



Agenda Item 2: Optimisation of the SAM airspace

ADS-B data as a source for analytical solutions of traffic behavior in terminal airspace

(Presented by the Secretariat)

SUMMARY	
<p>The availability of automatic dependent surveillance broadcast (ADS-B) data presents a useful source for analytical efforts on effective and efficient airspace and navigation procedure usage. The sufficient availability of such data depends, in-part, on a network of ground based receivers. Presently the ICAO SAM Region does not have adequate coverage of these receivers for meaningful analysis. This paper provides an overview on technical requirements for this type of analysis and illustrates possible solutions for the SAM Region, once appropriate coverage is established.</p>	
References:	
<ul style="list-style-type: none">• FlightAware (www.flightaware.com)• Airservice Australia• EUROCONTROL	
ICAO Strategic Objectives:	<i>A - Safety</i> <i>B – Air navigation capacity and efficiency</i>

1. Introduction

1.1 The Integrated Aviation Analysis Section (IAA) at ICAO Headquarters is continuously providing cross-organizational support in developing solutions and tools to analyze airspace usage effectively, efficiently and safely. In line with these efforts, IAA has identified the benefits of ADS-B data as a source for the analysis of traffic behaviour in terminal airspace. These efforts have already been successfully applied and implemented in areas with appropriate availability of ADS-B data but are limited in the SAM Region due to a relatively small number of ground based receivers.

2. Technology

2.1 ADS-B is a system intended to broadcast the precise location of the aircraft via a digital link to other aircraft and air traffic control without the need for secondary radar. The system involves a GPS equipped aircraft whose position can be determined through cross-validation of multiple on-board sources, and is capable of transmitting that position through a suitable ADS-B transmitter to a ground station (in the future, satellite-based receivers are perceived). The broadcast consists of information continually transmitted for monitoring by appropriately equipped aircraft or ground stations and is:

automatic (requires no pilot inputs or external interrogation); dependent (influenced by the accurate position and velocity data from the aircraft's navigation system – e.g. GPS); and offers surveillance capability. ADS-B data is broadcasted every half-second on a 1090 MHz datalink and may include:

- a) flight identification (flight number call sign or call sign);
- b) ICAO 24-bit aircraft address (globally unique airframe code);
- c) position (latitude/longitude);
- d) position integrity/accuracy (GPS horizontal protection limit);
- e) barometric and geometric altitudes;
- f) vertical rate (rate of climb/descent);
- g) track angle and ground speed (velocity);
- h) emergency indication (when emergency code selected); and
- i) special position identification (when IDENT selected).

2.2 Besides air navigation service providers, there are commercial companies collecting this type of data for various purposes, such as providing updates on scheduled flight progress to the public. FlightAware, based in Houston and founded in 2005, is a company providing flight tracking through a global solution integrating ADS-B data from over fifty air navigation service providers and their own worldwide network of ADS-B and Mode S receivers. FlightAware owns and operates this network at hundreds of airports, in conjunction with airport operators, and makes them available to professional users at no cost. The technical requirements to install the receivers are:

- a) an installation facility with a clear line of sight to the sky;
- b) a power source (110 – 240 V); and
- c) internet access (via ethernet).

2.3 Further to flight tracking by means of ADS-B data, information derived from radar data is added, where available, to enhance the position accuracy and update frequency. This data is provided by air navigation service providers and governed through specific agreements with FlightAware. Increased sharing and exchange of such information is beneficial to the overall analysis of effective airspace usage.

2.4 The capability of ground stations to receive ADS-B signals from transmitting aircraft is limited to a 250 NM range, and is influenced by altitude and obstructing terrain. Availability and quality of ADS-B data depends on the number, placement, and availability of ground receivers. The FlightAware network covers most of Australia, Europe, the United States and Southern Canada but has limited availability in the South American Region (SAM), mostly around the lower part of the Brazilian Atlantic coast (detailed coverage information is available at <https://flightaware.com/adsb/coverage#data-coverage>).

2.5 The availability of ADS-B data faces additional limitations since not all aircraft are equipped with ADS-B transmitters, and if they are, equipped operators may elect not to make use of it. Air traffic in the SAM Region is a combination of commercial air traffic (as per ICAO Annex 6 - *Operation of Aircraft*, Part I - *International Commercial Air Transport - Aeroplanes*, Part II - *International General Aviation - Aeroplanes* and Part III - *International Operations - Helicopters*). Thus, the fleet composition is complex and not 100% ADS-B equipped.

3. Analytical solutions using ADS-B

3.1 The aircraft position broadcasted through the ADS-B system enables the plotting of flight tracks relative to geographical position. An advantage of using a commercial provider of ADS-B data is

the availability of historical data and the possibility to connect the live data at pre-determined intervals. Understandably, the amount of data is limited only by available funding for the applicable user fees.

3.2 IAA at the ICAO Headquarters in Montréal started using ADS-B data provided by FlightAware in 2014 for the initial purpose of analyzing traffic volumes at high density airports. Since then, IAA continued to develop and refine algorithms, creating applications based on such data and making them available to users on the integrated Safety Trend Analysis and Reporting System (iSTARS).

3.3 Most recent applications include the traffic analysis in conflict zones (and any other defined airspace) by providing information on the volume of re-routed traffic and the associated increase in flight sector distance and inferred fuel cost. The algorithms used in determining real time and approximated flight tracks are also used in the analysis related to the effective usage of navigation procedures around airports. Where appropriate coverage is available, the data supports calculation of traffic volume using a specific existing terminal navigation procedure and density distribution in the respective airspace. The same methodologies and concepts were successfully applied in another study to extend the radar based EUROCONTROL Arrival and Metering Area (ASMA) concept to an independent ADS-B based solution.

3.4 Presently, the development of solutions are limited to Europe, North America and parts of Asia for reasons of data availability, as mentioned in paragraphs 2.3 and 2.4. However, the applications developed by IAA can easily be applied to other regions when sufficient ADS-B coverage becomes available. Future satellite-based ADS-B receivers will greatly solve the limited coverage by ground-based receivers, but in the meantime, as their implementation timeline is not yet determined, the increased availability of ADS-B data requires increased installation of ground-based ADS-B receivers, and increased installation of ADS-B transmitters in aircraft.

4. **Conclusion**

4.1 To provide the analytical capability for terminal airspace and procedure usage in the SAM Region, it is a fundamental requirement for the quantity and availability of ADS-B data to be increased. Presently, this can be achieved by increasing the number and coverage of ground-based receivers. Once the data is available, ICAO, through IAA, can apply the algorithms through their applications and thus, provide appropriate analysis of traffic analysis, density, and environmental to relevant stakeholders. The accuracy and details of such analysis can be greatly enhance by radar data provided through sharing mechanisms with the respective air navigation service providers.

5. **Suggested action**

5.1 The Meeting is invited to:

- a) Note the availability and limitations of commercially available ADS-B data in the SAM Region;
- b) Note ICAO's efforts to provide analytical solutions for the effective, efficient and safe use of airspace based on ADS-B data;
- c) Recommend the concept of ADS-B based analysis to GREPECAS to promote the installation of ground based receivers to improve coverage in the SAM Region;
- d) Note the benefit of air navigation service provider providing radar data to enhance the accuracy of ADS-B analysis.