



Agenda Item 3: Air Navigation Matters
3.3 Specific Developments in Air Navigation
CNS

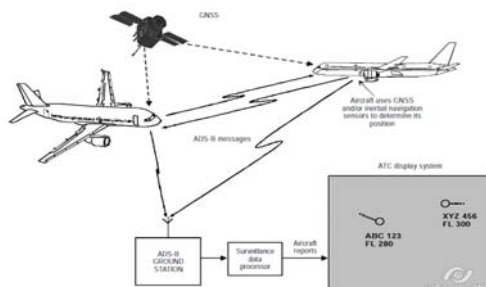
PROGRESS ON ADS-B ACTIVITIES AND MULTILATERATION

(Presented by the Secretariat)

SUMMARY	
This working paper presents a brief review on the ADS-B work and activities in the CAR Region; the results and agreements of the ADS-B/MLAT implementation workshop and proposes actions to continue with the participation in these activities.	
References:	
• E/CAR/WG/32 Meeting Report (Sint Maarten, Netherlands Antilles, 15 - 18 June 2010). • NACC/WG/3 Meeting Report (Guatemala City, Guatemala, 9 - 13 May 2011). • ICAO/FAA Workshop on ADS-B and Multilateration Implementation (México City, Mexico, 6 - 8 September 2011). • Minute of ADS-B Teleconference (9 February 2012).	
Strategic Objectives	<i>This working paper is related to Strategic Objectives A and C.</i>

1. Introduction

1.1 ADS-B is the broadcast by an aircraft of its position (latitude and longitude), altitude, velocity, aircraft ID and other information obtained from on-board systems. Every ADS-B position message includes an indication of the quality of the data which allows users to determine whether the data is good enough to support the intended function.



1.2 The Global Initiative Plan No. 9 of the Global Air Navigation Plan (GPI-9) *SITUATIONAL AWARENESS* contemplates the implementation of enhanced surveillance techniques (ADS-C or ADS-B), that will allow reductions in separation minima and an enhancement of safety, increase in capacity, improved flight efficiency, all on a cost-effective basis. These benefits may be achieved by bringing surveillance to areas where there is no primary or secondary radar, when cost-benefit models warrant it. In airspaces where radar is used, enhanced surveillance can bring further reductions in aircraft separation minima and improve, in high traffic density areas, the quality of surveillance information both on the ground and in the air, thereby increasing safety levels.

1.3 ADS-B can be used to enhance traffic surveillance in domestic airspace. In this respect, it should be noted that 1090 extended squitter is both available and should be accepted as the global choice for the ADS-B data link.

2. References and standards for the ADS-B implementation and use

2.1 ICAO has facilitated guides and guidance material for the ADS-B implementation and as detailed in Doc. 9924 – Aeronautical Surveillance Systems – Chapter 7 – Surveillance System Deployment Considerations and the steps recommended for planning and implementation of surveillance systems:

- a) Define the operational requirements
- b) Define local environment (current and future)
- c) Analyze design options and determine which techniques can be used
- d) Make a safety analysis of the new proposed system
- e) Implement
- f) Establish operational service
- g) Deliver operational service

2.2 There are available guidelines on ADS-B trials provided by GREPECAS and separation minima operational guides using ADS-B and/or multilateration systems (MLAT). Similarly, the implementation has been proposed for November 2012 through the ICAO proposal for amendment 4 of the PANS-ATM, Doc 4444 relating to separation minimum using ADS-B and/or multilateration systems (Ref. AN 13/2.5-11/24 dated 15 April 2011).

3. ADS-B trials and activities for the implementation

3.1 During the NACC/WG/3, several States informed on their ADS-B activities:

- a) COCESNA presented the progress on ADS-B trials in the Central American FIR, with their ADS-B initial trials carried-out since 2008 and the new trials for data collection;
- b) United States informed on their ADS-B services implementation progress;
- c) Cuba informed the results of the ADS-B data analysis collected during their trials;
- d) Trinidad and Tobago commented their system capabilities to process ADS-B and ADS-C in their new ATC system; and
- e) Mexico informed about the implementation of an ADS-B system in the Mexico City International Airport.

3.2 The NACC/WG/3 meeting formulated the Conclusion 3/6 - ADS-B TRIALS AND ANALYSIS IN THE CAR REGION, in order to consolidate ADS-B activities to have homogeneous

criteria in the analysis and data exchange, inviting the States/Territories/COCESNA that are carrying out ADS-B systems trials or having near-term plans to do so.

3.3 United States in coordination with the ICAO NACC Regional Office held an ADS-B/MLAT Workshop in September 2011, which covered the different implementation aspects, both technical and operational with the participation of the industry and States. This workshop recognized that the ADS-B activities would support the extension of PBN routes in the CAR Region, just as it is being supported through the PBN routes in the Gulf of Mexico. The Summary of Discussions of this workshop is presented in the **Appendix** to this working paper. The presentations and conclusions of this workshop are available in the ICAO web page: <http://www.mexico.icao.int/Meetings/ADSBMLTWorkshop.html>.

3.4 For the follow-up of the Ad-hoc group activities, data analysis and other activities for the ADS-B implementation, ICAO has created a web site with references and relevant information at: <http://www.mexico.icao.int/CNS.html#ADS>

3.5 The Ad-hoc group members and members from Mexico have continued the activities according to the action plan formulated and detailed in the ICAO web page.

3.6 In the E/CAR Region, and as informed during the E/CAR/WG/33 Meeting, Barbados advised that they completed the survey to implement MLAT in BGI and continues studies for feasibility. ECCAA also informed of their interest to implement MLAT as a surveillance system in the OECS States.

4. Suggested actions

4.1 The meeting is invited to:

- a) take note of the information and references for the ADS-B/MLAT implementation;
- b) support ADS-B data analysis Ad-hoc group and States;
- c) inform their plans or activities related to ADS-B/ADS-C/MLAT for consideration and participation of other States;
- d) review the E/CAR/WG Action Plans related with ADS-B, MLAT and ADS-C activities to converge this effort with the Regional planning and works by the ADS-B Ad-hoc Group; and
- e) encourage participation in the Ad-hoc groups and other States for this implementation designating a Focal Point for each State for future coordination.

APPENDIX



Revised 20/09/11

INTERNATIONAL CIVIL AVIATION ORGANIZATION

ICAO NACC REGIONAL OFFICE

ICAO/FAA Workshop on ADS-B and Multilateration Implementation

(Mexico City, 6 to 8 September 2011)

SUMMARY OF DISCUSSIONS

1. Introduction

1.1 The workshop was conducted by ICAO and the United States Federal Aviation Administration (FAA). The objectives of the workshop were to assist the CAR Region States/Territories and International Organizations with the following:

- a) Provide a forum for the provision of information on the aspects to be considered in the planning and implementation of ADS-B surveillance and Multilateration (MLAT) systems;
- b) provide an overview of what industry offers on ADS-B and Multilateration system;
- c) coordinate activities in the NAM/CAR Regions to have homogeneous criteria in the analysis and data exchange of ADS-B Data; and
- d) provide guidance on these surveillance techniques within the ICAO global ATM operational concept framework

1.2 The main workshop topics were: a) Industry briefing on current status of MLAT and ADS-B systems, b) Planning and implementation aspects for ADS-B and MLAT, c) Discuss and coordination for the homogeneous criteria in the analysis and data exchange of ADS-B Data and d) Evaluation of current State status and the future activities and potential benefits with implementing MLAT and ADS-B.

1.3 The workshop followed-up on GPI-9 *Situational Awareness*, GPI-17 *Datalink Applications* and the NAM/CAR Regional Performance Based Air Navigation Implementation Plan (NAM/CAR RPBANIP) Regional Performance Objectives No. 4 *Improve ATM Situational Awareness* and No.9 *Optimization and modernization of Communication Infrastructure*, applying ICAO SARPs and guidance material as well as the Unified CAR/SAM Regional Surveillance Strategy and other ICAO reference material. The final workshop programme is available on:
<http://www.mexico.icao.int/Meetings/Seminars/ADSBMLT/Programme-ADSMLATWhspBIL.pdf>.

1.4 The participants recognized the importance of this workshop for those States involved in ADS-B trials, those analyzing surveillance options for improving their situational awareness, and those involved with the implementation of the Gulf of Mexico 50 NM Lateral Separation Reduction Initiative and West Atlantic Route System Route Restructure (WATRS plus) initiative.

1.5 The main outcomes of the workshop were the knowledge of current and up-to-date industry information regarding ADS-B and MLAT, the evaluation of technical and operational issues for implementation of ADS-B and MLAT and the recommendations for future activities to be carried out in the region. The development of these outcomes are reflected in the information provided in the workshop and the experiences presented by States (presentations), the regional references (strategy and implementation guidelines) and the technical assistance provided by the FAA.

1.6 The workshop was attended by a total of 51 participants from 9 States, 2 international organizations, 8 industry representatives and 1 airline representative. The list of participants is available at <http://www.mexico.icao.int/Meetings/ADSBMLTWorkshop.html>.

1.7 Mr. Michiel Vreedenburgh, Regional Deputy Director of the ICAO NACC Regional Office on behalf of Mrs. Loretta Martin, Regional Director of the ICAO NACC Regional Office and Mr. Jim Linney, Manager- ADS B Central Service Area of the United States Federal Aviation Administration (FAA), opened the workshop. Mr. Julio C. Siu, RO/CNS, carried out the coordination and facilitation of the event with the assistance of Mr. Jim Linney.

2. Discussions

2.1 The first workshop day was dedicated to industry presentations, starting with one ICAO presentation regarding the ICAO concepts related to ADS-B, ADS-C and MLAT, describing its capacities and limitations and making references to ICAO SARPS and guidance documentation. The industry presentations emphasized:

- Airbus briefed an overview of the capabilities of Airbus related to Surveillance performance capability. They shared that Airbus is focused on ADS-B IN applications along with benefits the customers are expecting from the system. The Airbus roadmap identified that they are planning to upgrade aircraft to the DO-260B standard on new aircraft by 2015. This may include transponder software, aircraft wiring, and/or new pin programming.
- Boeing briefed on its plans to meet the ADS-B Out Regulatory Mandates around the world. Boeing strongly encouraged Latin America States to follow Asia Pacific mandate for ADS-B Out. The Boeing plan is for ADS-B Out to be in all production aircraft by Jan 2015 and retrofit by December 2017. Boeing shared that they are waiting on the European mandate to do a production cutover through Service Bulletin by 2014. Boeing stated that ANSPs should consider investing in ADS-B ground stations that can accept both DO-260A (Version 1) and DO-260B (Version 2) aircraft messages, and ANSPs should coordinate between ANSPs to ensure global harmonization.
- Indra spoke of their portfolio of air traffic control systems, highlighting the benefits of ADS-B including its low cost and mobility, discussed Multilateration and provided operational examples. Indra demonstrated numerous tools including data reduction and analysis of surveillance assessment tools. Indra has implemented various surveillance solutions in locations in Europe, Latin America and China. Indra also briefed on their experience with automation systems that can process ADS-B surveillance data among other surveillance sources.

- Era presented solutions on Multilateration and ADS-B, stating that ADS-B is certainly the future but that ANSPs can also consider Multilateration for solutions today. Era presented an integration approach of Multilateration with current systems, enhancing approach operations, as a coverage gap mitigation tool, and as an ADS-B augmentation and integrity check system. Era demonstrated MLAT/WAM solution hardware and then discussed example installations in 4 different locations.
- VNIIRA presented multiple ADS-B and MLAT/WAM surveillance solutions, including integrating performance monitoring capability. VNIIRA also provides what they call an “Intelligent surveillance sensor (ISS)” or “EMBER”. VNIIRA presented a large and diverse set of manufactured capabilities having Cuba as one of their successful implementation.
- Thales presented two technical approaches, WAM and ADS-B. Thales shared that MLAT provides a lower cost alternative to radar in most cases. Thales emphasized that the full picture of the needs for surveillance should be considered including the hardware and software needs. Thales mentioned some tradeoffs between surveillance choices, such as with WAM – it requires a large number of sites which introduce complications such as site complexities. For ADS-B, Thales mentioned asking some key questions that need to be considered, including what it is intended to be used for situation awareness or air traffic control separation, the type of airspace (with or without radar - En Route or Terminal) and regulatory requirements. Thales indicated ADS-B should consider the network and availability (coverage or other uses like Telecommunications diversity). Also ANSPs should consider what modifications are needed for ATM systems and controller tools/modifications.
- ITT presented overview of the services the FAA has awarded to ITT to provide. ITT shared that one of the reasons for the success of the program to date have to do with the maturity of the requirements which the FAA developed over 10 years of research and demonstrations efforts, as well as a technically mature system design built with a great degree of flexibility. ITT is the systems integrator, taking FAA requirements into an architecture, design and implementation. The radios were designed to account for areas of high spectrum congestion with 4 channel radios and sectorized antennas and single antennas in areas of reduced congestion. ITT discussed the status of US deployment which includes 329 radios reporting on ITT’s network. ITT also shared that some of the lessons learned, including ITT identifying enhancements in the network which add to the robust nature of its capability. ITT also highlighted the WAM solutions they also deploy, which include Multilateration service today with radios that are capable of ADS-B as well. ITT added this capability by simply expanding the existing architecture the FAA can expand WAM into the service contract. Lastly, ITT shared how they have commercialized the surveillance data, where ITT can share isolated traffic data with commercial users with real-time or delayed data that the ANSP desires.
- Honeywell provided a picture of the portfolio of projects that Honeywell has been working on since the last briefing to ICAO in 2008. Honeywell worked with the FAA on Surface Indications/Alerting for cockpit applications. Honeywell shared the pilot operator feedback on ADS-B Situation Awareness displays. Honeywell also briefed the In Trail Procedures (ITP) system and that Honeywell has an approved TSO and STC for (installed on United 747’s). Honeywell is also upgrading all avionics sets to be compliant with DO-260B in the coming year(s). Honeywell shared other ideas around General Aviation aircraft benefits of UAT and they are working on cost-effective ways of providing ADS-B benefits to those customers. Honeywell is committed to ADS-B and customers are starting to demand it. Honeywell also noted that the business case varies by ANSP and operator.

2.2 The second workshop day opened with ICAO explaining the ATM Global operational concept and how ADS-B and MLAT/WAM are foreseen as enablers for situational awareness and safety improvements concepts, describing the regional references (GREPECAS) and guidelines and how the implementation is being carried out through the NACC working groups and the mandates from GREPECAS and NACC/DCAs. The current operational scenario on radar coverage and communication infrastructure was presented. The FAA described the current ADS-B implementation status in United States and the alternative surveillance systems. CANSO briefed on their cost benefit experience in Asia/PAC region and Cuba, Jamaica, Mexico, and COCESNA presented their experience in ADS-B Data collection and analysis. IATA's presentation indicated their support for ADS-B out.

2.3 The third day was dedicated to the working sessions by the participants. Complementary information was available as "Other documents" under the workshop's ICAO NACC Webpage (<http://www.mexico.icao.int/Meetings/ADSBMLTWorkshop.html>).

3. Conclusions/ Recommendations

3.1 As a result of the discussion, the workshop developed the following conclusions/ recommendations to be addressed by CAR Region States/Territories/International Organizations and ICAO, as appropriate:

ADS-B Trials and Data Analysis:

1. To agree on a homogeneous ADS-B analysis criterion, an ADS-B Ad-hoc Group formed by Cuba, Jamaica, Trinidad and COCESNA and lead by the FAA and coordinated by ICAO was formed. United States will provide the Ad-hoc Group with the following:
 - i. Descriptions of ADS-B data fields in ADS-B Out messages
 - ii. United States expectations for parameters in those fields (DF17, etc. . .)
 - iii. Suggestions on which how to analyze the data analysis
2. With the criterion, States with ADS-B test sensors will verify recommended fields being collected (Trinidad & Tobago, Cuba, Jamaica and COCESNA) and inform ICAO how the ADS-B analysis criterion is being met.
3. States are invited to join the ADS-B Trials and ADS-B Ad-hoc Group implementation/ planning as to obtain the operational benefits identified by the workshop.
4. States to continue carrying out ADS-B trials in a collaborative manner, share the information for analysis and coordination activities among users in order to improve the integrity of this data, also taking into consideration the experience achieved in the Gulf of Mexico ADS-B programme by Mexico and the United States.

States:

5. ICAO guidance material (for example Aeronautical Surveillance Manual - Doc 9924), GREPECAS guidelines and the NAM/CAR Regional Performance based Air Navigation Implementation Plan (NAM/CAR RPBANIP) should be used by States while evaluating and implementing ADS-B and multilateration systems.
6. States should consider the use of MLAT/WAM for immediate benefits and ADS-B for medium term benefits as to improve/optimize radar coverage and to cover existing radar coverage gaps.
7. States and ANSPs should consider:
 - i. Internal evaluation of their surveillance service and identification of improvements with MLAT or Wide Area Multilateration (WAM)
 - ii. Consider ADS-B in their national plans
 - iii. Consider the operational benefits and opportunities with new surveillance by evaluating airspace and procedures, seeking to use new surveillance techniques to improve operations not possible with current surveillance infrastructure
 - iv. Apply the homogeneous criteria for ADS-B Data analysis to be developed by the ADS-B Ad-hoc Group
 - v. Follow-up regional guidelines for MLAT and ADS-B implementation and
 - vi. Follow-up NAM/CAR Working Groups tasks on the Regional Performance Objectives for situational awareness improvements and CNS infrastructure implementation;
8. States and ANSPs should continue the coordination and exchange of operational and technical issues to detail the future actions and activities to continue ADS-B and MLAT activities. This work shall be carried out by the initially identified PoCs:

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9. States/Territories/International Organizations should follow-up the conclusions/ recommendations resulted from this ADS-B and Multilateration Implementation workshop, under the work programmes of the corresponding NAM/CAR Working Groups, and will also be reported to the GREPECAS ATM Automation and Situational Awareness Programme for future regional planning and implementation.
10. Considering that training and development of the human resources is an essential factor for the success implementation and conduction of ADS-B and MLAT aspects, CAR States/Territories/International Organizations should identify training needs and their capacity to satisfy these needs. In this regard, States/Territories/International Organizations are encouraged to consider this aspect and inform ICAO regarding this issue, particularly on the forthcoming Training centres meeting to be held on the 1st Quarter of 2012 in the ICAO NACC Regional Office.
11. Trinidad and Tobago informed of: a) a their new Mode S radar, b) fused ADS-B from one sensor into ATM automation is considered, c) Radar service will continue with WAM as stepping stone to ADS-B and d) the specific geography in the E/CAR is a concern for this implementation.
12. Dominican Republic informed: of a) their 3 radars in operations (two of which have Mode-S capability) and one more planned, b) ATM automation planned to be completed in the near term is not ADS-B compatible, c) are interested on advice from States who have experience to help with ADS-B trials (Cuba and U.S.) and d) Radar data sharing with U.S. and Curacao in process.
13. Haiti informed that a) Radar, ATM automation, and ADS-B have not been implemented, b) Plan in place for ATM automation and radar and c) for terminal airspace, ADS-B is being considered.
14. Jamaica informed that a) Radar and ATM automation in place, b) Plans to upgrade ATM automation for ADS-B, c) ADS-B Test sensor in place and plans for additional data collection, d) Further analysis to determine if next step is ADS-B direct or intermediate step with MLAT and e) Continue technical cooperation with neighbouring States, including Haiti, Cuba, & CENAMER.
15. Cuba informed of their a) 6 Radar and ATM automation in place, b) short term plan to upgrade automation for ADS-B, c) ADS-B test sensors collocated with radars, d) Plan is to continue data collection and e) Due to geography constraints, WAM is not under consideration and MLAT for terminal use is being studied.
16. Costa Rica informed their interest for studying, implementing, feasibility and impact of the new surveillance techniques such as MLAT to improve the surveillance at the low airspace level for Juan Santamaria Airport operations in San José, Costa Rica.
17. México manifested their will with COCESNA to share another radar data feed different from Belize under the current Radar Data MoU, for which radar coverage and coordinates from adjacent radars to Mexico are to be analyzed.
18. Mexico and COCESNA will coordinated with ICAO the activities for making the Mode S Radar information operational, so further coordination and agreement will be made through ICAO.
19. Recognizing the importance of the airlines role in the ADS-B activities, COCESNA identified the need for a meeting with airspace users to show the operational benefits, implementation aspects, current status and the short and medium term planning for the Central American Region. COCESNA will coordinate with ICAO for arranging such a meeting.

United States/ FAA:

20. In facilitation for technical support on ADS-B activities from United States, FAA will draft a sample letter for states to allow them to quickly and easily request this support (expected October 2011);
21. For those States evaluating ADS-B data, FAA will provide a report to ICAO, capturing historical ADS-B data analysis from previous monitoring and a white paper identifying details and recommendations for data collection. This action will support ADS-B Ad-hoc Group activities.
22. FAA will support States who wish to visit the United States to view architecture by providing access to an FAA ADS-B facility for demonstrations and education
23. FAA and SENEAM (Mexico Work Group) enter into an agreement to install jointly beneficial ADS-B infrastructure in Mexico to support seamless ADS-B coverage over the entire Gulf of Mexico, along with collaboration on VHF Communications services in the region. This agreement can be a template for cooperative agreements with other states. An initial Mexico Team Group Meeting has been scheduled for 18 October 2011 at SENEAM premises at 10:00 am. SENEAM, Aeromexico, Mexico DGAC and United States will attend. ICAO will support the coordination of these activities. (expected December 2011)
24. FAA will provide for the Mexico Work Group support of the following items:
 - i. Draft agreement with industry to consider as a sample (expected October 2011)
 - ii. Business case data showing the sources for benefits to consider (expected October 2011)
 - iii. Avionics research results for Aeromexico aircraft to find out readiness for ADS-B capability based on information provided by Aeromexico during the seminar (expected November 2011)
 - iv. With the coordination of ICAO, the results of this initial meeting will be copied to the CAR States for similar meeting in the CAR Region.
25. To improve continuous surveillance coverage in the United States Caribbean Oceanic airspace, United States requests ICAO's support for the coordination in the implementation of an ADS-B agreement for service in the Caribbean with Turks and Caicos and Bahamas.
26. A sample of real time ADS-B data being collected in the United States is available from multiple sources, including FAA legacy radio stations and from ITT via the new ADS-B radio stations. States interested in access to this data are encouraged to contact the FAA.

ICAO:

27. ICAO to promote the establishment of an agreement among CAR States and United States for the continued collaboration between states on ADS-B and Multilateral surveillance harmonization. The agreement will allow technical support, data sharing and as a collaborative framework for cooperation. It will include development of a regional harmonization plan and agreement on standard requirements for ADS-B in the CAR region, with the objective to ensure that ADS-B solutions are harmonized in the region by ensuring states agree and commit to a common standard for ADS-B.
28. ICAO to lead the CAR states in the research and planning for the development of regional and targeted implementation of ADS-B that support states improving surveillance and situational awareness and to include cost-sharing for common benefit implementations.
29. The Meeting took note of CANSO proposal to assist the Region to carry out a cost benefit analysis as experienced with the Asia/PAC Region. This proposal will be coordinated by ICAO through the NACC/WGs.