



International Civil Aviation Organization

**Communication Navigation and Surveillance
Sub-Group (CNS SG)**

Fifth Meeting
(Cairo, Egypt, 11 - 13 December 2012)

Agenda Item 5: Performance Frame work for CNS implementation in the MID Region

SURVEILLANCE DEVELOPMENTS IN THE MID REGION

(Presented by the Secretariat)

SUMMARY

This paper presents the Mode S IC code allocation issues , along with ADS-B and MID surveillance Strategies.

Action by the meeting is at paragraph 3.

REFERENCE

- AN-Conf/12 draft Report
- MIDANPIRG/13 Report

1. INTRODUCTION

1.1 The introduction of SSR Mode S interrogators requires a coordinated approach to the allocation and implementation of the Interrogator Codes. Provisions regarding the implementation and monitoring of Mode S IC allocations have been defined by ICAO.

1.2 The Twelfth Air Navigation Conference (AN-Conf/12) held in Montreal from 19 to 30 November 2012, gained consensus, commitments and formulated recommendations to achieve a harmonized global air navigation system for international civil aviation, in order to optimize the opportunities in technology and maturing work programmes toward common global objectives. The AN-Conf/12 considered Aviation System Block Upgrades (ASBUs) and the Communications, Navigation, Surveillance (CNS), Aeronautical Information Management (AIM) and avionics roadmaps for inclusion in the Global Air Navigation Plan.

2. DISCUSSION

2.1 The meeting noted that MID States are installing mode S radars and some MID States experienced IC code conflicts with the European region that has a large number of operational mode S radars. Accordingly, MIDANPIRG/12 meeting agreed that ICAO MID Regional Office coordinate and formalize the process of IC code allocation for the ICAO MID Region with EUROCONTROL.

2.2 The meeting was apprised of agreement that MICA cell in EUROCONROL will provide the MICA web based application and same support to the MID Region as done in the ICAO EUR Region.

2.3 The meeting reviewed the document at **Appendix 4.50** to the Report on Agenda Item 4.5 laying down recommendations and requirements for an efficient support of the MICA cell to the allocation of IC codes for ICAO MID Region. Accordingly, the meeting agreed to the following Conclusion:

CONCLUSION 13/41: MID REGION PROCESS FOR MODE S IC CODES ALLOCATION

*That, the process for the allocation of IC codes for Mode S radars in the MID Region be adopted as at **Appendix 4.50** to the Report on Agenda Item 4.5.*

2.4 The meeting may wish to note that a recent incident occurred where IC code conflict was observed, accordingly, the meeting wish to emphasize, that when programming Mode S interrogators, Mode S operators have to comply with:

- the allocated IC provided in the latest issued IC allocation;
- the surveillance and lockout coverage provided in this issued IC allocation; and
- ensure that the Mode S interrogators are correctly programmed in order to avoid an IC conflict.

2.5 Based on the above, the meeting may wish to recommend that the Mode S Radar operators develop IC and coverage map programming procedures, taking their own specificities into account. As a minimum, local procedures have to include the following verification steps, to be completed for each interrogator parameter change:

- a. Verification of the compliance of the programming parameters with the IC allocation data, including: Position of the radar; IC; Lockout range and coverage map, if applicable.
- b. Verification of the validity status of the IC allocation used for programming.
- c. Verification of all parameter sets (current, factory defaults...) that may be used by the radar.
- d. When operating in a cluster, verification that all cluster states parameters are compliant with the IC allocation data.
- e. Verification of the correct application of the programmed data, including following radar chain switch-over and switch-off/switch-on cycles.

2.6 ICAO MID Regional Office received the updated IC code allocation for the MID Region as at **Appendix A** to this working paper, which is obtained from the MICA web allocation, which States can also obtain for their States once trained on the application.

2.7 MIDANPIRG/13 meeting was apprised of the MID Surveillance workshop that was held in Jeddah, Saudi Arabia, (08-10 May 2011), with the objective to provide MID States with a better understanding of evolving aeronautical surveillance infrastructure/technology to enhance situational awareness and harmonize the implementation in the MID Region.

2.8 MIDANPIRG/13 meeting reviewed the MID Region Surveillance strategy and timelines for the ADS-B out implementation developed during the workshop as at **Appendix B** to this working paper, MIDANPIRG/13 also reviewed the MID Region Strategy for the Implementation of ADS-B out, as at **C** to this working paper. Accordingly, MIDANPIRG/13 meeting was of the view that both strategies be consolidated. Accordingly, the meeting agreed to the following Decision:

DECISION 13/42: MID REGION SURVEILLANCE STRATEGY

That, the CNS SG review MID Surveillance Strategy and ADS-B Strategy at Appendices 4.5P (Appendix B to this WP) and 4.5Q (Appendix C to this WP) to the Report on Agenda Item 4.5 and develop a consolidated MID Surveillance Strategy.

2.9 MIDANPIRG/13 meeting noted that Bahrain exchange surveillance data with Kuwait, Qatar, and provide UAE surveillance data, also Qatar and UAE exchange surveillance data, furthermore, MIDANPIRG/13 meeting recalled MIDANPIRG/12 *Conclusion 12/46: Exchange of Surveillance data* and encouraged all MID States to share surveillance data to significantly reduce surveillance gaps in order to enhance safety and efficiency with no huge investments.

2.10 The AN-Conf/12 addressed a range of technology issues and enablers that support the modules of the aviation system block upgrades (ASBUs) and agreed that available and emerging technologies and a supporting regulatory framework, including ICAO Standards, Recommended Practices, Procedures and guidance material would be necessary to support the successful implementation of the ASBUs and the associated modules. It was also agreed that technology roadmaps and regional planning, supported by performance measurement metrics would be necessary to measure progress and the effectiveness of implementation, and accepted the following recommendations concerning ADS-B

Recommendation 1/7 – Automatic dependent surveillance — broadcast

That States:

- a) recognize the effective use of automatic dependent surveillance — broadcast (ADS-B) and associated communication technologies in bridging surveillance gaps and its role in supporting future trajectory-based air traffic management operating concepts, noting that the full potential of ADS-B has yet to be fully realized;*
- b) recognize that cooperation between States is key towards improving flight efficiency and enhancing safety involving the use of automatic dependent surveillance — broadcast technology.*

That ICAO:

- c) urge States to share automatic dependent surveillance — broadcast (ADS-B) data to enhance safety, increase efficiency and achieve seamless surveillance and to work closely together to harmonize their ADS-B plans to optimize benefits.*

2.11 The Based on the above the meeting may wish to consider the SURVEILLANCE STRATEGY FOR THE CAR/SAM REGIONS as at **Appendix D** to this working paper and fulfill the requirement of MIDANPRG/13 *Decision 13/42: MID Region Surveillance Strategy* taking into account the recommendation 1/7 from AN-Conf/12.

2.12 MIDANPIRG/12 meeting urged MID States to strictly adhere to the 24-bit aircraft addresses allocated to their States as listed in Annex 10, Volume III, Part I, Chapter 9, Table 9-1, and maintain databases for all the 24bit aircraft address allocation pertaining to their States and send the assigned allocations to ICAO MID Regional Office and MIDRMA for inclusion in their databases. Accordingly, the MIDANPIRG/13 meeting agreed to the following Conclusion:

CONCLUSION 13/43: ALLOCATION OF 24 BIT AIRCRAFT ADDRESS

That, States be urged to:

- a) allocate 24 bit aircraft address according to Annex 10, Volume III, Part I, Chapter 9, Table 9-1 (allocation of aircraft addresses to States);*
- b) send the allocation list to ICAO MID Regional Office and MIDRMA by 30 September 2012; and*
- c) provide ICAO MID Regional Office and MIDRMA with regular updates to the allocation list.*

2.13 Based on the above ICAO MID Regional office issued a follow-up State Letter AN 7/27 – 12/210 dated 11 July 2012, for which the following States (Bahrain, Egypt, Iraq, Jordan, Kuwait, Oman and Saudi Arabia) provided replies.

3. ACTION BY THE MEETING

3.1 The meeting is invited to:

- a) develop consolidated MID Region Surveillance Strategy;
- b) urge States to share ADS-B data;
- c) urge States to that did reply to SL 7/27 – 12/210 to do so; and
- d) propose any improvement for the surveillance in the MID Region.

Mod S IC Allocation

Allocations

Appendix A

Region: MID Allocation Reference between: and: Ad hoc: Yes
 Country: Allocation Status: Issued Cluster: Regular: Yes
 Organisation: Sensor Id: Interrogator Code: Processing Cycle:

Allocation Ref	Organisation	Sensor ID	Status	IC	Effective Date	Cluster	Process ID	Country	Regions
MICA/ALLOC 461	NANSC	Aswan ERR	Issued	II = 02	2009-05-14		Ad Hoc 2009-05-14	Egypt	MID
MICA/ALLOC 462	NANSC	Asyut ERR	Issued	II = 03	2009-05-14		Ad Hoc 2009-05-14	Egypt	MID
MICA/ALLOC 464	NANSC	Hurghada ERR	Issued	II = 05	2009-05-14		Ad Hoc 2009-05-14	Egypt	MID
MICA/ALLOC 465	NANSC	Mersa Matruh ERR	Issued	II = 06	2009-05-14		Ad Hoc 2009-05-14	Egypt	MID
MICA/ALLOC 467	Lebanon DGCA	Baysour	Issued	II = 02	2009-04-23		Ad Hoc 2009-04-23	Lebanon	MID
MICA/ALLOC 529	GACA	MADINAH	Issued	II = 04	2010-03-17		Ad Hoc 2010-04-06	Saudi Arabia	MID
MICA/ALLOC 530	GACA	RAFHA	Issued	II = 05	2010-03-17		Ad Hoc 2010-04-06	Saudi Arabia	MID
MICA/ALLOC 531	GACA	TURAIIF	Issued	II = 10	2010-03-17		Ad Hoc 2010-04-06	Saudi Arabia	MID
MICA/ALLOC 567	GACA	AL JOUF	Issued	II = 08	2010-10-21		ICAC 11	Saudi Arabia	MID
MICA/ALLOC 568	GACA	AL-WEJAH	Issued	II = 01	2010-10-21		ICAC 11	Saudi Arabia	MID
MICA/ALLOC 569	GACA	GASSIM	Issued	II = 03	2010-10-21		ICAC 11	Saudi Arabia	MID
MICA/ALLOC 570	GACA	HAIL	Issued	II = 02	2010-10-21		ICAC 11	Saudi Arabia	MID
MICA/ALLOC 571	GACA	KAIA	Issued	II = 08	2010-10-21		ICAC 11	Saudi Arabia	MID
MICA/ALLOC 572	GACA	TABUK	Issued	II = 06	2010-10-21		ICAC 11	Saudi Arabia	MID
MICA/ALLOC 615	MOTC	Muscat	Issued	II = 11	2010-06-29		Ad Hoc 2010-06-22	Oman	MID
MICA/ALLOC 630	NANSC	Cairo ERR	Issued	II = 11	2011-04-07		ICAC 12	Egypt	MID
MICA/ALLOC 631	GACA	ABHA	Issued	II = 02	2011-04-07		ICAC 12	Saudi Arabia	MID
MICA/ALLOC 632	GACA	BAHA	Issued	II = 06	2011-04-07		ICAC 12	Saudi Arabia	MID
MICA/ALLOC 633	GACA	KFIA	Issued	II = 08	2011-04-07		ICAC 12	Saudi Arabia	MID
MICA/ALLOC 634	GACA	KKIA	Issued	II = 01	2011-04-07		ICAC 12	Saudi Arabia	MID
MICA/ALLOC 635	GACA	QAISUMAH	Issued	II = 06	2011-04-07		ICAC 12	Saudi Arabia	MID

Allocation Ref	Organisation	Sensor ID	Status	IC	Effective Date	Cluster	Process ID	Country	Regions
MICA/ALLOC 636	GACA	SODA	Issued	II = 11	2011-04-07		ICAC 12	Saudi Arabia	MID
MICA/ALLOC 644	GACA	Training Station	Issued	II = 09	2011-03-02		Ad Hoc 2011-03-04	Saudi Arabia	MID
MICA/ALLOC 674	GACA	AFIF	Issued	II = 10	2011-09-22		ICAC 13	Saudi Arabia	MID
MICA/ALLOC 675	GACA	HARAD	Issued	II = 11	2011-09-22		ICAC 13	Saudi Arabia	MID
MICA/ALLOC 676	GACA	Khayber	Issued	II = 07	2011-09-22		ICAC 13	Saudi Arabia	MID
MICA/ALLOC 677	GACA	SHARURAH	Issued	II = 08	2011-09-22		ICAC 13	Saudi Arabia	MID
MICA/ALLOC 678	GACA	SHAYBAH	Issued	II = 07	2011-09-22		ICAC 13	Saudi Arabia	MID
MICA/ALLOC 679	GACA	WADI AL-DAWASIR	Issued	II = 07	2011-09-22		ICAC 13	Saudi Arabia	MID
MICA/ALLOC 743	BCAA	Site 116	Issued	II = 04	2011-12-17		Ad Hoc 2011-12-21	Bahrain	MID
MICA/ALLOC 744	BCAA	Site 117	Issued	II = 09	2011-12-17		Ad Hoc 2011-12-21	Bahrain	MID
MICA/ALLOC 823	Jordan CARC	ModeS-1	Issued	II = 12	2012-08-23		ICAC 15	Jordan	MID

APPENDIX B

MID REGION SURVEILLANCE STRATEGY

- Share experience and trial results in new surveillance technologies;
- Minimize reliance on position reporting, particularly voice reporting & Primary Radar;
- Maximize contiguous coverage and use of ADS-B on major routes/terminal areas;
- Make full use of SSR Mode 'S' capabilities, reduce reliance on 4 digit octal code;
- Make use of ADS-C when ADS-B, SSR or multilateration not supported;
- Encourage Multilateration for surface, terminal & area surveillance;
- Improve safety through sharing ATS surveillance data across FIR boundaries;
- Broaden scope of cooperation between ANSPs and Stakeholders;
- Acknowledge the development of other Regions and should consider incremental introduction of new surveillance technologies;
- Increase use of Aircraft Derived Data; and
- The MID Region ADS-B implementation times line set for 2017.

APPENDIX C

MID REGION STRATEGY FOR THE IMPLEMENTATION OF AUTOMATIC DEPENDENT SURVEILLANCE-BROADCAST (ADS-B)

Considering the:

- a) ICAO strategic objectives;
- b) ICAO Business Plan;
- c) Global Air Traffic Management Operational Concept;
- d) revised Global Air Navigation Plan and associated GPIs; and
- e) outcome of the 11th Air Navigation Conference.

Recognizing that:

- i) the implementation of data-link surveillance technologies is an evolutionary process, but which has significant potential for safety and cost-effectiveness; and
- ii) implementation of ADS-B is in support of various Global Plan Initiatives;

The MID Region strategy for the implementation of ADS-B is detailed below:

- A) the MID Region ADS-B implementation plan should:
 - 1) be evolutionary and consistent with the Global Air Navigation Plan taking into consideration associated MID Region priorities;
 - 2) when cost/benefit models warrant it, prioritize implementation in areas where there is no radar coverage surveillance, followed by areas where implementation would otherwise bring capacity and operational efficiencies;
 - 3) ensure that implementation of ADS-B is harmonized, compatible and interoperable with respect to operational procedures, supporting data link and ATM applications;
 - 4) identify sub-regional areas where the implementation of ADS-B would result in a positive cost/benefit in the near term, while taking into account overall Regional developments and implementation of ADS-B in adjacent homogeneous ATM areas;
 - 5) be implemented following successful trial programmes with regards to safety and operational feasibility, taking into account studies and implementation experiences from other ICAO Regions;
 - 6) be implemented in close collaboration with users;
 - 7) The proportions of equipped aircrafts are also critical for the ADS-B deployment, for which it is required to periodically provide, at least, the following information: number of equipped aircrafts operating in the concern airspace, number and name of the airlines that have equipped aircrafts for ADS-B, type of equipped aircrafts, categorization of the accuracy/integrity data available in the aircrafts;

- 8) The ADS-B deployment should be associated at early stages in coordination with the States/Regional/International Organizations responsible for the control of adjacent areas, and the correspondent ICAO Regional Office, establishing a plan in the potential areas of ADS-B data sharing, aimed at a coordinated, harmonious and interoperable implementation;
 - 9) Each State/Regional/International Organization should investigate and report their own Administration's policy in respect to the ADS-B data sharing with their neighbours and from cooperative goals;
 - 10) The ADS-B data sharing plan should be based selecting centres by pairs and analyzing the benefits and formulating proposals for the ADS-B use for each pair of centre/city with the purpose to improve the surveillance capacity;
 - 11) Likewise, it is necessary to consider implementing surveillance solutions for surface movement control by the implementation of ADS-B; and
 - 12) The implementation would be in conformity with the SARPs, ICAO guidelines and the MIDANPIRG conclusions and according to MID Surveillance Strategy where the time line for implementation is set for 2017.
- B) The implementation would require aircraft equipped with avionics compliant with either:
- i) Version 0 ES as specified in Annex 10, volume IV, Chapter 3, paragraph 3.1.2.8.6 (up to and including amendment 83 to annex 10) and chapter 2 of draft technical Provisions for Mode S services and extended Squitter (ICAO Doc 9871) to be used till at least 2020, or
 - ii) Version 1 ES as specified in chapter 3 draft Technical Provisions for Node S Services and Extended Squitter (ICAO Doc 9871) Equivalent to DO260A.
- C) Implementation should be monitored to ensure collaborative development and alignment with the MID Region projects and relevant elements of the GPIs.

APPENDIX F



SURVEILLANCE STRATEGY FOR THE CAR/SAM REGIONS

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 Annex C:

- Primary Radar (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 two 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 cooperative targets in TMA and en-route airspace; and
- Dependent cooperative surveillance.

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. SSR, 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)

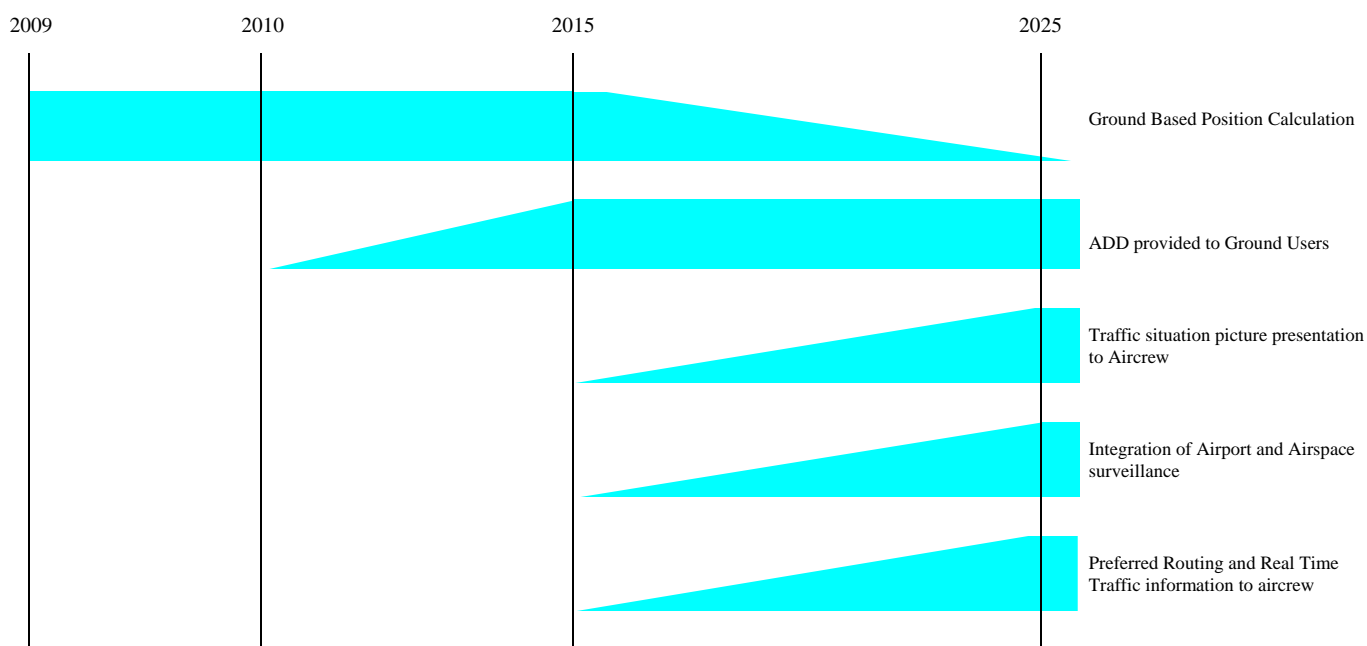
The implementation of new ground Surveillance Applications (ADS-B out), which will require integration between the aircraft navigation system and mode S transponders, in order to transmit intent information to other aircraft and ground users. This is enabled by ADS-B, using 1090 MHz Extended Squitter.

2.3.3 Long term (until 2015-2025)

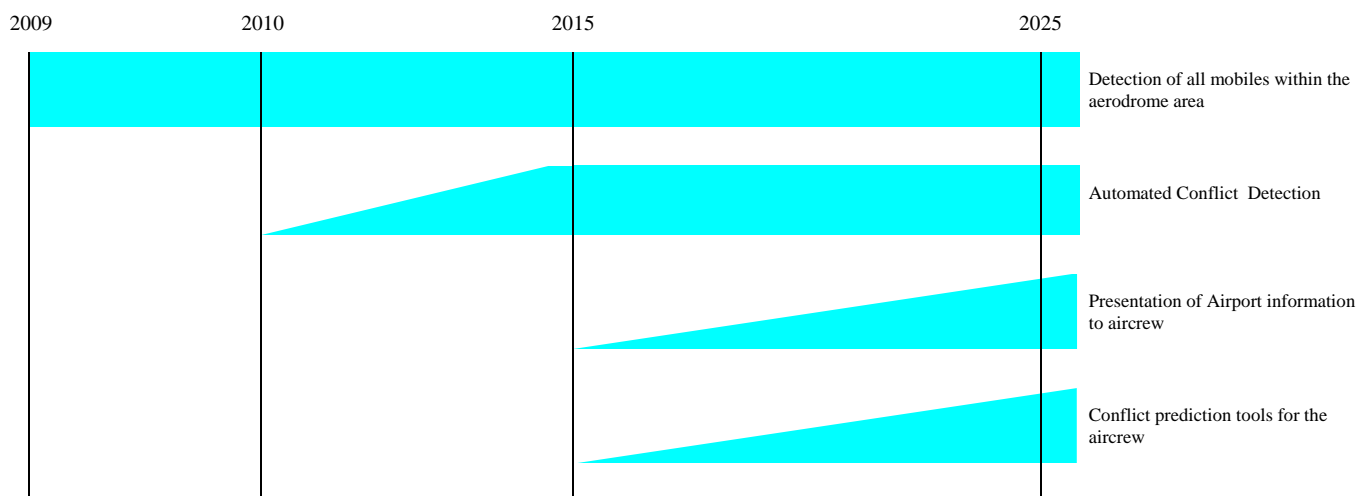
The implementation of ADS-B ASAS situational awareness applications will require an additional airborne SDPS and display system.

2.4 Operational Drivers Timeframe

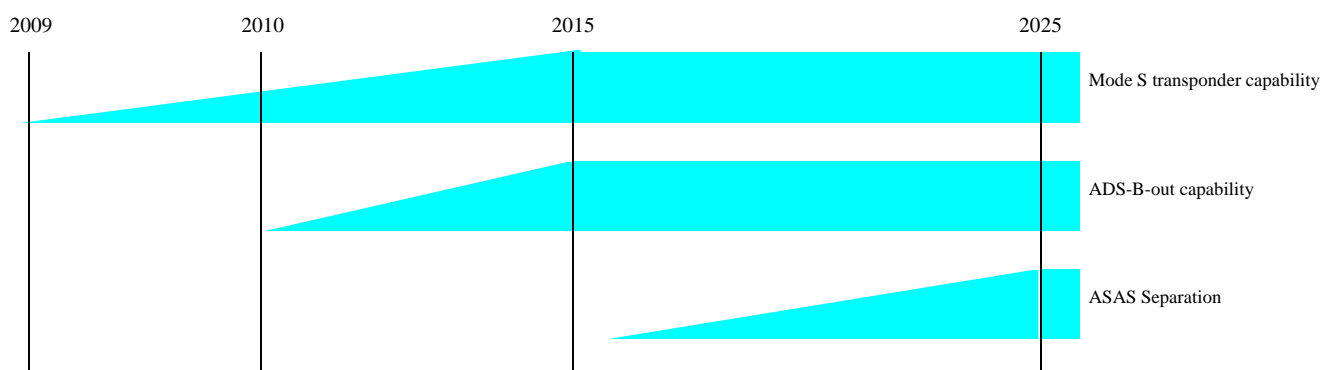
En Route and TMA Airspace



Aerodrome Operations



Aircraft Systems



3. Surveillance Infrastructure Evolution

3.1 En-Route and TMA Airspace

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).

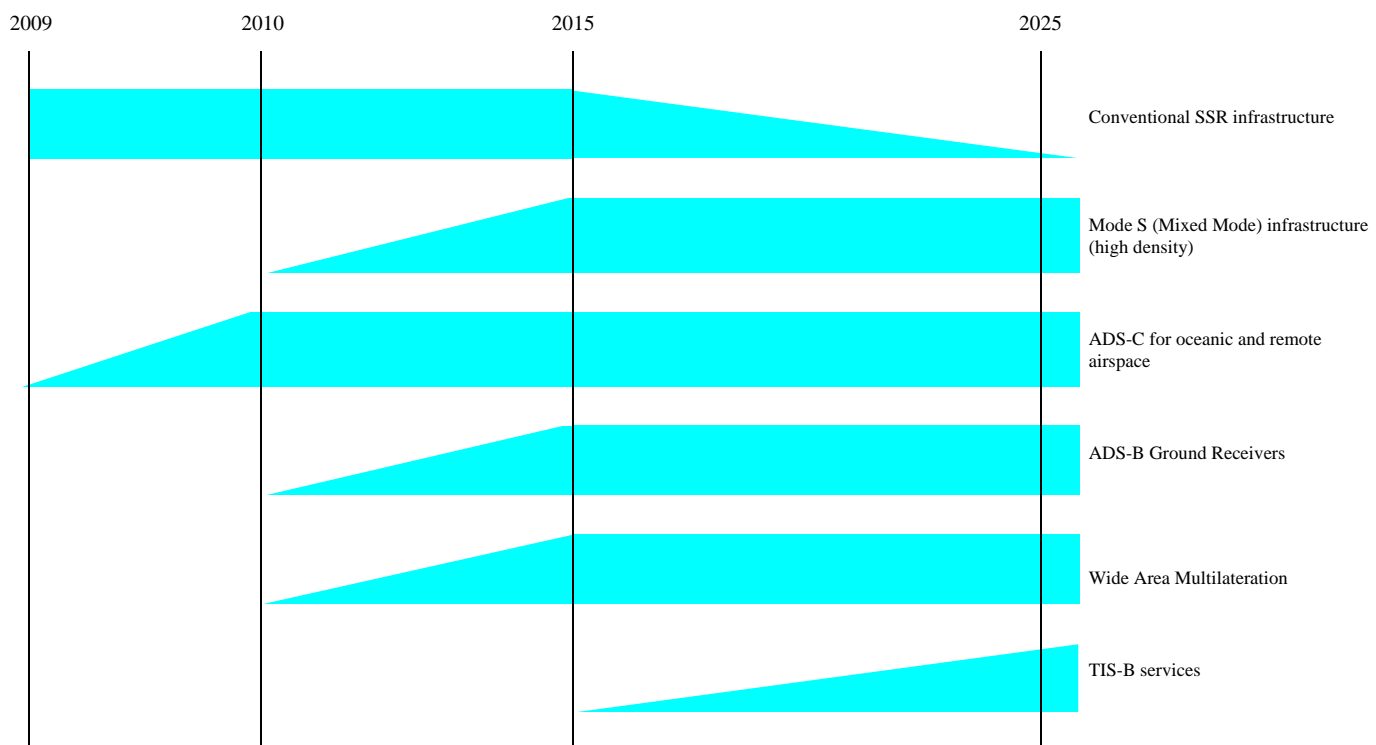
If aircraft are operating in airspace where the ADS-B Package I ground based surveillance applications are in use, then the avionics configuration will require changes to deliver the additional aircraft derived data required.

3.3.3 Long term (until 2015-2025)

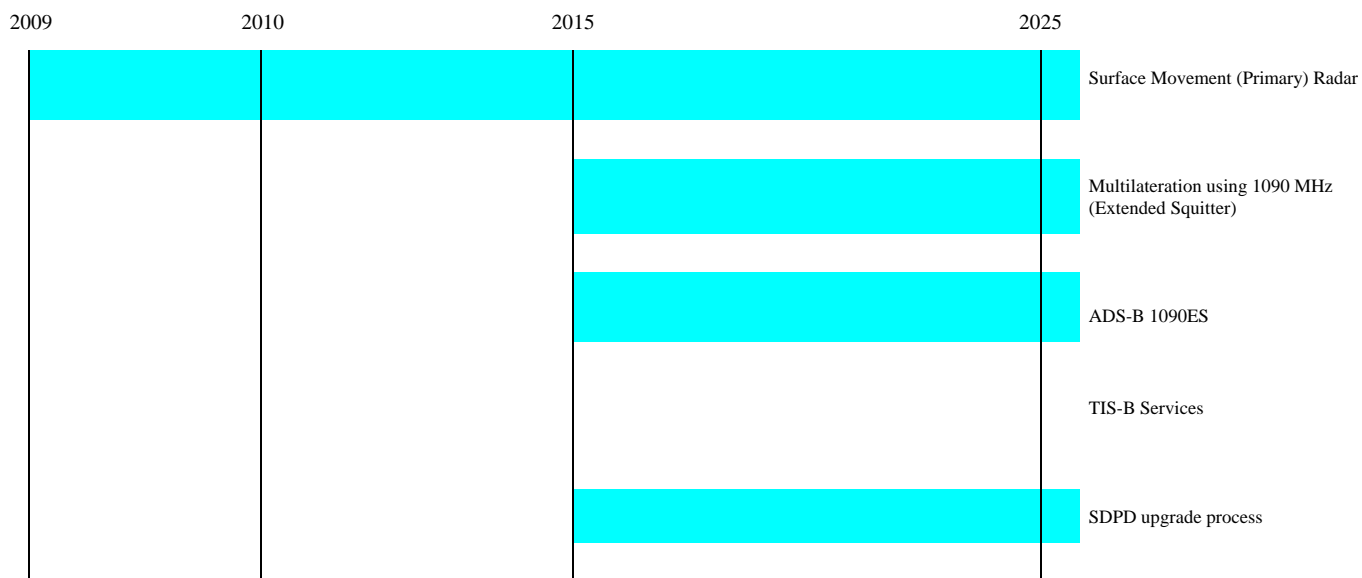
The move from ASAS spacing to ASAS separation and preferred routing may require a high integrity traffic situation picture, therefore the use of TIS-B may be required as well as the implementation of an airborne Surveillance Data Processing System (SDPS) to integrate ADS-B in and TIS-B for presentation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

3.4 Surveillance Infrastructure Timeframe

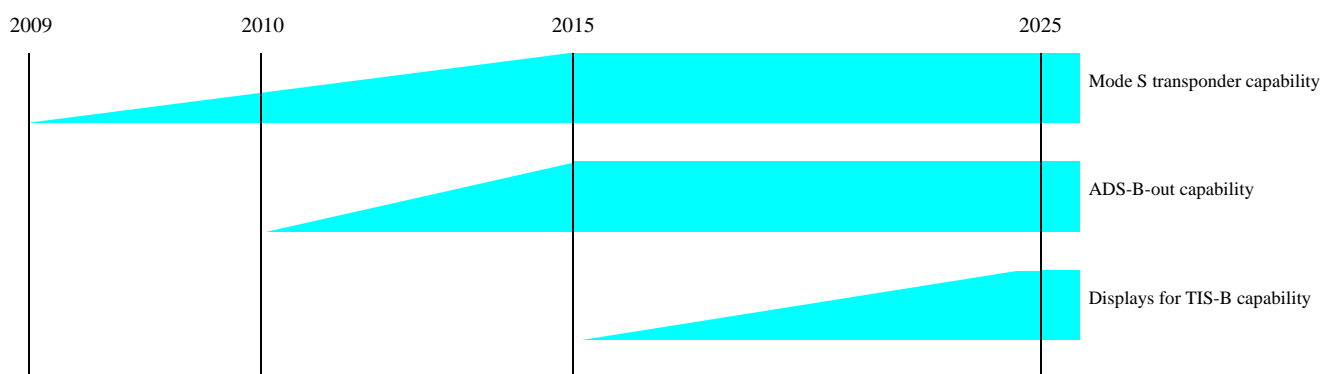
En Route and TMA Airspace



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.

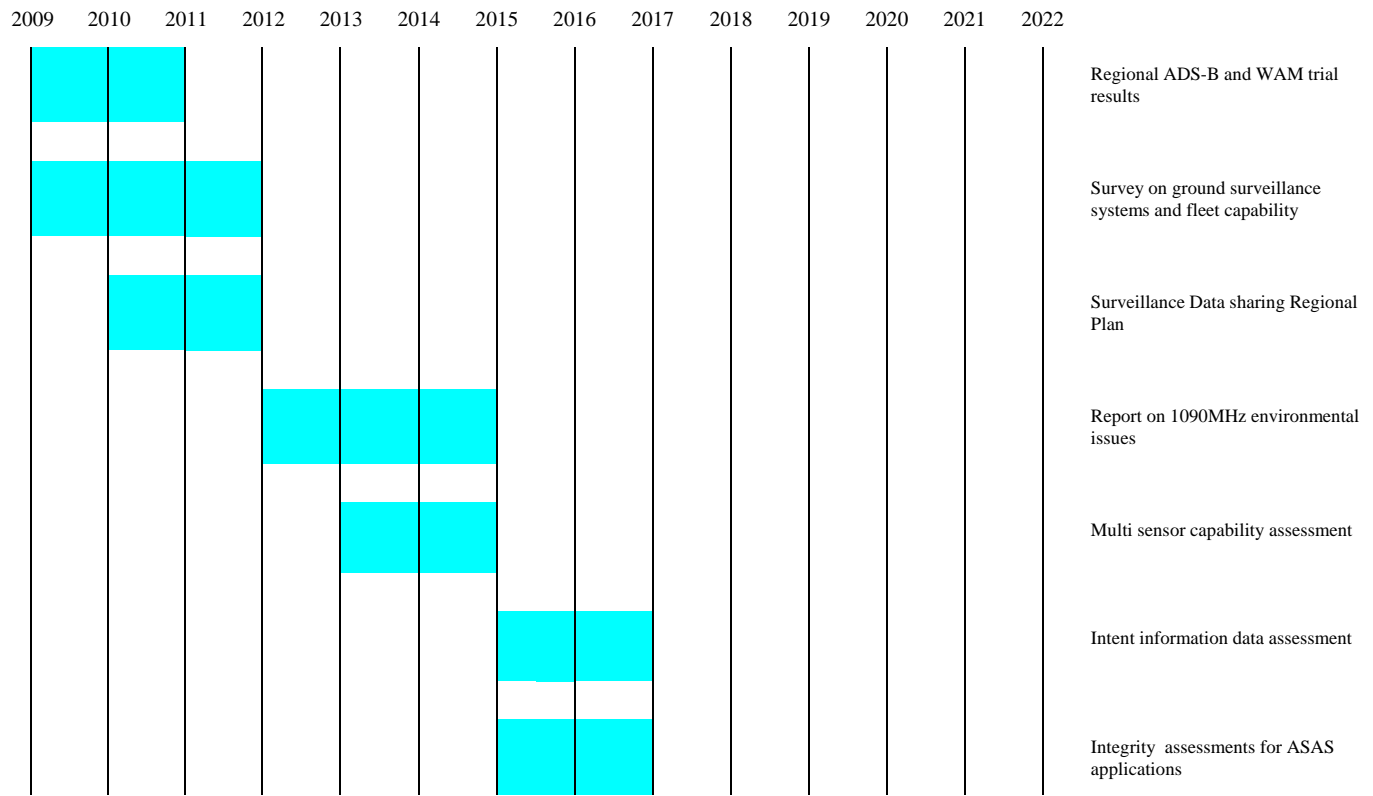
3.5.3 **Long term (until 2015-2025)**

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

Timeframe of the regional action plan



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.

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.