RTCA Special Committee 186, Working Group 3

ADS-B 1090 MOPS, Revision A

Meeting #12

Action Item 9-12

Revision to Appendix D to Include TIS-B Ground Processing

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SUMMARY

This Working Paper presents a revised draft of Appendix D to include TIS-B ground processing.

Based on agreement at previous meetings, the TIS-B ground processing material in Appendix D will only address issues specifically related to 1090 MHz. The remainder of the ground processing requirements will be included in a reference to the TIS-B MASPS. All of paragraph D.3 has been revised to incorporate this approach.

D.3 Traffic Information Service Broadcast (TIS-B)

D.3.1 Overview

The formats and protocols required for avionics implementing TIS-B on 1090 MHZ are specified the body of this MOPS and in Appendix A. Ground processing for TIS-B on 1090 MHz must implement these same formats and compatible algorithms to interoperate with airborne equipment.

Specific requirements for the ground processing component of TIS-B are contained in the TIS-B MASPS. The TIS-B MASPS contain requirements for TIS-B in a link independent manner. The purpose of this section of Appendix D is to provide additional guidance on implementing ground processing for TIS-B service on 1090 MHz.

D.3.2 Ground Determination of Extended Squitter Equipage

The normal mode of TIS-B operation on 1090 MHz. is to provide this service only for aircraft that are not equipped with extended squitter. It is therefore necessary for TIS-B ground processing to determine which aircraft are extended squitter equipped.

Mode S transponders are equipped to provide a data link capability report in response to an interrogation from a Mode S ground radar. This data link report contains a bit flag to indicate if the transponder is equipped for extended squitter. However, this bit flag is not a reliable indicator of actual extended squitter operation. The bit flag is a static indication of the capability of the transponder support for extended squitter formats and protocols. It would not reflect the loss of extended quitter operation due to a malfunction of the transponder or to the navigation input.

The recommended technique for determining active extended squitter operation is to monitor 1090 MHz for extended squitter reception using in an omni directional fashion. The most convenient way to implement this monitoring is to equip the 1090 MHz TIS-B ground stations to receive as well as transmit. This approach will also provide extended squitter determination for aircraft equipped with non-transponder devices.

D.3.3 TIS-B Antenna Siting to Enhance Equipage Determination

The most reliable configuration for the determination of active extended squitter operation is achieved if a ground radar (providing the basis for TIS-B service) and the TIS-B receiver-transmitter station cover the same volume of airspace. This avoids the situation where an extended squitter equipped aircraft is visible to the ground radar but not to the TIS-B station. In this case, the aircraft would not be declared to be extended squitter equipped and this would result in unnecessary TIS-B transmissions.

The way to achieve the same coverage for the ground radar and the TIS-B station is to locate the TIS-B antenna near and at about the same elevation as the ground radar antenna.

D.3.4 Ground Radar Data Considerations

Wherever possible, the ground radar data used as the basis for TIS-B service should be based upon Mode S surveillance. The availability of ground surveillance data identified with the aircraft 24-bit address for Mode S equipped aircraft significantly enhances the correlation of ground surveillance data with received extended squitters. If an ATCRBS radar is used as the basis for TIS-B service, correlation between the ground radar data and the received extended squitters must be based only on position and altitude since Mode A code is not provided by any of the ADS-B systems

D.3.5 TIS-B Format Selection

Two types of formats are defined for TIS-B on 1090 MHz:

1. Fine Formats

The fine TIS-B formats are similar to those used for Extended Squitter ADS-B operation. These formats are intended for use with surveillance data that is the same quality as that used for ADS-B. Examples of such data quality are surveillance inputs obtained by monitoring other ADS-B links, or a ground-based multilateration system.

The following fine TIS-B format types are defined:

Airborne Position
Airborne Velocity
Surface Position
Identification and Category

2. Coarse Format

The coarse format combines both position and velocity data into a single message. It is intended for use with surveillance data sources that are not accurate enough to warrant the use of the fine formats. The principal example is surveillance data derived from a scanning beam ground radar.

D.3.6 Ground Architecture

D.3.6.1 Overview

The TIS-B service area could be composed of a number of hexagonal cells. Each cell defines the area of service for the TIS-B transmitter located in the center of that cell. Overlap (or buffer zone) at cell boundaries only needs to be large enough to ensure continuity of service across the cell boundary. A minimum service overlap between adjacent cells is desirable in order to eliminate unnecessary duplicate TIS-B transmissions. Since TIS-B aircraft position reports are expected to be reasonably accurate in order to provide useful service, a buffer zone of 2 NM is assumed at cell boundaries.

A description of a typical TIS-B cell is presented in Figure 1.

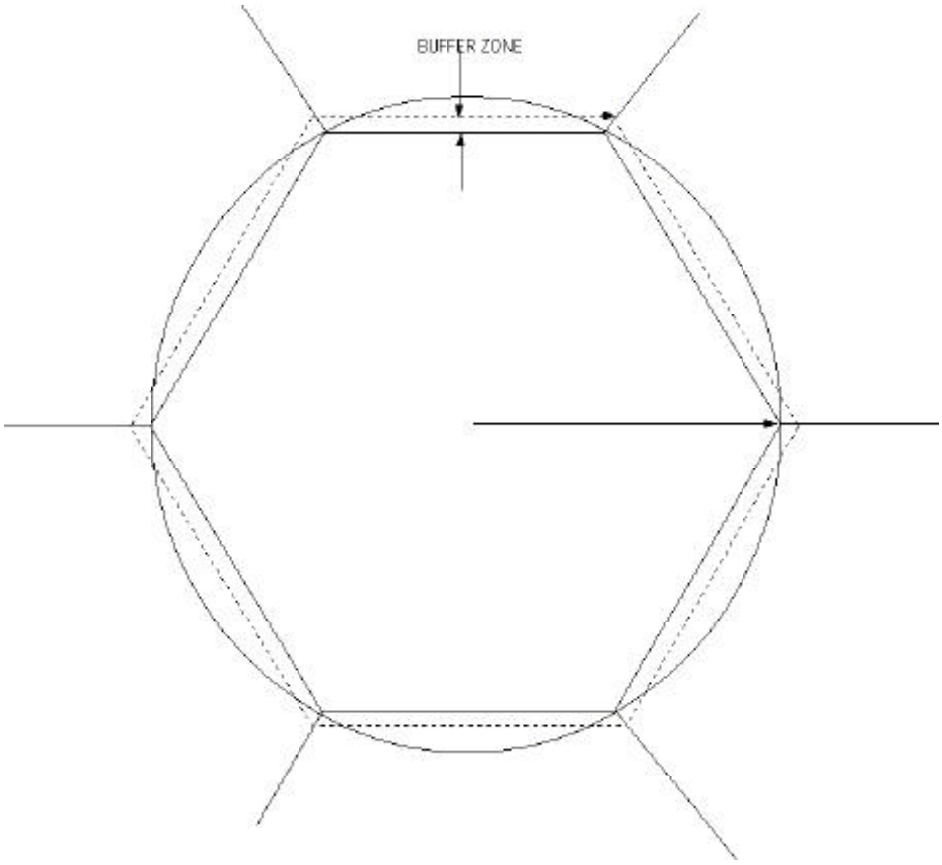

Figure 1. TIS-B Cell Characteristics

D.3.6.2 Cell Size Considerations

The cell size has an important role in determining TIS-B operating characteristics. A Smaller cell size is desirable for the following reasons:

a. A reduced maximum transmission range increases the probability of squitter reception.

b. A smaller cell contains fewer aircraft. This lowers the cell transmission rate and thus reduces the hot spot effect.

c. Due to earth curvature effects, a shorter operating range results in better low altitude coverage.

D.3.7 TIS-B Summary

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