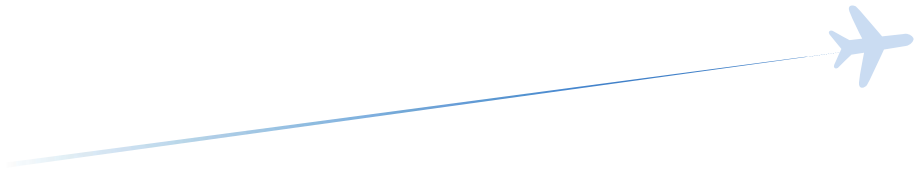

PJ.11-A3 V2 Validation Plan (Part1) for ACAS Xo

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Abstract

This deliverable is the VALP - Validation Plan. It aims at defining and planning the validation activities to be performed in V2 in the frame of the solution PJ.11-A3 "ACAS for Commercial Air Transport specific operations - ACAS Xo" included in the SESAR project PJ11 "CAPITO - Collision Avoidance Performance Improvement Technology".

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1 Executive Summary

This deliverable is the VALP - Validation Plan. It aims at defining and planning the validation activities to be performed in V2 in the frame of the solution PJ.11-A3 “ACAS for Commercial Air Transport specific operations - ACAS Xo” included in the SESAR project PJ11 "CAPITO - Collision Avoidance Performance Improvement Technology".

This plan provides objectives and scenarios to be used for validation trials. These trials will include:

- **Stakeholder Workshop** will be performed by Honeywell. These trials will take place in 2018 fall, in Honeywell facilities. The purpose of these trials is to assess and validate principles for solution in operation, and assess the maximum possible cases with variations on several parameters.
- **Real Time Simulations (RTS)** will be performed on Airbus integration simulator with V2 candidate prototype developed by project PJ.11-A3. These trials will take place in Airbus facilities with pilots from Airbus. These trials will take place in 2018 fall. The purpose of these trials is to assess and validate principles for intruder designation, alert triggering, and associated Human Machine Interface principles in case of specific operations, such as parallel approach.

This document includes:

- The context of the validation,
- The validation approach including:
  - objectives
  - assumptions
  - exercise list with planning
- A detailed view on each validation exercise with a description of the activities planned, notably validation scenarios:
  - EXE01: Stakeholder Workshop
  - EXE02: Real Time Simulations (RTS) on Airbus simulator

2 Introduction

2.1 Purpose of the document

This document provides the Validation plan for PJ.11-A3 (ACAS Xo) solution for V2 phase. It describes how stakeholder's needs (defined and formalised as a set of requirements in initial V2 OSED are intended to be validated. The validation plan consists of four parts (I to IV), the present document covers part I.

2.2 Intended readership

The intended audience for this initial document are PJ.11-A3 solution members, PJ.11 project members in general and transversal projects PJ.19 and PJ.20.

2.3 Background

"ACAS" is a generic acronym used by ICAO for the specific line of avionics that is certified to provide decision support to pilots during encounters with other aircraft when there is an imminent risk of collision. ACAS implementation, TCAS II, is mandated for all aircraft with a maximum take-off mass (MTOM) of over 5 700 kg or authorized to carry more than 19 passengers.

Since 2008, the FAA's TCAS Program Office (PO) initiated a research and development program under RTCA SC-147 of a new approach to collision avoidance – ACAS X. The work is done in cooperation with SJU, under aegis of FAA-SJU Coordination Plan 4.1. ACAS X has several variants which share an underlying common design, but have hardware, surveillance, and collision avoidance logic tailored for different user groups as summarized at the figure below.

User group	Surveillan Technolo
Current TCAS II users (large aircraft)	Active surveill supplemented ADS-B
Users of specific operations (e.g. closely-spaced parallel operations)	Active surveill supplemented ADS-B

Figure 1: ACAS X variants

In SESAR 1, two projects were addressing the development of ACAS Xa – SESAR 04.08.01 with focus on logic and SESAR 9.47 focusing on the surveillance aspects. The work undertaken in SESAR 1 now continues in SESAR2020 as solution PJ.11-A1.

Solution PJ.11-A3, address a specific function of the ACAS X system, variant ACAS Xo which allows the use of alternative CAS logic for specifically designated traffic while maintaining normal ACAS Xa alerting against all other aircraft. ACAS Xo is a supplement to ACAS Xa to allow special operations such as parallel approaches that would otherwise be likely to trigger ACAS Xa alerts. Both ACAS Xa and Xo are being developed in parallel and will share the same standard which is due at the end of 2018. In Europe, EUROCAE WG-75 group was tasked to develop ACAS X MOPS as a joint RTCA/EUROCAE activity.

2.4 Structure of the document

Sections 1 and **2** are introductory sections describing purpose of this document and its background.

Section 3 describes validation context, describes ACAS Xo feature in general, its mapping on PJ.11-A3 solution and provides traces to EATMA.

Section 4 introduces validation plan from solution point of view.

Section 5 provides more details on each exercise.

Section 6 lists reference documents.

Appendix A addressing KPI which is not applicable.

2.5 Glossary of terms

Term	Definition	Source of the definition
ACAS Xo Mode	An alternative ACAS X logic. Two ACAS Xo modes are included in MOPS document: DNA and CSPO-3000.	MOPS
Designated traffic	A particular ACAS X traffic that has been designated by the flight crew for a particular ACAS Xo mode.	CONUSE
Un-designation	A process by which either the flight crew or automation removes the designation of traffic for an ACAS Xo alternative logic mode. When traffic is undesignated, it is returned to normal ACAS X operation	CONUSE
Valid traffic	Traffic that meets the criteria, such as data quality requirements, defined for an ACAS Xo mode. Different criteria may be defined for each individual mode.	CONUSE

Table 1: Glossary of terms

2.6 Acronyms and Terminology

Term	Definition
1090ES	1090 MHz Extended Squitter
ACAS	Airborne Collision Avoidance System
ADS-B	Automatic Dependent Surveillance - Broadcast
ATC	Air Traffic Control
ATM	Air Traffic Management
CA/CAS	Collision Avoidance (System)
CDTI	Cockpit Display of Traffic Information
CNS	Communication Navigation and Surveillance
CONOPS	Concept of Operations
CR	Change Request
CSPO	Closely Spaced Parallel Operation
DNA	Designated No Alert
EATMA	European ATM Architecture
E-ATMS	European Air Traffic Management System
FAA	Federal Aviation Administration
HPAR	Human Performance Assessment Report
ICAO	International Civil Aviation Organization
IFR	Instrument Flight Rules
INTEROP	Interoperability Requirements
MOPS	Minimum Operational Performance Standards
MSL	Mean Sea Level
MTOM	Maximum Take-Off Mass
NMAC	Near Mid-Air Collision
NOZ	Normal Operating Zone

NTZ	Non Transgression Zone
KPA	Key Performance Area
OI	Operational Improvement
OPAR	Operational Performance Assessment Report
OSED	Operational Service and Environment Definition
PAR	Performance Assessment Report
PIRM	Programme Information Reference Model
RA	Resolution Advisory
QoS	Quality of Service
SAC	Safety Criteria
SAR	Safety Assessment Report
SecAR	Security Assessment Report
SESAR	Single European Sky ATM Research Programme
SJU	SESAR Joint Undertaking (Agency of the European Commission)
SPR	Safety and Performance Requirements
STM	Surveillance and Tracking Module
SWIM	System Wide Information Model
TA	Traffic Advisory
TCAS	Traffic Collision Avoidance System
TOPA	TCAS Operational Performance Assessment
TRM	Threat Resolution Module
TS	Technical Specification

Table 2: Acronyms and terminology

3 Context of the Validation

3.1 Validation Plan context

The purpose of validation is to evaluate a solution providing two ACAS Xo modes called DNA and CSPO-3000, allowing specific operations in approach (refer to next chapter for a deeper insight of the solution). The upcoming validation activities have **overall aim** to evaluate the following items:

- ACAS Xo alerting time,
- ACAS Xo designation operational acceptability,
- ACAS Xo automatic undesignation operational acceptability,
- ACAS Xo HMI and ACAS Xo algorithm acceptability at human factor perspective,
- the adapted Navigation Display symbology.

Regarding **operational environment**, ACAS Xo application can be used in airspace of any traffic density, without any additional ground equipment. CSPO-3000 operational environment is currently limited and cannot be used at high altitudes, above 14 000ft. Both modes of ACAS Xo are applicable during approaches since most of the nuisance RAs occur in this phase of flight, while DNA is not limited only to approaches and can be potentially used during closely spaced departures, or other closely spaced flight operations. Current definition of DNA however limits its application for visual conditions only. CSPO-3000 operation is possible in both visual and instrument conditions.

Regarding **geographical environment**, as there are no use cases known for parallel approaches eligible for ACAS Xo mode in the European environment, the scenarios are defined based on the study performed from US scenarios. However, these items will be rigorously similar in case of potential future European ACAS Xo operation (there is already a need for European Operators frequently serving destinations in the US). As a consequence, identified airport for DNA mode testing is SFO (San Francisco) and airport for CSPO-3000 will be picked up from one of European airports with parallel runways.

Validation exercises will be addressed with stakeholder workshop and with test sessions in a simulator with actual equipment in accordance with project PJ11a-03.

3.2 SESAR Solution PJ.11-A3: a summary

SESAR solution under the scope of this Validation Plan is ACAS Xo. ACAS Xo is a mode of operation of ACAS X designed for particular operations for which ACAS Xa is unsuitable and might generate an unacceptable number of nuisance alerts (e.g. procedures with reduced separation, such as closely spaced parallel approaches).

ACAS Xo is integrated with ACAS Xa systems, but activation of the ACAS Xo functionality is optional (through dedicated HMI). It provides additional collision avoidance logic modes designed to support closely-spaced flight operations, and allows specifically designated traffic to be monitored by an alternative ACAS logic more compatible with the flight operation than the standard ACAS Xa logic. So far, there are two Xo modes defined by RTCA in MOPS draft:

1. Closely Spaced Parallel Operations from 4,300ft down to 3,000ft runway separation mode (**CSPO-3000**) which provides designated traffic with modified CAS logic monitoring more appropriate for parallel operations; applicable in both visual and instrument conditions. ACAS Xa protection is maintained on all other cooperative traffic.

2. Designated No Alerts mode (**DNA**) which suppress all alerts and guidance (except during multi-threat encounters) on the specifically designated traffic; requiring flight crew to visually acquire the desired traffic before designating it and then maintaining visual separation from the DNA-designated aircraft. This mode is intended for use in closely-spaced operations on visual conditions, where ACAS Xa alerts would otherwise be a nuisance, ignored, and/or disruptive. DNA mode may be used instead of placing ACAS Xa into TA-only mode, preventing alerts on the designated traffic but still allowing full ACAS Xa protection from all other cooperative traffic. DNA mode is also applicable for parallel runways where separation is below 2500ft.

Additional ACAS Xo modes are expected in the future, however only CSPO-3000 and DNA will be defined in ACAS Xa/Xo MOPS with planned delivery in 2018.

OI step and enablers associated to the solution (applicable EATMA version: PUBLIC DS16—28 October 2016) are listed in the table below.

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)
PJ.11-A3	ACAS for Commercial Air Transport specific operations - ACAS Xo	M	N/A	CM-0808-o (Collision Avoidance for commercial air transport Adapted to New Separation Modes)	A/C-54a: Enhanced Airborne Collision Avoidance (ACAS)
					A/C-54b: ACAS adaptation to new separation modes

Table 3: SESAR Solution(s) under Validation

3.3 SESAR Solution PJ.11-A3: Key R&D Needs

According to R&D table that can be found in Validation Strategy [23] (which recalls the R&D needs for ACAS X), there is **no specific R&D need for ACAS Xo** compared to ACAS Xa.

3.4 Validation Targets apportioned to the SESAR Solution

The Validation Strategy for SESAR 2020 [23] defines the KPA / Focus areas for PJ11-A3 solution.

But the Validation Targets document [24] does not define values for any of each Sub-Operating Environment regarding PJ11-A3 solution: there is no quantitative information to transpose to these validation targets.

As a consequence, **this SESAR solution has no validation targets allocated**. PJ.11 is a safety project. The ATM Master Plan provides a Performance Ambition for Safety KPI as "improvement by a factor 3-4", together with "no increase in accidents", but these values are not measurable in order to assess the Validation Target for SESAR solutions.

3.5 Initial and Target Maturity levels

The maturity level of this SESAR solution currently differs for the system (technical) and HP (operational) aspects. From the system point of view, since ACAS Xo algorithms are about to be standardized in 2018 (together with ACAS Xo) and the requirements have already been defined, they can be considered mature. Within the standardization activities, initial concept of ACAS Xo system was described, initial functional architecture (FAD document) has been published, potential uses of ACAS Xo have been identified, and even the testing have been done (ACAS Xo was flight tested in September 2015). Moreover, sub-operating environment where solution can bring performance benefits is clear, as well as affected stakeholders.

From operational and HP point of view, initial human-in-the-loop evaluation has been performed by MITRE in 2015, collecting feedback on ACAS Xo. However, it has been identified, that there are still many V1 aspects that needs to be assessed. During initial maturity assessment, it was proposed, that missing V1 elements will be covered within V2 validation activities. For this reason, validation activities described in this document are covering not only V2, but also missing V1 objectives.

SESAR Solution	OI Steps	Initial Maturity level	Target Maturity level	Reused validation material from past R&D Initiatives
PJ.11-A3: ACAS for Commercial Air Transport specific operations - ACAS Xo	CM-0808-o	N/A (not introduced in SESAR1)	V2 (with missing V1 objectives)	• RTCA SC-147 standardization materials (MOPS ACAS Xo to be finalized end of April 2018). • R&D studies performed by MITRE (2015)

Table 4: Maturity levels table

4 SESAR Solution Validation Plan for V2

4.1 SESAR Solution PJ.11-A3 Validation Approach for V2

The validation approach for Project PJ11-A3 for V2 consists in two validation exercises for ACAS Xo solution.

Validation Exercise #01 will be a **Stakeholder Workshop** focused mainly on the ACAS Xo operational procedures for the modes CSPO-3000 and DNA. A low fidelity digital mock-up of ACAS Xo HMI will be developed and presented to the participants to help them define and validate the operating method. The data collected will include participant's feedback during the discussions, observation of their interaction with the mock-up and their responses to the questionnaires.

The main objective of Validation Exercise #01 will be to discuss on the benefits of ACAS Xo operations in the European environment and elicit the feedback of participants regarding the operating method. Potential HP issues, errors and their mitigation means will be identified.

The Validation Exercise #02 will be **Real Time Simulation (RTS)** for prototype and OI solutions, covering objectives defined in chapter 4.3. Real Time Simulations (RTS) will be performed on integration simulators with V2 candidate prototypes developed by project PJ11A-03. These trials will take place in Airbus facilities with pilots from Airbus.

The purpose of RTS is to validate principles in realistic environment for ACAS Xo alert triggering/inhibition, and associated Human Machine Interface. The pilots' participation to these trials will allow getting operational feedback on the solution.

Finally, the outputs of the two Validation Exercises #01 and #02 will be analysed and compared together in order to define conclusions for each of the solution-level Validation Objectives that are defined hereafter in 4.3. This work will be gathered in the Validation Report (VALR).

4.2 Stakeholder's expectations

Stakeholder	Involvement	Why it matters to stakeholder
Airspace Users (Pilots, mainline and regional scheduled airlines) - Direct	Will be directly involved in both exercises.	Safety & HP impact: Reduction of TCAS nuisance alerts for specific operations leading to possible reduction of go-arounds at low altitudes ACAS Xo requires modification of the HMI.
ANSP (ATCO) - Direct (if available)	Will be involved, if available and interested in results or discussions.	Synchronization between on-board ACAS Xo selection and on ground ATC awareness. Reduction of RAs leading to possible reduction of Go-arounds at low altitude.

		Reduction of RA investigations due to unnecessary alerts.
Airports - Indirect	Will not be directly involved, but might be interested in results.	Additional movements in congested airports through enabling of parallel operations.
Airborne Industry - Indirect	Indirectly involved through participation to SESAR	Continuous effort to improve safety
Other (Training centre) - Indirect	Are not involved at this stage.	ACAS Xo will require additional trainings due to modification of the HMI, new/modified ACAS logic, and addition of specific controls for mode selection.

Table 5: Stakeholders' expectations

4.3 Validation Objectives

[OBJ]

Identifier	OBJ-PJ.11.A3-V2-VALP-001
Objective	Identify potential use cases for the ACAS Xo capability within current and future European operations.
Title	European ACAS Xo use cases
Category	Operational Feasibility
Key environment conditions	Current and potential future European operations
V Phase	V2

[OBJ Trace]

Relationship	Linked Element Type	Identifier
<COVERS>	<SESAR Solution>	PJ.11-A3
<COVERS>	<ATMS Requirement>	N/A
<COVERS>	<Sub-Operating Environment>	N/A

<COVERS>	<Sub-Operating Environment>	N/A
<COVERS>	<Validation Target>	N/A
<COVERS>	<Validation Target>	N/A

[OBJ Suc]

Identifier	Success Criterion
CRT-PJ.11.A3-V2-001-001	Potential use cases for ACAS Xo capability within current of future European operations identified.

[OBJ]

Identifier	OBJ-PJ.11.A3-V2-VALP-002
Objective	Evaluate the suitability of the current ACAS Xo implementation in Europe.
Title	ACAS Xo suitability
Category	Safety, Human Performance, Acceptability
Key environment conditions	Current and potential future European operations
V Phase	V1/V2

[OBJ Trace]

Relationship	Linked Element Type	Identifier
<COVERS>	<SESAR Solution>	PJ.11-A3
<COVERS>	<ATMS Requirement>	N/A
<COVERS>	<Sub-Operating Environment>	N/A
<COVERS>	<Sub-Operating Environment>	N/A
<COVERS>	<Validation Target>	N/A
<COVERS>	<Validation Target>	N/A

[OBJ Suc]

Identifier	Success Criterion

CRT-PJ.11.A3-V2-002-001	V1 and V2 operational aspects assessed.
CRT-PJ.11.A3-V2-002-002	HMI aspects assessed including pilots in the loop.
CRT-PJ.11.A3-V2-002-003	ACAS Xo alerting algorithms evaluated.

[OBJ]

Identifier	OBJ-PJ.11.A3-V2-VALP-003
Objective	Identify the benefits potentially achievable by a tailored European ACAS Xo version and define high-level requirements on such a function.
Title	Potential for tailored European ACAS Xo version
Category	Performance, Acceptability
Key environment conditions	Current and potential future European operations
V Phase	V2

[OBJ Trace]

Relationship	Linked Element Type	Identifier
<COVERS>	<SESAR Solution>	PJ.11-A3
<COVERS>	<ATMS Requirement>	N/A
<COVERS>	<Sub-Operating Environment>	N/A
<COVERS>	<Sub-Operating Environment>	N/A
<COVERS>	<Validation Target>	N/A
<COVERS>	<Validation Target>	N/A

[OBJ Suc]

Identifier	Success Criterion
CRT-PJ.11.A3-V2-003-001	Potentially achievable benefits of tailored European ACAS Xo version identified.
CRT-PJ.11.A3-V2-	High-level requirements on potential European ACAS Xo version defined.

003-002	

Table 6: Validation Objective layout

4.4 Validation Assumptions

No validation-level assumptions identified.

Please refer to 0 for exercise-level assumptions on Validation Exercise #02.

4.5 Validation Exercises List

[EXE]

Identifier	EXE-PJ.11.A3-V2-VALP-001
Title	Stakeholder Workshop
Description	Stakeholder Workshop focused mainly on the definition of ACAS Xo operational procedures. The discussion will cover two ACAS Xo modes – CSPO-3000 and DNA. A low fidelity digital mock-up of ACAS Xo HMI will be developed and presented to the participants to help them define and validate the operating method.
Expected Achievements	Progress with the undefined operational aspects of ACAS Xo, and answer the questions on its applicability in European airspace.
V Phase	V1/V2
Use Cases	N/A
Validation Technique	Focus Group
KPA/TA Addressed	Safety, Human Performance
Start Date	03/09/2018
End Date	28/09/2018
Validation Coordinator	Honeywell
Validation Platform	N/A
Validation Location	Brno, Czech Republic
Status	<in progress>
Dependencies	N/A

[EXE Trace]

Linked Element Type	Identifier
<SESAR Solution>	PJ.11-A3
<Sub-Operating Environment>	N/A
<Validation Objective>	OBJ-PJ.11.A3-V2-VALP-001 OBJ-PJ.11.A3-V2-VALP-002 OBJ-PJ.11.A3-V2-VALP-003

[EXE]

Identifier	EXE-PJ.11.A3-V2-VALP-002
Title	Real-time Simulations on Airbus simulator
Description	Operational evaluation through real-time simulation, with pilots in-the-loop, to validate principles for ACAS Xo alert triggering/inhibition, and associated Human Machine Interface, for special operations such as parallel approaches that could cause nuisance RA alerts with surrounding traffic without this solution.
Expected Achievements	Pilots operational feedback on the solution, validating operational principles for ACAS Xo
V Phase	V1/V2
Use Cases	DNA approach at US airport; CSPO-3000 approach at European airport
Validation Technique	Real-time simulation
KPA/TA Addressed	Safety, Human Performance
Start Date	10/09/2018
End Date	15/10/2018
Validation Coordinator	Airbus
Validation Platform	Airbus A320 simulator
Validation Location	Toulouse, France
Status	<in progress>
Dependencies	N/A

[EXE Trace]

Linked Element Type	Identifier
<SESAR Solution>	PJ.11-A3
<Sub-Operating Environment>	N/A
<Validation Objective>	OBJ-PJ.11.A3-V2-VALP-001 OBJ-PJ.11.A3-V2-VALP-002 OBJ-PJ.11.A3-V2-VALP-003

Table 7: Validation Exercise layout

4.6 Validation Exercises Planning

The chart below captures the two validation exercises addressing the PJ11-A03 solution under the scope of this VALP for V2.

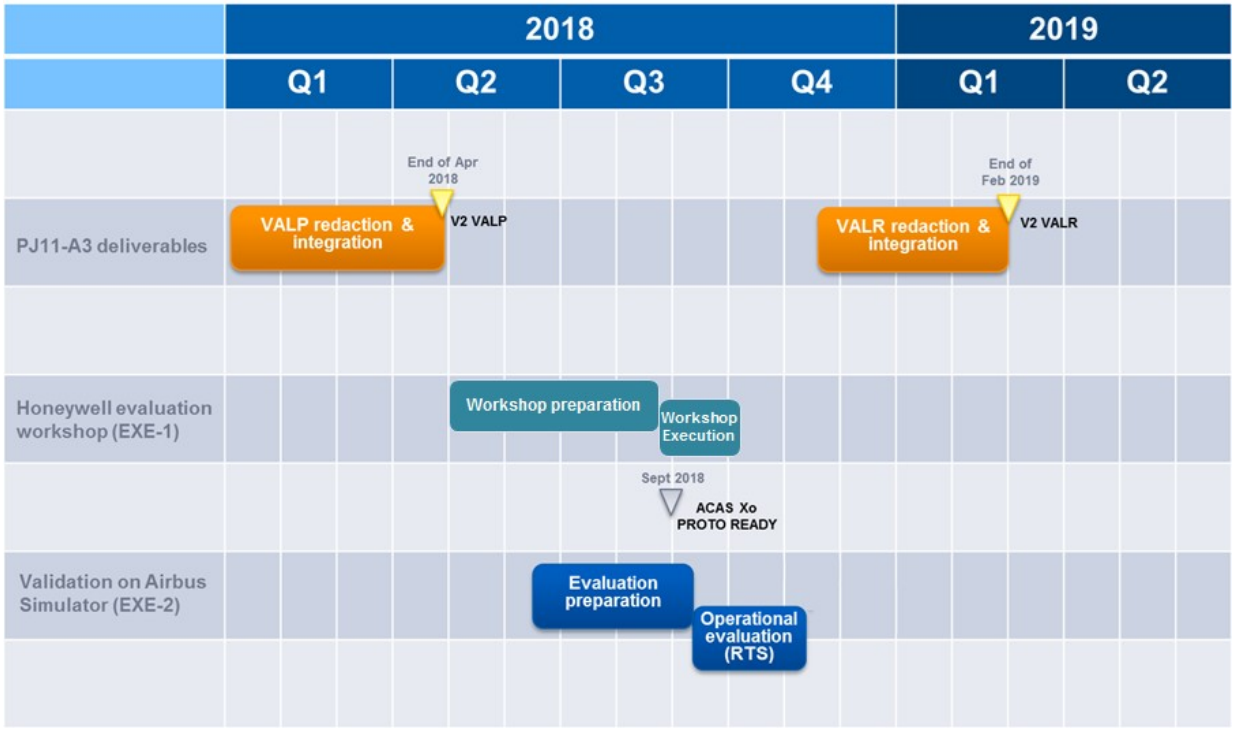

Figure 2: Exercises planning for PJ11-A3

4.7 Deviations with respect to the SJU Project Handbook

Use cases from US scenarios

Validation use cases are derived from US scenarios. There are no use cases known in the European environment today. There are parallel runways also at European airports, but the way they are used operationally have not resulted in frequent TCAS nuisance alerts, unlike at several locations in the US. In order to prepare to potential future European ACAS Xo operation, the scenarios will imply a US airport but also a European airport. The latter will be chosen among airports that could be subject to

potential nuisance RA if the future traffic demand in Europe would lead to change in operations on parallel runways. This should allow staying in line with Validation Strategy related to the SJU handbook project.

Coexisting V1 and V2 maturity levels

This project was directly introduced at V2 level in SESAR 2020 (not existing in SESAR 1). The maturity level of this SESAR solution currently differs for the system (technical), more mature thanks to standardization activities, and HP (operational) aspects, where some aspects still need to be addressed from V1 perspective. For this reason, validation activities described in this document are covering not only V2, but also missing V1 objectives. This should allow staying in line with Validation Strategy related to the SJU handbook project.

5 Validation Exercises

5.1 Validation Exercise #01 Plan: Stakeholder Workshop

This validation exercise is led by Honeywell.

5.1.1 Validation Exercise description and scope

This exercise will be a Stakeholder Workshop focused mainly on the definition of ACAS Xo operational procedures. The discussion will cover two ACAS Xo modes –CSPO-3000 and DNA. A low fidelity digital mock-up of ACAS Xo HMI will be developed and presented to the participants to help them define and validate the operating method. The data collected will include participant's feedback during the discussions, observation of their interaction with the mock-up and their responses to the questionnaires.

The primary objective of the workshop will be to discuss the use cases that will demonstrate the benefits of ACAS Xo operations in the European environment and elicit the feedback of participants regarding the operating method. Potential HP issues, errors and their mitigation means will be identified. A low-fidelity mock-up will be used to collect preliminary requirements for the ACAS Xo HMI.

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

Stakeholder	Involvement	Why it matters to stakeholder
Airspace Users (Pilots, mainline and regional scheduled airlines) - Direct	Validation will be performed by airborne industry representative; pilots will be directly involved.	Safety & HP impact: Pilots expect maintained or increased safety, ideally decreased risk of nuisance alerts which can potentially lead to go-arounds at low altitudes. Pilots expect not to have decreased situational awareness and are being informed about the manoeuvre of designated traffic. ACAS Xo requires modification of the HMI.

ANSP (ATCO) – Direct (if available)	ATCO Will be directly involved if available.	Synchronization between on-board ACAS Xo selection and on ground ATC awareness. Reduction of RAs leading to possible reduction of Go-arounds at low altitude. Reduction of RA investigations due to unnecessary alerts. Approach ATCO is crucial point of contact for approaching aircraft, the operation procedure must be clear and safe both for pilots and ATCO.

Table 8: Stakeholders' expectations

5.1.3 Validation objectives

SESAR Solution Validation Objective	SESAR Solution Success criteria	Coverage and comments [1]	Exercise Validation Objective	Exercise Success criteria
OBJ-PJ.11.A3-V2-VALP-001 Identify potential use cases for the ACAS Xo capability within current and future European operations.	**CRT-PJ.11.A3-V2-001-001** Potential use cases for ACAS Xo capability within current of future European operations identified.	Fully covered	**EX1-OBJ-PJ.11.A3-V2-VALP-001** Identify potential use cases for the ACAS Xo capability within current and future European operations.	**EX1-CRT-PJ.11.A3-V2-VALP-001** Potential use cases for ACAS Xo capability within current of future European operations identified.
OBJ-PJ.11.A3-V2-VALP-002 Evaluate the suitability of the current ACAS Xo implementation in Europe.	**CRT-PJ.11.A3-V2-002-001** V1 and V2 operational aspects assessed.	Partially covered	**EX1-OBJ-PJ.11.A3-V2-VALP-002** Assess that FC procedures can be determined and integrated in FC tasks during concerned operations	**EX1-CRT-PJ.11.A3-V2-VALP-002** Normal operating conditions are defined. Where possible initial needs/ requirements relating to the operating methods for normal operating conditions may be identified.
			EX1-OBJ-PJ.11.A3-V2-VALP-003 Assess whether the identified operating method is clear and judged as feasible.	**EX1-CRT-PJ.11.A3-V2-VALP-003** If preliminary operating methods are defined the content has been determined to be clear and non-contradictory by end users.
			EX1-OBJ-PJ.11.A3-V2-VALP-004 Assess the feasibility and timeliness of ACAS Xo-related tasks completion.	**EX1-CRT-PJ.11.A3-V2-VALP-004** Potential changes to the end users tasks are achievable within an acceptable time frame (acceptable can be defined based on end users opinion and good HF practice)
			EX1-OBJ-PJ.11.A3-V2-VALP-005 Identify the impact of ACAS-Xo procedure on FC workload.	**EX1-CRT-PJ.11.A3-V2-VALP-005** The potential changes to the level of workload/task demands and the preliminary mitigation identified are acceptable (acceptable can be defined based on end users opinion and good HF practice relating to workload).

SESAR Solution Validation Objective	SESAR Solution Success criteria	Coverage and comments [1]	Exercise Validation Objective	Exercise Success criteria
			EX1-OBJ-PJ.11.A3-V2-VALP-006 Identify pilots' information needs regarding the mode selection.	**EX1-CRT-PJ.11.A3-V2-VALP-006** Information needs/requirements are identified.
			EX1-OBJ-PJ.11.A3-V2-VALP-007 Identify factors that might have an impact on FC situational awareness.	**EX1-CRT-PJ.11.A3-V2-VALP-007** Potential changes to situation awareness & preliminary mitigation are identified and acceptable.
			EX1-OBJ-PJ.11.A3-V2-VALP-008 Identify preliminary training needs.	**EX1-CRT-PJ.11.A3-V2-VALP-008** Where possible, initial knowledge, skill and experience requirements are identified.
	CRT-PJ.11.A3-V2-002-002 HMI aspects assessed including pilots in the loop.	Partially covered	**EX1-OBJ-PJ.11.A3-V2-VALP-009** Identify potential errors and preliminary mitigations regarding the target designation task.	**EX1-CRT-PJ.11.A3-V2-VALP-009** Where possible, potential changes to human error and preliminary mitigation have been identified for consideration by the safety/project team.
			EX1-OBJ-PJ.11.A3-V2-VALP-010 Identify potential errors and preliminary mitigations regarding the mode awareness.	**EX1-CRT-PJ.11.A3-V2-VALP-010** Where possible, potential changes to human error and preliminary mitigation have been identified for consideration by the safety/project team.
			EX1-OBJ-PJ.11.A3-V2-VALP-011 Identify potential errors and preliminary mitigations regarding the target designation task.	**EX1-CRT-PJ.11.A3-V2-VALP-011** Where possible, potential changes to human error and preliminary mitigation have been identified for consideration by the safety/project team.
			EX1-OBJ-PJ.11.A3-V2-VALP-012 Assess that automatic undesignation is well understood by FC.	**EX1-CRT-PJ.11.A3-V2-VALP-012** Understanding of the technical system's behaviour is consistent with the operator's task demands.

SESAR Solution Validation Objective	SESAR Solution Success criteria	Coverage and comments [1]	Exercise Validation Objective	Exercise Success criteria
			EX1-OBJ-PJ.11.A3-V2-VALP-013 Assess whether information needs of the FC to be able to successfully use ACAS Xo are met with the proposed design.	**EX1-CRT-PJ.11.A3-V2-VALP-013** There is no discrepancy between system-provided information and user-required information.
			EX1-OBJ-PJ.11.A3-V2-VALP-014 Identify pilots' information needs regarding the mode awareness.	**EX1-CRT-PJ.11.A3-V2-VALP-014** Information needs/requirements are identified.
			EX1-OBJ-PJ.11.A3-V2-VALP-015 Assess the usability of HMI to select the target.	**EX1-CRT-PJ.11.A3-V2-VALP-015** End user experiences integrated interface including any new system components as sufficiently usable.
			EX1-OBJ-PJ.11.A3-V2-VALP-016 Assess the usability of HMI to activate the ACAS Xo function.	**EX1-CRT-PJ.11.A3-V2-VALP-016** End user experiences integrated interface including any new system components as sufficiently usable.
			EX1-OBJ-PJ.11.A3-V2-VALP-017 Assess the usability of the HMI to undesignate a target.	**EX1-CRT-PJ.11.A3-V2-VALP-017** End user experiences integrated interface including any new system components as sufficiently usable.
	CRT-PJ.11.A3-V2-002-003 ACAS Xo alerting algorithms evaluated.	Partially covered	**EX1-OBJ-PJ.11.A3-V2-VALP-018** Assess if FC alerts needs are met with the current concept.	**EX1-CRT-PJ.11.A3-V2-VALP-018** Where possible initial alarm/alerts needs/requirements are identified.

SESAR Solution Validation Objective	SESAR Solution Success criteria	Coverage and comments [1]	Exercise Validation Objective	Exercise Success criteria
OBJ-PJ.11.A3-V2-VALP-003 Identify the benefits potentially achievable by a tailored European ACAS Xo version and define high-level requirements on such a function.	**CRT-PJ.11.A3-V2-003-001** Potentially achievable benefits of tailored European ACAS Xo version identified.	Fully covered	**EX1-OBJ-PJ.11.A3-V2-VALP-019** Identify potentially achievable benefits of tailored European ACAS Xo version.	**EX1-CRT-PJ.11.A3-V2-VALP-019** Potentially achievable benefits of tailored European ACAS Xo version identified.
	CRT-PJ.11.A3-V2-003-002 High-level requirements on potential European ACAS Xo version defined.	Fully covered	**EX1-OBJ-PJ.11.A3-V2-VALP-020** Define high-level requirements on potential European ACAS Xo version.	**EX1-CRT-PJ.11.A3-V2-VALP-020** High-level requirements on potential European ACAS Xo version defined.

[1] Coverage and comments on the coverage of SESAR Solution Validation Objective in Exercise 001

Table 9: Validation Objectives addressed in Validation Exercise 001

5.1.4 Validation scenarios

Validation scenarios are not applicable due to the format of the activity, as Honeywell will prepare a Stakeholder workshop with pilots and an ATCO in September 2018.

5.1.4.1 Reference Scenario(s)

N/A

5.1.4.2 Solution Scenario(s)

N/A

5.1.5 Exercise Assumptions

No exercise-specific assumptions are defined.

5.1.6 Limitations and impact on the level of Significance

The significance of the results will depend on the identified use cases and the perceived benefit and the applicability of the Xo function to the European airspace. One of the limitations of the activity is its format, which will not allow to observe actual user interaction with the proposed function to collect the objective data for further analysis.

5.1.7 Validation Exercise Platform / Tool and Validation Technique

Validation will be performed by means of structured discussion with an inclusion of low fidelity digital mock-up which will serve as an aid/enabler to support the discussion. Digital mock-up will be a ND.

5.1.7.1 Validation Exercise Platform / Tool characteristics

Not applicable due to character of the exercise.

5.1.7.2 Architectural view: mapping Validation Infrastructure and SUTs onto EATMA

Not applicable due to character of the exercise.

This SESAR solution is not yet modelled in EATMA/MEGA.

5.1.7.3 Validation Exercise Technique

The validation exercise will be conducted by means of the Stakeholder Workshop that will attempt to determine flight crew procedures for the use of ACAS Xo in the European airspace. The workshop will consist of a structured discussion with operational experts and an initial HMI needs assessment with the help of a low fidelity mock-up.

5.1.8 Analysis Specification

5.1.8.1 Data collection methods

- Focus group (feedback record)
- Questionnaires
- Observation of the interaction with a mock-up.

5.1.8.2 Analysis method

Data will be statistically analysed and interpreted according to the project requirements.

5.1.9 Exercise Planning and management

5.1.9.1 Activities

- Workshop preparation & planning.
  - The HF experts will define the structure for the discussion, develop the low fidelity mock-up, prepare questionnaires and briefing materials for the participants (pilots).
- Workshop execution
  - Brief the participants
  - Moderate the discussion
  - Observe experts´ interaction with the mock-up
  - Take notes of all possible comments that participants may make during workshop
  - Administer questionnaires
  - Record the necessary and relevant data

- Workshop outcome data analysis & report preparation.
  - Analyse the recorded data and questionnaires
  - Evaluate the results and prepare the Validation Report.
  - Disseminate the results of the exercises towards all participating organisations.

5.1.9.2 Roles & Responsibilities in the exercise

Prepare	Honeywell will provide the HP experts to define the structure of the discussion and design the mock-up.
Execute	Honeywell will lead the workshop. Participants (Airspace Users) that will attend this exercise will be provided from external Honeywell resources. Five experts (pilots+ATCO) will attend - at least one with US operation experience, one ATCO with CSPO experience.
Analyse	Attendees feedback will be collected. Human Factors experts will also be focused on capturing observed flight crew and system (mock-up) behaviour during workshop and analyse the recorded data and questionnaires to prepare Validation report.

5.1.9.3 Time planning

Activity	Months (Year 2018)										
	02	03	04	05	06	07	08	09	10	11	12
Validation planning											
Validation Preparation											
Workshop execution											
Data analysis and report preparation											

Table 10: 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
Unavailability of proper number of experts	3	3	Address attendees and invite immediately

Table 11: Risks and mitigation actions

5.2 Validation Exercise #02 Plan: Real Time Simulation (RTS) on Airbus simulator

5.2.1 Validation Exercise description and scope

The scope of Validation Exercise #02 is the Real Time Simulation (RTS) for prototype and OI solutions, covering objectives defined in chapter 4.3.

Real Time Simulations (RTS) will be performed on integration simulators with V2 candidate prototypes developed by project PJ11A-03. These trials will take place in Airbus facilities with pilots from Airbus.

The purpose of these trials is to validate principles for ACAS Xo alert triggering/inhibition, and associated Human Machine Interface, for special operations such as parallel approaches that could cause nuisance RA alerts with surrounding traffic without this solution. The pilots' participation to these trials will allow getting operational feedback on the solution.

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

The following table identifies why the exercise #2 matters for relevant stakeholders, what they expect from the validation exercise and how they are involved.

Stakeholder	Involvement	Why it matters to stakeholder
Airspace Users (Pilots, flight crew)	Directly involved in the exercise	• Increasing current level of safety by maintaining normal ACAS Xa alerting against all other aircraft than designated one for specific operations such as parallel approach • Avoiding nuisance RA alerting in cockpit without need to set ACAS to TA-only
Airports operators	Indirect through participation to SESAR	• Maintaining or increasing current level of safety with increasing traffic • Reducing potential go-arounds at low-altitude due to nuisance alerts into aircraft cockpit during specific operations such as parallel approach • Preventing situations with TA-only approaches with full collision avoidance coverage
Airborne Industry	Indirect through participation to SESAR	• Continuous effort to improve safety

Table 12: Stakeholders' expectations

5.2.3 Validation objectives

SESAR Solution Validation Objective	SESAR Solution Success criteria	Coverage and comments[1]	Exercise Validation Objective	Exercise Success criteria
OBJ-PJ.11.A3-V2-VALP-001 Identify potential use cases for the ACAS Xo capability within current and future European operations.	**CRT-PJ.11.A3-V2-001-001** Potential use cases for ACAS Xo capability within current of future European operations identified.	Partially covered	**EX2-OBJ-PJ.11.A3-V2-VALP-001** Assess that FC procedures can be determined and integrated in FC tasks during concerned operations	**EX2-CRT-PJ.11.A3-V2-VALP-001** V2. Operating methods are found to cover identified normal operating conditions.
				EX2-CRT-PJ.11.A3-V2-VALP-002 V1. Normal operating conditions are defined. Where possible initial needs/ requirements relating to the operating methods for normal operating conditions may be identified.
OBJ-PJ.11.A3-V2-VALP-002 Evaluate the suitability of the current ACAS Xo implementation in Europe.	**CRT-PJ.11.A3-V2-002-001** V1 and V2 operational aspects assessed.	Fully covered	**EX2-OBJ-PJ.11.A3-V2-VALP-003** Confirm ATC involvement is not necessary to perform the designation task.	**EX2-CRT-PJ.11.A3-V2-VALP-004** V2. Tasks are effectively achieved.
			EX2-OBJ-PJ.11.A3-V2-VALP-004 Assess that FC has sufficient spare mental resources to activate the ACAS Xo function during the approach phase.	**EX2-CRT-PJ.11.A3-V2-VALP-006** V2. Level of workload within acceptable limits ('acceptable limits' to be defined with regard to the tool used for the assessment).
			EX2-OBJ-PJ.11.A3-V2-VALP-005 Assess that FC has sufficient spare resources to analyse the situation and designate the right aircraft.	**EX2-CRT-PJ.11.A3-V2-VALP-006** V2. Potential for errors is within acceptable limits, taking into account error type & operational/safety impact.

			EX2-OBJ-PJ.11.A3-V2-VALP-008 Assess that FC workload stay in acceptable limits when performing ACAS-Xo related tasks.	**EX2-CRT-PJ.11.A3-V2-VALP-009** V2. Level of workload within acceptable limits ('acceptable limits' to be defined with regard to the tool used for the assessment).
			OBJ-PJ.11.A3-V2-VALP-013 Assess that the FC workload is reduced in case of RA during an eligible procedure.	**N/A**
	CRT-PJ.11.A3-V2-002-002 HMI aspects assessed including pilots in the loop.	Fully covered	**EX2-OBJ-PJ.11.A3-V2-VALP-002** Assess that FC has sufficient information to be aware of the need to activate the appropriate ACAS Xo function in specific locations.	**EX2-CRT-PJ.11.A3-V2-VALP-003** V1. If preliminary operating methods are defined the content has been determined to be clear and non-contradictory by end users.
			EX2-OBJ-PJ.11.A3-V2-VALP-006 Assess that FC has sufficient information to quickly analyse the situation and identify the right target, even in non-visual conditions.	**EX2-CRT-PJ.11.A3-V2-VALP-007** V2. Tasks are effectively achieved
			EX2-OBJ-PJ.11.A3-V2-VALP-007 Assess that FC has sufficient information to quickly analyse the situation and identify the right target, even in busy airspace.	**EX2-CRT-PJ.11.A3-V2-VALP-003** V2. Tasks are effectively achieved.
			EX2-OBJ-PJ.11.A3-V2-VALP-009 Assess that automatic undesignation is well understood by FC.	**EX2-CRT-PJ.11.A3-V2-VALP-010** V2. Understanding of the technical system's behaviour is consistent with the operator's task demands.
			EX2-OBJ-PJ.11.A3-V2-VALP-010 Assess that FC is well aware of designation limitations and do not struggle with non-ADS-B paired aircraft.	**EX2-CRT-PJ.11.A3-V2-VALP-011** V1. Where possible, initial needs/requirements to support end-users acquisition of a mental model of the automated function are identified.
			EX2-OBJ-PJ.11.A3-V2-VALP-011 Assess the usability of HMI to select the target.	**EX2-CRT-PJ.11.A3-V2-VALP-012** V2. End user experiences integrated interface including any new system components as sufficiently usable.

			EX2-OBJ-PJ.11.A3-V2-VALP-012 Assess the usability of HMI to activate the ACAS Xo function.	**EX2-CRT-PJ.11.A3-V2-VALP-013** V2. End user experiences integrated interface including any new system components as sufficiently usable.
			EX2-OBJ-PJ.11.A3-V2-VALP-013 Assess the usability of the HMI to undesignate a target.	**EX2-CRT-PJ.11.A3-V2-VALP-014** V2. End user experiences integrated interface including any new system components as sufficiently usable.
			EX2-OBJ-PJ.11.A3-V2-VALP-014 Assess the automatic undesignation feedback is sufficient to be detected by the FC.	**EX2-CRT-PJ.11.A3-V2-VALP-015** V2. Team is able to perceive and interpret task relevant information and anticipate future events/actions.
	CRT-PJ.11.A3-V2-002-003 ACAS Xo alerting algorithms evaluated.	Fully covered	**OBJ-PJ.11.A3-V2-VALP-014** Assess that ACAS Xo availability reduces the number of go-around.	**N/A**
			OBJ-PJ.11.A3-V2-VALP-019 Assess the decision making time when a RA occurs is decreased.	**N/A**
OBJ-PJ.11.A3-V2-VALP-003 Identify the benefits potentially achievable by a tailored European ACAS Xo version and define high-level requirements on such a function.	**CRT-PJ.11.A3-V2-003-001** Potentially achievable benefits of tailored European ACAS Xo version identified.	Fully covered	**OBJ-PJ.11.A3-V2-VALP-014** Assess that ACAS Xo availability reduces the number of go-around.	**N/A**
			OBJ-PJ.11.A3-V2-VALP-019 Assess the decision making time when a RA occurs is decreased.	**N/A**
	CRT-PJ.11.A3-V2-003-002 High-level requirements on potential European ACAS Xo version defined.	Not covered		

[1] on the coverage of SESAR Solution Validation Objective in Exercise 002

Table 13: Validation Objectives addressed in Validation Exercise 002

5.2.4 Validation scenarios

5.2.4.1 Reference Scenario(s)

Reference Scenario 1: Simultaneous Close Parallel approaches on KSFO RWY 28L/R

The ownship is flying the LDA PRM 28R approach, while another traffic is flying the ILS PRM 28L approach.

Concurrent traffic conducts a classical ILS approach respecting published altitudes and intercepts the glidepath at waypoint HEMAN and at 3100ft alt.

The ownship is established on descent from waypoint ANETE at 7000ft and down to runway threshold. It is important that the ownship respects the altitude restrictions in order to respect any crossing restrictions and to avoid wake turbulences from the concurrent traffic. The ownship shall remain on the LDA until waypoint DARNE. Ownship shall acquire and report visual contact on the concurrent traffic as soon as practical and before passing waypoint DARNE. it shall not overtake the concurrent traffic.

After DARNE, the ownship shall manoeuver manually to land. During this visual segment, pilots are responsible for collision and wake avoidance.

As per FAA recommendation, in order to avoid any nuisance TCAS alert during a parallel approach, flight crew may activate the "TA only" TCAS modes, which converts any RA into a TA. Flight crew has to be aware that in that case all RAs are inhibited.

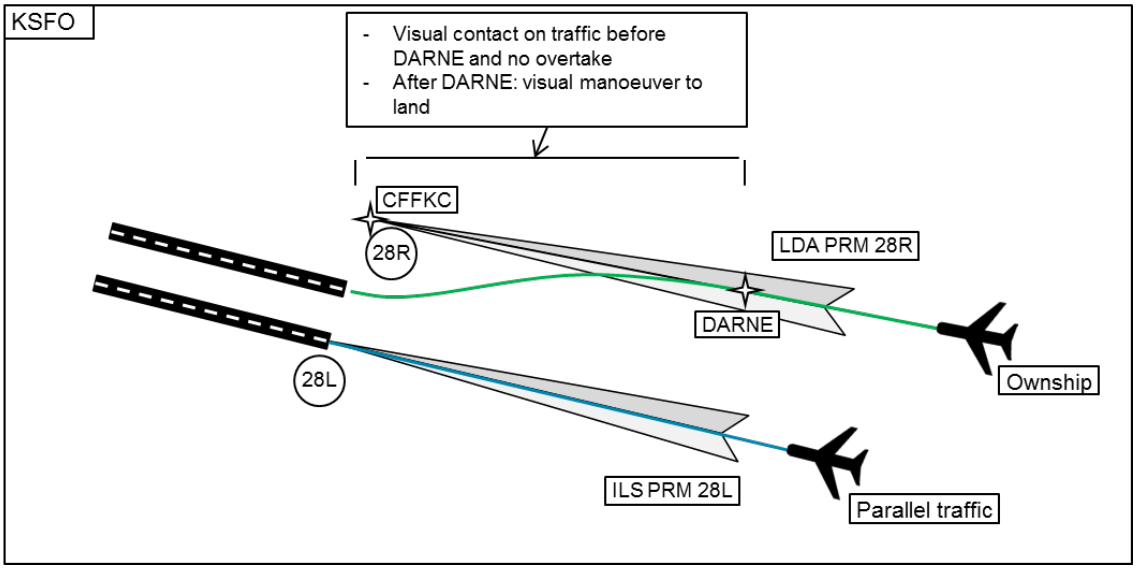

Figure 3: Simultaneous Close Parallel approaches on KSFO RWY 28L/R

Reference Scenario 2: Simultaneous Independent Parallel approaches on LEMD RWY 18L/R

The ownship is flying the ZMR 3A RNAV STAR followed by the ILS Z 18R approach for using waypoint LALPI as IAF.

Concurrent traffic is flying the BAN 3B STAR followed by the ILS Z 18L approach using waypoint TAGOM as IAF.

Note: in order to be able to evaluate the benefits of CSPO-3000 in this use case, the concurrent traffic is flying higher than the published leg altitude before interception of the localizer, at an altitude similar to the ownship's altitude, it means that the traffic should be passing TAGOM at 9500ft. This will lead to potential TCAS alerts.

As these are independent approaches, no particular procedure is applied regarding parallel operations. However, the proximity of both traffic during the approach and in particular during their convergence toward their respective localizers may trigger unnecessary TCAS alerts.

As per FAA recommendation, in order to avoid any nuisance TCAS alert during a parallel approach, flight crew may activate the "TA only" TCAS modes, which converts any RA into a TA. Flight crew has to be aware that in that case all RAs are inhibited.

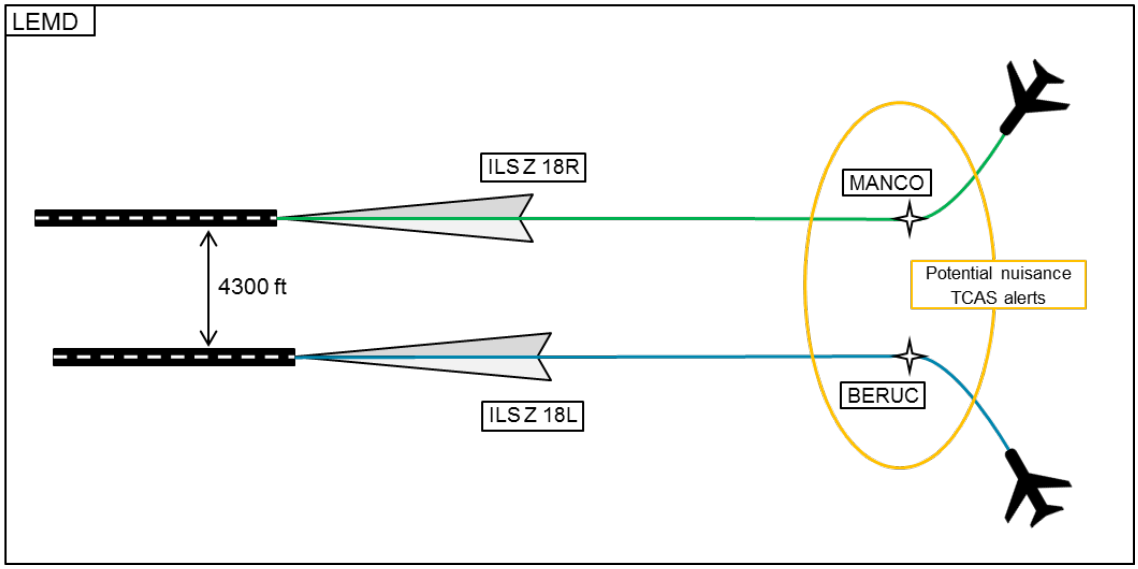

Figure 4: Simultaneous Independent Parallel approaches on LEMD RWY 18L/R

5.2.4.2 Solution Scenario(s)

Solution Scenario 1: Simultaneous Close Parallel approaches on KSFO RWY 28L/R with DNA

The ownship and the concurrent traffic are flying the standard PRM approaches as described in the reference scenario #1.

When the flight crew of the ownship has the traffic in sight, it shall designate it with ACAS Xo and activate the DNA mode. Any potential TCAS alert regarding this traffic is then inhibited.

Pursuing of the approach procedure remains unchanged.

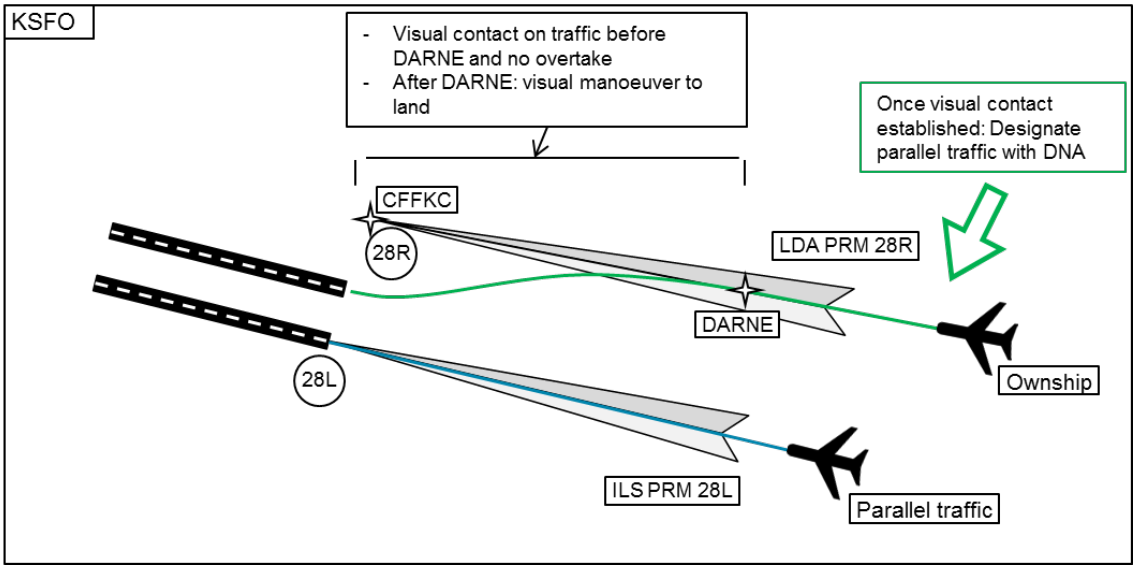

Figure 5: Simultaneous Close Parallel approaches on KSFO RWY 28L/R with DNA

Solution Scenario 2: Multithreat TCAS alert during Simultaneous Close Parallel approaches on KSFO RWY 28L/R with DNA

The ownship and the concurrent traffic are flying the standard PRM approaches as described in the reference scenario #1.

When the flight crew of the ownship has the traffic in sight, it shall designate it with ACAS Xo and activate the DNA mode. Any potential TCAS alert regarding this traffic is then inhibited.

Pursuing of the approach procedure remains unchanged.

During the approach, while the concurrent traffic is designated with DNA, another intruder triggers a TCAS RA onboard the ownship. Any inhibited alert on the concurrent parallel traffic is then uninhibited. The ownship's flight crew should then see two threatening traffics and react as indicated by the TCAS resolution advisory.

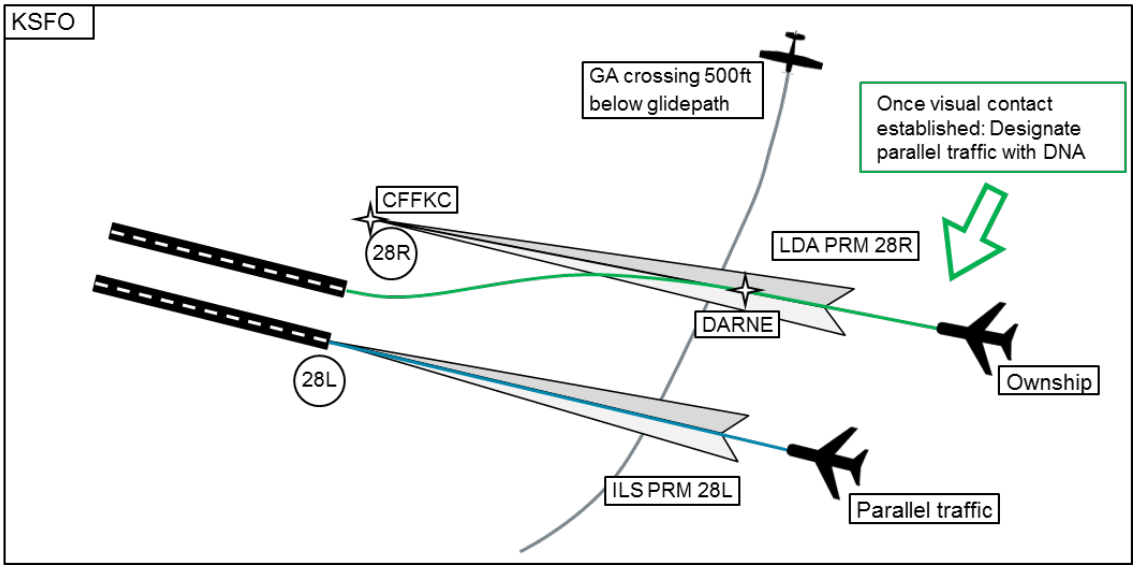

Figure 6: Multithreat TCAS alert during Simultaneous Close Parallel approaches on KSFO RWY 28L/R with DNA

Solution Scenario 3: Voluntary undesignation of DNA traffic during Simultaneous Close Parallel approaches on KSFO RWY 28L/R

The ownship and the concurrent traffic are flying the standard PRM approaches as described in the reference scenario #1.

When the flight crew of the ownship has the traffic in sight, it shall designate it with ACAS Xo and activate the DNA mode. Any potential TCAS alert regarding this traffic is then inhibited.

Pursuing of the approach procedure remains unchanged.

During the approach, while the concurrent traffic is designated with DNA, a visibility degradation leads the ownship's flight crew to lose the visual contact with the concurrent traffic. Prerequisites for DNA and PRM approach being not met anymore, flight crew shall deactivate DNA for the designated traffic, inform the ATC and possibly go around.

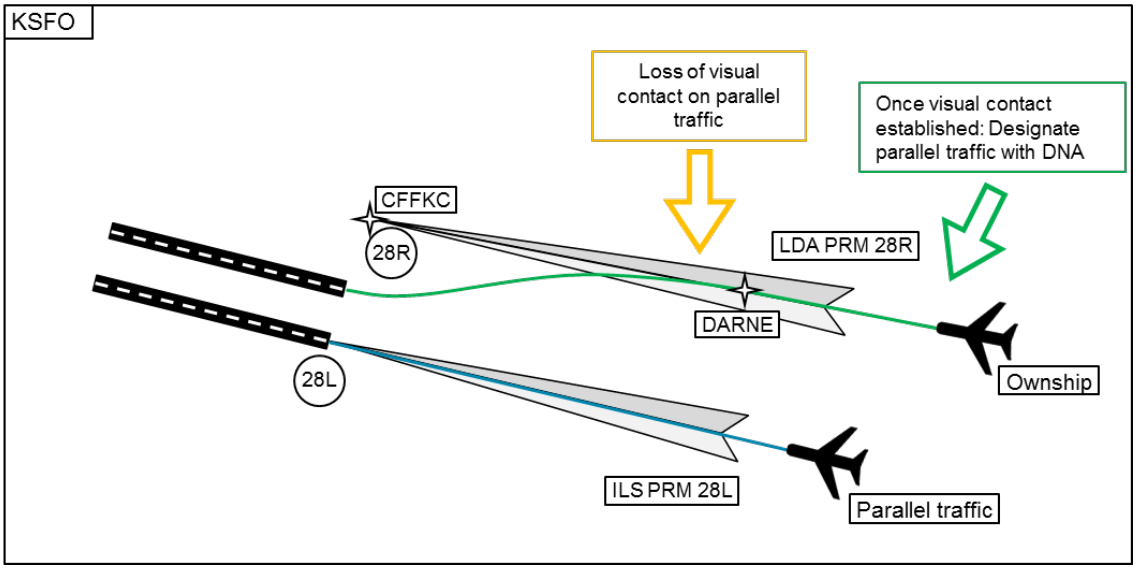

Figure 7: Voluntary undesignation of DNA traffic during Simultaneous Close Parallel approaches on KSFO RWY 28L/R

Solution Scenario 4: Simultaneous Independent Parallel approaches on LEMD RWY 18L/R with CSPO-3000

The ownship and the concurrent traffic are flying the same approaches as described in the reference scenario #2.

In this scenario, the flight crew of the ownship shall designate the concurrent traffic with ACAS Xo and activate the CSPO-3000 mode as soon as needed in order to avoid potential nuisance TCAS advisories.

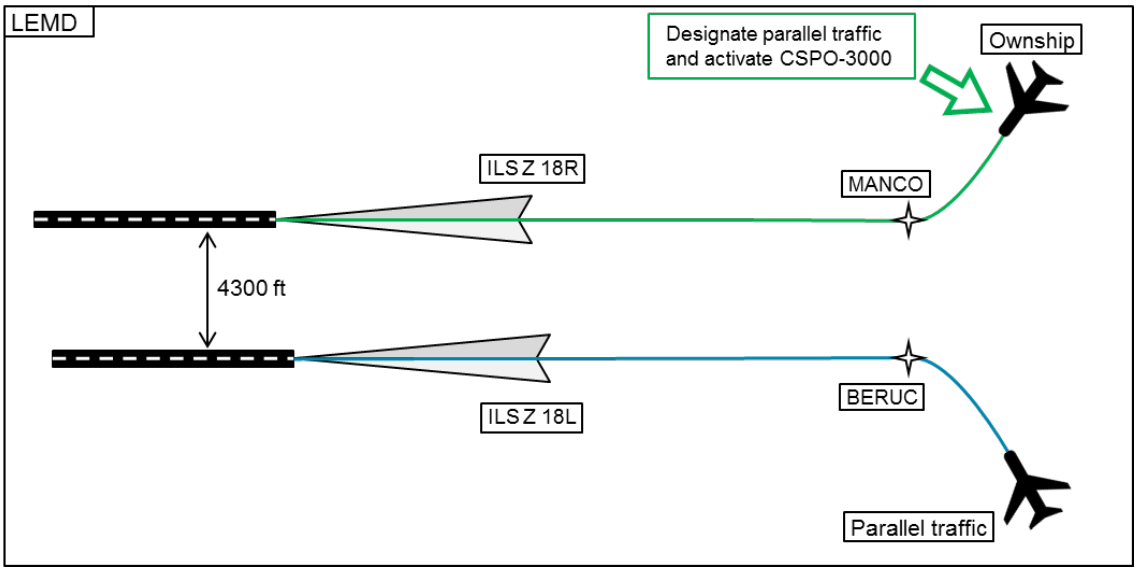

Figure 8: Simultaneous Independent Parallel approaches on LEMD RWY 18L/R with CSPO-3000

Solution Scenario 5: Simultaneous Independent Parallel approaches on LEMD RWY 18L/R with CSPO-3000 and traffic deviation

The ownship and the concurrent traffic are flying the same approaches as described in the reference scenario #2.

In this scenario, the flight crew of the ownship shall designate the concurrent traffic with ACAS Xo and activate the CSPO-3000 mode as soon as needed in order to avoid potential nuisance TCAS advisories.

Once established on their respective final axes the ownship is protected against nuisance TCAS alerts. However in this scenario the concurrent traffic deviates sharply from RWY 18L localizer toward 18R. This should trigger a TCAS resolution advisory onboard the ownship, demonstrating that while reducing the rate of nuisance TCAS alerts, CSPO-3000 is still protecting against real collision threats.

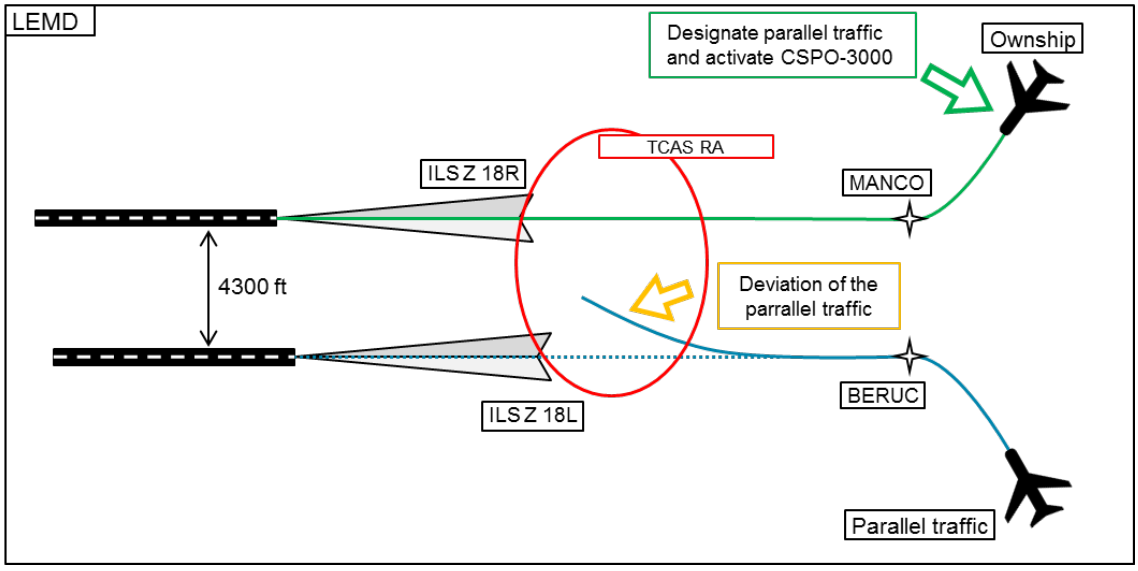

Figure 9: Simultaneous Independent Parallel approaches on LEMD RWY 18L/R with CSPO-3000

5.2.5 Exercise Assumptions

Identifier	Title	Type of Assumption	Description	Justification	Flight Phase	KPA Impacted	Source	Value(s)	Owner	Impact on Assessment
	Surrounding traffic	Aircraft equipage	All surrounding traffic are TCAS/ADS-B out equipped	The ACAS Xo prototype is useable with hybrid traffic only.	TMA	SAF HP	Expert opinion	Real situation tends to a hybrid traffic only environment (DO-260B		Med.

								mandate).		
	Existing operation	Procedure in place	Existing parallel approach procedures are unchanged.	The use of ACAS Xo is supposed to be transparent for ATC.	TMA	SAFHP	Standardisation	Refer to real situation		High

Table 14: Validation Exercise Assumptions

5.2.6 Limitations and impact on the level of Significance

At the time of writing, a limitation is identified on the validation exercise platform about the availability of "dual configuration" display simulation for ACAS Xo (i.e. independent display settings for captain and first officer), which is currently "single configuration" (same settings for captain and first officer). Its impact on the level of significance is minor, by preventing flight crew to set independent range/mode for display, as it is usually the case in approach phase (pilot flying / pilot monitoring tasks repartition). This limitation is on the way to be resolved with on-going actions to update display simulation.

Other limitation is that this EXE is setting for a European airport a customized approach procedure which does not exist for CSPO3000. This limitation will only impact significance level with a customization of speed/altitude in order to be in conditions where a TA/RA alert would be triggered without ACAS Xo activation. This procedure will be defined in the most realistic way using a combination of existing STAR approaches.

5.2.7 Validation Exercise Platform / Tool and Validation Technique

5.2.7.1 Validation Exercise Platform / Tool characteristics

V&V Platform Name		A320 integration simulator
A.1.1	It is a new developed V&V platform?	No, the platform is an existing A320 integration simulator.
A.1.2	If yes, which are the reasons supporting the development of a new platform?	N/A (see previous answer)
A.2	It is the first time to be used for a SESAR validation exercise	No, already used in SESAR 1 for similar exercises.
A.3	It is used the first time in a SESAR validation exercise and it needs new features to be implemented	No

B	Which operational scenarios / improvements/etc. (general) can be validated on the new V&V Platform?	The platform allow to run all planned scenarios on operational perspective, but also to evaluate most appropriate rendering on display for pilots thanks to "Light Cockpit Simulator" (LCS) features. LCS allows changing HMI colors and symbols dynamically to analyse pilots feedback on different propositions.
C	Which validation needs are going to be supported by the new platform (not covered by the existing platforms)?	N/A (not a new platform)
D	Which validation methods can be used on the new V&V Platform?	The validation of ACAS Xo modes will be done in real time with a software prototype loaded in a real TCAS equipment (future host of the function). Additional tools include a traffic signals generator designed for TCAS testing (TTG-7000), a visualisation simulator of the aircraft environment, and an additional "light cockpit simulator" feature for HMI purposes.

Table 15: Validation Exercise Platform / Tool characteristics

The following figure briefly describes the simulator architecture, with focus on interacting tools and equipment for ACAS Xo.

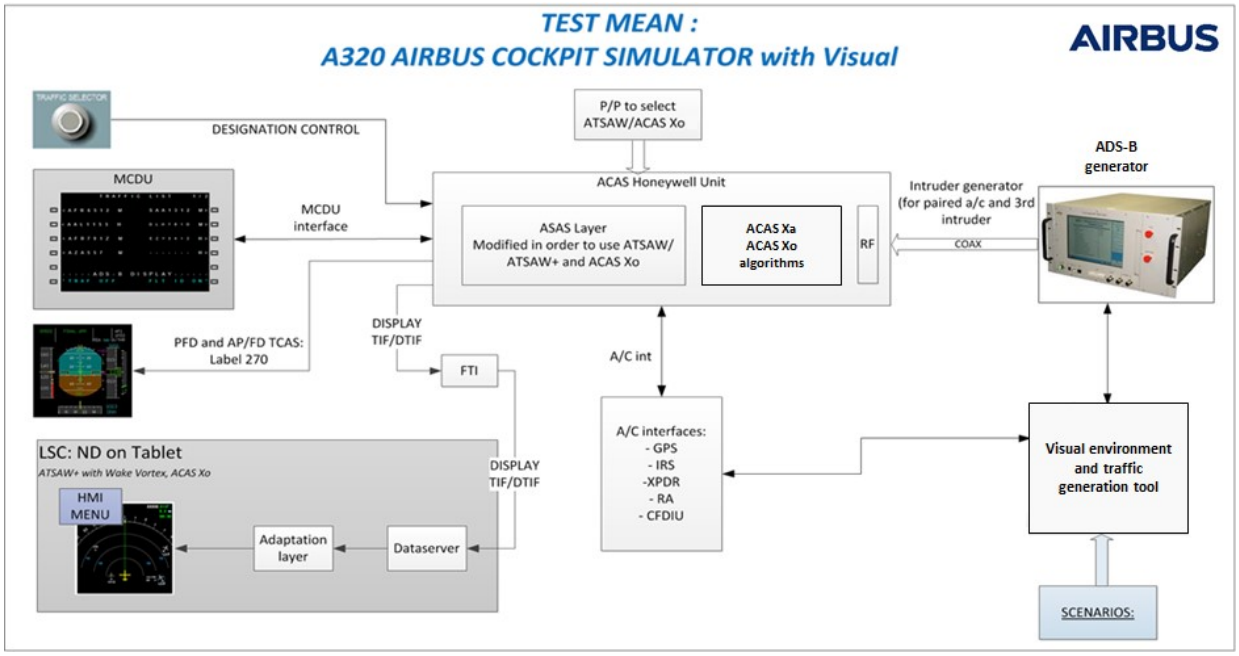

Figure 10: Validation exercise platform - Airbus A320 simulator

5.2.7.2 Architectural view: mapping Validation Infrastructure and SUTs onto EATMA

This SESAR solution is not yet modelled in EATMA/MEGA.

5.2.7.3 Validation Exercise Technique

The validation exercise will be conducted by means of the real-time simulation with the presence of pilots, operations specials and human factors experts.

5.2.8 Analysis Specification

5.2.8.1 Data collection methods

In order to validate the defined objectives (in 5.2.3), the following data collection methods are envisaged:

Qualitative collection methods which will be based on:

- *Over-the-shoulder observations* performed by operational experts assisted by Human Factors experts during each run. The aim is to :
    - make note of flight crew behaviour to observe task performance
    - analyse PF/PM workload repartition as in approach phase (which is a demanding phase in terms of workload)
    - have an idea of pilots' situational awareness as well as of the usability / utility of investigated functionalities and respective interfaces.

  The main points noted during these observations can be put on the table during debriefing sessions;
- *Debriefing sessions* which could be held at the end of each simulation day. The pilots will have the opportunity to discuss any issues / particular situations they experienced during the run. There should be also a final debriefing to fix the main points discussed during the validation and, therefore, consolidate operational feedback;
- *Questionnaires* consisting of ad hoc questions related to the validation objectives and associated success criteria. There should be a questionnaire after each run where the pilots will have the opportunity to report additional comments feeding the debriefing session or to gather information on points that cannot directly be observed during the simulation and which require an immediate feedback from participants (e.g.: workload).

Quantitative collection methods will consist mainly of *system data logs* collected either from system memory dump or simulator instrumentation recorders (e.g. reaction time measurement between an alert triggering and recovery action). The idea is to list precisely what should be recorded and used afterwards. To date, it was only identified the time of the activation of ACAS Xo and the 4D trajectory (flight path).

5.2.8.2 Analysis method

This section provides an overview of how the results collected through the above mentioned methods are expected to be analysed.

Regarding the qualitative data collected by observation, debriefings and questionnaire, they will be analysed by using the operational and Human Factors knowledge. Data from questionnaires will be analysed through the answers reflect ad hoc scales to check the level of agreement / disagreement of the pilots with the submitted questions.

Trend analysis will be mainly conducted on the data recorded during the validation to evaluate the benefits of the concepts.

5.2.9 Exercise Planning and management

5.2.9.1 Activities

The tasks that need to be performed throughout the exercise lifecycle can be grouped by the following phases: preparatory, execution and post-execution.

Preparatory activities

The preparatory activities for the exercise are as follows:

- High level definition of the exercise, including
  - Objectives
  - Scenarios
  - Validation platform capability and limitations regarding traffic generation, validation scenarios, special events;
- Platform and prototype testing/acceptance;
- Updating of the platform;
- Preparation of the exercise: this activity includes, amongst other:
  - Scenarios definition relative to specific approach operations with lower separation minima (for instance, parallel approach);
  - Definition of the data gathering methods that will be used including questionnaires, structured interviews, data log;
  - Preparation of the training material including briefing presentations
  - Preparation of an ATM phraseology with timestamps matching the planned traffic generations (there will be also “blank tests”)

Execution activities

The main execution activities for the exercise are as follows:

- Introduce the exercise by presenting introductory information regarding the project and the main objectives of the validation activity;
- Briefing session to ensure that pilots are familiar with the platform and the functionalities under assessment, and with the eventual limitations. The more pilots are familiar with the platform the more the collected results are reliable;
- Execution of the planned runs:

- During the execution, human performance experts as well as operational personnel will perform over the shoulder observations to note pilot behaviour;
- Data recording as well as screenshot capture have to be scheduled as support to the analysis of the results after the simulation

- Collect feedback from the involved operational pilots through the questionnaires and the planned debriefing sessions.
- 5 sessions are planned

Post-execution activities

The post-execution phase focuses on the analysis of qualitative and quantitative data collected during the exercise. All the processes will be based on the following steps:

- Data preparation,
- Data analysis,
- Comparison with hypothesis and validation objectives.

The results will be then integrated into the exercise Validation Report.

5.2.9.2 Roles & Responsibilities in the exercise

The following table lists participants involved in the exercise.

Involved participants	Roles and responsibilities
Design engineers	They define the functional requirements used as inputs for the system development.
Operations engineers	They are in charge of evaluation scenarios identification and definition.
Human Factors specialists	They are in charge of follow-up of both methodology and evaluations set-up.
Test engineers	They are in charge of detailed scenarios preparation and support sessions run
Pilots	Airbus pilots assess the function (tests pilots and training pilots)

Table 16: Roles & responsibilities for exercise #02

5.2.9.3 Time planning

This is only indicative planning, which is not frozen at the time of writing.

Activity	Months (Year 2018)										
	02	03	04	05	06	07	08	09	10	11	12
RTS de-risking											

tests					■						
RTS preparation						■	■	■			
RTS execution with pilots									■		
Data analysis and report preparation										■	■

Table 17: 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
Unavailability of ACAS Xo prototype	5-Very High	2-Low	Project planning - Monitoring development
Unavailability of the simulator	5-Very High	2-Low	Plan in advance possible slots
Unavailability of Airbus tests pilots	5-Very High	2-Low	Plan in advance possible slots
"Dual configuration" display not available on-time	2-Low	1-Very Low	Ensure on-time delivery of display simulation update, or, keep "single configuration" (not blocking for exercise)

Table 18: 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] D109 - Transition VALS SESAR 2020 - Consolidated deliverable with contribution from Operational Federating Projects

[24] D42 - PJ19: Validation Targets (2017)

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

System Engineering

[26] SESAR Requirements and V&V guidelines

Safety

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

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

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

[30] SESAR, Resilience Engineering Guidance, May 2016

Human Performance

[31] 16.06.05 D27 HP Reference Material D27

[32] 16.04.02 D04 e-HP Repository - Release note

Environment Assessment

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

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

Security

[35] 16.06.02 D103 SESAR Security Ref Material Level

[36] 16.06.02 D137 Minimum Set of Security Controls (MSSCs).

[37] 16.06.02 D131 Security Database Application (CTRL_S)

6.2 Reference Documents

[38] ED-78A GUIDELINES FOR APPROVAL OF THE PROVISION AND USE OF AIR TRAFFIC SERVICES SUPPORTED BY DATA COMMUNICATIONS.[1]

1

Appendix A KPI Data Collection for Performance KPIs

Not Applicable as there are no KPIs defined in VALS for ACAS Xo.