Release 5 SESAR Solution #11

Continuous descent operations (CDO) using point merge

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 Solution 11 focuses on Continuous Descent Operations (CDO) in the last portion of the flight, which contributes to noise reduction around airport as it is a major concern for airport surrounded by populated areas. Key factors to enable the realisation of continuous descent operations are the predictability of the arrival trajectory (i.e. flight crew need to be informed of the whole fly path from the En Route airspace to the Final Approach in order to compute the optimum vertical profile) and the flexibility for the aircraft during the descent (i.e. when there are no altitude or speed restriction during the descent, aircraft are able to use their preferred descent profile). In current operations, use of radar vectoring for sequencing or separation purpose limits predictability and prevents extensive deployment of continuous descent operations.

Therefore, by contributing to solve the issues mentioned above, the Solution defines a concept enabling environmentally friendly conduct of efficient operations during descent in terms of fuel efficiency without compromising safety and efficiency in M/M and H/H environments in different operational environments. The Solution is derived from the Point Merge concept while still partially relying on ATCOs' vectoring skills. This concept is also based on a new closed loop structure including different flight paths, a merge point and new operating methods (including new phraseology) with current tool/system. But here vectoring instructions are used to stretch the flight path and a "Direct to Merge Point" is issued when spacing is achieved.

The new closed loop flight procedure and new operating method is referred to as the Vectoring to Merge Point; an example of implementation in the case of Orly can be seen below.

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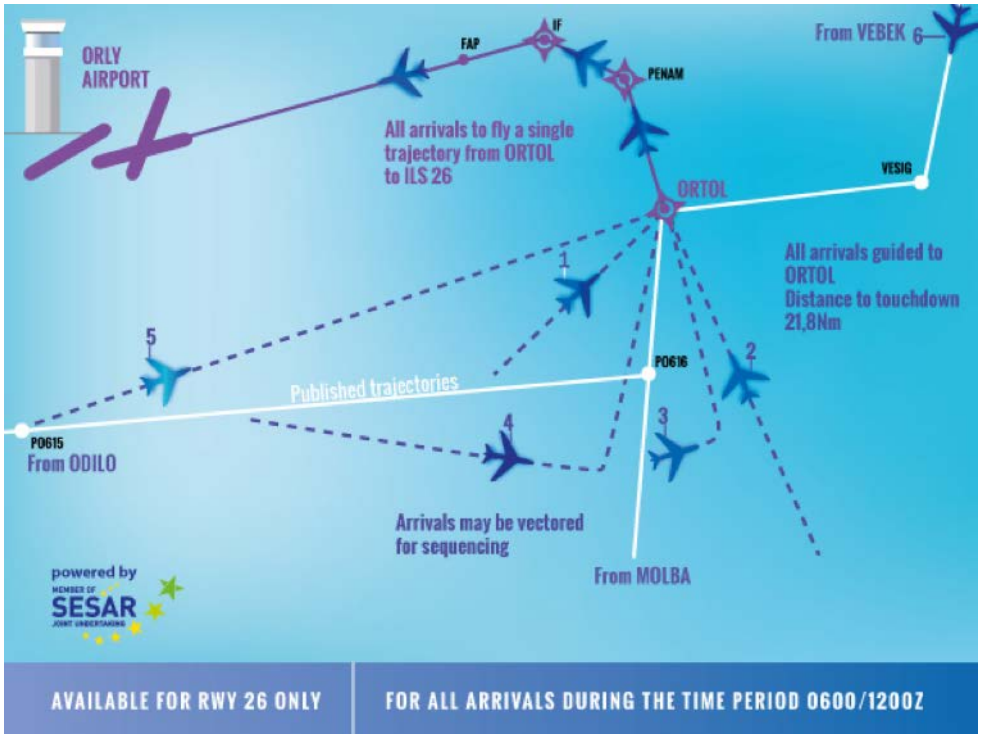


Operational Improvement Steps (OIs) & Enablers

OIs Steps:

AOM-0702-A: Continuous Descent Operations (CDO)

Enablers[1]: PRO-029: ATC Procedures to build a sequence and coordinate with other AoR in order to facilitate CCO/CDO

Applicable Integrated Roadmap Dataset is DS15.

Background and validation process

Over the years, many projects have investigated improvement mechanisms, notably during climb/descent phase, and several implementations have resulted from this work. Research of these investigations, projects and 'improvement activities' has revealed that:

- Significant fuel-savings and emissions-reduction are possible through improved ATM measures, and through enabling the aircraft to fly its optimal, or at least a more optimised, profile.
- Most of the projects/activities that have taken place recently have done so in low-density traffic, or have operated with 'special' circumstances.

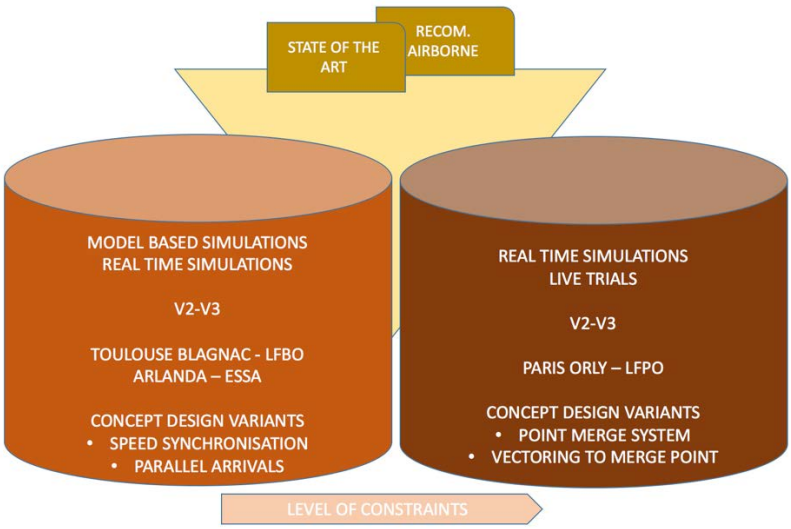
[1] DS15 includes two "optional enablers" (A/C-04, A/C-37a) that have not been validated as part of the SESAR Solution and should be removed / unlinked to AOM-0702-A

Nevertheless, although most projects tend naturally to report mainly favourable outcomes and results, it is acknowledged that many 'issues' remain in moving towards more efficient operations in higher density.

In an initial phase, issues and blocking points of current operations have been identified through workshops with ATCOs and Airspace Users. This part enabled to produce a State of the Art document. Furthermore, collaboration with airborne partners enabled to produce some airborne considerations regarding procedural design. Then a two-step approach to formulating proposals for improving vertical profiles was developed.

Firstly, 'Initial Ideas' were formulated to take forward for investigation through Model-Based-Simulation, where different arrivals/departures route-interaction philosophies were tested. These simulations were based on Stockholm Arlanda (Sweden) and on Toulouse Blagnac (France) airports, and assumed that no additional upgrades or system support improvements were in place. As those showed promising results, V3 Real Time Simulations based on the procedural principle tested for Toulouse Blagnac were conducted.

On a second phase, based on the fact that the tested procedural designs were quite inapplicable in a constrained environment, it was decided to conduct the study in a laterally constrained H/H environment, such as the one of Paris Orly. Real Time Simulations were conducted to refine and assess different PMS based options in western configuration for Paris Orly. Those enabled to refine the procedure design towards the actual Solution, i.e. based on the vectoring to merge point principle that was tested through wide-scale flight trials. The overall validation process can be figured below:



Results and performance achievements

Solution 11 aims at improving the vertical profile in terms of fuel efficiency (without compromising safety and efficiency) and it has been designed in order to be compatible with different local constraints. As such, it can be seen as a compromise between Airspace User needs and ANSP service provision capabilities, based on local particularities and local traffic. Main findings from overall validation exercises perspective can be summarised as follows:

- From Pilots' point of view, for regional and mainline aircraft:
  - The Solution leaves some flexibility to the pilots to optimise their descent profile,
  - Once the arrival/approach clearance or the direct to Merge Point clearance is received, pilot plans for an optimized vertical profile, using appropriate airborne techniques and equipment.
- From ATCOs' point of view:
  - The ATCOs understood and had a neutral or positive appreciation of the Solution depending on the context;
  - The new techniques associated to the Solution constitutes an important change in the sequencing task,
  - The Solution is viable in different context, but in order to manage situation such as peak of traffic, some adaptation would possibly be required, e.g. the implementation of an AMAN system and the definition of specific operating method.

The results and performance achievements can be summarized and completed by the table below:

Capacity (Airport, Airspace)	Capacity of the airport equivalent (throughput). Capacity in the arrival area considered equivalent (qualitative assessment).
Environment-Fuel Efficiency	Impact on fuel burn should be considered with caution (error model): while neutral value of the fuel efficiency indicator have been measure in one validation exercise (-0.7%), the solution is supposed to improve the gas emissions and fuel consumption by allowing aircraft to fly their optimum descent profile from the moment when they receive the "direct to merge point" clearance to the Intermediate Fix.

	Additionally new CDO concept is supposed to decrease the noise emission, by reducing the number of changes in thrust settings and by avoiding level offs at low levels, which result in higher flight profile around the airport.

Recommendations and Additional activities

The concept that has been investigated, associated with appropriate working methods, can lead to positive impacts in terms of fuel consumption, gas emissions and noise while maintaining current days' level of safety. Nevertheless, the following recommendations are to be considered to achieve best results when applying the studied concept to a given airspace:

- ATCOs shall be familiarized with the concept of operation and trained to the operating method associated to the flight procedure,
- Appropriate ATC operating method shall be defined to take advantage of the new procedure and leave maximum flexibility to the aircraft to optimise their descent profile,
- Airspace Users shall be familiarized with the concept of operation and associated flight procedure,
- Appropriate phraseology shall be defined to ensure mutual understanding between pilot and ATCO.

One of the main recommendations is therefore to develop/reinforce a shared understanding of the operating method between controllers and pilots in order to limit potential ATCOs or pilots' misinterpretation or confusion when applying any of those procedures. This concerns in particular phraseology (e.g. a specific indication in the vectoring instruction) and charting (e.g. a note explaining that in case of vectoring, a resume on published trajectory should be expected).

In addition, during implementation it is recommended that a security assessment is conducted, in accordance with the local security policy, in order to determine the applicable Security Controls.

Actors impacted by the SESAR Solution

Airspace Users: Pilots
APP and ACC: TMA ATCOs and En Route ATCOs

Impact on Aircraft System

The different procedural improvements take advantage of current airborne functionality. Aircraft shall have notably appropriate PBN approval. No impact is foreseen on airborne systems. Nevertheless, any new procedural design may have a potential impact on Avionics database, therefore aircraft manufacturers should consider this point.

Impact on Ground Systems

As the improvements proposed by the Solution are procedural, same considerations as for aircraft system do apply. Nevertheless, there may some minor – non-functional – modifications, related to the HMI, notably updates of the static maps in order to show the new procedures and/or the display of distance markers to provide a visual support for sequencing.

Regulatory Framework Considerations

Update of ICAO Doc 9931 for Continuous Descent Operations (CDO) and Continuous Climb Operations (CCO) Manual.

Standardization Framework Considerations

Not applicable

Considerations of Regulatory Oversight and Certification Activities

N/A

Solution Data pack

The Data pack for this Solution includes the following documents:

- 05.06.02-D47_CDO Step 1 SPR. This document sets out the Safety and Performance Requirements relating to the concept for improvement of the vertical profile through new closed loop flight procedure and new operating method: Vectoring to Merge Point.

Intellectual Property Rights (foreground)

The foreground is owned by the SJU.