Final Project Report

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ENAV	

Abstract

The project has aimed at defining and validating the ASAS Separation (ASEP) concept in en-route continental airspace operations. The study of ASEP has focused on the possibility of delegating, in specific and defined circumstances, the traffic separation responsibility to the flight crew of suitability equipped aircraft.

The validation activities under the scope of the project have been performed via Fast Time Simulations and expert groups (supported by Mock-ups) techniques.

Following the PCG decision on the ASEP subject, the project was suspended on November 2013, at the conclusion of its planned V1 activities, at an earlier stage of Step3 activities.

Authoring & Approval

Prepared By - *Authors of the document.*		
Name & Company	Position & Title	Date
[redacted] ENAV	[redacted]	15/09/2015

Reviewed By - *Reviewers internal to the project.*		
Name & Company	Position & Title	Date
[redacted] ENAV	[redacted]	15/09/2015

Reviewed By - *Other SESAR projects, Airspace Users, staff association, military, Industrial Support, other organisations.*		
Name & Company	Position & Title	Date
[redacted] DSNA	[redacted]	28/09/2015

Approved for submission to the SJU By - *Representatives of the company involved in the project.*		
Name & Company	Position & Title	Date
[redacted] / ENAV	[redacted]	15/09/2015
[redacted] DSNA	[redacted]	28/09/2015

Rejected By - *Representatives of the company involved in the project.*		
Name & Company	Position & Title	Date

Rational for rejection
None.

Document History

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00.01.00	30/09/2015	Final	ENAV	Final version to be submitted to SJU
00.01.01	23/11/2015	Final	ENAV	Edition updated to include the SJU's comments after the assessment

Intellectual Property Rights (foreground)

This deliverable consists of SJU foreground.

Acronyms

Acronym	Definition
ATM	Air Traffic Management
ASEP	ASAS Separation
ASAS	Airborne Separation Assurance System
C&P	Crossing and Passing
FTS	Fast Time Simulation
KPA	Key Performance Area
KPI	Key Performance Indicator
OSED	Operational Service Environment Definition
SESAR	Single European Sky ATM Research

1 Project Overview

The project has focused on the definition and validation of the ASAS Separation (ASEP) concept in en-route continental airspace operations and on the possibility of delegating, in specific and defined circumstances, the responsibility for traffic separation to the flight crew of suitability equipped aircraft.

1.1 Project progress and contribution to the Master Plan

The project has contributed to the target improvement CM-0702 - Ad hoc Delegation of Separation to Flight Deck – Crossing and Passing, which is expected to be delivered in Step 3 to achieve the ATM Service Level 4 – Performance Based Operations.

Due to the limited resources and available time only a limited number of ASEP applications has been studied and progressed; those applications are the outcome of a selection process which has involved experts covering the full spectrum of knowledge (controllers, airspace users, ground and airborne system experts, etc). The process has used various criteria to ensure that the selected applications are the ones best placed in terms of potential benefits versus development and implementation complexity; due care was also exercised to avoid effort duplication or parallel development with other SESAR projects. Selected Airborne Separation applications are described in the 04.07.06 Initial OSED. The applications bringing most benefits could be the following:

- Interval Achievement
- Interval Maintenance
- Lateral C&P
- Vertical C&P

The enabler needs for all the applications are:

- Identification of designated aircraft
- Transfer of Separation Responsibility

P4.7.6 has used the following validation techniques to advance the maturity of ASEP:

- Fast Time Simulations (FTS);
- Expert groups (supported by mock-ups).

<u>V1 FTS validation activities:</u>

Fast Time Simulation techniques were used to assess the impact on the KPAs affected by the concept:

- capacity
- temporal efficiency
- environmental sustainability/fuel efficiency

KPIs were properly chosen to address specific validation objectives and AIRTOP software was used taking into account the validation context to be investigated.

V1 Mock-up:

V1 validation activities were performed involving expert groups supported by appropriate mock-ups that allowed operational actors (i.e. ATCOs, pilots) to provide their early feedback on different aspects of the ASEP operational concept, procedures and requirements.

Ground and airborne aspects have been addressed separately. Generally, the air industry partners focused on the investigation of airborne aspects of ASEP applications while the ANSPs complemented that by studying the ground side. In order to obtain comparable results a set of assumptions and operational scenarios were shared. Traffic scenarios were developed and adapted (e.g. by filtering) to the needs of air and ground side V1 validation activities. The air side thereby focused on individual ASEP flights while the ground side emphasized the integration of ASEP flights into the remaining air traffic and therefore looked at a broader traffic scenario.

Code	Name	Project contribution	Maturity at project start	Maturity at project end
CM-0702	Ad Hoc Delegation of Separation to Flight Deck – Crossing & Passing (C&P)	Evidence gathered during V1 validation activities suggests the ASEP concepts are feasible. No issue was identified that would prevent the concept being developed further. This is a positive outcome at V1. All manoeuvres may bring benefits and no scenario should be neglected at this stage without further evidence of their potential benefits or risks. However, only some manoeuvres are seen as mature enough to be progressed to V2. Manoeuvres ready for V2: • Lateral Cross Behind – In level flight • Lateral Pass Right/Left – In level flight • Vertical Cross Above – In Descent • Vertical Cross Below – In Climb Manoeuvres requiring more analysis at V1: • Lateral Cross – In climb or descent • Vertical Cross Above – In Climb • Vertical Cross Below – In Descent • Vertical Pass Above – In Climb or Descent • Vertical Pass Below – In Climb and Descent	V1	V1

The OI description needs to be updated for the gathered evidences and that should be reflected in the next programme Data Set.

1.2 Project achievements

An high level summary of the main results for each investigated KPA/TA is reported in the following bullets list, deriving from the validation activities performed over the project execution phase.

- Environmental Sustainability/Fuel efficiency

Main results indicate that there is not a significant change in the fuel consumption and the use of ASEP applications doesn't have a negative impact on this KPA. Refer to [7] for more details.

- Temporal Efficiency

Although no positive impact has been recorded, no significant variation in the flight time resulting from the use of ASEP manoeuvres has been observed. Refer to [7] for more details.

- Airspace Capacity

A slight sector capacity increase is observed, even though this variation is not significant. Refer to [7] for more details.

- Human Performance

From both groundside and airside evaluation, all ASEP applications were feasible and acceptable to be used.

Proposed and implemented HMI for both groundside and airside evaluation was globally adequate. Some improvements are necessary but they do not call into question the ASEP procedure feasibility.

With regard to the pilot workload, it has been observed an increase due to the execution of the new tasks. However, this increase can be considered within a reasonable limit.

Nevertheless, test conditions and data collected are not sufficient to finally assess the impact on flight crew workload induced by the ASEP procedures.

Refer to [7] and [9] for more details.

The achieved results cannot be considered conclusive. In general, a slight improvement of each of the measured metrics was observed, although this variation resulting from the use of ASEP manoeuvres is not significant. For the investigated scenarios using traffic figures forecasted for 2025 and using current route structures, the performed validations indicate that the ASEP manoeuvres do not provide significant evidences of the expected benefits for the KPAs under analysis.

In addition, results regarding Interval Management manoeuvres are not representative enough to provide conclusions.

The appropriateness, feasibility and impact (on both controller and pilots) to combine CPDLC and ASEP manoeuvres shall be addressed in specific evaluations.

The investigations have been performed in fixed route network. Free route / 4D might be different.

1.3 Project Deliverables

The following table presents the relevant deliverables that have been produced by the project.

Reference	Title	Description
D02	Initial OSED	This initial OSED focuses on the definition of the ASAS Separation (ASEP) concept in En-route continental airspace operations and contributes to the targeted improvement CM-0702 – "Ad hoc Delegation of Separation to Flight Deck – Crossing & Passing" for the Operational Focus Area (OFA) 03.02.04. It also addresses ASEP considering all operational opportunities (e.g. in lower airspace/extended TMA) within continental airspace where benefits may be obtained while the project was initially targeting only the En Route continental airspace.
D06	4.7.6 Validation Strategy	This deliverable documents the project validation strategy as basis to guide the elaboration of detailed validation plans needed to the validation activities performed (Fast Time simulation techniques and Experts group supported by Mock-ups in V1 phase). The strategy at project level aimed to ensure the consistency and coherency amongst the validation activities.
D08	V1 - FTS Validation Report	This VALR describes the results of the validation exercises and how they were organised and conducted. It includes validation context and approach, validation objectives and detailed exercises plan of the validation activities. According to the validation plan (D07 V1–FTS VPLAN), two exercises were conducted based on two different operational scenarios: Madrid ACC and Rome ACC. The FTS validation activities aimed to measure the impact of the ASEP applications on certain KPAs, mainly focusing on capacity, efficiency and environmental sustainability.
D10	V1 - Mock-ups Validation Report	This document contains the validation report (VALR) of the SESAR P04.07.06 Step 3 V1 Groundside and Airborne side Mock-Up Validation to assess ASAS Separation (ASEP) applications under investigation. The VALR describes the results of the validation as well as the preparation and execution of the exercise and the subsequent data analysis. The validation context, the used approach and the validation objectives are described and referenced to the related Validation Plan (D09).

1.4 Contribution to Standardisation

No notable contribution from the project to standardisation activities.

1.5 Project Conclusion and Recommendations

The concept of delegation of separation responsibility has been rather welcome for conflict-solving manoeuvres.

Evidence suggests the concepts are feasible and no issues were identified at this stage that would prevent the concept being developed further. This is a positive outcome at V1.

All manoeuvres may have potential to bring benefits and no scenarios should be discounted at this stage without further evidence of their potential benefits or risks. However, only some manoeuvres are seen as mature enough to be progressed to V2. Further analysis is required for some manoeuvres to allow a judgement on their feasibility to be made. These should remain at V1 level.

As the validations have been conducted with the current route structures and ACC sectors which appear to be not adequate to accommodate the traffic figures forecasted for the targeted Step3 operational environment, it is strongly recommended to continue the validation activities incorporating future airspace and route structures (e.g. Free Route) in order that the traffic samples better accommodate the targeted Step 3 environment.

In addition, uncertainty over the target avionics platform and the operational baseline for Step 3 precludes a reasonable assessment of cost and benefit at this time. It is recommended to reconsider the assumptions made for the performed validation activities when a more consolidated information regarding Step 3 environment will be available.

In conclusion, the introduction of ASEP applications should be investigated with a possible introduction of an “airborne separation minima” smaller than the current ground one. That may bring to an additional increases in capacity and flight efficiency, enabling aircraft to fly more closely to their business optimum.

2 References

[1] SESAR Programme Management Plan, Edition 03.00.01

[2] European ATM Master Plan

[3] Multilateral Framework Agreement ("MFA") signed between the SJU, EUROCONTROL and its 15 selected members on August 11, 2009, amended on 14 June 2010, 19 October 2010 and 2 July 2012

[4] 04.07.06-D02-Initial OSED, final, 27/08/2013

[5] 04.07.06-D06.Validation Strategy 00.01.00, 17/06/2011

[6] 04.07.06-D07-V1 - FTS Validation Plan, 14/02/2012

[7] 04.07.06-D08-V1 - FTS Validation Report, 14/01/2013

[8] 04.07.06.D09-V1 Mock-ups Validation Plan, 20/02/2012

[9] 04.07.06.D10-V1 Mock-ups Validation Report, 02/04/2013

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