Safely Enabling Low-Altitude UAS Operations: Unmanned Aircraft System Traffic Management

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Innovate Relentlessly

Embracing innovation while respecting aviation’s safety tradition
Unmanned Aircraft Systems Applications
Where were we?

- Lack of rule
- Gaps in concepts for expanded multiple operations
- Lack of understanding in roles/responsibilities
- Lack of requirements for safe and scalable expanded operations
- Lack of requirements for scale and scalable urban operations

Overall interest in moving forward
Where are we now?

- Part 107 operational
- Pathfinders in action
- UTM concept of operations accepted
- UTM roles/responsibilities accepted
- UTM tests show promise
- Research underway for urban operations

FAA has shown agility and NASA focused research
What’s coming next?

• By 2020, 7M total and 2.6M commercial small UAS

• Urban and suburban personal air mobility operations

• UAS everywhere: in class A, B, C, D, E, and G airspace

• High altitude airspace operations (60,000 ft. and up)

• Commercial space operations

Characterizing uncontrolled and controlled operations
CAPABILITY 1: SHOWN HOW TO ENABLE MULTIPLE OPERATIONS UNDER CONSTRAINTS
- Notification of area of operation
- Over unpopulated land or water
- Minimal general aviation traffic in area
- Contingencies handled by UAS pilot
- Enable agriculture, firefighting, infrastructure monitoring

CAPABILITY 2: SHOWN HOW TO ENABLE EXPANDED MULTIPLE OPERATIONS
- Beyond visual line-of-sight
- Tracking and low density operations
- Sparsely populated areas
- Procedures and “rules-of-the road”
- Longer range applications

CAPABILITY 3: FOCUSES ON HOW TO ENABLE MULTIPLE HETEROGENEOUS OPERATIONS
- Beyond visual line of sight/expanded
- Over moderately populated land
- Some interaction with manned aircraft
- Tracking, V2V, V2UTM and internet connected
- Public safety, limited package delivery

CAPABILITY 4: FOCUSES ON ENABLING URBAN OPERATIONS
- Beyond visual line of sight
- Urban environments, higher density
- Autonomous V2V, internet connected
- Large-scale contingencies mitigation
- News gathering, deliveries, personal use

Each capability is targeted to type of application, geographical area and uses risk-based approach
Critical Technology Enablers

Earl Lawrence, Presented at Drone Advisory Committee

Increasing Operational Risk, Complexity & Cost Drivers

Commercial Small UAS, VLOS (Part 107 and Ops over People Rule)

BVLOS / Extended Operations (Part 107.xx)

Pathfinder 2 EVLOS

Pathfinder 3 BVLOS

Ground Based Sense & Avoid

Low Altitude Automation and Scheduling (UTM)

Geo-fencing Technologies

Dynamic Spectrum Allocations for Command & Control

Terminal Flight Data Manager

NAS System Integration (CNS)

Airborne Detect & Avoid

Registration Website

Online Airspace Authorization

Automated Airspace Notification & Authorization Tools

Hobbyist, VLOS (Part 101-E)

Pathfinder 1 VLOS Over People

Integrated (Part xx)

Sectors Framework

Hobbyist

Commercial VLOS

Commercial BVLOS

Integrated

Public

Federal Aviation Administration

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UTM Progress

• Concept of operations
• Roles/responsibilities – implications on who pays
• Information architecture paved way for FAA’s RFI
• Demonstrated initial feasibility of architecture, application protocol interface based approach, and overall construct
• Data exchange and protocols
• Demonstration of UTM TCL1 with all 6 test sites
• Initial demonstration of UTM TCL2 for BVLOS requirements
UTM Architecture

NAS Data Sources → Flight Information Management System

National Airspace System

Common data

Supplemental Data Service Provider

UAS Service Provider

Terrain Weather Surveillance Performance

Inter-USS communication and coordination

Inter-data provider communication and coordination

NAS impacts

NAS state

UAS Operator

UAS

Public Safety

Public

Operations, Constraints, Directives

Requests, Decisions

Operations, Deviations

Constraints, Directives

Requests, Decisions

Operations, Deviations

Operation requests Real-time information

Operations, Constraints, Modifications

Notifications Information

UAS Operator

UAS

Other Stakeholders

ANSP Function

Operator Function

Color Key:

Public Safety

Public

UAS Operator

UAS

NAS Data Sources

UAS Operator

UAS

UAS Operator

UAS
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Embracing innovation *while* respecting aviation’s safety tradition

| Excited | Nervous | Frustrated | Excited | Heads down (to beaver) | Close to impact |
Stages of Traffic Management: Balancing safety, efficiency, and scalability

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• Disruptions, off-nominals and contingencies
  – Weather and wind effects, and need for better predictions
  – Priority access: Clearing airspace based on dynamic conditions
  – Lost/delayed communications
  – Vehicle malfunctions
  – Rogue operation and its influence on other operations
  – Cyber security
  – Lack of availability of GPS and degraded conditions
Safety of Operations

UTM TCL2 Drone Operations Area

Ground Control Stations

GA Aircraft Track

Primary Radar (LSTAR)

Reno-Stead Airstrip
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National UAS Standardized Testing and Rating (NUSTAR)

| Excited | Nervous | Frustrated | Excited | Heads down | Close to impact |
• Performance data is critical to safety and acceptance
• Underwriter’s laboratory for UAS
  – Weather conditions: wind, icing, fog, rain
  – Security: Spoofing, hacking, and interference
  – Noise
  – Detect and avoid tests under variety of conditions
  – Failure modes
  – Drop tests
  – Sub-system level performance (e.g., battery, propulsion)
  – Conformance to geo-fence
• Users: Insurance, regulators, manufacturers, consumers, researchers
• Forensics testing and recreation of accidents

Performance data is needed
UTM Next Steps

- Exercises with all FAA test sites for expanded/BVLOS operations
- Working groups: active collaboration
  - Concept of operations and use cases, Data exchange, Detect and avoid, Communication and navigation, and Performance
  - Spectrum and Weather
- Airspace research: Architecture, high density and constraints, airspace configurations, demand/capacity balance, communication and navigation, and contingencies
- Vehicle research: geo-fence conformance, DAA, track and locate, hazard avoidance, trajectory uncertainty, and last/first 50 feet operations
- Air/ground capabilities: Towards complex and heterogeneous operations

Culminate in joint FAA-NASA UTM pilot project
Expanding Vision

• Airspace categories: services provided and not provided by ANSP
• Ensure UTM success and deliver
• Personal air mobility – uncontrolled airspace and/or uncontrolled operation
• High altitude UTM construct for airspace operations
• Ultra high altitude construct for space traffic management
• Interest where services could be provided to improve current operations

UTM type paradigm appears to be expandable to other airspace
Beaver is a keystone species: UTM has potential to do so!
Beavers - beavering - to beaver!
Thank you for your contributions!