EASA
European Union Aviation Safety Agency

EUROCONTROL

Electronic Conspicuity Air-to-Air

Use Case

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ABBREVIATIONS

ACRONYM	DESCRIPTION
ACAS	Airborne Collision Avoidance System
ADS-B	Automatic Dependent Surveillance-Broadcast
ADS-L	Automatic Dependent Surveillance-Light
AIRB	Airborne Traffic Situational Awareness (ADS-B application)
AMC	Acceptable Means of Compliance
APT	Airport
ASA	Aircraft Surveillance Applications
ATAS	Airborne Traffic Advisory System
ATC	Air Traffic Control
ATS	Air Traffic Services
ATSA	Air Traffic Situational Awareness
ATSAW	Air Traffic Situational Awareness
CAA	Civil Aviation Authority
CPA	Closest Point of Approach
EASA	European Union Aviation Safety Agency
ENR	En-route
FIS	Flight Information Service
FIS-B	Flight Information Service - Broadcast
GVA	Geometric Vertical Accuracy
HAE	Height Above Ellipsoid
HMI	Human Machine Interface
ICAO	International Civil Aviation Organization
IFR	Instrument Flight Rules
IMC	Instrument Meteorological Conditions
MASPS	Minimum Aviation System Performance Standards
MOPS	Minimum Operational Performance Standards
NACP	Navigation Accuracy Category for Position
NACV	Navigation Accuracy Category for Velocity
NIC	Navigation Integrity Category
NM	Nautical Mile
SA	Situational Awareness
SARPS	Standards and Recommended Practices
SDA	System Design Assurance
SERA	Standardised European Rules of the Air
SIL	Source Integrity Level
SRD860	Short Range Device band 860 MHz
STD	Standard (or Standard Pressure Setting)
SV	State Vector
TABS	Traffic Awareness Beacon System

ACRONYM	DESCRIPTION
TCAS	Traffic Alert and Collision Avoidance System
TD	Traffic Display
TSAA	Traffic Situational Awareness with Alert
U-space	A term for the European system designed to manage UAS traffic in the U-space airspace
VFR	Visual Flight Rules
VMC	Visual Meteorological Conditions
WGS	World Geodetic System

REFERENCES

[1] Commission Implementing Regulation (EU) 2021/666 amending Regulation (EU) No 923/2012 as regards requirements for manned aviation operating in U-space airspace, April 2021.

[2] Commission Implementing Regulation (EU) 2021/664 on a regulatory framework for the U-space, April 2021.

[3] Easy Access Rules for Standardised European Rules of the Air (SERA), European Union Aviation Safety Agency (EASA) August 2025.

[4] Technical Specification for ADS-L transmissions using SRD-860 frequency band (ADS-L 4 SRD-860), Issue 2, EASA December 2025.

[5] ICAO Annex 2 — Rules of the Air, 10th Edition, ICAO July 2005.

[6] EUROCAE ED-194A / RTCA DO-317B, Minimum Operational Performance Standards for Aircraft Surveillance Applications (ASA) System, EUROCAE 2014.

[7] RTCA DO-242B, Minimum Aviation System Performance Standards for Automatic Dependent Surveillance–Broadcast (ADS-B), RTCA 2023.

[8] EUROCAE ED-232, Safety and Performance Requirements (SPR) for Traffic Situational Awareness with Alerts (TSAA), EUROCAE 2016.

[9] EUROCAE ED-164, Safety, Performance and Interoperability Requirements document for Enhanced Traffic Situational Awareness during Flight Operations (ATSA-AIRB), EUROCAE 2010.

[10] EUROCONTROL Specification for ATM Surveillance System Performance (ESASSP), EUROCONTROL-GUID-147, edition 1.3, Volumes I and II, March 2024.

[11] CAP 2583 — Detect and Avoid Capability Requirements for Uncrewed Aircraft Systems Operations in UK Airspace, UK Civil Aviation Authority (CAA) 2023.

[12] CAP 1391 – Electronic conspicuousness for UK General Aviation (Issue 3), UK Civil Aviation Authority (CAA) 2023.

Introduction

This document provides an initial version of a use case description for the use of Electronic Conspicuity for systems supporting Air-to-Air aircraft detection, between manned aircraft.

1. Background

Since 2010, there have been 69 fatal mid-air collisions resulting in 129 fatalities in EASA States. All of these accidents involved small aircraft not subject to air traffic control. The analysis of these accidents revealed that the primary concern was the pilots' lack of situational awareness of the surrounding traffic. Many of these collisions could have been avoided if the aircraft involved had been equipped with interoperable traffic situational awareness systems.

In parallel, the U-space regulations [2], via SERA.6005(c) [1][3], requires all manned aircraft not subject to air traffic control to be continuously electronically conspicuous to U-space service providers (E-Conspicuity). The new SERA.6005(c) requirement provided an opportunity to try to improve the interoperability of systems used by recreational pilots to provide traffic situational awareness.

The objective should be a simple architecture ensuring interoperability and affordability with sufficient performance, enabling maximum adoption, resulting in that as many airspace users as possible can become electronic conspicuous and thereby visible to other airspace users using Air-to-Air systems.

In this context, the term Electronic Conspicuity is used to describe interoperable technology operating in line with agreed technical definitions for Electronic Conspicuity. It is to be noted that the transmission of any type of electronic signal does not constitute Electronic Conspicuity.

2. Air-to-Air use case overview

During flight operations, pilots build traffic situational awareness by integrating available information from two main sources: “out-the-window” (visual scan) observation and if available listening to radio communications.

Depending on the airspace, relevant radio communications can include traffic information provided by a controller, transmissions from a controller to other aircraft and responses from the other aircraft (the “party-line effect”) or air-to-air radio communications in uncontrolled airspace.

In the absence of an ATC service or to complement ATC service in areas without surveillance (i.e. Class G or E airspace) additional systems, e.g. based on Electronic Conspicuity, are desirable to enhance the pilots traffic situation awareness and thereby enhancing safety.

The Air-to-Air Situational Awareness (SA) use case can be supported by systems with or without a Traffic Display.

The objective of this use case is to:

- Improve the traffic situational awareness, mainly in uncontrolled airspace but also in controlled airspace,
- Enhance (support and guide), but not replace, the visual scan,
- Support pilots’ decision-making process in establishing a safe trajectory in relationship to other traffic,
- Support visual acquisition of traffic of interest (close enough to be visible),
- Draw the pilots’ attention to traffic in proximity/collision course by providing alerts,
- When equipped with a Traffic Display, enhance correlation of information derived from radio communications and visual scan.

3. Operational Environment

It is expected that an aircraft equipped with an Air-to-Air SA system can use the system during all phases of flight and in all airspace classes, i.e. the system can be used in both controlled and uncontrolled airspace. The system can also be used during all weather conditions and during both Instrument Flight Rules (IFR) and Visual Flight Rules (VFR).

For traffic to be detected by the Air-to-Air SA system, surrounding aircraft need to be continuously electronically conspicuous. Given voluntary equipage, all aircraft may not be electronic conspicuous and partial visibility of surrounding traffic is to be expected. This is a limitation for which the pilot needs to be informed and aware about. Furthermore, the traffic display must not encourage the pilot to take more risks, for example by operating in worse weather conditions or closer to other traffic.

4. Air-to-Air SA system

4.1 Traffic Display

The Traffic Display system enhances the pilot's visual scan by providing updated information on where to look for traffic. The system will make it easier to detect and acquire traffic as well as to correlate information obtained from radio communications and visual scans. The resulting enhanced traffic situational awareness contributes to improving the pilot's decision-making process for the safe and efficient operation of the flight, including avoiding becoming a hazard to other aircraft.

In visual flight conditions, when traffic of interest is initially detected on the Traffic Display during the regular instrument scans, its location guides the subsequent visual search for the aircraft. In reduced visibility, pilots may use the Traffic Display to build and maintain traffic situational awareness whether they can make visual contact or not. In any condition, the pilot can also be more attentive to radio communications involving traffic of interest (air to air, ATC if the airspace is controlled, FIS, etc.).

When the traffic of interest is first spotted visually, the pilot correlates the observation with the information on the Traffic Display.

The additional information provided by the Traffic Display should contribute in many cases to early detection of developing unsafe situations enabling timely resolution and reducing the likelihood of unauthorised manoeuvres.

If the Traffic Display information appears inconsistent with the visual scan, the Traffic Display information is expected to be ignored and conventional procedures that do not include the Traffic Display must be employed.

The information on the Traffic Display is in nominal conditions updated continuously, especially for traffic in close vicinity. However, when traffic is not updated as expected, an indication of stale data should be provided.

If traffic data is not having sufficient quality, the system may provide an indication of low-quality data or not display the data.

When operating in an *uncontrolled airspace*, it is the pilot's responsibility to manoeuvre the aircraft safely based on information available. Pilots will be responsible to aggregate the out of window information and possible air to air communications with the traffic information on the Traffic Display. In visual conditions, any changes of trajectory are preceded by out of window scan. The Traffic Display information is not intended to substitute any of the current procedures to manoeuvre the aircraft safely.

When operating in *controlled airspace*, the use of Air-to-Air SA system by pilots is not expected to supersede any existing ICAO SARPS. For example, Annex 2 "Rules of the Air" [5] regarding adherence to the flight plan

remain unchanged, see Annex 2 - Rules of the Air, Chapter 3 - General Rules, Section 3.6 - Air Traffic Control Service, paragraph 3.6.2 - Adherence to Flight Plan sub-paragraph (3.6.2.1):

> *Except as provided for in 3.6.2.2 and 3.6.2.4, an aircraft shall adhere to the current flight plan or the applicable portion of a current flight plan submitted for a controlled flight unless a request for a change has been made and clearance obtained from the appropriate air traffic control unit, or unless an emergency situation arises which necessitates immediate action by the aircraft, in which event as soon as circumstances permit, after such emergency authority is exercised, the appropriate air traffic services unit shall be notified of the action taken and that this action has been taken under emergency authority.*

4.2 Alerts

The alerting function aims to timely increase the pilot traffic awareness of aircraft in the vicinity of ownship. It supports the out-the-window visual acquisition of traffic through visual cues, additional symbology and audio annunciations of alerted traffic. The provision of alerts will improve direct visual acquisition of traffic in support of the see-and-avoid responsibility.

The alerts will as such supplement existing traffic avoidance procedures (e.g. see-and-avoid, radio communications).

The alerting function is available during all phases of flight in all airspace classes, after take-off until before landing and during all weather conditions, Instrument Meteorological Conditions (IMC) and Visual Meteorological Conditions (VMC), as well as during both Instrument Flight Rules (IFR) and Visual Flight Rules (VFR) operations. Alerts relative ground traffic are not part of this use case.

Alerts can be classified in levels or categories corresponding to priority: Warnings, Cautions, and Advisories.

- Traffic Warning Alerts require an immediate pilot response,
- Traffic Caution Alerts require immediate pilot awareness,
- Traffic Advisory assist the pilot in prioritising activities.

Traffic Warning Alerts are reserved for collision avoidance systems with directive commands, which are not provided by Air-to-Air SA systems.

Traffic Caution Alerts are issued when an aircraft is a potential threat, and the pilot needs to visually acquire the aircraft or query Air Traffic Control (ATC), if possible. The Traffic Caution Alerts provide both visual and aural cues to the pilot, supporting the out-the-window visual acquisition. The aural cue should include the word "Traffic", the bearing of the traffic, its range and relative altitude and possibly information if the traffic is determined to be climbing or descending.

Traffic Advisory assist the pilot in prioritising activities and are expected to occur for normal traffic situations. It is used to support out-the-window visual acquisition for aircraft within a given range and altitude of ownship.

The alerts provided by Air-to-Air SA systems are Traffic Advisory and Traffic Caution Alerts, which are not directive, i.e., do not provide manoeuvre guidance or commands. Traffic Advisory are provided for nearby traffic and Traffic Caution Alert for traffic that is detected in conflict with ownship.

The alerts are prioritised based on the predicted level of risk.

During active alerts, updated information is provided on the Alerted Traffic. If available, the pilot can obtain this information visually from a Traffic Display (the displayed information is continuously updated). If the Traffic Display is not available, the pilot will be able to obtain updated voice annunciations containing the same information as the Traffic Caution Alert through a manual request function, or as a result of an auto-update function.

The pilot can also acknowledge an active alert and suppress the remainder of the currently active voice annunciation. If the equipment does not support suppression of alerts, operational procedures may be applied to mitigate nuisance during critical flight phases such as final approach and take off.

A Traffic Caution Alert is only intended to occur in non-normal traffic situations where most pilots would benefit from increased traffic situation awareness. The Traffic Caution Alert is expected to provide the pilot adequate time to respond, nominally 20 to 40 seconds. The alert design considers the risk of missed alert versus nuisance generated by false alerts.

Traffic Advisory may vary with the speed of ownship and traffic, it may include traffic closer than 3 to 6 NM and within about +/-1 200 ft of ownship.

The Air-to-Air SA system can be implemented with Traffic Display or without Traffic Display, Table 1.

When implemented with a Traffic Display the Air-to-Air SA system provides consistent alert information both on the Display and Audio alerts (see Notes). The Air-to-Air SA system with a Traffic Display provides both Traffic Caution Alerts and Traffic Advisories.

When implemented without a Traffic Display the Air-to-Air SA system provides visual attention getting cue, such as a lamp or direction indicator located within the pilot's field of vision, as well as audio alerts (see Notes). The Air-to-Air SA system without a Traffic Display provides, at a minimum, Traffic Caution Alert, and if possible, according to the system design, Traffic Advisory Alert. At least one of the visual or audio attention-getting cues includes directive information. The visual cue could be a lamp indicating the clock position, while the audio cue could include the word "Traffic", the bearing, range and relative altitude and possibly information if the traffic is climbing or descending (e.g. "Traffic, one o'clock, three miles, same altitude, [descending]").

Table 1 - Air-to-Air SA system function and alerting overview

Alerting Function / System	Without Traffic Display	With Traffic Display
Visual cue	Strongly Recommended	Y
Voice annunciation (Note 1, 2)	Y	Y
Traffic Caution	Y	Y
Traffic Advisory	If possible	Y

Note 1: *Voice alerts may be provided in headset or, if audible, directly in cockpit.*

Note 2: *When used in combination with visual cues that provide information about the relative location of traffic, the voice annunciation can be replaced with non-directive audio. Other attention-getting mechanisms such as haptic feedback may be used.*

Note 3: *Equipment installation or mounting instructions should include clear guidance for appropriate installation/mounting such that alerts are detected.*

The pilot will only use the Air-to-Air SA alerts to supplement existing traffic avoidance procedures (e.g. see-and-avoid, radio communications) and not undertake any manoeuvres only based on alerts when other information is available.

The pilot will attempt to visually acquire the alerted traffic out-the-window using the alert information.

The pilot should use lateral rather than vertical manoeuvres to resolve traffic situations whenever possible. Manoeuvres made as a result of visual acquisition should be made laterally in accordance with the right-of-way rules. However, if a collision is imminent, the safety of flight is the pilot's responsibility, and a vertical and/or non-standard right-of-way manoeuvre may be necessary.

5. Operational scenarios

This section presents normal and abnormal operational scenarios for the use various configurations of the Air-to-Air SA system and identifies pilot actions and information needed to support the use case. It outlines a general description of normal and abnormal scenarios for Traffic Display and alerts. It is expected that information provided to pilots are tailored to the specific system and operations.

5.1 Traffic Display

5.1.1 Normal flight operations

The pilot builds traffic situational awareness by scanning the Traffic Display correlating the information with other available information (received radio communications and /or visual contact) and checking consistency between information. Then the pilot assesses the traffic situation based on available information for a better decision for the execution of actions.

The following actions are expected from the pilot in relationship with the traffic situational awareness:

- Visual out-the-window scan,
- Traffic display scan,
- Correlation of the traffic display information with other sources (visual scan, radio party line, etc.),
- Assessment of the information from different sources,
- If in contact with ATS and if needed, request for relevant information (either to ATC, FIS or air to air).

The pilot executes actions related to flight operations with an enhanced assessment of the traffic situation thanks to the Traffic Display information. The following actions are expected from the pilot:

- Modification of the flight trajectory,
- Collision avoidance manoeuvre according to the existing procedures,
- When needed, communication of flight/manoeuvre intentions or request for more information (depending on the operating environment, either via ATC/FIS or air to air).

To support the above actions, the following information related to surrounding traffic is relevant to be available for display on board the aircraft[1]:

- Relative horizontal position,
- Relative vertical position (Geo HAE is the minimum common denominator),
- Traffic vertical tendency (e.g. arrow symbol),
- Traffic direction (icon orientation, when available).

[1] Not all the information listed is mandatory to be displayed or available, e.g. the minimum requirement for traffic situational awareness could be only the relative position of the traffic

In certain situations, and if feasible, additional optional information may also be relevant to be able to show on the display:

- Traffic aircraft identification,
- Traffic ground speed,
- Traffic aircraft category (class, type, etc),
- Traffic manned/unmanned,
- Traffic absolute altitude,
- Traffic absolute position on map,
- Ownship position on map.

5.1.2 Abnormal scenarios

A set of abnormal mode scenarios can be defined for the use of traffic display information during flight operations:

- Inconsistent information between the Traffic Display and visual scan:
  - it is expected that the pilot is aware of possible causes, such as partial equipage/visibility and presence of additional traffic not shown on the Traffic Display and treats the information on the Traffic Display as partial or as possibly incorrect.
- Inconsistent information between the Traffic Display and the radio communications (air to air, party line, ATC/FIS):
  - it is expected that the pilot re-confirms the radio communication and if the inconsistency persists, is aware of possible causes such as partial equipage/visibility and that additional traffic may be present, i.e. traffic not displayed on the Traffic Display or not known based on radio communication, or that the position on the Traffic Display may be incorrect.
- Information on the Traffic Display for which no other information is available (visual scan, ATC/FIS, air to air):
  - the pilot is expected to assess the situation based on the information available (i.e. traffic display only) and take appropriate measures to ensure the safety of the operations.
- Detection of a failure mode of the Traffic Display:
  - it is expected that the pilot resumes normal operations without the use of the Traffic Display.

5.2 Alerts

5.2.1 Normal flight operations

The pilot builds traffic situational awareness by out-the-window visual scan and using received radio communications and assessing consistency between information. The pilot expects the Air-to-Air SA system to provide Traffic Alerts (and if possible Advisory) when an aircraft is a potential threat, requiring immediate pilot awareness, and the pilot needs to visually acquire the aircraft or query Air Traffic Control (ATC).

The pilot is expected to continuously look for traffic of interest employing out-the-window visual scan and, if available, listen to radio communication. For each flight, the pilot ensures that the Air-to-Air SA system alert indicator is in the visual field, and the alert audio volume is verified.

The pilot's ability to detect potential threats, requiring immediate awareness is enhanced thanks to the Air-to-Air SA alerts. In the event of an alert, the following actions are expected from the pilot:

- Detect the Air-to-Air SA alert visual cue and audio,
- Use the alert information to enhance the visual scan to aim for visual acquisition,
- Modify the flight trajectory as required,
- Manoeuvre to avoid collision, according to the procedures,
- Communication of flight/manoeuvre intentions or request for more information (depending on the operating environment, either via ATC/FIS or air to air).

To support the above actions, the following information related to surrounding traffic could be relevant to be available on the HMI on board the aircraft:

- Relative horizontal direction (clock position),
- Relative horizontal distance (nautical miles),
- Relative vertical position (same altitude, above, below),
- Vertical tendency (N/A, climbing, descending).

5.2.2 Abnormal scenarios

A set of abnormal mode scenarios can be defined during flight operations:

- Inconsistent information between the Traffic Alert and the out-the-window view
  - Missed Alert,
  - False Alert - no traffic is visible out-the-window,
  - Incorrect Alert - the alert information is incorrect e.g. incorrect directive cue,
    In these situations, the pilot is expected to assess the situation based on the information available and take appropriate measures to ensure the safety of the operations. It is expected that the pilot is aware of possible causes, such as partial equipage - resulting in presence of additional traffic which the system is unable to provide alerts to, as well as the possibility of False Alert e.g. due to incorrect data, including missing or incorrect position or altitude information etc.
- Detection of a failure mode of the Air-to-Air SA system:
  - It is expected that the pilot resumes normal operations without the use of the system.

6. Roles and Responsibilities

The use of the Air-to-Air SA system does not change roles or responsibilities for pilots in comparison with existing operations.

Pilots are still responsible for the safe and efficient control and navigation of their individual aircraft in all airspace. However, operations will now include pilots' use of the Air-to-Air SA system.

It is not intended that pilots in the nominal case will manoeuvre relative to traffic in close proximity only based on the information provided on the Air-to-Air SA system. The pilot-in-command is still ultimately responsible for the prevention of collisions.

The information provided on the Air-to-Air SA system can be misinterpreted since it may provide only partial information. The Air-to-Air SA system is not designed for self-separation or sequencing, using it for these purposes can be hazardous.

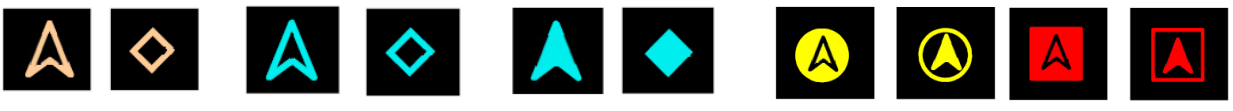
7. HMI considerations

The considerations focus on those aspects of the system that impact the usability of the system under nominal operation. Mapping the information to be provided to the pilot via the Human Machine Interface (HMI) to the information transmitted by the surrounding traffic, see Table 2.

Table 2 - HMI considerations

Item	Traffic Display (min. if available)	Traffic Display (optional)	Alerting (min. if available)
Horizontal position (WGS 84)	Relative Horizontal position	Traffic position on map	Relative bearing and distance
Geometric Altitude (HAE)	Relative Altitude		Relative vertical
Barometric Altitude (STD)		Relative Altitude Traffic altitude (Baro)	
Horizontal ground velocity	Traffic Direction	Traffic Ground Speed	
Vertical rate (Geo, inertial, baro)	Traffic vertical tendency		Vertical tendency
(Aircraft Identification)		Traffic Aircraft Identification	
(Aircraft Category)		Traffic Aircraft Category	
Horizontal position accuracy	(Traffic quality)		
Horizontal velocity accuracy	(Traffic quality)		
Manned/unmanned		(Manned/unmanned)	
Timestamp (optional)			
System function	Range scale (from ownship)	Ownship position on map	
System function	Vertical filter relative ownship		Alert filter
System function	Alerts		Visual + audio or other cue

Harmonised HMI requirements/recommendations would facilitate easier use of different types of equipment (including from different manufacturers), increasing the commonality across platforms. Initial requirements/guidelines could be based on existing material such as ASA MOPS [6], e.g. provided in Figure 1.



Ground Traffic | Airborne Traffic | Alert Advisory | Alert Caution

Figure 1 – Example of harmonised HMI representation

8. Performance Requirements

The performance requirements derived for this use case are based on existing material such as ASA MOPS [6], ADS-B MASPS [7], including the ATSAW AIRB and ATAS application etc. Consideration should also be given to the visual detection range which often is low, per UK Electronic Conspicuity study referenced in Appendix C – Electronic Conspicuity UK study, summary of key findings, below 1.5 NM up to 3 NM in good conditions. Performance recommendations for Air-to-Air SA are provided in Table 3, considering Table 4.

Table 3 - Expected performance

Metric	E-Conspicuity low speed (< 100 kt)	E-Conspicuity all ops	References
Time to CPA (Closest Point of Approach)[2]	A: 20 – 40 s TD: 2 min	A: 20 – 40 s TD: 2 min	**ATAS:** APT: 25 s (20 – 40 s) ENR: 28 s (20 – 40 s) **ASA MASPS:** 2 min traffic display (250 kt head-on -> Rng: 17 NM)
Coverage/range	A: 4 – 5 NM, ±4500 ft TD: 7 – 10 NM	A: 6 – 10 NM, ±4500 ft TD: 17 NM	**ATAS:** APT: 3 – 5 NM, ±1500/2500 ft, ENR: 6 – 10 NM, ±2400/4500 ft **ASA MASPS:** 10 NM [18.5 km] (excl. acq.)
Probability of update (SV)	5 s @ 95%	5 s @ 95%	ASA MASPS: <3 – 6 s @ 95%
Data age (SV) (end-to-end)	5 s @ 95%	5 s @ 95%	**ATAS:** Max age for alert 25 s **ASA MASPS:** < 4 – 6 s @ 95% (Measurement to Display), Max/Stale info > 25 s
Continuity	1E-3	1E-3	**AIRB/ATAS:** 1E-3 (based on SDA)

A – Alerts, TD – Traffic Display

[2] CPA is an estimated point in which the distance between the own ship and another object target will reach the minimum value.

Table 4 - Distance (NM, excl. acquisition) required to support the CPA time

Head-on speed (kt)		Time to CPA (s)				
Ac1	Ac2	20	25	28	40	120
100	100	1.11	1.39	1.56	2.22	6.67
100	175	1.53	1.91	2.14	3.06	9.17
100	250	1.94	2.43	2.72	3.89	11.67
175	175	1.94	2.43	2.72	3.89	11.67
175	250	2.36	2.95	3.31	4.72	14.17
250	250	2.78	3.47	3.89	5.56	16.67
500	500	5.56	6.94	7.78	11.11	33.33

Note: *In current operations, it is required to use higher power transponder when operating at speeds above 175 kt or altitudes > 15 000 ft, this may also be a possible upper bound for use of Electronic Conspicuity equipment, which is based on low power equipment.*

8.1 Data quality

In addition to the requirements related to data provision and availability, requirements on the provided data items are also needed. The initial data quality is here proposed to be based on ASA MOPS [6] AIRB and ATAS requirements, which address a very similar use case, Table 5.

Table 5 - Data quality

Metric	Electronic Conspicuity Air-to-Air SA	Reference		
		ATAS/AIRB (airborne)	TABS / CAP1391 [12]	ATS (ESASSP [10])
Horizontal Position Integrity (NIC)	-	-	0.5 NM (NIC = 6)	< 0.6 NM (NIC ≥ 6)
Source Integrity (SIL)	-	-	1E-3/h (SIL = 1)	< 1E-7/h (SIL ≥ 3)
System Design Assurance (SDA)	Recommended < 1E-3 (SDA ≥ 1)	< 1E-3 (SDA ≥ 1)	1E-3 (SDA = 1)	< 1E-5 (SDA ≥ 2)
Horizontal Position quality (NACp) (95%)	< 0.5 NM (NACp ≥ 5)	< 0.5 NM (NACp ≥ 5)	< 0.5 NM (NACp ≥ 5)	< 0.1 NM (NACp ≥ 7)
Vertical Position quality (GVA) (95%)	Geo (HAE) Alt ≤ 45m (GVA ≥ 2)	Baro or Geo (HAE) Alt Geo ≤ 45 m (GVA ≥ 2)	Baro or Geo (HAE) Alt Geo ≤ 45 m (GVA ≥ 2)	Baro Altitude
Horizontal Velocity quality (NACv) (95%)	< 10 m/s (NACv ≥ 1)	< 10 m/s (NACv ≥ 1)	10 m/s (NACv = 1)	Optional < 10 m/s (NACv ≥ 1)

9. Architecture

There are two main architectures envisaged for enabling interoperability for solutions used for the Air-to-Air use case, as illustrated in Figure 2.

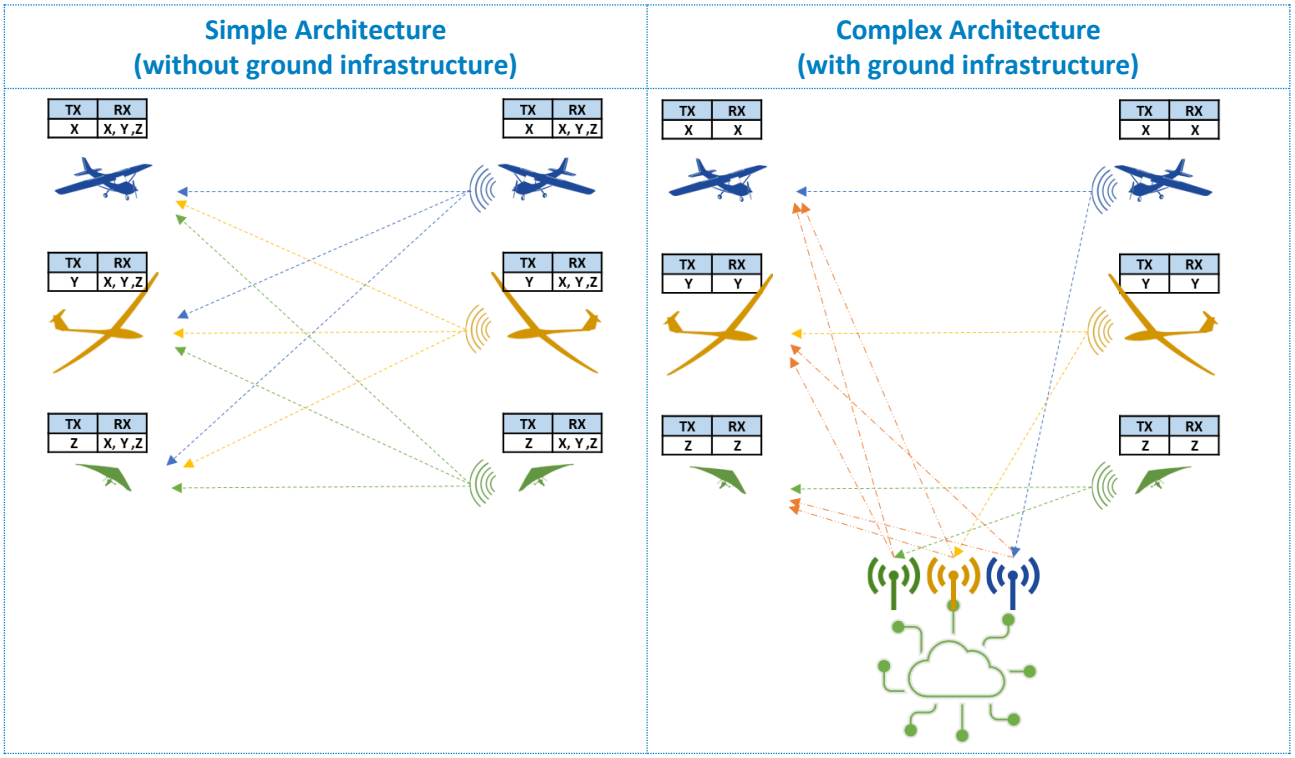


Figure 2 – Simple versus Complex Architecture

For this Use Case the community has strong preference for the simple architecture, in which direct Air-to-Air interoperability is enabled without the need for, or dependency on, ground infrastructure, especially outside U-space. In this context Safety and Affordability are the main priorities, with a performance considered “good enough” for the use case.

This does not preclude local area where ground infrastructure could provide complementary solutions supporting additional benefits (e.g. FIS-B) or enabling interoperability (e.g. in a very local area or while airspace users are transitioning to the interoperability solution).

To support correlation of traffic data the possibility to provide a unique system identification across all channels (i.e. unique per aircraft) must be supported/enabled.

Appendix A – Input and Reference material

The Assumptions and Requirements in this Appendix are derived from existing applications relating to operations of manned aircraft, both in controlled and uncontrolled airspace and during all visibility conditions. They have been used as input and reference material to the use case.

Functional and Performance Requirements from similar systems

Overview of various airborne alerting systems (ref. Table A-8 of ATAS/TSAA specification [8])

Table A-1 - Overview of various airborne alerting systems

	TIS	TAS	TCAS I	TCAS II	TSAA
Aural Alerts	Yes	Yes	Yes	Yes	Yes
Visual Alerts	Yes	Yes	Yes	Yes	Yes
Plan view display	Optional (Plan view or textual required)	Yes (Class A) Optional (Class B)	Optional (Plan view or textual required)	Yes	Yes (Class 2) No (Class 1)
Traffic Directionality Resolution on Plan view	45° increments	No	No	No	<5° increments (Class 2) NA (Class 1)
Avoidance guidance	No	No	No	Yes	No
Max Detection range	7nm +3500ft/ -3000ft	12-21nm Typically +/-10000ft	12-40nm Typically +/-10000ft	40nm Typically +/-10000ft	5 nm +/- 2500 ft Airport 10 nm +/- 4500 ft En route
Expected Detection Range	7nm +3500ft/- 3000ft	4-5nm +/-2700ft	4-5nm +/-2700ft	14nm +/-2700ft	3 nm +/- 1500 ft Airport 6 nm +/- 2400 ft En route
Time to Closest Approach for Alert	34 sec	15-30 sec (TA)	15-30 sec (TA)	15-35 sec (RA) 20-48 sec (TA)	25 sec Airport 28 sec En route
Proximate/nearby traffic	6nm +/-1200ft	6nm +/-1200ft	6nm +/-1200ft	6nm +/-1200ft	6nm +/-1200ft
Coverage	ASR-7,8,9 radar coverage	All transponder equipped aircraft	All transponder equipped aircraft	All transponder equipped aircraft	All for ADS-B, TIS-B within SSR coverage and ADS-B Service Volume (SV), ADS-R in ADS-B SVs

Information item requirements based on the ATSA-AIRB Traffic Display application

Relative horizontal position

Relative horizontal position is the minimum data information to be displayed for the surrounding traffic. Relative horizontal position perceived on the Traffic Display is a function of the true relative horizontal position plus all relevant inaccuracies impacting the position data from the measurement up to the display.

PR 1: Relative horizontal position derived by the Traffic Display from the horizontal position contained in the surveillance reports received from surrounding traffic shall be displayed graphically and with a resolution consistent with other onboard display standards.

PR 2: The Traffic Display shall enable the pilot to estimate the relative range between ownship and surrounding traffic

The main objective of the Traffic display information is to facilitate the identification (and correlation) of the traffic with visual scan information. Therefore, the main parameter to be analysed is the pilot perception of the surrounding traffic bearing relative to the own aircraft.

The displayed relative bearing is affected by the own ship actual heading and the display orientation. For example, in a heading-up display configuration, errors in the own ship heading as used by the Traffic Display may result in a rotation of the display. Such orientation inaccuracies are expected to be generally small. In the case of a track-up display configuration, the difference between heading and track due to wind is an effect pilots are used to working with.

As such, display orientation errors are not included as part of the analysis of traffic bearing relative to the own ship aircraft. Rather, it is assumed that these errors are less than 5 degrees, 95%. In the same way effects on relative bearing due to wind, forcing the own ship to use a crab angle are considered to be the same as in today's operations.

Two factors contributing to relative bearing errors are considered to be horizontal position errors and uncompensated latency. Horizontal position errors are the errors in the original measurement leading to the position used on the Traffic Display. They are incurred for both own ship and surrounding traffic.

Uncompensated latency of an aircraft's position on the Traffic Display is defined to be the difference between the time of observation of the displayed position by the pilot and the time of applicability of the measurement of the horizontal position data that was used to ultimately render that position. Uncompensated latency of the own ship aircraft position is defined similarly.

The uncompensated latency of an aircraft's position is separated into two components, according to the domains: transmitted and on-board latency. Within current implementation of existing systems, it is assumed that the transmitted latency is in the order of 1.5 seconds 95% of the time while the on-board uncompensated latency is 2.5 seconds in the worst case scenario.

In addition to the latency, a position measurement cannot be extrapolated indefinitely. Therefore, a maximum age of 25 seconds is considered before a surrounding traffic positional information is removed from the Traffic Display.

The analysis of several scenarios developed in ED-164 [9] (Safety, Performance and Interoperability requirements document for Enhanced Traffic Situational Awareness during flight operations) conclude for different operating environments and aircraft type characteristics that the minimum requirements for the horizontal position accuracy derived from position sensors, as well as requirements for uncompensated latency are:

PR 3: Horizontal position accuracy own ship and surrounding traffic: 0.5 NM at 95%.

PR 4: Uncompensated latency for own ship position data: 1.6 seconds at 95%.

PR 5: Uncompensated latency for surrounding traffic position data: 2.5 seconds at 95%.

Altitude

The objective of the altitude information is to support the pilot in interpreting visual scan information and radio communications provided by the party-line or the controller (in case of controlled airspace operations) to build traffic situation awareness and to determine the relative vertical position of the surrounding traffic. It is used to achieve most of the operational objectives, where some of the most important are visual correlation, detection of altitude changes of aircraft in the vicinity and to support verification of separation in the scenarios with converging flight paths.

The relative altitude is required to be displayed when available for qualified airborne surrounding traffic.

Assuming that the participating aircraft altimetry systems are performing at least as well as in the current operational environment (controlled and uncontrolled aircraft for certified altimetry systems) the following performance requirements were derived:

PR 6: Relative altitude shall be displayed with an increment not greater than 100 ft.

PR 7: The displayed altitude information for traffic depicted on the Traffic Display shall all have the same altitude reference or a clear indication to the altitude reference.

Direction (ground track)

Direction is required to be explicitly displayed when available for the surrounding traffic. The objective of this information is to support the pilot in interpreting the relative motion and visual scan information to determine the direction of the surrounding traffic. There is no operational need to provide a numeric value; the orientation of the symbol on the Traffic Display is sufficient to convey the information to the pilot.

Based on operational feedback from pilots (within the development of ED 164), it has been determined that the Traffic Display should allow the pilot to determine the direction of the surrounding traffic with a displayed accuracy (data accuracy and resolution) of +/- 30 degrees. Of this error budget, 5 degrees have been allocated to the Traffic Display and 25 degrees has been allocated to the transmitted direction data itself. Consequently, the following PR has been derived:

PR 8: The direction information shall be provided by the Traffic Display with a resolution of +/- 5 degrees or better.

Generally, data related to direction should include a ground-reference velocity and the velocity accuracy (e.g. ADS B). When direction is calculated from velocity, lower ground speeds impact the direction uncertainty. With a ground speed of e.g. 47 kt, the direction accuracy of 25 degrees is satisfied if the velocity accuracy is at least 19.4 kt.

PR 9: Direction information for surrounding traffic shall only be displayed to the pilot if it has an accuracy of +/- 25 degrees, 95% or better.

Vertical tendency

Vertical tendency is required to be displayed for the surrounding traffic when it is available and meet associated requirements. The objective of this information is to support detection of altitude changes of aircraft in the vicinity and identification of converging traffic. It also helps the pilot in visual correlation to determine whether the surrounding traffic is climbing, maintains level or descending.

Operational feedback during the development of ED-164 has indicated that there is no operational need to provide a rate of descent or climb value; an up indication for climbing traffic and down for descending traffic is sufficient (and desired).

PR 10: Vertical tendency shall be, at a minimum, conveyed to the pilot with an up or down indication representing climbing traffic or descending traffic.

PR 11: The Traffic Display shall indicate the vertical tendency of any surrounding traffic that is determined to be climbing or descending with a vertical rate of 500 feet per minute or greater.

The vertical rate information can be derived from received altitude information. Vertical rate is used to establish vertical tendency. For simplicity, if the Traffic Display is determining the vertical tendency based on received altitude information, then the vertical tendency must have an accuracy equivalent to that of other equipment that displays this information (e.g. TCAS).

Operational Assumptions and Requirements based on the ATSA-AIRB Traffic Display application

Assumptions

ASSUMP 1: The Traffic Display can be used by aircraft operating in any airspace class (i.e. A to G).

ASSUMP 2: The Traffic Display can be used by aircraft operating under Instrument Flight Rules (IFR) and Visual Flight Rules (VFR), in both Instrument Meteorological Conditions (IMC) and Visual Meteorological Conditions (VMC).

ASSUMP 3: The Traffic Display can be used in any traffic density and aircraft category mix (manned, unmanned, etc.).

ASSUMP 4: Provision of functions such as collision avoidance (resolution) is out of scope however, the existence on board of such equipment and the associated procedures are not expected to be influenced by the use of Traffic Display

> ***Note:*** *Traffic Display for surrounding traffic can be implemented as a standalone application, but when it is integrated with other Airborne Surveillance Applications it is recommended that concurring information from different application/systems are presented in a consistent way.*

ASSUMP 5: The traffic information provided on the Traffic Display may be partial, i.e. all traffic may not be visible on the Traffic Display.

ASSUMP 6: It is the pilot's decision whether to use the Traffic Display or not during flight operations.

ASSUMP 7: If operating in a controlled airspace (ATC or FIS), it is not expected that the use of the Traffic Display will change the existing phraseology.

ASSUMP 8: The use of the Traffic Display does not change roles or responsibilities for pilots, ATC and/or FIS controllers, in comparison with existing operations.

Requirements

OR 1: The manned aircraft supporting such application shall be equipped with a traffic situational awareness equipment (Traffic Display) which includes the capability of receiving, processing and displaying the Electronic Conspicuity information of surrounding traffic.

OR 2: The Traffic display shall be able to provide the pilot with the following information, if this information is available and meets the required performance requirements:

- Relative horizontal position,
- Relative altitude,
- Traffic direction (e.g. ground track),
- Traffic vertical tendency.

OR 3: The Traffic Display functionality shall enable the pilot to select the following information for display, if the information is available and meeting the required performance requirements:

- Traffic speed (ground speed),
- Traffic Aircraft Identification,
- Traffic Aircraft type information.

OR 4: The system shall enable the pilot to filter the displayed surrounding traffic on the Traffic Display using different ranges and altitude bands.

OR 5: Whenever visual conditions and workload permit, the pilot shall check consistency between the Traffic Display information and the visual scan information when visual contact is achieved.

OR 6: If the pilot detects traffic on the Traffic Display with displayed information not consistent with visual scan, the pilot shall be aware of possible causes including partial equipage and incorrect information on the Traffic Display.

OR 7: If operating in a controlled environment (ATC/FIS are provided), whenever information is available by radio communications, the pilot shall check consistency between the traffic information provided by ATC/FIS or air to air and the Traffic Display information.

OR 8: If operating in a controlled environment (ATC/FIS are provided), if the pilot detects that the information displayed on the Traffic Display is inconsistent with radio communication information and if the pilot wants to use the displayed information, the pilot shall cross-check with the ATC/FIS and/ or the traffic of interest pilot for confirmation.

OR 9: If operating in a controlled environment (ATC/FIS are provided), the pilot shall not undertake any manoeuvres relative to surrounding traffic based solely on the Traffic Display information that would lead to either a deviation from or a non-execution of an ATC clearance or instruction.

OR 10: If the pilot detects a Traffic Display failure, the pilot shall disregard the Traffic Display.

OR 11: As in existing operations in a controlled environment (ATC/FIS are provided), when alerted to a hazard by ATC/FIS, the pilot shall, without delay, take appropriate measures to ensure the safety of the operations.

OR 12: As in existing operations, upon visual detection of a hazard as a result of the visual scan, the pilot shall, without delay, take appropriate measures to ensure the safety of the operations.

OR 13: As in existing operations, before any manoeuvre, and visual conditions permitting, the pilot shall perform a visual scan to check if the area they want to manoeuvre towards is free of traffic.

OR 14: As in existing operations when equipped with a traffic collision avoidance system, if an alert is triggered, the pilot shall apply the associated procedure for traffic avoidance.

Appendix B – Electronic Conspicuity context

Current European regulations [1] require all manned aircraft not subject to air traffic control to be continuously electronically conspicuous to U-space service providers (E-Conspicuity). According to AMC1 SERA.6005(c) [3] this could be achieved by transmitting aircraft's position using ADS-B out on 1090 MHz or (following approval) 978 MHz or by transmitting information, in line with the ADS-L technical specification [4], using SRD860 frequency band or (following publication of specification) mobile telecommunications services.

Appendix C – Electronic Conspicuity UK study, summary of key findings

A UK CAA research project reviewed the human factors issues related to the current Electronic Conspicuity situation. The results were document in CAP2583 [11], November 2023, titled: Investigation into the human factors effects of Electronic Conspicuity devices in UK general aviation.

The study for example reported that:

- Due to the large mix of Electronic Conspicuity devices and the lack of interoperability, the overall mean chance of detecting and being detected was approximately but likely less than 50%, but highly variable across Electronic Conspicuity combinations.
- Realistic visual range was confirmed to be about two miles, and up to three in perfect circumstances.
- Given that visual acquisition is so limited (less than 1.5 miles in most cases), the opportunity to sight another aircraft is only available for a short period (about 20 to 30 seconds at best when head on, given two relative slow aircraft and less than a minute if converging from 90 degrees). Given the well-known difficulties of seeing converging targets (static in the visual field), the narrow band of high visual acuity, and the chance that the pilot will not look in that precise direction, this is a very short period on which to rely. Arguably it is far too short, and so the chance of pilots noticing is not high.

It provided some key recommendations:

- A pilot training programme around Electronic Conspicuity,
- Do not expect Electronic Conspicuity to see everything,
- Don’t spend time visually seeking Electronic Conspicuity detected aircraft that are:
    - Clearly no threat,
    - More than 3 miles away,
- Develop check lists for use of Electronic Conspicuity devices.

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