

Your First AREDN[®] Mesh Node

9/06/2018

An “Amateur Radio Emergency Data Network” or AREDN[®] mesh node needs a radio, antenna, Power Over Ethernet (PoE) injector (or adapter), a long STP Ethernet Cat5e cable to reach your antenna/radio, and one or two short UTP Ethernet Cat5e jumpers. All these items are available on Amazon for around \$175 total. Use <https://smile.amazon.com/> to support the ARRL[®] or your favorite charity. Use the following links (but note that they may have expired) and then check for lower prices and/or Amazon Prime resellers.

1. Ubiquiti[®] “Bullet M2” transceiver, <https://smile.amazon.com/gp/product/B002SYS22E>, \$78. You don’t want the “Titanium” version unless you’re planning a permanent outdoor installation; it’s more expensive and has no indicator lights. The lights can be helpful diagnostic tools. This transceiver attaches *directly* to the antenna and produces up to 28dBm of gain.
2. A 2.4 GHz omnidirectional 12dBi (\$37) or 15dBi vertical antenna (suddenly very pricy for unknown reasons), <https://smile.amazon.com/gp/product/B003CFATO2>. The 12dBi antenna will give you a total of up to 40dBm gain, or 10W EIRP, and the 15dBi antenna is good for almost 20W EIRP. An “airGrid M2” dish, used for directional links, can provide up to 28dBm + 20dBi = 63W EIRP. However, it is not designed for frequencies below 2.412 GHz and we’ll be operating at 2.397 GHz (WiFi channel -2) so there could be an SWR issue. An omnidirectional vertical antenna is probably best in an ad hoc environment, *e.g.*, the Marine Corps Marathon, so others can route through your node automatically, if needed, without you knowing where they’re located and vice versa.
3. Ubiquiti[®] 24VDC, 24W (1 Amp) PoE injector, model **POE-24-24W**, <https://smile.amazon.com/gp/product/B004EFHN66>, \$20. Do not get model POE-24-24W-G. Yes, you want the 24VDC injector that produces 1.0 Amp *minimum* output. This PoE requires 120VAC (or 240VAC) input so you’ll need an inverter or generator in the field. There are multi-port switches that have built-in PoE which could be handy for connecting multiple devices but this will get you going at minimum cost. An alternative for a field environment is a 12VDC to 24VDC converter that puts out at least 24W like <https://smile.amazon.com/dp/product/B00PZ022XS/> (\$57); just add battery and solar panel!
4. Your “feedline” (there’s no coax!) is *shielded* twisted pair (STP) Cat5e straight cable, <https://smile.amazon.com/gp/product/B00A6ULZG2>. Fifty feet is \$30 (other lengths are available). RF at 2.4 GHz is downconverted to a digital signal in the transceiver to minimize loss. You might be able to get away with unshielded (UTP) cable, but in any kind of RF environment STP is good insurance. This cable will go from the PoE injector’s “POE” port to the Bullet M2 transceiver to transfer data to/from your laptop and to supply 24VDC power.
5. A short, straight (not the “crossover” type) UTP Cat5e jumper to get from the PoE injector’s “LAN” port to your laptop. Do you really need to order one of these? Surely you have about ten of these stashed away somewhere; they came with every WiFi router you ever bought. A second short jumper is handy for flashing your node through the “POE” port, but at some point you do need to test the long STP cable. Once your mesh node is operational, you might not need a laptop connected to the “LAN” port on the PoE; your node could simply be a relay somewhere to provide connectivity for other AREDN[®] mesh nodes.

- You'll also need appropriate PVC pieces (and PVC cement) to fashion a mounting bracket for the antenna. Find what you need at Home Depot or Lowe's. A piece of 1.5" i.d. Schedule 40 PVC pipe fits nicely on a 4' aluminum military mast section. Then use a couple of reducers and 1" i.d. pipe to mount your antenna. A weatherproof SockitboX for \$20 might be handy for keeping the PoE dry, see <https://smile.amazon.com/gp/product/B006EUHS96>.

Firmware is at the "Software-Download" drop-down at <https://www.arednmesh.org> (a recent URL change). Download and run the "U-Boot Test" program *first* to see if your device needs to be rolled back (mine did) to an earlier Ubiquiti® OEM firmware version *before* loading the AREDN® firmware available at <http://downloads.arednmesh.org/firmware/ubnt/html/stable.html>.

Study the flashing instructions carefully so you don't accidentally brick your new transceiver (the latest firmware v3.16.2.0 is supposed to greatly reduce that probability). A naming convention for mesh nodes is "callsign-equipment-antenna-serial number" so my node is named "N8IK-BM2-OMNI-100". Other nodes then get an idea of what capability they can expect when routing through me. It's *critical* that you move your channel to **-2** (2.397 GHz) and set the channel width to **10 MHz** so that you're not overlapping WiFi channel +1 *and* still staying in the Part 97 area of the 2.4 GHz band which starts at 2.390 GHz. All the other 2.4 GHz mesh nodes will also be on WiFi channel **-2**.¹ If you're updating an earlier AREDN firmware simply upload the sysupgrade binary; all your current settings should be preserved. When you're connected to the mesh, the Bullet M2 will display steady *red* on the "lowest signal strength" LED. Also, the "activity" LED will blink green, and the "power" LED will be steady green. The "highest signal strength" LED is also steady green when the device successfully boots.

Create a browser bookmark called <http://localnode.local.mesh:8080> to get to your node easily. You *might* need to use Firefox since current versions of Chrome can throw warnings when not using secure connections (https://). Also upload the MeshChat 1.0 package available at <http://www.trevorsbench.com/meshchat-messaging-for-mesh-networks/#installing> (a MeshChat update is pending). Now enable it as an "Advertised Service" with a Zone Name of "MeshChat" on TCP port 8080 as shown below. You can only chat with other devices in the *same* Zone.

Name	Link	URL
MeshChat	<input checked="" type="checkbox"/> http	:// N8IK-BM2-OMNI-100 :8080 / meshchat Del
	<input type="checkbox"/>	:// N8IK-BM2-OMNI-100 : / Add

73, Ian N8IK

¹ The 5cm AREDN mesh nodes will be at WiFi channel 180 centered on 5.905 GHz with a **20 MHz** bandwidth. The Part 97 5cm band at 5.650-5.925 GHz is shared with other licensed and unlicensed services in ITU Region 2.