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

Automatic Dependent Surveillance – Broadcast OUT Implementation Meeting for the NAM/CAR Regions

ADS-B/OUT/M

Final Report

Ottawa, Canada, 21 to 23 August 2019

Prepared by the Secretariat

August 2019

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HISTORICAL

ii.1 Place and Date of the Meeting

The Automatic Dependent Surveillance – Broadcast OUT Implementation Meeting for the NAM/CAR Regions (ADS-B/OUT/M), where some States of the SAM Region also participated, was held in Ottawa, Canada, from 21 to 23 August 2019, hosted by Canada.

ii.2 Opening Ceremony

Mrs. Mayda Alicia Ávila, Regional Officer, Communications, Navigation and Surveillance of the North American, Central American and Caribbean (NACC) Office of the International Civil Aviation Organization (ICAO), thanked Canada on behalf of the ICAO NACC Regional Office for hosting the meeting, Mrs. Ávila also invited all participants to work jointly to achieve regional improvements for NAM/CAR and SAM Region.

Opening remarks were provided by Mr. Jeff Dawson, Director, ATS Standards, NAV CANADA, on behalf of Canada, and Mr. Pierre Ruel Chief, Flight Standards, on behalf of Transport Canada, welcomed the participants and officially opened the meeting.

ii.3 Officers of the Meeting

The ADS-B/OUT/M Meeting was held with the participation of the Chairperson, Mr. Pierre Ruel, Chief, Flight Standards, Transport Canada, and Mr. Carlos Jiménez, Rapporteur ANI/WG Surveillance Task Force. Mrs. Mayda Alicia Ávila chaired the meeting plenary and served as Secretary of the Meeting

ii.4 Working Languages

The working languages of the meeting were English and Spanish. The working papers, information papers and presentations of the meeting were available to participants in both languages. The Draft report was available in English only.

ii.5 Schedule and Working Arrangements

It was agreed that the working hours for the sessions of the meeting would be from 09:00 to 16:00 hours daily with adequate breaks. The Meeting carried out additional discussion sessions to discuss proposed changes to the CONOPS document.

ii.6 Agenda

Agenda Item 1: Review and Approval of Provisional Agenda and Schedule

Agenda Item 2: Update Status ADS-B Implementation for States

2.1 Review of previous conclusions, ADS-B implementation, Mexico City, November 2018
2.2 Update ADS-B Status implementation and regulation development by States
2.3 ADS-B trial Statistic collection
2.4 Presentation of Operational Concept (CONOPS)

Agenda Item 3: Surveillance Coverage (100%) for PBN Implementation.

3.1 Surveillance coverage needed for PBN implementation
3.2 Actual surveillance coverage
3.3 Discuss new requirements
3.4 Implementation of new surveillance Systems

Agenda Item 4: Satellite ADS-B Implementation

4.1 Use of Satellite ADS-B service in CAR region
4.2 Feasibility Study of Satellite ADS-B use

Agenda Item 5: Other Business

Agenda Item 6: Visit NAV-CANADA facilities

ii.7 Attendance

The Meeting was attended by nine States/Territories from the NAM/CAR/SAM Regions, four International Organizations and five from the Industry, totalling 34 delegates as indicated in the list of participants.

ii.8 Draft Decisions

The Meeting recorded its activities as Draft Decisions as follows:

DRAFT DECISIONS: Internal activities of the Automatic Dependent Surveillance – Broadcast OUT Implementation Meeting for the NAM/CAR Regions (ADS-B/OUT/M).

An executive summary of these conclusions/decisions is presented in **Appendix A** to this report.

ii.09 List of Decisions

Number	Title	Page
ADS-B/OUT/M/01	***NAM/CAR ADS-B Implementation planning***	2-2
ADS-B/OUT/M/02	***Establish a criteria to develop an ADS-B statistical analysis***	2-11
ADS-B/OUT/M/03	***Regional NAM/CAR Operational Concept of ADS-B implementation***	2-12

ii.10 List of Working and Information Papers and Presentations

Refer to the Meeting web page:
https://www.icao.int/NACC/Pages/meetings-2018-adsbout.aspx

WORKING PAPERS

Number	Agenda Item	Title	Date	Prepared and Presented by
WP/01	1	Review and approval of provisional agenda and schedule	19/07/19	Secretariat
WP/02	2.1	Review of previous conclusions, ADS-B Implementation, Mexico City, November 2018	07/08/19	Secretariat
WP/03	2.2	Ensuring preparedness for the U.S. 2020 ADS-B equipage mandate	22/07/19	United States
WP/04	2.2	Central America FIR, ADS-B implementation Status	11/08/19	COCESNA
WP/05	2.2	Status of ADS-B Implementation in Cuba	29/07/19	Cuba
WP/06	2.2	CANCELLED		Mexico
WP/07	2.2	Status of ADS-B Implementation in French Guyana	29/07/19	France
WP/08	5	New Version of the Global Air Navigation Plan and new NAM/CAR challenges	16/08/19	Secretariat
WP/09	2.3	ADS-B trial Statistic collection	19/08/19	COCESNA
WP/10	3.3	Automatic Dependent Surveillance – Broadcast (ADS-B) Out Survey	14/08/19	IATA
WP/11	2.2	ADS-B Implementation in Brazil – Campos Basin	13/08/19	Brazil

WORKING PAPERS

Number	Agenda Item	Title	Date	Prepared and Presented by
WP/12	2	Report on the developments of the work of the Surveillance Task Force (SUR-TF)	29/07/19	Rapporteur
WP/13	2.4	Proposed Revision to NAM/CAR/SAM Regional ADS-B CONOPS	24/07/19	CONOPS Ad Hoc Group
WP/14	2	Statistical compilation of ADS-B messages received in the Western Region of the Havana FIR	29/07/19	Cuba
WP/15	5	LATAM/CAR CNS/ATM Harmonization	13/08/19	IATA
WP/16	2.2	U.S. public ADS-B performance report	29/07/19	United States

INFORMATION PAPERS

Number	Agenda Item	Title	Date	Prepared and Presented by
IP/01	--	List of Working, Information Papers and Presentations	16/08/19	Secretariat
IP/02	4.1	Overview of the FAA'S operational evaluation of space-based ADS-B in the Caribbean	19/07/19	United States
IP/03	4	Evaluation of Space Based ADS-B in Brazil	14/08/19	Brazil
IP/04	5	Possible impact of small UAS transmitting on 1090 MHz	14/08/19	Surveillance Panel Secretariat
IP/05	4	Space-Based ADS-B Implementation Update	16/08/19	AIREON
IP/06	2.2	Canadian ADS-B OUT Performance Requirements Mandate	19/08/19	Canada
IP/07	2.3	Overview of ADS B equipage in the U.S., *Presented by United States*	22/08/19	United States
NI/08	2.2	Implementación de la Vigilancia dependiente automática por radiodifusión ADS-B (available only in Spanish)	21/08/19	México

PRESENTATIONS

Number	Agenda Item	Title	Presented by
1	3.4	Automatic Dependent Surveillance – Broadcast OUT Implementation Meeting for the NAM/CAR Regions (ADS-B/OUT/M)	Leonardo
2	3.4	Indra Surveillance Evolution for ASBU	INDRA
3	3.3	Optimal Surveillance Requirements for PBN implementation	Secretariat

LIST OF PARTICIPANTS

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CUBA/CUBA

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Agenda Item 1 Review and Approval of Provisional Agenda and Schedule

1.1 Under the WP/01, the Secretariat invited the Meeting to approve the provisional agenda and schedule. The Meeting approved the agenda as presented in the historical section of this report and did not make changes to the schedule.

Agenda Item 2 Update Status ADS-B Implementation for States

Under WP/12, the Rapporteur of the Surveillance Task Force of the Air Navigation Implementation Working Group (ANI/WG), Mr. Carlos Jiménez, presented the result of the activities carried out during 2019, to support surveillance data system, Air Traffic Services Inter-facility Data Communication (AIDC) implementation and other aligned with the Automatic dependent surveillance - broadcast (ADS-B) implementation.

The following activities were carried out by Surveillance Task Force:

1. Update of the Regional CONOPS for ADS-B implementation, task development by Cuba, Dominican Republic and COCESNA and led by United States.
2. Update about ADS-B status implementation by the States.

The Meeting discussed the potential operational needs for regional surveillance over the oceanic airspace to improve the safety reports. The Secretariat will coordinate this proposal to be discussed and analysed in the regional operational working groups to validate this need.

The regional implementation status of Multilateration (MLAT) and/or ADS-B is available in **Appendix B** to the WP/12.

The WP/12 presented the reports of the States on the development of their implementation. Updates were provided by some of the States during the Meeting.

Finally, the WP/12 invited the Meeting to:

a) note the information provided in this Working Paper;
b) urge States, that have not yet done so, to submit their ADS-B implementation plan to the ICAO NACC Regional Office before 31 October 2019.
c) carry out the actions they deem appropriate to comply with the current regional agreements on surveillance for all flight information regions (FIRs) in the region:

- 100% achievement of surveillance coverage when it is necessary according with the operations
- start the ADS-B operational use
- surveillance data sharing among neighbour States

d) comply with the agreed dates in the regional plans and the GREPECAS programme projects for the aforementioned subsections.

In this regard, the Meeting adopted the following Decision:

<table>
<tr><td colspan="4">DECISION
ADS-B/OUT/M/01 NAM/CAR ADS-B IMPLEMENTATION PLANNING</td></tr>
<tr><td colspan="3">What:
That, the States, the Surveillance Task Force will coordinate with the States that have not submitted their ADS-B implementation plan to the ICAO NACC Regional Office before 31 October 31 2019, which must include:

a) installed or foreseen installation date of ADS-B or MLAT receptors;
b) percentage of current coverage or to be covered in the future with ADS-B in the FIR, according with national operational requirements;
c) percentage of registered aircraft with implemented ADS-B; and
d) possible date for this to be operational.</td><td>Expected impact:
☐ Political / Global
☐ Inter-regional
☐ Economic
☐ Environmental
☒ Operational/Technical</td></tr>
<tr><td colspan="4">Why:
To comply with the regional agreement of the ADS-B operability by 2020.</td></tr>
<tr><td>When:</td><td>31 October 2019</td><td>Status:</td><td>☒ Valid / ☐ Superseded / ☐ Completed</td></tr>
<tr><td>Who:</td><td>☒ States ☐ ICAO ☐ Other:</td><td colspan="2">CAR States</td></tr>
</table>

2.1 Review of previous conclusions, ADS-B implementation, Mexico City, November 2018

2.1.1 WP/02 presented a review of the list of valid conclusions/decisions from previous meetings related to the implementation of ADS-B and activities agreed by the Surveillance Task Force.

2.1.2 During the last two years, two meetings have been held in order to discuss the aspects related to the ADS-B implementation and the actions to be developed by States to ensure the mandatory implementation of the ADS-B in United States.

2.1.3 Furthermore, within the Surveillance Task Force, a series of activities were agreed, with the objective to support the AIDC implementation, to provide oversight data in the areas of coordination among FIRs and to reduce the occurrence of Large height deviation (LHD) in the Caribbean area and among the CAR/SAM coordination.

2.1.4 **Appendix C** provides an update of the list of conclusions and decisions of previous Meetings that are still valid.

2.1.5 One of the most important activities that was agreed during the previous meeting was that CAR States would analyse the operational impact that the ADS-B mandatory implementation in United States could cause in their operations due to both their direct coordination with United States or the airlines with national flag that have direct operations between CAR States and North America.

2.1.6 During the Meeting the information of Appendix C was reviewed and the participants provided information that is requested for each State according to the table and took decisions on the activities that are still pending, which were handled in the discussion session of the Surveillance Task Force and the result is in the execution programme of the **Appendix E** to this report.

2.2 Update ADS-B Status implementation and regulation development by States

2.2.1 Under WP/03, United States provided information on their 01 January 2020 ADS-B mandate. United States indicated that in 2010 they published the regulatory airspace and operational requirements (i.e. 14 CFR 91.225 and 91.227) for the 2020 Mandate. United States is leveraging the precision and reliability information from ADS-B to transform their aviation system.

2.2.2 United States highlighted that although 91.225 allows for two frequencies 1090 MHZ and 978 MHZ, based on experience, do not recommends that other ICAO States follow suit. The United States recommends using 1090MHz, the only internationally approved frequency, as the requirement for ADS-B Out. UAT (978MHz) can be utilized to provide Flight Information services if desired.

2.2.3 To clarify information related to the US ADS-B mandate implementation, consult the following links: https://bit.ly/2LEcCNK and https://bit.ly/2M4VTCx.

2.2.4 States with operators that intend to operate within the affected United States airspace are encouraged to promote awareness of this upcoming requirement and the related policy statements published by the FAA.

2.2.5 The Meeting highlighted a number of the lessons learned from the United States gained through the ADS-B implementation process. During the discussion, the group identified the need to develop means to monitor avionics installations, ensuring compliance with desired operational requirements. Additionally, the United States emphasized the need for States with aircraft manufacturers to consider a forward-fit and retro-fit mandate approach. This approach will diminish the number of retro-fit aircraft that will proliferate prior to a State’s desired ADS-B mandate.

2.2.6 The Meeting was asked to take note of the upcoming 01 January 2020 ADS-B mandate, and to assist in ensuring compliance with the applicable operators regulated by their State. In addition, the Rapporteur and ICAO emphasized the need for States to take into account the identified lessons learned when implementing ADS-B.

2.2.7 Under WP/04, COCESNA presented the ADS-B implementation status in Central American FIR as part of the modernization strategy of the Aeronautical Surveillance Systems in the COCESNA and its Member States' planning framework, which is aligned with the Global Air Navigation Plan (GANP) and the Regional Plans to ensure interoperability, technological homogeneity, and to cover the needs of the region aimed at obtaining operational benefits, increasing capacity and efficiency as air navigation services in a cost-beneficial and secure manner.

2.2.8 COCESNA worked in five phases to improve its surveillance coverage capabilities and to update the MSSR radar to Mode S/ADS-B, an ADS-B capability to support ADS-C in the Pacific Ocean area, updating communication infrastructure to support radar data sharing between Central America States, and establishing a surveillance committee for Central America standardization and continuous monitoring of surveillance data to improve services.

2.2.9 Surveillance data sharing among Central American control centres and adjacent FIRs enhances surveillance coverage and contributes with the automation of air navigation services, allowing coverage overlapping and maximizing the availability of surveillance data.

2.2.10 COCESNA indicated that through its implementation safety in the region is improved. Additionally, COCESNA is also working to implement satellite ADS-B in the pacific airspace with the aim to reduce the longitudinal separation between aircraft in the same flight level with the same route.

2.2.11 Finally COCESNA indicated that in its experience there is not a unique solution for solving surveillance deficiencies. The usage of conventional surveillance systems and new technologies (MLAT, ADS-B and ADS-C) or a combination of these are being considered, as is the case of La Aurora terminal control area (TMA) where the first Central American Wide Area Multilateration (WAM) system will be installed, with ADS-B capacity in all the stations.

2.2.12 Under WP/05, Cuba provided information about ADS-B status implementation in Cuba and the operational actions derived from the ADS-B operational implementation by January 2020.

2.2.13 Cuba indicated that six ADS-B Version 1 facilities allow 100% coverage in the Havana FIR but these data is not integrated in their Air traffic control (ATC) system. Cuba is working on updating the ATC system software and it will be ready by 2020.

2.2.14 Cuba estimates having the automatized ATC system operational by 2020, receiving, processing and representing the signals of all the installed surveillance systems, as well as the signals from the data-sharing with the neighboring States in the surveillance mosaic of the Air Traffic Control Centre (CCTA) services. Since the ADS-B in United States is operational, no immediate operational changes are foreseen.

2.2.15 Under NI/08 Mexico provided information about the progress in the implementation of the ADS-B in Mexico. The Civil Aviation Authority has developed the national standard called *NOM-091/2-SCT-2018* that establishes the installation specifications in the ADS-B OUT, which is in the final process of publication in the Official Gazette of the Mexican State.

2.2.16 According to Mexican information over 90% of national airlines have already equipped their aircraft with the ADS-B OUT and 60% of general aviation has already been equipping its aircraft or has short and medium term equipment plans.

2.2.17 Mexico has not established the mandatory use of ADS-B, however it has informed that its operations are not affected by the mandatory implementation in United States and that the national flagged aircraft fleet is prepared with the necessary equipment to carry out operations towards United States.

2.2.18 Under WP/07 the status of ground based ADS-B Implementation in French Guiana was updated.

2.2.19 It was informed that the first antenna located on top of the tower is operational since May 2019. The next 4 antennas will be deployed between September 2019 and May 2020. Partial validation of the system is planned for November 2019, and the whole system whould be operational by the summer of 2020.

2.2.20 Testing of the navigation installation, accuracy and integrity, and the collection of statistics for technical analysis will start at the beginning of 2020.

2.2.21 As per the ADS-B CONOPS for French Guiana, the primary goal is to improve Search and Rescue (SAR) operations (planned for the Summer of 2020) and then, to implement surveillance services (by the end of 2021).

2.2.22 This Working Paper provided the current surveillance coverage in the FIR:

- Surveillance coverage in upper flight information region (UIR) is completed with the use of ADS-C
- Surveillance coverage of the continental area in lower airspace (TMA/CTR) is still in progress (new radar GM406 and ground based ADS-B data are expected for 2020)

2.2.23 Concern was raised about:

- How to convince the general aviation community of the benefit of ADS-B; and
- Low altitude coverage (GND to 1500ft) in the south west of the country once the system is operational

2.2.24 Finally, it was noted that in case that there is still a gap in the coverage in the continental FIR once the system is operational, other options will be investigated after a new cost-benefit analysis.

2.2.25 Under WP/11, Brazil provided an update on the implementation of ADS-B in Brazil – Campos Basin.

2.2.26 Under a project DECEA (Brazil's Airspace Control Department) has operationalized the ADS-B within the offshore airspace in the Campos Basin. The region, relevant for its oil concentration, corresponds to a remote area of approximately 100 thousand km2, subordinate to Macaé Terminal Control Area (TMA-ME), extending beyond 120 NM from the coast. The air operations are performed by helicopters flying from 500ft to 4500ft between the continent and the prospection platforms for the transportation of cargo and people.

2.2.27 The benefits of this project are: a) enhancement of situational awareness in low altitudes and users' trust; b) faster and more cost-effective SAR missions; c) reduction of workload due to significant decrease of VHF-AM use time, among which are estimates and position check requests; d) improved planning capacity at APP-ME; and e) optimized navigation allowed by direct heading clearances, reduction of flight times and consequent fuel saving, estimated in R$ MM 1,31/year.

2.2.28 Brazil concluded that the operational implementation of ADS-B OUT at TMA Macaé marks the beginning of the evolution of ATS surveillance systems in Non-Radar Airspace (NRA) in Brazil, with a significant increase in aeronautical surveillance coverage in the offshore region, improvement in the provision of Air traffic services (ATS) (ATC, Flight Information and alert) and safety in low altitude operations.

2.2.29 Under WP/16, a reporting capability that the FAA has fielded to assist operators in understanding their aircraft's ADS-B avionics performance relative to the requirements of the United States ADS-B mandate was described. The paper also helps describing the scope of information that the FAA collects for all ADS-B Version 2 messages that are received by the FAA's ADS-B ground stations.

2.2.30 The Meeting took into account the Federal Aviation Administration (FAA) approach for ensuring continued monitoring of ADS-B equipage and performance within United States airspace. United States provided an overview of the existing ADS-B Performance Monitor (APM) and Public ADS-B Performance Report (PAPR) designed to assist operators in determining whether their ADS-B installation complies with the performance requirements outlined in 14 CFR 91.227. United States emphasized the need for all operators, foreign and domestic, to utilize this tool to ensure compliance with the ADS-B mandate prior to 01 January 2020.

2.2.31 The Meeting took note of the tool available to operators equipped with ADS-B Version 2 flying in U.S. ADS-B covered airspace. The U.S. asked ICAO Member States to inform their existing operators of the PAPR. By utilizing the PAPR, operators can ensure compliance to the upcoming 2020 ADS-B mandate prior to 01 January 2020.

2.2.32 Under IP/06, Canada presented an overview of the Canadian mandate for ADS-B Out equipage, approved on 28 February 2019.

2.2.33 Canadian airspace includes 18 million square kilometres of domestic and oceanic airspace, much of which remains without surveillance and is controlled with less efficient procedural airspace rules and the availability of space-based reception of ADS-B as an ATS surveillance source presents an opportunity to expand surveillance coverage and enhance safety while increasing operational efficiency.

2.2.34 The mandate for ADS-B Out performance requirements was developed in accordance with the aeronautical study process as defined in Canadian Aviation Regulations (CARs) and the Civil Air Navigation Services Commercialization Act (CANSCA). The aeronautical study was conducted by NAV CANADA, in consultation with various domestic and international aviation stakeholders. Transport Canada, the ANSP regulator, granted concurrence with the Aeronautical Study on 28 February 2019, enabling the implementation of the mandate.

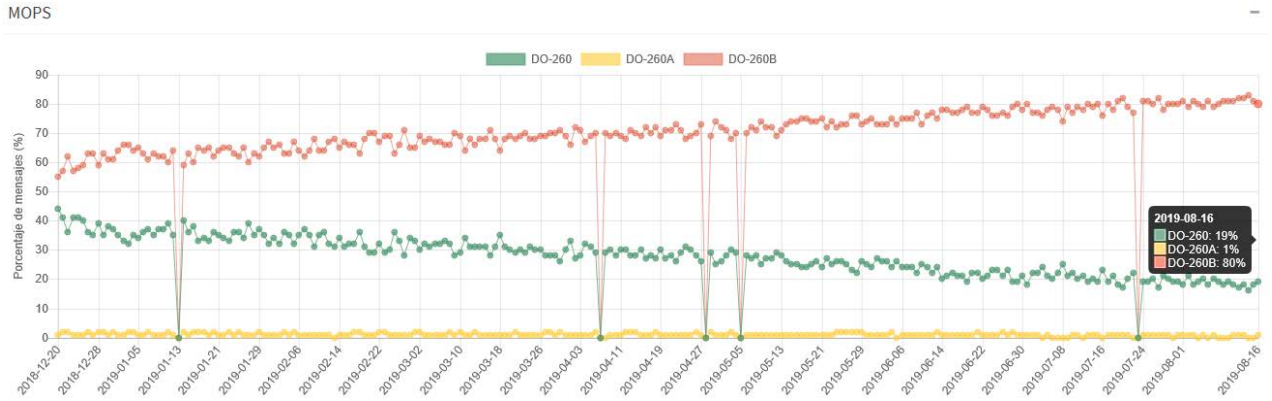
2.2.35 Implementation will be done in phases. The first one will be applied by January 2021 to class A Canadian airspace. Phase 2 will be effective on 1 January 2022 to Canadian Class B airspace. Phase 3 will apply to class E airspace, terminal, or transition areas.

2.3 *ADS-B trial Statistic collection*

2.3.1 Under WP/09, the results obtained by COCESNA related to statistics generation of ADS-B data on its capacity and the performance of aircraft notified position in Central American to comply with the monitoring requirements and assess the ADS-B information were presented.

2.3.2 COCESNA provided information according with the data obtained from the end of 2018 and during 2019 evaluating the ADS-B capacities, performance level of the position and the speed notified by the aircraft and other data. About 4 million messages were analyzed every day.

2.3.3 According to the results, ADS-B capacity and version in the aircrafts shows interesting data, due that in comparison with the 5% of aircraft with Version 2 that were detected in ADS-B trials in 2013, an increase has been observed in the last 8 months from 55% to 80% of aircrafts equipped with ADS-B DO-260B, decreasing the number of aircrafts with Version 0 (DO260). In the case of Version 1 (DO260A) it is stable in 1%.



2.3.4 Other information about precision and integrity of the position transmitted by ADS-B avionic and related to integrity and precision figures of merit of the messages was evaluated.

2.3.5 In conclusion, COCESNA indicated that it is necessary to permanently and periodically monitor the ground based ADS-B systems, avionics and the performance level of the data provided in an automated manner to ensure that safety of the ADS-B implementation complies with the established requirements for the different airspaces.

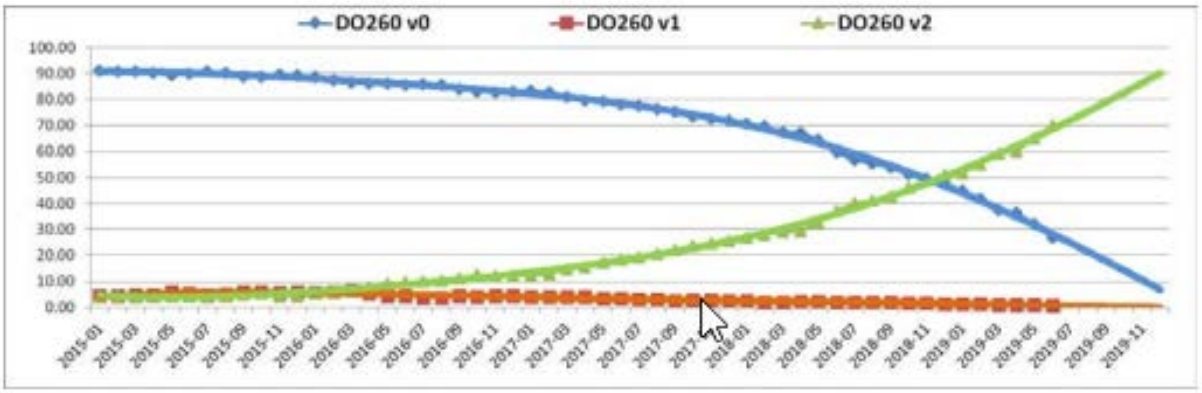
2.3.6 Under WP/14, Cuba presented a statistical analysis on the evolution of the ADS-B system implementation from 2015 to June 2019, in the aeronautical surveillance coverage zone within the Havana FIR.

2.3.7 The reports of the development of the States in the implementation were presented and updated with the information provided during the meeting.

2.3.8 The statistical analysis of the systems between 2015 and 2019 shows:

- Sustained growth of aircrafts with ADS-B transmissions
- Decrease of transponders with Version DO-260/DO-260A and increase of Version DO-260B
- Dominant Navigation integrity category (NIC) category is NIC=8
- There are errors in the identifier (ID) field, and it is not possible to correlate it with airline codes

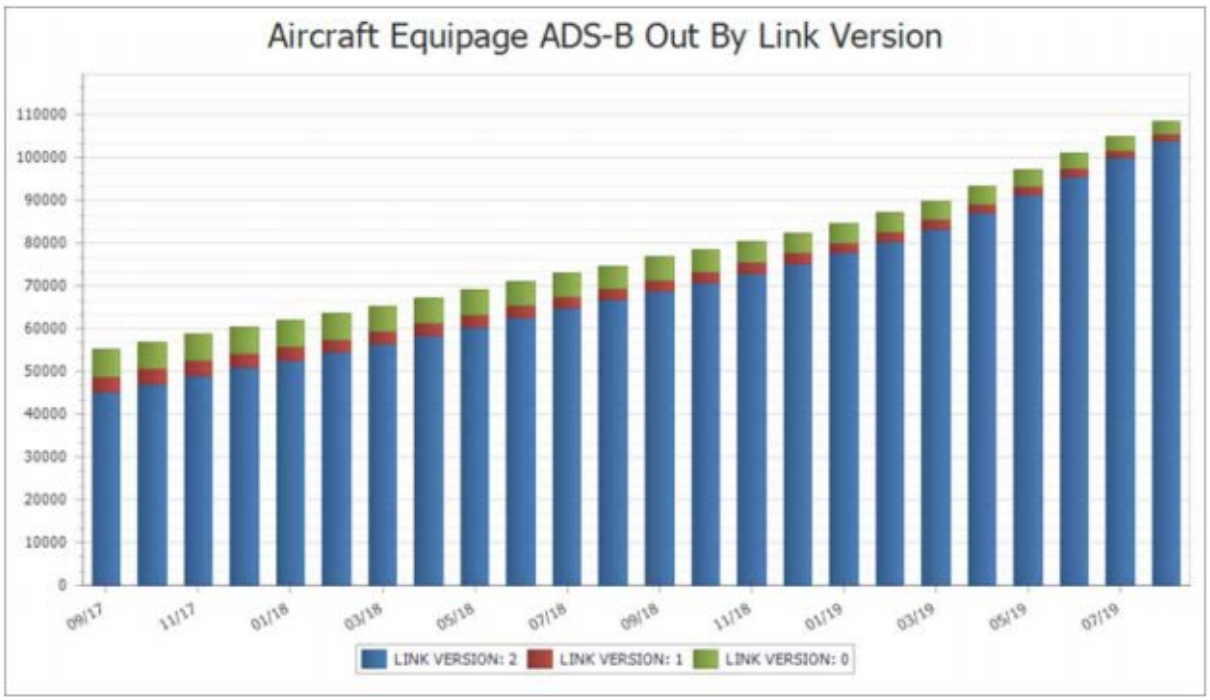
2.3.9 In this regard, the States were urged to take note of these statistics, analyse their results and the presented trends, compare presented data with the one obtained by the States or organizations and send to the national and IATA airlines the information related with errors that occur in ADS-B transmissions.



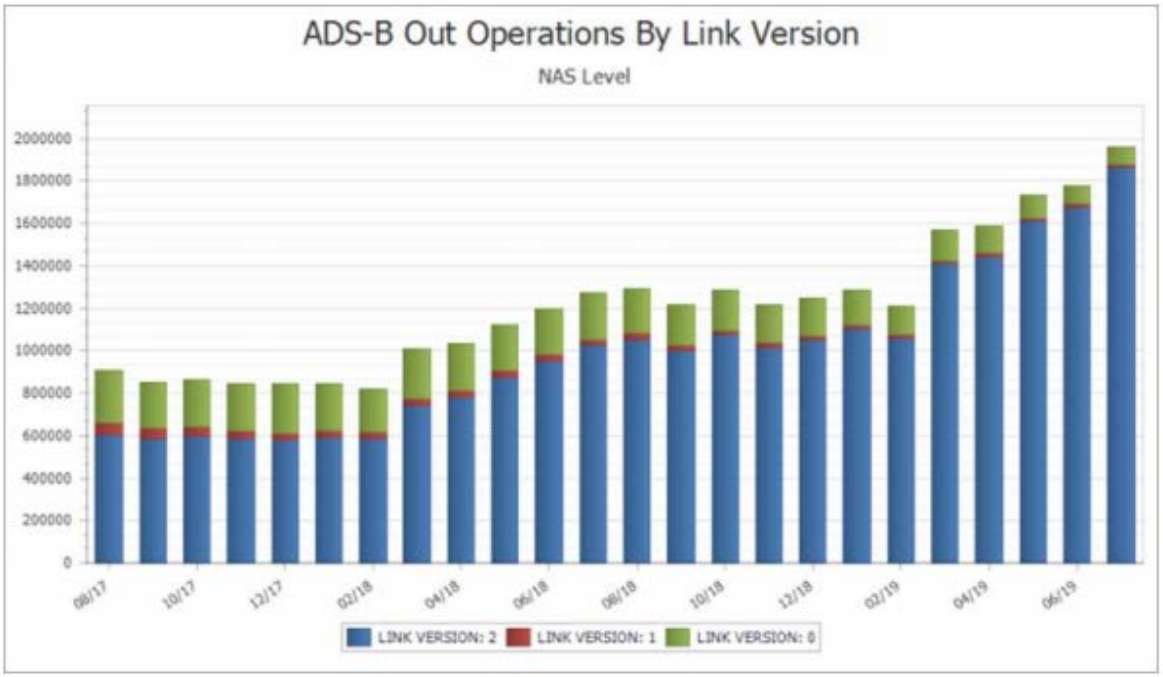
2.3.10 Under IP/07, United States presented an overview of ADS-B equipage trends and statistics as collected and analysed by the FAA, as of 1 August 2019.

2.3.11 FAA's ADS B Performance Monitor (APM) has various capabilities for tracking ADS B equipage trends. The APM tracks unique ICAO aircraft addresses and keeps statistics over the past two years. The count of ICAO aircraft addresses is based on the detected addresses during the year prior to the count period. For example, the count of ICAO aircraft addresses in July 2018 includes all addresses detected since July 2017.

2.3.12 In the following diagram is shown the number of ADS B Version 1 aircraft that has decreased from 3,522 to 1,630. In contrast, ADS B Version 2 aircraft equipage has more than doubled.



2.3.13 The APM can also display equipage trends as they impact ATC operations. The figure below shows the number of operations by different ADS B versions since 31 August 2017. During this period, the number of ADS B Version 0 operations has decreased from 248,176 per month to 80,056 per month; the number of ADS B Version 1 operations has decreased from 52,076 per month to 12,144 per month. In contrast, ADS B Version 2 operations have more than tripled, crossing the 1M operations per month threshold during June 2018.



2.3.14 Cuba, United States and COCESNA's analysis showed a significant decrease of DO-260 and DO-260A transponders, while DO-260B equipage increased. This increase applies to all NAM/CAR Regions. All three analysis presented similar results.

2.3.15 In this regard, the Meeting agreed to take note of this information and improve the ADS-B implementation taking into account that:

1. It is necessary to develop more analysis in the specific FIRs where ADS-B will be implemented, taking in account the avionics capacity.
2. It is necessary to develop more analysis and establish an acceptable level of implementation in the different types of airspace.
3. To carry out statistical analysis based on the same criteria and in a common technical language is also necessary; every State that develop ADS-B analysis may use the same criteria in order to understand the results in the same way.

2.3.16 The Meeting adopted the following Decision:

<table>
<tr><td colspan="2">DECISION
ADS-B/OUT/M/02 STABLISH A CRITERIA TO DEVELOPMENT AN ADS-B STATISTIC ANALYSIS</td></tr>
<tr><td>What:

That, is necessary to permanently and periodically monitor ground based ADS-B systems, avionics and the performance level of the provided data in an automated way to ensure safety and that the ADS-B implementation complies with established requirements for the diverse airspaces. Cuba, United States and COCESNA will carry out an analysis proposal by 31 December 2019, considering:

1. To establish minimum criteria and standards to carry out ADS-B statistical analysis, which include technical and operative criteria.
2. To establish ADS-B performance levels to filter data based on the different parameters to be measured.
3. To establish the parameters to be measured.
4. To develop a common interpretation language of the criteria and the results of the ADS-B statistical analysis.
5. That it is necessary to analyse data due the mandatory ADS-B implementation in United States.
6. To include the items listed above within the tasks of the Surveillance Task Force.</td><td>Expected impact:
☐ Political / Global
☒ Inter-regional
☐ Economic
☐ Environmental
☒ Operational/Technical</td></tr>
</table>

Why: Due that the obtained data of this analysis support decision making.		
When:	31 December 2019	**Status:** ☒ Valid / ☐ Superseded / ☐ Completed
Who:	☐ States ☐ ICAO ☒ Other:	Cuba, United States and COCESNA (Leader)

2.4 Presentation of Operational Concept (CONOPS)

2.4.1 As part of the Surveillance Task Force activities, an Ad Hoc Group reviewed the existing regional Concept of Operations (CONOPS), document created in approximately 2015. The Ad Hoc Group consisted of representatives from Cuba, Dominican Republic, United States and COCESNA.

2.4.2 Under WP13, United States as leader of the Ad Hoc Group, part of the NAM/CAR Surveillance Task Force, presented the latest version of the document *CONCEPT OF OPERATIONS (CONOPS).*

2.4.3 The document was reviewed and updated according with the needs and lesson learned in the region. In that sense the last version (both languages) is presented under **Appendix D.** Due to the aforementioned, the Meeting adopted the following Decision:

DECISION ADS-B/OUT/M/03	**REGIONAL NAM/CAR OPERATIONAL CONCEPT OF ADS-B IMPLEMENTATION**	
What: That, due that the updating of the document CONCEPT OF OPERATIONS (CONOPS) required a revision and update process aligned with the regional needs and that it was reviewed and updated with the provided comments from the States and Industry. The document was approved by the Meeting and it is recommended that the ICAO NACC Regional Office distribute the final version of the document to the NAM/CAR States, Brazil and French Guyana, due to the fact that this SAM States participated in the last revision of the document, and to the ANI/WG members.		**Expected impact:** ☐ Political / Global ☒ Inter-regional ☐ Economic ☐ Environmental ☒ Operational/Technical
Why: It is important that the States know and integrate to their processes the ADS-B implementation the information of this document.		
When:	Immediately	**Status:** ☒ Valid / ☐ Superseded / ☒ Completed
Who:	☐ States ☒ ICAO ☐ Other:	ICAO NACC Regional Office

Agenda Item 3 Surveillance Coverage (100%) for PBN Implementation

3.3 **Discuss new requirements**

3.3.1 Under P/03, the Secretariat presented an overview on optimal surveillance requirements for performance-based navigation (PBN) implementation. The presentation indicated the benefits of ATS surveillance to the ATS procedures, taking into account that surveillance data helps boosting safety, supports the enhancement of situational awareness and the objective to increase capacity and reduce workload.

3.3.2 One of ICAO´s implementation priority is to suppor many PBN advanced functions and options are being developed which will increase PBN use in challenging environments, allowing safer access to more airports and improved route efficiencies. Also the implementation of PBN in terminal airspace is seen as a key enabler for the advanced terminal operations, providing a mature programme for the Air Traffic Management (ATM) modernization.

3.3.3 The optimal surveillance capabilities for PBN provide:

1. While the PBN mainly addresses performance requirements for aircraft navigating on an ATS route, on a terminal or on an approach procedure, ATS surveillance is an enabler for full PBN potential.
2. The complexity of determining route spacing and minima separation is affected by the availability of a radar surveillance service and the type of communications used. If an ATS surveillance service is available, this means that the risk can be mitigated by including requirements for ATC intervention.
3. The availability of communications between the aircraft and ATS provider may impact the level of air traffic intervention capability needed for safe operations. In an ATS surveillance environment, one aircraft with a failure of navigation capability could normally be handled by ATC. Where there is no ATS surveillance, it is necessary to successfully consider two situations: 1) the complete failure of the RNAV system; and 2) the potential that an aircraft's navigation system has an unreported position error. In either case, mitigations will need to be identified and incorporated into the operating procedures in order to implement the navigation application.
4. The availability of ATS surveillance along the route is a major element in determining whether the desired route spacing for the implementation of the planned navigation.
5. Increased information from ATS surveillance system significantly reduces controller-pilot data link communication (CPDLC).
6. Enhanced separation minima can be applied while under ATS surveillance.

7. Traffic management increased capacity to allow multiple sequential operations.

3.3.4 Under WP/10, IATA provided an overview on the fleets equipped with Mode S extended squitter transponders in the region. This information was provided for the States and ICAO NACC Regional Office to be considered in the planning phase for the operational implementation of the ADS-B OUT, in addition to the information provided during the last ANI/WG/5.

3.3.5 For IATA to include other local carriers, general aviation or States aircrafts, provides the following link for each of the States was provided to be forwarded to their internal operators:

https://docs.google.com/forms/d/e/1FAIpQLSdqIUDhD8rfufXrDpIv_5T8wt-ryGmW798HhCTIxTUZ-Y9AWA/viewform

3.3.6 The following table summarizes the current aircraft ADS-B equipage situation, compared with other technologies for regional analysis.

	Central America	Curacao	Havana	Kingston	Mazatlan Oceanic	Mexico	Nassau	Piarco	Port Au Prince	Santo Domingo	AVR
ADS-B OUT DO-260B	39%	64%	57%	35%	56%	34%	36%	44%	48%	39%	45%
ADS-B OUT DO-260A	29%	34%	30%	23%	64%	24%	24%	14%	34%	27%	30%
ADS-B OUT DO-260	69%	98%	82%	60%	100%	58%	67%	88%	85%	75%	78%
Mode S EHS	38%	39%	53%	43%	38%	44%	31%	30%	47%	34%	40%
Mode S ELS	35%	34%	46%	40%	36%	39%	34%	24%	51%	37%	38%
Mode S	90%	65%	79%	84%	69%	88%	81%	60%	77%	84%	78%

3.4 ***Implementation of new surveillance Systems***

3.4.1 Under P/01 Leonardo provided information about its recent activities related to implementation of ADS-B in the world, and updates on implementation in the Caribbean area (Barbados).

3.4.2 The ADS-B/WAM/MLAT system of Leonardo is a well consolidate product, already presented to the community in Mexico City in November 2018.

3.4.3 For this reason, the focus of the presentation was more on the ATM system, its evolution according to Aviation System Block Upgrades (ASBU), and the impact of the integration of ADS-B data.

3.4.4 The next step to be done in this field was represented by the introduction of space based ADS-B, because it can provide ADS-B coverage in areas where other surveillance systems cannot be installed.

3.4.5 Leonardo signed a Memorandum of Understanding (MoU) with Aireon in September 2018, and demonstrated the integration of space based ADS-B in its system at the World ATM Congress in Madrid in March.

3.4.6 Potential future improvements enabled by the integration of space based ADS-B were included in the presentation.

3.4.7 Aireon fully agreed with the information provided in the presentation, and hoped the co-operation between industries.

3.4.8 After the presentation, COCESNA indicated that it considers convenient the involvement of the industry in a more efficient way on the development and operation of the projects, with the aim that the system and equipment providers be part of the successful implementation of the systems, and therefore recommended that the industry be an essential part of the operation of the system and of the assessment and validations of all the system functionality. The involvement of the industry in data validation and of the system is necessary.

3.4.9 Leonardo answered that, concerning its LeadInSky system, the integration of additional surveillance sources is quite straightforward, if the surveillance sources provide data respecting international standards.

3.4.10 Leonardo also suggested to foresee in the activities of a project, a pre-operational phase with the purpose of using new data and validate them, analysing received and processed data with specific tools, and eventually use flight tests in order to improve confidence in the data provided to the final User.

3.4.11 As a general conclusion, collaboration between the industry, ANSP and ICAO would mitigate the risk of implementation problems. Furthermore, an effort should be done in order to better define the real operational needs of each State, in order to guarantee that the implemented system really meets those needs. ICAO could play a fundamental role in this field.

3.4.12 Under P/02 INDRA presented the relationship between the surveillance aspects of the ICAO GANP ASBU and the consequences in the EUROPEAN framework, in particular in the ECTRL roadmap, leading the development of new functionalities under the approach of SESAR2020 activities and the implementation of such new functionalities by Indra in its own systems.

3.4.13 P/02 addressed improvements in different ADS-B related areas, such as:

- Composite surveillance
- Secured ADS-B
- Phase modulation
- Surveillance performance monitoring
- Multi sensor surveillance for airports
- Space based ADSB data integration

Agenda Item 4 Satellite ADS-B Implementation

4.1 Under IP/03, Brazil presented information about the Brazilian initiative to sign a cooperation agreement with AIREON LLC for the technical and operational evaluation of the collected and transmitted surveillance ADS-B data through satellite.

4.2 DECEA's strategic program for the evolution of Brazilian air traffic management, SIRIUS BRAZIL, aligned with the recommendations contained in Doc 9750 and aligned with the ASBU, considers the implementation of ADS-B in some of its projects to meet the operational demands, while contributing to the evolution of the future ATM concepts.

4.3 The evaluation of the technical and operational performance of ADS-B surveillance based on the AIREON solution applied to the DECEA airspace will consist of two phases: Phase - 1 - Tracking of Specific Aircraft and Phase - 2 – Real Time Tracking.

4.4 Brazil will continue with the implementation process according to the indicated phases and will monitor the measurement of the operational benefits obtained from this implementation.

4.5 Under IP/05 AIREON was informed that the space-based ADS-B service is operational since March 2019.

4.6 AIREON was officially approved on 4 June 2019 by the European Union Aviation Safety Agency (EASA) as an ANSP Organization that provides ATM/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.

4.7 This is a unique situation, where an organization with no airspace responsibility is granted such a certification and is a major milestone that validates the world’s first set of global real-time air traffic data.

4.8 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 is guaranteed by AIREON:

- Availability of ≥ 99.9%
- Latency ≤ 1.5s
- Update Interval of 8 seconds

4.9 NAV CANADA and United Kingdom 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. 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.

4.10 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.

4.11 AIREON continues to work collaboratively with other industry partners such as automation platform providers and aircraft manufacturers and others.

4.12 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.

4.13 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.

4.14 Testing was done on the performance of the space-based ADS-B signal at DC-ANSP, using the MEVA network for the time period of 6 July 6-6 August 2019. The surveillance performance parameters are met successfully, which shows that the MEVA regional network can be efficiently used as a backup line to connect an ANSP's Service Delivery Point and receive the space-based ADS-B signal for surveillance purposes.

4.15 AIREON concluded that:

- Space-based ADS-B is operational
- Nav Canada and NATS from United Kingdom are already using the system in the North Altantic oceanic airspace with reduced separation minima of 14 NM and 17 NM
- Nav Canada is also using the system at the Edmonton FIR on continental airspace
- Space-based ADS-B is EASA certified in the oceanic environment. En-route and terminal certifications are expected by September 2019
- The system has achieved excellent ATS surveillance performance parameters in the LATAM/CAR region
- Eight additional ANSPs will be operational by the end of 2019 and start using space-based ADS-B as a surveillance system
- The use of regional networks is a cost-effective and collaborative way to implement the signal. Results from the MEVA implementation in Curacao show accepted levels of performance for ATS surveillance (ED-129B)

4.16 Under IP/02, United States, presented an overview of the FAA's planned Operational Evaluation of Space-Based ADS-B (SBA) in the Caribbean. The operational Evaluation will occur over a one (1) year period beginning in March 2020 in order to assess impact to air traffic operations, SBA technical system performance, and operational benefits from use of SBA within the target airspace.

4.17 The United States informed the group of the planned trial that will take place to determine the feasibility of using SBA over Caribbean airspace. The use of SBA will allow for redundancy in the event the radar data from the Turks and Caicos Islands were to become unavailable.

4.18 The meeting noted the importance of the trial to validate the ability of the system to meet the United States operational requirements.

Agenda Item 5 Other Business

5.1 Under WP/15, IATA provided an overview of the different procedures, methodologies and standards used across the Americas, when implementing or applying the same technology or procedure.

5.2 IATA explained that during the last years, the different CNS and ATM implementations in the region have taken different directions, according to the traffic demand, operational needs, ANSP/State budget availability, strategies, among others. These differences have created an environment that differs from the seamless and interoperable goals described in the ICAO provisions increasing the complexity when operators plan their flights across airspaces/FIRs.

5.3 These differences apply items like legislation, aeronautical publication, operations and applicability.

5.4 Also, IATA indicated that other CNS/ATM implementation exist with different applicability in the region, for example:

1. CAO Avionics mandates (TCAS 7.1, TCAS X, ULB, etc.)
2. Radar separation (3NM, 5NM, 8NM, 10NM, 20NM) – for the same conditions
3. Procedural separation (10NM, 20NM, 40NM, 80NM/10MIN) – for the same
4. FPLs processes – for the same conditions and equipment
5. ATFM (Slots APTO vs Slots ATC – capacity estimations – TMIs, etc.) – for similar
6. AIDC (interoperable?)
7. ICAO phraseology
8. OPS approval for PBN
9. Coordinated action plans between regulators and Air Navigation Services Providers.
10. BADA or A/C performance database updates (performance or type of A/C)
11. Coordinated neighboring waypoint changes (FPLs errors in ATM system)
12. Others

5.5 IATA indicated that before any CNS enhancement in the region, there should be at least:

1. Harmonization or regulations in the region to address the different performance based requirements (Ex. standard publication and requirements for DO-260B or to use a separation minimum under the same conditions).

2. Harmonized ANSP agreements on performance on how to use any technology under the same conditions (Ex. Where coverage VHF + ADS-B = radar like separation).

5.6 Under WP/08, the Secretariat introduced the new version of Doc 9750 Global Air Navigation Plan that is expected to be approved in the 40th ICAO Assembly to be held in ICAO Headquarters from 24 September 2019 to 4 October 2019. Important information was provided about GANP documentation:

1. The Basic Building Blocks (BBB) were also introduced, which describe the base of any robust air navigation system, identify essential services that must provide each State in air navigation services, airport services, air traffic management, search and rescue, meteorology and information management, and CNS aeronautic infrastructure assets.

2. GANP Sixth Edition has a multilayer structure that comprehends two global levels; global (global strategic planning) and technical (ASBU), as well as the regional (Regional Air Navigation Plan) and national (National Air Navigation Plan).

3. ASBU pillars are classified in three groups: Operative, Information and Technological.

4. The ICAO six-step method is established. Steps 1 and 2 help to know the system, its strengths, weaknesses, opportunities and threats, as well as how it functions, acting to establish objectives. Based on these objectives, they can be established in step 3 and 4, and potential solutions can be identified to achieve objectives on weaknesses and threats of the system.

5. In the framework of the GANP performance, a list of Key Performance Indicators (KPI) linked with relevant objectives of the performance objectives catalogue is provided to establish objectives through the quantification of objectives.

5.7 The GANP also provides information about responsibilities of the different stakeholder, GANP integration with the Global Air Safety Plan (GASP) and other documents.

5.8 The Secretariat also explained about the process to update the Surveillance Task Force activities as a result of the ANI/WG/04 and NACC/DCA/9 meetings, where the new structure of the ANI/WG Task Force was approved to achieve the following three regional objectives and how surveillance data support them.

1. Efficiency/capacity: Operational longitudinal separation reduction in the region.
2. Predictability/efficiency: standardization of the aeronautical message information (AIM/SWIM).
3. Environment: CO2 emission reduction.

5.9 In that sense, the Meeting agreed to integrate to the Surveillance Task Force activities for September 2019 to August 2020, the following ones:

1. Development of a document that includes the considerations and requirements to achieve harmonized implementation of the TCAS Version 7.1 and to achieve the operational and safety benefits of its implementation.

2. Coordinate the collection of the management capacity information of the safety alarms of the different ATM systems and make the necessary recommendations to the States that are going to upgrade or buy new ATM systems.

3. Coordinate with the States that have not yet delivered their surveillance infrastructure its prompt delivery and establish mechanisms that ensure updated information.

4. Coordinate the assessment by the States of the raised surveillance requirements according to the BBB.

5. Once the new GANP version is approved, coordinate the analysis of the ASBU implementation, which is supported by the ADS-B or other surveillance system.

5.10 The Actions to achieve the activities are under the Surveillance Task Force Action Plan in **Appendix E.**

Agenda Item 6 Visit to NAV CANADA's facilities

6.1 On 23 August 2019 the participants of the Meeting had the opportunity to visit NAV CANADA facilities in Ottawa, Canada.

6.2 In this regard, NAV CANADA personnel exposed the satellite ADS-B implementation processes, ADS-C/CPDLC and its current use in the Canadian FIRs.

6.3 The participants carried out an operations simulation, involving management and the operation of the systems.

6.4 During the presentation of the ADS-B implementation, NAV CANADA explained and provided the coverage ADS-B areas, the satellite ADS-B implementation process, and the surveillance coverage increment through time.

6.5 Due to meteorological conditions in the Canada FIR and because of the difficulties in the installation of the equipment to provide the require maintenance, satellite ADS-B implementation satisfied the surveillance coverage needs in the North of Canada.

6.6 As part of the surveillance data and other information processing, NAV CANADA presented the FUSION system, which consists of an integrated data network that provides information to feed the air traffic control systems of NAV CANADA and other systems of external user.


NAVCANatm

APPENDIX A
EXECUTIVE LIST OF DECISIONS

Number	Draft Decision	Responsible for action	Deadline
ADS-B/OUT/M/01	NAM/CAR ADS-B Implementation planning		
	The Surveillance Task Force will coordinate with the States that have not submitted their ADS-B implementation plan to the ICAO NACC Regional Office before 31 October 31 2019, which must include:		
	a) Installed or foreseen installation date of ADS-B or MLAT receptors;	STF/States	31 October 2019
	b) Percentage of current coverage or to be covered in the future with ADS-B in the FIR, according with national operational requirements;	STF/States	31 October 2019
	c) Percentage of registered aircraft with implemented ADS-B, y	STF/States	31 October 2019
	d) Possible date for this to be operational	STF/States	31 October 2019
ADS-B/OUT/M/02	Establish a criteria to develop an ADS-B Statistical analysis		
	Is necessary monitoring permanently and periodically ground based ADS-B systems, avionics and the performance level of the provided data in an automated way to assure safety and that the ADS-B implementation complies with established requirements for the diverse airspaces. Hence, the Meeting considers advisable:		
	1. To establish minimum criteria to carry out ADS-B statistical analysis, which include technical and operative criteria.	STF/States	31 December 2019
	2. To establish ADS-B performance levels to filter data based on the different parameters to be measured.	STF/States	31 December 2019
	3. To establish the parameters to be measured.	STF/States	31 December 2019
	4. To develop a common interpretation language of the criteria and the results of the ADS-B statistical analysis.	STF/States	31 December 2019
	5. That is necessary to analyse data due the mandatory ADS-B implementation in the United States.	STF/States	31 December 2019

Number	Draft Decision	Responsible for action	Deadline
	6. To include the items listed above within the tasks of the surveillance Task Force.	States	31 December 2019
ADS-B/OUT/M/03	Regional NAM/CAR Operational Concept of ADS-B implementation		
	Due that the updating of the document CONCEPT OF OPERATIONS (CONOPS) required a revision and update process aligned with the regional needs and that it was reviewed and updated with the provided comments of States and Industry, the document was approved by the Meeting and it is recommended that the ICAO NACC Regional Office distribute the final version of the document to the NAM/CAR States and Brazil, due that this SAM State participated in this process.	ICAO	Immediately

APÉNDICE B

ADS-B IMPLEMENTATION COMPLIANCE STATUS /ESTADO DE CUMPLIMIENTO DE LA IMPLEMENTACIÓN DE ADS-B

No.	State/Estado	Installed ADS-B receivers that meet the technical requirements approved regional /Receptores ADS-B Instalados que cumplen con los requerimientos técnicos regionales aprobados	Representation automated radar system ready to use ADS-B data/Sistema automatizado de representacion radar listo para usar datos ADS-B	% Coverage of ADS-B FIR installed /% de cobertura ADS-B de la FIR instalada	ADS-B deployed operationally /ADS-B implementado operacionalmente	Date to begin the ADS-B implementation/Fecha para comenzar la implementación de ADS-B	Percentage of aircraft registered with ADS-B deployed/Porccentaje de aeronaves matriculadas con ADS-B implementado	Systems planned Multilateración (P) or implemented (I)/ Sistemas de Multilateracion Planeado (P) o implementado (I)	REMARKS/OBSERVACIONES
1.	Antigua and Barbuda	0	N		N	TBD			
2.	Aruba	0	N		N	TBD			
3.	Bahamas	0	N		N	TBD			
4.	Barbados	4	Y		N	TBD		P	Planned 7 MLAT stations
5.	Belize	1	Y		N	2019	~70%	N	
6.	Canada	Y (15)	Y	10% via terrestrial sites, 100% via space based SVA	Y	2009	~90% in areas where service is available	I	ADS-B operational FL290 and above since 2009. MLAT operational since 2009. Space-based ADS-B Operations implemented March 2019.
7.	Costa Rica	4 (2016)	N		N	2019	~70%	N	
8.	Cuba	6 (2010)	N	100%	N	2020	~83%	P	ADS-B Operational planned for 2020

No.	State/Estado	Installed ADS-B receivers that meet the technical requirements approved regional /Receptores ADS-B Instalados que cumplen con los requerimientos técnicos regionales aprobados	Representation automated radar system ready to use ADS-B data/Sistema automatizado de representacion radar listo para usar datos ADS-B	% Coverage of ADS-B FIR installed /% de cobertura ADS-B de la FIR instalada	ADS-B deployed operationally /ADS-B implementado operacionalmente	Date to begin the ADS-B implementation/Fecha para comenzar la implementación de ADS-B	Percentage of aircraft registered with ADS-B deployed/Porccentaje de aeronaves matriculadas con ADS-B implementado	Systems planned Multilateración (P) or implemented (I)/ Sistemas de Multilateracion Planeado (P) o implementado (I)	REMARKS/OBSERVACIONES
9.	Curacao	1(Note5)	Y(Note 6)	100%	Y	Q3-2019	~65 % (based on filed flight plans)	I	Space-based ADS-B Operations planned for Q3-2019
10.	Dominican Republic	0	Y	0	N	2020		P	Planea utilización del ADS-B Satelital en 2020
11.	El Salvador	N	Y		N				
12.	Grenada	0	N		N	TBD			
13.	Guatemala	2	Y		N	2019	~70%	Y (2020)	
14.	Haiti	0	N		N	TBD			
15.	Honduras	3	Y		N	TBD	~70%	3	
16.	Jamaica	0	N		N	TBD			Not planned
17.	Mexico	10	Y			2017		I	
18.	Nicaragua	2	Y		N	2019	~70%	2	
19.	Panamá	2	Y		Y	2017		I	
20.	Saint Kitts and Nevis	0	N		N	TBD			

No.	State/Estado	Installed ADS-B receivers that meet the technical requirements approved regional /Receptores ADS-B Instalados que cumplen con los requerimientos técnicos regionales aprobados	Representation automated radar system ready to use ADS-B data/Sistema automatizado de representacion radar listo para usar datos ADS-B	% Coverage of ADS-B FIR installed /% de cobertura ADS-B de la FIR instalada	ADS-B deployed operationally /ADS-B implementado operacionalmente	Date to begin the ADS-B implementation/Fecha para comenzar la implementación de ADS-B	Percentage of aircraft registered with ADS-B deployed/Porccentaje de aeronaves matriculadas con ADS-B implementado	Systems planned Multilateración (P) or implemented (I)/ Sistemas de Multilateracion Planeado (P) o implementado (I)	REMARKS/OBSERVACIONES
21.	Saint Lucia	0	N		N	TBD			
22.	Saint Vincent and the Grenadines	0	N		N	TBD			
23.	Trinidad and Tobago	0	Y	0%(note4)	N	TBD	60%	P	A full deployment of ADS-B/WAM in the continental airspace of the Piarco FIR is planned for Q4 2020
24.	United States	Over 600	Y	100% (note 3)	Y	Y	As of 1-Jul-2019, over 70% of U.S. air carrier fleet is equipped with ADS-B Version 2	P/I	ADS-B operational. Wide-Area MLAT (WAM) operational in some route locations and two terminal locations. Additional terminal WAM locations are planned.

Note 3 – this coverage percentage is applicable to all US "domestic" FIR airspace and US-managed airspace in the Gulf of Mexico – it does not include all US-managed oceanic FIR airspace

Note 4 - 1 Single installation supplied with ATM system and not operationalized.

Note5: Space-based ADS-B throws MEVA from AIREON host

APPENDIX C

STATUS OF THE DECISIONS AND CONCLUSIONS

ITEM	TASK	DELIVERABLE	STARTING DATE	ENDING DATE	STATUS
1	ADS - B trials in States that have not yet carried them out	Resulting statistics of the trials	30/10/14	31/12/19	Information update from States is expected on August 2019
2	ADS-B trial statistics collection	Trial statistics	30/10/13	31/12/19	Information update from States is expected on August 2019
3	CONOPS review and updating	CONOPS	26/11/18	31/01/19	Finalized
4	Feasibility study on the use of satellite ADS-B	Feasibility study on the use of satellite ADS-B	30/11/2018	30/04/2019	Information update from States is expected on August 2019
	Support the implementation of surveillance data sharing	Summary table of the implementation status	26/5/17	31/12/20	60% implemented at CAR level
6	Developing of a guide for the planning of acquisition of surveillance systems	Guide for the planning of surveillance systems	29/11/18	31/01/19	Still pending
7	Start the process of implementation of the new surveillance systems (ADS-B, ADS-C, CPDLC, MLAT and WAM)	Implementation Regional Plan	30/09/20	30/09/23	Still pending
8	Notify the implementation plans.	States Progress table updating	29/5/17	29/5/19	Information update from States is expected on August 2019
	Report the progress of the implementations	States Progress table updating	31/7/17	29/5/19	Information update from States is expected on August 2019

ITEM	TASK	DELIVERABLE	STARTING DATE	ENDING DATE	STATUS
10	Required national regulations for the implementation of the new surveillance systems.	States Progress table updating	29/11/18	31/12/19	Information update from States is expected on August 2019
11	Achieve 100% of the surveillance coverage required by the PBN in each FIR.	AIP publication	26/5/17	31/12/20	Information update from States is expected on August 2019
12	ADS-B Implementation Guide development	ADS-B Implementation Guide	26/11/2018	28/02/2019	Still pending

APPENDIX D

ICAO UNITING AVIATION
A UNITED NATIONS SPECIALIZED AGENCY

North American, Central American and Caribbean (NACC) Office

THE AUTOMATIC DEPENDENT SURVEILLANCE – BROADCAST (ADS-B) CONCEPT OF OPERATIONS (CONOPS)

Development by Surveillance ICAO Task Force

Mexico City, 28 April 2015
Revised on August 2019

Table of Contents

1. INTRODUCTION

The ICAO Global Air Navigation Plan (GANP) has recognized ADS-B out (and MLAT) as transformational capabilities under the Surveillance Systems Block Module B0.

On the Surface, ADS-B information is used when available as an element of an A-SMGCS to provide traffic situational awareness to the controller in the form of surveillance information. The availability of the data is dependent on the level of aircraft and vehicle equipage.
The GANP recognizes three (3) key developments in the Block 0 period:

I. A significant deployment of cooperative surveillance systems including ADS-B (ground- and space-based).

II. Ground processing systems will become increasingly sophisticated, as they will need to fuse data from various sources and make increasing use of the data available from aircraft.

III. In addition to the provision of ATS Surveillance, surveillance data from various sources along with aircraft data will be used to provide basic safety net functions and for non-separation purposes.

This concept of operations considers the use of Automatic Dependent Surveillance - Broadcast (ADS-B) data from aircraft to expand surveillance coverage into remote and oceanic areas, to augment current cooperative surveillance coverage, or to replace existing cooperative surveillance assets. Currently, some Air Traffic Service (ATS) providers depend upon ground-based infrastructure to receive ADS-B data from aircraft. Others are using low orbiting satellites to receive and relay ADS-B data from aircraft.

The CAR Region is working on using ADS-B data from aircraft to offer Air Traffic services in its various Flight Information Regions (FIRs). The supporting safety analyses, ATM Integration, testing and monitoring for these implementations provides the foundation for expansion of ATS surveillance services based on ADS-B. In this manner, the CAR Region also strives to promote regional harmonization and the sharing of best practices.

Besides the safety benefits of introducing ATS Surveillance for use by Air Traffic Controllers in areas currently using Procedural Separation, ATM system integration can deliver tangible ground-based safety net functions by using downlinked aircraft parameters. Deployment of ATS Surveillance enables enhancement of airspace capacity through safe reductions of horizontal separation between aircraft implemented with an appropriate communication infrastructure. Operators also benefit from the ability to file routings that closely resemble their user preferences (UPRs) and gain tactical benefits from efficient 'shortcuts' and being granted optimum flight levels and speeds.

1.1 Document Overview

The purpose of this document is to facilitate coordination between stakeholders who will be involved in, or affected by, the implementation of services using ADS-B. This concept of operations was developed to assist ICAO CAR region States considering the use of ADS-B as part of an ATS Surveillance System as defined in ICAO's Procedures for Air Navigation Services - Air Traffic Management (PANS-ATM, Doc 4444). Individual CAR region States may develop complementary implementation documents as needed to reflect their unique operating environments.

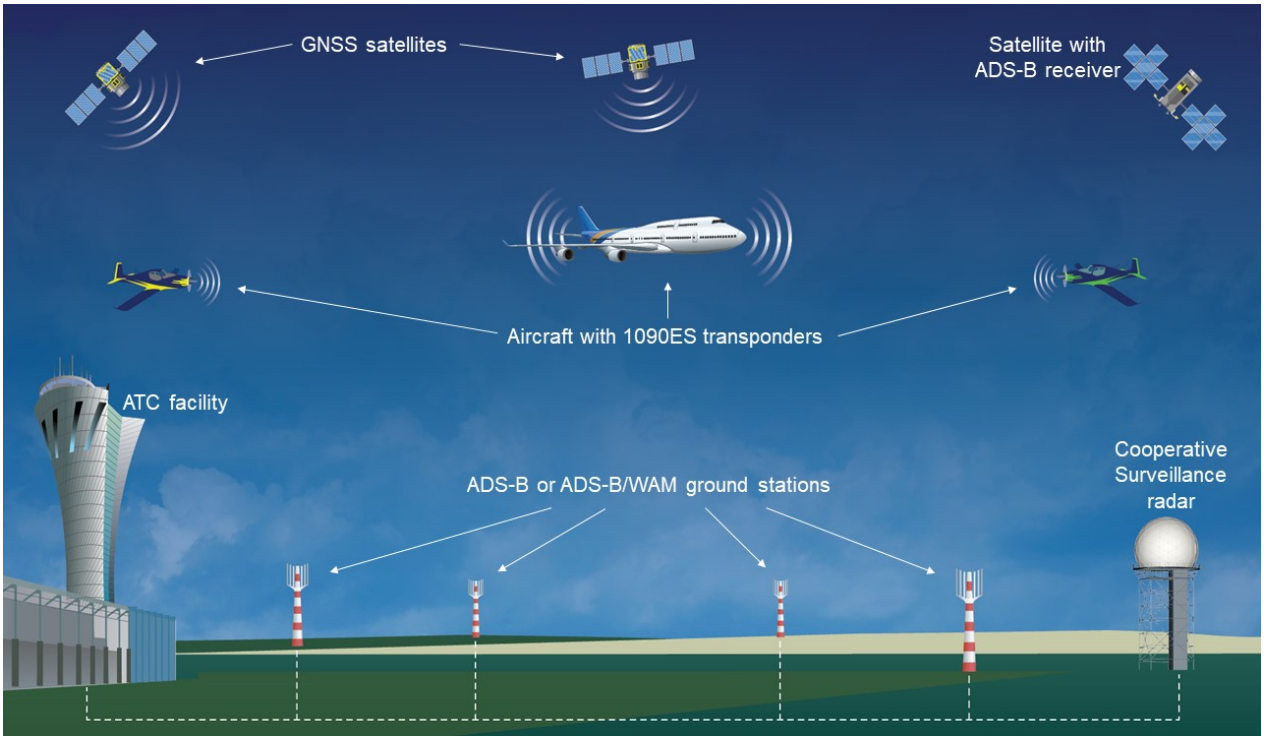
As developments occur, this Concept of Operations may need to be updated.

1.2 Operational use

The operational use of ADS-B can be realized in five areas:

a. Enroute – Terrestrial, Remote, and Oceanic Areas
b. Terminal
c. Surface/Airports
d. Search and Rescue
e. Aircraft Tracking

1.3 System Overview



1.4 References:

[1] APANPIRG ADS-B Study, Manual on Airspace Planning Methodology for the Determination of Separation Minima (Doc 9689), Second Edition, 2017
[2] ICAO Document 9854 “Global Air Traffic Management Operational Concept:” First Edition 2005
[3] DOC 9689, “Manual on Airspace Planning Methodology for the Determination of Separation Minima
[4] DOC 4444, “Procedures for Air Navigation Services, Air Traffic Management”, ICAO, Tenth six edition 2016
[5] Annex 2 to the Convention on International Civil Aviation, “Rules of the Air”, ICAO, July 2005
[6] Annex 4 to the Convention on International Civil Aviation, “Aeronautical Charts”, ICAO, July 2009.
[7] Annex 11 to the Convention on International Civil Aviation, “Air traffic Services”, ICAO, Fourteenth Edition, July 2016.
[8] Annex 15 to the Convention on International Civil Aviation, “Aeronautical Information Services”, ICAO, Fifteenth Edition, July 2016
[9] ICAO Cir 326, “Assessment of ADS-B and Multilateration Surveillance to Support Air Traffic Services and Guidelines for Implementation”, ICAO, 2012
[10] ICAO Doc 9750, Global Air Navigation Plan, Revision - Latest

2. OPERATIONAL NEED:

The use of ADS-B technology is needed to ensure the provision of ATS Surveillance services and thereby optimizing the use of airspace. Improved availability, integrity, and accuracy of flight tracking data with reduced latency should result in reduced separation minima. In addition, the reduction of separation minima may provide flight time reductions to passengers, lowers fuel savings, and reduces CO2 emissions.

2.1. Current Environment

A variety of surveillance equipment is used within the region (e.g. PSR, SSR, MLAT). Both Procedural Separation Standards and Cooperative Surveillance Radar standards are used within the region. There are currently large airspace volumes where Controllers are unable to “see” their traffic. Due to this basic inability of the ATS system to track aircraft, controllers rely instead on pilots to relay their current and next aircraft position. This is done either using Voice or by datalink (CPDLC or ADS-C). This method of Air Traffic Control relies entirely on pilots adhering to this established procedure- hence classified as Procedural Control.

3. SYSTEM JUSTIFICATION

3.1. Description of Desired Change

ADS-B Out uses global navigation satellite system technology to determine specific aircraft position and velocity information, which is then broadcast directly to other suitably equipped aircraft and air traffic controllers. This capability allows ATS systems to display and monitor the more frequent position update rates than radar. The improved accuracy of ADS-B means air traffic controllers might be able to safely reduce the mandatory separation between aircraft. ADS-B Out also provides greater surveillance coverage, since ADS-B receiver stations are much easier to place than radars.

To use ADS-B surveillance information (airborne and airport surface) for air traffic control operations (including improved automation system safety functions and traffic flow management), or for other services including situational awareness or search and rescue.

Other authorized facilities (ramp control, airline operations center, etc.) may use ADS-B surveillance information to track flight activities and optimize operations. ADS-B provides more information at a faster update rate and with improved accuracy as compared with existing SSR systems. This enables service providers and users to achieve improvements in safety, capacity, and efficiency. Additionally, ADS-B data is inherently easier to share among adjoining States as the data broadcast from the aircraft is in the longitude and latitude coordinate system.

3.2. Potential Benefit of new or Modified System

The following ADS-B surveillance capabilities will contribute to improved safety, capacity and efficiency:

Safety

- Provides aircraft-to-aircraft traffic surveillance capability
- Provides ATC and pilots (in the cockpit) with airport surface traffic surveillance
- Provides surveillance in areas currently not served by ground-based surveillance systems
- Improves or supplements existing ground-based surveillance information
- Improves ATC automation performance and safety features (e.g., target accuracy, alerting functions)

Capacity

- Enables the use of radar-like separation procedures in remote or non-radar areas
- Supports a common separation standard in select domains and airspace classifications
- Supports a potential reduction in existing separation standards in all domains and airspace classifications
- Supports increased airspace capacity through select user-executed airborne spacing and operations

Efficiency

- Provides a lifecycle cost reduction relative to cooperative surveillance radars
- Provides new information, allowing for enhanced sector & airport-derived predictions
- Provides improved information for traffic flow management, collaborative decision making, fleet management, and management by trajectory functions
- Provides a rapidly deployable, mobile surveillance sensor for contingency operations
- Provides precision surveillance and flight parameter information for unique operating areas

4. OPERATIONAL DESCRIPTION:

ADS-B is a surveillance tool in which, like radar, aircraft transmit identity and altitude information to the ATS unit. The position (and quality of this position), as determined by the aircraft sensors, is also broadcast, along with track vector information. Like a Mode S transponder, certain alert conditions are broadcast when selected by the flight crew. ADS-B messages are transmitted at regular intervals and any receiver may receive and process the data.

Some of the information transmitted by the aircraft can also be derived from radar data (speed, position and vertical rate) however, since ADS-B relies on high quality reports, under nominal conditions, it is more accurate than radar.
ADS-B is implemented in a Mode S transponder and uses the aeronautical protected frequency of 1090 MHz.

4.1 Surveillance

ATC will use ADS-B surveillance information in the same manner as current cooperative surveillance system information is used, for example, to assist aircraft with navigation, to separate aircraft, and to issue safety alerts and traffic advisories. ADS-B surveillance may be used to replace radar-based surveillance or to enhance the quality of existing radar-based surveillance information for ATC automation system functions, for example, aircraft tracking, Minimum Safe Altitude Warnings (MSAW), Conflict Alert, and Mode-C Intruder Alert. The possible implementation areas include surface, terminal, en-route, offshore, and oceanic domains. ADS-B surveillance will allow ATC to provide separation services between ADS-B-to-ADS-B, ADS-B-to-radar and fused (ADS-B/radar) targets. ADS-B can support a reduction in separation minima in current non-radar environments.

4.2 ADS-B Applications

4.2.1 Surface/Airport

The primary ADS-B surface application is airport surface traffic situation awareness in support of surface movement guidance and control. Any increase in ground surveillance can serve to reduce the incidence of runway incursions.

4.2.2 Terminal airspace

The airspace immediately surrounding an aerodrome is considered the Terminal Management Area (TMA). This is where aircraft on approach (instrument and visual), aircraft departing and those operating in the vicinity of aerodromes are in close proximity to terrain. Since this is the area of initial climb and final descent, aircraft would be crossing the levels of other aircraft.

In TMAs where the terrain restricts Secondary Surveillance Radar (SSR), ADS-B can be used to provide surveillance. The deployment of several ADS-B antennae would be a cost effective way to provide surveillance where it would not be possible via single SSR. The cost difference between radar and ADS-B installation makes it feasible to install several ADS-B antennae to provide overlapping coverage.

In terminal airspace, when ADS-B equals or exceeds the accuracy of SSR (see ICAO Circular 326), the minimum established radar separation in PANS-ATM (Doc 4444) sections 6.7.3.2.4; 6.7.3.2.5; 6.7.3.4.2, 6.7.3.5.1, as well as Chapter 8 may be applied without any further safety assessment requirement.

ADS-B increases situational awareness in the cockpit and at the controller work position. Aircraft equipped with ADS-B IN will receive information about other ADS-B equipped aircraft in the vicinity based on their transmitted positions. Minor adjustments in speed and heading could be used to adjust spacing in the TMA where there is a high concentration of aircraft. For controllers, having an accurate picture of traffic in the TMA would result in heightened situational awareness and improvements in safety.

ADS-B surveillance can be used to reduce separation and an increase in terminal airspace capacity. An increase in airspace capacity can then allow for increases in flight schedule flexibility, increases in flight path efficiency and reductions in delays or flight disruptions.

ADS-B integration supports safety nets such as MSAW for aircraft flying close to terrain and reduce the occurrence of Controlled Flight Into Terrain (CFIT). In radar airspace, ADS-B would provide redundant surveillance to enhance safety.

4.2.3 Enroute airspace – Terrestrial, Remote, and Oceanic Areas

The rapid update of information received from aircraft through ADS-B would increase the situational awareness of the controller since it would allow for a more accurate depiction of the aircraft's current track on the controller work position. This would improve the prediction of trajectories, increasing the effectiveness of ATM system conflict detection.

The coverage range of an ADS-B receiver is line-of-sight and can be two hundred and fifty (250) nautical miles at high altitude. If sufficient ADS-B receiving stations are used, complete coverage can be achieved despite the presence of mountainous terrain or tall structures.

The data obtained from adjacent FIRs could be shared across borders as long as there are compatible data formats. Compatibility considerations for ADS-B data sharing include: availability of different data fields if different ADS-B version(s) are supported; interoperability of different ASTERIX CAT021 editions; and handling of ADS-B data received from different ground stations in regions where coverage overlaps.

In a procedural environment, it is difficult for a controller to know if an aircraft is in an abnormal situation. In many cases, this only becomes clear after position reports have been omitted or the pilot sent an emergency (or urgency) report. In a surveillance area however, emergency reports are received instantaneously. This allows controllers and emergency professionals to see the aircraft's flight path and accurately locate its last position. A situation that significantly increases the likelihood of a favorable outcome.

ADS-B can provide redundant coverage for areas already served by SSR.

In non-radar airspace, pilot and Air Traffic Controller workload could also be reduced through the implementation of ADS-B. Accurate position reporting in non-radar airspace can create a significant amount of workload for a pilot and Air Traffic Controller.

4.2.3.1 Upper airspace

The characteristics of an aircraft in the Upper Airspace would be level flying or change of cruising level by only one or a few thousand feet (Flight Levels). Lateral changes to a flight path would be due to weather deviations or to avoid separation violations where aircraft tracks cross each other.

In procedural (non-surveillance) upper airspace, ADS-B could provide surveillance coverage and reduce the required separation therein, to that defined by ICAO PANS-ATM (Doc 4444) 8.7.3 provided:

- Identification of ADS-B equipped aircraft is established and maintained;
- The accuracy and integrity measures of ABS-B messages are adequate to support the separation minima;
- There is no requirement for detection of aircraft not transmitting ADS-B; and
- There is no requirement for determination of aircraft position independent of the aircraft navigation system.

The surveillance provided by ADS-B can improve efficiency by facilitating more direct flight paths in the en-route phase of flight. More direct flight paths have a positive impact on fuel and greenhouse gas emissions.

4.2.3.2 Lower en-route airspace

A mix of aircraft types with varying performance characteristics characterizes the lower airspace. There are significant changes in altitude (several thousand feet) for some aircraft while others would be operating at their cruise levels. There is also a high concentration of aircraft arriving and departing airports.

The speed, rate of climb and descent and general maneuverability vary widely for aircraft in the lower airspace. Commercial aircraft, general aviation and military operators all share the lower airspace. Different classes of aircraft have different performance characteristics and ADS-B can increase situational awareness for controllers. This leads to safer operations, especially in areas of high traffic density.

For aircraft with ADS-B IN, improved situational awareness would also be extended to the cockpit.

In areas of low traffic density, where the volume of traffic does not justify the installation of a radar, ADS-B offers a cheaper way to monitor a variety of aircraft.

4.3 Proposed environment

In the short term, ADS-B will continue to support conventional ATC surveillance systems. Due to its high update rate and the accuracy of its position reports, ADS-B is as reliable as SSR systems, and through its use, the same separation minima could be applied for a particular airspace as if it were monitored with a conventional SSR system. By using both SSR and ADS-B together, the accuracy of composite tracks is improved. For aircraft with ADS-B IN, pilots have increased situational awareness.

Radars will continue to be surveillance sources until the existing systems reach the end of their life cycle, at which time they could be replaced by ADS-B. ADS-B systems could be installed in anticipation of certain radars becoming obsolete to give sufficient lead-time for their acceptance as radar replacement. The cost-to-benefit ratio and small footprint of ADS-B infrastructure is an enabling factor for early deployment.

Terrestrial ADS-B coverage can vary depending on altitude and terrain. A range of two hundred and fifty (250) Nautical Miles is possible at high altitudes. This range is reduced at lower altitudes and in mountainous terrain. Existing modeling tools can determine the expected coverage based on these factors and should be considered when deciding where to place a ground-based antennae. The availability of additional infrastructure such as power, communications and security should also be considered when choosing a site. As space-based ADS-B develops and is proven to be as effective as terrestrial installations, these factors may be less restrictive.

5. SYSTEM DESCRIPTION:

5.1. Surveillance Services System

The Surveillance Services system's functions (Aircraft/Vehicle, Data Link Processor, Broadcast Server, ATC Automation, and Traffic Flow Management Automation) provide the ADS-B services that support ADS-B applications. The ADS-B surveillance service is supported by Aircraft/Vehicle, Data Link Processor, and ATC Automation functions.

5.2 Functional Description

The purpose of each function of the Surveillance Services System, how they interoperate with each other, and how the Surveillance Services System fits into the Region are described below.

5.2.1 Aircraft/Vehicle

The Aircraft/Vehicle is the source of ADS-B information. The Aircraft/Vehicle gathers information including position data from a GNSS or other navigation source, crew input, barometric altitude, vertical speed and aircraft identification data. The Aircraft/Vehicle processes the gathered information and determines the associated integrity and accuracy indicators. The Aircraft/Vehicle encodes and broadcasts all the information in an ADS-B message. The ADS-B system will monitor information broadcast by the aircraft avionics package. The quality of the data will be evaluated to ensure aircraft compliance with the mandated performance measurements and standards. If equipped with ADS-B IN, the Aircraft/Vehicle receives and decodes ADS-B messages transmitted by other Aircraft/Vehicles. The Aircraft/Vehicle may display ADS-B on a Cockpit Display of Traffic Information (CDTI).

5.2.2 Data Link Processor

The Data Link Processor receives ADS-B Messages broadcast by Aircraft/Vehicles over the 1090Extended Squitter (1090ES) data link, formats them into ADS-B reports, and sends the reports to an ATC automation system. The Data Link Processor generates status reports, containing information on alarms and events in the Data link Processor subsystems and sends them to the ATC automation system. The Data Link Processor will also generate internal test target messages and send the resulting ADS-B reports to the ATC automation system.

5.2.3 ATC Automation

ATC automation (systems) receives ADS-B reports and status reports from the Data Link Processor. ATC automation receives ADS-B reports in both an ADS-B-only environment as well as mixed surveillance (e.g., radar, ADS-B, and Wide Area Multilateration, WAM) environments. ATC automation performs MSAW and CA processing using the ADS-B data (and radar/WAM data if in a mixed surveillance environment). In mixed surveillance environments, radar/WAM data may be used to "validate" ADS-B data to mitigate ADS-B "spoofing" risk. ATC automation may be able to improve tracking and safety feature functions using the high accuracy and greater update rate of ADS-B reports. ADS-B reports may also feed targeted surface surveillance systems and support their alerting functions. ATC automation tracks and displays targets by using the information provided in the ADS-B reports.

5.2.4 Traffic Flow Management (TFM) Automation

TFM automation receives ADS-B reports as part of the surveillance data passed from an en route and/or terminal ATC Automation system. As the coverage areas increase, TFM decision support tools will incorporate the data to produce more accurate demand projections, operational response strategies, (such as Traffic Management Initiatives (TMIs)) for periods of excess demand relative to capacity and weather. Additionally, the resultant aggregate demand data provided to the ATM community will reflect the increased accuracy and support better informed collaborative decision-making through traffic management.

5.3 Modes of Operation

The Surveillance Services system is a system of systems, making the definition of modes of operation more complicated than those of a single system providing a single function. Applications are enabled by specific Surveillance Services. Under normal operating conditions, all functions are available and operational, thus all services and applications are supported. Degradation or loss of a system function leads to degradation or loss of the services supported by that function, and ultimately of the applications enabled by the service.

5.3.1 Normal Operations (All Services Available).

5.3.2 Aircraft/Vehicle Degradation or Loss

The Aircraft/Vehicle is required for all services and applications. The Aircraft/Vehicle could degrade such that transmit only, receive only, or both are lost. Additionally, this function can degrade or be lost on a per aircraft basis and regionally. Each of these outages has a different impact.

5.3.2.1 Loss of Reception Capability (ADS-B air-to-ground available, ADS-B air-to air lost)

Degradation or failure of the reception functionality on the aircraft would result in loss of ADS-B traffic information in the cockpit applications on a given aircraft.

5.3.2.2 Loss of Transmit Capability (ADS-B ground-to-air lost)

Degradation or failure of the Aircraft/Vehicle transmit function would result in the loss of ADS-B information to the Data Link Processor and to other aircraft. ADS-B IN-equipped aircraft in the vicinity cannot perform cockpit-based applications involving the failed aircraft, however applications involving other full-functioning aircraft would continue.

5.3.2.3 Loss of ADS-B Surveillance Source

Due to the criticality of aircraft surveillance data, a backup plan must be in place. In areas covered by other surveillance sources, including radar and WAM systems, data from the other system would be used as backup surveillance in the ATC/TFM Automation system when this occurs. In non-radar areas, controllers would revert to procedural separation. The loss of the ADS-B surveillance source, GNSS, could result in regional loss of ADS-B services. This would result in the loss of the Aircraft/Vehicle‘s ability to transmit ADS-B state vector information.

The Aircraft/Vehicle receive functionality would not be impacted. ATC controllers would lose all ADS-B surveillance data on all aircraft. Pilots would lose surveillance information on other ADS-B equipped aircraft in the vicinity.

5.3.2.4 Loss of ADS-B Reception Capability (ADS-B air-to-ground lost)

Degradation or loss of the Data Link Processor reception would result in the loss of ADS-B, supporting core surveillance applications.

5.3.3 ATC Automation

Each ATC Automation system should have system-specific backup strategies that will apply regardless of the source of surveillance data.

6. ASSUMPTIONS, CONSTRAINTS, AND DEPENDENCIES

6.1 Organizational Impacts

6.1.1 Staffing

The introduction of ADS-B applications may require adjustments to current ATC facility staffing schemes to optimize facility operations. Technical support personnel adjustments may need to be made to support and maintain local and remotely deployed ADS-B equipment, in addition to the maintenance responsibilities for existing infrastructure equipment. An adequate number of field support facilities and personnel will be required to install, maintain, and certify ADS-B equipment (both ATC equipment and avionics).

6.1.2 Acquisition Management System (AMS)

Surveillance Services ground infrastructure will require certification by Technical support personnel. Organizations with acquisition and implementation responsibilities should complete necessary System management training requirements.

6.1.3 Safety Management System (SMS)

The Surveillance Services **s**ystem should conform to ICAO SMS processes. See Appendix B for representative hazards and commensurate risk assessments.

6.1.4 Regulation and Policy

Rules may be required and procedures will be necessary to support ADS-B enabled spacing and separation operations. States may need to develop policy and performance standards for aircraft and operators to support the ADS-B technology. Any changes to flight rules may require public comment and resolution.

Other actions, such as airspace redesigns, may be necessary to realize full operational benefits. Initial ADS-B IN applications are informational, providing pilots with an improved situational awareness to enhance safety, and probably do not require rule or procedural changes. The strategy initially depends on users voluntarily equipping with ADS-B IN capabilities. However, it is expected that over time more users will equip to gain the operational benefits. In line with the industry agreed policy of “Best-equipped, Best-served”, States may consider airspace rules or may designate areas to provide preferred service for users who are capable and equipped for ADS-B operations

6.1.5 Publication/Notices

Changes to current publications will be required to reflect operational and compliance changes. Development of new operational, procedural, and training documentation is required. Notices announcing changes to operational, procedural, and compliance requirements will need to be developed and distributed. Examples of documentation that may or may not be affected include, but are not limited to:

- International Agreements
- Advisory Circulars (AC)
- Technical Standard Orders (TSO)
- Facility Operations and Administration
- Aeronautical Information Publication (AIP)
- Terminal Instrument Approach Procedures
- Instrument Approach Procedure Charts (IAP)
- Standard Terminal Arrival Routes (STAR)
- Departure Procedures (DP)
- High/Low/Sectional Navigation Charts
- Letters of Agreement (LOA)

6.2 Operational Impacts

6.2.1 ATC Automation

For ATC surveillance application, Data Link Processors will provide ADS-B reports and status reports to ATC automation systems. ADS-B reports received by automation will include not only aircraft position/altitude and Mode 3A codes, but also additional surveillance related parameters such as, but not limited to, velocity, aircraft flight identification, and accuracy/integrity measures of ADS-B position reports. When ADS-B accuracy/integrity measures are inadequate for the service being provided, either the corresponding ADS-B data should not be displayed to the controller, or the controller should be notified that the displayed data cannot be used. ADS-B ground stations will provide surveillance reports to automation at a higher update rate than radar. ADS-B reports will also be used by automation to improve aircraft tracking accuracy and safety functions such as CA and MSAW.

Because of the additional surveillance provided by ADS-B, ATS providers may desire to implement the use of fusion on ATC automation platforms. This capability fuses any available surveillance source (e.g., ADS-B, Radar, WAM) and displays a single tracked target to ATC. This allows automation to provide ATC with a faster synchronous display update and, when ADS-B surveillance is part of the fused target, a more accurate target position will be displayed to the controller.

6.2.2 TFM Automation

For TFM automation, ADS-B reports will be incorporated as elements of the already established provision of surveillance from en route and terminal ATC Automation systems. There are no anticipated significant operational impacts. The resolution of any asynchronous reporting/timing issues should be resolved within the ATC Automation systems prior to exchange with TFM. The use of the improved surveillance by TFM systems, processes and personnel will be as described above.

6.2.3 Radar-based Surveillance Systems

A communication interface method with existing primary and secondary radars or WAM systems and existing surface systems will be required to provide sensor measurements.

6.2.4 Service Provider and User Procedures

The introduction of ADS-B may require ATC procedural changes in order to optimize potential operational efficiency gains. New procedures, if needed, should be designed to minimally impact current procedures.

Emerging cockpit and ground automation capabilities enabled by ADS-B will give pilots the ability to achieve spacing without fundamentally changing the overall responsibilities between pilots and controllers. If using a new ADS-B IN application, procedures to clearly define the roles, responsibilities, and methods between users and service providers for initiating, executing, or terminating an ADS-B application will be required. Human factors analysis may be required to examine aircrew and controller workloads.

Analysis may be required to develop rules and procedures defining all factors associated with new application or operations. Examples include, but are not limited to:

- Specific phraseology for application/operations;
- Modification of the symbology on ATC screens for the different sensors;
- Rules and procedures between pilot and controller for new operations;
- Designated areas, conditions, and types of operations authorized;
- Service provider procedures for mixed operational environments (ADS-B participants versus non-participants);
- Rules governing airborne spacing operations;
- Backup, contingency, and transition procedures when surveillance is lost.

6.2.5 ADS-B Separation Standards

Analysis may be required to determine separation standards between mixed equipage targets received from different surveillance systems including the transition boundaries between these surveillance areas. Once a service provider shows that ADS-B positioning accuracy and integrity is equivalent to or better than cooperative surveillance radar, then ICAO radar separation minima (PANS-ATM, Chapter 8) can be utilized. Where service providers wish to use ADS-B in En Route airspace to support separation of less than 5NM, additional analysis is required. The goal is a common, standardized separation minimum for service providers.

6.3 Service Provider and User Impacts

The equipage decision will vary for different users and consideration must be given on the effect ADS-B implementation and operations will have on those that do or do not equip. Each state will define and enforce avionics and navigation equipment standards through Technical Standard Orders (TSO), Advisory Circulars, Airworthiness Inspections, etc. but must be within the minimum standards specified by ICAO.
Each state will issue regulations that prescribe minimum performance standards for navigation equipment used by the civil aviation community. ICAO issues standards and recommended practices for international civil aviation. The development of minimum performance standards for military users is the responsibility of the separate department services. These military standards must conform to civil airspace required navigation performance requirements, prevent violation of civil air traffic clearances, and ensure safe separation of military and civil air traffic.

6.3.1 User and Service Provider Training

Users and service providers will require training to understand the new technology's capabilities, characteristics, and limitations. Users and service providers must have an understanding about one another's use of ADS-B. Both service providers and users will require training on the operation of ADS-B equipment and knowledge of ADS-B-specific terms, phraseologies, and display symbology. Users and service providers will require training and certification/qualification on the use of ADS-B applications and operations. This will include, but not be limited to:

- Rules governing areas and conditions allowing an ADS-B application.
- Rules governing certified equipment levels and personnel qualifications.
- Rules and procedures for spacing and separation applications.

APPENDIX A – Definitions and Glossary

ACAS	(ICAO) Airborne Collision Avoidance System
ACC	Area Control Centre
ADS-B	Automatic Dependent Surveillance - Broadcast
ADS-C	Automatic Dependent Surveillance - Contract
ANS	Air Navigation Services
ANSP	Air Navigation Services Provider
ATC	Air Traffic Control
ATCO	Air Traffic Controller
ATM	Air Traffic Management
ATS	Air Traffic Service
CPDLC	Controller Pilot Data Link Communications
CRM	Collision Risk Model
CSP	Communication Service Provider
CTA	Control Area
DCPC	Direct Controller Pilot Communication
Doc 4444	(ICAO) Procedures for Air Navigation Services - Air Traffic Management (PANS-ATM)
FIR FL (number)	Flight Information Region Flight Level
GNSS	Global Navigation Satellite System
HF	High Frequency
IATA	International Air Transport Association
ICAO	International Civil Aviation Organization
IGA	International General Aviation
MNPS	Minimum Navigation Performance Specifications
MTCD	Medium Term Conflict Detection
NAT	(ICAO) North Atlantic (Region)
NM	Nautical Miles
OCA	Oceanic Control Area
PBN	Performance Based Navigation
RCP	Required Communication Performance
RNPC	Required Navigation Performance Capability

RVSM	Reduced Vertical Separation Minima
SAR	Search and Rescue
SATCOM	Satellite Communications
SATVOICE	Satellite Voice Communications
SMS	Safety Management System
TCAS	Traffic Collision Avoidance System
VHF	Very High Frequency

APPENDIX B: Hazard and Risk Evaluation of ADS-B Application:

Table Att-1. Severity table (basic)

Level	*Descriptor*	*Severity description (customize according to the nature of the product or the service provider's operations)*
1	Insignificant	No significance to aircraft-related operational safety
2	Minor	Degrades or affects normal aircraft operational procedures or performance
3	Moderate	Partial loss of significant/major aircraft systems or results in abnormal application of flight operations procedures
4	Major	Complete failure of significant/major aircraft systems or results in emergency application of flight operations procedures
5	Catastrophic	Loss of aircraft or lives

Table Att-3. Likelihood table

Level	*Descriptor*	*Likelihood description*
A	Certain/frequent	Is expected to occur in most circumstances
B	Likely/occasional	Will probably occur at some time
C	Possible/remote	Might occur at some time
D	Unlikely/improbable	Could occur at some time
E	Exceptional	May occur only in exceptional circumstances

Table Att-4. Risk index matrix (severity × likelihood)

	Severity				
Likelihood	*1. Insignificant*	*2. Minor*	*3. Moderate*	*4. Major*	*5. Catastrophic*
A. Certain/frequent	Moderate (1A)	Moderate (2A)	High (3A)	Extreme (4A)	Extreme (5A)
B. Likely/occasional	Low (1B)	Moderate (2B)	Moderate (3B)	High (4B)	Extreme (5B)
C. Possible/remote	Low (1C)	Low (2C)	Moderate (3C)	Moderate (4C)	High (5C)
D. Unlikely/improbable	Negligible (1D)	Low (2D)	Low (3D)	Moderate (4D)	Moderate (5D)
E. Exceptional	Negligible (1E)	Negligible (2E)	Low (3E)	Low (4E)	Moderate (5E)

(Adapted from Doc 9859)

Operational Activity	Identified Hazards and Risks	Description of Risk	Initial Risk Assessment			Further Mitigation factors	Revised Risk Assessment		
			Likelihood	Consequence	Risk Level		Likelihood	Consequence	Risk Level
ADS-B Operational Trial	Failure of Ground Station	Loss of ADS-B positional data to the controller. Increase in workload due to transitioning to procedural control and reassess traffic.	unlikely	Insignificant	3D	Revert to procedural control and apply appropriate separation standard for affected aircraft. A site monitoring system shall provide a degree of on-line integrity monitoring. Warnings would be provided to ATC if site monitoring is not received.	unlikely	insignificant	3D
Incorrect Data broadcast by an aircraft due to data corruption	Incorrect data due to data corruption broadcast by the aircraft ADS-B transponder. The GNSS on the aircraft still operating correctly.	Significant error in the displayed position of the aircraft that could lead to a breakdown in separation without the controller being aware.	remote	moderate	3D	controller observation of history trail and look for track jump	remote	minor	2D

Corruption of Data by the ground station	Incorrect data displayed to the controller due to data corruption at the ADS-B ground station	Error in the reported position of the aircraft therefore could lead to a breakdown in separation without the controller being aware. This may affect all data.	Improbable		3D	Controller observation of history trail and look for track jump. Ensure only tested and proven ADS-B ground station are used in the operational trials. Ensure Route adherence monitoring is implemented for ADS-B tracks.			
Loss of position accuracy of reported position	The accuracy performance of the navigational equipment in the aircraft has deteriorated to the level that it is not acceptable to support the specified separation standard	Loss of ADS-B positional data to the controller. Increase in workload due to transitioning back to procedural control and reassess traffic	remote	moderate	3D	Ensure the ATM system will detect degradation in accuracy performance below a specified threshold and provide appropriate visual notification to the Unit concerned (NUC value). Revert to procedural control for the affected aircraft. Site monitoring is used to validate that it is only one aircraft affected.	remote	minor	2D

Incorrect processing of ADS-B Data by the ATM system	Data reaching the ATM system processed in such a way as to give a false indication of position, altitude or trajectory	Possible error in the displayed position of the aircraft therefore could lead to a breakdown in separation	remote	moderate	3C	Conduct comprehensive testing of the ADS-B processing and displaying functionality of the ATM. Test should include the conduct flight tests and compare results to commissioned radar information.	improbable	moderate	3D
Failure of GNSS satellites	Loss of ADS-B tracks at the ATS unit	Loss of ADS-B data and Nuc drops causes an increase in workload and procedural control in re-established.	unlikely	moderate		site monitoring installed to provide a degree of on-line monitoring and warning to ATC if site monitoring			
Inadequate ATS Training	Introduction of ADS-B function to an ATS unit without adequate training introduces a new hazard.	Insufficient training in MHI, new procedures and transition from ADS-B control to procedural control and may increase the probability of breakdown in separation.	possible	moderate	3C	prove comprehensive training that covers all operational aspects including contingencies	unlikely	moderate	3D

Inadequate Operational Procedures	Introduction of new ADS-B function is new to ATS and adequate operational procedures will introduce a hazard to the system	inadequate operational procedures for managing and controlling ADS-B areas increases the probability of a breakdown	remote	minor	3C	Maximize the reuse of proven operational procedures to handle ADS-B control areas. Ensure sufficient procedures are developed and tested for the transition between ADS-B and Procedural control	unlikely	minor	2D
RF Jamming	Radio Frequency Jamming of ADS-B due to deliberate or non-deliberate actions	Loss of ADS-B positional data to the ATS unit result in in an increase in workload due to transitioning to procedural control.	improbable		3D	Increase in the level of security and security response at ground installations			
incorrect altitude data transmitted by aircraft	Aircraft transmitting wrong altitude because or faulty barometer or wrong geometric levels on display	Could lead to a loss of separation between aircraft or CFIT	unlikely	major	4D	obtain verbal verification of altitude when ADS-B target is observed	improbable	major	4D
Incorrect 24 bit code	incorrect 24 bit code filed on the flight plan leading to mismatch or no match ADS-B target to filed FPL	wrong call sign affixed to aircraft track leading to increase work load for controller to rationalize the proper callsign	remote	minor	2C	work by plight plan monitoring group to identify how often this occurs and put measures to reduce the incidents with operator	improbable	minor	2D

Failure of communication link between the ground station and ATS unit	loss of ADS-B position at the ATS unit due to the loss of data from ground station	increase in controller workload transitioning to procedural control and possible loss of separation between aircraft	unlikely	moderate	3D	ensure redundancy of communication lines and power and reliability of technical support for the ground installation	unlikely	moderate	3D
failure of site monitor	site monitor relays information on the suitability of data received from ADS-B returns	erroneous data could be reaching the ATM system and be undetected by the controller leading to loss of separation	remote	moderate	3C	scheduled checks on site monitoring equipment done at frequent intervals and data collection and analysis	remote	moderate	3C
Mixed operating environment	controller having different tracks to work with ADS-B, Flight Plan and SSR tracks	increase in controller workload transitioning different separation standards and possible loss of separation between aircraft	possible	moderate	3C	adequate initial training in procedures and regular refresher training to ensure controller competence	unlikely	moderate	3D

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APPENDIX E

2019-2020 SURVEILLANCE TASK FORCE WORKING PLAN
SURV/TF/ANIWG

ITEM	TASK	OBJECTIVES	STARTING DATE	ENDING DATE	RESPONSIBLE	OPERATIONAL IMPACT
1	Standardization of the technical and operative for the use of the TCAS in the CAR Region	Determine the current implementation status of the TCAS Version 7.1 in the CAR region and define the criteria to standardize its usage in the region.	30/09/19	30/10/2020	SURV/TF/ANIWG	1. Develop criteria for the regional usage. 2. Provide standardization recommendations on its usage 3. Support regional safety
2	To determine the current status in the usage of safe alarms (SAFENET) in the NAM/CAR region.	Determine the management capacity of the different control centres in the NAM/CAR regions.	30/09/19	30/10/2020	SURV/TF/ANIWG	1. Develop criteria for the regional usage. 2. Provide standardization recommendations on its usage 3. Support regional safety
3	Update radar data sharing possibilities	Boost States to maintain surveillance data sharing taking advantage of the new implementations of these systems in the region.	30/09/19	30/10/2020	SURV/TF/ANIWG	1. Support AIDC implementation. 2. Boost counting with surveillance data backup 3. Support regional safety

4	Analysis of the status of the regional implementation on BBB surveillance and the enabling of surveillance data, based on the new ASBU requirements	Determine the current status of the BBB implementation related with surveillance. Determine the need to update the e-ANP Volumes I and II in compliance with the new implementations of the surveillance systems.	30/09/19	30/10/2020	SURV/TF/ANIWG	1. Update the regional surveillance infrastructure to support the implementation of the regional objectives stipulated by the ANI/WG
5	Determine the criteria to carry out statistical analysis of the ADS-B systems	Implement the criteria under which the States will carry out the statistical analysis of the ADS-B with the objective of making measures based on these criteria.	30/09/19	30/10/2020	SURV/TF/ANIWG	1. Data analysis based on the same criteria; that the region uses the same criteria when carrying out data analysis.

Tarea	Duración	Comienzo	Cierre	Responsable	Liderada por:
SURVEILLANCE TASK FORCE WORKING PLAN (SURV/TF/ANIWG) (in Spanish only)	**285 days**	**Mon 30-09-19**	**Fri 30-10-20**	**SURV/TF/ANIWG**	**SURV/TF/ANIWG**
Estandarización de los criterios técnicos y operativos para el uso del TCAS en la región CAR		**30-09-19**	**30-10-20**	**SURV/TF/ANIWG**	**Relator SURV/TF**
1. Realizar una encuesta para determinar el estado de implementación y su uso actual en los Estados	90 days	**30-09-19**	**Fri 31-01-20**		
2. Analisis de datos	60 days	**Mon 03-02-20**	**Fri 24-04-20**		

3. Elaboración de recomendaciones	60 days	**Mon 27-04-20**	**Fri 17-07-20**		
Determinar el estado actual del uso de las alarmas de seguridad (SAFENET) en la región NAM/CAR		**30-09-19**	**30-10-20**	**SURV/TF/ANIWG**	**Relator SURV/TF**
1. Realizar una encuesta para determinar el estado de implementación y su uso actual en los Estados	90 days	**Mon 30-09-19**	**Fri 31-01-20**		
2. Análisis de datos	45 days	**Mon 03-02-20**	**Fri 03-04-20**		
3. Elaboración de recomendaciones	60 days	**Tue 04-02-20**	**Mon 27-04-20**		
Actualizar la posibilidades de intercambio de datos radar		**30-09-19**	**30-10-20**	**SURV/TF/ANIWG**	**Relator SURV/TF**
1. Actualizar el plan de intercambio radar de la región Nam/CAR	30 days	**Mon 23-12-19**	**Fri 31-01-20**		
2. Apoyar los Estados para realizar el intercambio radar	30 days	Mon 03-02-20	Fri 13-03-20		
Análisis del estado de implementación regional en cuanto a vigilancia de los BBB y de la habilitación de los datos de vigilancia en cuanto a los nuevos requisitos del ASBU	120 days	30-10-19	30-10-20	SURV/TF/ANIWG	
Elaborar una guía para la planificación de adquisición de sistemas de vigilancia y guía de implementación del ADS-B	150 days	Mon 26-08-19	Fri 20-03-20	SURV/TF/ANIWG	United States
Determinar los criterios para realizar análisis estadísticos de los sistemas ADS-B		**30-09-19**	**Wed 01-01-20**	**Cuba, Estados Unidos y COCESNA**	**COCESNA**
Determinar los parámetros a medir	20 days	Wed 30-10-19	Tue 26-11-19		
Realizar un análisis estadísticos de acuerdo a los criterios elegidos	15 days	Wed 27-11-19	Tue 17-12-19		

Analisis de resultados	20 days	Mon 16-12-19	Fri 10-01-20		
Ajustes de los parametros	20 days	Mon 13-01-20	Fri 07-02-20		
Realización de las recomendaciones	20 days	Mon 10-02-20	Fri 06-03-20		