Fire Integrated Real-Time Intelligence System (FIRIS)

After-Action Report

17 March 2020

FIRIS PILOT

Project Name	Fire Integrated Real-Time Intelligence System (FIRIS).
Exercise Dates	23 Aug 2019 – 19 January 2020.
Scope	This project was a pilot focused on providing Intelligence, Surveillance, and Reconnaissance (ISR) and real-time fire modeling to initial attack responders in Southern California.
Mission Area(s)	Response.
Core Capabilities	Emerging Technology: ISR, Information & Intelligence Data Dissemination, Predictive Fire Behavior Modeling Resources: People, Collaboration
Objectives	Establish and rapidly distribute data during initial response; focused on fire perimeter mapping in near real-time and within 5 minutes of aircraft arrival at incident. Provide ground-based wildland fire intelligence in a Common Operational Platform to decision makers, Regional Emergency Operating and Command Center staff, and agency policy makers. Utilize “continuous” fire spread projection modelling via University of California San Diego’s Supercomputer Center WIFIRE Firemap Program. Define lessons learned and share with statewide fire community.
Threat or Hazard	Wildland Fire.
Scenario	FIRIS combines a dedicated fixed-wing aircraft equipped with sensors capable of providing enhanced intelligence, surveillance and reconnaissance (ISR), a supercomputer-based fire prediction system and situational awareness software into one platform to support commanders and decision makers for initial response.
Sponsor	Orange County Fire Authority; AB 74.
Participating Organizations	Counties of Orange, Ventura, Los Angeles, Riverside & San Diego. Additional collaboration with: CAL FIRE, Southern California Geographic Area Coordination Center, CAL OES, Los Angeles Fire Department, City of San Diego Fire-Rescue Department and the Counties of San Bernardino, Santa Barbara, and Kern.
Point of Contact	Fire Chief Brian Fennessy, Orange County Fire Authority.

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EXECUTIVE SUMMARY

The Fire Integrated Real-time Intelligence System (FIRIS) Pilot Program demonstrated enhanced wildfire situational awareness for first responders by combining Intelligence, Surveillance, and Reconnaissance (ISR) capabilities with accurate, real-time wildland fire spread modeling and an integrated common operational software platform for sharing and accessing information. During the 150-day pilot program, FIRIS had a significant impact on combating the effects of wildfire in Southern California.

- Critical evacuation information was transmitted to incident commanders on 45 wildfire incidents in the Southern California region.
- Early predictive modeling from FIRIS assisted emergency response officials with evacuation decisions on 315,000 potentially impacted homes and 406,000 residents.
- Predictive fire modeling helped Incident Commanders and Agencies make better targeted evacuation decisions reducing number of people evacuated.
- Consistent and shared intelligence enhanced interagency coordination during rapid evolving fires like the Tick and Getty Fires when resources were mobilized from multiple jurisdictions.
- FIRIS real-time fire perimeters were provided to incident and agency personnel on 43 wildfires assisting in directing and applying resources from 10 jurisdictions.

FIRIS was successful because it was the first fully integrated approach to providing intelligence information **for initial response**. In order to integrate a wide array of technologies providing real-time information, FIRIS defined and managed a Concept of Operations (CONOPS) that focused on the interactions of four specific components under a single, unified command.

The Interagency Wildfire Community should begin now to integrate the lessons of FIRIS into operating agreements and CONOPS for 2020 and beyond.

- The Southern California Wildfire Fusion Center ('Fusion Center') – hosted by the Los Angeles Fire Department (LAFD), the Fusion Center provided on-demand and when needed, 24/7 FIRIS analytical support. The Fusion Center analysts utilized the advanced computing environment of the University of California San Diego WIFIRE supercomputer-based fire modeling and prediction system to perform accurate fire prediction and assessment based on the information synthesized in the Fusion Center.
- Dedicated ISR Aircraft – Courtney Aviation provided a dedicated ISR aircraft capable of producing real-time video and hot spot detection. The dedicated FIRIS ISR aircraft provided updated information to support rapid collection and reporting of fire activity for incident operations and real-time fire modeling.

- External ISR Sensors and Operational Response Information – Sensors throughout Southern California including static video cameras and weather sensors, along with the California National Guard, local and regional computer aided dispatch, real-time vehicle tracking, and alerts provided persistent, real-time data to augment and enhance situational awareness and fire modeling when the ISR aircraft was enroute or out of range.
- Common Operational Platform – The Intterra software platform aggregated sensor and operational data and distributed the fused intelligence results (perimeter map data and WIFIRE modeling) to decision makers and field personnel at the local, regional, and state level. Most important, it shared FIRIS data with statewide programs and information systems.

The components and concepts developed and demonstrated in FIRIS are readily available and can contribute at the most crucial decision phase in a wildland fire – the first few hours. In addition to technology adoption recommendations, the following broad policy and operating guidance recommendations can ensure that California and the fire community continue to leverage and build on the successes of FIRIS.

- Collaboration and data sharing are critical to leveraging today's ISR and modeling capabilities and 'moving left of ignition.'
- The rapid pace of intelligence and information flow highlighted the need to define the decision points that are supported and the standards that are used to support them.
- Emerging technology demands a standards-based ability to request, ingest and exchange data from multiple sources while understanding the capabilities and limitations of each.
- Information systems and sensors must share data seamlessly, and common operating platforms must allow decision makers from disparate agencies to share the same view.

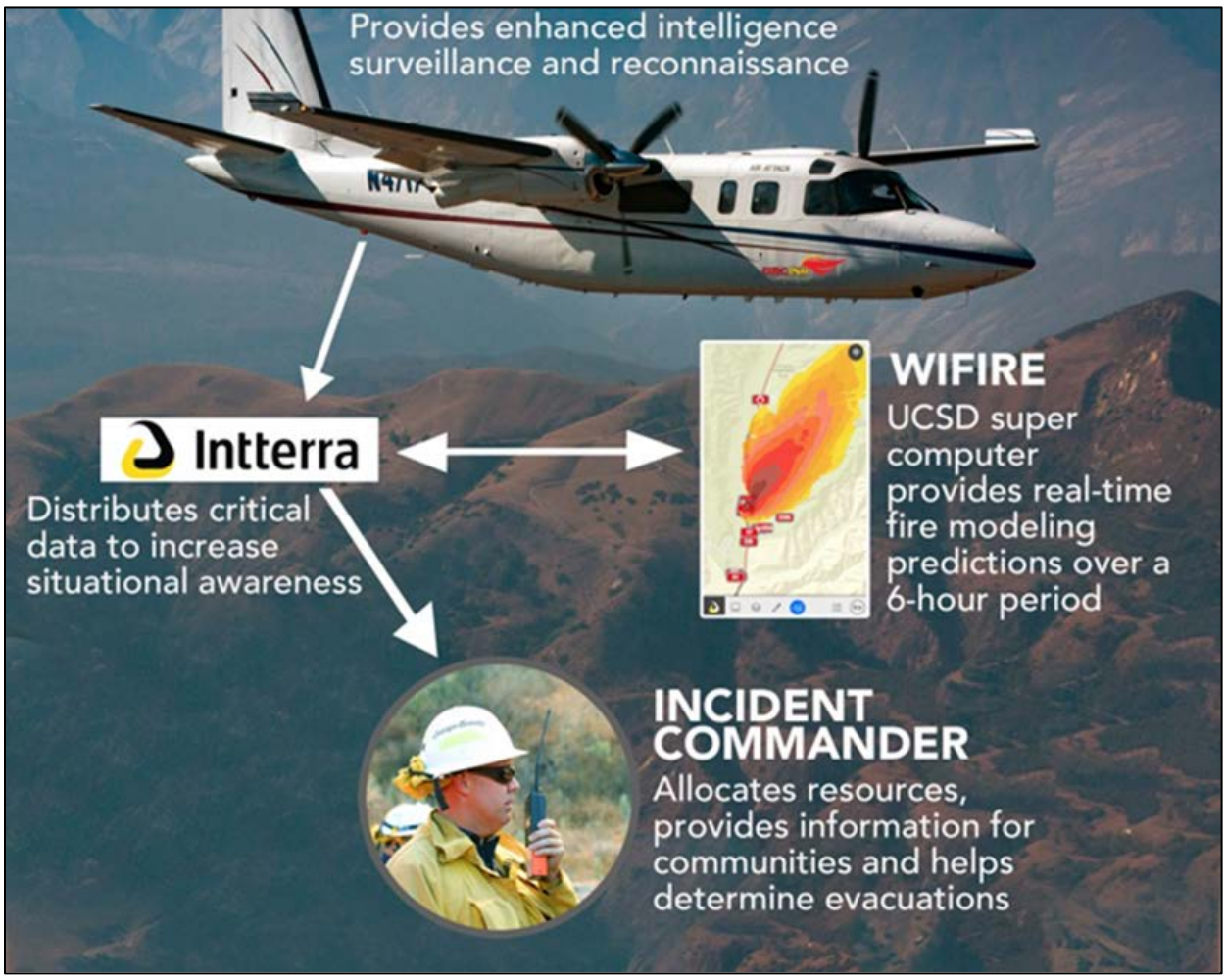
The capabilities demonstrated by FIRIS are a necessity to combat the dynamic fire events of 2020 and beyond. The integration of intelligence information and fire prediction during initial response is as important as rapid and direct concentration of ground fire resources and aerial fire suppression. Each primary geographic region *should develop a strategy to augment initial response with the primary components demonstrated by FIRIS* including:

- **Fire modeling and prediction** capable of alerting decision makers to evolving incidents.
- **'In place' ISR resources** (wildfire modeling cameras, satellite fire detection systems) capable of finding and locating events.
- **Dedicated overhead ISR systems** ready to provide support within 30 minutes of an evolving event.
- **A communications infrastructure** to ensure that a core set of ISR products are delivered regardless of location.
- A **data sharing framework that links everyone to an accurate, common view of the situation** to support regional operations and incoming mutual aid.

OVERVIEW

The Fire Integrated Real-time Intelligence System (FIRIS) Pilot Program provided enhanced wildfire situational awareness for first responders. Initial and extended response Incident Commanders (IC) often lack access to intelligence and information to support the complex decision requirements for today's dynamic wildfires. There may be no greater value to the decision makers on the ground and in the air, than having dedicated resources providing early intelligence on where and when an active wildfire is heading and how it is behaving.

The FIRIS Pilot Program demonstrated this ability by combining Intelligence, Surveillance, and Reconnaissance (ISR) capabilities with accurate, real-time wildland fire spread modeling and an integrated common operational software platform for sharing and accessing information.



History

Wildland fire remains one of the most significant threats to life and property in California. Lives, property, and natural resources are threatened on a 24-hour basis. A recent risk assessment conducted by the California Department of Forestry and Fire Protection (CAL FIRE)

concluded that an estimated 11 million residents, or the equivalent of 1 in 4 Californians, live in areas considered to be at high risk of a wildfire.

As a regional fire agency, the Orange County Fire Authority (OCFA) plays a key role in wildfire mitigation and suppression in Southern California. Given the devastating and destructive wildfires of 2018, and the anticipation of the 2019 wildfire season, the OCFA Fire Chief and staff sought legislative assistance to implement a pilot program focused on the experiences of Southern California and the unique blend of technology available.

In October of 2015, the Los Angeles Fire Department (LAFD) began a partnership with the WIFIRE Lab of the San Diego Supercomputer Center at the University of California San Diego to explore applying advanced modeling and data analysis research to operational wildfires and incident response.

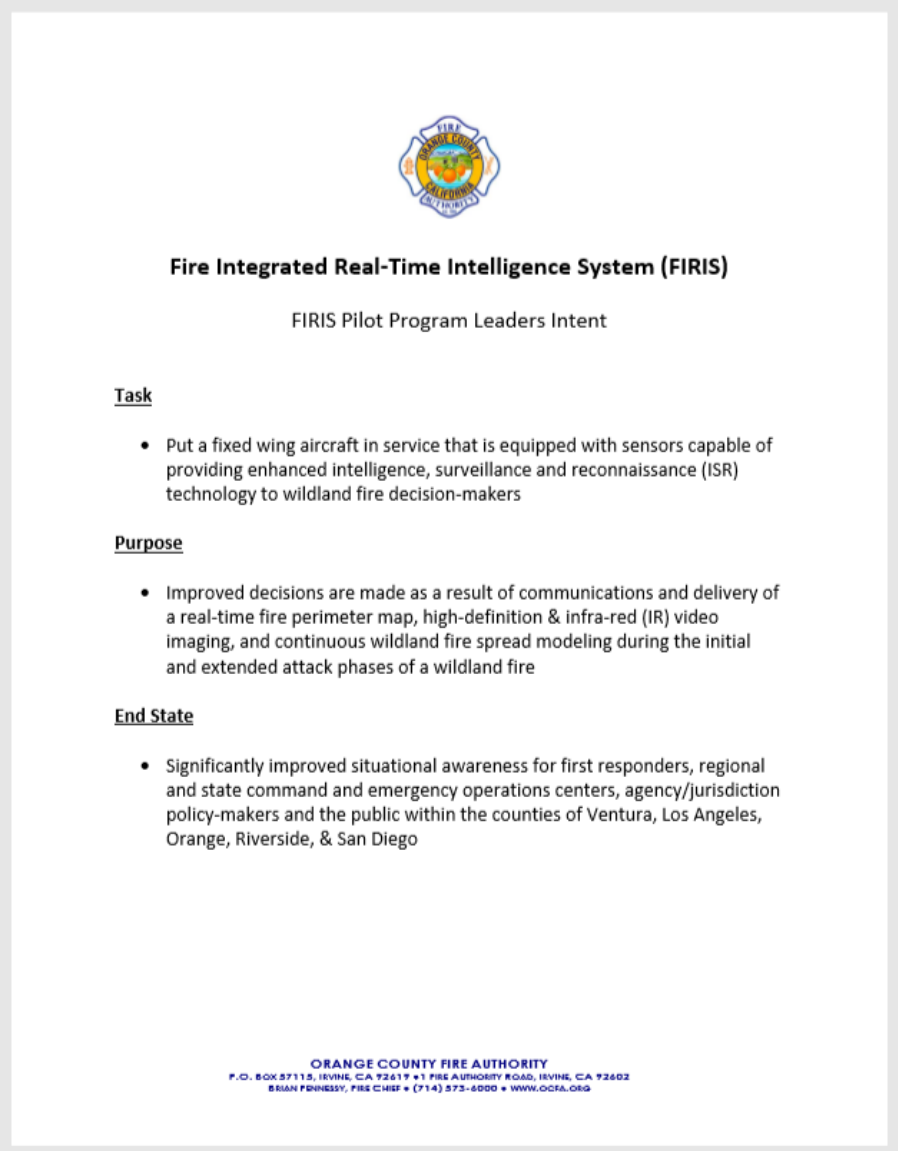
Between 2016 and 2017, the City of San Diego Fire-Rescue Department and OCFA partnered with local industry to evaluate ISR platforms and developed the concept that ISR aircraft could not only assist firefighting efforts for extended attack fires, but could also provide critical intelligence during initial response operations if they were available for local dispatch.

In late 2017, the City of San Diego Fire-Rescue Department combined the capabilities of an ISR aircraft and WIFIRE during the Santa Ana wind driven wildland fire (Lilac Fire) in North San Diego County. The ISR aircraft provided real-time high definition color and infra-red video and WIFIRE performed fire spread modeling. Dozens of fire spread models were completed over the first 36 hours of the fire. Each proved demonstrably accurate and validated the WIFIRE fire spread modeling capability.

In early 2019, OCFA met with State of California legislators and committees to share the value and application of real-time information to wildfire response and advocated that this information should be available at the outset of a wildfire. In spring 2019, as a result of legislator visits in Sacramento, the OCFA was notified that State Assemblymember Cottie Petrie-Norris, had requested and was successful in obtaining $4.5 million of the Governor's FY19/20 Budget to launch the FIRIS program.

Leaders Intent / Objectives

FIRIS was conducted as pilot program to provide initial response, real-time fire perimeter intelligence to first responders, command, and predictive services within 5 minutes of aircraft arrival at incident.



Fire Integrated Real-Time Intelligence System (FIRIS)

FIRIS Pilot Program Leaders Intent

Task

- Put a fixed wing aircraft in service that is equipped with sensors capable of providing enhanced intelligence, surveillance and reconnaissance (ISR) technology to wildland fire decision-makers

Purpose

- Improved decisions are made as a result of communications and delivery of a real-time fire perimeter map, high-definition & infra-red (IR) video imaging, and continuous wildland fire spread modeling during the initial and extended attack phases of a wildland fire

End State

- Significantly improved situational awareness for first responders, regional and state command and emergency operations centers, agency/jurisdiction policy-makers and the public within the counties of Ventura, Los Angeles, Orange, Riverside, & San Diego

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Operational Impact

The FIRIS program demonstrated the operational value of rapid ISR and fire prediction modeling during initial response operations. Over a 150-day period, the program supported over 45 wildfire incidents thru 60+ aircraft flights, 225 fire models, and provided 24/7 support during the most intense fire weather periods. The following fire incidents highlight some of the operational successes of FIRIS:

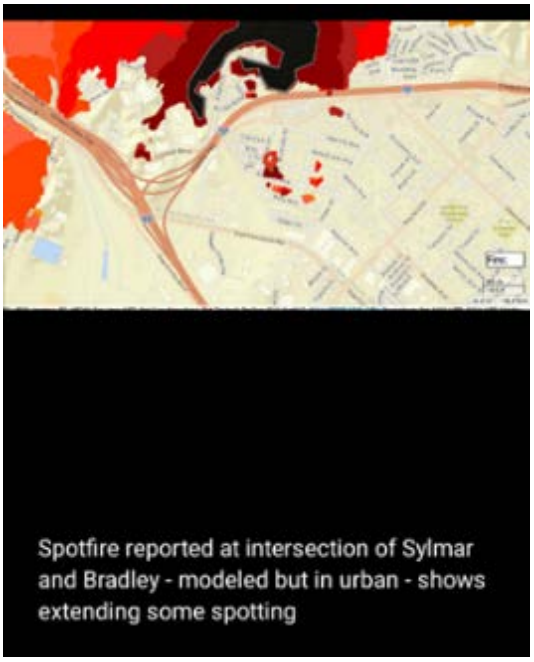
- Palisades Fire - The responding incident management team (IMT) knew where the worst potential damage was going to occur because of FIRIS perimeters and models. The IMT arrived knowing exactly where the fire was and what it was doing.

- Tick Fire – FIRIS provided overhead situational awareness in the first 3 hours of the Tick Fire. Los Angeles County Fire determined evacuation needs within 15 minutes of receiving a perimeter and prediction model. This information was used not only for evacuation decisions, but also to keep the public and media well informed of the fire's progress and containment efforts. Having access to this information early into the incident kept all stakeholders well informed from start to finish.
- Maria Fire – Evacuations were ordered within 20 minutes of dispatch on the Maria incident based on FIRIS fire predictions. Emergency management and law enforcement agencies relied on real-time intelligence to support multi-agency objectives.
- Wendy Fire – Direct communication with the FIRIS aircraft allowed the Incident Commander to refocus ISR efforts on recent fire activity and emerging areas of interest during the initial response.
- Getty Fire – The LAFD Fire Chief shared perimeters and models with law enforcement and used FIRIS real-time information to brief news media outlets and the public. Predictive models informed evacuations and fire suppression tactics.

Incident Snapshot – Saddle Ridge Fire

The Saddle Ridge Fire occurred near the San Fernando Valley of Los Angeles County, California. The fire started on October 10, 2019 at 9:03 p.m. Burning in a mixture of wildland and urban interface, firefighters were tasked initially with structure protection as the fire grew to 200 acres within one hour. Overnight, prompted by high winds, the fire crossed Interstate 5 and triggered spot fires in the foothills above Porter Ranch. The fire threatened the communities of Sylmar, Porter Ranch and Granada Hills. Mandatory evacuations were put in place for the Oakridge Estates.

The FIRIS program was on 24-hour staffing in response to an anticipated Santa Ana wind event. Over the course of one day, FIRIS supported three significant incidents, with Saddle Ridge being one of the most influential of the program. Based on direct intelligence from the FIRIS program, LAFD commanders oversaw evacuation and used modeling to assess the fire's threat to adjacent communities. Current and projected Fusion Center perimeters were also used to create resource orders from supporting agencies.

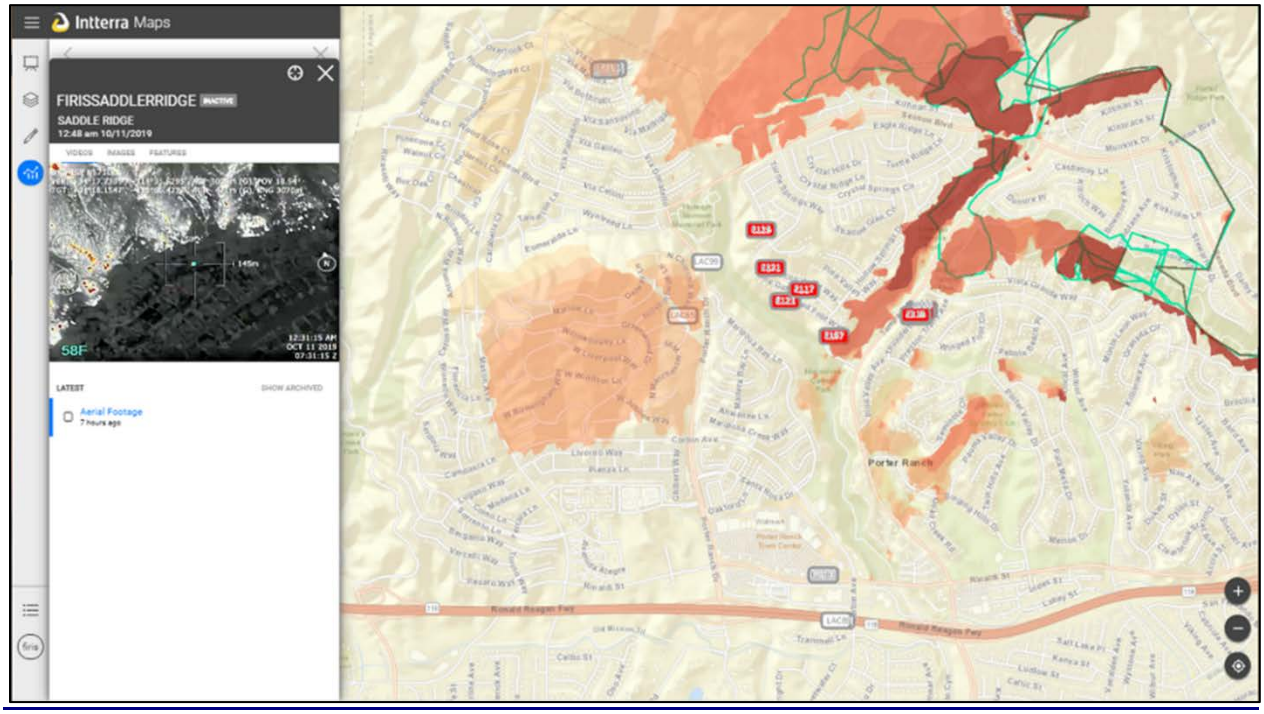


The Fusion Center began supporting the Saddle Ridge Fire and the LAFD resources with fire modeling based on dispatch information and communication with responders already on scene. The FIRIS aircraft

was diverted to the incident and delivered the first comprehensive fire perimeter by 22:52 (90 minutes after fire start).

The Saddle Ridge Fire was a pivotal moment in the FIRIS pilot program. The use and integration of FIRIS products during initial response helped to confirm the value of the program with LAFD and partner agencies while refining the FIRIS operations based on real-world events. The early coordination between all elements of the FIRIS program (Fusion Center, ISR aircraft, air tactical group supervisor (ATGS), and agency command centers) allowed FIRIS to provide seamless support from initial detection thru aircraft tasking to real-time overhead intelligence. Valuable intelligence (size up, perimeter, modeling) was available early, consistently and within minutes to support critical evacuation and size-up decisions. The following key lessons were adapted from the Saddle Ridge Fire and used throughout the remainder of the program.

- 24-hour/overnight staffing of ISR aircraft, ATGS, and Fusion Center during high threat weather conditions ensured support for rapidly evolving emerging fires.
- Repeat perimeters from the ISR aircraft during initial attack confirmed fire behavior and validated fire model forecasts, giving firefighters confidence in response tactics. Rapid model turnaround was the key for keeping teams informed in timely manner.
- The aircraft ordering and coordination procedures allowed for assignment and diversion of the aircraft during multiple near-simultaneous ignitions.
- The multi-agency response for Saddle Ridge provided the opportunity to expose a wide interagency audience to FIRIS in a short timeframe. FIRIS was able to familiarize new users into the common operating platform and share intelligence with the Southern California Geographic Area Coordination Center (South Ops) and partner agencies.

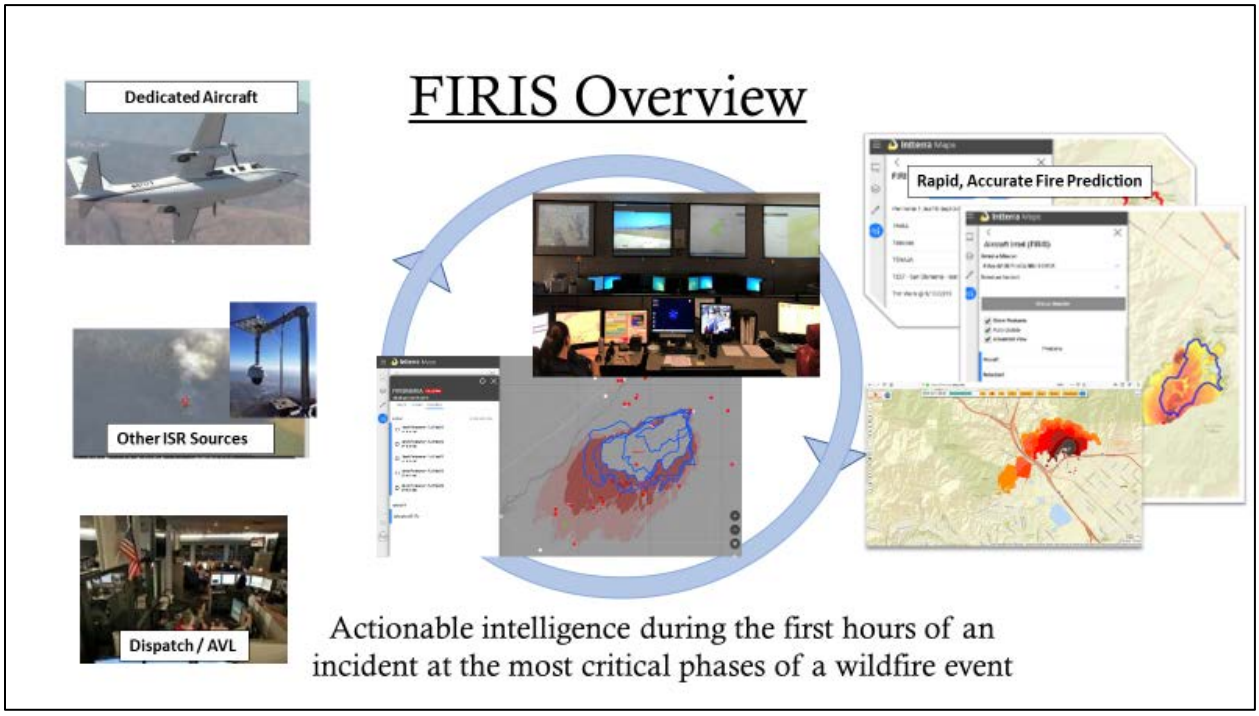


EXECUTION

Concept of Operations

The intent of the FIRIS program was to help Incident Commanders and agency decision makers allocate resources, communicate with community members and decide on evacuations during initial response. To support this goal, FIRIS developed a Concept of Operations (CONOPS) focused on:

- Providing intelligence (fire location, perimeters and projections) during the response phase (initial attack and extended attack).
- Providing a fire prediction model within 15 minutes of fire notification and location. Rapidly update predictions based on new information provided by field personnel, cameras, and aircraft.
- Providing a perimeter to response forces, emergency operations centers, and decision makers within 5 minutes of aircraft arriving on scene and additional perimeters every 15 minutes.
- Integrating all the information into a shared system that all responders could access.

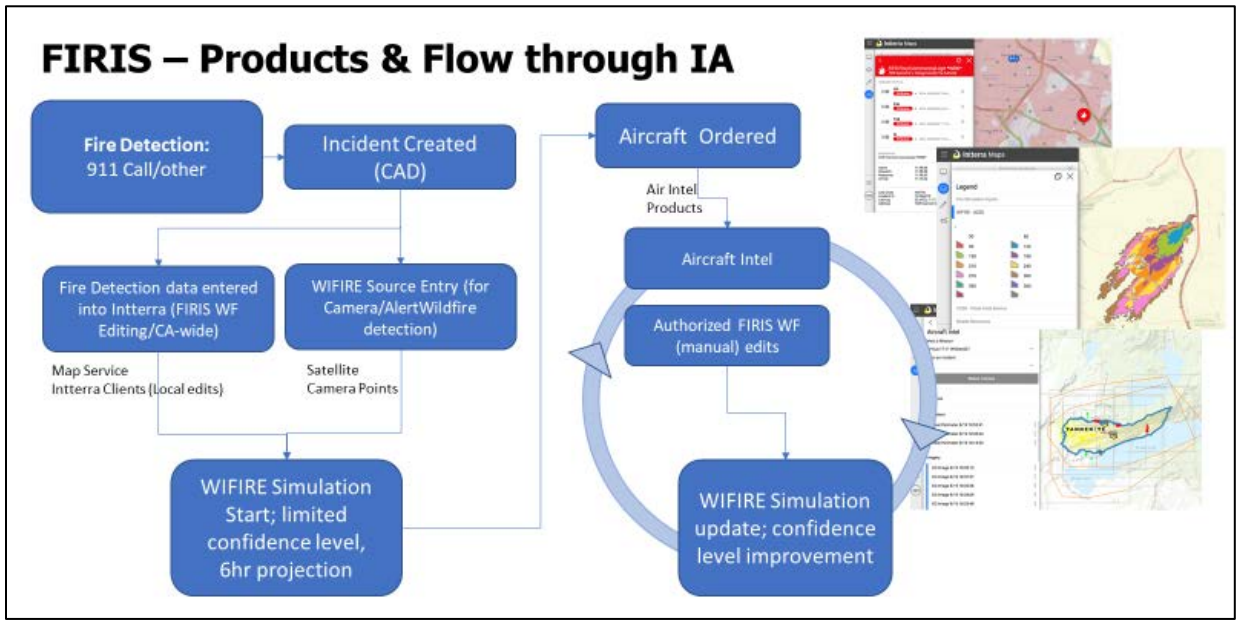


As an initial response capability, all FIRIS activity started with an initial intelligence input. The Southern California Wildfire Fusion Center ('Fusion Center'), hosted at LAFD, monitored sensor and operational inputs from throughout Southern California. By monitoring wildfire cameras, National Weather Service reports, and satellite-based fire detection reports alongside

operational fire agency data such as vehicle tracking and 911 dispatches, the Fusion Center was able to conduct initial assessments while emergency response crews were enroute or just arriving at vegetation and brush fires.

The Fusion Center assessed incoming intelligence and performed initial fire prediction modeling. Based on the analysis, the Fusion Center would disseminate the initial model via the FIRIS Common Operational Platform as well as direct communications (text messaging and WhatsApp 'Activation Channel') to responding units and the other elements of the FIRIS program including the ISR aircraft. In addition, each agency command center monitored traditional initial responses and resource allocation inputs from local dispatch centers.

Based on the operating guidelines of each agency, the IC or leading command center would request the FIRIS ISR aircraft or additional Fusion Center fire modeling and prediction capabilities. During transit to a fire incident, the FIRIS ISR aircraft would provide live video and aircraft positioning for situational awareness. Once on scene, the aircraft would begin mapping operations to provide hot spots and perimeters for use by the incident as well as inputs for refinement of the fire prediction model. Refined fire predictions and real-time mapping were disseminated by the FIRIS Common Operating Platform to field and agency decision makers as well as connected agency systems including CAL OES SCOUT and LAFD Ready.



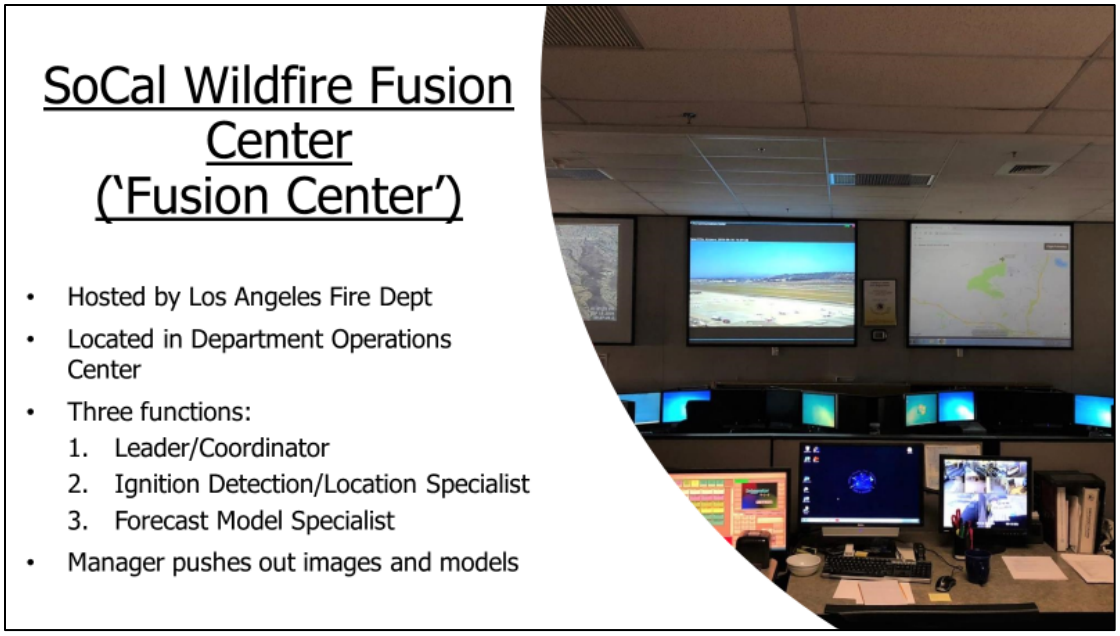
FIRIS Components

FIRIS was successful because it was the first fully integrated approach to providing intelligence information for initial response. In order to integrate the wide array of public and private technologies in real-time, FIRIS defined and managed a CONOPS that focused on the interactions of four specific components under a single, unified command.

- The Southern California Wildfire Fusion Center ('Fusion Center') – The integration of disparate intelligence sources requires a central, coordinated activity to review, filter, and coordinate their application in support of fire events. Hosted by LAFD, the Fusion Center provided on-demand and when needed, 24/7 FIRIS analytical support. The Fusion Center analysts utilized the advanced computing environment of the University of California San Diego's WIFIRE fire modeling and prediction system to perform accurate fire prediction and assessment based on the information synthesized in the Fusion Center.
- Dedicated ISR Aircraft – Dedicated overhead intelligence is the best source of real-time updated information on the overall extent of an emerging fire. Other sources can provide snapshots of what is happening, but an overhead resource provides a full, uninterrupted view of a fire event. Courtney Aviation supplied a dedicated ISR aircraft capable of producing real-time video, perimeter mapping and hot spot detection.
- External ISR Sensors and Operational Response Information – Sensors throughout Southern California including static video cameras, the California National Guard, local and regional dispatch system, real-time vehicle tracking, and weather sensors and alerts provide real-time information on emerging incidents and conditions. They were used to inform incident personnel and Fusion Center analyst about new ignitions, fire locations, spot fires, and fire behavior.
- Common Operational Platform – To integrate and exchange data from sensors and systems at the speed of emerging events requires a platform to assimilate the data as well as distribute it in real-time to the responder community to provide a single, common view of events. The Intterra software platform aggregated sensor data and distributed the fused intelligence results (perimeter map data and WIFIRE models) to decision makers and field personnel at the local, regional, and state level. Most important, it shared FIRIS data with statewide information systems.

Fusion Center

The Southern California Wildfire Fusion Center ('Fusion Center') served as the central data analysis, prediction, and center of communications activity for the FIRIS program. The Fusion Center monitored fire alerts and fire response activity, reviewed real-time ISR data, and supported initial response fire modeling for the FIRIS participants and all supported agencies. The Center also led communications for all FIRIS activations, confirming awareness of incidents across participants.



Fire Prediction Modeling

The WIFIRE Lab provided the fire data and modeling workflows for the Fusion Center and the FIRIS program. Staff from WIFIRE were integrated into the Fusion Center (virtually and physically) based on staffing levels. Fire modeling operations were performed in the WIFIRE Firemap tool. The WIFIRE Firemap tool is a data and modeling platform that enables real-time integration of data from multiple sources using automated workflows. It was adapted to support the FIRIS program including: (i) seamless integration with Intterra's common operating platform; (ii) addition of PulsePoint geolocated notifications; (iii) automatic dead fuel moisture updates; and (iv) visualizing multiple camera centerline viewpoints to triangulate and validate the initial ignition reports. Modeling outputs from Firemap were fully integrated into Intterra's Common Operating Platform for a seamless, single situational awareness view of fire operations.

ISR Fixed-wing Aircraft

Courtney Aviation provided a dedicated ISR aircraft and crew capable of performing data collection and real-time dissemination in support of ground operations. The aircraft were USFS Region 5 or CAL FIRE Type 1 Air Attack carded and equipped with communications systems for aviation and fire voice to voice (two-way radio) communications as well as data communications to transmit intelligence data to Fusion Center, WIFIRE, and the Common Operating Platform.

The primary FIRIS aircraft was configured with steerable thermal infrared (IR) and super-zoom color cameras capable of providing full motion video (FMV) streamed with a georeferenced moving map. The system was capable of extracting fire and perimeter information from the video during flight or post-flight. The aircraft utilized multiple communications systems to ensure that collected data was available in real-time. The communications systems available included:

- Cellular FirstNet/ATT and other cellular carriers
- MANET Mesh network capable radios
- Iridium satellite back-haul

To augment the communications capability, Courtney Aviation utilized a second relay aircraft as well as a ground communications van to extend the coverage and access of the ISR aircraft in situations where communications were degraded.

The FIRIS Pilot Program included the services of an Air Tactical Group Supervisor (ATGS). The ATGS served as crew members in the Courtney Aviation aircraft and coordinated the integration of the ISR aircraft into fixed- and rotary-wing aircraft operations over an incident.

The FIRIS ATGS primary functions were focused on supporting and integrating the aircraft ISR operations into operations within the airspace. These included the following:

- Coordinate, assign, and evaluate the use of the FIRIS aircraft in support of incident objectives.
- Collaborate with ground personnel to develop and implement tactical and logistical missions on an incident.
- Communicate current and expected fire and weather conditions.
- Provide candid feedback regarding the effectiveness of FIRIS aviation operations and overall progress toward meeting incident objectives.
- Work with dispatch staff to coordinate the ordering, assignment, and release of FIRIS aircraft in accordance with the needs of fire management and incident command personnel.

The ATGS were also used in a multi-mission role and served as ATGS on designated missions. This occurred when existing or exiting Aerial Supervision (both ATGS and Helicopter Coordinator) handed the Aerial Supervision role off to the ISR aircraft. The traditional ATGS roles and responsibilities include:

- Pre-Flight mission planning
- Enroute procedures
- Enroute communications

- Determining hazards
- Risk management
- Air Traffic Control in the Fire Traffic Area over a wildland fire
- Coordination of, and assignment of, aerial assets to support the IC needs for tactical support to ground fire fighters
- Crew resource management (information and task sharing)
- Frequency management

ISR and Operational Data Systems

In order to support modeling and assessment to initial response operations prior to request and launch of the ISR aircraft, FIRIS relied on a network of ISR sensors in Southern California as well as direct operational data from the participating agencies. The FIRIS Common Operating Platform connected and maintained data interfaces to sensor systems to enable the Fusion Center to quickly assess incident locations, detect changing conditions or behavior, and to validate what was happening on-the-ground to steer analysis.

The following ISR sensors were linked together:

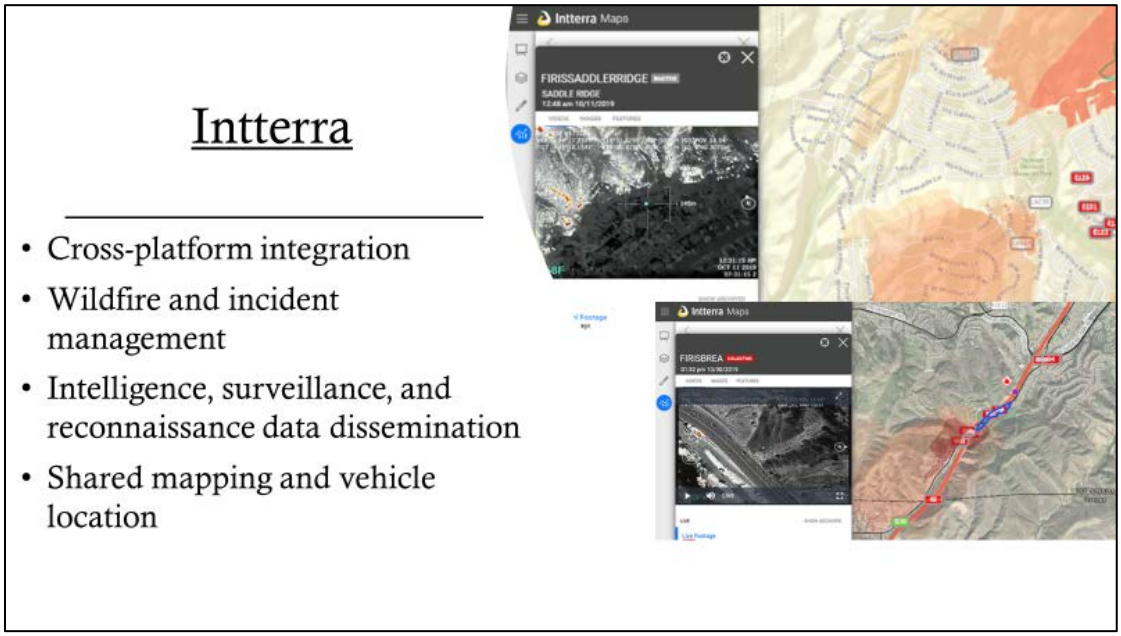
- HPWREN/ALERTWildfire Video Cameras – the HPWREN and ALERTWildfire video cameras are a series of state-of-the-art stationary and Pan-Tilt-Zoom (PTZ) fire cameras and associated tools to help firefighters and first responders to discover/locate/confirm fire ignition and monitor fire behavior through containment.
- Satellite IR Detection – In addition to NASA supported satellite fire detection from the MODIS and VIIRS systems, the National Weather Service in San Diego and other agencies provided alerts and reporting on large fires from the GOES weather satellites.
- California National Guard Watch Desk – the California National Guard staffed a 24/7 reporting activity desk to assist California in reporting and tracking fire events.
- Weather stations – The National Weather Service (NWS) and the interagency fire community operate a series of local weather stations including Mesonet and Remote Automatic Weather Stations (RAWS) which were used to gather local weather conditions for modeling and decision making.

In addition to ISR sensors, the FIRIS program linked and shared operational data from fire agencies using the Intterra platform and local agency platforms. These included vehicle location tracking data and Computer Aided Dispatch (CAD) data. In addition, the FIRIS project gained permission to obtain and share PulsePoint incident data.

Common Operating Platform

Intterra served as the technology integration tool and FIRIS Common Operating Platform. The Intterra software platform managed and exchanged data from all of the FIRIS sensors,

operational data from the participating agencies, and fire modeling results to present a single common view of FIRIS activities for supported fire agencies. In addition, Intterra managed and exchanged data interfaces to external-managed systems including the Situation Awareness and Collaboration Tool (SCOUT) and the Android Team Awareness Kit (ATAK) as well as LAFD Ready and other agency-based common operating platforms.



OBJECTIVE CAPABILITIES

FIRIS established objective capabilities to refine operations and measure the effectiveness of the program. Each functional area is described here with key observations and suggestions for continuous improvement.

Operations

Dispatch and Ordering

The FIRIS aircraft was operated as an OCFA exclusive-use platform to allow for immediate dispatch and response as requested by an incident. The aircraft ordering process was developed collaboratively after the program initiation in August 2019. It was modeled after dispatch guidelines for aircraft systems managed by local agencies. The cost for ordering and operating the aircraft was captured by the original state funding.

The FIRIS aircraft was available for ordering and use under the following guidelines.

- Federal Agency Request: Utilize the local forest agreement ordering process (Cooperative Fire Protection Agreement and Operating Plan). If no agreement was in place, the federal agency would place the request to the OES Operational Area to begin the OES Ordering Process.
- State Agency Request: CAL FIRE Unit requests via the Operations Coordination Center (OCC) in support of a State Responsibility Area (SRA) Direct Protection Area (DPA) incident or SRA Threat Area. The OCC would place the request to the contract county or agency hosting/controlling the aircraft (i.e. if aircraft was in Van Nuys, the request would be placed from OCC to Los Angeles County in the Resource Ordering and Status System).
- Local Government Agency Request:
    - Region 01: Request received from OES Operational Area within Region 01. OES Region 01 provided dispatch information to hosting/controlling agency.
    - Requests between Region 01 and Region 06: An OES Region received a request from an OES Operational Area in their Region. If ISR aircraft was in the adjacent OES Region, the OES Region would be allowed to place the request directly to the other OES Region. (*Only approved between Region 01 and Region 06.).*

Strengths

Strength 1: ISR aircraft dispatch procedures were aligned with local aircraft dispatch procedures. This allowed local agencies to easily request and dispatch aircraft within the local response area. The Region 01 and Region 06 process was clear.

Strength 2: ISR aircraft dispatch procedures included flexibility in mission tasking to allow for re-tasking of aircraft during a mission in the event of multiple ignition events. In addition, they allowed FIRIS to launch the ISR aircraft while the ordering process was being completed, provided that the agency controlling the aircraft received the incident and air frequencies.

Strength 3: Establishing a Resource Ordering and Status System (ROSS) identifier was important to agency adoption of the ISR asset.

Areas for Improvement

Area for Improvement 1: The lack of an operating agreement and established mutual aid agreement hampered the participation and coordination of FIRIS between local, state, and federal jurisdictions.

Area for Improvement 2: Dispatch procedures were developed mid-season and after program start. This led to an underutilization of the aircraft due to lack a familiarity with the process, uncertainty for cost implications, and excessive in-person coordination. ICs were reluctant to utilize the resource in the time-constrained dynamic of initial response.

Area for Improvement 3: Due to the unfamiliarity with the FIRIS ordering process and the desire to learn and understand how to use the resource, the dispatch process was shortened and placed an over-reliance on South Ops to coordinate and share information on what FIRIS was assigned to do and requested for.

Area for Improvement 4: Lack of insight into the daily status of the ISR aircraft outside of the program hindered interagency planning for and utilization of the asset. Agencies relied on monitoring the WhatsApp 'Activation Channel' which was inefficient and required time/frequent checking.

Area for Improvement 5: Out of area command centers were unsure of the role of the ISR aircraft as it was described as both ATGS and ISR. This resulted in confusion and delay in the ordering process.

Fusion Center

The Fusion Center transformed field information and data into intelligence in a timely fashion. For the 225 models run for FIRIS, the Fusion Center adhered to a 5-minute cadence of delivering model information once the location of an event was confirmed. Most often, the information was obtained from the aircraft, however, the 5-minute cadence was also adhered to whether obtaining information direct from the aircraft or from an alternate source such as WhatsApp, PulsePoint, static camera, or satellite detection system. As the 150-day pilot progressed, these near real-time models based on alternate, persistent intelligence sources were useful for understanding the fire potential of a reported ignition, proving valuable for initial size-up and risk assessment. Using WIFIRE's rapid modeling interface was especially valuable for turning

around models for assessment during wind driven events. They also demonstrated the value of using several sources of early intelligence to assess potential impact. Using all the sources available helped to validate the existence of an early fire report, and to validate the weather influencing a validated fire. The SCWFC ran fire models for every report of a fire during high wind days within seconds of receiving the report, giving all FIRIS participants a measure of fire potential with each alert.

The Fusion Center was staffed to serve operational needs depending on fire risk severity to include 24/7 operational staffing as needed. The Fusion Center was managed by an agency team lead from either LAFD and North County Fire Protection District and assisted by WIFIRE modelers from UC San Diego. The agency team lead(s) served as the primary link between Fusion Center analysis activities and incident response operations. The reliance on a lead with fire service experience ensured that Fusion Center operations were linked to decisions and actions occurring on-the-ground. Nominally, the Fusion Center included two modelers. Additional backup staffing was established for high threat days.

Fusion Center operations focused on providing detailed critical information needed for initial response support of vegetation fires – in contrast to extensive modeling and fire behavior requirements demanded for extended response operations. Specifically, fire prediction products for initial response included:

- Communicating the degree of uncertainty
- Describing the source of the report
- Attributing a level of confidence for the source location of the fire
- Communicating the weather data source utilized
- Providing a time that the model was executed

Models were developed for all reported vegetation fires in the Counties of Ventura, Riverside, Orange, Los Angeles, and San Diego. Any of the agencies that ordered the FIRIS aircraft also received fire behavior prediction models upon the Fusion Center's receipt of a fire perimeter from the aircraft. In addition, the Fusion Center modeled all reported vegetation fires from PulsePoint origin point locations and disseminated the confirmed reports via the WhatsApp 'Activation Channel.'

Strengths

Strength 1: The Fusion Center defined a workflow that allowed the Fusion Center to monitor and support incidents without placing a burden on the IC to gather information. The Fusion Center defined its workflow into: (a) internal monitoring, (b) modeling and assessment, and (c) dissemination. This allowed the Fusion Center team lead to serve as the direct filter and manage the information flow to and from busy incident management.

Strength 2: The Fusion Center refined the intelligence products to include confidence information and clarifying information (fire progression by time, confidence, source data, and population impacted.

Strength 3: The Fusion Center utilized a combination of virtual support and on-site staffing to manage support for the 150-day pilot. The three staffing positions (team lead, two modelers) served as the baseline but was adapted to include virtual support during non-threat conditions and on-site support for high threat conditions.

Strength 4: Proactive, 'push' alerts such as texts from the Intterra system alerted the Fusion Center analysts to act on incoming information in real-time. Alerting allowed the Fusion Center to shift into proactive mode rather than hunting for updates on the situation by monitoring multiple feeds of data.

Strength 5: Knowing that the Fusion Center was active, staffed, and trained to collect and analyze wildfire data provided confidence to the end user that the information is accurate and valid. When field and command personnel utilized tools such as Intterra, WIFIRE, or any other platform, they had confidence in the data and analysis provided to manage resources and make evacuation decisions.

Areas for Improvement

Area for Improvement 1: The 'bench staff' for the Fusion Center was limited resulting in an overuse of WIFIRE modeling staff and core personnel (team lead).

Area for Improvement 2: The role, capabilities, and products of the Fusion Center were not formally defined outside of the program. South Ops and other agencies were not aware of the capability or how to request or stay informed of activities other than monitoring the over-utilized WhatsApp 'Activation Channel.'

Data Dissemination

The FIRIS system managed and exchanged data to support program coordination, ISR data exchange, and intelligence dissemination. The following data sources were managed and distributed internally and externally:

- Internal and external program awareness (activations, ISR resource status)
- Real-time mapping information to and from Courtney Aircraft, WIFIRE, Intterra, and other common operating platforms (SCOUT, EGP)
- Streaming video from Courtney Aircraft
- Field-based incident mapping data from local agencies as well as the National Feature Service
- Real-time data from wildfire video cameras (HPWREN and ALERTWildfire)
- Connected CAD and vehicle location systems
- Satellite fire detection information

- Fire models from WIFIRE
- Real-time and predictive weather information from national weather stations and other agencies

The above sources of data were aggregated and shared with the Fusion Center, WIFIRE, and agency operations though the Intterra Common Operating Platform. In addition, they were made available via common data exchange protocols to local agency systems (LA Ready, Ventura Situation Awareness Tool, City of San Diego Fire-Rescue Department, San Bernardino County Fire), state-managed systems (SCOUT), and federal systems (EGP). Data formats were also tested with incident-based tools such as ATAK.

In addition, the pilot developed alerting protocols to streamline Fusion Center operations to include alerts for:

- Satellite fire detections
- FIRIS Aircraft real-time fire mapping

Strengths

Strength 1: The program adopted open source geospatial standards for data dissemination allowing primary dissemination to compatible information systems with reduced engineering.

Areas for Improvement

Area for Improvement 1: Ground forces conducting initial response require a streamlined, common, simple ‘snapshot’ to orient themselves quickly. To support initial response, a common ‘static map consisting of core elements’ should be developed to allow for rapid dissemination via any form of communications (pdf or graphic over text).

Area for Improvement 2: Initial response products require additional background information due to the uncertainty of data during the first few hours of an event. These include uncertainty, source of information, and time frame that data is valid.

Area for Improvement 3: The dissemination of video was confusing for supported agencies and the interagency community. Initially the video was available from multiple websites. This was clarified during later stages of the pilot when data was consolidated in the Intterra platform.

Area for Improvement 4: Maintaining access to and visibility to real-time data in the field was complex and time-consuming for incident personnel. Multi-tasking between operational tasks and maintaining awareness is difficult in a field environment.

Fire Modeling

The WIFIRE modeling and analysis workflow served as the primary decision support product of the FIRIS program. The outputs of WIFIRE were focused on providing real-time predictive rate of spread to initial response resources and decision makers.

WIFIRE ran models on over 80 reported fire starts from September 4 to January 7th. WIFIRE models were run and shared for every perimeter provided by officially ordered FIRIS flights. Unvalidated ignitions and vegetation fires automatically reported from PulsePoint and satellite detection systems (via NWS San Diego) were modeled on high risk days. In some cases (e.g. Saddle Ridge), these early reports became large fires to which FIRIS responded.

Strengths

Strength 1: The WIFIRE model allowed for predictive modeling using a variety of sources (from PulsePoint reports to mapped fire perimeters). In addition, the system allowed for use of automated weather station inputs and adjustments based on field reports.

Strength 2: The Fusion Center and WIFIRE developed a confidence tracking system for published models to clearly identify the confidence and source information for predictions. Sharing the source and uncertainty is a best practice recommended for the future.

Strength 3: The fire modeling outputs included potential population impacted, time of arrival, and burned area for each modeling result. Having access to information on the progress of a fire and the communities requiring evacuations within minutes after a fire's start was critical to successful initial response actions.

Areas for Improvement

Area for Improvement 1: The WIFIRE program was 'new' to many agencies and the training and preparation time required for adoption was insufficient to gain widespread confidence in the output.

Aviation

The FIRIS aircraft and crew along with ATGS were staffed to support a 10-hour day that started at 0800 hours (potential for extension to 14 hours) with rotating base assignment based on conditions and logistics. The aircraft was utilized on 45+ fire incidents and flew multiple missions on the larger fires.

Strengths

Strength 1: The selection of a 'carded' aircraft and crew and the addition of ATGS personnel assisted the program in overcoming a late season start and the acceptance of the ISR aircraft within fire operations.

Strength 2: Flight following is as important for ISR aviation assets as it is for fire suppression assets. The flight following systems utilized by the FIRIS aircraft allowed analysts and incident personnel to know where the aircraft was and which portion of the fire it was focused on.

Areas for Improvement

Area for Improvement 1: The busy airspace of Southern California impacted some ISR missions of the FIRIS aircraft due to high traffic and air traffic control's unfamiliarity with the flight profile needs of the aircraft. This hampered freedom of action for the aircraft in the busy airspace of the region.

Area for Improvement 2: ATGS operations require seamless integration with supported agency (OCFA) staffing and assignment. This requires a direct link with agency staffing and assignment systems as well as notification systems. ATGS staff were provided with systems from OCFA but not directly connected to OCFA staffing and notification systems.

ISR Operations

Aviation ISR operations included managing and directing the thermal camera and extracting hot spot and perimeter information for use in fire modeling and incident operations. During the pilot program, products were enhanced to include confidence information to enable decision makers and modelers to better interpret data. While the primary focus of FIRIS was on rapid perimeter and hot spot collection and dissemination, live streaming of the video was a desired secondary capability. The following primary products were created by the ISR platform:

- Fire perimeters and hot spots extracted from video imagery
- Streaming video (with and without embedded features)
- Streaming video and video 'snippets' with metadata (STANAG-compliant)

Additional ISR operations focused on the use and integration of persistent ISR sources such as video cameras, satellite fire detection, operational sources (CAD, AVL), and weather inputs.

Strengths

Strength 1: The use of external ISR sources (video cameras, satellite detection, CAD and PulsePoint) was useful for fire modeling – under the supervision of a trained Fusion Center team lead. The sources of error in each ISR sensor differ as does its impact on a fire model.

Strength 2: Mapping of perimeters in real-time from the aircraft was successful for small and emerging fires. The larger the fire, the more time consuming the extraction of a perimeter became.

Strength 3: The addition of an accuracy and confidence factor for all generated fire perimeters and hot spots proved useful for incident support and modeling.

Strength 4: Exposure to ISR products during initial response led supported ICs to request additional ISR products while securing the fire line. When not otherwise busy, the ISR aircraft fulfilled requests to map residual heat, determine acreage, burned assets, etc. These products supported the transition from initial response into extended response.

Areas for Improvement

Area for Improvement 1: The 'typing' of ISR aircraft and intelligence-based modeling products is not complete and resulted in uncertainty of what products and capabilities FIRIS provided. The fire service has familiarity with fire mapping and real-time video but is not familiar with matching ISR capabilities and products with desired outcomes. This lack of understanding and awareness in what FIRIS could provide resulted in confusion during the ordering process. This was most evident in support of Type 3 incident management teams.

Area for Improvement 2: The ISR aircraft sensor was designed for live situational awareness (real-time video) and tactical intelligence. The sensor was also capable of creating geolocated imagery with a varying degree of geolocation accuracy. The aircraft and crew developed a CONOPS to align the sensor to the FIRIS requirements (extraction of perimeter and hot spots). Future ISR aircraft should be categorized and 'typed' for specific information needs to allow for rapid request, assignment, and use for specific ISR functions. Typing of ISR sensor capabilities and deliverables would allow ICs to order the appropriate ISR platform for a given mission.

Area for Improvement 3: The video quality delivered was lower than expected and limited in ability to provide detailed information to assist in fire modeling or behavior. The addition of spatial and contextual overlays during the pilot helped to improve the application of the video.

Area for Improvement 4: The array of non-aircraft, external sensors (video cameras, satellite detection) was broad but did not provide the desired persistence and accuracy to confidently extract a fire location for modeling.

Logistics

Project Initiation

The project was initiated in late August 2019 after the start of fire season and after most work-up and training evolutions were completed. The project was managed by a single project manager with an operations coordinator and a technology integration lead. Each component (Fusion Center, ATGS, participating agencies) operated within the project team and coordinated activities.

Project startup activities were divided into internal project coordination activities between the FIRIS components and external outreach to supported agencies. Internal project coordination focused on data integration, fusion center operations, and ordering. External activities consisted of direct outreach, site visits by staff, and site visits by the ISR aircraft and ATGS group.

Strengths

Strength 1: Due to the late roll-out of the project, inter-agency relationships were the key to initial adoption and development of the FIRIS CONOPS and ordering process.

Areas for Improvement

Area for Improvement 1: Limited roll-out time challenged the project and resulted in workarounds and project misperceptions. Future projects should focus on either developing an operating plan early in the season or adopting and integrating with existing operating plans and agreements to speed up adoption.

Forward Aircraft Basing

During the first phase of the project, the ISR aircraft was based at interim locations for initial operational testing and use, as well as education and outreach. Once arrangements were made, the aircraft shifted to a semi-permanent basing arrangement at (ORC) Joint Forces Training Base Los Alamitos. The ISR aircraft was based at the following locations during the program:

- San Bernardino International Airport using Luxivair fixed-base operator
- Van Nuys Airport using LAFD ramp and facility
- Camarillo Airport using VNC sheriff / fire ramp and facility
- Van Nuys Airport using LAC ramp and facility
- Permanent Basing at Los Alamitos Joint Forces Training Base

Strengths

Strength 1: Temporary basing while securing permanent staging at Joint Force Training Base Los Alamitos allowed for project start while arrangements were being completed for permanent basing. In addition, the temporary basing at local agency locations allowed for training, outreach and testing.

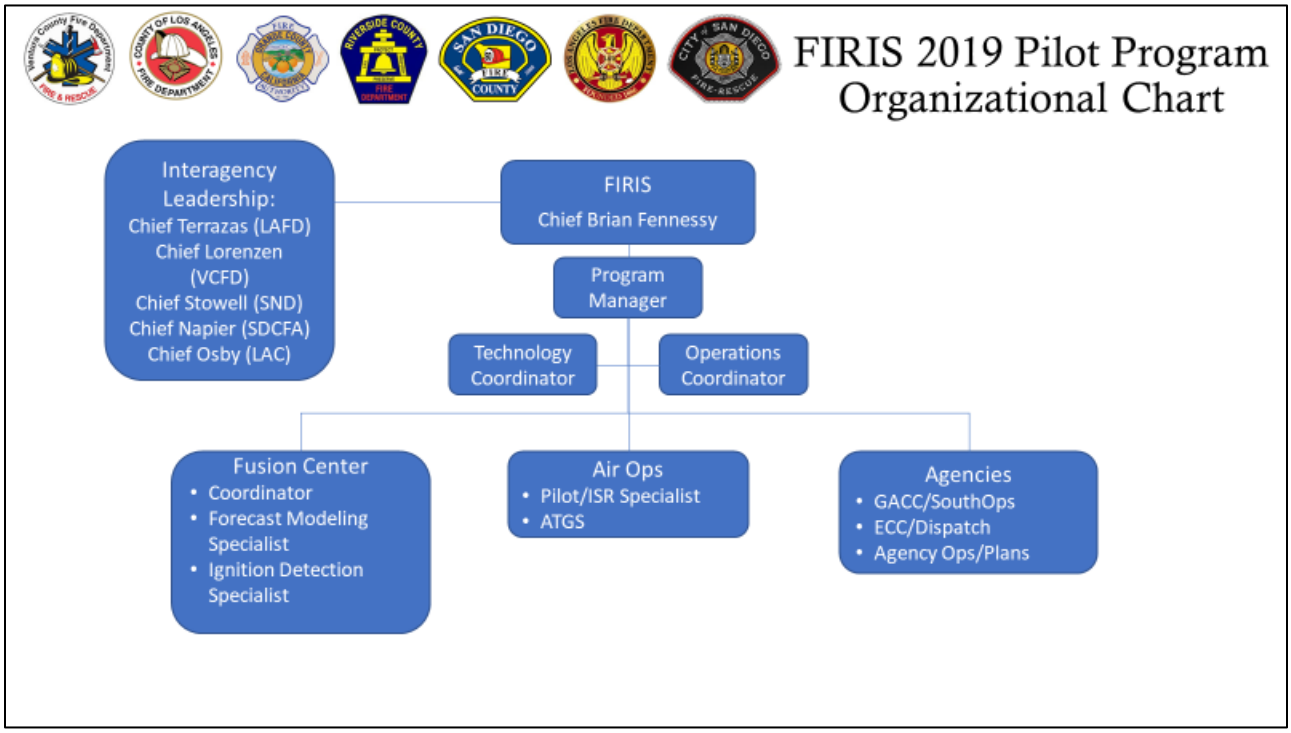
Areas for Improvement

Area for Improvement 1: Los Alamitos facilities were not adequate for sustained operations and need improvement for permanent use of an ISR resource. Elements such as fueling, and crew housing and operations areas had a significant impact on aviation operations. Most critically, the restricted fueling policy required the FIRIS contract aircraft to conduct refueling operations at adjacent airports for almost every mission.

Area for Improvement 2: Procedures to activate runway lights at Los Alamitos were not sufficient for quick launch and recovery of aircraft.

Staffing Support

The FIRIS program was staffed using a combination of agency personnel and contractor personnel. The FIRIS program was executed as a pilot program with a program manager coordinating the integration and operations of the project team and its interaction with the interagency community. Each agency staffed its participation with agency personnel. The Fusion Center was staffed with LAFD agency personnel assigned additional duties and augmented by staff from the WIFIRE Lab. The ATGS personnel were staffed through professional services agreements to individuals qualified to perform these duties for the Next Generation Aerial Operations Based Pilot Program.



Strengths

Strength 1: The FIRIS program started each week with a weather and operations overview which was used to set staffing levels for the week. The staffing pattern for regular days (10 hours per day with external standby up to 14 hours per day) was augmented to support 24-hour operations based on fire weather patterns.

Strength 2: The Fusion Center developed a core set of skills and a combination of virtual and onsite staffing to maintain the core capabilities of a Fusion Center. Assigned and defined roles (coordinator, forecast modeling specialist, ignition detection specialist) allowed the Fusion Center to use virtual staffing during low threat conditions to preserve capacity of the limited staff.

Areas for Improvement

Area for Improvement 1: South Ops performed additional duties as liaison between FIRIS activities and State and Federal ISR activities. This work requirement was not anticipated and placed a burden on South Ops task load during high threat conditions.

Area for Improvement 2: Participating agencies (ranging from OCFA and LAFD to South Ops) increased staffing and provided augmented skills and personnel to support the FIRIS program. As the concepts from FIRIS develop, they should be integrated into agency staffing and budget plans.

Project Coordination and Communications

The FIRIS project team relied on a weekly conference call and two WhatsApp communications channels to coordinate activities.

- Weekly conference call – weekly call of section leads to review all FIRIS activities and supported incidents from the previous week and prepare the team for planned and pending activities
- WhatsApp 'Management Channel' – live mechanism for section leads to review and coordinate non-operational activities in the FIRIS project
- WhatsApp 'Activation Channel' – live mechanism to coordinate operational activations ranging from requests for support to Fusion Center proactive monitoring

Strengths

Strength 1: The FIRIS weekly conference call prepared project staff to establish resources and conduct outreach based on anticipated activity levels. It also served as a rapid after-action review forum to review and record lessons learned from week to week.

Strength 2: FIRIS adopted a collaboration tool (WhatsApp) as the project coordination mechanism. It allowed FIRIS to link all the components of the project in a collaborative, intuitive platform. Communicating through a technology-based collaboration tool overcame geographic (seven counties) and agency (dozens) with real-time dispatching and data flow.

Areas for Improvement

Area for Improvement 1: South Ops assumed a crucial role of performing liaison duties between local and state operations and federal awareness due to the lack of involvement with federal during project initiation. This role was not anticipated or trained for.

Area for Improvement 2: The use of collaboration tools is critical to modern, rapid paced ISR operations – but each channel should be defined and managed to best support its intended use. The WhatsApp collaboration channels were difficult to manage and eventually became overwhelmed with disparate uses and users. The 'Activation Channel' was designed to

coordinate activation events between the ISR aircraft, the Fusion Center, and agencies. However, it rapidly expanded to an audience that used the channel for many purposes including situational awareness, tasking and ordering, account creation, and dissemination. The audience expanded to several hundred users – well beyond the ability of the project to manage and communicate.

Training, Outreach, and Education

Project Awareness

Due to the late start, the project relied on personal contacts and relationships as well as a series of site visits and demonstrations to build project awareness. The most effective and utilized awareness resource was direct agency-to-agency contact either thru a site visit, agency in brief, or direct relationship. To augment direct communication, a series of FIRIS information briefings and materials were created to be handed out or emailed as part of in brief. OCFA and the FIRIS partner agencies also conducted a press briefing in September 2019 to orient the region to the capability and technology goals of the pilot program.

Strengths

Strength 1: The FIRIS project staff leveraged interagency relationships to spread awareness of the project during site visits, community meetings and forums, and presentations. This outreach helped to spread awareness of the project late in the season.

Strength 2: The forward basing of the ISR aircraft provided excellent outreach and awareness opportunities for agencies and aviation elements at each basing location.

Areas for Improvement

Area for Improvement 1: FIRIS program was unknown to users/agencies due to late start. Activities to improve and spread awareness were not coordinated between different levels of command resulting in some agencies where command was supportive, but operations staff was unfamiliar or vice versa.

Operational Training

FIRIS performed a series of operational training flights which tested end-to-end throughput of the system from ISR sensor or CAD input to aircraft ordering and launch to fire modeling and dissemination. Nine (9) end-to-end training and testing sessions refined the ability of the FIRIS team to respond to incidents within the first month of project start. A total of 13 end-to-end tests were planned and completed for the program.

Strengths

Strength 1: To make up for lack of training, FIRIS conducted training during testing and outreach missions. These training activities were focused on training and testing of internal CONOPS and the FIRIS participating agencies.

Areas for Improvement

Area for Improvement 1: ATGS training was limited to defined testing and training evolutions but was not comprehensively planned and addressed resulting in difficulty for shift-based staff to have consistent levels of training.

Area for Improvement 2: No external training or familiarization was conducted. FIRIS was a quick start project that brought together disparate components. As a result, training opportunities were combined with technology testing flights and evolutions or outreach activities.

Technology

Communications Systems

The Courtney Aircraft was configured with multiple communications systems. The systems ensured that the primary intelligence products (fire perimeters and hot spots) were disseminated to the Fusion Center and incident personnel within the time frame of the leader's intent. They also provided communications options for the secondary intelligence products including video (live and recorded).

The aircraft had the following communications equipment installed:

- Multiple VHF-FM radios
- Multiple VHF-AM radios
- GPS navigation
- Iridium SATCOM for automatic flight following (AFF), voice and data transmission
- Bonded cellular system with 8 SIM cards – Verizon and AT&T
- Silvus mesh network radios

The Courtney Aircraft operated primarily in OES Region 1 in support of the FIRIS participating counties. It did support one out-of-area deployment in support of the Kincade Fire which provided an opportunity to test the communications requirements for an extended response fire outside of the normal FIRIS operating area.

Strengths

Strength 1: Due to the multiple communications systems available on the ISR aircraft (cellular, mesh, relay, and satellite backhaul), the FIRIS program was able to consistently meet its primary objective of real-time perimeters and inputs to fire modeling.

Strength 2: The multiple communications systems of the aircraft allowed the project to explore the potential for alternative communications for future missions (video) or in varied environments. The project explored:

- Bonded cellular communications/FirstNet – for streaming video, perimeter and hot spot
- Satellite backhaul – Low bandwidth Iridium for perimeter information
- Relay (mesh to aircraft/van) – for streaming video, perimeter and hot spot
- Mesh network (tower) - for streaming video, perimeter and hot spot

Areas for Improvement

Area for Improvement 1: The project communications plan was developed as part of the ISR aircraft operations. A comprehensive communications plan addressing the entire communications chain would allow for the potential of additional aircraft, sensors, and mobile resources to exchange data consistently and reliably.

Area for Improvement 2: Streaming video was a secondary product from the ISR aircraft. When available, it was useful for operations but the reliability of the live feed caused by intermittent communications coverage limited adoption and use.

Area for Improvement 3: The reliance on a relay aircraft for communications resulted in increased mission complexity. Relay aircraft operations required additional aviation coordination, created different flight profile constraints, and increased safety risk for operations. Due to the low altitude requirement of cellular connectivity, the relay aircraft was not flown after dark. This occasionally hampered downlink capabilities especially as the nights got longer.

Data Interoperability

The FIRIS program was focused on providing intelligence to initial response activities through a common framework. Due to the nature of wildfire response, the FIRIS project committed to making sure that all data was available to any and all authorized agencies and their information technology systems. The FIRIS program focused on achieving this thru a reliance on common, interoperable data formats and services.

FIRIS used the following services for data sharing:

- KML/KMZ formats for rapid exchange of perimeter data
- ArcGIS Server based Representational State Transfer (REST) Application Programming Interface (API) services for on-demand data access
- Motion Imagery Standards Board (MISB) conformant Video (transport stream)

Using these protocols, data was exchanged with the following systems:

- CAL OES SCOUT
- NIFC EGP
- LA Ready
- Intterra systems operating in California
- ATAK
- Tablet Command
- ArcGIS Online

Strengths

Strength 1: The project focused on and encouraged data to be shared from the single common operating platform to agency-supported compatible common operating systems. Data was exchanged and shared with SCOUT, ATAK, Tablet Command, and local agency systems.

Strength 2: Reference data including aerial imagery and DPAs, were provided in accessible, standard formats to support immediate situational awareness to decision makers. Utilization of KML files made the same data immediately available to across platforms for planning.

Areas for Improvement

Area for Improvement 1: The connection of external systems to FIRIS was occasionally delayed or stalled by lack of project awareness. For example, it was unclear what information should be shared with the NIFC EGP or SCOUT based on uncertainty about agency-to-agency agreements (data from ISR aircraft) and product utility and application (fire modeling).

KEY FINDINGS AND RECOMMENDATIONS

FIRIS demonstrated for the first time that rapid intelligence and fire modeling can assist in initial response and is an achievable capability. Based on the fast moving and rapidly evolving fire regime (as demonstrated during the Getty Fire and the Saddle Ridge Fire), the ability to adjust and impact initial response can mean the difference between a large, catastrophic wildfire and a localized event.

FIRIS demonstrated that the rapid interchange of ISR information (fire detection, perimeter updates) and fire modeling can dramatically improve resource planning, evacuation decisions, and command center awareness during Initial Response.

- FIRIS provided intelligence that supported the early mobilization of extra resources when the fire was confirmed to have a critical rate of spread (ROS).
- FIRIS products were used to enhance and speed up evacuation planning and resource placement during the dynamic initial stages of response.

The capabilities demonstrated by FIRIS are a necessity to combat the dynamic fire events of 2020 and beyond. The integration of intelligence information and fire prediction during initial response is as important as the rapid and direct concentration of ground resources and aerial fire suppression resources. Each primary geographic region *should develop a strategy to augment initial response with the primary components demonstrated by FIRIS* including:

- **Fire modeling and prediction** capable of alerting decision makers to evolving incidents
- **'In place' ISR resources** (wildfire modeling cameras, satellite fire detection systems) capable of finding and locating events
- **Dedicated overhead ISR systems** ready to provide support within 30 minutes of an evolving event
- **A communications infrastructure** to ensure that a core set of ISR products are delivered regardless of location
- A **data sharing framework that links everyone to an accurate, common view of the situation** to support regional operations and incoming mutual aid

While FIRIS demonstrated that ISR can support initial response, it also highlighted that an initial response capability requires *intense collaboration and preparation* along with dedicated, on-demand assets and an infrastructure ready to support… similar to all other aspects of initial response mutual aid.

The components and concepts developed and demonstrated in FIRIS are readily available and can contribute at the most important trigger point in a wildland fire – the first few hours. In addition to the technology consideration, the following broad policy and operating guidance recommendations can ensure that California and the fire community continue to leverage and build on the successes for FIRIS.

The Interagency Wildfire Community should begin now to integrate the lessons of FIRIS into operating agreements and CONOPS for 2020 and beyond.

- Collaboration and data sharing are critical to leveraging today's ISR and modeling capabilities and 'moving left of ignition'
- The rapid pace of intelligence and information flow highlighted the need to define the decision points that are supported and the standards that are used to support them
- Emerging technology demands a standards-based ability to request, ingest and exchange data from multiple sources while understanding the capabilities and limitations of each
- Information systems and sensors must share data seamlessly, and common operating platforms must allow decisions makers from disparate agencies to share the same view

APPENDIX A: SUPPORTED INCIDENTS

The following table lists the Incidents/Events supported by FIRIS. This table does not include test, demonstration or training events.

#	Incident	FIRIS Program Incident Start Time	IRWIN ID (If applicable)	ORC-ISR Intel Generated?	Models Run/ Final Versions in Intterra
1	TABLE	9/4/19 12:31	{BD5268ED-75BC-4A8D-A8D6-36DA61F68336}	yes	3
2	Santa Clarita	9/4/19 21:01		yes	6
3	TENAJA	9/5/19 2:52	{12D435C8-627E-438F-994A-1105E5DBB56F}	yes	7
4	Taboose	9/8/19 21:19		yes	1
5	Ortega Fire	9/14/19 0:22		yes	2
6	Horseshoe	9/15/19 3:16		yes	2
7	Fossil Fire	9/16/19 0:58		yes	4
8	BAUTISTA	9/16/19 1:32	{86B52E3B-892A-478E-946D-C2CB18B6C1E4}	yes	1
9	Arrow	9/18/19 23:28		yes	1
10	School	9/24/19 20:06		yes	3
11	DEHESA 11	9/24/19 23:22	{8E04E0FE-0F30-4A73-BFD4-B9327D5F7799}	yes	0
12	Saddle Ridge	10/11/19 7:19		yes	8
13	Wendy	10/11/19 12:22		yes	1
14	SANDALWOOD	10/11/19 23:52	{A5E9D94C-55BA-4F14-956A-4B5066297920}	yes	1
15	Palisades	10/21/19 19:03		yes	6
16	GETTY	10/22/19 22:54	{0866B07E-CA4D-4103-B5A9-7E2D94779E84}	yes	10
17	OAK	10/22/19 23:47	{77B6916A-8EE1-434C-B738-F7D8F3891199}	yes	0
18	Santiago	10/24/19 13:22		yes	1
19	OLD WATER	10/24/19 13:50	{92E71720-C1B0-4D47-84CB-1A5CC7C2F2C5}	yes	2

20	2019-CALAC-326096	10/24/19 22:40		yes	0
21	Tick	10/24/19 22:06	{31A016C8-AC09-4C58-ACA3-789CFCA0B830}	yes	5
22	Woodley	10/24/19 23:23		yes	1
23	VAL VERDE	10/24/19 23:52	{7C1C9411-71CD-4D9A-BC62-5FE9B1C2C7B4}	yes	1
24	Telega	10/25/19 16:41		yes	0
25	SAWDAY	10/25/19 16:51	{885384BC-9F60-4A0B-A777-37035140EE9C}	yes	
26	MILLER 2	10/25/19 21:05	{214BECAF-3E70-4B70-AD73-A89D1C962E0D}	yes	
27	Contempo	10/28/19 0:36		yes	2
28	KINCADE	10/28/19 1:22	{FE8285DB-86DE-4F8C-B54E-3FE4A9F2182A}	yes	4
29	EASY	10/30/19 17:00	{FC96A780-3096-487F-97EB-69D6CB7DC33E}	yes	7
30	MUREAU	10/30/19 17:59		yes	3
31	BREA	10/30/19 19:39	{DA3C3126-3DE6-42F0-AA1C-E880B4CA8A32}	yes	4
32	Hill	10/31/19 0:50		yes	3
33	Fullerton	10/31/19 0:51		yes	4
34	RRU-46	10/31/19 0:00			
35	DIDO	10/31/19 0:00			
36	46TH	10/31/19 13:07	{4DD25531-95E9-459C-A5A6-9C15D97D7A42}	yes	1
37	MARIA	11/1/19 2:56		yes	9
38	CASTLEWOOD	11/2/19 21:02	{F90DC43D-87B2-4EC2-9146-6BE141CEF311}	yes	1
39	Williams	11/3/19 20:51		yes	4
40	JAKE	11/6/19 22:26	{CD41E0E0-EDF9-44DC-9E81-C0564F1DDA46}	yes	3
41	Barham	11/10/19 17:55		yes	1
42	Reche	11/22/19 17:58		yes	2
43	Cave	11/26/19 0:00		yes	3
44	ElCarisoControl	1/15/2020		yes	2
45	SDCOPalomar	1/15/2020		yes	2

APPENDIX B: EARLY INFORMATION MODELING

The following table lists the supplemental Incidents where the Fusion Center captured early or supplemental data to establish an initial fire prediction model. (i.e. initial location information from PulsePoint, Dispatch, Other). Primarily shared to community via WhatsApp 'Activation Channel.'

#	Incident	Number of Models Run	Source of Location Information
1	Bouquet Canyon Dispatch	1	PulsePoint
2	Crystal Springs	1	PulsePoint
3	Dido	1	
4	Flintridge	2	Department confirmed
5	Lake Perris	several	
6	Lake Topez	several	
7	Las Virgenes	2	
8	Luis	1	
9	Olivas	1	CalGuard
10	Ortega	1	
11	Real	1	
12	Riparian	1	Satellite Fire Detection
13	Selkirk	1	
14	Sepulveda Basin	1	
15	Telegraph	1	
16	Valley Center	1	Satellite Fire Detection
17	Wolf	1	Satellite Fire Detection

APPENDIX C: COORDINATED TESTS

The following end-to-end scenarios were planned and coordinated among the various team members to either test/validate the process, establish naming conventions, develop data sharing practices and to test the procedural flow. Additional tests for each agency or functional area may have been conducted, however, are not captured here.

#	Event	Date	ORC-ISR data generated	Models distributed to Intterra
1	Fire73	8/31/19		**3**
2	Pendleton Test Run	9/4/19 12:27	yes	1
3	TEST - San Clemente - test run	9/4/19 12:28	yes	1
4	test10 Sept 2019	9/10/19 18:05	yes	0
5	Dawson CA-LFD-234567	9/12/19 17:54	yes	1
6	Conner CA-LFD-123456-09122019	9/12/19 18:10	yes	2
7	Elm	9/15/19	yes	1
8	Search for Geothermal Anomaly	9/20/2019	No	0
9	Laguna Beach Test	9/23/19 17:55	yes	4
10	Press Conference at Los Alamitos	9/23/19	yes	1
11	Test Ventura Flare	9/24/19 17:07	yes	2
12	Gecko	10/3/19 18:15	yes	3
13	Trabuco Test	10/3/19 19:35	yes	
14	TRAINING OCFA HAZMAT 12/13/19	12/13/19 17:09	yes	0