Release 5 SESAR Solution #110

ADS-B surveillance of aircraft in flight and on the surface

Contextual note – SESAR Solution description form for deployment planning

Purpose:

This contextual note introduces a SESAR Solution with a summary of the results stemming from R&D activities contributing to deliver it. It provides a summary of the SESAR Solution in terms of scope, operational and performance benefits and relevant system impacts as well as additional activities to be conducted during the industrialization phase or as part of deployment. This contextual note is part of the data package prepared for the SESAR Solution for which maturity has been assessed as sufficient to support a decision for industrialization. It complements the technical data pack comprising available deliverables required for further industrialization.

Improvements in ATM Operations

The ADS-B Surveillance of aircraft in flight and on the surface addressed by the SESAR projects consists of the ADS-B Ground station and the Surveillance Data Processing and Distribution (SDPD) functionality.

The baseline application was the ADS-B in Non-Radar Airspace. The SESAR projects developed prototype functionality enabling ADS-B in Radar Airspace and ADS-B for Airport Surveillance. The Solution developed is compliant with the latest version of ADS-B avionics standard which is a means of compliance with the relevant EU Regulation 1207/2011 (Surveillance Performance and Interoperability Implementing Rule SPI IR). Another key improvement included in this SESAR Solution is the security related functionality. This functionality mitigates security risks for ADS-B as sole means of Surveillance as well as for ADS-B in a multisensor environment, thus addressing the associated challenges.

This Solution enables the operational improvements attributed to Surveillance such as Flight Conformance monitoring. These contribute to improved safety, capacity and flight efficiency. Moreover, it is a key enabler for Performance Improvements, namely Surveillance infrastructure rationalisation (by improving both cost efficiency and spectrum efficiency). The associated cost is, in general, significantly lower than the one for classical means of Surveillance. The SESAR solution is also fully interoperable with other Surveillance means and derives synergies and additional potential for performance benefits incl. security when operated in combination with multilateration. Furthermore, ADS-B is a passive Surveillance technique, i.e. it reduces the 1030/1090MHz datalink use and thus enables the longevity of the Surveillance datalink and the best use of the stakeholder investments.

Operational Improvement Steps (OIs) & Enablers

The solution contains the following enabler (DS14):

- CTE-S03b: ADS-B station for RAD and APT surveillance

Predecessor enable used as baseline for this solution is:

- CTE-S03a: ADS-B station for NRA surveillance

- The next links to OI are under the scope of the solution (DS14) :
    - CM-0207-A: Advanced Automated Ground Based Flight Conformance Monitoring in En Route
    - CM-0210: Ground Based Flight Conformance Monitoring in En Route using Trajectory Data

  The next OI are linked to the predecessor enabler (CTE-S03a)

    - AO-0201-A: Enhanced Ground Controller Situational Awareness in all Weather Conditions for Step 1
    - CM-0203: Automated Flight Conformance Monitoring

- Performance improvement (DS16): Evolution of the surveillance technology with the use of ADS-B is not only led by operational factors, but also by rationalization in the use of systems and the provision of better performance. In this sense, new OIs called "performance improvements" were created in the masterplan and were linked to the ADS-B systems developed in this project.
    - CNS-0003-B: Rationalisation of SUR functionalities and/or technologies for CNS systems supporting cost efficiency, spectrum efficiency, etc. for Step 2.
    - CNS-0003-C: Rationalisation of SUR functionalities and/or technologies for CNS systems supporting cost efficiency, spectrum efficiency, etc. for Step 3.

  The next OI are linked to the predecessor enabler (CTE-S03a)

    - CNS-0003-A: Rationalisation of SUR functionalities and/or technologies for CNS systems supporting cost efficiency, spectrum efficiency, etc. for Step 1.

Background and validation process

The validation process of the ADS-B Surveillance of aircraft in flight and on the airport surface included the ADS-B Ground station and the Surveillance Data Processing and Distribution (SDPD) functionality. Three ADS-B Ground station prototypes were developed involving key industrial partners in order to ensure interoperability between the prototypes.

The overall aim was to demonstrate that the ADS-B Ground system has the potential to support ATC services in different types of airspace, under nominal and non-nominal conditions. A subset of the functionality explored was related to security and in particular the development of mitigation techniques against deliberate spoofing of the ground system by outside agents. These techniques can also be used to cope with malfunctioning of avionics equipment.

In support of the above aim, verification activities for each of the four prototypes were separately performed (three Ground stations and one SDPD).

Furthermore, the following validation related activities were undertaken:

- ✓ Validation in an Airport environment
  The exercises took place in the Malpensa airport as part of a wider operational validation activity. A SESAR Industrial Based platform was used, in which one of the ADS-B Ground stations was integrated. It used opportunity traffic in a shadow mode trial. The opportunity traffic was mixed in terms of ADS-B equipage and avionics performance, thus allowing to address non-nominal cases as well. The exercise included a part of the security functionality which was prototyped in the Solution.

- ✓ Validation in En-route and TMA environment
  The exercises took place at the EEC, as there was no SESAR operational project linking to this part of the functionality. They used the existing ADS-B Validation Testbed, in which the two other ADS-B Ground stations as well as the SDPD prototype were integrated. The validation used operational experts (air traffic controller) and was performed as a shadow-mode like exercise using recorded opportunity traffic data for different types of airspace and traffic loads. Two exercises were executed for nominal and non-nominal mode respectively, containing 3 scenarios each, i.e. en-route, TMA medium traffic density, TMA high density. Security related functionality was also assessed.

Results and performance achievements

The verification and validation activities performed demonstrated the potential of the ADS-B Ground Surveillance system prototypes to support ATC services in the different types of airspace considered (Airport, TMA, En-Route) and for both nominal and non-nominal conditions investigated. They supported the expected improvements in the areas of cost effectiveness, safety and security. The cost-effectiveness is enabled by the significantly reduced cost of the ADS-B Solution compared to classical means of Surveillance such as radars. The Solution was also assessed to improve safety by an improved controller situational awareness without increasing the associated controller workload. It also improves security by successfully mitigating associated threats.

Furthermore, the implementation of the Solution is expected to enable other performance benefits in terms of capacity, flight efficiency and spectrum efficiency.

In summary, this SESAR Solution will contribute to the overall performance improvements targeted, i.e. safety, capacity, cost and spectrum efficiency, environmental sustainability, as well as security.

Recommendations and Additional activities

It is recommended that in the transition towards and through industrialisation and deployment, including possible Large Scale Demonstration projects, a detailed assessment

of the performance of the overall system and its components w.r.t. associated emerging standards (e.g. EUROCAE) and Specifications as well as exercises of the applications to be implemented and their reachable benefits at generic and local levels, should be included. The security mitigation functionality is of particular importance in this context. Any specific recommendations from the project should be taken into account. Moreover, standardisation activities should take into account the results of the projects. This includes Ground Station functionality, SDPD functionality as well as ASTERIX change proposals for Categories 21, 23 and 62 which should be considered by the relevant stakeholder groups.

Actors impacted by the SESAR Solution

ANSPs, Airport authorities, ATM system manufacturers, Member States.

Impact on A/C System

The solution envisaged is a Ground system so it does not include avionic functionality. However, in order to support operations in radar airspace and for airport surveillance, the aircraft systems are assumed compliant with the EU Regulation 1207/2011 (Surveillance Performance and Interoperability Implementing Rule - SPI IR) and associated EASA certification material (CS-ACNS). The equipage process is ongoing as part of the Rule applicability incl. any amendments.

Impact on Ground Systems

The Ground system will have to be upgraded in terms of ADS-B Ground station functionality, SDPD functionality and ASTERIX interfaces. The specific parts of the developed functionality to be transferred to the industrialised and operational systems will be decided by the relevant stakeholders and their groups.

Regulatory Framework Considerations

EU Regulation 1207/2011, 1028/2014 and any further amendment
EASA CS-ACNS

Standardization Framework Considerations

The SESAR projects have contributed to the progress of the following standards:

- EUROCAE Technical Specifications for ADS-B Ground station (ED-129A)
  - Published
- EUROCAE Technical Specifications for ADS-B Ground system (ED-129B)
  - Published
- ASTERIX Interface Specifications not defined for composite use.

- Update is necessary ASTERIX categories relevant for ADS-B (ASTERIX CAT021 for Target reports and ASTERIX CAT023-025 for System Status reports). Proposals have been produced but are still under definition by EUROCAE.

The SESAR projects have also contributed to the SDPD Specifications.

Application standards to be considered are ADS-B in Radar Airspace, ADS-B for Airport Surveillance (both published by EUROCAE/RTCA), as well as the EUROCAE Generic Surveillance SPR (ongoing).

Considerations of Regulatory Oversight and Certification Activities

The provisions of the EU Regulation 1207/2011 (including safety case, monitoring etc.) and amendments as well as the associated provisions of EASA and/or National Authorities should be taken into account.

Solution Data pack

The Data pack for this Solution includes the following documents:

Project 15.4.5a

Code	Deliverable Name	Description
D18	First iteration of ADS-B Surveillance System Specifications	Overall Surveillance system Specifications for Iteration 1, including compliance with ADS-B v2 (ED102A/DO260B), ADS-B RAD application as well as a first set of security risk mitigation techniques.
D19	Second iteration of ADS-B Surveillance System Specifications	Overall Surveillance system Specifications for Iteration 2, including compliance with ADS-B APT application as well as a second set of security risk mitigation techniques.
D20	Third iteration of ADS-B Surveillance System Specifications	Overall Surveillance system Specifications for Iteration 3, including the third set of security risk mitigation techniques.

D13	Third iteration of ADS-B Ground Station Specifications (for Trajectory Based Operations)	Specifications of the ADS-B Ground Station for Iterations 1, 2 and 3, including the compliance with ADS-B v2 (ED102A/DO260B), ADS-B RAD and ADS-B APT applications as well as the security risk mitigation techniques.
D14	Third iteration of SDPD Specifications for Trajectory Based Operations	Specifications of the SDPD for Iterations 1, 2 and 3, including the compliance with ADS-B v2 (ED102A/DO260B), ADS-B RAD and ADS-B APT applications as well as the security risk mitigation techniques.
D15	Third iteration of Interface Specifications for Trajectory Based Operations	Specifications of the ASTERIX Interfaces for Iterations 1, 2 and 3, including compliance with ADS-B v2 (ED102A/DO260B), ADS-B RAD and ADS-B APT applications as well as the security risk mitigation techniques. These cover ASTX Cat 21, 23 and 62.
D08	First iteration of ADS-B Ground Station Test Specifications (for Time Based Operations)	Test Specifications of the ADS-B Ground Station Iteration 1, including compliance with ADS-B v2 (ED102A/DO260B), ADS-B RAD application as well as a first set of security risk mitigation techniques.
D12	Second iteration of ADS-B Ground Station Test Specifications (for Trajectory Based Operations)	Test Specifications of the ADS-B Ground Station Iteration 2, including compliance with ADS-B APT application as well as a second set of security risk mitigation techniques.

D16	Third iteration of ADS-B Ground Station Test Specifications for Trajectory Based Operations	Test Specifications of the ADS-B Ground Station Iteration 3, including the third set of security risk mitigation techniques.
D21	Validation Support Activities Report	Report on the validation support exercises of the project, covering both the support to Project 6.3.2 as well as the exercises at the EEC. The document includes the preparation, execution, results, conclusions and recommendations of these exercises.

Project 15.4.5b

Code	**Deliverable Name**	
D02	First Iteration - Baseline Report/Matrix	
D08	First Iteration - Provision of Final Safety Assessment Report	
D09	First Iteration - Security Assessment Report	
D10	Second Iteration - Baseline Report/Matrix	
D15	Second Iteration - Provision of Final Safety Assessment Report	
D16	Second Iteration - Security Assessment Report	
D17	Third Iteration - Baseline Report/Matrix	
D22	Third Iteration - Provision of Final Safety Assessment Report	
D23	Third Iteration - Security Assessment Report	

Intellectual Property Rights (foreground)

Only the documents listed in the prior Solution Data pack are seen as SJU foreground.