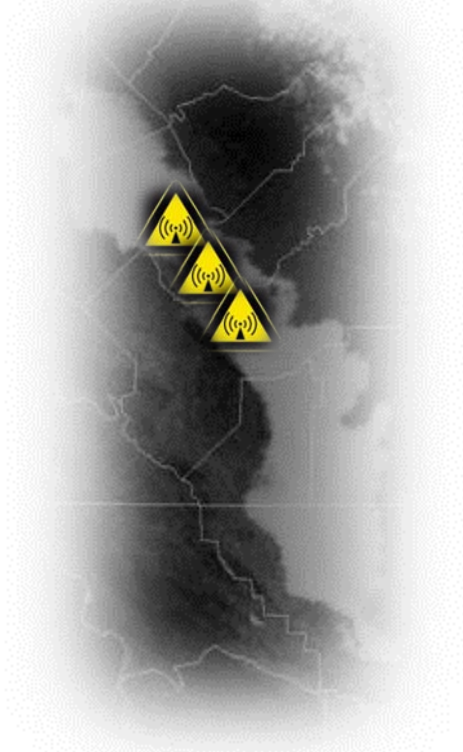
Fog Detection and Warning System (FDWS)



T3 Webinar	John Liu
01.30.2013	DDD-Caltrans

Fog Detection and Warning System (FDWS)

Presenter

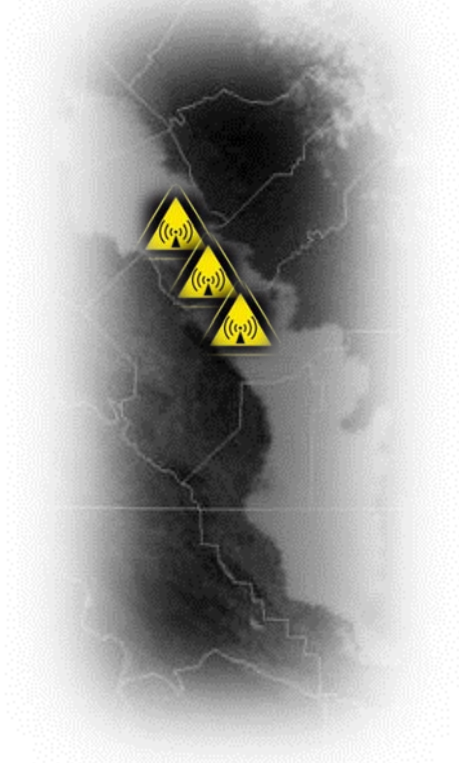
John Liu

Deputy District Director, District 6

Maintenance and Operations

California Department of Transportation

Fog Detection and Warning System (FDWS)



Presentation Topics

Purpose

Radiation | Tule Fog

Original Concept

Lessons Learned from CAWS and Other Systems

FDWS Overview

- Technical Approach
- Data Flows
- Field Hardware
- Central Control System – Cameleon
- Outreach

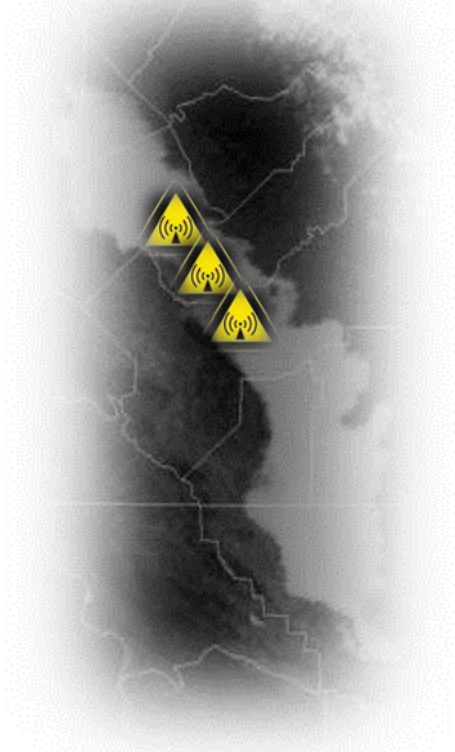
Ongoing Issues | Concerns

What's Next?

Questions

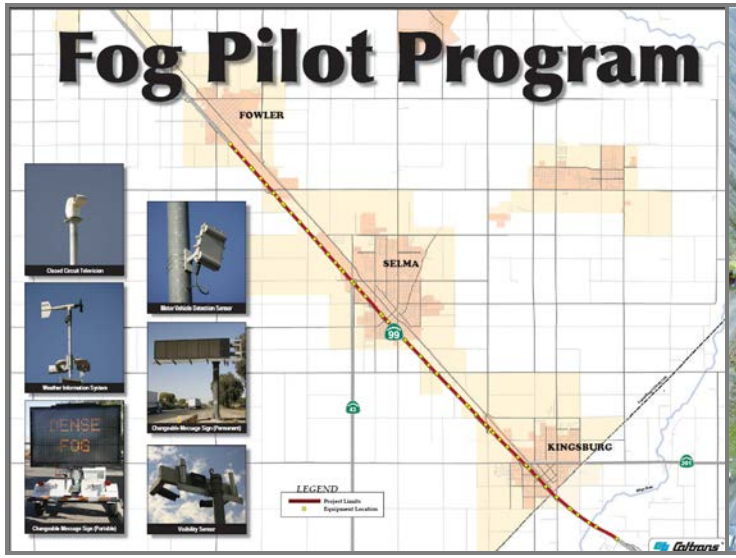
Caltrans

Fog Detection and Warning System (FDWS)



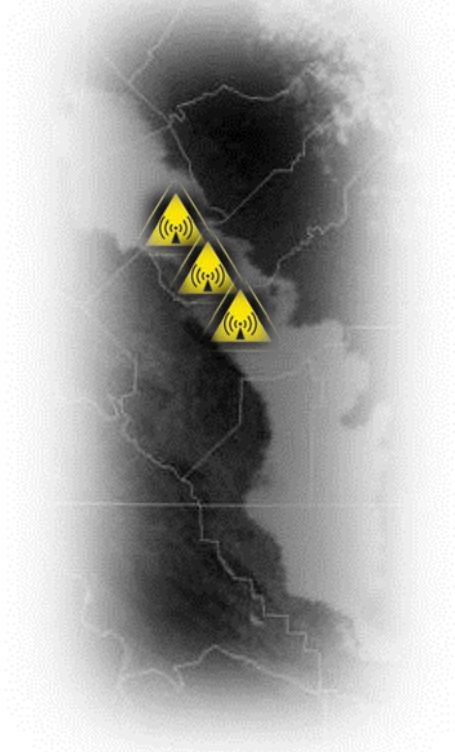
Purpose

The imperative to eliminate or minimize deadly multi-vehicle accidents during the San Joaquin Valley's Winter/Fog Season, along a 12-mile stretch of State Route 99 in Fresno and Tulare Counties.



November 3, 2007 crash involving 81 vehicles including 11 big rigs, 2 fatalities, and 68 injuries

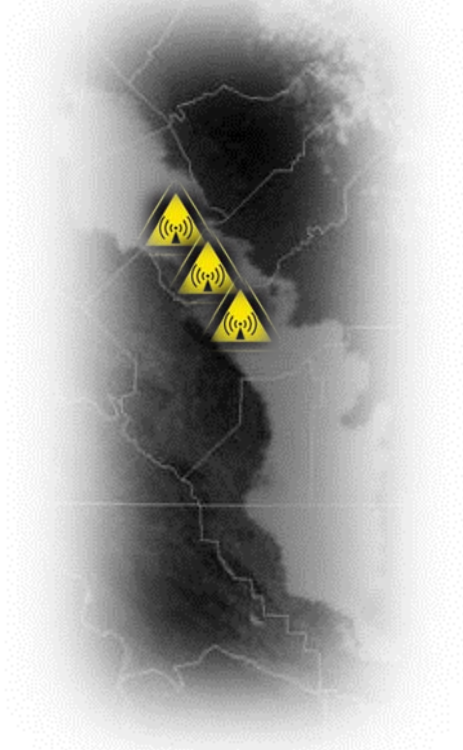
Fog Detection and Warning System (FDWS)



Radiation | Tule Fog

- Forms day or night under clear skies with calm winds
- Heat is absorbed by the earth's surface during the day is radiated into space
- As the surface continues to cool, provided a deep layer of moist air is present, the humidity will reach 100%
- Varies in depth from 3 feet to about 1,000 feet
- Always found at ground level and usually remains stationary
- Reduced visibility to near zero at times - making driving very hazardous

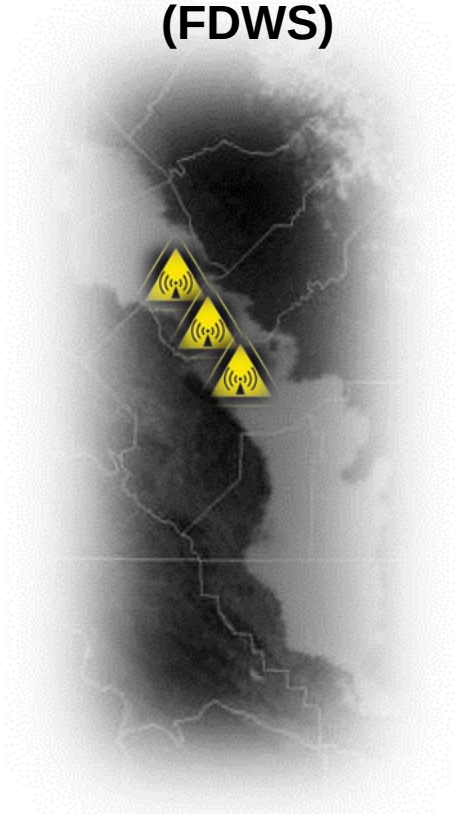
Fog Detection and Warning System (FDWS)



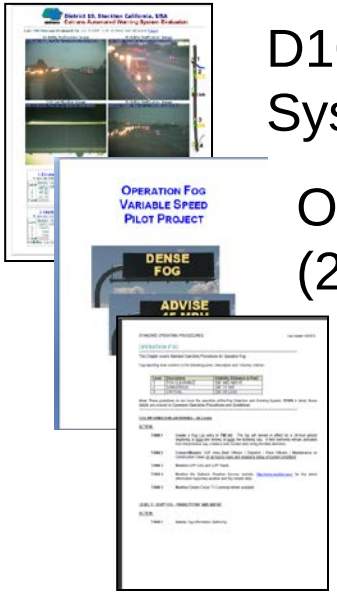
Original Concept

- Speed data from sensors and commercially available sources
- GPS for vehicle locations
- Smart phones to warn for stopped traffic

Fog Detection and Warning System (FDWS)



CAWS and Other Systems



D10 CAWS - Caltrans Automated Warning Systems (1996)

Operation Fog Variable Speed Pilot Project (2003)

CVTMC - Operation Fog | CHP Pace Program (1992)

Tennessee Low Visibility Warning System (1994)

Fog Detection and Warning System (FDWS)

FDWS Overview
Technical Approach

Detection

- Visibility (Fog)
- Traffic (Presence | Speed)
- Microwave Vehicle Detection System (MVDS)

Advanced Warning

- Changeable Message Signs (CMS)
- Smart-Extinguishable Message Signs (EMS)
- Highway Advisory Radio (HAR)

Verification (Visual)

- CCTV

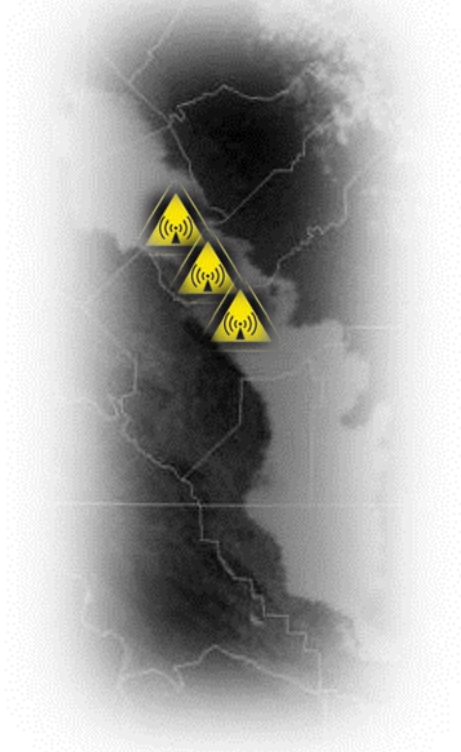
Field Communications

Central Control System

- Cameleon

Caltrans

Fog Detection and Warning System (FDWS)



FDWS Overview

ITS Elements

- 29 FCMS-Standard
- 4 FCMS-Color
- 6 PCMS
- 41 MVDS
- 22 Visibility Sensors
- 11 CCTV-Standard
- 2 HAR-BlackMax

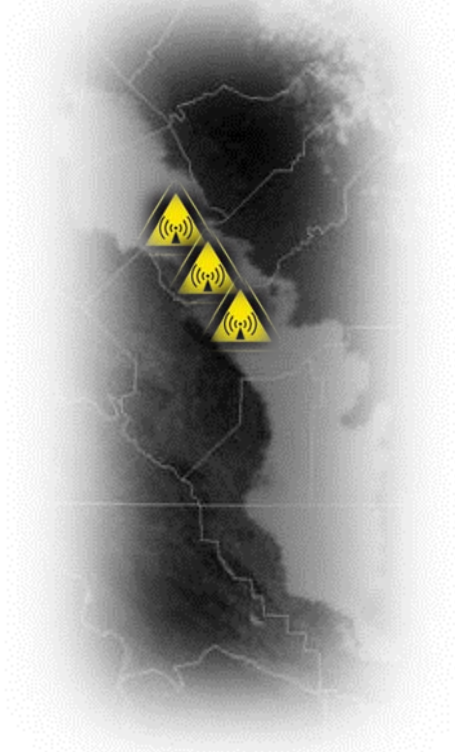
Cost

$12 Million

Prime Contractor

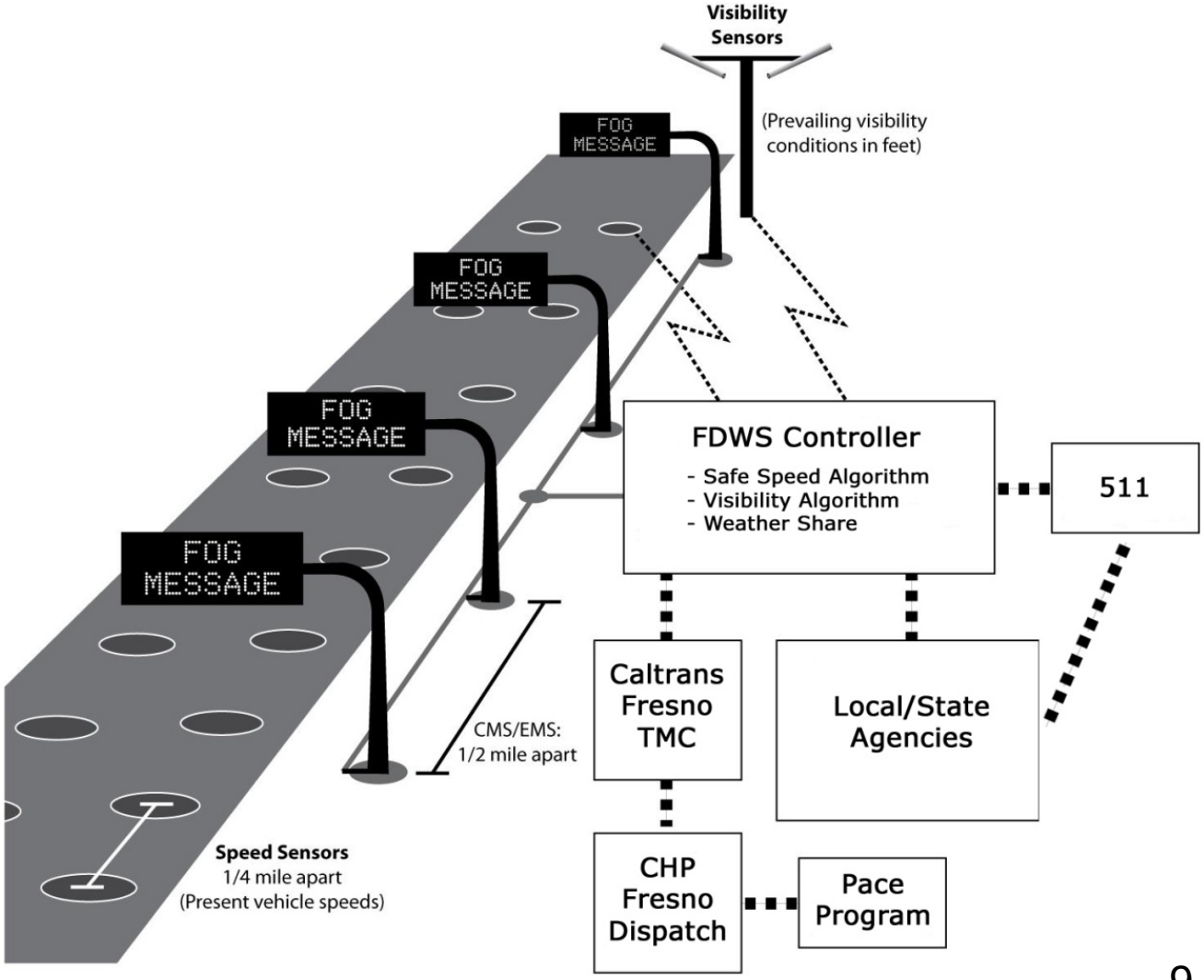
icx™ transportation

Fog Detection and Warning System (FDWS)



FDWS Overview

Data Flows



FDWS Overview – CMS Message Priority

Fog Detection and Warning System (FDWS)

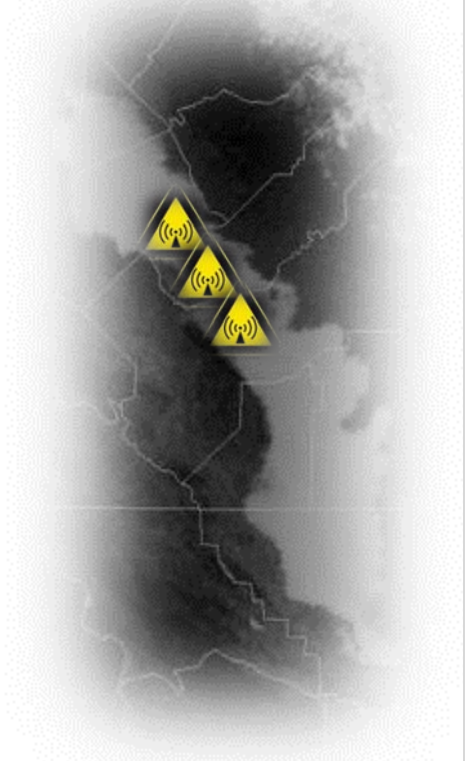
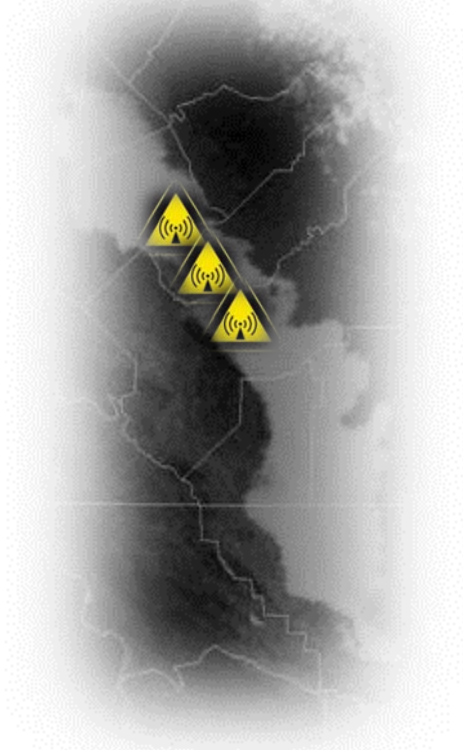


Table 1. System Fog/PACE/Vehicle-Speed Warning Logic		
Priority	Conditions	Warning Message
0	None of the following	Sign is blank
1	200'≤VISIBILITY<800' AND SPEED≥45	**FOG AHEAD**
2	0≤VISIBILITY<200' AND SPEED≥45	**DENSE FOG AHEAD**
3	CHP_PACE AND SPEED≥45	**DENSE FOG CHP PACE DO NOT PASS**
4	VISIBILITY<800' AND 35≤SPEED<45	**FOG AHEAD TRAFFIC SLOWS TO 40 MPH**
5	VISIBILITY<800' AND 25≤SPEED<35	**FOG AHEAD TRAFFIC SLOWS TO 30 MPH**
6	VISIBILITY<800' AND 15≤SPEED<25	**FOG AHEAD TRAFFIC SLOWS TO 20 MPH**
7	VISIBILITY<800' AND 5≤SPEED<15	**FOG AHEAD TRAFFIC SLOWS TO 10 MPH**
8	VISIBILITY<800' AND 0≤SPEED<5	**STOPPED TRAFFIC AHEAD**

Where, for a given CMS:
VISIBILITY is the minimum visibility detected in a zone and the adjacent zone in each direction.
SPEED is the minimum speed of downstream traffic in the same zone.
CHP_PACE is an operator input indicating that CHP Pace program is in effect.

Note: messaging shown for Permanent CMS

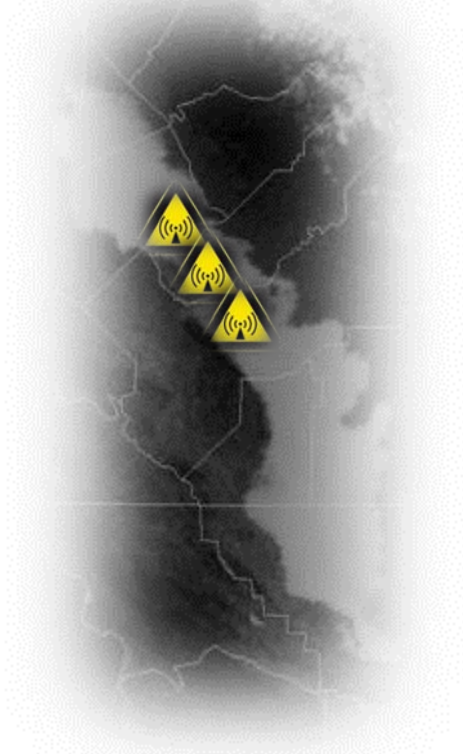
Fog Detection and Warning System (FDWS)



FDWS – Detection
Visibility

- Density-deploy enough sensors to detect localized fog pockets
- Deploy off-the-shelf standalone sensors that provide estimated visibility distance
- Sensors do not require periodic recalibration

Fog Detection and Warning System (FDWS)



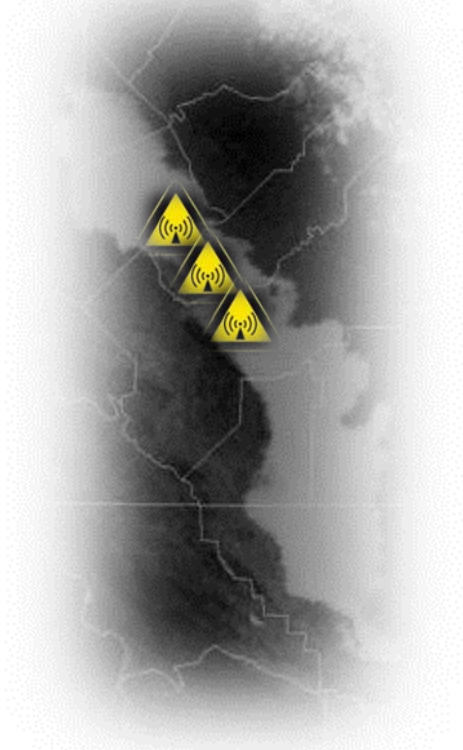
FDWS – Detection
Traffic Presence | Speed

Wavetronix (MVDS)
- Easy infill
- Solar powered

In-Pavement Loops

Caltrans

Fog Detection and Warning System (FDWS)

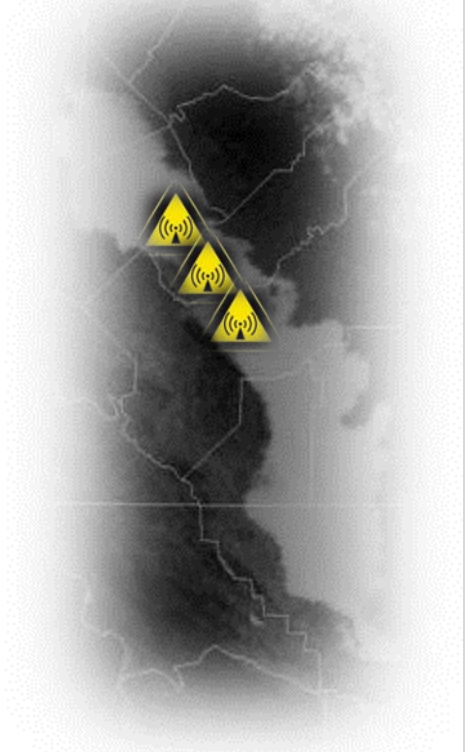


FDWS – Advanced Warning Signage

Fixed and Portable CMS
- Addco Brick
- Daktronics Color
- Legacy Model 500

Addco Trailer-Mounted PCMS

Fog Detection and Warning System (FDWS)

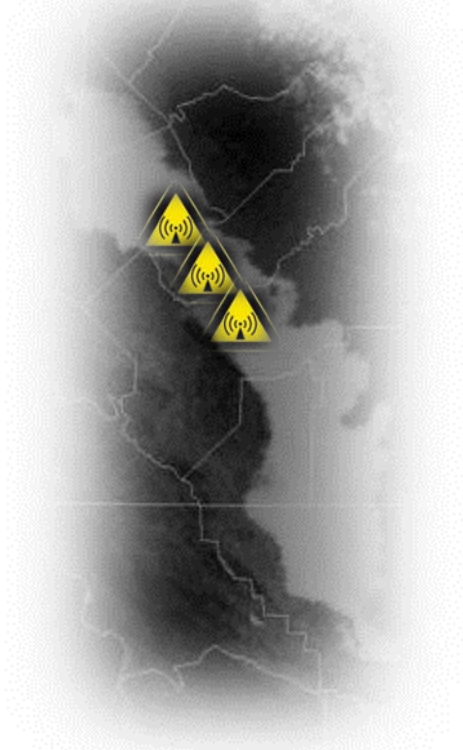


FDWS – Advanced Warning Highway Advisory Radio

Enhance existing corridor deployments

- Reduce/eliminate null near Tulare County
- Synchronize broadcast to create (near) seamless coverage
- Update field/TMC technology to IP-based devices
- Utilize EMS for enhanced/smart messaging

Fog Detection and Warning System (FDWS)



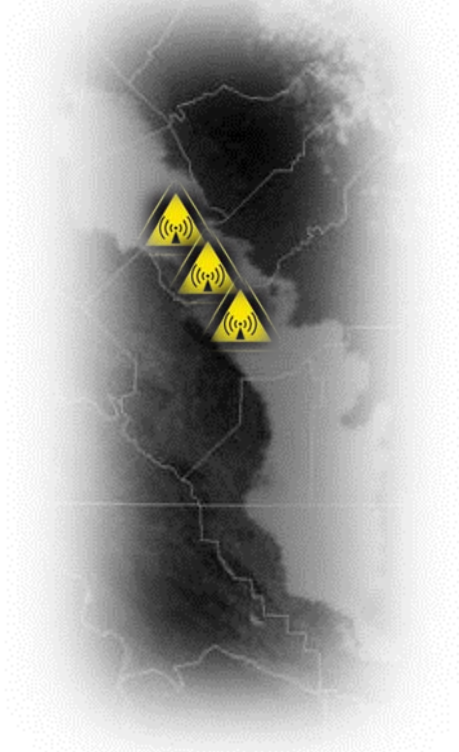
FDWS – Verification

CCTV

Verification

- Pelco 35x Zoom Esprit Camera
- 7 pixels per meter (ppm) at ½ mile

Fog Detection and Warning System (FDWS)



FDWS
Field Communications

PLC Architecture (Programmable Logic Controllers)

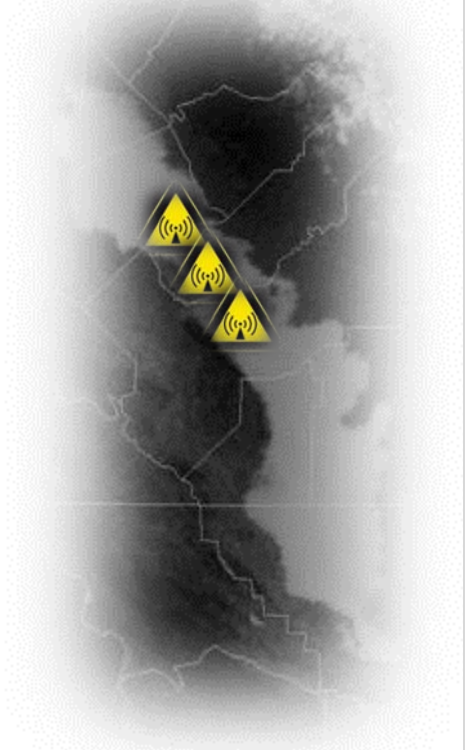
- Proven in D11 – I-15 Reversible Lane Control System
- Autonomous field operations in the event of communication loss to the central control system
- PLCs interface to Cameleon Central Control System in TMC
- Communications via Ethernet TCP/IP

Wireless Communications w/Backhaul

- Supports high bandwidth operations
- CCTV and element to element control
- Central Control System to field

Caltrans

Fog Detection and Warning System (FDWS)

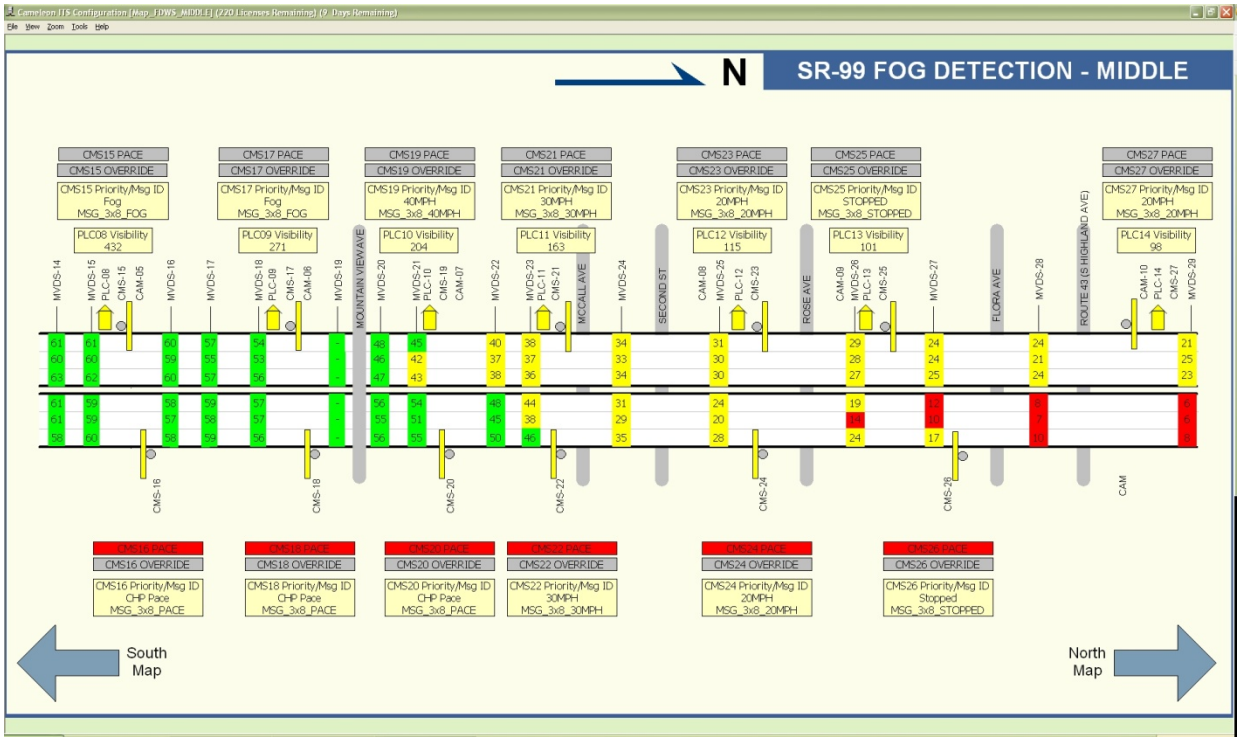


FDWS - Central Control System
Cameleon

- Advanced Scripting / Full System Automation
- Reliable and Scalable ITS Solution
- Off-The-Shelf Functionality
- Device Priority Control Management
- Dynamic Message Sign Control
- NTCIP Support
- Alarm / Event Management
- Full Logging and Trending Capability
- Configurable Desktop
- Multiple Monitor Configurations
- Customizable Site Maps

FDWS - Central Control System
Cameleon

Fog Detection and Warning System (FDWS)



Customizable Site Maps

Fog Detection and Warning System (FDWS)

FDWS – Outreach
www.foguniversity.com

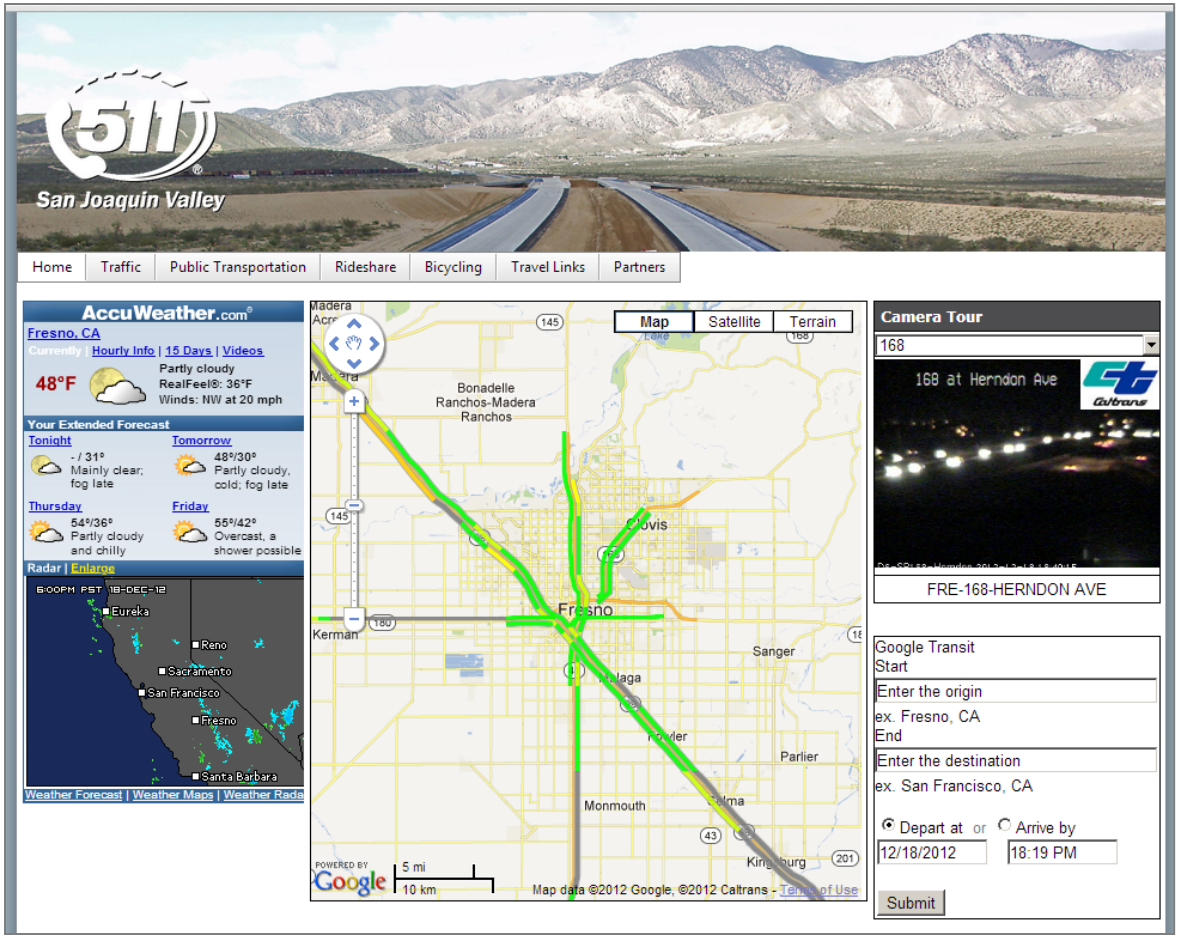
- Web
- PIO/Media (Modern Marvels)
- Billboard

Caltrans

Fog Detection and Warning System (FDWS)

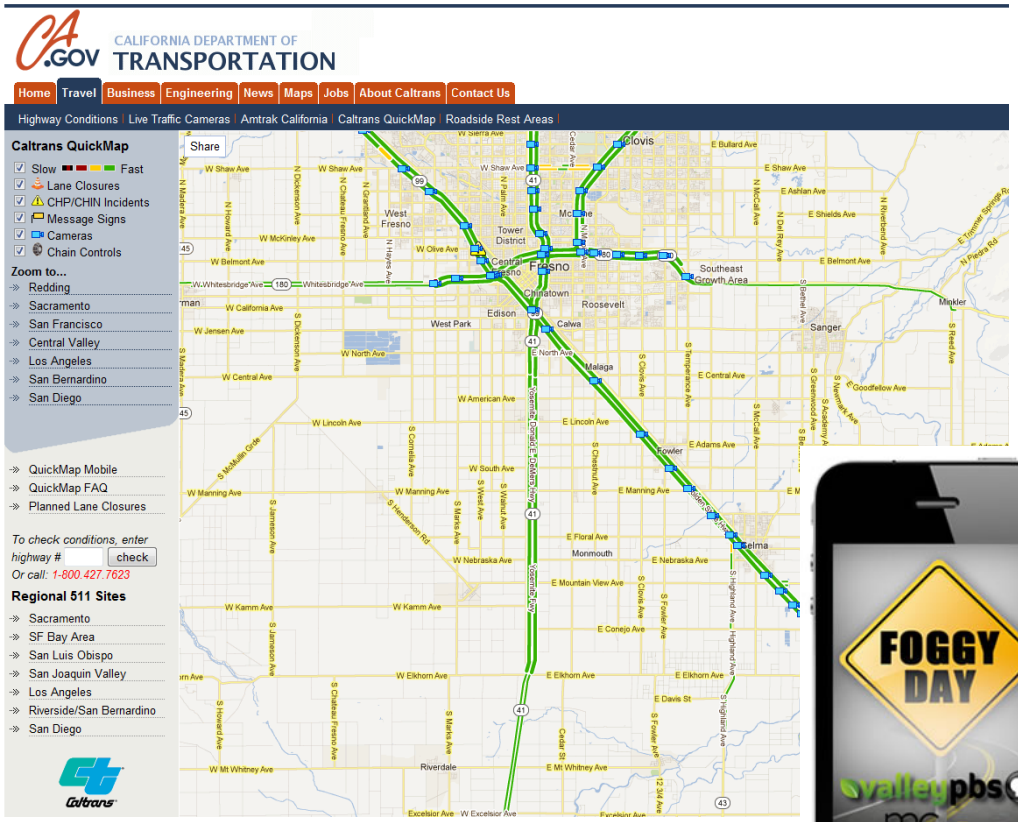
FDWS – Outreach

www.511.sjv



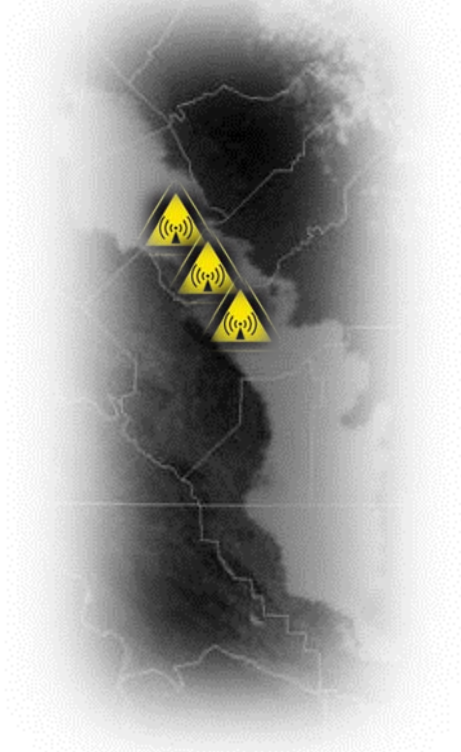
FDWS – Outreach
QuickMap, Apps, Social Media

Fog Detection and Warning System (FDWS)



www.quickmap.dot.ca.gov

Fog Detection and Warning System (FDWS)



FDWS – Conclusions

Ongoing | Concerns | Enhancements

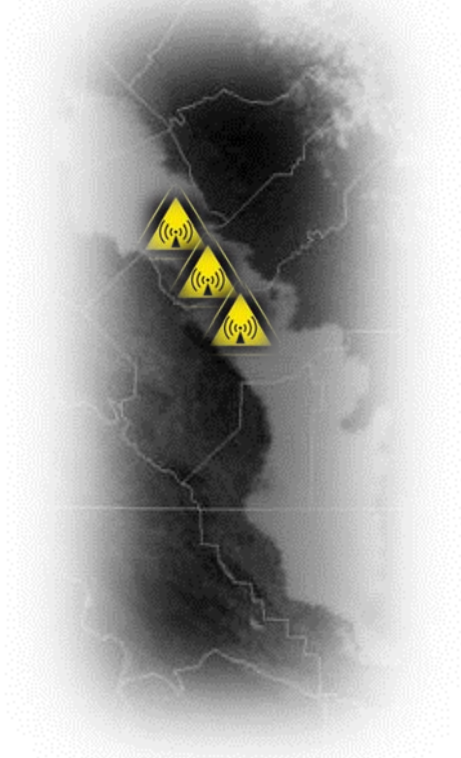
Concerns

- Recurring Maintenance Cost
- Solar Technology
- Wire Theft
- Additional Fixed Objects Along Roadway

Enhancements

- Integrate PeMS (Performance Measurement System)
- Automate HAR Activation
- Replace PCMS
- Replace Solar Technology
- Evaluate In-Roadway Lighted Markers
- Perform 3rd Party Evaluation
- Social Media

Fog Detection and Warning System (FDWS)

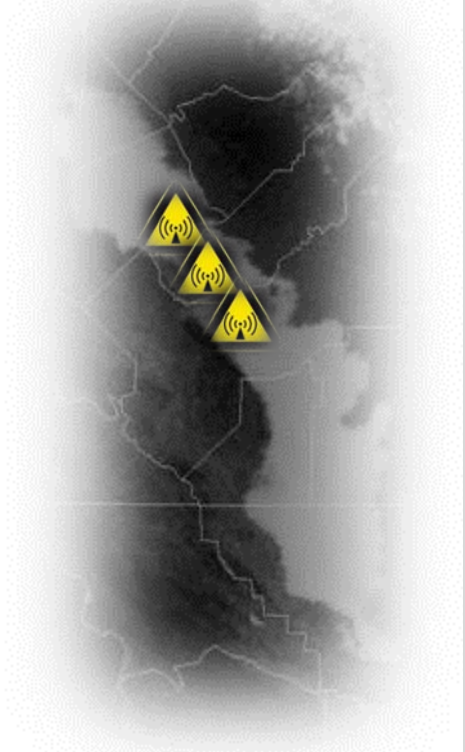


FDWS – Conclusions

What's Next?

- Expand the System?
- Replace with Phone Apps?
- Intelligent Vehicles?

Fog Detection and Warning System (FDWS)



Any Questions?

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