Contextual note – SESAR Solution PJ02-03

Purpose:

This contextual note introduces the SESAR Solution PJ02-03 (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.

Introduction:

This solution has a technical aspect and an operational aspect. On the technical aspect, the solution has validated to V3 that the application of 2NM minimum radar separation (MRS) between two aircraft established on the final approach course to the same runway sufficiently mitigates the risk of collision between them, provided the required surveillance performance (RSP) are complied with. In addition to the MRS, runway occupancy time and wake separation constraints need to be considered when determining the minimum separation or spacing required to be applied between two aircraft (the largest of the constraints will need to be applied).

The routine application of the 2NM minimum on final approach may require an increased consistency and accuracy in the separation delivery service on final approach. More specifically, the maximum acceptable rate of under-separated pairs on final approach may be lower if the minimum radar separation that is applied is 2NM than if it were to be 2.5 NM, because the consequences of an under-separation event are potentially more severe. For ATC facilities with a separation monitoring function (SMF) that alerts the supervisor, and also possibly the final approach controller, of a significant separation infringement on final approach, where there is currently a spacing minimum margin of 0.5 NM before the alert is triggered, consideration should be given to reducing this margin, e.g. to 0.2NM.

PJ.02 has also validated (within solution PJ.02-01-01) the optimised runway delivery (ORD) tool. The tool presents to the controllers and for each aircraft a final target distance (FTD) to indicate the separation minimum that applies to that pair (which will be the minimum of all applicable constraints, i.e. wake separation minimum, runway occupancy time constraint and MRS), and a target distance indicator (TDI), which gives an estimation of how close the two aircraft can be (depending on the distance to the threshold and the anticipated speed profile). It helps reducing the probability that compression further ahead causes the separation to fall below the FTD; as the aircraft get closer to the threshold, the TDI and the FTD converge.

The ORD tool supports controllers in providing increased accuracy in the delivery of separation on final approach, thereby supporting a reduction of the rate of under-separation instances. The validation activities for the operational use of the 2NM MRS have addressed both the with-ORD and the without-ORD cases. The data pack for this solution

documents the work done for both the with-ORD tool and the without-ORD tool. The SPR-INTEROP/OSED contains two types of requirements: those that the solution team considers would be applicable for all implementations (with or without ORD), and those that apply only to the with-ORD case. The safety assessment report (SAR) and human performance assessment report (HPAR) focus on the with-ORD tool use case, but also contain elements in support of the without-ORD tool use case. The performance assessment report (PAR) and the cost-benefit analysis (CBA) consider only the with-ORD tool.

Improvements in Air Traffic Management (ATM)

Solution PJ02-03 “Minimum Pair Separations Based on Required Surveillance Performance (RSP)” in support of a reduction of the in-trail minimum Radar Separation focus to provide a direct positive impact on runway throughput (capacity, efficiency and resilience):

The runway capacity and in particular the runway throughput resilience in moderate, strong and very strong headwind conditions on the straight-in approach to the runway landing threshold are improved thanks to the implementation of AO-0309: Minimum radar separations based upon required surveillance performance implying the application (by ATC) of a non-wake turbulence separation down to 2 NM for arrivals on final approach, based upon required surveillance performance. This minimum radar separation could be applied when separation is not constrained by wake turbulence, either because of favourable weather conditions (e.g. cross wind) or simply when the pair-wise wake turbulence separation is less than the MRS.

Operational Improvement Steps (OIs) & Enablers

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

- AO-0309: Minimum Radar Separations based upon Required Surveillance Performance (RSP).

The following enablers are required and covered in the solution data pack:

- APP ATC 159 – Approach ATC system updated for Minimum Separation Based on Required Surveillance Performance (separation delivery)
- PRO-257 – ATC Procedure to apply spacing minimum of less than 2.5 NM down to 2 NM
- REG-0526 – Regulatory provisions for Minimum-Pair separations based on RSP (Required Surveillance Performance)

The following enablers are assumed and used by the SESAR solution:

- APP ATC 120 – Approach ATC system to support optimised runway delivery on final approach

- CTE-S01 – Secondary SUR Radars
- CTE-S01a – SSR Mode A/C/S
- CTE-S02 – Primary SUR sensor
- CTE-S02a – Primary Surveillance Radar
- METEO-03 – Provision and monitoring of real-time airport weather information, Step 1
- METEO-04b – Generate and provide MET information services relevant for Airport and final approach related operations, Step 1
- STD-093 – EUROCONTROL Guidelines for Optimised Runway Delivery

The following enablers are optional to support the SESAR solution:

- A/C-48a – Air broadcast of aircraft position/vector (ADS-B OUT) compliant with DO260B
- AERODROME-ATC-59: Enhanced Surveillance data processing on Airport Surface (APT)
- CTE-S04a – Wide Area Multilateration (WAM)

The solution targets very large, large and medium airports that are capacity constrained during peak hours and where the runway throughput is impacted by moderate, strong and very strong wind conditions on the straight-in approach track resulting in the build-up of arrival delays and the potential need for flight cancelations.

Background and validation process

The SESAR Solution has been validated through two fast time simulations (FTS) and a real time simulations (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.

These three activities are complemented with additional activities conducted as part of the safety assessment process and human performance assessment process. These activities include a surveillance performance assessment of the current MRT and WAM surveillance services and a collision risk modelling study by NATS conducted at Heathrow specifically for 2NM MRS as part of the safety assessment.

Results and performance achievements

The reduction of the in-trail minimum radar separation from 2.5 NM to 2NM on final approach with a controller support tool was found to be operationally feasible in the validation exercises conducted with no negative impact on safety or human performance. However, the benefits in terms of runway throughput, rate of go-arounds and fuel efficiency are dependent on the wind conditions and separation scheme applied.

ADS-B surveillance mode was found to fulfil the criteria for safe operations under all conditions whilst SSR was found to fulfil the criteria for safe operations under certain conditions. For SSR there would have to be some limits placed regarding the velocities of aircraft. Regarding ADS-B, some limitations would have to be placed upon which aircraft

could be separated to the 2NM minimum radar separation, based upon aircraft equipage and the availability of ADS-B in at the airport.

From the results of the validation activities, it can be concluded that the reduction of the in-trail minimum radar separation from 2.5 NM to 2NM on final approach with the ORD tool has fully achieved the criteria to complete V3, while for the without ORD tool the maturity is V3 ongoing.

Recommendations and Additional activities

The following recommendations are made concerning the implementation of this solution:

- The collision risk modelling was performed for the 2NM to be applied between aircraft on final approach, for a runway where the distance from the final approach point (FAP) to the threshold is 7.4NM. However, the validation team analysis foresees that the reduced MRS applicability is not restricted to these conditions, e.g. it could be applied further from the runway (depending on the local procedures, potentially up to 20NM from the runway threshold), or between aircraft that are established on the final approach course and aircraft that are established on a heading to intercept the final approach course; this is further discussed in the SPR-INTEROP/OSED Part I;
- In order to quantify a benefit for a given location it is imperative that studies are conducted taking into account the wind profile data collected locally with the local traffic mix. This is to ensure that an appropriate runway throughput resilience gain can be identified prior to implementation;
- Prior to local implementation, controller training will be required. It is also recommended that further validation activities are conducted to fully understand the impact of implementing 2NM MRS on the final approach controllers and tower controller work in that specific environment. For this, it is recommended that an RTS is conducted with the local controllers using the approach and airport environments where the concept will be implemented as well as the local wind conditions and a traffic mix specific to that environment. Degraded modes also need to be tested at the local level;
- Depending on the local procedures and airspace design, it may not be possible in all cases where 2NM can be applied to have successive aircraft on final approach closer than 2.5NM if the separation that needs to be applied on the base leg is still 3NM. The operational feasibility of safely reducing the MRS on the base leg from 3NM to 2.5NM when MRS on the final approach is reduced from 3NM to 2.5NM or 2NM should be investigated. For each implementation, a local safety case made for this reduction in MRS on the base leg would be required. The SPR-INTEROP/OSED parts I and II contain more information on this topic;

- Prior to implementation, an information campaign for airlines and pilots should be developed to inform airlines of the benefits that can be gained by applying 2NM MRS on the final approach and to inform pilots of the importance of adhering to ATCO speed instructions and reacting to controller instruction in a timely manner and also to ensure they are aware that the separations on the final may reduce if MRS is applied;
- A speed monitoring campaign to assess the speed conformance of all aircraft flying on the final approach is also recommended prior to the implementation of a reduction of MRS to 2NM. This was done in Heathrow and found helpful to ensure pilots are adhering to controller instructions, as they should before the new separation minima are introduced.

Actors impacted by the SESAR Solution

Tower and TMA controllers.

Impact on Aircraft System

No impact.

Impact on Ground Systems

The solution requires a confirmation that the required surveillance performance requirements are satisfied by the surveillance service employed by the approach controllers. Therefore, a performance assessment of the local surveillance service employed by the approach controllers is needed to confirm that the RSP requirements are satisfied.

The solution is support by the ORD tool.

Regulatory Framework Considerations

The local safety regulator would needs to approve the employment of the 2 NM MRS on the basis of the RSP assessment and also the local CRM assessment taking into account the local separation and spacing delivery performance of the local ATC approach procedures and associated tool support.

Standardization Framework Considerations

EUROCONTROL ESASSP standard and EUROCAE WG102 standardisations documents need to be updated to take into account the 2NM separation.

Considerations of Regulatory Oversight and Certification Activities

RSP and CRM studies need to be conducted with associated regulatory oversight and approval certification.

Solution Data pack

The PJ02-03 solution data pack includes the following documents:

- SESAR Solution PJ02-03 SPR-INTEROP/OSED for V3 - Part I, D3.1.01, edition 01.00.00, 14 February 2020
- SESAR Solution 02-03: SPR-INTEROP/OSED for V3 - Part II - Safety Assessment Report, D3.1.01; edition 01.00.00, 14 February 2020
- SESAR Solution PJ02-03 SPR/INTEROP-OSED for V3 - Part IV - Human Performance Assessment Report, D3.1.01, edition 01.00.00, 14 February 2020
- SESAR Solution PJ02-03 SPR/INTEROP-OSED - Part V - Performance Assessment Report (PAR), D3.1.01, 01.00.00, 14 February 2020
- SESAR 2020 Solution 02-03 Technical Specification (TS/IRS) for V3/TRL6, D3.1.02, edition 01.00.00, 14 February 2020
- SESAR SOLUTION PJ.02-03: COST BENEFIT ANALYSIS (CBA) FOR V3, D3.1.05, edition 01.00.01, 25 February 2020

Intellectual Property Rights (foreground)

The foreground for PJ02-03 is owned by NATS, ENAIRE, EUROCONTROL and its members.