

Contextual note – SESAR Solution description form for deployment planning

Purpose:

This contextual note introduces a SESAR Solution (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)

The Free Routing concept allows Airspace Users to plan flight trajectories without reference to a fixed route network or published directs (DCT) so they can optimise their associated flights in line with their individual operator business needs or military requirements and fly as close as possible to their preferred trajectory. This concept is a transversal operational concept that affects many Air Traffic Management activities at regional, sub-regional and local level.

The ability to plan flight in Free Routing Airspace (FRA) in optimised alignment with business needs is expected to improve flight effectiveness in terms of flight time (more adequate with schedule) and/or flight distance (shorter) and/or fuel and cost (more efficient), and thus to contribute to a greener aviation. In-flight variability is also expected to be reduced thanks to less trajectory revisions (e.g. less tactical directs requested by pilots or given by Air Traffic Controller (ATCO) to expedite the traffic).

Free routing was previously addressed in SESAR 1 programme but additional activities were required to support the implementation of FRA across multiple ACCs/FIRs in high and very high complexity airspace.

The SESAR Solution PJ.06-01 ***“Optimized traffic management to enable Free Routing in high and very high complexity environment”*** supports the implementation of FRA across ACC/FIR borders by contributing to the improvement of air traffic management at local level. More precisely, it focuses on the improvement of Separation Provision to enable Free Routing operations within high and very high complexity cross-border environments in Upper En Route airspace. The Solution is not targeting unrestricted free routing operations, but aims at enabling safe and efficient operations in FRA with minimum structural limits to manage airspace and demand complexity while maintaining the required level of safety and capacity. The Solution also relies on the Network Management (NM) function to cope with any Demand and Capacity imbalances created from changes in dominant traffic flows in FRA through the monitoring of the traffic complexity levels together with the level of the traffic demand.

Operational Improvement Steps (OIs) & Enablers

PJ.06-01 contributes to **AOM-0505** “*Optimized traffic management to enable Free Routing in high and very high complexity environments*”. The OI step is partially covered.

Key Feature addressed by PJ.06-01 is Advanced Air Traffic Services; AU/FOC/WOC and NM operations are part of the operational environment of the Solution, but not in scope of the Solution.

The Enablers supporting the SESAR solution are:

- **ER APP ATC 78** (Update FDP to support 4D trajectory direct segments in free routing airspace beyond local AoR) - Required
- **ER APP ATC 129** (Upgrade FDP and provide Controller Tools to provide assistance to ATC Planning for Preventing Conflicts in ER) - Required (Baseline)
- **ER ATC 91** (ATC System Support for Advanced Conformance Monitoring in En-route Airspace) - Required
- **ER ATC 157** (Enhanced ATC System Support to the Tactical Controller for Conflict Detection and Resolution in En-Route) - Optional
- **ER ATC 157b** (Enhanced ATC System Support the Planning Activity for Conflict Detection and Resolution in En-Route) - Optional
- **PRO-046b** (ATC Procedures for Using Advanced System Assistance to Medium Term Conflict Detection and Resolution) – Optional

Applicable Integrated Roadmap Dataset in DS19¹

Background and validation process

The solution benefited from the work and the validations performed in SESAR 1 (AOM-0501)

- EXE-04.03-VP-797 (V2, Free Routing low to medium complexity with some runs of high complexity)
- EXE-04.03-VP-798 (V3, Free Routing - low to medium complexity)

Solution PJ.06-01 has been V3 validated through two validation threads:

- EXE-06.01-V3-VALP-001: Free Routing Concept development and assessment in very high complexity cross-border environment
- EXE-06.01-V3-VALP-002: Cross-FIR analysis of Barcelona FRA and Madrid FRA integration in high complexity environment.

¹ Change requests, as outputs from the Solution’s activities, have been proposed for DS20.

These two threads, conducted through Real Time Simulations, allowed together to address both high and very high complexity cross-border environments in upper En-route airspace.

To support the validations exercises structurally limited Free Routing Airspaces have been designed respectively cross-ANSP (EXE 1) and cross-ATSU (EXE 2) borders.

For both threads, the Flight Data Processing (FDP) system was upgraded to support direct segments beyond the local Area of Responsibility (AoR) and ATCOs were assisted by either baseline or enhanced ATC tools to support Conflict Detection and Resolution.

The objective was to assess the impact of the Solution on fuel efficiency and predictability and confirm the absence of any negative impact on safety and capacity. Human Performance aspects were also assessed.

Results and performance achievements

The validation exercises results show that the implementation of structurally limited cross-border FRA concept in high and very high complexity environment has no negative impact on ATCO's performance when assisted by appropriate ATC support tools adapted to free routing environment. Human performances are maintained thanks to the Solution PJ.06-01, but ATCOs are more dependent on the advanced ATC support tools and on the quality of the FRA structure put in place to maintain an acceptable traffic complexity level.

The outcomes of the safety assessment conducted at SPR level and the V3 validation exercises results, during which safety was maintained in all conditions, give confidence that the PJ.06-01 Solution does not have any negative impact on Safety.

The V3 validation activities also demonstrated that the PJ.06-01 Solution does not adversely affect the Airspace Capacity.

About Environment / Fuel Efficiency benefits, the Performance Assessment based on the V3 validation exercises results give confidence that the PJ.06-01 Solution could deliver significant benefits. At the 2035 timeframe, a reduction of the actual average fuel burn per flight of 26,57kg has been extrapolated.

When consolidating the validation results, it has not been possible to firmly conclude that the Solution PJ.06-01 would allow any reduction of in-flight variability variances. Indeed, it seems that the predictability benefits are very influenced by the airspace design of the structurally limited cross-border FRA. Some predictability benefits are nevertheless expected from the Solution in terms of local % of actual vs. planned wasted routes (i.e. difference [KEP-KEA]), which benefits will also depend the airspace design of cross-border FRA at local level.

The Cost Benefits Analysis concluded that the Net Result anticipated for PJ.06-01 (ECAC level at horizon 2040) would be a positive NPV of 797 M€² (with an 8% discount rate). Moreover, those results and the short-term payback period (5 years after IOC) decrease the risk level of the Solution for potential investors.

Recommendations and Additional activities

This Solution's performance is highly dependent on the structure of the Free Route Airspace, and the optimisation of offered flight planning options with minimum of AIP/RAD constraints. It is therefore recommended to give appropriate consideration to the design of the cross-border FRA to achieve maximum benefits for airspace users without detrimental effect on safety and capacity. This recommendation goes along with the outcomes of the Airspace Architecture Study, which has highlighted the importance of "an optimal cross-FIR and flow centric redesign of airspace sectors" as a support for "a seamless cross-FIR FRA for the whole ECAC region".

The structurally limited cross-border FRA implementation does not significantly modify working principles and operating methods of ATCOs. However, cross-border FRA implementation represents a significant change of the operational environment for ATCOs. It is therefore recommended to plan for training sessions and adaptation phase before industrialisation and deployment phase.

It has not been possible to fully validate transition of flights from FRA to Non-FRA and vice-versa. It is therefore recommended to perform deeper investigation of these FRA <->-Non-FRA transitions before any cross-border FRA implementation.

At CBA level the following recommendations are made:

- As PJ.06-01 benefits will only materialize if a large majority of the involved stakeholders implement the Solution, and since FRA implementation under PCP mandate has been broadly started at all ACCs in Europe, it is crucial to ensure that progressive benefits can be factored-in by implementing PJ06.01.
- It is recommended to present the V3 R&D outcomes (including the CBA results) to ANSPs who may be interested in pursuing a similar multilateral technological concept as a key foundation of their evolutionary roadmap, in order to foster a bottom-up drive towards adoption.

As an input to the SESAR 2020 wave 2 phase, other technological or operational SESAR 2020 Solutions with a targeted timeframe at or beyond the one of Solution PJ.06-01 should consider the Solution PJ.06-01 as a baseline for their validation in En-Route airspace. This is more

² Extrapolation is done at ECAC level and horizon 2040

particularly relevant for Solutions from PJ.09, PJ.10 and PJ.18 (e.g. Sol #44, Sol #48, Sol #53, Sol #73, Sol #93).

About trajectory management, the use of IOP both at network and local levels should in particular be further investigated (with consideration of ED133 draft V2 to be released soon by EUROCAE) with the aim to achieve further benefits in seamless cross-FIR Free Routing Airspace.

Actors impacted by the SESAR Solution

ATC actors at sector level – both Tactical Controller and Planner Controllers - are directly impacted by the SESAR Solution PJ.06-01

Impact on Aircraft System

No Aircraft Systems capabilities are impacted by this SESAR Solution.

Impact on Ground Systems

ATC ground systems shall be upgraded to support flight data processing of 4D trajectory direct segments in free routing airspace beyond local AoR.

For additional benefits, ATC ground systems should be upgraded to support Conflict Detection and Resolution including for problems along planned flight trajectory within AOR/AOI as well as advanced features like what-if/what else functions.

Regulatory Framework Considerations

There is no need for additional regulations.

Standardization Framework Considerations

There is no need for standardisation.

Considerations of Regulatory Oversight and Certification Activities

There is no need for specific consideration in the regulatory oversight and certification field.

Solution Data pack

PJ.06-01 V3 Data Pack consists of:

- PJ06-D2.1.030 PJ06-01 V3 SPR OSED INTEROP Final version Part I v00.03.02
- PJ06-D2.1.030 Part II Final SAR v00.02.01
- PJ06-D2.1.030 Part IV HPAR v00.02.00
- PJ06-D2.1.030 Part V PAR v00.01.00
- PJ06-D2.1.110 PJ06-01 TS-IRS check (V3) Final version v00.02.07
- PJ06-D2.1.200 PJ06-01 CBA (V3) v00.01.00
- PJ06-D2.1.530 PJ06-01 Consolidated VALR V3 v00.01.01

Intellectual Property Rights (foreground)

The foreground is owned by the SJU.