Contextual note – SESAR Solution PJ.02-08-03 "Reduced separation based on local Runway Occupancy Time characterisation"

Purpose:

This contextual note introduces the SESAR Solution PJ.02-08-03 (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 PJ.02-08-03 "Reduced separation based on local Runway Occupancy Time characterisation".

The Increased Runway Throughput based on local ROT characterization is a concept that intends to reduce the in-trail separation on final approach with the aim of increasing runway throughput by taking into account the Runway Occupancy Time (ROT). The most constraining factor for the reduction of the separation is, together with the wake turbulence, the ROT; and therefore a new separation minimum could be computed based on the prediction of the ROT, the MRS and the wake categorization separation

The operational application can be based either per aircraft type or per aircraft ROT-based category (ROCAT).

ROCAT defines separation sub-categories based on runway occupancy time, wake minima from RECAT and reduced radar separation based on ICAO approved minima. The solution can increase runway throughput by up to 12% where the aircraft traffic mix is predominantly medium aircraft, and the constraint for separation between medium aircraft is the ROT rather than the Minimum Wake Separation (MWS). Rather than making the same assumption on ROT for all aircraft (which would necessarily need to consider as a constraint the highest observed ROT values and result in higher separation minima), the enhanced ROT prediction based on local Runway Occupancy Time characterisation allows that different ROT assumptions for different aircraft be made, so that for leading aircraft with lower ROT the separation minima can be lower.

The solution consists on developing the runway occupancy minima through big data analytics to identify a runway occupancy time per aircraft type using machine learning techniques and historical data.

The separation minima can be delivered by ATC through a change in the separation minima used by controllers separating aircraft on final approach through a controller decision support tool called ORD (Optimised Runway Delivery).

Operational Improvement Steps (OIs) & Enablers

For this concept, the coverage of the following OI is full:

- AO-0337: Increased Runway Throughput based on local ROT characterization Applicable Integrated Roadmap Dataset is DS21.

The following enablers are required for solution PJ.02-08-03:

- AERODROME-ATC-55: Aerodrome ATC System to support Optimised Runway Delivery on Final Approach based on Aircraft ROT categorization
- APP ATC 169: Approach ATC System to support Optimised Runway Delivery on Approach based on Aircraft ROT categorization
- STD 094: EUROCONTROL Guidelines for reduced aircraft separation based on runway occupancy time.

The solution PJ.02-08-03 “Reduced separation based on local Runway Occupancy Time characterisation” targets High density Final approach and very large airport, the reduction of the separation based on ROT supposes that the airport is equipped with an A-SMGCS system.

Background and validation process

The SESAR Solution has been validated through a Real Time Simulation (RTS) using a Very Large Airport focusing on a range of objectives such as the operational feasibility, the acceptability of the tool by ATCOs, safety, human performance and the capacity.
The RTS Assessed the Enhanced Prediction of Runway Occupancy Time based on aircraft type integrated in a separation delivery function (the ORD tool) using Very Large airport and high-density approach environment.
The objective was to assess the benefits brought by the enhanced prediction of the ROT in various contexts with RECAT-EU and Time Based Separation-Pair Wise Separation and reducing Minimum Radar Separation to 2.5 NM.

Results and performance achievements

The validation showed that the use of the ORD tool with the solution (based on ROCAT) and a wake vortex pairwise separation scheme (per aircraft type) was operationally feasible and acceptable in segregated runway operations.

In addition to the following benefits:

- Arrival runway throughput increased by between 10-14% with compared to a baseline scenario of current Zurich operations (Zurich 5 category wake scheme, 3NM MRS and no tool support), and
- Safety benefits were observed as controller performance improved with fewer separation infringements and missed approaches.
- Controller workload was reduced (even though more aircraft were handled by the controllers per hour).

Recommendations and Additional activities

The following recommendation are made concerning the implementation solution PJ.02-08-03 “Reduced separation based on local Runway Occupancy Time characterisation” i.e. V4 / V5 activities:

- The validation used wind characterisation that did not include a wind parameter, and therefore correspond to a ROT prediction based on a study of the distribution across all wind conditions. In the V4 phase, it is recommended that a study be conducted to identify if there are certain wind conditions (outliars) in which the ROT may increase so as to require an extra buffer to be added to the ROT value in order to reduce the risk of go-arounds due to runway not vacated.
- The validations of the solution considered an environment where MRS was 2.5NM; however, SESAR PJ02 validated in parallel a solution allowing MRS on final approach to be reduced to 2NM (solution PJ.02-03). The solution is equally applicable in an environment where 2NM is the MRS; moreover, with a lower MRS, there are higher chances that the ROT is the constraining factor, and therefore the solution can be expected to produce more benefits.
- The ROT concept has been validated with ATCOs having the Optimised Runway Delivery (ORD) tool, which supports them in the accuracy for delivering aircraft to the minimum applicable separation on final approach. This tool (solution PJ.02-01-01) has been validated in parallel to the solution PJ.02-08-03; for more information about this tool, the reader should refer to the PJ.02-01 data pack.
- It is recommended that in the V4 phase the colour-coding of the ORD indicators be investigated; different colours would be used to display different constraints: the ROT, WT or MRS to support the ATCO situational awareness (applicable to FTD and ITD/ORD tools).
- To be able to work with the tool confidently and comfortably controllers need to have sufficient training and time to familiarise themselves with the tool and the changes in working methods that result from working with both the FTD and ITD/ORD tool, prior to implementation.
- To increase the confidence in the results obtained with the TB PWS for arrival concept with ITD/ORD with PJ.02-08-03 it is recommended to conduct alternative studies. Further studies could consider different traffic samples / increase the variety of aircraft pairs or different runway configurations. Additionally use of different validation techniques such as fast time simulation is also recommended to increase the reliability of the results.
- Finally, the legal aspect of responsibility in case of a loss of separation due to the FTD and /or ITD/ORD tool miscalculation needs to be addressed prior to implementation. The legal framework describing clearly the roles and responsibilities between controllers, air traffic service providers and tool developers need to be produced before the implementation into an operational environment.

Actors impacted by the SESAR Solution

Tower and TMA Controllers.

Impact on Aircraft System

No Impact

Impact on Ground Systems

The solution considers the use of a support tool for the controller to display Indicators for separation; the tool can be enhanced by a precise wind nowcast.

Regulatory Framework Considerations

The local safety regulator would need to define what reduced separations are safe / acceptable for the environment where the solution will be implemented.

Standardization Framework Considerations

EUROCONTROL is working on specification document for the solution, the document is to be considered as a first step toward the standardisation for reduced aircraft separation based on runway occupancy time.

Considerations of Regulatory Oversight and Certification Activities

A safety case will be required in order for the National Authorities to approve the use of PJ.02-08-03; the safety case will need to be based on the ROT data collected for each specific runway. Given that the solution allows a reduction of separation minima based on the distribution of observed ROTs, it can be expected that the regulatory approval will require that a process be set up to monitor ROT values after implementation.

No certification activities are required.

Solution Data pack

The solution is integrated in the PJ.02-08 data pack (SPR-INTEROP/OSED, TS/IRS and VALR) covering solutions PJ.02-08-01, PJ.02-08-02 and PJ.02-08-03. Note that the solution datapack refers to a previous version of solution PJ.02-08-03 (and AO-0337) that was limited to ROCAT (aircraft category based) while the content is valid also to aircraft type based. These definitions will be updated in DS21.