Validation Plan (VALP) for 2016 validation of ACAS Xa

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Abstract

This document provides the Technical Validation Plan for the second phase of ACAS Xa validation activities planned within the task T026 scope of SESAR 9.47 project focusing on performance evaluation of surveillance functions (STM) of ACAS Xa. While the first phase of validation defined in P9.47-D20 was conducted as fast-time simulation (with model based on Run13 version of ACAS X system), the second phase focuses on the technical validation of ACAS Xa surveillance in real European environment, when SESAR 9.47 ACAS Xa experimental platform will track the real traffic in the proximity of Toulouse airport via fixed roof-top antenna installation. The results obtained from roof-top validation, will be consequently compared with results obtained during Run13 STM evaluation (D21).

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Executive summary

This document provides the Technical Validation Plan for the second phase of ACAS Xa validation activities, planned within the task T026 scope of SESAR 9.47 project, focusing on performance evaluation of surveillance functions (STM) of ACAS Xa. While the first phase of validation defined in P9.47-D20 was conducted as fast-time simulation (with model based on Run13 version of ACAS X system), the second phase focuses on the technical validation of ACAS Xa surveillance in real European environment, when SESAR 9.47 ACAS Xa experimental platform will track the real traffic in the proximity of Toulouse airport via fixed roof-top antenna installation.

This validation plan consists of one exercise EXE-09.47-VP-824 with three main objectives:

- to validate the overall performance of ACAS Xa surveillance in real environment (roof –top),

- to compare the performance of ACAS Xa surveillance in real environment (roof-top) with results obtained during Run13 STM fast-time evaluation, and

- to evaluate the suitability of ACAS Xa surveillance settings for in current environment considering the active/passive surveillance data usage and 1030/1090 MHz frequency load.

Targeted maturity level within SESAR1 is V2 and this Validation Exercise concludes ACAS Xa validation within SESAR 9.47 and the results are expected to be used as input for next ACAS Xa development and validation activities planned within the scope of SESAR2020.

1 Introduction

1.1 Purpose of the document

This document provides the Technical Validation Plan for the second phase of ACAS Xa validation planned within the task T026 of SESAR 9.47 project. While the first phase of validation defined in P9.47-D20 was conducted as a fast-time simulation (based on Run13 version of ACAS Xa system), the second phase focuses on the technical validation of ACAS Xa surveillance in real European environment, when SESAR 9.47 developed experimental ACAS Xa platform will track the real traffic in the proximity of Toulouse airport via fixed roof-top antenna installation.

1.2 Intended readership

This document is addressed to all stakeholders with the aim to clearly describe ACAS Xa 2016 Technical Validation strategy within SESAR 9.47 project to elicit their feedback on the planned activities and validation goals.

1.3 Structure of the document

This document is organized in the following way:

- General context of the validation is provided in **Chapter 2**.

- Validation approach as well as its objectives, scenarios and assumptions are specified in **Chapter 3**.

- Validation exercise EXE-09.47-VP-824 is described in details in **Chapter 4**.

- And **Chapter 5** consists of the list of references.

1.4 Glossary of terms

Active surveillance - a type of surveillance including active tracking, where the tracking data about the target are obtained through interrogation of its transponder and subsequent analysis of transmission characteristics (delay, incoming direction) of its reply.

Passive surveillance – a type of surveillance including passive tracking, where the tracking data about the target are obtained through ADS-B reports.

True data – are the estimation of the true flown aircraft position and velocity. For real measured data this information is not known and it is obtained through post-processing by combining both active and passive data in order to exclude jitter, bias and latency errors from recorded measurements. For sensitivity study the "true" data are known and are represented by simulated trajectory before its degradation by surveillance errors.

Jitter – random deviation of measurements.

Bias – systematic offset between measurements and true values.

Latency – systematic time delay between real time of measurement and time of applicability.

1.5 Acronyms and Terminology

Term	Definition
ACAS	Airborne Collision Avoidance System
ACAS Xa	ACAS X - Active
ADD	Algorithm Design Description
ADS-B	Automatic Dependant Surveillance – Broadcast
ATM	Air Traffic Management
CPA	Closest Point of Approach
DOD	Detailed Operational Description
E-ATMS	European Air Traffic Management System
E-OCVM	European Operational Concept Validation Methodology
FAA	Federal Aviation Administration
GA	General Aviation
IRS	Interface Requirements Specification
INTEROP	Interoperability Requirements
KPA	Key Performance Area
MIT	Massachusetts Institute of Technology
MOPS	Minimum Operational Performance Standards
OFA	Operational Focus Areas
OSED	Operational Service and Environment Definition
RA	Resolution Advisory
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

Term	Definition
STM	Surveillance and Tracking Module
SUT	System Under Test
TA	Traffic Advisory
TAD	Technical Architecture Description
TCAS	Traffic Alert and Collision Avoidance System
TRM	Threat Resolution Module
TS	Technical Specification
VALP	Validation Plan
VALR	Validation Report
VALS	Validation Strategy
VP	Verification Plan
VR	Verification Report
VS	Verification Strategy

2 Context of the Validation

2.1 Scope/perimeter of the validation

Validation Exercise ID and Title	EXE-09.47-VP-824 : ACAS Xa validation in real environment (roof-top testing)
Leading organization	Honeywell
Validation exercise objectives	Evaluate the surveillance performance of ACAS Xa in real environment and compare it with Run13 performance
Rationale	The aim of this validation is to evaluate surveillance functions of ACAS Xa in real environment for the first time (in Europe) and compare observed performance with Run13 using model STM developed during P.09.47-T021.
Supporting DOD / Operational Scenario / Use Case	The overall performance of ACAS Xa system
OFA addressed	OFA 03.04.02 Enhanced ACAS operations
OI steps addressed	CM-0808 Enhanced ACAS logic adapted to Trajectory Based Operations
Enablers addressed	AC/54-A Enhanced Airborne Collision Avoidance (ACAS)
Applicable Operational Context	All airborne operations in En Route & TMA.
Expected results per KPA	Surveillance performance contributing to Increase in **Safety**
Validation Technique	Roof-top testing
Dependent Validation Exercises	N/A

Table 1: Concept Overview

2.2 Stakeholder identification, needs and involvement

❖ **SESAR 9.47** project consortium partners as this validation plan address the activities within the tasks T9.47-028.

❖ **SESAR 4.8.1 (Enhanced safety nets for en-route TMA operations)** and **OFA 3.4.2 (Enhanced ACAS Operations)** as the proposed activities complement their validation work.

❖ **EUROCAE WG 75/RTCA SC-147** and FAA ACAS X program as the proposed activities should help to mature the surveillance requirements for ACAS Xa and provide feedback for future development.

2.3 Maturity levels

The planned work addresses the enabler CM-0808: <u>Enhanced Airborne Collision Avoidance adapted to Trajectory based operations (CM-0808).</u>

As shown in Table 2, the initial maturity level of Enhanced ACAS (Step 2 OI CM-0808) is V1.

The targeted maturity level within SESAR1 is V2 and this Validation Exercise conclude ACAS Xa validation within SESAR 9.47. Next ACAS Xa development and validation activities are planned within the scope of SESAR2020.

Operational Package	Operational Sub-Package	Operational Focus Area	OIs	Initial Maturity level	Target Maturity level			Reused validation material from past R&D Initiatives
					V1	V2	V3	
PAC03 Moving from Airspace to Trajectory Management	**SPC03.04** Air Safety Nets	**OFA03.04.02**	**CM-0808**	**V1**		✓		SESAR 9.47 – D21

Table 2: Maturity levels table

3 Validation Approach

3.1 Validation Approach at OFA level

Table 3 summarises planned (and already completed) validation activities at OFA level, as well as the contributions of the primary projects participating to **OFA03.04.02 (Enhanced ACAS operations)**. These validation activities cover a series of OI Steps to validate the evolution of airborne safety net (i.e. ACAS) over the three Steps of the SESAR Concept Story board.

Operational Focus Area	OIs	Step	Planned validation activities in SESAR P04.08.01			Planned validation activities in SESAR P09.47		
			V1	V2	V3	V1	V2	V3
OFA03.04.02 Enhanced ACAS	CM-0802 ACAS Resolution Advisory Downlink	1		✓ *(VP-332)*	✓ *(VP-066)*			
	CM-0808 Enhanced ACAS logic adapted to Trajectory Based Operations	**2**	✓ *(04.08.02 : VP-M192)*	✓ (*VP-703, 704, 705, 706, 707,* **VP- 582, 812, 813, 814**)		✓ *(VP-807,808, 809)*	*(VP-810* **VP-824** *-> this VALP)*	

Table 3: Planned validation activities at OFA level

Exercise numbers written in **bold**, are under preparation.

As part of SPC03.04 (Air Safety Nets), **OFA03.04.02 (Enhanced ACAS) only contributes to the Safety KPA**. There are no targets on this OFA for other KPA (i.e. capacity, environment, etc…).

The main goal of OFA03.04.02 is to ensure that Airborne Safety Net (i.e. ACAS) will continue to play a major role as the last safety barriers against collision in future En-Route and TMA environment as envisaged for the three Steps of the SESAR Concept Story Board.

3.2 Validation Overview

Project SESAR 9.47 is part of OFA03.04.02 (Enhanced ACAS), and its contribution to validation activities at OFA level is described in table above.

The validation exercise defined in this document aims to validate the behaviour of Run14 ACAS Xa surveillance in real European environment, and together with human performance assessment (performed within P04.08.01) conclude European Run14 validation.

During this P09.47 validation, ACAS Xa experimental platform will be installed at a roof-top testing facility in Airbus lab in Toulouse to track real traffic in the proximity. The surveillance performance in real environment will be evaluated, and results obtained using installed system will be compared to results from previous PC-based evaluation of Run13 STM. Consequently the suitability of ACAS Xa surveillance setting in current European environment will be assessed.

3.3 Stakeholders Validation Expectations

Stakeholder	External / Internal	Involvement	Why it matters to stakeholder	Performance expectations	Exercise Identifier
Flight Crew	Internal	Direct (ACAS user)	Last safety barrier against the risk of mid-air collision Their lives are at risk	Maintaining or increasing current safety level on their aircraft	EXE-09.47-VP-824
Executive Controller (ATCO) / Air Navigation Service Provider (ANSP)	Internal	Direct (Alerted of ACAS event)	Last safety barrier against the risk of mid-air collision ACAS can save an accident	Maintaining or increasing current safety level in their airspace Increasing compatibility with their practises (e.g. reducing undesirable alert in their airspace)	EXE-09.47-VP-824
Airborne equipment manufacturer	External	Indirect	Developer and seller of ACAS	Validated operational, performance and safety requirements allowing evaluating impact on the avionics. **A good understanding of benefits and benefits mechanisms.**	EXE-09.47-VP-824
Airlines	External	Indirect	Buyer of ACAS	Maintaining or increasing current safety level on their aircraft **Reducing disruption of their aircraft trajectories**	EXE-09.47-VP-824
Standardisation bodies (EUROCAE / RTCA)	External	Indirect	Developer of ACAS MOPS	**Mature and beneficial changes to ACAS**	EXE-09.47-VP-824

Table 4: Stakeholders' expectations

3.4 Deviations with respect to the Validation Strategy and Transversal Reference Material

No deviations.

3.5 Benefit Mechanisms Overview

The benefits investigated and presented in this document are those of ACAS X. Table below provides benefit mechanisms of ACAS Xa produced within operational project P04.08.02 [4] (now P04.08.01).

Feature	Impact Area	Indicators		Benefit or negative impacts		Key Performance Area / Transversal Area
ACAS Xa	**Safety of ACAS**	Number of mid-air and near mid-air collisions	↓	Safety of ER / TMA operations	↑	Safety
	Alerting performance of ACAS	Number of not operationally relevant resolution advisories	↓	Compatibility of ACAS with ATM operations	↑	Safety
	Alerting performance of ACAS	Number of not operationally relevant resolution advisories	↓	Pilot acceptability of ACAS alerts	↑	Safety & Human Performance

Table 5: Benefit mechanisms overview

Validation activities described in this document address primarily the performance of the new surveillance functions and its impact on the overall system behaviour – and therefore also on the targeted benefits.

3.6 Validation Objectives

[OBJ]

Identifier	OBJ-09.47-VALP-Xa14-0001
Objective	Validate the overall performance of ACAS Xa surveillance in real environment
Title	ACAS Xa surveillance validation in real environment
Status	<In Progress>

[OBJ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<SATISFIES>	<V&V Objective>	V&V Objective Identifier (VALP,VALS)	<Full>
<COVERS>	<ATMS Requirement>	Requirement Identifier(OSED, SPR)	N/A
<COVERS>	<V&V SUT Requirement>	V&V SUT Requirement Identifier	N/A
<COVERS>	<OI Step>	CM-0808	N/A
<ALLOCATED_TO>	<Operational Focus Area>	OFA 03.04.02	N/A
<ALLOCATED_TO>	<Project>	09.47	N/A
<CHANGED_BECAUSE_OF>	<Change Order>	Change Reference	N/A

[OBJ Suc]

Identifier	Success Criterion
CRT-09.47-VALP-0001-0001	The probability that true state of intruder lies outside of sigma sample area shall be lower than (or equal to) 5%.
CRT-09.47-VALP-0001-0002	The accuracy of tracked values shall be better than the accuracy of the input surveillance data.

[OBJ]

Identifier	OBJ-09.47-VALP-Xa14-0002
Objective	Compare the performance of ACAS Xa in real environment (roof-top) with results obtained during Run13 STM fast-time evaluation.
Title	Surveillance performance comparison
Status	<In Progress>

[OBJ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<SATISFIES>	<V&V Objective>	V&V Objective Identifier (VALP,VALS)	<Full>
<COVERS>	<ATMS Requirement>	Requirement Identifier(OSED, SPR)	N/A
<COVERS>	<V&V SUT Requirement>	V&V SUT Requirement Identifier	N/A
<COVERS>	<OI Step>	CM-0808	N/A
<ALLOCATED_TO>	<Operational Focus Area>	OFA 03.04.02	N/A
<ALLOCATED_TO>	<Project>	09.47	N/A
<CHANGED_BECAUSE_OF>	<Change Order>	Change Reference	N/A

[OBJ Suc]

Identifier	Success Criterion
CRT-09.47-VALP-0002-0001	The probability that true state of intruder (during roof-top validation) lies outside of sigma sample area shall be lower or equal to Run13 STM evaluation result (62%).
CRT-09.47-VALP-0002-0002	The accuracy of tracked values (during roof-top validation) shall be better than accuracy of the input surveillance data when compared with Run13 STM evaluation results.

[OBJ]

Identifier	OBJ-09.47-VALP-Xa14-0003
Objective	Evaluate the suitability of ACAS Xa surveillance settings for current environment.
Title	Suitability of ACAS Xa surveillance settings
Status	<In Progress>

[OBJ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<SATISFIES>	<V&V Objective>	V&V Objective Identifier (VALP,VALS)	<Full>
<COVERS>	<ATMS Requirement>	Requirement Identifier(OSED, SPR)	N/A
<COVERS>	<V&V SUT Requirement>	V&V SUT Requirement Identifier	N/A
<COVERS>	<OI Step>	CM-0808	N/A
<ALLOCATED_TO>	<Operational Focus Area>	OFA 03.04.02	N/A
<ALLOCATED_TO>	<Project>	09.47	N/A
<CHANGED_BECAUSE_OF>	<Change Order>	Change Reference	N/A

[OBJ Suc]

Identifier	Success Criterion
CRT-09.47-VALP-0003-0001	The probability of cross-validation failure for ADS-B data quality shall be less than 5%.
CRT-09.47-VALP-0003-0002	Evaluation of active/passive data usage rate completed.
CRT-09.47-VALP-0003-0003	The usage or 1030/1090 MHz frequency shall not be higher than with TCAS II with extended hybrid surveillance capability.

Table 6: Validation Objective layout

3.7 Validation Scenarios

[SCN]

Identifier	SCN-09.47-VALP-Xa14-0001
Scenario	ACAS Xa experimental platform tracking real traffic in the proximity of roof-top antenna installation
Status	<In Progress>

[SCN Trace]

Relationship	Linked Element Type	Identifier	Compliance
<JUSTIFIES>	<V&V Objective>	V&V Objective Identifier (VALP,VALS)	N/A
<CHANGED_BECAUSE_OF>	<Change Order>	Change Reference	N/A

[SCN]

Identifier	SCN-09.47-VALP-Xa14-0002

Scenario	Use of surveillance data recorded during roof-top evaluation within Run 13 fast time simulations.
Status	<In Progress>

[SCN Trace]

Relationship	Linked Element Type	Identifier	Compliance
<JUSTIFIES>	<V&V Objective>	V&V Objective Identifier (VALP,VALS)	N/A
<CHANGED_BECAUSE_OF>	<Change Order>	Change Reference	N/A

Table 7: Validation Scenario layout

3.8 Validation Assumptions

Identifier	Title	Type of Assumption	Description	Justification	Flight Phase	KPA Impacted	Source	Value(s)	Owner	Impact on Assessment
ASS-00.09.47-VALP-Xa.0001	Representativeness of traffic sample	Traffic Characteristics	Traffic sample recorded during roof-top testing will represent typical European fleet equipment.	The validation should assess ACAS X performance in European environment.	N/A	Environment	Expert judgement	N/A	N/A	Low
ASS-00.09.47-VALP-2	Data sample	Airport Characteristics	Data collected during the validation will be sufficient for adequate data analysis and generating of representative results.	The validation will be performed using roof-top installation only, tracking aircraft near Toulouse airport.	N/A	Environment	Expert judgement	10-12 hours recorded	9.47	High

Identifier	Title	Type of Assumption	Description	Justification	Flight Phase	KPA Impacted	Source	Value(s)	Owner	Impact on Assessment
ASS-00.09.47-VALP-Xa.0003	ADS-B quality requirements decreased	Aircraft Equipage / Technology	ADS-B data with SIL=1 and SIL=2 will be allowed to pass to TRM	There is a requirement, that only ADS-B with SIL=3 can be qualified to pass to TRM. In current environment, this requirement would not be met.	N/A	Environment	Expert judgement	N/A	9.47	Medium
ASS-00.09.47-VALP-Xa.0004	ACAS X software version	Aircraft Equipage / Technology	The same software version that will be used for 04.08.01 human aspects validation will be used for this validation.	This will in the end enable to provide a full picture of Run14 ACAS X performance in European environment.	N/A	Safety	Overall validation goal	N/A	9.47	Medium

Table 8: Validation Assumptions overview

3.9 Validation Requirements

3.9.1 Validation SUT Requirements

[REQ]

Identifier	REQ-09.47-VALP-Xa.0001
Requirement	ACAS Xa shall have the same interface as TCAS II.
Title	ACAS Xa interface
Status	<In Progress>
Rationale	ACAS Xa is being developed with assumption of compliant interface with TCAS II.
Category	<Interface>
Validation Method	<Expert Group>
Verification Method	<Inspection>

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<INDUCED_BY>	<V&V Objective>	OBJ-09.47-VALP-Xa14-0001	N/A
<SATISFIES>	<V&V SUT Requirement>	REQ-09.47-VALP-Xa.0001	<Full>
<ALLOCATED_TO>	<Project>	P.09.47	N/A
<CHANGED_BECAUSE_OF>	<Change Order>	Change Reference	N/A

Table 9: Validation System Under Test Requirement layout

3.9.2 Other Validation Requirements

Other validation requirements (not related to Validation Platform or SUT) are as follows:

- On-time availability of ACAS Xa experimental platform integrated with roof-top installation

3.10 Integration and preliminary Validation activities

The validation exercise will be performed using fixed roof-top installed antenna at Airbus lab facility in Toulouse. First of all, a slot at lab has to be assured (coordination of Honeywell and Airbus). Prior to start of validation itself, the Run14 experimental platform has to be available (Honeywell / DSNA / Airbus coordination), integrated and correctly tested at Airbus lab roof-top testing facility. Prototype is verified as successful if sample recording shows that required data were correctly recorded.

3.11 Validation Exercises List

[EXE]

Identifier	EXE_09.47_VP_824
Status	<In Progress>

[EXE Trace]

Relationship	Linked Element Type	Identifier	Compliance
<EMBEDS>	<V&V Objective>	OBJ-09.47-VALP-Xa14-0001	N/A
<EMBEDS>	<V&V Objective>	OBJ-09.47-VALP-Xa14-0002	N/A
<EMBEDS>	<V&V Objective>	OBJ-09.47-VALP-Xa14-0003	N/A
<EXECUTES>	<V&V Scenario>	SCN-09.47-VALP-Xa14-0001	N/A
<EXECUTES>	<V&V Scenario>	SCN-09.47-VALP-Xa14-0002	N/A
<CHANGED_BECAUSE_OF>	<Change Order>	Change Reference	N/A

Table 10: Validation Exercise layout

3.12 Validation Exercises Planning

2015		2016				
November	December	January	February	March	April	May
	Experimental unit available for DSNA 4.8.1 evaluation	4.8.1. human aspect evaluation (EXE-04.08.01-VP-582)				
			Exercise #824			

2015		2016				
November	December	January	February	March	April	May
			Prototype integration at Airbus lab facility and data recording			
				Data analysis		
					VALR preparation and delivery	
						(T29) STM Technical Specifications refinement

Figure 1: Validation timeline

4 Validation Activities

4.1 Validation Exercise #824 Plan – EXE-09.47-VP-824

4.1.1 Exercise Scope and Justification

4.1.1.1 Exercise Level

Level of EXE-09.47-VP-824: Function level

4.1.1.2 Description of the Operational concept being addressed

From intended function perspective, there are two key modules in the ACAS X design:

- ❖ Surveillance and Tracking Module (STM), which detects aircraft in the vicinity and tracks their position, and

- ❖ Threat Resolution Module (TRM), which identifies threats and provides resolution guidance.

Within this exercise, the ACAS Xa STM functions will be primarily evaluated in real environment. In previous phase, ACAS Xa (Run13) surveillance processing was evaluated [9] using fast-time simulations, and the impact of imperfect surveillance information on the performance of ACAS Xa logic is currently being evaluated within SESAR 9.47 – T022 (to be delivered in November 2015 as D22).

This exercise is considered as second phase of ACAS Xa validation, for the first time using complete ACAS Xa implementation in a hardware unit. In parallel with preparation of this roof-top validation, a preparation of P04.08.01 evaluation is ongoing, addressing human aspects of the system.

Targeted maturity level within SESAR1 is V2 and this Validation Exercise concludes ACAS Xa validation within SESAR 9.47. Next ACAS Xa development and validation activities will continue within the scope of SESAR2020.

4.1.1.3 Stakeholders and their expectations

The list of internal and external stakeholders for whom the exercise outcomes matter is provided in section 3.3.

4.1.1.4 Validation objectives and hypothesis

Validation objectives and success criterions (defined in 3.6) are as follows:

Identifier	OBJ-09.47-VALP-Xa14-0001
Objective	Validate the overall performance of ACAS Xa surveillance in real environment
Title	ACAS Xa surveillance validation in real environment
Status	<In Progress>
Identifier	Success Criterion
CRT-09.47-VALP-0001-0001	The probability that true state of intruder lies outside of sigma sample area shall be lower than (or equal to) 5%.
CRT-09.47-VALP-0001-0002	The accuracy of tracked values shall be better than the accuracy of the input surveillance data.

Identifier	OBJ-09.47-VALP-Xa14-0002

Objective	Compare the performance of ACAS Xa in real environment (roof-top) with results obtained during Run13 STM fast-time evaluation.
Title	Surveillance performance comparison
Status	<In Progress>
Identifier	Success Criterion
CRT-09.47-VALP-0002-0001	The probability that true state of intruder (during roof-top validation) lies outside of sigma sample area shall be lower or equal to Run13 STM evaluation result (62%).
CRT-09.47-VALP-0002-0002	The accuracy of tracked values (during roof-top validation) shall be better than accuracy of the input surveillance data when compared with Run13 STM evaluation results.

Identifier	**OBJ-09.47-VALP-Xa14-0003**
Objective	Evaluate the suitability of ACAS Xa surveillance settings for current environment.
Title	Suitability of ACAS Xa surveillance settings
Status	<In Progress>
Identifier	Success Criterion
CRT-09.47-VALP-0003-0001	The probability of cross-validation failure for ADS-B data quality shall be less than 5%.
CRT-09.47-VALP-0003-0002	Evaluation of active/passive data usage rate completed.
CRT-09.47-VALP-0003-0003	The usage or 1030/1090 MHz frequency shall not be higher than with TCAS II with extended hybrid surveillance capability.

4.1.1.5 Validation scenarios

Two validation scenarios were defined:
1. ACAS Xa experimental platform as a roof-top installation tracking real traffic in Toulouse airport vicinity.
2. Use of surveillance data recorded during roof-top evaluation within Run 13 fast time simulations.

4.1.1.5.1 Reference & Solution Scenarios

The system will be used in real traffic environment. The behaviour of the ACAS Xa will be analyzed and compared with the expected system behaviour and results obtained during 9.47 D21 [9].

4.1.1.5.2 Airport Information

N/A

4.1.1.5.3 Airspace Information

The considered airspace will be delimited by the surveillance range of the roof-top antenna installation, so it will be primarily Toulouse TMA.

4.1.1.5.4 Traffic Information

Real traffic in the proximity of the roof top antenna installation will be used. High ratio of ADS-B Out equipped traffic is desirable for the system testing, nevertheless, the results analysis will be of course adapted to the observed traffic sample.

4.1.1.5.5 Simulation

N/A

4.1.1.5.6 Additional Information

4.1.1.5.6.1 Additional info #1

N/A

4.1.1.6 Exercise Assumptions

Refer to 3.8 for list of validation assumptions.

4.1.1.7 Exercise Tool, Validation Technique and/or Platform

This exercise will be performed at the Airbus facility in Toulouse, France. The developed ACAS Xa system will be integrated in the Airbus Lab and connected to the roof-top antenna installation. In addition a logging device will be connected to the ACAS X unit for data recording.

4.1.1.8 Entrance criteria

Experimental platform with Run14 ACAS Xa system integrated, and verified by Honeywell, delivered to Toulouse and installed in the Airbus lab.

4.1.1.9 Exit Criteria

Expert's judgement about the adequacy of recorded traffic sample.

4.1.1.10   Validation Requirements

4.1.1.10.1   Validation System Under Test Requirements

N/A

4.1.1.10.2   Other Validation Requirements

Other validation requirements (not related to Validation Platform or SUT) are as follows:

- On time availability of ACAS X experimental platform integrated with roof-top installation

4.1.1.11   Platform Configuration

The validated ACAS Xa platform will be installed in Airbus integration laboratory with logging device for data recording.

4.1.1.12   Links to other Validation Exercises

Exercise described in this document is the continuation of validation activities addressed in EXE-09.47-VP-807, EXE-09.47-VP-808, EXE-09.47-VP-809 [9] and EXE-09.47-VP-810 [upcoming P09.47-D22]. This exercise (with focus given on STM) together with human aspect evaluation (focusing on TMR) will provide a compact overview of ACAS X Run14 performance.

Indirect link exists with EXE-04.08.01-VP-582, a human performance evaluation of ACAS Xa led by DSNA, which will take place just before this exercise, and will use the same HW platform as is planned to be used for roof-top validation. EXE-04.08.01-VP-582 together with EXE-09.47-VP-824 will provide a complex insight to Run14 performance.

4.1.1.13   Dependent and Independent variables

The real traffic with diverse ADS-B quality will be used for this exercise.

4.1.2 Exercises Planning and management

4.1.2.1 Activities

4.1.2.1.1 Preparatory activities

- ACAS Xa (Run14) implementation into experimental platform;
- Platform delivery to Toulouse;
- Platform installation at the Airbus lab;
- Logging tool integration with ACAS Xa;

4.1.2.1.2 Execution activities

- Roof-top validation;
- Results comparison with fast-time simulation (Run13) results;

4.1.2.1.3 Post execution activities

- Data analysis
- Validation report preparation (deliverable, D27)
- ACAS Xa STM Technical Specifications refinement (D29)
- Results dissemination

4.1.2.2 Roles & Responsibilities in the exercise

Validation roles and responsibilities corresponds to what was defined in the latest project baseline:

Honeywell

- ACAS Xa platform delivery
- Integration support at the Airbus lab
- ACAS Xa data recording setting
- Data post-processing analysis
- Results consolidation into validation report

Airbus

- ACAS Xa platform integration at Airbus laboratory
- Preparation, follow-up and execution of exposure of the ACAS Xa unit during high traffic density (8h-11h or 16h30-19h) on CNS bench with real top antenna located at the roof of Airbus lab building

- Recording device connection

- Delivery of recorded data to Honeywell

Eurocontrol

- Review of validation results

DSNA

- Provision of advice on the technical validation or during post-processing analysis

- Review of validation results

4.1.2.3 Human Resources

Activities	Detail	Effort (%)		
		TCAS Experts	**Integration Engineers**	**ATM Researchers**
Preparatory	ACAS Xa development	Leader (100%)		
	ACAS Xa verification	Contributor (30%)		Leader (70%)
	ACAS Xa integration	Contributor (20%)	Leader (80%)	
Execution	Performing test session	Contributor (20%)	Contributor (30%)	Leader (50%)
Post-Exercise	Data analysis	Contributor (50%)		Leader (50%)
TOTAL by resource provider (units)				
TOTAL (units)				

Table 11: Resources

4.1.2.4 Training

N/A

4.1.2.5 Time planning

Activity	Weeks of year 2015/2016								
	45-50	**51**	**51-5**	**6**	**7**	**8**	**9-15**	**16**	**17-20**
ACAS Xa (Run14) implementation & testing									
ACAS Xa unit delivery (for P04.08.01 human performance									

Activity	Weeks of year 2015/2016								
	45-50	51	51-5	6	7	8	9-15	16	17-20
validation)		▓							
P04.08.01 validation activities			▓						
Unit hand-over (P04.08.01 > P09.47) & integration				▓					
Roof-top validation					▓	▓			
Results analysis & comparison						▓	▓		
VALR preparation & delivery						▓	▓	▓	
ACAS X STM TS update									▓

Table 12: Detailed time planning

4.1.2.6 Risks

- Run14 ACAS X platform not available on time

4.1.2.7 Errors and Observation handling

Each observed error or unexpected behaviour will be carefully analysed into detail in order to identify the cause, and then documented. Potential implementation errors will be corrected and the analysis will be repeated with the updated implementation.

4.1.3 Analysis Specification

4.1.3.1 Data collection methods

Experimental data will be recorded using a dedicated logging device connected directly to ACAS Xa unit. This device was already used in other projects and it does not have any impact on the ACAS Xa function.

4.1.3.2 Analysis method

Data from STM processing will be statistically analysed and compared with results obtained from previous validation exercise (D21).

4.1.3.3 Data logging requirements

All required data will be logged at 1 Hz frequency.

4.1.4 Level of Representativeness/ limitations

Validation Exercise #824 will be performed using a roof-top antenna installation, thus considered airspace will be delimited by the surveillance range around Toulouse airport.

ACAS X currently requires SIL=3 for ADS-B data to be validated as a sufficient surveillance source. Since there is only a limited number of aircraft who will meet this requirement, for this exercise we will

consider SIL=1 and 2 to be sufficient as well, in order to have more frequent use of passive data as expected for future with new ADS-B Out installations.

5 References

5.1 Applicable Documents

[1] Template Toolbox 03.00.00
https://extranet.sesarju.eu/Programme%20Library/SESAR%20Template%20Toolbox.dot

[2] Requirements and V&V Guidelines 03.00.00
https://extranet.sesarju.eu/Programme%20Library/Requirements%20and%20VV%20Guidelines.doc

[3] Templates and Toolbox User Manual 03.00.00
https://extranet.sesarju.eu/Programme%20Library/Templates%20and%20Toolbox%20User%20Manual.doc

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

[5] EUROCONTROL ATM Lexicon
https://extranet.eurocontrol.int/http://atmlexicon.eurocontrol.int/en/index.php/SESAR

5.2 Reference Documents

The following documents provide input/guidance/further information/other:

[6] V&V Road Map latest version of reference

[7] ATM Master Plan
https://www.atmmasterplan.eu

[8] WPB.01 Integrated Roadmap Latest version

[9] 09.47-D21 Validation Report from Initial STM Performance Evaluation, June 2015

Appendix A Safety Plan

Not Applicable.

Appendix B   Security Plan

Not Applicable.

Appendix C   Environment Plan

Not Applicable.

Appendix D   Human Performance Assessment Plan

Not Applicable.

Appendix E   KPI Data Collection for Performance KPIs

No Performance KPIs related to Fuel Efficiency, Airspace Capacity, Airport Capacity, Predictability and Cost Effectiveness are planned to be collected, as the OFA03.04.02 (Enhanced ACAS) only deals with Safety KPA.

Appendix F   Benefit Mechanisms

The benefit mechanisms are described in 3.5.

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