



ICAO

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

WORKING PAPER

ADS-B/IMP — WP/03
16/03/15

Automatic dependent surveillance – broadcast (ADS-B) Implementation Meeting (ADS-B/IMP)
Mexico City, Mexico, 27-29 April 2015

- 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**

ADS-B IMPLEMENTATION PROGRESS

(Presented by Cuba)

EXECUTIVE SUMMARY	
Present 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.	
Action:	<ul style="list-style-type: none">• To analyse data obtained in the trials.• Take note of the conclusions presented
<i>Strategic Objectives:</i>	<ul style="list-style-type: none">• Safety• Air Navigation Capacity and Efficiency• Environmental Protection
<i>References:</i>	<ul style="list-style-type: none">• Third North American, Central American and Caribbean Working Group Meeting (NACC/WG/3) Conclusion 3/6 - <i>ADS-B Trials and Analysis in the CAR Region</i>

1. Introduction

1.1 Since 2009, Cuba initiated the ADS-B trials phase with the systemic monitoring of signals received from the six surveillance positions we have, that guarantee a FIR full coverage with ADS-B OUT, as shown in Figure 1.

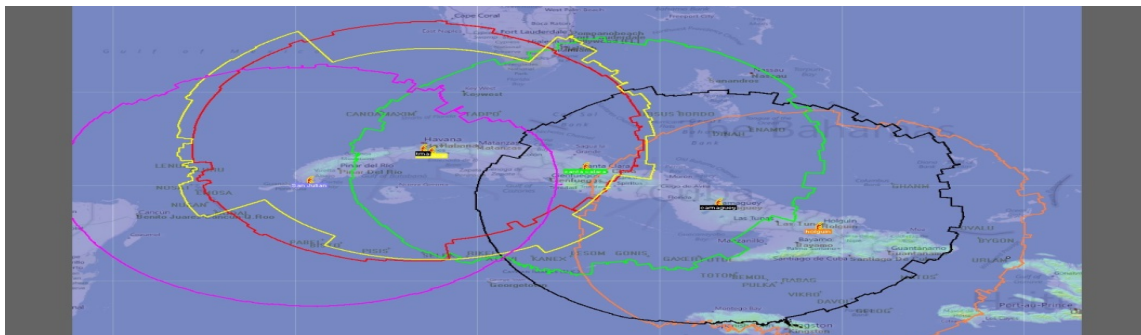


Fig. 1 ADS-B Coverage at 33000 feet in the Habana FIR

1.2 This has allow the evaluation of this service gradual implementation increment on-board aircraft overflying us, as well as the quality, precision and truthfulness of data transmitted.

2. Results of the ADS-B Trials continuation.

1.1 During the end of last year and the beginning of this year, as ADS-B trials continuation, an application was developed by our specialists that allow us to capture, statistical processing and representation of all data received (see Fig. 2).

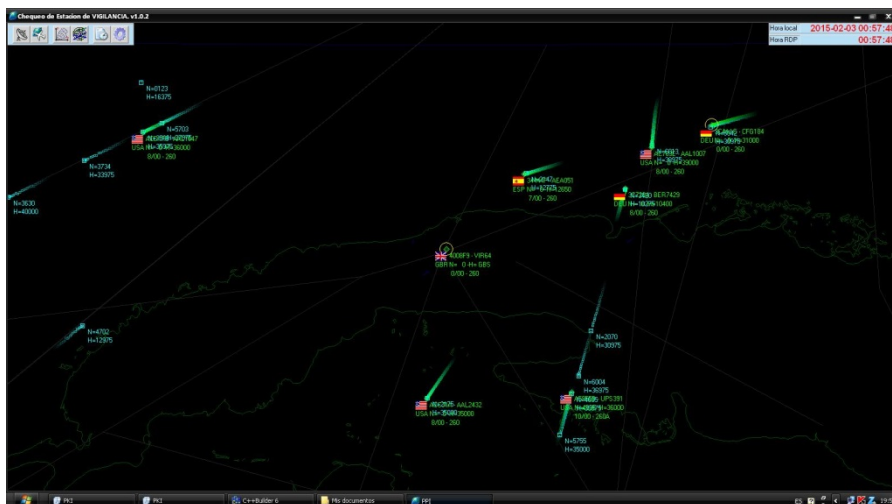


Fig.2 Mix representation screen

2.2 This software search parameters 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.

2.3 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 diagram) is followed.

2.4 Here are 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:**

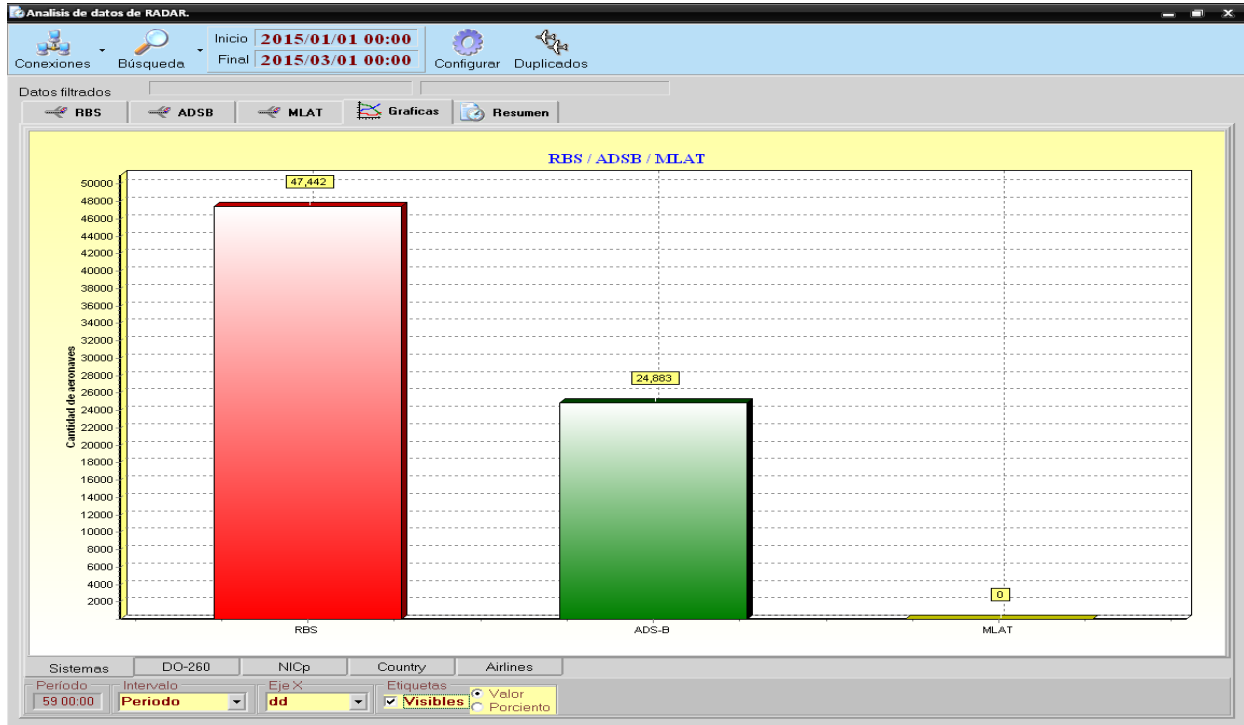
	A/C	ADS-B	
- Received:	789718	415382	(52.59%)
- Analyzed:	121764	62117	(51.01%)
- In the FIR:	47442	29153	(61.45%)
- Filtered:	47442	24883	(52.45%)

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

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

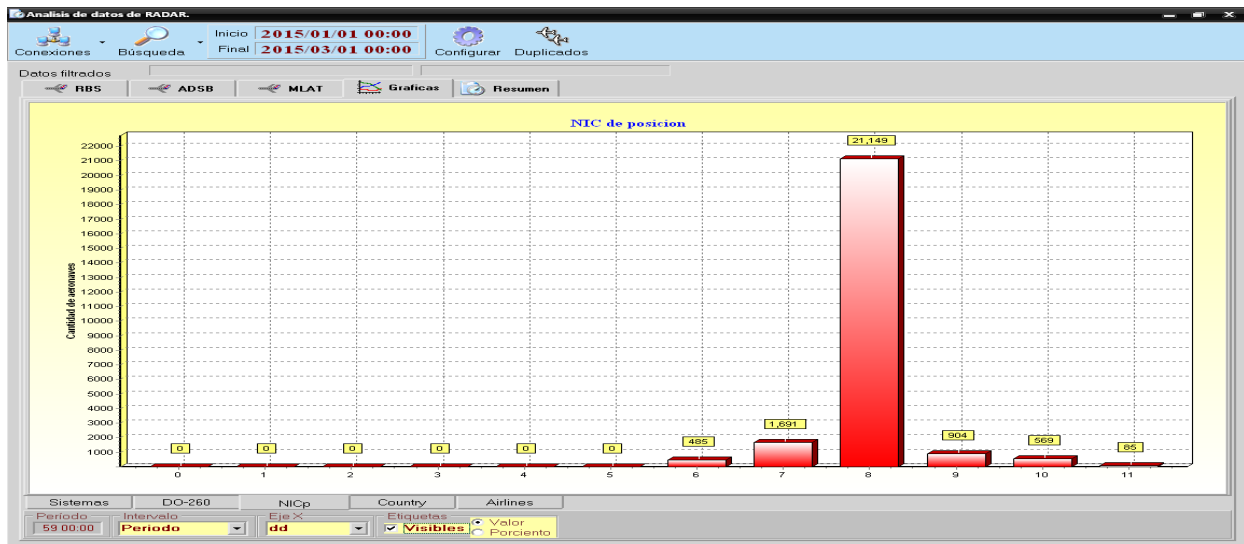
2.7 In a general way, comparatively it could be seen that from the radar total coverage (analyzed objectives) there were 51.01% of aircraft with ADS-B compared to those that respond in A/C and the 61.45% is the search region.

2.8 Meeting 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.

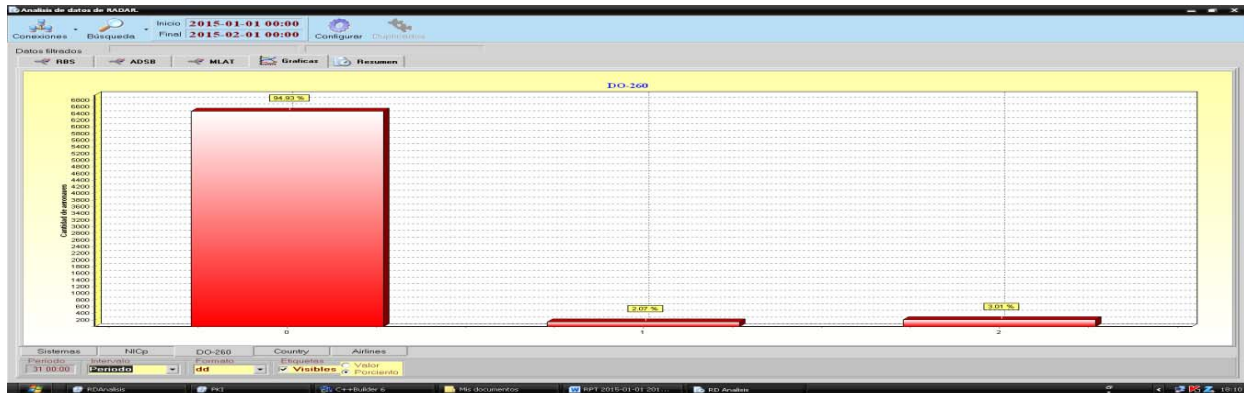
2.9 Similarly the NIC indicator behavior was analyzed in the analyzed responses and found that over 85% of responses reported a NIC 8, 6% for NIC 7, the remaining below 1%. The following graphic shows the different NIC responses received:



Graphic.2 Different NIC responses received.

2.10 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.

2.11 With respect to the analysis of the versions DO-260 received, it appears that more than 94.0% of the responses from the analyzed 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.

3. Evidence of a multilateration system (MLAT)

3.1 Since late December a multilateration system on test was installed at the "Juan Gualberto Gómez" Varadero International Airport, in cooperation with the VNIIRA firm of St. Petersburg, Russian Federation.

3.2 The structure of the installed system is the following:

- Five (5) receptors (A/C, ADS-B, Mode S) installed in locations with existing power and communications systems.
- One (1) receiving station located in the center of the runway, with solar power and wireless communication.
- Two (2) transmitting stations that guarantee the interrogation of aircraft in modes A/C and S.
- Two (2) timer stations, which guarantee synchronization of all stations and a responder control.
- Three (3) mobile receiving stations installed in working vehicles on platform.

3.3 The implemented design has ensured coverage of 500 Kms in ADS-B and 140 Kms to calculate position with MLAT, with an accurate forecast of 4 meters, but in the practice an accuracy of 80 cm is obtained.

3.4 An independent computer was installed in the Airport Control Tower where technical staff monitors the development of the tests, while serving for the acquisition of knowledge and familiarization of controllers with this new system.

3.5 It was coordinated with the provider to conduct quarterly cuts of its functioning, to analyze its behavior and improvements that may arise for its future operational work, both in this aerodrome or in another where it be decided to implement, according to the result of the corresponding cost-benefit analysis.

3.6 Some facilities nearby the airport were used to complete the deployment of the MLAT which have enough supply and communications, enabling data synchronization, reception and transmission to the central processor located at the airport, as shown in the following figure.

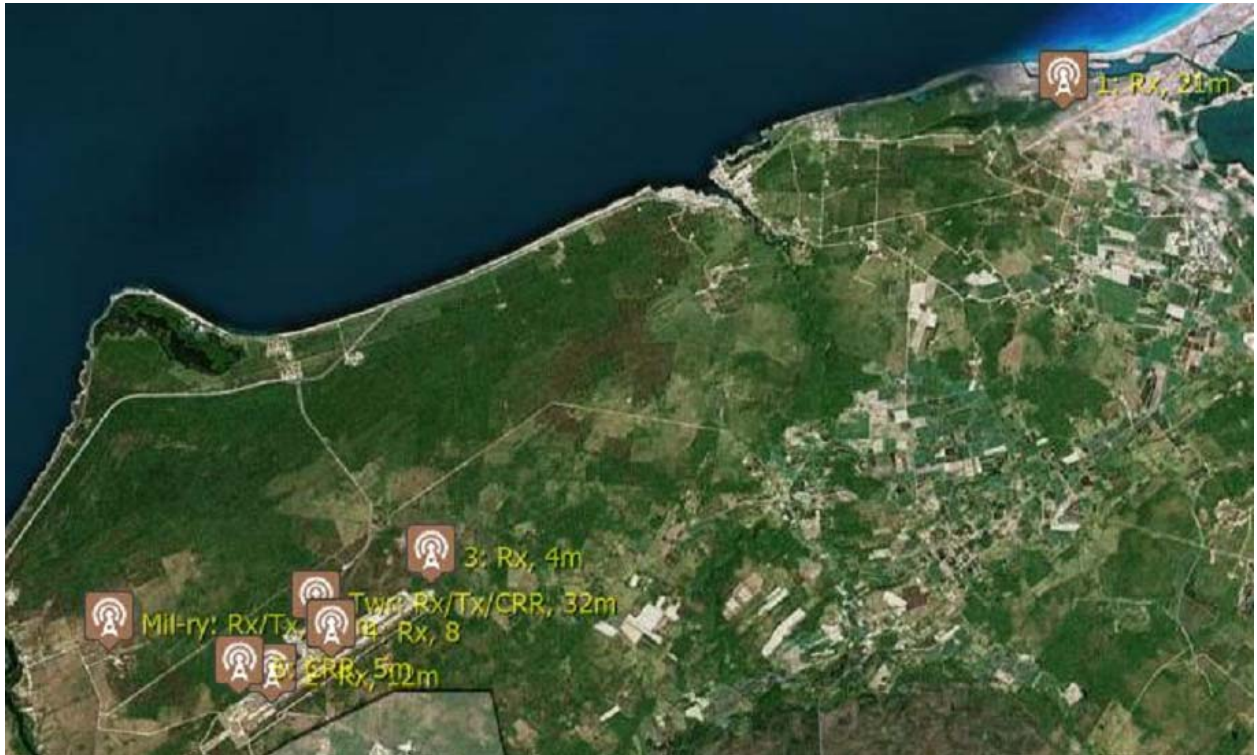


Fig.3 Map of the MLAT system deployment

4. Projections

4.1 Work is being performed on the modernization of the automated 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, the representation of information from secondary monopulse radars together with ADS-B receivers data and the multilateration equipment to be installed.

4.2 Based on the CONOPS of the NAM/CAR region to be approved, work will be performed in the operational requirements related to the use of the new surveillance systems in the Havana FIR Air Traffic Control.

4.3 Work is being carried out on the necessary arrangements to ensure that all our commercial aircraft on international flights have ADS-B transponders version DO-260B before 2018.

4.4 The cost-benefit analysis required, with a view to determining the aerodromes or areas where operational implementation of feasible multilateration systems, will be developed.

5. Conclusions

5.1 The analysis of trials for which the software developed for the collection, processing and statistical representation of all data received on ADS-B is been kept, and 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.

5.2 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.

5.3 The MLAT system trial was favorably started in Varadero Airport and has obtained excellent accuracy in the position data of aircraft and vehicles analyzed, which will share the results obtained with the members of group.

6. Actions to be taken:

- a) Take note of the results presented in this paper, with a view to analyzing the tasks in the work plan of the Task Force for the operational implementation of ADS-B; and
- b) Make available to any state you need statistical processing software for testing ADS-B.