PROPOSED INTERFACE REVISION NOTICE (PIRN)

Note: This Cover Page is not intended for signature. It is to be used during the document update (pre-ICWG) process.

Affected ICD/IS: IS-GPS-200 Rev H	**PIRN Number:** PIRN-IS-200H-007
Authority: RFC-00354	**PIRN Date:** 27-APR-2017

CLASSIFIED BY:

DECLASSIFY ON:

Document Title: NAVSTAR GPS Space Segment/Navigation User Interfaces

Reason For Change (Driver):

The linkage between different timing system is not properly captured in the current technical baseline. Using the existing IS-GPS-200, IS-GPS-705 & ICD-GPS-700 documentation, MNAV and CNAV users will calculate the wrong UT1 time immediately following a leap second change. As a result, user application that require high precision pointing will cause the pointing to be in error. Possible users may include optical telescope, or any military system that requires high precision pointing.

Description of Change:

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

(this RFC will also address an ICD-GPS-700 editorial change from RFC-329)

Prepared By: Perry Chang **Checked By: Amit Patel**

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IS200-623 :

Section Number :
30.3.3.5.1.1.0-7

WAS :

Table 30-VIII. Application of EOP Parameters	
Element/Equation	Description
$UT1 = UTC + \Delta UT1 + \dot{\Delta UT1}\ (t - t_{EOP})$ *	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). 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
$UT1 = t_{UTC-EOP} + \Delta UT1 + \dot{\Delta UT1}\ (t - t_{EOP})$ *	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). 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

$UT1 = t_{UTC-EOP} + \Delta UT1 + \Delta \dot{UT1} \ (t - t_{EOP})$ *	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 ($t-t_{EOP}$).	

Rationale :
-Replace “UTC” with “tUTC-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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IS200-1658 :
Insertion after object IS200-623

Section Number :
30.3.3.5.1.1.1

WAS :
N/A

Redlines :
When implementing the first equation in Table 30-VIII, tUTC-EOP shall be 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 ΔUT1(dot) values in message type 32 shall be consistent with the UTC parameters (A0-n, A1-n, A2-n, and ΔtLS) in the message type 33 and that the tEOP in message type 32 shall be identical to the tot in message type 33.

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 ΔUT1(dot). 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 + 64800(WN-WNot)) + A2-n (t-tot+604800 (WN-WNot))2

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 :
When implementing the first equation in Table 30-VIII, $t_{UTC-EOP}$ shall be 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 ΔUT1(dot) values in message type 32 shall be consistent with the UTC parameters (A_{0-n}, A_{1-n}, A_{2-n}, and Δt_{LS}) in the message type 33 and that the t_{EOP} in message type 32 shall be identical to the t_{ot} in message type 33.

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 ΔUT1(dot). The following definition of $t_{UTC-EOP}$ shall be used.

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

where

$\Delta t_{UTC-EOP} = \Delta t_{LS} + A_{0-n} + A_{1-n} (t-t_{ot} + 64800(WN-WN_{ot})) + A_{2-n} (t-t_{ot}+604800 (WN-WN_{ot}))^2$

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 :
This change explicitly specifies the relationship between message type 32 and message type 33. It requires the user to use ΔtLS in the tUTC-EOP calculation for UT1 in all cases. It does so in a manner that explicitly warns the user of the possible leap second problem.