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RTCA Special Committee 186, Working Group 3

ADS-B 1090 MOPS, Revision A

Meeting #9

Draft 4 of TIS-B MOPS Material for Sections 2.2.17 And 2.4.17

Action Item 8-9

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SUMMARY

This working paper presents the 4th draft of TIS-B MOPS material intended for insertion as paragraphs 2.2.17 and 2.4.17. The text that is changed is identified in red and with a change bar in the right hand margin.

Specific changes relative to the last version are: (1) the addition of NIC Supplement, NAC and SIL fields to the Operational Status message, (2) changing the material on management messages to indicate reserved for future use, and (3) the addition of details for Ground Track Status, Ground Track Angle and Ground Speed in the Coarse Position format based on comments received from industry.

Introduction

At the eighth meeting, the third draft of TIS-B MOPS material for insertion into DO-260A at subparagraph 2.2.17 was reviewed. This working paper represents the continuation of the flushing out of materials and text for the requirements for TIS-B in section 2.2.17 and 2.4.17.

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2.2.17.1 Introduction

TBD

2.2.17.2 TIS-B Format Structure

DF:5=18	CF:3	AA:24	ME:56	PI:24

Figure 2-18: TIS-B Format Definition

Table 2-77 "CF" Field Code Definitions in DF=18 ADS-B and TIS-B Messages.

CF Value	ICAO/Mode A Flag (IMF)	Meaning
0	N/A	ADS-B message from a non-transponder device, AA field holds 24-bit ICAO aircraft address
1	N/A	Reserved for ADS-B message in which the AA field holds anonymous address or ground vehicle address or fixed obstruction address
2	0	Fine TIS-B message, AA field contains the 24-bit ICAO aircraft address
	1	Fine TIS-B message, AA field contains the 12-bit Mode A code followed by a 12-bit track file number
3	0	Coarse TIS-B airborne position and velocity message, AA field contains the 24-bit ICAO aircraft address
	1	Coarse TIS-B airborne position and velocity message, AA field contains the 12-bit Mode A code followed by a 12-bit track file number.
4	N/A	Reserved for TIS-B management message AA field holds TIS-B service volume ID + other information (e.g., MSB of reference position for the service volume)
5 – 7	N/A	Reserved for other uses (e.g., for FIS-B messages)

2.2.17.2.1 "DF" Downlink Format

This field shall be set to DF=18 to indicate that this transmission is not from a Mode S transponder. See subparagraph 2.2.3.2.1.1.4.

2.2.17.2.2 "CF" control Field

This field shall be set to 2, 3 or 4 depending upon the TIS-B message as specified in Table 2-77.

2.2.17.2.3 "AA" Address Announced

As specified in Table 2-77, the AA field shall contain either:

(1) the ICAO 24-bit aircraft address as specified in subparagraph 2.2.3.2.1.1.1, or

(2) the 12-bit Mode A code followed by a 12-bit track number.,

2.2.17.2.4 "ME" Message Extended Squitter

This field shall be set as specified in subparagraph 2.2.3.2.1.1.5.

2.2.17.2.5 "PI" Parity/Identify

This field shall be set as specified in subparagraph 2.2.3.2.1.1.6.

2.2.17.3 TIS-B Messages

2.2.17.3.1 TIS-B Fine Airborne Position Message

TIS-B Fine Airborne Position Message Format								
MSG BIT #	33 --- 37	38 --------- 39	40	41 ----- 52	53	54	55 -------- 71	72 -------- 88
"ME" BIT #	1 ----- 5	6 ---------- 7	8	9 ----- 20	21	22	23 -------- 39	40 -------- 56
Field Name	TYPE [5]	Surveillance Status [2]	IMF [1]	Pressure Altitude [12]	Reserved [1]	CPR Format (F) [1]	CPR Encoded Latitude [17]	CPR Encoded Longitude [17]
	MSB LSB	MSB LSB		MSB LSB			MSB LSB	MSB LSB

Note: *"[#]" provided in the Field Name column indicates the number of bits in the specific field.*

Figure 2-19: TIS-B Fine Airborne Position Message Format

2.2.17.3.1.1 Relationship to ADS-B Format

The following fields shall be coded as specified for the ADS-B Airborne Position Message defined in subparagraph 2.2.3.2.3:

Type, Surveillance Status, Altitude, CPR Format, Encoded Latitude and Encoded

Longitude.

2.2.17.3.1.2 ICAO/Mode A Flag (IMF)

This one-bit field (bit 8) shall indicate the type of identity associated with the aircraft data reported in the TIS-B message. IMF equal to ZERO (0) shall indicate that the TIS-B data is identified by an ICAO 24-bit address. IMF equal to ONE (1) shall indicate that the TIS-B data is identified by a "Mode A" code. A "Mode A" code of all zeroes shall indicate a primary radar target.

***Note**: The AA field is coded differently for 24-bit addresses and Mode A codes as specified in Table A-21*

2.2.17.3.2 TIS-B Fine Surface Position Message

TIS-B Fine Surface Position Message Format								
MSG BIT #	33 -- 37	38 ------- 44	45	46 ----- 52	53	54	55 ------- 71	72 -------- 88
"ME" BIT #	1 ----- 5	6 --------- 12	13	14 ----- 20	21	22	23 ------- 39	40 -------- 56
Field Name	TYPE [5]	Movement [7]	Ground Track Status [1]	Ground Track [7]	IMF [1]	CPR Format (F) [1]	CPR Encoded Latitude [17]	CPR Encoded Longitude [17]
	MSB LSB	MSB LSB		MSB LSB			MSB LSB	MSB LSB

***Note:** "[#]" provided in the Field Name column indicates the number of bits in the specific field.*

Figure 2-20: TIS-B Fine Surface Position Message Format

2.2.17.3.2.1 Relationship to ADS-B Format

The following fields shall be coded as specified for the ADS-B Surface Position Message defined in subparagraph 2.2.3.2.4:

Type, Movement, Ground Track Status, CPR Format, Encoded Latitude and Encoded Longitude.

2.2.17.3.2.2 ICAO/Mode A Flag (IMF)

This one-bit field (bit 21) shall be set as specified in subparagraph 2.2.17.3.1.2.

2.2.17.3.3 TIS-B Identification and Category Message

TIS-B Identification and Category Message Format										
MSG BIT #	33--37	38 --------- 40	41 -46	47-52	53 -58	59 -64	65 -70	71 -76	77 -82	83 -88
"ME" BIT #	1 --- 5	6 ---------- 8	9 -- 14	15 -20	21--26	27- 32	33 -38	39 -44	45 -50	51 -56
FIELD NAME	TYPE [5]	ADS-B EMITTER CATEGORY [3]	Ident Char. #1 [6]	Ident Char. #2 [6]	Ident Char. #3 [6]	Ident Char. #4 [6]	Ident Char. #5 [6]	Ident Char. #6 [6]	Ident Char. #7 [6]	Ident Char. #8 [6]
	MSB LSB	MSB LSB	MSB LSB	MSB LSB	MSB LSB	MSB LSB	MSB LSB	MSB LSB	MSB LSB	MSB LSB

Note: *"[#]" provided in the Field Name column indicates the number of bits in the specific field.*

Figure 2-21: TIS-B Identification and Category Message Format

2.2.17.3.3.1 Relationship to ADS-B Format

All of the message fields shall be coded as specified for the ADS-B Identification and Type Message defined in subparagraph 2.2.3.2.5.

2.2.17.3.3.2 Application

This message shall only be used for aircraft identified with an ICAO 24-bit address.

2.2.17.3.4 TIS-B Airborne Velocity Message

TIS-B VELOCITY INFORMATION MESSAGE - SUBTYPES "1" and "2"												
MSG BIT #	33-37	38 ------ 40	41	42 ---------- 45	46	47 --- 56	57	58 --- 67	68	69	70 -- 78	79 ---------- 88
"ME" BIT #	1 --- 5	6 -------- 8	9	10 ---------- 13	14	15 --- 24	25	26 --- 35	36	37	38 -- 46	47 ---------- 56
FIELD NAME	TYPE [5]	SUBTYPE [3]	IMF [1]	Reserved [4]	E/W Direction Bit [1]	E/W Velocity [10]	N/S Direction Bit [1]	N/S Velocity [10]	Reserved [1]	Vert. Rate Sign [1]	Vert. Rate [9]	Reserved [10]
	MSB LSB	MSB LSB		MSB LSB		MSB LSB		MSB LSB			MSB LSB	MSB LSB

ED: Figure needs to be updated to add NIC Supplement, NAC and SIL

Note: *"[#]" provided in the Field Name column indicates the number of bits in the specific field.*

Figure 2-22: TIS-B Airborne Velocity Information Message

2.2.17.3.4.1 Relationship to ADS-B Format

The following fields shall be coded as specified for the ADS-B Airborne Velocity Message with Subtype equal to 1, as specified in subparagraph 2.2.3.2.6.1, or Subtype equal 2, as specified in subparagraph 2.2.3.2.6.2:

Type, Subtype, E/W Direction Bit, E/W Velocity, N/S Direction Bit, N/S Velocity, Vertical Rate Sign and Vertical Rate.

2.2.17.3.4.2 ICAO/Mode A Flag (IMF)

This one-bit field (bit 9) shall be set as specified in subparagraph 2.2.17.3.1.2.

2.2.17.3.4.3 Navigation Integrity Category (NIC) Supplement

This one-bit field (bit 47) shall be used together with the message type code to define the NIC value for the airborne and surface position messages.

Coding of the NIC Supplement field shall be as specified for the Operational Status Message in Table 2.2.3.2.3.1-B

2.2.17.3.4.4 Navigation Accuracy Coding (NAC)

This four-bit field (48-51) shall define the NAC value for the airborne and surface position messages.

Coding of the NAC field shall be as specified for the Operational Status Message in Table 2.2.3.2.7.3.7

2.2.17.3.4.5 Surveillance Integrity Level (SIL)

This two-bit field (52-53) shall define the SIL value for the airborne and surface position messages.

Coding of the SIL field shall be as specified for the Operational Status Message in Table 2.2.3.2.7.3.8

2.2.17.3.5 TIS-B Coarse Position Message

TIS-B Coarse Position Message Format										
MSG BIT #	33	34 ------- 35	36 -----39	40 -- 51	52	53 --- 57	58 -- 63	64	65 ------ 76	77 ------ 88
"ME" BIT #	1	2 --------- 3	4 ------- 7	8 ---19	20	21 --- 25	26 -- 31	32	33 ------ 44	45 ------ 56
Field Name	IMF [1]	Surveillance Status [2]	Service Volume ID (SVID)	Pressure Altitude [12]	Ground Track Status [1]	Ground Track Angle [5]	Ground Speed [6]	CPR Format (F) [1]	CPR Encoded Latitude [12]	CPR Encoded Longitude [12]

		[4]	[12]	[1]	[5]		[1]	[12]	[12]	
		MSB LSB	MSB LSB	MSB LSB		MSB LSB	MSB LSB		MSB LSB	MSB LSB

Note: *"[#]" provided in the Field Name column indicates the number of bits in the specific field.*

Figure 2-23: TIS-B Coarse Position Message Format

2.2.17.3.5.1 ICAO/Mode A Flag (IMF)

This one-bit field (bit 1) shall be set as specified in subparagraph 2.2.17.3.1.2.

2.2.17.3.5.2 Service Volume ID (SVID)

The 4-bit SVID field shall identify the TIS-B site that delivered the surveillance data.

Note: *In the case where TIS-B messages are being received from more than one TIS-B ground stations, the SVID can be used to select coarse messages from a single source. This will prevent the TIS-B track from wandering due to the different error biases associated with different sources*

2.2.17.3.5.3 Pressure Altitude

This field shall be coded as specified in subparagraph 2.2.3.2.3.4.1.

2.2.17.3.5.4 Ground Track Status

This one bit field shall define the validity of the ground track value. Coding for this field shall be as follows: 0=not valid and 1= valid.

2.2.17.3.5.5 Ground Track Angle

This 5-bit (21-25) field shall define the direction (in degrees clockwise from true north) of aircraft motion. The ground track shall be encoded as an unsigned angular weighted binary numeral, with an MSB of 180 degrees and an LSB of 360/32 degrees, with ZERO (0) indicating true north. The data in the field shall be rounded to the nearest multiple of 360/32 degrees.

2.2.17.3.5.6 Ground Speed

This 6-bit (26-31) field shall define the aircraft speed over the ground. coding of this field shall be as shown in Table TBD

Table TBD: Ground Speed Encoding

Coding (binary)	**Coding** (decimal)	**Meaning** (Ground Speed in knots)
00 0000	0	No Ground Speed information available
00 0001	1	Ground Speed is ZERO
00 0010	2	Ground Speed = 32 knot
00 0011	3	Ground Speed = 64 knots
***	***	***
11 1110	62	Ground Speed = 1952 knots
11 1111	63	Ground Speed > 2000 knots

Notes:

1. The encoding shown in the table represents Positive Magnitude data only.

2. Raw data used to establish the Ground Speed Subfield will normally have more resolution (i.e., more bits) than that required by the Ground Speed Subfield. When converting such data to the Ground Speed Subfield, the accuracy of the data shall be maintained such that it is not worse than +/- ½ LSB where the LSB is that of the Ground Speed subfield.

2.2.17.3.5.7 Encoded Latitude

This field shall be encoded as specified in subparagraph 2.2.3.2.3.7, except that the 12-bit CPR coding specified in ***TBD*** shall be used.

2.2.17.3.5.8 Encoded Longitude

This field shall be encoded as specified in subparagraph 2.2.3.2.3.8, except that the 12-bit CPR coding specified in ***TBD*** shall be used.

2.2.17.3.6 Reserved for TIS-B Management Messages

2.2.17.4 TIS-B Message Processing

2.2.17.4.1 TIS-B Message Decoding

2.2.17.4.2 TIS-B Track state Transition

2.2.17.4.2.1 Initialization State

2.2.17.4.2.2 Acquisition State

2.2.17.4.2.3 Track State

2.2.17.5 TIS-B Report Generation