Electronic Conspicuity in U-space without ATC

Use Case

CONTENTS

ABBREVIATIONS

ACRONYM	DESCRIPTION
ADS-B	Automatic Dependent Surveillance-Broadcast
AIP	Aeronautical Information Publication
AIRB	Basic Airborne Situation Awareness (ADS-B Application)
AMC	Acceptable Means of Compliance
AMSL	Above Mean Sea Level
ARA	Airspace Risk Assessment
ASA	Aircraft Surveillance Applications
ATAS	ADS-B Traffic Advisory System
ATC	Air Traffic Control
ATCO	Air Traffic Control Officer
ATS	Air Traffic Service
BVLOS	Beyond Visual Line of Sight
DAA	Detect and Avoid
DSS	Discovery and Synchronization Service
EASA	European Union Aviation Safety Agency
EMGY	Emergency
EU	European Union
FIS	Flight Information Service
GM	Guidance Material
GND	Ground
GVA	Geometric Vertical Accuracy
HAE	Height Above Ellipsoid
ICAO	International Civil Aviation Organization
ID	Identification
IFR	Instrument Flight Rules
MOPS	Minimum Operational Performance Standards
NACP	Navigation Accuracy Category for Position
NACV	Navigation Accuracy Category for Velocity
NIC	Navigation Integrity Category
NM	Nautical Mile
SDA	System Design Assurance
SERA	Standardised European Rules of the Air
SIL	Source Integrity Level
SIS	Signal In Space
SPI	Special Position Identification

ACRONYM	DESCRIPTION
STD	Standard
SV	State Vector
TABS	Traffic Awareness Beacon System
TBD	To Be Determined / To Be Defined
TIS	Traffic Information Service
TN	True North
TSAA	Traffic Situation Awareness with Alerts
UAS	Unmanned Aircraft System
USSP	U-space Service Provider
VFR	Visual Flight Rules
VLOS	Visual Line of Sight
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] Commission Implementing Regulation (EU) 2023/1770 laying down provisions on aircraft equipment required for the use of the Single European Sky airspace and operating rules related to the use of the Single European Sky airspace, September 2023.

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

[5] Acceptable Means of Compliance (AMC) and Guidance Material (GM) to Commission Implementing Regulation (EU) 2021/664 on a regulatory framework for the U-space – issue 1, EASA December 2022.

[6] ICAO Annex 10 — Aeronautical Telecommunications, Volume IV — Surveillance and Collision Avoidance Systems, 4th Edition, ICAO July 2014, including subsequent amendments.

[7] ASTM F3411-22a, Standard Specification for Remote ID and Tracking, ASTM International 2022.

[8] RTCA DO-365A, Minimum Operational Performance Standards (MOPS) for Detect and Avoid (DAA) Systems, RTCA 2020.

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

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

[11] 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 by manned aircraft for operations in the U-space airspace when not provided with Air Traffic Control (ATC) service.

1. Overview

Electronic Conspicuity data is required to be provided by manned aircraft operating in U-space airspace and not receiving Air Traffic Control (ATC) service (EU Regulation 2021/666 [1]).

The Electronic Conspicuity data is received by U-space service providers (USSPs) and provided as Traffic Information to the UAS/Operators receiving U-space services (EU Regulation 2021/664 [2]).

A graphical representation of this data flow is illustrated by the arrows in Figure 1.

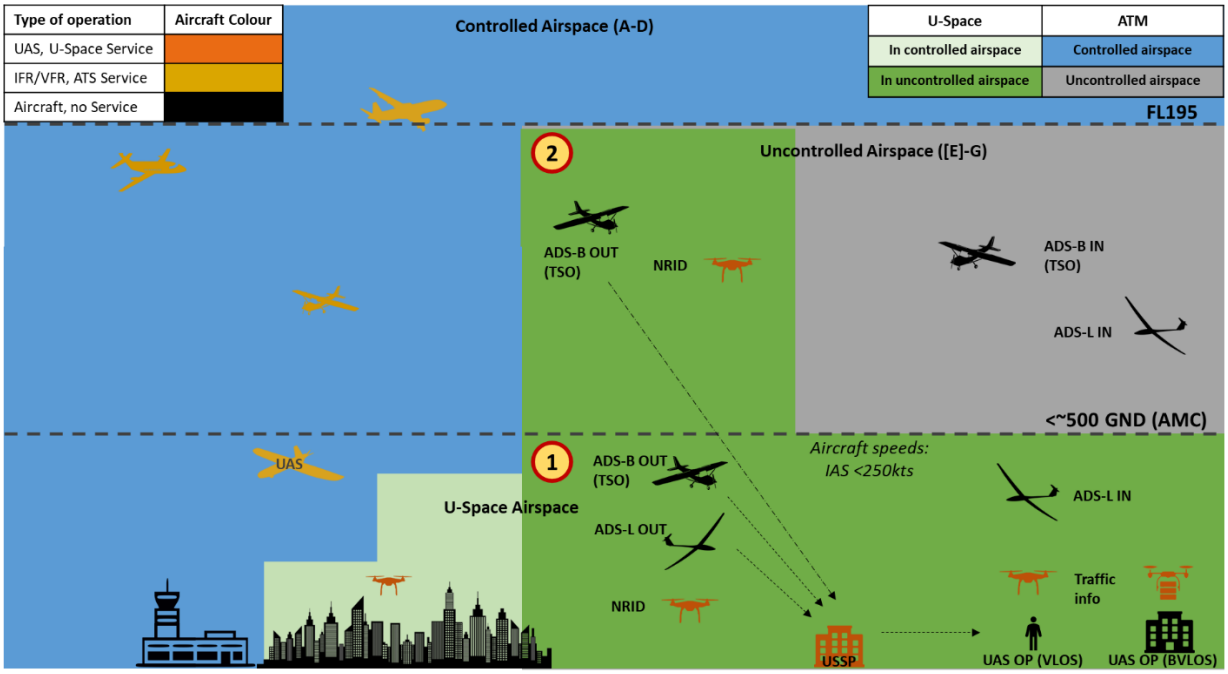


Figure 1 - Use case illustration of Electronic Conspicuity in U-space without ATC

Note: *There are possible upper operational envelope bounds for the use of Electronic Conspicuity other than 1090 ADS-B Equipment. For example, (1) per ICAO Annex 10 volume IV [6] §3.1.2.10.2, it is required to use higher power transponder when operating at speeds above 175 kt or altitude above 15 000 ft.*

As described, the manned aircraft is responsible for transmitting Electronic Conspicuity data and the USSP is responsible for receiving the Electronic Conspicuity data in the U-space airspace volume.

Further, through the Traffic Information Service (TIS), the USSP provides information to the UAS operator about other electronically conspicuous aircraft in the proximity [see note below and Appendix A - Proximity for definition of proximity] of the UAS.

Note: *There are different definitions of proximity, AMC/GM to Regulation 2021/664 [5] Art 3(4) refers to look-ahead distance of 20 NM (37 km), while the AMC/GM to Regulation 2021/664 [5] Art 11(1) as well as ASTM 3411-22a [7] refers to different distances specified based on diagonals of a rectangle ranging between 3.8 NM (7 km) and 11.3 NM (21 km). Further information is provided in Appendix A - Proximity.*

The UAS operator is using the Traffic Information to improve situational awareness and avoid any collision hazard.

The USSP will use the Traffic Information to determine if a UAS flight authorisation can be activated or not. A Flight Authorisation should not be activated in the following cases:

- manned aircraft in state of emergency, or
- manned aircraft intersecting the UAS trajectory (this aspect is envisaged to be removed in the next update of the AMC/GM).

1.1 Assumptions

Assumption 1: The Traffic information is displayed to the UAS operator.

Note 1: *The UAS operator display perspective may be either single UAS (more like a pilot, ownship oriented) or multi-UAS (more like ATCO overview oriented).*

Note 2: *The proximity volumes, within which traffic information is provided, are per ASTM F3411-22a [7] (Discovery and Synchronization Service, DSS), defined relative to each UAS, which means that multi-UAS traffic picture may not be well supported (i.e. traffic information only around the individual UAS).*

Assumption 2: During BVLOS operations, the UAS operator will not aim for visual acquisition of the manned Traffic. During VLOS and extended VLOS operations, visual acquisition is expected by the operator or with the support of a visual observer.

Assumption 3: The Electronic Conspicuity solution will not need to support radio communication contact, i.e. neither UAS operator nor the USSP will have radio communication contact with the manned Traffic.

Assumption 4: The UAS operator will use the traffic information to manoeuvre relative to the manned Traffic.

Assumption 5: Given the focus on the current U-space definition and services, the minimum design criteria for Electronic Conspicuity solutions will not include (1) DAA collision avoidance (while it may support remain-well clear) and (2) ATS services

Assumption 6: The Electronic Conspicuity solutions will support aircraft operations both Airborne and on Ground.

Note: *The UAS operations can occur in different environments, including near or around uncontrolled airports, which implies that relevant manned traffic may be on ground (e.g. just before take-off) and therefore need to be seen on ground as well as when airborne.*

Assumption 7: The Electronic Conspicuity solutions will support aircraft operations at various altitudes, initially at very low levels (Case 1) but later also at higher altitudes, up to FL195 (Case 2).

Note 1: *Initial U-space is expected to be established at very low level, e.g. typically below 500 ft GND.*

Note 2: *Conspicuity is only required for aircraft not provided with ATC. Per Standardised European Rules of the Air (SERA) [4], when operating VFR, operations without ATC can occur in airspace class E, F and G, while for IFR it can only occur in airspace class F and G. In most European states such airspace is not defined above FL195, and some states do not define such airspace above FL95 (some exceptions e.g. in high seas airspace etc.).*

Assumption 8: The Electronic Conspicuity solutions will support aircraft operations at speeds below 250 kt (and possibly below 175 kt).

Note: *Aircraft operating at speeds above 250 kt are generally required to be equipped with Transponder and ADS-B Out per regulation EU 2023/1770 [3] (some exemptions exist).*

Assumption 9: The pilot of the manned aircraft will not have any information about the UAS.

Assumption 10: The pilot of the manned aircraft is informed about the locations of UAS geographical zones, including U-space airspace volumes, and its status, based on information provided in AIP and on aviation charts.

2. Roles and responsibilities

It is the **pilot's** responsibility to ensure that the Electronic Conspicuity device is operating as required.

Note: *This verification refers to the airborne device itself, there is currently no function foreseen to in real-time verify or confirm that the Electronic Conspicuity data is received by the USSP. Post operations analysis verification of the airborne system performance and detectability may exist, but there is currently no responsibility allocated such function.*

It is the **USSP's** responsibility to ensure that the Electronic Conspicuity data is received within the entire U-space airspace volume (including sufficient margin outside U-space, if needed to ensure safe operation) from Electronic Conspicuity systems performing to specifications and to make the data available to relevant UAS operators as part of the traffic information service.

Note: *The interface between the pilot and the USSP is the Electronic Conspicuity specification. The pilot needs to be aware of limitations of the system e.g. in terms of operational envelope (speed and altitude) and similarly the USSP need to be aware of the minimum performance of the Electronic Conspicuity systems in order to design and deploy the receive system infrastructure appropriately.*

It is the **UAS operator's** responsibility to avoid collision hazards with manned aircraft that are provided as part of the traffic information service.

Note: *The distance and/or altitude from the manned aircraft, which the UAS is expected to manoeuvre is not yet prescribed. DAA collision avoidance functions are not expected to be used by UAS operating in U-space airspace. Therefore, remain-well-clear type of manoeuvre is expected to be initiated and controlled by the UAS operator, while remaining within the Flight Authorisation volume, when possible. The manoeuvre can as such be in four dimensions position, altitude and time, i.e. by changing the speed within the Flight Authorisation volume. It is expected that the UAS operator can use the full envelop of the Flight Authorisation volume for the manoeuvre (including the contingency volume).*

Further elaboration may be needed regarding the responsibility during abnormal events such as:

- Electronic Conspicuity data not received by USSP due to:
  - Electronic Conspicuity device not working to spec, or
  - Electronic Conspicuity device not installed per instructions.

3. Operational scenarios

This section briefly describes normal and abnormal operational scenarios for the use Electronic Conspicuity in U-space without ATC. It outlines a general description, and it is expected that information provided to involved actors are tailored to the specific system and operations.

3.1 Aircraft operator

3.1.1 Normal operation

During normal operations the pilot ensures that the Electronic Conspicuity system is installed/mounted per the instructions, turned on and operating as expected and no failure indications are provided.

3.1.2 Abnormal operations

In response to failure indication from the Electronic Conspicuity device, the pilot of the manned aircraft leaves the U-space airspace as soon as possible.

3.2 USSP

3.2.1 Normal operation

During normal operations the USSP acquire the Electronic Conspicuity data, either directly or based on agreements with third parties, and make it available as part of the traffic information service to relevant UAS operating under their responsibility (as well as to other USSPs).

The traffic information service system may be provided by the USSP and may include alerts, as such the responsibility for this may reside with the USSP. In this case the UAS operator may for example access the traffic information service via a web-interface providing a traffic picture of and, if needed, alerts for relevant traffic.

In the presence of a conspicuous manned aircraft in the state of emergency, the USSP are today not expected to change the Flight Authorisation for UAS under their responsibility, this may change in the future.

Note: *During normal operations, the USSP is not expected provide instructions to mitigate conflicts (by revising the UAS Flight Authorisation) between UAS and manned aircraft. It is the UAS operator's responsibility to remain well clear from manned traffic.*

To enhance the quality of the system, the USSP monitors that the Electronic Conspicuity data is received per the specifications.

3.2.2 Abnormal operations

USSP takes appropriate actions to mitigate risks for the following events:

- Electronic Conspicuity data from manned aircraft operating in U-space airspace is performing below expected performance (e.g. larger gaps),
- Electronic Conspicuity data is lost for one or many manned aircraft operating in U-space airspace.
- In the future, with enhanced capabilities to detect (currently not required):
    - Manned aircraft detected operating in U-space airspace without any detection from Electronic Conspicuity (currently no action required from USSP, possibly in the future),
    - Electronic Conspicuity data from manned aircraft operating in U-space airspace is detected to be incorrect and/or misleading (currently no action required from USSP, possibly in the future).

3.3 UAS Operator

3.3.1 Normal operation

During normal operations the UAS operator retrieves the Electronic Conspicuity data for relevant traffic in proximity as part of the traffic information service from the USSP. The UAS operator makes sure that the UAS is operating well clear from manned aircraft. The distance and/or altitude which the UAS is expected to maintain from to the manned aircraft is not yet prescribed and no DAA collision avoidance functions are expected to be available. If a manned aircraft is detected to conflict with the UAS operation, the UAS operator is expected to control the UAS such that it avoids the manned aircraft while remaining within the flight authorisation volume when possible. The manoeuvre can as such be in the three dimensions as well as in time, i.e. by changing the speed within the flight authorisation volume. It is expected that the UAS operator can use the full envelop of the flight authorization volume for the manoeuvre, including the contingency volume.

3.3.2 Abnormal operations

The UAS operator takes appropriate actions to mitigate risks for the following events (including reporting to the appropriate authority):

- Relevant traffic is performing below expectations/requirements in the TIS,
- Relevant traffic is lost from the TIS,
- Relevant traffic is detected but not visible in TIS,
- Traffic information provided by TIS is detected to be misleading.

Note: *The requirements and procedures for these mitigation actions would need to be defined.*

4. Data Items

Based on the use case description and assumptions, the following items are identified as required for display to the UAS operator and available to the USSP, see Table 1.

Table 1 - Data Items for Electronic Conspicuity in U-space without ATC

Item	Traffic Info provided to UAS Operator	USSP	Supporting data provided by E-Conspicuity
Traffic position	R (relative)	R (WGS 84)	Position (WGS 84)
Traffic altitude	R AMSL (Required per Regulation) Relative Altitude (Recommended)	R AMSL (Required per Regulation) HAE (Recommended)	Geo Height (HAE)
Traffic vertical direction	Recommended		Geo Vertical speed
Traffic Directionality	R		Geo track
Traffic Ground speed	R		Geo Gnd. Speed
Traffic ID (Callsign)			
Traffic Air/Ground Status			
Emergency status	R	R	EMGY indication
Aircraft Type (Fixed wing/glider etc.)			
Manned/Unmanned			
Traffic intent (if available)			
Display functions			
Ownship position	R		
Display range/map scale	R		
Altitude band filter (relative ownship)	R		
Alerts	R		

R - Required

5. Performance

The performance requirements may be allocated to components at interfaces (A to D) as shown in Figure 2.

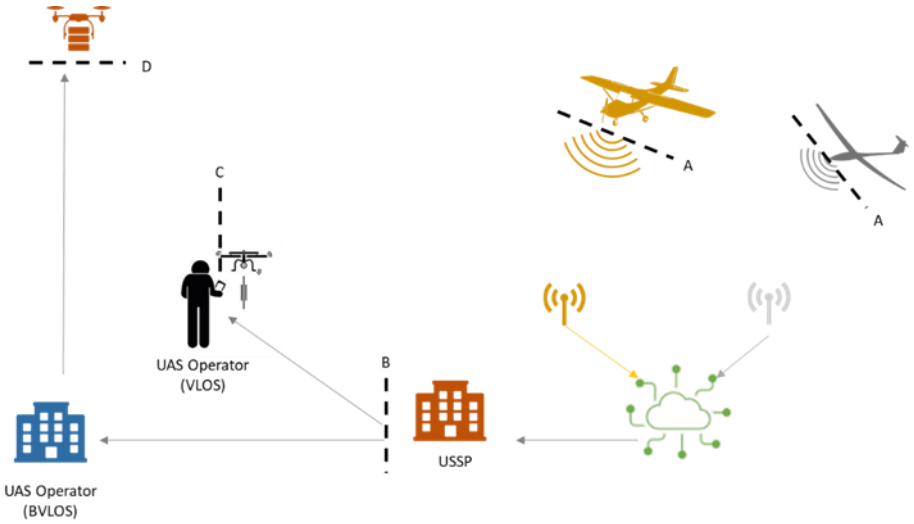


Figure 2 - Data Interfaces for Electronic Conspicuity in U-space without ATC

5.1 Provision of Electronic Conspicuity data (Aircraft)

The aircraft equipment specification for Electronic Conspicuity should define the requirements at interface A. This should also include instructions/control of antenna siting, to ensure the appropriate transmit signal (SIS) outside the aircraft, especially for portable equipment.

Note: *Electronic Conspicuity devices are envisaged to often be a portable device. Equipment design specifications will only cover the equipment itself and there will be no installation requirements (since it is portable). Given that the installation and specifically the antenna siting (incl. orientation) is critical for the system performance, the lack of installation requirements should at least be compensated by strong installation guidance.*

The airborne equipment requirements should include / be driven by a link performance assessment, to ensure feasibility for the use case.

The Electronic Conspicuity device needs to support all environments in which it may be used. This means the requirements are not linked to any specific U-space, instead it needs to support all possible U-space implementations.

Hence, for the U-space use case the following characteristics, Table 2, are identified to be required to be supported by an Electronic Conspicuity device.

Table 2 - Operational characteristics envisaged for Electronic Conspicuity in U-space without ATC

Metric	Description	Requirement
Altitude	Air-to-Ground between GND and (1) Very Low Level and (2) FL195	
Speed	0 – 250 kt (or 175kt with some margin)	
Range (PoU)	Air-to-Ground (Minimum Tx Rate / Power / Installation)	Per Electronic Conspicuity solution: Min Tx power and rates Clear user, carriage, mounting guidance
Continuity	Sufficient to support the Air-Risk mitigation	TBD (incl. top-down e.g. ARA and bottom-up)
Integrity		TBD (incl. top-down and bottom-up. Can be enhanced by Checks and Monitoring)

Note: *If Electronic Conspicuity devices only support a subset of this envelope, the limitations of such devices should be identified, and the device should not be considered supporting Electronic Conspicuity when the limits are exceeded.*

Specific equipment performance requirements are dependent on the several factors including: detailed application requirements, link technology, signal-in-space from the aircraft (transmit rates, power, signal type etc.), receiver network etc. These aspects need to be further detailed per solution/application. However that is outside the scope of this document, which is focused on the use case.

5.1.1 Data quality

In addition to the requirements related to data provision and availability, requirements on the provided data items are also needed, Table 3. Assuming similar type of operations, the data quality is proposed to be based on ASA MOPS [9] AIRB and ATAS/TSAA requirements, which are assumed to address a very similar use case.

Table 3 - Data Quality for Electronic Conspicuity in U-space without ATC

Metric	Electronic Conspicuity U-space	Reference		
		AIRB/ATAS (airborne)	TABS/CAP1391 [11]	ATS (ESASSP [1])
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)	-	< 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 ≤ 45 m (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)

Note: *Example of conversions between 1 Sigma and 95%. Pos: 450m@1σ / 900m@95%, Vert: 23m@1σ / 45m@95%, Vel: 5m/s@1σ / 10m/s@95%.*

5.2 Provision of Traffic Information (USSP)

As described earlier, it is the USSP's responsibility to receive the Electronic Conspicuity data and provide it as part of the traffic information service (TIS).

The requirements related to the Traffic picture should be defined where the data is used, e.g. at the display or at the UAS, interface C and D respectively. However, depending on how the data is transferred to the UAS operator, the responsibility of the USSP could end at interface B, if data availability from the USSP is the responsibility of the UAS operator (e.g. if it is the UAS operator's responsibility to take appropriate measures if the connection to the data is lost).

It is proposed that the USSP responsibility is between interface A and B. As such the USSP is responsible for ensuring appropriate coverage, processing and availability of subscription service to the UAS operator.

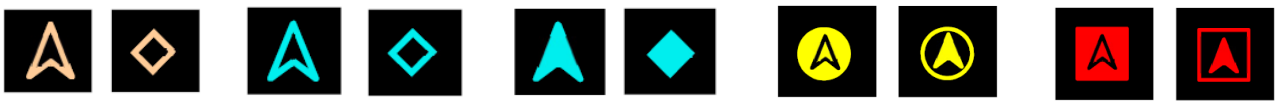
The identified related performance metrics are presented in Table 4, assuming similar operations as air-to-air needs for detection between manned aircraft.

Table 4 - Performance metrics for Electronic Conspicuity in U-space without ATC

Metric	Description
Coverage	Entire U-space horizontal and vertical
Probability of update (SV)	< 3 – 6 s @ 95%
Data age (SV)	AMC < 5 s 99% A->C / (< 4 – 6 s @ 95%)
Long gap rate (duration TBD)	Sufficient to support the Air-Risk mitigation TBD
Continuity	Sufficient to support the Air-Risk mitigation TBD
Integrity	Sufficient to support the Air-Risk mitigation TBD

5.3 UAS Operator - Display recommendations

Human factors contribute to safety. Harmonised traffic display symbology facilitates easier use of different types of equipment (including from different manufacturers), increasing the commonality across platforms and reducing the risk of human error. Initial recommendations could be based on existing material such as DAA MOPS DO-365 [8].



Ground Traffic | Airborne Traffic | Active DAA Manoeuvre | Alert Caution | Alert Warning

Figure 3 - Example of harmonised HMI representation

Appendix A - Proximity

EU Regulation 2021/664 Art11(1)

A traffic information service provided to the UAS operator shall contain information on any other conspicuous air traffic, that may be in proximity to the position or intended route of the UAS flight.

EASA AMC/GM to EU Regulation 2021/664 GM2 Art 11(1) PROXIMITY

Member States may support the definition of 'proximity' by specifying the associated 'surveillance volume' through the establishment of the relevant values (range, height) as part of the performance requirements established for each U-space airspace.

Regarding UAS traffic, a rectangular area with a diagonal of 7 km, may be used according to the value provided in ASTM F3411-22A [7].

For manned traffic, it is recommended to use 3 times this value (i.e. a rectangular area with a diagonal of 21 km).

EASA AMC/GM to EU Regulation 2021/664 GM9 Art 3(4) U-SPACE AIRSPACE —TRAFFIC INFORMATION AND SURVEILLANCE VOLUME

[…]

For instance, to enable a 10-minute reaction time for the UAS operator and considering a manned traffic velocity of 120 kt (≈240 km), a wider volume of 20 NM (≈37 km) and 5 000 ft (≈1 500 m) may be taken as reference to adequately monitor manned traffic patterns.

These factors are to be considered by Member States to ultimately specify the appropriate 'surveillance volume'.

Appendix B - Data items

To enable presentation of the required information the manned traffic must provide the data, Table B-1, as part of the Electronic Conspicuity data. Two additional use cases are also shown for reference.

Table B-1 – Data items

Data item	U-space Conspicuity	Air-to-Air SA Conspicuity	Reference ATS [10]
Horizontal position (WGS-84)	R	R	R
Geometric height (HAE)	R	R	
Barometric altitude (STD)			R
Vertical rate (Barometric, Inertial, Geometric)	R (Geometric)	R	
Track angle (TN)	R	R	
Ground Speed	R	R	
Aircraft Identity (Callsign)		?	R
Air/Ground status			
Emergency status (General)	R		R
SPI (Squawk ident)			R
Type of Aircraft			
Manned/Unmanned			
Data accuracy: position, geo height, velocity	R	R	R
Data integrity: position (e.g. NIC/SIL/SDA)			R

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