International Civil Aviation Organization

THE THIRD MEETING OF MODE S DOWNLINKED AIRCRAFT PARAMETERS WORKING GROUP (MODE S DAPs WG/3)

Web-conference, 12 – 15 May 2020

Agenda Item 6: Discussion on Roadmap on Mode S DAPs and related issues in APAC region

II/SI OPERATIONS

(Presented by Singapore)

SUMMARY

This paper shares with the meeting the details of the II/SI operations that is used in Europe.

1. INTRODUCTION

1.1 Mode S interrogators required an assignment of Interrogator Codes (IC). Such IC could either be Interrogator Identifier Codes (II Code) or Surveillance Identifier Codes Codes (SI Code).

1.2 Mode S radars make use of ICs to reduce the need for aircraft to reply unnecessarily, by means of lock-out protocol. This is to help reduce frequency congestion. Due to this purpose of locking out in Mode S radar operations, radars with overlapping coverage do not share the same ICs. The assignment of ICs is to be coordinated within regions by centralised coordinating bodies (e.g. Eurocontrol for Europe and ICAO APAC for the case of Asia-Pacific).

2. DISCUSSION

2.1 If 4-bit II codes are used, up to 15 distinct codes could be allocated to radars, ranging from II = 1 to II = 15. If 6-bit SI codes are used, up to 63 distinct codes could be allocated to radars, ranging from SI = 1 to 63. It is clear that use of SI codes will allow more IC to be available for assignment to radars.

2.2 According to Annex 10 Volume IV. 2.1.5.1.7:

> 2.1.5.1.7 *SI capability* — Transponders with the ability to process SI codes shall have the capabilities of 2.1.5.1.1, 2.1.5.1.2, 2.1.5.1.3, 2.1.5.1.4 or 2.1.5.1.5 and also those prescribed for SI code operation (3.1.2.3.2.1.4, 3.1.2.5.2.1, 3.1.2.6.1.3, 3.1.2.6.1.4.1, 3.1.2.6.9.1.1 and 3.1.2.6.9.2). Transponders with this capability shall be designated with a suffix "s".
> *Note.— For example, a level 4 transponder with extended squitter capability and SI capability would be designated "level 4es".*
>
> 2.1.5.1.7.1 SI code capability shall be provided in accordance with the provisions of 2.1.5.1.7 for all Mode S transponders installed on or after 1 January 2003 and by all Mode S transponders by 1 January 2005.
> *Note.— Mandates from certain States may require applicability in advance of these dates.*

2.3 Although ICAO stated that all Mode S transponders have to be SI capable, but in practice, not 100% of aircraft are SI capable. Only SI capable transponders will be able to recognize the full 6 bits of the SI in the roll-call (lock out) message. Non SI capable transponders will only be able to recognize the last 4 bits, hence will mistakenly lock out to other radars with different SI codes, but with the same last 4 bits.

2.4 To work around the situation, parts of Europe employed a special mode of operation known as the II/SI Operation. The details are shown in the attachment A.

3. ACTION BY THE MEETING

3.1 The meeting is invited to:
a) note the information in this paper;
b) discuss any matters as appropriate.

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Attachment A

II/SI Operations

1 An SI code, is composed of the IC field and the CL field. Only transponders complying with Amendment 73 of Annex 10 will decode the CL field in order to determine if the content of the IC field is an II code or an SI code. Transponders which have not been upgraded to handle SI code will, by default, consider the content of the IC field as being an II code value. Therefore, if CL is not equal to zero (meaning that the IC field contains a SI code), the non-upgraded transponders will encode the parity sequence of the reply using the "matching" II code rather than the SI code contained in the Mode S All-Call interrogation

Structure of all-call uplink

Bits 1 to 5	Bits 6 to 9	Bits 10 to 13	Bits 14 to 16	Bits 17 to 32	Bits 33 to 56
(UF = 11)	PR:4	IC:4	CL:3	-16- (all zeros)	AP:24

CL Code Label

Code	Description
000	IC Field contains the II code
001	IC Field contains SI codes 1 to 15
010	IC Field contains SI codes 16 to 31
011	IC Field contains SI codes 32 to 47
100	IC Field contains SI codes 48 to 63

Structure of all-call downlink

Bits 1 to 5	Bits 6 to 8	Bits 9 to 32	Bits 33 to 56
(DF = 11)	CA:3	AA:24	PI:24

AA Aircraft Address transponder address in clear
PI Parity/Interrogator Identity Aircraft Address overlaid with SI code. For the case of non-SI capable aircraft, the aircraft will only recognise the last 4 bits of the SI code. It will encode the PI field by overlaying the Aircraft address with the last 4 bits of the SI code (“matching” II code) instead of the entire SI code.

2 The system, when operating with an SI code, shall also acquire targets through All-Call replies which are encoded using the "matching" II code. This transponder shall be considered as a non SI equipped transponder.

2 Even if the content of BDS register 10_{16} (Datalink capability report) states that the transponder has the SI capability, if this transponder is detected as using the "matching" II code to encode the parity sequence of the replies, it shall be considered as a non SI equipped transponder.

3 The system, if operating with an SI code, shall interrogate targets equipped with non SI transponders using the Mode S selective protocols foreseen for II code operation. The II code to be used shall be the "matching" II code.

4 The system, if operating with an SI code, shall not lockout non SI capable transponders on the "matching" II code.

6 The system, if operating with an II code, shall not lockout Mode S transponders which do not report the SI capability in BDS register 10_{16} (i.e. non SI capable transponders).

7 The above requirements are to allow neighbouring stations operating with an SI code and the "matching" II code to acquire the non SI targets.

8 With this system management function, the lockout maps are not taken into account for non SI capable equipped transponders.

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