Unmanned Aircraft System Traffic Management (UTM) Project

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Topics

• What is UTM?
• Progress to Date
• What’s Next
• Partnering
• Summary
Why is UTM Needed?

- FAA small UAS forecast – 7 million total, 2.6 million commercial by 2020
  - Many use cases: package delivery, news collection, precision agriculture, infrastructure inspections, public safety, disaster response, etc.
- New entrants desire access and flexibility for operations
- Current users want to ensure safety and continued access
- Regulators need a way to put structure as needed
  - Current approach for air traffic control of manned aircraft won’t scale up for small UAS operations
  - Need to assure safe integration into the National Airspace
What is UTM?

- 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 enable the management of large scale, low-altitude UAS operations
  - Operational concept will address beyond visual line of sight UAS operations under 400 ft. AGL, Class G airspace
  - Roles/responsibilities of FAA and operators
  - Information architecture, data exchange protocols, software functions
  - Performance requirements
UTM Principles (Things That UTM Will Help With)

VS

Hello
my name is
4444-8888-FEEDDEADBEEF

banana

banana

VS

Hello
my name is
?

banana

cat

apples
Key Operational Assumptions

- FAA maintains regulatory AND operational authority for airspace and traffic operations
- UTM is used by FAA to issue directives, constraints, and airspace configurations
- Air traffic controllers are not required to actively “control” every UAS in uncontrolled airspace or uncontrolled operations inside controlled airspace
- FAA has on-demand access to airspace users and can maintain situation awareness through UTM
- UTM roles/responsibilities: Regulator, UAS Operator, and UAS Service Supplier (USS)
- FAA Air Traffic can institute operational constraints for safety reasons anytime

Key principle is safely integrate UAS in uncontrolled airspace without burdening current ATM
UTM Architecture

NAS Data Sources
National Airspace System

Flight Information Management System

Supplemental Data Service Provider
Inter-data provider communication and coordination

Constraints, Directives
Requests, Decisions
Operations, Deviations

Public Safety
Public

UAS Service Supplier
Operations Requests, Real-time Information
Operation Constraints, Modifications, Notifications

V2V Comm.
UAS
UAS
UAS

Other Stakeholders
Operator Function
ANSF Function
Other Stakeholders

Shared or TBD responsibilities
Discovery Registration Data/Services Authentication/Authorization

FAA Development & Deployment
Industry Development & Deployment

Terrain
Weather
Surveillance
Performance

Inter-USS communication and coordination

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UTM Project and Its Impact

Research Activities
- Research Transition
  - Team Working Groups
  - Concepts and Use Cases
  - Data and Information Exchange
  - Sense and Avoid
  - Communications and Navigation
- Concept and Software Development
  - Flight Information Management System
  - UAS Service Supplier
  - Supplemental Data Service Providers
  - UAS Operator Client
  - Public Portal
- Field Testing and Technology Evaluation
  - TCL Field Demonstrations
  - Targeted Technology Evaluations
- Simulation and Risk Analysis
  - Real-time and Fast-time Studies
  - Hazard Analysis.

Products
- Software Prototypes
  - FIMS Prototype
  - NASA UAS Service Supplier (USS)
  - USS Discovery Service
  - UAS Operator Client
  - Authentication/Authorization Service
- ICDs and APIs
  - USS-FIMS Specification
  - USS-USS Specification
  - Weather and Surveillance SDSP ICD
  - V2V Communication Specification
- Concept Documents
  - UTM CONOPS and Use Cases
  - USS Onboarding Process
  - Communication and Navigation Model
  - UTM Conflict Mitigation Model
  - Hazard Identification and Analysis
- Reference Technology Implementations
  - UAS Detect and Avoid System
  - Urban Operations UAS System

Outcomes
- Fielded Systems
  - FAA LAANC uses UTM concept
  - FAA to use UTM in their Pilot Program (UPP) demonstration in FY2019
  - DoT/FAA expected to use UTM system for the Integrated Pilot Program (IPP)
- UAS Rule Making
  - Beyond Part 107 (BVLOS)
  - FIMS/USS Roles and Responsibilities
- Industry Guidance
  - Safety Case Development
  - Data Exchange and Protocols
  - Industry Standards
- International Harmonization
  - UTM Construct and Architecture (e.g. ICAO)
  - Use Cases (e.g. JAXA Disaster Relief)
### NASA/FAA Research Transition Team

**Purpose**
- The RTT provides the forum for NASA researchers and FAA implementers to collaborate on UTM system and operational concepts and effectively transfer the project results.

**Four Working Groups**
- Concepts and Use Cases
- Data Exchange and Architecture
- Sense and Avoid
- Communication and Navigation

### Key RTT Deliverables (FAA needs)
- Tech transfer - to FAA and industry
  - Concepts and requirements for data exchange and architecture, communication/navigation and detect/sense and avoid
  - Cloud-based architecture and ConOps
  - Multiple, coordinated UAS BVLOS operations
  - Multiple BVLOS UAS and manned operations
  - Multiple operations in urban airspace
- Tech transfer to FAA
  - Flight Information Management System prototype (software prototype, application protocol interface description, algorithms, functional requirements)

### FAA-NASA Key RTT Deliverable
- Joint FAA-NASA UTM Pilot Program

RTT will culminate into key technical transfers to FAA and joint pilot program plan and execution.
UTM Development and Implementation

Tech transfers to the FAA support:
- NextGen
- UAS Integration Office
- Flight Standards
- Aircraft Cert. Service
- And others
Technical Capability Levels (TCL)

Risk-based development and test approach along four distinct TCL

<table>
<thead>
<tr>
<th>TCL1</th>
<th>TCL 2</th>
<th>TCL 3</th>
<th>TCL 4</th>
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<tbody>
<tr>
<td>Low Traffic Density</td>
<td>Low-Mod Traffic Density</td>
<td>Moderate Traffic Density</td>
<td>High Traffic Density</td>
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<tr>
<td>Rural Applications</td>
<td>Rural / Industrial Applications</td>
<td>Suburban Applications</td>
<td>Urban Applications</td>
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<tr>
<td>Multiple VLOS Operations</td>
<td>Multiple BVLOS Operations</td>
<td>Mixed Operations</td>
<td>Dense BVLOS Operations</td>
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<td>Notification-based Operations</td>
<td>Tracking and Operational Procedures</td>
<td>Vehicle to Vehicle Communication</td>
<td>Large Scale Contingency Management</td>
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TCL 1, 2 and 3 (in progress)

Nat’l Campaign 1: May 2016

TCL 1 demo: August 2015

Nat’l Campaign 2: May 2017

TCL 2 demo: Oct 2016

Nat’l Campaign 2: May 2017

Participating Orgs

<table>
<thead>
<tr>
<th>TCL 1</th>
<th>TCL 2</th>
<th>TCL 3</th>
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<tbody>
<tr>
<td>19</td>
<td>42</td>
<td>35</td>
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TCL3 UAS towards controlled airspace

TCL3 First Responders

TCL 3 March 2018
TCL 3 Flight Test Highlights

Test Types

- 3 Comm & Nav
  - 12 Unique Tests
- 6 Sense & Avoid
  - 10 Unique Tests
- 6 Data & Arch.
  - 21 Unique Tests
- 5 Concepts
  - 17 Unique Tests

Organizations

- 35 Operators
- 8 USS
- 5 Management
- 8 Sensor/surveillance/connectivity

UAS Vehicles

- 32 UAS Vehicles
  - 12 Fixed Wing
  - 15 Multirotor
  - 3 Hybrid
  - 2 Helicopter

Flight window

- March 6 – May 25

Unique Use Cases

- 11 Unique Use Cases
  - Package Delivery
  - Infrastructure Inspection
  - Aerial Photography
  - ....

Unique Tests

- 11 Unique Tests
  - 14 Operators
  - 21 Unique Tests
  - 17 Unique Tests
  - 5 Management
  - 8 Sensor/surveillance/connectivity
  - 12 Fixed Wing
  - 15 Multirotor
  - 3 Hybrid
  - 2 Helicopter

Unique Tests

- 6 FAA UAS Test Sites
- 11 Ranges
- 12 Fixed Wing
- 15 Multirotor
- 3 Hybrid
- 2 Helicopter

Unique Tests

- 13

Unique Tests

- 10 Unique Tests
- 21 Unique Tests
- 17 Unique Tests
- 14 Operators
- 8 USS
- 5 Management
- 8 Sensor/surveillance/connectivity
Technical Capability Level 3 Flight Tests

Augmented Navigation

Vehicle-to-Vehicle Communication

Inter-USS Communication

FIMS

Obstacle Avoidance

Detect and Avoid

Airborne Radar

Ground Radar

Direct C2

DSRC

Distributed C2

4G LTE
Upcoming TCL 4 Testing, Complex Urban Environments

- Key research areas
  - High density BVLOS operations
  - Large scale contingency management
  - USS/USS contingency procedures
  - Public safety data exchange and security
  - Obstacle avoidance
  - Off nominal separation
  - Distributed and degraded communications
  - GPS-denied environment
  - Supplemental Data Service Providers: weather, urban maps, risk modeling, etc.
UTM Partnering

• From project inception partnering has been a priority
• Very close collaboration with FAA and industry through RTT working groups which have approximately 40 partner organizations participating
• Many additional UTM partners in industry, government and academia with space act or other types of agreements
• FAA UAS test sites used for TCL 1-3 testing
• Each site collaborates with NASA partners and others
Opportunities

• Participate in TCL 4 testing – information later this year
  – Sense and avoid, communication and navigation, vehicle and ground technologies

• RTT Working Groups
  – Engage in discussions, studies

• FAA/NASA UTM Pilot Program
  – Upcoming solicitation to FAA Test Sites opportunity to participate in UPP

• Respond to the NASA Request for Information to introduce your capabilities
  – [Link](https://www.fbo.gov/index?s=opportunity&mode=form&id=34469d19af9f5745ea2cb4bf2e0145eb&tab=core&_cview=0)
  – Potential partnerships may result in Non Reimbursable Space Act Agreements
**Summary**

- **UTM is successfully developing the framework** for large scale, small UAS traffic management. See UTM website for publications: https://utm.arc.nasa.gov/documents
- **NASA and the FAA are closely collaborating** to ensure appropriate regulatory and operational requirements are included and that technology transfers support the development of future operational systems
- **TCL Demonstrations include many testing organizations, industry, and academia partners** that are crucial to validating requirements and investigating technology solutions
- **Next up TCL 4** will evaluate the effectiveness and interoperability of technologies to support separation, communication, navigation, data-exchange, and airspace management in more complex operational urban environments