

RTCA Special Committee 186, Working Group 3

ADS-B 1090 MOPS

Meeting #2

Suggested Changes to DO-260, Section 3

(Presented by Greg Kuehl, UPS Airlines)

SUMMARY

After several email exchanges between Greg Kuehl and Jerry Anderson, with verbal and email discussions with Bob Hilb on the subject of the TCAS and CDTI status bits in the Aircraft Operational Status Message, reflected in Tables 2-54 and A-13, Greg Kuehl is proposing changes/additions to DO-260, Section 3.5.

1. Background

During the 1st WG-3 meeting there was discussion of the TCAS and CDTI Status Bits reflected in the Aircraft Operational Status Message in Tables 2-54 and A-13 and described in Section 2.2.3.2.7.3.3.1. There were changes to Tables 2-54 and A-13 and proposed changes to the test procedures as reflected in Working Paper 1090-WP-2-12.

After verbal and email discussions with Bob Hilb on the changes proposed in Meeting #1, and email exchanges between Greg Kuehl and Jerry Anderson, which are attached to this Working Paper, Greg Kuehl proposed changes/additions to DO-260 Section 3.5, also as attached to this Working Paper.

2. Email Exchanges leading up to the proposed change

Following you will find the sequence of emails that were exchanged between Greg Kuehl and Jerry Anderson on the subject of the proposed changes to Tables 2-54 and A-13 and what other changes to DO-260 were appropriate.

3. Proposed Changes to Section 3.5

Attached to this Working Paper are the proposed additions to DO-260 Section 3.5

-----Original Message-----

From: Greg Kuehl [mailto:air2gwk@air.ups.com]
Sent: Wednesday, December 06, 2000 5:12 PM
To: MOPS1090 Listserver
Cc: Greg Wakeling; Bob Hilb
Subject: "CC_4" Encoding Table

All,

I spoke to Bob Hilb and traded e-mails on the TCAS and CDTI status bits in Table 2-54 (DO-260 pg. 98). I understand the requirement as follows: The ACM function, generating a conflict resolution (without TCAS), must not conflict with a TCAS R/A, executed by the intruder. Ideally, ACM receives the broadcast that TCAS has issued an R/A, the direction of the R/A, and the ID (if known) of the subject aircraft. With this information, ACM can adjust its resolution strategy appropriately. If ACM detects a conflict with an intruder which is executing a TCAS R/A against some other aircraft, ACM is free to resolve its detected conflict using all its options. On the other hand, if the subject of the TCAS R/A is unknown, ACM must assume that itself is the subject and avoid any resolution which is not compatible with the TCAS R/A. In addition, "knowing" that TCAS is operational, ACM can anticipate the issuance of an R/A and adjust accordingly.

Likewise, if a CDTI (with ACM) is operating in the intruder aircraft, ACM could anticipate a complimentary response (if any) to its resolution advisory.

Proposed Changes to CC_4 Coding bits 11,12 are (as we discussed):

00 TCAS Not Operational; CDTI Not Operational
01 TCAS Not Operational; CDTI Operational
10 TCAS Operational; CDTI Not Operational
11 TCAS Operational; CDTI Operational

Bob agrees that this will accomplish the intended purpose. And it is consistent and logical.
Greg Kuehl

==== Message Separator =====
Date: 12/7/00 8:17 AM
Sender: Jerry Anderson
To: air2gwk@air.ups.com; orlando@ll.mit.edu; Gary CTR Furr; Stuart Searight
Priority: Normal Receipt requested
Subject: Re: FW: "CC_4" Encoding Table

Hi,

At the WG-3 meeting last week I think we talked about using "CDTI Not Operational or Unknown". Are we still going to have the "or Unknown"?

As Ron Jones suggested, I think we should change CC-4 coding bits 9 thru 12 to "Reserved" and pick 4 new bits for this information.

Thanks,
Jerry

===== Message Separator =====

Subject:
Author: Greg Kuehl <air2gwk@air.ups.com> at SMTPGate
Date: 12/7/2000 12:54 PM

Jerry (et al),

You're right, the 00 state can mean no information. I thought we said that the transponder will always "know" if TCAS is installed since it is an integral part of the system. If TCAS is not installed, it is not operative on that aircraft and 0 is the appropriate status. I hope that FAA would not certify an installation in which TCAS was installed but the Valid signal was not connected!

I remember the discussion on the proper bit selection and I'm sure that is not an issue with Bob. I thought these were OK for the Status message. I thought we were going to find an appropriate place to transmit the TCAS R/A issuance as an "On-condition" message.

Later,
Greg Kuehl

===== Message Separator =====

-----Original Message-----

From: Jerry Anderson [mailto:Jerry.Anderson@faa.gov]
Sent: Monday, December 11, 2000 9:15 AM
To: air2gwk@air.ups.com
Cc: orlando@ll.mit.edu; J_Stuart_Searight@tc.faa.gov; Gary.CTR.Furr@tc.faa.gov
Subject: Re: CC 4 Coding

Hi Greg,

I think we are agreeing. The bit combinations are as follows:

- 00 TCAS Not Operational; CDTI Not Operational or Unknown
- 01 TCAS Not Operational; CDTI Operational
- 10 TCAS Operational; CDTI Not Operational or Unknown
- 11 TCAS Operational; CDTI Operational

I have added the "Unknown" to the CDTI. I think the manufacturers wanted the CDTI "Unknown" state.

You are right. A transponder implementation of ADS-B should always know the status of any associated TCAS. A non-transponder implementation should not be installed on an aircraft with a TCAS. We should add this restriction to Section 3 of the MOPS.

We also need to add tests to Section 2 to ensure that these bits can be set properly.

The failure classification for the TCAS information will be Hazardous/Level B, since it will be used to choose a maneuver that is compatible with TCAS.

Thanks,
Jerry

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===== Message Separator =====

Subject: RE: CC 4 Coding
Author: Greg Kuehl <air2gwk@air.ups.com> at SMTPGate
Date: 12/11/2000 10:56 AM

Yes Jerry, we agree. MOPS section 3 also needs to verify that the installation includes connection of the TCAS and/or CDTI (if installed) valids to allow ADS-B transmission of this status. I'm not sure exactly where, in the MOPS, it should go. What do you think of an additional paragraph under 3.5.3 "On-condition Sensors"? It is used to support a status message associated with a condition of failure of the TCAS or CDTI.

Any suggestions?

Also, if TCAS is installed, the R/A status information must be supplied to ADS-B. This is clearly an on-condition message, sent when the on-board TCAS (if installed) issues an R/A. ADD to 3.5.3 also?

If this is the place to put these, I will draft some proposed wording. I suppose I can draft wording anyway. We'll just put it where it belongs.

Later,
Greg

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===== Message Separator =====

From: Jerry Anderson [mailto:Jerry.Anderson@faa.gov]
Sent: Monday, December 11, 2000 2:04 PM
To: air2gwk@air.ups.com
Cc: orlando@ll.mit.edu; J_Stuart_Searight@tc.faa.gov; Gary.CTR.Furr@tc.faa.gov
Subject: Re[2]: CC 4 Coding

Greg,

Section 3.5.3 seems O.K. I guess the "Condition" is that you have or don't have TCAS?

The RA status information is more clearly "on condition." The specific requirements for the RA information have not yet been fully documented. Someone will have to determine the required information update rate, etc. Maybe the CD&R group will do this. When they are, we can incorporate the required info into our message structure.

Speaking of requirements, where in the ADS-B MASPS is the requirement for the TCAS and CDTI status information?

Thanks,
Jerry

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===== Message Separator =====

Subject: RE: Re[2]: CC 4 Coding
Author: Greg Kuehl <air2gwk@air.ups.com> at SMTPGate
Date: 12/12/2000 8:32 AM

Jerry,

In reverse order, the requirements for TCAS and CDTI status are in the Comments form the plenary that, I assume, were accepted as conditions for adoption of the draft. Specifically, these are from Bob Hilb,

#16 and #17 in the "ADS-B 1090 MHz Rev A Comments Related to MASPS Changes RTCA SC-186 WG-3 SC-186 WG-3/EUROCAE WG-51 SG-1" which we reviewed at the last meeting.

I agree, the CD&R group should set the data requirements, depending on their use of the TCAS R/A "condition".

Is the operational "status" (operational, not operational or not installed) a condition or a status message? I am thinking that we use status to indicate the level of equipage and functional capability, including equipment failures which might limit applications.

I think of the "on-condition" messages as being generated as the result of satisfying one or more conditions (e.g. TCAS R/A issued; TCAS R/A cleared; gear down and flaps up).

I'll write some words for 3.5.3.

Later,
Greg

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===== Message Separator =====  
Date: 12/12/00 3:19 PM  
Sender: Jerry Anderson  
To: Greg Kuehl <air2gwk@air.ups.com>; orlando@ll.mit.edu; Gary CTR Furr;  
Stuart Searight  
Priority: Normal Receipt requested  
Subject: Re[4]: CC 4 Coding
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Greg,

The TCAS/CDTI status information is in the "Aircraft Operational Status" message (Type Code 31). The "Aircraft Operational Status" message contains 4 Capability Classes (CC_1 thru CC_4) and 4 Operational Modes (OM_1 thru OM_4). I don't know what the difference is between CC and OM. The TCAS/CDTI status is only in the CC_4 encoding (titled En Route Operational Capabilities); it is not in the OM_4 encoding (titled En Route Operational Capability Status). I'm not sure the CC and OM titles can be applied to TCAS/CDTI, but these titles are just place holders and we can use them for whatever we want. We could move the TCAS/CDTI status somewhere else. We will need to move them somewhere, when we make the current bits reserved.

TCAS RA information would probably be in an Event-Driven Message (Type Code 25, 26 or 27).

It should be noted that the broadcast of TCAS information (either status or RA) will have a failure condition classification of Hazardous for hardware and software because it will be used to "coordinate" maneuvers with TCAS. I hope this is not a burden on any manufacturers. All Class A1, A2, A3 systems are required to transmit the "Aircraft Operational Status" message. I imagine most Mode S transponders are already built to the Hazardous level, but I don't really know.

Thanks,
Jerry

Proposed Addition to RTCA DO-260
“Minimum Operational Performance Standards for 1090 MHz Automatic Dependent Surveillance-Broadcast (ADS-B)”

Greg Kuehl
12/12/00

In consideration of the comments received from Bob Hilb, and the ensuing discussion, it is suggested that we add the following section(s):

3.5.2 Variable Data

3.5.2.1 System Monitors

If ADS-B applications or messages require data from, or crew use of other aircraft systems, the means to monitor subject system’s operational status (e.g. valid discrete, sign-status matrix, etc.) shall be provided to the ADS-B equipment.

3.5.3 On-condition Sensors

3.5.3.1 ACAS Interface

If a TCAS /ACAS system is installed on the aircraft, appropriate connection shall be made to ADS-B to support transmission of “on-condition” message(s) when:

- a. Resolution Advisory (R/A) is present
- b. A cross-link coordination occurs, including the sense (i.e. “don’t climb/don’t descend”).

In addition, the CDTI working Group should review Table 2-54 and new section 2.2.3.2.7.2.8A to insure that these changes meet the requirements for TCAS/ACAS information.