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Uncrewed aircraft systems — UAS traffic management (UTM) — Study on functional and performance requirements for UTM systems

Systèmes d'aéronefs télé-pilotés — Gestion du trafic UAS (UTM) — Étude des exigences fonctionnelles et de performance des systèmes UTM

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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, *Uncrewed aircraft system*.

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.

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Introduction

The implementation and operation of uncrewed aircraft system (UAS) traffic management (UTM) systems are progressing in many countries with the rapid development and penetration of UAS technology and usage. The International Civil Aviation Organization (ICAO) has published the fourth edition of its UTM guidance[11], which describes the principal guidelines and services for UTM implementation in each country, as well as gaps and issues related to UTM implementation.

ISO/TC 20/SC 16 has also been working on the definition of UTM based on UAS operations as defined in ISO 21384-3:2023[1]. It has developed standards such as ISO 23629-5:2023[2], ISO 23629-12:2022[4] and ISO 23629-9:2023[5], and other standards have been developed to clarify the composition of services and functions of the overall UTM system configuration.

The purpose of this document is to survey the current implementation status and requirements of UTM in different countries, classify possible services and functions not defined in existing standards, and identify the quality, safety and security requirements for each service or function.

Based on the different implementations of these UTMs in different countries and by different private UTM providers, this document identifies the classification of the services, stakeholders involved, functions encompassed and data handled, and examines the quality, safety and security requirements for these data to determine how much quality, safety and security each service requires, and security requirements for each service.

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Uncrewed aircraft systems — UAS traffic management (UTM) — Study on functional and performance requirements for UTM systems

1 Scope

This document comprehensively examines information grounded in International Standards applicable to uncrewed aircraft system (UAS) traffic management (UTM) systems and the operational frameworks for UTM systems across various countries. It systematically catalogues the current entities involved in UTM systems, including the actors, services, functions and data. Additionally, it delineates the safety, security and quality specifications for these services, focusing on data management and referring, where appropriate, to standards developed by other standard development organizations (SDOs).

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, *Uncrewed aircraft systems — Part 4: Vocabulary*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 21384-4 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
UAS traffic management
UTM
uncrewed aircraft system traffic management
set of traffic management and air navigation services aiming at safe, secure and efficient integration of multiple crewed and uncrewed aircraft flying inside the respective *designated operational coverage* (3.9) of each service

[SOURCE: ISO 23629-7:2021, 3.11, modified — “crewed and uncrewed” replaced “manned and unmanned”.]

3.2
UTM service
uncrewed aircraft system traffic management service
result of at least one *activity* (3.7) necessarily performed at the interface between the *UTM service provider (USP)* (3.3) and the *UTM user* (3.4), which consists in the provisions of digital data and information, in the context of *UTM* (3.1)

[SOURCE: ISO 23629-9:2023[5], 3.2]

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3.3
UTM service provider
USP
uncrewed aircraft system traffic management service provider
organization playing the role of a *UTM actor* (3.5), which provides, normally in exchange for a fee, digital data and information to *UTM users* (3.4) who may choose to take advantage of the offered service

[SOURCE: ISO 23629-9:2023[5], 3.3]

3.4
UTM user
uncrewed aircraft system traffic management user
organization or system which uses digital data and information offered by a *UTM service provider (USP)* (3.3) to fulfil their mission, that is neither a USP nor an *operation support service* (3.9) provider

[SOURCE: ISO 23629-9:2023[5], 3.4]

3.5
UTM actor
uncrewed aircraft system traffic management actor
role played by an *UTM user* (3.4) or *UTM service provider (USP)* (3.3) or provider of operation support that interacts with the *UTM subject* (3.6)

[SOURCE: ISO 23629-12:2022[4], 3.8, modified — Notes 1 and 2 to entry deleted.]

3.6
UTM subject
uncrewed aircraft system traffic management subject
information technology (IT) entity (including subsystem, component, or even class) representing a software system residing on a physical system or platform, supporting the exchange of digital data and information among several *UTM users* (3.4) and several *UTM service providers (USPs)* (3.3), and to which a set of use cases applies in the *UTM* (3.1) context

[SOURCE: ISO 23629-12:2022[4], 3.11, modified — "or operation support SPs" deleted. Notes 1 and 2 to entry deleted.]

3.7
activity
set of cohesive tasks of a process

[SOURCE: ISO/IEC TR 27550:2019[6], 3.1]

3.8
designated operational coverage
DOC
geographic volume of airspace within which an *uncrewed aircraft system traffic management* (*UTM) service* (3.2) is available in compliance with designation by competent authorities if applicable, with sufficient performance including *availability* (3.20), continuity, *integrity* (3.22) and timeliness and, if applicable, with sufficient radio signal quality and protection from other users of the electromagnetic spectrum

[SOURCE: ISO 23629-12:2022[4], 3.2, modified — Note 1 to entry deleted.]

3.9
operation support service
web-based tools and information provided by a service provider (SP) to an uncrewed aircraft system (UAS) operator or its staff, to support safe and efficient planning and execution of a flight mission, as well as post-flight *activities* (3.7)

[SOURCE: ISO 23629-12:2022[4], 3.4, modified — Note 1 to entry deleted.]

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3.10
safety-critical UTM service
safety-critical uncrewed aircraft system traffic management service
UTM service (3.2) providing functions that, if lost or degraded, or as a result of incorrect or inadvertent operation, could result in catastrophic consequences

[SOURCE: ISO 23629-12:2022[4], 3.5]

3.11
safety-related UTM service
safety-related uncrewed aircraft system traffic management service
UTM service (3.2) providing functions that have the potential to contribute to the violation of or achievement of a safety goal, but whose loss of degradation would not in itself produce catastrophic consequences

[SOURCE: ISO 23629-12:2022[4], 3.6]

3.12
UTM service base operation
uncrewed aircraft system traffic management service base operation
base operation providing access to functionality implemented within an *UTM service* (3.2) and used in each UTM service and *UTM subject* (3.6)

[SOURCE: ISO/IEC 21000-10:2006[7], 3.4, modified — "UTM service" replaced "Digital Item" in the term, and "MPEG-21 environment" in the definition. "each UTM service and UTM subject" replaced "authoring a Digital Item Method". Note 1 to entry deleted.]

3.13
data model
model that describes how data is represented and accessed

[SOURCE: ISO/IEC/IEEE 8802-3-2:2021[8], 3.1]

3.14
functional safety
safety that is part of the overall safety relating to the equipment under control (EUC) and the EUC control system that depends on the correct functioning of the electrical/electronic/programmable electronic (E/E/PE) safety-related systems and other risk reduction measures

[SOURCE: IEC 61508-4:2010[10], 3.1.12]

3.15
information security
preservation of *confidentiality* (3.21), *integrity* (3.22) and *availability* (3.20) of information

[SOURCE: ISO 20252:—[1)], 3.60]

3.16
quality of service
QoS
<network> ability to provide different priority to different applications, users or data flows, or to guarantee a certain level of performance to a data flow

[SOURCE: ISO 20205:2015, 1.6.3, modified — domain "<network>" added.]

1) Under revision. Current stage: ISO/DIS 20252:2025.

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3.17
ground risk
combination of the frequency (probability) of an occurrence and its associated level of severity, specifically concerning fatal injuries to third parties on the ground resulting from incidents such as a crash of an uncrewed aircraft

Note 1 to entry: The definition is adapted from SAE ARP 4754A[12] and JARUS SORA v2.0[13].

3.18
air risk
combination of the frequency (probability) of an occurrence and the associated level of severity, particularly concerning fatal injuries to third parties in the air resulting from events such as a mid-air collision with an uncrewed aircraft

Note 1 to entry: The definition is adapted from SAE ARP 4754A[12] and JARUS SORA v2.0[13].

3.19
reliability
ability to perform as required, without failure, for a given time interval, under given conditions

[SOURCE: IEC 60050-192:2015[9], 192-01-24]

3.20
availability
property of being accessible and usable on demand by an authorized entity

[SOURCE: ISO/IEC 27000:—[2)], 3.4]

3.21
confidentiality
property that information is not made available or disclosed to unauthorized individuals, entities or processes

[SOURCE: ISO/IEC 27000:—[2)], 3.2]

3.22
integrity
property of accuracy and completeness

[SOURCE: ISO/IEC 27000:—[2)], 3.3]

3.23
chronological order
arrival order along the sequence of dates in time

[SOURCE: ISO 5127:2017, 3.1.1.64, modified — “arrival order” replaced “order”.]

3.24
bi-directional
capable of operating in either of two directions, which are the opposite of each other

[SOURCE: ISO/IEC 19762:2025, 3.5.2.664, modified — EXAMPLE deleted.]

2) Under revision. Current stage: ISO/IEC DIS 27000:2025.

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3.25
UAS geographical zone
uncrewed aircraft system geographical zone
geozone
portion of airspace where UAS operations are either facilitated, restricted or excluded, based on regulatory and operational requirements

[SOURCE: Regulation (EU) 2019/947[37], Article 2 (4), modified — to reflect broader, non-EU applicability and to use the inclusive term "uncrewed".]

4 Functional requirements of UTM systems

4.1 General

This clause classifies the functional requirements of UTMs based on the concepts, design, and regulations of UA operational management as defined by international organizations such as ICAO and ISO, as well as regional and national standards and regulations.

This document considers:

— ICAO UTM Framework[11], ISO 21384-3[1], ISO 23629-5[2], ISO 23629-12[4] and ISO 23629-9[5];

— several international, regional and national standard documents such as JARUS[13], ASTM[14][15] and EUROCAE[16][17][18][19];

— regional and national concept of operation documents[20]to[33], including GUTMA's position paper[20], SESAR U-space ConOps[21] and FAA UTM ConOps[22];

— regional and national regulations[34]to[40];

— practical implementations such as InterUSS[41].

This clause organizes the functional requirements of the UTM system described in these documents, emphasizing the classification of actors, activities, services, functions as an information system, and data models. In particular, the analysis and classification focus on the correlation between actors and activities and how services function as information systems concerning the data model.

4.2 Actors on UTM systems

The actors in UTM differ according to the perspective of each document: ICAO has a perspective closer to aviation authorities and air traffic control, ISO 23629-12[4] has a perspective centred on UTM service providers, and ISO 23629-9[5] defines the six actors in the framework of the parts of the UTM system that contribute to the exchange of data. Table 1 lists 30 digitally coupled actors to the UTM system, derived from national documents, mainly SESAR U-space ConOps[21].

Table 2 shows the results of the actor activities inferred and extracted from each document. Ten actor activities are tied to how the actors use the UTM system.

The 32 actors noted in Table 1 are classified using the 10 activities shown in Table 2, and similarities are summarized into 10 actors in Table 3. A table of relationships between the 10 summarized actors and the 10 activities is also presented in Table 4.

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