

International Civil Aviation Organization



**AUTOMATIC DEPENDENT
SURVEILLANCE – BROADCAST SEMINAR
AND FOURTEENTH MEETING OF
AUTOMATIC DEPENDENT
SURVEILLANCE – BROADCAST (ADS-B)
STUDY AND IMPLEMENTATION TASK
FORCE (ADS-B SITF/14)**



Christchurch, New Zealand, 14 – 17 April 2015

Agenda Item 3: Review Subject/Tasks List and action items updated by the SEA/BOB ADS-B WG/10

ADS-B USE IN COMPLEX AIRSPACE

(Presented by Australia)

SUMMARY

ADS-B SITF 13 sought clarification on the applicability of ICAO Circular 326 in complex airspace. This paper attempts to provide that clarification.

1. Introduction

1.1 At ADS-B SITF13 Australia was requested to provide clarification on applicability of ICAO Circular 326 AN188 in complex air space including the definition of the low-complexity airspace.

2. Circular 326 Method

2.1 The working hypothesis of Circular 326 is that if the achieved performance of ADS-Bs proves to be “better or at least no worse than” the reference radar used for the same purpose in the same environment then ADS-B can be used for the same separation standard.

a) Circular 326 Appendix C says :

Table C-1 identifies the key minimum performance requirements for an ADS-B system to enable the use of a 3 NM or 5 NM separation minimum in the provision of air traffic control.

b) Circular 326 Appendix A details the reference radar used by SASP as

- an enroute monopulse SSR only radar rotating at 5 rev/minute for application of a 5nm separation standard, or

- A terminal area monopulse SSR only radar rotating at a 12-16 rev/minute for application of a 3nm separation standard.

3. What is complex airspace?

3.2 Whilst there seems to be no accepted definition of “complex” airspace one could consider more complex airspace is a mixture of

- Aircraft density
- Higher route crossing point density
- A higher mixture of different aircraft performance levels
- A higher rate of aircraft manoeuvring (as distinct from straight and level flight).

4. Circular 326 and complex airspace

4.1 Sections 4.16 to 4.21 of Circular 326 deals with Complex Airspace.

Circular 326 says:

4.17 The reference MSSR chosen by the State must be capable of supporting the target separation minima. Alternatively if a State or region uses an MSSR with particular performance characteristics in another location to support the target separation minima, this MSSR can be used as the "benchmark" or "reference" MSSR by the State/region.

4.18 Having selected this benchmark, the first task of the State or region is to compare the performance characteristics of their reference MSSR with the reference MSSR used by SASP. If the performance of the State or regional reference MSSR is equal to or less than that of the reference MSSR used by SASP, States and regions are strongly advised to use the SASP reference MSSR as the reference MSSR for their purposes. Without considering safety requirements, this would suggest that the SASP ADS-B or MLAT performance characteristics immediately apply.

4.19 If, on the other hand, the performance of the State or regional reference MSSR is more demanding than that of the reference MSSR used by SASP, States and regions should use their own reference MSSR as the benchmark against which the ADS-B or MLAT performance requirements are determined for their region or State.

4.2 The essence of this section, is that States should ensure that they compare the performance of their existing surveillance requirement (perhaps actually already deployed) to the SASP reference radar outlined in Appendix A of Circular 326.

Existing radar (or surveillance requirement) higher performance than SASP reference

In this case, the state should compare the performance parameters of the existing radar (or surveillance requirement) to the proposed ADS-B system. If the ADS-B system (using the parameters in Appendix C of Circular 326) meets or exceeds these surveillance requirements, Appendix C parameters may used, otherwise more demanding performance requirements may need to be imposed on the ADS-B system

Existing radar (requirement) equivalent or lower performance than SASP reference

In this case, the State can choose to use the Circular 326 ADS-B performance requirements expressed in Appendix C as the minimum requirements for use of ADS-B in complex airspace.

4.3 In all cases, States still need to examine all the other factors that need to be addressed for the complex airspace that possibly SASP did not make any assumptions for. ie. Do a safety assessment.

4.4 So a State using the Circ 326 para 4.18 process, could have a volume of complex airspace, agree that the performance criteria determined by SASP are valid, and still identify a range of additional factors related to the airspace and traffic density/mix, that need to be addressed through the safety assessment. Eg : Need for non co-operative surveillance, training etc.

5. Requirements in more complex airspace

5.1 The SASP view is that the surveillance system requirements for delivery of 3 nautical mile separation standards are more demanding than the surveillance system requirements for 5 nautical mile separation standards. This is because there is less tolerance for delay in detecting aircraft manoeuvre, less tolerance for garbling & merging of multiple aircraft into a single surveillance target (resolution) and a greater need for accuracy at the worst case range. This view is shared by Australia.

5.2 However, it is also Australia's view that dependent surveillance system requirements do not change with airspace complexity. In an airspace with just two aircraft being separated, the need for update rate, accuracy, and resolution is just as great as the case when 50 aircraft are displayed to the controller. The minimum separation standard is the MINIMUM that can be applied within the surveillance volume in the best conditions.

5.3 SASP did consider that in applying ADSB or MLAT in a complex terminal airspace, intruders may need to be captured with additional primary radar. This is airspace environment dependent and something that a State's safety assessment should determine. There may be other issues, unrelated to the surveillance technology, that need to be controlled to safely support higher density or higher complexity environments. These could include procedures, training and so on.

5.4 However, such complexity has not typically required higher capability radars – except for track update rate and in many cases the need for primary radar to detect non co-operative targets.

5.5 Some States have required higher reliability of service in more complex regions because contingency procedural separation might not be viable.

5.6 Circular 326 does not impose any greater ADS-B or MLAT performance characteristics in complex airspace, vs low-complexity airspace, unless the relevant State has a higher surveillance performance baseline requirement than the reference MSSR used in Circular 326.

6. Requirements in Terminal areas

6.1 A terminal area could be considered as a more complex airspace. In terminal areas there is a desire to

- a) Detect non co-operative targets; and
- b) Reduce separation standards to maximise the airspace throughput. Typically a minimum 3 nautical mile separation is required, to maximise throughput and efficiency.

6.2 Most States have concluded that higher performance “Terminal area” radars are required, rather than the use of enroute radars. Terminal area radars have the following characteristics compared to enroute radars :

- Co-mounted primary radar to detect non co-operative targets (although the positional accuracy reports from the primary radar component is generally worse than monopulse SSR)
- Higher rotation rate to reduce latency and improve ATC detection of aircraft deviation. A terminal area can be operated with a 3 nautical mile separation standard, and in this case, a slow rotation rate of 5 rpm is unacceptable. The major driver for higher performance in the Terminal area is the demand for a lower separation standard. Appendix A of ICAO Circular 326 specifies the “reference radar” for 3nm separation will have a rotation rate of 12-16 rev/minute.
- Shorter range may be a consequence because the higher rotation rate requires a higher pulse repetition frequency, limiting range. However some States are using 15rpm radars and still achieving 256nm range.
- The accuracy of terminal area radars is no better than an enroute monopulse radar at the same range. For both terminal and enroute monopulse SSR, azimuth accuracy (when measured as a distance) reduces as range increases. States may impose a range limit from the radar, beyond which the 3nm separation standard is not to be used. The worst case lateral accuracy is limited by the range so chosen.

7. Major performance factors

7.1 Circular 326 arrives at the required performance figures through comparison of the following major surveillance performance characteristics:

- Position accuracy
- Position integrity
- Position latency
- Position update rate

7.2 Other factors such as reliability/continuity, resolution (ability to resolve two targets at the same position), capacity could have also been considered.

8. A comparative assessment is not too difficult.

8.1 For example, in a Terminal area served by a monopulse radar, the most significant differences (compared to less ” complex” airspace) are shown below with arguments that support ADS-B use :

- a) A higher update rate (terminal radar rotates faster) : ADS-B and MLAT update rate is higher than almost all existing terminal area radars
- b) The increased lateral accuracy of terminal area radars (due to the reduced maximum range) : The higher ADS-B and MLAT accuracy required is already accounted for in the Circular 326 reference case – Appendix C (higher accuracy & higher integrity are required of the ADS-B reports)

9. Recommendations

- 1. Whether complex or not, States are urged to consider whether the current or required surveillance system performance is better, equivalent or worse than the SASP reference.
- 2. If the current or required surveillance system used by a State is lower or equivalent in performance than the reference MSSR used in Circular 326 Appendix A, then that State may use the Appendix C performance criteria.
- 3. If the current or required surveillance system used by a State is higher performance than the reference MSSR used in Circular 326 Appendix A, then the State must ensure that the ADS-B system achieves the more demanding performance.
- 4. State should undertake, in all cases, a safety assessment that ensures that any additional risks and safety requirements already identified for the airspace where ADSB or MLAT is to be implemented, or any newly identified risks, are effectively controlled and risk is reduced to an acceptable level.

10. Action by the Meeting

10.1 The meeting is invited to:

- a) note the information contained in this WP;
- b) consider the recommendations; and
- c) discuss any relevant matters as appropriate.
