UTM for Wildland Fire Air Domain Awareness

TFRSAC Fall Meeting
11/03/2016
Overview

• Public Safety R&D Team
• NASA UTM – UAS < 500’
• SBIR – UTM for the Fireground
• CONOPS
• ADCOP Architecture & Development
• Next Steps
• Questions
UMEX & Vertex Geo
PS S&T/SBIR Team

Ed Freeborn, CTO
• 16 years PS Technical Assistance, incl. NLECTC-NE
• 30 years in Geospatial & Imaging Technology

Dave Prall, VP Spec Ops
• 20 year LEO, rtd; SGT Elko Cty SO, NHP
• PPL, Level 4 UMEX Qualified Pilot, 1000+ UAS hrs
• Certified – Aeryon Scout & SkyRanger, Altavian Nova F6500

Drew Jurkofsky, CKO
• 16 years Fort Collins Police
• 14 years Accident Reconstruction
• ACTAR Accreditation #1348
• Larimer Co. UAS Team (LCUAST)

Loveland Fire & Rescue Authority Training Facility
NASA UTM Goal
UAS Integration Below 500’

• Near-term Goal – Enable initial low-altitude airspace and UAS operations with demonstrated safety as early as possible, within 5 years
• Long-term Goal – Accommodate increased UAS operations with highest safety, efficiency, and capacity as much autonomously as possible (10-15 years)

NASA UAS Traffic Management (UTM)
• Integration into the NAS
• Incremental Development

USDA SBIR – Air Domain COP (ADCOP)
• Integration into the FTA
• Develop in Parallel w/ UTM
UTM Builds, or TCL

**UTM Builds:** Each build is independent and deployable

**BUILD 1 (AUGUST 2015)**
- Reservation of airspace volume
- Over unpopulated land or water
- Minimal general aviation traffic in area
- Contingencies handled by UAS pilot
- Enable agriculture, firefighting, infrastructure monitoring

**BUILD 2 (OCTOBER 2016)**
- Beyond visual line-of-sight
- Tracking and low density operations
- Sparsely populated areas
- Procedures and “rules-of-the road”
- Longer range applications

**BUILD 3 (JANUARY 2018)**
- Beyond visual line-of-sight
- Over moderately populated land
- Some interaction with manned aircraft
- Tracking, V2V, V2UTM and internet connected
- Public safety, limited package delivery

**BUILD 4 (MARCH 2019)**
- Beyond visual line-of-sight
- **Urban environments, higher density**
- Autonomous V2V, internet connected
- Large-scale contingencies mitigation
- News gathering, deliveries, personal use
UTM Functionality Goals

• Safe, low-altitude UAS Operation with cloud-based Services
  – Airspace management and geofencing
    • Allow only authenticated operations
  – Maintain safe separation
    • Including with Airspace Reservations made in UTM
  – Weather and severe wind integration
  – Predict and manage congestion
  – Terrain and man-made objects: database and avoidance
UTM for the Fireground: USDA SBIR

• Develop a proof-of-concept air domain common operating picture (ADCOP)
  – Based on UTM services in ArcGIS Environment
  – For a wildland fire CONOPS
  – Get feedback from practitioners
  – Look at integration with FAM tools, WFEA, etc.
  – Other needs? IAMS, Air Hazards, Symbology...

• Evaluate with
  – Multiple Aircraft
  – Automatic Dependent Surveillance – Broadcast/Universal Access Transceiver (ADS-B/UAT) Transponders
  – Aeryon SkyRanger GCS
Concept of Operations

• Mission
• Technology
• Organization
• Essential for tailoring new technology to user requirements in R&D
  – Contrast with requirements analysis for well understood tech
Wildland Fire
UAS CONOPS Elements

• Wildland Fire Missions
  – Situational Awareness – real time, near RT sensing
  – Decision Support – remote sensing, modeling
  – Comms Op/Interop
  – Forensics

• UAS Technology
  – Small UAS (SUAS) – VTOL, Hand launched FW
  – Tactical UAS (TUAS) – Catapult launch
  – Medium Altitude, Long Endurance (MALE) Pred/Reaper
Wildland Fire Organization
Initial Attack

The ‘belt’ problem
Wildland Fire Organization
Incident Command Structure

Can improved airspace coordination improve MALE & TUAS viability?
ADCOP Architecture and Development
The OGC (Open Geospatial Consortium) is an international not for profit organization committed to making quality open standards for the global geospatial community.

**WMS**

A Web Map Service (WMS) produces maps of spatially referenced data dynamically from geographic information. *A map is not the data itself.*

**WFS**

A Web Feature Service (WFS) provides data access and manipulation operations on geographic features directly as vector entities. *The Data!*
Data Capture Process Description:

- Flight data collected via WiFi connection to Ground Control Station.
- GCS is connected to UMEX UTM Server via mobile internet
- Mission Plan / Flight location coordinates are stored for archival purposes
  - Point feature class in PostGIS
  - Listener enables real time updates
- GeoServer publishes OGC WFS containing aircraft data
  - Ownship attributes with location
- UMEX Location Tracker publishes required content to NASA UTM server
- NASA UTM publishes other relevant airspace information
Information Use Description:

- Flight data capture using UMEX UTM client.
- Operations Dashboard application (Desktop / Web / Mobile interface) consumes asset WFS and displays as “bouncing blue ball” on basemap for real time display.
  - Timestamps recorded for each location to support post mission playback
  - Flight location coordinates (archived copy) remains on UTM server for post mission analysis using ArcGIS Desktop.
Next Steps / Considerations

• Supplementing ADS-B Information
• Mobile UTM (Private LAN)
• Develop CONOPS
• NASA UTM TCL3
• Operational Evaluations with Wildland Fire Community (Any takers?)
• Integration with Wildland Fire Enterprise Architecture (IRWIN)
Questions?

UMEX
Telephone: 1 303 398 7056
Fax: 1 334 460 8111
operations@unmannedexperts.com
www.unmannedexperts.com
How Does ADS-B Work?

The aircraft get their position from the GNSS constellation.

Then they simultaneously broadcast their position and other data to any aircraft, or ground station equipped to receive it.

Ground Stations then transmit the aircraft’s position to Air Traffic Control.

Automatic Dependent Surveillance - Broadcast
**UTM Design Functionality**

- Cloud-based architecture
- UAS operations will be safer if a UTM system is available to support the functions associated with:
  - Airspace management and geo-fencing
  - Weather and severe wind integration
  - Predict and manage congestion
  - Terrain and man-made objects database and avoidance
  - Maintain safe separation
  - Allow only authenticated operations

---

**High-Level UTM Services**

<table>
<thead>
<tr>
<th>Security Services:</th>
<th>Information Services:</th>
</tr>
</thead>
<tbody>
<tr>
<td>- System Health Monitoring</td>
<td>- Airspace Definition</td>
</tr>
<tr>
<td>- Vehicle Registration</td>
<td>- Weather Information</td>
</tr>
<tr>
<td>- User Authentication</td>
<td>- Terrain and Obstructions</td>
</tr>
<tr>
<td>- Flight Monitoring</td>
<td>- Traffic Operations</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Flight Services:</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Flight Planning</td>
</tr>
<tr>
<td>- Scheduling and Demand Management</td>
</tr>
<tr>
<td>- Separation Assurance</td>
</tr>
<tr>
<td>- Contingency Management</td>
</tr>
</tbody>
</table>