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

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Foreword

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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 referring 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, pilot and UA operator in 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 through

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 certainty, 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.

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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.
	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.

Table 2 (continued)

Function		Description
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.
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.