



The Free Network Foundation



Who am I?

- Co founder and CTO of FNF
- 10 years of systems/storage/network/security engineering



History of the FNF

- Founded in 2011
- Built towers for OccupyAustin/Occupy Wall ST
- Awarded 10k innovation award at ContactCON
- Raised 3k more at IndieGoGo Campaign
- Covered in Ars Technica, BetaBeat, Time, CNN, FastCompany



Who/what is the FNF?

- Who is behind the FNF?
- Where is funding coming from?
- What is the FNF?
 - Vision
- What is the FNF doing to realize that vision?



What are the components to the FreeNetwork?

- FreedomBox/FreedomNode
- FreedomTower/FreedomTunnel
- FreedomLink/FreedomWAN



FreedomBox

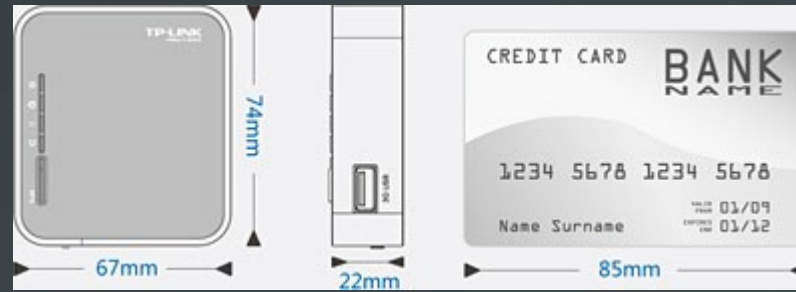
- Developed by the FreedomBox Foundation
- "Local cloud"



FreedomNode

- Allow any system to participate in the FreeNetwork
- Low priced (less then \$50.00)
- OpenWRT based
- Credit card sized hardware





3G Router Mode

Travel Router Mode (AP Mode)

WISP Client Router Mode

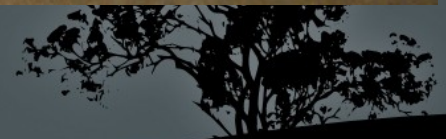
- 3G
- WISP
- AP

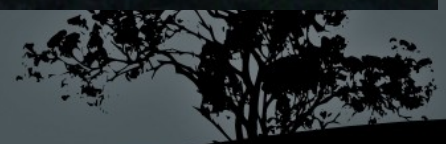
A photograph of the TP-LINK travel router device, shown from a three-quarter perspective. The device is white with a grey top panel. It features a green antenna on the top, a WAN/LAN port, a power port, and a USB port on the front. The background consists of concentric blue and green circles, suggesting a signal or network range.

FreedomTower

- Provide localized networks
- \$2500.00
 - Solar powered
 - 100.00 per month back haul cost (50mbps down/10mbps up)
 - ½ mile radius confirmed coverage
 - Several hundred user capacity







FreedomTower

Instructions for Configuration and Assembly

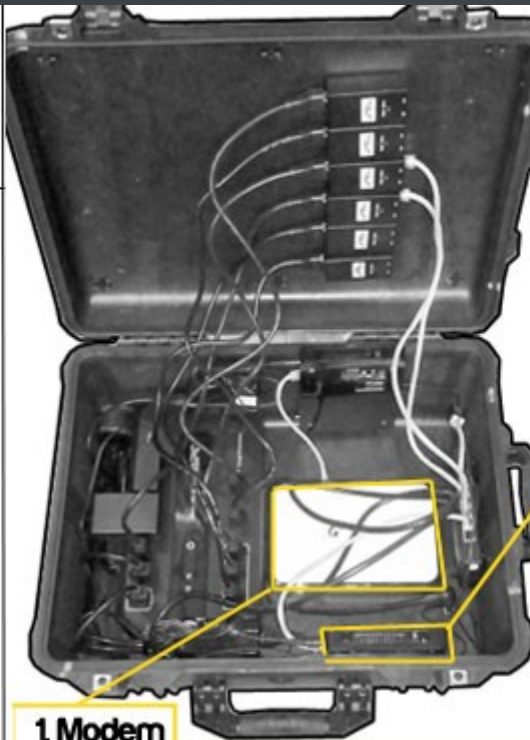
Bill of Materials:

- * A quiet power generator such as the Honda EU1000i (\$800)
- * A UPS such as the APC BE750G (\$100)
<http://amzn.to/dlobOm>
- * A nettop such as the Lenovo IdeaCentre (\$300)
<http://amzn.to/qs1UV>
- * An 8-port network switch (\$15)
- * Three USB->Ethernet adapters (\$30 x3)
- * Two 4G modems such as the Clear Series M (\$85.00 for each modem, \$45.00 for first month for each, \$30.00 activation fee total (\$320.00 total) [Procure from Clear store so no contract required]
- * Three Ubiquiti NSM22s (\$80 x3 = \$240)
<http://bit.ly/oUKomV>
- * Three Ubiquiti NSM5 Locos (\$50 x3 = \$150)
<http://bit.ly/oE7QF> or <http://bit.ly/nRk9FB>
- * Enclosure for UPS, computer, router, modems, and radio power injectors (\$115)
<http://www.letsurepro.com/Prod/PL1510NF.htm?&&>
- * EMT Conduit mast (9') \$12.00
- * Two ten-inch sections of 2x10" board \$10
- * Five power splitters
- * 50' red CAT5
- * 25' black CAT5
- * Velcro, zip ties (\$20)

Needed supplies:

- * Drill
- * 1/2" bit
- * RJ45 (ethernet) Crimper
- * Label maker
- * 1 Hour Epoxy

The heart of the FreedomTower is a nettop computer running pfsense, a variant of openbsd, that makes it easy to do network administration. We used the Lenovo Q150 in our build, but ran into problems when we discovered that the south bridge of the Q150's chipset is not supported by openBSD. You may wish to proceed as we have, by working around the problem using USB to Ethernet adapters, or you may wish to explore alternative nettop hardware. If you do the latter, please let us know how it goes.



1. Modem

We recommend that you procure the wimax modems for your Tower through a corporate account with Clear. There is no price difference, and it will give you access to second level support, should the need arise.

To configure your machine to look for an address via DHCP on your wired interface. Plug directly into each modem in turn.

Access the web administration interface of the modem by navigating to 192.168.15.1 - the password is set by default to CLEAR123, but may still be the OEM default of motorola. Once you're in, you should change the password, and record the WAN IP address of the modem.

If you're using two or more modems it will be necessary to change the DHCP settings so that each modem has a different address. Leave one modem as 192.168.15.1, and number additional modems by iterating the third octet: 192.168.16.1, 192.168.17.1, etc.

2. Server

Hook up your nettop to a monitor and keyboard. You will need a live image of pfsense. You should use the stable release of version 2. Before you proceed, connect the box to at any WAN connections, and to the network switch. Install pfsense on the box, configuring it to accept an address via DHCP on all WAN connections, and to serve addresses via DHCP to the LAN.

Once this is done, you'll want to reconfigure the LAN settings to expand the subnet. We recommend using 192.168.10.0 through 192.168.254.254. Then configure DHCP to hand out that range of addresses.

The next step is to set up load balancing against the WAN connections. This is done by creating a gateway group, and making a firewall rule to route all lan traffic to that gateway.



The Free Network Foundation is a nonprofit organization that builds tools and advocates for communities to become their own cooperatively run, locally owned internet service providers. Learn more about how to get involved at www.freenetworkfoundation.org

3. Radios

Flash the devices with the proper firmware. You'll need to do it for all six radios. We are using a version of Ubiquiti's AirOS that's been patched to support OLSR routing. You'll also need to have TFTP installed on your machine. It is widely available via your favorite package manager. The firmware can be found here: [LINK OR SHORTER URL](#).

Once you've got the firmware on your machine, you'll need to put it on the radios. First, you'll configure your machine to have a static address in the 192.168.1x subnet. Any address besides 192.168.120 will work. Next, take an unpowered radio, and depress the reset button. Continue to hold the reset button, and plug the radio in. Continue holding the reset button until the lights on the radio flash 1-3, 2-4, 1-3, 2-4. Release the reset button.

The radio is now in TFTP flash mode. You'll want to ping 192.168.120 to make sure that you've got a connection to the radio. Navigate to the directory where you've stored the firmware binary, and flash it to the radio using the following commands, there is not tab-to-finish in TFTP, so you'll have to type everything out: [LINK OR SHORT URL](#).

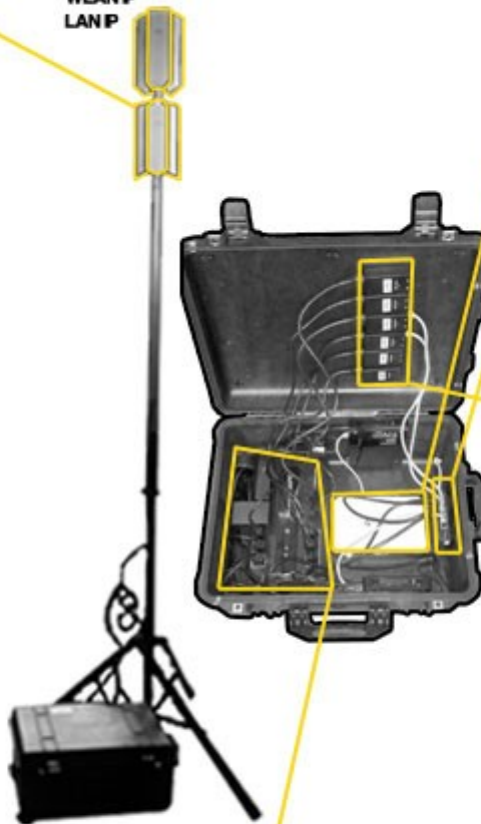
When the transfer has finished, you can quit TFTP and reboot. Once back online, navigate to 192.168.120 in your browser. You should be presented with the ubiquiti web interface. The default username and password are ubntubnt. We recommend changing the admin user name, and the hostname. Our radios are named FNF2-0, FNF2-1, FNF2-2, and FNF5-0, FNF5-1, and FNF5-2.

Once you've changed these settings, you should also ssh into the machine in order to change the password, using the command passwd.

All radios should be set to bridge mode, and configured to obtain an address via DHCP. The 2-0 and 5-0 radios will be configured as access points, and the 2-1, 2-2, 5-1, and 5-2 radios will be configured as stations. You should also make sure that all radios are set to a 20MHz channel width, and have AirMax turned off.

On the 2-0 and 5-0 machines, you'll set SSIDs for the networks. Ours are called 'The Free Network' and 'The Free Network 5Ghz'. Once you've set the SSIDs on the Access Points, you'll lock the station radios to the MAC address of their respective APs.

Label the radios with
Role (mesh node 5/2.4ghz node (x),
mesh node 5/2.4ghz gateway)
WLAN IP
LAN IP



4. Assembly

Step One: Enclosure

In order to keep the power supply stable, it will be necessary to fill the bottom gap (between the wheel wells of the case) with the boards. Epoxy the two boards together. Then epoxy the boards to the bottom of the case, being careful to keep the boards flush with the bottom. Once cured, attach the power supply on top using a couple strips of Velcro.

Be careful to affix the velcro such that the battery compartment of the UPS can open. The power supply cord exits at the bottom right corner of the case. The case can't shut with a power cord inbetween the base and the lid, so use a knife to carve away the closure lip, without cutting through the weather seal. You should be able to close the case around the power cord, and maintain a water-tight closure.

Next, you'll mount the modems, one (or more) on either side of the case. Use velcro. Be generous. Mount the nettop in the same way. We mounted ours so that the fan vent is up, which puts the power button against the back wall of the case. This helps avoid accidental power cycles.

Velcro the switch, but this time, mount it to the top of the case. Depending on what model of switch you have, you may want to remove the rubber feet before applying the velcro, as the feet tend to slip out of their fillings. Next task is to mount the power over ethernet injectors for the radios to the lid. The ports should face the top.

Now you're ready to plug the five power splitters into the five outlets labelled 'sure protections and battery backup'. This is so that the entire rig can run off of batteries. We use the three splitters on the left for the power injectors, and the two on the right for the modems, router, and switch.

Step Two: Mast

Drill two holes 1ft and 2ft down from the top of the mast. The top hole will be for the ethernet cables going to the NSM2s, and the bottom will be for the NSM5Ls.

5 inches from the bottom, drill two 1/2" holes in a horizontal line. Now run 11 sections of uncrimped ethernet cable through the mast. Cables that enter through the same hole should exit through the same hole.

Use two red cables and one black per hole. The black cable will carry power and data. The red cables will carry only power. You might use string, and a bent wire hanger to make the process go quicker. Once the cables are through, crimp both ends.

Zip tie the radios to the mast, and plug in the cables. Mount the mast on the tripod, and run the cables down around the tripod. You'll need to do the same for the two ethernet bundles as you did for the power cord.

Plug everything in, and you've got yourself a FreedomTower!

FreedomTunnel

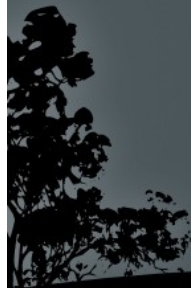
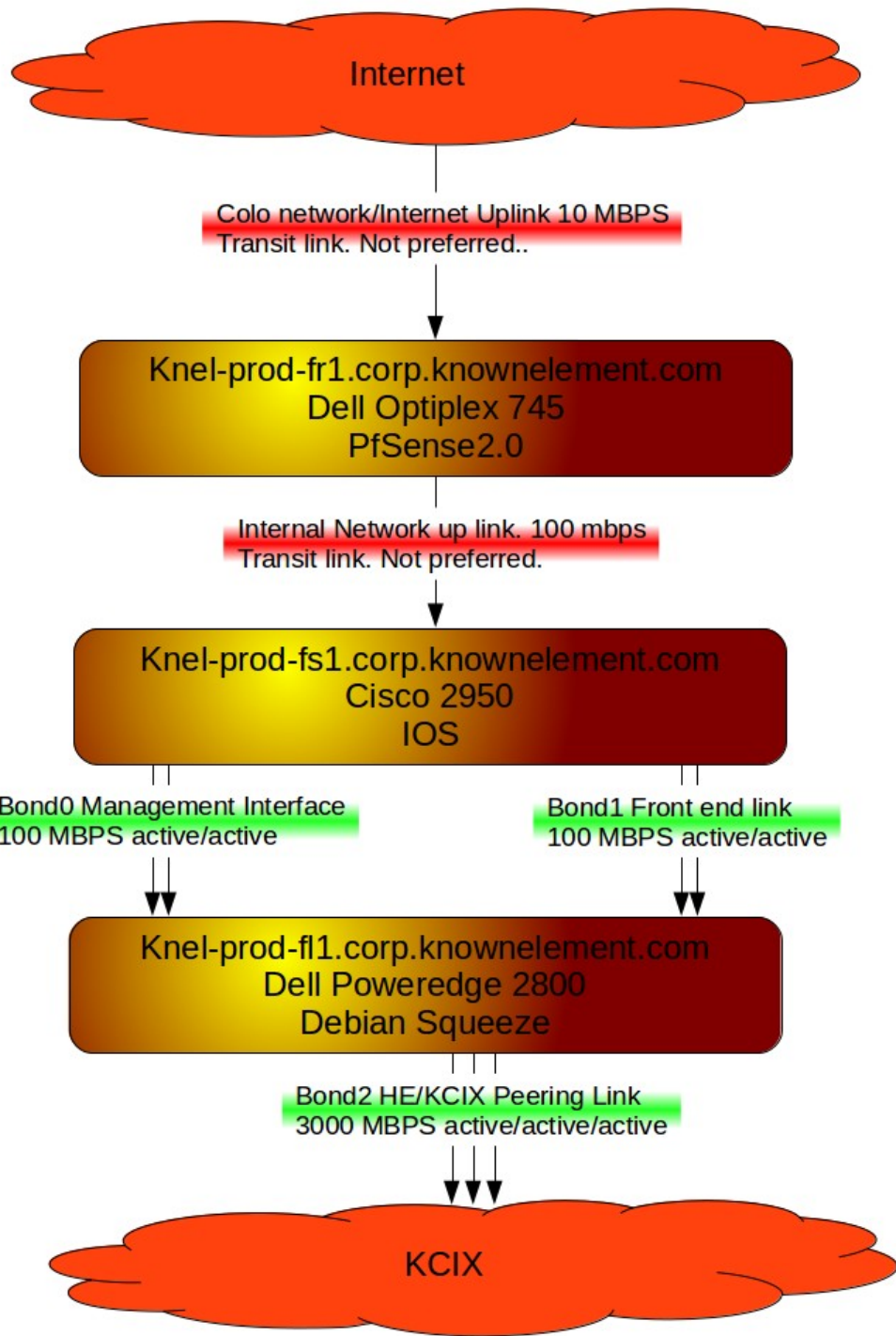
- Overlay network
- Single Sign On
- One time passwords



FreedomLink

- PfSense based
- BGP/Babel routing protocols
- \$2500.00





FreedomWAN (in (near) space)

- Fiber/Satellite just isn't cool enough



FreedomNOC

- Global NOC
 - Primary in KC
 - Backup in Dallas
- Ticketing (end user support, circuit turn up etc)
- Monitoring (towers, paths
 - **NEVER MONITOR TRAFFIC**
- Security (anti virus/spam)
- Backups
- IP management
- asset tracking
- technician dispatch
- GIS



FNF the movie



How do I help as a technoligist?

- Go to <http://chili.freenetworkfoundation.org> and create an account
- Introduce yourself to builders@freenetworkfoundation.org



How do I help as an operator (how do I build this in my neighborhood?)

- Community meetings
- FreedomTower instructions



How do I help as an end user?

- Spread the word



How much does this cost?

- It depends?
- 1 BILLION dollars?
- 5 cities, 1 year, 150k (that includes capex)
- Contribute donations at freenetworkfoundation.org

