tides restored.

IS :

Table 20-VII. Earth Orientation Parameters

Parameter Symbol	Parameter Description	No. of Bits**	Scale Factor (LSB)	Valid Range***	Units
t_{EOP}	EOP Data Reference Time	16	2^{4}	0 to 604,784	seconds
PM_X †	X-Axis Polar Motion Value at Reference Time.	21*	2^{-20}		arc-seconds
PMẊ	X-Axis Polar Motion Drift at Reference Time.	15*	2^{-21}		arc-seconds/day
PM_Y ††	Y-Axis Polar Motion Value at Reference Time.	21*	2^{-20}		arc-seconds
PMẎ	Y-Axis Polar Motion Drift at Reference Time.	15*	2^{-21}		arc-seconds/day
ΔUT1 †††	UT1-UTC Difference at Reference Time.	31*	2^{-24}		seconds
ΔU̇T1 †††	Rate of UT1-UTC Difference at Reference Time	19*	2^{-25}		seconds/day

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

** See Figure 20-5 for complete bit allocation in message type 32;

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

† Represents the predicted angular displacement of instantaneous Celestial Ephemeris Pole with respect to semi-minor axis of the reference ellipsoid along Greenwich meridian.

†† Represents the predicted angular displacement of instantaneous Celestial Ephemeris Pole with respect to semi-minor axis of the reference ellipsoid on a line directed 90° west of Greenwich meridian.

††† With zonal tides restored.

Rationale :

RFC-374 nomenclature update to place the dot over the letter X for PMX, Y for PMY, and U for Delta UT1

IS705-324 :

Section Number :
20.3.3.5.1.1-4

WAS :

Table 20-VIII. Application of EOP Parameters

Element/Equation	Description
$UT1 = UTC + \Delta UT1 + \dot{\Delta UT1}\ (t - t_{EOP})$	Compute Universal Time at time t
$x_p = PM\_X + \dot{PM\_X}\ (t - t_{EOP})$	Polar Motion in the x-axis
$y_p = PM\_Y + \dot{PM\_Y}\ (t - t_{EOP})$	Polar Motion in the y-axis
t is GPS system time at time of transmission, i.e., GPS time corrected for transit time (range/speed of light).	

Redlines :

Table 20-VIII. Application of EOP Parameters

Element/Equation	Description
$UT1 = UTC + \Delta UT1 + \dot{\Delta UT1}\ (t - t_{EOP})$	
$x_p = PM\_X + \dot{PM\_X}\ (t - t_{EOP})$	
$y_p = PM\_Y + \dot{PM\_Y}\ (t - t_{EOP})$	
UT1 = $t_{UTC\ EOP}$ + ΔUT1 + Δ$\dot{U}$T1 (t – t_{ot} + 604800 (WN – WN_{ot}))	Compute Universal Time at time t
x_p = PM_X + PM$\dot{X}$ (t – t_{ot} + 604800 (WN – WN_{ot}))	Polar Motion in the x-axis
y_p = PM_Y + PM$\dot{Y}$ (t – t_{ot} + 604800 (WN – WN_{ot}))	Polar Motion in the y-axis
~~t is GPS system time at time of transmission, i.e., GPS time corrected for transit time (range/speed of light).~~ GPS system time of transmission (t) shall be in seconds relative to end/start of week Note: Users should use caution when performing the calculations in Table 20-VIII for data where |(WN_{ot} – WN*604800) + (t- t_{EOP})|< 259200 s (3 days) as this is outside the EOP curve fit interval.	

IS :

Table 20-VIII. Application of EOP Parameters

Element/Equation	Description
$UT1 = t_{UTC\_EOP} + \Delta UT1 + \dot{\Delta UT1} (t - t_{ot} + 604800 (WN - WN_{ot}))$	Compute Universal Time at time t
$x_p = PM\_X + \dot{PMX} (t - t_{ot} + 604800 (WN - WN_{ot}))$	Polar Motion in the x-axis
$y_p = PM\_Y + \dot{PMY} (t - t_{ot} + 604800 (WN - WN_{ot}))$	Polar Motion in the y-axis
GPS system time of transmission (t) shall be in seconds relative to end/start of week Note: Users should use caution when performing the calculations in Table 20-VIII for data where $\|(WN_{ot} - WN*604800) + (t - t_{EOP})\| < 259200$ s (3 days) as this is outside the EOP curve fit interval.	

Rationale :

-Fix the equations to correctly calculate UT1 during a leap second transition

-Replace "UTC" with "t_{UTC_EOP}" in the first equation. Rationale: Define a specific variable for use in this section.

-Also italicized equation reverted back to standard text format

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IS705-1526 :

Section Number :

20.3.3.5.1.1-5

WAS :

N/A

Redlines :

When implementing the first equation in Table 20-VIII, WN_{ot} and t_{UTC_EOP} are derived from data contained in message type 33 (see Section 20.3.3.6). The Control Segment shall ensure the ΔUT1 and $\dot{\Delta UT1}$ values in message type 32 can be used with the UTC parameters (WN_{ot}, and Δt_{LS}) in message type 33 to calculate the correct UT1 time, provided the t_{EOP} in message type 32 is identical to the t_{ot} in message type 33 and the two message types are transmitted within a continuous 4-hour period.

IS :

When implementing the first equation in Table 20-VIII, WN_{ot} and t_{UTC_EOP} are derived from data contained in message type 33 (see Section 20.3.3.6). The Control Segment shall ensure the ΔUT1 and $\dot{\Delta UT1}$ values in message type 32 can be used with the UTC parameters (WN_{ot}, and Δt_{LS}) in message type 33 to calculate the correct UT1 time, provided the t_{EOP} in message type 32 is identical to the t_{ot} in message type 33 and the two message types are transmitted within a continuous 4-hour period.

Rationale :

Originally created as a part of RFC-354. This change explicitly specifies the relationship between message type 32 and message type 33, and the necessary conditions for the parameters within the messages to ensure a correct UT1 time calculation.

IS705-1529 :

Section Number :
20.3.3.5.1.1-6

WAS :
N/A

Redlines :
When calculating t_{UTC_EOP} for Table 20-VIII the user shall only use data from a message type 33 with the same t_{ot} as the t_{EOP} of the message type 32 containing ΔUT1 and ΔU̇T1 where both messages were received within a continuous 4-hour window.

IS :
When calculating t_{UTC_EOP} for Table 20-VIII the user shall only use data from a message type 33 with the same t_{ot} as the t_{EOP} of the message type 32 containing ΔUT1 and ΔU̇T1 where both messages were received within a continuous 4-hour window.

Rationale :
Provide detailed instructions on how MT 32 and MT 33 shall only be used within a continuous 4-hour window

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IS705-1530 :

Section Number :
20.3.3.5.1.1-7

WAS :
N/A

Redlines :
The following definition of t_{UTC_EOP} shall be used.

$t_{UTC\_EOP} = (t - \Delta t_{UTC\_EOP})$ [modulo 86400 seconds]

where

$\Delta t_{UTC\_EOP} = \Delta t_{LS} + A_{0-n} + A_{1-n}(t-t_{ot} + 604800(WN-WN_{ot})) + A2\text{-}n\,(t-t_{ot}+604800\,(WN-WN_{ot}))^2$

IS :
The following definition of t_{UTC_EOP} shall be used.

$t_{UTC\_EOP} = (t - \Delta t_{UTC\_EOP})$ [modulo 86400 seconds]

where

$\Delta t_{UTC\_EOP} = \Delta t_{LS} + A_{0-n} + A_{1-n}(t-t_{ot} + 604800(WN-WN_{ot})) + A_{2-n}(t-t_{ot}+604800\,(WN-WN_{ot}))^2$

Rationale :
Define explicit equations on how t_{UTC_EOP} and Δt_{UTC_EOP} are calculated

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IS705-1531 :

Section Number :
20.3.3.5.1.1-8

WAS :
N/A

Redlines :
To avoid discontinuities in UT1 across leap seconds, the value of Δt_{LS} must be used in the calculation of t_{UTC_EOP} regardless of whether a leap second has occurred. This accounts for the continuous nature of UT1 until a new upload after the leap second provides an update value for ΔUT1 that is consistent with the new Δt_{LS}.

IS :
To avoid discontinuities in UT1 across leap seconds, the value of Δt_{LS} must be used in the calculation of t_{UTC_EOP} regardless of whether a leap second has occurred. This accounts for the continuous nature of UT1 until a new upload after the leap second provides an update value for ΔUT1 that is consistent with the new Δt_{LS}.

Rationale :
Originally inserted as a part of RFC-354. This change explicitly specifies the relationship between message type 32 and message type 33. It requires the user to use Δt_{LS} in the t_{UTC_EOP} calculation for UT1 in all cases. It does so in a manner that explicitly warns the user of the possible leap second problem.

RFC-374 Cleanup Proposed Changes

IS705-225 :

Section Number :
20.3.3.1.1.2.0-2

WAS :
The predicted health data will be updated at the time of upload when a new CEI data set has been built by the CS. The transmitted health data may not correspond to the actual health of the transmitting SV.

Redlines :
The predicted health data will be updated at the time of upload when a new CEI data set has been built by the CS. The health indication shall be given relative to the "as designed" capabilities of each SV (see paragraph 20.3.3.3.1.4 of IS-GPS-200). The transmitted health data may not correspond to the actual health of the transmitting SV.

IS :
The predicted health data will be updated at the time of upload when a new CEI data set has been built by the CS. The health indication shall be given relative to the "as designed" capabilities of each SV (see paragraph 20.3.3.3.1.4 of IS-GPS-200). The transmitted health data may not correspond to the actual health of the transmitting SV.

Rationale :
4/3/2018: Input health bit clarifications to distinguish between interpreting a health bit for SVs with legacy (L1 C/A) vs modernized (L1C) signals. This also resolves a health bit clarity item regarding the L5 signal capability for SVs that do not have the L5 signal capability.

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
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 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.

IS :

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
$\dot{\Delta n_0}$	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 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.

Rationale :

Because this section calls out the table as including information regarding MTs 10 and 11, the ** note should be updated to match that, rather than exclude MT 11 in the note. To support this, t_{op}, the propagation time of week, is in MT11.

IS705-371 :

Section Number :
20.3.4.1.0-3

WAS :

Table 20-XII. Message Broadcast Intervals

Message Data	Message Type Number	Maximum Broadcast Intervals †
Ephemeris	10 & 11	24 sec
Clock	Type 30's	24 sec
ISC, IONO	30*	144 sec
Reduced Almanac	31* or 12	10 min**,****
Midi Almanac	37*	60 min**
EOP	32*	15 min****
UTC	33*	144 sec
Diff Correction	34* or 13 & 14	15 min***,****
GGTO	35*	144 sec****
Text	36* or 15	As needed****

* Also contains SV clock correction parameters.
** Complete set of SVs in the constellation.
*** When Differential Corrections are available.
**** Optional (interval applies if/when broadcast).

† The intervals specified are maximum. As such, the broadcast intervals may be shorter than the specified value.

Redlines :

Table 20-XII. Message Broadcast Intervals

Message Data	Message Type Number	Maximum Broadcast Intervals †
Ephemeris	10 & 11	24 sec
Clock	Type 30's	24 sec
ISC, IONO	30*	144 sec
Reduced Almanac	31* or 12	10 min**,****
Midi Almanac	37*	60 min**, ****
EOP	32*	15 min****
UTC	33*	144 sec
Diff Correction	34* or 13 & 14	15 min***,****
GGTO	35*	144 sec****
Text	36* or 15	As needed****

* Also contains SV clock correction parameters.
** Complete set of SVs in the constellation.
*** When Differential Corrections are available.
**** Optional (interval applies if/when broadcast).

† The intervals specified are maximum. As such, the broadcast intervals may be shorter than the specified value.

IS :

Table 20-XII. Message Broadcast Intervals

Message Data	Message Type Number	Maximum Broadcast Intervals †
Ephemeris	10 & 11	24 sec
Clock	Type 30's	24 sec
ISC, IONO	30*	144 sec
Reduced Almanac	31* or 12	10 min**,****
Midi Almanac	37*	60 min**,****
EOP	32*	15 min****
UTC	33*	144 sec
Diff Correction	34* or 13 & 14	15 min***,****
GGTO	35*	144 sec****
Text	36* or 15	As needed****

* Also contains SV clock correction parameters.
** Complete set of SVs in the constellation.
*** When Differential Corrections are available.
**** Optional (interval applies if/when broadcast).

† The intervals specified are maximum. As such, the broadcast intervals may be shorter than the specified value.

Rationale :
4/2018: We confirmed that the midi almanac for L5 CNAV is optional and must denote it as such in the table.

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.

Rationale :
4/19/2018: Update "invalid" to "obsolete" because if the receiver interprets the data as invalid, then the receiver may stop using the data until it decodes new CEI data. Rather than do that, tell the user that the data is obsolete because it will be superseded by new data, but to continue using the old data until the receiver fully decodes the new CEI data.
