WIRELESS MESH USING AMATEUR RADIO EMERGENCY DATA NETWORK
SUMMARY

• What is AREDN?
• Frequencies
• Hardware and Firmware
• Ubiquiti Antennas
• Use cases and deployment in Maine
• Demo
WHAT IS AREDN

Amateur Radio Emergency Data Network (arednmesh.org)

• What is AREDN? (Amateur Radio Emergency Data Network)

• Uses commercial off the shelf low-cost wireless equipment (access points) to create a self discovering network. (Ubiquiti, TP-Link, Mikrotik and GL.Inet)

• The access points are loaded with the AREDN firmware and become ham radios.

• AREDN development team formed in February 2015 to create this firmware

• AREDN team includes Project Managers, Programmers and Testers (All volunteers)
FREQUENCIES

- **900 Mhz**
  - 4 Channels and shared

- **2.4 Ghz**
  - 13 Channels, 11 shared and 2 unshared

- **3.4 Ghz**
  - 14 Channels shared, 10 removed

- **5.8 Ghz**
  - 54 Channels (lots of room)
  - All shared
HARDWARE AND FIRMWARE

- **Supported Platform Matrix** ([arednmesh.org](http://arednmesh.org))
- Mikrotik, Ubiquiti, TP-Link and GL.iNet
  - MIMO (Multiple Input Multiple Output) is a must. Horizontal and Vertical polarization at the same time with dual antennas.
- Firmware creates the core critical needs for a self-discovering network. Assigns IP addresses and allows for hostnames to be set (DNS and DHCP)
LINE OF SIGHT (LOS)

- LOS is a must. (get above tree line or between them)
- Microwave signals can go over 30 miles. (or one tree!)
- Two’s company and Tree’s a crowd 😊 (Per Orv W6BI)
- Demo [Ubiquiti free LOS tool](link.ui.com)
POINT TO POINT (REPEATER SITE) GEAR

The Mikrotik Basebox has 30 dBm of power output. When fed to a 30dBi gain dish that’s 1 KW of ERP. Use caution!

Ubiquiti PowerBeam M5 400mm 25dBi 25+ miles

Ubiquiti RocketDish with Rocket 40+ miles

Mikrotik mANT30 with BaseBox 5 45+ miles
UBIQUITI ANTENNAS (FOR ROCKETS M2 OR M5)

<table>
<thead>
<tr>
<th>Antenna Model</th>
<th>Beamwidth</th>
<th>Downtilt</th>
</tr>
</thead>
<tbody>
<tr>
<td>airMAX Omni 5 GHz, 13 dBi Antenna</td>
<td>7° beamwidth</td>
<td>4°</td>
</tr>
<tr>
<td>$165</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.4 GHz airMAX 24 dBi Rocket Dish Antenna</td>
<td>5° beamwidth</td>
<td></td>
</tr>
<tr>
<td>$169</td>
<td></td>
<td></td>
</tr>
<tr>
<td>airMAX Sector 5 GHz, 120°, 19 dBi Antenna</td>
<td>4° beamwidth that goes 120° side to side. Downtilt is 2°</td>
<td>4°</td>
</tr>
<tr>
<td>$139</td>
<td></td>
<td></td>
</tr>
<tr>
<td>airMAX Sector 2.4 GHz, 120°, 15 dBi Antenna</td>
<td>9° beamwidth that goes 120° side to side. Downtilt is 4°</td>
<td></td>
</tr>
<tr>
<td>$139</td>
<td></td>
<td></td>
</tr>
<tr>
<td>airMAX Sector 5 GHz, 120°, 16 dBi Antenna</td>
<td>8° beamwidth</td>
<td>4°</td>
</tr>
<tr>
<td>$79</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
HOME AND PORTABLE GEAR
(Most common and recommended)

Ubiquiti

MikroTik

GL.iNet
(indoor rated)
HOME AND PORTABLE GEAR

Mikrotik hap ac lite running AREDN Firmware. (below is from Orv W6BI)

- Port 1 – Wired connection to home network
- Ports 2-4 – other devices on your ham network
- Port 5 provides POE power plus DtD (Device to Device) link for routing info to/from node – your link to the mesh network
- 2 & 5 GHz internal radios can be used as ham network node (2 GHz only), wireless access points or wireless access clients.
- Wired this way, devices on ports 2-4 or connected via the internal wireless access point have access to both the hamnet and the internet.
- The AREDN software firewalls the hamnet off from your home network.
USE CASES

- Emergency communication (The “E” in AREDN)
- Data backbone (provides for services and our own intranet running on its own with no reliance on the internet)
  - Repeater (digital linking)
  - Packet Radio (20Mbps + backbone)
    - BPQ node at each site (as needed) connected to the mesh
    - BPQ node to node super fast over the Mesh
    - VHF/UHF 1200 baud still in place (mesh gets higher quality priority routing)
    - Excellent emergency Statewide coverage
  - VOIP communication (PBX, direct dial phone to phone)
    - Teamtalk running on raspberryPI voice and video QSO's
    - Teamtalk works with smart phone, PC (Linux, Windows and Mac)
  - Camera equipment (PTZ types for fire reporting/surveillance)
  - Web services and data sharing
DEPLOYMENT IN MAINE

- Lots of possibilities
  - Use of current repeater sites is a must to create a backbone
  - Grant money needed to fund this effort
    - Amateur Radio Digital Communications at ampr.org (501c3)
    - ARRL will be offering limited funds starting in April 2022
  - 5.8Ghz as the point-to-point backbone (to mesh repeater sites)
    - Lots of channels to use to prevent overlap/interference
  - 2.4Ghz with an omnidirectional for home/remote access per sites
    - Use 5Mhz width so we can divide between 2 channels per site
  - Packet BPQ nodes connected at sites (as needed) with VHF or UHF 1200bps access
DEPLOYMENT IN MAINE

Link (ui.com) Demo (Map of what a future mesh backbone could look like)

- Great free Line of Site (LOS) survey tool to show how current repeater sites could be linked
DEPLOYMENT EXAMPLE

✓ 3 (5.8Ghz) +/- point to point dish's (pending on need)
✓ 1 (2.4Ghz) omni + Rocket M2
✓ VHF or UHF omni for packet, coax and packet radio
✓ 1 RaspberryPi (BPQ node and other services as needed)
✓ 8 port VLAN capable switch (device to device connections)
✓ Small UPS (connect POE, switch and RaspberryPi)
✓ Shielded UV rated ethernet cables
✓ Certified tower climbers ($100 per hour)
Example channel assignments to prevent overlap (may change pending interference).

- **5.8Ghz** channels will be spaced using 20Mhz wide starting at channel 132 then every 4 channels up to be standard. The mesh will be configured to use 10Mhz wide channels with the option to use 20Mhz wide if needed for more bandwidth.

- **2.4Ghz** will be divided between sites using channels -1 or -2. (This will be just a 5Mhz wide use case MikroTik devices will not be supported as they only support 10 or 20Mhz wide.)
HOW TO GET STARTED?

• Cory KU1U has started a working group for this effort for New England. Email Cory (ku1u@nedev.arrl.org) to join in
  • Working on getting a grant to get more repeater locations on the mesh
• Get your own mesh node going (the more involved the bigger the mesh)
  • Device Selection Chart | Amateur Radio Emergency Data Network (arednmesh.org)
  • Supported Platform Matrix (arednmesh.org)
• Join the AREDN forums to build a better understanding (just about every question has been asked and answered (Read!) If you can’t find the answer, ask a question)
  • Amateur Radio Emergency Data Network (arednmesh.org)
• Make friends with repeater owners 😊
• Tunnelling in as a temporary solution until an RF link is created. (Like in my live demo today)
DEMO

• **Demo Network**

• AREDN® is a registered trademark of Amateur Radio Emergency Data Network, Inc
THANK YOU!