EUROPEAN ORGANISATION
FOR THE SAFETY OF AIR NAVIGATION

EUROCONTROL

The Surveillance Strategy for ECAC

Edition Number	**:**	**2.0**
Edition Date	**:**	**18 November 2005**
Status	**:**	**Released Issue**
Intended for	**:**	**General Public**

EUROPEAN AIR TRAFFIC MANAGEMENT PROGRAMME

DOCUMENT CHARACTERISTICS

The Surveillance Strategy for ECAC

	EATMP Infocentre Reference	5/10/17-2
Document Identifier	**Edition Number:**	2,0
	Edition Date:	18 November 2005

Abstract

This document defines the Surveillance Strategy for ECAC from today to 2020+. The document identifies the operational drivers for change during that period and identifies the surveillance evolution necessary to enable the operational changes.

In brief it foresees (for TMA and En-Route airspace):

- The continuation of Primary Surveillance Radars where required.
- A migration to dependent cooperative surveillance (based on ADS-B) combined with Cooperative Independent Surveillance such as SSR Mode S and Wide Area Multi-Lateration.
- An increasing use of Aircraft Derived Data.
- The increasing use of surveillance data onboard the aircraft to support Air Traffic Situational Awareness and later an increasing delegation of responsibility for separation to the aircraft.

Keywords

Surveillance	Strategy	Mode-S	ADS
Multi-Lateration	SSR	PSR	RSP

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STATUS, AUDIENCE AND ACCESSIBILITY

Status		**Intended for**		**Accessible via**	
Working Draft	☐	General Public	☑	Intranet	☐
Draft	☐	EATMP Stakeholders	☐	Extranet	☐
Proposed Issue	☐	Restricted Audience	☐	Internet (www.eurocontrol.int)	☑
Released Issue	☑	*Printed & electronic copies of the document can be obtained from the EATMP Infocentre (see page iii)*			

ELECTRONIC SOURCE

Filename	P:\EATM\DAS\BD_CSM\SUR\100 Surveillance Strategy Directory\02 SUR Strategies\Version 2,0	
	The Surveillance Strategy for ECAC version 2 0	
Host System	Software	Size
Windows_NT	Microsoft Word 10.0	**2967 Kb**

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DOCUMENT APPROVAL

The following table identifies all management authorities who have successively approved the present issue of this document.

AUTHORITY	NAME AND SIGNATURE	DATE
Please make sure that the EATMP Infocentre Reference is present on page ii.		
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DOCUMENT CHANGE RECORD

The following table records the complete history of the successive editions of the present document.

EDITION NUMBER	EDITION DATE	INFOCENTRE REFERENCE	REASON FOR CHANGE	PAGES AFFECTED
1.0	14.11.97		Approval by the Surveillance Team.	All
1.1	07.09.05	Intermediate deliverable – not for widespread distribution.	Scheduled update. (Note: Interim releases were made available to the Surveillance Strategy Task Force).	All
1.2	18.10.05	Ditto.	Feedback from the SSTF and Surveillance Team.	All
1.3	21.10.05	Ditto.	Post SSTF #6 feedback.	All
2.0	18.11.05	5/10/17-2	Approval by the Surveillance Team.	All

CONTENTS

Executive SUMMARY

Introduction

This document presents the Surveillance Strategy for ECAC. The strategy has been developed by the EUROCONTROL Communications and Surveillance Management (CSM) Business Division, in cooperation with its stakeholder forum, the Surveillance Team.

The objective of the surveillance strategy is to define an evolutionary path for surveillance and to promote safety, security, interoperability and cost effectiveness of the infrastructure to enable, in a timely manner, the future ATM concepts. The surveillance strategy recognises that the ATM community are extremely safety conscious. Therefore the surveillance strategy presents a set of 'evolutionary' rather than 'revolutionary' recommendations, encouraging a considered transition from current system to future systems where both surveillance systems operate side-by-side during the transition phase.

Content

The surveillance strategy is guidance material for stakeholders. It has no regulatory or mandatory requirements. Where the use of techniques, such as ADS-B or Multi-Lateration, are to be introduced it is necessary for the Air Navigation Service Provider and their regulatory counterpart to ensure that appropriate regulations are established.

This Surveillance Strategy provides an evolutionary and achievable path from the current SSR based infrastructure (more accurately described as cooperative independent surveillance - CIS) to an infrastructure using ADS-B (where the position information is based upon GNSS including GPS and Galileo) – a dependent cooperative surveillance technique, combined with CIS such as SSR Mode S and Wide Area Multi-Lateration where and when required.

This strategy should not be considered in isolation. Various initiatives are underway concerning Required Surveillance Performance, Implementation Rules and also Security considerations. Furthermore, EUROCONTROL and the European Commission are currently developing a Single European Sky ATM/CNS Master Plan for Europe (SESAME). The outcome of SESAME may influence this strategy and any impact arising from the SESAME proposals will be considered in subsequent updates of the Surveillance Strategy.

It is noted that no cost benefit, safety or security assessment has been performed to support the Strategy. Prior to the implementation of a surveillance system, a performance, safety and cost benefit analysis should be performed so that the risks for each option are identified and resolved.

Applicability

The surveillance strategy has been developed based on the operational requirements of the future ATM system in ECAC from today to 2020+ in four steps. These steps are from today to 2010, 2010 to 2015, 2015 to 2020 and 2020+. For each step the ATM operational changes have been characterised and their enabling surveillance requirements identified.

The dates illustrated in the surveillance strategy define when surveillance systems are expected to become operational 'on a widespread basis'. This means that the document defines strategies that apply to large areas of ECAC (typically expressed in terms of, for example 'Northern Europe' or 'Core Europe'). It is anticipated that some of the surveillance systems described in this strategy will be used on a 'local' basis to solve local issues, prior to the timescales in this document.

Ground Based Surveillance Systems for En-Route and TMA

The surveillance strategy 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:

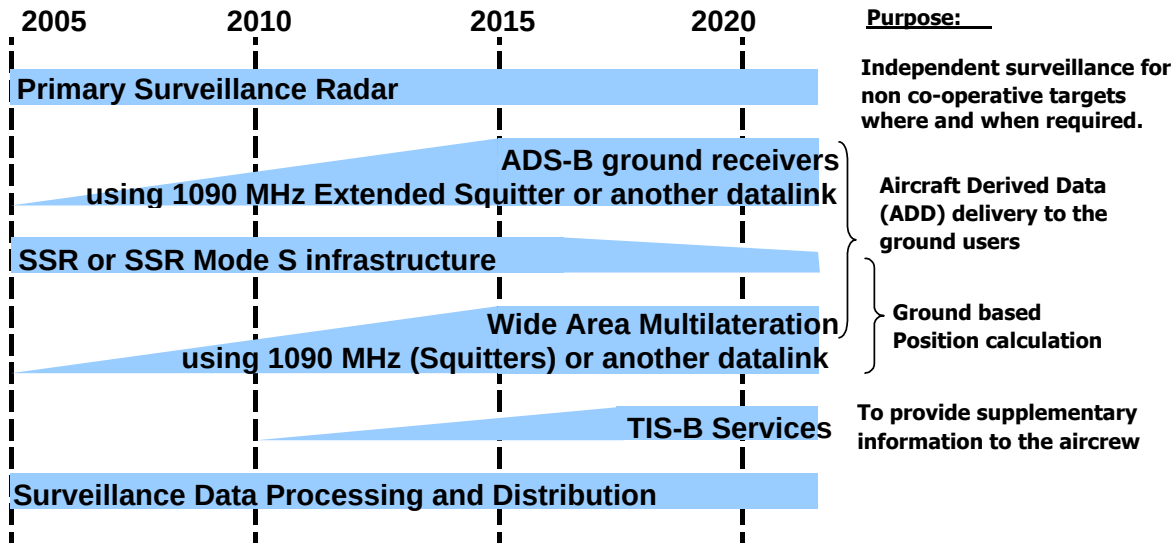
- An independent surveillance system to track non-cooperative targets in TMA and En Route airspace where and when required. This will be provided by primary radar unless and until an alternative solution is required and developed;
- Dependant cooperative surveillance (based upon ADS-B)
- An independent surveillance system to track cooperative targets in TMA and en-route airspace. This can be enabled by SSR and/or SSR Mode S or Multi-Lateration.

Where Airborne Separation Assistance Systems (ASAS) and Air Traffic Situational Awareness (ATSA) spacing and separation applications are being operationally implemented, a ground infrastructure delivering a TIS-B service may be required.

The surveillance strategy foresees the ADS-B datalink as initially being 1090 MHz Extended Squitter but in the longer term another (global) link may be required (either as a replacement to 1090 Extended Squitter, due to saturation of the 1090 MHz, or as a dual link)

The surveillance strategy foresees the continued need for surveillance data processing systems which will require updating to process and deliver the new information to surveillance users as the new systems become operational.

From 2007, the use of ADDs to support TMA and En Route operations is envisaged;

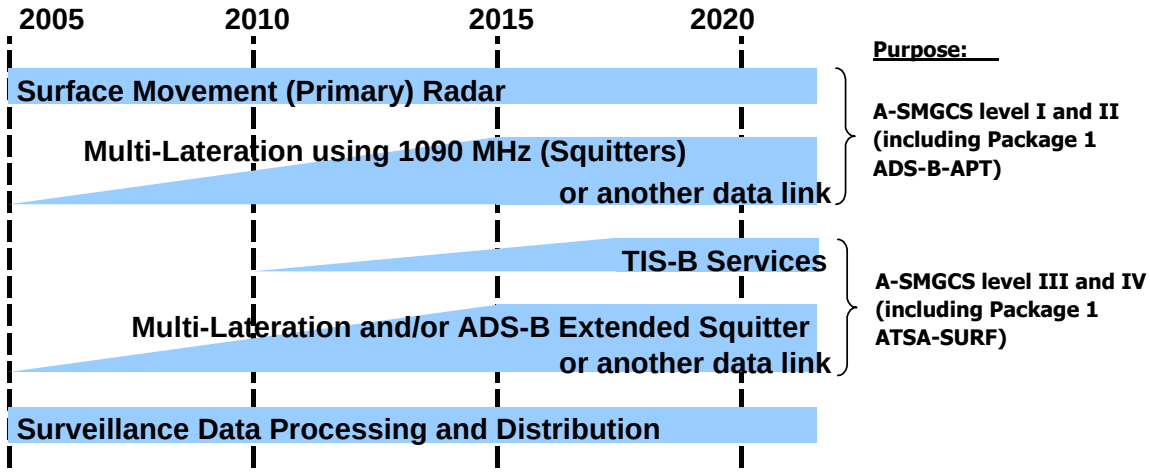


Ground Based Surveillance Systems for En-Route and TMA Surveillance Systems

Aerodrome Operations

Where appropriate the surveillance strategy for aerodromes is based on:

- The implementation of A-SMGCS level I (which may include ADS-B Package I, ADS-B-APT (Airport) application) and A-SMGCS level II from today onwards will be enabled by systems such as SMR and Multi-Lateration. From 2010, the use of ADDs to support aerodrome operations is envisaged;
- Where airport operators foresee a benefit of A-SMGCS level III (which may include the ADS-B Package I, ATSA SURF (Airborne Traffic Situation Awareness on the airport surface)) and IV[1] from 2010 onwards. This may require an ADS-B and TIS-B infrastructure and an equipage of selected, appropriate airport vehicles with transponders.



Aerodrome Surveillance Systems

Aircraft Systems

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

- Continuing the use of SSR or SSR Mode S systems for ground based surveillance radar or Multi-Lateration systems. This means that no additional equipment is foreseen on the aircraft in the short term;
- The implementation of ADS-B Package I ASAS applications from 2010 onwards which will require the aircraft to transmit information to other aircraft and ground users. This is enabled by ADS-B using 1090 MHz Extended Squitter or other data-links. In addition, an airborne SDPS and display system will be required;
- The implementation of ADS-B Package II ASAS separation applications from 2015 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.

[1] Note that the EUROCONTROL Airports and Environment Business Division is currently defining A-SMGCS Level III and IV

Conclusion

This Surveillance Strategy details a reasoned and achievable evolution of the Surveillance infrastructure to meet anticipated future requirements.

In brief it foresees for TMA and En-Route airspace:

- The continuation of Primary surveillance radars where required.
- A migration to dependent cooperative surveillance (based on ADS-B) combined with Cooperative Independent Surveillance such as SSR Mode S and Wide Area Mulit-Lateration.
- An increasing use of Aircraft Derived Data.
- The increasing use of surveillance data onboard the aircraft to support Air Traffic Situational Awareness and later an increasing delegation of responsibility for separation to the aircraft.

It also foresees an increased use of ADS-B and/or Multi-Lateration at aerodromes where appropriate.

This document is expected to influence, and in turn be influenced by, other initiatives that are ongoing in parallel. The influence of SESAME and such related activities is to be assessed over the near future.

1 Foreword

1.1 About the Document

1.1.1 General

1.1.1.1 The Surveillance Strategy for ECAC details the rationale for change and guidance activities for the future evolution of surveillance in ECAC.

1.1.2 Objectives of the surveillance strategy

1.1.2.1 The objective of the surveillance strategy is to define an evolutionary path for surveillance which promotes safety, security, interoperability and cost effectiveness of the infrastructure to enable, in a timely manner, the future ATM concepts.

1.1.2.2 The surveillance strategy has been developed in cooperation with stakeholders to agree the future direction of the surveillance infrastructure within ECAC, for both the ground and the airframe components.

1.1.2.3 A goal of the surveillance strategy is a seamless surveillance infrastructure that will permit an aircraft to fly throughout ECAC such that the surveillance equipage is interoperable[2] anywhere in ECAC in a cost effective manner.

1.1.2.4 The surveillance strategy is presented in four steps, namely:

- From today through to 2010;
- From 2010 to 2015;
- From 2015 to 2020;
- From 2020 onwards.

1.1.2.5 The purpose of the surveillance strategy is to ensure that the surveillance infrastructure in ECAC is operationally available at the required time and can be safely operated throughout ECAC.

1.1.2.6 The surveillance strategy recognises that the ATM community are extremely safety conscious. Therefore the surveillance strategy presents a set 'evolutionary' rather than 'revolutionary' recommendations, encouraging a gradual transition from old systems to new systems where dual surveillance systems operate side-by-side during the transition phase.

1.1.2.7 This document is guidance material for stakeholders. It contains no regulatory or mandatory requirements. Where the use of techniques, such as ADS-B or Multi-Lateration, are to be introduced it is necessary for the Air Navigation Service Provider and their regulatory counterpart to ensure that appropriate regulations are established.

1.1.2.8 The document identifies achievable objectives. It remains necessary to ensure that the future activities of detailing the requirements, validating the system performances and maintaining acceptable safety levels, are performed.

[2] Interoperability includes, from a technical perspective, the exchange of surveillance information from ground-to-air, air-to-ground and air-to-air. Interoperability also includes, from a gate-to-gate perspective, the seamless exchange of surveillance information throughout all phase of flight.

1.2 Responsible Body and Acknowledgements

1.2.1.1 This document has been developed by the EUROCONTROL Surveillance Domain of the Communications and Surveillance Management (CSM) Business Division, in cooperation with its stakeholder forum, the Surveillance Team. A dedicated Surveillance Strategy Task Force was established mid 2004 solely for the purpose of drafting the surveillance strategy.

1.2.1.2 The surveillance strategy will be reviewed and updated every two years.

2 Introduction

2.1 Relationship to other Strategies and documents

2.1.1.1 The surveillance strategy provides a link between the ICAO operational concept, future ATM concepts as defined in the EUROCONTROL Air Traffic Management Strategy for the Years 2000+ [reference 7] and regional strategies (such as national strategies). The surveillance strategy provides:

- A link between EUROCONTROL Air Traffic Management Strategy for the Years 2000+ and surveillance specific aspects;
- Guidance to stakeholders for local surveillance implementation;
- Guidance to EUROCONTROL for their activities;
- Guidance for aeronautics industry for product development.

2.1.1.2 A key driver for the surveillance strategy is to provide the 'glue' between the EUROCONTROL Air Traffic Management Strategy for the Years 2000+ and other strategies to ensure interoperability both from the air/ground perspective and across national borders. Therefore this strategy sits between the EUROCONTROL Air Traffic Management Strategy for the Years 2000+ and stakeholder strategies as illustrated in Figure 1.

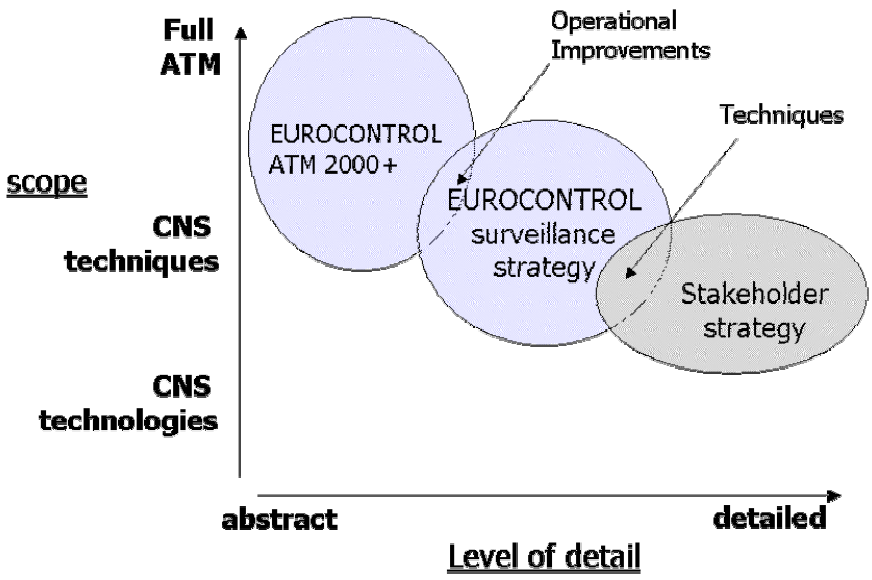


Figure 1 - Relationship between the EUROCONTROL Air Traffic Management Strategy for the Years 2000+, the surveillance strategy and stakeholder strategies

2.2 Scope of strategy

2.2.1.1 The surveillance strategy concerns surveillance within the ECAC area.

2.2.1.2 The EUROCONTROL Airspace Strategy for the ECAC States [reference 5] defines an evolution of ICAO airspace classifications towards a simpler 'N' or 'U' classification as illustrated in Figure 2. This strategy specifically applies to 'N' classification airspace where all traffic is known to ATS with position and flight data related to the intended flight path.

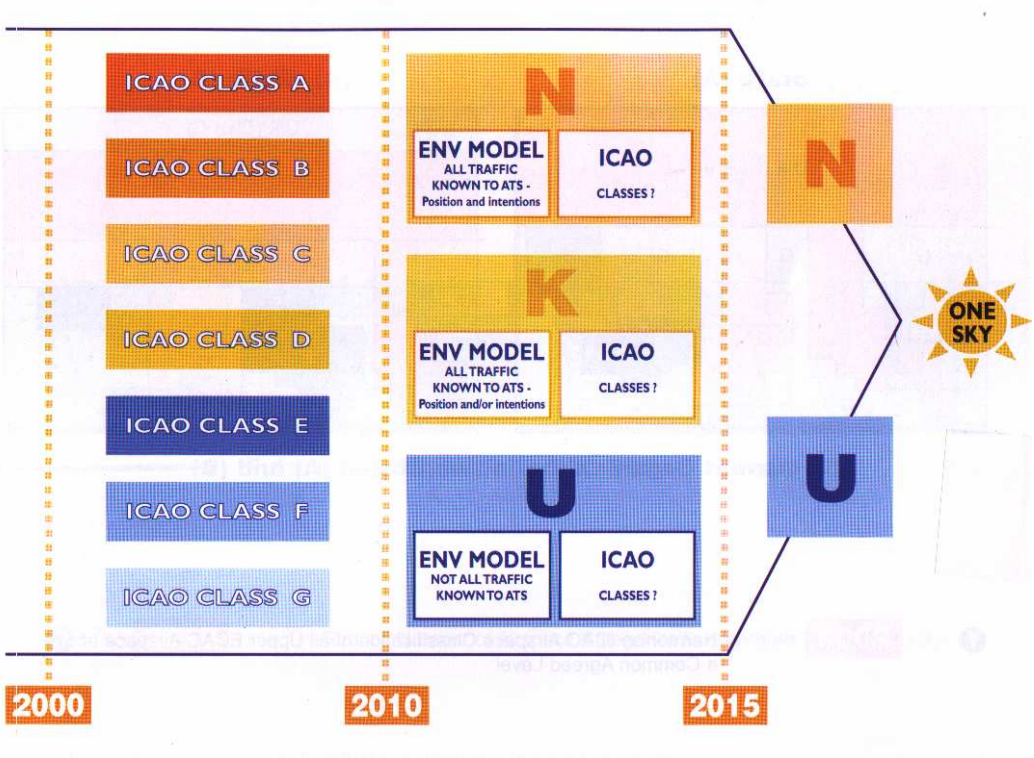


Figure 2 - Airspace design and change process

2.2.1.3 The surveillance strategy applies to any airspace outside segregated area where a surveillance service is required.

2.2.1.4 The surveillance strategy concerns all surveillance systems used in the gate-to-gate context. That is from aerodrome operations, through terminal and En-Route airspace. One long-term goal of this strategy is to encourage exchange of information between airport (surveillance) systems and TMA airspace (surveillance) systems through common standards, for example for Surveillance Data Processing systems.

2.2.1.5 The surveillance strategy covers the complete lifecycle of surveillance systems, from initial concept development, through research, development, operational use and decommissioning of the surveillance system.

2.2.1.6 The surveillance strategy, complemented by the Surveillance Product and Tools Strategy [3], is related to the EUROCONTROL Surveillance Functional Architecture (SFA) [reference 4], as represented in Figure 3.

2.2.1.7 The surveillance strategy considers the interface and service between civil and military surveillance systems.

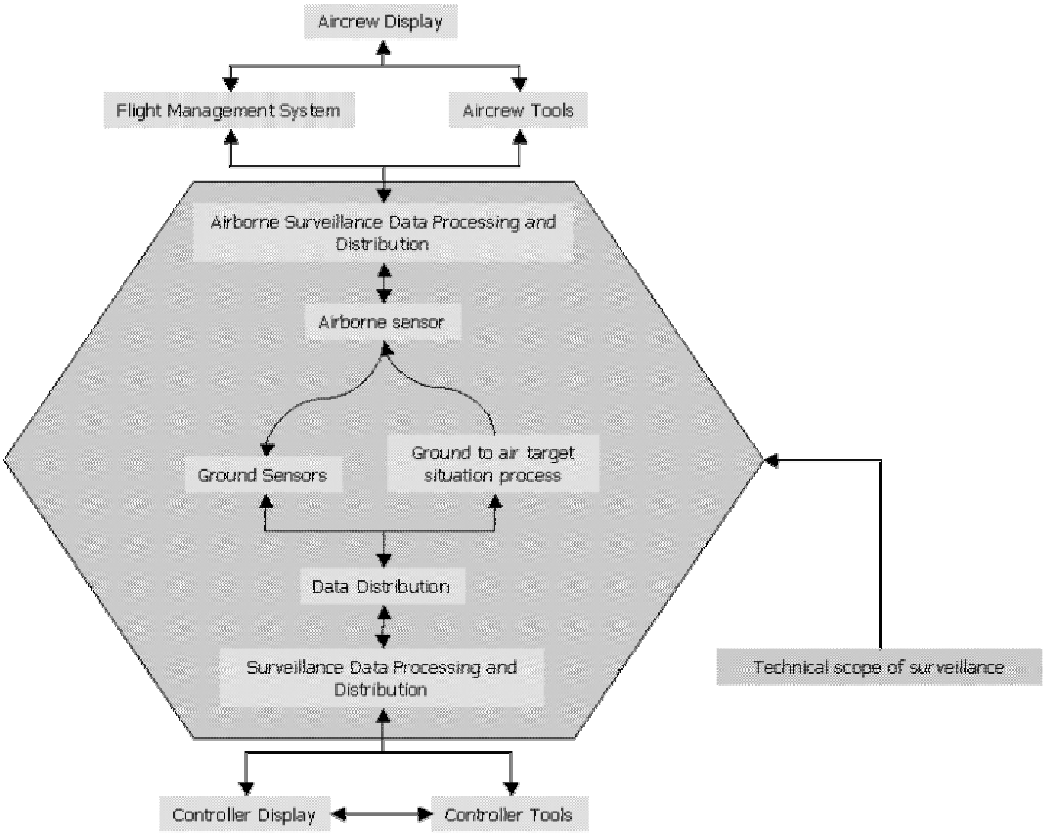


Figure 3 - Technical scope of the surveillance and surveillance products and tools strategy

[3] A Surveillance Products and Tools Strategy is in the process to be drafted.

2.2.1.8 It is noted that no cost benefit, safety or security assessment has been performed to support the Strategy. Prior to the implementation of a new surveillance system, a safety and cost benefit analysis should be performed so that the risks for each option are identified and resolved. Stakeholders may select the techniques and technologies best suited to their operational environment

2.3 Exclusions

2.3.1.1 The scope of the surveillance strategy does not include the following:

- The use of the information by the users (e.g. how the ATM tools [e.g. STCA, FDPS]) process the information or how it is displayed to and used by the human);
- The flight plan to track correlation function;
- Meteorological sensors, including the processing for display of weather returns;
- Wake vortex sensors;
- Alternative technology devices as employed at the aerodrome (e.g. Closed Circuit Television or induction pads);
- TCAS/ACAS;
- The use of surveillance information for non-ATM purposes (e.g. fleet management).

2.3.1.2 The surveillance strategy does not consider funding options for the recommendations made in this document.

2.3.1.3 The surveillance strategy does not consider whether mandates are necessary to meet the timescales in the document.

2.4 Stakeholders

2.4.1.1 The stakeholder groups considered in this strategy are[4]

- Aeronautics industry.
- Airport operators.
- Airspace users.
- Air Navigation Service Providers.
- EUROCONTROL Agency.
- International organisations.
- Military Authorities.
- Regulatory bodies.

2.4.1.2 It is noted that this surveillance strategy may impact upon air navigation services outside ECAC (for example the Federal Aviation Authority or the Russian aviation community). It is important that co-ordination with these entities takes place (e.g. through Memorandum of Co-operation) to ensure interoperability of systems, in particular at the border of ECAC.

[4] The stakeholder listed here are those defined in the ECIP (section 6) [reference 2] and the EATMP Stakeholder Segmentation Model [reference 1]

3 Inputs to the Surveillance Strategy

3.1 Introduction

3.1.1.1 This section identifies the drivers and inputs to the surveillance strategy.

3.2 EUROCONTROL

3.2.1 EUROCONTROL Air Traffic Management Strategy for the Years 2000+

3.2.1.1 The EUROCONTROL Air Traffic Management Strategy for the Years 2000+ was developed at the request of ECAC transport ministers to allow ECAC states to accommodate the predicted increase in air traffic

3.2.1.2 The EUROCONTROL Air Traffic Management Strategy for the Years 2000+ provides a high level strategic concept for the evolution of ATM. Within it, surveillance is identified as one of the key enablers for the future ATM concepts, for example, ADS-B is explicitly identified as a key enabler for air-to-air surveillance.

3.2.1.3 The key concepts from the EUROCONTROL Air Traffic Management Strategy for the Years 2000+ which will drive the surveillance strategy are

- The re-distribution of tasks:
  - Between controller and pilot
  - Between human and machine
- Deployment of advanced surveillance techniques (ATM sector productivity)
- Interoperability criteria and information management mechanisms, if possible at global scale, to allow system architecture convergence and seamless interfaces (infrastructure efficiency)
- Further use of satellite navigation (infrastructure efficiency)

3.2.1.4 The EUROCONTROL Air Traffic Management Strategy for the Years 2000+ also recommends a pan-European approach to ATM, including planning, management and information exchange. This includes the exchange of surveillance information.

3.2.1.5 The EUROCONTROL Air Traffic Management Strategy for the Years 2000+ also identifies[5] a need for 'improved surveillance systems' which will enable airports to reduce separation both in single and parallel runway configurations.

[5] Vol 2 para 6.6.4

3.2.2 Strategic Performance Planning Process

3.2.2.1 The aim of the EUROCONTROL Strategic Performance Planning process is to set performance targets and to select, group and plan the Operational Improvements into a set of 'clusters' as illustrated in Figure 4. The process further aims to clarify the relationship between Operational Improvements and also between Operational Improvements and their Enablers. This process provides stakeholders with a clearer 'Roadmap of Change' to achieve the goals of the EUROCONTROL Air Traffic Management Strategy for the Years 2000+.

3.2.2.2 It is noted that the current Roadmap is still a working draft that is not yet released pending possible impact and changes as a result of the SESAME. However, the results of the Strategic Performance Planning process have been used in several EUROCONTROL documents like the EATM Performance Enhancement Activities, Edition 2004 - Main Document [reference 3].

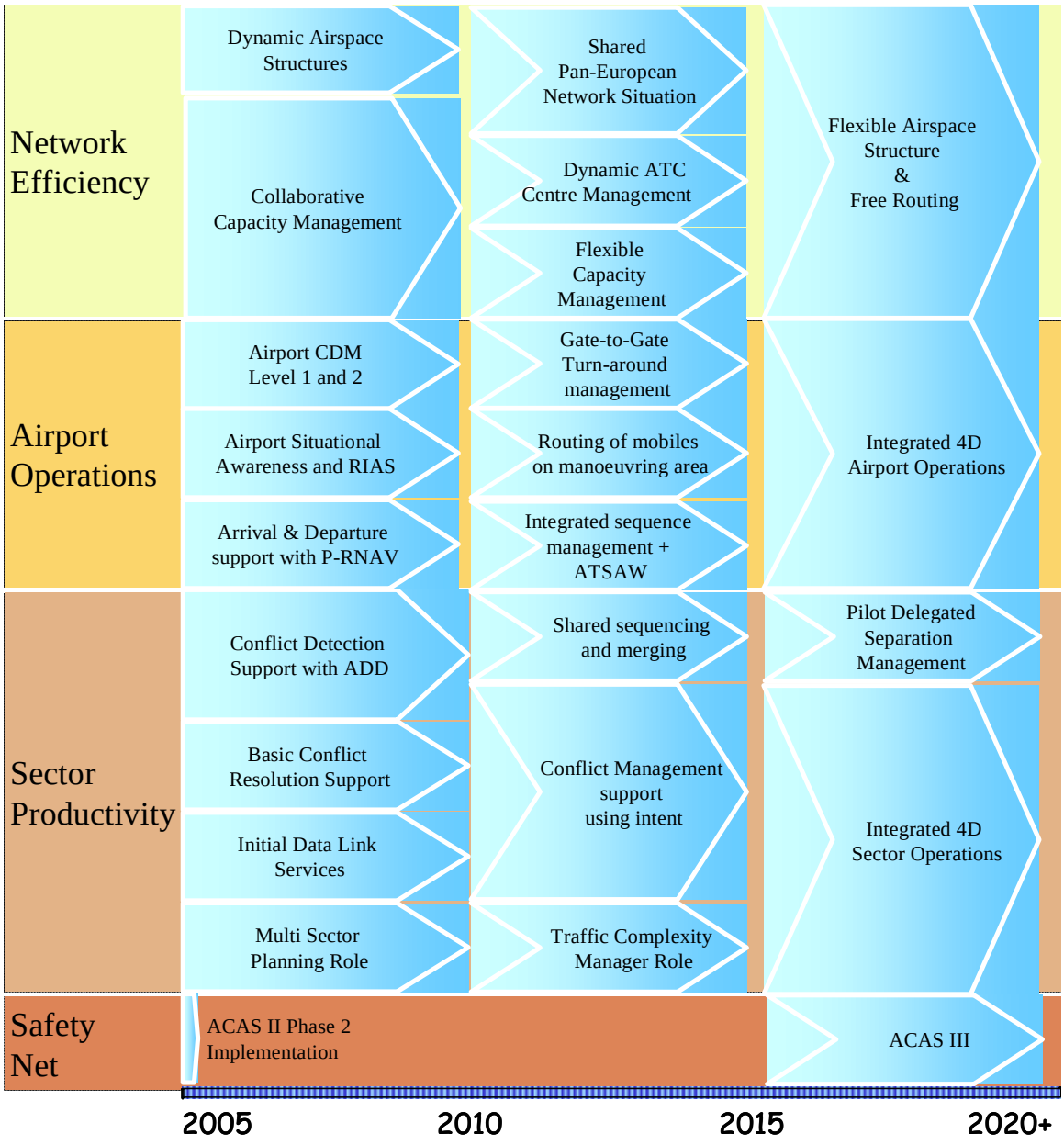


Figure 4 - overview of all SPF Operational Improvement Clusters

3.2.3 Operational Improvements Clusters

3.2.3.1 Operational Improvement Clusters are a set of high level statements to enable the EUROCONTROL Air traffic Management Strategy for the Years 2000+. They are defined in a number of time steps, namely

- 2005-2009
- 2010-2014
- 2015-2020

3.2.3.2 In general, the surveillance contributions, as enablers of the Operational Improvements, are that the surveillance systems provide a suitable, timely availability and cost/effective ATM surveillance system infrastructure.

3.2.3.3 Annex 3 provides descriptions of the Operational Improvement Clusters that form the Roadmap of change in support of realizing the EUROCONTROL Air Traffic Management Strategy for the Years 2000+.

3.3 National Strategy

3.3.1.1 No drivers have been identified from National strategies which conflict with this strategy

3.4 Additional sources

3.4.1 Safety

3.4.1.1 Safety is the key driver within Air Traffic Management. No systems shall be allowed to be operated which are not 'safe'. It is the responsibility of the EUROCONTROL programmes, ANSPs, airlines and the aeronautics industry to ensure that this is achieved.

3.4.1.2 For the surveillance strategy, all stakeholders are responsible for ensuring the surveillance systems meet their safety parameters (e.g. availability or reliability).

3.4.2 Security

3.4.2.1 Requirements are emerging relating to Security. In particular the following will need to be evaluated in co-ordination with Stakeholders and other EUROCONTROL Domains, like the Security Domain, and the Military Domain:

- Exchange of surveillance information between civil/civil users and civil/military users;
- Detection and tracking of non-cooperative aircraft;
- Secure data networks;
- Detection of the loss or degradation of service due to voluntary or involuntary interference by third parties;
- Detection of false targets introduced into the system.

3.4.2.2 These security requirements can have an impact on surveillance in two ways. Firstly the need for a ground based surveillance system where the ground based surveillance system can track and identify aircraft independent from avionics. To achieve this, an improved exchange of surveillance information between military and civil might be required. Secondly, all exchange of surveillance information may need to be protected. Consequently EUROCONTROL should consider whether the requirement that a move towards secure air-ground, ground-air and air-air communications (e.g. encrypted) is necessary.

3.4.2.3 These requirements could imply primary coverage in all airspace.

3.4.2.4 Whilst the requirements identified above are currently under investigation they are not yet formalised and are not therefore considered further within the scope of this strategy.

3.4.2.5 The security requirements should be co-ordinated within the SSM Business Division and the Military Domain and future versions of the Surveillance Strategy adapted accordingly.

3.4.3 Military ATM

3.4.3.1 The EUROCONTROL Air Traffic Management Strategy for the Years 2000+ states that the ATM network shall satisfy national security as well as national and international defence requirements.

3.4.3.2 The EUROCONTROL Air Traffic Management Strategy for the Years 2000+ states clearly that civil and military systems should be interoperable

3.4.3.3 Therefore this surveillance strategy supports national security in respect of the identification of flights entering a State's national territory, and Air Defense organizations have to be provided with all ATM information relevant to their task. In addition, the application of the Flexible Use of Airspace concept will also lead to a mixed environment where all airspace users share the same airspace. In this mixed environment it is extremely important that civil and military aviation co-ordinate their activities. The exchange of information between civil and military Air Navigation Service providers is therefore essential for civil-military co-ordination, and can only be achieved if civil and military systems are interoperable.

3.4.3.4 The surveillance strategy is concerned with airspace outside segregated areas, however the military impact is considered both through the sharing of information between civil and military centres and system interoperability.

3.4.4 Regulator requirements

3.4.4.1 The Regulators are responsible for ensuring the necessary regulatory procedures are established, implemented and maintained to provide an appropriate quality of service. This is achieved through the development and approval of certain documents or standards, such as Implementing Rules, prior to operational approval.

3.4.4.2 The regulator does not define strategy but will be responsible for approving standards and procedures for the operational approval of new services.

3.4.4.3 No specific regulatory requirements were identified for inclusion in this Surveillance Strategy.

3.4.5 ICAO

3.4.5.1 At the recent ICAO 11th Air Navigation Conference (2003), the conference supported the early implementation of packages of ground and airborne ADS-B applications [reference 6]. The set of ADS-B applications (typically referred to a Package I) is a group of ground based surveillance, air traffic situation awareness and spacing applications enabled by ADS-B.

3.4.6 Standardisation groups

3.4.6.1 Whilst Standardisation groups do not define strategy, they are responsible for developing the standards to enable the surveillance strategy. Examples include:

- Operational Standards (e.g. from ODIAC);
- Equipment specifications (e.g. from EUROCONTROL programmes or ANSPs) or MASPS and MOPS (e.g. from EUROCAE);
- SARPS (e.g. ICAO).

3.4.6.2 There are no requirements coming from the standardisation groups relevant to the surveillance strategy. However current standards (e.g. SSR Mode S transponders) should be adhered to.

3.4.7 Single European Sky ATM/CNS Master Plan (SESAME)

3.4.7.1 Various initiatives, such as Implementation Rules, are underway and these may impact upon the path the Strategy follows. Furthermore, EUROCONTROL and the European Commission are currently developing a Single European Sky ATM/CNS Masterplan for Europe (SESAME). Any impact arising from the these initiatives will be considered in subsequent updates of the Surveillance Strategy (foreseen in 2007).

4 Surveillance Strategy

4.1 Introduction

4.1.1 Timescales

4.1.1.1 The surveillance strategy is defined from today to 2020+ in four steps, namely:

- The surveillance strategy from today through to 2010 (section 4.2);
- The surveillance strategy from 2010 to 2015 (section 4.3);
- The surveillance strategy from 2015 to 2020 (section 4.4);
- The surveillance strategy from 2020 onwards (section 4.5).

4.1.1.2 Each step of the surveillance strategy details the operational and technical environment relevant during that period and discusses the surveillance infrastructure for En-Route and TMA, Aerodrome operations and aircraft systems, required to enable the environment at the end of that step.

4.1.1.3 Inevitably the accuracy of the surveillance strategy in the near term is higher than that of the longer term. Therefore, although the surveillance strategy up to 2015 is considered 'mature' it needs to be updated regularly.

4.1.1.4 The dates illustrated in the surveillance strategy define when surveillance systems are expected to become operational 'on a widespread basis'. This means that the document defines strategies that apply to large areas of ECAC (typically expressed in terms of, for example, 'Northern Europe' or 'Core Europe'). It is anticipated that some of the surveillance systems described in this strategy will be used on a 'local' basis to solve local issues, prior to the timescales in this document, and thereby supports the operational roll-out from pioneer areas into other areas.

4.1.2 Principal sources of information

4.1.2.1 Two principal sources of information have been used ECIP and SPF.

4.1.2.2 The European Convergence and Implementation Plan (ECIP) Level II for the years 2005-2009 [reference 2] provides a set of actions agreed by EUROCONTROL and the Stakeholders which will be carried out over the coming years.

4.1.2.3 The additional requirements for surveillance have been derived from the (draft) Strategic Performance Framework (SPF) Operational Improvement Clusters (see section 3.2.3).

4.1.2.4 Additional sources of information are indicated in the text.

4.2 Surveillance Strategy from today to 2010

4.2.1 Introduction

4.2.1.1 This section presents a overview of the ATM environment evolution from in today to 2010. It presents the operational and technical environment and discusses the surveillance infrastructure required to enable the environment in 2010.

4.2.1.2 The primary source of surveillance requirements is based upon the ECIP and the Operational Improvement Clusters for 2005 – 2009, see section 3.2.3:

CL-01-01	Dynamic Airspace Structures
CL-01-02	Collaborative Capacity Management
CL-02-01	Airport CDM level 1 and 2
CL-03-01	Airport Situational Awareness and RIAS
CL-03-02	Arrival and Departure support with P-RNAV
CL-05-01	Initial Datalink Services
CL-05-02	Conflict Detection Support with ADD
CL-05-03	Basic Conflict Resolution Support
CL-05-04	Multi Sector Planning Role
CL-05-05	ACAS II Phase 2 implementation

4.2.2 Operational and Technical Environment in 2010

4.2.2.1 The operational environment in 2010 is fundamentally the same as 2005. The ground service provider remains responsible for the separation service and for maintaining separation. Aircraft continue to fly fixed routes and are cleared by the ground prior to any manoeuvre (in normal operations). However there has been a limited implementation of the extended use of the Flexible Use of Airspace concept with dynamic airspace management (e.g. ECIP AOM12).

4.2.2.2 In 2010 safety continues to be of primary concern. The use of Primary Surveillance Radars within approach and in TMA airspace is expected to continue. This will provide detection of aircraft not equipped with SSR transponders or ADS-B equipment, will support the control of aircraft experiencing an avionics failure and support any need to detect non-cooperative targets.

4.2.2.3 In 2010, there is an increase in collaborative civil-military airspace planning (e.g. ECIP AOM07 or AOM16) including enhanced dynamic airspace allocation.

4.2.2.4 In 2010 there is an increased reliance by controllers on aircraft derived data and automated ATM tools for conflict prediction (e.g. ECIP ATC12 with tools such as Short Term Conflict Alert (ATC02.2) or Medium Term Conflict Alert (ECIP ATC02.4))

4.2.2.5 By 2010, ground-ground communications provide real-time surveillance information to ATFCM and there is a migration from X.25 to TCP/IP (e.g. for flight data exchange (ECIP COM04 and COM09)).

4.2.2.6 The principal technical solution for En-route surveillance remains secondary radar (SSR and SSR Mode S). For TMA operations SSR radars are supplemented by PSR. However by 2010 it is envisaged that:

- Limited pockets of ADS-B use, both in Europe and worldwide, have taken place to support ground based surveillance applications. The ICAO ANC11 in November 2003 adopted the SSR Mode S Extended Squitter as the initial global ADS-B standard data link (Recommendation 7/1 - Strategy for the near-term introduction of ADS-B). Local applications, based on VDL Mode 4 as the ADS-B datalink will also have been implemented.

- Limited pockets of Wide Area Multi-Lateration have been implemented.
- These would be introduced under local conditions and in accordance with local operational objectives. Supporting activities to ensure appropriate levels of equipage and safe operations would need to have been conducted.

4.2.2.7 At Airports, surveillance capabilities for detecting the position and identification of all mobiles will have been progressively introduced. A-SMGCS level I and II, using a combination of Surface Movement Radar and Multi-Lateration techniques, has been widely implemented at many airports.

4.2.2.8 Runway incursion alerting tools have been introduced to improve safety.

4.2.3 Surveillance requirements in 2010

4.2.3.1 Within the TMA there is a continued need to track non-cooperative targets (e.g. track targets when there is an avionics failure);

4.2.3.2 The ground based surveillance system for En-Route and TMA operations continues to require:

- A ground based surveillance system where the ground can track aircraft independent from the Navigation or Flight Management System in the aircraft.
- Co-operative surveillance to provide aircraft derived data to controllers and automated systems.

4.2.3.3 At airports the surveillance requirements remain the presentation to the controller of the position and identification of mobiles (aircraft and vehicles).

4.2.3.4 There are no new surveillance requirements for the aircrew; however avionics updates will be required to provide aircraft derived data to the surveillance ground systems.

4.2.4 Structure of the surveillance system at 2010

En-Route and TMA

4.2.4.1 Independent Surveillance in the form of Primary Surveillance Radar is widely used in ECAC within Air Traffic Management for Approach and Terminal Manoeuvring Area (TMA) surveillance. In some regional areas, Primary Surveillance Radar has been implemented in En-Route based on local requirements;

4.2.4.2 Co-operative Surveillance, in the form of SSR and SSR Mode S, is still the principal means of surveillance in 2010 and is extensively used for air traffic surveillance by civil agencies. In particular:

- SSR is widely used operationally in ECAC for TMA and En-Route services within coverage of (ground based) interrogator station(s);
- SSR Mode S elementary surveillance has been implemented in core Europe (ECIP SUR02).

4.2.4.3 Greater operational use of ADDs obtained via the surveillance infrastructure has been gradually introduced in ECAC and delivered in core Europe through Mode S enhanced Surveillance (ECIP SUR04). Limited, local pockets of ADS-B implementation (for ground based surveillance applications) have taken place based on SSR Mode S Extended Squitter (ECIP SUR05) or VDL Mode 4.

4.2.4.4 Limited operational use of Wide Area Multi-Lateration has taken place in ECAC where sufficient radar coverage is not available.

4.2.4.5 ADS Contract is used to supply information over the oceanic regions (ECIP SUR06).

4.2.4.6 Surveillance Data Processing and Distribution systems based on radar server technology (ECIP SUR03) are widely implemented in ECAC. The SDPD uses ADD to improve track quality and also distributes ADD with the track message.

4.2.4.7 The SDPD uses position information contained in the ADD and/or from Multi-Lateration position calculations.

4.2.4.8 There is more surveillance data sharing using IP v6 (e.g. through Radar Networks and civil/military exchanges).

Aerodrome operations

4.2.4.9 The enabling technology for calculating the position of mobiles (both aircraft and vehicles) is Surface Movement (primary) Radar and Multi-Lateration using Mode S SSR transponder replies and Mode S Squitter messages. Active SSR Mode S interrogation of the avionics and a limited use of ADS-B (via either Mode S Extended Squitter or VDL Mode 4) are used to deliver aircraft identification to the ground controller. Airport vehicles may be equipped with broadcast surveillance squitter transmitters.

4.2.4.10 A-SMGCS Level I and II will provide the benefits at the aerodrome. With the gradual introduction of AMAN and DMAN, additional information (e.g. ADD) may be required by the ground systems. The most effective means of achieving this would be via ADS-B because aircraft will already be equipped with ADS-B (based on 1090 MHz Extended Squitter or another datalink like VDL Mode 4) and there is a cost-effective upgrade path for the Multi-Lateration ground stations, although there may be an impact on the avionics (to provide additional ADD).

4.2.4.11 Airport SDPD is implemented providing ground controllers with an improved airport situation picture. Although many Multi-Lateration systems are configured with their own data fusion trackers as standard, a possible upgrade to existing SDPDs to support Aerodrome operations will be required.

Aircraft systems

4.2.4.12 In accordance with ICAO requirements, all aircraft flying within ECAC controlled airspace are required to be equipped with a pressure altitude reporting device. The majority of aircraft are fitted with a Mode S transponder.

4.2.4.13 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.

4.2.4.14 If Extended Squitter or VDL Mode 4 is mandated then aircraft flying in such airspace need to be adapted to accommodate this technology.

4.2.4.15 Otherwise, it is not foreseen that there will be significant changes for aircraft systems prior to 2010.

4.2.5 Issues for study by 2010

4.2.5.1 Surveillance information has a high impact on safety and security. Consequently it is required to investigate whether there is a longer term requirement to move towards secure (e.g. encrypted or IP secure) ground-ground communications (see also section 3.4.2).

4.2.5.2 It is required to investigate and define strategies, building upon the existing activities, to manage the potential 1090/1030MHz band saturation which is predicted from 2015. SSR replies, ADS-B using 1090 MHz Extended Squitter and TCAS take a significant proportion of the 1090 MHz bandwidth. A number of proposals to reduce the problem (such as TCAS Hybrid Surveillance where the TCAS interrogation rate is reduced when ADS-B is present, or more sensitive ground receivers or dual ADS-B datalinks) have been proposed. In addition the problem can be significantly reduced both by a reduction of the SSR interrogations through reducing the SSR infrastructure (when the end of the radar operational life occurs) and by information sharing culture is encouraged between users.

4.2.5.3 Building upon the activities performed in 4.2.5.2, it is also required to assess the impact of the ICAO requirement to equip all aircraft with a pressure altitude reporting device with adequate reliability.

4.2.5.4 It is required to initiate safety and security assessments to assess the requirement for a continued use of PSR within the TMA.

4.2.5.5 It is required to address whether the co-dependence of information used for both navigation and surveillance will result in a potentially unsafe situation. This may occur when position measurement (by radars) is supplied or complemented by down linking GPS or inertial navigation position via ADS-B. Therefore the surveillance strategy is to examine the need for maintaining a separate ground based surveillance system to fulfil surveillance performance requirements and whether ADS-B can be considered as meeting the requirements for a sole means of surveillance.

4.2.5.6 It is required to define Required Surveillance Performance (RSP). It is noted that the RSP may be developed for lower separation standards than today. It is required to assess whether current surveillance techniques can support the RSP and, if not, develop new techniques to enable the RSP.

4.2.5.7 It is required to ensure that the surveillance standards and surveillance functional architecture are consistent with the RSP.

4.2.5.8 It is required to investigate the requirements for the use of 4-D FMS information and assess the implementation implications if the need is confirmed.

4.2.5.9 It is required to ensure that the studies necessary to support the operational introduction of new techniques such as WAM are conducted. Such assessments would include Cost Benefit Analysis, safety assessments, ECIPs/LCIPs and detailing operational requirements.

4.2.5.10 It is required to further investigate the future implementation of ADS-B packages II and III.

4.3 The Surveillance Strategy from 2010 to 2015

4.3.1 Introduction

4.3.1.1 This section presents a overview of the ATM environment evolution from 2010 to 2015. It presents the operational and technical environment and discusses the surveillance infrastructure required to enable the environment by 2015.

4.3.1.2 The primary source of additional surveillance requirements is based upon the SPF Operational Improvement Clusters 2010-2014, see section 3.2.3:

CL-07-01	Shared Pan European Network Situation
CL-07-02	Dynamic ATC Centre Management
CL-07-03	Flexible Capacity Management
CL-08-01	Gate-to-gate turn-around management
CL-09-01	Routing of mobiles on Manoeuvring Area
CL-09-02	Integrated sequence management + ATSAW
CL-10-01	Traffic Complexity Manager Role
CL-10-02	Conflict Management Support using Intent
CL-10-03	Shared sequencing and merging

4.3.2 Operational and Technical environment in 2015

4.3.2.1 Between 2010 and 2015, the ground system retains responsibility for separation in En-Route and TMA airspace. There are a number of ATM concepts which will drive the evolution of the surveillance environment by 2015, 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 (e.g. Decision Support Tools). The controller will make use of more ADD to provide a more accurate view of the situation and improvements in safety nets;
- The detection of possible conflicts between flights from 5 to 20 minutes ahead will be supported by MTCD capabilities and the generation of automated proposals for conflict resolution;
- Surveillance derived information will be made available to support Airborne Traffic Situational Awareness and spacing applications as defined in 'Package I';
- Flight data processing systems will be upgraded to provide full 4D trajectory prediction aligned with the capabilities of 4D FMS;
- Security and safety remain key requirements.

4.3.2.2 At some airports A-SMGCS Levels III (which may include the ADS-B Package ATSA-SURF application) and Level IV[6] are being implemented. It is also foreseen that additional aerodrome ATM concepts may include:

- Improvement in airport management and throughput, requiring selected airport vehicles being transponder equipped as appropriate enabling them to be identified and displayed to the appropriate controllers;
- Increase use of arrival and departure management tools by airport services;

[6] Note that the EUROCONTROL Airports and Environment Business Division is currently defining A-SMGCS Level III and IV

4.3.3 Surveillance requirements in 2015

4.3.3.1 Within the TMA there is a continued safety need to track non-cooperative targets (e.g. track targets when there is an avionics failure);

4.3.3.2 The ground based surveillance system for En-Route and TMA operations continues to require:

- A ground based surveillance system where the ground can track aircraft independent from the Navigation or Flight Management System in the aircraft. The principal technical solution for En-route surveillance therefore remains secondary radar (SSR and SSR Mode S). For TMA operations SSR radars are supplemented by PSR.
- Co-operative surveillance to provide ADD to controllers and automated systems

4.3.3.3 Aircraft intent information (e.g. in the form of 4D trajectory data, Trajectory Change Points etc.) may be required by the ground systems, for medium term conflict detection and resolution. This may require additional information to be transmitted from the aircraft.

4.3.3.4 The cockpit will require a situation display for the aircrew that presents a traffic situation picture to support the spacing applications.

4.3.3.5 A-SMGCS Level I and II will continue to provide the benefits at the aerodrome. With the gradual introduction of AMAN and DMAN, additional information (e.g. ADD) may be required by the ground systems. The most effective means of achieving this would be via ADS-B because aircraft will already be equipped with ADS-B (based on 1090 MHz Extended Squitter or another datalink like VDL Mode 4) and there is a cost-effective upgrade path for the Multi-Lateration ground stations, although there may be an impact on the avionics (to provide additional ADD).

4.3.3.6 The introduction of A-SMGCS Levels III/IV and/or ADS-B Package I ATSA-SURF application at the aerodrome 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 applications then a TIS-B service may be required to ensure a complete and consistent airport situation picture.

4.3.4 Structure of the surveillance system at 2015

4.3.4.1 The surveillance strategy from 2010 to 2015 is based on the continued need for the ground system to monitor targets and the need for the aircrew to have a traffic situation picture in the cockpit.

En-Route and TMA

4.3.4.2 Independent Surveillance in the form of Primary Surveillance Radar is widely used in ECAC within Air Traffic Management for Approach and Terminal Manoeuvring Area (TMA) surveillance. In some regional areas, Primary Surveillance Radar has been implemented in En-Route based on local requirements;

4.3.4.3 It is predicted that by 2015 some SSR and SSR Mode S systems may be approaching the end of their operational life.

4.3.4.4 The surveillance strategy for the ground system is to:

- Maintain an independent surveillance system (PSR or other means not relying upon the aircraft avionics) where required;
- Deploy dependent cooperative surveillance based on ADS-B (using 1090 MHz Extended Squitter or another ADS-B datalink);

- Maintain a cooperative independent surveillance system (SSR, SSR Mode S or Multi-Lateration);
- Upgrade the SDPD to use the additional ADD in the tracking process;
- Upgrade the ground communications infrastructure to distribute additional surveillance information;
- Implement a TIS-B service where it is found necessary to support ADS-B Package I situational awareness or spacing applications are foreseen to provide benefit.

4.3.4.5 ADS-C continues to be used in remote or oceanic areas

Aerodrome operations

4.3.4.6 At appropriate airports the surveillance strategy is:

- The continued development of A-SMGCS level I and II enabled by SMR and Multi-Lateration;
- To implement an ADS-B sensor infrastructure to receive ADD required to support airport applications and the ADS-B Package I, ADS-B-APT application;
- To implement A-SMGCS Level III (which may include the ADS-B Package I ATSA-SURF application) and Level IV The impact on the aerodrome ground based surveillance systems may be to implement a TIS-B service
- To upgrade the airport SDPD to store and forward additional ADD (in particular flight plans);

Aircraft systems

4.3.4.7 The surveillance strategy for the aircraft component is:

- To provide ADS-B out to support the Package I applications ;
- To transmit intent information (e.g. in the form of 4D trajectory data, Trajectory Change Points etc.) for use by ground ATM tools;
- To develop ADS-B in, possibly supplemented by TIS-B, to provide the aircrew with a reliable air situation picture in support A-SMGCS Level II (or the ADS-B Package I, ATSA-SURF application);
- To implement 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.

4.3.5 Issues for study by 2015

4.3.5.1 It is required to identify whether the integrity requirements of the information presented to the aircrew whilst 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. The environment in which TIS-B is required to operate (mixed technologies, partial equipage of the aircraft fleet etc) and the role it is to fulfil (transition support, validation of air-air surveillance applications etc) are also to be assessed.

4.3.5.2 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 urgent clarification to ensure avionics equipment and ground processing products can be developed in time to deliver the required information.

4.3.5.3 It is required to continue to monitor the use of the SSR 1030/1090 MHz frequencies and assess the impact of increased usage. As the increased dependence on ADS-B (1090 MHz Extended Squitter) grows, 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.

4.4 The Surveillance Strategy from 2015 to 2020

4.4.1 Introduction

4.4.1.1 This section presents a overview of the ATM environment evolution from 2015 to 2020. It presents the operational and technical environment and discusses the surveillance infrastructure required to enable the environment by 2020.

4.4.1.2 The primary source of additional surveillance requirements is based upon the SPF Operational Improvement Clusters 2015-2020, see section 3.2.3:

CL-11-01	Flexible Airspace Structure & Free Routing
CL-12-01	Integrated 4D Sector Operations
CL-12-02	Integrated 4D Airport Operations
CL-14-01	Pilot delegated separation management
CL-14-02	ACAS III

4.4.2 Operational and Technical environment in 2020

4.4.2.1 The principal ATM concepts which will drive the evolution of the surveillance environment are:

- 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;
- Preferred routing from SID exit to STAR entry;
- Security and safety remain key requirements.

4.4.3 Surveillance requirements in 2020

4.4.3.1 The use of Primary Surveillance Radars within approach and in TMA airspace is expected to continue. This will provide detection of aircraft not equipped with SSR transponders or ADS-B equipment, will support the control of aircraft experiencing an avionics failure and additionally also supports any need to detect non-cooperative targets.

4.4.3.2 The ground based surveillance system for En-Route and TMA operations continues to include:

- An independent surveillance system to track non-cooperative targets in TMA and En Route airspace where and when required. This will be provided by primary radar unless and until an alternative solution is required and developed;
- Dependant cooperative surveillance (based upon ADS-B)
- An independent surveillance system to track cooperative targets in TMA and en-route airspace. This can be enabled by SSR and/or SSR Mode S or Multi-Lateration.

4.4.3.3 With the implementation of ASAS separation applications, additional information will be presented to the controller and to the aircrew (for example the display of separation assurance information).

4.4.3.4 The widespread introduction of preferred routing will require flight information to be displayed in real time to the controller (for example in the form of 4D trajectory data, Trajectory Change Points or selected route data) and this information may be required to be transmitted to the ground by the surveillance system.

4.4.3.5 At aerodromes, A-SMGCS level III (and the ADS-B Package I, ATSA-SURF application) and IV continue to be implemented on a more widespread basis.

4.4.3.6 It is expected that an integration of airport and airspace surveillance will become more widespread. This requires an increased integration of surveillance information at the SDPD level. The capabilities of current Multi Sensor Trackers is to be assessed in light of these more stringent requirements.

4.4.4 Structure of the surveillance system at 2020

En-Route and TMA

4.4.4.1 Independent Surveillance in the form of Primary Surveillance Radar is widely used in ECAC within Air Traffic Management for Approach and Terminal Manoeuvring Area (TMA) surveillance. In some regional areas, Primary Surveillance Radar has been implemented in En-Route based on local requirements;

4.4.4.2 This surveillance strategy from 2015 to 2020 is based on the continued need for the ground system to monitor targets and the need for aircrew to have a traffic situation picture in the cockpit.

4.4.4.3 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.

4.4.4.4 The surveillance strategy for the ground system is to:

- Maintain an independent surveillance system (PSR or other means not relying upon the aircraft avionics) where required;
- Deploy dependent cooperative surveillance based on ADS-B (using 1090 MHz Extended Squitter or another ADS-B datalink for the delivery of ADD to ground systems);
- Maintain an cooperative independent surveillance system (Multi-Lateration or SSR or SSR Mode S as appropriate);
- Upgrade the ground communications infrastructure to distribute additional surveillance information;
- Implement a TIS-B service for validating ADS-B position presented to the aircrew when operating spacing applications.

4.4.4.5 ADS-C continues to be used in remote or oceanic areas

Aerodrome operations

4.4.4.6 At appropriate airports the surveillance strategy is:

- The continued development of A-SMGCS level I, II enabled by SMR and Multi-Lateration;
- To continue the implementation an ADS-B sensor infrastructure to receive ADD for airport applications and the ADS-B Package I, ADS-B-APT application;
- To continue the implementation of Level III (which may include the ADS-B Package I, ATSA-SURF application) and Level IV The impact on the aerodrome ground based surveillance systems may be to implement a TIS-B service
- To upgrade the airport SDPD to store and forward additional ADD.

Aircraft systems

4.4.4.7 The surveillance strategy for aircraft systems is:

- To continue to provide ADS-B out;
- To transmit intent information and selected route information for ground and airborne users;
- To use ADS-B-in to provide the aircrew with a reliable air situation picture. The move from ASAS spacing to ASAS separation may require a high integrity traffic situation picture, therefore the use of TIS-B (to validate navigation data) will be required;
- To upgrade the airborne SDPS to integrate ADS-B in and TIS-B for presentation to the aircrew;
- To implement ASAS separation tools.

4.4.5 Issues for study by 2020

4.4.5.1 It is required to investigate whether ASAS separation will require additional automated tools in the cockpit and more information to be transmitted via ADS-B. If this is the case then it is likely that the aircraft systems will require an upgrade to existing ADS-B Package I infrastructure to provide a system of higher integrity and additional functionality.

4.4.5.2 This integration of airport and airspace surveillance requires an increased fusion of surveillance information at the SDPD level. The capabilities of current Multi Sensor Trackers are to be assessed in light of these more stringent requirements.

4.5 The Surveillance Strategy from 2020 onwards

4.5.1.1 Currently there are no significant surveillance developments documented in available literature beyond 2020. However it is likely that the main influences on surveillance will be political and economic, with a move towards rationalising the infrastructure and centralisation of systems and information.

4.5.1.2 The impact of the move towards centralisation will require data exchange across national boundaries and implicitly a more secure information exchange mechanism.

4.6 Summary

4.6.1.1 The surveillance strategy 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. This will be provided by primary radar unless and until an alternative solution is required and developed;
- Dependant cooperative surveillance (based upon ADS-B)
- An independent surveillance system to track cooperative targets in TMA and en-route airspace. This can be enabled by SSR and/or SSR Mode S or Multi-Lateration.

4.6.1.2 At appropriate aerodromes, the surveillance strategy is based on two phases:

- The implementation of A-SMGCS level I (which can include ADS-B Package I, ADS-B-APT application) and II from today onwards;
- The implementation of A-SMGCS level III (which can include the ADS-B Package I, ATSA-SURF application) and IV from 2010 onwards.

4.6.1.3 The surveillance data processing systems will require updating to process and deliver the new information to surveillance users as the new systems become operational.

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

- Continuing the use of SSR or SSR Mode S systems for ground radar or Multi-Lateration systems;
- The implementation of ADS-B Package I surveillance applications from 2010 onwards which will require the aircraft to transmit information to other aircraft and ground users. This is enabled by ADS-B using 1090 MHz Extended Squitter or VDL Mode 4. In addition, an airborne SDPS and display system will be required
- The implementation of ADS-B Package II surveillance applications from 2015 onwards. The enabling techniques are the same as Package I, however there may be higher integrity requirements on the information presented to the aircrew requiring an upgrade of the avionics.

4.6.1.5 The following sections present the surveillance techniques and technologies for En-Route, TMA and aerodrome operations. In addition, the impact on the avionics equipage is presented.

4.6.2 En-Route and TMA surveillance

4.6.2.1 Within En-Route and TMA airspace, the key operational drivers for surveillance are illustrated in figure 5.

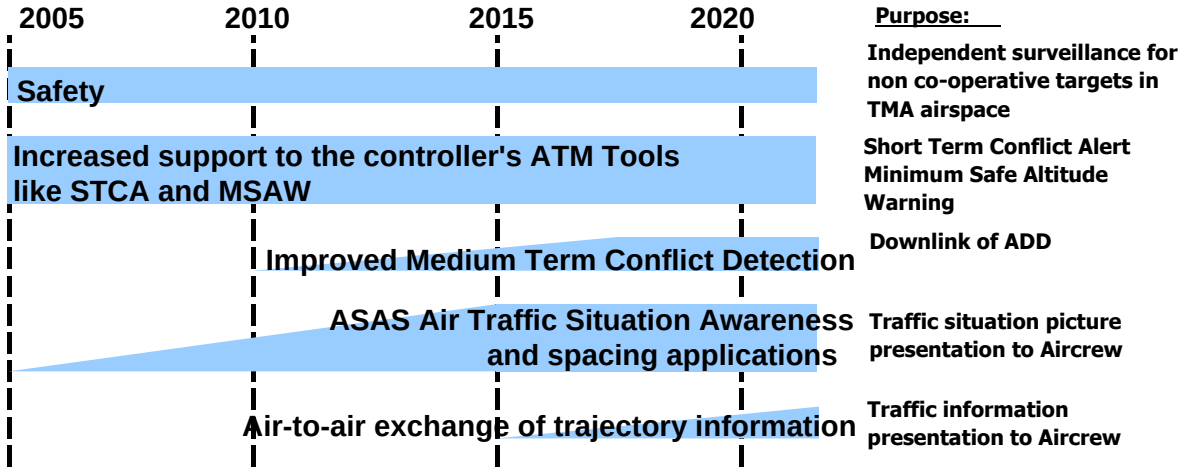


Figure 5. Key Operational Drivers for En-Route and TMA surveillance strategy

4.6.2.2 The surveillance strategy for ground systems to enable the operational environment over the next twenty years is illustrated in figure 6. This illustrates the transition from an SSR and SSR Mode S to a Wide Area Multi-Lateration system for position calculation and ADS-B based on 1090 MHz Extended Squitter (or another datalink) for ADD delivery as soon as the radars reach the end of their operational life.

4.6.2.3 It is also foreseen that:

- TIS-B may be required to enable spacing applications but it will certainly be needed for separation applications from 2015 onwards;
- The surveillance data processing system will be updated to process the new data sources;
- A ground-ground link between ATC and airport/military systems to exchange, in real time, aircraft data will be needed;
- A transition period where new systems are and old systems exist together will be required.

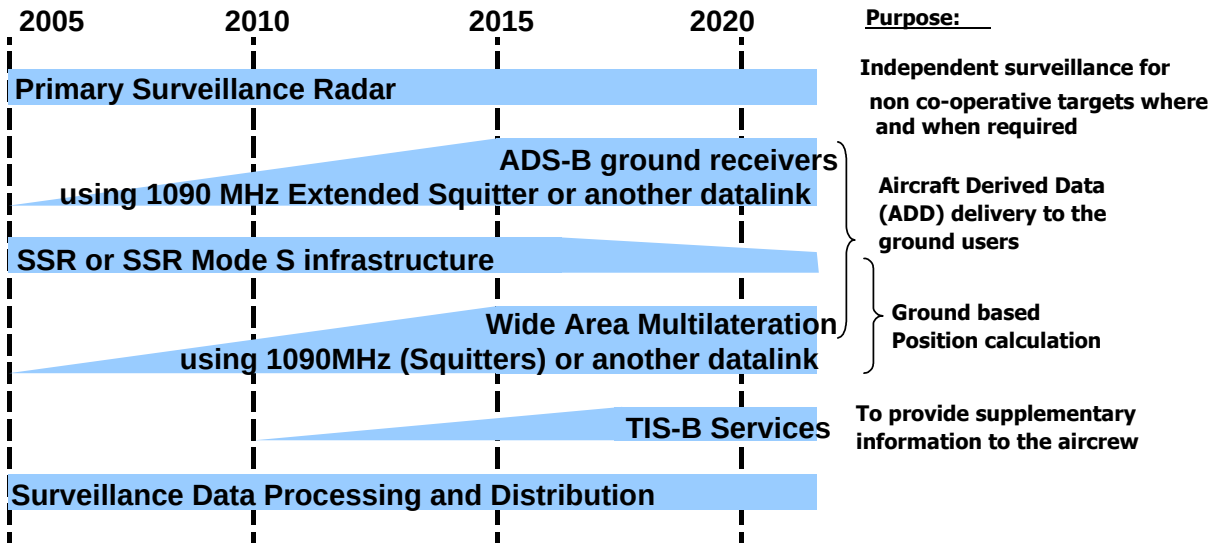


Figure 6. Ground surveillance infrastructure for En-Route and TMA

4.6.3 Aerodrome surveillance

4.6.3.1 At airports, the key operational drivers for surveillance are illustrated in figure 7. These are to implement A-SMGCS Level I, II, III and IV and to start the development of an infrastructure to enable the ADS-B Package I applications on the airport surface.

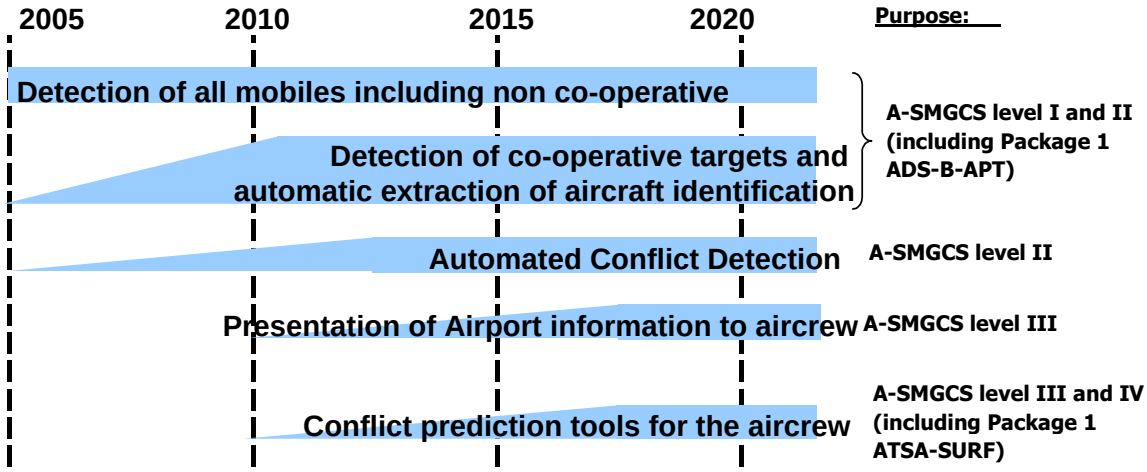


Figure 7. Key Operational Drivers for Airport surveillance strategy

4.6.3.2 The resulting airport surveillance strategy to enable the operational environment over the next twenty years is illustrated in figure 8. A-SMGCS level I and II are enabled by SMR and Multi-Lateration systems.

4.6.3.3 Where airport operators foresee a benefit of A-SMGCS level III and IV, which may include the ADS-B Package I airport application, then an ADS-B and possibly a TIS-B infrastructure will also be required.

4.6.3.4 It is also foreseen that:

- The airport tracking system will be updated to process the new data sources;
- A ground-ground link between airport and ATC to exchange, in real time, aircraft data will be needed.

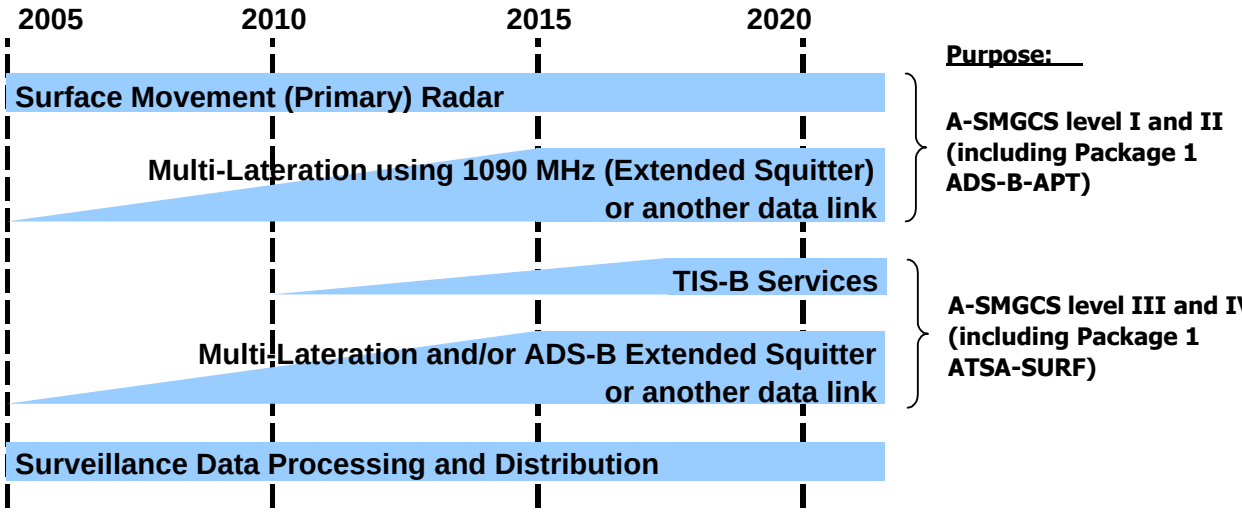


Figure 8. Surveillance Strategy at the Aerodrome

4.6.4 Impact on the airframe

4.6.4.1 The surveillance strategy impacts the airframe as illustrated in figure 9. This is based on providing an ADS-B infrastructure to support ADS-B Package I and later ASAS separation applications. The use of the SSR band also enables a cost effect transition from a ground based surveillance system based on radar to wide-area Multi-Lateration.

4.6.4.2 It is also foreseen that for ASAS separation applications an upgrade in the Flight Management System will be required.

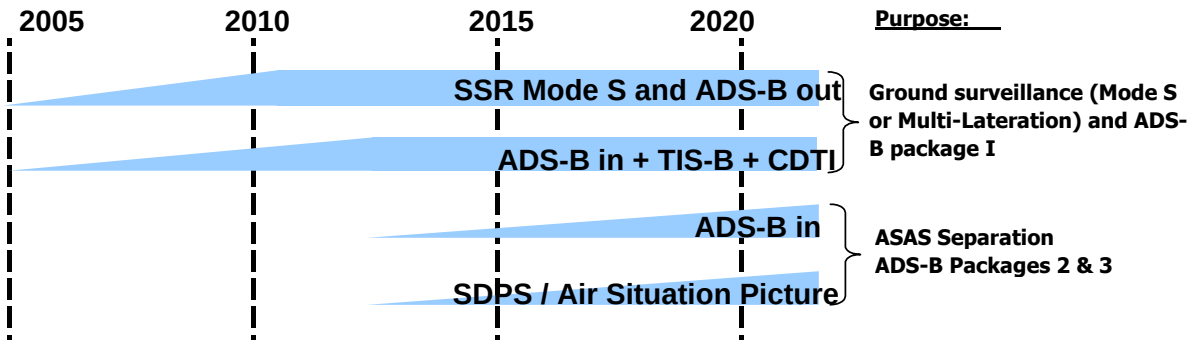


Figure 9. Aircraft surveillance strategy

5 Annex 1 Definitions and Acronyms.

5.1 Definitions

5.1.1 Surveillance

5.1.1.1 **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.

5.1.1.2 **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'

5.1.1.3 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.

5.1.1.4 The surveillance service delivered to ground users maybe based on a number of techniques and technologies. These are listed in this section

5.1.1.5 **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.

5.1.1.6 **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.

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

5.1.1.8 **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.

5.1.1.9 **Basic surveillance** delivers to the surveillance user:

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

5.1.1.10 **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.

5.1.1.11 **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 Multi-Lateration system (through active interrogations).

5.1.1.12 **Aircraft Derived Data** Different cooperative surveillance technologies extract different information from the aircraft.

5.1.1.13 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 downlinked aircraft parameters.

5.1.1.14 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

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

5.1.2 Surveillance users

5.1.2.1 The users of Surveillance include:

- Oceanic ATM Centres
- En-Route ATM Centres
- TMA/Approach ATM Units
- Airports/Tower ATM & Ground Traffic Management Units
- Military Centres
- 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).

5.1.3 Surveillance Data Processing and Distribution

5.1.3.1 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 receives ADD and distribute this to surveillance users attached to the position information.

5.1.4 A-SMGCS

5.1.4.1 A-SMGCS is an airport system which provides surveillance to a ground controller. It has four implementation levels that provide different levels of functionality. Within the timescales of the surveillance strategy, the main functions provided by the A-SMGCS Level I are:

- 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.

5.1.4.2 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.

5.1.4.3 This applies to arriving and departing movements and all transit movement on runways and closed areas

5.1.4.4 Level III 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, centreline lights,…) according to the route issued by the controller.

5.1.4.5 Level IV 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.

5.1.5 ADS-B Package I

5.1.5.1 **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 summarises the applications as of November 2005.

5.1.5.2 **ADS-B Package I Ground Based Surveillance Application**s 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
- ADS-B-NRA ATC surveillance in non-radar areas
- ADS-B-APT Airport surface surveillance
- ADS-B-ADD Aircraft derived data for ATC tools

5.1.5.3 **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, which contains three sub-applications:
    - Enhanced flight operations related to other traffic (AT)
    - Enhanced visual acquisition for see and avoid (GA)
    - Enhanced TIBA (Traffic Information Broadcast by Aircraft)

5.1.5.4 **ADS-B Package 1 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

5.1.5.5 **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. See reference 8.

5.1.5.6 **Airborne Traffic Situational Awareness (ATSA)** is an ASAS application category providing an enhancement of the current traffic situational awareness of the flight crew during flight and on the airport surface (reference 8). No change in the roles and responsibilities of the controller or aircrew is expected for ATSAW applications.

5.1.5.7 **Airborne Spacing (ASPA)** is an ASAS application category where the flight crew is able to maintain a time or distance from designated aircraft (reference 8). 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.

5.1.6 ADS-B Package II

5.1.6.1 A set of Airborne Separation Applications for ADS-B Package II (and 3) has to be defined. The following are expected to be implemented in these ADS-B Packages:

5.1.6.2 **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 (reference 8). 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.

5.1.6.3 **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. (reference 8).

5.2 Surveillance techniques

5.2.1 Primary Radar (PSR, SMR/ASDE)

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

5.2.1.2 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.

5.2.2 Secondary Surveillance Radar (SSR)

5.2.2.1 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.

5.2.2.2 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.

5.2.2.3 SSR enables Basic Surveillance.

5.2.3 SSR Mode S (Mode Select)

5.2.3.1 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.

5.2.3.2 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.

5.2.3.3 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.

5.2.3.4 SSR Mode S enables elementary and enhanced surveillance.

5.2.4 Automatic Dependent Surveillance-Broadcast (ADS-B)

5.2.4.1 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.

5.2.4.2 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 Europe], VDL Mode 4 (Very High Frequency Data Link) and UAT (Universal Access Time).

5.2.4.3 ADS-B enables elementary and enhanced surveillance.

5.2.5 Automatic Dependent Surveillance-Contract (ADS-C)

5.2.5.1 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.

5.2.5.2 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/A equipment currently carried by many aircraft.

5.2.6 Traffic Information Service – Broadcast (TIS-B)

5.2.6.1 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.

5.2.6.2 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 datalink, translated directly onto other data-links for the purpose of extending ADS-B connectivity to users of incompatible data links.

5.2.7 Multi-Lateration

5.2.7.1 Multi-Lateration 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.

5.2.7.2 In some Multi-Lateration systems, active Mode S selective interrogations are used to extract data from the aircraft.

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

- Basic operation in which Multi-Lateration 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.

5.3 Acronyms

5.3.1.1 Further definitions and explanations can be found in the EATMP Glossary

ACAS	Aircraft Collision Avoidance System
ADD	Aircraft Derived Data
ADS	Automatic Dependent Surveillance
ADS-B	ADS-Broadcast
ADS-C	ADS-Contract
AECMA	European Association of Aerospace Industries
AIC	Aeronautical Information Circular
AMAN	Arrival Manager
AMC	Airspace Management Cell
AMCP	Aeronautical Mobile Communications Panel (of ICAO)
ANC	Air Navigation Council
ANSP	Air Navigation Service Provider
AOM	(as in ECIP AOM) Airspace Organisation and Management
APP	Approach (Centre or Control)
ARINC	Aeronautical Radio Incorporated
ARTAS	ATM suRveillance Tracker and Server
ASAS	Airborne Separation Assistance System
ASDE	Airport Surveillance Detection Equipment
ASM	Airspace Management
A-SMGCS	Advanced Surface Movement and Guidance Control System
ASTERIX	all Purpose Standard EUROCONTROL Surveillance information exchange
ATC	Air Traffic Control
ATFCM	Air Traffic Flow and Capacity Management
ATFM	Air Traffic Flow Management
ATM	Air Traffic Management
ATN Router	A function or processor responsible for the routing of ATN messages
ATSA	Airborne Traffic Situation Awareness
CANSO	Civil Air Navigation Services Organisation
CDM	Collaborative Decision Making
CDTI	Cockpit Display of Traffic Information
CFMU	Central Flow Management Unit
CIMSEL	Civil/Military SSR Environment Liaison
CNS	Communications Navigation and Surveillance
CORA	Conflict Resolution Assistant
CPDLC	Controller Pilot Datalink Communications
CSM	Communications and Surveillance Management (Business Division)
DAP	Downlinked Airborne Parameters
DAS	Directorate of ATM Strategies
DMAN	Departure Manager
EATM	European Air Traffic Management
EC	European Commission
ECAC	European Civil Aviation Conference
ECIP	European Convergence and Implementation Programme
EUROCAE	European Organisation for Civil Aviation Equipment
FDPS	Flight Data Processing System
FFAS	Free Flight Airspace
FIS	Flight Information System
FMS	Flight Management System
FUA	Flexible Use of Airspace
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
ICAO	International Civil Aviation Organisation
ICAT	IC Code Allocation Tool
IFATCA	International Federation of Air Traffic Controllers Associations
IFR	Instrument Flight Rules
ISO	International Standards Organisation
JAA	Joint Aviation Authorities
LoA	Letter of Agreement

MASPS	Minimum Airborne System Performance Specifications
MOPS	Minimum Operational Performance Specifications
MSAW	Minimum Safe Altitude Warning
MSP	Multi Sector Planner
M-SSR	Mono-pulse Secondary Surveillance Radar
MTCD	Medium Term Conflict Detection
NATO	North Atlantic Treaty Organisation
NOP	Network Operations Plan
OAT	Operational Air Traffic
OATA	Overall ATM/CNS Target Architecture
OCD	Operational Concept Document
OI	Operational Improvement
P-RNAV	Precision-Area Navigation
PSR	Primary Surveillance Radar
RA	Resolution Advisory
R/T	Radio / Telephony
R&D	Research and Development
RCP	Required Communications Performance
RF	Radio Frequency
RF	Radio Frequency
RIAS	Runway Incursion Alert System
RMCDE	Radar Message Conversion Distribution Equipment
RNP	Required Navigation Performance
RSP	Required Surveillance Performance
RU	Regulatory Unit
SARPs	Standards and Recommended Practices
SDPD	Surveillance Data Processing and Distribution System
SDPS	Surveillance Data Processing System
SES	Single European Sky
SFA	Surveillance Functional Architecture
SID	Standard Instrument Departure
SMGCS	Surface Movement Guidance and Control System
SMGET	Mode-S Map Generator Tool
SPF	Strategic Performance Framework
SSM	Safety and Security Management (business division)
SSR	Secondary Surveillance Radar
STAR	Standard Arrival Route
STCD	Short Term Conflict Detection
SWIM	System Wide Information System
TA	Traffic Advisory
TCAS	Traffic Collision Avoidance System
TCM	Traffic Complexity Manager
TCP	Trajectory Change Points
TIS-B	Traffic Information Service - Broadcast
TMA	Terminal Manoeuvre (Control) Area
TOBT	Target Off Block Time
TSA	Temporary Segregated Area
VDL	VHF Digital Link

6 Annex 2 Reference Documents

Number	Reference	Version and date
1	EATMP Stakeholder Segmentation Model	Version 2.0 dated 11.01.2002
2	European Convergence and Implementation Plan Level 2 Years 2005-2009	
3	European ATM Performance Enhancement Activities http://www.eurocontrol.int/eatm/gallery/content/public/library/ewpd/ewp.pdf	Main Document Edition 2005
4	Target Surveillance Functional Architecture	Version 1.0 Dated 01/11/2003 EATM Info centre ref 031104-01
5	EUROCONTROL Airspace Strategy for the ECAC States	24 September 2002
6	ADS-B Package I CARE/ASAS Activity 5 Description of a first package of GS/AS applications	Version 2.2 September 30, 2002
7	EUROCONTROL Air Traffic Management Strategy for the Years 2000+	Volumes 1 and 2 July 2003
8	Principles of Operation for the Use of Airborne Separation Assurance Systems	Version: 7.1 Date: 19 June 2001
9	The EUROCONTROL Surveillance Products and Tools Strategy	TBD

7 Annex 3 – Strategic Performance Planning Process

7.1 Strategic Performance Planning Process

7.1.1 Context

7.1.1.1 The aim of the EUROCONTROL Strategic Performance Planning process is to set performance targets and to select, group and plan the Operational Improvements into a set of 'clusters' as illustrated in Figure 10. The process further aims to clarify the relationship between Operational Improvements and also between Operational Improvements and their Enablers. This process provides stakeholders with a clearer 'Roadmap of Change' to achieve the goals of the EUROCONTROL Air Traffic Management Strategy for the Years 2000+.

7.1.1.2 It is noted that the current Roadmap is still a working draft that is not yet released pending possible impact and changes as a result of the SESAME. However, the results of the Strategic Performance Planning process have been used in several EUROCONTROL documents like the EATM Performance Enhancement Activities, Edition 2004 - Main Document [reference 3].

7.1.2 Operational Improvements Clusters

7.1.2.1 Operational Improvement Clusters are a set of high level statements to enable the EUROCONTROL Air traffic Management Strategy for the Years 2000+. They are defined in a number of time steps, namely

- 2005-2009
- 2010-2014
- 2015-2020

7.1.2.2 In general, the surveillance contributions, as enablers of the Operational Improvements, are that the surveillance systems provide a suitable, timely availability and cost/effective ATM surveillance system infrastructure.

7.1.2.3 This annex provides descriptions of the Operational Improvement Clusters that form the Roadmap of change in support of realizing the EUROCONTROL Air Traffic Management Strategy for the Years 2000+.

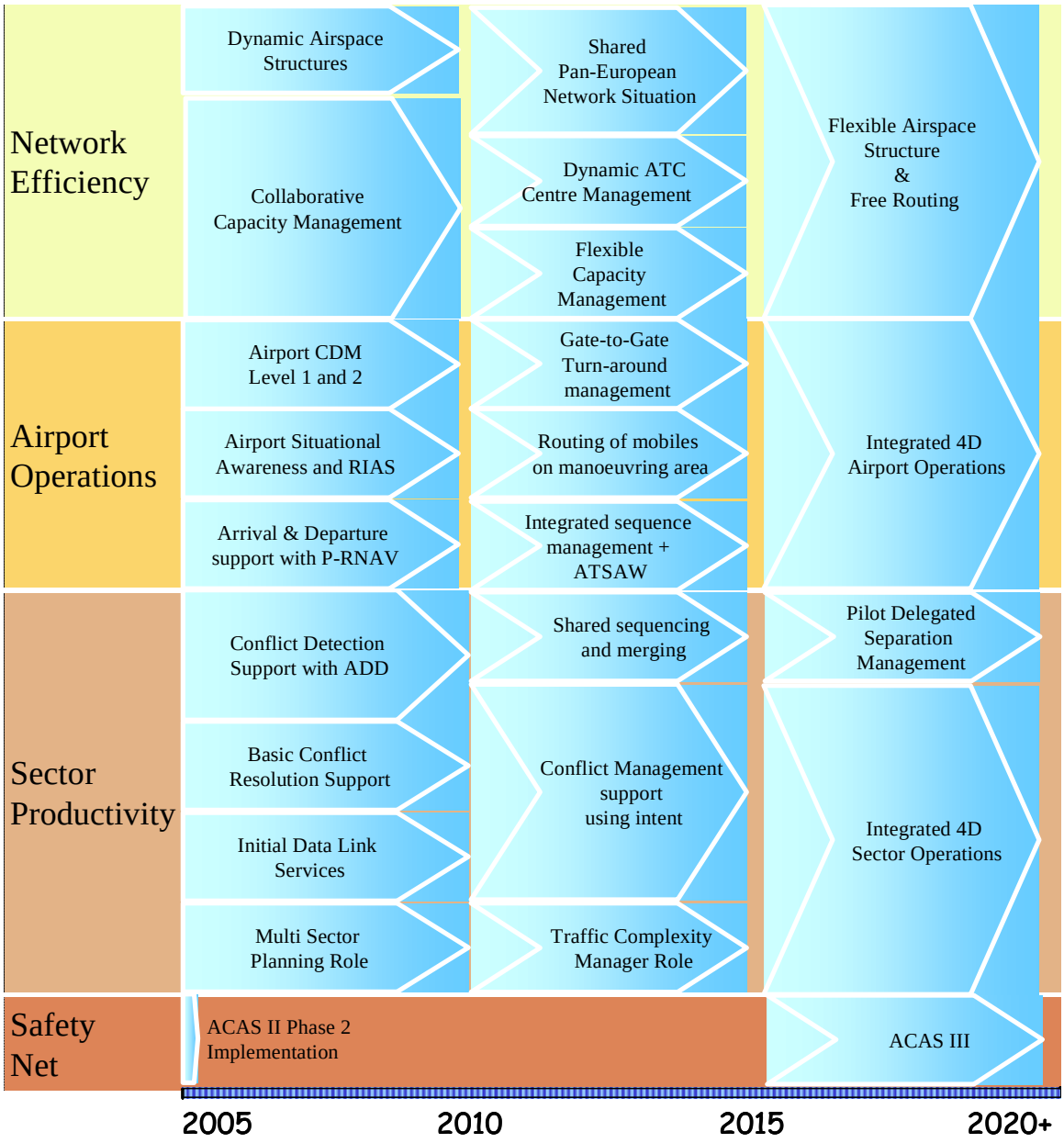


Figure 10 - overview of all SPF Operational Improvement Clusters

CL-01-01	Dynamic Airspace Structures				
	Draft	Initial:	2005	Full:	2009

The airspace will be designed to incorporate a more flexible route network (Advanced Airspace Scheme - AAS) while fully applying the Flexible Use of Airspace (FUA) concept. Route Options and extendable Temporary Segregated Areas (TSAs) will better support the demand for both General Air Traffic (GAT) and Operational Air Traffic (OAT). Filing and operating user preferred routes will become regular practice. A simpler airspace classification scheme will be introduced.

CL-01-02	Collaborative Capacity Management				
	Draft	Initial:	2005	Full:	2009

The shared view of CFMU, Airspace Management Cells (AMCs) and ATC Centre and Airport Managers will be improved by combining several information sources. This allows proactive deployment of capacity at regional or European scale using predefined airspace activation and airport configuration scenarios. At the same time tactical flow management will be improved by using surveillance-derived traffic information.

CL-02-01	Airport CDM level 1 and 2				
	Draft	Initial:	2005	Full:	2009

The major airports in Europe will implement capabilities for sharing flight progress information (Milestone Approach) between all the local stakeholders. This will facilitate Collaborative Decision Making (CDM) in support of the turn-around process of each aircraft, while allowing each stakeholder to optimise its business. All these local airport CDM implementations will be aligned with standardised information exchange interfaces with CFMU and Airlines Operations Control Centres.

CL-03-01	Airport Situational Awareness and RIAS				
	Draft	Initial:	2005	Full:	2009

The situational awareness of Airport ATC will be increased by providing capabilities for detecting the position and movements of all mobiles on the manoeuvring area and of all aircraft on aprons. Using this information the first step can also be made to provide automation support for detecting runway incursions (RIAS).

CL-03-02	Arrival and Departure support with P-RNAV				
	Draft	Initial:	2005	Full:	2009

An integrated application of P-RNAV, Continuous Descend Approaches and wake vortex optimised separation minima, together with automation support for Arrival and Departure Management will allow improvement of the inbound and outbound traffic with respect to track keeping accuracy, noise and gaseous emissions generation and applied spacing at most major airports.

CL-05-01	Initial Datalink Services				
	Draft	Initial:	2005	Full:	2009

Data link capabilities (CPDLC) will become available to replace some routine R/T exchanges. The system automation and the controllers will also be able to make use of some Aircraft Derived Data (ADD), giving a more accurate view on the situation.

CL-05-02	Conflict Detection Support with ADD				
	Draft	Initial:	2005	Full:	2009

The detection up to 20 minutes before the event of potential conflicts between flights or between flights and restricted airspace will be supported by Medium Term Conflict Detection (MTCD) capabilities, which will facilitate earlier handling of such events.
The monitoring for conformance of the traffic situation to planning and ATC clearances will be supported by flight path monitoring (MONA) capabilities.
Improvements will be made to safety nets including Area Proximity Warning (APW), and STCA.
These changes will have an impact on the roles and tasks of both the executive and planning controller

CL-05-03	Basic Conflict Resolution Support				
	Draft	Initial:	2005	Full:	2009

For early resolution of planning conflicts basic levels of 'what-if' probing functionality (CORA-2) will become available.

CL-05-04	Multi Sector Planning Role		
	Draft	Initial: 2005	Full: 2009

A Multi Sector Planning (MSP) role will be introduced for traffic planning over two or more of the present sectors and synchronisation of traffic flows in collaboration with other traffic management roles. The MSP will also balance the 'constraints' put on flights by various nearby destination airports.

CL-05-05	ACAS II Phase 2 implementation		
	Draft	Initial: 2005	Full: 2014

With effect from 1 January 2005 the mandatory ACAS II equipage will be extended to cover all civil fixed-wing turbine-engined aircraft having a maximum certificated take-off mass exceeding 5,700kgs, or a maximum approved passenger seating configuration of more than 19.

CL-07-01	Shared Pan European Network Situation		
	Draft	Initial: 2010	Full: 2014

Information on traffic demand, airspace and route configurations, airport configurations and ATFCM regulations will be brought together in a pan-European shared picture for all stakeholders (Network Operations Plan - NOP) to facilitate and improve collaborative planning for converging from strategic plans to actual plans for the day of operation. Stakeholders will get simulation capabilities to assess how their operations can be optimised within the total picture. Air Defence organisations will be able to access the pan-European NOP interactively to acquire any necessary information.

CL-07-02	Dynamic ATC Centre Management		
	Draft	Initial: 2010	Full: 2014

ATC Centre managers can be given a more proactive role in adapting their operations to the dynamic management of the whole network. They will collaborate closely with Airspace Management (ASM) and ATFCM roles to optimise their staff rosters and sectorisation scenarios. In the execution phase the civil and military ATS units are jointly involved in the resolution of actual airspace problems based on explicit rules and procedures laid down in LoAs.

CL-07-03	Flexible Capacity Management		
	Draft	Initial: 2010	Full: 2014

The collaboration between CFMU, Airspace Management Cells (AMCs), Flow Management Positions (FMPs)/ Air Traffic Control Centres (ATCCs), Airports and Aircraft Operators will be extended to the tactical level in order to dynamically adapt the execution of the Daily Operational Plan to developing circumstances. This will include the use of simulation capabilities for assessing the immediate impact of measures (ASM, ATFCM, Airport) on the network situation.

CL-08-01	Gate-to-gate turn-around management		
	Draft	Initial: 2010	Full: 2014

With more and more airports operating close to their maximum throughput for longer periods of time the need increases to be proactive to unforeseen changes that could disrupt schedules over a larger region. Building on the information that is shared between stakeholders at the airports and with Airline Operating Centres and the central Flow and Capacity Management function, the impact of such unforeseen changes will be minimised taking into account the gate-to-gate turn-around of aircraft.

CL-09-01	Routing of mobiles on Manoeuvring Area		
	Draft	Initial: 2010	Full: 2014

Upon landing there will be a seamless transition to the monitoring, guidance and control provided to all mobiles on the manoeuvring area. Taxi routing information will be provided to pilots and drivers of vehicles. Conflicts between the movements of mobiles will be detected by automation support and information on them provided to the controllers and concerned pilots/drivers. As a later development in this cluster advisories to controllers may be generated by the automated support capabilities for resolution of these conflicts.
Departure Management and A-SMGCS capabilities will support the controllers in managing the departing traffic from the gates to the runways with minimal delay and maximal predictability and just in time to integrate it into the en-route flows.

CL-09-02	Integrated sequence management + ATSAW				
	Draft	Initial:	2010	Full:	2014

At busy airports, aircraft will depart and arrive with minimal separation applied on the basis of wake vortex detection capabilities and enhanced procedures that build on RNP-RNAV and on-board spacing support. Management of traffic on the airport surface will be optimised to efficiently support the arrival and departure flows.

CL-10-01	Traffic Complexity Manager Role				
	Draft	Initial:	2010	Full:	2014

The Traffic Complexity Manager (TCM) role will be introduced to manage the traffic flow quality (w.r.t. bunching, complexity, etc) through all sectors in the area of responsibility (could be FAB or ACC) in close coordination with the CFMU/FMP and AMC. (The realisation of this role relative to other roles like a Supervisor, an FMP and an MSP would be a local decision).

CL-10-02	Conflict Management Support using Intent				
	Draft	Initial:	2010	Full:	2014

Data link support will enhance the collaboration between controllers and cockpit crew by linking on-board and ground side automation. The latter will actively support controllers in resolving any potential traffic problems well in advance.

CL-10-03	Shared sequencing and merging				
	Draft	Initial:	2010	Full:	2014

Sequencing and merging towards en-route and approach fixes can be delegated temporarily to cockpit crews (ADS AS/GS Package I applications).

CL-11-01	Flexible Airspace Structure & Free Routing				
	Draft	Initial:	2015	Full:	2020

In most parts of the airspace, except close to airports, the current role of the route structure for providing a framework for safe traffic separation will be overtaken by automation support with the appropriate procedures. Traffic can thus be filed and operated along user preferred 4D trajectories (using free routing) while the sectorisation is adaptive to the traffic flows.

CL-12-01	Integrated 4D Sector Operations				
	Draft	Initial:	2015	Full:	2020

Traffic management will be done mostly through planning on the basis of consistent 4D flight information that is widely shared via data link and ground networks amongst all that have to deal with each flight. Flights will use closed loop control to adhere to their 4D planning. All changes to the 4D planning, including conflict resolutions, will be strategically coordinated with the aircraft via data link and with adjacent areas through automated ground-ground coordination, so as to agree upon a revised 4D trajectory. Tactical intervention will only be used when more immediate change is required.

CL-12-02	Integrated 4D Airport Operations				
	Draft	Initial:	2015	Full:	2020

From approach to departure, the passage of aircraft through major airports will be managed on the basis of their 4D trajectory, which will also cover the part when moving on the ground. Arrival management support systems will allow delivery of aircraft on the runways with high (absolute) time accuracy. Automation support will be provided to pilots and controllers for active guidance of aircraft from runway to gate and back. Departure will take place within a relatively narrow time slot to allow controlled integration of the flight in the en-route traffic. The already existing airport CDM process will 'connect' the inbound and outbound timing of each aircraft with its handling at the gate.

CL-14-01	Pilot delegated separation management				
	Draft	Initial:	2015	Full:	2020

In certain parts of the airspace the responsibility for separation provision will be fully delegated to the pilots. In this airspace the air traffic service provision will be limited to safeguarding the density of the traffic flows and providing FIS.

CL-14-02	ACAS III				
	Draft	Initial:	2015	Full:	2020

ACAS III will implement the provision of Traffic Advisories (TAs) and Resolution Advisories (RAs) in both the vertical and horizontal planes, in particular to support traffic flying in Free Flight Airspace (FFAS).