SESAR SOLUTION PJ.25-01 & PJ.25-02 CONTEXTUAL NOTE TRLZ

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PJ25-xStream

CROSS BORDER SESAR TRIALS FOR ENHANCED ARRIVAL MANAGEMENT

Abstract

This contextual note provides information relevant for the industrialization and further deployment of the SESAR solutions PJ.25-01 "Collaborative Decision Making (CDM) between airports, TMAs and ACCs for Overlapping AMANs" and PJ.25-02 "Target Time of Arrival (TTA) management for seamless integration of out-of-area arrival flights".

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1 Purpose

This contextual note provides to any interested reader (external and internal to the SESAR programme) an introduction to the SESAR Solutions PJ.25-02 "Target Time of Arrival (TTA) management for seamless integration of out-of-area arrival flights" and PJ.25-01 "Collaborative Decision Making (CDM) between airports, TMAs and ACCs for Overlapping AMANs" in terms of scope, main operational and performance benefits, relevant system impacts.

The SESAR PJ.25 demonstration project has brought both solutions to V3 maturity. The contextual note is intended as an introduction to the technical data pack comprising the SESAR JU deliverables (for V3/TRL6, they are proposed to support industrialization/deployment).

2 Improvements in Air Traffic Management (ATM)

The SESAR Solutions PJ.25-02 "Target Time of Arrival (TTA) management for seamless integration of out-of-area arrival flights" and PJ.25-01 "Collaborative Decision Making (CDM) between airports, TMAs and ACCs for Overlapping AMANs" refer to enhancement of Arrival Management procedures. They complement already existing SESAR 1 solutions referring to Extended Arrival Management and overlapping AMAN horizons and target times (especially Solutions #05 "Extended arrival management (AMAN) horizon", #08 "Arrival management into multiple airports" and #18 "Calculated take-off time (CTOT) and target time of arrival (TTA)") and are applicable to medium to highly congested airspace. These enhancements are based on adding:

The coordination of out-of area departures (solution PJ.25-02). It complements SESAR 1 solutions #18 by extending the use of Target Times of Arrival (TTA) to traffic departing outside the European Regulation Area. Due to the different nature of the traffic, the usual TTA processes cannot be applied, and a different approach is needed:

- Long-haul aircraft departing from outside the European Regulation Area are assigned a TTA before departure. The allocation is done by the arrival airport/TMA, in collaboration with AOC.
- This TTA is passed to the flight crew by the AOC, for the flight crew to adjust their departure time as much as possible.
- During the execution of the flight, the ETAs are passed by the flight crew to the AOC, who then AOC shares them with the ANSP. Approximately four hours before the ETA, the demand-capacity balance at the arrival time is reassessed by the TMA. If a demand-capacity imbalance is detected, e.g., because some aircraft could not sufficiently adjust their departure time in accordance with the TTA, or because ATC constraints or unexpected winds have caused the expected flight-time for some aircraft to increase or decrease, a new TTA may be proposed to some aircraft via the AOC, for the aircraft to adjust their flight speed accordingly.
- The Network Manager (NM) stays in the loop through a B2B connection with the ANSP, in order to maintain the most accurate picture of the long-haul arrival demand into the airport,

thereby enhancing the TTA allocation processes affecting flights departing in the European Regulation Area.

These TTAs aim at smoothing the arrival traffic at an airport, avoiding a situation where many long-haul flights arrive at the same time at the arrival airport (e.g., early morning) and have to absorb a significant amount of delay in a holding pattern.

A collaborative process is applied to coordinate the TTAs with Airspace Users (solution PJ.25-01). The A-CDM portal for overlapping AMAN horizons is a collaborative process based on a collaborative support tool that allows a shared situational awareness of the status of the AMAN service availability between several TMAs and upstream Air-Traffic Control Centres (ACC) operating Extended AMAN procedures.

With the extension of AMAN horizon (SESAR solution #05), and the number of airport operating E-AMAN procedures, the cumulative effect of E-AMAN requests in the same ACC sector coming from different TMAs may lead to an increase in the ACC ATCO workload and a need to prioritise the requests. The A-CDM portal supports this prioritization process, and provides a shared situation awareness of the E-AMAN service availability status to all involved parties.

3 Operational Improvement Steps (OIs) & Enablers

The concept of collaborative TTAs for long hauls (solution PJ.25-02) is not covered by any of the existing Operational Improvements. A new operational improvement (DCB-XXXX) will be created to address this gap:

DCB-XXXX[1]: TTA management for seamless integration of out-of-area arrival flights

- FOCs and local FMPs collaborate iteratively in the management of TTAs for long-haul flights departing from airports located outside the European Regulation Area. The process starts before take-off and includes TTA revision and update during the flight. FMPs ensure that traffic departing the European Regulation Area are issued TTAs/CTOTs as required in order to ensure their seamless integration in the arrival flow with out-of-area traffic managed with TTA.

- Although the TTA is not a constraint, it is expected that long-haul flight crews, when possible, will adjust their take-off time and/or choose to apply small speed adjustments to adjust in-flight speed in accordance to their TTA and therefore improve the overall efficiency of DCB in the arrival TMA.

Rationale:

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[1] CR 04985 Create OI step DCB-XXXX TTA management for seamless integration of out-of-area arrival flights

- The consideration of traffic departing outside of the European Regulation Area in DCB processes allows their seamless integration in the arrival stream, thereby preventing arrival demand capacity imbalances that would result in long-haul arrivals having to hold before landing.

ENABLERS:

- ER APP ATC XX[2] Enhanced traffic and flow management sub-systems to support TTA management for traffic departing the European Regulation Area and AOC.

- AOC-ATMXX[3] Upgrade of FOC system for TTA management for long-haul flights

- PRO-XXX[4] FMP procedure for Target Time of Arrival (TTA) management for seamless integration of out-of-area arrival flights

The concept of the A-CDM portal for overlapping E-AMAN horizons (solution PJ.25-02) is in scope of the OI step TS-0305-B (Arrival Management Extended to En-Route Airspace - impact of overlapping AMAN operations for En Route ATC). This OI was also addressed by solution PJ.01-01 in Wave 1, but the concepts they researched did not reach V3 maturity. At the PJ.01-01 gate, it was agreed that this OI would be rescoped to cover exactly the scope that has been brought to maturity by PJ.25.

TS-0305-B — Collaborative Decision Making (CDM) between Airports, TMAs and ACCs for Overlapping AMANs

- There is a potential negative impact (increase in workload and complexity) on ACCs of providing AMAN service simultaneously to multiple airports. The CDM for overlapping AMANs concept allows ACCs, TMAs and airports to collaboratively manage the AMAN service in order to mitigate this negative impact.

Rationale:

- In execution phase of the flights, En-route sectors are affected by concurrent arrival management advisories due to a Multiple AMAN environment (AMAN systems of several independent TMAs; overlapping AMAN horizons).

ENABLERS:

- ER ATC 158 – En-route ATC System Share and Display Sequencing Advisories from Multiple AMANs – delete this enabler

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[2] CR 04989 Create ER APP ATC - xxx to support solution PJ.25-02

[3] CR 04988 Create FOC-xxx to support solution PJ.25-02

[4] CR 04990 Create PRO-xxx to support solution PJ.25-02

- METEO-05c – this enabler was originally linked to TS-0305-B, but is not relevant to the re-scoped OI and should be unlinked

- New enabler: NIMS-xxx – Collaborative portal for exchanging information on the AMAN service between ATSUs (airports, TMAs and En-route ACCs).

The text of the two new solutions, and the OIs steps and enablers are currently in draft form, to be reviewed in the scope of the EATMA dataset update process (target is DS21).

4 Background and validation process

The coordination of out-of-area departures was validated in the following exercises:

- A validation exercise within the SESAR1 iStream project, conducted at Zurich airport. A procedure delivering Target Times of Arrival at Initial Approach Fixes (IAFs) for all inbound long-haul flights within the timeframe [06:00 – 07:00] Local Time (LT) was designed. TTAs were computed by a local tool in Zurich ACC then sent to crews via AOCs before departure. About 4 hours before arrival, an assessment of potential demand-capacity imbalances was made by the TMA based on the ETAs of long-haul flights provided by the AOCs. In case of imbalance, an updated TTA was proposed to the AOC for them to pass it on to the aircraft so that the aircraft can adjust speed in flight.
- The Demonstration exercise EXE-VLD-09-002 "Frankfurt Early Morning Arrival Stream Optimization", where a similar process was live-trialled in Frankfurt.
- An exercise within the SESAR2020 PJ25-xStream Very Large-Scale Demonstration (EXE-VLD-08-003), whose purpose was to enhance the so-called "iStream" process by introducing automation support and integrating the Network Manager via a B2B connection, also in Zurich.

Both the Zurich and the Frankfurt exercises used scenarios in the early morning, because it had been observed that long-hauls aiming for arrival just after the airport opens in the morning often found themselves competing between them for a place in the sequence, or in some cases simply ending up arriving before the airport was actually open, which resulted in inefficient holding.

The A-CDM portal for overlapping AMAN horizons was validated through a shadow mode exercise EXE-VLD-09-003 within the xStream VLD, involving Maastricht, Reims and Karlsruhe UACs. For this exercise, the collaborative E-AMAN strategies were tested on real AMAN data feeds.

The objectives of the Demonstration Exercise EXE-VLD-09-003 (Multiple XMAN operation in ACC / UAC) was to elaborate and apply XMAN strategies via CDM process, assess the impact of XMAN Mode of operations, e.g., concrete application of XMAN constraint, on XMAN Strategy, identify criteria to maintain and/or degrade XMAN Service provision, identify measures for workload reduction related to XMAN Service provision and test XMAN Portal as A-CDM Tool portal tool.

The general approach of the exercise was to validate the multiple arrival constraints scenario for several Upper Area Control Centres in a real time shadow mode environment: Specific demonstration activity involving Maastricht (MUAC), Karlsruhe (KUAC) and Reims UAC (RUAC) with several airports providing their arrival information (Paris-CDG, Frankfurt, Amsterdam, London-LHR, and London-LGW).

An XMAN Strategy Management was developed in order to be able to balance demand on XMAN Services with ATCO workload in order to make best use of the available ACC/UAC capacity.

Both concepts have been brought to V3 maturity by PJ25 and are ready for industrialisation. In addition, the TTA management for seamless integration of out-of-area flights was demonstrated in the real Zurich environment with real traffic in an industrial platform fully integrated in the operational system, and can therefore be considered to have achieved V4.

5 Results and performance achievements

The coordination of out-of-area departures (solution PJ.25-02) led to the following benefits:

- Predictability: improved for FMP and Supervisors. The predictability of long-haul flights has also been improved when using the time estimates directly from the flight crews.
- Safety: all the trials were performed while maintaining a high safety level and with no incident reports.
- Flexibility/ Airspace User Support/service: the integration of Airspace Users' preferences can ensure their aircraft are streamed in order to arrive prior to an airport curfew, or immediately after the airport has opened.
- Environment: environmental benefits of this concept are important, because it applies to long-haul aircraft, which burn more fuel. In the Zurich demonstration days, average flight-time from the entry waypoints was reduced by an average of 40-110 seconds compared to the reference (depending on the waypoint).

The availability of an automated process for the coordination with NM (via B2B API service) was reported very efficient and is to be made durable. The possibility to send timely long haul flight arrival information was beneficial to improve the accuracy of flights outside IFPZ profiles.

The A-CDM portal for overlapping E-AMAN horizons and collaborative process (solution PJ.25-01) is providing a solution to manage the increased workload in ACCs (and potential negative impact on capacity) that is expected when all E-AMAN units are fully operational (from 2024 on as required by the CP1 regulation). The assessment of the trial offered the conclusions that:

- Safety: The application of the E-AMAN Strategies allows to maintain safe operations
- Capacity: The application of E-AMAN Strategies allows to exploit the available capacity while maintaining E-AMAN operations to the highest degree possible

The trial showed strong evidence for the usefulness of the A-CDM portal for overlapping E-AMAN horizons, which was developed as a first prototype to support the collaborative process of E-AMAN strategy management to be tested. In total N=7 participants (from UAC Maastricht, Reims & Karlsruhe and the XMAN units Paris and Frankfurt) answered the online questionnaire and took part in two debriefing sessions after the demonstration trials. The outcome of the assessment indicates positive feedback regarding feasibility, effectivity and usefulness of the strategies defined in the applied use cases as well as of the use of the A-CDM E-AMAN portal as a strategy management tool.

The participants agreed that the impact on workload by applying the CDM processes according to the use cases have been acceptable. The majority of participants also agreed that the XMAN portal was helpful in finding good solutions and that by using the strategies defined in the prepared use cases

they were able to mitigate critical situations caused by multiple XMAN constraints. The use cases also help to keep the workload on an acceptable level in situations with arrival constraints.

6 Recommendations and Additional activities

6.1 Recommendations for implementation

When implementing the out-of-area pre-departure process, it is recommended to implement in particular the following features:

- Update of ETFMS with transmitted TTA/TTO thanks to the NM B2B API.
- Provision automatic exchange between Airspace Users and ANSP/NM, so the Airspace Users can provide their preferences/priorities in the arrival sequence

The A-CDM portal for overlapping E-AMAN horizons has shown its usefulness. It is therefore recommended, that:

- The A-CDM Portal be further developed during industrialization and rolled out in the core area of Europe.

6.2 Recommendations for future R&D

For the regulation of out-of-area departures, it is recommended that R&D be performed in the following areas:

- Use of better ETA/ETO for airborne TTA/TTO calculation, in this case the availability of FMS data should be more automated (though the EPP).
- Investigation of the potential benefits of a continuous process to update ETA/ETO from flight deck, instead of making the update just once, four hours before arrival.
- Investigation of automatic ways to transmit an update to TTA/TTO to airborne flights, while keeping upstream ACCs that will be crossed by the flights and AOCs in the loop, thus allowing maximum transparency between all stakeholders
- Potential incorporation of aircraft capabilities and economical parameters, plus operational constraints (e.g. fix speed airspaces) in time determination process

The A-CDM portal for overlapping E-AMAN horizons has shown its usefulness. It is therefore recommended, that:

- E-AMAN Strategies further developed to have a complete set of operational scenarios related to E-AMAN operation which can be applied as needed
- Combine A-CDM Portal information with Flow Management information and Sector Load information to more precisely assess the impact of E-AMAN operations on sector capacity and workload

- Possibly provide also the Network Manager with the value-added E-AMAN information contained in the A-CDM Portal.

7 Actors impacted by the SESAR Solution

- Air Navigation Service Providers
- Airspace Users
- Network Manager

8 Impact on Aircraft System

None.

9 Impact on Ground Systems

The regulation of out-of-area flights requires FMP tools to manage the TTAs; in order to maximise the benefit, a new B2B connection to NM is also needed.

The collaborative A-CDM processes require the A-CDM tool to support the exchange of information and the shared situations. *E-AMAN systems shall be able to provide arrival sequence through SWIM (ED-254 standard).*

10 Regulatory Framework Considerations

None.

11 Standardization Framework Considerations

Provision of standardized E-AMAN information is key for having a common tool for the coordination of multiple E-AMAN operations. Therefore, the application of ED-254 "Arrival Sequence Service Performance Standard" should be promoted.

In general, data sharing between operational partners should be enhanced and possibly data sharing agreements should be in place to safeguard the reliable operational use of the data.

12 Solution Data pack

- D2.1 PJ25 XSTREAM Demonstration Report

- AIP Switzerland – iStream Procedure
- PJ25-Specific iStream Components – Zurich Maintenance Manual
- iStream Tool Requirements Strategic & Tactical Phases

Airline Team xStream (ATEAM) Consortium