CNS/COMM/6-WP/09
International Civil Aviation Organization 11/06/08
CAR/SAM REGIONAL PLANNING IMPLEMENTATION GROUP **(GREPECAS)**
Sixth Meeting of the CNS Committee of the GREPECAS ATM/CNS Subgroup (CNS/COMM/6)
Santo Domingo, Dominican Republic, 30 June to 4 July 2008

Agenda Item 3: Surveillance Systems Developments

3.1 Review of the regional strategy of the implementation of surveillance systems in the CAR/SAM Regions

3.2 Follow up to the surveillance systems planning/implementation/trials (ADS-C, ADS-B, Radar Mode S, multilateration, etc.)

(Presented by the Rapporteur Surveillance Task Force)

SUMMARY

This working paper presents to the Meeting the work accomplished by the Surveillance Task Force of the CNS Committee (CNS/COMM) of the GREPECAS ATM/CNS Sub-Group (ATM/CNS/SG).

***Strategic objectives*:**	*This working paper is related with Strategic objective D.*

1. Introduction

1.1 This paper is based on the work carried out by the Surveillance Task Force in accordance with the terms of reference and the work programme approved by the CNS Committee during the CNS/COMM/5 Meeting and based on its Decision CNS 5/15.

1.2 The Task Surveillance Force had met two times since the CNS/COMM/5 Meeting:

a) I CNS/SUR/TF Meeting held in Trinidad and Tobago from 20 to 21 June 2007. The Meeting counted with the assistance of 5 States and 2 International Organizations (Brazil, Cuba, Trinidad & Tobago (Rapporteur), United States, IATA and Thales, making a total of 16 participants, including the ICAO officers.

b) II CNS/SUR/TF Meeting held in ICAO Office in Lima from 9 to 10 May 2008. The Meeting counted with the assistance of 7 States and 3 International Organizations (Brazil, Bolivia, Cuba, France, Peru, Trinidad & Tobago (Rapporteur), United States, COCESNA, IATA and Thales, making a total of 15 participants, including the ICAO officers.

2. Follow-up on ADS-C, ADS-B and Multilateration Trials in the CAR/SAM Regions

2.1 The Meeting took note that to determine the feasibility of using ADS-B as a surveillance tool in the CAR/SAM Region, it is necessary to collect data to validate the quality of the ADS-B messages currently being broadcast and to identify the aircrafts that are ADS-B equipped.

2.2 ADS-B technology has been identified as the surveillance solution that can meet the needs of providing critical flight information simultaneously to several users as pilots and air traffic controllers. ADS-B transmits air traffic and flight information to aircraft, vehicles, and ground stations to improve situational awareness and provide unprecedented levels of service inside the cockpit and to air traffic control facilities.

2.3 The United States informed the Meeting that ADS-B systems were operational in Alaska.

2.4 The Meeting recalled that at the first meeting of the Surveillance Task Force of the CNS Committee of the ATM/CNS Subgroup of GREPECAS, in June 2007, several members of the CAR/SAM region of the International Civil Aviation Organization expressed interest in conducting an ADS-B data collection effort in the region. To determine the feasibility of using ADS-B as a surveillance tool in the CAR/SAM, it is necessary to collect data to validate the quality of the ADS-B messages currently being broadcast.

2.5 The United States informed that the CAR/SAM States that want to participate in ADS-B trials with the FAA should follow the process identified:

- The CAR/SAM State makes an official request via memorandum, e-mail, or fax to "The Federal Aviation Administration (Office of International Aviation, AWH-10,800 Independence Ave. S.W., Washington D.C." (202) 267-5032 --Fax).
- The FAA and the CAR/SAM State develop a bilateral agreement that both parties to sign.
- Timelines established in accordance to terms of bilateral agreement.
- Start of the activities.

2.6 As informed by the United States, the Meeting noted that for ADS-B trials between the United States and the CAR/SAM States the following roles and responsibilities would apply:

2.7 The FAA:

a) Following request from a Civil Aviation Authority, negotiate and enter into a bilateral agreement;
b) Provide a contract vehicle for the participating State to procure turn-key surveillance services; and
c) Provide technical assistance in data reduction and analysis.

2.8 The CAR/SAM StateS:

a) Establish a bilateral agreement with the United States;
b) Provide ground-based surveillance technology;
c) Provide infrastructure necessary to install ground stations in suitable geographic locations; the infrastructure will include telecommunications, power, and equipment shelters;
d) Collect and record ADS-B messages from aircraft transitioning, departing, or landing at various airports; and
e) Participate in data reduction and analysis.

2.9 The Meeting noted that the following considerations are to be made for the implementation of the ADS-B trials:

- The scope of ADS-B surveillance: for situational awareness or for separation;
- The type of airspace: en-route, TMA, upper, lower, with or without existing radar coverage, and associated coverage;
- The time frame considered;
- Preparation and publication of necessary regulatory material;
- Organization of controller training and users educations.

2.10 The Meeting also noted that to support the analysis of ADS-B implementation in a State or a region, ADS-B trials needed to be set-up to allow the direct observation and analysis of a number of parameters:

- The status of the aircraft fleet in this state or region with respect to ADS-B equipage;
- The local characteristics of the GPS signal, which directly generate the aircraft position reported by ADS-B;
- The impact of local environment (physical, radio, etc.) on the expected performance of the ADS-B surveillance.

2.11 The results of such trials will contribute to a decision for implementation. It will support dialogue with airlines for buy-in and plans to equip (or understand reasons for reluctance), and it will provide inputs for the preparation of safety case.

2.12 The set-up for ADS-B trial can be simple, as it generally consists of a single channel ADS-B ground station (redundancy is not strictly necessary), associated with a GPS equipped/RAIM reporting site monitor, a local or remote and control system (depending on where the station is installed), data recording capability and replay/data analysis tools, and the availability of experts resource to carry out the analysis. The trial will provide more results if a radar covers the same area as the ADS-B ground station to afford the comparison of ADS-B and radar reports, tracks.

2.13 The Meeting noted the Methodology for Data Analysis and in this respect considered the following:

- Which data is to be recorded for analysis depends on the intended operations i.e. whether it is en-route overflights, en-route domestic, approach in large TMA, and/ or approach to small airports;
- Depending on the operations required, the performance assessment might differ.

2.14 As an example of trial objectives the Meeting noted the following:

- Collection and analysis on a daily basis over a six-month period, the quantity and registration numbers of ADS-B equipped aircraft received by ADS-B ground station;
- Conclusion on the validity of the reports received to allow surveillance and/or separation of aircraft based on ADS-B
- Comparison of ADS-B targets to radar targets functionality and recommendations

2.15 Analysis to be carried out on data collected may include aircraft sorted by airline/type/ …the analysis of the content of the squitter (i.e. what are the fields provided, level of NUC, …), for the whole population of aircraft observed, establish a data base, identifying the aircraft with "good" ADS-B equipment and those with "bad" ADS-B equipment; the "bad" characteristic may come from an already identified issue or be a new one, for selected tracks with good NUC values assess:

- position accuracy, including investigation on along tracks error (on-board latency);
- update rate figures;
- the ground station range and compare with theoretical model;
- For selected tracks evaluate % of equipped aircraft.

2.16 Trials set-up in various places of the world allowed assessment of the overall performances of ADS-B:

- Percentage of aircraft equipped
- Percentage of aircraft broadcasting correct ADS-B data
- Measurement of update rate, NUC distribution
- Analysis of Call Sign correctness

2.17 The Meeting updated the ADS-B, ADS-C and multilateration trials as identified at the SUR/TF/1:

1. The delegate of Cuba informed the Meeting that the phase of collecting ADS-B data from their first trials has been completed and that the results of the analysis will be sent to the SUR/TF. Cuba also informed the meeting that more ADS-B trials will be done during the 2008-2010 period.

2. COCESNA informed the Meeting that ADS-B trials were conducted in order to obtain statistical information on the equipage of aircrafts in the Region. Refer to **Appendix A**.

3. Trinidad and Tobago stated that they have not progressed with the ADS-B trials as identified in the SUR/TF/1 and explained that as custodian of the Piarco FIR they will eventually migrate to ADS-B as its main mode of surveillance in accordance with the Regional Plan. For the near to medium term surveillance will be via MSSR the existing and planned Radars which are relatively new and are expected to be available for use beyond 2015. Surveillance within the Piarco FIR should migrate to ADS-B via MLAT and that ADS-B trials are to be conducted not before 2015 within the FIR.

4 Brazil informed that ADS-C operational capability will be achieved in Oct/2008, and that ADS/CPDLC FANS 1/A will attain operational capabilities in Apr/2009, using a final platform developed by ATECH.

- ADS-B and MLAT:

  During the past few years, Brazilian Administration has promoted modernization programs on current surveillance radar systems and has installed new radars throughout the country. The result of those initiatives is that the current radar network in Brazil is considerably new (less than 7 years old) and the coverage for secondary radars is complete for the entire territory (FL 200 and above). Considering the above mentioned, Brazil has no plans in short terms to migrate to ADS-B or MLAT for En-route and TMA in continental areas.

  Nevertheless, there is a specific operational need in the Oil Platforms area close to Rio de Janeiro (Bacia de Campos) that might be suitable for trials on ADS-B/MLAT, since it represents an homogeneous airspace (helicopters only) that has partial radar coverage and would be a good Test Bed for the comparison between the performance of ADS-B/MLAT and a radar system. Recently, DECEA, Petrobrás (Brazilian Oil Company) and the helicopters operators worked on the re-design of the routes (RNAV) based on GNSS procedures. It is expected that the design of new routes will be ready in September 2008. Once that work is done, it will be possible to identify the surveillance operational needs in order to decide which surveillance application would be the most appropriate to that area.

5. United States informed the Meeting that the ADS-B program in the United States will be deploying communications, weather, and ADS-B stations on oil platforms in the Gulf of Mexico, beginning this year 2008. Multilateration is being deployed in Colorado and Juneau, Alaska for surveillance services.

6. Trinidad & Tobago stated that implementation of ADS-C should be carried out in 2010/11 when the new ATM System is fully up and running.

2.18 The Meeting noted the survey that was carried out by IATA on the aircraft on-board communication, navigation and surveillance equipment, which is presented in **Appendix B.** The meeting requested a revision of the Table to contain the following information:

- An explanation for the “ADS” column information should be given for its understanding.
- Update the information on the Table of the airlines that operate in the CAR/SAM Region and it would be useful if the air route in which these aircraft fly is indicated.
- The survey should include all other airlines not listed in the current survey.
- For a better understanding of the information, a brief description on each column especially on the navigation and surveillance columns should be included, as well as a description of how to interpret the information given for each aircraft type for example when the answer is “N”, “Y”, “N(n)”, etc.
- Provide not only the current fleets but any airline new fleet projections with information on planning and implementation actions, indicating the estimated date of operation of the new aircrafts.
- The description for aircraft for JAL is redundant and can cause confusion in the sense that if aircraft type indicates that it has GPS or not, this additional information is already reflected in the columns for navigation avionics.

2.19 The Meeting noted that the CAR/SAM Region would benefit from a collaborated effort and compilation of activities for ADS-B trials and in this regard elaborated a list of requirements with the associated parameters and criteria in order to promote the ADS-B trails in the Region. Refer to **Appendix C**.

2.20 Based on the above considerations, the Meeting formulated the following draft Conclusion:

Draft Conclusion SUR/TF/02/01: Activity for ADS-B trials

That States of the CAR/SAM Region that want to make trials in ADS-B take note of the activities list presented in **Appendix C** of this Report.

3. Development of a Regional Strategy for Surveillance Implementation in the CAR/SAM Region

3.1 Under this agenda Item, ICAO presented the current surveillance aspects considered in the GREPECAS 14 and in the First Meeting of Surveillance task force of the CNS Committee with the status of implementation of the conclusions, as well as a summary of the current status of the SARPS and planning topics related to Surveillance Systems and an overview of the upcoming works in the ASP Panel.

3.2 The Meeting took note of the current Regional CAR/SAM Strategic considerations: “Draft elements for a regional Strategy for Surveillance Systems”, the “CAR/SAM Regional Strategy for the ADS-C/ADS-B System implementation” and “Potential air space to implement ADS-C and ADS-B considered by CAR/SAM states, territories, and international organizations” .

3.3 As a result of the first Surveillance Task Force Meeting, and in regards to GREPECAS/14 mandate, the Task Force presented an initial Unified Regional Surveillance Strategy, which was discussed and updated, based on the following considerations:

1. CAR/SAM Strategic considerations mentioned in the previous paragraph
2. ICAO surveillance documentation
3. IATA information on aircraft on-board communication, navigation and surveillance equipment

3.4 This initial unified Regional Surveillance Strategy is presented in **Appendix D**.

3.5 The meeting analyzed the results of the conclusion made during the First Surveillance Task Force Meeting (Trinidad & Tobago, 20-21 June 2007). The result is presented in **Appendix E**

3.5 The next meeting of the Surveillance Task Force is tentatively scheduled for the second quarter of 2009 to be held in Martinique.

5. Suggested Action

5.1 The Meeting is invited to:

a) Take note of the information provided in this paper,

b) review the activities to be considered for ADS B trial presented in the Appendix C of this working paper and the associated Draft Conclusion SUR/TF/02/01.

c) provide information on any other ADS-B, ADS-C or Multilateration Trial or experience not included in the CNS/TF/SUR reports,

d) review and comment the draft unified Regional Surveillance Strategy presented in this paper in its appendix D and if it is feasible adopt a draft conclusion to use it for the CAR/SAM Region.

e) review the term of reference and work programme for the CNS/TF/SUR, presented as **Appendix F** of this working papers; and

f) Suggest any other action as the meeting considers appropriated.

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APPENDIX A

COCESNA ADS-B TRIAL ACTIVITIES

Phase I:

This phase consisted in monitoring the aircrafts that have this technology and that over fly the Central American airspace. The activities carried out were:

- Acquisition of a receptor equipment Mode-S/ADS-B (SBS-1) for the management of aircrafts signs. This equipment included a software application (base station) that shows the received information on a screen as a virtual radar allowing the presentation in real time of the aircrafts. In the application all equipped Mode-S/ADS-B aircrafts, within the receptor's coverage, are shown. The real coverage of this receptor is approximately 250 NM.

- Since January 30, tests have been carried out by a team based on COCESNA Headquarters in Tegucigalpa and in the Radar Site of Monte Crudo. Preliminary results indicate that several aircrafts of the main airlines fleets that over fly the central area of Honduras and its proximities use ADS-B regularly, among the monitored ones:

  Taca (Flights: THAI 390 391 215 214)
  UPS (Flights UPS 392 376 368 364)
  BSK (Flights BSK 670 671)
  American (Flights AAL 953 954 940 2166 945)
  Continental (Flights COA 14471868 1446 1447)
  Mexican (I Fly MXA 382)
  Spirit Wing (I Fly NKS 756)
  Airtransac (I Fly TSC 325)
  Servivensa (Flights SSV 328 3285)
  Iberia (Flights IBE 6313 6347)
  Lacsa (Flights LRC 643 642 654 655 8632)

In total, 61 aircrafts has been registered (in different days and with different assigned flights).

The following fields of information has been identified among the ADS data that has been gathered of these flights: Track position (longitude and latitude), call sign, Mode-S Address, Ground speed, Altitude, Vertical Rate and status (on-ground or during flight).

Phase II

Among the planned activities, data is to be collected in different points of the Central America FIR, specifically in radar sites to have a greater number of data with the best coverage to process as statistic information.

Prosecution of ADS data and CPDLC Communications:

With respect to the facilities and capacities available in COCESNA Air Traffic Control Centers and the actions undertaken in the planning and execution of tests for the prosecution of the Data ADS and CPDLC communications, mainly for the Pacific non radar-covered oceanic area of the of the Central America FIR, the following is indicated:

- COCESNA has in Ilopango, El Salvador a system that serves as a contingency back-up for CENAMER ACC Control Center, with the same functionalities for ATC.

- The current functions in both Control Centers can process ADS C data and manage CPDLC communications,

- CENAMER Control Center has ADS/CPDLC Data Connection Servers (DataLink Servers–DLS). This system has the capacity to manage ADS/CPDLC communications through connections provided by Datalink Suppliers, carry out the exchanges of messages between the aircrafts and the Data Terminal, the distribution of ADS data to the Surveillance Data Proccesors (SDP) for processing as ADS and ADS/SSR information, as well as the recording of all these messages.

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IATA SURVEY

ON BOARD NAVIGATION, SURVEILLANCE AND COMMUNICATION EQUIPMENT

Airline	Airplane type	NAVIGATION																		SURVEILLANCE				COMMUNICATIONS					COMMENTS
		1 x FMS	2 x FMS	GNSS STAND ALONE	GNSS COUPLED TO FMS	IRU	RNAV DME/DME	RNAV DME/DME/IRU	RNAV GNSS	RNP 10	RNP 4 Oceanic	RNAV 5	RNAV 1	RNP 1.0	RNP .3	RNP <.3	SBAS	GBAS	FANS	ADS	ADS-B	Mode S	Mode S Enhan	HF	HF DATA LINK	ACARS	VDL 2	SATCOM	
Air Canada	A319		Y		Y	Y	Y	Y	Y	Y																Y			
	A320		Y		Y	Y	Y	Y	Y	Y																Y			
	A330		Y		Y	Y	Y	Y	Y	Y	Y	Y	Y						Y	Y	Y			Y		Y		Y	
	A340		Y		Y	Y	Y	Y	Y	Y	Y	Y	Y						Y	Y	Y			Y		Y		Y	
	B767		Y		Y	Y	Y	Y	Y	Y		Y												Y		Y		Y*	*15 of 40 have SATCOM
Air Europa	A330-200		Y		Y	Y		Y		Y	Y	Y	Y		Y				Y	Y			Y	Y		Y	Y	Y	
	B737-800	Y			Y	Y		Y				Y	Y			Y							Y	Y		Y	Y		
	B767-300		Y		Y	Y		Y		Y	Y	Y	Y			Y						Y		Y					
Air France	A320		Y		Y	Y		Y	Y	Y	Y	Y	Y	Y	Y						Y	Y	Y	Y		Y			ADS-B OUT capable but not certified
	A330		Y		Y	Y		Y	Y	Y	Y	Y	Y	Y	Y				Y	Y	Y	Y	Y	Y		Y		Y	ADS-B OUT capable but not certified
	A340		Y		Y	Y		Y	Y	Y	Y	Y	Y	Y	Y				Y	Y	Y	Y	Y	Y		Y		Y	ADS-B OUT capable but not certified
	B747-200F		Y		Y	Y	Y		Y	Y	Y	Y	Y	Y	Y							Y	Y	Y		Y	Y		
	B747-400/400ERF		Y		Y	Y		Y	Y	Y	Y	Y	Y	Y	Y				Y	Y		Y	Y	Y		Y	Y*	Y	*only 8 VDL2 equipped airplanes
	B777-200ER/300ER		Y		Y	Y		Y	Y	Y	Y	Y	Y	Y	Y				Y	Y		Y	Y	Y		Y		Y	
American Airlines	A300-600		Y			Y		Y		Y		Y										Y		Y		Y			
	B737-800		Y		Y	Y			Y	Y			Y		Y							Y		Y		Y			
	B757-200		Y		Y*	Y		Y	Y*	Y			Y		Y*	Y*						Y*	Y*	Y		Y	Y*		* some aircraft (partial fleet)
	B767-200		Y			Y		Y		Y		Y										Y		Y		Y		Y*	* voice only
	B767-300		Y		Y*	Y		Y	Y*	Y			Y							Y*			Y	Y		Y	Y*	Y	* some aircraft (partial fleet)
	B777-200		Y		Y	Y			Y	Y			Y		Y				Y	Y			Y	Y		Y		Y	
	MD80			Y					Y				Y									Y				Y			
Brithish Airways	A319		Y		Y	Y		Y	Y			Y	Y	Y	Y						Y	Y	Y			Y			
	A320		Y*		Y*	Y		Y	Y*			Y	Y	Y	Y						Y	Y	Y	Y		Y			* except older A320s
	B737-400	Y				Y		Y				Y	Y	Y								Y	Y	Y		Y			
	B747-400		Y		Y	Y		Y	Y	Y		Y	Y	Y	Y	Y					Y	Y	Y	Y		Y		Y	
	B767-300		Y	Y		Y		Y		Y		Y	Y									Y	Y	Y		Y			
	B777		Y		Y	Y		Y	Y	Y	Y	Y	Y	Y	Y	Y			Y	Y	Y	Y	Y	Y		Y		Y	
Caribbean Airlines	B737-800		Y		Y	Y		Y	Y		Y				Y							Y		Y		Y			
Continental Airlines	737-300	Y																				Y				Y			
	737-500		Y		Y	Y		Y	Y	Y		Y	Y	Y	Y							Y				Y			
	737-700		Y		Y	Y		Y	Y	Y		Y	Y	Y	Y	Y						Y		Y		Y			
	737-800		Y		Y	Y		Y	Y	Y		Y	Y	Y	Y	Y					Y	Y		Y		Y			40 existing + 35 new by end-2007
	737-900		Y		Y	Y		Y	Y	Y		Y	Y	Y	Y	Y						Y		Y		Y			
	757-200		Y		Y	Y		Y	Y	Y		Y	Y	Y	Y	Y						Y	Y	Y	Y	Y			Mode S Enhanced in work to meet European mandate
	757-300		Y		Y	Y		Y	Y	Y		Y	Y	Y	Y				Y			Y	Y	Y		Y	Y		
	767-200		Y		Y	Y		Y	Y	Y		Y	Y	Y	Y				Y		Y	Y	Y	Y	Y	Y		Y	Mode S Enhanced in work to meet European mandate
	767-400		Y		Y	Y		Y	Y	Y		Y	Y	Y	Y	Y			Y		Y	Y	Y	Y	Y	Y	Y	Y	Mode S Enhanced in work to meet European mandate
	777-200		Y		Y	Y		Y	Y	Y		Y	Y	Y	Y	Y			Y		Y	Y		Y	Y	Y		Y	Mode S Enhanced in work to meet European mandate
COPA	B737-700		Y		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y						Y		Y	Y	Y			
	B737-800		Y		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y						Y		Y	Y	Y			
	ERJ-190		Y		Y	Y	Y	Y	Y	Y	Y											Y		Y		Y			
Emirates	A310/F		Y		Y	Y	Y	Y	Y	Y		Y	Y	Y	Y							Y	Y	Y		Y			
	A330-200		Y		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y			Y	Y	Y	Y	Y	Y		Y		Y	
	A340-300		Y		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y					Y	Y	Y	Y		Y		Y	
	A340-500		Y		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y			Y	Y	Y	Y	Y	Y	Y	Y		Y	
	B777-200/300		Y		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y			Y	Y	Y	Y	Y	Y		Y		Y	

IATA SURVEY

ON BOARD NAVIGATION, SURVEILLANCE AND COMMUNICATION EQUIPMENT

Airline	Airplane type	NAVIGATION																		SURVEILLANCE				COMMUNICATIONS					COMMENTS
		1 x FMS	2 x FMS	GNSS STAND ALONE	GNSS COUPLED TO FMS	IRU	RNAV DME/DME	RNAV DME/DME/IRU	RNAV GNSS	RNP 10	RNP 4 Oceanic	RNAV 5	RNAV 1	RNP 1.0	RNP .3	RNP <.3	SBAS	GBAS	FANS	ADS	ADS-B	Mode S	Mode S Enhan	HF	HF DATA LINK	ACARS	VDL 2	SATCOM	
	B777-300ER		Y		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y			Y	Y	Y	Y	Y	Y		Y		Y	
FedEx	A300		Y		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y							Y	Y			Y	Y		
	A310		Y		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y							Y	Y			Y	Y		
	B727			Y*								Y																	* approx. 20% of fleet has GPS
	MD-10		Y		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y							Y	Y	Y	Y	Y	Y		
	MD-11		Y		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y				Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
Iberia	A319		Y		Y	Y	Y	Y	Y			Y	Y									Y	Y	Y		Y			
	A320		Y		Y	Y	Y	Y	Y			Y	Y									Y	Y	Y		Y			
	A340		Y		Y	Y	Y	Y	Y	Y		Y	Y									Y	Y	Y		Y		Y	
KLM	A330-200		Y		Y	Y	Y	Y	Y	Y	Y	Y	Y						Y	Y		Y	Y	Y		Y		Y	
	B747-400		Y		Y	Y	Y	Y	Y	Y	Y	Y	Y									Y	Y	Y		Y		Y	
	B747-400F		Y		Y	Y	Y	Y	Y	Y	Y	Y	Y						Y	Y		Y	Y	Y		Y		Y	
	B777-200		Y		Y	Y	Y	Y	Y	Y	Y	Y	Y						Y	Y		Y	Y	Y		Y		Y	
	MD-11		Y		Y	Y	Y	Y	Y	Y	Y	Y	Y									Y	Y	Y		Y		Y	
LAN	A319-100		Y		Y	Y	Y	Y	Y	Y		Y	Y			Y								Y		Y			
	A320-200		Y		Y	Y	Y	Y	Y	Y		Y	Y			Y								Y	Y	Y			
	A340-300		Y		Y	Y	Y	Y	Y	Y	Y	Y	Y						Y	Y			Y	Y		Y		Y	
	B767-300		Y		Y*	Y	Y	Y	Y	Y		Y	Y											Y	Y*	Y			*10 of 29 B767s have GPS. Non-GPS 767s have HF datalnk
Lufthansa	A340-300		Y		Y	Y		Y	Y				Y						Y			Y	Y	Y		Y	Y	Y	
	A340-600		Y		Y	Y		Y	Y				Y						Y			Y	Y	Y		Y	Y	Y	
	B747-400		Y		Y	Y		Y	Y				Y						Y			Y	Y	Y		Y	Y	Y	
Mexicana	A318		Y			Y		Y						Y								Y				Y			
	A319		Y			Y		Y						Y								Y		Y*		Y			* 3 of 16 have HF
	A320		Y			Y		Y						Y								Y		Y*		Y			* 20 of 30 have HF
	B757		Y			Y		Y				Y										Y				Y			
	B767		Y			Y		Y				Y										Y				Y			
Northwest	A319		Y			Y		Y		Y			Y									Y				Y			
	A320		Y			Y		Y		Y			Y									Y				Y			
	A330-200/300		Y		Y	Y		Y		Y		Y	Y		Y				Y	Y		Y	Y	Y		Y	Y	Y	
	B747-200					Y				Y		Y										Y		Y					
	B747-400		Y			Y		Y		Y		Y	Y									Y	Y	Y		Y			
	B757-200/300		Y		Y*	Y		Y		Y		Y	Y									Y	Y	Y*		Y			* part of the fleet only
Pluna	B767-300		Y			Y	Y	Y		Y	Y	Y										Y		Y		Y			
SAA	A319		Y			Y				Y	Y	Y	Y	Y	Y									Y	Y	Y			
	A340-200		Y			Y				Y	Y	Y	Y	Y	Y									Y		Y		Y	
	A340-300		Y			Y				Y	Y	Y	Y	Y	Y				Y	Y	Y			Y	Y	Y		Y	
	A340-600		Y			Y				Y	Y	Y	Y	Y	Y				Y	Y	Y			Y	Y	Y		Y	
	B737-800		Y			Y				Y		Y												Y	Y*	Y			* 6 of 21 have HF datalink
	B747-400		Y	Y*	Y	Y				Y	Y	Y							Y*					Y	Y	Y		Y*	* some aircraft only. Only 4 aircraft have SATCOM.
TACA	A319		Y		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y							Y		Y		Y			
	A320		Y		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y							Y		Y		Y			
	A321		Y		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y							Y		Y		Y			
TAM	A319		Y		Y	Y	Y	Y		Y		Y	Y		Y							Y		Y		Y		Y	
	A320		Y		Y	Y	Y	Y		Y		Y	Y		Y							Y		Y		Y		Y	
	A330-200		Y		Y	Y	Y	Y		Y		Y	Y	Y	Y				Y			Y	Y	Y		Y		Y	
	F100		Y			Y	Y	Y														Y		Y					

IATA SURVEY

ON BOARD NAVIGATION, SURVEILLANCE AND COMMUNICATION EQUIPMENT

Airline	Airplane type	NAVIGATION																		SURVEILLANCE				COMMUNICATIONS					COMMENTS
		1 x FMS	2 x FMS	GNSS STAND ALONE	GNSS COUPLED TO FMS	IRU	RNAV DME/DME	RNAV DME/DME/IRU	RNAV GNSS	RNP 10	RNP 4 Oceanic	RNAV 5	RNAV 1	RNP 1.0	RNP .3	RNP <.3	SBAS	GBAS	FANS	ADS	ADS-B	Mode S	Mode S Enhan	HF	HF DATA LINK	ACARS	VDL 2	SATCOM	
	MD-11		Y			Y	Y	Y		Y		Y										Y		Y		Y			
United	A319/A320		Y		Y*	Y		Y	Y*			Y	Y	Y	Y*							Y				Y			*About 50% of fleet has GPS and is RNP 0.3 capable
	B737-300/500	Y				Y		Y				Y	Y									Y				Y			
	B757-200		Y			Y		Y				Y	Y									Y				Y			
	B767-300		Y		Y*	Y		Y	Y*	Y	Y	Y	Y	Y	Y							Y	Y			Y		Y	*About 40% of fleet has GPS and is RNP 0.3 capable
	B777-200		Y		Y	Y		Y	Y	Y	Y	Y	Y	Y	Y				Y	Y	Y	Y	Y			Y		Y	
	B747-400		Y		Y	Y		Y	Y	Y	Y	Y	Y	Y	Y				Y	Y	Y	Y	Y			Y		Y	
UPS	A300		Y		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y							Y	Y	Y	Y		Y			
	B727			Y						Y		Y									Y	Y				Y			
	B747-100/200		Y			Y	Y	Y		Y	Y	Y									Y	Y	Y	Y		Y			
	B757		Y			Y	Y	Y		Y	Y	Y									Y	Y	Y	Y*	Y*	Y			* HF and HFDL on 20 out of 75 airplanes
	B767		Y		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y							Y	Y	Y	Y	Y	Y			
	DC-8					Y	Y	Y		Y		Y									Y	Y				Y			
	MD-11		Y		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y					Y	Y	Y	Y	Y	Y	Y	Y		Y	
US Airways	A319/320/321		Y		Y	Y			Y						Y								Y	Y*		Y			* Some A319/320/321
	A330-300		Y		Y	Y			Y		Y				Y				Y	Y			Y	Y		Y		Y	
	B737-300 *	Y				Y		Y		Y		Y	Y	Y	Y														
	B737-300/400 **	Y				Y		Y		Y		Y	Y													Y			
	B757-200 (23N) ETOPS		Y		Y	Y		Y	Y	Y	Y	Y	Y	Y	Y	Y			Y			Y		Y	Y	Y			
	B757-200 ETOPS		Y			Y		Y		Y	Y	Y	Y	Y	Y							Y		Y		Y			
	B757-200		Y			Y		Y		Y	Y	Y	Y	Y	Y											Y			
	B767-200		Y			Y		Y		Y	Y	Y	Y	Y	Y							Y		Y		Y			
	E-190		Y	Y	Y	Y	Y	Y	Y	Y			Y	Y	Y					Y	Y	Y	Y			Y	Y		

APPENDIX C

ACTIVITIES TO BE CONSIDERED FOR ADS-B TRIAL

Activities to be considered for ADS B Trial

1 Introduction

1.1 At the second meeting of the GREPECAS ATM/CNS Subgroup – CNS Committee, Surveillance Task Force, members of the CAR/SAM region of the International Civil Aviation Organization expressed an interest in conducting ADS-B trials in order to verify feasibility of using ADS-B as a surveillance tool in their States.

1.2 The Team discussed that there isn't a standardized way to plan, perform and check the actions involved in an ADS-B trial. Therefore, The TF coordinator assigned an ad hoc group in order to develop some guidelines for States.

2 Discussion

2.1 The ad hoc group has decided that five main topics should be considered by the States that are interested in performing some trials on ADS-B, which are:

- Planning Function
- Expected Criteria
- Test Parameters
- Trial Limitation
- Results Dissemination

2.1.1 Planning Function

There's a need to develop a Concept of Operations (CONOPS), in which the scope has to be clearly stated and what the operational requirements are, as well as the issues that have to be addressed (e.g. efficiency improvement, fuel savings, capacity enhancement, etc.)

The above mentioned CONOPS should also define what kind of service will be provided in the trial area (e.g. radar like service) and the complete schedule to perform the actions required, from planning to final report.

All stakeholders should be identified and brought to the program by promoting some user and customer conferences, to discuss the contents of the CONOPS and present the benefits of new technologies. It is also important to have some Airline candidates to commit and be part of the program from the beginning.

2.1.2 Expected Criteria

The ad hoc group understands that the items listed below should be satisfied in order to have an adequate justification for launching an ADS-B trial:

- The migration for an ADS-B environment should be cost effective;
- The use of the new technology must provide some safety benefit;
- The trial must be concluded in a reasonable time frame;

- The ANSP must get full commitment from users and regulators before the beginning of activities;
- It is important to have some radar coverage (at least partial) over the trial area to validate ADS-B position reports;
- A performance baseline for the designated areas of trials (e.g. existing routes) should be established to make future comparisons possible;
- A Cost Benefit analysis (CBA) should be performed for the customers by the ANSP; and
- Data collection should be performed and a safety case based on that data should be presented to regulators.

2.1.3 Test parameters

The ad hoc group understands that the parameters listed below should be measured during an ADS-B trial process.

- The update rate of the prototype system should be measured and compared to the expected rate, depending on the designated airspace (en-route, TMA, ground);
- The accuracy of the system should be evaluated by comparison with a known legacy system (e.g. secondary radars);
- The performance of the system should be monitored, in terms of NUC (for D260 compatible avionics) or Navigation Integrity Category (NIC), Navigation Accuracy Category (NAC), System Integrity Level (SIL) (for D260A compatible avionics);
- The probability of reception should also be measured over a very large sampling of flights;
- The flight ID sent by any aircraft should be assessed by the technical teams;
- The overall service availability must be measured and determined. Anomalies of all types shall be recorded and analyzed.

2.1.4 Trial Limitations

Some difficulties and limitations for an ADS-B trial were identified by the ad hoc group as follows:

- The trials should be limited to ADS-B out only;
- There is a need to validate the performance of the existing communication infrastructure;
- The spectrum within the trial area should be monitored in order to make sure that the frequency 1090MHz won’t be affected for the legacy systems that are currently deployed;
- It is desirable to have a monitoring system for the health of the GPS constellation to validate its performance during the test event.

2.1.5 Results dissemination

During the trial processes, a dedicated team should be assigned to collect, organize and analyze data that will be used to write a complete report of the ADS-B trial results and to submit that report to GREPECAS through the Surveillance Task Force. Data will be sent to the Rapporteur of the Surveillance Task Force.

APPENDIX D

UNIFIED REGIONAL SURVEILLANCE STRATEGY

CAR/SAM REGION

Table of Contents

Surveillance Strategy for CAR/SAM Region

1. Introduction

1.1 General considerations

1.1.1 This initial document is the result of the task assigned to CNS Committee - CNS/SUR/TF from GREPECAS 14 Meeting in which the Preliminary elements for a Regional Surveillance Strategy and the Regional CAR/SAM Strategy for short, medium and long term ADS-C and ADS-B use have been integrated into a Unified Regional Strategy for the Implementation of Surveillance Systems. This is a live document based on the Global and Regional Planning:

a) The Global Strategies are described on Doc 9750 Global Air Navigation Plan on its initiatives:

- GPI-09 Situational Awareness: promotes the operational implementation of data link surveillance, and the definition of the use of ADS-B and ADS-C.
- GPI-17 Data link Applications promotes the use of data link applications, and its harmonization for seamless and interoperable operations.

b) The CAR/SAM Regional Implementation of Surveillance Systems: Doc. 8733 "CAR/SAM Regional Air Navigation Plan" CNS Table 4A Surveillance System Regional Plan.

1.1.2 The main objective of this strategy is to propose the surveillance systems that are suitable to be applied in short and medium terms within CAR/SAM Region and to define an evolutionary path that will promote safety, interoperability and cost effectiveness of the required infrastructure to meet the future ATM needs.

1.1.3 The surveillance strategy should be seen as a guidance document to all stakeholders, without any regulatory or mandatory requirements. Appropriate regulations should be published by Air Navigation Authorities when the use of new surveillance techniques is to be introduced in the States.

1.1.4 The envisaged goal of this strategy is a regional surveillance infrastructure that enables the interoperability of aircraft equipage throughout CAR/SAM Region in cost effective way.

1.2 Scope of the Surveillance Strategy

1.2.1 Implementation of surveillance systems should be based on a harmonized strategy for the CAR/SAM Regions that would take into account the operational requirements and relevant cost-benefit analyses. It should also be based on Action Plans to ensure that CAR/SAM States, Territories and International Organizations implement the necessary systems in accordance with consistent timescales.

1.2.2 The surveillance technologies considered in this strategy to meet present and future operational expectations are listed bellow and briefly explained in Annex C:

- Primary Radar (PSR, SMR/ASDE);
- Secondary Surveillance Radar (SSR);
- Automatic Dependent Surveillance-Broadcast (ADS-B);
- Automatic Dependent Surveillance-Contract (ADS-C); and
- Multilateration.

1.2.3 In order to provide a global view of the surveillance strategy, the operational drivers, the required surveillance infrastructure and the regional studies and trials proposed in this document have been presented in chronological order.

1.2.4 The dates illustrated in this document define when surveillance systems are estimated to become regionally operational. Nevertheless, some of the surveillance systems described in this strategy will be used to solve local issues prior to the timelines in this document, and thereby will migrate from pioneer areas into larger regional areas.

1.2.5 New surveillance technologies implementation policy for CAR/SAM Region should be based first on a voluntary implementation in pocket areas, using certified existing equipage which is to be followed by an implementation in wider areas supported by the Implementing Rule related to the upgraded equipage.

1.2.6 Surveillance strategy should be seen as a link between the Global Air Navigation Plan for CNS/ATM Systems (Doc. 9750) and the stakeholders' strategy for the air surveillance applications.

1.2.7 This surveillance strategy is derived from the Global Air Navigation Plan for CNS/ATM Systems (Doc. 9750).

1.2.8 CAR/SAM States, Territories and International Organizations when implementing surveillance systems, need to be cognizant of the operational requirements of the Global ANP in particular GPIs 09 and 17 (Situational Awareness and Implementation of data link applications).

1.3 Structure of the Document

1.3.1 This document is structured as follows:

- Section 1 (this section) presents the aim of the document, explains its scope and structure and describes the intended readers and relationship with other documents.
- Section 2 describes the Surveillance Operational Scenario Evolution, i.e. the envisaged operational drivers for the period between 2007 and 2020 in the Air Surveillance field, for En-Route and TMA Airspace, Aerodrome Operations and Aircraft Systems.
- Section 3 details the Surveillance Infrastructure Evolution required to cope with the foreseen operational environment and specifies a tentative action plan that needs to be accomplished in a timely manner, in order to promote the operational use of the new surveillance technologies.
- Annex A provides the meaning of the Acronyms used in this document.
- Annex B provides the definitions of the different terms used in this document.
- Annex C describes the surveillance techniques discussed in this document.

1.4 Intended Readers

1.4.1 This strategy was developed for the following stakeholders group within CAR/SAM Region:

- The departments of the National Supervisory Authorities of CAR/SAM countries who are responsible for verifying ATM Surveillance Systems;
- The departments of the civil and military ANSP of CAR/SAM states that are responsible for procuring/designing, accepting, and maintaining ATM Surveillance Systems;
- The Airport Operators, who are responsible for procuring/designing, accepting, and maintaining Surveillance Systems at airports level; and
- The Airspace Users, who are the final clients of the ATM Surveillance Systems.

2. Surveillance Operational Scenario Evolution

2.1 En-Route and TMA Airspace

2.1.1 Each State/Territory/International Organization needs to evaluate the present day maximum density traffic and that expected for the year 2015 and give due consideration to the useful life of their radars and the potentiality for their replacement with ADS-B.

2.1.2 The surveillance operational scenario evolution for En-Route and TMA airspace is based on three fundamental principles for ground users in such airspace. These principles are dominant throughout the complete surveillance strategy and are:

- An independent surveillance system to track non-cooperative targets in TMA and En Route airspace where and when required;
- An independent surveillance system to track cooperative targets in TMA and en-route airspace; and
- Dependant cooperative surveillance.

2.1.3 For En-Route and TMA Airspace, security and safety will remain key requirements throughout. The need to provide detection of aircrafts that are not equipped with SSR transponders or ADS-B, as well as the ones experiencing an avionics failure, is permanent for TMA Airspace. Detection of non cooperative targets for En-Route Airspace will also remain for specific areas, according to homeland security requirements.

2.1.4 Short term (until 2011)

2.1.4.1 Before 2010, independent surveillance systems will be predominant in CAR/SAM Regions. Until then, target position will only be determined by the ground sensors (PSR, SSR and Mode S radars).

2.1.5 Medium term (2011-2015)

2.1.5.1 From 2010 onwards, the provision of ADDs to ground stations to support TMA and En Route operations is envisaged, following the increasing rate of SSR Mode S equipped aircraft (new and overhauled) that will be able to transmit ADS-B messages (ADS-B out).

2.1.5.2 The first set of new applications that are envisaged to be supported in CAR/SAM Region are the ground Surveillance (ADS-B out) in a non-radar environment (ADS-B-NRA), in a radar environment (ADS-B-RAD) and Airborne Derived Data (ADS-B-ADD). ADS-B-out is expected to reach initial operational capability status in 2015.

2.1.6 Long term (until 2015-2025)

2.1.6.1 Other possible new applications are related to Airborne Surveillance (ADS-B-in, possibly supplemented by TIS-B) including: Airborne situational awareness (ATSA-AIRB), visual separation on approach (ATSA-VSA) and In-trail Procedure in oceanic airspace (ATSA-ITP). ADS-B-in for air traffic situational awareness is expected to be launched after 2015.

2.1.6.2 It is anticipated that an integration of airport and airspace surveillance will become more widespread from 2015 onwards. This requires an increased integration of surveillance information at the SDPD level, which will require updating to process and deliver the new information to surveillance users as the new systems become operational.

2.1.6.3 Until 2015, the ground service provider will remain responsible for the separation service and for maintaining separation. However, from 2015 onwards, there will be a number of ATM concepts which will drive the evolution of the surveillance environment, these are:

- Enhanced medium term planning with the tasks of the controllers operating in En-Route and TMA sectors becoming increasingly supported by automation. The controller will make use of ADD to provide a more accurate view of the situation and improvements in safety nets;
- Surveillance derived information will be made available to support Airborne Traffic Situational Awareness;
- Flight data processing systems will be upgraded to provide full 4D trajectory prediction aligned with the capabilities of 4D FMS;
- The limited delegation of separation tasks to aircrews in low and medium density airspace will require additional avionics infrastructure and additional tools for the controller and aircrew; and
- Introduction of preferred routing will require flight information to be displayed in real time to the controller.

2.2 Aerodrome Operations

2.2.1 Short term (until 2011)

2.2.1.1 For selected airports, detection of all mobiles within the aerodrome area is permanent in short term and throughout the whole strategy timeframe.

2.2.2 Medium term (2011-2015)

2.2.2.1 The use of ADDs to support aerodrome operations is envisaged; and the implementation of A-SMGCS level I (which may include ADS-B Package I, ADS-B-APT application) and A-SMGCS level II will be enabled by systems such as Multilateration

2.2.3 Long term (until 2015-2025)

2.2.3.1 Where airport operators foresee a benefit, a long term implementation of A-SMGCS level III (which may include the ADS-B Package I, ATSA SURF application) and A-SMGCS IV may start. This may require an ADS-B-in infrastructure and an equipage of selected, appropriate airport vehicles with transponders.

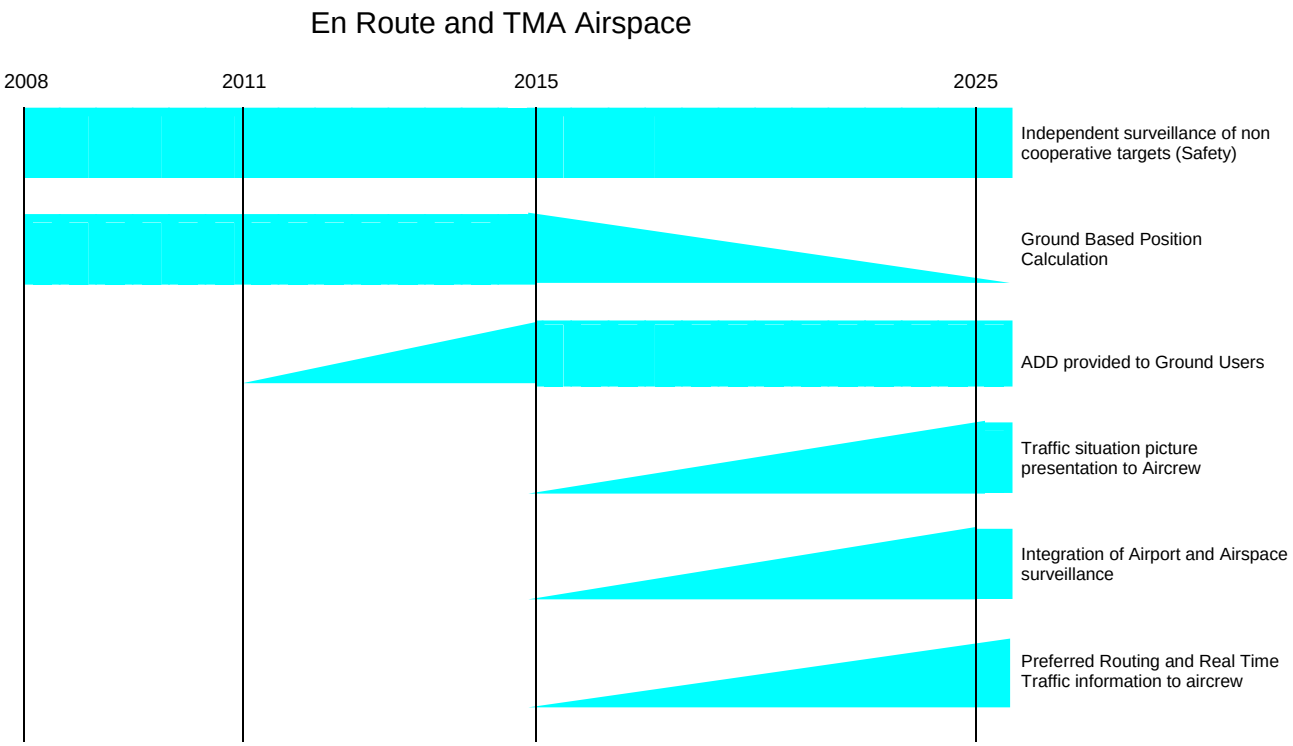
2.3 Aircraft Systems

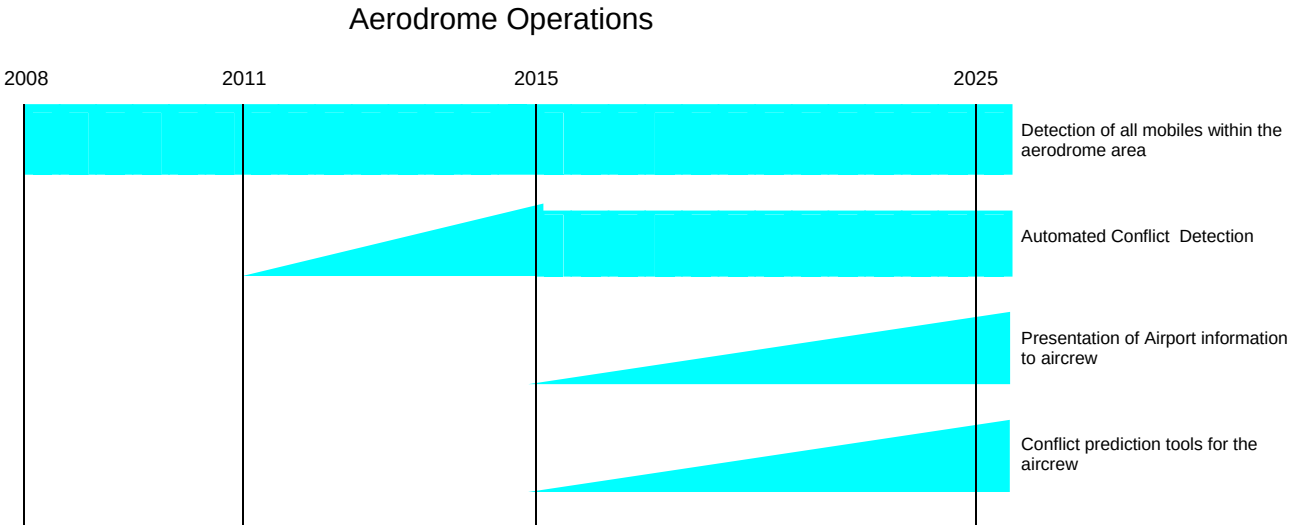
2.3.1 Short term (until 2011)
2.3.1.1 In short term, the use of SSR or SSR Mode S systems for ground based surveillance radar or Multilateration systems will continue. This means that no additional equipment is foreseen on the aircraft until 2011.

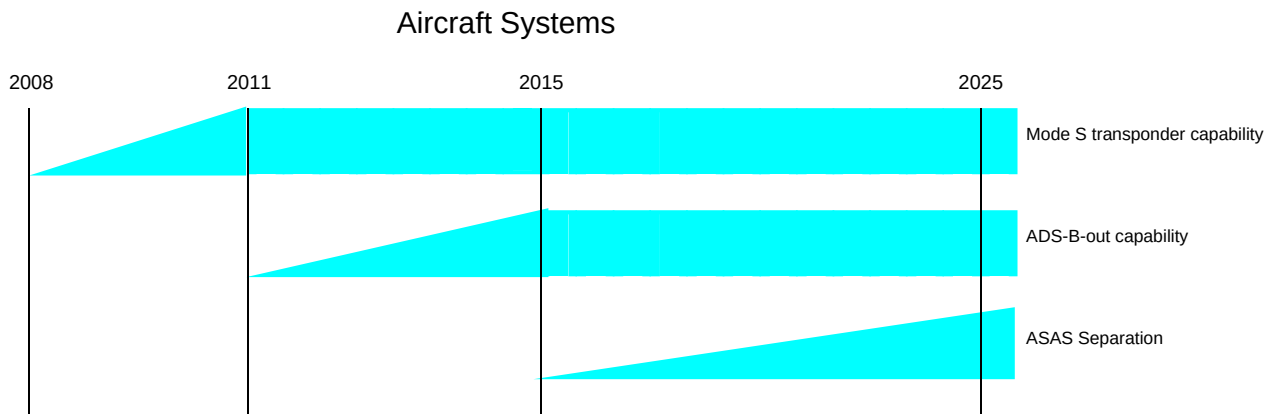
2.3.2 Medium term (2011-2015)
2.3.2.1 The implementation of new ground Surveillance Applications (ADS-B out) will increase, which will require integration between the aircraft navigation system and mode S transponders, in order to transmit intent information to other aircraft and ground users. This is enabled by ADS-B using 1090 MHz Extended Squitter or other data-links.

2.3.3 Long term (until 2015-2025)
2.3.3.1 The implementation of ADS-B ASAS situational awareness applications will require an airborne SDPS and display system.

2.4 Operational Drivers Timeframe







3. Surveillance Infrastructure Evolution

3.1 En-Route and TMA Airspace

3.1.1 Although PSR is not mandated in the CAR/SAM Regions some States may continue to use PSR in En-Route surveillance based on local country specific security requirements.

3.1.2 Short term (until 2011)

3.1.2.1 From 2007 to 2011, co-operative surveillance, in the form of SSR and SSR Mode S, will still be the main means of surveillance and will be extensively used for air traffic surveillance by civil agencies for TMA and En-Route services within coverage of (ground based) interrogator station(s);

3.1.3 Medium term (2011-2015)

3.1.3.1 SSR Mode S elementary surveillance will be implemented from 2010 onwards in high density TMAs in order to improve secondary radar performances. Since there will still exist legacy aircrafts that will not be able to reply on mode S, a mixed mode interrogation will be required up to 2015.

3.1.3.2 Ground implementation for ADS-B (based on ES Mode S receivers) will increase from 2010 onwards to fill en route and terminal areas not covered with radar and to strengthen surveillance in areas covered with SSR Modes A/C and S.

3.1.3.3 Depending on the percentage of ADS-B equipped aircrafts, wide area multilateration (WAM) implementation should be considered as a possible transition path to ADS-B environment in a shorter timeframe.

3.1.3.4 ADS-C surveillance should be operationally used in all oceanic and remote airspace associated with FANS 1/A capacities.

3.1.3.5 Surveillance Data Processing and Distribution systems based on surveillance server technology will have to be progressively upgraded, in order to merge legacy radar data information contained in the ADD and/or from Multilateration position calculations and promote data sharing between States using TCP/IP patterns.

3.1.3.6 The ADS-B deployment should be associated at early stages in coordination with the States/Territory/International Organizations responsible for the control of adjacent areas, and the correspondent ICAO Regional Office, establishing a plan in the potential areas of ADS-B data sharing, aimed at a coordinated, harmonious and interoperable implementation.

3.1.3.7 Each State/Territory/Organization should investigate and report their Administration’s policy in respect to the ADS-B data sharing with their neighbors and from cooperative goals.

3.1.3.8 The ADS-B data sharing plan should be based on selecting centres by pairs and analyzing the benefits and formulating proposals for the ADS-B use for each pair of centre/city with the purpose to improve the surveillance capacity.

3.1.3.9 To support the ADS-C and ADS-B regional plan, the States/Territories/International organizations, as well as the entity representing the airspace users, should organized and provide the following information; a focal point of contact, its respective implementation plan, including a time-table, and information on its air-ground communications and automation systems.

3.1.3.10 The ADS-B data links technology that will be used for the Mode S 1,090 MHz extended squitter (1090 ES). ADS-B data sharing could be initiated.

3.1.3.11 SSR Mode A/C and SSR Mode S will continue to be the main surveillance elements for approach, en route, and terminal areas.

3.1.4 Long term (until 2015-2025)

3.1.4.1 The majority of the SSR and SSR Mode S systems currently installed would be at the end of their operational life by 2015. SSR Mode A/C radars that have completed their life cycle by that time will not be replaced. Continuation of the ADS-B use with the 1090 ES technique and the planning initiation for the ADS-B implementation by new data links to satisfy the ATM global system requirements will fully replace those decommissioned SSRs.

3.2 Aerodrome Operations

3.2.1 Short term (until 2011)

3.2.1.1 The main technology for calculating the position of mobiles (both aircraft and vehicles) will be Surface Movement (primary) Radar. Implementation of multilateration will gradually increase, where aircraft respond to SSR Mode A/C or SSR Mode S queries.

3.2.2 Medium term (2011-2015)

3.2.2.1 A-SMGCS Level I/II will provide the benefits at the aerodrome and additional information may be required by the ground systems. The most effective means of achieving this would be via ADS-B, since aircraft will already be equipped and there will be a cost-effective upgrade path for the Multilateration ground stations, although there may be an impact on the avionics. Although many Multilateration systems are configured with their own data fusion trackers as standard, a possible upgrade to existing SDPDs to support Aerodrome operations will be required.

3.2.3 Long term (until 2015-2025)

3.2.3.1 The introduction of A-SMGCS Levels III/IV at selected aerodromes will require aircrew to be presented, with an airport map and other mobiles for situational awareness and possible conflict prediction tools in the aircraft. Where airports foresee a benefit from these kinds of applications then a TIS-B service may be required to ensure a complete and consistent airport situation picture.

3.3 Aircraft Systems

3.3.1 Short term (until 2011)

3.3.1.1 In accordance with ICAO requirements, all aircraft flying within CAR/SAM controlled airspace are required to be equipped with a pressure altitude reporting device. It is not foreseen that there will be significant changes for aircraft systems prior to 2011 on that matter.

3.3.1.2 The proportions of equipped aircrafts are also critical for the ADS-C and ADS-B deployment, for which it is required that ANSP and aircraft users periodically coordinate, al least, the following information: number of equipped aircrafts operating in the concern airspace, number and name of the airlines that have equipped aircrafts for ADS-C and ADS-B, type of equipped aircrafts, categorization of the accuracy/integrity data available in the aircrafts.

3.3.1.3 Until 2011 the implementation of ACAS II systems throughout commercial and general aviation will be completed using basic Mode S transponder for elementary surveillance (ELS). ADS transponders are to be integrated into the GNSS avionics for valid data.

3.3.1.4 This period will see:

· Implementation of SSR radars Mode S only in high-traffic-density approach, en route, and terminal areas,

· Implementation of monopulse SSR, adaptable to Mode S, in medium- and high-traffic en route and terminal areas.

· Begin ground implementation for ADS-B (ES Mode S receivers) for en route and terminal areas not covered with radar, and strengthen surveillance in areas covered with SSR Modes A/C and S.

· Begin the implementation of multilateration, where aircraft respond to SSR Mode A/C or SSR Mode S queries for aerodrome surface movement surveillance.

3.3.2 Medium term (2011-2015)

3.3.2.1 2011-2015 will see the implementation of Mode S in those monopulse SSRs that have Mode S capabilities, in areas with coverage and increased air traffic, increased ADS-B installations on ground (ES Mode S receivers) for en route and terminal areas not covered by radar, and strengthened surveillance in areas covered by SSR Mode A/C and SSR Mode S. The update of Mode S transponder will begin, so that it can operate in ADS-B and multilateration environments.

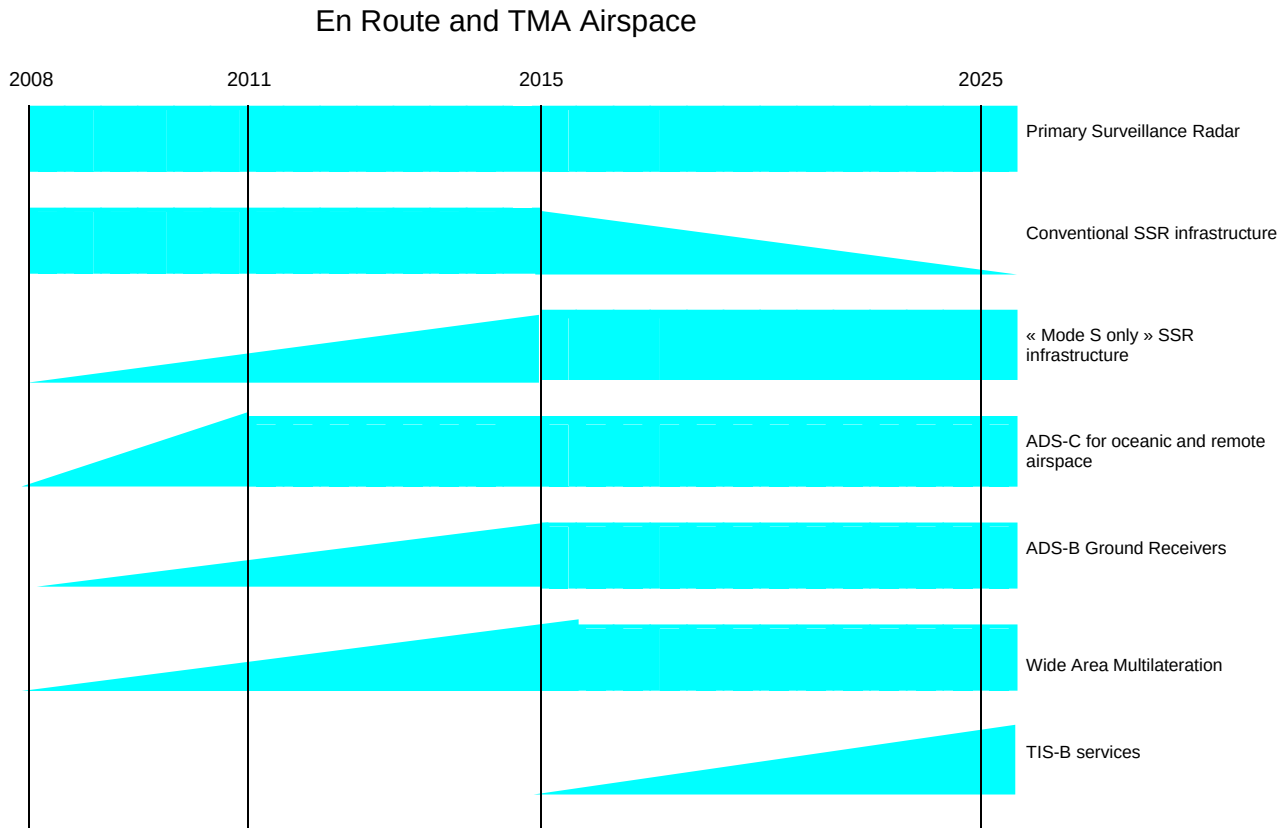
3.3.2.2 If aircraft are operating in airspace where the ADS-B Package I ground based surveillance applications are in use, then the avionics configuration will require changes to deliver the additional aircraft derived data required.

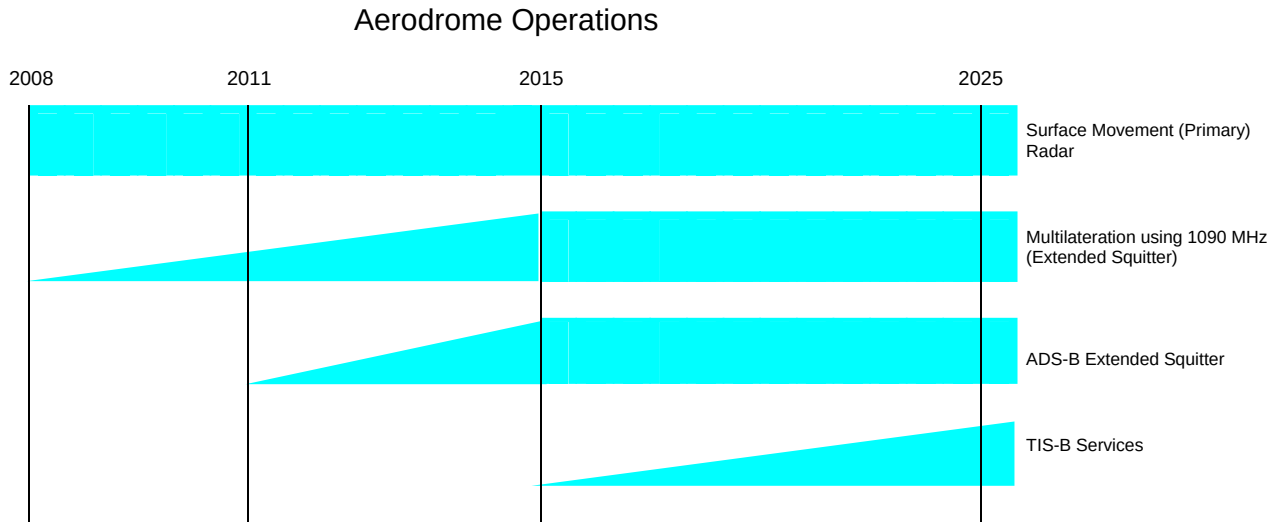
3.3.2.3 During the period 2011 – 2015 there will be increased implementation of multilateration, where aircraft respond to SSR Modes A/C and S queries for surveillance of aerodrome surface movements, and begin the implementation of surveillance applications in approach, en route and terminal areas (wide area multilateration, WAM) in areas that are not covered by radar surveillance and to strengthen radar surveillance.

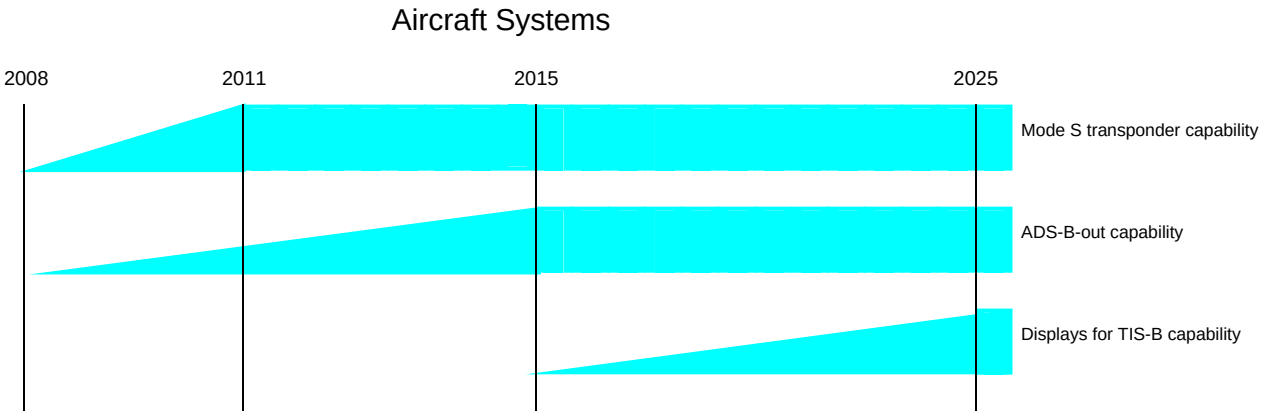
3.3.3 Long term (until 2015-2025)

3.3.3.1 From 2015 onwards, the move from ASAS spacing to ASAS separation and preferred routing may require a high integrity traffic situation picture, therefore the use of TIS-B will be required as well as the implementation of an airborne Surveillance Data Processing System (SDPS) to integrate ADS-B in and TIS-B for presentation of the air situation picture on a graphical display.

3.4 Surveillance Infrastructure Timeframe







3.5 Regional Action Plan

3.5.1 Short term (until 2011)

3.5.1.1 There will be a continuous need in short term to perform periodic assignment and monitoring of mode S 24-bits address by all Civil Aviation Authorities in CAR/SAM Region. Regional trials will have to be conducted in order to support the operational introduction of new techniques such as ADS-B and WAM. Such assessments would include Cost Benefit Analysis, safety assessments and detailing operational requirements. In order to validate the timeframe forecasted by this surveillance strategy and assess the proportions of equipped aircrafts, each State/Territory/International Organization should evaluate the:

- useful life of their radars and the potentiality for their replacement with ADS-B;
- locations of potential ADS-C or ADS-B ground station sites;
- capabilities of existing and planned ATC automation systems to support ADS-C or ADS-B applications;
- maximum density traffic nowadays and expected for the year 2025;
- number of equipped aircrafts operating in the concern airspace;
- number, name and type of equipped aircraft of the airlines that have equipped aircrafts for mode S, ADS-C and ADS-B;
- rate of faulty Mode S airborne equipment and its behavior; and
- categorization of the accuracy/integrity data available in the aircrafts.

3.5.1.2 The ADS-B deployment should be associated at early stages in coordination with the States/Territory/International Organizations responsible for the control of adjacent areas, and the correspondent ICAO Regional Office. Therefore, a plan for data sharing should be established, based on bilateral agreements, aiming at a coordinated, harmonious and interoperable implementation of ADS-B. It is also required to ensure that the regional surveillance standards and surveillance functional architecture are consistent with the Required Surveillance Performance (RSP), after the approval of RSP provisions (expected to be delivered by 2009).

3.5.1.3 As the increased dependence on ADS-B (1090 MHz Extended Squitter) is expected to grow, there is concern that the band will become saturated as more information is loaded onto the restricted band. Therefore it is required to study whether the use of 1090MHz continues to support the surveillance requirements.

3.5.2 Medium term (2011-2015)

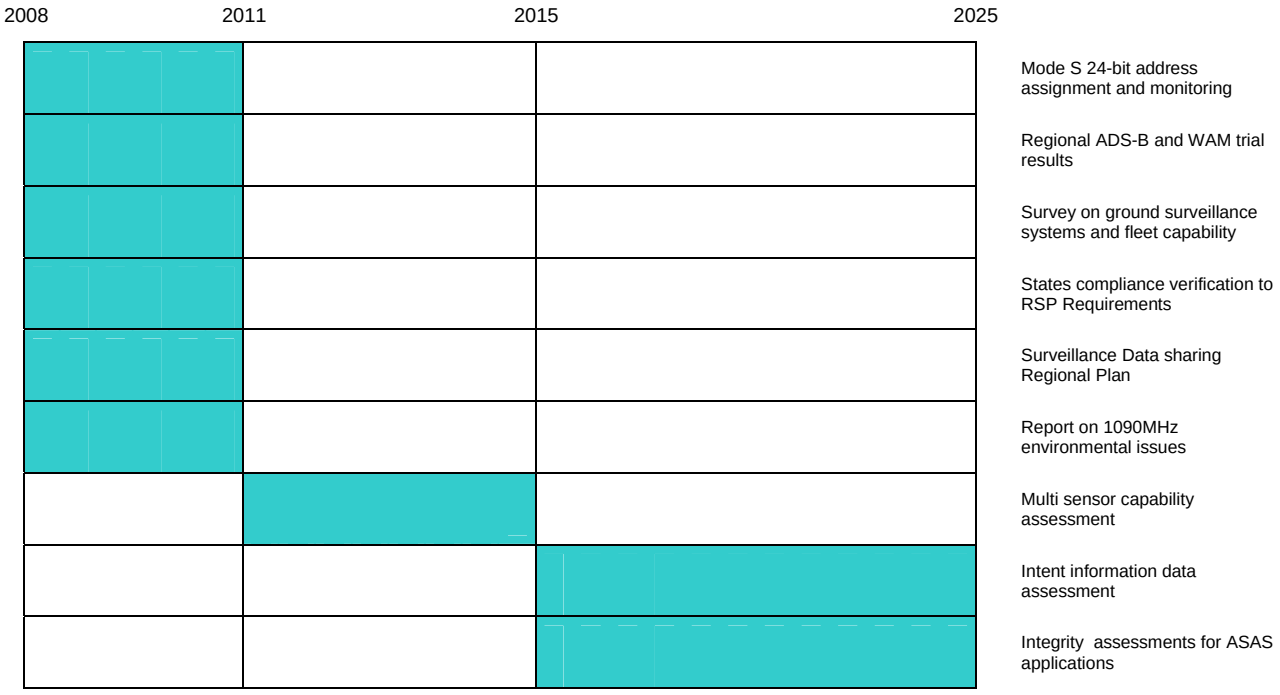
3.5.2.1 In medium term, the capabilities of current Multi Sensor Trackers are to be assessed in light of the more stringent requirements need to support and process increasing amount of ADD.

3.5.3 Long term (until 2015-2025)

3.5.3.1 In long term, it is required to identify the impact of the new procedures that are predicted to require 'intent' information from the aircraft. The precise definition of intent requires clarification to ensure avionics equipment and ground processing products can be developed in time to deliver the required information. It is also required to identify whether the integrity requirements of the information presented to the aircrew while performing ADS-B Package I airborne surveillance applications may require the need for the uplink of traffic information to the aircraft to validate the integrity of the navigation data transmitted by ADS-B.

3.6 Regional Action Plan Timeframe

Regional Action Plan Timeframe



Annex A

Acronyms

ACAS	Aircraft Collision Avoidance System
ADD	Aircraft Derived Data
ADS	Automatic Dependent Surveillance
ADS-B	ADS-Broadcast
ADS-C	ADS-Contract
ANC	Air Navigation Council
ANSP	Air Navigation Service Provider
APP	Approach (Centre or Control)
ASAS	Airborne Separation Assistance System
ASDE	Airport Surveillance Detection Equipment
A-SMGCS	Advanced Surface Movement and Guidance Control System
ATC	Air Traffic Control
ATM	Air Traffic Management
CDTI	Cockpit Display of Traffic Information
CNS	Communications Navigation and Surveillance
CPDLC	Controller Pilot Data link Communications
FDPS	Flight Data Processing System
FMS	Flight Management System
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
ICAO	International Civil Aviation Organization
M-SSR	Mono-pulse Secondary Surveillance Radar
PSR	Primary Surveillance Radar
RSP	Required Surveillance Performance
SARPs	Standards and Recommended Practices
SDPD	Surveillance Data Processing and Distribution System
SMGCS	Surface Movement Guidance and Control System
SMR	Surface movement Radar
SSR	Secondary Surveillance Radar
TCAS	Traffic Collision Avoidance System
TIS-B	Traffic Information Service - Broadcast
TMA	Terminal Maneuver (Control) Area

Annex B

Definitions

Surveillance is defined as the technique for the timely detection of targets and the determination of their position (and if required, the acquisition of supplementary information relating to targets) and the timely delivery of this information to users in support of the safe control and separation of targets within a defined area of interest.

Ground Based Surveillance is defined as 'ground based techniques for the timely detection of targets and the determination of their position (and if required, the acquisition of supplementary information relating to targets) and the timely delivery of this information to users in support of the safe control and separation of targets within a defined areas of interest'. The 'defined area of interest'' relates to the ability of the User to select which information is deemed necessary to ensure the safe implementation of the surveillance application within the physical airspace for which they are responsible.

Independent surveillance is a technique where the position of the aircraft is calculated by the ground and is not dependent on position data transmitted by the aircraft.

Dependent surveillance like ADS-B is based on the principle of the target informing the ground system and other targets of its own position. The target may also provide aircraft derived data. Dependent surveillance delivers Aircraft Derived Data (ADD). ADD may contain navigation position, identification and other data from the aircraft.

Cooperative surveillance is a technique that requires the mobile to equip with a dedicated surveillance systems which responds to transmissions from the ground system.

Non Cooperative surveillance is a technique where the position of the aircraft is calculated by the ground and is not dependent on position data transmitted by the aircraft or upon any deliberate interaction in the aircraft with active components e.g SSR transponders.

Basic surveillance delivers to the surveillance user:

- Aircraft position (latitude, longitude and altitude)
- Mode A

Elementary surveillance includes basic surveillance and also delivers to the surveillance user:

- Aircraft identity - Flight Identity or tail registration and 24 bit address,
- Flight Status,
- Aircraft pressure altitude in 100 ft or 25 ft units, if the aircraft is appropriately equipped.

Enhanced Surveillance delivers to the surveillance user a set of Aircraft Derived Data (ADD) to provide additional information to ground or air based ATM systems and safety nets. Enhanced surveillance may be delivered to ground system through Mode S SSR, ADS-B or Multilateration system (through active interrogations).

Aircraft Derived Data Different cooperative surveillance technologies extract different information from the aircraft. In its simplest form, the Mode A and Mode C information provided by the aircrafts SSR transponder can be classified as aircraft derived data or down linked aircraft parameters. When implemented using SSR Mode S, the following current or short term Aircraft Parameters are automatically extracted from the aircraft:

- Air Speed (Indicated Air Speed and Mach Number)
- Ground Speed
- Magnetic Heading Roll Angle
- Selected Altitude Track Angle Rate (or, if not available, True Air Speed)
- True Track Angle Vertical Rate

The enhanced surveillance parameters delivered by ADS-B include the position and longer term intent parameters e.g. 4D trajectory, trajectory change points etc.

Surveillance users are:

- Oceanic ATM Centers
- En-Route ATM Centers
- TMA/Approach ATM Units
- Airports/Tower ATM & Ground Traffic Management Units
- Military Centers
- Airline Aircraft Operations Centre
- Enhanced Tactical Flow Management System
- Data processing systems, such as Flight Data Processing Systems
- ATM Tools, such as Short Term Conflict Alert
- The target
- Adjacent Surveillance Functions
- Non ATM functions (e.g. Search and Rescue).

Surveillance Data Processing and Distribution systems accept information from surveillance sensors, process the information to develop the 'best' estimate of the position of a target and supply this information to users. In addition the SDPD may receive ADD and distribute this to surveillance users attached to the position information.

A-SMGCS is an airport system which provides surveillance to a ground controller. It has four implementation levels that provide different levels of functionality:

Level I A-SMGCS provides:

- Position; the presentation to a controller of the location of an aircraft or vehicle;
- Identification; the presentation to the controller the identity (flight identification or call sign) of the aircraft or vehicle.

Level II A-SMGCS provides a conflict prediction function to alert the controller of:

- Potential collisions (between aircraft/vehicle or aircraft/aircraft) on the runway surface or protected areas
- Potential entry of aircraft or vehicles into restricted areas.

Level III A-SMGCS includes functions that are being defined by the Airports and Environments Business Division to share traffic situation awareness amongst pilots and drivers and the introduction of the automated routing function. The guidance function may be enhanced by:

- Display of the airport map showing taxiways, runways, obstacles and the mobile position to aircrew and drivers;
- Providing dynamic map with updates of the runway status
- Triggering automatically the dynamic ground signs (stop bars, centerline lights, etc.) according to the route issued by the controller.

Level IV A-SMGCS corresponds to the improvement of the functions implemented at the level III. Of particular note to the surveillance strategy, the control function will be complemented by a conflict resolution function in the cockpit or vehicle.

ADS-B Package I is a set of Ground Based Surveillance, Airborne Traffic Situational Awareness and Airborne Spacing applications (reference 6). Note that since reference 6 was published, the application descriptions have been refined, although they remain largely in accordance with the referenced document. The text below summarizes the applications as of November 2005.

ADS-B Package I Ground Based Surveillance Applications are aimed at improving ATC surveillance on the ground for En-Route and TMA airspace and on the airport surface and at enhancing ATC tools through the provision of aircraft derived data enabled by ADS-B. These applications are:

- ADS-B-RAD ATC surveillance for TMA and En-Route airspace in areas that are already covered by radar systems
- ADS-B-NRA ATC surveillance in non-radar areas
- ADS-B-APT Airport surface surveillance
- ADS-B-ADD Aircraft derived data for ATC tools

ADS-B Package I Airborne Surveillance Applications are aimed at improving airborne (cockpit) surveillance in En-Route and TMA airspace as well as on the airport surface. These applications are:

- ATSA-SURF Enhanced traffic situational awareness on the airport surface
- ATSA-VSA Enhanced visual separation on approach
- ATSA-ITP In-trail procedure in oceanic airspace
- ATSA-AIRB Enhanced traffic situational awareness during flight operations

ADS-B Package I Airborne Spacing Applications are aimed at using airborne (cockpit) surveillance capabilities to carry out applications where the flight crew is able to maintain a time or distance from designated aircraft. These applications are:

- ASPA-S&M Enhanced sequencing and merging operations
- ASPA-C&P Enhanced crossing and passing operations

ASAS Applications are a set of operational procedures for controllers and flight crews that make use of the capabilities of Airborne Separation Assistance Systems to meet a clearly defined operational goal.

Airborne Spacing (ASPA) is an ASAS application category where the flight crew is able to maintain a time or distance from designated aircraft. The controller can use new spacing instructions to expedite and maintain an orderly and safe flow of traffic and is still responsible for providing separation in accordance with the applicable ATC separation minima. New procedures and responsibilities are expected with the introduction of Airborne Spacing applications.

Airborne Separation is an ASAS application category where the flight crew is able to provide separation from designated aircraft in accordance with the applicable airborne separation minima. In this application the controller can delegate separation relative to a designated aircraft to the flight crew through a new clearance however the controller is responsible for providing separation in accordance with the applicable ATC separation minima from other aircraft. New procedures and responsibilities are expected with the introduction of Airborne Separation applications.

Airborne Self Separation is an ASAS application where the flight crew is able to provide separation from all known aircraft in accordance with the applicable airborne separation minima. Airborne self separation is not considered within the timescales of this strategy.

Annex C

Surveillance Techniques

Primary Radar (PSR, SMR/ASDE)

Primary Radar operates by radiating high levels of electromagnetic energy and detecting the presence and characteristics of echoes returned from reflected objects.

Target detection is totally based on the reception of reflected energy, it does not depend on any energy radiated from the target itself, i.e. no carriage of airborne equipment is required.

Secondary Surveillance Radar (SSR)

Secondary Surveillance Radar (SSR) operates by transmitting coded interrogations in order to receive coded information from all SSR transponder equipped aircraft, providing a two way "data link" on separate interrogation (1030 MHz) and reply (1090 MHz) frequencies.

Replies contain positive identification, as requested by the interrogation, either one of 4096 codes (Mode A) or aircraft pressure altitude reports (Mode C). The co-operative concept ensures stable received signal strength and considerably lower transmitted power levels than Primary Radar. SSR enables Basic Surveillance.

SSR Mode S is a development of SSR using the same interrogation and reply frequencies as the SSR but the selective interrogations contain a unique 24 bit address that ensures all transmissions are only decoded by one aircraft's Mode S Transponder having that 24 bit address.

A Mode S station also transmits conventional SSR formats in order to detect SSR only aircraft (Mode A/C) in order to be downward compatible with SSR.

The SSR Mode S transponder is also a fundamental part of the ACAS airborne installation and the ADS-Broadcast when using the 1090 MHz Extended Squitter transmission. SSR Mode S enables elementary and enhanced surveillance.

Automatic Dependent Surveillance-Broadcast (ADS-B)

Automatic Dependent Surveillance - Broadcast (ADS-B) is a surveillance technique that allows the transmission of aircraft derived parameters, such as position and identification, via a broadcast mode data link for use by any air and/or ground users.

Each ADS-B emitter periodically broadcasts its position and other data provided by the onboard aircraft avionics systems. Any user, either airborne or ground based, within range of the emitter may choose to receive and process the information. Three technology options are available, these are ADS-B 1090ES [which has been selected as the initial link for CAR/SAM Region], VDL Mode 4 (Very High Frequency Data Link) and UAT (Universal Access Time). ADS-B enables elementary and enhanced surveillance.

Automatic Dependent Surveillance-Contract (ADS-C)

Automatic Dependent Surveillance - Contract (ADS-C) is a surveillance technique in which aircraft provide, via a data link, data such as position and identification, derived from the onboard aircraft avionics systems. A "contract" is established between the aircraft and the ground to transmit data at a particular event. An event could be time based, position based or as specified in the contract.

Currently ADS-C is usually implemented via SATCOM but any data link having the range capability would suffice. Whilst originally envisaged to be an ATN compliant data link, current implementations

exploit a large part of the functionality through the FANS 1/equipment currently carried by many aircraft.

Traffic Information Service – Broadcast (TIS-B)

An air traffic situation picture derived by a ground based Surveillance Data Processing System may be broadcast from the ground to all aircraft within range and equipped with correct receivers. There are three roles of TIS-B, these are:

- TIS-B fundamental service: This 'gap filler service broadcasts information about aircraft that cannot be adequately obtained directly by ADS-B and is used to enhance the availability of surveillance information to users that are not normally able to receive ADS-B transmissions from other aircraft. This service will normally exclude from transmission those aircraft broadcasting ADS-B messages
- ADS-B validation service: This optional service compares aircraft ADS-B state vector data with surveillance data from ground-based sensors and broadcasts validation data
- ADS-B rebroadcast service: The automatic rebroadcast of ADS-B messages received over one data link, translated directly onto other data links for the purpose of extending ADS-B connectivity to users of incompatible data links.

Multilateration

Multilateration is a surveillance technique where aircraft replies from other SSR or SSR Mode S interrogations or spontaneous squitter message from Mode S transponder are passively received by 3 or more ground receiver stations. Using time of arrival techniques the position and altitude of the target can be determined. In some Multilateration systems, active Mode S selective interrogations are used to extract data from the aircraft.

The surveillance strategy distinguishes three levels of functionality, which are:

- Basic operation in which Multilateration uses time of arrival of signals to determine the position of aircraft.
- Elementary operation, which includes basic operation and the addition of active integrations to extract aircraft identification information from the flight systems
- Enhanced operations, which includes basic operations and the addition of active interrogations to extract any information (including aircraft identification) from the aircraft systems.

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APPENDIX E

STATUS OF CONCLUSIONS FORMULATED DURING THE SUR/TF/1

CONCLUSIONS FORMULETED DURING THE SUR/TF/1				
Conclusion	**Title**	**Contents**	**Status**	**Remarks**
CNS SUR/TF 1/1	**ADS-C TRIALS IN THE CAR/SAM REGIONS**	That Brazil and Trinidad and Tobago be urged to conduct ADS-C trials with the following tentative schedule: i. Trials in Brazil; ii. Trials in the Piarco FIR; iii. the data and other results be informed to the ICAO NACC Office to be analyzed and coordinated through the GREPECAS CNS/SUR/TF; and iv. present an initial report on the analysis of the trials before **31 July 2008** to enable ICAO and the GREPECAS mechanism to present the results at the GREPECAS/15 Meeting tentatively to be held in October 2008.	Valid	Paragraph 1.17 of Agenda Item 1 indicates some trials in ADC C in the CAR SAM Region.
CNS/SUR/TF 1/2	**APPLICATION OF MULTILATERATION AS A SURVEILLANCE OPTION**	a) States / International Organizations consider multilateration as a viable option to provide immediate surveillance coverage in geographical areas where secondary radar cannot be effectively deployed and at the same time it provides an economically effective transition to ADS-B when all aircraft are fully and correctly equipped; And b) Trinidad & Tobago and Brazil be urged to conduct trials in mutilateration along similar guidelines used for the ADS-C trials as a transition path to ADS-B in the medium term.	Valid	Paragraph 1.17 of Agenda Item 1 indicates some trials in Multilateration. in the CAR/SAM Region
CNS/SUR/TF 1/3	**ADS-B TRIALS**	To urge, Cuba to continue its ADS-B trials in the Havana FIR; Trinidad and Tobago and the United States to establish and implement ADS-B trials project in the Piarco FIR; States/Territories/International Organizations from the CAR/SAM regions will be invited in the Project mentioned in b) above, expanding the trials in other airspaces and follow-up the execution and results of the projects mentioned in a) and b), as well as other initiatives; and all States/Territories/International Organizations who conduct trials and other ADS-B related activities, inform the ICAO NACC Office before 31 July 2008 on the status of implementation and results of their activities to ease the analysis and coordination through the GREPECAS CNS/SUR Task Force.	Valid	Paragraph 1.17 and APPENDIX A indicates some trials in ADS B in the CAR/SAM Region

CONCLUSIONS FORMULETED DURING THE SUR/TF/1				
Conclusion	**Title**	**Contents**	**Status**	**Remarks**
DECISION CNS/SUR/TF 1/4	**DRAFT STRATEGY FOR THE CAR/SAM REGIONS FOR THE EVOLUTIONARY IMPLEMENTATION OF AERONAUTICAL SURVEILLANCE SYSTEMS**	That Brazil as a Member of the CNS/SUR/TF will develop a draft strategy for the CAR/SAM Regions for the evolutionary implementation of aeronautical surveillance in the CAR/SAM Regions by October 2007. The draft will be circulated via email for comments.	Valid	A draft strategy was presented to the meeting, commentary was made, additional commentary is expected to obtain from the members of the task force not later than 23 May 2008 (Decision SUR/TF/02/02) The initial Strategy will be presented at the Sixth ATM/CNS Subgroup.

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APPENDIX F

GREPECAS ATM/CNS SUBGROUP – CNS COMMITTEE

SURVEILLANCE TASK FORCE
TERMS OF REFERENCE AND WORK PROGRAMME

1. Terms of reference

a) Development of a proposal on the regional surveillance systems implementation strategy by considering:

i. ATM defined requirements for the CAR/SAM Regions and the ICAO SARPs; and

ii. studies based on the ICAO operational requirements and the experiences from other regions of SSR in Mode S, ADS-B, multilateration, ADS-C and other surveillance systems in order to develop proposals to establish a CAR/SAM planning for these systems and to structure an action plan to implement the most adequate systems in the CAR/SAM regions.

2. Work Programme

See table attached.

3. Composition

Andre Jansen	(Brazil)
XXXXX	(Colombia)
Carlos Pérez	(Cuba)
Jean-Jacques Deschamps	(France)
Veronica Ramdath	(Trinidad and Tobago)
Rick Castaldo	(United States)
Romulo Velasquez	(COCESNA) and
Adriana Mattos	(SITA.)

4. Rapporteur:

Veronica Ramdath (Trinidad & Tobago)

CNS/SUR/TF WORK PROGRAMME

No.	Strategic Objetive	Global Plan/ Plan Mundial - GPI	Regional Plan - FASID	GREPECAS No. Con/Dec/Pa	Goal Activities	Follow-up	Deliverables	Responsable	Target Dates	Observations
1	2	3	4	5	6	7	8	9	10	11
1	A, D	GPI-09	CNS-4A	13/54	Propose surveillance systems susceptible to be implemented in the CAR/SAM regions.		- Update version of Unified CAR/SAM Surveillance Strategy	TBD in CNS/Com/06	SUR TF 03 (2009)	
2	D	GPI-09	CNS-4A	13/54	Develop an implementation plan for short and medium term Surveillance applications in the CAR/SAM regions		- Surveillance system comparison document and general considerations for implementation - Guidance considerations for Multilateration implementation	TBD in CNS/Com/06	SUR TF 03 (2009)	

- END -