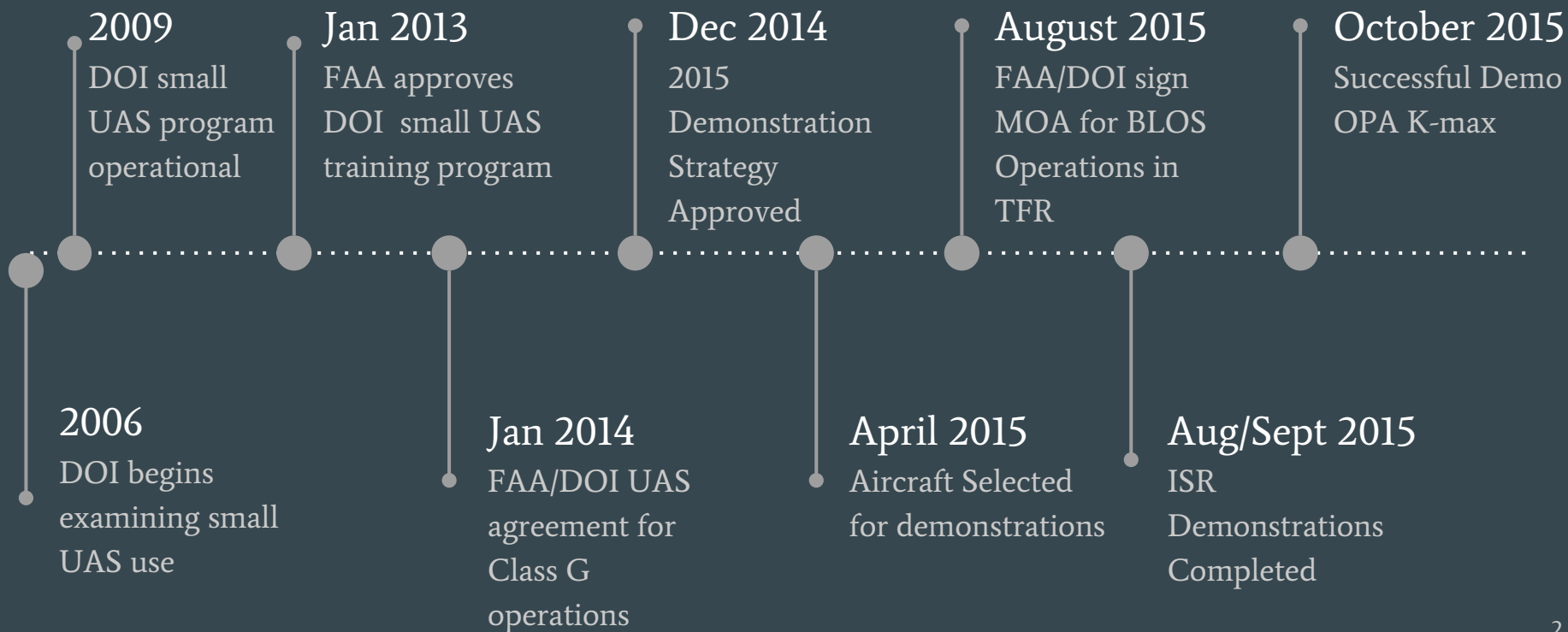


# Fire UAS Integration

...

2015 Demonstrations

# Milestones



# Aircraft Selected



## Insitu Scan Eagle

Electro-Optic Imager  
Up to 170X Zoom  
Mid Wave Infrared  
12X zoom  
24 Hour Endurance  
10' Wingspan  
50 Lbs MGTOW  
19,000' Ceiling

Catapult Launch/Skyhook Recovery



## Textron Aerosonde Mark 4.7

Electro-Optic Imager  
31X zoom  
Mid Wave Infrared  
10X zoom  
18 Hour Endurance  
11.8' Wingspan  
55 Lbs MGTOW  
15000' Ceiling

Catapult Launch/Net Recovery



## Lockheed Martin Stalker XE

Electro-Optic Imager  
26x Zoom  
Infrared  
2X zoom  
8 Hour Endurance  
10' Wingspan  
22.5 Lbs MGTOW  
15000' Ceiling

Hand/Bungee Launch/Belly landing



## Lockheed/Kaman OPA K-MAX

Optionally Piloted  
Electro-Optic Imager  
38x Zoom  
Infrared  
10X zoom  
3-Hour Endurance ( 12-aux)  
Up to 6000 lb Payload  
15000' Ceiling  
Water/Cargo Delivery

# Demonstrations Completed

## Paradise Fire

### Olympic National Park

- Real time ISR
- IR Mapping
- Data direct to web
- Integration with IMT
- First Ever DOI BLOS COA
- Airspace Integration
- Personnel/Wildlife Tracking

## Teepee Springs Fire

### Payette, NF

- Real time ISR
- IR/EO Mapping
- Data direct to web
- Integration with IMT
- Multi Agency
- Airspace Integration
- Highly Sensitive Public

## K-Max Demonstration

### Boise, ID

- Water Dropping
  - Spot
  - Trailing
  - Line Building
- Cargo Delivery
  - Carousel
  - 55-150' Line

# Paradise Fire Lessons Learned

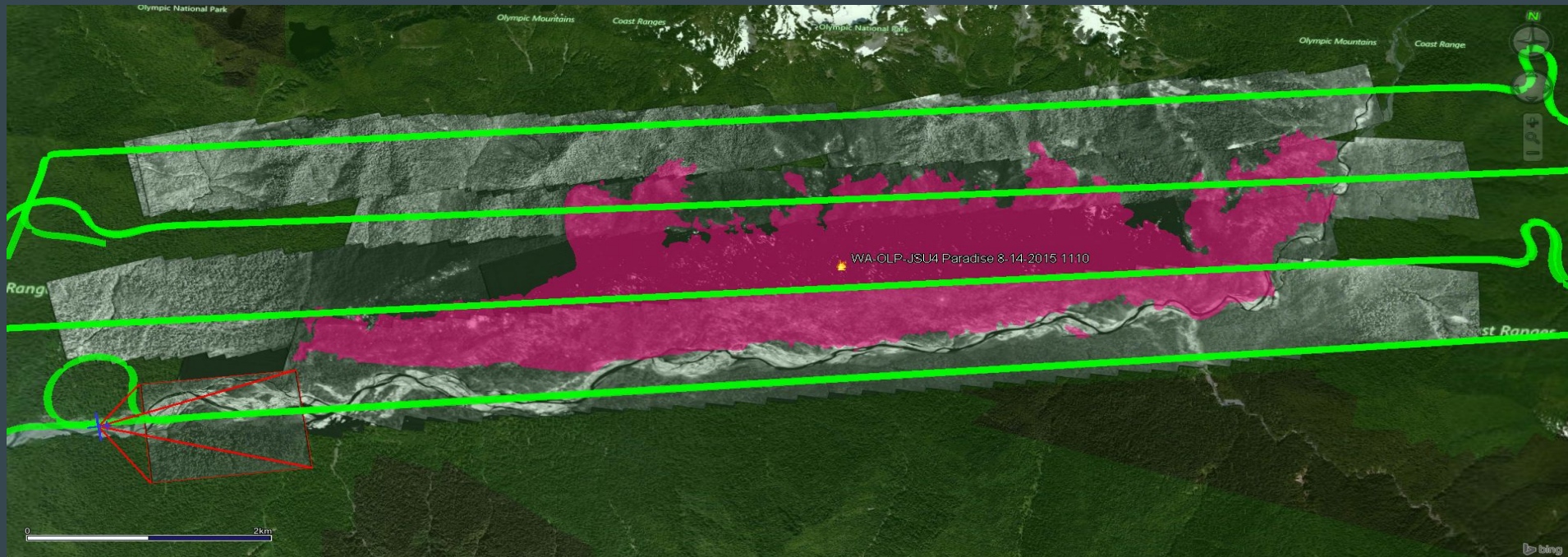
## Successes

- Aircraft was excellent for real-time ISR.
- Data was live streamed via satellite to the web.
- Integrated with Fire EGP seamlessly
- BVLOS operations worked well
- Airspace segregation was simple and effective. Crawl-Walk-Run
- Able to direct water dropping
- MWIR sensor is the best choice for wildfire monitoring
- 37 hours of flying over 6 days with no incidents
- Able to assess the impact of water drops

## Challenges

- Educating industry on the fire mission
- Initial approval was time consuming
  - Corrected with FAA via MOA
- Automatic sensor adjustments during mapping.
- Back-end data management for rapidly creating mapping products.

# Paradise Imagery



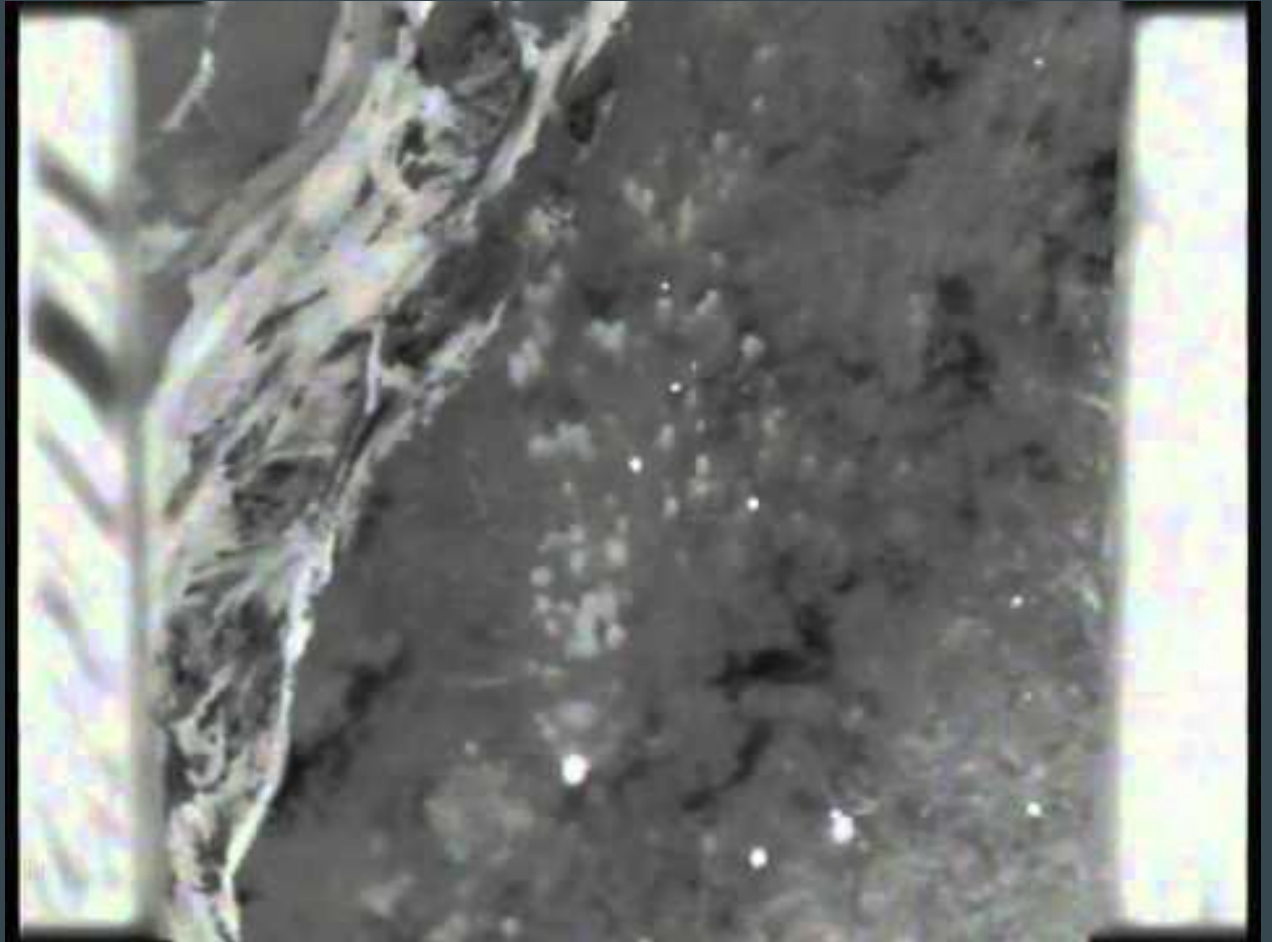
# Google Earth Export



# Helicopter Drops



# Mapping Strip



# Elk Survey



# Teepee Springs Lessons Learned

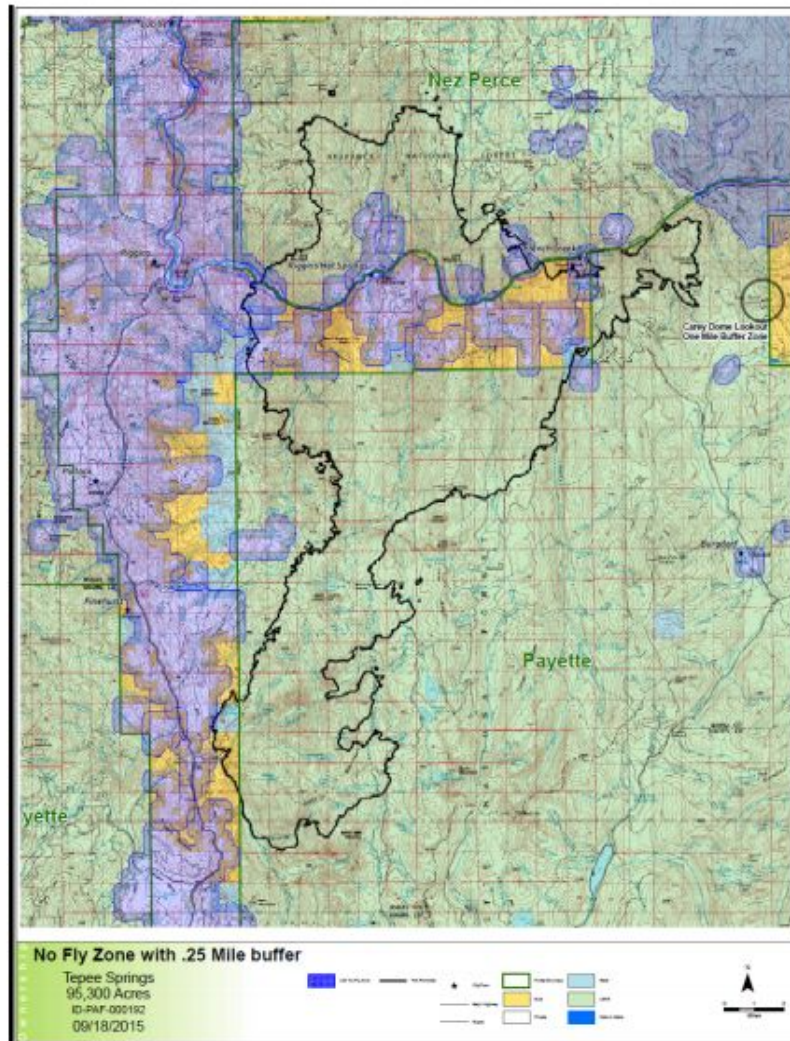
## Successes

- Aircraft was excellent for real-time ISR.
- Highly mobile launch recovery system
- Interface with ATGS and Helicopters
- Airspace segregation was simple and effective. ROZ
- Dual Imager was useful
- MWIR sensor is the best choice for wildfire monitoring
- 21 hours of flying over 4 days with no incidents
- No-fly zones built around private land
- Integrated with GISS on incident
- TCAS

## Challenges

- Sensor automation proved challenging for mapping.
- Spectrum requirements
- LOS communications vs. Satcom

# No Fly Zones



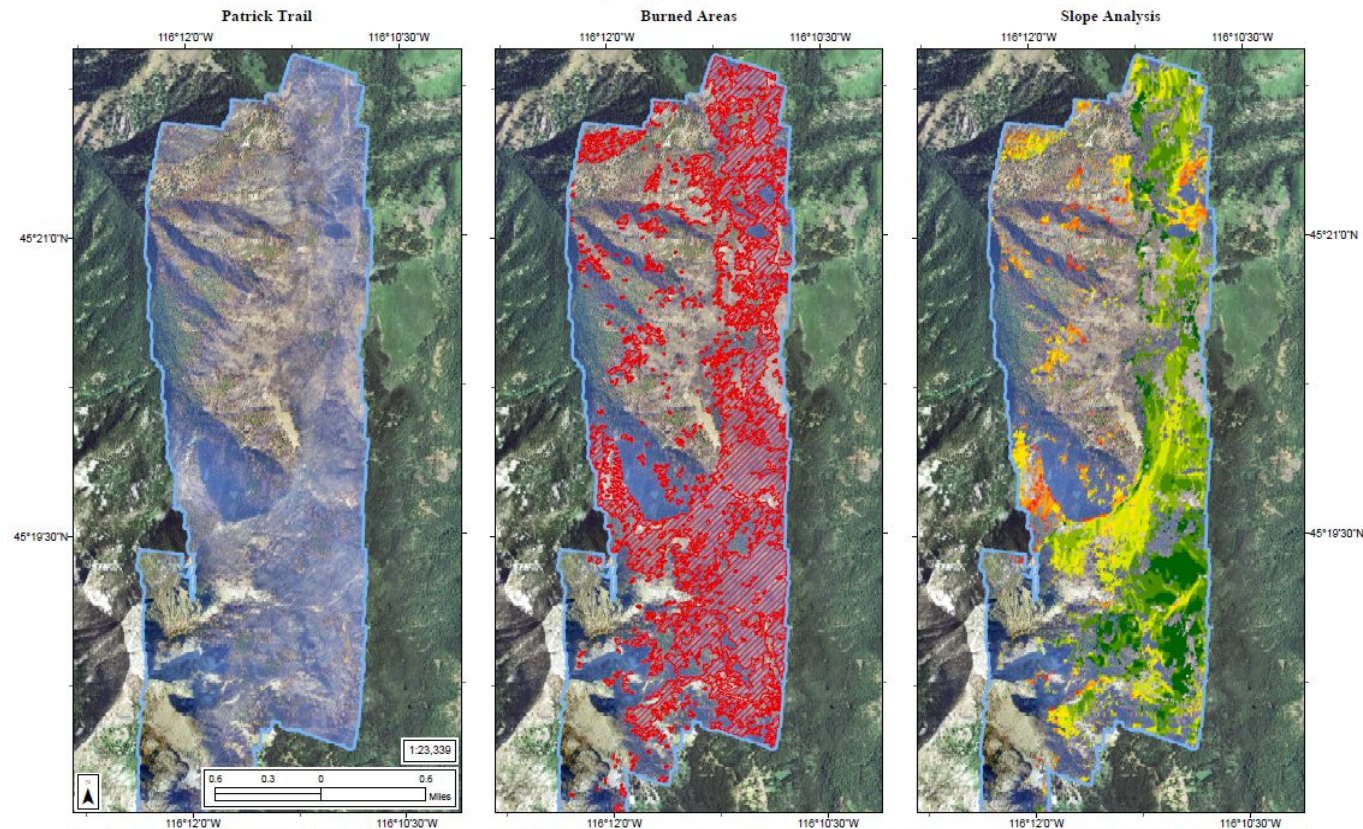
# Sample Imagery



# Sample Video



# Image Analysis



Description: Burn area analysis for Partridge Creek from imagery captured on 20 September 2015. Center image shows burned areas as identified by Feature Analyst. Right image shows slope map, masked by burn areas. This analysis visualizes the areas of steep slope that have incurred burn damage and may indicate potential for dangerous recovery sites.

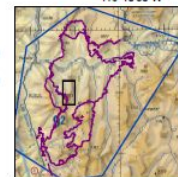


## Legend

- Burned Areas
- Patrick Trail Imagery

## Slope in Burned Areas

- 0 - 7.5
- 20 - 24.5
- 7.5 - 12
- 24.5 - 30
- 12 - 15.5
- 30 - 37
- 15.5 - 20
- 37 - 58



# 3D Modeling



# Optionally Piloted K-Max Demonstration

## Successes

- Consistently and reliably delivered cargo to a variety of locations
- Multiple loads on one flight
- Accurate to within 2-3 feet
- Fit into existing training for firefighters
- Able to build wetline
- IR camera can assess accuracy
- Satcom relay allowed for BLOS operations
- Camera was able to lock on and track targets
- IR capable of “erasing” smoke
- Able to operate in terrain with DTED

## Challenges

- Satcom can drop out if helo is on N heading
- 60 Meter DTED was not high enough resolution
- Radar altimeter sometimes senses load vs. ground
- Operators unfamiliar with tactics normally used in fire

# Video



## Sample EO/IR



# Recommendations

1. Continue with the current integration strategy
2. Develop contract specs for on-call or exclusive use contract for the 2016 fire season that will allow for further integration
3. Identify specific “modules” to assign with the aircraft when they are mobilized to act as aircraft managers/liaisons
4. Work with selected vendors to develop the rapid mapping processes to turn the data into usable product quickly
5. Proceed with testing of optionally piloted K-max on either a prescribed fire or low complexity wildfire
6. Steadily increase the availability of both ISR and tactical assets over the next 3 years
7. Target current gaps in capability as priority (night, inversions, etc...)