International Civil Aviation Organization
North American, Central American and Caribbean Office

INFORMATION PAPER

ADS-B/OUT/M — IP/05
16/08/19

Automatic Dependent Surveillance – Broadcast OUT Implementation Meeting for the NAM/CAR Regions (ADS-B/OUT/M)

Ottawa, Canada, 21-23 August 2019

Agenda Item 4: **Satellite ADS-B Implementation**

SPACE-BASED ADS-B IMPLEMENTATION UPDATE

(Presented by AIREON)

EXECUTIVE SUMMARY	
The purpose of this Information Paper is to present an update on the implementation of the space-based ADS-B service.	
Strategic Objectives:	• Safety • Air Navigation Capacity and Efficiency
References:	• Report of the SAM/IG/22 Meeting (Lima 19th – 23rd Nov/18) • Report of the ADS-B/LEG Meeting (Mexico City 26th – 30th Nov/18) • Report of the SAM/IG/23 Meeting (Lima 20th – 24th May/19) • Study on the Convenience and Feasibility of the Satellite ADS-B for Regional Implementation (SAM Region)

1. Introduction

1.1 In 1983, ICAO first developed the high-level concepts to a Future Air Navigation System, in order to use satellites to overcome the limitations of terrestrial systems and migrating to a modernized global Air Traffic Management system. With Navigation and Communication domains that are now satellite based, this vision of a seamless Air Navigation Service (ANS) surveillance platform – free from dependence on ground infrastructure has now come to fruition, with the start of operations of space-based ADS-B in late March 2019.

1.2 The system is designed to meet the EUROCAE ED-129B and EUROCONTROL GEN SUR SPR specifications as a surveillance solution for use by ANSPs to deliver safe & efficient Air Traffic Management operations. It is totally independent from ground sensors and not limited to line of sight over mountainous areas, providing 100% visibility of all ADS-B equipped aircraft all over the world, in all areas and at all flight levels.

1.3 At the 12th Air Navigation Conference held in 2012, all participating States made a Recommendation for global adoption of the ADS-B technology through satellite (**Appendix A**). This would allow States to 'leap-frog' the dependence on and limitations of ground infrastructure and associated costs and also provide full ATS surveillance to all flights pole-to-pole where Controllers currently do not "see" traffic. Based on the 12th Air Navigation Conference Recommendation (1/9), ICAO, through the Separation and Air Safety Panel (SASP) has developed a Proposal for Amendment to PANS ATM Doc.4444 to ratify Space-Based ADS-B as an equivalent means of ATS Surveillance on the one hand and also prescribed Performance Specifications for Navigation (RNP4 or 2) and Communications (RCP 240) for operations in non-VHF areas.

1.4 Twelve air traffic agencies on a global basis (5 represent majority Aireon owners) and supported by ICAO regional planning groups are well on their way towards deploying space-based surveillance.

1.5 With the support of the Regional Project RLA/06/901, the ICAO-Lima office has conducted a study on the Convenience and Feasibility of Space-based ADS-B for Regional Implementation. The study has concluded that the regional adoption of this service would bring operational benefits and advantages to the SAM Region.

1.6 During the ADS-B/LEG, held in the ICAO NACC office (Mexico City 26th – 30th Nov/18), the participants pointed out the need for an integrated and cooperative assessment to determine the correct use of space-based ADS-B.

1.7 In the following Sections, this IP presents the status of the implementation of the Space-based ADS-B Service, taking into account technical and operational aspects in order to achieve the adoption of such service by a State and / or Region.

2. Discussion

2.1 *SAFETY CASE AND CERTIFICATION PROCESS*

2.1.1 Given its level of performance for aircraft surveillance, AIREON received the EASA certification as an air navigation services provider by the European regulator in June 4th, 2019. This is a unique situation, where an Organization with no airspace responsibility is granted such a certification.

2.1.2 Following industry best practices, AIREON has produced a safety case that serves the EASA process. AIREON´s ANSP customers receive the AIREON Safety Case as a deliverable which identifies the operational hazards related to any ADS-B surveillance system. These hazards formulated the foundation to develop safety requirements as mitigations that control the hazards as low as reasonably practicable.

2.1.3 As depicted in Figure 1, the AIREON Safety Case and AIREON's In Service Acceptance Test (ISAT) documents are deliverables that can be used as input to an ANSP safety case which encompasses a broader perspective, taking into account the change to the existing operational environment.

Figure 1: AIREON Support to the ANSP Safety Case

2.1.4 AIREON was officially approved by the European Union Aviation Safety Agency (EASA) as an Air Navigation Service Provider (ANSP) Organization to provide Air Traffic Management (ATM)/Air Navigation Service (ANS) surveillance services in oceanic airspaces, to support the separation of aircraft. This authorizes AIREON as the first-ever certified provider of aircraft surveillance-as-a-service.

2.1.5 This designation represents the culmination of a three-year long collaboration between AIREON and EASA, the agency that determines and promotes civil aviation safety standards for the member States of the European Union (EU) and other associated States. EASA's rigorous and holistic certification process ensured the performance of the AIREON data for use in critical safety-of-life Air Traffic Services (ATS) surveillance.

2.1.6 AIREON is committed to the safe delivery of space-based Automatic Dependent Surveillance-Broadcast (ADS-B) services to its customers Air Traffic Control (ATC) systems. By recognizing the performance of AIREON's ADS-B service, this EASA certification is a major milestone to legitimize the world's first set of global real-time air traffic data.

2.1.7 AIREON is still undergoing the certification process for terrestrial en-route and terminal environments. Such certifications are expected by September 2019.

2.2 *OPERATIONAL TOPICS*

2.2.1 Aireon, a company inspired and owned by 5 forward-looking ANSPs took a futuristic business decision to invest and place aircraft signal receiving capability on 66 low earth orbiting satellites. Space-based automatic dependent surveillance-broadcast (ADS-B) expands on the existing and well-documented ADS-B technology recognized by ICAO under ASBU B0-ASUR, by deploying ADS-B receivers in space via satellites to overcome line of sight limitations of traditional ground installation air traffic services (ATS) systems. This is based on three key business objectives:

a) Overcome the dependence and limitations of ground infrastructure and associated costs.
b) Provide 100% surveillance across 70% of the world where Controllers currently do not "see' traffic.
c) Transform a Capital Expenditure model to a Surveillance as a Service- Data Services Model.

2.2.2 **System performance**. Space-based ADS-B has exceeded expectations in reaching surveillance performance parameters, since the first satellites launch. The system complies with standard performance metrics for a surveillance system and are guaranteed by Aireon:

- Availability of ≥ 99.9%
- Latency ≤ 2.0s
- Update Interval of 8 seconds

2.2.3 Figure 2 shows the average Update Interval in the Latin America and Caribbean Region for sample data taken on a 24-hour period on May 15th, 2019. The information shows that for most of the region, the average UI is around 1-2 sec.

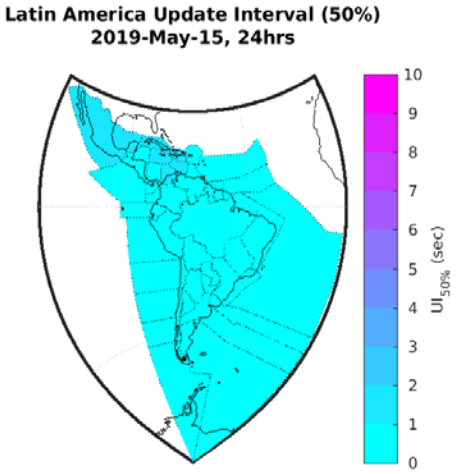
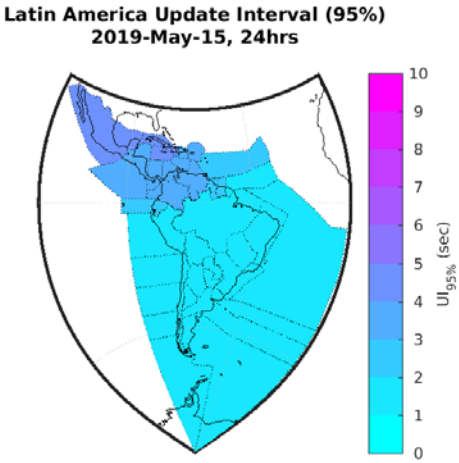


Figure 2. Average Update Interval in Latin America and Caribbean

2.2.4 Figure 3 shows the UI at 95% probability of update until 8 seconds. Results show UIs far below the 8 sec standard for a surveillance system. For the NACC region, UI is between 4-5 sec and for the SAM region between 2-3 sec.



2.2.5 **Reduced separation minima in the oceanic airspace with space-based ADS-B**. The ICAO North Atlantic PIRG (NAT SPG) at its 55th Meeting, 24-27 June 2019 issued Conclusion 55/10 ratifying that all of the pre-requisites for NAT SPG Conclusion 54/9 to deploy the Operational Trial of ASEPs using Space based ADS-B in the Longitudinal dimension that commenced 28 March 2019 had either been satisfied or a process had been put in place to ensure that they would be satisfied. The Conclusion also considered the Safety Cases covering the Shanwick and Gander Oceanic Control Areas (OCA) to authorize Operational Trials of ASEPs using Space-based ADS-B in the Lateral dimension on 10 October 2019. Consequently, the following was endorsed:

2.2.5.1 NAT SPG Conclusion 55/10 – Updates to ASEPS Implementation Plan and Task List and approval of NAT OPS Bulletin - Trial Implementation of ASEPS (Lateral) using ADS-B (Appendix B)

That, the NAT SPG, having agreed that the implementation date for the ASEPS lateral separation of 19 NM operational trial would be 10 October 2019, invite the ICAO regional Director, Europe and North Atlantic, to take appropriate actions to publish the:

a) Implementation Plan and Task List for An Operational Trial Of Advanced Surveillance-Enhanced Procedural Separation (ASEPS) Using Automatic Dependent Surveillance-Broadcast (ADS-B) as provided in Appendix G; and

b) NAT Operations (OPS) Bulletin addressing the operational trial of ASEPS to include a minimum of 19 NM lateral separation between non-intersecting tracks using ADS-B (Serial no: 2019_002) as provided in Appendix H.

2.2.6 **Current operations with space-based ADS-B**. NAV CANADA and UK NATS are the first Air Navigation Service Providers (ANSP) to deploy Space-Based ADS-B for ATS surveillance in the oceanic and en-route environments (NAT OPS Bulletin – Trial Implementation of ASEPS using ADS-B (Serial no: 2018_006) refers). As of 28 March 2019, the referred providers have incorporated Space-Based ADS-B in flights in the oceanic airspace (North Atlantic) and are using reduced longitudinal separations of 14 NM or 17 NM, plus 5 NM opposite direction, using CPDLC for communication.

2.2.7 Regarding continental usage, NAV CANADA has also incorporated Space-Based ADS-B using a 5 NM standard in airspace under VHF communication. This is in the Edmonton FIR in Northern Canada.

2.2.8 This first deployment by NAV CANADA and NATS sets the standard and will act as a guide to all nations in deploying this state-of-the-art air traffic surveillance technology.

2.2.9 NAV CANADA and UK NATS project a 76% reduction in collision risk over the NAT corridor, a figure that was endorsed by the International Civil Aviation Organization (ICAO).

2.2.10 Space-Based ADS-B is an enabler for User Preferred Routes (UPRs). In fact, NAV CANADA and UK NATS plan to remove the Organized Track System (OTS) and move to UPRs. There are no additional aircraft equipage requirements for standard RNP-10 separations that can be applied today- as the minimum airspace baseline.

2.3 ***INDUSTRY PARTNERSHIPS***

2.3.1 **Irish Aviation Authority – AIREON ALERT.** As of 21 May 2019, IAA, started the operation of Aireon ALERT, in partnership with AIREON, offering a public service to the world's aviation industry for the location and tracking of ADS-B equipped aircraft in emergency situations. The AIREON Aircraft Locating and Emergency Response Tracking (ALERT) is the aviation industry's first and only free, global emergency aircraft location service.

2.3.2 The AIREON ALERT 24/7 communications facility is located at IAA's North Atlantic Communications Centre in Ballygirreen, Ireland. AIREON ALERT users do not have to be customers of AIREON or IAA. All users simply have to register for the free, emergency service, using the URL https://aireonalert.iaa.ie/alert-register.

2.3.3 **FlightAware-GlobalBeacon**: FlightAware and AIREON have partnered to revolutionize flight tracking with the first, truly global solution that exceeds modern safety standards. Until now, flight tracking over remote regions such as the North Pole, South Pole, rainforests, deserts and oceans had never been possible. AIREON's Space-Based ADS-B changes that.

2.3.4 By combining FlightAware's data processing platform and web-interface with AIREON's Space-Based ADS-B information, GlobalBeacon support airlines in complying with ICAO's GADSS requirements.

2.3.5 FlightAware went live with GlobalBeacon, using Space-Based ADS-B data on April 16th, 2019, providing airlines with one-minute position updates of their fleet globally, more than 97 percent of the time.

2.3.6 **Airbus Defence and Space.** Provision of space-based ADS-B to AirSense, an Airbus advanced analytics solution, built upon real-time, multi-source data fusion. This partnership enables AirSense global live aircraft surveillance.

2.3.7 **Automation Platform Providers:** Aireon has partnerships with Thales, Leonardo and ATECH for integration of space-based ADS-B data into their air traffic control and ATFM automation platforms. These partnerships have facilitated a smooth integration into these platforms.

2.3.8 **Network Providers:** Harris, Frequentis and SITA. Through these partnerships, Aireon has tested data distribution into networks set up by these providers, which has enabled cost-effective connecting solutions to Aireon's customers.

2.4 ***IMPLEMENTATION ACTIVITIES IN THE AMERICAS REGION***

2.4.1 Curacao is AIREON's launch customer of Space-Based ADS-B in the Caribbean region. For its implementation, Curacao identified the need to use MEVA, as one of the telecommunications channels to connect the service to its facilities.

2.4.2 MEVA has become the communication infrastructure to support current and future aeronautical applications among its Member States and to interconnect with the South American (SAM) Aeronautical Telecommunication Network (ATN), called REDDIG.

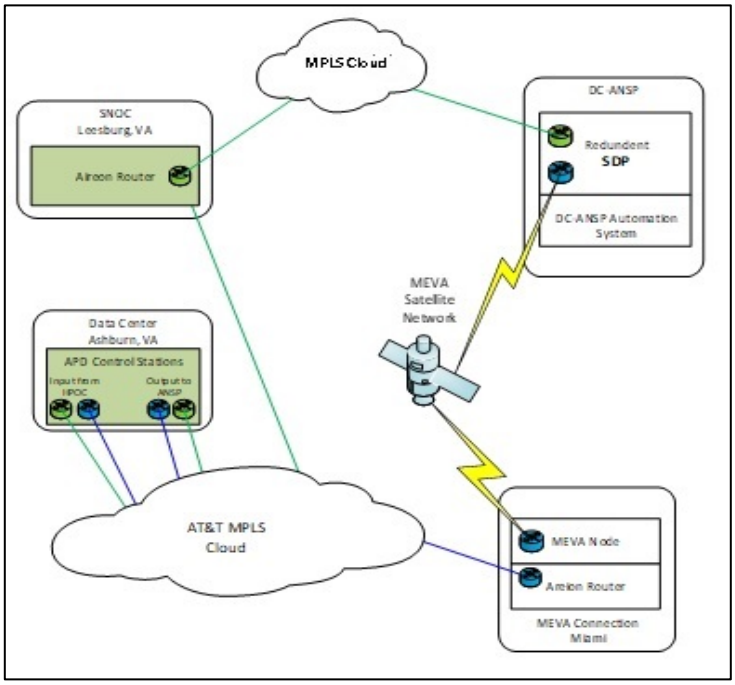


Figure 4: Curacao Space-Based ADS-B Network Architecture

2.4.3 AIREON and the MEVA provider, Frequentis assessed the feasibility to transport surveillance ADS-B data to Curacao and during TMG/33 meeting, Member States approved the use of the MEVA Infrastructure as one of the telecommunication links to support the transmission of Space-Based ADS-B services, between AIREON Processing and Distribution Centre (APD) to Curacao`s DC-ANSP and to any other member State that will use space-based ADS-B data in the future. The approved architecture is shown in Figure 4.

2.4.4 The primary link is an AT&T MPLS line that connects the ‘A’ side Service Delivery Point (SDP) in Curacao to the AIREON Processing Distribution (APD). The secondary link utilizes the MEVA network to connect the ‘B’ side SDP in Curacao to the AIREON Data Gateway via the MEVA node in Miami.

2.4.5 Figure 5 presents the performance of the space-based ADS-B signal at DC-ANSP, using the MEVA network for the time period of Jul 6-Aug 6, 2019. The surveillance performance parameters are met successfully which shows that the MEVA regional network can be efficiently used as a back up line to connect an ANSP’s Service Delivery Point and receive the space-based ADS-B signal for surveillance purposes.

Figure 5. Latency and Update Interval with the use of MEVA at DC-ANSP

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APPENDIX A
12th Air Navigation Conference Conclusion in respect to space-based ADS-B

AN-Conf/12-WP/162

Report on Agenda Item 1 1-5

Recommendation 1/9 – Space-based automatic dependent surveillance — broadcast

That ICAO:

a) support, subject to validation, the inclusion in the GANP, development and adoption of space-based automatic dependent surveillance — broadcast surveillance as a surveillance enabler;

b) develop Standards and Recommended Practices and guidance material to support space-based automatic dependent surveillance — broadcast as appropriate; and

c) facilitate needed interactions among stakeholders, if necessary, to support this technology.

				sufficient system redundancy
1/9	Space-based automatic dependent surveillance – broadcast	Parts a) to c): approved and referred to the appropriate expert groups for follow-up.	Parts a) to c): noted.	Parts a) to c): include, subject to validation, spaced-based ADS-B in the GANP; develop proposals for spaced-based ADS-B SARPs; facilitate interactions among stakeholders to support this technology.

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APPENDIX B
ICAO SASP RECOMMENDATION

2.7.8 Consequently, the following was endorsed:

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b) NAT Operations (OPS) Bulletin addressing the operational trial of ASEPS to include a minimum of 19 NM lateral separation between non-intersecting tracks using ADS-B (Serial no: 2019_002) as provided in **Appendix H**.

— END —