## **RTCA Special Committee 209**

## Working Group #1

#### **Mode S Transponder MOPS Maintenance**

Meeting #3

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# **Details of Suggested Change to Figure 2-19 in DO-181D**

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#### SUMMARY

I have been reviewing and updating figures for DO-181 and of course this includes our favorite Figure 2-19. Recently I pointed out a problem with our latest change to this figure that you seemed to concur in your response pending further review. I have included detail here that identifies this problem and makes a case for adopting my original proposed correction (ModeS-WP01-06). I have tried to just make adjustments to the current figure to resolve this but there isn't a simple change that works. It is my position that my proposed change is efficient as possible and correct. The attached paper presents my case.

There have been several proposed corrections to Figure 2-19. Figure 2-19 is a flow chart showing the Comm-B protocol. The latest Figure 2-19 includes an important correction that will enable a valid non-multisite closeout interrogation (PC=4 with RR $\neq$ 16) to closeout a non-multisite Comm-B message.

However, this correction introduces a new error with the figure. This error is highlighted in the figure below:



If the transponder is in a state with a non-multisite Comm-B message that has been transmitted at least once, the message is eligible for closeout from a non-multisite closeout interrogation with PC=4 (2.2.19.1.12.4). The **RED** highlighted path shows that with the transponder in this state, a multisite closeout (DI=1, MBS=2, PC $\neq$ 4) will also closeout a non-multisite message.

There has been a significant revision to the Comm-B protocol test Procedure #18 that includes a table that identifies the expected transponder state after each interrogation pattern is tested with each transponder state. There is currently a conflict between the expected state table in the test procedure and the current Figure 2-19 because the test procedure expects the multisite closeout interrogation to be rejected with the transponder in the state described above.

The following series of figures shows that the correction to Figure 2-19 originally proposed in ModeS-WP01-06 correctly processes all possible transponder states and interrogation patterns.

The section of the flowchart that is in question has two possible outcomes: to closeout a Comm-B message or not. The first figure shows that if basic conditions for closeout are not met, that closeout will not occur.



The **RED** path is taken if the Comm-B message was not transmitted at least 1 time.

The **BLUE** path is taken if the interrogation does not include closeout protocol ( $PC \neq 4$ , and  $DI \neq 1$ ).

The **GREEN** path is taken if a multisite interrogation does not include closeout protocol (DI=1 but MBS $\neq$ 2).

The next figure shows an example of a transponder that is in the state where a nonmultisite Comm-B message is active, has been transmitted at least once, and is ready for closeout. The transponder will accept and closeout the message upon receipt of an interrogation with PC=4.



The **BLUE** path shows the acceptance and subsequent closeout of the message from an interrogation with PC=4.

The **RED** path shows the rejection of a multisite closeout (DI=1, MBS=2) because the multisite timer is not running.

Note: If an interrogation included both multisite closeout protocol (DI=1, MBS=2) and non-multisite closeout protocol (PC=4) the message will be closed out (BLUE path). This is correct since with the transponder in this state, the only requirement for closeout is the presence of PC=4.

The next figure shows an example of a transponder that is in the state where a multisite Comm-B message is active, has been transmitted at least once, and is ready for closeout. The transponder will accept and closeout the message upon receipt of a valid multisite closeout (DI=1, MBS=2, IIS=Stored Value) or (PC=4, IIS=Stored Value).



The **RED** path shows the acceptance of an interrogation with PC=4.

The **BLUE** path shows the acceptance of an interrogation with DI=1, and MBS=2.

Either interrogation is subject to testing that the IIS code is equal to the stored value for the multisite timer. If the IIS matches the stored value the transponder will accept the closeout (**GREEN** path). If the IIS does not match, the closeout will be rejected (**ORANGE** path).