Urban Air Mobility (UAM)
Parimal Kopardekar, PhD
Director of NASA Aeronautics Research Institute (NARI)
NASA Senior Technologist, Air Transportation Systems
UAM Vision & Framework

Urban Air Mobility (UAM) Vision
Revolutionize mobility around metropolitan areas by enabling a safe, efficient, convenient, affordable, and accessible air transportation system for passengers and cargo

1. Design, manufacture, and system readiness of UAM vehicles
2. Operations and maintenance of a single UAM vehicle, independent of the sharing of airspace or other system resources
3. Airspace System Design & Implementation
4. Airspace & Fleet Operations Management
5. Societal integration and acceptance of UAM operations

Operations and management of multiple vehicles within a UAM system that enable safe and efficient sharing of airspace and other system resources

Design, development, and implementation of infrastructure to enable safe and efficient multi-vehicle UAM operations

Community Integration

Vehicle Development & Production

Individual Vehicle Management & Operations

Pillar number
UAM Maturity Levels (UMLs)

**Initial State**

- **UML-1**: Late-Stage Certification Testing and Operational Demonstrations in Limited Environments

**Intermediate State**

- **UML-2**: Low Density and Complexity Commercial Operations with Assistive Automation
- **UML-3**: Low Density, Medium Complexity Operations with Comprehensive Safety Assurance Automation
- **UML-4**: Medium Density and Complexity Operations with Collaborative and Responsible Automated Systems

**Mature State**

- **UML-5**: High Density and Complexity Operations with Highly-Integrated Automated Networks
- **UML-6**: Ubiquitous UAM Operations with System-Wide Automated Optimization
Grand Challenge Series

**Purpose:** To develop a robust proving ground through operational and safety scenarios emphasizing near-term UMLs to accelerate the UAM market.

- Builds knowledge base for requirements and standards
- Results in a UML – 4 scaled urban demonstration
Open Source Collaboration

NASA will rely on open source collaboration with the community to build out the following resources:

• **Book of Requirements**
  
  • Provide requirements, recommended practices, standards, regulatory guidance, accepted metrics and other information helpful for achieving UAM

• **Ecosystem Scorecard**

  • Measures industry performance against UAM milestones
Regional authorities lack the tools to make decisions regarding UAM implementation and operationalization.
Regional Modeling & Simulation

NASA is developing a modeling and simulation tool for regional authorities and state Department of Transportation aviation departments.
UAM Barriers

1. Airspace Design
   2. Operational Rules, Roles, & Procedures
   3. CNSI & Control Facility Infrastructure
   4. UAM Port Design

1. Public Acceptance
   2. Supporting Infrastructure
   3. Operational Integration
   4. Local Regulatory Environment & Liability

1. Safe Airspace Ops
   2. Efficient Airspace Ops
   3. Scalable Airspace Ops
   4. Resilient Airspace Ops
   5. Fleet Management
   6. Urban Weather Prediction

Airspace System Design & Implementation

Community Integration

Airspace & Fleet Operations Management

Vehicle Development & Production

Individual Vehicle Management & Operations

1. Vehicle Design & Integration
   2. Airworthiness Standards & Certification
   3. Vehicle Noise
   4. Weather-Tolerant Vehicles
   5. Cabin Acceptability
   6. Manufacturing & Supply Chain

Vehicle Barriers
Airspace Barriers
Community Integration Barriers

Pillar number

1. Safety
2. Security
3. Affordability
4. Noise
5. Autonomy
6. UAM Ports
7. Regulations/Certification
8. Ground Ops & Maintenance

1. Safe Urban Flight Management
   2. Increasingly Automated Vehicle Operations
   3. Certification & Ops Approval
   4. Ground Ops & Maintenance

1. Operational Integration
Building the Ecosystem

Scalability is a fundamental need for UAM

- More licensed pilots (or acceptable and reliable autonomy)
- Spectrum availability
- Airspace operations (e.g. Unmanned Aircraft System Traffic Management type construct)
- Acceptable noise
- Mass production of electric or hybrid VTOLS
- Infrastructure (including recharging stations)
Collaborative Innovation

UAM Working Groups

- Aircraft
- Airspace
- Community

Urban Capable Aircraft

- Supply Chain
- Grand Challenge
- UTM
- Simulations & Modeling
- Infrastructure Requirements

Book of Requirements
Industry Scorecard
Ecosystem-wide strategy
What to expect next?

• Supply chain and manufacturing workshop Feb 4-5
• NASA-FAA coordinated meeting on Feb 6-7 focused on airspace concept of operations for near term use cases
• NASA’s concept of operations Deloitte arranged meeting Feb 12-12, LA
• NASA’s working group for aircraft, airspace, and infrastructure
• Grand Challenge series
• Many regional initiatives
• Support development of requirements for aircraft, airspace, and community – community of practice
Questions