

Release 5 SESAR Solution #02

Airport safety nets for controllers:

conformance monitoring alerts and detection of conflicting ATC clearances

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 “Airport safety nets for controllers: conformance monitoring alerts and detection of conflicting ATC clearances” consists of the following new functions, which are made available to the Tower controllers:

1. **Conformance Monitoring Alerts for Controllers (CMAC):** this improvement detects deviations between the expected behaviour of the mobile (aircraft or vehicle) and its actual behaviour, as reported by the surveillance system. In the case of a deviation, an alert is triggered by the system and displayed to the tower controller. Deviations can be non-compliance to a clearance or instruction (e.g. an aircraft enters the runway without the appropriate clearance) but also a non-conformance to a procedure (e.g. the aircraft is given a taxi clearance which is not suitable for this aircraft type). These new alerts apply to the entire movement area.
2. **Detection of Conflicting ATC Clearances (CATC):** inconsistencies between clearances that are or could be given to mobiles are detected by this improvement. For instance a controller has cleared an aircraft to take-off and then clears another mobile to cross the same runway in front of the departing flight. The system initially displays a predictive indication on the Human-Machine Interface (HMI) to inform the controller that the crossing clearance should not be given. Should the clearance be given then an alert is triggered to warn the controller. The CATC currently applies to the runway area only.

At some airports the working procedures for the tower controllers may need to be adapted to ensure that they input all clearances given to aircraft or vehicles in the system.

These two new safety support functions complement the Advanced-Surface Movement Guidance and Control System (A-SMGCS) Runway Monitoring and Conflict Alerting (RMCA) that is currently in operation at many European airports. The current A-SMGCS RMCA is based only on airport surveillance to detect runway conflicts while the new safety support functions are additionally based on the knowledge of procedures, clearances and

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instructions that are input by the controllers into the system. Therefore they provide early detection of situations that if not corrected would end up being a safety incident or accident, which would be detected in turn by the existing A-SMGCS RMCA. Thus they are designed to predict potential incidents and provide alerts before the existing RMCA alerts trigger, providing more time for controllers to resolve the potential incidents.

The benefits of this SESAR Solution are expected in terms of **safety** because these improvements are expected to **reduce the number and severity of runway incursions** and, more generally, the number of airport surface incidents.

Operational Improvement Steps (OIs) & Enablers

Operational Improvement Steps under the scope of the SESAR Solution:

- AO-0104-A “Airport Safety Nets for Controllers in Step 1” (fully covered)

Note: The OI AO-0201 “Enhanced Ground Controller Situational Awareness in all Weather Conditions” is a predecessor of this SESAR Solution.

Enablers supporting the SESAR Solution:

- AERODROME-ATC-06 “A-SMGCS incorporating the function that detects Conflicting ATC Clearances (CATC) for runway operations” (Required – fully covered)
- AERODROME-ATC-07 “A-SMGCS incorporating the function that provides Conformance Monitoring Alerts for Controllers (CMAC) on the movement area” (Required – fully covered)
- AERODROME-ATC-12 “Provision of the optimised ground route minimising conflicts” (Required – fully covered)
- AERODROME-ATC-23a “Enhanced A-SMGCS Core Surveillance function for new A-SMGCS Services” (Optional – partly covered)
- AERODROME-ATC-50 “Advanced Airport Tower Controller Working Position (A-CWP)” (Required – partly covered)

Notes:

- *The names of AERODROME-ATC-06 and AERODROME-ATC-07 are those proposed in the Change Request (3115) created in the SESAR 1 backlog but not yet implemented in DS16.*
- *In DS16, AERODROME-ATC-12 is not linked to AO-0104-A. However as requested in the Change Request (3115), the cleared route is a necessary input for some controller alerts like “route deviation alert” or “non-suitable taxiway/runway detection”.. The need of AERODROME-ATC-12 for supporting this Solution #02, makes Solution #22 a pre-requisite for the implementation of this Solution.*

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- *In DS16, AERODROME-ATC-23a is indicated as mandatory. However, as requested in the Change Request (3115), it should be optional as SESAR 1 live trials in Riga did not show the need for improved surveillance for CATC and CMAC but it is understood that some airports might need it in the future.*
- *The name of AERODROME-ATC-50 is the one proposed in the Change Request (3165) created in the SESAR 1 backlog but not yet implemented in DS16.*
- *The enablers supporting AO-0201 are not listed.*
- *The enabler AERODROME-ATC-03 is in the baseline although it was addressed by Project 12.03.02. As this enabler is not supporting the OI step AO-0104-A in DS16, it is not mentioned in the list here-above.*

Applicable Integrated Roadmap Dataset is DS16.

Background and validation process

The CMAC and CATC functions were first evaluated separately through real-time simulations with tower controllers in the loop:

- **For CATC:**
 - V2 trials using Paris-CDG airport configuration.
 - V3 trials using Hamburg airport configuration. These first V3 trials on CATC identified the interest of providing predictive CATC indications to controllers, in addition to the CATC alerts. This concept of predictive indications was thus added in the CATC operational requirements.
- **For CMAC:**
 - V2 trials using Paris-CDG airport configuration.

The two safety support tools for Tower controllers were then evaluated together through real-time simulations with tower controllers in the loop:

- First V3 trials integrating both CMAC and CATC using Milan-Malpensa and Madrid-Barajas airport configurations (respectively). The results of the two validations were used to update the operational requirements, particularly the ones dealing with the display of alerts.
- Several trials, each with duration of one to two weeks, were then organised in order to reach the V3 maturity level, consisting of:
 - Four real-time simulations with controllers in the loop on different airport configurations: Barcelona-El Prat, Hamburg, Paris-CDG, Milan-Malpensa.
 - One shadow mode/live trial with live surveillance data at Riga airport (some aircraft were emulated by vehicles).

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Results and performance achievements

The main results from the Release 5 validation activities (V3) are described hereafter.

This solution has been successfully validated as a means to improve safety and the human performance through the potential improvement of the situational awareness.

The controllers reported that all the alert functions validated, CMAC and CATC, are useful and usable for their daily work. They also considered positively their integration with the RMCA alerts.

Regarding CATC prediction indication,, results indicate that it contributes to enhance their situational awareness.

The subjective assessment of CMAC and CATC could be dependent on the considered CMAC and CATC. This means that the relevance of each alert in the improvement of safety depends strongly on the local environment.

However it was felt that the workload on the runway position would be affected if there were false or nuisance alerts as both were encountered during the trials.

Part of the false alerts could be due to difficulties met by the controller to input clearances in the ATM System in a timely manner.

Moreover, too many alarms / warnings could result in a significant reduction of system reliability. Therefore, even if the display of both CMAC and CATC alerts / indications has been considered useful, the controllers stressed on the need to increase their usability.

Recommendations and Additional activities

The following recommendations are made for the industrialisation and deployment of this solution:

- The benefit in human performance strongly relies on the Human Machine Interface usability (HMI). HMI shall facilitate the clearance input the ATC System in a timely manner, without increasing the controller workload. Attention will be paid to the HMI usability as means to input clearances in the ATC System.
- Only the most relevant alerts to the local operational context should be selected as the full set of alerts described in this solution may not be required.
- The deployment of alerts should be progressive, starting with a limited set of alerts among the full set of alerts described in this solution.
- Further assessment of the interactions between RMCA, CATC and CMAC.
- Additional activities, particularly with real airport surveillance data and during a sufficiently long period are recommended in order to verify the assumption made on

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the airport surveillance performance and the validation of performance requirements. Some additional activities on this topic will be performed in the scope of SESAR2020 PJ28, a Very Large Demonstration aiming at facilitating the deployment of SESAR 1 airport solutions.

Actors impacted by the SESAR Solution

Tower controllers

Impact on Aircraft System

There is no impact on aircraft systems.

Impact on Ground Systems

The A-SMGCS processing will need to be upgraded to include the safety logic of the new set of predictive indications and alerts, together with the A-SMGCS Routing function (depending on the set of selected alerts).

This updated processing will require an interface to get the clearances and instructions that are input by the tower controllers into the system. Depending on the local context, this updated processing could also require an enhanced A-SMGCS core surveillance function to make sure that the overall number of false and nuisance alerts is kept at an acceptable level, taking also account of existing alerts.

The tower controller working positions will need to be upgraded to allow the display of both predictive indications and alerts on the controller's HMI, i.e. on the A-SMGCS display itself and/or any other part of the HMI, for example, the electronic flight strips.

Regulatory Framework Considerations

This SESAR Solution is part of the Pilot Common Project under ATM Functionality AF#2 "Airport Integration and Throughput" in Regulation (EU) No 716/2014. Deployment is requested from 1 January 2021 at designated European airports.

The Regulation (EU) No 716/2014 indicates that Community Specifications (CS) on "updated A-SMGCS" and that an AMC on Airport Safety Nets procedures are planned to be developed by EASA in support of this PCP deployment.

Standardization Framework Considerations

EUROCAE, through its Working Group WG-41 (A-SMGCS), will need to update the Minimum Aviation System Performance Specification (MASPS) for the A-SMGCS to integrate, inter alia, this SESAR Solution (leading to ED-87 Rev. D).

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EUROCONTROL initiated the revision of the EUROCONTROL A-SMGCS documentation which will lead to the development of a single A-SMGCS Specification Document, in collaboration with the EUROCAE WG-41. This A-SMGCS Specification Document will consider this SESAR Solution.

Considerations of Regulatory Oversight and Certification Activities

None

Solution Data pack

Note: Documents of the solution pack describe solution #02 through operational, technical and safety specifications. However traceability and alignment between all these documents is not complete following programme planning constraint. For instance, only the OSED D32 takes the results of Release 5 validation exercises into account.

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

- Final OSED for “Conflicting ATC Clearances” (CATC) and “Conformance Monitoring Alerts for Controllers” (CMAC); 06.07.01-D32; 00.01.01; 10/11/2016. This document contains the operational requirements of the SESAR Solution.
- SPR for “Conflicting ATC Clearances” (CATC) and “Conformance Monitoring Alerts for Controllers” (CMAC); 06.07.01-D29; 00.01.01; 21/11/2014. This document contains the safety and performance requirements of the SESAR Solution and is linked to the Safety Assessments 06 07.01-D29C-SAR-CMAC; 00.01.01; 21/11/2014 and to 06.07.01-D29B-SAR-CATC; 00.01.01; 21/11/2014. However, these documents have not been updated after the Release 5 activities.
- “Operational Concept Description for the integration of the safety support tools”; 06.07.01-D05; 00.01.03; 07/11/2016. This document analyses the coexistence of the SESAR Solution with the other types of alerts, existing or forthcoming, ground based or on-board vehicles or aircraft, in the airport environment.
- Final TS for CATC and CMAC; 12.03.02-D64; 00.02.00; 12/09/2016. This document contains the technical requirements of the SESAR Solution. 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.
- Final System Requirements, 12.05.04-D93, 00.03.00, 27/09/2016. This document contains technical requirements on the airport controller working position related to Solution #02. 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

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