AREDN

Amateur Radio Emergency Data Network

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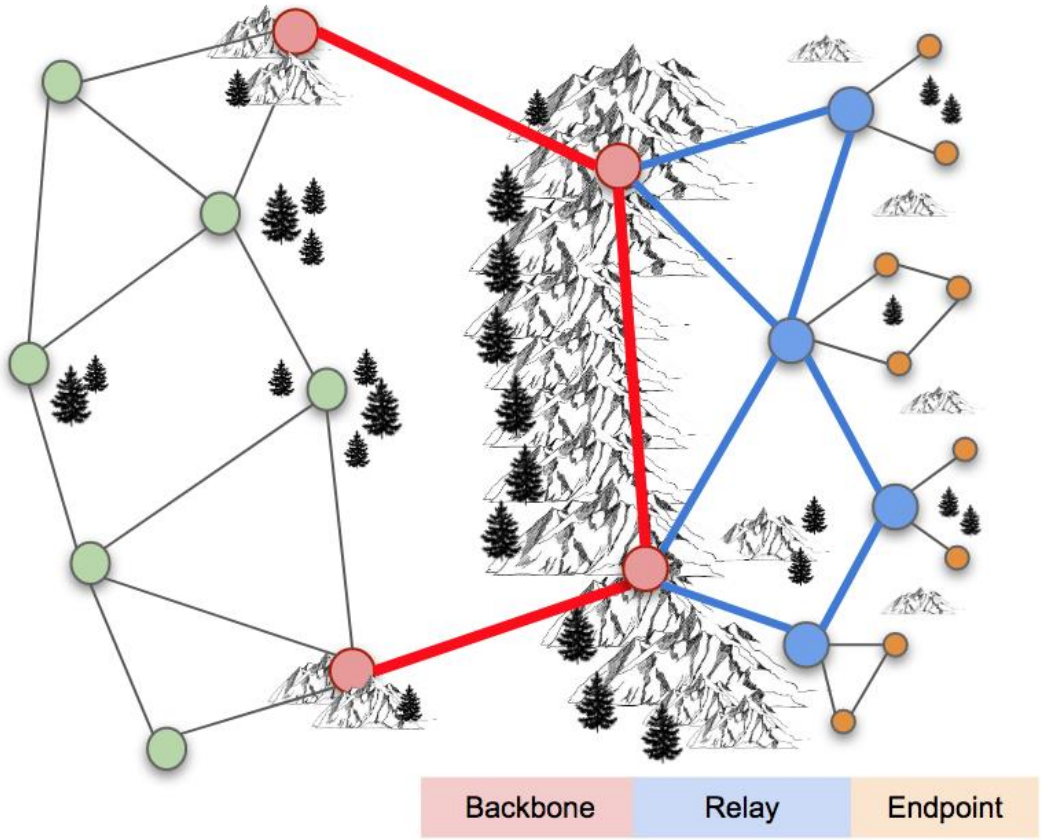
AREDN (Amateur Radio Emergency Data Network) is largely setup in USA with many fixed nodes utilising 900Mhz, 2.4G, 3G & 5GHz bands running an IP network on consumer/proconsumer Wi-Fi equipment.



With our fairly well organised and coordinated emergency services comms and telco ability in Victoria we probably have less need for a fixed network, but could look at providing adhoc data comms up to around 70 Mb/s (10MHz bandwidth) 130 Mb/s (20MHz bandwidth).

The two Wi-Fi bands available in Australia and therefore hardware fairly easy to obtain that runs ARDEN firmware are for 2.4GHz and 5GHz bands from Ubiquiti and TP-Link.

TP-Link is generally lower priced than similar spec Ubiquiti units for radios with built in antennas, however there is a bigger range of Ubiquiti radio/external antenna combinations. The radios run two transmitters and receivers (MIMO devices) into antennas one vertically polarised and one horizontally polarised for improved handling of multipathing.

Some supported 2.4 Ghz units are:

TP-Link CPE210

CPE220

Ubiquiti Nano Station loco M2

Nano Station M2

Some supported 5.8 Ghz units are:

TP-Link CPE510 (see CPE210 image), CPE610

Ubiquiti Nano Station loco M5 (see M2 image), Ubiquiti Nano Station M5 (see M2 image)

Various Ubiquiti more directional units and rocket radio unit with various external antenna types for dishes, Omni or 60/90/120 deg. Sector antennas.

The units use POE (power over Ethernet) so only a single Cat5e or higher type data cable needs to be run up mast. I suggest using shielded Cat6A if you are also using 2M/70cm or other RF close by.

The nodes are configured through their web interface similar to your home router.

Advantage/Disadvantage of 2.4G and 5.8G band

2.4G has few channels (3 at 20Mhz or 7 at 10Mhz width indoor/outdoor) with mostly high use compared to (16 indoor and 5 indoor/outdoor at 20Mhz) for 5.8G.

Slightly lower cost units for 2.4G (CPE210 $70) compared to 5.8G (CPE510 $90).

Wider beamwidth 60-65 deg.(2.4G) vs 45 deg.(5.8G) in base units may make seeing more nodes directly in mesh network easier.

Higher gain for size and more options in 5.8GHz units compared to 2.4Ghz units.

Frequency and power in 2.4G band

Ch 1 – 13 (2402 – 2472 Mhz) allowed unlicensed for outdoor units with up to 4W (36dBm) EIRP under LIPD.

Amateur allocation (2400 – 2450 Mhz) as secondary service.

Frequency and power in 5.8G band

Ch 149 – 165 (5735 – 5835 Mhz) allowed unlicensed for outdoor units with up to 4W (36dBm) EIRP under LIPD.

This allows for units such as Ubiquiti Nano Station Loco M5 or TP-Link CPE510 which have 23dBm max transmit with 13dBi built in antennas to comply on full power. Other units with higher gain antennas would need a lower transmitter setting unless used within amateur allocation (secondary service) on a no interference basis.
Eg. The TP-link CPE610 has 29dBm max power and 23dBi antenna or around 100W EIRP.

Ch 168 (5840) with 10MHz or 20MHz bandwidth is the only exclusive channel in top end of Amateur allocation (5650 – 5850 MHz), however in band plan it is designated as amateur satellite downlink.

What band to use

The choice of band and channel may differ depending on event/exercise.

For an exercise in Greater Melbourne between local government sites, 5.8G may be best to keep away from many local 2.4G networks and more choice in 5.8G channels.

On events in regional Victoria out of town such as Mallee Rally, it is likely to have some 2.4G networks around HQ, but not much, if any in field locations, so 2.4G could be considered. However to get distance with higher gain built in antennas or radio unit / separate antennas setup 5.8G has more equipment available.

Many events operate on an information flow between HQ and field stations, so field stations running a high gain directional unit towards HQ and HQ running a rocket radio with separate 13dBi Omni or 120 deg. sector antenna may be appropriate.

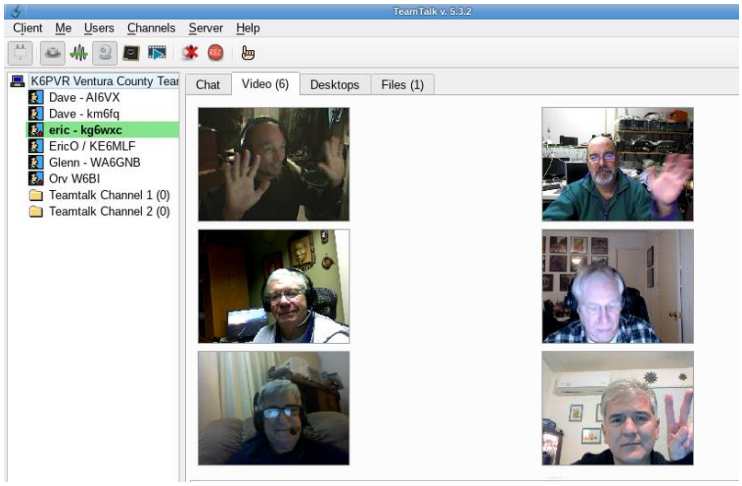
What to run on network

TRAK – Set your station to use network and select your IP address from dropdown and set IP address of Net Control.

RMS Express - Select ‘P2P telnet’ and set IP address required.

Software that can be run without internet access, where the server can be on a local device such as a Raspberry Pi connected to one of the nodes.

TeamTalk5 or other teleconferencing for audio, video and file sharing**.**



Linphone / IP phone / Voip and asterisk (or other) PBX server.

IP camera to view an unmanned checkpoint. Set at maybe 720p and 10 fps to give adequate info and keep network load down.

A simple network can be setup and treated as a large LAN, so UDP and TCP traffic can flow without any special port forwarding or other configuration.

My (VK3YYF) test setup

Nano Station Loco M5 on temporary 7.5m mast pointing towards another loco M5 at VK3IFMs home about 1Km away with no clear line of site due to many trees and small ridge between us, so only running 5 – 10db SNR and a few Mb/s.

Also have a Nano Station M5 on lowest power 8 dBm in house for testing various applications between it and outside node. Since this has around 25dB SNR one way and 40dB SNR the other way it runs at 130Mb/s when I used 20Mhz bandwidth and around 70+Mb/s using 10Mhz bandwidth.

Have setup a TP-link CPE610. The TP-link devices can load new firmware easily from their web interface. The Ubiquiti devices require a bit more work to copy image across with TFTP client after getting in TFTP server mode to accept it.

Yet to replace firmware on a GL-iNet AR750 router which is dual wifi band as the mesh is used on the 2.4GHz side only and the 5GHz is a normal access point. Have setup a Rocket M5 radio with 120deg sector antenna for possible use as a HQ base.

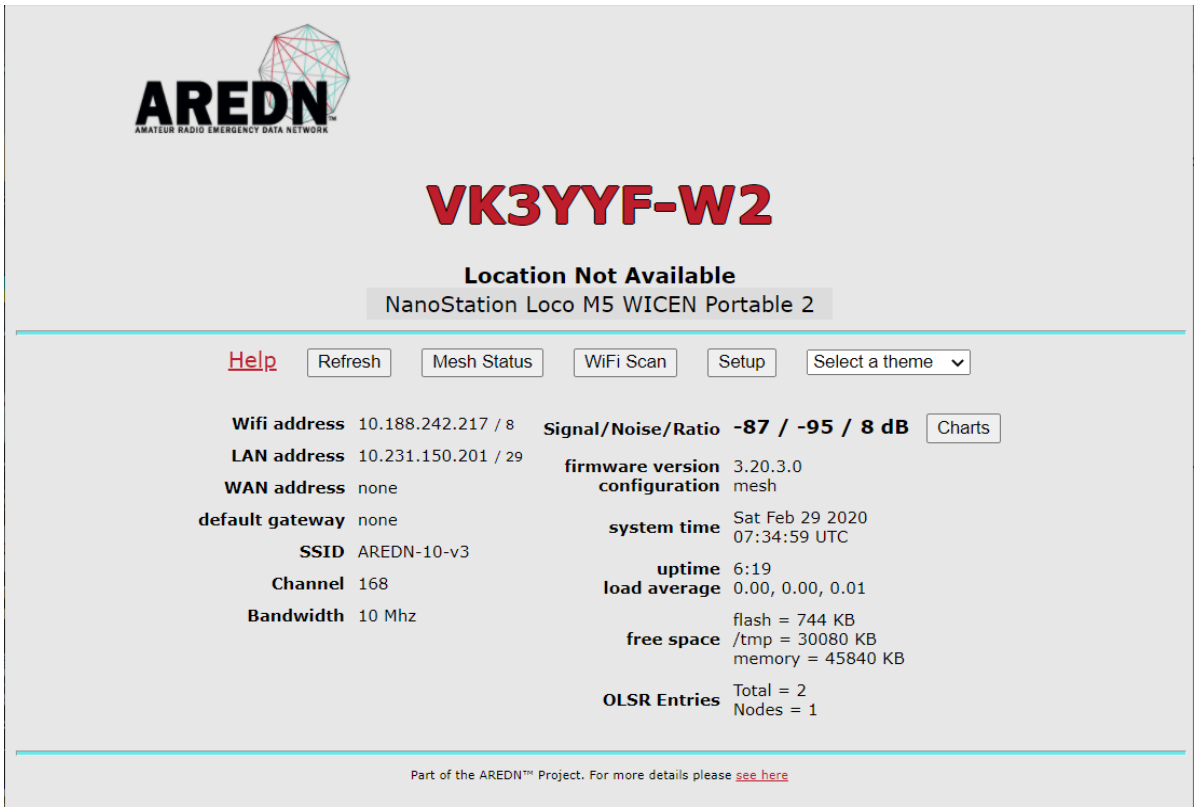
Have setup a Netgear GS105E switch with VLAN settings to allow my nodes to access the internet through the home router and have a tunnel connection to nodes in VK1, VK4 and NZ.

Portable Operation Power

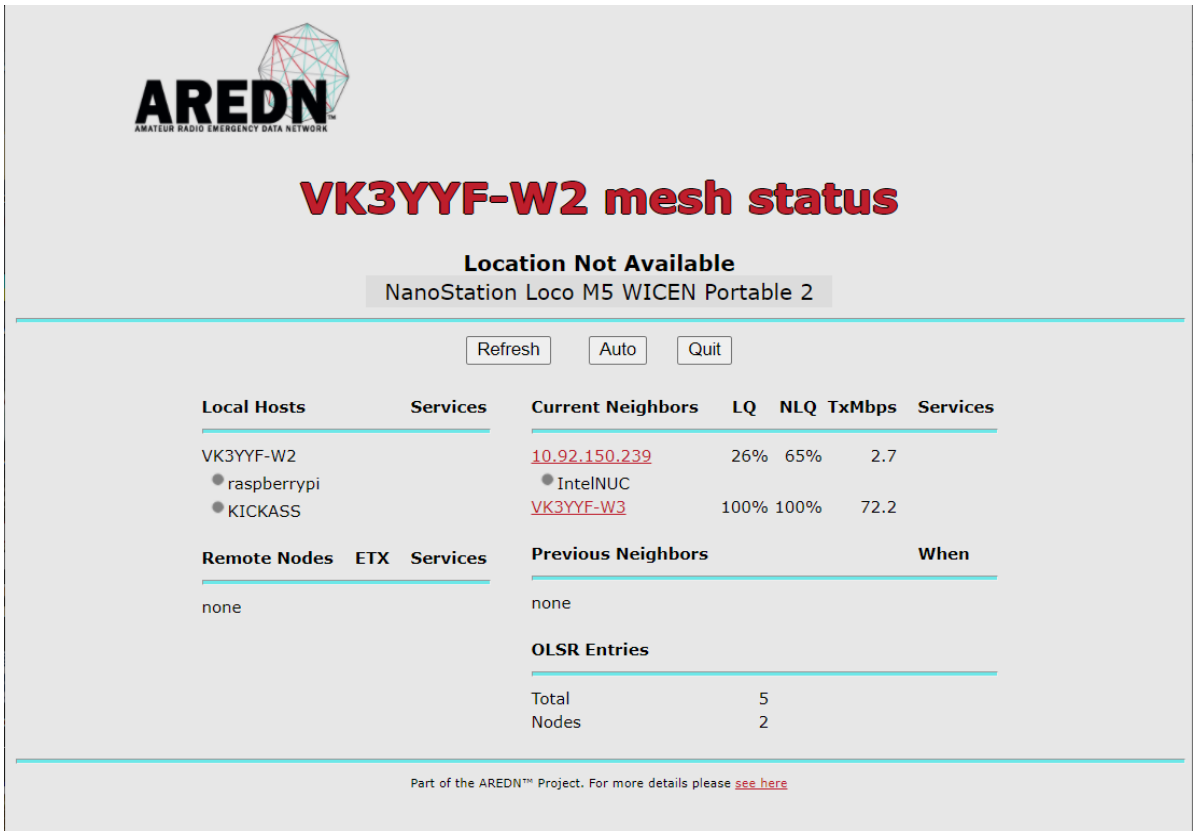
The Ubiquiti and TP-link radios come with 240V to 24V passive PoE adapters to allow the radios to be comfortably powered up to 100m away over cat cable with about 0.5v to 0.8v drop per 10m. However in a portable setup with a 10m cat cable and ubiquiti nanostation able to run down to 10.5 to 11 volts it is possible to run directly off 12v into a passive PoE injector. A standalone 12v 7AH battery would give about 10+ hours operation. If you are running multiple radios, Laptops and other loads off one large battery, it may be wise to use a small DC/DC converter to keep a stable 12v+ to the PoE injector.

Sample of some AREDN screens

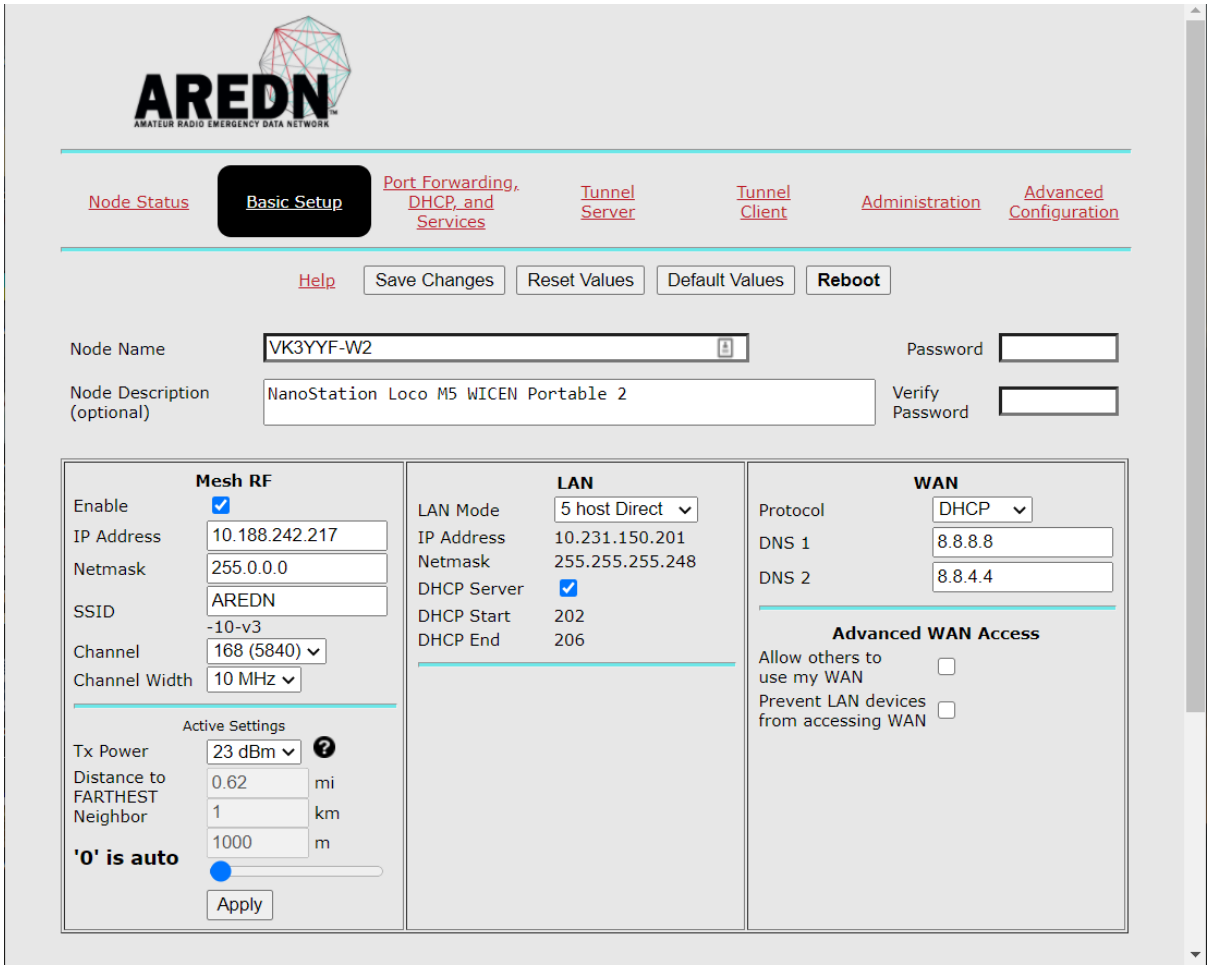
Node Status



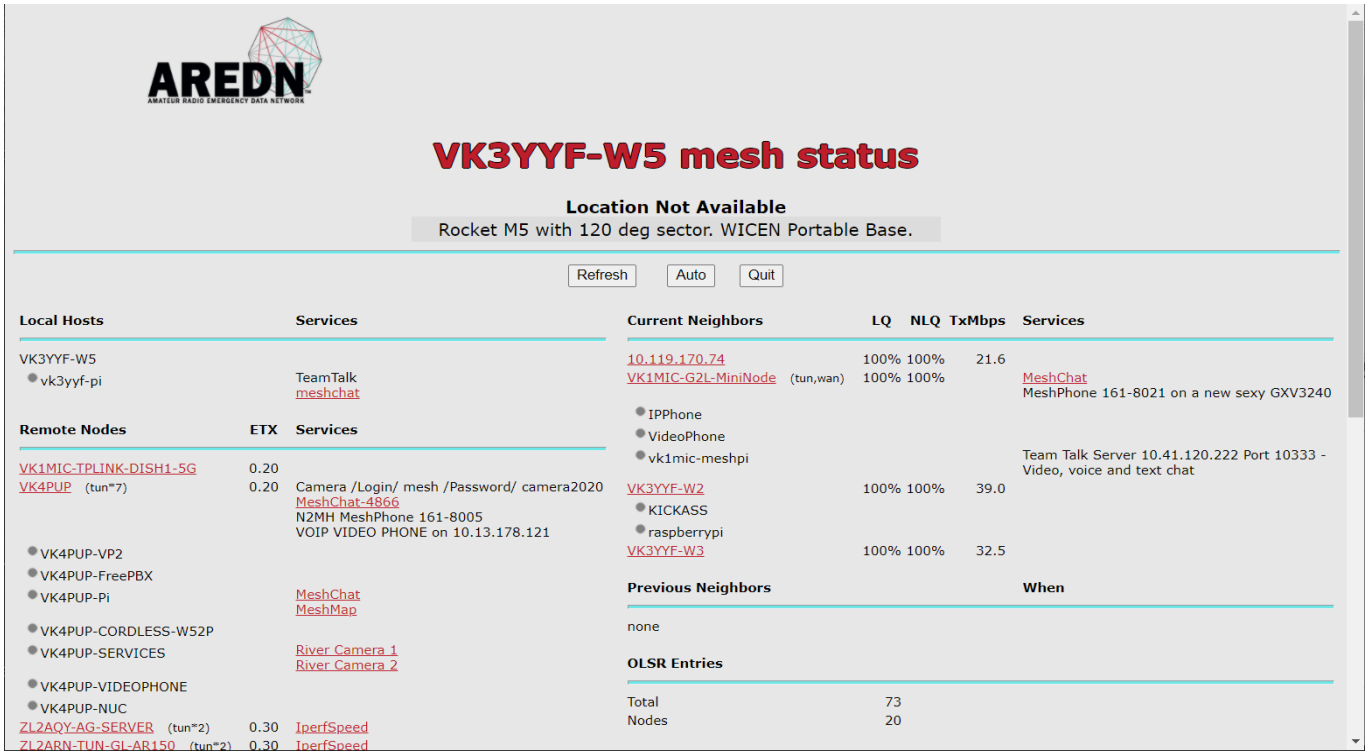
Mesh Status



Setup



Mesh Status with tunnel to other networks



Mesh RF or AP

The AREDN firmware on the unit allows it to be run as a node in a meshed RF network of nodes or as a standalone access point. When the unit is not enabled (ticked) for mesh RF, options appear in the section under the LAN section to enable and configure the unit as a regular LAN or WAN access point on permitted Wi-Fi channels.

For AREDN documentation, software and other info, go to: http://arednmesh.org

Some images in this doc came from AREDN documentation or retail web sites.

Paul Elvey VK3YYF
13/11/2020

Update 28/8/21

With the availablility of LiFePO4 batteries which can maintain 12.8+V down to 20% charge, they are well suited to running the Ubiquiti units within their specified minimum 12v operation.

Voltage	Capacity
14.4V	100%
13.6V	100%
13.4V	99%
13.3V	90%
13.2V	70%
13.1V	40%
13.0V	30%
12.9V	20%
12.8V	17%
12.5V	14%
12.0V	9%
10.0V	0%

No load voltage indication of capacity for LiFePO4 battery

Update 22/11/22

5.8GHz Devices in use:

Ubiquiti Rocket M5 with 120deg 16dBi sector antenna – 20W EIRP as shown in picture on right. Preferably mounted at high spot and field stations can point to it.

Ubiquiti NanoStation with integrated 16dBi antenna – 8W EIRP

Ubiquiti NanoStation Loco with integrated 13dBi antenna – 4W EIRP

Tp-Link CPE610 with integrated 23dBi reflector – 40W EIRP

Field Kit:

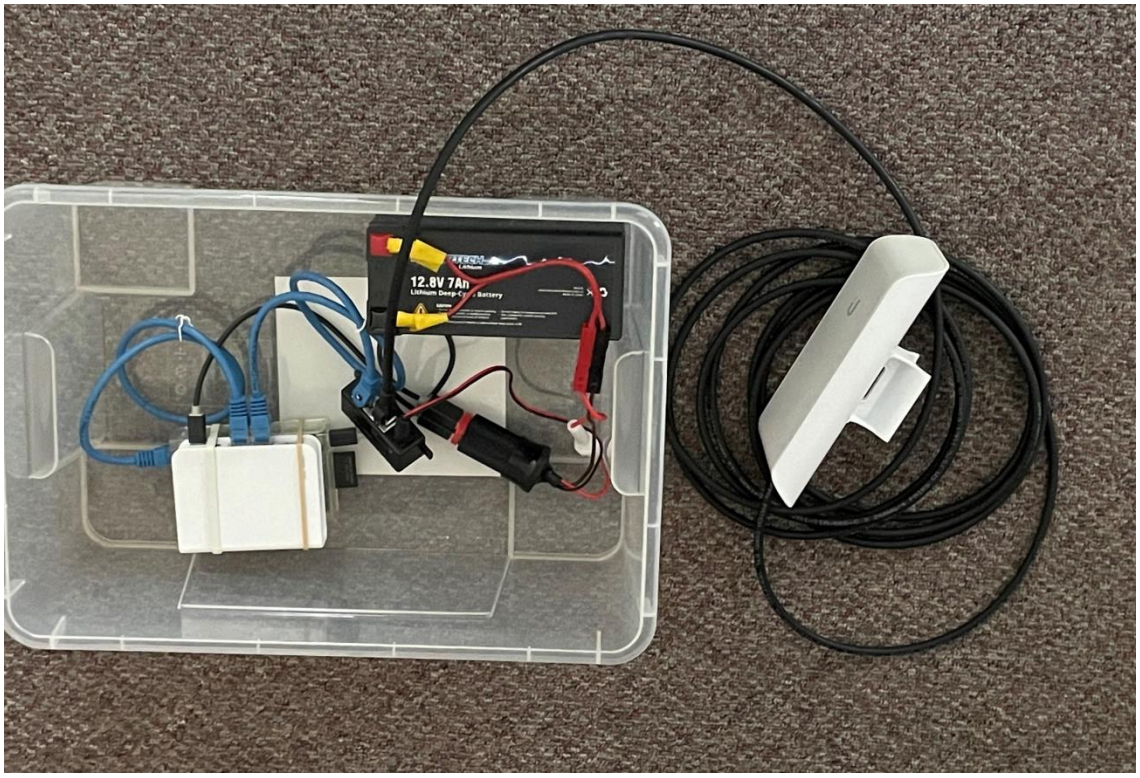
Dual band Wifi router GL.iNet AR750 running AREDN software. Can be used as AREDN mesh on 2.4G and generic 5G access or as generic 2.4G access. Allows local access for laptops and phones to network.

Raspberry Pi (sitting underneath router in picture) for file storage/access, network applications such as meshchat and PBX.

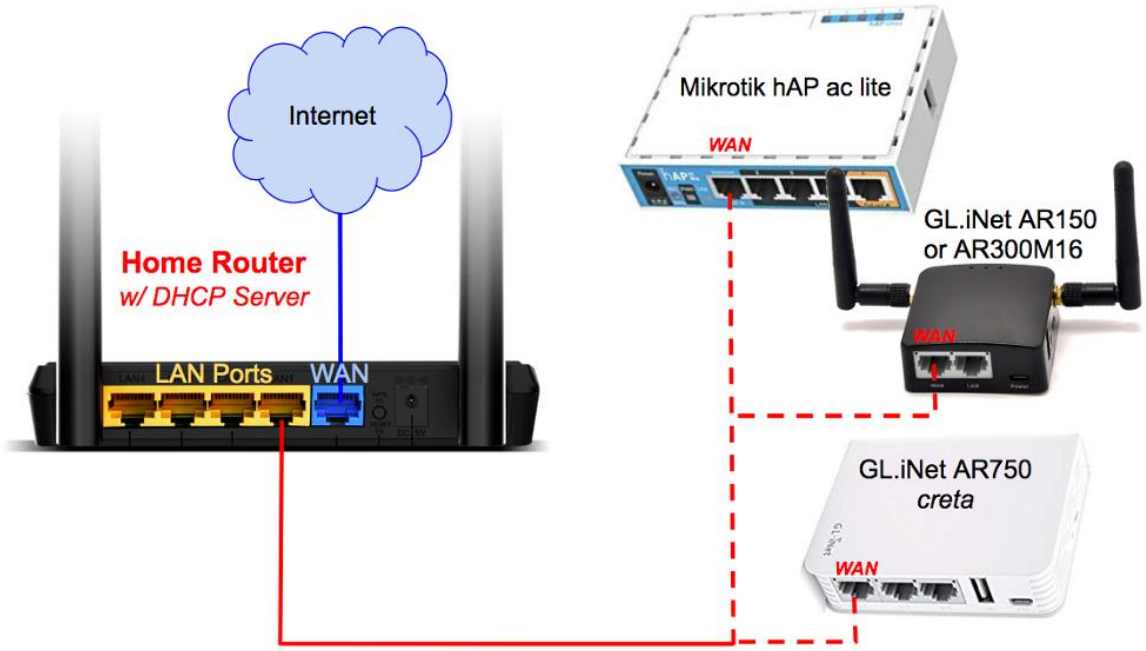
12.8V 7Ah LiFePO4 battery. Router, Pi and node draws < 500mA

12V aux socket with dual 5V usb converter plugged in to run router and Raspberry Pi.

POE injector to supply power to AREDN node (Nanostation Loco) via 5m Cat6A (shielded) cable.



Connecting AREDN network to Intenet via home or clients network access, however is firewalled from clients network.



Layout of network