



Persistent Elevated Systems Support To Wildfire Management

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Outline



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- Enhancing Operations with Awareness and Communication
 - “Vehicles” Defined
 - “Payloads” Defined
 - Evolving LTA Vehicles
 - Surveillance
 - Communications
 - First Step -- Aerostats
 - TEA System Components
 - TEA Performance
 - The Elegance of Elevation



Enhancing Ops with Awareness and Comms



- We're told Wildfire Fighters need situational awareness and reliable communications
- They say platform is not important but if you have a platform that provides awareness of the fire's behavior and operations in progress, along with persistent communications, these two major issues are resolved
- We are proposing a path to such system that offer:
 - Lighter than Air (LTA) vehicle for persistence, endurance and station keeping
 - Comm package that provides reliable comm compatible with existing hardware and procedures
 - Sensors specifically designed for detection, monitoring and tracking of fires and fuel
 - Processing that provides awareness products directly to users

Vision:

Persistent, operational awareness in fire suppression operations that connects all players with comm, video and sensory information. It is available to all participants and each participant can be a node and a sensor.



Vehicles Defined



- **“Persistence”** means a long time on-station, not brief, periodic overflights, generally below or above the fire controlled airspace.
- **“Systems”** include Lighter-than-Air” (LTA) helium vehicles.
 - Carefully deconflicted with other firefighting air traffic.
 - LTA vehicles evolving from Tactically Expedient Aerostats (TEAs) to free-flying airships
 - Semi-stationary LTA platforms are optimum for:
 - “Staring” sensors with temporal filtering to support early detection and motion
 - 99% continuity for wide-area communication
- **“Support”** means wide-area communications and specialized surveillance
 - Communication/network capitalizes on latest military technologies
 - Surveillance evolves from small areas with oblique angles from aerostats to wide-area views from higher altitude mobile airships



“Payloads” Defined



- **“Surveillance”** includes high spatial resolution visible thru LWIR imagery with video frame rates and temporal filtering which enables early detection (e.g. fires started by embers) and extraction of fire management parameters

- **“Communications”** include Mobile Ad hoc Network (MANET) coverage
 - With functionality which is highly applicable to remote area operations
 - An aerostat with altitude as low as 500 ft brings military grade reliability to ranges in excess of five miles, or over 75 square miles of coverage

TWAi is embarked on a developmental path for Airship UAVs

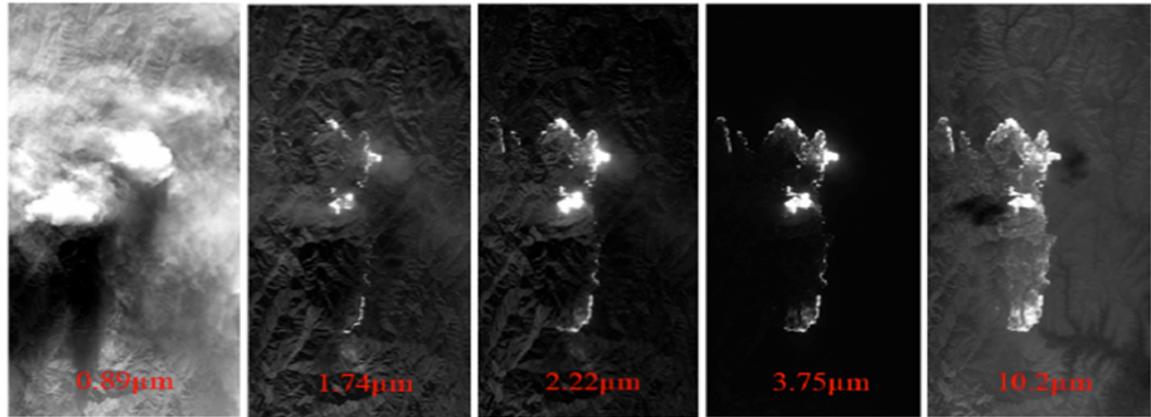
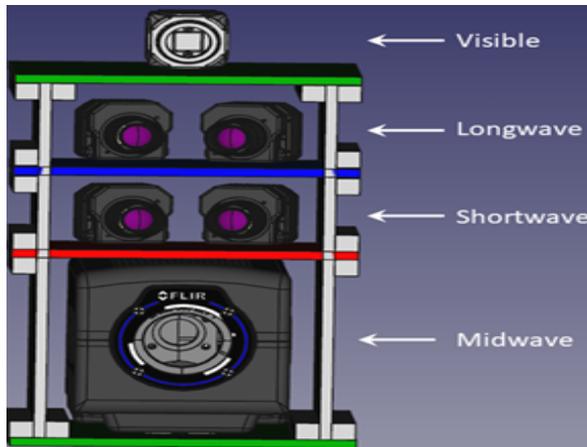
- We're suggesting a path embracing both technological and operational aspects in coordination with fire experts
- Early deployment of tethered, quickly moveable, aerostats will refine firefighting support and procedures for both remote sensing and operational communications
- Free-floating airships will be able to operate well above the TFR and other air traffic involved in the firefight. Move as directed by the airspace manager
- Airship will recover nearly vertically close to the Fire Base, as desired, for refueling and maintenance, using a mobile mooring trailer and inflatable shelter



TWAi Prototype Airship

Operational Characteristics:

- First generation of Airship UAV is being designed to carry 50 pounds to 8,000 feet MSL, with 36 hours duration on station in winds up to 20 knots
- Second generation will carry 50 pounds to 15,000 feet MSL, with 72 hours duration on station in winds up to 50 knots



EOIR Payload – Fireball Intelligence Mapping System

- Multi-band cameras calibrated with NIST-traceable standards and bore-sighted relative to GPS/IMU for download to geo-referenced maps.
- Allows extraction of management information, to include:
 - Fire perimeter location and width of flame front
 - Total fire radiative power
 - Fire radiated power from the flaming front
 - Location and temperature contours of all burning material
 - Vectors representing rate and direction of fire spread on the perimeter
 - Early detection of new fires created by wind-borne embers



We've tested and deployed several highly capable and reliable mesh network technologies, of varied capabilities and cost. Most popular tends toward 4G LTE due to versatility and familiarity with smart phones.

Firefighting functions of networked technologies include:

- Talk and text on Smartphones
- Send and receive videos and photos on the phones
- Geo-locate all other participants in the network
- Mark points of interest on shared maps
- Share numerous smart applications
- Reach outside the “intranet” to commercial communications and internet, either through direct link to adjacent towers or SATCOM deployed with system



High bandwidth links between aerostats can greatly expand network coverage, almost to “regional” proportions



Introducing Tactically Expedient Aerostats

(TEAs)



TEA System Components



The Trailer ~5,000 pound capacity; single axle, deck-over-wheels allows easy maneuvering on rugged terrain; fits in ISO-20 container, towed by standard pickup. Option for dual-axle for long haul trips.



The Mooring Platform ~6' x 12', Turnkey operating base with power, helium, tools, winches; moved by forklift or helicopter; enables aerostat towing & two person operations; folds to fit ISO-20 container



The Aerostat – a Helikite balloon-kite that lifts from helium & kite; operating in over 30 countries & with many US civil & Military agencies; varies from 2 to 100 cubic meter size



Mobile Command Center - Truck transportable, self-contained dual power, data storage, network control climate controlled work space. Auto-acquire SATCOM tracking and 50 MBps bandwidth. Input-Output ports for extended local communications



All of our elevated systems have been extensively field-tested & placed in Government inventories for multiple uses

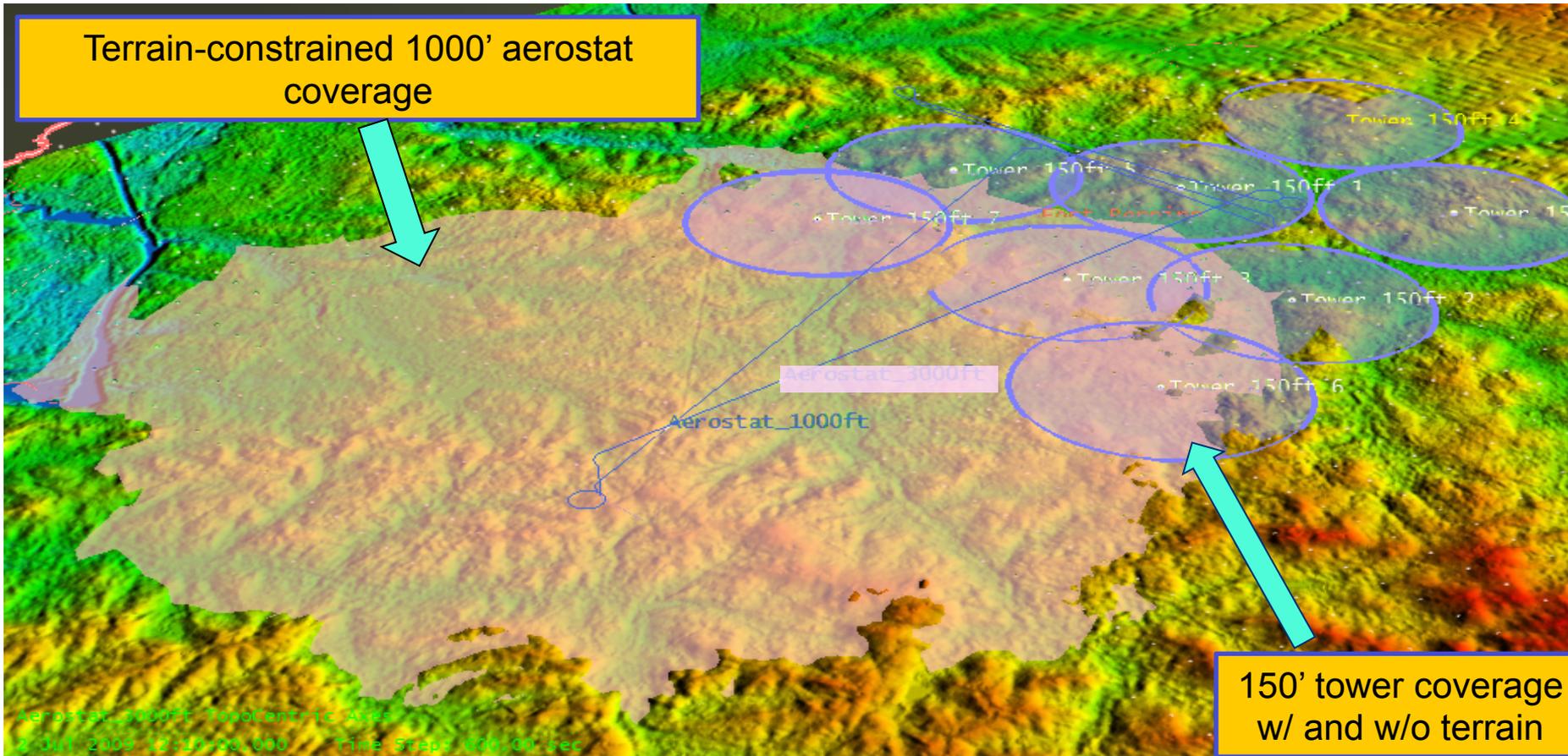


- Custom sized from 2– 64M³ volume
- Setup by 2 people in one our; two person flight crew
- Wind limits: 15 knots to inflate, 40 knots in flight, 50 knots moored
- Towable up to ~30 knots
- Approved Deflation Device

Very versatile capability to host various types of payloads

Operational Characteristics:

- “Kite” design provides greater lift in high winds, vs. blowdown suffered by other designs
- Flight at about 1,000 feet gives over 30 miles sight to horizon and avoids heat, but 500 feet may be desired for airspace management
 - Tough ripstop nylon outer shell resists punctures and tears
- Can be anchored with “copper-fiber” tether for constant power and data transmission. Otherwise, TEA will be brought down periodically for payload battery changes
 - Equipped with tether markings and lights for day-night ops IAW FAA



Line-of-Sight area increases as the square of the altitude

On a dollars-per-hour basis, aerostats cost significantly less than planes, UAVs, satellites. We expect LTA UAVs will prove the same.