

RTCA Special Committee 209 / EUROCAE WG49

ATCRBS / Mode S Transponder MOPS Maintenance

Joint Teleconference and WebEx Session

9 December 2010

9:00am EST (New York)

**Additional information in the UM field
to indicate which BDS content is provided in MB**

(In Response to Action 12-03)

Revision 1

**Eric Potier
EUROCONTROL**

SUMMARY

In response to Action Item 12-03, this Working Paper proposes to provide information in the UM field in order to indicate which Register content is downlinked in the MB field. This addition will allow detection and correction of BDS swap by ground station and will provide information to passive systems to decode DF20/21 they may receive and therefore will reduce the need for such systems to interrogate to get the information.

a) Introduction

With the deployment of Mode S interrogators supporting EHS it has been seen that the register content received in a reply may not correspond to the required register. This is known as the “BDS swap” phenomenon. This is due to collisions of interrogations generated by different interrogators requesting the extraction of different registers and arriving at almost the same time at the input of the transponder.

The Mode S protocol is currently not robust to such interference. Different ground filters may be used to filter out some of these bad replies. However the filter can not completely protect the system and causes lost of data.

This Working Paper proposes to provide information in the UM field in order to indicate which register content is downlinked in the MB field. This addition will allow detection and correction of BDS swap by ground stations and will provide sufficient information to passive systems (WAM) to decode DF20/21 they may receive without using active interrogations.

b) Which type of information

2.1 First option: to return an indication about the Interrogator Code received in the interrogation.

This will give an indication to check if the reply is coming from an interrogation with the same Interrogator Code.

Limitations:

Same code in the same area: Several overlapping interrogators can use the same code. This could happen when interrogators operate in Cluster or when they operate all on a specific code for example mobile radar operating on II code 0.

Number of codes: the solution should be capable to encode II codes and SI Codes. This will require 79 values. If there are not enough bits to encode all these values it will be necessary to encode SI codes and matching II codes using the same 4 bits. This will result in limited benefit as up to 5 interrogators could share the same indication.

Use by passive systems: A passive system listening the replies (e.g. a WAM) will not be able to know which register is contained in the reply and will need to re-interrogate.

2.2 Second option: provide information about the BDS number of the information contained in the MB field.

This could be obtained either by directly encoding the BDS number or by providing a specific number (tag) for the main registers used (17, 40, 50, 60,...) depending on the number of bits/values which can be found in the replies.

The implementation shall keep the backward compatibility with existing interrogators and existing transponders.

3 How to provide additional information in the replies.

3.1 Overlay information in CRC

The BDS code could be overlaid in the CRC calculation. This would provide an indication of the BDS code to the interrogator extracting the information.

Limitations:

Other passive systems able to receive the replies (multilateration) will have difficulty to decode and accept these replies.

It will require a change in the basic CRC encoding algorithm which may be implemented in the firmware of the transponder.

Old Mode S interrogators will not accept the reply due to bad CRC decoding. It means if such option is chosen it will be necessary to indicate in the request whether the reply is provided with a CRC calculated using the old or the new method.

3.2 Another DF format

An interrogator interested in having an indication of the BDS code transmitted would transmit an indication in the request using a reserved field/value in SD (e.g., a new field of 1 bit (REG) when DI=0,2,3,7 - Not available with DI=1) and the transponder would reply with a new format for example DF23:

10111	FS:3	DR:5	UM:6	Reserved:5	BDS:8	MB:56	AP:24
-------	------	------	------	------------	-------	-------	-------

Limitations:

No longer possible to download altitude or Mode A code in the same reply.

3.3 Use of field/s values not currently used in the reply

The following values are not used currently used:

- DR values 8-15
- IIS (4 bits) of the UM field when IDS=0

According to DO-181 Figure 2-19, IIS of the UM field is used either when there is a multisite status requested with a MBS≠0 or when there is a Comm-B or a Comm-D multisite reservation ongoing. This is indicated by an IDS≠0. Analysis of a real recording shows that today in Europe almost all replies contain UM=0.

The use of IIS when IDS=0 is therefore possible to provide a “Register Tag” when there is no reservation or no information requested through MBS in DI=1. This will allow encoding of 15 specific values.

This will not be enough to encode directly the BDS code. It is therefore proposed to use a table as below to associate a tag to specific chosen registers. Another possibility would be to use different values of DR (8-15) to allow the encoding of more numbers. This has not been further developed based on the fact that 15 values should be sufficient to cover the registers which are the most used and also because such indication would not be possible when there is a Comm-B broadcast announced.

Such solution will provide an indication of the content of the MB field for specific registers when there will be no Comm-B/Comm-D reservation or direct downlink transmissions, i.e., in the great majority of cases as today these protocols are not used.

The tag could be interpreted as follows:

- 0 means no BDS indication
- 1 means ES register with a type code provided in the first 5 bits
- 2 means the first 8 bits provide an identification of the content (using BDS code).
- 3..14 allocated to specific registers
- 15: reserved.

Transponder register number	Assignment	Minimum Update Interval	Register Tag
00 ₁₆	Not valid	N/A	0
01 ₁₆	Reserved	N/A	0
02 ₁₆	Linked Comm-B, segment 2	N/A	0
03 ₁₆	Linked Comm-B, segment 3	N/A	0
04 ₁₆	Linked Comm-B, segment 4	N/A	0
05 ₁₆	Extended squitter airborne position	0.2s	1
06 ₁₆	Extended squitter surface position	0.2s	1
07 ₁₆	Extended squitter status	1.0s	1
08 ₁₆	Extended squitter identification and type	15.0s	1
09 ₁₆	Extended squitter airborne velocity	1.3s	1
0A ₁₆	Extended squitter event-driven information variable		1
0B ₁₆	Air/air information 1 (aircraft state)	1.3s	0
0C ₁₆	Air/air information 2 (aircraft intent)	1.3s	0
0D ₁₆ -0E ₁₆	Reserved for air/air state information To be determined		0
0F ₁₆	Reserved for ACAS To be determined		0
10 ₁₆	Data link capability report	≤4.0s	2
11 ₁₆ -16	Reserved for extension to datalink capability reports	5.0s	0
17 ₁₆	Common usage GICB capability report	5.0s	3
18 ₁₆ -1C ₁₆	Mode S specific services GICB capability reports	5.0s	0
1D ₁₆	Mode S specific services MSP capability report	5.0s	4
1E ₁₆ -1F ₁₆	Mode S specific services MSP capability reports	5.0s	0
20 ₁₆	Aircraft identification	5.0s	2
21 ₁₆	Aircraft and airline registration markings	15.0s	5
22 ₁₆	Antenna positions	15.0s	0
23 ₁₆	Reserved for antenna position	15.0s	0
24 ₁₆	Reserved for aircraft parameters	15.0s	0
25 ₁₆	Aircraft type	15.0s	0
26 ₁₆ -2F ₁₆	Reserved	N/A	0

Transponder register number	Assignment	Minimum Update Interval	Register Tag
30 ₁₆	ACAS active resolution advisory [Ref 2, §4.3.8.4.2.2]		2
31 ₁₆ -3F ₁₆	Reserved	N/A	0
40 ₁₆	Selected vertical intention	1.0s	6
41 ₁₆	Next waypoint identifier	1.0s	0
42 ₁₆	Next waypoint position	1.0s	0
43 ₁₆	Next waypoint information	0.5s	0
44 ₁₆	Meteorological routine air report	1.0s	7
45 ₁₆	Meteorological hazard report	1.0s	8
46 ₁₆	Reserved for flight management system Mode 1 TBD		0
47 ₁₆	Reserved for flight management system Mode 2 TBD		0
48 ₁₆	VHF channel report	5.0s	0
49 ₁₆ -4F ₁₆	Reserved	N/A	0
50 ₁₆	Track and turn report	1.3s	9
51 ₁₆	Position report coarse	1.3s	10
52 ₁₆	Position report fine	1.3s	11
53 ₁₆	Air-referenced state vector	1.3s	0
54 ₁₆	Waypoint 1	5.0s	12
55 ₁₆	Waypoint 2	5.0s	12
56 ₁₆	Waypoint 3	5.0s	12
57 ₁₆ -5E ₁₆	Reserved	N/A	0
5F ₁₆	Quasi-static parameter monitoring	0.5s	13
60 ₁₆	Heading and speed report	1.3s	14
61 ₁₆	Extended Squitter Status Subtype = 1 = Emergency/priority Subtype = 2 = TCAS RA Broadcast	1.0s	1
62 ₁₆	Target state and status information	0.5s	1
63 ₁₆	Reserved for extended squitter	N/A	1
64 ₁₆	Reserved for extended squitter	N/A	1
65 ₁₆	Extended squitter aircraft operational status	1.7s	1
66 ₁₆ -6F ₁₆	Reserved for extended squitter	N/A	1
70 ₁₆ -75 ₁₆	Reserved for future aircraft downlink parameters	N/A	0
76 ₁₆ -E0 ₁₆	Reserved	N/A	0
E1 ₁₆ -E2 ₁₆	Reserved for Mode S BITE	N/A	2
E3 ₁₆	Transponder type/part number	15s	0
E4 ₁₆	Transponder software revision number	15s	0
E5 ₁₆	ACAS unit part number	15s	0
E6	ACAS unit software revision number	15s	0
E7 ₁₆	Transponder Status/Maintenance	15s	2
E8 ₁₆ -E9 ₁₆	Reserved	N/A	0
EA ₁₆	Transponder status vendor specific	15s	2
EB ₁₆ -F0 ₁₆	Reserved	N/A	0
F1 ₁₆	Military applications	15s	15
F2 ₁₆	Military applications	15s	0
F3 ₁₆ -FF ₁₆	Reserved	N/A	0

Note: It is not foreseen to indicate the BDS number for AICB and linked Comm-B since the multisite reservation protocol can be used (DI=1, MBS=1 Comm_B reservation request) together with RSS=1 to cause the reservation status to be added in the UM/IIS field with UM/IDS=1.

4.0 Propose Transponder MOPS changes to incorporate option 3 in DO-181/ED-73

The following sections have been reviewed to incorporate the option described in 3.3. The changes are highlighted in yellow.

2.2.14.4 Field descriptions

Replace 2.2.14.4.39 reference for UM with 2.2.14.4.40

2.2.14.4.40 UM Utility Message in DF=4, 5, 20, 21

This 6-bit (bits 14 – 19) downlink field in DF=4, 5, 20, 21 contains transponder status readouts or indication to differentiate which register is downlinked in the MB field (§2.2.14.4.20) in DF20 and DF21 formats.

ED-73C

3.18.4.37 Utility Message in DF=4, 5, 20, 21-UM

This 6-bit (14-19) downlink field in DF=4, 5, 20, 21 contains transponder status readouts or indication to differentiate which register is downlinked in the MB field (§2.2.14.4.20) in DF20 and DF21 formats.

2.2.19.1.9 UM Protocol (Figure 2-18)

The UM field shall support functions for the multisite protocol. The following paragraphs contain the requirements and descriptions of the protocol.

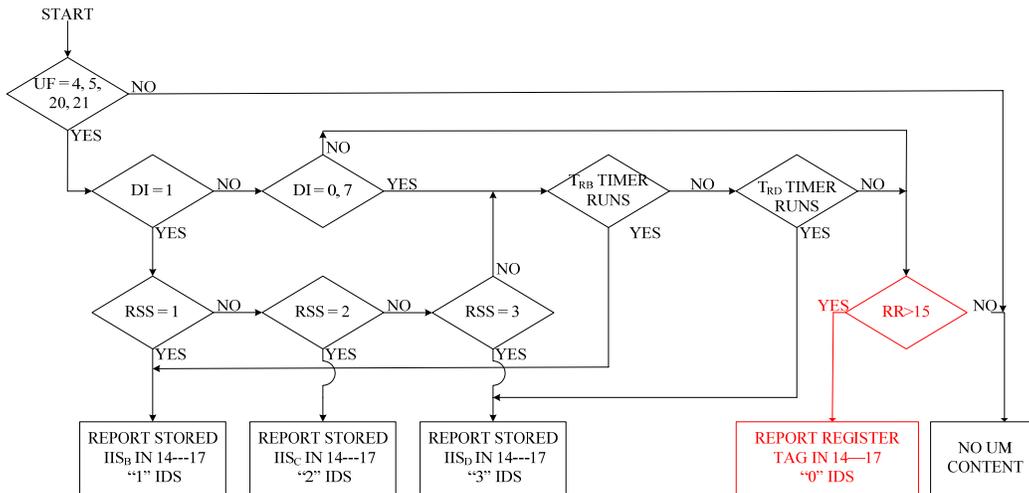
- a. Field description is in §.
- b. If DI=1, multisite information may be requested as specified in §.
- c. If no request appears, directed Comm-B/D information may appear in UM as specified in § and §.
- d. If no request appears, and if there is no multisite reservation, and no directed Comm-B/D and there is a Comm-B message accompanying the UM field (i.e., RR>15 resulting in a DF20/21 message) a Register Tag corresponding to the register downlinked in the MB field is transmitted using the UM field as specified in 2.2.19.2.1.2.

3.23.1.9 UM Protocol (Figure 3-17)

The UM field shall support functions for the multisite protocol. The following paragraphs contain the requirements and descriptions of the protocol.

- a. Field description is in paragraph 3.18.4.37.
- b. If DI=1, multisite information may be requested as specified in paragraph 3.23.2.1 b
- c. If no request appears, directed Comm-B/D information may appear in UM as specified in paragraphs 3.23.2.3 b and 3.25.2 b.
- d. If no request appears, if there is no multisite reservation and no directed Comm-B/D and there is a Comm-B message accompanying the UM field (i.e., RR>15 resulting in a DF20/21 message) a Register Tag corresponding to the register downlinked in the MB field is transmitted using the UM field as specified in 3.23.2.1.

DO-181 Figure 2-19 and ED-73 Figure 3-17 must be modified as follows:



Note 2: REGISTER TAG is defined in table B-2-1.

2-2.19.2.1-22.2.19.2.1.2 Subfields in UM for Multisite Protocols

If a surveillance or Comm-A interrogation (UF=4, 5, 20, 21) contains DI=1 and RSS equals other than "0," the following subfields will be inserted into the reply by the transponder.

----- move the following text here -----

IIS: The four-bit (14-17) Interrogator Identifier Subfield reports the identity of the interrogator that has made a multisite reservation.

IDS: The two-bit (18-19) Identifier Designator Subfield reports the type of reservation made by the interrogator identified in IIS. Assigned coding is:

Code	Description
0	no reservation information available and register tag available in IIS
1	Comm-B reservation active
2	Comm-C reservation active
3	Comm-D reservation active

If the above interrogation contains DI≠1=0 or 7, or when DI=1 and RSS=0,

- 1) the transponder shall insert IIS and IDS codes according to a Comm-B reservation if such reservation exists or is presently requested.
- 2) In the absence of a Comm-B reservation, IIS and IDS codes for an existing or requested Comm-D reservation shall be inserted.
- 3) In the absence of Comm-B and Comm-D reservation, if DI≠1 or when DI=1 and RSS=0, and RR>15 (i.e., the reply is a DF=20 or DF=21), IDS shall be set to zero and IIS shall

contain the Register Tag as defined in table B-2-1 corresponding to the downlinked register in the MB field.

4) In all other cases IDS and IIS shall be zeroed.

3.23.2.1 Multisite Data Formats

a. Subfields in SD

...

b. Subfields in UM for Multisite Protocols

If a surveillance or Comm-A interrogation (UF=4, 5, 20, 21) contains DI=1 and RSS other than 0, the following subfields will be inserted into the reply by the transponder.

IIS: The four-bit (14-17) Interrogator Identifier Subfield reports the identity of the interrogator that has made a multisite reservation.

IDS: The two-bit (18-19) Identifier Designator Subfield reports the type of reservation made by the interrogator identified in IIS.

Assigned coding is:

0 = no reservation information available and register tag available in IIS.

1 = Comm-B reservation active.

2 = Comm-C reservation active.

3 = Comm-D reservation active

When the interrogation contains DI=0 or 7, or when DI=1 and RSS=0,

1) the transponder shall insert IIS and IDS codes according to a Comm-B reservation if such reservation exists or is presently requested.

2) In the absence of a Comm-B reservation, IIS and IDS codes for an existing or requested Comm-D reservation shall be inserted.

3) In the absence of Comm-B and Comm-D reservation and RR>15 (i.e., the reply is a DF=20 or DF=21), IDS shall be set to zero and IIS shall contain the Register Tag corresponding to the downlinked register in the MB field as defined in table B-2-1.

4) In all other cases IDS and IIS shall be zeroed.

There is no change required in the following sections where UM is mentioned:

2.2.19.2.1.1 Subfield in SD

No change RSS still works as previously described.

2.2.19.2.2 Interrogator Identity Report

Transponders **shall** insert the interrogator identifier into the UM field of the reply according to the coding of RSS.

No change RSS still works as previously described.

2.2.19.2.3.1 Multisite Comm-B Reservation

2.2.19.2.3.2 Multisite Directed Comm-B Transmissions

No change UM is used as previously defined to indicate that there is a multisite directed Comm-B

2.2.20.1.3 Multisite Uplink ELM Protocol

2.2.20.1.3.1 Multisite Comm-C Reservations

No change RSS still works as previously defined

2.2.20.2.3 Multisite Downlink
2.2.20.2.3.1 Multisite Comm-D Reservation

No change RSS still works as previously described.

2.2.20.2.3.2 Multisite Directed Comm-D Transmissions

No change UM is used as previously defined to direct the DELM by making a self reservation resulting in IDS=3 And IIS = reserved II

Level 5 - Enhanced Multisite Air-Initiated Comm-B Protocol

2.2.21.1.2.2 Announcement and Extraction {ED73 3.26.1.2}

A waiting air-initiated Comm-B message **shall** be announced in the DR field of the replies to all interrogators for which a multisite directed Comm-B message is not waiting. The UM field of the announcement reply **shall** indicate that the message is not reserved for any II code, i.e., the IIS subfield **shall** be set equal to ZERO and IDS=1. When a command to read this message is received from a given interrogator, the B Timer for the associated interrogator is started and the reply containing the message **shall** contain the same IIS subfield content indicating that the message is reserved for the II code contained in the interrogation from that interrogator. After readout and until closeout, the message **shall** continue to be assigned to that II code. Once a message is assigned to a specific II code, announcement of this message **shall** be no longer made in the replies to interrogators with other II codes. If the message is not closed out by the assigned interrogator for the period of the B-timer, the message **shall** revert back to multisite air-initiated status and the process **shall** repeat. Only one multisite air-initiated Comm-B message **shall** be in process at a time.

Clarification of existing requirement: which IDS is used (0 or 1?) , 1 for Comm-B reservation

Figure 2-25: Enhanced Comm-B Protocol
Note 12.

2.2.2.3.2.2 Enhanced Multisite Downlink ELM Protocol
2.2.21.3.3.2 Announcement

No change announcement done as previously by indicating the destination II code in IIS and IDS =3

2.2.21.3.3.3 Delivery

No change UM managed as before for indication of DELM

Appendix B, Table B-2-1: GICB Register Number Assignments

Add a column to the register table B-2-1 as follows:

Transponder register number	Assignment	Minimum Update Interval	Register Tag
00 ₁₆	Not valid	N/A	0
01 ₁₆	Reserved	N/A	0
02 ₁₆	Linked Comm-B, segment 2	N/A	0
03 ₁₆	Linked Comm-B, segment 3	N/A	0
04 ₁₆	Linked Comm-B, segment 4	N/A	0
05 ₁₆	Extended squitter airborne position	0.2s	1
06 ₁₆	Extended squitter surface position	0.2s	1
07 ₁₆	Extended squitter status	1.0s	1
08 ₁₆	Extended squitter identification and type	15.0s	1
09 ₁₆	Extended squitter airborne velocity	1.3s	1
0A ₁₆	Extended squitter event-driven information variable		1
0B ₁₆	Air/air information 1 (aircraft state)	1.3s	0
0C ₁₆	Air/air information 2 (aircraft intent)	1.3s	0
0D ₁₆ -0E ₁₆	Reserved for air/air state information To be determined		0
0F ₁₆	Reserved for ACAS To be determined		0
10 ₁₆	Data link capability report	≤4.0s	2
11 ₁₆ -16	Reserved for extension to datalink capability reports	5.0s	0
17 ₁₆	Common usage GICB capability report	5.0s	3
18 ₁₆ -1C ₁₆	Mode S specific services GICB capability reports	5.0s	0
1D ₁₆	Mode S specific services MSP capability report	5.0s	4
1E ₁₆ -1F ₁₆	Mode S specific services MSP capability reports	5.0s	0
20 ₁₆	Aircraft identification	5.0s	2
21 ₁₆	Aircraft and airline registration markings	15.0s	5
22 ₁₆	Antenna positions	15.0s	0
23 ₁₆	Reserved for antenna position	15.0s	0
24 ₁₆	Reserved for aircraft parameters	15.0s	0
25 ₁₆	Aircraft type	15.0s	0
26 ₁₆ -2F ₁₆	Reserved	N/A	0
30 ₁₆	ACAS active resolution advisory [Ref 2, §4.3.8.4.2.2]		2
31 ₁₆ -3F ₁₆	Reserved	N/A	0
40 ₁₆	Selected vertical intention	1.0s	6
41 ₁₆	Next waypoint identifier	1.0s	0
42 ₁₆	Next waypoint position	1.0s	0
43 ₁₆	Next waypoint information	0.5s	0
44 ₁₆	Meteorological routine air report	1.0s	7
45 ₁₆	Meteorological hazard report	1.0s	8
46 ₁₆	Reserved for flight management system Mode 1 TBD		0
47 ₁₆	Reserved for flight management system Mode 2 TBD		0

Transponder register number	Assignment	Minimum Update Interval	Register Tag
48 ₁₆	VHF channel report	5.0s	0
49 ₁₆ -4F ₁₆	Reserved	N/A	0
50 ₁₆	Track and turn report	1.3s	9
51 ₁₆	Position report coarse	1.3s	10
52 ₁₆	Position report fine	1.3s	11
53 ₁₆	Air-referenced state vector	1.3s	0
54 ₁₆	Waypoint 1	5.0s	12
55 ₁₆	Waypoint 2	5.0s	12
56 ₁₆	Waypoint 3	5.0s	12
57 ₁₆ -5E ₁₆	Reserved	N/A	0
5F ₁₆	Quasi-static parameter monitoring	0.5s	13
60 ₁₆	Heading and speed report	1.3s	14
61 ₁₆	Extended Squitter Status Subtype = 1 = Emergency/priority Subtype = 2 = TCAS RA Broadcast	1.0s	1
62 ₁₆	Target state and status information	0.5s	1
63 ₁₆	Reserved for extended squitter	N/A	1
64 ₁₆	Reserved for extended squitter	N/A	1
65 ₁₆	Extended squitter aircraft operational status	1.7s	1
66 ₁₆ -6F ₁₆	Reserved for extended squitter	N/A	1
70 ₁₆ -75 ₁₆	Reserved for future aircraft downlink parameters	N/A	0
76 ₁₆ -E0 ₁₆	Reserved	N/A	0
E1 ₁₆ -E2 ₁₆	Reserved for Mode S BITE	N/A	2
E3 ₁₆	Transponder type/part number	15s	0
E4 ₁₆	Transponder software revision number	15s	0
E5 ₁₆	ACAS unit part number	15s	0
E6	ACAS unit software revision number	15s	0
E7 ₁₆	Transponder Status/Maintenance	15s	2
E8 ₁₆ -E9 ₁₆	Reserved	N/A	0
EA ₁₆	Transponder status vendor specific	15s	2
EB ₁₆ -F0 ₁₆	Reserved	N/A	0
F1 ₁₆	Military applications	15s	15
F2 ₁₆	Military applications	15s	0
F3 ₁₆ -FF ₁₆	Reserved	N/A	0

Add the following note below the table to explain how the register tag is used.

Note: The Register Tag is inserted in the UM field to allow unambiguous identification of certain contents of the MB field. If the Register Tag is '1' the register format can be determined using the first 5 bits (type code) of the MB field. If the Register Tag is 2 the content of the register can be determined using the first 8 bits which contain the BDS code. Other values of the Register Tag are specific to registers as listed in the above table.

Test sections mentioning UM

2.2.2.12.6 Comm-B Downlink Interface, Message Cancellation () Step3

2.5.4.18 Procedure #18: Comm-B Protocol

Verification of "e" UM= No comm. B reservation is still true. It could be improved and make reference to the register tag however it is not necessary as it is proposed to test the Register Tag when extracting a specific register.

2.5.4.18A Procedure #18A Enhanced Comm-B Protocol

UM Field Verification

In all cases, verify that the transponder reports the proper state in the UM field and the report is for the IIS contained in the interrogation pattern.

2.5.4.21 Procedure #21: Directed Comm-B

No modification required

2.5.4.23 Procedure #23: Downlink Interface, No Storage Design {ED73 5.5.8.25}

...

For directed Comm-B transmissions (Procedure #21), insertion of IIS and IDS into the UM field is required.

...

Verify that B-bit insertion is accepted by the transponder in all applicable formats and that IIS and IDS insertion is accepted by the transponder only if the UM field is not in use for another purpose **coming from an RSS request**.

2.5.4.24 procedure #24: Comm-C protocol

UM Field Verification

During the test sequence when a multisite reservation is made (patterns 6, 12), the following reply will contain IIS and IDS in the UM field according to §XX. Verify that the UM content is correct

No modification required

2.5.4.26 Procedure #26: Comm-D Protocol

UM Verification

If a multisite reservation is made during the test sequence (patterns 6, 12), the following reply will contain IIS and IDS in the UM field according to §XX. Verify that the UM content is correct.

...

UM Verification

In all cases, verify that the transponder reports the proper state in the UM field and the report is for the IIS contained in the interrogation pattern.

No modification required

2.5.4.27 Procedure #27: Directed Comm-D

During the D-protocol test procedure (Procedure #26) enter into the interface a downlink pattern containing DR corresponding to the number of segments to be transmitted, IDS=3 (the UM code for Comm-D reservation) and IIS corresponding to the desired destination's code.

No modification required

The retained option for testing is to integrate the verification of the register tag after each extraction of register in ES and ELS/EHS test. If retained the following modifications must be done in the same sections in ED73.

2.2.23.1.1 Extended Squitter Types

Change the note in a).. g) of 2.2.23.1.1 as follows

Note: A GICB request (see §) containing RR=16, DI=7 or 3 and RRS=5 will cause the resulting reply to contain the airborne position report in its MB field with IIS = 1 and IDS=0.

2.6.3.2.1 Bits 1 through 8, BDS Code {register 10}

Verify that the transponder replies with a DF=20 reply with IIS [bit14 through17 of the reply]= 2 and IDS[bit18-19 of the reply] =0, with bits 33 ...

2.6.4.2.1 Required Servicing of Register 17₁₆

Verify that the transponder replies with a DF=20 reply with:

- o IIS [bit14 through17 of the reply]=3 and IDS[bit18-19 of the reply] =0,
- o Bits 33....

Apply the same modification in future test extracting register 17₁₆ using an SI code.

2.6.5.2.1 Required Servicing of Register 18₁₆ Associated with Register 10₁₆

Verify that the transponder replies with a DF=20 reply with:

- o IIS [bit14 through17 of the reply]=0 and IDS[bit18-19 of the reply] =0,
- o Bits 33....

2.6.5.3 Mode S Specific Services Capability Report, Register 19₁₆

Verify that the transponder replies with a DF=20 reply with:

- o IIS [bit14 through17 of the reply]=0 and IDS[bit18-19 of the reply] =0,
- o Bits 33....

2.6.5.4 Mode S Specific Services Capability Report, Register 1A₁₆

Verify that the transponder replies with a DF=20 reply with:

- o IIS [bit14 through17 of the reply]=0 and IDS[bit18-19 of the reply] =0,
- o Bits 33....

2.6.5.5 Mode S Specific Services Capability Report, Register 1B₁₆

Verify that the transponder replies with a DF=20 reply with:

- o IIS [bit14 through17 of the reply]=0 and IDS[bit18-19 of the reply] =0,
- o Bits 33....

2.6.5.6 Mode S Specific Services Capability Report, Register 1C₁₆

Verify that the transponder replies with a DF=20 reply with:

- o IIS [bit14 through17 of the reply]=0 and IDS[bit18-19 of the reply] =0,
- o Bits 33....

2.6.6.1 Part 1: Aircraft Identification and Aircraft Registration Startup

c) Comm-B Broadcast Extraction because of Aircraft Identification

Change:

Verify that the transponder replies with a DF=20 reply with IIS [bit14 through17 of the reply]= 0 and IDS[bit18-19 of the reply] =0 and with the "MB" field providing Aircraft Identification data as follows:

...

f) Aircraft registration Verification

Verify that the transponder replies with a DF=20 reply with IIS [bit14 through17 of the reply]= 5 and IDS[bit18-19 of the reply] =0 and having the following "MB" field:

2.7.4.1 Register 1D₁₆ Mode S Specific Services MSP Capability

...

Verify that the transponder replies with a DF=20 reply with:

- o IIS [bit14 through17 of the reply]=4 and IDS[bit18-19 of the reply] =0,
- o Bits 33...

2.7.4.2 Register 1E₁₆ Mode S Specific Services MSP Capability

Verify that the transponder replies with a DF=20 reply with:

- o IIS [bit14 through17 of the reply]=0 and IDS[bit18-19 of the reply] =0,
- o Bits 33...

2.7.4.3 Register 1F₁₆ Mode S Specific Services MSP Capability

Verify that the transponder replies with a DF=20 reply with:

- o IIS [bit14 through17 of the reply]=0 and IDS[bit18-19 of the reply] =0,
- o Bits 33...

2.7.5.1 Part 1 – Register 40₁₆ and Register 5F₁₆ Initial Conditions

a) Register 40₁₆

...

Verify that the transponder replies with a DF=20 reply with IIS [bit14 through17 of the reply]= 6 and IDS[bit18-19 of the reply] =0 and with bits 33 ...

c) Register 5F₁₆ Initial Setting:

Verify that the transponder replies with a DF=20 reply with IIS [bit14 through17 of the reply]= 13 and IDS[bit18-19 of the reply] =0 and with bits 33 ...

2.7.6 Register 50₁₆ Enhanced Surveillance – Protocol and Interface

2.7.6.1 a)

...

Verify that the transponder replies with a DF=20 reply with IIS [bit14 through17 of the reply]= 9 and IDS[bit18-19 of the reply] =0 and with bits 33 ...

2.7.7.1 Register 60₁₆ – Enhanced Surveillance – Protocol and Interface

2.7.7.1 a)

...

Verify that the transponder replies with a DF=20 reply with IIS [bit14 through17 of the reply]= 14 and IDS[bit18-19 of the reply] =0 and with bits 33 ...

2.8 Generic Register XX Test Procedures

2.8.2

c) Verify that the transponder replies with a DF=20 reply with IIS [bit14 through17 of the reply]= the Register Tag value specified in table B-2-1 and IDS[bit18-19 of the reply] =0 and with Bits 33 through ...

5.0 ICAO change

ICAO Annex 10 Volume IV will need to be modified as follows:

3.1.2.6.5.3 *UM: Utility message.* This 6-bit (14-19) downlink field shall contain transponder communications status information as specified in 3.1.2.6.1.4.1 and 3.1.2.6.5.3.1.

3.1.2.6.5.3.1 Subfields in UM for multisite protocols

UM FIELD STRUCTURE

...

The following subfields shall be inserted by the transponder into the UM field of the reply if a surveillance or Comm-A interrogation (UF equals 4, 5, 20, 21) contains DI = 1 and RSS other than 0:

IIS: The 4-bit (14-17) interrogator identifier subfield reports the identifier of the interrogator that is reserved for multisite communications.

IDS: The 2-bit (18, 19) identifier designator subfield reports the type of reservation made by the interrogator identified in IIS.

Assigned coding is:

0 signifies Register Tag or no information

1 signifies IIS contains Comm-B II code

2 signifies IIS contains Comm-C II code

3 signifies IIS contains Comm-D II code.

3.1.2.6.5.3.2 *Multisite reservation status.* The interrogator identifier of the ground station currently reserved for multisite Comm-B delivery (3.1.2.6.11.3.1) shall be transmitted in the IIS subfield together with code 1 in the IDS subfield if the UM content is not specified by the interrogation (when DI = 0 or 7, or when DI = 1 and RSS = 0).

The interrogator identifier of the ground station currently reserved for downlink ELM delivery (3.1.2.7.6.1), if any, shall be transmitted in the IIS subfield together with code 3 in the IDS subfield if the UM content is not specified by the interrogation and there is no current Comm-B reservation.

3.1.2.6.5.3.3 *Downlinked Register indication*

If the content of the UM field is not specified by the interrogation (DI≠1 or when DI=1 and RSS=0), and if there is no ground station currently reserved for Comm-B delivery or Downlink ELM delivery,

and if the interrogation requires a Comm-B delivery in a DF 20 or 21 (RR>15) then a register tag indicating which register is transferred in the MB field shall be contained in the IIS sub-field of UM together with IDS=0.

Note: The register tags are specified in the table in Doc 9871 §A.2.1. This additional information allows the verification of which register is contained in the MB field. This can be used by passive surveillance system to decode the received MB field and by Mode S ground stations to confirm that the received reply contains the right register data.

An additional column defining the Register Tag will need to be added into the Register Allocation Table in Doc 9871 §A.2.1.

6.0 Action

The meeting is invited to review the proposed change to the transponder MOPS.