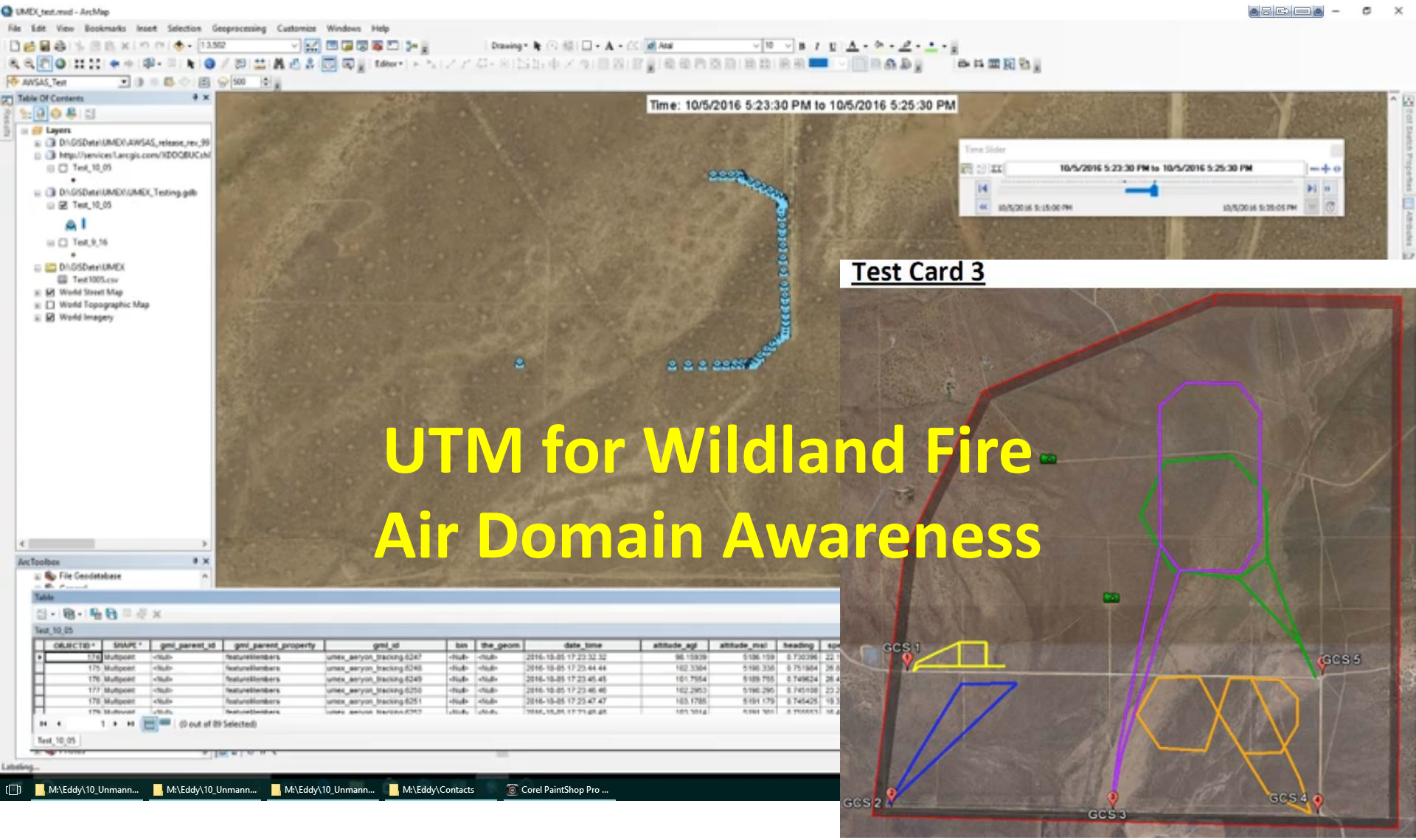


UTM for Wildland Fire
Air Domain Awareness

UNMANNED EXPERTS

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

Drew Jurkofsky, CKO

- 16 years Fort Collins Police
- 14 years Accident Reconstruction
- ACTAR Accreditation #1348

Vertex Geospatial Inc.

Dave Prall, VP Spec Ops

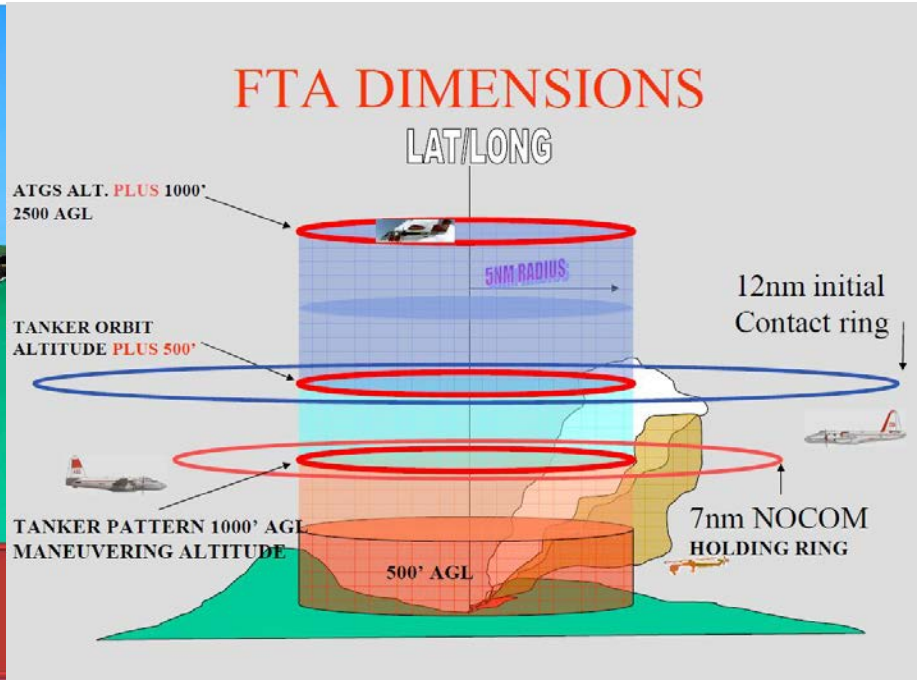
- 20 year LEO, rtd; SGT Elko Cty SO, NHP
- PPL, Level 4 UMEX Qualified Pilot, 1000+ UAS hrs
- Certified – Aeryon Scout & SkyRanger, Altavian Nova F6500

Research Testbed

- Larimer Co. UAS Team (LCUAST)

  Loveland Fire & Rescue Authority Training Facility

NASA UTM Goal
UAS Integration Below 500’



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

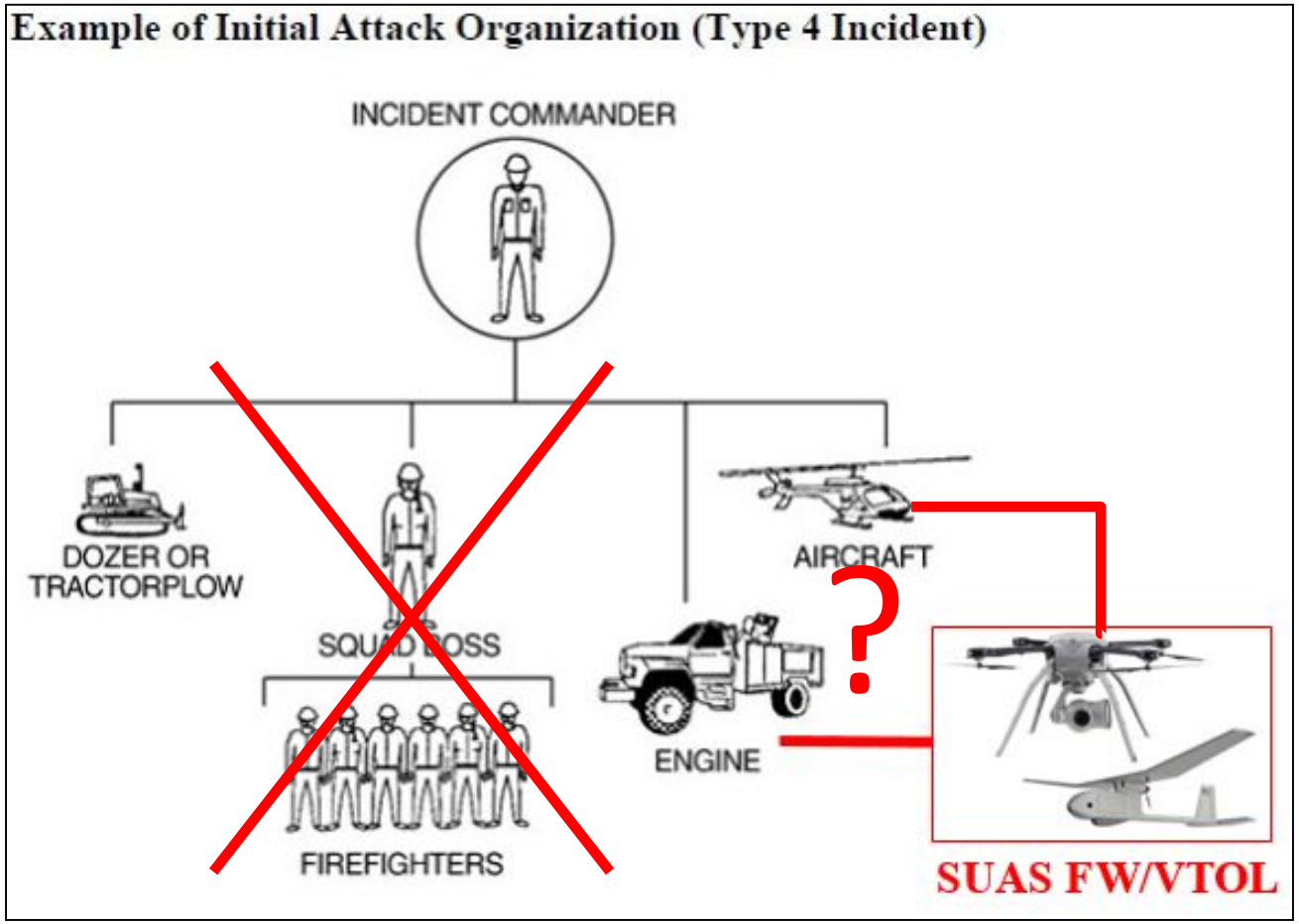
Concept of Operations

- 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

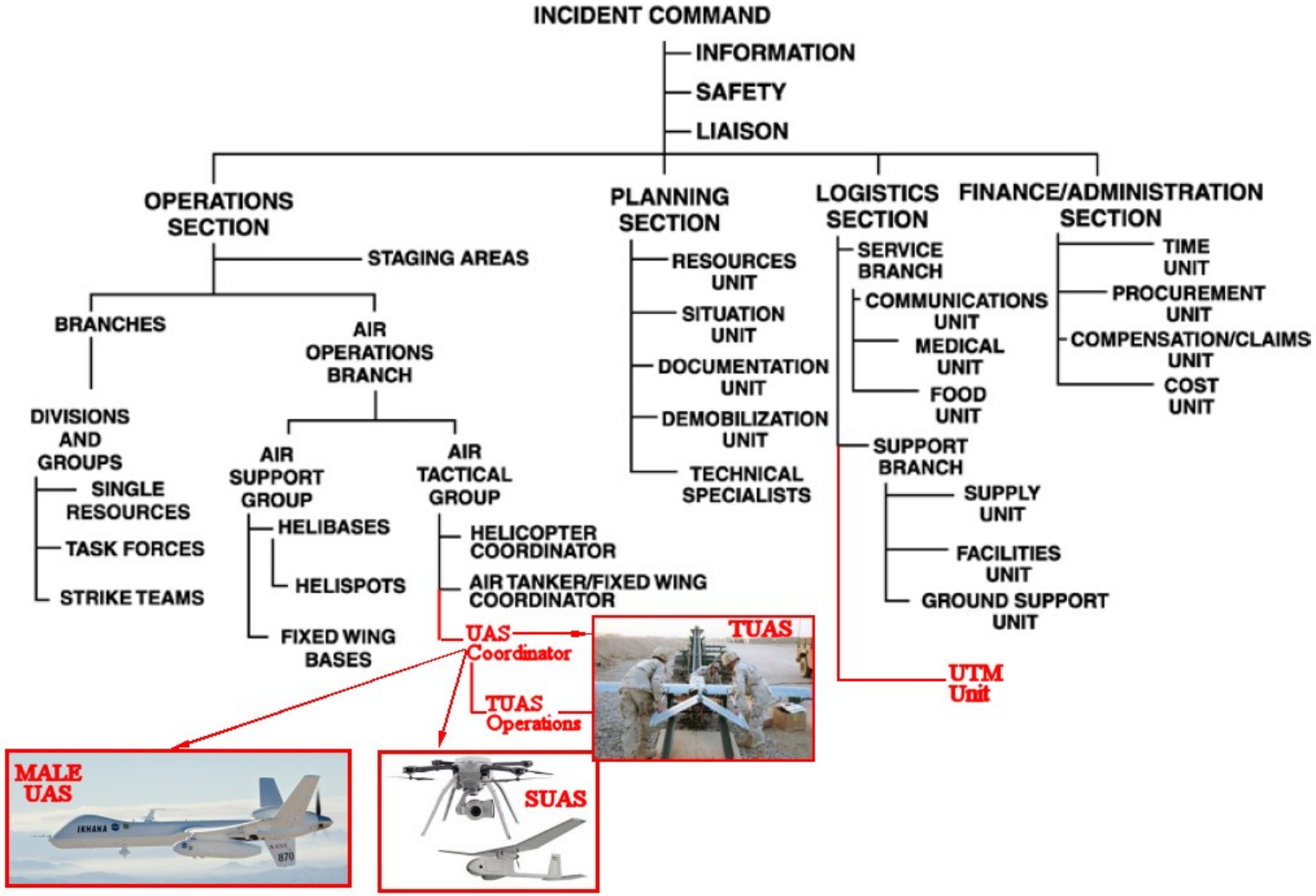
- Wildland Fire Missions
  - Situational Awareness – real time, near RT sensing
  - Decision Support – remote sensing, modeling
  - Comms Op/Interop
  - Forensics
- UAS Technology
  - Small UAS (SUAS) – VTOL, Hand launched FW
  - Tactical UAS (TUAS) – Catapult launch
  - Medium Altitude, Long Endurance (MALE) Pred/Reaper

Wildland Fire Organization
Initial Attack



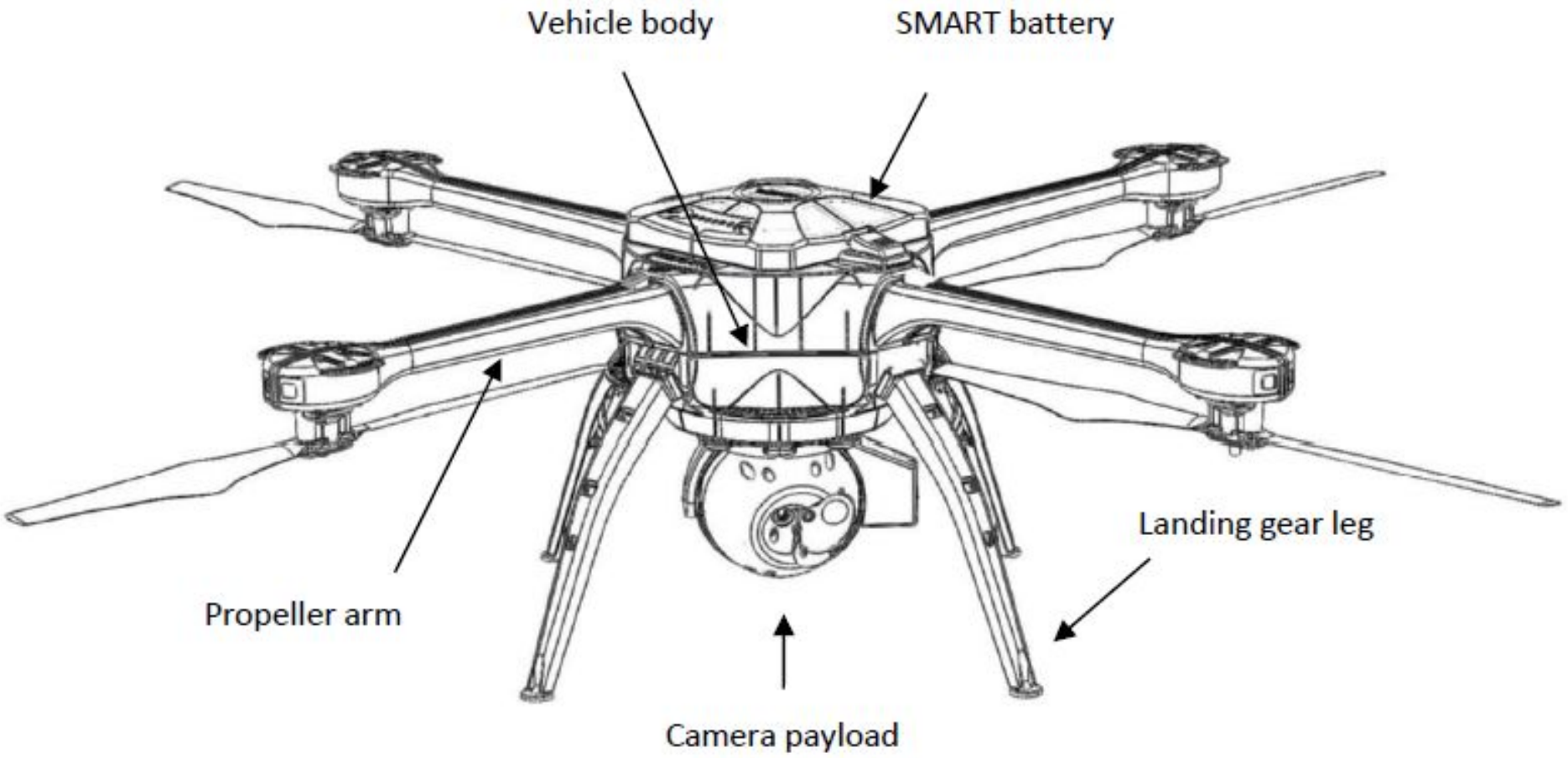
The ‘belt’ problem

Wildland Fire Organization
Incident Command Structure



Can improved airspace coordination improve MALE & TUAS viability?

ADCOP Architecture and Development



Service Definitions

OGC®
Making location count.

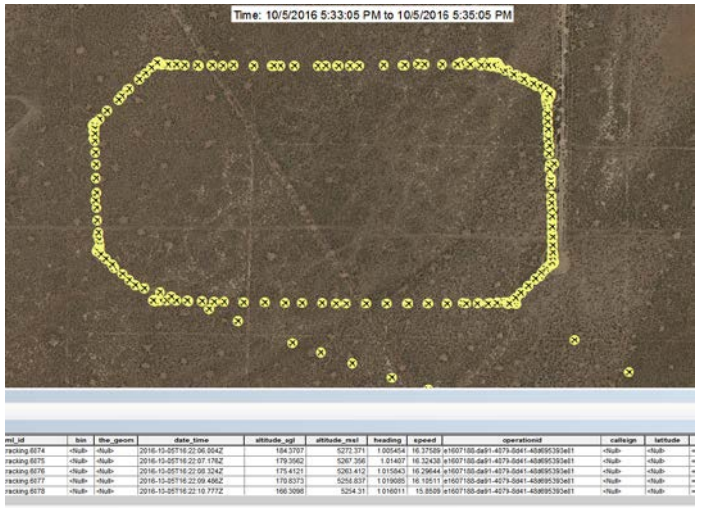
The OGC (Open Geospatial Consortium) is an international not for profit organization committed to making quality open standards for the global geospatial community.

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

UNMANNED EXPERTS

Aeryon SkyRanger™

UNMANNED EXPERTS

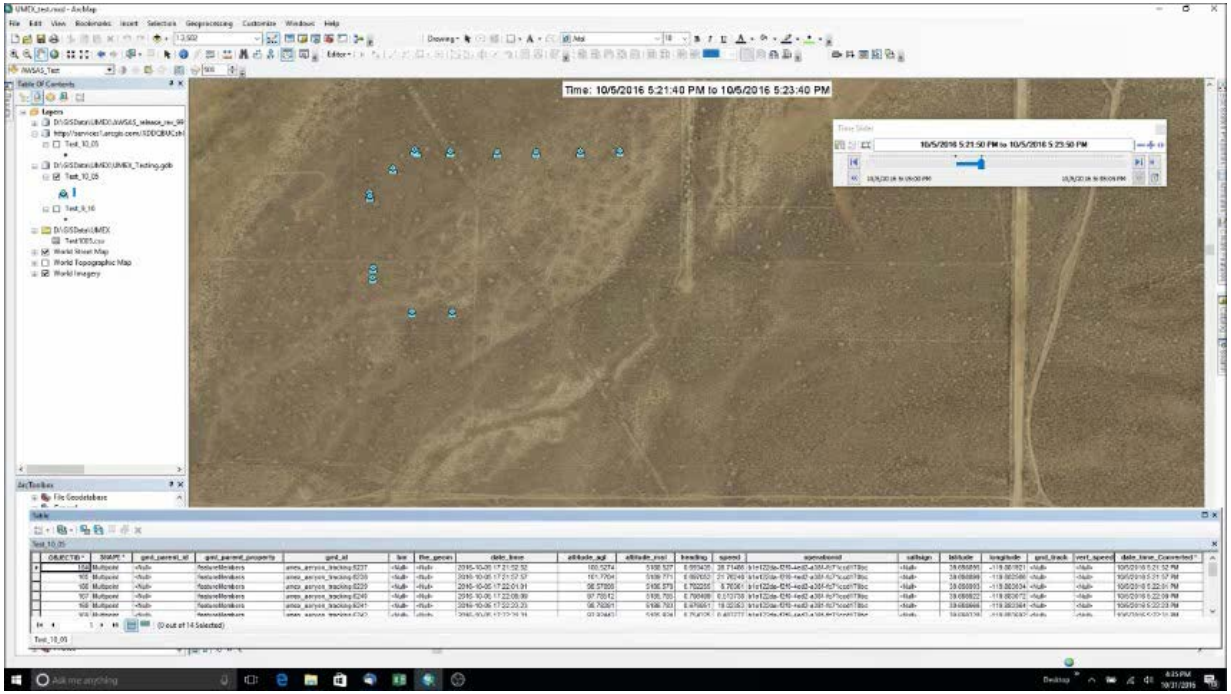
GeoServer

PostGIS

OGC® Making location count.

WFS

UNMANNED EXPERTS



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.

UNMANNED EXPERTS

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UNMANNED EXPERTS

GeoServer

PostGIS

Supporting Data
- Fire Locations
- Weather Services
- Aircraft Locations
- Air Hazards

OGC® Making location count.

WFS

ADCOP

ArcGIS

Browser Ops Dashboard

(Beta)

UNMANNED EXPERTS

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API

UNMANNED EXPERTS

GeoServer

PostGIS

OGC® Making location count.

WFS

Supporting Data
- Fire Locations
- Weather Services
- Aircraft Locations
- Air Hazards

ADCOP

ArcGIS

Browser Ops Dashboard

(Beta)

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?

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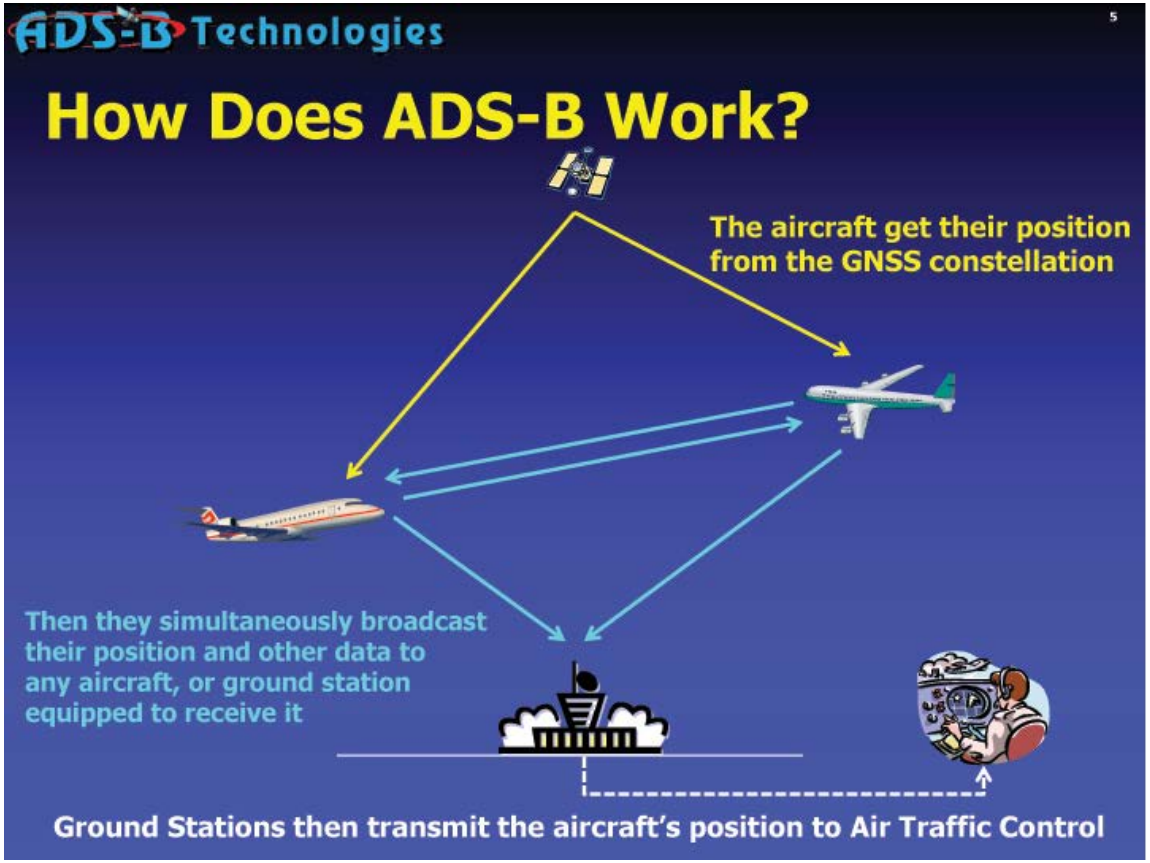
www.unmannedexperts.com



Automatic Dependent Surveillance - Broadcast

UTM Functions & Services

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

- Security Services:
  - System Health Monitoring
  - Vehicle Registration
  - User Authentication
  - Flight Monitoring
- Information Services:
  - Airspace Definition
  - Weather Information
  - Terrain and Obstructions
  - Traffic Operations
- Flight Services:
  - Flight Planning
  - Scheduling and Demand Management
  - Separation Assurance
  - Contingency Management