



WORKING PAPER

FOURTEENTH AIR NAVIGATION CONFERENCE

Montréal, Canada, 26 August to 6 September 2024

- Agenda Item 2: Timely and safe use of new technologies**
2.2: Addressing safety risks related to evolving aviation technologies

UNMANNED AIRCRAFT SYSTEM (UAS) TRAFFIC MANAGEMENT (UTM) AND LOW-LEVEL FLYING OPERATIONS

(Presented by Saudi Arabia)

EXECUTIVE SUMMARY

This paper is reviewing the on-going development of UAS operations at low-level altitude airspace. In fact, the operation of unmanned aircraft system (UAS) at low altitude airspace is evolving rapidly and are increasingly used in variety of applications such as agriculture activities, traffic monitoring, critical infrastructure surveillance and inspection, rapid response for emergencies and fires, and deliveries, etc. Moreover, there is also ongoing development of commercial and business platforms (e.g., delivery systems) which may greatly increase the scale of UAS operations and demand on low altitude operations and airspace usage. While the restriction of airspace access for unmanned aircraft (UA) and segregation of different types of airspace users for low-level flying operations is feasible with the current traffic density and can ensure safe aircraft operations, these arrangements will not cope with the increasing number of UA operating in low altitude airspace that might conflict with manned aviation. The ultimate goal should be, as specified in ICAO global UAS traffic management (UTM) framework, an integration and equitable access to all airspace users considering the safety and efficiency objectives.

The proposal of setting a layered structure for low-level altitude airspace and the possibility of division of the current Class G into sub-classes should be explored as it can be used to identify the required equipage and capabilities for each category of UAS and allow safe management and integration of a variety of users, including the manned aircraft operations.

Action: The Conference is invited to:

- a) note the information provided in this paper;
- b) discuss and adopt a recommendation inviting ICAO to progress the activities related to the development of a framework for low-level flights covering all aspects to ensure safe aircraft operations; and
- c) discuss the proposal to adopt a layered structure for low-level altitude airspace and explore the possibility of reclassification of Class G into sub-classes or setting of other classes for easy and safe integration of UAS operations.

1. INTRODUCTION

1.1 In October 2018, the Thirteenth Air Navigation Conference (AN-Conf/13) discussed the opportunities and challenges related to the emergence of a range of aviation activities in very low altitude airspace, typically at and below 1000 feet above ground level (AGL), in particular in urban or suburban environments. These

activities include the operation of unmanned aircraft (UA), with rapid increase and traffic density that vary depending on the State and region.

1.2 The Conference adopted Recommendation 5.2/1 — Very low altitude operations, which invites ICAO to “contribute to the development of operational solutions and guidance, including UTM systems, autonomous operations and tactical risk assessment models, to support the safe and coordinated implementation of aviation activities at very low altitude, particularly in urban and suburban environments, including in the vicinity of, and into, aerodromes”.

1.3 The Assembly Resolution A41-9: *New Entrants*, “directs ICAO to review Standards and Recommended Practices (SARPs) relating to, inter alia, the rules of the air, air traffic services, certification, licensing, liability and the environment, for amendment or expansion as necessary, and to develop specific concepts and guidance to facilitate the operation of New Entrants within a global, harmonized framework, taking into account regional frameworks and practices.” This Resolution defines the term “New Entrants” as higher airspace operations (HAO) and unmanned aircraft system (UAS) traffic management (UTM) operations.

1.4 As part of its work programme on New Entrants, ICAO, in collaboration with States, UAS industry leaders, academic institutions, and aviation professionals, developed a common global framework for UTM framework and issued Edition 4¹ which is providing guidance to States on the core capabilities of a “typical” UTM system that must be able to interact with the air traffic management (ATM) system in the short term and integrate with the ATM system in the long term. The core capabilities cover registration and identification systems; communications systems, detect and avoid (DAA) capabilities; geofencing-like systems; interoperability (with other systems and other States); UTM-ATM boundaries and information exchange; infrastructure performance requirements (including reliance on existing infrastructure); frequency spectrum (availability, suitability, security, etc.); cybersecurity considerations; structure and approval processes for UTM service providers; UTM risk assessment; separation; strategic deconflict; and contingency procedures etc.. It is expected that ICAO global UTM framework will be extended to include requirements on certification, integration into aerodromes and emerging advanced air mobility (AAM) traffic in the low altitude environment.

2. DISCUSSION

2.1 The operation of UAS at low altitude airspace is evolving rapidly and is increasingly used in a variety of applications such as agriculture activities, traffic monitoring, critical infrastructure surveillance and inspection, rapid response for emergencies and fires and deliveries, etc. Moreover, there is also ongoing development of commercial and business platforms (e.g., delivery systems) which may greatly increase the scale of UA operations and demand on low altitude operations and airspace usage.

2.2 Under the current ATM environment, the aircraft operating at low altitudes are mainly general aviation aircraft and helicopters used for government, private and business activities. The current ICAO Annex 2 — *Rules of the Air* provisions do not allow flying over congested areas of cities, towns, or settlements or over an open-air assembly of persons at a height less than 1000 ft above the highest obstacle to permit, in the event of an emergency arising, a landing to be made without undue hazard to persons or property on the surface.

2.3 To manage the increasing number of applications for access to low-level controlled or uncontrolled airspace, States apply, in general, restrictions and segregation based on conditions and measures coordinated with the air navigation services providers (ANSPs) for flying zones and routing. While the restriction of airspace access for UAS and segregation of different types of airspace users for low-level flying operations is feasible with the current traffic density and can ensure safe aircraft operations, these arrangements will not cope with the increasing number of UAS operating in low-altitude airspace that might conflict with manned aviation and the ultimate goal should be,

¹ The Edition 4 of the UTM Framework is available on the ICAO Unmanned Aviation public website <https://www.icao.int/safety/UA/Documents/UTM%20Framework%20Edition%204.pdf>

as specified in ICAO global UTM framework, an integration and equitable access to all airspace users considering the safety and efficiency objectives.

2.4 The ongoing research and rapid pace of development for the adoption of new flying concepts (e.g., electric and hybrid aircraft with new airborne technology and capabilities) operations in urban, suburban, and rural environments are supported by evolving technologies and business opportunities that may affect the whole State's economy. The New Entrants' projects and concept of operations are being pursued by companies creating new types of aircraft that have automation flying capabilities in low-altitude airspace, changing the current modes of air transportation. With this respect, the new electric Vertical Take-Off and Landing (eVTOL) aircraft capabilities and operations will impact the current airspace monitoring systems, working arrangements, practices, and regulatory framework. Some States have already certified certain models, and it is expected that eVTOL operations will be, gradually, a significant part of flying activities in low-altitude airspace.

2.5 The automation on the ground and on-board aircraft and digital data sharing network are the foundation for the UAS operators to facilitate their flights in low-altitude airspace, promote safety, and provide efficient traffic management, strategic deconflict and separation without using different supporting infrastructures, which may impact the level of UAS equipage i.e., multiple sensors and capabilities affecting their performance, size, weight, reliability, and overall cost.

2.6 The orderly growth and integration of UAS in low-altitude airspace should be based on a strategic evolution plan using a phased and iterative approach covering the development, testing, validation and introduction of new capabilities with the involvement of all stakeholders. The use cases with lower-risk operations can serve as opportunities to have a better understanding, build experience, and refine requirements to expand the traffic of new entrants in low-altitude airspace, allowing the establishment of a full set of requirements covering advanced capabilities required for urban environments, where increased population, obstruction and traffic density are more complex. The delivery, surveillance, inspection and transport operations in remote and less populated areas may be considered a starting point for the gradual integration of UAS in low-altitude airspace.

2.7 Considering the similarities between the current low-level flying operations (e.g., helicopter and general aviation flights) and the proposed concepts for new entrants i.e., UAM/AAM, the technical and operational regulatory requirements related to aircraft equipage, airspace, infrastructure, licensing, training may be advanced using other regulatory framework and developments related to ICAO UAS, global UTM framework, ATM operations.

2.8 The ICAO's role is to provide global policies and develop the provisions that will support the gradual and safe integration of UAS operations in low-altitude airspace. To enable the standardization, global harmonization, interoperability, safe and efficient new entrants' low-level flying operations, there is a need to:

- a) update the existing provisions based on operational concepts, identification of services, and interactions between the different stakeholders;
- b) identify Communication, Navigation, and Surveillance (CNS) performance requirements, including frequency spectrum needs and protection, performance-based navigation, and use of International Mobile telecommunication (IMT) networks as means of providing surveillance and monitoring capabilities;
- c) establish new airworthiness, certification, and licensing requirements covering single-piloted, remotely-piloted, and/or highly automated operations;
- d) develop new requirements for the design, certification, and development of ground infrastructure such as vertiports;

- e) develop new requirements on traffic management automation and data exchange standards considering the need for real-time information updates between ATM and UTM systems (The concept is already covered under the ICAO UTM global framework); and
- f) establish new requirements for the new competencies, roles, and responsibilities of personnel involved in the operations of the new entrants.

2.9 Based on the ICAO UTM framework, the Kingdom of Saudi Arabia is studying the adoption of layered structure for low-level altitude airspace for UAS operations as follows:

- a) Layer 1, Very Low Level (GND – 400 ft AGL): mostly UAS operations, supported by UTM. Occasional manned operations integrated by means of the same services;
- b) Layer 2, Urban Air Mobility (600 – 1000 ft) or (500-1000 ft): both manned and UAS traffic, including eVTOL and RPAS. Services to be defined, but an initial scenario could be the establishment of corridors for point-to-point operations, thus applying segregation with dynamic management of the corridors by Saudi Air Navigation Services Provider (ANSP); and
- c) Layer 3, legacy and conventional aviation flights (1200 ft and above) or (1500 ft and above): mostly manned traffic, unmanned traffic allowed if IFR compliant.

2.10 To support the development of the layered structure of low-level altitude airspace and safety management of UAS and manned flights, the option of reclassification of the current Class G airspace into sub-classes should be explored as it can be used to identify the required equipage and capabilities for each category of UAS and allow safe integration between a variety of users including the manned aircraft operations.

3. CONCLUSION

3.1 ICAO has a key role as a forum and facilitator for the development of frameworks and knowledge sharing on the operations of UAS at low altitude airspace. ICAO is bringing together States and industry stakeholders at both the global and regional levels to update SARPs, develop guidance material and share best practices on the concept of operations and requirements for safe and efficient integration of UAS in the aviation ecosystem. Even for UAS standards that are developed by States and specialized organizations, such as standards developing organizations (SDOs), ICAO would serve as a unifying body to support harmonization and ensure global consistency and interoperability.

3.2 The integration of UAS in low-altitude airspace with multiple applications and users is a complex and multidisciplinary challenge. With the contribution of States, stakeholders and the industry, ICAO has the capabilities, strong leadership and knowledgeable regulatory establishment to allow the organization to lead the development of frameworks, standards and guidance supporting the gradual evolution of new entrants' operations.

3.3 The similarities between current low-level flying operations and UAS flights and the approach used for the development of the ICAO UTM global framework may be considered to support adequate identification of requirements covering all aspects related to safe and efficient operations.

3.4 The proposal of setting a layered structure for low-level altitude airspace and the possibility of division of the current Class G into sub-classes should be explored as it can be used to identify the required equipage and capabilities for each category of UAS and allow safe management and integration of a variety of users including the manned aircraft operations.