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 7: Review Roadmap on Mode S Implementation for APAC Region

GENERAL STRATEGY ON MIGRATION TO SI CODE

(Presented by China, Singapore and Secretariat)

SUMMARY

This information paper serves to synchronize the APAC region on the approach for assignment of SI codes for radars.

1. INTRODUCTION

1.1 Arising from a study conducted by the Mode S and DAPs working Group, it is established that II codes are no longer sufficient to support the growing number of Mode S radars.

1.2 ICAO APAC therefore made the decision to transit from the use of II codes to SI code for the Mode S radars.

1.3 To aid the coordination and assignment of SI codes, this paper attempts to synchronise the region on the general principles applied when assigning SI codes.

2. DISCUSSION

2.1 Factors to consider when formulating the general strategy:

a) It was previously shared that radars using SI code cannot detect II-only transponders unless a work-around known as the II/SI code operation is used.

b) Even if a radar using SI code supports the II/SI code operation, it will not be able to detect an II-only transponder if that transponder is already locked to a matching II code by a radar using that matching II code. A way to overcome this is for II radars to also use the II/SI code operations whereby it will only lock out SI-capable transponders and not II-only transponders. However, it is difficult to ensure that all radars (including old radars) can support the II/SI code operations.

c) Transponders that support only II codes are unlikely to disappear totally. Even with strict enforcement by ICAO, there will still be aircraft not subjected to ICAO's provision.

d) While it is possible to configure the lock-out coverage to be smaller than the designated operating coverage, such configuration may not be intuitive and may be subjected to error.

e) The European region is reserving II 14 and 15 (and their matching SI codes) for special use (i.e. research/test and military purposes).

f) The Surveillance Panel is deliberating on a proposal to include a **requirement** for use of II/SI code operations for radars using SI code and a **recommendation** for the use of II/SI code operations for radars using II code.

g) The strategy is to be kept simple.

2.2 The following general strategy is thus proposed for the assignment of SI codes:

a) ICAO APAC regional office will assign SSR Mode S II or Mode S SI codes in accordance with the planning criteria in Appendix A, at the same time ensuring support for Mode S II-only transponders.

b) ICAO APAC regional office will only assign an SI code if the radar can support II/SI code operations.

c) ICAO APAC regional office will only assign an SI code to radars having overlapping coverage with another radar using "matching" II code when the radar using "matching" II code can support II/SI code operations.

d) The ICAO APAC Regional Office will assume that the designated operating coverage is the same as the lockout coverage. There will be a 5NM buffer between the coverages of two radars using the same II or SI code. States can, as necessary, select a lockout coverage that is smaller than the Designated Operational Coverage.

e) The ICAO APAC regional office will generally avoid assigning II 14 and 15 (and their matching SI codes) to new radars.

2.3 The following general strategy for migration is proposed:

a) States with Mode S radars that can support II/SI code operation are encouraged to coordinate with the ICAO APAC Office to assign or re-assign SI codes to these radars.

b) The ICAO APAC Regional Office may also approach certain States to start migrating to SI codes.

3. CONCLUSION

3.1 The meeting is invited to:

a) Review the proposed general strategy for the migration to SI codes.

b) Adopt the proposed general strategy for the migration to SI codes.

Appendix A

The following planning criteria for assigning SSR Mode S II or SSR Mode S SI codes have been agreed by the Surveillance Panel and will be incorporated in the ICAO Aeronautical Surveillance Manual (DOC 9924)

Editorial Note: Some of the texts below are edited from the original material in DOC. 9924

Table 1: Considered interrogator (interrogator for which an Interrogator is demanded)
Mode S II-only interrogator
Operating on II code
Can operate with Mode S II-only and Mode S II/SI transponders

Case	Capability of the overlapping interrogator	Operating code	Condition	Transponder Type
A	A Mode S II only	Different II code	Overlap OK	II-only and II/SI
		Same II code	No overlap	
B	Mode S SI operating with II code (1)	Different II code	Overlap OK	II-only and II/SI
		Same II code	No overlap	
C	Mode S SI operating with SI code (1)	Any SI code, including a "matching" SI code	Overlap OK	II/SI
D	Mode S II/SI+ operating with II code (2)	Different II code	Overlap OK	II-only and II/SI
		Same II code	No overlap	
E	Mode S II/SI+ operating with SI code (2)	Non-matching SI code	Overlap OK	II-only and II/SI
		Matching SI code	No overlap	

Note 1: Mode S SI means Mode S II/SI capable interrogator which does not support the II/SI code operation
Note 2: Mode S II/SI+ means Mode S II/SI capable interrogator which does support the II/SI code operation

Table 2: Considered interrogator (interrogator for which an Interrogator is demanded)
Mode S II/SI interrogator that does not support the use of II/SI code operation.
Operating on II code
Can operate with Mode S II-only and Mode S II/SI transponders

Case	Capability of the overlapping interrogator	Operating code	Condition	Transponder Type
A	A Mode S II only	Different II code	Overlap OK	II-only and II/SI
		Same II code	No overlap	
B	Mode S SI operating with II code (1)	Different II code	Overlap OK	II-only and II/SI
		Same II code	No overlap	
C	Mode S SI operating with SI code (1)	Any SI code, including a "matching" SI code	Overlap OK	II/SI
D	Mode S II/SI+ operating with II code (2)	Different II code	Overlap OK	II-only and II/SI
		Same II code	No overlap	
E	Mode S II/SI+ operating with SI code (2)	Non-matching SI code	Overlap OK	II-only and II/SI
		Matching SI code	No overlap	

Note 1: Mode S SI means Mode S II/SI capable interrogator which does not support the II/SI code operation
Note 2: Mode S II/S+I means Mode S II/SI capable interrogator which does support the II/SI code operation

Table 3: Considered interrogator (interrogator for which an Interrogator is demanded)
Mode S II/SI interrogator that does not support the use of II/SI code operation.
Operating on SI code
Can only operate with Mode S II/SI transponders

Case	Capability of the overlapping interrogator	Operating code	Condition	Transponder Type
A	A Mode S II only	Any II code including the matching II code	Overlap OK	II/SI
B	Mode S SI operating with II code (1)	Any II code including the matching II code	Overlap OK	II/SI
C	Mode S SI operating with SI code (1)	Different SI code	Overlap OK	II/SI
		Same SI code	No overlap	
D	Mode S II/SI+ operating with II code (2)	Any II code including the matching II Code	Overlap OK	II/SI
E	Mode S II/SI+ operating with SI code (2)	Different SI code	Overlap OK	II/SI
		Same SI code	No overlap	

Note 1: Mode S SI means Mode S II/SI capable interrogator which does not support the II/SI code operation
Note 2: Mode S II/SI+ means Mode S II/SI capable interrogator which does support the II/SI code operation

Table 4: Considered interrogator (interrogator for which an Interrogator is demanded)
Mode S II/SI+ interrogator that supports the use of II/SI code operation.
Operating on II code
Can operate with Mode S II-only and Mode S II/SI transponders

Case	Capability of the overlapping interrogator	Operating code	Condition	Transponder Type
A	A Mode S II only	Different II code	Overlap OK	II-only and II/SI
		Same II code	No overlap	
B	Mode S SI operating with II code (1)	Different II code	Overlap OK	II-only and II/SI
		Same II code	No overlap	
C	Mode S SI operating with SI code (1)	Any SI code including a matching SI code	Overlap OK	II/SI
D	Mode S II/SI+ operating with II code (2)	Different II code	Overlap OK	II-only and II/SI
		Same II code	No overlap	
E	Mode S II/SI+ operating with SI code (2)	Any SI code including a matching SI code	Overlap OK	II-only and II/SI

Note 1: Mode S SI means Mode S II/SI capable interrogator which does not support the II/SI code operation
Note 2: Mode S II/SI+ means Mode S II/SI capable interrogator which does support the II/SI code operation

Table 5: Considered interrogator (interrogator for which an Interrogator is demanded)

Mode S II/SI+ interrogator that supports the use of II/SI code operation. **Operating on SI code** Can operate with Mode S II-only and Mode S II/SI transponders				
Case	**Capability of the overlapping interrogator**	**Operating code**	**Condition**	**Transponder Type**
A	A Mode S II only	Non-matching II code	Overlap OK	II-only and II/SI
		Matching II code	No overlap	
B	Mode S SI operating with II code (1)	Non-matching II code	Overlap OK	II-only and II/SI
		Matching II code	No overlap	
C	Mode S SI operating with SI code (1)	Different SI code	Overlap OK	II/SI
		Same SI code	No overlap	
D	Mode S II/SI+ operating with II code (2)	Any II code including a matching II code	Overlap OK	II-only and II/SI
E	Mode S II/SI+ operating with SI code (2)	Different SI code	Overlap OK	II-only and II/SI
		Same SI code	No overlap	

Note 1: Mode S SI means Mode S II/SI capable interrogator which does not support the II/SI code operation
Note 2: Mode S II/SI+ means Mode S II/SI capable interrogator which does support the II/SI code operation