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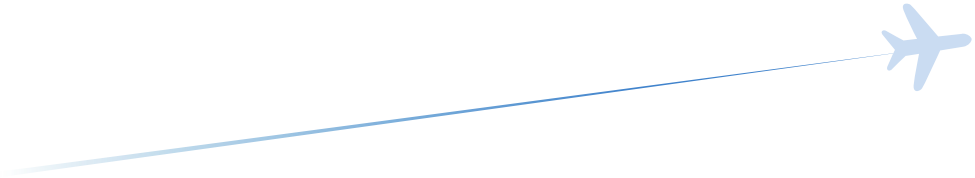

PJ08 AAM Final Project Report

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PJ08 AAM

ADVANCED AIRSPACE MANAGEMENT

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Abstract

The Project PJ08 Advanced Airspace Management addresses the evolution of the Dynamic Airspace Configuration (DAC) Concept developed in SESAR 1, to prove and further increase its maturity by enhancing the operational processes and automated tools that will support Sector Design and Sector Configurations.

The definition of a new generation of Airspace Reservations (ARES), the Dynamic Mobile Areas of Type 1 and Type 2 is refined; the data model is addressed as well as related performance and operational feasibility.

The major objective of PJ08 Advanced Airspace Management is to provide a Dynamic Airspace Configuration function including Dynamic Mobile Areas (Type 1 & 2) based on improved traffic prediction, to be integrated into the DCB processes, and that can be executed as one of the possible processes to adjust capacity, in order to meet traffic demand and respond to various performance objectives.

Wave 1 validated the PJ08 concept from the perspective of two Solutions:

- Management of Dynamic Airspace Configurations
- Dynamic Airspace Configuration supporting Moving Areas

The Project identified considerable benefits for key ATM stakeholders and finalised all the proposed solutions at the V2 maturity level.

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Executive Summary

The S2020 Project PJ08 Advanced Airspace Management addresses the evolution of the Dynamic Airspace Configuration (DAC) Concept developed in SESAR 1, to prove and further increase its maturity by enhancing the operational processes and automated tools that will support Sector Design and Sector Configurations.

The definition of a new generation of Airspace Reservations (ARES), the Dynamic Mobile Areas of Type 1 and Type 2 is refined; the data model is addressed as well as related benefits and performance assessment and operational feasibility.

The Project consists of two SESAR Solutions:

Solution 1 – Management of Dynamic Airspace Configurations – developed the processes, procedures and tools related to Dynamic Airspace Configuration (DAC) management, supporting Dynamic Mobile Areas of Type 1 and Type 2.

The main results from this Solution are the following:

- The acceptance and workability of DAC concept and tools from ATCOs' perspective
- The use of AI techniques to define capacity of new Dynamic Airspace Configurations
- Evidence of Operational and Technical feasibility of the concept in the Free-Route environment
- The operational feasibility of the DAC Planning CDM process at Regional and Local level.

The Solution has been validated through a series of activities including model based, shadow-mode trials, gaming, and real-time simulations, in order to cover the whole roadmap. The topics related to this Solution achieved the expected level of maturity, i.e. V2.

Solution 2 – Dynamic Airspace Configuration supporting Moving Areas – extended the management of Dynamic Airspace configuration to support moving areas. This included the so-called Moving Hazard Zones (MHZ): the automated impact assessment of hazard zones due to weather phenomenon that can evolve in four dimensions, and the integration of those in the DAC process (meaning quantification of their impact on elementary volumes of airspace that would further constitute sectors) were addressed through a Study Case.

The Dynamic Mobile Areas of Type 3, initially included in the scope of Solution 2, have not been addressed. We recommend to address this concept in the context of Exploratory Research activities.

These two SESAR Solutions are the main building blocks to develop the concept of Dynamic Airspace Configuration Management into an operational process supported by automated tools that can be completely integrated in, and executed as part of the DCB process.

1 Project Overview

1.1 Operational/Technical Context

This Industrial Research Project continued the work carried out in SESAR1, and was meant to address the current Airspace management related shortcomings:

- DCB (ATFCM) service limited by various constraints (military activities, local resources availability) and focused mainly on minimising delays only;
- Despite some free route initiatives, current ATM does not accommodate user preferred trajectories; instead routings are determined by the available airspace capacity (rather than vice versa);
- The current ATM environment is not fully compatible with accurate prediction of traffic and sector predicted workload with which to determine efficient airspace configurations, thus leaving to ACCs to determine the “optimal” airspace configurations, in regard with their staff and equipment, helped by the current ATFCM tools.
- Decisions on sector opening made primarily only on the experience of local unit management;
- Configuration options limited and not necessarily able to manage the traffic demand efficiently;
- ACC keep a kind of “capacity buffer”, to cope with uncertainty in traffic load;
- Configuration options selected to provide a local benefit. Configuration options not comparable to the options of neighbouring ACC (with only some little adjustment possible by the NMC);
- Airspace management service provided separately from DCB services, even though coordination between DCB and ASM CDM process exists (TSAs/TRAs);
- ASM process characterised by use of static and modular (VPA) temporary segregated areas;
- As most sectors are monitored on a daily basis, each weather counter-effect creates high uncertainty (too many level changes). Thus capacity instability.Within the scope of SESAR 2020, the improved and better integrated ASM/ATFCM/ATS process developed in PJ08 contributed to the Network performance through the closer interaction between operating phases, by providing consolidated and harmonised solutions along ATM planning phases namely long-term, medium to short term planning and execution phase. This interaction would result in a seamless and dynamic (running) process enabled by continuous CDM.

1.2 Project Scope and Objectives

The major objective of the Project is to provide a Dynamic Airspace Configuration function including Dynamic Mobile Areas (Type 1 & 2) based on improved traffic prediction with confidence index, to be

fully integrated into the DCB process, and that can be executed as one of the possible processes to adjust capacity to meet demand and respond to various performance objectives.

The goal of DAC is to improve Demand/Capacity balancing, to allow for improved ATM resource planning and better use of existing capacities hence being more cost/effective and improving fuel efficiency.

The following key concept elements are addressed:

- Enhance the functions that support ATC sector shapes and volumes that are dynamically adapted to fulfil the AUs' demand in response to changes in traffic patterns and/or short-term changes in environment and users' intentions
- Develop and validate Flexible Airspace designed, for long term planning, to predict the resources (ATCOs) needed for meeting the forecasted AUs' traffic demand
- Realise Dynamic Airspace Configurations (DAC) by building sectors' configurations which will be based on traffic flow complexity and historical data
- Develop and validate the definition and interfaces of Dynamic Mobile Areas, temporary volumes of airspace designed to separate the activities performed inside from civil traffic. DMAs aim at satisfying users' needs whilst minimising impacts on the network
- Contribute to the definition and refinement of relevant coordination and interfaces between Advanced Airspace Management and other processes such as DCB (incl. dynamic DCB), Network Planning, and flight planning and trajectory management in Free Route Airspace Operational environment.

These ASM functions can be executed at Regional, Sub-regional, and Local levels (NM, FABs, ANSPs).

1.3 Work Performed

1.3.1 Solution 08-01: Management of Dynamic Airspace Configurations

This SESAR Solution was defined to develop the process, procedures and tools related to Dynamic Airspace Configuration or DAC management, supporting Dynamic Mobile Areas of Type 1 and Type 2, through:

- En-route ATC sectors design and sector configurations principles based on 4D trajectories forecast, enabling a seamless and coordinated approach for airspace configurations from planning to execution phases, increasing the Network capability to continuously adapt to demand pattern changes and traffic flows volatility induced through the extensive implementation of free route operations

- The activation of Airspace configurations through an integrated collaborative decision making process, at national and regional levels. Procedures and system support tools (also based on Artificial Intelligence techniques) have been developed to enable the management of the airspace configurations as a continuum to meet the users' expectations (civil and military airspace managers, flow managers)

- En-route ATC sectors configurations aiming at adapting to dynamic TMA boundaries and both fixed and dynamic elements (i.e. fixed and flexible routing, reserved/restricted airspace (ARES, CBA, CBO, DMA)).

To accomplish these objectives, the work was conducted in the following tasks and produced the related deliverables:

- Solution Management: Monitor and control of the Project execution. Organisation and hosting of coordination meetings. Contribution to the Project's reporting

- SPR-INTEROP/OSED: Elaboration of the concept elements through a series of concept brainstorm sessions with the concerned stakeholders, EATMA modelling, identification of requirements (safety, performance, interoperability) and writing of specific contributions. The OSED task had also to coordinate and finally include a set of important appendices, namely Safety Assessment Report (SAR), Human Performance Assessment Report (HPAR), and Performance Assessment Report (PAR)

    - Human Performance Assessment: Contribution to the Project's Human Performance Assessment. This included the participation in ad-hoc meetings, as well as the elaboration and review of the appropriate contributions.

    - Safety Assessment: Contribution to the Project's Safety Assessment. This included the participation in ad-hoc meetings, as well as the elaboration and review of the appropriate contributions.

    - Performance Assessment Report: Contribution to the Project's Safety Assessment. This included the participation in ad-hoc meetings, as well as the elaboration and review of the appropriate contributions.

- VALP/VALR: The Validation Plan was developed by detailing the Benefit Impact Mechanisms, and defining the high-level validation objectives for the entire PJ008-01 validation roadmap. The subsequent iterations of the VALP focused on more detailed planning of each validation activity/exercise, defined the lower level validation objectives, validation exercises' planning, platforms, metrics etc. All exercises have been conducted as planned, analysed and documented in the corresponding Validation Report (VALR)

- TS/IRS: Elaboration of the Technical Specifications and Availability Notes for the simulation platforms used in the different validation exercises. The work included organisation and participation in coordination and technical meetings, as well as the elaboration of contributions, their review and the final edit of the deliverable

- Validation Roadmap Execution: The Solution has been validated through a series of activities including model based, shadow-mode trials, gaming, and real-time simulations, whose objectives focused on the benefit assessment and the operational feasibility of the DAC concept elements, on the impact on CWP and ATCOs, and on the feasibility of the overall DAC process. The validation activities have been run as follows:

    - Model based:

        - Two exercises to perform a benefit assessment of DMA type 1 and DMA type 2 in the context of the DAC, within a FRA environment

    - Gaming:
        - To assess the operational feasibility of the pre-tactical DAC CDM process
    - Real Time/Human in the Loop Simulations – shadow mode exercises:
        - To assess the operational feasibility of the DAC concept elements focused on FMPs and ACC Supervisors activities, in the context/timeframe of INAP processes
        - To assess the impact of DAC concept on CWP and ATCOs
        - To assess the feasibility of the overall DAC concept/process up to execution

- CBA: Leadership and coordination of the overall Cost Benefit Analysis task. This included the coordination of the overall task, inputs from all main partners (validation and CBA experts), participation in cost and benefit assessment meetings, as well as the elaboration and review of the appropriate contributions.

1.3.2 Solution 08-02: Dynamic Airspace Configuration supporting Moving Areas

This Solution was defined aiming at implementing a systematic and seamless method to integrate hazardous weather phenomena into airspace management taking into account the design imposed by DAC.

This solution consisted of two OIs:

- AOM-0208-C Dynamic Mobile Areas (DMA) Type 3
- AOM-0209 Integrate Hazard Zones in DAC process

In Wave 1 the Solution only addressed the AOM-0209 OI Step and its sole related Enabler AAMS-01 Automated impact of Hazard Zones.

For Wave 1, the objective of this Solution was limited to a study of the currently available METEO information to analyse how this data feeds could supply specialised tools that would predict the moving hazard zones. The result of this work was to extend the DAC solution to the support of Dynamic Moving Areas and Moving Hazard Zones.

To accomplish these objectives, the work was conducted in the following tasks, and produced the related deliverables:

- Solution Management: Monitor and control of the project. Organisation and hosting of coordination meetings. Contribution to the project reporting requirements
    - Four F2F meetings and three WebExes were held in periods as from December 2016 until April 2019 to ensure the Solution progress, experts' discussions and progress

monitoring. Some other meetings were held at the level of subtasks between Solution partners to prepare a Workshop and address specific issues

- (Moving Hazard Zones) Study Report: Moving Hazard Zones Study Report provided the results of the development conducted in the Solution. Preliminary V0-V1 Moving Hazard Zones concept was developed as a part of SESAR Solution PJ08-02. That document also contains the envisaged operational setup of the Moving Hazard Zones concept, process automation concept and preliminary definition of other operational characteristics. Moving Hazard Zones Study Report addressed the MET Gate data content to be evaluated, in order to determine the scope of the initial implementation of the moving hazard zones concept. The assessment also focused on the state of the DAC framework providing necessary recommendations for Wave 2

- (Early) prototype development: In order to assess the appropriateness of the concept, a workshop was organised in February 2019. The workshop methodology was essentially an expert judgement obtained during series of discussions. A tool for FMP developed by THALES was used to support the discussions, and to illustrate discussions finding and possible scenarios.

Key Project Results

1.4.1 Solution 08-01 Management of Dynamic Airspace Configurations

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

- Performance
    - Civil and Military Coordination: Military operational training capabilities remain unchanged with the application of DMA principles. The CDM processes provide opportunities to reduce transit times in military missions by 17min. The impact on the civil traffic rerouting is reduced when using DMA Type 2, there is a decrease in the total number of impacted flights compared to static ARES and a gain (in terms of distance, fuel and time) also for individual flights
    - Operational feasibility: The concept was recognised to enhance predictability & flexibility, representing therefore an improvement to today's operations. In general, all actors confirmed their preference for the decentralized model. One exercise provided evidence of the operational feasibility of the DAC principles for dynamic sectors configurations (within the INAP time horizon), with a high level of acceptability by the operational actors. One major outcome was the considerable time saving thanks to the automated tool in detection, resolution and decision making for the management of sectors configurations. Operational feasibility of the ATC operational procedures in an environment without predefined sector configurations was confirmed
- General
    - Fast time and modelling exercises clarified certain aspects of the DAC concept implementation through the use of an automated tool, as the optimization criteria in

order to build workable sectors and acceptable transition from one configuration to another

- In tactical operations and at ACC level, it is possible to get rid of predefined sectors' configuration. An exercise confirmed it is possible to rely on a digitalized configuration optimizer to build adequate non-predefined sectors configurations, providing that the collapsed sectors/blocks processed are authorized ones for tactical operation
- Different ANSP requirements would necessitate different ''levels of implementation'' in order to provide the appropriate benefits in terms of KPI's, and this is not reflected in the currently named " levels of implementation" which obliges each ANSP to adapt a hierarchical approach, in order to reach the highest degree of dynamicity and automation as proposed by the DAC tool box
- The gaming, the human-in-the-loop and the real-time simulation exercises yielded positive feedback from the actors from the assessment of the operational feasibility, procedures, workload and the situational awareness of the DAC concept, including free route environment. The DAC improved the management of resources on the day of operations, as well as predictability and flexibility
- The Performance assessment exercises ascertained that DMA types 1 and 2 accommodate both military and ATC needs and that the definition of DMA in accordance with MT concept requirements is feasible
- Early implementation of some mature DAC concept elements in Bordeaux ACC (France) in shadow mode in July 2018

KPI	Validation Targets – Network Level (ECAC Wide)	Performance Benefits Expectations at Network Level (ECAC Wide or Local depending on the KPI)
FEFF1: Fuel Efficiency – Fuel burn per flight	2.43Kg (0.4%)	0.51 kg (0.010%) Even if the solution reach only 18,2% of the target, 24,562,385 (68%) of ECAC En route flights could be impacted, with a fuel saving 0.75 kg for each of them
CAP1: TMA Airspace Capacity – TMA throughput, in challenging airspace, per unit time.	N/A	N/A
CAP2: En-Route Airspace Capacity – En-route throughput, in challenging airspace, per unit time	2.021%	3.5% En-Route throughput higher than the target.
CAP3: Airport Capacity – Peak Runway Throughput **(Mixed mode).**	N/A	N/A

PRD1: Predictability – Variance of Difference in actual & Flight Plan or RBT durations	0.06%	0 Not calculated, as predictability is a measure of the change in variance between the "planned" flight and the "executed" flight
PUN1: Punctuality – % Flights departing within +/- 3 minutes of scheduled departure time due to ATM and weather related delay causes	N/A	N/A
CEF2: ATCO Productivity – Flights per ATCO -Hour on duty	-0.53%	-0.42% Close to the validation target
CEF3: Technology Cost – Cost per flight	N/A	N/A

Figure 1 – Solution 08-01 Benefits Assessment

1.4.2 Solution 08-02 Dynamic Airspace Configuration supporting moving areas

The most significant results obtained can be summarised as follows:

- Preliminary Concept of Moving Hazard Zones concept of V0-V1-ongoing maturity (based on Self Maturity Assessment results - see Appendix B.1) has been developed in the Study
- Set of possible scenarios, main assumptions, link with DAC concept and DCB have been identified
- Early prototype ECOsystem tool for FMP to support the Solution Concept Workshop was made available to support experts' discussions during the MHZ concept Workshop. Quick simulations using WLF were run as a way to assist tactical decisions where MHZ were treated similarly to DCB hotspots – clearly showing users which flights and for how long would be impacted allowing for introduction of tactical regulations or other means of situation management.

The main findings of the 08-02 Solution can be summarised as follows:

- Introduction of MHZ type 1 and 2 into complexity/workload/trajectory calculations directly affecting simulated sector capacity. However, this role could be also fulfilled by good WLF algorithms that would take into account both weather and traffic information at the same time.
- There is a need for a decision support tool that would consider all probable scenarios (both weather and traffic) and propose resolutions for those situations. In tactical phase a human actor would be offered a limited set of operational scenarios to be applied as well clear triggering conditions for each of the scenarios.

- Airspace Management and FMP stations could perform their work well and according to procedures with a result being very problematic. This could happen if military actor reserves airspace that does not contain weather hazards leaving civil airspace users to fly in airspace filled with weather hazards. This situation is the result of Airspace Management not being aware of predicted traffic while FMP not being aware of airspace reservations until very late in the process. This possibility calls for weather aware FMP – Airspace Management and MHZ type 1 (maybe also type 2) would be an excellent tool for this. This should be included in the DAC CDM process in order to make it more robust.

- Finally, a challenging question was posed on a way how predictions could be made to foresee airspace users reaction to weather using data science methods. It was clear that not only weather hazards are important for this kind of calculation, but also 3D wind field, and other factors. One way to handle this issue would be to include airspace users in DAC CDM process.

As this Solution was not meant to undergo an official Maturity Gate, a Maturity self-assessment has been performed to show the achievement of the V1-ongoing Maturity Level (from the initial V0). See Appendix B for details.

1.5 Technical Deliverables

Reference	Title	Delivery Date	Dissemination
D2.1.020	SESAR Solution 08.01 SPR-INTEROP-OSED (including SAR, HPAR, PAR) for V2	02/09/2019	PU
This document defines the Operational Service and Environment for SESAR2020 PJ08 Advanced Airspace Management, and in particular the Solution 1 - **Management of Dynamic Airspace Configurations.** The document includes the specification of the requirements, covering functional, non-functional and interface requirements related to the Project.			
D2.1.030	SESAR Solution 08.01 Technical Specification (TS/IRS) for V2	02/06/2019	PU
This document provides the future architecture technical specifications of the concepts developed by the SESAR Solution 08.01 as described in the SESAR Sol. 08.01 Final OSED Part I document. Technical specifications are based on validation results presented in the SESAR Solution 08.01 Validation Report (VALR) V2 deliverable. The future architecture is developed following the European Air Traffic Management Architecture (EATMA) methodology as described under the B.04.01 D138 document.			
D2.1.050	SESAR Solution 08.01 Validation Report (VALR) for V2	02/09/2019	PU
This document describes the V2 validation results of the Solution 1 of the PJ08 Advanced Airspace Management. It describes the results of validation exercises defined in the Validation Plan (VALP), and how they have been conducted. The V2 validation activities consist of six different exercises: • Two model based exercises, EXE-08.01-V2-VALP-001 and EXE-08.01-V2-VALP-004, for benefit assessment			

• A gaming exercise EXE-08.01-V2-VALP-002 to assess the process of collaboration decision making • A passive shadow mode and simulation EXE-08.01-V2-VALP-005, to assess the operational feasibility of the DAC concept elements and mainly focuses on FMPs and ACC Supervisors activities. It contributes to DAC performance assessment DAC using metrics for the DAC process • A HIL/Gaming exercise, EXE-08.01-V2-VALP-006, to assess the impact on CWP and ATCOs. • A final HIL, EXE-08.01-V2-VALP-003 to assess the feasibility of the overall solution, reaching end of V2			
D2.1.051	SESAR Solution 08.01 Cost Benefit Analysis (CBA) for V2	24/07/2019	CO
This document provides the V2 Cost Benefit Analysis (CBA) results for SESAR Project PJ.08 – Solution 1. This Solution is developing the processes, procedures and tools related to the management of Dynamic Airspace Configurations including support for new types of Dynamic Mobile Areas. The Solution involves the deployment of the following Operational Improvement Steps: AOM-0208-B, AOM-0805, AOM-0809-A and CM-0102-B. This V2 CBA estimates costs and benefits of a potential deployment of Solution PJ.08-01 across ECAC. Details of areas for further development and improvement in V3 are provided.			
D3.1	Moving Hazard Zones Study Report	15/07/2019	PU

Table 1: Project Technical Deliverables

2 Links to SESAR Programme

2.1 Contribution to the ATM Master Plan

Code	Name	Project contribution	Maturity at project start	Maturity at project end
PJ.08-01	**Management of Dynamic Airspace Configurations**			
AOM-0208-B	Dynamic Mobile Areas (DMA) of type 1 and 2	Refinement of the DMA concept (a defined volume of airspace that satisfies specific operational requirements from different Airspace Users), and validation (performance and operational) as an input to NM system for DCB and DAC processes	V2-ongoing	V2
AOM-0805	Collaborative Airspace Configuration	Refinement of the concept (Regional and Local models definition) and validation of the CDM process. Development of support tools enabling the management of the airspace configurations as a continuum to meet the users' expectations	V2-ongoing	V2
AOM-0809-A	Initial Sector Design and Configurations	En-route ATC sectors “new” design principles,	V2-ongoing	V2

	Unconstrained by Predetermined Boundaries	based on dynamic definition and delineation of volumes of airspace vertically and/or horizontally in addition to traditional ATC sectors that enable more flexible and more dynamic approach for airspace configurations from planning to execution phases		
CM-0102-B	Dynamic Airspace Management based on complexity	Optimisation of workload and complexity functions related to DAC in a more global approach, through wider areas based on better information sharing (starting from the local level as developed in CM-0102-A): Airspace volumes, interfaces En-Route/TMA, Free Route Airspace structures, DMAs and Cross-Border Areas.	V2-ongoing	V2
PJ.08-02	**Dynamic Airspace Configuration supporting moving areas**			
AOM-0209	Integrate Hazard	Implementation	V0	V1-ongoing

	Zones in DAC process	of a systematic and seamless method to integrate hazardous weather phenomena into airspace management taking into account the DAC		

Table 2: Project Maturity

2.2 Contribution to Standardisation and regulatory activities

At the end of Wave 1, as the Project reached V2 maturity level, no contribution to regulation and standardisation has been performed.

In the context of the TS/IRS deliverable task, the following was developed:

- System Functionality and Flow Diagram (NSV-4) models for all use cases listed in the OSED
- Resource Connectivity Diagram (NSV-1) models for all the Use Cases listed in the OSED.

3 Conclusion and Next Steps

3.1 Conclusions

3.1.1 Conclusions from Solution 08-01

Solution 08-01 key conclusions are summarized here below:

DAC and DMA Concept:

- The validation outcomes of the fast time and modelling exercises clarified certain aspects of the DAC concept implementation with an automated tool, as the optimisation criteria in order to build workable sectors and acceptable transition from one configuration to another. It was clearly stated that in tactical operation and at an ACC level, it was possible to get rid of predefined sectors configuration. Validation activities also confirmed it was possible to rely on a digitalized configuration optimizer to build adequate non-predefined sectors configurations, providing that the collapsed sectors/blocks processed would be authorized ones for tactical operation

- DAC improves the management of resources on the day of operations. In addition, the potential cost efficiency benefits of using complexity evaluation for monitoring sector capacity was observed, as the high number of entry/occupancy values did not always imply high workload. The proposed 10-15 minute notification time before a change of configuration was considered as acceptable by ATCO's in terms of situation awareness. The decision of implementing airspace configurations would remain under the responsibility of the FMP or Room Supervisor

- The DAC concept is considered to enhance predictability and flexibility, representing therefore an improvement to today's operations. Although the Solution scenarios had a lower task load as compared to current operations and the proposed tools had limitations (normal for a V2 phase), all actors concluded that with a traffic increase, the importance of a similar system would be highly valuable

- The high number of possible configurations is a risk for concept feasibility, which needs to be addressed since the ATCO would adequate training to work in many different configured sectors as well as a knowledge of the related operational procedures. Training is seen as a very important aspect of the concept to ensure safe operations in DAC environment

- The Artificial Intelligence methodology applied to define capacity values of the dynamically shaped sectors has been validated in the Polish and German airspace with success

- DMA types 1 and 2 accommodate both military and ATC needs, and the definition of DMA in accordance with MT concept requirements is feasible. The performance assessment revealed a positive impact with only a limited number of civil flights being re-routed due to DMA activations. In addition, it demonstrated that the number of civil flights impacted by DMA type 2 were significantly reduced, and feedback from military expertise who participated in this exercise indicated that the application of DMA design principles would

enable a flexible access to airspace to military AU whilst military operational training capabilities would be maintained.

DAC and DMA Technical Feasibility:

- The automated tools provided to support the DAC were assessed as acceptable, and some improvements were proposed. These improvements include refinement of workload algorithm and improved functionalities (i.e. DMA best location) which could increase support to user. An area of further development is the ability of the tool to calculate simultaneously an optimal DMA location for two or more active DMA's. Visualisation aids are required to support the presentation of changes. Some improvements proposed are the vertical changes to be visible on a second smaller screen, an automatic zoom after sector change

- An aid tool to support ATCO visualization of the sector configuration changes as well as Supervisor/EAP decision making for implementing it were developed. The results of the technical feasibility assessment showed that the tool was considered a good support to ATCO functions and situation awareness. Requirements to improve this tool, and how it should be integrated within the CWP for next SESAR phase Wave 2 have identified and described.

- The automated tool developed to build, assess, and compare the different airspace configurations is fit for use and supports the concerned actors (both FMPs and Supervisors) in their decision making tasks. The sectors configurations calculated by the Configuration Optimizer are relevant and make sense to the operational experts

- The technical feasibility of prototyping and interconnecting the systems to provide for the exchange of information between all actors has been successfully assessed. Despite the identification of some current technical limitations, these are not considered as showstoppers because the validation of the tools is at V2 Maturity Level of the concept.

3.1.2 Conclusions from Solution 08-02

Solution 08-02 conclusions are summarised here below:

- MHZ concept has been defined as a set of four elements in SESAR PJ.08-02 Solution. The whole package has been analysed during a dedicated expert workshop. Two general use scenarios by multiple stakeholders were considered: tactical phase use and pre-tactical planning use. The resulting conclusions were different dependent on the use scenario.

- Discussion about use of MHZ concept as a mean to minimise weather induced workload by transfer of weather management from tactical phase to pre tactical planning phase displayed clearly a set of challenges. Even though feasible ideas how to tackle those challenges were proposed each of those concepts would require further exploratory level research.

- The situation is different for tactical phase use. Experts felt more confidence in forecast accuracy (as the lead times are relatively small) allowing them to adapt the forecast in their decision making. Both MHZ type 1 and 2 seem to be able to play a role in this setting possibly integrating well with DAC concept.

- Further work is suggested to be conducted in framework of forthcoming SESAR exploratory research (ER4).

3.2 Plan for next R&D phase (Next steps)

Next steps for PJ08 Advanced Airspace Management Solutions:

The Wave 1 scope of the solutions is changing for the work programme of the Wave 2. The V3 phase of the main PJ08 Wave 1 conceptual elements will be covered in the following PJ.07 and PJ.09 Wave 2 Solutions, and Exploratory Research activities (ER4 Call):

- **DAC and DMA concepts, processes and automation tools** – Solution 40 and Solution 44 for further validation and integration into the DCB processes and toolset. The concept will be adapted to take on board the new degrees of dynamicity of the DAC to replace the previously existing hierarchical approach provided through "levels of implementation". This will allow ANSP's to more effectively attain their KPI's. In detail:
    - Further performance assessment of DAC (Wave 2 S44)
    - Future validation to provide a wider scope of ANSP's so that NM functions including CDM process can be fully investigated (Wave 2 S44)
    - Increasing complexity of military airspace requests (including additional ARES, rejection and counterproposal) (Wave 2 S40/S44)
    - DMA concept assessed and validated outside the DAC (Wave 2 S40)
    - Further development of ATC volumes to investigate different usage for re-routing of traffic (e.g. NM dealing with negative weather conditions, critical hotspots, etc.) (Wave 2 S44)
    - Further assessment and optimization of DAC sector configuration changes and impact for the ATCO, including the ATC planner through real-time simulation (Wave 2 S44)
- **Moving Hazard Zones and DAC**
    - Inclusion of moving hazard zones in complexity/trajectory/workload calculations
    - D-1 prediction of weather impact on airspace users flight planning.
    - Decision support tools for exploring multiple operational weather-related scenarios. Tools for construction and management of many operational scenarios in dynamic tactical landscape.
    - Influence of forecast accuracy on traffic performance in various use scenarios.
    - Weather loading factor (WLF) integration with traffic simulation tools for better sector planning is necessary.
    - Precise definition of MHZ usage in tactical phase – procedures, actors, roles timeliness and influence of information on decision making

4 References

[1] SESAR2020 Programme Management Plan 01.00 Nov 2017

[2] S2020 Project Handbook v01.00.01 June 2017

[3] PJ19 Concept of Operations 1 Dec 2017

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[9] 08.01.01 D49: SWIM Compliance Criteria B.04.05 Common Service Foundation Method

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[12] B.04.01 D42 SESAR2020 Transition Validation

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[16] 16.06.06_D26-08 ATM CBA Quality Checklist Transition VALS SESAR 2020 - Consolidated deliverable with contribution from Operational Federating Projects European Operational Concept Validation Methodology (E-OCVM) - 3.0 [February 2010] SESAR, Safety Reference Material, Edition 4.0, April 2016 16.06.05 D 27 HP Reference Material D27 16.06.02 D103 SESAR Security Ref Material Level

Project Deliverables

Ref. number	Project Id	Title	Del. Id	Edition	Date
[1]	PJ08 AAM		D1.1	Ed. 1.15	08/10/2019
[2]	PJ08 AAM		D1.3	Ed. 1.1	03/02/2017
[3]	PJ08 AAM		D1.4		
[4]	PJ08 AAM		D1.5		
[5]	PJ08 AAM		D1.6		

[6]	PJ08 AAM		D1.7		
[7]	PJ08 AAM		D1.8		
[8]	PJ08 AAM		D1.9		
[9]	PJ08 AAM		D1.10		
[10]	PJ08 AAM		D1.11		
[11]	PJ08 AAM		D1.12		
[12]	PJ08 AAM				
[13]	PJ08 AAM				
[14]	PJ08 AAM				
[15]	PJ08 AAM				
[16]	PJ08 AAM	SESAR Solution 08.01 SPR-INTEROP-OSED for V2 - Part I	D2.1.020	Ed. 3.1	02/09/2019
[17]	PJ08 AAM	SESAR Solution 08.01 SPR-INTEROP-OSED for V2 - Part II - Safety Assessment Report	D2.1.021	Ed. 1.0	05/07/2019
[18]	PJ08 AAM	SESAR Solution 08.01 SPR-INTEROP-OSED for V2 - Part IV - Human Performance Assessment Report	D2.1.023	Ed. 1.2	04/07/2019
[19]	PJ08 AAM	SESAR Solution 08.01 SPR/INTEROP-OSED V2 - Part V - Performance Assessment Report (PAR)	D2.1.024	Ed. 3.1	05/07/2019
[20]	PJ08 AAM	SESAR Solution 08.01 Technical Specification (TS/IRS) for V2	D2.1.030	Ed. 1.7	02/09/2019
[21]	PJ08 AAM	SESAR Solution 08.01 Validation Plan (VALP) for V2 - Part I	D2.1.040	Ed. 6.1	08/04/2019

[22]	PJ08 AAM	SESAR 2020 PJ08 EXE08.01.02 Availability Note	D2.1.042	Ed. 1.0	08/04/2019
[23]	PJ08 AAM	SESAR 2020 PJ08 EXE08.01.03 Availability Note	D2.1.043	Ed. 1.0	08/04/2019
[24]	PJ08 AAM	SESAR 2020 PJ08 EXE08.01.04 R-NEST Availability Note	D2.1.044	Ed. 1.20	30/06/2018
[25]	PJ08 AAM	SESAR 2020 PJ08 EXE08.01.05 SINAPS Availability Note	D2.1.045	Ed. 1.1	25/07/2018
[26]	PJ08 AAM	SESAR 2020 PJ08 EXE08.01.06 SIMADES Availability Note	D2.1.046	Ed. 1.1	11/09/2018
[27]	PJ08 AAM	SESAR Solution 08.01 Validation Report (VALR) for V2	D2.1.050	Ed. 3.2	02/09/2019
[28]	PJ08 AAM	SESAR Solution 08.01 Cost Benefit Analysis (CBA) for V2	D2.1.051	Ed. 1.0	24/07/2019
[29]	PJ08 AAM	Moving Hazard Zones Study Report	D3.1	Ed. 1.1	15/07/2019
[30]	PJ08 AAM	SESAR 2020 PJ08 Ethics Requirements IR	D4.1/4.2 /4.3/4.4	Ed. 0.2	15/01/2018

Table 3: Project Deliverables List

4.2 Project Communication and Dissemination papers

[1] “SESAR investigates benefits of dynamic airspace configuration”, SESAR JU E-NEWS #81, P. Criscuolo (Techno Sky), G. Esposito (ENAV), March 2018.

[2] “Exploring the benefits of dynamic airspace configuration”, P. Criscuolo (Techno Sky), G. Esposito (ENAV), EUROCONTROL NEWSROOM, 29 March 2018.

[3] "Human Factors in Dynamic Airspace Configurations", A. Karahasanovic, 11 February 2019, Invited talk at research seminar, Naval Postgraduate School, Monterey, USA

[4] "Early design and validation of complex solutions", E. G. Nilsson and A. Karahasanovic, presentation at the conference NFEA Alarm handling and control room solutions 2019, 3-4 April 2019, Stavanger, Norway

[5] SIMADES ATC and EXE 08.01.06, A.Karahasanovic, E.G.Nilsson and V Volden-Freberg, SINTEF research seminar, 31 May 2018, SINTEF, Oslo, Norway

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[7] SINTEF Aviation Open Day, A. Karahasanovic, T. Bakken, P. Schittekat, A. Riise and I. Andrade Herrera, #SINTEFblogg, 2018

[8] SINTEF in Aviation, A. Karahasanovic, FB and LinkedIn of Norwegian Research Council

[9] PJ08 Advanced Airspace Management, G. Murgese, 2019 World ATM Congress, 12-14 March 2019

[10] Application of AI techniques to assess Airspace Capacity, E. Allard, EUROCONTROL Aviation & Artificial Intelligence Workshop, 23 May 2019

[11] PJ08 Advanced Airspace Management , G. Murgese, 2019 Tandem AERODays, 27-29 May 2019

[12] Evaluation of airspace declared capacity using an artificial neural network, E. Allard, Federico Aguilar Calvo, Nuria Alsina-Pujol, 19th ATM R&D Seminar, 17-21 June 2019

[13] SINTEF at SESAR Innovation Days, A. Karahasanovic, 4 December 2019, SINTEF Digital blogg

[14] SESAR 2020 Wave 1 Improving Network Performance closure, A.Karahasanovic, 22 November 2019, SINTEF blogg

[15] “Supporting Air Traffic Controllers During Sector Configuration Changes in Dynamic Air Space Configuration”, A. Karahasanovic, E. Nilsson, P. Schittekat, V. Volden-Freberg, M. Smedsrud (SINTEF Digital), P. Criscuolo (Techno Sky) and G. Esposito (ENAV), SIDSesar Innovation Days 2019, research paper N° 81

Appendix A Glossary of Terms, Acronyms and Terminology

A.1 Glossary of terms

Term	Definition	Source of the definition
Actor	An actor in the context of Air Navigation Service Providers (ANSP) can be an organisation/unit like an ATS unit (ACC,APP, TWR) or an individual like an air traffic controller, planning controller, executive controller etc.	SESAR Integrated Dictionary
Ad-hoc Airspace Structures	Ad-hoc Structures refer to two different concepts: Airspace structures pre-defined at ASM level 1, whose usage is requested at short notice (see definition of Non Pre-coordinated Airspace Structures below) Airspace structures not pre-defined at ASM level 1, and whose creation is requested for a specific temporary purpose.	SESAR 1 Project 07.05.02
Airspace Building Block	Elementary volume of modularised airspace (As defined by the appropriate ANSP) that are too small individually for controlling purposes, but instead form the basic constituent parts of a Controlled Airspace Block as part of an optimising process.	SESAR 1 SWP 7.2 DOD
Airspace Configuration	Is a pre-defined and coordinated organisation of routes and their associated airspace structures, temporary airspace reservations and ATC sectorisation.	SESAR 1 SWP 7.2 DOD
Airspace Constraint	An Airspace Constraint is a reservation of airspace for activities not linked to a mission trajectory. Examples include ground-to-air or ground-to-ground gunnery sessions. As for any ARES, the activity inside an Airspace Constraint is not shared.	SESAR 1 Project 07.05.02
Airspace Reservation (ARES)	Airspace Reservation is a defined volume of airspace temporarily reserved for exclusive or	European Route Network Improvement Plan (ERNIP), Part 3 - The ASM

	specific use by categories of users.	Handbook
Airspace Restriction	Airspace Restriction is a defined volume of airspace within which, variously, activities dangerous to the flight of aircraft may be conducted at specified times (a 'danger area'); or such airspace situated above the land areas or territorial waters of a State, within which the flight of aircraft is restricted in accordance with certain specified conditions (a 'restricted area'); or airspace situated above the land areas or territorial waters of a State, within which the flight of aircraft is prohibited (a 'prohibited area').	European Route Network Improvement Plan (ERNIP), Part 3 - The ASM Handbook
Airspace Structure	Airspace Structures are specific portions of airspace designed to accommodate the safe operation of aircraft. In the context of the FUA Concept, "Airspace Structures" include Controlled Airspace, ATS Route, including CDRs, ATC Sectors, Danger Area (D), Restricted Area (R), Prohibited Area (P), Temporary Segregated Area (TSA), Temporary Reserved Area (TRA), Cross-Border Area (CBA).	European Route Network Improvement Plan (ERNIP), Part 3 - The ASM Handbook
Airspace User	Airspace user means civil or military aircraft operating in the air as well as any other parties requiring airspace.	Reg. 2150/2004 (definition of 'users')
Airspace User	The term "airspace users" mainly refers to the organizations operating aircraft including rotorcraft, and their pilots. Three classifications of airspace users are considered: ICAO-compliant manned flight operations (the largest segment by far): ICAO-compliant manned flight operations are those conducted in accordance with ICAO provisions (e.g. SARPs, PANS). ICAO-compliant airspace users include: all civil aircraft operators engaged: In commercial air transport -scheduled and non-scheduled (passenger transport, mail and cargo services, emergency medical services,	SESAR 1 SWP 7.2 DOD

	etc...), in business and general aviation: air taxi operators, aerial work, private air transport, sporting and recreational aviation, etc... ; and the portion of State users operating State aircraft using civil air traffic rules (GAT) ICAO non-compliant manned flight operations: ICAO non-compliant manned flight operations are those which cannot comply for operational or technical reasons (e.g.: conducted by State aircraft -OAT-) Flight operations of unmanned aerial systems (UASs): Flight operations of unmanned aerial systems (UASs), a growing segment of airspace users, include both civil and military applications of UAV technology	
ATM actor	ATM actor is a person, organisation or technical system authorised/licensed to act within the ATM System. ATM actor can take a role (the role is a collection of responsibilities). Several ATM actors can perform one role. One ATM actor can perform several roles.	SESAR 2020 Concept Of Operations Edition 2017 D19.2.1 Edition date: 28 November2017, Edition: 01.00.00
Business Trajectory	A 4D trajectory which expresses the business intentions of the user with or without constrains. It includes both ground and airborne segments of the aircraft operation (gate-to-gate) and is built from, and updated with, the most timely and accurate data available.	SESAR 1 Project 11.01.01 Transversal consistency of BT/MT requirements (across WPs) SESAR 1 D11.01.01-1 Definition of trajectory requirements for Step 1, including gap analysis, support to standardization report from Airspace Users perspective
Computed Take-off Time (CTOT)	An Air Traffic Flow & Capacity Management (ATFCM) departure slot, forming part of an Air Traffic Control (ATC) clearance, which is issued	ICAO Doc 7030/4 – EUR SESAR 1 D11.01.01-1

	to a flight affected by Network Management regulations. It is defined by a time and tolerance (-5 to +10 minutes) during which period the flight is expected to take-off.	Definition of trajectory requirements for Step 1, including gap analysis, support to standardization report from Airspace Users perspective
Controlled Airspace Block	A Controlled Airspace Block (replacing the current predefined elementary sectors) is a section of modularized airspace within which a Tactical Air Traffic Controller performs his controlling functions defined as a result of dynamic airspace configuration process. Controlled Airspace Blocks are created as a result of a dynamic airspace configuration process in which each controlled block is an optimised grouping of Airspace Building Blocks under consideration of the forecast traffic pattern and ATCO availability and Safety/Performance metrics. The Controlled Airspace Block forms the elementary size of a "Hotspot Unit."	SESAR 1 SWP 7.2 DOD
Controlled Time of Arrival (CTA)	An ATM imposed time constraint on a defined merging point associated to an arrival runway.	SESAR 2020 Concept Of Operations Edition 2017
Controlled Time Over (CTO)	An ATM imposed time constraint over a point.	SESAR 2020 Concept Of Operations Edition 2017
Collaborative Decision Making (CDM)	Collaborative decision-making (CDM) is defined as a process focused on how to decide on a course of action articulated between two or more community members. Through this process, ATM community members share information related to that decision and agree on and apply the decision-making approach and principles. The overall objective of the process is to improve the performance of the ATM system as a whole while balancing the needs of individual ATM community members. From a military perspective CDM is a process from which all participating parties can gain benefits through the negotiation of proposed options. The negotiation stops either at the moment when all participating parties agree with the result or when they reach a limit in their capability to accept further compromise	ICAO Doc 9971 + SESAR 1 B4.2 (mil aspects) SESAR 2020 Concept Of Operations Edition 2017

	due to defined priorities.	
Critical Events	Critical Event. An unusual situation or crisis involving a major loss of EATMN capacity, or a major imbalance between EATMN capacity and demand, or a major failure in the information flow in one or several parts of EATMN.	EUROCONTROL DNM
	Critical event refers to a sudden and usually unforeseen event leading to a high drop in network capacity and a potential crisis situation, involving many partners and requiring immediate action to minimize consequences and to retrieve network stability. The management of critical events may be mostly reactive (unplanned). Real time information sharing will help the different partners to assess the situation, to take appropriate and coordinate actions at their levels and to provide support to the Crisis Coordination Cell.	SESAR 1 SWP 7.2 DOD
DAC role	DAC role within this OSED refers to composition of responsibilities for of carrying out of main DAC management related tasks and activities associated with DAC management processes at Local or Sub regional levels which include DAC planning, assessment, negotiation, publication and sharing, decision making and implementation.	Newly defined term in the project.
Deployment Baseline	The Deployment Baseline consists of operational and technical solutions that have successfully completed the R&D phase and have been implemented or are being implemented. Additional Note: The Deployment Baseline encompasses the current baseline (what exists today), augmented by the Operational Improvements of the former “IP1” (Implementation Package 1). The Deployment Baseline precedes SESAR Step 1.	Master Plan 2012 update
Dynamic mobile area (DMA)	Dynamic mobile area (DMA) is an integral part of the MT described by a 4D data set, where	SESAR 2020 Concept Of Operations Edition 2017

	the velocity parameter is equal to zero. DMA constitutes a defined volume of airspace that satisfies specific requirements from different Airspace Users. There are two types of DMA that have been identified for Step 2: DMA Type 1 is a volume of airspace of defined dimensions as integral part of MT at flexible geographical locations agreed upon a CDM process, satisfying Airspace Users requirements in terms of a time and/or distance constraint parameters from a reference point as specified by AU (e.g. Aerodrome of Departure). DMA2: is a volume of airspace of defined dimensions described as integral part of MT and agreed upon a CDM process, satisfying the Airspace Users requirements.	
Early Flight Intents	Early flight intents are a set of data provided by an Airspace User to express its intentions to use the airspace. This set of data includes a first level of trajectory description.	Newly defined term in the project.
Flight Intents	The future aircraft trajectory expressed as a 4-D profile until destination (taking account of aircraft performance, weather, terrain, and ATM service constraints), calculated and "owned" by the aircraft flight management system, and agreed by the pilot.	ICAO Doc 9854
Flight Operation Centre (FOC)	Flight Operation Centre is a part (department, employee) of an Airspace user or a system used by an Airspace user providing FOC services and support like operational control, flight planning, pre-flight briefing, in-flight support and post-flight analyses in accordance to AU's Operational Manual and Standard Operational Procedures.	SESAR 1 P11.01.01 Transversal consistency of BT/MT requirements (across WPs) SESAR 1 D11.01.01-1 Definition of trajectory requirements for Step 1, including gap analysis, support to standardization report from Airspace Users perspective
Forecast Business	4D definition of the trajectory associated with a level of uncertainties which evolved	Newly defined term in

Trajectory	according to the time horizon. The FBT uncertainties are characterised by Time uncertainty, Lateral uncertainty, Vertical uncertainty. The purpose is to elaborate the best predictable 4D Trajectory representation called Forecast Business Trajectory (FBT) using uncertainty modelling and including result on FBT itself. The FBT shall be built from historical data (statistical model) and various database (Airport, AO, …), then the FBT shall be refined all along the timeline based on SBT (2D + schedule or 3D + schedule or 4D profile), and trajectory elements that will be known only at a later stage of the planning process (information on 4D route, Constraints …) FBT will be complemented by prediction algorithms and simulation tools used to anticipate flight intentions which are not yet known at the considered anticipated time (SBT maturity, weather conditions, etc.)	the project.
Full Operational Capability (FOC)	It is the date at which a given capability is sufficiently deployed to provide its full benefits.	SESAR ATM Lexicon
Hotspot	Where the estimated ATC workload exceeds an established acceptable threshold.	Newly defined term in the project.
Imbalance	Imbalance between Demand and Capacity (measured by the occupancy rate in a Controlled Airspace Block)	Newly defined term in the project.
Improved OAT Flight Plan	A flight plan based upon the ICAO 2012 FPL format, improved with initial Mission Trajectory data and harmonised military information items, managed centrally at European level and used by military organisations operating IFR in European airspace.	SESAR 1 Project 07.06.02 OSED Step 1 V3 Volume 2
Initial Operational Capability (IOC)	It is the date at which a given capability is sufficiently deployed to provide its first benefits.	SESAR ATM Lexicon
Interoperability	The condition achieved among communications-electronics systems or items of communications-electronics equipment	SESAR 1 SWP 7.2 DOD Dictionary of Military and

	when information or services can be exchanged directly and satisfactorily between them and/or their users. The degree of interoperability should be defined when referring to specific cases.	Associated Terms 08 November 2010
Major Events	Examples of Major Events include: large scale military exercises, Chief of States Summit, Olympic Games, Football World Cup, etc.	SESAR 1 SWP 7.2 DOD
Network Operations Plan (NOP)	[NOP consists of]: a set of information and actions derived and reached collaboratively both relevant to, and serving as a reference for, the management of the Pan-European network in different timeframes for all ATM stakeholders, which includes, but is not limited to, targets, objectives, how to achieve them, anticipated impact. The NOP has a dynamic and rolling lifecycle starting in the strategic phase and progressively updated up to and including the execution and post-operations phases. It supports and reflects the result of the collaborative ATM planning process: at each phase, stakeholders collaborate at developing a common view of the planned network situation, allowing each of them to take informed decisions considering the network effect and the Network Manager to ensure the overall coordination of individual decisions needed to support network performance.	SESAR 1 SWP 7.2 DOD
Revision of the Reference Business or Mission Trajectory	The revision of the Reference Business or Mission Trajectory (RBT/RMT) is triggered at Controller or Flight crew initiative when there is the need to change the route and/or altitude constraints and/or time constraints, mainly due to hazards (traffic, weather), fine sequencing (CTA or CTO allocation) or inability for the aircraft system to meet a constraint (CTA missed).	SESAR 2020 Concept Of Operations Edition 2017
Shared Business/Mission Trajectory	Published Business/Mission trajectory that is available for collaborative ATM planning purposes. The refinement of the SBT/SMT is an iterative process.	SESAR ATM Lexicon
System Wide	[SWIM consists of] standards, infrastructure	SESAR Integrated

Information Management	and governance enabling the management of ATM information and its exchange between qualified parties via interoperable services.	Dictionary
Temporary Segregated Area (TSA)	Temporary Segregated Area (TSA) is a defined volume of airspace normally under the jurisdiction of one aviation authority and temporarily segregated, by common agreement, for the exclusive use by another aviation authority and through which other traffic will not be allowed to transit. In the context of the FUA Concept, all TSAs are airspace reservations subject to management and allocation at ASM Level 2.	European Route Network Improvement Plan (ERNIP), Part 3 - The ASM Handbook
Temporary Reserved Area (TRA)	Temporary Reserved Area (TRA) is a defined volume of airspace normally under the jurisdiction of one aviation authority and temporarily reserved, by common agreement, for the specific use by another aviation authority and through which other traffic may be allowed to transit, under ATC clearance. In the context of the FUA Concept, all TRAs are airspace reservations subject to management and allocation at ASM Level 2.	European Route Network Improvement Plan (ERNIP), Part 3 - The ASM Handbook
Reference Business/Mission Trajectory	The business/mission trajectory which the airspace user agrees to fly and the ANSP and Airports agree to facilitate (subject to separation provision).	SESAR ATM Lexicon SESAR Integrated Dictionary
	Note : The Reference Business or Mission Trajectory (RBT/RMT) is the last instantiation of the SBT/SMT. It is associated to the filed flight plan and includes both air and ground segments. It consists of 2D routes (based on published way points and/or pseudo waypoints computed by air or ground tools to build the lateral transitions and vertical profiles); altitude and time constraints where and when required; altitude, time and speed estimates at waypoints, etc. When an RBT/RMT is agreed a NOP update is triggered.	(source SESAR Definition phase)
Unplanned Events	Ad-hoc, non nominal situations that happens without any advance pre-notification	Newly defined term in the project.

Update of the Reference Business or Mission Trajectory	The update of the Reference Business or Mission Trajectory (RBT/RMT) is automatically triggered when the trajectory predictions continuously computed by the aircraft system, differ from the previously shared trajectory predictions more than the delta defined by ATC in Trajectory Management Requirements (TMR). The update of the RBT/RMT can also be triggered on request or periodically.	SESAR Def Phase
Wing Operations Centre	The WOC is a generic term, which gathers the operational processes and services directly related to the airspace users and linked to Mission Trajectories and other aerial activities. This definition avoids detailing the diverse organisational structures existing in Europe. It is the Military equivalent to the civil Flight Operations Centre (FOC)	SESAR 1 P11.01.01 Transversal consistency of BT/MT requirements (across WPs) SESAR 1 D11.01.01-1 Definition of trajectory requirements for Step 1, including gap analysis, support to standardization report from Airspace Users perspective
What if tools	„What-If“ re-routing simulations allow selecting a single flight and perform re-route trials using flight route alternatives provided by the system, so that the delay imposed on this single flight is minimized and there is no overload on the traffic volumes crossed by the re-route flight. The system automatically provides the benefit and overload, and also automatically calculates and displays the EET and route length differences between the original flight route and the provided flight route alternatives.	Newly defined in the project

Table 4: Glossary

A.2 Acronyms and Terminology

Term	Definition
AA	Approved Agency
AAMS	Advanced Airspace Management System

AAR	Air to Air Refuelling
ABB	Airspace Building Block
ACC	Area Control Centre
ADD	Architecture Definition Document
ADU	Air Defence Unit
AFUA	Advanced Flexible Use of Airspace
AIP	Aeronautical Information Publication
AMC	Airspace Management Cell
AMT	Airspace Monitoring Tool
ANSP	Air Navigation Service Provider
AO	Aircraft Operator
AOM	ATM Organisation and Management
AoR	Area of responsibility
APW	Area Proximity Warning
ARN	ATS Route Network (Réseau de routes ATS)
ARES	Airspace Reservation/Restriction
ASM	Airspace Management
ATC	Air Traffic Control
ATCO	Air Traffic Controller
ATM	Air Traffic Management
ATS	Air Traffic Services
ATSU	ATS unit
ARN	ATS Route Navigation
AU	Airspace User
AUA	ATC Unit Airspace
AUP	Airspace Use Plan
BIM	Benefit and Input Mechanism
BT	Business Trajectory
CAS	Close Air Support
CBA	Cross-Border Areas
CBO	Cross-Border Operations
CDM	Collaborative Decision Making
CDR	Conditional Route
CFMU	Central Flow Management Unit
CIAM	CFMU Interface for Airspace management
CNS	Communication Navigation and Surveillance
CM	Conflict Management
CONOPS	Concept of Operations
COP	Coordination Point
CPDLC	Controller Pilot Data Link Communications
CQZ	Controllers Qualification Zone
CR	Change Request
CS	Configured Sectors
CTA	Control Area

CTA	Controlled Time of Arrival
CTO	Controlled Time Over
CTR	Control Zone
CWP	Controller Working Position
DAC	Dynamic Airspace Configuration
DCB	Demand Capacity Balancing
DCT	DireCT (Flight plan clearances & approach) Direct Routing
dDCB	Dynamic DCB (Demand Capacity Balancing)
DMA	Dynamic Mobile Area
DOD	Detailed Operational Description
DOW	Description of Work
EAP	**Extended ATC Planning**
EATMA	European ATM Architecture
E-ATMS	European Air Traffic Management System
eAUP	electronic Airspace Use Plan
EC	European Commission
EDAC	European Dynamic Airspace Configuration
EPP	Extended Projected Profile
ES	Elementary Sector
ETO	Estimated Time Over
EUROCAE	European Organisation for Civil Aviation Equipment
FAB	Functional Airspace Block
FBT	Forecast Business Trajectory
FDPS	Flight Data Processing System
FIR	Flight Information Region
FMP	Flow Management Position
FRA	Free Route Airspace
FOC	Flight Operations Centre
FUA	Flexible Use of Airspace
GAT	General Air Traffic
HLAPB	High Level National / Sub-regional Airspace Policy Body
HPAR	Human Performance Assessment Report
I-4D	Initial 4D Trajectory
ICAO	International Civil Airspace Organisation
IFR	Instrument Flight Rules
INAP	Integrated Network ATC Planning
INTEROP	Interoperability Requirements
IRS	Interface Requirements Specification
KPA	Key Performance Area
KPI	Key Performance Indicator
LTM	Local Traffic Manager
MET	Meteorological Service
MMS	Mission Management System

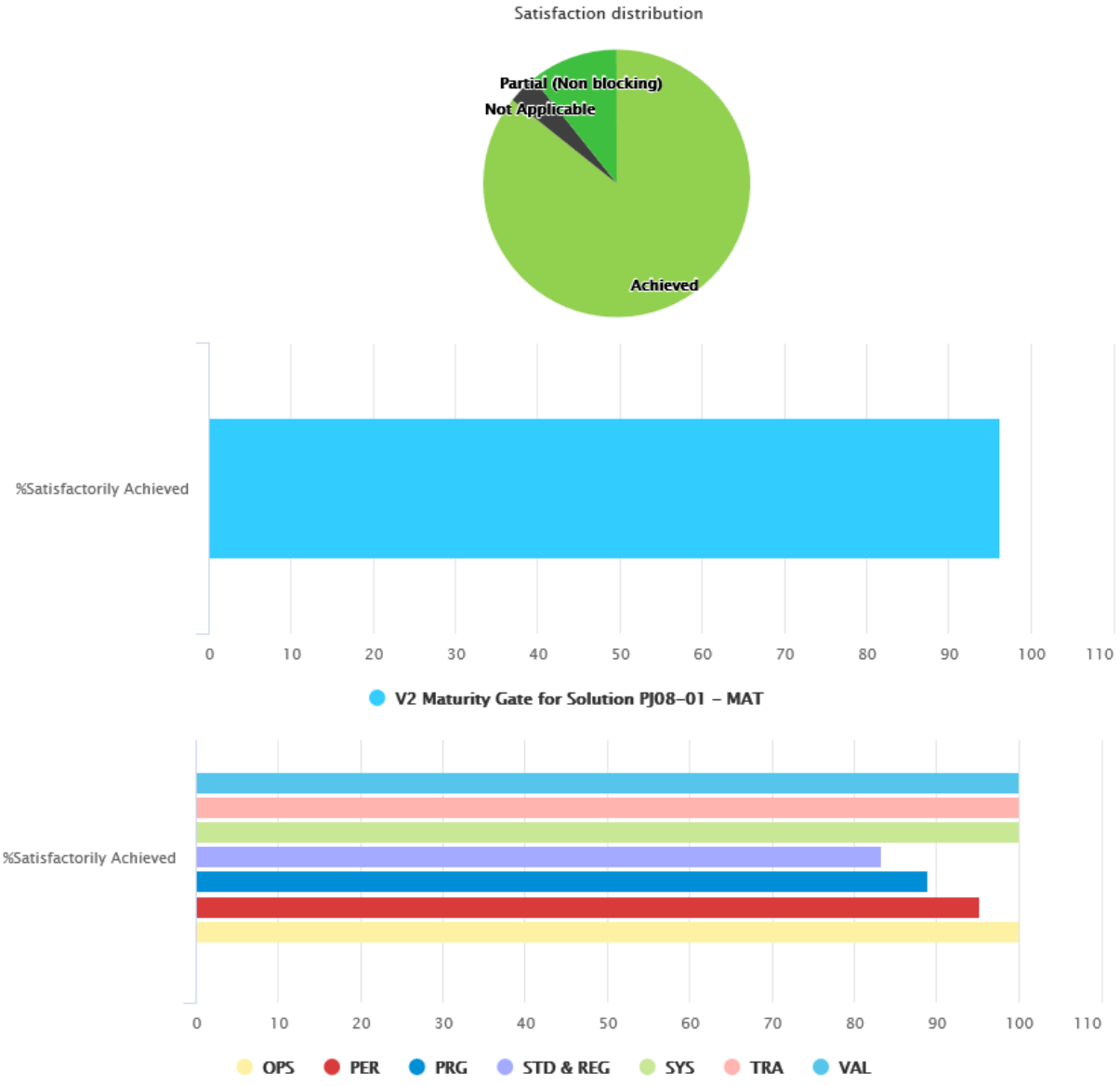
MT	Mission Trajectory
MTCD	Medium Term Conflict Detection
MVPA	Military Variable Profile Area
NIMS	Network Information Management System
NMF	Network Management Function
NOP	Network Operations Plan
NSA	National Supervisory Authority
NWP	Network Working Position
OAT	Operational Air Traffic
OCD	Operational Concept Description
OFA	Operational Focus Areas
OI	Operational Improvement
OPAR	Operational Performance Assessment Report
OSED	Operational Service and Environment Definition
PAR	Performance Assessment Report
PIRM	Programme Information Reference Model
PT	Predicted Trajectory
QoS	Quality of Service
RBT	Reference Business Trajectory
RMT	Reference Mission Trajectory
SAC	Safety Criteria
SAM	Sharable airspace module
SAR	Safety Assessment Report
SecAR	Security Assessment Report
SBT	Shared Business Trajectory
SMT	Shared Mission Trajectory
SES	Single European Sky
SESAR	Single European Sky ATM Research Programme
SESAR Programme	The programme which defines the Research and Development activities and Projects for the SJU.
SJU	SESAR Joint Undertaking (Agency of the European Commission)
SJU Work Programme	The programme which addresses all activities of the SESAR Joint Undertaking Agency.
SPR	Safety and Performance Requirements
STAM	Short-Term ATFCM Measures
SWIM	System Wide Information Management
SWP	Sub-Work Package (within the SESAR Programme) – Sub-division of a Work Package; divided into Projects
TAD	Technical Architecture Description
TFL	Transfer Flight Level
TMA	Terminal Area
TMRs	Trajectory Management Requirements

TRA	Temporary Reserved Area
TRM	Trajectory Management
TSA	Temporary Segregated Area
TS	Technical Specification
UAS	Unmanned Airborne Systems
UAV	Unmanned Aerial Vehicle
UDPP	User Driven Prioritisation Process
UIR	Upper Information Region
UPR	User Preferred Routing
UPT	User Preferred Trajectory
UUP	Updated Airspace Use Plan
VDFL	Vertical Division Flight Level
VFR	Visual Flight Rules
VPA	Variable Profile Area (a design principle)
VPN	Virtual Private Network
WOC	Wing Operations Centre
WP	Work Package (within the SESAR Programme) – divided into SWPs (Sub Work Packages)

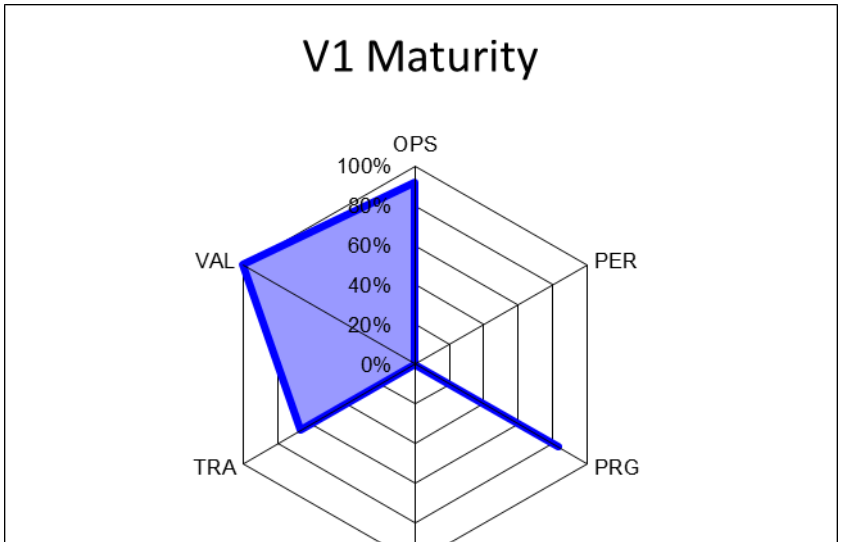
Table 5: Acronyms and technology

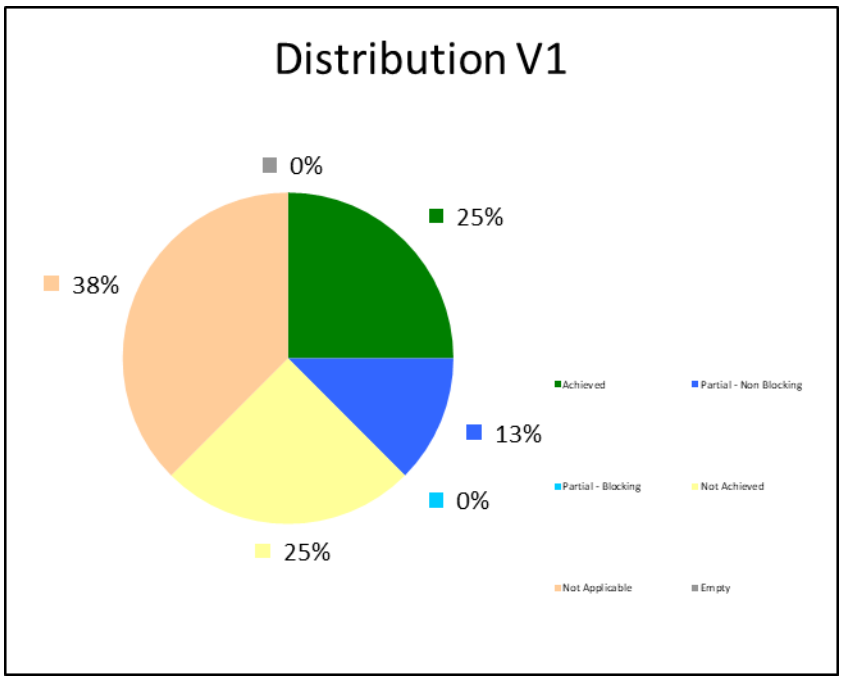
Appendix B Additional Material

B.1 Final Project maturity self-assessment



Conclusion: Majority of V2 criteria achieved. No blocking points, **V2 maturity reached.**





Conclusion: Majority of V1 criteria are achieved or partially achieved, but further work still required to be done. No blocking points have been identified. The MHZ concept has been developed significantly in the wave 1 given limited resources and ambitions on the programme level. Not much effort would be required to mature it to full V1 (especially that lot of non-critical criteria are fulfilled already).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