International Civil Aviation Organization
South American Regional Office
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(Lima, Peru, 4 to 8 November 2019)

SAM/IG/24-IP/5.4
28/10/2019

Agenda Item 5: Operational implementation of new ATM automated systems and integration of the existing systems

SPACE-BASED ADS-B IMPLEMENTATION UPDATE

(Presented by AIREON)

SUMMARY

The purpose of this Information Paper is to present an update about the implementation of the ADS-B Satellite service.

References

- Report of the Nineteenth Meeting / Workshop of the SAM Implementation Group (SAM / IG / 19 - Lima, Peru, 22-26 May 2017).
- Report of the Eleventh Meeting of the Project Coordination Committee of RLA / 06/901 (RCC / 11) - Lima, Peru, 5 October 2018).
- Report of the Twenty-First Meeting / Workshop of the SAM Implementation Group (SAM / IG / 21 - Lima, Peru, from 21 to 25 May 2018).
- Study on the Convenience and Feasibility of the Satellite ADS-B in a Regional Implementation.

1. Introduction

1.1 In 2009, AIREON identified the opportunity to solve one of the main problems of aviation: the inability to track and monitor aircraft real-time anywhere in the world.

1.2 With the partnership of Nav Canada, ENAV, Naviair, NATS, IAA and IRIDIUM, the plan to set up ADS-B receivers in the 66 satellites of the IRDIUM NEXT constellation was carried out and the constellation is now complete, since the 11th of January 2019, and the space-based ADS-B service has already started around the globe.

1.3 Over time, major ANSPs have believed in the AIREON project and have signed partnerships for the implementation of the satellite-delivered ADS-B application in airspace under their responsibilities.

1.4 Curacao is the first country in the CAR / SAM Regions to deploy the Space-Based ADS-B. The MEVA network will be used as one of the lines for the application transmission from the Miami MEVA node to the ANSP.

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 In the same way as with MEVA, AIREON is conducting studies on the best transmission topology of the Space-Based ADS-B application using REDDIG II.

1.7 In the following Sections, this IP presents the status of the implementation of the ADS-B Satellite Service, taking into account the infrastructure, 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 December 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.

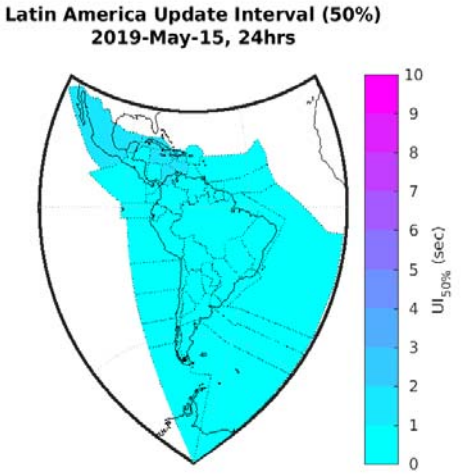

Figure 2. Average Update Interval in Latin America and Caribbean

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.

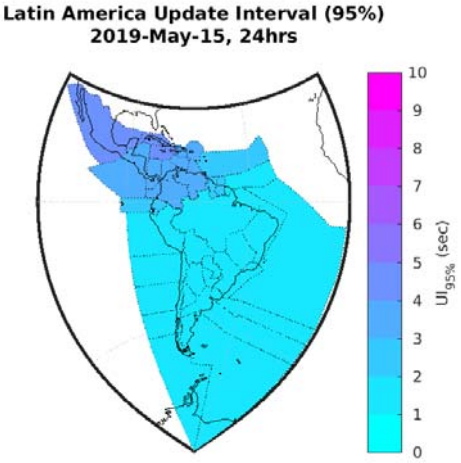

Figure 3. Update Interval at 95% probability

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**

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 Defense 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 ACITIVITIES 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.

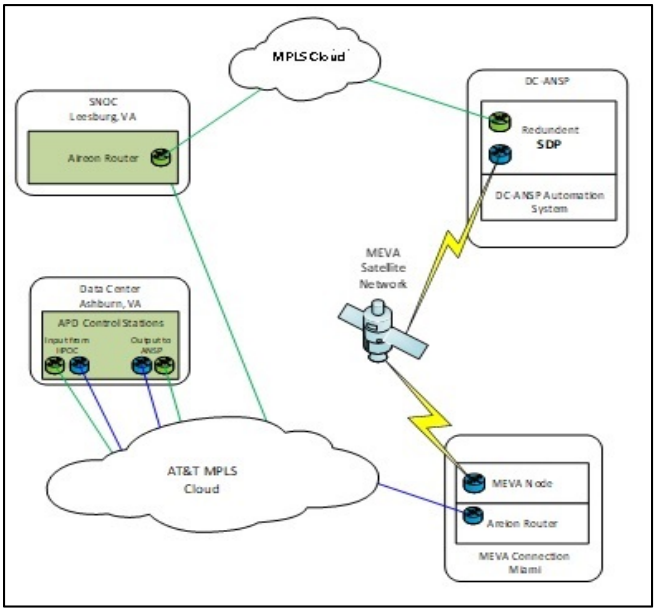

Figure 4: Curacao Space-Based ADS-B Network Architecture

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 Center (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

2.5 *BRAZILIAN TRIALS*

2.5.1 On the 17th May 2019, the Department of Airspace Control (DECEA) and AIREON signed a mutual Technical Cooperation Agreement (TCA) agreement, aiming the in-depth assessment of Space-Based ADS-B.

2.5.2 The TCA has the objective of collecting surveillance data for aircraft using airspace under the responsibility of DECEA, obtained through satellite ADS-B technology.

2.5.3 With this data, it will be possible for DECEA specialists to carry out technical and operational studies and analyzes, which will support the decision-making by DECEA's senior management, as to the suitability of its adoption for the improvement of surveillance and airspace control.

2.5.4 The assessment of the technical and operational performance of the AIREON solution-based ADS-B surveillance applied to DECEA airspace will consist of two phases:

2.5.5 **Phase 1: Specific Aircraft Tracking:** AIREON tracked aircraft during the planned test period in DECEA's areas of interest, in order to test the capabilities of the satellite ADS-B. The deliverables, to be sent to DECEA in the following months, comprise:

a) Tracking data recorded for the planned test period and selected screened aircraft;

b) Representation in geo-referenced videos, showing the location of the screened aircraft selected during the planned test period;

c) Performance measurement report showing the refresh rate and latency during the planned test period for the crawled aircraft.

2.5.6 **Phase 2: Live-Data Gathering and Reporting:** live-data is being sent via a Virtual Private Network ("VPN") server connected to the Internet of ADS-B equipped aircraft and flying in pre-test areas -selected by DECEA. These tests aim to expand the analysis from Phase 1 to all FIRs under the jurisdiction of DECEA and to continue testing the ADS-B satellite services.

3. **Suggested Action**

3.1 The Meeting is invited to take note of the content provided in this Information Paper.

- End -