RTCA Special Committee 186, Working Group 5

ADS-B UAT MOPS

Meeting #25

Recommendations for the Target State and Status Format In Response to Action Item 24-03

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SUMMARY

This working paper is in response to UAT Action Item 24-03, to "Review the 1090-WP27-04R1 for the revised Target State and Status format and make proposals for all UAT MOPS changes related to requirements, formats, test procedures and Target State Reports."

Introduction:
The working paper "1090-WP28-05" specifies a recommended format for the Mode S BDS 6,2 register for use in a Version 2 ADS-B system. This working paper identifies the portions of that register that are applicable to the UAT datalink with regard to Target State and Status. Table 1 on the next page is copied from "1090-WP28-05". I have green-shaded the portions that are proposed for inclusion in the UAT MOPS.

The text following the table discusses the proposed data fields.

The section following that gives a proposed format for the Target State Element in Version 2 transmitted UAT ADS-B messages.

Table_1. BDS 6,2 UPDATED PROPOSED TARGET STATE AND STATUS MESSAGE			
"MB" FIELD DEFINITION			
1 2 3 4 5	MSB LSB	**FORMAT TYPE CODE = 29**	
6 7	MSB LSB	**SUBTYPE CODE = 1**	
8		**SPARE**	
9		**SELECTED ALTITUDE TYPE** (0 = MCP/FCU, 1 = FMS)	
10 11 12 13 14 15 16 17 18 19	MSB	= 32,768 feet **MCP / FCU SELECTED ALTITUDE** (when Selected Altitude Type = 0) **FMS SELECTED ALTITUDE** (when Selected Altitude Type = 1) Coding: 111 1111 1111 = 65,472 feet *** **** **** 000 0000 0010 = 32 feet 000 0000 0001 = 0 feet 000 0000 0000 = No Data or Invalid	
20	LSB	= 32 feet	
21 22 23 24 25 26 27 28	MSB	= 204.8 millibars **BAROMETRIC PRESSURE SETTING (MINUS 800 millibars)** Range = [0, 408.0] Resolution = 0.8 millibars Coding: 1 1111 1111 = 408.00 millibars * **** **** 0 0000 0010 = 0.800 millibars 0 0000 0001 = 0.000 millibars 0 0000 0000 = No Data or Invalid	
29	LSB	= 0.8 millibars	
30	STATUS	(0 = Invalid, 1 = Valid)	Updated Status Bit definition to be consistent with ICAO Doc. 9871 and RTCA DO-181D Appendix B.
31	SIGN	(0 = positive, 1 = negative)	
32 33 34 35 36 37 38	MSB	= 90 degrees **SELECTED HEADING** Range = [+/- 180 degrees Resolution = 0.703125 degrees (Typical Selected Heading Label = "101")	
39	LSB	0.703125 degrees (180/256)	
40 41 42 43	MSB LSB	**NAVIGATION ACCURACY CATEGORY__POSITION (NAC_P)**	
44		**NAVIGATION INTEGRITY CATEGORY_BARO (NIC_{BARO})**	
45 46	MSB LSB	**SYSTEM INTEGRITY LEVEL (SIL)**	
47		**STATUS OF MCP / FCU MODE BITS** (0 = INVALID, 1 = VALID)	
48		**AUTOPILOT ENGAGED** (0 = NOT ENGAGED, 1 = ENGAGED)	
49		**VNAV MODE ENGAGED** (0 = NOT ENGAGED, 1 = ENGAGED)	
50		**ALTITUDE HOLD MODE** (0 = NOT ENGAGED, 1 = ENGAGED)	
51		**Reserved for ADS-R Flag (ADS-B Rebroadcast) (see section 2.2.18.4.6)**	
52		**APPROACH MODE** (0 = NOT ENGAGED, 1 = ENGAGED)	
53		**TCAS OPERATIONAL** (0 = Not Operational, 1 = Operational)	
54 55 56	MSB LSB	EMERGENCY / PRIORITY STATUS	

Discussion of Target State fields

Material presented here is a summary of the proposed Target State Element. Specific MOPS text may readily be copied from the appropriate sections of "1090-WP28-05".

1. Selected Altitude Type (1 bit - SAT)
   0 indicates that the Selected Altitude is from a MCP or FCU.
   1 indicates that the Selected Altitude is from a FMS.

2. Selected Altitude (11 bits)
   Altitude encoded with 32 foot resolution. Range 0 to 65,472 feet. Value=0 encodes "No Data or Invalid".

3. Barometric Pressure Setting (9 bits)
   Barometric Pressure Setting minus 800 milllibars, encoded in 0.8 millibar resolution. Range 0.000 to 408.00 millibars. Value=0 encodes "No Data or Invalid".

4. Selected Heading (10 bits)
   Magnetic Heading encoded with 0.703125 degree resolution (180deg / 256). Range -180 to +180 degrees. Uses a separate sign bit, 0 = positive. Status bit encodes validity, 1 = Valid.

5. Status of MCP/FCU Mode Bits (1 bit - ST)
   This bit indicates whether the following four Mode indicators are valid for use by an ADS-B receiving application. Valid = 1.

6. Mode: Autopilot Engaged (1 bit - APE)
   0 = Not Engaged, 1 = Engaged

7. Mode: VNAV Mode Engaged (1 bit - VNAV)
   0 = Not Engaged, 1 = Engaged

8. Mode: Altitude Hold Mode (1 bit - ALT)
   0 = Not Engaged, 1 = Engaged

9. Mode: Approach Mode (1 bit - APP)
   0 = Not Engaged, 1 = Engaged

Proposed UAT Target State format
The existing UAT MOPS defines a Target State Report, which is Optional for Class A1H and higher.

Note that "1090-WP28-05" indicates that the Target State report is intended for periodic transmission (rather than on-condition). This is compatible with current UAT MOPS implementation. Adjustments may be needed in the Payload Transmission Cycle, depending on the required periodic transmission rate.

Since the existing Target State Element is not supported by any fielded avionics, either in report transmission or reception, this paper proposes that the existing Target State Element be superseded in-place by the definition shown in the following table.

Note that there are two forms for the Target State Element, one for Payload Type Codes 3 and, and another for Payload Type Code 6. Both forms may take the same format, with the appropriate byte offset. PTC 3 and 4 use Payload Bytes 30-33. PTC 6 uses Payload Bytes 25-28. See DO-282A Tables 2-51 and 2-62 for reference. Both byte offsets are listed in the first column of the following table.

The legacy Target State Element occupied 32 bits. The proposed Target State Element requires 36 bits. The report format has been expanded to use the reserved byte (34 or 29) shown in the referenced tables.

Proposed Target State Element

Payload Byte #	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7	Bit 8
30/25	SAT	(MSB)			Selected Altitude			
31/26				(LSB)	(MSB)			
32/27	Barometric Pressure Setting				(LSB)	Status	Sign	(MSB)
33/28	Selected Heading						(LSB)	ST
34/29	AP	VNAV	ALT	APP	(reserved)			

True/Mag Indicator in support of the Target State Report
DO-282A § 2.2.4.5.4.14 defines a bit in the Mode Status register which defines the angle reference for the Heading or Track Angle in the legacy Target State Element format. Since the proposed Target State Element only supports magnetic heading, this bit is no longer necessary. It may be deleted from the Mode Status Element, or marked as "reserved".