



International Civil Aviation Organization
CAR/SAM Regional Planning Implementation Group (GREPECAS)
**First Meeting of the Communications, Navigation and Surveillance / Air
Traffic Management Subgroup (CNS/ATM/SG/1)**
(Lima, Peru, 15 to 19 March 2010)

Agenda Item 4: Review to pending matters of the ATM/CNS/SG, ATM/COMM, CNS/COMM and respective Task Forces, for consideration in the CNS/ATM Subgroup work programme

REPORT OF THE SURVEILLANCE TASK FORCE

(Presented by the Rapporteur)

| SUMMARY | |
|---|--|
| This working paper presents the results of the Third Surveillance Task Force, the same describes the implementation status of the Surveillance activities and the surveillance work programme based on pending and new activities to be included in the work programme of the new CNS ATM Subgroup. | |
| References: <ul style="list-style-type: none">• Third Meeting of the Surveillance Task Force (SUR/TF/3) (Mexico City, Mexico, 10 to 11 September 2009); and• GREPECAS/15 Meeting Report (Rio de Janeiro, Brazil, 13-17 October 2008). | |
| Strategic objectives : | <i>This working paper is related to Strategic Objectives A – Safety and D - Efficiency</i> |

1. Introduction

1.1 The Third Meeting of the Surveillance Task Force of GREPECAS (SUR/TF/3) was carried out in the ICAO North American, and Caribbean (NACC) Regional Office, in Mexico City, Mexico, from 10 to 11 September 2009. The meeting counted with the assistance of 5 States and 2 International Organizations (Brazil, Colombia, Cuba, Trinidad & Tobago, United States, COCESNA and Thales), making a total of 12 participants, including ICAO officers.

1.2 The SUR/TF/3 meeting discussed seven Agenda Items and subsequently formulated five draft conclusions and one draft decision. The Meeting reviewed the two tasks which arose from the SUR/TF/2 and the work programme:

- a) To propose surveillance systems susceptible to be implemented in the CAR/SAM regions with the deliverable of an updated version of the Unified CAR/SAM Surveillance Strategy; and

- b) To develop an implementation plan for short and medium term surveillance applications in the CAR/SAM Regions with the deliverable of a surveillance system comparison document and general considerations for implementation and a documentation on guidance considerations for multilateration implementation.

2. Discussion

2.1 The SUR/TF/3 meeting discussed the following agenda Item:

- a) Review and follow-up on the second meeting of Surveillance Task Force Report and on conclusions and decisions adopted by the Surveillance Task Force meetings;
- b) Review and consolidation of ADS-B and multilateration trials progress and other on-going surveillance systems improvements in the CAR/SAM Regions;
- c) Review progress made by the Aeronautical Surveillance Panel (ASP);
- d) Develop a regional strategy for surveillance system implementation in the CAR/SAM Regions;
- e) Develop an implementation plan for short and medium term surveillance applications in the CAR/SAM regions;
- f) Review of terms of reference and future work programme; and
- g) Other matter

Review and follow-up on the second meeting of Surveillance Task Force Report and on conclusions and decisions adopted by the Surveillance Task Force meetings

2.2 The meeting reviewed the status of the pending tasks, conclusions and decisions of the Second Surveillance Task Force Meeting. IATA informed of its new proposal (form) for collecting information on CNS related avionics, and the deployment of a global database with this information. The Meeting formulated recommendations regarding IATA's form.

Review and consolidation of ADS-B and multilateration trials progress and other on-going surveillance systems improvements in the CAR/SAM Regions

2.3 The meeting took note of the advances in ADS B and multilateration trials as well as the improvements in other surveillance systems in the CAR/SAM Regions. The meeting noted that the States' trials results need to be comprehensively analyzed towards the identification of future actions in the CAR/SAM Regions. The meeting reminded the States conducting trials to follow the guidance given by the GREPECAS/15 meeting on activities to be considered for ADS-B trials (Appendix Q of GREPECAS/15 report) and formulated Draft Conclusion SUR/TF/3-1.

Review progress made by the Aeronautical Surveillance Panel (ASP)

2.4 The Meeting was informed on the recent developments by ICAO with respect to aeronautical surveillance and collision avoidance systems.

Develop a regional strategy for surveillance system implementation in the CAR/SAM Regions

2.5 The Unified CAR/SAM Surveillance Strategy was reviewed by the Surveillance Task members, and **Appendix A** of this working paper presents such information.

2.6 In order to guide the evolution of the surveillance systems and to update the document on Unified Surveillance Strategy for CAR/SAM Regions for long term operation, the meeting considered that the CNS/ATM Subgroup has to identify the foreseen operational scenario for that period, and formulated draft conclusion SUR/TF/3-2.

Develop an implementation plan for short and medium term surveillance applications in the CAR/SAM regions

2.7 The meeting reviewed the assigned task for the development of an implementation plan for short and medium term surveillance applications in the CAR/SAM Regions (Surveillance system comparison document and general considerations for implementation and Guidance considerations for multilateral implementation), concluding that the above tasks are no longer required since this information will be included in the Aeronautical Surveillance Manual developed by the ASP. The subject manual will be posted on the ICAO-NET before the end of 2009.

2.8 The meeting received information related to Guidance on Wide Area Multilateration (WAM).

Review of terms of reference and future work programme

2.9 The meeting conducted a follow-up on the progress and status of the surveillance related activities in the CNS Committee work programme. The meeting carried out an analysis of these activities towards its support and accomplishment of existing performance objectives and elaborated a proposal on a new work programme to support and assist the new CNS/ATM Subgroup. **Appendix B** presents this proposal.

Other matter

2.10 The meeting examined information identified by the ICAO Aeronautical Surveillance Panel related to the incorrect use of SSR by military authorities and special precautions and appropriate procedure to be made during ground testing of transponders. In this respect, Draft Conclusions SUR/TF/3-3, SUR/TF/3-4 and SUR/TF/3-5 were formulated.

List of conclusions and report of the SUR/TF/03 meeting

2.11 **Appendix C** of this working paper presents the detailed draft conclusions formulated by the SUR/TF/3 meeting and **Appendix D** shows the complete report of this meeting.

3. **Suggested action**

3.1 The Meeting is invited to:

- a) take note of the information presented in this paper;
- b) Analyse and approve the Unified CAR/SAM Surveillance Strategy presented in the Appendix A;

- c) evaluate and adopt the proposed activities related to surveillance issues / new work programme as presented in Appendix B in order to be included in the work programme of the CNS/ATM subgroup;
- d) Adopt the draft conclusions presented in Appendix C;
- e) Taking in consideration that the activities of the new CNS/ATM Subgroup will be under project development, agree that all the surveillance activities should be worked under a specific project as the situational awareness project management; and
- f) take any other action that the meeting considers necessary.

APPENDIX A

INTERNATIONAL CIVIL AVIATION ORGANIZATION

**SURVEILLANCE STRATEGY FOR
CAR/SAM REGION**

First Edition

Rev 2.0

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1. **Introduction**

1.1 **General Considerations**

Within the context of the GREPECAS/14, the Surveillance Regional Plan was updated and it was recognized that further analysis on that matter should take place by CNS Committee. The CNS Surveillance Task Force (CNS/SUR/TF) was then created and tasked, among other activities, to define a unified Air Surveillance Strategy for CAR/SAM Regions.

Subsequently, this initial document is the result of the task assigned to CNS Committee - CNS/SUR/TF, in which the preliminary elements for a Regional CAR/SAM Strategy in short, medium and long term for ADS-C and ADS-B use have been integrated into an Unified Regional Strategy for the Implementation of Surveillance Systems.

This surveillance strategy is derived from the “Global Air Navigation Plan for CNS/ATM Systems” (Doc. 9750) and the “CAR/SAM Regional Air Navigation Plan” (Doc. 8733), since technology is not an end in itself and should be based on clearly established operational requirements for ATM evolution.

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.

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.

This strategy is a live document and should be reviewed and updated every two years.

1.2 **Scope of the Surveillance Strategy**

The 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.

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.

The surveillance technologies considered in this strategy to meet present and future ATM expectations are listed below and briefly explained in Attachment C:

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

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 displayed in each chapter in a chronological presentation.

The timeframes illustrated in this document define the tentative dates 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 timescales in this document, and thereby will migrate from pioneer areas into bigger regional areas.

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

1.3 **Structure of the Document**

This document is structured as follows:

- Section 1 (this section) presents the general considerations, explains its scope and structure and describes its intended readers.
- Section 2 describes the Surveillance Operational Scenario Evolution, i.e. the envisaged operational drivers for short (2009-2010), medium (2010-2015) and long terms (2015-2025) in the Air Surveillance field, for En-Route and TMA Airspace, Aerodrome Operations and Aircraft Systems.
- Section 3 specifies 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 principles of known surveillance techniques.

1.4 **Intended Readers**

This strategy was developed to 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 who 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 client of the ATM Surveillance Systems chain.

2. **Surveillance Operational Scenario Evolution**

2.1 **En-Route and TMA Airspace**

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
- Dependent cooperative surveillance.

For En-Route and TMA Airspace, security and safety will remain key requirements throughout the strategy period. Therefore, 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.

2.1.1 **Short term (until 2010)**

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

2.1.2 **Medium term (2010-2015)**

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

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 full operational capability status in 2015.

2.1.3 **Long term (until 2015-2025)**

Another set of possible new applications is 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.

It is expected that an integration of airport and airspace surveillance will become more widespread in long term. 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.

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 begin to drive the evolution of the surveillance environment, these are:

- Enhanced planning with the tasks of the controllers operating in En-Route and TMA sectors becoming increasingly supported by more automation. The controller will make use of more 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. This 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 2010)**

For selected airports, detection of all mobiles within the aerodrome area is permanent throughout the whole strategy timeframe.

2.2.2 **Medium term (2010-2015)**

The use of ADDs to support aerodrome operations is envisaged; and the implementation of A-SMGCS level I (which may include 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)**

Where airport operators foresee a benefit, a long term implementation of A-SMGCS level III (which may include the 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 2010)**

In short term, the use of SSR or SSR Mode S transponders for ground based surveillance radar or Multilateration systems will continue. This means that no additional equipment is foreseen on the aircraft until 2010.

2.3.2 **Medium term (2010-2015)**

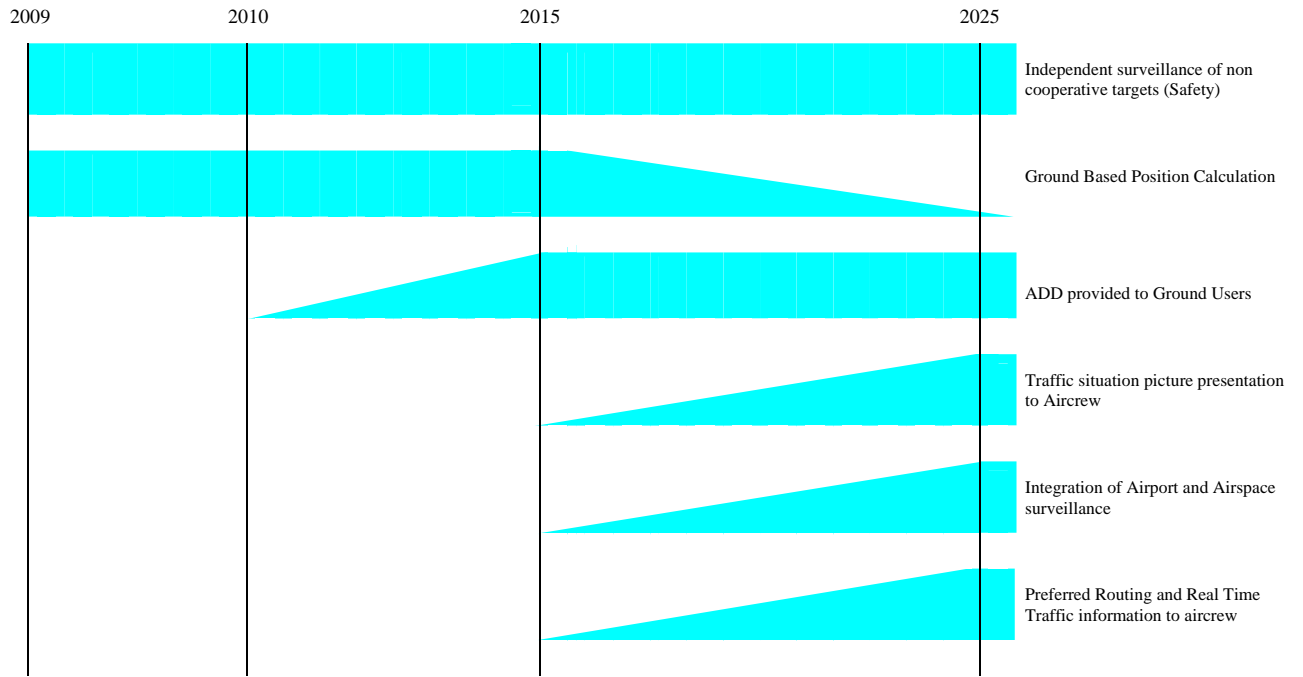
The implementation of new ground Surveillance Applications (ADS-B out), which will require integration between the aircraft navigation system and mode S transponders, in order to transmit intent information to other aircraft and ground users. This is enabled by ADS-B, using 1090 MHz Extended Squitter.

2.3.3 **Long term (until 2015-2025)**

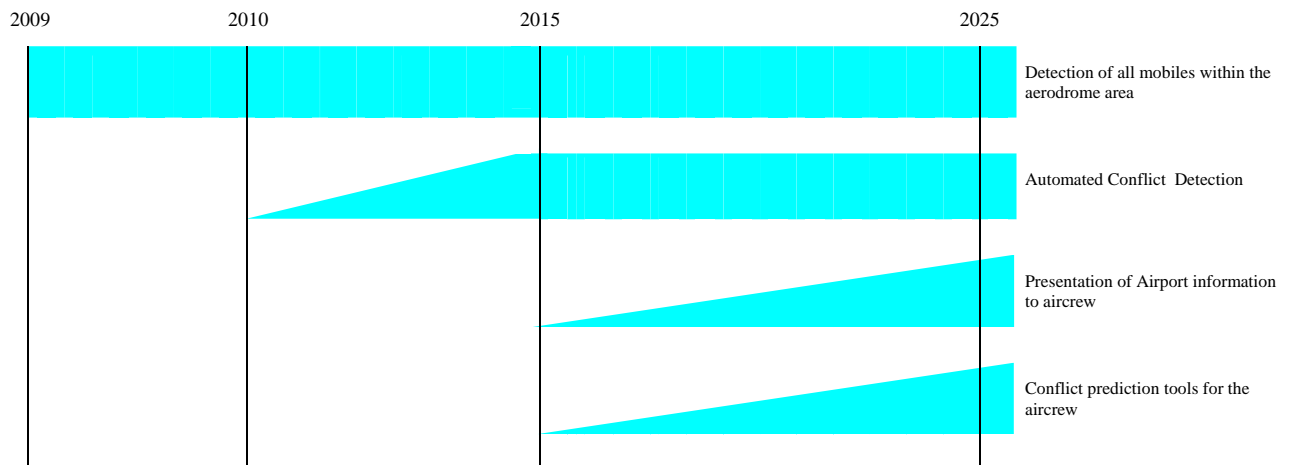
The implementation of ADS-B ASAS situational awareness applications will require an additional airborne SDPS and display system.

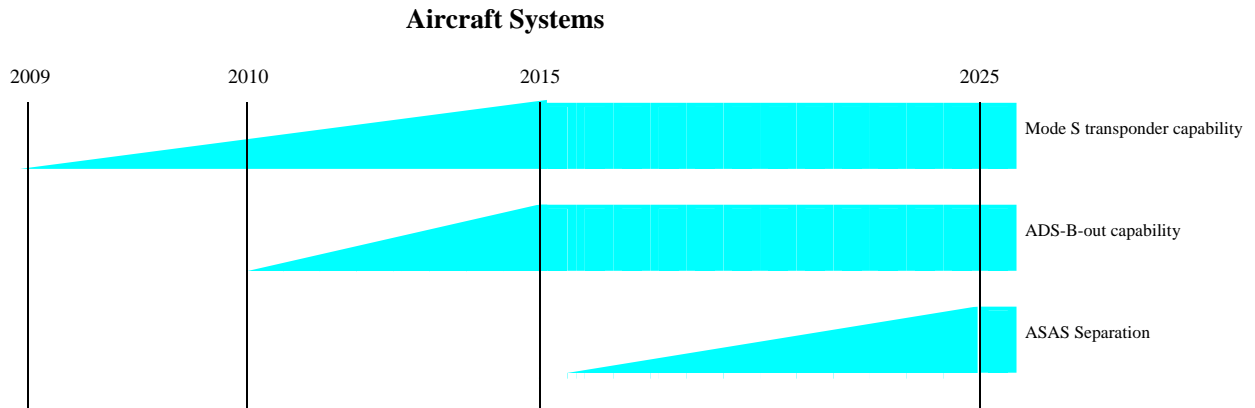
2.4 Operational Drivers Timeframe

En Route and TMA Airspace



Aerodrome Operations





3. Surveillance Infrastructure Evolution

3.1 En-Route and TMA Airspace

Independent Surveillance, in the form of Primary Surveillance Radar will be widely used in CAR/SAM regions within Air Traffic Management for Approach and Terminal Maneuvering Area (TMA) surveillance throughout the whole strategy period. In some areas, Primary Surveillance Radar will still be used in En-Route surveillance, based on local requirements, especially for homeland security.

3.1.1 Short term (until 2010)

Co-operative surveillance, in the form of SSR radars, 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).

Implementation of monopulse SSR, in medium- and high-traffic en route and terminal areas will continue.

Use of ADS-B (ES Mode S receivers) will begin to provide surveillance for en-route and terminal areas not covered with radar, and to strengthen surveillance in areas covered with SSR Modes A/C and S.

3.1.2 Medium term (2010-2015)

SSR Mode S surveillance will be implemented in high density, State-selected TMAs in order to improve secondary radar performances. Since there will still exist legacy aircrafts that won't be able to reply on mode S, a mixed mode interrogation will be required up to 2015.

Ground implementation for ADS-B (based on ES Mode S receivers) will increase 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.

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.

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

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

3.1.3 **Long term (until 2015-2025)**

It is predicted that by 2020 the majority of the SSR and SSR Mode S systems currently installed are at the end of their operational life. Therefore, SSR Mode A/C radars that have completed their life cycle by that time won't be replaced anymore. ADS-B or multilateration systems will fully replace those decommissioned SSRs.

3.2 **Aerodrome Operations**

3.2.1 **Short term (until 2010)**

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 (2010-2015)**

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)**

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 2010)**

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 2010 on that matter.

Until 2010 the implementation of ACAS II systems throughout commercial and general aviation will be almost completed, using Mode S transponder.

3.3.2 **Medium term (2010-2015)**

Begin the update of Mode S transponders, by integrating them to GNSS airborne systems, so that they will operate in ADS-B environments (ADS-B out).

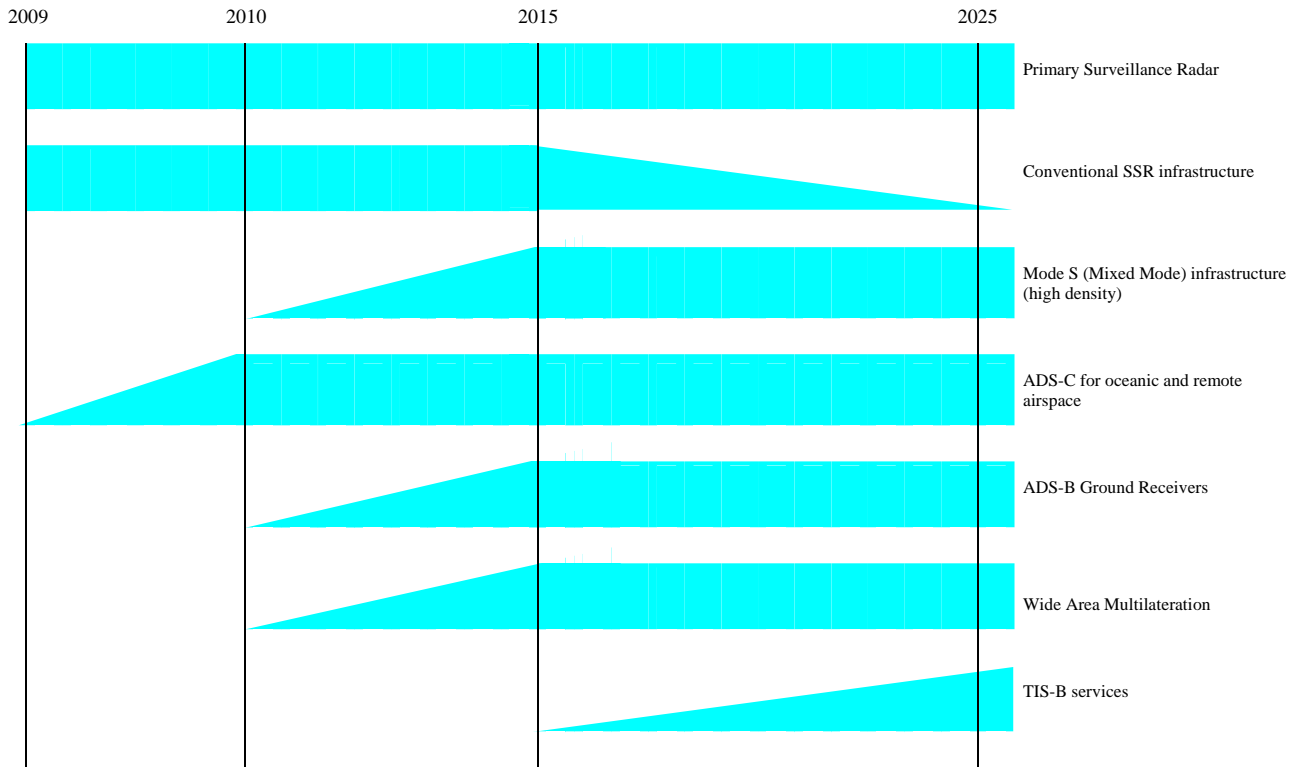
If aircraft are operating in airspace where the ADS-B Package I ground based surveillance applications are in use, then the avionics configuration will require changes to deliver the additional aircraft derived data required.

3.3.3 **Long term (until 2015-2025)**

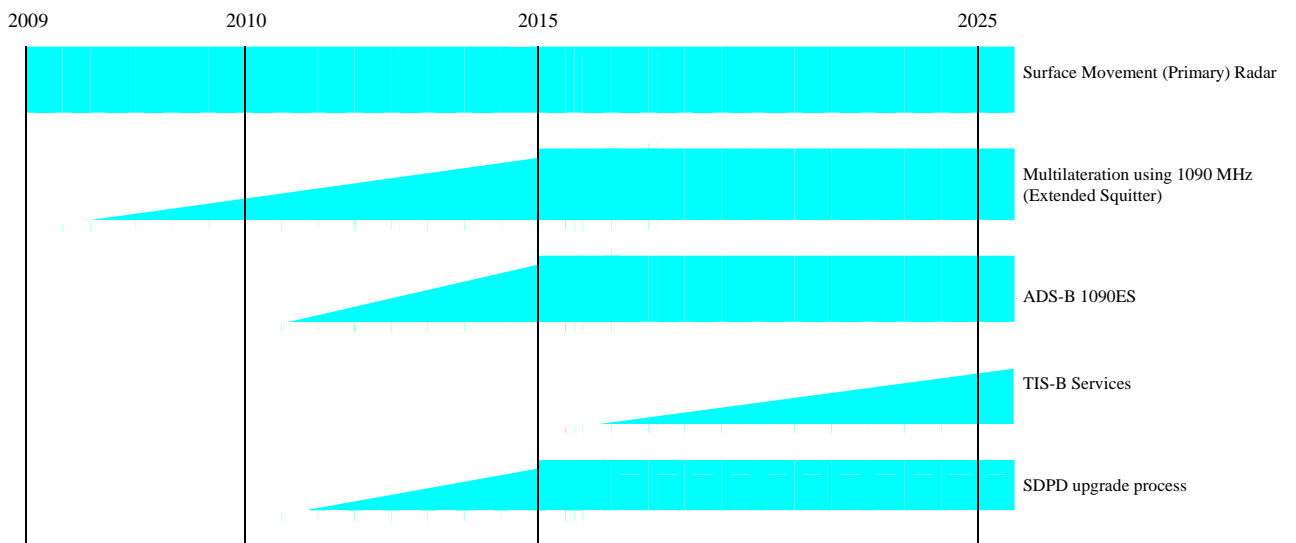
The move from ASAS spacing to ASAS separation and preferred routing may require a high integrity traffic situation picture, therefore the use of TIS-B may be required as well as the implementation of an airborne Surveillance Data Processing System (SDPS) to integrate ADS-B in and TIS-B for presentation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

3.4 Surveillance Infrastructure Timeframe

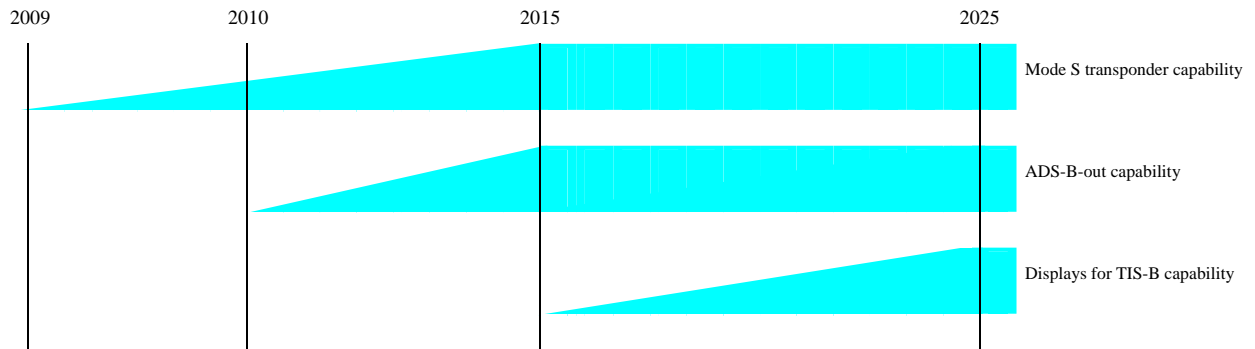
En Route and TMA Airspace



Aerodrome Operations



Aircraft Systems



3.5 Tentative Action Plan

3.5.1 Short term (until 2010)

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.

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.

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 (2010-2015)

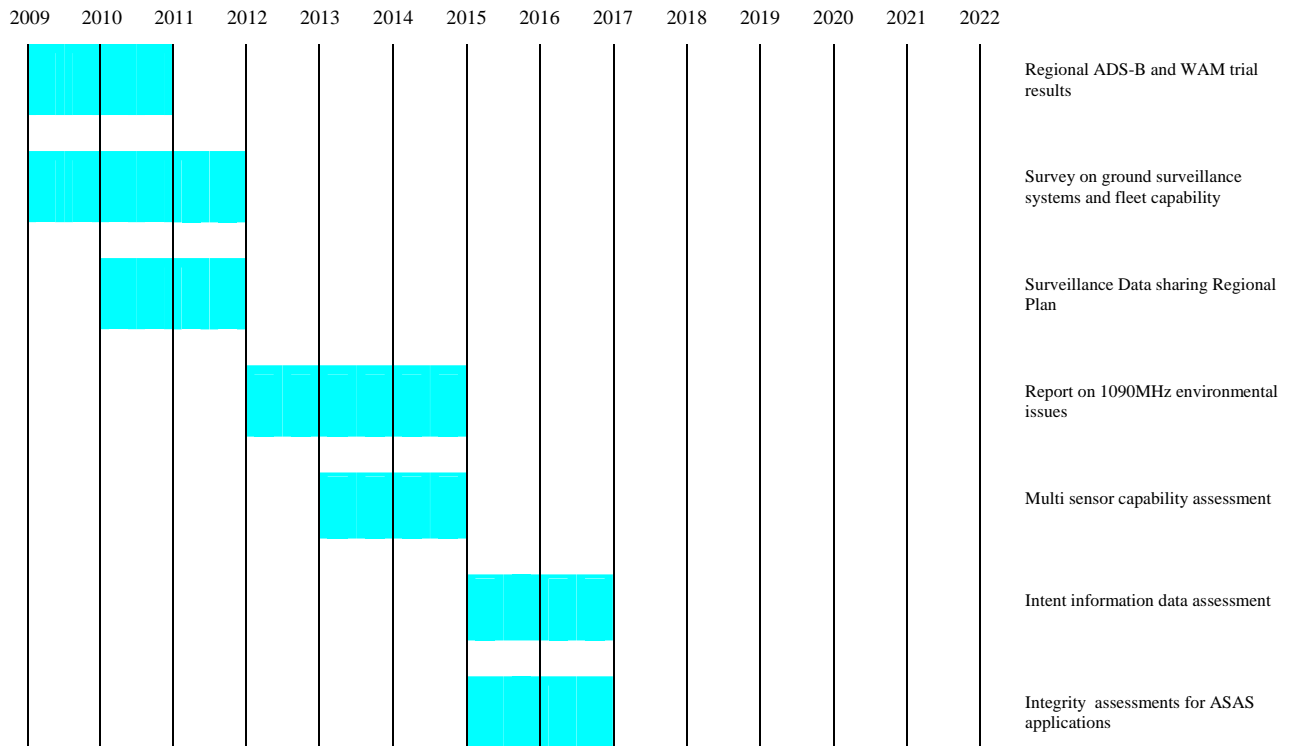
In medium term, the capabilities of current Multi Sensor Trackers are to be assessed in light of the more stringent requirements need to support and process increasing amount of ADD.

3.5.3 Long term (until 2015-2025)

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.

3.5.4 Studies and Trials 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 Commission |
| 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 |
| SSR | Secondary Surveillance Radar |
| TCAS | Traffic Collision Avoidance System |
| TIS-B | Traffic Information Service – Broadcast |

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.

4. **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 interrogations 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.

APPENDIX B / APENDICE B

PROPOSED WORK PROGRAMME ON SURVEILLANCE-RELATED ACTIVITIES FOR NEW CNS/ATM SUBGROUP /
PROGRAMA DE TRABAJO PROPUESTO AL NUEVO SUBGRUPO CNS/ATM SOBRE ACTIVIDADES RELACIONADAS CON VIGILANCIA

| Conclusiones/ Decisiones Validas de GREPECAS/ Objetivo Estratégico, Valid GREPECAS Conclusions/ Decisions Strategic Objective, | Numero de Tarea/ Task Number. | Tarea/ Task | Acción de seguimiento/ Follow-up Action | A ser iniciado por:/ To be started by: | Estado/ Status | Entregable/ Deliverable | Fecha límite/ Deadline |
|--|----------------------------------|--|--|--|-------------------|---|-------------------------------|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| Objetivo EsT: D, IPM/GPI: 9 y 17, Tabla CNS 4A, Conclusión 13/87 | CNS/4-3.3 | Elaboración de un plan regional para la implantación ADS-C y ADS-B. Elaboration of a regional plan for ADS-C and ADS-B implementation. | | Subgrupo CNS/ATM CNS/ATM Subgroup | Valida/ Valid | Seguimiento a los ensayos y aspectos de implantación sobre ADS y MLAT (comparación con dato radar, probabilidad de detección, integridad de los datos, compartición de datos, etc.)/ Follow-up ADS and MLAT trials and implementation aspects (comparison with radar data, probability of detection, data integrity, data sharing, etc.) | Octubre 2010/ October 2010 |
| Objetivo EsT: D, IPM/GPI: 5 y 7, CAR/SAM PBN Roadmap. Task CNS2-1.3.6 “Analyse proposals for data communication infrastructure in support of ATFM implementation“ was included in this new task with regards to its surveillance related componen | CNS/ New | Apoyar la implantación del PBN y ATFM, la optimización de rutas ATS y orientar la automatización de servicios ATM. Support PBN and ATFM implementation, optimization of ATS routes and guidance for ATM Service Automation. | | Subgrupo CNS/ATM CNS/ATM Subgroup | Valida/ Valid | Evaluación de la infraestructura de vigilancia e identificación de mejoras a los sistemas de vigilancia para apoyar los espacios aéreos enruta y terminal en las regiones CAR/SAM, la clasificación del espacio aéreo, la PBN y el ATFM/ Evaluation of surveillance infrastructure and Identification of Surveillance system improvements to support continental enroute and terminal Airspace in CAR/SAM Regions, airspace classification, PBN and the ATFM . Orientaciones para el uso/ integración de los datos ADS-B a Sistemas ATC de Procesamiento multisensoriales/ Guidelines for using/integrating ADS-B Data to ATC Multi sensor Processing Systems | Octubre 2011/ October 2011 |
| Objetivo EsT: D, IPM/GPI: 23 and GREPECAS Conclusión 15/46 | CNS/New 2 | Actividades para optimizar el uso del entorno de radio frecuencia/ Activities to optimize the use of radio frequency environment | | Subgrupo CNS/ATM CNS/ATM Subgroup | Valida/ Valid | Acciones recomendadas para evitar la congestión de frecuencias en 1030/1090 MHz/ Recommended actions for avoiding 1030/ 1090 frequencys congestion | Octubre 2011/ October 2011 |

APPENDIX C

LIST OF CONCLUSIONS AND REPORT OF THE SUR/TF/03 MEETING

Draft Conclusion SUR/TF/3-1 Improvements to ADS-B trial activities

States/Territories/International Organizations with already on-going ADS-B trials are urged to:

- a) Continue with the collection and analysis of data following GREPECAS guidance (**Appendix Q of GREPECAS/15 Report**);
- b) Pursue the exchange of data among the States, particularly in the overlapping coverage and of analysis criteria;
- c) Resolve discovered duplicate or illegal 24-bit aircraft addresses with respective airspace users and inform ICAO Regional Offices accordingly;
- d) Inform airspace users of any anomalies in received ADS-B messages in preparation for future ADS-B implementation; and
- e) Inform ICAO Regional Offices of trials results on a timely basis for ICAO to publish these results.

Draft Conclusion SUR/TF/3-2 Identification of the long-term operational surveillance requirements

That the GREPECAS CNS/ATM Subgroup develop a document showing the foreseen operational scenario(s) in CAR/SAM Regions mainly for the 2015-2025 timeframe to guide the evolution of the Surveillance systems and to update the document on Unified Surveillance Strategy for CAR/SAM Regions.

Draft Conclusion SUR/TF/3-3 Measures to protect the 1030/1090 RF environment

That the CAR/SAM States/ Territories and International Organizations, in order to ensure the sustainability of the 1030/1090 MHz RF environment serving SSR, ACAS, ADS-B and Multilateration systems, apply the measures indicated (Appendix A of WP/02 of SUR/TF/03) and inform the ICAO Regional Offices the action that will take at this respect no later than **30 November 2010**.

Draft Conclusion SURTF/3-4 Incorrect SSR practices by military authorities

That, CAR/SAM States, Territories and International Organizations:

- a) Take the necessary actions and coordination with their corresponding military authorities to avoid the incorrect SSR practices (as outlined in Appendix A) including:
 - the use of X pulse in SSR Mode A replies to distinguish a UAS from a manned aircraft;
 - the allocation of a distinct interrogator code for the mobile Mode S interrogator (mainly used by military); and
 - the upgrading of some military interrogators Mode A/C to mode S capability without the use of the monopulse technique.
- b) Inform ICAO Regional Offices the action that will be made at this respect no later than **30 November 2010**.

Draft Conclusion SURTF/3-5

Special precautions and appropriate procedures during ground testing of transponders

That the CAR/SAM States, Territories and International Organizations apply the considerations and procedure contained in the guidance on transponder ground testing (Appendix B to the SUR/TF/3 report), in order to avoid the generation of ACAS TAs and RAs during ground testing of transponders.



SUR/TF/3

International Civil Aviation Organization

**CAR/SAM REGIONAL PLANNING AND IMPLEMENTATION GROUP
(GREPECAS)**

**THIRD MEETING OF THE SURVEILLANCE TASK FORCE
(SUR/TF/3)**

FINAL REPORT

(Mexico City, México, 10 – 11 September 2009)

The designations employed and the presentation of material in this publication do not imply the expression of any opinion whatsoever on the part of ICAO concerning the legal status of any country, territory, city or area of its authorities, or concerning the delimitation of its frontiers or boundaries.

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HISTORY OF THE MEETING

1. PLACE AND DURATION OF THE MEETING

The Third Meeting of the Surveillance Task Force of GREPECAS was carried out in the ICAO North American, and Caribbean (NACC) Regional Office, in Mexico City, Mexico, from 10 to 11 September 2009.

2. OPENING

Mr. Michiel Vreedendurgh Deputy Director of the ICAO NACC Regional Office welcomed the participants, pointing out the importance of the issues to be treated and its relevance for the new CNS/ATM SG activities.

3. WORKING LANGUAGES

The meeting working language for the discussions and documentation was English.

4. PARTICIPANTS AND ORGANIZATION

The meeting counted with the assistance of 5 States and 2 International Organization (Brazil, Colombia, Cuba, Trinidad & Tobago, United States, COCESNA and Thales), making a total of 12 participants, including ICAO officers. The list of participants is being presented in pages iii-1 to iii-4.

Mrs. Veronica Ramdath, Rapporteur of the Surveillance Task Force of the CNS Committee of the GREPEGAS ATM/CNS Sub-Group, acted as moderator and secretariat, assisted by Mr. Julio Siu, Regional Officer of Communications, Navigation and Surveillance (CNS) of the ICAO North American, Central American and the Caribbean Regional Office and Mr. Masoud Paydar, Technical Officer of Communications, Navigation and Surveillance (CNS) of the ICAO Headquarters in Montreal.

5. LIST OF CONCLUSIONS AND DECISIONS OF THE SUR/TF/3 MEETING

| No. | Title | Page |
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Agenda Item 1: Review and follow-up on the Second Meeting of Surveillance Task Force Report and on conclusions and decisions adopted by the Surveillance Task Force meetings

1.1 The Meeting reviewed the report and agreed tasks of the Surveillance Task Force/2 Meeting. There were two tasks arising from the SUR/TF/2 and the work programme:

- (a) To propose surveillance systems susceptible to be implemented in the CAR/SAM regions with the deliverable of an updated version of the Unified CAR/SAM Surveillance Strategy to be presented by Brazil. This was explored under Item 4.
- (b) To develop an implementation plan for short and medium term Surveillance applications in the CAR/SAM regions with the deliverable of a Surveillance system comparison document and general considerations for implementation and a documentation on guidance considerations for Multilateration implementation to be presented by the United States and SITA. This was explored under Item 5.

1.2 The meeting carried out a revision of the status of application of conclusions and decisions adopted within the frameworks of Surveillance Task Force Meetings. From SUR/TF/2 there was one conclusion and one decision:

(a) Conclusion SUR/TF/02/01: Activity for ADS-B trials

Under Conclusion SUR/TF/02/01 the activities and advances in ADS-B and multilateration trials and other surveillance systems improvements were further expanded by States in Item 2.

(b) Decision SUR/TF/02/02: Updates of Initial Unified CAR/SAM Surveillance Strategy and IATA survey results

Under Decision SUR/TF/02/02 the Task Force members reviewed the initial Unified Regional Surveillance Strategy and the updated version of IATA survey results and based on the comments the updated information on the Unified Regional Surveillance Strategy and the Surveillance Capabilities Survey Results were presented to GREPECAS/15 Meeting by the CNS Committee through the ATM/CNS SG Report.

1.3 IATA presented their new proposal proforma for collecting information on CNS related avionics which includes the deployment of a global database on this topic. The meeting reviewed the proforma and recommended the additional columns indicating the status of certification and the certification authority as it relates to ADS-B avionics, and to change the column labelled **LATAM** to two columns to reflect especially the **CAR** and **SAM** Regions information. Refer to Appendix A.

APPENDIX A / APENDICE A

IATA SURVEY FORM ON CURRENT AND FUTURE AVIONICS / FORMULARIO DE ENCUESTA IATA SOBRE AVIONICA EXISTENTE Y FUTURA



Airspace Planning - Equipment Survey Version 5

NOTES:

- (1) Data provided will be de-identified before publication unless specific permission is obtained from the airline(s) concerned to identify the source.
- (2) In the pull down menus, BF = BEFORE, BF2010 means before the year 2010.
- (3) Please use your flight plan aircraft type designator for each type.

Airline two letter IATA code >>>>>> If your airline is not an IATA member, please enter your airline name >>>>>>

| Aircraft types you CURRENTLY operate | Number of aircraft | Expected Fleet Retire Date | Regions where you operate or propose to operate these aircraft (Please select all that apply and estimate the number of flights or projected flights per week) | | | | | | | | | | | | | | | | | | | | | | | | |
|--------------------------------------|--------------------|----------------------------|--|---------|-------------|---------|------|---------|-----|---------|--------------|---------|-------|---------|-----|---------|-----|---------|----------------|---------|----------------|---------|------------------------|---------|-----------------|---------|-------|
| | | | AFI | Flights | ARABIAN SEA | Flights | ASIA | Flights | EUR | Flights | INDIAN OCEAN | Flights | LATAM | Flights | MID | Flights | NAM | Flights | Atlantic - NAT | Flights | Atlantic - SAT | Flights | Pacific - NOPAC/CENPAC | Flights | Pacific - SOPAC | Flights | POLAR |
| Aircraft type 1 | >>>>> | >>>>> | | | | | | | | | | | | | | | | | | | | | | | | | |
| Aircraft type 2 | >>>>> | >>>>> | | | | | | | | | | | | | | | | | | | | | | | | | |
| Aircraft type 3 | >>>>> | >>>>> | | | | | | | | | | | | | | | | | | | | | | | | | |
| Aircraft type 4 | >>>>> | >>>>> | | | | | | | | | | | | | | | | | | | | | | | | | |
| Aircraft type 5 | >>>>> | >>>>> | | | | | | | | | | | | | | | | | | | | | | | | | |
| Aircraft type 6 | >>>>> | >>>>> | | | | | | | | | | | | | | | | | | | | | | | | | |
| FUTURE FLEET 1 | Service Entry Date | >>>>> | | | | | | | | | | | | | | | | | | | | | | | | | |
| FUTURE FLEET 2 | Service Entry Date | >>>>> | | | | | | | | | | | | | | | | | | | | | | | | | |

| Aircraft Equipment and Capabilities | Type 1 | Type 2 | Type 3 | Type 4 | Type 5 | Type 6 | Future Fleet 1 | Future Fleet 2 |
|--|--------|--------|--------|--------|--------|--------|----------------|----------------|
| FANS 1/A | | | | | | | | |
| FMS RTA | | | | | | | | |
| ADS-C | | | | | | | | |
| ADS-B OUT (Mode S ES) DO-260 transponder | | | | | | | | |
| ADS-B OUT (Mode S ES) DO-260A transponder | | | | | | | | |
| ADS-B OUT (Mode S ES) DO-260B transponder | | | | | | | | |
| If fitted with ADS-B, Transponder Power Output | | | | | | | | |
| ADS-B IN (Mode S ES) with EFB display | | | | | | | | |
| ADS-B IN (Mode S ES) with other MFD | | | | | | | | |
| CPDLC via ACARS-CPDLC FANS 1/A VDL Mode A | | | | | | | | |
| CPDLC via FANS 1/A VDL Mode 2 | | | | | | | | |
| CPDLC via ATN VDL Mode 2 | | | | | | | | |
| CPDLC FANS 1/A SATCOM (INMARSAT / MTSAT) | | | | | | | | |
| CPDLC FANS 1/A SATCOM (IRIDIUM) | | | | | | | | |
| CPDLC via FANS 1/A HF/DL | | | | | | | | |
| Digital Data Link (ARINC 623) | | | | | | | | |
| GPS | | | | | | | | |
| GPS TSO status | | | | | | | | |
| GLS (GBAS) | | | | | | | | |
| RNP 10 (RNAV 10) | | | | | | | | |
| RNAV 5 | | | | | | | | |
| RNP 4 | | | | | | | | |
| PRNAV | | | | | | | | |
| RNAV 2+1 | | | | | | | | |
| Basic RNP 1 | | | | | | | | |
| RNP APCH | | | | | | | | |
| RNP AR APCH | | | | | | | | |
| API BARO VNAV (LNAV / VNAV) | | | | | | | | |
| RNP 0xxx (select from pull down menu) | | | | | | | | |
| DME | | | | | | | | |
| FMG WPR ACARS | | | | | | | | |
| RF / FRT Turn Capability | | | | | | | | |
| HF RTF | | | | | | | | |
| Inertial Navigation | | | | | | | | |
| ILS | | | | | | | | |
| ATC RTF SATCOM (INMARSAT / MTSAT) | | | | | | | | |
| ATC RTF SATCOM (IRIDIUM) | | | | | | | | |
| VHF RTF (8MHz/3) | | | | | | | | |

Additional Information You Wish To Provide

Thank you for your assistance with the survey. Please send the completed spreadsheet to Infrastructure@iata.org Click >>> Infrastructure@iata.org

Agenda Item 2: Review and consolidation of ADS-B and Multilateration Trials progress and other on-going surveillance systems improvements in the CAR/SAM Regions

2.1 Under this agenda Item, information was presented on the development of ADS B trials made in Lima, Peru (IP/05), in preparation for the implementation of an ADS B trial programme in the SAM Region as part of the activities of the RLA/06/901 - *Assistance in the implementation of a ATM regional system according to the ATM operational concept and the corresponding technological support for communications, navigation, and surveillance (CNS)* SAM regional technical cooperation project.

2.2 The objectives of the trials were to know the ADS-B technology, the necessary considerations for its implementation, information related to the amount of aircraft equipped with ADS-B in the selected area, the ADS B data transmitted by the aircraft (current position, altitude, velocity vector, call sign (flight identification) and others), plus the coverage, the accuracy and integrity of the data. **Appendices A-1 to A-4, B-1 to B-7 and C-1 to C-2** of this Agenda Item detail the results and analysis of the data collected. As the result of the ADS B trials, a workshop seminar was scheduled to be held from 3 to 5 June 2009 for the SAM States members of RLA/06/901 project. The event was postponed until 2010.

2.3 Cuba presented (IP/06) its modernization of the surveillance systems and ADS-B trials by the Institute of Civil Aeronautics of Cuba (IACC) and informed the meeting of the installations of six state of the art Monopulse secondary radars with 1090 Extended Squitter receptors incorporated (ADS-B) within the period 2008-2010. The present conventional radars (A/C) shall be progressively replaced as the modernisation plan of the Havana's FIR is implemented.

2.4 The Meeting took note that Cuba's new investment will consolidate Havana FIR radar coverage and increase the availability and reliability of their surveillance systems. ADS-B trials started in 2007 and continued from May 2009 with the radar collocated with 1090 ES receivers at Ignacio Agramonte International Airport in the province of Camagüey. These further trials shall contribute to the decision in reference to payments and schedule for future implantation of ADS-B as an operational surveillance system in the Havana FIR.

2.5 With the start up of Camagüey's new radar, collection and analysis of ADS-B data has already been initiated with software which allows processing and visualization of aircraft equipped with ADS-B transponders in real time. The system allows for storage of all data received for future analysis and statistics from suitably equipped aircraft overflying within an average of 200 Nm. **Appendix D** of this Agenda Item shows some of the statistical information collected to date.

2.6 Efforts are also being made to exchange radar information with adjacent Area Control Centres and to this end a Memorandum of Understanding (MoU) and an Action Plan for the exchange of radar information and AIDC was signed between the Aeronautical Authorities of Cuba and Jamaica.

2.7 The Meeting took note of the surveillance advances in the CAR region as presented by ICAO (IP/07) and reported under the working group mechanism and the implementation of performance based action plans under the *Performance based Air Navigation Implementation Plan for the NAM/CAR Regions*. Among the CNS issues, several activities and agreements on surveillance related aspects had been made. The most recent working group meetings are the NACC/WG/02 Meeting and the C/CAR/WG/07. In **Appendices E and F** of this Agenda Item the relevant surveillance related issues of the NACC/WG/02 and C/CAR/WG/07 Meetings are addressed.

2.8 Brazil (IP/04) informed the meeting that during the past few years the Brazilian Administration has promoted modernization programs on current surveillance radar systems and has installed some new radars throughout the country. The result of those initiatives is that the current radar network in Brazil is considerably new (less than 8 years old) and the coverage for monopulse secondary radars is complete throughout the territory (FL 200 and above).

2.9 Most of the existing radar systems are going to reach the end of their operational lives between 2015 and 2020. There is an ongoing upgrade program at Brazilian ATC Centers that aims, among other features, to prepare those centers to receive and process MLAT and ADS-B data and perform data fusion with radar tracks, according to the following timeline: ACC Curitiba – April 2011, APP Brasilia – October 2011, ACC Recife – October 2011, APP Sao Paulo – March 2012, APP Rio de Janeiro – March 2012, ACC Brasília – June 2012, and ACC Manaus – June 2012.

2.10 Taking into account the need to develop a strategic planning document oriented to a gradual, coordinated, opportune and effective introduction of the Global ATM Operational Concept components, the Airspace Control Department (DECEA) has developed the National ATM Operational Concept based on the “Air Navigation Global Plan”, specifically on the Global Plan Initiatives, and on the CAR/SAM Regions planning.

2.11 Brazil’s plan for their CONOPS are presented in the following phases:

Phase 1, short-term: up to 2010:

- To introduce ADS-B in the off-shore operations of Campos Basin and other similar air spaces;
- To introduce ADS-C service on the EuroSAM corridor;
- To install a test platform for the implementation of ADS-B within the continental air space; and
- To provide surface movement surveillance capacity in selected airports, using Multilateration and/or ADS-B.

Phase 2, medium-term: from 2011 to 2015:

- To introduce ADS-B coverage infrastructure in the entire Brazilian airspace;
- To plan the phasing out of Primary Radar used for civil aviation where there is no operational requirement; and
- To plan the phasing out of Secondary Radar overlapping coverage for en-route operations (assuming the users are appropriately equipped with ADS-B).

Phase 3, long-term: from 2016 to 2020:

- To begin the phasing out of Primary Radar used for civil aviation where there is no operational requirement;
- To begin the phasing out of Secondary Radar overlapping coverage for en route operations (assuming the users are appropriately equipped with ADS-B); and
- To make services available to regional partners.

2.12 Brazil informed the meeting that ADS-C in ACC-AO reached its operational capability on 23/Oct/2008, and ADS/CPDLC FANS 1/A reached full operational capabilities in July, 2009. Analysis showed that there may be an operational need in the Oil Platforms area close to Rio de Janeiro for the implementation of new surveillance technologies. Some preliminary studies show that the use of five ADS-B stations on selected oil rigs would provide the required coverage (with redundancy) over the designated operational area.

2.13 Trinidad and Tobago (IP/10) informed the meeting of the status of their new ATM Modernization Project. The Air Traffic Management Automation (ATM) System is a central system that would integrate all information/data necessary to perform safely and effectively air traffic management functions, including airspace management, air traffic flow management, air traffic services at the appropriate level of automation as recommended by ICAO; and to support control operations of Piarco Area Control Centre, Approach and Tower. The system comes complete with a new Mode S MSSR/PSR radar, electronic flight strips and integrates the most advanced flight data processing (FDP), surveillance data processing (SDP), data link processing (DLP) and displays available today.

2.14 The Radar remoting aspect of the project is well underway with data from the combined radars of Martinique and Guadeloupe being currently displayed under pre-operational test conditions at the Piarco Area Control Centre. Following this phase the Radar Data from the Trinidad and Tobago (new) radar will be fused with data from Barbados and the existing data (that from the French Antilles) resulting in a seamless Enroute Surveillance System covering all the airspace west of 057°W in the Piarco FIR. This phase of the project initially projected to be completed by the end of the third quarter of 2008 is now anticipated to be operational by the end of the second quarter of 2010.

2.15 Trinidad and Tobago re-affirmed its decision that was stated at the SUR/TF/2 Meeting to (i) Implement ADS-B Surveillance within the Piarco FIR via MLAT and that ADS-B trials are conducted not before 2015 within the FIR and (ii) Implement ADS-C to coincide with the main new ATM system in the new air navigation facilities at Piarco.

2.16 The WP/05 submitted by Jamaica informed on the status of their Surveillance activities including plans to enter into radar sharing with adjacent States and implementation of ADS-B. Jamaica presently has three (3) co-located Primary and Secondary Radars that provide coverage to 90 percent of the flight Information region (FIR). These radars are almost at the end of their useful life cycle.

2.17 On November 7, 2008 Jamaica signed a Letter of Agreement with Cuba to share Secondary Radar Data as well as conduct automated radar hand offs via ATS Inter-facility ground/ground Data Communication (AIDC). The next step is for the exchange of one radar feed at 9600 bps (Serial) via the MEVA II VSAT Network, in a pre-operational trial environment. Further discussion is underway with COCESNA to obtain feeds from their Cayman and Puerto Cabeza radars and similar discussions with Colombia.

2.18 In March 2009 Jamaica signed a contract with one of the leading ADS-B manufacturers to conduct trials which began in May 2009 with a single ground station. Jamaica expressed interested in partnering with its neighbours to leverage a bi-lateral or multi-lateral agreement as well as to take advantage of regional economies of scale. The results of these trials will determine the next step in the provision of surveillance service -- be it replacement of the PSR/MSSR radar heads or implementation of MSSR mode S, ADS-B or MLAT; or whichever combination.

2.19 The United States (IP/08) provided an overview briefing of the Surveillance and Broadcast Services program. The overview presented a status of its current program strategy, rulemaking, agreements, routes and near term steps. Some of the near term key milestones are as follows: Louisville, Gulf of Mexico, Philadelphia, and Juneau Initial Operating Capability (IOC) of Surveillance Services in October 2009, December 2009, February 2010 and April 2010, respectively. Critical Surveillance Services In-Service-Decision (ISD) for ADS-B in September 2010.

2.20 The Final Rule for ADS-B Out will be issued in 2010 with a compliance date in 2020. The United States has also initiated some tracks analysis along the East Coast and North Atlantic, including parts of the Caribbean and Bermuda. The United States stated its commitment to continue working collaboratively with the aviation community, and also continues to meet major program milestones with integrity, discipline, transparency and measured risk taking.

2.21 COCESNA (IP/11) gave a briefing on their surveillance related activities and presented the recent advances on radar data sharing with:

- Mexico: agreement signed since 2008 for sharing Cancun and Belize data radar,
- Cuba (San Julian and Grand Cayman radars) and
- Among the Central American Region: Belize, Guatemala, El Salvador, Honduras, Nicaragua and Costa Rica

2.22 COCESNA informed on their ADS-B data collection activities, as well as the current capabilities in the CENAMER Control Center in Tegucigalpa/Honduras and its backup/simulator Control Center in Ilopango/El Salvador for ADS-C and CPDLC data processing functionalities and their tentative dates for the renewal of the MSSR radar SSR for Mode S compatible Radar in the 2009-2010 timeframe.

2.23 The table presented in **Appendix G** of this Agenda Item of the report summarizes the aforementioned trials and surveillance activities in the NAM/CAR/SAM Regions.

2.24 The meeting noted that the results from trials made by States need to be comprehensively analyzed towards the identification of future actions in the CAR/SAM Regions. The meeting reminded the States conducting trials to follow the guidance given by the GREPECAS 15 on *activities to be considered for ADS-B trials (Appendix Q of GREPECAS/15 Report)*. In this regard the meeting recommended the following conclusion:

Draft Conclusion SUR/TF/03/01:

Improvements to ADS-B trial activities

States/Territories/International Organizations with already on-going ADS-B trials are urged to;

- (i) Continue with the collection and analysis of data following GREPECAS guidance (**Appendix Q of GREPECAS/15 Report**);
- (ii) Pursue the exchange of data among the States, particularly in the overlapping coverage and of analysis criteria;
- (iii) Resolve discovered duplicate or illegal 24-bit aircraft addresses with respective airspace users and inform ICAO Regional Offices accordingly;
- (iv) Inform airspace users of any anomalies in received ADS-B messages in preparation for future ADS-B implementation; and
- (v) Inform ICAO Regional Offices of trials results on a timely basis for ICAO to publish these results.

APPENDIX A / APENDICE A

ADS-B DATA COLLECTION, LIMA, PERU / RECOLECCION DE DATOS ADS-B, LIMA, PERU

| 24 BITS ACFT ADDRESS / DRECCION AERONAVE 24 BITS | FLIGHT IDENTIFICATION / IDENTIFICACION VUELO | ACFT TYPE / TIPO AERONAVE | ACFT REGISTER / REGISTRO AERONAVE | MODE S LEVEL / NIVEL MODO S | MODE C LEVEL / NIVEL MODO C | POSITION / POSICION | ADS B SPEED / VELOCIDA D ADS B | RADAR SPEED / VELOCIDA D RADAR | NUC | TIME / HORA | REMARKS / OBSERVACIONES |
|---|--|------------------------------------|--|--------------------------------------|--------------------------------------|------------------------|---|---|-----|----------------|----------------------------|
| E80401 | LPE307 | A319 | CCCYF | 021 | 022 | DALNA | 134.25 | 136 | 7 | 20:10:50 | |
| E8024E | LPE072 | A319 | CCCOU | 020 | 021 | DALNA | 185 | 187 | 6 | 20:13:31 | |
| 4841AD | KLM743 | B772 | PHBQN | 020 | 021 | DALNA | 186.11 | 190 | 6 | 20:21:50 | |
| E80253 | LPE394 | A319 | CCCPPE | 020.25 | 020 | DALNA | 158 | 172 | 0 | 20:25:10 | |
| E80400 | LPE028 | A319 | CCCYE | 020.5 | 021 | DALNA | 176.88 | 182 | 7 | 20:29:06 | |
| / | FAP325 | AN32 | FAP325 | / | 016 | DALNA | / | 143 | / | 20:50:02 | |
| / | OB1309 | L337 | OB1309 | / | 019 | DALNA | / | 114 | / | 20:57:54 | |
| E80258 | LPE034 | A319 | CCCPF | 020.5 | 020 | DALNA | 190.5 | 187 | 7 | 9:09:52 | |
| E80260 | LPE111 | A319 | CCCPM | 359.75 | 360 | SCO | 394.41 | 392 | 7 | 22:19:18 | |
| II | II | II | II | 019.5 | 020 | DALNA | 153.37 | 144 | 7 | 22:45:44 | |
| E80252 | LPE276 | 319 | CCCOZ | 165.75 | 163 | PELIK | TAS | 372 | 0 | 22:21:55 | |
| E80401 | LPE108 | A319 | CCCYF | 019.25 | 020 | DALNA | 170.95 | 182 | 7 | 0:10:15 | |
| E80208 | LPE330 | A319 | CCCQK | 234 | 233 | R300/50NM | 407.37 | 409 | 7 | 0:22:27 | |
| E8025E | LPE309 | A319 | CCCPJ | 040.25 | 040 | SIGAS | 208.96 | 222 | 6 | 0:32:50 | |
| E80211 | LPE2706 | B763 | - | 231.75 | 231 | KADEL | 465.6 | 459 | 6 | 0:38:39 | |
| A62455 | TPU041 | A320 | N495TA | 112.25 | 114 | SLS | 360.79 | 378 | 6 | 0:41:26 | |
| E8020A | LPE371 | A319 | CCCPX | 154.25 | 156 | MULAM | 358.59 | 400 | 6 | 0:45:59 | |
| A62455 | TPU041 | A320 | N495TA | 020 | 021 | DALNA | 145.9 | 172 | 6 | 0:51:58 | |
| E8020A | LPE371 | A319 | CCCPX | 039.5 | 040 | SIGAS | 230.71 | 229 | 6 | 0:55:48 | |
| E80252 | LPE277 | A319 | CCCOZ | 040.25 | 040 | SIGAS | TAS | 159 | 0 | 1:00:30 | |
| A62BC3 | TPU033 | A320 | N497TA | 060.00 | 061 | SIGAS | 160.62 | 160 | 6 | 1:02:28 | |
| E80260 | LPE028 | A319 | CCCPM | 020 | 020 | DALNA | 162 | 180 | 7 | 20:20:32 | |
| E80401 | LPE379 | A319 | CCCYF | 019 | 019 | DALNA | 172.71 | 195 | 7 | | |
| E80258 | LPE205 | A319 | CCCPF | 145.25 | 146 | SLS | 286.96 | 294 | 7 | 3:54:46 | |
| E8020A | LPE2583 | A319 | CCCPX | 018.75 | 020 | DALNA | 171.83 | 187 | 7 | 3:57:38 | |
| E80209 | LPE160 | A319 | CCCPK | 018.75 | 019 | DALNA | 143.48 | 148 | 7 | 4:03:01 | |
| E80210 | LPE2428 | B763 | CCCWV | 018.75 | 020 | DALNA | 177.98 | 183 | 7 | 4:05:47 | |
| E80260 | LPE257 | A319 | CCCPM | 019.25 | 020 | DALNA | 144.36 | 169 | 5 | 4:09:56 | |
| A5EA43 | TPU131 | A319 | | 020.00 | 021 | DALNA | 159.74 | 189 | 7 | 14:03:36 | |
| A61579 | TPU008 | A320 | N491TA | 019.25 | 020 | DALNA | TAS | 187 | 0 | 14:06:18 | |
| A62455 | TPU038 | A320 | N495TA | 019.00 | 020 | DALNA | 181.71 | 193 | 7 | 14:00:00 | |
| E80251 | LPE074 | A319 | CCCOY | 019.75 | 020 | DALNA | TAS | 168 | 0 | 19:22:38 | |
| A90898 | LRC611 | A320 | N681TA | 044.75 | 047 | SIGAS | 200.61 | 203 | 7 | 19:45:24 | |
| E80252 | LPE307 | A319 | CCCOZ | 135.25 | 138 | GALGO | TAS | 339 | 0 | 19:54:44 | |
| II | II | II | II | 040.25 | 041 | SIGAS | TAS | 204 | 0 | 20:03:22 | |
| E8025E | LPE028 | A319 | CCCPJ | 199.75 | 251 | PERLA | 358.15 | 539 | 7 | 20:07:31 | |

| 24 BITS ACFT ADDRESS / DRECCION AERONAVE 24 BITS | FLIGHT IDENTIFICATION / IDENTIFICACION VUELO | ACFT TYPE / TIPO AERONAVE | ACFT REGISTER / REGISTRO AERONAVE | MODE S LEVEL / NIVEL MODO S | MODE C LEVEL / NIVEL MODO C | POSITION / POSICION | ADS B SPEED / VELOCIDA D ADS B | RADAR SPEED / VELOCIDA D RADAR | NUC | TIME / HORA | REMARKS / OBSERVACIONES |
|---|--|------------------------------------|--|--------------------------------------|--------------------------------------|------------------------|---|---|-----|----------------|----------------------------|
| II | II | II | II | 019.25 | 020 | DALNA | 170.95 | 184 | 7 | 20:22:56 | |
| E80261 | LPE072 | A319 | CCCPO | 128 | 202 | PERLA | 335.3 | 369 | 7 | 20:11:36 | |
| II | II | II | II | 019 | 020 | DALNA | 177 | 192 | 7 | 20:26:55 | |
| 4841AD | KLM743 | B772 | PHBKN | 245.75 | 248 | | 440 | 445 | 7 | 20:31:46 | |
| E80251 | LPE109 | A319 | CCCOY | 198.5 | 191 | ISENO | TAS | 393 | 0 | 21:02:23 | 397 TAS |
| E80400 | LPE040 | A319 | CCCYE | 367.25 | 368 | CEDRO | 420.56 | 413 | 7 | 21:28:03 | |
| E80206 | LPE2427 | B763 | CCCWG | 019 | 019 | DALNA | 179.3 | 185 | 7 | 15:56:36 | |
| E80252 | LPE025 | A319 | CCCOZ | 019 | 019 | DALNA | TAS | 156 | 0 | 15:56:36 | |
| E80253 | LPE353 | A319 | CCCPE | 017.75 | 018 | | TAS | 141 | 0 | 16:49:39 | INM POS. DALNA |
| E80261 | LPE111 | A319 | CCCPO | 129.75 | 128 | ARC 20 NM | 365.19 | 361 | 7 | 16:55:06 | |
| E80401 | LPE123 | A319 | CCCYF | 189.75 | 191 | | 360.35 | 359 | 7 | 17:43:18 | BORDE ASI |
| E80258 | LPE029 | A319 | CCCPF | 066 | 063 | | 284.77 | 271 | 7 | 17:34:28 | ARCO 10NM |
| E8025F | LPE035 | A319 | CCCPE | 316.5 | 315 | PUDUL | 473.95 | 471 | 7 | 19:33:42 | |
| E8024F | LPE076 | A319 | CCCOX | 020.75 | 021 | DALNA | TAS | 179 | 0 | 19:41:05 | |
| E80258 | LPE028 | A319 | CCCPF | 198 | 191 | PERLA | 353.1 | 342 | 7 | 20:04:33 | |
| E80209 | LPE2639 | A319 | CCCPL | 224.5 | 222 | ARPON | 423.67 | 415 | 7 | 20:13:49 | |
| E80400 | LPE074 | A319 | CCCYE | 207.35 | 208 | PERLA | 364.97 | 370 | 7 | 20:24:56 | |
| 4843F2 | KLM743 | B772 | - | 116.5 | 113 | MULAM | 395.29 | 394 | 7 | 20:34:22 | |
| II | II | II | - | 019.75 | 021 | DALNA | 189.18 | 191 | 6 | 20:44:55 | |
| E80251 | LPE306 | A319 | CCCOY | 380 | 380 | BTE | 452 | 431 | 7 | 17:18:00 | |
| II | II | II | II | 380 | | 266NM | 453 | | | 17:29:00 | FIN DE COBERTURA |
| E8020C | LPE026 | A319 | CCCQL | 019.6 | 020 | DALNA | 133.3 | 131 | | 17:22:00 | |
| E80253 | LPE074 | A319 | CCCDE | 019.25 | 020 | DALNA | TAS | 174 | 0 | 19:14:25 | 167 TAS |
| E8020B | LPE038 | A319 | CCCQK | 019.50 | 020 | DALNA | 148.97 | 164 | 7 | 22:54:04 | |
| 342250 | IBE6651 | A346 | | 021.5 | 023 | 10NM R333 | 179.74 | 187 | 7 | 23:01:48 | |
| II | II | II | | 019.5 | 020 | | 165.45 | 171 | 7 | 23:03:07 | |
| E80401 | LPE123 | A319 | CCCYF | 017.75 | 018 | DALNA | 167.65 | 188 | 7 | 12:21:30 | |
| E8020B | LPE202 | A319 | CCCQK | 217.25 | - | 180NM | 359.47 | - | 7 | 15:13:00 | |
| E8020C | LPE018 | A319 | CCCQL | 018.5 | 019 | DALNA | 143.7 | 143 | 7 | 15:39:12 | |
| E8040D | LPE2764 | A319 | | 360 | 360 | | 402 | 390 | | 15:52:00 | |
| E8025B | LPE2589 | A319 | CCCPF | 019.25 | 020 | DALNA | 180 | 197 | 7 | 15:58:07 | |
| E8020A | LPE2585 | A319 | | 019.25 | 019 | DALNA | 194.9 | 199 | 6 | 16:05:03 | |
| E8022A | LPE2630 | B763 | CCCWF | 380 | 380 | | 431 | 430 | | 16:31:45 | |
| EB020B | LPE203 | A319 | CCCQK | 019 | 020 | | 178.86 | 192 | 7 | 17:04:04 | |
| E8040L | LPE255 | A319 | CCCYF | 019.25 | 020 | DALNA | 189.79 | 198 | 7 | 19:06:18 | |
| EB0260 | LPE074 | A319 | CCCPM | 021.5 | 022 | DALNA | 159.3 | 163 | 7 | 19:15:49 | |
| 484368 | KLM743 | B772 | PHBQA | 019.25 | 020 | DALNA | 185.23 | 171 | 7 | 20:38:31 | |
| E80261 | LPE116 | A319 | CCCPO | 340 | 340 | | | | 7 | 12:40:00 | |
| E8040C | LPE273 | A319 | CCCYE | 370.75 | 380 | | | | 7 | 12:46:53 | |
| EB0253 | LPE075 | A319 | CCCPE | 330 | 330 | | | | 0 | 12:49:59 | |
| EB0208 | LAN531 | B763 | CCCYN | 370 | 370 | | 463 | 470 | 7 | 13:07:43 | |
| E8020B | LPE162 | A319 | CCCQK | 380 | 380 | PISCO | 385 | 382 | 7 | 13:21:27 | |

| 24 BITS ACFT ADDRESS / DRECCION AERONAVE 24 BITS | FLIGHT IDENTIFICATION / IDENTIFICACION VUELO | ACFT TYPE / TIPO AERONAVE | ACFT REGISTER / REGISTRO AERONAVE | MODE S LEVEL / NIVEL MODO S | MODE C LEVEL / NIVEL MODO C | POSITION / POSICION | ADS B SPEED / VELOCIDA D ADS B | RADAR SPEED / VELOCIDA D RADAR | NUC | TIME / HORA | REMARKS / OBSERVACIONES |
|---|--|------------------------------------|--|--------------------------------------|--------------------------------------|------------------------|---|---|-----|----------------|----------------------------|
| A68E4F | TPU049 | A319 | N521TA | 380 | 380 | | | | 7 | 13:48:06 | |
| A904E1 | TPU040 | A320 | N680TA | 360 | 360 | | | | 7 | 13:57:38 | |
| A63331 | TPU008 | A320 | N499TA | 300 | 300 | ASI | 357 | 355 | 7 | 14:04:13 | |
| A63331 | TPU008 | A320 | N499TA | 019.5 | 019 | DALNA | 156.01 | 169 | 7 | 14:29:35 | |
| E8022A | LAN530 | B763 | CCCWF | 018.75 | 019 | DALNA | 185.23 | 187 | 7 | 3:26:32 | |
| E80258 | LPE305 | A319 | CCCPF | 019.00 | 019 | DANA | 162.38 | 177 | 7 | 3:30:21 | |
| E80209 | LPE2581 | A319 | CCCPQ | 018.00 | 019 | DALNA | 197.31 | 223 | 7 | 3:33:08 | |
| E80252 | LPE2583 | A319 | CCCOZ | 017.00 | 019 | DALNA | TAS | 201 | 0 | 3:35:51 | TAS |
| A67181 | NKS977 | A319 | - | 018.25 | 020 | DALNA | 201.27 | 221 | 7 | 3:38:33 | |
| E8020C | LPE2638 | A319 | CCCQL | 018.00 | 018 | DALNA | 138.21 | 136 | 7 | 3:41:45 | |
| E8020B | LPE331 | A319 | CCCQK | 018.75 | 019 | DALNA | 135.13 | 148 | 7 | 3:43:28 | |
| A11F59 | COA1037 | B752 | N17104 | 018.75 | 020 | DALNA | TAS | 179 | 0 | 3:48:09 | ID NO MOSTRADO |
| AB7AE4 | DAL235 | B764 | - | 040.00 | 041 | SIGAS | TAS | 277 | 0 | 3:51:46 | EL ID SOLO MOSTRABA "D2" |
| AB7AE4 | DAL235 | B764 | - | 018.75 | 020 | DALNA | TAS | 209 | 0 | 3:53:42 | EL ID SOLO MOSTRABA "D2" |
| E80251 | LPE379 | A319 | CCC0Y | 038.75 | 039 | SIGAS | TAS | 230 | 0 | 3:56:17 | |
| E80251 | LPE379 | A319 | CCC0Y | 018.00 | 018 | DALNA | TAS | 184 | 0 | 3:58:37 | |
| E80401 | LPE279 | A319 | CCCYF | 018.75 | 020 | DALNA | 147.66 | 161 | 7 | 4:00:56 | |
| E80259 | LPE205 | A319 | CCCPI | 038.75 | 039 | SIGAS | 221.04 | 233 | 7 | 4:01:34 | |
| E80259 | LPE205 | A319 | CCCPI | 018.00 | 018 | DALNA | 192.26 | 205 | 7 | 4:03:46 | |
| E80400 | LPE160 | A319 | CCCYE | 018.25 | 019 | DALNA | 178.86 | 190 | 7 | 4:12:18 | |
| E8024F | LPE257 | A319 | CCCOX | 019.50 | 020 | DALNA | TAS | 242 | 0 | 4:09:34 | |
| E80253 | LPE357 | A319 | CCCPE | 018.25 | 019 | DALNA | TAS | 148 | 0 | 4:19:04 | |
| E8024E | LPE106 | A319 | CCCOU | 018.50 | 019 | DALNA | TAS | 188 | 0 | 4:16:25 | |
| E80205 | LAN600 | B763 | CCCWH | 021.25 | 023 | DALNA | 190.72 | 193 | 6 | 4:26:57 | ID MUESTRA SOLO "600" |
| E8021D | LAN601 | B763 | - | 038.00 | 038 | SIGAS | 273.78 | 275 | 6 | 4:30:12 | |
| E8021D | LAN601 | B763 | - | 018.25 | 019 | DALNA | 196.44 | 228 | 6 | 4:32:04 | |

ADS-B DATA COLLECTION, LIMA, PERU, 29 MAY 2009/ FROM 03:26 TO 4:32 UTC
RECOLECCION DE DATOS ADS-B, LIMA, PERU, 29MAY2009 / DE 03:26 A 4:32 UTC

| 24 BITS ADDRESS / DIRECCION 24 BITS | FLIGHT IDENTIFICATION / IDENTIFICACION VUELO | ACFT TYPE / TIPO AERONAVE | ACFT REGISTER / REGISTRO AERONAVE | MODE S LEVEL / NIVEL MODO S | POSITION / POSICION | ADS B SPEED / VELOCIDAD ADS B | NUC | TIME / HORA | REMARKS / OBSERVACIONES |
|-------------------------------------|--|---------------------------|-----------------------------------|-----------------------------|---------------------|-------------------------------|-----|-------------|---|
| E8022A | LAN530 | B763 | CCCWF | 018.75 | DALNA | 185.23 | 7 | 3:26:32 | |
| E80258 | LPE305 | A319 | CCCPF | 019.00 | DANA | 162.38 | 7 | 3:30:21 | |
| E80209 | LPE2581 | A319 | CCCPQ | 018.00 | DALNA | 197.31 | 7 | 3:33:08 | |
| E80252 | LPE2583 | A319 | CCCOZ | 017.00 | DALNA | | 0 | 3:35:51 | |
| A67181 | NKS977 | A319 | - | 018.25 | DALNA | 201.27 | 7 | 3:38:33 | |
| E8020C | LPE2638 | A319 | CCCQL | 018.00 | DALNA | 138.21 | 7 | 3:41:45 | |
| E8020B | LPE331 | A319 | CCCQK | 018.75 | DALNA | 135.13 | 7 | 3:43:28 | |
| A11F59 | | B752 | N17104 | 018.75 | DALNA | | 0 | 3:48:09 | No velocity and no flight indication information appeared (COA1037) |
| AB7AE4 | D2 | B764 | - | 040.00 | SIGAS | 273.34 | 0 | 3:51:46 | Flight identification do not correspond to the identification flight in the Flight Plan (DAL 235) |
| E80251 | LPE379 | A319 | CCC0Y | 038.75 | SIGAS | | 0 | 3:56:17 | No velocity indication |
| E80401 | LPE279 | A319 | CCCYF | 018.75 | DALNA | 147.66 | 7 | 4:00:56 | |
| E80259 | LPE205 | A319 | CCCPI | 038.75 | SIGAS | 221.04 | 7 | 4:01:34 | |
| E80259 | LPE205 | A319 | CCCPI | 018.00 | DALNA | 192.26 | 7 | 4:03:46 | |
| E80400 | LPE160 | A319 | CCCYE | 018.25 | DALNA | 178.86 | 7 | 4:12:18 | |
| E8024F | LPE257 | A319 | CCCOX | 019.50 | DALNA | | 0 | 4:09:34 | No velocity indication |
| E80253 | LPE357 | A319 | CCCPE | 018.25 | DALNA | | 0 | 4:19:04 | No velocity indication |
| E8024E | LPE106 | A319 | CCCOU | 018.50 | DALNA | | 0 | 4:16:25 | No velocity indication |
| E80205 | 600 | B763 | CCCWH | 021.25 | DALNA | 190.72 | 6 | 4:26:57 | Flight identification do not correspond to the identification in the Flight Plan (LAN 600) |
| E8021D | LAN601 | B763 | - | 038.00 | SIGAS | 273.78 | 6 | 4:30:12 | |
| E8021D | LAN601 | B763 | - | 018.25 | DALNA | 196.44 | 6 | 4:32:04 | |

APPENDIX B / APENDICE B

ADS-B - RADAR SSR DATA COLLECTED / ADS-B - DATOS SSR RADAR RECOLECTADOS

11-May-09

| 24 BIT ACFT ADDRESS / DIRECCION AERONAVE 24 BIT | FLIGHT IDENTIFICATION / IDENTIFICACION VUELO | ACFT TYPE / TIPO AERONAVE | ACFT REGISTRATION / REGISTRO AERONAVE | MODE S LEVEL / NIVEL MODO S | MODE C LEVEL / NIVEL MODO C | REFERENCE POSITION / POSICION DE REFERENCIA | ADS B GROUND SPEED / VELOCIDAD TERRESTRE ADS B | SSR GROUND SPEED / VELOCIDAD TERRESTRE SSR | NUC | HOUR / HORA | REMARKS / OBSERVACIONES |
|---|--|---------------------------|---------------------------------------|-----------------------------|-----------------------------|---|--|--|-----|-------------|-------------------------|
| E80401 | LPE307 | A319 | CCCYF | 21 | 22 | DALNA | 134.25 | 136 | 7 | 20:10:50 | |
| E8024E | LPE072 | A319 | CCCOU | 20 | 21 | DALNA | 185 | 187 | 6 | 20:13:31 | |
| 4841AD | KLM743 | B772 | PHBQN | 20 | 21 | DALNA | 186.11 | 190 | 6 | 20:21:50 | |
| E80253 | LPE394 | A319 | CCCPE | 20.25 | 20 | DALNA | 158 | 172 | 0 | 20:25:10 | |
| E80400 | LPE028 | A319 | CCCYE | 20.5 | 21 | DALNA | 176.88 | 182 | 7 | 20:29:06 | |
| / | FAP325 | AN32 | FAP325 | / | 16 | DALNA | / | 143 | / | 20:50:02 | |
| / | OB1309 | L337 | OB1309 | / | 19 | DALNA | / | 114 | / | 20:57:54 | |
| E80258 | LPE034 | A319 | CCCPF | 20.5 | 20 | DALNA | 190.5 | 187 | 7 | 9:09:52 | |

12-May-09

| 24 BIT ACFT ADDRESS / DIRECCION AERONAVE 24 BIT | FLIGHT IDENTIFICATION / IDENTIFICACION VUELO | ACFT TYPE / TIPO AERONAVE | ACFT REGISTRATION / REGISTRO AERONAVE | MODE S LEVEL / NIVEL MODO S | MODE C LEVEL / NIVEL MODO C | REFERENCE POSITION / POSICION DE REFERENCIA | ADS B GROUND SPEED / VELOCIDAD TERRESTRE ADS B | SSR GROUND SPEED / VELOCIDAD TERRESTRE SSR | NUC | HOUR / HORA | REMARKS / OBSERVACIONES |
|---|--|---------------------------|---------------------------------------|-----------------------------|-----------------------------|---|--|--|-----|-------------|-------------------------|
| E80260 | LPE111 | A319 | CCCPM | 359.75 | 360 | SCO | 394.41 | 392 | 7 | 22:19:18 | |
| | | | | 019.5 | 020 | DALNA | 153.37 | 144 | 7 | 22:45:44 | |
| E80252 | LPE276 | 319 | CCCOZ | 165.75 | 163 | PELIK | TAS | 372 | 0 | 22:21:55 | |
| E80401 | LPE108 | A319 | CCCYF | 019.25 | 020 | DALNA | 170.95 | 182 | 7 | 0:10:15 | |
| E80208 | LPE330 | A319 | CCCQK | 234 | 233 | R300/50NM | 407.37 | 409 | 7 | 0:22:27 | |
| E8025E | LPE309 | A319 | CCCPJ | 040.25 | 040 | SIGAS | 208.96 | 222 | 6 | 0:32:50 | |
| E80211 | LPE2706 | B763 | - | 231.75 | 231 | KADEL | 465.6 | 459 | 6 | 0:38:39 | |
| A62455 | TPU041 | A320 | N495TA | 112.25 | 114 | SLS | 360.79 | 378 | 6 | 0:41:26 | |
| E8020A | LPE371 | A319 | CCCPX | 154.25 | 156 | MULAM | 358.59 | 400 | 6 | 0:45:59 | |
| A62455 | TPU041 | A320 | N495TA | 020 | 021 | DALNA | 145.9 | 172 | 6 | 0:51:58 | |
| E8020A | LPE371 | A319 | CCCPX | 039.5 | 040 | SIGAS | 230.71 | 229 | 6 | 0:55:48 | |
| E80252 | LPE277 | A319 | CCCOZ | 040.25 | 040 | SIGAS | TAS | 159 | 0 | 1:00:30 | |
| A62BC3 | TPU033 | A320 | N497TA | 060.00 | 061 | SIGAS | 160.62 | 160 | 6 | 1:02:28 | |
| E80260 | LPE028 | A319 | CCCPM | 020 | 020 | DALNA | 162 | 180 | 7 | 20:20:32 | |

14-May-09

| 24 BIT ACFT ADDRESS / DIRECCION AERONAVE 24 BIT | FLIGHT IDENTIFICATION / IDENTIFICACION VUELO | ACFT TYPE / TIPO AERONAVE | ACFT REGISTRATION / REGISTRO AERONAVE | MODE S LEVEL / NIVEL MODO S | MODE C LEVEL / NIVEL MODO C | REFERENCE POSITION / POSICION DE REFERENCIA | ADS B GROUND SPEED / VELOCIDAD TERRESTRE ADS B | SSR GROUND SPEED / VELOCIDAD TERRESTRE SSR | NUC | HOUR / HORA | REMARKS / OBSERVACIONES |
|---|--|---------------------------|---------------------------------------|-----------------------------|-----------------------------|---|--|--|-----|-------------|-------------------------|
| E80401 | LPE379 | A319 | CCCYF | 019 | 019 | DALNA | 172.71 | 195 | 7 | | |
| E80258 | LPE205 | A319 | CCCPF | 145.25 | 146 | SLS | 286.96 | 294 | 7 | 3:54:46 | |
| E8020A | LPE2583 | A319 | CCCPX | 018.75 | 020 | DALNA | 171.83 | 187 | 7 | 3:57:38 | |
| E80209 | LPE160 | A319 | CCCPK | 018.75 | 019 | DALNA | 143.48 | 148 | 7 | 4:03:01 | |
| E80210 | LPE2428 | B763 | CCCWV | 018.75 | 020 | DALNA | 177.98 | 183 | 7 | 4:05:47 | |
| E80260 | LPE257 | A319 | CCCPM | 019.25 | 020 | DALNA | 144.36 | 169 | 5 | 4:09:56 | |
| A5EA43 | TPU131 | A319 | | 020.00 | 021 | DALNA | 159.74 | 189 | 7 | 14:03:36 | |
| A61579 | TPU008 | A320 | N491TA | 019.25 | 020 | DALNA | | 187 | 0 | 14:06:18 | No ADSB speed |
| A62455 | TPU038 | A320 | N495TA | 019.00 | 020 | DALNA | 181.71 | 193 | 7 | 14:00:00 | |
| E80251 | LPE074 | A319 | CCCOY | 19.75 | 020 | DALNA | | 168 | 0 | 19:22:38 | No ADSB speed |
| A90898 | LRC611 | A320 | N681TA | 44.75 | 047 | SIGAS | 200.61 | 203 | 7 | 19:45:24 | |
| E80252 | LPE307 | A319 | CCCOZ | 135.25 | 138 | GALGO | | 339 | 0 | 19:54:44 | No ADSB speed |
| E80252 | LPE307 | A319 | CCCOZ | 40:25 | 41 | SIGAS | | 204 | 0 | 20:03:22 | No ADSB speed |
| E8025E | LPE028 | A319 | CCCPJ | 199.75 | 251 | PERLA | 358.15 | 539 | 7 | 20:07:31 | |
| E80261 | LPE072 | A319 | CCCPO | 128 | 202 | PERLA | 335.3 | 369 | 7 | 20:11:36 | |
| E8025E | LPE028 | A319 | CCCPJ | 19.25 | 020 | DALNA | 170.95 | 184 | 7 | 20:22:56 | |
| E80261 | LPE072 | A319 | CCCPO | 19 | 020 | DALNA | 177 | 192 | 7 | 20:26:55 | |
| 4841AD | KLM743 | B772 | PHBKN | 245.75 | 248 | | 440 | 445 | 7 | 20:31:46 | |
| E80251 | LPE109 | A319 | CCCOY | 198.5 | 191 | ISENO | | 393 | 0 | 21:02:23 | No ADSB speed |
| E80400 | LPE040 | A319 | CCCYE | 367.25 | 368 | CEDRO | 420.56 | 413 | 7 | 21:28:03 | |

15-May-09

| 24 BIT ACFT ADDRESS / DIRECCION AERONAVE 24 BIT | FLIGHT IDENTIFICATION / IDENTIFICACION VUELO | ACFT TYPE / TIPO AERONAVE | ACFT REGISTRATION / REGISTRO AERONAVE | MODE S LEVEL / NIVEL MODO S | MODE C LEVEL / NIVEL MODO C | REFERENCE POSITION / POSICION DE REFERENCIA | ADS B GROUND SPEED / VELOCIDAD TERRESTRE ADS B | SSR GROUND SPEED / VELOCIDAD TERRESTRE SSR | NUC | HOUR / HORA | REMARKS / OBSERVACIONES |
|---|--|---------------------------|---------------------------------------|-----------------------------|-----------------------------|---|--|--|-----|-------------|-------------------------|
| E80206 | LPE2427 | B763 | CCCWG | 019 | 019 | DALNA | 179.3 | 185 | 7 | 15:56:36 | |
| E80252 | LPE025 | A319 | CCCOZ | 019 | 019 | DALNA | | 156 | 0 | 15:56:36 | No ADS B speed |
| E80253 | LPE353 | | CCCPE | 017.75 | 018 | | | 141 | 0 | 16:49:39 | No ADS B speed |
| E80261 | LPE111M | A319 | CCCPO | 129.75 | 128 | ARC 20 NM | 365.19 | 361 | 7 | 16:55:06 | |
| E80401 | LPE123 | A319 | CCCYF | 189.75 | 191 | | 360.35 | 359 | 7 | 17:43:18 | BORDE ASI |
| E80258 | LPE029M | A319 | CCCPF | 066 | 063 | | 284.77 | 271 | 7 | 17:34:28 | ARCO 10NM |
| E8025F | LPE035 | A319 | CCCPE | 316.5 | 315 | PUDUL | 473.95 | 471 | 7 | 19:33:42 | |
| E8024F | LPE076 | A319 | CCCOX | 020.75 | 021 | DALNA | TAS | 179 | 0 | 19:41:05 | |
| E80258 | LPE028 | A319 | CCCPF | 198 | 191 | PERLA | 353.1 | 342 | 7 | 20:04:33 | |
| E80209 | LPE2639 | A319 | CCCPL | 224.5 | 222 | ARPON | 423.67 | 415 | 7 | 20:13:49 | |
| E80400 | LPE074 | A319 | CCCYE | 207.35 | 208 | PERLA | 364.97 | 370 | 7 | 20:24:56 | |
| 4843F2 | KLM743 | B772 | | 116.5 | 113 | MULAM | 395.29 | 394 | 7 | 20:34:22 | |
| 4843F2 | KLM743 | B772 | | 019.75 | 021 | DALNA | 189.18 | 191 | 6 | 20:44:55 | |

19-May-09

| 24 BIT ACFT ADDRESS / DIRECCION AERONAVE 24 BIT | FLIGHT IDENTIFICATION / IDENTIFICACION VUELO | ACFT TYPE / TIPO AERONAVE | ACFT REGISTRATION / REGISTRO AERONAVE | MODE S LEVEL / NIVEL MODO S | MODE C LEVEL / NIVEL MODO C | REFERENCE POSITION / POSICION DE REFERENCIA | ADS B GROUND SPEED / VELOCIDAD TERRESTRE ADS B | SSR GROUND SPEED / VELOCIDAD TERRESTRE SSR | NUC | HOUR / HORA | REMARKS / OBSERVACIONES |
|---|--|---------------------------|---------------------------------------|-----------------------------|-----------------------------|---|--|--|-----|-------------|-------------------------|
| E80251 | LPE306 | A319 | CCCOY | 380 | 380 | BTE | 452 | 431 | | 17:18:00 | |
| E80251 | LPE306 | A319 | CCCOY | 380 | 380 | 266NM | 453 | | | 17:29:00 | End of coverage |
| E8020C | LPE026 | A319 | CCCQL | 019.6 | 020 | DALNA | 133.3 | 131 | | 17:22:00 | |
| E80253 | LPE074 | A319 | CCCDE | 019.25 | 020 | DALNA | TAS | 174 | 0 | 19:14:25 | 167 TAS |
| E8020B | LPE038 | A319 | CCCQK | 019.50 | 020 | DALNA | 148.97 | 164 | 7 | 22:54:04 | |
| 342250 | IBE6651 | A346 | | 021.5 | 023 | 10NM R333 | 179.74 | 187 | 7 | 23:01:48 | |
| 342250 | IBE6651 | A346 | | 019.5 | 020 | DALNA | 165.45 | 171 | 7 | 23:03:07 | |

22-May-09

| 24 BIT ACFT ADDRESS / DIRECCION AERONAVE 24 BIT | FLIGHT IDENTIFICATION / IDENTIFICACION VUELO | ACFT TYPE / TIPO AERONAVE | ACFT REGISTRATION / REGISTRO AERONAVE | MODE S LEVEL / NIVEL MODO S | MODE C LEVEL / NIVEL MODO C | REFERENCE POSITION / POSICION DE REFERENCIA | ADS B GROUND SPEED / VELOCIDAD TERRESTRE ADS B | SSR GROUND SPEED / VELOCIDAD TERRESTRE SSR | NUC | HOUR / HORA | REMARKS / OBSERVACIONES |
|---|--|---------------------------|---------------------------------------|-----------------------------|-----------------------------|---|--|--|-----|-------------|-------------------------|
| E80401 | LPE123 | A319 | CCCYF | 017.75 | 018 | DALNA | 167.65 | 188 | 7 | 12:21:30 | |
| E8020B | LPE202 | A319 | CCCQK | 217.25 | - | 180NM | 359.47 | - | 7 | 15:13:00 | |
| E8020C | LPE018 | A319 | CCCQL | 018.5 | 019 | DALNA | 143.7 | 143 | 7 | 15:39:12 | |
| E8040D | LPE2764 | A319 | | 360 | 360 | | 402 | 390 | | 15:52:00 | |
| E8025B | LPE2589 | A319 | CCCPF | 019.25 | 020 | DALNA | 180 | 197 | 7 | 15:58:07 | |
| E8020A | LPE2585 | A319 | | 019.25 | 019 | DALNA | 194.9 | 199 | 6 | 16:05:03 | |
| E8022A | LPE2630 | B763 | CCCWF | 380 | 380 | | 431 | 430 | | 16:31:45 | |
| EB020B | LPE203 | A319 | CCCQK | 019 | 020 | | 178.86 | 192 | 7 | 17:04:04 | |
| E8040L | LPE255 | A319 | CCCYF | 019.25 | 020 | DALNA | 189.79 | 198 | 7 | 19:06:18 | |
| EB0260 | LPE074 | A319 | CCCPM | 021.5 | 022 | DALNA | 159.3 | 163 | 7 | 19:15:49 | |
| 484368 | KLM743 | B772 | PHBQA | 019.25 | 020 | DALNA | 185.23 | 171 | 7 | 20:38:31 | |

26-May-09

| 24 BIT ACFT ADDRESS / DIRECCION AERONAVE 24 BIT | FLIGHT IDENTIFICATION / IDENTIFICACION VUELO | ACFT TYPE / TIPO AERONAVE | ACFT REGISTRATION / REGISTRO AERONAVE | MODE S LEVEL / NIVEL MODO S | MODE C LEVEL / NIVEL MODO C | REFERENCE POSITION / POSICION DE REFERENCIA | ADS B GROUND SPEED / VELOCIDAD TERRESTRE ADS B | SSR GROUND SPEED / VELOCIDAD TERRESTRE SSR | NUC | HOUR / HORA | REMARKS / OBSERVACIONES |
|---|--|---------------------------|---------------------------------------|-----------------------------|-----------------------------|---|--|--|-----|-------------|-------------------------|
| E80261 | LPE116 | A319 | CCCPO | 340 | 340 | | | | 7 | 12:40:00 | |
| E8040C | LPE273 | A319 | CCCYE | 370.75 | 380 | | | | 7 | 12:46:53 | |
| EB0253 | LPE075 | A319 | CCCPE | 330 | 330 | | | | 0 | 12:49:59 | |
| EB0208 | LAN531 | B763 | CCCYN | 370 | 370 | | 463 | 470 | 7 | 13:07:43 | |
| E8020B | LPE162 | A319 | CCCQK | 380 | 380 | PISCO | 385 | 382 | 7 | 13:21:27 | |
| A68E4F | TPU049 | A319 | N521TA | 380 | 380 | | | | 7 | 13:48:06 | |
| A904E1 | TPU040 | A320 | N680TA | 360 | 360 | | | | 7 | 13:57:38 | |
| A63331 | TPU008 | A320 | N499TA | 300 | 300 | ASI | 357 | 355 | 7 | 14:04:13 | |
| A63331 | TPU008 | A320 | N499TA | 019.5 | 019 | DALNA | 156.01 | 169 | 7 | 14:29:35 | |

APPENDIX C / APENDICE C
ADS-B - RADAR SSR DATA COLLECTED / ADS-B - DATOS RADAR SSR RECOLECTADOS

22-May-09

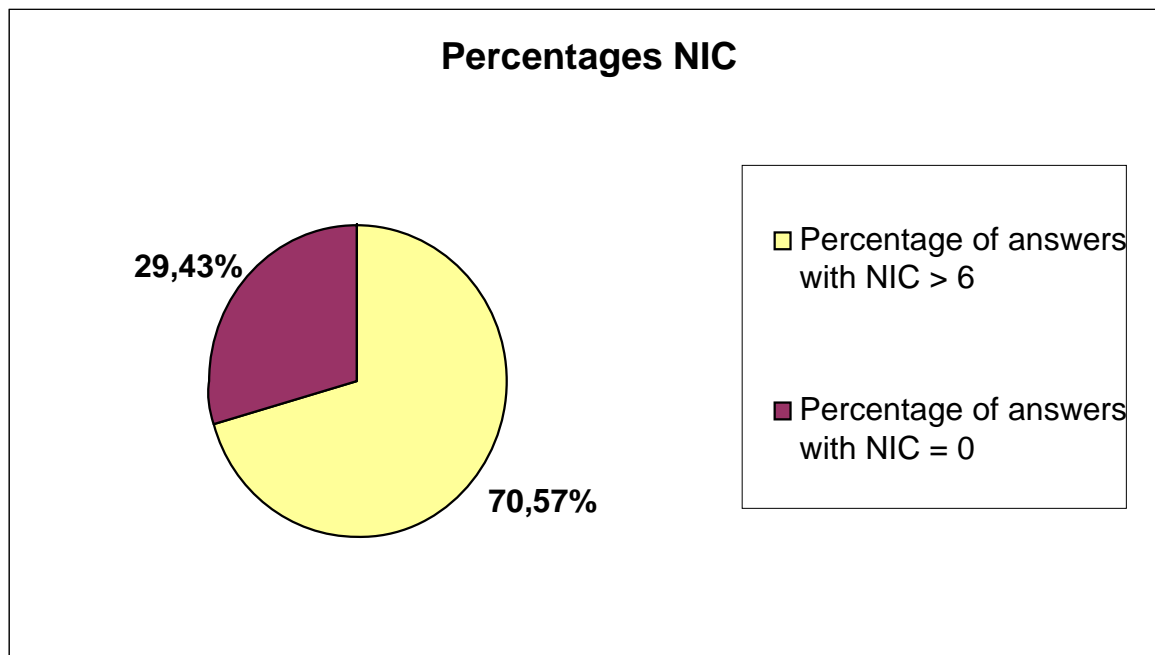
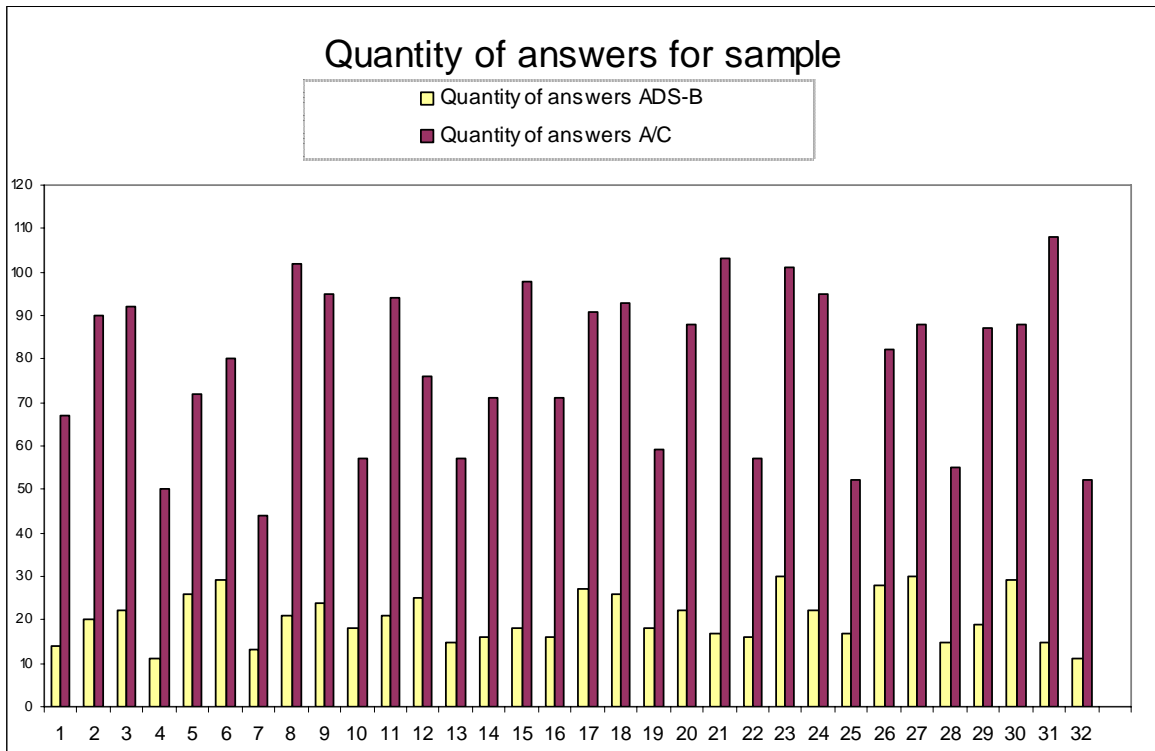
| 24 BIT ACFT ADDRESS / DIRECCION AERONAVE 24 BIT | FLIGHT IDENTIFICATION / IDENTIFICACION VUELO | ACFT TYPE / TIPO AERONAVE | ACFT REGISTRATION / REGISTRO AERONAVE | MODE S LEVEL / NIVEL MODO S | FLIGHT IDENTIFICATION / IDENTIFICACION VUELO | ACFT TYPE / TIPO AERONAVE | ADS B GROUND SPEED / VELOCIDAD TERRESTRE | SSR GROUND SPEED / VELOCIDAD TERRESTRE | NUC | ADS B DISTANCE/ DISTANCIA ADS B | RADAR DISTANCE/ DISTANCIA RADAR | HOUR / HORA | REMARKS / OBSERVACIONES |
|---|--|---------------------------|---------------------------------------|-----------------------------|--|---------------------------|--|--|-----|---------------------------------|---------------------------------|-------------|-------------------------|
| E80401 | LPE123 | A319 | | 17.75 | LPE123 | A319 | | | 7 | | | | |
| E8020B | LPE202 | A319 | CCCQK | 217.25 | LP2202 | A319 | 359.47 | - | 7 | 187 | | 15:13:58 | |
| E8020C | | | | | LPE018 | A319 | | | 7 | | | | |
| E8040D | LPE2764 | A319 | | 360 | LPE 2764 | A319 | 402 | 390 | | 141 | 141 | 15:52:00 | UM415 |
| E8025B | LPE2589 | A319 | CCCPF | 019.25 | LPE 2589 | A319 | 180 | 197 | 7 | | | 15:58:07 | |
| A6280C | TPU040 | | | 240 | TPU040 | | 452 | | | 230 | | 16:10:00 | |
| E8022A | LPE2630 | B763 | CCCWF | 380 | LPE041 | A319 | 431 | 430 | | 200 | 237 | 16:31:45 | LPE |
| EB0251 | LPE041 | A319 | | 350 | | A319 | | | 0 | 130 | | | Cuzco, Peru |

26-May-09

| 24 BIT ACFT ADDRESS / DIRECCION AERONAVE 24 BIT | FLIGHT IDENTIFICATION / IDENTIFICACION VUELO | ACFT TYPE / TIPO AERONAVE | ACFT REGISTRATION / REGISTRO AERONAVE | MODE S LEVEL / NIVEL MODO S | FLIGHT IDENTIFICATION / IDENTIFICACION VUELO | ACFT TYPE / TIPO AERONAVE | MODE C LEVEL/ NIVEL MODO C | REFERENCE POSITION/ POSICION DE REFERENCIA | ADS B GROUND SPEED / VELOCIDAD TERRESTRE | SSR GROUND SPEED / VELOCIDAD TERRESTRE | NUC | ADS B DISTANCE/ DISTANCIA ADS B | RADAR DISTANCE/ DISTANCIA RADAR | HOUR / HORA | REMARKS / OBSERVACIONES |
|---|--|---------------------------|---------------------------------------|-----------------------------|--|---------------------------|----------------------------|--|--|--|-----|---------------------------------|---------------------------------|-------------|-------------------------|
| E80206 | LPE33 | A319 | CCCOL | | LPE353 | A319 | 320 | | | | 7 | 230 | 230 | | Chiclayo, Peru |
| E80261 | LPE116 | A319 | CCCPO | 340 | LPE116 | A319 | 340 | | | | 7 | 238 | 238 | 12:40:00 | Chiclayo, Peru |
| E8040C | LPE273 | A319 | CCCYE | 370.75 | LPE273 | A319 | 380 | | | | 7 | 249 | 250 | 12:46:53 | Peru |
| E8025F | LPE303 | A319 | CCCPL | | LPE303 | A319 | 330 | | | | 7 | 230 | 236 | | Peru |
| EB0253 | LPE075 | A319 | CCCPE | 330 | LPE075 | A319 | 330 | | | | 0 | 130 | 125 | 12:49:59 | Peru |
| E8020B | LAN531 | B763 | CCCYN | 370 | LAN531 | B763 | 370 | | 463 | 470 | 7 | 228 | 231 | 13:07:43 | Santiago, Chile |
| A61CE7 | LRC610 | A320 | | | LPE162 | A320 | | | | | 7 | 220 | 213 | 13:33:21 | Santiago, Chile |
| A68E4F | TPU049 | A319 | N521TA | 380 | TP049 | A319 | 380 | | | | 7 | 120 | 120 | 13:48:06 | Maiquetia, Venezuela |
| A904E1 | TPU040 | A320 | N680TA | 360 | TP008 | A320 | 360 | | | | 7 | 200 | 196 | 13:57:38 | Montevideo, Uruguay |

APPENDIX D

Next we present the statistics obtained starting from a sampling of the answers received by A/C and ADS-B in the position of Camagüey:



| No. of the Sample | Aircraft that responded with A/C | Aircraft that responded with ADS-B | Percentage of answers with ADS-B | Quantity of answers ADS-B with NIC > 6 | Percentage of answers with NIC > 6 | Quantity of answers ADS-B with NIC = 0 | Percentage of answers with NIC = 6 |
|-------------------|----------------------------------|------------------------------------|----------------------------------|--|------------------------------------|--|------------------------------------|
| 1 | 67 | 14 | 20,90% | 11 | 78,57% | 3 | 21,43% |
| 2 | 90 | 20 | 22,22% | 14 | 70,00% | 6 | 30,00% |
| 3 | 92 | 22 | 23,91% | 18 | 81,82% | 4 | 18,18% |
| 4 | 50 | 11 | 22,00% | 6 | 54,55% | 5 | 45,45% |
| 5 | 72 | 26 | 36,11% | 18 | 69,23% | 8 | 30,77% |
| 6 | 80 | 29 | 36,25% | 20 | 68,97% | 9 | 31,03% |
| 7 | 44 | 13 | 29,55% | 10 | 76,92% | 3 | 23,08% |
| 8 | 102 | 21 | 20,59% | 17 | 80,95% | 4 | 19,05% |
| 9 | 95 | 24 | 25,26% | 19 | 79,17% | 5 | 20,83% |
| 10 | 57 | 18 | 31,58% | 14 | 77,78% | 4 | 22,22% |
| 11 | 94 | 21 | 22,34% | 16 | 76,19% | 5 | 23,81% |
| 12 | 76 | 25 | 32,89% | 15 | 60,00% | 9 | 36,00% |
| 13 | 57 | 15 | 26,32% | 9 | 60,00% | 6 | 40,00% |
| 14 | 71 | 16 | 22,54% | 12 | 75,00% | 4 | 25,00% |
| 15 | 98 | 18 | 18,37% | 14 | 77,78% | 4 | 22,22% |
| 16 | 71 | 16 | 22,54% | 12 | 75,00% | 4 | 25,00% |
| 17 | 91 | 27 | 29,67% | 16 | 59,26% | 11 | 40,74% |
| 18 | 93 | 26 | 27,96% | 17 | 65,38% | 9 | 34,62% |
| 19 | 59 | 18 | 30,51% | 12 | 66,67% | 6 | 33,33% |
| 20 | 88 | 22 | 25,00% | 16 | 72,73% | 6 | 27,27% |
| 21 | 103 | 17 | 16,50% | 13 | 76,47% | 4 | 23,53% |
| 22 | 57 | 16 | 28,07% | 10 | 62,50% | 6 | 37,50% |
| 23 | 101 | 30 | 29,70% | 19 | 63,33% | 10 | 33,33% |
| 24 | 95 | 22 | 23,16% | 16 | 72,73% | 6 | 27,27% |
| 25 | 52 | 17 | 32,69% | 11 | 64,71% | 6 | 35,29% |
| 26 | 82 | 28 | 34,15% | 14 | 50,00% | 14 | 50,00% |
| 27 | 88 | 30 | 34,09% | 25 | 83,33% | 5 | 16,67% |
| 28 | 55 | 15 | 27,27% | 9 | 60,00% | 6 | 40,00% |
| 29 | 87 | 19 | 21,84% | 14 | 73,68% | 5 | 26,32% |
| 30 | 88 | 29 | 32,95% | 20 | 68,97% | 9 | 31,03% |
| 31 | 108 | 15 | 13,89% | 12 | 80,00% | 3 | 20,00% |
| 32 | 52 | 11 | 21,15% | 9 | 81,82% | 2 | 18,18% |
| Totales | 2515 | 651 | 25,88% | 458 | 70,35% | 191 | 29,34% |

It is observed that the answers of ADS-B don't surpass 40% in any case and they continue showing very little advance in their implementation on board the aircraft that overflying the analyzed area.

Of the total of answers received ADS-B, around 70% presents an approach of usable integrity, with what even diminishes more the real availability of this system.

APPENDIX E**NACC/WG/02 Meeting*****Surveillance Systems Regional Implementation Plan***

1. The Meeting took note of the update to the Regional Surveillance Plan contained in Table CNS 4A – *Surveillance Systems* of the FASID (Doc 8733), the CAR/SAM Regional Strategy for ADS-C and ADS-B Systems Implementation in the Short, Medium and Long-Term; the Preliminary Elements for a Regional Strategy for Surveillance Systems; and the work that has to be performed by the Surveillance Task Force of the CNS Committee for a unified regional strategy on the implementation of surveillance systems. The Surveillance Task Force Rapporteur informed the Meeting about the progress accomplished with the unified regional strategy for implementation of surveillance systems and the list of activities that States/Territories/International Organizations have to consider for the implementation of ADS-B trials.
2. United States informed the Meeting of the benefits from future use of ADS-B, and that they can assist CAR/SAM States by providing both technical expertise and a contract vehicle for procuring turn-key surveillance services. Interested CAR/SAM States should contact the FAA Office of International Aviation, Western Hemisphere Division, via letter, fax, or e-mail to express interest in participating in the data collection effort. Additionally, interested CAR/SAM States should identify point-of-contact information to begin necessary discussions to enter into a bilateral agreement with the FAA.
3. Based on the study performed by Trinidad and Tobago, and considering that they are in the midst of an ATM/CNS Modernization Project, which initially involves the sharing of radar data from the French Antilles and Barbados and the processing of data from the following sources/sensors PSR/SSR/MSSR/ADS-B/ADS-C/TIS-B and MLAT, it is envisaged:
 - i. That surveillance within the Piarco FIR will be best served through the use of radar;
 - ii. MLAT, based on successful trials, appears to be the better option taking into consideration the traffic density, projected growth trends and fleet equipage within the Piarco FIR at this time. Surveillance within the Piarco FIR should migrate to ADS-B via MLAT and ADS-B trials should not be conducted before 2015 within the FIR; and
 - iii. Implementation of ADS-C should be carried out in 2010/11, when the ATM system is fully up and running.
4. Cuba informed the Meeting that they concluded the ADS-B data collection phase at the end of 2007, and are working on the development of their surveillance systems in order to have a capable radar system that guarantees control of their airspace based on radar data until the year 2018, while simultaneously preparing the infrastructure needed for the assimilation of new surveillance systems based on ADS-B.
5. COCESNA informed the Meeting of their ADS-B data collection activities, as well as the current capabilities in the CENAMER Control Centre for ADS-C and CPDLC functionalities.
6. The Meeting was informed that GREPECAS would provide information and guidance to States in order to standardize the 24 bit address assignment registry for the identification of aircraft with Mode S transponder.
7. The Meeting noted the coverage of current radar systems operating in the region illustrated in Appendices A, B and C to WP/17 of the NACC/WG/02 Meeting. The Meeting was informed of radar data sharing activities being carried out by States/Territories/International Organizations:

- Mexico and COCESNA have signed a technical co-operation agreement for radar data exchange, especially the Belize and Cancun radar systems. Likewise, information was received on radar data sharing coordination carried out between Cayman Islands and COCESNA as part of the existing co-operation agreement between both administrations.
- Data sharing between Bahamas, Bermuda, Canada and United States.
- Radar data exchange in Central America among the States and COCESNA: Niktun (Guatemala) radar, Managua and Bluefields (Nicaragua) radar, Monte Crudo (Honduras) radar and Mata de Caña (Costa Rica) radar, as well as radar data sharing for operational use (radar data from Monte Crudo at the Toncontin Airport in Honduras and radar data from Mata de Caña at the Juan Santa Maria airport in Costa Rica).
- Radar data sharing between COCESNA and Cayman Islands, as well as between COCESNA (Puerto Cabezas radar) and Panama.
- The beginning of a project for the exchange of radar data between Cuba, Jamaica and COCESNA.
- Coordination for radar data exchange between Trinidad and Tobago and French Antilles and Barbados.
- The modernization of the radar system installed in San Jose, Costa Rica.

Considerations for Surveillance Data Sharing and Exchange

8. Information was provided regarding radar data exchange agreements, analysis of data integrity, explanation of the current ASTERIX protocol, among the other necessary topics for achieving this type of agreement. Particularly the following information was considered useful for achieving and facilitating radar data exchange:

- Spain's experience on radar data sharing with its neighbouring countries through the Joint AEFMP Plan, including considerations and relevant aspects to be taken into account regarding these activities, and a generic sample letter of agreement
- The considerations and experience of the United States regarding radar data sharing, including cost effective benefits for involved States and the establishment of bilateral agreements, which take time to develop and negotiate but clearly define each State's responsibilities. Likewise, information was provided on additional effort required during integration testing and certification; States were encouraged to work together to overcome obstacles.
- The current evolution status of the ASTERIX protocol administered by EUROCONTROL, including categories for handling radar data and ADS-B and multilateration data.
- In the CAR/SAM Region the SAC Asterix code was formulated through Conclusion 12/48 of GREPECAS.

9. Based on radar coverage and the information provided during the Meeting, the participants identified several radar data sharing arrangements that could be carried out including Dominican Republic with Haiti, Colombia/Venezuela with Netherlands Antilles, among others.

10. Likewise, the Meeting noted the existence of communication means and capabilities for this radar data exchange through the regional digital networks.

APPENDIX F

C/CAR/WG/07 Meeting

1. COCESNA informed the Meeting of the advances in its activities on radar data sharing with several states in the region, for increasing the availability, reliability and coverage of the surveillance service among the FIRs of Mexico/Merida, La Habana and Central America:

- Mexico (SENEAM) – COCESNA: Agreement signed since 2008, Cancun radar data exchange for use in CENAMER Control Center, and Mexico (SENEAM) receives radar data from Belize/ COCESNA for its use in Merida Control Center. The communication mean is the CAMSAT network and ground circuits leased with the PTTs of Mexico and Guatemala.
- Cuba – COCESNA: Agreement in progress, exchange of COCESNA radar data in Gran Cayman with radar data from San Julian. The planned communication mean will be the MEVA network.

2. United States discussed their experience in radar data sharing between Miami and Bahamas and the importance of the establishing responsibilities between the parties involved in radar exchange agreements. USA offered a sample of a Memorandum of Understanding (MOU) for consideration to the States.

4. Similarly, the Meeting was informed about the Air Surveillance Regional System (SRVA), which is an initiative for the implementation of a regional coordination centre that will support the civil aviation operations in the Central America FIR, Panama FIR and Santo Domingo FIR with representatives of civil aviation, Military forces and/or security. The SRVA tasks include SAR missions, humanitarian assistance, support for natural disasters, security and surveillance, among others. The SRVA also looks for building a technical compatible platform with a common interface for radar data sharing with the adjacent FIR radar systems.

5. Jamaica informed the Meeting of its implementation plans for Surveillance systems, which includes radar data sharing with adjacent FIRs and assessment of new technologies with a view towards implementation.

6. The Meeting agreed in the performance-based action plan for the implementation of surveillance system for the achievement of the Performance Objective of “improve Situation Awareness” and PBN related performance objectives; objectives of the *Performance based Air Navigation Implementation Plan for the NAM/CAR Regions*.

APPENDIX G

ADS-B AND ADS-C PROGRESS IN THE CAR/SAM REGION

| No | State or Organization | Location | Technology | Status | Remarks |
|----|-----------------------|--|------------|----------------|--|
| 1 | Peru | Lima Jorge Chavez International Airport | ADS-B | Trial | Data collection with radar data comparison and assessment already performed (SUR/TF/3 - IP/05) |
| 2 | Chile | Arturo Merino Benitez Santiago International Airport | ADS B | Trial | Data collection with radar data comparison and assessment already performed |
| 3 | Cuba | "Ignacio Agramonte" International Airport | ADS-B | Trial | ADS-B station collocated with MSSR Data collection with radar data comparison and assessment already performed (SUR/TF/3 - IP/06) |
| 4 | Trinidad and Tobago | Piarco International Airport | ADS-B | Planned (2015) | Planned to be implemented in 2015 |
| | | | ADS-C (*) | Planned (2011) | *Oceanic East Sector Planned to be implemented with the new ATC Center (2011) |
| 5 | COCESNA | Cenamer ACC | ADS-B | Trial | Data collection and assessment already performed (SUR/TF/3 – IP/11). Trials defined in two phases. Phase I ongoing. |
| | | | ADS-C (*) | Planned | * Pacific Oceanic sectors |
| 6 | Brasil | ACC-AO (Atlantic FIR) | ADS-C | Operational | On going data collection and assessment |
| | | Campos Basin | ADS-B | Planned (2010) | On going System specification for procurement, which tentatively starts in Oct 2009 |

| No | State or Organization | Location | Technology | Status | Remarks |
|----|-----------------------|--|--|------------------------|---|
| 7 | Jamaica | Kingston FIR | ADS-B | Trial | Data collection and assessment to start on May 2009 (SUR/TF/3 - WP/19) |
| 8 | United States | Golf of Mexico (Central zone between Houston Oceanic and Mexico FIRs) | ADS-B | Operational deployment | Based on an agreement Mexico – USA On-going data collection and assessment (Service acceptance test completed, formal integration with automation – Sep 2009 and Initial Operating Capability in Dec 2009) |
| | | Miami Oceanic FIR (Domestic Zone) East Coast of USA and North Atlantic, including parts of the Caribbean and Bermuda. | ADS-B | Planned | |
| | | Continental USA: <ul style="list-style-type: none"> • Colorado and Juneau, Alaska • Louisville and Philadelphia | Wide area Multilateration ADS-B | Operational deployment | |

Agenda Item 3: Review progress made by the Aeronautical Surveillance Panel (ASP)

3.1 The Meeting was informed on recent developments in ICAO with respect to aeronautical surveillance and collision avoidance systems. The work programmes of ICAO panels dealing with surveillance related issues are shown in **Appendices A, B** and **C** of this Agenda Item.

3.2 The first meeting of the Working Group of the Whole of the ASP (ASP-WGW/1) was held in Montreal from 8 to 12 December 2008 and formulated eleven recommendations including amendments to Annex 10 — Aeronautical Telecommunications and Volume IV — Surveillance and Collision Avoidance Systems, Technical Provisions for Mode S Services and Extended Squitter (Doc 9871) and Doc 8071, Manual on Testing of Radio Navigation Aids and Volume III — Testing of Surveillance Radar Systems relating to secondary surveillance radar (SSR) and/or automatic dependent surveillance — broadcast (ADS-B) using 1090 MHz extended squitter.

3.3 The ASP-WGW/1 recommended the publication of a new Aeronautical Surveillance Manual (Doc xxxx) which will consolidate all the valid parts of Manual of the Secondary Surveillance Radar (SSR) Systems (Doc 9684) and the Manual on Mode S Specific Services (Doc 9688) with new guidance material on emerging surveillance techniques. The ASP-WGW/1 finalized a proposal to introduce an initial set of technical requirements for identification, tracking and display of other aircraft on the flight deck based on received ADS-B IN messages. It proposed system-level requirements for processing and display of traffic in the flight deck support the introduction and further development of airborne surveillance applications in a safe and harmonized manner and finalized draft SARPs for multilateration (MLAT) systems used for air traffic surveillance and recommended that they be incorporated in Annex 10, Volume IV, as a new chapter.

3.4 The ASP-WGW/1 concluded that the RF environment would be sustainable and capable of accommodating the foreseen traffic growth and the introduction of new systems and services beyond the year 2020 only if certain measures are taken. It was also agreed that monitoring activities and relevant simulation and studies would still be needed to ensure the continued sustainability of the environment and recommended disseminating the material containing the necessary measures to protect the RF environment to States and international organizations. Moreover, a number of incorrect radar implementation practices by military were also identified.

3.5 Further to the work of the Separation and Airspace Safety Panel (SASP) to support 5 NM separations with ADS-B done and publishing Circular 311 on the ICAO-NET, the fourteenth meeting of the Working Group of the Whole of the panel was held in at the ICAO Regional Office in Paris, France from 13 to 24 October, 2008. The work of SASP has been progressed by several project teams including Project Team 13 dealing with ADS-B and MLAT. The outcome of the Project Team 13 considered by the Working Group of the Whole of SASP is summarized as follows:

- a) The main focus for the team had been final reviews of the comparative assessment circular and Procedures for Air Navigation Services — Air Traffic Management (PANS-ATM, Doc 4444) amendment proposal that made provision for MLAT in Chapter 8 of the PANS-ATM. As a result of this work, the team considered that the work on developing the documentation for 3NM and 5NM ADS-B and MLAT separation was essentially complete and that these documents would now be processed through the Secretary; and

- b) A significant issue noted by the team is regarding limitations in the ability of ADS-B to transmit individual emergency codes. Further work in developing required amendment proposals in this regard will be undertaken at the next meeting. The meeting considered it more expedient to progress the current amendment proposal and the work towards the development of appropriate provisions for the emergency code issue.

APPENDIX A**WORK PROGRAMME OF THE ASP (MOSTLY FOR COMPLETION BY 2011)
AUGUST 2009**

1. Develop technical provisions for:
 - a) increasing the capacity of 1 090 MHz extended squitter;
 - b) passive acquisition of aircraft by Mode S radar; and
 - c) determination/reporting of on-the-ground status by aircraft with no squat switch.
2. Develop a timeline indicating the projected evolution of ground surveillance systems and applications.
3. Develop guidance material on flight testing of new surveillance systems (i.e. ADS-B and MLAT).
4. Propose updates to existing material relating to surveillance and collision avoidance systems in light of operational experience.
5. In coordination with relevant external organizations and operational bodies, develop the following provisions in support of airborne surveillance applications;
 - a) procedure for identification of reference aircraft;
 - b) functional requirements and related material for Airborne Traffic Situational Awareness – In-Trail Procedure (ATSA-ITP);
 - c) functional requirements and related material for merging and sequencing (M&S); and
 - d) relevant technical material needed for the aforementioned applications.

APPENDIX B**WORK PROGRAMME OF THE ASP (MOSTLY FOR COMPLETION BY 2011)
AUGUST 2009****Work Programme Items of OPLINK
August 2009**

Develop guidance material, as well as implementation guidelines to further the use of current data link technology (as of 2008) (including ADS C, CPDLC, D-FIS, AIDC, RCP and satellite voice communications).

Develop Standards, Recommended Practices, Procedures and guidance material, to support the implementation of emerging data link technology (developed post-2008) (including ADS C, CPDLC, D-FIS, AIDC, RCP and satellite voice communications)

In general, the panel will act as the focal point for the consolidation and development of ATM data link operational requirements.

APPENDIX C**WORK PROGRAMME ITEMS OF THE SASP****August 2009**

Develop criteria, performance Standards and separation minima if necessary in relation to airborne separation assurance.

Develop Standards and Recommended Practices, guidance material, as well as implementation guidelines to allow the application and use of new and emerging technologies with existing separation minima.

In coordination with Regional Monitoring Authorities, produce updated version of the RMA manual with specific recommendations related to long term monitoring of height-keeping performance.

Develop lateral and longitudinal separation Standards for emerging Performance-Based Navigation applications.

In general, the panel will develop separation minima and the required level and performance of communications, navigation and surveillance requirements needed to support such minima, taking into account future demand and airspace capacity. In addition, the panel will develop the related ATM procedures and techniques required as well as guidelines for the determination of ATM safety indicators, acceptable levels of safety and appropriate metrics for expressing these.

Agenda Item 4: Develop a Regional Strategy for Surveillance System Implementation in the CAR/SAM Regions

4.1 The meeting reviewed the last version of the Unified Regional Strategy for Surveillance Implementation in the CAR/SAM Region as approved in GREPECAS/15 Meeting and formulated the following decision:

DECISION SUR/TF/03/01 UPDATES OF INITIAL UNIFIED CAR/SAM SURVEILLANCE STRATEGY

The TF members are to review the initial Unified Regional Surveillance Strategy presented in the Meeting and present, *no later than 1st October 2009*, any comments and observations to the Surveillance Task Force Rapporteur regarding this document.

4.2 The meeting agreed that the final updated version of this strategy should be presented to the CNS/ATM SG. In this regard Brazil is to update this document by October 15, 2009. The following conclusion is proposed:

**DRAFT
CONCLUSION SUR/TF/03/02 IDENTIFICATION OF THE LONG-TERM OPERATIONAL SURVEILLANCE REQUIREMENTS**

That the GREPECAS CNS/ATM Subgroup develop a document showing the foreseen operational scenario(s) in CAR/SAM Regions mainly for the 2015-2025 timeframe to guide the evolution of the Surveillance systems and to update the document on Unified Surveillance Strategy for CAR/SAM Regions.

4.3 The meeting took note of information identified by ICAO Aeronautical Surveillance Panel on the measures that should be taken to ensure the sustainability of the 1030/1090 MHz RF environment serving SSR, ACAS, ADS-B and Multilateration systems.

4.4 The first meeting of the Working Group of the Whole of the Aeronautical Surveillance Panel (ASP WG/1) that was held in Montreal from 8 to 12 December 2008, identified several measures that should be taken to ensure the sustainability of the 1030/1090 MHz RF environment serving SSR, ACAS, ADS-B and Multilateration systems that needed attention by States and relevant international organizations.

4.5 The following measures are needed to ensure the sustainability of the RF environment:

- a) To the extent possible, ground SSRs (Mode A/C) that use sliding window technique should be upgraded to monopulse or Mode S. New sliding window interrogators should not be deployed in high density environments. This is critical to sustain performance of all systems that operate on 1030/1090 MHz;
- b) For ground radars (and multilateration systems), better regional coordination should be put in place to minimize interrogation rates and transmission power as well as to use appropriate antenna patterns. Moreover, in any given region, Mode S radars must be operated with an appropriate installed monopulse antenna and should be clustered as much as possible and the use of different interrogator codes should be minimized;

- c) Better coordination should be performed between civil and military authorities specifically regarding the 1030/1090 MHz RF environment;
- d) As much as feasible, airborne Mode A/C transponders should be replaced with Mode S transponders. This will significantly reduce FRUIT generated by ground and airborne interrogations; and
- e) It should be ensured that only properly tested and maintained airborne equipment are operated on aircraft.

4.6 In this regards the following draft conclusion is proposed:

DRAFT

CONCLUSION SUR/TF/3/03

MEASURES TO PROTECT THE 1030/1090 RF ENVIRONMENT

That the CAR/SAM States/ Territories and International Organizations, in order to ensure the sustainability of the 1030/1090 MHz RF environment serving SSR, ACAS, ADS-B and Multilateration systems, apply the measures indicated (Appendix A of WP/02 of SUR/TF/03) and inform the ICAO Regional Offices the action that will take at this respect no later than 30 November 2010.

4.7 IATA presented a report on guidance to Air Navigation Service Providers (ANSPs), States, vendors and funding organizations on international airline infrastructure requirements for air traffic services between now and 2020. This report considers technologies that are widely available or under consideration to provide Communications, Navigation and Surveillance (CNS) for Air Traffic Management (ATM). The structure consists of a brief technology description followed by IATA's position on implementation. Recommendations are based on the evaluation of operational benefits, e.g. schedule, safety, efficiency, cost, risk, and availability. This document is meant to serve as a planning tool and represents the consolidated view of IATA's members, which comprise some 230 airlines as of December 2008 – the world's leading passenger and cargo airlines among them - representing 93 percent of scheduled international air traffic.

4.8 In general, IATA's position on short to mid-term CNS/ATM infrastructure improvements is to maximise the existing capabilities that are on aircraft today and to support the implementation of the technologies where operationally feasible. Refer to **Appendix A** of this Agenda Item of the report.

4.9 The meeting agreed to consider the aforementioned report and other input by States and organizations/users for further development and evolution of the Unified Surveillance Strategy for the CAR/SAM Regions.



User Requirements for Air Traffic Services

Effective 8 May 2009

1st Edition

infrastructure@iata.org

Foreword

Dear Reader,

There are times when airlines are taken by surprise from announcements of new equipment for air traffic control being purchased that, as far as airlines are concerned, holds little promise of benefit. In most of these cases, airlines and other airspace users were not consulted during the planning process and the technology was bound to disappoint.

Such misadventures are costly to everyone and are a waste of scarce funding. Regrettably, such undesirable situations continue to occur today, when waste can be ill afforded by the air transport industry.

On the other hand, successful procurement projects are invariably associated with a planning and consultation process that draws upon input from representatives of the airspace users, as well as equipment manufacturers and neighbouring States. Such planning also helps airlines schedule their own investments in aircraft technology to work in synch with new air navigation services equipment, leading to clear operational benefits.

Based on a thorough understanding of airspace user requirements and capabilities, these projects are far more successful in providing much-needed benefits to airspace users in terms of increased safety, on-schedule operations and cost efficiency.

We have prepared this report to offer a better understanding of international airlines' requirements and capabilities for communications, navigation, surveillance and air traffic management.

Best regards,



Günther Matschnigg,
Senior Vice President
Safety, Operations & Infrastructure
International Air Transport Association

IATA Report on User Requirements for Air Traffic Services

Executive Summary

IATA has prepared this report to offer guidance to Air Navigation Service Providers (ANSPs), States, vendors and funding organizations on international airline infrastructure requirements for air traffic services between now and the 2020 timeframe.

This report considers technologies that are widely available or under consideration to provide Communications, Navigation and Surveillance (CNS) for Air Traffic Management (ATM). The structure consists of a brief technology description followed by IATA's position on implementation. Recommendations are based on the evaluation of operational benefits, e.g. schedule, safety, efficiency, cost, risk, and availability.

This document is meant to serve as a planning tool and represents the consolidated view of IATA's members, which comprise some 230 airlines as of December 2008 – the world's leading passenger and cargo airlines among them - representing 93 percent of scheduled international air traffic.

In general, IATA's position on short to mid term CNS/ATM infrastructure improvements is to maximise the existing capabilities that are on aircraft today and to support the implementation of the following technologies where operationally feasible, in consultation with airlines:

- Voice migrating to data link as the primary means of controller-pilot communication while continuing the provision of voice communication as a backup and for non-routine communications.
- Performance Based Navigation (PBN), enabled by GNSS as the primary radio navigation aid for all phases of flight.
- Surveillance based primarily on Automatic Dependent Surveillance Broadcast (ADS-B) and when required supplemented with Multilateration (MLAT) as the next generation replacement to radar. Additionally, Automatic Dependent Surveillance Contract (ADS-C) should be the common means of surveillance in oceanic airspace.

The following table summarizes IATA's position on current CNS/ATM Infrastructure technologies and applications, while figures 1-3 offer suggested timelines for the commissioning of the newer technologies and the decommissioning of the older technologies.

Summary: IATA's Positions on CNS / ATM Infrastructure

| Technologies & Applications | | IATA's Position | | |
|-----------------------------------|------------------------------------|-------------------------|----------------------------|--|
| | | Support where justified | Maintain during transition | Do NOT support or support in limited cases |
| COMMUNICATIONS | AFTN | | X | |
| | AMHS | X | | |
| | VSAT | X | | |
| | AIDC | X | | |
| | VHF Voice 8.33 KHz Channel Spacing | X | | |
| | HF Voice | X | | |
| | SatCom | X | | |
| | IRIDIUM | X | | |
| | HFDL | X | | |
| | ACARS | X | | |
| | VDL Mode 2 | X | | |
| | VDL Mode 3 | | | X |
| | VDL Mode 4 | | | X |
| | CPDLC | X | | |
| | ATN | To be Determined | | |
| NAVIGATION | PBN | X | | |
| | WGS-84 | Essential | | |
| | DME | X | | |
| | ILS | X | | |
| | MLS | | | X |
| | NDB | | | X |
| | TACAN | | | X |
| | VOR | | X | |
| | GNSS | X | | |
| | ABAS | X | | |
| | GBAS | X | | |
| | SBAS | | | X |
| SURVEILLANCE | PSR | | | X |
| | SSR Mode A/C | | X | |
| | SSR Mode S | X | | |
| | PAR | | | X |
| | ADS-B OUT | X | | |
| | ADS-B IN | X | | |
| | ADS-C | X | | |
| | TIS-B | | X | |
| MLAT | X | | | |
| CANDIDATE ADS-B DATA LINKS | 1090 ES | X | | |
| | VDL Mode 4 | | | X |
| | UAT | | | X |
| OTHER DATA LINK SERVICES | D-ATIS | X | | |
| | AWOS | X | | |
| | PDC | X | | |

Infrastructure should have timelines for commissioning and decommissioning. An approximate transition roadmap through the 2020 timeframe is depicted in figures 1 through 3 and table 1.

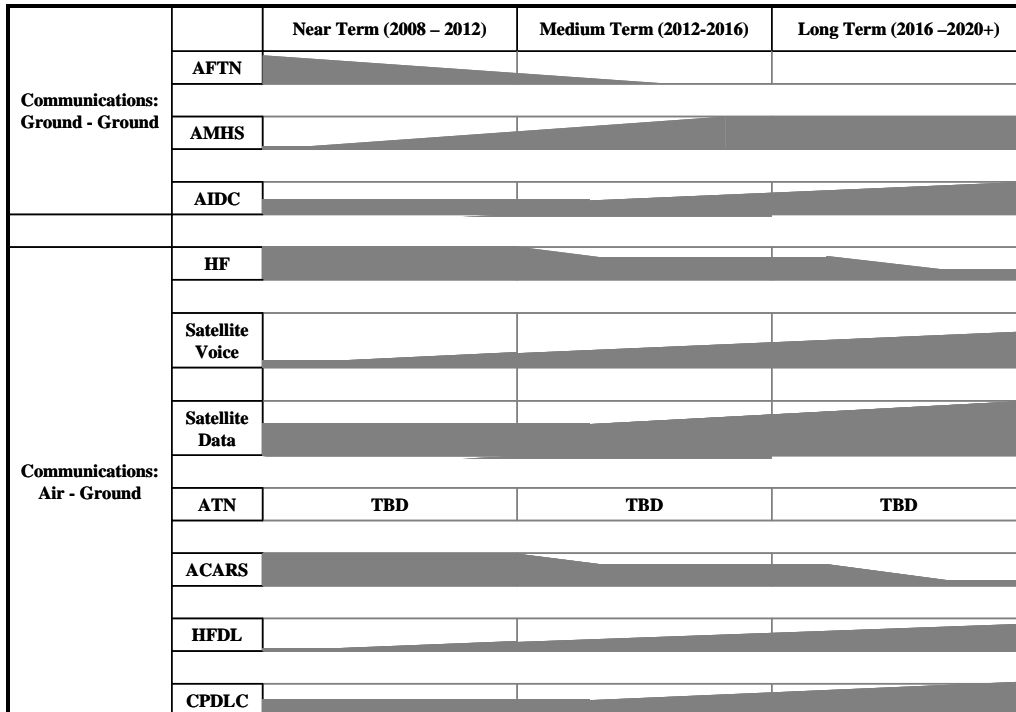


Figure 1. Communications Roadmap (present – 2020)

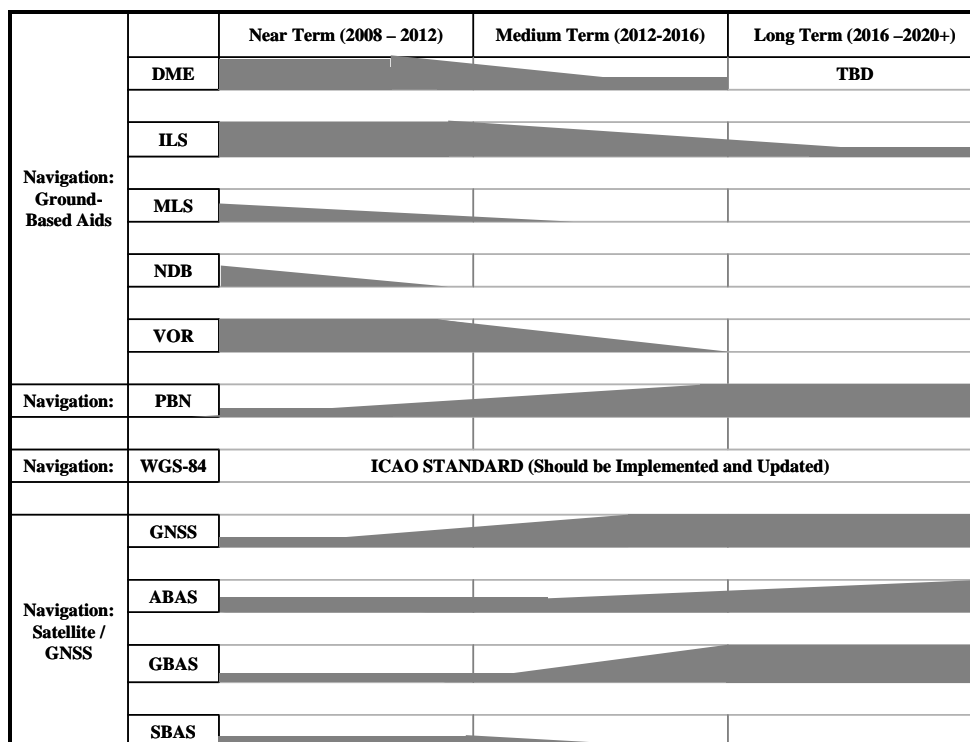


Figure 2. Navigation Roadmap (present – 2020).

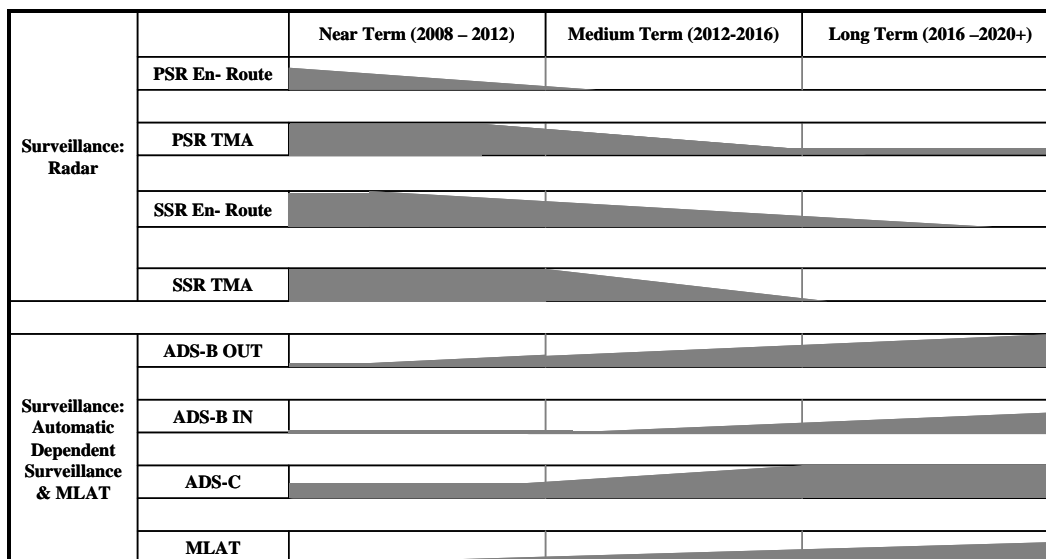


Figure 3. Surveillance Roadmap (Present – 2020)

Table 1. Surveillance Technologies (2020 approximate time frame)

| | Oceanic / Remote | En-Route Continental | Terminal Area | Surface Monitoring |
|----------------|-----------------------------|---------------------------------|----------------------|-------------------------------|
| Primary | ADS-C / ADS-B | ADS-B | ADS-B or MLAT | ADS-B or MLAT |
| Backup | Procedural Control | MLAT | MLAT | MLAT or ADS-B |

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1. Ground-to-Ground Communications

Ground-ground communications refer to exchanges of messages concerning planning and movement of aircraft between ATS units and with other aeronautical or military organizations. Such communications are moving from analogue to digital format and are becoming increasingly automated.

Technologies and applications reviewed in this section include:

- Aeronautical Fixed Telecommunications Network (AFTN) and ATS Message Handling Services (AMHS)
- Very Small Aperture Terminal (VSAT) and
- Air Traffic Services Interfacility Data Communications (AIDC)

1.1 Infrastructure

1.1.1 Aeronautical Fixed Telecommunications Network (AFTN) and ATS Message Handling Services (AMHS)

The AFTN is a message-handling network that has existed for over 40 years. It is a closed network in the sense that its users belong to ATS authorities and associated organizations such as airline operators, general aviation, and meteorological offices.

The AFTN is character-based only and cannot meet the need to carry bit-oriented applications.

The aviation industry has adopted AMHS to replace the AFTN. The AMHS can carry digital information such as text, graphics, images, files, databases, audio and video. ICAO has specified standards to ensure interoperability between AMHS and AFTN during the migration period.

IATA's Position:

IATA supports a rapid decommissioning of AFTN and replacement by AMHS. Interoperability during transition must be ensured by interconnecting legacy AFTN terminals to the AMHS.

1.1.2 Very Small Aperture Terminal (VSAT)

The VSAT is a ground station that uses satellites to relay voice and data from small terminals to other terminals. VSATs are typically used for communications between ATC centers in areas where leased circuits are unreliable or uneconomical.

VSAT ground station terminals on a shared network are versatile, economical and scalable, whereas the deployment of new VSAT networks is considerably more expensive.

IATA's Position:

Support deployment of VSAT station terminals where operationally justified, as they offer a versatile, economical, and scalable solution for ground-to-ground aeronautical communications. However, proliferation of VSAT networks, which are considerably more expensive, should be avoided where existing ones, both national and international, can be expanded to serve new areas.

1.2 ATS Application

1.2.1 Air Traffic Services Interfacility Data Communication (AIDC)

AIDC is a ground-ground data link communication service that provides the capability to automatically exchange data between ATS units for notification, coordination and transfer of aircraft between flight information regions (FIRs). AIDC message format and procedures is an international standard designed for use through any ground-ground circuit, including the legacy AFTN.

AIDC greatly reduces the need for voice coordination between ATC facilities, resulting in fewer errors and reduced workload.

IATA's Position:

Support AIDC deployment as the primary means of coordination between ATC facilities, while maintaining the capability for controllers to intervene via voice for non-routine communications.

2. Air-to-Ground Communications

Controller-pilot communications use primarily voice links provided by analog radios operating in the VHF and HF bands. Aviation is moving towards a new communications infrastructure that will provide superior communication through use of air-ground data link. A first generation of ATC applications was implemented using Aircraft Communications Addressing and Reporting System (ACARS) air-ground data links. ACARS now needs to transition to modern communications protocols (e.g. VDL Mode 2) in order to support increasing user traffic and provide the performance needed for ATS.

The objective is to adopt data link as the primary means of communication while maintaining the requirement for voice communications as a backup and for non-routine communications.

This section overviews the following technologies and applications:

- VHF Voice 8.33 KHz Channel Spacing
- High Frequency (HF Voice)
- Satellite Communications (SatCom)
- IRIDIUM
- Aeronautical Telecommunications Network (ATN)
- VHF Data Link (VDL) Mode 3
- Aircraft Communications Addressing and Reporting System (ACARS)
- High Frequency Data Link (HFDL)
- VHF Data Link (VDL) Mode 2
- Controller Pilot Data Link Communications (CPDLC)

2.1 Infrastructure

2.1.1 VHF Voice 8.33 KHz Channel Spacing

VHF analog radios use channels of varying bandwidth. Since aircraft started using VHF radios, progress in radio technology has enabled the channel bandwidth to be reduced from 100 kHz down to 8.33 kHz.

In March 2007, the ICAO European Region made the carriage and operation of 8.33 kHz radios mandatory above FL195.

IATA's Position:

Support implementation of 8.33 kHz channel spacing only in regions where 25 KHz channel spacing does not provide an adequate number of frequencies. Where implemented, carriage of 8.33 kHz-capable radios should be mandatory to ensure that all potential safety and capacity benefits are realized.

2.1.2 High Frequency (HF) Voice

HF voice is used for air-ground ATC communications in remote and oceanic areas outside the range of VHF frequencies. In most cases, an HF radio operator functions as an intermediary between controllers and pilots, transcribing and relaying the contents of HF voice communications.

Aircraft can use radios operating in the HF radio band for long-range communications because signals are reflected by the ionosphere. Link quality and availability are variable, and influenced by a number of factors, including frequency congestion, sunspot activity, the eleven-year solar cycle, and day/night ionospheric conditions.

Data communication can reduce the current congestion of HF voice traffic, and therefore improve HF voice communication services.

IATA's Position:

Support data link as the primary means of communication for oceanic and remote areas while continuing to provide HF voice service as a backup. Ground based HF transceivers should be equipped with Selective Calling (SELCAL).

2.1.3 Satellite Communications (SatCom)

Satellite communications for the provision of air traffic services in oceanic and remote airspace are primarily offered through a constellation of 11 INMARSAT geosynchronous orbit (GEO) satellites and associated Ground Earth Stations (GES) operated by independent telecommunications providers. The INMARSAT satellite network offers voice and data services except in extreme Polar Regions (above 82° 30' North). The Japanese MTSAT system offers voice and data services in parts of the Pacific and Asia.

SatCom enables a direct communication channel between pilots and controllers, as opposed to transcribed data messaging where an HF radio operator functions as intermediary. Satellite communications are considered more reliable (although more costly) than HF, which is subject to interference, disruption, and delays due to its exposure to ionospheric and operating conditions.

IATA's Position:

Support SatCom as the data link enabler to allow direct controller-pilot data communications in oceanic and remote areas. Satellite voice for non-routine communications is recommended to reduce HF voice congestion in oceanic and remote areas.

2.1.4 IRIDIUM

The IRIDIUM Satellite Network is a constellation of 66 Low Earth Orbit (LEO) satellites, allowing aircraft to have smaller and lighter avionics than necessary for service via Geostationary satellites.

IRIDIUM offers complete earth coverage, including voice and data service in the Polar Regions. Additionally, IRIDIUM can be a good backup for ground-to-ground communications for ATS.

Air transport aircraft are beginning to be equipped with avionics that use IRIDIUM satellites. ICAO is currently working on approval of IRIDIUM for safety of life services by Air Traffic Control. Once approved, there will be airlines using this service.

IATA's Position:

There is a global requirement for satellite data link and voice air-ground communications in airspace outside of VHF coverage (see 2.1.3), including the Polar Regions.

2.1.5 High Frequency Data Link (HFDL)

HFDL is used for air-ground communications in remote and oceanic airspace. Many carriers use HFDL instead of satellite services, or as a backup system. The addition of HFDL communications represents only a small increment in cost for HF equipped aircraft. One drawback of HFDL is that it does not have the communication performance of SatCom data link. However, HFDL provides data-link coverage for polar operations, where GEO based SatCom has no coverage.

IATA's Position:

Support HFDL service availability in oceanic and remote areas, especially in the polar region, while considering that HFDL does not have the communication performance of SatCom data.

2.1.6 Aircraft Communications Addressing and Reporting System (ACARS)

ACARS is a data link technology developed for airlines in the late 1970s for exchange of operational data between their operations centers and aircraft in flight.

Today, ACARS is also used by many ANSPs for controller-pilot-data-link communications (CPDLC) for air traffic control with FANS-1/A aircraft.

Use of ACARS for ATC purposes has reduced workload for controllers and pilots, reduced potential for error inherent in voice communications, and off-loaded congested ATC radio voice channels.

ACARS is available via HF, VHF, and satellite data links.

IATA's Position:

Support upgrade to a full-bit oriented service while continuing to use ACARS as a basis for transition. ACARS is a proven technology that still meets user requirements for aeronautical communications.

2.1.7 VHF Data Link (VDL) Mode 1

ICAO developed VDL Mode 1 based on the ACARS physical layer in an effort to transition from a character-oriented VHF data link to a bit-oriented protocol with higher data integrity. Although ICAO published Standards and Recommended Practices (SARPs) for VDL Mode 1 in 1996, the development of VDL Mode 2 rendered VDL Mode 1 obsolete.

VDL Mode 1 has been withdrawn from ICAO standards.

2.1.8 VHF Data Link (VDL) Mode 2

VDL Mode 2 is an air-ground digital data link that is being introduced as an ACARS upgrade for ATC controller-pilot data communications while still allowing ACARS equipped aircraft to use the same network.

VDL Mode 2 is a bit-oriented system, which means that messages are sent more efficiently. ACARS transmission is limited to letters and numbers, while VDL Mode 2 sends coded data.

VDL Mode 2 delivers data at 31.5 Kbps, which is over 13 times faster than the VHF ACARS 2.4 kbps rate. This is the highest possible bit rate that can be supported by a 25 kHz channel while providing a range of 200 nautical miles. A 250 character block will take about 0.06 seconds to cross the VDL Mode 2 link instead of 0.83 seconds on the ACARS link.

VDL Mode 2 uses the Carrier Sense Multiple Access (CSMA) protocol to detect when a VHF channel is clear in order to avoid overlap with other transmissions. The VDL Mode 2 CSMA technology is superior to that of ACARS, as it detects a clear channel much quicker. This in turn results in reduced message delay and higher success rates under heavy loading conditions.

VDL Mode 2 has been accepted by the industry as the natural upgrade for ACARS.

IATA's Position:

Support upgrade of existing ACARS networks to a more efficient full-bit oriented service via VDL Mode 2.

2.1.9 VHF Data Link (VDL) Mode 3

VDL Mode 3 is a four-channel, digital/analog VHF digital link providing a pipeline for data and digital voice communications. VDL Mode 3 is based on a Time Division Multiple Access (TDMA) protocol, which operates by dividing a single channel into continuous discrete time slots and enabling up to four channels in a single 25 KHz frequency. Users interact with a master control station to mediate access to the channel. TDMA supports the delivery of time-critical messages and non-interfering voice and data transmissions.

VDL Mode 3 data link was proposed to relieve VHF voice channel congestion in the U.S. It faced competition from 8.33 kHz channel spacing, which is already implemented in Europe. Because many airlines have already equipped to 8.33 kHz, the proposal for VDL Mode 3 was withdrawn.

International airlines are against requirements for multiple equipment carriage to serve similar ATS services.

IATA's Position:

Do not support VDL Mode 3 deployment.

2.1.10 VHF Data Link (VDL) Mode 4

VDL Mode 4 is a bit-oriented VHF data link capable of providing air to air and air to ground communications. VDL Mode 4 supports time-critical applications and it is efficient in exchanging short repetitive messages.

VDL Mode 4 is based on the Self-organising Time Division Multiple Access (STDMA) protocol. Through this self-organizing system, the time available for transmission is subdivided into multiple time-slots. Each time slot is planned and reserved for transmission by users' radio transponders within range of each other. This enables efficient data link use and prevents simultaneous transmission from different users. STDMA allows users to mediate access to discrete time slots without reliance on a master control station.

VDL Mode 4 was a data link candidate for ADS-B. However, 1090 MHz Mode S Extended Squitter (ES) has been chosen as the standard for international aviation.

IATA's Position:

Do not support VDL Mode 4 deployment.

2.1.11 Summary VHF Data Links

Table 2 provides a summary on the physical and data communication characteristics of the VHF data links 2.1.7 through 2.1.10.

Table 2. Summary: Comparison VHF Data Links

| | VHF ACARS | VDL M2 | VDL M3 | VDL M4 |
|-----------------------------------|--|---|---|---|
| Voice | No | No | Yes | No |
| Data | Yes | Yes | Yes | Yes |
| Spectrum required | 25KHz | 25 KHz | 25 KHz | 25 KHz |
| Data Rate | 2.4 Kbps | 31.5 Kbps | 31.5 Kbps | 19.2 Kbps |
| Protocol Specification | Character - oriented | Bit – oriented May also handle character-oriented messages, uses lower bandwidth | Bit – oriented | Bit – oriented |
| | Air-to-ground | Air-to-ground | Air-to-ground | Air-to-ground & air-to-air |
| Media Access Control (MAC) | CSMA | CSMA | TDMA | STDMA |
| Applications | AOC & ATS comm. (PDC/DCL, ATIS, CPDLC) | Supports CPDLC comm. & graphic weather services. | Digitized voice & data comm. Supports 4 sub-channels within the 25Khz channel | Supports comm., graphic weather service, ADS-B, TIS-B, CDTI, GNSS local area augmentation |
| IATA Supports | Yes | Yes | No | No |

2.2 ATS Application

2.2.1 Controller Pilot Data Link Communications (CPDLC)

CPDLC refers to communications between controllers and pilots using pre-defined message sets, with a free-text option for non-routine messages.

CPDLC is significantly safer and more reliable than voice communications, as it reduces voice errors and misinterpretations, increases clarity, and helps reduce communication delays.

IATA's Position:

Support CPDLC deployment as the primary means of communication in oceanic and remote airspace where the quality of voice communications is often poor. At the same time, CPDLC should be gradually introduced to busier en-route and terminal airspace in order to relieve voice communications.

2.2.2 Aeronautical Telecommunication Network (ATN)

ATN is an internetwork architecture that allows ground, air-ground and avionic data sub-networks to interoperate by adopting common interface services and protocols based on the International Organization for Standardization (ISO) Open Systems Interconnection (OSI) reference model.

During the mid-eighties, the ICAO Future Air Navigation System 1 (FANS 1) Committee recognized the need for aviation to introduce a global data network that would connect those playing a role in air transport such as Air Traffic Control (ATC), pilots, airlines, and military. The methodology chosen was designated the Aeronautical Telecommunication Network (ATN). Shortly thereafter, the aviation industry developed a FANS 1/A¹ data link capability using VHF air-ground stations and communication satellites. Despite its successful implementation, specifically in the Pacific Ocean region, it was not considered an integral part of the ATN.

ICAO started work on standardization of the ATN, based on the Open Systems Interconnect (OSI) seven-layer protocol stack as defined in International Telecommunications Union (ITU) and International Standards Organisation (ISO) specifications. ICAO further developed standards for the interface of Secondary Surveillance Radar (SSR) Mode S data link, Very High Frequency Data Link (VDL) modes 2, 3 and 4, and SatCom air ground data links.

ATN standards for an airborne certifiable ATN/OSI system became available in 2002, by which time the OSI protocol stack was already becoming outdated in the telecommunication industry.

Since 2003, ICAO has endeavoured to transform the ATN into a modern network by specifying use of Internet Protocol (IP) - the same protocol suite used today by the telecommunication industry. This development facilitates an ATN topology in which all relevant parties can be connected whilst at the same time making the physical network transparent to users. The relevant ICAO standards have been adopted by the ICAO Council and became applicable in November 2008.

Consequent to the need for a high quality communication infrastructure in the SESAR and NextGen programmes, a draft communication roadmap has been developed. Table 3 provides a comparison of communication technologies supporting information exchange within SESAR / NextGen.

It should be noted that SESAR divides the transition roadmap toward the year 2020 in three implementation steps IP 1, 2 and 3, while NextGen identifies three phases towards its target year of 2025, level 1, 2 and 3.

¹ FANS 1 is the Boeing designation while FANS A is the Airbus term.

Table 3. NextGen and SESAR Transition Roadmap – Communication Technologies

| | Air-Ground | Ground-Ground | Air-Air |
|---------------------|---|--|--|
| NextGen: Legacy | VHF voice UAT SatCom HF Voice/DL Mode S | Legacy voice switching | 1030/1090 ACAS |
| SESAR: Present | VHF voice SatCom HF Voice/DL Mode S | | 1030/1090 ACAS |
| NextGen: Level 1 | VDL Mode 2 | Analog services, point-to-point digital services and IP network services over a common data transport layer. | ADS-B not addressed as air to air link but only surveillance |
| SESAR: IP 1 | VDL Mode2/ATN | VoIP IP based network | 1090 ES (ADS-B OUT) |
| NextGen: Level 2 | VDL Mode 2 Multiple A/G links beyond VHF band | Integrated VoIP, data and Video IP services. | ADS-B not addressed as air to air link but only surveillance |
| SESAR: IP 2 | VDL Mode2/ATN IEEE 802.16(WIMAX-Surface communication) | | 1090 ES (ADS-B IN/OUT) |
| NextGen: Level 3 | Integrated Ground and Air Network for Voice /Data | Integrated Ground and Air Network for Voice /Data | ADS-B not addressed as air to air link but only surveillance |
| SESAR: IP3 | New L-band Terrestrial and satellite link | | L-band link |

Under these programmes the following conclusions can be drawn:

- a) The projects are specific on the next generation network physical elements and protocols, without being precise on the next steps.
- b) Acknowledgment of the need for an increased air-ground data communication capacity, but system selection will be left to system planners.
- c) IP protocols are favoured over original ATN specification.
- d) Move to voice/data network integration.
- e) Aside from identifying the content and evolution of the information to be exchanged, there is very limited data on the measurable Quality of Service parameters (e.g. capacity, latency, integrity, and availability) required to support the operational concept.
- f) Issue of VHF congestion due to inefficient voice spectrum utilization is suppressed.
- g) Appears to be no clear overall roadmap to a net centric architecture supporting System Wide Information Management (SWIM) services.

Today, the lines between traditional telecommunication services are becoming increasingly blurred due to convergence in the Information Technology (IT) sector. This facilitates a wide range of services over a single, Internet Protocol (IP) based network. Therefore, regarding ATN versus IP, the main question is how fast are we moving and can we go directly to IP without taking the ATN intermediate step? Reasons to directly move to IP are that ATN is an aviation

specific solution, meaning that there are no commercial off-the-shelf (COTS) solutions and it has limited backwards compatibility.

In summary, although FANS 1/A and aeronautical telecommunication network (ATN) applications support similar functionality, the avionics requirements are different. There are a little over 350 aircraft today ATN equipped flying in Europe and about 3,000 aircraft that are FANS 1/A equipped, which take advantage of the data link services offered in certain oceanic and remote regions.

IATA's Position

Due to the rapid evolution of telecommunication standards and protocols, further evaluation is required before a final recommendation can be made on the next generation global communication network system.

3. Navigation: Performance Based Navigation (PBN)

Performance-based navigation (PBN) is a global set of area navigation standards, defined by ICAO, based on performance requirements for aircraft navigating on departure, arrival, approach or en-route. These performance requirements are expressed as navigation specifications in terms of accuracy, integrity, continuity, availability and functionality required for a particular airspace or airport. PBN will eliminate the regional differences of various Required Navigation Performance (RNP) and Area Navigation (RNAV) specifications that exist today.

The PBN concept encompasses two types of navigation specifications:

- **RNAV specification:** navigation specification based on area navigation that does not include the requirement for on-board performance monitoring and alerting, designated by the prefix RNAV, e.g. RNAV 5, RNAV 1.
- **RNP specification:** navigation specification based on area navigation that includes the requirement for on-board performance monitoring and alerting, designated by the prefix RNP, e.g. RNP 4.

The 2007 36th ICAO General Assembly resolution A36-23 urges all States to implement PBN for en route and terminal areas, and to implement PBN approach procedures with vertical guidance (APV) using Baro-VNAV and/or augmented GNSS (see section 6.1) for all instrument runway ends (as primary or back-up for precision approach) by 2016 - with 30% by 2010, 70% by 2014.

It is expected that all future navigation applications will identify the navigation requirements through the use of PBN performance specifications, rather than defining equipment of specific navigation sensors. Table 4 gives a more complete description and status of the PBN RNAV and RNP values.

Table 4. PBN Values & Application

| Area of Application | Navigation Accuracy (NM) | Navigation Specification (current) | Navigation Specification (new) | Require performance monitoring & alerting |
|-------------------------------------|--------------------------|------------------------------------|--------------------------------|---|
| Oceanic & Remote | 10 | RNP 10 | RNP 10 | No |
| | 4 | RNP 4 | RNP 4 | Yes |
| En route – Continental | 5 | RNP 5 Basic RNAV | RNAV 5 | No |
| En route – Continental and Terminal | 2 | US RNAV type A | RNAV 2 | No |
| | 2 | N/A | <i>Basic-RNP 2 (TBD*)</i> | Yes |
| Terminal | 1 | US RNAV type B P RNAV | RNAV 1 | No |
| | 1 | N/A | Basic-RNP 1 | Yes |
| | 1 | N/A | <i>Advanced RNP 1 (TBD)</i> | Yes |
| Approach | 0.3 | RNP 0.3 | RNP APCH (RNP 0.3) | Yes |
| | 0.3-0.1 | RNP SAAAR | RNP AR APCH (RNP 0.3-0.1) | Yes |

* To be Developed (TBD)

Benefits

The advantage of PBN to the ANSP is that PBN avoids the need to purchase and deploy navigation aids for each new route or instrument procedure. The advantage to everyone is that PBN clarifies how area navigation systems are used and facilitates the operational approval process for operators by providing a limited set of navigation specifications intended for global use.

The safety benefits to PBN are significant, as even airports located in the poorest areas of the world can have runway aligned approaches with horizontal and vertical guidance to any runway end without having to install, calibrate and monitor expensive ground based navigation aids. Therefore, with PBN all airports can have a stabilized instrument approach that will allow aircraft to land into the wind, as opposed to a tail wind landing.

Airline Requirements

Airlines want to quickly adopt PBN, as the benefits are significant for all phases of flight.

- For departures, airlines want standard instrument departures (SIDs) for every departing runway that quickly allows aircraft to join their route to destination.
- For en-route, airlines ideally want routes that are flexible based on that day's operating conditions and upper winds. If flexible routes are not possible then a network of RNAV or RNP direct routes is preferred.
- For arrivals, airlines want standard arrivals (STARs) off every airway that provides the least track miles to the initial approach fix, preferably with a continuous descent profile from the top of descent.
- For approaches airlines need a runway aligned approach with lateral and vertical guidance (APV) for every runway end that terrain allows.

The decision to plan for RNAV or RNP has to be decided on a case by case basis in consultation with the airspace user. Some areas need only a simple RNAV to maximise the benefits, while other areas such as nearby steep terrain or dense air traffic may require the most stringent RNP. Also, since RNP AR Approaches require significant investment and training, ANSPs should work closely with airlines to determine where RNP AR Approach should be implemented. In all cases PBN implementation needs to be an agreement between the airspace user, the ANSP and the regulatory authorities.

IATA's Position:

Fully support early implementation of RNAV and RNP based on the ICAO PBN. IATA also supports the implementation of Approach with Vertical Guidance (APV) for all runways with a Barometric VNAV used for vertical path guidance during the final approach segment.

During the transition period to PBN, regional specific area navigation requirements should honour PBN navigation approvals that also meet the regional specific criteria. For example, in the European Flight Efficiency Plan there is a provision where all operators that are approved against the PBN criteria for RNAV 1 should be eligible to operate on European P-RNAV routes with no further approval required.

4. Navigation: WGS-84

There are many different geodetic reference datums in use throughout the world that provides reference to terrain and charting. However, for aviation there is only one acceptable standard, which is WGS-84. This ICAO Standard is found in Annexes 4, 11 and 14, which states “World Geodetic System — 1984 (WGS-84) shall be used as the horizontal (geodetic) reference system for air navigation.” These requirements became applicable on 1 January 1998.

Consequently the Global Navigation Satellite System (GNSS) and all aircraft navigation and terrain avoidance systems are based solely on WGS-84. All aircraft systems assume that the latitude and longitude coordinates provided are based on WGS-84. If such charted coordinates are not WGS-84, then there is a positional discrepancy between where the pilot and controller thinks the aircraft is at and the actual position of the aircraft itself. Such a discrepancy is not tolerable and adversely affects the safety of flight, especially at lower altitudes near terrain and obstacles. Therefore, all routes and all instrument procedures must be based upon WGS-84 coordinates.

States that have not implemented WGS-84 are in a serious safety violation and need to implement WGS-84 as soon as possible. Additionally, WGS-84 must undergo periodic maintenance and validation, as terrain and man-made obstacles (whether temporary or permanent) do change.

IATA's Position:

Implementation and maintenance of WGS-84 coordinates is a paramount priority due to consequential safety implications.

5. Navigation: Ground-Based Aids

Conventional navigation aids are ground stations in fixed locations with limited coverage according to their Standard Service Volumes. Aircraft usually calculate their position using radio signals from navigation aids in known locations. This section provides an overview of the following ground-based navigation aids:

- Distance Measuring Equipment (DME)
- Instrument Landing Systems (ILS)
- Microwave Landing System (MLS)
- Non-Directional Beacon (NDB)
- Tactical Air Navigation (TACAN)
- VHF Omni-directional Range (VOR) stations

5.1 Distance Measuring Equipment (DME)

The DME is a ground-based navigation aid that measures distance between an aircraft and a ground station by timing the propagation delay of radio signals.

DME has been considered a cost effective contingency navigation system to GNSS, and it is also part of the navigation infrastructure that supports Performance Based Navigation.

IATA's Position:

Support continued DME deployment where required as a contingency navigation system to GNSS and in accordance with an agreed airspace concept.

5.2 Instrument Landing System (ILS)

The ILS is a ground-based precision landing system that provides horizontal and vertical guidance to an aircraft approaching a runway. ILS is the primary international non-visual precision approach system approved by ICAO, serving the industry for over 40 years and undergoing a number of safety related improvements to increase its accuracy and reliability.

IATA's Position:

ILS is a proven technology that meets user requirements today and is still considered an essential navigation system where precision approaches are required. When the Ground Based Augmentation System (GBAS) becomes a viable option for CAT II/III approaches, then there should be a transition to replace ILS with GNSS Landing System (GLS).

5.3 Microwave Landing System (MLS)

The MLS is a ground-based precision landing system operating in the microwave spectrum. MLS was intended to be the next generation precision approach system that would replace ILS. MLS has the potential to enable closely spaced auto-land approaches in low visibility conditions, as it does not suffer from broadcast interference problems like ILS. Additionally, MLS enables curved approaches through its ± 60 degrees of lateral coverage from the runway.

Although some MLS systems became operational in the 1990s, widespread application never occurred due to the introduction of GPS. Consequentially the majority of airlines did not equip. Although there is some renewed interest in Europe, most of the aviation world is waiting to see if GBAS will be able to provide cost effective CAT II/III services to replace ILS (target date for CAT II / III ICAO Standards is 2013).

IATA's Position:

ANSPs / States should only consider MLS implementation at specific aerodromes and these should be limited to places where the airspace users are willing and able to equip and fund for its installation.

5.4 Non-Directional Beacon (NDB)

The NDB is a ground-based navaid that broadcasts non-directional signals, which permit equipped aircraft to determine bearing to or from radio beacon. NDBs were the basis of early air route systems and are used as non-precision approach aids for NDB instrument approaches.

Many of the NDBs in service today are deemed to be obsolete and not required for safe navigation in a navigational infrastructure utilizing GNSS.

IATA's Position:

Support transition to GNSS as the primary radio navigation aid and recommend rapid decommission of NDBs for navigation services. Additionally, airports that only have a non-precision NDB approach should develop a RNAV or RNP approach that meets ICAO's PBN criteria.

5.5 Tactical Air Navigation (TACAN)

TACAN is a ground-based navigation aid used primarily by the military for en-route, non-precision approaches and other military applications. It provides azimuth in the form of radials and distance from the ground station.

IATA's Position:

There are no civil aviation requirements for TACAN.

5.6 VHF Omni-directional Range (VOR)

VOR is a navigation aid that transmits very high frequency navigation signals 360° in azimuth. VOR is the basis for the VHF airway structure and is used for VOR non-precision instrument approaches.

The majority of VORs are over 30 years old and are becoming difficult to maintain. Several ANSPs have indicated a reduced reliance on VORs and are planning their withdrawal as they transition to a Performance Based Navigation (RNAV and RNP) environment.

IATA's Position:

Support transition to GNSS as the primary radio navigation aid and recommend a target date of 2016 for the withdrawal of all VORs. Additionally, airports that only have a non-precision VOR approach should develop an RNP approach that meets ICAO's PBN criteria.

6. Navigation: Global Navigation Satellite System (GNSS)

Navigation is evolving from ground based navigation aids to satellite based navigation systems called the Global Navigation Satellite System (GNSS). GNSS provides standardized positioning information to the aircraft for precise navigation globally. Satellites in the core constellations broadcast a timing signal and a data message. Aircraft GNSS receivers use these signals to calculate their range from each satellite in view and also calculate 3-D position and precise time. Airlines are urging States to move from the current ground-based navigation systems to GNSS that is capable of being used in all airspace during all phases of flight.

As of 2008, the United States NAVSTAR Global Positioning System (GPS) is the only fully operational GNSS used by airlines. However, the Russian GLONASS is currently being restored to full operation (20 satellites by 2009) and the European Galileo global navigation system is scheduled to be operational in 2013. Other future GNSS candidates include China's COMPASS navigation system (potential of 35 satellites) and India's Regional Navigational Satellite System (IRNSS).

GNSS is the ideal radio navigation aid to allow full exploitation of the global benefits to be gained from RNAV and RNP. IATA member airlines have expressed support for GNSS as the primary radio navigation aid for positioning and timing in the future, allowing navigation to migrate from an inefficient fragmented terrestrial system to an efficient GNSS based global air navigation system.

IATA's Position:

Support GNSS as the primary radio navigation aid for all phases of flight.

6.1 GNSS Augmentation

To meet required performance for the more stringent navigational applications, such as precision approaches, augmentation of the GNSS signal is required in order to improve accuracy and monitor data integrity.

The following sections present an overview of IATA's positions on:

- 6.1.1 Aircraft Based Augmentation System (ABAS)
- 6.1.2 Ground Based Augmentation System (GBAS); and
- 6.1.3 Satellite Based Augmentation System (SBAS)

ICAO has published Standards and Recommended Practices (SARPs) for all three of these augmentation systems.

6.1.1 Aircraft Based Augmentation System (ABAS)

ABAS is a self-contained system on board the aircraft that augments and/or integrates the information obtained from the other GNSS elements with information available on board the aircraft. ABAS meets ICAO's GNSS signal-in-space performance requirements for accuracy, integrity, continuity and availability.

ABAS is the most cost-effective augmentation system, as it utilizes avionics already on board the aircraft.

IATA's Position:

With the exception of GBAS for precision approach, ABAS is the preferred and most cost-effective system for augmenting the accuracy, integrity, availability, and continuity of the GNSS signal.

6.1.2 Ground Based Augmentation System (GBAS)

GBAS is an augmentation system in which the user receives augmentation information directly from a ground-based transmitter. GBAS uses a group of local ground stations, typically located at an airport, to collect information from the GPS constellation. The correction message is broadcasted from the local ground-based transmitter via a VHF data link to the aircraft operating within the range of the transmitter. A single GBAS installation, which should cost approximately the same as an ILS, is designed to provide precision approach capability for all runway ends at an airport.

GBAS meets ICAO's GNSS signal-in-space performance requirements for accuracy, integrity, continuity and availability. GBAS is intended to support all types of approach, landing, departure and surface operations and may support en-route and terminal operations. ICAO has published SARPs that support Category I precision approach with curved and segmented flight paths. The SARPs for Category II/III precision approach should be effective 2013.

GBAS has the potential to be a superior cost-effective replacement for ILS at a fraction of the cost of SBAS or ILS to all runway ends.

IATA's Position:

IATA considers GBAS as the GNSS candidate to replace ILS CAT I/II/III. However, a business case is still required based on CAT II/III requirements.

6.1.3 Satellite Based Augmentation System (SBAS)

SBAS is a satellite based wide-coverage augmentation system in which the user receives augmentation information from a satellite-based transmitter. Compared to the other forms of augmentation, SBAS is extremely costly, as it comprises a network of ground-based reference stations to monitor satellite signals; master stations to process data from ground reference stations and generate SBAS signals; uplink stations to send messages to geostationary satellites, and satellite transponders to broadcast integrity and correction messages to aircraft. Additionally, SBAS would require costly changes to airborne equipment used by airlines today.

SBAS can provide vertical guidance down to 250-foot decision height, and the United States SBAS system (WAAS), under favourable specific conditions, can provide vertical guidance to a 200-foot decision height for Category I precision approach. In this case, there is a 50-foot improvement over RNP with Baro-VNAV. However SBAS is not a solution for 100-foot decision height or for auto-land. Moreover, the vast majority of airports that service air transport operators (and alternates) offer standard ILS operations. Therefore, SBAS is not an airline requirement but GBAS remains a requirement for the future implementation of GNSS Category II and III precision approach.

There are several SBAS systems either operational or under development that enhance the performance of the GPS signal for general public use, such as WAAS in North America, EGNOS in Europe, MSAS in Japan, and GAGAN in India. However, SBAS does not offer a global solution for aviation. There is no Cost-Benefit Analysis (CBA) supporting a business case for airlines, and their aircraft are not equipped for SBAS. Furthermore, most aircraft manufacturers do not offer SBAS avionics as an option for airlines, nor do they have plans to offer SBAS capability in the future - one reason being is that the new generation aircraft already have RNP 0.3-0.1 functionality already available. This capability combined with Baro-VNAV meets airlines' GNSS approach requirements until GBAS CAT II/III capability is available (around the 2013 timeframe).

In conclusion, airlines see no operational benefit from SBAS and are not convinced of its short or long term potential. Therefore, IATA does not support the continued development and implementation of SBAS.

IATA's Position:

Do not support the continued investment, development, and implementation of SBAS. No business case involving tangible operational benefits has been demonstrated for airlines in support of SBAS; therefore, this is the only GNSS augmentation system that airlines are not willing to pay for cost recovery.

7. Surveillance: Radar

Technologies used for surveillance of air transport category aircraft are varied. Systems currently employed include:

- Procedural Position Reports
- Primary Surveillance Radar (PSR)
- Secondary Surveillance Radar (SSR) – Mode A, Mode C, and Mode S
- Multilateration (MLAT)
- Precision Approach Radar (PAR)
- Automatic Dependent Surveillance – Contract (ADS-C)
- Automatic Dependent Surveillance – Broadcast (ADS-B)

ANSPs traditionally base aircraft surveillance on radar in dense airspace and voice or ADS-C position reports in remote and oceanic airspace. Where radar needs to be maintained or established, IATA views Secondary Surveillance Radar (SSR) & Mode S as the preferred technology. Further details on radar surveillance technologies are provided in the following sections.

7.1 Primary Surveillance Radar (PSR)

Primary surveillance radar (PSR) relies on a narrow beam of transmitted pulses of radio energy being reflected back from aircraft. The PSR uses the reflected energy to determine the aircraft's position for presentation on the controller's display.

Although in the past PSR provided useful support to en-route ATC, currently there is no airline requirement for using this technology. Secondary Surveillance Radar (SSR), Multilateration, and Automatic Dependent Surveillance Broadcast (ADS-B) have vastly superseded PSR.

Some ANSPs have justified PSR retention on its ability to detect thunderstorms. However, PSR has limited storm penetration and it may sometimes display rudimentary (or false) thunderstorm activity. Airborne radar systems provide accurate weather information to airlines and State meteorological services provide weather information derived from Doppler radar to ATC.

PSR remains the system of choice for the identification of unknown or unlawful intrusions into sovereign or territorial airspace. However, this is a national security service and its infrastructure cost should be borne by the State and not by air navigation fees for civil aviation.

Continued use of PSR within terminal areas may ensure detection and tracking of non-cooperative targets i.e. aircraft not equipped with SSR transponder or experiencing avionics failure. However, Multilateration (see section 8.6) will be a superior replacement for PSR in terminal airspace.

IATA's Position:

Do not support PSR deployment for civil air traffic services, as SSR and ADS-B have vastly superseded this technology and there is currently no operational benefit for PSR surveillance. Therefore, user charges associated with future upgrades or new PSR installations should be removed.

7.2 Secondary Surveillance Radar (SSR): Mode A/C and Mode S

SSR sends out signals that interrogate aircraft transponders. Replies provide position and include a four-digit identity code (Mode A) and pressure-altitude reports (Mode C). Replies are used to display aircraft position, altitude and identity on controllers' screens. Due to the increase in air traffic density, the number of potential Mode A code combinations became insufficient.

Mode S (Selective Addressing) is now a commonly employed SSR technique. Aircraft equipped with Mode S transponders are assigned a permanent and unique 24-bit ICAO address code. Mode S radars interrogate airframes selectively and receive individual replies. SSR Mode S improves the quality and integrity of the detection, identification and altitude reporting, overcoming some of the issues associated with mode A/C, such as the 4096-code limitation, radio frequency (RF) pollution, and lost targets.

IATA's Position:

Support SSR Mode S over SSR Mode A/C where radar must be established or replaced. SSR Mode S improves the quality and integrity of surveillance compared to Mode A/C.

7.3 Precision Approach Radar (PAR)

PAR allows controllers to monitor the approach path of an aircraft and provide lateral and vertical guidance by issuing instructions to pilots.

PAR is still used by military organisations but airline users no longer derive benefit from this technology.

IATA's Position:

- ***There is no airline requirement for PAR. User charges associated with existing PAR installations should be eliminated.***

8. Surveillance: Automatic Dependent Surveillance and Multilateration

In general, IATA views ADS-B IN based on the 1090 Extended Squitter (ES) data link as the most desirable next-generation form of surveillance, while acknowledging that equipage requirements are still being defined.

ADS-B and Multilateration (MLAT) build on a common technological framework. Surveillance based primarily on ADS-B and supplemented with MLAT should be used, whenever operationally feasible, as the next generation replacement to radar. In oceanic and remote areas, ADS-C is the preferred surveillance technology.

Technologies reviewed in this section include:

- Automatic Dependent Surveillance Broadcast (ADS-B) OUT
- Automatic Dependent Surveillance Broadcast (ADS-B) IN
- Candidate ADS-B Links
- Automatic Dependent Surveillance Contract (ADS-C)
- Traffic Information Service Broadcast (TIS-B)
- Multilateration (MLAT)

8.1 Automatic Dependent Surveillance Broadcast (ADS-B) OUT

ADS-B OUT is a surveillance technology by which an aircraft periodically and automatically broadcasts its state vector (horizontal and vertical position and velocity) and other aircraft data such as identification. Ground stations receive ADS-B OUT position reports and display them on air traffic controllers' screens. ADS-B OUT broadcasts may also be received, processed, and displayed by other aircraft in the vicinity that are equipped with ADS-B IN.

IATA's Position:

Support implementation of ADS-B OUT based on Mode S Extended Squitter (1090ES) data link to supplement and eventually replace radar, and in non-radar airspace if traffic could benefit from ATC surveillance. Transition timelines need to be determined in consultation with airspace users. Operational and maintenance savings should be passed on to airspace users.

8.2 Automatic Dependent Surveillance Broadcast (ADS-B) IN

ADS-B IN is a surveillance technology by which an aircraft is able to broadcast as well as receive, process, and display the information broadcasted by another ADS-B equipped aircraft. Such information is shown on a Cockpit Display of Traffic Information (CDTI).

ADS-B IN is seen as a long-term (2020+) solution. Although information obtained through ADS-B IN greatly improves cockpit situational awareness and provides the potential for further shared air and ground separation responsibility, much remains to be accomplished in terms of system certification, application validation, human factors considerations / roles, procedures, and

regulatory policies. Additionally, retrofit of existing fleets implies a major avionics upgrade and will require a lead-time of approximately ten years.

IATA's Position:

ADS-B IN is seen as the preferred next generation surveillance technology for air transportation. IATA endorses the concept of ADS-B IN according to ICAO's Global Air Navigation Plan.

However, before going forward with implementation, global consensus must be reached on:

- ***Avionics requirements and standards***
- ***Roles, responsibilities, and liabilities of pilots and air traffic controllers***
- ***Cost and benefit Analysis that presents a positive business case for airspace users and ATS providers.***

8.3 Candidate ADS-B Data links

ICAO has formalized standards for three broadcast mode data links for ADS-B: 1090 MHz Mode S Extended Squitter (1090 ES), VDL Mode 4, and Universal Access Transceiver (UAT).

Although there are three standards, there is general global consensus, including IATA, CANSO, EUROCONTROL, FAA, Airbus and Boeing, to use 1090 ES as the supporting data link for international ADS-B applications, as it is available and mature, enabling early implementation.

The majority of stakeholders do not support VDL Mode 4 after consideration of the risks and investments associated to its implementation versus the added value.

UAT carriage is of no interest to commercial air carriers.

IATA's Position:

Support Mode S 1090 ES as the single, interoperable data link to support ADS-B for the foreseeable future. Mode S 1090 ES is a technology available and mature today, enabling early application. IATA does not support VDL Mode 4 or UAT for international air traffic services or user charges associated with these technologies.

8.4 Automatic Dependent Surveillance Contract (ADS-C)

ADS-C is a surveillance technology designed for oceanic and remote airspace. ADS-C reports are sent from the aircraft to ATC via a VHF or SatCom data link and include position, velocity, intent, and weather.

Reports are automatically generated based on an electronic contract established between the aircraft Flight Management System (FMS) and a ground-based ATC installation. An aircraft typically transmits its information every 32, 27, or 14 minutes (per ICAO PANS-ATM recommendation for 50nm or 30nm separation minima), as determined by the FMS electronic

contract with ATC. Contracts could be based on a specified reporting rate, event, or on-demand. The information is displayed to ATC and can also be used by automated flight tracking and monitoring systems.

IATA's Position:

Support ADS-C based surveillance for oceanic and remote airspace where appropriate. ADS-C contracts should be determined with an agreed service in consultation with airspace users, i.e. a 32 minute periodic contract for a RNP4 approved aircraft for 50NM longitudinal separation or a 14 minute periodic contract for a RNP4 approved aircraft for 30NM longitudinal separation, etc.

8.5 Traffic Information Service - Broadcast (TIS-B)

TIS-B enables SSR (Mode S and Mode A/C) or ADS-B surveillance data from multiple link sources to be combined and uplinked to an aircraft equipped with ADS-B IN, increasing situational awareness in the cockpit.

TIS-B is designed to deliver benefits in a mixed surveillance environment during the transition from radar to ADS-B surveillance or in a dual link ADS-B environment. TIS-B could fulfill an intermediary role until full deployment of ADS-B IN. It is anticipated that cockpit display of traffic information (CDTI) will predominantly be based on TIS-B during the initial transition period from radar to ADS-B IN.

IATA's Position:

Support a single data link standard based on 1090ES. If a single standard is not implemented, then ADS-B IN systems will require TIS-B functionality to display all aircraft of relevance in any given traffic situation. TIS-B should be considered to increase situational awareness during the transition from radar to a full ADS-B environment.

8.6 Multilateration (MLAT)

MLAT is a ground based surveillance system that uses transmissions from a transponder, Traffic Collision Avoidance System (TCAS), ADS-B, or military IFF transmissions to triangulate the position of a cooperative target. MLAT is also known as Hyperbolic Positioning and functions by measuring the Time Difference of Arrival (TDOA) of a signal at a number of dispersed receivers.

Note: Wide Area Multilateration (WAM) is a term commonly used to describe the surveillance of en-route airspace, while the abbreviation MLAT tends to be employed when discussing the monitoring of terminal airspace and airport surface traffic.

A limited number of ANSPs have deployed MLAT/WAM for ATM surveillance in combination with ADS-B or SSR to meet specific surveillance requirements. Some ANSPs are also deploying

MLAT as a Precision Runway Monitor (PRM) sensor and for surveillance of airport ground movements. Additional MLAT/WAM applications include ADS-B backup and RVSM height monitoring.

Depending upon the required number of sites and their locations, MLAT/WAM systems can cost considerably less than conventional radar to purchase, install, and maintain.

Global MLAT separation standards have been agreed. The Aeronautical Surveillance Panel (ASP) and the Separation and Airspace Safety Panel (SASP) have developed ICAO guidance materials and separation minimums of 5nm and 3nm for MLAT/WAM. Anticipated availability is 2010.

IATA's Position:

Support MLAT to meet specific surveillance requirements when supported by clear operational requirements, separation minima, and a Cost-Benefit Analysis (CBA) involving all stakeholders. If MLAT is deployed, it should be configured to facilitate possible integration of ADS-B ground stations in a future surveillance mix.

9. OTHER DATA LINK OPERATIONAL SERVICES

Airlines support the move to migrate to a fully digital environment for aeronautical information and meteorological services to ensure that information is made available to the user in a timely manner.

This section provides an overview on the following technologies and applications:

- Digital Automatic Terminal Information Service (D-ATIS)
- Automated Weather Observing System (AWOS)
- Departure Clearance Service (DC)

9.1 Digital Automatic Terminal Information Service (D-ATIS)

ATIS is predominantly a voice broadcast service over a dedicated VHF frequency that provides operational information to aircraft operating in the vicinity of an airport, eliminating the need for a controller to transmit the information to each aircraft individually. It is normally accomplished through a voice recording, updated when conditions change.

Data link is an alternative means of transmitting ATIS to suitably equipped aircraft. It reduces flight crew workload as D-ATIS information is printed on a cockpit printer or is recallable on a data link display.

IATA's Position:

Support D-ATIS deployment at major international airports while providing dual-stack support during transition from ATIS to D-ATIS.

9.2 Automated Weather Observing System (AWOS)

AWOS is a suite of sensors that measure, collect, and disseminate weather data to help meteorologists, pilots, and flight dispatchers prepare and monitor weather forecasts. The sensors measure such elements as wind velocity, ambient air and dew point temperatures, visibility, cloud height and sky condition, precipitation occurrence and type, as well as identifying icing or freezing conditions.

In addition to safety benefits associated with weather, AWOS facilitates potential reduction in flight disruptions.

IATA's Position:

Support AWOS where operationally justified and cost-effective, for example, at airports where weather observers are not available 24 hours.

9.3 Pre-Departure Clearance Service (PDC)

A flight due to depart from an airfield must first obtain departure information and clearance from the controlling ATS unit. The pre-departure clearance service provides an automated means for requesting and delivering clearances, with the objective of reducing pilot and controller workload and diminishing clearance delivery delays.

The benefits for the introduction of PDC are:

- a) Reduction of the potential for communication errors between pilots and controllers;
- b) Reduction of frequency congestion;
- c) Reduction of ground delays.

IATA's Position:

Support PDC deployment at major international airports to supplement and eventually replace conventional voice clearances.

10. SPECTRUM REQUIREMENTS FOR INTERNATIONAL CIVIL AVIATION

Performance of CNS/ATM systems are dependent upon the availability of radio frequency spectrum that can support the integrity and availability requirements associated with aeronautical safety of life systems, and demands special protection measures to avoid harmful interference to these systems. It was recognized by the ICAO 11th Air Navigation Conference that new radio spectrum for CNS/ATM systems will be required while the current systems continue to be maintained.

Global allocations of radio spectrum, including that for aviation, are agreed by the 191 States of the International Telecommunications Union (ITU) at World Radiocommunication Conferences (WRCs), which meet every 3-4 years. The resolutions that come out of these meetings become radio regulations and, once signed by States, have the status of international treaties.

Article 4.10 of the Radio Regulations states that ITU Member States recognize that the safety aspects of radionavigation and other safety services requires special measures to ensure their freedom from harmful interference. These factors must be taken into consideration in the allocation, assignment and use of frequencies for aeronautical systems.

IATA's Position:

To work jointly with ICAO to promote a common aviation position at the ITU WRC that aims to preserve and protect aeronautical spectrum for radiocommunication and radionavigation systems, which are required for current and future safety-of-flight applications.

11. CONCLUSION

The introduction of any new technology must be managed in a manner that enables airlines to develop a business case with near-term investment payback. IATA encourages ANSPs / States to only adopt technologies which have valid business and operational cases as agreed in consultation with airlines and other airspace users.

There are many technological “solutions” that have been developed by industry for air traffic services. However, unless they are adopted as a global standard and have agreed cost/benefits and implementation timelines with the airspace users, such technologies have no value to international aviation. For technologies that will soon be introduced (e.g., ADS-B, Multilateration, GBAS, etc.), it is essential that each application undergoes a thorough due process of safety case analysis, agreed cost-benefit, development of globally harmonized policies and procedures, establishment of separation minimums and standards, and setting of deployment timelines, involving all airspace users.

IATA is happy to address specific questions on infrastructure. Please send questions and comments to...

infrastructure@iata.org

GLOSSARY

| | |
|-----------|---|
| ABAS | Aircraft Based Augmentation System |
| ACARS | Aircraft Communications Addressing and Reporting System |
| ACAS | Airborne Collision Avoidance System |
| ADS | Automatic Dependent Surveillance |
| ADS-B | Automatic Dependent Surveillance – Broadcast |
| ADS-C | Automatic Dependent Surveillance – Contract |
| AIDC | Air Traffic Services Interfacility Data Communication |
| AMSS | Aeronautical Mobile Satellite Service |
| ANS | Air Navigation Services |
| ANSP | Air Navigation Service Provider |
| AOC | Aeronautical Operational Control Communications |
| APV | Approach with Vertical Guidance |
| ASP | Aeronautical Surveillance Panel |
| ATC | Air Traffic Control |
| ATIS | Automatic Terminal Information Service |
| ATM | Air Traffic Management |
| ATN | Aeronautical Telecommunications Network |
| ATS | Air Traffic Services |
| AWOS | Automated Weather Observing System |
| Baro-VNAV | Barometric Vertical Navigation |
| CANSO | Civil Air Navigation Services Organization |
| CBA | Cost-Benefit Analysis |

| | |
|--------------|---|
| CDTI | Cockpit Display of Traffic Information |
| CNS/ATM | Communications Navigation Surveillance/Air Traffic Management |
| COTS | Commercial Off-The-Shelf |
| CPDLC | Controller Pilot Data Link Communications |
| CSMA | Carrier Sense Multiple Access |
| D-ATIS | Digital - Automated Terminal Information Service |
| DL | Data Link |
| DME | Distance Measuring Equipment |
| EGNOS | European Geostationary Navigation Overlay Service (Europe) |
| ES | Extended Squitter |
| EURO-CONTROL | European Organisation for the Safety of Air Navigation |
| FAA | Federal Aviation Administration (USA) |
| FANS | Future Air Navigation Systems (FANS) |
| FIR | Flight Information Region |
| FMS | Flight Management System |
| GAGAN | GPS Aided Geo Augmented Navigation (India) |
| GBAS | Ground Based Augmentation Service |
| GEO | Geosynchronous Orbit |
| GES | Ground Earth Station |
| GLS | GNSS Landing System |
| GNSS | Global Navigation Satellite System |
| GPS | Global Positioning System |
| HF | High Frequency |

| | |
|---------|---|
| HFDL | High Frequency Data Link |
| IATA | International Air Transport Association |
| ICAO | International Civil Aviation Organization |
| IEEE | Institute of Electrical and Electronics Engineers |
| IFF | Identification Friend or Foe |
| ILS | Instrument Landing System |
| IRNSS | Indian Regional Navigational Satellite System |
| ISO | International Organization for Standardization |
| IP | Internet Protocol |
| IT | Information Technology |
| ITU | International Telecommunications Union (ITU) |
| LEO | Low- Earth Orbit |
| MLS | Microwave Landing System |
| MSAS | MTSAT Satellite Based Augmentation System (Japan) |
| MTSAT | Multi-functional Transport Satellites (Japan) |
| NextGen | Next Generation Air Transportation System |
| NDB | Non Directional Beacon |
| NRA | Non-Radar Airspace |
| OSI | Open Systems Interconnection |
| PAR | Precision Approach Radar |
| PBN | Performance Based Navigation |
| PDC | Pre-Departure Clearance |
| PRM | Precision Runway Monitor |

| | |
|----------|--|
| RAIM | Receiver Autonomous Integrity Monitoring |
| RF | Radio Frequency |
| RNAV | Area Navigation |
| RNP | Required Navigation Performance |
| RNP APCH | Required Navigation Performance Approach |
| RNP/AR | Required Navigation Performance Authorization Required |
| RVSM | Reduced Vertical Separation Minimum |
| SASP | Separation and Airspace Safety Panel |
| SARPs | Standards and Recommended Practices |
| SBAS | Satellite Based Augmentation System |
| SESAR | Single European Sky ATM Research |
| SMR | Surface Movement Radar |
| SSR | Secondary Surveillance Radar |
| STDMA | Self-Organising Time Division Multiple Access |
| SWIM | System Wide Information Management |
| TCAS | Traffic Collision Avoidance System |
| TDMA | Time Division Multiple Access |
| TDOA | Time Difference of Arrival |
| TIS-B | Traffic Information Service Broadcast |
| TMA | Terminal Area |
| UAT | Universal Access Transceiver |
| VDL | VHF Digital Link |
| VHF | Very High Frequency |

| | |
|--------|---|
| VNAV | Vertical Navigation |
| VoIP | Voice over IP |
| VOR | VHF Omni-directional Range |
| WAM | Wide Area Multilateration |
| WAAS | Wide Area Augmentation System (USA) |
| WGS-84 | World Geodetic System –1984 |
| WIMAX | Worldwide Interoperability for Microwave Access |

APPENDIX 1.

User Requirements for Air Traffic Services – Planning Checklist

Some of the questions that ANSPs, States and international funding organizations need to answer when planning for the implementation of new technology are:

- What are the current and forecast requirements of airlines?
- What are the benefits of this technology to airlines in terms of safety, schedule maintenance, operation and efficiency?
- What is the timeline for realization of benefits and technology transition?
- What are the system and infrastructure requirements as well as the policies and procedures necessary to enable full realization of technology benefits?
- What is the cost to airlines in terms of increased air navigation and communication fees, on-board equipment, aircraft down time, training, maintenance, etc?
- When do these benefits recover the associated costs?
- Does the technology meet existing international standards? If new standards are required, will they be ready within an appropriate timeframe?
- Is the investment consistent with international planning, and does it contribute to seamlessness of regional and global airline operations?
- Does the technology represent the most effective use of resources?
- Is the purchase consistent with an incremental approach to technology deployment that promises early benefits to airlines and a path to future benefits?
- Are neighbouring ANSPs and States willing to consider sharing common infrastructure projects in order to save costs and promote seamless operations?

Agenda Item 5: Develop an implementation plan for short and medium term Surveillance applications in the CAR/SAM Regions

5.1 The Meeting reviewed the assigned task for the development of an implementation plan for short and medium term Surveillance applications in the CAR/SAM Regions:

1. Surveillance system comparison document and general considerations for implementation
2. Guidance considerations for Multilateration implementation

5.2 Based on these works and the other inputs presented in Agenda Item 1, the Meeting concluded that the deliverables identified in (1) and (2) above are no longer required since the Aeronautical Surveillance Manual developed by the ASP already contains the aforementioned material. The subject manual will be posted on the ICAO-NET before the end of 2009.

5.3 The meeting was provided with guidance on Wide Area Multilateration (WAM) which is a surveillance technology that offers high-accuracy, high update rate, and coverage in difficult areas. However, it requires relatively larger number of sites and associated infrastructure as compared to RADAR and ADS-B. The most relevant application of WAM is for covering limited, specific areas, where the operators require a surveillance means and the radar does not offer a satisfactory solution. This includes typical surveillance for approach in difficult environments or Precision Runway Monitor application.

5.4 The combination of WAM with other surveillance means (radar, ADS-B) through the choice of a multi-sensor tracking system in the ATM automation system allows benefits from the various technologies available and guarantees to the air traffic controller a reliable and accurate display of the air situation.

Agenda Item 6: Review of Terms of Reference and future Work Programme

6.1 The meeting conducted a follow-up on the progress and status of the activities scheduled in the work programme of the CNS Committee from the previous ATM/CNS Subgroup related to surveillance aspects, and carried out an analysis of these activities towards its support and accomplishment of existing performance objectives and proposed activities related to surveillance issues that can be included in the new CNS/ATM Subgroup.

6.2 GREPECAS/15 meeting approved, under its Decision 15/4 *New CNS/ATM Subgroup*, the proposal of a new CNS/ATM Subgroup, which replaces the current ATM/CNS subgroup. The terms of references (ToR) of the new subgroup are based on objectives of performance, aligned with the Global ATM Operational Concept and the Global Air Navigation Plan (GANP). Under these ToRs, the development of the tasks of the new subgroup is to be made under a project management concept. The terms of reference of the new subgroup is presented as **Appendix A** to this paper.

6.3 The GREPECAS 15 meeting recognized that the work done by subgroup ATM/CNS and the ATM and CNS committees should provide the basis from which the new subgroup develop the ATM and CNS issues in the CAR/SAM regions, which should be duly considered during the first meeting of the CNS/ATM Subgroup. On this first meeting and for the activities of the new subgroup, the available tasks and results may be included, mainly generated by the work done by the ATM and CNS committees.

6.4 Based on the discussion the meeting agreed on a new work programme on surveillance related activities for the new CNS/ATM Subgroup as detailed in **Appendix B**. This new proposal includes the following:

- a) **Analyse proposals for data Communications infrastructure in support of ATFM implementation (CNS/2-1.3.6)**, to be considered as part of a new task labeled “Support PBN and ATFM implementation, optimization of ATM routes and guidance for ATM service automation”.
- b) **Studies and recommendations for the SSR Mode S, ADS-C, ADS-B and other surveillance Systems for sub-regional/regional implementation (CNS/4-3.2)** has been removed from the work programme since the soon to be published Aeronautical Surveillance Manual contains such material.
- c) **Support PBN and ATFM implementation, optimization of ATM routes and guidance for ATM service automation (new task)**.
- d) **Activities to optimize radio frequency environment (new task)**.

6.5 Taking in consideration that the activities of the new CNS/ATM Subgroup will be under project development it is recommended that all the Surveillance activities should be worked under the Situational awareness project management which will then coordinate the related activities with the other relevant project management.

APPENDIX A**TERMS OF REFERENCE OF THE CNS/ATM SUBGROUP****1. Terms of Reference (TORs)**

1. To plan a performance based transition to the ATM system envisaged in the Global ATM Operational Concept, considering the regional performance objectives, supported by the Global Air Navigation Plan Initiatives (GPIs);
2. Carry out CNS/ATM CAR/SAM planning activities to facilitate and harmonize the inter-regional implementation process to obtain in the near and medium-terms, clear benefits for the ATM community; and
3. In meeting these TORs, the Subgroup should perform the following tasks:
 - a) monitor the CNS/ATM aspects of the CAR/SAM Air Navigation Plan and propose corresponding amendments to keep it up-to-date;
 - b) identify and report CNS/ATM air navigation deficiencies based on the Council approved methodology and GREPECAS complemented procedures; and
 - c) considering the existing performance objectives (new objectives to be developed as necessary), develop detailed tasks, identify deliverables with deadlines and monitor implementation of the following:
 - Performance Based Navigation
 - Air Traffic Flow Management
 - Civil/Military coordination
 - Automation
 - Situational awareness (surveillance)
 - RVSM
 - Infrastructure for ground-to-ground and ground to air Communication
 - Transition to the new ICAO Flight Plan Model
 - Identify the environmental benefits derived from short and medium-term ATM improvements

Note: Identified performance objectives are attached. A new document will be developed containing all performance objectives to be reviewed at each meeting.

APPENDIX B/APENDICE B

**PROPOSED WORK PROGRAMME ON SURVEILLANCE-RELATED ACTIVITIES FOR NEW CNS/ATM SUBGROUP
PROGRAMA DE TRABAJO PROPUESTO AL NUEVO SUBGRUPO CNS/ATM SOBRE ACTIVIDADES RELACIONADAS CON VIGILANCIA**

| Conclusiones/ Decisiones Validas de GREPECAS/ Objetivo Estratégico, Valid GREPECAS Conclusions/ Decisions Strategic Objective, | Numero de Tarea/ Task Number. | Tarea/ Task | Acción de seguimiento/ Follow-up Action | A ser iniciado por:/ To be started by: | Estado/ Status | Entregable/ Deliverable | Fecha límite/ Deadline |
|---|-------------------------------|--|---|--|------------------|---|-------------------------------|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| Objetivo EsT: D, IPM/GPI: 9 y 17, Tabla CNS 4A, Conclusión 13/87 | CNS/4-3.3 | Elaboración de un plan regional para la implantación ADS-C y ADS-B. Elaboration of a regional plan for ADS-C and ADS-B implementation. | | Subgrupo CNS/ATM CNS/ATM Subgroup | Valida/ Valid | Seguimiento a los ensayos y aspectos de implantación sobre ADS y MLAT (comparación con dato radar, probabilidad de detección, integridad de los datos, compartición de datos, etc.)/ Follow-up ADS and MLAT trials and implementation aspects (comparison with radar data, probability of detection, data integrity, data sharing, etc.) | Octubre 2010/ October 2010 |
| Objetivo EsT: D, IPM/GPI: 5 y 7, CAR/SAM PBN Roadmap. Task CNS2-1.3.6 “ <i>Analyse proposals for data communication infrastructure in support of ATFM implementation</i> “ was included in this new task with regards to its surveillance related componen | CNS/ New | Apoyar la implantación del PBN y ATFM, la optimización de rutas ATS y orientar la automatización de servicios ATM. Support PBN and ATFM implementation, optimization of ATS routes and guidance for ATM Service Automation. | | Subgrupo CNS/ATM CNS/ATM Subgroup | Valida/ Valid | Evaluacion de la infraestructura de vigilancia e identificación de mejoras a los sistemas de vigilancia para apoyar los espacios aéreos enruta y terminal en las regiones CAR/SAM, la clasificación del espacio aéreo, la PBN y el ATFM/ Evaluation of surveillance infrastructure and Identification of Surveillance system improvements to support continental enroute and terminal Airspace in CAR/SAM Regions, airspace classification, PBN and the ATFM . Orientaciones para el uso/ integración de los datos ADS-B a Sistemas ATC de Procesamiento multisensoriales/ Guidelines for using/integrating ADS-B Data to ATC Multi sensor Processing Systems | Octubre 2011/ October 2011 |
| Objetivo EsT: D, IPM/GPI: 23 and GREPECAS Conclusión 15/46 | CNS/New 2 | Actividades para optimizar el uso del entorno de radio frecuencia/ Activities to optimize the use of radio frequency environment | | Subgrupo CNS/ATM CNS/ATM Subgroup | Valida/ Valid | Acciones recomendadas para evitar la congestión de frecuencias en 1030/1090 MHz/ Recommended actions for avoiding 1030/ 1090 frequencys congestion | Octubre 2011/ October 2011 |

Agenda Item 7: Other matter

7.1 The meeting examined information identified by the ICAO Aeronautical Surveillance Panel related to the incorrect use of SSR by military authorities and special precautions and appropriate procedure to be made during ground testing of transponders.

7.2 Incorrect SSR practices by military authorities include the use of the X pulse in SSR Mode A replies to distinguish a UAS from a manned aircraft, the allocation of a distinct interrogator code for the mobile Mode S interrogator (mainly used by military) and the upgrading of some military interrogators Mode A/C to mode S capability without the use of the monopulse technique. These practices as outlined in **Appendix A**, are having detrimental effects on civil air traffic surveillance since they cause the invalidation of Mode A replies in systems used by some States, severely impact the operation of other ground Mode S surveillance systems used for civil aviation and/or air defence systems and cause excessive channel occupancy that results in degraded performance of all other systems using 1030/1090 MHz. In this regard the following draft conclusion is proposed:

DRAFT**CONCLUSION SURTF/03/04****INCORRECT SSR PRACTICES BY MILITARY AUTHORITIES**

That, CAR/SAM States, Territories and International Organizations:

- a) Take the necessary actions and coordinations with their corresponding military authorities to avoid the incorrect SSR practices (as outlined in Appendix A) including:
 - the use of X pulse in SSR Mode A replies to distinguish a UAS from a manned aircraft;
 - the allocation of a distinct interrogator code for the mobile Mode S interrogator (mainly used by military); and
 - the upgrading of some military interrogators Mode A/C to mode S capability without the use of the monopulse technique.
- b) Inform ICAO Regional offices the action that will be made at this respect no later than 30 November 2010.

7.3 Incorrect testing of SSR transponders on the ground can adversely affect the operation of ACAS on airborne aircraft resulting in potentially unsafe situations. **Appendix B** contains guidance on transponder ground testing that describes special precautions and appropriate procedures to avoid the generation of ACAS TAs and RAs during transponder testing and maintenance. Because of the importance of this consideration, the following draft conclusion is proposed:

DRAFT**CONCLUSION SURTF/03/05****SPECIAL PRECAUTIONS AND APPROPRIATE PROCEDURES DURING GROUND TESTING OF TRANSPONDERS**

That the CAR/SAM States, Territories and International Organizations apply the considerations and procedure contained in the guidance on transponder ground testing (Appendix B to this report), in order to avoid the generation of ACAS TAs and RAs during ground testing of transponders.

7.4 The meeting was informed about ICAO initiative “Next Generation Aviation Professional Symposium” to be held on March 2010 in Montreal (www.icao.int/ngap). This issue was also discussed during the GNSS/TF/03 Meeting, and the meeting agreed on the draft conclusion GNSS/TF/04/02 for including the technical training considerations as part of the initiative for the next generation aviation professionals. The Meeting recognized the importance of including Surveillance Technical training in that initiative.

7.5 It was noted that in order to fully complete the tasks assigned more meetings (twice per year) would be required. Further discussion on the subject was deferred until the results of the CNS/ATM/SG/01 meeting (planned for December 14-18, 2009) with respect to the allocation of various tasks and timeframes become known. In this regard no future meeting of the TF was scheduled.

APPENDIX A

ISSUES RELATED TO THE USE OF SSR BY MILITARY AUTHORITIES

1. INTRODUCTION

1.1 It has been observed that certain military authorities have been using incorrect practices in their implementation and operation of SSRs. Those practices are described below:

X pulse in the SSR Mode A reply

1.1.1 The X pulse in SSR Mode A replies is being used to distinguish a UAS from a manned aircraft. As stated in Annex 10, Volume IV, Chapter 3 and *Manual of the Secondary Surveillance Radar (SSR) Systems* (Doc9684), the X pulse was foreseen for future expansion of the systems and not for any use within the existing system. The aforementioned provisions also states that it has finally been decided that such expansion would be achieved using Mode S. The X pulse should therefore not be used today, and it is not foreseen to be used in the future.

1.1.2 There are operational consequences to aeronautical surveillance if the X pulse is used to distinguish a UAS from a manned aircraft. The presence of a pulse in the X pulse position has the effect of invalidating Mode A replies in systems used by some States. Any air vehicle transmitting the X pulse, including a UAS, may therefore not be visible to ATC if this method of operation is adopted. This is a flight safety issue.

1.1.3 If requested by States, ICAO will be able to establish a procedure for the identification of UAs as part of the Mode S acquisition.

Use of IC Codes by Mobile Interrogators

1.1.4 By default, any mobile Mode S interrogator (mainly used by military) should not be allocated a distinct interrogator code. They should use a special mode of target acquisition using interrogator code II=0, defined in ICAO Annex 10 Volume IV. Alternative means are possible to acquire targets passively, such as using the acquisition squitter and an angle of arrival antenna, or the extended squitter with an omni antenna to determine the azimuth angle and address of aircraft, removing the need for mobile interrogators to use the lockout protocol.

1.1.5 In any case, Mode S operations using other interrogator code, even at sea, without prior coordination with air navigation service providers should be prohibited as it could severely impact the operation of other ground Mode S surveillance systems used for civil aviation and/or air defence systems.

Requirement for monopulse for Mode S scanning beam interrogators

1.1.6 Some military Mode A/C interrogators are being upgraded to Mode S capability without the use of the monopulse technique. In Mode A/C operation, an interrogation elicits replies from all equipped aircraft in the antenna main beam. Azimuth is determined by center marking of eight or more consecutive replies from each detected aircraft using a technique known as "beam splitting." Mode S has been developed to provide azimuth information based on a single reply using monopulse processing which determines the off-boresight angle of the received reply. Monopulse is also used in the processing of Mode S and Mode A/C replies to improve correct decoding in the presence of interference.

1.1.7 Since Mode S is based on the use of an addressed interrogation to a specific aircraft, implementing a Mode S interrogator without monopulse processing results in each Mode S aircraft being interrogated eight or more times during beam passage in order to support beam splitting. This approach dramatically increases the 1030/1090 MHz channel occupancy (also called RF pollution).

1.1.8 Operating a Mode S interrogator without monopulse capability in high density environments will cause excessive channel occupancy that will result in degraded performance of all other systems using 1030/1090 MHz (e.g., Mode S, ACAS and extended squitter). Therefore such improper implementation should be prohibited.

APPENDIX B**GUIDANCE ON TRANSPONDER GROUND TESTING**

To avoid the generation of ACAS TAs and RAs, special precautions and appropriate procedures described below are required during transponder testing and maintenance:

- a) when not required, ensure that all transponders are set to 'OFF' or 'Standby';
- b) before starting any test, contact the local ATC Unit and advise them of your intention to conduct transponder testing and indicate the planned start time and test duration. Also inform them of your intended Mode A code (see c below) and your intended Aircraft Identification (Flight ID, see d below);
- c) prior to "switch-on" or with the transponder in "standby" mode, set the Mode A code to a value that is regionally agreed to be used for transponder testing;

Note.— Mode A code 7776 is assigned as a reserved code in Europe, specifically for the testing of transponders. The Australian CASA requires the use of Mode A code 2100 for transponder testing.

- d) for a Mode S transponder, set the Aircraft Identification (Flight ID) to the first 8 characters of the name of the company that is conducting the tests, (or something to that effect);
- e) set the on-the-ground status for all Mode S replies, except when an airborne reply is required (e.g., for altitude testing);
- f) where possible, perform the testing inside a hanger to take advantage of any shielding properties it may provide;
- g) as a precaution, use antenna transmission covers whether or not testing is performed inside or outside;
- h) when testing the altitude parameter of a Mode A/C or Mode S transponder, radiate directly into the ramp test set via the prescribed attenuator;
- i) manually set the altitude to an unrealistically high value (i.e., over 60000 feet);
- j) in between testing, i.e., to transition from one altitude to another, or changing the Mode A code, set the transponder to 'Standby' mode before changing the altitude input;
- k) when testing is complete, immediately set the transponder(s) to 'OFF' or 'Standby';
- l) simulation of ACAS operation must not be carried out by radiating from an antenna located on, or remotely based, from a workshop; and
- m) finally, it should be noted that the current practices of testing transponders with different altitudes using Gilham encoders may no longer be required for aircraft using altitude encoders with serial output.