Enhanced traffic situational awareness and airport safety nets for the vehicle drivers

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 "Enhanced Situational Awareness and Airport Safety Nets for the vehicle drivers" consists of the following improvements that are made for the vehicle drivers:

1. Provision of an Airport Moving Map in the vehicle, together with the display of the surrounding traffic, to enhance the driver's situation awareness: The **Airport Moving Map** function indicates the position of the vehicle on the airfield and the **Ground Traffic Display** function displays other traffic operating on the movement area of the airport. The other traffic to be displayed includes both aircraft and vehicles.

2. Provision of alerts to vehicle drivers to warn them of situations that if not corrected could end up in hazardous situations. Two types of alerts are considered:

    a. **Traffic alerts** to warn the vehicle driver of a potential or actual conflict with an aircraft. Traffic alerts are not triggered with another vehicle but only with an aircraft.

    b. **Area infringement alerts** to warn the vehicle driver when the vehicle is in a closed or restricted area while the vehicle is operating on the manoeuvring area.

The alerts are provided to the vehicle drivers in the form of an aural and/or visual alert with two levels of alert severity depending on the severity of situations:

- Caution alert for the less critical situations; and

- Warning alert for the most critical situations.

Two implementations have been considered for the generation of alerts:

1. Alerts may be generated by an on-board system; or

2. Alerts may be generated by a centralised server (connected to the A-SMGCS) with an uplink to the vehicle.

In conflicting situations, the system provides an alert to the vehicle driver but does not issue a resolution as it will be encompassed within local procedures to be developed by individual airport authorities.

The benefits of this SESAR Solution are expected in terms of **safety** because the Airport Moving Map, together with the Ground Traffic Display, will improve the overall situational awareness of the vehicle drivers and this combined with the alerting system will provide an additional measure of safety enhancement for traffic operating on active areas of the airfield. Particularly, these improvements are expected to translate into a **reduction of runway incursions**.

Operational Improvement Steps (OIs) & Enablers

Operational Improvement Steps under the scope of the SESAR Solution:

- AO-0204 Airport Vehicle Driver's Traffic Situational Awareness

- AO-0105 Airport Safety Net for Vehicle Drivers

Enablers supporting the SESAR Solution[1]:

- AIRPORT-47 "Surface Traffic Situational Awareness to process and display in an "On-board Vehicle System" the own position and surrounding traffic" (Required)

- AIRPORT-45 "On-board vehicle system to provide safety net alerts to vehicle drivers" (Required)

- AIRPORT-46 "On-board vehicle safety net alerts generation" (Required)

- AERODROME-ATC-21 "A-SMGCS extended with dedicated processing to provide alerts for vehicles" (Optional)

- AIRPORT-30 "Use of airport wireless communication infrastructure for mobile data" (Required)

- CTE-S03 "ADS-B Receiving Station" (Required)

- *Notes:*

    o *AIRPORT-47 is considered "Optional" in DS16 for AO-0204 but it should be changed to "Required". A Change Request (3117) has been created in the SESAR 1 backlog to implement these changes in SESAR 2020.*

    o *AERODROME-ATC-21 in the Integrated Roadmap Dataset DS16 has been reworded to avoid any misunderstanding between the different types of alerts (i.e. the alerts for controllers and the alerts for drivers), which are different in terms of functions and performances. Additionally, this Enabler is optional and not mandatory (as currently defined in DS16) because there is the option to implement either AERODROME-ATC-21 or AIRPORT-46. A Change Request*

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[1] The following optional enablers attached to the OI steps AO-0105 and AO-0204 are not covered by the SESAR Solution: CTE-S03f, CTE-C02b, CTE-C02d, CTE-C02e, CTE-C02f, CTE-C02h, CTE-C04 and PRO-137.

(3116) has been created in the SESAR 1 backlog to implement these changes in SESAR 2020.

- o AIRPORT-46 *has to be identified as required as at least one of the two enablers AIRPORT-46 and AERODROME-ATC-21 has to be set to "required" in the Integrated Roadmap Dataset. A Change Request (3116) has been created in the SESAR 1 backlog to implement these changes in SESAR 2020.*

- o AIRPORT-30 *is considered "Optional" in DS16 for AO-0204. However it should be changed to "Required" for AO-0204 because surveillance data should be uplinked to the vehicle. A Change Request (3117) has been created in the SESAR 1 backlog to implement these changes in SESAR 2020.*

Applicable Integrated Roadmap Dataset is DS16.

Background and validation process

The validation process consisted in the performance of two real-time simulations at V2 maturity level involving operational drivers and two live trials at V3 maturity level in two different airport environments.

The two real-time simulations were first performed, leading to an update of the operational, safety, performance and interoperability requirements. These simulations were performed using the LFV/NLR tower simulator NARSIM and a vehicle driver display developed by LFV. The simulated environment was using the Stockholm Arlanda airport layout. The two types of alerts were assessed: Traffic alerts on the manoeuvring area involving aircraft, and Area alerts in the case of infringement of predefined areas. Two levels of alerts were considered: a "Warning alert" and a "Caution alert", depending on the severity of the situation. The objective of these validations was to evaluate these alerts in a realistic environment using operational vehicle drivers. In the last real-time simulation exercise, this was achieved by using three vehicle drivers from Stockholm Arlanda airport, two from Malmö airport, Sweden and one from Zurich Airport, Switzerland.

The two live trials were then performed in the same timeframe, leading to the final update of the operational, safety, performance and interoperability requirements. One of the live trials was performed at Dublin airport. These trials validated the two types of alerts using a centralised implementation, i.e. the alerts were generated in a ground server and uplinked to the vehicles for display to the drivers. The other live trials were performed at Paris-CDG airport. These trials validated the two types of alerts but using a different implementation as the alerts were directly generated on-board the vehicles.

Results and performance achievements

The main findings from the operational validations can be summarised as follows:

- All traffic alerts triggered in a potentially dangerous situation with aircraft were felt useful by vehicle drivers.

- Alerts triggered in a situation of potential infringement of a restricted or closed area were felt useful by vehicle drivers. However, some of these new area infringement alerts may overlap with existing alerts at the concerned airport (e.g. CAT III alert) and would need to be disabled at this airport.

- The number of nuisance and false alerts was acceptable.

- The safety level of vehicles operating in the manoeuvring area increases. Particularly, the airport moving map with the ownship position and surrounding traffic contribute to a better situational awareness.

- The generated alerts and the presence of the on-board system (visual surveillance) did not lead to a significantly higher workload.

- No specific procedures in case of alerts were designed but the drivers indicated that they were able to appropriately react to alerts.

Recommendations and Additional activities

The following additional activities may have to be completed in the industrialisation and or deployment phases:

1. Supporting data link network for the uplink of alerts from a central server.
2. Enhancement of airport surveillance to reduce the number of nuisance alerts.

Actors impacted by the SESAR Solution

Airport vehicle drivers

Impact on Aircraft System

There is no impact on aircraft systems.

Impact on Ground Systems

The vehicle will be equipped with a moving map display that will be used for the display of:

- Airport layout, including the restricted and closed areas;

- Vehicle's own position;

- Surrounding traffic (aircraft and vehicles); and

- Area infringement and traffic alerts (with aircraft only), together with an aural alert.

The moving map display is also used for system status display and for limited manual inputs from the vehicle driver.

A data link must be available for the uplink and periodic update of the surrounding traffic information to the vehicle. This traffic information will come from the A-SMGCS surveillance function.

The alerts can be generated on-board or generated in a ground server and then uplinked to the vehicle. In the latter case, a ground server will need to be installed and connected to the A-SMGCS in order to use the surveillance data.

Regulatory Framework Considerations

There is no impact on the European regulatory frameworks. Local airport regulation may be required.

Standardization Framework Considerations

There is no standardization activity. Considering the potential market for this SESAR Solution and the fact that it requires an interface to the A-SMGCS, the development of standards can be justified.

Considerations of Regulatory Oversight and Certification Activities

None

Solution Data pack

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

- Final OSED for Alerts for Vehicle Drivers; 06.07.01-D77; 00.01.01; 07/06/2016. This document contains the operational requirements of the SESAR Solution.

- Final SPR for Alerts for Vehicle Drivers; 06.07.01-D78; 00.01.02; 19/10/2016. This document contains the safety and performance requirements of the SESAR Solution and is linked to the Safety Assessment 06.07.01-D78A-V3-AVDR;09/06/2016.

- Final INTEROP for Alerts for Vehicle Drivers; 06.07.01-D79; 00.01.01; 10/10/2016. This document contains the interoperability requirements of the SESAR Solution.

- "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 aircraft, in the airport environment.

Intellectual Property Rights (foreground)

The foreground is owned by the SJU.