INTERFACE REVISION NOTICE (IRN)

Note: This Summary Signature Page is to be used after all signatories have signed separate Signature Pages.

Affected IS:	**IRN Number**	**Date:**
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RFC-00354	PIRN-IS-200H-007	26-APR-2017

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

Document Title: NAVSTAR GPS Space/Navigation User Interfaces

Reason For Change (Driver):
The linkage between different timing systems is not properly captured in the current technical baseline. Using the existing IS-GPS-200 & IS-GPS-705 documentation, CNAV users will calculate the wrong Universal Time 1 (UT1) immediately following a leap second change. As a result, user applications that require high precision pointing will cause the pointing to be in error. Possible users may include any systems that require high precision pointing.

Description of Change:

The proposed changes to the impacted technical baseline documents would correctly calculate UT1 during a leap second transition.

Prepared By: Perry Chang **Checked By: Huey Nguyenhuu**

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

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Interface Control Contractor:
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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:

With Comments: Yes ☐ No ☐

With Exceptions: Yes ☐ No ☐

______________________ ______________________ ______________
Name of Approving Organization   Authorized Signature   Date

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IS200-621 :

Section Number :
30.3.3.5.1.1.0-5

WAS :

Table 30-VII. Earth Orientation Parameters

Parameter		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
$\dot{\text{PM}}$_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
$\dot{\text{PM}}$_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
$\Delta\dot{\text{U}}$T1 †††	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 30-5 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 30-VII. Earth Orientation Parameters

Parameter		No. of Bits**	Scale Factor (LSB)	Valid Range***	Units
t_{EOP}	EOP Data Reference Time	16	2^{4}	0 to 604,784	seconds
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$\dot{\text{PM}}$_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
$\dot{\text{PM}}$_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
~~$\dot{\text{AUT1}}$ †††~~ $\Delta\dot{\text{UT1}}$ †††	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 30-5 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.

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IS :

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** See Figure 30-5 for complete bit allocation in Message type 32;

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††† With zonal tides restored.

IS200-623 :

Section Number :
30.3.3.5.1.1.0-7

WAS :

Table 30-VIII. Application of EOP Parameters	
Element/Equation	Description
$UT1 = UTC + \Delta UT1 + \Delta \dot{UT}1\ (t - t_{EOP})$ *	Compute Universal Time at time t
$x_p = PM\_X + PM\ \dot{X}\ (t - t_{EOP})$ *	Polar Motion in the x-axis
$y_p = PM\_Y + PM\ \dot{Y}\ (t - t_{EOP})$ *	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). Furthermore, the quantity (t-t_{EOP}) shall be the actual total time difference between the time t and the epoch time t_{EOP}, and must account for beginning or end of week crossovers. That is, if (t-t_{EOP}) is greater than 302,400 seconds, subtract 604,800 seconds from (t-t_{EOP}). If (t-t_{EOP}) is less than -302,400 seconds, add 604,800 seconds to (t-t_{EOP}).	

Redlines :

Table 30-VIII. Application of EOP Parameters	
Element/Equation	Description
~~$UT1 = UTC + \Delta UT1 + \Delta \dot{UT1}\ (t - t_{EOP})$ *~~ $UT1 = t_{UTC\_EOP} + \Delta UT1 + \Delta \dot{U}T1(t - t_{EOP}$ $+ 604800\ (WN - WN_{ot}))$	Compute Universal Time at time t
~~$x_p = PM\_X + PM\_\dot{X}\ (t - t_{EOP})$ *~~ $x_p = PM\_X + PM\dot{X}\ (t - t_{EOP}$ $+ 604800\ (WN - WN_{ot}))$	Polar Motion in the x-axis
~~$y_p = PM\_Y + PM\dot{Y}\ (t - t_{EOP})$ *~~ $y_p = PM\_Y + PM\dot{Y}\ (t - t_{EOP}$ $+ 604800\ (WN - WN_{ot}))$	Polar Motion in the y-axis
GPS system time at time of transmission (t) shall be in seconds relative to end/start of week ~~*t is GPS system time at time of transmission, i.e., GPS time corrected for transit time (range/speed of light). Furthermore, the quantity (t-t_{EOP}) shall be the actual total time difference between the time t and the epoch time t_{EOP}, and must account for beginning or end of week crossovers. That is, if (t-t_{EOP}) is greater than 302,400 seconds, subtract 604,800 seconds from (t-t_{EOP}). If (t-t_{EOP}) is less than -302,400 seconds, add 604,800 seconds to (t-t_{EOP}).~~	

IS :

Table 30-VIII. Application of EOP Parameters	
Element/Equation	Description
$UT1 = t_{UTC\_EOP} + \Delta UT1 + \Delta \dot{U}T1(t - t_{EOP}$ $+ 604800\ (WN - WN_{ot}))$	Compute Universal Time at time t
$x_p = PM\_X + PM\dot{X}\ (t - t_{EOP}$ $+ 604800\ (WN - WN_{ot}))$	Polar Motion in the x-axis
$y_p = PM\_Y + PM\dot{Y}\ (t - t_{EOP}$ $+ 604800\ (WN - WN_{ot}))$	Polar Motion in the y-axis
GPS system time at time of transmission (t) shall be in seconds relative to end/start of week	

IS200-1662 :
Insertion after object IS200-623

Section Number :
30.3.3.5.1.1.0-8

WAS :
N/A

Redlines :
When implementing the first equation in Table 30-VIII, WNot and tUTC_EOP is derived from data contained in message type 33 (see Section 30.3.3.6). For a given upload, the Control Segment shall ensure the ΔUT1 and ΔU̇T1 values in message type 32 are consistent with the UTC parameters (WNot, A0-n, A1-n, A2-n, and ΔtLS) in the message type 33, and the tEOP in message type 32 is identical to the tot in message type 33.

IS :
When implementing the first equation in Table 30-VIII, WN_{ot} and t_{UTC_EOP} is derived from data contained in message type 33 (see Section 30.3.3.6). For a given upload, the Control Segment shall ensure the ΔUT1 and ΔU̇T1 values in message type 32 are consistent with the UTC parameters (WN_{ot}, A_{0-n}, A_{1-n}, A_{2-n}, and Δt_{LS}) in the message type 33, and the t_{EOP} in message type 32 is identical to the t_{ot} in message type 33.

IS200-1671 :
Insertion after object IS200-1662

Section Number :
30.3.3.5.1.1.0-9

WAS :
N/A

Redlines :
When calculating tUTC_EOP for Table 30-VIII the user shall only use data from a message type 33 with the same tot as the tEOP of the message type 32 containing ΔUT1 and ΔU̇T1.

IS :
When calculating t_{UTC_EOP} for Table 30-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.

IS200-1672 :
Insertion after object IS200-1671

Section Number :
30.3.3.5.1.1.0-10

WAS :
N/A

Redlines :
The following definition of tUTC_EOP shall be used.

tUTC_EOP = (t - ΔtUTC_EOP) [modulo 86400 seconds]

where

ΔtUTC_EOP = ΔtLS + A0-n + A1-n (t-tot + 604800(WN-WNot)) + A2-n (t-tot+604800 (WN-WNot))2

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

t_{UTC_EOP} = (t - Δt_{UTC_EOP}) [modulo 86400 seconds]

where

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

IS200-1673 :
Insertion after object IS200-1672

Section Number :
30.3.3.5.1.1.0-11

WAS :
N/A

Redlines :
To avoid discontinuities in UT1 across leap seconds, the value of ΔtLS must be used in the calculation of tUTC_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 ΔtLS.

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}.