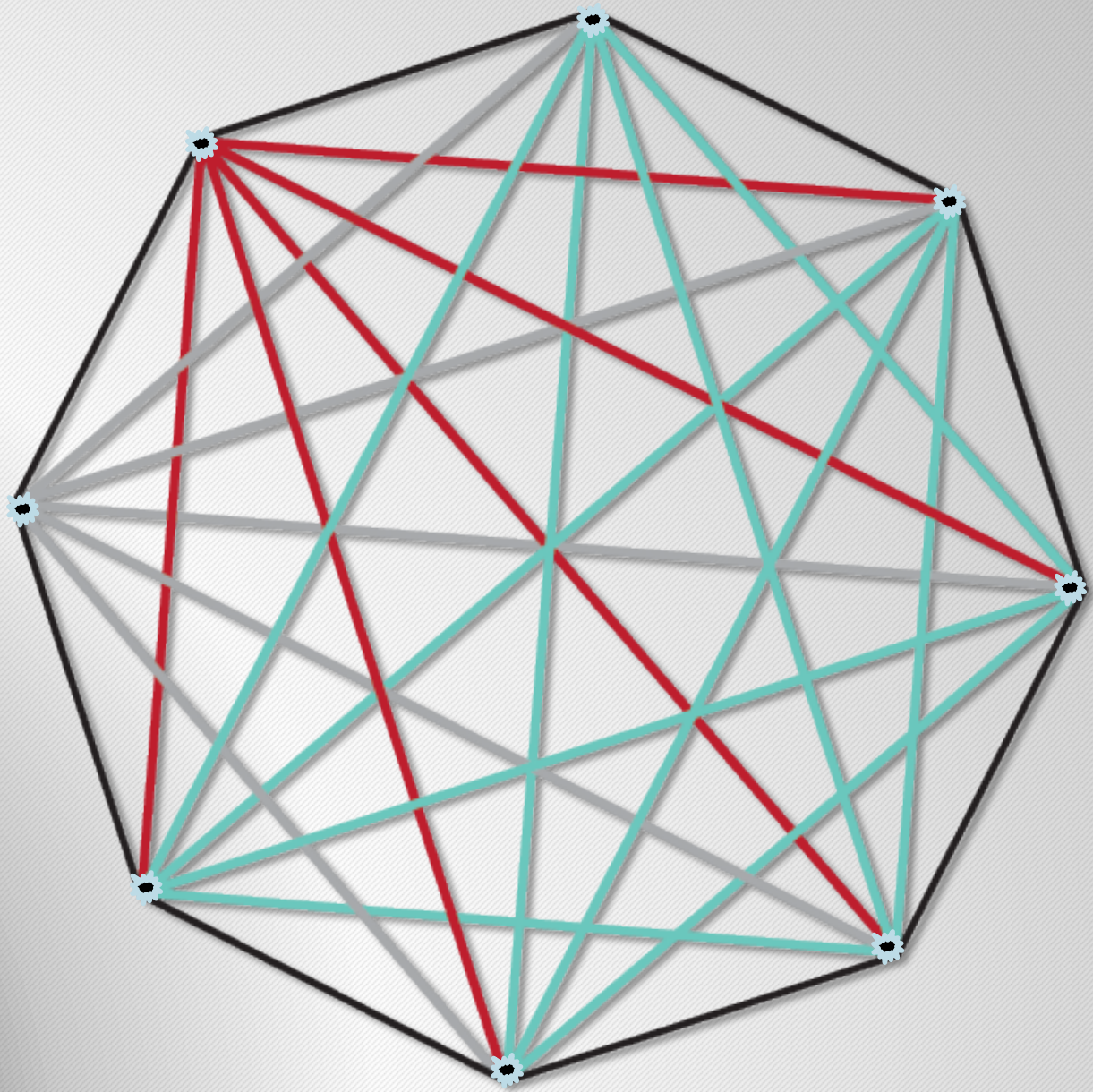

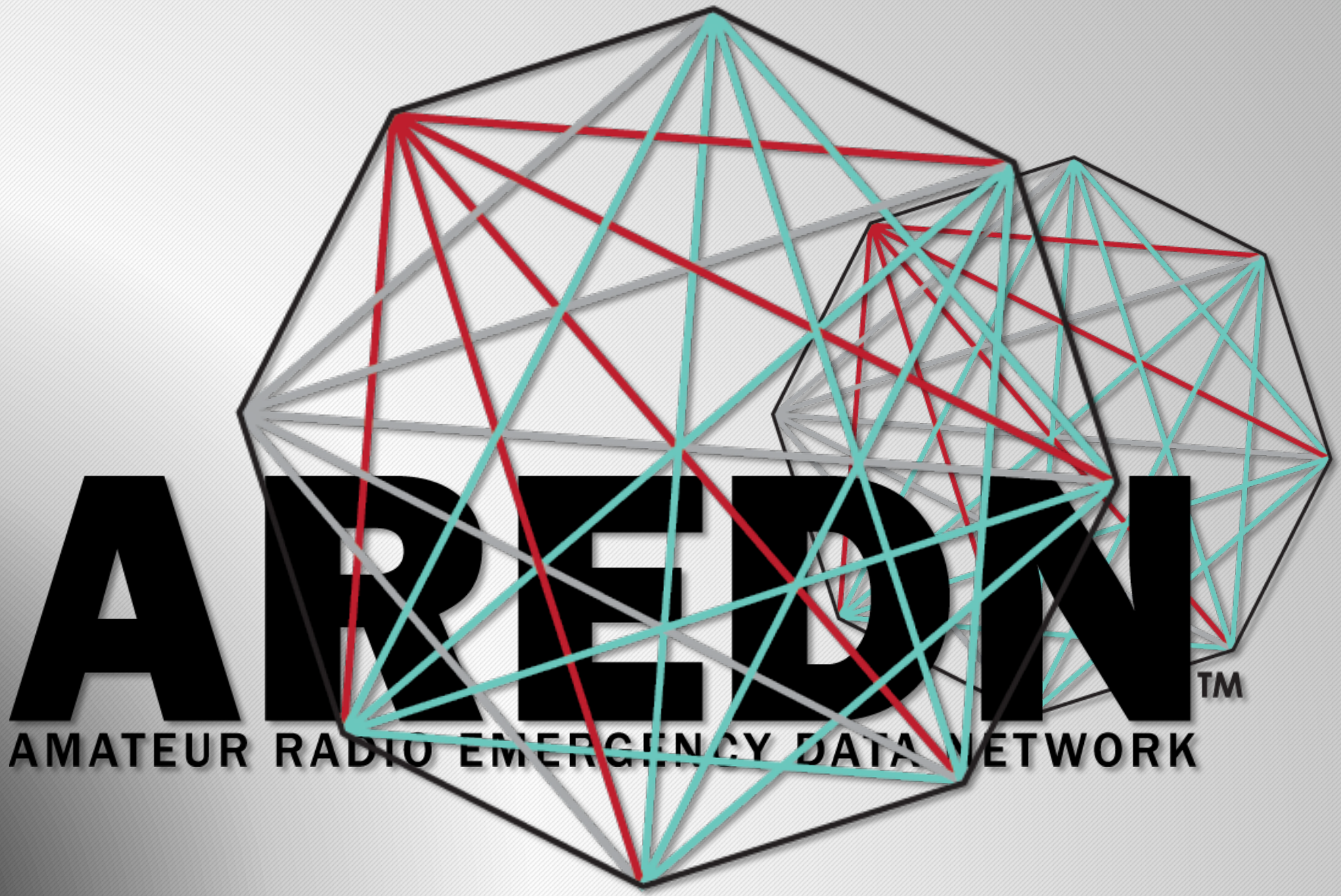
AREDN™
AMATEUR RADIO EMERGENCY DATA NETWORK

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Building a High-Speed EmComm (AUXCOMM) Data Network

Gloucester County ARC
Mullica Hill, NJ
Randy Smith, WU2S
October 6, 2018

How many of you have used a high-speed microwave data network?

I would have figured most of you...

Introduction

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Who, what, where, why, when?

HSMM Networks Today

BBHN

Pioneered first real implementation of Ham-based Mesh networks

With low-power, aging, Linksys “blue-boxes”

Limited to noisy Part 15 shared spectrum in 2Ghz and 5Ghz bands

Relatively inactive today

HAMWAN

Traditional fixed point-to-point network

Highly dependent on the Internet

High-level of network expertise needed to setup

AREDN

Can be built on the fly

Easily Ham-deployed

Commercially robust H/W

Actively developed and supported

Part 97 In 900Mhz, 2Ghz, 3Ghz, and 5GHz bands

What is AREDN ?

Software

Open Source

Agile, flexible dev model

Highly active forums

Developers also implement

Focused on EmComm

Nightly Builds available

Wireless Mesh

Repurposed WISP routers (radios)

In the Ham Bands

Up to 144 Mbps IP Network (802.11n)

Part 97 (Tech, General, Extra)

The Team

Randy, WU2S

Andre, K6AH

Joe, AE6XE

Darryl, K5DLQ

Trevor, K7FPV

New Contributors

KG6WXG, KK4ZUZ, KF5DEB

Awards, Accolades, and Media

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HAMRADIO2.0
LIVE FROM THE HAMSHACK

Home Episodes Become a Sponsor

Episode 98: AREDN MESH Networking Forum from Dayton Hamvention 2017

Written by kc5hwb on May 28, 2017 · Leave a Comment

AREDN MESH Networking Forum from Dayton Hamvention AREDN is a new sponsor of this YouTube series! Go visit their website at www.AREDN.org. This forum was given by Andre, K6AH, at the 2017 Dayton Hamvention. It details the new updates in AREDN networking, and gives details on different types of nodes [...] Read more »

Categories: AREDN MESH, Forums, Hamfest Circuit - Tags: AREDN, AREDN MESH Firmware

aredn
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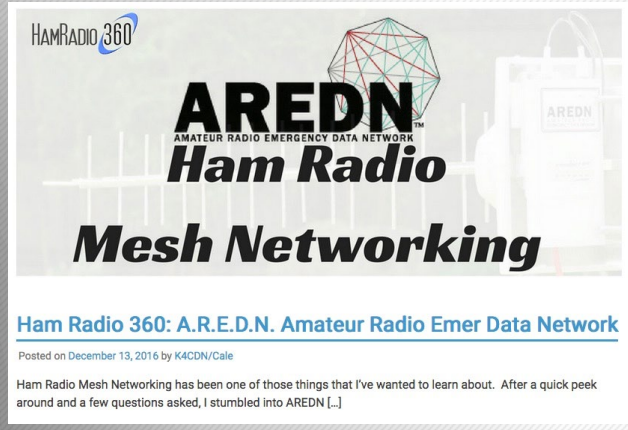
QST – June 2017

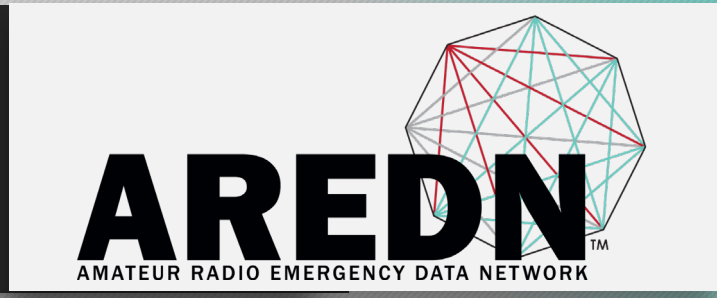


Ham Radio 360: A.R.E.D.N. Amateur Radio Emer Data Network

Posted on December 13, 2016 by K4CDN/Cale

Ham Radio Mesh Networking has been one of those things that I've wanted to learn about. After a quick peek around and a few questions asked, I stumbled into AREDN [...]

If you forget how to spell our name…



We are at the center of

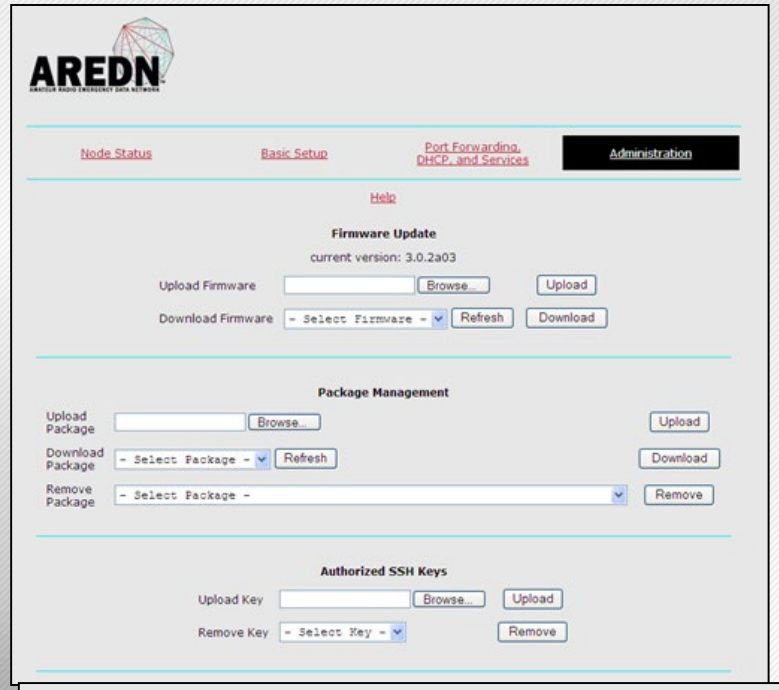
prep**AREDN**ess

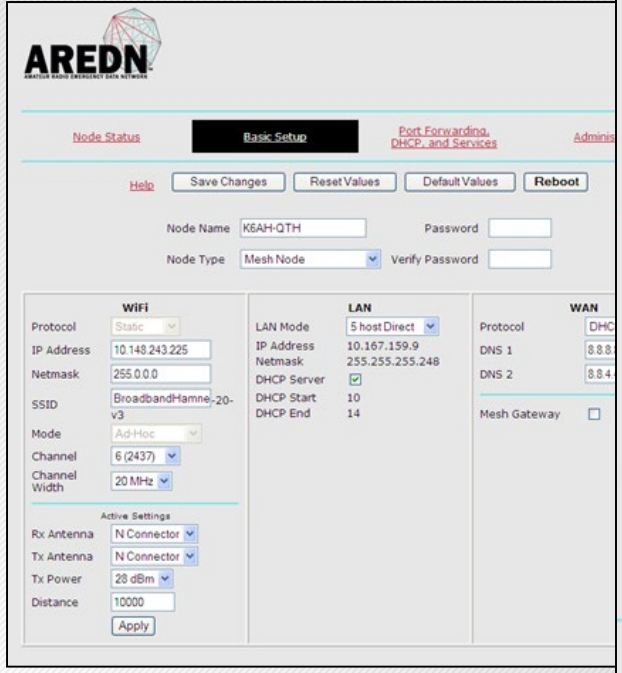
Nomenclature

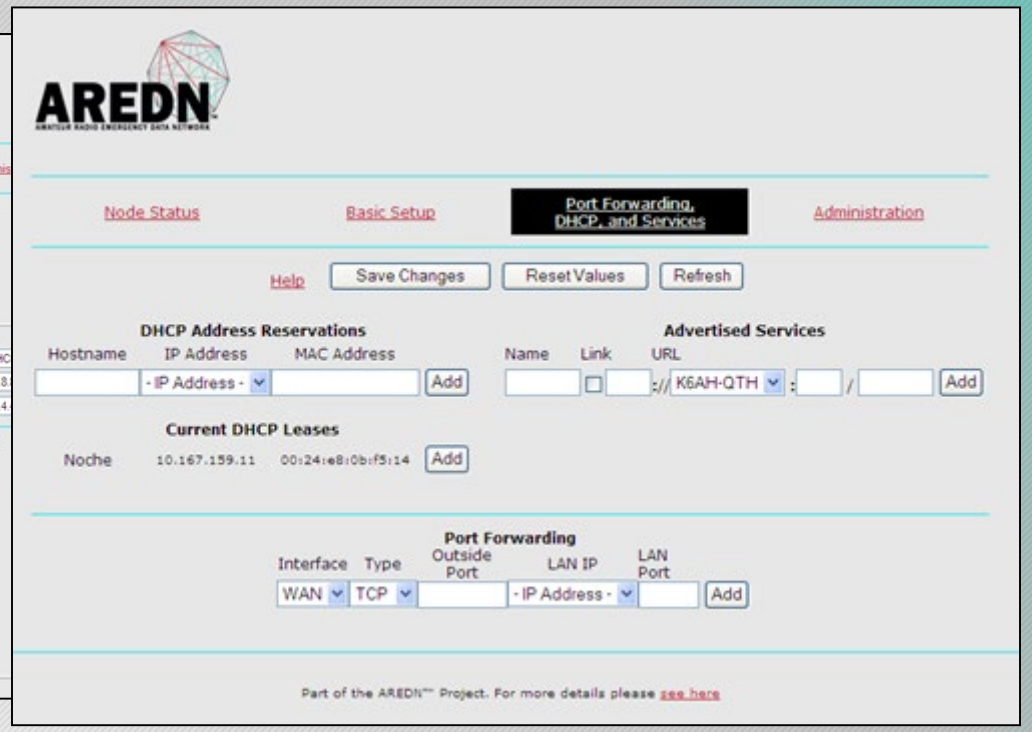
- **Node**: a radio with an embedded linux computer that performs network routing functions
- **Mesh network**: a network topology in which each node relays data for the network. All mesh nodes cooperate in the distribution of data in the network.
- **OLSR**: Optimized Link State Routing Protocol is an IP routing protocol optimized for mobile ad hoc networks. Responsible for determining the path data will take to get to it's destination.

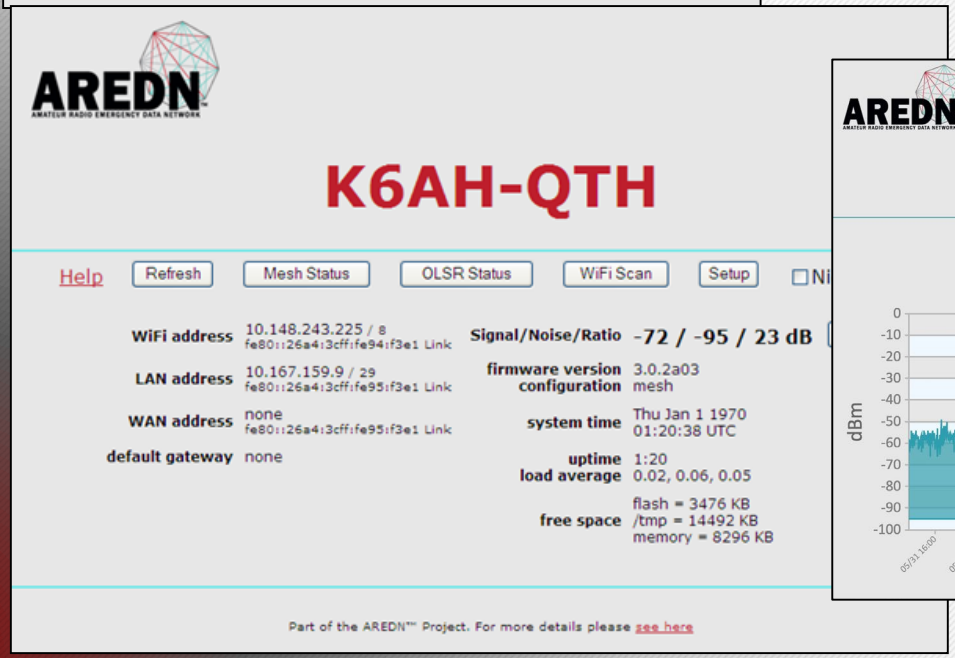
What does the AREDN Web UI do?

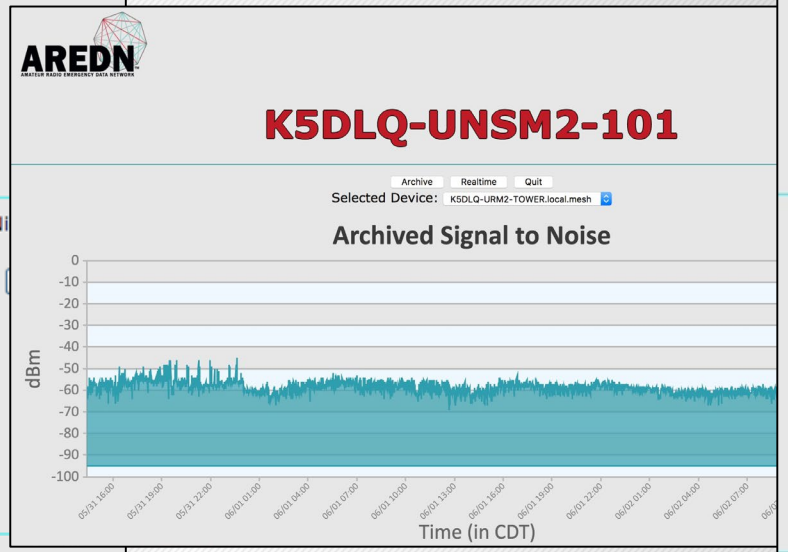
- Basic Node Setup
- Port Forwarding / DHCP / Advertised Services
- Check for traffic / congestion on the channel
- Displays Node Status and connections to nodes
- SNR Charts (Realtime and 24hr archives)
- Tunnel Configuration
- Administration
  - Update firmware “over-the-air”
- Many new features in 2018 release

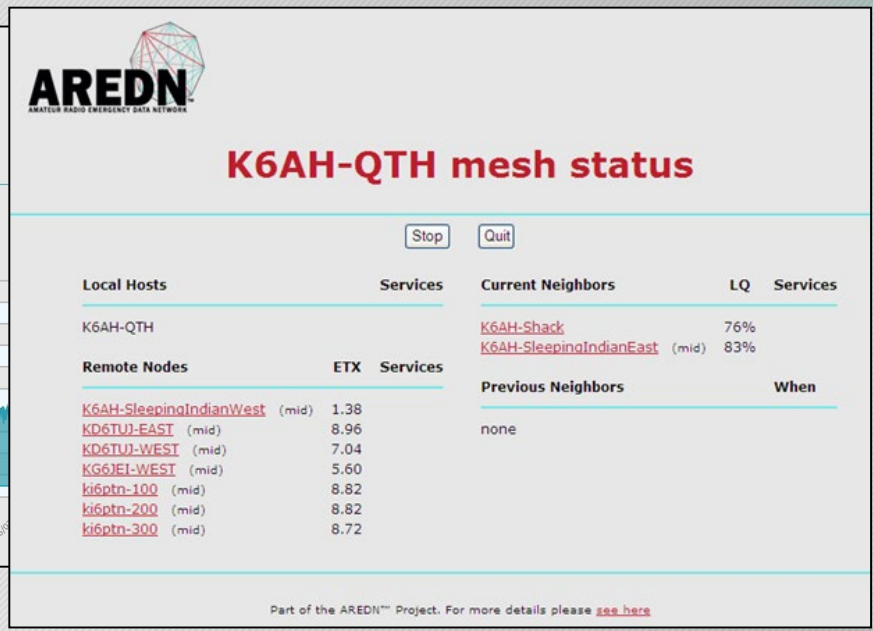

AREDN
Node Status
Basic Setup
Port Forwarding, DHCP, and Services
Administration
Help
Firmware Update
current version: 3.0.2a03
Upload Firmware
Browse...
Upload
Download Firmware
- Select Firmware -
Refresh
Download
Package Management
Upload Package
Download Package
- Select Package -
Remove Package
Remove
Authorized SSH Keys
Upload Key
Remove Key
- Select Key -


AREDN
Node Status
Basic Setup
Port Forwarding, DHCP, and Services
Help
Save Changes
Reset Values
Default Values
Reboot
Node Name
K6AH-QTH
Password
Node Type
Mesh Node
Verify Password
WiFi
Protocol
IP Address
10.148.243.225
Netmask
255.0.0.0
SSID
BroadbandHamne-20-v3
Mode
Channel
6 (2437)
Channel Width
20 MHz
Active Settings
Rx Antenna
N Connector
Tx Antenna
Tx Power
28 dBm
Distance
10000
Apply
LAN
LAN Mode
5 host Direct
IP Address
10.167.159.9
Netmask
255.255.255.248
DHCP Server
DHCP Start
10
DHCP End
14
WAN
DNS 1
DNS 2
Mesh Gateway


AREDN
Node Status
Basic Setup
Port Forwarding, DHCP, and Services
Administration
Help
Save Changes
Reset Values
Refresh
DHCP Address Reservations
Hostname
IP Address
- IP Address -
MAC Address
Add
Advertised Services
Name
Link
URL
K6AH-QTH
Current DHCP Leases
Noche
10.167.159.11
00:24:e8:0b:f5:14
Port Forwarding
Interface
Type
Outside Port
LAN IP
LAN Port
WAN
TCP
Part of the AREDN™ Project. For more details please see here


AREDN
K6AH-QTH
Help
Refresh
Mesh Status
OLSR Status
WiFi Scan
Setup
WiFi address
10.148.243.225 / 8
fe80::26a4:3cff:fe94:f3e1 Link
LAN address
10.167.159.9 / 29
fe80::26a4:3cff:fe95:f3e1 Link
WAN address
none
fe80::26a4:3cff:fe95:f3e1 Link
default gateway
none
Signal/Noise/Ratio
-72 / -95 / 23 dB
firmware version
3.0.2a03
configuration
mesh
system time
Thu Jan 1 1970 01:20:38 UTC
uptime
1:20
load average
0.02, 0.06, 0.05
free space
flash = 3476 KB
/tmp = 14492 KB
memory = 8296 KB
Part of the AREDN™ Project. For more details please see here


AREDN
K5DLQ-UNSM2-101
Archive
Realtime
Quit
Selected Device:
K5DLQ-URM2-TOWER.local.mesh
Archived Signal to Noise
dBm
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
Time (in CDT)


AREDN
K6AH-QTH mesh status
Stop
Quit
Local Hosts
Services
K6AH-QTH
Remote Nodes
ETX
Services
K6AH-SleepingIndianWest (mid) 1.38
KD6TUJ-EAST (mid) 8.96
KD6TUJ-WEST (mid) 7.04
KG6JEI-WEST (mid) 5.60
ki6ptn-100 (mid) 8.82
ki6ptn-200 (mid) 8.82
ki6ptn-300 (mid) 8.72
Current Neighbors
LQ
Services
K6AH-Shack 76%
K6AH-SleepingIndianEast (mid) 83%
Previous Neighbors
When
none
Part of the AREDN™ Project. For more details please see here

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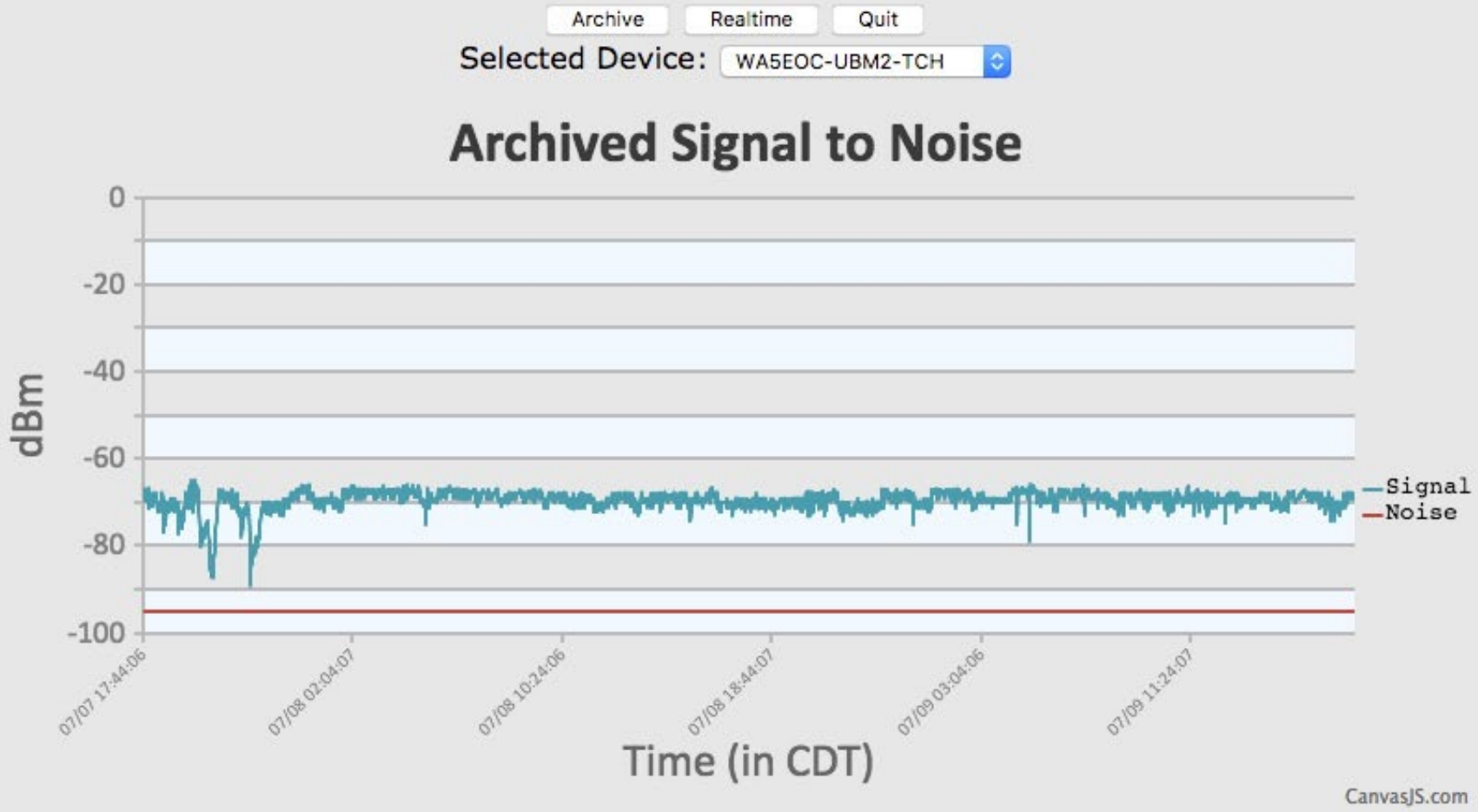
WA5EOC-UBM2-EOC



Standard WiFi (Access Point)

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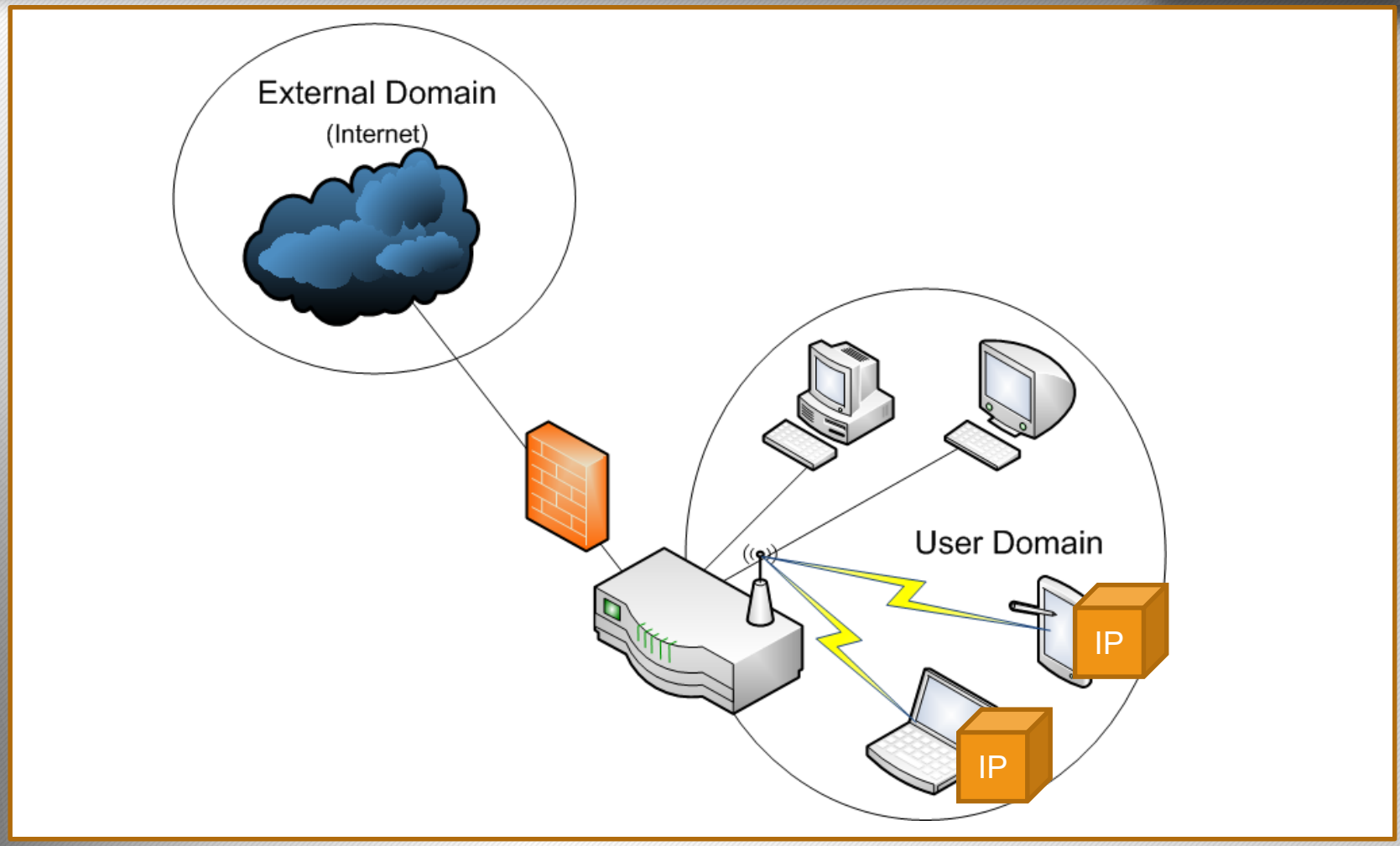
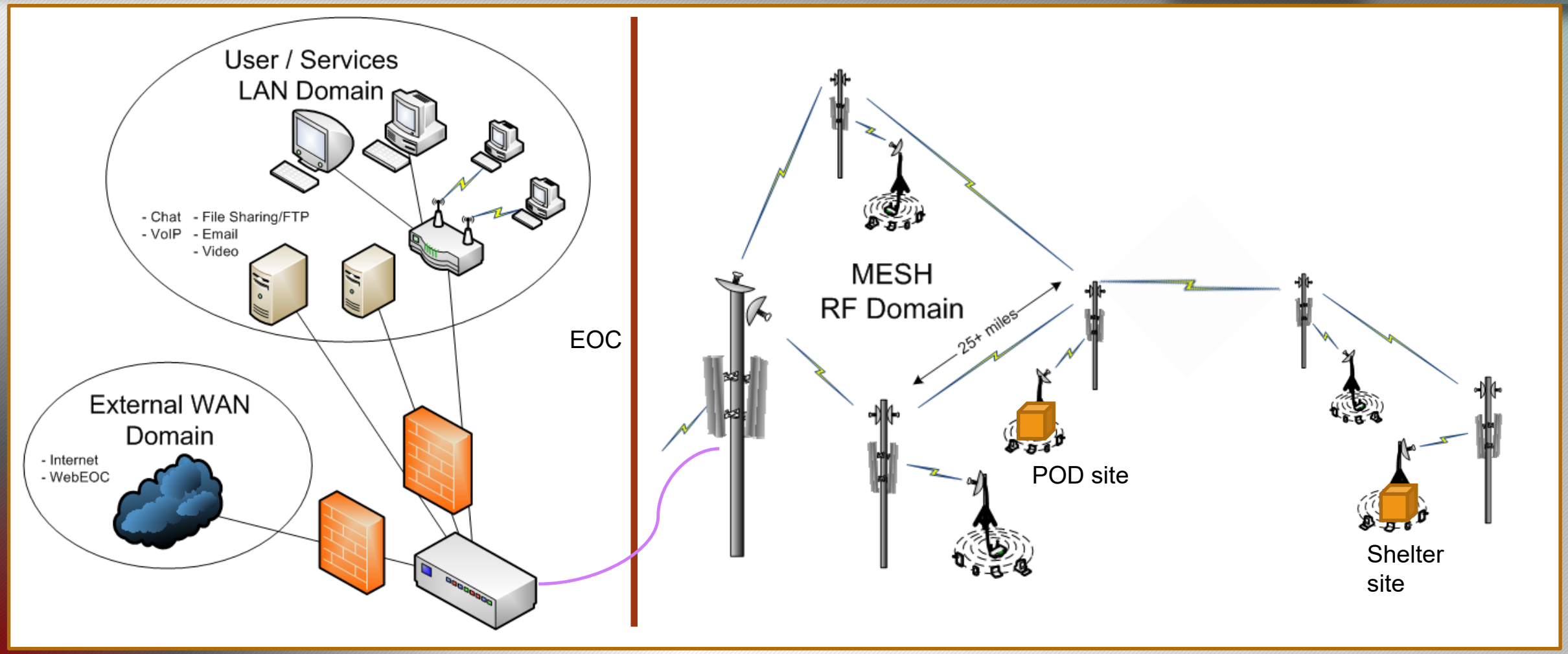


AREDN Mesh Network



Equipment

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Yes, you get to buy new radios…

AREDN Offers 2 Non-Shared Channels on 2.4 GHz

2.4 GHz	Channel	-2	-1	0*	1	2	3	4	5	6
	Status	Ham Band			Shared Ham and ISM/WiFi Band					
	Freq	2.397	2.402	2.407	2.412	2.417	2.422	2.427	2.432	2.437

*Not available for use

24 Non-Shared Channels on 3.4 GHz

3.4 GHz	Channel	76	77	78	79	80	81	82	83	84	85	86	87
	Status	Ham Band											
	Freq	3.380	3.385	3.390	3.395	3.400	3.405	3.410	3.415	3.420	3.425	3.430	3.435

	88	89	90	91	92	93	94	95	96	97	98	99
	3.440	3.445	3.450	3.455	3.460	3.465	3.470	3.475	3.480	3.485	3.490	3.495

Refer to your local band plan for coordination

Channels on 2.4 and 3.4 GHZ

2 Non-Shared channels on 2.4 GHz

24 Non-Shared channels on 3.4 GHz

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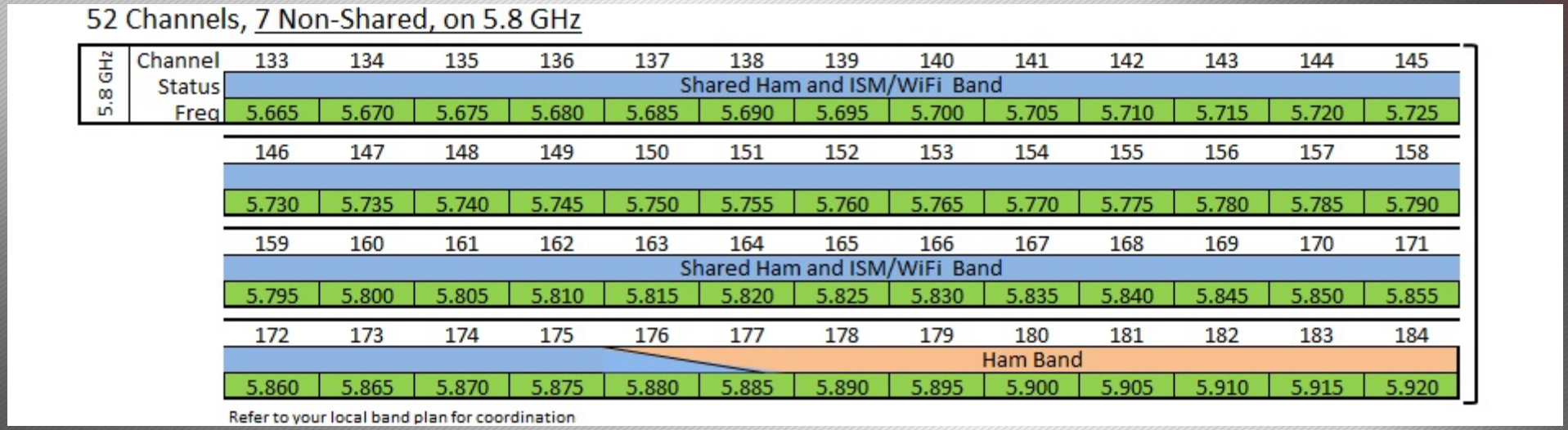
AMATEUR RADIO EMERGENCY DATA NETWORK



52 Channels, 7 Non-Shared, on 5.8 GHz

5.8 GHz														
	Channel	133	134	135	136	137	138	139	140	141	142	143	144	145
	Status	Shared Ham and ISM/WiFi Band												
	Freq	5.665	5.670	5.675	5.680	5.685	5.690	5.695	5.700	5.705	5.710	5.715	5.720	5.725
		146	147	148	149	150	151	152	153	154	155	156	157	158
		5.730	5.735	5.740	5.745	5.750	5.755	5.760	5.765	5.770	5.775	5.780	5.785	5.790
		159	160	161	162	163	164	165	166	167	168	169	170	171
		Shared Ham and ISM/WiFi Band												
		5.795	5.800	5.805	5.810	5.815	5.820	5.825	5.830	5.835	5.840	5.845	5.850	5.855
		172	173	174	175	176	177	178	179	180	181	182	183	184
						Ham Band								
		5.860	5.865	5.870	5.875	5.880	5.885	5.890	5.895	5.900	5.905	5.910	5.915	5.920

Refer to your local band plan for coordination

Channels on 5.8 GHz

7 Non-Shared channels on 5.8 GHz

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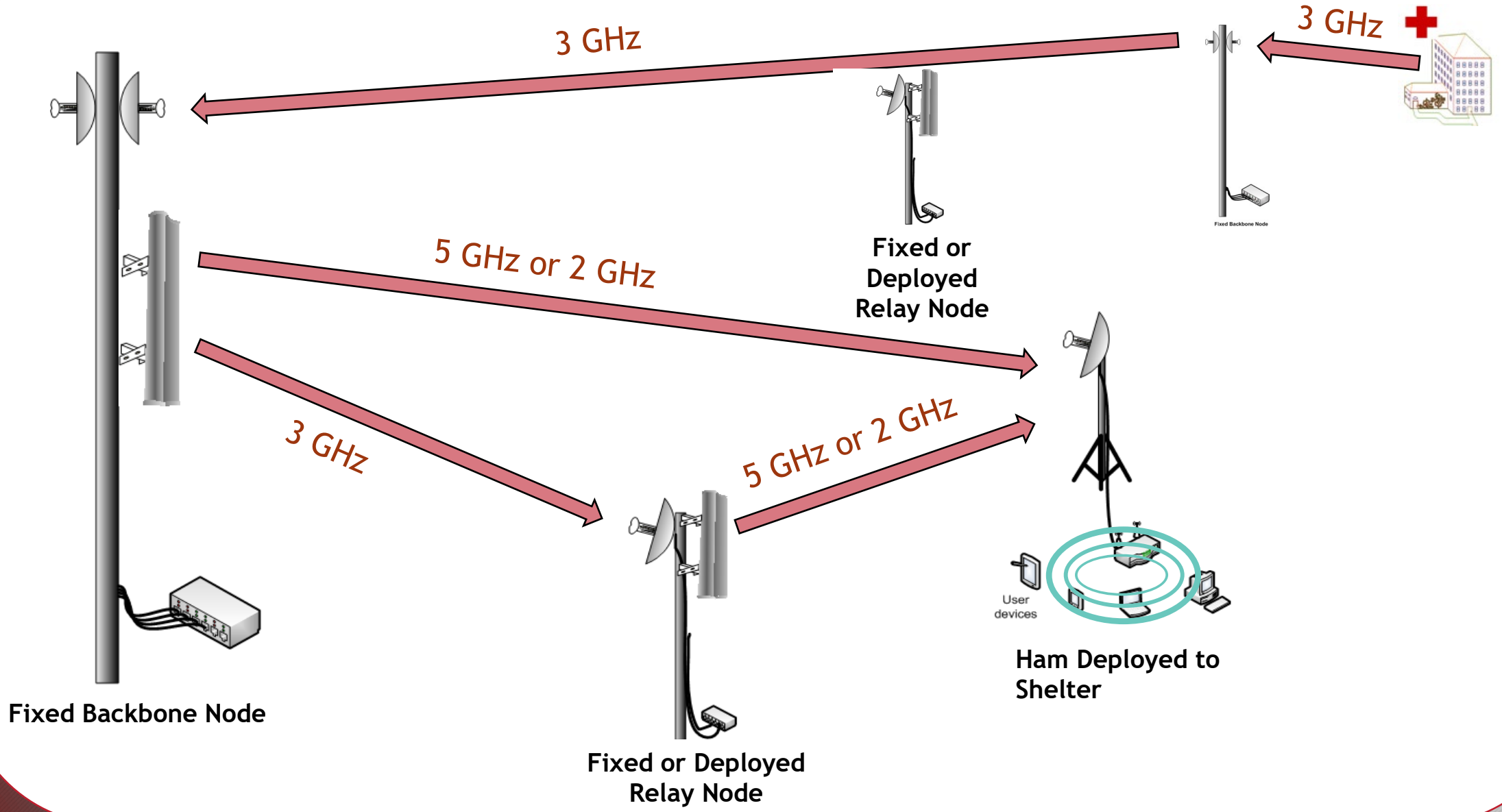
Microwaves

Line of Sight (our biggest challenge)


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

- Ubiquiti airMAX M-series WISP routers
  - AirGrid ($65)
  - AirRouter ($35 and $60)
  - Bullet ($79) (+ antenna)
  - NanoBridge ($100)
  - NanoStation ($85)
  - PicoStation
  - PowerBeam ($200)
  - Rocket ($80) (+ antenna)
  - (and TP-Link equivalents)

- Robust Specifications
  - Power Output: 23 – 28 dBm (200mW – 630mW)
  - Antenna Gain: 11 – 30 dBi
  - Temperature: -40° to 176°F
  - Voltage: 12V – 24VDC
  - Outdoor rated (except AirRouter)

tp-link

Antenna Choices

Omni

- Single polarity (usually)
- 360 degree
- General coverage
- $ (cheap)
- Most aren't MIMO ☹

Sector

- Dual polarity (MIMO) ☺
- 90, 120 degree
- General/localized coverage
- $$

Dish

- Dual polarity (MIMO) ☺
- Narrow beam
- Point to point
- Backbone links
- $$ - $$$

Network Design Considerations

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Backbone

Elevation

High-gain

High power

MIMO (multiple-input, multiple-output)

Point-to-Point

3 or 5 GHz

Relay Nodes

High-gain upwards

Broad-coverage down

MIMO

Cross-band (w/network switches)

Strategically placed

Use Path Prediction tools

Deployed Nodes

May be Ham-owned

Inexpensive <$100

12-24VDC power

Augment go-kits

MIMO preferred

How Do I Build It ?

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Backbone

Mountains, water towers, buildings, antenna towers

24-30dB Dish

Rocket M2/M3/M5

Relay Nodes

Hills, tall masts, buildings

RadioMobile to determine location

NanoBeam, PowerBeam, NanoStation, Rocket

Deployed Nodes

NanoBeam, Nanostation, Bullet

WIFI Access Point

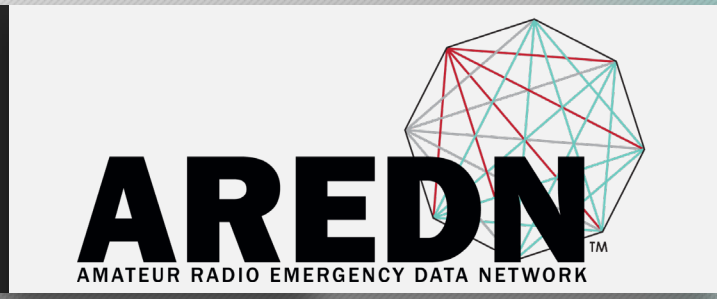
10-20’ mast

Keep it simple

Solar panel

12VDC Battery

Backbone Sites



The rib bone connects to the.. back bone

Using the Vertical Dimension

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Backbone Using High Ground

Mt. Palomar, 6200’ ASL to Mt. Otay at 48 miles distance

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3 GHz and 2 GHz Downlinks

High Ground at Ham's Mountain Cabin

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Club Repeater Site Towers

Benefits

Cheap or free

Gets the club involved

No QRM from WISPs

Commercial Towers

Benefits

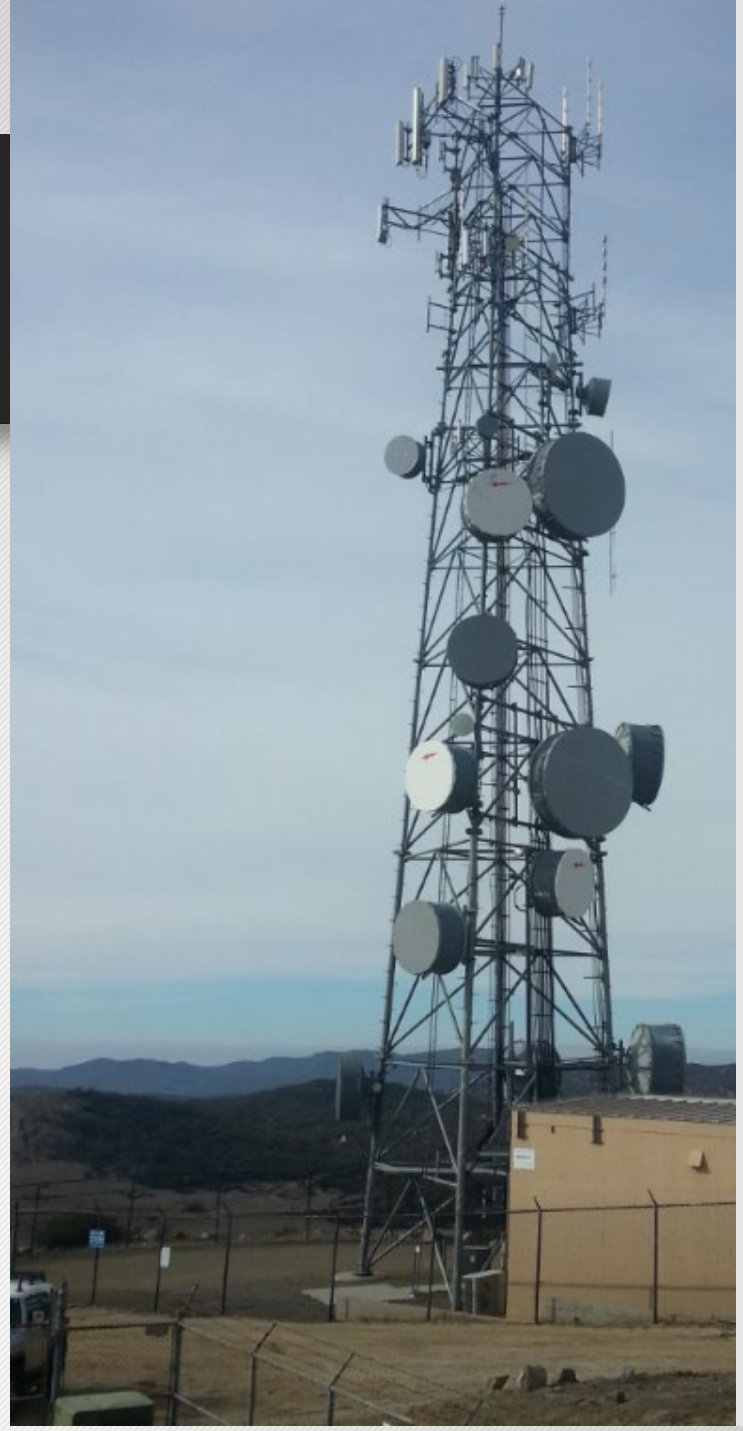
Generally well-placed

Often much taller

May be ham-owned

May be county-owned

($$) climbers, lighting protection, etc.



Relay Sites

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I’m giving it all she’s got Captain… But I need more Mr. Scott…

Small Footprints / Large Coverage Area

Chatsworth Peak - Ventura County, CA

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Small Footprints / Large Coverage Area

Saddleback Peak - Mission Viejo, CA

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Water Tower Relay Site

San Bernardino County - Redlands, CA

Deployed Relay Node

Temporary Shelter/POD Site/Served Agency

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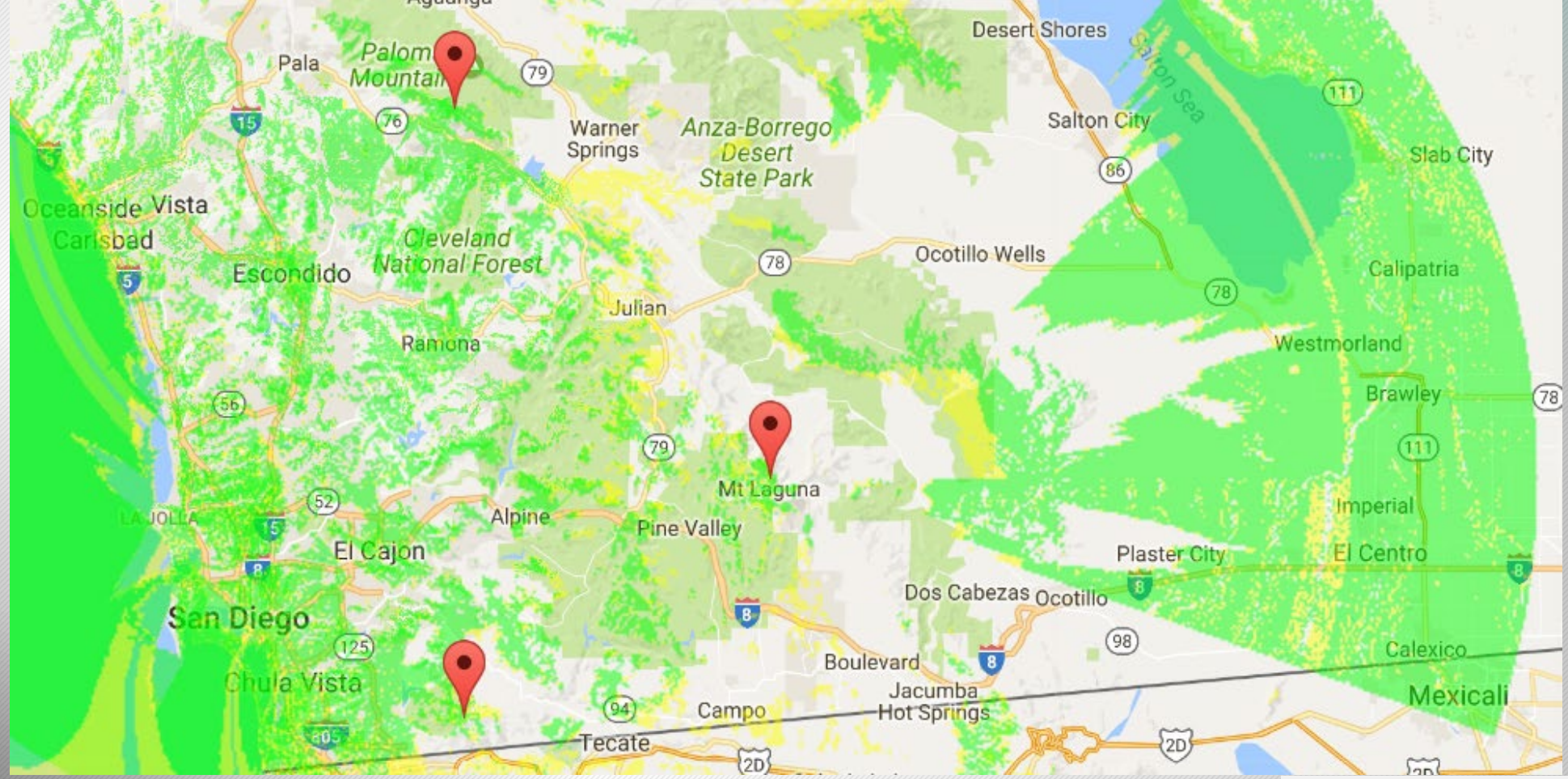

Locating Relay (and other) Sites

Using RadioMobile to Find Common Ground

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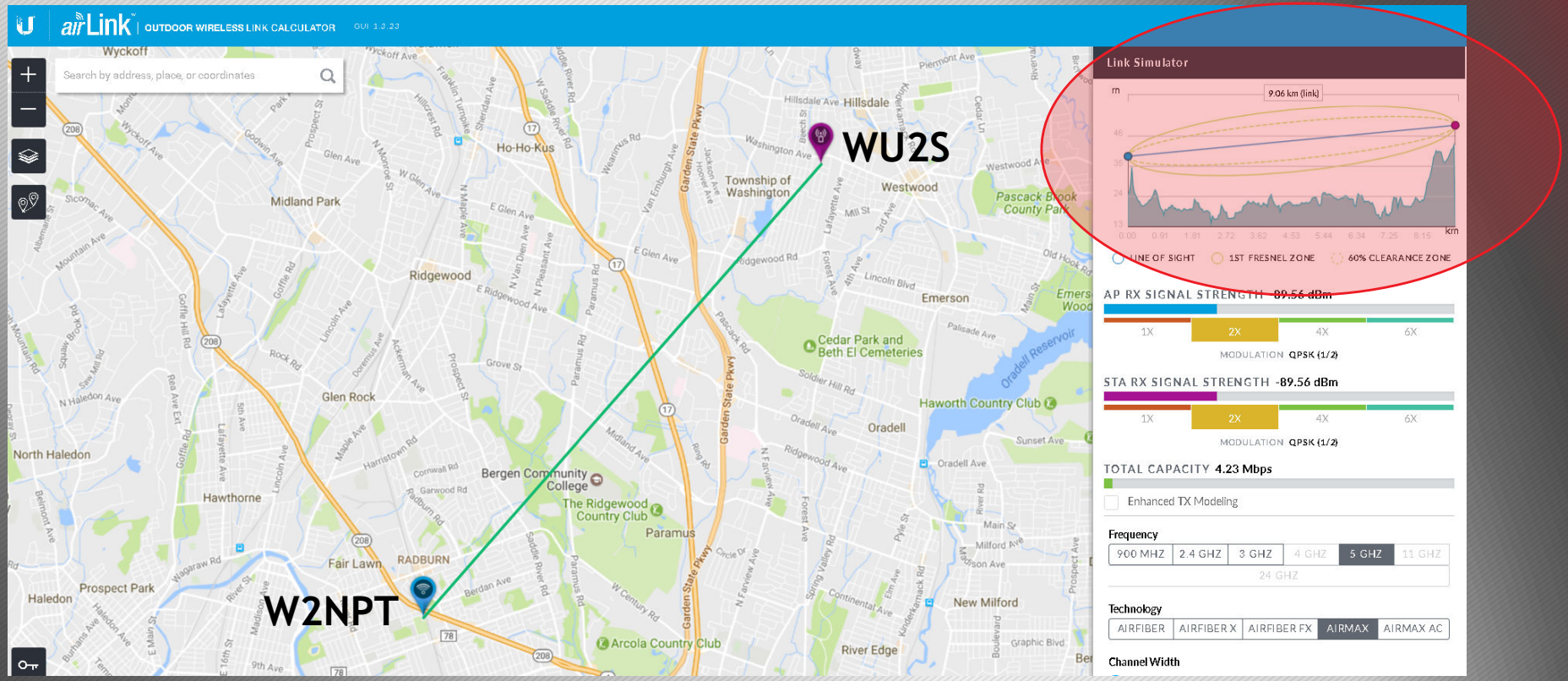
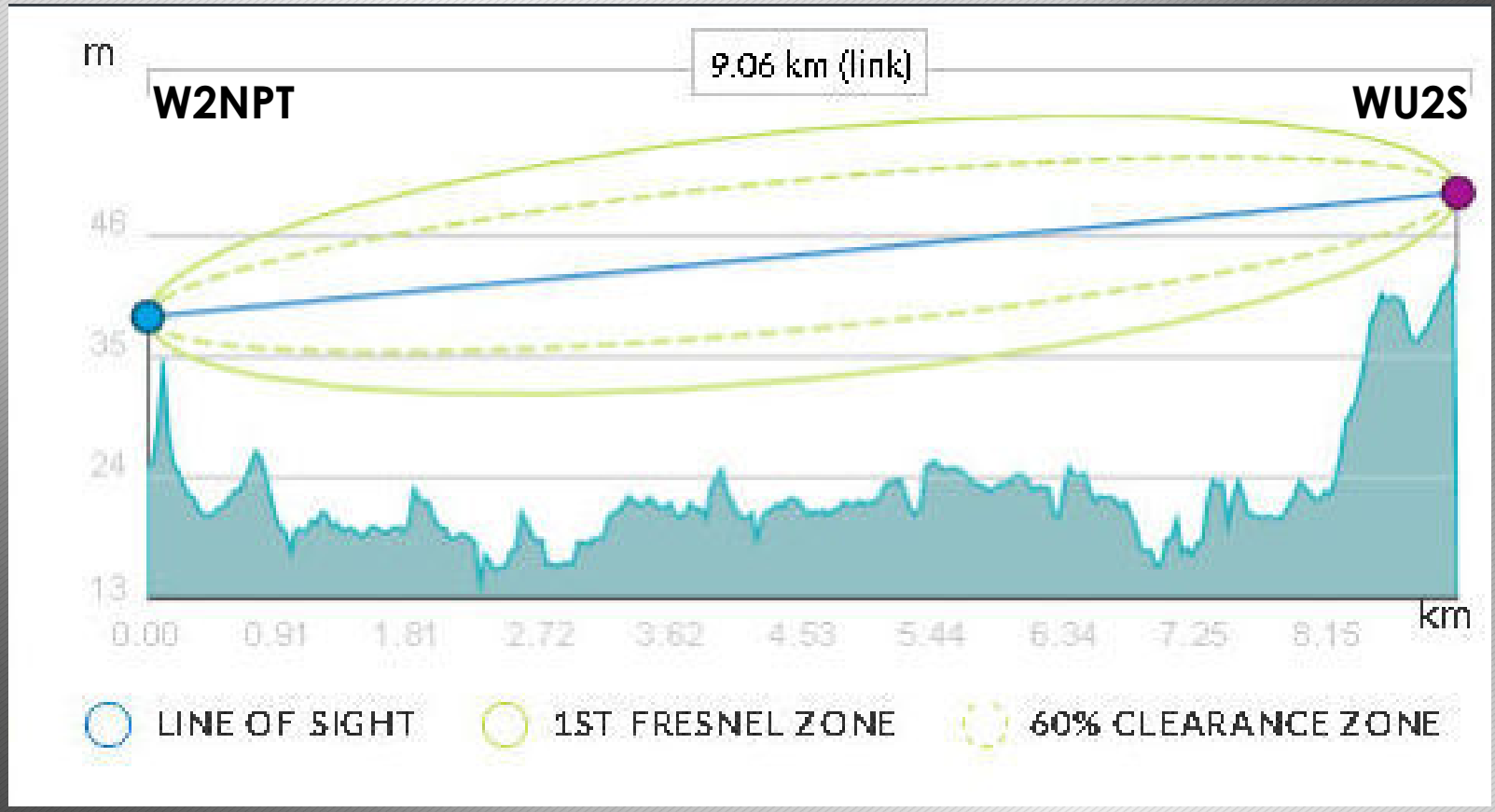


airLink™

https://airlink.ubnt.com/

WU2S to W2NPT 9.06 km

AREDN™
AMATEUR RADIO EMERGENCY DATA NETWORK



airLink™

https://airlink.ubnt.com/

WU2S to W2NPT 9.06 km

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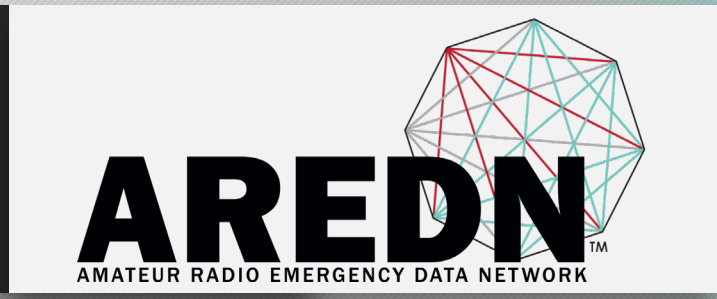
Network Services



We built it… now what?

Network Services

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WINLINK
Global Radio Email

csipsimple

3CX

Asterisk

FreePBX
let freedom ring™

GRANDSTREAM
CONNECTING THE WORLD

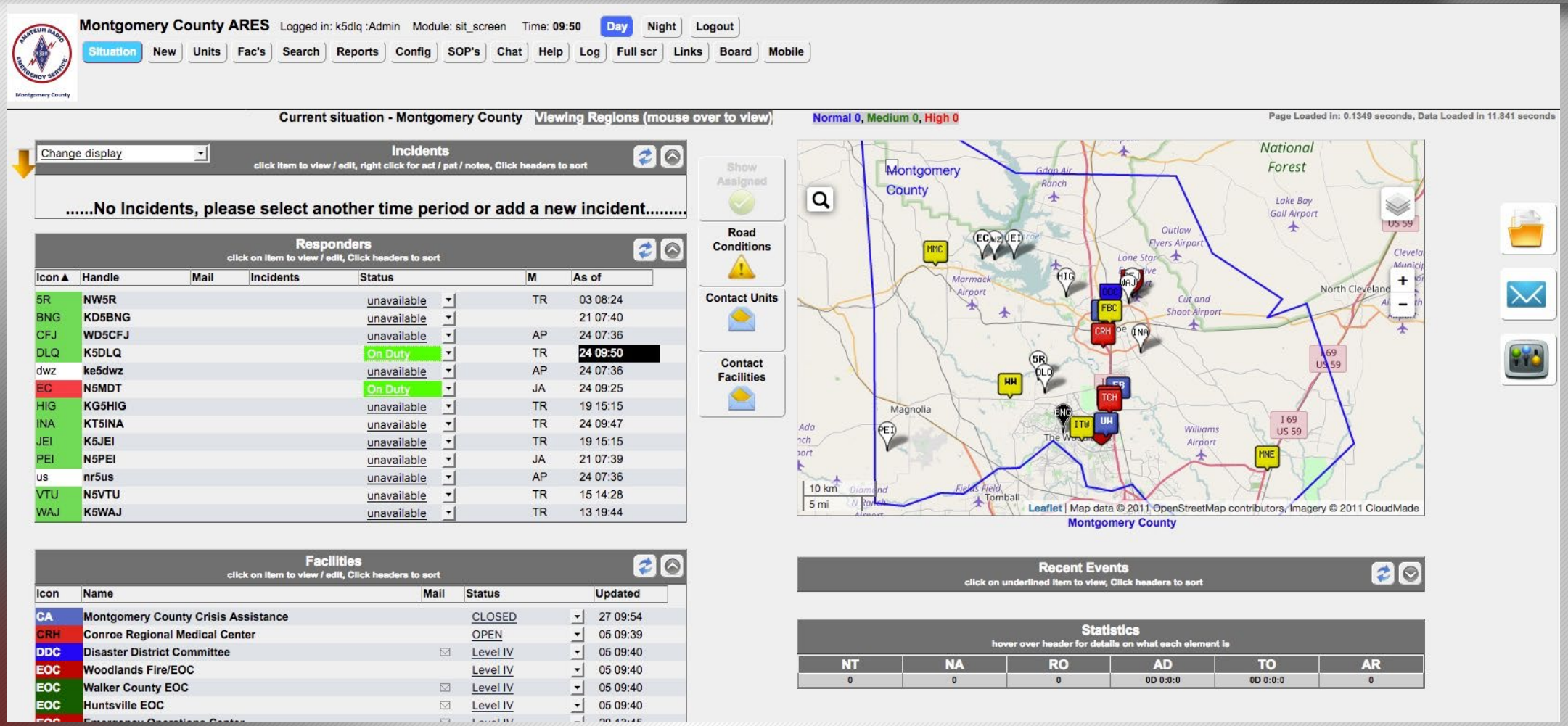
Safe and Well
Register yourself or search for a loved one.

American Red Cross

CERT
COMMUNITY EMERGENCY RESPONSE TEAM

TicketsCAD - Incidents

AREDN™
AMATEUR RADIO EMERGENCY DATA NETWORK



Membership Database

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AMATEUR RADIO EMERGENCY DATA NETWORK

Tickets Membership Database 2.0 Beta 8/10/16 on **Montgomery Couny ARES** Logged in: k5dlq :Super Module: member

Main | Add Member | Member List | Search | Config | Help | Reports | Log | Logout

FORM CONTROLS: Edit Member | Back

VIEW CONTROLS: Show Vehicle | Show Training | Show Equipment | Show Capabilities | Show Clothing | Show Files | Other Details | Show Map

Viewing Member Data for "Mark Taylor"

Personal Details

Surname:	Taylor
First Name:	Mark
Middle Name:	
Team:	
Team ID:	
Availability:	Yes
Member Type:	EC
Member Status:	Available
Date of Birth:	[redacted]
Join Date:	2016 / 5 / 30
Membership Due date:	2016 / 5 / 30
Subscriptions Paid:	No
Background Check Complete:	Yes
CRB Reference:	
Driving Licence Number:	
Driving License Points:	
State:	
Driving Licence Expiry:	2016 / 5 / 30

ID Picture

Location Details

Member List

Name	Description	Completed	Due
Advanced	WGD Taskbook Advanced	11/06/2014	30/05/2016
Basic	WGD Taskbook Basic	11/06/2014	30/05/2016
EC-001		01/01/2014	30/05/2016
EC-016	EmComm for Managers	01/01/2014	30/05/2016
ICS-100	FEMA ICS-100	01/01/2014	30/05/2016
ICS-200	FEMA ICS-200	01/01/2014	30/05/2016
ICS-700		01/01/2014	30/05/2016
ICS-800		01/01/2014	30/05/2016
Intermediate	WGD Taskbook Intermediate Level	11/06/2014	30/05/2016
IS-1	Emergency Manager - An Orientation	30/01/2015	30/05/2016
IS-120	Introduction to Exercises	30/01/2015	30/05/2016
IS-130	Exercise Evaluation	30/01/2015	30/05/2016
IS-139	Exercise Design	30/01/2015	30/05/2016
IS-15	Special Events Contingency Planning	30/01/2015	30/05/2016
IS-230	Fundamentals of Emergency Management	30/01/2015	30/05/2016
IS-235	Emergency Planning	30/01/2015	30/05/2016
IS-240	Leadership and Influence	30/01/2015	30/05/2016
IS-241	Decision making and Problem Solving	30/01/2015	30/05/2016
IS-242	Effective Communications	30/01/2015	30/05/2016
IS-244	Developing and Managing Volunteers	30/01/2015	30/05/2016
IS-250	Emergency Support Functions	30/01/2015	30/05/2016

MeshChat – Distributed Messaging

AREDN™
AMATEUR RADIO EMERGENCY DATA NETWORK

CHAT FILES STATUS LOGOUT

Mesh Chat v1.0

Zone: MeshChat.MONT.TX.US.NOAM
Call Sign: K5DLQ

Node: k5dlq-pi1
Updated: 7 seconds ago

Send a Message

New Message

Enter message here

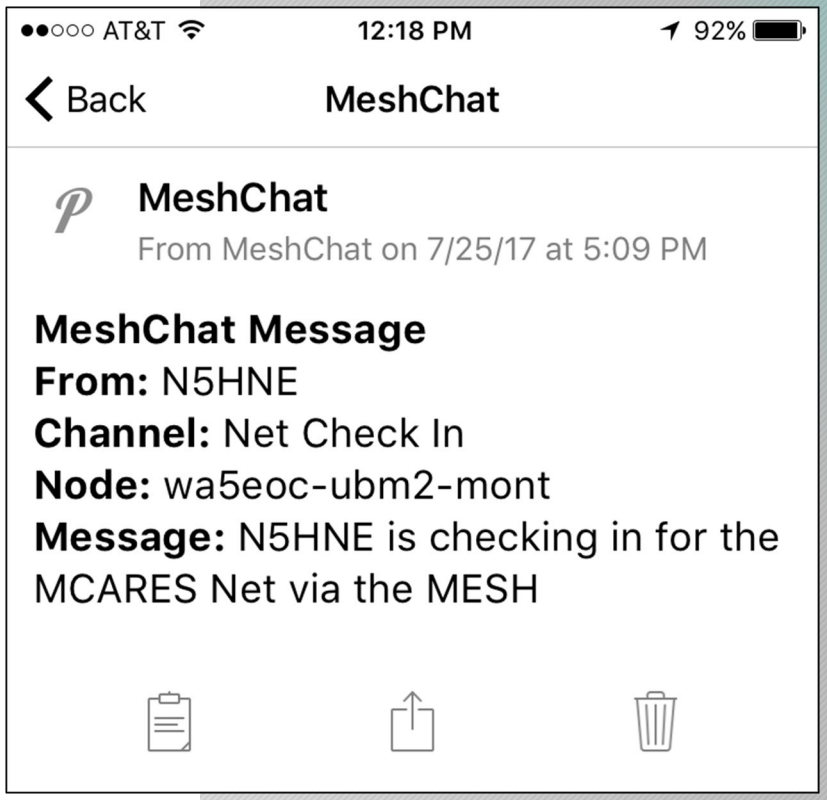
Channel: Everything SEND

Mesh Chat Users 1

Call Sign	Node	Last Seen
K5DLQ	k5dlq-pi1	7/9/17 5:45 PM

Messages Search: Enter search Channel: Everything

Time	Message	Call Sign	Channel	Node
7/4/17 7:16 PM	Checking In	K5WAJ	Net Check In	k5dlq-pi1
6/27/17 5:51 PM	Good evening. Please check me in via the mesh. 73, Bob, KG5HIG	KG5HIG		wa5eoc-ubm2-mont
6/27/17 1:46 PM	Sorry for the multiple messages, receiving send error timeout	K5WSAJ	Add New Channel	wa5eoc-ubm2-eoc
6/27/17				wa5eoc-



OwnCloud Sync'd Files

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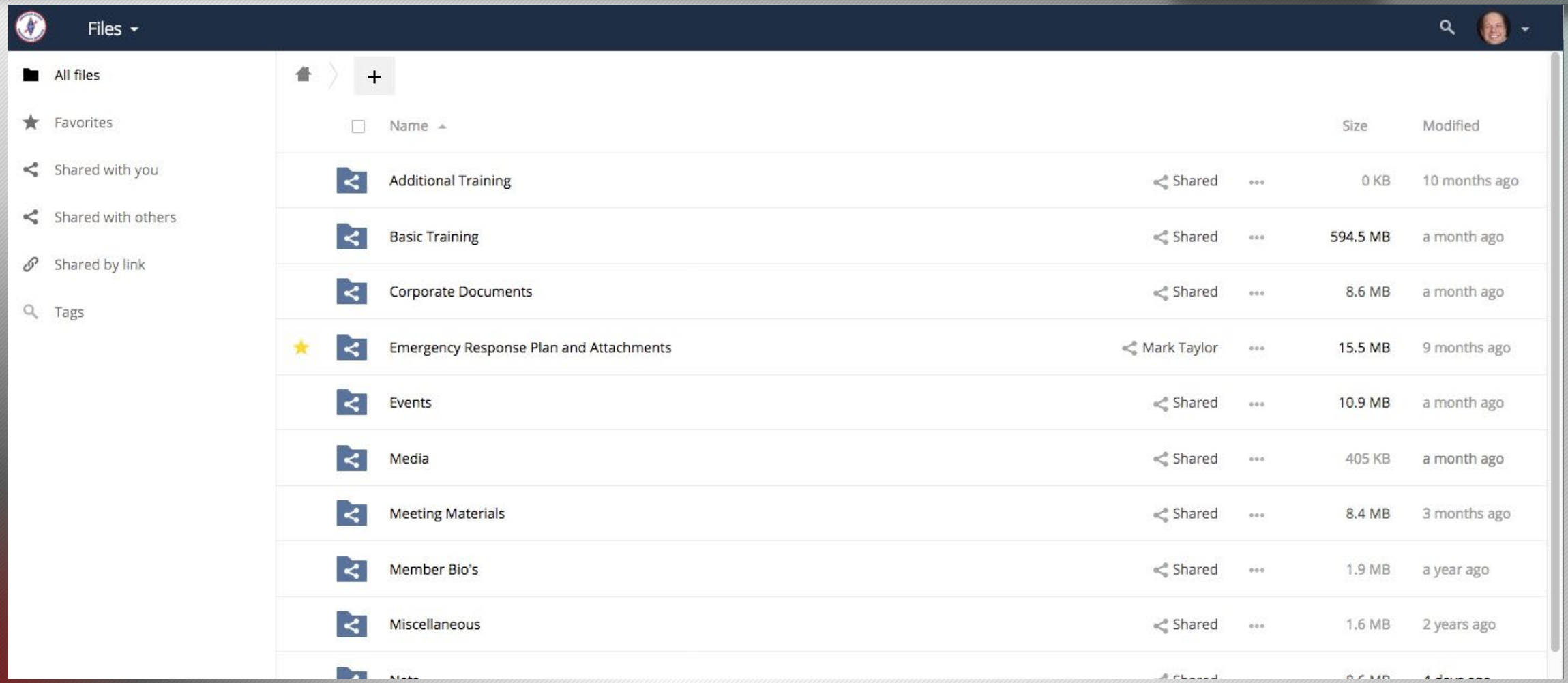

Services in Montgomery County, Texas

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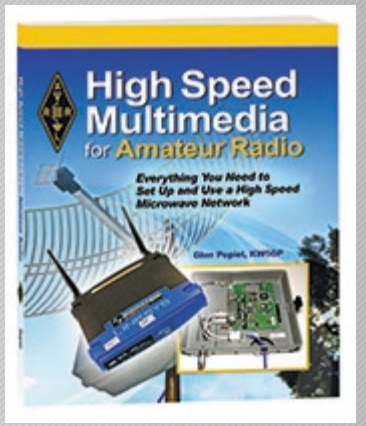
AMATEUR RADIO EMERGENCY DATA NETWORK

- Winlink Network Post Office
- Winlink P2P
- Winlink RMS Packet and Relay
- BPQ Node
- Packet Mail Box
- Java APRS Igate/digipeater
- Video Cameras
- Traccar Personnel Tracking
- Reports
- DMR Openspot Gateway
- DMR Repeater Linking **
- Speed tests, SNMP network monitors, etc.

Resources

AREDN™
AMATEUR RADIO EMERGENCY DATA NETWORK

- www.arednmesh.org - Firmware, instructions, assistance
- www.ispsupplies.com
- www.flyteccomputers.com
- www.streakwave.com
- ARRL HSMM Book by Glen Popiel (KW5GP) (We forgave him for the Linksys and incorrectly configured grid antenna on the cover)



Features & Benefits

AREDN™
AMATEUR RADIO EMERGENCY DATA NETWORK

- Exclusive Part 97 Channels
- Over-the-Air firmware upgrades
- Maximum data rate of 144 Mbps
- Low investment entry
- Rapid deployment and implementation
- Multiple antenna choices
- Interfaces easily with other Internet capable devices

New Features 2018

AREDN
AMATEUR RADIO EMERGENCY DATA NETWORK

- OpenWRT 18.06.1 released in August 2018
- Can be loaded onto any supported Ubiquiti device by using the TFTP method
- Supports many of new Ubiquiti XW devices
- Available for specific Mikrotik Basebox models
- SSID, Channel and Bandwidth are now displayed on the main page

New Features 2018

AREDN™
AMATEUR RADIO EMERGENCY DATA NETWORK

- Reduced code size for better performance and more memory
- SNR displays above the real-time chart to aid aiming
- Pages are now accessible via HTTP port 80
- Show the OLSR routing table size
- Node description on the Mesh Status page
- Display node’s Latitude and Longitude on the main page

PowerBeam 300/400/620

AREDN™
AMATEUR RADIO EMERGENCY DATA NETWORK

Weight: M2 400 = 1.8 kg

M5 300/400/620 = 1.2/1.8/6.4 kg

Gain: M2 = 18 dBi

M5 300/400/620 = 22/25/29 dBi

Current Price: M2 = $79

M5 = $95/115/200

Memory: M2/M5 = 64 Mb

Pwr Output: M2 = 28 dBm

M5 300/400/620 = 26//26/24 dBm

Mikrotik BaseBox 2 & 5

AREDN™
AMATEUR RADIO EMERGENCY DATA NETWORK

Weight: 390 g

Gain: Depends on antenna

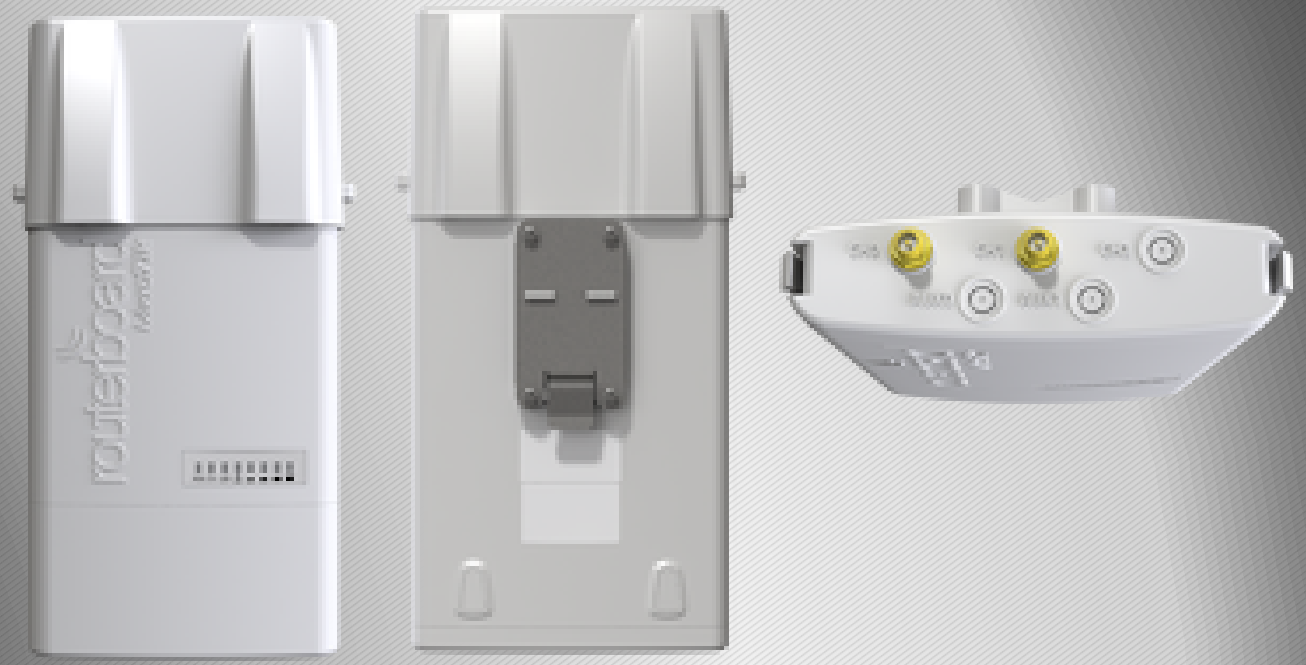
Current Price: 2 GHz = $89

5 GHz = $89

Memory: 2 / 5 = 64 Mb

Power Output: 2 GHz = 30 dBm

5 GHz = 30 dBm



Mikrotik hAP ac lite

AREDN
AMATEUR RADIO EMERGENCY DATA NETWORK

Weight: Unknown

Gain: 2 GHz = 1.5 dBi

5 GHz = 2 dBi

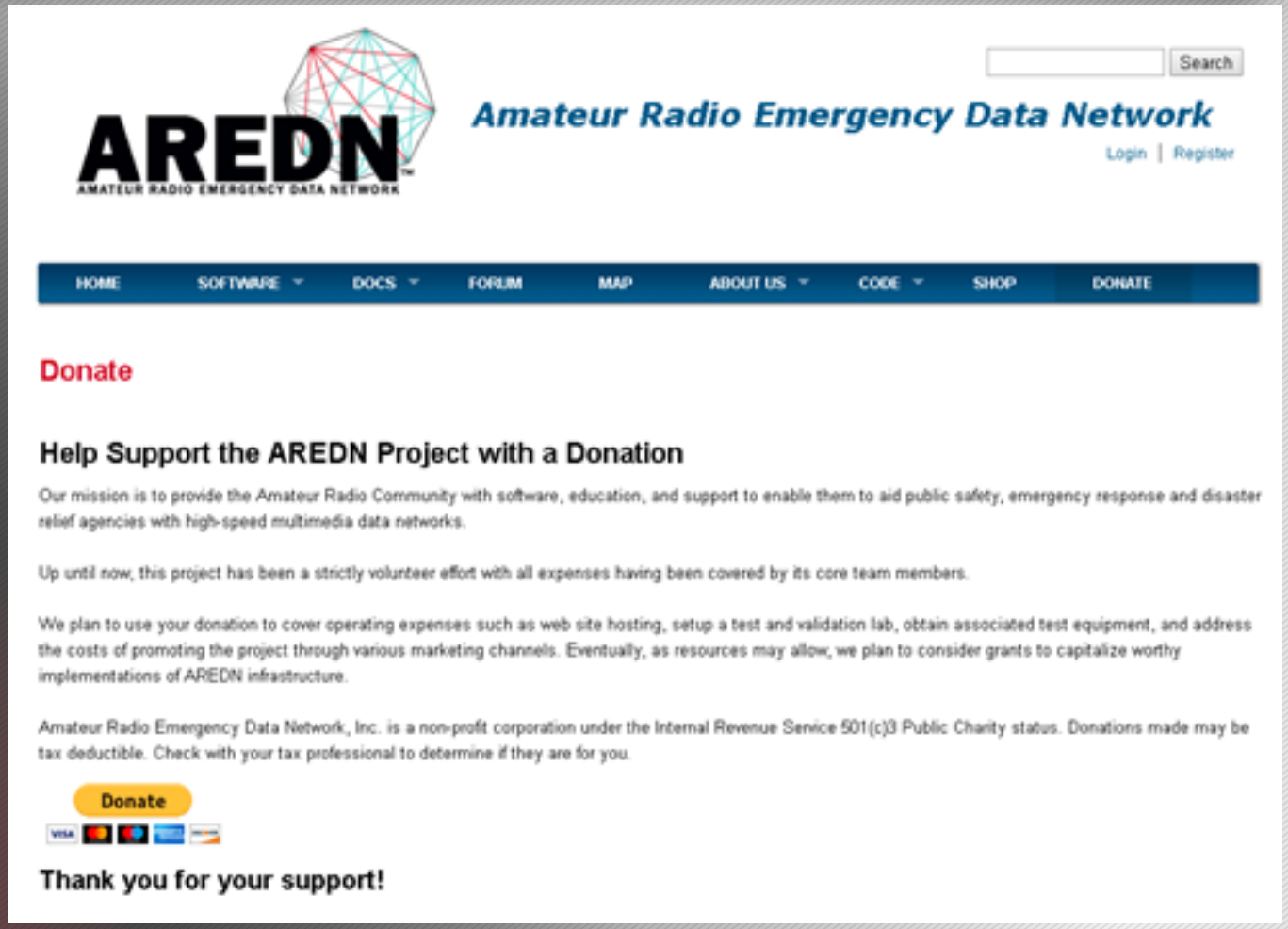
Current Price: = $54

Memory: = 64 Mb

Power Output: 2 GHz = 22 dBm

5 GHz = 23 dBm

Support the AREDN Project



At the Center of Emergency PrepAREDNess

AREDN™
AMATEUR RADIO EMERGENCY DATA NETWORK

Thank You from the AREDN Project Team

Randy Smith, WU2S
wu2s@arednmesh.org

AREDN™
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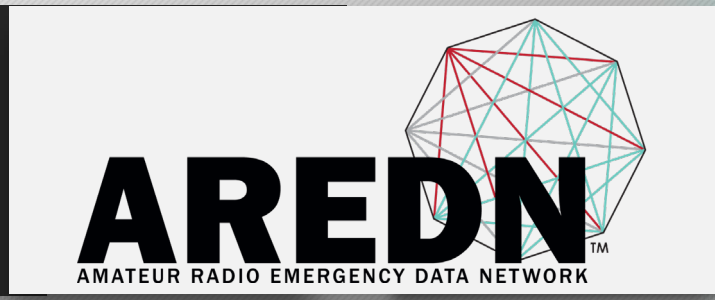
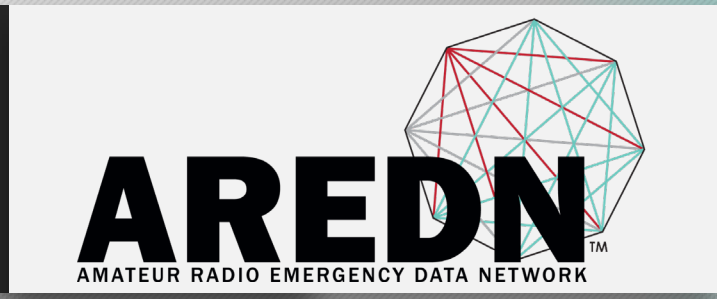
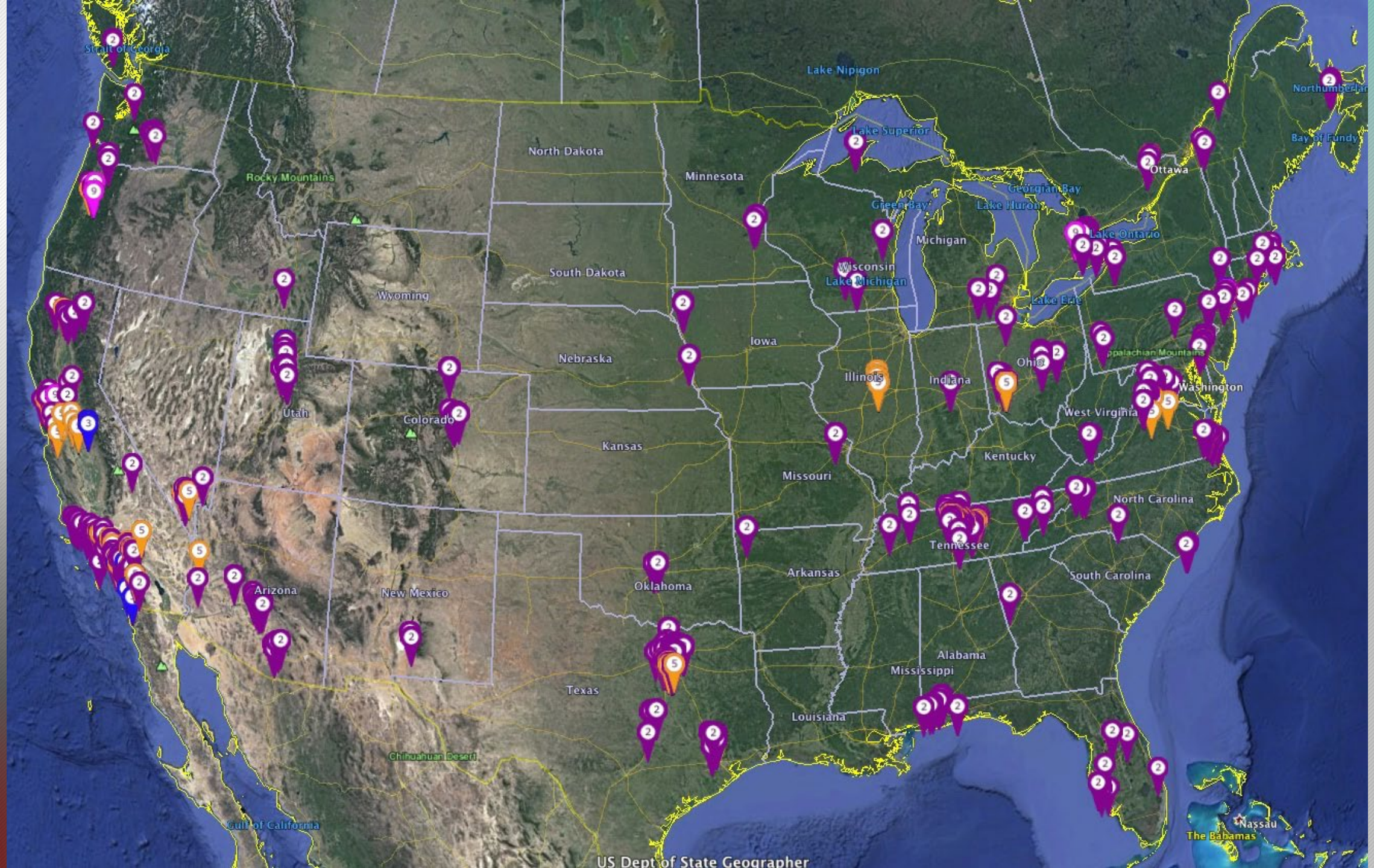
Questions and Answer time



Supplemental Material




Strait of Georgia
Lake Nipigon
Lake Superior
Northumberland
Bay of Fundy
North Dakota
Minnesota
Rocky Mountains
Ottawa
Georgian Bay
Green Bay
Lake Huron
Lake Ontario
Michigan
Wisconsin
Lake Michigan
South Dakota
Wyoming
Lake Erie
Iowa
Nebraska
Appalachian Mountains
Ohio
Illinois
Indiana
Washington
Utah
Colorado
West Virginia
Kansas
Kentucky
Missouri
North Carolina
Tennessee
Arkansas
South Carolina
Oklahoma
Arizona
New Mexico
Alabama
Mississippi
Texas
Louisiana
Chihuahuan Desert
Gulf of California
Nassau
The Bahamas
US Dept of State Geographer

Hams Are Frugal

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AMATEUR RADIO EMERGENCY DATA NETWORK

Nanostation Loco
Weight: M2/M5 = 0.18 kg
M9 = 0.9 kg
Gain: M9/M2 = 8 dBi
M5 = 13 dBi
Current Price: M2 = $46 - $49
M5 = $62 - $67
M9 = $113 - $129
Memory: M2 = 32 Mb
M5/M9 = 64 Mb
Power Output: M9 = 28 dBm
M2/M5 = 23 dBm

Nanostation M

AREDN™
AMATEUR RADIO EMERGENCY DATA NETWORK

Weight: M2/M5 = 0.40 kg
M3 = 0.50 kg
Gain: M2 = 10.4-11.2 dBi
M3 = 12.2-13.7 dBi
M5 = 14.6-16.1 dBi
Current Price: M2/M5 = $89
M3 = $129
Memory: M2/M3 = 32 Mb
M5 = 64 Mb
Power Output: M2 = 28 dBm
M3 = 25 dBm
M5 = 27 dBm

Rocket M

AREDN™
AMATEUR RADIO EMERGENCY DATA NETWORK

Weight: M2/M3/M5/M9 =
0.50 kg

Gain: Depends on antenna

Current Price: M2 = $82 - $89

M3/M9= $179

M5 = $89

Memory: M2/M3/M5/M9
64 Mb

(**datasheet 128 Mb M2/M5*)

Pwr Output: M2/M9 28 dBm

M3 = 25 dBm

M5 = 27 dBm

NanoBridge

AREDN™
AMATEUR RADIO EMERGENCY DATA NETWORK

Weight: M2/M3/M9 = 2.4/4.7/5 kg

Gain: M2/M3/M9 = 18/21.5/10.6

Current Price: M2 = $89

M3= $189

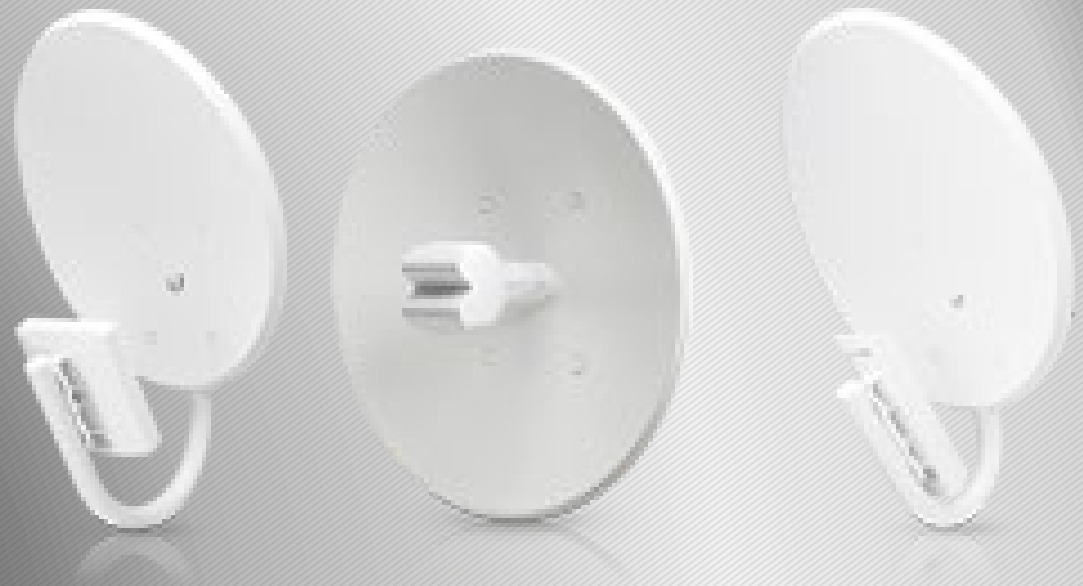
M9 = $159

Memory: M2/M3/M9
32/32/64 Mb

Pwr Output: M2 23 dBm

M3 = 25 dBm

M9 = 28 dBm



AirGrid - Single Polarity

AirGrid - 2 Antenna Sizes

Weight: M2/M5 = 1.65 kg

M2/M5 = 2.75 kg

Gain: M2/M5 = 16/23 dBi

M2/M5 = 20/27 dBi

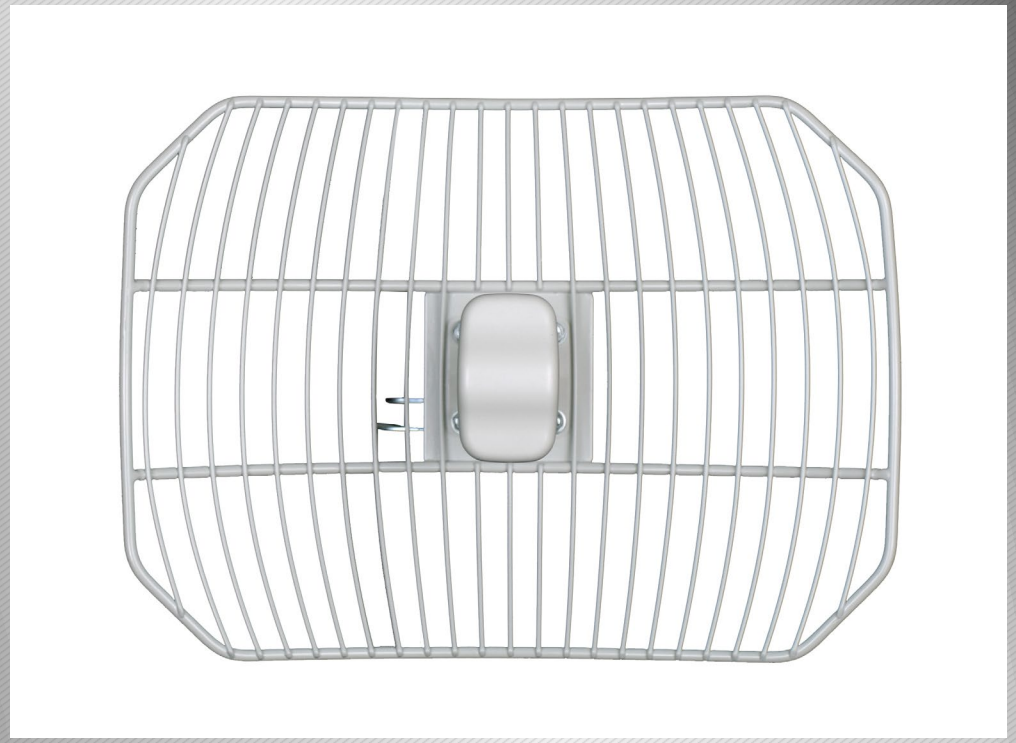
Current Price:M2 = $46 - $49

M5 = $62 - $67

Memory: M2/M5 = 32 Mb

Power Output: M2 = 28 dBm

M5 = 25 dBm



Bullet – Single Polarity

AREDN™
AMATEUR RADIO EMERGENCY DATA NETWORK

Bullet – Single Polarity

Weight: M2/M5 = 0.18 kg

Gain: M5/M5 = Depends on antenna selection

Current Price: M2/M5= $79

Memory: M2/M5 = 32 Mb

Power Output:

M2 = 28dBm

M5 = 25 dBm

AirRouter – Indoor Use

AREDN™
AMATEUR RADIO EMERGENCY DATA NETWORK

Two Models – AR and AR-HP
Weight: AR/HP = .22/.32 kg
LAN Ports = 4
WAN Port = 1

Current Price:
AR = $32 - $39
AR-HP = $62
Memory: 32 Mb
Power Output:
AR = 19dBm
AR-HP = 28 dBm

TP-Link CPE210/510

AREDN™
AMATEUR RADIO EMERGENCY DATA NETWORK

Weight: Unknown – about the same as a Nanostation

Gain: CPE210 = 9 dBi

CPE510 = 13 dBi

Current Price: CPE210 = $58

CPE510 = $64

Memory: 210/510 = 64 Mb

Power Output: 210 = 27 dBm

510 = 23 dBm