NASA is exploring airspace operations incorporating unmanned vehicles and novel operations occurring in all airspaces (controlled and uncontrolled), with a goal to safely and efficiently integrate with existing operations and mission types. NASA’s research to enable unmanned vehicles to be safely and fully integrated into existing airspace structures (or lack thereof) has already demonstrated the potential benefits and capabilities of a service-based architecture [such as developed for the Unmanned Aircraft Systems Traffic Management (UTM) Research and Development (R&D) evaluations], and has led to new procedures, equipage and operating requirements, and policy recommendations, to enable widespread, harmonized, and equitable execution of diverse unmanned missions.

This subtopic seeks proposals to continue to adapt the UTM concept elements for application to Urban Air Mobility (UAM)/Advanced Air Mobility (AAM), including:

- Service-based architecture designs that enable dense and/or increasingly complex UAM operations.
- Dynamic route planning that considers changing environmental conditions, vehicle performance and endurance, and airspace congestion and traffic avoidance.
- Dynamic scheduling for on-demand access to constrained resources and interaction between vehicles with starkly different performance and control characteristics.
- Integration of emergent users with legacy users, large commercial transport, including pass-through to and from ultrahigh altitudes and interactions around major airports.
- Operational concepts for fleet and network management, market need and growth potential for future operations, and airspace integration.
- Identification of potential certification approaches for new vehicles operations (such as electric vertical takeoff and landing).

Future service-based architectures also require resiliency to cyberattacks to ensure safe and robust operations that maintain expected levels of safety, as well as accommodating changes to environmental and operational conditions. Therefore, proposals incorporating cyber-resiliency methods, tools, or capabilities, or address cyber-
resiliency as part of the proposed effort are also being solicited. 

New this year, this solicitation is focused on UAM/AAM airspace operations only, and is not accepting proposals specific to other nontraditional operations. In addition, proposals that focus only on cyber-resiliency solutions without proposing specific UAM/AAM services, will be rejected.

**Expected TRL or TRL Range at completion of the Project:** 1 to 4  
**Primary Technology Taxonomy:**  
Level 1: TX 16 Air Traffic Management and Range Tracking Systems  
Level 2: TX 16.3 Traffic Management Concepts  
**Desired Deliverables of Phase I and Phase II:**

- Research  
- Analysis  
- Prototype  
- Software  

**Desired Deliverables Description:**  
Technologies that can advance safe and efficient growth in global operations [Aeronautics Research Mission Directorate (ARMD) Thrust 1 Goal] as well as developing autonomy applications for aviation (as under ARMD Thrust 6), that are specifically applicable to UAM operations, and address post-pandemic recovery, as appropriate.  

Phase I deliverables may take the form of a prototype/proof-of-concept decision support tool, automation and/or service, a proof-of-concept demonstration of the underlying architecture, and/or validation of the approach taken, which shows focus on a particular aspect or use case of the R&D challenge being investigated. Phase II deliverables would presumably take the form of higher TRL tools decision support services that convincingly demonstrate a solution to the proposed R&D challenge.  

**State of the Art and Critical Gaps:**  
Current state of the art: NASA has been researching advanced air transportation concepts and technologies to improve commercial operations in the National Airspace System and has been applying this expertise, as well as a service-based architecture and concepts pioneered for UTM towards UAM.  

Critical gaps: Significant challenges remain to fully develop the UAM/AAM airspace concept of operations, including integrating air transportation technologies across different domains and operators, providing comprehensive, strategic scheduling and traffic management technologies, and enabling concepts that will allow for scaling demand and complexity of operations.

This subtopic is focused on the Airspace Operations of the UAM/AAM concept only. Proposals must have clear application to UAM/AAM airspace operations. Proposals that focus on UAM/AAM vehicle capabilities, or onboard vehicle technologies or systems, will be rejected. Proposals that are specific to other nontraditional operations (such as, but not limited to, space traffic management, automated air cargo, UTM, and ultrahigh altitude), without clear application to UAM/AAM, will be rejected.

**Relevance / Science Traceability:**  
Airspace Operations and Safety Program (AOSP).  
Air Traffic Management-eXploration (ATM-X) Project.  

Successful technologies in this subtopic will help NASA pioneer UAM concepts and technologies. The technologies
also incorporate new autonomy/artificial intelligence/data science methods and approaches to air transportation problems for current and near-future application.

References:

https://www.nasa.gov/aeroresearch/programs/aosp

https://www.aviationsystemsdivision.arc.nasa.gov/publications/index.shtml
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