International Civil Aviation Organization

THE FOURTH MEETING OF MODE S DOWNLINKED AIRCRAFT PARAMETERS WORKING GROUP (MODE S DAPs WG/4)

Web-conference, 29 – 31 Mar 2021

Agenda Item 3: Sharing of State's implementation on Mode S and related issues, including the experience in Mode S Interrogator Identifier (II) Code usage in APAC region

STRATEGY TO MIGRATE TO SI CODES

(Presented by China and Singapore)

SUMMARY

This paper presents the proposed strategy for the Asia Pacific region to migrate from II to SI codes.

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 (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

Difference between II and SI codes

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 the use of SI codes will allow more IC to be available for assignment to radars. Hence, its beneficial for SI codes to be deployed at regions with high density of radars.

Difficulties faced in transiting to SI codes and workaround

2.2 To deploy SI codes effectively and safely, the aircraft within the radar coverage must be SI capable. Although ICAO Annex 10 vol 4 required that all Mode S transponders have to be SI capable by 1 January 2005, 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.

2.3 As a work-around, Europe employed a special mode of operation known as the II/SI Operation. Under this mode, the radar will only issue lock-out command to SI capable transponders leaving non-SI transponders to reply to further all-calls. Details of this II/SI operation can be found in IP05 of Mode S DAPs WG/3.

2.4 It is also noted that II/SI mode may not be available in all Mode S radars.

Easing shortage of IC in future

2.5 China is facing a shortage of II codes for assignment of its high density of radars. Other places are also facing high density of radars and there may be a shortage of II codes in the future. It is also noted that some of the II codes were not declared and density is higher than what is seen today. There is hence a need to explore strategies to transit to SI codes, considering the readiness of the aircraft fleet and the readiness of individual States.

2.6 There are two options that can be employed:
a) Option 1: All States in Asia Pacific to switch from II to SI code (using II/SI mode) on a fixed date.
b) Option 2: States to transit from II to SI (using II/SI mode) individually.

2.7 Under Option 1, States will agree on a schedule to cut over from II to SI on a fixed date. The advantage is that ICAO APAC will only need to keep track of the SI code. However, due to varying readiness by states on the radar capability, varying urgencies and long lead time for the replacement of radars, it will not be possible any time soon to agree on the fixed date. There is a concern that a non-SI capable transponder might be locked out by a II code radar causing the transponder to be invisible to another radar using the "matching" SI code (i.e. same last 4 bits).

2.8 Under Option 2, States will switch from II to SI individually upon coordination with ICAO on the assigned SI code. The disadvantage is that ICAO APAC will have to keep track of both the II and SI code and ICAO APAC will have to ensure that the SI codes assigned do not match the II code of the overlapping radars. Matching SI codes can be used when there are no more radars using matching II codes.

2.9 Comparing the two options, Option 2 is preferred as it allowed the region to move forward.

2.10 The following conclusion is proposed:

<table>
<tr><td colspan="3">Draft Conclusion/Decision DAPs WG/4/XX - TRANSITION FROM II CODE TO SI CODE</td></tr>
<tr><td colspan="2">What: States with Mode S radar capable of performing II/SI mode operations are urged to transit from II code to SI code, so as to ease the shortage of II codes. States planning to perform the transition shall coordinate with ICAO APAC to obtain the SI codes.</td><td>Expected impact:
☐ Political / Global
☐ Inter-regional
☒ Economic
☐ Environmental
☒ Ops/Technical</td></tr>
<tr><td>Why: Due to higher density of radars, some states are facing a shortage of IC codes,</td><td>Follow-up:</td><td>☒Required from States</td></tr>
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which has to be solved by transiting from II to SI code. It is noted that radars using II and SI codes can co-exist with some restrictions in place, hence there is no need for a big bang approach. However, States still have to coordinate with ICAO APAC on the allocation of SI codes.	
When: 27-Aug-21	Status: Draft to be adopted by PIRG
Who: ☒Sub groups ☐APAC States ☐ICAO APAC RO ☐ICAO HQ ☐Other: XXXX	

3. ACTION BY THE MEETING

3.1 The meeting is invited to:

a) Note the contents of this paper; and

b) Discuss the issue as appropriate.

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