INTERNATIONAL CIVIL AVIATION ORGANIZATION
NORTH AMERICAN, CENTRAL AMERICAN AND CARIBBEAN OFFICE

NAM/CAR AIR NAVIGATION IMPLEMENTATION WORKING GROUP MEETING (ANI/WG)
AUTOMATIC DEPENDENT SURVEILLANCE – BROADCAST (ADS-B) IMPLEMENTATION TASK FORCE

AUTOMATIC DEPENDENT SURVEILLANCE – BROADCAST (ADS-B) IMPLEMENTATION MEETING (ADS-B/IMP)

ADS-B/IMP

FINAL REPORT

MEXICO CITY, MEXICO, 27 TO 29 APRIL 2015

Prepared by the Secretariat

April 2015

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HISTORICAL

ii.1 Place and Date of the Meeting

The Automatic dependent surveillance – broadcast (ADS-B) Implementation Meeting (ADS-B/IMP) represented the ANI/WG Second NAM/CAR Air Navigation Implementation Working Group (ANI/WG) ADS-B Task Force Meeting (ADS-B/TF/2), and was held at the ICAO NACC Regional Office in Mexico City, Mexico, from 27 to 29 April 2015.

ii.2 Opening Ceremony

Mr. Jorge Fernández Chacón, Deputy Regional Director of the North American, Central American and Caribbean (NACC) Office of the International Civil Aviation Organization (ICAO) provided opening remarks and highlighted the ADS-B relevant tasks and deliverables to be done by the Meeting. Similarly, Mr. Julio C. Siu, Regional Officer, Communications Navigation and Surveillance (RO/CNS), provided a chronology and background of the activities to be done for the ADS-B implementation and the main goals to be accomplished by the ADS-B Task Force (TF) in accordance with the NAM/CAR Regional Performance-Based Air Navigation Implementation Plan (RPBANIP) targets and the NAM/CAR Air Navigation Implementation Working Group (ANI/WG) work programme. Mr. Carlos Jimenez, ADS-B Task Force Rapporteur, welcomed the participants and officially opened the meeting.

ii.3 Officers of the Meeting

Mr. Carlos Jimenez State, chaired the meeting plenary. Mr. Julio Siu, Regional Officer, Communications Navigation and Surveillance of the ICAO NACC Regional Office served as Secretary of the Meeting.

The meeting was conducted in plenary and Ad hoc groups were formed to discuss specific topics of the agenda.

ii.4 Working Languages

The working languages of the Meeting were English and Spanish.

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 16:30 hours with adequate breaks.

ii.6 Agenda

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

Agenda Item 2: Review and Update on ADS-B Activities by States

2.1 Implementation status and Regional ADS-B Plan
2.2 Trials and data analysis

Agenda Item 3: Review of ADS-B Regional Operational Concept (CONOPS)

Agenda Item 4: Review of ADS-B Receiver Specifications and Project RLA/09/801 — *Implementation of Performance Based Air Navigation Systems for the CAR Region* assistance

Agenda Item 5: Status of ADS-B on-board avionics and Air Navigation Services Provider (ANSP) System

Agenda Item 6: Review and update of the ADS-B Task Force Work programme

Agenda Item 7: Other Business

ii.7 Attendance

The meeting was attended by 11 States/Territories from the NAM/CAR Regions and 1 International Organization, totalling 41 delegates as indicated in the list of participants.

ii.8 Draft Conclusions and Decisions

The Meeting recorded its activities as Draft Conclusions and Decisions as follows:

DRAFT CONCLUSIONS: Activities requiring endorsement by the NAM/CAR Air Navigation Implementation Working Group (ANI/WG).

NO.	DRAFT CONCLUSIONS	PAGE
2/2	**SURVEILLANCE IMPLEMENTATION PLAN- ADS-B/MLAT FOLLOW-UP**	2-3
2/4	**ADS-B IMPLEMENTATION OPERATIONAL CONCEPT**	3-1
2/5	**TECHNICAL SPECIFICATIONS FOR ADS-B EQUIPMENT**	4-1
2/6	**ADS-B DATA PROCESSING CAPABILITIES**	5-1

ii.9 List of Working, Discussion and Information Papers, Discussion Papers and Presentations

WORKING PAPERS

Number	Agenda Item	Title	Date	Prepared and Presented by
WP/01	1	Review and Approval of Provisional Agenda and Schedule	05/03/15	Secretariat
WP/02	4	Proposal on ADS-B Equipment Specifications	23/04/15	ANI/WG ADS-B Spec Ad-Hoc Group Rapporteur
WP/03	2.1/2.2	ADS-B Implementation Progress	16/03/15	Cuba
WP/04	4	ICAO RLA/09/801 Project: ADS-B equipment specifications	24/04/15	Secretariat
WP/05	3	Proposal on ADS-B Regional Operational Concept (CONOPS)	25/04/15	ANI/WG ADS-B CONOPS Ad-Hoc Group Rapporteur

INFORMATION PAPERS

Number	Agenda Item	Title	Date	Prepared and Presented by
IP/01	----	List of Working, Information Papers and Presentations	24/04/15	Secretariat
IP/02	5	Differences between ADS-B Requirements Across the Globe	21/04/15	United States
IP/03	5	Performance of Current ADS-B Version 2 Systems	21/04/15	United States
IP/04	2.1	Status of ADS-B Equipage in the United States	21/04/15	United States
IP/05	2.1	ADS-B Implementation Status in the United States	21/04/15	United States
IP/06	2.1	Global Flight Tracking	23/04/15	Secretariat
NI/07	2.1	Santo Domingo ATC, Capacidades ADS-B (*available only in Spanish)*	28/04/15	Dominican Republic

DISCUSSION PAPERS

Number	Agenda Item	Title	Presented by
1	4	Proposal on ADS Equipment Specifications	ANI/WG ADS-B Spec Ad-Hoc Group Rapporteur
2	2.1	Surveillance Systems	ANI WG ADS-B Task Force Rapporteur
3	3	ADS-B OUT Operational Concept (CONOPS)	ANI/WG ADS-B CONOPS Ad-Hoc Group Rapporteur

PRESENTATIONS

Number	Agenda Item	Title	Presented by
1	2.2	Software for statistical analysis of surveillance data (ADS-B)	Cuba
2	2.2	Avances en la Implementación Sistemas ADS–B, COCESNA *(available only in Spanish)*	COCESNA
3	6	Progress of the Task Force ADS-B ANIWG	ADS-B Task Force Rapporteur
4	5	ADS-B Implementation and Status of CAR ANSP Automated System	Secretariat
5	2.1	Mexico ADS-B Project Preview	Mexico
6	2.1 / 2.2	ADS-B Planning Initiative	Trinidad and Tobago
7	2.1	ADS-B Operational Overview	Canada
8	5	Update on Space – Based ADS-B	Canada

Refer to the Meeting web page:
http://www.icao.int/NACC/Pages/meetings-2015-adbsimp.aspx

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Agenda Item 1 Review and Approval of Provisional Agenda and Schedule

1.1 Under WP/01, the Meeting approved with minor changes, the provisional agenda, working method and schedule of the meeting, referring to IP/01 with the list of associated documentation. The approved meeting agenda is presented in the historical section of this report.

Agenda Item 2: Review and Update on ADS-B Activities by States

2.1 Implementation status and Regional ADS-B Plan

2.1.1 Cuba presented under WP03, their progress achieved and experiences acquired with the ADS-B trials and tests of a Multilateration system, towards ADS-B implementation as an aeronautical surveillance system, highlighting the following:

- Six ADS-B stations that guarantee a Flight Information Region (FIR) full coverage with ADS-B OUT, as shown in Figure 1
- Results of the continuation of ADS-B Trials (since the end of 2014 and the beginning of 2015)
- The architecture and the results of the tests on their Multilateration (MLAT) system installed at the "*Juan Gualberto Gómez*" Varadero International Airport, in cooperation with the VNIIRA firm of St. Petersburg, Russian Federation.

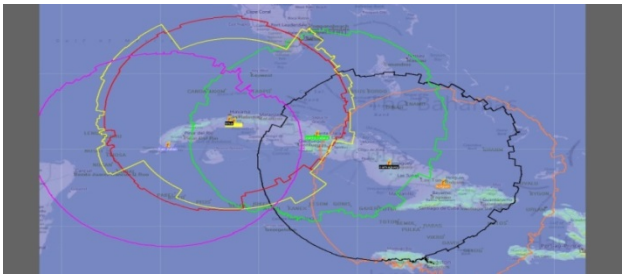
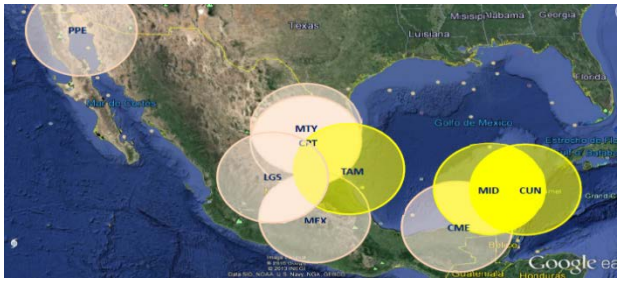


Fig. 1 ADS-B Coverage at 33000 feet in Habana FIR

2.1.2 Similarly, Cuba informed on the work that is being performed on the modernization of the automated Area Control Centre (ACC) Havana system, with a view, among other improvements, to be ready by 2018 in the mosaic of the surveillance screens of air traffic controllers, representation of information from secondary monopulse radars, together with ADS-B receivers data and the multilateration equipment to be installed.

2.1.3 Under P/02, COCESNA informed on their progress in the ADS-B implementation, with the continuation of their ADS-B testing and final adjustments to their ADS-B Station at Cerro de Hula. COCESNA commented on the testing with the data integrated to the new control center CENAMER; the continuous survey on statistics for aircraft capabilities equipped with ADS-B in the region, upgrading of their Mode S radars and the inclusion of ADS-B capability to cover the entire continental area by radar and the northern part of the Central American Flight Information Region (FIR) before 2018. The expansion of ADS-B coverage to the south of the Central American FIR that is not covered by radar (i.e. Isla El Coco), and the plans to conduct feasibility studies for MLAT systems with ADS-B capability to improve coverage for Air Traffic Control (ATC) terminal radar service at airports were also commented.

2.1.4 To increase safety and efficiency of air/ground operations, mainly about surveillance, separation, coverage redundancy and obtaining surveillance data in non-radar areas, Mexico informed under P/05, of their ADS-B Project. The Project includes the installation of 10 ADS-B stations on strategic sites to feed with ADS-B data (DO-260, DO- 260A and Asterix Cat 21) the existing 4 ACC systems to improve surveillance in the México Valley for ATC (Terminal Control Area (TMA) and helicopters operations), ATC in Monterrey Airport Terminal Area and Merida, Surveillance redundancy in Puerto Peñasco station and Surveillance of helicopters flying from/to oil Platforms on the Gulf of México



2.1.5 Moreover, Mexico commented that the ADS-B regulation has been developed following a similar approach to United States´ final rule for ADS-B. This regulation is on the consultation phase, being issued since 3 March and the deadline for comments is by **2 May 2015**.

2.1.6 The ADS-B Project also includes the collaborative initiative between "*Servicios a la Navegación en el Espacio Aéreo Mexicano*" (SENEAM) Mexican Air Navigation Service Provider (ANSP) and the Federal Aviation Administration (FAA) for sharing ADS-B Stations for the Gulf of Mexico operations to improve ATC in Cancun, Merida and Tampico, complete surveillance of helicopters flying from/to oil Platforms on the Gulf of México and enhance the Air Traffic Management (ATM) between both countries. A schedule for this implementation was provided also under P/05.

2.1.7 Under P/06, Trinidad and Tobago presented their ADS-B Planning Initiative, currently supported by a single antenna ADS-B Station and planning to expand their coverage with additional antennas. Data analysis results from the trials made in 2013 were presented.

2.1.8 The Meeting recalled the existing Mexico ADS-B Ad hoc Group for streamlining this implementation in Mexico. ICAO highlighted that Mexico could be the champion in the CAR Region on this implementation, and considering the ICAO NACC Office explicit support for this implementation, the following decision was adopted:

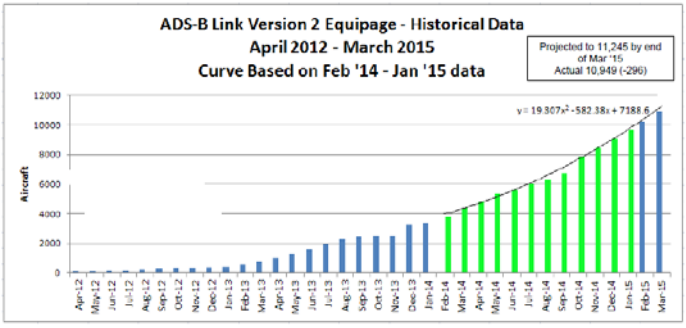
DECISION
ADS-B/TF/2/1 ADS-B IMPLEMENTATION IN MEXICO

That, in order to streamline and support the ADS-B implementation in Mexico, Mexico "*Direccion General de Aeronautica Civil*" (DGAC), SENEAM and the ICAO NACC Office:

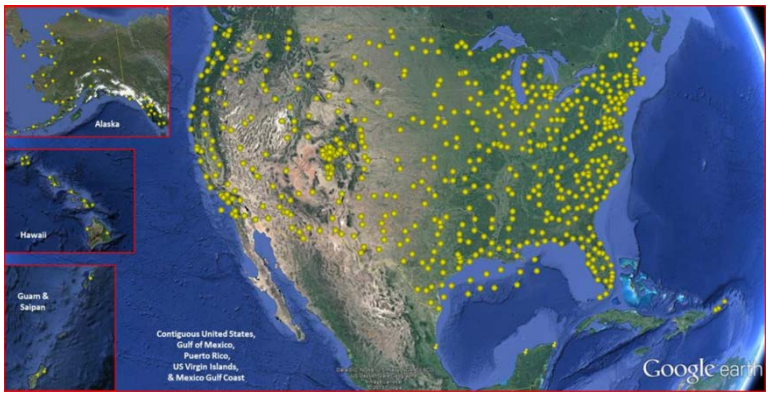
a) conduct the necessary coordination and discussion for this implementation; and

b) inform their progress to the next ADS-B Implementation Meeting/teleconference.

2.1.9 Under IP04, United States presented the increase of their ADS-B equipped aircraft (number of aircrafts in US Airspace identified as being equipped with DO-260B or DO-282B ADS-B Out equipment), FAA-Approved V2 ADS-B Out Avionics, FAA-Sponsored Projects that will result in Version 2 ADS-B Out Avionics, ADS-B Compliance Monitor, along with pertinent installation/configuration issues and the corrective actions taken to resolve them: creation of the ADS-B Focus Team to investigate compliance issues and work with owner/operators and industry to resolve them, support outreach programmes related to ADS-B, and provide ADS-B Avionics Checks. United States provided their reference on ADS-B Flight check for the Meeting consideration, FAA Order 8200.45.



2.1.10 Similarly, under IP05, United States provided an update on their ADS-B implementation activities, including regulatory, supporting committees, publications, Service Monitoring (Contract Technical Performance Monitoring, Avionics Compliance Monitor, Service Status Monitoring), FAA Surveillance and Broadcast Services Programme delivering Surveillance and Broadcast Services (SBS) through a set of FAA-specified service volumes in en-route airspace, terminal area airspace, and on airport surfaces. As of 31 March 2015, the "baseline" set of Service Volumes planned by the FAA in 2007 are operational, using data from 634 radio sites installed by Exelis.



2.1.11 Under P/07, Canada briefed the Meeting on their ADS-B operations, including their current Ground-based surveillance network, Regulatory approvals - safety case, Service Delivery using ADS-B Out, ADS-B related Aeronautical Information Publication (AIP), anomaly reporting and the NAV CANADA process for avionics anomalies.

2.1.12 Under IP/07, Dominican Republic presented a brief overview of the current state of surveillance service in the Santo Domingo FIR and on their plans for the evaluation and implementation of multilateration and Automatic Dependent Surveillance (ADS). The ADS-B plans seek to provide surveillance in areas of poor coverage at lower levels with three ADS-B receivers, one for the Terminal Control Area (TMA) Cibao, a second receiver in Loma Hoz and a third receiver to complement backup radar to satisfy the high traffic areas of the TMA's of Santo Domingo and Punta Cana.

2.1.13 Based on the existing Surveillance Plan of the CAR/SAM Air Navigation Plan, CNS Table 4, the Meeting reviewed this Plan to include the necessary implementation status for tracking ADS-B and MLAT implementation as shown in **Appendix A**. In this regard, the Meeting adopted the following draft conclusion:

DRAFT CONCLUSION

ADS-B/TF/2/2 SURVEILLANCE IMPLEMENTATION PLAN - ADS-B/MLAT FOLLOW-UP

That, in order to support the ADS-B implementation and MLAT in the CAR Region:

a) the Surveillance Plan shown in Appendix A to this report be adopted as a reference for planning and implementing ADS-B and MLAT systems; and

b) ICAO requests the update of this surveillance plan by **20 December 2015**.

2.2 Trials and data analysis

2.2.1 Under P/01, Cuba presented their software for statistical analysis of surveillance data, showing the features, facilities and reports available from the application and an implementation proposal and its advantages. **Appendix B** shows the results of the data analysis evaluation conducted with this application. 60% of aircrafts flying in Habana FIR are providing a valid ADS-B report.

2.2.2 From COCESNA´s presentation, 40% of aircraft flying the Central American FIR are providing valid ADS-B reports.

2.2.3 The Meeting congratulated Cuba for the development of this application and agreed that it should be available to any State that needs statistical processing software for testing ADS-B before transitioning to the operational implementation of ADS–B. In this regard, the following decision was adopted:

DECISION
ADS-B/TF/2/3 SOFTWARE FOR STATISTICAL ANALYSIS OF SURVEILLANCE DATA (ADS-B)

That, in order to support the ADS-B trials and data analysis on the ADS-B implementation:

a) States interested in using the software send an official letter to ICAO;

b) ICAO will inform Cuba the names of the countries that have requested; and

c) Cuba agreed with each state bilaterally the conditions for using the software.

2.2.4 Under IP/06, ICAO presented the Global Flight Tracking initiative, which involves the use of different technologies and particularly the space-based ADS-B application, informing on the efforts made to include the discussion of the frequency matters for making Space-based ADS-B operative in the ITU meeting.

2.2.5 In this regard, Canada under P/08, provided an overview of the Service Delivery Future - Aireon space-based ADS-B, detailing the benefits, the Aireon ADS-B via Low Earth Orbit (LEO) Satellites, the companies participating in this service, Aircraft equipage requirements, Air Naviagtion Service Providers (ANSPs) consideration, implementation Plan, and the concept of Aireon ALERT (www.aireon.com/ALERT). Canada indicated that when the service is already implemented, each interested State/ANSPs shall contact Aireon to hire the data service volume needed.

Agenda Item 3: Review of ADS-B Regional Operational Concept (CONOPS)

3.1 Using the draft CONOPs document presented under WP/05 by the CONOPS Ad hoc group, the CONOPS Ad hoc group reviewed this draft and elaborated a new version as presented in **Appendix C.** Considering the relevance and importance of this CONOPS Document, the Meeting adopted the following draft conclusion:

DRAFT CONCLUSION
ADS-B/TF/2/4 ADS-B IMPLEMENTATION OPERATIONAL CONCEPT

That in order to support and guide the ADS-B out implementation in the CAR Region and to achieve the regional milestone date of **December 2018**, the Regional ADS-B CONOPS Document (Appendix C to this report) be adopted as a guidance for planning and implementing ADS-B service to the States/Territories in the region.

3.2 The Meeting identified several updates to the ADS-B CONOPS document, for which the ADS-B TF Rapporteur will ensure that a final version is available for its presentation to the ANI/WG/2 Meeting and its final approval.

Agenda Item 4: Review of ADS-B Receiver Specifications and Project RLA/09/801 — *Implementation of Performance Based Air Navigation Systems for the CAR Region* assistance

4.1 Under WP/02, the Meeting was informed of a draft document on technical specifications, developed by the ANI/WG ADS-B Spec Ad-Hoc Group Rapporteur and to serve as a reference for States/ANSPs planning on acquiring this equipment, as well as for the Project RLA/09/801 — *Implementation of Performance Based Air Navigation Systems for the CAR Region* activities.

4.2 Similarly, under WP/04, ICAO recalled that the RLA/09/801 Project is a regional tool agreed to support the implementation of Air navigation and Safety matters in the CAR Region, one of the supporting activities of the project is the lending of ADS-B Equipment to allow the familiarization and State involvement in the ADS-B use for the projection of its final implementation by the end of 2018. For this equipment sharing, the Project will conduct a tender process for its acquisition and will define a sharing procedure among the Project Members. For the acquisition of technical specifications for the desired ADS-B equipment, the ANI/WG ADS-B TF was required for its support on the development of these specifications.

4.3 Using the two previous mentioned working papers, the ADS-B Spec Ad-Hoc Group Rapporteur developed an updated version with a view to be used by those States that have not initiated the testing phase of ADS-B and pre-operational implementation of ADS-B in the CAR Region. The ADS-B Technical Specifications Document is shown in **Appendix D**. In this regard, the following draft conclusion was proposed:

DRAFT CONCLUSION
ADS-B/TF/2/5 TECHNICAL SPECIFICATIONS FOR ADS-B EQUIPMENT

That in order to support and guide the ADS-B out implementation in the CAR Region and to achieve the regional milestones by **December 2018**, the ADS-B Technical specifications document (Appendix D to this report) be adopted as a guidance for acquiring and implementing ADS-B Service.

4.4 The Meeting identified some updates to the Technical Specifications document, for which the ADS-B TF Rapporteur will ensure that a final version is available for its presentation and final approval at the ANI/WG/2 Meeting.

Agenda Item 5: Status of ADS-B on-board avionics and Air Navigation Services Provider (ANSP) System

5.1 ICAO informed the Meeting that IATA will provide to the ADS-B TF the assigned on-board avionics information to the ANI/WG/2 Meeting.

5.2 Under IP/02, United States presented information on the differences in ADS-B requirements across the globe, describing United States ADS-B performance requirements different from other countries and the differences between the United States rules and foreign requirements. Comparison between United States and other countries is shown in **Appendix E**.

5.3 United States presented under IP/03, their analyses of observed ADS-B Version 2 quality parameters in comparison to the requirements of the United States ADS-B Out rule.

5.4 Under P/04, ICAO recalled several ADS-B/MLAT implementation considerations and the existing Regional CAR/SAM ADS-B Implementation Guidance, as well as the Operational Scenario for the CAR Region, highlighting the following:

a) Full radar coverage in the upper airspace for all the CAR Region
b) Some non-radar airspaces at low altitudes
c) Full and up-to-date regional telecommunication services and capabilities
d) Several radar data sharing activities completed and some in process

5.5 Finally, ICAO presented the ANSPs ADS-B Data Processing capabilities as shown in **Appendix F**. In this regard, the following draft conclusion was adopted:

DRAFT CONCLUSION
ADS-B/TF/2/6 ADS-B DATA PROCESSING CAPABILITIES

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

b) ICAO requests the confirmation of these capabilities to all the CAR States by **December 2015**.

Agenda Item 6: Review and update of the ADS-B Task Force Work programme

6.1 Under P/03, the Meeting recalled the ADS-B Task Force Terms of Reference (ToRs) and reviewed and update its work programme as shown in **Appendix G**. This update will be presented to the ANI/WG/2 Meeting in June 2015.

6.2 Similarly, the ADS-B TF Rapporteur highlighted the different NAM/CAR Regional Performance-Based Air Navigation Implementation Plan (RPBANIP) targets that are related to ADS-B as follows:

Element	Targets	Source of data to measure it/supporting body	Action needed/Concern
1. Surveillance System for Ground Surface Movement (PSR, SSR, ADS B or Multilateration)	30% of selected aerodromes with SMR/ SSR Mode S/ ADS-B/ Multilateration for ground surface movement by June 2018 States/airport operator	Regional ADS-B/MLAT Plan for selected aerodromes (TBD) / ADS-B TF	• Define criteria for selecting the aerodrome with SMR/ SSR Mode S/ ADS-B/ Multilateration (AGA) • Define selection
2. On-board Surveillance Systems (transponder with ADS-B capacity)	20% of aircraft on the NAM/CAR State registries to have surveillance system on board (SSR transponder, ADS B capacity) by June 2018 Aircraft operators	IATA and States (General aviation) / ADS-B TF	• Define total aircraft registry in NAM/CAR • Define procedure for data collection from States/IATA
3. Vehicle Surveillance Systems	20% of vehicles at selected aerodromes with a cooperative transponder systems by June 2018 Vehicle operators	Regional ADS-B/MLAT Plan for selected aerodromes (TBD) / ADS-B TF	• Define of cooperative transponder system for vehicles • Define criteria for selecting the aerodrome where vehicles are to have collaborative transponders (AGA) • Define selection
4. Implementation of ADS-B	30% of selected aerodromes with ADS-B implemented by Dec 2018	Regional ADS-B/MLAT Plan for selected aerodromes (TBD) / ADS-B TF	• Define criteria for selecting the aerodrome with ADS-B • Define selection
5. Implementation of Multilateration	80% of multilateration system implemented in selected aerodromes by June 2018	Regional ADS-B/MLAT Plan for selected aerodromes (TBD) / ADS-B TF	• Define criteria for selecting the aerodrome to have Multilateration System • Define selection

6.3 The Meeting recognized the need to define the criteria on "*selected aerodromes*" on the ADS-B related metrics:

- 30% of selected aerodromes with Surface Movement Radar (SMR)/ Secondary Surveillance Radar (SSR) Mode S/ADS-B/ Multilateration for ground surface movement by **June 2018**
- 20% of vehicles at selected aerodromes with a cooperative transponder systems by **June 2018**
- 30% of selected aerodromes with ADS-B implemented by **Dec 2018**
- 80% of multilateration system implemented in selected aerodromes by **June 2018**

6.4 Dominican Republic (Julio Mejia), Mexico (Jose de Jesus) and United States (Alex Rodriguez and Doug Arbuckle) volunteered to work on this definition, supported by ICAO. In this regard, the following decision was adopted:

DECISION
ADS-B/TF/02/07 DEVELOPMENT OF SELECTION CRITERIA FOR ADS-B METRICS

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.

Agenda Item 7: Other Business

7.1 The ADS-B TF Rapporteur informed the Meeting of the preparation of working papers for the ANI/WG/2 Meeting to report the progress made by the TF. Similarly, the Meeting was invited to attend the ANI/WG/2 Meeting, where the Task Forces will be able to meet prior to the final presentation of their works.

Taken from TABLE CNS 4A – Tomado de TABLA CNS 4A

SURVEILLANCE SYSTEMS - SISTEMAS DE VIGILANCIA

EXPLANATION OF THE TABLE

Column

1 Name of State/Territory and location of the surveillance station

2 Air traffic services unit served by the facility

3 PSR/Function - Primary surveillance radar/Function
E - En-route area control centres
T - Terminal

4 Coverage of primary surveillance radar in nautical miles

5 PSR/Status - Primary surveillance radar/Status of implementation

6 SSR/MSSR/Function - Secondary surveillance radar/Monopulse secondary surveillance radar/Function
E - En-route area control centres
T - Terminal

7 SSR/MSSR/Modes - Modes A, C or S

8 Coverage of secondary surveillance radar in nautical miles

9 SSR/MSSR/Status - Secondary surveillance radar/Monopulse secondary surveillance radar/Status of implementation

10 ADS-B Function

11 ADS-B Implementation Status

12 ADS-C Function

13 ADS-C Implementation Status

14 MLAT Function

15 MLAT Implementation Status

Note.- The following codes are to be used for columns 5, 9, 11, 13 and 15:

5, 9, 11,13 and 15 I – Implementation of the surveillance system (this includes the ATS automation capability to present the information in the ATC)
I* - Partially implemented (indicate in column 16)
I/P - (Implemented/foreseen) Indicates implemented and a surveillance improvement/replacement to be done in the next two years
P (date) - Planned – not implemented- Include implementation date
NP - (Not planned)
T- Test (end date)

Note.- The following codes are to be used in columnas 10, 12 and 14

E – enroute ATC
T - Terminal
SM- Surface Movement Control / Control de Movimiento de Superficie

16 Remarks

Associated to field I* of column 15: A- Automation no concluded / C- required communications not completed

EXPLICACIÓN DE LA TABLA

Columna

1 Nombre del Estado/Territorio y ubicación de la estación de vigilancia

2 Dependencia de los servicios de tránsito aéreo servida por la instalación

3 Función PSR - Función/Radar primario de vigilancia
E - Centros de control de área en ruta
T - Terminal

4 Cobertura del radar primario de vigilancia en millas marinas

5 Situación PSR - Situación de la implantación/Radar primario de vigilancia

6 Función SSR/MSSR - Función/Radar secundario de vigilancia/Radar secundario de vigilancia de monoimpulso
E - Centros de control de área en ruta
T - Terminal

7 Modos SSR/MSSR - en Modos A, C o S

8 Cobertura del radar secundario de vigilancia en millas marinas

9 Situación SSR/MSSR - Situación de la implantación/Radar secundario de vigilancia/Radar secundario de vigilancia de monoimpulso

10 Función en que se proveerá servicio ADS-B

11 Situación de la implantación

12 Función en que se proveerá servicio ADS-C

13 Situación de la implantación

14 Función en que se proveerá servicio MLAT

15 Situación de la implantación

Nota.- Los códigos siguientes se utilizan en las Columnas 5, 9, 11, 13 y 15:

5, 9, 11,13 y 15 I - Implantado el sistema de vigilancia indicado (esto incluye la capacidad de automatización requerida para su representación en el Control de Tránsito Aéreo)

I* - Implantado parcialmente (indicar en la casilla 16)
I/P - (Implantado/previsto) implantada y ampliación o reemplazo del sistema de vigilancia indicado a corto plazo (dos años)
P (fecha) - Previsto - Sin implantar- Incluir fecha de implementación
NP - (No previsto) Indica que el Estado no ha previsto la implantación del sistema de vigilancia indicado
T- Test (fecha limite)

Nota.- Los códigos siguientes se utilizan en las Columnas 10, 12 y 14

E - Centros de control de área en ruta
T - Terminal
SM- Control de Movimiento de Superficie

16 Observaciones a sistemas de vigilancia
Asociada a I* de campo 15: A- no se ha concluido la automatización / C- no se cuenta con las comunicaciones requeridas

State(Territory)/Location Estado(Territorio)/Ubicación	ATS Unite Served Unidad ATS Servida	PSR			SSR				ADS-B		ADS-C		MLAT		Remarks Observaciones
		Function Función	Coverage Cobertura (NM)	Status Impl. Estado	Function Función	Modes Modos (A,C&S)	Coverage Cobertura (NM)	Status Impl. Estado	Function Función	Status Impl. Estado	Function Función	Status Impl. Estado	Function Función	Status Impl. Estado	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
ANGUILLA (UK)								NP							
ANTIGUA & BARBUDA															
Airport (4 NM North)	V.C. Bird APP				T	A/C	180	I*							* MSSR
ARUBA (Kingdom of the Netherlands)															
	Reina Beatrix APP	T	80	I	T	A/C	256	I*							*MSSR
BAHAMAS															
Nassau	Miami ACC	E/T		I	E/T	A/C	200	I	NP	NP	NP	NP	NP	NP	Installing MSSR End 2015
	Nassau APP														
BARBADOS															
Airport	Adams APP				T	A/C	250	I*							*MSSR
BELIZE															
	Belize APP				E/T	A/C	250	I							*MSSR
COSTA RICA															
El Coco	El Coco APP	E/T	60	I	E/T	A/C	245	I							*MSSR MODOS
POAS					E/T	A/C & S	250	I*							
CUBA															
Camagüey	Habana ACC				E/T	A/C	200	I/P*	T	T	NP	NP	NP	NP	*MSSR
	Camagüey APP														
Habana	Habana TMA	T	60	P	T	A/C	200	I/P*	T	T	NP	NP	P	P (2017)	*MSSR
	Habana APP														

State(Territory)/Location Estado(Territorio)/Ubicación	ATS Unite Served Unidad ATS Servida	PSR			SSR				ADS-B		ADS-C		MLAT		Remarks Observaciones
		Function Función	Coverage Cobertura (NM)	Status Impl. Estado	Function Función	Modes Modos (A,C& S)	Coverage Cobertura (NM)	Status Impl. Estado	Function Función	Status Impl. Estado	Function Función	Status Impl. Estado	Function Función	Status Impl. Estado	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Holguín	Habana ACC				E/T	A/C	200	I/P*	T	T	NP	NP	NP	NO	*MSSR
	Santiago de Cuba TMA														
	Holguín APP														
Menocal	Habana ACC				E/T	A/C	200	I/P*	T	T	NP	NP	NP	NP	*MSSR
	Habana TMA														
	Habana APP														
	Varadero APP														
San Julián	Habana ACC				E	A/C	200	I/P*	T	T	NP	NP	NP	NP	*MSSR
Sta. Clara	Habana ACC				E	A/C	200	I/P*	T	T	NP	NP	NP	NP	*MSSR
Varadero									T	T	NP	NP	NP	NP	
DOMINICA															
				NP				NP							
DOMINICAN REPUBLIC															
Puerto Plata	Puerto Plata APP	E/T	74	I										P	
Punta Cana	Santo Domingo ACC	E/T	60	I	E/T	A/C/S	250	I	E/T	P					MSSR
	Punta Cana APP	T							E/T	P					
Santo Domingo	Santo Domingo ACC	E/T	60	I	E/T	A/C/S	250	I	E/T	P					MSSR
	Santo Domingo APP														
EL SALVADOR															
El Salvador	El Salvador APP	T		I	T	A/C	200	I*							*MSSR
Ojo de Agua,	El Salvador APP				E/T	A/C	250	I*							*MSSR
FRENCH ANTILLES															
Fort-de-France	Fort-de-France APP				T	A/C	250	I*							*MSSR
Point-à-Pitre	Point-à-Pitre APP				T	A/C	250	I*							*MSSR

State(Territory)/Location Estado(Territorio)/Ubicación	ATS Unite Served Unidad ATS Servida	PSR			SSR				ADS-B		ADS-C		MLAT		Remarks Observaciones
		Function Función	Coverage Cobertura (NM)	Status Impl. Estado	Function Función	Modes Modos (A,C& S)	Coverage Cobertura (NM)	Status Impl. Estado	Function Función	Status Impl. Estado	Function Función	Status Impl. Estado	Function Función	Status Impl. Estado	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
GRENADA															
	Point Salines APP							NP							
GUATEMALA															
C. Guatemala	La Aurora APP	T	80	I	T	A/C	250	I	---	N/P	---	---	---	N/P	*MSSR
San José Escuintla	San José TWR	----	80	---	T	A/C	250	I*	---	---	---	---	---	---	MSSR
Santa Elena	Tikal APP	T	80	----	T	A/C	250	I*	---	---	---	---	---	---	MSSR
GUYANA															
	Georgetown ACC							NP							
HAITI															
	Port-au-Prince ACC				E/T	A/C		P*							*MSSR
	Port-au-Prince APP				T	A/C		P*							*MSSR
HONDURAS															
San Pedro Sula	La Mesa APP				T	A/C	250	I							*MSSR
JAMAICA															
Kingston	Kingston APP	T	60	I	E/T	A/C	250	I*	E/T	P 2017	---	N/P	---	N/P	*MSSR
Montego Bay	Montego Bay APP	T	60	I	T	A/C	250	I*	E/T	P 2017	---	N/P	---	N/P	*MSSR
Mount Denham	Kingston ACC	E	120	I	E	A/C	250	I*	E/T	P 2017	---	N/P	---	N/P	*MSSR
MEXICO															
Acapulco	Acapulco APP				T	A/C	240	I*	E	P	2016				*MSSR
Bajio Gto	México ACC				E/T	A/C, S	240	I*							*MSSR
	Bajio APP														
Cancún	Mérida ACC	E/T	60	I	E/T	A/C	240	I*							*MSSR

State(Territory)/Location Estado(Territorio)/Ubicación	ATS Unite Served Unidad ATS Servida	PSR			SSR				ADS-B		ADS-C		MLAT		Remarks Observaciones
		Function Función	Coverage Cobertura (NM)	Status Impl. Estado	Function Función	Modes Modos (A,C& S)	Coverage Cobertura (NM)	Status Impl. Estado	Function Función	Status Impl. Estado	Function Función	Status Impl. Estado	Function Función	Status Impl. Estado	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
	Cancún APP		60	I	T	A/C/S	240								PSR MSSR
Cerro Gordo	México ACC		200	I	E	A/C	240	I*	E	I					*MSSR
	Monterrey ACC		80	I	T	A/C/S	240								PSR MSSR
Cerro Potosi	Monterrey ACC	E	200	I	E	A/C	240	I*	E	I					*MSSR
	México ACC														
Cerro Rusias	Mazatlán ACC		200		E	A/C	240	I*	E	I					*MSSR
	México ACC														
	Monterrey ACC														
Cerro Los Gallos	Mazatlán ACC				E	A/C	240	I*							*MSSR
	México ACC														
	Monterrey ACC														
Cerro Santa Eulalia	Monterrey ACC		200		E/T	A/C	240	I*	E	P	2015				*MSSR
	Chihuahua APP														
Guadalajara	Guadalajara APP	T	80	I	T	A/C	240	I*		P	2016				*MSSR
Hermosillo	Mazatlán ACC				E/T	A/C	240	I*		P	2017				*MSSR
	Hermosillo APP														
	Tijuana APP														
La Paz	Mazatlan ACC				E/T	A/C	240	I*		P	2017				*MSSR
	San Jose del Cabo														
Los Mochis	Mazatlán ACC				E	A/C	240	I*							*MSSR
Mazatlán	Mazatlán ACC				E	A/C	240	I*		P	2016				*MSSR
Mérida	Mérida ACC	E/T		I	E/T	A/C	240	I*							*MSSR
	Mérida APP														
Monterrey	Monterrey ACC	E/T	80	I	E/T	A/C	240	I*	T/E	1					*MSSR
	Monterrey APP														
Peñón	México APP	E/T	80	I	E	A/C	240	I*	T/E	1					*MSSR
Puerto Peñasco	Mazatlán ACC				E	A/C	240	I*	E	P	2016				*MSSR
Puerto Vallarta	Puerto Vallarta APP				T	A/C	240	I*							*MSSR
San José del Cabo	Mazatlán ACC				E	A/C, S	240	I*		P	2016				*MSSR
Tampico	México ACC				E	A/C, S	240	I*	E	I					*MSSR

State(Territory)/Location Estado(Territorio)/Ubicación	ATS Unite Served Unidad ATS Servida	PSR			SSR				ADS-B		ADS-C		MLAT		Remarks Observaciones
		Function Función	Coverage Cobertura (NM)	Status Impl. Estado	Function Función	Modes Modos (A,C& S)	Coverage Cobertura (NM)	Status Impl. Estado	Function Función	Status Impl. Estado	Function Función	Status Impl. Estado	Function Función	Status Impl. Estado	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
	Mérida ACC														
	Monterrey ACC														
Tijuana	Tijuana APP				T	A/C	240	I*	T/E	P	2017				PSR/MSSR
Toluca	México ACC	E/T	80	I	E/T	A/C	240	I*							PSR/MSSR
	Toluca APP														
Mexico AICM TWR									T/E	I					
Cerro Catedral									E	I					
Cd del Carmen-Merida									E	I					
Culiacan Mazatlam			200		E	A/C	240			P	2016				
Veracruz	México ACC				E	A/C	240	I*		P	2016				*MSSR
	Mérida ACC														
Villahermosa	México ACC				E	A/C, S	240	I*		P					*MSSR
Torreon	Monterrey ACC	E	200		E	A/C	240	I	E	P	2016				MSSR
Tuxtla Gutierrez	Merida ACC	E	200		E	A/C	240	I	E	P	2016				
MONTSERRAT (United Kingdom)								NP							
NETHERLANDS ANTILLES (Netherlands)															
Willemstad	Curaçao ACC	E/T	120	I	E/T	A/C	256	I*							*MSSR
	Curaçao APP														
Saint Maarten	Juliana APP	T	60	I	T	A/C	256	I*							*MSSR
NICARAGUA															*MSSR
Managua	Managua APP	T	60	P	T	A/C	250	I							Modo S
Bluefields	Bluefields TWR				T	A/C	250	NI							
PANAMA															
Panamá	Panamá ACC	T	60	I	E/T	A/C	200	I*							*MSSR

State(Territory)/Location Estado(Territorio)/Ubicación	ATS Unite Served Unidad ATS Servida	PSR			SSR				ADS-B		ADS-C		MLAT		Remarks Observaciones
		Function Función	Coverage Cobertura (NM)	Status Impl. Estado	Function Función	Modes Modos (A,C& S)	Coverage Cobertura (NM)	Status Impl. Estado	Function Función	Status Impl. Estado	Function Función	Status Impl. Estado	Function Función	Status Impl. Estado	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
	Panamá APP														
PUERTO RICO (United States)															
Pico del Este	San Juan ACC	E/T	200	I	E/T	A/C	200	IP*							*MSSR
San Juan	San Juan APP	E/T	60	I	E/T	A/C	180	I							
SAINT KITTS AND NEVIS								NP							
SAINT LUCIA															
	Santa Lucia APP							NP*							* Radar data sharing with Martinica planned/ Proyecta compartir datos radar con Martinica.
SAINT VINCENT & THE GRENADINES															
	E.T.Joshua APP							NP							
SURINAME								NP							
TRINIDAD & TOBAGO															
Mt Catherine	Piarco ACC	E/T	80	I	E/T	A/C	250	I	E/T	I*	E	I*	NP	NP	*Items under test
	Piarco APP														

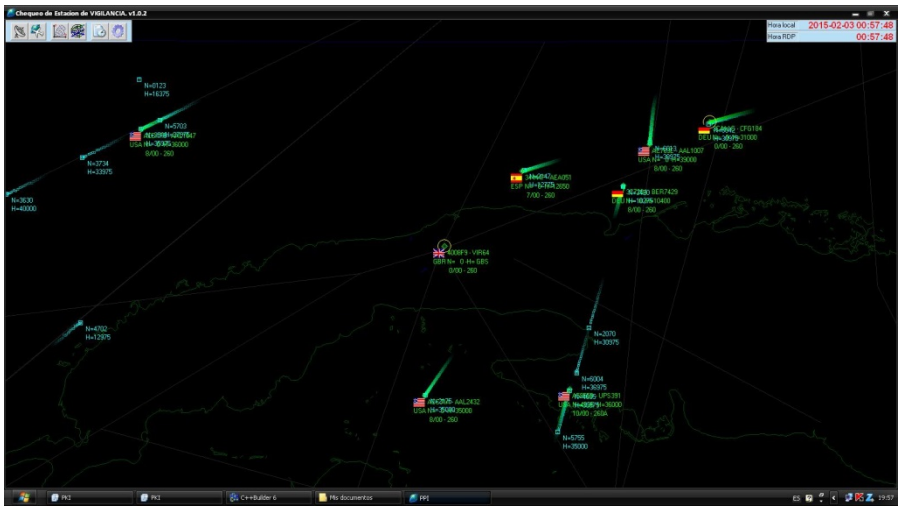
State(Territory)/Location Estado(Territorio)/Ubicación	ATS Unite Served Unidad ATS Servida	PSR			SSR				ADS-B		ADS-C		MLAT		Remarks Observaciones
		Function Función	Coverage Cobertura (NM)	Status Impl. Estado	Function Función	Modes Modos (A,C&S)	Coverage Cobertura (NM)	Status Impl. Estado	Function Función	Status Impl. Estado	Function Función	Status Impl. Estado	Function Función	Status Impl. Estado	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
TURKS & CAICOS IS. (United Kingdom)															
Grand Turks	Miami ACC				E	A/C	250	IP*							*MSSR
	San Juan ACC														
VIRGIN IS. (United Kingdom)															
								NP							
VIRGIN IS. (United States)															
Saint Thomas	San Juan ACC	E/T	60	I	E/T	A/C	180	I							
	San Juan APP														
COCESNA															
Cerro Santiago, Guatemala	CENAMER ACC				E	A/C/S*	250	I/P*							*MSSR-Modo S
Costa Rica	CENAMER ACC				E/T	A/C/S*	250	I							*MSSR-Modo S
	El Coco APP														
Grand Cayman, Cayman I.	CENAMER ACC				E/T	A/C/S*	250	I*							*MSSR-Modo S
	Owen Roberts TWR														
Mata de Caña, Costa Rica	CENAMER ACC				E	A/C/S*	250	I							*MSSR-Modo S
Puerto Cabezas, Nicaragua	CENAMER ACC				E	A/C/S*	250	I							*MSSR-Modo S
Dixon Hill, Honduras	CENAMER ACC				E	A/C/S*	250	I*							*MSSR-Modo S
Monte Crudo, Honduras	CENAMER ACC				E	A/C/S*	250	I*							*MSSR-Modo S

— — — — — — — — — — — —

APPENDIX B

CUBA DATA ANALYSIS SOFTWARE

Illustration on the application screen and targets:



Mix representation screen

The software search parameters that are fully configurable, which are used for the processing that will define the tracking for each aircraft. This is done to really quantitatively assess aircrafts detected by each radar, ADS-B or MLAT station.

The fundamental premise of not losing a single received data, assess statistics more accurately and achieve a more thorough analysis to shape detection coverage (vertical and horizontal diagramme) is followed.

Here is some data obtained with the following search criteria implemented:

- Time Range: From 02/01/2015 to 01/03/2015.
- Flight Time: More than 00:10:00 - Less than 23:59:59.
- Region: HAV-FIR
- Flight Level: More than 10000 feet - Less than 55000 feet.
- NICp: More than 6 – Less than 11.
- DO-260: Version from 0 to 2.

Aircraft Reports:

- Messages Received: 789718
- Messages Analyzed: 121764
- In the FIR: 47442 (38.96%)

ADS-B Reports:

- Messages Received: 415382
- Messages Analyzed: 62117
  - In the FIR: 29153 (46.93%)
    - NIC: 24883 (85.35%)
    - DO-260: 29153 (100.00%)

General Comparison:

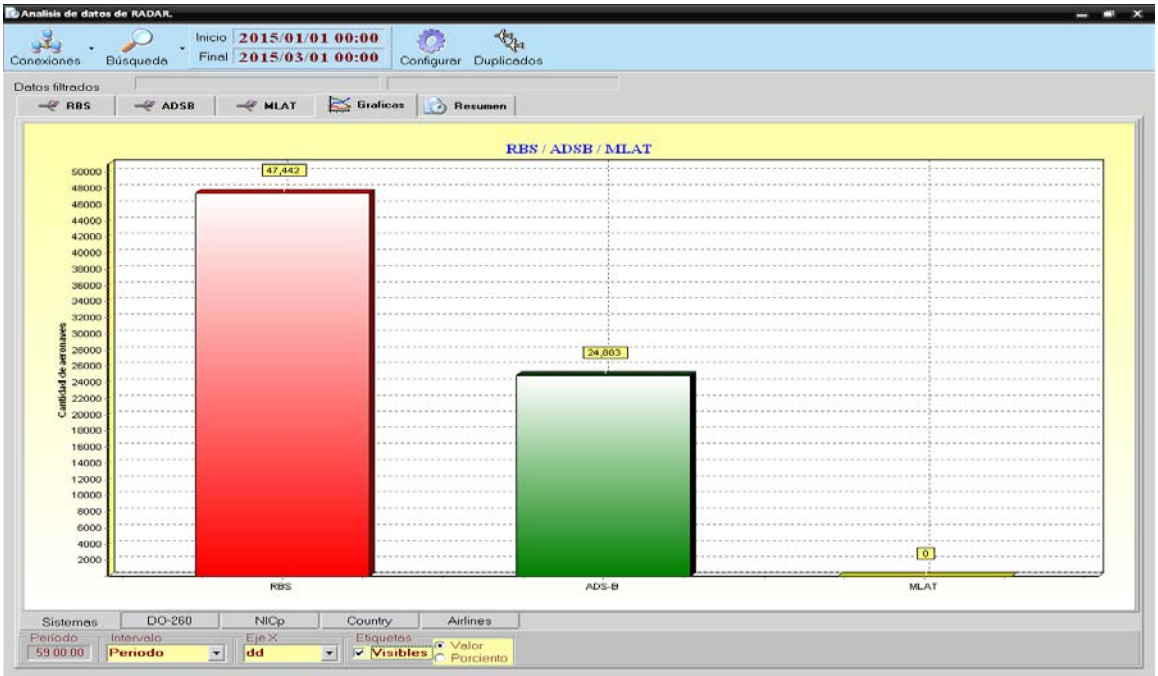
		A/C	ADS-B	
-	Received:	789718	415382	(52.59%)
-	Analyzed:	121764	62117	(51.01%)
-	In the FIR:	47442	29153	(61.45%)
-	Filtered:	47442	24883	(52.45%)

The Aircraft report shows that from 121764 objectives analyzed in the selected time interval, 47442 (38.96%) were within the selected region.

The ADS-B report shows that from 62117objectives analyzed, 29153 (46.93%) were within the selected region, which only 24883 (85.35%) met the filtering criteria set out in 2.4.

In a general way, comparatively it could be seen that from the radar total coverage (analyzed objectives) there were 51.01% of aircraft with ADS-B compared to those that respond in A/C and 61.45%. is the search region.

Meeting with the search criteria, it is shown that from 47442 aircraft that respond to A/C, only 24883 respond with ADS-B (52.45%).



Graphic 1. Comparison of signals received in A/C and ADS.B mode.

Similarly, the NIC indicator behavior was analyzed in the responses and found that over 85% of responses reported a NIC 8, 6% for NIC 7, the remaining below 1%. The following graphic shows the different NIC responses received:

Graphic.2 Different NIC responses received.

It is noteworthy that there have been several changes in the NIC values of a same aircraft during the flight, indicating changes in the on-board equipment internal parameters that determine this result, these changes being predominant in the approach and taxiing moments and in a lesser extent during routes.

In accordance to the analysis of the versions DO-260 received, it appears that more than 94.0% of the responses from the analysed aircraft, reported in DO-260, being around 2% those that reported in DO-260A and a 3.01% those corresponding to DO-260B, indicating a low implementation of this latest version, which apparently would be ultimately the one required for the operational input of ADS-B.

Graphic 3. Comparison between DO-260 versions received.

The analysis of trials for which the software was developed for the collection, processing and statistical representation of all data received on ADS-B has been kept, also has been satisfactory and constitutes an excellent tool for both, monitoring of the current trials, as well as for controlling the operation of the surveillance systems.

From the statistical analysis of ADS-B data received, it can be confirmed that about 60% of total aircraft flying over us respond to these systems.

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APPENDIX C

INTERNATIONAL CIVIL AVIATION ORGANIZATION
CAR/NAM MEXICO OFFICE

ADS-B OUT OPERATIONAL CONCEPT (CONOPS)

MEXICO CITY, MEXICO
28 APRIL 2015

1. INTRODUCTION

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1.2. Operational Use
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APPENDIX A – Definitions and Glossary
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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.
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 in 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- En-route.
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:

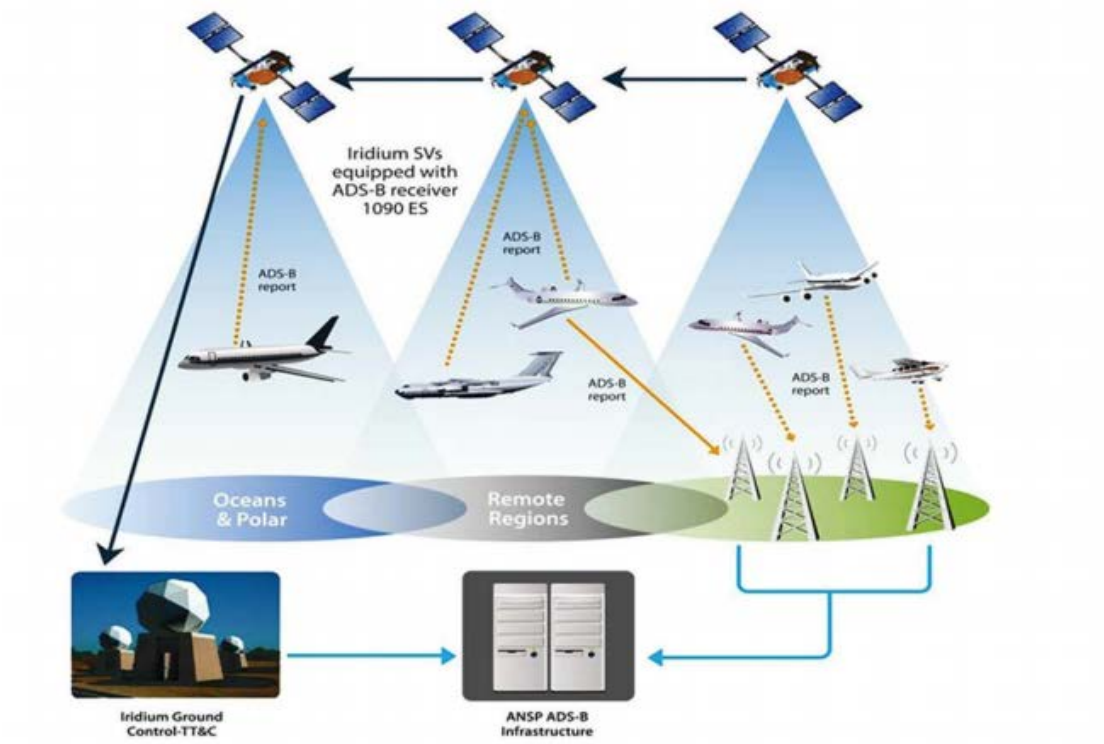

Image: AIRPLANE, Ground ADS-B ANTENNA, Iridium satellite (Space Base ADS-B), GPS Satellite and ATC Air Situation Display.

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- Space Based ADS-B Surveillance in Oceanic Airspace Concept of Operations Draft 0.2 dated February 1, 2012.
1.4.4- CAO Document 9854 "Global Air Traffic Management Operational Concept:" First Edition 2005
1.4.5- Doc 9689 Manual on Airspace Planning Methodology for the determination of separation Minima
1.4.6- DOC 4444, "Procedures for Air Navigation Services, Air Traffic Management", ICAO, November 2007
1.4.7- Annex 2 to the Convention on International Civil Aviation, "Rules of the Air", ICAO, November 2005
1.4.8- Annex 4 to the Convention on International Civil Aviation, "Aeronautical Charts", ICAO, July 2009.
1.4.9- Annex 11 to the Convention on International Civil Aviation, "Air traffic Services", ICAO, July 2001.
1.4.10- Annex 15 to the Convention on International Civil Aviation, "Aeronautical Information Services", ICAO, July 2013.
1.4.11- ICAO Cir 326, "Assessment of ADS-B and Multilateration Surveillance to Support Air traffic Services and Guidelines for implementation", ICAO, 2012
1.4.12- "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

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 near real-time, in-the-cockpit aeronautical information during flight operations.
- 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.

ADS-B uses existing ACARS equipment operating on a protected frequency of 1090 MHz.

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.
- ASDE-X (?)

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 En-route 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 en-route 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 and cockpit based situational awareness
- 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-B

5. – SYSTEM DESCRIPTION:

5.1. Surveillance and Broadcast Services 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. TIS-B and FIS-B services are supported by the Aircraft/Vehicle, Data Link Processor, and Broadcast Server functions. The ADS-B Rebroadcast (ADS-R) is implemented by the Aircraft/Vehicle and Data Link Processor functions.

5.2 Functional Description

The purpose of each function of the Surveillance and Broadcast Services System, how they interoperate with each other, and how the Surveillance and Broadcast 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 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 and TIS-B and ADS-R Messages transmitted by the Data Link Processor. Aircraft/Vehicles equipped with the 978 UAT data link additionally receive and decode FIS-B Messages transmitted by the Data Link Processor. The Aircraft/Vehicle may display ADS-B and TIS-B data on a CDTI/MFD. Properly equipped 978 UAT-equipped Aircraft/ Vehicles can display FIS-B data.

5.2.2 Data Link Processor.

The Data Link Processor receives ADS-B Messages broadcast by Aircraft/Vehicles over both the 978 UAT and 1090ES data links. The Data Link Processor processes the received ADS-B Messages, formats them into ADSB 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 Broadcast Server.

The Broadcast Server receives ADS-B Reports and status reports from the Data Link Processor. The Broadcast Server provides Surveillance and Broadcast Services information to authorized external users. The Broadcast Server includes a TIS-B Server function. The Broadcast Server receives surveillance data from radar and WAM systems and potentially other surveillance sources. The Broadcast Server processes the surveillance data, including tracking, filtering, and applying quality indicators to the data. The Broadcast Server generates TIS-B Reports and forwards them to the Data Link Processor. The Broadcast Server includes a FIS-B function. The Broadcast Server receives textual and graphical weather information and other data that will be used in generating FIS-B Reports. The Broadcast Server sends FIS-B Reports to the Data Link Processor. The Broadcast Server includes a control and monitoring function. The Broadcast Server provides an interface for control and monitor to the Maintenance Technician. The Broadcast Server provides control information to the Data Link Processor and receives monitor information from the Data Link Processor.

5.2.4 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. ATC Automation displays target positions based on ADS-B Reports. In addition, systems such as User Request Evaluation Tool (URET) will probe for conflicts between aircraft trajectories based on flight plan data and aircraft position information. In the future, new decision support tools will be implemented in the En Route, Terminal, and Surface Automation systems. These decision support tools may exchange information with the Broadcast Server to provide enhanced situational awareness to aircraft.

5.2.5 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.

5.2.6 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.

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Function	Service				
	Surveillance			Broadcast	
	ADSB	WAM	ADS-R	TIS-B	FIS-B
Aircraft /Vehicle (Para 5.2.1)					
Transmit	x	x			
Receive	X note		x	x	x
Data Link Processor (Para 5.2.2)					
Transmit			x	x	x
Receive	x	x	x		
Broadcast Server (Para 5.2.3)			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 Broadcast Services System functions are available and operational, all services can be provided, depending upon the implementation segment. In the case of the Broadcast Server, this also assumes that the interfacing systems providing the surveillance reports for TIS-B and weather and aeronautical data for FIS-B are operational and providing that data. Otherwise, the TIS-B and FIS-B services would not be 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 also NAS wide or 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, ADS-R, TIS-B, and FIS-B lost).

Degradation or failure of the Aircraft/Vehicle reception functionality would result in loss of ADS-B, ADS-R, TIS-B, and FIS-B information in the cockpit. The cockpit-based applications could no longer be supported in the failed aircraft, but could continue for other equipped aircraft in the vicinity.

5.3.2.2 Loss of Transmit Capability (TIS-B and FIS-B available, ADS-B ground-to-air and ADS-R 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. If the aircraft is in coverage of another surveillance source, the TIS-B service would begin including that aircraft's information in TIS-B message transmissions. This would permit the continuation of cockpit-based situational awareness and spacing applications, but cockpit-based separation applications would not be supported for the failed aircraft. Additionally, other equipped aircraft in the vicinity could not perform cockpit-based separation applications involving the failed aircraft.

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 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 NAS-wide or regional loss of ADS-B and ADS-R 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 their own position reference, as well as, surveillance information on other ADS-B equipped aircraft in the vicinity. The Aircraft/Vehicle would be able to receive TIS-B and FIS-B transmissions, providing some situational awareness applications. FAA Surveillance and Broadcast Services Concept of Operations (CONOPS) SBS-006, Rev.06 – June 26, 2012 Page 39 of 66 5.3.3 Data Link Processor Degradation or Loss.

5.3.3.1 Loss of ADS-B Reception Capability (TIS-B & FIS-B available, ADS-B air-to ground & ADS-R lost).

Degradation or loss of the Data Link Processor reception would result in the loss of ADS-B, supporting core surveillance applications. ADS-R would additionally be lost. As the TIS-B service continues to be available, information on all aircraft in coverage of another surveillance system would be broadcast, continuing support for cockpit-based situational awareness and spacing applications in that airspace. And, TIS-B would unnecessarily generate radar-based target reports on ADS-B aircraft resulting in aircraft receiving two reports (TIS-B generated and ADS-B aircraft generated) on a single aircraft.

5.3.3.2 Loss of ADS-B Transmit Capability (ADS-B available, ADS-R, TIS-B, & FISB lost).

Degradation or failure of the Data Link Processor transmit would result in loss of ADS-R, TIS-B, and FIS-B, thus loss of all cockpit-based applications other than pair-wise applications for the airspace covered by that Data Link Processor.

5.3.4 Broadcast Server Degradation or Loss (ADS-B & ADS-R available, TIS-B & FIS-B lost).

Degradation or loss of the Broadcast Server, or supporting data sources, would impact only the TIS-B and FIS-B services, supporting the cockpit-based situational awareness and spacing applications. It's expected that the Broadcast Server will have system-specific back-up strategies.

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 and Broadcast Services 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 and Broadcast Services **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 to provide sensor measurements and/or track data for the TIS-B uplink.

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

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APPENDIX D

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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APPENDIX E

COMPARISON OF US AND OTHER ADS-B MANDATES/REQUIREMENTS

Parameters	U.S./Mexico	E.U.	Australia[1]	Other[2]
Length and width of the aircraft	R	R	O	O
Latitude and longitude	R	R	R	R
Barometric pressure altitude	R	R	R	R
Velocity	R	R	O	O
TCAS II or ACAS is installed & operating in a mode that can generate resolution advisories	R	R	O	O
If a resolution advisory is in effect when an operable TCAS II or ACAS is installed	R	R	O	O
Mode 3/A transponder code	R	R	O	O
Aircraft Identification (the aircraft's call sign)	R	R	R	R
An emergency, radio, communication failure, or unlawful interference indication	R	R	O (allows generic EMG)	R[3] (allows generic EMG)
''IDENT'' indication (SPI)	R	R	O	O
Assigned ICAO 24-bit address	R	R	R	R
Emitter category	R	R	O	O
ADS–B In capability	R	O	O	O
Geometric altitude	R	R	O	O
Navigation Accuracy Category for Position (NAC_P)	R ≥8	R (≥7)	R (DO260A/B)	R
Navigation Accuracy Category for Velocity (NAC_V)	R ≥1	R (≥1)	O	O
Navigation Integrity Category (NIC)	R ≥7	R (≥6)	R (or NUC in DO260)	R (or NUC in DO260)
System Design Assurance (SDA)	R ≥2	R ≥2	O	O
Source Integrity Level (SIL)	R =3	R =3	R (≥2 for ATC)	R
Version number	R =2[4]	R =2[5]	R	R
Geometric Vertical Accuracy (GVA)	O	R	O	O
Vertical rate	O	R	O	O
GNSS antenna offset	O	R	O	O
Selected altitude	O	R	O	O
Barometric pressure setting	O	R	O	O

R = required information; O = optional

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[1] Australia requires DO-260 (Version 0) ADS-B above flight level (FL) 285 in its domestic airspace, but allows & encourages later ADS-B versions. Australia has a forward-fit GPS mandate for which requires SA-Aware receivers on newly registered aircraft in 2016. Australia also has an ADS-B forward fit requirement from Feb 2014, and an ADS-B mandate for all IFR aircraft by Feb 2017.

[2] This column describes the European Aviation Safety Agency (EASA) Acceptable Means of Compliance (AMC) 20-24 standard used by Canada and many countries in the ICAO Asia-Pacific region; this is the default minimum standard for providing ATC separation in non-radar airspace. Even though AMC 20-24 lists "Velocity" as optional, there are no known aircraft implementations without it.

[3] AMC 20-24, 8.8.2: For ATC transponder-based ADS-B transmit systems, the discrete emergency code declaration capability should be integrated into the transponder functionality and should be controlled from the transponder control panel. Permissible deviation for initial implementations: For initial implementations, instead of the required transmission of the discrete emergency codes 7500, 7600 and 7700 when selected by the flight crew, the transmission of only the generic emergency indicator can satisfy this requirement. Such deviation from the above target requirement needs to be listed in the Aircraft Flight Manual.

[4] Specifically-approved aircraft equipped with Version 1 avionics are currently receiving ADS-B-only ATC separation services from the FAA in Alaska and the Gulf of Mexico. On or before 1-Jan-2020, all U.S./Mexico ATC separation services will require ADS-B Version 2. Mexico has proposed a requirement for ADS-B Version 2 for ATC separation in their Gulf of Mexico offshore low-altitude airspace from 1-Jan-2018.

[5] The E.U. mandate requires Version 2 ADS-B avionics. However, specific (early) local deployments in Europe accept the legacy ADS-B standards, ADS-B Version 0 and 1.

APPENDIX F

STATUS OF ATC SYSTEM READINESS TO PROCESS ADS-B DATA
FOLLOW-UP: FEBRUARY 2015

ANSP	Status	
	ATC Automated System – Surveillance Data Processor	**Remark**
Anguilla	NIL	
Antigua and Barbuda	NIL	
Aruba	Implemented	
Bahamas	New ATC Automated System implemented 4 Q of 2015.	Mode S radar data processing
Barbados	Radar Data Processor only	RDP to be updated for ADS-B Data processing
Belize	Radar Data Processor available	RDP to be updated for ADS-B Data processing
British Virgin Islands	NIL	
Canada	Implemented	
Cayman Islands	Radar Data Processor available	RDP to be updated for ADS-B Data processing
COCESNA	Implemented	
Costa Rica	Radar Data Processor available	RDP to be updated for ADS-B Data processing
Cuba	Implemented	
Curacao	Radar Data Processor available	RDP to be updated for ADS-B Data processing
Dominica	NIL	
Dominican Republic	Implemented	
El Salvador	Implemented	
Grenada	NIL	
Guatemala	Implemented	
French Antilles	Implemented	
Haiti	NIL	
Honduras/San Pedro Sula	Radar Data Processor available	RDP to be updated for ADS-B Data processing
Jamaica	Implemented	
Mexico	Implemented	
Montserrat	NIL	
Netherlands (BES Islands)	NIL	
Nicaragua	Implemented	
Saint Kitts and Nevis	NIL	
Saint Lucia	NIL	
Saint Vincent and the Grenadines	NIL	
Sint Maarten	Implemented	

ANSP	Status	
	ATC Automated System – Surveillance Data Processor	**Remark**
Trinidad and Tobago	Implemented	
Turks and Caicos	Radar Data Processor available	RDP to be updated for ADS-B Data processing
United States	Implemented	

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APPENDIX G

AUTOMATIC DEPENDENT SURVEILLANCE – BROADCAST (ADS-B) IMPLEMENTATION TASK FORCE

1. Background

During the first ANI/WG meeting, an ADS-B Implementation Task Force was formed in order to streamline related air navigation implementation activities. This Task Force shall support ADS-B trials and implementation activities as well as update and report progress to the ANI/WG based on the action plan for these tasks.

2. Responsibilities

The Task Force is responsible for:

a) Work Programme Management
b) Providing advice and support to States wishing to initiate operational ADS-B trials
c) Guiding States that have conducted trials to project operational implementation
d) Recommending targets for ADS-B implementation based on air navigation service providers (ANSPs) and user needs
e) Periodically requesting statistics from States resulting from their trials

3. Working Methods

The Task Force will:

a) Present its work programme containing activities in terms of objectives, responsibilities, deliverables and timelines
b) Avoid duplicating work within the ANI/WG and maintain close coordination among the existing entities to optimize use of available resources and experience
c) Designate, as necessary, Ad hoc Groups to work on specific topics and activities and organize clearly defined tasks and activities
d) Coordinate tasks to maximize efficiency and reduce costs via electronic means including emails, telephone and teleconference calls, and convene meetings as necessary
e) Report on and coordinate the progress of assigned tasks to the ANI/WG

4. Work Programme – to be included

TASK NAME	DELIVERABLE	DATE START	DATE END	PERCENTAGE COMPLETED	RESPONSIBLE
ADS-B TF Activities		1/8/13	31/12/18		
1.0 Creation of ADS-B TF	List of Participants	1/8/13	1/8/13	100 %	Group Members
2. Terms and references	Terms of Reference of the Working Group	1/8/13	1/8/13	100 %	Cuba (Rapporteur)
3. Develop Work Programme	Work Plan	2/8/13	14/8/13	100%	Cuba (Rapporteur)
3.1 Provide to ICAO the Work Programme		14/8/13	14/8/13	100%	Cuba (Rapporteur)
4.0 Approve ADS- B TF Work Programme in Block 0		24/01/14	24/01/13	100%	Group Members
5.0 Begin implementation of the Work Programme		31/10/13	31/12/18		Group Members
5.1 Develop ADS- B survey	Survey on the status of the ADS –B	23/01/14	14/02/14	100%	COCESNA
5.1.1 Send ICAO a survey for distribution to the States of the region		18/02/14	18/02/14	100%	COCESNA
5.1.2 Collect survey results	Current situation of ADS- B in the States	18/02/14	30/4/14	20%	ICAO NACC
5.2 Survey information on the implementation of ADS –B aircraft	Survey on the status of ADS –B aircraft	23/01/14	30/4/14	100%	IATA
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	30/04/14	¿?	IATA
6.0 Implementation of ADS- B trials	Recommendations / testing improvements towards operational implementation	30/10/13	29/5/15	¿?	Group Members
6.1 ADS –B trials are ongoing	List of States that are under the process	30/10/13	29/5/15	¿?	Canada, Cuba, Dominican Republic, Jamaica, México, Trinidad and Tobago, United States and COCESNA
6.2 Send to the members of the TF the Guide for testing	Guide for testing	13/02/14	13/02/14	100%	Rapporteur
6.3 Start ADS-B trials in States where they are not still carried out	Support for those who wish trials	30/10/14	29/5/15	¿?	States / Territories in the region that have not yet done so
6.4 Sending quarterly reports to ICAO on trials deficiencies	Trials results	30/10/13	29/5/15	¿?	Cuba, Jamaica, México Trinidad and Tobago and COCESNA

TASK NAME	DELIVERABLE	DATE START	DATE END	PERCENTAGE COMPLETED	RESPONSIBLE
6.5 Deliver results of ADS-B statistics comparisons	Results of ADS-B statistics comparisons	23/05/14	29/05/15	¿?	Cuba, Jamaica, México Trinidad and Tobago and COCESNA
7.0 Follow-up meeting to the ADS- B development	Final Report	19/05/14	23/05/14	100%	ICAO NACC
8.0 Develop relevant operational requirements for the ADS-B implementation		15/11/13	30/04/14	70%	Create Ad Hoc Group
8.1 Creation of an Ad hoc group for the elaboration of the proposal	Op AdHoc Group	23/05/14	23/05/14	100%	CONOPS Ad Hoc Group
8.2 Deliver the regional operational concept for ADS-B implementation	CONOPS	23/05/14	30/10/14	70%	CONOPS Ad Hoc Group Rapporteur
9.0 Develop technical requirements to purchase equipment for ADS-B trials	Tec Ad hoc Group	23/05/14	15/05/15	70%	Spec Ad Hoc Group
9.1 Deliver technical requirements for ADS-B equipment	Technical requirements for ADS-B equipment	30/06/14	08/05/15	70%	Spec Ad Hoc Group Relator
10. Assist in the process of ADS-B implementation	Letters of agreement (LoAs) between Regional States and metric	29/5/15	31/12/18		ADS-B TF
11 Follow-up process of ADS-B operational Implementation	ANRFs	29/5/15	31/12/18		ADS-B TF

Performance Objectives (RPO) included in the Regional Air Navigation Plan related to the ADS-B TF.

No.	Task description	Start-End	Responsible	Status
1.	Identify and implement additional ATM surveillance systems to improve the accuracy and coverage of information of the traffic situation (ADS-B, MLAT, etc.) and associated procedures.	2014-2018	States/ Territories, Intl Org	Valid
2.	Use of A-SMGC in specific aerodromes, as required	2014-2018	States/ Territories, Intl Org	Valid
3.	Training in the application and implementation of automated monitoring and automation systems technologies ATS	2014-2018	States/ Territories, Intl Org	Valid
4.	Strengthening training infrastructure in the region and training programmes related to monitoring systems and automation	2014-2018	States/ Territories, Intl Org	Valid
5.	Implementation and Control System Advanced Surface Movement Guide (A-SMGCS) according to the needs	2014-2018	States/ Territories, Intl Org	Valid

Designation of the ADS-B TF modules for ASBU Block 0

Category	Description	Name	Priority
Desirable	B0-ASUR	initial ground surveillance capability	1
Optional	B0-SURF	Operational safety and efficiency of surface operations (A-SMGCS Level 1-2)	2

Note 1 Priority criteria:

1- Immediate implementation.
2- Recommended deployment.

Note 2 Categorization:

Essential: Modules that significantly need interoperability, security and regularity.
Desirable: Modules which by their nature are recommended to be implemented simultaneously in the region.
Specific: Modules whose implementation is recommended in a specific operational environment of a specific country in the region.

Optional: Modules that have a specific operational requirement for a country of the region and bring additional benefits but does not necessarily have to be implemented simultaneously in the region.

Work programme related to ASBU modules

TASK NAME	DELIVERABLE	START DATE	END DATE	PERCENTAGE COMPLETED	RESPONSIBLE
ADS- TF B activities related to ASBU		Mar 2014	Dec 2018		
1. Group Creation	List of participants	Feb 2014	Mar 2014	100%	Group Members
2. Present terms and references	Working Group ToRs	Mar 2014	Apr 2014	100%	Coordinator
3. Develop Work Programme of the Working Group	Working Group Work Programme	Mar 2014	Jul 2014	100%	Coordinator
3.1 Execute work programmes for the development of each module group responsibilities	Work Programme for modules				Group Members
	B0-84/ASUR	Apr 2014	Dec 2018		Group Members
	B0-75/SURF	Apr 2014	Dec 2018		
3.2 Evaluation and analysis Meetings to evaluate progress	Minutes and agreements adopted	Annual	Dec 2018		Group Members
4.1 Approve Subgroup Work programme and modules		Mar 2014	Apr 2014		Group Members
5.0 Begin execution of the Work Programme		Apr 2014	Dec 2018		Group Members
5.1 Develop the proposal of the information required for each module annually	ANRF´s	Apr 2015	Dec 2018		Group Members
6.0 Send quarterly the information on deficiencies identified in trials	Results of trials	Quarterly	May 2015		Group Members
7.0 Evaluation and analysis Meetings to evaluate progress	Report and agreements adopted	Annual	Dec 2018		Group Members
8.0 Tasks: module BO-ASUR Block 0					
8.1 Controlling the performance of tests with ADS-B		Jan 2014	May 2015		
8.2 Collect information quarterly on test results and send a report to ICAO	Quarterly Statistics	Quarterly	May 2015		
8.3 Approve the regional CONOPS for the implementation of ADS-B.	CONOPS	Apr 2015	Apr 2015		
8.4 Ensure sending and receiving data from all ADS-B sensors to the ACC	Checking data	Jun 2015	Dec 2018		
8.5 Ensure automated processing systems for representing the ADS-B data in the Air Traffic Control	Automation System				
8.6 Ensure training of drivers in the use of ADS-B data for	Capacitation Task				

TASK NAME	DELIVERABLE	START DATE	END DATE	PERCENTAGE COMPLETED	RESPONSIBLE
radar control JOBS TRAINING					
8.7 Implement operational ADS-B in regional ATM					
9.0 Tasks of the B0-SURF Module Block 0					
9.1 Perform the preparatory work for the realization of MLAT proof	Implementation Project				
9.2 Control the execution of multilateration tests in the Region.					
9.3 Develop MLAT testing					
9.4 Evaluate test results on multilateration.					
9.5 Receive quarterly reports on MLAT test results and send them to the ADS-B regional work group	Report of results				
9.6 Implement operationally cost-benefit by the desire of implementing the MLAT study at selected airports.	Cost-Benefit Analysis				
9.7 Select airports to implement MLAT					
9.8 Develop operational requirements for MLAT implementation	CONOPS				
9.9 Controlling system implementation in selected airports					

5. Membership

Task Force Member- Name:	State/T/IO	email
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