

AERONAUTICAL SURVEILLANCE PANEL (ASP)

THIRD WORKING GROUP MEETING

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**WG Agenda Item
#5.8.1.**

WORKING PAPER

Revised Coding of ACAS Bits in Register 10

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SUMMARY

This working paper is generated by the ASSG in response to WP/ASP03-06. ASSG members agree to the basic idea to provide a mean to downlink the information on version of ACAS logic. Also, the members agreed to maintain backward compatibility.

This working paper proposes a coding of bit 71 to improve the backward compatibility. Also, it proposes to reduce the modification from current standards to avoid potential problems.

References

- [1]. ICAO: "ANNEX 10", volume IV, amendment 77, 2003
- [2]. ASP-TSG: "CODING OF ACAS BITS IN REGISTER 10₁₆", WP/ASP03-06, October, 2007

1. Introduction

1.1 The working paper ASP03-06 is proposing a new coding to represent the version of ACAS algorithm with some bits in register 10HEX. This register is used to store the information for capability of onboard equipments. The new coding can indicate the version of ACAS algorithm whether it is amendment 77 to ANNEX 10 or later. It should be noted that the amendment 82 to ANNEX 10 does not change the ACAS algorithm.

1.2 Since SSR Mode S stations have already been operating to downlink the RA information with Mode S transponders, the backward compatibility of coding is required for the new assignments of bits in signal. The new coding in ASP03-06 is proposed with taking the backward compatibility into account.

1.3 This paper proposes another option of coding to improve the backward compatibility after the discussion in ASSG.

2. Consideration by ASSG at the meeting in Toulouse

2.1 The current implementation to decode the information in BDS 10HEX is summarized as follows. This paper is focused on the bits under consideration in WP03-06.

2.2 Although bit 71 is defined to indicate ACAS fitment, it has been used to indicate whether the equipment is ICAO ACAS compliant or not. It is used by SSR Mode S ground stations to distinguish the format in BDS 30HEX for RA downlink. The ICAO ACAS compatible format in BDS 30HEX is available only when both the ACAS unit and the Mode S transponder have the capability to do so. It should be noted that there are old transponders without the capability to transmit ICAO compatible coding in BDS 30HEX, even if it is connected to an ICAO compliant ACAS unit. For example, these transponders are observed in the Asia-Pacific region. SSR Mode S systems should decode correctly using bit 71 at any time for any combination of onboard equipments. As a result, currently, the coding of bit 71 represents the format in BDS 30HEX as follows.

71	0	ACAS not fitted (<i>this coding means that it is a version 6.04 TCAS</i>)
	1	ACAS fitted (<i>this coding means that it is a version 7.0 TCAS</i>)

2.3 The bit 69 represents the capability of ACAS logic to generate horizontal RA, i.e., it is ACAS II or ACAS III. There is no current report to ICAO that indicates any active project to develop and implement ACAS III, as written in WP03-06. However, some transponders have been observed in Europe and in Asia transmitting this bit as 1 and this is clearly a failure.

2.4 The bit 72 represents the hybrid surveillance capability of onboard ACAS unit. WP03-06 reports that there have not been any ACAS implementations or any commercial products with hybrid surveillance. WP03-06 is proposing to change the meaning of bit 72 from that in

current ACAS SARPs to indicate the version of ACAS logic. The AS-SG does not see the need to change the definition of bit 72 and it is preferred to keep it as in the standards today.

2.5 As a consequence, the AS-SG agrees that bit 69 is available for further coding and bit 71 should be defined more clearly in ICAO Annex 10, which still provides two bits in BDS10HEX to code the various ACAS status.

3. Proposal for coding to improve the backward compatibility

3.1 The ASSG suggests another coding for bit 71. The bit 71 is required to keep its meaning as in 2.2 of this paper for its full backward compatibility with existing SSR mode S systems. If the format in BDS 30HEX is the same with current ICAO SARPs or TCAS-II v7.0, the bit 71 should be kept to 1 even after the amendment to other parts of ACAS SARPs including its algorithm. If the format in BDS 30HEX will differ from the current ICAO standard, then it will be required to turn the bit to 0 again. Also, the ASSG suggests for clarification of the description in ACAS SARPs on bit 71 as follows.

Bit 71=0 ACAS not fitted (*this coding means that BDS30HEX relates to a version 6.04 TCAS*)
=1 ACAS fitted (*this coding means that BDS30HEX relates to a version 7.0 or later (V7.1)*)

3.2 It is proposed to use bit 69 to indicate whether it is a TCAS v7.0 or a TCAS v7.1 instead of the capability for generating horizontal RA.

Bit 69 =0. ICAO ACAS SARPs as amendment 77 (TCAS v7.0)
=1. ICAO ACAS SARPS later than amendment 82 (TCAS v7.1)

The coding 0 for bit 69 means that the TCAS unit is DO185A compliant, while coding 1 means DO185B compliant or later. Do185C is not foreseen in this coding now. It is not necessary to take DO185C and later versions into account for this case. If this happened, then BDS E5HEX and E6HEX may be used to provide the information on ACAS unit or its logic version.

As a result, the proposed coding is as follows.

Bit 71	69	coding
0	0	ACAS not fitted (TCAS version 6.04A)
0	1	ACAS not fitted (TCAS version 6.04A) (or invalid)
1	0	ACAS fitted (TCAS version 7.0)
1	1	ACAS fitted (TCAS version 7.1)

This proposal covers the need for coding DO185, DO185A and DO185 B without affecting the coding of bit 72 for hybrid surveillance.

3.3 The modification of bit 72 has more risk compared with that for bit 69, because the current version of Annex 10 was published in 2003 with this bit assignment and there might be earlier implementation by industries than that for bit 69 on ACAS-III.

3.4 The documents associated with Mode S transponders complying with amendment 77 will be need to be updated after the SARPs modification with WP/ASP03-06, because they may have the descriptions on bit 69 and 72 associated with current assignments.

3.5 The ASSG suggests picking up the option which improves the backward compatibility while requiring the minimum changes.

3.6 In any case, the bits in registers should be set correctly by resolving the implementation problems that have been observed. False settings of bit 69 have been observed, and they will lead to false decoding for the information on ACAS capability. The applications of down-linked information of RA and capability require sufficient integrity for each purpose.

4. **Recommendation**

4.1 ASP/WG members are invited to discuss about the backward compatibility of the formats or bit assignments for the representation of ACAS logic version and its downlink capability of RA information.

4.2 The ASSG suggests keeping the meaning of bit 71 as today to indicate ACAS or TCAS fitment for BDS30HEX decoding.

4.3 The ASSG suggests using bit 69 to indicate the TCAS logic version 7.0 or 7.1.

4.4 The ASSG suggests to retain bit 72 unchanged to indicate hybrid surveillance capability.