International Civil Aviation Organization

THE SIXTH MEETING OF MODE S AND DOWNLINKED AIRCRAFT PARAMETERS WORKING GROUP (MODE S AND DAPs WG/6)

Bangkok, Thailand 28 – 30 March 2023

Agenda Item 6: Interrogator Code (IC) planning and coordination

FUTURE REQUIREMENT BY ICAO TO USE II/SI CODE OPERATIONS

(Presented by Singapore)

SUMMARY

This information paper shares with the on-going proposals within the Surveillance Panel to include a requirement for radars using SI codes to support the II/SI code operations.

1. INTRODUCTION

1.1 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 must 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 SI in the all-call message. Non-SI capable transponders will only be able to recognize the last 4 bits and will reply using with a matching II code. The result is that the aircraft will not be acquired by the radar and therefore not detected.

1.2 As a work-around, a special mode of operation known as the II/SI Code Operation is used. Under this mode, the radar will interrogate the aircraft using SI code and acquire aircraft that reply using the same SI code, as well as those replying with the matching II code (i.e. aircraft that does not support SI code). Subsequently, it will only lock out the SI capable transponder and not the non-SI capable transponder. This is to allow the non-SI capable transponder to be acquired by nearby radars using matching SI codes.

2. DISCUSSION

2.1 Despite the ICAO Annex 10 Vol 4 requirement on the SI capable transponders, there are still aircraft not compliant. It may take a very long time before all aircraft are able because aircraft are not all subject to ICAO provisions (e.g. military, local small general aviation). In Europe, about 40 aircraft per month are seen without reporting the SI capability (some may be linked to level 1 transponders). In cumulative, more than 100 were detected as not SI capable over a period of 9 months in Europe.

2.2 At the Surveillance Panel, proposals are being consider including a provision on the use of II/SI code operations ICAO Annex 10 Vol 4. The addition of such a provision will improve the visibility of this requirement and will facilitate its traceability during the procurement, testing of systems and the allocation of SI codes by regional offices that will need to ask whether this mode of operation is supported before allocating an SI code.

2.3 The following text is currently being deliberated.

CHAPTER 1. DEFINITIONS

Matching SI code. *SI code whose binary format in the IC field is the same as the binary format in the IC field of the II code.*

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2.1.9 Mode S interrogator capability

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2.1.9.2 II/SI code operation

Note .- A mode of operation, known as II/SI code operation, enables the use of SI codes by Mode S ground stations before all transponders are SI code capable in a mixed environment where II and SI codes are used. A radar supporting 2.1.9.2.1 and 2.1.9.2.2 is known as supporting II/SI code operation. More information about this specific II/SI code operation can be found in Doc 9924 Appendix H and J.

2.1.9.2.1 Mode S ground station using an SI code shall

a) acquire Mode S II-only transponders on the matching II code,

b) selectively interrogate Mode S II-only transponders on the matching II code,

c) only lockout Mode S II/SI capable transponders.

Note 1.- A matching II code is an II code whose binary format in the IC field is the same as the binary format in the IC field of the SI code. Each Mode S SI code has one "matching" II code. A table of matching II-SI codes can be found in Doc 9924 Appendix H.

Note 2.-Mode S II/SI capable transponders supporting both II and SI codes as defined in Annex 10 Volume IV. Only locking Mode S II/SI transponder means that the old Mode S II-only transponders remain not lockout.

Note 3.-This requirement is necessary to make possible the allocation of SI codes to Mode S ground stations in areas in which not all transponders are SI capable.

2.1.9.2.2 ***Recommendation****.- Mode S II/SI capable interrogator using an II code should be configurable to only lockout Mode S II/SI capable transponders.*

Note 1.- This mode of operations is used when matching SI codes are used by overlapping interrogators.

Note 2. – A matching SI code is an SI code whose binary format in the IC field is the same as the binary format in the IC field of the II code. Each Mode S II code has four "matching" SI codes. A table of matching II-SI codes can be found in Doc 9924 Appendix H.

Note 3. – This recommendation is to make possible the allocation of matching II codes to Mode S interrogators in areas in which not all transponders are SI capable and where a matching SI code is allocated.

Note 4. – This recommendation is not necessary if a monitoring programme has demonstrated that all transponders are SI code capable or if SI codes do not need to be used on the ICAO region. More information on the use of this capability to make possible the allocation of SI codes can be found in Doc 9924 Appendix J.

2.4 Thus far, the above proposed text is endorsed by the Aeronautical Surveillance Working Group of the Surveillance Panel in March 2023. The discussion process is still ongoing.

3. CONCLUSION

3.1 The meeting is invited to note the content presented in this information paper.
