Development of an Unmanned Aerospace Test Site
U-space Sandbox

Project CACTUS

U-space Sandbox Standards and Services

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1. Introduction

ANRA Technologies, Inc. (ANRA), in partnership with the Tartu Science Park Foundation (TSP) are pleased to submit this document in support of the Development of an Unmanned Aerospace Test Site (U-space Sandbox). The project is called CACTUS, an acronym for "Competent Authority Coordinating Testing in U-space Sandbox." This document satisfies Deliverable 5.3 (U-space Sandbox Standards and Services).

2. Background

Existing standards and standards under development, which are related to the U-space service delivery framework, are described and mapped to Commission Implementing Regulation (EU) 2021/664. It is assessed how they can be used in the implementation and assessment of compliance of U-space services in the context of the U-space regulatory requirements.

3. Description of U-space Services

This section contains a brief description of the four mandatory U-space services and two optional U-space services:

Mandatory U-space services

Network Identification Service

Article 8 in Regulation (EU) 2021/664 addresses the network identification service. This service enables the identification and traceability of a UAS during operation and supports authoritative bodies with enforcing aspects related to security and privacy. In addition, it is assumed that UAS operators would provide traffic information to USSPs through the network identification service.

Geo-awareness Service

This service, as defined in Article 9 in Regulation (EU) 2021/664, provides UAS operators with information about airspace constraints, UAS geozone information, and operational conditions, and this information is provided prior to the flight, as well as during the flight. The geo-awareness service includes geo-fencing, dynamic airspace restriction (DAR), and collaboration with ATC on DAR.

UAS Flight Authorisation Service

A UAS operator who wishes to perform a flight must submit a UAS flight authorisation request before the flight. This service provides authorisations for each flight and ensures that there are no conflicts with other operations in a specific U-space airspace. Flight authorisation requests have a state associated with them, namely accepted, activated, withdrawn, and ended.

Traffic Information Service

According to Article 11 in Regulation (EU) 2021/664, traffic information service provides information on any and all traffic in close proximity to the UAS or the intended route of the flight. This service ensures that the remote pilot has situational awareness and is able to take the necessary action in case an event

ensues, which might compromise safety.

Optional U-space services

Weather Information Service

This optional service provides information on the weather to ensure that the UAS operations are carried out in appropriate conditions. Regulation (EU) 2021/664 states the information that must be included and provided as part of this service.

Conformance Monitoring Service

This optional service ensures that UAS operators comply with the flight authorisation and verifies if there is a deviation that exceeds the threshold, if there is a violation of any terms and conditions associated with the flight authorisation, and if there is a non-conformance with operations conditions pertaining to the airspace.

Common Information Service

The Common Information Service (CIS) is not a U-space service. It is a service consisting in the dissemination of static and dynamic data to enable the provision of the U-space services for the purpose of the management of the unmanned traffic. It is included in the Geo-awareness service table below as it might be addressed by the same standard.

4. Standards as a Means of Compliance

Standards developed by Standards Developing Organisations (SDOs), such as ASD-STAN, ASTM, EUROCAE, ISO, and others, may be recognised as Acceptable Means of Compliance (AMC) or Guidance Material (GM) by the regulator, which enables organisations to establish and demonstrate compliance to a particular regulatory requirement. Standards that are recognised as AMC/GM are considered as soft law.

Standards complement the U-space regulatory framework by being performance-based and enable industries to deploy new technology in a safe and compliant manner. When a standard adequately addresses a regulatory requirement, it is listed in the AMC or GM to the article (example below), where the relevant section in the standard may be referenced. Implementing this standard in the organisation provides a presumption of compliance to the regulatory requirement.

AMC4 Article 8(1) Network identification service

DATA EXCHANGE INTERFACE

USSPs should use the interface defined in Annex 4 to ASTM F3411-22A 'Standard Specification for Remote ID and Tracking'.

GM1 Article 8(1) Network identification service

GEOGRAPHIC PROXIMITY

Member States may support the definition of 'geographic proximity' by setting a value as part of the performance requirements established for each U-space airspace. Alternatively, the value provided in ASTM F3411-22A which specifies a rectangular area with a diagonal no greater than 7 km as a maximum display area may be used. Establishing a value for a geographic proximity smaller than the size of the U-space airspace limits the sharing of unnecessary data among the USSPs and thus supports the technical and economic efficiency of the network.

5. Published Standards Addressing U-space Services

U-space service	Regulatory Requirements	Standard Identifier and Name	Description
Network Identification ServiceTraffic Information Service	Article 8(1) Article 8(2) Article 8(3) Article 8(4)	ASTM F3411-22a: Standard Specification for Remote ID and Tracking	This standard addresses the performance requirements for remote identification of UAS. Several AMCs and GMs in Articles 8(1), 8(2), 8(3), and 8(4) refer to ASTM F3411-22a and indicate how the standard can support in complying with the requirements in the regulation.
Geo-awareness ServiceFlight Authorisation ServiceConformance Monitoring Service	Article 9 Article 10 Article 13	ASTM F3548-21: Standard Specification for UAS Traffic Management (UTM) UAS Service Supplier (USS) Interoperability	This standard addresses performance and interoperability requirements pertaining to constraint processing, constraint management, strategic conflict detection and coordination, and conformance monitoring. GM3 Article 10(5) refers to this standard for activation of flight authorisations, and GM1 Article 10(6) indicates that USSPs may follow this standard to ensure interoperability in terms of flight authorisation services.
Geo-awareness Service	Article 5(1) Article 5(1)(a) Article 5(1)(e) Article 5(1)(f) Article 5(4) Article 5(5) Article 5(6)	ED-269: Minimum Operational Performance Standard for UAS Geo-Fencing	Chapters 8, 9, and Appendix 2 are used for the data model and interface protocol for providing information on the UAS geozones to UAS and associated users. AMC1 Article 5(1) and GM1 Article 5(1)(b) refers to ED-269 for the format of airspace information and geozone data format. The standard may also be used to demonstrate compliance with AMC2 Article 5(1), Annexes to Article 5(4), AMC1 Article 5(5), and AMC1 Article 5(6).
Network Identification Service	Article 8(1) Article 8(2)(b) Article 8(2)(c) Article 8(2)(d) Article 8(2)(f) Article 8(2)(g) Article 8(3)	ED-282: Minimum Operational Performance Standard for UAS E-Reporting	This standard partially addresses the requirements listed in Article 8(1), 8(2)(c), and Article 8(3), more specifically, AMC3(a) and (b) associated with Article 8(1), GM1 and AMC1 associated with Article 8(2)(c), GM1 Article 8(2)(f), and GM1 Article 8(3). In

U-space service	Regulatory Requirements	Standard Identifier and Name	Description
			addition, requirements in Article 8(2)(b), 8(2)(d), and Article 8(2)(g) may be fulfilled by complying with the appropriate sections in ED-282.
	Article 15(1)(e)	ISO 23629-12:2022: UAS Traffic Management (UTM) - Part 12: Requirements for UTM Service Providers	This standard describes responsibilities and organisational requirements of UTM service providers, including an integrated management system for service providers, which addresses compliance monitoring, safety, security, and privacy. The standard may partially address certain requirements in Article 15(1)(e).
Geo-awareness Service	Article 9	ISO 23629-7:2021: UAS Traffic Management (UTM) - Part 7: Data Model for Spatial Data	This standard defines the data model related to spatial information that is shared between UAS operators and the UTM system, however the communication architecture is not defined therein.
Software development and assurance		ED-109A: Software Integrity Assurance Considerations for Communication, Navigation, Surveillance and Air Traffic Management (CNS/ATM) Systems	This standard describes system aspects relating to software development, software lifecycle and pertaining processes, and it contains information on CNS/ATM system approval process. It provides guidance on producing non-airborne software for CNS/ATM systems and equipment that meets the required level of safety.
Traffic Information Service		Technical Specification for ADS-L Transmissions Using SRD-860 Frequency Band (ADS-L 4 SRD-860)	This document contains technical specifications for ADS-L transmissions using SDR-860 frequency band, so that aircraft can be electronically conspicuous to USSPs. This solution can easily be implemented in existing devices, thereby reducing costs for general aviation pilots and providing the required traffic information to USSPs.

6. Standards under Development

U-space service	Standard Identifier and Name	Description
Traffic Information Service	**ASTM WK69690: New Specification for Surveillance UTM Supplemental Data Service Provider (SDSP) Performance**	The standard aims to define minimum performance requirements for Supplemental Data Service Provider (SDSP) equipment and services provided to USSPs.
Weather Information Service	**ASTM WK73142: New Specification for Weather Supplemental Data Service Provider (SDSP) Performance**	This standard, which is currently under development, aims to define minimum performance requirements for weather SDSP data and services to the appropriate U-space actors (USSPs, UAS operators).
Geo-awareness Service	**ED-318: Technical Specification for Geographical Zones and U-Space Data Provision and Exchange**	This draft standard develops the data exchange model that is described in ED-269, and it extends the scope beyond geo-fencing by addressing dynamic airspace reconfiguration. Data scope, data format, quality requirements and exchange of data through information service is also addressed therein.
Flight Authorisation Service	**ISO/FDIS 23629-9: UAS Traffic Management - Part 9: Interface between UTM Service Providers and Users**	This draft standard will define minimum requirements for information exchange between the U-space service providers and the users, such as UAS operators.
Network Identification Service	**ED-xxx: Minimum Operational Performance Standard for Network Identification Service of Unmanned Aerial Vehicles in A/UTM/U-space**	This standard aims to be an interface control document for N-RID exchanges between USSPs, as well as a technical investigation on the impact of the DSS mechanism and a “non-DSS” mechanism in a centralised architecture. It is expected to align with the ASTM standard on Remote ID.
Flight Authorisation Service	**ED-xxx: Minimum Operational Performance Standard for Flight Planning and Authorization Service for Global Awareness in A/UTM in U-Space**	This standard aims to address certain requirements in Article 10. Further information will be available upon publication of the standard, which is expected in 2024.

U-space service	Standard Identifier and Name	Description
Traffic Information Service	**ED-xxx: Minimum Operational Performance Standard for Traffic Information/Situation Dissemination Exchange Format and Service**	It is expected that this standard will define minimum requirements for the traffic information service in alignment with ASTM WK69690.
Geo-awareness Service	**ED-xxx: Minimum Operational Performance Standard for U-Space Geo-Awareness Service**	This standard aims to address Article 3(4) on how Member States shall determine UAS capabilities and performance requirements, performance requirements for U-space services, and the applicable operational conditions and airspace constraints.
Traffic Information Service	**EASA ADS-L 4 Mobile Standard**	This draft document, expected to be published in 2023, is a standard that addresses mobile telephony application transmitting in compliance with ADS-L specifications. It would allow aircraft to transmit their position and receive information about other aircraft to enhance situational awareness.

7. Conclusion

The AMC/GM to Regulation (EU) 2021/664 is expected to be updated and published in 2025, and it is expected to provide clarifications, necessary adjustments and additions to the existing content. Items such as expected performance requirements, standardisation of interfaces, U-space models and data exchange, specific aspects pertaining to flight authorisation and the system safety assessment are expected to evolve and include further clarification.

At the same time, new standards pertaining to U-space are expected to be published, while some standards are expected to be reviewed on a periodic basis by SDOs to determine if they are adequate and updated for the current U-space environment. In addition, projects like AW-Drones and SHEPHERD have or will make recommendations on the amendment/evolution of existing standards and may propose topics for new standards to SDOs, in order to ensure that performance-based standards exist to demonstrate compliance with regulatory requirements.

The Competent Authority will need to have adequate staff in house with the necessary background knowledge or alternatively provide adequate training in order to perform certification duties and activities.