

**Contextual note – SESAR Solution description form for deployment planning**

**Purpose:**

*This contextual note introduces a SESAR Solution (for which maturity has been assessed as sufficient to support a decision for industrialization) with a summary of the results stemming from R&D activities contributing to deliver it. It provides to any interested reader (external and internal to the SESAR programme) an introduction to the SESAR Solution in terms of scope, main operational and performance benefits, relevant system impacts as well as additional activities to be conducted during the industrialization phase or as part of deployment. This contextual note complements the technical data pack comprising the SESAR deliverables required for further industrialization/deployment.*

**Improvements in Air Traffic Management (ATM)**

The SESAR Solution “Guidance assistance through airfield ground lighting” is intended for controllers, flight crews and vehicle drivers<sup>1</sup> and corresponds to the **Advanced Surface Management Guidance and Control Systems (A-SMGCS) Guidance function** foreseen in the International Civil Aviation Organisation (ICAO)’s A-SMGCS Manual (Doc. 9830). It is a ground-based service which provides individual guidance information to any mobile by automatically and progressively activating taxiway centreline lights, either in segments of several lights or individually, along the route cleared by the controller. If this cleared route includes a limit and if a physical stop bar exists at this point, this stop bar is also automatically activated when the mobile nears it.

The automation in this SESAR Solution also includes the management of priorities at intersections, based on pre-defined criteria (e.g. aerodrome rules, speed or target times). However, controllers are able to override the guidance decisions via their working position, which shows activated lights on the radar display. This SESAR Solution also provides adequate longitudinal spacing between mobiles on a same taxiway by attaching a segment of definitely de-activated lights behind each mobile and reducing the length of the activated lights in front of the trailing mobile if it closes on the leading one.

Working procedures for the controllers have to be adapted to ensure that detailed taxi clearances given to aircraft and vehicles are input in the system by the controllers and that appropriate phraseology, instructing the flight crew or vehicle driver to follow the greens up to a given destination point, is used.

The benefits of this SESAR Solution are:

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<sup>1</sup> A vehicle is only considered if a route is planned for it which is usually the case when it drives along the taxiway centreline (e.g. a tug towing an aircraft). Hence, most vehicle drivers at the airport are not concerned.

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- In **flight crew performance** because they can rely on visual cues to navigate on the airport rather than on complex taxi clearances and maps as in current operations.
- On **radio use**, as flight crews are less prone to hesitations and errors, thus requiring less assistance for navigation from controllers.
- In **controller performance** because they have to provide fewer instructions to mobiles operating on the aerodrome and have a better awareness of the traffic situation with the additional information displayed on their working position.
- On the **environmental impact** of taxiing operations, because flight crews taxi with more confidence, resulting in more regular speeds and less stops and go. Consequently, gaseous emissions and fuel burn are reduced.
- In the **predictability** of surface operations, as mobiles taxi with increased and more regular taxi speeds, thus allowing to predict the duration of each taxi phase more accurately.
- In the **safety** perceived by flight crews and controllers, as less route deviations can be expected with this SESAR Solution.

#### Operational Improvement Steps (OIs) & Enablers

The following Operational Improvement is under the scope of SESAR Solution #47:

- AO-0222-A: Enhanced Guidance Assistance to mobiles based on the automated switching of Taxiway lights and Stop bars according to the "Airfield Ground Lighting" operational service. It is fully covered by this Solution.

The following enablers are supporting SESAR Solution #47:

- AERODROME-ATC-50: Advanced Controller Working Position (A-CWP) supporting A-SMGCS functionalities (partially covered)
- AERODROME-ATC-61: Enhanced surface guidance management services to process the automatic triggering of airport ground signs according to the route issued by ATC (fully covered)
- REG-0201: Means of Compliance for A-SMGCS Routing and Planning (partially covered)
- Optionally, REG-0200: Safety Targets in Relation to Reductions of Runway Incursions (partially covered)

Applicable Integrated Roadmap Dataset is DS16.

This SESAR Solution depends on SESAR Solution #22 (Automated assistance to controller for surface movement planning and routing), as knowing the clearances and the detailed taxi route assigned to each mobile is a requirement.

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**Background and validation process**

Solution #47 has been validated through a series of activities including two Real Time Simulations and one Live Trial, with an objective to demonstrate the feasibility of providing guidance to mobiles by automatically switching taxiway lights according to controller clearances, to assess the acceptance of the resulting procedures and operations by controllers and flight crews, and to evaluate the performance benefits offered by this Solution.

- At V2 and V3 maturity levels, Real Time Simulations conducted in Frankfurt, Paris Charles De Gaulle (CDG) (North part) and Munich environments:
  - Quantification of performance benefits for human actors (situational awareness, workload), for airport operations (predictability, emissions, perceived safety, radio occupancy) and for airlines (fuel burn).
  - Determination of the preferred light switching method (single lamp or in segments) and set of parameters to achieve most important benefits.
  - Assessment of the acceptance of this new guidance means by controllers and flight crews.
- At V3 maturity level, a Live Trial conducted at Riga airport:
  - Assessment of the ability of AGL to provide appropriate guidance information and safe separation to mobiles through the automated activation of taxiway lights and stop bars in an environment with actual airport surveillance.

**Results and performance achievements**

The above-mentioned validation exercises have provided the following main findings:

- From pilots' point of view:
  - The situational awareness of flight crews is improved, as this Solution helps their understanding of the operational situation and reduces the need for attentional resources, especially in low visibility conditions.
  - The workload of flight crews is reduced, as they can rely on the external visual cues to perform their navigation tasks.
  - The perceived safety is increased and flight crews have not identified any safety critical issues.
- From controllers' point of view:
  - The situational awareness of controllers is improved, notably because this Solution helps their understanding of the operational situation.
  - The workload of controllers is reduced, as they can rely on increased automation to perform their tasks.

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- The perceived safety is increased and controllers have not identified any safety critical issues.

The following benefits have been identified:

- The adverse effects of low visibility on apron performance can be compensated.
- The average duration of ground movements can be reduced by 25% as flight crews taxi with more confidence and in a smoother manner.
- The overall duration of R/T can be reduced by 25% and clearance delays for pushbacks can be reduced by 2/3.
- The amount of fuel burnt during taxi can decrease by 18% in good visibility conditions and by 40% in low visibility conditions.
- The predictability of ground movements is improved as the variability of actual taxi times compared to predicted values is divided by two in good visibility conditions.

### Recommendations and Additional activities

A key requirement for this Solution is the availability of adequate surveillance performance, as losses of tracks, inaccurate target reports or flickering around the actual aircraft or vehicle position can lead to incorrect or lack of guidance indications.

When implementing this Solution based on the use of segments of lights, rather than single-lamp control, the definition of the segments can affect the quality of the guidance provided to flight crews and vehicle drivers, as well as the management of the spacing between aircraft. This has to be carefully addressed when deploying this Solution at a given airport in order to achieve the full benefits offered by this Solution.

Also, rules and priorities for automatic management of conflicts at intersections are to be defined in light of local procedures

The phraseology and procedures for the operational use of this Solution by controllers, flight crews and vehicle drivers has to be clearly defined, using SESAR proposals as a starting point.

### Actors impacted by the SESAR Solution

Airspace Users (Pilots), Tower Ground Controllers, Apron Managers, Vehicle Drivers.

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**Impact on Aircraft System**

There is no impact on aircraft systems.

**Impact on Ground Systems**

The Airfield Ground Lighting (AGL) system needs to be upgraded to enable the selective switching of lamps in segments or, preferably, individually.

The A-SMGCS processing needs to be upgraded to translate taxi routes given by controllers to individual aircraft and vehicles into commands to the AGL system (taxiway centreline lights and stop bars), to monitor the spacing between mobiles and to determine priorities between mobiles at intersections.

The controller working positions also needs to be upgraded to allow the display of activated lights on the radar display and the management of the lights and routes via HMI functionality (e.g. route updates and input of clearances).

**Regulatory Framework Considerations**

Currently, no regulatory activity is identified specifically for SESAR Solution #47, although the Integrated Roadmap of the European ATM Master Plan associates two regulatory enablers to this Solution:

- REG-0200: Safety Targets in Relation to Reductions of Runway Incursions
- REG-0201: Means of Compliance for A-SMGCS Routing and Planning

As this Solution introduces a significant change in the way guidance is provided to aircraft in a safety-critical phase of the flight, EASA should set up a dedicated rulemaking task to assess whether specific regulation is required.

**Standardization Framework Considerations**

EUROCAE, through its Working Group WG-41 (A-SMGCS), needs to update the Minimum Aviation System Performance Specification (MASPS) for the A-SMGCS to integrate, inter alia, this SESAR Solution.

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EUROCONTROL has initiated the revision of the A-SMGCS Implementation Package which should lead to the development of a single A-SMGCS Specification Document, in collaboration with EUROCAE WG-41. This A-SMGCS Specification Document considers this SESAR Solution.

Lastly, as new phraseology is required to operate this SESAR Solution, it should be defined in ICAO Procedures for Air Navigation Services — Air Traffic Management (PANS-ATM Doc. 4444).

**Considerations of Regulatory Oversight and Certification Activities**

SESAR has not identified needs for the oversight of the new systems.

**Solution Data pack**

The Data pack for this SESAR Solution includes the following documents:

- OFA04.02.01 (Integrated Surface Management) Final OSED; 06.07.02-D46; 00.01.02; 10/11/2016. This document contains the operational requirements of SESAR Solution #47, as part of the new operational service “Airfield Ground Lighting”.
- OFA04.02.01 (Integrated Surface Management) Final SPR; 06.07.02-D45; 00.01.01; 24/10/2016. This document contains the safety and performance requirements of SESAR Solution #47, as part of the new operational service “Airfield Ground Lighting”.
- OFA04.02.01 (Integrated Surface Management) Final INTEROP; 06.07.03-D28; 00.01.00; 16/09/2016. This document contains the interoperability requirements of SESAR Solution #47, as part of the new operational service “Airfield Ground Lighting”.
- Final Technical Specifications for enhanced surface guidance; 12.03.04-D40; 00.02.00; 22/07/2016. This document contains the technical requirements of the surface guidance server supporting this SESAR Solution. However, due to the closure of SESAR 1, the document was delivered after the verification results were known and after the last validation activities took place but before the results of these validations were published. Therefore, there may be discrepancies between the operational and the system requirements.

**Intellectual Property Rights (foreground)**

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