High Performance Wireless Research and Education Network

http://hpwren.ucsd.edu/

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National Science Foundation awards 0087344, 0426879 and 0944131
Interdisciplinary and multi-institutional collaborative cyberinfrastructure for research, education, and public safety activities.

Enabled initially by an NSF funded high-speed wireless network, which spanned a vast and diverse geographic region.

Allows for real-time data transfers from many hard-to-reach San Diego and Riverside county locations.

Traffic examples include high-volume bulk data (e.g., astronomy) as well as the aggregation of continuous traffic generated by many sensors throughout the region (e.g., seismic, weather, cameras).

In short: HPWREN is a system allowing UCSD researchers to deploy sensors and access sensor data throughout a widening coverage area.
HPWREN topology, December 2000

- UCSD
- Mount Laguna Observatory
- Pala Native American Reservation
- Backbone/relay node
- Astronomy science site
- Biology science site
- Earth science site
- University site
- Researcher location
- Native American site
- First Responder site

Bandwidth options:
- 155Mbps FDX 6 GHz FCC licensed
- 155Mbps FDX 11 GHz FCC licensed
- 45Mbps FDX 6 GHz FCC licensed
- 45Mbps FDX 11 GHz FCC licensed
- 45Mbps FDX 5.8 GHz unlicensed
- 45Mbps-class HDX 4.9GHz
- 45Mbps-class HDX 5.8GHz unlicensed
- ~8Mbps HDX 2.4/5.8 GHz unlicensed
- ~3Mbps HDX 2.4 GHz unlicensed
- 115kbps HDX 900 MHz unlicensed
- 56kbps via RCS network

Dashed lines = planned
Various real-time network cameras for environmental observations (one of 3 view sets)
360 degree environment observing cameras

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- 56kbps via RCS network via Tribal Digital Village Network
- dashed = planned

Red circles: HPWREN or SDG&E supplied cameras
Yellow circles: SD County supplied cameras

- Note: locations are approximate
- approximately 50 miles:
July 2003

Coyote Fire HPWREN connection

Palomar Mountain relay

Fire operations relay

Cuyamaca Mountain HPWREN backbone site

Operations camp

High Performance Wireless Research and Education Network
Real-time weather sensors
(many of them able to produce 1/sec data)
WIFIRE: A Scalable Data-Driven Monitoring, Dynamic Prediction and Resilience Cyberinfrastructure for Wildfires

Development of: cyberinfrastructure for analysis of large dimensional heterogeneous real-time sensed data for fire resilience before, during and after a wildfire …

Supporting real-time assessment, simulation, prediction, and visualization of wildfire behavior

High Performance Wireless Research and Education Network
IDI Efforts

• HPWREN is in transition, with past and future leadership working together to expand research support, collaboration and system sustainability

• Overall goal is to enable UCSD researchers to more easily use HPWREN to deploy sensors and access sensor data throughout a widening coverage area

• Efforts to do this, aligning with IDI campus goals include
  – Evaluating current operational models
  – Integrating best IT infrastructure practices
  – Consolidating and documenting data workflows and lifecycle
  – Curating data for publication, access and preservation
  – Embracing economies of scale offered by latest IT technologies
  – Improving system services and maintenance response time
Specific activities

• Widening coverage area of HPWREN with sector antennas
• Expanding operational documentation of HPWREN
• Increasing system monitoring activities across SDSC, SIO and Calit2, incorporating automation tools for monitoring and maintenance response tracking
• Adding web site redundancies and load sharing for camera real-time and archival data at Calit2
• Reviewing integration of HPWREN servers into SIO’s IT management model, including virtualization efforts
• Reviewing network backbone and SDSC gateway configuration to improve performance, reliability and redundancy
• Considering an additional gateway to CENIC networks
Anticipated Outcomes

• Expand HPWREN network infrastructure to allow UCSD researchers to deploy and access Internet capable sensors in a wider coverage area ... we want to support
  – New researchers and research activities
  – New PIs and their funding efforts
  – New sensor deployments

• Make HPWREN data more accessible to researchers
• Preserve HPWREN data, a critical UCSD intellectual property
• Expand training and outreach across UCSD to leverage new discoveries and build collaborations
• Provide public safety information to the community as part of UCSD’s service-oriented mission
• Engage with Pacific Research Platform to broaden the reach of UCSD investigators
High Performance Wireless Research and Education Network
Research and New Discoveries

Palomar Observatory’s automated and remotely operated telescopes, together with the availability of high speed wireless data connection via HPWREN (High Performance Wireless Research and Education Network) facilitate advanced astronomy science. It allows for long term studies and projects, high volumes of data that can be transferred and stored elsewhere, and enabling researchers to respond rapidly to real-time events from anywhere in the world. This is setting the stage for New Discoveries and a greater understanding of our Universe.

http://www.astro.caltech.edu/palomar/
http://hpwren.ucsd.edu/
Collaborative agency connections
High Performance Wireless Research and Education Network

HPWREN topology, real-time met sensors

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Note: locations are approximate

Backbone/relay node
Astronomy science site
Biology science site
Earth science site
University site
Researcher location
Native American site
First Responder site

Red circles: 1/sec wind data
Purple circles: 1/second wind data (SD County supplied sensor)
Yellow circles: 1/minute wind data

approximately 50 miles:
Real-time data based alerts

Trigger real-time computer-generated alerts, if:

condition “A” AND condition “B” AND condition “C”
OR  condition “D”

exists, in which case several San Diego emergency officers are being paged or emailed during such alert conditions, based on HPWREN data parameterization by a CDF Division Chief. This system has been in operation since 2004.

Date: Wed, 4 Aug 2010 09:31:05 -0700
Subject: URGENT weather sensor alert

LP: RH=26.1 WD=135.2 WS=1.9 FM=6.8
AT=80.7 at 20100804.093100
More details at http://hpwren.ucsd.edu/Sensors/
Incident-based sensor alert concept

Wildland fire incident

Event-deployed networked sensors

Raw sensor data

Centralized analysis and automated alert generation

Configuration of alert parameters

Computer-generated alerts

Command center

Notification to active firefighters about critical environmental changes