

## **ELEVENTH AIR NAVIGATION CONFERENCE**

**Montreal, 22 September to 3 October 2003**

**Agenda Item 1: Introduction and assessment of a global air traffic management (ATM) operational concept**

**1.2 Enabling concepts in support of the global ATM operational concept**  
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### **AUTOMATIC DEPENDENT SURVEILLANCE-BROADCAST (ADS-B) FOR AIR-TO-GROUND SURVEILLANCE**

(Presented by Australia)

#### **SUMMARY**

This paper discusses the deployment of ADS-B for air-to-ground surveillance in support of air traffic control, and discusses the synergy of combining ADS-B fitment with transponder changes mandated in Europe and foreshadowed in the United States.

It proposes that the regional deployment of ADS-B based air-to-ground surveillance for air traffic control purposes coincide with these transponder changes, and outlines a programme Australia is commencing to provide ADS-B surveillance in the upper airspace of the Australian FIRs.

Action by the conference is in paragraph 13.

#### **REFERENCES**

1. "Initial Automatic Dependent Surveillance-Broadcast (ADS-B) Applications for Global Interoperability", AN-Conf/11-WP/41 presented by the United States.
2. "Initial Ground Surveillance and Airborne Surveillance Applications Enabled by ADS-B", AN-Conf /11, WP/86 presented by Eurocontrol.
3. "Automatic Dependent Surveillance-Broadcast (ADS-B) Concept of Use", AN-Conf/11-WP/6, presented by the Secretariat.
4. "United States Endorsement of Automatic Dependent Surveillance-Broadcast (ADS-B) Concept of Use", AN-Conf/11-WP/66 presented by the United States.
5. "The UAT's role in the United States FAA ADS-B link decision", AN-Conf/11-IP/18, presented by the United States.

6. “Asia/Pacific Regional Strategies for ADS-B Implementation”,  
AN-Conf/11-WP/128, presented by Australia.

## 1. INTRODUCTION

1.1 Automatic dependent surveillance — broadcast (ADS-B) technology has been developing quickly in recent years. As indicated in Reference 5, “The UAT’s role in the United States FAA ADS-B link decision”, AN-Conf/11-IP/18, presented by the United States, European and North American States have identified 1 090 MHz extended squitter (1 090 ES) as a common ADS-B link for international interoperability to support near-term applications.

1.2 This position is supported by many other organisations, including International Air Transport Association (IATA), Civil Air Navigation Service Organization (CANSO), the Association of European Airlines (AEA), ICAO’s ASIA/PAC Air Navigation Planning and Implementation Regional Group (APANPIRG), ADS-B Task Force, ICAO’s Surveillance and Conflict Resolution Systems (SCRS) Panel and the Eurocontrol ATM/CNS Consultative Group (ACG).

1.3 Appropriate avionics and ICAO Standards already exist for “ADS-B out” using 1 090 ES.

1.4 Aircraft manufacturers Boeing and Airbus have released service bulletins which include “ADS-B out” using Mode S extended squitter as part of upgrades to meet European mandates for Mode S enhanced surveillance in 2005. Airbus now also offer “ADS-B out” as standard fit on new aircraft.

1.5 General aviation category 1 090 ES transponders are also available, such as the product used by Airservices Australia in the Burnett Basin trial (see below). Development of even lower cost products has also commenced.

## 2. ADS-B IN NON-RADAR AIRSPACE

2.1 States which do not have comprehensive radar surveillance coverage now see the potential for early benefits from using ADS-B as an alternative to radar for surveillance to support en route and terminal area air traffic control, using avionics packages which exist today. Early adoption of this technology would particularly assist in improving air traffic services in areas where a cost/benefit analysis can not justify an expensive radar infrastructure.

## 3. ICAO ADS-B SEPARATION STANDARDS

3.1 Work is well advanced in the ICAO Separation and Airspace Safety Panel (SASP) regarding the development of ICAO separation minima for the use of ADS-B data for air traffic control. This work has centred on the use of the proven 5 NM radar separation minima for services where ADS-B is used as the surveillance medium. It is anticipated that the associated amendments to the *Procedures for Air Navigation Services — Air Traffic Management* (PANS-ATM, Doc 4444) will be finalized by SASP in late 2004, with final publication by ICAO in late 2005. SASP is developing these Standards by comparing the characteristics of ADS-B to a reference radar system in accordance with the comparative assessment methodology detailed

in the *Manual on Airspace Planning Methodology for the Determination of Separation Minima* (Doc 9689).

#### **4. SAFETY FROM ADS-B SURVEILLANCE**

4.1 ADS-B provides significant safety benefits when used for air-to-ground surveillance, compared to procedural ATC without radar surveillance. ADS-B data can support automated safety tools such as short-term conflict alert, cleared level adherence warning, route adherence warning, and danger area infringement warning, to increase the safety and security of airspace. Air traffic controller situational awareness is significantly improved with surveillance. Discontinuities in management of flights across sector and flight information region (FIR) boundaries are significantly improved when high update, high integrity positional and altitude data is provided. Mismatches between controller expectations and reality are identified earlier.

#### **5. AUSTRALIA'S OPERATIONAL ADS-B TRIAL**

5.1 Airservices Australia is conducting an operational trial using “ADS-B out” for ATC surveillance in a region near Bundaberg, Queensland. A single ADS-B ground station has been installed, a number of aircraft have been equipped with ADS-B 1 090 ES avionics, and Australia’s operational air traffic management system has been upgraded to process and display ADS-B tracks. A safety case supporting the use of a radar like 5 NM minimum separation standard has been prepared, and is expected to be approved shortly, after sufficient data has been collected and analysed.

5.2 The performance being achieved by this ADS-B system in the Australian environment has exceeded expectations. Coverage is excellent, and exceeds the performance that would be expected from a secondary radar installed at the same site. Manoeuvre performance is better than from radar, the update rate is higher, and identity data is reliably received. Figures 1 and 2 in the appendix illustrate this performance.

#### **6. ADS-B FOR AUSTRALIA’S UPPER AIRSPACE**

6.1 Encouraged by the performance of the trial system, Airservices Australia plans to install a network of approximately twenty ADS-B ground stations across the non-radar areas of Australia to provide nationwide coverage at and above flight level 300. Figure 3 illustrates the ADS-B coverage, which complements the coverage from a radar network down the east coast.

6.2 While the first benefit of this ADS-B surveillance system will be a significant improvement in safety, Airservices Australia is also examining the introduction of ATC procedures to give priority to ADS-B equipped aircraft in this airspace. A draft Aeronautical Information Publication (AIP) amendment proposing that “an ADS-B equipped aircraft will be given priority when by so doing an operational advantage is presented to ATC” is under review.

## **7. APANPIRG ADS-B TASK FORCE**

7.1 ICAO's Asia/Pacific Air Navigation Planning and Implementation Regional Group (APANPIRG) has established an ADS-B Implementation Task Force to plan the implementation of ADS-B in the Asia/Pacific Region. The Task Force met in March 2003. Fifty-three experts from Australia, China, Hong Kong China, Fiji, India, Japan, New Zealand, Pakistan, Singapore, Thailand, United States, International Air Transport Association (IATA), International Federation of Air Line Pilots' Associations (IFALPA) and Société internationale de télécommunications aéronautiques (SITA) attended. The meeting unanimously supported the use of Mode S extended squitter datalink for ADS-B in the Asia/Pacific Region.

7.2 Furthermore, the meeting concluded that "early implementation of "ADS-B out" supports ground-based surveillance immediately" and that "this can be regarded as an appropriate first step and that target implementation of "ADS-B out" for ground-based surveillance services in Asia/Pacific commence January 2006". A more comprehensive report of the work of the Task Force is given in Reference 6, "Asia Pacific Regional Strategies for ADS-B Implementation", AN-Conf/11-WP/128, presented by Australia.

## **8. POTENTIAL FOR ADS-B IN ASIA PACIFIC**

8.1 Existing radar coverage in the Asia/Pacific Region is far from complete. ADS-B has the potential to provide coverage in areas where there is no surveillance today, at a very low cost compared to providing radars to cover the same areas.

## **9. COMBINING 1090 ES ADS-B OUT FITMENT WITH OTHER TRANSPONDER CHANGES**

9.1 Mode S transponders on many aircraft are currently being upgraded to meet the elementary and enhanced surveillance requirements of certain European States. These changes include the ability of the transponder to provide callsign, bank angle, selected altitude and other aircraft parameters to interrogating Mode S radars. ATC systems may then use this data to increase safety and performance. The changes are mandatory for operations in certain parts of Europe from March 2005.

9.2 Most avionics manufacturers are providing an option to include ADS-B out capabilities at the same time as elementary and enhanced surveillance is provided on an airframe, as the addition of ADS-B then comprises another software function in the same transponder. Aircraft manufacturers are including ADS-B extended squitter ("ADS-B out") capability in their service bulletins for elementary and enhanced surveillance.

9.3 The Federal Aviation Administration (FAA) has issued a Notice of Proposed Rulemaking (Number 03-02) to change the operation of transponders when the "Unlawful Interference code" is entered. The FAA has proposed these changes as mandatory from March 2005. This change will require transponder upgrades, and may also provide a convenient opportunity to include at the same time upgrades to provide enhanced surveillance and 1 090 extended squitter capabilities.

9.4 The opportunity exists for Asia/Pacific to mandate or encourage the fitment of “ADS-B out” capability at the same time as transponder changes to meet European and FAA requirements. Such an action can markedly lower the cost of fitment of “ADS-B out” avionics.

9.5 In addition, some States using Mode S radar sensors, for example in terminal areas, will also gain the benefits of elementary and enhanced surveillance from the upgraded transponders. These include read down of flight management system (FMS) flight level settings, to provide earlier prediction of potential “level bust” incidents, read down of callsign to reduce reliance on 4-digit octal codes, and improved tracker and safety net performance.

## 10. THE PROPOSED ADS-B “PACKAGE 1”

10.1 The European Joint Co-ordination Board and FAA have proposed an ADS-B “Package-1” of applications for the initial deployment of ADS-B. This package includes five ground surveillance applications and seven airborne applications, and is described in detail in Reference 1, “Initial Automatic Dependent Surveillance-Broadcast (ADS-B) Applications for Global Interoperability”, AN-Conf/11-WP/41 presented by the United States, and Reference 2, “Initial Ground Surveillance and Airborne Surveillance Applications Enabled by ADS-B”, AN-Conf/11-WP/86 presented by Eurocontrol.

10.2 While some of the ground surveillance applications can be implemented in the very near future, development and deployment of the airborne applications in Package 1 is expected to take a significant time, certainly beyond the mandated time for meeting the European enhanced surveillance requirements.

10.3 For States without the benefit of extensive radar coverage, an early introduction of ADS-B ground surveillance applications is possible using avionics packages which exist today.

## 11. TIMELINESS OF DEPLOYMENT

11.1 A critical issue in the implementation of any new system or technology is the timeliness of its introduction. If debate continues too long, the achievable benefits are lost for a period and the technological assumptions and economics of deployment change, invalidating earlier work.

11.2 “ADS-B out” using Mode S extended squitter is already mature enough to deploy for air-ground surveillance. Appropriate technical standards exist in ICAO, Radio Technical Commission for Aeronautics (RTCA), European Organisation for Civil Aviation Equipment (EUROCAE) and Airlines Electronic Engineering Committee (AEEC) to permit the use of Mode S extended squitter.

11.3 The operational concept for this application is consistent with Reference 3, “Automatic Dependent Surveillance-Broadcast (ADS-B) Concept of Use”, AN-Conf/11-WP/6, presented by the Secretariat, and supported in Reference 4, “United States Endorsement of Automatic Dependent Surveillance-Broadcast (ADS-B) Concept of Use”, AN-Conf/11-WP/66 presented by the United States.

11.4 Any delay to the introduction of “ADS-B out” ground surveillance deprives airlines and States of the economic and particularly the safety advantages that can be gained through its introduction.

## 12. CONCLUSION

12.1 Australia considers that deployment of ADS-B technology for ground surveillance applications using Mode S extended squitter at the same time as the European enhanced surveillance mandate (March 2005) is a cost-effective, efficient and responsible course of action. Doing so will allow many States to provide effective ATC radar-like surveillance where there is no surveillance today, increasing efficiency and making significant improvements to safety.

12.2 In the case of Australia, this technology brings the possibility of cost-effective surveillance being provided over the whole continent. Safety and commercial benefits will result when compared with the inefficiencies of today's procedural control in these areas.

## 13. ACTION BY THE CONFERENCE

13.1 The meeting is invited to:

- a) note the conduct of the Australian ADS-B operational trial;
- b) note the proposed deployment of ADS-B in the upper airspace across Australia;
- c) note the recommendation of the APANPIRG ADS-B Task Force to deploy ADS-B for ground surveillance in the Asia/Pacific Region commencing January 2006;
- d) support and encourage the fitment of “ADS-B out” capabilities to aircraft at the same time as transponders are being upgraded to meet the European mandate for enhanced and elementary surveillance in March 2005, or to meet improved “unlawful interference” signalling requirements; and
- e) endorse the early use of “ADS-B out” for ground surveillance as an initial ADS-B application, without waiting for the full proposed ADS-B “Package 1” to become commercially available.

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