RTCA Special Committee 186, Working Group 3

ADS-B 1090 MOPS, Revision A

Meeting #10

Proposed Requirement for Enhanced Reception Techniques

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Summary

SC-186 WG-3 had previously accepted to add provisions in DO-260A for Class A2E and A3E avionics that would be required to support the enhanced reception techniques. Based on the results of test data and simulations for high traffic density operational environments and considering the pending revisions to the ADS-B MASPS, it is now proposed to require the enhanced reception techniques for all Class A2 and A3 avionics.

Reference 1: Working Paper 6-03, "Proposal to Define 1090 MHz ADS-B Receiver Classes Requiring Enhanced Reception," Jerry Anderson and Ron Jones, 21 August 2001

Reference 2: Ballot Draft of the revision A of the ADS-B MASPS, DO-242A, March 2, 2002

1. Introduction

SC-186 WG-3 had previously accepted the proposals of Reference 1 [WP6-03] to add provisions in DO-260A for Class A2E and A3E avionics that would be required to support the enhanced reception techniques.

2. Discussion

Based on the results of test data and simulations for high traffic density operational environments it was previously considered that the enhanced reception techniques would probably be needed to satisfy the DO-242 requirements future very high traffic density environments and that was the basis for the original proposal to define Class A2E and A3E avionics. However, considering the pending revisions to the ADS-B MASPS, it is now proposed to require the enhanced reception techniques for all Class A2 and A3 avionics. There are changes proposed for the ADS-B MASPS revision (DO-242A) that justify such a requirement in the 1090 MHz MOPS.

Specifically the new requirements associated with the reporting of intent information and the associated update rates place substantial new requirements on the 1090 MHz for achieving improved reception performance (as compared to the old TCP and TCP+1 requirements) in high density airspace. Intent reporting capability is required by DO-242A for Class A2 and A3 avionics and must be supported in high traffic density environments at ranges to at least 40 NM. Further, DO-242A for the requirements in the 40 to 90 NM range has included in Note 11 to table 3-4a, a statement that "However, the minimum range may apply even in high interference environments, such as over-flight of high traffic density terminal areas." If viewed as a requirement this is a substantial change from DO-242 where ranges beyond 40 NM only applied in low-density airspace and the aircraft density was explicitly define.

3. Proposal

It now appears that Class A2 and A3 avionics with enhanced reception techniques are appropriate to addressing the revised requirements of the ADS-B MASPS (draft DO-242A). It is proposed to require that all Class A2 and A3 avionics support the enhanced reception techniques. If accepted Table 2-5 of DO-260 will need to be revised (see Attachment B), section 2.2.4.4 will need to be revised (see Attachment A for the proposed changes), and a general review of the DO-260A MOPS will be needed in order to require the enhanced reception techniques for Class A2 and A3 avionics, rather than simply being offered as an option as was done in DO-260.

ATTACHMENT A

Proposed DO-260A provisions for Enhanced Reception Techniques

2.2.4.4 Enhanced Squitter Reception Techniques

The enhanced squitter reception techniques are required for Class A2 and A3 airborne systems and optional for Class A0 and A1 airborne systems.

2.2.4.4.1 Need for Enhanced Techniques

The 1090 MHz ADS-B Message Reception Techniques specified in subparagraph 2.2.4.3.4 provide a high probability of correct reception when the desired squitter is overlapped with one ATCRBS interfering reply of equal or greater power. In some high interference environments (e.g., U.S. northeast corridor, Los Angeles or Frankfurt, Germany), there is a relatively high probability that the desired squitter signal will be overlapped with multiple ATCRBS replies. In these environments, the air-to-air range may be reduced because of the effects of this interference.

2.2.4.4.2 Enhanced Squitter Reception Technique Overview

Enhanced squitter reception techniques have been developed (see Appendix I) that provide the ability to receive squitters with multiple overlapping ATCRBS fruit. Such enhanced reception techniques are composed of the following elements:

a. Improved preamble detection to reduce the probability of a false alarm caused by detection of an apparent Mode S preamble synthesized by overlapped ATCRBS fruit replies.

b. Improved code and confidence bit declaration typically based on the use of amplitude to aid in the interpretation of the squitter data block.

c. More capable error correction techniques that are optimized to the characteristics of the code and confidence process.

Equipment intended to meet the minimum requirements for enhanced reception techniques shall demonstrate compliance with test procedures specified in subparagraph 2.4.4.4.

Note: *If enhanced reception techniques other than the preferred multi-sample techniques described in Appendix I are employed for Class A2 or A3 equipment, then equivalent performance shall be demonstrated under high levels of Mode A/C fruit and in the presence of multiple Mode S fruit.*

2.2.4.4.3 Error Correction Restriction

The enhanced reception techniques are intended to operate in very high Mode A/C fruit environments. For this reason, the sliding window error correction technique shall not be used in conjunction with the enhanced techniques since it produces an unacceptably high undetected error rate in these high fruit environments.

Note: *See Appendix I, subparagraphs I.3.3 and I.4.3 for more details on error correcting techniques.*

ATTACHMENT B

Proposed changes to Table 2-5 to require Enhanced Reception Techniques for Class A2 and A3 receivers (also indicates changes in to reference DO-242A and Minimum Report Required)

Table 2-5 ADS-B Class A Receiver Equipment To Report Coverage

RECEIVER CLASS	MINIMUM TRIGGER THRESHOLD LEVEL (MTL)	RECEPTION TECHNIQUE	OPERATION	MASPS REQUIREMENT (RTCA/DO-242A)	MINIMUM REPORT REQUIRED
A_0 (Basic VFR)	-72 dBm	Standard	• Aid to Visual Acquisition • Airport Surface	SV	ADS-B State Vector Report (per Section 2.2.8.1)
A_1 (Basic IFR)	-74 dBm	Standard	• Aid to Visual Acquisition • Conflict Avoidance • Simultaneous Approaches • Airport Surface	SV MS-P_{IFR}	ADS-B State Vector Report (per Section 2.2.8.1) AND ADS-B Mode Status Report (per Section 2.2.8.2)
A_2 (Enhanced IFR)	-79 dBm	Enhanced (per section 2.2.4.4)	• Aid to Visual Acquisition • Conflict Avoidance • Separation Assurance and Sequencing • Simultaneous Approaches • Airport Surface	SV MS OC	ADS-B State Vector Report (per Section 2.2.8.1) AND ADS-B Mode Status Report (per Section 2.2.8.2) AND Target State and Status Information (per section x.x.x.x)
A_3 (Extended Capability)	-84 dBm	Enhanced (per section 2.2.4.4)	• Aid to Visual Acquisition • Conflict Avoidance • Separation Assurance and Sequencing • Flight Path Deconfliction Planning • Simultaneous Approaches • Airport Surface	SV MS OC	ADS-B State Vector Report (per Section 2.2.8.1) AND ADS-B Mode Status Report (per Section 2.2.8.2) AND ~~ADS-B TCP+1 Report (per Section 2.2.8.3)~~ Target State and Status Information (per section x.x.x.x)