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

MODE S ROADMAP

(Presented by Singapore)

SUMMARY

This paper summarizes the practices in other parts of the world and makes recommendations on the roadmap for Asia Pacific region.

1. Introduction

1.1 The Terms of Reference for the Mode S DAPs Working Group includes the formulation of a roadmap for DAPS Application.

1.2 This paper attempts to summarise the current practises as well as those in other parts of the world, thus allowing the Working Group to decide on the roadmap for various Mode S related issues for the Asia Pacific Region.

2. Mode S Mandates

2.1 Most States in the Asia Pacific region do not have widespread Mode S mandates in the FIR. There are some States which mandated Mode S for ground MLAT operations.

2.2 However, there are some applications which will require Mode S. The use of conspicuity code, will require significant number of aircraft to be equipped with level 2 Mode S. Application requiring Flight ID will require significant number of aircraft to be equipped with Elementary Mode S. Applications requiring Selected Vertical Intention, Track & Turn Report and Heading & Speed Report will require significant number of aircraft to be equipped with Enhanced Mode S.

2.3 Europe currently mandate that all IFR aircraft to minimally be Elementary Mode S equipped by 7 June 2020[1]. For aircraft with a mass >5700kg or a speed >250kt, aircraft shall be equipped with Enhanced Mode S and ADS-B (version 2) effectively on 7 June 2020.

2.4 USA do not have an equivalent mandate for Mode S but has a mandate for ADS-B (version 2) to be effective on 1 Jan 2020. For the case of flights at FL180 and above, the ADS-B must be 1090ES.

[1] Many Europe States already have Elementary Mode S mandates but not entire Europe. This new mandate will be applicate in the entire Europe.

2.5 All new aircraft from Airbus and Boeing delivered will be equipped with at least Elementary Mode S. Options to upgrade to Enhanced Mode S is also available.

2.6 As more and more aircraft are equipped with ADS-B, it's almost certain that they are also minimally Elementary Mode S capable, especially for passenger aircraft. There could still be some which are non-Mode S and would need time to be equipped.

2.7 In view of the above, it is recommended that the Working Group encourages equipage of Mode S. Sufficient time also has to be provided for equipage. A reasonable timeline could be to mandate ELS Mode S by 1 Jan 2022 and forward fit of EHS Mode S in the same year 1 Jan 2022.

3. Use of SI Codes

3.1 Interrogation Codes (IC) are required for selective interrogation to work. Interrogators will first perform all-call to acquire all the aircraft address within its coverage that were previously not identified. Following the all-call, interrogators can then selectively interrogate aircraft and 'orders' aircraft not to respond to subsequent all-call interrogation from that radar (this is known as lockout) for the next 18s.

3.2 The IC code will allow the aircraft to identify the radar. Such IC codes comes in 4 bits (known as Interrogator Identifier Code or II Code) and 6 bits (known as Surveillance Identifier Code or SI Code). The IC codes of two radars with overlapping coverage must not be the same. The SI code, using more bits compared to the II codes, will enable more IC codes to be allocated to radars with overlapping coverage.

3.3 Asia Pacific region currently uses II code for mode S radars. ICAO APAC is currently reviewing whether there is a need to use SI codes.

3.4 Mode S transponders, by default, support II Code. According to ICAO Annex 10 Vol 4, all Mode S transponders have to support SI code by 1 January 2005. However, in reality, there are still aircraft not supporting the SI code.

3.5 The mode S radars in Europe and the Middle-east region are using SI codes. To cover aircraft equipped with transponder not supporting SI code, a special mode of operation known as the II/SI Code Operation needs to be enabled on Mode S interrogators. Refer to related paper.

3.6 USA has yet to use SI codes as there were significant number of aircraft not supporting SI code in USA.

3.7 Parts of Asia Pacific may require the use of SI code due to high concentration of Mode S radars. Other parts may not. It is possible for certain regions in Asia Pacific to commence the use of SI codes first while the rest continue to uses the II code first. To overcome the issue with non SI-capable aircraft, the II/SI Code Operation may also be considered.

4. Radar clustering

4.1 Radar clustering is a technique whereby a group of radar with overlapping coverage using the same IC code. The radars are networked together such that information on aircraft acquisition is shared between the radars. This will reduce the need for all-call replies.

4.2 The potential advantages of clustering are the use of a single IC (thus reducing the pressure on demands for ICs) and potential reduction in all-call FRUIT. The main limitation of clustering is that it

adds complexity (and hence cost) to the overall system design and requires additional management functionality for control and co-ordination.

4.3 Thus far, only Germany and the Netherlands practices radar clustering.

4.4 There is no urgency to perform clustering in the APAC region within the near future. But States with the competency and operational requirement may apply such technique.

5. Use of Conspicuity Codes

5.1 In most ATM systems, Mode A is the primary means for flight plan coupling. Due to limited number of Mode A addresses, there may not be sufficient unique Mode A addresses to be allocated to the flights.

5.2 In the case of Europe, due to their European Mode S mandate, Mode S address can be used for flight plan coupling for some flights, thus reduce the usage of the Mode A codes. The Mode A code 1000 is assigned as the conspicuity code (i.e. Aircraft using Mode S addresses for flight plan coupling will use 1000 ad the Mode A code).

5.3 USA is still using Mode A codes for coupling.

5.4 Most Asia Pacific States still uses Mode A codes for flight plan coupling. In anticipation that Mode S codes would be used in future, it was agreed that the Mode A code of 1000 be reserved as the conspicuity code for Asia Pacific so as to match the European region. It is likely to take many years before all States can support this capability across APAC and EUR. The ATM systems must support the conspicuity code feature.

5.5 In preparation on the use of the conspicuity code, States developing new automation systems are encouraged to include the conspicuity code capability into the system.

6. Weather Reporting Capability

6.1 It is widely recognised that weather information downlinked from aircraft is very useful for ATM operations. However, only less than 1% of aircraft provide the data via BDS 4,4 (Wind Speed, Wind Direction, Temperature) and BDS 4,5 (Temperature, Turbulence).

6.2 Based on information provided by aircraft manufacturers, there is currently no service bulletins that will help upgrade aircraft with such capability. There is also currently no plan to develop such upgrades.

6.3 States such as Japan and New Zealand are developing algorithms to derive the weather information from data provide via BDS 5,0 (Track and Turn Report) and BDS 6,0 (Heading and speed report).

6.4 It is envisaged that weather reporting capability will be available in the next generation transponder. Instead of mandating weather reporting capability, it may be more practical to Mandate Enhanced Mode S and derive weather information using algorithms.

7. Datalink map

7.1 Europe is experiencing very high usage of the 1090MHz frequency. In order to prevent States from over interrogating, Europe has a datalink map which restricts the registers that States can extract from. Europe even have rules stating that Mode S radars should not actively interrogate for Mode A and Flight ID unless there is a change.

7.2 USA does not have such a map as USA do not make use of DAPs.

7.3 At this moment, the frequency congestion situation within Asia Pacific is not as severe as that in Europe. Hence it is not foreseen that such datalink map is required soon within APAC.

7.4 This issue may be revisited in future.

8. Summary Table

8.1 The proposed roadmap for the various issues are summarised in **attachment A**.

9. Action by the meeting

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

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Attachment A

Summary table for the Roadmap of various Mode S related issues

S/N	Issue	Recommendation
1	Mode S Mandate	Forward fit of Enhanced Mode S by 1 Jan 2022. Retrofit of Elementary Mode S by 1 Jan 2022. Minimally for aircraft with a mass >5700kg or a speed >250kt,
2	Use of SI Codes	Asia Pacific may consider the use of SI codes in sub-regions where there is high concentration of Mode S radars. II/SI Code operations may also be considered.
3	Radar clustering	There is no urgency to perform clustering in the APAC region within the near future. But States with the competency and operational requirement may apply such technique.
4	Use of conspicuity codes	States are encouraged to incorporate conspicuity code capability into ATM system.
5	Weather reporting capability	Not practical to mandate weather reporting capability in Mode S. States requiring such capability should consider other means to generate weather information (such as using algorithm to derive weather information).
6	Datalink Map	No immediate need for datalink map. But continue to monitor what the rest of the world is doing.