

RTCA Special Committee 186, Working Group 3

ADS-B 1090 MOPS, Revision A

Meeting #1517

**Proposed Accommodation of the Broadcast of
Mode A Codes**

Prepared by Ron Jones, FAA, ASD-140

Summary

There has been some consideration of requiring ADS-B systems to broadcast Mode A codes when operated within certain U.S. airspace. This Working Paper, while not endorsing the need for the broadcast of Mode A codes, proposes a technical approach for accommodating the broadcast of Mode A codes using the 1090 MHz Extended Squitter.

Reference: DO-260A Draft 4F

1. Discussion

There has been some consideration within SC-186 of requiring ADS-B systems to broadcast Mode A codes when operated within certain U.S. airspace. This Working Paper, while not endorsing the need for the broadcast of Mode A codes, proposes a technical approach for accommodating the broadcast of Mode A codes using the 1090 MHz Extended Squitter.

The basis for the proposed approach is summarized in the following points:

1. Knowledge of the aircraft's Mode A identity codes is only needed by certain ground ATC automation systems and not by other aircraft
2. Future U.S. ATC automation systems will eliminate the need for including Mode A ID codes in ADS-B.
3. Based on discussions with ICAO SCRSP, the desire to include Mode A codes within ADS-B appears to be unique to the U.S. since most other countries planning for the use of ADS-B do not have the same limitations within their ATC automation systems. Therefore, it will not be possible to include a requirement ~~for the~~ to broadcast ~~of~~ Mode A identity codes within ICAO standards.
4. As a consequence of 3) above, the broadcast of Mode A identity codes will need to be inhibited when aircraft operate outside of the U.S.
- ~~5. With 1090ES, when equipped aircraft are operating within SSR coverage, there is no need to broadcast the Mode A codes. This occurs since the ADS-B target reports will need to be "fused" with the corresponding SSR target report before it is processed by the ground ATC automation functions and as a result the target report provided to the controller and the ATC automation functions will include the Mode A code as received by the SSR. Therefore, within SSR coverage the broadcast of Mode A codes by ADS-B will need to be inhibited to preserve link capacity. Thus, in most of the NAS where 1090ES will be used there will be no need, nor desire to allow, for the broadcast of Mode A codes by ADS-B. Exceptions will include parts of Alaska and potentially certain other low altitude airspace below the coverage floor of SSR.~~
65. It is desirable to select a 1090ES message format that would not be received and used for report generation onboard airborne ADS-B systems.

As a result of the above the use of 1090ES "TEST" message is recommended as the best solution to convey the Mode A codes. In order to do this it will be necessary to define a SUBTYPE code for the "TEST" (i.e., TYPE=23) messages and to then assign a Subtype code specifically for allowing "TEST" messages to convey an aircraft's Mode A code. Also a means will need to be provided to allow the flight crew to enable or disable the transmission of this "TEST" message. In DO-260A we would need to revise the specification for the TEST message, the associated update rate and the TEST message lifetime.

2. Proposal

If it is determined that accommodation must be provided within ADS-B for the broadcast of Mode A codes, then the following revisions to DO-260A are proposed.

CHANGE #1

2.2.3.2.7.3 Type “23” ADS-B Messages for “TEST”

Type “23” ADS-B Messages shall be used for Test Purposes. “TEST” messages **shall** be used exclusively for the broadcast of information in support of bench and/or certification testing of 1090 MHz ADS-B system or for the broadcast of information of interest only to local ~~ground~~ ADS-B ground applications. “TEST” message broadcasts ~~will~~ **are** not ~~to~~ result in an ADS-B report being generated onboard any other ADS-B equipped aircraft, nor is the specific information being included in the test message expected to be generally codified within internationally accepted standards. “TEST” messages containing information of interest only to local ~~ground~~ ADS-B ground applications are intended to be used in support of technical or operational evaluations or in support of local operational requirements.

These MOPS define two categories of use for “TEST” Messages, **SUBTYPE** **SUBTYPE=0** and **SUBTYPE-SUBTYPE=7**. “TEST” messages of SUBTYPEs 1 through 6 are reserved.

2.2.3.2.7.3.1 “TEST” Messages with SUBTYPE=0 ~~SUBTYPE “0” “TEST” Message~~

“TEST” Messages with SUBTYPE=0 ~~SUBTYPE “0” “TEST”~~ **messages shall** be used only for messages in support of bench and or certification testing of 1090 MHz ADS-B systems. The format for the “TEST” Messages with SUBTYPE=0 ~~SUBTYPE “0” “TEST”~~ **messages** shall be as shown in Figure 2.2.3.2.7.3-1.

“TEST MESSAGE (TYPE=23 and SUBTYPE=0)”					
Msg. Bit #	33	37	38	40	44 <u>41</u> 88
“ME” Bit #	1	5	6	8	12 <u>9</u> 56
Field Name	Type = 23 [5]		Subtype = 0 [3]		Unformatted Test Data [48]
	MSB	LSB	MSB	LSB	MSB LSB

Figure 2.2.3.2.7.3-1: “TEST” Messages with SUBTYPE=0 ~~TEST Message (TYPE=23 and SUBTYPE=0)~~ Format

2.2.3.2.7.3.2 ~~“TEST” Messages with SUBTYPE=7~~ ~~SUBTYPE “7” “TEST” Message~~

Notes:

1. The ~~“TEST” Message with SUBTYPE=7~~ ~~SUBTYPE 7 TEST message~~ is provided as a transitional feature to aid operation of ground ATC automation systems that use the Mode A code for flight plan correlation. The requirement for this message may be removed from future versions of these MOPS.
2. The ~~“TEST” Message with SUBTYPE=7~~ ~~SUBTYPE 7 TEST message~~ is not applicable to Class B2 equipment.

~~“TEST” Messages with SUBTYPE=7~~ ~~SUBTYPE “7” “TEST” messages~~ shall be used for the broadcast of the Mode A, 4096, code currently assigned to the aircraft. The format for ~~“TEST” Messages with SUBTYPE=7~~ ~~SUBTYPE “7” “TEST” messages~~ shall be as shown in Figure 2.2.3.2.7.3-2. The Mode A Code subfield shall be coded as defined in RTCA DO-181C, §2.2.13.1.2.b and §2.2.4.1.2. Starting with “ME” bit ~~129~~, the sequence shall be C1, A1, C2, A2, C4, A4, ZERO, B1, D1, B2, D2, B4, D4. ~~The generation of the SUBTYPE “7” “TEST” messages shall be inhibited if the Mode A code has not been received from an on-board source within the past 5 seconds.~~

~~“TEST” Messages with SUBTYPE=7~~ ~~The SUBTYPE “7” “TEST” messages~~ shall not be broadcast when the aircraft is in the “on the ground” state (2.2.3.2.1.2).

“TEST MESSAGE (TYPE=23 and SUBTYPE=7)”								
Msg. Bit #	33	37	38	40	44 41	57 54		
					56 53	88		
“ME” Bit #	1	5	6	8	12 9	25 22		
					24 21	56		
Field Name	Type = 23 [5]		Subtype = 7 [3]		Mode A Code [13]		Reserved [35]	
	MSB	LSB	MSB	LSB	MSB	LSB	MSB	LSB

Figure 2.2.3.2.7.3-2: ~~“TEST” Messages with SUBTYPE=7~~ ~~TEST Message (TYPE=23 and SUBTYPE=7) Format~~

2.2.3.2.7.3.2.1 ~~“TEST” Messages with SUBTYPE=7~~ ~~SUBTYPE “7”~~ Global Enable/Inhibit

Provision shall be made for a global parameter to control the transmission of the ~~“TEST” Message with SUBTYPE=7~~ ~~SUBTYPE 7 TEST message~~. This parameter shall specify one of the following conditions:

- a. Inhibit transmission of the SUBTYPE 7 TEST message
- b. Enable transmission of the SUBTYPE 7 TEST message
- c. Enable transmission of the SUBTYPE 7 TEST message with a geographic filter (2.2.3.2.7.3.2.2)

For this version of these MOPS, the parameter shall be set as specified in subparagraph c, above

2.2.3.2.7.3.2.2 ~~“TEST” Messages with SUBTYPE=7, SUBTYPE “7”~~ Geographic Filter

Note: Geographic filtering is used as a means to automatically enable or inhibit the broadcast of ~~“TEST” Messages with SUBTYPE=7, Type=23 with Subtype=7 test messages~~ conveying the Mode A code of the aircraft. The following subparagraphs define the minimum level of geographic filtering necessary to satisfy this requirement. More sophisticated geographic filtering techniques may be used provided they can be demonstrated to enable the broadcast of ~~“TEST” Messages with SUBTYPE=7, Type=23 with Subtype=7 test messages~~ when the aircraft is operating within US airspace and inhibited ~~when~~with operating outside the general boundaries of North America (plus Hawaii).

~~Broadcast of “TEST” Messages with SUBTYPE=7, SUBTYPE “7” TEST message broadcast~~ shall be enabled only if the following geographic conditions are satisfied:

(Latitude-A1 = Lat_{current} = Latitude-A2 (north positive), AND

Longitude-A1 = Lon_{current} = Longitude-A2 (east positive))

OR

(Latitude-B1 = Lat_{current} = Latitude-B2 (north positive), AND

Longitude-B1 = Lon_{current} = Longitude-B2 (east positive))

~~Where Lat_{current} and Lon_{current} define the current aircraft position.~~

OR

(Latitude-C1 = Lat_{current} = Latitude-C2 (north positive), AND

Longitude-C1 = Lon_{current} = Longitude-C2 (east positive))

Where Lat_{current} and Lon_{current} define the current aircraft position.

Latitude and longitude with a resolution of 0.1 degree or better shall be used for the purpose of determining whether the above criteria are satisfied.

For this version of these MOPS:

Latitude-A1 = 18.0 <u>degrees</u>	Latitude-A2 = 75.0 <u>degrees</u>
Longitude-A1 = -170.0 <u>degrees</u>	Longitude-A2 = -65.0 <u>degrees</u>
Latitude-B1 = reserved	Latitude-B2 = reserved
Longitude B1 = reserved	Longitude-B2 = reserved
Latitude-C1 = reserved	Latitude-C2 = reserved
Longitude C1 = reserved	Longitude-C2 = reserved

Notes:

1. Negative longitudes listed above are synonymous with west longitude.
2. Additional geographic areas may be used if ~~required~~desired to better define the specified operating area.

~~Broadcast of “TEST” Messages with SUBTYPE=7~~SUBTYPE “7” TEST message broadcast shall be inhibited if the current position is not available.

CHANGE #2

2.2.3.3.1.4.4 “TYPE 23 (TEST)” ADS-B Event-Driven Message Broadcast Rate

~~The following broadcast rate requirements shall apply only under the condition that “TEST” Messages of the SUBTYPE indicated are authorized to be transmitted. Section 2.2.3.2.7.3 requires a means for the flight crew to enable the transmission of “TEST” Messages when operating in airspace or under operating conditions where such transmissions are authorized. The default condition shall be to inhibit transmission of the “TEST” Messages.~~

The “TEST” ADS-B Event-Driven Messages with SUBTYPE = “0” shall be broadcast NOT MORE THAN ONCE each time the Event Driven Test Information is updated to the transponder.

~~Note: Section 2.2.3.2.7.3 requires a means for the flight crew to enable the transmission of SUBTYPE = “0” “TEST” Messages when operating in airspace or under operating conditions where such transmissions are authorized. The default condition is to inhibit transmission of the SUBTYPE = “0” “TEST” Messages.~~

~~The~~When enabled (§2.2.3.2.7.3.2.2), the “TEST” ADS-B Event-Driven Messages with SUBTYPE = “7” shall be broadcast at random intervals that are uniformly distributed

over the range of 11.8 to 12.2 seconds from the time of transmission of the previous “TEST” ~~message~~ Message with SUBTYPE=-7.

CHANGE #3

Modify the entry in Table 2.2.3.3.1.4.6.1 for Message Type 23 as follows:

Message Type	Message SUBTYPE	Message Lifetime (seconds)
23	= 0	5.0 seconds (+/- 0.2 sec.)
	= 1, 2, 3, 4, 5 or 6	Reserved (see note)
	= 7	24 seconds (+/- 0.2 sec.)

CHANGE #4

Insert 2.2.5.1.52:

The ADS-B Transmitting Subsystem **shall** accept the own vehicle Mode A (4096) Code from the transponder function and use such data to establish the Mode A Code subfield transmitted in the ADS-B “TEST” Message as specified in §2.2.3.2.7.3.

CHANGE #5

Insert 2.4.5.1.52 testing the data input for the Mode A Code.

CHANGE #6

Insert the following text as a second paragraph to 2.2.3.3.2.7

~~The~~ When enabled (§2.2.3.2.7.3.2.1), the “TEST” ADS-B Event-Driven Messages with SUBTYPE = “7” **shall** be broadcast at random intervals that are uniformly distributed over the range of 11.8 to 12.2 seconds from the time of transmission of the previous “TEST” message with SUBTYPE = 7.

CHANGE #7

Insert the following text on to the end of the paragraph in both §2.2.3.3.1.4.6.1 and §2.4.3.3.1.4.6.1 that defines the priority level of 4 (iv):

When enabled (§2.2.3.2.7.3.2.1), the “TEST” Message with SUBTYPE=7 **shall** be transmitted at the rate specified in §2.2.3.3.1.4.4.

CHANGE #8

Add a row onto the bottom of Table 2.4.3.3.1.4.6.1 which defines the Message Priority Level of the “TEST” Message with SUBTYPE=7, with a value of “4”