

Contextual note
SESAR Solution PJ.02-08-02 and SORT VLD 3
WP5

“Traffic optimisation on single and multiple runway airports”

Purpose:

This contextual note introduces the SESAR SORT VLD3 WP5 IRSF including Solution PJ02-08-02 (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)

This Contextual Note is focusing on solution PJ02-08-02 “Traffic optimisation on single and multiple runway airports”.

Solution PJ.02-08-02 “Optimised use of runway configuration for multiple runway airports” focuses on the planning for optimised use of runway capacity, for the Tower Supervisor to determine the optimal runway configuration and distribution of demand according to capacity and local constraints.

During the Medium/Short term Planning Phase, the runway management checks the intentional demand versus the available capacity and it is capable of forecasting imbalances, raising alarms and alerts based on the indicators provided.

In the Execution Phase, the Integrated Runway Sequence Management monitors departure, arrival and overall delay and punctuality, in addition to the capacity shortage proposing changes if necessary. Since the demand is continuously evolving along time, the runway management continuously computes the optimal runway configuration and the associated Target Landing Times (TLDT) and Target Take off Times (TTOT) of arrival and departures flights that maximises the runway throughput.

The combination of the Runway Management (TS-0313) and the Integrated Runway Sequence Management (TS-0301) has the aim of improving the punctuality of flights and reducing flight duration and average delay.

As a conclusion TLDT and TTOT calculated by the Integrated Runway Sequence Management follows the Airport DCB Plan allowing the feedback to the runway management to monitor the status of the runway and to detect possible imbalances.

Operational Improvement Steps (OIs) & Enablers

The following tables present the Operational Improvement (OI) step for Solution PJ.02-08-02 “Optimised use of runway configuration for multiple runway airports”, including the description and coverage.

The relevant Enablers, both required and optional are listed below.

Applicable Integrated Roadmap Dataset is DS20.

OI Step code	OI Step title	OI Step coverage
TS-0313	Optimized Use of Runway Capacity for Multiple Runway Airports	Fully
<p>The controller of a multiple runway airport is provided with decision support tools enhanced to allow runway capacity optimization from planning phase throughout the day of operations, improving predictability on airport operations.</p>		

Required Enablers

AERODROME-ATC-74 “Runway Demand and Capacity system enhanced for multiple runway airport”

APP-ATC-164 “APP ATC System adapted to support integrated arrival/departure sequence functionalities in ATCOs HMI”

Optional Enablers;

SWIM-APS-12a “Provision and Consumption of general information for air traffic management using SWIM”

Background and validation process

PJ02-08-02 has been validated through a series of activities including real-time and fast-time simulations.

PJ02-08-02 reached the V2 maturity level through a validation performed by Indra: Real-time simulation in Barcelona–El Prat Airport on Integrated Runway Sequence supported by Airport DCB monitoring, due to its Very Large Airport category and its surface layout with multiple runways. management tool (RMAN). The simulation focused on analysing the impact of the combination aspects between the use of an Integrated Runway Sequence and the use of RMAN.

For the V3 phase, a Real Time simulation has been carried out by Indra:

- Runway optimisation by using a runway planning tool (RMAN) integrated into the arrival and departure management.

The validation addressed a set of objectives such as proving the technical feasibility of the integration of RMAN into the Integrated Runway Sequence Function, as well as assessing the impact in the Punctuality, average delay, Fuel Efficiency and Predictability.

In 2022, SESAR VLD3-W2-SORT large scale demonstration the Integrated Runway Sequence Function (IRSF) including runway management was demonstrated with live traffic in a shadow-mode setup at Stockholm Arlanda airport. Feedback from air traffic controllers confirmed the value of increased awareness with early planning of an integrated runway sequence, including new functions to update the plan progressively based on real time flight events. Safety and human performance areas were addressed where the air traffic controllers confirmed the concept of integrated runway sequence with the ability to handle the balance between predictability, flexibility, and stability, while meeting requirements for operational acceptability.

The main goal for the IRSF with runway management is to establish the best possible integrated arrival and departure sequence with flexible runway allocation, by providing accurate target take-off times and target landing times, including dynamic balancing of arrivals and departures. The integrated runway sequence is planned before the arrival flight's top of descent and synchronized with progress of departure flights, by use of the A-CDM. Fine tuning of arrival and departure target times is provided to ensure efficient runway throughput.

Results and performance achievements

The main findings from PJ02-08-02 validation exercises can be summarised as follows:

- Integration between RMAN and Integrated Runway Sequence Function is technically and operationally feasible. Information calculated by RMAN updates the sequence and is shown properly in the HMI.
- A stable and reliable arrival/departure sequence is produced.
- Average delay is reduced due to the RMAN optimising take-off and landing times taking advantage of gaps in the sequence that would have been missed otherwise.
- The average delay reduction leads to an increase of the Punctuality. A more efficient sequence is followed by the ATCOs.
- Average flight time is reduced on the Arrivals side, since the Forecasted Landing Times (FLDT) proposed by the RMAN take advantage of free gaps in the sequence.
- Time spent on ground by aircrafts is maintained, considering that the baseline scenario is the Integrated Runway Sequence Function, which already optimises the TSAT based on the TTOT and therefore the time spent on ground.
- In nominal situation, Predictability can decrease as a trade-off between KPAs, since times get more scattered due to the introduction of RMAN.

The main findings from SESAR VLD3-W2-SORT large-scale demonstration can be summarised as follows:

- Integration between Integrated Runway Sequence Function and runway management is technically and operationally feasible when introduced with live traffic at Stockholm Arlanda airport.
- The SESAR large scale demonstration confirmed the ability to increase runway throughput by early and enhanced planning, applicable both in single runway operations, dependent runways and when using the two parallel runways in mixed mode.

- IRSF with runway management was able to identify and allocate a number of landings on the departure runway, thereby with a potential increase of the airport capacity.
- The use of an IRSF with runway management provided valuable support to enable an increase in the number of planned and assigned curved approaches, particularly when used together with performance-based navigation.

Recommendations and Additional activities

The following PJ02-08-02 V3 activities are relevant once transitioned to industrialization (V4):

- Consider the integration of the RMAN with an Extended AMAN with the purpose of making the most of Forecasted times and compute TTG or TTL at an early stage. Flights departing from an airport within E-AMAN horizon could be delayed on ground, which would boost Fuel Efficiency benefits.
- Analyse means to avoid a scattered (less predictable) situation, such as limiting the amount of minutes that the proposed FTOT and FLDT can differ from the original TTOT and TLDT. Assess the optimal trade-off between Predictability figures and the rest of KPAs when looking at the whole picture (positive figures regarding Punctuality, Fuel Efficiency, average delay).
- Training for the Tower Supervisor regarding the use and understanding of RMAN is recommended.
- It is assumed that this concept builds upon the Integrated Runway Sequence Function (Concept 1), hence the latter must be implemented prior to the deployment of Concept 2.

The overall positive result of the CBA supports the decision of proceeding with the concept.

The following SESAR VLD3-W2-SORT (TRL7) large-scale recommendations can be summarised as follows:

- IRSF can when combined with runway management provide optimised use of available runways.
- With early planning there are options to propose and allocate curved approaches.
- Locally defined Airport and ATC prioritisation strategies can be set in view of different objectives per KPA/KPI depending on the traffic and the time of the day.

Actors impacted by the SESAR Solution

Actors involved in the operations are;

- Aerodrome ATS
 - TWR Runway Controller
 - TWR Ground Controller
 - TWR Clearance Delivery
 - TWR Supervisor
- En Route/Approach ATS
 - Executive Controller ACC/APP
 - Planning Controller
 - Approach Coordinator
- Flight Deck

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- Pilots (indirectly)
- Airspace Users OPS support

Impact on Aircraft System

No impact on Aircraft System identified.

Impact on Ground Systems

To support ATC with an overview of the integrated runway sequence an appropriate HMI presenting the integrated runway sequence order for both arrivals and departures will be provided. This HMI will provide to each ATC role the relevant information on the integrated runway sequence. This HMI may include support functions to enhance awareness and increase controller ability to comply with a predefined integrated runway sequence.

These support/HMI functions can be used according to local ATC preferences.

A specific HMI for the RMAN will be provided as well to support ATC by both displaying information and receiving manual inputs.

RMAN requires access to demand data in order to be able to detect imbalances and calculate fine-tuned times so as to optimise the arrival/departure sequence.

Main functional implementation option is:

- RMAN together with Integrated Runway Sequence function.

RMAN is integrated into the Integrated Runway Sequence Function, which requires data connections between them.

To handle different operational environments implementation can cover TWR, APP and ER or cover TWR and APP.

Regulatory Framework Considerations

None.

Standardization Framework Considerations

Applicable standard:

Standard Name	Standard Description	Comment
EUROCAE ED-141 Airport-CDM Technical	Minimum Technical Specification for Airport-CDM	Existing standard.

Considerations of Regulatory Oversight and Certification Activities

None.

Solution Data pack

The SESAR SORT VLD3 WP5 Data pack includes the following documents;

- D5.1-Availability Note
 - D5.1 SESAR 2020 VLD03-004 EXE-VLD-03-004 Availability Note v00.01.01
- D1.1.0.4-DEMOP-VLD3-W2
 - Part I – D1.1.0.4Edition 00.03.00 (10/02/2023)
 - Part II – D1.1.0.4Edition 00.03.00 (10/02/2023)Safety Assessment Plan
 - Part III – D1.1.0.4Edition 00.03.00 (10/02/2023)Human Performance assessment Plan
 - Part IV – D1.1.0.4Edition 00.03.00 (10/02/2023) Environmental Assessment Plan
 - Part V – D1.1.0.4Edition 00.03.00 (10/02/2023) Performance Assessment Plan
- D1.4-DEMOR-VLD3-W2
 - Part I – D1.4 Edition 00.02.00 (17/04/2023)
 - Part II – D1.4 Edition 00.02.00 (17/04/2023) Safety Assessment Report
 - Part III – D1.4 Edition 00.02.00 (17/04/2023) Human Performance assessment Report
 - Part IV – D1.4 Edition 00.02.00 (17/04/2023) Environmental Assessment Report
 - Part V – D1.4 Edition 00.02.00 (17/04/2023) Performance Assessment Report

The V3 Data pack for this Solution includes the following documents:

- V3 SPR/INTEROP/OSD Part I – D6.1.203 Edition 00.01.00 (26.07.2019). The document provides contextual information, concept description and safety, performance and interoperability requirements.
 - Part II – Safety Assessment Report, SAR
 - Part IV – HP Assessment Report, HPAR
 - Part V – Performance Assessment Report, PAR
- V3 TS/IRS – D6.1.214 Edition 00.02.00 (11.09.2019). This document refines the functional analysis of the combination of the Integrated Runway Sequence Function and RMAN, as well as the rest of the Concepts that make up the Solution. Functional, non-Functional, Safety and Security requirements are included;
- V3 CBA – D6.1.243 Edition 00.02.00 (11.09.2019). This document provides the Cost Benefit Analysis.

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