Innovate Relentlessly

Embracing innovation while respecting aviation’s safety tradition
Unmanned Aircraft Systems Applications

Embracing innovation
Small UAS Operations

- By 2020, 7M total and 2.6M commercial small UAS
- Air Navigation Service Providers: some airspace has services and others don’t
- Understanding Gap: How to enable small UAS operations in low altitude airspace
- Uncontrolled airspace (Class G) and uncontrolled operations inside controlled airspace
- Urban and suburban personal air mobility operations

Characterizing uncontrolled and controlled operations
UAM Research Technical Capability Level

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

**CAPABILITY 1: SHOWED 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: SHOWED 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
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 R&D continues to make good progress
UTM Architecture

National Airspace System

Supplemental Data Service Provider

UAS Service Provider

NAS Data Sources

Flight Information Management System

Inter-data provider communication and coordination

Terrain Weather Surveillance Performance

Inter-USS communication and coordination

NAS state

NAS impacts

Common data

Constraints, Directives, Requests, Decisions

Operations, Deviations

Operations, Constraints, Notifications, Information

Operation requests

Real-time information

UAS Data Sources

Public Safety

Public

ANSP Function

Operator Function

Other Stakeholders

Color Key:

UAS Operator

UAS

UAS

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Stages of Traffic Management: Balancing safety, efficiency, and scalability
UTM Key Lessons: Proving safety together

Beyond basics

- 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

Airspace operations requirements based on solid research
Safety of Operations

UTM TCL2
Drone Operations Area

Ground Control Stations

GA Aircraft Track

Primary Radar (LSTAR)

Reno-Stead Airstrip
APLU Contributions and Opportunities

• Business opportunities – innovation

• Airspace research:
  – Architecture
  – Trajectory uncertainty
  – Acceptance: noise, visual noise, privacy

• Vehicle research:
  – Geo-fence conformance,
  – Detect and avoid,
  – Track and locate,
  – Hazard avoidance,
  – Last/first 50 feet operations

• Air/ground capabilities: Towards complex and heterogeneous operations

Safest possible air/ground integrated system
Working with NASA

• UTM research platform available for further research and situation awareness for universities

• Participate in flight tests

• Research on broader aspects of autonomy
  – Airspace
  – Vehicle
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!