Flight Demonstration of Unmanned Aircraft System (UAS) Traffic Management (UTM) at Technical Capability Level 3

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Presentation Outline

● Background

● UAS Traffic Management (UTM) Design

● High-Level Purpose of Technical Capability Level (TCL) 3 Demonstration

● TCL3 Flight Demonstration Highlights

● Summary
Background

- Millions of small Unmanned Aircraft Systems (UAS) to fly in U.S. airspace
- UAS Traffic Management (UTM): air traffic management ecosystem for small UAS in low altitude
- Other countries using the UTM architecture to integrate UAS
Technical Capability Levels (TCL) Progression for System Development and Testing

<table>
<thead>
<tr>
<th>TCL1</th>
<th>TCL2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remote Population</td>
<td>Sparse Population</td>
</tr>
<tr>
<td>Low Traffic Density</td>
<td>Low-Mod Traffic Density</td>
</tr>
<tr>
<td>Rural Applications</td>
<td>Rural / Industrial Applications</td>
</tr>
<tr>
<td>Multiple Visual Line of Sight (VLOS) Operations</td>
<td>Multiple Beyond Visual Line of Sight (BVLOS) Operations</td>
</tr>
<tr>
<td>Notification-based</td>
<td>Completed 2015</td>
</tr>
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<td></td>
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<td>Public Safety Operations</td>
</tr>
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**Completed Dates:**
- TCL1: 2015
- TCL2: 2017
- TCL3: 2018
Technical Capability Levels (TCL) Progression for System Development and Testing

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<th>TCL4</th>
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<td>Dense BVLOS Operations</td>
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<tr>
<td>Notification-based</td>
<td></td>
<td>Public Safety Operations</td>
<td>Large Scale Contingency Management</td>
</tr>
</tbody>
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- TCL1 Completed 2015
- TCL2 Completed 2017
- TCL3 Completed 2018
- TCL4 2019
UTM Service-Based Architecture

UTM Architecture

FAA Development & Deployment

Supplemental Data Service Provider

Industry Development & Deployment

NAS Data Sources

National Airspace System

Flight Information Management System

Constraints, Directives

Requests, Decisions

Operations, Deviations

Inter-data provider communication and coordination

Inter-USS communication and coordination

Terrain Weather Surveillance Performance

Public Safety

Public

UAS Service Supplier

Operations, Constraints

Notifications, Information

Operation requests Real-time information

Operations Modifications Notifications Information

UAS Operator

UAS Operator

UAS Operator

UAS Operator

V2V Comm.

UAS

UAS

UAS

Shared responsibilities

Discovery

Registration Data/Services

Authentication/Authorization

COLOR KEY:

FAA Function

Operator Function

Other Stakeholders
UTM Architecture

UTM Service-Based Architecture

National Airspace System (NAS)

Flight Information Management Service (FIMS)

FAA Development & Deployment

Supplemental Data Service Provider

Industry Development & Deployment

UAS Service Suppliers (USS)

UAS Operators

COLOR KEY:
FAA Function
Operator Function
Other Stakeholders

Shared responsibilities
Discovery Registration Data/Services Authentication/Authorization

Public Safety
Public
TCL3 Flight Demonstration
High-Level Purpose of TCL3 Demonstration

Demonstrate, evaluate, and refine the functional designs, technology prototypes, and UTM Concepts of Operation

- Across a wide range of operating locations
- With a wide range of UAS platforms and USS implementations
- Utilizing service based architecture
  - Operator-USS
  - USS-USS
  - USS-FIMS
High-Level Purpose of TCL3 Demonstration

- Accelerate UAS stakeholder development of UTM components

- Objectives pertinent to the work of the NASA-FAA Research Transition Team (RTT) Working Groups
  - Communication and Navigation (C&N)
  - Sense and Avoid (SAA)
  - Data and Information Exchange (DAT)
  - Concept Use Cases (CON)
Technology for TCL3 Demonstration

*DSRC- Dedicated short range communication
*C2- Command and Control
Flight Demonstration Highlights

- 6 FAA UAS Test Sites
- 7 Ranges
- Flight Window
  - March 6 – May 30, 2018
- Participating Entities
  - 30
- UAS Vehicles
  - 31
- Test Types
  - 4
  - C&N
  - SAA
  - DAT
  - CON
- 10 Unique Use Cases
FAA Test Sites and Demonstration Schedule

March - April, 2018
CNS, DAT, CON

March - May, 2018
CNS, DAT, CON

March - May, 2018
DAT, CON, SAA

March 2018
CNS, DAT

March - May, 2018
CNS, DAT, CON

March - May, 2018
DAT, CON, SAA

Selected UAS Test Site Operators
## Unique Range Characteristics

<table>
<thead>
<tr>
<th>Test Site</th>
<th>Capabilities</th>
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<tr>
<td><strong>Alaska</strong>- University of Alaska, Fairbanks (UAF)</td>
<td>- Limited GPS performance due high latitude.</td>
</tr>
<tr>
<td><strong>Nevada</strong>- Reno-Stead Airport</td>
<td>- Terrain includes obstacles to avoid in flight planning and that can enable BVLOS operations.</td>
</tr>
<tr>
<td><strong>New York</strong>- Griffiss International Airport</td>
<td>- UAS controlled from an indoor operations center allowing BVLOS and can takeoff from and return to a hangar.</td>
</tr>
<tr>
<td><strong>North Dakota</strong>- Camp Grafton North (CGN)</td>
<td>- Wide variety of environments to emulate suburban and rural environments and access to a lake for expanded operations.</td>
</tr>
<tr>
<td><strong>Texas</strong>- Port Mansfield, TX</td>
<td>- Test range extends over the Gulf of Mexico and can be used to explore overwater UA operations.</td>
</tr>
<tr>
<td><strong>Virginia</strong>- Kentland Farms and Virginia Smart Road</td>
<td>- Provides a full-scale, closed testbed research facility to explore integration of ground-based and airborne DSRC systems.</td>
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</table>
Participating Entities

- 30 Total Participants
  - 13 Operators
  - 8 USS
  - 5 Management
  - 8 Sensor/surveillance/connectivity
Use Cases

- Package delivery
- Infrastructure inspection
- Disaster response
- Coastal video survey
- Aerial photography
- Hotel surveillance & security
- Critical medical supply delivery to disaster sites & victims
- Contingency management (loiter, return to bases, land now, etc.) due to intruder aircraft and/or aircraft failure
- Aircraft leaving authorized airspace and flying into controlled airspace
- UTM Public Key Infrastructure (PKI) broadcast information to properly identified authorities
Data Flow Design

- Ground Control Station
- Vehicle/Operator Data
- Surveillance

UAS Service Provider

Data Management Plan

USS Data Collector

Human Factors Data
- field and remote observations
- participant interviews
- debrief discussions
- questionnaires
- off-nominal reports

Data Archive

Evaluation
Airspace Operations Lab Monitoring
Four Drones Flying Over Reno, NV, June 18, 2019
Summary

● Focused testing to address the joint FAA-NASA RTT’s four target research areas
  ○ Development and testing of systems that enable improved navigation, long-range communications, and sense and avoid capabilities
  ○ Testing of existing technologies to determine potential improvements
  ○ Development and testing of tools that provide increased situational awareness of the flight environment and air traffic
● Accelerated partner development of their USSs (8 including NASA prototype) to NASA specifications
● TCL3 Demonstration
  ○ Assisted in identifying gaps in the data model and interface between components of the UTM System
  ○ Assisted in refining the UTM Concept for specific technical capability levels and envisioned operational environment
  ○ Will assist in development of performance requirements and guidelines for SAA and C&N technologies and procedures