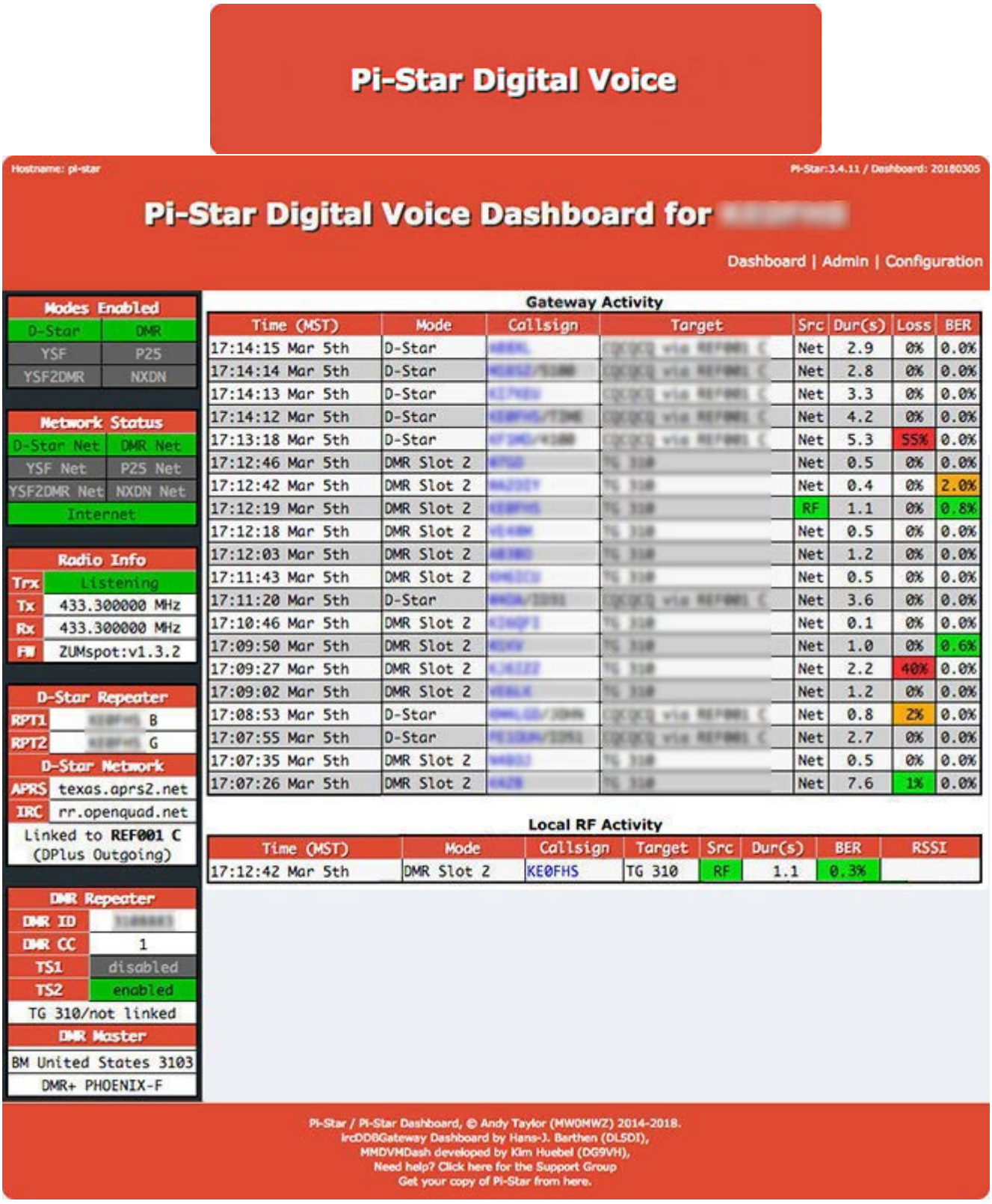

Pi-Star can be what ever you want it to be, from a simple single mode hotsport running simplex providing you with access to the increasing number of Digital Voice networks, up to a public duplex multimode repeater!

Disclaimer: These are my personal notes and opinions based on my experience using Pi-Star, as well as by learning from what others are sharing. I'm not affiliated with the Pi-Star project,

except as an appreciative user. I've tried to be accurate, but there may be things I'm mistaken about; please let me know if you come across anything needing correction.

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1) Learning about Pi-Star

Pi-Star is relatively easy to set up as a personal hotspot, so don't be put off by the length of this article. Even though I was able to get Pi-Star working quickly, I wanted to understand more about its rich set of features and configuration options, so I have continued to research and write this article as a personal reference based on what I'm learning.

1a) To get quickly up and running

Just follow the easy steps outlined in the excellent Pi-Star initial setup video by Craig, W1MSG.

1b) Other good resources for learning about Pi-Star

- Pi-Star website
- Pi-Star wiki
- Pi-Star Users Support Group – What a great community of helpful users! I've spent a ton of time browsing answers there, and numerous times throughout this article I quote answers provided by Andy Taylor and others in the support group.
- All of the many great videos by Craig, W1MSG.
- DMR, Fusion, MMDVM and other DV NEWS, by Ron, VE1AIC. Ron shares a wealth of info on his blog, including coverage of Pi-Star.

1c) Be sure to set up your D-STAR radio properly!

If you're going to be using a hotspot for D-STAR, it's really important that you set up your radio correctly. For example, you must set up RPT1, RPT2, and a zero offset (either +/–0.000). Sometimes, this is referred to as Duplex mode; other times, as D-STAR Repeater (DR) mode.

Craig, W1MSG, has a good video about this: D-STAR Radio Primer for using Pi-Star. For more info about setting up the D-STAR radio I use with my hotspots, see Programming the Kenwood TH-D74A for D-STAR.

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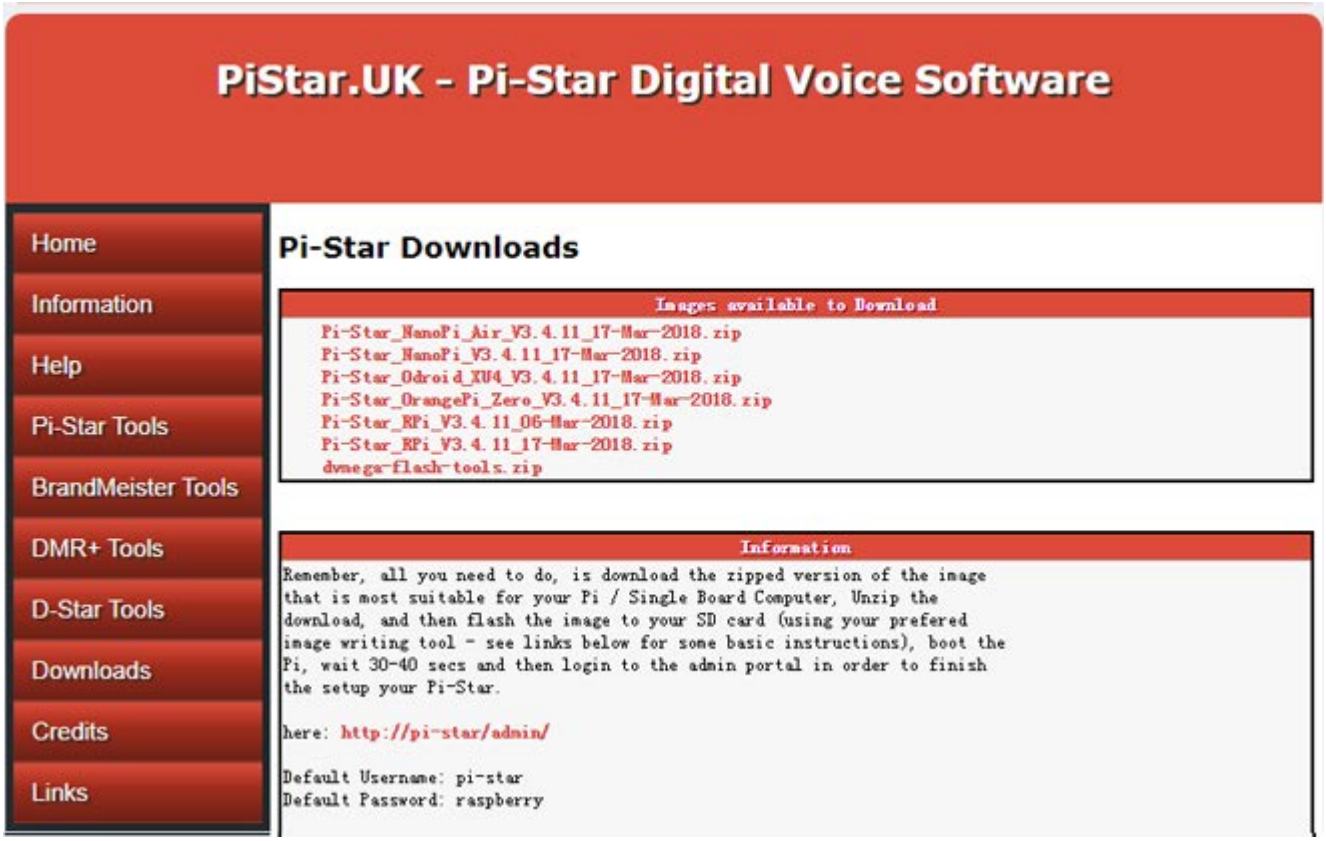
2) Downloading Pi-Star

First things first: grab the latest Pi-Star image designed for your hotspot from Pi-Star Downloads.

At this time, I'm using Pi-Star with a ZUMspot mounted on a Raspberry Pi. Initially, I used it with a DVMEGA-DUAL mounted on a Raspberry Pi. So I use the RPi image.



In addition to the RPi image, there are Pi-Star images available for FriendlyARM NanoPi and NanoPi Air, Hardkernel ODROID, and Xunlong Software Orange Pi.

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3) Flashing Pi-Star

Unzip the Pi-Star image zip file you downloaded, and then flash the image file itself (the one with the `.img` extension) to a microSD card. I did this using, for the first time, Etcher SD Card Imager [1].

[1] Etcher SD Card Imager is an open source project by resin.io available for Mac, Linux, and Windows with a modern design that is totally easy to use. Thanks resin.io team for bringing SD card imaging into the 21st century!

3a) Preparing to connect to WiFi

Using the AutoAP (Auto Access Point) method

If you're using Pi-Star 3.4.11 or later and a Raspberry Pi 3 or Zero W, you don't have to do anything to prepare to connect to WiFi.

Basically, if Pi-Star can't connect to a known WiFi network within two minutes of being powered on, it activates its own network access point that you'll use to connect to Pi-Star in order to configure WiFi.

For more info, watch the video Pi-Star WiFi AutoAP by Craig W1MSG.

Manually preparing to connect to WiFi

If you can't use AutoAP of you just like to do things the hard way, after you have finished flashing the image to a microSD card, you can manually add your initial WiFi settings to the root folder so they'll auto-install on first boot up:

1. Create a wpa_supplicant.conf file with your WiFi setting(s):
    - Use the Pi-Star WiFi Builder tool on the Pi-Star website.
    - Alternatively, roll your own: Manually adding WiFi settings to RPi.
2. Copy the wpa_supplicant.conf file to the microSD card's Boot volume. *Note:* The first time you boot Pi-Star, that file is moved automatically to its permanent location (/etc/wpa_supplicant/), so don't be surprised if you don't see it the next time you look at the root folder.

3b) Preparing your hotspot for boot up

Insert the microSD card into your hotspot.

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4) Booting up Pi-Star

These steps differ depending on your circumstances. Do all the steps that apply to your current circumstance, in this order:

a. For all boot ups
b. If using AutoAP and setting up a new WiFi connection
c. For all boot ups
d. If starting Pi-Star for the first time
e. If using AutoAP and setting up a new WiFi connection
f. If starting Pi-Star for the first time

a) For all boot-ups

1. Power on your hotspot.
2. Wait for Pi-Star to boot up. Normally, Pi-Star takes a minute or so to boot up (a bit longer when using a RPi Zero W)

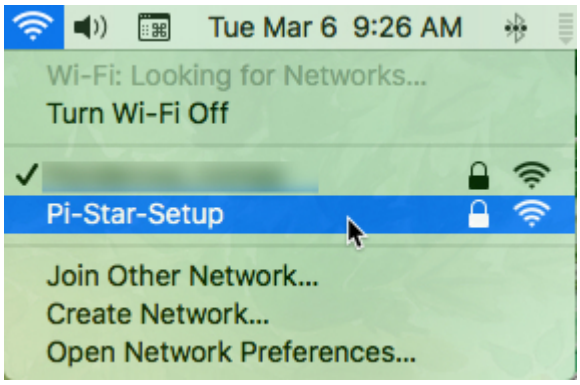
   Note: If you have a display attached to your hotspot, optionally upi can watch the Linux-based startup process until it displays a login prompt; however, you can't access the dashboard directly via the hotspot, so don't log in there.

b) If using AutoAP and setting up a new WiFi connection

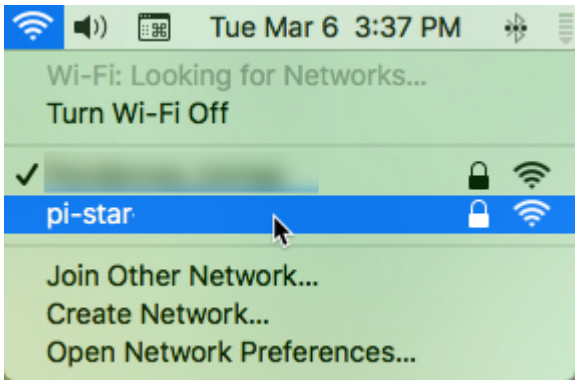
Perform this step when you start Pi-Star for the first time or when you need to connect to a new WiFi network.

1. Let another minute pass so that Pi-Star can activate its own AutoAP access point.
2. On another Windows, Mac, or Linux-based computer that has WiFi enabled, look in the WiFi settings to find the Pi-Star access point, and select it to connect to it:

- If you're starting Pi-Star for the first time, it will be named "Pi-Star-Setup."



- If this isn't the first time, but you need to connect to a new WiFi network, it will be named using the hostname of your hotspot, by default, "pi-star" (or whatever you've changed the hostname to in the General Configuration section).



3. Enter the Pi-Star AutoAP password: raspberry.

c) For all boot ups

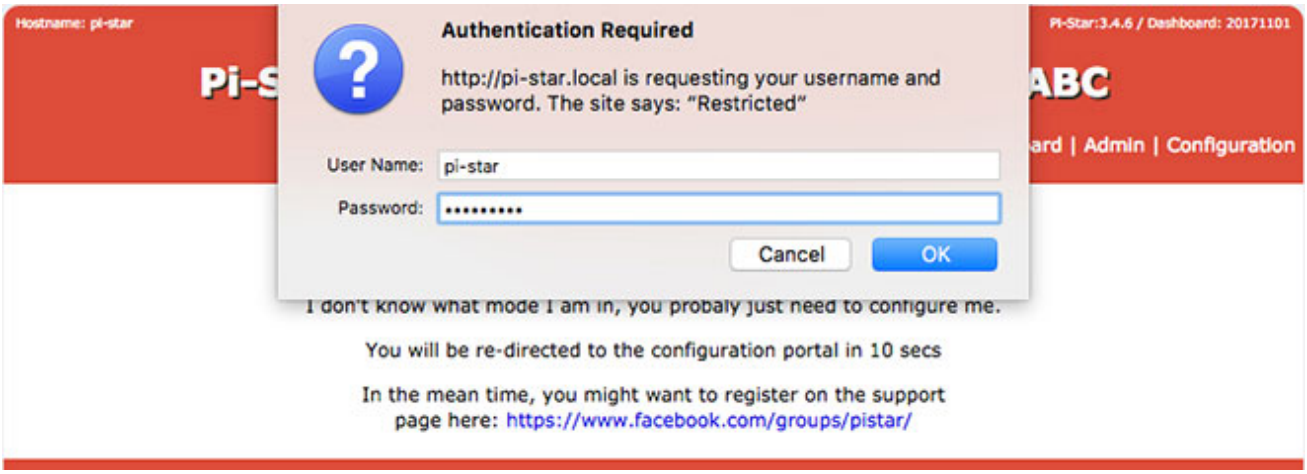
1. On another Windows, Mac, or Linux-based computer connected to the same network, open a browser window.

2. Navigate to: http://pi-star.local/
   Note: That URL will work on all computers, but on Windows, you can get by with just: http://pi-star/

d) If starting Pi-Star for the first time

1. You'll be greeted by a "No Mode Defined" screen. This is normal because you haven't yet defined the mode you want to use (like D-STAR or DMR).

2. At this point, you can either click the Configuration link or wait 10 seconds to be redirected automatically.
3. The Configuration view requires authentication: the factory default user name is pi-star and the password is raspberry.

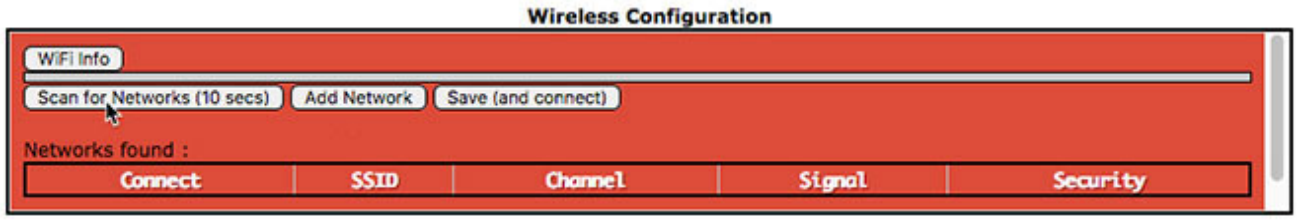


   Note: An important security step that should be part of your initial configuration of Pi-Star is changing that default password, which is discussed below: 5k) Remote Access Password.

e) If using AutoAP and setting up a new WiFi connection

Perform this step when you start Pi-Star for the first time or when you need to connect to a new WiFi network.

1. In the Configuration View, find the Wireless Configuration section.
2. Click Scan for Networks (takes about 10 seconds), find the one you want, and click Connect.



   Alternatively, for example, if the scan doesn't find the network you want to use, you can add a network manually. For more info, see 5j) Wireless Configuration.

3. Reboot Pi-Star to disable AutoAP and initiate the connection to the WiFi network you just added.
4. While Pi-Star is rebooting, reconnect your computer to its usual WiFi connection.
5. Give Pi-Star time to finish rebooting, and then open the dashboard by navigating once again to: http://pi-star.local/

f) If starting Pi-Star for the first time

Continue performing initial Pi-Star configuration, as follows.

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5) Performing initial Pi-Star configuration

After authentication, the Configuration view is displayed. The first sets of options cover the Control Software, MMDVMHost Configuration (if you have MMDVMHost enabled), and General Configuration.

5a) Control Software

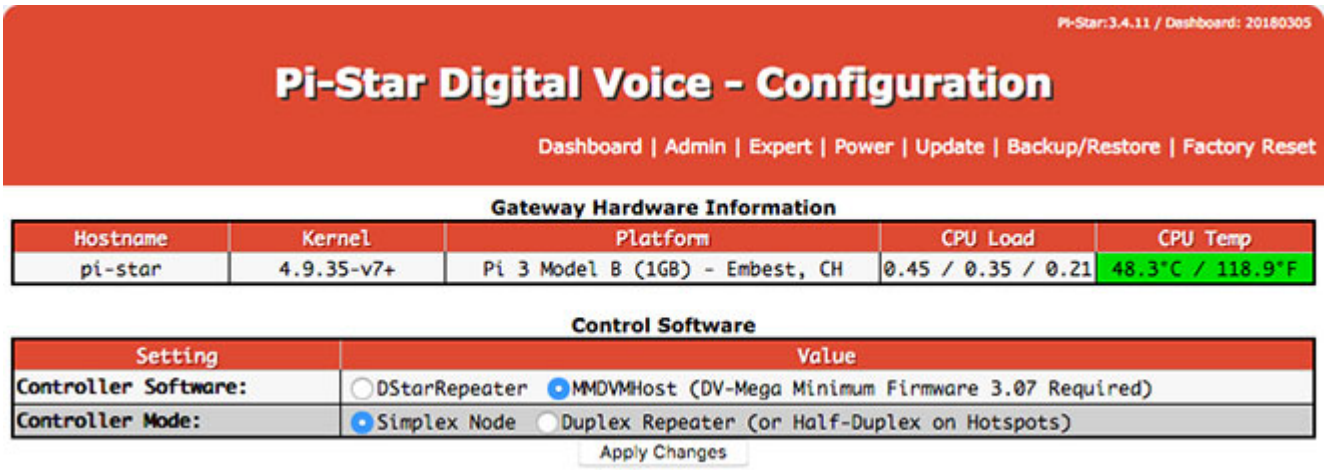
5b) MMDVMHost Configuration

5c) General Configuration

Jump to: Digital mode configuration settings

Jump to: Additional Pi-Star configuration settings

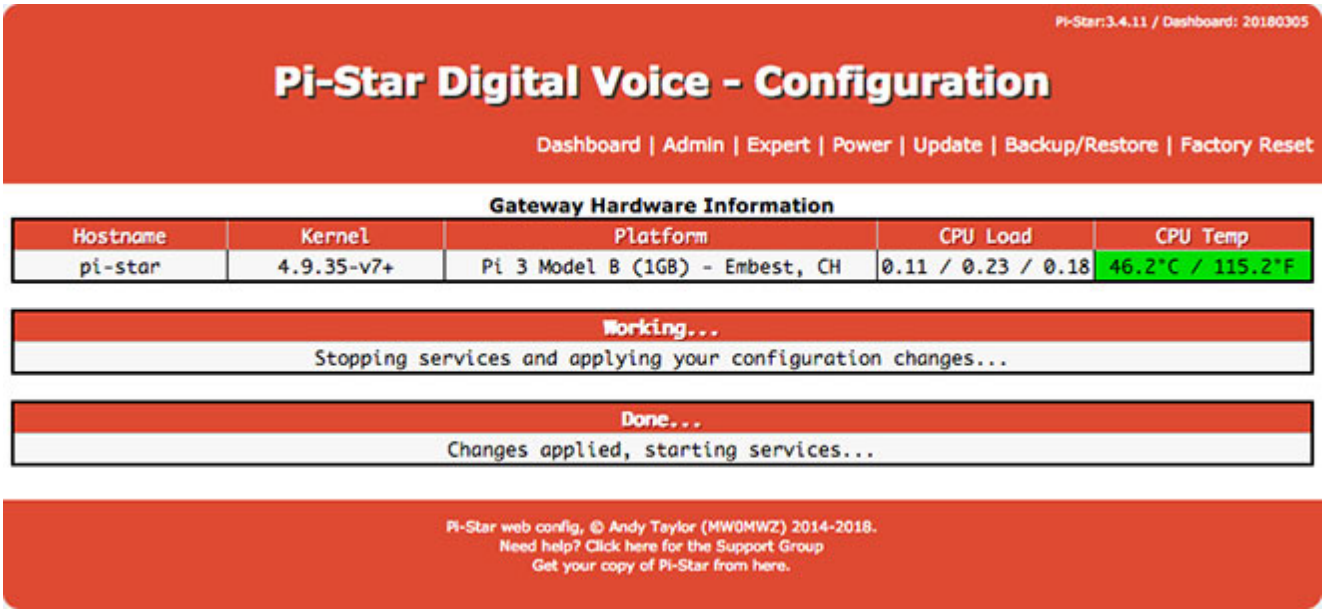
5a) Control Software



- Controller Software
  - If you'll be using Pi-Star with multiple modes, choose MMDVMHost. (MMDVM stands for Multi-Mode Digital Voice Modem).
  - If you'll be using just D-STAR, you can select DStarRepeater instead.
  - *Note:* DVMEGA has minimum firmware requirements when using MMDVMHost with the following modes: DMR = 3.07 and YSF = 3.14. Beyond those minimums, there are even newer versions available. For more info about updating the DVMEGA firmware, see DVMEGA firmware update on the Notes page at the end of my Diving into D-STAR article.
- Controller Mode – For setting up a personal hotspot, choose Simplex Node.

Save your changes!

After making changes in any of the configuration sections, click the Apply Changes button below the section. The services are stopped, the changes are applied, and then the services are restarted, after which you'll be returned to the Configuration view.



Note: Clicking any of the Apply Changes buttons will apply all changes made in any of the sections, but it's a good idea to save after working in each section. For example, if you have enabled various modes (DMR, D-STAR, etc.), the associated configuration section is displayed only after saving.

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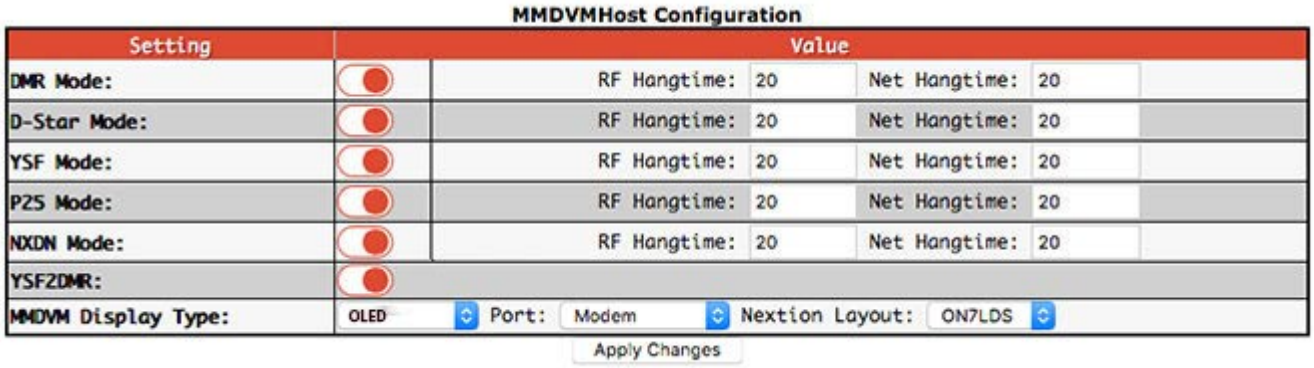
5b) MMDVMHost Configuration



- **Modes** – Initially, I enabled all modes so I'd have access to all the configuration options for them. Subsequently, I enable only the one or two modes I want to use. For more info about the modes, see the Digital mode configuration settings section below.
- **Hangtime** – Related to multi-mode use. The RF hang time is measured from the beginning of a transmission.

- *Note 1:* Per Andy Taylor in the Pi-Star Users Support Group: "these set the amount of time that mode is 'sticky' for – so if you have an incoming call over DMR from the network, how long would you like to stay stuck to DMR mode." For more info, watch Pi-Star Hang Time Update, by Craig, W1MSG.
- *Note 2:* The DVMEGA is "super snappy" when running a single mode, but can be a bit sluggish if you're running multiple modes because it needs about 1.5 seconds of RF to determine what the incoming mode is in order to latch onto it. In that case, it can be helpful to extend the hang time to something like 90. [Reference: See Andy Taylor's replies in this post in the Pi-Star Users Support Group.]

- **MMDVM Display Type** – If you're using a display with your MMDVM, select:
  - Type of display: OLED, Nextion, HD44780, TFT Serial, or LCDproc.
  - Port you're using: Modem, /dev/ttyAMA0, or /dev/ttyUSB0.
  - Layout, if you're using a Nextion display: G4KLX or ON7LDS.
  - *Note 1:* To learn more about Nextion screens, visit the Nextion Ham-Radio Screens group administered by Rob van Rheenen, PD0DIB, a Dutch ham and Pi-Star enthusiast.
  - *Note 2:* Nextion screen layouts: see Nextion subfolders of the g4klx/MMDVMHost Github page.

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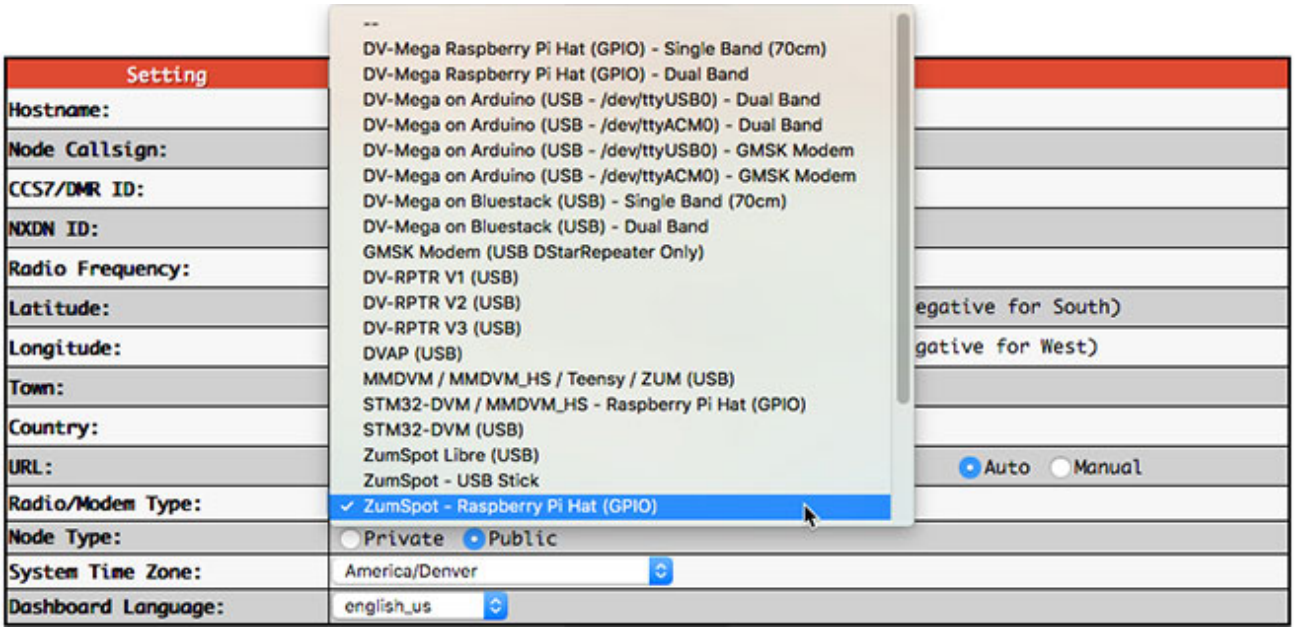
5c) General Configuration

General Configuration

Setting	Value	
Hostname:	pi-star	Do not add suffixes such as .local
Node Callsign:	KE0FHS	
CCS7/DMR ID:	3108883	
NXDN ID:		
Radio Frequency:	433.300.000	MHz
Latitude:	40.205	degrees (positive value for North, negative for South)
Longitude:	-105.275	degrees (positive value for East, negative for West)
Town:	Lyons, DN70IE	
Country:	USA	
URL:	http://www.qrz.com/db/KE0FHS	(•) Auto ( ) Manual
Radio/Modem Type:	ZumSpot - Raspberry Pi Hat (GPIO)	
Node Type:	( ) Private (•) Public	
System Time Zone:	America/Denver	
Dashboard Language:	english_us	

Apply Changes

- **Hostname** – You can give your hotspot a unique hostname, for example, if you're running two hotspots simultaneously, you'll need different hostnames for each, such as pi-star and pi-star-2. If you do change the hostname, you must reboot the hotspot before it takes effect. *Note:* This doesn't change the authentication user name, which remains pi-star.
- **Node Callsign** – For a hotspot, use your own callsign. For a repeater, use your repeater's callsign.
- **CCS7/DMR ID** – For more info, see Optionally, register with CCS7 for DCS (and DMR) on page 2 of my D-STAR article.
- **NXDN ID** – The IDs are 2 bytes long, for example, 0-65533. For more info, see NXDN-Forum and NXDNINFO.COM.
- **Radio Frequency** – Used for connecting your radios to the hotspot or modem you're using. For help choosing a frequency, see your country's band plan (U.S. Band Plan) or the helpful info that Ron, VE1AIC, has posted on his blog: Digital Voice frequencies. See also the Pi-Star Users Support Group discussion about frequencies.
  Important! Avoid frequencies used for other purposes, especially for satellites, for example, 435.00 - 438.00 (used internationally), as satellite communication can be disrupted easily by low power transmissions, such as those used for digital voice.
- **Lat, Lon, Town, QTH Locator grid square, and Country** – Where the gateway (hotspot) is located. Per Andy Taylor in the Pi-Star Users Support Group: "If you are running D-Star mode, and you add your position information to the dashboard, you will get D-PRS positioning from ircDDBGateway." In addition, location info is used for your Brandmeister hotspot listing. To find your locator grid square, use a service like QTH Locator.
- **URL** – If you want to use this for QRZ and your QRZ page uses the same callsign as your hotspot, select Auto; if they're different, select Manual and replace the placeholder callsign at the end of the URL with your own. Or, per Andy Taylor in the Pi-Star Users Support Group: "set to manual and you can set what you like here, this is reported upstream on some modes like D-Star and DMR; "Auto" populates it with your QRZ page, "Manual" allows you to enter whatever you like."
- **Radio/Modem Type** – The Pi-Star RPi image supports a bunch of radios and modems running on the Raspberry Pi 3 or Raspberry Pi Zero W:



For a full list, see the note RPi image supported radios and modems.

- **Node Type** – Per Andy Taylor in the Pi-Star Users Support Group: "this relates to the UK restrictions, a Public node is just that, can be used by any callsign, while a Private node can only be accessed by the same callsign assigned to the Pi-Star." In his video, Craig, W1MSG, sets it to Public because he's in the U.S., and says that in the U.K. it needs to be set to Private.
- **System Time Zone** – Select the time zone of where the gateway (hotspot) is located.
- **Dashboard Language** – Select the default for the dashboard. English (US) is a good option for someone like me who wasn't able to understand much of anything being said when I was a visitor wandering around the streets of London!

If any changes made, click Apply Changes.

Radio/Modem Type do-over

When I saved after making changes in General Configuration section, I received a WARNING message: "The Modem selection section has been updated, Please re-select your modem from the list." I presume this was because either new or revised items had been added to the list, or the mode(s) I had selected changed the list. After re-selecting the radio/modem type and re-applying changes, everything was fine.

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Digital mode configuration settings

5d) DMR Configuration

5e) D-STAR Configuration

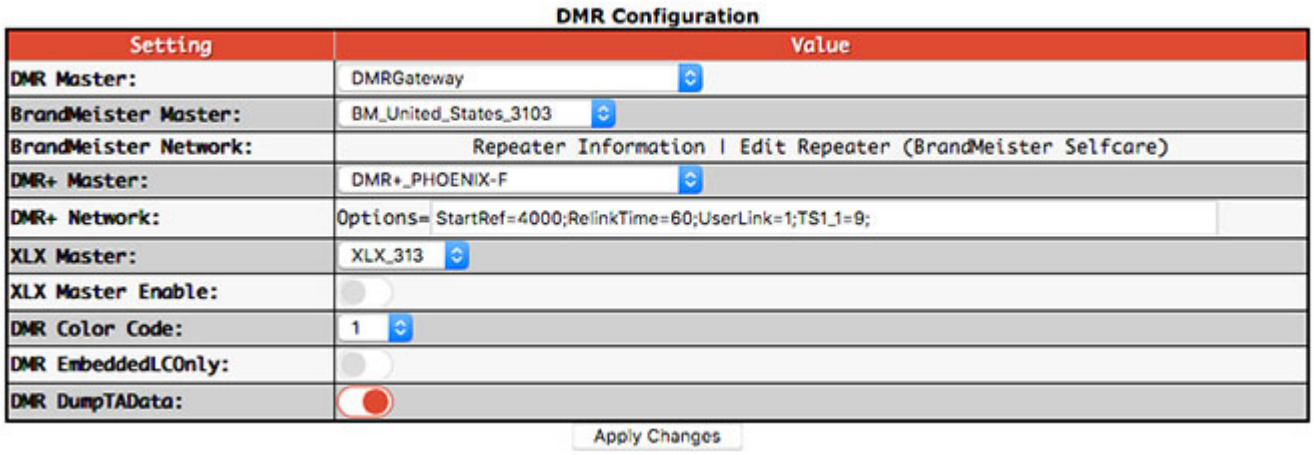
5f) Yaesu System Fusion Configuration (including YSF2DMR)

5g) P25 Configuration

5h) NXDN Configuration

Jump to: Additional Pi-Star configuration settings

5d) DMR Configuration



- DMR Master – If you want to use only a specific system, choose a specific BrandMeister or DMR+ master. In that case, everything is simpler as you'll see only a few options for that system.
  If you want access to multiple systems simultaneously, choose DMRGateway as your DMR master, and then you'll see options for BrandMeister, DMR+, and XLX [2].
  If you choose to use DMRGateway, make sure to read the following note, DMRGateway can be confusing.
- BrandMeister Master – Choose a nearby master server.
- BrandMeister Network – Click Edit Repeater to edit settings via BrandMeister My hotspots for your CCS7 ID [2].
- DMR+ Master – Choose a nearby master server.
- DMR+ Network – Set up any options you want to use [2].
  Note: If you change modes via MMDVMHost Configuration, for example, if you turn off DMR Mode and turn on D-STAR mode, your options won't be saved, so you'll need to re-enter them

the next time you turn on DMR Mode and choose DRM+ or DMRGateway as your DMR master.

- **XLX Master** – Choose the XLX master server you want to use.
- **XLX Master Enable** – Toggle the XLX master on/off.
- **DMR Color Code** – Hotspots typically use color code 1.
- **DMR EmbeddedLCOnly** – The default is off. Per Andy Taylor in the Pi-Star Users Support Group: "this feature relates to some of the data passed in/out from some radios.... Some radios are affected by this (Connect Systems, for example) and some are not (Motorola). Most of us can take the default."
- **DMR DumpTAData** – The default is on, which enables "Talker Alias" information to be received, if your radio supports that.

If any changes made, click Apply Changes.

★ *DMRGateway can be confusing!*

As I discussed in my Discovering DMR article, DMR in general can be confusing because it was originally designed for commercial use and is a bit of an awkward fit for amateur radio. As powerful as DMRGateway is, I find that it can magnify this confusion because it enables so many additional options, is a work in progress on the bleeding edge, and changes fairly frequently.

Added to that, DMRGateway is the method by which Pi-Star makes access to the XLX system available. The XLX system is comprised of masters, reflectors, and talkgroups, and is also evolving rapidly.

I try to read everything I can about both DMRGateway and the XLX system, but some aspects of both still confuse me. All in all, this is a bit of a wild rollercoaster ride, for sure. The best advice I can offer is to pull down the safety bar and hold on tight!

[2] See also the notes:

- DMRGateway notes
- Constellation reflectors

- Auto-static talkgroups

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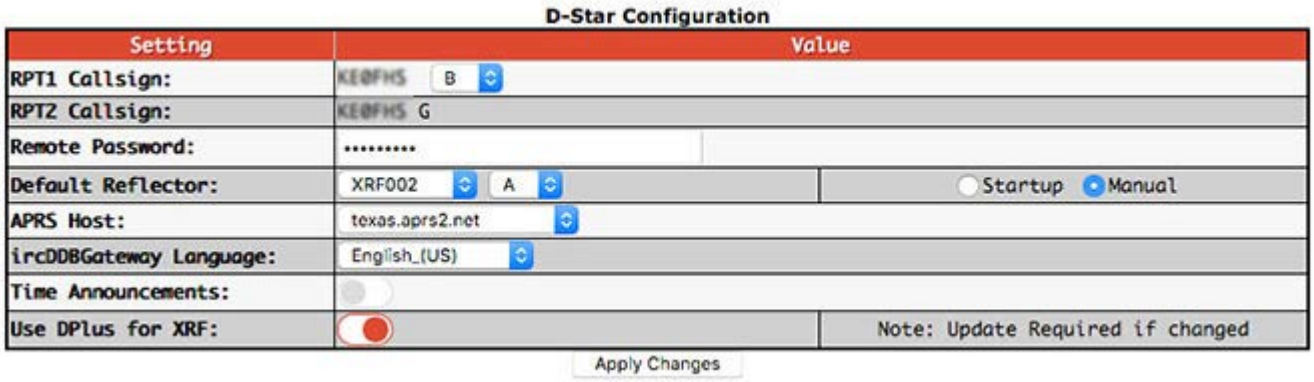
5e) D-STAR Configuration



- **RPT1 Callsign** – Pi-Star autofills the callsign you set up in General Configuration, and the B module is selected initially, which is what is used typically for UHF hotspots. If necessary, change the module to the one you want your radio to connect to.
- **RPT2 Callsign** – This is set up automatically, with the module set to G for Gateway. (This is why it's so important to set up your D-STAR radio properly. This is the RPT2 setting.)
- **Remote Password** [3] (formerly labeled ircDDBGateway Password) – Use for any kind of remote access to this system. Per Andy Taylor in the Pi-Star Users Support Group: "the ircDDBGateway password on the dashboard is for ircDDBGateway remote."
  Note: This is different from the Remote Access Password that is used for accessing the Pi-Star Admin and Configuration settings, as well as for SSH access. For that, see 5k) Remote Access Password.
- **Default Reflector** – You can select your default reflector, as well as whether you want Pi-Star to connect to it automatically when it starts up.
- **APRS Host** – Select your preferred APRS host, typically the nearest.
- **ircDDBGateway Language** – Pick one you understand.
- **Time Announcements** – If enabled, you'll hear a time announcement every 15 minutes when D-STAR mode is enabled. I found that these can override incoming calls, so turned them off.
- **Use DPlus for XRF** [4] – If your router doesn't support automatic uPNP port forwarding and you don't want to manually set up port forwarding for X-Reflectors, you can enable this option to make it possible for Pi-Star to connect to all X-Reflectors.
  Important! If you change this option, you must update Pi-Star.

[3] David, PA7LIM, the ham behind the BlueDV apps, also created Android and i0S "ircDDB Remote" apps, which handle REF, XRF, and DCS reflector connections. For more info, see the videos:

- irdDDB Remote Android app, by Michael Carey, VK5ZEA.
- ircDDB Remote Control Pi-Star (for iOS), by David Cappello, KG5EIU.

[4] X-Reflectors using either the older Dextra protocol or the FreeStar protocol (for example, XRF720, a Colorado statewide reflector) require port forwarding in order for Pi-Star to connect to them. This doesn't apply to X-Reflectors running the newer Dextra Enhanced protocol (for example, the XRF002 reflector). If 1) your router doesn't support uPNP, 2) you don't want to enable the "Use DPlus for XRF" option, and 3) you want to manually set up port forwarding, see the note: Port forwarding.

If any changes made, click Apply Changes.

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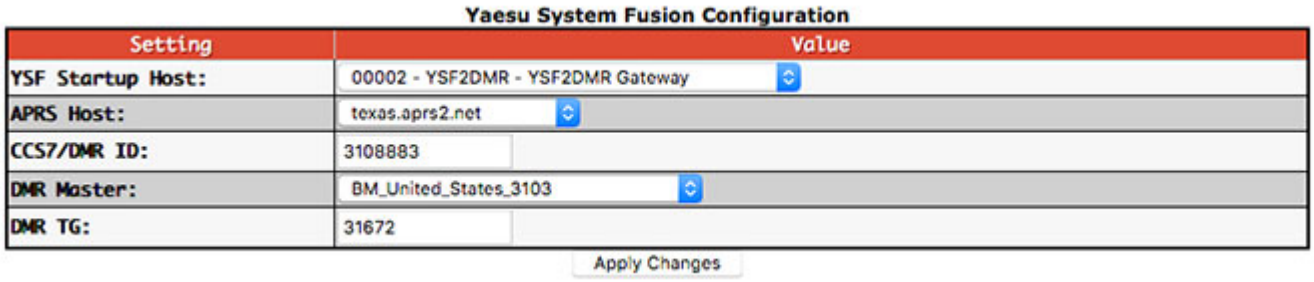
5f) Yaesu System Fusion Configuration (including YSF2DMR)



To use the optional YSF2DMR capability (requires Pi-Star 3.4.10 or later), in the MMDVMHost Configuration section enable both the YSF and YSF2DMR modes (and normally you should disable the DMR mode). Once YSF mode is enabled, this Yaesu System Fusion Configuration section is enabled. Once YSF2DMR mode is enabled, additional options specific to YSF2DMR are enabled in this section.

- **YSF Startup Host** – If you want to use a specific YSF Host, choose it. In that case, you'll see only a couple of options in this section.
  For YSF2DMR: Choose the YSF2DMR Gateway option. This enables room 00002 (the default defined in YSFGateway) to be used by your Yaesu System Fusion radio to access DMR.
- **APRS Host** – Select your preferred APRS host for YSF.
- **YSF2DMR mode options**:
  - **CCS7/DMR ID** – Select the ID you want to use for YSF2DMR mode. For more info, see Optionally, register with CCS7 for DCS (and DMR) on page 2 of the D-STAR article.
  - **DMR Master** – Select the master you want to use for YSF2DMR mode.
  - **DMR TG** – Select the talkgroup you want to use for YSF2DMR mode.

- For more info, see the Using YSF2DMR mode note below.

If any changes made, click Apply Changes.

Using YSF with Pi-Star

Thanks to Dave Young for posting this info in the Pi-Star Users Support Group:

> To change rooms, disconnect, or connect with the radio, you need to use the Wires-X button on your Yaesu radio to connect to Pi-Star. Make sure that you only have YSF mode selected in Pi-Star as the radio only sends out a short transmission to connect to Wires-X and the DvMega scans all active modes and will not hear a short Tx unless it is the only mode scanning. Once you make the Wires-X connection to Pi-Star you can use the radio to change rooms or disconnect as you would normally do as if you were connected to a Wires-X node. Note that if you are using the FT70 Yaesu radio, you need the latest radio firmware installed, which gives that radio Wires-X capability.

Using YSF2DMR mode

Thanks to Andrew Midns and Andy Taylor for all the great info about using YSF2DMR that they posted in the Pi-Star Users Support Group.

Once you have enabled YSF and YSF2DMR modes, select YSF2DMR Gateway as the YSF Startup Host, set the YSF2DMR mode options, apply your changes, and then:

1. Key up (PTT) a second or two to make sure your modem has locked onto Yaesu System Fusion mode (C4FM).
2. This step varies based on the radio you're using, but basically, click the radio's Wires-X button and then navigate to or search for the YSF2DMR room, and then select it.
3. Now you can talk through the YSF2DMR room (00002) to the DMR talkgroup you set up in the Yaesu System Fusion Configuration DMR TG setting. At this time, you must use that setting to change DMR talkgroups, but it's possible that a change will be made at some point to enable changing talkgroups through the radio.

Note: Normally, you should make sure that you're logged into DMR in only one place, or else that you are using different CCS7/DMR IDs for each login instance (for example, if you're

running DMR on one hotspot and YSF2DMR on another). However, if you're using the BrandMeister DMR network, you have the option of appending a two-digit SSID (00 - 99) to your regular CCS7/DMR ID so that BrandMeister can distinguish between your logins.

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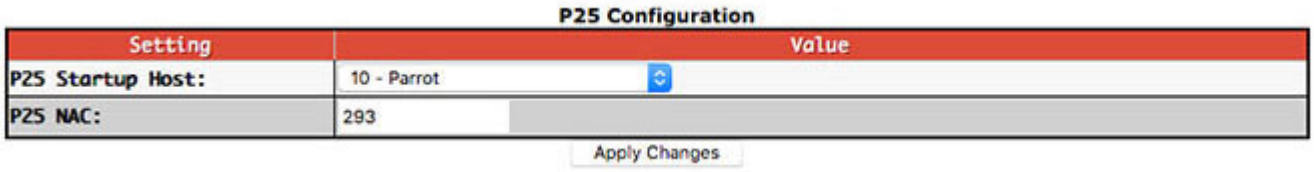
5g) P25 Configuration



- **P25 Startup Host** – Select your preferred startup host.
- **P25 NAC** – Enter your P25 Network Access Code.

If any changes made, click Apply Changes.

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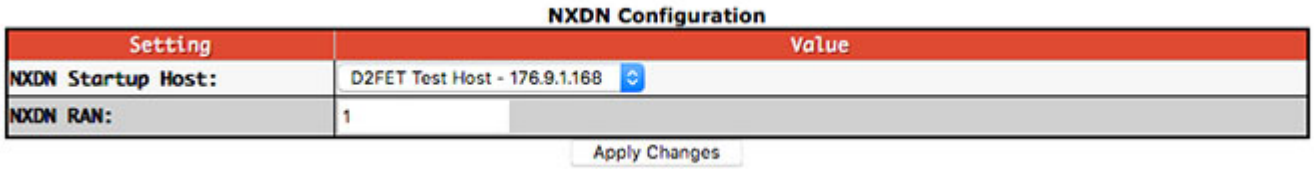
5h) NXDN Configuration



- **NXDN Startup Host** – Select your preferred startup host.
  Note: According to Pi-Star Change Log, NXDN was added to MMDVMHost in version 3.4.10; however, there is no NXDN Gateway service yet (supposed to be coming soon). In the meantime, the NXDN service is hardcoded to use the single public reflector that is available.
- **NXDN RAN** – Enter your NXDN Random Access Number.

If any changes made, click Apply Changes.

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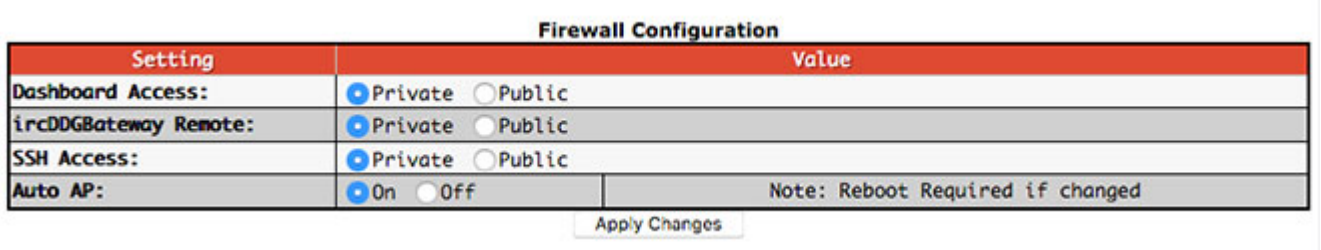
Additional configuration settings

- 5i) Firewall Configuration
- 5j) Wireless Configuration
- 5k) Remote Access Password

5i) Firewall Configuration



Dashboard Access, ircDDBGateway Remote, SSH Access

- Dashboard Access: requests TCP/80
- ircDDBRemote Access: requests UDP/10022
- SSH Access: requests TCP/22

These options are used for accessing the dashboard remotely, from outside your network. Per Andy Taylor in the Pi-Star Users Support Group: "These settings tell the uPNP daemon to request port forwards from your router. If you don't use uPNP, they have NO effect."

AutoAP (Auto Access Point)

The AutoAP feature, which works with the RPi 3 and RPi Zero W, was added in version 3.4.11. If the feature is enabled and Pi-Star can't connect to a known WiFi network within two minutes of boot up, it activates its own access point.

AutoAP makes initial configuration easier because you don't need to create a wpa_supplicant.conf and copy it to the root folder of your microSD card. Instead, you can just flash the Pi-Star image file to the microSD card, boot up, and then create your network.

If any changes made, click Apply Changes.

Some notes about AutoAP:

- You can use AutoAP when traveling to connect to new networks.

- AutoAP includes limited support for a small number of 3rd-party WiFi cards (limited by the Linux driver used for the support).
- AutoAP also enables connection sharing, so if you connect your hotspot to a wired network or tether it to your phone via USB, you also can share the connection via AutoAP.

For more info, watch the video Pi-Star WiFi AutoAP by Craig, W1MSG.

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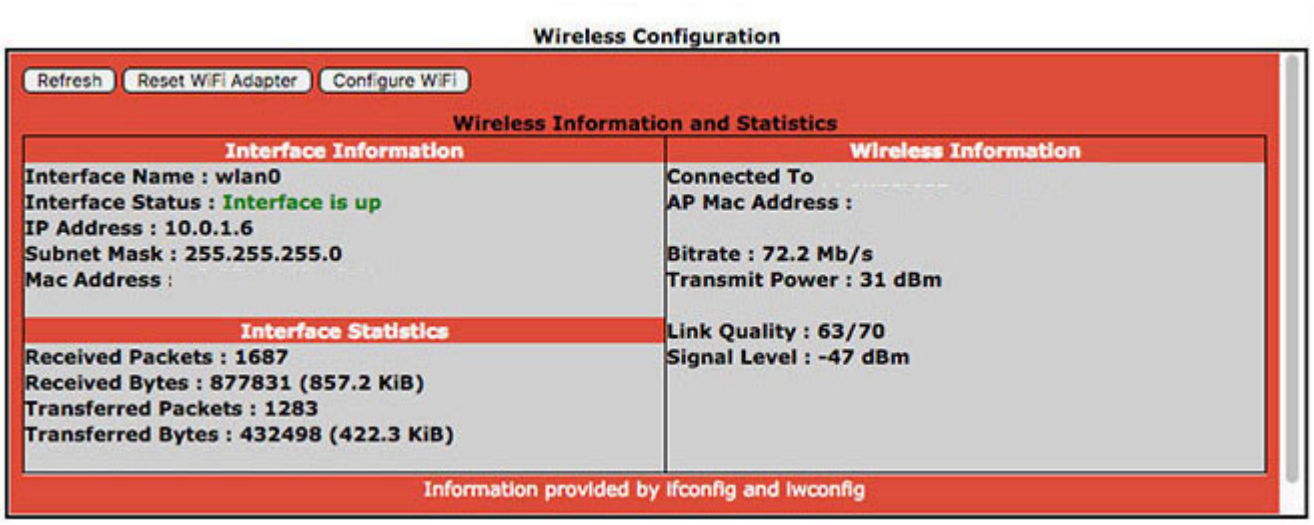
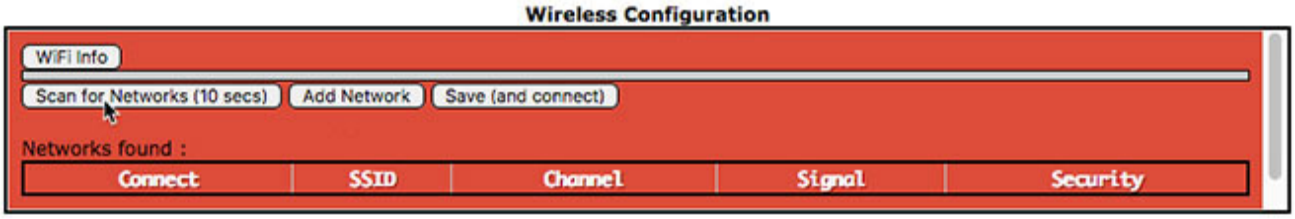
5j) Wireless Configuration



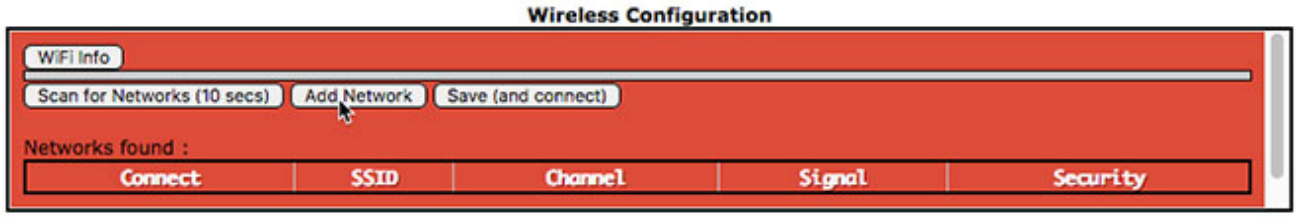
1. To add or modify your WiFi network connections, click Configure WiFi.
2. Click Scan for Networks (takes about 10 seconds), find the one you want, and click Connect.

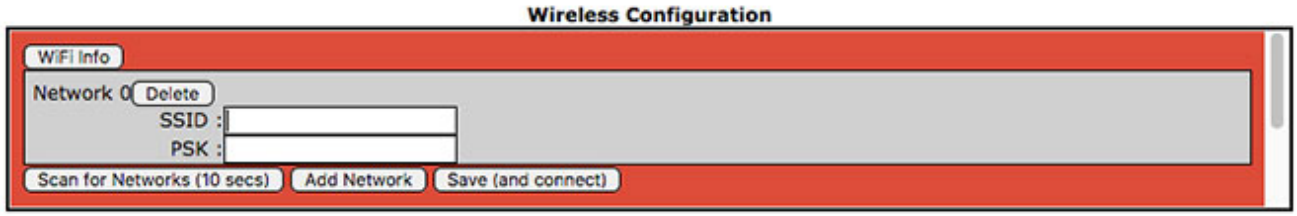


   Alternatively, for example, if the scan doesn't find the network you want to use, you can add a network manually.

Manually adding networks

1. Click Add Network to open the options to manually add a WiFi network.





2. Type the SSID (wireless network name).
3. Type the PSK (password to access the wireless network). The field will be highlighted green.
4. Click Save (and connect) [5]. When it has finished, the field will be highlighted white.
   AutoAP note: If you're setting up a wireless configuration using AutoAP, you'll need to reboot Pi-Star to disable AutoAP and initiate the connection to the WiFi network you just added. While Pi-Star is rebooting, reconnect your computer to its usual WiFi connection.
5. Optionally, you can add additional wireless network connections.

[5] This step tripped me up initially when I was setting up my DVMEGA + RPi, which was connected to my network via cable. After saving, Pi-Star basically froze waiting to reconnect. I had to shut down and power off my RPi, disconnect the network cable from the RPi, and also shut down the Pi-Star dashboard and power off my computer, before restarting everything. After that, it all started working smoothly (and wirelessly).

Adding multiple wireless network connections

If you have multiple wireless network connections, when you turn on your Pi-Star hotspot, it will scan each one in turn based on its priority until it finds one to connect to.

- Be patient: connection attempts can take ~40 seconds each.
- The first wireless network connection you add is given an ID of 0 and a priority of 100.
- For each additional wireless network connection you add, the ID is incremented by one and the priority is decremented by one.

Thanks to Bob, NØYWB, for his post in the Pi-Star Users Support Group explaining how this works.

For more info, see Manually adding WiFi settings to RPi.

Scanning for networks

This feature seems to be a bit unreliable. It didn't always work for me, sometimes finding neither my own wireless network nor any of the neighboring networks I see when I scan with other devices. Other people in the Pi-Star Users Support Group have reported similar experiences.

It's not clear what the underlying issue is. Some people have said that if they run the scan several times, eventually their network will show up. Others say it's a Raspberry Pi 3 issue, but haven't yet identified what the exact issue is. Still others say it's an issue with the wireless network names (SSID), that they need to be short and simple, but haven't identified what the maximum length should be or which characters are breaking the scan feature (and anyway, I'm a firm believer in using long passwords).

Regardless, it's easy to configure wireless using the manual method outlined above.

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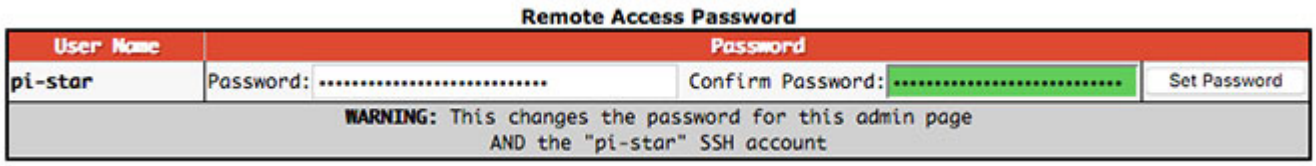
5k) Remote Access Password

Used both for accessing the Pi-Star Admin and Configuration settings, and for SSH access.

★ ***Strongly recommended:*** In order to protect your settings and network, change the password from the default to something stronger and more challenging to hack. A challenging password is especially important if you make your dashboard publicly accessible in the Firewall Configuration section.



1. The user name is pi-star, and can't be changed. This is different from the Hostname that can be changed in the General Configuration section.
2. In the Password field, type your new password, preferably something long and strong.

3. Confirm your password. Once you have typed an identical password, the field turns from red to green.
4. Once you get the green light, click Set Password.
5. Once the password has been set, the Authentication Required dialog box will be presented, and you can sign in using your new password.

★ *Remote Access Password gotcha*

Apparently, some special characters work for accessing Pi-Star Admin and Configuration settings, but not for SSH. For example, including a tilde symbol (~) in the password worked for logging into Pi-Star Admin, but prevented me from signing in via SSH.

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6) Running Pi-Star

Once you've finished the initial configuration, running Pi-Star is easy peasy. Just start your hotspot modem and give the Pi-Star RPi image a minute or two to fully boot up. As long as you have your radio set up correctly, you should be able to start using your radio for digital voice mode activity.

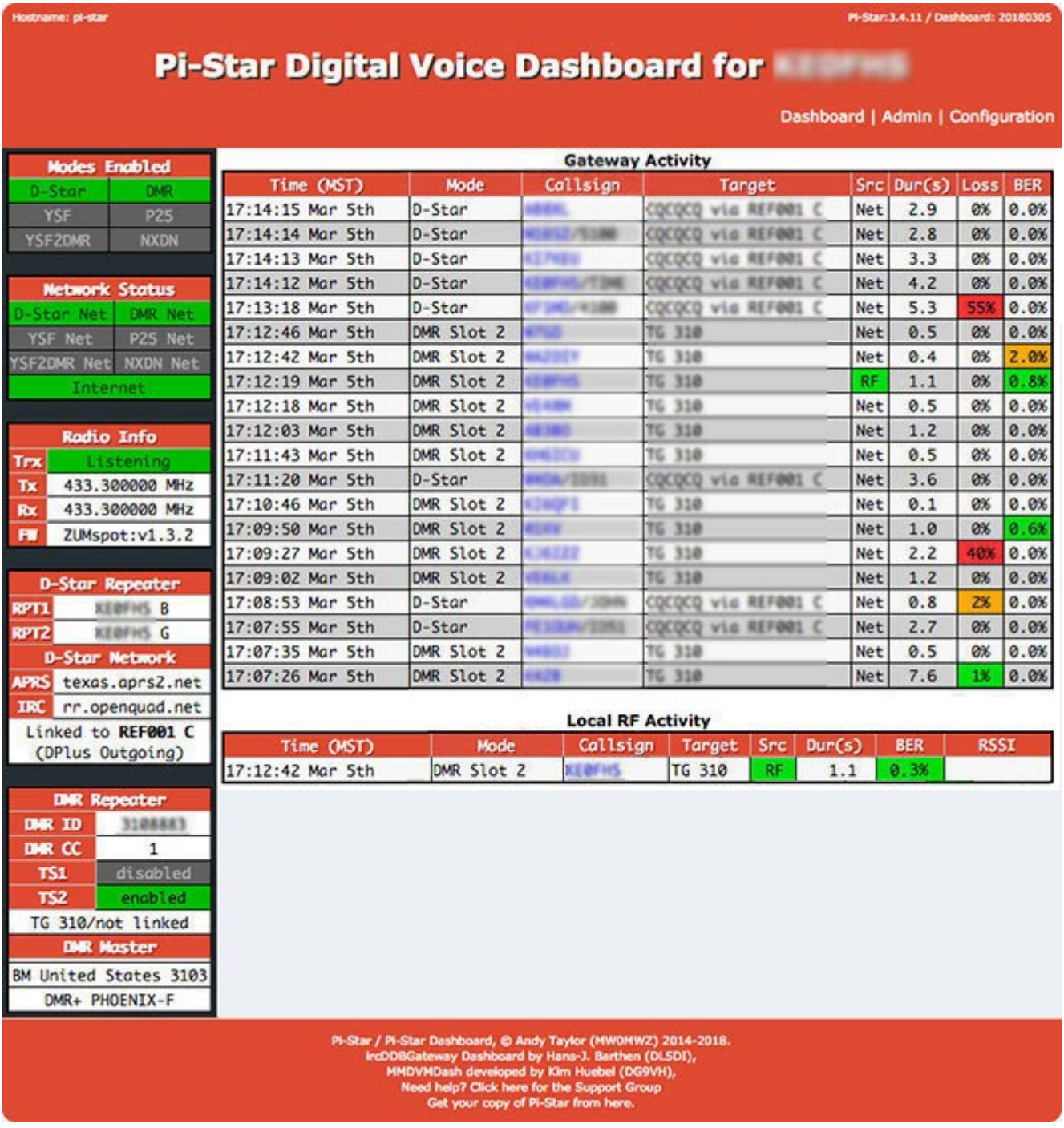
Optionally, you can browse to http://pi-star.local/ on any computer connected to your network to open the Pi-Star dashboard. You'll see the mode(s) you've configured to run highlighted in green, and you can monitor activity.

Important! If you're using D-STAR, you must set up your radio correctly in order to use Pi-Star successfully. It doesn't work to use DV mode; instead, you must set up RPT1, RPT2, and a zero offset (either +/–0.000). Sometimes, this is referred to as Duplex mode; for my TH-D74A, it's called D-STAR Repeater (DR) mode.

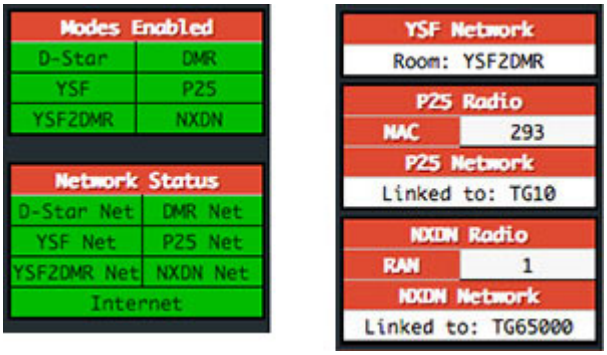
Craig, W1MSG, has a short video that addresses this: D-STAR Radio Primer for using Pi-Star. And if you want more detailed info, see my write-up, Programming the TH-D74A for D-STAR. While my doc is specific to the Kenwood TH-D74A, some of the info applies to any D-STAR radio.

6a) Dashboard view

Here's what the dashboard looks like with D-STAR and DMR modes enabled after it's been running for a while linked to D-STAR REF0001 C and DMR TG 310 (TAC310). You can click a callsign to open the associated QRZ page in a new tab.

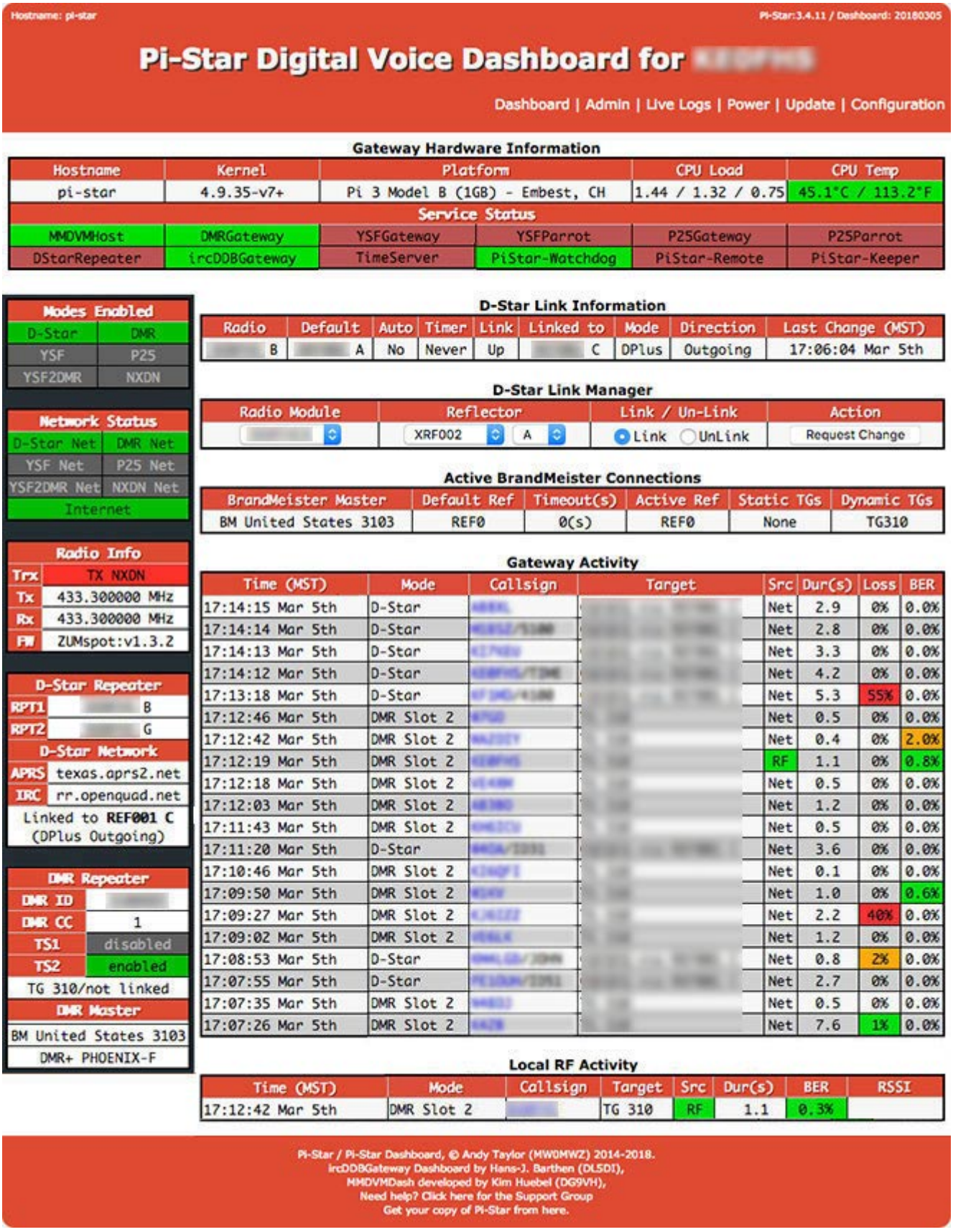


If you enable the YSF, P25, NXDN, or YSF2DMR modes, you'll see additional info displayed in the dashboard's left column.



6b) Admin view

You can switch to the Admin view (requires authentication) to see more info, like Gateway Hardware Information and Service Status.



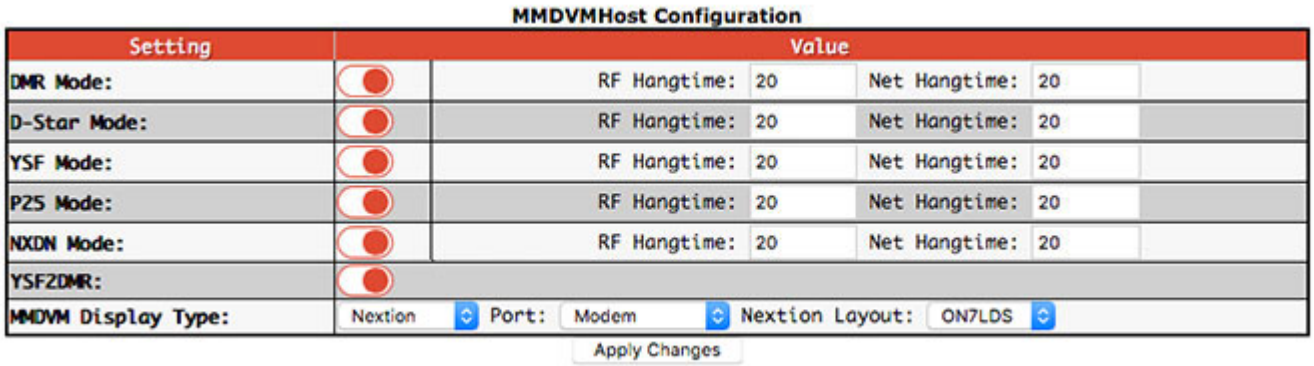
If you're running D-STAR mode, in Admin view you have the option of changing the reflector and linking/unlinking directly from the D-Star Link Manager section. Admin view also can be helpful for troubleshooting, though I haven't had to do much of that.

6c) Live Logs view

From the Admin view, you can select the Live Logs view, which starts a more detailed live logging process that can be useful for troubleshooting.

6d) Changing active mode(s)

If you want to change which modes are active, just hop over to the Configuration view. In the MMDVMHost Configuration section, switch modes on and off as wanted, and then apply the changes.



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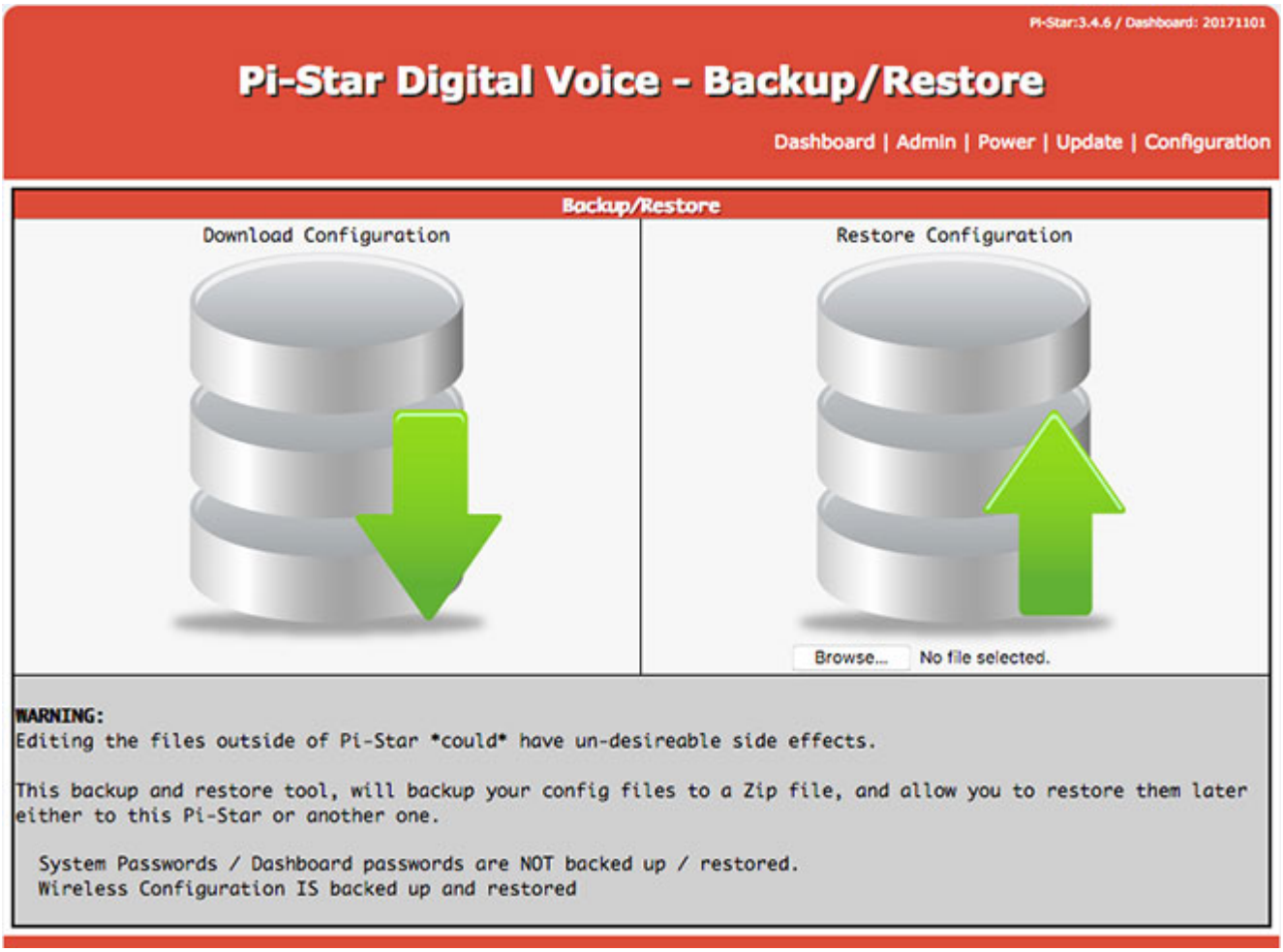
7) Backing up or restoring Pi-Star

After you've done all the work of setting up Pi-Star just the way you want, it's a good idea to back it up. In Admin view, click the Backup/Restore link.

In the Backup/Restore view, click Download Configuration, and then choose a location to safely tuck away your work so that you can easily restore your configuration if things ever go sideways, for example, if you decide to play around in the Expert Editor (discussed below) and muck things up totally.



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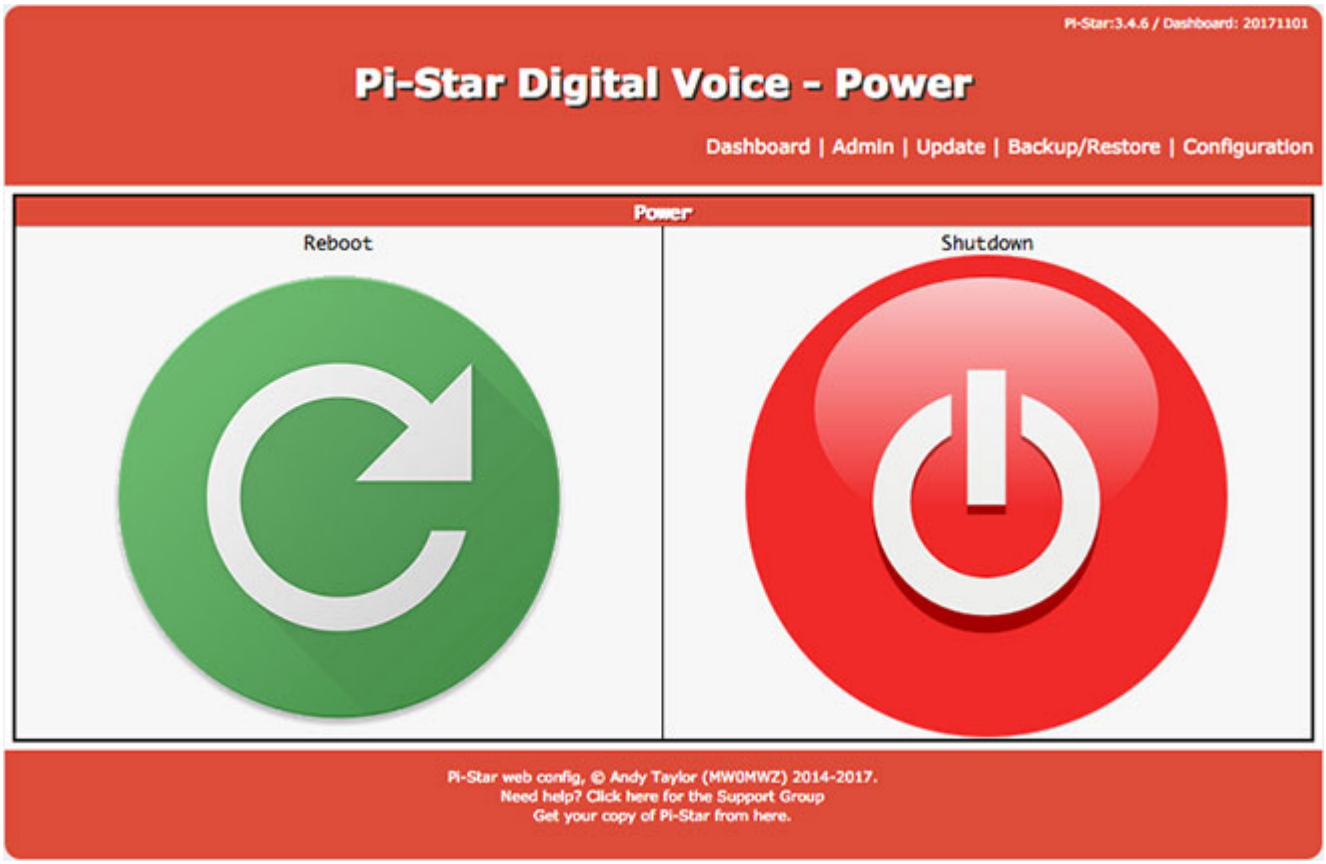
8) Rebooting or shutting down Pi-Star

Pi-Star provides a graceful way to reboot or shut down your hotspot. In Admin view, click the Power link.

In the Power view, click Reboot or Shutdown. Give your hotspot or modem a couple minutes to complete rebooting or powering down.



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9) Updating Pi-Star

One of the nice things about Pi-Star is that it's updated on a regular basis to add new features and options, including MMDVMhost updates.

Per Andy Taylor in the Pi-Star Users Support Group: " just for info here, MMDVMHost is updated reasonably often, Pi-Star will pull in the updates over night after I release them, or you can press update on the dashboard to pull in the updates if you want it before the nightly pull. I don't update the binaries daily, but I do try and track the upstream source reasonably often."

Note: Running Pi-Star Update updates the dashboard and binaries. The **update** process doesn't **upgrade** the operating system, services, and packages (there's a manual process for that discussed further below). Upgrades are released less frequently.

If you don't leave Pi-Star running overnight or you want to manually launch an **update** at any other time, in the Admin view, click Update. (Alternatively, you can run the update via SSH, which is discussed below.)

In the Update view, you'll see the process running. Let it run until it's totally finished.

Note: In my experience, sometimes the log entries displayed on this screen hang. When that happens, I simply give the process a few minutes to run, and then switch my view back to Dashboard, Admin, or Configuration. Every time I've encountered this, the update has still always completed. To avoid this possibility, use optional "fullscreen SSH client" built into Pi-Star. There's a link for it at the bottom of the Expert Editor's built-in SSH Access window. I find that for some reason the update script log runs better in the fullscreen SSH client, and the bigger window also makes it easier to read the log entries and spot any errors, which are quite rare, but can happen.

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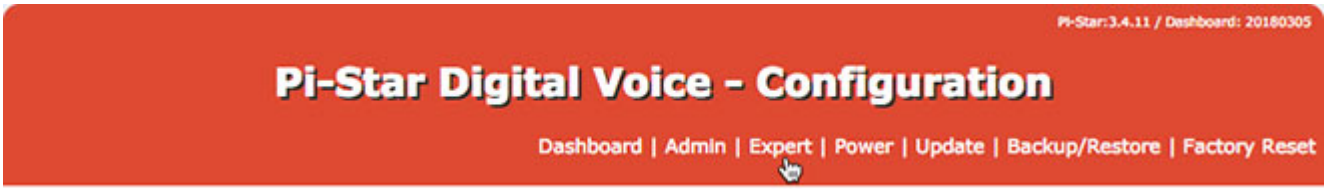
10) Advanced Pi-Star configuration (Expert Editor)

If you are in Configuration View, you can click the Expert link to access the "Expert Editor," a set of advanced quick editors, full editors, and tools. Alternatively, navigate to: pi-star.local/admin/expert.



You'll be greeted by a **WARNING** message, which you should pay attention to:

> "Please keep in mind when making your edits here, that these config files can be updated by the dashboard, and that your edits can be over-written. It is assumed that you already know what you are doing editing the files by hand, and that you understand what parts of the files are maintained by the dashboard."

The Expert Editor provides access to:

- Quick Editors:
  - DStarRepeater
  - IrcDDBGateway
  - TimeServer
  - MMDVMHost
  - DMRGateway
  - YSFGateway
  - P25Gateway
- Full Editors:
  - DMRGateway
  - PiStar-Remote [6]

    - WiFi Config (wpa_supplicant.conf)
    - System Cron
- Tools:
    - Built-in SSH Access window

[6] The PiStar-Remote Config File provides configuration options for:

1. The Pi-Star Keeper remote control system, which gives repeater keepers an RF KillSwitch for their repeaters.
2. Some basic remote control ability via RF. For more info, including a Pi-Star Easter Egg, see 15) Watchdogs, Remote RF commands, and Keepers on the Pi-Star notes page.

10a) Performing firmware updates via Pi-Star

It's possible to update the firmware of several hotspot boards via Pi-Star's SSH Access, including the ZUMspot, MMDVM_HS Hat, BD7KLE/BG3MDO, and the DVMEGA mounted on an RPi. For more info, see Performing firmware updates via Pi-Star on the Pi-Star notes page.

10b) Other advanced configuration notes

See the Pi-Star notes page for some other advanced configuration notes, including:

- Running Pi-Star SSH Access
- Expanding the root partition
- Fine tuning for high BER
- Forcing RPi system time re-sync
- Watchdogs, Remote RF commands, and Keepers

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11) Upgrading Pi-Star

To **upgrade** the operating system, services, and packages, you need to SSH into Pi-Star and run an **upgrade** (you can run this in the default read-only mode).

For upgrades, it's recommended that you use an SSH (Secure Shell) app like Termius or PuTTY. This minimizes the chance of upgrade errors that may be caused by Pi-Star's built-in (shell-in-a-box) SSH Access.

1. SSH into Pi-Star and log in.

2. Begin with an **update** of the dashboard and binaries:

   ```
   sudo pistar-update
   ```

   Allow the update process to run until you see:

   ```
   Updates complete, sleeping for a few seconds before making the disk Read-Only
   Finished
   ```

3. Next, **upgrade** the operating system, services, and packages:

   ```
   sudo pistar-upgrade
   ```

4. Run the process as many times as needed until the system reports you are on the most recent version:

   ```
   Detected Pi-Star #.#.# running on RPi hardware, attached to dvmpid modem...
   You are already running the latest version...
   Sleeping a few seconds before making the disk Read-Only...
   Finished
   ```

5. It's a good idea to reboot the hotspot after upgrading:

   ```
   sudo reboot
   ```

6. In your browser window, navigate back to the dashboard:

   ```
   http://pi-star.local/
   ```

To view the upgrade changes, visit the Pi-Star Downloads page and scroll down to Change Log.

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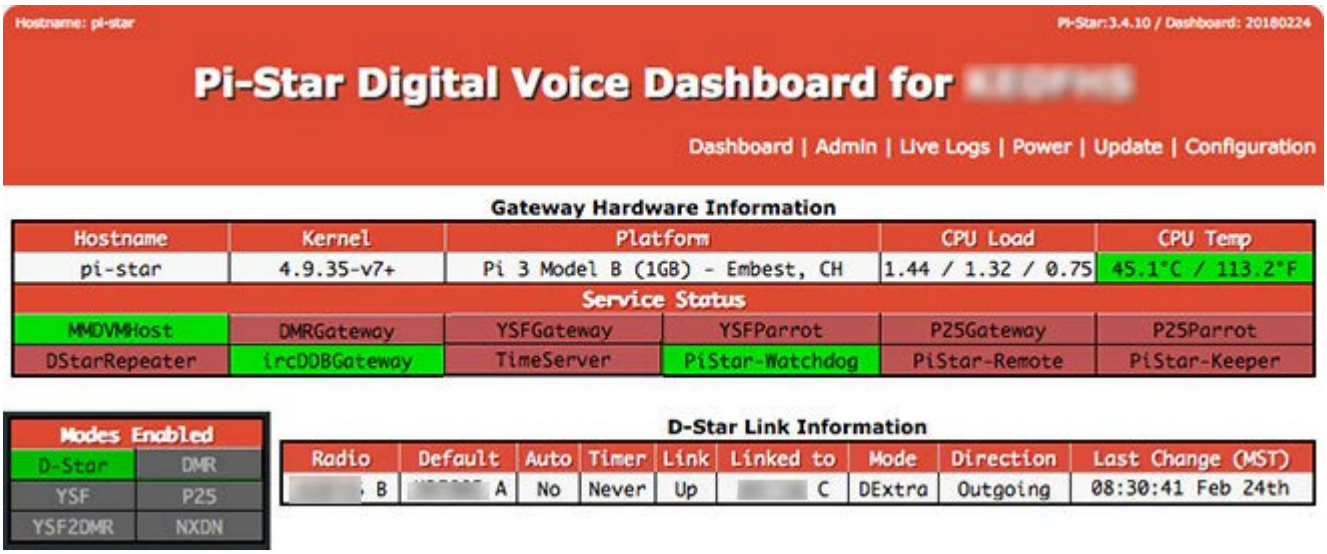
12) Pi-Star – Summary thoughts

I really like Pi-Star!

Pi-St is my favorite hotspot software for the two digital radio modes I use: D-STAR and DMR. It also handles YSF, and even P25 and NXDN (when used with an MMDVM-capable modem like the ZUMspot).

At this time, I'm using Pi-Star with a ZUMspot mounted on a Raspberry Pi. Initially, I used it with a DVMEGA-DUAL mounted on a Raspberry Pi. They're both great combinations, though the ZUMspot has the advantage of P25 and NXDN support.



12a) The dashboard is great

I'm actually surprised by how much I like the dashboard. I thought it would be a "nice-to-have" feature, but it turns out that it's great to be able to watch the activity on a reflector, especially during a net. It's also nice to be able to easily look up people's QRZ pages.

12b) Actively developed and supported

Another thing I really appreciate is how actively and enthusiastically Andy Taylor and team are developing and supporting Pi-Star; they're very responsive to the community of Pi-Star users.

12c) Totally won over

The moment I became totally won over was when Andy documented a method for updating the DVMEGA firmware via Pi-Star while it's mounted on the RPi. That was a pain point for me—having

to take apart my RPi hotspot and mount the DVMEGA-DUAL on my BlueStack board every time I wanted to update its firmware—so I really appreciated this much easier method. Thanks, Andy and team!

For more info, see: Performing firmware updates via Pi-Star.

My appreciation was further solidified when, as of version 3.4.8, a new "Use DPlus for XRF" setting was introduced in the D-STAR Configuration section for people like me who don't have a router that supports automatic uPNP port forwarding and who don't want to manually set up port forwarding. The new setting enables linking to X-Reflectors that run either older versions of their operating software or the FreeStar operating software (like XRF720, a Colorado statewide reflector I like to connect to). Thanks to Adrian Fewster, VK4TUX, a helpful member of the Pi-Star Users Support Group who originally came up with this solution, which was subsequently incorporated into a Pi-Star upgrade.

As each new version is released, I am further won over. The new features being incorporated into Pi-Star make the experience of using it richer and more exciting. Pi-Star is definitely changing the face of digital voice!

12d) Magic 8-Ball!

If all that weren't enough, when I discovered the Magic 8-Ball [7] built into Pi-Star ... well, as they say in movie trailers: "My life was changed forever!"

Question: "How is my sanity?"
Answer: "Outlook is not so good!"

[7] See Remote Control RF commands on the Pi-Star Notes page.

12e) A base station and a mobile hotspot

Paired with a ZUMspot RPi UHF Hotspot board, Pi-Star is a great solution for use both as a base station and as a mobile hotspot.

For more info, see:

- ZUMspot + Pi-Star – An invitation to play more.
- Connecting Pi-Star via cell phone

12f) Worth supporting

Obviously, Andy and team are pouring a lot of energy, intelligence, and heart into creating Pi-Star, which they're giving away freely to digital hams. There's also a robust community of hams contributing to helping Pi-Star users via the Pi-Star Users Support Group. Per Andy:

> And now to you dear reader, you are probably reading this because you already run Pi-Star, or you are about to start. Without you, this project wouldn't be where it is today, a shining beacon of what can be when a few like-minded people with similar interests are prepared to set monetary gain aside and just give away their work. You might not be a coder, you might not feel that you understand digital radio enough to give anything back, but that time will come. Enjoy the hobby, tell your friends what we got right with Pi-Star, and tell us when it does something it shouldn't.

TX some support!

If you end up appreciating Pi-Star as much as I do, consider supporting this work by contributing to the Pi-Star Users Support Group or by sending some monetary support their way toward the running costs of the server / build / test environments that they're using to make Pi-Star what it is. For more info, see Pi-Star – How can I help?.

Thanks for creating a really nice solution, Andy and team!

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    b. Other good resources for learning about Pi-Star
    c. Be sure to set up your D-STAR radio properly!
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3. Flashing Pi-Star
    a. Preparing to connect to WiFi
        Using the AutoAP (Auto Access Point) method
        Manually preparing to connect to WiFi
4. Booting up Pi-Star
5. Performing initial Pi-Star configuration
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    b. MMDVMHost Configuration
    c. General Configuration
    d. DMR Configuration
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f. Yaesu System Fusion Configuration

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h. NXDN Configuration

i. Firewall Configuration

Dashboard Access, ircDDBGateway Remote, SSH Access

AutoAP (Auto Access Point)

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e. A base station and mobile solution

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