

Contextual note – SESAR Solution PJ.02-08-02

“Optimised use of runway configuration for multiple runway airports”

Purpose:

This contextual note introduces the SESAR Solution PJ.02-08-02 “Optimised use of runway configuration for multiple runway airports” (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)

Solution PJ.02-08-02 “Optimised use of runway configuration for multiple runway airports” focuses on the Runway Manager (RMAN), a support tool 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 RMAN tool 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 Runway Management tool 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 RMAN continuously computes the optimal runway configuration and the associated Forecasted Landing (FLDT) and Take Off (FTOT) Times of arrival and departures flights that maximises the runway throughput.

As described before, in the same phase, the Integrated Runway Sequence function calculates Target Landing and Take-Off Times based on the flight plan information and considering the active runways.

The combination of the Runway Manager and the Integrated Runway Sequence (TS-0313) has the aim of improving the punctuality of flights and reducing flight duration and average delay. The Forecasted Times calculated by the RMAN are provided to the Integrated Runway Sequence using them to calculate the final Target Times.

As a conclusion TLDT and TTOT calculated by the Integrated Sequence follows the Runway DCB Plan allowing the feedback to the RMAN 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.

<table>
<thead>
<tr>
<th>OI Step code</th>
<th>OI Step title</th>
<th>OI Step coverage</th>
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<tbody>
<tr>
<td>TS-0313</td>
<td>Optimized Use of Runway Capacity for Multiple Runway Airports</td>
<td>Fully</td>
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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.

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

In SESAR 1, two ways to build an integrated runway sequence were validated compared to a reference scenario that considered the use of non-coupled standalone AMAN and standalone DMAN:

- Step 1 (covered by SESAR 1 solution #54): pattern-based coupling, with AMAN as a master of the sequence. This achieved V3 in SESAR 1.
- Step 2: dynamic coupling to achieve a trajectory based integrated runway sequence.

As documented in the SESAR 1 Step 2 final OSED the assumption was that the coupled AMAN-DMAN covered by solution #54 was not a reference scenario for Step 2. This assumption has been kept in Wave 1 and it is still applicable for solution PJ.02-08-02.

The SESAR Solution has been validated through a series of activities including real-time and fast-time simulations.
Solution PJ.02-08-02 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 and 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.

Also in SESAR1, V3 validation activities were performed on RMAN as part of the “Airport Demand Capacity Balancing” concept in OFA 05.01.01, focusing on Runway Management and less detailed Taxiways and TMA. The RMAN (A-DCB prototype) was tested and the analysis showed that most of the Validation Objectives were met. The airport DCB experts present observed the RMAN’s performance and assessed the key functionalities.

During the validation, the Tower Supervisor outlined the runway configurations that best coped with the expected demand, and the results were compared with the plan proposed by the RMAN. The RMAN solution resulted in fewer periods containing a shortage, the average delay being reduced and the punctuality improved.

Besides, the Tower Supervisor could consult the optimal schedule, the most optimal point in time for a runway closure and the comparison between different runway combinations using the ‘what-if’ mode.

Due to the stated above, the RMAN has been considered operationally validated and the work in Wave 1 focused on the integration between Integrated Runway Sequence Function and RMAN (solution PJ.02-08-02).

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.

The scenario was again Barcelona–El Prat Airport, due to its Very Large Airport category and its surface layout with multiple runways.

### Results and performance achievements

The main findings from the overall 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. This is due to the extension of the planning horizon along with the provision of a pre-sequence by the RMAN to the Integrated Runway sequence function.
The average delay reduction per flight leads to an increase of the Punctuality. A more efficient sequence is followed by the ATCOs.

The abovementioned delay reduction contributes as well to an increase of Airport Capacity.

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. This worsens Predictability KPA as defined in SESAR, because the variance of average delay is increased. The update and optimisation of TTOT and TLDT increases Punctuality, reduces delays but leads to a less predictable situation.

**Recommendations and Additional activities**

The following 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 (solution PJ.02-08-01), hence the latter must be implemented prior to the deployment of solution PJ.02-08-02.

The overall positive result of the CBA supports the decision of proceeding with the concept for industrialization and deployment.

**Actors impacted by the SESAR Solution**

Actors involved in the operations are:

- Aerodrome ATS
  - TWR Runway Controller
  - TWR Ground Controller
  - TWR Clearance Delivery
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:
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<th>Standard Name</th>
<th>Standard Description</th>
<th>Comment</th>
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**Considerations of Regulatory Oversight and Certification Activities**

None.

**Solution Data pack**

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

- V3 SPR-INTEROP/OSED
  - Part I – D6.1.20 Edition 00.03.00 (31/01/2020)
  - Part II – D6.1.20, Edition 00.04.00 (31/01/2020), Safety Assessment Report
  - Part IV – D6.1.20, Edition 00.03.00 (08/11/2019), Human Performance Assessment Report
  - Part V – D6.1.20, Edition 00.03.00 (08/11/2019), Performance Assessment Report
- V3 TS/IRS, D6.1.21, Edition 00.04.00 (17/01/2020)
- V3 VALR, D6.1.23, Edition 00.04.00 (31/01/2020)
- V3 CBA, D6.1.24, Edition 00.03.00 (08/11/2019)

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