LITERATURE SEARCH

Task 1-1
Guidance Development WG
Advanced Air Mobility Study Group (AAM SG)

Version 1.0—as of May 16, 2025

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I. Introduction

This literature search identifies documents that may support the work of other WG tasks, including those developing a regulatory framework gap analysis, lexicon, and UAS Traffic Management (UTM) implementation guidance; as well as providing an accessible selection of foundational and actionable UTM documents supporting exploration, learning, planning, implementation and governance for the Member States.

The methodology used to draft the literature search includes:

1. a longitudinal review of concepts of operation (ConOps), regulations, roadmaps, standards, and other relevant work product informing the development and implementation of UTM;

2. consultation with a variety of recognized UTM experts – both affiliated and unaffiliated with ICAO expert groups;

3. solicitation of content from, and review by, leadership from standards development organizations (SDOs) and non-governmental organizations (NGOs); and

4. contributions and recursive review by the Task team, WG leadership, and external experts.

While aiming at providing relevant and non-exhaustive content, the information herein should not be construed as constituting an endorsement of any particular material, solution or organization. Links (URLs) to the listings were operational at the time of publication.

In addition to the terms and conditions of the ICAO Website, use of this material constitutes agreement with the following:

The material herein is provided for the sole objective of sharing non-exhaustive information on the work of ICAO expert group(s), which are under development. The Literature Search list of documents, and their associated links, are not anticipated to be updated in the future.

Since UAS and UTM are dynamic fields, and constitute works in progress, the Task 1-1 team has sought to make the literature search a "living document". To ensure that new and future important content becomes accessible to the readership, and to extend its useful shelf life, URLs to certain relevant *portals* are included—primarily to NGOs and SDOs containing noteworthy UTM resources. Portals are considered responsive to the need to constrain the volume of documents appearing herein and reflect contemporary information research and distribution practices.

The value in getting started with basic UTM services before deploying more advanced services is recognized, and the documents listed in the literature search have been selected accordingly. Where available and deemed relevant, documents from diverse Member States are included. Given the inherent complexity and nuances of UTM, it was recognized that selecting only cursory or oversimplified documents would not serve the best interests of the anticipated readers – particularly those unfamiliar with UTM.

To enhance the accessibility of the literature search, particularly to States without significant UTM expertise, each document listed includes a "*RATIONALE*" providing a short summary description and context. Quotation marks denote material sourced verbatim from the text.

As directed by the WG, detect and avoid (DAA) is not addressed substantively, although a surveillance supplemental data service provider (SDSP) standard is included. The accelerating roles and implications of artificial intelligence are considered.

To assist the readership, each document is explicitly tagged with 1 to 4 categories depicted within brackets "[*Category:*]" following each document's "*RATIONALE*". Additionally, a dynamic *categorization tool* (in a spreadsheet format) is offered [Link] which facilitates filtering, sorting and searching. The following categories are offered nonexclusively, and limited in number to enhance usability:

Airspace –	Includes 3D/4D perimeters, corridors & boundaries, with associated rules.
Autonomy/AI –	Relates to use of advanced algorithms to support decision-making and control.
Business –	Includes business cases and strategies, private-sector economics, competition, and finance considerations.
Certification –	Formal assessment and approval of components, systems, and organizations.
Communications –	Protocols, standards, and technologies enabling data exchange supporting UTM and UAS.
ConOps –	Describes system characteristics and limitations, mission objectives, and operational procedures to stakeholders; includes concepts, frameworks, and strategies.
Data Security –	Includes the protection of data during storage/retention and transmission.
Environmental –	Includes, inter alia, air and noise pollution and their mitigations.
Fairness –	Includes impartiality in operational intents, negotiation, data exchange, access to airspace, and prioritization.
Governance –	Includes regulations, public/civil and private law, and policy.
Implementation –	Considerations for research and development, operationalisation and deployment.
Infrastructure –	Systems and services enabling UTM and UAS operations.
Privacy –	Includes mechanisms to assure appropriate control and protection of (personal) information from unauthorized disclosure.

Safety – The reduction of risk to an acceptable level and the methodology to assess and manage the risk. It may be supported, e.g., by safety cases and safety management systems (SMS).

Societal Acceptance – Includes community engagement and acceptance, noise, congestion, air pollution, access to services, planning, and participation.

Standards – Voluntary, consensus-based documents to facilitate quality, safety, interoperability, or other criteria supporting products, systems, and services.

II. Literature Search Content

Aerial Connectivity Joint Activity (ACJA), GSMA & GUTMA, *Interface for Data Exchange between MNOs and the UTM Ecosystem, Network Coverage Service Definition v2* (Dec. 2022), https://www.gsma.com/smartmobility/wp-content/uploads/2023/07/Interface-for-Data-Exchange.pdf

RATIONALE: A foundation for reliable BVLOS communications via the cellular network/mobile network operators (MNOs). It also provides population density data to supplement ground risk assessment, describes architecture, and defines logical messaging between UTM parties and MNOs.

[*Category:* Communications; Standards]

Aerial Connectivity Joint Activity (ACJA), GSMA & GUTMA, *Landscape Whitepaper on UAS Cellular Ecosystem*, ACJA, Work Task #4 (Feb. 2023), https://www.gsma.com/smartmobility/wp-content/uploads/2023/07/UAS_Cellular_Ecosystem_Whitepaper.pdf

RATIONALE: Focused on cellular MNOs, cellular connectivity and UTM components, it "describes entities involved in cellular communication of uncrewed aviation systems", their interrelationship, ACJA activities, and external standardization initiatives.

[*Category:* Communications; Implementation]

Airbus, *Evaluating Fairness in UTM Architecture and Operations*, Ver. 1 (Feb. 2020), Peter Sachs, Antony Evans, Maxim Egorov, et al., https://www.airbus.com/sites/g/files/jlcbta136/files/2022-07/Airbus-whitepaper-utm-fairaccessairspace.pdf

RATIONALE: Asserts it "fills an important gap by articulating what fairness is in a UTM context, and why it is important to start addressing it now [and recommends] that industry and academia conduct a series of studies to better quantify the effects of unfair operations." It cites *obligation*, *cooperation* and *efficiency* as "reason why we need fairness in allocation of UTM resources."

[*Category:* Fairness]

Airbus, *Protocol-Based Congestion Management for Advanced Air Mobility* (2021), Christopher Chin, Maxim Egorov, et al., https://arc.aiaa.org/doi/10.2514/1.D0298

RATIONALE: Citing short lead-times and resistance or inability to sharing flight intent information due to privacy concerns, congestion management algorithms are urged that are "efficient and fair in dynamic reduced-information settings."

[*Category:* Fairness; Privacy]

Airbus, Safety *Assessment of UTM Strategic Deconfliction (2023),* Antony Evans, Maxim Egorov, et al., https://storage.googleapis.com/blueprint/AIAA_SciTech_2023_UTM_SD.pdf

RATIONALE: The simulation results generated suggest that UTM strategic deconfliction provides a significant safety benefit that is approximately constant with operational density, and applies under both the low complexity and high complexity operational profiles simulated. The simulated benefit is sensitive to participation rate, but not to the range of operational intent conformance rates simulated in this paper. The paper concludes, in part, "[t]he value with strategic deconfliction in place would be significantly greater than without, and would increase with increasing participation rate."

[*Category:* Infrastructure; Safety]

Airbus & Boeing, *New Digital Era of Aviation: The Path Forward for Airspace and Traffic Management* (Nov. 2020), https://www.icao.int/Meetings/innovation-series/Pages/New-Digital-Era-of-Aviation-The-Path-Forward-for-Airspace-and-Traffic-Management.aspx (ICAO TV link).

RATIONALE: Presents benefits and rationale for use of UTM, and how it can contribute to the safe and efficient advancement of future airspace. Raises awareness on the need for new global standards and regulations to enable seamless interoperability and the secure and efficient delivery of new aviation services to the entire community, while ensuring the long-term sustainable growth in the air transportation sector.

[*Category:* Governance, Standards]

ANSI, UASSC, *GAPS Progress Report* (March 19, 2024), to the *Standardization Roadmap for Unmanned Aircraft Systems* (v. 2.0, June 2020), GAPS - share.ansi.org

RATIONALE: Identifies multiple gaps without available standardization or specification to respond to particular industry needs.

[*Category:* Standards]

Asia-Pacific Regulators on AAM and UAS, (Nov. 9, 2023), [Portal], https://www.caas.gov.sg/who-we-are/newsroom/Detail/caas-convenes-first-ever-meeting-of-asia-pacific-regulators-to-collaborate-on-safety-rules-for-air-taxis-and-drones

RATIONALE: "Asia-Pacific civil aviation authorities agree on eight areas of priority to facilitate harmonization of air taxis and implementation of complex drone operations." The resource includes three annexes:

Annex A – *List of 17 CAAs and 24 AAM/UAS institutes and companies* – https://www.caas.gov.sg/docs/default-source/default-document-library/annex-a---list-of-17-caas-and-24-aam-uas-institutes-and-companies.pdf

Annex B – *Details on eight workstreams* – https://www.caas.gov.sg/docs/default-source/default-document-library/annex-b---details-on-eight-workstreams.pdf

Annex C – *DG CAAS' Opening Remarks at the Engagement Meeting* – https://www.caas.gov.sg/docs/default-source/default-document-library/annex-c---opening-remarks-by-dg-caas-at-asia-pacific-regulator-industry-engagement-meeting.pdf

[*Category:* Governance]

ASTM, AC377 AUTONOMY DESIGN AND OPERATIONS IN AVIATION, *Roles and Responsibilities for Operational Control in the Age of Increasingly Autonomous Flight,* Whitepaper, Mark Blanks, et al. (2024), Roles and Responsibilities for Operational Control in the Age of Increasingly Autonomous Flight

RATIONALE: Reexamines "the traditional roles and responsibilities of operators, pilots, and other stakeholders [and] addresses the changing nature of accountability and the potential for shared responsibility and accountability between operators, OEMs, and other stakeholders in this dynamic environment."

[*Category:* Autonomy/AI]

ASTM, *F3411-22a, Standard Specification for Remote ID and Tracking* (July 13, 2022), https://www.astm.org/f3411-22a.html

RATIONALE: Includes network remote ID interoperability and testing—potentially becoming a widely implemented mandatory service—and providing noncooperative detection supporting UTM. RID may also satisfy the requirement for the network RID mandatory service for U-space.
[*Category:* Data Security; Standards; Communications]

ASTM, *F3548-21, Standard Specification for UAS Traffic Management (UTM) UAS Service Supplier (USS) Interoperability* (2021), https://www.astm.org/f3548-21.html

RATIONALE: A recognized UTM standard specification establishing methods to exchange communication between UAS service suppliers that are the basis for key UTM services, including strategical deconfliction. This standard can also be used for demonstrating compliance with U-space requirements. Revision of this standard is underway as ASTM WK85414 and anticipated to include: increased flexibility in allowing conflicts between operational intents when permitted by regulations; priority and preemption; negotiation; and related fairness concepts.
[*Category:* Standards; Infrastructure; Implementation; Communications]

ASTM, *F3623-23, Standard Specification for Surveillance UTM Supplemental Data Service Provider (SDSP) Performance* (2023), https://www.astm.org/f3623-23.html

RATIONALE: A primary SDSP standard that defines minimum performance standards for SDSP equipment and services to UAS Service Suppliers/Providers (USS/USP) in a UTM ecosystem. Surveillance services will provide aircraft track information to Detect and Avoid (DAA) systems to enable BLVOS UAS operations and may also support other USS capabilities such as traffic information and traffic situational awareness systems. The standard includes service level agreement (SLA) structure and paradigms and will also support spectrum radio-navigation equipment.
[*Category:* Standards; Infrastructure]

ASTM F38.02, WK85415, *Standard Specification for UAM PSU Interoperability*, WK85415 - New Specification for UAM PSU Interoperability | ASTM

RATIONALE: Builds upon the digital traffic management infrastructure established in the UTM F3548 standard and adapts to unique characteristics of the AAM domain. For example, to: define interoperability protocols, APIs, and functional requirements for digital traffic management systems for AAM; focus on Provider of Services for UAM (PSU) and its necessary functions and interfaces; introduce AAM-specific entities (e.g., constrained waypoints, volumes); address unique interfaces and integrations (e.g., Vertiports, Legacy ATM, UTM); provide flight planning, coordination, and execution as per prevailing AAM CONOPS; address UAM Interoperability Performance Requirements Focus Areas; provide CONOPS and description of target operating environment; and provide Prioritization Framework, Resource Definition, Status, and Information Sharing, Conformance Monitoring.
[*Category:* Standards; Infrastructure; ConOps; Fairness]

ASTM, *F3673-23, Standard Specification for Performance for Weather Information Reports, Data Interfaces, and Weather Information Providers (WIPs)* (2023), https://www.astm.org/f3673-23.html

RATIONALE: The WIP standard supports UTM and AAM operations up to 5,000 ft (1,524 m) AGL, helps derive encountered weather and winds interoperable with WIXM]-recognized data formats and standards; supports new/emerging concepts for UTM/xTM equivalent of PIREPs, and addresses the related acquisition and dissemination of an expansion in approved weather-related data and analysis, especially as it relates to BVLOS and operations in built-up urban areas. It does not address weather prediction, with a standard of performance for weather information reports,

analysis and services performed by WIP. Furthermore, it defines weather data performance requirements for qualified WIPs that provide services to users and provides a tier-based weather data quantification framework to support user risk-based decisions and increases the density of reliable weather measurements to mitigate gaps in low altitude and boundary layer airspaces.
[*Category:* Standards; Infrastructure]

ASTM F38, *Standards Mapping to U-Space Regulation* (Sept. 2022), https://drive.google.com/drive/folders/1OKYEcugfK1FmhgFnVDwsiCVwOyV0EdUo

RATIONALE: "[A] a detailed mapping of relevant ASTM standards to the U-space regulation [presenting] a high-level summary of findings from the assessment of ASTM standards coverage for the U-space regulation and gaps and impacts from the standards mapping exercise.... This spreadsheet provides separate worksheets for each U-space service, for the SWIM Technical Infrastructure Yellow Profile, and for the SWIM Service Description with a detailed breakdown of associated AMC and GM or requirements mapped to relevant sections and performance requirements from ASTM standards [and] provides a brief explanation for those GM and AMC for which the Working Group did not find direct mapping to ASTM standards. and/or clarity."
[*Category:* Standards; Governance]

ASTM F38, [WK84631 – pending F38 ballot completion - expected July '24], *Standard Guide for Credential-Based A2X Broadcast Security* (2024), https://www.astm.org/workitem-wk84631

RATIONALE: A framework-oriented guide for securing localized, broadcast-type Aircraft-to-Everything (A2X) communications without the use of real-time connected services or establishment of a session-based security association between communicating entities in the airspace.
[*Category:* Standards; Data Security]

Australia – *Australian Government, Part 101 (Unmanned Aircraft and Rockets) Manual of Standards 2019*, https://www.legislation.gov.au/F2019L00593/latest/text

RATIONALE: The Australian Manual of Standards 2019 provides comprehensive guidelines for the operation and training of Remote Piloted Aircraft (RPA). The document puts a significant focus on beyond visual line of sight (BVLOS) operations, including specific requirements, approvals, and documented procedures necessary for EVLOS (Extended Visual Line of Sight) operations. This includes communication protocols, handover procedures between remote pilots, pre-flight briefings, and maintaining control and communication links. The manual also addresses necessary weather and visibility conditions, and procedures for handling loss of control or communications during BVLOS operations. The document further outlines the standards for examinations, record-keeping, and practical competencies needed to ensure safe and efficient BVLOS operations.
[*Category:* Standards; Governance]

Australia – *Australian Government, Civil Aviation Safety Regulations 1998, volume 3, Part 101,* https://www.legislation.gov.au/F1998B00220/latest/text/3

RATIONALE: Part 101 of the Australian Civil Aviation Safety Regulation 1998 governs the operation of unmanned aircraft and rockets. It details general provisions, such as applicability and exemptions (Subpart 101.A) and details authorizations for operations without certificates of airworthiness in Subpart 101.AB. The document also lists prohibitions of hazardous operations (Subpart 101.B). It outlines the general requirements for unmanned aircraft, including operations in controlled airspace and within visual line of sight (VLOS), in Subpart 101.C. The document also offers specific provisions for tethered balloons, kites, and unmanned free balloons and covers remotely piloted aircraft (RPA), including licensing, certification, and operational restrictions.
[*Category:* Governance]

AUVSI, *Blueprint for Autonomy – from Small UAS Operations Today to Advanced Air Mobility "Tomorrow"* (2023), https://www.auvsi.org/sites/default/files/Blueprint-for-Autonomy-Building-Blocks-for-Our-Collective-Future.pdf

RATIONALE: "This document is intended to guide us forward as an industry into a future that methodically enables new automation capabilities and is intended to encompass all forms of autonomous flight... [It] attempt[s] to map a set of actions that can be taken to more fully realize autonomous flight [presenting] five foundational building blocks of this autonomous future that we want to build upon within aviation: motivation, technology, airworthiness, operations, and integration…. [to] help focus the efforts of the wider autonomous aviation industry and facilitate industry and regulator[y] alignment."
[*Category:* Autonomy/AI]

Boeing & Wisk, *Concept of Operations for Uncrewed Urban Air Mobility*, Ver. 2.0 (Dec. 2023), https://wisk.aero/wp-content/uploads/2023/12/Concept-of-Operations-for-Uncrewed-Urban-Air-Mobility-v2.0.pdf

RATIONALE: "[D]escribes how uncrewed UAM [Urban Air Mobility] operations can be safely integrated into the NAS by the end of the decade, as well as convey a pathway for scalable industry growth" via concepts underlying 'Automated Flight Operations (AFO)' [for] aircraft without an onboard pilot that are capable of carrying 4-6 passengers over distances that typically span 30 to 60 nautical miles."
[*Category:* ConOps]

Brazil – ANAC, *Brazilian Regulation of Civil Aviation RBAC-E No 94. EMENDA No 03* (March 2023), https://www.anac.gov.br/assuntos/legislacao/legislacao-1/rbha-e-rbac/rbac/rbac-e-94

RATIONALE: This Special Regulation establishes the conditions for the operation of unmanned aircraft in Brazil, considering the current stage of the development of this technology. It aims to promote sustainable and safe development for the sector.
[*Category:* Governance]

Brazil – DECEA, *Concepção Operacional UAM Nacional*, DCA 351-6 (Oct. 2022) [Language: Portuguese], https://publicacoes.decea.mil.br/publicacao/DCA-351-6 and https://www.decea.mil.br/

RATIONALE: Proposed National UAM Concept of Operations seek[ing] to establish air operations characteristics for implementation of Urban Air Mobility (UAM) in Brazilian Airspace.
[*Category:* ConOps; Governance]

Canada – Nav Canada, *RPAS Traffic Management (RTM) System: Concept of Operations,* V1.1 (Dec. 1, 2023), https://www.navcanada.ca/en/rpas-conops.pdf

RATIONALE: "[P]resents a vision for Canada's RPAS Traffic Management framework as it may exist in the 2030 timeframe. It foresees a collaborative eco-system contributing to safe and sustainable growth in the RPAS sector, supported by RPAS Operators and Pilots, RTM Service Suppliers, NAV CANADA, Transport Canada and other industry stakeholders." This "system of systems link[s] Communication Navigation and Surveillance (CNS) technology with traffic management functions and services to enable the integration of large scale RPAS operations in higher risk airspace…. The purpose of RTM Trials is to validate the proposed technologies and build a risk-based framework to determine performance requirements."
[*Category:* ConOps; Infrastructure]

Canada – *Canada Gazette, Part I, Volume 157, Number 25: Regulations Amending the Canadian Aviation Regulations (RPAS – Beyond Visual Line-of-Sight and Other Operations)* (June 24, 2023), https://www.gazette.gc.ca/rp-pr/p1/2023/2023-06-24/html/reg6-eng.html

RATIONALE: Introduces rules for routine BVLOS operations "with an RPA up to 150 kg over sparsely populated areas, at low altitudes, and in uncontrolled airspace .... remove[s] the requirement for a Special Flight Operations Certificate (SFOC)."
[*Category:* Governance; Airspace]

Canada – National Research Council, *Canadian Certification of Autonomous Flight Systems Working Group (CCAFS WG) - summary report FY19 through FY 22*,
https://nrc-publications.canada.ca/eng/view/ft/?id=9d30d63b-b89f-4f41-8faf-ee43d59ebeba

RATIONALE: The CCAFS WG aims to prioritize research activities related to the certification of autonomous flight systems and provide a forum for sharing knowledge about the regulation of such systems. This report provides a summary of the work done in the working group up to 2022 and the roadmap for future work.
[*Category:* Autonomy/AI; Certification]

Canada – Transport Canada, *Advisory Circular (AC) No. 903-001, Subject: Remotely Piloted Aircraft Systems Operational Risk Assessment* (June 6, 2021), https://tc.canada.ca/en/aviation/reference-centre/advisory-circulars/advisory-circular-ac-no-903-001

RATIONALE: Presents the Canadian Operational Risk Assessment process which provides a methodology for approving a specific operation which may utilize technical services (including UTM style services) to support operations.
[*Category:* Safety]

Canada – Transport Canada, *Transport Canada's Drone Strategy to 2025,* (2021), https://tc.canada.ca/en/aviation/publications/transport-canada-s-drone-strategy-2025

RATIONALE: Provides Canada's "… strategic vision for drones, with a focus on raising awareness of the significance of drones, the untapped economic potential of the sector, and the priorities that will drive Transport Canada going forward." Additionally, "[c]reating a drone traffic management in Canada that includes mobile drone flight planning and airspace access request systems, communication, navigation, and airspace surveillance systems."
[*Category:* Governance; Airspace]

CANSO, *Emerging Technologies for Future Skies, Whitepaper-Artificial Intelligence* (2021), https://canso.fra1.digitaloceanspaces.com/uploads/2021/04/CANSO-Emerging-Technologies-for-Future-Skies-Whitepaper-Artificial-Intelligence.pdf

RATIONALE: An aviation-centric primer on AI addressing enablers and challenges in ATM, and expressly including UTM.

[*Category:* Autonomy/AI]

China – *Interim Regulations on Unmanned Aerial Vehicles Flight Management*, National Order No. 761 (effective Jan. 1, 2024), [*Mandarin*], http://big5.www.gov.cn/gate/big5/www.gov.cn/zhengce/content/202306/content_6888799.htm

RATIONALE: The document presents the regulations governing China's UAV management framework that are designed to ensure safe and orderly development of unmanned aerial vehicle operations across the country.

Chapter 1 provides general guidance on national security, aviation safety, and public welfare, establishing centralized leadership under the national ATM agency.

Chapter 2 focuses on civil UAV management, defining standards for design, production, and use. It mandates airworthiness certification, registration, liability insurance, and compliance with safety regulations. It also details licensing requirements for operators' training and legal criteria.

Chapter 3 addresses airspace and flight activity management, establishing UAV flight zones and controlled airspace. It outlines procedures for temporary airspace adjustments, compliance with airspace rules.

Chapter 4 covers the importance of supervision, emergency handling, and crisis response for UAS operations. It ensures regulatory adherence through reporting protocols, emergency preparedness requirements in UAS design, and enforcement measures.

Chapter 5 focuses on legal responsibilities, certification requirements, and compliance registration, and insurance for UAVs, promoting accountability and adherence to standards.

Chapter 6 provides supplementary clarifications and exemptions for specific UAV categories, defines key terms, and sets the regulation implementation date for standardized.

[*Category:* Governance]

China – CAAC, *Management Rules for the Operation Safety of Civil Unmanned Aerial Vehicles* (Jan. 1, 2024), [*Mandarin*], http://www.caac.gov.cn/PHONE/XXGK_17/XXGK/MHGZ/202401/P020240103569247124102.pdf

RATIONALE: The CAAC introduced the China Civil Aviation Regulation Part 92 (CCAR-92) "Civil Unmanned Aerial Vehicle Operation Safety Management Rules" to prepare for the implementation of the "Interim Regulations on Unmanned Aircraft Flight Management" effective on January 1, 2024. It establishes a comprehensive framework for managing civil unmanned aircraft. These regulations aim to establish comprehensive rules covering all aspects of necessary elements from airworthiness management, personnel qualifications, registration, to flight activities. They are designed to ensure operational safety and efficiency across various sectors where unmanned aircraft are increasingly utilized such as agriculture, forestry, logistics, surveying, safety inspections, cultural events, and passenger transportation.

[*Category:* Governance, Safety, Infrastructure, Certification]

DLR Institute of Flight Guidance, *DLR Blueprint – Initial ConOps of U-Space Flight Rules (UFR)*, Ver. 1.0 (March 2024), Sievers, T. F., Geister, D., et al., https://elib.dlr.de/203268/

RATIONALE: "[P]roposes an initial Concept of Operations (ConOps) of new flight rules for crewed and uncrewed airspace users in U-space airspaces, called U-space Flight Rules (UFR). Based on current European U-space architectures, UFR are intended to enable high-density UAS operations while harmonizing with today's flight rules and ATM system."
[*Category:* ConOps]

Dubai CAA, *Dubai Civil Aviation Regulations for UAS*, Rev. 1 (Dec. 10, 2023), https://betawebapi.dcaa.gov.ae/Uploads/Dubai%20Civil%20Aviation%20Regulations%20for%20UAS%20Operations.pdf

RATIONALE: "[D]eveloped to define policies and requirements in the aim of regulating all related to UAS and its Operations in the Emirate of Dubai." Note: "Section H, Reserved for UAS Operations Traffic Management".
[*Category:* Governance]

EASA, *AMC & GM to Commission Implementing Regulation (EU) 2019/947* (Oct. 9, 2019), https://www.easa.europa.eu/en/acceptable-means-compliance-and-guidance-material-group/amc-gm-commission-implementing-regulation-0 and https://www.easa.europa.eu/en/document-library/easy-access-rules/easy-access-rules-unmanned-aircraft-systems-regulations-eu

RATIONALE: Provides comprehensive AMC & GM for Reg. 2019/947.
[*Category:* Governance; Safety]

EASA, Artificial Intelligence Materials:

- EASA *Artificial Intelligence Concept Paper Issue 2: Guidance for Level 1 & 2 Machine Learning Applications* (Mar. 2024), https://www.easa.europa.eu/en/document-library/general-publications/easa-artificial-intelligence-concept-paper-issue-2

  RATIONALE: Characterized as a "significant step" beyond its Artificial Intelligence (AI) Roadmap, this paper "refines the guidance for Level 1 AI applications (those enhancing human capabilities) and deepens the exploration of 'learning assurance', 'AI explainability' and 'ethics-based assessment'. These foundation concepts are crucial for the safe and trustworthy development and implementation of AI technologies in aviation…. Level 2 AI introduces the groundbreaking concept of 'human-AI teaming' (HAT), setting the stage for AI systems that automatically take decisions under human oversight."
  [*Category:* Autonomy/AI]

- EASA *Artificial Intelligence Roadmap 2.0* (May 2023), https://www.easa.europa.eu/en/downloads/137919/en

  RATIONALE: "An update of the EASA vision for addressing the challenges and opportunities of AI in aviation, intended to serve as a basis for continued discussion with the Agency stakeholders. It is a living document [and provides] practical work on AI development in which the Agency is already engaged. It builds further on the central notion of trustworthiness of AI and identifies high-level objectives [and] addresses a number of challenges."
  [*Category:* Autonomy/AI]

EASA, *Drones and Air Mobility* [Portal], https://www.easa.europa.eu/en/domains/civil-drones

RATIONALE: "The EASA Innovative Air Mobility (IAM) Hub is a unique digital platform that brings together all actors in the European system including cities, regions, National authorities, the EU, operators and manufacturers. The primary goal is to facilitate the safe, secure, efficient, and sustainable implementation of IAM practices."
[*Category:* Societal Acceptance; Implementation]

EASA, *Easy Access Rules for Unmanned Aircraft Systems (Regulations (EU) 2019/947 and 2019/945)* (Sept. 28, 2022), https://www.easa.europa.eu/en/document-library/easy-access-rules/easy-access-rules-unmanned-aircraft-systems-regulations-eu

RATIONALE: "[C]ontains the rules and procedures for the operation of unmanned aircraft, displayed in a consolidated, easy-to-read format, with advanced navigation features through links and bookmarks. It covers Commission Implementing Regulation (EU) 2019/947, and the related acceptable means of compliance (AMC) and guidance material (GM), as well as Commission Delegated Regulation (EU) 2019/945 on unmanned aircraft systems (UAS) and on third-country operators of UAS.

Introduces the operation centric approach to drone operations to cover the wide range of risks. The innovative element is the categorization of all operations into three categories, according to risk: (1) Open category of operations with a low risk – where drones can be flown without permission, if additional requirements are met regarding operational features, drone and pilot; (2) Specific category of operations with an intermediate risk, where drones can only be operated with authorization that can be granted after a Specific Operations Risks Assessment; and (3) Certified category of operations with a high risk – where drones are always subject to a certification procedure (e.g. for air taxis). It also includes requirements for implementing three basic services of the U-space system: registration, geo-awareness and remote identification.

Introduces product quality rules for smaller drones as a mass consumer product, applying the CE standards mechanism to guarantee the quality of drones in a proportionate way, without need for the traditional aviation certification method."
[*Category:* Governance; Safety]

EASA, *Guidelines for UAS operations in the open and specific category [Ref to Regulation (EU) 2019/947]* (Jan. 31, 2024), https://www.easa.europa.eu/en/downloads/139435/en

RATIONALE: "[Shares] additional material with the UAS Community, so that both industry and Member States may use it as a reference to support application of Regulations (EU) No 2019/945 and No 2019/947."
[*Category:* Governance; Safety]

EASA, *Guidelines on Design verification for UAS operated in the 'specific' category*, Issue 3 (Sept. 26, 2023), https://www.easa.europa.eu/en/downloads/126318/en

RATIONALE: "Compliance with design requirements of UAS used for operations in the 'specific' category classified in medium risk (i.e. SAIL IV according to SORA) or mitigations means or containment functions with high level of robustness, may be demonstrated according to a simplified certification process called design verification report."
[*Category:* Certification]

EASA, *Introduction of a regulatory framework for the operation of drones, Enabling innovative air mobility with manned evtol-capable aircraft,* RMT.0230 – SUBTASK C#3, Opinion 03/2023 (Aug 31, 2023), https://www.easa.europa.eu/en/document-library/opinions/opinion-no-032023

RATIONALE: "This Opinion puts forward the establishment of a comprehensive regulatory framework to address new operational and mobility concepts that are based on innovative technologies, like unmanned aircraft systems (UAS) and aircraft with vertical take-off and landing (VTOL) capability...." It "proposes amendments to existing EU aviation regulations and the establishment of two new ones to address:

- the initial airworthiness of UAS subject to certification in accordance with Article 40 of Commission Delegated Regulation (EU) 2019/945;
- the continuing airworthiness of UAS subject to certification and operated in the 'specific' category; and
- the operational requirements applicable to manned VTOL-capable aircraft (VCA)."

[*Category:* Governance]

EASA, *Introduction of a regulatory framework for the operation of drones, Enabling innovative air mobility with manned evtol-capable aircraft,* RMT.0230 – SUBTASK C#3, NPA 2024-01 (Feb. 6, 2024), https://www.easa.europa.eu/en/document-library/notices-of-proposed-amendment/npa-2024-01

RATIONALE: Proposes "establishment of a set of acceptable means of compliance (AMC) and guidance material (GM) associated with the proposed — through Opinion No 03/2023 — regulatory framework that addresses new operational and mobility concepts that are based on innovative technologies, such as aircraft with vertical take-off and landing (VTOL) capability, and fosters and promotes their acceptance and adoption by European citizens [and] proposes amendments to existing AMC and GM and the creation of new ones to illustrate the means to show compliance with the operational requirements applicable to manned VTOL-capable aircraft (VCA)."

[*Category:* Governance; Implementation]

EASA, *Technical Specification for ADS-L transmissions using SRD-860 frequency band (ADS-L 4 SRD-860),* issue 1 edition 20 (Dec. 20, 2022), https://www.easa.europa.eu/sites/default/files/dfu/ads-l_4_srd860_issue_1.pdf

RATIONALE: This document is the initial technical specification of ADS-L transmissions using SDR860 frequency band for aircraft to become electronically conspicuous to U-space Service Providers (USSPs). It is intended for manufacturers interested in developing ADS-L compliant e-Conspicuity device/systems.

[*Category:* Standards; Communications; Safety]

EASA, *Opinion No 02/2023 proposing a new regulation for the continuing airworthiness of UAS with type certificate and amendments to Regulations (EU) 2019/945* (certification of UAS), 2019/947 (operations of UAS), 748/2012 (part 21), 965/2012 (part ops).

RATIONALE: Adopted by the EU Commission on 10 April 2024 and expected to be published by end of May 2024, these regulations introduce a regulatory framework for the operation of drones — Enabling innovative air mobility with manned vehicle capable aircraft (MVCA), the initial airworthiness of UAS subject to certification, and the continuing airworthiness of those UAS operated in the 'specific' category.

[*Category:* Governance; Certifications]

EASA, *U-space*, [Portal], https://www.easa.europa.eu/en/regulations/U-space

RATIONALE: Provides access to key U-space regulations, AMC and GM, to U-space and Rules of the air. It includes:

- *Commission Implementing Regulation (EU) 2021/664 of 22 April 2021, on a regulatory framework for the U-space*, https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32021R0664 and https://www.easa.europa.eu/en/document-library/easy-access-rules/easy-access-rules-u-space-regulation-eu-2021664

  RATIONALE: Core regulation for U-Space, setting the legal framework for European implementation of UTM (in combination with regs. 665, 666). Addresses, inter alia, the creation of U-space airspace, the provision of mandatory U-space services (a network identification service, geo-awareness service, UAS flight authorization service and traffic information service), the common information services (CIS), and the certification of U-space service providers and single CIS providers.
  [*Category:* Governance; Airspace; Certification]

- *Commission Implementing Regulation (EU) 2021/665 of 22 April 2021, amending Implementing Regulation (EU) 2017/373 as regards requirements for providers of air traffic management/air navigation services and other air traffic management network functions in the U-space airspace designated in controlled airspace,* https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32021R0665&qid=1692280425223

  RATIONALE: Makes the link between UTM (U-space) and ATM, describes, in part, amendments to Reg. (EU) 2017/373 to provide the relevant/necessary traffic information (including coordination procedures and communication facilities between air traffic services and U-space) regarding manned aircraft as part of the common information services to avoid conflicts in regs. and provide for the dynamic reconfiguration of the U-space airspace.
  [*Category:* Governance; Airspace; Certification]
- *Commission Implementing Regulation (EU) 2021/666 of 22 April 2021, amending Regulation (EU) No 923/2012 as regards requirements for manned aviation operating in U-space airspace*, https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32021R0666

  RATIONALE: Describes amendments needed to Reg. (EU) 923/2012 pertaining to manned aviation conflicts in U-space airspace, specifying changes to SERA.6005 with requirements to ensure e-conspicuity, and establishing radio and transponder mandatory zones.
  [*Category:* Governance; Airspace; Certification]

- *AMC and GM to Implementing Regulation (EU) 2021/664 — Issue 1, Acceptable means of compliance and guidance material (GM) to the U-space regulatory package* (Dec. 20, 2022), https://www.easa.europa.eu/en/document-library/acceptable-means-of-compliance-and-guidance-materials/amc-and-gm-implementing

  RATIONALE: Presents EASA's "first set of acceptable means of compliance (AMC) and guidance material (GM) to the U-space regulatory framework."
  [*Category:* Governance; Airspace; Certification; Communications]

EU, *Artificial Intelligence Act* (May 21, 2024),
Artificial intelligence (AI) act: Council gives final green light to the first worldwide rules on AI - Consilium (europa.eu), https://www.consilium.europa.eu/en/press/press-releases/2024/05/21/artificial-intelligence-ai-act-council-gives-final-green-light-to-the-first-worldwide-rules-on-ai/
and data.consilium.europa.eu/doc/document/PE-24-2024-INIT/en/pdf

RATIONALE: Provides a "uniform legal framework [for] use of artificial intelligence systems in the Union in conformity with Union values, to promote the uptake of human centric and trustworthy artificial intelligence while ensuring a high level of protection of health, safety, fundamental rights [and] ensures the free movement of AI-based goods and services cross-border ...."
[*Category:* Autonomy/AI]

EUROCAE, *ED-269, Minimum Operational Performance Standard for UAS Geo-Fencing* (Jun. 2, 2020),
ED-269 | Minimum Operational Performance Standard for UAS Geo-Fencing - EUROCAE
ED-269 Change 1 | MOPS For Geofencing - EUROCAE

RATIONALE: Specifies the functional, performance and test requirements for the UAS Geo-awareness function and the smooth interaction of an optional automatic limitation of UAS access to certain airspace and of the UAS flight control system; specifies the data model and interface protocol for the delivery of the UAS geographical zone information to UAS and users, independently of how this information is developed and maintained. ED-269 is referenced by ASTM *F3548-21* (UTM); reproduced in European Standard EN 4709-003 (Aerospace series - UAS - Part 003: Geo-awareness requirements), means of compliance to cover Geo-awareness-related requirements for the Open Category UAS operations, Commission Delegated Regulation (EU) 2019/945; and referenced by EASA as AMC/GM to comply with U-space requirements and article 15 of the regulation 2019/947 on the geographical zones.
[*Category:* Standards; Airspace]

EUROCAE, *ED-270, Minimum Operational Performance Specification for UAS geo-caging,* (Jun. 23, 2020),
https://www.eurocae.net/product/ed-270-minimum-operational-performance-specification-for-uas-geo-caging/

RATIONALE: Specifies the minimum performance and test requirements expected for the geocaging function, without prescribing its design and implementation to the extent possible; referenced and reproduced in European Standard EN 4709-003 (Aerospace series - UAS - Part 003: Geo-awareness requirements), means of compliance to cover Geo-awareness related requirements for the Open Category UAS operations, Commission Delegated Regulation (EU) 2019/945.
[*Category:* Standards; Airspace]

EUROCAE, *ED-282, Minimum Operational Performance Standard for UAS E-Reporting* (Jan. 2022),
ED-282 | Minimum Operational Performance Standard for UAS E-Reporting - EUROCAE

RATIONALE: Specifies the minimum performance and test requirements expected for the electronic reporting of UAS surveillance information (e-Reporting) for safety purposes.
[*Category:* Standards; Safety; Communications; Airspace]

EUROCAE, *ED-318, Technical Specification for Geographical Zones and U-Space data provision and exchange* (Jan. 2024), ED-318 | Technical Specification for Geographical Zones and U-Space data provision and exchange - EUROCAE

RATIONALE: Specifies the recommended requirements on all aspects related to Data Provision and Exchange (i.e., data scope, quality requirements, data format and model, exchange of data through information service). Expected to be referenced by EASA in support of Commission Regulations (EU) 2019/947 and (EU) 2021/664, in replacement of ED-269 on this specific topic.
[*Category:* Standards; Communications; Airspace]

EUROCAE, [Portal], EUROCAE - Driving the standard of aviation
and https://eurocae.net/about-us/working-groups/

RATIONALE: Provides information on EUROCAE's annual Technical Work Programme and ongoing activities of each EUROCAE Working Group.
[*Category*: Standards]

EUROCONTROL, *EU Legislation for ATM/ANS, Aerodromes & Drones* [infographic] (Mar. 2024), [Portal],
https://learningzone.eurocontrol.int/ilp/pages/mediacontent.jsf?catalogId=5190174&mediaId=11848305

RATIONALE: Presents graphical overview of legislation that includes drones. The "Aviation Learning Centre supports European Aviation with unique high-quality courses, tools and services."
[*Category:* Governance; Implementation]

EUROCONTROL, *Expanded Safety Reference Material (E-SRM)*, (Jan. 20, 2024), https://www.eurocontrol.int/publication/expanded-safety-reference-material-e-srm

RATIONALE: A safety assessment method expanded to address U-space and safety support assessment.
[*Category:* Safety; Airspace]

EUROCONTROL, SESAR Joint Undertaking, CORUS-XUAM, *U-space Concept of Operations and Architecture* (Ed. 4) (July 20, 2023), https://sesarju.eu/node/4544

RATIONALE: "The ConOps [serves] as a reference manual for delivering U-space ... into the airspace.... addresses urban air mobility needs, in particular processes at vertiports, airspace structure and flight rules, and eVTOL passenger-carrying operations; is aligned with EU U-space regulations; includes inputs coming from other SESAR research and innovation projects."
[*Category:* ConOps; Implementation; Infrastructure]

EUROCONTROL, *U-space Airspace Risk Assessment – Method and Guidelines – Vol. 1* (Apr. 17, 2023), https://www.eurocontrol.int/publication/u-space-airspace-risk-assessment

RATIONALE: Describes a methodology for the execution of an airspace risk assessment [ARA] in support of the designation of U-space airspace(s) by EU member states. ARA is an obligation of article 3 of Commission Implementing Regulation 2021/664, thus serving as additional GM for the regulation.
[*Category:* Safety; Airspace]

EUROCONTROL, *UAS ATM CARS, Common Altitude Reference System, Ed. 1* (Nov. 27, 2018), https://www.eurocontrol.int/publication/uas-atm-common-altitude-reference-system-cars

RATIONALE: This discussion document addresses the difference between conventional manned aviation using pressure altitude obtained from barometric readings and UAS using other systems to determine altitude. While each of these systems can enable safe separation on its own, each furnish different altitude values from each other. A common altitude reference system needs to be established.
[*Category:* Safety; Infrastructure]

European Commission, *COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS, 'A Drone Strategy 2.0 for a Smart and Sustainable Unmanned Aircraft Eco-System in Europe',* COM (2022) 652 final (Nov. 29, 2022), https://ec.europa.eu/commission/presscorner/detail/en/ip_22_7076

RATIONALE: The European Drone Strategy 2.0 sets out a vision for the further development of the European drone market. The first of its ten strategies includes, for example, "Improving airspace capabilities (U-space development and integration with Air Traffic Management)," and develop drone technologies and marketplaces in Europe.
[*Category:* Governance; Airspace]

EUSCG, *European UAS Standardisation Rolling Development Plan V 8.0* (March 2023), https://www.euscg.eu/rdp/

RATIONALE: The Rolling Development Plan lists the industrial standards applicable to UAS design, UAS operations, remote pilot training and U-space. Moreover, it lists the requirements applicable in EU on the same subjects.
[*Category:* Standards]

Global UTM Association (GUTMA), *The future of aviation has arrived. The next steps to build the drone service ecosystem*, GUTMA position paper, *European Commission consultation – EU Drone policy 2.0 2022*, https://drive.google.com/file/d/14axgUjI-yWX2LKR2X-17zjtBt3MhnKxy/view

RATIONALE: One of the rare papers that transcends technology and calls for a thriving drone service ecosystem that comprises all actors in three distinct but interdependent markets such that: (1) The UTM service enables the BVLOS operations; (2) The drone operations manages the tool to create value – the drone to gather data or transport goods or people; and (3) The drone service market, where the final customer is served and most value may be created. Given the expected level of automation and competition in the UTM and drone operations markets, businesses may improve their chances to find a sustainable business by integrating horizontally or vertically. Additionally, it includes *UTM Legislation Timelines* – providing quick identification of, and perspective on UTM-relevant legislative initiative globally.
[*Category:* Governance; Business]

Global UTM Association (GUTMA), *USS Data Sharing and Governance Agreement Template*, V1.0 Rev. Initial release (May 27, 2024), https://drive.google.com/drive/folders/1pLWLGePK2grixB-kcqbpo6h59bQ3hmhv

RATIONALE: Provides that the parties to the agreement "intend to share data provided by UTM Service Providers in order to [if provision of network identification service: [identify] and [if provision of strategic conflict detection service: self-separate] from other UAS operating in the same area (the "Purpose"). The Purpose includes the provision of UTM Services described in this Agreement and the use of such data by other UTM Service Providers. The scope of the Shared data will include operational data related to the Purpose and may include Shared Personally Identifiable Information."
[*Category:* Governance; Business]

ICAO, *Manual on Information Security*, Doc 10204 ([publication expected Nov.] 2024), https://elibrary.icao.int/home

RATIONALE: Contains guidance on information security informing collaborative information environments such as SWIM, connected aircraft and air/ground communications. It includes chapters addressing risk management, identity, and access management—and serves as a fundamental companion to aviation stakeholders implement trusted information sharing environments including remote ID and Detect and Avoid applications.
[*Category:* Data Security; Standards; Implementation]

ICAO, *Manual on Remotely Piloted Aircraft Systems (RPAS)* (Doc 10019), 1st Ed. (2015), https://store.icao.int/en/manual-on-remotely-piloted-aircraft-systems-rpas-doc-10019 [subject to revision underway]

RATIONALE: Provides information relevant to the introduction of remotely piloted aircraft systems (RPAS) into non-segregated airspace and at aerodromes, including discussion of airworthiness, operations, licensing, air traffic management, command and control, detect and avoid, safety management, as well as legal and security issues.
[Category: Certification; Safety, Governance]

ICAO, *Safety Management Manual (SMM)*, Doc 9859 (4th Ed., 2018), https://www.icao.int/safety/SafetyManagement/Pages/Access%20to%20ICAO%20%20Annexes%20and%20Guidance%20Material.aspx

RATIONALE: Safety management underlies [acceptable] [effective] UTM implementation. Correspondingly, this document provides "guidance to develop the regulatory framework and the supporting guidance material for the implementation of safety management systems (SMS) by service providers [and] a State safety programme (SSP)" per SARPs. *Note:* ICAO's complementary website addressing safety management implementation: www.icao.int/SMI .
[*Category:* Safety; Standards]

ICAO, *UAS Toolkit*, [Portal], https://www.icao.int/safety/UA/UASToolkit/Pages/default.aspx

RATIONALE: Provides helpful tools to assist States with UAS, inter alia, with developing UAS guidance and regulation relevant to UTM operations.
[*Category:* Implementation; Safety]

ICAO, *Unmanned Aircraft Systems Traffic Management (UTM) – A Common Framework with Core Principles for Global Harmonization, Ed. 4* (2023), https://www.icao.int/safety/UA/Documents/UTM%20Framework%20Edition%204.pdf

RATIONALE: Provide a framework and core capabilities of a "typical" UTM system to States that are considering the implementation of one. It includes the foundations for consistent rules and regulations, facilitates consensus on best practices and standards, and supports the development of common guidance material, consistent with the principles laid out in the Preamble to the Convention on International Civil Aviation.
[*Category:* Governance; Standards; Implementation]

ICAO, *X.509 Certificate Policy for the International Aviation Trust Framework (IATF) Certification Authority*, Ver. 0.93 (Dec. 1, 2021), https://www.icao.int/airnavigation/IATF

RATIONALE: This certificate policy conveys within the civil aviation community a level of digital identity assurance to facilitate necessary trusted aeronautical communications. It underpins information security, providing trustworthy interoperability between associated entities in a peer-to-peer fashion. As such, it is proposed to support UAS and UTM operations. Further work is underway to better accommodate use of certain air-link communications.
[*Category:* Data Security; Infrastructure; Communications]

IETF, *RFC 6698, The DNS-Based Authentication of Named Entities (DANE) Transport Layer Security (TLS) Protocol: TLSA* (July 29, 2020), https://datatracker.ietf.org/doc/rfc6698/

RATIONALE: DANE leverages the DNS namespace authenticated lookup mechanism to enable public key-based TLS authentication, which is resilient to impersonation.
[*Category:* Data Security; Infrastructure; Communications]

IETF, *RFC 6749, The Oauth 2.0 Authorization Framework* (Oct. 2012), DOI: 10.17487/rfc6749, https://tools.ietf.org/html/rfc6749

RATIONALE: The Oauth Authorization Framework is specified in UTM standards (e.g., ASTM F3848-21a) to mitigate security risks of passwords (or other client/owner credentials) to access protected resources. In particular, a client (e.g., USS server platform) obtains an access token (denoting a specific scope, lifetime, etc.) to third-party clients (e.g., other USS servers) by an authorization server with the approval of the resource owner to access such resources hosted by the resource server.
[*Category:* Data Security; Infrastructure; Communications]

IETF, RFC 9434, *Drone Remote Identification Protocol (DRIP) Architecture* (Jul. 2023), https://www.rfc-editor.org/rfc/rfc9434.html

RATIONALE: "[D]escribes an architecture for protocols and services to support Unmanned Aircraft System Remote Identification and tracking (UAS RID), plus UAS-RID-related communications. This architecture adheres to the requirements listed in the Drone Remote Identification Protocol (DRIP) Requirements document (RFC 9153)." A complete list of DRIP standards is available at https://datatracker.ietf.org/wg/drip/documents/.
[*Category:* Data Security; Infrastructure; Communications]

IETF, RFC 9374, *DRIP Entity Tag (DET) for Unmanned Aircraft System Remote ID (UAS RID)* (March 2023), https://datatracker.ietf.org/doc/html/rfc9374
and https://datatracker.ietf.org/group/dance/documents/

RATIONALE: "This document describes the use of Hierarchical Host Identity Tags (HHITs) as self-asserting IPv6 addresses, which makes them trustable identifiers for use in Unmanned Aircraft System Remote Identification (UAS RID) and tracking.
Within the context of RID, HHITs will be called DRIP Entity Tags (DETs). HHITs provide claims to the included explicit hierarchy that provides registry (via, for example, DNS, RDAP) discovery for third-party identifier endorsement.
This document updates RFCs 7343 and 7401."
[*Category:* Data Security; Infrastructure; Communications]

India, Gov't of, Ministry of Civil Aviation, *National Unmanned Aircraft Systems Traffic Management Policy Framework* (Oct. 24, 2021), https://digitalsky.dgca.gov.in/assets/files/National-UTM-Policy-Framework-2021-24-Oct-2021.pdf and [Portal], https://www.civilaviation.gov.in/ministry-documents/policies-document

RATIONALE: Defines the architecture and mechanism for UA traffic management in Very Low Level (VLL) airspace up to 1000 feet AG—defined as UTM Airspace. It further establishes the roles and responsibilities of key stakeholders within the UTM ecosystem in India.
[*Category:* Governance; Airspace]

ISA/IEC, *ISA/ IEC 62443 Series of Standards*, https://www.isa.org/standards-and-publications/isa-standards/isa-iec-62443-series-of-standards

RATIONALE: Addresses the security of industrial automation and control systems (IACS), which are defined as "A collection of personnel, hardware, software, and policies involved in the operation of the industrial process and that can affect or influence its safe, secure, and reliable operation." They have since been applied also to the transportation sectors, as well as to industrial drone operations, hardware and related software. Impact of a successful cyberattack on IT systems (addressed in ISO 27001) is likely only financial and privacy loss (due to information disclosure) whereas the impact of successful cyberattack on an IACS may additionally include loss of life or health, damage to the environment, or loss of product integrity. These standards aim to "improve the safety, reliability, integrity, and security of IACS using a risk-based, methodical, and complete process throughout the entire lifecycle."
[*Category:* Data Security; Standards]

ISO, *ISO 23629* (series supporting UTM), [Portal], https://www.iso.org

RATIONALE: Provides access to the entire 23629 suite of standards supporting UTM. These include:

- ISO/TR 23629-1: UTM survey result
- ISO 23629-2: Safety and quality requirements for UTM services (transaction time, availability, continuity, integrity, security, etc.)
- ISO 23629-3: General functional requirements for UTM
- ISO 23629-4: Requirements for UTM in each use case
- UTM architecture and air traffic management
- ISO 23629-5: UTM functional structure
- ISO 23629-6: UAS air traffic management (integration of manned and unmanned aircraft in the airspace at Low Level and coordination of UTM services with ATM services)
- UTM data and information
- ISO 23629-7: Data model related to spatial data for UTM
- ISO 23629-8: Remote identification
- ISO 23629-9: Interface between UTM service providers and clients (e.g. police)
- ISO 23629-10: Interface between UTM and UAS
- ISO 23629-11: Interface between ATM and UTM
- ISO 23629-12: UAS traffic management (UTM) - Requirements for UTM Service Providers

[*Category:* Standards; Infrastructure; Implementation]

ISO, *ISO 23629-5 :2023(en), UAS traffic management (UTM) — Part 5: UTM functional structure*, https://www.iso.org/obp/ui/en/#iso:std:iso:23629:-5:ed-1:v1:en

RATIONALE: "To avoid discordance and promote a common understanding, this standard provides generic UTM functional structure, and can serve as a mechanism to evaluate and compare different UTM systems and foster adoption of better technologies and solutions."
[*Category:* Standards; Infrastructure; Implementation]

ISO, *ISO 23629-12:2022(en), UAS traffic management (UTM) — Part 12: Requirements for UTM service providers*, https://www.iso.org/obp/ui/#iso:std:iso:23629:-12:ed-1:v1:en:fn:1

RATIONALE: "[Provides] a framework for ensuring safety and security controlling related risks and opportunities." Addresses responsibilities of UTM service providers for associated safety, security and compliance monitoring and data protection.
[*Category:* Standards; Infrastructure; Data Security; Safety]

ISO/IEC *27001:2022, Information Security Management Systems*, https://www.iso.org/standard/27001
RATIONALE: "[P]romotes a holistic approach to information security: vetting people, policies and technology. An information security management system implemented according to this standard is a tool for risk management, cyber-resilience and operational excellence." (emphasis removed)
[*Category:* Data Security; Standards]

Ison, D., *Consumer Willingness to fly on advanced air mobility (AAM) electric vertical takeoff and landing (eVTOL) aircraft*, Collegiate Aviation Review Int'l, 42(1), 29–56, (2024), https://ojs.library.okstate.edu/osu/index.php/CARI/article/view/9681/8586
RATIONALE: "An online survey of 975 individuals in the U.S. was conducted using an existing Willingness to Fly (WTF) scale designed specifically for assessing the acceptance of new aviation technologies and services. Most respondents expressed interest in flying on an eVTOL but planned to wait a few months after service starts before participating in AAM."
[*Category:* Social Acceptance]

Japan – Japan Civil Aviation Bureau (JCAB), Ministry of Land, Infrastructure, Transport and Tourism (MLIT), *Drone / UAS Information Platform System (DIPS) 2.0*, [Portal], https://www.ossportal.dips.mlit.go.jp/portal/top/?lang=en
RATIONALE: JCAB uses this site for drone and pilot registration for flight authorizations. While processing is largely manual on the back end today, it is expected to evolve to provide more automated functions (e.g., automated deconfliction of flight plans).
[*Category:* Implementation; Infrastructure]

Japan – MLIT, *Access to Civil Aviation Bureau Drone and UAS Materials*, https://www.mlit.go.jp/en/koku/uas.html and https://www.ossportal.dips.mlit.go.jp/guide/dips/DIPS-Manual_FPA_ALL_En.pdf
RATIONALE: Present issues and risks (e.g., prohibited airspace) to be checked by drone operators in advance to applying for flight permit approval; and includes the associated Drone Information Platform System (DIPS) online flight application manual.
[*Category:* Governance; Implementation]

Japan – Public-Private Committee for Advanced Air Mobility, *Concept of Operations for Advanced Air Mobility (ConOps for AAM), Rev. A* (Apr. 3, 2024), https://www.mlit.go.jp/koku/content/001757082.pdf
RATIONALE: "[O]utlines the key components and stakeholders, and describes the phases of gradual implementation" for AAM in Japan. Includes an appendix "roadmap" depicting the "flow of technology development" for AAM.
[*Category:* ConOps; Implementation]

Japan – *Realization of Advanced Air Mobility Project* (ReAMo), https://reamo.nedo.go.jp/en/
RATIONALE: ReAMo is a national government funded research project that includes "development of integrated traffic management for sharing airspace at low altitudes among UAS, UAM, and existing aircraft" and features a proposed UTM architecture. https://reamo.nedo.go.jp/en/introduction/introduction_1_2_1_2#al03 . It succeeds a previous multi-year government UTM research project (the DRESS (Drones and Robots for Ecologically Sustainable Societies) projects within NEDO – https://nedo-dress.jp/en/topics/706.html.
[*Category:* Infrastructure; Airspace]

Johns Hopkins Institute for Assured Autonomy, *The Roles of Autonomy and Assurance in the Future of Uncrewed Aircraft Systems in Low-Altitude Airspace Operations*, Lanier Watkins, Denzel Hamilton, Tyler A. Young, et al. (July 2023), https://ieeexplore.ieee.org/abstract/document/10154235, https://hub.jhu.edu/magazine/2023/winter/air-traffic-control-for-drones/ and https://doi.org/10.1109/MC.2023.3242579

RATIONALE: Extending the research in uncrewed aircraft systems by further investigating safety in more realistic and congested airspace operations; and. "more realistically" examining "the roles that autonomy and assurance should play in future airspace operations."

[*Category:* Autonomy/AI; Safety]

Joint Authorities for Rulemaking on Unmanned Systems (JARUS), *JARUS guidelines on Specific Operations Risk Assessment (SORA) v2.5 package*, Doc. No. JAR_doc_25 – JAR_doc_32 (May 13, 2024), http://jarus-rpas.org/wp-content/uploads/2024/06/SORA-v2.5-Main-Body-Release-JAR_doc_25.pdf and [Portal], http://jarus-rpas.org/publications/

RATIONALE: "[R]ecommends a risk assessment methodology to establish a sufficient level of confidence that a specific operation can be conducted safely." It consists of a 10 steps assessment, analyzing ground and air risk and associated mitigation measures. Based on the risk of the operation, it identifies appropriate safety objective for the design of the drone, operational limitations, requirements of the operator and training of the remote pilots. It includes UTM services as part of its risk mitigation approach. Some jurisdictions, such as the EU, have already integrated the SORA in their legislation as a way to apply the Operation Centric Approach. SORA v2.5 includes the following annexes which address key elements in depth:

Annex A – Guidelines on collecting and presenting system and operation information for a specific UAS operation,
Annex B – Integrity and assurance levels for the mitigations used to reduce the Intrinsic Ground Risk Class,
Annex C – Strategic Mitigation Collision Risk Assessment,
Annex D – Tactical Mitigations Collision Risk Assessment,
Annex E – Integrity and assurance levels for the Operational Safety Objectives (OSO),
Annex F – Theoretical Basis for Ground Risk Classification and Mitigation,
Annex I – Glossary of Terms, and Cyber Safety Extension."
[Annex H – UAS Safety Services Considerations, *Note* – This is a draft document for consultation. Given its relevance to UTM service provision, a separate entry appears below.]

[*Category:* Standards; Safety; Governance]

Joint Authorities for Rulemaking on Unmanned Systems (JARUS), *JARUS guidelines on SORA, Annex H, UAS Safety Services Considerations*, Doc. Identifier: JARUS- DEL-WG-AUTO Whitepaper (Feb. 27, 2024), http://jarus-rpas.org/wp-content/uploads/2024/02/SORA-Annex-H-2.5-for-external-consultation.pdf

RATIONALE: Addresses "safety functions enabled by third-party services, and how competent authorities can be assured that responsibilities are clearly divided between Operators and the Providers of any services they may rely on." Establishes service levels proportional to the risk introduced by the failure of a service and the corresponding level of assurance needed to manage risk introduced by the service.

[*Category:* Standards; Safety; Governance]

Joint Authorities for Rulemaking on Unmanned Systems (JARUS), *White Paper on the Automation of the Airspace Environment,* JARUS- DEL-WG-AUTO-Whitepaper (Jan. 12, 2024), http://jarus-rpas.org/wp-content/uploads/2024/02/JARUS-Whitepaper-Automation-of-the-Airspace-Environment-v1.0.pdf

RATIONALE: "[A]ims to provide a comprehensive outline for assessing the impact of automation on various facets of aviation safety. It emphasizes the importance of considering automation in the context of enhancing safety measures while also paving the way for the future evolution of automation within airspace operations…. [and] serves as a foundational document, providing a structured framework for stakeholders to navigate the challenges and opportunities presented by automation while upholding safety standards."

[*Category:* Autonomy/AI; Safety, Airspace]

Korea – *Act on Promotion of Utilization of Drones and Creation of Infrastructure Therefor*, Act No. 16420 (Apr. 30, 2019), Amended by Act No. 18556 (Dec. 7, 2021), https://elaw.klri.re.kr/eng_mobile/viewer.do?hseq=60030&type=part&key=41

RATIONALE: "[L]ay the foundation for the development of the drone industry and contribute to providing more convenience to people and developing the national economy through the promotion of the drone industry by providing such matters as promoting the utilization of drones, laying the foundation therefor, and the operation and management of drone systems."

[*Category:* Governance; Infrastructure]

Korea – *Aviation Safety Act* (Enforcement Date Oct. 19, 2023), Act No.19394, Apr. 18, 2023, Partial Amendment, https://law.go.kr/LSW/lsInfoP.do?lsiSeq=250091&chrClsCd=010203&urlMode=engLsInfoR&viewCls=engLsInfoR

RATIONALE: "[P]rescribe[s] methods for safe and efficient navigation of aircraft, light sport aircraft, or ultra-light vehicles, the obligations of the States, aviation business operators, personnel, etc., and other matters in accordance with standards adopted and methods recommended by the Convention on International Civil Aviation and Annexes…."

[*Category:* Governance; Safety]

Korea – Institute for Aerospace Industry-Academica Collaboration and MITRE, *The Advanced Air Mobility Concept of Operations for Incheon Metropolitan City* (Dec. 2023), https://www.mitre.org/news-insights/publication/advanced-air-mobility-concept-operations-incheon-metropolitan-city

RATIONALE: "[P]resents a vision and approach to proactively establish an AAM ecosystem that considers urban development, environmental issues, and infrastructure changes in the setting of the large city of Incheon. It describes necessary changes and initial plans [and] offers a way forward not only for Incheon Metropolitan City and its surrounding region but also serves as a guide for cities worldwide having similar geographies, hosting major airports, and supporting regional maritime locations."

[*Category:* ConOps]

Korea – Jung, K. Kim, S.; Jung, B., et al, *UTM Architecture and Flight Demonstration in Korea*, Aerospace (Oct. 26, 2022), [9(11):650], https://www.mdpi.com/2226-4310/9/11/650

RATIONALE: Introduces the Korean UTM system, covering Korea's UTM architecture, operational procedures, and flight demonstration; and presents policy and technical challenges that UTM must be resolved for future deployment.

[*Category:* Implementation]

Malaysia – Civil Aviation Authority of Malaysia (CAAM), *Unmanned Aircraft Systems (UAS)*, [Portal], https://www.caam.gov.my/public/unmanned-aircraft-system-uas/

RATIONALE: Refers to the Civil Aviation Authority of Malaysia (CAAM)'s website portal that outlines the regulatory framework, guidelines, and requirements for operating drones in Malaysia. It specifies the Malaysian Civil Aviation Regulation 2016 (CAR 2016) in 5 key regulation documents (140-144) to which all UAS activities must comply. It also details its identified types of approvals and authorizations (such as Authorization to Fly (ATF)) and the need to obtain a Certificate of Approval (COA) per CAD 6011 Part (I). It further highlights the requirements for agricultural UAS operations to have an Airworthiness Certificate (AWC) as detailed in CAD 6011 Part (II) – UAS AGR. The section also emphasizes adherence to safety standards and proper maintenance and record-keeping to ensure compliance. These measures aim to ensure safe and regulated UAS operations within Malaysian airspace.
[*Category:* Governance]

MIT and Airbus, *Protocol-Based Congestion Management for Advanced Air Mobility*, C. Chin, K. Gopalakrishnan, H. Balakrishnan, A. Evans. (ATM 2021), https://doi.org/10.2514/1.D0298

RATIONALE: Presents a "protocol centering on the construction of priority queues to determine access to each congested volume of airspace. [It] leverage[s] the concepts of backpressure (measure of queue buildup) and cycle detection (vehicles that block each other from proceeding) to promote efficiency and present several flight- and operator-level prioritization schemes. [It also studies] three scenarios: random origin–destination missions, crossflow traffic patterns, and simulated hub-based package delivery operations. [It] evaluates our protocols on two performance measures: efficiency (i.e., magnitudes of delays) and fairness (i.e., equitable distribution of delay across flights and operators)."
[*Category:* Communications; Fairness]

NASA Aeronautics Research Institute (NARI), *UAS Traffic Management (UTM) Project Technical Interchange Meeting (TIM)* (Feb. 23, 2021), https://nari.arc.nasa.gov/events/utm2021tim/

RATIONALE: Presents the results of a key Technical Interchange Meeting, sharing research insights, lessons learned, and next steps toward the future of UTM. Extensive recordings and presentation materials are linked.
[*Category:* ConOps; Infrastructure]

NASA, *Description of the NASA Urban Air Mobility Maturity Level (UML) Scale*, https://ntrs.nasa.gov/citations/20205010189

RATIONALE: NASA's UAM Coordination and Assessment Team developed a framework known as the UAM Maturity Level (UML) scale. This framework is intended to have multiple applications including: 1) insight into the likely operational capabilities as a UAM air transportation system develops over time; 2) analysis of technology and regulatory requirements associated with the UAM maturation process; 3) assessment of the current maturity of various segments of the UAM ecosystem; 4) coordination of UAM ecosystem priorities and areas of emphasis; and 5) increasing community and public awareness of UAM and how it may affect mobility in the future. This paper describes the structure of the UML scale and its levels. The paper also describes candidate strategies for advancing between levels, along with associated regulatory gaps and considerations.
[*Category:* ConOps; Governance; Societal Acceptance]

NASA, *Digital Flight: A New Cooperative Operating Mode to Complement VFR and IFR,* NASA/TM–20220013225 (Sept. 2022), Digital Flight: A New Cooperative Operating Mode to Complement VFR and IFR - NASA Technical Reports Server (NTRS)

RATIONALE: Describes an operating mode in which flight operations are conducted by reference to digital information, with the operator ensuring flight-path safety through cooperative practices and self-separation automation enabled by connected digital technologies and automated information exchange. Digital flight offers airspace access and operational flexibility, operating under regulations as an alternative means of separation in VMC and IMC, in lieu of employing visual procedures (i.e., VFR) or receiving Air Traffic Control separation services (i.e., IFR).
[*Category:* Airspace; Autonomy/AI; Governance]

NASA, *Flight Demonstration of Unmanned Aircraft System (UAS) Traffic Management (UTM) at Technical Capability Level 3,* Aweiss, Arwa, Jeffrey Homola, Joseph Rios, Jaewoo Jung, Marcus Johnson, Joey Mercer, NASA Ames Research Center, Hemil Modi, Science and Technology Corp., Edgar Torres, Metis Flight Research Associates, LLC. IEEE-DASC (Sept. 8-12, 2019), San Diego, CA, https://aviationsystems.arc.nasa.gov/publications/2019/2019-73054_Aweiss_DASC2019_manuscript.pdf

RATIONALE: "[R]eports the technical and operational capabilities demonstrated during the UTM flight demonstration TCL 3 and is characterized by multiple small UAS safely operating in moderately populated areas and beyond the visual line of sight of their operators."
[*Category:* Airspace; ConOps; Communications]

NASA, *Flight Test Evaluation of an Unmanned Aircraft System Traffic Management (UTM) Concept for Multiple Beyond-Visual-Line-of-Sight Operations,* Johnson, M., Jung, J., Rios, J., Mercer, J., Homola, J., Prevot, T., Mulfinger, D., and Kopardekar, P., 12th USA/Europe ATM R&D Seminar (ATM2017) (June 27, 2017), https://ntrs.nasa.gov/api/citations/20170011344/downloads/20170011344.pdf

RATIONALE: Captures the lessons learned from the TCL2 field test—the first major flight test of UTM with multiple operators and service suppliers flying BVLOS use cases to support the feasibility and safety of routine BVLOS operations for small UAS.
[*Category:* ConOps; Infrastructure; Safety]

NASA, *In-time System-wide Safety Assurance (ISSA) Concept of Operations and Design Considerations for Urban Air Mobility (UAM),* NASA/TM—20205003981 (June 2020), https://ntrs.nasa.gov/api/citations/20205003981/downloads/%20UPDATED%20ISSA.Conops.Final.20.07.01.pdf

RATIONALE: ISSA is recognized in ICAO's UTM – Framework doc. (Ed. 4) as "[a] potential replacement for the SMS…. This approach to safety management may help scale safety processes to suit the complexity of the UTM environment."
[*Category:* Safety; Implementation]

NASA, *MAAP UPP2 Final Report Attachment A: Security Considerations for Operationalization of UTM Architecture*, Technical Papers and Reports (January 12, 2021), https://www.nasa.gov/wp-content/uploads/2024/03/20210112-final-upp2-security-analysis.pdf?emrc=d4bab4

RATIONALE: Security analysis undertaken by industry – documenting "the results of an analysis of security considerations for operationalization of the [UTM] ecosystem. This analysis was performed by the Virginia Tech Mid-Atlantic Aviation Partnership (MAAP) UPP2 team, including industry representatives from AirMap, AiRXOS (part of GE Aviation), ANRA, Wing, and Google as well as FAA and NASA security representatives.
[*Category:* Data Security; Implementation]

NASA, *Non-Repudiation for Drone-Related Data*, NASA/TM-20220016658, J. Rios, et al. (Nov. 2022), https://ntrs.nasa.gov/api/citations/20220016658/downloads/Non-Repudiation-NASA-TM-20220016658.pdf

RATIONALE: Highlights the current and future need for non-repudiation, provides references to multiple international organizations, and presents an approach to implementing non-repudiation leveraging open standards.
[*Category:* Data Security; Standards]

NASA, *Overview of NASA's Extensible Traffic Management (xTM) Research* (2021), https://ntrs.nasa.gov/api/citations/20210025112/downloads/20210025112_Jung_SciTech2022.pdf

RATIONALE: Foundational UTM requirements and core properties were generalized to become xTM requirements to support new entrants, e.g., at high altitudes – extending / integrating UTM beyond low altitude airspace.
[*Category:* Infrastructure; Airspace]

NASA, *UAS Service Supplier Framework for Authentication and Authorization*, Joseph L. Rios, et al. (Sept. 1, 2019), https://ntrs.nasa.gov/citations/20190032004

RATIONALE: "[T]he basis for secure and confident data exchanges between the Flight Information Management System (FIMS) and the USS Network and within the USS Network itself. UFAA is built upon the Oauth 2.0 approach to federated authorization, with details supplied by various Internet Engineering Task Force (IETF) Request for Comment documents (RFCs)."
[*Category:* Data Security; Infrastructure; Communications]

NASA, *UAS Traffic Management Research Project*, [Portals], https://www.nasa.gov/directorates/armd/aosp/armd-aosp-utm/utm-nasa-technical-documents-papers-and-presentations/ and https://aviationsystems.arc.nasa.gov/publications/category/utm.shtml

RATIONALE: Presents key research documents, technical papers and presentations commencing 2016. Results also include the Technical Capability Level (TCL) reports.
[*Category:* Infrastructure; Standards]

NASA, *TCL4 UTM (UAS Traffic Management) Nevada 2019 Flight Tests, Airspace Operations Laboratory (AOL) Report*, NASA/TM—20205003361 (Mar. 2020), https://ntrs.nasa.gov/citations/20205003361

RATIONALE: Designed to demonstrate five scenarios with five diverse sets of UAS events and activities.
[*Category:* Airspace; Fairness]

NASA, *Unmanned Aircraft System Traffic Management (UTM) Concept of Operations* (2019), Parimal Kopardekar, et al., https://ntrs.nasa.gov/api/citations/20190000370/downloads/20190000370.pdf

RATIONALE: A seminal paper describing the underlying problems, research considerations, responsive vision, guiding principles which have endured globally, the initial ConOps with roles and responsibilities of the parties and architecture for UTM. It posits the enduring "two main mantras" of UTM: "(1) flexibility where possible and structure where necessary and (2) a risk based approach where geographical assets and UAS use cases will indicate the performance required to operate in the airspace."

[*Category:* ConOps; Infrastructure]

NASA, *Unmanned Aerial System (UAS) Traffic Management (UTM): Enabling Low-Altitude Airspace and UAS Operations*, Parimal Kopardekar, Ph.D., Ames Research Center, NASA/TM—2014–218299 (2014), https://ntrs.nasa.gov/api/citations/20140013436/downloads/20140013436.pdf

RATIONALE: Describes "initial ideas to generate discussions and multiple design options to enable low altitude airspace and UAS operations."

[*Category:* Infrastructure; Airspace; Data Security; Communications]

NASA, *UTM Field Test, Final Report*, Ver. 1 (Nov. 6, 2023), https://www.faa.gov/uas/advanced_operations/traffic_management/UFT-Final-Report.pdf

RATIONALE: The UTM "Field Test (UFT) was an important activity for validating and field testing the next set of industry and Federal Aviation Administration (FAA) capabilities needed to support UTM. The activities within the UFT project helped to bring UTM further towards future implementations of operational UTM services. UFT was established as an important component in continuing the collaboration between FAA, National Aeronautics and Space Administration (NASA), and industry to mature UTM."

[*Category:* Infrastructure; Implementation]

RTCA, SC-228, *Minimum Performance Standards for Uncrewed Aircraft Systems*, [Portal], https://www.rtca.org/sc-228/ (Terms of Reference: https://www.rtca.org/wp-content/uploads/2024/02/SC-228-TOR-Rev-17-Approved-2024-02-19.pdf)

*RATIONALE: "*SC-228 supports the safe integration of UAS into the National Airspace System by developing minimum operational performance standards (MOPS) for Detect and Avoid (DAA) equipment, Command and Control (C2) Data Link Systems, and Navigation Systems."

[*Category:* Standards; Communications]

RTCA, DO-377B, *Minimum Aviation System Performance Standards for C2 Link Systems Supporting Operations of Unmanned Aircraft Systems in U.S. Airspace* (Sept. 16, 2021), https://my.rtca.org/productdetails?id=a1BDm000000A28FMAS

RATIONALE: Contains, inter alia, a "small package delivery" use case utilizing UTM to support such operations, although not necessarily scoped for UTM. "When able, the C2 Link is used to communicate status and health information related to package delivery." Sect. B.4.6.1.

[*Category:* Standards; Communications]

RTCA, DO-396, *Minimum Operational Performance Standards for Airborne Collision Avoidance System sXu (ACAS sXu)* (Dec. 15, 2022), https://my.rtca.org/productdetails?id=a1BDm000000GuyIMAS

RATIONALE: This document presents MOPS "for [ACAS sXu] equipment, designed for platforms with a wide range of surveillance technologies and performance characteristics typical of smaller Unmanned Aircraft Systems (sUAS). [Includes] system characteristics that should be of value to users, designers, manufacturers, and installers."

[*Category:* Standards, Infrastructure]

RTCA, *Forum for Digital Flight: Enabling Future Operational Concepts in the National Airspace System for All Airspace Users,* RTCA Secretariate Paper No: 339-23/SECR-020 (Dec. 20, 2023), https://www.rtca.org/wp-content/uploads/2023/12/RTCA-FDF-White-Paper_FNL-1.pdf

RATIONALE: "[P]rovides a brief introduction of Digital Flight, a discussion of the use cases that enable users of the airspace, barriers, solutions, and a path forward for the community. A key principle underpinning this report, and every discussion around the topic of Digital Flight, is that the safety and efficiency of all aviation activities must be preserved and should be improved. The prospect of introducing Digital Flight offers the potential for significant value to the aviation industry, the airspace user communities, individuals such as pilots, controllers, and dispatchers, and the ultimate beneficiary of aviation: the general public."

[*Category:* Governance; Airspace; Standards; Communications]

Rwanda – RCAA, *Rwanda Civil Aviation Regulations, Part 27: Unmanned Aircraft Systems,* https://www.caa.gov.rw/index.php?eID=dumpFile&t=f&f=40004&token=8e4aa686c32668b4bd9958cbb9bf8c4f68c227ec

RATIONALE: Includes: "Requirements for Provision of UTM Service;" categorization and classification of UAS and operations, operating rules, airspace, VLOS and BVLOS requirements, "highly automated" operations considerations, operator certification including manufacturer requirements, training organization certification, and security. "Consolidated to include Special Regulations issued since last amendment of Ministerial Order Nº01/CAB.M/019 OF 06/02/2019 Establishing Civil Aviation Regulations."

[*Category:* Governance; Safety, Implementation]

SAE, *Guidelines for Conducting the Safety Assessment Process on Civil Aircraft, Systems, and Equipment,* ARP4761A (Dec. 2023), https://www.sae.org/standards/content/arp4761a/

RATIONALE: "[P]resent guidelines for performing safety assessments of civil aircraft, systems, and equipment [and other applications; and] compliance with certification requirements [and] to assist a company in meeting its own internal safety assessment standards. The guidelines [] identify a systematic safety assessment process…."

[*Category:* Safety; Certification; Standards]

SESAR 3 Joint Undertaking, [Portals], https://www.sesarju.eu/ and https://www.sesarju.eu/projects/corus and https://www.sesarju.eu/U-space

RATIONALE: Significant U-space research by SESAR – an institutionalized European partnership between private and public sector partners set up to accelerate through research and innovation the delivery of the Digital European Sky.

[*Category:* Infrastructure; Airspace; ConOps; Implementation]

SESAR JU, CORUS-XUAM, *U-Space Concept of Operations,* Fourth Ed. (Sept. 7, 2023), https ://www.sesarju.eu/sites/default/files/documents/reports/U-space%20CONOPS%204th%20edition.pdf

RATIONALE: "[A]ims to serve as a reference manual for U-space." Developed by a wide consortium of relevant European players to reflect the results of multiple research projects.

[*Category:* ConOps; Infrastructure: Implementation]

Singapore – CAAS, *Beyond Visual Line-Of-Sight Operations For Unmanned Aircraft*, Advisory Circular, AC 101-2-2(0) (Dec. 30, 2019), https://www.caas.gov.sg/docs/default-source/default-document-library/ac-anr101-2-2-bvlos-operations-for-ua_301219.pdf

RATIONALE: "[P]rovides an overview of CAAS' assessment methodology for Beyond Visual Line of Sight (BVLOS) operations for Unmanned Aircraft (UA) in Singapore…. "These requirements use risk-based approach to calibrate the range of BVLOS operations while mitigating the risks involved" ensuring maximum safety while "enabling beneficial use of UA."
[*Category:* Safety; Governance]

Singapore – CAAS, *Permits For Unmanned Aircraft Operations*, Advisory Circular, AC 101-2-1(Rev 4) (Dec. 23, 2022), https://www.caas.gov.sg/docs/default-source/docs---srg/ac-anr101-2-1(4)-permits-for-unmanned-aircraft_clean.pdf

RATIONALE: Presents the different types and applicability of permits "required to ensure the safe operation of UA [both indoor and outdoor] and to mitigate any safety risks posed to other aviation users and the public when a UA is operated." The document also provides guidance on permit application processes and associated fees.
[*Category:* Safety; Governance; Implementation]

Singapore – CAAS, *Unmanned Aircraft (UA) Operations Over Roads Within Visual Line Of Sight*, Advisory Circular, AC 101-2-4 (Dec. 23, 2023), https://www.caas.gov.sg/docs/default-source/docs---srg/ac-anr101-2-4-ua-operations-over-roads-within-vlos.pdf

RATIONALE: Presents the framework the CAAS has developed for assessing UA operations over roads. Although this document addresses VLOS flights, the described framework presents various road risk categories that should also support BVLOS operations to guide operators to perform the necessary risk assessment on their intended UA operations over roads to mitigate risks to the public as much as possible.
[*Category:* Safety; Governance]

Spain – *Real Decreto 517/2024*, de 4 de junio (Royal Decree 517/2024 of June 4, 2024), BOE No. 136, from 5 June 2024, pp. 65362-65436, Entry into force: June 25, 2024, [*Spanish*], https://boe.es/buscar/doc.php?id=BOE-A-2024-11377 , and Perma link: https://www.boe.es/eli/es/rd/2024/06/04/517

RATIONALE: The decree defines some of the operational limitations which will apply to drone operators in U-space areas, or areas defined as "geographic zones of general UAS for reasons of citizen security and the protection of people and property in urban environments". The new standard complements the European Union regulations (Delegated Regulation (EU) 2019/945 and Implementing Regulation (EU) 2019/947) as well as the legal regime of Implementing Regulation (EU) 2021/664 on a regulatory framework for U-Space (U-Space Regulation), in terms of organization and competences. The decree also designates ENAIRE as the sole provider of common information services (CSIP) to provide its services in all U-Space airspaces designated in airspace under Spanish responsibility to help ensure the efficient implementation of U-Space in Spain.
[*Category*: Governance; Airspace]

Switzerland – Swiss U-Space Implementation (SUSI), *Amended and Restated Swiss Remote Identification Master Agreement*, Ver. 2.0 (Dec. 2, 2021), https://susi.swiss/2021/12/06/swiss-remote-identification-srid-master-agreement/

RATIONALE: While focused on RID, this agreement provides structure, policy, liability apportionment, and related content of general applicability supporting U-space / UTM. These types of agreement play a role in SUSI and influence global practices.
[*Category:* Governance; Infrastructure; Implementation]

Switzerland – Swiss U-Space Implementation (SUSI), *Swiss U*-Space *ConOps, Ver. 1.1* (Apr. 2, 2020), https://susi.swiss/2020/04/02/conops-v-1-1/

RATIONALE: Explains the goals of the Swiss U-Space Program (Ch. 2), scope and operational concept (Ch. 3 & 4), roles of the various stakeholders (Ch. 5) and provides the definitions and purposes of the services currently envisioned (Ch. 6).
[*Category:* ConOps; Governance; Implementation]

Trinidad & Tobago – Trinidad & Tobago CAA, *Unmanned Aircraft Systems*, [Portal], https://caa.gov.tt/unmanned-aircraft-systems-uas-drones/

RATIONALE: Facilitates the 2016, Civil Aviation Regulation [(No. 19) Unmanned Aircraft Systems] Regulations (which accommodates application for BVLOS operations), https://caa.gov.tt/wp-content/uploads/2020/07/Legal-Notice-No.-183-of-2016.pdf. The regulation includes a registration process and requires UAS commercial operation approval.
[*Category:* Governance]

UK Civil Aviation Authority, *CAP 722H, Unmanned Aircraft Systems, Specific Category Operations – Pre-defined Risk Assessment Requirements, Guidance & Policy*, Second Ed. (Aug. 2023), https://www.caa.co.uk/our-work/publications/documents/content/cap-722h/ and http://www.caa.co.uk/CAP722H

RATIONALE: Describes the concept of a pre-defined risk assessment and sets out each Pre-Defined Risk Assessment (PDRA) (and associated limitations) available in the UK to UAS operators for use in the Specific category only. Note that PDRAs published by JARUS, EASA or any other body are currently not recognized within the UK.
[*Category:* Safety]

UK Civil Aviation Authority, *CAP1711, Airspace Modernisation Strategy 2023–2040 Part 1: Strategic objectives and enablers,* (Jan. 2023),
https://www.caa.co.uk/our-work/publications/documents/content/cap1711/

RATIONALE: Presents the ends, ways and means of modernizing airspace through a series of "delivery elements' to modernize the design, technology and operations of airspace. Originally published in 2018, it was refreshed in 2023. Although this document addresses much more than UTM/BVLOS, the strategic objective of integration (and its associated delivery) is relevant.
[*Category:* Airspace; Infrastructure; Governance]

UK Civil Aviation Authority, *CAP1868,* Innovation Hub, *A Unified Approach to the Introduction of UAS Traffic Management* (Dec. 2019),
https://www.caa.co.uk/our-work/publications/documents/content/cap1868/

RATIONALE: Explores the background of UTM, related workstreams across government and industry, and the current positions of the CAA. It also gives an appreciation of the scale and breadth of impact that the integration of UAS into UK airspace could have across the entire aviation ecosystem.
[*Category:* Infrastructure; Implementation; Governance]

UK Civil Aviation Authority, *CAP2262, UAS Traffic Management: Developing the Concept*, (Aug. 2021), https://publicapps.caa.co.uk/modalapplication.aspx?appid=11&mode=detail&id=10860

RATIONALE: Provides a high-level examination of the strategic, safety and market considerations relevant to UTM. Building on CAP1868 and subsequent work, it also describes current exploration of UK regulatory development of UTM.

[*Category:* Infrastructure; Governance; ConOps]

UK Civil Aviation Authority, *CAP2616, Regulatory Sandbox for the development of capabilities to integrate Uncrewed Aerial Systems (UAS) in unsegregated airspace* (Dec. 2023), https://www.caa.co.uk/our-work/publications/documents/content/cap-2616/

RATIONALE: As a policy concept document, the Sandbox objectives are to

- Demonstrate technologies, airspace management procedures and Air Traffic Service (ATS) provisions, and flight operation procedures that may enable the safe and managed integration of BVLOS UAS and crewed aircraft.
- Enable participants to progress beyond segregation towards integration of BVLOS UAS flights with crewed aircraft and deliver integrated use of airspace.
- Enable the CAA to validate the use of the airspace policy concept with real world use cases to evidence how it supports and enables the accommodation phase.

[*Category:* Infrastructure; Airspace; Governance; ConOps]

US - FAA, *Operation of Small Unmanned Aircraft Systems Over People*, Final Rule (Dec. 23, 2020), https://www.faa.gov/sites/faa.gov/files/2021-08/OOP_Final%20Rule.pdf

RATIONALE: "This rule [permits] routine operations of small unmanned aircraft over people and at night under certain conditions, in addition to changing the recurrent training framework, expanding the list of persons who may request the presentation of a remote pilot certificate, and making other minor changes."

[*Category:* Governance; Safety]

US - FAA, *Order 8040.6A – Unmanned Aircraft Systems (UAS) Safety Risk Management (SRM)* Policy, (Sept. 1, 2023), https://www.faa.gov/regulations_policies/orders_notices/index.cfm/go/document.information/documentID/1042092

RATIONALE: "[E]stablishes the methods by which the FAA manages applicants' requests to operate unmanned aircraft systems, and how AVS [Office of Aviation Safety] performs safety risk management in accordance with FAA Order 8040.4, Safety Risk Management Policy." Through the recent precedent-setting exemptions and UTM Key site operational evaluation activities, FAA expects that the most effective way to manage UA to UA collision risk at scale is through use of strategic deconfliction UTM services.

[*Category:* Governance; Safety]

US - FAA, *Remote Identification of Unmanned Aircraft*, Final Rule (Dec. 23, 2020), https://www.faa.gov/sites/faa.gov/files/2021-08/RemoteID_Final_Rule.pdf

RATIONALE: "This action requires the remote identification of unmanned aircraft .... in the airspace of the United States [to] address safety, national security, and law enforcement concerns regarding the further integration of these aircraft into the airspace of the United States, laying a foundation for enabling greater operational capabilities."

[*Category:* Data Security; Governance; Communications]

US - FAA, *Portal for Part 107 Waivers Issued*, [Portal],
https://www.faa.gov/uas/commercial_operators/part_107_waivers/waivers_issued

RATIONALE: BVLOS waivers that include the approaches/paradigms informing and anticipated to be included in the impending regulation authorizing complex UAS operations.
[*Category:* Governance; Implementation]

US - FAA, *Unmanned Aircraft Systems Beyond Visual Line of Sight Aviation Rulemaking Committee, Final Report* (March 10, 2022),
https://www.faa.gov/regulations_policies/rulemaking/committees/documents/index.cfm/document/information/documentID/5424
(Direct link:
https://www.faa.gov/regulations_policies/rulemaking/committees/documents/media/UAS_BVLOS_ARC_FINAL_REPORT_03102022.pdf)

RATIONALE: Asserts that "current [FAA] regulations [neither] enable the domestic UA [BVLOS] industry to scale and achieve meaningful results from those benefits[; nor] reflect the competencies needed to safely operate highly automated UAS, which hinders the ability to expand [such] operations to achieve the maximum societal and economic benefits for the American public." Key recommendations included: that the FAA "set an acceptable level of risk
(ALR) for UAS that is consistent across all types of operations being performed – to facilitate adoption of "a common and consistent set of regulations and guidance," to facilitate flexibility in compliance; modification to right of way and see-and-avoid rules; extend remote pilot certification rules; establish a new BVLOS Rule which includes a process for
qualification of UA and UAS; and "a non-mandatory regulatory scheme for third party
services to be used in support of UAS BVLOS operations."
[*Category:* Governance; Safety; Implementation]

US - FAA, *Unmanned Aircraft Systems (UAS) Traffic Management (UTM) Implementation Plan*, Ver. 1.8 (July 31, 2023),
https://www.faa.gov/sites/faa.gov/files/PL_115-254_Sec376_UAS_Traffic_Management.pdf
(Source page: https://www.faa.gov/uas/advanced_operations/traffic_management)

RATIONALE: Summarizes some of the work underway, challenges and policy issues in developing the UTM ecosystem and proposed regulatory approaches/solutions.
[*Category:* Implementation; Governance]

US - FAA, *Urban Air Mobility (UAM) Concept of Operations*, Ver. 2.0 (Apr. 2023), https://www.faa.gov/sites/faa.gov/files/Urban%20Air%20Mobility%20%28UAM%29%20Concept%20of%20Operations%202.0_0.pdf

RATIONALE: Addresses UTM interoperation, information exchange, combined services, extension, and off-nominal operations support within the context of the continued maturation of UAM.
[*Category:* ConOps; Communications]

US - FAA, *UTM Concept of Operations,* Ver. 2.0 (Mar. 2020), https://www.faa.gov/researchdevelopment/trafficmanagement/utm-concept-operations-version-20-utm-conops-v20

RATIONALE: Documents the continued maturation of UTM operations below 400' AGL, addresses increasingly more complex operations within and across both uncontrolled (Class G) and controlled (Classes B, C, D, E) airspace, updates and expands operational scenarios, describing more complex operations in denser airspace, including BVLOS operations in controlled airspace, and addresses UA Volume Reservations, Performance Authorizations, data archiving and access, USS service categories, UTM/ATM contingency notification, and security. It also introduces Airspace Authorization for BVLOS flight within controlled airspace, UTM architecture support to remote ID of UAS Operators, and enabling standards development.
[*Category:* ConOps; Airspace]

US - FAA and NASA, *UTM Pilot Program (UPP),* [Portal], https://www.faa.gov/uas/research_development/traffic_management/utm_pilot_program

RATIONALE: Provides details and access to all UPP pilots, including an expanded infrastructure for the UTM ecosystem; and facilitated extensive UTM technologies testing and development (with NASA and industry partners).
[*Category:* Implementation; Infrastructure]

US – Government Accountability Office, *Advanced Air Mobility: Legal Authorities and Issues to Consider for Operations*, GAO-24-106451(Mar. 14, 2024), https://www.gao.gov/products/gao-24-106451

RATIONALE: "[D]escribes (1) the legal authorities held by DOT relevant to the future regulation of civilian AAM operations, and actions taken relevant to these authorities, (2) relevant legal authorities of selected tribal, state, and local governments, and (3) issues to consider as the AAM industry develops, as identified by selected government entities and other stakeholders." The document focuses "on five key areas": certification and safety of aircraft, pilot and mechanic training, airspace management, vertiport construction, and noise management.
[*Category:* Governance; Certification; Safety; Airspace]

US – US UTM Implementation Operations Committee, *US Shared Airspace*, GitHub repository (2024), https://github.com/utmimplementationus/getstarted

RATIONALE: Provides resources supporting "the operationalization of UTM services to support complex UAS operations, with an initial focus on furthering shared airspace. . . . Understanding the need to share airspace amongst scaled operations and leverage applicable standards, seven operators engaged in a project to operationalize strategic conflict detection in the Dallas-Fort Worth area. . . . The effort is applicable to UTM across the US."
[*Category:* Implementation; Airspace; Standards]

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III. Change History

Date:	Version:	Change:
May, 16, 2025	V 1.0	Revised for publication

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[End of Document]