Final Project Report

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Abstract

The project provided a controller tool to support the time-based separation procedure. The tool has been based on the operational inputs from the 6.8.1 project and used in a validation exercise in Release 3.

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Rational for rejection
None.

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00.01.00	30/09/2015	Final Version	SELEX ES	Update including NATS comments and SJU Assessment

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This deliverable consists of SJU foreground.

Acronyms

Acronym	Definition
ADD	Architecture Definition Document
ATCO	Air Traffic Controller
ATM	Air Traffic Management
AMAN	Arrival Manager
ANSP	Air Navigation Service Provider
ASAS	Airborne Separation Assurance System
ATC	Air Traffic Control
CWP	Controller Working Position
DBS	Distance Based Separation
DLR	German Aerospace Research Institute
DMAN	Departure Manager
DME	Distance Measuring Equipment
DOD	Detailed Operational Description
E-ATMS	European Air Traffic Management System
FDP	Flight Data Processing
GS	Ground Speed
HMI	Human Machine Interface
IAS	Indicated Air Speed
ICAO	International Civil Aviation Organisation
INTEROP	Interoperability Requirements
IRS	Interface Requirements Specification
ITV	Intelligent Time Vector
Kt	Knots
LVP	Low Visibility Procedure

MTBCF	Mean Time Between Critical Failures
MTTR	Mean Time To Repair
NM	Nautical Mile
OCD	Operational Concept Description
OR	Operational Requirements
OSED	Operational Service and Environment Definition
PWS	Pair Wise Separation
RNAV	Area Navigation
SDPS	Surveillance Data Processing System
SESAR	Single European Sky ATM Research Programme
SJU	SESAR Joint Undertaking (Agency of the European Commission)
SJU Work Programme	The programme which addresses all activities of the SESAR Joint Undertaking Agency.
SNET	Safety Nets
SPR	Safety and Performance Requirements
TAD	Technical Architecture Description
TAS	True Air Speed
TBS	Time Based Separation
TR	Technical Requirements
TS	Technical Specification
TTP	Trailing Target Position
VISn	Visibility condition “n”
WDS	Weather Dependent Separation
WP	Work Package
WTC	Wake Turbulence Category

1 Project Overview

The project defined detailed technical documentation (system requirements, architecture assessment, safety assessment) and prototypes for Time Based Separation procedures, based on the operational inputs from the 6.8.1 project and used in a validation exercise in Release 3.

1.1 Project progress and contribution to the Master Plan

The activities addressed by project 10.04.04 contributed to the following system enablers as captured in the ATM Master Plan.

Code	Name	Project contribution	Maturity at project start	Maturity at project end
APP ATC 156	Approach ATC system to support TBS in final approach	The Project 10.04.04 delivered system specifications and prototypes for implementing an ATC tool to support TBS in final approach phase.	V2	V2
APP ATC 74	Support for Reduced, Weather-Dependent Separation Standards in Final Approach	The Project 10.04.04 delivered system specifications and prototypes for implementing an ATC tool to support TBS in final approach phase.	V2	V2

The project defined, developed and tested the tool to support the Time Based Separation on the Final Approach Controlling Position.

The objective of applying time based separation on final approach is to improve the landing rate resilience to headwind conditions on final approach through recovering the lost landing rate currently experienced when applying distance based separations (DBS). This is to be achieved by stabilising the delivered time spacing between aircraft on final approach across headwind conditions.

To achieve this objective, the project defined the technical specifications and the architecture assessment of an appropriate tool which has been implemented by three different industry partners and used in a validation exercise in Release 3.

In particular, project 10.04.04 activities have been sub-divided into the following tasks:

- **Technical Specification**

  The project formulated System Requirements for the TBS ground tool taking into account the operational requirements received from the operational counter-part project 06.08.01. A considerable amount of effort has been spent to ensure the traceability of the TS to the 06.08.01 OSED, which will help for subsequent deployment of safety assurance.

  Key system function is the calculation of the Time Based Separation based on the landing aircraft sequence and on a defined WTC table. The time separation, expressed in seconds, is then translated into a spacing separation and displayed on the final approach controller position.

The system specification constituted the reference document for the TBS system prototype development and for their verification. A part of the System Requirements have been validated with the exercise EXE-05.06.06-VP-199, while the rest of them have been only implemented in different prototypes.

- **Architecture Assessment**

  The project formulated the system design, including logical interfaces with ATC and weather systems. The Technical Architecture Document delivered has been a main input to the following phases of the P 12.02.02 Wake Vortex Decision Support System Architecture, to include additional functionalities.

  The Architecture Assessment Report was aligned with the System Requirements document and with the Preliminary System Architecture. It was also aligned with the System Requirements Phase 1 - Time Based Separation of the 12.02.02.

- **Safety Assessment**

  The project performed the Safety Assessment of the Time-Based Separations (TBS) concept as defined in the OFA 01.03.01. It was performed an initial safety assessment aiming at the identification of potential safety issues due to the introduction of Time Based Separation operations. The analysis has been performed in compliance with WP16 requirements.

- **Prototype Development and Test Execution**

  The project developed the Time Based Separation tool integrated in the CWP of the Final Approach Controllers based on the Technical Specifications. The prototype was developed by the three different industry partners with different scopes.

  In particular the Selex prototype was delivered implementing the first set of requirements and used in the validation exercise EXE-05.06.06-VP-199.

  The Thales and Indra prototypes implemented the final set of requirements. Both of them were planned to be used in two exercises (EXE-06.08.01-VP-688 for the Thales prototype, EXE-06.08.01-VP-136 for the Indra prototype) but the exercises have been cancelled.

  All prototypes and tools have been subject to internal testing and verification before being integrated into the background system.

- **Support to Validation**

  During the Validation Exercise EXE-05.06.06-VP-199 the project gave technical support for the integration and the usage of the TBS tool. The project gave also support in the post-exercise analysis of the collected data.

Concluding, project 10.04.04 results offered support to other SESAR projects in the evaluation of the TBS concept. In particular 10.4.4 demonstrated the technical feasibility of achieving the benefits relating to TBS.

The SESAR 10.04.04 project team was composed by one ANSP (NATS) and three industry partners (Indra, Thales and Selex (Lead)).

1.2 Project Achievements

A summary of the project achievements is presented below:

- The project defined detailed technical requirements for TBS tool traced to 6.8.1 OSED. They can be used by a standardisation group as base reference input for the preparation of standard technical system specification
- The project defined the technical documentation (architecture assessment and preliminary safety assessment) supporting the technical requirements
- The project prototypes have been implemented and used in validation exercises to demonstrate the benefits of the TBS concept
- The technical contribution of the project highlighted the need of future investigation on the following areas: Safety analysis, requirements for the integration of the TBS with the AMAN tool, requirements for the integration of the TBS with SNETs.

1.3 Project Deliverables

A summary of the project deliverables is presented in the table below:

Deliverable Code	Deliverable Name	Description
D03	Safety Assessment Report	Initial Safety analysis linked to the operational Safety Assessment performed in the Operational project.
D04	Architecture Assessment Report	The deliverable addresses the proposed Architecture Assessment for the TBS tool.
D07	Thales Verification Plan	The deliverable constitutes the list of the Verification objectives and tests to be performed on the TBS prototype developed by Thales.
D08	Selex Verification Plan	The deliverable constitutes the list of the Verification objectives and tests to be performed on the TBS prototype developed by Selex.
D10	Thales test verification report	The deliverable constitutes the list of the tests executed on the TBS prototype developed by Thales.
D11	Selex test verification report	The deliverable constitutes the list of the tests executed on the TBS prototype developed by Selex.

D13	Selex support to validation report	The deliverable contains a report on the support to the validation activities conducted using the TBS prototype developed by Selex.
D16	Indra Verification Plan	The deliverable constitutes the list of the Verification objectives and tests to be performed on the TBS prototype developed by Indra.
D17	Indra Test verification report	The deliverable constitutes the list of the tests executed on the TBS prototype developed by Indra.
D18	System Requirements Finalized	The deliverable addresses the final version of the System Requirements, closing the loop after the operational requirements updates.

1.4 Contribution to Standardisation

The project contributed to the Time Based Separation concept with the definition of technical requirements for the TBS tool and for the integration with other tools (e.g. AMAN).

It provided useful inputs for the project 6.8.1 (operational), for the technical activities of the 12.2.2 and for the exercise EXE-05.06.06-VP-199 in Release 3.

1.5 Project Conclusions and Recommendations

From the project point of view, 10.4.4 demonstrated the technical feasibility of achieving the benefits related to TBS. The implementation of the concept by three different industries shown that the developments are achievable on different platforms. This suggests that the requirements, passing through different review and update cycles, are platform independent and mature enough for the future deployment. Anyway more validation exercises are expected, in order to validate the entire set of requirements. From an operational point of view, the results shown that TBS represents a good foundation for progressing with Pairwise and Weather Dependent Separation within a Service Oriented Architecture.

The integration of the TBS concept in aerodromes without strong headwind conditions as well as the integration of TBS with other tools and procedures (e.g. ASAS spacing manoeuvres, SNET, etc.) might need to be further investigated before entering into a future operational employment. In addition to this, prior to any deployment within an operational environment, it will be needed a full Safety and Security assessment.

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] Latest Project baseline please see https://extranet.sesarju.eu/WP_10/Project_10.04.04/Latest/SCH_10.04.04_Latest_Approved_Baseline.mpp

[5] 10.04.04 D02 System Requirements Edition 00.01.00 – Date 23/Jul/2012

[6] 10.04.04-D03-Safety Assessment Report Edition 00.01.00 – Date 26/Feb/2015

[7] DEL10.04.04-D06_Selex_Prototype_Development-availability_note Edition 00.01.01 – Date 30/Oct/2013

[8] 10.04.04-D07- Thales Verification Plan Edition 00.01.00 – Date 17/Jan/2014

[9] DEL10.04.04_D08_Selex_verification_plan Edition 00.01.01 – Date 31/Oct/2013

[10]10.04.04-D18-System Requirements finalized_update Edition 00.01.01 – Date 28/May/2015

[11]DEL10.04.04_D11_Selex_Verification_Report Edition 00.01.01 – Date 08/Nov/2013

[12]DEL10.04.04-D13 Selex Support to validation report Edition 00.01.00 – Date 27/Feb/2014

[13]10.04.04-D16-Indra verification plan Edition 00.01.00 – Date 10/Apr/2014

[14]10 04 04-D04-Architecture Assessment Report Edition 00.01.00 – Date 09/Oct/2012

[15]10.04.04-D05- Thales Availability Note Edition 00.01.00 – Date 17/Jan/2014

[16]10.04.04-D10- Thales Verification Report Edition 00.01.00 – Date 17/Jan/2014

[17]10.04.04-D14-System requirements consolidated Edition 00.01.00 – Date 20/May/2014

[18]10.04.04-D15-Indra prototype development delivery sheet Edition 00.01.00 – Date 06/06/2014

[19]10.04.04-D17 - Indra test verification report Edition 00.01.00 – Date 06/06/2014

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