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

DISCUSSION PAPER

ANI/WG/2 — DP/06
01/06/15

Second NAM/CAR Air Navigation Implementation Working Group Meeting (ANI/WG/2)
Puntarenas, Costa Rica, 1 to 4 June 2015

Agenda Item 4 **Follow-up on the NAM/CAR Regional Performance Based Air Navigation Implementation Plan (NAM/CAR RPBANIP)**
4.1 Progress reports of the Task Forces and the ANI/WG

REPORT OF PROGRESS OF THE TASK FORCE ADS-B TO ANI/WG

(Presented by ADS-B Task Force Rapporteur)

EXECUTIVE SUMMARY	
In the note the progress of the task force of ADS-B ANIWG is presented	
Strategic Objectives:	• Safety • Air Navigation Capacity and Efficiency • Environmental Protection
References:	• Implementation Meeting of the Automatic Dependent Surveillance - Broadcast (ADS-B / IMP) Task Force Working Group on Air Navigation Implementation for the NAM / CAR (ANI / WG), Mexico City, Mexico regions from 27 to April 29, 2015 • State Letter EMX475, 20 May 2015, Automatic Dependent Surveillance – Broadcast (ADS-B) Implementation Meeting (ADS-B/IMP) of the ADS-B Implementation Task Force of the NAM/CAR Air Navigation Implementation Working Group (ANI/WG)

1. Review of Members of the Task Force of ADS-B Introduction

1.1 We add three new members from Costa Rica:

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2.- Review of ADS-B Task Force Work programme Status:

2.1 The group reviewed the work programme Date End and the ADS –B trials were changed from 29/5/2015 to 31/12/2017.

3. ADS-B Task Force Work programme Status:

TASK NAME	DELIVERABLE	DATE START	DATE END	PERCENTAGE COMPLETED	RESPONSIBLE	REMARKS
Activities Task ADS- B		1/8/13	31/12/18			
1.0 Formation of ADS-B TF	Participant List	1/8/13	1/8/13	100 %	Group Members	Completed
2. Terms and references	present Terms of Reference of the Working Group	1/8/13	1/8/13	100 %	Cuba (Rapporteur)	Completed
3. Develop Work Plan	Work Plan	2/8/13	14/8/13	100%	Cuba (Rapporteur)	Completed
3.1 Provide to OACI the Work Plan		14/8/13	14/8/13	100%	Cuba (Rapporteur)	Completed
4.0 Approve Work Plan TF ADS- B in Block 0		24/01/14	30/10/14	100%	Group Members	Completed
5.0 Begin implementation of the Work Plan		31/10/13	31/12/18		Group Members	
5.1 Develop ADS- B survey	Survey on the state of the ADS –B	23/01/14	14/02/14	100%	COCESNA	Completed
5.1.1 Send ICAO survey for distribution to the states of the region		18/02/14	18/02/14	100%	COCESNA	Completed
5.1.2 Collect survey results	Current situation of ADS- B in the states	18/02/14	30/4/14	20%	ICAO NACC	On-going

5.2 Surveying information on the implementation of ADS –B aircraft	survey on the status of ADS –B aircraft	23/01/14	30/4/14	100%	IATA	Completed
5.2.1 Information on implementation of ADS –B aircraft	ICAO Current Status of ADS- B aircraft (Recommendation of target dates for the ADS –B)	30/04/14	29/05/15	¿?	IATA	On-going
6.0 Implementation of ADS- B trials	Recommendations / testing improvements towards operational implementation	8/2/13	5/20/15		States/Territories from the Region	
6.1 ADS –B trials are underway	List of states that are making (Progress)	30/10/13	31/12/17	25%	United States, Cuba, México, Canada, COCESNA, T and T, Dominican Republic, and Jamaica	On-going
6.2 Send to the members of the task group the Guide for testing	Guide for testing	13/02/14	13/02/14	100%	Relator	Completed
6.3 Begin to ADS- B trials in states that do not yet list of states that implemented and date (Progress)	Support for those who wish to trials	30/10/14	31/12/17	75%	States / Territories in the region that have not yet done	On-going
6.4 Sending quarterly reporting ICAO deficiencies in trials	Test quarterly results	30/10/13	31/12/17	10%	Canada, Cuba, Dominican Republic, Jamaica, México, Trinidad & Tobago and COCESNA	On-going
6.5 Deliver results of comparisons of statistics of ADS-B	results of comparisons of statistics of ADS-B	23/05/14	31/12/17	10%	Cuba, México, Jamaica, Trinidad & Tobago y and COCESNA	On-going
7.0 Follow-up meeting to the development of ADS- B	Final Report		At the end of each meeting	100%	ICAO NACC	Completed
8.0 Develop relevant operational requirements for the ADS-B implementation		15/11/13	30/04/14	100%	Create Ad Hoc Group	Completed
8.1 Creation of ad hoc group for the formation of the proposal	Op Ad Hoc Group members	23/05/14	23/05/14	100%	CONOPS Ad Hoc Group	Completed

8.2 Development the regional operational concept for the implementation ADS-B	CONOPS DRAFT	23/05/14	30/10/14	100%	CONOPS Ad Hoc Group	Completed
8.3 Deliver the regional operational concept for the implementation ADS-B	CONOPS	27/04/15	15/05/15	100%	Relator del Goupo AdHoc CONOPS	On-going
9.0 develop technical requirements to purchase equipment for ADS-B trials	Tec Adhoc Group	23/05/14	15/05/15	100 %	Spec AdHoc Group	Completed
9.1 Creation of ad hoc group for the formation of the proposal	Op AdHoc Group members	23/05/14	23/05/14	100%	Create Spec AdHoc Group	Completed
9.2 Development of technical requirements for ADS-B equipment	Technical requirements for ADS-B equipment DRAFT	30/06/14	08/05/15	100%	Spec AdHoc Group	Completed
9.3 Deliver technical requirements for ADS-B equipment	Technical requirements for ADS-B equipment	30/06/14	08/05/15	100%	Spec AdHoc Group Relator	Completed
10. Assist the process of implementation ADS-B operational	Letters of agreement between States regional and Metrics	29/5/15	31/12/18		ADS-B TF	To be started
11 follow-ups process of implementation ADS-B operational	ANRF´s	29/5/15	31/12/18		ADS-B TF	To be started

4. Activities undertaken by the Task Force of ADS-B ANIWG:

- COCESNA informed on progress made in the implementation of ADS-B to continue its testing and end your station Cerro de Hula settings. He also commented on the test with the new integrated control center CENAMER data; statistics have been carried capabilities of aircraft equipped with ADS-B in the region, improving their Mode S radars and the inclusion of the ability of ADS-B to cover the entire continental area covered by the radar and northern part FIR by 2018, expanding the coverage of ADS-B, south of the FIR which are not covered by radar (Ex. Isla El Coco), and plans to conduct feasibility studies of MLAT systems with ADS-B capability to improve service coverage terminal ATC radar at airports.
- Mexico reported its ADS-B project which includes the installation of 10 ADS-B stations at strategic locations to feed data ADS-B (DO-260 and DO-260A and Asterix Cat 21) for

systems 4 ACC existing, with a view to improving surveillance for ATC in the Valley of Mexico (TMA operations and helicopters), ATC in Monterrey and Merida Airport Terminal Area, redundancy monitoring station Puerto Peñasco and Surveillance helicopters Flying from / to the oil rig in the Gulf of Mexico.

- The United States presented to the Task Force the observed increase in the number of aircraft in US airspace identified as being equipped with DO-260B and DO-282B ADS-B OUT Similarly I present sponsored by the FAA Projects for regulations the mandatory use of version 2 of the ADS-B avionics, analysis of installation problems / relevant settings and corrective action taken, as was the creation of the team responsible for investigating compliance issues of ADS-B and working with owner / operators and industry to solve and extension programs related support operational implementation of ADS-B, referring to the specific regulations for the verification of the ADS-B flight.
- Canada informed the Meeting of their ADS-B operations, including its current network of ground-based surveillance, the safety study-regulatory approvals for the provision of services through ADS-B Out, AIP information related to ADS B, reports of anomalies and testing of NAV CANADA satellite link for ADS-B.
- Dominican Republic presented a brief overview of the current status of monitoring service in Santo Domingo FIR and his plans for the evaluation and implementation of multilateration and ADS. The plans seek to provide ADS-B surveillance in low coverage areas at lower levels with three ADS-B receivers, one for the TMA Cibao, a second receiver in Loma Hoz and a third receiver to complement the radar as a backup security, to meet the high traffic areas TMA Americas and Punta Cana.
- Cuba presented its progress and lessons learned from the results of the continuation of the ADS-B trials (late 2014 and early 2015), the development of software for statistical analysis of ADS-B signals with very good results for testing and testing these systems are developing a multilateration system at Varadero airport, with excellent results, both for use in Surveillance and Control Surface Movement.
- Jamaica has an ADS receptor - B, but no data are being analyzed as it is currently in the planning process to improve its automation system and plans to summarize the data collection and statistical processing end of the year.
- Trinidad and Tobago presented its ADS-B trial plans, currently supported for only 1 equipment, which will require its extension to increase its coverage with additional receivers.
- In this period, the Task Force held a teleconference in January and its annual Meeting on April.

5. ADS-B Task Force proposed Decisions and Conclusions for ANI/WG approval

5.1 The ADS-B TF met at its second meeting in April 2015, tracking the tasks related to ADS-B and recommending actions to expedite implementation, testing and promotion of ADS-B as well as work to define RPBANIP metrics related to ADS-B. The final report of this meeting was submitted for approval ANI / WG, by letter of EMX 475 state, requesting the review and approval of the Draft Conclusions not later than the meeting of the ANI / WG / 2 (1 to 4 June 2015).

5.2 The final report is available at: http://www.icao.int/NACC/Pages/meetings-2015-adbsimp.aspx and the following conclusions and decisions are proposed for the ANI/WG approval:

Number	Description	Contents
DECISIÓN ADS-B/TF/2/1	***ADS-B IN MEXICO***	That in order to expedite and support the implementation of ADS-B in Mexico, Mexico DGAC, SENEAM and ICAO NACC Office: a) out the coordination and discussion needed for this application; and b) report its progress to the next ADS-B Implementation Meeting / teleconference. VALID
CONCLUSION ADS-B/ TF/2/2	***MONITORING IMPLEMENTATION PLAN MONITORING ADS-B / MLAT***	That, in order to support the implementation of ADS-B and MLAT in the CAR Region: a) the accompanying Monitoring Plan (Appendix A refers) will be taken as a reference for the planning and implementation of MLAT and ADS-B systems; and b) request ICAO to update the monitoring plan for the December 20, 2015. VALID
DECISION ADS-B/TF/2/3	***SOFTWARE FOR STATISTICAL DATA ANALYSIS SURVEILLANCE (ADS-B)***	That, in order to support ADS-B trials and data analysis on the implementation of the ADS-B: a) Cuba define and inform the ICAO NACC Office on the conditions for the exchange, installation and use of its software statistical processing of ADS-B signals; by 30 July 2015; b) ICAO inform States of the above conditions; and c) States interested in using the software, send an official letter to the ICAO. VALID
CONCLUSION ADS-B/TF/2/4	***APPLICATION OF THE CONCEPT OPERATIONAL ADS-B***	That in order to support and guide implementation of ADS-B in the CAR Region and to achieve regional milestone date of December 2018 for the implementation of ADS-B OUT, the Regional ADS-B CONOPS document **.(Appendix C)** be adopted as a guide to planning and implementation of ADS-B service to the States / ANSPs in the region. VALID
CONCLUSION ADS-B/TF/2/5	***TECHNICAL SPECIFICATIONS FOR EQUIPMENT ADS-B***	To support and guide the implementation of ADS-B in the CAR Region and to achieve regional milestone date of December 2018 for the operational implementation ADS-B OUT, Technical Specification document **(Appendix B)** be adopted as a guide for the acquisition and implementation of ADS-B service. VALID

CONCLUSION ADS-B/TF/2/6	***DATA PROCESSING CAPABILITIES FOR ADS-B***	That in order to follow-up and guide the ADS-B implementation in the CAR Region, and to achieve the regional milestones by December 2018 for ADS-B Out implementation: a) the ADS-B Data Processing Capabilities Table (Appendix F to this report) be adopted as a guidance on the status of the ATS Automation System to process ADS-B data; and ADS-B data; and b) ICAO requests the confirmation of these capabilities to all the CAR States by December 2015. VALID
DECISION ADS-B/TF/2/7	***DEVELOPMENT OF SELECTION FOR METRIC CRIRERIOS ADS-B***	That, in order to follow-up and measure the progress of the ADS-B related metrics and targets of the RPBANIP, Dominican Republic (Julio Mejia), Mexico (Jose de Jesus Jimenez) and United States (Alex Rodriguez, Doug Arbuckle), assisted by ICAO NACC Office (Victor Hernandez): a) develop the requirements (criteria) for the definition of selected Airports for the ADS-B related metrics; and b) inform the ADS-B TF Rapporteur for this proposal to the ANI/WG/2 Meeting**.(Appendix A) CONCLUDED**
Conclusion /2/8	***INVITATION TO STATES / TERRITORIES TO BEGIN CONDUCTING TRIALS***	Invitation to States / Territories that have not yet conducted trials to acquire the necessary equipment in order to join the test implementation / planning of ADS-B and ADS-B TF in order to obtain the operating profit identified. VALID

6. Suggested Actions

a) take note of what is presented in this paper;

b) review and approve the report of the ADS-B/IMP/02 meeting;

c) approve the conclusions of the ADS-B TF detailed in Section 5; and

d) take any other action as deemed appropriate

— END —

APPENDIX / APÉNDICE A
DEFINICIÓN DE LOS AEROPUERTOS SELECCIONADOS RELACIONADOS CON LAS MÉTRICAS ADS-B

1. INTRODUCCIÓN

En atención a la DECISIÓN ADS-B/TF/2/7, *Desarrollo de los Criterios de Selección para Metricas ADS-B* en la que se encomienda a Republica Dominicana, México y Estados Unidos, sito: “desarrollar los requisitos (criterios) para la definición de los aeropuertos seleccionados relacionados con las Métricas ADS-B”, y visto que el uso del ADS-B en los aeródromos como herramienta de vigilancia para los Sistemas de Guía y control del Movimiento en la Superficie (SMGCS), cuyos criterios de implementación están definidos en el Doc. 9476, Manual de sistemas de Guía y control del Movimiento en la Superficie (SMGCS), , y visto que los receptores de ADS-B ya sea solos o combinados con el Radar de Movimiento en la Superficie (SMR), formarían parte de los elementos necesarios para la operación de un aeropuerto en condiciones de baja visibilidad, entendemos recomendable acoger estos mismos criterios como guía para los Estados al momento de definir en cual o cuales de sus aeropuertos debería implementarse el uso del ADS-B para los fines de mejorar la conciencia situacional en la superficie.

2. CONDICIONES OPERACIONALES

El sistema SMGC que ha de establecerse en un aeródromo depende de dos condiciones operacionales principales:

a) las condiciones de visibilidad en las que la administración del aeródromo proyecta mantener el aeródromo abierto para las operaciones; y
b) la densidad del tránsito.

Cada una de estas condiciones, ha sido definida con mayor extensión en la Tabla 2, en las que se establece el criterio que determina la necesidad de utilizar un sistema de un SMGCS.
Aun cuando uno de los criterios utilizados es una visibilidad inferior a 400 m, no se han tomado en consideración en el presente manual las necesidades relativas al rodaje de aeronaves en condiciones de visibilidad nula o cercana a este valor. La experiencia en las operaciones revela que estas condiciones no suelen corrientemente ocurrir y el coste del equipo electrónico necesario que permita la realización de operaciones de este género no justifican su consideración en el momento actual.

3. CONDICIONES DE VISIBILIDAD Y DE TRANSITO

Las condiciones de visibilidad en las que la administración del aeródromo proyecta la realización de operaciones, así como la densidad del tránsito, son los dos factores más importantes que han de tenerse en cuenta al elegir los componentes de un sistema de guía y control del movimiento en la superficie (SMGC) destinado a un aeropuerto. Para fines de examen de los sistemas SMGC, las condiciones de visibilidad y de tránsito han sido sub- divididas y definidas con arreglo a los términos indicados en la Tabla 1. En todos los casos en que se utilizan estos términos, sus significados son los definidos en la misma.

Tabla 1. Condiciones de visibilidad y de tránsito relativas a los sistemas SMGC - Explicación de términos	
CONDICIONES DE VISIBILIDAD	
1	Visibilidad suficiente para que el piloto pueda efectuar el rodaje y evitar visualmente cualquier colisión con otro tránsito en las calles de rodaje y en las intersecciones y para que el personal de las dependencias de control pueda controlar visualmente todo el tránsito;
2	Visibilidad suficiente para que el piloto pueda efectuar el rodaje y evitar visualmente cualquier colisión en las calles de rodaje y en las intersecciones, pero insuficiente para que el personal de las dependencias de control pueda controlar visualmente todo el tránsito; y
3	Visibilidad inferior a un RVR de 400 m (operaciones con poca visibilidad)
DENSIDAD DE TRANSITO	
(durante la hora de punta media determinada por el Estado)	
Reducido:	Inferior o igual a 15 movimientos por pista, o inferior a un total de 20 movimientos en el aeródromo;
Medio:	Del orden de 16 a 25 movimientos por pista, o un total de 20 a 35 movimientos en el aeródromo; y
Intenso:	Del orden de 26 movimientos o más por pista, o superior a un total de 35 movimientos en el aeródromo.

Tabla 2. Orientación respecto a la necesidad de Sistema de Vigilancia										**Doc. de Consulta**
Condiciones de Transito	Reducido			Medio			Intenso			Doc 9476
Condiciones de Visibilidad	1	2	3	1	2	3	1	2	3	Doc 9476
Ayuda requerida										
Requerimiento de Sistema de vigilancia para el Movimiento y control de superficie (ADS-B/SMR)						X		X	X	Doc 9426

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APPENDIX/ APÉNDICE B

TECHNICAL SPECIFICATIONS FOR ADS-B EQUIPMENT

1. INTRODUCTION

1.1 The ICAO Regional Office in the fulfillment of their main regional strategies, is supporting the introduction of ADS-B as a base element for the implementation of several improvement modules of the Aviation System Blocks Upgrades (ASBUs).

2. BACKGROUND

2.1 Within the framework of the ANI/WG/1 an ADS-B Task Force was created, which at its last meeting assumed the responsibility to deliver the technical specifications that the ADS-B equipment must comply, and will be proposed for purchase through RLA/09/801 Project to those States that do not have such equipment, with a view to joining the phase of trials in which we currently find ourselves. The proposal prepared by ADS-B TF is as follows:

3. GENERAL REQUIREMENTS

3.1 The system shall have, as a minimum, the following functionalities and configurations:

- Reception: real time reception of 1090 MHz Extended Squitter RF Signals conformant to the RTCA MOPS for 1090 MHz ES ADS-B (DO-260, DO-260A and DO-260B) from airborne aircraft.
- Meets the requirements of ICAO and EUROCONTROL.
- Decoding: receiving and processing Extended Squitter messages of Downlink Format (DF 17, 18 and 19).
- Report Assembly: compilation of ADS-B reports to be forwarded to a third party client ground systems using ASTERIX Category 021 with a configurable reporting period.
- UTC Time Synchronization: to be equipped with a GPS receiver for system time synchronization and time stamping, as well as autonomous monitoring of GPS quality and integrity.
- Ground Station Management and Status Reporting: availability of station management, monitoring and control functions (local/remote) and service status, including Built in Test Equipment (BITE).
- The Ground Station has to include a function for reporting Ground Station and service status to client systems over a ground network. These status reports will use the ASTERIX Category 023 message format, generated periodically, with a configurable reporting period.
- Performance monitoring and statistical analysis of the ADS-B signals: perform statistical studies, including coverage analysis, positional accuracy, aircraft statistics classified by MOPS capabilities, etc.
- Communications: be able to operate on narrowband communication means, such as: VSAT connections.
- Technical Situation Display and Recording: the technical situation display will be located in the technical maintenance room of the facility where the indoor equipment is located.

4. MINIMUM TECHNICAL EQUIPMENT REQUIREMENTS

Ground Station ADS-B Specifications

Antenna:

- Omnidirectional or antenna array with high gain (at least 12 dB)
- 360° coverage for at least 250 NM, provided that a line of sight exists.
- Antenna surge protection elements, both indoor and outdoor

Receiver:

- A fully redundant receiver including the antenna system and cabling
- Operating Frequency: 1090 MHz
- Bandwidth 3 dB: ± 10 MHz
- Sensitivity -87 dBm
- Dynamic range 70 dB
- Noise Figure <3 dB
- Availability 99.9%
- Probability of detection 99.99
- Processing Capacity at least 600 aircraft / second.
- Probability of false alarms 10-6.
- MTBF >20000 hours

Communications:

- Configurable data output formats, supporting ASTERIX CAT021, Version 0.23 to the last available by EUROCONTROL and ASTERIX CAT023, Version 0.11 to last available by EUROCONTROL
- Two physically independent network interfaces (Ethernet 100base T)
- Outputs: Serial Port RS-232 and Ethernet (TCP/IP, UDP/IP)
- USB ports for flexible interfaces
- Transmitted information refresh rate of one second and configurable up to 10 seconds.
- Two individually configurable ASTERIX output data streams, for operational and maintenance access.

Special Features:

- Redundant GPS clock systems.
- Evaluation software tool for data reporting and analysis (textual and graphical).
- Licenses and software requirements

Other features:

- Indoor/Outdoor operations
- AC 110V/220V 50Hz/60Hz
- UPS with reserve battery for 30 minutes.

- Temperature: - 10 to +50 °C.
- Lightning protection system.
- COTS products
- Site test.
- Basic parts repair kit
- Spanish/English language documentation (depending on the country where the receiver is mounted).
-

The ground station equipment shall:

- Be fully configurable via SNMP and locally at the site by means of command line interface. The tenderer shall utilize open architecture concepts as much as possible to ease interface requirements.
- Allow uploading and downloading of the complete configuration in a file.
- Be able to receive software updates from a remote control and monitoring station in a failsafe way without service interruption.
- Allow filtering of ADS-B targets according to the following criteria:
  - ✓ Altitude level(s)
  - ✓ Airborne/ground
  - ✓ MOPS version
  - ✓ Figure of merit

- Be able to output a Figure of Merit contained in the messages complying with MOPS DO260, DO 260A and DO 260B.
- The ADS-B and GPS antennas shall be provided with all the appropriate fittings for tower structure mounting.
- The equipment shall possess hardware maintenance features to reduce repair time, providing the technical personnel with the capability to diagnose a fault rapidly and identify the failed unit and replace it quickly in order to satisfy the availability requirements. Minimal preventive maintenance is a fundamental design requirement. The BIT capability should be sufficient to isolate the fault to the Line Replaceable Unit (LRU).
- Maintenance design features shall include on-line and off-line diagnostics, power block diagnostics, test points, Built-In Test Equipment (BITE) and Fault Isolation Testing (FIT). All equipment shall be equipped with diagnostic programmes as a part of the support and diagnosis software tool provided.
- Specifically the system BITE shall have the following capabilities:
  - ✓ Periodically perform BITE tests to verify performance and operational status
  - ✓ Output the BITE status as a hardware signal, as a visual indicator at the front panel (e.g. LED) and via the communications network to the local and remote control and monitoring system
  - ✓ Be able to distinguish between critical failures requiring immediate attention or corrective action and warnings
  - ✓ Be equipped with a site monitor that periodically injects a signal containing a fixed data pattern into one of two ADS-B antenna monitor points
  - ✓ Be able to verify the received signal level of the site monitor signal at the ground station in order to verify the complete RF path
  - ✓ Be able to verify the received signal content and periodicity

- ✓ Be able to verify the detected position of the internal GPS receiver in order to monitor operational status of the GPS as a basis of ADS-B status
- ✓ Be able to generate a test target using the detected GPS position and the site's monitor signal level.
- ✓ Provide secure access via password protection to the operating system level.

5. ADS-B FUNCTIONAL PERFORMANCE REQUIREMENTS

Ground Station Functional Requirements

5.1 The ground station shall have, as a minimum, the following capabilities and equipment configuration.

- Be able to adjust the actual target report update rate to adapt it to the available network capacity
- Detect when the actual data rate is close to the defined network transfer capacity
- Be designed for unattended operation
- Operate within the proximity of other systems without degrading its own performance, as well as the performance of the existing systems.
- Recover from short time frame transients in voltage and amperage without operational degradation.

Remote Control and Monitoring System

5.2 The remote control and monitoring system shall have, as a minimum the, following capabilities and equipment configuration:

- Be able to remotely monitor, configure and control the ground station equipment via SNMP protocol (or equivalent) providing access to all system parameters
- All system events shall be logged
- Log system status for a minimum of 30 days. The log duration should be configurable.
- Display overall system status in a graphical illustration showing, with different colors, each system real time status
- It shall be capable of executing system commands, with a basic protection via keyword or password
- Notification of alarm messages in a visual and audible way
- Displaying of the fundamental equipment parameters and basic configuration
- The alarm codes generated by the system shall be supported with the necessary information for their interpretation.
- Implementation based on COTS equipment and state of the arts compatible software
- Provide the capability to produce daily reports sorted according to defined parameters such as time of entry, country of origin, aircraft type, etc. A full description of the system capabilities is required

5.3 Technical Situation Display and Software processing requirement for statistical analysis of the ADS-B signals shall exhibit the following functionalities as a minimum:

- Be able to receive ASTERIX Category 21 Cat protocol 21, 23 and 247 in different versions, target reports from one or more ground stations and display the message contents
- Be able to provide a simple map of coverage area and shall indicate target tracks as received within the target reports
- Attach a label to the most recent target position with the following minimum content information:
  - ✓ 24 bit Mode S address and registration
  - ✓ Mode 3/A code data if available
  - ✓ Flight level
  - ✓ Call sign
  - ✓ Target dynamics (ground speed, track angle, etc.)
- Upon selecting a target, allow the display of the current ASTERIX target report content in a separate detailed menu list
- Log on installation and only the result of statistics (serving the result data) is transmitted
- Log possessing anywhere connectivity to the system
- Filter by time, areas, flight levels, levels of information quality, response parameters
- Perform a statistical study including coverage analysis, analysis of positional accuracy, number of response by the various surveillance systems countries and airlines
- Storing and recording of all events
- Allow panning, rotating, and zooming of the display content
- Present range, azimuth, and relative elevation between two selected targets and between a target and a ground station site
- Be able to display a configurable history trail of target plots in steps of several seconds up to several hours
- Allow the recording of ASTERIX Cat 021 surveillance data o raw output
- Allow local replay and conversion of the recorded ASTERIX data for analysis purposes
- Provide a technical situation display showing selected ASTERIX data from ground station
- Show a list of aircraft currently in coverage in an on-screen menu with filtering capabilities of at least time of first plot, call sign, country of origin, MOPS version, etc. A fully description of the target filtering capabilities is required.

Target Capacity/Characteristics

5.4 The target processor shall have the capability to output as a minimum the following parameters as a target message, besides those which the tenderer considers necessary for adequate signal processing:

- **Identification:**
  - i. Call sign
  - ii. ICAO 24 bit address or registration
  - iii. Mode A
- **Aircraft Category**
- **Aircraft Size (length and width)**
- **Position (from aircraft reference point)**

iv. Lat/Long (WGS-84)
v. Barometric altitude

- **Velocity vector**

vi. Ground (or air) speed
vii. Vertical speed

- **Time stamp**
- **Heading**
- **Emergency messages (medical urgency, loss of fuel, etc.)**
- **Figures of merit (according MOPS version)**

5.5 The system shall be able to process extended squitter messages at the following rates:

- Airborne position every 0.5 sec. This message also includes the integrity figure
- Ground position every 0.5 sec if the aircraft is moving, otherwise every 5 sec
- Identification and aircraft type every 5 sec
- Velocity and the accuracy quality indicator every 0.5 sec
- Aircraft status, including heading and other quality indicators, if necessary every 1.25 sec.
- Emergency messages every 0.8 sec. when required

6 INTEGRATION WITH AIR SITUATION DISPLAY

6.1 The tenderer shall provide support for the integration of the ADS-B data with the existing Surveillance Data Processor (SDP) and Air Situation Display available.

6.2 If there is a cost associated with this requirement it shall be identified separately with a detailed scope of the level of support and services available.

7. STANDARDS

- ICAO Annex 10
- RTCA DO-260, DO-260A, DO-260B
- VDL 4 SARPs
- ETSI EN 301 842-1
- ETSI EN 301 842-2

8 DELIVERY AND PACKAGING

8.1 Indicate Freight/Shipment/Delivery requirements, considering that the equipment could be shipped to another location.

Note: *The tenderer is free to offer any equipment, design or service, which in his opinion, is equal to or superior to the requirements of this specification. Any such alternative(s) or variation(s) must be fully and clearly defined and supported.*
All alternative(s) or variation(s) proposed shall be described and quoted separately with an explanation of the resultant improvement from their implementation.

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INTERNATIONAL CIVIL AVIATION ORGANIZATION
CAR/NAM MEXICO OFFICE

ADS-B OUT OPERATIONAL CONCEPT (CONOPS)

MEXICO CITY, MEXICO
28 APRIL 2015

1. – INTRODUCTION:

Installing and maintaining ground-based aviation infrastructure in remote areas can be challenging and costly. In some cases, such as oceanic areas, there is no viable way it can be done at the time of creating this CONOPS.
Currently, some Air Traffic Services (ATS) providers depend upon ground-based infrastructure to receive Automatic Dependent Surveillance - Broadcast (ADS-B) data from aircraft. This concept of operations also proposes the use of Orbiting Satellites to receive ADS-B data from aircraft so as to expand the geographic area where ATS surveillance services can be provided.
CAR Region is working on the commissioning of ground-based ADS-B for its Flight Information Region (FIR). The supporting safety analyses, testing and monitoring for these implementations provides the foundation for expansion of ATS surveillance services based on ADS-B.
This concept of operations has been developed in accordance with the guidance provided in ICAO's Manual on Airspace Planning Methodology for the Determination of Separation Minima (Doc 9689).

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 Automatic Dependent Surveillance – Broadcast (ADS-B).
This Concept of Operations identifies at a high level both the needs and means to incorporate the use of ADS-B into Air Traffic Management (ATM) across the ICAO CAR Region.
Individual CAR Region states will develop complementary implementation documents that reflect their unique operating environments.
As developments occur this Concept of Operations may be required to be updated.

1.2 – Operational use:

1.2.1- Surveillance
1.2.1.1- Enroute.
1.2.1.2- Terminal.
1.2.1.3- Search and Rescue.
1.2.1.4- Oceanic Areas.
1.2.1.5- Aircraft Tracking.

1.3 – System Overview:

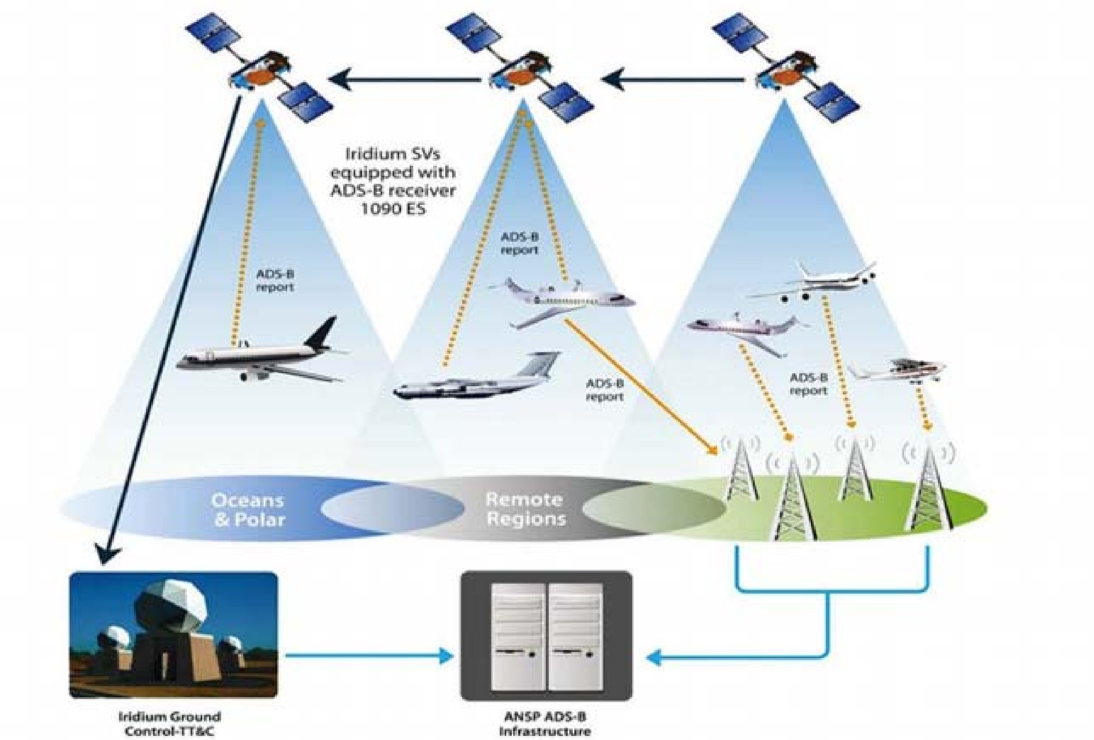

Image: AIRPLANE, Ground ADS-B ANTENNA, GPS Satellite and ATC Air Situation Display.

1.4 – References:

1.4.1- "Automatic Dependent Surveillance-Broadcast (ADS-B) Concept of Use," Appendix to the AN/-Conf/11-WP/6, ICAO, April 2003.
1.4.2- APANPIRG ADS-B Study, Manual on Airspace Planning Methodology for the Determination of Separation Minima (Doc 9689) and PANS-ATM (Doc 4444) and Annexes 2, 4, 11 and 15.
1.4.3- CAO Document 9854 "Global Air Traffic Management Operational Concept:" First Edition 2005
1.4.4- Doc 9689 Manual on Airspace Planning Methodology for the determination of separation Minima
1.4.5- DOC 4444, "Procedures for Air Navigation Services, Air Traffic Management", ICAO, November 2007
1.4.6- Annex 2 to the Convention on International Civil Aviation, "Rules of the Air", ICAO, November 2005
1.4.7- Annex 4 to the Convention on International Civil Aviation, "Aeronautical Charts", ICAO, July 2009.
1.4.8- Annex 11 to the Convention on International Civil Aviation, "Air traffic Services", ICAO, July 2001.
1.4.9- Annex 15 to the Convention on International Civil Aviation, "Aeronautical Information Services", ICAO, July 2013.
1.4.10- ICAO Cir 326, "Assessment of ADS-B and Multilateration Surveillance to Support Air traffic Services and Guidelines for implementation", ICAO, 2012
1.4.11- "Automatic Dependent Surveillance-Broadcast (ADS-B) Concept of Use," Appendix to the AN/-Conf/11-WP/6, ICAO, April 2003.

2. – OPERATIONAL NEED:

Optimization of Airspace
Improve Surveillance capability, reliability and accuracy
Reduce Cost of service provision

2.1. Current Environment

Surveillance- Different variation on equipment within the region
Procedural Separation Standards and Radar standards are used within the region

2.2. Capability Shortfalls

The regional air space is constrained by surveillance limitations leading to the inefficient use of airspace. The current system does not provide contiguous surveillance coverage with a consistent basis of Performance. This leads to low confidence prediction characteristics that prevents highly improved deterministic estimation of aircraft location and intent.

3. –SYSTEM JUSTIFICATION:

3.1. Description of Desired Change:
To use ADS-B surveillance information (airborne and airport surface) for air traffic control operations and traffic flow management and other services including situational awareness, separation assurance, and improved automation system safety functions.
Other authorized facilities (ramp control, airline operations center, etc.)
May use ADS-B surveillance information to track flight activities and optimize operations.
The inherent accuracy and high update rate will provide service providers and users improvements in safety, capacity, and efficiency.

3.2. Potential Benefit of new or Modified System.
The following Surveillance and capabilities will contribute to improved safety, capacity and efficiency:

Safety

- Provides aircraft-to-aircraft traffic surveillance capability.
- Provides ATC and in-the-cockpit, airport surface traffic surveillance capability.
- Provides surveillance capabilities in areas currently not served by ground-based surveillance systems.
- Provides near real-time, in-the-cockpit aeronautical information (weather, NOTAMs, Temporary Flight Restrictions, Special Use Airspace, etc.).
- Improves or supplements existing ground-based surveillance information.
- Improves air traffic control automation performance and safety features e.g., target accuracy improvement for MSAW and CA alerting capabilities.
- Provides cost effective, Controlled Flight Info Terrain (CFIT) awareness.

Capacity

- Provides radar-like separation procedures in remote or non-radar areas.
- Supports a potential 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, sequencing, and separation operations.

Efficiency

- Provides reduced cost infrastructure.
- Provides information not currently available resulting in 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 that is received by the Air Traffic Services Unit. In addition to this basic data set, the position (and quality of this position) as determined by the aircraft sensors is also broadcast. Additionally ADS-B systems may be able to broadcast track vector, air speeds and alerts of abnormal conditions on the aircraft. These broadcasts are transmitted at 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, it may be considered more accurate than radar.

4.1 Surveillance

ATC will use ADS-B surveillance information in the same manner as current dependent/cooperative surveillance system information is used, e.g., to assist aircraft with navigation, to separate aircraft, and to issue safety alerts and traffic advisories. The ADS-B surveillance information will be used to enhance the quality of existing radar-based surveillance information for ATC automation system functions, i.e ., tracking, MSAW, Conflict Alert, and Mode-C Intruder Alert. The targeted 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 and ADS-B-to radar and fused targets. ADS-B can support a potential reduction in separation minima in certain En Route and some current non-radar environments.

4.2 ADS-B Applications
4.2.1 Surface movements

- The primary ADS-B surface application is Airport Traffic Situation Awareness. as it can be used as a source 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 Control Airspace (TMA). This is where aircraft on approach (instrument and visual), aircraft departing and those operating in the vicinity of aerodromes are at close proximity to terrain. Since this is the area of initial climb out and final descent to land aircraft would be crossing the levels of other aircraft.

In the TMAs where the terrain restricts SSR and PSR, ADS-B could be used to provide surveillance. The topography of mountainous areas limit surveillance as it requires line of sight with the respective antennae. The deployment of several ADS-B antennae would be a cost effective way to provide surveillance where it would not be possible via single radar antenna. The cost difference of ADS-B installation makes it feasible to install several antennae to provide overlapping coverage.

Only high quality position reports are used by ADS-B processors. In the terminal airspace the minimum established radar separation in PANS-ATM (Doc 4444) 6.7.3.2.4; 6.7.3.2.5; 6.7.3.4.2 and 6.7.3.5.1 may be applied without any further safety assessment requirement.

ADS-B increases situational awareness in the cockpit as well as at the Controller Work Position (CWP). Aircraft equipped with ADS-B IN will receive information about other aircraft in the vicinity based on the positions transmitted. Minor adjustments in speed and heading could be made to increase spacing In the TMA where there is a convergence and concentration of aircraft increased situational awareness would mean an increase in safety. For controllers, having an accurate picture of traffic in the TMA would result in heightened situational awareness and improvement in safety.
ADS-B surveillance can result in reduction of separation and increase of terminal airspace capacity. As a result of increased capacity there can be increase in flight schedule flexibility, increase in flight path efficiency and reduction in delays or flight disruptions.
ADS-B integration supports safety nets such as Minimum Safe Altitude Warnings (MSAW) for aircraft flying close to terrain and reduce the occurrence of CFIT. In Radar airspace, ADS-B would provide redundant surveillance enhance safety.

4.2.3 Enroute airspace

The rapid rate of interrogation of aircraft through ADS-B would increase the situational awareness of the controller since an accurate depiction of intended track is be provided and changes to the track more readily observed. This would improve the prediction trajectories and increase the effectiveness of ATM system conflict detection.
The coverage range of an ADS-B receiver is fifty (250) nautical miles. The distribution of land masses and pelagic structures, such oil rigs, in the region could create a coverage area without gaps if sufficient antennae are used. The data obtained from each FIR could be shared across boarders as long as there equipment compatible.
In a procedural environment, certain position report has to be omitted or an emergency (or urgency) report received from the pilot for the controller to know that an aircraft has an abnormal situation, in a surveillance area emergency reports are received instantaneously. The last position and flight path of such aircraft could be accurately determined increasing the likelihood of a favorable outcome.
There is a distribution radar antenna in the region but gaps exist the coverage. The strategic positioning of ADS-B could close these gaps and provide overlapping coverage. ADS-B could also provide redundant coverage for areas already served by SSR.
Accurate position reporting make up a significant amount of a pilot's work load. The priority in flight is to aviate, navigate and communicate. If less time is required to make position reports then there would be more time to spend on aviating and navigating. The cockpit workload would be reduced with the implementation of ADS-B.

4.2.3.1 Upper airspace

The characteristics of aircraft in the Upper Airspace would be level flying or change of cruising level by only a few thousand feet (Flight Levels). Lateral changes in flight path would be predicated upon weather deviations or the change airway (route) direction based navigational infrastructure.

In procedural (non-surveillance) high level airspace ADS-B would be a means of surveillance and reduce the required separation to that defined by PANS-ATM (Doc 4444) 8.7.3 provided:

- Identification of ADS-B equipped aircraft is established and maintained
- The data integrity measure of ABS-B message is adequate to support the separation minim
- There is no requirement for detection of aircraft not transmitting ADS-B
- There is no requirement for determination of aircraft position independent of the position-determining elements of the aircraft navigation system.

The surveillance provided by ADS-B could 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 emission.

4.2.3.2 Lower enroute airspace

The lower airspace (below Flight Level 250) is characterized by a mix of aircraft types with varying performance characteristics. There are significant changes in altitude (several thousand feet) for some aircraft while others would be operation at their cruise levels. There is also a high concentration of aircraft converging and diverging of traffic to and from of airports.

The speed, rate of climb and descent and general maneuverability vary widely for aircraft in the lower airspace. The different classes of aircraft all have different performances and ADS-B would increase situational awareness for the controller. This leads to safer operations especially in areas of high traffic density. For aircraft with ADS-B IN this improvement of situational awareness is extended to the cockpit as well.

In areas of low traffic density, ADS-B is a cost effective way monitor a variety of aircraft. Surveillance increases safety and if the volume of traffic is not sufficiently high to justify the cost of installation of Radar, ADS-B could be employed.

Aircraft equipment and capability would vary because of the mix of aircraft class. Commercial aircraft, general aviation and military operations all share the lower airspace. Aircraft that carry TCAS equipment can be detected ADS-B in the lower airspace and with sufficient lead-time even the smallest operators and general aviation would be able to comply.

4.2.4 Oceanic and Remote airspace

The objective of this application is to enable more frequent approval of flight level requests between properly equipped aircraft using a reduced separation standard in Oceanic Airspace, improving flight efficiency and safety. Flight crews request flight level changes for various reasons to improve flight efficiency and safety including; optimum fuel burn, accessing favoring wind conditions, avoidance of turbulence. ITP enables flight level change maneuvers that are otherwise not possible using non-ADS-B based oceanic procedural separation standards. ITP allows ATC to approve these flight level change requests between properly equipped aircraft using reduced separation minima during the maneuver.

4.3 Proposed environment

- In the short term ADS-B would support ATC surveillance. Owing to the high update rate and accuracy of position reports ADS-B has been accepted to be as good as SSR surveillance and the same separation minima could be applied for a particular airspace (enroute or terminal). The inclusion of ADS-B increases the accuracy of composite tracks and with the advent of ADS-B IN, improved cockpit based situational awareness will be realized.
- Radar would continue to be a surveillance source until the various antennae reach the end of their life cycle when their coverage would be replaced by ADS-Bat which time they would be replaced by ADS-B. ADS-B can be installed of in anticipation of certain radars becoming obsolete to give sufficient lead-time for their acceptance as radar replacement. The cost benefit and small footprint of ADS-B is an enabling factor for early deployment. Terrestrial ADS-B installations cover a range of up to two hundred and fifty (250) Nautical Miles at high flight levels. This range is reduced at lower altitudes and in mountainous terrain. The availability of modeling tools can determine the expected coverage based on these factors. The availability of additional infrastructure such as power, communications and security would also be factors to consider in choosing a site. As space based ADS-B develops and is proven to be as effective as terrestrial installations, these factors would be less restrictive.

5. – SYSTEM DESCRIPTION:

5.1. Surveillance System

The Surveillance and Broadcast Services system's functions (Aircraft/Vehicle, Data Link Processor, Broadcast Server, and ATC/TFM 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 System, how they interoperate with each other, and how the Surveillance 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 GPS or other navigation source, crew input, barometric altitude, vertical speed and aircraft identification data. The Aircraft/Vehicle processes the information gathered 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. Detailed reporting of compliant and non-compliant aircraft broadcast with the associated avionics package will be provided to Aviation Safety (AVS) for analysis. The Aircraft/Vehicle receives and decodes ADS-B Messages transmitted by other Aircraft/ Vehicles equipped with the same data link Messages transmitted by the Data Link Processor.

5.2.2 Data Link Processor.

The Data Link Processor receives ADS-B Messages broadcast by Aircraft/Vehicles over the 1090ES data links. The Data Link Processor processes the received ADS-B Messages, formats them into ADS-B Reports and WAM Reports, and sends the reports to the Broadcast Server and ATC Automation. Service coverage. The Data Link Processor generates status reports, containing information on alarms and events in the Data link Processor subsystems and send them to ATC Automation. The Data Link Processor will also generate internal test target messages and send the resulting ADS-B Reports to ATC Automation.

5.2.3 ATC Automation.

ATC Automation 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 a mixed surveillance (e.g., radar, WAM and ADSB) environments. ATC Automation performs Minimum Safe Altitude Warning (MSAW) and Conflict Alert (CA) processing using the ADS-B data and radar data if in a mixed surveillance environment. 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 will also feed targeted surface surveillance systems and support their alerting functions. ATC Automation tracks the targets given the information provided in the ADS-B Reports. In the future, new decision support tools will be implemented in the En Route, Terminal, and Surface Automation systems.

5.2.4 ATFM Automation.

ATFM automation receives ADS-B reports as part of the surveillance data passed from the en route and terminal ATC systems. As the coverage areas increase, ATFM 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 and Broadcast 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 services provided by specific Surveillance and Broadcast Services system functions. Under normal operating conditions, all functions are available and operational, thus all services and applications are supported, depending upon the implementation segment. 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.

Function	Service		
	Surveillance		
	ADSB	WAM	ADS- R
Aircraft /Vehicle (Para 5.2.1)			
Transmit	x	x	
Receive	X note		x
Data Link Processor (Para 5.2.2)			
Transmit			x
Receive	x	x	x
ATC/TFM Automation (Para 5.2.4/5.2.5)	x	x	

5.3.1 Normal Operations (All Services Available).

When all Surveillance System functions are available and operational, all services can be provided, depending upon the implementation segment.

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 also State wide or regionally. Each of these outages has a different impact.

5.3.3 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 ATC/TFM Automation System when this occurs. In non-radar areas, controllers would have to revert to procedural separation. In addition to the ground-based surveillance backup systems, navigational backup systems are also being considered. The loss of the ADS-B surveillance source, GPS, would result in state-wide or regional loss of ADS-B. This would result in the loss of the Aircraft/Vehicle‘s ability to transmit ADS-B state vector information. ATC controllers would lose all ADS-B surveillance data on all aircraft. Pilots would lose their own position reference, as well as, surveillance information on other ADS-B equipped aircraft in the vicinity.

5.3.4 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.

5.3.5 ATC Automation.

Each ATC Automation system has 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 the ADS-B applications may require adjustments to current ATC facility staffing schemes to optimize facility operations. Technical Operations 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 avionics equipment.

6.1.2 Acquisition Management System (AMS) Surveillance System ground infrastructure will require certification and acceptance by Technical Operations. Organizations with acquisition and implementation responsibilities must complete necessary System management training requirements.

6.1.3 Safety Management System/Safety Risk Management (SMS/SRM).
The Surveillance **s**ystem must conform to Safety Management System and Safety Risk Management (SRM) processes. Organizations with development and deployment responsibilities must comply with SMS/SRM requirements.

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 design, may be necessary to realize full operational benefits. It is expected that initial ADS-B applications will be informational, providing pilots with an improved situational awareness to enhance safety, and probably will not require rule or procedural changes. The strategy initially depends on users voluntarily equipping for ADS-B. 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:

Advisory Circulars (AC)
Maintenance and Technical Standard Orders (TSO)
Facility Operations and Administration
Aeronautical Information Manual (AIM)
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 all current and future ATC Automation Systems. ADS-B reports received by automation will include not only aircraft position and Mode 3A/C codes, but also additional surveillance related parameters such as, but not limited to, velocity, aircraft flight identification and accuracy/ integrity measure of ADS-B position report. 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 Conflict Alert and Minimum Safe Altitude Warning. Because of the additional surveillance provided by ADS-B, SBS has implemented the use of fusion on most ATC automation platforms. This 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 systems. There are no anticipated significant operational impacts. The resolution of any asynchronous reporting/timing issues is expected to be resolved within the ATC automation systems prior to exchange with TFM (other than TMA and other metering systems). TMA and other higher resolution metering system may be impacted by the asynchronous reporting and changes to those systems may be necessary. 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 and existing surface and wide area multilateration systems will be required.

6.2.4 Service Provider and User Procedures.
The introduction of ADS-B will necessitate Air Traffic Control procedural changes in order to optimize potential operational efficiency gains. New procedures should be designed to minimally impact current procedures. The goal is to minimize increase to cognitive workloads due to the implementation of ADS-B surveillance applications. New cockpit and ground automation capabilities provided by ADS-B give users the ability to achieve spacing and separation without fundamentally changing the overall responsibilities between pilots and controllers. Users may request or accept an ADS-B-enabled operation while service providers retain the authority for approving or applying a procedure depending on factors such as duty priorities and the operational situation at the time. However, 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 will be required to examine aircrew and controller workloads. Analysis will be required to develop rules and procedures defining all factors associated with the application or operations. Examples include, but are not limited to:

- ADS-B specific phraseology for application/operations.
- Rules and procedures between pilot and controller for the positive transfer of separation responsibilities.
- Designated areas, conditions, and types of ADS-B operations authorized.
- Service provider procedures for mixed operations (ADS-B participants versus non-participants) environments.
- Rules governing airborne spacing and separation operations.
- Backup, contingency, and transition procedures when ADS-B surveillance is lost.

6.2.5 ADS-B Separation Standards

Analysis will be required to determine separation standards between mixed equipage targets received from different surveillance systems including the transition boundaries between these surveillance areas. Additional analysis is required to support reduced separation using ADS-B in En Route airspace. The goal is a common, standardized separation minimum for service providers. Future analysis will be undertaken to determine

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 TSO's that prescribe minimum performance standards for navigation equipment used by the civil aviation community. The 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 the ADS-B technologies and the Surveillance and Broadcast Services system. 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 Services
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 he 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

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
Incorrect Data broadcast by an aircraft due to data corruption	Incorrect data due to data corruption broadcast by the aircraft ADS-B transponder. The GPS 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

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
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.			

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
Loss of position accuracy of reported position	The accuracy performance of the navigational equipment in the aircraft has deteoriated 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

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
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 GPS 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			

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**
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

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**
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			

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
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 call sign	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

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
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

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
Mixed operating environment	Controller having different tracks to work with ADS-B, Flight Plan and SSR tracks this introduces the	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

— END —