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ConOps

Federal Office of Civil Aviation (FOCA) and the Swiss U-Space Implementation (SUSI) Public-Private Partnership

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1.0	Initial Release	29.03.2019
1.1	Updates through the whole document aimed at aligning concepts with the latest regulatory and standard developments. Change in numbering, consolidation of goals in one section. Significant changes in section 6 (previously 3.4) Actor/Entities.	02.04.2020

Contents

1 Preface **4**
2 Executive Summary **5**
3 Goals **5**
3.1 U-Space Program 5
3.2 Swiss U-Space Implementation 6
3.3 ConOps 6
4 Scope **7**
5 Swiss U-Space Operational Concept **7**
5.1 Overview 7
5.2 Notional Architecture 8
6 Actors/Entities **9**
6.1 CIF 9
6.1.1 Flight Information Management System (FIMS) 9
6.1.2 Legal Considerations and Open Platform 10
6.1.3 Registration of UAS Operators and Certified UAS 10
6.1.4 Geozone Information 10
6.2 U-Space Service Provider (USP) 11
6.2.1 Communications Bridge 11
6.2.2 Demand/Capacity Balancing 12
6.2.3 Data Archiving 12
6.2.4 Legal Considerations and Open Platform 12
6.2.5 Approval Process 13
6.3 The InterUSP Network 13
6.4 Supplemental Data Service Providers (SDSP) 14
6.5 Communication Service Providers 14
6.6 Operator 14
6.7 Pilot 14
6.8 Unmanned Aircraft System (UAS) Manufacturer 15
7 Services Overview and Functional Breakdown **15**
7.1 Communication Service 15
7.2 Discovery Services 15
7.3 Authentication and Authorization Service 15
7.4 Registration Service 16
7.5 Remote Identification Service 16
7.6 Airspace Authorization Service 16
7.7 Geoawareness Service 16
7.8 Notification Service 17
7.9 Rules Awareness Service 17
7.10 Geographical Information Service 17
7.11 Tracking Service 17
7.12 Operation Planning Service 17
7.13 Separation Services 18
7.13.1 Strategic Deconfliction Service 18
7.13.2 Conformance Monitoring Service 18
7.13.3 Conflict Advisory and Alert Service 18
7.13.4 Dynamic Reroute Service 19
7.14 Risk Assessment Service 19
7.15 Weather Service 19
7.16 Noise Mitigation Service 19
7.17 Liability Insurance Service 20
7.18 Emergency Management Service 20
7.19 Accident and Incident Reporting Service 20
7.20 Digital Logbook Service 20
8 Annex **21**
8.1 List of Acronyms 21

1 Preface

The update to the Swiss U-Space ConOps coincides with the publication of European Aviation Safety Agency's (EASA) Opinion[1] 01/2020 "High-level regulatory framework for the U-space"[2] (the Opinion). Both publications are largely aligned. Readers will notice a few differences between the Opinion and some principles exposed in the ConOps. Those will be addressed as part of the regular rulemaking process. Three areas in particular are concerned:

1. **Designation of U-space airspace**
   The Opinion gives Member States the possibility to designate one or more volumes of airspace as U-Space airspace. Those must be made publicly available, in accordance with Article 15(3) of Regulation (EU) 2019/947, also called "UAS geographical zones" or "Geozones". The ConOps considers that the U-Space airspace might eventually extend to the entire national airspace. On top of it, additional UAS geographical zones would be used to provide specific requirements in environments like cities, airports, etc.

2. **Common Information Service or Function**
   Like the Opinion, the ConOps groups a set of centralized services under the umbrella term "Common Information". The ConOps, however, describes it as a high-level function, not as a service. The Common Information Function can be provided by several entities, including FOCA itself, and it encompasses capabilities related to existing regulation, such as the Operator and UAS registry and the provision of geozones data. As part of the Common Information Function, the Flight Information Management System (FIMS) is a gateway for data provided by the national air navigation service provider, skyguide, in relation with their existing mandate. Providers of Common Information data could also provide U-Space services, as long as they use a distinct infrastructure to do so and are subject to the principles of market regulation.

   The rationale is that a function with several providers rather than a service with a single provider would allow for additional flexibility and a better use of resources. For instance, information related to U-Space airspaces could be provided by FOCA itself, using the tools developed for geozones, while the list of service providers in a U-Space airspace might be supported by another entity, potentially by the industry itself. Some measures, like those related to cybersecurity protection, might not require a service provider but only leverage industry standards.

3. **Scope of Traffic Information**
   The Opinion and the ConOps both include pre-flight sharing of operation plans, linked to an in-flight conformance monitoring capability. The Opinion includes the former in a broader "authorization" service, whereas the ConOps points to a distinct "strategic deconfliction" service. It also restricts the term "authorization" to actions by competent authorities.

   The Opinion requires information about manned aircraft positions to be made available to U-Space service providers in any U-Space airspaces, including in uncontrolled airspace. In contrast, the ConOps uses traffic information as a complement to strategic deconfliction, providing an additional level of safety in specific areas. In controlled airspace, information about known traffic is already supplied by skyguide via the FIMS. At high-level, the ConOps favours operation sharing linked to a strong conformance monitoring service as the primary mechanism for collision avoidance, an approach that would be compatible with, and benefit from the voluntary participation of manned aircraft to U-Space in uncontrolled airspace.

[1] EASA can submit Opinions to the European Commission for the development and issuing of rules related to the implementation of the Basic Regulation (EU) 2018/1139. Opinions consist of a draft regulation and an explanatory memorandum. When the Agency has published an Opinion, the decision-making process is transferred to the European Commission (and thus is continued outside EASA's mandate). See www.easa.europa.eu/document-library/rulemaking-process-overview

[2] www.easa.europa.eu/document-library/opinions/opinion-012020

2 Executive Summary

Unmanned Aircraft Systems (UAS) technologies are evolving fast and, consequently, the inherent capabilities of unmanned aircraft keep improving, enabling a broader range of operations and applications. This rapid change has spawned a substantial increase in the number of recreational and commercial UAS operators. The growth in new aircraft types, usage and users – linked with the need to fly Beyond Visual Line of Sight (BVLOS) – raises the questions of how responsibilities for these innovative unmanned aircraft operations should be shared. This is where the concept of U-Space comes in.

U-Space is a federated set of services designed to ensure the safe, secure and efficient integration of multiple manned and unmanned aircraft in U-Space airspace with collaboration between all involved parties. Airspace and traffic flow management, as well as monitoring services, represent the core of U-Space. Its overarching architecture supports operational data exchange, collects operational intentions, manages the balance of demand and capacity, facilitates authorisation requests, and provides directives and advice to its users. Ultimately, it will ensure fair and easy access to the airspace for all.

Significant policy and regulatory requirements are necessary to integrate UAS into the airspace. Most importantly, any policy effort at national level must be compatible with existing or planned European and international rules. The existing European UAS regulation already provides a unified framework for the establishment of basic U-Space services. The upcoming European U-Space regulation will govern and allow additional capabilities. UAS and U-Space technologies, as well as operations, will need to keep maturing to shape and address present and future regulatory requirements. A close collaboration between regulators and industry stakeholders is therefore mandatory. In particular, the implementation of U-Space services requires a common and reliable reference model that is sufficiently robust to encourage investments, plan new operations and create job opportunities, hence the creation by FOCA and industry of the Swiss U-Space Implementation (SUSI) Public-Private Partnership (PPP).

The regulatory process must be designed to maintain transparency for policymakers, the public and industry, providing ample opportunities for feedback on draft regulations - and impact assessments – prior to enforcement. As reaching maturity on the technical, operational, regulatory and acceptance front will require a number of years, it is critical that Switzerland is proactive and leads rather than merely reacts to the rapid pace of developments of the promising emerging UAS industry.

Within the context described above, this document – Swiss U-Space ConOps – explains the goals of the Swiss U-Space Program (Chapter 2), the scope and operational concept (Chapters 3 & 4), lists and explains the roles of the various stakeholders (Chapter 5) and provides the definitions and purposes of the Swiss U-space services currently envisioned (Chapter 6).

3 Goals

3.1 **U-Space Program**

In December 2018, FOCA established a U-Space Program with the following goals:

1. Establish a national U-Space regulatory framework activating and supporting FOCA’s rulemaking process.
2. Test and support the implementation of specific U-Space services, once internationally recognized standards are available.
3. Coordinate the efforts of a national PPP composed of the regulator, the ANSP and industry participants tasked to gather experience and inputs from demonstrations, and to establish best practices, standards and business models to inform the regulatory process.

In enabling the development of a Swiss U-Space FOCA will:

1. Implement and develop a U-Space regulatory framework compatible with the evolution of the technology and the resulting systems that support the U-Space. The framework shall be technology-neutral, economically sustainable, compatible with international developments and shall ensure a high degree of flexibility.
2. Ensure the safety of existing Air Traffic Management (ATM) by performing its traditional oversight over those elements of U-space interfaced with ATM.
3. Take all necessary actions at an international level to ensure that the developed framework is fully compatible with the evolving situation in Europe and, more in general, worldwide.
4. Adopt an "authorize and assess" philosophy to meet the core concern of this nascent industry. This philosophy will allow experimentations around new technologies and will promote innovation. The constant assessments done by the competent authorities will guarantee the safe conduct of operations.
5. Evolve the required frameworks in a time-based fashion following a plan that will evolve with the market and the complexity of the operations. The development of frameworks may be leveraged to drive innovation especially when it comes to aviation security.

3.2 **Swiss U-Space Implementation**

The outcome of the third objective was the launch of the Swiss U-Space Implementation (SUSI) Public-Private Partnership[3] (PPP) in December 2018. SUSI is a collaborative effort between FOCA, the Swiss Air Navigation Service Provider (ANSP) skyguide, U-Space Service Providers, Supplemental Data Service Providers, Technology Providers and Drone, Ground Control Station or Flight control manufacturers who have agreed to the Memorandum of Cooperation (MoC)[4]. It was created to jointly identify, quantify, conduct, and effectively implement U-Space capabilities and technologies. Its goals are:

1. Research and mature increasingly complex U-Space operational and regulatory scenarios, services, technologies and capabilities
2. Demonstrate and implement those capabilities within the Swiss U-Space framework
3. Deliver to FOCA technology packages that provide insight and capability requirements for U-Space services.
4. Enable the deployment of mature technologies through effective national legislation
5. Ensure full compatibility of Swiss legislative and technological solutions with international developments

3.3 **ConOps**

This ConOps presents a vision for the Swiss U-Space and aims to describe the associated high-level requirements for developing and deploying operations, manned and unmanned, within the Swiss U-Space system. U-Space services shall contribute to safe, secure and environmentally friendly operations in a way that also respects the privacy of the citizens.

The document is technology-neutral[5]. It supports innovation by providing objectives rather than by prescribing technical solutions to be used. The services and capabilities described in this ConOps are those foreseen at the time of writing. It is expected that additional capabilities will be added to the system without compromising the validity of this document.

[3] The partnership is defined as a voluntary and collaborative relationship between various parties, both State and non-State, in which all participants agree to work together to achieve a common purpose or undertake a specific task and to share risks, responsibilities, resources, competencies and benefits. (Source, United Nations: https://digitallibrary.un.org/record/501843?ln=en)

[4] For more information about SUSI, visit: https://www.bazl.admin.ch/bazl/en/home/good-to-know/drones-and-aircraft-models/u-space.html

[5] Technology-neutral: The regulators should refrain from using regulations to push the market toward a particular structure that they consider optimal. In a highly dynamic market, regulators should not try to set the most advanced technology as a standard.

4 Scope

This ConOps focuses primarily on operations conducted in Switzerland under the Open[6] and Specific[7] categories as defined by the European Regulation. The Certified category, which includes operations with Urban Air Mobility (UAM) vehicles, are however not excluded from the applicability of this document.

Although most of unmanned operations currently happen in very-low-level airspace, the ConOps applies to operations occurring in any airspace at any level. Operational and technical requirements will vary with the unique characteristics and implications of the airspace class and level in which the UAS are operating and depending on the type of operations. Individual U-Space services will be gradually introduced while making sure that existing conventions and processes are adhered to and not impacted.

The document is informed by the activities of SUSI and is based on the Federal Aviation Authority (FAA) UAS Traffic Management (UTM) ConOps v1.0. The concepts have been adapted to suit the need of the Swiss U-Space and to consider on-going efforts in the European Union (e.g. EASA U-Space Opinion[8]).

This ConOps is a living document. It evolves with technological, legal and economic changes. This is its second iteration. It includes significant changes regarding actors and entities involved in U-Space. A major revision, with a focus on services and operations, is expected toward the end of 2020.

5 Swiss U-Space Operational Concept

5.1 **Overview**

The flexibility of the regulatory approach applied to UAS in Switzerland has supported the conduct of safe UAS operations without the need to superimpose the complete suite of sometimes unsuitable traditional aviation administrative procedures, certification and oversight mechanisms. This risk and performance-based approach to regulation has allowed tremendous growth of the drone industry. It has now been adopted in Europe and by the Joint Authorities for Rulemaking on Unmanned System (JARUS) with the Recommendations for UAS Category A and B Operations[9]. U-Space is a system designed to support an increasing density and complexity of UAS operations. It leverages the industry's ability to supply services under FOCA and/or the EASA regulatory authority. The system must respond to criteria of safety, security, efficiency, scalability and equity. It will also be a testbed for innovative solutions in the traditional ATM environment.

The Swiss U-Space system incorporates a set of federated services and associated functions plus an all-encompassing framework designed to support multiple UAS operations. These services are distinct and may be offered by different providers. They must nonetheless guarantee a seamless experience for the end-user and support accurate inter-service data transmission to support safety. The services are complementary to traditional ATM and a variety of interactions are foreseen between the U-Space and the ATM systems.
Different layers of information will "flow" within the U-Space network and between its various actors (e.g. Operator to Operator, Operator to FOCA, etc.). The primary means of communication and coordination

[6] Open Category: This category identifies those UAS operations that present low unmitigated risk. Self-certification or adoption of industry standards may apply but there are no mandatory airworthiness requirements. Risk mitigation is applied through the adoption of operational limitations and hence there will be no mitigation applied through approvals issued by an aviation regulator. The Operator is responsible for safe operations.

[7] Specific Category: Where an UAS operation goes beyond the operational limitations of Category A and safety is not assured by relying on a certificated design as foreseen in Category C, the operation will need to be independently assessed by the Authority under this category. An acceptable level of risk is ensured by a risk assessment of the operation that identifies the applicable mitigations, which can contain requirements addressing the design, operational limitations, and qualifications of the Operator or of the pilot. Varying levels of oversight will be needed in this category.

[8] www.easa.europa.eu/document-library/opinions/opinion-012020

[9] http://jarus-rpas.org/sites/jarus-rpas.org/files/jar_doc_14_ops_cat_a_b_edition1.0.pdf

is via a distributed network of digital, highly automated systems and not between pilots and controllers via voice. Static and real-time airspace constraints will be made available to the end-users via different mechanisms: directly by the FOCA, through a FIMS for data related to the mandate of the national ANSP, skyguide, or by U-Space Service Providers via a synchronized data exchange capability (see 6.3). The remote pilots (as defined in 6.7) are expected and responsible to comply with these constraints, in many cases in absence of air traffic services (ATS) from skyguide. UAS Operators may choose to use U-Space Service Providers (USP) to meet their obligations (U-Space as a Service) or to deploy their own set of services and thus becoming a USP themselves.

The Swiss U-Space system encompasses all infrastructure, policies, humans and procedures required to support the UAS operations. It requires the establishment of regulatory frameworks, operating rules and performance requirements commensurate with the demands of operations, as well as a data exchange and information architecture enabling a shared situational awareness among participants.

5.2 **Notional Architecture**

The Swiss U-Space system enables FOCA, skyguide and any other competent authorities to maintain their regulatory and operational authority over airspace operations. It will complement the ATM system for operations not managed by ATM or will be used to enhance existing ATM features where services are already provided. U-Space services are organized, coordinated and managed by a federated set of actors in a distributed network of highly automated systems. Information is exchanged using a set of Application Programming Interfaces (APIs).

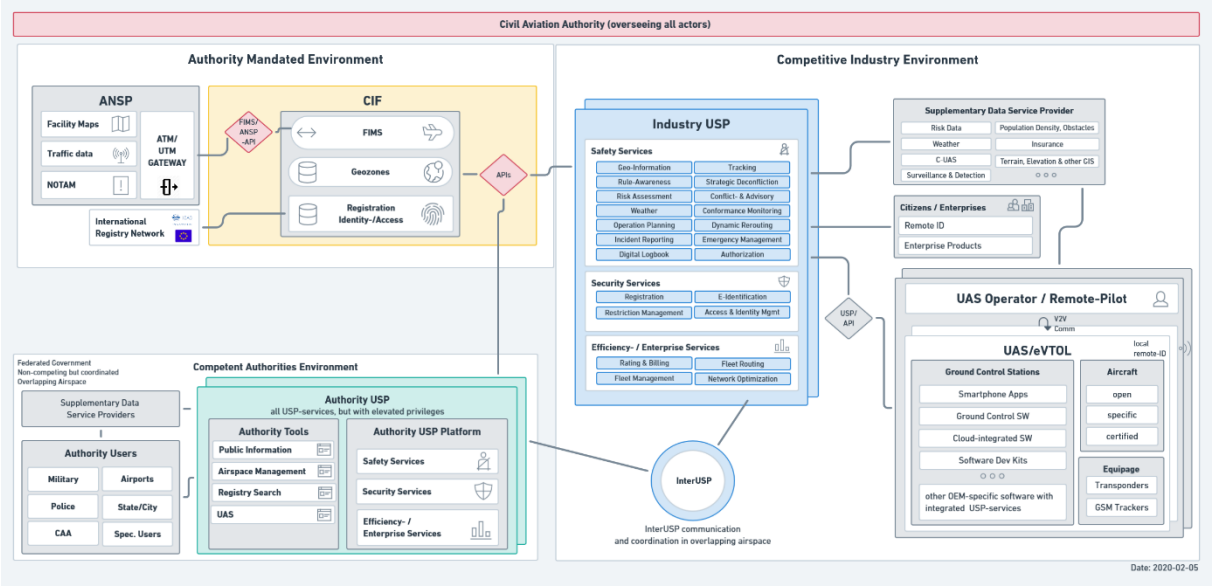

Figure 1 – Swiss U-Space Architecture Overview

The Swiss U-Space architecture supports FOCA, skyguide and all other actors in their respective roles and responsibilities. It offers high regulatory flexibility for a market of data and services. It also allows existing regulatory bodies like FOCA to retain their prerogatives where a need for centralization exists.

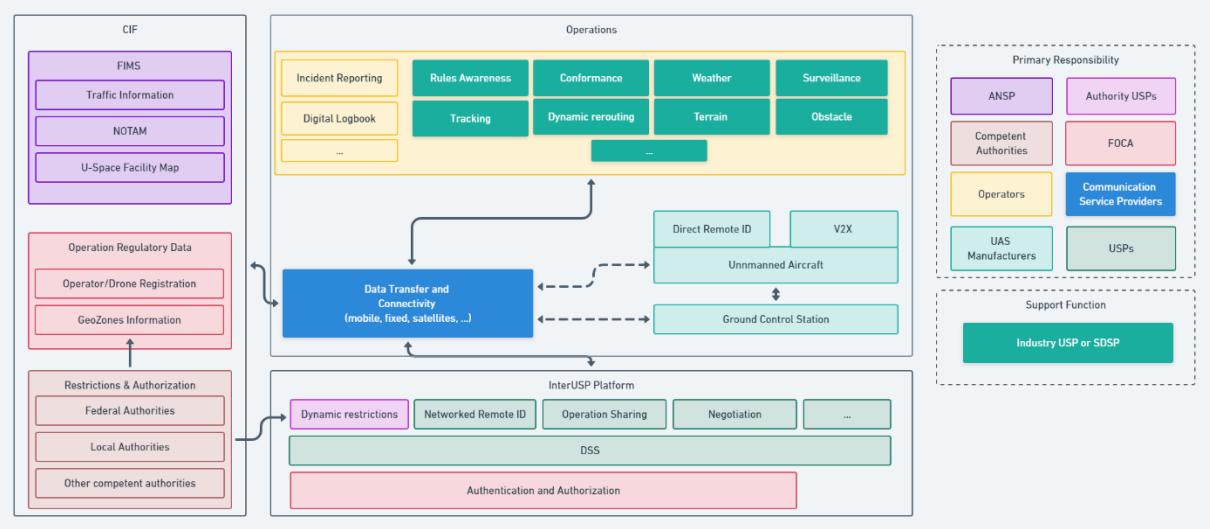

Figure 2 – Swiss U-Space Services Overview

6 Actors/Entities

6.1 Common Information Function (CIF)

The Common Information Function is an overarching function regrouping all centralized services and capabilities. It includes services provided by distinct stakeholders: the FIMS (skyguide), the national operators and drone registries (FOCA), as well as a geozones repository (FOCA). More details on each of those functions are provided below.

6.1.1 Flight Information Management System (FIMS)

The FIMS is a gateway through which the national ANSP, skyguide, can provide relevant airspace information available to UAS Operators via USPs (see 6.1.3). Considering new standards and improvements in services provided by industry participants, this section incorporates significant changes compared to the first version of the ConOps.

The FIMS is a centrally managed U-Space component that skyguide has built to support U-Space operations. The provision of the data below is part of skyguide's mandate:

1. **U-Space Facility Maps**
   U-Space Facility Maps depict the maximum altitudes where skyguide may authorize UAS operations without further coordination. Those maps are provided for airports operated by skyguide only (all the main Swiss airports). They are free and publicly available.

2. **Traffic Data**
   Skyguide provides a traffic picture, available through standard ATC surveillance means. The traffic does not contain callsign or means to identify the object, except for its SSR code and Mode-S information.

3. **NOTAM**
   Skyguide publishes updates on NOTAM with an impact on U-Space operations. Skyguide publishes this information without the GML geometry of the impacted areas. A NOTAM database and NOTAM with GML geometry are separate commercial services that are not part of the FIMS.

The centralized nature of those data is justified by the fact they are already part of skyguide's existing mandate for manned aviation and that they contribute to aviation safety.

6.1.2 Legal Considerations and Open Platform

The FIMS is limited in scope by design. The Swiss U-Space system must have low access barriers for end-users, as well as providers of data and U-Space services. The related regulatory framework aims to promote the ability for the Pilots and Operators to consume and distribute information, data and services of their choice. The FIMS shall therefore not provide functions that are not in the ANSP mandate. It shall serve all approved USPs under reasonable and non-discriminatory terms. In the framework of this ConOps, these restrictions only apply to the addition of commercial services to the FIMS. If allowed under the European U-Space regulation, the FIMS provider will be able to offer commercial services using a distinct channel, meaning that they will act as a USP or SDSP.

FOCA and other national regulatory and other competent authorities are empowered to intervene against agreements or commercial practices which, because of their scale, lead to situations where end-users' choice is materially reduced in practice. In addition, national authorities should be required, as part of their monitoring and enforcement function, to intervene when agreements or commercial practices would result in the undermining of the essence of the end-users' rights. This is an area where further economics and legal research is required.

6.1.3 Registration of UAS Operators and Certified UAS

Starting 1st July 2020, the Commission Implementing regulation (EU) 2019/947[10] will be applicable in Switzerland as well. Accordingly, FOCA will maintain two registration systems, one for UAS operators and one for UAS subject to certification (see Art. 14 of the regulation). Those two registration systems will be managed by FOCA directly. The operator registry is expected to launch in the second half of 2020. A UAS registry will complement the operator registry once the European requirements on UAS subject to certification become available. As a mandatory centralized service, the registration of UAS operators and certified UAS is part of the CIF.

The operator identification number is required for the remote identification of UAS (see the Annex "UAS Operations in the 'open' and 'specific' Categories" in (EU) 2019/947). Law enforcement agencies will get access to the registry under conditions that are being defined at the time of writing. As far as the U-Space system is concerned, a data exchange capability with the registries is being envisaged in future iterations. Additional registration needs from those expressed in the (EU) 2019/947 might emerge for operational purposes and result in global standardization efforts (e.g. ICAO's Trust Framework)[11].

6.1.4 Geozone Information

Article 15 of (EU) 2019/947 enables the creation of geographical zones (geozones) that prohibit or restrict access to drones for safety, security, privacy or environmental reasons. Geozones in which UAS operations are exempt from one or more of the 'open' category requirements can also be created. The creation of geozones is based on competencies of agencies at different levels: national and local. Each geozone will be tied to a competent authority responsible for authorizing flights.

FOCA plans to consolidate information on quasi-static UAS geographical zones and to make them publicly available in the common unique digital format defined by EASA as an Acceptable Means of Compliance. Quasi-static UAS geographical zones encompass needs that are known in advance, such as protected nature areas, sensitive infrastructures or outdoor public events. Those zones can be temporary or cyclical. FOCA will leverage existing data exchange mechanisms between the Swiss Confederation and cantons and municipalities to consolidate the geozones.

The delivery mechanism for dynamic data must be different because it cannot use the Swiss Confederation's existing infrastructure. Dynamic geozones encompass unexpected needs, such as fire areas, accidents or Helicopter Emergency Medical Services (HEMS). They will be implemented as soon

[10] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32019R0947

[11] https://www.icao.int/Meetings/a40/Documents/WP/wp_369_en.pdf

as a standard to disseminate such data in the U-Space system becomes available. It is expected that law enforcement agencies would publish temporary geozones via an authority USP, an approved USP with privileged access (see 6.2.5).

6.2 U-Space Service Provider (USP)

A USP is an entity that provides services to support safe and efficient operations by providing services to the Operator and authorities. A USP:

1. acts as a communications bridge between federated U-Space actors to support Operators' abilities to meet some regulatory and operational requirements for UAS operations
2. archives operations data in historical databases for analytics, regulatory, and Operator accountability purposes. This could be implemented as a commercial fleet-management service.
3. provides the Operators with core services (e.g. geoawareness) and value-added services (e.g. risk-reduction, noise analysis, etc.)

These characteristics allow a network of USPs to provide cooperative management of operations without direct authority involvement. USP services support operations planning, aircraft deconfliction, conformance monitoring, and emergency information dissemination. USPs may also qualify, under conditions to be specified, to work with federal and local agencies to gather and disseminate dynamic airspace restrictions (see Geozones 6.1.4). USPs may also provide other value-added services to support U-Space actors as market forces create opportunities to meet business needs.

The USP is an integral and essential part of the Swiss U-Space system. They are expected to develop and implement a wide variety of capabilities and services to assist the Operator in the safe conduct of their operations. USPs provide infrastructure and services that may be burdensome for individual UTM participants to develop, access, or maintain. By ensuring the sharing of information, USPs play a critical role in maintaining shared situational awareness across participants.

6.2.1 Communications Bridge

USPs act as a real-time or near real-time communications bridge between UAS Operators, ANSPs, other USPs, SDSPs, public entities, and other stakeholders to share information required to manage nominal and off-nominal operations (for example, flights in the vicinity of aerodromes). USPs assist Operators in meeting the requirements set forth for each operation either by acting as a coordination mechanism to relay safety-critical information to the Operator and other entities or provide services that enable efficient, safe and compliant operations. The USP coordinates and distributes to appropriate entities:

1. Operator intent
2. Airspace constraint data
3. Weather data
4. Vehicle tracking and conformance data
5. Surveillance data
6. Other data critical to the safety of flight.

Numerous services are expected to be based on those data, including strategic deconfliction, notifications of priority services (temporary flight restrictions), inflight deconfliction/sense and avoid functions, hazard avoidance, and terrain and obstacle clearance, and other value-added services.

Adherence to common requirements for information exchange within a USP Network (see InterUSP Network, 6.3) and/or with other specified entities is necessary.

6.2.2 Demand/Capacity Balancing

USPs support collaborative decision-making and conflict avoidance/deconfliction, which promote safety, equitable airspace access, and efficient operations. When users are competing for airspace, USP Operator provide negotiation capabilities and operation planning tools (e.g., route planning functions, airspace configuration options) to support collaborative decision making and/or offer alternatives. They enable equitable access to airspace and optimize its use by resolving demand/capacity imbalances. The related regulatory requirements still need to be developed and harmonized at the international level.

6.2.3 Data Archiving

As the regulator, FOCA sets the target levels of safety, authorizes operations and monitors Operators' compliance with relevant rules and regulations. It may collect and analyse operations data to evaluate whether operations are meeting their compliance requirements. USPs will assist FOCA by archiving requested operations data sets (e.g. operations of specific category UAS) in historical databases for FOCA analytics, regulatory, and Operator accountability purposes. USPs must be capable of providing data upon FOCA's request. Any data archiving capability will have to comply with applicable data protection and privacy law. The USP might also be subject to mandatory recording and data retention requirements outlined in ICAO Annexes 10 and 11 (depending on the services provided to the ANSP) in which case additional data archiving requirements will apply.

6.2.4 Legal Considerations and Open Platform

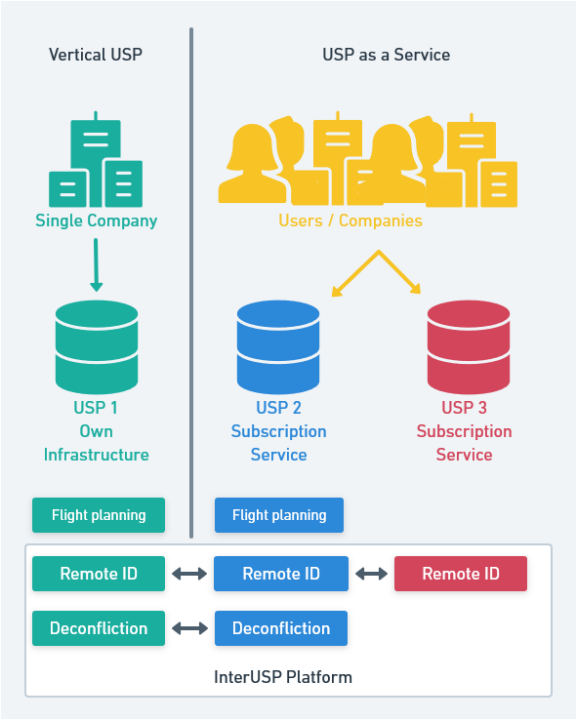

Figure 3 – Vertical USP and USP as a Service

A variety of business models has emerged for USPs. Some companies expressed an interest in vertically integrating USP functions in their own business, relying on their own infrastructure and technical stack, whereas others aim to sell services (USP as a Service). Hybrid models are also possible, some operators might have the capacity to develop some but not all services necessary to their operations.

Access to U-Space

When providing U-Space services, the USPs should treat all traffic equally, without discrimination, restriction or interference, independently of its sender or receiver, content, application or service, or terminal equipment. Traffic management measures applied by the USPs should follow the applicable Rules of the Air, transparent, non-discriminatory and proportionate, and should not be based on commercial considerations. The requirement for traffic management measures to be non-discriminatory does not preclude providers of U-Space services from implementing traffic management measures that differentiate between objectively different categories of traffic (e.g. best-equipped, best-served principle) when they contribute to the overall airspace safety, security and efficiency. Any differentiation should only be permitted based on measurable requirements (for example, in terms of latency, jitter, packet loss, and bandwidth), and not based on commercial considerations. Such differentiating measures should be proportionate to the purpose of overall airspace optimisation, should treat equivalent traffic equally and should not be maintained for longer than necessary. Any traffic management practices which go beyond reasonable traffic management measures, by blocking, slowing down, altering, restricting, interfering with, degrading or discriminating between Operators should be prohibited, subject to justified and defined exceptions. Those exceptions should be subject to strict interpretation and proportionality requirements.

6.2.5 Approval Process

The scope and extent of the approval and oversight processes linked to each U-Space service is a critical piece of information for USP. FOCA will incrementally implement a framework for approval of selected services in collaboration with SUSI and in alignment with international initiatives. There are already models proposed by other authorities. For instance, the FAA is qualifying USP as Low Altitude Authorization and Notification Capability (LAANC) providers[12]. They also announced a similar mechanism for Networked Remote Identification (Net-RID)[13]. In parallel, the draft U-Space regulation from the European Union lays out the foundations for USP certification.

The incremental process will start with a voluntary stage, pending the publication of the U-Space regulation and related standards. Its main goal will be to find a balance between the security and efficiency of the U-Space system and to gain administrative experience to avoid creating any undue burden for USPs and FOCA. The opportunities for automation of the approval process and the need for continuous monitoring of the system health by the authority will be thoroughly examined.

The exact services requiring approvals as well as the associated roles will be defined. For instance, Networked Remote Identification has three roles: Net-RID Service Provider, Net-RID Display Provider, and Display Client[14]. Each will be considered separately. Approval of entities collecting and sharing data might be required but those only displaying data to final customers might not. Large-scale trials will support a clearer understanding of regulatory boundaries.

6.3 **The InterUSP Network**

The term “InterUSP” refers to the capability by which USPs share data or interact with one another (e.g., how a USP makes intent information available to all other USPs). Multiple USPs will operate in the same geographical area and thus will support “overlapping” operations that require orchestration. In this environment, the InterUSP Network defines the interfaces and flow of information to use for sharing relevant data between USP for U-Space service requiring coordination.

The network must be based on a global standards that can manage a large number of USPs and UAS. The implementation of the capability for each service might vary but it must follow certain common rules, in particular around data protection. The InterUSP Network should not store or process details about the UAS operations being shared and, more in general, should comply with applicable privacy and data protection regulation (e.g. GDPR). The capability could be described as a “phone book”, in the sense that it enables communication without providing or storing details on data shared between two parties.

An example of implementation of the capability exists. The ASTM Standard Specification for Remote ID and Tracking[15] provides specifications for interoperability requirements, APIs, and testing for a Networked Remote Identification service. Service providers can choose how to implement access to the network. Each participant may decide to develop or buy a custom solution compatible with the standard, or a consortium of stakeholders may choose to collaborate in managing their infrastructure jointly. FOCA encourages the exploration of collaborative approaches as they might reduce risks and costs for each USP. A group of USPs has already published one possible implementation as an open-source project[16].

The primary functions of the InterUSP Network are:

1. Provide the capability for data exchange between USPs (data formats and protocols)
2. Assure the quality and accuracy of information being shared
3. Provide a staging environment to demonstrate interoperability with the InterUSP Network

[12] https://www.faa.gov/uas/programs_partnerships/data_exchange/laanc_for_industry/

[13] https://www.faa.gov/uas/research_development/remote_id/industry/

[14] For details, see https://www.astm.org/Standards/F3411.htm

[15] https://www.astm.org/Standards/F3411.htm

[16] https://interussplatform.org/

Additional functions will emerge as the InterUSP Network is developed.

6.4 **Supplemental Data Service Providers (SDSP)**

Supplemental Data Service Providers (SDSPs) provide data and services via the U-Space system to stakeholders within the U-Space ecosystem for essential or enhanced services (e.g. terrain and obstacle data, specialized weather data, surveillance, constraint information). SDSPs provide information directly to USPs or Operators. SDSPs are generally not approved by Swiss FOCA but should adhere to the applicable technical and performance standards of the system to which they connect. SDSPs are expected to establish Service Level Agreements (SLA) with their clients clarifying all aspects of provided services with a particular focus on roles and responsibilities.

It is in principle possible for an SDSP to offer services via non-U-Space network sources (e.g., public/private internet sites). In this case, as the SDSP establishes a relation with an Operator with no other relation to the U-Space system, it is not considered part of the U-Space. The distinction between USPs and SDPs will be further examined in future iterations of the ConOps.

6.5 **Communication Service Providers**

Communication Service Providers offer connectivity to U-Space systems during operations. Connectivity is not assumed to be obtained or maintained by any specific mean or to any specific endpoint. For a simple VLOS operation connecting a ground control station to the internet via data sharing through the operator's phone might be enough. For some other operations, the UA itself might get connected to U-Space service via satellite. It is not assumed either that connectivity will be required at all times for all operations. A significant amount of work is required in this area to determine and match the needs of operators and the capacity of the telecommunication industry.

Communication services are also not limited from/to sharing operational data with human beings. Cellular vehicle-to-everything (C-V2X) is being developed as a way to support autonomous operations for all kinds of vehicles. A dialog between communication service providers and UAS manufacturers (see 6.8) is necessary. It is one of the objectives of SUSI to develop a position paper on (C-)V2X.

6.6 **Operator**

The Operator is the person or entity responsible for the overall management of the operation. The Operator meets regulatory responsibilities, plans flight/operations, shares operation intent information and safely conducts operations using all available information.

The Operator is identified when operating within the U-Space system via its registration number or related mechanisms, such as operations unique identification numbers that can be linked to the Operator id. 'Operator' in this document is inclusive of airspace users electing to participate in the Swiss U-Space, including manned aircraft Operators, except when specifically called out as a manned or UAS Operator. The Operators have the right and the ability to access the USPs and SDSPs of their choice, if publicly available. In some circumstances, an Operator might elect to be a USP (for example for large fleet management) but will then have to comply with the applicable requirements for operating as a USP.

6.7 **Pilot**

a) Remote Pilot (role): is the actor (human or machine) operating the drone
b) Automatic onboard pilot (system), this refers to the level of automation of the drone: at the low levels of automation, this could be limited to data collected by on-board sensors and sent to the system when at highest this is about piloting functions and on-board decision making with little or no human intervention.

6.8 Unmanned Aircraft System (UAS) Manufacturer

UAS must meet the technical and performance requirements applicable to the area of operation, including those required for the provision of U-Space services. The role of UAS manufacturers is therefore critical in the system. The Delegated Act (EU) 2019/945 sets rules for access to the European Market through the CE Marking certification process. It covers broadcast identification of the operator as well as geoawareness standards, including geofencing and geocaging. Although those are not specifically U-Space related, they are an integral part of safe and secure operations.

The capability for drones to communicate directly among themselves and to infrastructures might have a significant impact on the development of U-Space. The role of UAS manufacturer in the implementation of V2X (Vehicle-to-Everything) communication will be investigated within SUSI.

7 Services Overview and Functional Breakdown

The following services can be provided by USPs, interUSP and/or SDSPs to the Operator or the remote pilot on the U-Space system. The services can serve the FIMS, FOCA, USPs internal procedures as well as interUSP communication. This list is not exhaustive and is expected to evolve.

7.1 Communication Service

A service, which provides the appropriate connectivity to support data exchange between U-Space stakeholders and systems. The purpose of this service is to:

- Support data exchange in the U-Space system, including machine to machine.

This service benefits the Operators by providing a communication infrastructure in the U-Space system.

7.2 Discovery Service

A service, which allows USP and Operators to be aware of other USPs providing specific services in a defined geographical area. It provides the following functions:

- Discover the services provided in the area of operation
- Provide awareness of other USP in the area of operation
- Establish interUSP communication

The service will benefit the Operator by providing a possibility to find a specific required service for his intended flight. It will also benefit the USPs by providing information about operations in the vicinity and awareness of other USPs for future interactions.

7.3 Authentication and Authorization Service

A service, which supports the authentication of U-Space stakeholders and ensures that the authorized stakeholders have appropriate access to resources.The service fulfils the following functions:

- Enable authorized U-Space stakeholders to access services, such as Network Remote ID, Flight Plan Sharing, Registration, or FIMS.
- Provide an interface to a subset of FOCA employees to register, provision, manage access (scope) and revoke users, as well as add or remove services.

The service benefits U-Space stakeholders (i.e law enforcement agencies, USPs) that need to share resources or data in the U-Space system.

7.4 Registration Service

A service, which allows the Operator to register himself and, when required, data related to UAS. This service entails the following functions:

- Provide an interface for data entry/manipulation to the Operator
- Provide unique identification to registered entities when needed
- Securely store relevant user data
- Exchange registry information with relevant stakeholders

This gives a way to competent authorities to access information about the identity of Operators. It is required to comply with the existing regulatory requirements.

7.5 Remote Identification Service

A service, which provides a position report of a Unmanned Aerial Vehicles (UAV) and identification data of its Operator. It will:

- Provide the Operator's identity and other relevant UAV parameters to the U-Space system and other relevant stakeholders

It will benefit competent authorities, in particular law enforcement agencies, by providing a mean to identify a UAV and its Operator. FOCA has published a report on the topic based on a trial organized within the framework of SUSI[17]

7.6 Airspace Authorization[18] Service

A service, which provides the needed authorizations to fly from a competent authority to a UAS Operator. It fulfils the following functions:

- Provide the opportunity for the pilot and/or the Operator to request an authorization.
- Automatically approve requests when possible
- Support the authorization process when automatic approval is not possible
- Support competent authorities in managing the authorization requests
- Notify other relevant parties of issued authorizations

This service benefits the UAS Operator, the pilot, as well as the competent authorities. Airspace Authorization will be managed digitally with efficiency gains for all actors involved.

7.7 Geoawareness Service

A service, which provides information on airspace data and constraints. It entails the following functions:

- Collect geographical zones from relevant stakeholders
- Distribute airspace data and constraints to affected UAS operations
- Exchange airspace allocation and constraint with affected participants

The service benefits the competent authorities by providing a channel for constraints exchange. The service benefits the end-users by providing them with official data regarding areas where flight authorizations are required, as well as a mean to contact the related competent authority.

The service also allows the publication of dynamic geozones by competent authorities. It then fulfils these additional functions:

[17] Available in the Documents section at: www.bazl.admin.ch/bazl/en/home/good-to-know/drones-and-aircraft-models/u-space.html

[18] Airspace Authorization: An approval provided by the ATC or the local airport responsible where applicable. This approval is based on the Art 18 a. of the OSCA. This authorization does not refer to the airspace authorization, as it is comprehended in the ATM environment.

- Provide an interface to create dynamic access restricted areas
- Automatically create dynamic restricted areas

The regulation (EU) 2019/945 provides instructions to drone manufacturers in the Open category regarding how to inform the pilot of a geoawareness event. At the time of writing, a standard was about to be published by ASD-STAN.

7.8 **Notification Service**

The Notification Service provides periodical information on UAS operations occurring within the subscribed airspace volume and time, which includes real-time information. Filtering is a part of the service. It includes the following functions:

- Provide the pilot with relevant information during the flight
- Provide status and failure information of the communication means to the end-users

This service will benefit the remote pilot. It will provide the remote pilot information to supervise and plan his operations safely and efficiently. It might for instance allow the ATC to communicate relevant information to the remote pilot. It will also allow the surrounding remote pilot to be aware of communication failures and degradation in order to take proper action and use contingency procedures.

7.9 **Rules Awareness Service**

The Rule Awareness Service provides information about rules to follow in a specific area at a given time for a particular operation. It will:

- Provide the pilot with rules and regulations applicable to the area and type of operations.

This service benefits the remote pilot. It will give him awareness about rules and allow him to plan his operations in the regulatory framework foreseen by FOCA.

7.10 **Geographical Information Service**

The geographical information service provides data as appropriate and necessary to meet the safety and operational requirements of individual UAS operations. It fulfils the following function:

- Provide a digital map of the terrain, obstacle data, population density, etc.

This service supports the creation of digital maps and ensures that the information displayed is accurate. It will benefit the participants by supporting operations planning. It will consolidate airspace data and operation planning information from various sources (for instance SDSPs).

7.11 **Tracking Service**

A service, which tracks and shares position reports for other services to operate (deconfliction, operation planning and so on). It includes the following functions:

- Track real-time position information
- Securely store tracked data
- Provide traffic information to relevant stakeholders

The service will gather positions of the UAS and ensure the privacy of its users and their activity. It will further ensure the safety of the flight by communicating the position reports to the relevant services.

7.12 **Operation Planning Service**

A service, which, prior to a flight, arranges and optimizes intended operational volumes/trajectories for safety, dynamic airspace flight rules, airspace restrictions, and mission needs. It entails the following functions:

- Provide an interface for operation planning
- Provide all relevant information (from all other services) to plan the flight
- Suggest flight path and associated flight volumes geography
- Notify the Operator/Pilot of possible conflicts/rules violation of the proposed flight
- Attest legal compliance of proposed flight according to applicable rules
- Provide the possibility to submit the operation plan to the relevant stakeholders

The service provides the Operator/Pilot with operation planning relevant information. It increases safety and allows efficient airspace management. It will benefit the Operator/Pilot by exchanging intentions and constraints. It will provide a possibility for the Operator/Pilot to change his plans in case of conflicts. It will also benefit the separation[19] services, other inflight services and the competent authorities by providing them with the relevant flight information to ensure legal compliance.

7.13 **Separation Services**

The separation services are split in four different groups.

7.13.1 Strategic[20] Deconfliction Service

A service, which arranges, negotiates and prioritizes intended operational volumes/trajectories of UAS operations to minimize the likelihood of planned airborne conflicts between operations. This service may include the following functions (non-exhaustive):

- Exchange relevant operation plan information
- Negotiate alternative flight routes in case of planned airborne or ground conflicts
- Prioritize access to the airspace when collaborative deconfliction is not possible.
- Ensure that the overall encounter rate for deconflicted operations is within acceptable limits.
- Provide the possibility for remote pilots to plan intersecting operations if the conflicting remote pilots explicitly mutually acknowledge the intersecting operational volumes.
- Exchange with the UAS Operator of the final, deconflicted operational volume/trajectory for approval/modification

This service will help solve collaboratively conflicts between operations and gather the necessary constraints for deconfliction. It will ensure safety even when collaborative deconfliction is unsuccessful by prioritizing operations. The conflicting remote pilots will also be able to plan intersecting operations in case they attest to have acquired the necessary awareness about intersecting operational volumes.

7.13.2 Conformance Monitoring Service

A service that provides real-time alerting of non-conformance of intended operational volume to the concerned remote pilot. It provides the following function:

- Inform the remote pilot in case the UA leaves the operational volume.
- Inform authorities, when required, when flights deviate from intended operational volume.

This will benefit the concerned remote pilot and help him/her decide whenever contingency measures are necessary in order to avoid that the UAV becomes a hazard for other operations.

7.13.3 Conflict Advisory and Alert Service

A service that provides real-time monitoring and alerting through suggestive or directive information of UAV proximity for other airspace users. It will:

- Provide relevant conflict information to the remote pilot
- Provide conflict alerts to the remote pilot in case of potential conflicts and other dangers to air navigation

[19] Separation: Separation is defined as a distance provided by the applicable standard for unmanned traffic management (SORA). This separation does not refer to the separation as it is comprehended in the ATM environment.

[20] In this context, “strategic” should be understood as activities performed before the flight.

- Provide resolution advisory to the remote pilot to avoid a collision

This service will be able to identify which remote pilots are involved in a specific conflict and will be able to actively support the remote pilots during encountering. It will benefit the remote pilots by giving him/her advisories to avoid conflicts.

7.13.4 Dynamic Reroute Service

A real-time service, which provides modifications to, intended operational volumes/trajectories to minimize the likelihood of airborne conflict and maximize the likelihood of conforming to airspace restrictions and maintaining mission objectives. It arranges, negotiates and prioritizes inflight operational volumes of operations. It fulfils the following functions:

- Exchange all relevant information in the service area
- Negotiate and rearrange an alternative flight route in case of impending airborne conflicts
- Prioritize access to the airspace when conflicts arise
- Exchange with the remote pilots the final, deconflicted operational volume/trajectory for approval/modification.

This service provides following benefits: to modify the operational volume/trajectories, to solve collaboratively conflicts between remote pilots in real-time, to ensure safety standards, to apply prioritization during the operation, and to ensure that modifications are performed in order to solve conflicts.

7.14 **Risk Assessment Service**

A service, which provides U-Space participants with a risk estimate based on a flight route with respect to air and ground risks. It will:

- Estimate air and ground risks based on a flight route
- Estimate, when required, the predicted radio space on a flight route
- Provide routing optimization towards ground risks
- Minimize the encounter rate for the mission
- Minimize, when required, communication degradation and failures

The service will give an understanding of risk to the Operators and provide enhanced routing options.

7.15 **Weather Service**

A service, which publishes forecast and/or real-time weather information to support operational decisions of individual Operators, and/or services. It will:

- Inform about the weather forecast.
- Support the remote pilot/UAS Operator with operation planning and execution with respect to weather, using real-time information

This service will benefit the Operator/Pilot. It will provide a tool to plan operations (for example avoiding icing conditions or thunderstorms) accounting weather and provide support as well as advisories in terms of weather forecasts. It will also provide support during flight concerning weather conditions.

7.16 **Noise Mitigation Service**

A service, which defines areas with respect to acceptable noise levels in time and space and which supports the Pilot with operation planning through these areas. It will:

- Define zones with respect to noise sensitivity as well as allowed noise levels
- Support flight route planning in order to minimize the noise impact on surrounding populated areas

This service will benefit the Operator by simplifying planning but also people on the ground that could possibly suffer from the UAs noise. The Operator will know which zones to avoid during operations planning and will get support and advisories in order to minimize the noise impact on the surrounding populated areas.

7.17 **Liability Insurance Service**

A service, which allows the Operator to contract liability insurance to cover himself, as a minimum, according to Art 20 of the Ordinance on Special Category Aircraft (OSCA, SR 748.941). It will:

- Insure Operators for potential damages to third parties during operations

This service will benefit Operators by allowing them to contract liability insurance.

7.18 **Emergency Management Service**

A service, which allows the Pilot, the Operator and possibly the UAS itself to report a contingency situation and/or emergency. It provides functions to:

- Identify contingency and/or emergency situations
- Exchange information related to the emergency flight with all relevant stakeholders
- Provide the pilot with relevant information for the management of the emergency

This service benefits the authorities and services by identifying which pilots and Operators are in contingency and/or emergency situations so that mitigation measures can be engaged. It also benefits the relevant stakeholders in case of inflight emergency and provides them with support and assistance to minimize hazards. This service will also give the pilot, the necessary awareness during the contingency situation, to minimize hazards and manage the emergency.

7.19 **Accident and Incident Reporting Service**

A service, which provides the Operator with a way to report an accident or an incident to FOCA, and other competent authorities. Reports will be used to:

- Provide means of reporting information about an accident and/or incident.
- Acknowledge the transmission of data such that the Operator can be sure that all regulatory duties of the accident and incident reporting service are met.

It will ease the Operator communication with the authorities in case of an accident and/or incident.

7.20 **Digital Logbook Service**

A service, which provides a digital logbook for Operators/pilots and UAVs operations. These records will serve in case of accidents or emergencies as well as to provide a way to document safety compliance by the competent authorities. Digital Logbooks will be used to:

- Keep a record of the operations (UAVs and Pilots)
- Provide a way to document safety compliance and performance requirements for FOCA.
- Document problems and malfunctions

This service will further improve the safety and performance of the intended operations. It will benefit FOCA by providing a simplified tool to control and assess safety compliance and performance. It will improve the management and operation of flights in case of contingencies or emergencies and so benefit the UAS Operator and the safety crew.

8 Annex

8.1 List of Acronyms

ANSP	Air Navigation Service Provider
API	Application Program Interface
ATC	Air Traffic Control
ATM	Air Traffic Management
ATS	Air Traffic Services
BVLOS	Beyond Visual Line of Sight
CIF	Common Information Function
ConOps	Concept of Operations
EASA	European Aviation Safety Agency
JARUS	Joint Authorities for Rulemaking of Unmanned Systems
FAA	Federal Aviation Authority
FIMS	Flight Information Management System
FOCA	Federal Office for Civil Aviation
GDPR	General Data Protection Regulation
LAANC	Low Altitude Authorization and Notification Capability
MoC	Memorandum of Cooperation
OSCA	Ordinance on Special Category Aircraft
PPP	Public Private Partnership
SDSP	Supplementary Data Service Provider
SLA	Service Level Agreement
SUSI	Swiss U-Space Implementation
UAS	Unmanned Aircraft System
UAV	Unmanned Aerial Vehicle
USP	Unmanned Aircraft System Service Provider
UAM	Urban Air Mobility
UTM	Unmanned Aircraft System Traffic Management
VLOS	Visual Line of Sight