

**RTCA Special Committee 186, Working Group 3
EUROCAE WG-51, SG-1**

ADS-B 1090ES MOPS Maintenance

**WG-3 Meeting #26
SG-1 Meeting #3
Joint Session**

**RTCA Headquarters, Washington DC
31 March – 3 April 2009**

**Proposed Changes to DO-260A for T=1 Non-Precision Cases
In Response to Action Item 25-17**

**Tom Pagano
FAA ATO-P, FAA Technical Center**

Summary
This Working Paper reviews the original proposals for modifications to DO-260A as proposed by Bill Harman of MIT Lincoln Labs in Working Paper 1090-WP24-02. Following discussions by WG-3/SG-1 on WP24-02, it was believed that the specific approach taken in WP24-02 deleted requirements and test procedure sections of DO-260A which were valuable and should not be deleted. This Working Paper revises the proposal for the cases of T=1 and Non-Precision.

1. INTRODUCTION

As a result of discussion in Working Paper 1090-WP 24-02, “The Time Synchronization Issue in 1090ES” by Dr Harman of MIT Lincoln Lab, RTCA SC-186 WG 3 and EUROCAE WG 51, SG 1 agreed to incorporate requirements to permit T=1, time synchronized position reporting, in the case of non-precision NIC values. WP 24-02 had specific change recommendations in the WP to incorporate the T=1 non-precision case. After review of WP24-02 and the specific change proposals, this Working Paper contains a list of suggested changes different than Dr Harman’s recommended changes. The deviation from Dr Harman’s WP24-02 is driven primarily by the attempt to minimize the impact to the existing document (DO-260A Change 2) and also to retain requirements that allow estimation techniques to be used in the non-precision non-UTC coupled case as described below. Also, the recommended changes below may minimize confusion between requirements associated with precision and non-precision position transmission. The following 2.2 sections are the main areas that require updating:

2.2.3.2.3.7.2 Airborne Latitude Position Extrapolation/Estimation (Precision Case, TYPE Codes 9, 10, 20 and 21)

2.2.3.2.3.7.2.1 GPS/GNSS Time Mark Coupled Case (Extrapolation, “TIME” (T)=1)

2.2.3.2.3.7.2.2 Non-Coupled Case (Estimation, “TIME” (T)=0)

2.2.3.2.3.7.3 Airborne Latitude Position Extrapolation/Estimation (non - precision)

2.2.3.2.3.7.3.1 Airborne Latitude Position Extrapolation Case (non - precision)

2.2.3.2.3.7.3.2 Airborne Latitude Position Estimation Case (non - precision)

2.2.3.2.3.8.2 Airborne Longitude Position Extrapolation/Estimation (Precision Case, TYPE Codes 9, 10, 20 and 21)

2.2.3.2.3.8.2.1 GPS/GNSS Time Mark Coupled Case (Extrapolation, “TIME” (T)=1)

2.2.3.2.3.8.2.2 Non-Coupled Case (Estimation, “TIME” (T)=0)

2.2.3.2.3.8.3 Airborne Longitude Position Extrapolation/Estimation (non-precision)

2.2.3.2.3.8.3.1 Airborne Longitude Position Extrapolation Case (non - precision)

2.2.3.2.3.8.3.2 Airborne Longitude Position Estimation Case (non - precision)

2.2.3.2.4.7.2 Surface Latitude Position Extrapolation/Estimation (Precision Case, TYPE Codes 5 and 6)

2.2.3.2.4.7.2.1 GPS/GNSS Time Mark Coupled Case (Extrapolation, “TIME” (T)=1)

2.2.3.2.4.7.2.2 Non-Coupled Case (Estimation, “TIME” (T)=0)

2.2.3.2.4.7.3 Surface Latitude Position Extrapolation/Estimation (non-precision)

2.2.3.2.4.7.3.1 Surface Latitude Position Extrapolation Case (non - precision)

2.2.3.2.4.7.3.2 Surface Latitude Position Estimation Case (non - precision)

2.2.3.2.4.8.2 Surface Longitude Position Extrapolation/Estimation (Precision Case, TYPE Codes 5 and 6)

2.2.3.2.4.8.2.1 GPS/GNSS Time Mark Coupled Case (Extrapolation, “TIME” (T)=1)

2.2.3.2.4.8.2.2 Non-Coupled Case (Estimation, “TIME” (T)=0)

2.2.3.2.4.8.3 Surface Longitude Position Extrapolation/Estimation (non-precision)

2.2.3.2.4.8.3.1 Surface Longitude Position Extrapolation Case (non - precision)

2.2.3.2.4.8.3.2 Surface Longitude Position Estimation Case (non - precision)

2. 1090-WP24-02 PROPOSAL

The proposal in Working Paper 1090-WP24-02 was as follows:

Steps 1 and 2 reflect the changes to the Airborne Position Message Latitude data:

- 1) Move the material and title from §2.2.3.2.3.7.2.1 GPS/GNSS Time Mark Coupled Case (Extrapolation, “TIME” (T)=1) to §2.2.3.2.3.7.2. Section §2.2.3.2.3.7.2.1 is no longer used.
- 2) Move the material and title from §2.2.3.2.3.7.2.2 Non-Coupled Case (Estimation, “TIME” (T)=0) to section number §2.2.3.2.3.7.3. Section §2.2.3.2.3.7.2.2 is no longer used.

Sections §2.2.3.2.3.7.3.1 and §2.2.3.2.3.7.3.2 are deleted and no longer used.

Steps 3 and 4 reflect the changes to the Airborne Position Message Longitude data:

- 3) Move the material and title from §2.2.3.2.3.8.2.1 GPS/GNSS Time Mark Coupled Case (Extrapolation, “TIME” (T)=1) to §2.2.3.2.3.8.2. Section §2.2.3.2.3.8.2.1 is no longer used.
- 4) Move the material and title from §2.2.3.2.3.8.2.2 Non-Coupled Case (Estimation, “TIME” (T)=0) to section number §2.2.3.2.3.8.3. Section §2.2.3.2.3.8.2.2 is no longer used.

Sections §2.2.3.2.3.8.3.1 and §2.2.3.2.3.8.3.2 are deleted and no longer used.

This would result in the following sections in the MOPS:

2.2.3.2.3.7.2 GPS/GNSS Time Mark Coupled Case (Extrapolation, “TIME” (T)=1)

2.2.3.2.3.7.3 Non-Coupled Case (Estimation, “TIME” (T)=0)

2.2.3.2.3.8.2 GPS/GNSS Time Mark Coupled Case (Extrapolation, “TIME” (T)=1)

2.2.3.2.3.8.3 Non-Coupled Case (Estimation, “TIME” (T)=0)

This change as it was recommended consolidates the precision and non-precision T=0 case and the precision and non-precision T=1 case. However, it additionally removes the implementation which instead of extrapolation of the position data, estimation techniques such as Kalman filters, alpha-beta trackers, etc. may be used for position update determination.

Therefore, the next section offers an alternative to this proposed change.

3. **ALTERNATE PROPOSAL**

The following sections are recommended in lieu of the above. The highlighting indicates area of change:

2.2.3.2.3.7.2 Airborne Latitude Position Extrapolation/Estimation (Precision Case, TYPE Codes 9, 10, 20 and 21)

2.2.3.2.3.7.2.1 GPS/GNSS Time Mark Coupled Case (Extrapolation, "TIME" (T)=1)

2.2.3.2.3.7.2.2 Non-Coupled Case (Estimation, "TIME" (T)=0)

2.2.3.2.3.7.3 Airborne Latitude Position Extrapolation/Estimation ("TIME" (T)=0, non-precision)

2.2.3.2.3.7.3.1 Airborne Latitude Position Extrapolation Case (non - precision)

2.2.3.2.3.7.3.2 Airborne Latitude Position Estimation Case (non - precision)

2.2.3.2.3.7.3.3 GPS/GNSS Time Mark Coupled Case (Extrapolation, "TIME" (T)=1, non-precision)

2.2.3.2.3.8.2 Airborne Longitude Position Extrapolation/Estimation (Precision Case, TYPE Codes 9, 10, 20 and 21)

2.2.3.2.3.8.2.1 GPS/GNSS Time Mark Coupled Case (Extrapolation, "TIME" (T) =1)

2.2.3.2.3.8.2.2 Non-Coupled Case (Estimation, "TIME" (T)=0)

2.2.3.2.3.8.3 Airborne Longitude Position Extrapolation/Estimation ("TIME" (T)=0, non-precision)

2.2.3.2.3.8.3.1 Airborne Longitude Position Extrapolation Case (non - precision)

2.2.3.2.3.8.3.2 Airborne Longitude Position Estimation Case (non - precision)

2.2.3.2.3.8.3.3 GPS/GNSS Time Mark Coupled Case (Extrapolation, "TIME" (T)=1, non-precision)

2.2.3.2.4.7.2 Surface Latitude Position Extrapolation/Estimation (Precision Case, TYPE Codes 5 and 6)

2.2.3.2.4.7.2.1 GPS/GNSS Time Mark Coupled Case (Extrapolation, "TIME" (T)=1)

2.2.3.2.4.7.2.2 Non-Coupled Case (Estimation, "TIME" (T)=0)

2.2.3.2.4.7.3 Surface Latitude Position Extrapolation/Estimation ("TIME" (T)=0, non - precision)

2.2.3.2.4.7.3.1 Surface Latitude Position Extrapolation Case (non - precision)

2.2.3.2.4.7.3.2 Surface Latitude Position Estimation Case (non - precision)

2.2.3.2.4.7.3.3 GPS/GNSS Time Mark Coupled Case (Extrapolation, “TIME” (T)=1, non – precision)

2.2.3.2.4.8.2 Surface Longitude Position Extrapolation/Estimation (Precision Case, TYPE Codes 5 and 6)

2.2.3.2.4.8.2.1 GPS/GNSS Time Mark Coupled Case (Extrapolation, “TIME” (T)=1)

2.2.3.2.4.8.2.2 Non-Coupled Case (Estimation, “TIME” (T)=0)

2.2.3.2.4.8.3 Surface Longitude Position Extrapolation/Estimation, “TIME” (T)=0, non - precision)

2.2.3.2.4.8.3.1 Surface Longitude Position Extrapolation Case (non - precision)

2.2.3.2.4.8.3.2 Surface Longitude Position Estimation Case (non - precision)

2.2.3.2.4.8.3.3 GPS/GNSS Time Mark Coupled Case (Extrapolation, “TIME” (T)=1, non - precision)

1) Add the following four sections to the MOPS:

2.2.3.2.3.7.3.3 GPS/GNSS Time Mark Coupled Case (Extrapolation, “TIME” (T)=1, non-precision)

The requirements if “TIME” (T) = 1 (see §2.2.3.2.3.5) in an Airborne Position Message for non-precision TYPE Codes **shall** be as specified in §2.2.3.2.3.7.2.1.

2.2.3.2.3.8.3.3 GPS/GNSS Time Mark Coupled Case (Extrapolation, “TIME” (T)=1, non-precision)

The requirements if “TIME” (T) = 1 (see §2.2.3.2.3.5) in an Airborne Position Message for non-precision TYPE Codes **shall** be as specified in §2.2.3.2.3.8.2.1.

2.2.3.2.4.7.3.3 GPS/GNSS Time Mark Coupled Case (Extrapolation, “TIME” (T)=1, non - precision)

The requirements if “TIME” (T) = 1 (see §2.2.3.2.3.5) in a Surface Position Message for non-precision TYPE Codes **shall** be as specified in §2.2.3.2.4.7.2.1.

2.2.3.2.4.8.3.3 GPS/GNSS Time Mark Coupled Case (Extrapolation, “TIME” (T)=1, non - precision)

The requirements if “TIME” (T) = 1 (see §2.2.3.2.3.5) in a Surface Position Message for non-precision TYPE Codes **shall** be as specified in §2.2.3.2.4.8.2.1.

2.4.3.2.3.7.3.3 Verification of GPS/GNSS Time Mark Coupled Case Extrapolation, “TIME” (T)=1) (§2.2.3.2.3.7.3.3)

The test procedures provided in §2.4.3.2.3.7.2.1 shall be used to validate performance of §2.4.3.2.3.7.3.3.

2.4.3.2.3.8.3.3 Verification of GPS/GNSS Time Mark Coupled Case (Extrapolation, “TIME” (T)=1) (§2.2.3.2.3.8.3.3)

The test procedures provided in §2.4.3.2.3.8.2.1 shall be used to validate performance of §2.4.3.2.3.8.3.3.

2.4.3.2.4.7.3.3 Verification of GPS/GNSS Time Mark Coupled Case Extrapolation, “TIME” (T)=1) (§2.2.3.2.4.7.3.3)

The test procedures provided in §2.4.3.2.4.7.2.1 shall be used to validate performance of §2.4.3.2.4.7.3.3.

2.4.3.2.4.8.3.3 Verification of GPS/GNSS Time Mark Coupled Case (Extrapolation, “TIME” (T)=1) (§2.2.3.2.4.8.3.3)

The test procedures provided in §2.4.3.2.4.8.2.1 shall be used to validate performance of §2.4.3.2.4.8.3.3.

2) In §A.1.4.2.2, delete the following sentence:

“Synchronization will only be used for Airborne Position Messages having the top two horizontal position precision categories (TYPE Codes 9, 10, 20 and 21).”

3) Add the following Note in §A.1.4.2.2:

Note: Whereas in an earlier version of these MOPS T=1 was forbidden when TYPE Code is other than 9, 10, 20, or 21, in this version of these MOPS and future versions, that combination is no longer restricted.

4) In §A.1.4.3.4, delete the following sentence:

“Synchronization will only be used for Surface Position Messages having the top two horizontal position precision categories (TYPE Codes 5 and 6).”

5) Add the following Note in §A.1.4.3.4:

Note: Whereas in an earlier version of these MOPS T=1 was forbidden when TYPE Code is other than 5 or 6, in this version of these MOPS and future versions, that combination is no longer restricted.