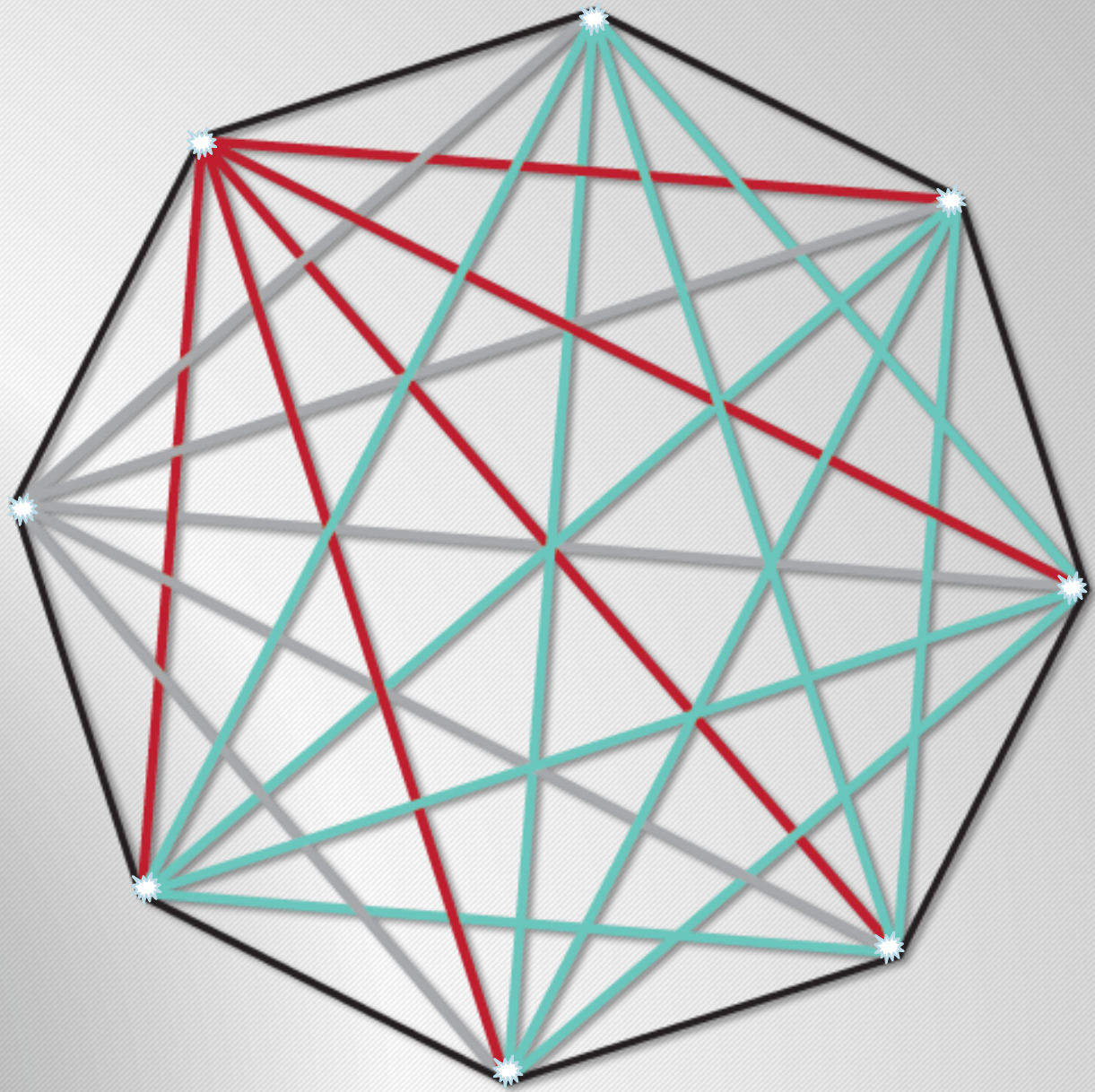

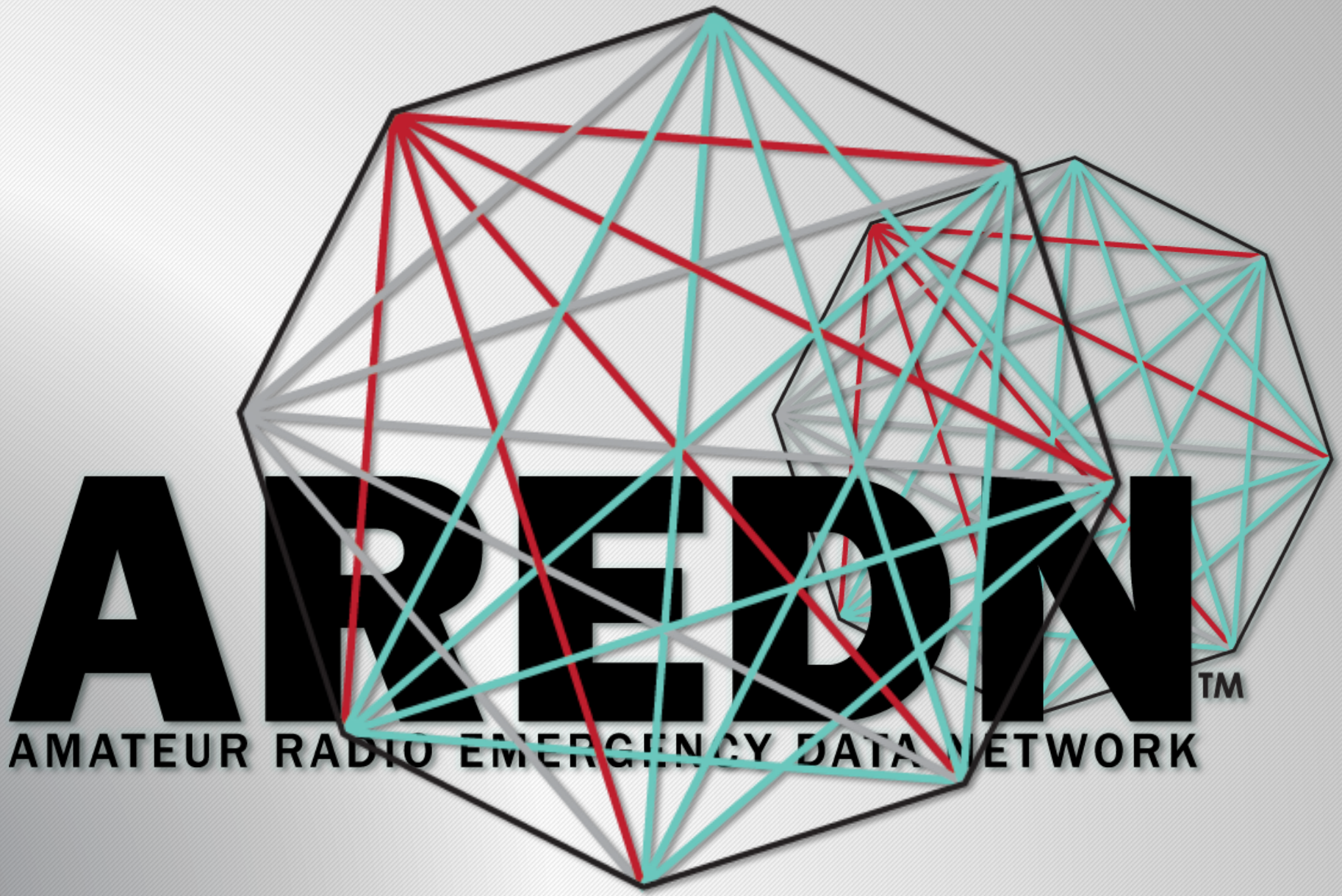
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AMATEUR RADIO EMERGENCY DATA NETWORK

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# Cactus Intertie Annual Meeting

Andre, Hansen, K6AH

Cactus Intertie Annual Meeting, 2019
Lake Havasu City, AZ
March 2, 2019

# What is the AREDN Project?

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AMATEUR RADIO EMERGENCY DATA NETWORK

## HSMM Mesh

- Repurpose WISP routers – replaces OEM FW
- In the Ham Bands (.9, 2.4, 3.4, & 5.8 GHz)
- Part 97 Tech License
- Up to 144 Mbps IP Network (802.11n)
- Nodes are comprised of:
  - Linux computer w/Ethernet I/F
  - Software Defined Radio (SDR)
  - Amplifier
  - Often includes an antenna
  - $45-$90

# What is the AREDN Project?

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## Software

- OpenSource development project
- Distributed under Free Software Foundation GNU GPL version 3
- Free to Hams (and anyone else for that matter)
- Focused on AuxComm/Emcomm
- Active user forum
- Agile, flexible dev model
- Nightly builds available
- Entirely a Ham volunteer effort
- Developers also implement

# Typical WiFi

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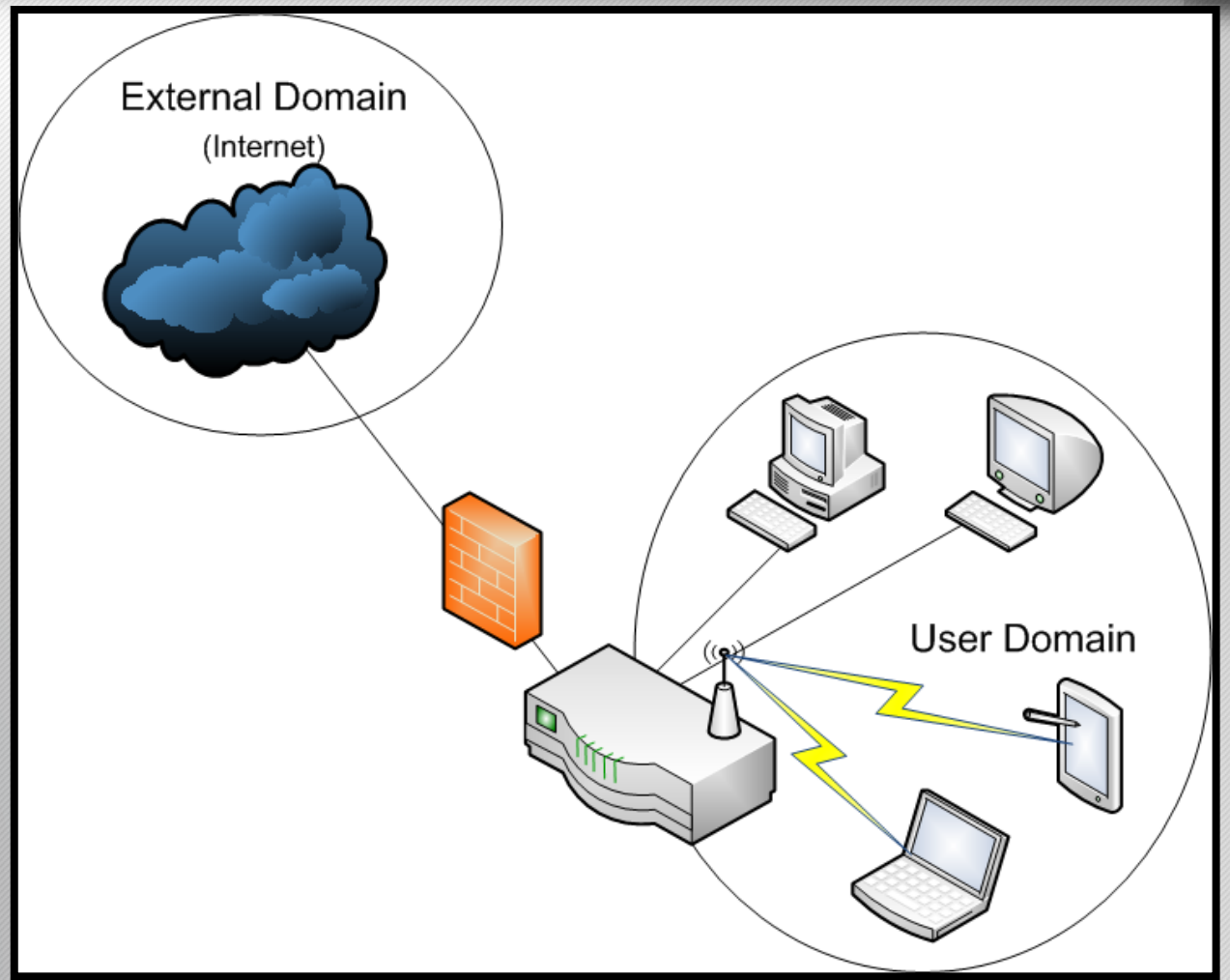

# Repurposed Hardware

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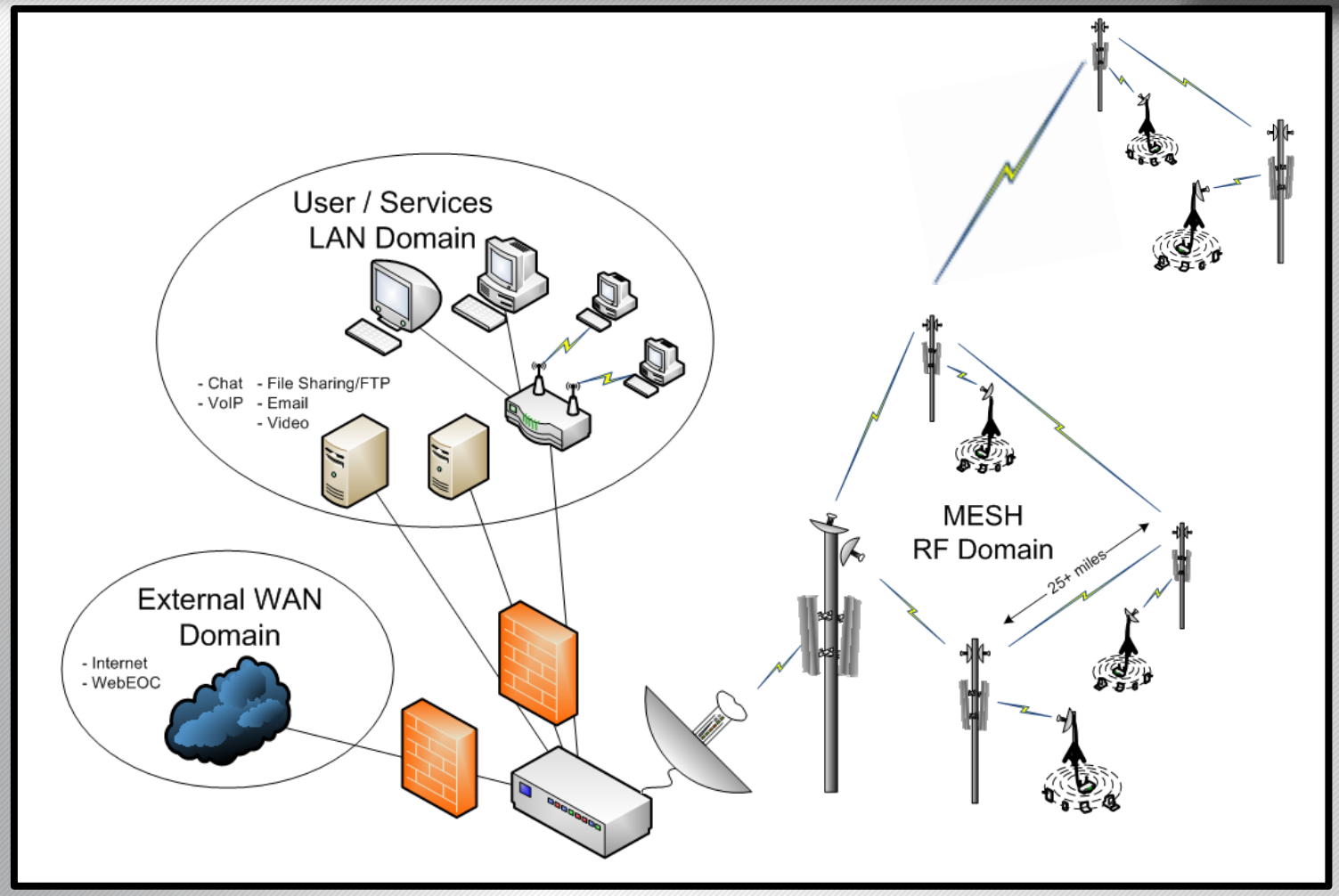

# Optimized Link State Routing

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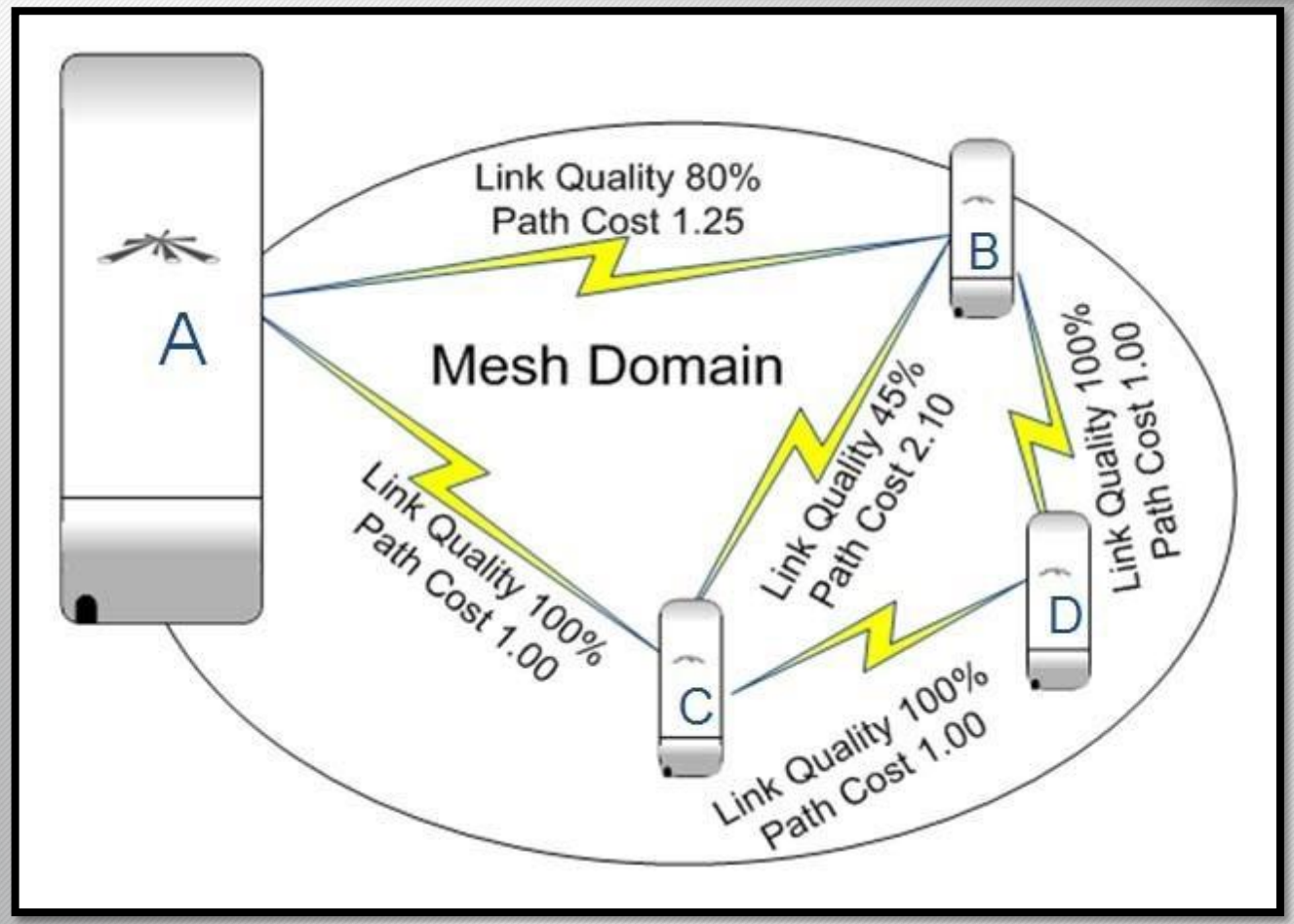


## Ubiquiti

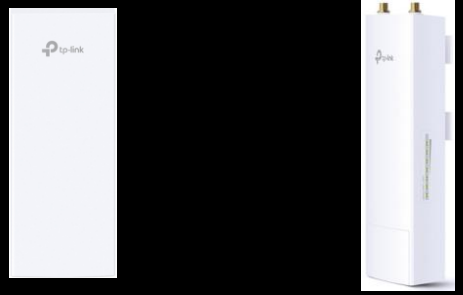
Wide variety of devices for all topologies

## Mikrotik

Wide variety of devices for all topologies

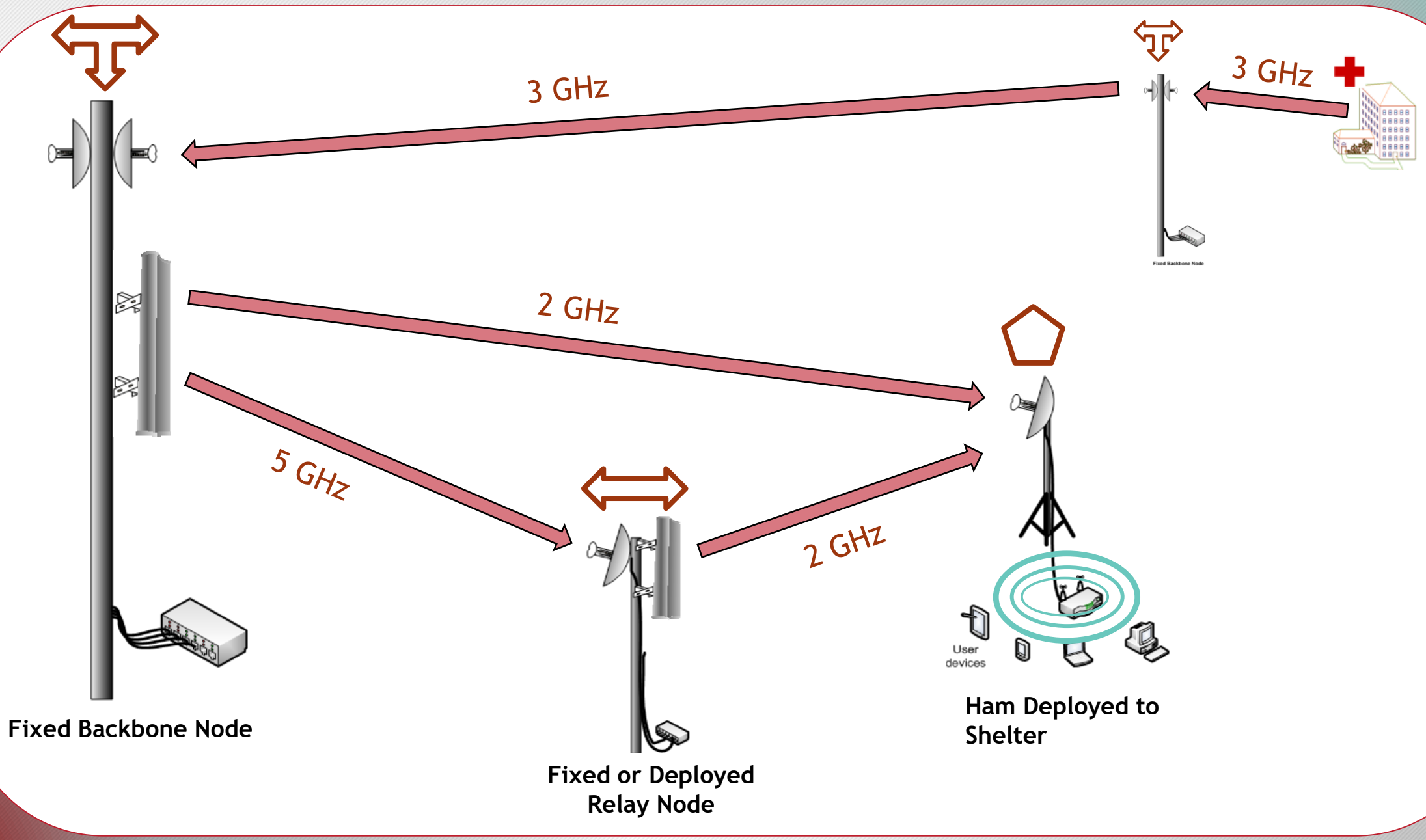
## TP-Link

NanoStation and Rocket look-alikes



## Robust Specifications

- Power Output: 23 – 28 dBm (200mW – 630mW)
- Antenna Gain: 11 – 30 dBi
- Some configurations capable of 50+ mile range
- Temperature: -40° to 176°F


3 GHz
3 GHz
2 GHz
5 GHz
2 GHz
User devices
Fixed Backbone Node
Fixed or Deployed Relay Node
Ham Deployed to Shelter

# Design Considerations

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## Backbone

Elevation

High-gain/high power

Point-to-Point 3 GHz or 5 GHz

Distribution downward 2 and 5 GHz

## Deployed Nodes

Typically be Ham-owned

Inexpensive <$100

12v power

Augment go-kits

Typically 2 GHz (channel -2, 2397 MHz)

## Relay Nodes

High-gain upwards

Broad-coverage down

Cross-band 5 to 2 GHz

Strategically placed

Path prediction tools greatly simplify locating these

# Construction Considerations

## Backbone

Mountains, water towers, buildings, towers

Dish 24-30 dBi

Rockets (MIMO)

Sector distribution downward

## Deployed Nodes

NanoBeam

WIFI Access Point

10-20’ mast

Keep it simple

## Relay Nodes

Hills, tall masts, buildings

RadioMobile to determine location

Up: NanoBeam, PowerBeam

Down: NanoStations

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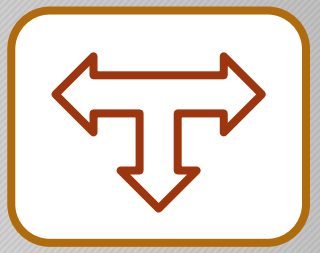
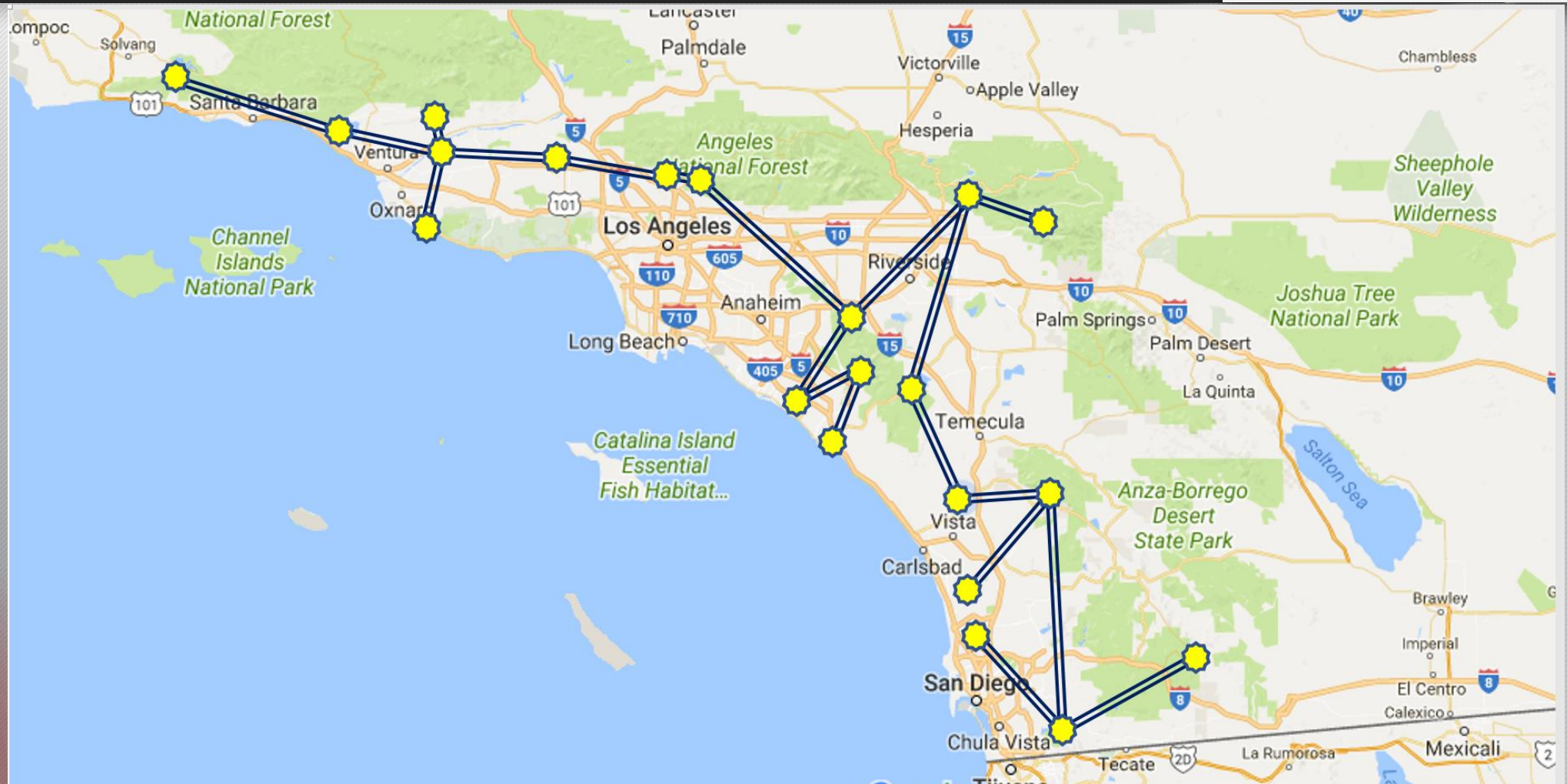
# Backbone Sites



# The SoCA AREDN Federation



# Using the Vertical Dimension

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# Effective Use of High Ground

Mt. Palomar, 6200’ ASL to Mt. Otay at 49 miles

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# 2 GHz and 5 GHz Downlinks

## Mt. Palomar at Ham's Mountain Cabin

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# Club Repeater Site Towers

Mt Otay – Doghouse Junction, CA


## Benefits

Cheap or free

Gets the club involved

No QRM from ISPs

# Commercial Towers

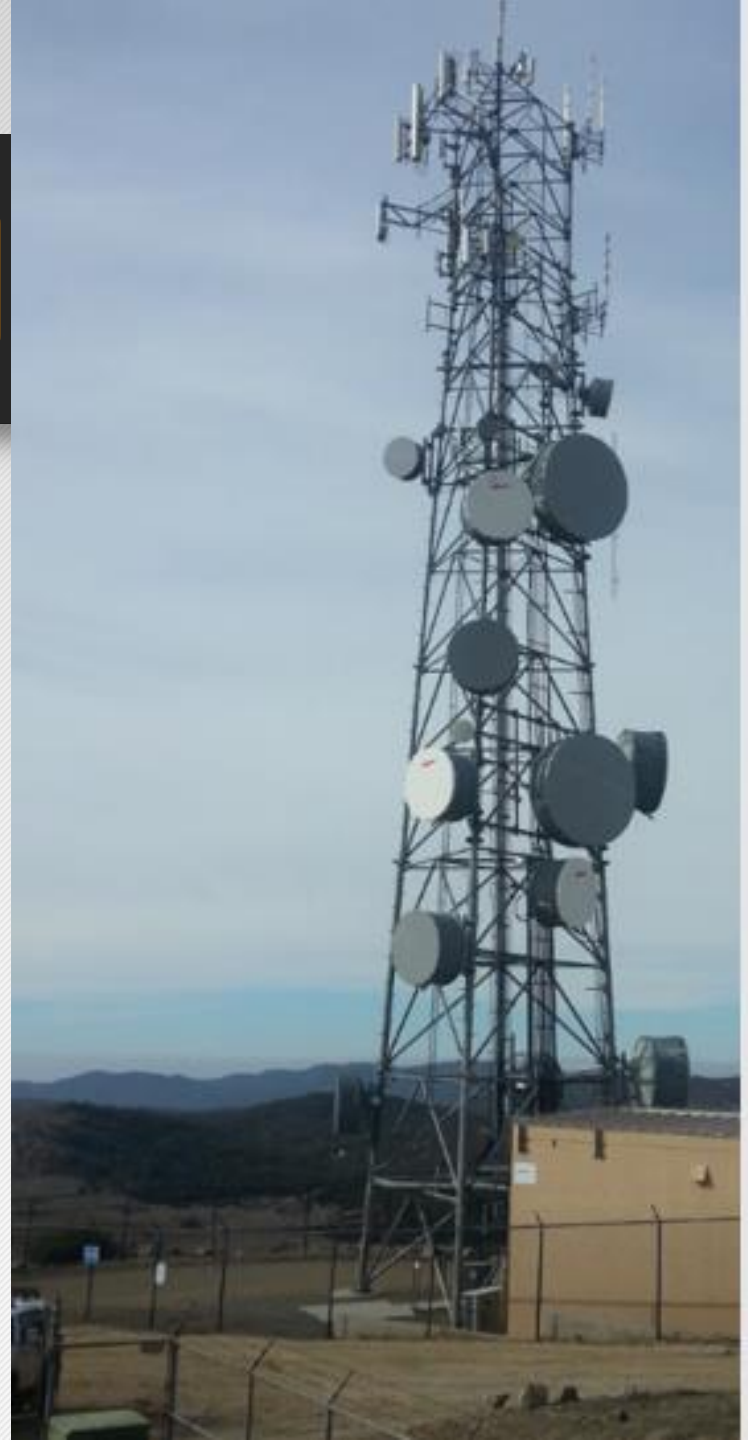
- Elsinore Peak – Cleveland NF, CA

## Benefits

Generally well-placed

Often much taller

May be ham-owned



# Self Contained Backbone Site

## Ventura County - Camarillo Hills, CA

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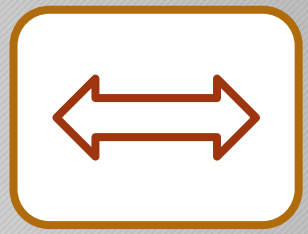
# Relay Sites




# Relay Node “In the Wild”

Unspecified location

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# Small Footprints / Wide Coverage

## Chatsworth Peak - Ventura County, CA

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# Small Footprints / Wide Coverage

Saddleback Peak - Mission Viejo, CA

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# Water Tower Relay Site

## San Bernardino County - Redlands, CA

# Deployed Relay Node

## Temporary Shelter Deployment

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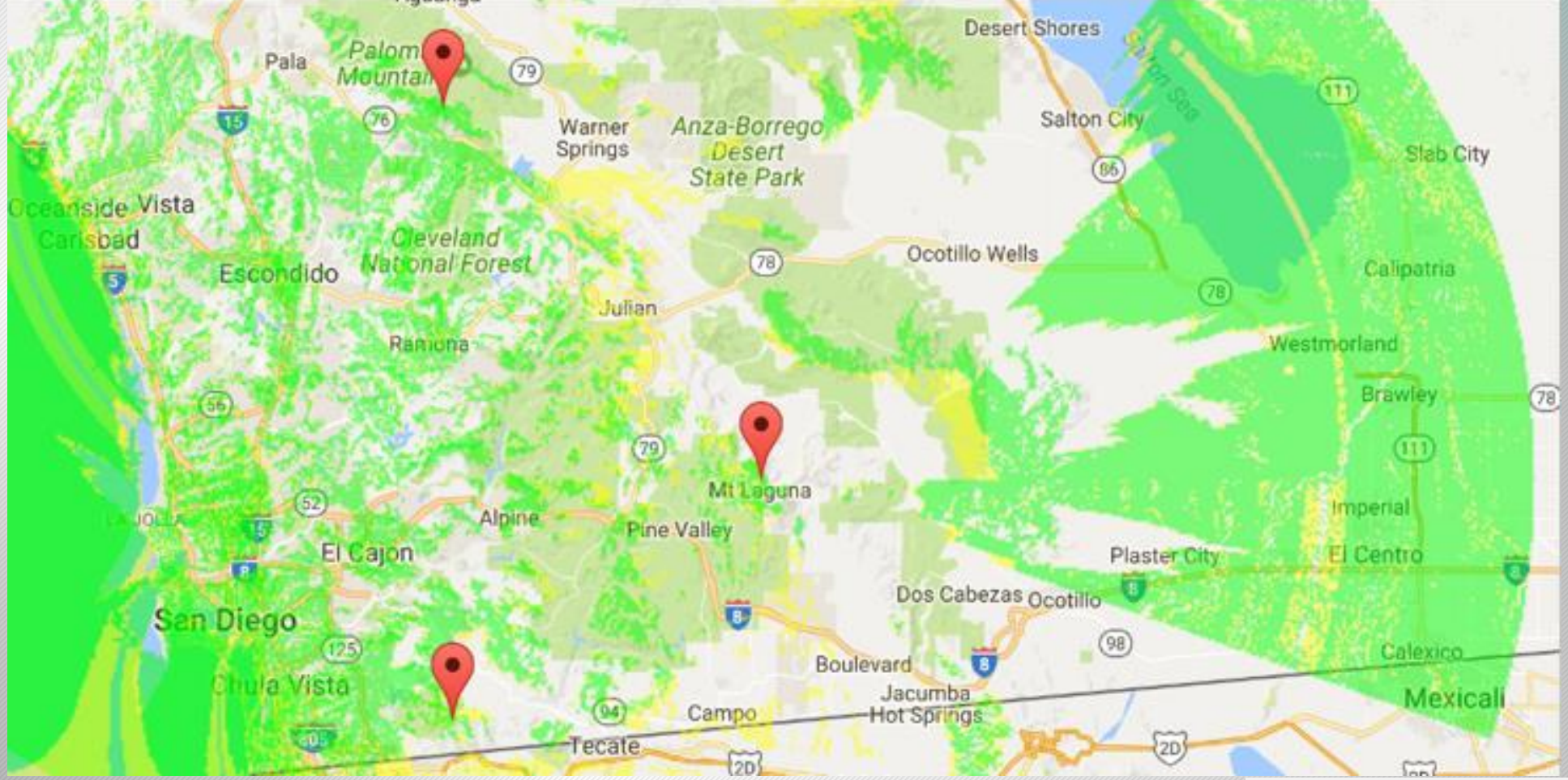


# Predicting Coverage

## RadioMobile

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# Documentation

# Documentation

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Docs » AREDN Overvie

## AREDN Over

The AREDN™ acronym s
for *Amateur Radio* operat
service-oriented commu

For many years amateur
transmissions for emerge
involved conveying the n
ICS-213 form. The mess
or type it on another ICS
delivered to the recipien
then be handled through

This tried-and-true scen
emergency and event tra
of traditional methods ar
electronic form, with me
Pactor, Fldigi, and others

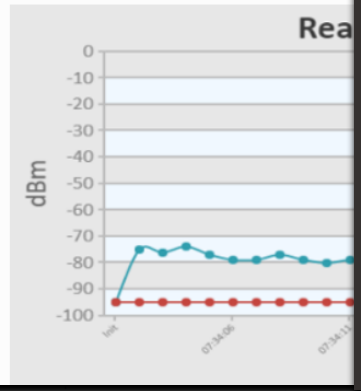
In today's high-tech soci
accustomed to different
communication needs. T
short messaging and key



Most of the latest AREDN™ devices
that exploit multipath propagation.
chain" radios, another way to achiev
antennas so that one is vertically po
a signal separation of up to 20 dB. V
less susceptible to reflections and ra
signal with clear line of sight. Note t
the same way.

## Aligning Link Nodes

The AREDN™ web interface provide
being installed to form a link. On the
*Signal to Noise* graph. Slowly turn an
you see the best signal, as shown be
focus on the antenna position witho
*Sound* feature and align the antenna
Signal to Noise Ratio of 15 dB is ade

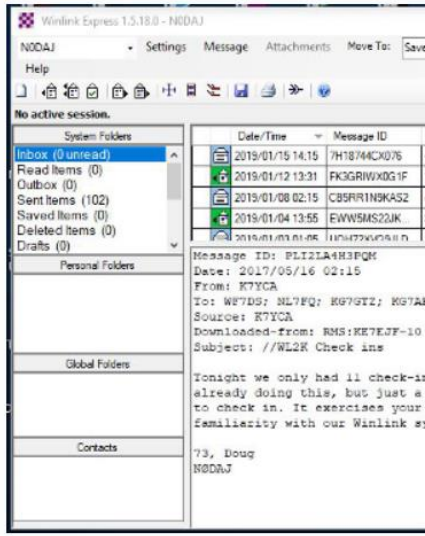




Radio Spectrum Characteristics
Channel Planning
Network Modeling
APPLICATIONS AND SERVICES GUIDE
AREDN Services Overview
Chat Programs
Email Programs
Citadel/UX
Open Source Email Server
Using WinLink to Send Email
Example Email Service Comparison
File Sharing Programs
VoIP Audio/Video Conferencing
Video Streaming and Surveillance
Computer Aided Dispatch
Other Possible Services
HOW-TO GUIDES
AREDN How-to Guides Overview
How-to Use PuTTYGen on Windows to Make SSH Keys and Use Them on AREDN™ Nodes
Settings for Radio Mobile
APPENDIX
Frequencies and Channels


## Using WinLink to Send Email

Although it is not typically used as a TCP/IP netw
familiar with WinLink 2000 for sending message
amateur radio frequencies. It is possible to config
P2P for sending email with attachments across a
Windows computer with plenty of memory to ru
information link below for details about the spec
maximum attachment size is currently 5MB per m
HF and Packet RMS stations. For additional infor
on Winlink located here: Winlink Forum



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# Applications for AREDN

# How will you use AREDN ?

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- Public Service / Public Safety
- Red Cross Disaster Services Technology
- Community Emergency Response Team
- Support MOUs with your municipal EOC
- Deliver paradigm changing services
  - VoIP & Chat with other sites
  - Cell Service Restoration – BYO
  - Access to cloud-based systems
  - Augment Winlink services

WINLINK
Global Radio Email

## Administrative

Advanced config

iperf Speed Test

Network monitoring (snmp)

UPS monitoring

NNTP Time services

Antenna pointing/peaking

## User Applications

Air Traffic Control

EmComMap

CERT Damage Assessment

MeshChat

Weather Stations

Remote cameras

VoIP telephony (226 assigned numbers)

Winlink

DMR linking

Web-based Email

Mattermost

FTP / fileshare

Website with network/node info

# Applications Running on AREDN Networks

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# PBX Configuration for VoIP Phones

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# MeshChat

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CHAT FILES STATUS LOGOUT

**Mesh Chat v1.0**

**Zone:** MeshChat
**Call Sign:** K6AH
**Node:** kd7vea-rocketdish-to-westmountain
**Updated:** 86 seconds ago

**Send a Message**

**New Message**

Enter message here

**Channel:**

Everything

**Mesh Chat Users** 2

| Call Sign | Node | Last Seen |
|---|---|---|
| K6AH | kd7vea-rocketdish-to-westmountain | 2/14/19 9:33 AM |
| [illegible] | [illegible] | 2/14/19 |

**Messages**

Search: Enter search

Channel: Everything

| Time | Message | Call Sign | Channel | Node |
|---|---|---|---|---|
| 2/13/19 6:02 PM | Testing... | W6BI | | ai6bx-2-chatpi |
| 2/13/19 6:01 PM | Just checking in | W6BI | | ai6bx-2-chatpi |

# Node Management thru Smart Switches

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TOUGHSwitch PoE PRO

STATUS | DEVICE | PORTS | VLANS | ALERTS

Tools: ▼ Logout


**Status**

| | | | |
|---|---|---|---|
| Device Name: | K6AH-Elsinore-ToughSwitch | Date: | 2015-07-17 22:51:24 |
| Device Location: | | Uptime: | 1 day 19:18:30 |
| Firmware: | SW.v1.3.2 | Device MAC: | 80:2A:A8:DF:8F:23 |

**Port Status**

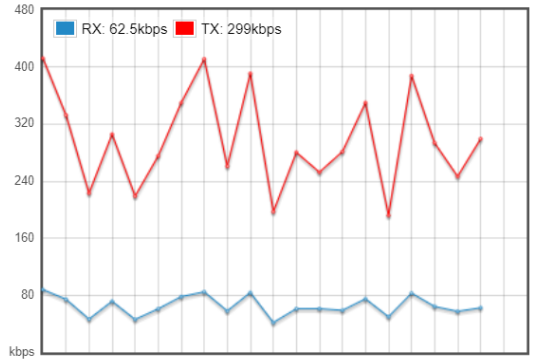
| Port | Name | Port Status | Link Status | PoE | STP State | MTU | Alerts |
|---|---|---|---|---|---|---|---|
| 1 | 5GHz Backbone to Redlands | Enabled | 100Mbps-Full | 24V | Forwarding | 1518 | Off |
| 2 | 3GHz Downlink to N Riverside | Enabled | 100Mbps-Full | 24V | Forwarding | 1518 | Off |
| 3 | 2GHz Downlink to S Riverside | Enabled | 100Mbps-Full | 24V | Forwarding | 1518 | Off |
| 4 | 2GHz Downlink to N Riverside | Enabled | 100Mbps-Full | 24V | Forwarding | 1518 | Off |
| 5 | 3Ghz Downlink S Riverside | Enabled | 100Mbps-Full | 24V | Forwarding | 1518 | Off |
| 6 | 5GHz Backbone to Sleeping Indian | Enabled | 100Mbps-Half | 24V | Forwarding | 1518 | Off |
| 7 | Camera | Enabled | 100Mbps-Full | Off | Forwarding | 1518 | Off |
| 8 | Management | Enabled | Down | Off | Blocking | 1518 | Off |

**Port Statistics**

| Port | Name | RX Data | RX Packets | RX Errors | TX Data | TX Packets | TX Errors |
|---|---|---|---|---|---|---|---|
| 1 | 5GHz Backbone to Redlands | 1375945217 | 1234806 | 0 | 230703932 | 979975 | 0 |
| 2 | 3GHz Downlink to N Riverside | 32296798 | 140863 | 0 | 1100714639 | 1132231 | 0 |
| 3 | 2GHz Downlink to S Riverside | 86482703 | 439282 | 0 | 1472374475 | 1447618 | 0 |
| 4 | 2GHz Downlink to N Riverside | 39250492 | 142563 | 0 | 1095815961 | 1134112 | 0 |
| 5 | 3Ghz Downlink S Riverside | 37242938 | 145915 | 0 | 1096856328 | 1137787 | 0 |
| 6 | 5GHz Backbone to Sleeping Indian | 121095258 | 281768 | 0 | 1056993576 | 1290701 | 151 |
| 7 | Camera | 1099545 | 15940 | 0 | 5044910 | 78361 | 0 |
| 8 | Management | 0 | 0 | 0 | 0 | 0 | 0 |

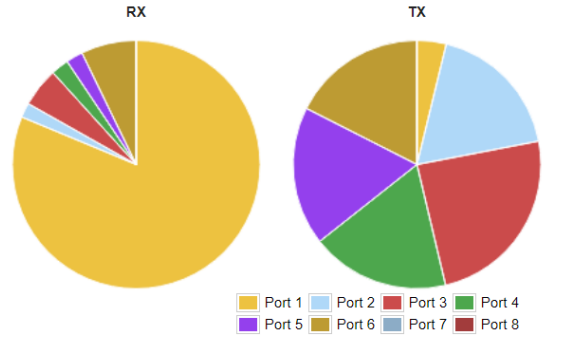
Reset Statistics

**Total Throughput**




**Data Distribution**

All | Last 20 sec




GENUINE PRODUCT

# Network Management with SNMP

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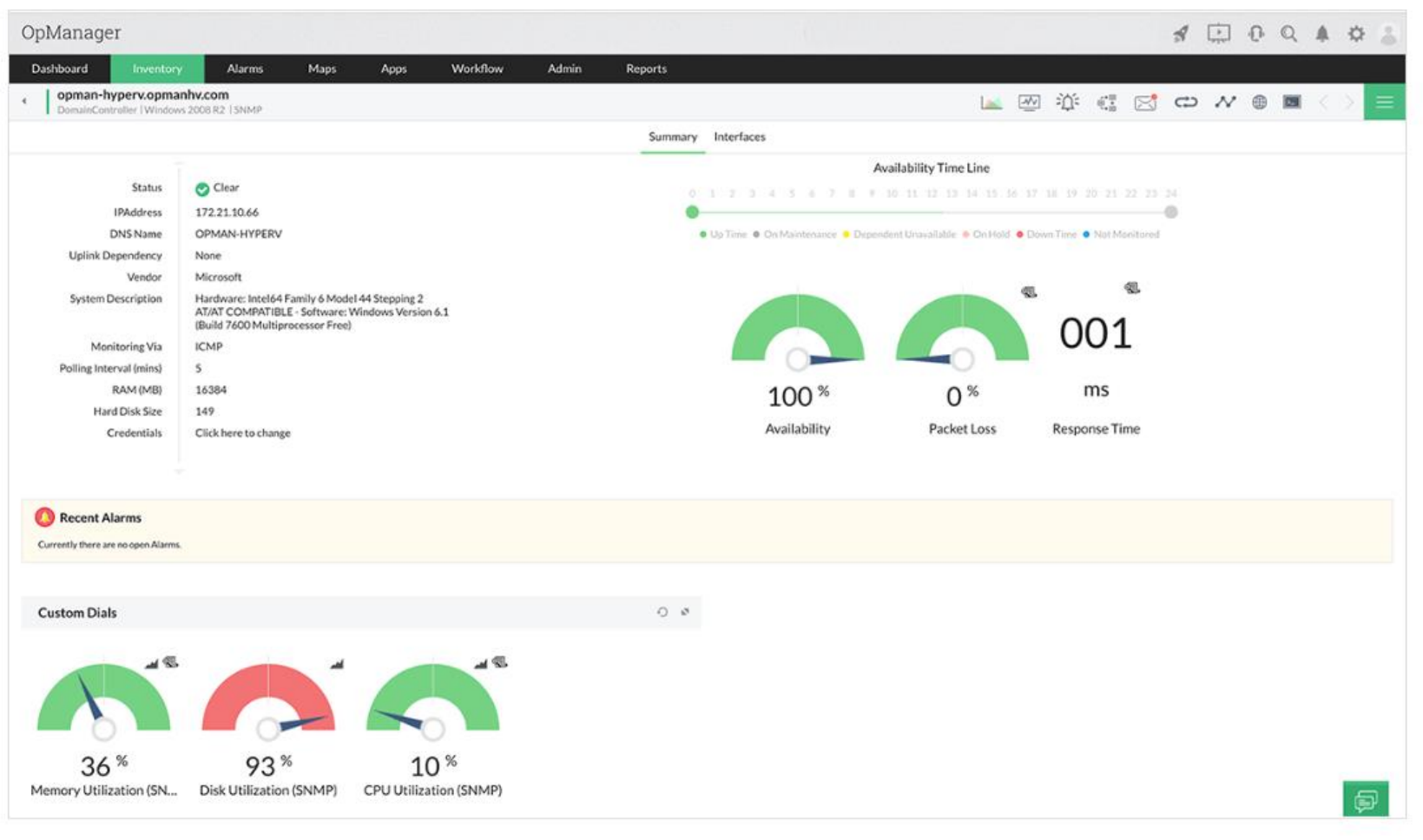

# Team Collaboration Systems

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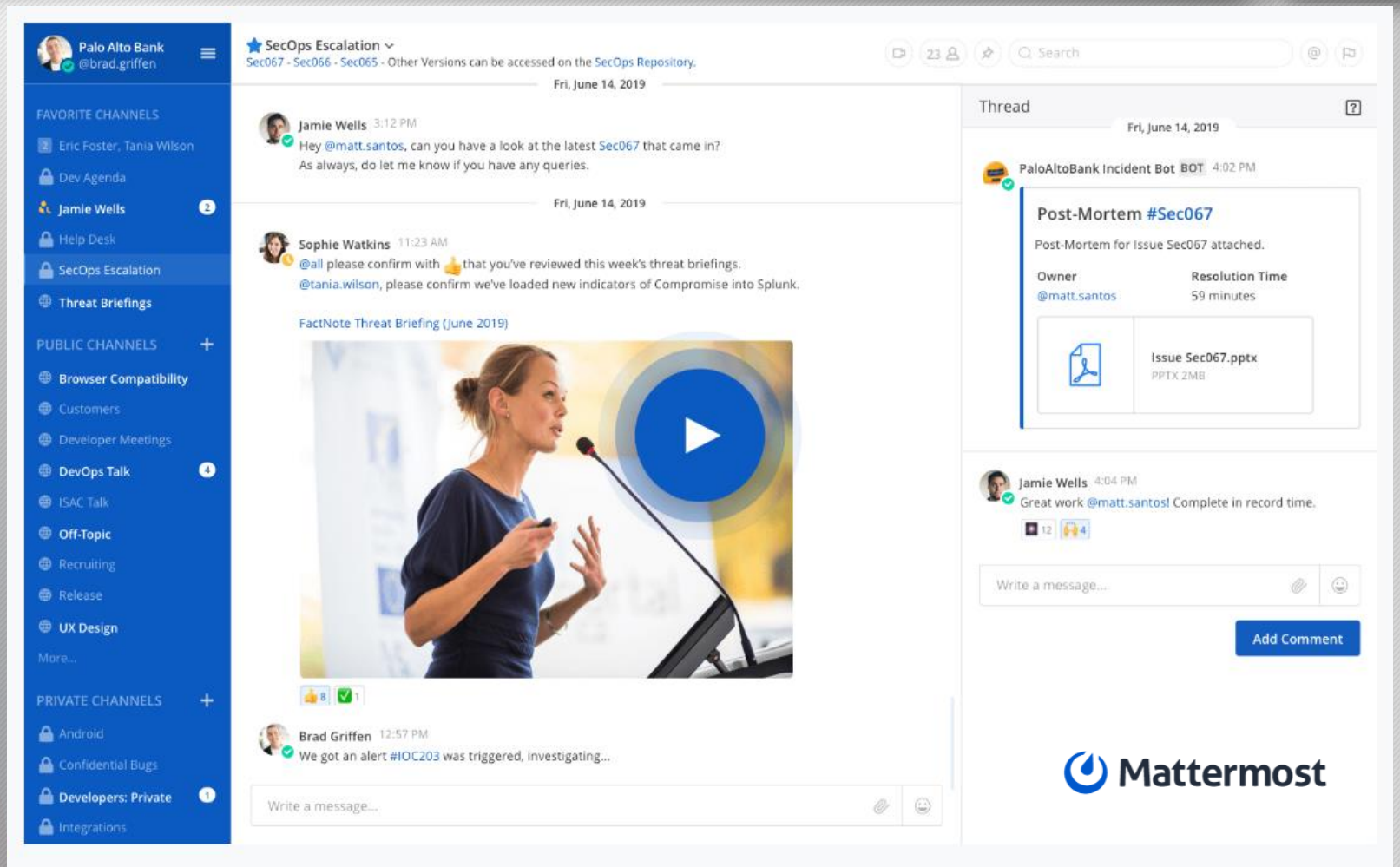

# EmComMap

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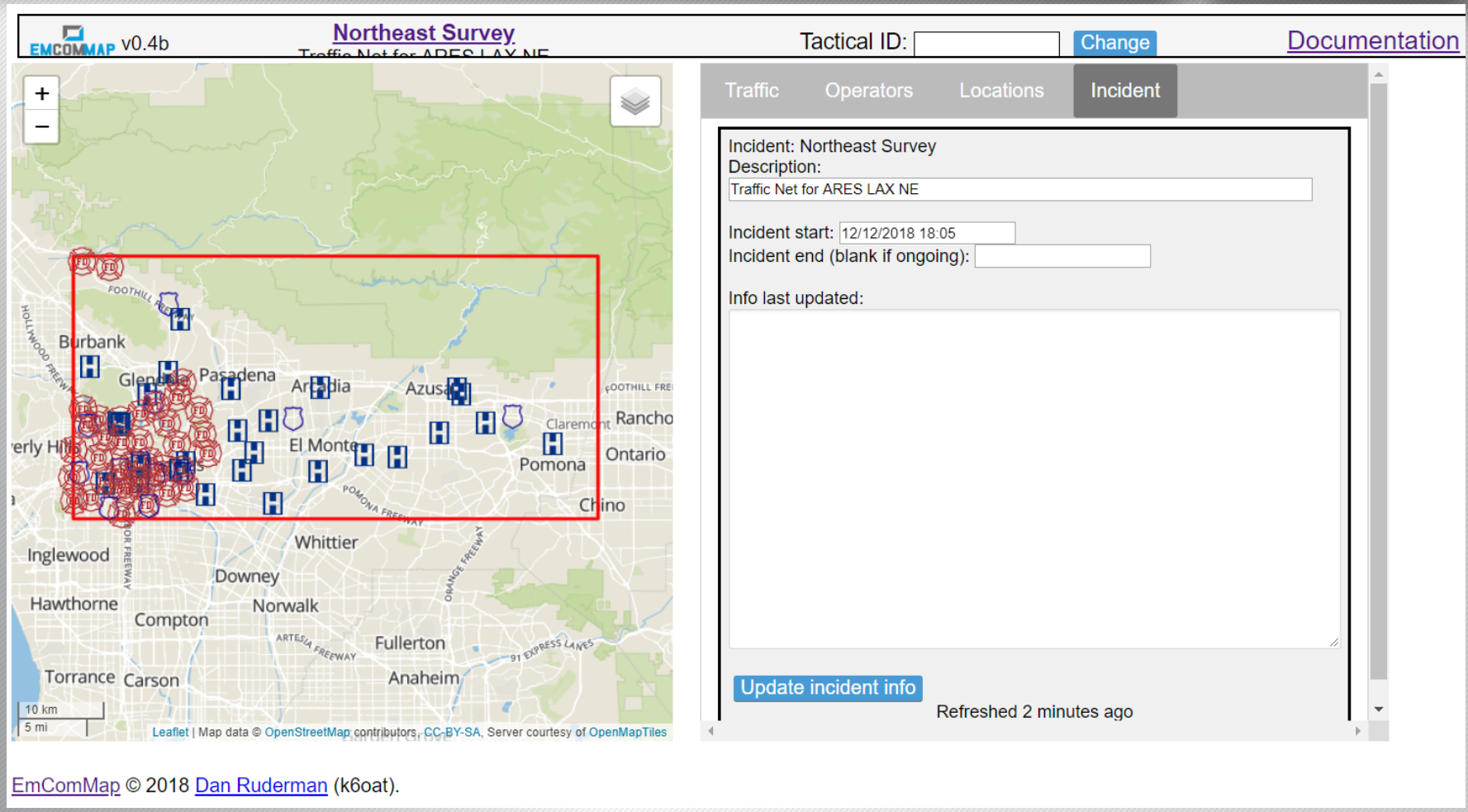


EmComMap © 2018 Dan Ruderman (k6oat).

# Tickets

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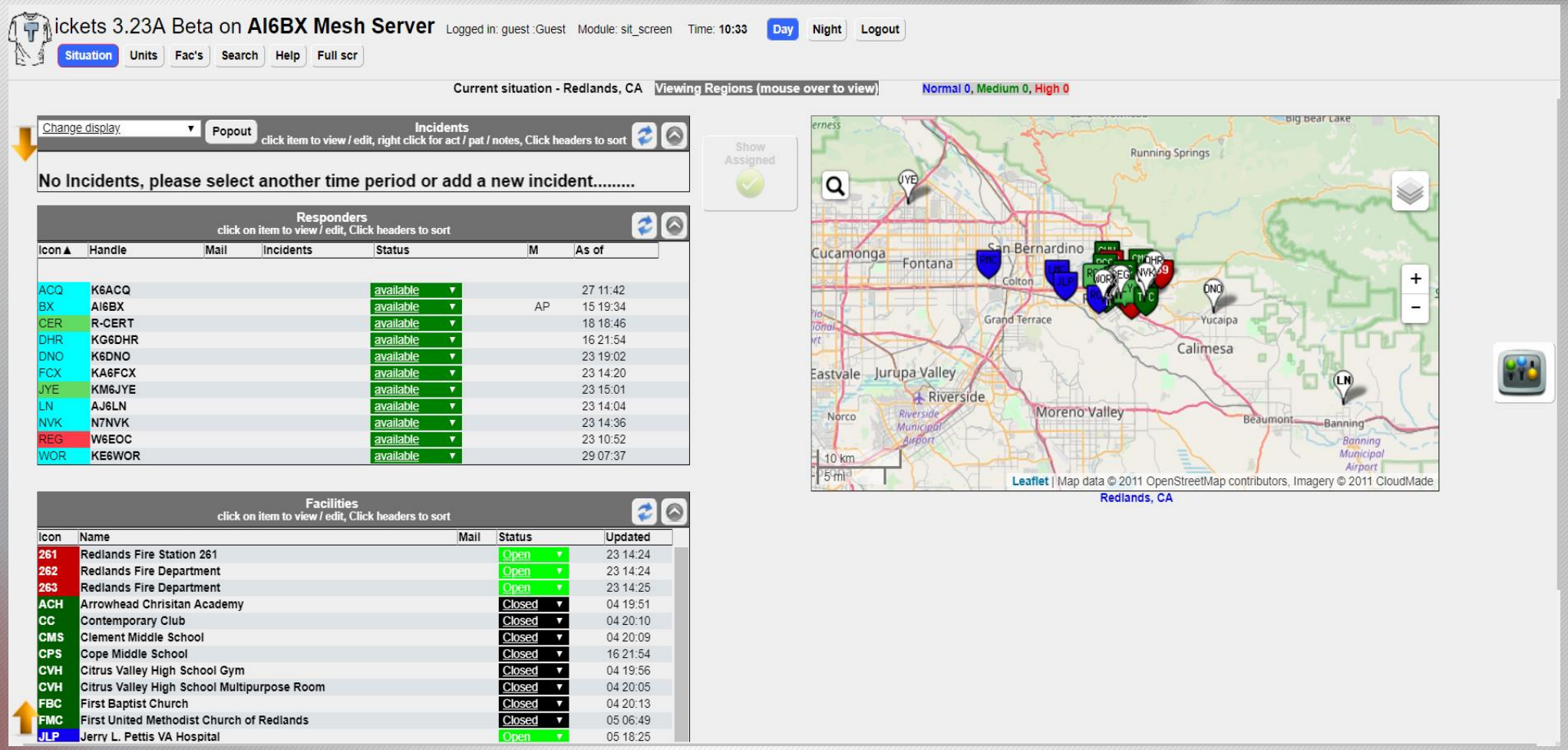

# Allstar Management via Web GUI

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AMATEUR RADIO EMERGENCY DATA NETWORK

## Status for K8BKT - Node 44098

Last update - 02/14/2019 11:40:15 My IP - 76.27.25.238

View this Node Graphically  Search/Command another Node

| | |
|---|---|
| Selected system state | 0 |
| Signal on input | NO |
| System | ENABLED |
| Parrot Mode | DISABLED |
| Scheduler | ENABLED |
| Tail Time | STANDARD |
| Time out timer | ENABLED |
| Incoming connections | ENABLED |
| Time out timer state | RESET |
| Time outs since system initialization | 2 |
| Identifier state | CLEAN |
| Kerchunks today | 0 |
| Kerchunks since system initialization | 2662 |
| Keyups today | 61 |
| Keyups since system initialization | 26398 |
| DTMF commands today | 0 |
| DTMF commands since system initialization | 49 |
| Last DTMF command executed | 22256 |
| TX time today | 00:12:0675 |
| TX time since system initialization | 90:12:15148 |
| Uptime | 3211:51:54 |
| Nodes currently connected to us | 2256 |
| Autopatch | ENABLED |
| Autopatch state | DOWN |
| Autopatch called number | N/A |
| Reverse patch/IAXRPT connected | DOWN |
| User linking commands | ENABLED |
| User functions | ENABLED |

| Node | Call | Description | Location |
|---|---|---|---|
| 44098 | K8BKT | 449.775 - | Pleasant Grove, Utah |
| 2256* | VE3RTR | 444.975- | Cobourg, ON |

| Node | Peer | Reconnects | Direction | Connect Time | Connect State |
|---|---|---|---|---|---|
| 2256 | 72.142.154.178 | 0 | OUT | 11:25:50.61 | ESTABLISHED |

| Host | Node | State |
|---|---|---|
| 44.98.254.145:4569 | 44098 | Registered |

# Allstar via Pi-Star Application

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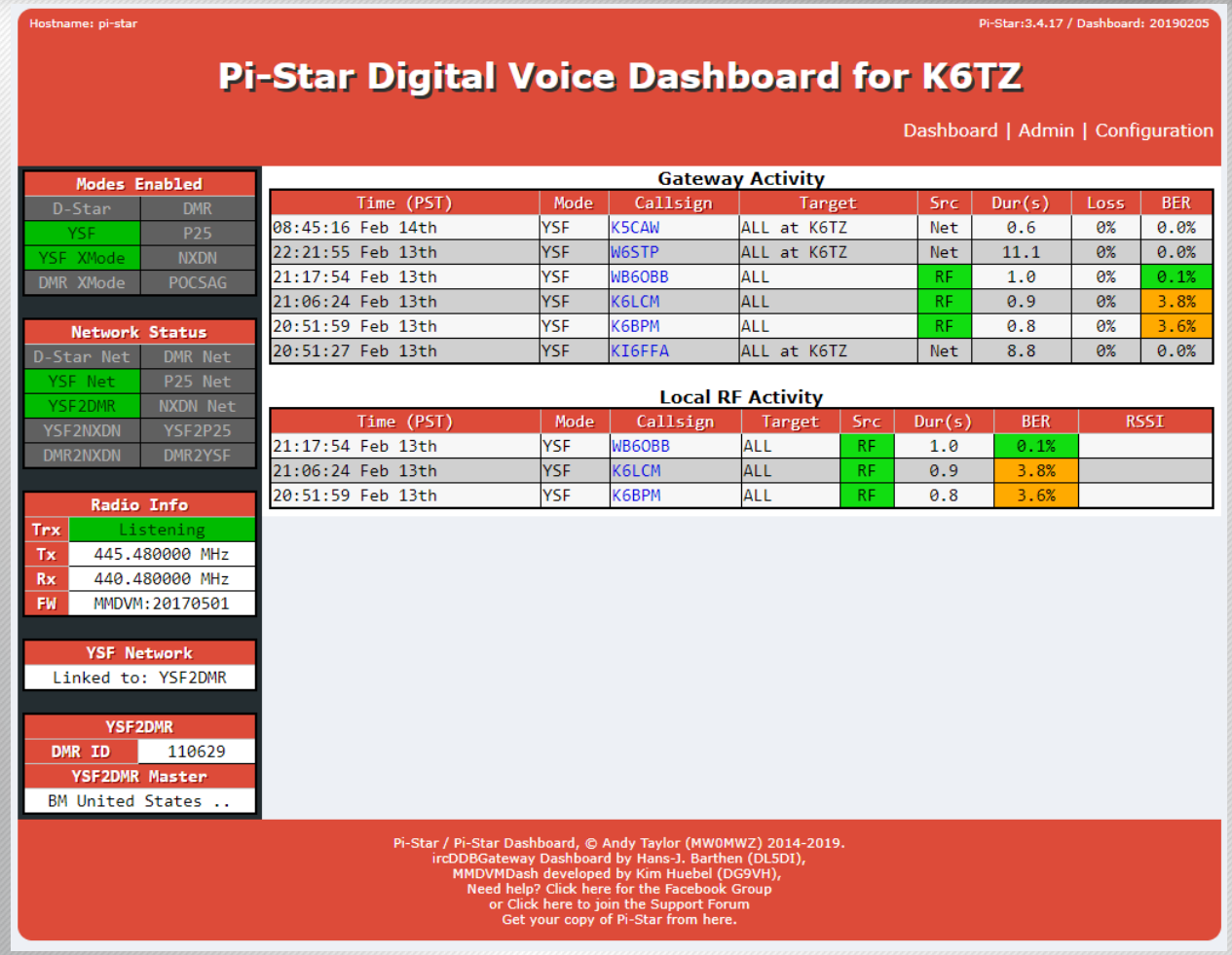

# Fileshare / FTP

AREDN™
AMATEUR RADIO EMERGENCY DATA NETWORK

## Index of /

| Name | Size | Date Modified |
|---|---|---|
| 3CXPhone6.msi | 13.3 MB | 8/21/16, 5:00:00 PM |
| AV.exe | 6.0 MB | 9/5/18, 5:00:00 PM |
| Camera Uploads/ | | 1/28/19, 4:46:00 PM |
| DMR Software/ | | 12/25/16, 4:00:00 PM |
| emergencycommplan.pdf | 2.5 MB | 10/14/18, 5:00:00 PM |
| ExtIO_RTL_TCP.zip | 58.2 kB | 10/11/16, 5:00:00 PM |
| HDSDR/ | | 10/11/16, 5:00:00 PM |
| ipscan-3.5.2-setup (1).exe | 3.1 MB | 7/23/18, 5:00:00 PM |
| js8call-0.7.3-devel-win32.exe | 18.3 MB | 10/10/18, 5:00:00 PM |
| KD7BKO Shared Docs/ | | 3/19/17, 5:00:00 PM |
| My radio software/ | | 6/14/17, 5:00:00 PM |
| P2P ID Finder Software/ | | 9/30/16, 5:00:00 PM |
| Packages/ | | 10/23/16, 5:00:00 PM |
| phpsysinfo/ | | 11/5/16, 5:00:00 PM |
| sdrsharp-x86/ | | 11/10/16, 4:00:00 PM |
| South-Tower-Camera/ | | 4/18/17, 5:00:00 PM |

# TeamTalk Video Conferencing / Fileshare

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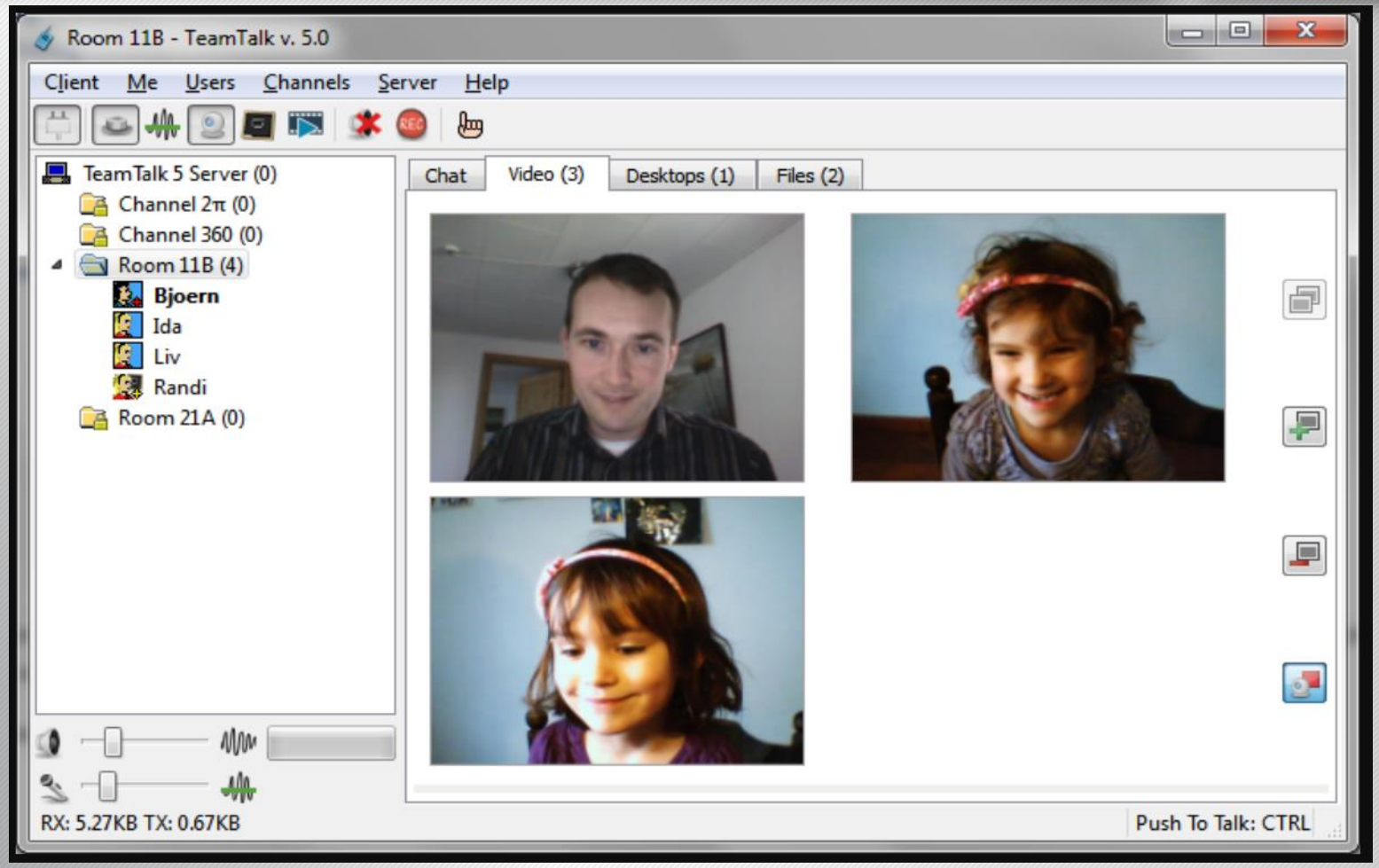
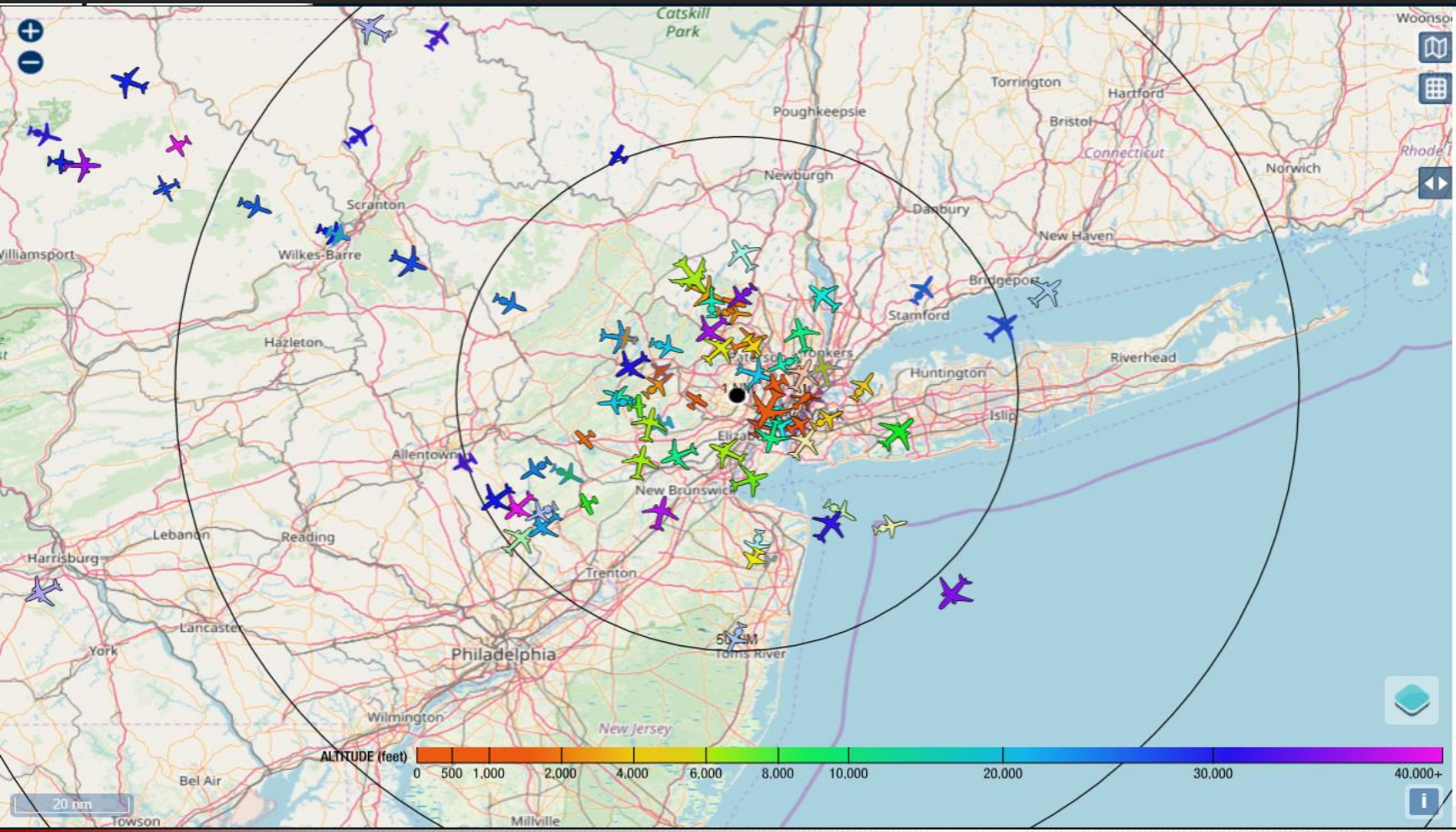


# Air Traffic ADS-B / SDR Dongle

AREDN™
AMATEUR RADIO EMERGENCY DATA NETWORK



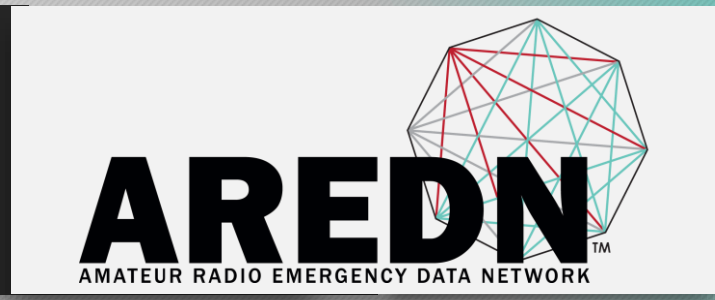

3.6.3~bpo8+1

**Total Aircraft:** 102 **Messages:** 635.6/sec
**With Positions:** 85 **History:** 5757 positions

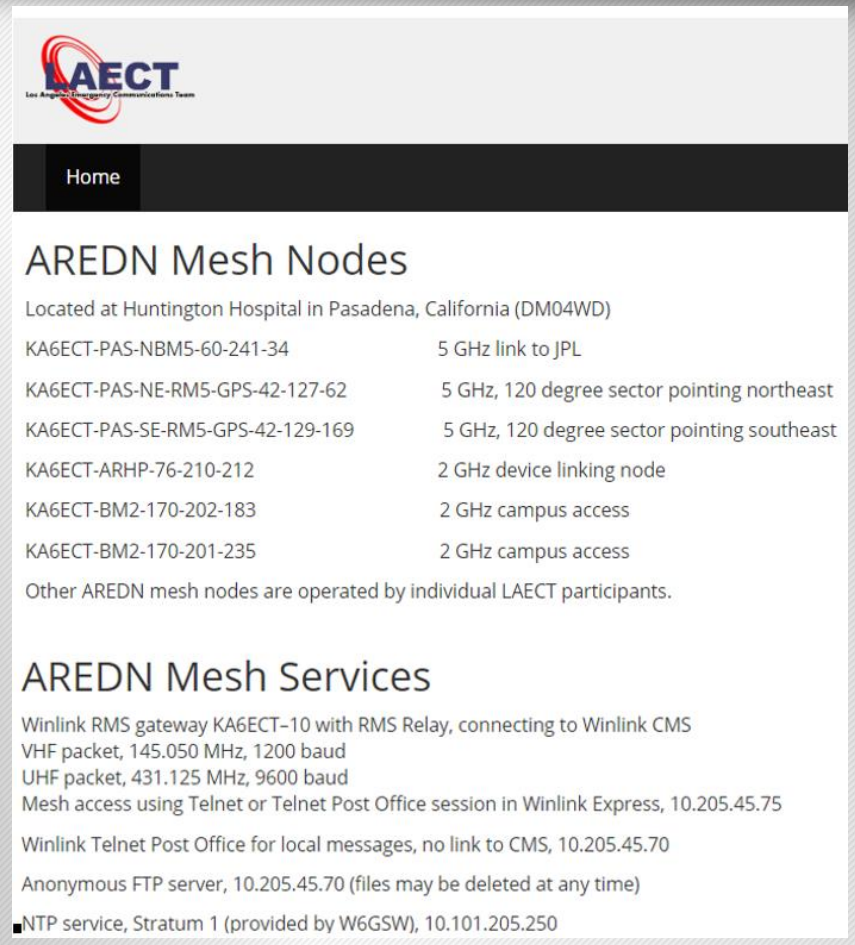
**Filter by Altitude:** ft to ft Filter Reset

| ICAO | | Ident | Squawk | Altitude (ft) | Speed (kt) | Distance (NM) | Headi |
|---|---|---|---|---|---|---|---|
| AD6884 | | AAL2287 | 4033 | 18,975 | 397 | 5.2 | 10 |
| A8C4D8 | | UAL18 | 2465 | 1,100 ▼ | 135 | 6.2 | 20 |
| C01EC5 | | POE130 | | ground | 19 | 7.0 | 2 |
| AAB37C | | | 3042 | 1,375 | 202 | 7.0 | 24 |
| A936FA | | N693MM | 1200 | 1,025 ▲ | 104 | 7.5 | 3 |
| ADA227 | | JBU516 | 3223 | 16,400 ▼ | 321 | 9.3 | 16 |
| ACB285 | | AAL1489 | 3567 | 4,875 ▲ | 229 | 9.5 | 4 |
| A2CFA2 | | SKW3846 | 1735 | 12,175 ▲ | 261 | 10.0 | 19 |
| 478F43 | | SAS909 | 2451 | 4,375 ▼ | 282 | 10.0 | 14 |
| A6F280 | | LXJ547 | 2643 | 14,925 | 298 | 10.0 | 24 |
| A48438 | | EJA390 | 3656 | 2,625 ▼ | 241 | 10.6 | 6 |
| ACBF73 | | N920PD | | | | 11.0 | |
| A1AD1F | | N207MH | 0327 | 1,425 ▲ | 85 | 11.1 | 1 |
| AC0A22 | | AAL1333 | 3035 | 5,850 ▲ | 225 | 11.2 | 29 |
| A07CBB | | N130RU | 1200 | 1,400 | 97 | 11.8 | 4 |
| A08095 | | | | 200 ▼ | 123 | 12.1 | 7 |
| A7D464 | | N603WM | 3310 | 1,300 | 192 | 12.3 | 2 |
| *2AC772* | | | | *200 ▼* | *87* | *12.6* | *5* |
| A9BA85 | | N726H | 0307 | 1,900 | 6 | 13.2 | 23 |

# ARES Informational Site




# Node and Service Info



LAECT

Home

## AREDN Mesh Nodes

Located at Huntington Hospital in Pasadena, California (DM04WD)

| | |
|---|---|
| KA6ECT-PAS-NBM5-60-241-34 | 5 GHz link to JPL |
| KA6ECT-PAS-NE-RM5-GPS-42-127-62 | 5 GHz, 120 degree sector pointing northeast |
| KA6ECT-PAS-SE-RM5-GPS-42-129-169 | 5 GHz, 120 degree sector pointing southeast |
| KA6ECT-ARHP-76-210-212 | 2 GHz device linking node |
| KA6ECT-BM2-170-202-183 | 2 GHz campus access |
| KA6ECT-BM2-170-201-235 | 2 GHz campus access |

Other AREDN mesh nodes are operated by individual LAECT participants.

## AREDN Mesh Services

Winlink RMS gateway KA6ECT–10 with RMS Relay, connecting to Winlink CMS
VHF packet, 145.050 MHz, 1200 baud
UHF packet, 431.125 MHz, 9600 baud
Mesh access using Telnet or Telnet Post Office session in Winlink Express, 10.205.45.75

Winlink Telnet Post Office for local messages, no link to CMS, 10.205.45.70

Anonymous FTP server, 10.205.45.70 (files may be deleted at any time)

NTP service, Stratum 1 (provided by W6GSW), 10.101.205.250

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# For More Info

- WWW.AREDNmesh.ORG
- QST June and September 2017, ARRL
- TAPR/ARRL DCC Proceedings 2015 and 2016
- Search YouTube, HamRadio360, HamRadioNow, HamNation videos

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# Contact Info

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