The HPWREN team worked with CDF firefighters to demonstrate an ad-hoc rapid response mobile wireless access point at Dos Picos Park, a pre-designated Incident Command Post.

**2001**

**February**

The HPWREN team worked with CDF firefighters to demonstrate an ad-hoc rapid response mobile wireless access point at Dos Picos Park, a pre-designated Incident Command Post.

**August**

- Along with several governmental agencies, the HPWREN team tested the feasibility of using real-time images and maps during a pre-simulated incident management situation.

**2002**

**May**

HPWREN participated in a UCSD activity that demonstrated an ad-hoc and temporary multimedia installation of seismic and visual instrumentation at the Coronado Bridge.

**June**

The HPWREN team transitioned its Mount Laguna backbone site to a County facility, which also enabled the creation of a new link to Toro Peak.

**July**

- A feasibility check was conducted for the CDF’s Red Mountain fire station link.

**September**

- The Mt. Laguna HPWREN backbone site was instrumented with several real-time meteorological sensors, with the data being made available to various parties and via public web sites.

**2003**

**May**

Firefighters at the remote Coyote Fire operations site were provided with HPWREN connectivity for the week-long incident so that they could update wildfire status reports, images, and weather information in real-time.

**June**

- In addition to a 45 Mbps link, HPWREN installed high-resolution remote-control cameras for the San Diego County Fair wireless demo.

**July**

- The CDF’s Ramona Air Attack Base is connected to HPWREN (shown here during the Cedar Fire of October 2003).

**September**

- Real-time wildfire images are now collected via motion-detect HPWREN-connected cameras atop Laguna Mountain, and the Ramona CDF Air Attack base.

**October**

- HPWREN cameras captured about 150,000 still images of the Cedar and Paradise Fires. Many were turned into DVD-quality MPEG2 time lapse animations.

**December**

- The CDF La Cima Fire Camp’s comm’s were restored with voice (VoIP), fax, and Internet access via HPWREN after the Cedar Fire devastated their phone lines.

**2004**

**May**

Four HPWREN video cameras were installed to improve firefighters with a 360-degree view from Lyons Peak to observe wildland fuel areas along the US/Mexico border area. Another HPWREN camera was installed at Red Mountain, which views Palomar Mountain, Valley Center, and the northern San Diego River.

**July**

The HPWREN team provided ad-hoc connectivity for the Mataguay Fire Incident Command Post. This marked HPWREN’s first experience with incident response deployment at night-time.

**August**

Scrapes Institution of Oceanography Visualization Center produced a DVD from HPWREN Cedar Fire images as narrated by Retired CDF Fire Captain Ron Serabia.

**September**

New software was developed by HPWREN, in collaboration with the CDF, atop Mount Laguna and Lyons Peak that allowed first responders to be paged by real-time data when humidity and fuel moisture levels as well as wind speed and direction reach alarming levels.

**October**

CDF’s Puerta La Cruz Fire Command and designated Incident Command Post was connected to HPWREN in collaboration with SDSU and TDI/Net. This enabled first responders at Puerta La Cruz to have access and high-speed connectivity via the network.

**November**

CDF’s Incident Command Post for the Border 50 Wildfire was connected to HPWREN.

**2005**

**May**

HPWREN researchers worked with CDF and San Diego Sheriff’s Dept for ad hoc network relay demo at Lake Hodges fire exercise.

**July**

The San Diego County Sheriff’s Department and the California Department of Forestry and Fire Protection aircraft replacement sensors for HPWREN real-time weather alerts.

**October**

HPWREN establishes high-speed connectivity at the Volcan Fire ICP.

**November**

CDF’s Puerta La Cruz Fire Camp and designated Incident Command Post was connected to HPWREN in collaboration with SDSU and TDI/Net. This enabled first responders at Puerta La Cruz to have access and high-speed connectivity via the network.

**December**

CDF’s Border 50 Wildfire Command Post was connected to HPWREN.

**2006**

- HPWREN researchers continue to conduct experiments with Voice over Internet Protocol (VoIP) that may be useful for incident management scenarios where and when high-speed Internet connectivity is available.

- The HPWREN team continues to work with the San Diego County Sheriff’s Department on ways in which the 4.9 GHz public safety spectrum can be utilized for county-wide incident management.

- Again this spring, the HPWREN team expects to participate in this year’s multi-agency wildland fire exercise. Last year’s activities at Lake Hodges provided the team with great insights into new ways to deploy high-speed networking at remote wildfire scenes.
The Utilization of HPWREN for Incident Management

May 2005 Joint Exercise with CDF and San Diego Sheriff’s Department at Lake Hodges

Lessons Learned

Working with first responders allows HPWREN researchers to experiment with and demonstrate rapid deployments of networking technologies, as well as how best to create and maintain high-speed data connectivity under difficult circumstances (e.g., wildfires). While the team continues to explore ways in which incident management applications can continued to be added to the research portion of the network, the following lessons have already been learned:

Basic Needs. The need for digital data (Internet) communication is substantial for both Incident Command Posts (ICPs) and remote fire station/camp deployments. Furthermore, this need for digital communication access appears to have increased over the past few years. Further recognition and understanding of appropriate requirements would appear useful along the agency management chain.

Service Integration. There is an increasing requirement for more service integration including Voice-over-IP, such as phone and FAX across the data network. Additionally, video conferencing as well as real-time sensor telemetry and data integration may soon provide significant value to the first responder community.

The ability to create ad-hoc expansions of the network via a high-speed data connection is of great value in its potential for an array of incidents. This can support ICP-local wired and wireless networks for activities such as an expanded dispatch. Example uses are relaying video downlinks, IR mapping from aircraft of the incident, and many others. Providing a “big” pipe to an ICP will enable more that we can probably envision at this time. The connectivity could furthermore be useful to conduct remote Computer Assisted Dispatch (CAD).

Multi-Agency System. While it is reasonable to utilize a National Science Foundation funded research project (e.g., HPWREN) to get things underway for a long-term availability and expansion potential the first responder agencies need to develop a systemic plan overall to how about to sustain high-performance data communication for ad-hoc and persistent settings. Specifically, it is desirable to work together to make ONE system that everyone can share and have access to, because when large-scale incidents such as big earthquakes or wildfires happen, it doesn’t matter who’s area it is in levering across multiple agencies is possible if people are willing.

First Responders Comment on HPWREN

In 2002, Hans-Werner Braun asked the CDF if he could use its radio repeater towers, scattered across mountaintops around the county, to install his system. “He put cameras there to make sure his antennas faced the right way. We had never seen an arrangement like this before. My first thought was ‘Could we use this?’” said Tom Gardner (Emergency Command Center Chief) said. “Then we asked ‘Could you install weather stations up there? Could we get internet data access in the fire camps? And that’s how it started.”

In addition to giving them sweeping looks across miles of the county, the system also gives firefighters high-speed Internet access in areas too remote even to use cellular phones. It also can transmit vital weather data such as wind speed and relative humidity from a fire zone to an incident commander.

There are now 24 remote cameras mounted on peaks and hilltops across the county, and discussions are under way with property owners to erect more. Braun said. Each camera is sharp enough to see up to about 70 miles away. Some of the cameras are mounted in fixed positions, while others can be panned, tilted and zoomed remotely. The cameras are activated by motion or any other change in the image. It sees motion and automatically transfers images to the image. “It sees motion and automatically transfers images to the image. ‘It sees motion and automatically transfers images to the image. We saw those cameras and that started us working.”

In 2005, Rick Henson, Division Chief, Puerta La Cruz, said that information, and even in the middle of the night know that wind speed and direction, humidity and fuel moistures are becoming critical. The sensors allow us to verify the fire weather forecasts in real time, so we can begin to plan for fires more certain now.”

“Your team has done a fantastic job developing the package into a nearly self-contained and readily deployable by air system,” said Steve Shoemaker, CDF Fire Captain, and Gillespie Helitack Base. “With many of the enhanced changes and additions, the system continues to become more users friendly. I also appreciate the inter-agency approach to the mission. HPWREN is a good partner to Public Safety Agencies and has been creatively supporting and enhancing our capabilities. I eagerly look forward to working together on technologies like airborne imaging systems and data links for fire to-ground applications.”

“Another benefit of the HPWREN linkup is that a separate line has been run out in front of the camp exclusively for ICP/Fire Camp use. It is ready to be tapped into for immediate use to the Command Unit and onto the fire at a Camp,”

“Wildland Fire Fighters know that a good size up begins early in the morning when we see what the new day will bring us weather-wise,” says Randy Lyle. "With these remote sensors we can now get a big jump on that information, and even in the middle of the night know that wind speed and direction, humidity and fuel moistures are becoming critical. The sensors allow us to verify the fire weather forecasts in real time, so we can begin to plan for fires more certain now.”

"Until recently, Puerta La Cruz Camp, like many outlying CDF facilities, suffered with a slow dial-up Internet connection. Our hookup speeds ranged from 22 to 28 Kbps, slow even by Dial-up modem standards. With larger and larger emails being sent out, just going through our email took 1 to 2 hours, doing Eapay was an exercise in frustration, twice a day was a luxury! In addition, the Fax machine was hooked up to the same line, so faxes could not be sent or received while someone was online. Often, if a fax came in, we had to disconnect. Office functions were scheduled around time on the Internet and the phone bill bordered on excessive." On Thursday, December 8, 2005, with the help of Hans-Werner, Ron Senvaia and Rick Duckworth, Puerta La Cruz was hooked into the HPWREN network. The connection at Puerta La Cruz is now running at 4.3 Mbps! This is three times faster than the T-1 line at Monte Vista or 100 times faster than our old dial-up connection! Needless to say all Internet related operations are occurring in minutes instead of hours! Also, our fax line is doing just that.

Lesson Learned

- HPWREN is based on work sponsored by the National Science Foundation under Grant Numbers 0087344 and 0426879.
- HPWREN is an interdisciplinary and multi-institutional UC San Diego research program, led by Principal Investigator Hans-Werner Braun.
- "As part of our National Science Foundation funded project, we would like to stimulate a vision of high performance ubiquitous data networking," says HPWREN principal investigator Hans-Werner Braun. "As such, we are collaborating with various agencies on demonstrating various values that can be supported by real-time data networking, examples of which being sensor networks and an ability to rapidly deploy 'anywhere' ad hoc networks."