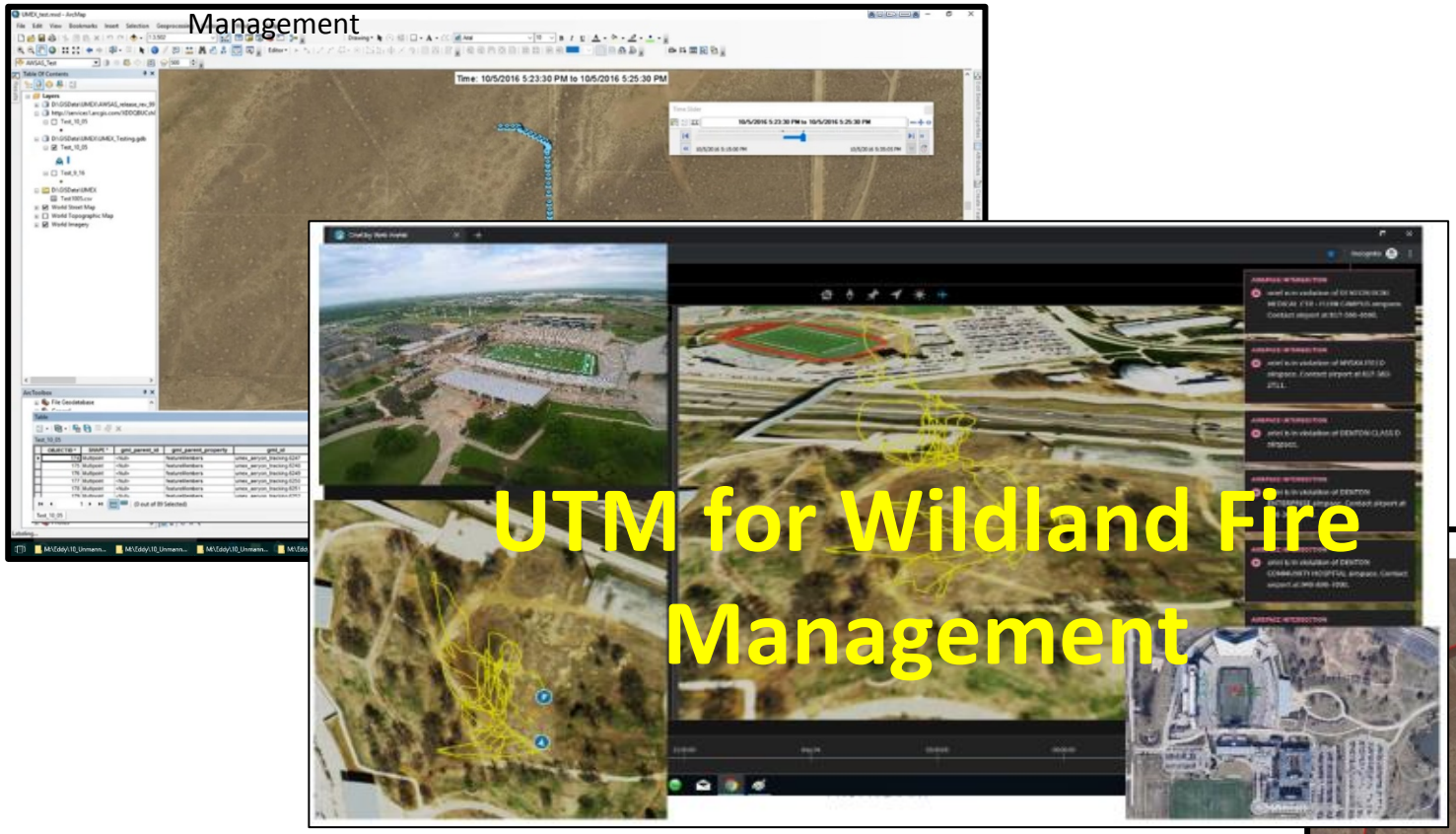
This material is based upon work that is supported by the National Institute of Food and Agriculture, U.S. Department of Agriculture Small Business Innovation Research (SBIR) Program, under award number 2018-33610-28590, entitled Unmanned Aircraft Systems (UAS) Traffic Management (UTM) for Wildland Fire Management



UTM for Wildland Fire Management

Phase II Concepts & Progress
Spring 2019 TFRSAC

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USDA United States Department of Agriculture National Institute of Food and Agriculture

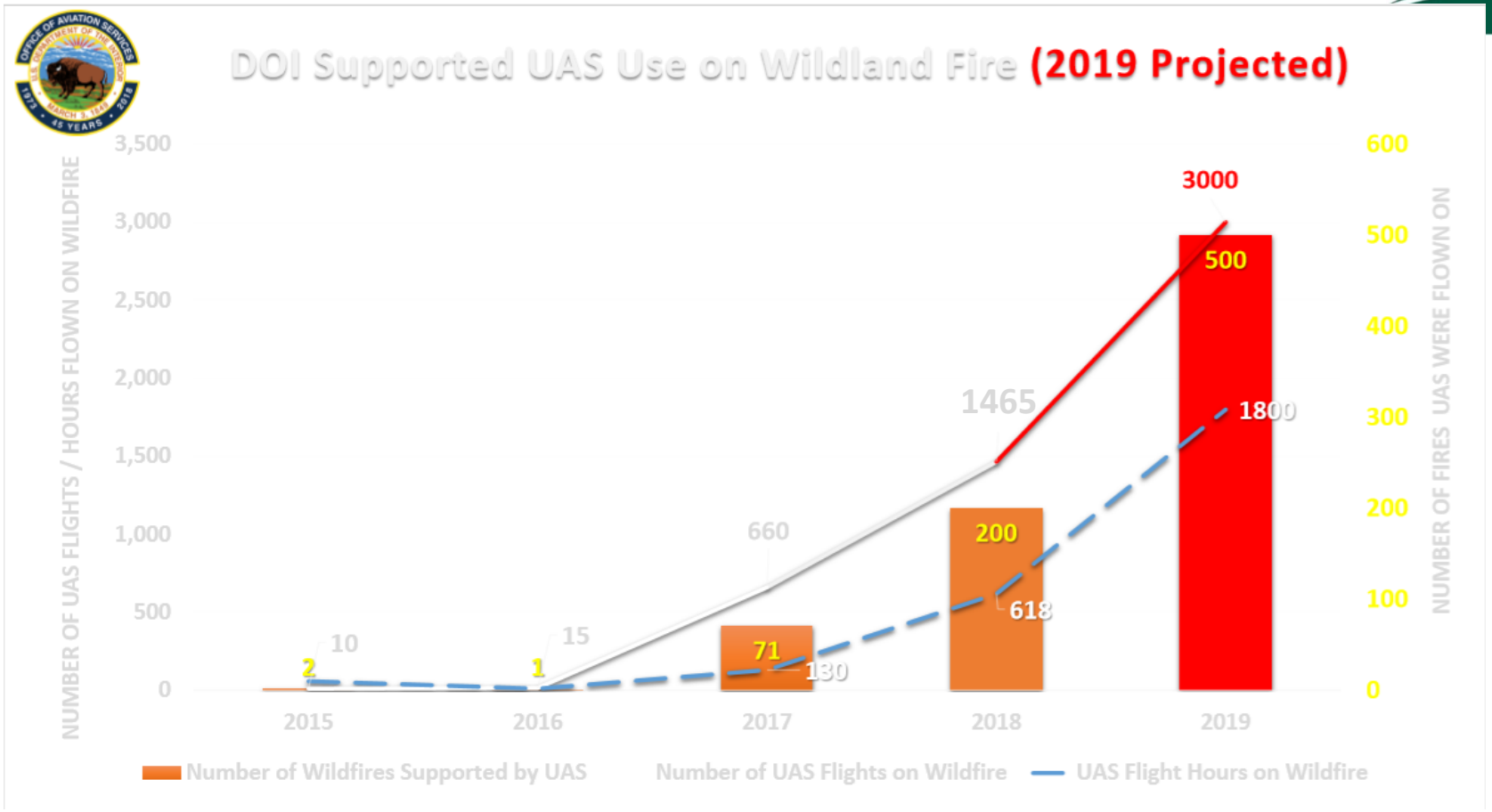
NASA

Fire Aviation

As “one of the highest risk suppression activities” that the U.S. Forest Service performs, the safety of fire aviation operations “depends on understanding what other aircraft are in the airspace and where those aircraft are operating.”

James Hubbard, 2015. “Ensuring Aviation Safety in the Era of Unmanned Aircraft Systems” http://docs.house.gov/meetings/PW/PW05/20151007/104029/HHRG-114-PW05-Wstate-HubbardJ-20151007.pdf

Wildland Fire UAS Trends

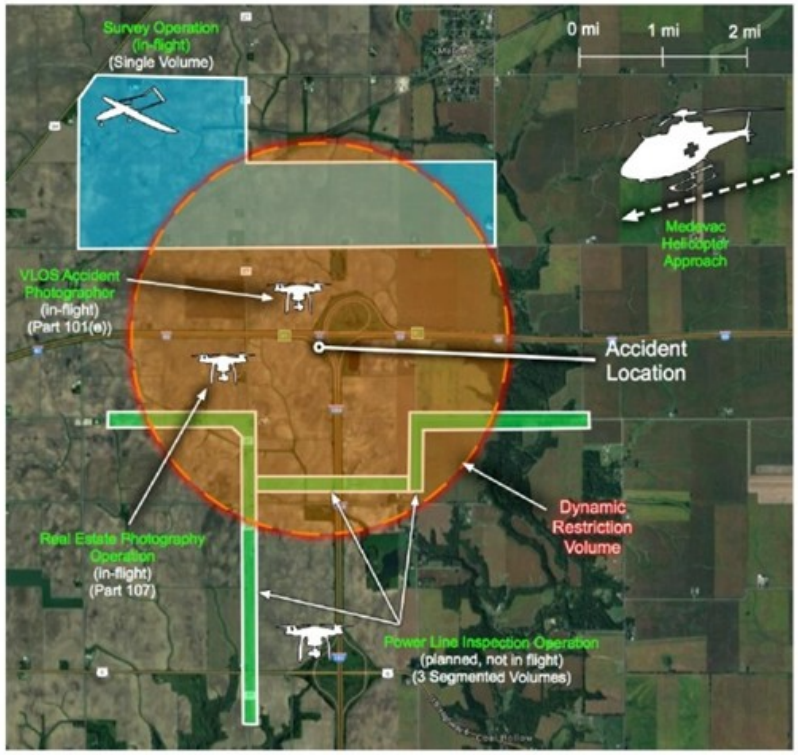


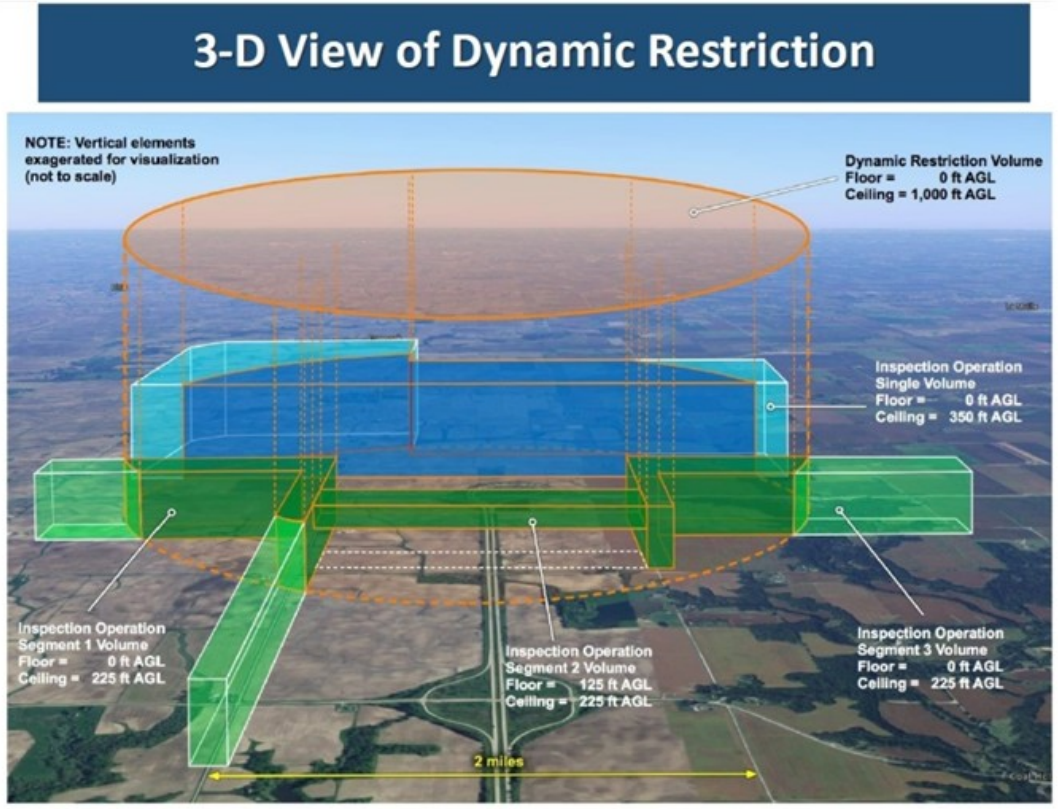
https://www.doi.gov/sites/doi.gov/files/uploads/doi_supported_uas_flights_on_wildfire_2015-2018_2019_projected.pdf

SBIR Concepts

- Motivation - apply NASA UTM to wildland fire
  - UMEX Flying support for NASA Build 1 and TCL2 exercises
  - TCL2 supported by Phase I
- Phase I: 9 months, COP proof of concept
  - User-facing common operating picture (see next slide)
  - GIS & ArcGIS paradigm (EGP Integration)
- Phase II: 2 years, UTM Service Supplier (USS) R&D
  - Y1: Develop with a validated (TCL4) UTM Service Supplier platform
    - NIST Public Safety Communications Research (PSCR) + Initial Attack use case
  - Y2: USS dispatch integration as interagency/interoperability nexus
- After Phase II – Track UTM evolution and operationalization
  - Partner engagement? USDA, NASA, DOI, CAL FIRE, CO COE, FAA

UTM Deconfliction





- NASA/FAA UPP dynamic restrictions

ADCOP Phase I

- Air Domain Common Operating Picture
- NASA UTM Airspace Management
- Airborne Communications
- Mission Planning

Red Outline Shows Phase I Development Components

Aeryon SkyRanger™

Interface via GCS API

NASA UTM

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

amazon web services

GeoServer

PostGIS

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DCOP Server

OGC® Making location count.

Web Feature Service Standards

Interface via ADS-B UAT Transponder

ADCOP & UTM Client

Phase II Use Case

- Deployable Systems Use Case 1
  - An unplanned scenario in an environment where there is no terrestrial LTE coverage or access to the existing Public Safety Broadband Network (PSBN).

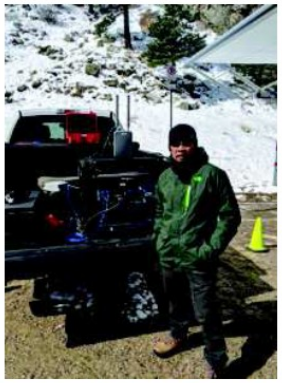
  https://www.nist.gov/ctl/pscr/resilient-systems-resources-and-publications
- Initial Attack
  - Safe and effective response to wildfires is the highest priority of the National Strategy
  - Includes enhancing wildfire response preparedness ... to maximize the effectiveness of initial response.

  https://forestsandrangelands.gov/documents/strategy/strategy/CSPhaseIIINationalStrategyApr2014.pdf

Deployable Systems Use Case 1

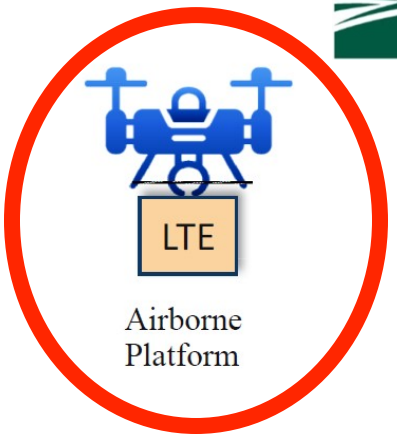
NIST PSCR FirstNet/PSBN R&D

Cell On Wheels (COW)



System On Wheels (SOW)

Backpack



PSCR

- UTM depends on connectivity
- "In Your Hand and On Demand"
  - Establish temporary cell/broadband network over large wildfires

https://www.doi.gov/sites/doi.gov/files/uploads/doi_uas_concept_paper_in_your_hand_and_on_demand-a_concept_for_enhancing_the_awarenesss_effectiveness_and_safety_of_wildland_firefighters_2018_0731.pdf

May 2017 - First Ever Airborne Cell Tower

UNIVERSITY OF NORTH TEXAS®

Virtual Network Communications

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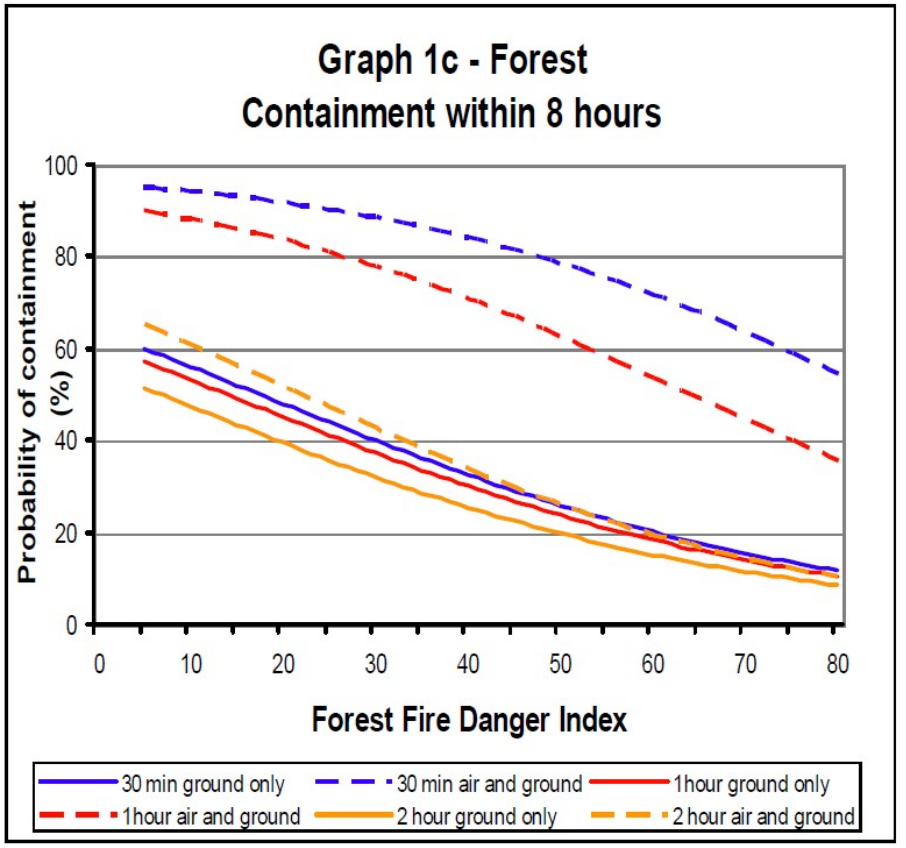
AIRROBOT®

- Complete FirstNet LTE Network hosted on an Airborne Platform
  - Virtualized LTE Evolved Packet Core + eNodeB Radio + Application Software + Backhaul Radio

https://news.unt.edu/news-releases/unt-demonstrates-first-ever-drone-provided-cell-service-disaster-response

Initial Attack

- 2-3% of fires escape initial attack
  - Escapes account for 80-95% of Federal suppression costs
    - Nearly $3 billion in 2017
- "… fast, aggressive, initial attack on new fires […] can reduce the number of mega fires that may burn hundreds of homes and cost the taxpayers tens of millions of dollars in suppression costs." (Bill Gabbert)



- The effect of Fire Aviation after 2 hours is nearly indistinguishable from ground-only attack

Local FD's Support **80%** of Initial Attacks

FireRescue1 News

Topics > Special coverage: Emergency response in the drone age

Special coverage: Emergency response in the drone age

With public safety usage and applications exploding, fire department drones are poised to be the next technology to redefine emergency response. Already in use to identify wildfire origins and water deployment targets, to survey mass casualty incidents and disaster sites, and to provide eye in the sky views of active fires, the uses for UASs continue to grow.

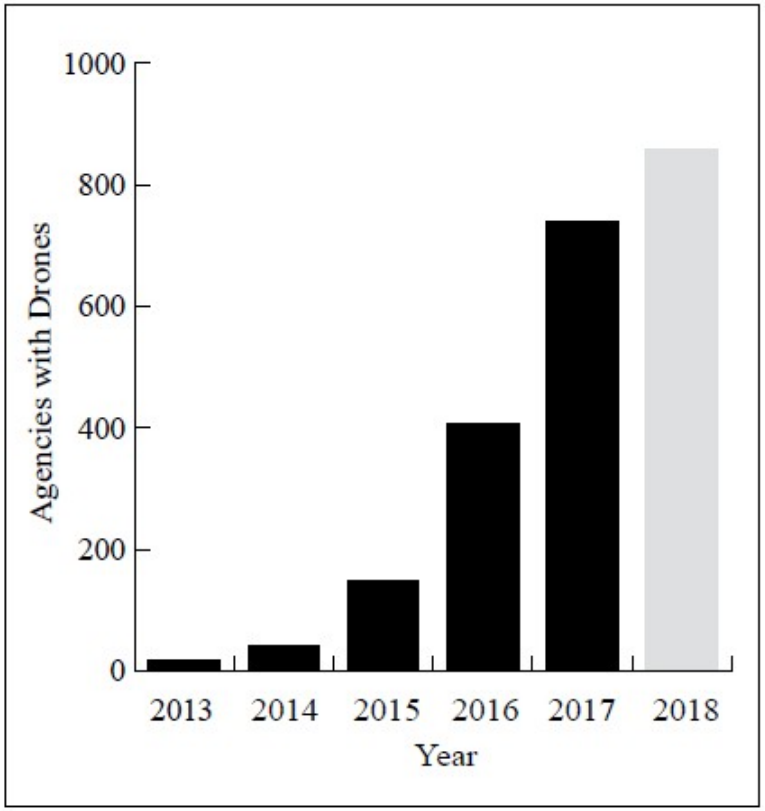
~88% of FD's have a Wildland/WUI Fire Role

26,000 departments

- 56 departments serve communities > 500,000
  - **67%** have a wildland/WUI role
- 24,000 departments serve communities ≤ 10,000
  - **91%** have a wildland/WUI role

Local FD's Adopting Drones

Public Safety Agencies with Drones by Year*



Public Safety Agencies with Drones

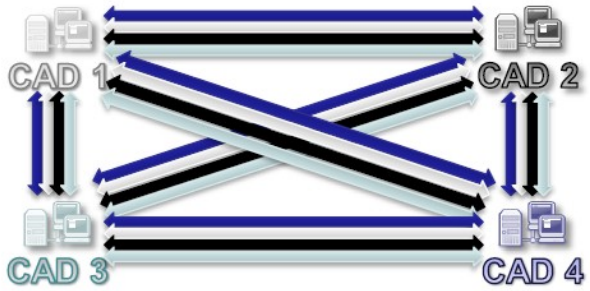
Agency Type	Qty
County Police and Sheriff	302
Municipal Police	278
Fire and EMS	186
City/County Emergency Management	107
Statewide Agency	37

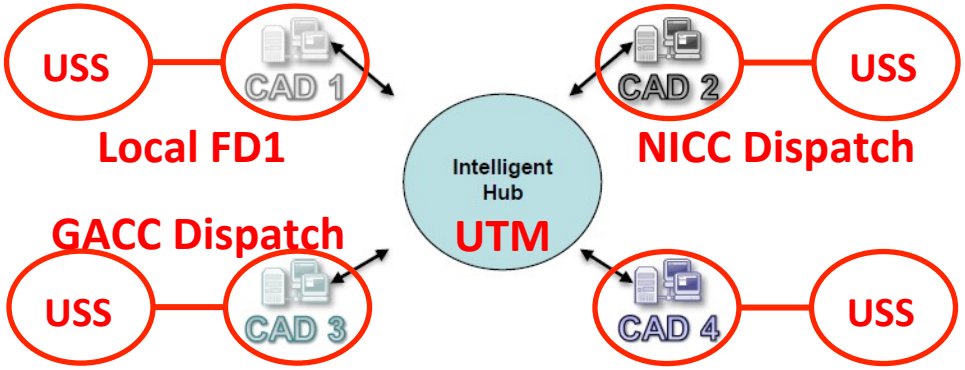
Bard Study update – published May 2018
https://dronecenter.bard.edu/public-safety-drones-update/

Let's Share the Air!

SBIR Y2: UTM & CAD as an Interoperability Nexus

Traditional CAD-to-CAD vs Intelligent Hub





TRADITIONAL POINT-TO-POINT

- Customer requirements are built and maintained by the CAD Providers
- CAD vendors must maintain network connectivity, session management, codes translation, and rules between systems
- Interfaces are complex and expensive

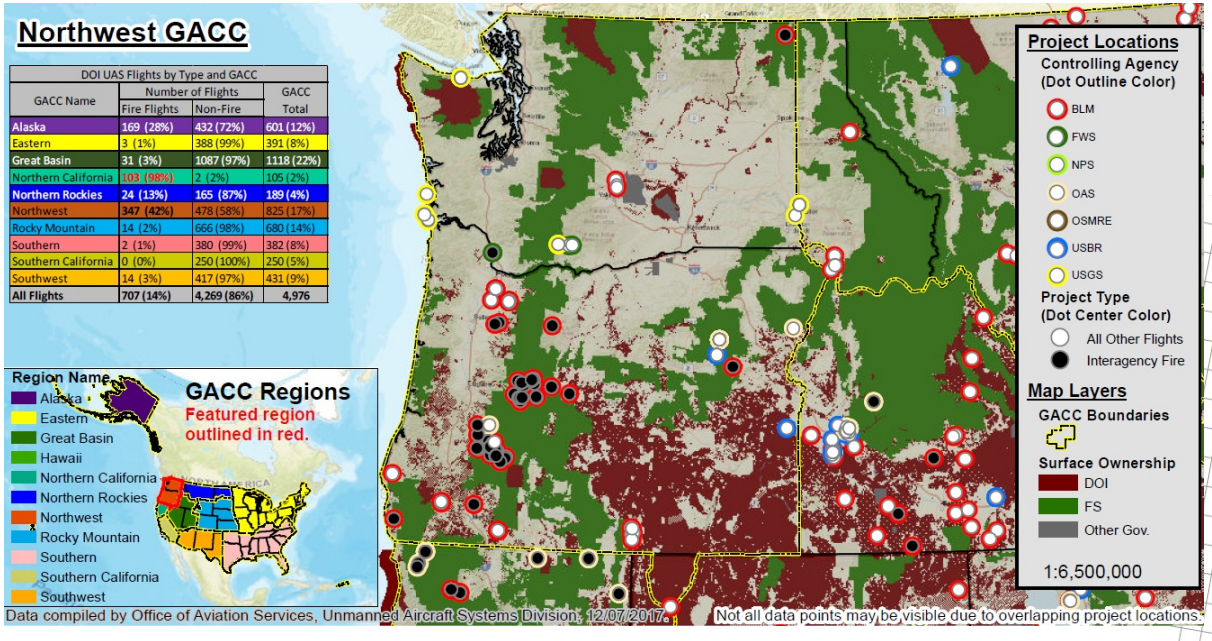
INTELLIGENT HUB

- Configurations maintained by the customer
- All CAD vendors write to a common API
- "Future-proof" forward compatibility
- Common code translations from/to all systems
- Adapters are simple, flexible, and reusable

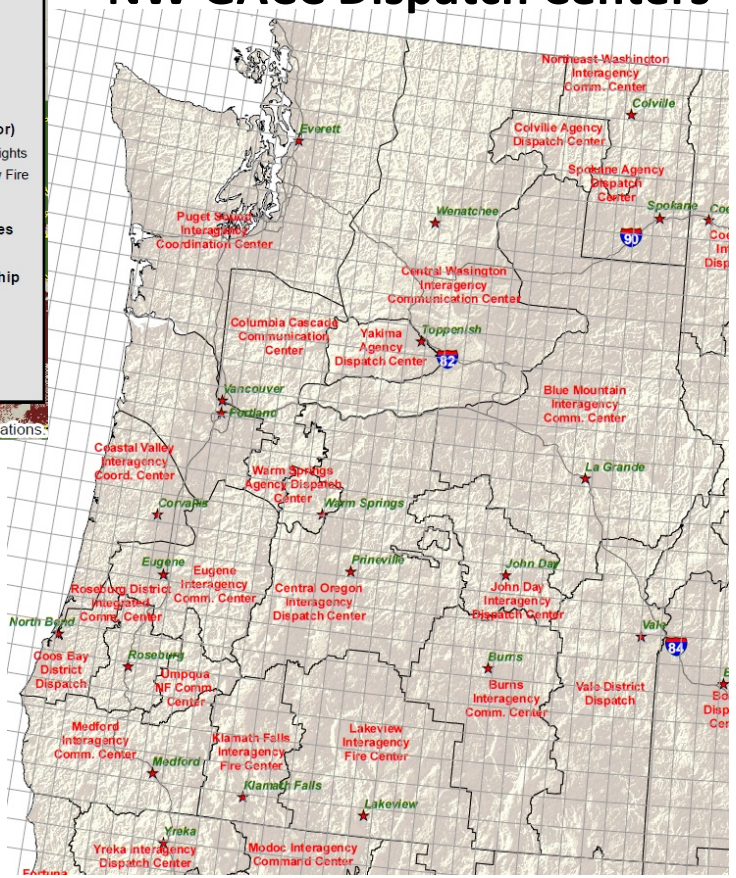
- UTM will be an 'official' FAA-authorized system
- UTM will support wildland fire air traffic control and airspace management
  - in contrast with air asset management

Wildland Fire Interagency Dispatch

2017 NW GACC UAS Interagency Fire Flights



NW GACC Dispatch Centers



DOI– 707 UAS flights on interagency fire

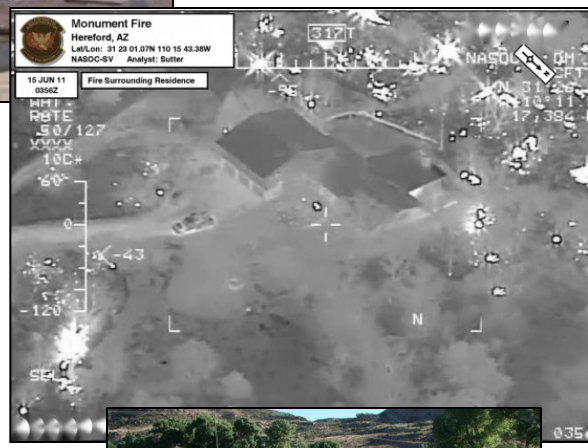
- 14% of 4976 total UAS flights
- NW GACC: 347 or 42% of fire flights

Phase II CONOPS work

- CONOPS is Mission, Technology & Organization
- Current architecture use mesh network radios
  - PSBN/FirstNet LTE is a longer-term solution
- Leapfrogging bubbles of connectivity, as incident complexity increases
  - Type 4 & 5 Incidents
- Needs validation with practitioners and field trials

UAS-Related Factors

- **UAS Characteristics**
  - UAV Flight Envelope
  - Datalink Range
  - Autopilot Capabilities
- **Mission / Role**
  - Near Real Time ISR
  - Decision Support
  - Communications Operability
- **Organizational Structure**
  - Basing / Deployability
  - Number of UAS
  - Culture (Wildland/Municipal/Rural)
  - Integration (Manned/Unmanned)



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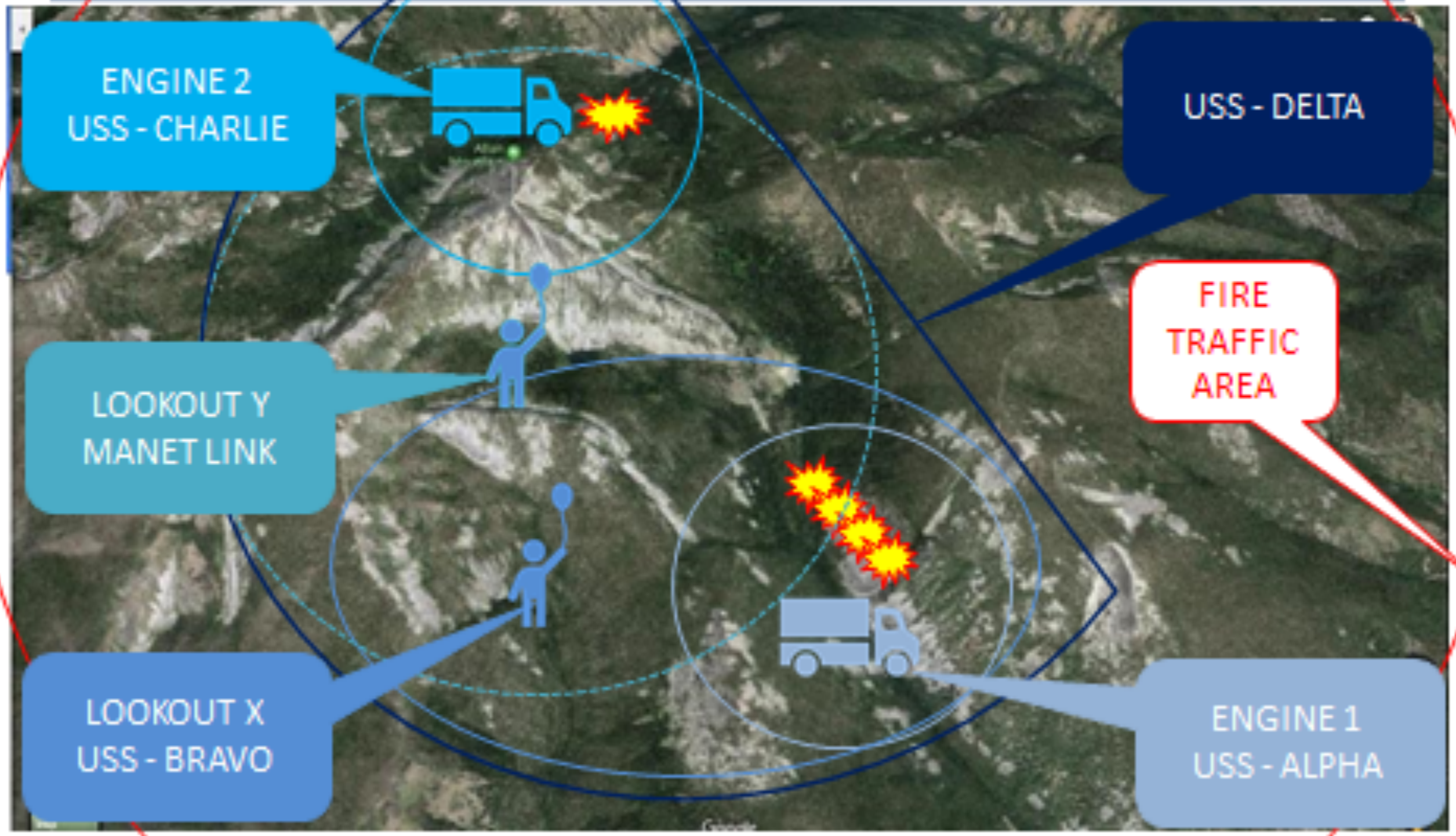
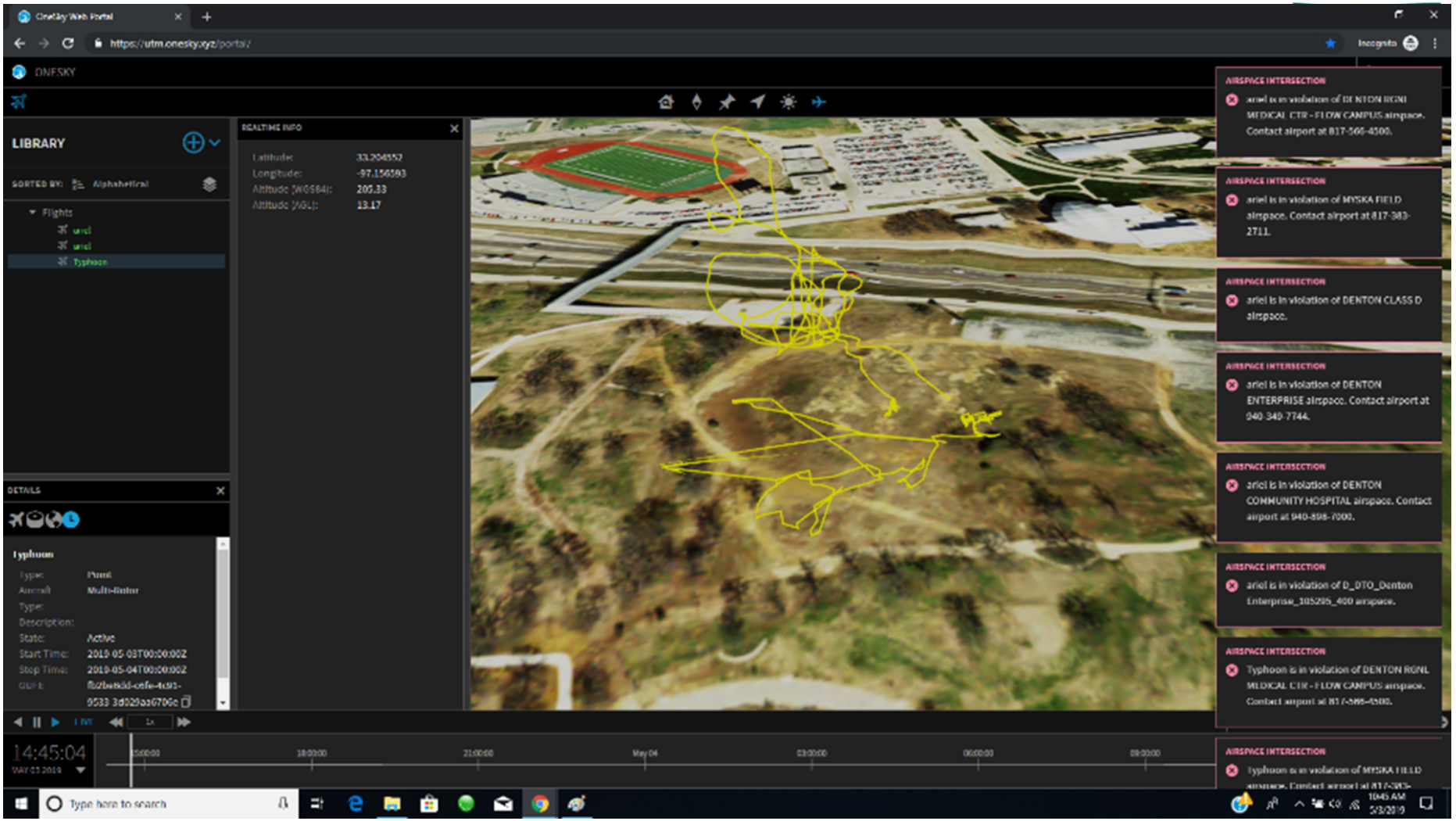
MULTI-USS CONOPS

NASA

USDA

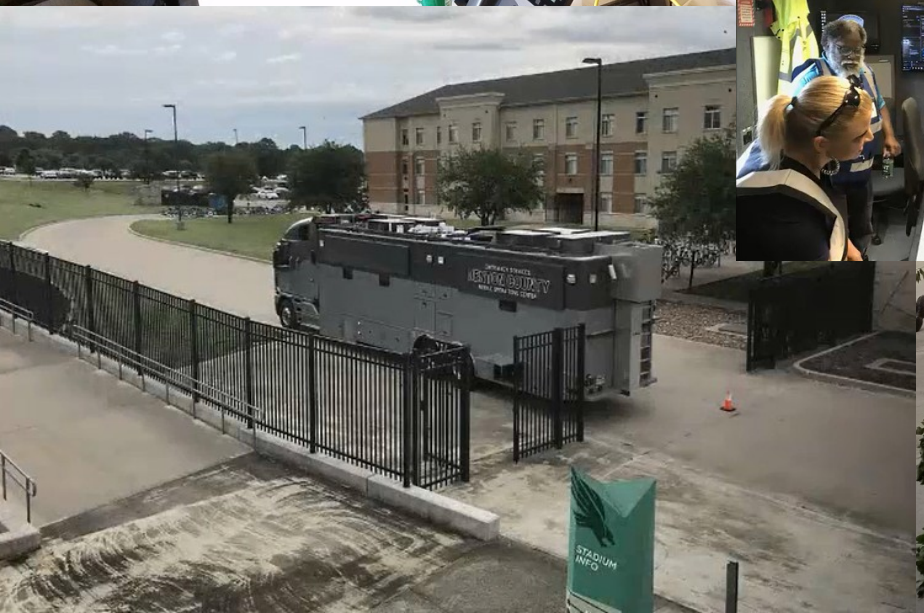


Operation Thunderstruck



- Denton County & City, University of North TX
  - 3 May, 2019

Integration & Evaluation



Programs of Interest

- USDA Wildland Fire Tech Modernization
- CAL Fire Request for Innovative Ideas (RFI2)
- NASA ARMD, System-Wide Safety, Increasing Autonomy
- FAA Remote ID

Acronyms

COP – common operating picture

GCS – ground control station

OGC – Open Geospatial Consortium

GACC – (Regional wildland fire interagency) Geographic Area Coordination Center

NICC - (National wildland fire interagency) National Interagency Coordination Center

DOI – Department of Interior

PSCR – (NIST) Public Safety Communications Research Program

PSAP – Public safety answering point, part of the 911 system

CAD – computer aided dispatch (NG – next generation)

RMS – records management system, associated with a public safety records

ESInet – Emergency Services Internet Protocol Network, the network associated with NextGen 911 transition from legacy analog systems to IP