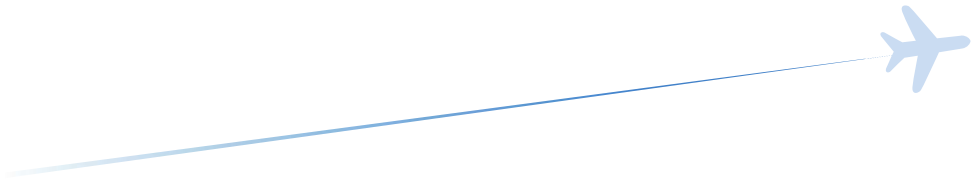

# SESAR 2020 PJ.11-A3 V2 TS

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# CAPITO

CAPITO

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## Abstract

This document is a TS/IRS for ACAS Xo system, which was already standardized in October 2018 by both EUROCAE and RTCA together with ACAS Xa. Since the intent of this document is not to duplicate already existing and standardized requirements, purpose of this document primarily aims providing the functional description, and necessary logical interfaces with other functional blocks from EATMA perspective (to the extent required for V2 maturity). In addition to that, Airbus HMI requirements as implemented for the EXE-02 V2 validation purposes, are captured in this document.

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# 1 Executive summary

This document is a TS/IRS for ACAS Xo system, which was already standardized in October 2018 by both EUROCAE and RTCA together with ACAS Xa. Minimum performance requirements and technical specifications for ACAS Xo are therefore already captured in RTCA DO-385/EUROCAE ED-256, which also include the Algorithm Design Description (ADD) document with prescribed and suggested algorithms for both ACAS Xa/Xo.

Since the intent of this document is not to duplicate already existing and standardized requirements, purpose of this document primarily aims providing the functional description, and necessary logical interfaces with other functional blocks from EATMA perspective (to the extent required for V2 maturity). In addition to that, Airbus HMI requirements as implemented for the EXE-02 V2 validation purposes, are captured in this document.

List of assumptions considered during preparation of this document and EATMA modelling is also captured in this document.

# 2 Introduction

## 2.1 Purpose of the document

The TS/IRS documents are intended to form the basis for the development or industry standards for the systems or sub-systems in standardisation development organizations, such as EUROCAE or RTCA.

ACAS Xo system was standardized in October 2018 by both EUROCAE and RTCA together with ACAS Xa. Minimum performance requirements and technical specifications for ACAS Xo are therefore already captured in RTCA DO-385/EUROCAE ED-256 [6], which also includes the Algorithm Design Description (ADD) document with prescribed and suggested algorithms for both ACAS Xa/Xo.

Since the intent of this document is not to duplicate already existing and standardized requirements, purpose of this document primarily aims providing the functional description, and necessary logical interfaces with other functional blocks from EATMA perspective. In addition to that, Airbus HMI requirements as implemented for the EXE-02 V2 validation purposes, are captured in this document.

In the past, in SESAR1 – project P.9.47 – a Technical Specifications for ACAS Xa and ACAS Xo system were delivered. These specifications were however produced at the time when ACAS Xa/Xo systems were under development, and are not relevant anymore.

## 2.2 Scope

This is the TS/IRS for Solution PJ.11-A3 for V2 phase, once verification activities and validation exercises EXE-PJ.11.A3-V2-VALP-001 and EXE-PJ.11.A3-V2-VALP-002 have been performed and their results analyzed and consolidated.

## 2.3 Intended readership

The intended audience of for this document are members of PJ.11-A3 solution (EUROCONTROL, Airbus) and PJ.11 members in general.

At a higher programme level, this document is intended for SJU, the Content Integration project (PJ.19), who is responsible for coordination and integration of solutions, as well as development of validation strategy, and Validation and Demonstration Engineering project (PJ.22) which manages the requirements.

## 2.4 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 Technolog |
|---|---|
| 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 were developed in parallel and share the same standard released in September 2018 (RTCA DO-385/EUROCAE ED-256).

## 2.5 Structure of the document

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

**Section 3** describes SESAR Solution Impacts on Architecture and provides traces to EATMA.

**Section 4** provides Technical Specifications from different view, as well as HMI requirements for ACAS Xo.

**Section 5** describes implementation options for ACAS Xo.

**Section 6** lists assumptions that have an impact on the technical specifications and description of technical architecture described in sections 3 and 4.

**Section 7** lists reference and applicable documents.

**Appendix A** is not applicable for this solution.

**Appendix B** is not applicable for this solution.

## 2.6 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. | Pre-FRAC MOPS |
| Cooperative traffic | Aircraft, proximate to another aircraft, using avionics equipment that provides identification, position, or other data, e.g., for ATM surveillance, which can be detected by suitably equipped aircraft and used to provide situation awareness and for detecting and assessing potential conflicts.<br><br>Examples of such devices are transponders (Mode A/C and Mode S), position reporting systems such as ADS-B transceivers or general aviation devices (e.g., FLARM). | Modified EUROCAE ED-238 |
| CSPO-300 mode | An ACAS Xo mode for Closely Spaced Parallel Operations down to 3,000ft runway separation. | Pre-FRAC MOPS |
| Designated traffic | A particular ACAS X traffic that has been designated by the flight crew for a particular ACAS Xo mode. | CONUSE |
| DNA mode | An ACAS Xo Designated No Alerts mode which suppress all alerts and guidance (except during multi-threat encounters) on the specifically designated traffic. | Pre-FRAC MOPS |
| No Transgression Zone (NTZ) | A corridor of airspace established equidistant between 2 extended | EUROCONTROL |

| | | |
|---|---|---|
| | runway centre lines. | |
| Normal Operating Zone (NOZ) | Airspace in which aircraft are expected to operate while manoeuvring to pick up and fly the ILS localizer course or the MLS final approach track. | EUROCONTROL |
| To undesignate | 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**

## 2.7 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 |
| **FRAC** | Final Review And Comments |
| **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 |

| | |
|---|---|
| **TPCS** | Third Party Call Sign |
| **TRM** | Threat Resolution Module |
| **TS** | Technical Specification |

**Table 2: Acronyms and terminology**

# 3 SESAR Solution Impacts on Architecture

## 3.1 Target Solution Architecture

### 3.1.1 SESAR Solution(s) Overview

SESAR solution under the scope of this TS/IRS document 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 EUROCAE/RTCA in MOPS:

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 are defined in ACAS Xa/Xo MOPS published in 2018.

The following architecture elements are based on EATMA model V13.0 Draft / DS20 Draft.

| SESAR Solution ID and Title | Functional Blocks/Role impacted by the SESAR Solution (from EATMA) | Enabler ID (from EATMA) | Enabler Title (from EATMA) | Enabler coverage |
|---|---|---|---|---|
| PJ.11-A3<br><br>ACAS for Commercial Air Transport specific | Airborne Collision Avoidance (ACAS) / Flight Crew | A/C-54a | Enhanced Airborne Collision Avoidance (ACAS) | Partial (Xo addressing tailored logic for designated |

| | | | | |
|---|---|---|---|---|
| operations - ACAS Xo | | | | intruder during particular operations) |
| | | A/C-54b | ACAS adaptation to new separation modes | Fully |
| | | HENA01094[1] | ACAS Xo functions to be performed by the Flight Crew | Fully |

**Table 3: SESAR Solution PJ.11-A3 Scope and related Functional Blocks/roles & Enablers**

PJ.11-A3: ACAS for Commercial Air Transport specific operations - ACAS Xo

ACAS for Commercial Air Transport specific operations - ACAS Xo improves ACAS (Airborne Collision Avoidance System) building on optimised resolution advisories and additional surveillance data, while avoiding unnecessary triggering of resolution advisories (RAs) in new separation modes (e.g. ASAS), in particular if lower separation minima are considered.

| OI Step | | OI description | Open CR |
|---|---|---|---|
| CM-0808-o | | Collision Avoidance for commercial air transport Adapted to New Separation Modes | CR 03277 Update CM-0808-o with links with Activities and update of OE |
| | EN code | EN description | Open CR |
| | A/C-54a | Enhanced Airborne Collision Avoidance (ACAS) | |
| | A/C-54b | ACAS adaptation to new separation modes | CR 03278 Update A/C-54b with links to technical elements |
| | HENA01094[2] | ACAS Xo functions to be performed by the Flight Crew | CR 03283 Creation of new functions in Flight Crew |

[1] By the time of writing this TS, a CR for the creation of the EN has been produced. It is expected that it will be endorsed during the next DS20 campaign.

[2] By the time of writing this TS, a CR for the creation of the EN has been produced. It is expected that it will be endorsed during the next DS20 campaign.

Open CRs are described in the section 3.2 where also more details about EN HENA01094 are provided.

#### 3.1.1.1 Deviations with respect to the SESAR Solution(s) definition

| Enabler | Opt/Req | Deviation |
|---|---|---|
| A/C-54a_Enhanced Airborne Collision Avoidance (ACAS) | Required | N/A |
| A/C-54b_ACAS adaptation to new separation modes | Required | CR 03278 Update A/C-54b with links to technical elements |
| HENA01094_ ACAS Xo functions to be performed by the Flight Crew | Required | CR 03283 Creation of new functions in Flight Crew |

#### 3.1.1.2 Relevant Use Cases

| Operational Use Case | Description |
|---|---|
| [NOV-5] ACAS Xo with mode CSPO-3000 | This use case refers to the nominal use of the CSPO-3000 mode for ACAS Xo, which provides CAS logic monitoring that is appropriate for parallel operations.<br>While ACAS Xo with CSPO-3000 mode still provides TAs and RAs on the traffic, applying modified Xo logic (the TA''s and RA''s are triggered later than with ACAS Xa), this use case represents nominal use case, when CSPO-3000 mode is activated, and parallel runway approach is performed without issuing any alert.<br>CSPO-3000 can be used in both visual and instrumental conditions.<br><br>CSPO-3000 mode pre-conditions:<br>· Distance between runways is comprised between 3000 and 4300 ft.<br>· Approaches are independent. This means that 2 aircraft may fly parallel final approaches without consideration of visually monitoring each other.<br>· These approaches can be managed by 2 different controllers managing different aircraft flows.<br>· Maximum applicable altitude: 14,000 ft MSL<br><br>If during the approach, ownship or designated traffic deviates from the approach path up to a certain threshold, TA and even RA is issued.<br><br>Conditions for automatic mode un-designation:<br>· Designated traffic is invalid for more than 30 sec;<br>· Designated traffic climbed above max. altitude (14,000ft MSL) |

| Operational Use Case | Description |
|---|---|
| | · Required ownship data is available, but does not meet performance criteria (unavailable to run) |
| [NOV-5] ACAS Xo with mode CSPO-3000 with a TA alert issued | In this use case, either designated or ownship aircraft on the approach deviates from the approach path causing ACAS Xo ownship issuing a Traffic Advisory (TA).<br>TA is giving pilot audio announcement ““Traffic Traffic”” and highlighting the intruder on a traffic display. The intended function of TA is to help pilot to achieve visual acquisition and prepare for potential avoidance manoeuvre. In this use case, RA is not issued. |
| [NOV-5] ACAS Xo with mode CSPO-3000 with TA and RA alerts issued | In this use case, either designated or ownship aircraft on the approach deviates from the approach path causing ACAS Xo ownship issuing a Traffic Advisory (TA) and later also threshold for Resolution Advisory (RA). In this case, flight crew is obliged to follow ACAS X instructions.<br>TA’’s and RA’’s with CSPO-3000 mode are issued later than they would with ACAS Xa. |
| [NOV-5] ACAS Xo with DNA mode | This use case refers to the use of the DNA (Designated No Alert) mode for ACAS Xo which suppress all alerting (TA and RA) against designated traffic.<br>Normal (ACAS Xa) collision avoidance is provided to all other traffic.<br><br>Pre-conditions:<br>· Flight crew much visually acquire the designated traffic before designating and maintain visual separation from the DNA designated aircraft.<br>Diverging DNA Traffic Range limit is 6NM. Exceeding this limit leads to automatic un-designation.<br>In case of multi-threat encounters, DNA alert suppression is temporarily suspended.<br><br>Conditions for automatic mode un-designation:<br>· Designated traffic is invalid for more than 30 sec;<br>· Ownship descends below on-ground threshold (50ft AGL);<br>· Ownship descend below aural inhibit altitude (400ft AGL), then climbs above 600ft AGL (go-around situation);<br>· Traffic range of diverging DNA target exceeds 6NM threshold;<br>· Traffic bearing becomes invalid;<br>· Required ownship input data is available but does not meet performance criteria (unavailable to run); |

For operational use cases, we have separated CSPO situations, when there is only TA alert ("ACAS Xo with mode CSPO-3000 with a TA alert issued") from the situation, when both TA and later RA alert are issued ("ACAS Xo with mode CSPO-3000 with TA and RA alerts issued"). But from the technology point of view (NSV-4), both situations can be merged in the one system process "ACAS Xo with CSPO-3000 mode with TA and RA".

| System Process | Description |
|---|---|
| [NSV-4] ACAS Xo with CSPO-3000 mode with TA and RA | This NSV-4 view describes the process when a TA alert and RA are issued by ACAS Xo with mode CSPO-3000 activated |
| [NSV-4] ACAS Xo with DNA mode | This NSV-4 view describes the normal process of flight of an A/C with ACAS Xo activating the mode DNA |
| [NSV-4] ACAS Xo with mode CSPO-3000 (Normal case) | This NSV-4 view describes the normal process of flight of an A/C with ACAS Xo with mode CSPO-3000 activated without issuing a TA or RA. |

#### 3.1.1.3 Applicable standards and regulations

Elements of the technical architecture designed have been linked to existing standards:

- The *Functional Block* Airborne Collision Avoidance (ACAS Xa/Xo) (PJ.11-A3) is linked to:
  - RTCA DO-317B
  - RTCA DO-385 / EUROCAE ED-256
- The *Data Element* ADS-B report is linked to:
  - RTCA DO-260B/EUROCAE ED-102A

### 3.1.2 Capability Configurations required for the SESAR Solution

| ACAS Xo with mode CSPO-3000/DNA Resource Connectivity diagram | | | | |
|---|---|---|---|---|
| **CC** | **Op Env** | **Capability** | **Node** | **Stakeholder** |
| APP ACC (Step 2) | | Air Traffic Complexity Management; Air Traffic Flow Management; Airspace Configuration Management; Airspace Infringement Avoidance; Airspace Reservation Management; Arrival Sequencing; Arrival/Departure Routes Management; Clearance/Instruction Management; Coordination and Transfer; Crisis Management; CTA/CTO Management; | Air Traffic Flow and Capacity Management; Airspace Management; Airspace Organisation; En-Route/Approach ATS; | |

| ACAS Xo with mode CSPO-3000/DNA Resource Connectivity diagram | | | | |
|---|---|---|---|---|
| **CC** | **Op Env** | **Capability** | **Node** | **Stakeholder** |
| | | Integrated Arrival/Departure Sequencing;<br>Interval Management (IM);<br>Mid-Air Collision Avoidance;<br>Minimum Pair Separation Provision;<br>Separation Provision (airspace);<br>Separation Technique Management;<br>Trajectory Conformance Monitoring;<br>Trajectory Information Synchronisation;<br>Trajectory Management;<br>Trajectory Revision in Execution;<br>Wake Turbulence Separation Provision;<br>Weather-Dependent Separation Provision; | | |
| Civil Aircraft (Designated) (PJ.11-A3) | Terminal Airspace; | Clearance/Instruction Management;<br>Mid-Air Collision Avoidance; | Airspace User Operations;<br>Flight Deck; | Civil Scheduled Aviation; |
| Civil Aircraft (Ownship) (PJ.11-A3) | Terminal Airspace; | Clearance/Instruction Management;<br>Mid-Air Collision Avoidance; | Airspace User Operations;<br>Flight Deck; | Civil Scheduled Aviation; |
| Communication Infrastructure | | Airport Operations Management; | Flight Deck; | Air Navigation Service Provider; |
| TWR (Step 2) | | Adverse Condition Operations Provision;<br>Air Traffic Flow Management;<br>Airspace Infringement Avoidance;<br>Airspace Reservation Management;<br>Arrival Sequencing;<br>Arrival/Departure Routes Management;<br>Crisis Management;<br>Departure Sequencing; | Network Operations; | Air Navigation Service Provider; |

| ACAS Xo with mode CSPO-3000/DNA Resource Connectivity diagram | | | | |
|---|---|---|---|---|
| **CC** | **Op Env** | **Capability** | **Node** | **Stakeholder** |
| | | Dynamic Runway Allocation; Ground Collision Avoidance; Integrated Arrival/Departure Sequencing; Interval Management (IM); Remote Tower Operations Provision; Separation Provision (airspace); Separation Technique Management; Surface Guidance Provision; Surface Route Management; Wake Turbulence Separation Provision; Weather-Dependent Separation Provision; | | |

**Table 4: List of Capability Configuration required for the SESAR Solution**

## 3.2 Changes imposed by the SESAR Solution on the baseline Architecture

| Enabler | Element type | Element name | Impact | Change |
|---|---|---|---|---|
| A/C-54b (CR) | ACAS adaptation to new separation modes | | | |
| | FB | Airborne Collision Avoidance (ACAS Xa/Xo) (PJ.11-A3) | Update | New functions related to ACAS Xo has been allocated to the FB |
| | Function | Trigger RA (CSPO-3000 mode of ACAS Xo) | Introduce | New function related to ACAS Xo |
| | Function | Trigger TA (CSPO-3000 mode of ACAS Xo) | Introduce | New function related to ACAS Xo |
| HENA01094 (CR) | ACAS Xo functions to be performed by the Flight Crew | | | |
| | Role | Flight Crew (PJ.11-A3) | Update | The following Functions have to be performed by the Flight Crew in order to correctly use the ACAS Xo system:<br>- Acquire and maintain visually traffic to designate (DNA mode of |

| | | | | |
|---|---|---|---|---|
| | | | | ACAS Xo)<br>- Designate, select mode and activate Xo mode<br>- Suppress RAs and TAs for designated A/C (DNA mode of ACAS Xo)<br>- Trigger RA (CSPO-3000 mode of ACAS Xo)<br>- Trigger TA (CSPO-3000 mode of ACAS Xo) |

**Table 5: List of changes due to the SESAR Solution**

Beside changes in the Enablers, there is a CR 03277 to update OI step CM-0808-o with links with Activities and update of OE.

# 4 Technical Specifications

## 4.1 Functional architecture overview

*Functions required to perform needed Operational Activities can be allocated to Resources of a different type: Human Role, Infrastructure System or Functional Block.*

| Role | Functional Block | Function |
|---|---|---|
| [NSV-4] ACAS Xo with CSPO-3000 mode with TA and RA | | |
| | A/G Datalink Communications | A/G Datalink Communications; |
| | A/G Voice Communication | A/G Voice Communication;<br>A/G Voice Communication; |
| | ADS-B In | ADS-B In; |
| | ADS-B Out | ADS-B Out; |
| | Airborne Collision Avoidance (ACAS Xa/Xo) (PJ.11-A3) | Actively providing collision avoidance;<br>Trigger RA (CSPO-3000 mode of ACAS Xo);<br>Trigger TA (CSPO-3000 mode of ACAS Xo); |
| ATC Executive Controller (PJ.11-A3) | | Issue Approach Clearance;<br>Process RA report; |
| | CPDLC | CPDLC; |
| Flight Crew (PJ.11-A3) | | Acquire and maintain visually traffic to designate (DNA mode of ACAS Xo);<br>Contact ACC ATCo;<br>Designate, select mode and activate Xo mode;<br>Fly A/C during approach;<br>Fly A/C during approach;<br>Follow RA instruction;<br>Notice the TA; |

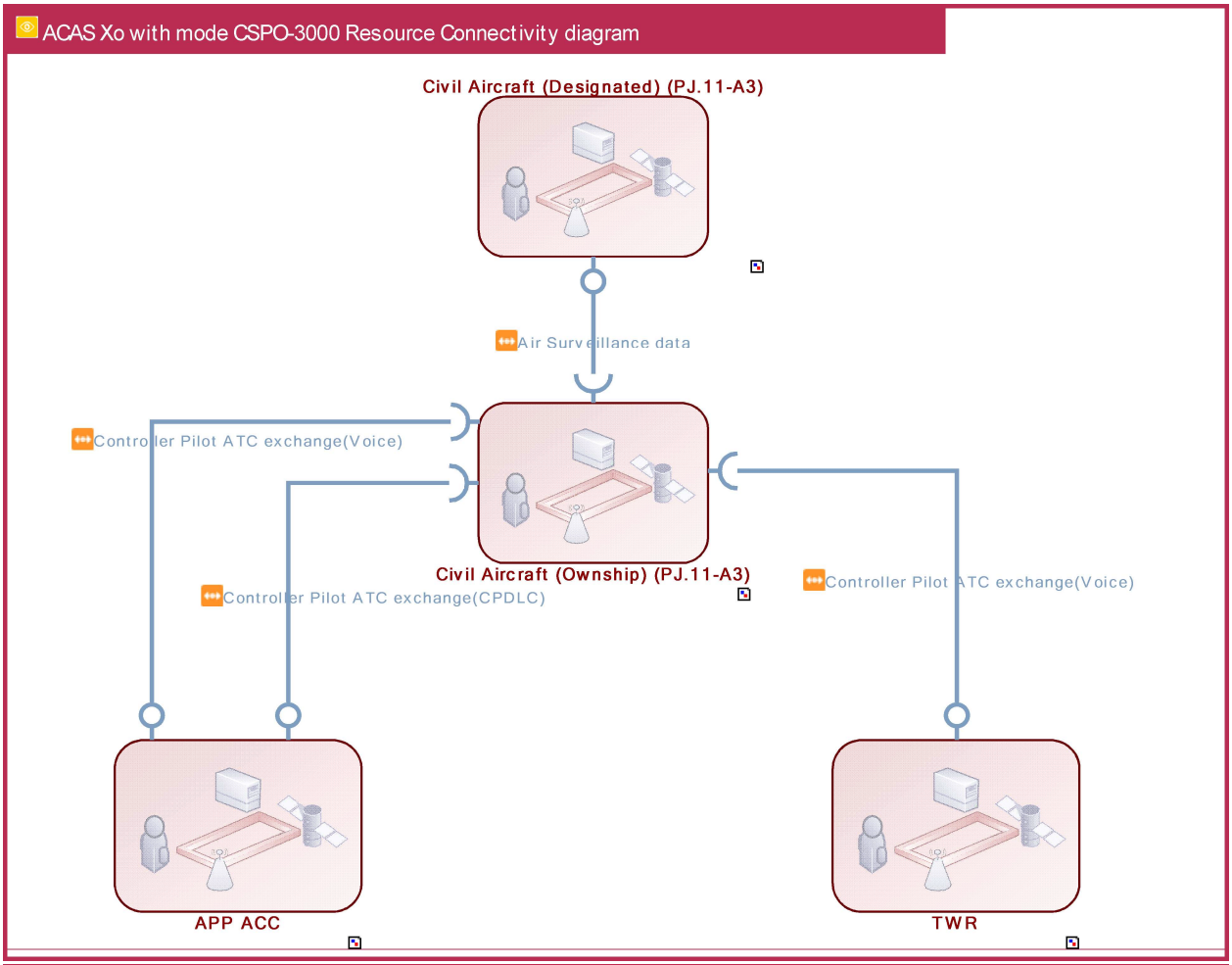
| Role | Functional Block | Function |
|---|---|---|
| | | |
| Flight Crew (PJ.11-A3) | | Fly A/C during approach; |
| | Mode S (PJ.11-A3) | Validate ADS-B data; |
| | Voice | Voice; |
| [NSV-4] ACAS Xo with mode CSPO-3000 (Normal case) | | |
| | A/G Voice Communication | A/G Voice Communication;<br>A/G Voice Communication; |
| | A/G Voice Communication | A/G Voice Communication; |
| | ADS-B In | ADS-B In; |
| | ADS-B Out | ADS-B Out; |
| | Airborne Collision Avoidance (ACAS Xa/Xo) (PJ.11-A3) | Task;<br>Actively providing collision avoidance; |
| ATC Executive Controller (PJ.11-A3) | | Issue Approach Clearance; |
| Flight Crew (PJ.11-A3) | | Fly A/C during approach; |
| Flight Crew (PJ.11-A3) | | Fly A/C during landing;<br>Task;<br>Task;<br>Acquire and maintain visually traffic to designate (DNA mode of ACAS Xo);<br>Designate, select mode and activate Xo mode;<br>Fly A/C during approach; |
| | Mode S (PJ.11-A3) | Validate ADS-B data; |

| Role | Functional Block | Function |
|---|---|---|
| | | |
| Tower Runway Controller (PJ.11-A3) | | Issue Landing Clearance; |
| | Voice | Voice;<br>Voice;<br>Voice; |
| [NSV-4] ACAS Xo with DNA mode | | |
| | A/G Voice Communication | A/G Voice Communication; |
| | A/G Voice Communication | A/G Voice Communication; |
| | ADS-B In | ADS-B In; |
| | ADS-B Out | ADS-B Out; |
| | Airborne Collision Avoidance (ACAS Xa/Xo) (PJ.11-A3) | Actively providing collision avoidance;<br>Suppress RAs and TAs for designated A/C (DNA mode of ACAS Xo); |
| ATC Executive Controller (PJ.11-A3) | | Issue Approach Clearance; |
| Flight Crew (PJ.11-A3) | | Fly A/C during approach; |
| Flight Crew (PJ.11-A3) | | Acquire and maintain visually traffic to designate (DNA mode of ACAS Xo);<br>Designate, select mode and activate Xo mode;<br>Fly A/C during approach;<br>Fly A/C during landing; |
| | Mode S (PJ.11-A3) | Validate ADS-B data; |
| Tower Runway Controller | | Issue Landing Clearance; |

| Role | Functional Block | Function |
|---|---|---|
| (PJ.11-A3) | | |
| | Voice | Voice;<br>Voice; |

### 4.1.1 Resource Connectivity Model

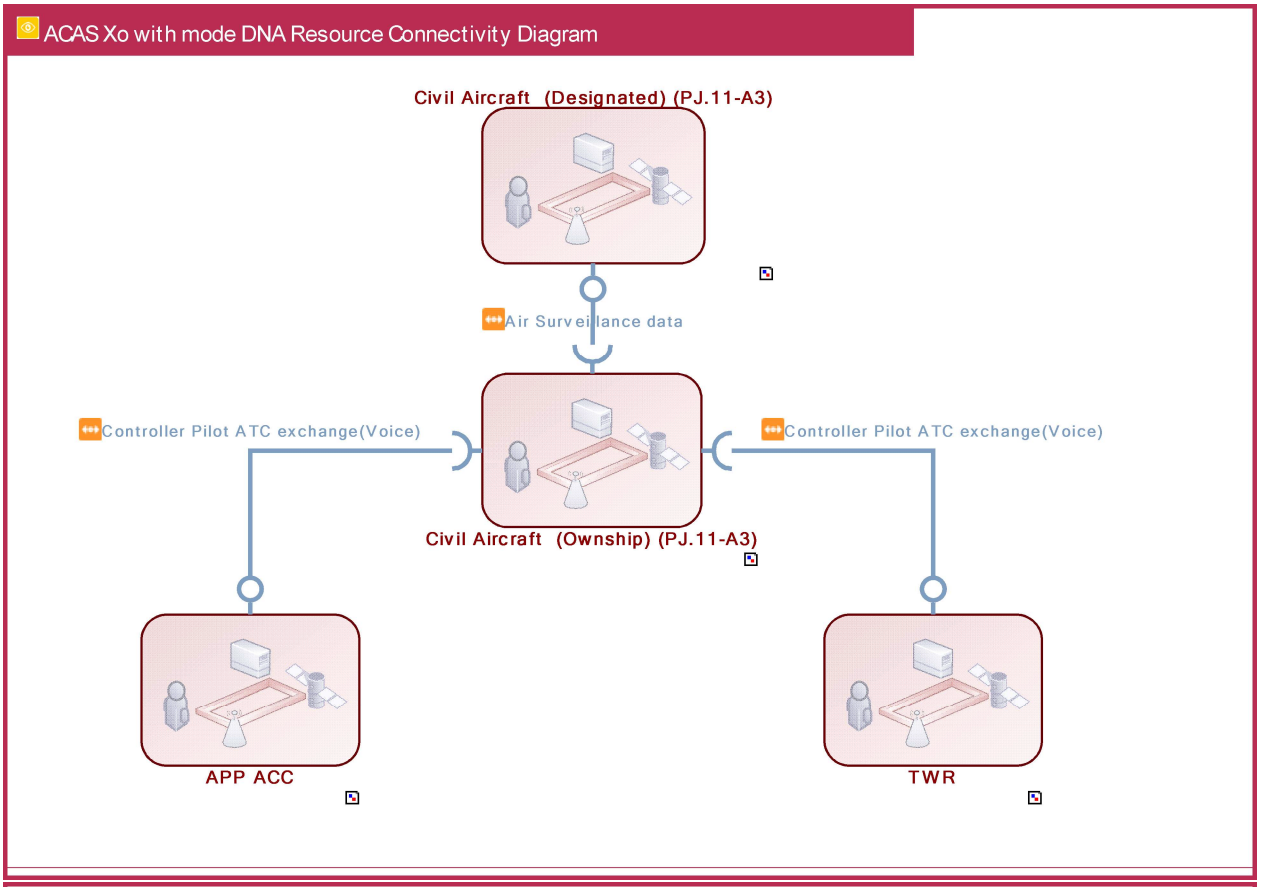
This view shows the interactions between the different participants when the flight crew activates the ACAS Xo with mode CSPO-3000. It encompasses the normal case, a case with only a TA, and a case with a TA and a RA.




**[NSV-4] ACAS Xo with CSPO-3000 mode with TA and RA [A/G Datalink Communications, A/G Voice Communication, ADS-B In, ADS-B Out, Airborne Collision Avoidance (ACAS Xa/Xo) (PJ.11-A3), ATC Executive Controller (PJ.11-A3), CPDLC, Flight Crew (PJ.11-A3), Flight Crew (PJ.11-A3), Mode S (PJ.11-A3), Voice]**

**[NSV-4] ACAS Xo with mode CSPO-3000 (Normal case) [A/G Voice Communication, A/G Voice Communication, ADS-B In, ADS-B Out, Airborne Collision Avoidance (ACAS Xa/Xo) (PJ.11-A3), ATC Executive Controller (PJ.11-A3), Flight Crew (PJ.11-A3), Flight Crew (PJ.11-A3), Mode S (PJ.11-A3), Tower Runway Controller (PJ.11-A3), Voice]**

This view shows the interactions between the different participants when the flight crew activates the ACAS Xo with mode DNA.

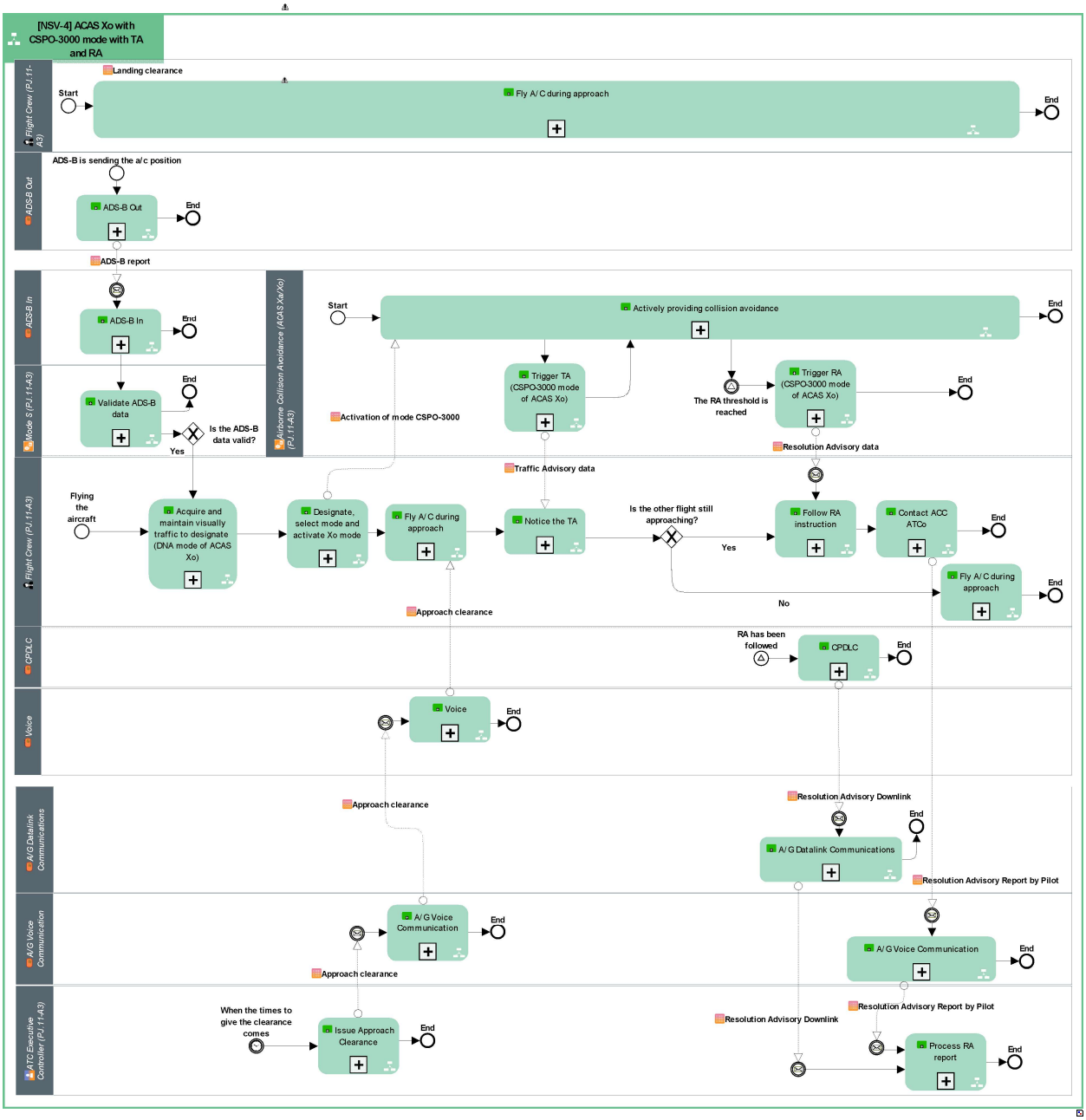



[NSV-4] ACAS Xo with DNA mode [A/G Voice Communication, A/G Voice Communication, ADS-B In, ADS-B Out, Airborne Collision Avoidance (ACAS Xa/Xo) (PJ.11-A3), ATC Executive Controller (PJ.11-A3), Flight Crew (PJ.11-A3), Flight Crew (PJ.11-A3), Mode S (PJ.11-A3), Tower Runway Controller (PJ.11-A3), Voice]

## 4.1.2 Resource Orchestration view

### 4.1.2.1 [NSV-4] ACAS Xo with CSPO-3000 mode with TA and RA

This NSV-4 view describes the process when a TA alert and RA are issued by ACAS Xo with mode CSPO-3000 activated



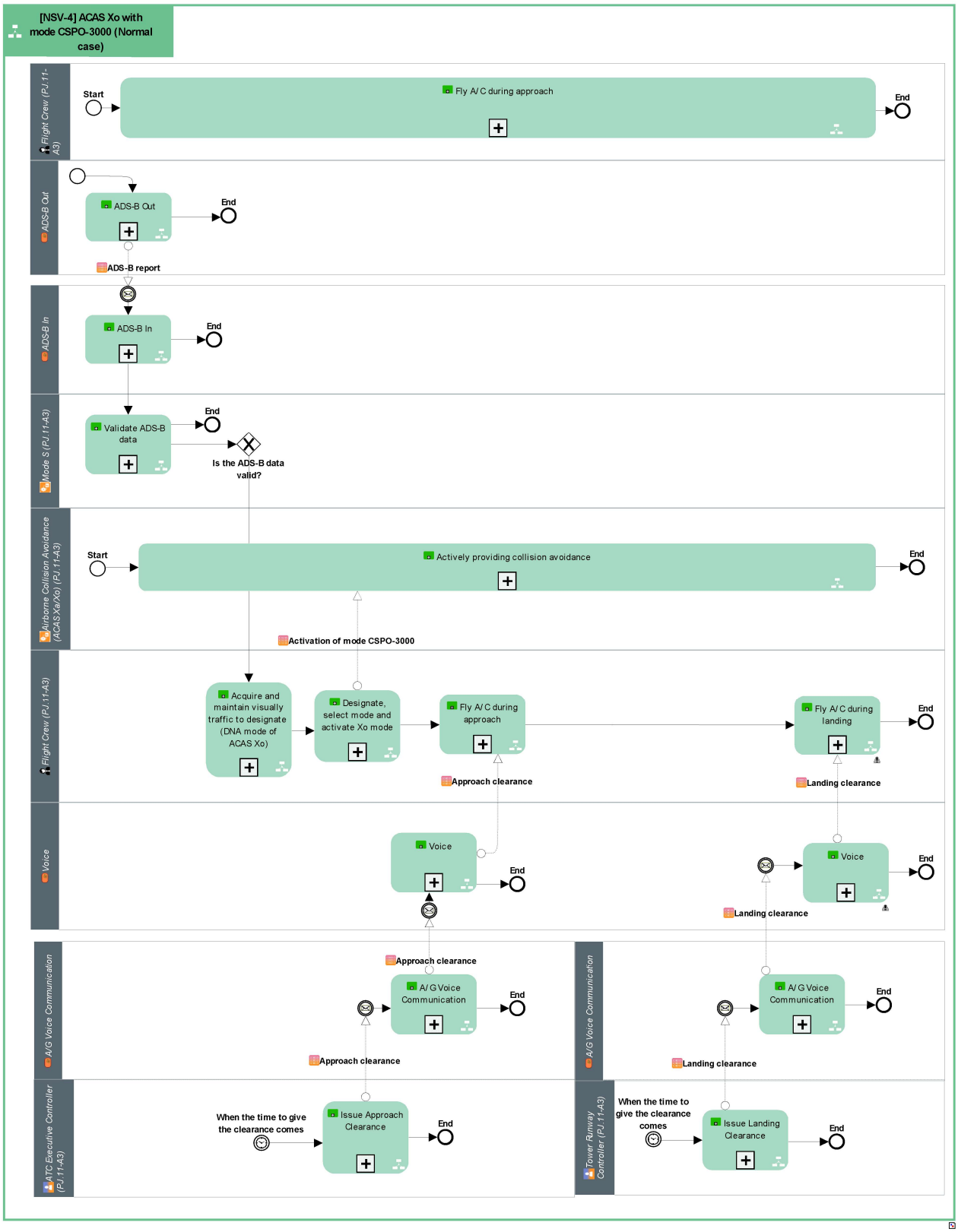

| Function | Description |
|---|---|
| A/G Datalink Communications | The Air-Ground Datalink Communication functional block comprises the communication function (as defined in 10.07.01-D03) that provides the means to exchange air-ground datalink communication and surveillance messages through standardised datalink communication protocols, relayed by external air-ground data communication networks (i.e. the ATN and/or the ACARS networks). This comprises:<br><br>· translating the generic datalink communications internal |

| Function | Description |
|---|---|
| | protocol (i.e. CM, CPDLC, ADS-C and DFIS) into the two main standard communication protocols (i.e. the ATN/OSI protocol and/or the ACARS based protocols);<br><br>· Ensuring the reception and transmission of the standardised datalink message on the air-ground communication network via the ATN and ACARS ground stacks. |
| A/G Voice Communication | The Air-Ground Voice Communication functional block provides the functions performed by a Radio VCS |
| Acquire and maintain visually traffic to designate (DNA mode of ACAS Xo) | To acquire and maintain visually traffic to designate performed by the Flight Crew when applying DNA mode of ACAS Xo. |
| Actively providing collision avoidance | Refers to intended function of ACAS, i.e. to detect and track surrounding traffic and if another airborne aircraft is a potential threat, then: (1) to issue TA to help pilot to achieve visual acquisition and prepare for potential avoidance maneuver, (2) if a maneuver becomes necessary, issue an RA instructing pilot to climb or descend to maintain a safe distance |
| ADS-B In | The function supporting the reception and processing (e.g. for ATSAW Spacing...) of surrounding aircraft traffic or ground mobile transmitting their position via ASD-B Out broadcasted data |
| ADS-B Out | The capability for a non-solicited aircraft to broadcast surveillance data (e.g. Latitude/Longitude, Speed...) |
| Contact ACC ATCo | To contact the ATCo to inform about the decision taken by the pilot |
| CPDLC | Capability for the Crew to exchange datalink clearance/instructions with ATC (in replacement of Voice). |
| Designate, select mode and activate Xo mode | When applying ACAS Xo mode (designate = selection of the traffic to be designated for Xo; select mode = which mode should be applied; activate = Xo mode activation). |
| Fly A/C during approach | To fly the A/C during approach phase of the flight. |
| | Flight Crew (or autopilot) is obliged to perform once ACAS triggers an |

| Function | Description |
|---|---|
| Follow RA instruction | RA in order to avoid the collision. |
| Issue Approach Clearance | To provide a clearance for approach |
| Notice the TA | To notice the Traffic Advisory alert issued by ACAS Xo |
| Process RA report | To process the RA reported by the Flight Crew |
| Trigger RA (CSPO-3000 mode of ACAS Xo) | When surrounding traffic is declared a threat, and maneuver becomes necessary, ACAS will issue a RA (Resolution Advisory) instructing pilot to climb or descend to maintain a safe distance. |
| Trigger TA (CSPO-3000 mode of ACAS Xo) | To trigger a Traffic Advisory alert |
| Validate ADS-B data | ADS-B data is actively validated (cross-checked) through Mode S interrogation. |
| Voice | Function for voice mobile communications (which is of 2 basic types: short-range/continental, long-range/remote-oceanic). |

#### 4.1.2.2 [NSV-4] ACAS Xo with mode CSPO-3000 (Normal case)

This NSV-4 view describes the normal process of flight of an A/C with ACAS Xo with mode CSPO-3000 activated without issuing a TA or RA.

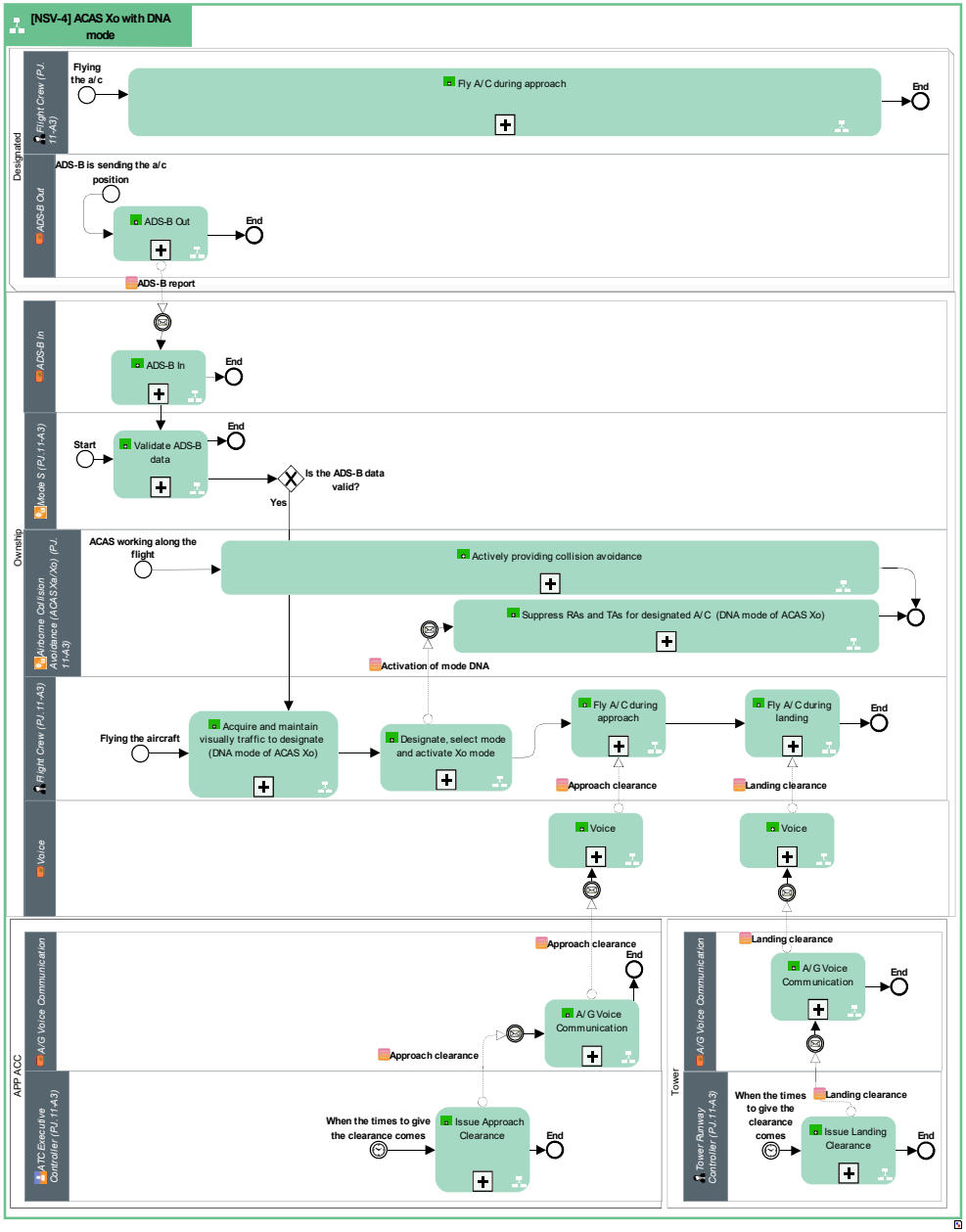



| Function | Description |
|---|---|

| Function | Description |
|---|---|
| A/G Voice Communication | The Air-Ground Voice Communication functional block provides the functions performed by a Radio VCS |
| Acquire and maintain visually traffic to designate (DNA mode of ACAS Xo) | To acquire and maintain visually traffic to designate performed by the Flight Crew when applying DNA mode of ACAS Xo. |
| Actively providing collision avoidance | Refers to intended function of ACAS, i.e. to detect and track surrounding traffic and if another airborne aircraft is a potential threat, then: (1) to issue TA to help pilot to achieve visual acquisition and prepare for potential avoidance maneuver, (2) if a maneuver becomes necessary, issue an RA instructing pilot to climb or descend to maintain a safe distance |
| ADS-B In | The function supporting the reception and processing (e.g. for ATSAW Spacing...) of surrounding aircraft traffic or ground mobile transmitting their position via ASD-B Out broadcasted data |
| ADS-B Out | The capability for a non-solicited aircraft to broadcast surveillance data (e.g. Latitude/Longitude, Speed...) |
| Designate, select mode and activate Xo mode | When applying ACAS Xo mode (designate = selection of the traffic to be designated for Xo; select mode = which mode should be applied; activate = Xo mode activation). |
| Fly A/C during approach | To fly the A/C during approach phase of the flight. |
| Issue Approach Clearance | To provide a clearance for approach |
| Issue Landing Clearance | To provide a clearance for landing |
| Validate ADS-B data | ADS-B data is actively validated (cross-checked) through Mode S interrogation. |
| Voice | Function for voice mobile communications (which is of 2 basic types: short-range/continental, long-range/remote-oceanic). |

#### 4.1.2.3 [NSV-4] ACAS Xo with DNA mode

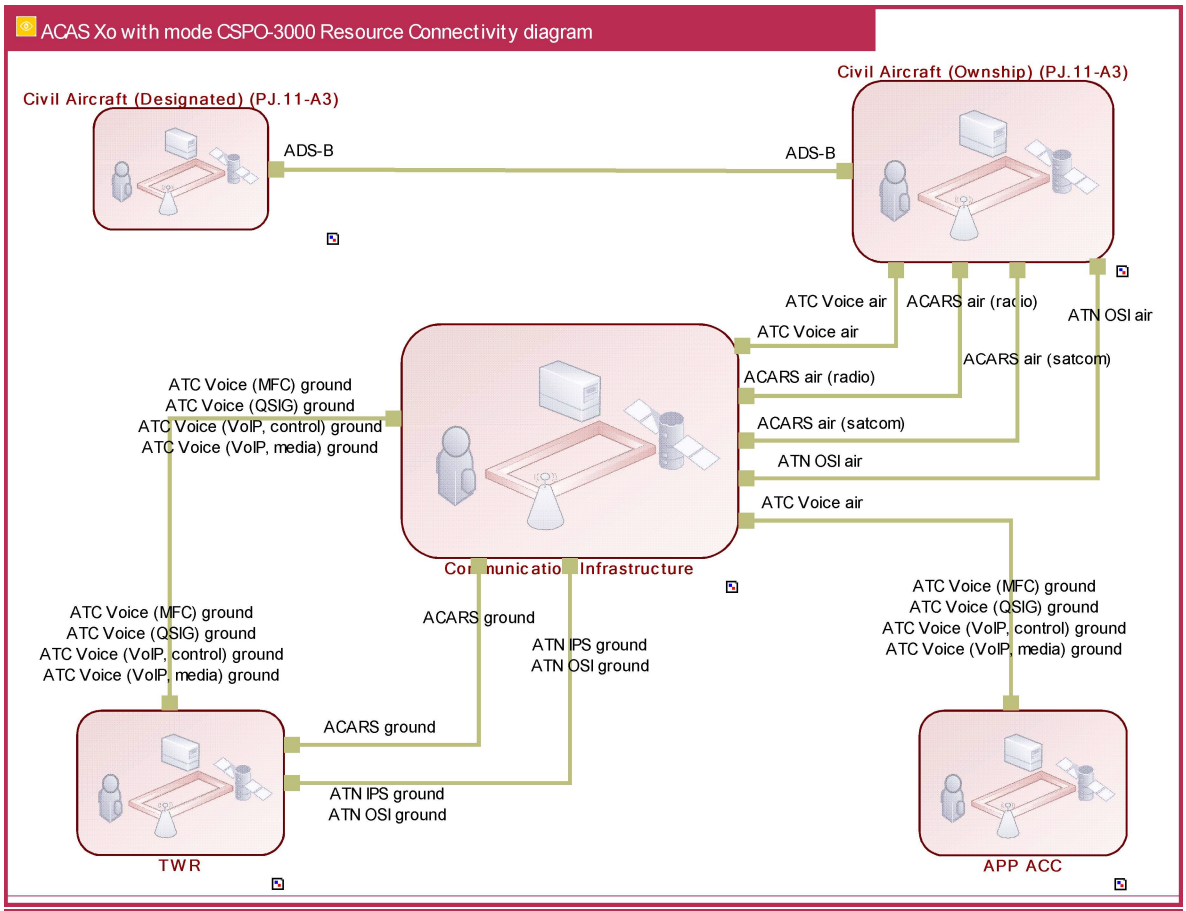
This NSV-4 view describes the normal process of flight of an A/C with ACAS Xo activating the mode DNA


[NSV-4] ACAS Xo with DNA mode
Designated
Flight Crew (PJ. 11-43)
Flying the a/c
Fly A/C during approach
End
ADS-B Out
ADS-B is sending the a/c position
ADS-B Out
End
ADS-B report
Ownship
ADS-B In
ADS-B In
End
Mode S (PJ.11-A3)
Start
Validate ADS-B data
End
Is the ADS-B data valid?
Yes
Airborne Collision Avoidance (ACAS Xa/Xo) (PJ. 11-A3)
ACAS working along the flight
Actively providing collision avoidance
Suppress RAs and TAs for designated A/C (DNA mode of ACAS Xo)
Activation of mode DNA
Flight Crew (PJ.11-A3)
Flying the aircraft
Acquire and maintain visually traffic to designate (DNA mode of ACAS Xo)
Designate, select mode and activate Xo mode
Fly A/C during approach
Fly A/C during landing
End
Approach clearance
Landing clearance
Voice
Voice
APP ACC
A/G Voice Communication
Approach clearance
End
A/G Voice Communication
Approach clearance
ATC Executive Controller (PJ. 11-A3)
When the times to give the clearance comes
Issue Approach Clearance
End
Tower
A/G Voice Communication
Landing clearance
A/G Voice Communication
End
Tower Runway Controller (PJ. 11-A3)
When the times to give the clearance comes
Landing clearance
Issue Landing Clearance
End

| Function | Description |
|---|---|
| A/G Voice Communication | The Air-Ground Voice Communication functional block provides the functions performed by a Radio VCS |
| Acquire and maintain visually traffic to designate (DNA mode of ACAS Xo) | To acquire and maintain visually traffic to designate performed by the Flight Crew when applying DNA mode of ACAS Xo. |
| Actively providing collision avoidance | Refers to intended function of ACAS, i.e. to detect and track surrounding traffic and if another airborne aircraft is a potential threat, then: (1) to issue TA to help pilot to achieve visual acquisition and prepare for potential avoidance maneuver, (2) if a maneuver becomes necessary, issue an RA instructing pilot to climb or descend to maintain a safe distance |
| ADS-B In | The function supporting the reception and processing (e.g. for ATSAW Spacing...) of surrounding aircraft traffic or ground mobile transmitting their position via ASD-B Out broadcasted data |
| ADS-B Out | The capability for a non-solicited aircraft to broadcast surveillance data (e.g. Latitude/Longitude, Speed...) |
| Designate, select mode and activate Xo mode | When applying ACAS Xo mode (designate = selection of the traffic to be designated for Xo; select mode = which mode should be applied; activate = Xo mode activation). |
| Fly A/C during approach | To fly the A/C during approach phase of the flight. |
| Fly A/C during landing | To fly the A/C during landing phase of the flight. |
| Issue Approach Clearance | To provide a clearance for approach |
| Issue Landing Clearance | To provide a clearance for landing |
| Suppress RAs and TAs for designated A/C (DNA mode of ACAS Xo) | To suppress RAs and TAs for designated A/C with ACAS Xo DNA mode. |
| Validate ADS-B data | ADS-B data is actively validated (cross-checked) through Mode S interrogation. |
| | Function for voice mobile communications (which is of 2 basic types: |

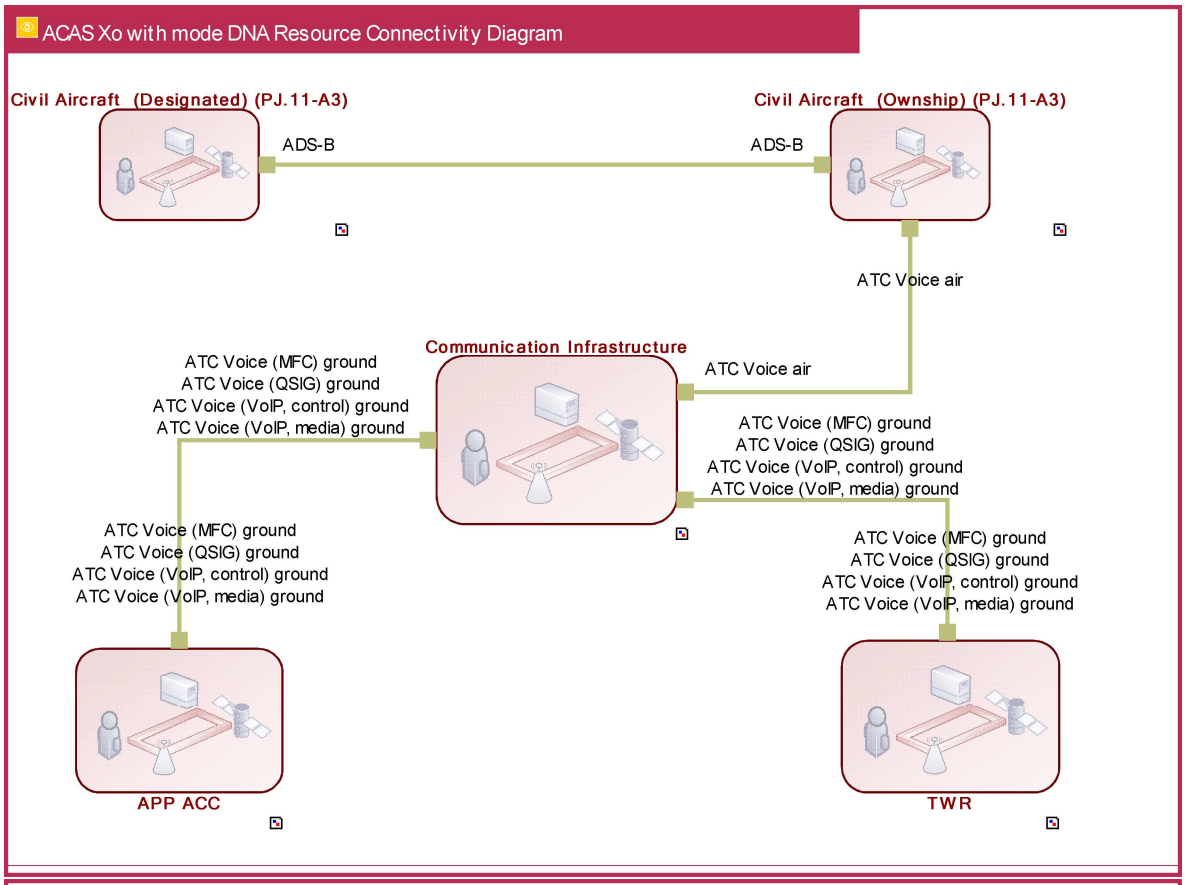
| | |
|---|---|
| Voice | short-range/continental, long-range/remote-oceanic). |

### 4.1.3 Infrastructure connectivity model




**[NSV-4] ACAS Xo with CSPO-3000 mode with TA and RA [A/G Datalink Communications, A/G Voice Communication, ADS-B In, ADS-B Out, Airborne Collision Avoidance (ACAS Xa/Xo) (PJ.11-A3), ATC Executive Controller (PJ.11-A3), CPDLC, Flight Crew (PJ.11-A3), Flight Crew (PJ.11-A3), Mode S (PJ.11-A3), Voice]**

**[NSV-4] ACAS Xo with mode CSPO-3000 (Normal case) [A/G Voice Communication, A/G Voice Communication, ADS-B In, ADS-B Out, Airborne Collision Avoidance (ACAS Xa/Xo) (PJ.11-A3), ATC Executive Controller (PJ.11-A3), Flight Crew (PJ.11-A3), Flight Crew (PJ.11-A3), Mode S (PJ.11-A3), Tower Runway Controller (PJ.11-A3), Voice]**




**[NSV-4] ACAS Xo with DNA mode [A/G Voice Communication, A/G Voice Communication, ADS-B In, ADS-B Out, Airborne Collision Avoidance (ACAS Xa/Xo) (PJ.11-A3), ATC Executive Controller (PJ.11-A3), Flight Crew (PJ.11-A3), Flight Crew (PJ.11-A3), Mode S (PJ.11-A3), Tower Runway Controller (PJ.11-A3), Voice]**

## 4.1.4 Service view

### 4.1.4.1 Service description

N/A

### 4.1.4.2 Service Provisioning

| Interaction | Consumer CC | Consumer System | Provider CC | Provider System |
|---|---|---|---|---|
| Controller Pilot ATC exchange(Voice).Civil Aircraft (Ownship) (PJ.11-A3)_CC and TWR_CC | Civil Aircraft (Ownship) (PJ.11-A3) | Aircraft; | TWR | Voice; |
| Controller Pilot ATC exchange(Voice).Civil Aircraft (Ownship) (PJ.11-A3)_CC and APP ACC_CC | Civil Aircraft (Ownship) (PJ.11-A3) | Aircraft; | APP ACC | Voice; |

| Interaction | Consumer CC | Consumer System | Provider CC | Provider System |
|---|---|---|---|---|
| Air Surveillance data.Civil Aircraft (Ownship) (PJ.11-A3)_CC and Civil Aircraft (Designated) (PJ.11-A3)_CC | Civil Aircraft (Ownship) (PJ.11-A3) | Aircraft; | Civil Aircraft (Designated) (PJ.11-A3) | Aircraft; |
| Controller Pilot ATC exchange(Voice).Civil Aircraft (Ownship) (PJ.11-A3)_CC and APP ACC_CC | Civil Aircraft (Ownship) (PJ.11-A3) | Aircraft; | APP ACC | Voice; |
| Controller Pilot ATC exchange(CPDLC).Civil Aircraft (Ownship) (PJ.11-A3)_CC and APP ACC_CC | Civil Aircraft (Ownship) (PJ.11-A3) | Aircraft; | APP ACC | En-Route / Approach ATC; |
| Air Surveillance data.Civil Aircraft (Ownship) (PJ.11-A3)_CC and Civil Aircraft (Designated) (PJ.11-A3)_CC | Civil Aircraft (Ownship) (PJ.11-A3) | Aircraft; | Civil Aircraft (Designated) (PJ.11-A3) | Aircraft; |
| Controller Pilot ATC exchange(Voice).Civil Aircraft (Ownship) (PJ.11-A3)_CC and TWR_CC | Civil Aircraft (Ownship) (PJ.11-A3) | Aircraft; | TWR | Voice; |

### 4.1.4.3 Service Realization

#### 4.1.4.3.1 Interaction Air Surveillance data.Civil Aircraft (Ownship) (PJ.11-A3)_CC and Civil Aircraft (Designated) (PJ.11-A3)_CC

**System Port:** ADS-B_IN at Civil Aircraft (Step 2) (PJ.11-A3)_CC

| Protocol Stack | Protocol |
|---|---|
| ADS-B | |
| | DF17 |
| | DF18 |
| | DF19 |

**System Port:** ADS-B_OUT at Civil Aircraft (Step 2) (PJ.11-A3)_CC

| Protocol Stack | Protocol |
|---|---|
| ADS-B | |
| | DF17 |
| | DF18 |
| | DF19 |

#### 4.1.4.3.2 Interaction Controller Pilot ATC exchange(CPDLC).Civil Aircraft (Ownship) (PJ.11-A3)_CC and APP ACC_CC

**System Port:** CPDLC_ACARS at Civil Aircraft (Step 2) (PJ.11-A3)_CC

| Protocol Stack | Protocol |
|---|---|
| ACARS air (radio) | |
| | ARINC 618 |
| | ARINC 622 |
| | AVLC |
| ACARS air (satcom) | |
| | AMSS618 |
| | ARINC 622 |
| | AMSS Data 2 |

**System Port:** ACARS_RADIO_AIR at Communication Infrastructure_CC

| Protocol Stack | Protocol |
|---|---|
| ACARS air (radio) | |
| | ARINC 618 |
| | ARINC 622 |
| | AVLC |

**System Port:** ACARS_SATCOM_AIR at Communication Infrastructure_CC

| Protocol Stack | Protocol |
|---|---|
| ACARS air (satcom) | |
| | AMSS618 |
| | ARINC 622 |
| | AMSS Data 2 |

**System Port:** CPDLC_ACARS at Civil Aircraft (Step 2) (PJ.11-A3)_CC

| Protocol Stack | Protocol |
|---|---|
| ACARS air (radio) | |
| | ARINC 618 |
| | ARINC 622 |
| | AVLC |
| ACARS air (satcom) | |
| | AMSS618 |
| | ARINC 622 |
| | AMSS Data 2 |

**System Port:** CPDLC_ACARS_GND at TWR (Step 2)_CC

| Protocol Stack | Protocol |
|---|---|
| ACARS ground | |
| | ARINC 618 |
| | ARINC 620 |
| | BATAP |
| | MATIP |
| | TCP |
| | IP |

**System Port:** ACARS_GND at Communication Infrastructure_CC

| Protocol Stack | Protocol |
|---|---|
| ACARS ground | |
| | ARINC 618 |
| | ARINC 620 |
| | BATAP |
| | MATIP |
| | TCP |
| | IP |

**System Port:** ATN_RADIO_AIR at Communication Infrastructure_CC

| Protocol Stack | Protocol |
|---|---|
| ATN IPS (tcp) air | |

| | |
|---|---|
| | TCP |
| | IP |
| | M-SNDCF |
| ATN IPS (udp) air | |
| | UDP |
| | IP |
| | M-SNDCF |
| ATN OSI air | |
| | ASN.1 |
| | ATN ULCS |
| | TP4 |
| | CLNP |
| | M-SNDCF |
| | SNAcP |

**System Port:** CPDLC_ATN at Civil Aircraft (Step 2) (PJ.11-A3)_CC

| Protocol Stack | Protocol |
|---|---|
| ATN OSI air | |
| | ASN.1 |
| | ATN ULCS |
| | TP4 |
| | CLNP |
| | M-SNDCF |
| | SNAcP |

#### 4.1.4.3.3 Interaction Controller Pilot ATC exchange(Voice).Civil Aircraft (Ownship) (PJ.11-A3)_CC and APP ACC_CC

**System Port:** ATC_VOICE_GND at APP ACC (Step 2)_CC

| Protocol Stack | Protocol |
|---|---|
| ATC Voice (MFC) ground | |
| | ATS MFC R2 |
| ATC Voice (QSIG) ground | |
| | ATS QSIG |
| | |

| | |
|---|---|
| ATC Voice (VoIP, control) ground | |
| | SIP |
| | TCP |
| | IP |
| ATC Voice (VoIP, media) ground | |
| | RTP |
| | UDP |
| | IP |

**System Port:** VOICE_RADIO_AIR at Communication Infrastructure_CC

| Protocol Stack | Protocol |
|---|---|
| ATC Voice air | |
| | VHF - AM 25kHz/8.33kHz |
| | HF - AM 25kHz |
| OPC (Operational) Voice air | |
| | VHF |
| | HF (selcal) |

**System Port:** VOICE_RADIO_AIR at Communication Infrastructure_CC

| Protocol Stack | Protocol |
|---|---|
| ATC Voice air | |
| | VHF - AM 25kHz/8.33kHz |
| | HF - AM 25kHz |
| OPC (Operational) Voice air | |
| | VHF |
| | HF (selcal) |

**System Port:** ATC_VOICE at Civil Aircraft (Step 2) (PJ.11-A3)_CC

| Protocol Stack | Protocol |
|---|---|
| ATC Voice air | |
| | VHF - AM 25kHz/8.33kHz |
| | HF - AM 25kHz |

#### 4.1.4.3.4 Interaction Controller Pilot ATC exchange(Voice).Civil Aircraft (Ownship) (PJ.11-A3)_CC and TWR_CC

**System Port:** ATC_VOICE_GND at TWR (Step 2)_CC

| Protocol Stack | Protocol |
|---|---|
| ATC Voice (MFC) ground | |
| | ATS MFC R2 |
| ATC Voice (QSIG) ground | |
| | ATS QSIG |
| ATC Voice (VoIP, control) ground | |
| | SIP |
| | TCP |
| | IP |
| ATC Voice (VoIP, media) ground | |
| | RTP |
| | UDP |
| | IP |

**System Port:** VOICE_RADIO_GND at Communication Infrastructure_CC

| Protocol Stack | Protocol |
|---|---|
| ATC Voice (MFC) ground | |
| | ATS MFC R2 |
| ATC Voice (QSIG) ground | |
| | ATS QSIG |
| ATC Voice (VoIP, control) ground | |
| | SIP |
| | TCP |
| | IP |
| ATC Voice (VoIP, media) ground | |
| | RTP |
| | UDP |
| | IP |

| | |
|---|---|
| OPC (Operational) Voice ground | |

**System Port:** VOICE_RADIO_AIR at Communication Infrastructure_CC

| Protocol Stack | Protocol |
|---|---|
| ATC Voice air | |
| | VHF - AM 25kHz/8.33kHz |
| | HF - AM 25kHz |
| OPC (Operational) Voice air | |
| | VHF |
| | HF (selcal) |

**System Port:** ATC_VOICE at Civil Aircraft (Step 2) (PJ.11-A3)_CC

| Protocol Stack | Protocol |
|---|---|
| ATC Voice air | |
| | VHF - AM 25kHz/8.33kHz |
| | HF - AM 25kHz |

#### 4.1.4.3.5 Interaction Air Surveillance data.Civil Aircraft (Ownship) (PJ.11-A3)_CC and Civil Aircraft (Designated) (PJ.11-A3)_CC

**System Port:** ADS-B_IN at Civil Aircraft (Step 2) (PJ.11-A3)_CC

| Protocol Stack | Protocol |
|---|---|
| ADS-B | |
| | DF17 |
| | DF18 |
| | DF19 |

**System Port:** ADS-B_OUT at Civil Aircraft (Step 2) (PJ.11-A3)_CC

| Protocol Stack | Protocol |
|---|---|
| ADS-B | |
| | DF17 |
| | DF18 |
| | DF19 |

#### 4.1.4.3.6 Interaction Controller Pilot ATC exchange(Voice).Civil Aircraft (Ownship) (PJ.11-A3)_CC and APP ACC_CC

**System Port:** ATC_VOICE_GND at APP ACC (Step 2)_CC

| Protocol Stack | Protocol |
|---|---|
| ATC Voice (MFC) ground | |
| | ATS MFC R2 |
| ATC Voice (QSIG) ground | |
| | ATS QSIG |
| ATC Voice (VoIP, control) ground | |
| | SIP |
| | TCP |
| | IP |
| ATC Voice (VoIP, media) ground | |
| | RTP |
| | UDP |
| | IP |

**System Port:** VOICE_RADIO_GND at Communication Infrastructure_CC

| Protocol Stack | Protocol |
|---|---|
| ATC Voice (MFC) ground | |
| | ATS MFC R2 |
| ATC Voice (QSIG) ground | |
| | ATS QSIG |
| ATC Voice (VoIP, control) ground | |
| | SIP |
| | TCP |
| | IP |
| ATC Voice (VoIP, media) ground | |
| | RTP |

| | |
|---|---|
| | UDP |
| | IP |
| OPC (Operational) Voice ground | |

**System Port:** VOICE_RADIO_AIR at Communication Infrastructure_CC

| Protocol Stack | Protocol |
|---|---|
| ATC Voice air | |
| | VHF - AM 25kHz/8.33kHz |
| | HF - AM 25kHz |
| OPC (Operational) Voice air | |
| | VHF |
| | HF (selcal) |

**System Port:** ATC_VOICE at Civil Aircraft (Step 2) (PJ.11-A3)_CC

| Protocol Stack | Protocol |
|---|---|
| ATC Voice air | |
| | VHF - AM 25kHz/8.33kHz |
| | HF - AM 25kHz |

#### 4.1.4.3.7 Interaction Controller Pilot ATC exchange(Voice).Civil Aircraft (Ownship) (PJ.11-A3)_CC and TWR_CC

**System Port:** ATC_VOICE_GND at TWR (Step 2)_CC

| Protocol Stack | Protocol |
|---|---|
| ATC Voice (MFC) ground | |
| | ATS MFC R2 |
| ATC Voice (QSIG) ground | |
| | ATS QSIG |
| ATC Voice (VoIP, control) ground | |
| | SIP |
| | TCP |
| | IP |

| | |
|---|---|
| ATC Voice (VoIP, media) ground | |
| | RTP |
| | UDP |
| | IP |

**System Port:** VOICE_RADIO_GND at Communication Infrastructure_CC

| Protocol Stack | Protocol |
|---|---|
| ATC Voice (MFC) ground | |
| | ATS MFC R2 |
| ATC Voice (QSIG) ground | |
| | ATS QSIG |
| ATC Voice (VoIP, control) ground | |
| | SIP |
| | TCP |
| | IP |
| ATC Voice (VoIP, media) ground | |
| | RTP |
| | UDP |
| | IP |
| OPC (Operational) Voice ground | |

**System Port:** VOICE_RADIO_AIR at Communication Infrastructure_CC

| Protocol Stack | Protocol |
|---|---|
| ATC Voice air | |
| | VHF - AM 25kHz/8.33kHz |
| | HF - AM 25kHz |
| OPC (Operational) Voice air | |
| | VHF |
| | HF (selcal) |

**System Port:** ATC_VOICE at Civil Aircraft (Step 2) (PJ.11-A3)_CC

| Protocol Stack | Protocol |
|---|---|
| ATC Voice air | |
| | VHF - AM 25kHz/8.33kHz |
| | HF - AM 25kHz |

## 4.2 Functional and non-Functional Requirements

There are no operation requirements defined for ACAS Xo and therefore no trace to SPR-INTEROP/OSED requirements is provided in the traceability tables.

[REQ]

| | |
|---|---|
| Identifier | REQ-PJ.11-A3-TS-Xo00.1000 |
| Title | ACAS Xo system implementation |
| Requirement | ACAS Xo system shall be implemented in accordance with ACAS Xa/Xo MOPS, in particular as given by prescriptive ACAS Xo algorithms in ADD (MOPS vol.II) |
| Status | <in progress> |
| Rationale | RTCA DO-385 / EUROCAE ED-256 |
| Category | <Functional> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| < ALLOCATED_TO > | <SESAR Solution> | PJ.11-A3 |
| < ALLOCATED_TO > | <Enabler> | A/C-54a |
| < ALLOCATED_TO > | <Enabler> | A/C-54b |
| <ALLOCATED_TO> | <Functional block> | Airborne Collision Avoidance (ACAS Xa/Xo) |

Next sections describe the basic requirements to enable the capability of activation and deactivation of ACAS Xo modes for a specific aircraft selected among surrounding aircrafts (named 'intruders' here under).

### 4.2.1 Intruder designation and Xo modes activation means

[REQ]

| | |
|---|---|
| Identifier | REQ-PJ.11-A3-TS-Xo00.0001 |
| Title | Designation means |

| | |
|---|---|
| Requirement | ACAS Xo function shall include a graphical intruder designation means linked to CDTI. |
| Status | <in progress> |
| Rationale | To designate the aircraft identified to be subject to ACAS Xo during the concerned approach |
| Category | <HMI> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| < ALLOCATED_TO > | <SESAR Solution> | PJ.11-A3 |
| < ALLOCATED_TO > | <Enabler> | A/C-54a |
| < ALLOCATED_TO > | <Enabler> | A/C-54b |
| <ALLOCATED_TO> | <Functional block> | Airborne Collision Avoidance (ACAS Xa/Xo) |

[REQ]

| | |
|---|---|
| Identifier | REQ-PJ.11-A3-TS-Xo00.0002 |
| Title | Consistency with ASAS |
| Requirement | ACAS Xo designation means shall be consistent with other potentially existing ASAS designation means |
| Status | <in progress> |
| Rationale | Use of already existing means for Traffic Designation, in order to avoid additional activation means and to ease flight crew training. |
| Category | <HMI> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| < ALLOCATED_TO > | <SESAR Solution> | PJ.11-A3 |
| < ALLOCATED_TO > | <Enabler> | A/C-54a |
| < ALLOCATED_TO > | <Enabler> | A/C-54b |
| <ALLOCATED_TO> | <Functional block> | Airborne Collision Avoidance (ACAS Xa/Xo) |

[REQ]

| | |
|---|---|
| Identifier | REQ-PJ.11-A3-TS-Xo00.0003 |
| Title | Mode selection |

| | |
|---|---|
| Requirement | ACAS Xo function shall add a modes selection interface allowing activating ACAS Xo modes for the designated intruder. |
| Status | <in progress> |
| Rationale | To give visibility on the Xo function to the pilots when an intruder has been elected. |
| Category | <HMI> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| < ALLOCATED_TO > | <SESAR Solution> | PJ.11-A3 |
| < ALLOCATED_TO > | <Enabler> | A/C-54a |
| < ALLOCATED_TO > | <Enabler> | A/C-54b |
| <ALLOCATED_TO> | <Functional block> | Airborne Collision Avoidance (ACAS Xa/Xo) |

[REQ]

| | |
|---|---|
| Identifier | REQ-PJ.11-A3-TS-Xo00.0004 |
| Title | Mode selection accessability |
| Requirement | ACAS Xo modes selection interface shall be accessible for the designated intruder from sub-menu linked to existing traffic designation means. |
| Status | <in progress> |
| Rationale | To integrate ACAS Xo in the existing traffic designation means. |
| Category | <HMI> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| < ALLOCATED_TO > | <SESAR Solution> | PJ.11-A3 |
| < ALLOCATED_TO > | <Enabler> | A/C-54a |
| < ALLOCATED_TO > | <Enabler> | A/C-54b |
| <ALLOCATED_TO> | <Functional block> | Airborne Collision Avoidance (ACAS Xa/Xo) |

| | |
|---|---|
| Identifier | REQ-PJ.11-A3-TS-Xo00.0005 |
| Title | Quick access to mode selection |
| Requirement | ACAS Xo modes selection interface shall be accessible in fewest possible steps for the designated intruder. |

| | |
|---|---|
| Status | <in progress> |
| Rationale | To give a quick access to Xo function to the pilots when they are in a high workload situation as a final approach phase. |
| Category | <HMI> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| < ALLOCATED_TO > | <SESAR Solution> | PJ.11-A3 |
| < ALLOCATED_TO > | <Enabler> | A/C-54a |
| < ALLOCATED_TO > | <Enabler> | A/C-54b |
| <ALLOCATED_TO> | <Functional block> | Airborne Collision Avoidance (ACAS Xa/Xo) |

| | |
|---|---|
| Identifier | REQ-PJ.11-A3-TS-Xo00.0006 |
| Title | Two Xo modes |
| Requirement | ACAS Xo modes selection interface shall propose to activate the two ACAS Xo sub-modes: CSPO-3000 and DNA. |
| Status | <in progress> |
| Rationale | To ensure a comprehensive naming of the ACAS Xo modes. |
| Category | <HMI> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| < ALLOCATED_TO > | <SESAR Solution> | PJ.11-A3 |
| < ALLOCATED_TO > | <Enabler> | A/C-54a |
| < ALLOCATED_TO > | <Enabler> | A/C-54b |
| <ALLOCATED_TO> | <Functional block> | Airborne Collision Avoidance (ACAS Xa/Xo) |

| | |
|---|---|
| Identifier | REQ-PJ.11-A3-TS-Xo00.0007 |
| Title | No default Xo mode |
| Requirement | ACAS Xo modes selection interface shall not activate any ACAS Xo mode by default. |
| Status | <in progress> |
| Rationale | No reduction of alerts thresholds are applied without pilot confirmation. |

| | |
|---|---|
| Category | <HMI> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| < ALLOCATED_TO > | <SESAR Solution> | PJ.11-A3 |
| < ALLOCATED_TO > | <Enabler> | A/C-54a |
| < ALLOCATED_TO > | <Enabler> | A/C-54b |
| <ALLOCATED_TO> | <Functional block> | Airborne Collision Avoidance (ACAS Xa/Xo) |

| | |
|---|---|
| Identifier | REQ-PJ.11-A3-TS-Xo00.0008 |
| Title | Aircraft change |
| Requirement | On ACAS Xo activation on a given aircraft, ACAS Xo function shall be de-activated on any other aircraft |
| Status | <in progress> |
| Rationale | ACAS Xo cannot be activated on more than one intruder. |
| Category | <HMI> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| < ALLOCATED_TO > | <SESAR Solution> | PJ.11-A3 |
| < ALLOCATED_TO > | <Enabler> | A/C-54a |
| < ALLOCATED_TO > | <Enabler> | A/C-54b |
| <ALLOCATED_TO> | <Functional block> | Airborne Collision Avoidance (ACAS Xa/Xo) |

| | |
|---|---|
| Identifier | REQ-PJ.11-A3-TS-Xo00.0015 |
| Title | Xo mode exclusivity |
| Requirement | ACAS Xo modes (CSPO-3000 and DNA) shall be exclusive. |
| Status | <in progress> |
| Rationale | It is not possible to have two Xo modes active at the same time. |
| Category | <HMI> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| < ALLOCATED_TO > | <SESAR Solution> | PJ.11-A3 |

| | | |
|---|---|---|
| < ALLOCATED_TO > | <Enabler> | A/C-54a |
| < ALLOCATED_TO > | <Enabler> | A/C-54b |
| <ALLOCATED_TO> | <Functional block> | Airborne Collision Avoidance (ACAS Xa/Xo) |

| | |
|---|---|
| Identifier | REQ-PJ.11-A3-TS-Xo00.0009 |
| Title | Active mode on interface |
| Requirement | The ACAS Xo modes selection interface shall allow identifying which mode is currently activated. |
| Status | <in progress> |
| Rationale | Pilots shall not be confused with a design that could be too different than usual. |
| Category | <HMI> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| < ALLOCATED_TO > | <SESAR Solution> | PJ.11-A3 |
| < ALLOCATED_TO > | <Enabler> | A/C-54a |
| < ALLOCATED_TO > | <Enabler> | A/C-54b |
| <ALLOCATED_TO> | <Functional block> | Airborne Collision Avoidance (ACAS Xa/Xo) |

| | |
|---|---|
| Identifier | REQ-PJ.11-A3-TS-Xo00.0010 |
| Title | Mode activation without confirmation |
| Requirement | The ACAS Xo modes selection interface shall implement no confirmation menu before mode activation, but means for pilot to identify easily that a Xo mode has been activated. |
| Status | <in progress> |
| Rationale | Pilots need to spend the minimum possible time on the ACAS Xo function, as they can be in a high workload situation while in approach phase. |
| Category | <HMI> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| < ALLOCATED_TO > | <SESAR Solution> | PJ.11-A3 |
| < ALLOCATED_TO > | <Enabler> | A/C-54a |
| < ALLOCATED_TO > | <Enabler> | A/C-54b |

| | | |
|---|---|---|
| <ALLOCATED_TO> | <Functional block> | Airborne Collision Avoidance (ACAS Xa/Xo) |

### 4.2.2 Intruder undesignation

| | |
|---|---|
| Identifier | REQ-PJ.11-A3-TS-Xo00.0011 |
| Title | Return to Xa mode |
| Requirement | Once an ACAS Xo mode is activated, modes selection interface shall allow going back to the ACAS Xa mode manually. |
| Status | <in progress> |
| Rationale | Pilots may want to go back to ACAS Xa mode before automatic undesignation occurs (refer to MOPS for conditions of automatic designation). |
| Category | <HMI> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| < ALLOCATED_TO > | <SESAR Solution> | PJ.11-A3 |
| < ALLOCATED_TO > | <Enabler> | A/C-54a |
| < ALLOCATED_TO > | <Enabler> | A/C-54b |
| <ALLOCATED_TO> | <Functional block> | Airborne Collision Avoidance (ACAS Xa/Xo) |

| | |
|---|---|
| Identifier | REQ-PJ.11-A3-TS-Xo00.0012 |
| Title | Automatic undesignation |
| Requirement | When an automatic undesignation occurs (as defined in ACAS X MOPS – RTCA DO-385/EUROCAE ED-256), the ACAS Xo function shall give a clear feedback to the pilots. |
| Status | <in progress> |
| Rationale | Pilots need to be aware of undesignation reasons. |
| Category | <HMI> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| < ALLOCATED_TO > | <SESAR Solution> | PJ.11-A3 |
| < ALLOCATED_TO > | <Enabler> | A/C-54a |
| < ALLOCATED_TO > | <Enabler> | A/C-54b |

| | | |
|---|---|---|
| <ALLOCATED_TO> | <Functional block> | Airborne Collision Avoidance (ACAS Xa/Xo) |

### 4.2.3 Symbology and rendering on CDTI

| | |
|---|---|
| Identifier | REQ-PJ.11-A3-TS-Xo00.0013 |
| Title | Xo consistency with Xa |
| Requirement | ACAS Xo information shall be presented consistently with TCAS/ACAS Xa and ATSAW. |
| Status | <in progress> |
| Rationale | For the overall pilot situation awareness and understanding. |
| Category | <HMI> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| < ALLOCATED_TO > | <SESAR Solution> | PJ.11-A3 |
| < ALLOCATED_TO > | <Enabler> | A/C-54a |
| < ALLOCATED_TO > | <Enabler> | A/C-54b |
| <ALLOCATED_TO> | <Functional block> | Airborne Collision Avoidance (ACAS Xa/Xo) |

| | |
|---|---|
| Identifier | REQ-PJ.11-A3-TS-Xo00.0014 |
| Title | Xo representation on CDTI |
| Requirement | When CSPO-3000 or DNA mode is active, the aircraft representation on CDTI of the designated intruder shall have a specific label indicating the active Xo mode (excepted in RA situation). |
| Status | <in progress> |
| Rationale | Give to pilots an immediate feedback of the Xo mode activated for the designated intruder, and help to track it. |
| Category | <HMI> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| < ALLOCATED_TO > | <SESAR Solution> | PJ.11-A3 |
| < ALLOCATED_TO > | <Enabler> | A/C-54a |
| < ALLOCATED_TO > | <Enabler> | A/C-54b |

| | | |
|---|---|---|
| <ALLOCATED_TO> | <Functional block> | Airborne Collision Avoidance (ACAS Xa/Xo) |

| | |
|---|---|
| Identifier | REQ-PJ.11-A3-TS-Xo00.0018 |
| Title | TA representation in CSPO mode |
| Requirement | When a TA occurs while CSPO-3000 mode is active, the aircraft representation on CDTI shall display the label indicating Xo mode with same color as the one used by existing TCAS/ADS-B symbology. |
| Status | <in progress> |
| Rationale | Keep in line with existing TCAS/ADS-B symbology (the aircraft information is typically *amber* during TA). |
| Category | <HMI> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| < ALLOCATED_TO > | <SESAR Solution> | PJ.11-A3 |
| < ALLOCATED_TO > | <Enabler> | A/C-54a |
| < ALLOCATED_TO > | <Enabler> | A/C-54b |
| <ALLOCATED_TO> | <Functional block> | Airborne Collision Avoidance (ACAS Xa/Xo) |

| | |
|---|---|
| Identifier | REQ-PJ.11-A3-TS-Xo00.0019 |
| Title | RA representation in CSPO mode |
| Requirement | When RA occurs while CSPO-3000 mode is active, the aircraft representation on CDTI shall not display ACAS Xo labels until RA situation has ended. |
| Status | <in progress> |
| Rationale | Keep in line with existing TCAS/ADS-B symbology, and do not add any non-mandatory information while in critical situation as a resolution advisory. |
| Category | <HMI> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| < ALLOCATED_TO > | <SESAR Solution> | PJ.11-A3 |
| < ALLOCATED_TO > | <Enabler> | A/C-54a |
| < ALLOCATED_TO > | <Enabler> | A/C-54b |
| <ALLOCATED_TO> | <Functional block> | Airborne Collision Avoidance (ACAS Xa/Xo) |

### 4.2.4 Interface requirements

| | |
|---|---|
| Identifier | REQ-PJ.11-A3-TS-Xo00.0021 |
| Title | Xo ARINC labels |
| Requirement | ACAS Xo function shall output ARINC labels with respect to ARINC 735B-2. |
| Status | <in progress> |
| Rationale | Labels will include the selected traffic information for display. |
| Category | <Interface> |

[REQ Trace]

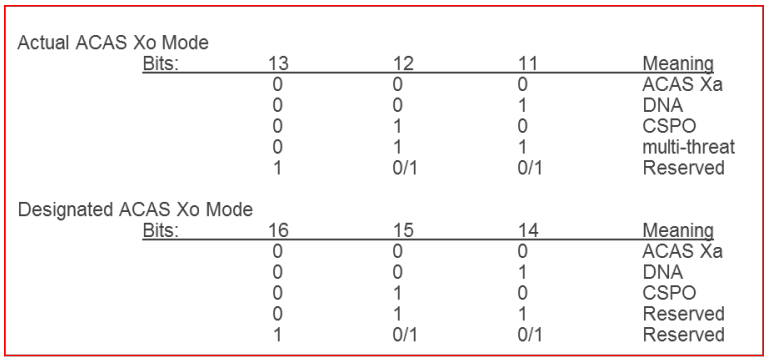
| Relationship | Linked Element Type | Identifier |
|---|---|---|
| < ALLOCATED_TO > | <SESAR Solution> | PJ.11-A3 |
| < ALLOCATED_TO > | <Enabler> | A/C-54a |
| < ALLOCATED_TO > | <Enabler> | A/C-54b |
| <ALLOCATED_TO> | <Functional block> | Airborne Collision Avoidance (ACAS Xa/Xo) |

| | |
|---|---|
| Identifier | REQ-PJ.11-A3-TS-Xo00.0022 |
| Title | Xo availability label |
| Requirement | ACAS Xo function shall output an ARINC label indicating ACAS Xo availability. |
| Status | <in progress> |
| Rationale | Give availability status of the function for any concerned system (for instance, maintenance system) |
| Category | <Interface> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| < ALLOCATED_TO > | <SESAR Solution> | PJ.11-A3 |
| < ALLOCATED_TO > | <Enabler> | A/C-54a |
| < ALLOCATED_TO > | <Enabler> | A/C-54b |
| <ALLOCATED_TO> | <Functional block> | Airborne Collision Avoidance (ACAS Xa/Xo) |

| | |
|---|---|
| Identifier | REQ-PJ.11-A3-TS-Xo00.0023 |

| | |
|---|---|
| Title | Xo label definition |
| Requirement | ACAS Xo function shall output an ARINC label for control Word as follow:<br>- Bit 1 to 8: Label<br>- Bit 9, 10: SDI<br>- Bit 11 to 16: ACAS Xo control word :<br>○ "Actual mode" is the mode currently active and displayed (as decided by the unit). This could be different from pilot request during multi-threat situation.<br>○ "Designated mode" is the Xo mode selected by the pilot for the intruder<br>  <br>Actual ACAS Xo Mode<br>Bits: 13 12 11 Meaning<br>0 0 0 ACAS Xa<br>0 0 1 DNA<br>0 1 0 CSPO<br>0 1 1 multi-threat<br>1 0/1 0/1 Reserved<br>Designated ACAS Xo Mode<br>Bits: 16 15 14 Meaning<br>0 0 0 ACAS Xa<br>0 0 1 DNA<br>0 1 0 CSPO<br>0 1 1 Reserved<br>1 0/1 0/1 Reserved<br>Fig: Label ACAS Xo Control Word, bit 11 to 16 description<br>- Bit 14 to 29: spare<br>- Bit 30, 31: SSM<br>- Bit 32: Parity |
| Status | <in progress> |
| Rationale | New Label for ACAS Xo modes, for the actual applied logic and the designated ACAS Xo mode. |
| Category | <Interface> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| < ALLOCATED_TO > | <SESAR Solution> | PJ.11-A3 |
| < ALLOCATED_TO > | <Enabler> | A/C-54a |
| < ALLOCATED_TO > | <Enabler> | A/C-54b |
| <ALLOCATED_TO> | <Functional block> | Airborne Collision Avoidance (ACAS Xa/Xo) |

# 5 Implementation Options

From the capability configuration point of view – there are no alternative implementation options other than those modelled in EATMA (i.e. ACAS Xo is to be implemented on Civil Aircraft – Ownship, and the ACAS Xo logic will be applied against other Civil Aircraft – Designated).

CSPO-3000 mode will be primarily used in TMA / Terminal operating environment, and for the DNA both Terminal and En-Route operating environments are applicable.

# 6 Assumptions

These technical specifications and whole EATMA modelling activity was prepared with the assumptions, that:

- There are only two ACAS Xo modes, as defined in the ACAS Xa/Xo MOPS [6]. The two modes are tailored for specific US operations and do not have a use case in European environment.
- Described technical use cases does not consider multi-threat situations. Multi-threat situations are however captured in OSED-SPR/INTEROP document.
- The order of “traffic selection” and “Xo mode selection” is implementation-dependant. Order used for EATMA modelling is compliant with implementation used for V2 validation purposes.
- HMI requirements listed in this document reflects requirements provided by Airbus to Honeywell for the ACAS Xo prototyping and V2 validation purposes. Existing MOPS for ACAS Xa/Xo captures also general HMI requirements to be followed. Detailed HMI requirements may differ across different platforms.

# 7 References and Applicable Documents

## 7.1 Applicable Documents

### Content Integration

[1] PJ.19 D5.7 EATMA Guidance Material and Report (2018) V11

[2] EATMA Community pages

[3] SESAR ATM Lexicon

### System and Service Development

[4] PJ.19 D3.7 ADD (2018)

### System Engineering

[5] SESAR 2020 Requirements and Validation Guidelines

## 7.2 Reference Documents

[6] RTCA DO-385 / EUROCAE ED-256, Minimum Operational Performance Requirements for ACAS Xa/Xo, October 2018.

[7] STM Technical Specifications – issue 3, P09.47, 00.01.00, August 2016

# Appendix A Service Description Document (SDD)

N/A

# Appendix B Service Technical Design Document (STDD)

N/A

**-END OF DOCUMENT-**