The UAM vision will only prove useful with buy-in and engagement from across the ecosystem.
## Agenda

**July 16th, 2020**

3:00pm-4:30pm

<table>
<thead>
<tr>
<th>Topic</th>
<th>Content</th>
<th>Presenters</th>
<th>Timing</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Welcome</strong>&lt;br&gt;<strong>UAM ConOps Overview Recap</strong></td>
<td>Introductions&lt;br&gt;Brief review to spur conversation</td>
<td>Misty Davies&lt;br&gt;Michael Patterson&lt;br&gt;Jim Murphy</td>
<td>3:00-3:10</td>
<td>0:10</td>
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<tr>
<td><strong>Session Engagement Ground Rules</strong></td>
<td>How we will handle feedback from 100 over the next 60 or so minutes.</td>
<td>Misty Davies</td>
<td>3:10-3:15</td>
<td>0:05</td>
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<tr>
<td><strong>Feedback from the Audience</strong></td>
<td>Open mic&lt;br&gt;Questions from chat&lt;br&gt;Questions from original ConOps overview session</td>
<td>N/A</td>
<td>3:15-4:30</td>
<td>1:15</td>
</tr>
</tbody>
</table>
Speakers

Dr. Misty Davies, National Aeronautical and Space Administration (NASA)
System Wide Safety Deputy Project Manager, NASA Ames Research Center
AAM Ecosystems Crosscutting Working Group Lead

Dr. Michael Patterson, National Aeronautical and Space Administration (NASA)
Aerospace Technologist, NASA Langley Research Center

Jim Murphy, National Aeronautical and Space Administration (NASA)
Integration Manager, NASA Ames Research Center

Nancy Mendonca, National Aeronautical and Space Administration (NASA)
Deputy Team Lead, UAM Coordination and Assessment Team (UCAT), NASA COR
Urban Air Mobility Community Concept of Operations

Vision ConOps
(Structure Based on NASA OpsCon)

Community Integration
Airspace System Design & Implementation
Airspace & Fleet Operations Management
Vehicle Development & Production
Individual Vehicle Management & Operations

UAM Vision
Revolutionize mobility around metropolitan areas by enabling a safe, efficient, convenient, affordable, and accessible air transportation system

“Vision ConOps”
- High-level – Providing a vision of key concepts in the future
- Broad covering all pillars

Scope
- Passenger-carrying operations
- Vision at the Intermediate state (UML-4)
- Placing air mobility within reach of the general public (i.e., realistic / cost effective transportation choice for general public)
### UAM Nominal Gate-to-Gate Operations Overview

<table>
<thead>
<tr>
<th></th>
<th>Pre-Flight</th>
<th>Take-off</th>
<th>Climb &amp; Cruise</th>
<th>Descend</th>
<th>Land/De-Plane</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Operator</strong></td>
<td>• Request performance authorization</td>
<td>• Approves taxi/takeoff authorization and execute take-off</td>
<td>• Conformance monitoring</td>
<td>• Conformance monitoring</td>
<td>• Conformance monitoring</td>
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<tr>
<td></td>
<td>• File operations plan</td>
<td></td>
<td>• Vehicle monitoring</td>
<td>• Vehicle monitoring</td>
<td>• Ready for turnaround</td>
</tr>
<tr>
<td></td>
<td>• Confirm vehicle ready for departure</td>
<td></td>
<td>• Maintain open data exchange with U4-PSU and vehicle</td>
<td>• Maintain open data exchange with U4-PSU and vehicle</td>
<td></td>
</tr>
<tr>
<td><strong>U4-PSU</strong></td>
<td>• Initiate take-off planning</td>
<td>• Transmit taxi/takeoff authorization and departure sequencing command</td>
<td>• Conformance monitoring</td>
<td>• Conformance monitoring</td>
<td>• Confirm all clear for vehicle landing</td>
</tr>
<tr>
<td><strong>FAA</strong></td>
<td>• Automated Operations Plan approval (through data exchange)</td>
<td></td>
<td>• Communicate updated operations plan</td>
<td>• Communicate and sequencing of route changes, issues landing clearance</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>• Maintain open data exchange</td>
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<tr>
<td><strong>Vertiport Operator</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>• Screen passengers &amp; cargo</td>
<td>• Confirm all clear for vehicle departure</td>
<td>• N/A</td>
<td>• Confirm vertiport clear for vehicle landing</td>
<td>• Confirm landing area is clear</td>
</tr>
<tr>
<td></td>
<td>• Perform vehicle boarding</td>
<td></td>
<td></td>
<td>• Allocate landing pad</td>
<td>• Deplane vehicle</td>
</tr>
<tr>
<td></td>
<td>• Confirm all clear for departure</td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td><strong>Vehicle</strong></td>
<td>• Perform systems check</td>
<td>• Execute take-off procedure and sequencing</td>
<td>• Execute climb &amp; cruise procedures</td>
<td>• Execute descent procedure and sequencing</td>
<td>• Scan and confirm all clear for landing</td>
</tr>
<tr>
<td></td>
<td>• Confirm ready for departure</td>
<td></td>
<td>• Maintain vehicle-to-vehicle performance-based separation</td>
<td>• Maintain vehicle-to-vehicle performance-based separation</td>
<td>• Execute landing</td>
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<td></td>
<td></td>
<td></td>
<td>• Monitor systems &amp; push vehicle health and status to operator</td>
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</table>

**UAM operations are highly collaborative & rely on constant information exchange between stakeholders**
Discussion Ground Rules

We will be utilizing the microphone and chat features on the MS Teams platform.

• Leave your cameras/webcams off to preserve WiFi bandwidth
• Enter comments/questions in the chat function on the right side of the screen
• Use your mute/unmute button
• Type “REQUEST TO SPEAK: [Insert First & Last Name]” in the chat box to notify the emcee that you would like to verbally comment/ask a question
• Say your name and affiliation before you begin speaking
• Speak loudly and clearly
  • You will be given up to 90 seconds (1.5 minutes) to verbally comment/ask a question
• Be professional in all verbal and written comments/questions
Backup
Develop validated AAM System Architectures that define a safe, certifiable, and scalable system
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.
UAM Framework and Barriers

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

## Airspace System Design & Implementation
1. Safe Urban Flight Management
2. Increasingly Automated Vehicle Operations
3. Certification & Ops Approval
4. Ground Ops & Maintenance

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

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

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

## Safety
- Security
- Affordability
- Noise
- Autonomy
- Vertiports
- Regulations/Certification

## Vehicle Barriers
- Airspace Barriers
- Community Integration Barriers
UAM Maturity Levels (UML)

**UML-1**
Late-Stage Certification Testing and Operational Demonstrations in Limited Environments
Aircraft certification testing and operational evaluations with conforming prototypes; procedural and technology innovation supporting future airspace operations (e.g., UTM-inspired); community/market demonstrations and data collection

**UML-2**
Low Density and Complexity Commercial Operations with Assistive Automation
Type certified aircraft; initial Part 135 operation approvals; limited markets with favorable weather and regulation; small UAM network serving urban periphery; UTM Construct and UAM routes supporting self-managed operations through controlled airspace

**UML-3**
Low Density, Medium Complexity Operations with Comprehensive Safety Assurance Automation
Operations include urban core; operational validation of advanced airspace operations and management including UTM inspired ATM, CNSI, C^2, and automation for scalable, weather-tolerant operations; few high-capacity vertiports; noise compatible with urban soundscape; model-local regulations

**UML-4**
Medium Density and Complexity Operations with Collaborative and Responsible Automated Systems
100s of simultaneous operations; expanded networks including closely-spaced high throughput vertiports; many UTM inspired ATM services available, simplified vehicle operations for credit; low-visibility operations

**UML-5**
High Density and Complexity Operations with Highly-Integrated Automated Networks
1,000s of simultaneous operations; large-scale, highly-distributed networks; high-density UTM inspired ATM; autonomous aircraft and remote, M:N fleet management; high-weather tolerance including icing; high-volume manufacturing

**UML-6**
Ubiquitous UAM Operations with System-Wide Automated Optimization
10,000s of simultaneous operations (capacity limited by physical infrastructure); ad hoc landing sites; noise compatible with suburban/rural operations; private ownership & operation models enabled; societal expectation

INITIAL STATE

INTERMEDIATE STATE

MATURE STATE

**UAM Framework and Barriers**

**Vehicles**

**Airspace**

**Community**
Key Elements of Airspace at UML-4

**UAM Maturity Level (UML)-Level 4**: Medium Density and Complexity Operations with Collaborative and Responsible Automated Systems

- **U4 UAM Operations Environment (U4-UOE)** – Dynamic airspace volumes with high UAM activity
- **U4 Provider of Services to UAM (U4-PSU)** – Federated 3rd party suppliers of services including air traffic management

**Other Characteristics**

- Advanced automation (vehicles and air traffic management) largely human over the loop
- High performance vehicles (e.g., EVTOL) capable of detect and avoid and performance based separation
- All vehicles operating in U4-UOE are appropriately equipped and actively participate in U4-UOE
- U4-UAM is characterized by medium density operations between closely-spaced, high throughput vertiport
- Higher throughout combined with lower operating costs reduce per passenger price & place air travel within reach of the general public as a practical mode of transportation
Key UAM Elements of Vehicles at UML-4

Advanced **technologies** enable:
- New vehicle configurations
- High performance aircraft
- Efficient propulsion systems
- Greater weather tolerance
- Greater design and production agility

Advanced design and engineering methods (model-based, digital engineering, etc.) along with advanced rapid testing enable more rapid commercialization

Certification process are adapted for new technologies, materials, vehicles and manufacturing **process** building on the regulatory frameworks in place and enable more rapid incorporation of safety improvements

**Mature manufacturing and supply chains**, including secure digital processes to track parts and ensure authenticity and traceability, **will enable rapid ordering and receipt of parts**
Key UAM Elements of Community Integration at UML-4

U4-UAM is a value added, integrated component of a city/region’s multi-modal transportation system and is part of local/regional transportation plans.

Cohesive federal, state, and local roles and authorities support design and development of air and ground UAM infrastructure.

Effective processes established to engage and consider community integration concerns (e.g., Safety / Noise Visual / Privacy).

Infrastructure meets industry standards, local ordinances and other regulations.

Infrastructure integrates advanced technologies to support UAM operations (e.g., grid/power capacity, security, ground transportation, weather sensing, and navigational infrastructure).