
UAS traffic management (UTM) —
Part 5:
UTM functional structure

Gestion du trafic des aéronefs sans pilote (UTM) —
Partie 5: Structure fonctionnelle de l'UTM

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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This document was prepared by Technical Committee ISO/TC 20, *Aircraft and space vehicles*, Subcommittee SC 16, *Unmanned aircraft systems*.

A list of all parts in the ISO 23629 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

The market expects rapid growth of civil unmanned aircraft system (UAS) operations in the near future. To manage growing operations, several states are making an effort to develop UAS traffic management (UTM). However, this can cause a lack of harmonization among countries and affect safety, security, the environment, system reliability and economic efficiency.

Some organizations have already created models and references of UTM functional structure, for example, existing documents and ongoing discussion in other organizations such as ASTM to create the UTM functional structure. These models are recognised to share a lot of common aspects.

To avoid discordance, the creation of a generic UTM functional structure as a basis of further developments is needed. The reference functional structure can serve as a mechanism to evaluate and compare different UTM systems and can foster adoption of better technologies and solutions.

The UTM structure and core functions are to be harmonized with the following perspectives:

- creating terms and definitions related to core functions of UTM referencing existing international standards;
- listing existing documents and ongoing discussion related to UTM functional structure;
- creating a common UTM structure;
- checking contradiction and inconsistency between terms and definition and UTM structure.

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UAS traffic management (UTM) —

Part 5: UTM functional structure

1 Scope

This document is dedicated to establishing a common understanding of UTM core functions and functional structure. It provides a detailed description of the UTM system layer given in the UTM Framework.

This document excludes:

- role-sharing among entities constituting UTM, which is left to implementations;
- technical methodology of communication or data transaction among core functions;
- business model of players engaging in a function of UTM.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 21384-4, *Unmanned aircraft systems — Part 4: Vocabulary*

ISO 23629-12, *UAS traffic management (UTM) — Part 12: Requirements for UTM service providers*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 21384-4, ISO 23629-12 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

3.1 UTM constituent related terms

3.1.1

UTM function

function which constitutes UTM and contributes to safe UA operation

3.1.2

UTM functional structure

UTM structure in functional perspective which consists of mutual complementary and interacting *UTM functions* ([3.1.1](#))

3.1.3

registration

making an official record of UA, remote pilot and UA operator by relevant authorities or delegated entities

3.1.4

UA operation

activity of UA organized to execute a particular mission

3.1.5

flight plan

specified information provided to ATS units, relative to an intended flight or portion of a flight of a manned aircraft

3.1.6

operation plan

specified information provided to UTM service providers, relative to an intended flight or portion of a flight of a UA

3.1.7

supplemental data

reference information to conduct safe *UA operation* ([3.1.4](#)) such as geospatial information, meteorological information and so on

3.2 UA operation related terms

3.2.1

UTM route

reserved airspace where UA with a proper capability and performance are permitted to fly within

3.2.2

UAS geographical zone

volume of airspace defined by the competent authority in which UAS operations are prohibited, restricted to specific conditions (UA type, specific equipment, effective period, etc.) or authorization by a geozone manager on a regulatory perspective is required

4 General recommendations

Whilst UTM services are relevant for UTM actors, it is significant to get into the UTM system layer and to clarify its components for further installation efforts of UTM systems, including evaluation and verification. This document gives definitions of UTM functions indispensable from the view point of safety in a manner to enable localization of UTM systems as well. Functions that are not unique to UTM (for example, communication and database) are not described.

[Clause 5](#) and [6](#) describe the detailed recommendations.

In [Clause 5](#), classification of UTM functionalities are identified from the perspective of ensuring safety and to fulfil service layer requirements. Related service providers should comply with requirements in ISO 23629-12. The high-level functionalities common to UTM systems retain flexibility in designing system architecture and implementation in accordance with local needs.

In [Clause 6](#), interactions between the UTM functional elements and the UTM functional structure are provided.

Implementation of UTM systems should consider to include, but not limited to, the UTM functions described in [Clause 5](#) and to implement the functional structure described in [Clause 6](#) in the following situations:

- Global efforts to develop UTM systems should use the functional structure for reference purposes, to resolve certain requirements into their own UTM architectural designs, and to conduct tests and verifications.
- UTM procurement agencies should use the functional structure as a reference, for procurement criteria and UTM technology evaluation.
- Possible evaluation/verification frameworks of UTM and any organization willing to evaluate UTM should use the functional structure for reference purposes, to design conformance criteria for requirements and compliance to regulations.

5 Classification of UTM functionalities

5.1 Functional categories

UTM functions are identified by reference to available UTM frameworks (see [Annex A](#)). UTM is composed of functional categories as follows:

a) Registration function

To ensure operation of UA with legal authority, the registration function provides a mechanism to register and share the official record of UA, operator and remote pilot with authorised UTM actors, including law enforcement agencies. Registration is one of the UTM services which a state authority may provide directly or which could be delegated to a service provider.

b) Flight information management function

To ensure the safe operation of manned aircraft and UA in the same airspace, flight information management function exchange information such as flight information, traffic information and aeronautical information with traffic management system for manned aircraft.

c) Operation plan management function

Operation plan management function supports to set route of flight, departure and arrival times, etc. so that operations can be carried out safely and efficiently at the planning stage in advance.

The function also supports necessary plan changes when conditions such as weather conditions change during operation.

d) Position data management function

To support safe operation, the position management function manages the position and status information provided by the UA, and shares it among UTM actors. In addition, the function confirms that the operation is being executed correctly as planned, and issues an advisory and alert to UTM users when a danger such as an accident is foreseen.

e) Reporting function

For analysis when an incident or accident occurs and operational improvement to prevent recurrence of the accident, the reporting function collects and share the incident or accident report on UA operation from operators or third parties.

f) Supplemental data supply function

Supplemental data supply function provides UTM actors with supplemental data, such as weather information and 3D map information to conduct safe and efficient operation.

For all involved exchanges of digital data by utilizing the functions above, a UTM communication service, identified in ISO 23629-12 is in addition necessary.

5.2 UTM functions

5.2.1 General

For each functional category, UTM functions are identified in the following subclauses.

5.2.2 Registration function

[Table 1](#) shows the detailed description of the registration functions.

Table 1 — Registration functions

	Function	Description
1-1	Remote pilot registration	Register and manage information about qualification and competency of remote pilot. The information managed by this function could be provided to appropriate UTM users, such as national authority and police. The information to be registered and managed, and the provision destination are regulated in each country according to the specifications of various international standards and based on laws and regulations.
1-2	UA registration	Register and manage information about UA such as manufacturer, type of aircraft, performance, specifications, aircraft unique serial number, owner, on-board equipment, etc. The information managed by this function could be provided to appropriate UTM users, such as national authority and police. The information to be registered and managed, and the provision destination are regulated in each country according to the specifications of various international standards and based on laws and regulations.
1-3	Operator registration	Register and manage information about operator who fly or intend to fly UA. Such as name of operator, authorization information, etc. The information managed by this function could be provided to appropriate UTM users, such as national authority and police. The information to be registered and managed, and the provision destination are regulated in each country according to the specifications of various international standards and based on laws and regulations.

5.2.3 Flight information management function

[Table 2](#) shows the detailed description of the flight information management functions.

Table 2 — Flight information management functions

	Function	Description
2-1	Aeronautical information management for UA	Exchanges information which is necessary for safe UA operation such as vertiport, UTM route, airspace and operational restriction among UTM/ATM.
2-2	Collaborative interface with ATC	Provides UA operators and remote crew member with communication means to contact ATS services when they intend to fly or enter into controlled airspaces.
2-3	Airspace organization and management	Design the structure of airspace and manage the usage of airspace to achieve safe and efficient UA operation.
	2-3-1 Airspace organization	Define the geographical zones where UA activity should be prohibited or restricted. It also designs and establishes the geographical zones and UTM routes where UA can fly safely. The horizontal and vertical dimensions of the section of the UTM route and airspace depend on the navigation performance of the UA in terms of total system error.

Table 2 (continued)

	Function		Description
	2-3-2	Geo-awareness	Publish airspace definition information defined by airspace organization function. Provide UA operators and UTM users with geospatial information of airspaces in which UA activity is permitted. It also provides UA operators and other UTM users with information such as the geographical information of airspaces that require the permission of the authorities to fly the UA and the conditions under which the flight is permitted. This function is part of the 'geospatial information service' listed in ISO 23629-12.
	2-3-3	Airspace access control	Control UA's access to predefined airspace. It monitors UA and permits UA to enter to or exit from controlled airspaces according to characteristic of mission and performance of UA. The access permission is decided from a regulatory perspective not from a safety one.
2-4	Demand and capacity management		Set proper capacity of each airspace, and also measure traffic demand of UA. If the demand is expected to exceed capacity, it coordinates operation plan with each operator to form safe and efficient traffic flow.
2-5	Traffic information exchange		Provide UA information to ATM. It also receives manned aircraft information.
2-6	Flight plan exchange		Exchange UA's operation plan and manned aircraft's flight plan between UTM and ATM each other. This function contributes to strategic conflict management.

5.2.4 Operation plan management function

Table 3 shows the detailed description of the operation plan management functions.

Table 3 — Operation plan management functions

	Function	Description
3-1	Operation planning	Support operators to decide safe and efficient route of flight. To decide the route of flight, the constraints on the flight path (UAS geographical zone, etc.), safety (interference with terrains, obstacles, severe weather condition, etc.) and the capabilities of the UA and remote pilot (UA's performance, skills, etc.) are verified by the operator. Support for adjusting and modifying routes in flight. Support modifying route of flight when irregularities such as instructions from UTM systems, sudden changes in weather, approaching manned aircrafts, detecting priority UA, and failure of UAs are detected by conformance monitoring.
3-2	Strategic conflict management	In operation planning phase, it secures proper separation between UAs and between UAs and manned aircraft based on the filed operation plan. To ensure proper separation, it compares the operation plans of each UA. Then, it confirms that the time, route and height of the operation plans do not interfere with each other between UAs in a dynamic manner.
3-3	Operation plan approval	Confirm completeness and acceptability of the operation plan which filed by the operator from airspace management perspective, and return the result to the operator. It confirms that the operation plan does not interfere with other UAs, UAS geographical zones, terrain, obstacles, and any other restrictions. Before start UA operation, it provides UA operator with approval to take-off. This function is part of the Flight Clearance Service (FCS) listed in 23629-12.
3-4	Operation plan sharing	Shares UA operation plan among UTM actors.

5.2.5 Position data management function

Table 4 shows the detailed description of the position data management functions.

Table 4 — Position data management functions

	Function	Description
4-1	UA tracking	Determine the respective positions, vector and intentions of manned and unmanned aircraft based on telemetry messages from aircraft, flight plans and identification information and distribute this information to authorized UTM users including operators of aerodromes, vertiports or other facilities supporting take-off/launch or landing/recovery of UA, or other UTM service providers, for the purpose of maintaining safe mutual distances.
4-2	Tactical conflict management	Based on the UA tracking data, it performs calculations to ensure consistency with the operation plan and proper separation between UAs and between UAs and manned aircraft. This function is used in conformance monitoring.
4-3	Conformance monitoring	Monitor the operation status of the UA. Monitor inconsistency with operation plans (route of flight, altitude), proximity to non-fly zone, terrestrial structures, and other UAs and manned aircraft, and for abnormal status of UAs. Also, measure the ground altitude of the UA and distance from ground obstacles by using terrain information and ground obstacle information, and if the altitude is too low, use "Conflict advisory and alert" and send an alert. In addition, provide altitude conversion system such as pressure altitude and sea level altitude.
4-4	Conflict advisory and alert	Based on the UA Tracking data and UA operational status, provide advisory and alert to ensure proper separation between UAs and between UAs and manned aircraft, and consistency with the flight plans and operations. This function is used in conformance monitoring, and it may support the vertical alert service (VALS) listed in ISO 23629-12.
4-5	UA identification	Provide referral to UA with ID individually assigned to the UA. Obtain detailed information identifying the UA, such as model, manufacturer, performance, owner, and operator, based on the ID assigned to each UA individually.
4-6	Flight data recording	Record the data reported by UA Tracking/Conformance monitoring. This function may support also digital logbook service (DLB) and legal recording service (LRS) listed in ISO 23629-12.

5.2.6 Reporting function

Table 5 shows the detailed description of the reporting functions.

Table 5 — Reporting functions

	Function	Description
5-1	Incident/Accident reporting	Reporting function from operators and other UTM users when an incident or accident occurs, or illegal operation is observed. Also provide relevant information to authorized UTM users such as aviation authorities, police, insurance and so on, for investigation and audit purpose. Relevant information includes detailed information about the incident/accident, intention, trajectory of the UA, and so on.

5.2.7 Supplemental data supply function

Table 6 shows the detailed description of the supplemental data supply functions.

Requirements for the service providers of supplemental data are contained in ISO 23629-12.

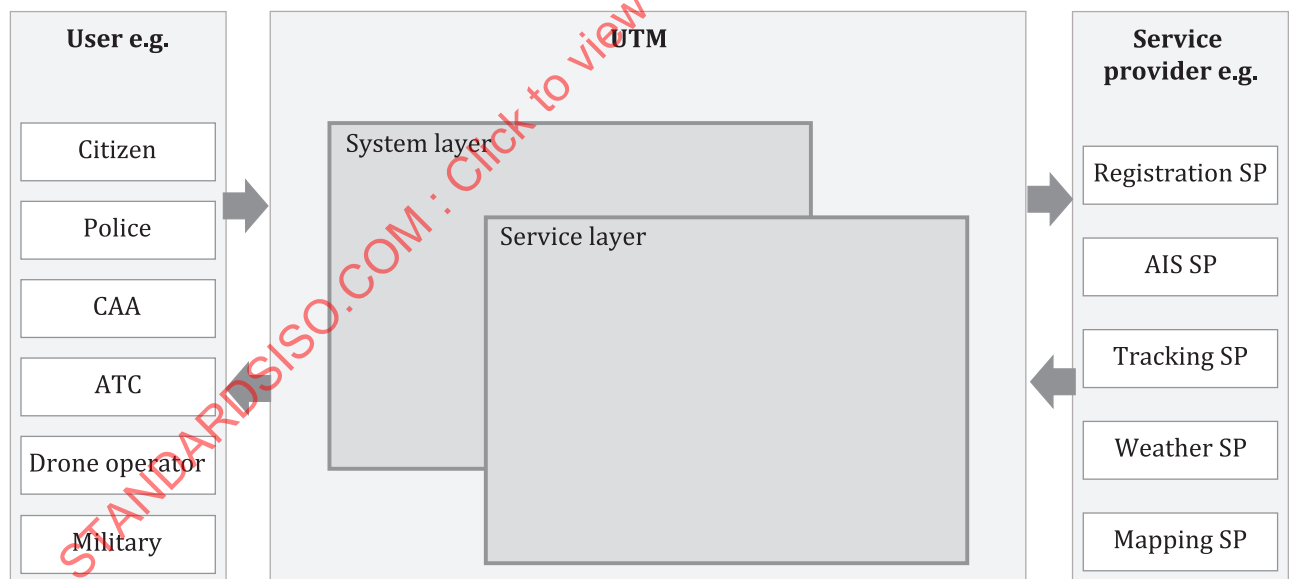
Table 6 — Supplemental data supply functions

Function		Description
6-1	Geospatial information provision	Provides UTM users with geographic information, including terrain, buildings and obstacles, for safe operation.
6-2	Navigation coverage information provision	Provides UTM users with operating status and coverage area of navigation assistance equipment.
6-3	Population density information provision	Provides UTM users with information on population density to estimate the risk by which the operation affects to the ground.
6-4	Weather information provision	Provides UTM users with Meteorological information to plan and conduct safe and efficient operation.
6-5	Communication coverage information provision	Provides UTM users with operating status, coverage area and signal strength of air-to-ground communication means.
6-6	Electro-magnetic interference function	Provides UTM ecosystem with information on known electro-magnetic interferences to radio navigation signals or other signals, during the flight planning phase and during the flight.

6 UTM functional structure

6.1 Functional structure and configuration

UTM framework is shown in [Figure 1](#).



Note Users and Service Providers in this figure are examples which would play key roles from the view point of safety

Figure 1 — UTM Framework

[Figure 2](#) describes the UTM functions and their interactions in the UTM system layer.

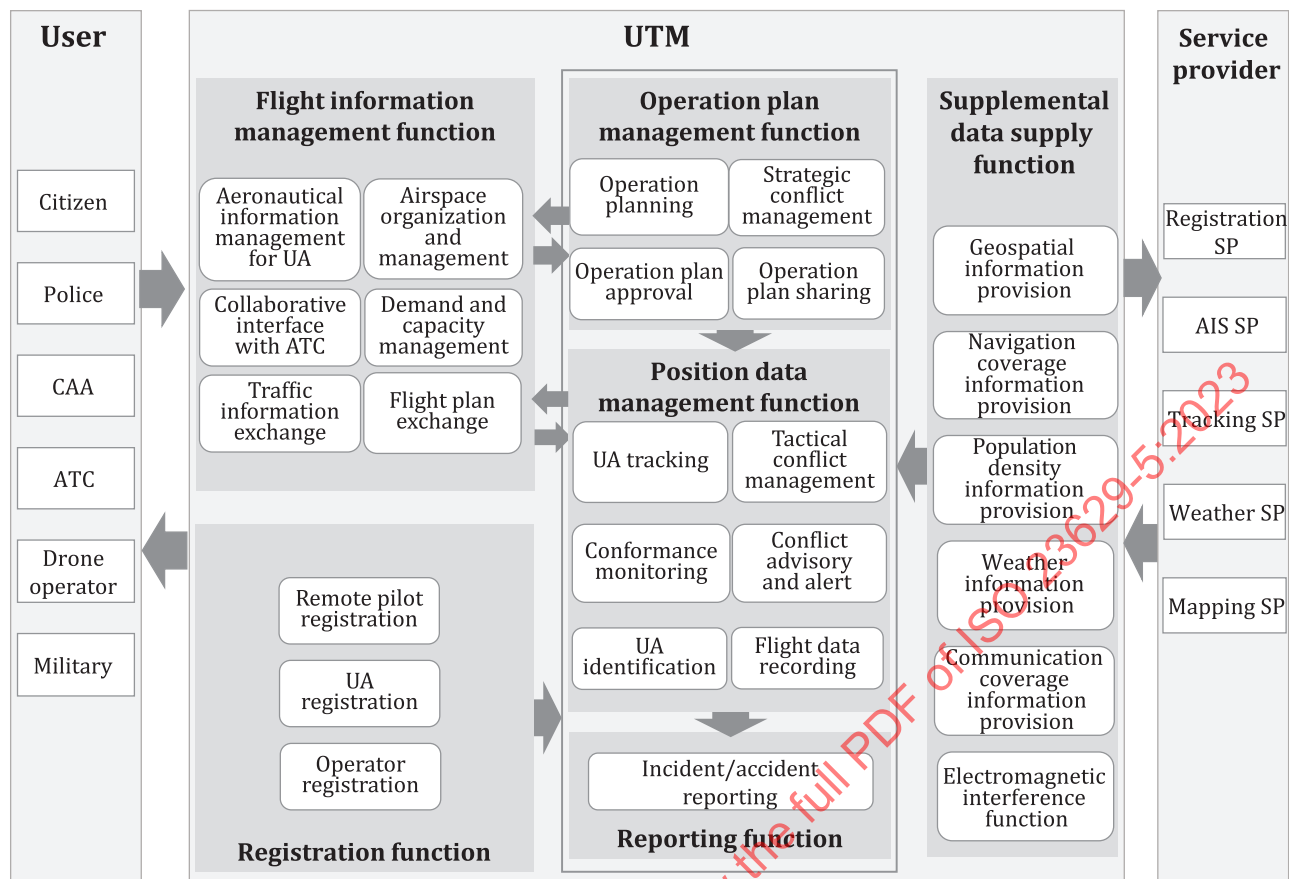


Figure 2 — UTM functional structure

6.2 Relationships and interactions among UTM functions

Table 7 shows the description of interactions among UTM functions.

Table 7 — Interactions among UTM functions

Function A	→	Function B	Purpose	Information
Registration function	→	Operation plan management function, Position data management function, Reporting function	A third party with appropriate authority for public safety purposes inquires the information of the UA (model, aircraft type, manufacturer, performance), remote pilot, and operator etc.	— UA information (model, performance, specifications, serial number, owner, and equipment etc.) — Operator information (overview, and certification etc.) — Remote pilot information (credentials, and skills etc.)

Table 7 (continued)

Function A	→	Function B	Purpose	Information
Flight information management function	→	Operation plan management function	Determines and manages the structure and usage strategy of the entire airspace to realize safe and efficient operation of the UA. Operators and other relevant stakeholders receive those types of information. With the aim of forming a safe and smooth traffic flow, manage the number of UAs flying in a certain airspace at the same time and the route to fly. Provides information restrict UA operation such as airspace restriction, airport operation, and route of flight of manned aircraft.	— Airspace structure — UAS geographical zone — Airspace — UTM route — Allowance to enter into controlled airspace and restricted airspace — Airspace capacity value — Traffic volume — Route of flight/Alternate route of flight — Airspaces and route of flight of manned aircraft, airport, etc.
Flight information management function	→	Position data management function	Provides UTM actors with flight status and flight plans of manned aircraft to avoid collisions between UAs and between manned aircraft and UA.	— Flight status of manned aircraft — Flight plan of manned aircraft — Flight status of UA — Flight plan of UA
Operation plan management function	→	Flight information management function. Position data management function	Provides ATM/UTM actors with UA operation plan and operation status for coordination, situational awareness, and monitoring.	— UA operation plan — UA operation status
Position data management function	→	Flight information management function	Provides ATM/UTM actors with UA position data for situational awareness.	— UA position — Flight data recording — Flight status of UA
Position data management function	→	Reporting function	Provides actual trajectory of UA operation to use it as evidence of operational activities in case of incident or accident.	— UA position
Supplemental data supply function	→	Operation plan management function, Position data management function, Reporting function	Provides UTM actors with supplemental information for safe and efficient UA operations.	— Geospatial information — Weather information — Navigation coverage information — Population density information — Communication coverage information — Electro-magnetic interference information

Annex A (informative)

Design models comparison of UTM frameworks and approach to determining UTM functions

A.1 Comparison of UTM framework

Table A.1 shows a comparison of available UTM frameworks and explains how UTM functions and functional structure in this document are identified. This matrix is neither exhaustive nor up to date and may be removed before publication in order to avoid misleading readers with outdated information.

Table A.1 — Comparison of UTM frameworks

No.	Category of function	Function		Comparison document					
				ISO	ICAO	SESAR	FOCA	EASA	FAA
				ISO 23629-12 Requirements for UTM service providers	A Common Framework with Core Principles for Global Harmonization	U-Space concept of operation	Swiss U-Space ConOps	EUROPEAN COMMISSION IMPLEMENTING REGULATION (EU) 2021/664	Concept of operations
1	Registration function								
1-1		Remote pilot registration		Electronic registration service	Registration service	Registration, Registration assistance	Registration service		
1-2		UA registration		Network (electronic) identification service, Electronic registration service	Registration service, Identification service	Registration, Registration assistance	Registration service		
1-3		Operator registration		Electronic registration service	Registration service	-	Registration service		Operator registration
2	Flight information management function								
2-1		Aeronautical information management for UA		Aeronautical information management for UAS	AIS restriction management service, Activity reporting service	Drone aeronautical information management service		Traffic information service	
2-2		Collaborative interface with ATC		Collaborative interface with ATC, Procedural interface with ATC					
2-3		Airspace organization and management			Restriction management service				Constraint management
2-3-1			Airspace organization	UTM route design service	Restriction management service		Geoawareness service	Geo-awareness service	Constraint management

Table A.1 (continued)

No.	Category of function	Function		Comparison document					
				ISO	ICAO	SESAR	FOCA	EASA	FAA
				ISO 23629-12 Requirements for UTM service providers	A Common Framework with Core Principles for Global Harmonization	U-Space concept of operation	Swiss U-Space ConOps	EUROPEAN COMMISSION IMPLEMENTING REGULATION (EU) 2021/664	Concept of operations
2-3-2			Geo-awareness	Geo-awareness service	Restriction management service, Activity reporting service	U-space geo-awareness service	Geoawareness service	Geo-awareness service	Constraint management
2-3-3			Airspace access control		Airspace authorization service		Airspace authorization service	Geo-awareness service	Airspace authorization
2-4		Demand and capacity management		Dynamic (airspace) capacity management service	Activity reporting service	Dynamic capacity management service			
2-5		Traffic information exchange		Traffic information service		Traffic information		Traffic information service	FAA messaging
2-6		Flight plan exchange			Activity reporting service				
3	Operation plan management					Drone operation plan processing service	Airspace authorization service, Risk assessment service		
3-1		Operation planning		Operational plan preparation, Risk analysis assistance	Flight planning service, Dynamic reroute service	Drone operational plan preparation assistance, Risk analysis assistance	Operation planning service, Risk assessment service, Dynamic reroute service		Operation planning, Flight dispatch, Dynamic reroute
3-2		Strategic conflict management		Strategic conflict management service	Strategic deconfliction service	Strategic conflict resolution service	Strategic deconfliction service		Strategic de-confliction
3-3		Operation plan approval		Flight clearance service	Airspace authorization service			UAS flight authorisation service	
3-4		Operation plan sharing			Activity reporting service				
4	Position data management function								
4-1		UA tracking		Tracking service	Tracking and location service	Tracking service, Surveillance data service, Network remote identification sub-service, Position report submission sub-service	Tracking service		Surveillance operator messaging
4-2		Tactical conflict management		Tactical conflict management service		Conflict management, Tactical conflict resolution			Conflict advisory and alert Conformance monitoring