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BURDI Project – Initial CONOPS

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Authoring & Approval

Author(s) of the document

Company Name	Date
skeyes	10/04/2023

Reviewed by

Company Name	Date
skeyes	30/09/2023
SkeyDrone	28/09/2023
Unifly	26/09/2023
Skyports	18/04/2023
Helicus	18/04/2023
Port of Antwerp-Bruges	26/04/2023

Approved for submission to the SESAR 3 JU by[1]

Company Name	Date
skeyes	28/04/2023
Skeydrone	28/04/2023
Unifly	28/04/2023
Future Needs	28/04/2023
Alliance For New Mobility Europe (AME)	28/04/2023
Stichting Koninklijk Nederlands Lucht – en ruimtevaartcentrum (NLR)	28/04/2023
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EuroUSC-Nenelux	28/04/2023
Airial robotics	28/04/2023
Infrabel sa	28/04/2023

[1] Representatives of all beneficiaries involved in the project

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Haven Antwerpen	28/04/2023
Societe anonyme belge de constructions aeronautiques-S.A.B.C.A.	28/04/2023
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[2] Representatives of beneficiaries involved in the project

BURDI

BELGIUM NETHERLANDS U-SPACE REFERENCE DESIGN IMPLEMENTATION

BURDI

This document is part of a project received funding from the Connecting Europe Facility programme under grant agreement No GA - 101079693 - 21-EU-TG-BURDI under CINEA.

Abstract

This document is the Initial Concept of Operations about implementation of U-space airspace concept in the context of the BURDI project. It describes how the consortium intents to implement U-space airspaces in order to be compliant with the ad-hoc regulations, as well as the solutions to clarify or to cover lack of directives in some topics which are not covered or detailed enough in these regulations. This document will be revised as far as necessary considering outcomes of demonstrations, operational or safety issues and their mitigations identified. These revisions will be presented during regular technical reviews already planned within the project (Milestones 2 & 3).
It is to note that the U-space airspace concept is completed by 2 others specific “single CISP” and “USSP” concepts of operations detailing functionalities of these 2 roles.

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1 List of Acronyms & Terms

Acronym & Terms	Description
AGL	Above Ground Level
AIP	Aeronautical Information Publication
AMSL	Above Mean Sea Level
ANSP	Air Navigation Service Provider
ARP	Aerodrome Reference Point
ATSP	Air Traffic Service Provider
BCAA	Belgian Civil Aviation Authority
BVLOS	Beyond Visual Line Of Sight
CAA	Civil Aviation Authority
CIS	Common Information Services
CISP	Common information service provider
CTR	Control Zone
ConOps	Concept of operation
DAR	Dynamic U-space airspace reconfiguration
DSA	Drone Service Application
Geozone manager	The entity designated by BCAA in accordance with the Belgian Ministerial Decree, article 5, establishing fixed UAS geographical zones dated on 21/12/2020, who have proposed the existence of the geozone and its associated operational and/or technical access conditions in the framework of the IR (EU) 2019/947,
NCAA	National Civil Aviation Authority
QNH	Air pressure at Mean Sea Level
RLOS	Radio Line of Sight
sCISP	Single CISP
TMPR	Tactical Mitigation Performance Requirement
UAS	Uncrewed aerial systems
UAS geographical zone (geozone)	Established in the framework of the article 15 of the IR (EU) 2019/947, and for which access by UAS operators is conditional
USSP	U-space service provider

VFR	Visual Flight Rules
VLL	Very Low Level
VLOS	Visual Line Of Sight

Table 1: List of Acronyms & Terms

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2 Introduction

The fast-evolving market of uncrewed aerial systems, UAS, has triggered the need for a regulatory framework in order to allow this market to further grow without lowering the level of safety and security. Initial steps were taken by introduction of the EU wide regulations 2019/947 and 2019/945. As a continuous growth is foreseen, we can expect a further rise in number of operations as well as an increase of complexity of the missions and areas of operation.

This need was captured by the European Commission and the regulatory bodies which led to the development of a complete set of rules. EU regulations 2021/664, 2021/665, 2021/666 created new functionalities and responsibilities for legacy aviation stakeholders and introduced new entities picking up new roles within this eco-system. To encourage the implementation of these new regulations, dedicated projects have been set up in order to consolidate results from previous projects and lift the technological advancements up to the required level of sustained operations. The BURDI project is one of these projects, aiming to develop a reference design implementation for U-space in the Belgian airspace.

Common Information Service Providers (CISP), and U-space Service Providers (USSP), are newly created entities ensuring that safety and security levels are met, enabling UAS operators to focus on the tasks at hand. The different roles and responsibilities are to be made well clear for the eco-system participants to know how to interact with each other. Therefore, this U-space Concept of Operations (ConOps) shall translate the EU regulations into working methods for all to understand what to expect and how to interact within the framework of the BURDI project.

The document is organised as followed :

- **Section 3 – Scope and objectives** : What is the objective of this ConOps
- **Section 4 – Creation, re-assessment and U-space airspace publication process** : General process envisaged to designate, publish and review U-space airspaces
- **Section 5 – Stakeholders roles and responsibilities** : Rights and obligations of each stakeholders concerned by U-space airspace designation
- **Section 6 – Services and functions** : Detailed description of U-space services and associated functions
- **Section 7 – Operational environment** : Description of the mitigation layers introduced by U-space implementation
- **Section 8 – U-space operational concept** : Definition of operational volumes, U-space services provision and general principles for Dynamic Airspace Reconfiguration
- **Section 9 – Technical guidelines** : Definition of standards to be used
- **Section 10 – References** : Documents/regulations used in support of this ConOps

Some annexes are available in order to provide more details on specific topics :

- **Annex 01 –** Airspace risk assessment procedures
- **Annex 02 –** Certification process for USSP
- **Annex 03 –** Certification process for CISP
- **Annex 04 –** Emergency management plan & Contingency plan
- **Annex 05 –** Dynamic Airspace Reconfiguration

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3 Scope and objectives

3.1 Scope of the ConOps

This ConOps focusses on the implementation and working methodologies to be applied in the U-space airspace created and used within the framework of the BURDI project. During this project UAS operations conducted in U-space shall be limited to the OPEN and SPECIFIC category. Operations within CERTIFIED category are out of scope.

It covers the methodology used to create, assess and publish the U-space airspaces, even though these tasks, outside this project environment, are performed by the Competent Authority. Within the BURDI project, dedicated teams are organised to perform these tasks. The result of the task will be added to this document for completeness.

This U-space ConOps serves as an overarching ConOps, describing the general way of translating current legislation into a workable method, ensuring compliance with legal definition of stakeholders' roles. This ConOps shall serve as a basis for single CISP and USSP respective specific ConOps. It will be the basis as well for the ConOps to be locally elaborated for future U-space airspace in the framework of the Airspace risk assessment.

It will not detail the working methodology of the different service providers as such. The U-space ConOps already identifies how certain values (e.g. deviation threshold, dimensions of geographic area) need to be taken into account or determined, if not defined within the regulations. An initial value shall be set, and, during testing activities, this value shall be challenged as part of the objective of the DEMOP taking into account operational requirements and safety levels. Results gathered during these activities shall be consolidated within the DEMOR and shall serve as a reference for updating the initial value set at the beginning of the activities. It is to be understood that intermediate updates of values are possible as well as the project is applying a gradual implementation and increase of complexity.

3.2 Document objectives

The objectives of this document are the following:

- Provide a working methodologies for U-space set in controlled and in uncontrolled airspace.
- Provide guidelines for CISP and USSP in order to allow further elaboration and development of the proper working methodology.
- Describe a first workable guideline for operations within U-space, covering the following elements:
    - Working methodologies for U-space set in controlled and in uncontrolled airspace.
    - Integration of state operators, performing some use cases, in the U-space eco-system.
    - Initial capacity management.

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4 Creation, re-assessment and U-space airspace publication process

4.1 Creation

The aim of this section is to allow for Belgian Civil Aviation Authority, BCAA, to use this document as a guide to structure the different steps to be taken. It is important to make effective use of the benefits U-space brings for UAS operations without over-dimensioning the U-space airspace structure as this will unbalance the required investment costs, especially for USSPs regarding the surveillance infrastructure, versus the potential commercial return.

The different steps to be taken into consideration are:

Designation phase

The competent authority receives request for creating U-space airspace, in accordance with Belgian law, this request can be filed by governmental or legal entities. The minister of Mobility or BCAA director general can at own initiative start the procedure for establishing U-space airspace as well.

This request shall be accompanied by:

- Justification, reason for establishing U-space airspace
- Geographical coordinates (3D)

Request analysis and evaluation

The competent authority performs an airspace risk assessment. This assessment is covering different domains of impact:

- Safety:
  - Air
  - Ground
- Security;
- Environment;
- Privacy.

The result of the airspace risk assessment, in coordination with directly impacted stakeholders, will set out following parameters:

- the mandatory services to be provided by a USSP within this U-space airspace;
- UAS performance requirements;
- U-space service performance requirements;
- Applicable operational conditions and airspace constraints.

Consultation and coordination mechanism

Within the framework of the coordination mechanism, performed with non-operationally impacted stakeholders, the results of the draft airspace risk assessment could be communicated toward the parties impacted by the designation/creation of the intended U-space airspace.

Update initial airspace risk assessment

In case changes to the initial design are conducted, the competent authority shall redo/revise the airspace risk assessment.

The final results of the airspace risk assessment and its accompanied performance requirements, applicable operational conditions and airspace constraints as well as the outcome of the stakeholders' coordination mechanism will be communicated toward the minister of Mobility for decision on implementation of the concerned U-space airspace.

As all the existing UAS geographical zones, so-called geozones[3], were also established for the sake of safety, security, privacy or environmental reason, the introduction of U-space airspace cannot be seen in isolation of already existing geozones.

Such is the case for the first BURDI early adopter area associated with the Port of Antwerp which has been deemed to be most prone for becoming U-space airspace due to an expected large number of simultaneous UAS operations and the proximity of the Antwerp international airport. This means elements resulting from the initial evaluation within the context of geozone creation can be updated taking into account the potential impact of U-space and outcomes of the associated coordination mechanism.
Whether this first U-space airspace would either replace or co-exist with the existing 'EBR-54 Antwerp Harbour' geozone remains subject for further analysis.

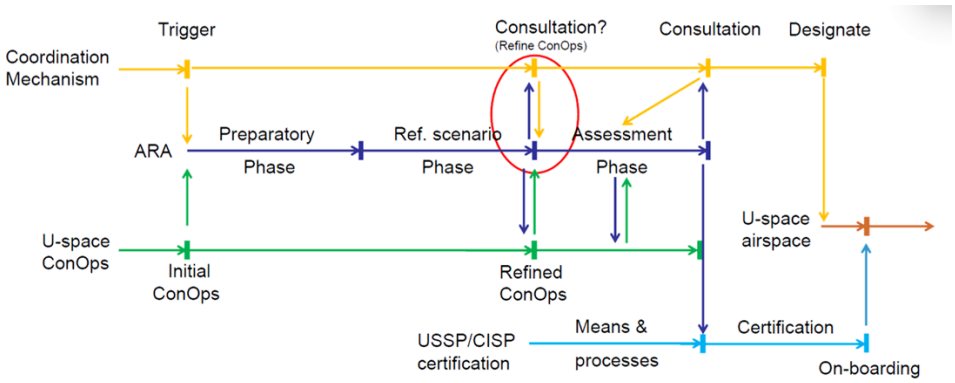

Figure 1: Risk assessment method

4.2 Re-assessment

After a piece of UAS geographical zones gets designated as U-space, the need for re-assessing its parameters arises. The aim is to ensure all involved stakeholders that the U-space airspace parameters are fit for purpose.

The re-assessment cycle can be requested by multiple actors based on two types of triggers.

[3]To avoid confusion between U-space airspaces and other UAS geographical zones which were rather established only in the framework of the article 15 of the IR (EU) 2019/947, the term 'geozone' is for the sake of this U-space ConOps document only referring to the latter

- Time based re-assessment: A time-based re-assessment shall consider a fixed amount of time starting as from the moment the U-space airspace is published in the AIP (Aeronautical Information Publication).

- Event based re-assessment: An event-based re-assessment shall be triggered as from the moment the trigger has been officially notified to the Member State. A register of approved triggers shall be kept up to date by the Member State to allow for a structured maintenance of the re-assessment cycles and events.

In practise both type of triggers will allow initiation of the U-space airspace re-assessment.

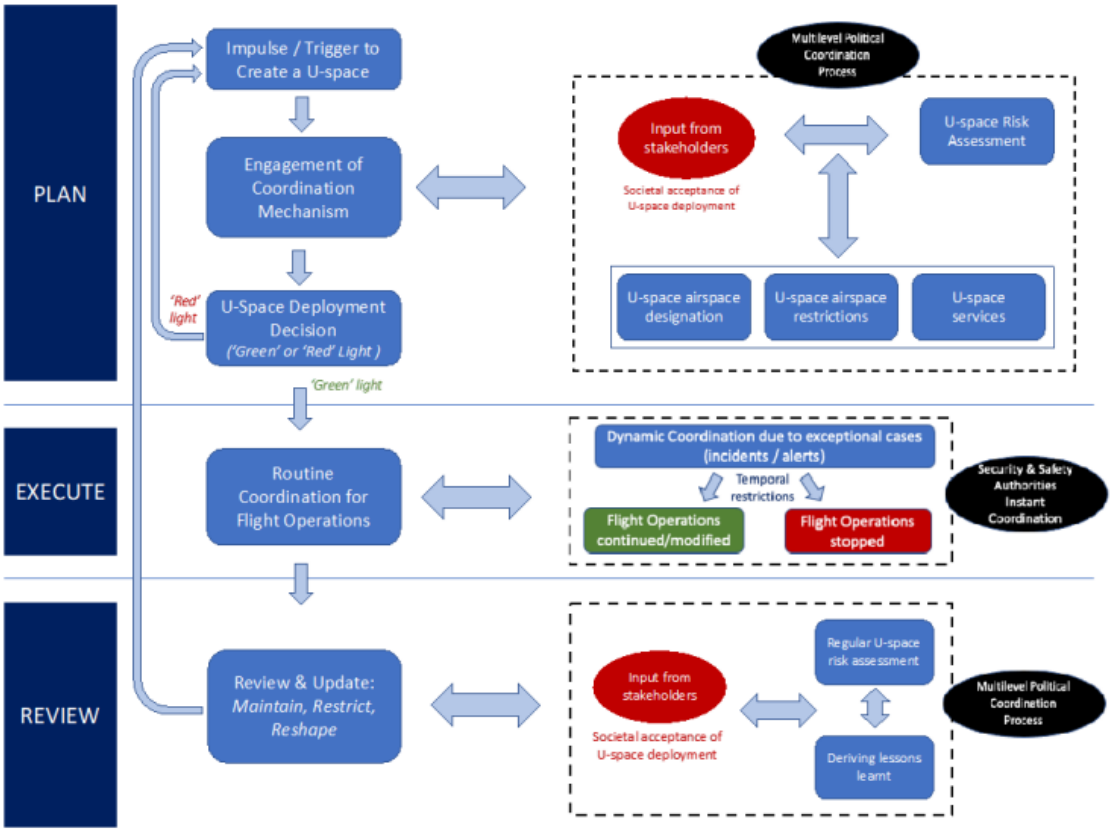

Figure 2: U-space airspace creation process

4.3 Publication

Publication is one of the elements of the creation of U-space airspace. As U-space has a direct impact on manned aviation intending to operate within its limits, this is an element not to be underestimated. Proper communication of the newly established U-space airspace for this very specific airspace user is the first step in mitigating the risk of potential conflicts.

First, it needs to be clear what information needs to be included in the publications.

Secondly, the way how the publication is performed will depend on the progress within the project, in coordination with competent authority.

4.3.1 Content of publication

The content of a publication depends on the intended receiver and the anticipated reaction.

In the case of U-space, the anticipated reaction from the manned aviation operators is for them to be informed on the exact location and, if any, time restrictions on the active U-space enabling them to know prior to go flying where they will need to make themselves e-conspicuous.

The exact content of the U-space publication shall be defined by the BCAA.

4.3.2 Means of publication

During the project the implementation of U-space is conducted in an incremental way. This means that the way of publication shall differ as well.

During the first implementation phase, UAS operations within the framework of the BURDI project shall be conducted in a U-space-like airspace which is not U-space as such. We will have benefit from existing conditions to access to current geozones and EBR54, formal authorisation to get in, as well as additional implementation of Tactical Mitigation Performance Requirement (TMPR), traffic information provision (on manned and unmanned aircraft). This first step will allow USSPs and CISP support flights with actual U-space-like services in order to finetune and improve supporting tools and procedures attached to those services prior to certification. As from the moment both entities are certified the next phase of implementation can then be finalised.

During this second phase, operations shall be conducted within officially designated U-space airspace, meaning that the U-space airspace shall then already be published. In order to more easily and rapidly publish the required information toward other airspace users this initial publication shall make use of an AIP supplement.

As a final stage, and if designation of the U-space airspace is confirmed by the State, the incremental publication process is the complete integration into the AIP. It will be the BCAA who will decide on the exact location of the U-space airspaces publication.

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5 Stakeholders roles and responsibilities

5.1 UAS operators

5.1.1 Civil UAS operators

UAS operators are able to fulfil requests expressed by customers in a structured way managing the UAS flights of their fleet, enabling planification and deconfliction of their activities at strategic and pre-tactical level as well as the following-up at tactical level, even in case of urgent requests having priority. UAS operators will call upon the USSP in order to be provided with U-space services.[4]

5.1.2 State UAS operators

Even though State, including Military, operations could be exempted to apply the U-space regulation, the operators conducting this type of operations are to not endanger other airspace users. Therefore, these operators are encouraged to consider this new eco-system and to ensure that their activities and services are meeting the safety objectives of the EU regulation.

Within the BURDI project State operators shall act as opted in. Testing will allow for state operators to understand the benefits as well as help define what are the elements to be considered by USSP in order to be able to act as a service provider during State missions in terms of data sharing and privacy.

5.2 UAS pilots

UAS pilots are responsible for handling drones in accordance with applicable regulations and operational constraints defined by the USSP providing U-space services as well as in compliance with U-space airspace and UAS geographical zone access conditions.

5.3 USSPs

USSPs provide services relying on digital services and automation of functions designed to support a safe, secure and efficient access to U-space airspace for a large number of UAS, especially considering U-space airspace configuration. USSPs ensure to give appropriate priority to flights in accordance with defined prioritisation, especially in case of special operation (Article 4 of EU IR No 923/2012, single European rules of the air, SERA), through delivery of required U-space services.

5.4 sCISP

sCISP is the single common information service provider disseminating static and dynamic data to enable the provision of U-space services by USSPs to other relevant stakeholders

4 regulation (EU) 2021/664 (13) Although military and State aircraft operations are excluded from the scope of this Regulation, there is a need to ensure safe separation of aircraft in the U-space airspace. Therefore, Member States should be able to define static and dynamic U-space airspace restrictions to enable such operations in a safe and efficient manner.

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An overarching IT technical solution supports the provision of CIS. It is a gateway type solution making available relevant operational data to USSPs delivering U-space services and to other stakeholders as identified in relevant regulation. U-space eco-system members concerned are able to collect and/or to make available data in accordance with their dedicated function within this eco-system. This technical solution highly depends on the standardised format of the information to be distributed among the different participants.

The full functioning of the IT technical solution shall be specified in the dedicated sCISP ConOps.

5.5 ATSP

In controlled airspaces, Air traffic service (ATS) units are in charge of Air traffic services provision for the benefit of manned aviation. ATS units providing Air traffic control service ensure "Dynamic reconfiguration of U-space airspace", meaning temporarily limit the area within the designated U-space airspace where UAS operations can take place in order to accommodate short-term changes in manned traffic demand by adjusting the lateral and vertical limits of the U-space airspace. Therefore, when handling the topic of dynamic reconfiguration of airspace, the ATSP is managing the CTR. The ATSP shall ensure that the relevant USSPs, through the single CISP, are notified in accordance with the prenote timeframe specified in the operational conditions and airspace constraints of the U-space airspace concerned.

The ATSP shall provide the relevant traffic information to USSPs regarding manned aircraft on a non-discriminatory basis, making use of its existing infrastructure. The ATSP is providing clearances to manned aircraft operating within CTR taking due account of the Dynamic reconfiguration in force, avoiding interference of manned aircraft with portion of U-space active airspace (i.e. in which UAS activities are allowed).

In uncontrolled airspace, the ATSP provides only Flight Information Service to manned aircraft under two-way radio communication and Dynamic reconfiguration of U-space airspace is not applicable. The ANSP could provide the relevant traffic information regarding manned aircraft as far as practical, making use of its existing infrastructure. In Belgian FIR, during day, in uncontrolled airspace outside U-space, there is no obligation for manned traffic to make itself e-conspicuous.

5.6 UAS geographical zone managers

U-space airspaces are in itself also defined as UAS geographical zones be it a special type of UAS geographical zone for which access by UAS operators is conditional to the consumption of U-space services. In Belgium, it is decided by the NCAA that when a U-space airspace is created, a specific UAS geographical zone is created and designated as such, co-existing with UAS geographical zone if any.

However, to avoid confusion between U-space airspaces and other UAS geographical zones which are rather established only in the framework of the article 15 of the IR 2019/947, the term "geozone" is for the sake of this U-space ConOps document only referring to the latter. For each of these already existing (and future) geozones, in accordance with the Ministerial Decree, article 5, establishing fixed UAS geographical zones dated on 21/12/2020, a geozone manager is identified as being the entity

which proposed the existence of the geozone and its associated operational and/or technical access conditions as finally agreed upon and published[5] by the CAA in the framework of the IR 2019/947.

U-space airspace and geozones – although they are both to be considered as UAS geographical zones – therefore co-exist next to each other and might or might not overlap in space and time. In case a UAS flight plans overlap with both U-space airspace and one or more geozones, it is the operator's responsibility to comply with all relevant access conditions, i.e. those associated with U-space airspace AND all access conditions associated with the geozones.

The distinction to be made between U-space airspace and other geozones is particularly important in those cases where the access conditions of a geozones contain the obligation for the operator to apply for a flight authorization. In such case an individual flight authorization is required and issued by the geozone manager to the operator. This geozone flight authorization as foreseen by article 15.1.(a)[6] of the IR 2019/947 has however nothing to do with the UAS flight authorization issued by the USSP as part of the obligatory UAS flight authorization service to which the UAS operator needs to adhere within U-space airspace.

To avoid confusion between the two types of flight authorisation the following convention is being set:

- Flight authorisations issued by the USSP in the framework of the obligatory flight authorisation are called "UAS flight authorisation"
- Flight authorisations issued by a geozone manager are called "flight permission"

In case a geozone is partially or completely embedded in a U-space airspace, it is up to the relevant geozone manager and the USSPs providing services in the U-space airspace to define whether or not the geozone management activity can be delegated to USSPs and under which conditions this is possible. As this is a coordination and potential benefit on the purely commercial aspect the further elaboration of such a coordination procedure is not within the scope of this ConOps.

5.7 U-space coordinator

The competent authority is responsible for establishing the coordination mechanism, and in particular for nominating a "U-space coordinator" responsible for preparing, performing and completing the coordination process by providing recommendations to the competent authority throughout the life cycle phases of the U-space airspace.

The U-space coordinator should identify, involve, and consult all these relevant other authorities and entities, including at local level. These authorities or entities may be affected by, or interested in, the deployment of a U-space airspace in some way and therefore should be considered accordingly.

[5] In Belgium all geozones including all there access conditions can be found at map.droneguide.be

[6] "When defining UAS geographical zones for safety, security, privacy or environmental reasons, Member States may: (a) prohibit certain or all UAS operations, request particular conditions for certain or all UAS operations or require a prior flight authorization for certain or all UAS operations;"

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5.8 General Public

The general public is an important part of the U-space ecosystem as they will experience the daily impact of intensive UAS activities at first hand. They play a passive and an active role in the U-space ecosystem. The passive interaction can be envisioned as the consumption of the network remote identification data available through the CIS platform. Their active contribution is felt through the interaction with the U-space coordinator during consultation activities.

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6 Services and functions

It is to be noted that during the research and development of different U-space projects the term "service" has been used for all types of data exchange and provision of information towards whomever requested the info within the U-space eco-system. This has led to a large number of so-called "services" which makes it difficult to find the correlation between the known services as described according the U1, U2, U3 and U4 classification and the actual U-space regulated services as described in the EU regulation 2021/664.

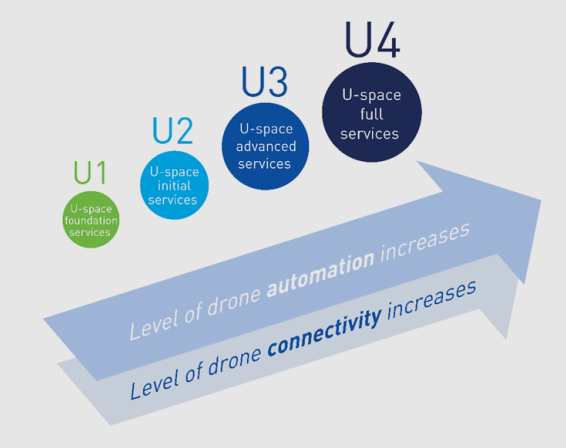

Figure 3: U-space service implementation plan

For CAAs, USSPs, CISPs and UAS operators to clearly understand everyone's role and responsibility within the eco-system, clear definitions on this matter are necessary. We make a distinction between "U-space service" and "function".

U-space service

In compliance with the EU Regulation 2021/664 on regulatory framework for the U-space, it is a service relying on digital services and automation of functions designed to support safe, secure and efficient access to U-space airspace for a large number of UAS. The definition of the regulated (mandatory or additional) U-space services, objectives and content, are defined within the EU Regulation 2021/664.

Function

A function is an activity performed by the USSP enabling provision of data that can be relevant for UAS operators. Some functions are essential for USSPs enabling them to provide required U-space services within the U-space airspace concerned. There are some other functions which are not within the scope of required U-space services, but which can be interesting for UAS operators. Such functions provision is not within the scope of the U-space concept nor this U-space ConOps.

A U-space airspace is a UAS geographical zone designated by Member States, where UAS operations are only allowed to take place with the support of U-space services which are determined as required during the airspace risk assessment phase. It means that UAS operators will need to make use of these services and ensure the equipment used is able to comply with the UAS capabilities and performance

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requirements. When unable to comply with these UAS capabilities and performance requirements the UAS operator is not allowed to access that specific U-space airspace.

As a reminder, 4 services are by default indicated as mandatory within the EU Regulation 2021/664. These U-space services are listed here below in part 5.1 mandatory services. The other services are identified as "additional" within the EU Regulation 2021/664, and are listed under 5.2 additional services. Whether or not an additional service becomes mandatory for a particular U-space airspace or portion of that U-space will be part of the Airspace Risk Assessment outcome.

6.1 Mandatory U-space Services

These mandatory services are the minimum set of services to be provided by the USSP toward the UAS operator throughout the complete U-space airspace of operation during the complete duration of the flights. These digital and highly automated services are in place for mitigating risks at pre-tactical and tactical level. In the table below the services and their subsequent functions are listed including the SESAR solution code linked to the function. It is to be made clear that the link with the SESAR solution is required for development in line with IR (EU) 2021/664, in order to be able to link it to previously developed functionalities which might already have a certain level of maturity. Future developments shall no longer make reference to the SESAR solutions as such but will refer to the regulation on U-space only.

SERVICES	FUNCTIONS	SESAR solution code
Network identification	e-Registration	U1S-01
	e-Identification	U1S-02
	Emergency Management	U2S-02
Geo-Awareness	UAS aeronautical information management	U2S-09
	Procedural Interface with ATC	U2S-10
	Dynamic geo-fencing	U3S-01
	Collaborative interface with ATC	U3S-03
UAS flight authorization	Pre-tactical geo-fencing	U1S-03
	Tactical geo-fencing	U2S-01
	Strategic de-confliction	U2S-03
	Flight planning management	U2S-06
	Tactical de-confliction	U3S-02
	Dynamic capacity management	U3S-04

Traffic information	Tracking	U2S-05
	Traffic information	U2S-08

Table 2: Mandatory services, functions and SESAR solution correlation

6.2 Additional U-space services

Within the IR (EU) 2021/664 regulation only 2 additional U-space services were elaborated: weather information service and conformance monitoring service. It is to be expected that during the airspace risk assessment, when it is determined that operations shall benefit from an additional service(s) to make the operations safe, secure and efficient, this additional service is enforced as mandatory service.

The additional services are:

SERVICES	FUNCTIONS	SESAR solution code
Weather information	Weather information	U2S-04
Conformance monitoring	Monitoring	U2S-07

Table 3: Additional services, functions and SESAR solution correlation

To specify future maturity levels of the different services it is required to be able to make the correlation with the results consolidated in previous SESAR projects, therefore, a clear link needs to be identified between the current services as described in IR (EU) 2021/664 and the U1-U4 services and associated SESAR solutions.

BURDI specific statements and decisions 1: services, functions, SESAR solutions

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7 Operational environment

Before the implementation of U-space a large amount of effort must be poured into the evaluation of the different risks originating from the operations and the operational environment. The aim of the U-space regulation is to relieve UAS operators and national CAAs from a significant amount of work. Therefore, evaluating the operational environment in which the U-space airspace will be established is part of the safety mitigation in depth approach. This approach has a triple-layered mitigation structure: strategic, pre-tactical and tactical. The understanding of the operational environment is the first step in the airspace risk assessment, which is the main component of the strategic mitigation layer.

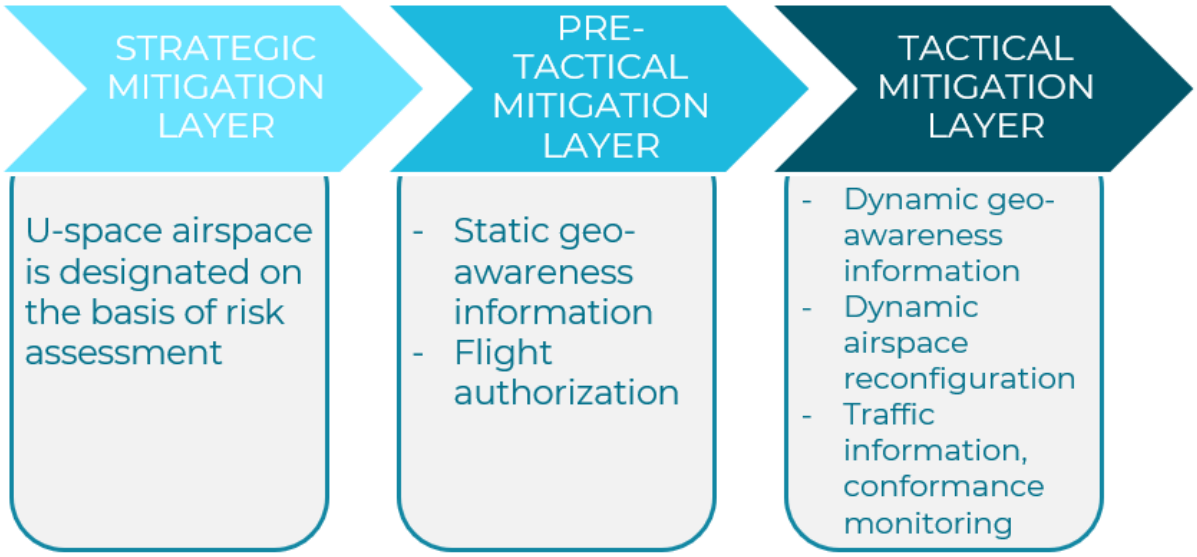

Figure 4: U-space mitigation layers, REF [1]

The newly created airspace structures and certified services provided within create a level field, a new starting point for UAS operators and NCAAs when filing and evaluating operational authorization[7] requests for operations conducted within the U-space airspace concerned.

The U-space framework should focus on the direct reduction of the air risk class (ARC) and the indirect reduction of the ground risk.

As mentioned in the AMC & GM complementing the EU regulation 2021/664, the U-space airspace risk assessment should result in a residual Air Risk Class within all U-space equal to ARC-b[8].

For a good understanding, U-space will not relieve UAS operators from their obligation to file a request for an operational authorization at the NAA, when required. The regulatory U-space framework and

[7] 'Operational authorizations' granted by the CA as part of a requirement to execute certain flight with the Specific category, in accordance with IR (EU) 2019/947, article 12, are not to be confused with' flight authorizations' as part of the access conditions of either U-space airspace and/or certain geozones.

[8] REF [3]: GM4 Article 3(4) U-space airspace

the associated operational environment with provision of U-space services by USSPs and sCISP, shall in those cases merely ensure the use of a pre-defined residual Air Risk Class when drafting a SORA. This should allow the operator to more easily receive the SORA-based operational authorization from the competent authority.

Other obligations specified in the IR (EU) 2019/947 remain in force for the UAS operator and the pilot.

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8 U-space operational concept

The operational concept of the U-space airspace established within the framework of the BURDI project aims to define interactions between the main U-space eco-system participants: the ATSP, CISP, USSP and the UAS operators. These interactions depend on the operational environment in which the U-space is established. The services provided depend highly on standardisation and automation. Further details on the standards and the refresh rate of the different data sets needed to deliver the services described in this section are detailed in section 8.1: Standards for U-space services and functions.

U-space can be established in controlled and in uncontrolled airspace. The U-space services provided within, as defined by EU Regulation 2021/664, remain the same. However, the way segregation of activities between manned and uncrewed aircraft is ensured differ, depending if U-space airspace is established within uncontrolled airspace or within controlled airspace.

8.1 Operational volumes

In order to clarify the working method within U-space airspace, this section will focus on terms that are still to be clarified with regard to applicable operational volumes.

UAS Flight Authorization volume:

The UAS operator first defined a 4D volume of airspace within which it intends to fly to then subsequently use that 4D flight plan to request a UAS flight authorization to its USSP of choice. The volume to be requested is the volume within the SORA activity described as the 'contingency volume'. This ensures the different mitigation measures put in place by the UAS operator is by default already taken into account by the USSP when providing UAS flight authorizations. This assumption is in line with the point of view expressed by EASA during the June 2023 U-space workshop "From the concept to the implementation" in which the proposed link between the SORA-defined volumes and the U-space UAS flight authorisation got depicted as per the Figure 4 below.

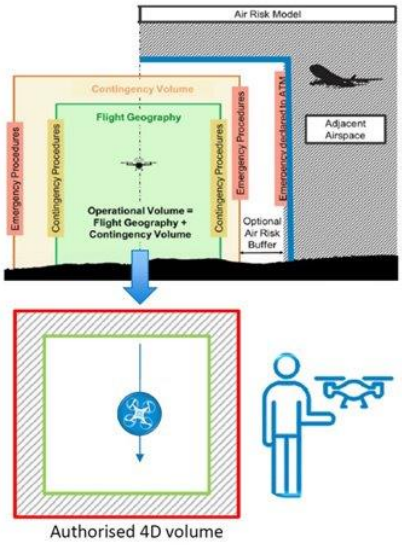

Figure 5: UAS flight authorization volume

Deviation threshold[9]:

The deviation threshold is the maximum deviation (due to lack of location precision, pilot error, …) from the submitted UAS flight plan, to be considered by the USSP when processing a flight authorisation or to generate a non-conformance alert. Its value is defined by the Member State during the airspace risk assessment. Every individual U-space airspace shall have its deviation threshold determined during this assessment, mainly depending on drone types envisaged to be used within. The 4D value is expressed in meters, feet and seconds, and creates an enlargement of the requested flight plan and its duration which will be considered by the USSPs when performing the UAS flight authorisation. For the geographical part, the enlargement is considered in the horizontal and vertical plans. By including this 4D volume in the UAS flight authorisation it shall automatically be taken into consideration when performing conformance monitoring by the USSP and strategic deconfliction activities.

The higher the performance of UASs and services, the smaller the deviation threshold to be taken into consideration.

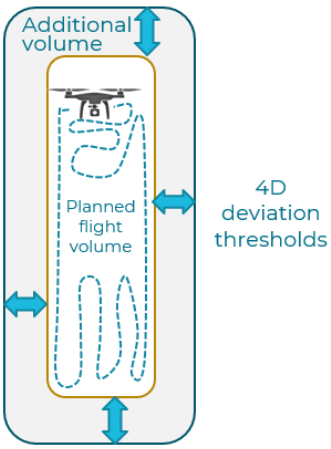

Figure 6 : Deviation threshold

Proximity:

The aim of providing traffic information toward UAS operators is to ensure an increased situational awareness and to enable the UAS pilot to avoid any risk of collision with any crewed and uncrewed traffic. The proximity defines a volume - centred around the real-time position of a UAS - within which the USSP (supporting the flight of that UAS) has to provide the real-time position of all other aircraft (crewed and uncrewed) as traffic information to the UAS operator/pilot. The distance defining the proximity is a result of the calculation made on the reaction time as well as the speed at which the

[9] REF [3]: GM9 Article 3(4) U-space airspace

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potential conflict is traveling. Therefore, a specific proximity parameter is defined for crewed traffic and one for uncrewed traffic:

- Proximity C – for crewed aircraft
- Proximity U – for uncrewed aircraft

The proximity value will ensure potentially conflicting traffic is communicated/displayed sufficiently in advance mitigating the delay between the moment the potential conflict is detectable and the moment the potential conflict is resolved. To come to this end stage, several steps need to be addressed and they all require a certain amount of time to be completed. As a good reference, the timings and delays established in the PDRA-05 set out the reference time to be considered.

The table below shows the breakdown of actions making up the total amount of reaction time to be taken into account. It includes the values used by JARUS for the development of the Predefined Risk Assessment 05 (PDRA 05 – BVLOS, over sparsely populated area, bellow 120m, in airspace where at last 50% of manned traffic can be detected). The same values are used within the BURDI project, updated in accordance with the maximum flight height resulting in a reduced delay. This will impact the additional detection/surveillance volume required enabling UAS operators to anticipate and take relevant actions with regard to a conflicting manned traffic communicated via the traffic information service.

PDRA 05		**BURDI U-space ConOps**	
Action	**Time (s)**	**Action**	**Time (s)**
Means to detect cooperative aircrafts: update rate[1]	5	Means to detect cooperative aircrafts: update rate[1]	5
Means to detect cooperative aircrafts: latency[1]	10	Means to detect cooperative aircrafts: latency[1]	10
Remote pilot response[1]	5	Remote pilot response[1]	5
UAS C2 link latency (RLOS, UA at 500 ft AGL)[2]	5	UAS C2 link latency (RLOS, UA at 500 ft AGL)[2]	5
Time to descend to 60 ft from 500 ft AGL at 500 fpm[3]	53	Time to descend to 60 ft from 400 ft AGL at 500 fpm[3,4]	41
total	78	total	66

[1] Values considered adequate by the subject matter experts consulted by JARUS for low TMPR.
[2] See value for the 'command' function in SORA Annex D, for BURDI this value is not recalculated taking into account the maximum altitude of 400ft as the impact should be rather marginal.
[3] For example at 15 m above trees of 3 m (typically between 2 and 4 m): 18 m ~ 60 ft
[4] Operations within the BURDI project are limited to 400ft AGL resulting in a new calculated time for descending the UAS

Table 4: Breakdown and total response time considered for means to detect and mitigate potential conflict with manned traffic, REF[2].

In order to come to an exact dimension, it is required to take into account the time delay as specified in the table above and the speed of the traffic operating below 500ft AGL.

Proximity C: The type of crewed traffic expected to operate within this portion of airspace are helicopters and slow-moving general aviation actors. The speed associated to these types of actors is 100kts. In order to take into account the worst-case scenario we need to calculate the closing speed of the uncrewed aircraft and the crewed aircraft in a head-on situation. Anticipating a closing speed of 160kts combined with a reaction time of 66 seconds leads to a proximity C value of 2.933NM. This leads to a useful parameter of 3NM giving the UAS pilot sufficient time to take the necessary evasive actions for resolving a potential conflict.

The same calculation is required to be able to define the vertical limit of the proximity C value. Therefore, the time required by manned aviation to descend into the U-space airspace is to be taken into account, considering the worst scenario depending on the expected manned activities, aircraft or helicopter, as the basis for calculation. The time required to descend into the U-space airspace with potential impact on UAS operations shall match the time calculated in table 4: *Breakdown and total response time considered for means to detect and mitigate potential conflict with manned traffic, REF[2].*

Proximity U: we will consider a worst-case scenario where 2 uncrewed aircraft are flying in opposite direction leading to a closing speed of 120kts. Combined with the reaction time of 66 seconds, this leads to a lateral distance of 2.2 NM.
As a result the proximity U value is 2.2NM.

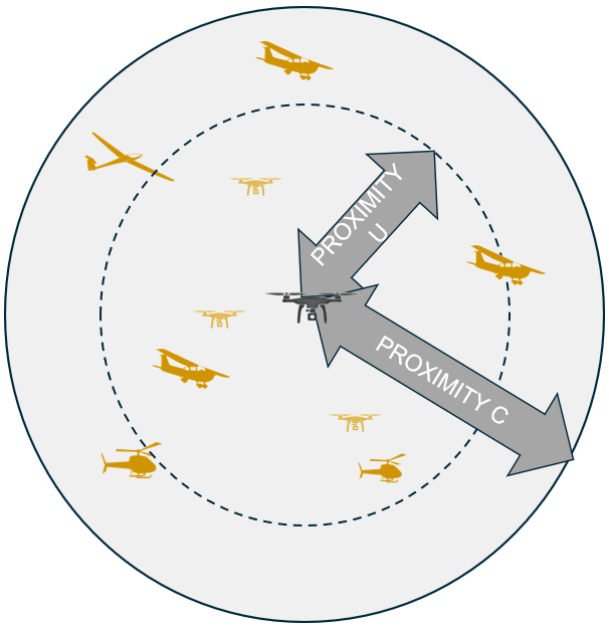

Figure 7: Risk proximity volume

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During the airspace risk assessment, the proximity values shall be defined taking into account the following element:

- Maximum allowed height of the UAS operations, expressed in feet AGL.
- Vertical travel distance from U-space airspace limits to be maintained by manned aviation allowing sufficient reaction time for UAS operator, expressed in feet.
- Lateral travel distance from U-space airspace limits to be maintained by manned aviation allowing sufficient reaction time for UAS operator, expressed in nautical miles (NM)
- The maximum terrain elevation within the U-space airspace, expressed in feet AMSL.

As uncrewed traffic operating within U-space are all subject to an UAS flight authorization it is not required to define a vertical parameter for the proximity U value. It is to be taken as such that all uncrewed traffic intending to operate within U-space shall be known to the USSPs active within that U-space and as such the UAS operators shall be informed.**Geographic proximity:**

USSPs have to share the real-time positions of all the UAS under its management toward other USSPs and authorized users. The USSP needs to ensure it is still capable of detecting/receiving the position of any drone under its management even when the UAS is deviating from its intended flight plan. The volume describing this additional around the UAS flight plan volume is called the geographic proximity. This detection area within which the USSP still needs to be able to detect the UA should be default be bigger than the flight plan including deviation threshold.

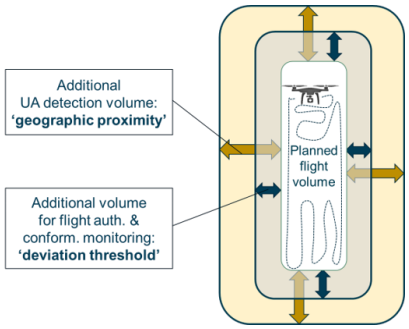

Figure 8: Geographic proximity volume

Minimal coverage: In order for the USSP to be able to adhere to the proximity parameters for displaying crewed traffic as part of its traffic information service, the USSPs need to be able to detect e-conspicuous crewed traffic already from a certain distance from the UAS flight plan it supports.

For UAS operators operating within U-space airspace established within uncontrolled airspace[10] ,to be able to take the appropriate actions to avoid potential conflict with manned aircraft, two conditions need to be addressed:

[10] If U-space airspace is established within controlled airspace, there is no need for the USSP to detect crewed aviation itself as to tackle this as crewed aviation is provided with Air Traffic Control services by an ATS unit who will not provide authorisation to enter the active part of the U-space airspace. There the principle of segregation of airspace is applied.

- The surveillance infrastructure used by the USSP must be able to detect sufficiently in advance the manned traffic enabling provision of adequate traffic information towards the UAS operators.
- Manned traffic intending to operate within the U-space airspace must make themselves e-conspicuous sufficiently in advance prior entering.

As no traffic can be visualised as part of the traffic information service without it first being properly detected, the minimal coverage shall as a minimum cover the proximity values defined.

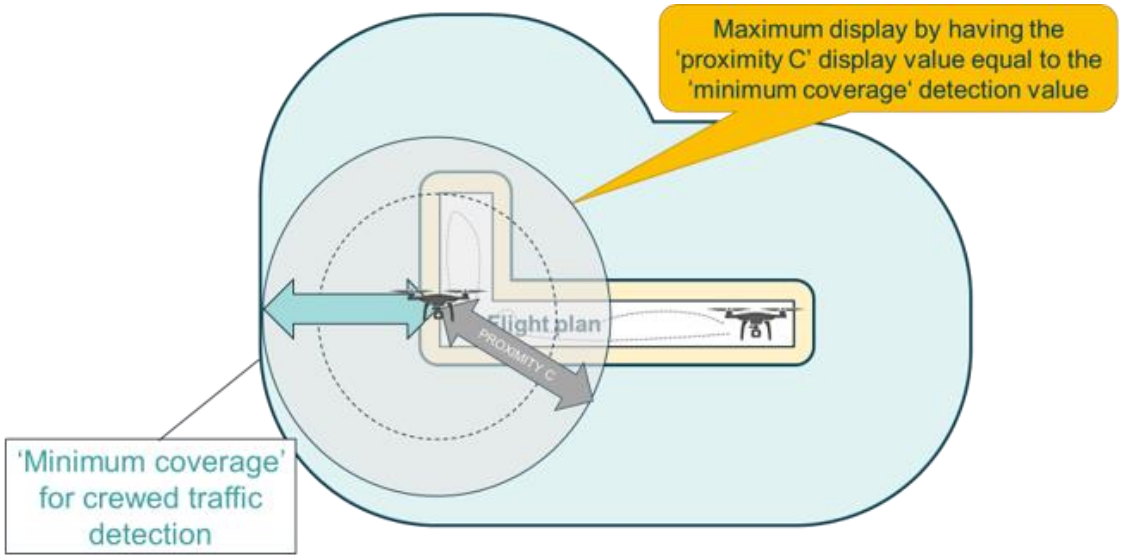

Figure 9: The value for minimum coverage for the detection of crewed traffic should at least be equal to the value of the proximity for the display of crewed traffic

Inner protection buffer: As suggested in the AMC & GM of the EU Regulation 2021/664, the inner protection buffer shall be established. In order to minimise the impact attributed to this volume of airspace, the aim is set to only establish it where it is really needed, taking as less space as possible and applicable only to those type of operations needing the benefits it brings. In a later stage it is the intention to challenge this approach in order to find out if other economically sustainable and safe solution are possible.
These initial parameters define the inner protection within the framework of BURDI to be found under the following conditions:

- It is only established in U-space in controlled airspace environment. This only on the inner side of the border between the U-space airspace volume and the uncontrolled airspace on the other side.

- The inner protection buffer is only to be consider for operations conducted under BVLOS conditions. Indeed, VLOS flights are able to visually detect sufficiently in advance other aircraft and take adequate actions to avoid any risk of collision.

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- The size of the buffer is to be kept as small as safety allows. For defining the size of the buffer we consider the already existing parameters used today. A VFR traffic is to remain 500ft above the highest obstacle within a radius of 150m from the aircraft. A UAS is considered to be flying around an obstacle, and thus part of the obstacle protection volume, when flying within a radius of 50m and 45ft above this obstacle. This means the horizontal distance, between a manned aircraft and a UAS, of 100m is considered as sufficient.

The inner protection buffer is put into place in order for UAS and manned traffic not to fly on the border of U-space airspace and uncontrolled airspace at the same moment without having mitigations in place for the UAS operator to adhere to the obligations UAS.SPEC.060 Responsibilities of the remote pilot specified in IR (EU) 2019/947.

Reading Acceptable Means of Compliance and Guidance Material to Regulation (EU) 2021/664 on a regulatory framework for the U-space it becomes clear that further specifying the intention of the deviation threshold the protection buffer is highly needed. Up until now these two elements are seemingly aiming at mitigating the same risk. Therefore, within the BURDI framework we define 3 elements to mitigate the risk of conflicts between the different airspace users:

Deviation threshold aiming in mitigating the uncertainty linked to the navigation error of the UAS and U-space services. This uncertainty is to be taken into account by the USSP when performing conflict mitigation activities via the UAS flight authorisation service. This volume doesn't need to be considered by the operator. He/she shall file a 4D volume which corresponds to the 'Operational volume' as defined in the SORA process (i.e., the flight geography plus the contingency volume).

minimal coverage is established within uncontrolled airspace, this to enable USSPs to detect other traffic allowing the UAS operator sufficient time to react on potential conflict situations with crewed aviation. The minimal volume will have to be communicated toward the manned aviation actors. This has to be coordinated with the competent authority and could be done via the AIP publication, a solution could be a TMZ

The inner protection buffer and its initial parameters are defined within the framework of BURDI. These are to be defined under the following conditions:

1. It is only established in U-space in controlled airspace environment. This is only on the inner side of the border between the U-space airspace volume and the uncontrolled airspace on the other side.

2. The inner protection buffer is only to be considered for operations conducted under BVLOS conditions.

3. The size of the buffer is to be kept as small as safety allows. For defining the size of the buffer we consider the already existing parameters used today.

4. A VFR traffic is to remain 500ft above the highest obstacle within a radius of 150m from the aircraft. A UAS is considered to be flying around an obstacle, and thus part of the obstacle protection volume, when flying within a radius of 50m and 45ft above this obstacle. This means the horizontal distance, between a manned aircraft and a UAS, of 100m is considered as sufficient.

BURDI specific statements and decisions 2: deviation threshold, surveillance/detection volume and inner protection buffer

Summary :

The table below provides an overview on all described volumes and the stakeholder responsible for implementing/adhering this volume.

Volume name	Purpose	Responsible stakeholder
UAS Flight Authorisation volume	The volume describing the request for UAS flight authorization introduced at the USSP platform by the UAS operator.	UAS operator
Deviation threshold	Compensate for imprecision in navigational performance and U-space service performance. This volume is added to the UAS flight authorization request.	USSP
Proximity	Volume defining the area for visualizing manned and unmanned traffic towards UAS operators (in reference to the real-time position of the UAS for which the operator is being provided with traffic information).	USSP
Geographical proximity	The minimum volume in which the USSP needs to be able to track the position of an airborne UAS operated by its own customers (in reference to the supported UAS flight plan).	USSP
Minimal coverage	The minimum volume in which the USSP needs to be able to detect crewed aviation (in reference to the supported UAS flight plan). Only applicable in uncontrolled airspace)	USSP
Inner protection buffer		

Table 5: volume descriptions

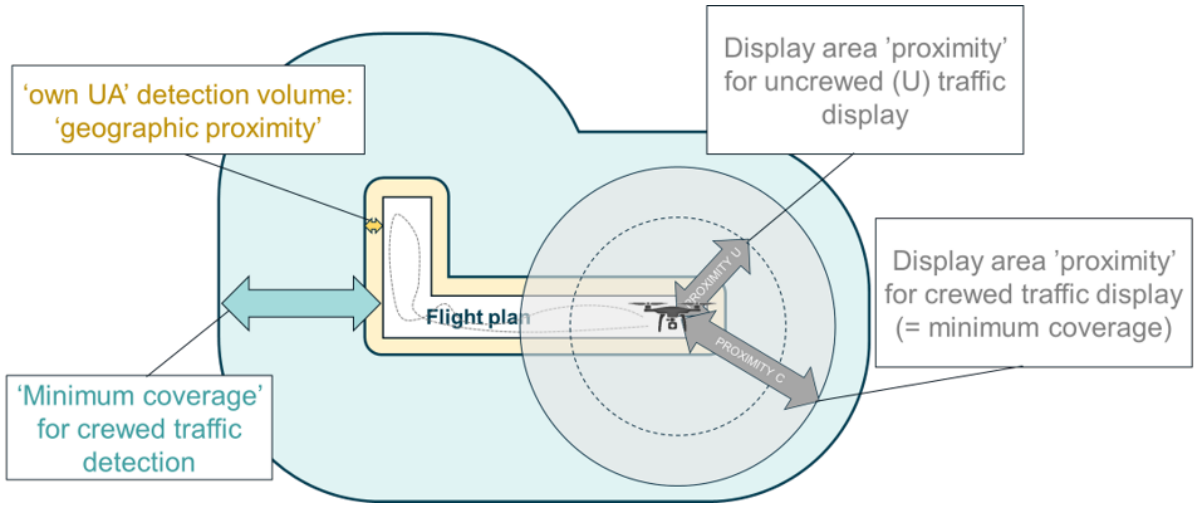

Figure 11: volumes summary

8.2 Operational approach on U-space services provision

Disregard to the implemented environment, U-space services are defined for operational objectives that shall be understood by all U-space services users. Thus, this section intents to clarify the origins of the data used in U-space service concerned as well as its purpose.

Network identification

Network identification service (NIS) is a supporting service serving a dual purpose:

1. enabling USSPs to each acquire[11] the real-time position data of the airborne UAS of their own customers.

2. share these real-time position data among each other (to be used as input to their traffic information service), subsequently aggregate all these data make them available to authorised users.

Within the U-space data infrastructure this service shall originate from the UAS operator, be collected by the USSP handling the UAS, who, at his turn, shall coordinate with other USSPs active in the same U-space airspace.
Each USSP shall then aggregate the remote IDs into one single tracking overview. This default Network Identification Service dissemination data flow is depicted below.

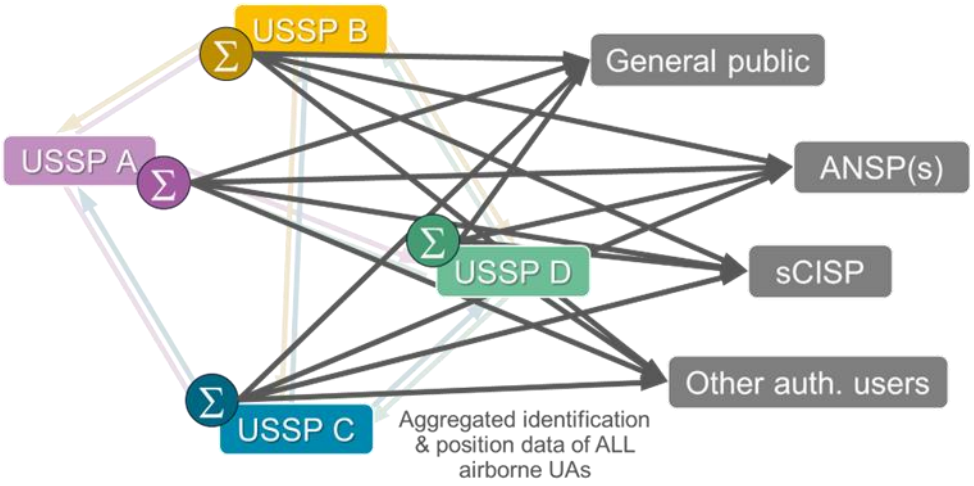

Figure 13: Default NIS-data dissemination data flow

[11] which cooperative detection/acquisition technology is being used by the USSP to acquire the real-time position data of a UAS operated by its customer is not defined in the U-space regulation and is hence to be agreed by the USSP and its customer. It is therefore not within scope of this overarching BURDI ConOps but rather the BURDI USSP ConOps.

This default data flow however poses several challenges related to:

- data integrity: as every USSP is obliged to do the aggregation to then make those data available do all the authorised users, it would be up to these authorised users to solve the problem of eventual inconsistency between the data provided by each of the USSPs (which should always be identical, whichever the source).

- The role of the sCISP: it remains unclear why in the U-space regulation the aggregate NIS data (which are not part of the CIS data set as defined in art. 5 of the IR2021/664) also needs to be provided to the sCISP, especially taking in to account that all the authorised users already have direct access to these data from each of the USSPs.

That is why it makes more sense – in the scenario of the implementation of a CIS centralized approach with one single CISP – to opt for what EASA called 'the non-forbidden option', i.e. have the sCISP platform acting as a data broker platform involved not only in collecting the NIS data from all USSPs, but also in the aggregation and dissemination of the NIS data (collected by each of the USSPs from its respective customers).

Such alternative approach as implemented in the Belgian context of the BURDI project with the presence of a single CISP, is depicted below.

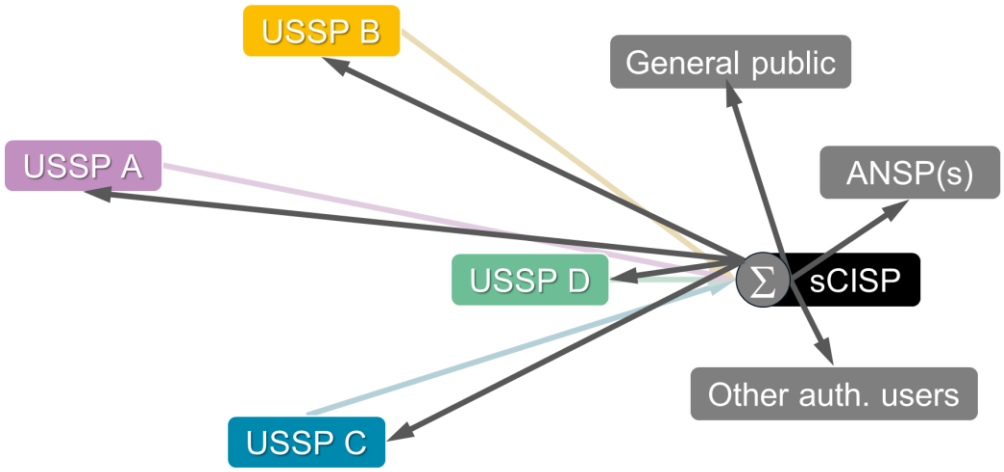

Figure 14: Alternative NIS-data dissemination data flow for the BURDI project

Geo-awareness service

Geo-awareness information is provided by the CISP towards the USSP to be used by both the USSP itself as well as by the UAS operator. The USSP will use it for the UAS flight authorization service as a source of data to inform UAS operators of relevant operational constraints and changes both prior and during the flight. The operator will use it as part of the pilot's responsibility to take due consideration to the geo-awareness data in a timely manner when operating the UAS. The environment in which the U-space is embedded, controlled or uncontrolled airspace will have an impact on the build-up of the geographical data set but will not impact the responsibilities of the actors.

Geographical data resulting from the dynamic reconfiguration of airspace is the result of the segregation of airspace methodology which is applied in controlled airspace. This added layer of

geographical data shall be treated by the UAS operator in the same way as if an 'ad hoc'[12] no drone zone is being introduced. The ATS unit is at the origin of these geographical data, as detailed in point 7.4. The CISP retrieves this data and distributes them to the USSP. The USSP shall take this change into account and shall alter the activated UAS flight authorizations accordingly. The exact functioning of this coordination mechanism is elaborated further in point 7.4.1 DAR in civil controlled airspace.

The table below shows the different subparts building up the complete geographical data set required for providing geo-awareness service. The rows indicate the environment in which the considered U-space airspace is located, the rows identify the different data sets need to build the complete geographical data overview.

Controlled airspace	Static geographical zone (AIP data)	NOTAM data	Geographical data resulting from Dynamic airspace reconfiguration
Uncontrolled airspace	Static geographical zone (AIP data)	NOTAM data	

Table 6: Geo-awareness data build-up

UAS flight authorisation service

This service consists of the USSP receiving from the UAS operator an UAS flight authorisation request whereby the USSP will only accept the UAS flight authorisation request if the flight is free of intersection in space and time with any other notified UAS flight authorisations within the same U-space airspace.
It is provided by USSP to UAS operators based on:

- Traffic information with regard to manned aircraft providing by ATS unit concerned via CISP, when U-space airspace is established within controlled airspace.
- Geo-awareness information distributed by CISP to USSP.
- Traffic information with regard to e-conspicuous manned aircraft collected by USSP when U-space airspace is established within uncontrolled airspace.
- Traffic information with regard to UAS flight collected by USSP via the Network identification service.

Information about other UAS flight authorisations delivered by other USSPs operating within the same U-space airspace as the USSP concerned.
The latter obviously requires the exchange of already granted flight authorisation between all USSPs.
Taking to account the Belgian context of the BURDI project with the presence of a single CISP, such exchange of flight plan information will not occur by means of individual inter-USSP connections but rather via the sCISP platform. It is however important to note that the sCISP will merely act as a data-broker between USSPs (making available to USSPs its platform acting as inter-USSP platform) and will as such in no way be part of the granting of actual UAS flight authorisations.

[12] 'Ad hoc' zones is part of the Belgian Droneguide nomenclature which corresponds to a category of temporary UAS geographical zones

Traffic information service

This service is provided by USSP to UAS operators based on:

- Traffic information regarding manned aircraft provided by the ANSP via sCISP, when U-space airspace is established within controlled airspace.
- Traffic information with regard to e-conspicuous manned aircraft collected by USSP when U-space airspace is established within uncontrolled airspace.
- Traffic information with regard to UAS flight collected by USSP via the Network identification service.

Traffic information is "triggered" by the USSP depending on criteria defined during the planning/creation phase of the U-space airspace concerned (applicable operational conditions, separation or spacing from other UAS or manned aircraft, and airspace constraints).

Weather information service

This service has a dual purpose. First it is a service provided by the USSP towards the UAS operator to plan and execute his intended operations considering the meteorological conditions and the potential risk it can pose.

Secondly, when during the airspace risk assessment meteorological maxima and minima are defined the USSPs operating in the same U-space shall use the meteorological data made available via the CISP in order for all USSPs to perform the meteorological evaluation, regarding these weather limitations, for approving and activating UAS flight authorizations using the same data. This secondary function of the weather information service shall make use of observations for the actual evaluation of the meteorologic limitations.

The sCISP shall function as a single point of truth when considering provision of relevant weather information to the different USSPs.

This concerns Weather information service for the sake of enforcing meteorological minima or maxima put in place by the member state as part of the operational conditions and airspace constraints

BURDI specific statements and decisions 3: CISP as single point of truth for weather information service

Making use of the forecast for evaluation enables the USSP to warn the UAS operator about the possibility on exceeding the metrological limitation resulting in a withdrawal of the UAS flight authorization.

Meteorological element	Unit
wind direction	measured clockwise through the true north
Wind speed	metres per second, including gusts
Cloud base (broken or overcast layer)	hundreds of feet above ground level
visibility	metres and kilometres
temperature and dew point	°C
indicators of convective activity and precipitation	
the location and time of the observation, or the valid times and locations of the forecast	
appropriate QNH with geographical location of its applicability	

Table 7: Weather information data elements

Conformance monitoring service

Conformance monitoring service can be subdivided into 2 subdivisions. The first part focussing on the USSP-UAS operator coordination. The second subdivision is focussing on an ecosystem wide coordination.

1. USSP- UAS operator conformance coordination: The USSP shall advice the UAS operator on the infringement of any of the UAS capabilities and/or performance requirement and on any infringement on the applicable operational conditions and airspace restraints laid down by the Member State. These criteria are a product of the airspace risk assessment and are part of the U-space airspace description.

2. Ecosystem wide, Conformance monitoring is linked to the UAS flight authorization service, the network remote identification service, and the deviation threshold determined during the U-space airspace risk assessment. The aim is to advise other UAS in the vicinity, USSPs operating in the same U-space airspace and relevant ATSP, about the deviation from intended operation by an UAS.

   Whenever a UAS is deviating more, in time and/or position, from the maximum allowed value set by the deviation threshold defined during Airspace Risk Assessment, the USSP shall consider this operation as no longer conform with its UAS flight authorization. This shall trigger a communication process from the USSP to the UAS operator of the related UAS. The non-conformance status shall be included in the network remote id communication toward the Single CISP. This way other USSP operating within the same U-space airspace shall be made aware that a UAS is outside the operational volume initially defined, including the deviation threshold. It will trigger a non-conformance alert about the specific situation and position of the non-conformant UAS toward other USSPs, the UAS operator, single CISP, relevant authorities and when U-space is located inside controlled airspace, toward local ATSP if created a threat to manned aircraft (e.g. if exiting the U-space airspace).

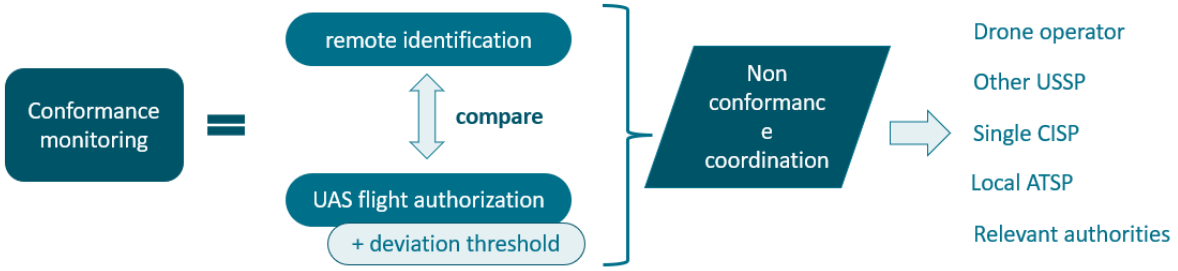

Figure 15: Conformance monitoring

The diagram above indicates that conformance monitoring shall compare remote identification to the current UAS flight authorization. Whenever a direct remote ID sensor picks up a signal send out by a UAS not having any UAS flight authorisation to operate within the U-space airspace, this will trigger a non-conformance alert. This makes the conformance monitoring service an initial rogue UAS detection mechanism towards other U-space stakeholders, including the UAS operators.

Within the regulation the relevant authorities and other users is an unconclusive list of potential entities who would benefit from the data generated in the U-space ecosystem.

It is to be noted that the U-space ecosystem has a clear safety related objective, nevertheless this is a partially commercial activity. Therefore, the list of relevant authorities should be kept to the entities involved in contributing to safety and enforcement of regulation. Within BURDI the relevant authorities are:

- ***skeyes***
- ***Belgian Defence***
- ***Ministry of internal affairs for law enforcement purposes; local, federal, airport, harbour and railway police***
- ***Ministry of Justice***
- ***BCAA, as the competent authority***

These actors shall be able to receive the data resulting from the network identification service

BURDI specific statements and decisions 4: Relevant authorities

8.3 U-space in uncontrolled airspace

As already specified before, the way segregation of activities is achieved in U-space airspace established within uncontrolled airspace differs from the methodology applied when in controlled airspace. The general approach for U-space in uncontrolled airspace is based on pre-tactical deconfliction via UAS flight authorizations delivery and on tactical one via traffic information provision.

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Table below focusses on how the UAS flight authorization is used in order to achieve the segregation of activities. For coordination purposes the USSPs and UAS operators will agree on using the terms 'Rejected', 'Accepted', 'Activated', 'Withdrawn', 'Ended', for indicating the status of the UAS flight authorization.

1. **Accepted**: The UAS flight authorization request is submitted, evaluated and accepted by the USSP. This means it is conflict free regarding other already accepted and activated UAS flight authorizations and not intersecting with 'NO-DRONE' zones. Intersections with other UAS geographical zones shall trigger an alert to the UAS operator advising him on the presence of that zone.

2. **Activated**: on request of the operator the USSP verifies pre-tactical deconfliction with other already accepted or activated UAS flight authorizations and e-conspicuous manned traffic[13].

3. **Withdrawn**: The UAS flight authorization shall be withdrawn whenever the USSP estimates a conflict free UAS flight authorization can no longer be guaranteed.

4. **Ended**: The UAS flight authorization shall be ended by the UAS operator whenever it has no intend in continuing the active UAS flight authorization. In this situation the UAS shall be on the ground, without any intent to execute another take-off if included in the UAS flight operation (e.g. activity within an area of operation for a defined duration) and the operator indicates termination of operation. After the closure of the UAS flight authorisation, if the UAS operator wants to conduct another operation within U-space, a new UAS flight authorization shall be required in order to cover this new operation.

[13] REF [3]: AMC1 Article 10(5)

UAS flight authorization update responsibility	Pre-flight	Upon activation	Activated UAS flight authorization
USSP	Taking into account other, overlapping accepted and activated (4D) UAS flight authorizations, the request shall only be accepted when clear of any intersection with other UAS flight authorizations even granted by other USSPs in the same U-space airspace. The planned UAS flight is compatible with the current weather maxima or minima, when relevant.	The USSP confirms UAS flight authorization activation without delay when the following conditions are satisfied: (a) acceptance of the terms and conditions associated to the UAS flight authorisation. (b) activation within the allowed time frame, (c) the UAS flight remains compatible with the U-space airspace restrictions and temporary airspace limitations. (d) The planned UAS flight is compatible with the current weather maxima or minima, when relevant. (e) The UAS flight authorisation does not intersect with another UAS flight authorisation that has a higher priority. (f) In the proximity of the UAS flight, there are no: *(1) manned aircraft in state of emergency;* *(2) non-conforming cooperative drones, or non-cooperative drones (when their detection is possible);* *(3) e-conspicuous manned aircraft intersecting 4D*	UAS Flight authorizations shall be updated in case of any intersection with another UAS flight authorization of a higher priority, even when granted by other USSPs in the same U-space airspace

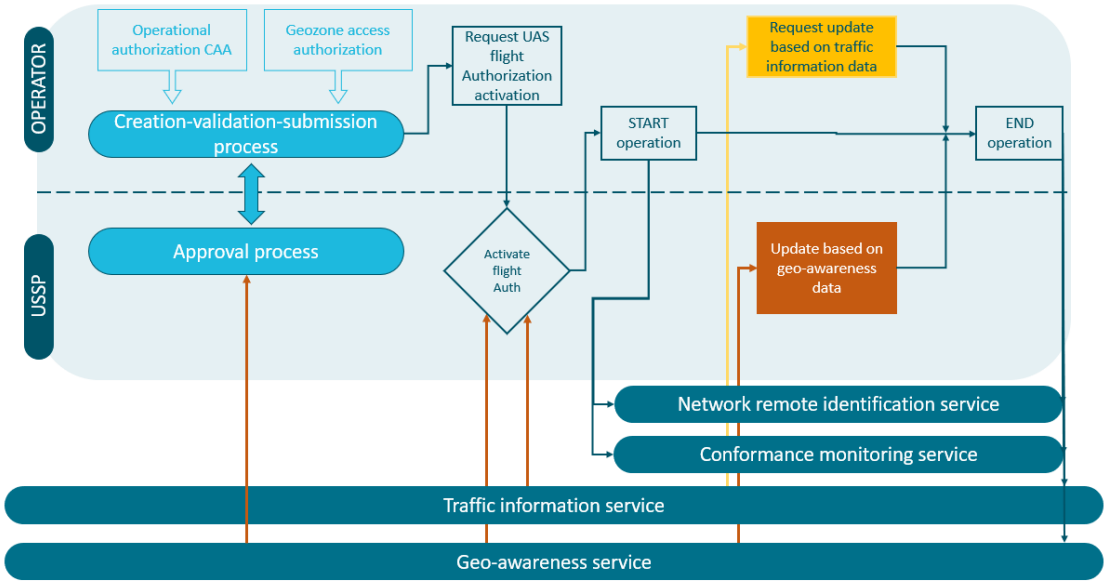
		volume of the UAS flight authorization USSP shall provide reason for not activating the UAS flight authorization.	
UAS operator	Nihil	The action of activating the UAS flight authorization is the moment at which the USSP is handing over the responsibility of deconfliction to the UAS operator.	First step will be to deconflict from the current situation. Second step, if required, is to alter the UAS flight authorization

Table 8: Roles and responsibility UAS flight authorization update in uncontrolled airspace

When considering the table above it is clear the traffic information service is used by the UAS operator in support of fulfilling his obligation in ensuring the safety of their flights and for ensuring separation or spacing from other manned and uncrewed traffic.

Upon activation of the UAS flight authorization the USSP hands over the responsibility for deconflicting manned traffic and the responsibility to request for an updated UAS flight authorization triggered by conflicting manned traffic to the UAS operator.

The procedural steps of the flight authorization service are visualized in the image here below. This is a visualisation of a positive flow.



* The orange arrows indicate the consumption of own data and services by the USSP in order to be able to perform certain action within the UAS flight authorization process.

*The yellow arrow indicates the interaction from the UAS operator making use of the traffic information service leading to the request to update the flight authorization.

Figure 16: UAS flight authorization service approval process in uncontrolled airspace

The image above is demonstrating a positive process where the operators request is approved, activated and closed as requested.

Only during the activation request phase of the process, in case of conflict with a manned and/or unmanned traffic, the UAS flight authorization request shall not be activated by the USSP.

As BURDI is the first implementation of the U-space ecosystem in Belgium the aim is to have a pragmatic approach. Within this first publication of the ConOps we will not focus on real time updating of UAS flight authorization taking into account tactical deconfliction manoeuvres of UAS operators due to several factors. Nevertheless, this functionality shall be picked up in the DEMOP in order to find solutions within the framework of the project. This type of changes shall lead to an updated version of BURDI U-space ConOps:

1. The Operational authorization provided by the competent authority might not leave room for an important deviation from the intended trajectory.

2. Withdrawing an active UAS flight authorization is not possible as this would automatically trigger a non-conformance. The network remote ID would not be covered by a UAS flight authorization.

Time and effort is poured into the clear and distinct definition of the different types of alerts to be generated by the USSP towards the UAS operators and/or other U-space stakeholders

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(e.g. other USSP and/or ATSP). This will improve the situational awareness of the operator and avoid unnecessary complexification in the early stage of implementation. Within this document only the 'what' is specified, how this can be done is up to the USSP to define.

Alerts to be generated by the USSP are elaborated in the table below

alert	*description*	*addressee*
Traffic data provision	*the general provision of other manned and uncrewed activity positions reports shall be provided by the USSP considering the surveillance/detection volume defined REF[3] GM9 Article 3(4) U-space airspace. This is not the same volume as the surveillance/detection volume specified in BURDI specific statements and decisions 2 enforcing an obligation of e-conspicuity for manned aviation.*	*UAS operator*
UAS non-conformance	*these types of alerts differ with regard to the intended addressee.*	
	1. The USSP shall inform the concerned UAS operator about the non -conformance status of his UAS. The exact parameters used by the USSP are specified in the terms and conditions accepted by the UAS operator.	*Concerned UAS operator*
	2.: The USSP shall inform other stakeholders of the U-space ecosystem whenever a UAS operation is out of conformance. It is possible specific stakeholders determine a specific set of parameters which will determine additional layers in non-conformance alerting. *For example: Local ATS requesting only to be advised on non-conformance in case the UAS is infringing with the current DAR situation.*	*- ATSP* *- Other USSP* *- Other UAS operators*
Potential conflict detection	*The USSP shall ensure parameters defined during the Airspace Risk Assessment (spacing, geographical proximity,…) are set in order to be able to advise the UAS operator on potential conflicts. These parameters shall be specified in the terms and conditions accepted by the UAS operator. These criteria shall take into account reaction time required by the UAS operator.*	*UAS operator*

BURDI specific statements and decisions 5: focus on alert definitions

8.4 U-space in controlled airspace

Due to the higher amount of manned traffic and the critical phases of manned flight conducted within CTRs, U-space airspace established in controlled airspace shall apply the segregation of airspace method. In order to be able to apply this principle the ATSP and USSP shall make use of the dynamic airspace reconfiguration principle. The USSP and the local ATSP shall have a written agreement covering the operational procedures for normal, contingency and emergency operating conditions.

The new concept of dynamic airspace reconfiguration is an activity conducted by the local ATSP making temporarily unavailable for uncrewed activity portions of the designated U-space airspace concerned. The exact functioning and how dynamic airspace reconfiguration is communicated is further explained in section 8.4.1 DAR/U-space airspace in civil controlled airspace.

The data resulting from this activity shall be made available as geo-awareness information, through the CIS platform ensuring equal information distribution to all active USSPs within the U-space airspace concerned. USSPs shall be able to use this data in order to provide Geo-awareness service toward UAS operators and if needed update UAS flight authorization for the approved and active UAS flight authorization for the operation to remain within the confines of the available U-space airspace.

The table below visualizes the application and the use of the different services provided within U-space in controlled airspace.

U-space in controlled airspace		Conflicting uncrewed traffic		Conflicting manned traffic	
		Responsible	Means	Responsible	Means
Uncrewed traffic	Pre-tactical	USSP	UAS flight authorization	USSP	Update UAS flight authorization making use of dynamic airspace reconfiguration data received from local ATSP via CISP
	Tactical	UAS operator	Traffic Information service	UAS operator	Consider Traffic information service to take actions with regards to other unmanned aircraft or manned traffic outside part of the U-space airspace concerned, if considered as conflicting (see figure 8)

Table 9: Roles and responsibility UAS flight authorization update in controlled airspace

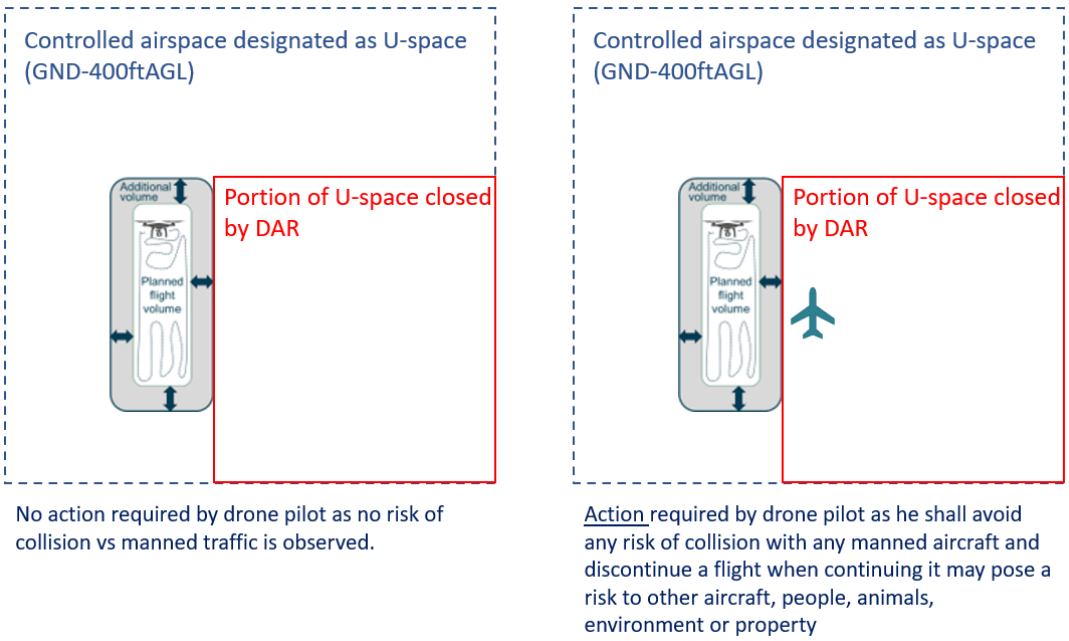

Figure 17: UAS pilot responsibility IR (EU) 2019/947 within controlled airspace

In order to ensure predictability in time and volume of the available U-space airspace the intension is to have as few dynamic U-space airspace reconfigurations as possible. Therefore, the design of the designated U-space airspace portions will have to be conducted with great care.

The subdivision of the U-space airspace shall be organised in a way that the available U-space airspace shall be linked to the runway in use. This way local ATSP can more easily and with a higher level of standardisation make available U-space airspace portions. The local ATSP will first notify the USSP on the upcoming reconfiguration and on effective time the U-space airspace shall be reconfigured. This notification shall be conducted in due time and shall contain information on the portions that are being made unavailable for UAS operations and, if applicable, on the portions that will be made available. This information shall allow the USSP to perform the necessary steps in order to vacate the subpart(s) of U-space that become inaccessible for UAS and already consider UAS flight authorizations in the subparts that are to become available again.

1. ***There is only a slight difference in how the UAS flight authorization will work in controlled airspace when comparing to uncontrolled airspace. The difference in methodology of separating manned and uncrewed traffic only results in additional geo-awareness data to be considered by the USSP.***

The biggest impact can be found in the coordination mechanism and the data exchanged for applying dynamic reconfiguration of airspace.

- The USSP needs to be able to acknowledge the reception of geo-awareness data resulting from dynamic reconfiguration of airspace (DAR).

- As the data resulting from DAR is to be considered part of geo-awareness data, this data shall be transferred making use of the CIS platform. The CISP shall make use of its coordination and data quality control infrastructure to ensure a reliable reception of the geo-awareness data.

- USSP shall be able to clearly coordinate relevant non-conformance status of UAS.

2. Within civil controlled airspace the CTRs are UAS geographical zones. In order to access these, an operator is required to file a flight permission request making use of the UAS Service Application. In those CTRs where U-space airspace is established, this geozone co-exist with the U-space airspace, and relevant previous geozones access conditions are integrated within the access conditions of the U-space airspace. This enables skeyes, as a geozone manager, to no longer request a dedicated flight permission request separate from the UAS flight authorization required to operate in that portion of U-space airspace.

BURDI specific statements and decisions 6: Dynamic reconfiguration

8.4.1 DAR/U-space airspace in civil controlled airspace

Dynamic reconfiguration of U-space airspace is an action performed by local ATSP to accommodate a short-term change of demand in capacity for manned aviation, or in case of emergencies.

It will be the responsibility of the ATCO to perform the DAR activity taking into account the prenote time between the announcement of the change and the activation of the change. As from the moment the U-space is available for uncrewed aviation it will be up to the ATCO to inform crewed traffic under its management to not enter the U-space airspace volume.

By default, this implies that only few changes are to be expected. The U-space airspace shall be subdivided into portions in order not to unnecessarily impact U-space capacity.

It is to be understood that when temporarily limiting the available U-space airspace, this unavailable portion of U-space airspace is not disappearing. This only means the USSP is not allowed to approve UAS flight authorisations and instruct ongoing operations to vacate that portion of U-space airspace as from the moment the limitation comes into force. Rejecting or revising a UAS flight authorisation is the responsibility of the USSP providing service to UAS operators.

To allow for a widely supported implementation of this concept, the U-space airspace(s) and the portions shall be based on the current known skeyes' concept of the VLL UAS geographical zones established since January 2021 in civil CTRs. Within this concept the CTR is covered by 3 types of geozones:

- VLL0: It has the form of one (or more if multiple runways) bar with as lateral limits, on the one hand, the length of the respective landing and take-off runway on both sides, plus 3 kilometres from the threshold and, on the other hand, a width of 2 kilometres, the centre line of which is formed by the central axis of the longitudinal and take-off runway. The height of the VLL0 extends from ground level to the maximum height of the CTR concerned as published in the AIP Belgium-Luxembourg. This VLL0 geozone is permanently active.

- VLL1: The geographical UAS zone VLL1 includes, to the extent that it falls outside the lateral and vertical limits of the geozone VLL0:

1° a cylinder having as its radius four thousand five hundred metres or more if deemed necessary for aviation safety reasons, from the ARP or from an other point approved by the BCAA Director General, and extending from ground level to an altitude of four hundred feet AAE;

2° one or more beams having as lateral limits, on the one hand, the length of the landing and take-off runways on both sides plus eight thousand five hundred metres from the thresholds, or any other distance approved by the BCAA Director General, and on the other hand, a width of three kilometres whose centre line is formed by the central axis of the landing and take-off runways, and extending from ground level to a height of four hundred feet AAE

3° a zone with the lateral limits of the CTR concerned, extending from four hundred feet AAE to the maximum height of the CTR, as published in the AIP Belgium-Luxembourg.

The VLL1 geozone is active at the times described for the CTR concerned in the AIP Belgium-Luxembourg or according to NOTAM.

- VLL2: The geozone VLL2, as it falls outside the lateral and vertical limits of the geozones VLL0 and VLL1, includes the lateral limits of the CTR concerned, as published in the AIP Belgium-Luxembourg, and extending vertically from ground level to four hundred feet AAE.
The VLL2 geozone is active at the times described for the CTR concerned in the AIP Belgium-Luxembourg or according to NOTAM.

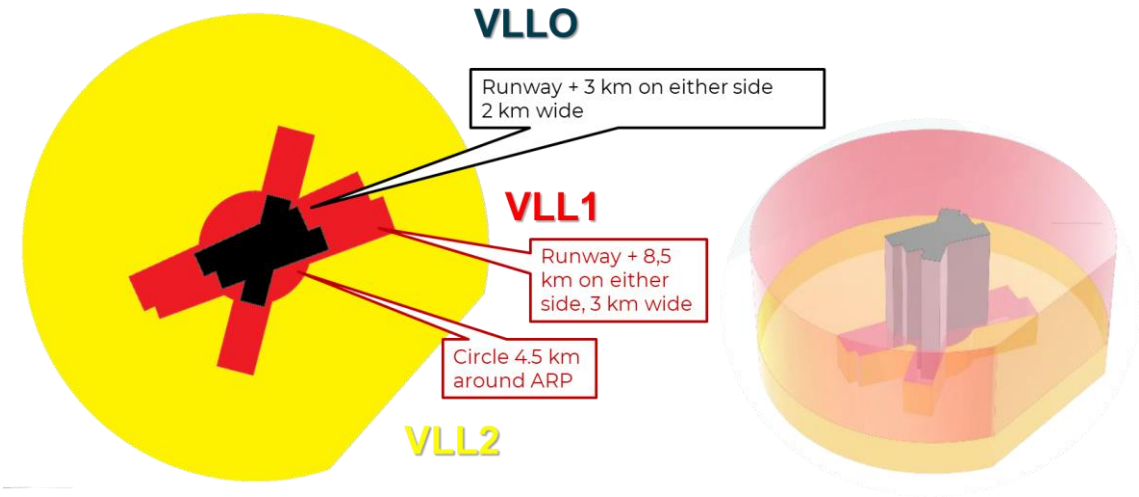

Figure 18: generic layout of VLL geozones in civil CTRs

When U-space airspaces will be designated, based on these VLLs, further subdivision of these U-space airspaces shall be conducted considering local traffic patterns and particular low-level activities within the CTR boundaries concerned. As an example, VLL0 and VLL1 could be considered as one and unique

U-space airspace, to be investigated. Further subdivisions of U-space airspaces into relevant portions shall be part of the required agreement between the ATSP managing the controlled airspace and the different USSPs providing their services within the considered U-space airspaces. As these portions could be dynamically reconfigured, that manned aircraft are provided with air traffic control service by ATSP and UAS are provided with U-space services by USSPs, ensuring safe and secure segregation of airspace between manned and unmanned aircraft operations, publication of these portions to the general public will not have any added value. Nevertheless, the USSP is free to communicate these blocks to its customers via their own user interface.

In accordance with IR (EU) 2021/664, article 5, referring to IR (EU) 2019/947, article 15, information on U-space airspaces will be communicated to the general public in a digital format as well as within the AIP. The subdivided portions of the U-space airspace will only be considered when operating DAR in U-space airspace concerned and will be exchanged between ATS unit and the USSPs, as regulatory required. Manned aircraft are provided with air traffic control service by ATSP and UAS are provided with U-space services by USSPs, ensuring a high level of safety via segregation of airspace between UAS and manned aircraft operations. Therefore, there is no added value publishing these subdivided portions within geozones information tool (Droneguide) nor in the AIP.

Subdivided portions of U-space airspaces will not be communicated to the general public in order to simplify the airspace structure presented to them, keeping in mind that the existence of U-space airspace is the most important information to provide towards airspace users, and that this doesn't hamper the safety level thanks to the provision of air traffic control and U-space services to respective airspace users.

BURDI specific statements and decisions 7: depicting subdivision of U-space in UAS geographical zone information tool and AIP

An inevitable effect of dynamic airspace usage is the uncertainty, as already stated before effort shall be invested in a logical and useful design of the U-space airspace and its subparts. In some cases, a higher certainty is required for very dedicated and time critical operations. Corridors will be established to ensure a higher certainty for priority operation to be able to cross the runway extended centrelines on one or both sides of the runway itself. The USSP(s) shall be able to use this corridor whenever operations adhere to very specific characteristics. The kind of operations which are expected to be able to use these dedicated corridors are operations conducted within the medical sector, other than non-time critical logistical operations, and special operations of public interest as defined in the Implementing Rules (EU) n°923/2012, laying down common rules of the air, article 4.

Taking into account current VLL design and organisation, it is to be expected that in its standard configuration VLL0 will be closed to UAS operations. Without any additional coordination procedure in place this would mean U-space within the civil CTRs would result in less useable airspace volume for uncrewed operations. In order to counter this reduction in capacity an initial capacity management system will allow for the USSP to indicate active demands for operations in VLL0.

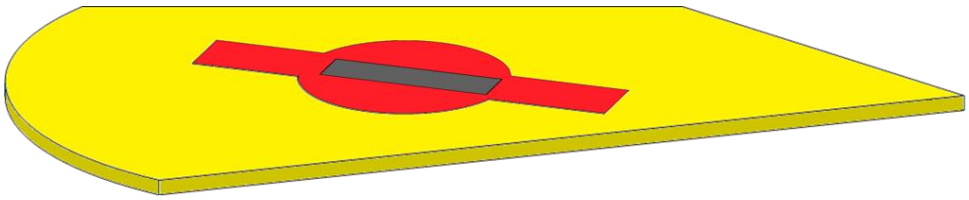

Figure 19: EBAW CTR - VLLs below 400ft AAE

The activity of performing a dynamic U-space reconfiguration shall follow the chronological steps depicted in table below. No specific values in regard to timing are set as those will depend on the airport environment.

Local ATSP	CISP	USSP	UAS operator
Manned traffic needing access to U-space airspace established in controlled airspace			
Send prenote for DAR applicable to a portion of U-space airspace			
	Geo-data resulting from DAR integrated in geo-awareness information		
		If required update UAS flight authorizations with regard to change in available U-space airspace volume for UAS	
			Manoeuvre UAS to make clear U-space airspace to be closed via DAR (type of action depends on remaining flying time compared to the DAR prenote time)
		Send notification of implementation towards ATSP	

		Send conformance monitoring alert to UAS operator and ATSP in case of UAS not adhering to DAR implementation	
After manned traffic made clear volume of airspace concerned, make available again U-space airspace portion to UAS			
	Revised Geo-data resulting from DAR integrated in geo-awareness data		
		Provide update on the geo-awareness information	
			Make use of the geo-awareness information to evaluate the upcoming available U-space airspace volume and if required file for an update of the UAS flight authorization.

Table 10: Dynamic airspace reconfiguration actions per stakeholder

8.4.2 DAR/U-space airspace in military controlled airspace

Within the framework of the BURDI project, no U-space airspace is foreseen to be established inside military controlled airspace. Therefore, no further elaboration on this matter is described.

8.5 Incident/accident reporting

In conformity with the EU regulation 2021/664, article 15, (g), certified CISP and USSP shall be able to report occurrences. However, it should be beneficial to extend this possibility to all stakeholders.

Thus, during execution of the BURDI project, as part of the overall management of the operations within U-space airspace, all ecosystem participants shall be able to report incidents and accidents in a predefined format allowing for the competent authority to collect these reports. A format shall be defined, knowing that CISP and USSP have to be in accordance with EU Regulation 2017/373.

These reports shall at the longer term serve for further improvements and will help to define adjustments to the procedures and regulations. Collecting these reports for building an historical database will allow assessments to be conducted with greater assurance and accuracy.

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9 Technical guidelines

9.1 Standards for U-space services and functions

In order to ensure a scalable and interoperable implementation of U-space through-out the complete duration of the project, and whenever possible beyond, here below, the standards used for carrying the different data types across the different partners throughout the U-space eco-system are specified.

The list below sums up the data required to enable the services and the specific data standards to be used.

The aim is to gradually implement and improve these standards. It is to be noted that during the execution of the project further improvements on existing and establishing new standards shall be required for the further scaling of the U-space ecosystem.

DATA TYPE	STANDARD	Origin	Destination	TIME INTERVAL
Static registration data	No standard specified	BCAA	USSP	Daily
Static and dynamic data on geographical zones	EUROCAE ED-269	AIM	USSP	Several times a day, every 30 minutes
Dynamic airspace reconfiguration geo-data	EUROCAE ED-269	ATSP	USSP	Upon ATC unit request, within 5 seconds
UAS Remote ID	ASTM F3411-22A Annex 4	USSP	Other USSP	Update frequency no more than 3 seconds for 95 % of the time, and in 1 second for 99 % of the time
		USSP	ANSP[14]	
		USSP	Authorised users[15]	
UAS Flight authorization	ASTM F3548-21	USSP	Other USSP	Without undue delay
Relevant operational manned traffic data	ASTERIX cat 062	ANSP	USSP[16]	Without undue delay

[14] Making use of the CISP infrastructure
[15] Making use of the CISP infrastructure
[16] Making use of the CISP infrastructure

Complementary manned traffic data				lower than 5 seconds for at least 99 % of the time.
Weather information (observation and forecast)	No standard specified	Authoritative source	USSP	Available 30s after publication

Table 11: U-space service data requirements

9.2 Standards for system wide interoperability

The U-space eco-system relies on a high level of digitalisation and automation. This can only be ensured if not only standards are being used for the different data types but, for the technical infrastructure ensuring the communication itself as well. These communication flows shall always be bi-directional. The communication flows to be established between the different partners within the eco-system are:

Sender/receiver	Sender/receiver	Standard
Single CIS provider	USSP	Not yet defined
USSP	UAS operator	Not yet defined
USSP 1	USSP 2(active in the same U-space)	ASTM F3548-21 'Standard Specification for UAS Service Supplier (USS) Interoperability'

Table 12: U-space coordination standards

It is the aim to at the end of the project be able to complete as much as possible this table and come with an update on this subject. It is to be expected that the project will continue updates or that new standards will be included, thus, the ConOps will be continuously updated accordingly.

10 References

[1] EASA. “NPA 2021-14 Draft AMC/GM to support the U-space regulatory framework”. EASA, 15 February 2022, www.easa.europa.eu/en/downloads/136009/en

[2] JARUS. “Pre-Defined Risk Assessment, PDRA-05 for Aerial Work operations”: *http://jarus-rpas.org/*, 21 June 2022, jarus-rpas.org/sites/jarus-rpas.org/files/jarus_pdra-05_edition_1.0_1.pdf

[3] Acceptable Means of Compliance and Guidance Material to Regulation (EU) 2021/664 on a regulatory framework for the U-space

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Annex 01 Airspace risk assessment procedure

Type of approach (comparative) will be retrieved via T3.3. The task T3.3 is not completed yet.

Annex 02 Certification process for CISP

To be developed in task 4.3 and included in this annex. The task T4.3 is not completed yet.

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Annex 03 Certification process for USSP

To be developed in task 5.3 and included in this annex. The task T5.3 is not completed yet.

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Annex 04 Emergency management plan & Contingency plan

When considering an **emergency management plan** for U-space itself this must be seen as a safe way of terminating the ongoing operations making use of the U-space framework until all operations are terminated. This implies that as from the moment the decision is taken to activate this plan no new U-space operation can be initiated by any stakeholder nor approved by the USSP(s). The aim is to clear the sky of U-space participants. In accordance with the EU Regulation 2021/664, article 15, 2. , emergency management plan shall be elaborated by USSPs.

As from the moment it is clear that issues remain and that a restart of U-space activity is not to be expected, the U-space airspace shall be closed and, where possible, the geographical zones enabling UAS operations can be restarted under the geozone specific conditions. It means that, during this interruption of U-space services, alternative solutions will be implemented in the framework of a **Contingency plan** which will be respectively developed by USSP and CISP.
This also means that the Member State shall have ready an action plan with regard to its obligation on making available UAS geographical zone data in accordance with IR (EU) 2019/947 Article 15. This plan shall contain the details on specific tasks to be executed in order to inform the UAS community on the activation of certain UAS geographical zones and the deactivation of all or some U-space airspaces.

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Annex 05 Dynamic Airspace Reconfiguration

A position paper will be elaborated with details on how dynamic airspace reconfiguration will be applied within U-space airspaces established within CTRs managed by skeyes, following general principles defined in chapter 8.4.

When finalised, this position paper will be attached to this annex.