International Civil Aviation Organization

A38-WP/132
TE/45
22/8/13

WORKING PAPER

ASSEMBLY — 38TH SESSION

TECHNICAL COMMISSION

Agenda Item 38: Other issues to be considered by the Technical Commission

THE CONCEPT OF SPACE-BASED RECEPTION OF AUTOMATIC DEPENDENT SURVEILLANCE — BROADCAST (ADS-B)

(Presented by Canada)

EXECUTIVE SUMMARY

Extending the use of automatic dependent surveillance — broadcast (ADS-B) surveillance data for air traffic management in oceanic, polar and remote regions using satellite-based reception is being actively investigated. The use of space-borne ADS-B receivers and provision of accurate aircraft position data to air traffic management has the potential to enhance safety and significantly contribute to more efficient airspace management, optimum altitude aircraft operations, preferred routings and reduced fuel burn in remote regions where ground-based surveillance is not feasible or practical. The same aircraft equipage that is required for ground-based ADS-B reception would be required for space-based ADS-B reception.

Action: The Assembly is invited to:

a) endorse the concept of space-based reception of ADS-B;

b) endorse the benefits of efficient airspace management in oceanic, polar and remote regions;

c) consider the enhanced safety benefits of making ADS-B aircraft position data available to ATM;

d) consider the possibility that space-based ADS-B reception could support the safe reduction of separation minima in remote regions;

e) consider the economic and operational benefits to airlines from reduced fuel burn and availability of more optimal flight profiles;

f) consider the potential for this technology to contribute to minimizing the adverse environmental effects of civil aviation activities;

g) consider the potential for this technology to be deployed in remotely piloted aircraft systems (RPAS) operating in remote regions;

h) ensure that the *2013-2028 Global Air Navigation Plan* reflects the Assembly's endorsement of the concept of space-based ADS-B reception by including it in the appropriate Aviation System Block Upgrades (ASBU) modules, threads and technology roadmaps; and

i) request ICAO to facilitate the timely development of supporting Standards and Recommended Practices (SARPs), Procedures for Air Navigation Services (PANS) and relevant guidance material.

Strategic Objectives:	This working paper relates to the Safety and Environmental Protection and Sustainable Development of Air Transport Strategic Objectives.
Financial implications:	Not applicable.
References:	Doc 10007, *Report of the Twelfth Air Navigation Conference* Doc 9958, *Assembly Resolutions in Force* (as of 8 October 2010) Doc 9750, *2013-2028 Global Air Navigation Plan* (Fourth edition)

(4 pages)

1. INTRODUCTION

1.1 The automatic dependent surveillance — broadcast (ADS-B) is an airborne surveillance technology developed and standardised by ICAO that does not require interrogations from a ground-based system. ADS-B entails the aircraft broadcasting of position (latitude and longitude), altitude, velocity, aircraft ID and other information obtained from on-board avionics systems. Every ADS-B position message includes an indication of the quality of the data which allows air traffic management to determine whether the data is of sufficient integrity to support the intended air traffic management function.

1.2 The aircraft position, velocity and associated data quality indicators are usually obtained from an on-board global navigation satellite system (GNSS). Current inertial navigation sensors can provide a portion of the required accuracy and integrity data. However, more recent aircraft installations use an integrated GNSS and inertial navigation system to provide position, velocity and data quality indicators for the ADS-B transmission. These systems have better performance than a system based solely on GNSS, since inertial and GNSS sensors have complementary characteristics that when combined together can mitigate any potential dilution of position accuracy of each system. Altitude is obtained from the pressure altitude encoder. The necessary equipage is available for most aircraft types, encompassing both commercial and general aviation.

1.3 ADS-B is a proven technology that supports both ground-based and airborne surveillance applications. In airborne applications, aircraft equipped with ADS-B receivers can also process the messages from other aircraft to determine the location of surrounding traffic in support of enhanced situational awareness and, in the future, limited self-separation. Those same transmissions are received by ground-based facilities and used to support air traffic management functions. However, in oceanic, polar and remote regions the installation of ground-based facilities is not feasible or practical; hence ADS-B position data from aircraft operating in these areas is unavailable to air traffic management.

1.4 It should also be noted that the use of space-based ADS-B reception could assist with the integration of remotely piloted aircraft systems (RPAS) in areas currently not covered by air traffic services (ATS) surveillance.

2. CONCEPT OF SPACE-BASED RECEPTION OF ADS-B

2.1 To support ATS surveillance beyond the terrestrial limitations, particularly in oceanic and polar areas, or remote land mass where minimal or no ground surveillance infrastructure exists, the concept of space-based reception of ADS-B is being actively investigated. This concept is in line with Assembly Resolution A37-19 (Doc 9958) which, inter alia, requested States to “accelerate efforts to achieve environmental benefits through the application of satellite-based technologies that improve the efficiency of air navigation and work with ICAO to bring these benefits to all regions”.

2.2 The attention of the Assembly is also drawn to Recommendations made by the Twelfth Air Navigation Conference (Montréal, 2012). Recommendation 1/7 (Doc 10007) recognizes the potential effective uses of ADS-B and encourages cooperation between States, supported by ICAO, to ensure the full benefits are realized. Recommendation 1/9 specifically addressed space-based ADS-B, the inclusion of it in the *Global Air Navigation Plan* (GANP, Doc 9750) and the need for SARPs and guidance material and for interactions between stakeholders to support the technology. The Assembly is also invited to recall Recommendation 1/16 which encourages States to provide fair, equitable and efficient access to airspace improvements, including to general aviation.

2.3 Presently a space-based system is under development by a consortium of air navigation services providers (ANSP) and industry partners which would use ADS-B receivers on a constellation of polar orbiting satellites to provide global coverage and overcome the aforementioned limitations of terrestrial ADS-B ground stations. The launches of the satellites are planned to begin in 2015 with initial operational capability foreseen for 2017. The planned objective is to have ADS-B receivers as part of a hosted payload on each satellite. The satellite network would have the capability of receiving ADS-B messages from aircraft routed via inter-satellite links to terrestrial gateway stations in near real time, for transfer to air traffic management for processing and display. It is important to note the envisaged application would require the same aircraft equipage as is required for ground-based ADS-B reception. This will enable the use of ATS surveillance to support separation provision in areas where, currently, procedural separation minima, based on voice or automated position reporting, can be applied. Procedural separations are generally applied by restricting the altitude, route and/or speeds at which aircraft operate to achieve and maintain specified vertical, lateral or longitudinal spacing between projected flight profiles.

2.4 The initial operating environment will be the airspace over the North Atlantic Ocean, which is the busiest remote airspace in the world. Eighty-five per cent of the flights operating in the core area of this airspace are already equipped with ADS-B; it is expected this percentage, and the percentage in the entire North Atlantic airspace, will rise in response to rule-making activities by the European Commission and the United States requiring specified ADS-B equipage by 1 January 2020. It can be foreseen that current and planned equipage mandates for ADS-B in other oceanic and remote regions will support the use of space-based ADS-B reception on a global basis in a similar timeframe.

2.5 A satellite communications network with ADS-B reception capability would also extend and augment the current ANSP terrestrial ATS surveillance (ADS-B and radar) systems to include oceanic, polar and remote regions on a global basis and in a seamless manner.

3. OPERATIONAL BENEFITS

3.1 Compared to the present requirement to apply procedural separation standards, using space-based ADS-B reception in oceanic, polar and remote regions will lead to:

a) the ability for air traffic management to extend the provision of ATS surveillance services, providing enhanced safety in very busy remote airspace;

b) the reduction of carbon dioxide and other GHG emissions in support of ICAO’s environmental objectives;

c) the ability to apply reduced separation minima between aircraft;

d) significantly increased availability of optimum speeds and altitudes and preferred routings;

e) increased capacity and airspace efficiency; and

f) overall significant operational benefits and reduced fuel costs to air carriers.

3.2 The benefits foreseen support the current ICAO Strategic Objectives of Safety and Environmental Protection and Sustainable Development of Air Transport.

3.3 Space-based ADS-B reception would also support four of the five proposed ICAO Strategic Objectives for 2014 to 2016, namely: *A.* ***Safety*** *– Enhance global civil aviation safety*; *B.* ***Air Navigation Capacity and Efficiency*** *– Increase capacity and improve efficiency of the global civil aviation system*; *D.* ***Economic Development of Air Transport*** *– Foster the development of a sound and economically-viable civil aviation system* and *E.* ***Environmental Protection*** *– Minimize the adverse environmental effects of civil aviation activities.*

4. CONCLUSION

4.1 As the aviation industry constantly seeks ways to improve safety, gain environmental, operational and financial efficiencies, especially on unsurveilled long-haul operations, more direct routings and flexible altitudes would significantly contribute to reduced fuel burn and operator cost savings. The provision of space-based reception of ADS-B will support more efficient airspace management and reduced separation standards in oceanic and remote regions which will bring forth all of these benefits, particularly in the most heavily used oceanic regions.

4.2 The Assembly is therefore invited to endorse the concept of space-based reception of ADS-B, recognizing the economic and environment benefits of efficient airspace management in oceanic, polar and remote regions.

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