RTCA Special Committee 186, Working Group 3
EUROCAE WG-51, SG-1

ADS-B 1090ES MOPS Maintenance

Meeting #28

16 to 19 June 2009

Report on Action Item 26-05 regarding
Change Item #29 - Clarify start/end of squittering
Revision 1

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Summary
This Working Paper addresses Change Item #29, "Clarify start/end of squittering" taking into account and complementing the proposed changes related to the use of TYPE code 0 as proposed in WP26-09.

1 Introduction

This Working Paper is an update of WP26-27. It addresses Change Item #29, "Clarify start/end of squittering". It addresses the different issues as discussed during previous meetings of SC186-WG3/ WG51-SG1 and proposes changes to ED102/DO260 taking into account the proposed changes related to TYPE code zero (WP24-06 + ICAO TSG WP06-04R1+ WP26-09) and changes related to the termination of Target State and Status and Operational Status when removed from event driven squitter..

~~3~~2 Summary of current and proposed ES timeout and termination

	Timeout		**Termination**	
Messages	**Existing**	**Proposed**	**Existing**	**Proposed**
Airborne position	2.2.3.3.2.11 a Cleared after 2s except altitude and surveillance status field	Same	2.2.3.3.2.12 a + A.1.5.3 after 60s Continue to be transmitted if altitude is present (A.1.5.3)	continues to be transmitted if altitude remains available, stops if position and altitude disappears for 60s
Surface position	2.2.3.3.2.11 a Cleared after 2s	same + clarify that movement is also cleared	2.2.3.3.2.12 + A.1.5.3 after 60s Continue if movement information is received (*Conflict with format TYPE code = 0!)*	transmission stopped after the timeout Movement/ground track not sufficient to continue broadcast
Airborne Velocity	2.2.3.3.2.11 a Cleared after 2s	Cleared after 2.6s	2.2.3.3.2.12 a + A.1.5.3 after 60s	transmission stopped after the timeout
Aircraft Identification	2.2.3.3.2.11 b Not cleared before 60s	Same = Not cleared	2.2.3.3.2.12 a states that it shall stop after 60s however continuation tested at 61s in 2.4.3.3.2.4 step 4	never cleared
Target State and Status		2s for certain fields		when transmission of airborne position stopped
Operational Status		not cleared		when transmission of airborne and surface position stopped
Event-Driven	Never 2.2.3.3.2.11 c		Target State and Status + Operational Status are cleared after 60s event driven specific	No change

Clearing of content:

It is proposed to use the same approach than in ICAO Doc 9871, i.e., the content of the registers or the specific fields is cleared when the registers or fields are not updated for a time greater than twice the specified maximum update interval, or 2 seconds (whichever is the greater).

It results in a time of:

- 2s for airborne and surface position squitter;
- 2.6s for the Airborne Velocity Message;
- 2s for some fields of TSS;
- 2s for some fields of OS.

The Surface Position message is containing position fields to be updated every 200ms and movement/ ground track fields to be update every 1.3s. The new approach considers that the Movement and Ground Track fields are not sufficient to continue to broadcast a non-zero message and therefore the time-out value used remains 2s.

Clearing of Airborne Velocity message is questionable as each main parameters (velocity, vertical rate,…) can be coded to indicate that there is no data available. Nevertheless the proposal has kept the current approach for the Airborne velocity message.

43 Proposed text for timeout and termination requirements:

The following pages contain existing text with suggested changes using **MS revision marks**.

When required some portions of text have been highlighted in yellow to show the differences with WP26-09 and in red to show the difference with WP26-27.

In order to clarify the timeout and termination it is proposed to specify what shall be done register per register in section 2.2.3.3.2.11 (timeout) and 2.2.3.3.2.12 (termination) as follows:

2.2.3.3.2.11 ADS-B Message Timeout

Notes:

1. The messages are cleared to prevent the reporting of outdated position and velocity information.

2. During a register timeout event, the "ME" field of the ADS-B Broadcast Message may contain ALL ZEROs, except for those fields that may be updated due to the receipt of new data.

a. The ADS-B Transmitting Subsystem **shall** clear all ~~56-bits~~but the altitude and surveillance status subfields of the Airborne Position Message~~, Surface Position Message and Airborne Velocity Message~~ if no new position data is received within two (2) seconds of the previous input data update ~~. This timeout requirement **shall** be applied individually for each of the three (3) message types identified.~~

Note: During a timeout event the Format TYPE Code is set to zero (see §2.2.3.2.3.2.3.1).

~~***Notes:***~~

~~*1. These messages are cleared to prevent the reporting of outdated position and velocity information.*~~

~~*2. During a register timeout event, the "ME" field of the ADS-B Broadcast Message may contain ALL ZEROs, except for those fields that may be updated due to the receipt of new data.*~~

b. The ADS-B Transmitting Subsystem **shall** clear all 56-bits of Surface Position Message if no new position data is received within two (2) seconds of the previous input data update.

Note:

*1. During a timeout event the Format TYPE Code is set to zero (*see *§2.2.3.2.4.1.3.1).*

2. When position is available, the ADS-B Transmitting subsystem manages the movement and the ground track subfields such that the subfields and applicable status bits are set to ZERO (0) if no new data is received for the subfield within 2.6 seconds of the last data update of the subfield.

3. *When position data is not received all bits of the Surface Position Message are zeroed to avoid confusion with altitude data in airborne position message sent with TYPE code 0.*

c. The ADS-B Transmitting Subsystem **shall** clear all 56-bits of Airborne Velocity Message if no data is received within 2.6 seconds of the previous input data update.

Note: The Intent change information ~~and the IFR capability flag update are~~is not sufficient to consider that new data ~~have~~has been received (2.2.3.2.6.1.c)

~~b~~d. The ADS-B Transmitting Subsystem **shall not** clear the Aircraft Identification Message (see §2.2.3.2.5) if no new data (neither aircraft type, emitter category, nor identification data) is received within up to 60 seconds of the previous input data update.

Note: *The Aircraft Identification Message is not cleared since it contains data that rarely changes in flight and is not frequently updated.*

e. The ADS-B Transmitting Subsystem **shall** clear each of the Selected Altitude, Selected Heading, or Barometric Pressure Setting subfields of the Target State and Status Message if no

new data is received within 2.0 seconds of the previous input data update. Each of the fields shall be cleared independently of the other fields. That is, each of the three specified subfields **shall** be processed mutually exclusively of the other two specified subfields. The remaining subfields of the Target State and Status Message **shall not** be cleared as they contain other integrity, mode, or status information.

f. The ADS-B Transmitting Subsystem **shall not** clear the Operational Status Messages as the subfields of the message contain various integrity, mode, or status information.

g. The ADS-B Transmitting Subsystem **shall not** clear the Event-Driven Messages (see 2.2.3.2.7) if no new data is received within up to 60 seconds of the previous input data update.

Note: *The Event-Driven Messages do not need to be cleared since contents of such messages are only broadcast once each time that new data is received.*

2.2.3.3.2.12 ADS-B Message Termination

a. The ADS-B Transmitting Subsystem **shall** terminate broadcast transmissions of the Airborne Position Message when position (latitude/longitude) and altitude data are both ~~, Surface Position, Aircraft Identification and Category, Velocity, Target State and Status, and/or Aircraft Operational Status Messages if input data necessary to update the particular ADS-B Message TYPE is~~ not~~ more~~ available for a period of 60 seconds.

Notes:

~~1~~. *For the Airborne Position Message, ~~specifically,~~ Altitude Data alone is sufficient to maintain broadcast of the message once the message has been initiated. When altitude is available, the airborne position message continues to be transmitted after 60s however if the altitude is~~becomes~~ not available for 60s the airborne position message transmission is stopped and the conditions for start-up defined in 2.2.3.3.2.1.2 are necessary to resume the transmission of Airborne Position Message.*.

~~. For all other ADS-B Messages, the receipt of new data necessary to update any single parameter of the message is sufficient to maintain broadcast of the message once the message has been initiated~~

b. The ADS-B transmitting Subsystem **shall** terminate the transmission of Surface Position Message if position data necessary to update the message is not available for a period of 60 seconds. Transmission termination of Surface Position Messages does not apply to Non-Transponder Devices on aircraft that are on the surface, or on surface vehicles.

Note~~s~~: ~~2.~~ For the Surface Position Message, the receipt of new ~~Position (i.e., Latitude and Longitude, combined)~~,Movement, or Ground Track data is not sufficient to maintain broadcast of the message once the message has been initiated.

c. The ADS-B Transmitting Subsystem **shall not** terminate broadcast transmissions of Aircraft Identification and Category Message even if input data necessary to update the message is not available for a period of 60 seconds.

d. The ADS-B Transmitting Subsystem **shall** terminate broadcast transmissions of the Airborne Velocity Message if input data necessary to update the fields of the Airborne Velocity Message, other than the Intent Change Flag, ~~and IFR Capability Flag are~~ is not available for a period of 2.6 seconds.

Notes:

1. The receipt of new data necessary to update any single field other than the Intent Change Flag ~~and IFR Capability Flag~~ is sufficient to maintain broadcast of the Airborne Velocity Message .

2. Previous versions of these MOPS required velocity squitter to be transmitted for an additional 60 seconds with all zeros including the Type Code field. In the event of a loss of GPS data the airborne position squitter would have barometric altitude in it, the velocity squitter would not. However, a receiver could not determine the difference between these cases, therefore the transmitted altitude was not usable.

e. The ADS-B Transmission Subsystem **shall** continue to broadcast transmissions of the Target State and Status message for as long as Airborne Position Messages are being broadcast. ~~That is, broadcast transmissions of the Target State and Status message **shall not** be terminated unless broadcast transmissions of the Airborne Position Messages have been terminated.~~

Note: *Target State and Status Messages do not need to be terminated until the Airborne ~~and surface~~ Position Messages are terminated since the Target State and Status Messages contain various integrity, mode, or status information that is applicable to the Airborne Position Messages.*

f. The ADS-B Transmission Subsystem shall continue to broadcast transmissions of the Operational Status Messages for as long as Airborne Position Messages or Surface Position Messages are being broadcast. ~~That is, broadcast transmissions of the Operational Status message shall not be terminated unless broadcast transmission of the Airborne Position Messages and the Surface Position messages have been terminated.~~

Note: *Operational Status Messages do not need to be terminated until the Airborne Position Messages and the Surface Position Messages are terminated since the Operational Status Messages contain various integrity, mode, or status information that is applicable to the Airborne Position Messages or the Surface Position Messages.*

~~Note: The Event-Driven Messages do not need to be cleared since contents of such messages~~

In addition the different sub-sections of 2.2.3.2.6 must be checked and adapted as proposed below. The differences with WP 26-09 are highlighted in yellow.

2.2.3.2.6.1 ADS-B Airborne Velocity Message - Subtype=1

a. The Airborne Velocity Message - Subtype=1 is illustrated in Figure 2-7 and shall be transmitted by the Airborne ADS-B Transmitting Subsystem when Velocity Over Ground information is available, and the transmitting device is installed in an environment having *NON*-supersonic airspeed capability.

b. The Supersonic Version of the Airborne Velocity Message (i.e., Subtype=2) shall be used if either the East/West velocity OR the North/South velocity exceeds 1022 knots. A switch to the normal velocity message (i.e., Subtype=1) shall be made if both the East/West and the North/South velocities drop below 1000 knots.

c. The Airborne Velocity Message shall not be broadcast if the only valid data are the Intent Change and the IFR Capability Flags.

(1). Transponder-Based ADS-B Transmitting Subsystems shall suppress the broadcast by loading Register 09_{16} with all "ZEROs" and then discontinuing updating of the register until data input is available again. The Transponder will ZERO the Velocity Message after 2.6 seconds and terminate the broadcast ~~after 60 seconds, as specified in RTCA DO-181D (EUROCAE ED-73C)~~.

(2). Non-Transponder-Based ADS-B Transmitting Subsystems shall ZERO the Velocity Message after 2.6 seconds and terminate the broadcast ~~after 60 seconds~~ as specified in §2.2.3.3.2.11 and §2.2.3.3.2.12.

…

2.2.3.2.6.2 ADS-B Airborne Velocity Message - Subtype=2

a. The Airborne Velocity Message - Subtype=2 is illustrated in Figure 2-7 and shall be transmitted by the Airborne ADS-B Transmitting Subsystem when Velocity Over Ground information is available, and the transmitting device is installed in an environment having a Supersonic airspeed capability.

b. The Supersonic Version of the Airborne Velocity Message (i.e., Subtype=2) shall be used if either the East/West Velocity OR the North/South Velocity exceeds 1022 knots. A switch to the normal Airborne Velocity Message (i.e., Subtype=1) shall be made if both the East/West and the North/South Velocities drop below 1000 knots.

c. The Airborne Velocity Message shall not be broadcast if the only valid data are the Intent Change and the IFR Capability Flags.

(1). Transponder-Based ADS-B Transmitting Subsystems shall suppress the broadcast by loading Register 09_{16} with all "ZEROs" and then discontinuing updating of the Register until data input is available again. The Transponder will ZERO the Velocity Message after 2.6 seconds and terminate the broadcast ~~after 60 seconds, as specified in RTCA DO-181D (EUROCAE ED-73C)~~.

(2). Non-Transponder-Based ADS-B Transmitting Subsystems shall ZERO the Velocity Message after 2.6 seconds and terminate broadcast ~~after 60 seconds~~, as specified in §2.2.3.3.2.11 and §2.2.3.3.2.12.

…

2.2.3.2.6.3 ADS-B Airborne Velocity Message - Subtype=3

a. The Airborne Velocity Message - Subtype=3 is illustrated in Figure 2-8 and **shall** be transmitted by the Airborne ADS-B Transmitting Subsystem when Velocity Over Ground information is not available, and the transmitting device is installed in an environment having *NON*-supersonic airspeed capability.

b. The Supersonic Version of the Airborne Velocity Message (i.e., Subtype=4) **shall** be used if the airspeed exceeds 1022 knots. A switch to the normal Velocity Message (i.e., Subtype=3) **shall** be made if the airspeed drops below 1000 knots.

c. The Airborne Velocity Message **shall** not be broadcast if the only valid data is the Intent Change and the IFR Capability Flags.

(1). Transponder-Based ADS-B Transmitting Subsystems **shall** suppress the broadcast by loading Register 09_{16} with all "ZEROs" and then discontinuing updating of the Register until data input is available again. The Transponder will ZERO the Velocity Message after 2.6 seconds and terminate the broadcast ~~after 60seconds, as specified in RTCA DO-181D (EUROCAE ED-73C)~~.

(2). Non-Transponder-Based ADS-B Transmitting Subsystems **shall** ZERO the Velocity Message after 2.6 seconds and terminate the broadcast ~~after 60 seconds~~, as specified in §2.2.3.3.2.11 and §2.2.3.3.2.12.

2.2.3.2.6.4 ADS-B Airborne Velocity Message - Subtype=4

a. The Airborne Velocity Message - Subtype=4 is illustrated in Figure 2-8 and **shall** be transmitted by the Airborne ADS-B Transmitting Subsystem when Velocity Over Ground information is ***NOT*** available, and the transmitting device is installed in an environment having Supersonic airspeed capability.

b. The Supersonic Version of the Airborne Velocity Message (i.e., Subtype=4) **shall** be used if the airspeed exceeds 1022 knots. A switch to the normal Velocity Message (i.e., Subtype=3) **shall** be made if the airspeed drops below 1000 knots.

c. The Airborne Velocity Message **shall** not be broadcast if the only valid data is the Intent Change and the IFR Capability Flags.

(1). Transponder-Based ADS-B Transmitting Subsystems **shall** suppress the broadcast by loading Register 09_{16} with all "ZEROs" and then discontinuing updating of the Register until data input is available again. The Transponder will ZERO the Velocity Message after 2.6 seconds and terminate the broadcast ~~after 60 seconds, as specified in RTCA DO-181D (EUROCAE ED-73C)~~.

(2). Non-Transponder-Based ADS-B Transmitting Subsystems **shall** ZERO the Velocity Message after 2.6 seconds and terminate the broadcast ~~after 60 seconds~~, as specified in §2.2.3.3.2.11 and §2.2.3.3.2.12.

Each of the subfields of the Airborne Velocity Message - Subtype=4 is specified in the following subparagraphs.

Modifications in Annex A

Just a commentary or reminder at this point that the following will need to be updated in RTCA DO-260A Appendix A due to the redefinition of the Target State and Status Message as well as the movement of the Target State and Status and Operational Status Messages out of the Event Driven Squitter and into being periodic squitter messages.

a. Section A.1.4.8 needs update due to addition of the RA Broadcast

b. Section A.1.4.9 –through- A.1.4.9.16 need to be updated due to redefinition of the Target State and Status message and movement of the message into the periodic squitter message set.

c. Section A.1.4.10 –through- A.1.4.10.2 need to be updated due to movement of the Operational Status Message into the periodic squitter message set.

d. Section A.1.5.2 needs to be updated to be consistent with the changes made above in section 2.2.3.3.2.11.

e. Section A.1.5.1 and A.1.5.2 will need to be updated to take into consideration the moving of the Target State and Status and Operational Status Messages from Event Driven to Periodic messages protocol.

f. Section A.1.5.3 needs to be updated to take into consideration timeout of the Target State and Status and Operational Status Messages as was done above for section 2.2.3.3.2.12.

A.1.5.3 Termination of Extended Squitter Broadcast

If input to Register 05_{16} or 06_{16} ~~, 07_{16}, or 09_{16}~~ stops for 60 seconds broadcast of the associated Extended Squitter type will be discontinued until data insertion is resumed.

The insertion of altitude by the transponder will satisfy the minimum requirement for continuing to broadcast the airborne position squitter.

If input to register 09_{16} stops for 2.6s broadcast of the associated Extended Squitter type will be discontinued until data insertion is resumed.

Notes:

1. Until timeout, an Extended Squitter type may contain an ME field of ALL ZEROs.

2. Continued transmission for 60 seconds is required so that receiving aircraft will know that the data source for the message has been lost.

A.1.6.3.2 Broadcast of Format TYPE Code Equal to Zero

Format TYPE Code 0 will only be set by the following events:

1. Airborne Position or Surface Position ~~Extended Squitter Register monitored by the transponder~~ (Register 05_{16} and~~,~~ 06_{16}~~, 07_{16} and 09_{16}~~) has not been loaded by the GFM for 2 seconds. In this case the transponder clears the entire 56 bits of the register that timed out. (In the case of the Airborne Position register, the altitude subfield is only ZEROed if no altitude data is available). Transmission of the Airborne and Surface Position Extended Squitter that broadcasts the timed out register will itself stop in 60 seconds except for the airborne position message when altitude is still available. Broadcast of this Extended Squitter will resume when the GFM begins to insert data into the register.

2. The GFM determines that all navigation sources that can be used for the Extended Squitter airborne or Surface Position Message are either missing or invalid. In this case the GFM can clear the Format TYPE Code and all other fields of the airborne position, surface position~~, or airborne velocity message~~ and insert this zeroed message in the appropriate register. This should only be done once so that the transponder can detect the loss of data insertion and suppress the broadcast of the related squitter

   Note that in all of the above cases, a Format TYPE Code of ZERO contains a message of ALL ZEROs. The only exception is the airborne position format that may contain barometric altitude and surveillance status data as set by the transponder. There is no analogous case for the other Extended Squitter format types, since a ZERO value in any of the fields indicates no information. No other squitter types are broadcast with TYPE code Zero.

The associated tests should be modified as follows:

…

2.4.3.2.3 Verification of ADS-B Airborne Position Messages (§2.2.3.2.3)

…

2.4.3.2.3.1.3.1 Verification of Significance of TYPE Code Equal to ZERO (§2.2.3.2.3.1.3.1)

Measurement Procedure:

~~Step 1: TYPE ZERO Verification - Part 1~~

Configure the ADS-B Transmitting Subsystem to Airborne status. Provide valid altitude code data and a permanent alert (emergency condition) to the ADS-B Transmitting Subsystem. Connect the GNSS data input and verify that Airborne Position, Velocity and Aircraft Identification Messages are transmitted at the proper rate.

Stop update of the Navigational source of Airborne Latitude and Longitude position information. If the ADS-B Transmitting Subsystem is capable of receiving Airborne position data from more than one Navigation source, verify the following by disconnecting each Navigation source separately. Verify that after 2 seconds, the TYPE code of ZERO is transmitted twice per second. Verify that the remaining ME Bits of the message are ZERO, except for the Altitude subfield, ~~Single Antenna Flag,~~ and Surveillance Status subfield[rhs4]. After 60s verify that the Airborne Position Message continues to be transmitted.

Stop providing valid altitude. After 60 seconds, verify that the Airborne Position Message is no longer transmitted. ~~Connect the GNSS data input and verify that Surface Position and Airborne Position Messages are no longer transmitted.~~

Connect the GNSS data input and verify that Airborne Position Messages are broadcast at a nominal rate of 2 per second[rhs6].

Repeat above if the Latitude and Longitude sources can be received separately. Stop update of Latitude data while maintaining update of Longitude data and verify that TYPE code of ZERO is transmitted twice per second after 2 seconds from data input disconnection.

Repeat above except stop update of Longitude data while maintaining update of Latitude data and verify that TYPE code of ZERO is transmitted twice per second after 2 seconds from data input disconnection.

~~Step 2: TYPE ZERO Verification - Part 2~~

~~Setup the ADS-B Transmitting Subsystem as in Step 1. Provide valid altitude code data to the ADS-B Transmitting Subsystem. Connect the GNSS data input and verify that Airborne Position, Velocity and Aircraft Identification Messages are transmitted at the proper rate. Stop update of the Navigational source of Airborne Latitude and Longitude position information. If the ADS-B Transmitting Subsystem is capable of receiving Airborne position data from more than one Navigation source, verify the following by disconnecting each Navigation source separately. Verify that after 2 seconds, the TYPE code is ZERO and the remaining ME Bits are ZERO, except for the altitude data. After 60 seconds, verify that the Airborne Position Message is no longer transmitted[rhs7].~~

2.4.3.2.4 Verification of ADS-B Surface Position Messages (§2.2.3.2.4)

…

2.4.3.2.4.1.3.1 Verification of Significance of TYPE Code Equal to ZERO (§2.2.3.2.4.1.3.1)

Purpose/Introduction:

TYPE code equal to ZERO is broadcast as a result of loss of ADS-B data updates. The following test verifies that the ADS-B Transmitting Subsystem correctly outputs TYPE code equal to ZERO for each ADS-B Position Message type and correctly terminate the transmission when required.

Measurement Procedure:

Setup the ADS-B Transmitting Subsystem to the On-Ground status. Connect the GNSS data input, provide valid non-zero "Movement" and "Heading/Ground Track" data to the ADS-B System, If the ADS-B transmitting Subsystem is capable of receiving "Movement" and "Heading/Ground Track" data from a source other than GNSS then provide such data from the[rhs9] other source. ~~and v~~Verify that Surface Position and Aircraft Identification Messages are transmitted at the proper rate.

Stop update of the Navigational source of Latitude and Longitude position information. If the ADS-B Transmitting Subsystem is capable of receiving position data from more than one Navigation source, verify the following by disconnecting each Navigation source separately. Verify that after 2 seconds, the TYPE code is ZERO and all the remaining "ME" Bits are ZERO. For Mode S Transponder-Based systems, verify that the Surface Position Message is no longer transmitted after 60 seconds. For Non-Mode S Transponder-Based systems, monitor for 120 seconds and verify that TYPE Code of ZERO is output at the high transmission rate.

2.4.3.2.6 Verification of ADS-B Airborne Velocity Messages (§2.2.3.2.6)

2.4.3.2.6.1 Verification of ADS-B Airborne Velocity Message - Subtype=1 (§2.2.3.2.6.1)

Appropriate test procedures required to validate the correct transmission of the parameters of the ADS-B Airborne Velocity Message – Subtype=1 are provided in §2.4.3.2.6.1.1 through §2.4.3.2.6.1.15.

Purpose/Introduction:

Additionally, the requirement of §2.2.3.2.6.1.c states that: "this message **shall** not be broadcast if the only valid data are the Intent Change and the IFR Capability Flags."

Measurement Procedure:

Configure the ADS-B Transmitting Subsystem to transmit Airborne Velocity Messages by providing velocity information at the nominal update rate. Provide the data externally at the interface to the ADS-B system. Set up the system to enable broadcast of Airborne Velocity Messages. Set the ADS-B Transmitting Subsystem to Airborne Status. Provide valid input data and verify that Airborne Velocity Messages − Subtype=1 are being broadcast. Discontinue all of the input data to the data fields except for the Intent Change and IFR Capability flag data. Wait 2.6 Seconds and verify that the ~~next output Airborne Velocity Message − Subtype=1 is set to ALL ZEROs. Verify that after 60 seconds~~ Airborne Velocity Messages ~~− Subtype=1 are~~is no longer being broadcast.

Repeat this procedure for Airborne Velocity Messages of Subtypes "2," "3" and "4."

2.4.3.3.2 Verification of Transmission Rates for Stand Alone Transmitters (§2.2.3.3.2)

…

2.4.3.3.2.1 Verification of Power-On Initialization and Start Up (§2.2.3.3.2.1)

…

2.4.3.3.2.1.2 Verification of Start Up (§2.2.3.3.2.1.2)

Note: *To save time and repeating of tests the tests in this section can be combined with those testing §2.2.3.3.2.2 to §2.2.3.3.2.9 inclusive.*

Equipment Required:

Provide a method of loading valid data for ADS-B broadcast messages into the ADS-B equipment under test. Provide a method of detecting the RF pulses of the ADS-B Broadcast Message for display on an oscilloscope.

Measurement Procedure:

Step 1: Data Available for only One Variable Data Field (§2.2.3.3.2.1.2.a and b)

Ensure that no appropriate valid message data are available for any of the possible ADS-B broadcast messages. Power up the equipment. Verify that no transmissions occur. For ADS-B broadcast message specified in §2.2.3.3.2.2, for each data field in turn, make data available for only that data field. Verify that for each data field, the message is transmitted at the rate specified in §2.2.3.3.2.3 to §2.2.3.3.2.9 inclusive.

Repeat Step 1 for all of the ADS-B broadcast message types specified in §2.2.3.3.2.3 to §2.2.3.3.2.9 inclusive.

Step 2: Data Ceases to be Available After Transmission has been Initiated (§2.2.3.3.2.1.2.c)

Ensure that appropriate valid ADS-B Message data are available for each ADS-B Message type. For each ADS-B Message type in turn, make all data fields unavailable and verify that the broadcast of the relevant message is discontinued when the input data has not been available for a period ~~of 60 seconds~~as specified in 2.2.3.3.2.12.

2.4.3.3.2.2 Verification of ADS-B Airborne Position Message Broadcast Rate (§2.2.3.3.2.2)

Equipment Required:

Provide a method of loading valid data for ADS-B broadcast messages into the ADS-B equipment under test. Provide a method of detecting the RF pulses of the ADS-B Broadcast Message for display on an oscilloscope, or equivalent method of observing the message content.

Measurement Procedure:

Step 1: All Data Available (§2.2.3.3.2.2)

Ensure that the equipment is set to the "Airborne" condition and that the appropriate valid ADS-B Airborne Position data is available. Verify that the ADS-B Airborne Position Message is broadcast at intervals that are uniformly distributed over the range of 0.4 to 0.6 seconds as specified in §2.2.3.3.2.2.

Step 2: Only Barometric Altitude Data Available (§2.2.3.2.3.1.3.1)

Repeat Step 1 with only barometric altitude data available this time and verifying that the TYPE Code = 0.

Step 3: Data Ceases to be Updated (§2.2.3.3.2.11a)

Establish the broadcast of the ADS-B Airborne Position Message as in Step 1 above. Then stop the input of data (no position and no altitude) for the ADS-B Airborne Position Message.

Verify that the ADS-B Airborne Position Message is broadcast with all data bits being set to ZERO[rhs10] 2.0[rhs11] seconds after stopping the data input.

Verify that the ADS-B Airborne Position Message is no longer broadcast 60 ±1 seconds after stopping the data input.

2.4.3.3.2.3 Verification of ADS-B Surface Position Message Broadcast Rate (§2.2.3.3.2.3)
Equipment Required:

Provide a method of loading valid data for broadcasting ADS-B Messages into the ADS-B equipment under test. Provide a method of monitoring the transmitted ADS-B Messages and measuring the rate at which they are output.

Measurement Procedure:

Step 1: Switching from High Rate to Low Rate & Data Ceases to be Updated (§2.2.3.3.2.3.a(1) and c & §2.2.3.3.2.12)

Ensure that the equipment is set to the "On the Ground" condition and that the appropriate valid ADS-B Surface Position data is provided such that the position is changing at a rate of 10.1 meters in any 30 second interval. At least 61 seconds after the start of the data input, verify that the ADS-B Surface Position Message is broadcast at intervals that are uniformly distributed over the range of 0.4 to 0.6 seconds as specified in §2.2.3.3.2.3.b.

Input new ADS-B Surface Position data with the position data changing at a rate of 9.9 meters in any 30 second interval. At least 61 seconds after the inputting of the new data, verify that the ADS-B Surface Position Message is broadcast at intervals that are uniformly distributed over the range of 4.8 to 5.2 seconds as specified in §2.2.3.3.2.3.c.

Stop the input of data, and for Transponder-Based systems verify that the ADS-B Surface Position Messages are no longer broadcast 60 ±1 seconds after the data becomes unavailable. For Non-Transponder-Based systems verify that TYPE Code of ZERO is output at the "High" transmission rate after 2 seconds. Monitor for 120 seconds and verify that TYPE Code of ZERO continues to be broadcast.

Step 2: Switching from Low Rate to High Rate & Data Ceases to be Updated (§2.2.3.3.2.3.a(2) and c & §2.2.3.3.2.12)

Ensure that the equipment is set to the "On the Ground" condition and that the appropriate valid ADS-B Surface Position data is provided such that the position is stationary. At least 61 seconds after establishing the data, verify that the ADSB Surface Position Messages are broadcast at intervals that are uniformly distributed over the range of 4.8 to 5.2 seconds as specified in §2.2.3.3.2.3.c.

Input new ADS-B Surface Position data such that the position is stationary and 10.1 meters away from the position above. One (1) second after inputting the new data, verify that the ADS-B Surface Position Messages are broadcast at intervals that are uniformly distributed over the range of 0.4 to 0.6 seconds as specified in §2.2.3.3.2.3.b. Also verify that at least 61 seconds after establishing the new data that the ADS-B Surface Position Message is broadcast at intervals that are uniformly distributed over the range 4.8 to 5.2 seconds as specified in §2.2.3.3.2.3.c.

Stop the input of data, and for Transponder-Based systems verify that the ADS-B Surface Position Messages are no longer broadcast 60 ±1 seconds after the data becomes unavailable. For Non-Transponder-Based systems verify that TYPE Code of ZERO is output at the "High" transmission rate after 2 seconds. Monitor for 120 seconds and verify that TYPE Code of ZERO continues to be broadcast.

2.4.3.3.2.4 Verification of ADS-B Aircraft Identification and Category Message Broadcast Rate(§2.2.3.3.2.4)

Equipment Required:

Provide a method of loading valid data for ADS-B broadcast messages into the ADS-B equipment under test. Provide a method of detecting the RF pulses of the ADS-B Broadcast Message for display on an oscilloscope.

Measurement Procedure:

Step 1: Airborne with No Target State, and Aircraft Operational Status (§2.2.3.3.2.4.a)

Ensure that the equipment is set to the "Airborne" condition and that the appropriate valid ADS-B Aircraft Identification and Category data is available. Verify that the ADS-B Aircraft Identification and Category Message is broadcast at intervals that are uniformly distributed over the range of 4.8 to 5.2 seconds as specified in §2.2.3.3.2.4.a.

Step 2: Airborne with Target State, and Aircraft Operational Status (§2.2.3.3.2.4.b)

Ensure that the equipment is set to the "Airborne" condition and that the appropriate valid ADS-B Aircraft Identification and Category data is available.

Provide the equipment with valid Target State Data necessary to establish Target State and Status Broadcast Messages (see §2.2.3.2.7.1 and §2.2.3.3.2.6.1).

Provide the equipment with valid Target State Data necessary to establish Target State and Status Broadcast Messages (see §2.2.3.2.7.1 and §2.2.3.3.2.6.1).

Provide the equipment with valid Operational Status Data necessary to establish Aircraft Operational Status Messages (see §2.2.3.2.7.2 and §2.2.3.3.2.6.2).

Verify that Target State and Status, and Aircraft Operational Status Messages are being broadcast.

Note: It is not necessary to verify the rate of broadcast for the Intent Messages at this time since direct verification of the broadcast rates for these messages is verified in procedures later in this document.

Verify that the ADS-B Aircraft Identification and Category Message is broadcast at an average rate of one message per 5 seconds over a time period of 60 seconds.

Step 3: On the Ground (§2.2.3.3.2.4.c)

Ensure that the equipment is set to the "On the Ground" condition and that the appropriate valid ADS-B Aircraft Identification and Category data is available.

Verify that the ADS-B Aircraft Identification and Category Message is broadcast at intervals that are uniformly distributed over the range of 9.8 to 10.2 seconds as specified in §2.2.3.3.2.4.c.

Step 4: Data Ceases to be Updated (§2.2.3.3.2.11)

Establish the broadcast of the ADS-B Aircraft Identification and Category Message as in Step 1 above. Then stop the input of data for the ADS-B Aircraft Identification and Category Message.

Verify that the ADS-B Aircraft Identification and Category Message continues to be broadcast with the same data that existed prior to stopping the data input for at least 61 seconds after stopping the data input.

2.4.3.3.2.5 Verification of ADS-B Velocity Information Message Broadcast Rate (§2.2.3.3.2.5)
Equipment Required:

Provide a method of loading valid data for ADS-B broadcast messages into the ADS-B equipment under test. Provide a method of detecting the RF pulses of the ADS-B Broadcast Message for display on an oscilloscope.

Measurement Procedure:

Step 1: Data Available (§2.2.3.3.2.5)

Ensure that the appropriate valid ADS-B Velocity Information data is available. Verify that the ADS-B Velocity Information message is broadcast at intervals that are uniformly distributed over the range of 0.4 to 0.6 seconds as specified in §2.2.3.3.2.5.a.

Step 2: Data Ceases to be Updated (§2.2.3.3.2.11)

Establish the broadcast of the ADS-B Airborne Velocity Message as in Step 1 above. Then stop the input of data for the ADS-B Airborne Velocity Message except for the Intent Change ~~and the IFR Flag~~.

~~Verify that the ADS-B Airborne Velocity Message is broadcast with all data bits being set to ZERO no more than 2.6 seconds after stopping the data input.~~

Verify that the ADS-B Airborne Velocity Message is not[rhs12] broadcast ~~60 ±1~~2.6 seconds after stopping the data input.

2.4.3.3.2.6 Verification of ADS-B Target State and Status, and Operational Status Message Broadcast Rates (§2.2.3.3.2.6)
2.4.3.3.2.6.1 Verification of ADS-B Target State and Status Message Broadcast Rates (§2.2.3.3.2.6.1[rhs14])
…

Step 6: ADS-B Message Broadcast Sixty Second Timeout – ADS-B Target State and Status Messages (§2.2.3.3.2.11c & §2.2.3.3.2.12)

Interrupt the changing of the input data necessary for transmission of ADS-B Target State and Status Messages (TYPE=29, Subtype=0) with new (valid) data, and after 60 seconds verify that the unchanged data fields are NOT cleared to ZERO.

Stop the input of data, and verify that the ADS-B Target State and Status Messages (TYPE=29, Subtype=0) are no longer broadcast 60 ±1 seconds after the data becomes unavailable.

2.4.3.3.2.6.2 Verification of ADS-B Aircraft Operational Status Message Broadcast Rates (§2.2.3.3.2.6.2[rhs15])
…

Step 9: ADS-B Message Broadcast Sixty-Second Timeout – Aircraft Operational Status Messages (§2.2.3.3.2.11.c & §2.2.3.3.2.12)

Interrupt the changing of the input data necessary for transmission of Aircraft Operational Status Messages (TYPE=31, Subtype=1) with new (valid) data, and after 60 seconds verify that the unchanged data fields are NOT cleared to ZERO.

Stop the input of data, and verify that the Aircraft Operational Status Messages (TYPE=31, Subtype=1) are no longer broadcast 60 ±1 seconds after the data becomes unavailable.

Step 10: ADS-B Message Broadcast Sixty Second Timeout – Aircraft Operational Status Messages (§2.2.3.3.2.11.c & §2.2.3.3.2.12)

Replace the Aircraft Operational Status Messages (TYPE=31, Subtype=1) with Aircraft Operational Status Messages (TYPE=31, Subtype=0), interrupt the changing of the input data necessary for transmission of Aircraft Operational Status Messages (TYPE=31, Subtype=0) with new (valid) data, and after 60 seconds verify that the unchanged data fields are NOT cleared to ZERO.

Stop the input of data, and verify that the Aircraft Operational Status Messages (TYPE=31, Subtype=0) are no longer broadcast 60 ±1 seconds after the data becomes unavailable.

4 Impact on other documents

Required updates to RTCA DO-181D:

2.2.23.1.2 Extended Squitter Types

a. Airborne Position Squitter. The airborne position Extended Squitter **shall** use format DF=17 with the contents of ground-initiated Comm-B Register 05_{16} inserted in the ME field.

Note: *A GICB request (see §2.2.19.1.12.3) containing RR equals 16, DI equals 7 and RRS equals 5 will cause the resulting reply to contain the airborne position report in its MB field.*

b. Surface Position Squitter. The surface position Extended Squitter **shall** use format DF=17 with the contents of ground-initiated Comm-B Register 06_{16} inserted in the ME field.

Note: *A GICB request (see §2.2.19.1.12.3) containing RR equals 16, DI equals 7 and RRS equals 6 will cause the resulting reply to contain the surface position report in its MB field.*

c. Aircraft Identification Squitter. The aircraft identification Extended Squitter **shall** use format DF=17 with the contents of ground-initiated Comm-B Register 08_{16} inserted in the ME field.

Note: *A GICB request (see §2.2.19.1.12.3) containing RR equals 16, DI equals 7 and RRS equals 8 will cause the resulting reply to contain the aircraft identification report in its MB field.*

d. Airborne Velocity Squitter. The airborne velocity Extended Squitter **shall** use format DF=17 with the contents of GICB Register 09_{16} inserted in the ME field.

Note: *A GICB request (see §2.2.19.1.12.3) containing RR equals 16, DI equals 7 and RRS equals 9 will cause the resulting reply to contain the airborne velocity report in its MB field.*

e. Target[rhs16] State and Status. The Target State and Status Extended Squitter shall use format DF=17 with the contents of GICB Register 62_{16} inserted in the ME field.

Note: *A GICB request* (see *§2.2.19.12.3) containing RR equals 22 (16 HEX), DI equals 7 and RRS equals 2 will cause the resulting reply to contain the Target State and Status report in its MB field.*

f. Aircraft Operational Status. The Aircraft Operational Status Extended Squitter shall use format DF=17 with the contents of GICB Register 6516 inserted in the ME field.

Note: *A GICB request* (see *§2.2.19.12.3) containing RR equals 22 (16 HEX), DI equals 7 and RRS equals 5 will cause the resulting reply to contain the Aircraft Operational Status report in its MB field.*

g. Event-driven Squitter. The event-driven Extended Squitter **shall** use format DF=17 with the contents of GICB Register $0A_{16}$ inserted in the ME field.

Note: *A GICB request (see §2.2.19.1.12.3) containing RR equals 16, DI equals 7 and RRS equals 0A will cause the resulting reply to contain the eventdriven report in its MB field.*

2.2.23.1.3 Extended Squitter Rate

a. Initialization. At power up initialization, the transponder **shall** commence operation in a mode in which it broadcasts only acquisition squitters (see §2.2.18.2.6). The transponder **shall** initiate the broadcast of Extended Squitters for airborne position, surface position, airborne velocity and aircraft identification when data are inserted into GICB Registers 05_{16}, 06_{16}, 09_{16} and 08_{16} respectively. This determination **shall** be made individually for each squitter type. The insertion of altitude data into Register 05_{16} by the transponder (see §2.2.23.1.8) **shall** not satisfy the minimum requirement for broadcast of the airborne position squitter.

Note 1: *This suppresses the transmission of Extended Squitters from aircraft that are unable to report position, velocity or identity information.*

If input to the register 05_{16}, 06_{16} and 09_{16} ~~for a squitter type~~ stops for 60 seconds, broadcast of that Extended Squitter type will be discontinued until data insertion is resumed. The insertion of altitude by the transponder **shall** satisfy the minimum requirement for continuing to broadcast the airborne position squitter. After timeout (see §2.2.23.1.4.2), this squitter type may contain an ME field of ALL ZEROs.

Note 2: *Continued transmission for 60 seconds is required so that receiving aircraft will know that the data source for the message has been lost.*

When Extended Squitters are broadcast, transmission rates **shall** be as indicated in the following paragraphs. Acquisition squitters **shall** be reported in addition to Extended Squitters as specified in §2.2.18.2.6.c. Acquisition squitters **shall** always be reported if no Extended Squitters are reported.

b. Airborne Position Squitter Rate. Airborne position squitter transmissions **shall** be emitted as specified in §2.2.23.1.5 at random intervals that are

uniformly distributed over the range from 0.4 to 0.6 seconds using a time quantization no greater than 15 milliseconds relative to the previous airborne position squitter, with the exceptions as specified in subparagraph "g."

c. Surface Position Squitter Rate. Surface position squitter transmissions **shall** be emitted as specified in §2.2.23.1.5 using one of two rates depending upon whether the high or low squitter rate has been selected (see §2.2.23.1.6). When the high squitter rate has been selected, surface position squitters **shall** be emitted at random intervals that are uniformly distributed over the range from 0.4 to 0.6 seconds using a time quantization no greater than 15 milliseconds relative to the previous surface position squitter (termed the high rate). When the low squitter rate has been selected, surface position squitters **shall** be emitted at random intervals that are uniformly distributed over the range of 4.8 to 5.2 seconds using a time quantization no greater than 15 milliseconds relative to the previous surface position squitter (termed the low rate) Exceptions to this transmission rate are specified in subparagraph "g."

Notes:

1. *High and low squitter rate status is determined on board the aircraft.*
2. *The low rate is used when the aircraft is stationary and the high rate is used when the aircraft is moving.*

d. Aircraft Identification Squitter Rate. Aircraft identification squitter transmissions **shall** be emitted at random intervals that are uniformly distributed over the range of 4.8 to 5.2 seconds using a time quantization no greater than 15 milliseconds relative to the previous identification squitter when the aircraft is reporting the airborne position squitter, or when the aircraft is reporting the surface position squitter and the high surface squitter rate has been selected. When the surface position squitter is being reported at the low surface rate, the aircraft identification squitter **shall** be emitted at random intervals that are uniformly distributed over the range of 9.8 to 10.2 seconds using a time quantization no greater than 15 milliseconds relative to the previous identification squitter. Exceptions to these transmission rates are specified in subparagraph "g."

e. Airborne Velocity Squitter Rate. Airborne velocity squitter transmissions **shall** be emitted as specified in §2.2.23.1.5 at random intervals that are uniformly distributed over the range from 0.4 to 0.6 seconds using a time quantization no greater than 15 milliseconds relative to the previous velocity squitter, with the exceptions as specified in subparagraph "g."

f. Event-Driven Squitter Rate. The event-driven squitter **shall** be transmitted once, each time that GICB Register $0A_{16}$ is loaded, while observing the delay conditions specified in subparagraph "g." The maximum transmission rate for the event-driven squitter **shall** be limited by the transponder to twice per second. If a message is inserted in the event-driven register and cannot be transmitted due to rate limiting, it **shall** be held and transmitted when the rate limiting condition has cleared If a new message is received before transmission is permitted, it **shall** overwrite the earlier message.

Note: *The squitter transmission rate and the duration of squitter transmissions is application dependent. Choices made should be the*

minimum rate and duration consistent with the needs of the application.

g. Delayed Transmission. Extended squitter transmission **shall** be delayed in the following circumstances:

(1) the scheduled Extended Squitter **shall** be delayed if the transponder is in a transaction cycle (see §2.2.18.2.2.k); or

(2) the scheduled Extended Squitter **shall** be delayed if an acquisition or another type of Extended Squitter is in process; or

(3) the scheduled Extended Squitter **shall** be delayed if a mutual suppression interface is active.

Note: *A mutual suppression system may be used to connect on-board equipment operating in the same frequency band in order to prevent mutual interference. Squitter action resumes as soon as practical after a mutual suppression interval.*

The delayed squitter **shall** be transmitted as soon as the condition causing the delay no longer exists.

2.2.23.1.4 Transponder Support for Extended Squitter Registers

2.2.23.1.4.1 Data Insertion

When the transponder determines that it is time to emit an airborne position squitter, it **shall** insert the current value of the barometric altitude (unless inhibited by the ATS subfield, §2.2.23.1.9) and surveillance status into the appropriate fields of Register 05_{16}. The contents of this Register **shall** then be inserted into the ME field of DF=17 and transmitted.

Note: *Insertion in this manner ensures that (1) the squitter contains the latest altitude and surveillance status, and (2) ground readout of Register 05_{16} will yield exactly the same information as contained in the previous squitter.*

2.2.23.1.4.2 Register Timeout

The transponder **shall** clear all 56-bits of the airborne position, surface position, squitter status and velocity GICB Registers 05_{16}~~,~~ and 06_{16}~~, 07_{16} and 09_{16}~~ if these registers are not updated within two seconds of the previous update. This timeout **shall** be determined separately for each of these registers. The internal insertion of data by the transponder into these registers (altitude and surveillance status) **shall** not qualify as a register update for the purposes of this timeout condition.

Notes:

1. *These registers are cleared to prevent the reporting of outdated position, velocity and squitter rate information.*

2. *The identification Register, 08_{16}, is not cleared since it contains data that rarely changes in flight and less frequently updated. The event-driven Register, $0A_{16}$ does not need to be cleared since its contents are only broadcast once each time that the register is loaded.*

Transponder data insertion and squitter transmission **shall** not be affected by a register timeout event except as specified in §2.2.23.1.3.a.

Note 3: *During a register timeout event, the ME field of the Extended Squitter may contain all zeroes, except for any data inserted by the transponder.*

2.5.4.6.2.2 Extended Squitter Protocol Verification

Step 7 Configure the transponder to inhibit Acquisition squitters when Extended Squitters are broadcast. Prior to providing Extended Squitter updates, verify that Acquisition squitters are broadcast. Provide Extended Squitter updates at a rate as specified in Appendix B, Table B-1 to GICB Registers 05_{16}, 06_{16} and 08_{16} and provide altitude code input to the transponder. Verify that Extended Squitters are broadcast and Acquisition squitters are not broadcast. Verify that airborne position and aircraft identification squitters are broadcast at the proper rate and alternately on the top and bottom antenna ports as specified for airborne state if antenna diversity is supported. Additionally provide updates to GICB Register 09_{16}. Verify the broadcast of airborne position squitters, aircraft identification squitters and airborne velocity squitters at the proper rate and the ME data content matches the data stored in GICB Registers 05_{16}, 08_{16} and 09_{16}, respectively. Verify that the transponder does not broadcast Acquisition squitters. Set the ALT switch to the "off" position and stop update to GICB Registers 05_{16}, 06_{16}, 08_{16} and 09_{16}. After 2 seconds, verify that the ME fields of the airborne position and airborne velocity squitters are ZERO. Verify that the airborne velocity squitters are not broadcast. Interrogate with UF=4, RR=16, DI=7 and RRS=5, 6, and 8 and 9, respectively. Verify that the MB fields of the replies match the data of the corresponding Extended Squitter reply. After 60 seconds, verify that Extended Squitter transmissions stop and the transponder resumes Acquisition squitter broadcast.

Repeat above sequence except stop update to GICB Registers 05_{16} and 06_{16} only[DW1]. After 2 seconds, verify that the ME field of the airborne position report is ZERO. After 60 seconds, verify that the transponder no longer broadcasts airborne position squitters and continues to broadcast airborne velocity and aircraft identification squitters. Verify that the transponder continues to inhibit the broadcast of Acquisition squitters.

Repeat above except stop update to GICB Register 09_{16} only. Again, vVerify that after 2 seconds the ME field of the airborne velocity squitter is no longer broadcast.is ZERO and after 60 seconds, both airborne velocity andVerify that Acquisition squitters are not transmitted.

Required update to ICAO Annex 10 Volume IV

3.1.2.8.6.6 *Register time-out*. The transponder shall clear all 56-bits of the airborne position, surface position, squitter status and airborne velocity information transponder registers 05 and~~,~~ 06~~, 07 and 09~~ {HEX} if these registers are not updated within two seconds of the previous update. This time-out shall be determined separately for each of these registers.

Note 1.— Termination of extended squitter broadcast is specified in the Technical Provisions for Mode S Services and Extended Squitter (Doc 9871).

Note 2.— These registers are cleared to prevent the reporting of outdated position, velocity and squitter rate information.

Required update to ICAO Doc9871

The following was taken from 1090-WP26-09 in regards to ICAO Doc. 9871 material.

A.2.4 EXTENDED SQUITTER INITIALIZATION AND TIME-OUT

Initialization and time-out functions for extended squitter broadcast shall be performed by the transponder and are specified in Annex 10, Volume IV, §3.1.2.8.6.4 and §3.1.2.8.6.6.

Note.— A description of these functions is presented in the following paragraphs to serve as reference material for the section on the general formatter/manager (GFM) (see §A.2.5).

A.2.4.1 INITIATION OF EXTENDED SQUITTER BROADCAST

At power-up initialization, the transponder shall commence operation in a mode in which it broadcasts only acquisition squitters. The transponder shall initiate the broadcast of extended squitters for airborne position, surface position, airborne velocity and aircraft identification when data are inserted into transponder registers 0516, 0616, 0916 and 0816, respectively. This determination shall be made individually for each squitter type. The insertion of altitude or surveillance status data into transponder register 0516 by the transponder shall not satisfy the minimum requirement for broadcast of the airborne position squitter.

Note.— This suppresses the transmission of extended squitters from aircraft that are unable to report position, velocity or identity information.

A.2.4.2 REGISTER TIME-OUT

The transponder shall clear all but the altitude and surveillance status subfields in the airborne position register (transponder register 0516) and all 56 bits of the surface position, squitter status and airborne velocity registers (transponder register numbers 0616, 0716 and 0916) if these registers are not updated for a time no greater than twice the specified maximum update interval, or 2 seconds (whichever is the greater). This time-out shall be determined separately for each of these registers. The insertion of altitude or surveillance status data by the transponder into these registers shall not qualify as a register update for the purposes of this time-out condition.

Note 1.— These registers are cleared to prevent the reporting of outdated position.~~,~~
~~velocity and squitter rate~~
~~information.~~

Note 2.— The identification register, 0816, is not cleared since it contains data that rarely changes in flight and is less frequently updated. The event-driven register, 0A16 or equivalent transmit register, does not need to be cleared since its contents are only broadcast once each time that the register is loaded (see §A.2.5.5).

Note 3.— During a register time-out event, the ME field of the extended squitter may contain all zeros, except for any data inserted by the transponder.

A.2.4.3 TERMINATION OF EXTENDED SQUITTER BROADCAST

If input to the airborne position or surface position squitter type stops for 60 seconds, broadcast of that extended squitter type shall be discontinued until data insertion is resumed. The insertion of altitude by the transponder satisfies the minimum requirement for continuing to broadcast the airborne position squitter.

The broadcast transmissions of the Airborne Velocity Message is discontinued if input data necessary to update the fields of the Airborne Velocity Message other than Intent Change Flag and IFR Capability Flag are not available for a period of 2.6 seconds.

Broadcast transmissions of Aircraft Identification and Category Message is not terminated if input data necessary to update the message is not available for a period of 60 seconds.

The Target State and Status message broadcast is discontinued when the Airborne Position Messages are no ~~more~~ longer broadcast.

The Operational Status Messages broadcast is discontinued when the Airborne Position Messages and the Surface Position messages are no ~~more~~ longer broadcast.

~~If input to any other squitter type stops for a time no greater than twice the specified maximum update interval or 2 seconds (whichever is the greater), broadcast of that extended squitter type shall be discontinued until data insertion is resumed.~~

~~The insertion of bits that are constant for an aircraft installation does not satisfy the minimum requirement for continuing to broadcast a squitter type.~~

A.2.5.3.2 BROADCAST OF FORMAT TYPE CODE EQUAL TO ZERO

Format TYPE Code = 0 shall only be set by the following events:

1) An extended squitter register monitored by the transponder (registers 05_{16}, 06_{16}) has timed out (see §A.2.4.2). In this case, the transponder shall clear the entire 56 bits of the register that timed out. In the case of the airborne position register, the altitude subfield shall only be zeroed if no altitude data are available. Transmission of the airborne position or surface position squitter shall itself stop in 60 seconds. ~~Transmission of all other squitters shall stop after a time no greater than twice the specified maximum update interval or 2 seconds (whichever is the greater). Broadcast of an extended squitter shall resume when the GFM begins to insert data into the register.~~

2) The GFM determines that all navigation sources that can be used for the extended squitter airborne or surface position message are either missing or invalid. In this case, the GFM shall clear the format TYPE Code and all other fields of the airborne or surface position message and insert this zeroed message in the appropriate register. This shall only be done once so that the transponder can detect the loss of data insertion and suppress the broadcast of the related squitter.

Note.— The termination of velocity squitters~~, other than airborne position and surface position,~~ coincides with the timeout of the data. This ensures that only airborne position and surface position squitters are ever broadcast with Type Code ZERO.

Note that sections B.2.4.1 –through- B.2.4.3 of ICAO Doc. 9871 will need to be updated in order to implement the moving of the Target State and Status and Operational Status messages from Event Driven to Periodic message protocol.

5 Recommendations

The meeting is invited to consider the changes proposed in complement to the changes proposed in WP26-09 and to note the need to update ICAO Annex 10 Volume IV (3.1.2.8.6.6), Doc9871 and the transponder MOPS DO181-D/ED73-C to have consistency through all documents.