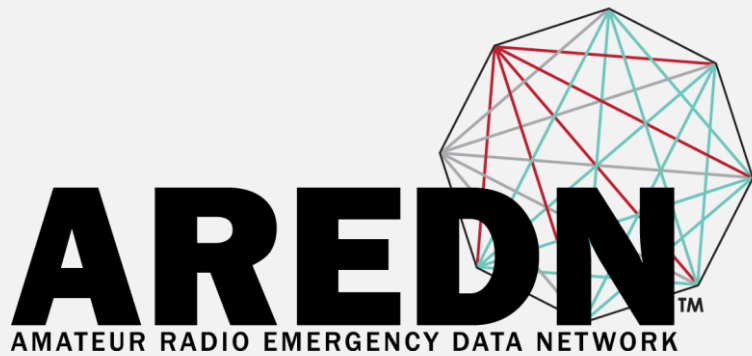




AREDN™

AMATEUR RADIO EMERGENCY DATA NETWORK



Amateur Radio Emergency Data Network

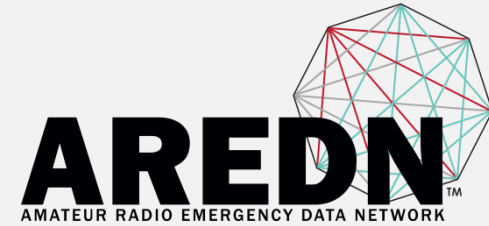
Successful Implementation Techniques

ARRL TAPR Data Communications Conference

St. Petersburg, FL

September 16, 2016

A Changing AUXCOM Landscape



From Paper → To Digital → To AREDN

ICS-213

Voice sent
Transcribed

Winlink

Packet
Pactor
FLdigi
Text-based

Multi-Megabit

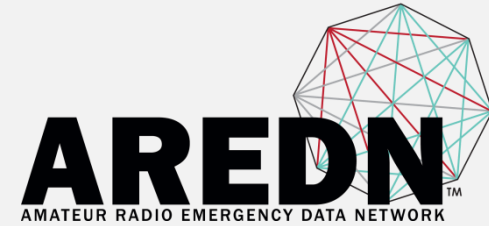
Eliminates
congestion

**Opportunities for
VoIP**

Video

**Agency-specific
applications**

What is AREDN ?



HSMM Mesh

Repurpose WISP routers

In the Ham Bands

Up to 144 Mbps
(802.11n)

Part 97 Tech
License

Tech Specs

Linux-based

Strip OEM F/W

OpenWRT

OLSR

Custom modules

Support

OpenSource

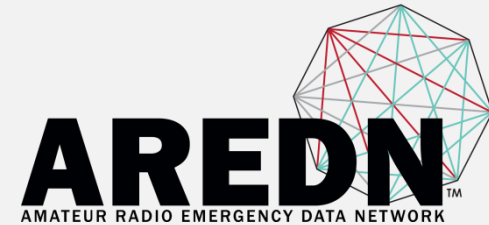
Developers are
implementers

Agile, flexible dev
model

Active forum

Centers of
Excellence

Project Objectives



Customer

Emcomm
AUXCOM

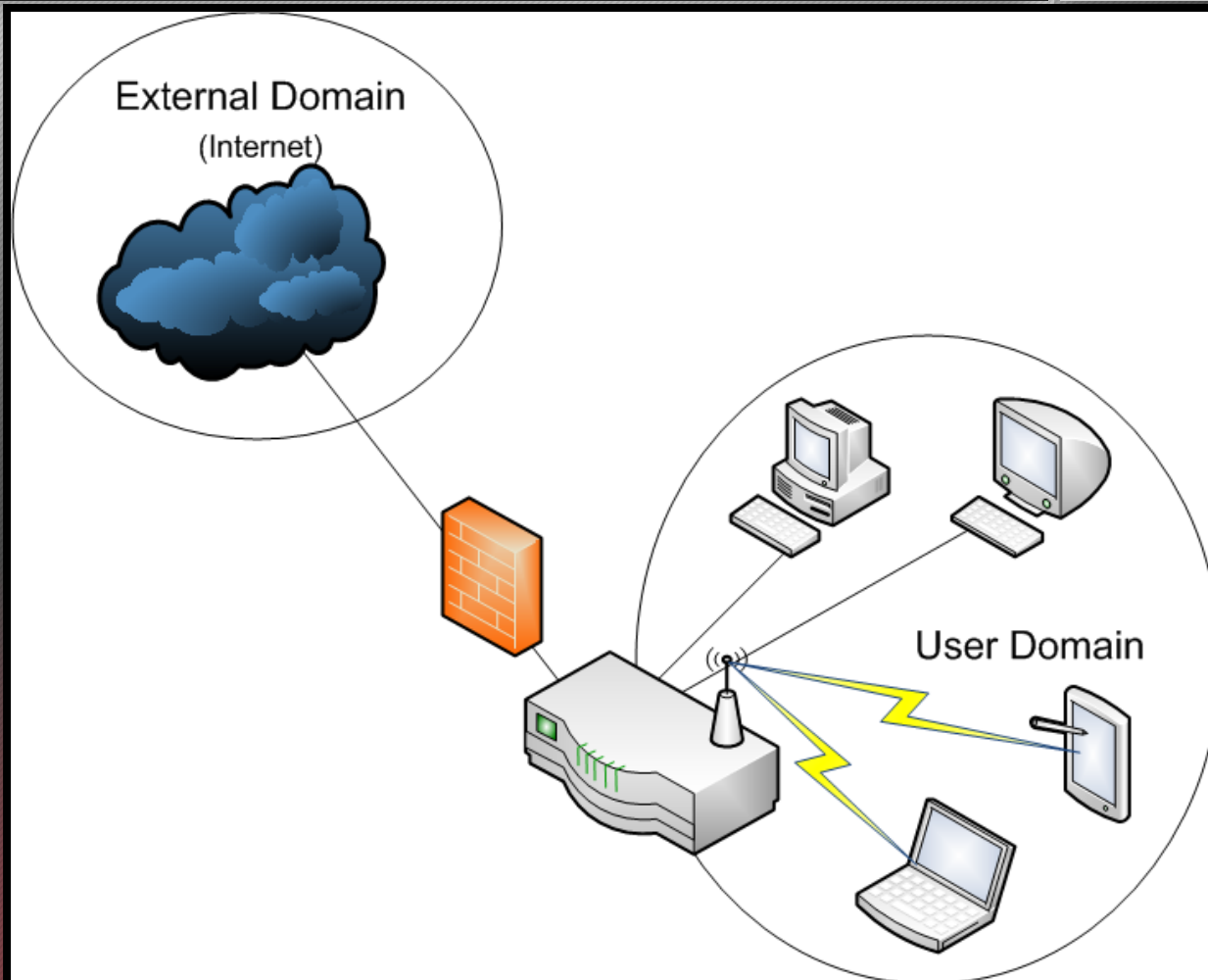
Product

Easily deployed
Inexpensive
No experience
required
Net-agnostic

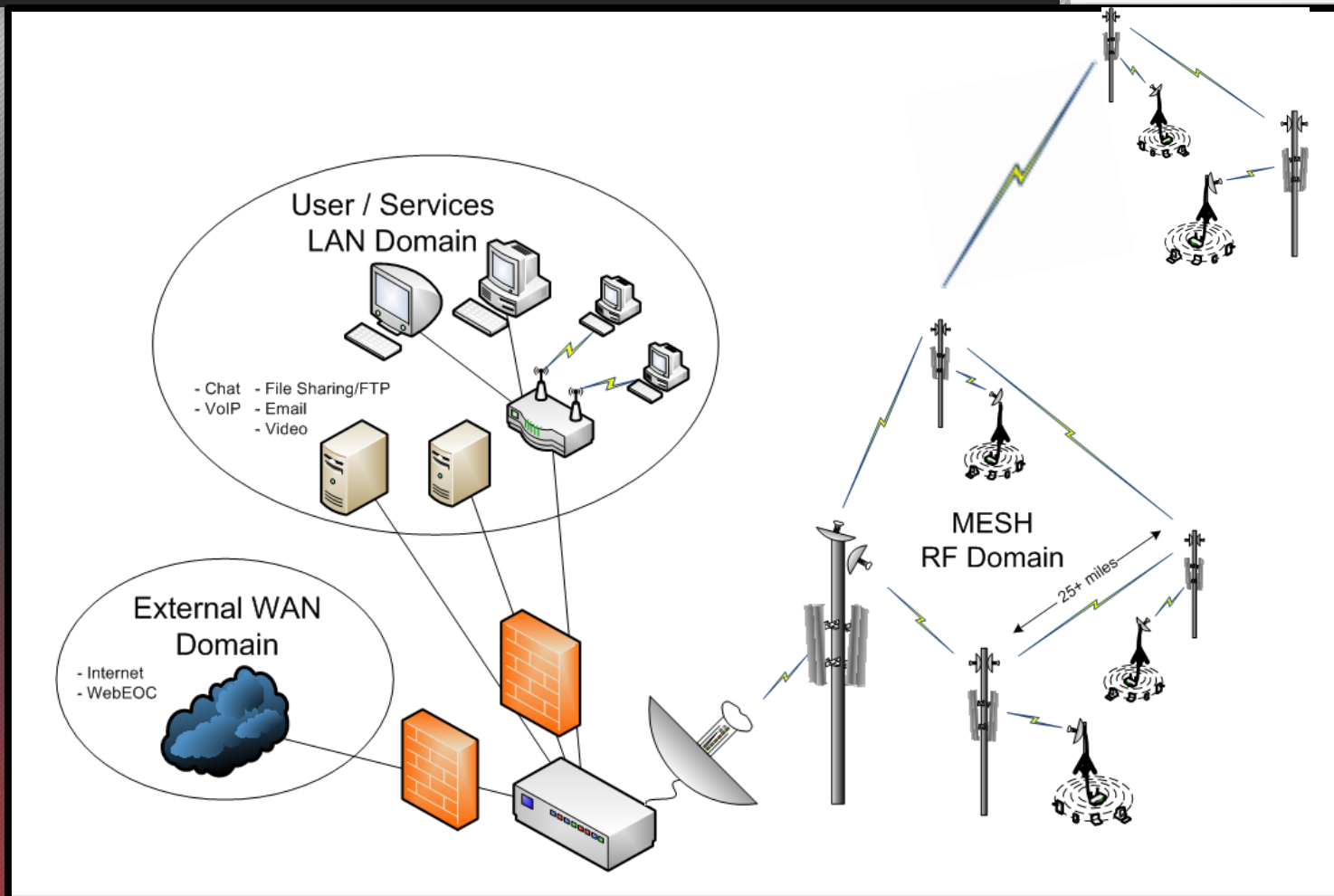
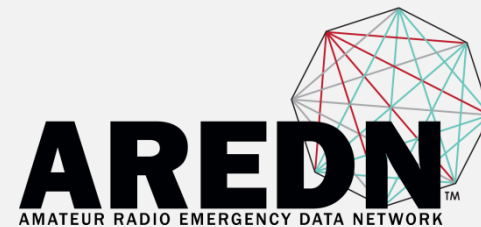
Management

Tools
Aiming
BW Monitoring
Troubleshooting
Node Status
Mesh Status
Network Params
DNS

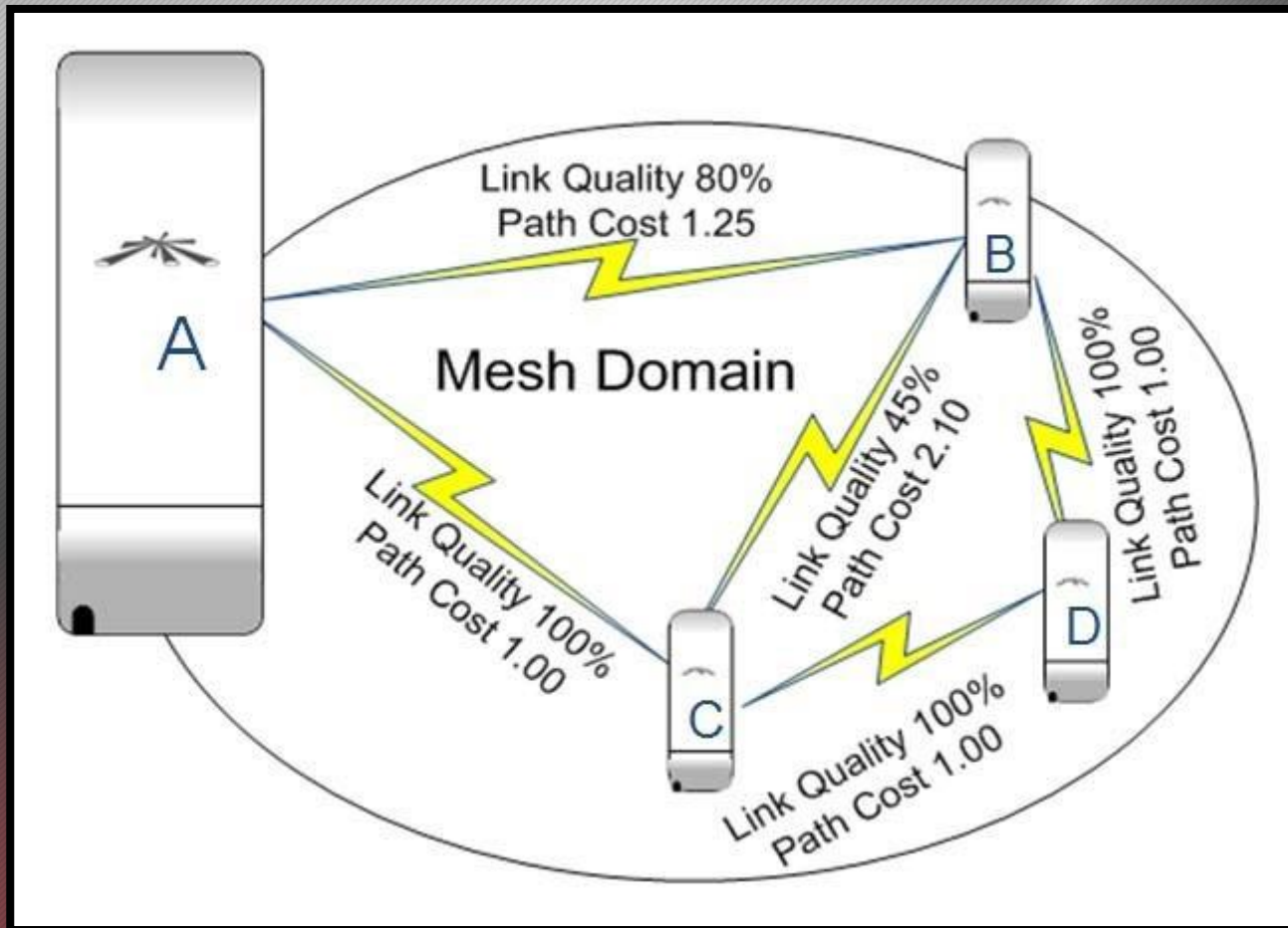
Typical WiFi



Repurposed Hardware



Optimized Link State Routing



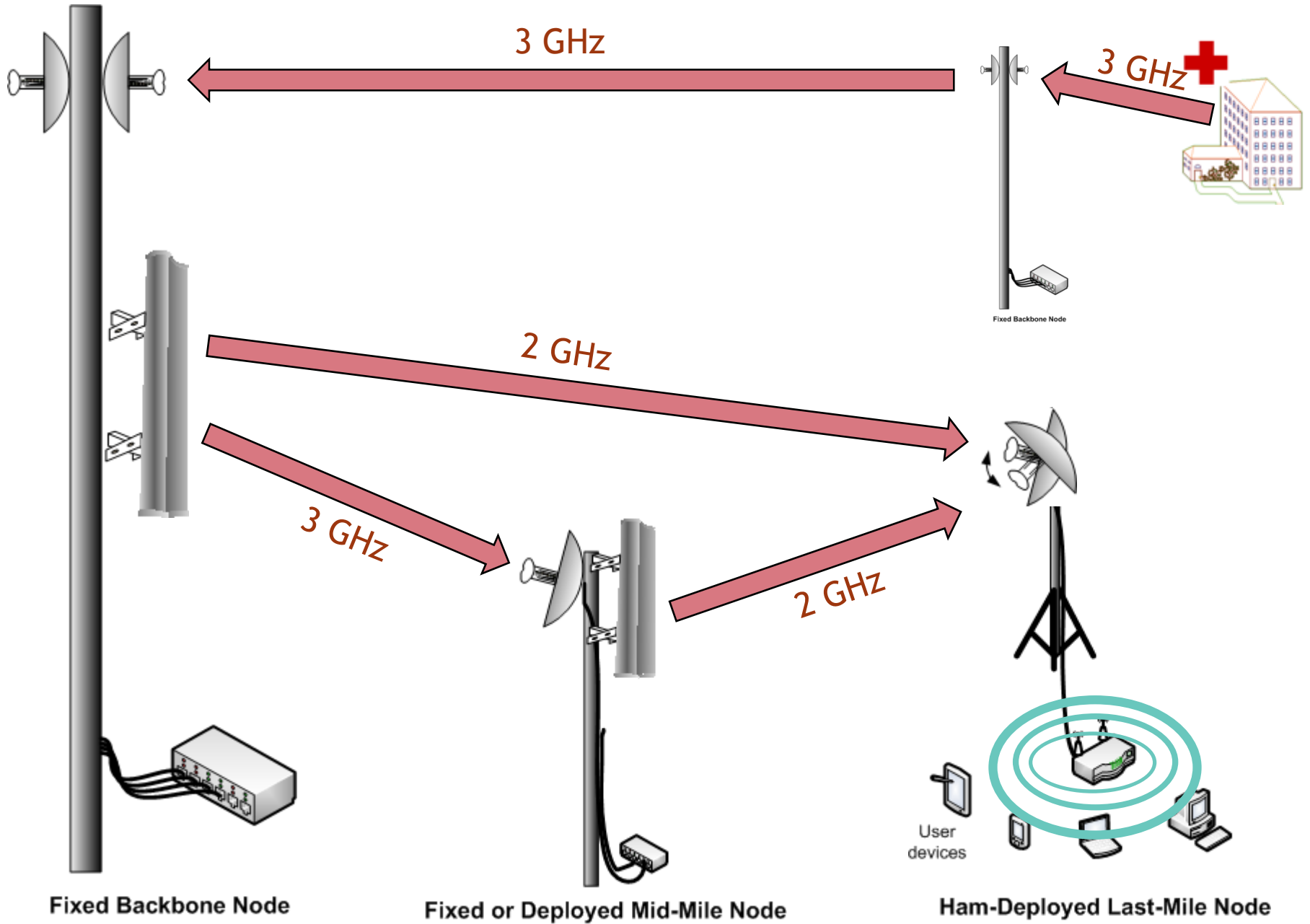
- Ubiquiti airMAX M-series WISP routers

- Rocket
- Bullet
- NanoStation
- NanoBridge
- AirGrid

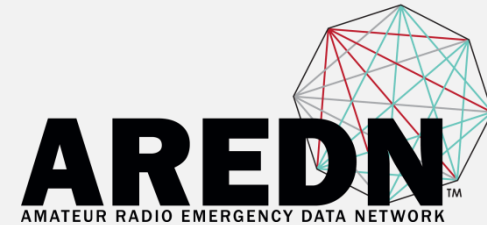


- Robust Specifications

- Power Output: 23 - 28 dBm (200mW - 630mW)
- Temperature: -40° to 176° F,
- Humidity: 5 - 95% Condensing



Implementation Tips



Model

Radio Mobile

SNR

Verify

Fresnel Zone

Noise

Bandwidth

Colocation

Cross-band

RF Armor

Separation

Competition

Commercial

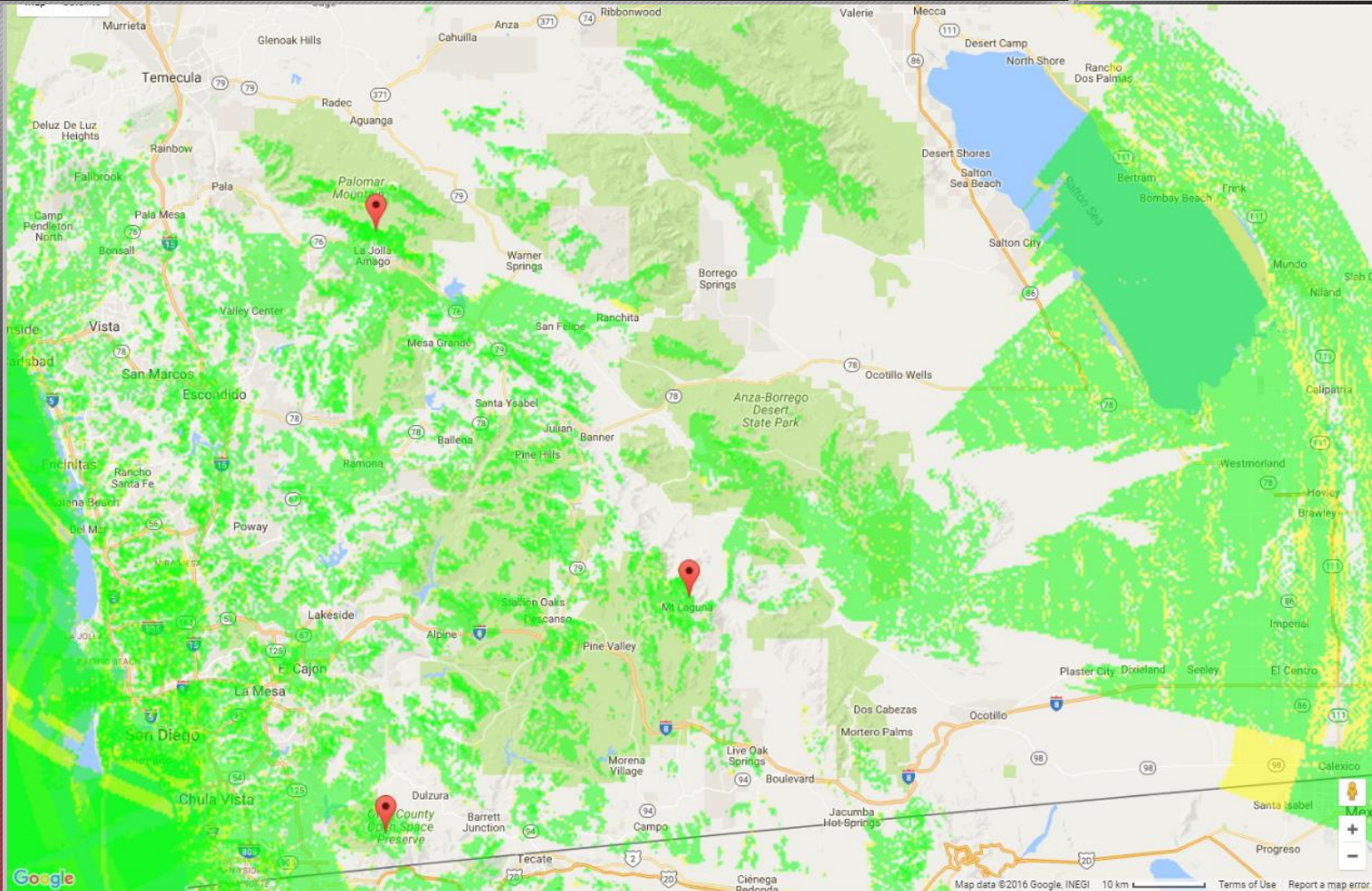
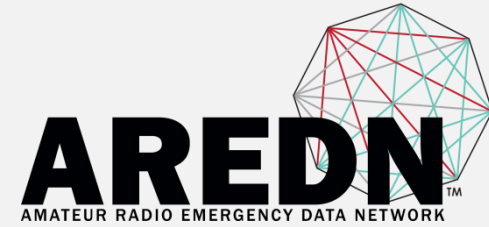
Band Selection

Coordination

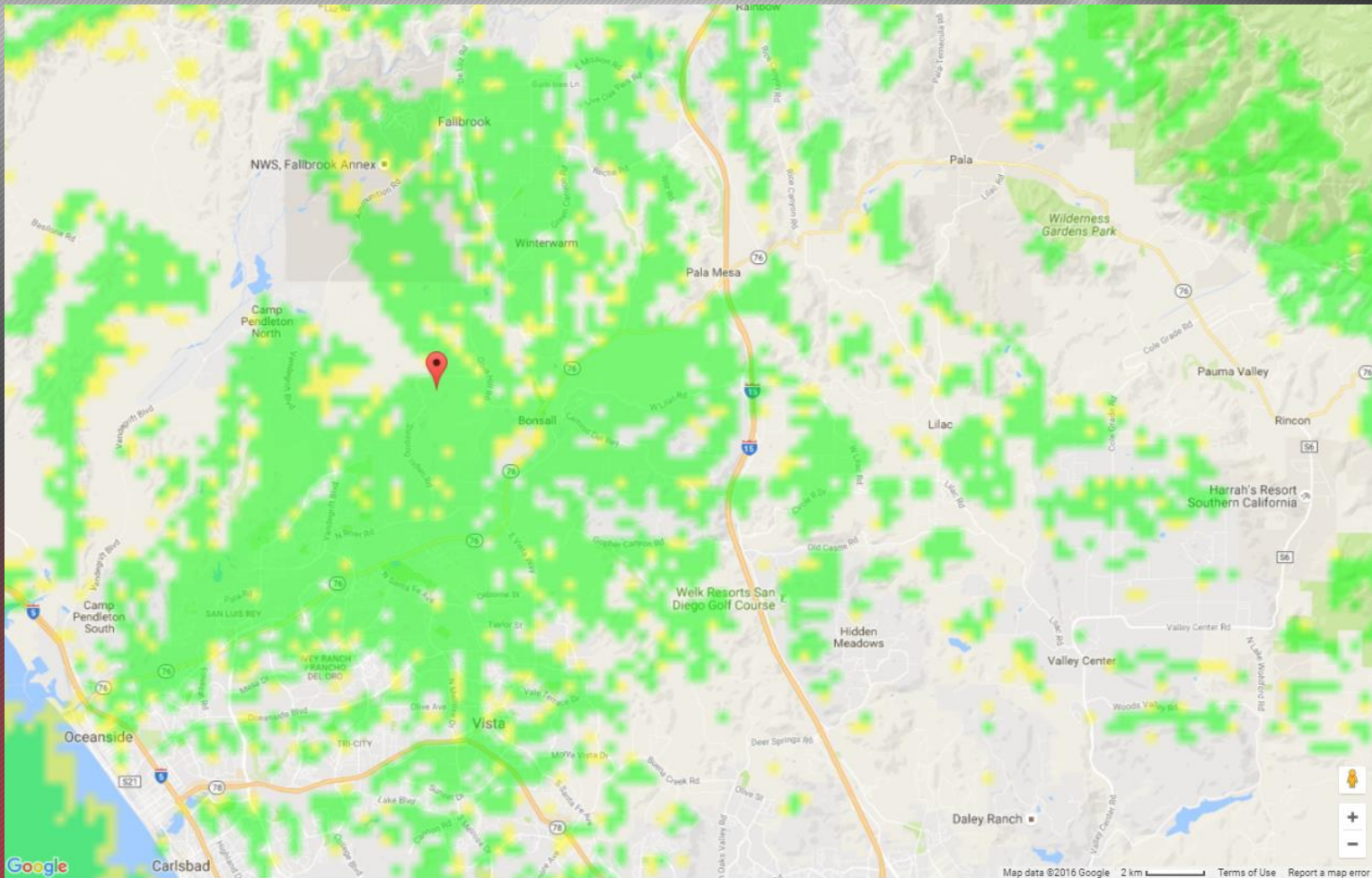
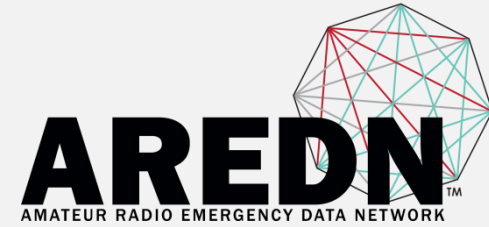
Frequency/Channel

Environment

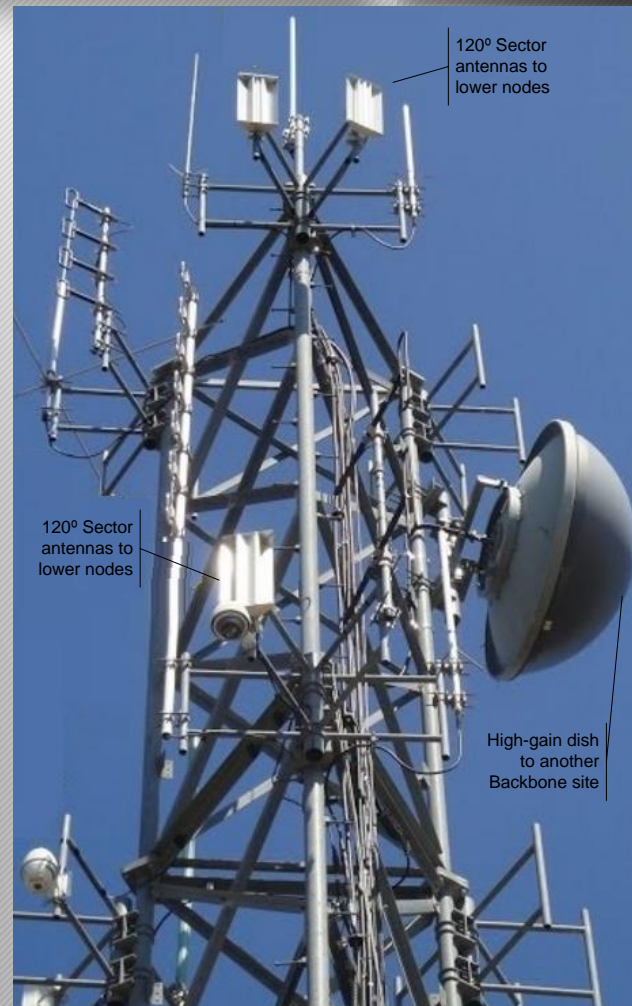
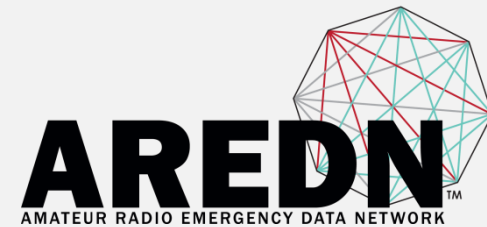
San Diego Network Coverage



San Diego Network Coverage



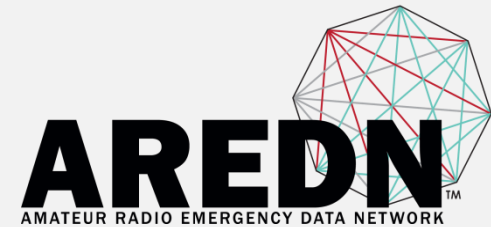
San Diego Network Images





Backbone Node

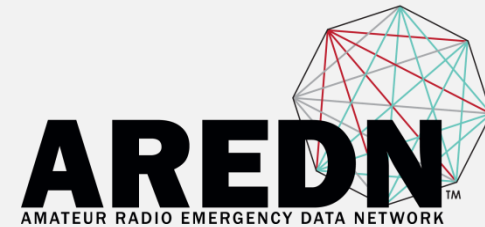
Mt. Palomar, 6200' ASL - Link to Mt. Otay at 48 miles distance





Backbone Downlinks

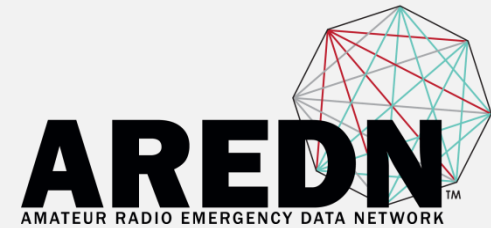
Mt. Palomar - Links to Mid-mile and Deployed Nodes





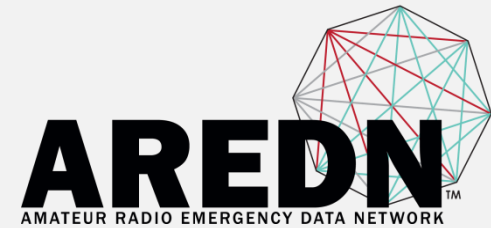
Deployed Mid-Mile Node

Links to Backbone and Deployed Nodes

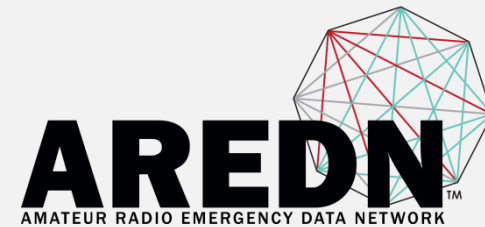




Mid-Mile Node in the Wild



Pointing and Aligning

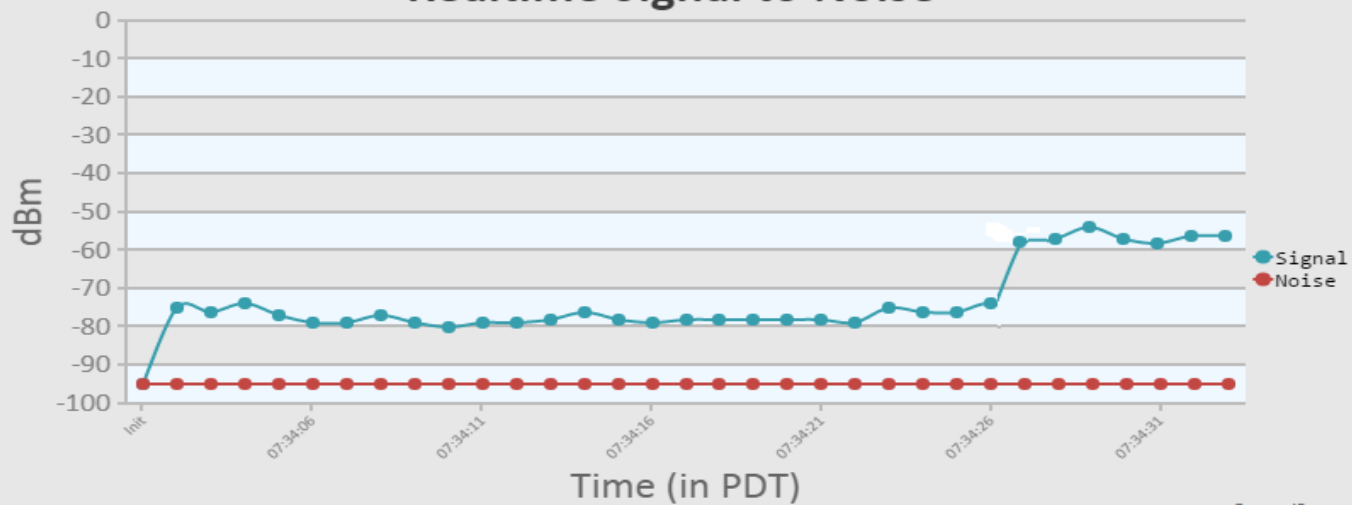


K6AH-SAREDN-PA3GDL23

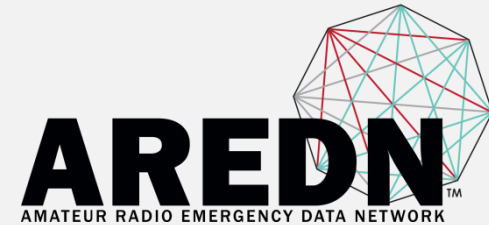
Archive Realtime Quit

Selected Device: Strongest Signal

Realtime Signal to Noise



Monitoring



K6AH-SleepingIndian-East mesh status

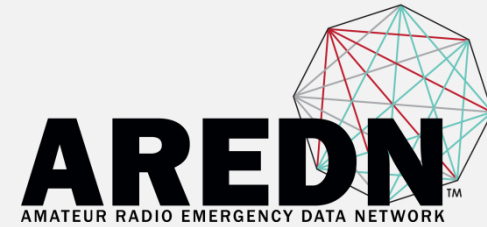
Refresh

Auto

Quit

Local Hosts	Services	Current Neighbors	LQ	NLQ	TxMbps	Services
K6AH-SleepingIndian-East.local.mesh		K6AH-QTH.local.mesh	86%	100%	14.7	
		K6AH-SAREDN-PA2GDL23.local.mesh	64%	60%	5.8	
Remote Nodes	ETX	Services				
K6AH-NanoStationM3.local.mesh	1.26	● k6ah-pasw.local.mesh				k6ah-pasw
K6AH-AirRouter.local.mesh	1.26	● k6ah-papi.local.mesh				k6ah-papi
● W6RDX-AP.local.mesh		K6AH-SleepngIndian-West.local.mesh (dtd)	100%	100%		NTP IP 10.0.100.2
● W6RDX-Mesh-Test.local.mesh		N3IZN-QTH.local.mesh	56%	96%	7.8	GPS-NTP
● K6AH-AirGateway.local.mesh		● N3IZN-NTP.local.mesh				MeshChat
N6FQ-RM-SW-5G.local.mesh	1.63	N6FQ-RM-SW.local.mesh	76%	85%	13.8	Web Page
N3IZN-QTH-5-8.local.mesh	1.94	● KG6HSQ-GATEWAY.local.mesh				
KJ6HOV-tunnel.local.mesh	2.26	Previous Neighbors				When
K6AH-SAREDN-PA3GDL23.local.mesh	2.44	none				
K6AH-SAREDN-PABBOT.local.mesh	2.54					
KG6HSQ-5G-2.local.mesh	2.63					
K6AH-SAREDN-OTBBPA.local.mesh	3.54					
K6AH-SAREDN-OT2GDL23.local.mesh	3.64					
● k6ah-otsw.local.mesh						
● k6ah-otpi.local.mesh						
K6AH-SAREDN-OT3GDL33.local.mesh	3.64					
W6QAR-WTE.local.mesh	4.30					
W6QAR-WTN.local.mesh	4.40					
W6QAR-5GHZ.local.mesh	4.40					
W6QAR-WTS.local.mesh	4.40					
W6RDX-SDARC-Chapter.local.mesh	4.76					

Monitoring

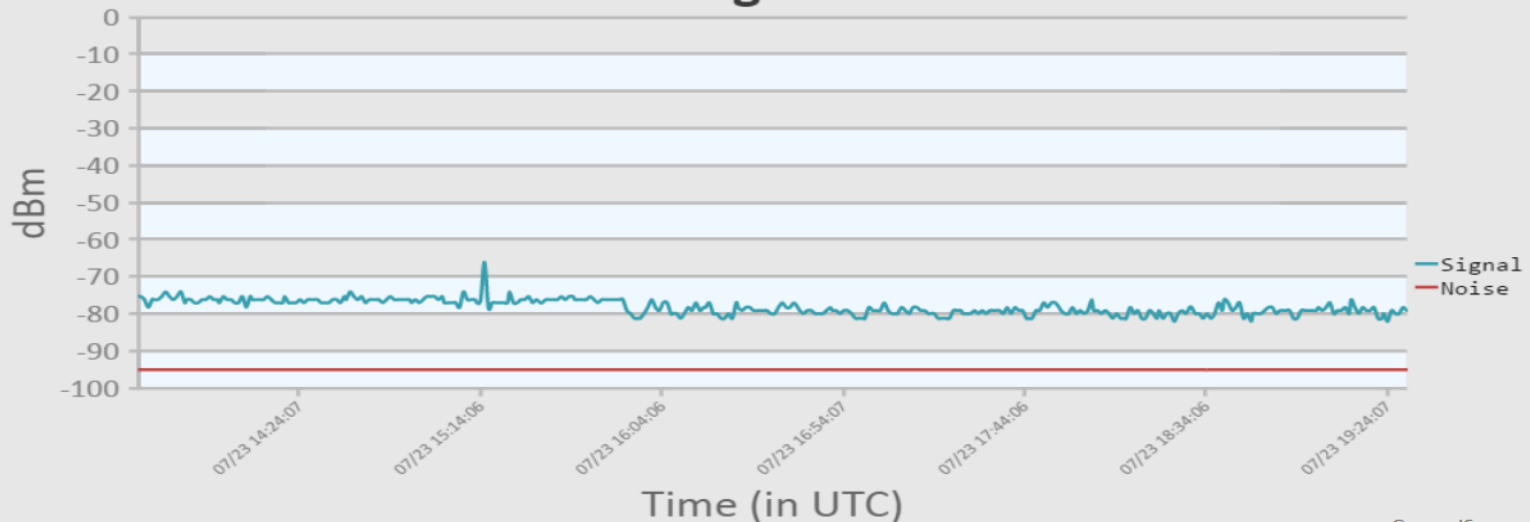


K6AH-SleepingIndian-East

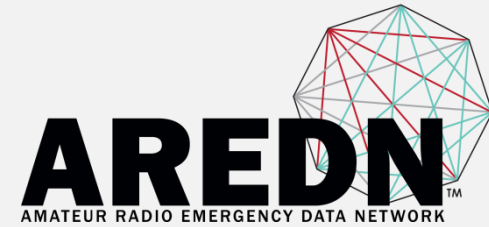
Archive Realtime Quit

Selected Device: K6AH-QTH

Archived Signal to Noise



General Comments



Polarization

30dB Null

Noise Canceling

MIMO

Power

24v PoE

Spec is 10.5v

5-6 watts

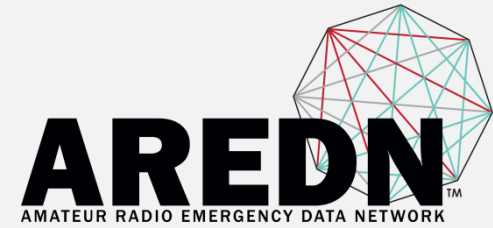
Misc

Back-to-back (DtD)

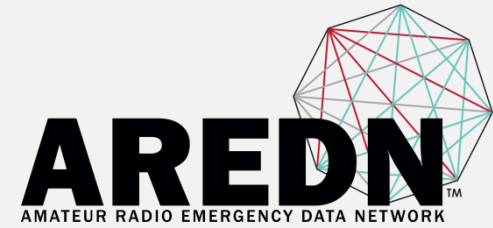
Outboard switch

VLAN for network distinction

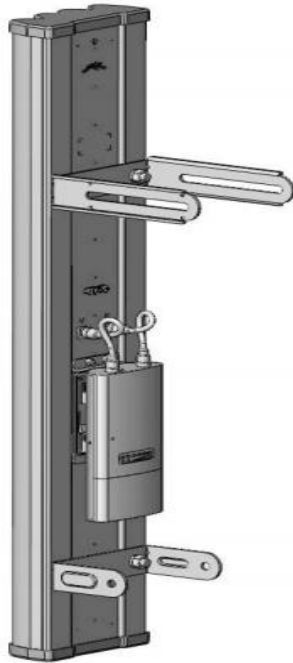
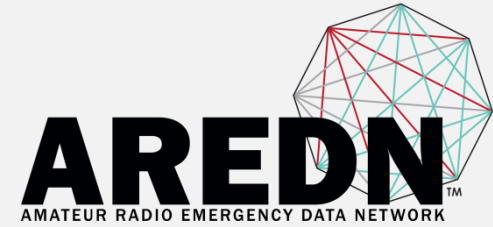
General Purpose Nodes



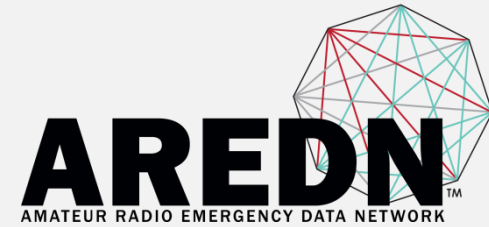
High Gain Nodes



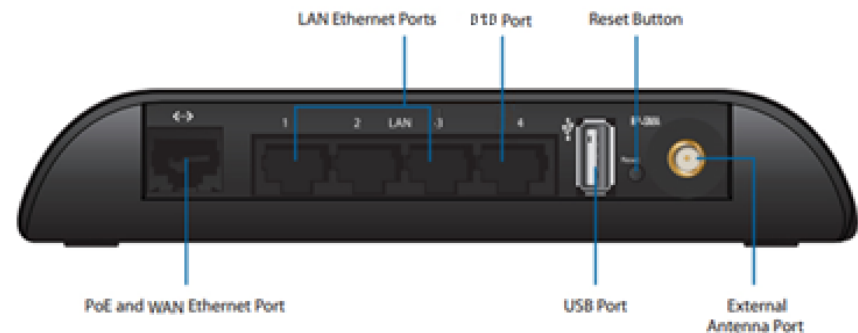
Broad Distribution Nodes



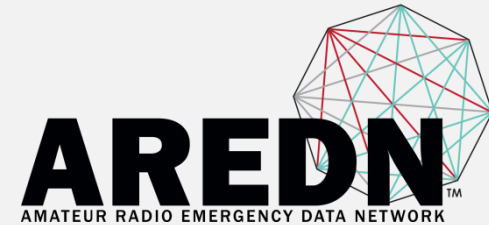
Ubiquiti AirRouter



Port Label	Usage
WAN	Internet (default route), also PoE port
1, 2, and 3	Local Area Network (LAN)
4	Other local AREDN devices (device-to-device)



Implementation Challenges



Agency Support

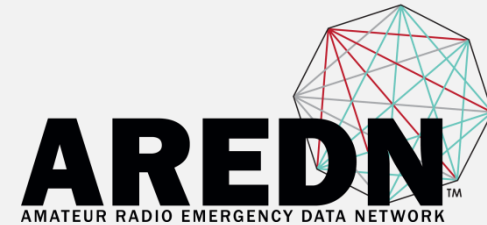
Want to see it work

**Hard sell with only a few sites
and few services**

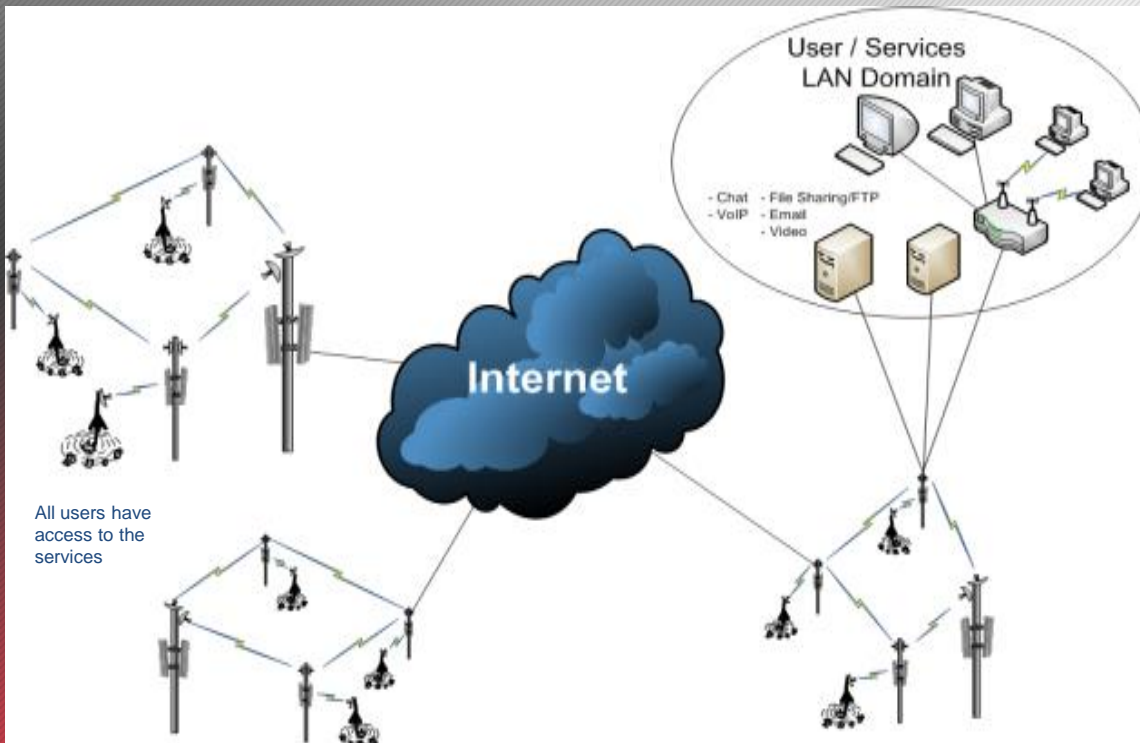
**Tough to justify building
services**

Results in Mesh Islands

Implementation Challenges



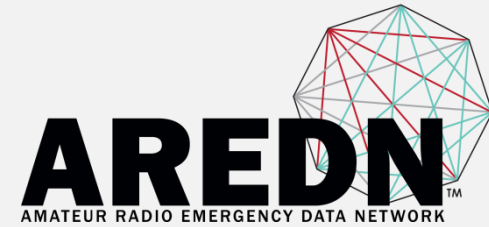
Internet Tunneling



As an EMCOMM strategy

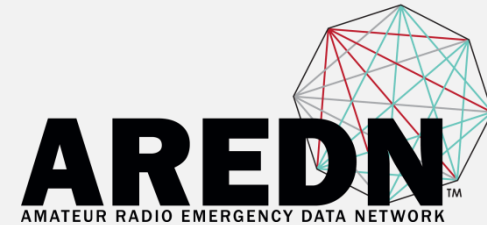
Justification for building out services

Parting Thoughts



The Internet Access
Alternative
Encryption

The AREDN Team



2014 ARRL Microwave Development Award



presented to

The Principals and Developers
of Broadband-Hamnet™

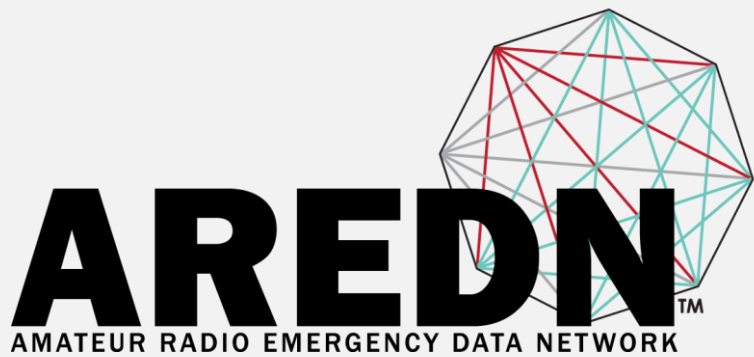
For developing and promoting commercial, off-the-shelf based mesh networking technology that is used within the 900 MHz, 2.4 GHz, and 5.8 GHz Amateur Radio bands. Currently, this technology is widely used by Amateur Radio operators around the world.



ARRL The national association for
AMATEUR RADIO®

The development team is comprised of:

- Conrad, KG6JEI
- Joe, AE6XE
- Darryl, K5DLQ
- Randy, WU2S
- Trevor, K7FPV
- Andre, K6AH



Amateur Radio Emergency Data Network

Demonstration

ARRL TAPR Data Communications Conference

St. Petersburg, FL

September 16, 2016