RTCA Special Committee 186, Working Group 3

ADS-B 1090 MOPS, Revision A

Meeting #7

Proposed Changes to Section 2.2, 2.4 & Appendix A required by the addition of a Version Number

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SUMMARY
In Working Paper 1090-WP-3-01 it was proposed that a 4-bit subfield be added to the Aircraft Operational Status Message to indicate the Version Number to which the 1090 MHz system was conformant. In 1090-WP-6-08 changes were proposed to several subparagraphs in Sections 2.2 and 2.4 which were believed necessary because of the implementation of the Version Number. In Meeting #6, it was also agreed to make the proposed subfield a 3-bit field instead of a 4-bit subfield. This Working Paper shows the actual changes proposed to each subparagraph agreed to during Meeting #6.

1.0 Background

At Meeting #2 in Melbourne FL, the Working Group agreed to add a Version Number subfield to the Aircraft Operational Status Message. The purpose of this subfield is to define the Version Number of the formats and protocols in use by the transmitting device. A Version Number is required because it is expected that the formats and protocols will evolve with time and more than one version may be in use during the transition period. The receiver uses the Version Number in order to correctly process ADS-B Messages.

In Meeting #3 in Phoenix AZ, in Working Paper 1090-WP-3-01A Vince Orlando proposed that modifications be made to Figure A-12 (Aircraft Operational Status Message definition) to define a 4-bit Version Number, and that a new paragraph be added to Appendix A as A.4.11.11 to define the 4-bit Version Number.

During the discussion of Working Paper 1090-WP-6-08 at Meeting #6, it was ***agreed*** by the Working Group that the Version Number field would be a 3-bit subfield, defined in A.4.11.11 as:

A.4.11.11 Version Number (VN)

This 3-bit (41-43) subfield shall be used to indicate the Version Number of the formats and protocols in use on the aircraft installation. Encoding of the subfield shall be as shown in Table A-21.

Table A-21: Version Number Encoding

VERSION NUMBER SUBFIELD	
Coding	**Meaning**
0	Conformant to DO-260
1	Conformant to DO-260A
2 to 7	Reserved

2.0 Proposal

The definition of which subparagraphs should be changed or added as a result of the implementation of the Version Number was presented in Working Paper 1090-WP-6-08 and ***agreed*** to by the Working Group as the following:

1. Addition of the Version Number subfield to Figure 2-10, on DO-260 page 97

2. Re-number existing subparagraph 2.2.3.2.7.3.5 (“Not Assigned Subfield”) on DO-260 page 103 to 2.2.3.2.7.3.6.

3. Addition of a new subparagraph 2.2.3.2.7.3.5 entitled “**Version Number Subfield in Aircraft Operational Status Messages**” on DO-260 page 103.

4. Re-number existing subparagraph 2.4.3.2.7.3.5 (“Verification of Not Assigned Subfield”) on DO-260 page 407 to 2.4.3.2.7.3.6, plus editing of the existing text to correct paragraph references.

5. Additional of a new subparagraph 2.4.3.2.7.3.5 entitled "**Verification of the Version Number Subfield in Aircraft Operational Status Messages (subparagraph 2.2.3.2.7.3.5)**" followed by the text required to specify a test procedure to verify the Version Number.

6. Modification of subparagraph 2.2.3.3.2.6.1, DO-260 page 107, to insert a new subparagraph "c" to indicate that the Aircraft Trajectory Intent Message(s) shall not be transmitted during the high-rate transmission of the Aircraft Operation Status Messages as defined in the modified subparagraph 2.2.3.3.2.6.3.

7. Modification of subparagraph 2.4.3.3.2.6.1 to comply with the modifications to 2.2.3.3.2.6.1.

8. Modification of subparagraph 2.2.3.3.2.6.3, DO-260 page 108, to eliminate subparagraph "a" which restricted initialization of the Aircraft Operational Status Message to situations when there was CC or OM data available. And, to replace subparagraph "a" with a new subparagraph that defines a high-rate transmission.

9. Modification of subparagraph 2.4.3.3.2.6.3 to comply with the modifications to 2.2.3.3.2.6.3.

10. Addition of a new subparagraph 2.2.5.1.44 entitled "**Version Number Data**" to be added on DO-260 page 134.

11. Addition of a corresponding new subparagraph 2.4.5.1.44 entitled "**Verification of the Version Number Data (subparagraph 2.2.5.1.44)**" on DO-260 page 450.

12. Addition of the Version Number as Item #17 in the definition of Mode Status Data Elements in Table 2-70, DO-260 page 166, and adjustment of the number of total bytes of the MS to accommodate the size of the Version Number.

13. Addition of the Version Number "Presence Bit" in Table 2-71a, DO-260 page 168, in the position of Byte 2, Bit 4, with size of one (1) Byte, as defined in Table 2-70 above.

14. Addition of a new subparagraph 2.2.8.2.17 entitled "**Version Number**" on DO-260 page 176, with supporting text defining the Version Number in the Mode Status.

15. Addition of a corresponding new subparagraph 2.4.8.2.17 entitled "**Verification of Version Number Reporting (subparagraph 2.2.8.2.17)**" on DO-260 page 557.

16. Addition of a new subparagraph A.4.11.11 entitled "**Version Number (VN)**" on DO-260 page A-28, as originally defined in 1090-WP-3-01A, except as specified for a Version Number subfield of only 3 bits, as agreed to in Meeting #6.

17. Modification of Figure A-12 to include the 3-bit Version Number.

The remainder of this Working Paper attaches copies of the proposed changes to those subparagraphs identified above.

Table 2-52: "ENGINE OUT" Subfield Encoding

Coding (binary)	Coding (decimal)	Meaning
00	0	No "Engine Out" Information available
01	1	Aircraft IS NOT experiencing an "Engine Out" condition
10	2	Aircraft IS experiencing an "Engine Out" condition
11	3	This Coding IS NOT Used

2.2.3.2.7.2.9 "NOT ASSIGNED" Subfield in Aircraft Operational Coordination Messages

The "NOT ASSIGNED" subfield is a 9-bit ("ME" bit 48 through 56, Message bit 80 through 88) field that remains Unassigned and may be used for future growth.

2.2.3.2.7.3 "AIRCRAFT OPERATIONAL STATUS" Messages

The "Aircraft Operational Status" is used to provide the current status of the aircraft. Format of the message is provided in Figure 2-10, while further definition of each of the subfields is provided in the subsequent paragraphs.

"AIRCRAFT OPERATIONAL STATUS" MESSAGE "ME" FIELD													
MSG BIT #	33--37	38 ------ 40	41 ---------- 56				57 ---------- 72				73 --- 75	76 ---------- 88	
			41--44	45--48	49--52	53--56	57--60	61--64	65--68	69--72			
"ME" BIT #	1 --- 5	6 --------- 8	9 ---------- 24				25 ---------- 40				41 --- 43	44 ---------- 56	
			9 -- 12	13--16	17--20	21--24	25--28	29--32	33--36	37--40			
FIELD NAME	TYPE =31 [5]	SUBTYPE [3]	CAPABILITY CLASS [16]				OPERATIONAL MODE [16]				Version Number [3]	NOT ASSIGNED [13]	
			CC_4 [4]	CC_3 [4]	CC_2 [4]	CC_1 [4]	OM_4 [4]	OM_3 [4]	OM_2 [4]	OM_1 [4]			
	MSB LSB	MSB --- LSB	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 indicates the number of bits in the field.*

Figure 2-10: "Aircraft Operational Status" ADS-B Event - Driven Message Format

2.2.3.2.7.3.1 "TYPE" Subfield in Aircraft Operational Status Messages

The "TYPE" subfield was previously defined for the Airborne Position Message in subparagraph 2.2.3.2.3.1 and remains the same for the Aircraft Operational Status ADS-B Event - Driven Message which uses Type Code 31.

2.2.3.2.7.3.2 "SUBTYPE" Subfield in Aircraft Operational Status Messages

The "SUBTYPE" subfield is a 3-bit ("ME" bits 6 through 8, Message bits 38 through 40) used to indicate various types of Aircraft Operational Status messages defined in Table 2-53.

Table 2-61: "OM_1" Encoding (Surface Operational Capability Status)

0M_1 CODING		MEANING
Bit 37, 38	**Bit 39, 40**	
0 0	0 0	*TBD*
	0 1	*TBD*
	1 0	*TBD*
	1 1	*TBD*
0 1	0 0	*TBD*
	0 1	*TBD*
	1 0	*TBD*
	1 1	*TBD*
1 0	0 0	*TBD*
	0 1	*TBD*
	1 0	*TBD*
	1 1	*TBD*
1 1	0 0	*TBD*
	0 1	*TBD*
	1 0	*TBD*
	1 1	*TBD*

2.2.3.2.7.3.5 ~~2.2.3.2.7.3.5~~ Version Number Subfield in Aircraft Operational Status Message

The "Version Number" subfield is a ~~3~~-bit ("ME" bits 41 through 43, Message bits 73 through 75) field used to indicate the Version Number of the formats and protocols in use on the aircraft installation. Encoding of the Version Number subfield shall be as shown in Table A-21.

2.2.3.2.7.3.6 "NOT ASSIGNED" Subfield in Aircraft Operational Status Message

The "NOT ASSIGNED" subfield is a ~~16~~13-bit ("ME" bits ~~41~~ 44 through 56, Message bits ~~73~~ 76 through 88) field reserved for future application.

2.2.3.2.7.4 RESERVED TYPE "23" ADS-B Event - Driven Messages for "TEST"

TYPE "23" ADS-B Message are Reserved Exclusively for Test Purposes.

2.2.3.2.7.5 RESERVED TYPE "24" ADS-B Event - Driven Messages for Surface System Status

TYPE "24" ADS-B Messages are Reserved for Surface System Status.

2.2.3.2.7.6 RESERVED TYPE "25" ADS-B Event - Driven Messages

TYPE "25" ADS-B Messages are Reserved for Future Expansion.

2.2.3.2.7.7 RESERVED TYPE "26" ADS-B Event - Driven Messages

TYPE "26" ADS-B Messages are Reserved for Future Expansion.

Note: *Pending further study and analysis of surface broadcast rates and their triggering mechanisms by regulatory authorities, it is widely assumed that the "Low" rate will be raised to a nominal rate approaching once per second.*

d. In the event that the transmission device cannot determine the required transmission rate, then the "High" rate shall be used as the default transmission rate.

e. Exceptions to these transmission rate requirements are defined in subparagraph 2.2.3.3.2.9.

2.2.3.3.2.4 ADS-B Aircraft Identification and Type Message Broadcast Rate

a. Once started, ADS-B Aircraft Identification and Type Messages shall be broadcast by the transmission device at random intervals that are uniformly distributed over the range of 4.8 to 5.2 seconds relative to the previous Identification and Type Message, when the ADS-B transmitting device is reporting the Airborne Position Message, or when reporting the Surface Position Message at the high rate.

b. When the Surface Position Message is being reported at the low surface rate, then the Aircraft Identification and Type Message shall be broadcast at random intervals that are uniformly distributed over the range of 9.8 to 10.2 seconds relative to the previous Identification and Type Message.

c. When neither the Airborne Position Message nor the Surface Position Message is being transmitted, then the Aircraft Identification and Type Message shall be broadcast at the rate specified in subparagraph a.

d. Exceptions to these transmission rate requirements are defined in subparagraph 2.2.3.3.2.9.

2.2.3.3.2.5 ADS-B Velocity Information Message Broadcast Rate

a. Once started, ADS-B Velocity Information Messages shall be broadcast by the transmission device at random intervals that are uniformly distributed over the range of 0.4 to 0.6 seconds relative to the previous Velocity Information Message.

b. Exceptions to these transmission rate requirements are defined in subparagraph 2.2.3.3.2.9.

2.2.3.3.2.6 ADS-B Trajectory Intent, Operational Coordination, and Status Message Broadcast Rates

2.2.3.3.2.6.1 ADS-B Aircraft Trajectory Intent Message Broadcast Rates

a. The Aircraft Trajectory Intent Message(s) (subparagraph 2.2.3.2.7.1) shall be initiated only when either TCP (or TCP+1) Latitude, TCP (or TCP+1) Longitude, TCP (or TCP+1) Altitude, or TCP (or TCP+1) TTG is available and valid as a minimum.

b. ~~b.~~ The Aircraft Trajectory Intent Message shall be broadcast at random intervals that are uniformly distributed over the range of 1.6 to 1.8 seconds relative to the

previous Aircraft Trajectory Intent Message for as long as data is available to satisfy the requirements of subparagraph "a." above.

c. Aircraft Trajectory Intent Message(s) shall not be transmitted during the high-rate transmission of the Aircraft Operational Status Messages as defined in subparagraph 2.2.3.3.2.6.3.

~~c~~d. Exceptions to these transmission rate requirements are defined in subparagraph 2.2.3.3.2.9.

Note: *The ADS-B system must be capable of processing TCP and TCP+1 Trajectory Intent Messages that are independent each other. That is, that one message is used to transfer of Current TCP information while the other message is used to transfer Next TCP (TCP+1) information. Likewise, the broadcast rates for each of the two messages shall be independent.*

2.2.3.3.2.6.2 ADS-B Aircraft Operational Coordination Message Broadcast Rates

a. The Aircraft Operational Coordination Message(s) (subparagraph 2.2.3.2.7.2) shall be initiated only when either Paired Address, Runway Threshold Speed, Roll Angle, Go Around, or Engine Out data is available and valid as a minimum.

b. Once initiated, or if the message data content changes, the Aircraft Operational Coordination Message shall be broadcast at random intervals that are uniformly distributed over the range of 1.9 to 2.1 seconds relative to the previous Aircraft Operational Coordination Message for a period of 30 +/- 1 seconds, assuming no additional change in data content occurred during this period. If data does change, the timer is reset, and the content is updated and sent for 30 +/- 1 seconds.

c. After the initial broadcast period defined in subparagraph b. above, expires, the Aircraft Operational Coordination Message shall be broadcast at random intervals that are uniformly distributed over the range of 4.8 to 5.2 seconds relative to the previous Aircraft Operational Coordination Message for as long as data is available to satisfy the requirements of subparagraph "a." above.

d. Exceptions to these transmission rate requirements are defined in subparagraph 2.2.3.3.2.9.

2.2.3.3.2.6.3 ADS-B Aircraft Operational Status Message Broadcast Rates

a. The Aircraft Operational Status Message (subparagraph 2.2.3.2.7.3) shall be broadcast at random intervals that are uniformly distributed over the range of 1.6 to 1.8 seconds relative to the previous Aircraft Operational Status Message. ~~initiated only when either Capability Class or Operational Mode data is available and valid as a minimum.~~

b. In the event that the values of NIC or NAC or SIL decrease, then the Aircraft Operational Status Message shall be broadcast at random intervals that are uniformly distributed over the range of 0.5 to 0.7 seconds relative to the previous Aircraft Operational Status Message, for a period of [12] seconds. During this [12] second period, the Aircraft Trajectory Intent Message(s) shall not be transmitted.~~The Aircraft Operational Status Message shall be broadcast at random intervals that are~~

~~uniformly distributed over the range of 1.6 to 1.8 seconds relative to the previous Aircraft Operational Status Message for as long as data is available to satisfy the requirements of subparagraph "a." above.~~

c. Exceptions to these transmission rate requirements are defined in subparagraph 2.2.3.3.2.9.

2.2.3.3.2.6.4 "Extended Squitter Aircraft Status" ADS-B Event - Driven Message Broadcast Rate

The "Extended Squitter Aircraft Status" (Type 28), "Emergency/Priority Status" ADS-B Event - Driven Message (Subtype =1) shall be broadcast at random intervals that are uniformly distributed over the range of 0.8 to 1.2 seconds relative to the previous Emergency/Priority Status Message for the duration of the emergency condition established in accordance with Appendix A~~.~~, Figure A~~.8~~-9, Note 2. The delay conditions specified in 2.2.3.3.2.9 shall be observed.

2.2.3.3.2.7 "TYPE 23 (TEST)" ADS-B Event - Driven Message Broadcast Rate

The "TEST" ADS-B Event - Driven Messages shall be broadcast ***NOT MORE Than*** ONCE each time the Event Driven Test Information is updated to the ADS-B transmission device. The delay conditions specified in 2.2.3.3.2.9 shall be observed.

2.2.3.3.2.8 "TYPE 24 - 27" ADS-B Event - Driven Message Broadcast Rate

In general, TYPE 24 - 27 ADS-B Event - Driven Messages shall be broadcast ONCE each time the Event Driven TYPE 24 - 27 Information is updated to the ADS-B transmission device. The delay conditions specified in 2.2.3.3.2.9 shall be observed.

2.2.3.3.2.9 ADS-B Message Transmission Rate Exceptions

ADS-B Message transmissions shall be delayed under the following conditions:

a. The scheduled message transmission shall be delayed if another ADS-B or Extended Squitter transmission is in process; or

b. The scheduled message transmission shall be delayed if a Mutual Suppression interface is active.

2.2.3.3.2.10 Maximum ADS-B Message Transmission Rates

a. The maximum ADS-B message transmission rate of non-transponder ADS-B transmitter implementations shall not exceed 6.2 transmitted messages per second.

b. If the Event-Driven message transmission rate must be reduced in order not to exceed the maximum rate specified in section 2.2.3.3.2, then transmission priority shall be assigned as follows:

(1). If the Emergency/Priority Status message (2.2.3.3.2.6.4) is active, it shall continue to be transmitted at the specified once per second rate and other Event-Driven messages shall be allocated equal priority for the remaining capacity.

2.2.5.1.40 Operational Mode (Terminal Area) Data

The ADS-B transmitting device shall accept own vehicle Terminal Area Operational Mode information via an appropriate variable data input interface and use such data to establish the "Operational Mode_3 (OM_3)" subfield in the Aircraft Status Messages (see subparagraph 2.2.3.2.7.3) as specified in subparagraph 2.2.3.2.7.3.4.2.

If appropriate Terminal Area Operational Mode data is not available to the ADS-B transmission device, then the device shall set the "Operational Mode_3 (OM_3)" subfield specified in subparagraph 2.2.3.2.7.3.4.2 to ZERO.

2.2.5.1.41 Operational Mode (Approach/Landing) Data

The ADS-B transmitting device shall accept own vehicle Approach/Landing Operational Mode information via an appropriate variable data input interface and use such data to establish the "Operational Mode_2 (OM_2)" subfield in the Aircraft Status Messages (see subparagraph 2.2.3.2.7.3) as specified in subparagraph 2.2.3.2.7.3.4.3.

If appropriate Approach/Landing Operational Mode data is not available to the ADS-B transmission device, then the device shall set the "Operational Mode_2 (OM_2)" subfield specified in subparagraph 2.2.3.2.7.3.4.3 to ZERO.

2.2.5.1.42 Operational Mode (Surface) Data

The ADS-B transmitting device shall accept own vehicle Surface Operational Mode information via an appropriate variable data input interface and use such data to establish the "Operational Mode_1 (OM_1)" subfield in the Aircraft Status Messages (see subparagraph 2.2.3.2.7.3) as specified in subparagraph 2.2.3.2.7.3.4.4.

If appropriate Surface Operational Mode data is not available to the ADS-B transmission device, then the device shall set the "Operational Mode_1 (OM_1)" subfield specified in subparagraph 2.2.3.2.7.3.4.4 to ZERO.

2.2.5.1.43 Radio Altitude Data

The ADS-B transmitting device shall accept Radio Altitude via an appropriate variable data input interface and use such data to establish the "Air/Ground" state and thereby the "CA" field as provided in subparagraph 2.2.3.2.1.1.2.

2.2.5.1.44 Version Number Data

The ADS-B transmitting device shall accept the Version Number via an appropriate variable data input interface and use such data to establish the "Version Number (VN)" subfield in the Aircraft Operational Status Message (see subparagraph 2.2.3.2.7.3) as specified in subparagraph 2.2.3.2.7.3.5.

If appropriate Version Number data is not available to the ADS-B transmission device, then the device shall set the "Version Number" subfield specified in subparagraph 2.2.3.2.7.3.5 to ZERO.

Table 2-70: ADS-B Mode Status Data Elements - Source Data Mapping To Report Structure

	REPORT STRUCTURE		MESSAGE STRUCTURE RELEVANT			REPORT STRUCTURE RELEVANT					
Column #	1	2	3	4	5	6	7	8	9	10	11
Item #	**Parameter / Contents**	**Notes**	**Received Message Sources**	**"ME" Field Bits**	**Message Field Bits**	**# of Bits**	**Range**	**Resolution**	**Units**	**Data Structure**	**Data Byte #**
0a,0b	Report Type and Structure	5	Airborne Position - "DF"	N/A	1 - 5	24	N/A	N/A	discrete	MddL dddd dddddddL dddddddL	0 - 2
0c	Validity Flags		Not Applicable			8	See Section 2.2.8.2.1.2			dddddddd	3
1	Participant Address	3	Airborne Position - "AA" Surface Position - "AA"	N/A N/A	9 - 32 9 - 32	24	N/A	N/A	discrete	Mddddddd ddddddd dddddddL	4 - 6
2	Call Sign (up to 8 alpha-number characters)	3	Aircraft Identification - "Ident. Char"	9 - 56	41 - 88	64	See Section 2.2.8.2.2			0MdddddL 0MdddddL 0MdddddL 0MdddddL 0MdddddL 0MdddddL 0MdddddL 0MdddddL	7 - 14
3	Participant Category	3	Aircraft Identification	1 - 5 6 - 8	33 - 37 38 - 40	8	See Section 2.2.8.2.3			MddddddL	15
4	Emergency / Priority Status	3	Aircraft Status (Emergency)	9 - 11	41 - 43	8	See Section 2.2.8.2.4			xxxx xMdL	16
5	TCP Latitude		Aircraft Trajectory Intent	13 - 26	45 - 58	24	+/- 180	0.0003433	degrees	SMddddddd ddddddd dddd0000	17 - 19
6	TCP Longitude		Aircraft Trajectory Intent	27-40	59 - 72	24	+/- 180	0.0003433	degrees	SMddddddd ddddddd dddd0000	20 - 22
7	TCP Altitude		Aircraft Trajectory Intent	41-50	73 - 82	16	+/- 131,072	4.0	feet	SMddddddd ddddddL	23 - 24
8	TCP Time to Go (TTG)		Aircraft Trajectory Intent	51-56	83 - 88	8	See Section 2.2.8.2.8			00MddddL	25
9	Operational Mode Specific Data		Aircraft Operational Status	9 - 24	41 - 56	16	See Section 2.2.8.2.9			MddL MddL MddL MddL	26 - 27
10	Flight Mode Specific Data		Aircraft Operational Status	25 - 40	57 - 72	16	See Section 2.2.8.2.10			MddL MddL MddL MddL	28 - 29
11	Paired Address		Aircraft Operational Coordination	9 - 32	41 - 64	24	See Section 2.2.8.2.11			Mddddddd ddddddd ddddddL	30 - 32
12	Runway Threshold Speed		Aircraft Operational Coordination	33 - 37	65 - 69	8	See Section 2.2.8.2.12			xxxM dddL	33
13	Roll Angle		Aircraft Operational Coordination	38 - 43	70 - 75	8	See Section 2.2.8.2.13			xxSM dddL	34
14	Discrete (Go Around, Engine Out)		Aircraft Operational Coordination	44 - 47	76 - 79	8	See Section 2.2.8.2.14			xxxx MLML	35
15	Current Trajectory Point / Leg Type		Aircraft Trajectory Intent	7 - 10	39 - 42	8	See Section 2.2.8.2.15			xxxx MddL	36
16	Report Time of Applicability		Aircraft Position Surface Position	21 21	53 53	16	511.9921875	0.0078125 (1/128)	seconds	Mddddddd ddddddL	37 - 38
17	Version Number		Aircraft Operational Status	41 – 43	73 – 75	3	See Section 2.2.3.2.7.3.5			MdL	39
	TOTAL:									**BYTES:**	**40~~39~~**

Notes:

1. *In the "Data Structure" column (i.e., column 10), "S" indicates the "sign-bit," "M" indicates the Most Significant Bit of the data field, "d" indicates data bits in the field, "L" indicates the Least Significant Bit of the data field, and "x" indicates "Don't Care" bits in the data field.*

2. *If data is not available to support a particular fields, then the entire data field shall be set to ALL ZEROs if the field is delivered to the application.*

3. *Items annotated with this note comprise the Partial Mode Status Report.*

4. *Items annotated with Note 4 represent "Critical" State Vector items.*

5. *The Report Type and Structure Identifier is used to identify the type of ADS-B Report being generated and the data parameters provided in the report as defined in section 2.2.8.1.1.*

2.2.8.2.1 Mode Status Report Type and Structure Identification and Validity Flags

2.2.8.2.1.1 Mode Status Report Type and Structure Identification

The Report Type requirements were previously provided in subparagraph 2.2.8.1.1. Report Type formats and the maximum number of bytes to be contained in each report are identified in Table 2-70.

The Report Structure field is used to indicate the exact data parameters identified in Table 2-70 that are being provided in the Mode Status report and is intended to provide a methodology for the Report Assembly Function to structure shorter reports when data for some parameters is not available. In order to provide the capability to provide shorter Mode Status reports the following basic conventions shall be adhered to:

a. Any given data parameter to be used in the report shall use the designated number of bytes and format as designated in Table 2-70.

b. Parameters that are designated in Table 2-70 are restricted to byte boundaries.

c. Whenever a data parameter identified in Table 2-70 is not provided in the report, then it is permissible to concatenate the next parameter to be included into the report immediately following the inclusion of the previous reported parameter.

d. Each parameter of the Mode Status report identified in Table 2-70 must be properly declared in the Report Structure field as detailed in the following paragraphs and Table 2-71a.

Note: *Implementation of the methodology just provided is realizable and controllable due to the fact that the exact length of each report parameter is defined in Table 2-70 and the Report Structure field identifies exactly which parameters are included in the report. Therefore, the report user can easily re-construct the length and general format of the report.*

The Report Structure is a 20-bit field and shall be provided in the least significant nibble (i.e., bits 3 - 0) of the first byte (i.e., byte "0") and continuing into bytes 1 and 2 of the Report. The Report Structure format is defined in Table 2-71a where each bit is associated with a particular data parameter of the Mode Status Report. If the bit is set to "1," then the data parameter is considered to be available and shall be transmitted in the report. Otherwise, the data parameter is considered to not be available and shall not be transmitted in the report. Note that Table 2-71a does not address the Report Type and Structure Identification parameter, the Validity Flags parameter, nor the Participant Address parameter **since it is mandatory that these three parameters shall be included in the Mode Status Report.**

Table 2-71a: ADS-B Mode Status Report Structure Coding

Byte #	Bit #	Mode Status Data Parameter to be Reported	Number of Bytes	Notes
0	3	Call Sign (Up to 8 Alpha-numeric characters)	6	
	2	Participant Category	1	
	1	Emergency / Priority Status	1	
	0	Trajectory Change Point (TCP) Latitude	3	
1	7	Trajectory Change Point (TCP) Longitude	3	
	6	TCP Altitude (Baro Alt / FL)	3	
	5	TimetoGo (TTG) / TCP Type	2	
	4	Operational Mode Specific Data	2	
	3	Flight Mode Specific Data	1	
	2	Paired Address Data	3	
	1	Runway Threshold Speed	1	
	0	Roll Angle	1	
2	7	Discrete (Go Around, Engine Out)	1	
	6	Current Trajectory Point / Leg Type	1	
	5	Report Time of Applicability	2	
	4	Version Number	1	
	3	Reserved for Future Growth		
	2			
	1			
	0			

2.2.8.2.1.2 Mode Status Report Validity Flags

Validity Flags for data provided in the Mode Status Report shall be indicated in byte #3 of the Mode Status Report as shown for item "0c" in Table 2-70. The Mode Status Report elements that require validity flags are identified in Table 2-71b. Table 2-71b identifies the byte and bit that shall be used as a flag for each element that requires a validity flag. Each validity flag bit shall be set to "1" to indicate that the corresponding Mode Status Report Element data is valid. If such data is not valid, then the corresponding validity flag bit shall be set to "0."

b. Report Time of Applicability data shall be provided in the Mode Status report in binary format as defined in Table 2-70.

2.2.8.2.17 Version Number

a. The ADS-B Report Assembly Function shall extract the Version Number data (subparagraph 2.2.3.2.7.3.5) from the ADS-B Aircraft Operational Status Message and provide the Version Number to the user application in the Mode Status Report in the binary format defined in Table 2-70.

b. When a valid Version Number is not available, the Version Number sent to the user application shall be set to ALL ZEROs.

2.2.8.3 ADS-B TCP + 1 Report Characteristics

Table 2-73 and the subsequent subparagraphs identify the data structure for all ADS-B TCP + 1 Reports.

The intent of Table 2-73 is to illustrate the structure of all Items required to be reported in an ADS-B TCP + 1 Report. The exact structure of the data indicated in columns 10 and 11 is provided as a guide line or one possible method of satisfying the report structure. Implementers may choose to organize the data in another format; however, delivery to a user interface or application of all Items in Table 2-73 shall be consistent with the range, resolution, and units indicated in column 7, 8 and 9 of Table 2-73 respectively. Those requirements in subparagraphs 2.2.8.3.1 to 2.2.8.3.7 below that relate to specific data structure details (byte numbers, and bit numbers within the bytes) shall only apply to equipment that uses the sample data structure shown in columns 10-11 of Table 2-73.

Note: *Table 2-73 is structured such that column 1, 2, and 6 through 11, pertain to the On - Condition Report elements and how such elements should be structured into the report. Columns 3 through 5 provide information on where the appropriate data can be located in the ADS-B Messages for each of the Report elements.*

2.4.3.2.7.3.4.3 Verification of "OM_2" Subfield in Aircraft Operational Status Message (subparagraph 2.2.3.2.7.3.4.3, 2.2.5.1.41)

Purpose/Introduction:

The "OM_2" subfield is a 4-bit field (Message Bits 65 through 68, ME Bits 33 through 36) used to indicate the status of Approach and Landing Operational Capabilities of the ADS-B transmitting system to other aircraft.

Measurement Procedure:

The meanings of each of the Operational Mode subfields have yet to be defined. Once such meanings are defined, appropriate test procedures will be added to this document in order to verify the settings of the Operational Mode subfields.

2.4.3.2.7.3.4.4 Verification of "OM_1" Subfield in Aircraft Operational Status Message (subparagraph 2.2.3.2.7.3.4.4, 2.2.5.1.42)

Purpose/Introduction:

The "OM_1" subfield is a 4-bit field (Message Bits 69 through 72, ME Bits 37 through 40) used to indicate the status of Surface Operational Capabilities of the ADS-B transmitting system to other aircraft.

Measurement Procedure:

The meanings of each of the Operational Mode subfields have yet to be defined. Once such meanings are defined, appropriate test procedures will be added to this document in order to verify the settings of the Operational Mode subfields.

2.4.3.2.7.3.5 ~~2.4.3.2.7.3.5~~ Verification of "Version Number" Subfield in Aircraft Operational Status Message (subparagraph 2.2.3.2.7.3.5)

Purpose/Introduction:

The "Version Number" subfield is a 3-bit field (Message Bits 73 through 75, ME Bits 41 through 43) used to indicate the Version Number of the formats and protocols in use on the aircraft installation.

Measurement Procedure:

Configure the ADS-B Transmitting System to transmit Aircraft Operational Status Messages at the nominal rate (see 2.2.3.3.2.6.3). Verify that the unit under test was built in conformance with RTCA DO-260A. Verify that the "Version Number" subfield in the Aircraft Operational Status Message is correctly set to binary 001 in Message Bits 73 through 75.

Discontinue the input of the Version Number data and verify that the "Version Number" subfield in the Aircraft Operation Status Message is correctly set to ALL ZEROs (binary 000) in Message Bits 73 through 75.

2.4.3.2.7.3.6 Verification of "NOT ASSIGNED" Subfield in Aircraft Operational Status Message (subparagraph 2.2.3.2.7.3.~~5~~6)

No specific test procedure is required to validate subparagraph 2.2.3.2.7.3.~~5~~6.

2.4.3.2.7.4 Verification of RESERVED TYPE "23" ADS-B Event - Driven Messages for "TEST" (subparagraph 2.2.3.2.7.4)

No specific test procedure is required to validate subparagraph 2.2.3.2.7.4.

2.4.3.2.7.5 Verification of RESERVED TYPE "24" ADS-B Event - Driven Messages (subparagraph 2.2.3.2.7.5)

No specific test procedure is required to validate subparagraph 2.2.3.2.7.5.

2.4.3.2.7.6 Verification of RESERVED TYPE "25" ADS-B Event - Driven Messages (subparagraph 2.2.3.2.7.6)

No specific test procedure is required to validate subparagraph 2.2.3.2.7.6.

2.4.3.2.7.7 Verification of RESERVED TYPE "26" ADS-B Event - Driven Messages (subparagraph 2.2.4.3.2.7.7)

No specific test procedure is required to validate subparagraph 2.2.3.2.7.7.

2.4.3.2.7.8 Verification of RESERVED TYPE "27" ADS-B Event - Driven Messages (subparagraph 2.2.3.2.7.8)

No specific test procedure is required to validate subparagraph 2.2.3.2.7.7.

2.4.3.2.7.9 Verification of Extended Squitter Aircraft Status Messages (TYPE "28") (subparagraph 2.2.3.2.7.9)

Purpose/Introduction:

The Extended Squitter Aircraft Status Message (TYPE "28") is used to provide additional information regarding aircraft status. Subtype "1" is used specifically to provide Emergency / Priority status.

Specific formatting of the TYPE "28," Subtype "1" is provided in Appendix A, Figure A-9.

Measurement Procedure:

Configure the ADS-B Transmitting System to transmit Airborne Position Messages. Set the ADS-B Transmitting System to Airborne status. Produce valid Airborne Position Messages at the nominal rate with valid position and altitude data with the Surveillance Status Subfield set to ONE (binary 01) to signify an emergency condition.

Verify that the ADS-B Transmitting System begins to transmit Extended Squitter Aircraft Status Messages at the nominal rate with the TYPE Subfield set to 28 (binary 1 1100) and the SUBTYPE Subfield set to ONE (binary 001).

2.4.3.3.2.6.1 Verification of ADS-B Aircraft Trajectory Intent Message Broadcast Rates (subparagraph 2.2.3.3.2.6.1)

Equipment Required:

Provide a Method of loading valid data for ADS-B broadcast messages into the ADS-B equipment under test.

Provide a method of detecting the RF pulses of the ADS-B Broadcast Message for display on an oscilloscope.

Measurement Procedure:

Step 1: Initialization (subparagraph 2.2.3.3.2.6.1.a and b)

Ensure that no Trajectory Intent data is available. Verify that no Trajectory intent message is output for a period of 20 seconds. Inject the appropriate valid ADS-B Trajectory Intent data and verify that the ADS-B Trajectory Intent message is broadcast at intervals that are distributed over the range of 1.6 to 1.8 seconds as specified in subparagraph 2.2.3.3.2.6.1.b for as long and data is available.

Repeat the procedure for each Trajectory Intent message independently as necessary.

Step 2: Data Ceases to be Updated (Subparagraph 2.2.3.3.2.11)

Establish the broadcast of the ADS-B Trajectory Intent message as in Step 1 above. Then stop the input of data for the ADS-B Trajectory Intent message.

Verify that the ADS-B Trajectory Intent message continues to be broadcast with the same data that existed prior to stopping the data input for up to 60 +/- 1 second after stopping the data input.

Verify that the ADS-B Trajectory Intent message is no longer broadcast 60 +/- 1 seconds after stopping the data input.

Repeat the procedure for each Trajectory Intent message independently as necessary.

Step 3: Termination of Aircraft Trajectory Intent Message(s) while transmitting high-rate Aircraft Operational Status Messages (subparagraph 2.2.3.3.2.6.1.c)

Establish the broadcast of the ADS-B Trajectory Intent Message as in Step 1 above. Alter input data to cause the Aircraft Operational Status Message to be broadcast at the high-rate as defined in subparagraph 2.2.3.3.2.6.3.b. Verify that the Aircraft Trajectory Intent Message is not being transmitted during the period of high-rate transmission of the Aircraft Operational Status Message.

2.4.3.3.2.6.2 Verification of ADS-B Aircraft Operational Coordination Message Broadcast Rates (subparagraph 2.2.3.3.2.6.2)

Equipment Required:

Provide a method of loading valid data for ADS-B broadcast messages into the ADS-B equipment under test.

Provide a method of detecting the RF pulses of the ADS-B Broadcast Message for display on an oscilloscope.

Measurement Procedure:

Step 1: Initialization (subparagraph 2.2.3.3.2.6.2.a and b)

Ensure that no Aircraft Operational Coordination data is available. Verify that no Operational Coordination message is output for a period of 20 seconds. Inject the appropriate valid ADS-B Operational Coordination data. Verify that the ADS-B Aircraft Operational Coordination message is broadcast at intervals that are distributed over the range of 1.9 to 2.1 seconds as specified in subparagraph 2.2.3.3.2.6.2.b for a period of 30 +/- 1 seconds.

Step 2: Steady State (Subparagraph 2.2.3.3.2.6.2.c)

Initialize the equipment as in Step 1 above and when a time of 19 seconds has elapsed, verify that the ADS-B Aircraft Operational Coordination message is broadcast at intervals that are distributed over the range of 4.8 to 5.2 seconds as specified in subparagraph 2.2.3.3.2.6.1.c.

Step 3: Changed Data (subparagraph 2.2.3.3.2.6.2.b)

With the equipment in the steady state as in Step 2 above, change the Operational Coordination data. Verify that the ADS-B Aircraft Operational Coordination message is broadcast at intervals that are distributed over the range of 1.9 to 2.1 seconds as specified in subparagraph 2.2.3.3.2.6.2.b for a period of 30 +/- 1 seconds. Also verify that the steady state ADS-B Aircraft Operational Coordination message is broadcast at random intervals that are uniformly distributed over the range of 4.8 to 5.2 seconds as specified in subparagraph 2.2.3.3.2.6.2.c, 31 seconds after the data change. Repeat Step 3 ten times verifying correct operation for each change of data.

Step 4: Data Ceases to be Updated (Subparagraph 2.2.3.3.2.11)

Establish the broadcast of the ADS-B Operational Coordination message as in Step 1 above. Then stop the input of data for the ADS-B Operational Coordination message.

Verify that the ADS-B Operational Coordination message continues to be broadcast with the same data that existed prior to stopping the data input for up to 60 +/- 1 second after stopping the data input.

Verify that the ADS-B Operational Coordination message is no longer broadcast 60 +/- 1 seconds after stopping the data input.

2.4.3.3.2.6.3 Verification of ADS-B Aircraft Operational Status Message Broadcast Rates (subparagraph 2.2.3.3.2.6.3)

Equipment Required:

Provide a method of loading valid data for ADS-B broadcast messages into the ADS-B equipment under test.

Provide a method of detecting the RF pulses of the ADS-B Broadcast Message for display on an oscilloscope.

Measurement Procedure:

Step 1: Initialization (subparagraph 2.2.3.3.2.6.3.a ~~and b~~)

Ensure that ~~no Aircraft Operational Status data is available. Verify that no Aircraft Operational Status message is output for a period of 20 seconds. Inject the appropriate~~ valid ADS-B Aircraft Operational Status data, including a valid Version Number, is available. Verify that the ADS-B Aircraft Operational Status message is broadcast at intervals that are distributed over the range of 1.6 to 1.8 seconds as specified in subparagraph 2.2.3.3.2.6.3.~~b~~ a. ~~for a period of 30 +/- 1 seconds.~~

Step 2: High-Rate Transmission (subparagraph 2.2.3.3.2.6.3.b)

Establish the broadcast of the ADS-B Aircraft Operational Status Message as in Step 1 above. Alter input data to cause the Aircraft Operational Status Message to be broadcast at the high-rate as defined in subparagraph 2.2.3.3.2.6.3.b. Verify that the Aircraft Operational Status Message is broadcast at random intervals that are uniformly distributed over the range of 0.5 to 0.7 seconds relative to the previous Aircraft Operational Status Message, for a period of [12] seconds. During this [12] second period, verify that the Aircraft Trajectory Intent Message is not being transmitted.

Step ~~2~~3: Data Ceases to be Updated (Subparagraph 2.2.3.3.2.11)

Establish the broadcast of the ADS-B Operational Status message as in Step 1 above. Then stop the input of data for the ADS-B Operational Status message.

Verify that the ADS-B Operational Status message ~~is no longer broadcast 60 +/- 1 seconds after stopping the data input.~~continues to be broadcast at intervals that are distributed over the range of 1.6 to 1.8 seconds as specified in subparagraph 2.2.3.3.2.6.3.a.

2.4.5.1.44 Verification of the Version Number Data (subparagraph 2.2.5.1.44)

Appropriate test procedures to verify subparagraph 2.2.5.1.44 were previously provided in subparagraph 2.4.3.2.7.3.5.

2.4.5.2 Unused Section

2.4.5.3 ADS-B Transmission Device Message Latency (subparagraph 2.2.5.3)

No specific test procedure is required to validate subparagraph 2.2.5.3.

2.4.5.3.1 Verification of Airborne Position Message Latency (subparagraph 2.2.5.3.1)

Purpose/Introduction:

This test verifies the latency of the Airborne Position Message.

Step 1: Airborne Position Message - "Type" Subfield (subparagraph 2.2.3.2.3.1 and 2.2.5.3.1.a)

Purpose/Introduction:

Any change in the TYPE information identified in subparagraph 2.2.3.2.3.1 shall be reflected in the TYPE subfield of the next scheduled Airborne Position message transmission provided that the change occurs and is detected at least 100 milliseconds prior to the next scheduled Airborne Position message transmission.

Measurement Procedure:

Configure the ADS-B Transmitting System to transmit Airborne Position Messages by providing position information at the nominal update rate. Provide the data externally at the interface to the ADS-B system. Set the ADS-B Transmitting System to Airborne status. Provide valid non zero barometric pressure altitude data to the ADS-B System. Continue transmitting Airborne Position Messages at the nominal rate with all parameters unchanged. Verify that the TYPE subfield in the Airborne Position Message correctly matches the TYPE subfield value from the navigational accuracy depicted in Table 2-11.

Change input to the ADS-B System so as to affect the TYPE subfield value so that the change occurs and is detected at least 100 milliseconds prior to the next scheduled Airborne Position Message transmission. Verify that the TYPE subfield value has changed in the next transmitted Airborne Position Message and that it is the correct value.

Step 2: Airborne Position Message – "Surveillance Status" Subfield (subparagraph 2.2.3.2.3.2 and 2.2.5.3.1.b)

Purpose/Introduction:

Any change in the Surveillance Status identified in subparagraph 2.2.3.2.3.2 shall be reflected in the Surveillance Status subfield of the next scheduled Airborne

2.4.8.2.17 Verification of the Mode Status Report Version Number (subparagraph 2.2.8.2.17)

Purpose/Introduction:

The ADS-B Report Assembly Function must provide "Version Number" (see 2.2.3.2.7.3.5) data, when available, as received in the Aircraft Operational Status Messages (see 2.2.3.2.7.3), in the Mode Status Report. Otherwise, the Version Number must be assumed to be ZERO.

Measurement Procedure:

Step 1: Initialization

Provide valid ADS-B Aircraft Operational Status Messages to the ADS-B receiving system such that the ADS-B Report Assembly Function enters the Track State (see subparagraph 2.2.10.4) and is outputting Mode Status Reports to the Report Buffer.

Step 2: Verification of Version Number when Data is Not Available

Receive the resulting Mode Status Report from the Report Buffer. If the Version Number presence bit (Report Byte 2, bit 4) is set to ONE, and it has been verified that no Version Number data is actually available, then verify that the Version Number field (Report Byte 39 in the full Mode Status Report) is set to ALL ZEROs.

Step 3: Verification of Version Number

Provide a valid ADS-B Aircraft Operational Status Message to the ADS-B receiving system with the Version Number set as specified in Table A-21. Retrieve the resulting Mode Status Report from the Report Buffer. Verify that the Version Number presence bit (Report Byte 2, bit 4) is set to ONE. Verify that the Version Number field (Report Byte 39 in the full Mode Status Report) is set, bit for bit, to the same Version Number encoding provided to the receiver via the Aircraft Operational Status Message.

2.4.8.3 Verification of the ADS-B TCP + 1 Report Characteristics (subparagraph 2.2.8.3)

No specific test procedure is required to validate subparagraph 2.2.8.3.

2.4.8.3.1 Verification of the TCP + 1 Report Type and Structure Identification and Validity Flags (subparagraph 2.2.8.3.1)

Appropriate test procedures are provided in 2.4.8.3.1.1 and 2.4.-8.3.1.2

A.4.11.10 Surface Operational Capability Status (OM-1)

This 4-bit (37-40) subfield shall be used to indicate the surface operational capability status of the ADS-B transmitting system to other aircraft as specified by the following encoding shown in Table A-20.

Table A-20: Surface Operational Capability Status Encoding

OM-1 ENCODING: SURFACE OPERATIONAL CAPABILITY STATUS		
OM_1 CODING		
Bit 37, 38	Bit 39, 40	MEANING
0 0	**0 0**	*TBD*
	0 1	*TBD*
	1 0	*TBD*
	1 1	*TBD*
0 1	**0 0**	*TBD*
	0 1	*TBD*
	1 0	*TBD*
	1 1	*TBD*
1 0	**0 0**	*TBD*
	0 1	*TBD*
	1 0	*TBD*
	1 1	*TBD*
1 1	**0 0**	*TBD*
	0 1	*TBD*
	1 0	*TBD*
	1 1	*TBD*

A.4.11.11~~2~~ Version Number (VN)

This 3-bit (41-43) subfield shall be used to indicate the Version Number of the formats and protocols in use on the aircraft installation. Encoding of the subfield shall be as shown in Table A-21.

Table A-21: Version Number Encoding

VERSION NUMBER SUBFIELD	
Coding	Meaning
000	Conformant to DO-260
001	Conformant to DO-260A
010 – 111	Reserved

A.4.12 Additional Identification and Category Transmission

The aircraft identification and category squitter shall be formatted as specified in the definition of register 0,8.

Note: *It is automatically broadcast by the transponder or non-transponder device every 5 seconds as part of the basic ADS-B message broadcast.*

Figure A-12: Aircraft Operational Status

BDS 6,5

1	MSB
2	
3	FORMAT TYPE CODE = 31
4	
5	LSB
6	MSB
7	Subtype Code=0
8	LSB
9	MSB
10	Enroute Operational Capabilities (CC-4)
11	(See A.4.11.3)
12	LSB
13	MSB
14	Terminal Area Operational Capabilities(CC-3)
15	(See A.4.11.4)
16	LSB
17	MSB
18	Approach/ Landing Operational Capabilities (CC-2)
19	(See A.4.11.5)
20	LSB
21	MSB
22	Surface Operational Capabilities (CC-1)
23	(See A.4.11.6)
24	LSB
25	MSB
26	Enroute Operational Capability Status (OM –4)
27	(See A.4.11.7)
28	LSB
29	MSB
30	Terminal Area Operational Capability Status (OM-3)
31	(See A.4.11.8)
32	LSB
33	MSB
34	Approach/ Landing Operational Capability Status (OM-2)
35	(See A.4.11.9)
36	LSB
37	MSB
38	Surface Operational Capability Status (OM-1)
39	(See A.4.11.10)
40	LSB
41	MSB
42	Version Number (VN) (See A.4.11.11)
43	LSB
44	
45	
46	
47	Not Assigned
48	
49	
50	
51	
52	
53	
54	
55	
56	

Purpose. To provide the capability class and current operational mode of ATC related applications on board the aircraft.