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SESAR Solution PJ.07-W2-39 Contextual Note V3

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Copyright Statement

PJ07-W2-39 OAUO

OPTIMISED AIRSPACE USERS OPERATIONS

This Contextual Note is part of a project that has received funding from the SESAR3 Joint Undertaking under grant agreement No 874465 under European Union's Horizon 2020 research and innovation programme.

Abstract

This V3 contextual note provides SESAR Solution description for industrial consideration.

The document presents a summary of the work done for PJ.07-W2-39 (Collaborative framework for managing arrival delay within an ATFM regulation), pertaining to OI step AUO-0110. It gives a brief overview of the Solution, the main operational and performance benefits, relevant system impacts and recommends additional activities needed prior to implementation. This contextual note complements the Solution's Data Pack.

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1 Purpose

This contextual note provides to any interested reader (external and internal to the SESAR programme) an introduction to the SESAR Solution PJ.07-W2-39, 'Collaborative framework for managing arrival delay within an ATFM regulation', in terms of scope, main operational and performance benefits and relevant system impacts. It also recommends additional activities needed prior to implementation.

The document describes additional activities to be conducted during the industrialization phase or as part of deployment. Furthermore, it introduces the technical data pack comprising the SESAR JU deliverables to support industrialization/deployment.

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2 Improvements in Air Traffic Management (ATM)

This Solution introduces a framework for single point of entry for AUs to provide prioritisations for their flights in a harmonised format that will allow the Network Manager (NM) to use these prioritisations for arrival air traffic flow management (ATFM) regulations. This Solution greatly extends the ability of an AU to influence the sequence of arrivals for regulated flights in the pre-departure phase.

2.1 Relevant Operational Environments

Solution 39 is expected to affect the following operational environments:

- **Very Large Airport** environment (>250k movements per year)
- **Large Airport** environment (>=150k and < 250k movements per year[1])

Although the Solution acts upon Arrival regulations, the Network Manager Operations Centre and the local demand-capacity balancing (DCB) actor will be using the Solution.

The Solution could potentially provide a benefit to arrival ATFM regulations for smaller airports too.

2.2 Expected Impacts

The following three figures show the latest understanding of the benefits and impacts brought by the Solution. For a more detailed description refer to the OSED[2].

For participating AUs, the expectation is reduced costs of delay, but more workload for dispatchers. However, AUs can choose whether to take part or not, and if they choose not to take part the impacts will be different to today.

For Local DCB / Airports, there is a minor increase in workload (although evidence from validation indicates that this is manageable).

For the Network Manager, there is no expected impact at the level of the network, and an increase in workload (although evidence from validation indicates that this is manageable).

[1] Definition taken from 'PJ19-W2: Validation Targets - SESAR2020 Wave 2 & Wave 3', edition 00.01.00, 4th May 2021.
[2] 'SESAR Solution 39 OSED-SPR-INTEROP for V3 - Part I', edition 00.07.06, 10/02/2023.

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3 Operational Improvement Steps (OIs) & Enablers

Here is a description of the Solution's operational improvement step and its associated enablers:

OI Step code	OI Step title	OI Step coverage
AUO-0110	Collaborative framework for managing arrival constraints at Local DCB level	Full
In case of arrival Network constraints in the planning phase, a set of collaborative DCB resolution procedures and decision support tools will be required, to ensure reconciliation of local DCB measures with Airport collaborative decision making (CDM) and Network Management process. These procedures may include the allocation of computer-aided slot algorithm (CASA) regulations or means of directly managing arrival flights combined with the User Driven Prioritization Process (UDPP) into the overall reconciliation process, also in case of multiple constraints. Expected benefits would include coherency between the different processes, enhanced predictability from common usage of most up-to-date flight data by all users, and reduced impact of delays on AU operations.		
Enabler Code	Title	Coverage
AOC-ATM-18	Flight Operations Centre (FOC) adaptation to support UDPP	Develop; required
NIMS-44	Evolution of Network Information Management System (NIMS) to support management of UDPP, inclusion of user preferences and priority as part of SBT	Develop; required
NIMS-46	Integrated local DCB working position	Use; required
NIMS-46b	Interface to the integrated local DCB working position	Develop; required

Table 1: A description of the Solution's operational improvement step and its associated enablers.

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4 Background and validation process

Solution PJ07-W2-39 develops a collaborative framework that will enable the integration and necessary coordination of constraints (limited to arrivals management) among various stakeholders (Airports, ANSPs, AUs and NM). This will ensure continued stability and performance of the network and will give the opportunity to the Airspace Users to prioritize their flights, thereby reducing the impact of the delays generated by the ATFM planning constraints and to limit the additional costs on their operations. In this framework, the AUs may contribute to a demand-capacity balancing (DCB) solution so that their operational performance interests are best served.

The main objective of the Solution is to define and validate a collaborative framework for the coordination and collaboration among different ATFM processes (including UDPP), dealing with delay constraints on arrivals (considered the most important contributor to capacity performance issues).

This Solution:

- Addresses the need for harmonisation at European level of arrival prioritisation processes (managed by local DCB) in pre-flight phase; and
- Focuses on more integrated Network/Airport processes, beyond the current integration of airport and network operational plans (AOP, NOP) that relies on simple data exchange.

Two main validation activities were organised and run for V3 for this Solution:

Title	Brief Description

Table 2: Validation activities for this Solution.

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5 Results and performance achievements

Validation has demonstrated operational and technical feasibility at V3 maturity level.

Validation activities indicate the following performance impacts from the Solution (a missing key performance area means there no impact was detected and/or expected):

- **Punctuality (PUN1 and PUN5[3]):** the table below summarises the results from the validation exercise (second column: SWISS at Zurich airport), and by extrapolating the validation results obtain estimates of the ECAC-wide impact on punctuality. The fast-time simulation with RNEST showed negligible impacts on departure punctuality.

Performance Indicator	Zurich/SWISS 2019	ECAC 2019	ECAC 2035
PUN1 (The average departure delay per flight)	0.056 mins/flight improvement[4]	0.0285 mins/flight improvement	0.025 mins/flight improvement
PUN5 (The percentage of flights departing within +/- 15 minutes of the SOBT)	0.42 percentage-point improvement	0.21 percentage-point improvement	0.19 percentage-point improvement

Table 3: The Solution's estimated impact on punctuality.

The very modest impact on punctuality was expected because the purpose, and therefore the main impact, of the Solution is to improve AU cost efficiency.

- **AU Cost Efficiency:** the 'Airspace User Cost Efficiency' focus area is relevant to Solution 39:
  - **Reactionary delay (AUC1):** reactionary delays for the full sequence of rotations were not measured due to the experimental designs of the exercises. Whether AUs employ the Solution's concept to reduce operational costs of delay or to improve punctuality, a reduction of reactionary delay is likely;
  - **Sequence optimisation benefit (AUC2)[5]:** For a set of prioritisations for an AU, sometimes what appeared would lead to a cost saving in fact turned out to be a cost increase. On average, however, the reduction of delay cost was about 15%. Scaled up to ECAC for 2019, the cost reduction was about 7%. (See the following bullet for an explanation of how these two percentages were obtained.)

[3] PUN1, PUN5 and other key performance indicator codes are described in 'PJ19.04: Performance Framework (2019)', edition 01.00.01, 30th November 2019.

[4] Calculated for all flights operated by SWISS, (i.e., *not* per UDPP prioritised flight); this was recorded in the Zurich human-in-the-loop simulation.

[5] This KPI is better suited to measuring classical slot swaps, that is, when two flights swap positions in an ATFCM regulation.

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- **Direct Operating Costs (AUC3):** In the human-in-the-loop simulation with SWISS, a 10% reduction in direct operating costs was achieved (measured by comparing the pre-Baseline and post-Submit data snapshots in the Solution scenario). When scaling up to include all potential AUs at the 32 'large' and 'very large' for 2019, the benefit is a 5% reduction of excess cost[6].
- For the fast-time simulation using RNEST, there was mixed picture of estimated cost impacts on AUs, which depended on the scenario.

- **Flexibility:** validation activities show that 30 minutes for the arrival optimisation period (AOP) appears to be an acceptable trade-off between AU and L-DCB flexibility for their respective interventions.
- **Safety:** there is no significant difference between baseline and Solution scenarios in terms of entry and occupancy counts for the traffic volumes that were investigated, meaning that the stability of the network is not expected to be compromised.
- **Human Performance:**
  - The new operating methods introduce changes in coordination and possibly delegation of responsibilities between all actors including NM, APT and L-DCB (L means local). Actors agreed that the roles and responsibilities were generally clearalthough there was also feedback – primarily from L-DCB actors – that certain parts of roles and responsibilities might need more clarification prior to deployment. **(HP1)**
  - Actors confirmed that the complexity of their tasks with the new operating method was either lower or remained unchanged. In parallel, they confirmed that the workload remained within acceptable limits. The likelihood of error thus should not be increased. **(HP2)**
  - Actors confirmed that the workload remained within acceptable limits, although it would be useful to confirm this with a larger sample of airport actors. AU feedback said that workload would depend on the system support and degree of automation in the 'prioritisation phase'. For instance, supporting automation facilities in the FOC tools would be highly desirable, such as automatic computation and assignment of UDPP inputs based on a range of customisable objectives. **(HP3)**

[6] There are several assumptions in this scaling calculation, which can be summarised as: the major AUs at the 32 other airports will experience similar benefits to Swiss at Zurich. The calculation relates to traffic in 2019; in 2035 (the timeframe for the CBA), more airports could qualify as large or very large, and there could more major AUs, so the 5.3% figure could increase accordingly.

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6 Recommendations and Additional activities

This solution has generated the following recommendations for post V3:

- Decide whether all the UDPP margins provided by AUs (time not after (TNA), time not before (TNB)) are associated with arrivals or departures. The alignment/harmonisation is essential for the correct application of the concept in the operational environment, including the interoperability of systems;
- An AU may be implicated in more than one UDPP measure, so a decision is required to either insist on a unique set of priority numbers for all the flights involved in these UDPP measures (the “absolute approach”), or to insist that the priorities in one UDPP measure are independent of those in another (“relative approach”). It is important to choose which approach to adopt before proceeding with further validation/development activities.
- Decide whether the UDPP service should treat each AU’s submission of UDPP priorities as incremental changes, or as a full rewrite over any previous submissions.
- Run live trials with a limited scope in terms of AU involvement, focusing on AUs with advanced system support for UDPP and with good understanding of UDPP mechanisms. Such trials would require the transfer of UDPP service from the NMVP validation platform to the operations part of NM systems, to be able to use the full suite of functionalities in operations. The main objectives of these trials would be to confirm the benefits quantified and obtained, and expand these wherever applicable, e.g., observe and quantify key metrics at the end of the operational day to confirm the benefits such as airport curfew breach avoidance stemming from UDPP interventions on CCS earlier in the day. Good and clear operational procedures will be required, which should be developed from the experiences of the procedures used in the Zurich exercise. The two previous bullets should be seen as prerequisites for this recommendation.
- Although the roles and responsibilities were generally clear, certain parts might need more clarification prior to deployment. The live trials in the previous recommendation provide this opportunity.
- clarify the concept for AUO-0109 to further progress the convergence of this UDPP concept with the use of cherry-pick measures. Emphasis should be put on equity aspects in specific operational situations. This recommendation is greyed out because it concerns OI step AUO-0109, which was removed from the Solution in December 2022 due to its immaturity. However, it is listed here because it is an important recommendation if this OI step is to be further matured. The next step would be to define again the benefits of this OI step and quantify them prior to deciding whether or not to continue working on it.
- There are no recommendations for updating the ATM Master Plan Level 2 or for regulation and standardisation.
- Solution 39 has significant conceptual links with Solution 38 for the expression of AU priorities, and with Solution 44 on aspects related to the management of hotspots by local flow managers. These solutions conducted V3 validation activities independently of each other. In

the E-OCVM's V4 phase (industrialisation) it will be important to clarify some procedures and interrelationships, in particular to:

- refine procedures and the requirements for AU systems for AUs to express their priorities using UPPP and FDCI (Flight Delay Criticality Indicator) in a complementary and optimal way;
- refine procedures and the requirements for local DCB systems related to the management of an AU's priority flights (including UDPP and FDCI) within the context of hotspot management processes.

The proposal is to implement a SESAR Digital Sky Demonstrator (DSD) specifically for the DCB area. The DSD will serve as a simulation platform that will bring together different tools and systems including (at least) traffic flow management, flight planning and AU fleet management systems.

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7 Actors impacted by the SESAR Solution

The following actors affected by the Solution are the:

- **AUs**, by being able to express the priorities of their flights caught up in capacity constrained situations (via SFP – selective flight protection, and FDR – Fleet Delay Reordering) and constraints (via margins of manoeuvre). AUs are the most affected, and have most to gain, but participation will be optional.
- **Local DCB / Airports**, by creating and activating the arrival regulation, and by monitoring the capacity-constrained situation in case it requires modification.
- **Network Manager**, by taking account of the priorities and constraints of the AUs as well as it is able when assigning delay in arrival regulations.

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8 Impact on Aircraft System

No impact on aircraft systems is currently foreseen.

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9 Impact on Ground Systems

Collaborative DCB resolution decision support tools will be required to ensure reconciliation of local DCB measures with Airport CDM and Network Management process. These needs/impacts are expressed via the Solution's enablers:

Flight Operations Centre (FOC) System

System supporting UDPP integrated within FOC systems to support an AU's prioritisation processes in collaboration with the other ATM stakeholders. (Enabler: AOC-ATM-18)

Local Flow Management System

Integrated local DCB working position with improved situation awareness need to be developed for better identification and integration of local measures (including the link to ATC and Airports) and the interface with regional NM for coordinated 4D constraints management. (Enabler: NIMS-46)

An interface to the integrated local DCB working position with improved situation awareness for better identification and integration of local measures (including the link to airports and airlines). The Integrated Local DCB working position is to be developed by NIMS-46; this Enabler therefore provides the interface to the said working position. (Enabler: NIMS-46b)

NM System

System supporting UDPP integrated with DCB systems to consider an AU's preferences and priorities in the DCB activity, in particular 'Flight Priority within Fleet/Operator Priority'. (Enabler: NIMS-44)

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10 Regulatory Framework Considerations

Current NM ATFCM standards and regulations are applicable for this Solution.

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11 Standardization Framework Considerations

Current NM ATFCM standards and regulations are applicable for this Solution.

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12 Solution Data pack

The Data pack for this Solution includes the following documents:

Document Type	Name	Edition	Edition Date
Operational Specifications (OSED)	**D3.1.008 – PJ.07-W2-39-V3 – Final OSED/SPR – Part I** SESAR Solution 39 OSED-SPR-INTEROP for V3 - Part I	00.07.08	07/04/2023
	D3.1.008 – PJ.07-W2-39-V3 – Final OSED/SPR – Part II SESAR Solution 39 SPR-INTEROP/OSED for V3 - Part II - Safety Assessment Report	00.01.00	09/02/2023
	D3.1.008 – PJ.07-W2-39-V3 – Final OSED/SPR – Part IV SESAR 2020 Solution 39 OSED-SPR-INTEROP for V3 - Part IV - Human Performance Assessment Report	00.01.00	31/01/2023
	D3.1.008 – PJ.07-W2-39-V3 – Final OSED/SPR – Part V SESAR Solution PJ.07-W2-39 SPR-INTEROP/OSED for V3 - Part V - Performance Assessment Report (PAR)	00.01.01	03/05/2023
Technical Specifications (TS/IRS)	**D3.1.009 – PJ.07-W2-39 - V3 - Final TS/IRS** SESAR Solution 39 - TS_IRS	04.04	07/04/2023
Validation Report for V3	**D3.1.010 – PJ.07-W2-39-V3 – Final VALR** SESAR 2020 VALR for PJ07-W2 Solution 39	00.01.03	06/04/2023
Cost-Benefit Analysis	**D3.1.011 - PJ.07-W2-39-V3 – CBA** SESAR Solution 39: Cost Benefit Analysis (CBA) For V3 *TO BE UPDATED TO ADDRESS COMMENTS FROM THE SJU*	01.01.03	11/05/2023
Contextual Note	**D3.1.012 – PJ.07-W2-39-V3 – Contextual Note** SESAR Solution PJ.07-W2-39-V3 Contextual Note	See front cover	

The **Operational Specifications (OSED)** provides a description of the concept and provides the operational and performance requirements. The **Technical Specifications (TS/IRS)** provides the technical architecture and specifications, covering functional, and non-functional requirements related to the SESAR Solution. The **Validation Report (VALR)** provides the results, conclusions and recommendations of the validation activities for the SESAR Solution. The **Cost Benefit Analysis (CBA)** provides the cost-benefit analysis for SESAR solution.

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