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
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
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
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
Each build is independent and deployable

**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
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.
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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