Ministry of Civil Aviation
Government of India

NATIONAL UNMANNED AIRCRAFT SYSTEM TRAFFIC MANAGEMENT (UTM) POLICY FRAMEWORK

24th October 2021

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MINISTRY OF CIVIL AVIATION
NEW DELHI-110 003

24th October 2021

Dear Stakeholder,

Unmanned Aircraft Systems (UAS), commonly known as drones, offer tremendous benefits to almost every sector of the economy, including but not limited to, agriculture, healthcare, surveillance, disaster relief, transportation, geospatial mapping, media and entertainment, law enforcement and national defence, etc. Drones automate repetitive and dangerous tasks and enable them to be performed in a transparent, efficient and cost-effective manner.

With a vision to make India a global hub of drones by 2030 under the Atmanirbhar Bharat Abhiyan, the Central Government has carried out a series of reform measures. It notified the liberalised Drone Rules, 2021 on 25th August 2021 and published the drone airspace map on 24th September 2021. To promote manufacturing of drones and drone components in India it notified the Production Linked Incentive (PLI) scheme on 30th September 2021. The single-window digital sky platform is being developed in line with the new Drone Rules, 2021 and is expected to be fully ready by 26th January 2022.

The number of unmanned aircraft operating in the Indian airspace is expected to increase multifold. The interplay between manned and unmanned aircraft has to be managed with utmost attention to global safety norms. India's UAS Traffic Management systems shall play a vital role in doing so.

The policy framework for establishing a UAS Traffic Management System in India has been drafted by the National UTM Committee constituted by the Central Government. It has been drafted under the overarching framework of the Drone Rules, 2021.

The policy framework will be dynamic and will evolve based on technological advancements, actual experiences and other developments in airspace management systems. The Central Government welcomes implementable insights from you (at sdit.div-moca@gov.in) on how to make the policy framework better.

Thanking you,

Yours faithfully,

24.10.21

(Amber Dubey)
Chairperson
National UTM Committee

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1. INTRODUCTION

The Unmanned Aircraft Systems (UAS) industry has been pushing the boundaries of the global aviation sector by introducing technological advancements at an unprecedented pace. These technological advancements have enabled unmanned aircraft to conduct complex operations including but not limited to surveillance, surveying, spraying, delivery of goods etc. especially in low-level airspace.

1.1 Need for UTM

With rapid technological evolution of unmanned aircraft, opening up of new use cases and policy reforms, the number of unmanned aircraft operating in the Indian airspace is poised to increase rapidly. India has started taking steps towards enabling advanced use cases like delivery of goods using unmanned aircraft and is also looking at human transportation using unmanned aircraft.

Such use cases may require unmanned aircraft to fly alongside manned aircraft. The safety of manned and unmanned aircraft across the Indian airspace is a critical requirement and needs to be enabled by a combination of standards, procedures, technology and real-time data exchange.

Current Air Traffic Management (ATM) systems have not been designed to handle the traffic from unmanned aircraft. Integration of unmanned aircraft in the Indian airspace using conventional means may require unmanned aircraft to be equipped with bulky and expensive hardware, which is neither feasible nor advisable. This requires the creation of a separate, modern, primarily software-based, automated UAS Traffic Management (UTM) system. Such systems may subsequently be integrated into traditional ATM systems.

1.2 Scope and objectives

This policy framework defines the architecture and mechanism for traffic management of unmanned aircraft in Very Low Level (VLL) airspace up to 1000 feet above ground level. This airspace shall be defined as UTM Airspace. Further, this framework establishes the roles and responsibilities of key stakeholders who are a part of the UTM ecosystem in India.

UTM systems are envisioned to enable safe and complex operations in the UTM Airspace. They shall assist in achieving the following objectives:

Objective 1: Allow identified stakeholders to seamlessly communicate with each other.
Objective 2: Assist in separating unmanned aircraft from other manned and unmanned aircraft.
Objective 3: Provide situational awareness of VLL airspace to concerned stakeholders.

2. UTM STAKEHOLDERS

The UTM ecosystem is envisioned as an active collaboration between multiple stakeholders connected to each other through information sharing and data exchange standards. The key stakeholders are as follows:

2.1 Central Government

The Central Government is primarily responsible for formulating rules, regulations and frameworks for supporting operation of unmanned aircraft and the traffic management of unmanned aircraft in India.

Additionally, the Central Government, through the DigitalSky Platform shall also be responsible for approving permissions for operating unmanned aircraft in red zones.

2.2 Directorate General of Civil Aviation (DGCA)

The Directorate General of Civil Aviation (DGCA) is the regulatory body in the field of civil aviation primarily dealing with safety issues. It is responsible for regulations, air safety and airworthiness standards. It also coordinates all regulatory functions with the International Civil Aviation Organisation (ICAO). The DGCA owns the DigitalSky Platform being developed under the aegis of the Ministry of Civil Aviation, Government of India.

DGCA issues a type certificate for each specific type of unmanned aircraft, approves Remote Pilot Training Organisations and issues Remote Pilot License in India. The DGCA may also approve UTMSPs and UTM Personnel.

2.3 Bureau of Civil Aviation Security (BCAS)

The Bureau of Civil Aviation Security (BCAS) is the regulatory authority for ensuring security of the civil aviation sector in India. BCAS is responsible for laying down aviation security-related standards and regulations and monitoring the implementation of the same.

2.4 Airspace Management Agencies

The airspace map for UAS operations in India is divided into red, yellow and green zones and is managed within the DigitalSky Platform as a real-time digital repository. Several Central and State Government agencies and departments collectively termed as Airspace Management Agencies have been given access to DigitalSky Platform for demarcating a portion of airspace as red or yellow zone and add, change or remove such a demarcation from time to time. The Airspace Management Agencies also have the rights to demarcate a portion of airspace as a temporary red zone which shall be valid for a period of ninety six (96) hours at a time.

2.5 Air Traffic Control (ATC) Authority

The Air Traffic Control Authorities are the primary authorities responsible for the management of manned and unmanned aircraft within the airspace allotted to them. Each Air Traffic Authority is primarily responsible for approving flight permissions for unmanned aircraft within the yellow zone allocated to them and may provide clearance within airport red zones after the remote pilot obtains necessary permissions from the Central Government. Additionally, the air traffic control authorities, if required, may monitor unmanned aircraft and coordinate with Remote Pilots.

2.6 Air Defence Authority

The Air Defence Authority of the Indian Air Force is responsible for monitoring all manned and unmanned aircraft operations in the national airspace. The Air Defence Authorities shall, through the DigitalSky platform provide Air Defence Clearance for unmanned aircraft operations in the yellow zone. In the airport red zone such Air Defence Clearance may be provided after the remote pilot obtains necessary permissions from the Central Government.

2.7 UAS Traffic Management Service Provider (UTMSP)

A UAS Traffic Management Service Provider (UTMSP) is an approved public or private entity that would assist various stakeholders to meet the operational requirements for enabling safe and efficient

use of airspace, through the provision of UTM services. Further, the UTMSP shall aid remote pilots to seek permissions, manage UAS operations and access UTM services. The UTMSP shall also be primarily responsible for segregating, separating and managing unmanned aircraft traffic in the airspace allocated to them. The UTMSP shall have licensed UTM Personnel for UTM operations.

2.8 Supplementary Service Providers (SSP)

UTM stakeholders require additional data such as navigation data, airspace surveillance data, weather data, terrain and obstacle data during the pre-flight and in-flight stages to ensure safe conduct of UAS operations. For the enablement of additional value added services, various entities like insurance providers, analytics providers, UAS manufacturers etc. may be provided access to DigitalSky Platform via Application Programming Interface (API). Such data and service providers are collectively termed as Supplementary Service Providers (SSPs).

2.9 Remote Pilot

The remote pilot is an individual charged by the operator with duties essential to the operation of an unmanned aircraft and who manipulates the flight controls, as appropriate, during flight time. The remote pilot is the primary person responsible for the safe conduct of each unmanned aircraft flight and may use a UTMSP for exchange of information with the DigitalSky Platform.

The remote pilot is required to adhere to the operational requirements of the airspace in which the unmanned aircraft is flying. This includes conformance with the approved flight path, avoiding obstacles, avoiding flights during inappropriate weather and giving way to manned aircraft. The remote pilot constantly monitors the flight performance and the location of the unmanned aircraft either directly; or is assisted by a remote observer or a UTM Service Provider.

2.10 General Public

The UTM Ecosystem will make specific information as determined by the Central Government available to the general public via UTMSP on a need-to-know basis. The general public may use UTMSPs to access such data and report issues in case they may suspect that a particular unmanned aircraft may not be flying as per the regulations or may be breaching their privacy.

2.11 Law Enforcement and Security Agencies

Law Enforcement and Security Agencies may require access to real-time or historical information about unmanned aircraft operations for security and surveillance; or for countering rogue unmanned aircraft systems. The access to specific information will be provided to nodal officers of such agencies to ensure the security of persons, airspace and critical assets like airports and strategic installations. Such agencies may also set up various Counter UAS (C-UAS) systems to protect sensitive areas by detecting and identifying unmanned aircraft systems operating in such areas. These C-UAS systems may be interfaced with the UTM ecosystem for identifying whether an unmanned aircraft system detected by the C-UAS system is a friend or foe.

3. UTM ARCHITECTURE

The UTM ecosystem is envisioned as a collaborative extension of the current ATM services, but for unmanned aircraft in airspaces where such ATM services currently either do not exist or are not adequate to handle the expected volume of unmanned aircraft traffic.

The UTM ecosystem utilises the industry's capabilities to create, deploy and provide such services through software platforms i.e. UTMSP as per various standards published by the Central Government from time to time. This includes the DigitalSky Platform and a set of distributed services which are separate but are to a fair extent, similar to ATM services provided to manned aircraft and are primarily based on sharing flight intent and situational awareness. These services rely on an automated and layered approach of information sharing and data exchange standards rather than voice communication.

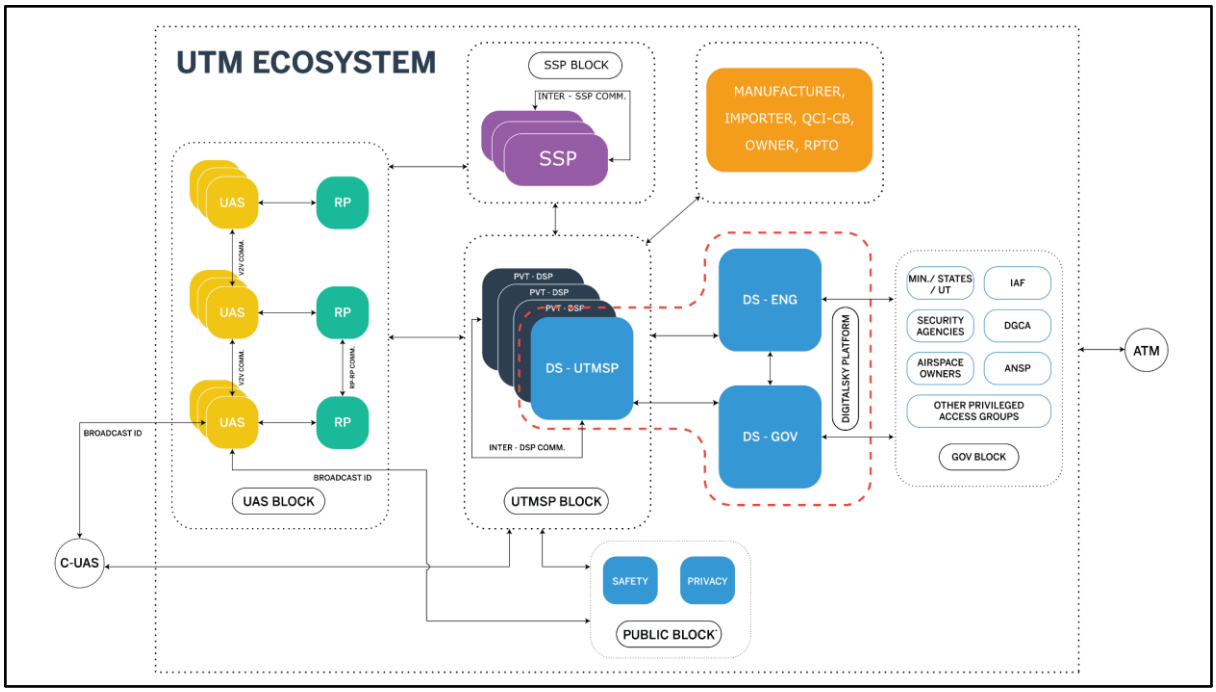

Figure 1: UTM Architecture

The DGCA and Airports Authority of India (AAI) shall maintain their regulatory and operational authority for granting permissions, managing air traffic and other related activities. However, such activities shall be organised and coordinated in a highly automated software-based ecosystem. In some cases, such activities shall also be performed through a distributed set of stakeholders.

The UTM architecture of India is represented in Figure 1 above. The building blocks of the UTM architecture are represented by boxes bordered with blue dashes. The solid black arrows represent information flow between different blocks.

The UTM architecture is primarily divided into the following components: DigitalSky Platform, UTM Service Providers, UAS Supplementary Service Providers, unmanned aircraft systems, Remote Pilots, Government stakeholders and the general public. Each component provides specific user interfaces and APIs for stakeholders to interact with the UTM ecosystem and perform their primary functions while ensuring the safety and security aspects related to UAS operations in India.

The UTM ecosystem of India has been divided into modular blocks that may communicate with each other via standardised communication protocols.

3.1 DigitalSky Block

The DigitalSky Block is the central block of the UTM architecture of India. The DigitalSky Platform creates a centralised digital regulatory ecosystem and enables the primary stakeholders of the UTM ecosystem to collaborate with each other in a real-time mode. The DigitalSky Block is further subdivided into three components: DigitalSky Engine, DigitalSky Government and DigitalSky UTMSP.

a) DigitalSky Engine

The DigitalSky Engine component serves as the core of the entire Indian UAS ecosystem and is responsible for managing different databases, implementation of business rules and integration with various third party services and platforms. It manages the digital airspace map for unmanned aircraft operations with various permanent and temporary airspace zones. It contains the user registry of various UTM stakeholders like airspace management agencies, manufacturers, remote pilot training organisations, licensed remote pilots and other government and administrative users. It shall store data regarding all flight permissions and flight logs. The DigitalSky Engine shall manage a centralised repository of information and act as the single source of truth for critical information.

b) DigitalSky Government

The DigitalSky Government component acts as the primary user interface for departments and agencies of both central and state governments to interact with the UTM ecosystem and perform various administrative functions. Airspace Management Agencies can create, edit, view and manage airspace constraints like definition of permanent or temporary yellow and red zones.

DGCA shall be able to issue type certificates for each type of UAS, remote pilot license and other regulatory requirements through this component. Additionally, this component shall allow various the central government, Air Traffic Control and Air Defence Authorities to approve permissions for unmanned aircraft operations or cancel any previously approved unmanned aircraft operation in case of any emergency. This component shall also provide situational awareness to various stakeholders like law enforcement and security agencies.

c) DigitalSky UTMSP

The DigitalSky UTMSP component shall operate pan-India and provide services necessary for the safe conduct of unmanned aircraft operations to both government and private stakeholders. This shall ensure in case a private UTMSP is not able to provide services for some reason, the UTM stakeholders shall always have an alternative to continue unmanned aircraft operations. The DigitalSky UTMSP and Private UTMSPs shall be treated as equals; with a few exceptions e.g. where DigitalSky UTMSP shall provide a reserved set of services.

3.2 UTM Service Provider Block

This block is an integral part of the UTM architecture. The primary responsibility of the UTMSP is to develop technical and operational capabilities for augmenting the functionalities of the DigitalSky Platform, manage unmanned aircraft traffic and share essential information across the UTM ecosystem to relevant stakeholders for maintaining safety and situational awareness.

UTMSPs act as real-time or near real-time interface between key stakeholders of the UTM ecosystem. It allows unmanned aircraft owners and remote pilots to register, seek permissions and communicate with other stakeholders as required. In addition to providing basic services, the UTMSPs may also provide industry-specific niche functionality as value addition. UTMSPs aggregate different types of information such as flight intents and real-time location of manned and unmanned aircraft for separating an unmanned aircraft from other manned and unmanned aircraft. UTMSPs will share information with the DigitalSky Platform as and when required.

Since it is envisioned that India shall have multiple UTMSPs, each UTMSP shall synchronise its data with other UTMSPs. This data-sharing shall be on a need-to-know basis. For example, each UTMSP after finalising a flight intent shares it with other UTMSPs to ensure other UTMSPs use such information during strategic deconfliction. Another example would be the DigitalSky UTMSP sharing information about a new temporary airspace restriction. Such synchronisation will happen over secure protocols and use a Discovery and Synchronisation Service hosted within the DigitalSky Engine. This will ensure coordinated and cooperative airspace management by different UTMSPs.

The UTMSPs will employ suitably qualified and authorised personnel with an appropriate background in aviation and/or information technology to supervise and manage the UTM operations. These personnel are not envisaged to get involved in the day to day operations of the UTM system but may take actions to manage emergency situations.

3.3 Supplementary Service Providers (SSPs)

Supplementary data providers may provide weather data, terrain and obstacle data, navigation and airspace surveillance data etc. for enhancing the safety of unmanned aircraft operations. Remote pilots may obtain such information from service providers who conform to the minimum accuracy standards specified by the regulator.

Some stakeholders may integrate with the UTM ecosystem for providing value add services such as verification of UAS registration and remote pilot license details during insurance claim processing. Some stakeholders like fleet management software providers may help in managing multiple UAS by integrating with UTMSPs.

3.4 UAS Block

This block represents the UAS and the remote pilots and showcases different channels of information exchange between two remote pilots, between two UAS and between a remote pilot and the UTMSP. The level of participation of both the remote pilot and the UAS may vary depending upon category, sub-category, classification of UAS and the type of airspace (green, yellow or red zone) in which the operation is intended.

3.5 Government Block

Government stakeholders form the core group for issuing licenses, permissions, defining airspace, approving flight permissions, monitoring traffic, creating advisories to ensure that unmanned aircraft operations are safe and secure to all involved and uninvolved stakeholders. Government stakeholders are responsible for creating business rules and standards for safe operations of UAS within the Indian airspace.

3.6 Public Block

The UTM ecosystem may make some data about active unmanned aircraft operations available to the general public via UTMSPs. The general public may also report violations by unmanned aircraft systems to the UTMSPs.

4. UTM SERVICES

The stakeholders of the UTM ecosystem perform their roles and responsibilities by either utilising data or publishing actions and decisions through various UTM Services. These services enable data exchange between multiple stakeholders in a modular approach. Such services are used to connect UTMSPs with each other to support various functionalities necessary for safe unmanned aircraft operations.

The responsibility matrix under UTM is defined in Appendix I. Availability of the UTM service at the UTMSP level does not necessarily mean that the core responsibilities of providing the service shall be the responsibility of the UTMSP. The UTMSP may act as an interface and still rely on the DigitalSky Block to provide some of these services. For instance, a remote pilot may seek flight authorisation using the flight planning service from the UTMSP interface but the primary responsibility of authorising the flight shall still remain with the DigitalSky Block.

4.1 Registration

This service shall provide all stakeholders the functionality to register and identify themselves as required for utilisation of various UTM services and for smooth data exchange in the UTM ecosystem. This service shall also allow nodal officers of law enforcement and security agencies to query such registration data, as may be required.

4.2 Constraint Mapping

This service shall provide airspace management authorities the functionality to create, edit, view and manage airspace constraints like definition of permanent or temporary yellow and red zones.

4.3 Airspace Authorisation

This service shall enable the Central Government, ATC, Air Defence Authorities and other concerned stakeholders to approve a flight plan for operating a unmanned aircraft in a yellow or red zone.

4.4 Flight Planning

This service shall provide remote pilots the ability to submit flight intents and flight plans while accounting for various constraints like weather, unmanned aircraft performance restrictions, other manned and unmanned aircraft operations.

4.5 Exemption Processing

This service shall allow manufacturers, remote pilots and customers to apply for flight authorisation by way of exemption from regulations. For example, this may happen when a unmanned aircraft needs to be operated for a unique but limited use case. In such a case the unmanned aircraft might be uncertified

or the remote pilot may not have an appropriate license for operating such an uncertified unmanned aircraft.

4.6 DigitalSky Engine Messaging

This service shall allow UTM stakeholders to receive on-demand, periodic, or event-driven messages from the DigitalSky Engine such as notification of new airspace zones, cancellation of approved unmanned aircraft operations, etc.

4.7 Strategic Deconfliction

This service shall use the flight intent of an unmanned aircraft and facilitate the static separation of such unmanned aircraft in respect of manned aircraft, unmanned aircraft and other airspace constraints. It shall arrange, negotiate and prioritise intended unmanned aircraft operation volumes of unmanned aircraft operations in the pre-flight stage with the objective of minimizing the likelihood of airborne conflicts between manned and unmanned aircraft operations.

4.8 Dynamic Deconfliction

This service shall use real-time location information of manned and unmanned aircraft to enable a dynamic separation of unmanned aircraft in respect of manned aircraft, unmanned aircraft and other airspace constraints. It shall arrange, negotiate, and prioritise the unmanned aircraft operation and notify the remote pilot with suggestions to avoid any airborne conflicts between both manned and unmanned aircraft operations in real-time.

4.9 Conformance Monitoring

This service shall assist the remote pilot by providing information necessary for keeping the unmanned aircraft within the intended area of operation. Additionally, it shall also provide alerts to remote pilots in real-time when the breach of the intended area of operation is imminent.

4.10. Conflict Advisory and Alert

This service shall assist remote pilots in avoiding any conflict in case of unintended weather, terrain, obstacles, other manned and unmanned aircraft in proximity due to which the safety of a particular intended unmanned aircraft operation might be hampered. This service shall also provide alerts and messages to key stakeholders from time to time.

4.11 Contingency Management

In case an unmanned aircraft participating in the UTM Ecosystem is undergoing a certain emergency, this service shall provide contingency information to all other participating manned and unmanned aircraft either digitally; or via voice communication through the nearest Air Traffic Control unit.

4.12 Occurrence Management

This service shall provide remote pilots and other stakeholders the ability to report an occurrence with details that may occur during unmanned aircraft operations.

4.13 Discovery and Synchronisation

Different UTMSPs may be required to share information for the safe conduct of unmanned aircraft operations across the airspace and such information would also need to be synchronised in real-time. This synchronisation shall be enabled via this service.

4.14 Surveillance

This service shall provide both static and dynamic locations about manned and unmanned aircraft for any given geographic area to concerned stakeholders on a need-to-know basis.

4.15 Weather

This service shall provide weather forecast data and real-time weather information to support operational decisions of remote pilots and other UTM services.

4.16 Terrain

This service shall provide access to accurate terrain data to further enhance the remote pilot's capabilities during the pre-flight and in-flight phase of unmanned aircraft operations.

4.17 Communication

This service shall provide infrastructure and quality assurance for Command, Control, Communication and Telemetry (C3T) capabilities between UAS, remote pilots and UTMSPs.

4.18 UAS Health Monitoring

This service shall monitor the health and status of unmanned aircraft in real-time. It may utilise the input data to formulate predictions about the unmanned aircraft's health at desired time horizons.

5. UTM PARTICIPATION

Both manned and unmanned aircraft pilots are required to participate in the UTM ecosystem. The participation may be active or passive; and mandatory or voluntary, depending upon the aircraft type and the nature of the operation.

5.1 Passive Participation and Active Participation

Passive Participation: Involves sharing of flight intents which may be utilised by participating stakeholders during the flight planning stage.

Active Participation: Involves the sharing of flight intent and real-time telemetry of participating aircraft and the same is made available to all other stakeholders participating in the UTM airspace for ensuring situational awareness and enabling deconfliction.

5.2 Mandatory and Voluntary Participation

Participation of various stakeholders in the UTM ecosystem may be recommended mandatorily or voluntarily depending upon the unmanned aircraft type, operating airspace, nature of operations and several other factors.

The participation of various stakeholders in the UTM ecosystem may be as below:

	Mandatory	**Voluntary**
Active	All UAS (except Nano UAS operating in green zones)	All manned aircraft through UTM-ATM integration
Passive	Heavy Unmanned Free Balloons	1. Small and Medium Unmanned Free Balloons 2. Model Aircraft 3. Other flying objects such as Gliders, Hang-gliders, Paragliders, Paramotors, Manned (Hot Air) Balloons, Tethered Balloons, Non-Detachable Tethered UAS, Airships and Gyroplanes

6. REAL-TIME IDENTIFICATION AND TRACKING

The ability to identify and track an unmanned aircraft flying in the Indian airspace is a critical requirement while enabling high-density, complex unmanned aircraft operations. Real-time Identification and Tracking (RIT) of the unmanned aircraft would enable sharing of the identity of the UAS and its location to other airspace owners and people on the ground. This would provide stakeholders situational awareness and allow law enforcement and security agencies to track unmanned aircraft, where required.

6.1 RIT via Broadcast

RIT via Broadcast is the functionality of an unmanned aircraft to advertise its identity, location and other information over WiFi and/or Bluetooth which can be received and displayed by a handheld device such as a mobile phone. This functionality, however, would require manufacturers to integrate additional hardware.

The operational range of such devices is expected to be less than 100 metres due to conventional WiFi and Bluetooth standards. This range is significantly low for identifying an unmanned aircraft in a practical scenario.

It is recommended that studies be conducted or alternatives be proposed for RIT via Broadcast due to its shortcomings, is case it is made operational and mandatory.

6.2 RIT via Network

RIT via Network is the functionality of a UAS to transmit its identity, location and other information to a UTM Service Provider. This functionality would allow UTMSPs to monitor the position of all unmanned aircraft centrally, share information with other UTMSPs and manage traffic by providing advisories if required. It would allow law enforcement and security agencies to monitor and track specific unmanned aircraft, where required.

Since this functionality transmits the information using internet and other communications networks, it overcomes the shortcomings of range in RIT via Broadcast. However this functionality would not be available in areas without a telecommunication network.

All unmanned aircraft (except Nano) may implement RIT via Network. This may include unmanned aircraft operated by defence agencies, law enforcement agencies and first responders. This is required for UTMSPs to know the location of such unmanned aircraft and keep them at a safe distance from other manned and unmanned aircraft, using separation and deconfliction methods.

In case a Government entity operating an unmanned aircraft does not want to disclose its identity or operational details, such entity should use a DigitalSky UTMSP to conduct its operations.

In case of large unmanned aircraft that file their flight plans through ATM systems and report their position using conventional methods like ADS-B equipment, such a requirement could be exempted.

6.3 RIT Implementation

The RIT message should at least contain:

a) Unique Identification Number (UIN) of the unmanned aircraft;
b) Location of the unmanned aircraft including its latitude, longitude and barometric pressure altitude;
c) Timestamp (in UTC);
d) Intent information (heading and ground speed); and
e) Emergency status of the UAS such as C2 link loss.

All UAS operating in India (except Nano operating in green zones) **may be equipped with RIT via Network functionality**. This may also be applicable to existing UAS. Such UAS can either retrofit RIT functionality inside the UAS or integrate a tamper proof strap-on device.

7. UTM DATA COMMUNICATION, SECURITY AND PRIVACY

7.1 Data Security and Privacy

UTM systems shall collect, generate, exchange and process identity data; pre-flight, in-flight and post-flight data; and various other sensitive data points over the internet. It will be susceptible to various data and network security threats. It shall be mandatory for UTMSPs to implement robust data privacy and data security mechanisms.

In addition to storing and transferring data in encrypted form and following general industry best practices, the Central Government may also mandate the implementation of specific cyber security

standards and IT audit mechanisms for UTMSPs. All hardware, software and data shall need to be located and hosted in India and UTMSPs shall strictly adhere to the guidelines of the Ministry of Electronics and Information Technology (MeitY).

7.2 Authentication and Network Security

As there are multiple entities providing different services in the UTM ecosystem, there is a need for a framework for identification, authentication and authorisation of the entities. In this regard, a Registration Authority (RA) and Certificate Authority (CA) service would be provided by the government through the DigitalSky Platform to perform the vetting of identity.

The authorisation and authentication between entities would be enabled by using identities issued by the RA and CA. Authorised entities will utilise Discovery and Synchronisation service of the DigitalSky Platform to identify UTMSPs, SSPs and other stakeholders of the UTM ecosystem and further request and receive data commensurate with access credentials. The data exchange across entities shall use industry best practices for network layer data exchanges like TLSv1.3. In future, the ICAO IATF and GRAIN standards may be evaluated for adoption.

8. INTEGRATION OF UTM AND ATM

8.1 Introduction

To achieve the phased objective of Segregation to Accommodation to Integration of unmanned aircraft systems into the Indian airspace, UTM and ATM systems will need to communicate with each other at the systems level. Operation of manned and unmanned aircraft near UTM-ATM boundary and transition of manned aircraft into UTM space or vice-versa should happen seamlessly with as less human intervention as possible, which requires mutually interoperable UTM and ATM systems.

8.2 ICAO UTM Framework

The ICAO document "Unmanned Aircraft Systems Traffic Management (UTM) – A Common Framework with Core Principles for Global Harmonization Edition 2" examines the issues related to the operation of aircraft (manned and unmanned) near or across boundaries between UTM and ATM airspace.

ICAO suggests that:
States should consider several key operational aspects while establishing boundaries between UTM-ATM areas of responsibilities. These include, inter alia:

- *a) Identification of roles and responsibilities of UTM and ATM systems in terms of the level of service provided and service responsibility, should the two overlap.*
- *b) Development of operational procedures and coordination processes:*
  - *i) for transitioning between UTM and ATM;*
  - *ii) to allow traffic under UTM control to operate in an ATM environment and vice-versa; and*
  - *iii) for operations in close proximity to adjacent airspaces*
- *c) Establishing separation standards between unmanned aircraft as well as between manned aircraft and unmanned aircraft.*
- *d) Establishing the prioritization of operations (e.g. in-flight emergency or medical operations having priority over other aircraft).*

Under technology considerations, ICAO further suggests that:

States should consider several technological aspects while establishing boundaries between UTM and ATM areas of responsibilities. These include, inter alia:

a) technology to support collision avoidance;
b) automation to support traffic management and transitions between UTM to ATM;
c) information exchange capabilities between UTM and ATM systems for operations planning purposes and to enable situational awareness; and
d) capabilities to meet performance requirements needed to achieve interoperability (e.g. CNS requirements).

The ICAO framework document also provides guidance on various elements of information exchange between UTM and ATM systems. This policy recognises the need for a robust UTM-ATM interoperability and integration policy which is globally acceptable and consistent with the seamless ATM concept.

Accordingly, the requirement of information exchange between UTM and ATM systems has already been considered in the UTM architecture. This policy framework supports the ICAO UTM framework and intends to align itself with the ICAO policy on UTM-ATM interoperability and integration.

9. UTM DEPLOYMENT PLAN

The type and density of unmanned aircraft operations will vary across geographical locations. Some UAS operations may be relatively complex in nature due to the technology advancement and special requirements of the business case. Thus, different airspaces may have different levels of UTM requirements and the deployment plan of UTM services in India would play a key role in effectively managing UAS operations.

Three primary strategies are generally considered while planning deployment of UTM systems in any country:

a) Single UTM Strategy: Single UTMSP shall manage traffic in a non-overlapping, separate airspace allocated to them.

b) Multiple UTM Strategy: Multiple UTMSP shall coordinate and cooperatively manage traffic in the airspace allocated to them.

c) Hybrid Strategy: This strategy allows multiple UTMSP to manage the same airspace to avoid a single point of failure and but also allows for smaller UTMSP managing special or segregated unmanned aircraft operations like delivery of health packages in rural areas by a pocket of airspace. This pocket of airspace can either be managed in a segregated manner or can be managed in an integrated manner with larger UTMSPs managing the bigger airspace within which such a pocket of airspace is created. This strategy allows complete flexibility for anyone to manage airspaces on his own provided that they are compliant with the technical, safety and business standards specified by the Government.

The hybrid strategy creates a best-case scenario for enabling UTMSPs in India and is the **selected UTM deployment strategy for India**, to be implemented in a phased manner.

10. UTM SERVICE CHARGES

UTMSPs host technical infrastructure, deploy complex software services and partner with supplementary service providers to provide UTM services to manufacturers, traders, importers, owners, operators, remote pilots and other public and private stakeholders. This may involve significant cost overheads. UTMSPs may choose to charge the user for services provided by them and may choose different pricing models for the same.

The pricing models may depend on multiple factors like category and number of unmanned aircraft being operated by a remote pilot or an organisation, the number of remote pilots, the number of flights, etc. UTMSP may also choose to have dynamic pricing models for depending on various conditions like the density of UAS operations in real-time, number of UTM-ATM crossovers, the risk level of operations, use of supplementary data, use of other additional non-mandatory features, etc.

The UTMSPs may consider charging the users as per pricing models below:

a) Subscription Model: This model may include fixed cost per time period and may be based on number of UAS, flight plans, remote pilots and other value added services.

b) Pay-per-use Model: This model may be based on a per flight or per minute basis and may be billed in real-time.

c) Hybrid Model: This model may use a combination of subscription and pay per use models, to provide the users with a fixed price for basic services and a flexible price for value-added services.

The pricing models mentioned above are indicative. The UTMSP may choose to implement their own unique pricing models in compliance with the fee-bands and procedures that may be specified by the competent authorities from time to time.

The Airports Authority of India (AAI) may charge the UTMSP, a fee, as Service Charges. This fee would be in addition to the registration and other fees charged by the Central Government and other competent authorities during the setting up of the UTMSP. These charges, mainly Service Charges, would be charged on a per-flight basis, the pricing of which may be decided by competent authorities from time to time.

11. NEXT STEPS

The aim of this document is to lay down a policy framework for enabling high density, complex unmanned aircraft operations in Very Low Level Indian airspace. This framework has defined the overall architecture of the UTM ecosystem and has recognised various stakeholders and their primary responsibilities. The operational scenarios, standards, business rules and technical requirements for UTM systems are evolving across the world.

The Central Government plans to carry out an evidence-based policy formation for enabling UTM systems in India. The key steps involved therein are as follows.

11.1 UTM Experiments

a) The Central Government will publish a Request for Expression of Interest (RFEOI) for UTM experiments.
b) The duration of such UTM experiment will not exceed six months.
c) The experiments will be outcome-based and each participating UTMSP will propose recommendations as per the RFEOI requirements.
d) The experiments will provide an opportunity for participating UTMSP to conduct sample integration with the DigitalSky Platform.

11.2 Proposed Outcomes of the UTM Experiments

The UTM experiments will help establish:
a) Standard and non-standard unmanned aircraft operational scenarios pertaining to UTM systems.
b) The minimum separation standards for various classes and categories of unmanned aircraft.
c) The minimum separation standards between manned and unmanned aircraft.
d) The minimum technical requirements and personnel requirements for a UTMSP.
e) The minimum requirements regarding integration with the DigitalSky Platform.
f) The minimum accuracy requirements for supplementary service providers.
g) The minimum technical requirements for data security including storage, sharing, transport and data privacy standards.
h) The mechanism of regular technical and administrative audits, if any.
i) The minimum deployment region to be undertaken by each UTMSP for management of unmanned traffic and phase-wise scale up plan.
j) The minimum service charges to be paid to the Airports Authority of India or other competent authorities.

11.3 Onboarding of UTM Service Providers

a) A Request for Proposal (RFP) shall be floated by the Central Government for onboarding UTMSPs in India.
b) An evaluation process shall be undertaken for participating stakeholders.
c) Selected participants shall be awarded regions for establishment of UTM services.
d) The regions shall be scaled up based on successful deployment of UTM services.

12. CONCLUSION

The UTM policy framework will be dynamic and will evolve based on technological advancements, actual experiences and other developments in airspace management systems. The Central Government welcomes implementable insights from stakeholders (at sdit.div-moca@gov.in) on how to make the policy framework better.

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APPENDIX I – UTM RESPONSIBILITY MATRIX

S No	Service	DigitalSky	UTMSP	SSP
1.	Registration	✓	✓	
2.	Constraint Mapping	✓		
3.	Airspace Authorisation	✓		
4.	Flight Planning	✓	✓	
5.	Exemption Processing	✓	✓	
6.	DigitalSky Engine Messaging	✓		
7.	Strategic Deconfliction	✓	✓	
8.	Dynamic Deconfliction	✓	✓	
9.	Conformance Monitoring	✓	✓	
10.	Conflict Advisory and Alerts	✓	✓	
11.	Contingency Management	✓	✓	
12.	Occurrence Management	✓	✓	
13.	Discovery and Synchronisation	✓		
14.	Surveillance	✓	✓	✓
15.	Weather	✓	✓	✓
16.	Terrain	✓	✓	✓
17.	Communication	✓	✓	✓
18.	UAS Health Monitoring	✓	✓	✓

APPENDIX II – REFERENCES

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