
Pi- Star Hotspots

- A HAM'S PERSONAL REPEATER
- JB EDMONDS N4NQY

Basics: What is a Hotspot

A Hotspot is a Personal Repeater that connects to the Internet

The typical Hotspot (or Repeater) consists of:

- A Raspberry Pi (Pi-Zero-W, Pi 2, Pi 3 or Pi 4)
- A low power Transceiver Board (Pi-Hat), 5-20mw on UHF, or VHF (or a Repeater Controller Board in the case of a High Powered Repeater)
- Antenna(s)
- An Operating System for the Raspberry Pi (Linux)
- A collection of Software Packages (Most typically Pi-Star) that:
 - Allows Control of the Transceiver
 - Decodes and Encodes Signals into and out of it
 - Connects the Hotspot to the Internet

\$25.88 eBay MMDVM Hotspot Kit (No Pi)



Examples of Available Hotspots





Definitions

All of the Following are Interchangeable in this Presentation, and in practice

- Repeater
- Reflector
- Talkgroup
- Room



Purpose of a Hotspot

Allow Hams to Connect to other Hams across town or across the World from a Hand-held or Mobile/Stationary Radio

Provide a 24 Hour-a-Day Super-Repeater System where you have total control your Repeater Node

Take advantage of the Internet to enhance Ham Radio

Why are Hotspots on VHF or UHF? That's where the bandwidth is to use these devices and where there is commercial equipment available (Radios).

Use Cases

First, a Perspective

- BrandMeister alone, at any given time has over 6000 repeaters connected, over 17,000 Hotspots connected, to its over 1600 Talkgroups. Many of these Talkgroups cater to Special Interests, like ARES, Satellite, Skywarn, Astronomy, Greek Americans, Trucking and RV Hams, etc.

Technician Class Licensees have VHF and UHF privileges and can contact Hams anywhere in the world with modest equipment without tying up a Repeater

Hams who find themselves in an HOA situation (or living with relatives) can continue to enjoy the hobby with modest equipment (an HT) and no outdoor antennas.

The abundance of Digital Ham Networks provide a way to have instantaneous Region-Wide Nets, accessible to any Ham near a Digital Repeater, or who has a Hotspot, with Internet Access for EMCOMM, SkyWarn, Search and Rescue, etc.



Ham Radio Digital Networks

DMR Oriented HUBS

- Brandmeister
- TGIF
- DMR-MARC
- ChicagoLand
- PRN (NC Statewide network)

D-Star

- DCS, REF, XRF and XLX Reflectors

Fusion Oriented

- YSF
- FCS
- Wires-X (Not all Rooms easily accessible with Hotspot)

P25 and NXDN Oriented

- P25 and NXDN have a loosely organized network of Talkgroups/Reflectors

Ham Radio Networks

AllStar

- AllStarLink HUB

Repeater Oriented Networks (more Localized Examples)

- DMRVA (Va. Statewide Repeater Network of 15 DMR Repeaters)
 - now includes Hospital Emergency Amateur Radio System (HEARS) Network of 8 VA Repeaters and 15 NC Repeaters)
 - Some of the DMR repeaters can be accessed via Fusion and P25
- Alabama Link
 - A HUB that ties together RF Repeaters (Analog, D-Star, DMR, Fusion, P25, AllStar) and Hotspots
- SkyHubLink
 - Over 63 Interconnected Repeaters in Colorado and Southern Wyoming
 - Accessible by Hotspot through Allstar, DMR, IRLP, Echolink, M-17 and VOIP Telephone (HamShack Hotline)

Before Hotspots

You could Link Repeaters to each other with:

- RF
- IRLP
- Echolink
- AllStar

These were and are, primarily Analog-based modes and Analog networks, many times linked via RF and Telephone lines

Not every repeater had the capabilities to Link

The Repeater Owner had complete control (as they should)

One Ham conversation could tie up a regional repeater for quite a while

The Origin of the Hotspot

The first Hotspots were the D-Star Dongles. Still used and they work.

Jonathan Naylor, G4KLX is the Father of Modern Day Hotspots

Jonathan was given a D-Star radio in 2009 and then wrote an Open Source D-Star Repeater (i.e. Digital Sound Card Modem) as an alternative to ICOM's Proprietary Repeaters for D-Star

From 2009 until 2014 Jonathan concentrated on D-Star, D-Plus, D-Extra and various Reflector software (he is also credited with inventing Reflectors)

In 2014, at the Dayton Hamfest, Connect Systems gave Jonathan a DMR radio to play with

In 2015 DMR was added, as a mode, to the D-Star Modem software and the name changed to MMDVM (Multi-Mode Digital Voice Modem)

Around 2015 the "Pi-Hat" Transceiver became available from a number of Homebrew developers (DVMega, KI6ZUM (Zumspot) and the DF2ET(MMDVM_HS)). These allowed a Ham to create a Personal, Simplex Repeater using G4KLX's MMDVM software.



The Origin of the Hotspot

In 2016 Fusion support was added and YSF Reflectors created

In 2017, after a gift of a P25 radio, P25 was added to the Software

In 2018 NXDN was added to the MMDVM Software and the software development officially moved to Linux (i.e. a Raspberry Pi) from Arduino because the added modes needed the horsepower.

At this point, early adopters had to gather all the software and create a working Linux system on the Raspberry Pi. Everyone was on their own version of a Hotspot, and initially there were only a handful of us trying to do this. It was very difficult to get all the pieces working. A lot of sharing of Pi images was going on.

Today MMDVM supports DMR, Fusion, D-Star, NXDN, P25, M17, FM and POCSAG



Brandmeister

In 2017-2018 the German Hams created [Brandmeister](#) (a DMR Network) using G4KLX's Homebrew MMDVM Protocol to transfer Voice and Data.

BrandMeister created a huge market for Hotspots with the help of cheap Chinese DMR radios (TYT MD-380, etc.)

Problem: You had to be a very knowledgeable Linux Guru to get a Hotspot up and running in 2015-2017

Because of BrandMeister, many Hams wanted a Hotspot but only about 10% of those who wanted one had the “know how” to actually create one and keep it working. That opened the door for Pi-Star.



Enter Pi-Star

In England, Andy Taylor, MW0MWZ was developing a “Wrapper” for the MMDVM software in the 2016-2017 timeframe

A “Wrapper” is essentially a pre-packaged collection of software that provides a User Interface, a Dashboard and Configuration program for the software.

Pi-Star itself provides nothing other than the, basic programs and a User Interface to MMDVM Software developed by G4KLX.

Andy made the decision to “Lock Down” Pi-Star and make it a “Hotspot for Dummies”. It is distributed as a Raspberry Pi image, and the image is read only. But configurable via the included Dashboard.

Pi-Star updates itself every night as long as the Hotspot is connected to the Internet.

Pi-Star can be used on both as Hotspot and as a Homebrew Repeater controller.



Pi-Star Hotspots

Turnkey Pi-Star Hotspots can be purchased from eBay, Ham Radio Outlet, Amazon and a number of other resellers on-line.

There are over 20,000 Pi-Star Hotspots that are Registered on BrandMeister

They come in all sizes and shapes

They vary in price from \$40 to \$240

Almost all work exactly the same! **Pi-Star is Pi-Star!** Hardware may vary....

An OpenSpot is a unique Hardware Hotspot that does not use Pi-Star but does use some of G4KLX's software. It is very proprietary.

There is a Pi-Star spinoff called MPSPD. Stable, but not quite ready for "Prime Time".
Demo Later!

Get Pi-Star Going

A Hotspot may come with Pi-Star but you can always download the latest from **pistar.uk** or update directly from the Pi-Star Dashboard later. I suggest you download the Beta Version 4 of Pi-Star

You setup Pi-Star with you Browser. Enter either the IP address or “pi-star.local”

Power the Hotspot on and you will need to know the following in order to do the initial configuration:

- Your Call
- The mode(s) you are going to use with the Hotspot. (What Radio do you have?)
- Your DMR ID (even if you are not going to work DMR) – RadioID.net
- The type of modem board in your Hotspot (MMDVM_HS is the most common)
- A simplex frequency you are going to use. 99% of Hotspots are on 440, so stay away from the Satellite portion of the band (435-438, try a repeater output frequency not used in this area).
- If you are going to do DMR, your BrandMeister Master should be set to “**BM_3102_United States**” and you need to setup a BrandMeister account before the Hotspot can use their network (www.brandmeister.network).
- There are configuration options such as location, etc. you can enter at your leisure.

Initial Configuration Issues

The most common Pi-Star Issue is DMR Radio Transmit and Receive Frequency. Either Pi-Star does not see the radio, or the Bit Error Rate (BER) is High (RED)

TIP: Every radio is a little off frequency. To fix the program,

- Open a Browser Tab to the Pi-Star Dashboard
- Open another Browser Tab and Go to the Configuration Menu
- Select Expert Menu
- Select the MMDVMHost Menu Item
- Find “TXOffset and RXOffset” and write down the initial setting
- Adjust these to offsets by 200 cycles (up or down) until the Pi-Star Dashboard **BER** reads in the GREEN when you transmit. Sometimes the settings may be as low as -1800 or +1800 (normally around 500)
- There is also a MMDVMCal tool to find the offset.
- The two settings are usually set to the same number, and can be different for every radio you use



Hotspot (Live Demo)

Configuration Page ([DMR](#)) ([YSF](#)) ([D-Star](#))

Admin Dashboard ([DMR](#)) ([YSF](#)) ([D-Star](#))

Connect D-Star Hotspot to XLX497

Connect Fusion Hotspot to XLX497

[INSTRUCTIONS](#)

Connect DMR Hotspot to XLX497



Questions ???



Multi-Mode Example

AlabamaLink

- BrandMeister [TG 31010](#)
- TGIF DMR Network TG 31010
- C4FM YSF [Room 31010](#)
- C4FM FCS Room FCS003
- C4FM Wires-X Room 28933
- D-Star Reflector [REF090B](#), [XLX334B](#), XLX205B, XLX256B
- NXDN [TG 31010](#)
- P25 [TG 31010](#)
- Allstar Node 44110
- Echolink Node 358391