Unmanned Aerial Systems Traffic Management (UTM)

SAFELY ENABLING UAS OPERATIONS IN LOW-ALTITUDE AIRSPACE

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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
UTM Design Functionality: Cloud-based

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

**Digital, Virtual, & Flexible Risk-Based Approach and Service Infrastructure**

- 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

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**Multiple customers with differing mission needs**

**LINE-OF-SIGHT TO BEYOND LINE-OF-SIGHT: PILOTED TO AUTONOMOUS RANGE OF UAS EQUIPAGE AND DIVERSE MISSIONS**

- UAS 1
- UAS 2
- UAS 3
- Fleet

**UTM SERVICES**

- Tracking
  - ADS-B, cell, and satellite
  - Low-altitude radar/sensors at key locations (uncooperative)

- Authentication
- Airspace design and geofence definition
- Weather integration
- Constraint management
- Sequencing and spacing
- Trajectory changes
- Separation management
- Contingency management

- Transition between UTM and ATM airspace
- Constraints: noise, sensitive areas, privacy, etc.
- 3D maps: terrain and human-made structures

**Real-time Weather & Wind**

**Weather & Wind Predictions**

**Airspace Constraints**

**Other Low-altitude 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
### BUILD 1 (AUGUST 2015)
- Reservation of airspace volume
- Over unpopulated land or water
- Minimal general aviation traffic in area
- Contingencies handled by UAS pilot
- Enable agriculture, firefighting, infrastructure monitoring

### BUILD 2 (OCTOBER 2016)
- Beyond visual line-of-sight
- Tracking and low density operations
- Sparsely populated areas
- Procedures and “rules-of-the road”
- Longer range applications

### BUILD 3 (JANUARY 2018)
- Beyond visual line-of-sight
- Over moderately populated land
- Some interaction with manned aircraft
- Tracking, V2V, V2UTM and internet connected
- Public safety, limited package delivery

### BUILD 4 (MARCH 2019)
- Beyond visual line-of-sight
- *Urban environments, higher density*
- Autonomous V2V, internet connected
- Large-scale contingencies mitigation
- News gathering, deliveries, personal use

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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
Consideration of Business Models

Regulator has a key role in certifying UTM system and operations. All UTM systems must interoperate.

Single service provider: government entity
- Traditional ANSP, like the FAA
- 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
- General Aviation flight service station model
- Each state may implement or delegate to counties/cities

UTM POTENTIAL BUSINESS MODELS
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 allows to connect partners to the UTM
- **Build 1 tests** with 12 partners were successfully completed – data is being analyzed
  - Included NASA and partner vehicles, ADS-B, cell-based communications, and low-altitude radar for non-cooperative targets
  - Data: Trajectory conformance accuracy, geo-fencing conformance reliability, UTM usability
- International interest
• NASA and FAA will work together to institute RTCA committee
• Terms of reference are being finalized
• Close coordination between NASA and FAA will be maintained for one government voice for move forward strategy
• UTM construct may be adapted based on FAA and industry inputs, as well as UTM field tests
Next Steps

• UTM Build 1 testing in August
• Development, simulations, and testing of UTM Builds 2-4
• Safety analysis

• 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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