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Agenda Item 2 Development of a Regional Strategy for Surveillance Implementation in the CAR/SAM Region

DRAFT SURVEILLANCE STRATEGY FOR CAR/SAM REGIONS

(Prepared and presented by Brazil)

Summary

This working paper presents a Draft Surveillance Strategy for CAR/SAM Region that defines an evolutionary path to promote safety, interoperability and cost effectiveness of the required infrastructure to meet the ATM needs, in short and medium terms.

1 Introduction

1.1 During the First Surveillance Task Force Meeting (Trinidad & Tobago 20-21 July 2007) was decided that the most effective manner to elaborate a draft for a surveillance strategy for CAR/SAM Region was to address this issue to a delegate of the Surveillance Task Force. Brazil volunteered to carry out this task.

1.2 The draft Surveillance Strategy for CAR/SAM Region was completed in October 2007 and distributed to all the members of the Surveillance Task Force for its commentary

2 Analysis

2.1 The **Appendix** of this working paper presents the Draft Surveillance Strategy for CAR/SAM Region.

3 Actions Required

3.1 The meeting is invited to

- a) take note of this working paper;
- b) analyze the content of Appendix of this working paper;
- c) take action for the necessary amendments of the draft document in order to be presented at the Sixth ATM/CNS Subgroup (CNS Committee) that will be held in Dominican Republic from 30 June to 4 July 2008.
- d) analyze other matters related with this agenda item that the meeting consider necessary

APPENDIX

**The Surveillance Strategy for
CAR/SAM Region**

**First Edition
Rev 1.0**

INTERNATIONAL CIVIL AVIATION ORGANIZATION

DRAFT

**ADS-B TASK FORCE
Draft Surveillance Technology Comparison**

Table of Contents

1.	Introduction	3
1.1	Aim of the surveillance strategy	3
1.2	Scope of the Surveillance Strategy	3
1.3	Structure of the Document.....	4
1.4	Intended Readers	4
1.5	Relationship with other documents	4
1.6	Acknowledgments	4
2.	Surveillance Operational Scenario Evolution	5
2.1	En-Route and TMA Airspace	5
2.2	Aerodrome Operations	6
2.3	Aircraft Systems	6
2.4	Operational Drivers Timeframe.....	7
3.	Surveillance Infrastructure Evolution	9
3.1	En-Route and TMA Airspace	9
3.2	Aerodrome Operations	9
3.3	Aircraft Systems	9
3.4	Surveillance Infrastructure Timeframe	11
4.	Surveillance Related Issues	13
4.1	Required Regional Studies and Trials	13
4.2	Studies and Trials Timeframe.....	14
5.	Annex A – Acronyms.....	15
6.	Annex B – Definitions.....	16
7.	Annex C – Surveillance Techniques	19

The Surveillance Strategy for CAR/SAM Region

INTRODUCTION

Aim of the surveillance strategy

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.

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

Scope of the Surveillance Strategy

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.

Within the context of the GREPECAS/14, that was held in Costa Rica, in April 2007, the meeting took note of the new surveillance technologies that are arising and analyzed the Global Air Navigation Plan for CNS/ATM Systems (Doc. 9750) initiatives related to data link based surveillance and ADS-C and ADS-B implementation.

Even though the Surveillance Regional Plan was updated during the referred meeting, 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 an Air Surveillance Strategy for CAR/SAM Regions.

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

- Primary Radar (PSR, SMR/ASDE);
- Secondary Surveillance Radar (SSR);
- Automatic Dependent Surveillance-Broadcast (ADS-B);
- Automatic Dependent Surveillance-Contract (ADS-C);
- Traffic Information Service – Broadcast (TIS-B); 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 dates illustrated in this document define when surveillance systems are expected 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 implementation in pocket areas, using certified existing equipage which is to be followed by an implementation in wider areas supported by the Implementing Rule related to the upgraded equipage.

Structure of the Document

This document is structured as follows:

- Section 1 (this section) presents the aim of the document, explains its scope and structure and describes the intended readers and relationship with other documents.
- Section 2 describes the Surveillance Operational Scenario Evolution, i.e. the envisaged operational drivers for the period between 2007 and 2020 in the Air Surveillance field, for En-Route and TMA Airspace, Aerodrome Operations and Aircraft Systems.
- Section 3 specifies the Surveillance Infrastructure Evolution required to cope with the foreseen environment for En-Route and TMA Airspaces, Aerodrome operations and Aircraft systems, during the above mentioned period.
- Section 4 specifies the regional studies and trials that are needed to be accomplished in a timely manner in order to gather sufficient knowledge about 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.

Intended Readers

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

- The departments of the National Supervisory Authorities of ECAC 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.

Relationship with other documents

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

Therefore, CAR/SAM States, Territories and International Organizations should, when implementing surveillance systems, the operational requirements of the mentioned Plan, specially the ones related to GPIs 09 and 17 (Situational Awareness and Implementation of data link applications).

In other words, 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.

Acknowledgments

This surveillance strategy has been developed by the CNS Surveillance Task Force, according to its Reference Terms and Working Program.

This document should be reviewed and updated every two years.

SURVEILLANCE OPERATIONAL SCENARIO EVOLUTION

EN-ROUTE AND TMA AIRSPACE

THE SURVEILLANCE OPERATIONAL SCENARIO EVOLUTION FOR EN-ROUTE AND TMA AIRSPACE IS BASED ON THREE FUNDAMENTAL PRINCIPALS FOR GROUND USERS IN SUCH AIRSPACE. THESE PRINCIPALS ARE DOMINANT THROUGHOUT THE COMPLETE SURVEILLANCE STRATEGY AND ARE:

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

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.

Before 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, SSR and mode S radars).

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

The first set of new applications that are envisaged to be supported in CAR/SAM Region are the ground Surveillance (ADS-B out) in a non-radar environment (ADS-B-NRA), in a radar environment (ADS-B-RAD) and Airborne Derived Data (ADS-B-ADD). ADS-B-out is expected to reach initial operational capability status in 2010.

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 from 2015 onwards. This requires an increased integration of surveillance information at the SDPD level, which will require updating to process and deliver the new information to surveillance users as the new systems become operational.

Until 2018, the ground service provider will remain responsible for the separation service and for maintaining separation. However, from 2018 onwards, there will be a number of ATM concepts which will drive the evolution of the surveillance environment, these are:

- Enhanced medium term planning with the tasks of the controllers operating in En-Route and TMA sectors becoming increasingly supported by 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.

Aerodrome Operations

At selected airports, the aerodrome operations will be based on:

- The implementation of A-SMGCS level I (which may include ADS-B Package I, ADS-B-APT application) and A-SMGCS level II will be enabled by systems such as SMR and Multilateration, from 2007 onwards;
- From 2010, the use of ADDs to support aerodrome operations is envisaged; and
- Where airport operators foresee a benefit of A-SMGCS level III (which may include the ADS-B Package I, ATSA SURF application) and A-SMGCS IV from 2015 onwards. This may require an ADS-B and TIS-B infrastructure and an equipage of selected, appropriate airport vehicles with transponders.

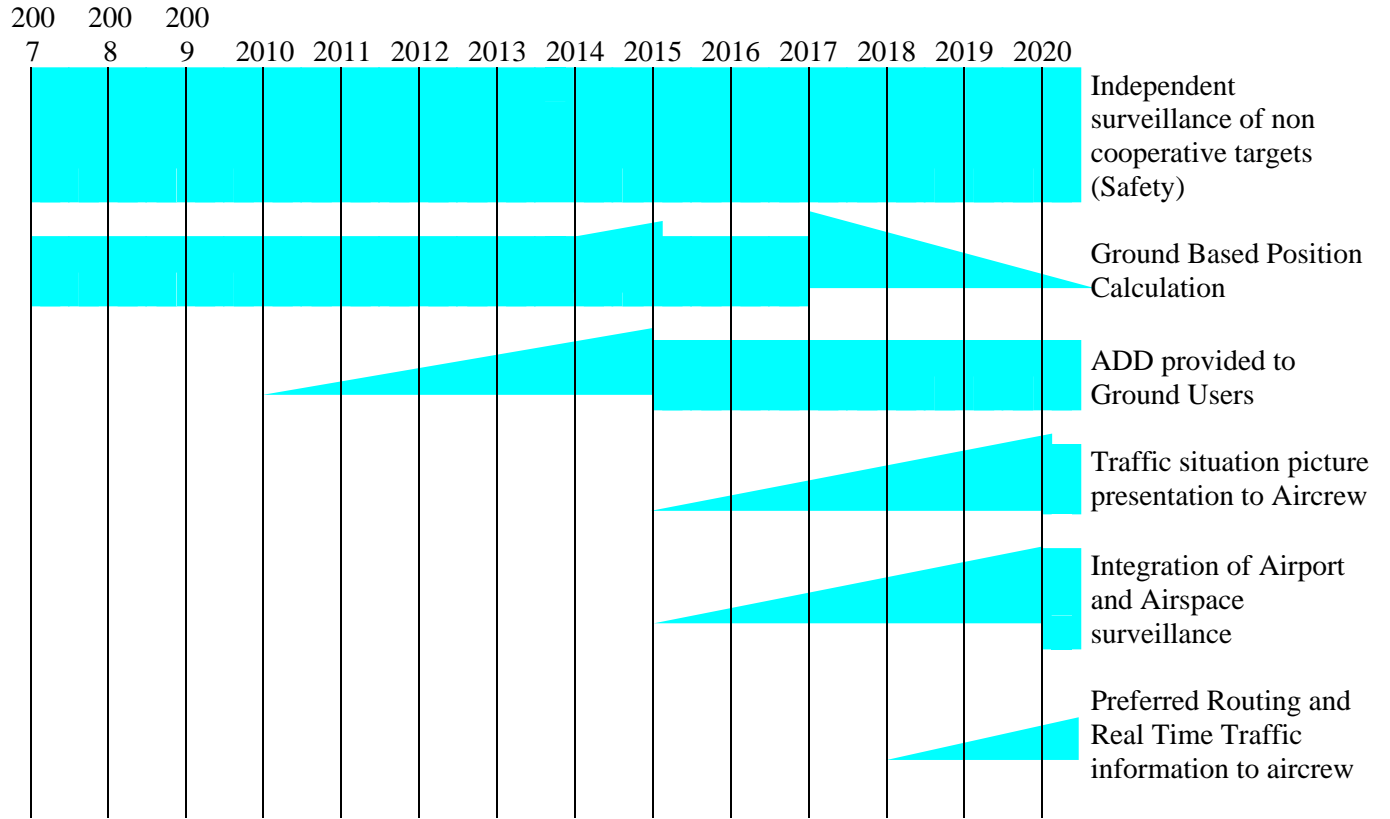
Aircraft Systems

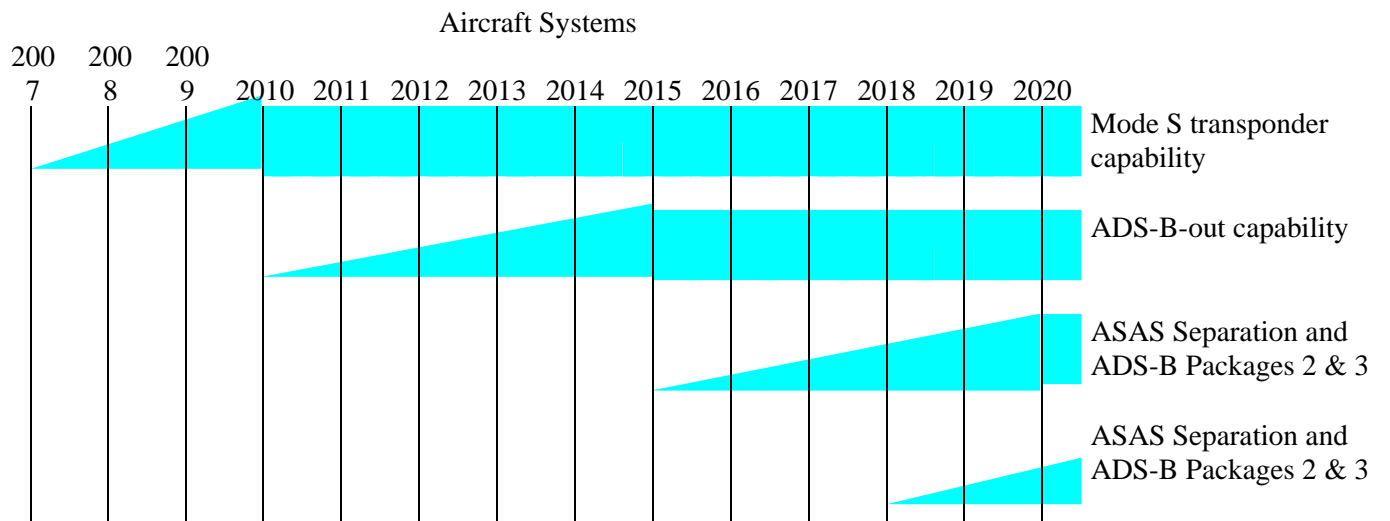
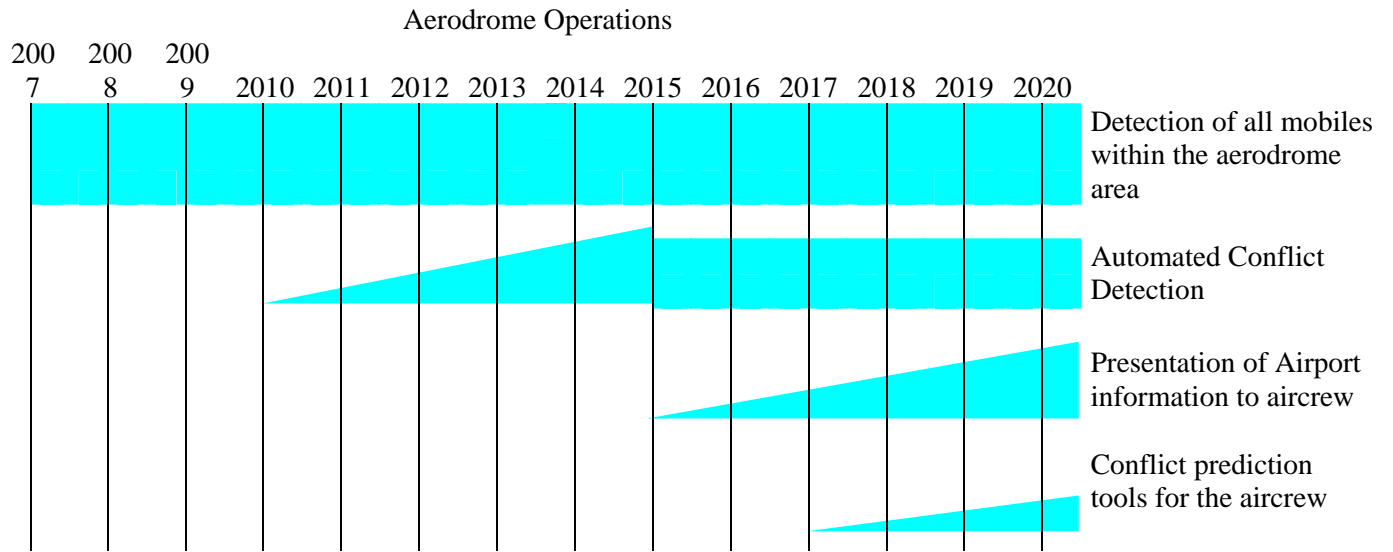
From an airborne perspective, the surveillance strategy is based on four steps, these are:

- Continuing the use of SSR or SSR Mode S systems for ground based surveillance radar or Multilateration systems. This means that no additional equipment is foreseen on the aircraft until 2010;
- The implementation of new ground Surveillance Applications (ADS-B out) from 2010 onwards which will require integration between the aircraft navigation system and mode S transponders, in order to transmit intent information to other aircraft and ground users. This is enabled by ADS-B using 1090 MHz Extended Squitter or other data-links;
- The implementation of ADS-B Package I ASAS situational awareness applications from 2015 onwards which will require an airborne SDPS and display system; and
- The implementation of ADS-B Package II ASAS separation applications from 2018 onwards. The enabling techniques are the same as ADS-B Package I, however there may be higher integrity requirements on the information presented to the aircrew which may result in an upgrade of the avionics.

Operational Drivers Timeframe

En Route and TMA Airspace





SURVEILLANCE INFRASTRUCTURE EVOLUTION

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.

From 2007 to 2010, co-operative surveillance, in the form of SSR and SSR Mode S, will still be the main means of surveillance and will be extensively used for air traffic surveillance by civil agencies for TMA and En-Route services within coverage of (ground based) interrogator station(s);

SSR Mode S elementary surveillance will be implemented from 2010 onwards in high density TMAs in order to improve secondary radar performances. Since there will still exist legacy aircrafts that 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 from 2010 onwards to fill en route and terminal areas not covered with radar and to strengthen surveillance in areas covered with SSR Modes A/C and S.

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.

From 2010 onwards ADS-C surveillance will be operationally used in all oceanic and remote airspace associated with FANS capacities.

Surveillance Data Processing and Distribution systems based on radar server technology will have to be progressively upgraded, from 2010 on, 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.

From 2012 on there will be an increasing implementation of "Mode S only" radars in high-traffic-density approach, en route, and terminal areas, and monopulse SSR, adaptable to Mode S, in medium-traffic en route and terminal areas.

It is predicted that by 2015 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.

Aerodrome Operations

From 2007 up to 2010, the main technology for calculating the position of mobiles (both aircraft and vehicles) will be Surface Movement (primary) Radar and Multilateration, using Mode S SSR transponder replies and Mode S Squitter messages.

From 2010 onwards, 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 from 2010 onwards.

The introduction of A-SMGCS Levels III/IV at selected aerodromes will require aircrew to be presented, from 2015 onwards, 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.

Aircraft Systems

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.

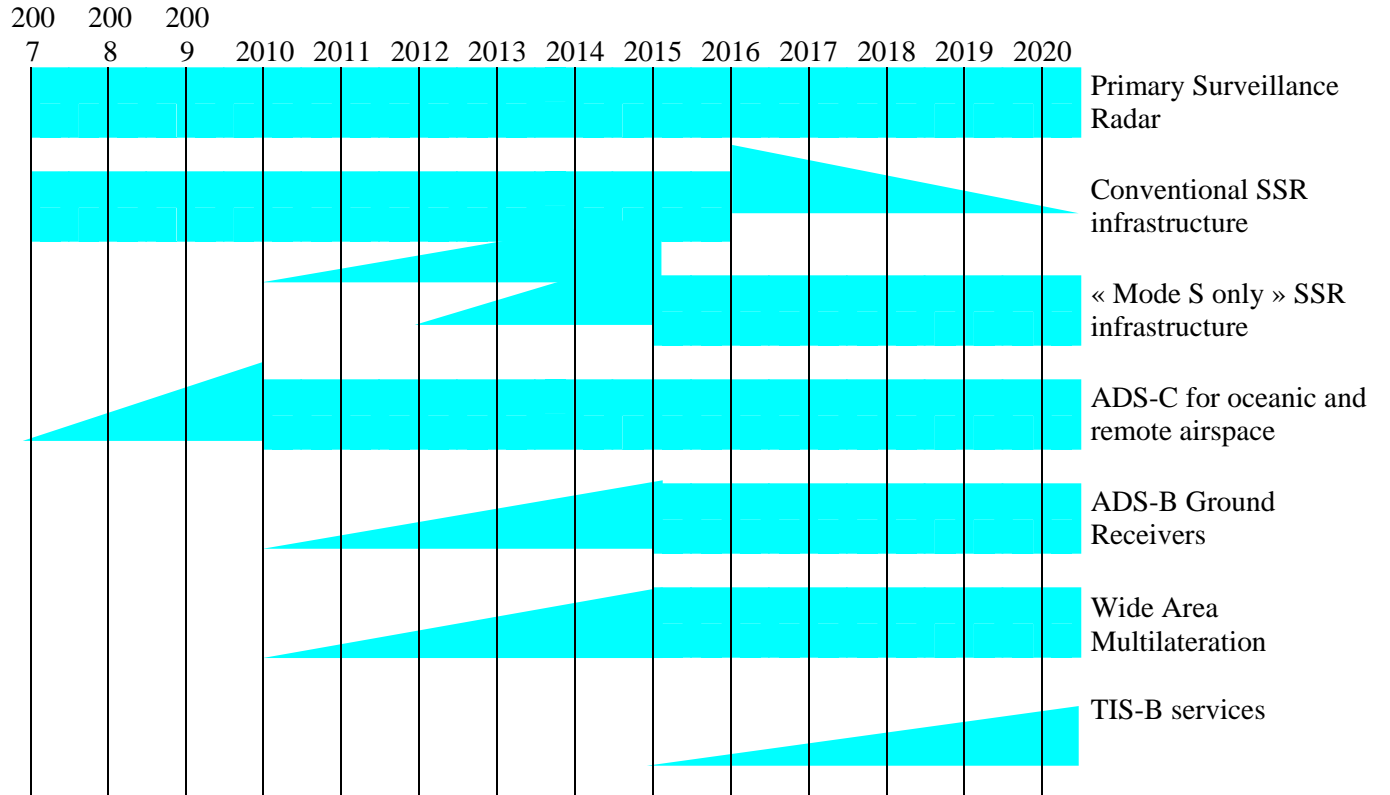
Until 2010 the implementation of ACAS II systems throughout commercial and general aviation will be completed, using Mode S transponder for elementary surveillance (ELS). From 2010 onwards, those transponders will have to be integrated to GNSS airborne systems so that they will operate in ADS-B environments (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. Therefore, until 2015 Mode S transponders will have to be updated (enhanced surveillance – EHS).

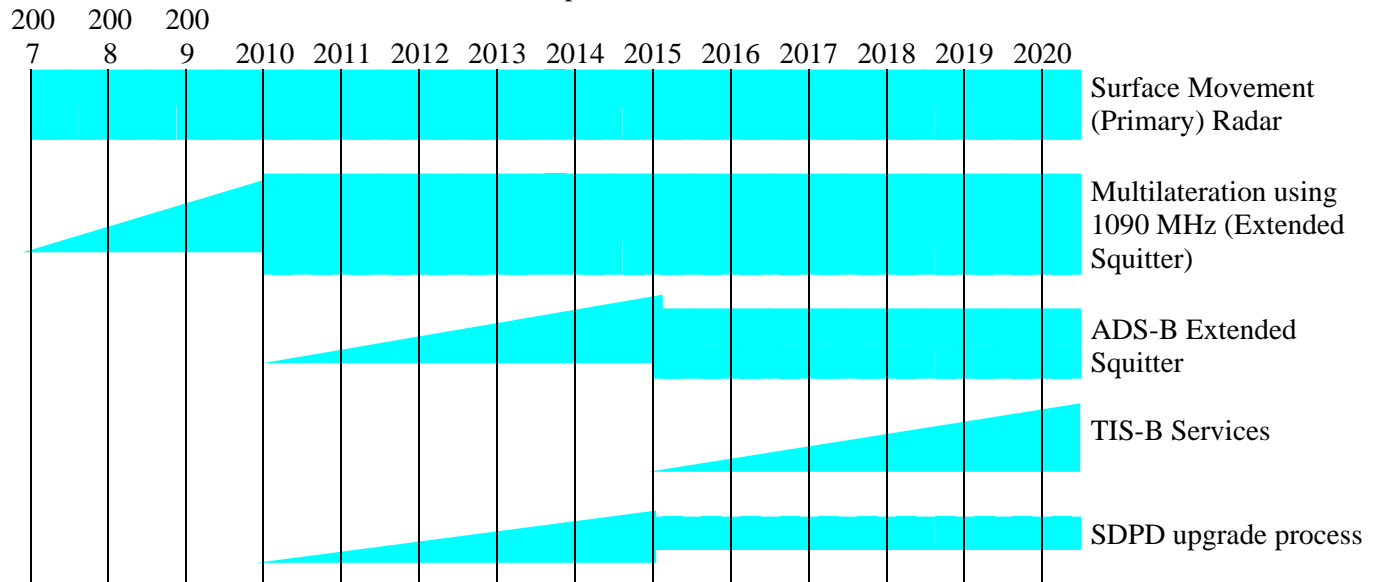
From 2015 onwards, the move from ASAS spacing to ASAS separation and preferred routing may require a high integrity traffic situation picture, therefore the use of TIS-B will be required as well as the implementation of an airborne Surveillance Data Processing System (SDPS) to integrate ADS-B in and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

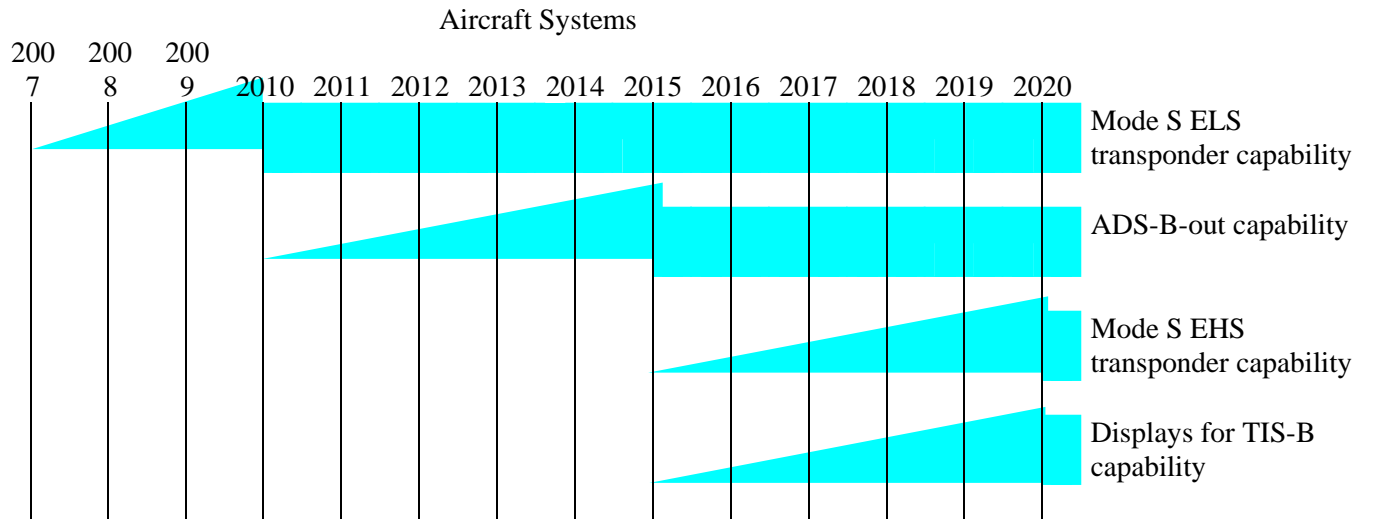
Surveillance Infrastructure Timeframe

En Route and TMA Airspace



Aerodrome Operations





SURVEILLANCE RELATED ISSUES

Required Regional Studies and Trials

From 2007 onwards, there will be a continuous need to perform periodic assignment and monitoring of mode S 24-bits address by all Civil Aviation Authorities in CAR/SAM Region.

By the end of 2008 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, until 2009, 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 2020;
- 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, until 2009 a plan for data sharing should be established, aiming at a coordinated, harmonious and interoperable implementation of ADS-B.

It is also required to ensure that the regional surveillance standards and surveillance functional architecture are consistent with the Required Surveillance Performance (RSP), after the approval of RSP provisions (expected to be delivered by 2009).

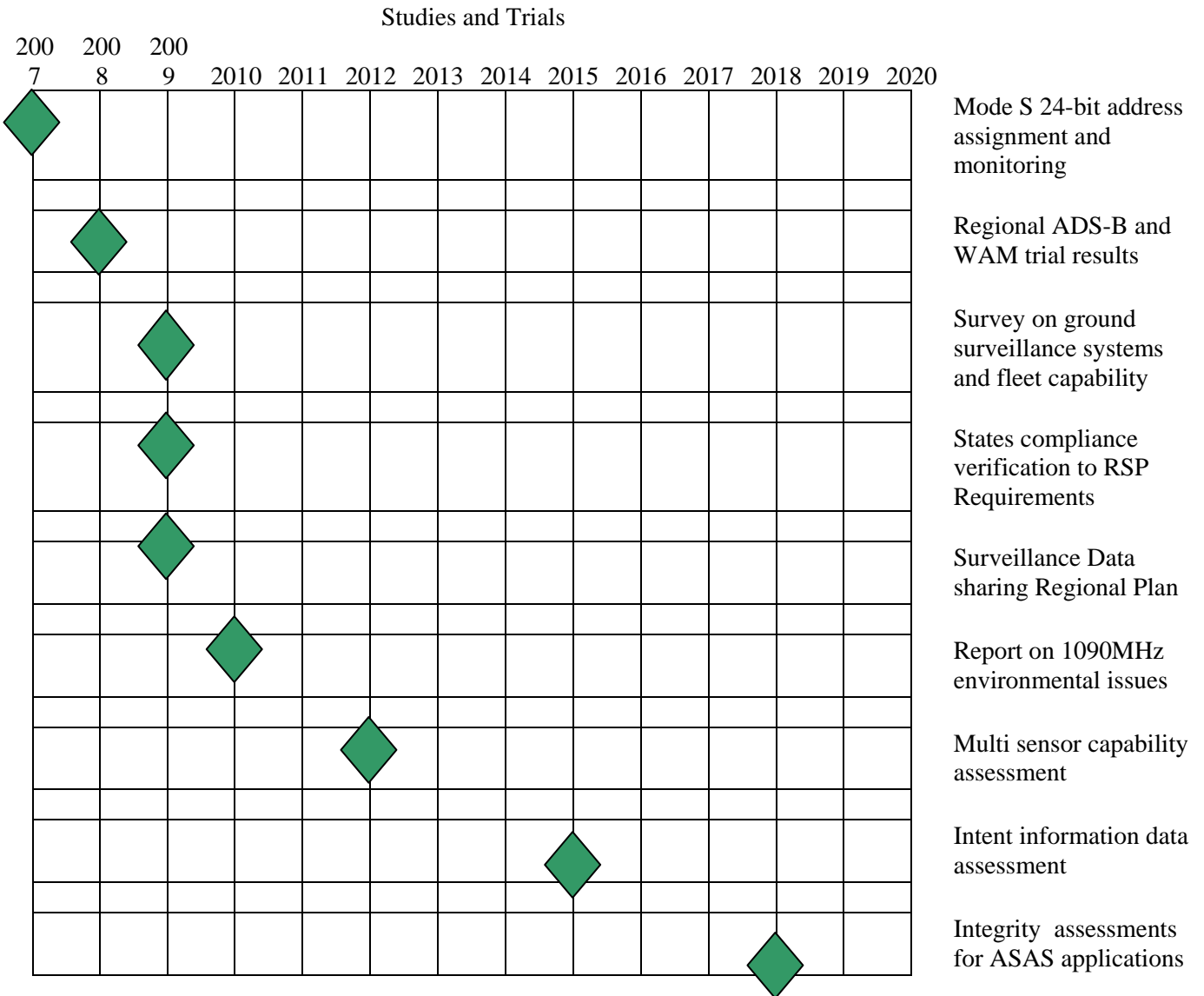
As the increased dependence on ADS-B (1090 MHz Extended Squitter) is expected to grow, there is concern that the band will become saturated as more information is loaded onto the restricted band. Therefore it is required to study before 2010 whether the use of 1090MHz continues to support the surveillance requirements.

Until 2012, 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.

It is required to identify, before 2015, 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.

By 2018 it is 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.

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 Council
ANSP Air Navigation Service Provider
APP Approach (Centre or Control)
ASAS Airborne Separation Assistance System
ASDE Airport Surveillance Detection Equipment
A-SMGCS Advanced Surface Movement and Guidance Control System
ATC Air Traffic Control
ATM Air Traffic Management
CDTI Cockpit Display of Traffic Information
CNS Communications Navigation and Surveillance
CPDLC Controller Pilot Data link Communications
FDPS Flight Data Processing System
FMS Flight Management System
GNSS Global Navigation Satellite System
GPS Global Positioning System
ICAO International Civil Aviation Organisation
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
TMA Terminal Maneuver (Control) Area

ANNEX B – DEFINITIONS

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

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

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

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

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

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

Basic surveillance delivers to the surveillance user:

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

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

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

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

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

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

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

Surveillance users are:

- Oceanic ATM Centers
- En-Route ATM Centers
- TMA/Approach ATM Units
- Airports/Tower ATM & Ground Traffic Management Units

- Military Centers
- Airline Aircraft Operations Centre
- Enhanced Tactical Flow Management System
- Data processing systems, such as Flight Data Processing Systems
- ATM Tools, such as Short Term Conflict Alert
- The target
- Adjacent Surveillance Functions
- Non ATM functions (e.g. Search and Rescue).

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

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

Level I A-SMGCS provides:

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

ANNEX C – SURVEILLANCE TECHNIQUES

Primary Radar (PSR, SMR/ASDE)

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

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

Secondary Surveillance Radar (SSR)

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

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

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

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

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

Automatic Dependent Surveillance-Broadcast (ADS-B)

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

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

Automatic Dependent Surveillance-Contract (ADS-C)

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

Currently ADS-C is usually implemented via SATCOM but any data link having the range capability would suffice. Whilst originally envisaged to be an ATN compliant data link, current implementations exploit a large part of the functionality through the FANS 1/equipment currently carried by many aircraft.

Traffic Information Service – Broadcast (TIS-B)

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

- TIS-B fundamental service: This 'gap filler service broadcasts information about aircraft that cannot be adequately obtained directly by ADS-B and is used to enhance the availability of surveillance information to users that are not normally able to receive ADS-B transmissions from other aircraft. This service will normally exclude from transmission those aircraft broadcasting ADS-B messages

- ADS-B validation service: This optional service compares aircraft ADS-B state vector data with surveillance data from ground-based sensors and broadcasts validation data
- ADS-B rebroadcast service: The automatic rebroadcast of ADS-B messages received over one data link, translated directly onto other data links for the purpose of extending ADS-B connectivity to users of incompatible data links.

Multilateration

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

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

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