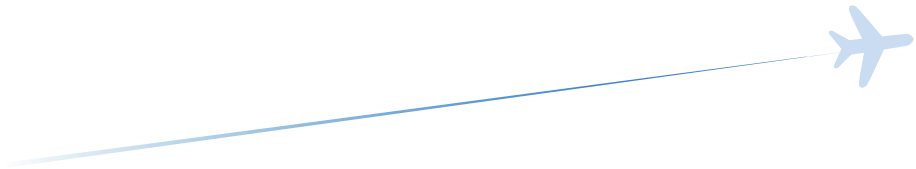

SESAR Solution PJ.11-A4: Initial VALP for V2 - Part I

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00.00.03	23/04/2018	Initial VALP	Eva Jošth Adamová	Safety criterions added into EXE-04
00.01.00	02/05/2018	Initial VALP	Eva Jošth Adamová	Partner's comments

incorporated.

CAPITO

CAPITO

This [insert type of result] is part of a project that has received funding from the SESAR Joint Undertaking under grant agreement No 732996 under European Union's Horizon 2020 research and innovation programme.

Abstract

- [list]

Table of Contents

The VALP Template includes the following parts:

- ***VALP Template – Part I (this volume)***
- VALP Template – Part II Safety Assessment Plan (SAP)
- VALP Template – Part III Security Assessment Plan (SeAP)
- VALP Template – Part IV Human Performance Assessment Plan (HPAP)

List of Tables

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Note to Authors (please reveal formatting ¶ to see instructions)

THESE INSTRCUTIONS MUST BE REMOVED BEFORE THE SUBMISSION OF THE DELIVERABLE

1 Executive Summary

2 Introduction

2.1 Purpose of the document

This document provides the Initial Validation plan for PJ.11-A4 (SA+ capability) for V2 – to the extent required for V1 gate.

It describes how stakeholder's needs (defined and formalised as a set of requirements in) are intended to be validated.

[…]

2.2 Intended readership

The intended audience for this document are members of PJ11-A4 solution and PJ11 members in general. At a higher programme level, the Content Integration project (PJ19) who is responsible for coordination and integration of solutions, as well as development of validation strategy with appropriate validation targets. In addition, GA/R/military airspace users, as main stakeholders, may have an interest in this document.

2.3 Background

TSAA is an application based on ADS-B aimed to provide an alerting to General Aviation (GA) pilots for surrounding traffic for which the algorithm detects a future conflict. The application has been specified in RTCA DO-317B/DO-348 standards, which have been adopted by EUROCAE as equivalent ED-194A/ED-232. TSAA algorithm and application requirements have been tuned against encounter models representative of the US airspace and, while recognizing “military aircraft could potentially utilize this application to reduce the risk of a mid-air collision” considered only GA.

2.4 Structure of the document

2.5 Glossary of terms

Term	Definition	Source of the definition
Automatic dependent surveillance broadcast (ADS-B)	A means by which aircraft, aerodrome vehicles and other objects can automatically transmit and/or receive data such as identification, position and additional data, as appropriate, in a broadcast mode via a data link.	ICAO
General Aviation	General Aviation (GA) is defined by ICAO as "all civil aviation operations other than scheduled air services and non-scheduled air transport	PJ.11-A4

	operations for remuneration or hire". This encompasses a wide range of activity: • Pilot training • Business aviation • Recreation including balloon, glider and model aircraft flying • Agriculture including crop spraying • Mail and newspaper deliveries • Transport of dangerously ill people and of urgently needed human organs, medical equipment and medicines • Monitoring ground traffic movements from the air • Civil search/rescue • Law enforcement including operations against smuggling • Aerial survey including photography for map making and pipeline and power cable patrols • Pollution control and fire fighting • Flying displays and aircraft platforms: • Fixed wing • Rotary wing • Unconventional (e.g. balloons, airships, gliders, autogyro) In the context of PJ11-A4 "General Aviation" will indicate Fixed Wing platforms used for GA activities. This PJ11-A4 GA definition will include the EASA Safety Categories: "Aerial Work/Part SPO Aeroplanes" and "Non−Commercial Operations Aeroplanes".	
Rotorcraft (R)	In the context of PJ11-A4 with Rotorcrafts (or Helicopters) will indicate a rotary wing platform of any size (from Ultra-light to Medium, Heavy) used for GA, Commercial, Aerial Work, Customs, Police activities, including military helicopters as part of their operations in non-segregated	PJ.11-A4

	airspaces.	
State aircraft	In the context of PJ11-A4 "State Aeroplanes" will indicate any Military, Police, Customs Fixed Wing platform flying in non-segregated airspace, excluding Transport Type aircrafts. Example of aeroplanes considered in this category are: military fast jets, military trainers, BizJet used e.g. for: police, custom, search & rescue, VIP transport, hospital transport, etc.	PJ.11-A4
Near Mid Air Collision	Near Mid Air Collision (NMAC) occurs when two aircraft come within 100 feet vertically and 500 feet horizontally	TCAS MOPS (DO-185)
Unequipped aircraft	An aircraft which is not equipped with any collision avoidance.	PJ.11-A4
Equipped aircraft	An aircraft equipped with TCAS II or potentially ACAS X system.	PJ.11-A4
Mixed encounters	In terms of this validation plan, mixed encounters refer to encounters involving two aircraft where one is equipped by ACAS and second is unequipped.	PJ.11-A4

Table 1: Glossary of terms

2.6 Acronyms and Terminology

Acronym	Definition
1090ES	Mode S Extended Squitter
A/C	Aircraft
ACAS	Airborne Collision Avoidance System
ACAS Xa	ACAS X – Active
ACAS Xp	ACAS X – Passive
ACE	Active Coordination Emulation
ADD	Architecture Definition Document
ADS-B	Automatic Dependent Surveillance – Broadcast
ADS-R	ADS-B Rebroadcast

Acronym	Definition
AIRB	Basic Airborne Situation Awareness
AMC	Acceptable Means of Compliance
ASA	Aircraft Surveillance Applications
ASIAS	Aviation Safety Information Analysis and Sharing
ASRS	Aviation Safety Reporting System
ATC	Air Traffic Control
ATM	Air Traffic Management
ATS	Air Traffic Services
AU	Airspace Users
AVAL	European encounter model based on 2007/2008 radar data
CA/CAS	Collision Avoidance (System)
CAT	Commercial Air Transport
CATI	Cockpit Annunciator for Traffic Information
CAZ	Collision Airspace Zone
CDTI	Cockpit Display of Traffic Information
CPA	Closest Point of Approach
DOD	Detailed Operational Description
EATMA	European ATM Architecture
E-ATMS	European Air Traffic Management System
E-OCVM	European Operational Concept Validation Methodology
EASA	European Aviation Safety Agency
ECAC	European Civil Aviation Conference
EVAcq	Enhanced Visual Acquisition
FAA	Federal Aviation Administration

Acronym	Definition
FLARM	Traffic and collision warning system for GA
GA	General Aviation
GNSS	Global Navigation Satellite System
HAZ	Hazard Zone
HAZ'	No Hazard Zone
HMD	Horizontal Miss Distance
IA	Intersect Angle
IFR	Instrument Flight Rules
IMC	Instrument Meteorological Conditions
IRS	Interface Requirements Specification
LLEM	Lincoln Lab Encounter Model
LPAT	Low Power ADS-B Transceiver
INTEROP	Interoperability Requirements
MAC	Mid-Air Collision
MOPS	Minimum Operational Performance Standards
MTOM	Maximum Take-Off Mass
MTOW	Maximum Take-Off Weight
MTTA	Military Transport-Type Aircraft
NAS	National Airspace System
NAT	Nearby Airborne Traffic
NMAC	Near Mid-Air Collision
NTSB	National Transportation Safety Board
OPA	Operational Performance Assessment
PAZ	Protected Airspace Zone

Acronym	Definition
PCAS	Portable Collision Avoidance System
PRs	Performance Requirements
RA	Resolution Advisory
RHV	Relative Horizontal Velocity
RTCA	American Standardisation body that produces MOPS for TCAS
RVV	Relative Vertical Velocity
RWY	Runway
OFA	Operational Focus Areas
OSED	Operational Service and Environment Definition
SA	Situation Awareness
SA+	Enhanced Situation Awareness (TSAA+)
SBS	Surveillance and Broadcast Services
SESAR	Single European Sky ATM Research Programme
SESAR Programme	The programme which defines the Research and Development activities and Projects for the SJU.
SJU	SESAR Joint Undertaking (Agency of the European Commission)
SJU Work Programme	The programme which addresses all activities of the SESAR Joint Undertaking Agency.
SPR	Safety and Performance Requirements
SUA	Special Use Airspace
SUT	System Under Test
SVFT	Special Visual Flight Rules
TA	Traffic Advisory
TABS	Traffic Awareness Beacon system
TAD	Technical Architecture Description

Acronym	Definition
TAS	Traffic Advisory System
TCA	Traffic Caution Alert
TCAS	Traffic Alert and Collision Avoidance System
TD	Traffic Display
TIS	Traffic Information Service
TIS-B	Traffic Information Services – Broadcast
TRAMS	TCAS RA Monitoring System
TS	Technical Specification
TSA	Traffic Situational Awareness
TSAA	Traffic Situation Awareness with Alerts
TSAA+	Enhanced TSAA (refer to SA+)
VALP	Validation Plan
VALR	Validation Report
VALS	Validation Strategy
VFR	Visual Flight Rules
VMC	Visual Meteorological Conditions
VMD	Vertical Miss Distance
VP	Verification Plan
VR	Verification Report
VS	Verification Strategy
UAT	Universal Access Transceiver

Table 2: Acronyms and terminology

3 Context of the Validation

3.1 Validation Plan context

This validation will consist of three exercises aiming to elaborate and validate the operational concept and achievable benefits of TSAA+ and TSAA systems.

1. Honeywell exercise (EXE-04) will be a real-time simulation using TSAA+ system prototype in a cockpit simulator, focusing on validation of human and technology integration, and pilot's acceptability using selected GA and R scenarios.
2. Thales exercise (EXE-05) will be a fast-time simulation aiming to assess quantitatively the benefits of TCAS II information broadcast ("+" functionality of TSAA) on TSAA-equipped aircraft, in terms of probability of near-mid-air collision (NMAC). Four different types of potential GA pilot manoeuvres will be simulated and evaluated in terms of NMAC probability.
3. Leonardo exercise (EXE-06) will be a fast-time simulation complementing EXE-03 of V1 validation, by refining evaluation of TSAA alerting performance through differentiation between GA fixed wing and helicopter scenarios, airport and en-route operations, and evaluation of additional military mixed-equipage encounters. The need for refined evaluation has been identified during V1 validation.

All three exercises will be based on real European mixed-equipage encounters provided by EUROCONTROL.

3.2 SESAR Solution XX: a summary

SESAR Solution ID	SESAR Solution Description	Master or Contributing (M or C)	Contribution to the SESAR Solution short description	OI Steps ref. (from EATMA)	Enablers ref. (from EATMA)
SESAR Solution PJ.11-A4 Airborne Collision Avoidance for General Aviation and	Airborne Collision Avoidance for General Aviation and Rotorcraft - ACAS Xp provides Airborne Collision Avoidance to GA/RC, taking into	C	This VALP address SA+ capability only.	CM-0808-p Collision Avoidance for General Aviation and Rotorcraft (ACAS Xp)	AC-54a

Rotorcraft (ACAS Xp)[2]	account their limited capability to carry equipment and their operational specificities.				

Table 3: SESAR Solution(s) under Validation

[…]

3.3 SESAR Solution XX: Key R&D Needs

[…]

3.4 Validation Targets apportioned to the SESAR Solution

KPA/Sub-Operating Environment	Sub-Operating Environment 1	Sub-Operating Environment 2	Sub-Operating Environment 3	…

Table 4: Validation Targets apportioned to the SESAR Solution

3.5 Initial and Target Maturity levels

SESAR Solution	OI Steps	Initial level	Maturity	Target level	Maturity	Reused validation material from past R&D Initiatives

Table 5: Maturity levels table

[2] Note, since PJ.11-A4 is currently addressing two different capabilities, they will most likely split in 2019 (once SA+ capability reach V1 maturity). Consequently – solution title, description, OI steps and enablers will be updated.

4 SESAR Solution Validation Plan for V2

4.1 SESAR Solution PJ.11-A4 Validation Approach for V2

High-level approach to validation concept, covering all three exercises, is depicted at the figure below.

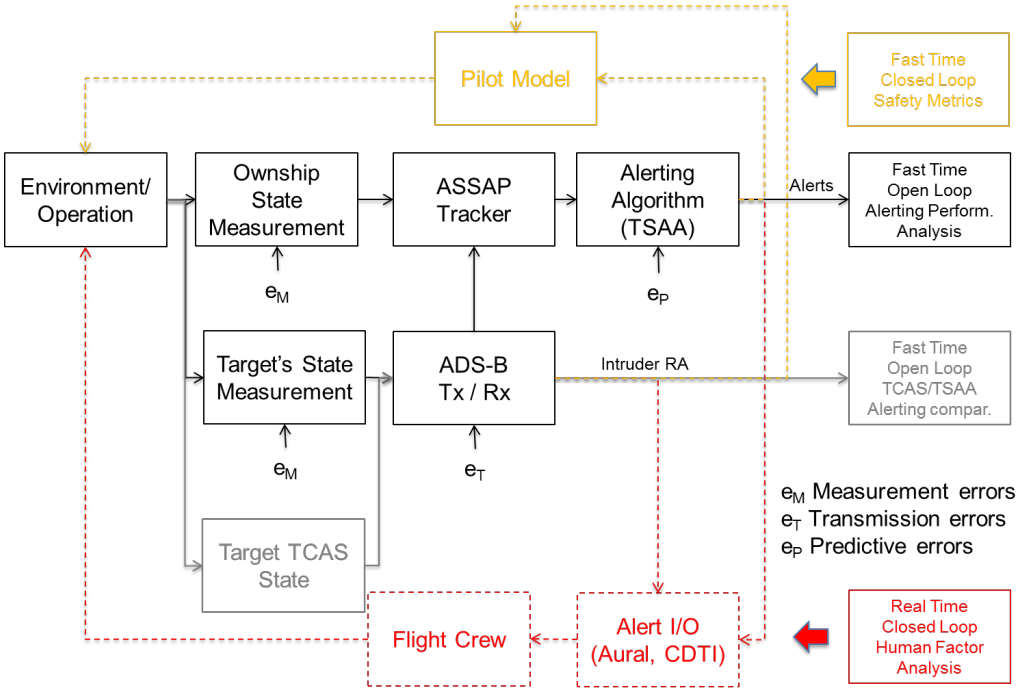

Figure 1: PJ11-A4 Overall Validation Concept

EXE-04 (red)

Real-time human-in-the-loop cockpit simulation will be performed by Honeywell in Brno, Czech Republic. Goal of this exercise will be to demonstrate safety benefits and HMI acceptability for pilots. Several GA and Heli pilots, actively controlling the aircraft, will be presented to traffic scenarios specifically designed to provide controlled encounters that would test TSAA+ system in different ways.

Figure 2: Honeywell part-task simulator to be used for EXE-04

Honeywell part-task simulator, with low fidelity cockpit layout, can simulate both GA aircraft and helicopter. Out-of-the-window view is displayed on 240° wide curved visualization. TSAA+ system prototype will depict traffic on smartphone or tablet (depending on pilot preference). Traffic generator to repeatedly execute scenarios in both en-route and highly maneuvering traffic pattern environment will be used. Two to four background targets (both TCAS II equipped and unequipped) will be displayed.

Both safety and human performance aspects will be addressed by this validation exercise.

EXE-05 (yellow)

Fast-time simulation by Thales will be performed in Paris, France. Using Thales simulation platform SIMPLY with improved pilot model implemented, the V2 validation activities will concern the assessment of TSAA+ benefits vs. TSAA in encounters, where the intruder is a TCAS II-equipped aircraft, as in V1 phase.

The difference between V1 and V2 phases is that in V2 phase 4 types of TSAA+ manoeuvre will be performed:

1. Level Off: The pilot maintains a vertical speed between -250 and +250 ft/min.
2. Do Not Descend/Do Not Climb: The pilot maintains a vertical speed that complies with RA from intruder. If RA is Don't Climb, then any vertical speed less than or equal to 0 ft/min complies with the advisory.
3. Descend/Climb: The pilot maintains a vertical speed of at least 500 ft/min in the direction that complies with RA. If RA is Don't Descend, then any climb rate greater than 500 ft/min complies with the advisory.
4. Maintain Vertical Speed: The pilot maintains the current vertical speed of the aircraft.

TSAA aircraft behaviour against TCAS II intruder will be improved.

The assessment criteria for TSAA+ and TSAA encounters will be based on NMAC probability.

As an input, European de-identified mixed equipage encounters (equipped/unequipped) provided by EUROCONTROL will be used.

EXE-06 (black)

Fast-time simulation by Leonardo will be performed in Genova, Italy. Using Leonardo simulation platform with TSAA system implemented, the exercise will aim to address gaps identified in V1 evaluation (EXE-03), and complement incomplete V1 results for:

- TSAA alerting performance assessment differentiated between GA Fixed Wing and Helicopter scenarios;
- TSAA alerting performance assessment differentiated between Airport and en-route;
- Enhance TSAA Assessment for TCAS <-> Military encounters;

4.2 Stakeholder's expectations

Stakeholder	Involvement	Why it matters to stakeholder
Airspace Users – Pilots (GA/R/MIL)	Direct	GA pilots expect to have improved situational awareness by using visual information and being informed about the manoeuvre issued on board of TCAS II equipped aircraft. All pilots expect safety to be maintained or increased (potential reduction of NMAC and MAC). Pilots confidence will be increased if knowing the manoeuvre the intruder is about to take. Pilots expect decreased risk of GA aircraft manoeuvring against TCAS equipped aircraft.
Airspace Users - Airlines	Indirect	Airlines expect maintained or increased safety (potential reduction of NMAC).
ANSPs	Indirect	ANSPs expect maintained or increased safety, ideally decreased risk of NMAC/MAC.
Airborne Industry	Indirect	Airborne industry expect to develop useful application improving situational awareness of airspace users in need that will bring revenues (profit). Airborne industry expect to participate in safe integration of GA and rotorcraft operations.
National Governments	Indirect	National governments expect improved overall flight safety through safe GA/Rotorcraft/StA operations integration. They expect reduced risk of NMAC/MAC and thus less time spent on analysis of accidents.

Regulatory Authorities	Indirect	Regulatory authorities expect to have harmonized regulations.

Table 6: Stakeholders' expectations

4.3 Validation Objectives

The SA+ capability of this solution has only one objective defined for V2 phase: **Evaluate operational benefits of SA+ during mixed equipage encounters and achieve 2 maturity level for this capability.**

This high-level objective, can be consequently broken into three V2 validation objectives as follows:

[OBJ]

Identifier	OBJ-PJ.11.A4-VALP-0004
Objective	Demonstrate safety benefits and HMI acceptability for pilots.
Title	Real-time evaluation of TSAA+.
Category	<human performance>, <safety>
Key environment conditions	Core European airspace, mixed equipage encounters, based on real data collected during 2015/2016.
V Phase	V2

[OBJ Trace]

Relationship	Linked Element Type	Identifier
		PJ.11-A4

[OBJ Suc]

Identifier	Success Criterion
CRT-PJ.11.A4-VALP-0004-001	See and avoid failures involving GA aircraft were reduced by about 3% (which is about half of the IFR/GA *6%* cases where see and avoid currently fails).[3]
CRT-PJ.11.A4-VALP-0004-002	GA Pilot induced conflict situation identified in the encounter set (if any) shows improvement when using TSAA+ system

[3] safety success criterions are to be verified with EUROCONTROL safety expert to ensure that they are properly set for the final V2 VALP.

CRT-PJ.11.A4-VALP-0004-003	The role of human is shown to be consistent with human capabilities and limitations.
CRT-PJ.11.A4-VALP-0004-004	Proposed HMI demonstrated to be human-centered, designed to efficiently supervise GA/Heli pilots.
CRT-PJ.11.A4-VALP-0004-005	Transition factors have been considered.

Table 7: Validation Objective layout (EXE-04)

[OBJ]

Identifier	OBJ-PJ.11.A4-VALP-0005
Objective	Evaluate different pilot reactions with SA+/TSAA+ system during mixed equipage encounters and assess the improvement of ACAS performance with GA involvement.
Title	Pilot reaction & safety assessment of TSAA+
Category	<performance>, <safety>
Key environment conditions	Core European airspace, mixed equipage encounters, based on real data collected during 2015/2016.
V Phase	V2

[OBJ Trace]

Relationship	Linked Element Type	Identifier

[OBJ Suc]

Identifier	Success Criterion
CRT-PJ.11.A4-VALP-0005-001	The probability of NMAC without and with TSAA+ was assessed for encounters including GA/R/military.
CRT-PJ.11.A4-VALP-0005-001	50% reduction of the cases when GA aircraft compromises an ACAS resolution advisory on a nearby equipped aircraft intended to resolve a potential collision with it (risk of avoidance invalidated by other aircraft is currently 6%)

Table 8: Validation Objective layout (EXE-05)

[OBJ]

Identifier	OBJ-PJ.11.A4-VALP-0006
Objective	To assess TSAA alerting capability in European airspace for GA fixed wing, Rotorcrafts and Military airspace users in encounters with TCAS equipped aircrafts.
Title	TSAA alerting capability assessment
Category	<acceptability> <performance>
Key environment conditions	Mixed equipage encounters, based on real data collected during 2015/2016. Airport, En-Route (Low), En-Route (High)
V Phase	V2

[OBJ Trace]

Relationship	Linked Element Type	Identifier

[OBJ Suc]

Identifier	Success Criterion
CRT-PJ.11.A4-VALP-0006-001	Missed Alert % and Outlying Alert % are <5% for GA Fixed Wing Encounters with TCAS equipped Intruders in Airport environments
CRT-PJ.11.A4-VALP-0006-002	Missed Alert % and Outlying Alert % are <5% for Rotorcraft Encounters with TCAS equipped Intruders in Airport environments
CRT-PJ.11.A4-VALP-0006-003	Missed Alert % and Outlying Alert % are <5% for Military Encounters with TCAS equipped Intruders in Airport environments
CRT-PJ.11.A4-VALP-0006-004	Missed Alert % and Outlying Alert % are <5% for GA Fixed Wing Encounters with TCAS equipped Intruders in En-Route environments
CRT-PJ.11.A4-VALP-0006-005	Missed Alert % and Outlying Alert % are <5% for Rotorcraft Encounters with TCAS equipped Intruders in En-Route environments
CRT-PJ.11.A4-VALP-0006-006	Missed Alert % and Outlying Alert % are <5% for Military Encounters with TCAS equipped Intruders in En-Route environments

Table 9: Validation Objective layout (EXE-06)

[…]

4.4 Validation Assumptions

Identifier	Title	Type of Assumption	Description	Justification	Flight Phase	KPA Impacted	Source	Value(s)	Owner	Impact on Assessment

Table 10: Validation Assumptions overview

[…]

4.5 Validation Exercises List

[EXE]

Identifier	
Title	
Description	
Expected Achievements	
V Phase	
Use Cases	
Validation Technique	
KPA/TA Addressed	
Start Date	
End Date	
Validation Coordinator	

Validation Platform	
Validation Location	
Status	
Dependencies	

[EXE Trace]

Linked Element Type	
<SESAR Solution>	
<Sub-Operating Environment>	
<Validation Objective>	

Table 11: Validation Exercise layout

4.6 Validation Exercises Planning

[…]

4.7 Deviations with respect to the SJU Project Handbook

[…]

5 Validation Exercises

5.1 Validation Exercise #04 Plan (Honeywell)

5.1.1 Validation Exercise description and scope

[…]

5.1.2 Stakeholder's expectations and Benefit mechanisms addressed by the exercise

Stakeholder	Involvement	Why it matters to stakeholder

Table 12: Stakeholders' expectations

[…]

5.1.3 Validation objectives

SESAR Solution Validation Objective	SESAR Solution Success criteria	Coverage and comments on the coverage of SESAR Solution Validation Objective in Exercise 001	Exercise Validation Objective	Exercise Success criteria

Table 13: Validation Objectives addressed in Validation Exercise 1

[…]

5.1.4 Validation scenarios

[…]

5.1.4.1 Reference Scenario(s)

[…]

5.1.4.2 Solution Scenario(s)

[…]

5.1.5 Exercise Assumptions

Identifier	Title	Type of Assumption	Description	Justification	Flight Phase	KPA Impacted	Source	Value(s)	Owner	Impact on Assessment

Table 14: Validation Exercise Assumptions

5.1.6 Limitations and impact on the level of Significance

[…]

5.1.7 Validation Exercise Platform / Tool and Validation Technique

5.1.7.1 Validation Exercise Platform / Tool characteristics

V&V Platform Name	[…]	
A.1.1	It is a new developed V&V platform?	
A.1.2	If yes, which are the reasons supporting the development of a new platform?	
A.2	It is the first time to be used for a SESAR validation exercise	
A.3	It is used the first time in a SESAR validation exercise and it needs new features to be implemented	
B	Which operational scenarios / improvements/etc. (general) can	

	be validated on the new V&V Platform?	
C	Which validation needs are going to be supported by the new platform (not covered by the existing platforms)?	
D	Which validation methods can be used on the new V&V Platform?	

Table 15: Validation Exercise Platform / Tool characteristics

[…]

5.1.7.2 Architectural view: mapping Validation Infrastructure and SUTs onto EATMA

V&V Platform Name	[…]	
B.1	Which are the ATM Domain Systems supported by the V&V Platform?	
B.2	Which functional blocks of the IBP will be provided and/or needed to support the operational concepts validation?	

Table 16: Validation Exercise Platform / Tool mapping onto EATMA

[…]

[…]

5.1.7.3 Validation Exercise Technique

[…]

5.1.8 Analysis Specification

5.1.8.1 Data collection methods

[…]

5.1.8.2 Analysis method

[…]

5.1.9 Exercise Planning and management

5.1.9.1 Activities

[…]

5.1.9.2 Roles & Responsibilities in the exercise

[…]

5.1.9.3 Time planning

[…]

Activity	Week					
	1	2	3	4	…	n

Table 17: Detailed time planning

5.1.9.4 Identified Risks and mitigation actions

Risks	Impact (1-Very Low, 2-Low, 3-Medium, 4-High, 5-Very High)	Probability (1-Very Low, 2-Low, 3-Medium, 4-High, 5-Very High)	Mitigation Actions

Table 18: Risks and mitigation actions

[…]

5.2 Validation Exercise #05 Plan (Thales)

5.2.1 Validation Exercise description and scope

V1 validation activities were performed as FTS (Fast Time Simulation) on Thales simulation platform SIMPLY using TSAA capability model and TCAS II capability model.

The objective was to assess qualitatively, the benefits of TCAS II information broadcast ("+") on TSAA-equipped aircraft, in terms of probability of near mid-air collision (NMAC).

Following scenarios have been applied in the validation:

1. TCAS II-equipped intruder vs. TSAA equipped ownship with modification of original ownship trajectory by pilot reaction (using preliminary pilot reaction model described below) as soon as SA alert is raised,

2. TCAS II-equipped intruder vs. TSAA+ equipped aircraft with the assumption, that TSAA+ pilot will, after the reception of RA information from intruder, **not modify originally planned trajectory** (e.g. no pilot model applied). **During validation execution, this assumption has been shown as inappropriate from operational point of view and might even have a negative impact on the probability of NMAC**. It was concluded that such scenario rather describes **baseline scenario, which represent today situation** in which the ownship does not have an ADS-B In capability, not AIRB/EVAq applications nor TSAA and in which the intruder and ownship encounter tracks are identical to those recorded by SSR (provided by EUROCONTROL).

V2 validation activities for Thales concern the assessment of TSAA+ benefits vs TSAA in encounters where the intruder is a TCAS II-equipped aircraft, as in V1 phase.

The difference between V1 and V2 phases is that in V2 phase 4 types of TSAA+ maneuver will be performed:

1. Level Off: The pilot maintains a vertical speed between -250 and +250 ft/min.
2. Do Not Descend/Do Not Climb: The pilot maintains a vertical speed that complies with RA from intruder. If RA is Don't Climb, then any vertical speed less than or equal to 0 ft/min complies with the advisory.
3. Descend/Climb: The pilot maintains a vertical speed of at least 500 ft/min in the direction tht complies with RA. If RA is Don't Descend, then any climb rate greater than 500 ft/min complies with the advisory.
4. Maintain Vertical Speed: The pilot maintains the current vertical speed of the aircraft.

TSAA aircraft behaviour model against TCAS II intruder will be improved.

As an input, European de-identified mixed equipage encounters (equipped/unequipped) provided by EUROCONTROL will be used.

5.2.2 Stakeholder's expectations and Benefit mechanisms addressed by the exercise

Stakeholder	Involvement	Why it matters to stakeholder

Table 19: Stakeholders' expectations

[…]

5.2.3 Validation objectives

SESAR Solution Validation Objective	SESAR Solution Success criteria	Coverage and comments on the coverage of SESAR Solution Validation Objective in Exercise 001	Exercise Validation Objective	Exercise Success criteria

Table 20: Validation Objectives addressed in Validation Exercise 1

[…]

5.2.4 Validation scenarios

[…]

5.2.4.1 Reference Scenario(s)

[…]

5.2.4.2 Solution Scenario(s)

[…]

5.2.5 Exercise Assumptions

Identifier	Title	Type of Assumption	Description	Justification	Flight Phase	KPA Impacted	Source	Value(s)	Owner	Impact on Assessment

Table 21: Validation Exercise Assumptions

5.2.6 Limitations and impact on the level of Significance

[…]

5.2.7 Validation Exercise Platform / Tool and Validation Technique

5.2.7.1 Validation Exercise Platform / Tool characteristics

V&V Platform Name	[…]	
A.1.1	It is a new developed V&V platform?	
A.1.2	If yes, which are the reasons supporting the development of a new platform?	
A.2	It is the first time to be used for a SESAR validation exercise	
A.3	It is used the first time in a SESAR validation exercise and it needs new features to be implemented	
B	Which operational scenarios / improvements/etc. (general) can be validated on the new V&V Platform?	
C	Which validation needs are going to be supported by the new platform (not covered by the existing platforms)?	
D	Which validation methods can be used on the new V&V Platform?	

Table 22: Validation Exercise Platform / Tool characteristics

[…]

5.2.7.2 Architectural view: mapping Validation Infrastructure and SUTs onto EATMA

V&V Platform Name		[…]
B.1	Which are the ATM Domain Systems supported by the V&V Platform?	
B.2	Which functional blocks of the IBP will be provided and/or needed to support the operational concepts validation?	

Table 23: Validation Exercise Platform / Tool mapping onto EATMA

[…]

[…]

5.2.7.3 Validation Exercise Technique

[…]

5.2.8 Analysis Specification

5.2.8.1 Data collection methods

[…]

5.2.8.2 Analysis method

[…]

5.2.9 Exercise Planning and management

5.2.9.1 Activities

[…]

5.2.9.2 Roles & Responsibilities in the exercise

[…]

5.2.9.3 Time planning

[…]

Activity	Week					
	1	2	3	4	…	n

Table 24: Detailed time planning

5.2.9.4 Identified Risks and mitigation actions

Risks	Impact (1-Very Low, 2-Low, 3-Medium, 4-High, 5-Very High)	Probability (1-Very Low, 2-Low, 3-Medium, 4-High, 5-Very High)	Mitigation Actions

Table 25: Risks and mitigation actions

[…]

5.3 Validation Exercise #06 Plan (Leonardo)

5.3.1 Validation Exercise description and scope

TSAA is an application based on ADS-B aimed to provide an alerting to General Aviation (GA) pilots for surrounding traffic for which the algorithm detects a future conflict. The application has been specified in RTCA DO-317B/DO348 standards, which have been adopted by EUROCAE as equivalent ED-194A/ED-232. TSAA algorithm and application requirements have been tuned against encounter models representative of the US airspace and, while recognizing “military aircraft could potentially utilize this application to reduce the risk of a mid-air collision” considered only GA.

SESAR2020 PJ11-A4 has in its scope the study of possible benefit of providing to TSAA Pilot the information of a TCAS RA in case of a TCAS intruder (TSAA+). As part of this activity the TSAA

performance has been preliminarily evaluated as a baseline for the TSAA+ improvements, considering:

- SSR radar tracks gathered in central Europe over 1 year (2015/16)
- mixed encounters (i.e. TSAA ownship and TCAS intruder)
- in which ownship were a mix of GA Fixed Wing, Rotary wing and Military aircraft (with no TCAS)

While established methodology has been adopted for TSAA performance assessment, a different set of key performance indicators have been used, as considered more suitable for Safety and Operational Performance acceptability (Missed Alert %[4] and Outlying Alert %[5]). Results of preliminary assessment performed in V1 Validations on this initial set of EU encounters and comparison with similar results obtained for US airspace as described in RTCA/EUROCAE specifications, have highlighted some anomalies which have been presented to SC-186 experts. While the PJ11-A4 results are still incomplete, mainly due to the European encounters set under development (e.g. no GA-GA encounters, very few military encounters, no separate helicopters encounters) it is anticipated that an update of RTCA/EUROCAE standards may be necessary.

Considering that EUROCONTROL will not make available radar tracks of Uneq-Uneq close encounters in a timeframe compatible with V2 validations, V2 Validation objectives are:

- Encounter Modelling (EUROCONTROL + PJ11-A4/A2 partners):
    - continue filtering out anomalous/unsuitable encounters from existing encounter set (e.g. split tracks, military parallel flights)
    - identification of «Airport encounters» from the existing Encounter Data set
    - identification of «Helicopter encounters» from the Encounter Data set
    - analysis and validation of additional encounters from other ANSP
- V2 FTS Simulation Runs objectives:
    - TSAA alerting performance assessment differentiated between GA Fixed Wing and Helicopter scenarios
    - TSAA alerting performance assessment differentiated between Airport and Enroute
    - Enhance TSAA Assessment for TCAS <-> Military encounters

5.3.2 Stakeholder's expectations and Benefit mechanisms addressed by the exercise

[4] Missed alerts % includes both late alerts and events when no alert is issued; a late alert is any required alert issued less than 12.5 seconds before Closest Point of Approach (CPA)

[5] is the portion of the total issued Alerts, which are not due as the intruder never entered an HAZ' volume

Stakeholder	Involvement	Why it matters to stakeholder

Table 26: Stakeholders' expectations

[…]

5.3.3 Validation objectives

SESAR Solution Validation Objective	SESAR Solution Success criteria	Coverage and comments on the coverage of SESAR Solution Validation Objective in Exercise 001	Exercise Validation Objective	Exercise Success criteria

Table 27: Validation Objectives addressed in Validation Exercise 1

[…]

5.3.4 Validation scenarios

[…]

5.3.4.1 Reference Scenario(s)

[…]

5.3.4.2 Solution Scenario(s)

[…]

5.3.5 Exercise Assumptions

Identifier	Title	Type of Assumption	Description	Justification	Flight Phase	KPA Impacted	Source	Value(s)	Owner	Impact on Assessment

Table 28: Validation Exercise Assumptions

5.3.6 Limitations and impact on the level of Significance

[…]

5.3.7 Validation Exercise Platform / Tool and Validation Technique

5.3.7.1 Validation Exercise Platform / Tool characteristics

V&V Platform Name	[…]	
A.1.1	It is a new developed V&V platform?	
A.1.2	If yes, which are the reasons supporting the development of a new platform?	
A.2	It is the first time to be used for a SESAR validation exercise	
A.3	It is used the first time in a SESAR validation exercise and it needs new features to be implemented	
B	Which operational scenarios / improvements/etc. (general) can be validated on the new V&V Platform?	
C	Which validation needs are going to be supported by the new platform (not covered by the existing platforms)?	
D	Which validation methods can be used on the new V&V Platform?	

Table 29: Validation Exercise Platform / Tool characteristics

[…]

5.3.7.2 Architectural view: mapping Validation Infrastructure and SUTs onto EATMA

V&V Platform Name		[…]
B.1	Which are the ATM Domain Systems supported by the V&V Platform?	
B.2	Which functional blocks of the IBP will be provided and/or needed to support the operational concepts validation?	

Table 30: Validation Exercise Platform / Tool mapping onto EATMA

[…]

[…]

5.3.7.3 Validation Exercise Technique

[…]

5.3.8 Analysis Specification

5.3.8.1 Data collection methods

[…]

5.3.8.2 Analysis method

[…]

5.3.9 Exercise Planning and management

5.3.9.1 Activities

[…]

5.3.9.2 Roles & Responsibilities in the exercise

[…]

5.3.9.3 Time planning

[…]

Activity	Week					
	1	2	3	4	…	n

Table 31: Detailed time planning

5.3.9.4 Identified Risks and mitigation actions

Risks	Impact (1-Very Low, 2-Low, 3-Medium, 4-High, 5-Very High)	Probability (1-Very Low, 2-Low, 3-Medium, 4-High, 5-Very High)	Mitigation Actions

Table 32: Risks and mitigation actions

[…]

6 References

6.1 Applicable Documents

Content Integration

[1] B.04.01 D138 EATMA Guidance Material

[2] EATMA Community pages

[3] SESAR ATM Lexicon

Content Development

[4] B4.2 D106 Transition Concept of Operations SESAR 2020

System and Service Development

[5] 08.01.01 D52: SWIM Foundation v2

[6] 08.01.01 D49: SWIM Compliance Criteria

[7] 08.01.03 D47: AIRM v4.1.0

[8] 08.03.10 D45: ISRM Foundation v00.08.00

[9] B.04.03 D102 SESAR Working Method on Services

[10] B.04.03 D128 ADD SESAR1

[11] B.04.05 Common Service Foundation Method

Performance Management

[12] B.04.01 D108 SESAR 2020 Transition Performance Framework

[13] B.04.01 D42 SESAR2020 Validation Targets for SESAR1 Step1 and for SESAR 2020 Transition

[14] B.05 D86 Guidance on KPIs and Data Collection support to SESAR 2020 transition.

[15] 16.06.06-D68 Part 1 –SESAR Cost Benefit Analysis – Integrated Model

[16] 16.06.06-D51-SESAR_1 Business Case Consolidated_Deliverable-00.01.00 and CBA

[17] Method to assess cost of European ATM improvements and technologies, EUROCONTROL (2014)

[18] ATM Cost Breakdown Structure_ed02_2014

[19] Standard Inputs for EUROCONTROL Cost Benefit Analyses

[20] 16.06.06_D26-08 ATM CBA Quality Checklist

[21] 16.06.06_D26_04_Guidelines_for_Producing_Benefit_and_Impact_Mechanisms

Validation

[22] 03.00 D16 WP3 Engineering methodology

[23] Transition VALS SESAR 2020 - Consolidated deliverable with contribution from Operational Federating Projects

[24]European Operational Concept Validation Methodology (E-OCVM) - 3.0 [February 2010]

System Engineering

[25] SESAR Requirements and V&V guidelines

Safety

[26] SESAR, Safety Reference Material, Edition 4.0, April 2016

[27] SESAR, Guidance to Apply the Safety Reference Material, Edition 3.0, April 2016

[28] SESAR, Final Guidance Material to Execute Proof of Concept, Ed00.04.00, August 2015

[29] SESAR, Resilience Engineering Guidance, May 2016

Human Performance

[30] 16.06.05 D27 HP Reference Material D27

[31] 16.04.02 D04 e-HP Repository - Release note

Environment Assessment

[32] SESAR, Environment Reference Material, alias, “Environmental impact assessment as part of the global SESAR validation”, Project 16.06.03, Deliverable D26, 2014.

[33] ICAO CAEP – “Guidance on Environmental Assessment of Proposed Air Traffic Management Operational Changes” document, Doc 10031.

Security

[34] 16.06.02 D103 SESAR Security Ref Material Level

[35] 16.06.02 D137 Minimum Set of Security Controls (MSSCs).

[36] 16.06.02 D131 Security Database Application (CTRL_S)

6.2 Reference Documents

[37] ED-78A GUIDELINES FOR APPROVAL OF THE PROVISION AND USE OF AIR TRAFFIC SERVICES SUPPORTED BY DATA COMMUNICATIONS.[6]

6

Appendix A KPI Data Collection for Performance KPIs

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