Unmanned Aerial Systems Traffic Management (UTM)

SAFELY ENABLING UAS OPERATIONS IN LOW-ALTITUDE AIRSPACE

utm.arc.nasa.gov

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Unmanned Aerial System Traffic Management (UTM)

**Near-term Goal:** Safely enable initial low-altitude UAS as early as possible

**Long-term Goal:** Accommodate increased demand with highest safety, efficiency, and capacity
UTM: Balancing Multiple Needs

**NATIONAL AND REGIONAL SECURITY**
Protecting key assets

**SAFE AIRSPACE INTEGRATION**
Flexibility where possible and structure where needed
Geographical needs, application, and performance-based airspace operations

**SCALABLE OPERATIONS FOR ECONOMIC GROWTH**
Ever-increasing applications of UAS: Commercial, Agricultural, and Personal
Five Basic Principles

- Drones should not hit each other
- Drones should stay away from manned aviation
- Drone operator should have complete awareness of all constraints in the airspace
- Drones operating in airspace should have positive identification
- Drones should give preference to public safety drones and manned aircraft

System should scale to accommodate future demand
• Safe low-altitude UAS operations with
  – Airspace management and geofencing
  – Weather and severe wind integration
  – Predict and manage congestion
  – Terrain and man-made objects: database and avoidance
  – Maintain safe separation (Airspace reservation, V2V, & V2UTM)
  – Allow only authenticated operations

DIGITAL, VIRTUAL, & FLEXIBLE RISK-BASED APPROACH AND SERVICE INFRASTRUCTURE

Self-driving car does not eliminate lanes and rules for efficient and safe operations
UTM Functions

AIRSPACE OPERATIONS & MANAGEMENT

• ~500 ft. and below
• Geographical needs and applications
• Rules of the airspace: performance-based
• Geofences: dynamic and static
**UTM Functions**

**Wind & Weather Integration**
- Actual and predicted winds/weather

**Congestion Management**
- Demand/capacity imbalance
- Only if needed – corridors, altitude for direction, etc.
UTM Functions

**Separation Management**
- Airspace reservation
- V2V and V2UTM
- Tracking: ADS-B, cellphone, & satellite based

**Contingency Management**
- Large-scale GPS or cell outage
- 9-11 like situations
### UTM Builds:

Each build is independent and deployable

<table>
<thead>
<tr>
<th>Build 1 (August 2015)</th>
<th>Build 3 (January 2018)</th>
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</thead>
<tbody>
<tr>
<td>Reservation of airspace volume</td>
<td>Beyond visual line-of-sight</td>
</tr>
<tr>
<td>Over unpopulated land or water</td>
<td>Over moderately populated land</td>
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<tr>
<td>Minimal general aviation traffic in area</td>
<td>Some interaction with manned aircraft</td>
</tr>
<tr>
<td>Contingencies handled by UAS pilot</td>
<td>Tracking, V2V, V2UTM and internet connected</td>
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<tr>
<td>Enable agriculture, firefighting, infrastructure monitoring</td>
<td>Public safety, limited package delivery</td>
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<tr>
<th>Build 2 (October 2016)</th>
<th>Build 4 (March 2019)</th>
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<tbody>
<tr>
<td>Beyond visual line-of-sight</td>
<td>Beyond visual line-of-sight</td>
</tr>
<tr>
<td>Tracking and low density operations</td>
<td>Urban environments, higher density</td>
</tr>
<tr>
<td>Sparsely populated areas</td>
<td>Autonomous V2V, internet connected</td>
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<tr>
<td>Procedures and “rules-of-the road”</td>
<td>Large-scale contingencies mitigation</td>
</tr>
<tr>
<td>Longer range applications</td>
<td>News gathering, deliveries, personal use</td>
</tr>
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</table>

Each build is independent and deployable.
Multiple providers could offer some UTM services

Tailoring operational services based on geographical area needs

Vehicle performance could be different
Regulator has a key role in certifying UTM system and operations. All UTM systems must interoperate.

Consideration of Business Models

Single service provider: government entity
- Government/designated ANSP
- Each state may implement or delegate to counties/cities

Single service provider: a non-government entity
- Web services - General Aviation flight service station model
- Regional implementations by various companies - customized

Multiple service providers: state/local government entities

Multiple service providers: non-government entities

UTM POTENTIAL BUSINESS MODELS

General Aviation flight service station model
- Government/designated ANSP
- Each state may implement or delegate to counties/cities

Regional implementations by various companies - customized
- Web services - General Aviation flight service station model
- Government/designated ANSP
- Each state may implement or delegate to counties/cities
• Self-regulation: responsible, credible, collaborative
• National UAS Standardized Testing and Rating (NuSTAR)
• Parallel: Underwriter’s Laboratory, Consumer Reports, JD Powers, Which?
• Credible test bed and scenarios
  – Urban, rural, atmospheric conditions (e.g., fog, smog, rain)
  – Simulated pets
  – Failure modes
  – Sub-system level performance: engine/propulsion, networking, battery, sensor systems, software systems
  – Cyber-security
  – GPS denied conditions
• Support UAS manufacturers, consumers, FAA, insurance companies, and public at large through objective assessments
• Forensics analysis: Recreation of incidences and accidents
Progress

- Research Transition Team with FAA, DHS, and DoD
- 125+ industry and academia collaborators and increasing
- Initial UTM Concept of Operations: Industry, academia, and government
- Client interface is ready – **Partners can connect with UTM**
- **Build 1 tests** with 12 partners completed in August, next step is to roll out to FAA test sites for further validation
- **International interest**
Next Steps

- Roll out UTM Build 1 to FAA test sites for further validation
- Development, simulations, and testing of UTM Builds 2-4
- Safety analysis of BVLOS

- NASA will continue to work with industry, academia, and government groups
  - Refine operational requirements, system architecture(s), prototype, and conduct tests – Continue until safe airspace integration is proven!

- National initial safe UAS integration campaign: coordinated effort for data collection and demonstrations
  - Through FAA test sites and other approved locations

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