RTCA Special Committee 186, Working Group 5

ADS-B UAT MOPS

Meeting #26

Requirements and Test Procedures for the TARGET STATE Element In Response to Action Item 25-04

Revision 1

Presented by T. Mosher, Garmin AT, Inc.

SUMMARY
In response to Action Item 25-04, formal requirements and test procedures are provided for the TARGET STATE Element. The definition of these requirements was approved in UAT-WP25-10.

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2.2.4.5.6 TARGET STATE Element (Payload Type Codes "3" and "4")

The format for the TARGET STATE element shown in Table 1 **shall** apply to ADS-B Messages with "PAYLOAD TYPE CODES" of "3" and "4". Each of the fields show is defined in the following subparagraphs.

Table 1: Format of TARGET STATE Element for Payload Type Codes "3" and "4"

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

2.2.4.5.6.1 "Selected Altitude Type (SAT)" Field Encoding

The Selected Altitude Type (SAT) field (bit 1 of byte 30) shall be set to ZERO to indicate that the contents of the Selected Altitude field are provided from a Mode Control Panel (MCP) or Flight Control Unit (FCU). SAT shall be set to ONE to indicate that the contents of the Selected Altitude field are provided from a Flight Management System (FMS).

If the source for this field is unavailable, or if the "Data Lifetime" timeout listed for this field in Table 2-qq has expired, then the SAT field shall default to a value of ZERO.

2.2.4.5.6.2 "Selected Altitude" Field Encoding

The Selected Altitude field (bit 2 of byte 30 through bit 4 of byte 31) shall contain the Selected Altitude of the ADS-B Transmitting Subsystem as defined in Table 2.

If a source for this field is unavailable, or if the "Data Lifetime" timeout listed for this field in Table 2-qq has expired, then the Selected Altitude field shall default to a value of ALL ZEROS.

Table 2: "Selected Altitude" Field Encoding

Coding MSB(binary)LSB	**Coding** (decimal)	**Meaning**
000 0000 0000	0	No Data or Invalid
000 0000 0001	1	0 ft
000 0000 0010	2	32 ft
…	…	…
111 1111 1111	2,047	65,472 ft

Note: *When converting raw source data into the Selected Altitude field encoding, the accuracy of the data is maintained such that it is not worse than +/- 16 ft (+/- 1/2 LSB).*

2.2.4.5.6.3 "Barometric Pressure Setting" Field Encoding

The Barometric Pressure Setting field (bit 5 of byte 31 through bit 5 of byte 32) shall contain the Barometric Pressure Setting of the ADS-B Transmitting Subsystem minus 800 millibars, as defined in Table 3.

If a source for this field is unavailable, or if the "Data Lifetime" timeout listed for this field in Table 2-qq has expired, then the Barometric Pressure Setting shall default to a value of ALL ZEROS.

Table 3: "Barometric Pressure Setting" Field Encoding

Coding MSB(binary)LSB	**Coding** (decimal)	**Meaning**
0 0000 0000	0	No Data or Invalid
0 0000 0001	1	800.0 millibars
0 0000 0010	2	800.8 millibars
…	…	…
1 1111 1111	511	1,208 millibars

Note: *When converting raw source data into the Selected Altitude field encoding, the accuracy of the data is maintained such that it is not worse than +/- 0.4 millibars (+/- 1/2 LSB).*

2.2.4.5.6.4 "Selected Heading" Field Encoding

The Selected Heading field (bit 6 of byte 32 through bit 7 of byte 33) contains the Selected Heading of the ADS-B Transmitting Subsystem.

The Selected Heading Status (bit 6 of byte 32) shall be set to ONE if the contents of the Selected Heading sign and magnitude subfields are valid, or set to ZERO otherwise.

The Selected Heading Sign (bit 7 of byte 32) shall be set to ZERO if the Selected Heading is a positive angle, or to ONE if the Selected Heading is a negative angle.

The magnitude of the Selected Heading subfield (bit 8 of byte 32 through bit 7 of byte 33) shall be encoded as defined in Table 4.

If a source for this field is unavailable, or if the "Data Lifetime" timeout listed for this field in Table 2-qq has expired, then the entire Selected Heading field shall default to a value of ALL ZEROS.

Table 4: "Selected Heading" Magnitude Subfield Encoding

Coding MSB(binary)LSB	**Coding** (decimal)	**Meaning when Status = ONE (Valid)**
0000 0000	0	0.0 degrees
0000 0001	1	0.703 degrees (180/256)
0000 0010	2	1.406 degrees (2*180/256)
…	…	…
1111 1111	255	179.3 degrees (255*180/256)

Note: *When converting raw source data into the Selected Altitude field encoding, the accuracy of the data is maintained such that it is not worse than +/- (180/512) degrees (+/- 1/2 LSB).*

2.2.4.5.6.5 "Status of MCP/FCU Mode Bits (ST)" Field Encoding

The "Status of MCP/FCU Mode Bits (ST)" field (bit 8 of byte 33) shall be set to ONE when any of the "Mode:" fields defined in § 2.2.4.5.6.6 through § 2.2.4.5.6.9 are valid, or set to ZERO otherwise.

If the source for this field is unavailable, or if the "Data Lifetime" timeout listed for this field in Table 2-qq has expired, then the ST field shall default to a value of ZERO.

2.2.4.5.6.6 "Mode: Autopilot Engaged (AP)" Field Encoding

The "Mode: Autopilot Engaged (AP)" field (bit 1 of byte 34) shall be set to ONE when the MCP/FCU source indicates that the Autopilot function is engaged, or set to ZERO otherwise.

If the source for this field is unavailable, or if the "Data Lifetime" timeout listed for this field in Table 2-qq has expired, then the AP field shall default to a value of ZERO.

2.2.4.5.6.7 "Mode: VNAV Mode Engaged (VNAV)" Field Encoding

The "Mode: VNAV Mode Engaged (VNAV)" field (bit 2 of byte 34) shall be set to ONE when the MCP/FCU source indicates that the VNAV function is engaged, or set to ZERO otherwise.

If the source for this field is unavailable, or if the "Data Lifetime" timeout listed for this field in Table 2-qq has expired, then the VNAV field shall default to a value of ZERO.

2.2.4.5.6.8 "Mode: Altitude Hold Mode (ALT)" Field Encoding

The "Mode: Altitude Hold Mode (ALT)" field (bit 3 of byte 34) shall be set to ONE when the MCP/FCU source indicates that the Altitude Hold function is engaged, or set to ZERO otherwise.

If the source for this field is unavailable, or if the "Data Lifetime" timeout listed for this field in Table 2-qq has expired, then the ALT field shall default to a value of ZERO.

2.2.4.5.6.9 "Mode: Approach Mode (APP)" Field Encoding

The "Mode: Approach Mode (APP)" field (bit 4 of byte 34) shall be set to ONE when the MCP/FCU source indicates that the Approach Mode function is engaged, or set to ZERO otherwise.

If the source for this field is unavailable, or if the "Data Lifetime" timeout listed for this field in Table 2-qq has expired, then the APP field shall default to a value of ZERO.

2.2.4.5.7 TARGET STATE Element (Payload Type Code "6")

The format for the TARGET STATE element shown in Table 5 **shall** apply to ADS-B Messages with "PAYLOAD TYPE CODES" of "6". Each of the fields that are shown are defined in §2.2.4.5.6 and its subsections, with the exception of the Payload Byte offset shown.

Table 5: Format of TARGET STATE Element for Payload Type Code "6"

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

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2.4.4.5.6 Verification of TARGET STATE Element (Payload Type Codes "3" and "4") (§2.2.4.5.6)

Appropriate test procedures required to verify the requirements in §2.2.4.5.6 are included in §2.4.4.5.6.1 through §2.4.4.5.6.9.

2.4.4.5.6.1 Verification of "Selected Altitude Type (SAT)" Field Encoding (§2.2.4.5.6.1)

Purpose/Introduction:

The Selected Altitude Type (SAT) field (bit 1 of byte 30) shall be set to ZERO to indicate that the contents of the Selected Altitude field are provided from a Mode Control Panel (MCP) or Flight Control Unit (FCU). SAT shall be set to ONE to indicate that the contents of the Selected Altitude field are provided from a Flight Management System (FMS).

If the source for this field is unavailable, or if the "Data Lifetime" timeout listed for this field in Table 2-qq has expired, then the SAT field shall default to a value of ZERO.

Measurement Procedure:

Step 1: Selected Altitude from MCP/FCU

Via an appropriate means, indicate to the ADS-B Transmitting Subsystem that the Selected Altitude source is an MCP or FCU. Verify that the SAT field is set to ZERO.

Step 2: Selected Altitude from FMS

Via an appropriate means, indicate to the ADS-B Transmitting Subsystem that the Selected Altitude source is an FMS. Verify that the SAT field is set to ONE.

Step 3: Source Timeout

If appropriate for the installation, make the data source unavailable to the ADS-B Transmitting Subsystem, and verify that the SAT field is set to ZERO after the appropriate data lifetime has expired.

2.4.4.5.6.2 Verification of "Selected Altitude" Field Encoding (§2.2.4.5.6.2)

Purpose/Introduction:

The Selected Altitude field (bit 2 of byte 30 through bit 4 of byte 31) shall contain the Selected Altitude of the ADS-B Transmitting Subsystem as defined in Table 2.

If a source for this field is unavailable, or if the "Data Lifetime" timeout listed for this field in Table 2-qq has expired, then the Selected Altitude field shall default to a value of ALL ZEROS.

Measurement Procedure:

Step 1: Initial Conditions

Provide a source of Selected Altitude data to the ADS-B Transmitting Subsystem.

Step 2: Selected Altitude Encoding

For each row of Table 6, provide the given altitude to the ADS-B Transmitting Subsystem, and verify that the Selected Altitude field contains the corresponding value.

Table 6: Selected Altitude Encoding Values

Altitude	Coding MSB(binary)LSB
0 ft	000 0000 0001
32 ft	000 0000 0010
96 ft	000 0000 0100
224 ft	000 0000 1000
480 ft	000 0001 0000
992 ft	000 0010 0000
2,016 ft	000 0100 0000
4,064 ft	000 1000 0000
8,160 ft	001 0000 0000
16,352 ft	010 0000 0000
32,736 ft	100 0000 0000
65,472 ft	111 1111 1111

Step 3: Source Timeout

Make the source of Selected Altitude data unavailable to the ADS-B Transmitting Subsystem, and verify that the Selected Altitude field is set to ZERO after the appropriate data lifetime has expired.

2.4.4.5.6.3 Verification of "Barometric Pressure Setting" Field Encoding (§2.2.4.5.6.3)

Purpose/Introduction:

The Barometric Pressure Setting field (bit 5 of byte 31 through bit 5 of byte 32) shall contain the Barometric Pressure Setting of the ADS-B Transmitting Subsystem minus 800 millibars, as defined in Table 3.

If a source for this field is unavailable, or if the "Data Lifetime" timeout listed for this field in Table 2-qq has expired, then the Barometric Pressure Setting shall default to a value of ALL ZEROS.

Measurement Procedure:

Step 1: Initial Conditions

Provide a source of Barometric Pressure Setting data to the ADS-B Transmitting Subsystem.

Step 2: Barometric Pressure Setting Encoding

For each row of Table 7, provide the given pressure setting to the ADS-B Transmitting Subsystem, and verify that the Barometric Pressure Setting field contains the corresponding value.

Table 7: Barometric Pressure Setting Encoding Values

Barometric Pressure Setting (millibars)	**Coding** MSB(binary)LSB
800.0	0 0000 0001
800.8	0 0000 0010
802.4	0 0000 0100
805.6	0 0000 1000
812.0	0 0001 0000
824.8	0 0010 0000
850.4	0 0100 0000
901.6	0 1000 0000
1,004.0	1 0000 0000
1,208.0	1 1111 1111

Step 3: Source Timeout

Make the source of pressure setting data unavailable to the ADS-B Transmitting Subsystem, and verify that the Barometric Pressure Setting field is set to ALL ZEROS after the appropriate data lifetime has expired.

2.4.4.5.6.4 Verification of "Selected Heading" Field Encoding (§2.2.4.5.6.4)

Purpose/Introduction:

The Selected Heading field (bit 6 of byte 32 through bit 7 of byte 33) contains the Selected Heading of the ADS-B Transmitting Subsystem.

The Selected Heading Status (bit 6 of byte 32) shall be set to ONE if the contents of the Selected Heading sign and magnitude subfields are valid, or set to ZERO otherwise.

The Selected Heading Sign (bit 7 of byte 32) shall be set to ZERO if the Selected Heading is a positive angle, or to ONE if the Selected Heading is a negative angle.

The magnitude of the Selected Heading subfield (bit 8 of byte 32 through bit 7 of byte 33) shall be encoded as defined in Table 4.

If a source for this field is unavailable, or if the "Data Lifetime" timeout listed for this field in Table 2-qq has expired, then the entire Selected Heading field shall default to a value of ALL ZEROS.

Measurement Procedure:

Step 1: Initial Conditions

Provide a source of Selected Heading data to the ADS-B Transmitting Subsystem.

Step 2: Selected Heading Encoding

For each row of Table 8, provide the given selected heading value to the ADS-B Transmitting Subsystem, and verify that the Selected Heading and Sign fields contain the corresponding value, and that the Selected Heading Status field is set to ONE.

Table 8: Selected Heading Encoding Values

Selected Heading (degrees)	**Coding** sign	**Coding** magnitude MSB(binary)LSB
0	0	0000 0000
0.7	0	0000 0001
+45.0	0	0010 0000
+90.0	0	1000 0000
+135.0	0	1100 0000
+179.3	0	1111 1111
-180	1	1111 1111
-135	1	1100 0000
-90	1	1000 0000
-45	1	0010 0000

Step 3: Source Timeout

Make the source of selected heading data unavailable to the ADS-B Transmitting Subsystem, and verify that all of the Selected Heading fields are set to ALL ZEROS after the appropriate data lifetime has expired.

2.4.4.5.6.5 Verification of "Status of MCP/FCU Mode Bits (ST)" Field Encoding (§2.2.4.5.6.5)

Purpose/Introduction:

The "Status of MCP/FCU Mode Bits (ST)" field (bit 8 of byte 33) shall be set to ONE when any of the "Mode:" fields defined in § 2.2.4.5.6.6 through § 2.2.4.5.6.9 are valid, or set to ZERO otherwise.

If the source for this field is unavailable, or if the "Data Lifetime" timeout listed for this field in Table 2-qq has expired, then the ST field shall default to a value of ZERO.

Measurement Procedure:

Step 1: Initial Conditions

Provide a source of MCP/FCU Mode Bits to the ADS-B Transmitting Subsystem.

Step 2: Status of the MCP/FCU Mode Bits

Verify that the ST Field is set to ONE.

Step 3: Source Timeout

Make the source of MCP/FCU Mode Bits unavailable to the ADS-B Transmitting Subsystem, and verify that the ST Field is set to ZERO after the appropriate data lifetime has expired.

2.4.4.5.6.6 Verification of "Mode: Autopilot Engaged (AP)" Field Encoding (§2.2.4.5.6.6)

Purpose/Introduction:

The "Mode: Autopilot Engaged (AP)" field (bit 1 of byte 34) shall be set to ONE when the MCP/FCU source indicates that the Autopilot function is engaged, or set to ZERO otherwise.

If the source for this field is unavailable, or if the "Data Lifetime" timeout listed for this field in Table 2-qq has expired, then the AP field shall default to a value of ZERO.

Measurement Procedure:

Step 1: Initial Conditions

Provide a source of MCP/FCU Mode Bits to the ADS-B Transmitting Subsystem.

Step 2: Status of the AP Field

Verify that the AP Field is set to ONE when the Autopilot is engaged. Verify that the AP Field is set to ZERO when the Autopilot is disengaged.

Step 3: Source Timeout

Make the source of the AP Field unavailable to the ADS-B Transmitting Subsystem, and verify that the AP Field is set to ZERO after the appropriate data lifetime has expired.

2.4.4.5.6.7 Verification of "Mode: VNAV Mode Engaged (VNAV)" Field Encoding (§2.2.4.5.6.7)

Purpose/Introduction:

The "Mode: VNAV Mode Engaged (VNAV)" field (bit 2 of byte 34) shall be set to ONE when the MCP/FCU source indicates that the VNAV function is engaged, or set to ZERO otherwise.

If the source for this field is unavailable, or if the "Data Lifetime" timeout listed for this field in Table 2-qq has expired, then the VNAV field shall default to a value of ZERO.

Measurement Procedure:

Step 1: Initial Conditions

Provide a source of MCP/FCU Mode Bits to the ADS-B Transmitting Subsystem.

Step 2: Status of the VNAV Field

Verify that the VNAV Field is set to ONE when the VNAV mode is engaged. Verify that the VNAV Field is set to ZERO when the VNAV mode is disengaged.

Step 3: Source Timeout

Make the source of the VNAV Field unavailable to the ADS-B Transmitting Subsystem, and verify that the VNAV Field is set to ZERO after the appropriate data lifetime has expired.

2.4.4.5.6.8 Verification of "Mode: Altitude Hold Mode (ALT)" Field Encoding (§2.2.4.5.6.8)

Purpose/Introduction:

The "Mode: Altitude Hold Mode (ALT)" field (bit 3 of byte 34) shall be set to ONE when the MCP/FCU source indicates that the Altitude Hold function is engaged, or set to ZERO otherwise.

If the source for this field is unavailable, or if the "Data Lifetime" timeout listed for this field in Table 2-qq has expired, then the ALT field shall default to a value of ZERO.

Measurement Procedure:

Step 1: Initial Conditions

Provide a source of MCP/FCU Mode Bits to the ADS-B Transmitting Subsystem.

Step 2: Status of the ALT Field

Verify that the ALT Field is set to ONE when the Altitude Hold mode is engaged. Verify that the ALT Field is set to ZERO when the Altitude Hold mode is disengaged.

Step 3: Source Timeout

Make the source of the ALT Field unavailable to the ADS-B Transmitting Subsystem, and verify that the ALT Field is set to ZERO after the appropriate data lifetime has expired.

2.4.4.5.6.9 Verification of "Mode: Approach Mode (APP)" Field Encoding (§2.2.4.5.6.9)

Purpose/Introduction:

The "Mode: Approach Mode (APP)" field (bit 4 of byte 34) shall be set to ONE when the MCP/FCU source indicates that the Approach Mode function is engaged, or set to ZERO otherwise.

If the source for this field is unavailable, or if the "Data Lifetime" timeout listed for this field in Table 2-qq has expired, then the APP field shall default to a value of ZERO.

Measurement Procedure:

Step 1: Initial Conditions

Provide a source of MCP/FCU Mode Bits to the ADS-B Transmitting Subsystem.

Step 2: Status of the APP Field

Verify that the APP Field is set to ONE when the Approach mode is engaged. Verify that the APP Field is set to ZERO when the Approach mode is disengaged.

Step 3: Source Timeout

Make the source of the APP Field unavailable to the ADS-B Transmitting Subsystem, and verify that the APP Field is set to ZERO after the appropriate data lifetime has expired.

2.4.4.5.7 Verification of TARGET STATE Element (Payload Type Code "6") (§2.2.4.5.7)

Appropriate test procedures required to verify the requirements in §2.2.4.5.7 are included in §2.4.4.5.6.1 through §2.4.4.5.6.9.