Safely integrating drones in to Europe's airspace: Building on experience, progressing through partnership

Introduction

The growth in the use of drones for commercial and recreational purposes presents both huge opportunities and significant challenges. Safely integrating a new class of airspace user in to our already busy skies requires careful planning and strong cooperation across different industries and between different actors.

The European Commission's 'U-space' initiative provides a policy framework to enable that safe integration. This paper sets out to build on that framework and articulate the critical role the A6 Alliance believes Air Navigation Service Providers have to play in facilitating the safe integration and thereby sustainable growth of this new industry, while protecting Europe's existing manned aviation and preserving existing levels of safety.

This role will not be the same as it is in today's air traffic management system, nor should it be. ANSPs are aware that it will require new ways of working, new partnerships and new attitudes but equally, it should build on the significant experience that ANSPs have accumulated in managing busy, complex airspace and contributing to industry-leading safety performance. It is only by working together that the two industries – manned and unmanned – will safely and sustainably continue to flourish.

What is at stake?

Estimates vary on the volume and value of the drone industry in the future. However, the SESAR Joint Undertaking's Drone Outlook Study[1] estimates the industry to be worth € 10 billion annually by 2035, with a fleet of more than 400,000 commercial and government drones expected to be in use across Europe by 2050.

On top of this, the misuse of drones (unintentional or otherwise) presents a significant safety and commercial risk to Europe's manned aviation industry and may reduce public trust in the aviation sector as a whole. Safely integrating these new operations in to Europe's already crowded skies and ensuring fair access to the airspace for all actors is therefore one of the greatest challenges facing the transport industry today.

[1] https://sesarju.eu/sites/default/files/documents/reports/European_Drones_Outlook_Study_2016.pdf

The U-space concept articulated by the European Commission[2] and further elaborated in the SESAR Joint Undertaking's *Blueprint for U-space*[3] offers a framework for the integration of drones which, by design, relies on high levels of automation and connectivity. U-space will support the management of safe and efficient drone operations and addresses the necessary and crucial interface between manned Air Traffic Management (ATM) and UAS Traffic Management (UTM), which is the focus of this paper.

What are the key principles that should underpin U-space?

We believe a set of core principles need to underpin the evolution of U-space:

- Existing high levels of safety for all airspace users and the public must be maintained, building on existing Safety Management Systems and Europe's excellent record in aviation safety;
- Fair and equal access to the airspace should be provided for all users;
- Open market competition should be maximised wherever possible;
- Unnecessary duplication should be avoided and maximum value extracted from new automation and drone technologies;
- Implementation costs should be minimised by maintaining alignment with European and international regulations and standards.
- Solutions deployed should be interoperable and scalable in order to prevent safety or capacity being compromised during this rapid market growth.

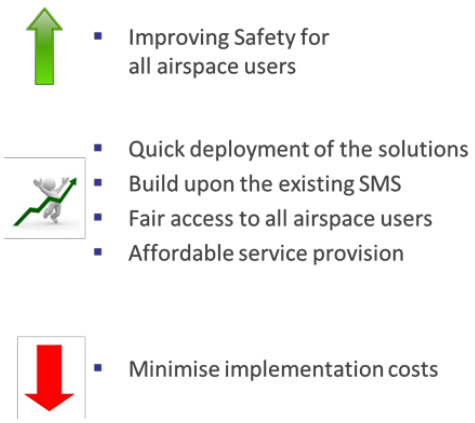


Figure 1: U-space core principles

[2] https://ec.europa.eu/commission/commissioners/2014-2019/bulc/announcements/speech-commissioner-bulc-drones-conference-warsaw_en
[3] https://www.sesarju.eu/sites/default/files/documents/reports/U-space%20Blueprint%20brochure%20final.PDF

Other factors also need consideration, which are beyond the scope of this paper. This includes the economic model required to underpin core U-space services, which should be funded by its users and not manned aviation. Privacy and security issues will also need to be addressed to protect both the privacy of the public and of the operators and their customers.

What is the A6 Alliance View on U-space?

The A6 Alliance acknowledges and supports the long-term ambition of the U-space concept to integrate drone operations in to Europe's airspace. This will enable the widest range of drone based applications and capabilities, which represent a huge opportunity for EU growth.

Initially these U-space services will be provided to support the large demand for operations in Very Low Level airspace (i.e. below 500 ft). These low level operations are likely to occur in areas of 'controlled airspace' (either existing controlled zones or newly classified control zones), where operators will need to receive some form of air traffic control service and possibly share position or intent information with other operators.

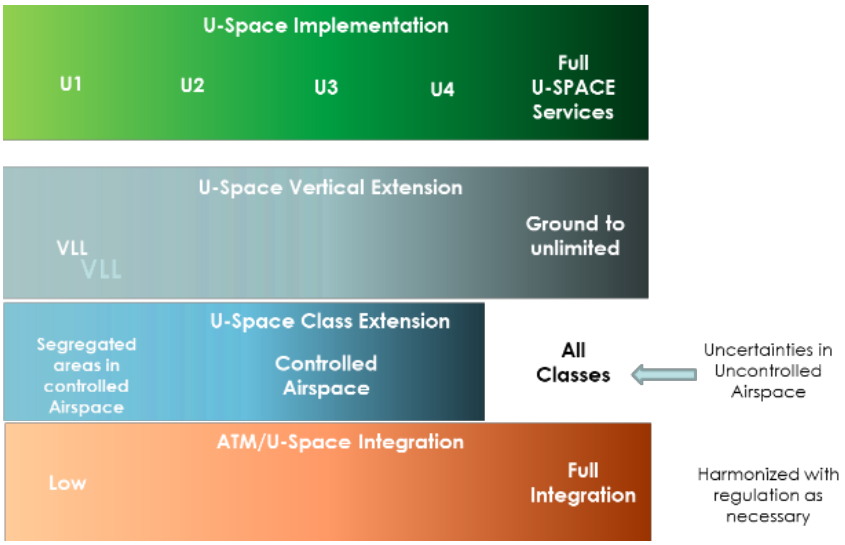


Figure 2: U-space Services versus Integration Complexity

It is anticipated that, as the U-space infrastructure and services evolve, interactions between UTM systems and ATM systems will inevitably increase, requiring infrastructure and services to allow more flexible access to either existing or new controlled airspace for U-space users. Such access will require harmonised regulation across both domains, in order to ensure access is granted on equal terms whilst taking in to account the unique attributes of manned and unmanned operations and yet also their common needs around safety, predictability and optimisation.

There is no clearly defined path towards the integration of manned and unmanned aircraft in uncontrolled airspace – the areas of airspace in which operators are not mandated to use air traffic control services. One of the greatest challenges in this area is that, today, not all users make themselves "visible" (i.e they do not transmit electronically their identity or location) and indeed, some are reluctant to do so. Although there's no international consensus on how this should be addressed, it is worth stressing that without situational awareness of all manned aircraft it will be difficult to accommodate complex drone operations such as BVLOS and autonomous flights, which in turn limits the growth potential of drone based services.

A high-level architecture to support the evolution of U-space

The A6 Alliance supports the work being performed within the SJU co-funded CORUS[4] project. Building upon the currently available draft material, the A6 Alliance proposes the following high-level U-space architecture, with each of the roles described afterwards. The A6 Alliance has taken every effort to ensure the architecture proposes role titles that convey the general sense of the roles whilst being sensitive to European preferences and avoiding introducing new or local, colloquial, phrases that might be contentious or detract from the actual role descriptions. Indeed, the focus should be on the role descriptions themselves.

The A6 Alliance believes this architecture is very flexible and can easily fit with the different implementation models being discussed by EASA, ANSPs, civil aviation authorities and other relevant stakeholders.

[4] *CORUS Concept of Operations for U-space Ed. 01.00.00 dated 25/06/2018.*

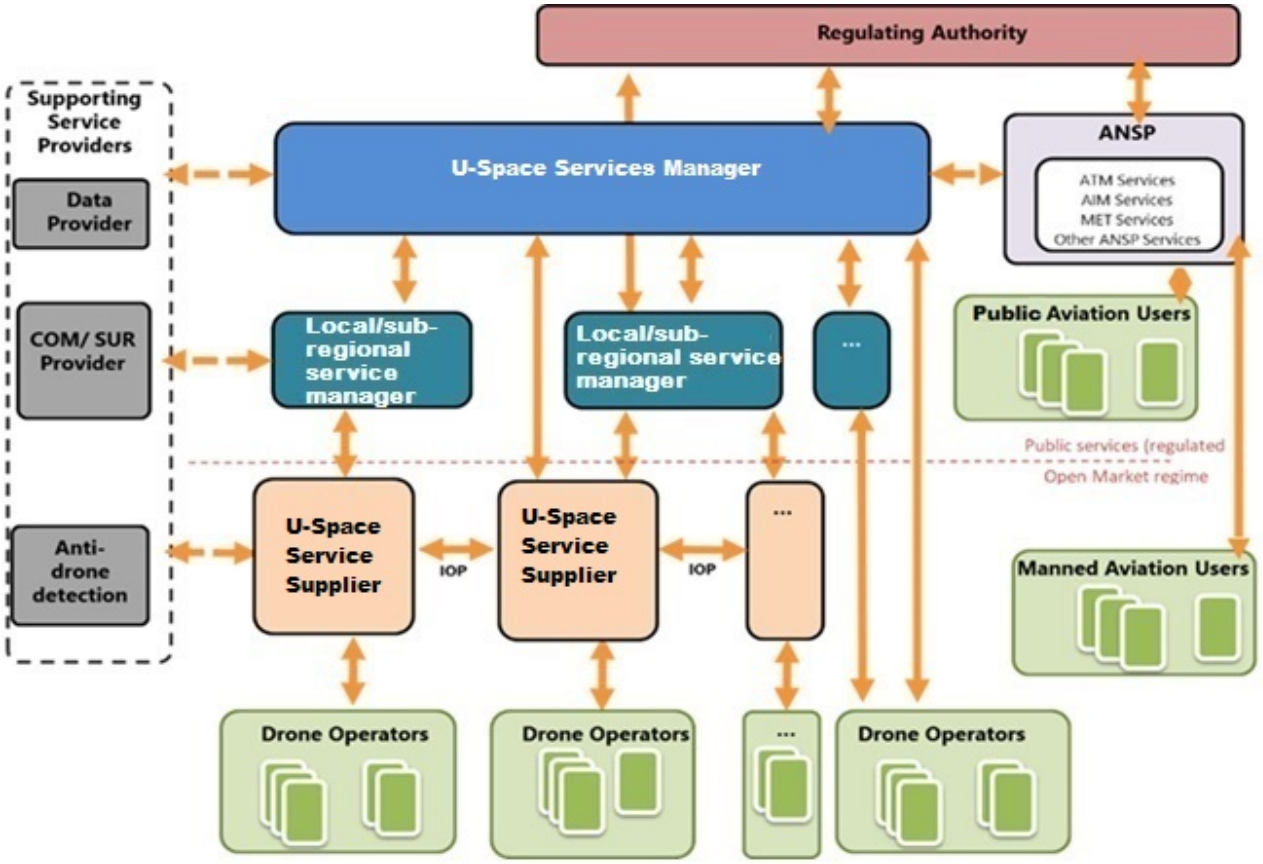


Figure 3: Proposed U-space Architecture Model

The architecture consists of the following roles:

- A publicly-mandated U-space Services Manager: An entity designated by the National Authority to deploy, manage and operate the essential services required for the safe integration of drones, providing a set of basic functions to downstream U-space Service Suppliers (see definition below) as a public service[5]. Services would include drone flight plan dissemination and/or approval where required; the provision of reliable aeronautical and airspace data (restricted areas, temporary restricted zones, etc.) for geo-awareness; and the interface with ATC, among others. The U-space Services Manager ensures equitable access to the airspace to all U-space Service Suppliers and harmonises the interaction between them and with manned aviation, with the authority to determine and impose a solution in cases of prioritisation and when safety might be compromised. The existence of the U-space Services Manager ensures interoperability and conformity between different U-space Service Suppliers. For every downstream U-space Service Supplier, the U-space Services Manager may act as a

[5] Ref. Services of general economic interest - European Commission (http://ec.europa.eu/competition/state_aid/overview/public_services_en.html)

proxy/intermediary to the manned Air Traffic Management system. Whilst the core role of the U-space Services Manager is to provide the basic U-space functions outlined above the provider of this service could, dependent on national preferences, also act as default U-space Service Supplier.

- A federation of U-space Service Suppliers (U-space SS)**:** These service suppliers would act as the main interface of the system with their U-space customers (Drone Operators and other users). Each U-space SS would provide a subset of U-space services within a volume of airspace. Core functions would include the exchange of information, data provision and navigation services. These services will usually be customer oriented and can consist of all possible complementary services not directly rendered by the U-space Services Manager (e.g. specialist drone operation services for a user group e.g. Metropolitan, Military; Micro-weather provision; flight planning assistance; mission planner; drone fleet management).

- Supporting Data Service Providers: an entity that provides trustworthy information to the U-space ecosystem, especially to support its U-space traffic management services. These providers could provide data for different organisations for different domains, so they are not specific for U-space. Such a model would be consistent with the proposal outlined in the recent Airspace Architecture Study published by the SESAR Joint Undertaking on behalf of the European Commission.

- Drone Operators: are licensed entities or persons accountable for U-space drone operations. Drone Operators could manage and supervise a fleet of one or several drones and execute the authorized operations (VLOS, BVLOS, in the future: automated, autonomous). They are users of the services provided by the system through the U-space Service Supplier and/or the U-space Services Manager.

- Local/Sub-regional U-space Service Manager: locally supports and complements the U-space Services Manager, offering added services or restrictions for a specific zone or service. There might be a range of local/sub-regional U-space Service Managers – Metropolitan, Military, controlled airspace, National Park, ad hoc for public event. The set of services will be determined by the regulatory requirements of the local airspace, derived from its safety or security needs. This, for example, might result in a drone tracking requirement in an urban area but not necessarily in a national park. The Local/sub-regional U-space Services Manager might implement the required functionalities and on that basis the central or national U-space Services Manager might provide a different set of raw data and core services. U-space Service Suppliers would also locally interface with, and draw upon the Local/Sub-regional services.

- Regulating Authority: A nationally appointed body in charge of filing and maintaining registries (e.g. drone, drone operator/drone pilot), issuing licenses, developing regulations of drone operations as well as keeping historical records of past drone operations. This entity may be a

separate government designated authority or in some cases be part of the U-space Services Manager.

Roles and responsibilities

The A6 Alliance support the roles and responsibilities identified by the CORUS project for the different U-space services. Each service is differentiated as either uniquely provided or provided by multiple service Suppliers, and as either mandatory or optional. This is shown in Table 1, where a blue cell indicates that the designated stakeholder shall provide the service and a green cell indicates that other stakeholders can complement or add further value to the service (e.g. providing additional relevant information):

	Regulating Authority	U-space Services Mgr	Local/Sub- regional services	U-space Service Suppliers	Supporting Service Providers
e-Registration					
Drone Aeronautical Information Publication					
Geo-fencing provision to drone operators					
Flight plan processing					
Mission/Flight plan preparation assistance					
Strategic Conflict Management					
Legal Recording					
Tracking					
Monitoring					
Traffic Information					
Tactical De-Confliction					
Emergency Management					
Accident/Incident Reporting					
Digital Logbook					
Weather Information					
Terrain Map					
Buildings Obstacles Map					
Population density map					
Procedural Interface with ATS					
Collaborative Interface with ATS					

Table 1: U-space Services Roles & Responsibilities

Benefits of a distributed U-space Architecture

Fostering competition: The above proposed architecture illustrates how competition could be fostered in a secure, neutrally governed and standardised environment. The role of the U-space Services Manager acting as a proxy for the U-space Service Suppliers ensures the commercial privacy of each U-

space Service Supplier and their respective customers drone operators. It also offers scalability, with the U-space Services Manager easily able to incorporate a new U-space Service Supplier entering the market.

Security: For reasons of national security, local authorities may require that repositories of airspace, tracking, e-registry, and mission plans (or flight plans) reside in the Member State territory, and possibly being managed by the state authority or by the U-space Services Manager. In this role, the U-space Services Manager could quickly and easily provide law enforcement authorities with critical information required by investigations, instead of depending on multiple service providers operating from different jurisdictions.

Also of paramount relevance is that the U-space Services Manager will provide the interface to the national ATM system. This limits the number of interfaces to the ATM system, thereby reducing the threat from hostile cyber-attacks. A single interface, limited to the U-space Services Manager becomes an additional security barrier to isolate highly critical ATM systems from external threats.

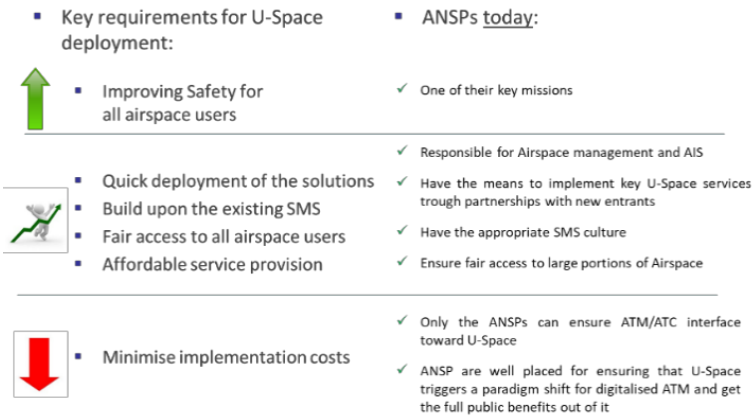
Avoids duplication: ANSPs continue to retain a core role in helping to ensure the safety of manned airspace users operating in the airspace. Increasing drone use is already forcing ANSPs to adopt measures that help to protect the safety of those existing airspace users. Many of those measures are either the same or similar to those required to facilitate the safe growth of drone application and envisaged as shown in Table 1 as being provided by the U-space Services Manager. Having a single organisation providing those core essential services offers the most efficient way to ensure they are only undertaken once but can be used by multiple users in both manned and UAS industries to facilitate their safe use of the skies.

The role of ANSPs in enabling U-space

In order to fulfil the requirements for U-space and facilitate the integration of drones into existing airspace operations, a number of principles and practical considerations point to the benefits of ANSPs providing the essential services that will underpin the delivery of U-space:

1. ANSPs already provide a wide range of services in all classes of airspace – i.e., ATS, CNS, AIS/AIM, or MET. Some of these services are directly applicable to the U-space context (e.g., AIS/AIM), others constitute the basis for many of the new services required to deliver U-space;
2. ANSPs have an obligation to maintain and improve safety for all airspace users in all classes of airspace, including new entrants;
3. ANSPs are uniquely placed to provide situational awareness to all users through their surveillance tracking and fusion capability;
4. Fair and equitable access to the airspace is at the heart of integrated airspace management - this becomes more difficult and more costly to achieve if there is not a single airspace manager for all airspace users;
5. Fulfilling a core role in U-space allows ANSPs to manage the safety, priority and interests of all airspace users, reducing the need to segregate unmanned airspace users. This maximises the overall capacity and efficiency of the airspace whilst minimising the costs on all airspace users;

6. Only ANSPs can ensure a procedural and collaborative ATM/ATC interface, and its related technologies, toward U-space;
7. ANSPs already demonstrate their ability to provide a range of differing services to suit different users' needs; this includes general aviation users (flight information services), emergency, security, humanitarian, SAR and other military and state flights;
8. ANSPs are already certified for the provision of high quality, safety-of-life services;
9. ANSPs are considered as trusted and independent entities with whom all airspace users can feel secure when sharing valuable information in a highly competitive market.
10. ANSPs are already restructuring the European airspace to deliver the capacity needs of future air traffic growth. If drone services are not anticipated from the outset, their integration at a future point will be more difficult.



11. Figure 4: Synergy of U-space principles versus ANSP capability

Conclusions and recommendations

Facilitating the safe integration of drones and enabling the growth of the unmanned aircraft industry is one of the greatest challenges facing aviation today. It is also a huge opportunity for the industry to learn from new actors and to find new ways of working, whilst helping to ensure that Europe is at the forefront of this exciting new industry.

The A6 Alliance believes that adopting a distributed architecture approach to delivering the services required for U-space is the most appropriate way to ensure safety, maximise competition and create a level playing field on which the downstream services can flourish, whilst simultaneously protecting the excellent safety levels present in Europe's manned aviation industry today.

There is a strong rationale for ANSPs to provide some essential services on which downstream U-space services can develop. ANSPs already have the appropriate safety, airspace and traffic management responsibilities, capabilities and culture. Furthermore, many ANSPs are already implementing key U-space functions through partnerships with drone technology providers, which demonstrates the growing collaboration between these sectors and the fact that an open and competitive environment can still underpin elements of the essential services.

Europe has a unique opportunity to build on the strength and reputation of its manned aviation industry, which is renowned worldwide for its safety and its ability to manage high volumes of traffic in complex airspace. ANSPs have been critical to that success, working in partnership with the rest of the industry.

Today, at the dawn of the next era of air mobility in Europe, ANSPs are uniquely placed to provide the essential services that will enable U-space to become a reality and to ensure that manned and unmanned aviation industries in Europe can grow safely and sustainably alongside one another. We will continue to work together with policy-makers, regulators, and industry – both manned and unmanned – to ensure that vision is realised.