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U.S. Policy Trends on Advanced Air Mobility

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1. Overview

To present a future image of the operational environment of Urban Air Mobility (UAM), the Federal Aviation Administration (FAA) announced the UAM Concept of Operations v1.0 (ConOps) in June 2021.*, [1] Futhermore, with the subsequent maturity of UAM and further input from within and outside of the government, the UAM ConOps v2.0 revision was announced in May 2023.[2]

Moreover, as mentioned in a previous report by my colleague Yoshihiro Fujimaki, in October 2022 the Advanced Air Mobility Coordination and Leadership Act was enacted in the United States. This Act required the Secretary of Transportation to establish a cross-federal Advanced Air Moblity Interagency Working Group (AAM IWG) to develop a national AAM strategy.*, [3] As such, on May 17, 2023, the U.S. Department of Transportation (DOT) issued a Request for Information (RFI) for drafting the national strategy.[4]

This report provides an overview of these UAM/AAM-related policy trends in the US government.

2. The Revision of UAM ConOps

2.1 UAM ConOps v1.0

As was explained by Mr. Fujimaki, the UAM ConOps v1.0 published in June 2020 consists of seven sections as follows: (1) Introduction (demonstrates ConOps scope and background), (2) Overarching Principles and Assumption, (3) Evolution of UAM Operations, (4) UAM Operational Concept, (5) Notional Architecture (identifies the main stakeholders and roles of UAM operations), (6) UAM Use Cases and Scenarios (illustrated examples of sections 4 and 5), and (7) UAM Implementation (presents ConOps concepts and their benefits, beginning with low-frequency, low-complexity operations and gradually expanding to high-frequency operations).[5]

Specifically, the development process of UAM operations consists of three stages as shown in Table 1, and the concept of the UAM Corridor (airspace defined by a three-dimensional route, performance requirements imposed on UAM operating within or crossing through, and the lack of planned separation services performed by Air Traffic Control (ATC) within the area) and so forth are explained.

Table 1: Image of the development process of UAM operations in UAM ConOps v1.0

Stages of Operations	Initial Operations	ConOps 1.0 Operations	Mature State Operations
Operational tempo	Low	The operational tempo remains low; however, it may have increased to a point that necessitates changes in the existing regulatory framework and procedures.	High
UAM structure	No UAM unique structures or procedures exist. Operations will utilize existing ATS and routes but may create new routes as necessary.	Operations of UAM aircraftoccur within defined UAM Corridors from specific aerodromes based on UAM performance requirements. There is minimal UAM Corridor structureor intersections.ATC tactical separation services are not provided for	UAM operations continue to occur within UAM Corridors. The UAM Corridors may form a network to optimize paths to support an increasing number of vertiports; the internal

		operations within the UAM Corridors.Tactical separation is allocated to the UAM operators, PICs, and PSUs (Providers of Services for UAM).	structure of the UAM Corridors is expected to increase in complexity, and the necessary performance parameters for UAM participation may increase.
UAM driven regulatory changes	Initial UAM operations are conducted leveraging current rules, regulations, and local agreements.	Changes to ATM regulations and new UAM regulations that enable operations within UAM Corridors.	Extensive UAM-driven regulations will be necessary to enable cooperative operations within UAM Corridors.
UAM CBRs**	There are no CBRs, but operational needs may be addressed in agreements such as Letters of Agreement (LOAs).	CBRs are defined by industry to meet industry standards or FAA guidelines when specified.CBRs will require FAA approval.	The complexity of CBRs and FAA involvement in establishing guidelines and approving CBRs may evolve to match the specific topic addressed.
Aircraft automation level	Consistent with current, crewed fixed-wing and helicopter technologies (e.g., autopilots, auto-land).	PICs actively control the aircraft with UAM-specific capabilities	Automation improvements may lead to HOVTL capabilities.***
Location of the PIC	Onboard.	Onboard.	Remote.

2.2 Main Revisions in UAM ConOps v2.0

In the revision from UAM ConOps v1.0 to v2.0, the structure of the seven sections described previously didn't change significantly, but some updates were included.

For example, the concept of Extensible Traffic Management (xTM), which complements the traditional provision of Air Traffic Services (ATS) for future passenger or cargo-carrying operations/flights, and new language such as Cooperative Operation Practices (COPs), which replaced CBRs from v1.0., have been incorporated throughout the ConOps. The former xTM is a traffic management concept that corresponds to new flying entity operations including UAS Traffic Management (UTM) related to the operation of Unmanned Aircraft Systems (UAS) in airspace under 400 feet, traffic management related to UAM/AAM described in UAM ConOps, and Upper Class E Traffic Management (ETM) in response to the development of high altitude long endurance vehicles, unmanned free balloons, airships, and supersonic/hypersonic aircraft, that can fly in airspace above 60,000 feet with low air density.[6,7] As for UTM and ETM, like the UAM ConOps, a ConOps has been published by the FAA.[8,9] Furthermore, replacing the v1.0 CBR are the latter COPs, characterized as industry-defined, FAA-approved practices that address how operators cooperatively manage their operations within the Cooperative Area (CA) (i.e., UAM Corridor), including conflict management, equity of airspace usage, and Demand-Capacity Balancing (DCB).****

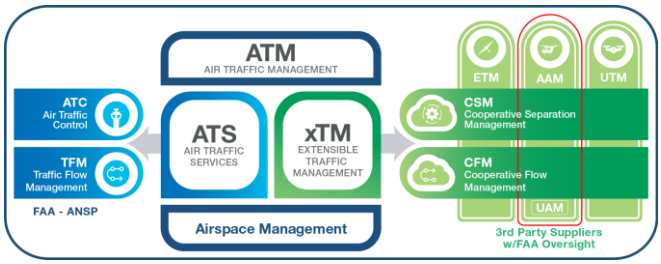

Figure 1: Notional Overview of Future Complementary Service Environments (from UAM ConOps v2.0)

Moreover, regarding the development process of operations in Section 3, in addition to changes in the name of second stage from "ConOps 1.0 Operations" to "Midterm Operations," the role of the ATC has been clarified to "ensure separation of non-participating aircraft from the cooperative operations and/or CA."

Furthermore, in Section 4, the UAM Corridor's development process is described in greater detail. Initial UAM operations, characterized by low tempo, will be executed using the current regulatory framework. As the operations continue to increase in volume and complexity, the implementation of UAM Corridors may become operationally advantageous. Initial UAM Corridors are expected to be "simple" in design (e.g., one-way UAM Corridors or single track in each direction), as illustrated in Figure 2.

Later, as UAM operational demands exceed the initial UAM Corridor design capacity, additional structures including tracks and increased performance capabilities (e.g., ability to safely reduce separation minima within the UAM Corridor through improvements in navigation and/or other technologies) may provide additional capacity. One method is to establish vertical and lateral "passing zones," as shown in Figures 3 and 4. Figure 5 shows an image of a UAM Corridor with multiple "tracks," and it

is expected that increased performance requirements (speed, etc.) will be required on the UAM side in response to these addition of tracks.

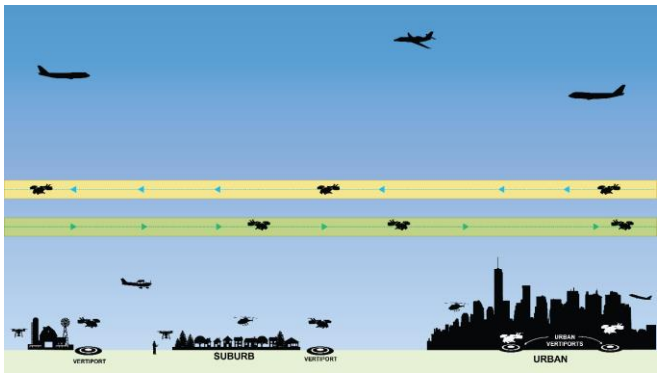

Figure 2: Early UAM Corridor Concept (from UAM ConOps v2.0)

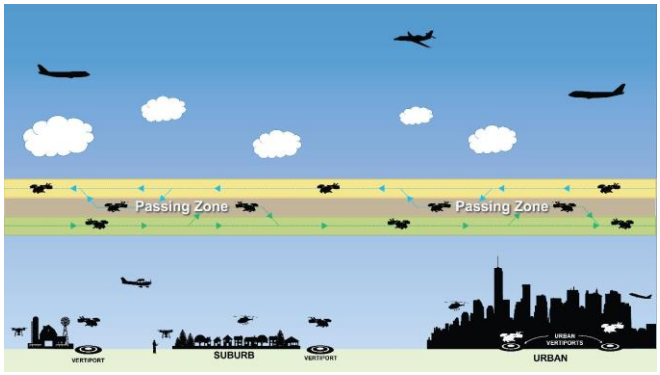

Figure 3: Image of Vertical Common Passing Zone (from UAM ConOps v2.0)

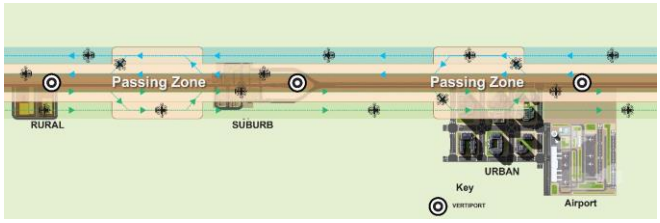

Figure 4: Image of Lateral Passing Zones (from UAM ConOps v2.0)

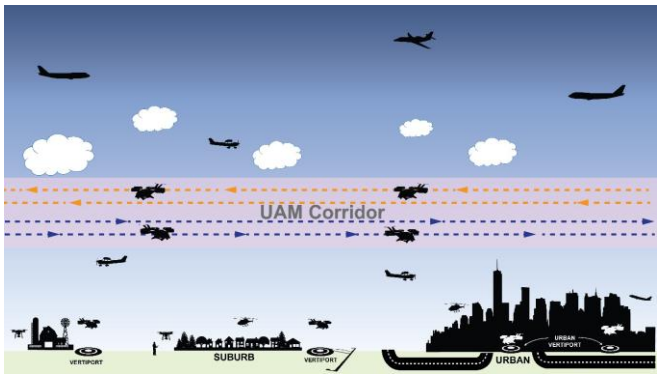

Figure 5: UAM Corridor with Multiple "Tracks" (from UAM ConOps v2.0)

In addition, details of communication data and descriptions regarding vertiports (vertical take-off and landing airfields) have been added to Section 5's Notional Architecture, and updates to Section 6's Use Cases/Scenarios include changes from Nominal (planned) operations and Off-Nominal operations (those that have deviated from plans for whatever reason) to Nomial operations that are completed within the UAM Corridor and Nomial operations that span in and outside the UAM Corridor.

3. RFI to Develop a National Strategy for AAM

3.1 AAM IWG

The AAM IWG is chaired by the DOT, and is comprised of 22 members from the DOT (including the FAA), Department of State, Department of Defense, the Department of Justice, Department of Commerce, Department of Energy, Department of Homeland Security, National Aeronautics and Space Administration (NASA), Office of Science and Technology Policy, and Federal Communications Commission etc.[10] Furthermore, in order to address specific issues related to AAM, the AAM IWG is organized into subgroups (Table 2), which include Automation Strategy, Security Requirements, Air Traffic Federation, Infrastructure Development, and Community Roles.

Table 2: AAM IWG Subgroups

Subgroup	Leading Org.	Role
Automation Strategy	NASA	Understanding the acceleration of the desired transition from initial AAM operations with conventionally qualified, onboard pilots through advanced capabilities proposed by the AAM industry, such as remotely piloted operations and autonomous operations
Security Requirements	Transportation Security Administration: TSA)	Resolving security concerns related to the introduction and expansion of AAM operations into the existing interconnected transportation domain, etc.
Air Traffic Federation	FAA	Identifying the requirements and operations management needed to ensure continued safety of the national airspace system (NAS)
Infrastructure Development	Federal Communications Commission /FAA	Understanding the aviation facilities needed to support AAM operations (ground infrastructure; services, including emergency services; communication; etc.)
Community	NASA/FAA	Understanding the need for

Roles		good public planning for these new technologies and issues such as land governance, transportation equity and accessibility, economic impacts, environmental issues, and workforce development

3.2 Contents of the RFI

Under these circumstances, through this RFI, the DOT is primarily seeking information on the following, with a deadline of August 16, 2023 (extended from the original July 17):

- What should be addressed in a national strategy on AAM
- What respondents believe are existing barriers to success of AAM implementation
- What steps should the Federal Government focus on in the short (2-3 years), medium (4-8 years), and long term (8+ years) in order to maximize the potential for successful AAM implementation in the United States.

In addition to the above, DOT welcomes further and more detailed input. Specifically, the AAM IWG is required to review and examine the following, which is summarized in Section 2(e) of the Advanced Air Mobility Coordination and Leadership Act:

(1) The steps that will mature AAM aircraft operations, concepts, and regulatory frameworks beyond initial operations

(2) The air traffic management and safety concepts that might be considered as part of evolving AAM to higher levels of traffic density

(3) Current Federal programs and policies that could be leveraged to advance the maturation of the AAM industry

(4) Infrastructure, including aviation, cybersecurity, telecommunication, multimodal, and utility infrastructure, necessary to accommodate and support expanded operations of AAM after initial implementation

(5) Steps needed to ensure a robust and secure domestic supply chain

(6) Anticipated benefits associated with AAM aircraft operations, including economic, environmental, emergency and natural disaster response, and transportation benefits

(7) The interests, roles, and responsibilities of Federal, State, local, and Tribal governments affected by AAM aircraft operations

(8) Other factors that may limit the full potential of the AAM industry, including community acceptance or restrictions of such operations.

In addition to the eight topics listed above, there are 20 topics shown in Table 3 that were deemed important by the AAM IWG subgroup.

Table 3: Detailed topics for which information is requested in the RFI

Topic	Overview
1. Most Likely Use Cases	Descriptions of the most likely use cases for AAM in the short, medium, and long term along with high-level estimations of when these use cases may come to market. Also, what government actions could enhance or inhibit those market timelines? Are there use cases that are a national priority?
2. Safety Enhancements	Understanding that safety must be the key component of any future AAM operations, provide information on how new concepts in aviation, such as third-party service providers, automation, and new forms of navigation-enabling infrastructure, provide for, or even enhance, the level of safety of operations.
3. Expected Customer Experience	Information about AAM regarding scheduling and ticketing a flight, arrival at a vertiport, passenger and baggage screening, flights boarding, and flight and postflight experience.
4. Research, Development, and Testing Environment	Information about the current status, accessibility, and adequacy of policies and institutions to promote research and development that enable a world-class AAM industry in the United States. Please comment on the adequacy and suitability of existing, congressionally directed test sites.
5. Statutory and Regulatory Scheme	Information about specific statutes, federal regulations, or other legal authorities that could be created or updated to support AAM in the United States and maintain the regulatory agility necessary to safely enable this new form of transportation..
6. Role of State, Local, Tribal, and Territorial Governments	Information about the role that state, local, tribal, and territorial governments should play in enabling AAM in the United States.
7. Anticipated Power Requirements	Information about the anticipated demand on power grids by AAM, the ability of municipal power grids to accommodate this anticipated demand, and improvements or investments in power infrastructure needed to enable such operations. This also includes information on how AAM could generally assist in achieving long-term energy sustainability and efficiency goals, such as using alternative forms of energy for propulsion (e.g., hydrogen), and the infrastructure requirements that would accompany these alternative power structures.
8. Supply Chain	Information about existing or planned supply chain requirements for current AAM manufacture, including traceability of components and potential vulnerabilities in the event of possible international supply chain disruptions such as what occurred during the COVID pandemic.

9. Privacy	Information about the technologies, data systems, software, or other products that can be used in conjunction with emerging technologies that potentially impact the privacy of the public.
10. Workforce Development	Information about the knowledge, skills, and abilities needed in the working population to accelerate AAM in the United States, including federal labor policies that could assist or expand the populations available to support the AAM industry. This inquiry also includes information about educational pathways and training programs necessary to produce a competent workforce.
11. Global Leadership and International Practices	Information about the steps that the United States needs to take to become a durable global leader in AAM and safe automated technologies. In addition, the AAM IWG seeks information about the impact of foreign government approaches to regulate emerging airspace technologies, including recommended practices the U.S. government should consider adopting as well as practices the U.S. government should avoid.
12. National Security and Aviation Security Implications	Information about the national security implications of accelerating AAM in the United States, specifically how physical security of passengers and cargo should be addressed and who should bear responsibility for security assurances, security and system resilience, and what threats exist in considering the growth of counter-drone capabilities that will operate in similar low-altitude airspace.
13. Vertiport Development and Operations	Information about the expected role of governments and private industries at all levels as to the development, funding, and operation of vertiports. The term "vertiport" in this capacity is meant to describe a range of specialty landing, boarding, and takeoff areas designed for AAM operations, including single-operation vertiports, vertiports integrated into existing airports and heliports today, as well as sprawling, multi-operation, multi-purpose, and multi-transportation option vertiports that act as commercial and transportation hubs.
14. Electromagnetic Spectrum	Information on the electromagnetic spectrum and telecommunications infrastructure needs of piloted and autonomous AAM applications in the near, medium, and long term, including what spectrum-using applications (e.g.communications, navigation, radar, command and control, payload, telemetry, or others) should be considered necessary components of an AAM ecosystem and what the state of development of such applications is in the near, medium, and long term.
15. System Resilience	Information about how the AAM industry plans to secure critical systems by integrating cybersecurity and identifying critical systems in the design of overall architecture of the sector as it evolves. The government also seeks information about how overall transportation system resilience will be affected by AAM.
16. Environmental Impacts and Public Involvement	Information regarding the reasonably foreseeable environmental benefits and costs of integrating AAM operations into the U.S. airspace and broader transportation system, Information regarding opportunities to synchronize, sequence, or coordinate applicable permitting/licensing and public involvement/consultation requirements or processes across Federal, State, local, or Tribal government to minimize duplication and improve efficiency and effectiveness.
17. Alternative Means of Navigation Beyond GPS	Given that these vehicles are expected to operate in urban, suburban, and remote places, reliable and persistent GPS may not be always available. Additionally, AAM are expected to operate in areas where today's radar arrays do not or cannot provide service. What are the most efficient, reliable, and readily available means to provide communication, navigation, and surveillance for AAM in a way that will not disrupt other modes of transportation?
18. Overall Functional Architecture	Given that AAM is an ecosystem consisting of aircraft, airspace, enabling communication, navigation, and surveillance technologies, as well as infrastructure, it is important to ensure consistency of assumptions about functions and requirements from each of these components. Please provide information regarding your assumptions about functional capabilities needed for infrastructure, communication, navigation, and surveillance technologies.
19. Automation Standards	Information on needed consensus areas, standards, and design guidelines related to automation; critical integration challenges with the national airspace system; and data needed or available to inform standards, safety tools, and artificial intelligence/machine learning enabled systems.
20. Other Areas of Interest	Respondents are encouraged to identify areas that are not directly identified or not adequately expressed for which inter-governmental coordination is critical to the success of AAM ecosystem.

4. Conclusion

This report has provided an overview of the FAA's revision of UAM ConOps v1.0 to v2.0 and the DOT's issuance of an RFI to develop a national strategy for AAM. ConOps v2.0 revises and specifies existing content, including updating terminology according to discussions that have occurred since the release of v1.0 and adding detail about the development process of the UAM Corridor, in addition to making it more concrete. Based on the Advanced Air Mobility Coordination and Leadership Act, RFI covers not only technical aspects such as safety, communication, navigation, and automation, but also cross-cutting aspects of the U.S. federal government, such as workforce development related to AAM and cooperation with local governments. The content is high-level and shows the commitment of the entire U.S. government to AAM. Various activities are being carried out in parallel in the United States to realize AAM, including the

Advanced Aviation Advisory Committee (AAAC) mentioned in a previous report,[11] and we will continue to monitor these developments closely.

Notes

* For definitions of UAM and AAM, please refer to Reference 11)。

** An abbreviation for Community Business Rules, which refers to business rules for UAM operations established by stakeholders to be consistent with industry standards and FAA guidelines, etc., and is expected to require FAA approval.

*** Human-over-the-Loop, the level of automation where humans are notified and involved by the automated system to take action. Humans passively monitor the system and are informed by the automated system as to what action is required when needed. Humans are involved for exceptions that automated systems cannot resolve or that cannot be accommodated by expanding the rules.

**** Strategic system-wide traffic flow and airfield capacity considerations that allow airspace users to decide when, where, and how to operate, while mitigating conflicting needs for airspace and airfield capacity.

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