RTCA SC-209 / EUROCAE WG-49

ATCRBS / MODE S TRANSPONDER MAINTENANCE

JOINT MEETING #11

RTCA Headquarters
8 – 10 September 2010

Reconsideration of the Proposal to Clarify Interrogation Acceptance Protocol when DI is Undefined

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Summary

Working Papers ASP TSG WP09-18 and SC209-WP10-10R1 discussed the issues that the existing requirements for Interrogation Acceptance Protocol are not specific about how a transponder should respond when the DI field contains an undefined value. Those Working Papers indicated that this has the potential to cause undesired consequences when those values are defined. Those Working Papers proposed requirements to make transponder behavior deterministic when the DI field is undefined. However, after further review of these proposed changes, this Working Paper proposes an alternate solution to insure proper operation when an unassigned DI code is received by the transponder.

1.0 Introduction

As presented to the ICAO ASP TSG in Working Paper TSGWP09-18 and to the Joint Session of RTCA SC-209 and EUROCAE WG-49 as Working Paper SC209-WP10-10R1, there was indication that the existing requirements for Interrogation Acceptance Protocol are not specific about how a transponder should respond when the DI field contains an undefined value. Those Working Papers indicated that this has the potential to cause problems if the SD field is misinterpreted when these values are contained in an interrogation. Those Working Papers proposed requirements to make transponder behavior deterministic when the DI field is undefined. Those Working Papers argued that if left unchanged, vendors could potentially alter transponder states when the DI codes are potentially defined in the future.

2.0 Proposed Changes to DO-181D

Working Papers ASP TSG WP09-18 and SC209-WP10-10R1 proposed making the following changes in DO-181D to §2.2.19.1.1 and Figure 2-15.

In Figure 2-15, add a decision diamond ~~immediately before the Accept box~~ between States "J" and "X" with the following text: "If Present, DI = 4, 5, 6." The YES exit to the diamond should point to "Recover" to indicate the interrogation is not accepted. The NO exit to the diamond should continue to the Accept box.

Add bullet "d." to paragraph 2.2.19.1.1

d. When the DI field equals 4, 5, or 6, the interrogation **shall not** be accepted.

3.0 Proposed Changes to ED-73C

Working Papers ASP TSG WP09-18 and SC209-WP10-10R1 proposed making the following changes in ED-73C to §3.23.1.1 and Figure 3-15.

In Figure 3-15, add a decision diamond ~~immediately before the Accept box~~ between States "J" and "X" with the following text: "If Present, DI = 4, 5, 6." The YES exit to the diamond should point to "Recover" to indicate the interrogation is not accepted. The NO exit to the diamond should continue to the Accept box.

Add bullet "e." to paragraph 3.23.1.1

e. When the DI field equals 4, 5, or 6, the interrogation **shall not** be accepted.

4.0 Proposed Changes to ICAO Doc 9871

No changes were proposed in Working Papers ASP TSG WP09-18 and SC209-WP10-10R1 to Doc 9871.

5.0 Consideration of the ICAO Annex 10, Vol 4 SARPs with the proposed changes.

Working Papers ASP TSG WP09-18 and SC209-WP10-10R1 proposed that there were no changes required to the SARPs.

However, an action item was generated during the TSG Meeting in Paris for Gary Furr to prepare a new ICAO ASP Working Paper ASP09-05 for the upcoming ICAO ASP Working Group meeting in Brussels in October 2010 for a SARPs Change Proposal (CP) related to the changes in the Transponder MOPS documents that were agreed to in 2.0 and 3.0 above during the TSG and Joint RTCA/EUROCAE Meetings.

Upon research of Volume 4 of the Annex 10, several issues became clear.

(a) §3.1.2.6.1.3 of the SARPs defines the encoding for the DI field and in that definition, the values for 4, 5 and 6 are defined as "signifies SD not assigned."

(b) The definition for DI values 4, 5 and 6 in DO-181D/ED-73C only indicates that the values are "not assigned."

(c) §3.1.2.4.1.2 of the SARPs gives the requirements for "Interrogation Acceptance" and upon reading through this section, it becomes clear that if the requirement identified in 2.0 and 3.0 above is accepted, then at a minimum a new requirement would have to be entered as bullet "e)" under §3.1.2.4.1.2.3 to indicate that an interrogation would not be accepted if DI=4, 5 or 6.

6.0 Conclusion / Recommendation

Since the vagueness in the current requirement could lead an implementer to decide that DI=4, 5 or 6 is an interrogation it cannot interpret, a non reply in these cases should be considered acceptable. Since many manufacturers have already implemented in this fashion, we are not suggesting that the requirement be changed to require a reply. However, we don't think that we should make the **do not reply** the requirement either. If a manufacturer replies in this case, there is no down side. In fact, it is an advantage.

Looking at the requirements, if done properly, there should be no impact to the multisite and other protocols and the UM content should contain no information based on Figure 2-19 of DO-181D. If a reply is generated and the SD format is not decoded according to DI = 0, 1, 2, 3 or 7, this is acceptable and in accordance with the philosophy of the SARPs.

Therefore, we are recommending that we do not change the interrogation acceptance criteria. We should allow either a reply or no reply when an interrogation contains DI=4, 5 or 6. We should clarify requirements and modify/enhance test procedures appropriately to allow either implementation.

The DI description should be clarified that when DI=4, 5 or 6, that there is no SD content. Test procedures should verify that there is no effect on the state of the transponder (misinterpreted SD) and UM=0 when DI=4, 5 or 6. This is a negative test that could be incorporated in the test procedure section.

Review of existing requirements and test procedures in DO-181D:

2.2.14.4.11 DI Designator Identification

Since the existing table containing DI codes simply labels DI = 4, 5 and 6 as "Not assigned", the addition of a Note to clarify that these values result in no SD information and SD should not decoded.

2.5.4.5 Procedure #5 Selective Lockout Tests

Adequate negative testing is included in the current procedure. There is a test verifying that incorrect DI codes do not initiate Selective Lockout timer.

2.5.4.6.3 Squitter Control Verification

No negative tests are contained in the current procedure that would test DI ≠ 2 codes incorrect interpretation of the SD field as DI=2 to impact squitter control.

2.5.4.18 Procedure #18 Comm-B Protocol

No negative tests are contained in the current procedure that would test that DI = 4, 5 or 6 codes do not lead to incorrect interpretation of the SD field and impact Comm-B transponder state.

2.5.4.24 Procedure #24: Comm-C Protocol

Adequate negative testing is included in the current procedure. There are test cases that verify no Comm-C action (reservation or cancellation) when an incorrect DI code (DI≠ 1) is used in an interrogation.

2.5.4.26 Procedure #26: Comm-D Protocol

Adequate negative testing is included in the current procedure. There are test cases that verify no Comm-D action (reservation or cancellation) when an incorrect DI code (DI≠ 1) is used in an interrogation.