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RTCA Special Committee 186, Working Group 3
ADS-B 1090 MOPS
Meeting 2

Proposal to Develop an ADS-B 1090 MOPS Appendix on Techniques for Improved Reception Range

(Presented by Ron Jones)

Summary

The evidence to date suggests that most of requirements of the first edition of the ADS-B MASPS can be satisfied by the provisions already specified by ADS-B 1090 MOPS. However, it has been recognized that the ADS-B MASPS requirements for ADS-B operations in the highest density airspace will require enhanced decoding techniques for which the requirements will be included in the first update to the ADS-B 1090 MOPS. Updates to the ADS-B MASPS are currently being developed and future editions may reflected additional requirements for longer range air-to-air ADS-B reception, perhaps in moderate to high density airspace. This paper proposes that SC-186 WG3 initiate an activity to develop an appendix to the ADS-B 1090 MOPS to address techniques, not addressed in the main body of the MOPS, that would provide improvements in 1090 extended squitter reception in terms of air-to-air range that would be applicable to the most capable class of user.

References:

1 FAA Report: Measurement of the 1090 MHz Extended Squitter in the Los Angeles Basin, DOT/FAA/ND/00-7, May 2000.

2. Interim Report: Measurement of the 1090 MHz Extended Squitter Performance and the 1030/1090 MHz Environment in Frankfurt, Germany, Draft 30 November 2000.

1. Introduction

The evidence to date suggests that most of requirements of the first edition of the ADS-B MASPS can be satisfied by the provisions already specified by ADS-B 1090 MOPS. However, it has been recognized that the ADS-B MASPS requirements for ADS-B operations in the highest density airspace will require enhanced decoding techniques for which the requirements will be included in the first update to the ADS-B 1090 MOPS. Updates to the ADS-B MASPS are currently being developed and future editions may reflected additional requirements for longer range air-to-air ADS-B reception, perhaps in moderate to high density airspace. This paper proposes that SC-186 WG3 initiate an activity to develop an appendix to the ADS-B 1090 MOPS to address techniques, not addressed in the main body of the MOPS, that would provide improvements in 1090 extended squitter reception in terms of air-to-air range that would be applicable to the most capable class of user.

2. Discussion

Analysis of the requirements of the current ADS-B MASPS vs. the characteristics of the 1090 extended squitter have shown that surveillance tracking for the longer range applications (e.g., de-confliction application) where a 12 second state vector update rate is required (at 95% probability) the probability of individual extended squitter reception needs to be approximately 6%. However, for applications that require TCP and TCP+1 information with a 24 second update rate (also at 95% probability) the probability of individual extended squitter reception needs to be 22.9%. Thus the requirement for providing the TCP and TCP+1 updates requires substantially better performance from the system than is required simply for surveillance tracking.

Measurements made in Los Angles in June 1999, as discussed in Reference 1, indicate that the above MASPS requirements for TCP and TCP+1 updates could be satisfied at air-to-air ranges up to 90 nmi., thus satisfying the MASPS range and update rate requirements when applied to the current LA basin environment (i.e., 1090 fruit rates). Preliminary results from the analysis of data collected in May 2000 in the airspace around Frankfurt, Germany, as described in Reference 2, indicate that the air-to-air range achieved while satisfying the above MASPS TCP and TCP+1 update rate requirements is on the order of 60 to 80 nmi. The current ADS-B MASPS has no requirements for applications requiring air-to-ranges of greater than 40 nmi. in high density airspace as the 90 nmi. MASPS range requirement for the de-confliction application only applies to oceanic and low density remote airspace. Thus it appears that the current MASPS requirements could be satisfied even in the high traffic and very high 1090 fruit environment around Frankfurt.

The ADS-B MASPS is expected to evolve and it is very possible that applications will be identified that will require relatively long air-to-air ADS-B reception. For example, recent Eurocontrol inputs have suggested application requirements for reception ranges of 150 nmi. even in high density airspace in support of free flight types of service.

It is generally recognized, by the current ADS-B MASPS and recent Eurocontrol documents, that the maximum air-to-air reception range is required in the forward direction. For example the current ADS-B MASPS requires for the de-confliction application 90 nmi. in the forward direction, 45 nmi. to the port and starboard and 30 nmi. aft. Given the asymmetric reception range requirements one approach for enhancing the reception range would be via the use of direction antennas for the reception of 1090 extended squitters. The results from the Frankfurt evaluation (reference 2), where diversity antennas were used, show that reception via the top mounted antenna generally provided the longest reception range and experienced lower fruit levels as compared to reception via the bottom antenna. This suggests the use of a direction top antenna could provide improved overall reception performance.

3. Proposal

It is proposed that SC-186 WG3 initiate work to develop a new appendix to the ADS-B 1090 MOPS to address techniques to provide for the maximum forward reception range for the most capable class of user. Such enhancements should explore approaches applicable to both low density and to moderate/high density airspace. As a starting point for this work the use of directional 1090 receive antennas should be investigated with the goal of defining one or more optimal antenna configuration(s) taking into account the anticipated installed gain patterns in both the horizontal and vertical planes.