

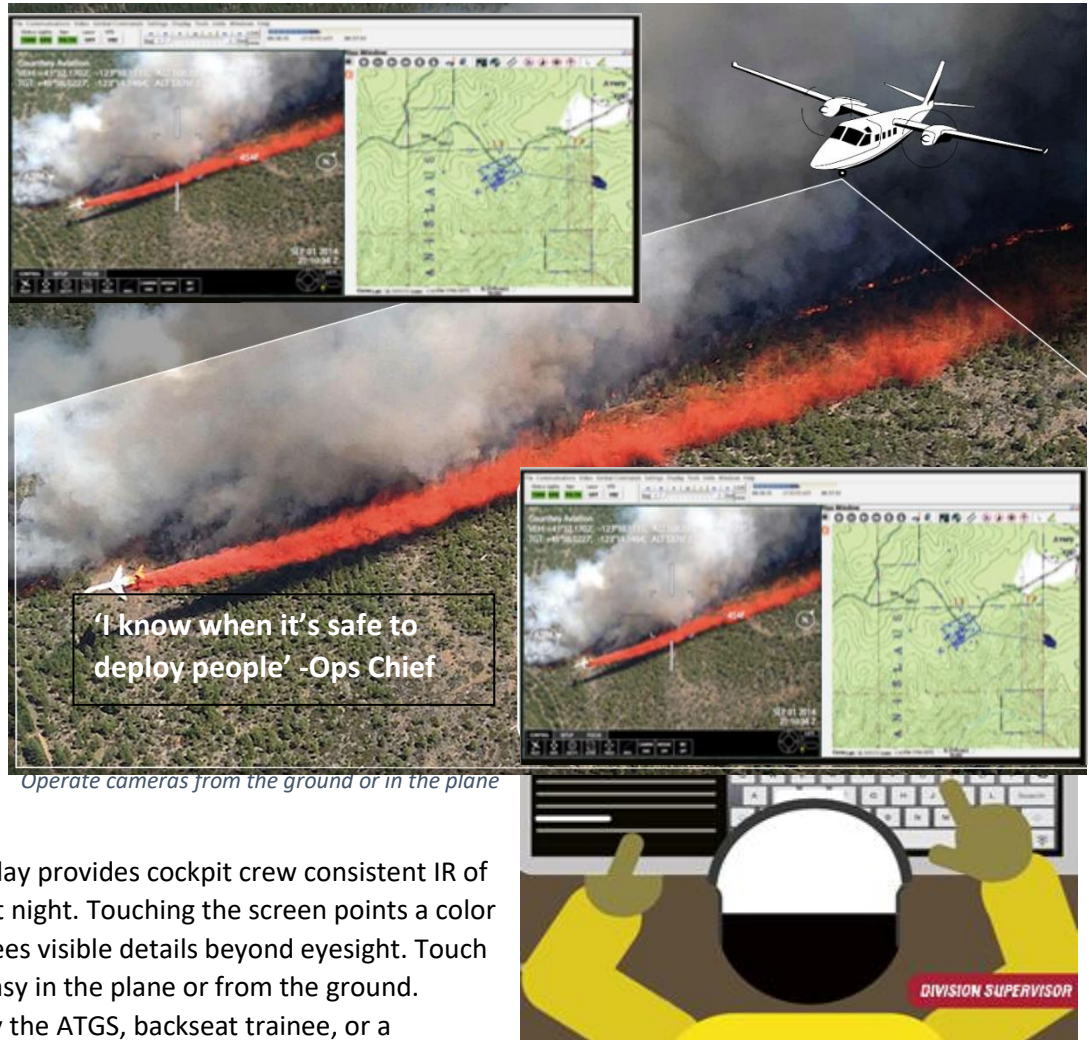
Fire View Infrared Downlink (FirstNet)

Wildland Fire Common Operating Picture and Interactive Drawing

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Infrared sensors sees through smoke, improving Air Attack's situation awareness. Downlinking infrared imagery (IR) to divisions, Incident Command (IC) or any headquarters, all at once, is called Common Operating Picture (COP). COP extends consistent situational awareness across a fire. This translates to less radio chatter, people in the right place sooner and requests fulfilled faster. If a picture is worth a 1000 words, then live video fire wide might be worth 10,000.

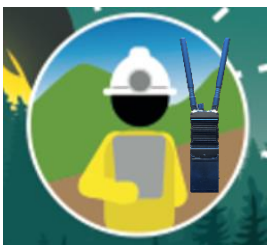
Each Courtney 690 Aero Commander has a thermal infrared sensor and a color superzoom (26x) camera in an auto tracking gimbal. Color zoom sees ground details from high altitudes. Gyro stabilization locks on and minimizes shake. These Type 1 Air Attack planes also have the second thermal sensor fixed on the right side to provide an Air Tactical Group Supervisor (ATGS) persistent view in the direction they normally look (out the right windows).



Fire video plays live on any device and/or overlaid on a moving GIS map. A flight display provides cockpit crew consistent IR of the fire through smoke and at night. Touching the screen points a color and IR camera. Zooming in sees visible details beyond eyesight. Touch Tablet PCs make operation easy in the plane or from the ground.

Aerial control is conducted by the ATGS, backseat trainee, or a Courtney operator in the air or on the ground. Ground control is equal to sitting in the plane, even from the Incident Command Post, firecamp, deep wilderness, or an Emergency Operations Center (EOC).

FirstNet downlink mesh radios for individuals, vehicles and camps transmit live IR beyond line of sight to backcountry teams anywhere on the fire or across the Internet. Each remote user makes the mesh network stronger, faster, and wider reaching. Relay stations extend the mesh into deep canyons, over millions of acres, and distances beyond a hundred miles; even when the plane is not overhead. When ground operated, the first priority is still tactical air attack. Division Supervisors are a next high-priority. Third are requests from IC Ops, Situations (GIS and Mapping), Fire Behavior, and the Incident Commander, who can watch live or receive a condensed emailable video clip. Everyone can equally draw on the moving map interactively. Live shared whiteboard lets remote teams simultaneously communicate visually. With or without overlaid fire video, shared drawing provides air and ground leadership real-time Common Operating Picture. In addition to suppressing fires faster, COP saves time and radio chatter, gets fire personnel positioned quickly and reduces retardant costs.



Boots on ground see the fire

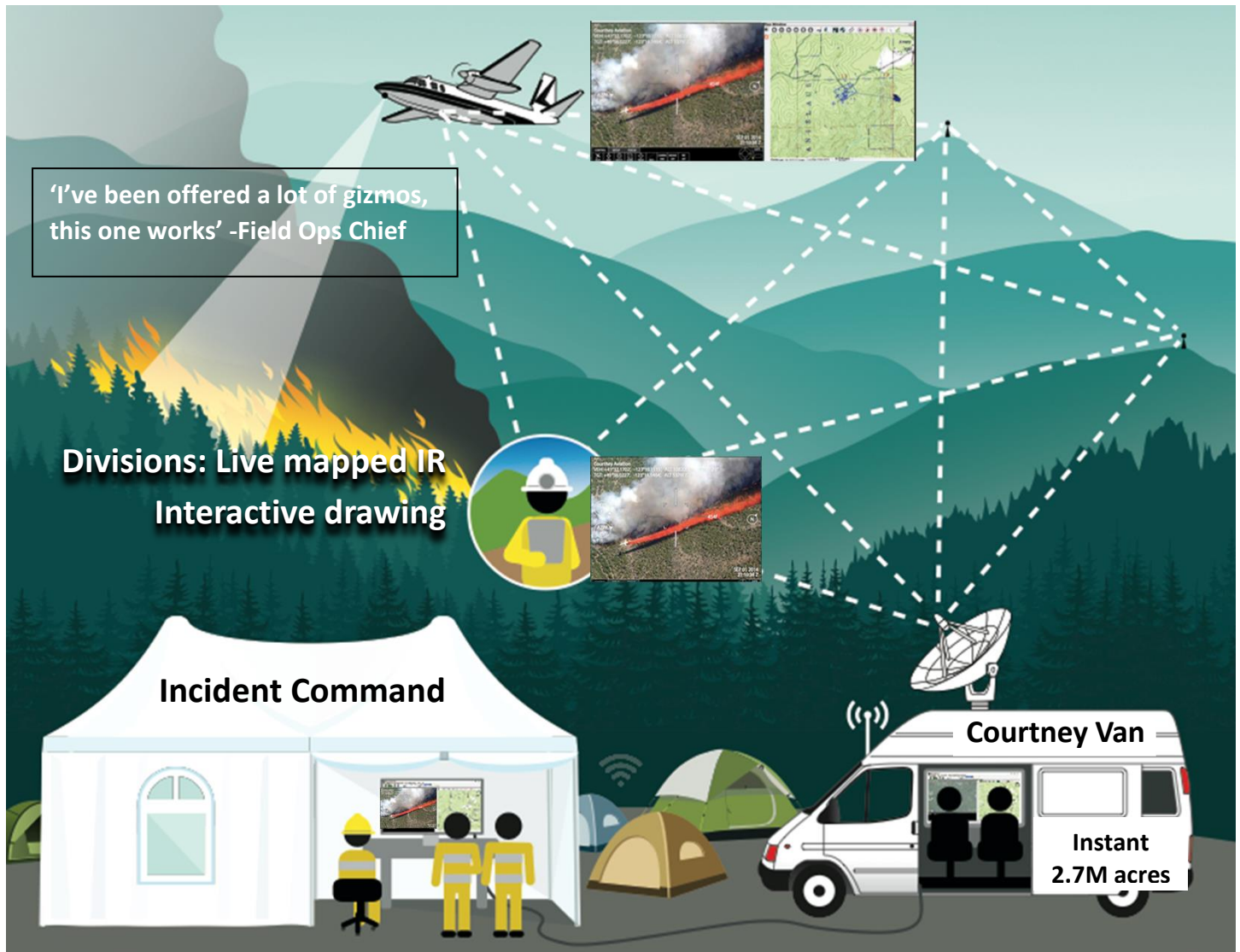
How it Works



Drone gimbal on
Manned aircraft

Courtney Aviation has a color zoom camera and two long wave thermal infrared (LWIR) cameras (FAA approved) in all Type 1 Air Attack 690A Commanders. Hitchhiking for free, a gyro stabilized drone gimbal rotates (slews) by touching or mouse clicking the Tablet PC's video, and a target is locked into highly-stabilized cameras for no-hands tracking. An integrated Inertial Management Unit (IMU) geo-locates every frame on the team's GIS map & drawing whiteboard. Eyes-on-the-fire from air to ground get the same situational awareness, and Courtney's whiteboard server interactively transmits the same map, fire video, and hand-drawing between participants.

Aerial video is transmitted out for ground personnel to simply view, or a ground based operator can have full remote control of the camera system through the mesh network, as though flying in the aircraft. Internet Incident Action Plan (IAPs), updated weather and other documents can also be transmitted throughout the fire.

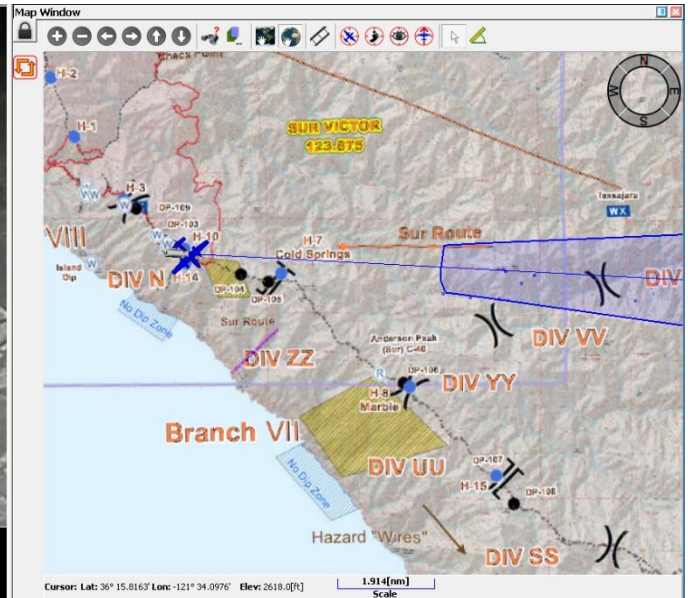


Mesh network: Hi-speed, low latency, self-building and self-healing simplifies connectivity from plane to deep canyons to camp to headquarters

Downlinking live video to ground teams (Division and Branch Supervisors) is possible directly point to point from plane to ground. If the plane is beyond sight, then video is relayed via solar powered mountain top repeaters. The mesh network is stronger, faster, and wider reaching with every additional node (self-building nodes and self-healing). Although one pair of radios can transmit up to 100 miles in a single hop, normally multiple 30 mile hops build redundant reliability, faster speeds, and greater overall distances. Mesh radios (handheld or stationary) have Wi-Fi so participants can watch, draw or control from their own phone/tablet, as well as receive Internet, IAPs, weather, and documents.

Courtney's mesh network normally supports just a few users (10 to 20) without latency (delay), but adding more users or repeaters will further improve speed. Solar powered mountain top repeaters extend the mesh into deep canyons and the backcountry to boots on the ground. Courtney's quick deploy radio vans create a mesh network up to 4,300 square miles (2.75 million-acres) upon arrival. During initial attack, a van on an adjacent hill can quickly relay live air attack video to incoming ground teams, back to a headquarters/base, or anywhere in the world.

Operator stations are Touch Tablet PC laptops. Any mobile device can be used for viewing: iPhone, iPad, Android Tablet/Phone, etc. Most ground users have the possibility to live operate the aerial camera, but normally operation is reserved for a few, since users are happy seeing what the air attack chooses, especially if they can also make requests.



Embedded Fire whirl a mile long visible only by Infrared

Fire video is recorded with embedded metadata for geo-positioned playback (KLV/MSIB/STANAG). Metadata also displays relevant information real-time on screen, like Latitude-Longitude and fire size. Courtney pilots and ground personnel are trained to interpret details for anyone during or post flight. Although IR video is most important for tactical use, updated fire perimeters are mapped after flight for Situations, Operations and Fire Behavior and NIFC EGP.

Benefits to Air Attack and Division/Branch Ground Crews



Air Attack controls from front, back, or operator can be on ground

Fire View's primary purpose is to aid real time tactical firefighting by sharing improved situational awareness and whiteboard drawing with everyone. Perimeter mapping is a bonus.

- See heat, slopovers and spot fires through smoke and night
- Draw and share retardant target line to minimize mistakes
- Keep eyes on the fire as the aircraft flies in or away
- View from all sides of plane
- Determine fire locations and coordinates precisely: Lat-Long, relative to creeks, ridges and dozer lines
- Mountains through smoke
- Night and dark canyons





Hands-off retardant drop tracking with live mapping

Shared Oversight. Quiet and high

- Draw on moving map live to others
- See retardant drops (and everything else) even when not aligned out the window
- Thermal footprint of water (cold) visualized
- Drops auto-recorded for mapping
- Mark any spot to revisit easily
- Coordinates emailed or spoken over the radio
- Google Earth photos (KMZ) emailed
- See multiple targets from one location
- Transmit medical or accident incidents
- Increased level of safety

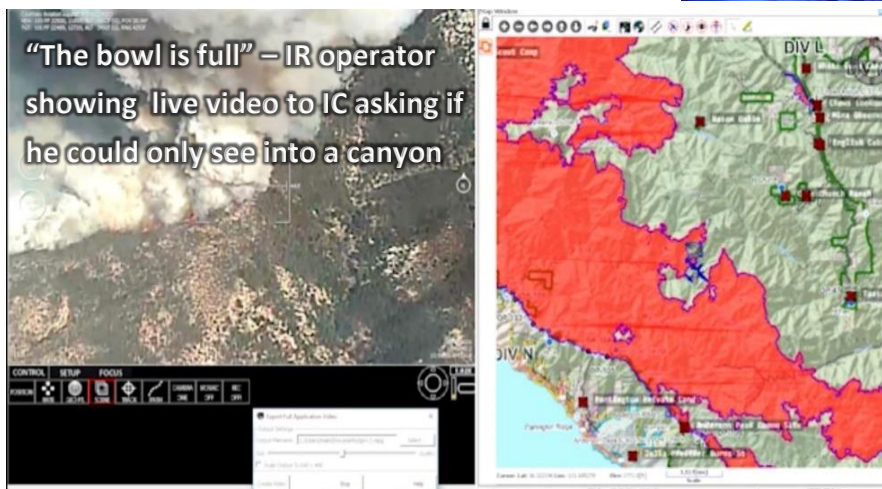


Division, Branch & Incident Command live all at once

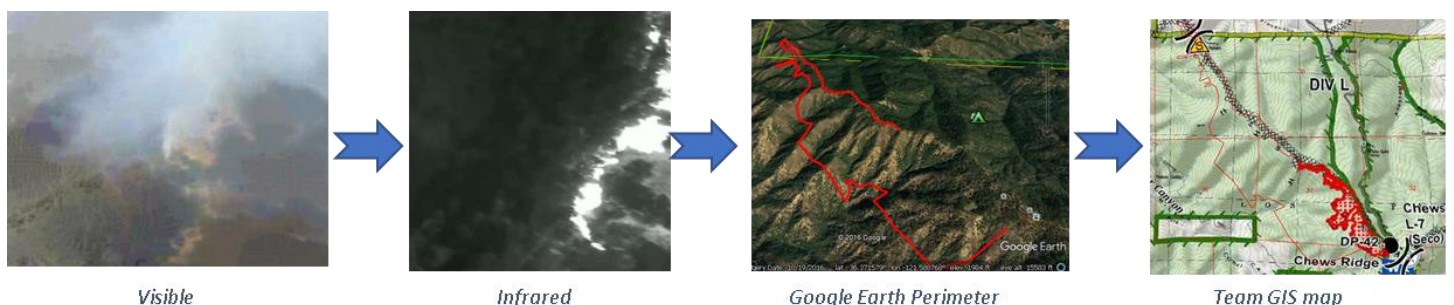
- Transmit and record/map Assets at risk and Assess burned
- Guard people & vehicles under smoke
- Debrief AirOps/Ops and meetings

Live Mapping

- Live Fire updates to team
- Fire Behavior
- Fresh content to Situations and GIS
- Meteorological winds



Aggressive fire behavior is seen prior to personnel deployment



Common Operating Picture (COP)

Provide ground teams on the fire and in camp a common real time situational awareness from the Air Attack's aerial fire view.

- Air ground and Ops are synchronized
- Actions happen correctly and faster
- Reduced radio talk - chatter
- Operator interprets IR
- Leadership all have "Eyes on the Fire"
- Informed decision making
- Assist with escape routes
- Safety improved for everyone involved
- Perimeter updated near real time
- Fire dynamics prior to deploying team
- Fire Behavior Analyst data available nowhere else
- Ops & Supervisors see real time during issues and crucial areas
- Instant Replay always available
- Perimeter import to FS Pro ignition
- Headquarters, dispatch, NIFC and forest headquarters, see, all at the same time
- Naturally keeps different teams all on the same page without distraction
- ICS Situations and GIS mapping utilize the Air Attack video (live and recorded)
- Mesh net delivers team GIS maps and IAP to remote teams
- Internet access available to ground teams through self-healing mesh network
- Public Information Officer (PIO) video for community meetings, supporting government agencies and forest supervisors
- Air attack video is used to brief other agencies like a military EOC, Governor's Office of Emergency Services (OES), Headquarters
- No need to depend on TV stations to view fire video
- Geo-video for BAER teams, and other post fire analysis
- Off season team review and training



Solar powered mountain repeaters run indefinitely & reaches ~1.2 million acres



62 foot mast van oversees whole fire



Ops desk at Soberanes Fire. Live view for decision makers

Technical overview

Fire View is a highly-integrated system of flexible multiple subsystems and components

Base system:

- Imaging sensors with lens
- Gyro stabilized 360-degree gimbal
- Automated image processing and tracking
- Inertial Management Unit (IMU) hardware/software for geo-spatial positioning and metadata

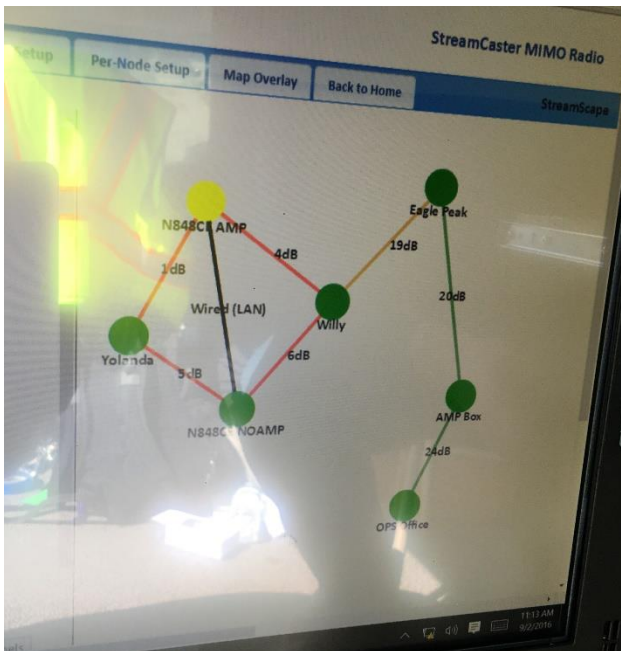


Flame height during burnout, watching progress and scanning for spots

- Analog – Digital conversion of imagery, serial output and control input
- Gigabit Ether Network, Routing, Switching, Virtual Private Network (VPN) Internet feed and redistribution
- View, control and map-whiteboard-drawing server-computers with special software and hardware
- 2D/3D Mapping system for moving-map, viewing integrated video and new map generation

Ground Operation and Advanced Usability systems include:

- FirstNet: Multiple Input/output (MIMO) high speed self-healing microwave mesh radio data network
- Towers, antennas, amplifiers, radio Vans, power systems, chargers and solar panel arrays
- PCs, Laptops, Touch Tablets, iPads, iPhones, Androids for viewing and ground operation
- Personnel for setup, management, operations, interpretation, and mapping
- Common Operating Environment master software and hardware



Radio mesh constant real-time changes and self-healing

Technology ranges from simple deployments with no additional staffing to very sophisticated. An Infrared equipped 690 Commander has excellent Infrared capabilities for tactical Air Attack completely by itself. The pilot and ATGS benefit by operating the components they desire with no outside help at all. A Courtney operator or ATGS trainee on board will triple the usefulness of the infrared, even with no ground support. Downlinking directly to ground crews (Division and Branch Supervisors), especially on Initial Attack requires little to no new ground support once the team has a Fire View downlink radio and viewing device. Ground teams can use their own iPhone, iPad, Android, PC or Mac, or Courtney will supply an iPad.

Extended Attack fires will benefit from a more sophisticated configuration. The airborne infrared system will be operational when the first Courtney plane first arrives on scene, and become more functional to ICS and ground teams as downlink equipment

is deployed. An extended network between plane, ICS Fire camps and Ground Teams starts when Radio Vans arrive. Seamlessly

interconnecting deep canyons, spike camps and different teams with live video, drawing and internet may take several days depending on how large the fire is, and how much support the fire team's communications provide.

Summary

Beyond Air Attack seeing through smoke and darkness, Fire-View Downlink brings this situational awareness and drawing real-time to everyone as a Common Operating Picture. Updated perimeters and fire behavior are a bonus.