Urban Air Mobility – NASA Perspectives

June 18, 2018
Future Mobility

Market: Large UAS & HALE

- HALE UAS
- Supersonic Manned Aircraft
- Subsonic Fixed wing

Market: Large UAS
- Supersonic Manned Aircraft
- Small airport
- Weather Tolerant Operations

Market: Thin/Short Haul
- Weather Tolerant Operations
- Large UAS
- Droneport
- Weather Tolerant Operations

Market: Small / Medium UAS
- Large UAS
- Weather Tolerant Operations
- Distribution Center

Market: Urban Air Mobility
- Vertiport at airport
- Urban Vertiport
- Rotary Wing
- Subsonic Fixed wing
- Weather Tolerant Operations
- Supersonic Manned Aircraft
- Fixed wing
- Rotary Wing

Class A Airspace

Upper E Airspace

International Airport

Asia

U.S.A.
Large projected market—McKinsey analysis of demand by 2030 in 15 major U.S. cities:
• 500 Million annual UAS package deliveries
• 750 Million annual passenger trips

Extrapolation to the global market would likely increase demand by 5 to 10x
Urban Air Mobility

Market Potential

- McKinsey & Company Market Analysis
- Assessed market potential across 15 U.S. cities
  - Last-mile parcel delivery – projecting a profitable market with ~500M deliveries by UAS. Commercial break-even point by 2030 with significant ramp-up by 2025
  - Air transportation – projecting a profitable market with ~750M passenger trips by 2028 with a ramp-up by 2025
- Assumes major issues can be solved
  - Safety, Privacy, Environment, and Noise / Visual Disruption
Emerging Aviation Markets
Global Race to Achieve Leadership

Urban Air Mobility

And many other U.S. and international competitors have the same vision and are capable of innovative vehicle design, development and flight demonstration

The race to capture the market will be won based on…
• Ability to certify innovative aviation technologies and configurations
• Achieving equitable community noise standards
• Enabling safe airspace access at high densities
• Achieving safe vertiport infrastructure standards

But most demonstrations and early market growth are overseas – all four key issues easier to manage in many other countries. The U.S. must lead or fall behind.

NASA is adjusting its portfolio to address the issues, support FAA and industry to accelerate U.S. competitive posture, and do it through a technically sound, sustainable and scalable approach.
Focus highest priority for ATM Pivot on UAM requirements

Develop NASA Proving Ground to support industry demonstration of readiness to address / solve key safety issues for automated, eVTOL operations

Establish robust private partnership (PPP) model to develop and V&V critical industry standards

Develop research and technology products on key challenges (autonomy, safety, noise, adverse weather operations)
Enabling Safe UAS Operations in the U.S.
Firm Foundation for Airspace Operations Capabilities Development

UAS in the NAS – Primary Focus is IFR-Like and VFR-Like Operations with Current NAS System

UAS Traffic Management (UTM) Primary Focus in Low Altitude Urban within a New Operational Model

Emerging, Long-Term Urban Air Mobility Focus builds off of UAS in the NAS and UTM to enable Air Taxi type operations in urban areas
UAM Reference Missions

Non-Passenger Carrying Reference Missions

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<th>INITIAL STATE</th>
<th>INTERMEDIATE STATE</th>
<th>MATURE STATE</th>
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<tr>
<td>PUBLIC SAFETY VEHICLES</td>
<td>SMALL PACKAGE DELIVERY</td>
<td>UAS MULTI-PACKAGE DELIVERY</td>
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Passenger Carrying Reference Missions

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<td>UBIQUITOUS INTRA-METRO TAXI</td>
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Urban Air Mobility (UAM) Vision
Revolutionize mobility within metropolitan areas by enabling a safe, efficient, convenient, affordable, and accessible air transportation system for passengers and cargo

Societal integration and acceptance of UAM operations

Design and implementation of systems to enable vehicles to share airspace and other resources

Design, manufacture, and system readiness of UAM aircraft

Operations and maintenance of a single UAM vehicle, independent of the sharing of airspace or other system resources

Vehicle Development & Production

Airspace System Design & Implementation

Individual Vehicle Management & Operations

Air Traffic & Fleet Operations Management

Community Integration
Laying the Ground Work for Aviation in 2040

- The **global aviation system of 2040** is emerging today – new companies and new systems built on advanced technologies pioneered by NASA based on steady U.S. investment

- Based on what is emerging today, what can we see for 2040:
  - An **Urban Air Mobility** system that is all electric, autonomous and environmentally friendly moving billions of commuters and packages across the world’s megacities. As a result, ground-based traffic congestion will be reduced, local air quality will be improved, and urban areas will be transformed
  - **Transformative subsonic airliners** developed by U.S. industry will approach near-optimal levels of efficiency, reducing cost and environmental impact, and will continue to enable more people to travel around the world supporting a vibrant and growing U.S. and global economy
  - A growing segment of increasingly affordable and **environmentally friendly supersonic air travel**. This will once again shrink our world and project U.S. technological leadership.
  - All of this will ride upon a **transformed airspace system** that provides the access and efficiency to enable this broad range of business models and provides proactive and prognostic "in-time" safety assurance, providing all citizens confidence that every flight is safe and secure.