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UAS traffic management (UTM) —

Part 1: Survey results on 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, *Unmanned aircraft systems*.

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.

UAS traffic management (UTM) —

Part 1:
Survey results on UTM

1 Scope

This document provides results of a survey on UTM which indicates aggregated data from survey respondents. It does not cover detailed analysis of regions and organizations.

UTM is expected to reveal hundreds of commercial applications already in place, as well as social systems as their background conditions. The results can be used to analyze benefits and gaps for possible future standardization topics in consultation with authorities such as ICAO.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

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

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
detect and avoid
DAA
capability to see, sense or detect conflicting traffic or other hazards and take the appropriate action to comply with the applicable rules of flight

Note 1 to entry: The definition is adapted from Reference [2].

3.2
unmanned aircraft system
UAS
aircraft and its associated elements which are operated remotely or autonomously

[SOURCE: ISO 21384-4:—, 3.79]

4 UTM survey

4.1 General

This survey is composed of part 1 and part 2. The survey period is March 3, 2019 to March 22, 2019. ISO/TC 20/SC 16 conducted a survey to gather information about UAS traffic management around the world. Part 1 is a survey of selection type. Part 2 is a follow-up survey of part 1 for the respondents to provide free responses. During the survey period, 107 people responded to part 1, 16 people responded to part 2. In part 1 and part 2, it's not required to provide responses to all items.

4.2 UTM survey items

4.2.1 UTM survey part 1

This subclause describes the UTM survey part 1 that focused on the interest on UTM.

Q1. What is your level of interest or involvement in the development of UAS traffic management (UTM) systems?

a. I am developing or helping to develop a UTM system, or will be directly impacted by a UTM system in the future. → Q2

b. I am interested in UTM systems and would like to receive periodic updates on the work of ISO group on UTM. → Q5

Q2. Which of the following are you?

a. UTM system developer

b. UAS (unmanned aircraft systems) operator

c. UAS service supplier (provider)

d. Air navigation service provider

e. Data service provider

f. UAS manufacturer

g. ATM (air traffic management)-related

h. Others ( )

Q3. What are the key applications of a UTM system for you?

a. Delivery

b. Construction

c. Measurement or surveying

d. Inspections of infrastructure

e. Aerial photography

f. Surveillance and security

g. Agriculture

h. Urban air mobility

i. All of the above

j. Others ( )

Q4. What do you expect for standardization on UTM?

a. Safety and quality requirements

b. General functional requirements

c. Requirements for specific use cases

d. UTM architecture

e. Data structure, identification and control

f. Interface between ATM and UTM

g. All of the above

h. Others ( )

i. None

Q5. Please provide your contact information (all fields required):

First name:

Last (family) name:

Company/Organization:

Email address:

4.2.2 UTM survey part 2

This subclause describes the UTM survey part 2 items.

1. What are the key applications of an unmanned traffic management (UTM) system?
2. What are the key capabilities that you would like to see a UTM deliver?
3. What are the key safety considerations which must be addressed within a UTM?
4. Please provide a list of stakeholders that you believe would need to be involved in the development of the international standard.
5. What is the status of regulations around UTM in your country (roadmap related to UTM, necessary regulation development)?
6. Who are potential actors in the implementation of a UTM in your country/area/region (who ordered the core system, the budget) ?
7. What are the requirements for implementation (necessary standards to assist the implementation, quality assurance)?
8. What are the comparative advantages and features of the above UTM ecosystem?
9. Are there any technical challenges or regulatory issues preventing the establishment of the UTM ecosystem?

4.3 UTM survey results

4.3.1 UTM survey part 1

UTM survey part 1 consists of 5 items and received answers from 107 people. The results show the number of responses and the voting rate. The rate is rounded to the nearest whole number.

Table 1 shows the result of Question 1 that 75 % of the survey respondents are involved in UTM development.

Table 1 — Survey part 1 result 1

Q.1	What is your level of interest or involvement in the development of UTM?	Number	Rate
a.	I am devoloping or helping to develop UTM systems, or will be directly impacted by UTM systems in the future.	80	75 %
b.	I am interested in UTM systems and would like to receive periodic updates on the work of ISO group on UTM.	27	25 %

Table 2 shows the result of Question 2. Question 2 examines the role of the respondent and allows multiple answers. The most voted answer is UTM system developer. The next voted answer is UAS service supplier (provider). In this document, a UAS service supplier is a person who provides services using UAS, e.g., aerial photography, infrastructure inspection, logistics services. From this result, it becomes clear that there are many UTM developers and UTM users. Other answers include aviation authority, airports, regulator, cybersecurity design, etc.

Table 2 — Survey part 1 result 2

Q.2	Which of the following are you?	Number	Rate
a.	UTM system developer	29	27 %
b.	UAS operator	20	18 %
c.	UAS service supplier (provider)	26	24 %
d.	Air navigation service provider	5	5 %
e.	Data service provider	13	12 %
f.	UAS manufacture	7	7 %
g.	ATM (air traffic manegement)-related	5	5 %
h.	Others (airports, aviation autority, ardupilot development , cybersecurity design, developing standards for UTM, international regulator and so on)	17	16 %

Table 3 shows the result of Question 3. Question 3 examines the key applications of UTM. The results show that the respondents believed that urban air mobility and inspection of infrastructure would be the key application for UTM. In this survey, UTM system and UAS are mixed. This will be reviewed after UTM functions and services are defined in ISO.

Table 3 — Survey part 1 result 3

Q.3	What are the key applications of a UTM system for you?	Number	Rate
a.	Delivery	8	11 %
b.	Construction	0	0 %
c.	Measurement or surveying	5	7 %
d.	Inspections of infrastructure	13	17 %
e.	Aerial photography	2	3 %
f.	Surveillance and security	8	11 %
g.	Agriculture	1	1 %
h.	Urban air mobility	14	18 %
i.	All of the above	11	14 %
j.	Others (detection and tracking, UAS training ,UTM-ATM integration traffic monitoring and incident response, fire protection and so on)	14	18 %

Table 4 shows the result of Question 4. Question 4 examines what to expect for UTM standardization. The most voted answer is safety and quality requirements. The next voted answer is interface between ATM and UTM. From this result, it becomes clear that safety and quality requirements are most expected and data linkage with ATM is important.

Table 4 — Survey part 1 result 4

Q.4	What do you expect for standarization on UTM?	Number	Rate
a.	Safety and quality requirements	22	28 %
b.	General functional requirements	10	13 %
c.	Requirements for specific use cases	3	4 %
d.	UTM architecture	9	11 %
e.	Data structure, identification and control	10	13 %
f.	Interface between ATM and UTM	15	19 %
g.	All of the above	5	6 %
h.	Others (interface, cybersecurity, data exchange format and so on)	5	6 %
i.	None	0	0 %

Table 5 shows Question 5. This survey result is private according to the policy.

Table 5 — Survey part 1 result 5

Q.5	Please provide your contact information (all fields required):
First name:	
Last (family) name:	
Company/Organazation:	
Email address:	

4.3.2 UTM survey part 2

UTM survey part 2 consists of 9 items. Survey results are described below. The result of Question 4 is undisclosed in accordance with the survey policy.

Table 6 shows the result of Question 1. Question 1 examines the key applications of the UTM system.

Table 6 — Survey part 2 result 1

Q.1	What are the key applications of an unmanned traffic management (UTM) system?
— Separation of RPA, situational awareness of active RPAS operations, situational awareness of developing RPAS operating environment (e.g. weather). — Commercial, recreational, governmental. — Regional traffic management of unmanned BVLOS operations in VLL over rural, sub-urban and urban areas. — Cooperative separation, intent sharing, manage by exception, digital exchanges and not overloading air traffic control system. — Enable deconflicting of airspace between manned & unmanned aircraft. Allow UAS to use the same airspace safely. Help enable BVLOS operations. — Tracking - to create a visibility on drone operations, interoperability with ATM. — Support all operations of manned and unmanned aircraft flying below 3000 ft AGL, whether in VLOS over rural areas or in BVLOS along ATS routes dedicated to UAS, carrying cargo or passengers over urban areas and covering all the traffic management phases (i.e. from flight plan submission to invoicing) as well as registration. If connected to the CAA it may also support processing and delivery of regulatory approvals. If connected to police it may also support national security. — Tracking movement of drones; having detect and avoid geo-fenced areas to alert users, file flight plans and provide supplemental data services via supplemental data service providers--communication dead zones, no fly areas, weather, etc. — UAS location and flight path deconfliction. — Enabling complex UAS operations, specifically BVLOS which is not overly restricted to a specific environment. For instance, BVLOS ops over people at night. The actual mission of the UAS is not particularly relevant to the UTM system. — Enable safe operation of UAS-- by all operators-- in the airspace. This should not be limited to a specific set of operations (survey, photography, package delivery, etc.), but should support all (reasonable) use-cases. — The efficient and effective service provision. — Survey, photos, video mapping, archaelogism. — Ability to notify, communication between key stakeholders. The flight corridor which will eventually allow UAV's to operate safely in. The ATM interface with others. — UTM should be looked at as complimentary in every aspect similar to that of ATM systems and the application should not be restrictive or exclusive. Everything from delivery to surveys to recreational use. — Provision of services for UAS either at low altitude or in coordination with ATC for any comercial application.	

Table 7 shows the result of Question 2. Question 2 examines the key capabilities of UTM deliver.

Table 7 — Survey part 2 result 2

Q.2	What are the key capabilities that you would like to see a UTM deliver?
— Capabilities to support the applications noted above (RPA separation, SA of operations, and SA of operating environment). — Airspace booking, traffic advisory (incl. ATM). — E-Identification and position reporting geo-limitation (fencing/caging) tracking and monitoring tactical deconfliction. — Data services: weather, 3D maps, etc - services: remote id, intent sharing, cooperative separation by flight planning, demand/capacity management (for spectrum, volume, noise) - USS to USS exchanges - USS to ANSP/flight information management system. — Compatible across most UAS (from the size of a Mavic Pro & up). Low cost. Easy to use. Ability to see all manned & unmanned aircraft in 3D in current & upcoming airspace for flights. — Tracking - to create a visibility on drone operations, interoperability with ATM. — 1. Support the registration process, whose output is a registration certificate and a code; 2. Support flight operations trough several services, such as providing AIS and MET information; providing COM, NAV (e.g. satellite) and traffic SUR services; provide Airspace Management also dynamic (e.g. geofencing); provide flow management (i.e. assign capacity before take-off); provide ATS but not ATC; support detect and avoid; and possible additional services peculiar to U-Space. A common geo-spatial model and a common altitude reference are necessary for all this. — Track, detect and avoid capabilities. — Real-time datalink with participating UAS operations. Emergency services in the event of UA lost signal or fly away. Human briefer for preflight planning (like manned AFSS). — Identify the risks associated with complex operations. Define capabilities which mitigate those risks. Define performance requirements for those capabilities. Enable performance based authorization based on the utilized UTM capabilities, operator capabilities and UAS capabilities. — Mission sharing, negotiation, de-confliction, vehicle status, prioritized operations (for medical, public safety, etc.). — Competence of operators, crews, ATS personnel. — Detect & avoid. — Ability to provide ATC and navigational systems the information on blue UAV's and ability to ensure the remain in safe working corridors. Plus a link to drone detection systems allowing to observe the red drones and deal accordingly. — Communication and deconfliction between various USS or ANSPs. — Safety, efficiency and capacity.	

Table 8 shows the result of Question 3. Question 3 examines the key safety consideration which must be addressed within a UTM.

Table 8 — Survey part 2 result 3

Q.3	What are the key safety considerations which must be addressed within a UTM?
— Participation within the system, identification of intruder systems, management of participatory and intruder systems, availability and reliability of UTM services, and interoperability of different UTM systems/services. — Interaction with established air traffic. Safety of UAS operations. — Cybersecurity and high standards software development. — Cooperative separation. — Helping ensure that UAS don't run into each other. Provide warnings to manned & unmanned aircraft operations about proximity. — Separation standards, contingency operations, UTM risk assessment. — Safety oversight and ISO certification of the UTM service providers base on published ISO standards. — No air to air collisions. — Preflight route deconfliction and real-time,in-flight air traffic awareness and TCAS-like resolution advisories. — System robustness. These is a lack of design assurance, the system is complex and federated, there is no single entity in charge of a “UTM System”. This loosely coupled environment will have a hard time dealing with failure or faults within the ecosystem. Standardized interfaces and data flows. The lack of process as compared to traditional aviation is going to require extremely clear interface definitions. — Communications latency maximums, specific SLAs on data-exchange for key functions (i.e. human operator vs. autonomous mission), and failover of hardware. — Safety for third on the ground and in the airspace. — Attention to third parties at ground level. — Separation factors, ability to avoid various airspaces that are considered no go (military infra or civil sites classed as no fly). The redundancy of systems and back up processes and systems. — Safety starts with reliability of a system in place for UTM to assure fail-safe and communications to support unencumbered movement of aircraft. — Avoidance of collisions with other UAS, manned aircraft or terrain.	

Table 9 shows the result of Question 5. Question 5 examines the status of regulation around UTM.

Table 9 — Survey part 2 result 5

Q.5	What is the status of regulations around UTM in your country (roadmap related to UTM, necessary regulation development)?
— Roadmap in Canada is being developed. System-of-systems safety allocations are being derived based on operational capabilities. Regulations are still incipient. — Early regulation of lighter VLOS UAS. Segregation of BVLOS and of larger UAS. Licensing of all UAS operators. — Aligned with U-space. — It's being implemented in pieces thru FAA's UTM Pilot Project. — U.S. roadmap in progress. — UTM framework is currently under development in Europe. — In the European Union there is no UTM regulation so far. EASA only regulates the traditional ANS providers and the UAS operations (i.e. considering a single aircraft in the sky). — Discovery and testing. — UTM development is still an inter-agency development concept between the USA's FAA and NASA organizations. There is currently little information to or requests for input by UAS users. — FAA has a mandate to put out some plans over the next 2 years. Likely 3 years off before they "certify" or accept a UTM system and 5 years off before automated performance authorization takes place. — Initial research is somewhat complete, and minimal roll-out of base features will happen this year (in a limited and controlled environment). No timeline on when these regulations will be finalized. — Satisfactory for UAS up to 25Kg including the availability of scenarios. — In Italy it would be necessary to apply the EU rules integrating them into the ENAC regulation. — UTM still in development but working with a leading organisation that provides a layered approach in other countries for UTM. — Roadmaps or CONOPS have been published by NASA and FAA. Regulations not yet in place. — There is a strategic plan for UAS which includes UTM activities.	

Table 10 shows the result of Question 6. Question 6 examines potential actors in the implementation of a UTM.

Table 10 — Survey part 2 result 6

Q.6	Who are potential actors in the implementation of a UTM in your country/area/region (who ordered the core system, budget)?
— UTM is a joint effort between industry (UTM Service Suppliers, and RPAS Operators), the regulator (Transport Canada), the ANSP (NAV CANADA), and the general public. — Government civil aviation agency (Transport Canada), air navigation service provider, UAS operators, air operators. — FAA, NASA, third party service suppliers. — NASA, potentially state government, private sector. — ANSPs, CAAs, State. — EASA will establish the legally binding rules, possibly based on recommendations from JARUS. ENAC in Italy and the other CAAs in the EU will apply the rules. ISO standards and certification mechanisms may be acceptable means of compliance. Investors will deploy the infrastructure: they may be traditional ANSPs wishing to enter the new market (e.g. DFS or ENAV) or new comers (e.g. D-Flight or Altitude Angels). UAS operators will pay for the services. — NASA, FAA, State Governments, local communities, private sector companies, non-profits. — In the USA, the office of primary responsibility is the U.S. Department of Transportation's Federal Aviation Administration. Other extra-agency participants include the U.S. Department of Homeland Security and the U.S. Department of Defense. — USA appears to be adopting a public/private partnership (P3) model. Individual states, primarily through Dept. of Transportation (DOTs) and UAS Test Sites, are investing in UTM systems/technology as a way to bolster economic development and to be out in front of the industry. The NY UAS Test Site, through NUAIR, is developing one such system with a budget on the order of $20-30M. The Ohio DOT is also doing research and putting up infrastructure for a UTM system with a budget of around $6M. — U.S. Government (primarily the FAA, but states and regional aviation authorities as well). — CAA, industry, operators. — ENAC, ENAV, industries like Telespazio and Leonardo. — They are commercial entities such as LAANC providers and future USS providers which can also established commercial entities ready to market their services. The budgets will not be wholy funded by the FAA at this point. — IT companies, air navigation service providers, UAS services providers and systems engineers.	

Table 11 shows the result of Question 7. Question 7 examines the requirements for implementation.

Table 11 — Survey part 2 result 7

Q.7	What are the requirements for implementation (necessary standards to assist the implementation, quality assurance)?
— Requirements for implementation have not yet been addressed in detail. — Safety, equitable use of airspace, user friendly, dependability. — EUROCAE WG-105 UTM related standards (OSED, MOPS). — Roles/responsibilities, data exchange protocols, USS-USS coordination, remote ID, prototype UTM, flight tests, simulation, requirements document. — Standards need to be cross-system compatible, and well tested that they help with safe, longer distance, busier dedicated use of airspace for UAS. — Minimum performance standards for each service, system. — 1. Clear taxonomy of services, related as much as possible to traditional ANS. 2. Geospatial model and data architecture. 3. DIM card and protocols to transmit E-ID and position information. 4. ISO standards on responsibilities, privileges quality and safety of UTM service providers. — Tested ability to track, detect and alert to users. — A regulatory framework must be developed and promulgated. Further, a training and testing system must be implemented to create user awareness and responsibility. Finally, an outreach and standards enforcement program must be established. — CONOPS requirements (functional and performance), risk assessment for complex operations, risk mitigations in the form of UTM capabilities and their effectiveness, standardized interfaces and data flows/contracts, verification and validation (preferably to standards), in-time watchdog functionality for system safety, configuration management of the various services and capabilities., etc. (it's a big complex problem). — ASTM Remote-ID and UTM standards (at a minimum), checkout process to vet USS implementations. — Clear rules and easy to apply. Safety granted to manned traffic. Safety granted to people/goods on the ground.Security and data protection to be granted. — An accurate risk assessment certification and safety approval with CAA and DfT before operational use. (developing a standard process for all UAV users) . — Chicken before the egg here maybe. A concerted effort is in place developing an industry consensus standard(s) for UTM with input from the FAA. Much of the information used is gleaned from roadmaps and conops developed by NASA/FAA and research. Requirements will more than likely be addressed through regulation (see Question 4). — It is necessary to establish regulations and standardization to allow the interoperability of service provision between different UAS service providers and UAS manufacturers.	