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RTCA Special Committee 186, Working Group 3
ADS-B 1090 MHz Extended Squitter (1090ES) MOPS
Meeting #24

Honeywell Aerospace, Phoenix Arizona
13 – 15 January 2009

BROADCAST OF SELECTED ALTITUDE VIA ADS-B

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SUMMARY

This working paper proposes the creation of an ADS-B 1090ES Message to broadcast the contents of BDS Register 4,0 (Selected Vertical Intention) otherwise known as Selected Altitude.

Action by the meeting is in paragraph 5.

1. INTRODUCTION

1.1 Automatic Dependent Surveillance – Broadcast (ADS-B) is in use in many parts of the world. Implementations range from technical trials to operationally commissioned systems employed for the delivery of air traffic control services. Some airborne surveillance applications are also in operation.

1.2 Renewal of aircraft fleets and avionics upgrades have led to a steady increase in the number of ADS-B equipped aircraft in recent times.

1.3 Some states are planning ADS-B programs which will come into effect during the course of the next decade. The development of requirements for these programs has led to a review of existing standards to determine how they need to be modified to support future applications. Manufacturers are planning avionics upgrades to meet these future requirements.

1.4 Selected Altitude, the altitude entered into an aircraft's automated flight control systems, is one of the aircraft parameters that may be obtained through Mode S Enhanced Surveillance. Aircraft which comply with the European mandates for Enhanced Surveillance are required to supply this data. The information is currently used by air traffic control (ATC) in some parts of the world to help prevent aircraft altitude or flight level infringements.

1.5 This working paper proposes that an ADS-B 1090ES Message be defined for the broadcast of Selected Altitude. It will prove useful in regions where ADS-B is used, either alone or as a supplement to radar surveillance.

2. ADS-B SELECTED ALTITUDE MESSAGE

2.1 Selected Altitude is stored in transponder BDS Register 4,0 "Selected Vertical Intention". The Register is defined in ICAO documents, and is shown in Appendix A of this paper.

2.2 For the purposes of broadcasting this information via ADS-B, Subtype 3 of the Aircraft Status Message (Msg. Type 28) may be used. Subtypes 3 to 7 are currently reserved. Subtype 1 of the message is used for the Emergency/Priority Status, and Subtype 2 for airborne collision avoidance system (ACAS) RA broadcast.

2.3 The proposed message contents are shown in Appendix B of this paper. Any of the currently unassigned transponder registers may be used to store this message, e.g., Register 6,3.

3. BROADCAST OF SELECTED ALTITUDE VIA ADS-B

3.1 Message Delivery

3.1.1 The proposal is for ADS-B broadcast of Selected Altitude to be performed using an event-driven message, triggered by a change in the contents of the register defined in Appendix B.

3.1.2 Because of concerns about the high rate of 1030/1090 MHz signal usage in parts of the world, and the requirement to limit extended squitter transmission rates to 6.2 per second, an event-driven message has been suggested in lieu of a routine broadcast.

3.1.3 The broadcast of this message shall be lower in priority than an ACAS RA Broadcast, and the Emergency/Priority status message, but shall take precedence over the other event-driven messages. Transmission of this message will not lead to an increase in the currently specified maximum rate of 6.2 squitters/second.

3.2 Message Format

3.2.1 The Selected Altitude message shall be created by inserting the contents of the register shown in Appendix A into the ME field of a DF=17 or DF=18 extended squitter. The format of a DF=17 extended squitter is shown below for reference.

DF=17 (5 Bits)	Capability (3 Bits)	Aircraft Address (24 Bits)	ADS-B Msg (ME) (56 Bits)	Parity (24 Bits)
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3.3 Broadcast Rate and Duration

3.3.1 The Selected Altitude message shall be broadcast for 18 +/- 1 seconds, at 1 second intervals, after each change in the contents of the register defined in Appendix B.

3.3.2 If the contents of the Register change while it is being broadcast, the existing broadcast shall be terminated prior to the next transmission, and a new 18 second broadcast commenced with the newly updated register contents.

4. CONCLUSION

4.1 Selected Altitude provides a useful safety net in air traffic management, allowing level infringements to be detected and addressed prior to incidents occurring. The broadcast of the data via ADS-B will make it available in parts of the world where ADS-B is used.

5. ACTION BY WG-3

5.1 The meeting is invited to consider including an ADS-B message for the broadcast of Selected Altitude along the lines of what is proposed in this paper.

APPENDIX A

BDS CODE 4,0 - SELECTED VERTICAL INTENTION

1	STATUS	<p>PURPOSE: To provide ready access to information about the aircraft's current vertical intentions, in order to improve the effectiveness of conflict probes and to provide additional tactical information to controllers.</p> <p>1) Target altitude shall be the short-term intent value, at which the aircraft will level off (or has levelled off) at the end of the current manoeuvre. The data source that the aircraft is currently using to determine the target altitude shall be indicated in the altitude source bits (54 to 56) as detailed below.</p> <p><i>Note. – This information which represents the real “aircraft intent,” when available, represented by the altitude control panel selected altitude, the flight management system selected altitude, or the current aircraft altitude according to the aircraft's mode of flight (the intent may not be available at all when the pilot is flying the aircraft).</i></p> <p>2) The data entered into bits 1 to 13 shall be derived from the mode control panel/flight control unit or equivalent equipment. Alerting devices may be used to provide data if it is not available from “control” equipment. The associated mode bits for this field (48 to 51) shall be as detailed below.</p> <p>3) The data entered into bits 14 to 26 shall be derived from the flight management system or equivalent equipment managing the vertical profile of the aircraft.</p> <p>4) The current barometric pressure setting shall be calculated from the value contained in the field (bits 28 to 39) plus 800 mb. When the barometric pressure setting is less than 800 mb or greater than 1 209.5 mb, the status bit for this field (bit 27) shall be set to indicate invalid data.</p> <p>5) Bits 48 to 56 shall indicate the status of the values provided in bits 1 to 26 as follows: Bit 48 shall indicate whether the mode bits (49, 50 and 51) are already being populated: 0 = No mode information provided 1 = Mode information deliberately provided</p> <p>Bits 49, 50 and 51: 0 = Not active 1 = Active</p> <p>Bit 54 shall indicate whether the target altitude source bits (55 and 56) are actively being populated: 0 = No source information provided 1 = Source information deliberately provided</p> <p>Bits 55 and 56 shall indicate target altitude source: 00 = Unknown 01 = Aircraft altitude 10 = FCU/MCP selected altitude 11 = FMS selected altitude</p>
2	MSB = 32 768 feet	
3		
4		
5		
6		
7	MCP/FCU SELECTED ALTITUDE	
8	Range = [0, 65 520] feet	
9		
10		
11	LSB = 16 feet	
12		
13		
14	STATUS	
15	MSB = 32 768 feet	
16		
17		
18		
19		
20	FMS SELECTED ALTITUDE	
21	Range = [0, 65 520] feet	
22		
23		
24	LSB = 16 feet	
25		
26		
27	STATUS	
28	MSB = 204.8 mb	
29		
30		
31		
32	BAROMETRIC PRESSURE SETTING MINUS 800 mb	
33	Range = [0, 410] mb	
34		
35		
36		
37	LSB = 0.1 mb	
38		
39		
40		
41		
42		
43		
44	RESERVED	
45		
46		
47		
48	STATUS OF MCP/FCU MODE BITS	
49	VNAV MODE	
50	ALT HOLD MODE MCP/FCU Mode bits	
51	APPROACH MODE	

52	RESERVED	
53		
54	STATUS OF TARGET ALT SOURCE BITS	
55	MSB	TARGET ALT SOURCE
56	LSB	

APPENDIX B

ADS-B SELECTED ALTITUDE MESSAGE

1	MSB	<p>PURPOSE: To provide ready access to information, via ADS-B, about the aircraft's current vertical intentions, in order to improve the effectiveness of conflict probes and to provide additional tactical information to controllers.</p> <p>1) Subtype (Bits 6 – 8) shall be coded as follows:</p> <ul style="list-style-type: none"> 0 = No information 1 = Emergency/priority status 2 = ACAS RA Broadcast 3 = Selected Altitude Broadcast 4 – 7 = Reserved 	
2	FORMAT TYPE CODE = 28		
3			
4	LSB		
5			
6	MSB		
7	SUBTYPE CODE = 3		
8	LSB		
9	STATUS	<p>2) Target altitude shall be the short-term intent value, at which the aircraft will level off (or has levelled off) at the end of the current manoeuvre. The data source that the aircraft is currently using to determine the target altitude shall be indicated in the altitude source bits (54 to 56) as detailed below.</p> <p><i>Note. – This information which represents the real “aircraft intent,” when available, represented by the altitude control panel selected altitude, the flight management system selected altitude, or the current aircraft altitude according to the aircraft’s mode of flight (the intent may not be available at all when the pilot is flying the aircraft).</i></p> <p>3) The data entered into bits 9 to 21 shall be derived from the mode control panel/flight control unit or equivalent equipment. Alerting devices may be used to provide data if it is not available from “control” equipment. The associated mode bits for this field (48 to 51) shall be as detailed below.</p> <p>4) The data entered into bits 22 to 34 shall be derived from the flight management system or equivalent equipment managing the vertical profile of the aircraft.</p> <p>5) The current barometric pressure setting shall be calculated from the value contained in the field (bits 36 to 47) plus 800 mb.</p> <p>When the barometric pressure setting is less than 800 mb or greater than 1 209.5 mb, the status bit for this field (bit 35) shall be set to indicate invalid data.</p> <p>6) Bits 48 to 56 shall indicate the status of the values provided in bits 1 to 26 as follows:</p> <p>Bit 48 shall indicate whether the mode bits (49, 50 and 51) are already being populated:</p> <ul style="list-style-type: none"> 0 = No mode information provided 1 = Mode information deliberately provided <p>Bits 49, 50 and 51:</p> <ul style="list-style-type: none"> 0 = Not active 1 = Active <p>Bit 54 shall indicate whether the target altitude source bits (55 and 56) are actively being populated:</p> <ul style="list-style-type: none"> 0 = No source information provided 1 = Source information deliberately provided <p>Bits 55 and 56 shall indicate target altitude source:</p> <ul style="list-style-type: none"> 00 = Unknown 01 = Aircraft altitude 10 = FCU/MCP selected altitude 11 = FMS selected altitude 	
10	MSB = 32 768 feet		
11	MCP/FCU SELECTED ALTITUDE		
12			Range = [0, 65 520] feet
13			
14			
15			
16			
17	LSB = 16 feet		
18			
19			
20			
21			
22	STATUS		
23	MSB = 32 768 feet		
24	FMS SELECTED ALTITUDE		
25		Range = [0, 65 520] feet	
26			
27			
28			
29			
30			
31			
32	LSB = 16 feet		
33	BAROMETRIC PRESSURE SETTING		
34		MINUS 800 mb	
35		Range = [0, 410] mb	
36			
37			
38			
39			
40			
41	MSB = 204.8 mb		
42	LSB = 0.1 mb		
43			
44			
45			
46			
47			
47			

48	STATUS OF MCP/FCU MODE BITS	
49	VNAV MODE	
50	ALT	HOLD MCP/FCU Mode
51	APPROACH	
52	RESERVED	
53		
54	STATUS OF TARGET ALT SOURCE	
55	MSB	TARGET ALT SOURCE
56	LSB	

— END —