Appendix N

Proposed DO-260B Provisions for Backward Compatibility with DO-260 and DO-260A

Message Formats

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N Proposed DO-260BA Provisions for Backward Compatibility with DO-260 and DO-260A Message Formats

N.1 Introduction

N.1.1 Purpose of this Appendix

This Appendix:

a) Defines the formats and coding for extended squitter ADS-B Messages that are broadcast by ADS-B Version Zero (0), RTCA DO-260 conformant 1090 MHz ADS-B Subsystems;

b) Defines the formats and coding for extended squitter ADS-B Messages that are broadcast by ADS-B Version One (1), RTCA DO-260A conformant 1090 MHz ADS-B Subsystems; and

cb) Defines how the ADS-B report generation function of Version TwoOne (21) 1090 MHz ADS-B Receiving Subsystems is to utilize messages received from targets that are broadcasting with either Version Zero (0) or Version One (1) message formats.

N.1.2 Message Version Number

The Version Number for all 1090 MHz ADS-B Messages originating for each specific ADS-B target is determined from the decoding of the Version Number subfield of the Aircraft Operational Status Message. An ADS-B Version One (21) Receiving Subsystem initially assumes that the messages conform to Version Zero (0) message formats, until or unless received Version Number data indicates otherwise. The Version Number is retained and associated with all messages from that specific target. This Version Number is used for determining the applicable message formats to be applied for the decoding of all 1090 MHz ADS-B Messages received from that target.

N.2 1090 MHz ADS-B 1090 MHz ADS-B Version 0 Message Processing

N.2.1 ADS-B Version 0 Message TypesMessage Types

Table N-1 provides those ADS-B Version Zero (0) (i.e., originating from a RTCA DO-260 conformant 1090 MHz ADS-B Transmitting Subsystem) 1090 MHz ADS-B Messages that are to be used for ADS-B report generation by a Version One Two (21) conformant 1090 MHz ADS-B Receiving Subsystem.

Note: *Table N-1 lists only those Version Zero (0) 1090 MHz ADS-B Message types that are required to be received and used for ADS-B report generation by a Version OneTwo (12) 1090 MHz ADS-B Receiving Subsystem. The other Version Zero (0) ADS-B Messages types defined by RTCA DO-260, including messages types 29 and 30, are not to be used by Version TwoOne (12) ADS-B Receiving Subsystems for the purpose of ADS-B report generation.*

Table N-1: Version Zero (0) ADS-B Message Types

Message Format TYPE Code(s)	Assignment	Nominal Broadcast Rate
1 through 4	Extended Squitter Identification and Category	5.0 s airborne/10.0 s surface
5 through 8	Extended Squitter Surface Position	0.5 s in motion/5.0 s stationary
9 through 18 and 20 through 22	Extended Squitter Airborne Position	0.5 s
19	Extended Squitter Airborne Velocity	0.5 s
28	Extended Squitter Aircraft Status (e.g., emergency/priority)	1.0 s
31	Aircraft Operational Status	1.7 s

~~N.2.1~~N.2.1.1 Message TYPE Codes

The first 5-bit field in every 1090 MHz ADS-B Message contains the message format TYPE. As shown in Table N-2, the TYPE code (i.e., format type) is used to differentiate the messages into several classes: airborne position, airborne velocity, surface position, identification, aircraft status, etc. The general definition for all ADS-B Messages Types used for Version Zero (0) ADS-B Messages has been retained for Version ~~One~~ Two (~~1~~2) messages. It must be noted for Version Zero (0) ADS-B Messages, format TYPE Code 29 was defined but the corresponding messages were not to be transmitted. For Version Zero (0) ADS-B Subsystems, TYPE code 29 was associated with intent messages conveying Trajectory Change Point (TCP) information. Although the message formats for TCP related messages were defined within RTCA DO-260 the requirements and the associated test procedures prohibited the broadcast of such messages. RTCA DO-260 defined TYPE Code 30 for Aircraft Operational Coordination Messages. The requirements and associated provisions for Aircraft Operational Coordination Messages have now been withdrawn by this version of these MOPS. Although RTCA DO-260 (i.e., Version 0) conformant implementations are not prohibited from transmitting Aircraft Operational Coordination Messages (i.e., using TYPE Code 30), Version Two~~One~~ (2~~1~~) conformant ADS-B Receiving Subsystems have no requirement for the reception and processing of these broadcasts. Version ~~One~~ Two (~~1~~2) ADS-B Receiving Subsystems will generate ADS-B reports based only on the reception of Version Zero (0) ADS-B Messages with ADS-B Message TYPE Code values of 0 through 22, 29 and 31.

Table N-2: Format TYPE Codes for Version 0 and Version 2~~1~~ Messages

TYPE Code	Version 0 Message Format	Version 2~~1~~ Message Format
0	No Position Information	No Position Information
1	Identification (Category Set D)	Identification (Category Set D)
2	Identification (Category Set C)	Identification (Category Set C)
3	Identification (Category Set B)	Identification (Category Set B)
4	Identification (Category Set A)	Identification (Category Set A)
5	Surface Position	Surface Position
6	Surface Position	Surface Position
7	Surface Position	Surface Position
8	Surface Position	Surface Position
9	Airborne Position	Airborne Position
10	Airborne Position	Airborne Position
11	Airborne Position	Airborne Position
12	Airborne Position	Airborne Position
13	Airborne Position	Airborne Position
14	Airborne Position	Airborne Position
15	Airborne Position	Airborne Position
16	Airborne Position	Airborne Position
17	Airborne Position	Airborne Position
18	Airborne Position	Airborne Position
19	Airborne Velocity	Airborne Velocity
20	Airborne Position	Airborne Position
21	Airborne Position	Airborne Position
22	Airborne Position	Airborne Position
23	Reserved for Test Purposes	Test Message
24	Reserved for Surface System Status	Reserved for Surface System Status
25	Reserved	Reserved
26	Reserved	Reserved
27	Reserved	Reserved for Trajectory Change
28	Extended Squitter Aircraft Status	Extended Squitter Aircraft Status
29	Reserved for Trajectory Intent	Target State and Status
30	Operational Coordination	Reserved
31	Operational Status	Operational Status

~~N.3~~N.2.2 State Vector Reports Generated using Version Zero (0) Messages

The following subparagraphs summarize the ADS-B State Vector Report generation requirements (see §2.2.8.1) for Version ~~One~~ Two (2~~1~~) systems when receiving Version Zero (0) ADS-B Messages.

The contents of State Vector Reports are specified in Table 2.2.8.1. The contents of the State Vector Reports are composed primarily from the information received from airborne aircraft in Airborne Position Messages and Airborne Velocity Messages or for aircraft/vehicles on the airport surface in Surface Position Messages. Many of the parameters contained within these messages are encoded the same, and occupy the same positions with the overall message structure, for both Version Zero (0) and for Version ~~One~~ Two (2~~1~~) messages. However, in a few cases the decoding and/or report assembly processing must be handled differently for Version Zero (0) messages as compared to that required by these MOPS (§2.2.8.1) for Version ~~One~~ Two (2~~1~~) messages. The following subparagraphs describe the required use of Version Zero (0) messages for ADS-B report generation by a Version ~~One~~ Two (~~1~~2) compliant ADS-B Receiving Subsystem.

~~N.3.1~~N.2.2.1 State Vector Report to 1090 MHz ADS-B Message Mapping

Table 2.2.8.1 specifies the overall State Vector Report format and the source for each parameter that is to be reported when the target aircraft/vehicle is broadcasting with Version ~~One~~ Two (~~1~~2) ADS-B Message formats. In a similar fashion, Table N-3 below defines the 1090 MHz ADS-B Message-to-State Vector Report mapping that will be used when the target aircraft/vehicle is broadcasting using Version Zero (0) ADS-B Messages. Note there are some minor differences in the specific names applied to certain otherwise identical Version Zero (0) versus Version Two (~~1~~2) messages subfields. The only new or changed State Vector Report parameter between RTCA DO-260 (i.e., Version 0) and these MOPS is ~~for~~ the Navigation Integrity Category (NIC) parameter, which has replaced Navigation Uncertainty Category (NUC) from the initial version of these MOPS. The following subparagraph discusses the NIC parameter and its mapping from Version Zero (0) messages to the State Vector Report. The remaining State Vector Report parameters are described in §2.2.8.1.

The format~~s~~ of the Version Zero (0) 1090 MHz ADS-B Messages are specified in Figure N-1 through Figure N-7.

Table N-3: ADS-B State Vector Data Elements – Version Zero (0) 1090 MHz ADS-B Messages to Report Structure Mapping

Column #	REPORT STRUCTURE		VERSION ZERO (0) MESSAGE STRUCTURE RELEVANT			REPORT STRUCTURE RELEVANT					
	1	2	3	4	5	6	7	8	9	10	11
Item #	Parameter / Contents	Notes	Received Message Structure	"ME" Field Bits	Message Field Bits	# of Bits	Range	Resolution	Units	Data Structure	Data Byte #
0a, 0b	Report Type and Structure Identification	4	Airborne Position - "DF"	N/A	1 – 5	24	N/A	N/A	discrete	MddL Mddd ddddddddd ddddddL	0 -2
0c	Validity Flags		N/A	N/A	N/A	16	N/A	N/A	discrete	ddddddddd ddddddddd	3 - 4
1	Participant Address	4	Airborne Position - "AA" Surface Position - "AA" Airborne Velocity – "AA"	N/A N/A N/A	9 - 32 9 – 32 9 - 32	24	N/A	N/A	discrete	Mddddddd ddddddddd DddddddL	5 - 7
2	Address Qualifier		N/A	N/A	N/A	8	N/A	N/A	discrete	00000M0L	8
3	Time of Applicability (Position and Velocity)	4	Airborne Position – "Time" Surface Position – "Time" Airborne Velocity	21 21 N/A	53 53 N/A	24	511.9921875	0.0078125 (1/128)	seconds	Mddddddd ddddddddL Mddddddd ddddddddL Mddddddd ddddddddL	9 - 11
4	Latitude (WGS-84)	4	Airborne Position – "Encoded Latitude" Surface Position – "Encoded Latitude"	23 - 39 23 - 39	55 - 71 55 – 71	24	+/- 180	0.0000215	degrees	SMddddddd ddddddddd DddddddL	12 - 14
5	Longitude (WGS-84)	4	Airborne Position – "Encoded Longitude" Surface Position – "Encoded Longitude"	40 - 56 40 - 56	72 - 88 72 – 88	24	+/- 180	0.0000215	degrees	SMddddddd ddddddddd DddddddL	15 - 17
6	Altitude, Geometric (WGS-84)	4, 5	Airborne Position – "TYPE", ***&*** "Altitude" Airborne Velocity – "Diff. Sign Bit" & "Geo Height Diff. from Baro. Alt."	1 - 5, ***&*** 9 - 20 49 50 - 56	33 - 37 41 – 52 81 82 - 88	24	+/- 131,072	0.015625	feet	SMddddddd ddddddddd ddddddddL	18 - 20
7	North / South Velocity	4, 5	Airborne Velocity – "Direction Bit for N-S Vel." & "N/S Velocity"	25 26 - 35	57 58 – 67	16	+/- 4,096	0.125	knots	SMddddddd ddddddddL	21 - 22
8	East / West Velocity	4, 5	Airborne Velocity – "Direction Bit E-W Vel." & "E/W Velocity"	14 15 - 24	46 47 – 56	16	+/- 4,096	0.125	knots	SMddddddd ddddddddL	23 - 24
9	Ground Speed while on the Surface	4, 6	Surface Position – "Movement"	6 - 12	38 – 44	8	N/A	N/A	discrete	MddddddL	25

Column #	REPORT STRUCTURE		VERSION ZERO (0) MESSAGE STRUCTURE RELEVANT			REPORT STRUCTURE RELEVANT					
	1	2	3	4	5	6	7	8	9	10	11
Item #	Parameter / Contents	Notes	Received Message Structure	"ME" Field Bits	Message Field Bits	# of Bits	Range	Resolution	Units	Data Structure	Data Byte #
10	Heading while on the Surface	4, 6	Surface Position – "Ground Track"	14 - 20	46 – 52	8	+/- 180	1.40625	degrees	SMdddddL	26
11	Altitude, Barometric (Pressure Altitude)	4, 5	Airborne Position – "TYPE", & "Altitude"	1 - 5 9 - 20	33 – 37 41 – 52	24	+/- 131,072	0.015625	feet	SMdddddd ddddddddddddddL	27 - 29
12	Vertical Rate, Geometric/Barometric (WGS-84)	4, 5	Airborne Velocity – "Source Bit for Vert. Rate ", "Sign Bit for Vert. Rate " & "Vert. Rate"	36 37 38 - 46	68 69 70 – 78	16	+/- 32,768	1.0	ft./min.	SMdddddd ddddddddL	30 - 31
13	Navigation Integrity Category (NIC)	4	Airborne Position "Type Code" Surface Position "Type Code"	1 – 5 1 - 5	33 – 37 33 - 37	8	N/A	N/A	discrete	0000MddL	32
14	Estimated Latitude (WGS-84)	7	Airborne Position – "Encoded Latitude" Surface Position – "Encoded Latitude"	23 - 39 23 - 39	55 - 71 55 – 71	24	24	+/- 180	0.0000215	degrees	33 - 35
15	Estimated Longitude (WGS-84)	7	Airborne Position – "Encoded Longitude" Surface Position – "Encoded Longitude"	40 - 56 40 - 56	72 - 88 72 – 88	24	24	+/- 180	0.0000215	degrees	36 - 38
16	Estimated North/South Velocity	7	Airborne Velocity – "Direction Bit for N-S Vel." & "N-S Velocity"	25 26 - 35	57 58 – 67	16	+/- 4,096	0.125	knots	SMddddddddddddddL	39 - 40
17	Estimated East/West Velocity	7	Airborne Velocity – "Direction Bit for E-W Vel." & "E-W Velocity"	14 15 - 24	46 47 – 56	16	+/- 4,096	0.125	knots	SMddddddddddddddL	41 - 42
18	Surveillance Status/Discretes		Airborne Position – "Surveillance. Status" Airborne Velocity – "Intent Change Flag"	6 – 7 9	38 – 39 9	4 4	N/A	N/A	discrete	dddd dddd	43
19	Report Mode		N/A	N/A	N/A	8	N/A	N/A	discrete	000000ML	44
										TOTAL BYTES	45

Notes for Table N-3:

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, "0" indicates the bit is to always be set to a value of zero (0) and "x" indicates "Don't Care" bits in the data field.*

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

3. *The Report Type Identifier is used to identify the type of ADS-B Report being generated as defined in §2.2.8.1.1.1.*

4. *Items annotated with Note 4 represent "Critical" State Vector items, however certain items are only applicable while airborne and others only applicable while on the surface (see Notes 5 and 6 below).*

5. *Parameters annotated with Note 5 are only present in the State Vector Report when the aircraft is airborne*

6. *Parameters annotated with Note 6 are only present in the State Vector Report with the aircraft is on the airport surface*

7. *Estimated values may be either an actual value from a received message, if available, or a calculated value such as produced by a surveillance tracker algorithm. For example it is possible for a surveillance tracker to produce an updated estimate of the target's horizontal position based on just the receipt of a new velocity message.*

8. *The Time of Applicability is actually a grouping of 3 individual parameters as defined in §2.2.8.1.4*

~~N.3.1.1~~N.2.2.2 Navigation Integrity Category (NIC)

The ADS-B Version Zero (0) Surface and Airborne Position Messages have associated with each specific TYPE Code a corresponding Horizontal Protection Limit and a 95% Containment Radius. For the purpose of generating a State Vector Report, RTCA DO-260 (i.e., Version 0) mapped these message parameters to a Navigation Uncertainty Category (NUC). As defined by Table 2-11, Version ~~One~~ Two (2~~1~~) Surface and Airborne Position Messages associated the ADS-B Message TYPE Code with the parameters of Horizontal Containment Limit (R_C) and Navigation Integrity Category (NIC). Although Version Zero (0) ADS-B Messages were not defined by RTCA DO-260 to directly include a value for NIC, the values defined by Table 2-11 for R_C and NIC have been selected such that the it is possible to map the TYPE Code values from Version Zero (0) ADS-B Message to a corresponding value for NIC. The Surface and Airborne Position Message TYPE Codes associated with Version Zero (0) 1090 MHz ADS-B Messages are mapped to the NIC values shown in Table N-4 for the purpose of generating State Vector Reports.

Table N-4: Version Zero (0) Format Type Code Mapping to Navigation Source Characteristics

"TYPE" Subfield Code Definitions (DF = 17 or 18)				
TYPE **Code**	**Format**	**Horizontal Protection Limit, HPL**	**Altitude Type**	**Reported NIC**
0	No Position Information		Baro Altitude or No Altitude Information	0
5	Surface Position	HPL < 7.5 m	No Altitude Information	11
6	Surface Position	HPL < 25 m	No Altitude Information	10
7	Surface Position	HPL < 185.2 m (0.1 NM)	No Altitude Information	8
8	Surface Position	HPL ≥ 185.2 m (0.1 NM)	No Altitude Information	0
9	Airborne Position	HPL < 7.5 m	Baro Altitude	11
10	Airborne Position	7.5 m ≤ HPL < 25 m	Baro Altitude	10
11	Airborne Position	25 m ≤ HPL < 185.2 m (0.1 NM)	Baro Altitude	8
12	Airborne Position	185.2 m (0.1 NM) ≤ HPL < 370.4 m (0.2 NM)	Baro Altitude	7
13	Airborne Position	380.4 m (0.2 NM) ≤ HPL < 926 m (0.5 NM)	Baro Altitude	6
14	Airborne Position	26 m (0.5 NM) ≤ HPL < 1852 m (1.0 NM)	Baro Altitude	5
15	Airborne Position	1852 m (1.0 NM) ≤ HPL < 3704 m (2.0 NM)	Baro Altitude	4
16	Airborne Position	7.704 km (2.0 NM) ≤ HPL < 18.52 km (10 NM)	Baro Altitude	1
17	Airborne Position	18.52 km (10 NM) ≤ HPL < 37.04 km (20 NM)	Baro Altitude	1
18	Airborne Position	HPL ≥ 37.04 km (20 NM)	Baro Altitude	0
20	Airborne Position	HPL < 7.5 m	GNSS Height (HAE)	11
21	Airborne Position	HPL < 25 m	GNSS Height (HAE)	10
22	Airborne Position	HPL ≥ 25 m	GNSS Height (HAE)	0

Notes for Table N-4:

1. *"Baro-Altitude" refers to barometric pressure altitude, relative to a standard pressure of 1013.25 millibars (29.92 in Hg). It does not refer to baro corrected altitude.*

2. *The GNSS height (HAE) defined in Type Codes 20 to 22 is used when baro altitude is not available.*

3. *The horizontal protection level, HPL, is derived from ARINC 429 label 130, which is variously called HIL (Horizontal Integrity Limit) or HPL (Horizontal Protection Level).*

~~N.4~~N.2.3 Mode Status Reports

Table 2.2.8.2 defines the overall Mode Status Report format and the source for each parameter that is to be reported when the target aircraft/vehicle is broadcasting with Version ~~One~~ Two (2~~1~~) ADS-B Message formats. In a similar fashion, Table N-5 below defines the 1090 MHz ADS-B Message-to-State Vector Report mapping that will be used when the target aircraft/vehicle is broadcasting using Version Zero (0) ADS-B Messages. Note that there are some significant differences in the message parameters available from Version Zero (0) versus Version Two (2~~1~~) ADS-B Messages. As a result, ~~This results in~~ Mode Status Reports related to target aircraft/vehicles broadcasting Version Zero (0) ADS-B Messages ~~being~~ are substantially less complete than ~~would be possible when~~ Mode Status Reports generated from Version ~~One~~ Two (~~1~~2) ADS-B Messages ~~are being received~~. The following subparagraphs discuss those Mode Status Report parameters that must be processed and/or mapped differently for Version Zero (0) ADS-B Messages. The remaining Mode Status Report parameters not specifically addressed in the following subparagraphs will be generated as specified in §2.2.8.2 (i.e., using the same mapping as for Version ~~One~~ Two (2~~1~~) ADS-B Messages).

The formats of the Version Zero (0) 1090 MHz ADS-B Messages are specified in Figure N-1 through Figure N-7.

Table N-5: ADS-B Mode Status Data Elements – Version Zero (0) 1090 MHz ADS-B Messages to Report Structure Mapping

Column #	REPORT STRUCTURE		MESSAGE STRUCTURE RELEVANT			REPORT STRUCTURE RELEVANT					
	1	2	3	4	5	6	7	8	9	10	11
Item #	**Parameter / Contents**	**Notes**	**Received Version 0 Message Sources**	**"ME" Field Bits**	**Message Field Bits**	**# of Bits**	**Range**	**Resolution**	**Units**	**Data Structure**	**Data Byte #**
0a,0b	Report Type and Structure		N/A	N/A	N/A	24	N/A	N/A	discrete	MddL Mddd dddddddd ddddddL	0 - 2
0c	Validity Flags		N/A	N/A	N/A	8	N/A	N/A	discrete	dddddddd	3
1	Participant Address		Airborne Velocity - "AA" - OR - Operational Status – "AA" - OR - Aircraft Identification – "AA"	N/A N/A N/A	9 – 32 9 – 32 9 – 32	24 24 24	N/A	N/A	discrete	Mddddddd dddddddd ddddddL	4 – 6
2	Address Qualifier		N/A reserved for future use			8	N/A	N/A	discrete	00000M0L	7
3	Time of Applicability		N/A	N/A	N/A	16	511.9921875	0.0078125 (1/128)	seconds	Mddddddd ddddddL	8 - 9
4	ADS-B Version		Operational Status – "Version Number"	41 - 43	73 - 75	8	0 - 7	1	discrete	00000MdL	10
5a	Call Sign		Aircraft Identification – "Ident Char."	14 – 56	41 – 88	64	N/A	N/A	Alphanumeric characters	0MddddL 0MddddL 0MddddL 0MddddL 0MddddL 0MddddL 0MddddL 0MddddL	11 – 18
5b	Emitter Category		Aircraft Identification – "Emitter Category"	6 – 8	38 - 40	8	N/A	N/A	discrete	000MdddL	19
5c	A/V Length and Width Codes	5	N/A	21 - 24	53 - 56	8	N/A	N/A	N/A	00000000	20
6	Emergency/Priority Status		Aircraft Status Message – Subtype 1 – "Emergency/Priority Status"	9 - 11	36 - 38	8	N/A	N/A	discrete	00000MbL	21
7	Capability Codes		Operational Status – "CC-4"	9 - 12	41 - 44	24	See Section N.4.4			00000000 dd000000 00000000	22 - 24
8	Operational Mode	4	N/A			16	N/A	N/A	N/A	00000000 00000000	25 - 26
9a	SV Quality - NACp		Airborne Position "Type Code" Surface Position "Type Code"	1 – 5 1 - 5	33 – 37 33 - 37	8	N/A	N/A	discrete	00000000	27
9b	SV Quality - NACv		Airborne Velocity Message –	11 - 13	43-45	8	N/A	N/A	discrete	00000MdL	28

Column #	REPORT STRUCTURE		MESSAGE STRUCTURE RELEVANT			REPORT STRUCTURE RELEVANT					
	1	2	3	4	5	6	7	8	9	10	11
Item #	Parameter / Contents	Notes	Received Version 0 Message Sources	"ME" Field Bits	Message Field Bits	# of Bits	Range	Resolution	Units	Data Structure	Data Byte #
			"NUC_R"								
9c	SV Quality – SIL	4, 5	Airborne Position – "Type Code" Surface Position – "Type Code"	1 – 5 1 - 5	33 – 37 33 - 37	8	N/A	N/A	discrete	000000ML	29
9d	SV Quality – SIL Supplement		N/A	N/A	N/A	8	N/A	N/A	discrete	xxxxxLxx	29
9e	SV Quality – SIL Supplement		N/A	N/A	N/A	8	N/A	N/A	discrete	xxxMLxxx	29
9f~~9d~~	SV Quality – GVA~~SV Quality – BAQ (reserved)~~		N/A~~N/A~~	N/A~~N/A~~	N/A~~N/A~~	8~~8~~	N/A~~N/A~~	N/A~~N/A~~	discrete~~discrete~~	xxxxxxML~~000000ML~~	30~~30~~
9~~g~~	SV Quality – NICbaro	4	N/A	N/A	N/A	8	N/A	N/A	discrete	0000000L	31
10a	Track/Heading and Horizontal Reference Direction (HRD)	4	Airborne Velocity – "SUBTYPE" - "Magnetic Heading Status Bit" Surface Position Message – "Status Bit for Ground Track"	6 - 8 14 13	38 - 40 46 45	8	N/A	N/A	discrete	0000000L	32
10b	Vertical Rate Type		Airborne Velocity – "Vert. Rate Source"	36	68	8	N/A	N/A	discrete	0000000L	33
11	(Reserved for) Flight Mode Specific Data					8	N/A	N/A	discrete	xxxxxMdL	34
12~~1~~	Other (Reserved)		Reserved			8	Reserved			dddddddd	35~~4~~
										TOTAL BYTES:	36~~5~~

Notes for Table N-5:

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, "0" indicates the bit is to always be set to a value of zero (0), and "x" indicates "Don't Care" bits in the data field.*

2. *If data is not available to support these fields, then the entire data field shall be set to ALL ZEROs.*

3. *The Report Type Identifier is used to identify the type of ADS-B Report being generated as defined in §2.2.8.1.1.1.*

4. This parameter is not available for aircraft/vehicles broadcasting Version Zero (0) ADS-B Messages. If included in the Mode Status report the value of this parameter is to be set to all zeros otherwise it may be omitted from the Mode Status Report and its omission indicated in the Report Type and Structure Parameter using the format defined in Table 2.2.8.2.1.1.

5. This parameter is not available for aircraft/vehicles broadcasting Version Zero (0) ADS-B messages. This parameter is to be omitted from the Mode Status Report and its omission indicated in the Report Type and Structure Parameter using the format defined in Table 2.2.8.2.1.1.

~~N.4.1~~N.2.3.1 ADS-B Version

The format of the Aircraft Operational Status Message substantially differs between the Version Zero (0) ADS-B Message format shown in Figure N-7 and the Version ~~One~~ Two (~~1~~2) ADS-B Message format specified in §2.2.3.2.7.3 of these MOPS. The Version ~~One~~ Two (2~~1~~) Aircraft Operational Status Message format includes an explicit Version Number subfield (ME bits 41-43). For a Version Zero (0) ADS-B Aircraft Operational Status Message, these same bits are unassigned and are expected to be set to a value of ZERO (0). A Version ~~One~~ Two (2~~1~~) ADS-B Receiving Subsystem will, as a default, assume the received messages are using Version Zero (0) ADS-B Message format unless, or until, an Aircraft Operational Status Message is received and the Version Number is confirmed to be other than Zero. However, in the case of a Version ~~One~~ Two (2~~1~~) ADS-B Subsystem's reception of an Aircraft Operational Status Message, the ADS-B Receiving Subsystem will decode "ME" bits 41-43 and determine if the target aircraft is broadcasting messages that are ADS-B Version Zero (0) or Version One (1) or Version Two (2) and then decode the remainder of the message in accordance with the message format applicable to that Version Number.

Note: *The Version Number determined from the decoding of the Version Number subfield of the Aircraft Operational Status message must be retained and associated with the specific target since it is used in determining the applicable formats to be used for the decoding of the other message types.*

~~N.4.2~~N.2.3.2 Emitter Category

The ADS-B Report Assembly Function will extract "TYPE" and "ADS-B Emitter Category" from the Aircraft Identification and Category Message (Figure N-3) and encode the "Emitter Category" field of the Mode Status Report as shown in Table 2.2.8.2.7. The Emitter Category conveyed in the Aircraft Identification and Category Message is mapped into the Mode Status Report, Emitter Category field as specified by Table 2.2.8.2.7. However, it must be noted that in the Version Zero (0) Aircraft Identification and Category Message, the Emitter Category subfield conveys a subset of the Emitter Categories allowed by the Mode Status Report.

~~N.4.3~~N.2.3.3 A/V Length and Width Code

The A/V Length and Width Code is not conveyed by Version Zero (0) 1090 MHz ADS-B Messages. This parameter is only included in the Mode Status Report when reporting on an aircraft or vehicle that is on the airport surface. When no A/V Length and Wide Code is available, as is the case for target A/V that are broadcasting Version Zero (0) ADS-B Messages, the A/V Length and Wide Code parameter will not be included in the Mode Status Report and its omission so indicated in the Report Type and Structure Parameter using the coding specified in Table 2.2.8.2.1.1.

~~N.4.4~~N.2.3.4 Emergency/Priority Status

The Emergency/Priority Status conveyed in the Aircraft Status Message (Figure N-6) will be directly mapped into the Mode Status Report, Emergency/Priority Status field as

specified in §2.2.8.2.9. However, it must be noted that in the Version Zero (0) Aircraft Extended Squitter Status Message, the Emergency/Priority Status subfield conveys a subset of the Emergency/Priority Status categories allowed by the Mode Status Report.

~~N.4.5~~N.2.3.5 Capability Codes

The Version Zero (0) Operational Status Message (Figure N-7) conveys Control Codes with information limited to TCAS and CDTI capabilities, as shown in Table N-6. The Version Zero (0) Aircraft Operational Status Message format specifies coding only for the case of CC-4 (En Route Operational Capabilities). Therefore the CC-1, CC-2 and CC-3 subfields, as specified in Figure N-7, are to be considered reserved and not used for Version Zero (0) ADS-B Messages.

For the case of CC-4, this 4-bit (bits 9-12) subfield will be mapped to the Capability Code field of the Mode Status Report as shown in Table N-6. The remaining bits within the Mode Status Report Capability Code field will be set to Zero (0). If no Aircraft Operational Status Message has been received, then the Capability Code field may be omitted from the Mode Status Report and its omission so indicated in the Report Type and Structure Parameter using the coding specified in Table 2.2.8.2.1.1.

Table N-6: En-Route Operational Capabilities Encoding

CC-4 Encoding: En Route Operational Capabilities			
CC-4 Coding (Version Zero (0) Messages)		**Meaning (Version Zero (0) Messages)**	**Mapping to MS Report Capability Code field**
Bit 9,10	Bit 11,12		CC Field Bits 11, 12
0 0	0 0	TCAS Operational or unknown; CDTI not Operational or unknown	10
	0 1	TCAS Operational or unknown; CDTI Operational	11
	1 0	TCAS not Operational; CDTI not Operational or unknown	00
	1 1	TCAS not Operational; CDTI Operational	01

~~N.4.6~~N.2.3.6 Operational Modes

Version Zero (0), RTCA DO-260 conformant, ADS-B Message formats do not define coding for the Operational Mode subfield of the operational status message. Therefore the OM-1, OM-2, OM-3 and OM-4 subfields, as shown in Figure N-7, are to be considered reserved and not used for ADS-B Version Zero (0) messages. Mode Status Reports for target aircraft/vehicles broadcasting Version Zero (0) ADS-B Messages will not include the Operational Mode field in the report and indicate the omission of this parameter in the Report Type and Structure Parameter using the coding specified in Table 2.2.8.2.1.1.

~~N.4.7~~N.2.3.7 Navigation Accuracy Category for Position (NAC_P)

The Version Zero (0) ADS-B Surface and Airborne Position Messages have associated with each specific TYPE code a corresponding Horizontal Protection Limit and a 95% Containment Radius (i.e., position error). For a Version One (1) ADS-B Receiving Subsystem, the TYPE codes of the received Version Zero (0) ADS-B Messages will be mapped into the value of the Navigation Accuracy Category for Position (NAC_P) as shown below in Table N-7 for the purpose of generating the Mode Status Report.

Table N-7: Type Code to NAC_P Mapping

Version 0 Message TYPE CODE	Message Format	Position Error (95%)	ADS-B MS Report NAC_P value
0	No Position Info	Unknown	0
5	Surface Position	< 3 m	11
6	Surface Position	< 10 m	10
7	Surface Position	< 0.05 NM	8
8	Surface Position	> 0.05 NM	0
9	Airborne Position	< 3 m	11
10	Airborne Position	< 10 m	10
11	Airborne Position	< 0.05 NM	8
12	Airborne Position	< 0.1 NM	7
13	Airborne Position	< 0.25 NM	6
14	Airborne Position	< 0.5 NM	5
15	Airborne Position	< 1 NM	4
16	Airborne Position	< 5 NM	1
17	Airborne Position	< 10 NM	1
18	Airborne Position	> 10 NM	0
20	Airborne Position	< 4 m	11
21	Airborne Position	< 15 m	10
22	Airborne Position	> 15 m	0

Note: *The Position Error column of the table indicates the greater of the horizontal or vertical 95% containment radius as listed in Table N-4 for Version Zero (0) messages.*

~~N.4.8~~N.2.3.8 Navigation Accuracy Category for Velocity (NAC_V)

The Version Zero (0) ADS-B Airborne Velocity Message (see Figure N-4 and Figure N-5) includes a subfield that conveys the Navigation Uncertainty Category for Velocity (NUC_R). The received value of NUC_R will be mapped directly one-for-one to the Navigation Accuracy Category for Velocity (NAC_V) field of Mode Status Report.

~~N.4.9~~N.2.3.9 ~~Surveillance~~ Source Integrity Level (SIL)

The ~~Surveillance~~ Source Integrity Level (SIL) defines the probability of the integrity containment region described by the NIC parameter being exceed for the selected geometric position source, including any external signals used by the source. The value of SIL can only be inferred from the information conveyed in Version Zero (0) ADS-B

Messages. Table N-8 provides the mapping between the message Type Code for a Version Zero (0) transmitting system and the value of SIL to be reported by a Version One (1) receiving system within the Mode Status Report (see §2.2.8.2.14).

Table N-8: SIL Reporting

Version 0 Message TYPE CODE	Message Format	Integrity Level (probability of exceeding the horizontal containment radius (R_C) without an indication)	ADS-B MS Report SIL value
0	No Position Info	No Integrity	0
5	Surface Position	1 X 10^{-5} per flight hour or per sample	2
6	Surface Position	1 X 10^{-5} per flight hour or per sample	2
7	Surface Position	1 X 10^{-5} per flight hour or per sample	2
8	Surface Position	1 X 10^{-5} per flight hour or per sample	2
9	Airborne Position	1 X 10^{-5} per flight hour or per sample	2
10	Airborne Position	1 X 10^{-5} per flight hour or per sample	2
11	Airborne Position	1 X 10^{-5} per flight hour or per sample	2
12	Airborne Position	1 X 10^{-5} per flight hour or per sample	2
13	Airborne Position	1 X 10^{-5} per flight hour or per sample	2
14	Airborne Position	1 X 10^{-5} per flight hour or per sample	2
15	Airborne Position	1 X 10^{-5} per flight hour or per sample	2
16	Airborne Position	1 X 10^{-5} per flight hour or per sample	2
17	Airborne Position	1 X 10^{-5} per flight hour or per sample	2
18	Airborne Position	No Integrity	0
20	Airborne Position	1 X 10^{-5} per flight hour or per sample	2
21	Airborne Position	1 X 10^{-5} per flight hour or per sample	2
22	Airborne Position	No Integrity	0

~~N.4.10~~N.2.3.10 Barometric Altitude Integrity Code (NIC_{BARO})

The Barometric Altitude Integrity Code (NIC_{BARO}) parameter of the Mode Status Report is a 1-bit flag used to indicate if the barometric altitude being reported in the State Vector Report has been cross-checked against another source of pressure altitude. The Version Zero (0) ADS-B Messages do not include information related to the cross-checking of barometric altitude. Therefore, Mode Status Reports for target aircraft/vehicles broadcasting Version Zero (0) ADS-B Messages will not include the NIC_{BARO} field in the report and therefore will indicate the omission of this parameter in the Report Type and Structure Parameter using the coding specified in Table 2.2.8.2.1.1.

~~N.4.11~~N.2.3.11 Track/Heading and Horizontal Reference Direction (HRD)

Version Zero (0) Airborne Velocity Messages with SUBTYPE equal to 3 or 4 include a "Magnetic Heading Status Bit" as shown in Figure N-4. A 1090 MHz ADS-B Receiving Subsystem, upon receiving an Airborne Velocity Message with a Subtype of 3 or 4, must decode the Magnetic Heading Status Bit to determine if Magnetic Heading Data is "Available." The ADS-B Receiving Subsystem will set the value of the True/Magnetic Heading subfield (see §2.2.8.2.17, of the Mode Status Report), as specified in Table N-9.

Table N-9: Track/Heading and HRD Subfield

Version 0 Airborne Velocity Message SUBTYPE	Airborne Velocity Message "Magnetic Heading Status Bit"	Surface Position Message "Ground Track Status Bit"	Meaning	ADS-B MS Report True/Magnetic Heading subfield coding Bits 1 - 0
N/A	N/A	0	No Valid Track/ Heading or Heading Direction Reference information available	00
1 or 2	N/A	1	Ground Track being reported	01
3 or 4	0	N/A	Heading relative to true north being reported	00
3 or 4	1	N/A	Heading relative to magnetic north being reported	11

Notes:

1. *When no valid data is available the "Track/Heading and HRD" parameter may be reported as ALL ZEROs, or omitted, from the Mode Status Report and the omission of this parameter indicated in the Report Type and Structure Parameter using the coding defined in Table 2.2.8.2.1.1.*

2. *As defined in §2.2.8.2.17, when receiving Version One (1) messages, the Track/Heading and HRD information are conveyed within the Operation Status Message. However, when receiving Version Zero (0) messages the equivalent information can be determined for airborne aircraft from the value of the "SUBTYPE" subfield and for Subtype=3 or 4 messages the value of the "Magnetic Heading Status Bit" of the Airborne Velocity Message (Figure N-4 and Figure N-5). When a target aircraft/vehicle is on the surface a value of 01 should be reported when a Surface Position Message (Figure N-2) is received with the "Ground Track Status Bit" set to a value of ONE (1) indicating that the valid ground track data is provided.*

3. *Version 0 Airborne Velocity Messages, Subtypes 3 and 4 always report Heading relative to Magnetic North, never relative to True North.*

~~N.5~~N.2.4 Air Referenced Velocity Reports

The requirements of §2.2.8.3.2 for Air Referenced Velocity (ARV) Reports apply to the ARV Report Assembly requirements when the target aircraft is broadcasting either Version Zero (0) or Version Two~~One~~ (2~~1~~) ADS-B Message formats.

~~N.6~~N.2.5 Target Status Reports

RTCA DO-260 defined a message format using message TYPE Code 29 to convey Aircraft Trajectory Intent information in the form of Trajectory Change Point (TCP) information. A 1090 MHz ADS-B Receiving Subsystem conforming to these MOPS ~~(i.e., RTCA DO-242A)~~ does not use any message with a TYPE Code of 29 that is received from a Version Zero (0) ADS-B Transmitting Subsystem for the purpose of report generation.

Note: *Prior to generation of a Target Status Report, the 1090 MHz ADS-B Receiving Subsystem must positively confirm that any received message with a TYPE Code of 29 has originated from a target aircraft with an ADS-B Version Number other than Zero (0). The ADS-B Version can be determined from the contents of the Version Number subfield of the Aircraft Operational Status Message (see §2.2.8.2.5 and §N.4.2~~1~~).*

N.3 1090 MHz ADS-B Version 1 Message Processing

N.3.1 ADS-B Version 1 Message Types

ADS-B Version One (1) (i.e., originating from a RTCA DO-260A conformant 1090 MHz ADS-B Transmitting Subsystem) 1090 MHz ADS-B Messages are the same basic message types as Version Two (2). Some messages have different formats and contain additional or eliminated message subfields. The Target State and Status Message changed from Version One (1) to Version Two (2). Version One (1) transmitters use subtype 0 for the Target State and Status Message and Version Two (2) transmitters use subtype 1 for backward compatibility. Version Two (2) receivers do not generate Target State and Status Reports from Version One (1) Target State and Status Messages but utilize the accuracy and integrity parameters in the message (see §N.3.2 and §N.3.3). See §N.4.2 for Version One (1) message formats. Version One (1) transmitters do not broadcast the Extended Squitter Aircraft Status Message (subtype 2), the 1090ES TCAS Resolution Advisory (RA) Message.

N.3.1.1 Message TYPE Codes

The first 5-bit field in every 1090 MHz ADS-B Message contains the message format TYPE. The TYPE code (i.e., format type) is used to differentiate the messages into several classes: airborne position, airborne velocity, surface position, identification, aircraft status, etc. The general definition for all ADS-B Messages Types used for Version One (1) ADS-B Messages has been retained for Version Two (2) messages.

N.3.2 State Vector Reports Generated using Version One (1) Messages

The following subparagraphs summarize the ADS-B State Vector Report generation requirements (see §2.2.8.1) for Version Two (2) systems when receiving Version One (1) ADS-B Messages.

The contents of State Vector Reports are specified in Table 2.2.8.1. The contents of the State Vector Reports are composed primarily from the information received from airborne aircraft in Airborne Position Messages and Airborne Velocity Messages or for

aircraft/vehicles on the airport surface in Surface Position Messages. Many of the parameters contained within these messages are encoded the same, and occupy the same positions with the overall message structure, for both Version One (1) and for Version Two (2) messages. However, in a few cases the decoding and/or report assembly processing must be handled differently for Version One (1) messages as compared to that required by these MOPS (§2.2.8.1) for Version Two (2) messages. The following subparagraphs describe the required use of Version One (1) messages for ADS-B report generation by a Version Two (2) compliant ADS-B Receiving Subsystem.

N.3.2.1 State Vector Report to 1090 MHz ADS-B Message Mapping

Table 2.2.8.1 specifies the overall State Vector Report format and the source for each parameter that is to be reported when the target aircraft/vehicle is broadcasting with Version Two (2) ADS-B Message formats. In a similar fashion, Table N-10 below defines the 1090 MHz ADS-B Message-to-State Vector Report mapping that will be used when the target aircraft/vehicle is broadcasting using Version One (1) ADS-B Messages. Note there are some minor differences in the specific names applied to certain otherwise identical Version Zero (0) versus Version Two (2) messages subfields. The following subparagraph discusses the NIC parameter and its mapping from Version Zero (0) messages to the State Vector Report. The remaining State Vector Report parameters are described in §2.2.8.1.

The formats of the Version One (1) 1090 MHz ADS-B Messages are specified in Figure N-8 through Figure N-15.

Table N-10: ADS-B State Vector Data Elements – Version One (1) 1090 MHz ADS-B Messages to Report Structure Mapping

Column #	REPORT STRUCTURE		VERSION ONE (1) MESSAGE STRUCTURE RELEVANT			REPORT STRUCTURE RELEVANT					
	1	2	3	4	5	6	7	8	9	10	11
Item #	Parameter / Contents	Notes	Received Message Structure	"ME" Field Bits	Message Field Bits	# of Bits	Range	Resolution	Units	Data Structure	Data Byte #
0a, 0b	Report Type and Structure Identification	4	Airborne Position - "DF"	N/A	1 – 5	24	N/A	N/A	discrete	MddL Mddd ddddddddddddddL	0 -2
0c	Validity Flags		N/A	N/A	N/A	16	N/A	N/A	discrete	dddddddd dddddddd	3 - 4
1	Participant Address	4	Airborne Position - "AA" Surface Position - "AA" Airborne Velocity – "AA"	N/A N/A N/A	9 - 32 9 – 32 9 - 32	24	N/A	N/A	discrete	Mddddddd ddddddddddddddL	5 - 7
2	Address Qualifier		N/A	N/A	N/A	8	N/A	N/A	discrete	00000M0L	8
3	Time of Applicability (Position and Velocity)	4	Airborne Position – "Time" Surface Position – "Time" Airborne Velocity	21 21 N/A	53 53 N/A	24	511.9921875	0.0078125 (1/128)	seconds	Mddddddd ddddddddddddddddddddddddddddddL	9 - 11
4	Latitude (WGS-84)	4	Airborne Position – "Encoded Latitude" Surface Position – "Encoded Latitude"	23 - 39 23 - 39	55 - 71 55 – 71	24	+/- 180	0.0000215	degrees	SMddddddd ddddddddddddddL	12 - 14
5	Longitude (WGS-84)	4	Airborne Position – "Encoded Longitude" Surface Position – "Encoded Longitude"	40 - 56 40 - 56	72 - 88 72 – 88	24	+/- 180	0.0000215	degrees	SMddddddd ddddddddddddddL	15 - 17
6	Altitude, Geometric (WGS-84)	4, 5	Airborne Position – "TYPE", & "Altitude" Airborne Velocity – "Diff. Sign Bit" & "Geo Height Diff. from Baro. Alt."	1 - 5, & 9 - 20 49 50 - 56	33 - 37 41 – 52 81 82 - 88	24	+/- 131,072	0.015625	feet	SMddddddd ddddddddddddddL	18 - 20
7	North / South Velocity	4, 5	Airborne Velocity – "Direction Bit for N-S Vel." & "N/S Velocity"	25 26 - 35	57 58 – 67	16	+/- 4,096	0.125	knots	SMddddddd ddddddddL	21 - 22
8	East / West Velocity	4, 5	Airborne Velocity – "Direction Bit E-W Vel." & "E/W Velocity"	14 15 - 24	46 47 – 56	16	+/- 4,096	0.125	knots	SMddddddd ddddddddL	23 - 24
9	Ground Speed while on the Surface	4, 6	Surface Position – "Movement"	6 - 12	38 – 44	8	N/A	N/A	discrete	MddddddL	25

Column #	REPORT STRUCTURE		VERSION ONE (1) MESSAGE STRUCTURE RELEVANT			REPORT STRUCTURE RELEVANT					
	1	2	3	4	5	6	7	8	9	10	11
Item #	Parameter / Contents	Notes	Received Message Structure	"ME" Field Bits	Message Field Bits	# of Bits	Range	Resolution	Units	Data Structure	Data Byte #
10	Heading while on the Surface	4, 6	Surface Position – "Ground Track"	14 - 20	46 – 52	8	+/- 180	1.40625	degrees	SMdddddL	26
11	Altitude, Barometric (Pressure Altitude)	4, 5	Airborne Position – "TYPE", & "Altitude"	1 - 5 9 - 20	33 – 37 41 – 52	24	+/- 131,072	0.015625	feet	SMdddddd ddddddddddddddL	27 - 29
12	Vertical Rate, Geometric/Barometric (WGS-84)	4, 5	Airborne Velocity – "Source Bit for Vert. Rate ", "Sign Bit for Vert. Rate " & "Vert. Rate"	36 37 38 - 46	68 69 70 – 78	16	+/- 32,768	1.0	ft./min.	SMdddddd ddddddddL	30 - 31
13	Navigation Integrity Category (NIC)	4	Airborne Position "Type Code" Surface Position "Type Code" Operational Status – "NIC Supplement"	1 – 5 1 – 5 44	33 – 37 33 – 37 76	8	N/A	N/A	discrete	0000MddL	32
14	Estimated Latitude (WGS-84)	7	Airborne Position – "Encoded Latitude" Surface Position – "Encoded Latitude"	23 - 39 23 - 39	55 - 71 55 – 71	24	24	+/- 180	0.0000215	degrees	33 - 35
15	Estimated Longitude (WGS-84)	7	Airborne Position – "Encoded Longitude" Surface Position – "Encoded Longitude"	40 - 56 40 - 56	72 - 88 72 – 88	24	24	+/- 180	0.0000215	degrees	36 - 38
16	Estimated North/South Velocity	7	Airborne Velocity – "Direction Bit for N-S Vel." & "N-S Velocity"	25 26 - 35	57 58 – 67	16	+/- 4,096	0.125	knots	SMdddddd ddddddddL	39 - 40
17	Estimated East/West Velocity	7	Airborne Velocity – "Direction Bit for E-W Vel." & "E-W Velocity"	14 15 - 24	46 47 – 56	16	+/- 4,096	0.125	knots	SMdddddd ddddddddL	41 - 42
18	Surveillance Status/Discretes		Airborne Position – "Surveillance. Status" Airborne Velocity – "Intent Change Flag"	6 – 7 9	38 – 39 9	4 4	N/A	N/A	discrete	dddd dddd	43
19	Report Mode		N/A	N/A	N/A	8	N/A	N/A	discrete	000000ML	44
										TOTAL BYTES	45

Notes for Table N-10:

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, "0" indicates the bit is to always be set to a value of zero (0) and "x" indicates "Don't Care" bits in the data field.

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

3. The Report Type Identifier is used to identify the type of ADS-B Report being generated as defined in §2.2.8.1.1.1.

4. Items annotated with Note 4 represent "Critical" State Vector items, however certain items are only applicable while airborne and others only applicable while on the surface (see Notes 5 and 6 below).

5. Parameters annotated with Note 5 are only present in the State Vector Report when the aircraft is airborne

6. Parameters annotated with Note 6 are only present in the State Vector Report with the aircraft is on the airport surface

7. Estimated values may be either an actual value from a received message, if available, or a calculated value such as produced by a surveillance tracker algorithm. For example it is possible for a surveillance tracker to produce an updated estimate of the target's horizontal position based on just the receipt of a new velocity message.

8. The Time of Applicability is actually a grouping of 3 individual parameters as defined in §2.2.8.1.4

N.3.2.2 Navigation Integrity Category (NIC)

As defined by Table 2-11, Version Two (2) Surface and Airborne Position Messages have associated with each specific ADS-B Message TYPE Code a corresponding Horizontal Containment Limit (R_C) and Navigation Integrity Category (NIC). The TYPE Code is used along with the NIC Supplement in the Operational Status Message to decode the NIC. The Surface and Airborne Position Message TYPE Codes associated with Version One (1) 1090 MHz ADS-B Messages along with the NIC Supplement are used to map to the NIC values shown in Table N-11 for the purpose of generating State Vector Reports.

Table N-11: Version One (1) Format Type Code Mapping to Navigation Source Characteristics

~~"TYPE" Subfield Code Definitions (DF = 17 or 18)~~

"TYPE" Subfield Code Definitions (DF = 17 or 18)

TYPE Code	NIC Supp	Format	Horizontal Containment Radius Limit (Rc)	Altitude Type	Reported NIC
0	N/A	No Position Information		Baro Altitude or No Altitude Information	0
5	0	Surface Position	Rc < 7.5 m	No Altitude Information	11
6	0	Surface Position	Rc < 25 m	No Altitude Information	10
7	1	Surface Position	Rc < 75 m	No Altitude Information	9
7	0	Surface Position	Rc < 0.1 NM (185.2 m)	No Altitude Information	8
8	0	Surface Position	Rc > 0.1 NM (185.2 m)	No Altitude Information	0
9	0	Airborne Position	Rc < 7.5 m	Baro Altitude	11
10	0	Airborne Position	Rc < 25 m	Baro Altitude	10
11	1	Airborne Position	Rc < 75 m	Baro Altitude	9
11	0	Airborne Position	Rc < 0.1 NM (185.2 m)	Baro Altitude	8
12	0	Airborne Position	Rc < 0.2 NM (370.4 m)	Baro Altitude	7
13	0	Airborne Position	Rc < .5 NM (926 m)	Baro Altitude	6
13	1	Airborne Position	Rc < 0.6 NM (1111.2 m)	Baro Altitude	6
14	0	Airborne Position	Rc < 1.0 NM (1852 m)	Baro Altitude	5
15	0	Airborne Position	Rc < 2 NM (3.704 km)	Baro Altitude	4
16	1	Airborne Position	Rc < 4 NM (7.408 km)	Baro Altitude	3
16	0	Airborne Position	Rc < 8 NM (14.816 km)	Baro Altitude	2
17	0	Airborne Position	Rc < 20 NM (37.04 km)	Baro Altitude	1
18	0	Airborne Position	Rc > 20 NM (37.04 km)	Baro Altitude	0
20	0	Airborne Position	Rc < 7.5 m	GNSS Height (HAE)	11
21	0	Airborne Position	Rc < 25 m	GNSS Height (HAE)	10
22	0	Airborne Position	Rc > 25 m	GNSS Height (HAE)	0

Notes for Table N-11:

1. *"Baro-Altitude" refers to barometric pressure altitude, relative to a standard pressure of 1013.25 millibars (29.92 in Hg). It does not refer to baro corrected altitude.*

2. *The GNSS height (HAE) defined in Type Codes 20 to 22 is used when baro altitude is not available.*

3. *Rc, is derived from ARINC 429 label 130, which is variously called HIL (Horizontal Integrity Limit) or HPL (Horizontal Protection Level).*

N.3.3 Mode Status Reports

Table 2.2.8.2 defines the overall Mode Status Report format and the source for each parameter that is to be reported when the target aircraft/vehicle is broadcasting with Version Two (2) ADS-B Message formats. In a similar fashion, Table N-5 below defines the 1090 MHz ADS-B Message-to-State Vector Report mapping that will be used when the target aircraft/vehicle is broadcasting using Version Zero (0) ADS-B Messages. Note that there are some significant differences in the message parameters available from Version Zero (0) versus Version Two (2) ADS-B Messages. As a result, Mode Status Reports related to target aircraft/vehicles broadcasting Version Zero (0) ADS-B Messages are substantially less complete than Mode Status Reports generated from Version Two (2) ADS-B Messages. The following subparagraphs discuss those Mode Status Report parameters that must be processed and/or mapped differently for Version Zero (0) ADS-B Messages. The remaining Mode Status Report parameters not specifically addressed in the following subparagraphs will be generated as specified in §2.2.8.2 (i.e., using the same mapping as for Version Two (2) ADS-B Messages).

The formats of the Version One (1) 1090 MHz ADS-B Messages are specified in Figure N-8 through Figure N-15.

Table N-12: ADS-B Mode Status Data Elements – Version One (1) Source Data Mapping To Report Structure

Table 2-88: ADS-B Mode Status Data Elements – Source Data Mapping To Report Structure											
Column #	REPORT STRUCTURE		MESSAGE STRUCTURE RELEVANT			REPORT STRUCTURE RELEVANT					
	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		N/A	N/A N/A	1 – 5 1 - 5	24	N/A	N/A	discrete	MddL Mddd ddddddd ddddddL	0 - 2
0c	Validity Flags		N/A	N/A	N/A	8	N/A	N/A	discrete	ddddddd	3
1	Participant Address		Airborne Velocity - "AA" - OR - Operational Status – "AA" - OR - Target State & Status - "AA" - OR - Aircraft ID & Category Msg – "AA"	N/A N/A N/A **N/A**	9 – 32 9 – 32 9 – 32 9 - 32	24 24 24 24	N/A	N/A	discrete	Mddddddd ddddddd ddddddL	4 – 6
2	Address Qualifier		Aircraft ID & Category "Emitter Category" All Messages with DF=18 – "CF"	6 – 8 N/A	38 – 40 6 – 8	8	N/A	N/A	discrete	xxxxxMdL	7
3	Time of Applicability		Operational Status Airborne Position Target State & Status	N/A	N/A	16	511.9921875	0.0078125 (1/128)	seconds	Mddddddd ddddddL	8 - 9
4	ADS-B Version		Operational Status – "Version Number"	41 - 43	73 - 75	8	0 - 7	1	discrete	xxxxxMdL	10
5a	Call Sign		Aircraft ID & Category Msg – "Ident Char."	14 – 56	41 – 88	64	N/A	N/A	Alphanumeric characters	xMddddddL xMddddddL xMddddddL xMddddddL xMddddddL xMddddddL xMddddddL xMddddddL	11 – 18
5b	Emitter Category		Aircraft ID & Category Msg – "Emitter Category"	6 – 8	38 - 40	8	N/A	N/A	discrete	xxxMdddL	19
5c	A/V Length and Width Code	4	Operational Status – Subtype=1 – "L/W Code"	21 – 24	53 – 56	8	N/A	N/A	discrete	xxxxMddL	20
6	Emergency/Priority Status		Aircraft Status Message – Subtype 1 – "Emergency / Priority Status" Target State and Status – Subtype 0 - "Emergency / Priority Status"	9 – 11 54 - 56	36 – 38 86 - 88	8	N/A	N/A	discrete	xxxxxMdL	21
7	Capability Class Codes		Operational Status – Subtype=0 – "CC" Target State & Status "Capability/Mode Codes"	9 - 24 52 - 53	41 - 56 84 - 85	24 24	See Section **Error! Reference source not found.**~~2.2.8.2.10~~			ddddddd ddddddd ddddddd	22 - 24

Table 2-88: ADS-B Mode Status Data Elements – Source Data Mapping To Report Structure

Column #	REPORT STRUCTURE		MESSAGE STRUCTURE RELEVANT			REPORT STRUCTURE RELEVANT					
	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 #
8	Operational Mode		Operational Status – "OM" Target State & Status "Capability/Mode Codes"	25 – 40 52 - 53	57 - 72 84 - 85	16 16	See Section Error! Reference source not found.~~2.2.8.2.11~~			ddddddd ddddddd	25 - 26
9a	SV Quality - NACp		Operational Status – "NAC_p" Target State & Status - "NAC_p"	45 - 48 40 - 43	77 - 80 72 - 75	8	N/A	N/A	discrete	xxxxMddL	27
9b	SV Quality - NAC_V		Airborne Velocity – "NAC_V"	11 - 13	43 - 45	8	N/A	N/A	discrete	xxxxxMdL	28
9c	SV Quality – SIL		Operational Status – "SIL" Target State & Status - "SIL"	51 – 52 45 – 46	83 - 84 77 – 78	8	N/A	N/A	discrete	xxxxxxML	29
9d	SV Quality – SIL Supplement		N/A			8	N/A	N/A	discrete	xxxxxLxx	29
9e	SV Quality – SDA		N/A			8	N/A	N/A	discrete	xxxMLxxx	29
9f	SV Quality – GVA		N/A			8	N/A	N/A	discrete	xxxxxxxL	30
9g	SV Quality – NIC_{BARO}		Operational Status – Subtype=0 – "NIC_{BARO}" Target State & Status - "NIC_{BARO}"	53 44	85 76	8	N/A	N/A	discrete	xxxxxxxL	31
10a	Track/Heading and Horizontal Reference Direction (HRD)		Operational Status – Subtype=1 – Trk/Hdg & Subtype=0,1 – HRD"	53 -54	85 -86	8	N/A	N/A	discrete	xxxxxxML	32
10b	Vertical Rate Type		Airborne Velocity – "Vert. Rate Source"	36	68	8	N/A	N/A	discrete	xxxxxxxL	33
11	(Reserved for) Flight Mode Specific Data					8	N/A	N/A	discrete	xxxxxMdL	34
12	Other (Reserved)		Reserved			8	Reserved			ddddddd	35
										TOTAL BYTES:	36

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. 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 specified in §**Error! Reference source not found.**~~2.2.8.1.1~~.*

3. The A/V Length and Width Code parameter is only applicable to Mode Status Reports for aircrafts or vehicles that are on the airport surface.

N.3.3.1 ADS-B Version

The format of the Aircraft Operational Status Message differs between the Version One (1) ADS-B Message format shown in Figure N-14 and the Version Two (2) ADS-B Message format specified in §2.2.3.2.7.3 of these MOPS. There are additional parameters in Version Two (2) Aircraft Operational Status Message that are not contained in Version One (1) messages. A Version Two (2) ADS-B Receiving Subsystem will, as a default, assume the received messages are using Version Zero (0) ADS-B Message format unless, or until, an Aircraft Operational Status Message is received and the Version Number is confirmed to be other than Zero. However, in the case of a Version Two (2) ADS-B Subsystem's reception of an Aircraft Operational Status Message, the ADS-B Receiving Subsystem will decode "ME" bits 41-43 and determine if the target aircraft is broadcasting messages that are ADS-B Version Zero (0), Version One (1) or Version Two (2) or higher and then decode the remainder of the message in accordance with the message format applicable to that Version Number.

Note: *The Version Number determined from the decoding of the Version Number subfield of the Aircraft Operational Status message must be retained and associated with the specific target since it is used in determining the applicable formats to be used for the decoding of the other message types.*

N.3.3.2 Emitter Category

The ADS-B Report Assembly Function will extract "TYPE" and "ADS-B Emitter Category" from the Aircraft Identification and Category Message (Figure N-10) and encode the "Emitter Category" field of the Mode Status Report as shown in Table 2.2.8.2.7. The Emitter Category conveyed in the Aircraft Identification and Category Message is mapped into the Mode Status Report, Emitter Category field as specified by Table 2.2.8.2.7.

N.3.3.3 A/V Length and Width Code

This parameter is only included in the Mode Status Report when reporting on an aircraft or vehicle that is on the airport surface. When no A/V Length and Wide Code is available, the A/V Length and Wide Code parameter will not be included in the Mode Status Report and its omission so indicated in the Report Type and Structure Parameter using the coding specified in Table N-13.

Table N-13: Version One (1) "Aircraft/Vehicle Length and Width Code" Encoding

A/V - L/W Code (Decimal)	Length Code			Width Code	Upper-Bound Length and Width for Each Length/Width Code	
	ME Bit 49	ME Bit 50	ME Bit 51	ME Bit 52	Length (meters)	Width (meters)
0	0	0	0	0	15	11.5
1				1		23
2	0	0	1	0	25	28.5
3				1		34
4	0	1	0	0	35	33
5				1		38
6	0	1	1	0	45	39.5
7				1		45
8	1	0	0	0	55	45
9				1		52
10	1	0	1	0	65	59.5
11				1		67
12	1	1	0	0	75	72.5
13				1		80
14	1	1	1	0	85	80
15				1		90

N.3.3.4 Emergency/Priority Status

The Emergency/Priority Status conveyed in the Aircraft Status Message (Figure N-13) and the Target State and Status Message (Figure N-15) will be directly mapped into the Mode Status Report, Emergency/Priority Status field.

N.3.3.5 Capability Codes

The ADS-B Report Assembly Function will extract the "Capability Class Codes" data from Aircraft Operational Status Messages and the Target State and Status Messages and provide the Capability Class Codes to the user application in the Mode Status Report in the binary format specified in Table N-12.

Capability Class Codes from the ADS-B Operational Status and the Target State and Status Messages, **shall** be mapped bit for bit into the 3-byte long Capability Class Codes field of the ADS-B Mode Status Report as specified in Table N-14.

When valid "Capability Class" data is not available for a given parameter, then the Capability Class data sent to the user application for that parameter is set to ALL ZEROs.

When a Mode Status Report is generated and when the only received update to the "Capability Class" data has come from a Target State and Status Message, the reported value of all Capability Class parameters are based on the most recently received

Operational Status Message, except updated with the data (i.e., TCAS parameter) received in the subsequent Target State and Status Message.

Table N-14: Capability Code Mapping

MS Report			Operational Status Message Subtype 0 (Airborne)		Operational Status Message Subtype 1 (Surface)		Target State and Status Message	
MS Report CC Field Byte #	Bit #	Parameter	Msg. Bit # (ME field)	Mapping to MS Report	Msg. Bit # (ME field)	Mapping to MS Report	Msg. Bit # (ME field)	Mapping to MS Report
0	7	Service Level	9	Direct Mapping	9	Direct Mapping		
	6		10	Direct Mapping	10	Direct Mapping		
	5		13	Direct Mapping	13	Direct Mapping		
	4		14	Direct Mapping	14	Direct Mapping		
	3	B2 Low			15	Direct Mapping		
	2	Reserved						
	1	Reserved						
	0	Reserved						
1	7	TCAS	11	Inverse Mapping			52	Inverse Mapping
	6	CDTI	12	Direct Mapping	12	Direct Mapping		
	5	ARV	15	Direct Mapping				
	4	TS Report	16	Direct Mapping				
	3	TC Report	17	Direct Mapping				
	2		18	Direct Mapping				
	1	POA			19	Direct Mapping		
	0	Reserved						
2	7	Reserved						
	6	Reserved						
	5	Reserved						
	4	Reserved						
	3	Reserved						
	2	Reserved						
	1	Reserved						
	0	Reserved						

Note: *Direct Mapping means the message bit state (i.e., 0 or 1) remains the same when mapped into the Mode Status Report. Inverse Mapping means the message bit state is reversed when mapped into the Mode Status Report.*

N.3.3.6 Source Integrity Level (SIL)

The Source Integrity Level (SIL) defines the probability of the integrity containment region described by the NIC parameter being exceed for the selected geometric position source, including any external signals used by the source. In Version One (1), the Surveillance Integrity Level parameter represented this probability as well as other elements of integrity. The Surveillance Integrity Level may have also included the reliability of the aircraft systems given by a failure rate corresponding to the equipment design assurance. In Version Two (2), this aspect of integrity is represented by the System Design Assurance parameter. The ADS-B Report Assembly Function will

extract the Surveillance Integrity Level data from Aircraft Operational Status Messages and the Target State and Status Messages and provide the Source Integrity Level to the user application in the Mode Status Report in the binary format.

Note: *Applications using Reports from Version One (1) participants may be able to use the Surveillance Integrity Level to derive both Source Integrity Level and System Design Assurance.*

N.3.3.7 Track/Heading and Horizontal Reference Direction (HRD)

The ADS-B Report Assembly Function will extract the Track Angle/Heading (§**Error! Reference source not found.**~~2.2.3.2.7.2.12~~) and the Horizontal Reference Direction (HRD) (§**Error! Reference source not found.**~~2.2.3.2.7.2.13~~) flag bits from the Aircraft Operational Status Message (§**Error! Reference source not found.**~~2.2.3.2.7.2~~) and set the True/Magnetic Heading field in the Mode Status Report in the binary format specified in Table N-12. This item within the Mode Status Report is used to indicate the nature of the Horizontal Direction information being reported in the State Vector Reports and Target State Reports. This applies to the aircraft reported Horizontal Direction (in the State Vector Report). The encoding of bits 0 and 1 of the report True/Magnetic Heading field **shall** be as specified in Table N-15. Bit 1 of the True/Magnetic Heading field indicates when Ground Track is being reported (i.e. set to zero) or when Heading is being reported (i.e., set to one). Bit 0 of the True/Magnetic Heading field indicates when Heading based on True North (i.e. set to zero) or when heading based on Magnetic North (i.e. set to one) is being reported.

Table N-15: True/Magnetic Heading Encoding

Coding		Meaning
bit 1	**bit 0**	
0	0	No Track/Heading or HRD Information Available
0	1	Ground track being reported
1	0	Heading relative to true north being reported
1	1	Heading relative to magnetic north being reported

Note: *Bits 2 through 7 of byte 32 of the True/Magnetic Heading subfield are always set to ZERO (0).*

N.3.4 Air Referenced Velocity Reports

The requirements of §2.2.8.3.2 for Air Referenced Velocity (ARV) Reports apply to the ARV Report Assembly requirements when the target aircraft is broadcasting either Version One (1) or Version Two (2) ADS-B Message formats.

N.3.5 Target State Reports

Since the content and use of Target State Reports changed between Version One (1) and Version Two (2), there is no requirement to output Version One (1) Target State Reports.

N.4 Formats for Version Zero (0) and Version One (1) 1090 MHz ADS-B Messages

1090 MHz ADS-B Receiving Subsystems conformant to these MOPS (RTCA DO-260B) are required to receive and decode all Version Two (2) compliant messages plus, for backward compatibility, must receive and decode certain messages types conforming to the previous RTCA DO-260, ADS-B Version Zero (0) formats and RTCA DO-260A, ADS-B Version One (1) formats.

~~N.7~~N.4.1 Formats for Version Zero (0) 1090 MHz ADS-B Messages

~~1090 MHz ADS-B Receiving Subsystems conformant to these MOPS (RTCA DO-260A) are required to receive and decode all Version One (1) compliant messages plus, for backward compatibility, must receive and decode certain messages types conforming to the previous RTCA DO-260, ADS-B Version Zero (0), formats.~~ The following figures define the format of ADS-B Version Zero (0) Extended Squitter Messages that must be received and decoded and used for the generation of ADS-B reports as defined in §N.2.2~~3~~ through §N.2.5~~6~~.

Notes:

1. *In some cases, ARINC 429 labels are referenced for specific message fields. These references are only intended to clarify the field content, and are not intended as a requirement to use these ARINC 429 labels as the source for the message field.*

2. *The formats of the Version Zero (0) ADS-B Messages that are not required to be received and used for report generation by a Version ~~One~~ Two (~~1~~2) 1090 MHz ADS-B receiving system are not shown in the following figures.*

Figure N-1: Extended Squitter Airborne Position Message

1	
2	
3	FORMAT TYPE CODE
4	(See §N.2.1)
5	
6	SURVEILLANCE STATUS
7	
8	SINGLE ANTENNA FLAG (SAF)
9	
10	
11	ALTITUDE
12	Specified by the Format Type Code
13	
14	(1) the altitude code (AC) as specified
15	in §2.2.13.1.2 of DO-181D but
16	with the M-bit removed
17	(Ref ARINC 429 Label 203), or
18	
19	(2) GNSS height (HAE)
20	(Ref. ARINC 429 Label 370)
21	TIME (T)
22	CPR FORMAT
23	MSB
24	
25	
26	
27	
28	
29	
30	ENCODED LATITUDE
31	
32	(CPR Airborne Format)
33	
34	
35	
36	
37	
38	
39	LSB
40	MSB
41	
42	
43	
44	
45	
46	
47	ENCODED LONGITUDE
48	
49	(CPR Airborne Format)
50	
51	
52	
53	
54	
55	
56	LSB

Purpose: To provide accurate airborne position information

Surveillance Status coding
0 = no condition information
1 = permanent alert (emergency condition)
2 = temporary alert (change in Mode A identity code other than emergency condition)
3 = SPI condition

Codes 1 and 2 take precedence over code 3.

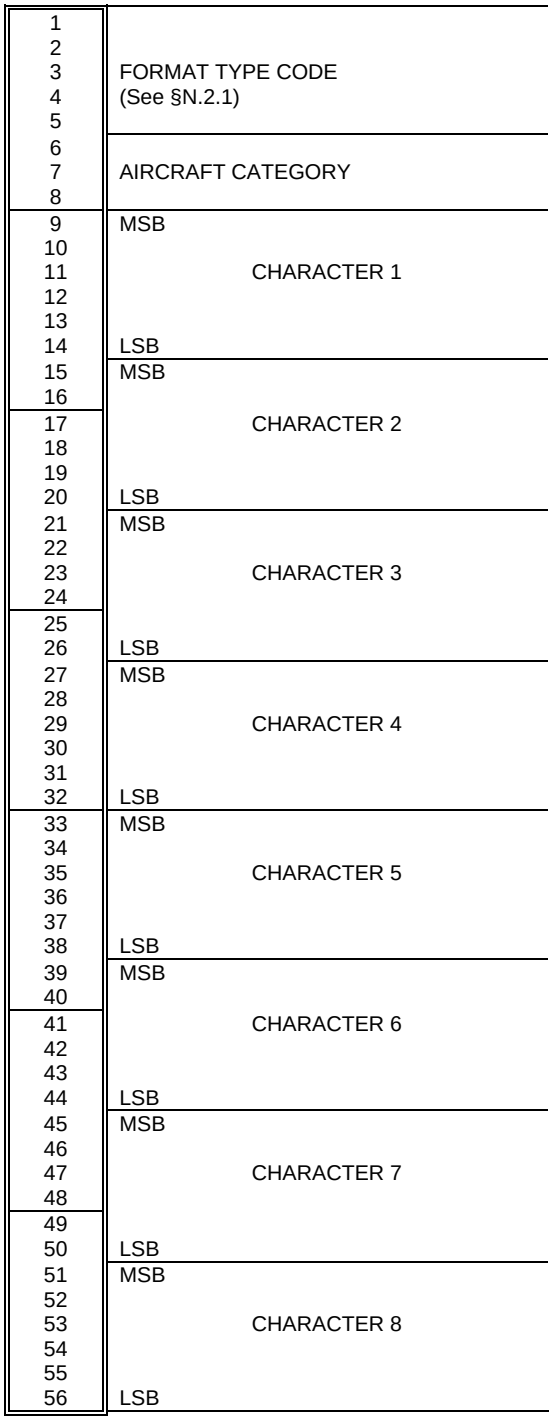
Note: When horizontal position information is unavailable, but altitude information is available, the airborne position message is transmitted with a Format Type Code of ZERO in bits 1-5 and the barometric pressure altitude in bits 9 to 20. If neither horizontal position nor barometric altitude information is available, then all 56 bits of Register 05_{16} shall be ZEROed. The ZERO Format Type Code field indicates that latitude and longitude information is unavailable, while the ZERO altitude field indicates that altitude information is unavailable.

Figure N-2: Extended Squitter Surface Position Message

1	
2	
3	FORMAT TYPE CODE
4	(See §N.2.1)
5	
6	
7	
8	
9	MOVEMENT
10	
11	
12	
13	STATUS for Gnd Tk (1 =valid, 0 = not valid)
14	MSB
15	
16	GROUND TRACK (7 bits)
17	
18	
19	**Resolution = 360/128 deg**
20	LSB
21	TIME (T
22	CPR FORMAT (F)
23	MSB
24	
25	
26	
27	
28	
29	
30	ENCODED LATITUDE
31	
32	(CPR Surface Format)
33	
34	
35	
36	
37	
38	
39	LSB
40	MSB
41	
42	
43	
44	
45	
46	
47	ENCODED LONGITUDE
48	
49	(CPR Surface Format)
50	
51	
52	
53	
54	
55	
56	LSB

Purpose: To provide accurate surface position information.

Figure N-3: Extended Squitter Aircraft Identification and Category Message



Purpose: To provide aircraft identification and category.

Type coding:

1 = Aircraft identification, category set D
2 = Aircraft identification, category set C
3 = Aircraft identification, category set B
4 = Aircraft identification, category set A

ADS-B Emitter Category coding:

Set A

0 = No ADS-B Emitter Category Information
1 = Light (< *15 500* lbs.)
2 = Small (*15 500* to 75 000 lbs.)
3 = Large (75 000 to 300 000 lbs.)
4 = High Vortex Large (aircraft such as B-757)
5 = Heavy (> 300 000 lbs.)
6 = High Performance (> 5 g acceleration and > 400kts)
7 = Rotorcraft

Set B

0 = No ADS-B Emitter Category Information
1 = Glider/sailplane
2 = Lighter-than-Air
3 = Parachutist/Skydiver
4 = Ultralight/hang-glider/paraglider
5 = Reserved
6 = Unmanned Aerial Vehicle
7 = Space/Trans-atmospheric vehicle

Set C

0 = No ADS-B Emitter Category Information
1 = Surface Vehicle – Emergency Vehicle
2 = Surface Vehicle – Service Vehicle
3 = Fixed Ground or Tethered Obstruction
4-7 = Reserved

Set D : Reserved

Aircraft identification coding:

Coding as specified for N.4.4

Figure N-4: Extended Squitter Airborne Velocity Message
(Subtypes 1 and 2: Velocity Over Ground)

1	MSB		**1**		
2			**0**		
3	FORMAT TYPE CODE = 19		**0**		
4	(See §N.2.1)		**1**		
5	LSB		**1**		
6	SUBTYPE 1	0	SUBTYPE 2	0	
7		0		1	
8		1		0	
9	INTENT CHANGE FLAG)				
10	IFR CAPABILITY FLAG				
11	NAVIGATION UNCERTAINTY				
12	CATEGORY – VELOCITY				
13	(NUC_R)				
14	DIRECTION BIT for E-W velocity **(0=East, 1=West)**				
15	EAST-WEST VELOCITY (10 bits)				
16	NORMAL : LSB = 1 knot		SUPERSONIC : LSB =4 knots		
17	All zeros = no velocity info		All zeros = no velocity info		
18	Value	Velocity	Value	Velocity	
19	1	0 kts	1	0 kt	
20	2	1 kt	2	4 kt	
21	3	2 kt	3	8 kt	
22	-	-	-	-	
23	1022	1021 kt	1022	4084 kt	
24	1023	>1021.5 kt	1023	> 4086kt	
25	DIRECTION BIT for N-S velocity **(0=North, 1=South)**				
26	NORTH-SOUTH VELOCITY (10 bits)				
27	NORMAL : LSB = 1 knot		SUPERSONIC : LSB =4 knots		
28	All zeros = no velocity info		All zeros = no velocity info		
29	Value	Velocity	Value	Velocity	
30	1	0 kts	1	0 kt	
31	2	1 kt	2	4 kt	
32	3	2 kt	3	8 kt	
33	-	-	-	-	
34	1022	1021 kt	1022	4084 kt	
35	1023	>1021.5 kt	1023	> 4086kt	
36	SOURCE BIT FOR VERTICAL RATE: 0 = Geometric, 1 = baro (1 bit)				
37	SIGN BIT FOR VERTICAL RATE: 0 = up, 1 = down				
38	VERTICAL RATE (9 bits)				
39	All zeros – no vertical rate information, LSB = 64 ft/min				
40	Value	Vertical rate	Ref. ARINC 429 labels		
41	1	0 ft/min	GPS: 165		
42	2	64 ft/min	INS: 365		
43	-	-			
44	510	32576 ft/min			
45	511	> 32608 ft/min			
46					
47	TURN INDICATOR (2 bits)				
48	TBD				
49	DIFFERENCE SIGN BIT (0 = above baro, 1 = below baro alt))				
50	GEOMETRIC HEIGHT DIFFERENCE FROM BARO. ALT. (7 bits)				
51	All zeros = no info; LSB = 25 ft				
52	Value	Difference			
53	1	0 ft			
54	2	25 ft			
55	-	-			
56	126	3125 ft			
	127	> 3137.5 ft			

Purpose: To provide additional state information for both normal and supersonic flight.

Subtype Coding

Code	Velocity	Type
	As in first edition of the ICAO Manual on Mode S Specific Services	
1	Ground speed	normal
2		supersonic
3	Airspeed, heading	normal
4		supersonic
5	Not assigned	
6	Not assigned	
7	Not assigned	

IFR Capability Flag coding:

0 = Transmitting aircraft has no capability for applications requiring ADS-B equipage class A1S/A1 or above

1 = Transmitting aircraft has capability for applications requiring ADS-B equipage class A1S/A1 or above.

Ref. ARINC Labels for Velocity:

East-West	North-South
GPS: 174	GPS: 166
INS: 367	INS: 366

Ref. ARINC Labels
GNSS Height (HAE): GPS: 370
GNSS Altitude (MSL): GPS: 076

Navigation Uncertainty Category:

$HFOM_R$ value		**$VFOM_R$ value**	**NUC_R value**
$HFOM_R$ < 0.3 m/s (0.984 fps)	AND	$VFOM_R$ < 0.46 m/s (1.5 fps)	4
$HFOM_R$ < 1 m/s (3.28 fps)	AND	$VFOM_R$ < 1.5 m/s (5.0 fps)	3
$HFOM_R$ < 3 m/s (9.84 fps)	AND	$VFOM_R$ < 4.6 m/s (15.0 fps)	2
$HFOM_R$ < 10 m/s (32.8 fps)	AND	$VFOM_R$ < 15.2 m/s (50 fps)	1
$HFOM_R$ unknown or $HFOM_R$ ≥10 m/s (32.8 fps)	OR	$VFOM_R$ unknown or $VFOM_R$ ≥ 15.2 m/s (50 fps)	0

Figure N-5: Extended Squitter Airborne Velocity Message
(Subtypes 3 and 4: Airspeed and Heading)

1	MSB			**1**	
2				**0**	
3	FORMAT TYPE CODE = 19			**0**	
4	(See §N.2.1)			**1**	
5	LSB			**1**	
6	SUBTYPE 3	0	SUBTYPE 4	1	
7		1		0	
8		1		0	
9	INTENT CHANGE FLAG				
10	IFR CAPABILITY FLAG				
11	NAVIGATION UNCERTAINTY				
12	CATEGORY – VELOCITY				
13	(NUC_R)				
14	STATUS BIT – 1 = Magnetic heading available, 0 = not available				
15	MSB				
16					
17					
18	MAGNETIC HEADING (10 bits)				
19	(§N.4.5.5)				
20					
21				Ref. ARINC 429 Label:	
22				INS: 320	
23	Resolution = 360/1024 deg				
24	LSB				
25	AIRSPEED TYPE: 0 = IAS, 1 = TAS				
26	AIRSPEED (10 bits)				
27	NORMAL : LSB = 1 knot		SUPERSONIC : LSB =4 knots		
28	All zeros = no velocity info		All zeros = no velocity info		
29	Value	Velocity	Value	Velocity	
30	1	0 kts	1	0 kt	
31	2	1 kt	2	4 kt	
32	3	2 kt	3	8 kt	
33	-	-	-	-	
34	1022	1021 kt	1022	4084 kt	
35	1023	>1021.5 kt	1023	> 4086 kt	
36	SOURCE BIT FOR VERTICAL RATE: 0 = Geometric, 1 = baro (1 bit)				
37	SIGN BIT FOR VERTICAL RATE: 0 = up, 1 = down				
38	VERTICAL RATE (9 bits)				
39	All zeros – no vertical rate information				
40	LSB = 64 ft/min				
41	Value	Vertical rate	Ref. ARINC labels		
42	1	0 ft/min	GPS: 165		
43	2	64 ft/min	INS: 365		
44	-	-			
45	510	32576 ft/min			
46	511	> 32608 ft/min			
47	TURN INDICATOR (2 bits)				
48	TBD				
49	DIFFERENCE SIGN BIT (0 = above baro, 1 = below baro alt))				
50	GEOMETRIC HEIGHT DIFFERENCE FROM BARO. ALT. (7 bits)				
51	All zeros = no info; LSB = 25 ft				
52	Value	Vertical rate	Ref. ARINC 429 labels		
53	1	0 ft			
54	2	25 ft			
55	-	-			
56	126	3125 ft			
	127	> 3137.5 ft			

Purpose: To provide additional state information for both normal and supersonic flight based on airspeed and heading.

Note: *This format is only used if velocity over ground is not available*

See the definition of NUC_R in DO-260 §2.2.3.2.6.1.5.

Subtype Coding

Code	Velocity	Type
0	As in first edition of the ICAO Manual on Mode S Specific Services	
1	Ground speed	normal
2		supersonic
3	Airspeed, heading	normal
4		supersonic
5	Not assigned	
6	Not assigned	
7	Not assigned	

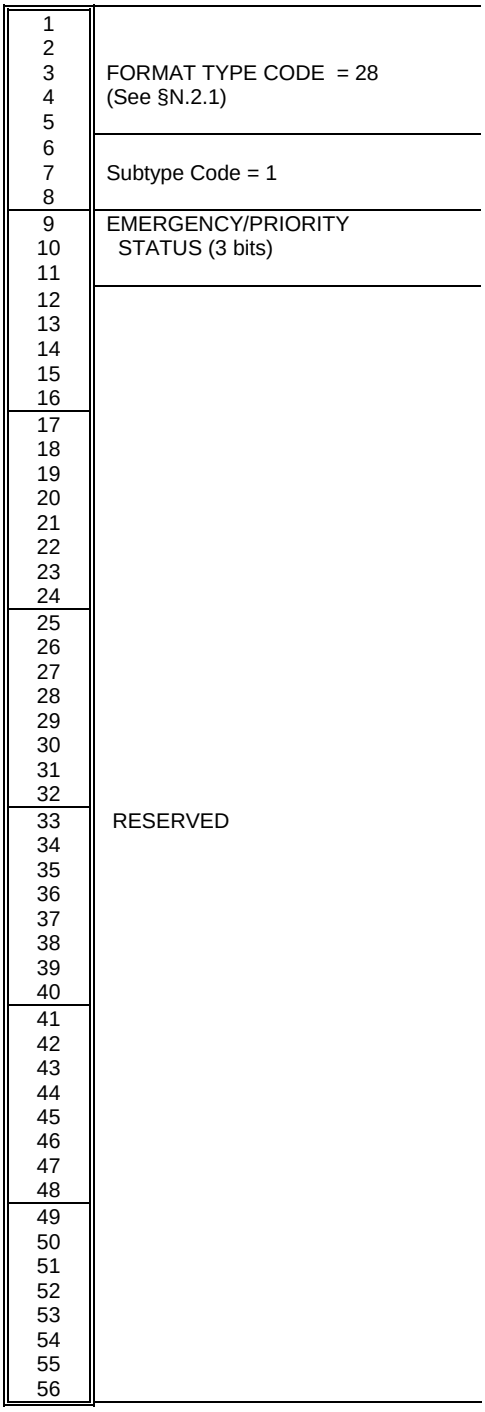
IFR Capability Flag coding:

0 = Transmitting aircraft has no capability for applications requiring ADS-B equipage class A1S/A1 or above

1 = Transmitting aircraft has capability for applications requiring ADS-B equipage class A1S/A1 or above.

Ref. ARINC 429 Labels for Air Data Source:
IAS: 206
TAS: 210

Figure N-6: Extended Squitter Aircraft Status Message
(Subtype 1: Emergency/Priority Status)



Purpose. To provide additional information on aircraft status.

Subtype Coding:

0	=	No Information
1	=	Emergency/Priority Status
2-7	=	Reserved

Emergency/Priority Status Coding

Value	*Meaning*
0	No emergency
1	General emergency
2	Lifeguard/medical
3	Minimum fuel
4	No communications
5	Unlawful interference
6	Reserved
7	Reserved

Notes:

1. *Message delivery is accomplished once per second using the event driven protocol.*

2. *Termination of emergency state is detected by coding in the surveillance status field of the airborne position message.*

Figure N-7: Aircraft Operational Status Message

1	MSB
2	
3	FORMAT TYPE CODE = 31
4	(See §N.2.1)
5	LSB
6	MSB
7	SUBTYPE Code = 0
8	LSB
9	MSB
10	En-Route Operational Capabilities (CC-4)
11	
12	LSB
13	MSB
14	Terminal Area Operational Capabilities(CC-3)
15	
16	LSB
17	MSB
18	Approach/ Landing Operational Capabilities (CC-2)
19	
23	LSB
21	MSB
22	Surface Operational Capabilities (CC-1)
23	
24	LSB
25	MSB
26	Enroute Operational Capability Status (OM –4)
27	
28	LSB
29	MSB
30	Terminal Area Operational Capability Status (OM-3)
31	
32	LSB
33	MSB
34	Approach/ Landing Operational Capability Status (OM-2)
35	
36	LSB
37	MSB
38	Surface Operational Capability Status (OM-1)
39	
40	LSB
41	
42	
43	
44	
45	
46	
47	
48	Not Assigned
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.

N.4.2 Formats for Version One (1) 1090 MHz ADS-B Messages

Figure N-8: Extended Squitter Airborne Position Message