Release 5 SESAR Solution ID #31

"Variable profile military reserved areas and enhanced civil-military collaboration"

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 "Variable profile military reserved areas and enhanced civil-military collaboration" provides in all phases of the operations, from initial planning to the execution phase more flexibility by allowing dynamic airspace management through modular airspace structures following the Variable Profile Area (VPA) design principle. This Solution allows making the intents and planning of Airspace Users (AUs) – civil and military - more consistent and transparent, gives more flexibility between planning and execution phase and allows exploiting any opportunities from the actual available airspace. In the execution phase, the exchange of ARES (Airspace Reservation) status information is performed in real time (RTSA).

This SESAR Solution is supported by:

- The Variable Profile Area design principle based on flexible allocation and management of small fixed predefined modules of airspace. These modules are designed to fulfil airspace users' needs individually or as a combination of modules as an ARES, dependant on individual mission profiles. To fully exploit the VPA design principle, conditional routes and variable profile areas should be complementary. The VPA modules are requested by the military airspace user and negotiated with the Airspace Managers through a CDM process. The objective is to offer greater flexibility to accommodate military requirements by defining different airspace scenarios with acceptable network impact through extension or sub-division of military training areas (TSA/TRA/CBA) adjusted to match the military training and operational requirements.
- The real-time sharing of airspace status amongst all ATM actors such as the Network Manager Operations Centre (NMOC), Airspace Managers, Flow Management Positions (FMPs), ATC controllers, Airspace Users (Flight Operations Centres (FOC) and Wing Operations Centres (WOC)) allows Airspace Users to update their flight plans in real-time, so as to take advantage of the early release of airspace from the military. With timely information on airspace status, Airspace Users can reassess and optimise their trajectories, either while aircrafts are airborne (not validated in SESAR 1) or when they are in the pre-departure phase, so maximising usage of available airspace.

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This SESAR Solution introduces new operating methods, practises and elements in airspace organisation and management:

- The ARES booking process (request, allocation and use of an ARES) and ASM/ATFCM CDM process between civil and military is facilitated with the use of automated ASM support systems enabled to process VPA related data. They provide shared situation awareness to all ATM actors in real time and indicate possible booking conflicts via prediction tools.
- The sharing in real time of both planned and real time airspace status via the Network Operations Portal (NOP) provides a Pan-European airspace situation awareness and contributes to safety improvements, capacity optimisation and flight efficiency increase at network level by
    - Promoting the use of the airspace/capacity as soon as it is made available.
    - Enabling more accurate and relevant ATFCM measures based on real use of airspace and not only on intentions
    - Improving Post-Ops Analysis and KPA/KPI assessment thus improving the ASM/ATFCM strategic and pre-tactical phases
    - Providing Pan European Situation Awareness of airspace utilisation
- Any changes, not only of the airspace planning but also of actual airspace status, can be taken into account immediately by the airspace managers, ATCOs, FMPs, NM and FOC/WOCs to improve their operations.
- The process to modify, activate or de-activate an ARES is automated to update the Controller Working Position (CWP), Network Manager and other connected and interested stakeholders in real time.

Implementing AFUA concept provides benefits in different areas:

- **Safety**: the sharing of the airspace planning and the real status provides common situation awareness to all ATM actors.
- **Environmental sustainability**: the flexibility provided by the implementation of VPA offers more plannable airspace. It contributes to reduce emissions through the use of more optimum trajectories.
- **Capacity**: facilitating the sharing of used military training areas improves the usage of available capacity when and where needed for the benefit of civil airspace users whilst safeguarding the military mission effectiveness. The ARES are tailored to the individual mission meeting the real need. The availability of ARES status information in real time additionally improves the situational awareness for the Demand and Capacity Balancing process in order to optimise the airspace configuration.
- **Mission effectiveness**: thanks to VPA design principle the military have the real volume of airspace needed for each of their missions.
- **Civil-Military cooperation & coordination**: The implementation of VPA offers several combinations of modules to allocate the requested volume of airspace and additional opportunities to accommodate traffic flow demand with military mission needs. It facilitates the negotiation process to allocate ARES and provides opportunities to accommodate traffic flow demand with military mission needs.

Operational Improvement Steps (OIs) & Enablers

OI Steps:

- **AOM-0202-A** (Fully covered): Automated Support for strategic, pre-tactical and tactical Civil-Military Coordination in Airspace Management (ASM).

  Enablers addressed for the Solution:
  - **AAMS-06b**: ASM support systems enhanced to exchange static data and airspace usage data with NM systems in AIXM format.
  - **AAMS-09a**: NM systems enhanced to exchange static data and airspace usage data with ASM support systems in AIXM format.
  - **AAMS-11**: ASM support systems enhanced to exchange real-time airspace status updates
  - **ER APP ATC 77**: ATC systems enhanced to exchange real time (tactical) airspace status data with ASM support system.
  - **MIL-0502**: Upgrade of military ground systems to allow bi-directional exchanges with non-military IP networks
  - **NIMS-42**: NM systems enhanced to receive, process and display real-time tactical (ASM level III) airspace usage information
  - **PRO-011**: ASM Procedures to ensure that the change in airspace availability is promulgated through SWIM and reflected in the NOP
  - **PRO-024**: ASM Procedures related to real-time (tactical) ASM level III information exchange

  Pre-requisited Enablers:
  - **AIMS-06**: Ground-Ground AIS provision to ASM
- **AOM-0206-A** (Fully covered): Flexible and modular ARES in accordance with the VPA design principle

  Enablers addressed for the Solution:
  - **AAMS-06b**: ASM support systems enhanced to exchange static data and airspace usage data with NM systems in AIXM format.
  - **AAMS-06c**: Local ASM Tools to be updated to support Transmission of VPA-related data from local ASM tool to the NM.
  - **AAMS-09a**: NM systems enhanced to exchange static data and airspace usage data with ASM support systems in AIXM format.
  - **AOC-ATM-15**: Upgrade of Wing Ops System Technical Architecture to provide Military Mission Trajectory Services
  - **ER APP ATC 77**: ATC systems enhanced to exchange real time (tactical) airspace status data with ASM support system.

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Pre-requisited Enablers:

- **SWIM-APS-03a**: Provision of ATFCM Information Services for Step 1
- **SWIM-APS-04a**: Consumption of ATFCM Information Services for Step 1
- **SWIM-STD-01**: AIRM
- **SWIM-STD-02**: ISRM Rulebook

Applicable Integrated Roadmap Dataset is **DS14**.

Background and validation process

The SESAR Solution has been validated through a series of activities including Fast Time Simulations, Real Time Simulations, and Live Trials, focusing on a range of objectives from the validation of the VPA design principle in different airspaces, in a route network environment and in a free route airspace (with Low to Medium complexity) to the distribution of the real-time status of airspace to all involved ATM stakeholders, via systems interconnections, and the display of this status on ATC systems ensuring the process is safe. A high level summary of each validation is presented hereafter:

- Fast-Time Simulation (FTS):
  - Address ASM Level 1 (VPA design principle) and ASM Level 2 (CDM and network impact assessment) for different airspaces, analysing the impact on Network Operations when using a VPA and validating the use of modular ARES and the benefits provided for civil and military users.
  - Validate the VPA design principle in a free route environment (with Low to Medium complexity) and in an ATS route as well. The effect of using a VPA instead of the common ARES design was compared in regard to fuel efficiency by calculating the extra distance flown in miles leading to extra fuel burned and extra emissions emitted when circumnavigating an ARES.
- Real-Time Simulation (RTS):
  - Demonstrate the feasibility and benefits of updating the real-time airspace status automatically into the NM systems, delivering a closed CDM process between ASM Support Systems, NM systems and ATC system and thus to make better use of available capacity. The main objective was to validate the expected benefit from the exchange of real-time ASM information for the Military, ATC, NM and AO stakeholders.
  - Demonstrate the interconnection between the ASM, NM, FOC and WOC systems. The RTSA have been distributed and processed among the ATM actors concerned. This RTSA data has been used by the involved actors in order to provide their own impact assessments and facilitate a new flight planning cycle for the re-routing of the eligible flights to take advantage of early release of airspace or to avoid a newly reserved area. The involvement of FOC/WOC in this Validation Exercise confirmed the strategic significance of the airspace users' participation in AFUA.
- Live trial:

- Address ASM Level 1 and ASM Level 2 focused on the integration of VPA in the Network and network improvement by sharing in real-time the airspace planning and its status. Refinement of the interoperability requirements to interface ASM support systems with NM systems in order to automatically provide the static airspace and Airspace Use Plan data to the network managers and the FMPs.
- Validate the automated process of activation and/or deactivation of ARES in ATC systems by interfacing an ASM Support System with ATC systems. The exercise also demonstrated the automatic update of ATC systems with RTSA via ASM Support Systems, and the safety of this process.

Results and performance achievements

The main findings from the overall validation exercises can be summarised as follows:

- From Airspace Users' point of view:
  - VPA reduces fuel burnt by civil flights in order to fly around active ARES while at the same time military needs are fulfilled,
  - Improves the environmental sustainability for the military AU it is important that the ARES is close to the airbase,
  - Increases situational awareness for AOs/AUs providing opportunities for civil flights to benefit from early released ARES and to reduce the negative impact of ad-hoc activated ARES.
- From Airspace Managers' point of view:
  - The benefits depend on the specificity of VPA configuration, which should be designed in order to minimize the number of conditional routes blocked when active,
  - To fully exploit the VPA design principle, conditional routes and variable profile areas should be complementary,
  - Facilitates the cross-border operations and the CDM process.
- From ATCO's point of view:
  - Increases situational awareness
- From Network Manager's point of view:
  - Reduces the number of flights affected by ATCFM measures and therefore the total delay,
  - Allows a better usage of available capacity

The following benefits have been identified:

- Reduces the impact of active ARES on civil traffic while allowing the military AUs to achieve their mission objectives as planned,
- Reduces track mileage resulting in less fuel consumption and associated CO_2 emissions,
- Increases situational awareness for all ATM stakeholders and reduces uncertainty and misinterpretation of current airspace status information

Recommendations and Additional activities

The validation activities are considered to achieve V3 maturity level, however some gaps have been identified and some recommendations have been made to be undertaken in V4:

- Enhance the automated tools support especially on performance impact assessment times and flight list exchange between NMOC and FOC/WOC.
- Update working methods and trainings taking into account the enhancement of tools automation.
- Finalize RTSA data message content in AIXM 5.1 format.
- Ensure SWIM compliancy of services.
- Newly assigned procedures will need to be better integrated into the ATC HMI design to better address human detection and usability.

It has been showed as well that there is a need to refine the principles for identification of the eligible flights based on AUs' priorities reflected in relative values to their KPIs (for instance the shortest route is not always the most preferable one for the AU).

Actors impacted by the SESAR Solution

The following actors are impacted by the Solution (on different ASM levels):

- High Level Airspace Policy Body (HLAPB)
- Approved Agency (AA)
- Network Manager (NM)
- Airspace Manager (local/regional airspace manager)
- ACC Supervisor
- Flow Management Position (FMP)
- ATC controller (ATCO)
- Airspace Users: FOC (Flight Operation Centre) & Wing Operation Centre (WOC)

Impact on Aircraft System

This solution has no impact on Aircraft System.

Impact on Ground Systems

The connection to the NM reference environmental database will enable the local and regional systems to be kept updated with the latest information on airspace status. The exchange of information will be based on AIXM 5.1 standard data model supported by B2B services.

Airspace configurations will be accessible via Network Manager's systems, which shall contain the up-to-date and planned airspace configurations, to allow airspace users to file and modify their flight plans based on timely and accurate information. The system shall allow a continuous assessment of the impact of changing airspace configurations on the network.

The ASM support system shall:

- Be able to respond to changing demands for airspace;
- Support cross-border activities, resulting in shared use of segregated airspace regardless of national boundaries.

The ATC system shall:

- Support flexible configuration of sectors so that their dimensions and operating hours can be optimised according to the demands of the NOP.
- Correctly depict the activation and de-activation of configurable airspace reservations and the change of a volume of airspace from a fixed route network to FRA

ASM, NM, FOC/WOC and ATC systems shall be able to process real time airspace status data. ATC actors (e.g. ATCO) automatically receive real time airspace status information update from the local ASM system and / or input such real time airspace status information actively via their individual CWP into the ATC system that processes it further into an ASM support system.

Regulatory Framework Considerations

This solution is directly linked to one (identified as "Flexible Airspace Management and Free Route") of the six ATM Functionalities identified in the Implementing Regulation (EU) No 716/2014 on the establishment of the Pilot Common Project supporting the implementation of the European Air Traffic Management Master Plan.

These two other regulations are applicable to this solution:

- COMMISSION REGULATION (EU) No 255/2010 of 25 March 2010 laying down common rules on air traffic flow management;
- COMMISSION REGULATION (EC) No 2150/2005 of 23 December 2005 laying down common rules for the flexible use of airspace

Standardization Framework Considerations

The content of the RTSA data message shall be integrated in AIXM 5.1.

Considerations of Regulatory Oversight and Certification Activities

N/A

Solution Data pack

The data pack for this Solution includes the following documents:

- OSED - 07.05.04-D45 "Advanced Flexible Use of Airspace for Step 1 OSED", Edition 00.04.01 (16/04/2016). This document describes the operational concept, its

expected benefits, the operating methods, the Roles and Responsibilities and the operational requirements of the solution.

- SPR - 07.05.04-D47 "Advanced Flexible Use of Airspace Safety and Performance Requirements for Step 1", Edition 00.04.01 (18/04/2016). This document describes the Safety and Performance Requirements in relation with the Solution. The main concept elements described by these requirements are airspace organisation and management, airspace reservation, airspace allocation, airspace activation/de-activation, post-ops analysis (including KPA-KPIs).
- INTEROP - 07.05.04-D46 "Advanced Flexible Use of Airspace Interoperability Requirements for Step 1", Edition 00.04.01 (18/04/2016). This document provides the interoperability requirements supporting the integration of the Solution in Network Operations. The purpose of this document is to describe the interoperability requirements that will support the automated processes to update the airspace status in real time via interfacing an ASM support system with NM and ATC systems.
- Technical Specifications - 07.05.04-D49 "Real Time Status Airspace TS", Edition 00.01.02 (11/12/2015). This document contains the Technical Specifications describing the Real Time Status of Airspace (RTSA) update process and the interface to exchange such information among national/sub-regional ASM support tools, ATC and regional ATFCM systems, making the RSTA information available as well to FOCs and WOCs at a very early stage in the airspace information sharing process.
- Technical Specifications – 11.01.03-D06 "AFUA (FOC) Step1 Technical Specification", Edition 00.02.00 (31/10/2014). This document contains the Technical Specifications applicable to adapt the FOC systems to manage the RTSA-related information.
- ISRM: 08.03.10-D65 00.01.01 (25/07/2016) including the ISRM v2.0, the ISRM Service Portfolio and the SDDs of the services: ARESActivation, ARESDeActivation, ARESPreActivation, ARESQuery and ARESRelease.
- 14.01.04-D44-004 00.01.00 (04/07/2016). This document specifies the SWIM Yellow Profile including the requirements applicable to interface with the SWIM-TI.
- 08.01.01-D48 SWIM Compliance Report for EXE-07.05.04-VP-710, Edition 00.01.03 (04/11/2015).
- SWIM Compliance Report for EXE-11.01.05-VP-789 (08.01.01-D48 SWIM Compliance Report for EXE-11.01.05-VP-789, Edition 00.01.00 (28/07/2016).

In addition to the above mentioned documents, the SWIM reference documents are included in the data packs of the SESAR Solutions SWIM Yellow Profile and SWIM Framework.

Intellectual Property Rights (foreground)

The foreground is owned by the SJU.