

QUEEN CREEK AMATEUR RADIO CLUB (QCARC)

ELMER SERIES – MESH NETWORKING II

Ham Mesh Network – Sources

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QCARC

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Scope

Our friends at Queen Creek Emergency Communications Group (QCECG) will be building out a mesh network (or several) in the coming year and in preparation, a primer had been created (Mesh Networking I) to afford members the opportunity for a bit of self-learning. As a follow up to that primer, this document briefly discusses the two dominant amateur radio mesh network systems currently available and also provides recommendations for specific mesh network components: node and antennas. Any questions that you may have can be submitted to the QCARC YAHOO Group at queen_creek_hams@yahoogroups.com. You need to be a member of that Group prior to sending any email to it. Or, send an email to queencreekarcc@gmail.com.

Credits

Thanks to past members of QCECG, Jay, N1RWY, and Brad, N7LZD for their input and suggestions.

Broadband-Hamnet

Broadband-Hamnet™ is a network, it is not application software. It is a special firmware build that transforms consumer wireless gear to a specialized ham radio function. It can use application software to transport your data from place to place, but you must provide the application software just like you do at your home or office.



In non-emergency situations, an established ham mesh network can serve as infrastructure for the ham community, providing access to amateur radio reference material, community video streams, club/group email servers, etc.

AREDN

AREDN™ - The Amateur Radio Emergency Data Network

Mesh technology has evolved over the years. Most notably, Broadband-Hamnet™ (BBHN) has made substantial progress over the past 2 years in expanding their unique approach to environmentally robust, commercially available, Ubiquiti, hardware. This has changed the complexion of mesh implementations from an experimental, hobby-oriented, novelty into a viable alternative network suitable for restoring some level of Inter/intra-net connectivity when “all else fails.”



Recently, the developers of BBHN software have kicked-off a new project focused on taking this technology to the next level. Comprised of the project manager, developers, and several of the testers who brought BBHN to Ubiquiti hardware, this team is geared to pick up where BBHN left-off.

The AREDN Project mission is to provide the Amateur Radio Community with a quality solution for supporting the needs of high speed data in the Amateur Radio and Emergency Communications field.

Broadband-Hamnet Versus AREDN

AREDN is preferred for QCECG applications. Here are some reasons why AREDN can provide a better mesh node experience for emergency (and non-emergency) applications:

- Only two non-overlapping 20MHz channels (1, 6) in Part 97 so channels -2 and -1 introduced in AREDN release 3.15.1.0 are uniquely under Part 97 and offer considerable improvement in Link Quality and distance given lack of unlicensed noise.
- Typical Broadband-Hamnet use of crowded and noisy band (ch 1+) results in interference from cordless phones, wireless routers and WIFI clients (part 15 and ISM unlicensed space).

Basic Components of a Mesh Network Node

A mesh node consists of the mesh node – typically a 2.4/5 GHz outdoor Wi-Fi radio, an antenna, and a PoE (Power over Ethernet) adapter. The Wi-Fi radio could also be a single integrated radio/antenna unit.

Here are the components selected by QCECG for the proposed mesh network deployment in 2017:

Node Radio:

- [Ubiquiti Bullet Titanium 2.4 GHz Radio](#)

Node Antenna Options:

- [Phonetone 8db Wifi 2.4GHz Omni-directional Fiberglass Antenna with N female Connector](#)
- [TP-Link 2.4 GHz 12 dBi Outdoor Omni-directional Antenna](#)
- [TP-Link 2.4 GHz 15 dBi Outdoor Omni-directional Antenna](#)
- [TP-Link 2.4GHz 24dBi Directional Grid Parabolic Antenna, N Female Connector, \(TL-ANT2424B\)](#)

PoE Adapter:

- [Ubiquiti Poe-15 15VDC 0.8A Output Power over Ethernet Adapter](#)

An easy and rapid path to deployment is to purchase a complete ready-to-install mesh network kit. Here are two recommended options:

Complete Mesh Network Node (directional)

- [Ubiquiti BulletM2-Ti BM2-Ti Bullet M2HP Titanium + 2.4GHz 15dBi Grid Antenna](#)

Complete Mesh Network Node (Omni-directional)

- [Ubiquiti BulletM2-Ti BM2-Ti Bullet M2HP Titanium + 2.4GHz 6dBi Omni WiFi Antenna](#)

Additional Mesh Network Node Options

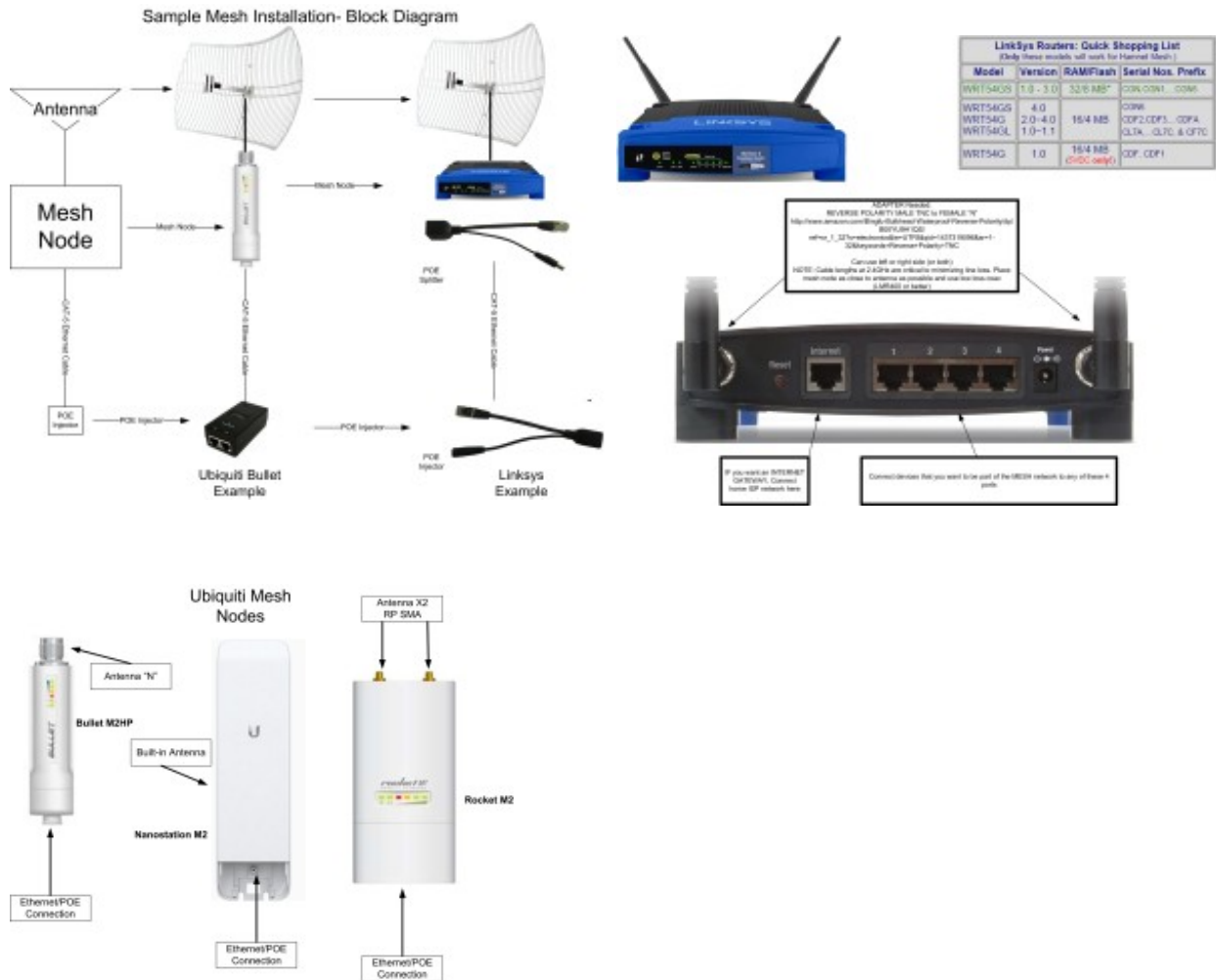
Many more radio options are available for experimenting and deployment. The following table from AREDN describes these options and some have navigation links to sources.

Compatibility and Source Table from AREDN.org

Current As of AREDN™ 3.16.1.0 (updated on 09/27/2016)				
Manufacturer/Model	Band			
	900Mhz	2.4Ghz	3Ghz	5.8Ghz
Ubiquiti Networks (www.ubnt.com)				
AirGrid (XM revision/old)		M2		M5
AirGrid (XW)				AG-HP-5Gxx
AirRouter		M2		
AirRouter HP		M2		
Bullet		M2		M5
Bullet Titanium		M2		M5
NanoBeam (XW)				NBE-M5-16/19
NanoBridge	M3	2G18	M3	8G22/4G28
NanoStation Loco (XM)	M3	M2		M5
NanoStation Loco (XW)				M5
NanoStation (XM)		M2	M3	M5
NanoStation (XW)				M5
PicoStation		M2		
PowerBeam ^(see note 3)		PBE-M2-400		PBE-M5-300/400
PowerBeam				PBE-M5-620
Rocket (XM)	M3	M2	M3	M5
Rocket (XW)				M5
Rocket Titanium		M2		M5
Rocket Titanium (XW)				M5
TP-Link				
CPE		CPE210		CPE510
-				
GREEN = "GO"	AREDN Supported			
RED="STOP"	No Compatibility or Support			
ORANGE="CAUTION"	High Confidence of compatibility. Included in current release, but not rigorously tested			
YELLOW="RESEARCHING"	Under research for future support consideration.			
GREY="N/A"	No such device			
**	In beta			

Hardware Examples

(click on the image for a larger view)



Mesh Networking Lingo

Access Point (AP)

A device that acts as the bridge between wireless clients and the wired network. Often abbreviated as AP.

Ad Hoc Mode

A peer to peer mode of networking using Wi-Fi networking but no access point. Ad Hoc networks can include more than two devices.

Beacon

A beacon is transmitted by an AP ten times per second, and advertises the existence of the AP on a particular channel or channels. It includes information needed by clients to associate and may include the ESSID, the supported channels and data rates, and whether it is open or requires authentication. In HAM Radio mesh networking, the owners ham radio callsign is also broadcast.

Mesh Networking Lingo - continued

Channel

A channel is the network path for wireless transmissions. Each Wi-Fi standard has numerous channels, each of which is a center frequency. There are 11 channels in 802.11b and g networks in the United States and Canada; 14 in most other countries. Channels have a bandwidth-the greater the bandwidth, the greater the potential throughput. Ham Mesh bandwidth can be set to 5 MHz, 10 MHz, and 20 MHz.

Diversity

Using multiple antennae to reduce interference and improve both transmission and reception of signals. LinkSys nodes and some Ubiquiti nodes use two antennae in diversity mode for better link quality. This is also referred to MIMO.

MIMO

Multiple Input/Multiple Output signaling that uses several transceivers and antennae to improve throughput and range of the wireless network. APs with more than one antenna uses MIMO.

Node

A node is a device that was originally a wireless router that has been converted to transfer data between other nodes in the mesh network. Nodes are self discovering, self configuring, self advertising and fault tolerant.






Peer to peer

In mesh networking, nodes are peer to peer devices. That is, if a node is within radio range of another node and they broadcast the same SSID, they will connect to each other.

SSID

The Service Set Identifier (SSID) is the name of the wireless network. It is contained in the beacons sent out by the nodes.

Mesh Networking Links

- [Antenna Basics](#) 
- [Parabolic Dish Antenna Theory](#) 
- [Offset Dish Antenna Theory](#) || [Offset Dish Antenna Specs](#) 
- [Patch Antenna Design](#) 
- [BroadBand-Hamnet](#)
- [Wasatch Meshers](#)
- [Taylorsville Hamnet](#)
- [Heart O' Texas Mesh](#)
- [Multipath and Diversity Mode](#) 
- [Link Path Profiler](#)
- [Amateur Radio IP Networks](#)
- [AE5CA](#)
- [Broadband-Hamnet](#)
- [AREDN](#)

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