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MILITARY AND U-SPACE: GUIDELINES

SC3 REPORT

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Document information

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1 - EXECUTIVE SUMMARY

1.1 - Overview of the "Military and U-space: guidelines" study

The "Military and U-space: guidelines" study consists of 3 Specific Contracts (SC1, SC2, SC3) that all contribute to informing the military on their future relation with U-space in order to preserve national and security defence requirements and to raise the awareness of the organisations implementing U-space about military needs and constraints. Each SC has its respective deliverables and the whole study is structured as depicted in Figure 1.

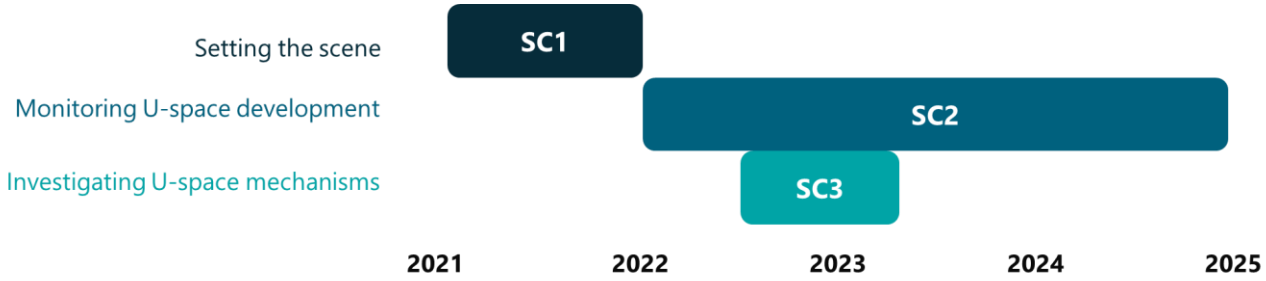

FIGURE 1: STRUCTURE OF THE "MILITARY AND U-SPACE: GUIDELINES" STUDY

1.1.1 - SC1 – setting the scene

SC1 represented the first phase of the study and aimed at developing awareness and consensus on the role of the military with regard to U-space development, based on an impact assessment covering operational, technical and financial aspects. SC1 led to the development of three main deliverables

- D1: U-space evaluation, including the military U-space Use Cases;
- D2: financial costs calculation for the military from the U-space implementation; and
- D3: military guidelines and recommendations for further U-space involvement and engagement with the civilian stakeholders.

1.1.2 - SC2 – monitoring U-space development

Considering that the development of U-space is an on-going process, the objective of SC2 is to monitor U-space activities and to inform EDA and its Member States about the progress of U-space implementation. Under SC2, the three deliverables developed under SC1 are regularly updated to reflect the state of U-space across Member States and to confirm the assumptions taken during the development of these deliverables.

1.1.3 - SC3 – investigating U-space mechanisms

The goal of SC3 is to investigate in details the applicability of two U-space mechanisms on military operations, the electronic conspicuity of manned aircraft and the dynamic reconfiguration of U-space airspace, and develop proposals for the military to adapt to, and potentially benefit from these mechanisms, in particular for uncontrolled traffic.

1.2 - Approach for including military objectives into U-space

The conclusions, recommendations and guidelines developed in the various deliverables of this study (which the present report is only an element) are intended to first raise awareness among military authorities of EDA Members States about the impact of U-space implementation on their activities and second, to help developing consensus on the position they could defend in discussions with other aviation stakeholders.

The "Drone Strategy 2.0" vision document recently published by the European Commission recognises the expertise of the military in drone operations and their role as a key stakeholder in the overall drone eco-system. Military stakeholders have also been actively involved in the development of the Acceptable Means of Compliance supporting the U-space regulatory package, which publication is expected very soon.

However, additional work is still needed to make U-space an operational reality, notably around the definition of principles and processes that will allow military aircraft to operate safely in U-space environment. This is why SC3 has investigated in detail two key mechanisms proposed by the U-space regulation that ensure the segregation of manned and unmanned traffic in U-space airspace, and assessed their applicability to military operations. The result is a number of issues brought to the attention of the EDA Member States and the proposal of an operational concept for the shared use of U-space airspace by the military and drone operators.

1.3 - Outcome of SC3

On the two topics investigated in SC3, the study has developed different sets of results, which are detailed in the following sections.

1.3.1 - e-conspicuity

The goal of the e-conspicuity task was to identify the electronic conspicuity systems currently equipping military aircraft (e.g. transponder Mode 3/A) and to assess whether and how these would meet the requirements of the U-space regulation (IR (EU) 2021/664), which expects manned flights operating within a U-space airspace to be conspicuous to the USSPs managing this airspace. Although the military are not subject to this regulation[1], it would help mitigating the operational and financial costs of adapting to U-space if the current aircraft equipage would ensure the expected level of conspicuity.

The Acceptable Means of Compliance for the U-space regulatory package ([5]) and the subsequent coordination work to help finalising this document have provided insight into EASA's approach. Electronic conspicuity in U-space will use the so-called "ADS-L" concept, which relies on a triptych of compliant technologies: ADS-B out, devices operating in the SRD 860 frequency band and mobile telephony. As only ADS-B out is currently available on military aircraft, and only for a fraction of the fleet, fitting into this framework would require significant investments from the military. The other two options are less costly and may help to alleviate the financial impacts, but might not suit all kinds of military operations. Conversely, civil use of e-conspicuity will provide limited input for military ATS.

Therefore, the most sensible and affordable approach would be to rely on other mechanisms, such as strategic and tactical airspace management, to improve the safety of military operations in U-space airspaces.

It is also worth noting that EASA has launched at the end of 2022 a specific project[2] on the interoperability of e-conspicuity for general aviation (not limited to U-space), which will set the direction of e-conspicuity development in Europe and could provide an interesting channel for the military to raise awareness about their requirements. The results and conclusions of this project are expected in 2024.

1.3.2 - Dynamic airspace reconfiguration

Dynamic Airspace Reconfiguration (DAR) is the process defined in IR (EU) 2021/664 through which Air Traffic Control services can coordinate with a USSP to ensure that a manned aircraft under ATC can remain segregated from drone traffic when operating within a U-space airspace. Recital 13 of the regulation places the responsibility of defining these dynamic restrictions on Member States, recognising that State aircraft are excluded from the regulation.

The DAR process is a welcome way to offer some flexibility in the management of the overall airspace while maintaining an appropriate level of safety. However, the definition of a similar process for military flights is a complex issue as they frequently operate in airspace where uncontrolled traffic operate and may not be conspicuous to USSPs.

The present report proposes an initial process allowing to use U-space airspace in a flexible, dynamic and cost-effective manner, supported by information sharing for strategic/pre-tactical airspace management and the availability in military operational units of an interface with the CISP/USSP systems for tactical management.

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[1] Unless a Member State considers it preferable to apply, instead of their national law, this Regulation to aircraft carrying out military activities, as offered by Regulation (EU) 2018/1139.

[2] https://www.easa.europa.eu/en/research-projects/interoperability-electronic-conspicuity-systems-general-aviation

This approach uses as much as possible the principles of the Flexible Use of Airspace and of the Dynamic Airspace Reconfiguration to reduce the impact on current operations.

1.4 - Proposed way forward

Even though the AMC/GM for the U-space regulatory package clearly recognize the military as a key stakeholder in the implementation of U-space, the current regulation does not define requirements or mechanisms that would help addressing the risk of collision with drones for military aircraft operating in U-space airspace designated in uncontrolled airspace and not fitted with a system making them electronically conspicuous to USSPs. Information provided so far by EASA indicate that the specificity of military operations makes it difficult to enter the e-conspicuity framework envisaged for U-space.

Significant efforts and costs (qualified personnel, additional or upgraded equipment, workload) will be required from the military to adapt to the future U-space environment and collaborate with the U-space stakeholders in the way foreseen by the civilian-driven introduction of U-space and described in the U-space regulatory package. Implementing specific military infrastructure to detect drones in uncontrolled airspace and thus achieve a level of safety equivalent to the pre-U-space environment would push these costs even further.

Therefore, the safety of manned military flights in U-space, particularly in uncontrolled airspace, would be better ensured by cost-effective airspace management processes, inspired from the Flexible Use of Airspace process, for which an initial proposal has been developed under SC3 and which Member States are invited to consider.

2 - INTRODUCTION

The European Defence Agency (EDA) has initiated the "Military and U-space: guidelines" study in January 2021 to assess military impacts and cost benefits of large scale drone operations. Understanding normal/nominal operations in a U-space "eco-system" is a prerequisite for the military to collaborate in U-space concept development.

The present report presents the conclusions and recommendations of the 3rd Specific Contract (SC3) carried out under the study, which focuses on understanding in details the impact on military operations of two key U-space mechanisms and their applicability to the military:

- Electronic conspicuity: regulation (IR (EU) 2021/666) requires manned aircraft operating within a U-space airspace to be electronically conspicuous to the USSPs managing this airspace when not provided with an Air Traffic Control service by the ANSP.
- Dynamic Airspace Reconfiguration (DAR): the process defined in IR (EU) 2021/664 through which ATC services can coordinate with a USSP to ensure that a manned aircraft under ATC can remain segregated from drone traffic when operating within a U-space airspace.

Although these mechanisms improve the safety of manned aircraft in U-space airspace, their efficiency is limited when it comes to military flights, as:

- The military are not subject to the U-space regulation;
- The military frequently operate in uncontrolled airspace where no ANSP can use DAR to maintain the segregation between manned and unmanned traffic and collision avoidance only relies on see-and-avoid/detect-and-avoid;
- Not all military flights can provide notice of intent to enter an area as the flight route might change at short notice or advance information cannot be given due to security requirements
- Not all military flights can be electronically conspicuous to other airspace users, whether for operational or technical reasons.

SC3 thus investigates in details the potential consequences of these limitations to the e-conspicuity and DAR mechanisms from a military perspective, and develops proposals for similar mechanisms that would allow the military to improve the safety of their flights operating in U-space airspace, notably in uncontrolled airspace.

Note 1: "Controlled airspace" is a generic term that covers the different classification of airspace (Class A, Class B, Class C, Class D, and Class E airspace) and defined dimensions within which air traffic control service is provided to IFR flights and to VFR flights in accordance with the airspace classification. Because of this definition, drone traffic in U-space could be considered as under some form of control service because of the mandatory use of U-space services and hence, U-space airspace could be considered as some form of controlled airspace, from a drone operations perspective.

To prevent any confusion, in this document, "controlled/uncontrolled airspace" should always be understood from a manned aviation perspective, i.e. referring to airspace classes where ATC service is provided to manned flights. Consequently, a U-space airspace designated in Class G airspace will be considered as uncontrolled airspace.

Note 2: using the above terminology, VFR flights in uncontrolled airspace can be provided with air traffic services in accordance with the airspace classification. This report assumes that military flights under VFR in uncontrolled airspace can be provided with the same services as civilian flights. This report also does not envisage IFR flights at very low level (except in the specific case of a CTR).

2.1 - U-space development

The development of U-space is essentially led by civilian entities and the "Military and U-space: guidelines" study conducted by EDA contributes to ensuring that military needs and constraints are properly understood and addressed in this development. The regulatory framework supporting the implementation of U-space is coming closer to completion and introduces significant changes to the way air traffic is currently managed by defining new types of airspace and new actors in charge of delivering services to airspace users in these areas. It is recognised that U-space is a new structure, which will impact both VFR GAT and OAT flights, e.g., in terms of aeronautical information and services.

2.1.1 - U-space at a glance

U-space is a set of new services relying on a high level of digitalisation and automation of functions and specific procedures designed to support safe, efficient and secure access to airspace for large numbers of drones. As such, U-space is an enabling framework designed to facilitate any kind of routine drone mission, in all classes of airspace and all types of environment - even the most congested - while addressing an appropriate interface with manned aviation and air traffic control.

U-space facilitates any kind of operations[3] for both, private and public drone users (including commercial and leisure users as well as State (including military) and public entities with appropriate prioritisation for special missions) *"in all operating environments[4], and in all types of airspace (in particular but not limited to very low level airspace[5])"* ([3]) by *"enabling framework to support routine drone operations, as well as a clear and effective interface to manned aviation, ATM/ANS service providers and authorities."* ([3]).

The definition of U-space has been initiated by SESAR which proposed a definition of the new services brought by U-space as well as a concept of operations applicable to European airspace. Based on this work and through cooperation with aviation stakeholders, EASA has defined the regulatory framework in IR (EU) 2021/664, 2021/665 and 2021/666, that details the requirements around U-space – a set of new services and specific procedures designed to support safe, efficient, and secure access to airspace for large numbers of drones. This regulation enters into force on 26 January 2023 and introduces some important new features:

- **A new type of airspace**: a UAS geographical zone (as defined in IR (EU) 2019/947) can be designated by States as U-space airspace, where drones will only be able to operate if they use specific services.
- **A new set of services** for drone operators: in a given U-space airspace, drone operators will be required to use at least 4 mandatory services, and at the discretion of each State, up to 2 additional services. Those services are:
  - Geo-awareness - providing drone operators with the information about the latest airspace constraints and information on UAS geographical zones.
  - UAS flight authorisation - ensuring that authorised drone operations are free of intersection in space and time with any other notified drone flight authorisation within the same portion of U-space airspace.
  - Network identification - providing the identity of drone operators, the location and flight vector of drones, and sharing relevant information with other U-space airspace users.
  - Traffic information service - alerting drone operators about other air traffic that may be present in proximity to their drone.
  - Conformance monitoring (optional) - providing real-time alerting of non-conformance with the granted flight authorisation and informing the drone operators when they deviate from it.
  - Weather information (optional) - providing the drone operator with weather forecasts and actual weather information either before or during the flight.

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[3] Including visual line of sight (VLOS) and beyond visual line of sight (BVLOS) operations

[4] Urban, suburban, rural, regardless the density of population

[5] Very low level airspace refers to the airspace below 500ft

- **New actors**: U-space Service Providers (USSPs) will be responsible for delivering the above services to drone operators. USSPs will rely on Common Information Services (CIS) to access some of the elementary data required to build the U-space services (cf. IR (EU) 2021/664 and its AMC/GM for details on this data). States can designate a single CIS provider (CISP) that will be responsible for providing CIS in all or some of the U-space airspaces within this State on an exclusive basis.

This new framework is illustrated by the following figure:

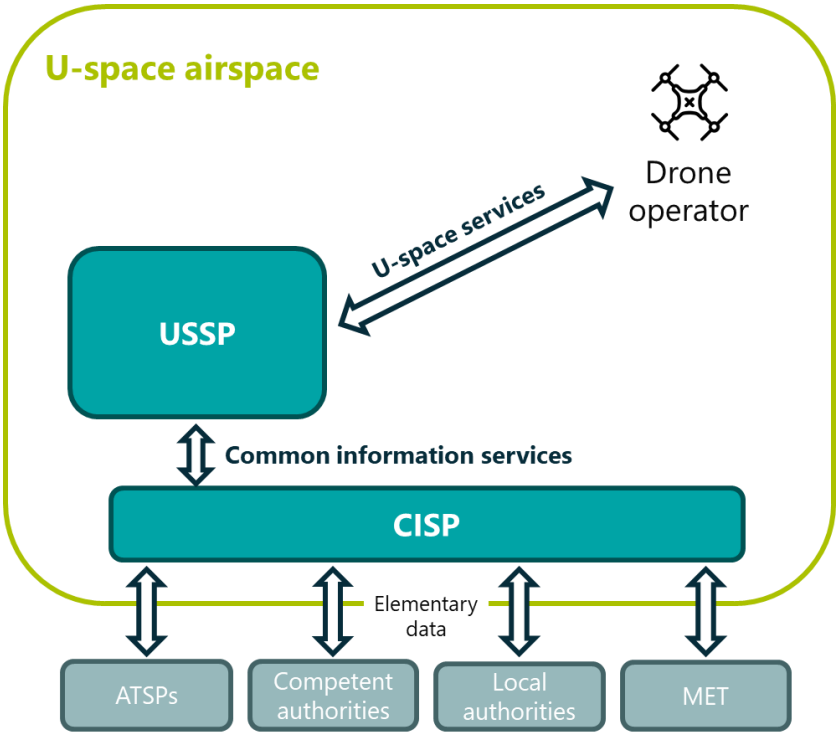

FIGURE 2: KEY FEATURES OF U-SPACE

At its core, U-space uses the principle of segregation between manned and unmanned traffic to ensure that the risk of collision between manned aircraft and drones is adequately mitigated. When a manned aircraft operates in U-space, it is required to be conspicuous to USSPs in that airspace, which can then inform drone operators about this traffic through the Traffic Information U-space service and take appropriate tactical measures (e.g. airspace restrictions, cancellation of flight authorisations) to ensure they are segregated. As for air traffic control before, it can be expected that USSPs will use data contained in the Traffic Information U-space service to extrapolate manned aircraft trajectories or feed sophisticated Conformance Monitoring algorithms that warn human actors and systems of impending hazardous situations or deviations before they actually occur.

In controlled airspace[6], ANSPs are also able to initiate a dynamic reconfiguration of the airspace to coordinate airspace restrictions with the USSPs, although this mechanism is expected by EASA to be used exceptionally as airspace design should be the primary means of maintaining the segregation between manned and unmanned traffic.

2.1.2 - Current state of U-space development

Following the publication of the European Commission's Drone Strategy 2.0 in November 2022, the publication of the AMC/GM for the U-space regulatory package in December 2022 and the entry into force of the U-space regulatory package in January 2023, the on-going implementation U-space has accelerated in 2023.

Many EU Member States are actively working towards implementing U-space through the publication of national strategies and roadmaps, the transcription of EU regulation into national law, the designation of ANSPs

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[6] *Cf. Note 1 in section 2 - Introduction, page 9*

as single CISP for all the U-space airspaces in the country and the definition of the processes that will allow certifying the future CISPs and USSPs. Implementation projects sponsored either by European institutions (e.g. SESAR 3 JU) or individual Member States continue to be launched to help stakeholders progress in the common understanding of U-space and to increase the maturity operational concepts, processes and technological solutions.

In parallel, some MS are also preparing the designation of U-space airspaces, by identifying these airspaces and defining the processes and means to issue the corresponding information to interested stakeholders.

Those ANSPs that have already been designated at CISPs, or will be soon, are defining the systems that will allow them to collect elementary data from the various sources and provide the CIS to USSPs and other interested U-space stakeholders. In parallel, they are also preparing the associated certification processes with their civil aviation authority.

EASA has also clarified the proposed technical requirements associated with the electronic conspicuity of manned aircraft for U-space operations (SERA 6005 (c)). Given the diversity of electronic conspicuity devices used by manned aviation, that are not always interoperable with each other, EASA is finalising a broad concept called ADS-L (Automatic Dependent Surveillance – Light) that should allow meeting the SERA 6005 (c) requirement through various means:

- Certified ADS-B out, which has been mandated in Europe for most civilian aircraft with a maximum take-off mass above 5.7t or a maximum cruise speed above 250kts and operating in accordance with IFR;
- Devices using the non-aviation SRD-860 frequency band, such as FLARM that is widely used by General Aviation (GA) communities;
- Mobile telephony, as smartphone applications are an affordable solution for making lighter aircraft conspicuous.

However, although over 40 entities have expressed an interest in becoming a USSP in a recent survey conducted by Swiss FOCA, few are openly working toward that goal. At present, an important actor in the U-space ecosystem is thus missing and this is a major challenge for the definition of coordination processes.

2.1.3 - The safety challenges for the military

The future environment described above induces a safety challenge for the military because their operations and technical capabilities do not fit exactly in the framework being put in place for civilian airspace users. In particular, the military routinely operate in uncontrolled, low-level airspace which increase the likelihood they will interact with U-space airspaces, but without the ability to rely on the DAR process to ensure segregation with drone traffic. In addition, military assets are not subject to the ADS-B out mandate and are generally not equipped with devices covered by the ADS-L concept proposed by EASA.

As a result, considering how U-space is envisaged today, the military need to identify additional means to e-conspicuity and DAR to ensure that they can operate safely in U-space airspace. It is the purpose of this report to suggest possible solutions and to assess the corresponding costs to the military.

2.2 - On this report

Drawing a parallel with the ICAO's concept of a three-layered approach for protecting aircraft against the risk of collision, this SC3 report investigates several means associated with strategic and tactical conflict management, as well as collision avoidance, which could allow the military to benefit from an improved level of safety when operating in U-space airspace.

FIGURE 3: ICAO'S THREE LAYERS OF PROTECTION AGAINST RISK OF COLLISION

Having a clear picture of the current and future e-conspicuity landscape for both military and civilian aircraft and drones allows to identify to what extent collision avoidance based on detect and avoid (or sense and avoid) can be ensured for all airspace users in U-space.

Military and civil cooperation in the strategic and tactical management of the airspace, including U-space airspace, could make the segregation principle used in U-space applicable to military aircraft and this report proposes processes, inspired from the Flexible Use of Airspace process, to that end.

2.3 - Document structure

This report is composed of the following 7 main sections:

SECTION 1 - EXECUTIVE SUMMARY that brings a condensed and clear outline of the SC3 report.

SECTION 2 - INTRODUCTION is intended to provide a detailed presentation of the report, its objectives and the approach undertaken.

SECTION 3 - E-CONSPICUITY This section provides a summary of e-Conspicuity today and identifies the potential benefits and challenges for military use of e-Conspicuity in the future .

SECTION 4 - DYNAMIC AIRSPACE RECONFIGURATION proposes an initial concept of operations for the in a flexible, dynamic and cost-effective management of U-space airspace in uncontrolled airspace[6], using similar principles to FUA. The application of these principles is illustrated through four Use Cases.

SECTION 5 - FINANCIAL ASSESSMENT provides an assessment of the costs that the military would accrue to implement the concept proposed in the previous section.

SECTION 6 - CONCLUSIONS concludes on the work presented in the report.

This report is complemented by 3 annexes providing a definition of the terms used in the document, a list of key reference documents and a detailed Use Case for the application of the Dynamic Airspace Reconfiguration mechanism defined in the U-space regulatory package.

3 - E-CONSPICUITY

This section provides a summary of e-Conspicuity today, and key plans for its development within Europe (3.1 -). The current, and constraints to, usage by EDA members is then summarised (3.2 -). These two driving areas are then analysed to identify the potential benefits and challenges for military use of e-Conspicuity in the future (3.3 -). Finally the key conclusions and recommendations (related to e-Conspicuity) are summarised (3.4 -).

3.1 - Overview of e-Conspicuity

3.1.1 - e-Conspicuity technologies

e-Conspicuity is a term which encompasses a broad range of technologies enabling airspace users to make themselves electronically visible (conspicuous) to other stakeholders. Through reception of other airspace users e-Conspicuity transmissions, an airspace user may also be able to identify other airspace users in their vicinity.

Typically, e-Conspicuity refers to broadcast systems, but the viability of transponders as part of the solution space is considered here.

Historically e-Conspicuity is split into two broad categories: certified and uncertified. Certified e-Conspicuity is ADS-B and, arguably, all forms of certified transponders used in secondary surveillance. Uncertified e-Conspicuity include a range of open and proprietary technologies supporting situational awareness by providing traffic information. Uncertified technologies do not provide defined performance. The uncertified category has become increasingly diverse as it is a competitive and innovative space, where manufacturers tailor their product capabilities to serve needs of specific airspace user groups.

The information generated by these systems strengthens the principle of 'see and avoid' by adding the ability to 'detect and be detected'. Airborne transponders, air traffic data displays, ground-based antennas and satellite surveillance services are all examples of e-Conspicuity currently in use in EDA member states.

There are range of e-Conspicuity solutions currently available to aircraft on the market from many manufacturers (such as Thales, Collins, uAvionix, Garmin, Air Avionics, Trig, L3, Skytrax, Funke, PilotAware, Avidyne, Sagetech etc). Equipment able to be used on an aircraft for e-Conspicuity purposes currently includes (but is not limited) to:

- ADS-B Out capable transponder inclusive of GNSS position source
- ADS-B Out capable transponder reliant on external certified GNSS source
- FLARM
- Power FLARM
- Pilot Aware Rosetta
- Portable ADS-B In/Out Devices

Within Class G airspace several Air Traffic Services Providers (ATSPs) operate including civil, military and combined in different member states. The majority of the larger ATSPs utilise traditional electronic surveillance (PSR, SSR, WAM etc), whilst several smaller providers currently only provide Flight Information Services (non-surveillance).

e-Conspicuity is delivered today via mobile telephony (e.g. SafeSky) and through three main frequency ranges:

- 1090MHz for ADS-B and secondary surveillance globally.
- 978MHz for ADS-B in the USA (in addition to 1090MHz).
- 860-870MHz for uncertified technologies (such as FLARM, skyEcho, PilotAware).

1090MHz and 978MHz are within 'aeronautical' spectrum, which provides a suite of protection measures (controls) to limit interference. 860-870MHz operates with varying definitions within member states, but are not afforded the same level of controls. They typically include more restrictions on transmission power.

In future it may also be the case that e-Conspicuity is transmitted over mobile networks, which would encompass a range of potential frequencies and associated controls, and also sharing of frequency with other spectrum users. This adds further complications to the provision of USSPs and challenges to the military use of e-Conspicuity data from other airspace users, and is considered in section 3.3.2 -

3.1.2 - U-space and e-Conspicuity

It is important to note that e-Conspicuity is not in, and of, itself a component of U-space, but a technology with broader use today and the potential to support further applications in future.

U-space IR 2021/664, within Article 11, requires the provision of a traffic information service to UAS operators on any other conspicuous air traffic in proximity of the UAS flight and that upon receiving the traffic information services from the U-space service provider, UAS operators shall take the relevant action to avoid any collision hazard. Article 11 further requires that this information be shared with other relevant air traffic service units.

Furthermore, SERA.6005 (not applicable to military) requires all *manned* aircraft entering U-space airspace without an ATC service to be electronically conspicuous to the USSP. This U-space airspace requirement is applicable from 26 January 2023[7]. These rules do not apply to unmanned aircraft, the operators of which are required to be connected to USSPs separately.

In summary:

- e-Conspicuity itself exists beyond U-space.
- e-Conspicuity includes certified and uncertified technologies.
- e-Conspicuity will be required for all civil manned aircraft wishing to enter U-space airspace in uncontrolled airspace[6].
- The rules requiring e-Conspicuity do not apply to unmanned aircraft.

3.1.3 - e-Conspicuity in use today

This section provides more details on the usage of e-Conspicuity today, particularly by civil airspace users. Military airspace users must reserve the right to ***not*** be conspicuous depending on the nature of their flight. Military and state aircraft are not mandated to be equipped with ADS-B. The preferred method for military aircraft to be conspicuous to ATSPs is through secondary surveillance transponders.

As described above the focus of this study is U-space, whilst e-Conspicuity itself is a broader subject, which may support several other use cases. Today no single entity has a fully accurate picture of the equipage of different e-Conspicuity technologies across airspace users – indeed a survey of this adoption will be a focus of EASA's ongoing study on e-Conspicuity interoperability (described below in section 3.1.4 -). Given this status, a high-level summary of usage by airspace user groups is provide below:

- Commercial Air Traffic (CAT). Operations are mainly concentrated within controlled airspace[6], although some Class G transits. CAT are Transponder equipped and most are ADS-B (1090 MHz equipped) owing to mandates.
- Fixed Wing General Aviation (GA). Operate in a wide range of airspace, but most abundant within Class G Wide variety of e-Conspicuity equipment fits depending upon airspace entry requirements.
- Rotary Wing GA. Operate in a variety of airspace classifications but again mostly operate within Class G at lower levels. Wide variety of e-Conspicuity types fitted including Protected Aviation Band and ISM Band Systems, depending upon airspace requirements.
- Gliders. Mostly operate in Class G. A wide variety of e-Conspicuity types fitted including Protected Aviation Band and ISM Band Systems, depending upon airspace requirements, although they are the largest user group of FLARM technology which offers algorithms tuned to their use cases.

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[7] https://www.easa.europa.eu/en/downloads/68174/en

- Non-Powered GA, including flying pilots and skydivers. Normally within Class G airspace. Limited use of e-Conspicuity.
- Large Model Aircraft (Up to 150kg). Model Flying Clubs, normally within Class G airspace. Limited use of e-Conspicuity.
- UAS. Mostly in Class G airspace below 400ft - line of sight. BVLOS currently in temporary segregated airspace. Very limited use of e-Conspicuity.

In summary, the level of adoption of e-Conspicuity varies significantly, and there is no firm requirement for airspace users to be equipped outside of controlled airspace[6].

3.1.4 - e-Conspicuity in future

As described above, SERA.6005 came into effect in January 2023. This should theoretically cause an increase in the level of adoption of e-Conspicuity generally and ensure adoption in designated U-space airspace outside of ATC volumes. In practice the mechanisms for a USSP to detect all forms of e-Conspicuity are not clear and there is an on-going challenge of interoperability. Although this has been partially addressed in the recently published AMC/GM to SERA.6005c by the development of the ADS-L technical specification for SRD860 band (i.e. standardisation of transmission on the band), it is unlikely to have an immediate impact on the level of adoption.

iConspicuity, EASA's project to deliver interoperability of e-conspicuity for GA, as "an 'in-flight capability' to transmit position and/or receive, process and display information about other aircraft, airspace, or weather in real-time with the objective to enhance pilots' situational awareness"[8]. Effectively it expands the concept of SERA.6005 to cover GA and rotorcraft operations more generally (outside U-space airspace) and support Flight Information Service – Broadcast (FIS-B). Beyond U-space, e-Conspicuity is likely to support other use cases in future, such as ICAO FIS with surveillance, drone detect and avoid, and ACAS X/hybrid ACAS.

These uses of e-Conspicuity move away from today's use as an aid to situational awareness, towards support for applications with a more direct safety impact. This demands both an understanding of performance and interoperability. To address this and improve GA safety performance, EASA has launched a study on e-Conspicuity interoperability for GA. A summary of the study is provided below.

EASA e-Conspicuity interoperability study sets out to improve GA safety outcomes and support the use of e-Conspicuity to address SERA.6005c. It will engage with stakeholders through a survey and a series of workshops, to derive scenarios, requirements, case studies and a concept of operations for interoperable e-Conspicuity deployment in Europe. Whilst any e-Conspicuity requirements will not apply to military airspace users, the impact on civil operations will affect military use of airspace.

This project is in tandem with the development of ADS-L ('L' stands for light) – a version of ADS-B that drops requirements for quality indicators and opens the possibility for transmission through SRD860 or mobile telecoms. To comply with ADS-L, an aircraft user can utilise:

- today: certified ADS-B out technology.
- in the near future: a non-certified device transmitting at low power on SRD860 in compliance with ADS-L 4 SRD860 specifications.
- further in the future: a mobile telephony application transmitting in compliance with ADS-L 4 MOBILE specifications.

ADS-L will develop a minimum standard for manned aircraft to be conspicuous to USSPs. It will be a simplified version of ADS-B, low cost and based on GNSS. It *should* support future applications such as traffic awareness, but this is not a mandatory requirement. Currently required parameters include aircraft ID, type, timestamp, aircraft category, position and altitude, velocity and track, and position accuracy. Optional parameters include emergency status, velocity accuracy, design assurance and integrity information. ADS-L will transmit at 1Hz for position and 0.1Hz for other parameters and include some basic error detection technique.

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[8] *https://www.easa.europa.eu/en/downloads/134980/en*

3.2 - Current use of Electronic Conspicuity by EDA members

3.2.1 - Overview

e-Conspicuity (broadcast) is generally not in use by military airspace users. Transponders (some Mode S/5 and Mode C) are equipped on certain aircraft types, particularly transport aircraft. Military drones are typically not equipped.

Military users have security concerns, and many missions cannot participate in e-Conspicuity as a result. From a U-space context fitment rules will not apply to military or state aircraft, but are not precluded from 'opting in' by fitment of suitable avionics meeting ADS-L standards. It is also extremely unlikely that secondary radar coverage can be expected to form part of the coverage of U-space airspace, as line of sight constraints combined with radar costs would place a financial burden on the infrastructure provider (USSP) that would negate any business case.

3.2.2 - Transponder fitment on military aircraft

"The preferred method for military aircraft to be conspicuous to the USSP, **if participating** is Mode C transponder"[9].

Transport aircraft (CN35, A400, C130, A330) are typically equipped with Mode S + 5 transponders. These are rarely likely to need to enter U-space airspace. However, such types that are used for maritime patrolling involving flight at very low levels and may need to enter U-space particularly if it is established in the vicinity of coastal regions/islands. In such circumstances, although equipped, the mission may require that the aircraft is not conspicuous.

Rotorcraft have a varying level of equipage of Mode S, but typically below 50% of the fleet. These aircraft may perform missions, such as fire and policing, which could require entry to U-space airspace.

A very small number of fighter aircraft may be equipped with Mode S + 5, which may or may not be transponding depending upon the sensitivity of the mission. These aircraft may need to interact with U-Space airspace.

Mode 5 will not be relevant to U-space as it is not available for civil entities.

3.2.3 - e-Conspicuity fitment

Military or state aircraft (fixed wing > 5.7 t or TAS >250 kts) are not mandated to be equipped with ADS-B. Few aircraft are equipped with ADS-B, which are flying under GAT such as transporters and AWACS, and such aircraft are less likely to require entry into the very low levels outside of controlled airspace[6] that U-space airspace will occupy *and* require e-Conspicuity to enter.

3.2.4 - ATS use of surveillance and e-Conspicuity data

Military aircraft in low-level airspace ranging from fast jets to helicopters require short notice access to low-level airspace and routinely will not comply with the rules of the air. Military aircraft may not want to be conspicuous to either ANSP's or USSP's depending on the nature of the flight. Efficient and timely sharing of certain data however may be possible. The sharing of data would take place only after safety and security issues are considered. Military authorities must reserve the right not to be conspicuous to the USSP and to control the sharing of information on military flights with civil entities.

3.2.5 - Summary

- Military aircraft are not typically equipped with e-Conspicuity.
- Those military aircraft that are equipped with e-Conspicuity are less likely to need to enter U-space airspace.

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[9] DRAFT MILITARY POSITION PAPER ON THE CONSPICUITY REQUIREMENT TO ENTER U-SPACE THROUGH IMPLEMENTATION OF (EU) 2021/666 AMENDMENT TO SERA.6005. 16th September 2021

- The use of transponders will not address the gap in fitment, as equipage is only partial, and would be cost-prohibitive from a ground infrastructure perspective.
- Security issues will mean that it is not possible to equip e-Conspicuity on all military aircraft that may need to enter U-space airspace.

3.3 - Gap Analysis

3.3.1 - Need for e-Conspicuity fitment on military aircraft

Fundamentally, it may be necessary for military aircraft to transit U-space airspace outside controlled airspace[6]. It is not clear at this stage the extent that such action may be required, or which mission types may be involved. It is simply noted as a possibility, since current military missions involve transiting airspace that is likely to be designated as U-space airspace.

Given this possibility, and the design of U-space airspace, military aircraft compliance with e-Conspicuity could support acceptably safe transition of U-space airspace outside controlled airspace[6], as intended for other manned aircraft.

No particular developments appear to address security concerns over conspicuity, and in fact, potentially introduce additional third parties which would need to handle such data including mobile network operators, and third-party manufacturers who operate proprietary e-Conspicuity networks through volunteers.

There remains limited evidence for the need for military to equip e-Conspicuity devices. There are no regulations applicable to military airspace users which require it, and there is significant uncertainty in future need and technologies. There may also be military mission profiles for which e-Conspicuity and U-space airspaces are simply not compatible – for example a fast and low military jet interacting with a small U-space airspace may simply not provide sufficient warning for USSP and drone operators to respond appropriately. These scenarios would require analysis should complete military adoption of e-Conspicuity be considered.

It is noted that the ADS-L concept allows for certified ADS-B to be considered as compliant. Existing military aircraft equipped with such will therefore already be compliant with U-space airspace requirements. Other aircraft, including those equipped with Mode-C transponders (or even Mode-S) would not be considered compliant. Since most military aircraft will not be compliant, ensuring the safety of the military airspace user through the U-space airspace will infer either:

- the need for coordination with the relevant USSP, or
- a military surveillance capability that is able to detect unmanned aircraft, or
- other mitigation means that, combined, are assessed as adequate

A solution involving the partial or temporarily enabled/disabled equipage by military to access U-space airspace is likely to be counter-productive to safety:

- It would introduce a division of responsibilities – military aircraft would need to know when they are about to enter U-space airspace and enable e-Conspicuity *if* security constraints allow it.
- Several places where human error could result in missed coordination with civil actors – in the case that e-Conspicuity could not be enabled other coordination between military and USSP would be required. This assumes that a USSP is suitably vetted and operated to receive such security sensitive information.
- There may still be circumstances where security constraints mean the details of military aircraft with a need to enter U-space airspace cannot be shared with the USSP, which means some other means of ensuring safety would be required.

Never-the-less, a solution *should* be sought to allow the safe passage of military aircraft through U-space airspace, and this may require further study. The passage of a military aircraft through U-space airspace is explored in more detail in section 4 - .

Other potential use cases for e-Conspicuity do not relate to U-space and are therefore beyond the scope of this report.

3.3.2 - Need for military ATS use of e-Conspicuity data from other airspace users

The introduction of SEAR.6005 is expected to result in more GA aircraft equipped with e-Conspicuity. This is especially relevant for U-space airspace outside controlled airspace[6], which may mean previously non-conspicuous aircraft become conspicuous. Since military aircraft have the potential to interact with such users, the potential benefits of e-Conspicuity data from other airspace users, for military ATS and surveillance is considered here.

Military air traffic services could potentially benefit from e-Conspicuity data as a contribution to an overall recognised air picture, however there are several significant concerns of the completeness and quality of the data that will be available:

- Regulations (SERA and IRs) only require *manned* aircraft not subject to air traffic control by an ANSP to be conspicuous *if* they are entering U-space airspace. This means that e-Conspicuity cannot be relied upon to provide a complete recognized air picture outside of U-space.
- Even though technical specifications for ADS-L transmissions have started to be published by EASA ([8]), the iConspicuity concept (and associated ADS-L) do not have a specified timeline for deployment. Whilst they infer wider and more consistent adoption of e-Conspicuity, it is not possible to plan any decision making on their basis at the time of writing.
- EASA's e-Conspicuity interoperability study has recently launched and will propose solutions for GA interoperability that will be of particular relevance to this issue and should generally drive the evolution of e-Conspicuity within Europe. The study will mostly focus on the remaining need for air-to-air interoperability (uplink or collection of all three SERA options for use in an aircraft) and will not complete until 2024.

For ADS-L using SRD860 or mobile telephony then either a USSP or some other ground infrastructure provider (including potentially the military) will have to provide coverage of the uncontrolled airspace[6]. In U-space, we can anticipate that the overall system performance will need to meet required safety target and that the level of quality will allow for the remain-well-clear use case. However, pending the publication of related regulations and requirements, this raises the following questions:

- How can an infrastructure provider ensure they can fully and correctly provide coverage of all proprietary technologies as they evolve?
- The infrastructure provider cannot monitor mobile telecoms themselves (not least due to privacy concerns), so will have to have arrangements with numerous operators.
- As the regulations do not apply to civil RPAS ATS would need to monitor them in some different way, potentially through agreements with USSPs. The number and technical/security capability of USSPs is not clear at the time of writing.

Finally, the ADS-L concept makes the quality indicators present in ADS-B data optional. It is unclear how military ATS could make use of e-Conspicuity data with unknown quality in a meaningful way.

Given the above questions and uncertainty in the specific implementation and usability of future e-Conspicuity (from a military perspective), the key recommendation is to actively monitor the progress of the iConspicuity concept and associated programmes. EDA and its members should provide input on and coordination as a key stakeholder to avoid the potential for such programmes to result in detrimental impact to the safety of military operations.

3.4 - Conclusions

There is a need for military ATS to receive information on civil air traffic (including drones) which would be at least partially provided through the USSPs. There are significant concerns over the quality and completeness of such data which make its use in a military ATS context unclear, and it is likely to be an information tool only.

It must therefore be concluded that civil use of e-Conspicuity will provide limited input for military ATS. It is recommended that EDA seeks to provide a common military view as input to EASAs interoperability study as an important stakeholder.

It may be possible for some of the military aircraft (particularly rotorcraft) that may require entry into U-space airspace to comply through the fitment of certified ADS-B devices. These will meet requirements, are already mature in the marketplace and have relevant TSO/ETSOs which enable their approved fitment. As such they represent the only feasible route for military aircraft to participate in U-space via e-Conspicuity. It is noted that this will never be a complete solution (utilised by all military aircraft) due to security needs. This may be further beneficial as the iConspicuity concept matures.

As discussed in section 3.3.1 - , a solution involving the partial equipage (or a temporary enabling/disabling) by military to access U-space airspace is likely to be counter-productive to safety.

It must be concluded that military conspicuity systems are not currently suitable for meeting U-space requirements, and there is no reason to believe this will change in future. It is therefore clear that the mitigation of safety risks must be dealt with through airspace management (see below).

An additional study is recommended to ensure a suitably safe solution is identified, as military aircraft will certainly continue to interact with airspace that will be designated U-space airspace.

4 - DYNAMIC AIRSPACE RECONFIGURATION

4.1 - U-space regulation

The U-space regulation promulgated by the European Commission creates a new type of airspace, U-space airspace, that 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. U-space airspace can be defined in either controlled or uncontrolled airspace[6] (c.f. Appendix to IR (EU) 2021/664). The key principle to ensure the safety of flights within U-space airspace is the segregation of manned and unmanned flights.

Depending on the case, segregation can be ensured in two ways:

- Within controlled U-space airspace, the dynamic reconfiguration of the airspace should be applied to make sure that manned aircraft which are provided with ATC service remain segregated from drones.
- Within uncontrolled U-space airspace, USSPs use a combination of the UAS flight authorization, geo-awareness services and traffic information to allow safe operations of drones.

4.2 - Airspace design

The Member State is responsible for defining the airspace structures in accordance with Regulation (EU) 2017/373; in addition, as required in Article 15 of the UAS Regulation, the Member State will define the geographical zones for UAS operators (Figure 4). The Member State, when defining the airspace structure, considers the traffic type and complexity and defines the airspace classes and services being provided in accordance with the SERA (Standardised European rules of the air). This information, which can be published either in the Aeronautical Information Publication (AIP) or any other aeronautical publication, can be used by the UAS operator to identify the initial air risk.

A UAS geographical zone is a part of the airspace in which particular conditions apply to the drone operations for security, privacy and protection of personal data, security or environmental reasons. These UAS geographic zones are established for geo-awareness or geo-caging purpose. Data are updated according to the AIRAC (Aeronautical Information Regulation and Control) Cycle, supplemented with national reference documentations (AIP, Sup AIP, NOTAM).

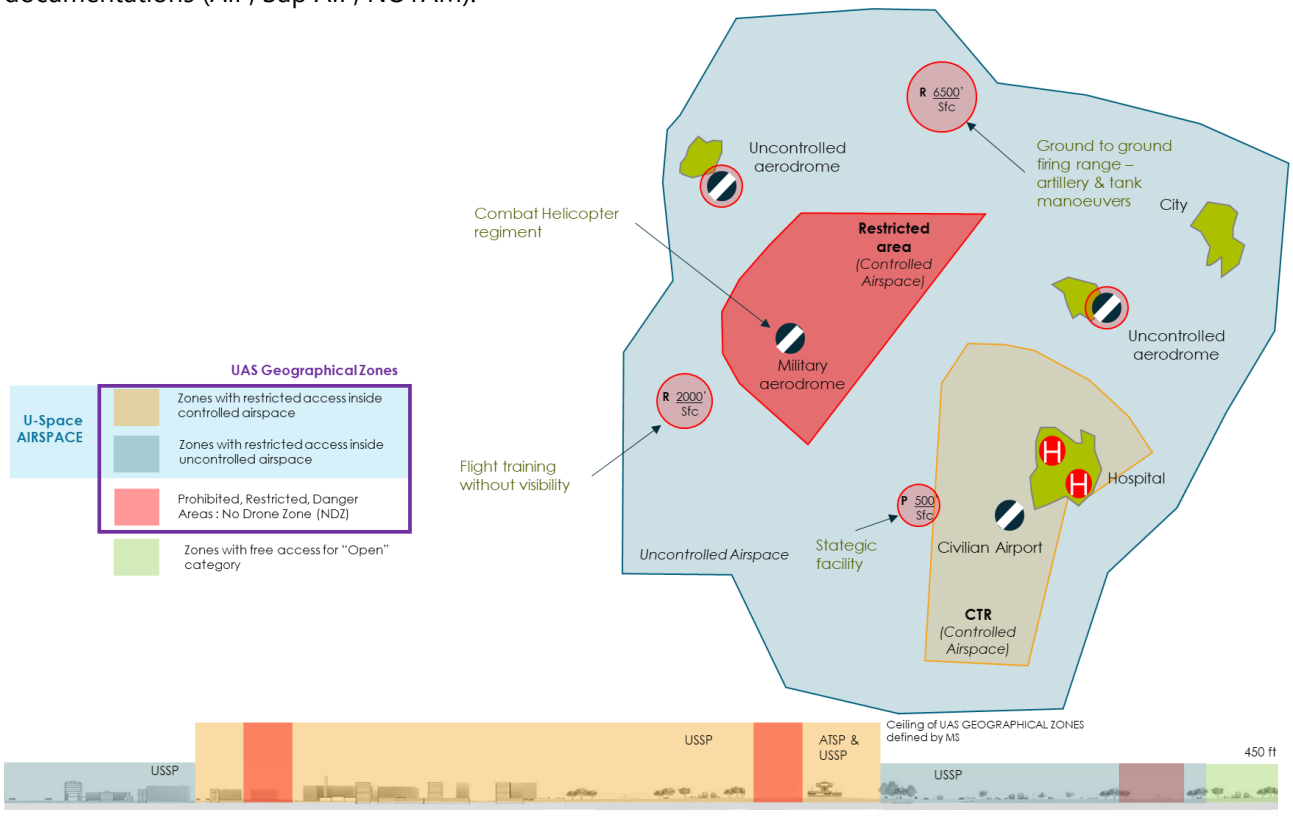

FIGURE 4: AIRSPACE DESIGN AS DEFINED BY THE U-SPACE REGULATORY PACKAGE

Thus a first step of strategic risk mitigation by using a common airspace structure is accomplished by controlling the airspace infrastructure through physical characteristics, that reduce conflicts or make conflict resolution easier.

- Military airfields and facilities[10]
  - The UAS geographic area to protect a military TMA or military CTR is determined by the lateral and vertical boundaries published for that TMA or CTR in the national AIP.
  - This UAS geographical area should be active during the periods described for the area concerned in the national-AIP or by NOTAM. This is an area in which all UAS operations are prohibited.
  - The UAS geographic area to protect a controlled military airfield outside its opening hours is determined by the lateral and vertical limits of the "restricted areas" provided for this purpose described in the National AIP.
  - Tactical units remain the area managers.
- Restricted and dangerous areas
  - The UAS geographical areas to protect military restricted, dangerous areas are determined by the lateral and vertical boundaries of these areas as described in national AIP.
  - The UAS geographical areas are active during the periods described in the national AIP or by NOTAM.
  - Tactical units remain the area managers.
- Prohibited areas
  - The UAS geographical areas to protect military prohibited areas are determined by the lateral and vertical boundaries of these areas as described in national AIP.
  - This UAS geographical area should be permanently active.
- Uncontrolled airfield
  - The UAS geographical area to protect an uncontrolled aerodrome published in the national AIP is a cylinder with a radius of two NM from the ARP (Aerodrome Reference Point) and a height of up to four thousand five hundred feet (Belgian example).
  - This UAS geographical area should be permanently active.

    Access to the UAS geographical area should be subject to the prior flight authorization from the area manager.

Although the U-space services defined in IR (EU) 2021/664 provide a certain level of protection, the military can operate within the whole airspace and the future airspace structure thus creates an underlying risk for military aircraft flying in uncontrolled U-space airspace if the static segregation mechanism does not cover all cases and Armed Forces needs.

The right to access all airspace, within the limits of the operational needs, is a crucial requirement to enable the military, customs and police[11] to perform the security, defence and law enforcement operations mandated by their States and by international agreements. It is a fundamental requirement for States to be able to train and operate State aircraft when and where they want while having due regard for the safety of navigation of civil aviation[12]. The USSP should facilitate the access to U-space airspace to State aircraft and UAS without delay, in order to perform institutional duties.

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[10] *Included those opened to public use.*

[11] *This study focuses on military aircraft and other State aircraft will not be considered further. However, most issues discussed here are relevant for customs and police aircraft.*

[12] *ICAO Convention Article 3-d)*

The Dynamic Airspace Reconfiguration[13] process extended to the Uncontrolled U-space airspace is a welcome way to offer some flexibility in the management of the overall airspace while maintaining an appropriate level of safety. However, the definition of a similar process for military flights is a complex issue as they frequently operate within uncontrolled airspace[6] and may not be conspicuous to USSPs. Therefore, we investigated how the military could benefit from the DAR process, or a similar one in uncontrolled airspace[6], so the U-space airspaces can be managed in the most flexible and efficient manner for all users. Our proposal builds on initial work conducted within SC1, where a preliminary exploration of the applicability of a Flexible Use of uncontrolled U-space airspace was initiated, based on a civil/military UTM-ATM coordination and cooperation, including:

- airspace design,
- airspace access requirements,
- long- and medium-term planning,
- short-term coordination, and
- standardised procedures.

4.3 - Flexible use of uncontrolled U-space airspace

4.3.1 - Approach

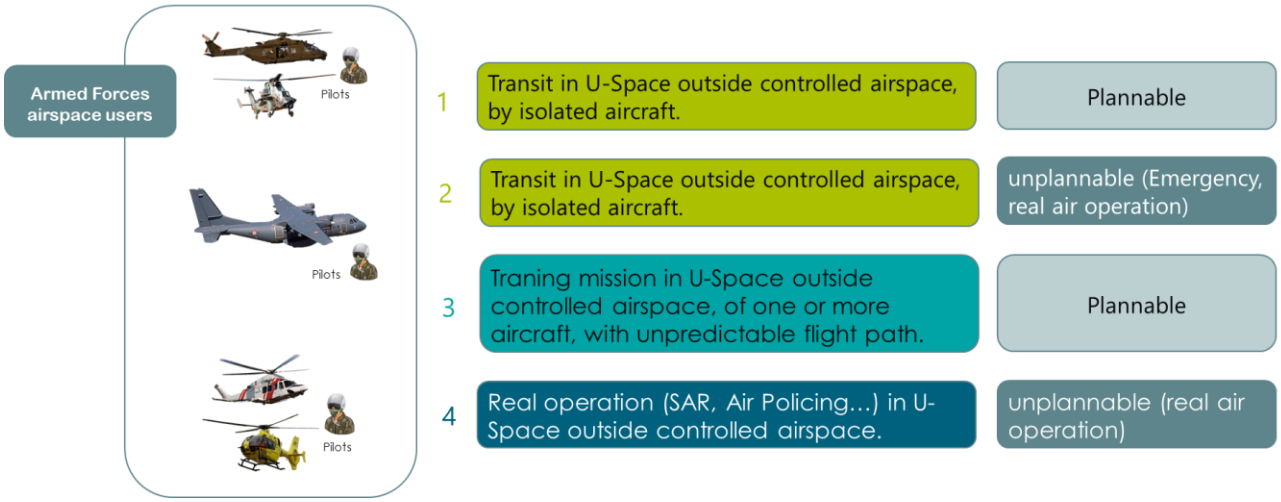

FIGURE 5: INTERACTION CASES BETWEEN UAS AND ARMED FORCES OPERATING WITHING U-SPACE, OUTSIDE CONTROLLED AIRSPACE

We identified four possible interaction cases (Figure 5) between the UAS and the armed forces operating at very low levels (e.g. 400 ft AGL and below) within U-space outside controlled airspace[6] covering all military key needs and defined four dynamic segregation process planned or unplanned to apply. The SERA Regulation requirement where all aircraft, manned and UAS, have to remain well clear from and avoid collisions with other manned aircraft:

- UC1: Planned transit in U-space airspace outside controlled airspace[6]: single aircraft requiring Transit Corridor (flight without evolutions and the flight path is identified).
- UC2: Single aircraft carrying out an operational mission whose unplanned transit requiring segregated corridor (flight without evolutions). However, the flight path could be known by the ATS Unit providing flight information service

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[13] *Dynamic Airspace Reconfiguration (DAR) is the process defined in IR 2021/664 through which Air Traffic Control services can coordinate with a USSP to ensure that a manned aircraft under ATC can remain segregated from drone traffic when operating within a U-space airspace. Recital 13 of the regulation places the responsibility of defining these dynamic restrictions on Member States, recognizing that State aircraft are excluded from the regulation.*

- UC3: Flight of an isolated aircraft or patrol whose planned training evolutions requiring training sector (volume greater than a Transit Corridor).
- UC4: Operational mission requiring total or partial neutralization of the U-space airspace inside uncontrolled airspace[6].

4.3.1.1 - Requirements / Main assumption

4.3.1.1.1 - Strategic Airspace Management Level:

- Military authorities should design **HTA** (Helicopter Training Areas) within uncontrolled airspace[6] (Class G) from ground up to 500 feet. These areas should have a regulated status (like R or D areas) and published in national AIP.
  - The UAS geographical areas to protect military HTA have to be determined by the lateral and vertical boundaries of these areas and described in national AIP.
  - The UAS geographical areas are active during the periods described by NOTAM and a VLL training activity plan message (see section 4.3.4 - UC3 _ Training mission in U-space outside controlled airspace: Airspace management cell - U-space (AMC[U])).
  - A section of the national Airspace Management Cell dedicated to uncontrolled U-space airspace (called here **AMC[U]**) could be the pre-tactical manager.

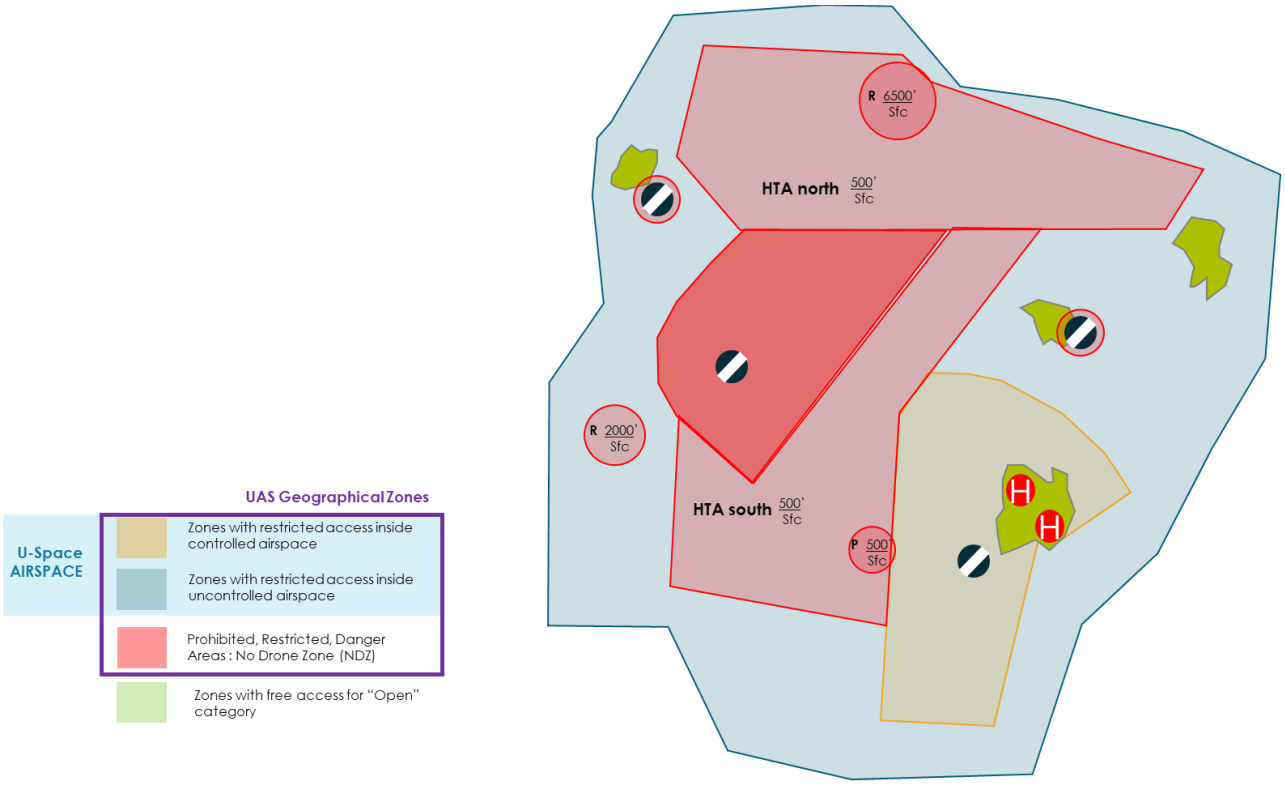

FIGURE 6: HELICOPTER TRAINING AREA

- **LFA** (Low Flying Areas) dedicated to fighter or transport aircraft or a mixed training forces should be designed by Military authorities within uncontrolled airspace[6] (Class G) from ground up to 500 feet. These areas should have a regulated status (like R or D areas) and published in national AIP.
  - The UAS geographical areas to protect military LFA have to be determined by the lateral and vertical boundaries of these areas and described in national AIP.
  - The UAS geographical areas are active during the periods described by NOTAM and VLL training activity plan message (see see section 4.3.4 - UC3 _ Training mission in U-space outside controlled airspace: Airspace management cell - U-space (AMC[U])).
  - A section of the national Airspace Management Cell dedicated to uncontrolled U-space could be the pre-tactical manager.

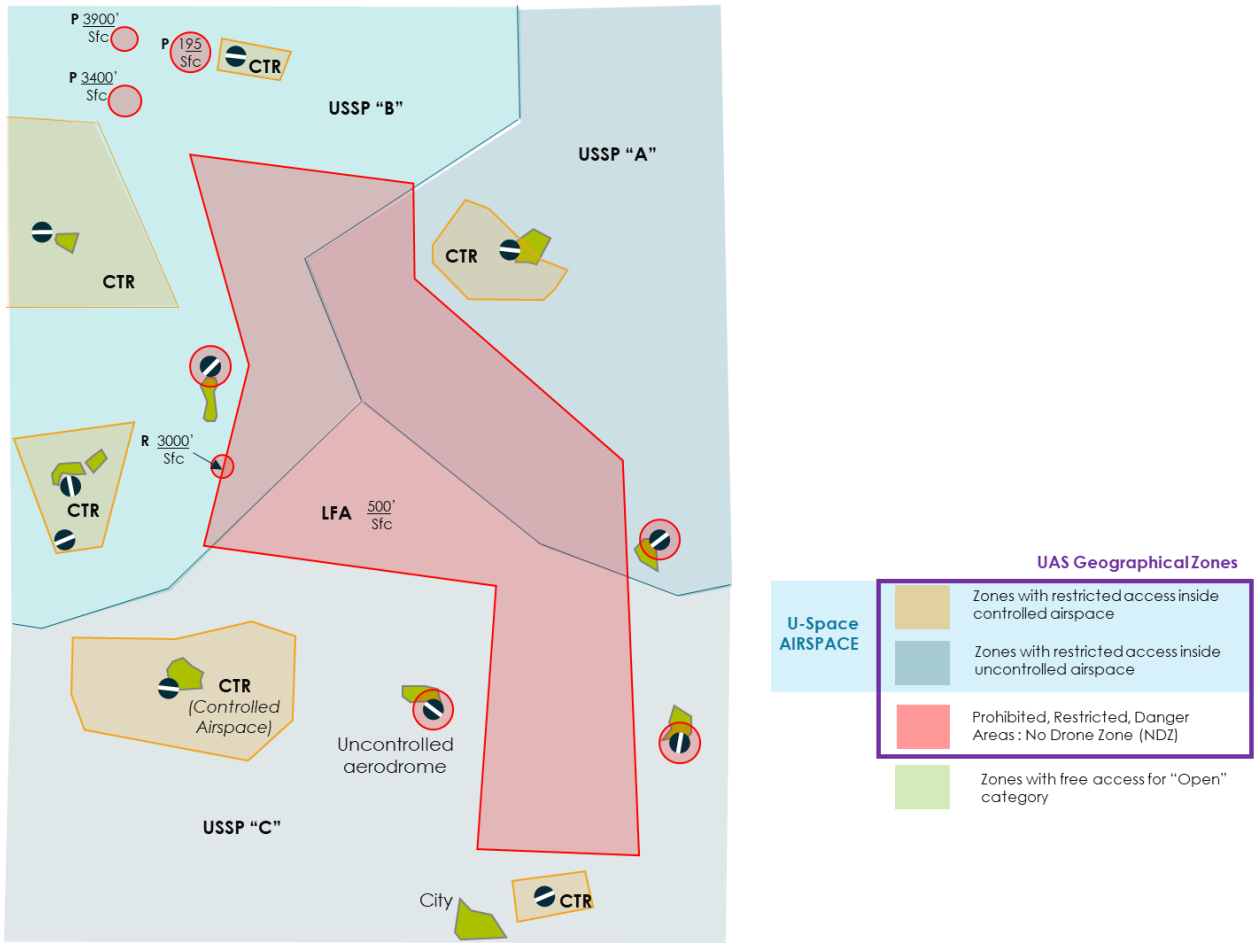

FIGURE 7: LOW FLYING AREA

- Military authorities should design a **Common grid** partitioning all U-space airspace in order to have a common reference and efficient coordination between NAOC and CISP/USSP within uncontrolled airspace[6]. These GRID could be published in national AIP.
  - UAS geographical areas have to be determined by the all partitions of the grid unit elements and described in national AIP.

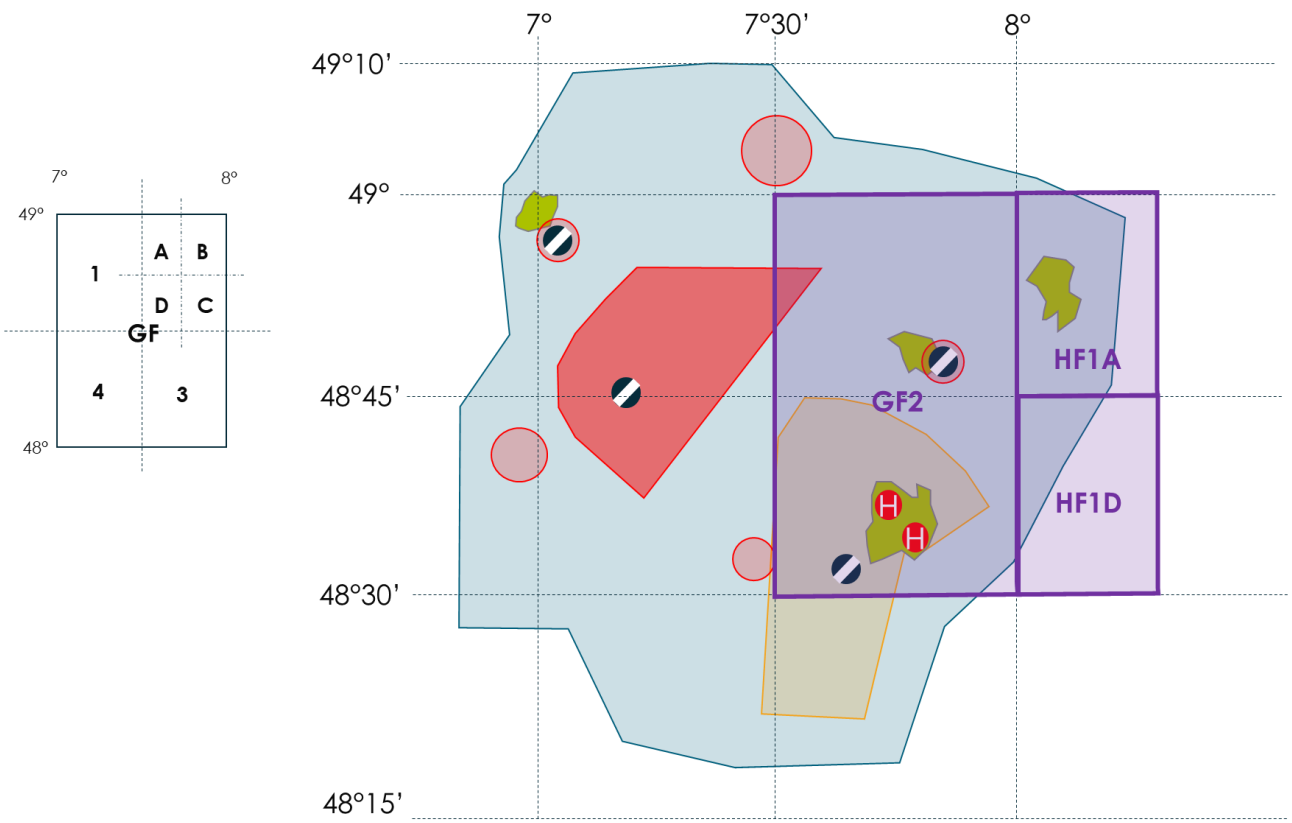

FIGURE 8: EXAMPLE OF COMMON GRID REFERENCE

4.3.1.1.2 - Systems interoperability

Interoperability among civil and military systems is a must, notably because a dynamic and efficient exchange of data is participating to reach the best level of security. In the context of Dynamic airspace reconfiguration Military and Member states should ask to CISP/USSP to assume the overall technical interoperability, relying on the ability to exchange information between their own devices or systems.

- VFR Flight Plan:

The CISP / USSP system should be able to receive and process the information transmitted in the flight plan in particular ROUTE field and EET indicator field 18 (see section 4.3.4 - UC3 _ Training mission in U-space outside controlled airspace: Airspace management cell - U-space (AMC[U]).

- CISP/USSP Remote Human-Machine Interface (HMI):

All ATS Units (civilian and military) / Military Controlling Unit providing advisory, flight information and alerting services within uncontrolled U-space airspace, as the coordinator in the context of Dynamic Airspace Reconfiguration should ideally have a connected CISP/USSP remote HMI in order to confirm the effective Transit Corridors, areas' activations and deactivations, to create and activate Emergency Transit Corridors.

- Benefits

A stand alone, CISP/USSP remote HMI supplied by UTM service providers

- Ensure military information systems security.
- Allows ATS Unit to view Transit Corridors, Areas (HTA, LFA, R, D, P) activated, the neutralized sectors and the 3D location of drones airborne.
- Enable ATS Unit to provide flight information (protection volumes activated and position of the drones) to pilots operating within the U-space outside controlled airspace[6] and to facilitate emergency exits.

The NAOC (National Air Operation Centre) as the air operation commander should ideally have a connected CISP/USSP remote HMI in order to order partial or total neutralization.

- Benefits

  A stand alone, CISP/USSP remote HMI supplied by UTM service providers

  - Ensure military information systems security.
  - allows NAOC to view neutralized sectors.

4.3.1.2 - Actors (individuals and organisations)

The compatibility of the military operations and UAS operations within Uncontrolled U-space airspace should be carried out by strategic, pre-tactical and tactical AirSpace managers, ATM service providers and UTM service providers applying a dynamic coordination and reconfiguration of the segregation.

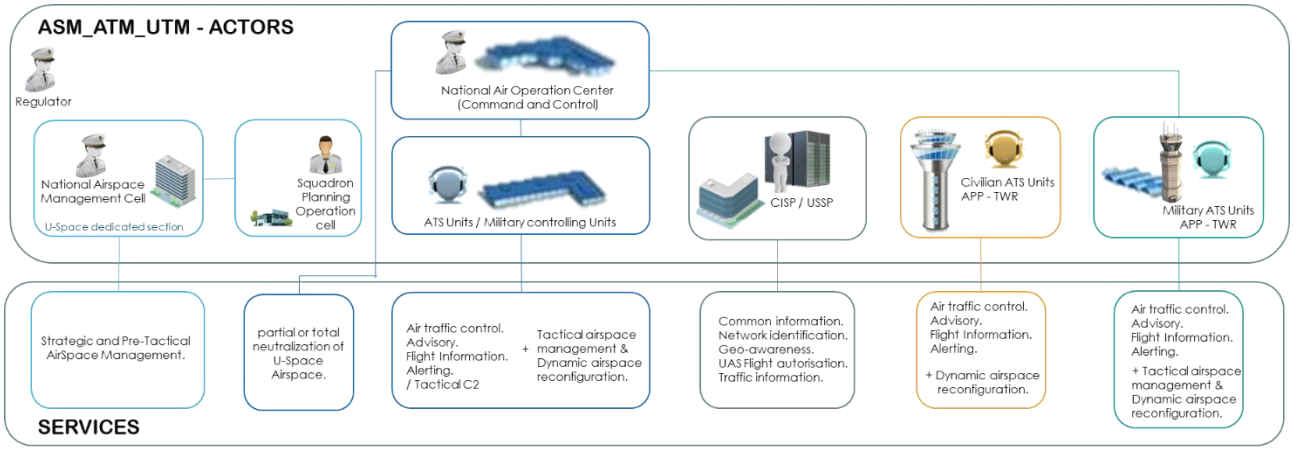

FIGURE 9: ASM, ATM AND UTM ACTORS AND SERVICES

Where :

- AMC[U] is the Uncontrolled U-space dedicated section of national Airspace Management Cell.
- ATS Units will be the general term representative of Flight Information Centres, Military Controlling Units, Civilian and military Approach Units providing advisory, flight information and alerting service within uncontrolled airspace[6].
- ATS Units should be the tactical coordinator for Dynamic Airspace Reconfiguration.

FIGURE 10: AIRSPACE USERS

4.3.2 - UC1 _ Planned transit in U-space airspace outside controlled airspace: Filing a VFR[U] Flight Plan

In order to coordinate a U-space outside controlled airspace[6] transit, pilot of an isolated military aircraft has to fil in a specific VFR Flight Plan, we will call VFR[U]. It should be sent to additional recipients:

- ATS Unit providing information and alert services of the FIR in which the U-space transiting is located.
- CISP / USSP providing services within designated U-space sector.
- Destination airfield and alternate airfield

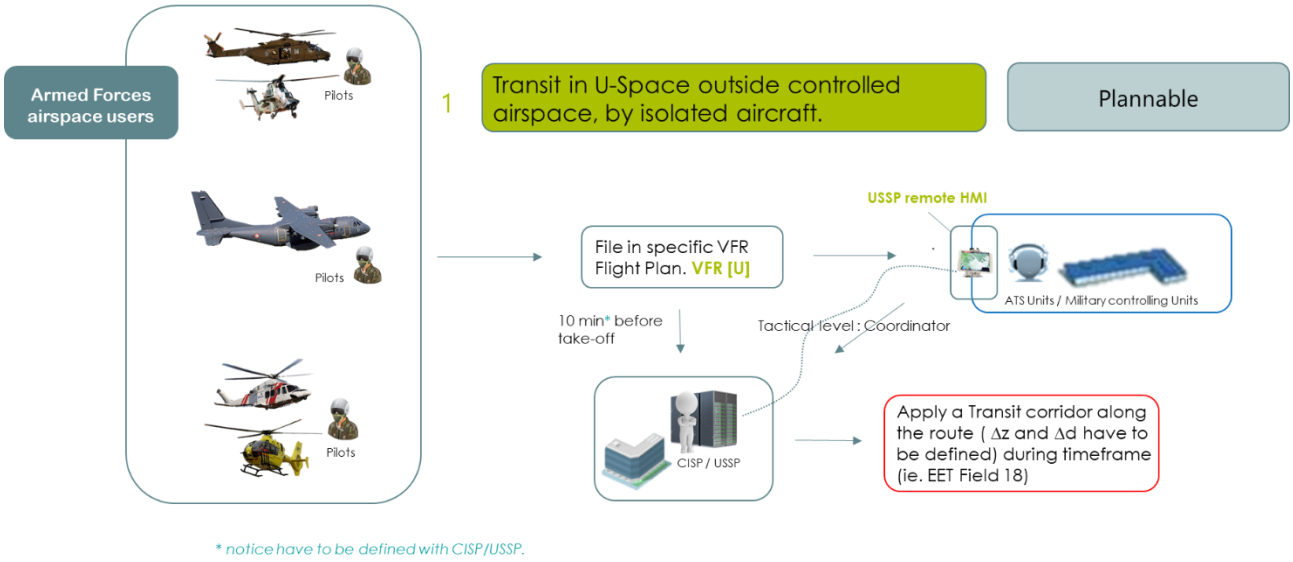

FIGURE 11: REQUEST TRANSIT CORRIDOR COORDINATION – MEDIUM-TERM PLANNING

4.3.2.1 - VFR[U] flight plan filing time

- Deadline for filing: 30 minutes[14] before take-off. Should not exceed 24 hours.

In case of foreseeable delay leading to non-compliance with the U-space entry time:

- a delay message (DLA) if the flight is delayed by more than 30 minutes from its Estimated Time of Departure.
- Any cancellation of a flight for which VFR[U] flight plan has been filed would be notified as soon as possible to the USSP system by a cancellation message (CNL) in order not to multiply the U-space airspace reconfiguration notices.

4.3.2.2 - VFR[U] flight plan contexture

The VFR[U] flight plan is filed on an ICAO Flight plan Form with some special features concerning the U-space transit, in order to:

- inform the USSP of the route, altitude and time elements in order to apply the appropriate segregated Transit Corridor. The receipt of the VFR[U] flight plan constitutes the transit notice.

The USSP system should be able to process the information transmitted in the flight plan.

[14] *Notice has to be defined with CISP/USSP.*

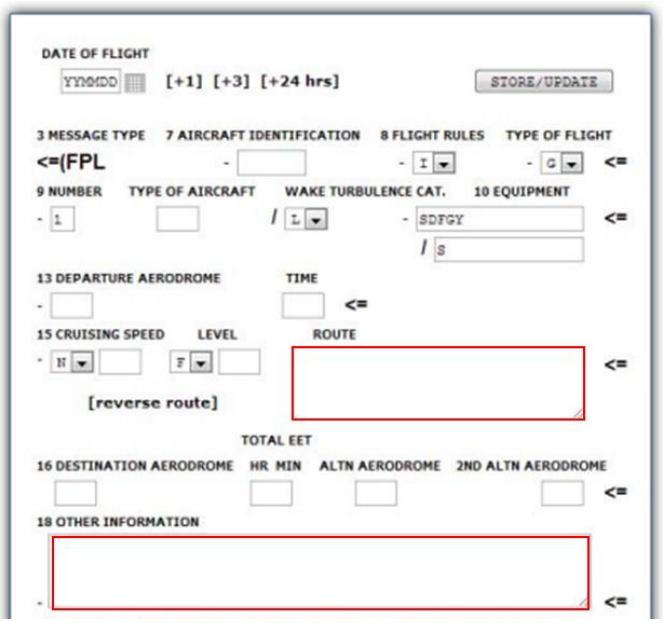

FIGURE 12: ICAO FLIGHT PLAN FORM

- ROUTE field (cf. Figure 12):

A string of points (and connecting airways or DCTs where applicable) describing an ATS route or path of fixes no more than 30 minutes flying time or 200 NM apart, including those points where a change of speed, level, track, or flight rules is planned. Points can be listed by their coded designator (e.g., LN, MAY, HADDY), a 7 or 11-character representation of their coordinates (i.e. 4620N07805W), or a point relative to a reference point based on bearing and distance (i.e. DUB190040 being 40nm out on the 190 degrees magnetic bearing from DUB).

Change of speed and/or level is indicated by appending data formatted as in 15 CRUISING SPEED and LEVEL to a point, after a slash (e.g., MAY/N0130A002, 4620N07805W /N0250A004).

U-space transit is shown by a "**EUSPACE**" to the entry point after a slash follow by speed and altitude data formatted: 4620N07805W/EUSPACE N0250A004.

The U-space exit is shown by a "**XUSPACE**" to the point after a slash: 4630N07320W/XUSPACE;

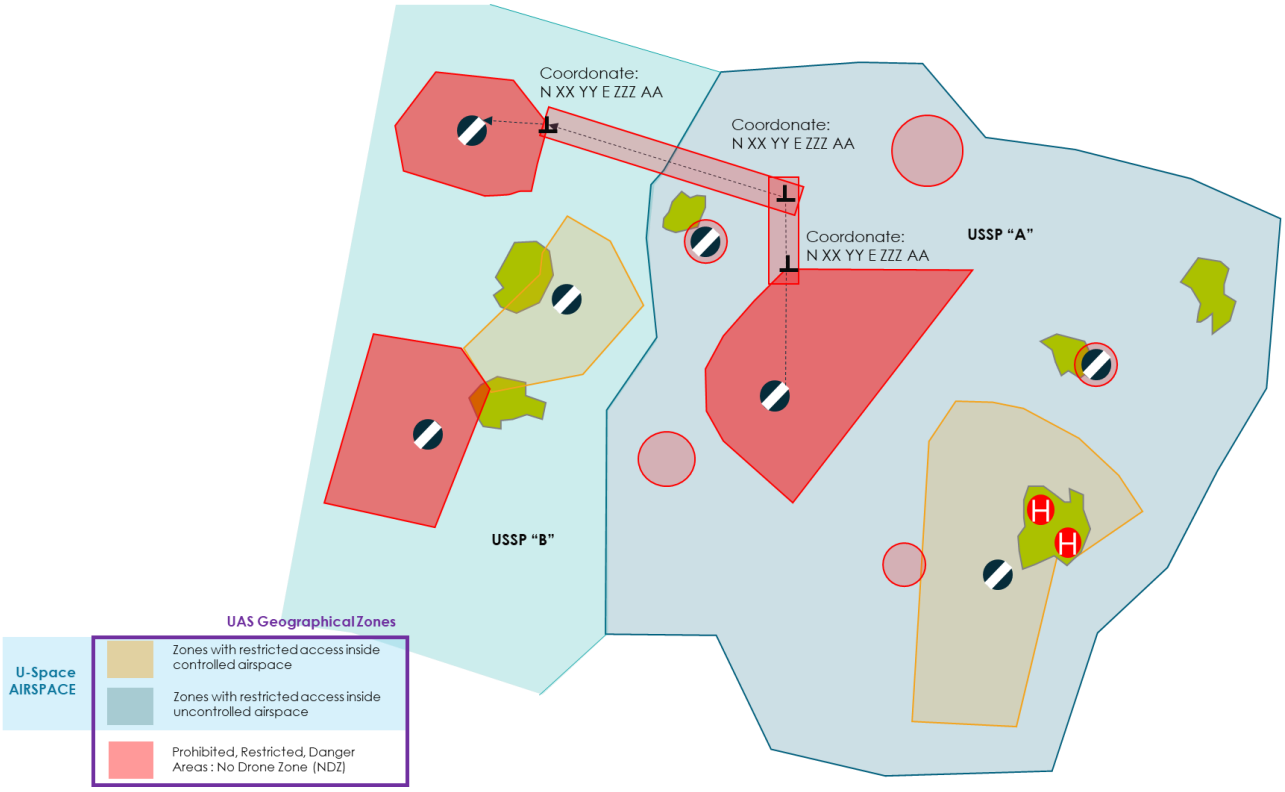

FIGURE 13: COORDINATED TRANSIT CORRIDOR BY VFR[U] FLIGHT PLAN

- Field 18 Other Information (cf. Figure 12):

Indicators filled in in the case of a U-space transit outside controlled airspace[6]:

EET indicator will recall U-space entry and exit points and associated times. EET/ Estimated Elapsed Time(s) in "HHMM" format to Significant Fixes or FIR Boundaries. i.e. **EET/EUSPACE0745 XUSPACE0830**

RMK/ plain language remarks where necessary

STAYINFO/ when the transit is the way in and/or way out to/from a training sector within U-space outside controlled airspace[6].

When filing a flight plan, the pilot will verify that his route is deconflicted from the AMC[U] planned training sector activations (see section 4.3.4 - UC3 _ Training mission in U-space outside controlled airspace: Airspace management cell - U-space (AMC[U])).

4.3.3 - UC2 _ Unplanned operational transit in U-space airspace outside controlled airspace.

In order to coordinate a U-space outside controlled airspace[6] Emergency and or operational transit (Figure 14), pilot of a single military aircraft has to transmit to the ATS Unit (civilian and military) / Military Controlling Unit providing advisory, flight information and alerting services within this portion of uncontrolled U-space airspace, intentions and flight path elements. The ATS Unit is the coordinator and manages the Dynamic Airspace reconfiguration.

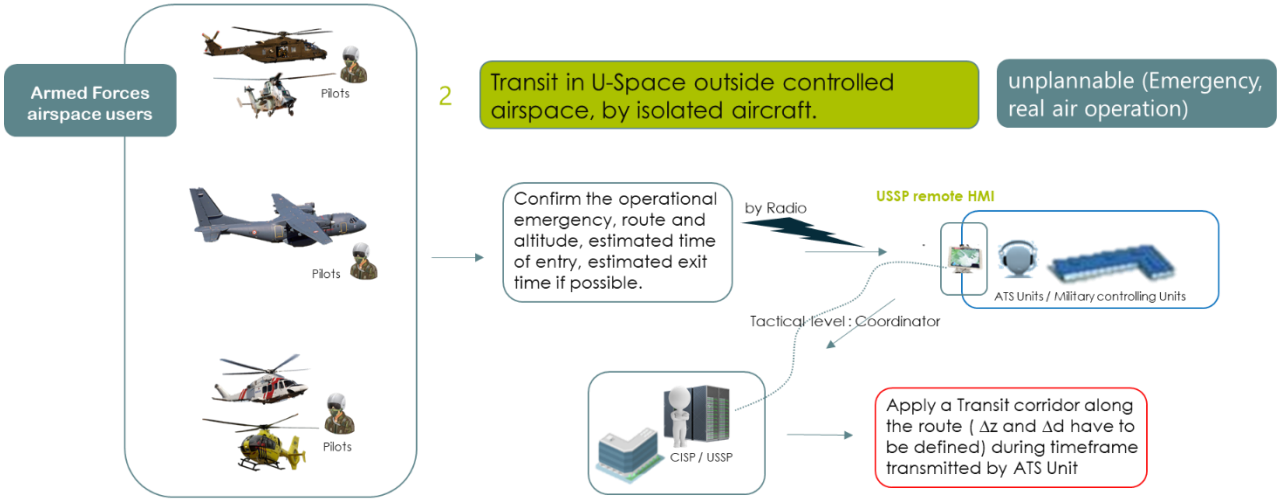

FIGURE 14: REQUEST TRANSIT CORRIDOR COORDINATION – SHORT-TERM COORDINATION

The ATS Units / Military controlling units as the coordinator connected to CISP/USSP create and activate the Emergency Transit Corridor directly in the CISP/USSP System. The USSP applies a Transit corridor along the route implemented (cf. Figure 14).

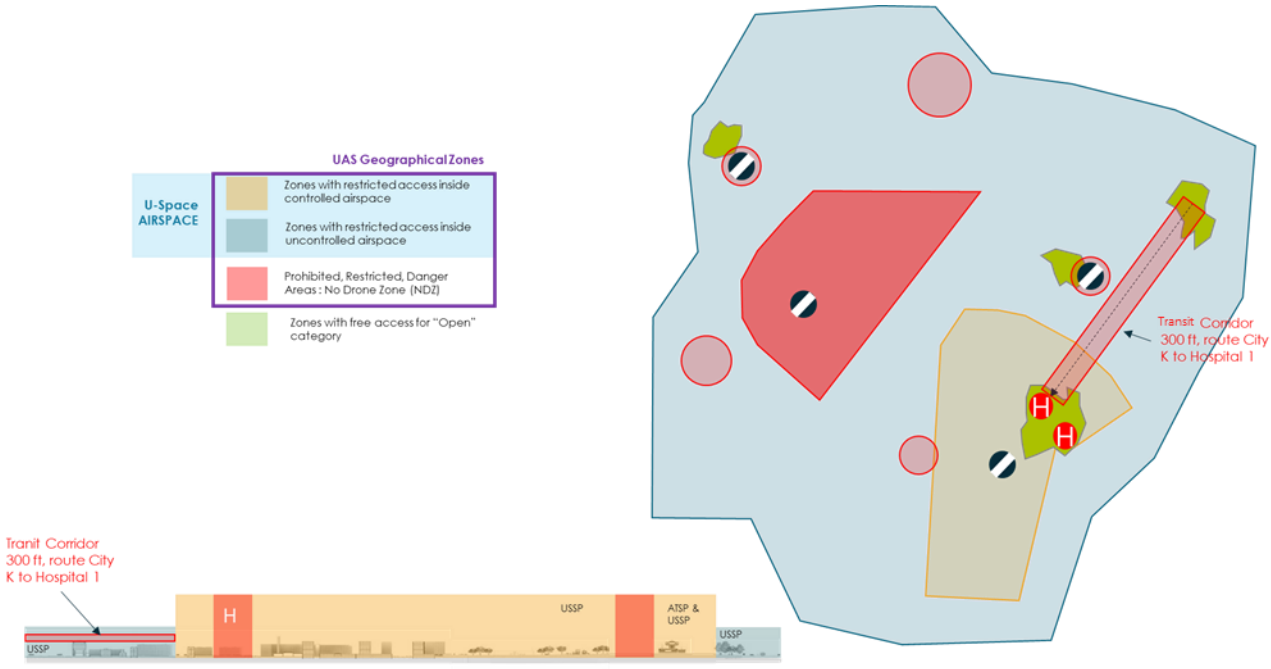

FIGURE 15: COORDINATED TRANSIT CORRIDOR BY ATS UNIT

4.3.4 - UC3 _ Training mission in U-space outside controlled airspace: Airspace management cell - U-space (AMC[U])

Within U-space airspace outside controlled airspace[6], AMC[U] plans training activities inside Low Flying or Helicopter Training areas (LFA & HTA) (defined in the AIP at strategic level) and Temporary Restricted Zone (TRZ) when areas defined at strategic level are not suitable for specific exercises (defined by SUP AIP). AMC[U] disseminates aeronautical information through NOTAM (12 hours' notice or less notice after agreement with Aeronautical Information Service (AIS) and CISP) and VLL training activity plan message.

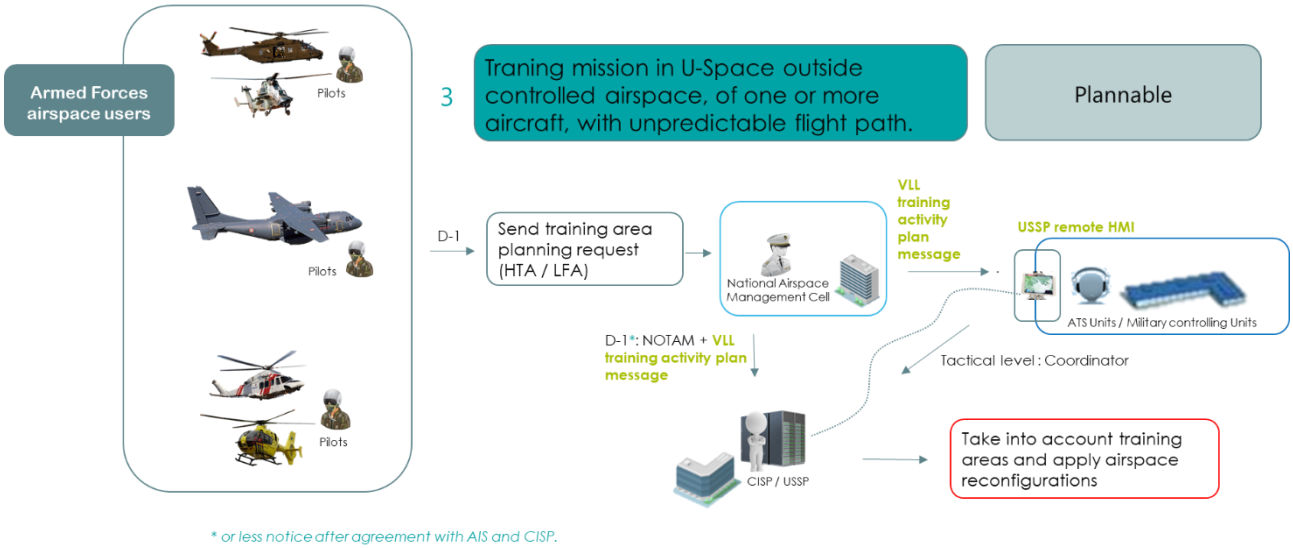

FIGURE 15: HTA, LFA TRAINING PLAN ACTIVITY - LONG- OR MEDIUM-TERM PLANNING

4.3.4.1 - Status of training areas.

The airspaces that make up the training areas are Helicopter Training Areas (HTA), LFA (Low Flying Area) or Temporary Restricted Zone (TRZ).

4.3.4.2 - Lateral and Vertical Limits.

The lateral and vertical limits are defined by the AIP (HTA, LFA areas) or by NOTAM (TRZ).

4.3.4.3 - Activation schedules.

Regarding the management of these areas and the information transmitted to users, only the UTC time refers.

4.3.4.4 - Informing the CISP/USSP.

Information on areas activity is provided by: messaging and NOTAM.

4.3.4.5 - Areas and Zone Management within U-space airspace outside controlled airspace.

The planning activity of Helicopter Training or Low Flying areas and Temporary Restricted Zones is the responsibility of the Defence AMC[U]. According to the specific context of missions within the U-space airspace outside controlled airspace[6], to ensure collision prevention, rigorous management of military activity is essential.

4.3.4.5.1 - Pre-Tactical Airspace Management

Within U-space outside controlled airspace[6], National or sub-regional Airspace Management Cell provides :

- The planning of the activation and use of the HTA, LFA or Temporary restricted Zones contained wholly or partly in U-space Airspace, regardless of the nature of the Defence activities taking place there. This activity plan is stopped on D-1 working day before 14:00 local time, then published.
- The request for associated NOTAMs from the national AIS (Aeronautical Information Service) 12 hours prior to the scheduled time of the activity.

4.3.4.5.2 - Tactical Airspace Management

- The activation status of an area is transmitted to the USSP, by the ATS unit providing the flight information service. The activation request is the responsibility of the pilot or patrol leader as per the schedule. The circumvention of activated zones is mandatory by the other users (UAS). The extension of a defined slot in the activity plan is not possible in real time.
- In special cases (forest fires, MEDEVAC, Emergency Medical operation, air policing operation, SAR operation etc.), the NAOC may have to interrupt drone activity in all or part of the uncontrolled U-space airspace. The procedure for total or partial neutralisation of the waste activity is described in section 4.4 - Neutralization of the U-space airspace outside controlled airspace.

4.3.4.5.3 - Provision of air traffic services

Air traffic services may be provided to military aircraft operating within U-space outside controlled airspace[6]:

- The segregation of the two circulations (manned and unmanned) is guaranteed by an exclusive space reservation.
- The advisory, flight information and alert services are provided by the ATS unit (civilian or military).

4.3.4.6 - Definition of area status

An area can be assigned two separate states, each meeting a specific need:

- INACTIVE: no manned activity is scheduled in the area. The airspace may be accessed by all drones.
- ACTIVE: manned military missions that may pose a risk to air navigation and require special protection are scheduled within the area. This airspace must be bypassed by drones. Other military aircraft apply See and avoid and should be aware of training activity by NOTAM or by AMC[U] VLL training activity plan message. They may also benefit from traffic information if they request it from the ATS unit.
- Special case:

  Although the area is activated in favour of common missions, it may be necessary to interrupt the scheduled activity within the latter and the surrounding drone activity in order to allow other priority military activities to be carried out for a specified period of time. This emergency neutralisation is the subject of section 4.4 - Neutralization of the U-space airspace outside controlled airspace.

4.3.4.7 - Procedure for planning fixed (strategic level definition) or temporary (specifically created for a particular activity) areas for the protection of military aircrafts within U-space outside controlled airspace

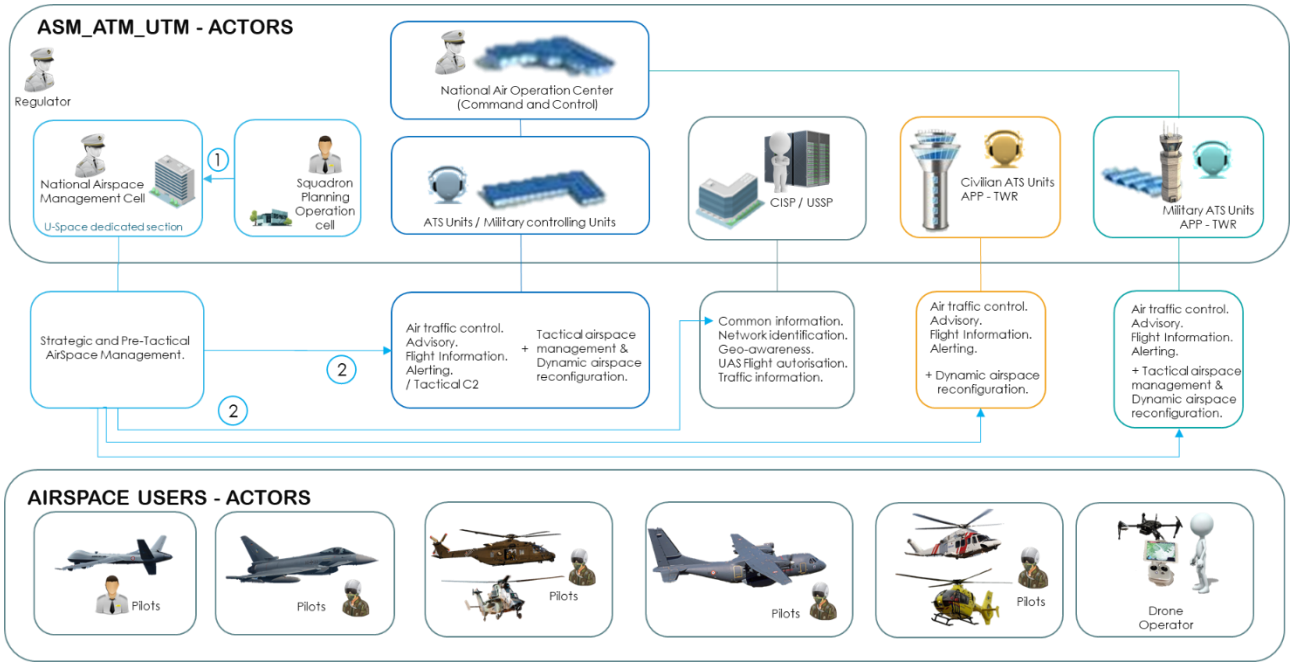

FIGURE 16: HTA, LFA TRAINING PLAN ACTIVITY – LONG- OR MEDIUM-TERM PLANNING

4.3.4.7.1 - Routing of requests

(1 – Figure 16) All area planning requests should be received by the AMC[U] no later than the last business day prior to the flight before 14:00 local time and at least 12 hours[15] prior to the flight (for NOTAM publication).

4.3.4.7.2 - Planning of activity

- The AMC[U] collates all military request and schedules the use of areas or portions of areas within the U-space outside controlled airspace[6], asks the AIS to publish NOTAM's areas:
  - for training activities that cannot be satisfied with AIP areas,
  - For training activities within AIP areas.
- The AMC[U] ensures the deconfliction (geographical and temporal) between the different requests.
- (2 – Figure 16) The AMC[U] is responsible for the dissemination of aeronautical information.
- If it is not possible to give a favourable response to a request for a particular activity, the AMC[U] should inform the applicant as soon as possible and no later than D-1 14:00 local time.

4.3.4.7.3 - Updating planning

- A VLLAct[U] (Very Low level training activity plan within U-space outside controlled airspace[6]) message is broadcast on D-1 by 17:00 local to the squadrons, ATS Units and CISP/USSP, specifying the D-Day, HTA, LFA and TRZ usage activity planning, including day and night flights if applicable.

4.3.4.7.4 - Information for Service Providers and Users

The activations scheduled of the HTA, LFA and TRZ within U-space outside controlled airspace[6] are brought to the attention of civilian and military users by the broadcast of the VLLAct[U] message.

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[15] *or less notice after agreement with AIS and CISP.*

Thus, on a daily basis, AMC[U] :

- Publish before 17:00 local time a VLLAct[U] message specifying the activation times of the areas for the next business day, distributed to all military and civilian users, via the AIS.
- Publish before 17:00 local time a VLLAct[U] message addressed to all civilian and military ATS Units, CISP/USSPs and military organizations and indicating, for each mission of the following working day, the usable areas, a time of activation (entry) and a time of deactivation (exit) within U-space outside controlled airspace[6].
- Transmits to AIS, on D-1, or the previous business day, a NOTAMs request specifying the activation of HTA, LFA and TRZ within U-space outside controlled airspace[6] for D-Day. Only the areas mentioned in this message may be used. It is therefore up to the different users (military) to check that the planning corresponds to their request.

4.3.4.7.5 - Mission cancellation

- Any mission cancellations should be communicated as soon as possible to the AMC[U] (to the NAOC outside of business hours).
- This cancellation information is immediately transmitted to:
  - The CISP/USSP concerned,
  - The ATS Units responsible for ensuring the activation area or zone at entry and deactivation at effective exit from U-space airspace for the benefit of the mission concerned.

4.3.5 - General principles for military flights within U-space airspace outside controlled airspace

This section introduces general principles for procedures, that can then be adapted locally.

4.3.5.1 - General information

- Military aircraft display transponder code 3/A 2000, (or other specific code defined by regulator).
- It is forbidden for military aircraft to enter a U-space airspace in case of IFF failure.
- Only areas planned by the AMC[U] via the VLLAct[U] message can be used.
- The pilot or patrol leader adheres to the schedules indicated in the VLLAct[U] message or the VFR[U] flight plan. Scheduled anticipation needs to be coordinated.. Schedule overrun can be applied if and only if it does not interfere with any other military activity within this portion of-U-space.

4.3.5.2 - Principles for transits within U-space airspace outside controlled airspace

Flight safety is ensured through the application of three basic principles:

- Adherence to planned time of entry;
- Adherence to coordinated route and altitudes or maintaining area boundaries (HTA, LFA or TRZ);
- Respect for the planned exit time.

4.3.5.3 - Entering U-space

- All entries are under the control of the ATS Unit designated as coordinator (only interlocutor of the USSP).
- No entry is possible outside the planned (VLLAct[U] message) or coordinated (VFR[U] Flight Plan) entry point.
- Without bilateral radio contact, integration into the U-space network is prohibited.
- ATS Units designated coordinators in charge of military integration in U-space, facilitate the phases of flight prior to onboarding, but are not allow to modify schedules.
- No anticipation of the planned time of entry should not be possible without coordinated action.

4.3.5.4 - U-space exit

The exits are made at the identified exit point, at the scheduled (VLLAct[U] message) or coordinated (VFR[U] flight plan) time.

In the event of an estimated delay after the scheduled or coordinated exit time, the pilot reassesses the exit time with the ATS Unit identified as the coordinator, so that the latter transmits the extra time to the USSP.

As long as the ATS Unit has not deactivated the area or Transit Corridor with the CISP/USSP, the latter remains active.

4.3.5.5 - Navigation in U-space

4.3.5.5.1 - Procedures

During navigation the crews apply the following instructions:

- Altimeter set to the appropriate regional QNH (or consider SESAR work about Common Altitude reference System),
- Transponder code 3/A 2000 (or other specific code defined by regulator) squawking;
- Radio:
  - Listen to the frequency of the ATS Unit (coordinator) providing information and alert services.
  - Obligation to contact before entry and exit.

4.3.5.5.2 - Emergency exit

Events can force crews to leave the segregated airspace:

- With the help of the ATS Unit (coordinator) providing the services of information and Alert, which Ideally, will have the 3D location of the drones in flight on the CISP/USSP remote HMI.
- Without the assistance of the ATS Unit (coordinator) providing the information and Alert services, promoting an exit through the ceiling of the U-space sector by ensuring special surveillance of the sky and applying the see and avoid rule.

4.3.6 - Dynamic Airspace Reconfiguration procedure.

The objective of this chapter is to define the coordination procedure to be applied by military pilots and service providers for the transit of U-space outside controlled airspace[6] by armed forces flights for training reasons or for imperative duty reasons.

It is recalled that U-space airspaces outside controlled airspace[6] are located below the minimum control altitude (as MRVA: Minimum Radar Vectoring Altitude) of the ATS Unit. Also the air traffic control service is provided through an exclusive space reservation. The advisory, information, alert and assistance services will be provided. ATS Unit will coordinate with the CISP/USSP via CISP/USSP remote HMI. If no radio contact can be established between the applicant (Pilot) and the coordinator (civilian or military) then the procedure is prohibited.

4.3.6.1 - Scope of application

This transit within U-space airspace outside controlled airspace[6] on an exceptional basis (operational reason – emergency operations of assistance or safeguarding of human lives and for imperative missions of public security) or as a training (planned and pre-coordinated – VFR flight plan / NOTAM Zone / SUP AIP Zone) is strictly reserved for military, security forces and HEMS. This procedure is applicable except for the partial or total neutralisation procedure of the U-space airspace (by the National Operations Centre - NAOC).

4.3.6.2 - Pilot procedure in transit within U-space outside controlled airspace

At least 5 minutes before the scheduled time of entry into U-space outside controlled airspace[6], the pilot of the aircraft:

- squawk the mode 3/A 2000, (or other specific code defined by regulator) "Ident" transponder code,
- Contact the ATS Unit (civilian or military) providing Flight Information Service.

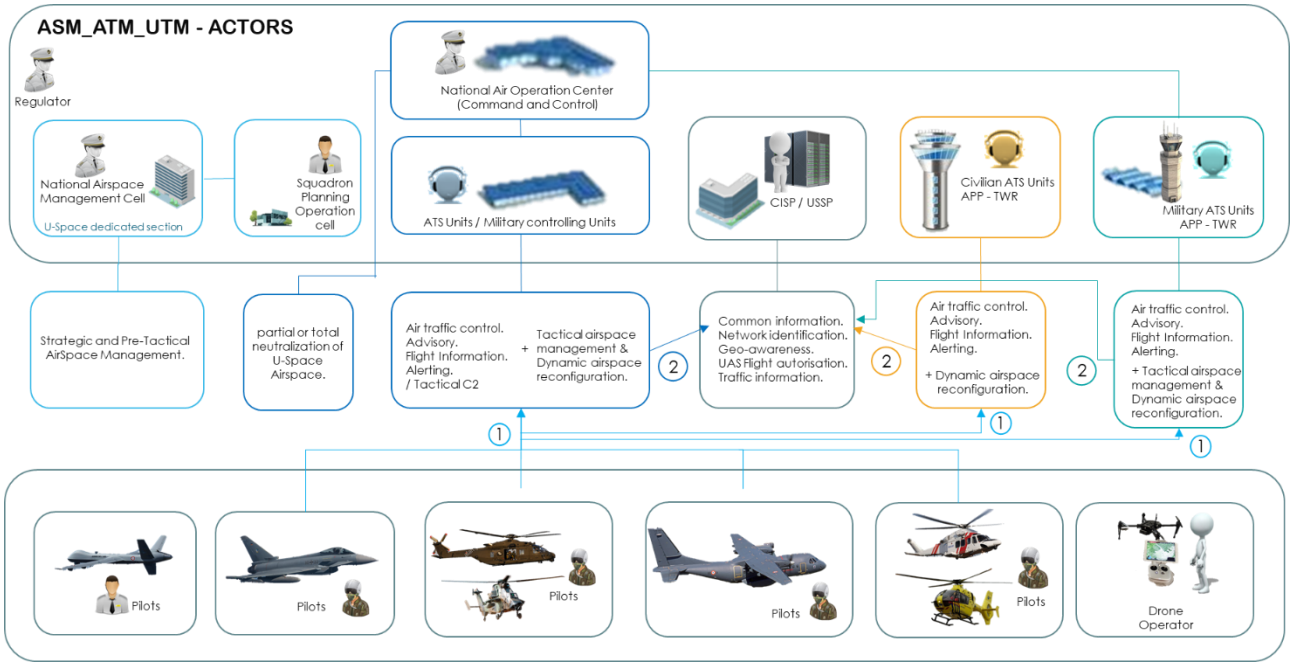

FIGURE 17: PILOTS - ATS UNITS COORDINATION

4.3.6.2.1 - [Planned transit activity] Pilot under VFR[U] flight plan.

(1 – Figure 17) Confirms transit, provide elements of the VFR[U] flight plan: route, altitude or altitude block, U-space entry and exit time.

4.3.6.2.2 - [Planned training activity] Training area (HTA or LFA) defined at strategic level and planned by AMC[U]

(1 – Figure 17) Confirms activation of planned area, start and end time of work.

4.3.6.2.3 - [Planned training activity] Training area (TRZ) defined by NOTAM or SUP AIP and planned by AMC[U]

(1 – Figure 17) Confirms activation of planned Temporary Restricted Zone, start and end time of work.

4.3.6.2.4 - [Unplanned operational transit activity or emergency request] excluding total or partial neutralisation of the U-space airspace outside controlled airspace

(1 – Figure 17) Confirms the operational emergency, route and altitude or altitude block (in feet at QNH Regional or consider SESAR work about Common Altitude Reference System), estimated time of entry, estimated exit time if possible.

The pilot will transmit as soon as possible these elements (by radio or by phone) in order to give sufficient notice to the CISP/USSP. The segregation will be achieved by applying a Transit Corridor along the route described.

4.3.6.3 - Information transmitted by the ATS Unit (civilian or military) to the CISP/USSP

The ATS Unit **confirms** (2 – Figure 17) with the CISP/USSP (digital information):

4.3.6.3.1 - Planned activity:

- Mission number (defined by VLLAct[U] message published by AMC[U]) or VFR[U] flight plan number
- Number and type of aircraft
- Route or training area (HTA, LFA or TRZ associated with NOTAM),
- Entry and Exit time
- Altitude or Altitude Block.

The ATS Unit **informs** (2 – Figure 17) the USSP (digital information):

4.3.6.3.2 - Unplanned activity (excluding partial or total neutralisation):

- Number and type of aircraft
- Route,
- Entry and Exit time
- Altitude or Altitude Block.

Without notice of Transit Corridor or training AREA activation, the aircraft cannot enter the U-space outside controlled airspace[6]. The effective sending to the CISP/USSP of the coordination elements; establishes the authorization of transit in the U-space airspace. The ATS Unit confirms the transit authorisation. The pilot reports the effective entry, flying at the altitude, location and time corresponding to the coordinated or planned flight elements.

Adherence to U-space out of controlled airspace[6] entry schedules is imperative. Without a pilot area or transit corridor activation request from the ATS Unit, entry into the U-space airspace is prohibited. The pilot will perform a delay action (hover, 360°, speed reduction, diverging heading...) if he is in advance or without authorization from the coordinating ATS Unit.

- Ideally, the CISP/USSP should provide a remote HMI to the ATS Unit:
  - To create and activate an Emergency TC
  - displaying the Transit Corridors or Training sector (HTA, LFA or TRZ) volumes activated.
  - Displaying the 3D location of drones in flight.
- Benefit: enable the ATS Unit to provide flight information (protection volumes activated and position of the drones) to pilots operating within the U-space outside controlled airspace[6] and to facilitate emergency exits.

4.3.6.4 - Prerogatives and actions of the CISP/USSP

The CISP/ USSP should make every effort to ensure compliance with the prohibited Transit corridors or training areas by drones during the scheduled timeframe.

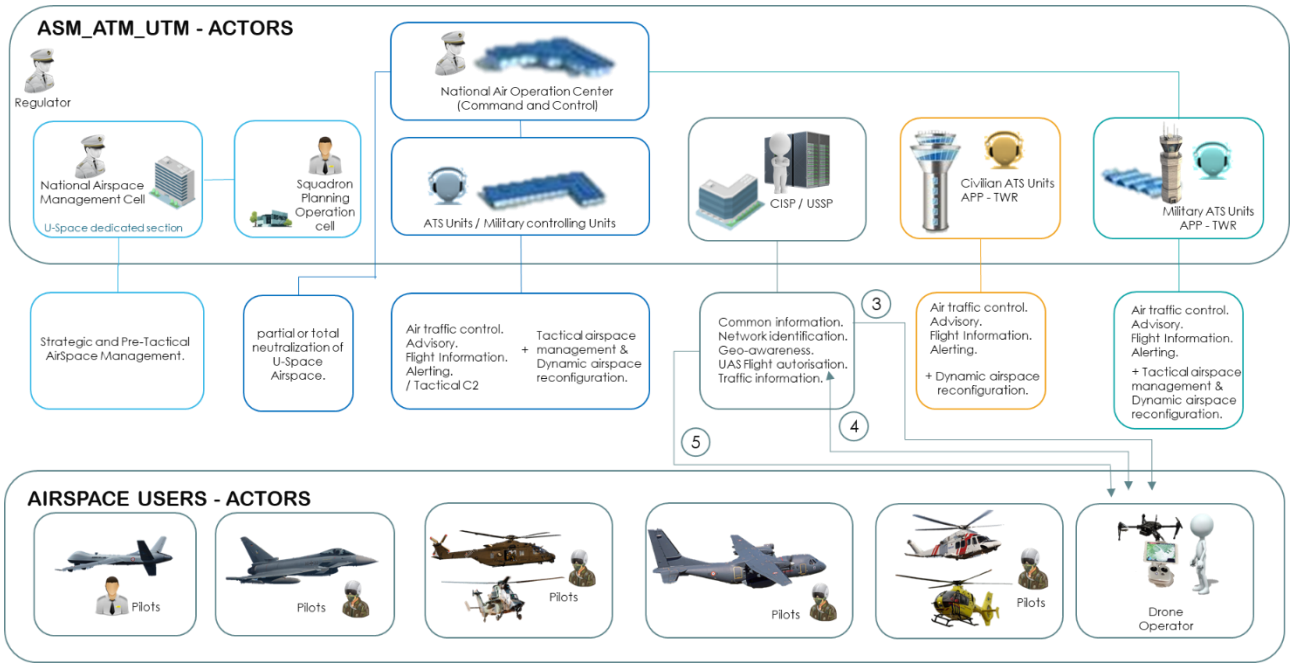

FIGURE 18: CISP/USSP GEO-CAGING

4.3.6.4.1 - Planned activity

- Takes into account the elements of restrictions (reconfigurations) of space to be applied by the study of:
  - the training activity plan transmitted by the AMC[U], (2 – Figure 17)
  - aeronautical information: VFR [U] flight plan, NOTAM, SUP AIP…
- Have these temporal reconfigurations applied by the drones via the services of flight authorization (4 – Fig16) (pre-deconfliction) and geo awareness (5 – Fig16) (real-time deconfliction) in order to guarantee the segregation of manned and unmanned flights.

4.3.6.4.2 - Unplanned activity (excluding partial or total neutralisation)

- Takes into account airspace reconfigurations (2 – Figure 17) to be applied (Transit Corridor), created and transmitted by the ATS Unit.
- Applies this time reconfiguration (TC or Training area segregating the route or training activity of military aircraft). (Δz or Δd to be defined by the regulator according to the type of aircraft) by the drones via the U-space Geo-awareness service (real-time deconfliction) to ensure the segregation of manned and unmanned flights.

4.3.6.5 - End of Dynamic Airspace Reconfiguration

- The pilot contacts the ATS Unit (civilian or military) providing flight Information Service exiting U-space outside controlled airspace[6].
- The ATS Unit **confirms** to the CISP/USSP the end of the dynamic reconfiguration of the U-space by deactivating volumes (TC, HTA, LFA, TRZ).

4.4 - Neutralization of the U-space airspace outside controlled airspace

4.4.1 - UC4 _ Partial or total Neutralization of the U-space airspace outside controlled airspace

In order to allow the accomplishment of priority missions (emergency medical evacuation, forest fires, air policing, SAR, etc.), training and/or in transit military activity as well as military drone operations in the U-space airspace outside controlled airspace[6] can be partially or totally neutralized.

The NAOC is responsible for the emergency neutralization of the activity in U-space outside controlled airspace[6].

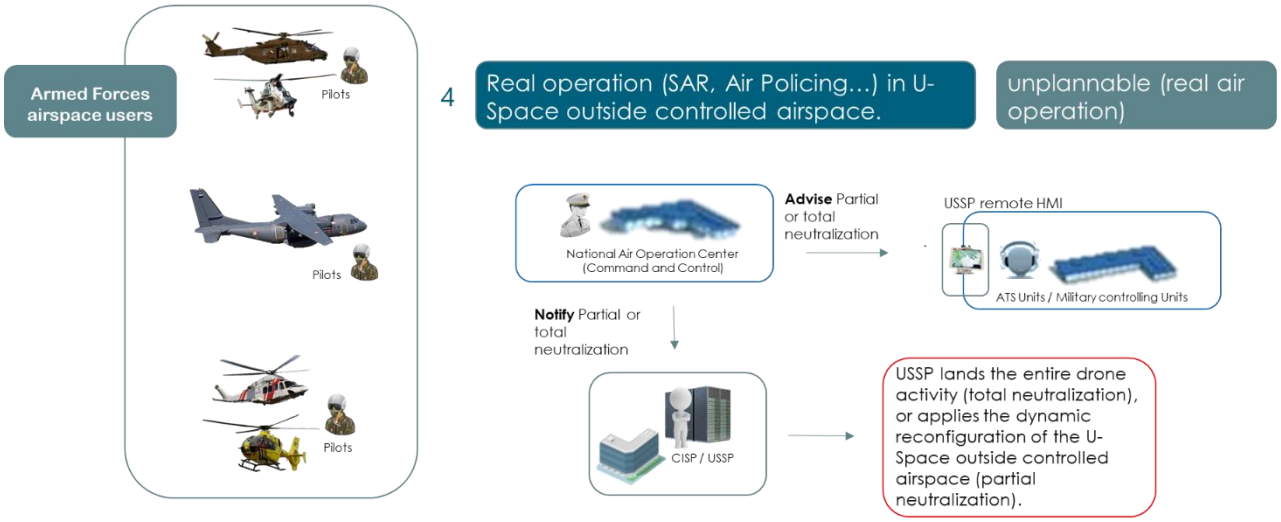

FIGURE 19: PARTIAL OR TOTAL NEUTRALISATION - SHORT-TERM COORDINATION

4.4.2 - Emergency Neutralization Procedure:

- As soon as it is aware of the need, the ATS Unit (civilian or military) in charge of the priority mission sends a request for neutralisation of the U-space sector to the NAOC.
- The NAOC defines with the applicant the sectors concerned (U-space airspace Common Grid defined at the strategic level) as well as the expected duration of the emergency neutralisation.

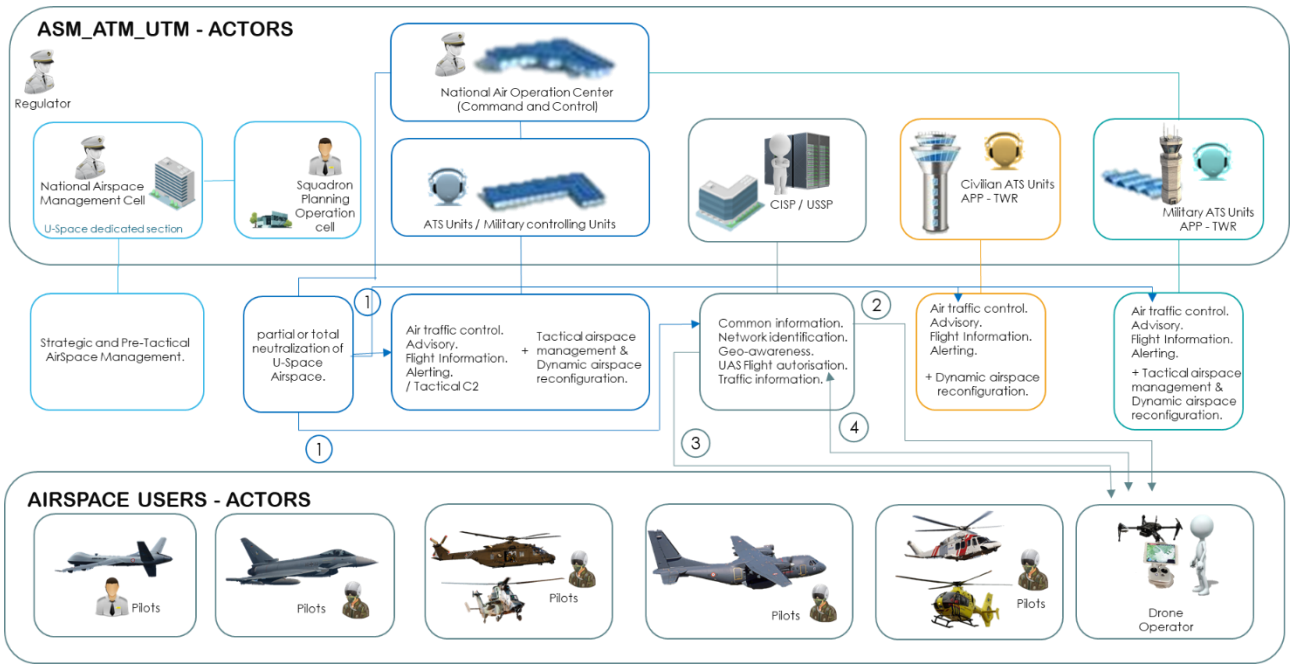

FIGURE 20: PARTIAL OR TOTAL NEUTRALISATION - SHORT-TERM COORDINATION

- After determined the U-space sectors to be neutralized, the NAOC immediately transmits the order of activity neutralization to the USSP (1 – Figure 20) (by digital message defining the impacted sectors) and the ATS Units (1 – Figure 20) (coordinators, providing information and alerting services in these areas) and ordering the following actions:
  - ATS Unit broadcasts emergency neutralization notification to ongoing activities and transits.
  - ATS Units prohibits future integration into U-space;
  - USSP (3 - Figure 20) lands the entire drone activity (total neutralisation), or applies the dynamic reconfiguration of the U-space outside controlled airspace[6] (partial neutralisation).
- Crews operating inside U-space airspace should apply the emergency exit procedure (see section 4.3.5.5.2 -) as soon as they receive the neutralization call from the ATS Unit.

4.4.3 - End of partial or total neutralisation

- As soon as the NAOC announces the end of priority operations:
  - USSP ceases to enforce induced space reconfiguration,
  - ATS Unit reports the end of U-space neutralization, authorizes and coordinates scheduled transits and training activities.

4.5 - Miscellaneous

Elements of assessment:

- An EC145 at a cruising speed of 130 kts travels 2 NM/ minute,
- A CN235 CASA at a cruising speed of 242 kts travels 4 NM/ minute,
- A C130 Hercules at a cruising speed of 291 kts travels 4.8 NM/ minute,
- A fighter aircraft flying at 450 kts travels 7.5 Nm/minute and 9.2 Nm/minute at 550 kts.

5 - FINANCIAL ASSESSMENT

5.1 - Identification of costs

In order to implement the airspace management approach defined in the previous section, investments will be required in a number of areas which are detailed in this section.

5.1.1 - IT implementation

The information systems needed by the military to implement the airspace management concept detailed in section 4 - Dynamic airspace reconfiguration are limited to operator workstations and connectivity to a communication network. No server or data centre is required on the military side, as this infrastructure would be provided by the USSP.

In deliverable D2 (Cost benefit analysis) of the 1st Specific Contract of the "Military and U-space: guidelines" study, the costs of a workstation is estimated to be €10.000 and would have to be renewed every 10 years (estimated lifetime of the workstation's hardware). This amount has to be multiplied by the number of operators performing coordination with USSPs, which depends on the local organisation (see also 5.1.4 -).

The airspace management concept detailed in section 4 - Dynamic airspace reconfiguration does not rely on system interfaces, so the military would not face any cost in this area.

5.1.2 - Process implementation

The review and update of U-space related processes to implement the airspace management concept may involve various operational and non-operational stakeholders of the Member States' military organisations and their interaction with external stakeholders. Depending on the organisational structure and existing processes in place, the implementation of changes can vary significantly between Member States and the scope of the processes in question.

The military would incur costs at national level to define the detailed processes required for airspace management and implement them into their operations, and then to propagate this information to military operational units. These costs have been estimated to €0.15 million per Member State SC1's D2

Then, implementing these processes would require additional staff, or additional involvement from existing staff, which has been estimated to €60k per additional staff.

5.1.3 - Implementation studies

Each Member State is assumed to need a detailed study about the implications for the military of implementing the proposed airspace management concept. The study would reiterate the scope of this concept, applying specific and detailed inputs applicable to the Member State. The scope of the study would encompass strategic, economic, operational as well as detailed technical questions concerning the required system upgrades, including ATM, aircraft and IT related issues.

The corresponding are estimated to be about 25% of those of a full U-space implementation, as envisaged in SC1's D2. Depending on the size of the MS, this would amount to €60k to €125k€.

5.1.4 - Staff training and documentation

The costs of updating training material and other documentation are expected to vary depending on the Member State and the number of staff to be trained, the size of the affected military organisations, the number of operational units involved, etc. At the level of the operator, the scope and frequency of the coordination tasks described in section 4 - Dynamic airspace reconfiguration is probably sufficiently low to not require recurring training, so only initial training is considered here.

The corresponding are estimated to be about 25% of those of a full U-space implementation, as envisaged in SC1's D2. So costs related to training material and documentation would amount to €25k per MS and costs related to initial training activities would amount to €25k to €75k per MS.

5.1.5 - Office space

As the hardware required to implement the airspace management concept detailed in section 4 - Dynamic airspace reconfiguration is very limited, the impact on office space is considered to be negligible for the purpose of this cost assessment. However, costs of office accommodation will occur and will depend on the number of extra personnel required in the national implementation.

5.1.6 - Utilities

The cost for data subscriptions and data links into the premises of the CISP/USSP is estimated to be of €10,000 per year and per operational unit coordinating with U-space.

5.1.7 - Cost summary

The following table provide a summary of the above costs, per area.

Cost area	Category	Amount
IT implementation	Visualisation of data CISP/USSP to ATS	€10k per operator's workstation
Process implementation	Strategic/pre-tactical airspace management coordination	€50k per Member State
	Propagation of strategic/pre-tactical information to operational units	€100k per Member State
	Staff to support strategic/pre-tactical airspace management	€60k per additional staff
	Staff to support tactical coordination	€60k per additional staff
Implementation studies	Studies	€60k to €125k€. per Member State
Training and documentation	Update of training materials and manuals	€25k per Member State
	Initial training	€25k to €75k per Member State
Office space		0
Utilities		€10.000 per operational unit

TABLE 1: OVERVIEW OF U-SPACE-RELATED COSTS FOR THE MILITARY

5.2 - Cost sharing

As indicated above, the information systems to implement the U-space airspace management would be provided by the USSP, and therefore, the corresponding costs would be supported by this actor, either entirely or in part.

Consequently, in order to support the U-space, the military will have recurring costs related to staff costs and utilities (i.e. power, data subscriptions, data links etc.).

5.3 - Funding opportunities

SC1's deliverable D2 investigated the funding opportunities available to the military to help supporting the costs of U-space implementation. Although the costs identified above are limited and may not justify going through the process of requesting dedicated funding through national or European mechanisms, the options identified in SC1 remain valid at this stage.

6 - CONCLUSIONS

The European Defence Agency (EDA) has initiated the "Military and U-space: guidelines" study in January 2021 to assess military impacts and cost benefits of large scale drone operations in dedicated U-space airspaces. Understanding normal/nominal operations in a U-space "eco-system" is a prerequisite for the military to collaborate in U-space concept development.

The present report presents the conclusions and recommendations of the 3rd Specific Contract (SC3) carried out under the study, which focuses on understanding in detail the impacts on military operations of two key U-space mechanisms and their applicability to the military:

- Electronic conspicuity: regulation (IR (EU) 2021/666) requires manned aircraft operating within a U-space airspace to be electronically conspicuous to the USSPs managing this airspace when not provided with an Air Traffic Control service by the ANSP.
- Dynamic Airspace Reconfiguration (DAR): the process defined in IR (EU) 2021/664 through which ATC services can coordinate with a USSP to ensure that a manned aircraft under ATC can remain segregated from drone traffic when operating within a U-space airspace.

The Acceptable Means of Compliance for the U-space regulatory package ([5]) and the subsequent coordination work to help finalising this document have provided insight into EASA's approach. Electronic conspicuity in U-space will use the so-called "ADS-L" concept, which relies on a triptych of compliant technologies: ADS-B out, devices operating in the SRD 860 frequency band and mobile telephony. As only ADS-B out is currently available on military aircraft, and only for a fraction of the fleet, fitting into this framework would require significant investments from the military. The other two options are less costly and may help to alleviate the financial impacts, but might not suit all kinds of military operations.

Therefore, the most sensible and affordable approach would be to request CISPs/USSPs to also use Mode S where this is applicable and to rely on other mechanisms, such as strategic and tactical airspace management, to improve the safety of military operations in U space airspaces.

To this effect, the present study proposes an initial process allowing to use U-space airspace in a flexible, dynamic and cost-effective manner, supported by information sharing for strategic/pre-tactical airspace management and the availability in military operational units of an interface with the CISP/USSP systems for tactical management. This approach uses as much as possible the principles of the Flexible Use of Airspace process and of the Dynamic Airspace Reconfiguration mechanism to reduce the impact on current operations.

Lastly, it is worth noting that EASA is about to launch a specific project on the interoperability of e-conspicuity for general aviation (not limited to U-space), which will set the direction of e-conspicuity development in Europe and could provide an interesting channel for the military to raise awareness about their requirements.

7 - APPENDIX A: TERMINOLOGY

Acronym	Definition
ACAS	Airborne Collision Avoidance System
ADS-B	Automatic Dependent Surveillance – Broadcast
ADS-L	Automatic Dependent Surveillance – Light
AGL	Above Ground Level
AIP	Aeronautical Information Publication
AIRAC	Aeronautical Information Regulation and Control
AMC (regulation)	Acceptable Means of Compliance
AMC (airspace management)	Airspace Management Cell
ANS	Air Navigation Services
ANSP	Air Navigation Service Provider
ARP	Aerodrome Reference Point
ASM	Airspace Management
ATSP	Air Traffic Service Provider
ATC	Air Traffic Control
ATM	Air Traffic Management
AWACS	Airborne Warning and Control System
BVLOS	Behind Visual Line Of Sight
CAT	Commercial Air Traffic
CIS	Common Information Services
CISP	Common Information Service Provider
CTR	Control Zone
DAR	Dynamic Airspace Reconfiguration
EASA	European Union Aviation Safety Agency
EDA	European Defence Agency
EET	Estimated Elapsed Time
ETSO	European Technical Standard Order
EU	European Union

Acronym	Definition
FIR	Flight Information Region
FIS-B	Flight Information Service – Broadcast
FOCA	Federal Office of Civil Aviation
GA	General Aviation
GAT	General Air Traffic
GM	Guidance Material
GNSS	Global Navigation Satellite System
HEMS	Helicopter Emergency Medical Services
HMI	Human-Machine Interface
HTA	Helicopter Training Area
ICAO	International Civil Aviation Organization
IFF	Identification Friend or Foe
ISM	Industrial, Scientific, and Medical
IR	Implementing Regulation
LFA	Low Flying Area
MEDEVAC	Medical Evacuation
MHz	Megahertz
MRVA	Minimum Radar Vectoring Altitude
MS	Member State
NAOC	National Air Operation Centre
NDZ	No Drone Zone
NM	Nautical Mile
NOTAM	Notice To Airmen
OAT	Operational Air Traffic
SAR	Search And Rescue
SC	Specific Contract
SERA	Standardised European Rules of the Air
SESAR	Single European Sky ATM Research
SRD	Short-Range Device

Acronym	Definition
TAS	True Air Speed
TC	Transit Corridor
TMA	Terminal Control Area
TRZ	Temporary Restricted Zone
TSO	Technical Standard Order
UAS	Unmanned Aircraft System
UTC	Coordinated Universal Time
USSP	U-space Service Provider
UTM	UAS Traffic Management
VFR	Visual Flight Rules
VLL	Very Low Level
VLOS	Visual Line Of Sight

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8 - APPENDIX B: REFERENCES

[1] ICAO – Unmanned Aircraft Systems Traffic, Management (UTM) – A Common Framework with Core Principles for Global Harmonization, Edition 3

[2] EDA – White paper - U-space, Drones and Military Low Level Flights, April 2019

[3] SESAR JU – U-space Blueprint, 2017

[4] European Commission, U-space regulatory package (IR (EU) 2021/664, 2021/665 & 2021/666), 2021

[5] EASA, Acceptable Means of Compliance and Guidance Material to Regulation (EU) 2021/664 on a regulatory framework for the U-space
https://www.easa.europa.eu/en/document-library/agency-decisions/ed-decision-2022024r

[6] EDA – Military and U-space: guidelines, SC1 Final Report, 2022

[7] European Commission, Drone Strategy 2.0, 2022

[8] EASA - Technical Specification for ADS-L transmissions using SRD-860 frequency band (ADS-L 4 SRD-860)
https://www.easa.europa.eu/sites/default/files/dfu/ads-l_4_srd860_issue_1.pdf

9 - APPENDIX C: DAR DETAILED UC

UC1 _ Planned transit in U-space airspace outside controlled airspace: Filing a VFR[U] Flight Plan procedure

	Airspace Class	Potential airspace restrictions	Drone activities	U-space services
inside U-space Airspace Restricted ACCESS	Uncontrolled: F, G	NDZ (permanent or temporary) : R, P, D, LFA, HTA, TRZ + Planned & Coordinated TC	VLOS/BVLOS	In U-space airspace only: Common information services Network identification service Geo-awareness service UAS flight authorisation service Traffic information service [Weather information Conformance monitoring]
Nominal actions	1. At least 5 minutes before the scheduled time of entry into U-space outside controlled airspace[6], the pilot of the aircraft: ○ squawks the mode 3/A 2000, (or other specific code defined by regulator) "Ident" transponder code, ○ Contacts the ATS Unit (civilian or military) confirming transit and providing elements of the VFR[U] flight plan: route, altitude or altitude block, U-space entry and exit time. 2. The ATS Unit confirms with the CISP/USSP (digital information): o Mission number (defined by VFR[U] flight plan number) o Number and type of aircraft o Route or training area (HTA, LFA or TRZ associated with NOTAM), o Entry and Exit time o Altitude or Altitude Block. 3. The CISP/USSP takes into account the elements of restrictions (reconfigurations) of space to be applied by the study of aeronautical information: VFR [U] flight plan, NOTAM, SUP AIP… 4. These temporal reconfigurations have to be applied by the drones via the services of flight authorization (4 - pre-deconfliction) and geo awareness (5 - real-time deconfliction) in order to guarantee the segregation of manned and unmanned flights. 5. The pilot contacts the ATS Unit (civilian or military) providing flight Information Service exiting U-space outside controlled airspace[6].			

	6. The ATS Unit confirms to the CISP/USSP the end of the dynamic reconfiguration of the U-space by deactivating volumes

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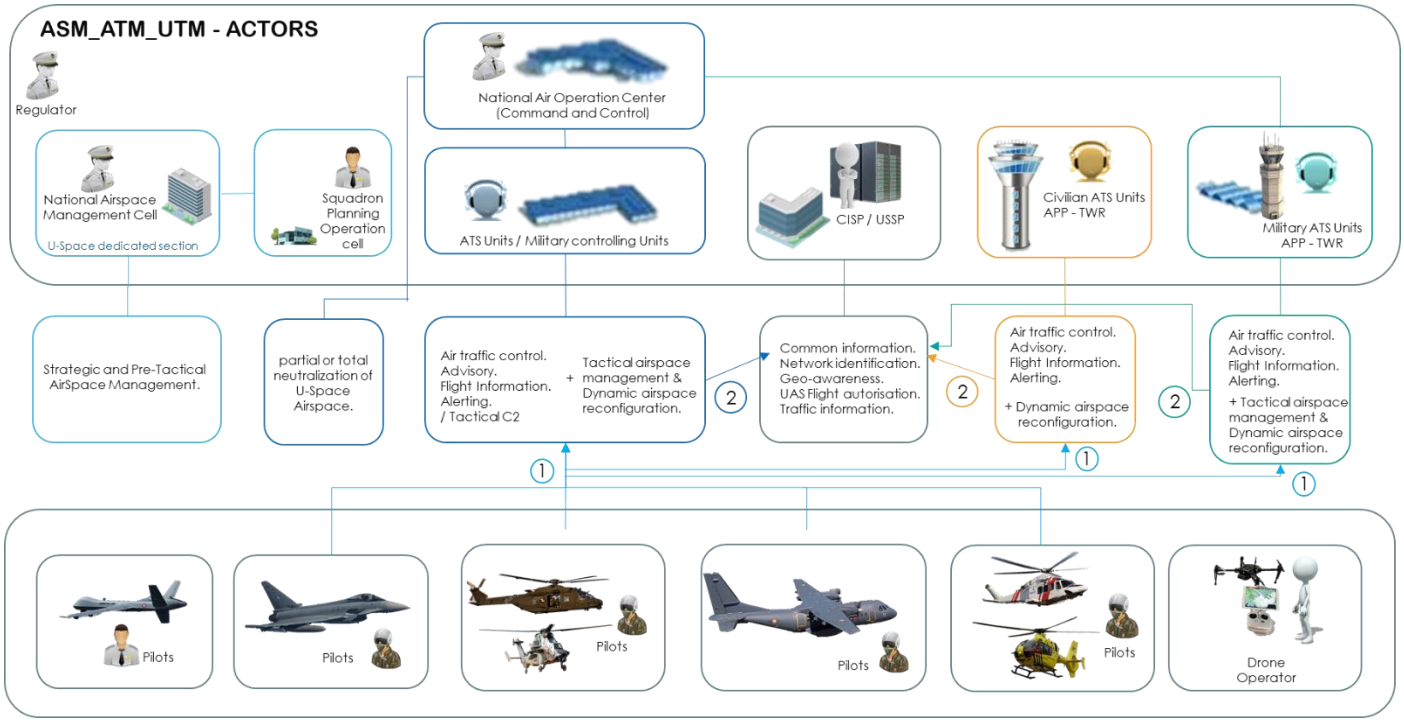

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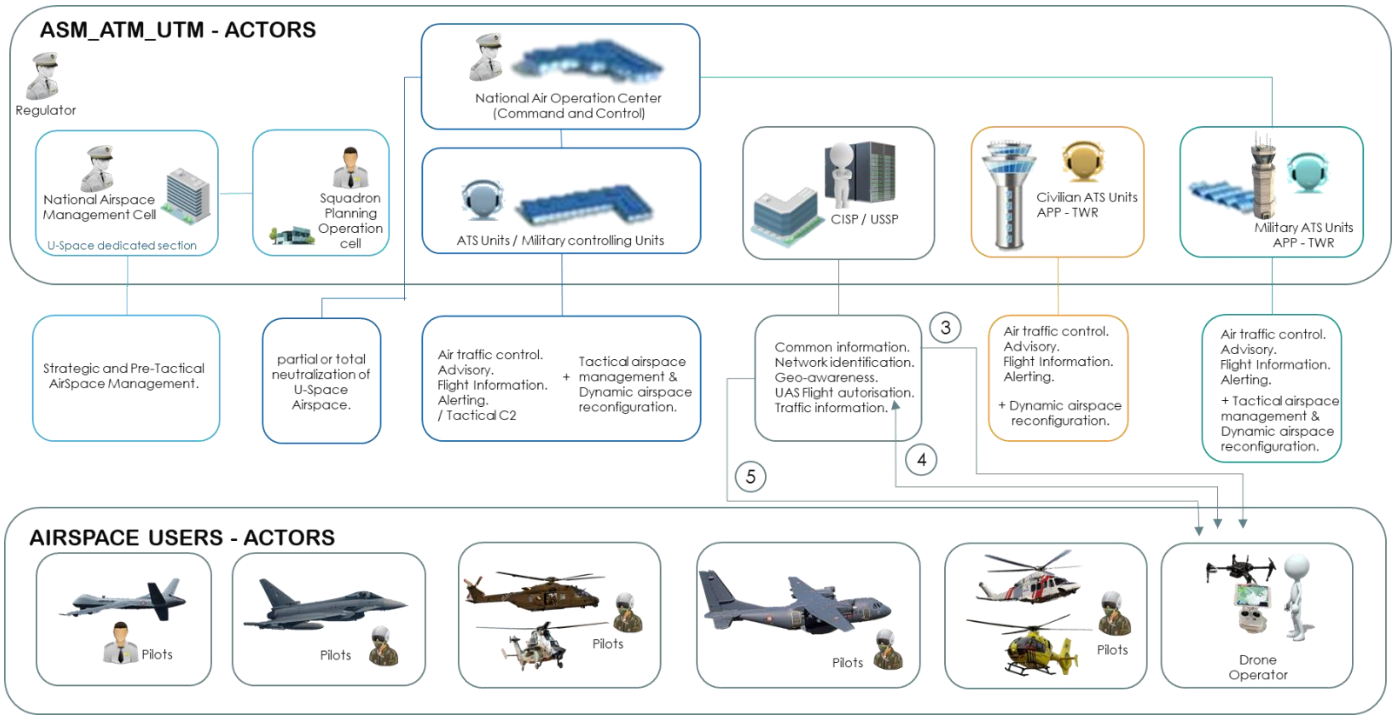

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58 **UC2 _ Unplanned operational transit in U-space airspace outside controlled airspace procedure**

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	Airspace Class	Potential airspace restrictions	Drone activities	U-space services
inside U-space Airspace Restricted ACCESS	Uncontrolled: F, G	NDZ (permanent or temporary): R, P, D, LFA, HTA, TRZ + Planned & Coordinated TC	VLOS/BVLOS	In U-space airspace only: Common information services Network identification service Geo-awareness service UAS flight authorisation service Traffic information service [weather information conformance monitoring]
Nominal actions	1. At least 5 minutes before the scheduled time of entry into U-SPACE outside controlled airspace[6], the pilot of the aircraft: ○ squawks the mode 3/A 2000, (or other specific code defined by regulator) "Ident" transponder code, ○ Contacts the ATS Unit (civilian or military) to confirm the operational emergency, route and altitude or altitude block (in feet at QNH Regional or consider SESAR work about Common Altitude reference System), estimated time of entry, estimated exit time if possible. The pilot will transmit as soon as possible these elements (by radio or by phone) in order to give sufficient notice to the CISP/USSP. 1. The ATS Unit confirms with the CISP/USSP (digital information): ○ Number and type of aircraft ○ Mission type ○ Route, ○ Entry and Exit time ○ Altitude or Altitude Block. 2. The CISP/USSP takes into account airspace reconfigurations to be applied (Transit Corridor), created and transmitted by the ATS Unit. 5. Applies this time reconfiguration (TC or Training area segregating the route or training activity of military aircraft) (Δz or Δd to be defined by the regulator according to the type of aircraft) by the drones via the geo awareness service (real-time deconfliction) to ensure the segregation of manned and unmanned flights.			

	6. The pilot contacts the ATS Unit (civilian or military) providing flight Information Service exiting U-space outside controlled airspace[6]. 7. The ATS Unit confirms to the CISP/USSP the end of the dynamic reconfiguration of the U-space by deactivating volumes

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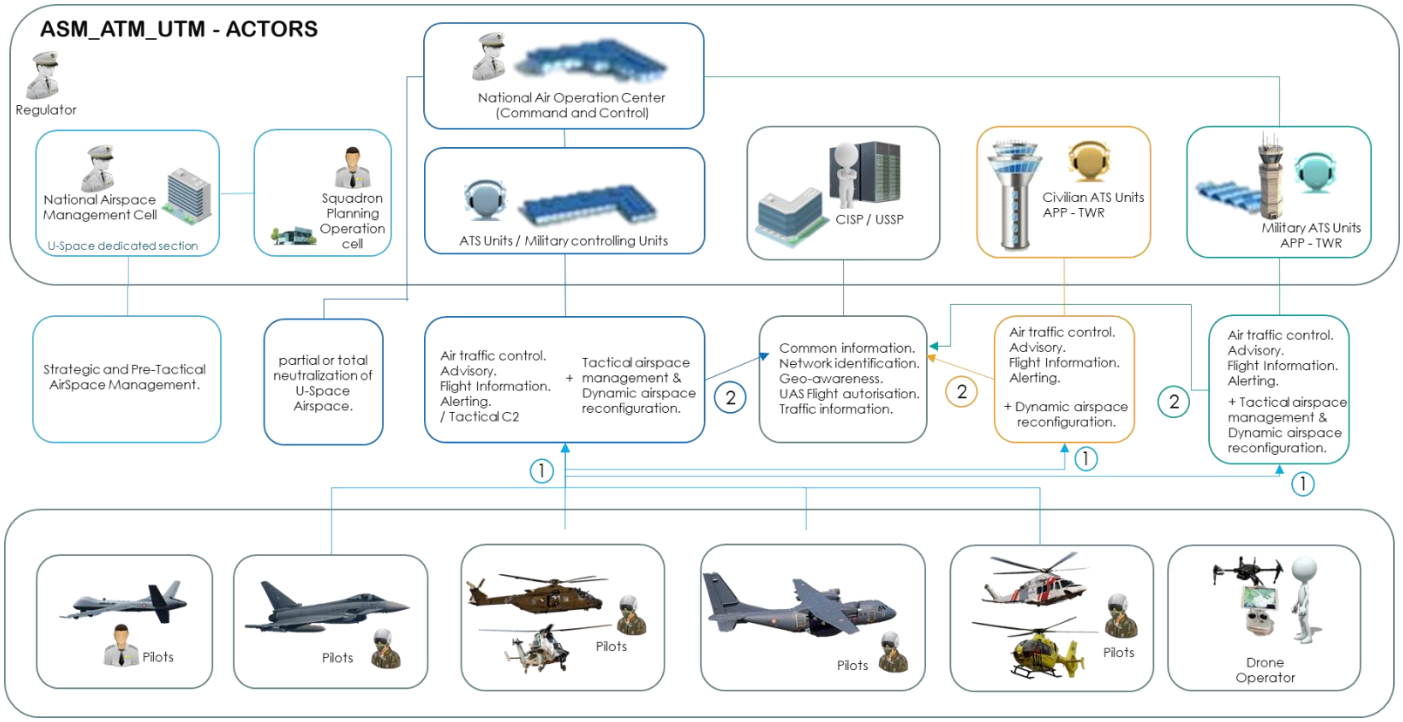

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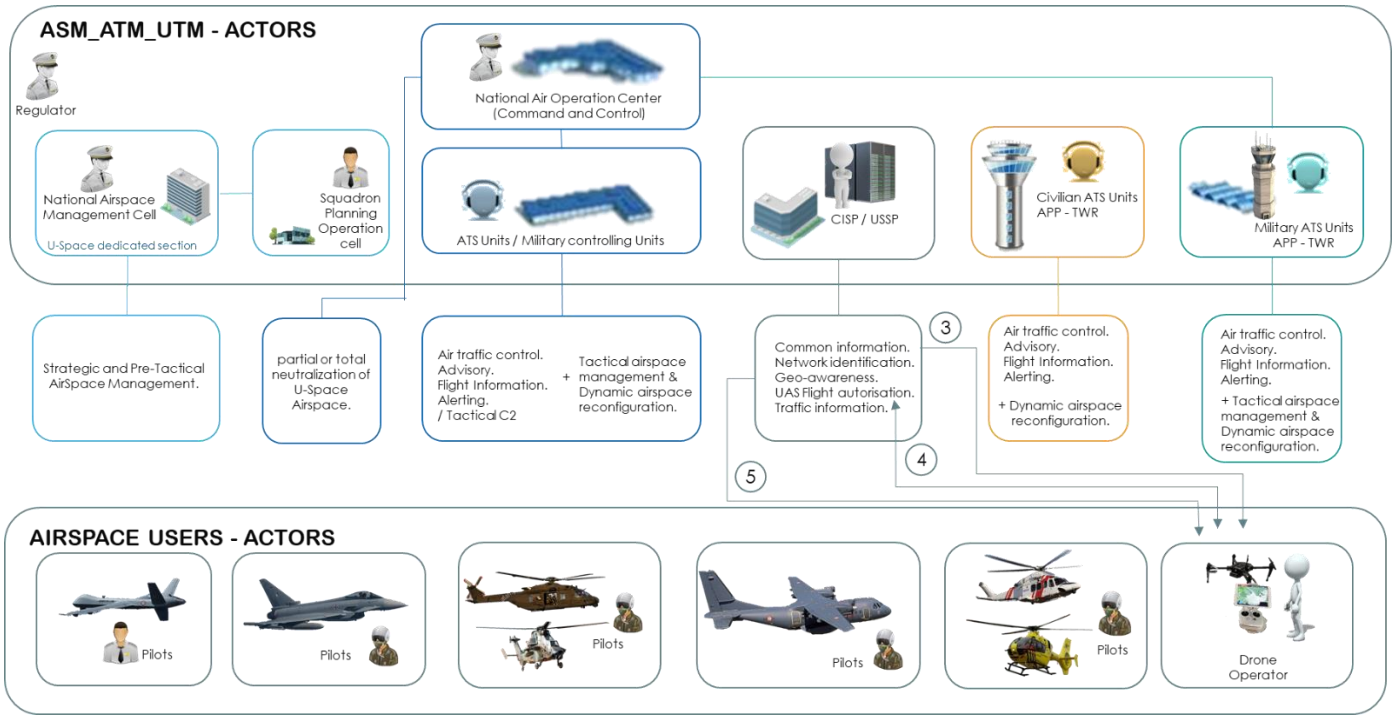

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UC3 _ Training mission in U-space outside controlled airspace: Airspace management cell - U-space (AMC[U]) procedure

Procedure for planning fixed (strategic level definition) or temporary (specifically created for a particular activity) areas for the protection of military aircraft within U-space outside controlled airspace[6]:

	Airspace Class	Potential airspace restrictions	Drone activities	U-space services
inside U-space Airspace Restricted ACCESS	Uncontrolled: F, G	NDZ (permanent or temporary): R, P, D, LFA, HTA, TRZ + Planned & Coordinated TC	VLOS/BVLOS	In U-space airspace only: Common information services Network identification service Geo-awareness service UAS flight authorisation service Traffic information service [weather information conformance monitoring]
Nominal actions	1. AMC[U] plans training activities inside Low Flying or Helicopter Training areas (LFA & HTA) (defined in the AIP at strategic level) and Temporary Restricted Zone (TRZ) no later than the last business day prior to the flight before 14:00 local time and at least 12 hours[16] prior to the flight (for NOTAM publication). 2. The AMC[U] ensures the deconfliction (geographical and temporal) between the different requests. 2. The AMC[U] asks the AIS to publish NOTAM's areas: a. for training activities that cannot be satisfied with AIP areas, b. For training activities within AIP areas. 3. The AIS broadcasts a VLLAct[U] (Very Low-level training activity plan within U-space outside controlled airspace[6]) message on D-1 by 17:00 local to the squadrons, ATS Units and CISP/USSP, specifying the D-Day, HTA, LFA and TRZ usage activity planning, including day and night flights if applicable. 4. In case of mission cancellation, the cancellation information is immediately transmitted by AMC[U] to: o The CISP/USSP concerned,			

[16] *or less notice after agreement with AIS and CISP.*

	○ The ATS Units responsible for ensuring the activation area or zone at entry and deactivation at effective exit from U-space airspace for the benefit of the mission concerned.

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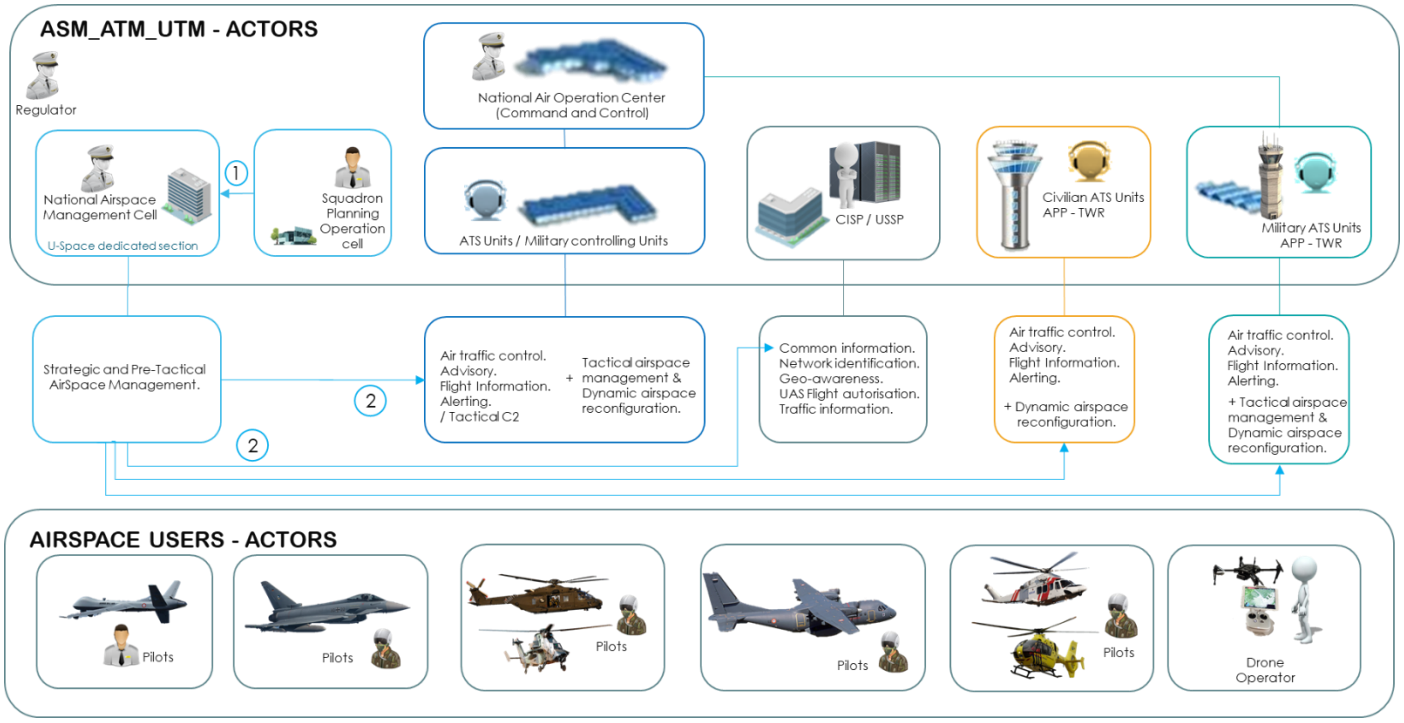

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74 Dynamic Airspace Reconfiguration procedure:

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	Airspace Class	Potential airspace restrictions	Drone activities	U-space services
inside U-space Airspace Restricted ACCESS	Uncontrolled: F, G	NDZ (permanent or temporary) : R, P, D, LFA, HTA, TRZ + Planned & Coordinated TC	VLOS/BVLOS	In U-space airspace only: Common information services Network identification service Geo-awareness service UAS flight authorisation service Traffic information service [weather information

				conformance monitoring]
Nominal actions	1. At least 5 minutes before the scheduled time of entry into U-SPACE outside controlled airspace[6], the pilot of the aircraft: ○ squawks the mode 3/A 2000, (or other specific code defined by regulator) "Ident" transponder code, ○ Contacts the ATS Unit (civilian or military) providing Flight Information Service to confirm activation of planned area or planned Temporary Restricted Zone, start and end time of work. 2. The ATS Unit confirms with the CISP/USSP (digital information): • Mission number (defined by VLLAct[U] message published by AMC[U]) • Number and type of aircraft • Route or training area (HTA, LFA or TRZ associated with NOTAM), • Entry and Exit time • Altitude or Altitude Block. 3. The CISP/USSP takes into account the elements of restrictions (reconfigurations) of space to be applied by the study of the training activity plan transmitted by the AMC[U] 4. These temporal reconfigurations have to be applied by the drones via the services of flight authorization (4 - pre-deconfliction) and geo awareness (5 - real-time deconfliction) in order to guarantee the segregation of manned and unmanned flights. 5. The pilot contacts the ATS Unit (civilian or military) providing flight Information Service exiting U-space outside controlled airspace[6]. 6. The ATS Unit confirms to the CISP/USSP the end of the dynamic reconfiguration of the U-space by deactivating volumes (HTA, LFA, TRZ).			

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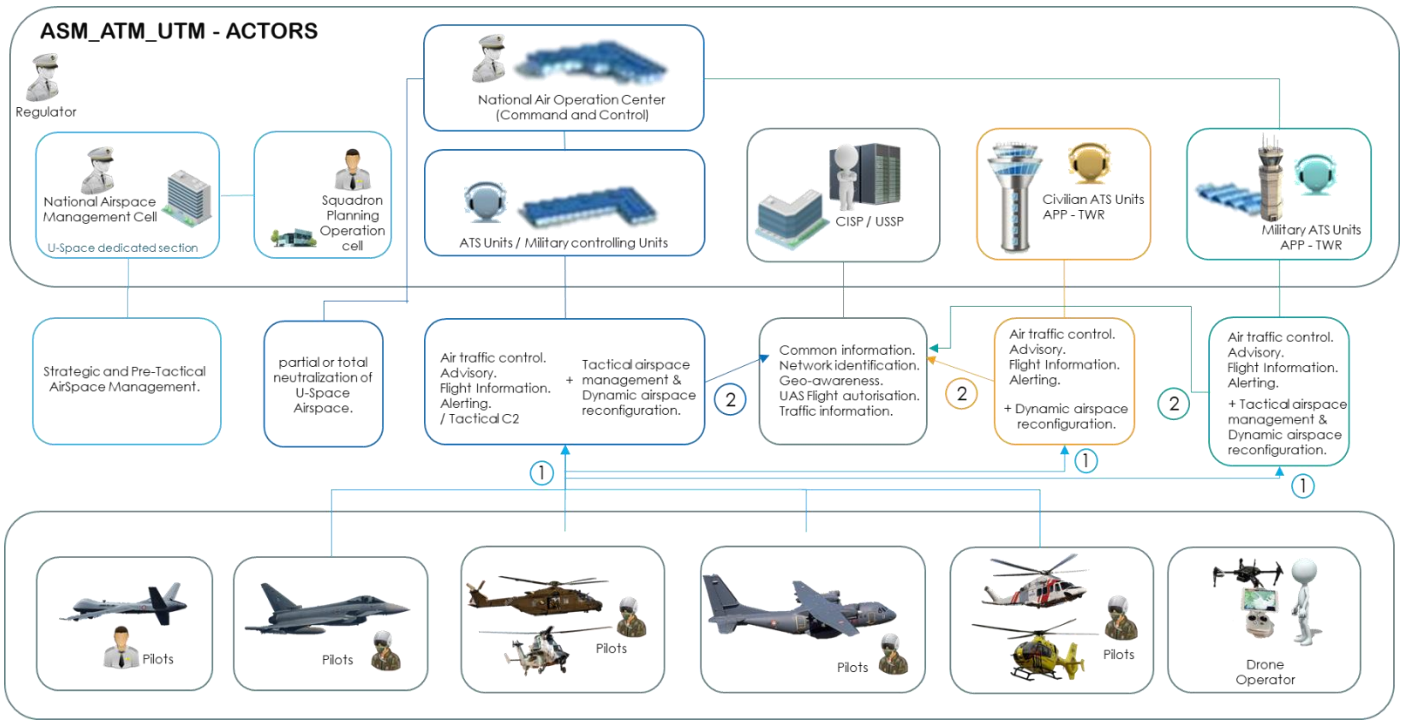

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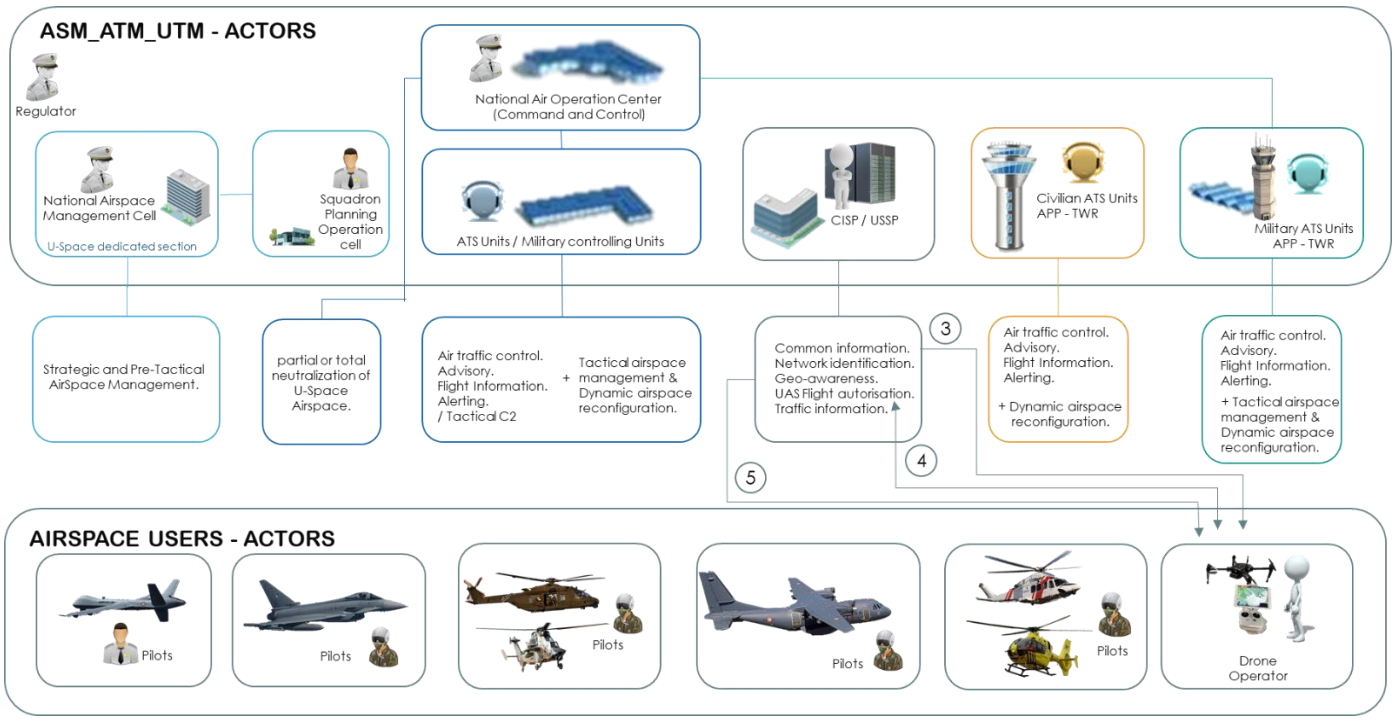

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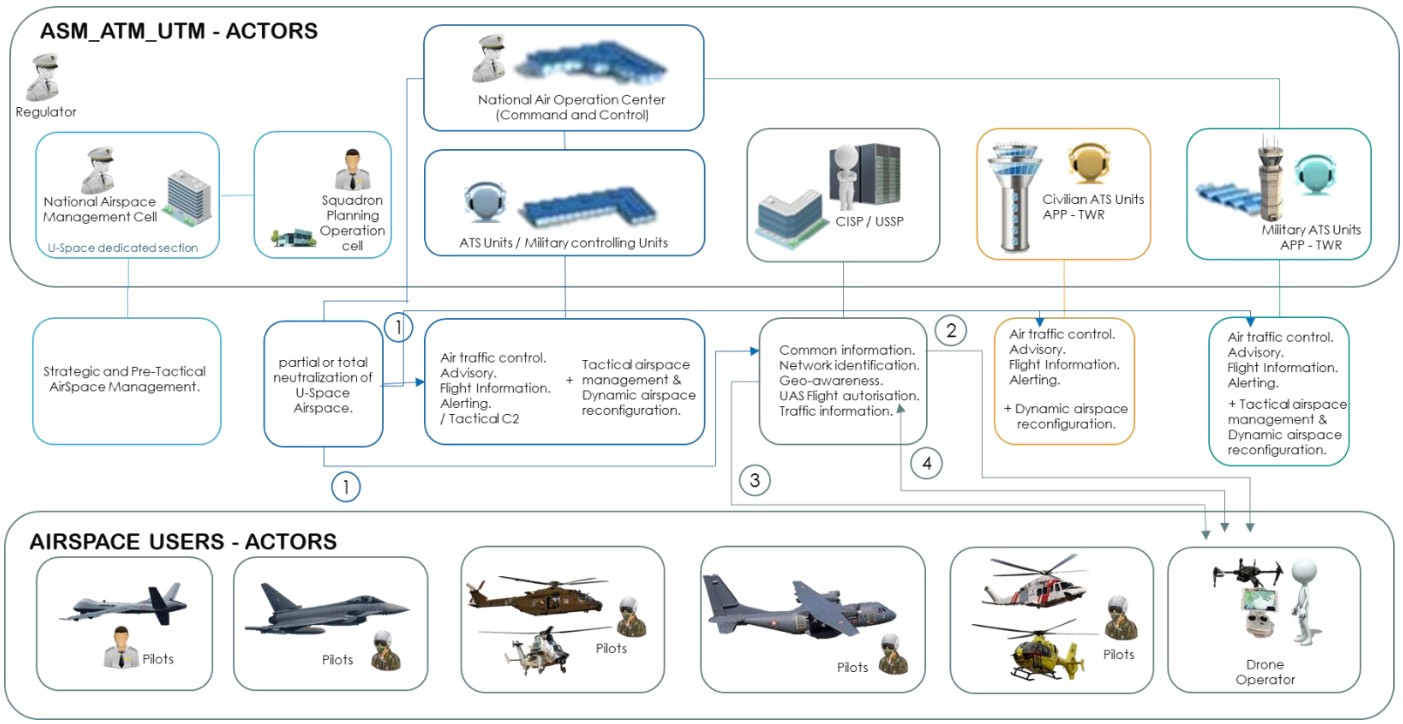
UC4 _ Partial or total neutralization of the U-space airspace outside controlled airspace procedure

	Airspace Class	Potential airspace restrictions	Drone activities	U-space services
inside U-space Airspace Restricted ACCESS	Uncontrolled: F, G	NDZ (permanent or temporary): R, P, D, LFA, HTA, TRZ + Planned & Coordinated TC + Partial neutralization Or Total neutralization	VLOS/BVLOS	In U-space airspace only: Common information services Network identification service Geo-awareness service UAS flight authorisation service Traffic information service [weather information conformance monitoring]
Nominal actions	1. After determined the U-space sectors to be neutralized, the NAOC immediately transmits the order of activity neutralization to the USSP (by digital message defining the impacted sectors) and to the ATS Units (coordinators, providing information and alerting services in these areas) 2. ATS Unit should broadcast emergency neutralization notification to ongoing activities and transit and prohibit future integration into U-space; 3. USSP should land the entire drone activity (total neutralisation), or applies the dynamic reconfiguration of the U-space outside controlled airspace[6] (partial neutralisation). 4. Crews operating inside U-space airspace should apply the emergency exit procedure as soon as they receive the neutralization call from the ATS Unit. 5. As soon as the NAOC announces the end of priority operations: o USSP ceases to enforce induced space reconfiguration, o ATS Unit reports the end of U-space neutralization, authorizes and coordinates scheduled transits and training activities.			


ASM_ATM_UTM - ACTORS
Regulator
National Air Operation Center
(Command and Control)
National Airspace
Management Cell
U-Space dedicated section
Squadron
Planning
Operation
cell
ATS Units / Military controlling Units
CISP / USSP
Civilian ATS Units
APP - TWR
Military ATS Units
APP - TWR
Strategic and Pre-Tactical
AirSpace Management.
partial or total
neutralization of
U-Space
Airspace.
Air traffic control.
Advisory.
Flight Information.
Alerting.
/ Tactical C2
+
Tactical airspace
management &
Dynamic airspace
reconfiguration.
Common information.
Network identification.
Geo-awareness.
UAS Flight autorisation.
Traffic information.
Air traffic control.
Advisory.
Flight Information.
Alerting.
+ Dynamic airspace
reconfiguration.
Air traffic control.
Advisory.
Flight Information.
Alerting.
+ Tactical airspace
management &
Dynamic airspace
reconfiguration.
1
1
2
3
4
AIRSPACE USERS - ACTORS
Pilots
Pilots
Pilots
Pilots
Pilots
Drone
Operator

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