EUROCONTROL Document
(Specification or Guidelines)
for A-SMGCS

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## Abstract


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EXECUTIVE SUMMARY
1. Introduction

1.1 Purpose of the document

The ICAO A-SMGCS Manual DOC 9830 [1] has not been updated since the First Edition was released in 2004. Shortly after this, EUROCONTROL released guidance material on A-SMGCS Level 1 (Surveillance) and Level 2 (Control) and this material was last updated with minor formatting corrections in 2010. In parallel EUROCAE WG41 developed a document defining the Minimum Aviation System Performance Specification (MASPS) for A-SMGCS, the latest version of which in ED87C [2].

Based on the material mentioned above several other documents have been developed to help partners tackle issues such as Implementation, training and procedures.

Also, since 2004 two major projects, EMMA2 and SESAR, have studied and tested new A-SMGCS functionality and there has also been a natural improvement in the basic Level 1 and 2 technology and operational use.

It has therefore been agreed that the time is right to review and restructure the current EUROCONTROL documentation to take into account recent developments and new functionality, and at the same time integrate the existing documents into one user friendly specification document.

1.2 Scope of the document

This specification document aims at defining the operational concept and requirements for the A-SMGCS functions:

- Surveillance,
- Airport Safety Nets,
- Routing & Planning,
- Guidance.

The EUROCONTROL A-SMGCS project originally defined A-SMGCS functions as Levels; Level 1 focused on the implementation of surveillance and Level 2 was the Control service which provided a runway safety net and prevented incursions into restricted areas. A guidance service was also provided to the vehicles driver as an option.

This document will take the previous material and update it in preparation for the introduction of the new A-SMGCS functions Routing/Planning and Guidance. At the same time the reference to ‘Levels’ will disappear and the functions/services will be referred to by name, this decision has been made to avoid confusion with the ICAO Manual and to dispel the assumption that the functions need to implemented in numerical order.

The document links very closely to the ICAO A-SMGCS Manual [1] and the EUROCAE WG41 MASPS document ED87C [2], therefore it is recommended that these 2 documents are also referenced when implementing A-SMGCS.

There will be two main releases of the document; the first one in 2015 will incorporate the present documentation on Level 1 and 2, and other supporting documents from the EUROCONTROL website such as Implementation material and transponder procedures. It will also merge the current Level 2 material with the new Airport Safety Nets that have been developed in SESAR.

The second release in 2016 will see the introduction of the Routing & Planning and Guidance functions that are being validated in the SESAR program.
1.3 Conventions

The following categories have been identified to decompose the statements included in the requirement specification:

- Assumptions: an assertion about some characteristics that underlies the A-SMGCS operations or systems
- Recommendations: designates general design principles applicable to A-SMGCS
- Requirements: designates formal requirements about what must be delivered from an A-SMGCS operations or A-SMGCS system/sub-system perspective and that is verifiable through analysis, inspection or test.

The following conventions are used in the formal requirement statements of this document:

- Specification using the operative verb shall indicate that they must be implemented to provide conformity with this specification.
- Specification using the operative verb should indicate that they are recommended to achieve the best possible implementation of this specification.
- Specification using the operative verb may indicate options.
- The word “will” denotes a statement of intent.

1.4 Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>ADS</td>
<td>Automatic Dependent Surveillance</td>
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<tr>
<td>ADS-B</td>
<td>Automatic Dependent Surveillance Broadcast</td>
</tr>
<tr>
<td>ANSPs</td>
<td>Air Navigation Service Provider</td>
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<tr>
<td>AMAN</td>
<td>Arrival Manager</td>
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<tr>
<td>AOP</td>
<td>Airport Operations Programme</td>
</tr>
<tr>
<td>AOPG</td>
<td>ICAO Aerodrome Operations Group</td>
</tr>
<tr>
<td>AOT</td>
<td>Airport Operation Team</td>
</tr>
<tr>
<td>A-SMGCS</td>
<td>Advanced Surface Movement Guidance and Control Systems</td>
</tr>
<tr>
<td>ATC</td>
<td>Air Traffic Control</td>
</tr>
<tr>
<td>ATCO</td>
<td>Air Traffic Control Officer</td>
</tr>
<tr>
<td>ATM</td>
<td>Air Traffic Management</td>
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<tr>
<td>ATS</td>
<td>Air Traffic Services</td>
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<td>ATSU</td>
<td>Air Traffic Service Unit</td>
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<tr>
<td>AVOL</td>
<td>Aerodrome Visibility Operational Level</td>
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<td>CATC</td>
<td>Conflicting ATC Clearances</td>
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<td>CDM</td>
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<td>CNS</td>
<td>Communication Navigation Surveillance</td>
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<tr>
<td>DMAN</td>
<td>Departure Manager</td>
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1.5 Definitions

This section provides the explanation of terms required for a correct understanding of the present document. Most of the following explanations are drawn from the A-SMGCS manual, the ICAO Annex 14 or the EUROCAE MASPS for A-SMGCS, in that case it is indicated in the definition. definitions are used as a first option. In general, other definitions are only used where there is no ICAO definition. If not, it is explained why another definition is preferred to the ICAO one.

Advanced Surface Movement Guidance and Control Systems (A-SMGCS)

Systems providing routing, guidance, surveillance and control to aircraft and affected vehicles in order to maintain movement rates under all local weather conditions within the Aerodrome Visibility Operational Level (AVOL) whilst maintaining the required level of safety.

Aerodrome

and definition
A defined area on land or water (including any buildings, installations, and equipment) intended to be used either wholly or in part for arrival, departure and surface movement of aircraft.

**Aerodrome movement**

Definition addresses only aircraft movement, we extended the definition to all mobiles.

The movement of a mobile (aircraft or vehicle) on the movement area.

**Aerodrome Visibility Operational Level (AVOL)**

Definition

The minimum visibility at or above which the declared movement rate can be sustained.

**Airport authority**

Definition

The person(s) responsible for the operational management of the airport.

**Alert**

Definition

An indication of an existing or pending situation during aerodrome operations, or an indication of abnormal A-SMGCS operation, that requires attention/action.

**Alert Situation**

Definition

Any situation relating to aerodrome operations which has been defined as requiring particular attention or action.

**Apron**

Definition

A defined area on a land aerodrome, intended to accommodate aircraft for purposes of loading or unloading passengers, mail or cargo, fuelling, parking or maintenance.

**A-SMGCS capacity**

Definition

The maximum number of simultaneous movements of aircraft and vehicles that the system can safely support within an acceptable delay commensurate with the runway and taxiway capacity at a particular aerodrome.

**Conflict**

Definition

A situation when there is a possibility of a collision between aircraft and/or vehicles.

**Control**

Definition

Application of measures to prevent collisions, runway incursions and to ensure safe, expeditious and efficient movement.

**Cooperative mobile**

“Cooperative target” definition in which “target” is replaced by “mobile” (see mobile definition)

Mobile which is equipped with systems capable of automatically and continuously providing information including its Identity to the A-SMGCS.
Note: as several cooperative surveillance technologies exist, a mobile is cooperative on an aerodrome only if the mobile and the aerodrome are equipped with cooperative surveillance technologies which are interoperable.

**Cooperative surveillance**

The surveillance of mobiles is cooperative when a sensor, named cooperative surveillance sensor, collects information about the mobiles from an active element of the transponder type which equips the mobiles. This technique allows to collect more mobile parameters than the non-cooperative surveillance, for instance the mobiles identity.

The cooperative surveillance may be:

- Either dependant on the cooperative mobile, when the mobile automatically generates the information and transmits it to the surveillance sensor, for instance via ADS-B;
- Or Non-dependant on the cooperative mobile, when the mobile is interrogated by the surveillance sensor, for instance Mode S Multilateration.

**Data Fusion**

**definition**

A generic term used to describe the process of combining surveillance information from two or more sensor systems or sources.

**False Alert**

**definition**

Alert which does not correspond to an actual alert situation.

Note: It is important to understand that it refers only to false alerts and does not address nuisance alerts (i.e. alerts which are correctly generated according to the rule set but are inappropriate to the desired outcome).

**Guidance**

**definition**

Facilities, information and advice necessary to provide continuous, unambiguous and reliable information to pilots of aircraft and drivers of vehicles to keep their aircraft or vehicles on the surfaces and assigned routes intended for their use.

**Identification**

**definition**

The correlation of a known aerodrome movement callsign with the displayed target of that mobile on the display of the surveillance system.

**Identity**

“Aircraft identification” definition extended to all mobiles.

A group of letters, figures or a combination thereof which is either identical to, or the coded equivalent of, the mobile call sign to be used in air-ground communications, and which is used to identify the mobile in ground-ground air traffic services communications.

**Incursion**

**definition**

The unauthorized entry by an aircraft, vehicle or obstacle into the defined protected areas surrounding an active runway, taxiway or apron.

**Intruder**

Any mobile which is detected in a specific airport area into which it is not allowed to enter.

**Manoeuvring area**
That part of an aerodrome to be used for the take-off, landing and taxiing of aircraft, excluding aprons.

**Mobile**

**A mobile is either an aircraft or a vehicle.**

Note: when referring to an aircraft or a vehicle, and not another obstacle, the term “Mobile” will be preferred to “Target”. The term “Target” will only be used when considering an image of a mobile or other obstacle displayed on a surveillance screen.

**Modularity**

**definition**

Capability of a system to be enhanced by the addition of one or more modules to improve its technical or functional performance.

**Movement area**

**definition**

That part of an aerodrome to be used for the take-off, landing and taxiing of aircraft, consisting of the manoeuvring area and apron(s).

**Non-Cooperative mobile**

“Non-cooperative target” definition in which “target” is replaced by “mobile” (see mobile definition)

Mobile which is not equipped with systems capable of automatically and continuously providing information including its identity to the A-SMGCS.

**Non-Cooperative surveillance**

The surveillance of mobiles is non-cooperative when a sensor, named non-cooperative surveillance sensor, detects the mobiles, without any action on their behalf. This technique allows to determine the position of any mobile in the surveillance area and in particular to detect intruders. Examples of non-cooperative surveillance sensors are the Primary Surveillance Radars.

**Normal Visibility**

Visibility conditions sufficient for personnel of control units to exercise control over all traffic on the basis of visual surveillance (correspond to visibility condition 1 defined by ICAO).

**Nuisance Alert**

**definition**

Alert which is correctly generated according to the rule set but are inappropriate to the desired outcome.

**Obstacle**

**definition extended to all mobiles**

All fixed (whether temporary or permanent) and mobile obstacles, or parts thereof, that are located on an area intended for the surface movement of mobiles or that extend above a defined surface intended to protect aircraft in flight.

**Participating mobile**

Mobile whose identity is known by the aerodrome authority, and likely to move on airport movement areas. As illustrated in the Error! Reference source not found., a participating mobile is either cooperative or non-cooperative.
Protection area
A protection area is a virtual volume around a runway, a restricted area or a mobile. This protection area is used to detect an alert situation. For instance, an alert situation is detected when a mobile is on a runway and one or more mobiles enter the runway protection area.

Reduced Visibility
Visibility conditions insufficient for personnel of control units to exercise control over all traffic on the basis of visual surveillance (correspond to visibility conditions 2, 3, and 4 defined by ICAO).

Restricted Area
Aerodrome area where the presence of an aircraft or a vehicle is permanently or temporarily forbidden.

Route
A track from a defined start point to a defined endpoint on the movement area.

Routing
The planning and assignment of a route to individual aircraft and vehicles to provide safe, expeditious and efficient movement from its current position to its intended position.

Runway Incursion
ICAO global definition of a runway incursion (2004)
Any occurrence at an aerodrome involving the incorrect presence of an aircraft, vehicle or person on the protected area of a surface designated for the landing and take off of aircraft.

Stand
A stand is a designated area on an apron intended to be used for the parking of an aircraft.

**Surveillance**

A function of the system which provides identification and accurate positional information on aircraft, vehicles and obstacles within the required area.

**Target**

An aircraft, vehicle or other obstacle, which image is displayed on a surveillance display.

Note: when referring to an aircraft or a vehicle, and not another obstacle, the term “Mobile” will be preferred to “Target”. The term “Target” will only be used when considering an image of a mobile or other obstacle displayed on a surveillance screen.

### 1.6 Reference material

6. [6] EVA Project Final validation report for A-SMGCS Levels 1 and 2 at Frankfurt, Vienna and Zurich, version 0.2, April 2006

### 1.7 Reference material

**Introduction**

Chapter 1, the purpose of this document, its structure, the reference documents and gives an explanation of terms used throughout the document.

**A-SMGCS Users**

Chapter 2 presents the various actors that can use the A-SMGCS services.

**A-SMGCS Services**

Chapter 3 presents the different services available within the A-SMGCS.

**Operational Procedures**

Chapter 4 introduces the different procedures that are associated with the use of the different A-SMGCS services and being developed by EUROCONTROL in close coordination with ICAO.
**System Overview and Interoperability**

Chapter 5 presents a high level description of the components of an A-SMGCS and explains how it is operated with other ATC and Airport systems.

**Operational Requirements**

Chapter 6 contains the operational requirements associated to Level 1, i.e. from an A-SMGCS user point of view, the general requirements attached to Level-1 surveillance service, the functionalities and interfaces needed (functional requirements) and the corresponding non-functional requirements (performances). Both normal and exceptional conditions (failure) are covered.

**Annexes**

A. Details Guidance material for Implementation such as Procurement Process, Regulation and Certification, Training, Security and Generic Safety Case to support ANSP, APT OPR to develop a local Safety Case.
## 2. A-SMGCS USERS

### 2.1 Introduction

Various stakeholders are involved in the A-SMGCS environment. The professional domain and objectives of each stakeholder determine their level of participation/involvement.

<table>
<thead>
<tr>
<th>ACTIVE</th>
<th>PASSIVE</th>
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</table>
| ANSP / Approach Controller  
ANSP / Terminal Users  
Airport Operations Centre  
Airline Operations Control Centre | Ground Handler / Vehicle drivers  
Fire Brigade  
Airport Operator / Airside Operations Staff  
Aircraft Operator / Airside Operations Staff |
| ANSP / Technical Staff  
ANSP / Tower Clearance Delivery Controller | |
| ANSP / Tower Runway Controller  
ANSP / Tower Ground Controller  
Airport Operator / Apron Controller | |

The main organisations in relation to the A-SMGCS environment are:
The term ‘Controller’ is used as common denominator for the following professional stakeholders:

- Tower Runway Controller
- Tower Ground Controller
- Tower Clearance Delivery Controller
- Apron Manager/Controller

Are these stakeholders to be considered as contributors/users of each A-SMGCS Service?

<table>
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<th>A-SMGCS Service</th>
<th>Stakeholder</th>
<th>Type</th>
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<td>1. Controllers¹</td>
<td>1. Active User/Active Contributor</td>
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<td>2. Active Contributor</td>
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<td></td>
<td>5. Aircraft Operator</td>
<td>5. Passive User?</td>
</tr>
<tr>
<td></td>
<td>6. Fire Brigade (Emergency Services)</td>
<td>6. Passive Contributor</td>
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<td>3. Active Contributor</td>
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<td>AIRPORT</td>
<td>1. Controllers</td>
<td>1. Active User</td>
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</tbody>
</table>

¹ The term Controller is introduced to cover following professional categories: Air Traffic Control Officers, Apron Management.
What do these stakeholders get from A-SMGCS?

## 2.2 SURVEILLANCE

### 2.2.1 Preliminary

Do we speak, in relation to mobiles, about:

- **Participating** aircraft / vehicles
- **Authorised** aircraft / vehicles
  - Authorised to operate on runways, taxiways and apron
  - Authorised to operate on the apron only
- **Suitably equipped** aircraft / vehicles
  - Absolute requirement to be authorised?
  - Differentiate between equipment for aircraft / vehicles

The intrinsic difference between the equipment for aircraft / vehicles will define the category/type of stakeholder: **User** or **Contributor**. Should another terminology be used?

Determining whether the aircraft transponder and vehicle location transmitter operates satisfactorily, to ensure appropriate contribution to the A-SMGCS, can in first instance be assessed by the controller through its A-SMGCS HMI display.

<table>
<thead>
<tr>
<th>SURVEILLANCE</th>
<th>Category</th>
<th>Stakeholder</th>
</tr>
</thead>
</table>
| Controller   | Active User | ▪ Detect and locate mobiles on the manoeuvring area and/or aprons;  
▪ Correlate position reports of authorised/participating mobiles with the information displayed on the A-SMGCS HMI;  
▪ Identification of mobiles within the area of the controller's responsibility;  
▪ Issue clearances and instructions to authorised/participating mobiles²; |
| Flight Crew  | Active Contributor | ▪ Select the appropriate setting of the transponder depending on the position of the aircraft on the airport;  
▪ Exchange information on the position of the aircraft with the controller either through datalink or voice |

² *This statement is to trigger a discussion.* SMGCS allowed for the issuance of clearances to all participating mobiles (Ref. in ICAO SMGCS Manual Doc9476). How were take-off, line-up and landing clearances provided with only SMGCS available (on some airports enhanced with SMR)? Most probably, solely by position reports, provided through voice communications. If enhanced with SMR display, additionally with the position of the primary radar blip in relation to the airport layout. The current A-SMGCS technology is much more performant compared to SMGCS, eventually enhanced with SMR. This has been proven for over 10 years with operationally used systems.
<table>
<thead>
<tr>
<th>Vehicle Driver</th>
<th>Passive Contributor</th>
<th>Ensure the vehicle is suitably equipped to be operated on the movement area;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Exchange information on the position of the vehicle with the controller either through a vehicle location transmitter, datalink (e.g. WiMAX) or voice communication.</td>
</tr>
<tr>
<td>Ground Handler</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### 2.3 RIMS

#### 2.3.1 Preliminary

- **2.3.1.1.** This service has been currently designated as A-SMGCS Level 2 (according to EUROCONTROL).

- **2.3.1.2.** Two basic alerts are provided to the controller: INFORMATION and WARNING.

- **2.3.1.3.** No solution to de-conflict the situation triggering an INFORMATION or WARNING is provided to the controller. The Level 2 does not cater for conformance to clearances or instructions.

- **2.3.1.4.** The two basic alerts are currently only provided to the controller.

#### 2.3.2 Questions:

- **2.3.2.1.** Would it be interesting to provide and show in the future potential conflicts between vehicles and other mobiles on a vehicle-mounted display (authorised/participating vehicles)? The final responsibility, for safe taxiing outside the runway protected area, remains with the flight crew. Would the representation of potential conflicts with the ‘own ship’ on on-board displays contribute to this service? Retrofit cost for Aircraft Operators?

- **2.3.2.2.**

<table>
<thead>
<tr>
<th>RIMS Category Stakeholder</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Controller</strong></td>
<td><strong>Active User</strong></td>
</tr>
<tr>
<td></td>
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</tr>
<tr>
<td><strong>Flight Crew</strong></td>
<td><strong>Active Contributor</strong></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Vehicle Driver</strong></td>
<td><strong>Passive Contributor</strong></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
2.4 AIRPORT SAFETY NETS

The role of the Flight Crew is to navigate the aircraft following ATCO instructions and clearances provided through R/T, and with the help of visual aids and ATCO. The main tasks related to SMGCS are the following:

- Report its position to ATCO by R/T;
- Monitor surrounding traffic to prevent collision by visual means and traffic information provided by ATCO.

The role of the Pilot will not change with the implementation of A-SMGCS level 1. Contrary to the controller, the above tasks will not evolve as the pilot will not have access to the surveillance service.

However, the use of an A-SMGCS level 1 will have the following impact on the pilot work:

Reduction of R/T report

Since the controller knows the position and identity of aircraft provided by A-SMGCS, it is possible that some aircraft position reports be not necessary anymore. This statement has to be confirmed by the definition of the procedures related to the use of A-SMGCS.

Cooperative sensor checking

Since aircraft are supposed to provide their identity through cooperative surveillance sensors, aircrew should check that this piece of equipment operates satisfactorily on board and should use it in the correct manner.

2.5 ROUTING & PLANNING

In the SMGCS current situation, the role of the driver is to drive his vehicle following ATCO instructions and clearances provided by R/T, and with the help of visual aids and ATCO. The main tasks related to SMGCS are the following:

- Report its position to ATCO by R/T;
- Monitor surrounding traffic to prevent collision by visual means and traffic information provided by ATCO.

As for the pilot, the role of the driver will not change with the implementation of A-SMGCS level 1. However, when the controller knows the position and identity of vehicles, provided by A-SMGCS, it is possible that some vehicle position reports are not necessary anymore. It has to be confirmed in the procedures related to the use of A-SMGCS.

Moreover, if the vehicle is equipped for A-SMGCS, for instance with a transponder, the driver should check the equipment is activated and should use it in the correct manner.

2.6 GUIDANCE

If not automatic, one or more operators are needed to update the traffic context required by A-SMGCS, this includes:

- MET data, visibility conditions (including transition between visibility 1, 2, 3 and 4), ...
- Airport Configuration: runway in use, open taxiways,…
- List of participating mobiles,…
3. A-SMGCS Services

3.1 Objectives (Background and services)

The A-SMGCS intends primarily to enhance safety and efficiency of ground operations based on the introduction of the surveillance service.

The main objective is to enhance ATM operations, in particular visual surveillance (performed in SMGCS) by an automated system capable of providing the same level of service in all-weather operations.

3.2 Surveillance

The surveillance component represents the first step in an A-SMGCS implementation, allowing the subsequent introduction of other A-SMGCS services such as safety nets, routing and guidance.

The surveillance component consists of an automated system capable of providing airport traffic situational awareness through the representation of identification and position of aircraft and vehicles within a predefined area of interest.

The areas of interest are defined as follows:

- manoeuvring area for vehicles;
- movement area for aircraft.

The A-SMGCS surveillance component should be able to assist the controller in preventing collisions between all moving aircraft and vehicles especially in conditions when visual contact cannot be maintained.

The application of A-SMGCS may lead to reallocation of responsibilities for positioning the mobiles when the controller cannot establish visual contact. Less reliance is placed on the ability of the pilot or control authority to provide a visual surveillance function.

A-SMGCS surveillance assists controllers by providing:

- a representation of the actual airport traffic on a display, independent of line-of-sight connection between the controller and the object;
- the position, and, if available, the identity, of all mobiles, in particular not directly visible ones (reduced visibility conditions, building hiding a mobile,…).

Other users can benefit from the traffic display in passive mode, i.e. without the possibility to interact with the system.

To achieve the objectives above the A-SMGCS surveillance component will display a synthetic representation of the ground traffic situation based on the following features:

- Traffic context (airport configuration);
- Position of all vehicles on the manoeuvring area and of all relevant aircraft on the movement area;
- Identity of all cooperative vehicles on the manoeuvring area and of all relevant aircraft on the movement area.
The controller should be able to confirm the identity of all participating mobiles through the application of the controller identification procedures if still valid.

**Airport Environment**

The airport environment contains all data, except traffic information (mobiles position and identity), which is necessary for the controller to perform the surveillance task. This includes:

- Airport layout: geographical representation of various airport areas (TWY, RWY, ...), their status (open / closed), the reason a runway or taxiway is closed;
- Reference points: RWY thresholds, holding points, stop bars, center line lighting etc.;
- Fixed Obstacles (see definition in section Error! Reference source not found.);
- Status of ATS systems: landing systems, visual aids, ATIS…;
- Other data: meteorological conditions, information about emergencies etc.

To complement surveillance data provided to the controller, traffic information is displayed in the traffic context. It means traffic mobiles should be seen in the correct position with respect to the aerodrome layout and other traffic.

**Position of mobiles**

The display of the position of all mobiles is necessary for the Controller in order to monitor the traffic and in particular to detect the intruders.

As controllers are responsible for the manoeuvring area, the surveillance service must provide the position of all mobiles on the manoeuvring area.

In addition, ICAO Aerodrome control functions (paragraph 7.1.1) recognise local delegation to ATC for ‘push-back’ control, therefore aircraft that are of concern for ATC (“relevant” aircraft) need to be identified as well on the apron prior to push-back.

Consequently, the surveillance service requires covering the vehicles on the manoeuvring area and the relevant aircraft on the movement area (or relevant part of the movement area).

Detection and positioning of potential intruders is required, which implies the use of a non-cooperative sensor.

**Surveillance Display/HMI**

All data of the A-SMGCS will be displayed on a dedicated display system. This includes as a minimum the features described in the previous paragraphs. If additional functionalities like surface safety nets, routing, planning and guidance are implemented, the interaction with these should be performed using the A-SMGCS HMI.

The A-SMGCS display shall be adaptable to the user’s area of interest by using zooming and panning functions. The interaction with the system should be as easy and intuitive as possible. Therefore the use of menu bars with dropdown menus-like in most computer applications today- has become a standard for these applications.
Another useful display feature is the tool bar to enable easy access to frequently used functions by clicking one icon (see bottom of Fig. 1).

In many cases an overlay of the synthetic target and airport environment data with the video signal from the primary radar is shown on the display—see Fig. 2. Depending on the quality of the primary signal this can provide valuable information about the detected aircraft’s size and orientation. It also helps to detect intruders which do not have an operating transponder or transmitter.
One of the most important capabilities of the A-SMGCS surveillance function is the identification of the detected targets. Therefore the labelling features of the used HMI play an important role. As a minimum, the HMI shall be able to provide different label types for inbound, outbound and vehicle traffic (see Fig ...3). On airports with a high proportion of towed aircraft, a label category for these has shown clear benefits.

3.3 Airport Safety Nets

3.3.1 Overview

A-SMGCS can provide an automated alerting service to Controllers called Airport Safety Nets. This service detects the following sorts of alerts:

- Runway Incursion Monitoring System (RIMS),
- Conflicting ATC Clearances (CATC),
- Conformance Monitoring Alerts for Controllers (CMAC).

This service gives assistance to the Controller in their control tasks by:

- Anticipating potential conflicts / hazardous situations;
- Detecting conflicts and infringements.

For each conflict / non-conformance to procedures or instructions detected, the A-SMGCS Airport Safety Net service provides an appropriate alert to ATCOs.
The A-SMGCS Airport Safety Net service primarily intends to contribute to operations as a safety net, preventing hazards resulting from Controller, Flight Crew or Vehicle Driver operational errors or deviations.

The RIMS function is in use at many European airports and acts as a short term alerting tool, whereas the CATC and CMAC are new tools just starting to be implemented and will serve more as predictive tools that aim at stopping situations arising where a RIMS alert would be triggered.

### 3.3.1.1 Stages of Alert

Different levels of severity for alert situations may be distinguished. For each level a different alert stage is defined. Two stages of alerts are recommended based on the experience and practices of current A-SMGCS systems in Europe.

These 2 stages of alert are defined as follows:

- **Stage 1 alert** is used to inform the controller that a situation which is potentially dangerous may occur, and he/she needs to be made aware of. According to the situation, the controller receiving a stage 1 alert may take a specific action to resolve the alert if needed. This is called an INFORMATION alert.

- **Stage 2 alert** is used to inform the controller that a critical situation is developing which needs immediate action. This is called an ALARM alert.

In general, a stage 2 alert is preceded by a stage 1 alert in order to anticipate the conflicts / infringements. However, it is not systematic and depends on the scenario. Depending on the detected situation a prediction will not necessarily be issued and the system will directly trigger an Alarm.

Controllers have different preferences, some of them want to be alerted only when the situation is critical (only stage 2 alerts), and others wish more anticipation (2 stages of alert). As a consequence, some ATS providers may choose to have ALARM only, and not use INFORMATION alerts.

The end of an alert situation can be either manual, controller input, or automated based on local parameters.

### 3.3.1.2 Compliance with ATC Procedures and Working Methods

In order to efficiently assist the Controller (and build confidence), the A-SMGCS Airport Safety Net service shall be compatible with local procedures and working methods. It could have requirements for additional amended procedures that should be harmonised (i.e. ICAO).

In particular, the detection of conflict / infringements shall take into account local working methods implemented according to the ICAO relevant provisions e.g. multiple line-ups, intersection departures, conditional clearance (see definitions in Error! Reference source not found.).

The Airport Safety Net service shall also take into account that such working methods vary with respect to traffic load or meteorological conditions.

According to given visibility conditions (local parameter) operations such as multiple line-ups, may not be authorised and in such a case appropriate alerts shall be generated.

However, in some cases the Airport Safety Net service could allow the ATM providers to perform multiple line-ups and conditional clearances even in reduced visibility conditions, provided that aircrew can see each other.
3.3.1.3 Protection Areas

Many of the alerts defined in the Airport Safety Nets service require that a protected area around the runways and restricted areas is defined, and this area will be dependent on different weather conditions (e.g. Non-LVP and LVP).

As an example an infringement is detected when a mobile crosses the Runway Protection Area (RPA) boundary without a clearance.

The form and size of the protection areas may vary depending on airport layout and ATC procedures.

The RPA is composed of two boundaries:

- A ground boundary to detect the mobiles on the surface,
- An air boundary to detect airborne aircraft.

Around the same runway several “layers” of protection areas may be defined, each one corresponding to an alert situation severity level (and associated to alert stages, see section 3.3.1.1).

The boundaries of the RPA must be as close as possible to the runway to avoid unnecessary alerts, but must be carefully determined to allow time for immediate action / reaction in order to prevent any mobile from entering the runway after having been detected as a potential hazard.

3.3.1.4 Ground boundary

The length of the ground boundary must at least include the runway strip. The width could be defined, and different, according to the meteorological conditions, e.g. Non-LVP, LVP.

As an example based on today ILS holding positions:

- In Non-LVP : ground boundary defined by Cat I holding position (normally extends 90 metres from Runway centreline)
- In LVP : ground boundary defined by Cat II / III holding position (normally extends 150 metres from Runway centreline)

This ground boundary will be used for both prediction and alert stages.

![Figure 1: Example of RPA CAT1 Ground boundary](image)

Subject to further development, if the runway protection is ensured by an algorithm which could predict that a mobile is able or not to stop before entering the protection area, i.e. the ground boundary, an alert could be generated before the mobile crosses the boundary.
Such algorithms, based on the speed and position of a mobile, may already exist but they have to be evaluated.

### 3.3.1.5 Air boundary

The air boundary is defined as a flight time to the runway threshold and would take into account the two stages of alert, prediction and alert, as well as the meteorological conditions:

- **Non-LVP**: INFORMATION around $T_1 = 30''$, ALARM around $T_2 = 15''$
- **LVP**: INFORMATION around $T_1 = 45''$, ALARM around $T_2 = 30''$

These times of the two alert stages outlined above should be configurable, depending upon optimisation at the aerodrome.

![Figure 3-2: Example of RPA Air boundary for Information Alert](image)

### 3.3.1.6 Alerts to Controllers

When an alert is triggered it is presented to the Controller on the HMI and in the case of an ALARM alert an audio warning will also sound.

**The provision of the alert situation on the HMI will include**: type and location of alert situation, identification of the conflicting mobiles. This visual alert is presented on the same HMI used for the surveillance service.  
As part of the controllers’ task is to monitor the operational situation by looking outside of the window, they often will not be looking down at the A-SMGCS, therefore an Audio warning is also used to instantly inform the controller of an ALARM situation which has been triggered.

**The audio warning will always be associated with a visual alert** and can take the form of a buzzer, bell, siren etc depending on local implementation, but it should be distinctive from other audio warnings that maybe used in the tower and when activated it should be possible to turn the sound off before resolution of the problem as a continuous noise can be distracting.

The alerts can be displayed on the EFS, the radar/track label and in a dedicated Alert Window on the screen. **It is recommended that all alerts that are triggered are shown in the Alert Window until they are resolved.** In the case where more than one alert is triggered for the same mobile it is recommended to display the alert with the highest priority only in the radar/track label and /or EFS, bearing in mind that all the alerts are always being displayed in the Alert Window. Studies have highlighted the following issues,

- Display of alerts will be subject to local agreements as there has been a divided opinion on when to show an ALARM to ATCOs, when an INFORMATION alert would suffice, in other words restrict the number of ALARM to a minimum so that when they are triggered ATCOs react with the urgency they warrant. Also,
should a Runway Incursion alert always be an ALARM regardless of whether other traffic is present or not?

- The number of false or nuisance alerts must be kept to a minimum so that ATCOs do not become complacent and ignore them. An example could be at an airport with high intensity runway operations where arrivals are closely spaced and regularly receive a late landing clearance; there might not be a need to implement the No Landing Clearance alert.

- The question of which controller position/s should display the alerts and when to display alerts also brings divided opinion, however, initial requirements have now been defined as guidance to implementation and it will be left to individual sites to define their own rules for this.

- It is not always possible to resolve the alert situation straight away, therefore, in the case of an ALARM ATCOs have requested the possibility to silence the warning buzzer once it has been activated so as not to continue to distract them or their colleagues. Similarly for an INFORMATION alert ATCOs requested the possibility to remove the alert from the EFS and the radar/track label but leave the alert showing in the alert window until it was resolved. This action helps to reduce clutter and distraction on the HMI.

### 3.3.2 Runway Incursion Monitoring System (RIMS)

The RIMS is based on surveillance and programmed constraints and has proven to be a difficult challenge to implement correctly without displaying false alerts to controllers. RIMS will detect when 2 or more mobiles end up in conflict on or near the runway. The following cases remain specific to every airport.

**Airport layout:** the triggering of a runway incursion could be different at an airport with only one runway to an airport with two crossing runways.

**Local Procedures:** The conflicts / infringements cases are closely related to ATC local procedures. For instance, in order to increase the departure rate, some airports apply multiple line-up departures under which several aircraft may be lined-up at the same time on the same runway. In such an airport, two aircraft that are lined-up are not considered as a conflict. Therefore, in that case, the Airport Safety Nets should deal with two aircraft in the same protection area without issuing an immediate alert. This implies the use of A-SMGCS safety net whose algorithm goes further and deeper than the traditional algorithm.

In other airports where multiple line-up is not in operation, the case where 2 aircraft are lined-up may be recognised as a runway incursion.

**Integration with EFS:** Linking the clearance input on the EFS to the surveillance position of the mobile will provide more information to the system and reduce the need for some specific tuning. Currently most Airports use RIMS as a standalone tool, but it is foreseen with the new CMAC and CATC alerts that the use of EFS inputs will be essential to enable the new alerts and RIMS to function in harmony.

In the following sections some general cases are listed where RIMS is expected to trigger an alert.

#### 3.3.2.1 Scope of conflicts / infringements on runway
The Airport Safety Nets is to detect incidents or potential incidents caused only by aircraft or vehicles, not people.

The detection of conflicts / infringements on the runway must take into account the specific runway configuration of each airport. An airport may have one, two or more runways. The analysis of conflicts / infringements on an airport with more than two runways, may be done by considering each pair of runways.

According to this scope, the different conflicts / infringements on runway scenarios are defined in the following sections. We address the different runways configurations (one or two runways) and the different mobiles configurations (a single mobile or conflicts between an aircraft and another mobile).

The Airport Safety Nets service works on the assumption that every mobile entering the RPA must have a clearance from the controller.
**The mobile is a vehicle**

The objective is to detect vehicles entering the runway without authorisation according to the ICAO rule: “The movement of pedestrians or vehicles on the manoeuvring area shall be subject to authorization by the aerodrome control tower. Persons, including drivers of all vehicles, shall be required to obtain authorization from the aerodrome control tower before entry to the manoeuvring area. Notwithstanding such an authorization, entry to a runway or runway strip or change in the operation authorized shall be subject to a further specific authorization by the aerodrome control tower.” (7.5.3.2.1).

Prior to delivering an authorisation, the controller must identify the vehicle. In A-SMGCS Level 2, all participating vehicles (those likely to enter the manoeuvring area) are cooperative, which means able to provide their identity to A-SMGCS. As a consequence, for the system, any vehicle unable to provide its identity is considered an intruder.

- The vehicle is not identified by A-SMGCS
  
  Unidentified vehicles are intruders and not authorised to enter not only the runway but the whole manoeuvring area. Consequently, provided that the system makes sure that the unidentified vehicle does not correspond to a false detection, the system will trigger an alert when an unidentified vehicle enters the runway protection area. As previously, the A-SMGCS could be equipped with a predictive algorithm which issues an alert before the vehicle enters the manoeuvring area.

  Note: The system could be enhanced by using the vehicle speed to anticipate its incursion in the runway protection area. It also could be extended to the detection of unidentified vehicles on the whole manoeuvring area.

- The vehicle is identified by A-SMGCS
  
  Although the vehicle is identified, A-SMGCS doesn’t know if the vehicle is authorised or not. One way to do it, is to manually enter each authorisation in the system. This will highly increase the controller workload, and it is not acceptable. Consequently, the system will not know whether or not a vehicle is authorised and it will never alert when an unauthorised identified vehicle enters the runway or the
manoeuvring area. However, in any case the conflict between a vehicle entering the runway and an aircraft will be detected (see section Error! Reference source not found.).
Conflicts / infringements involving an aircraft and another mobile

In order to trigger the appropriate alerts to the controllers, the position of the mobiles should be analysed according to the set time-parameters, their relative speeds and positions when entering the RPA:

- Aircraft / vehicle
- Arrival / Arrival
- Arrival / Departure
- Departure / Departure
- Including aborted takes-off and go-around

Consideration should be given to the working methods of every airport and the local parameters like reduced separations on the runway when approved by the ATS authorities.

Arriving Aircraft

If a mobile (aircraft or vehicle) is in the RPA and:

1. the arriving aircraft < T1 from threshold => INFORMATION
2. the arriving aircraft < T2 from threshold => ALARM, until the arriving aircraft has passed the mobile (mobile behind the arriving aircraft)

Add Image of ARR vs Checker

If there is a slower preceding departing aircraft which has not crossed the end of the runway-in-use or has not started a turn and:

1. the arriving aircraft < T1 from threshold => INFORMATION
2. the arriving aircraft < T2 from threshold => ALARM

Implementation Tip: The system could be enhanced, as some existing systems do, by using the acceleration difference between both aircraft. It will allow to predict with more accuracy if there is a risk of collision or not, and so avoid unnecessary alerts.

Add Image of ARR vs DEP

If there is a preceding arriving aircraft which has not cleared the RPA and:

1. the arriving aircraft < T1 from threshold => INFORMATION
2. the arriving aircraft < T2 from threshold => ALARM
3. 

Implementation Tip: At certain airports the runway exits may be sufficiently far down the runway where it is deemed that the vacating aircraft is not in conflict with the arriving aircraft at the normal T1/T2 parameters. In this case the local implementation should agree on when the alerts should trigger.

Add Image of ARR vs Vacating aircraft

Departing aircraft

If a mobile (aircraft or vehicle) is in the RPA not behind the departing aircraft:

1. the departing aircraft is taking off (speed < 50 knots) => INFORMATION
2. the departing aircraft is taking-off (speed > 50 knots) => ALARM
In the case of a multiple line-up (where it is permitted), the system shall trigger an ALARM if the departing aircraft which is behind is detected as moving past the area where it is supposed to stop its line up and hence is considered to have started its take-off roll. The use of an INFORMATION alert in this case is left to local decision but would most likely be too late as the controller might not see it.

Parallel or Converging runways

When operations are conducted on two parallel or converging runways, each runway will be considered with its own RPA and as a consequence two parallel or converging runways are considered as two individual runways.

At most major airports the distance between the runways centrelines is such that the RPAs will not overlap.

Nevertheless in order to avoid unwanted warnings, consideration should be given to the layout of the taxiways / runways (see ICAO Annex 10) when deciding about the parameters for the ground boundaries of the RPAs.

The position of the mobile will be analysed according to the protection areas of both runways then depending on the mode of operations (mixed or segregated) the A-SMGCS will issue, alert warnings already defined for the same configuration (landing or taking-off aircraft) for the one-runway scenarios.
**Intersecting runways**

When 2 or more runways cross they share a common part and the controller has to be alerted if there is a risk that any two mobiles, one being an aircraft, are predicted to be in this common part at the same time.

In order to avoid this critical situation, the A-SMGCS should analyse the position of any mobile according to the protection areas of both runways at the same time.

For that reason the protected area will encompass 3 protection areas: each runway protection area and the common part of the protection areas.

---

**Figure 3-3 : Protection areas common part**

The A-SMGCS will analyse the position of the mobile according to each runway protection area and to the runway protection areas common part.
**Same runway**

If a mobile is detected in the same protection area as the one of an already engaged runway: the single runway scenario cases will apply.

E.g. aircraft on final runway 2, mobile entering runway protection area 2 or aircraft taking off on runway 1, mobile entering runway protection area 1

**Different runways: not aiming at the common part**

If a mobile is detected in a protection area different from the one of an already engaged runway => no warning

E.g. aircraft runway 2, mobile runway 1

**Different runways: aiming at the common part**

**Arriving aircraft**

If a vehicle enters the runway protection area common part and:

1. the arriving aircraft < T1 from threshold => INFORMATION
2. the arriving aircraft < T2 from threshold => ALARM

If an aircraft is lined-up on the other runway => INFORMATION

If an aircraft is taking off on the other runway => ALARM

**Departing aircraft**

If a vehicle enters the runway protection area common part and:

1. the departing aircraft is lined-up => INFORMATION
2. the departing aircraft is taking off => ALARM

If an aircraft is lined-up on the other runway => INFORMATION

If an aircraft is taking off on the other runway => ALARM

**3.3.2.2 Restricted Area Incursions**

The restricted area incursions generally concern incursions by a mobile into area where the presence of an aircraft or a vehicle is permanently or temporarily forbidden e.g. closed TWY, ILS or MLS critical areas. Local procedures may define some areas where certain mobiles are permitted to enter without an alert being raised. When closed, runways may also be considered as restricted areas.

The restricted areas and their associated protections used to detect incursions should be defined locally with respect to each airport particularity. However, since restricted areas incursions deal only with ground traffic, the definition of the corresponding protection areas is easier than for runways. The protection area will be composed of only a ground boundary to detect incursions and the protection area boundary will be defined by the boundary of the restricted area (closed TWY, ILS critical area).

An ALARM will be provided to the controller when a mobile enters a restricted area.

Note: When the Routing service is implemented and the cleared route of the mobile is known, then an INFORMATION alert will be triggered predicting that the mobile will pass through the area, this alert is covered in the CMAC section 3.3.4.
Example of an Aircraft entering a closed Taxiway

3.3.3 Conflicting ATC Clearances (CATC)

It is important to note that the term ‘Conflicting’ in the title refers to the fact that certain clearances input on the EFS at the same time by an ATCO do not comply with the local ATC rules/procedures, it does not mean that the aircraft/vehicles have ended up in conflict with each other.

The detection of CATC is to provide an early prediction of situations that if not corrected would end up in hazardous situations that would normally be detected in turn by the RIMS if in operation.

The detection of CATC will be performed by the ATC system and depending on the situation, some or all of the following data will need to be known by the ATC system,

- The clearances given to the mobiles concerned.
- The assigned runway.
- The assigned holding point.
- The route of the mobile/s.
- The position of the mobile/s using A-SMGCS Surveillance data (e.g. position, velocity, track angle…) correlated to flight plans on the mobiles concerned.

The ATCO should therefore be provided with an HMI to input into the ATC system when clearances are given to aircraft or vehicles. The HMI should also be capable of displaying alert messages to the controllers for the CATC detected by the ATC system. The HMI can also be adapted to give an indication to the ATCO that if a specific clearance is input it will trigger a CATC alert so this will in fact help the ATCOs situational awareness and normally prevent them from giving a wrong clearance.

Working procedures for the controllers shall be adapted to ensure that all clearances given to aircraft or vehicles are input in the ATC system by the controller in a timely manner (click/input at the same time as the R/T clearance is given).
Any clearance input in the ATC system will be a triggering event for the ATC system to detect any new CATC.

Different types of CATC are identified and shall be implemented. Some of them are only based on the controller input; others are in addition using other data such as A-SMGCS Surveillance data to confirm that an abnormal situation is detected.

An alert message shall be automatically triggered when conditions matching those described in paragraphs xxxx are detected by the ATC system.

The following situations are considered for the triggering of CATC alert,

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Alert Message</th>
</tr>
</thead>
<tbody>
<tr>
<td>Take Off vs Line Up, Take Off vs Land, Take Off vs Take Off</td>
<td>Alert</td>
</tr>
<tr>
<td>Cross vs Take Off, Cross vs Land, Cross vs Cross.</td>
<td>Alert</td>
</tr>
<tr>
<td>Enter vs Take off, Enter vs Land, Enter vs Enter</td>
<td>Alert</td>
</tr>
<tr>
<td>Land vs Land, Land vs Take off, Land vs Enter, Land vs Cross, Land vs Line Up</td>
<td>Alert</td>
</tr>
<tr>
<td>Line Up vs Line Up, Line Up vs Land,</td>
<td>Alert</td>
</tr>
</tbody>
</table>

### 3.3.4 Conformance Monitoring Alerts for Controllers (CMAC)

The introduction of Electronic Flight Strips (EFS) means that the instructions given by the ATCO are now available electronically and can be integrated with other data such as flight plan, surveillance, routing, published rules and procedures. The integration of this data allows the system to monitor the information and when inconsistencies are detected, the ATCO can be alerted via the HMI and audibly with a buzzer. The main benefit of this is the early detection of flight crew / vehicle driver errors that, if not detected and resolved, might result in a hazardous situation. The current A-SMGCS RIMS will still exist as the last minute warning system based on the position of the mobiles.

The CMAC Alerts have been developed following the investigation of actual incidents on airports and the identification of the cause of the incidents. The following situations are considered for the triggering of a CMAC alert

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Alert Message</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROUTE DEVIATION</td>
<td>An aircraft deviates from cleared route on a taxiway</td>
</tr>
<tr>
<td>RWY/TWY TYPE</td>
<td>For a flight, when a selected runway is inappropriate / unsuitable w.r.t the aircraft type, i.e. runway is too short. (A380 a/c to take – off RWY26, negative)</td>
</tr>
<tr>
<td>RWY CLOSED</td>
<td>For a flight, when a selected runway is closed. (e.g. 19L CLOSED) (RED Alarm if Aircraft given LUP/TOF)</td>
</tr>
<tr>
<td>TWY CLOSED</td>
<td>The taxi route is planned to go through a closed taxiway (RED Alarm if Aircraft enters closed area)</td>
</tr>
<tr>
<td>NO PUSH / NO TAXI CLR</td>
<td>Aircraft Pushes back or taxi without clearance from ATC</td>
</tr>
<tr>
<td>Event</td>
<td>Description</td>
</tr>
<tr>
<td>--------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>HIGH SPEED</td>
<td>Aircraft taxies with speed exceeding x knots</td>
</tr>
<tr>
<td>RWY INCURSION</td>
<td>A Mobile in runway protection area with no clearance (Also displayed as No Line Up/Cross/Enter Clearance)</td>
</tr>
<tr>
<td>ROUTE DEV</td>
<td>An aircraft deviates from cleared route on a taxiway (close to an active Runway)</td>
</tr>
<tr>
<td>NO TOF CLR</td>
<td>Aircraft cleared to line-up and it takes-off without TOF clearance</td>
</tr>
<tr>
<td>NO LND CLR</td>
<td>Aircraft close to runway without a Landing Clearance</td>
</tr>
<tr>
<td>STATIONARY IN RPA</td>
<td>Aircraft that has landed and is within RPA for 30seconds, or lined up for more than 200secs or more without moving</td>
</tr>
<tr>
<td>RED STOP BAR CLOSED</td>
<td>Mobile Crosses a RED Stop bar (Intermediate Holding Point)</td>
</tr>
<tr>
<td>RWY CLOSED</td>
<td>A mobile has entered a closed Runway</td>
</tr>
<tr>
<td>TWY CLOSED</td>
<td>A mobile has entered a closed Taxiway</td>
</tr>
</tbody>
</table>
RESTRICTED AREA INCURSIONS

The restricted area incursions only concern incursions by an aircraft (not vehicles) into an area where the presence of an aircraft or a vehicle is permanently or temporarily forbidden. Closed TWY, ILS or MLS critical areas are example of restricted areas. When closed, runways may be considered as restricted areas. The case of incursion on a closed runway is covered separately by the runway safety net (section Error! Reference source not found.).

The restricted areas and their associated protections used to detect incursions should be defined locally with respect to each airport particularity. However, since restricted areas incursions deal only with ground traffic, the definition of the corresponding protection areas is easier than for runways. The protection area will be composed of only a ground boundary to detect aircraft incursions and the protection area boundary will be defined by the boundary of the restricted area (closed TWY, ILS critical area,…).

An alert will be provided to the controller when an aircraft enters a restricted area or before the entrance if a predictive algorithm is used.

3.4 Routing and Planning (TBC Future)

3.5 Guidance (TBC Future)
4. Operational Procedures

The implementation of A-SMGCS level 1 requires the review of SMGCS procedures and the definition of a new set of operational procedures to be applied by ATC controllers, pilots and vehicle drivers.

In addition, procedures benefiting from A-SMGCS surveillance service are being harmonised on a European and international level. The activities on procedures are carried out by EUROCONTROL in close cooperation with ICAO. The following section purpose is to present the categories of procedures associated to A-SMGCS Level 1.

4.1 Operations

Aircraft will operate on different aerodromes, not equipped with the same kind of A-SMGCS. Therefore, to facilitate aircrew operations, A-SMGCS categories need to be defined corresponding to the implementation levels (1 / 2 / 3 / 4), as well as potentially required aircraft equipment. A formal agreement that aircraft will be equipped to provide cooperative surveillance (e.g. carriage of mode S transponder) may be needed.

Airport A-SMGCS category will be notified to airspace users in order to allow aircrews to anticipate provided services and applicable procedures.

4.2 General Procedures

4.2.1 Identification of mobiles

Add process of identifying Arrival/Departure and Vehicles.

The identity of mobiles is necessary for the controller to communicate with the pilots or vehicle drivers in particular to issue clearances. The surveillance service will display the identity of all mobiles in a label attached to the corresponding target.

The automatic labelling of a mobile implies the use of on-board cooperative surveillance equipment that provides mobile identity to A-SMGCS. Provided with the mobile identity, the A-SMGCS is then able to attach the identity label to the mobile target. In case a same mobile transponder is used for several vehicles, ATC should have the ability to manually put the right call sign in the associated label. This manual labelling shall remain exceptional.

In A-SMGCS level 1, most of the mobiles “known” by the ATC authorities, called “participating mobiles”, are expected to be cooperative. Therefore, participating traffic will be automatically labelled with its identity, which will then be confirmed by ATC through the application of identification procedures.

As for position information, the identity labels are attached to relevant aircraft on the movement area and to vehicles on the manoeuvring area.

4.2.2 Transponder Operating Procedures

Introduction

XXXX airport has installed an improved surface surveillance system, using Mode-S multilateration. Operational trials using this system will commence on dd/mm/yy.
2. Operation of Mode S transponders when the aircraft is on the ground

Aircraft operators intending to use XXXX airport shall ensure that the Mode S transponders are able to operate when the aircraft is on the ground. Pilots shall:

- Select AUTO mode and assigned Mode A code
- If AUTO mode is not available Select ON (e.g. XPDR) and assigned Mode A code
  - From the request for push back or taxi whichever is earlier.
  - After landing, continuously until the aircraft is fully parked on stand
  - When fully parked on stand select STBY
- Whenever the aircraft is capable of reporting Aircraft Identification (i.e. callsign used in flight), the Aircraft’s Identification should also be entered from the request for push back or taxi whichever is earlier (through the FMS or the Transponder Control Panel).
- Air crew must use the ICAO defined format for entry of the Aircraft Identification (e.g. AFR6380, SAS589, BAW68PG)

To ensure that the performance of systems based on SSR frequencies (including airborne TCAS units and SSR radars) is not compromised, TCAS should not be selected before approaching the holding point. It should then be deselected after vacating the runway.

For aircraft taxiing without flight plan, Mode A code 2000 should be selected.

4.2.3 Low Visibility Operations (LVO)

Amendment 7030

Use of ASMGCS instead of out of the window, local safety assessment followed by endorsement from the regulator?

Flight Crew no need to give position reports

(what has been the Task Force members experience?)

Quid vehicle drivers?

4.2.4 Controller

For the controller, it is necessary to define the procedures for the use of A-SMGCS as a surveillance means for positioning and identification of the mobiles, like those already defined for the use of radar.

For each procedure, conditions under which they can be applied must be defined. Examples of application conditions are the status of the A-SMGCS and the visibility conditions. The A-SMGCS status may be nominal mode, failure mode or OFF. For instance, when a surveillance sensor breaks down, A-SMGCS status switches into failure mode. When A-SMGCS will not function correctly enough to be used as a surveillance means, its status should be OFF. The limits between the different system status will be accurately defined with their associated procedures.

As in the current SMGCS situation where specific procedures (LVP) apply when the visibility is reduced, procedures will also differ according to the visibility conditions.
when A-SMGCS level 1 is implemented. The procedures to be applied under each visibility condition have to be defined.

The surveillance service provided by A-SMGCS level 1 is automatic, but may exceptionally require manual actions from the controller or other operator. In particular, when the identity of a participating mobile is not automatically provided by A-SMGCS, the procedures must define how the controller can perform the identification of such a mobile (i.e. the use of identification procedures). This manual labelling shall remain exceptional.

4.2.5 Flight Crew

In A-SMGCS level 1, there will be limited changes to pilot responsibilities. As explained in section Error! Reference source not found., the pilot must check if the equipment operates correctly. A-SMGCS category of each airport, defining its A-SMGCS level, and the aircraft equipment required to interoperate, is expected to be determined in, for example, the aeronautical publications.

4.2.6 Vehicle Drivers

In A-SMGCS level 1, there will be limited changes to vehicle drivers responsibilities. As explained in section Error! Reference source not found., the driver must check if the A-SMGCS equipment of its vehicle operates correctly in case it is equipped.

What if the Vehicle Location Transmitter is U/S? on the manoeuvring area.

4.3 Other procedures

Mention generically in scope of document that other users are not considered Routing and Planning Mix of Voice Communication and Datalink to provide clearances and instructions
5. System Overview and Interoperability

5.1 System overview

The A-SMGCS surveillance service has to be modular to adapt to the needs of different aerodromes and also to allow implementation of future A-SMGCS functionalities.

The design of interfaces and subsystems will be specific for each individual airport, depending on the airport configuration and the exchange of flight related data with adjacent ATSUs.

The aim of this section is to present the equipment required for the A-SMGCS surveillance service without favouring any technology.

Firstly, to display the traffic situation picture to the controller, an HMI is needed. On the HMI screen, the traffic context and traffic information (position and identity) should be provided, with an adequate update rate to give a continuous flow of traffic information.

To provide the position of any mobile, it is essential that some means of surveillance be available to enable the system to detect non-cooperative targets including intruders and obstacles. An example of non-cooperative surveillance sensor is the Surface Movement Radar.

Non-cooperative surveillance sensors are not able to provide the identity of the mobiles, therefore a system providing cooperative surveillance is required. For cooperative surveillance, targets need to be equipped with a means of communicating position and identity information to the A-SMGCS. An example of cooperative surveillance sensor is the Mode-S Multilateration. The sensor may also be dependant of the mobile for instance when using ADS-B to broadcast the position and the identity of the mobile.

The surveillance service for an A-SMGCS will therefore comprise several sensor systems. As shown on , the information from these systems sensors will be combined by a data fusion process to provide a single combined and identified target to the controller HMI. The three elements (sensors, data fusion and display) represent the minimum configuration for an A-SMGCS. However, it needs to be noted that for integration into the airport environment a data exchange with the ASR and the airport database are essential elements.
5.2 Interoperability

To make the implementation and operation of ATM systems more efficient, the EC has published the Interoperability Regulation 552/2004. This regulation is applicable for any newly built ATM system, including A-SMGCS and its main goals are lower costs for procurement and maintenance as well as improved operational coordination.

One part of the regulation provides the so called Essential Requirements (ER), which are very high level and consist of the following:

- Seamless operation
- Support for new concepts of operation
- Safety
- Civil-military coordination
- Environmental constraints
- Principles governing the logical architecture of systems
- Principles governing the construction of systems

For each system, conformity with these ERs needs to be demonstrated to the NSA of the country—see guidelines in annex...

To comply with the SES Interoperability Regulation, the manufacturer has to either provide a Declaration of Conformity (DOC) or a Declaration of Suitability of Use (DSU) to the ANSP.
A DOC has to be used when the manufacturer complies with the Community 
Specifications for A-SMGCS, EN 303 213-1 to 4 published by ETSI. As this CS is an 
acceptable means of compliance, it seems to be the most straightforward way to 
achieve compliance.

However, if a manufacturer chooses to use alternative means of compliance, a DSU 
can be used. A DSU has to be based on the manufacturers own expertise and has 
to be giving respect to the items laid down in the Interoperability Regulation.

Based on the documentation described above, the ANSP has to provide a 
Declaration of Verification (DOV) and a Technical File (TF) to the NSA. The NSA will 
review the documentation, and after clarification of open questions and resolution of 
any issues the ANSP can put the system into operation.

Fig.XXX The steps for complying with the IOP Regulation
6. A-SMGCS Requirements

6.1 Introduction

The objective of this section is to capture the requirements that are relevant to the A-SMGCS services described in previous paragraph.

In the initial EUROCONTROL A-SMGCS documentation, 55 Operational requirements, 55 Functional requirements for Surveillance were defined. 20 Operational requirements and 15 Functional requirements were defined for the Airport initial safety net (RIMS). A lot of repetition and overlap between these requirements are leading to the decision to rationalise their definition but also to adapt the description format in order to be more comprehensive and concise.

General requirements applicable to more than one service are in the “General” sub-section, and then requirements per service are defined in dedicated sub-sections.

The following table is defined to collect the A-SMGCS requirements:

<table>
<thead>
<tr>
<th>Requirement Identifier</th>
<th>Unique requirement Identifier</th>
</tr>
</thead>
<tbody>
<tr>
<td>Requirement Title</td>
<td>Unique requirement title</td>
</tr>
<tr>
<td>Requirement Text</td>
<td>Requirement description</td>
</tr>
<tr>
<td>Requirement Type</td>
<td>Operational or Functional</td>
</tr>
<tr>
<td>Reference (optional)</td>
<td>e.g. ICAO, EUROCAE, SESAR….</td>
</tr>
</tbody>
</table>

Note:

1. A mandatory requirement is characterised by a “shall”.
2. An optional requirement is characterised by a “may”.
3. Operational requirements are more human oriented and could address HMI, safety, human performance aspect, air traffic control procedures etc…
4. Functional requirements are more system oriented but do not describe how the system should work (EUROCAE scope) but more what the system should do.

Few general requirements and some specific requirements for A-SMGCS Surveillance and Safety Nets are defined below to illustrate the proposal and get agreement from the task force to proceed in that direction.

6.2 General Requirements

<table>
<thead>
<tr>
<th>Requirement Identifier</th>
<th>ECTL-ASMGCS-GEN-001</th>
</tr>
</thead>
<tbody>
<tr>
<td>Requirement Title</td>
<td>Self-checking system</td>
</tr>
<tr>
<td>Requirement Text</td>
<td>A self-checking system with failure alerts shall be in the system design.</td>
</tr>
<tr>
<td>Requirement Type</td>
<td>Functional</td>
</tr>
<tr>
<td>Reference (optional)</td>
<td>ICAO A-SMGCS Manual 2.7.5.1</td>
</tr>
</tbody>
</table>

| Requirement Identifier | ECTL-ASMGCS-GEN-002  |

<table>
<thead>
<tr>
<th>Requirement Identifier</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Requirement Title</td>
<td>Self-checking system</td>
</tr>
<tr>
<td>Requirement Text</td>
<td>A self-checking system with failure alerts shall be in the system design.</td>
</tr>
<tr>
<td>Requirement Type</td>
<td>Functional</td>
</tr>
<tr>
<td>Reference (optional)</td>
<td>ICAO A-SMGCS Manual 2.7.5.1</td>
</tr>
</tbody>
</table>

| Requirement Identifier | ECTL-ASMGCS-GEN-002  |
### 6.3 Requirements for Surveillance Function

<table>
<thead>
<tr>
<th>Requirement Identifier</th>
<th>Requirement Title</th>
<th>Requirement Type</th>
<th>Reference (optional)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECTL-ASMGCS-SURV-001</td>
<td>Standardized Data Format</td>
<td>Functional</td>
<td>ICAO A-SMGCS Manual 2.6.16.2</td>
</tr>
<tr>
<td>ECTL-ASMGCS-SURV-002</td>
<td>Interference with ATC</td>
<td>Operational</td>
<td>ICAO A-SMGCS Manual 2.6.15.1</td>
</tr>
<tr>
<td>ECTL-ASMGCS-SURV-003</td>
<td>Airport Traffic Situation</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
6.4 Requirements for Airport Safety Net Function

Requirement Identifier: ECTL-ASMGCS-SAFN-001
Requirement Title: Restricted area incursions
Requirement Text: The controller shall be presented with mobile incursions detected in restricted area such as closed TWY, ILS or MLS critical area, to be defined locally for each aerodrome.
Requirement Type: Operational
Reference (optional): ICAO A-SMGCS Manual 2.5.4.1

Requirement Identifier: ECTL-ASMGCS-SAFN-002
Requirement Title: Stages of Alert
Requirement Text: The controller shall be presented with 2 different stages of alert characterising its importance
- INFORMATION
- ALARM
INFORMATION being less important than AMARM
Requirement Type: Operational
Reference (optional)

Requirement Identifier: ECTL-ASMGCS-SAFN-003
Requirement Title: Air boundary
Requirement Text: The air boundary shall be defined as a flight time to threshold and would take into account the two stages of alert, INFORMATION and ALARM, as well as the meteorological conditions:
- Non-LVP: INFORMATION around T1 = 30", ALARM around T2 = 15"
- LVP: INFORMATION around T1 = 45", ALARM around T2 = 30".
Requirement Type: Operational
6.5 Requirements for Routing Function

6.6 Requirements for Guidance Function
ANNEX A – Guidance for Implementation

A.1 Procurement Process
A.2 Regulation and Certification
A.3 Training
A.4 Security
A.5 Generic Safety Case to support ANSP, APT OPR to develop a local Safety Case