Unmanned Aircraft System Traffic Management (UTM)

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Low-Altitude UAS Operations

FAA Small UAS forecast – 2.8M total, 450k commercial by 2022

Vehicles are automated and airspace integration is necessary

New entrants desire access and flexibility for operations

Current users want to ensure safety and continued access

Regulators need a way to put safety structures in airspace

Operational concept being developed to address beyond-visual-line-of-sight (BVLOS) UAS operations at low altitude in uncontrolled airspace using UTM construct
Challenges with Expanding Operations

Visual Line of Sight
14 CFR Part 101(e) [Hobbyists]
14 CFR Part 107 [Commercial]

- No Operations over People
- Daylight Only
- Up to 400 ft. AGL
- Operation in controlled airspace allowed

Beyond Visual Line of Sight

- Operations Near Airports
- Command and Control
- Aircraft Performance
- Tracking and UAS Identification
- Separation
- Weather
- Awareness
- Operations over People
What is UAS Traffic Management?

UTM is an “air traffic management” ecosystem for uncontrolled airspace

UTM utilizes industry’s ability to supply services under FAA’s regulatory authority where these services do not exist

UTM development will ultimately identify services, roles/responsibilities, information architecture, data exchange protocols, software functions, infrastructure, and performance requirements to enable the management of low-altitude uncontrolled UAS operations

UTM addresses critical gaps associated with lack of support for UAS operations in uncontrolled airspace
Flight Information Management System
- Enables airspace controls
- Facilitates requests
- Supports response in emergencies impacting NAS

UAS Service Supplier
- Federated Structure
- Cloud-based system
- Automated System
- Supports UAS with services (e.g. separation, weather, flight planning, contingency management, etc.)

Supplemental Data Service Provider
- Supplies supplemental data to USS and UAS Operator to support operations

UAS / UAS Operator
- Individual Operator
- Fleet Management
- On-board capabilities to support safe operations
## UTM Principles and Services

**Principles**
- Only authenticated UAS operations allowed
- UAS stay clear of each other
- UAS and manned aircraft stay clear of each other
- UAS operator has awareness of airspace and other constraints
- Public safety UAS have priority over other UAS

**Key UAS-related services**
- Authorization/Authentication
- Airspace configuration and static and dynamic geo-fence definitions
- Track and locate
- Communications and control (spectrum)
- Weather and wind prediction and sensing
- Conflict avoidance (e.g., airspace notification)
- Demand/capacity management
- Large-scale contingency management (e.g., GPS or cell outage)
Technical Capability Level (TCL) Progression

TCL1: *multiple VLOS*
- Networked Operations
- Info sharing

TCL2: *multiple BVLOS, rural*
- Initial BVLOS
- Intent sharing
- Separation by geo-fencing

TCL3: *multiple BVLOS, near airports, suburban*
- Routine BVLOS
- Detect and Avoid (DAA) / Vehicle to Vehicle (V2V)
- Avoid static obstacles

TCL4: *complex urban BVLOS*
- BVLOS to doorstep
- Track and locate
- Avoiding dynamic obstacles
- Large scale contingencies
Technical Capability Level 2 Flight Test

Evaluate the feasibility of multiple BVLOS operations using a UTM research platform
Flight Test Overview

Operational Area

Reno-Stead Airport

UAS Range
Elevation: 5050 feet
Desert Terrain
Missions up to 500 ft
Operations at 5 Locations

SRHawk Radar
Weather Equipment
LSTAR Radar

Nevada UAS Test Range

October 2016
TCL 2 UTM Functionality

- Scheduling and Planning
- Tracking
- Contingency Management

UTM Mobile Application

- Conflict Alerts
- Intruder Alerts
- Contingency Alerts
- Flight Conformance Alerts
- Priority Operations
Flight Test Highlights

Situation Awareness Displays
Critical alerts, operational plan information and map displays

Altitude Stratified Operations

Live-Virtual Constructive Environment

BVLOS

Visual Line of Sight

Simultaneous Operations

2 + 3 = 5

Flights
74

UAS Vehicles
11

Partnerships
14

Days of Flight
5

Scenarios
4

Minutes per scenario
30
TCL 2 Flight Test Lessons Learned
Inconsistent Altitude Reporting

Increased risk of controlled flight into terrain and airborne collision hazard

Altitude reporting should be consistent or translatable across airspace users
Weather Impact on UAS

Nominal Aircraft Endurance
- Multi-Rotors: 20-40 minutes
- Fixed-Wing: 45-200+ minutes
- Reno-Stead Elevation: 5,050 ft

Cool Temperatures
- Density Altitude: 4,000 ft
- Winds: 5-35 knots
- Aircraft encountered thermals, microbursts and high winds which resulted in reduced endurance and degraded flight plan conformance

Warm Temperatures
- Density Altitude: 9,000+ ft
- Winds: 5-15 knots
- Aircraft experienced substantially shorter endurance

UAS should be tested and rated against different operational environments
Operators should display airspace information and have access to other operator’s operational intent and contingency actions in off-nominal conditions.

Altitude reporting should be standardized and consistent/translateable to current airspace users.

In the absence of acceptable weather products, atmospheric conditions should be self-reported from GCS and UAS.

Initial BVLOS should avoid altitude stratification, until improved position sharing (e.g. V2V) and weather products.

Flight trajectories should be contained within geo-fence boundaries that are shared with the UTM research platform to support separation.
TCL 2 National Campaign

May 15th – June 9th 2017

- ~40 partners total across 6 testing locations
- 6 USS Implementers (Amazon Prime Air, Google Project Wing, Airmap, Simulyze, ANRA, NASA)
- NASA USS and FIMS run in the cloud
- Data feeds monitored in UTM lab and at each location
- Multiple Media days

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<tr>
<th>Test Sites</th>
<th>USS Technology</th>
<th>Geofence Technology</th>
<th>Ground-based Sense &amp; Avoid</th>
<th>Airborne Sense &amp; Avoid</th>
<th>Communication, Navigation, Surveillance</th>
<th>Human Factors</th>
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Multiple BVLOS operations near airports and suburban areas (TCL 3)
Augmented Navigation

Vehicle-to-Vehicle Communication

Direct C2

DSRC

FIMS

Inter-USS Communication

USS 1

USS 2

Distributed C2

4G LTE

Obstacle Avoidance

Detect and Avoid

Airborne Radar

Ground Radar

USS 1

USS 2

Inter-USS Communication

FIMS

Augmented Navigation

Vehicle-to-Vehicle Communication

Direct C2

DSRC

Distributed C2

4G LTE

Obstacle Avoidance

Detect and Avoid

Airborne Radar

Ground Radar
UAS Traffic Management is an automated cloud-based “air traffic management” ecosystem for uncontrolled airspace where services do not exist.

TCL 2 Demonstration and TCL 2 National Campaign successfully showed the feasibility of supporting multiple BVLOS operations in a rural environment, engaged industry to contribute to the development of UTM and highlighted areas of future research.

Next Steps will evaluate the effectiveness and interoperability of technologies to support separation, communication, navigation, data-exchange, and airspace management in more complex operational environments (suburban and urban).
Thank You