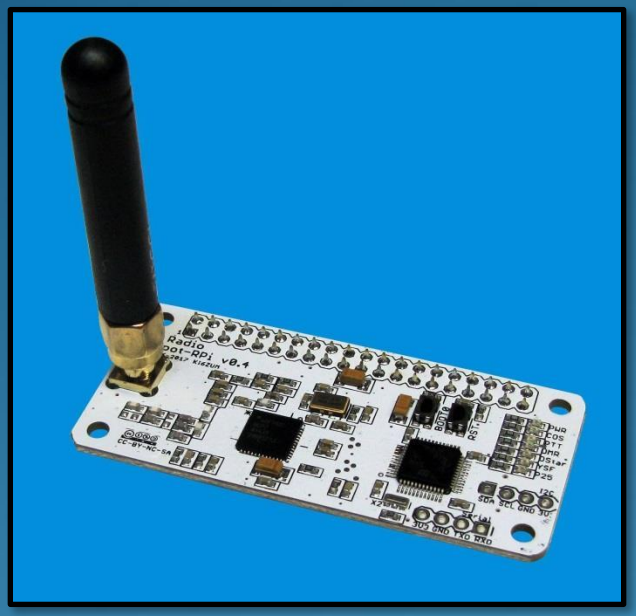
ZUMspot/PiStar

ZUMspot/Pi-Star Bring-up and initialization

Updated for Pi-Star v4.1.5



David Hull, KC6N

Revised (11/26/2021)

Preface

This document covers initial setup and maintenance of ZUMspot based “hotspots” running on Raspberry PiZeroW (or Pi3) platforms using Pi-Star software. Parts I through III describe steps needed to bring up a new system. This is followed by a series of appendices that cover other topics likely to be encountered during subsequent operation.

Contents

- Preparing your ZUMspot for first use
  - Part I: Preparing a Pi-Star µSD card
  - Part II: Configuring/Customizing Pi-Star
  - Part III: Configuring your radios
- Appendices: (specific topics and issues)
  - Updating FW, Setting up Brandmeister, Access to special features, etc.

Note on SW versions:

Many of the screen shots in the first sections are based on release 3.4.11. Some of the material in the appendices are based on later versions. Everything in the PDF should work on versions up to and including the version referenced on the title page. It is a bit of work to replace the screenshots each time a new release is made so I don't do it if the older ones are still good. As a result, if you are bringing up something later than 3.4.11, your screens might look slightly different in some cases.

ZUMspot/PiStar

Part I

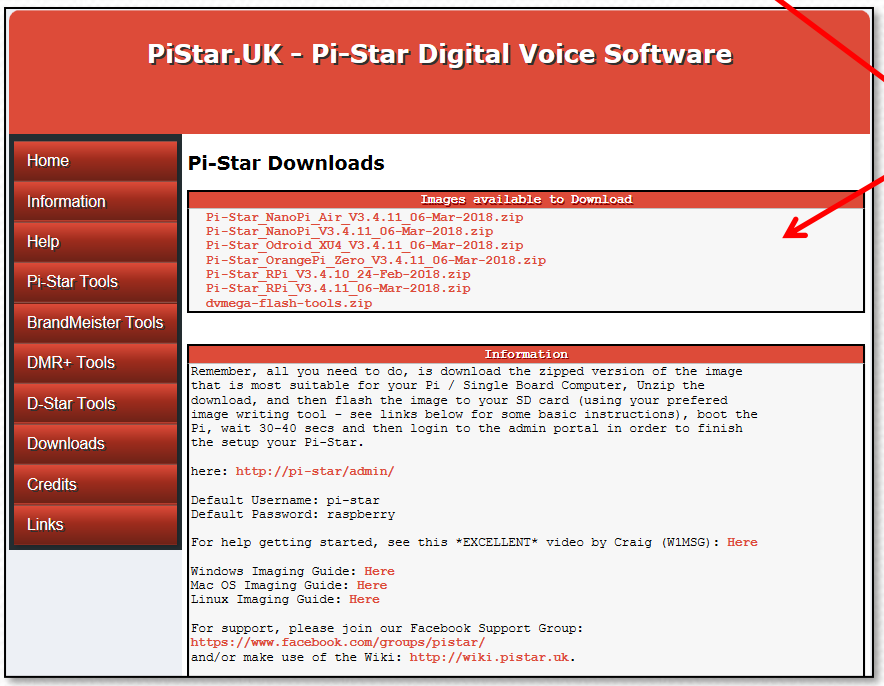
Preparing a µSD card with a Pi-Star Image

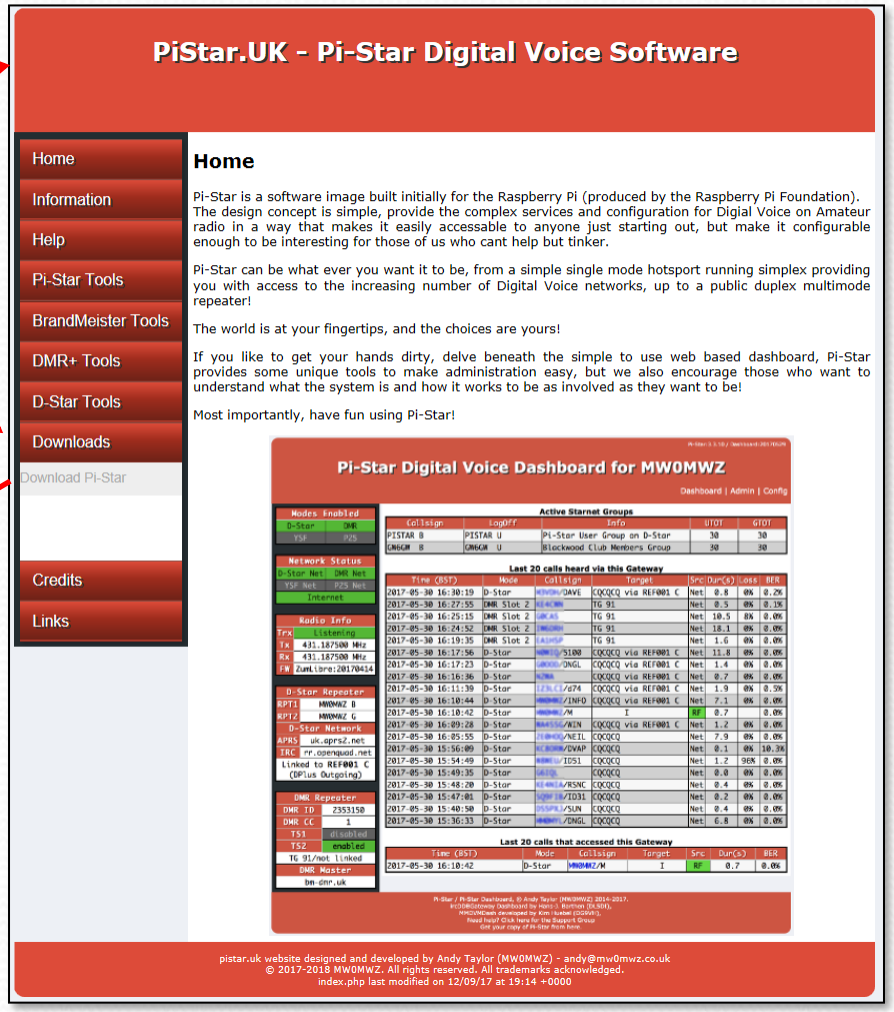
Do this section if you are starting anew with a blank µ-SD card, or you are upgrading to a new version using a new blank card. If you are starting from a kit that came with an imaged card, as long as the image is later than v3.4.11 (and it probably will be) you can skip to Part II.

Download the Pi-Star Image (1)

Go to the following URL:
http://www.pistar.uk/index.php

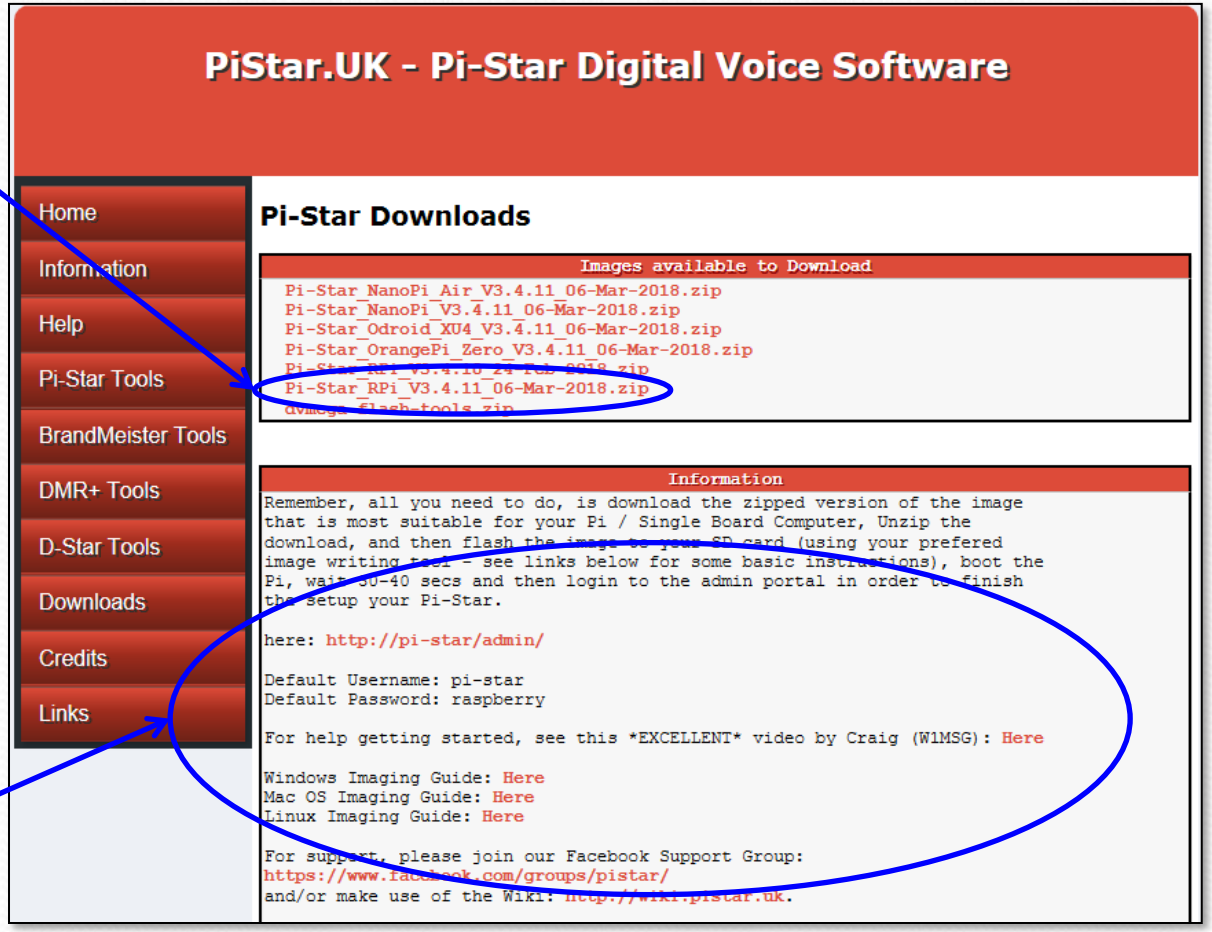
Click: “Downloads”, Click: “Download Pi-Star”





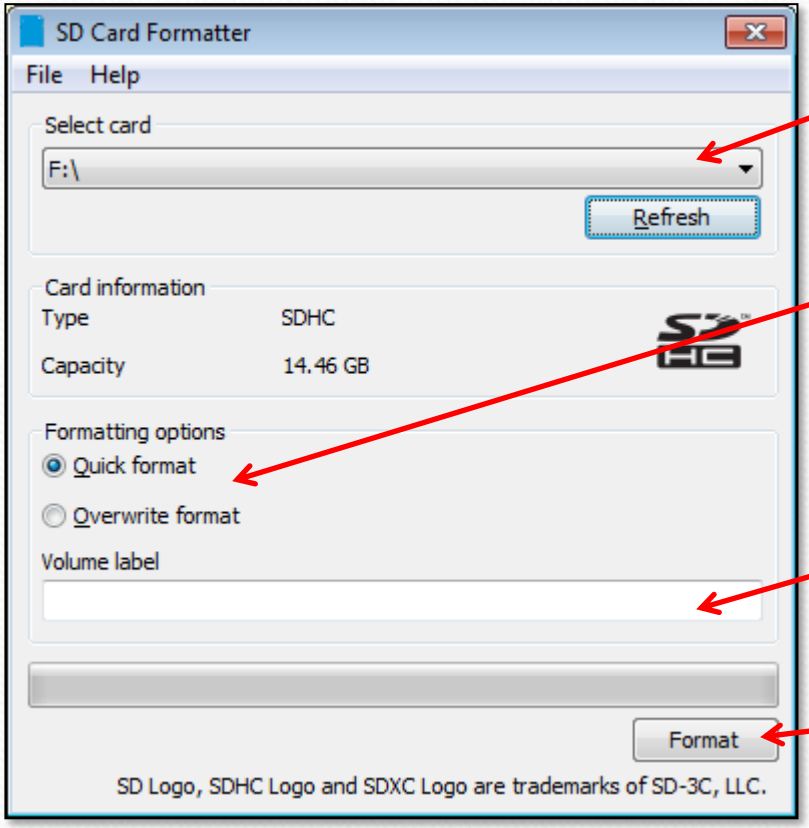
Download the Pi-Star Image (2)

1. Download the file with the name “Pi-Star_Rpi…” and save it somewhere that you will remember.
2. Note this is a “zip’ed” file, you will need to “un-zip” it to get the xxx.img file which you will put on your µ-SD card.
3. Unzip the folder and note the “xxx.img” file (that is what you will use later)
4. Note that there are some other interesting links on this page you may want to look at as well.



Format a blank µSD Card

Use “SDFormatter” to format a µ-SD card prior to loading an image.



1. Set the drive letter for your µ-SD card here

2. Select a format option

3. Leave this blank, the Pi-Star image will change it to “boot” when it loads.

4. Select “Format”

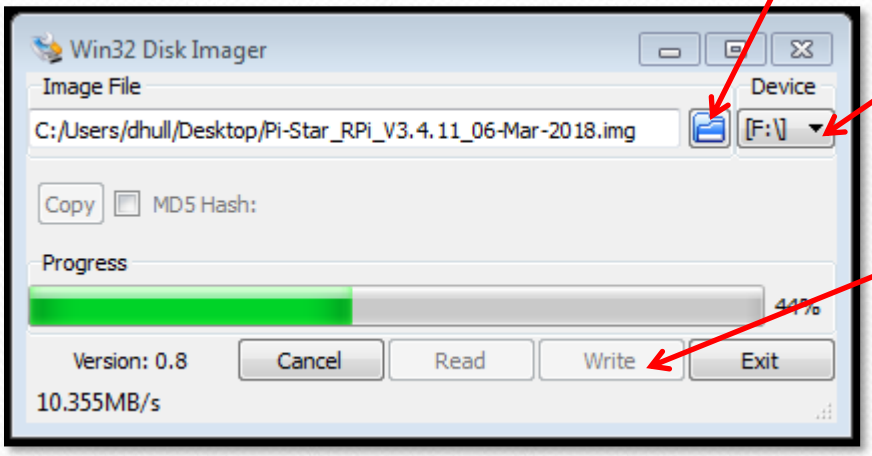
Transferring the image

- The XXX.img file is a compressed µ-SD card image which must be uncompressed by an imager program to create the file structure on the final µ-SD card.
- There are several options out there, here are three that all work very well:
  - Win32 Disk Imager
  - SDImager
  - Etcher

Using Win32 Disk Imager

Option 1: Writing an image to a µ-SD card using “Win32 Imager”.

1. Navigate to your image file (for example): Pi-Star_RPi_V3.4.11_06-Mar-2018.img



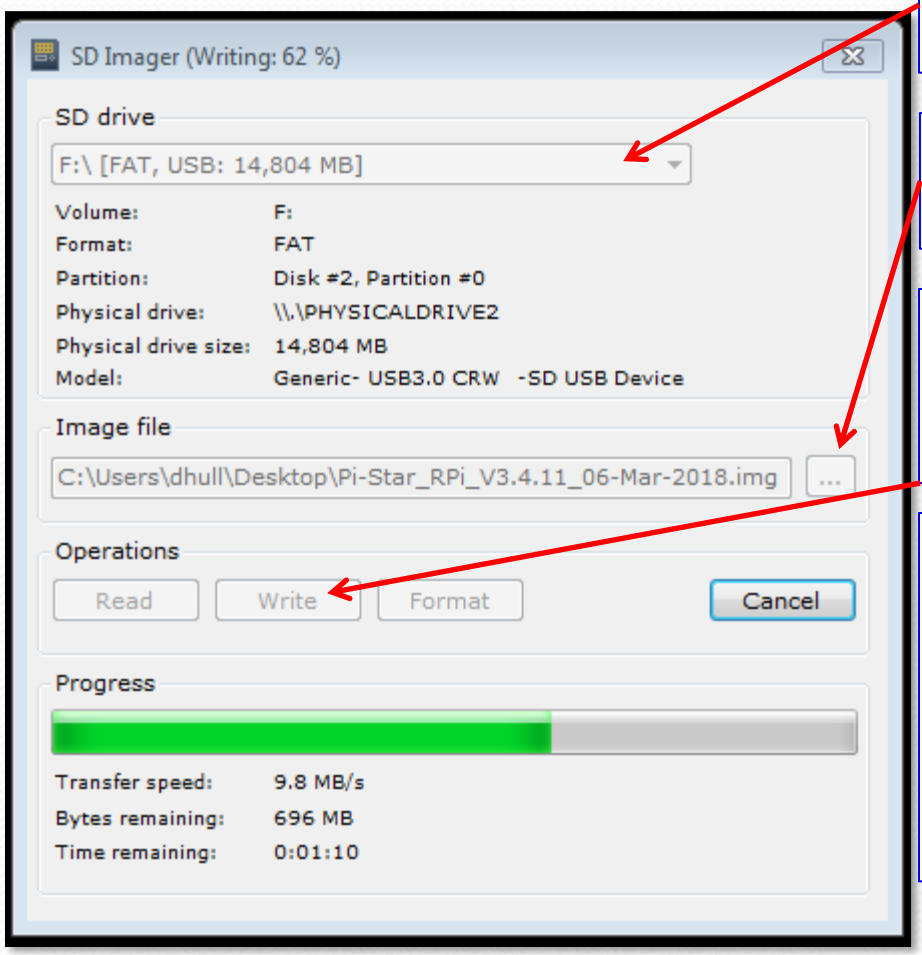
2. Set the drive letter of your µ-SD card: “F” (in this case)

3. Select “Write” and be prepared to wait a while as the green progress bar creeps along.

Note: To back up an image, simply reverse the process: In step 1, designate a the path and filename to a spot on your HDD where you want to save the image, in step 2, select the drive letter for the µ-SD card. Click “Read”. This will copy an image of the card to an .img file on your HDD. You can then use the “Write” process to “clone” another card. Note: I never do this, I always image a new card.

Using SDImager

Option 2: Writing an image to a µ-SD card using SD Imager.



1. Set the drive letter of your µ-SD card: "F" (in this case)

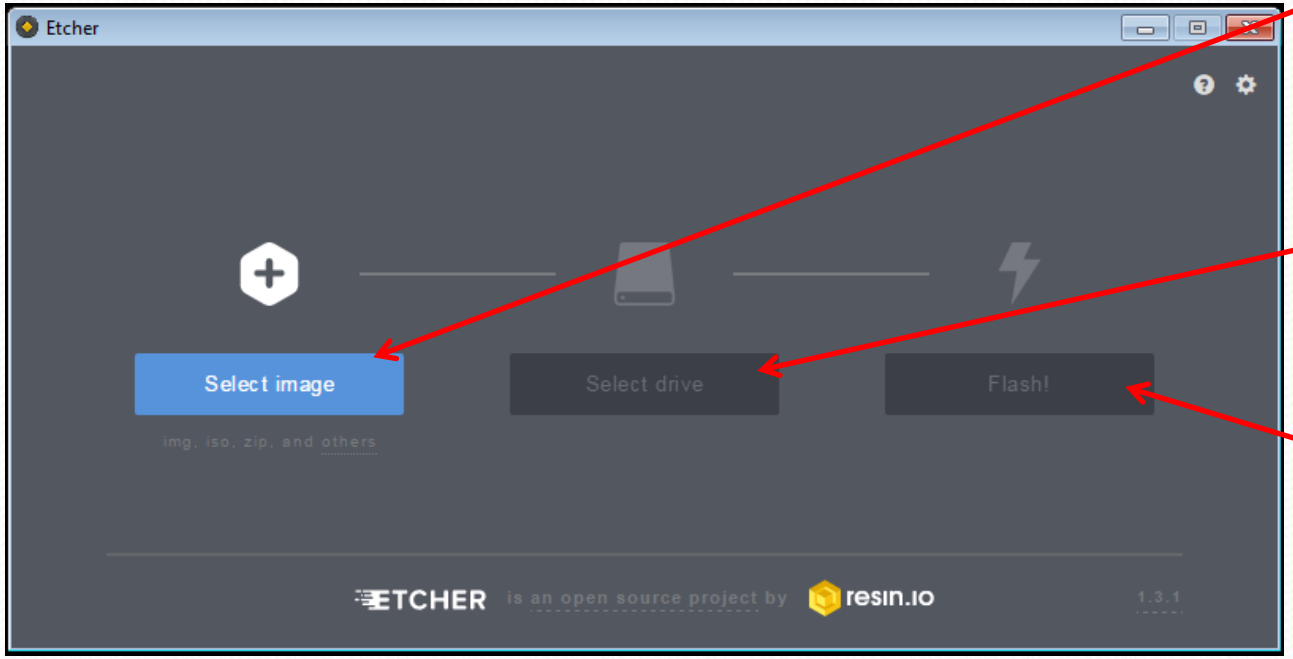
2. Navigate to your image file (i.e.): Pi-Star_RPi_V3.4.11_06-Mar-2018.img

3. Select "Write" and be prepared to wait a while as the green progress bar creeps along.

Note: You can back up an image and clone cards as described for Win32 Disk Imager on the previous slide. Note that this application can also format a card. This application does everything you need.

Using Etcher

Option 3: Writing an image to a µ-SD card using Etcher.



1. Click “Select image and Navigate to your image file (i.e.): Pi-Star_RPi_V3.4.11_06-Mar-2018.img

2. Select the drive letter of your µ-SD card.

3. Click Flash and wait for the process to complete.

This is a nice applet that has a very simple interface that a lot of people like. It also validates the image as part of the flash process *and can be initiated from the .zip file*. I prefer the “portable” version since I can take it with me on a thumb drive.

Websites:

- Win32DiskImager: https://sourceforge.net/projects/win32diskimager/
- SDImager: https://sourceforge.net/projects/sdimager/
- Etcher: https://etcher.io/
- SDFormatter: https://www.sdcard.org/downloads/formatter_4/

ZUMspot/PiStar

Part II

Bringing up ZUMspot/Pi-Star the first time

You now have an imaged card, let's configure pi-star with your customized setup.

Gather up the following:

- Basic ZUMspot kit
  - ZUM Board (w/ Antenna)
  - Raspberry Pi ZeroW (w/ connector)
  - µSD card (w/ Image, v3.4.11 or later)
  - Case (Optional)
- Windows or iOS PC with Internet access
- USB µSD card reader
- WiFI Credentials for at least one WiFi connection (SSID and PSK), DMR ID

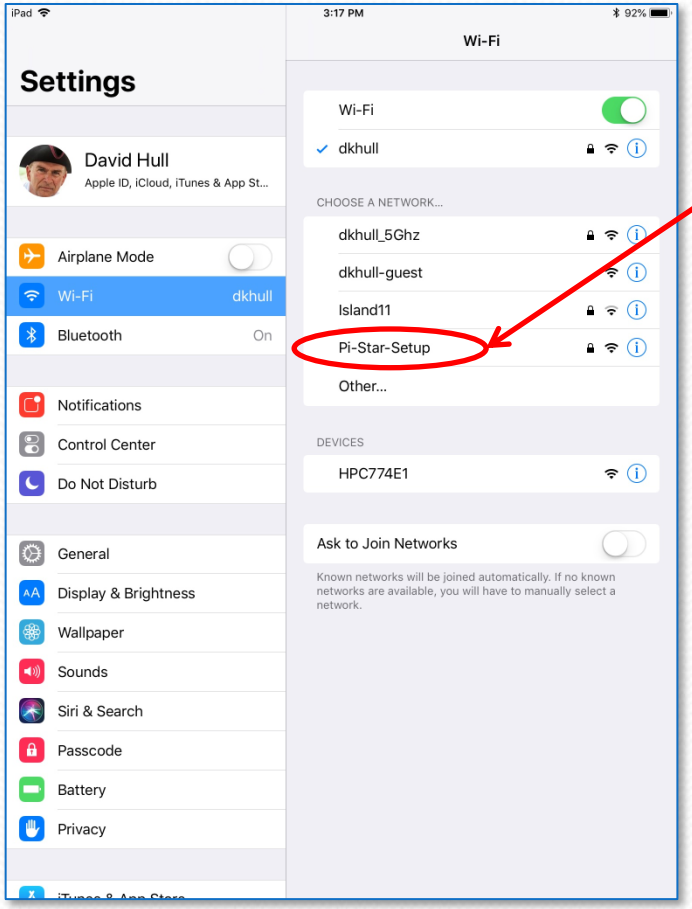
Before you start:

- Install the ZUMspot onto the Raspberry Pi Zero/W – case optional at this point.
- Install The ZUMspot's antenna.
- Install the µSD card you just prepared with the Pi-Star image
- Power up the assembled contraption and wait about 3 minutes for it to complete it's boot sequence.

Pi-Star starts in AutoAP mode

- Pi-Star automatically forms a WiFi access point if it cannot otherwise make a connection after a couple minutes.
- Search for the WiFi network "Pi-Star-Setup" on your PC and join it.
- Point a browser to http://pi-star (PC) or http://pi-star.local (MAC/IOS)
- Log into Pi-Star setup and wait for the Initial Pi-Star info screen.

Example: Pi-Star AutoAP

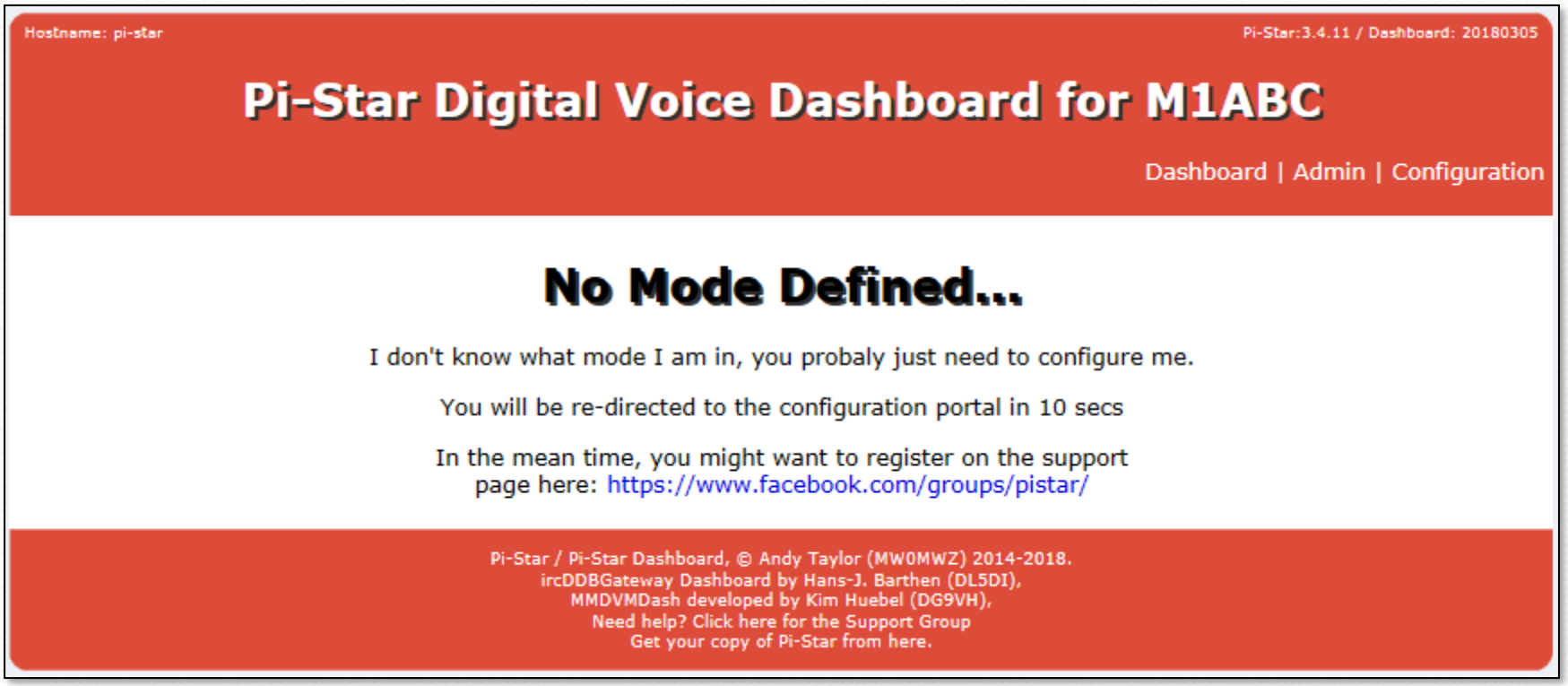


Using a WiFi enabled device (iPhone, iPad, PC etc.) you should see that Pi-Star has formed a WiFi network called “Pi-Star-Setup”. This should appear as one of your WiFi options after 2 to 3 minutes as shown here (on an Apple iPad). Join this network (PW: raspberry).

Point the browser to “http://pi-star.local” (iOS) or “http://pi-star” (Windows) as described on the previous page and log onto your Pi-Star.

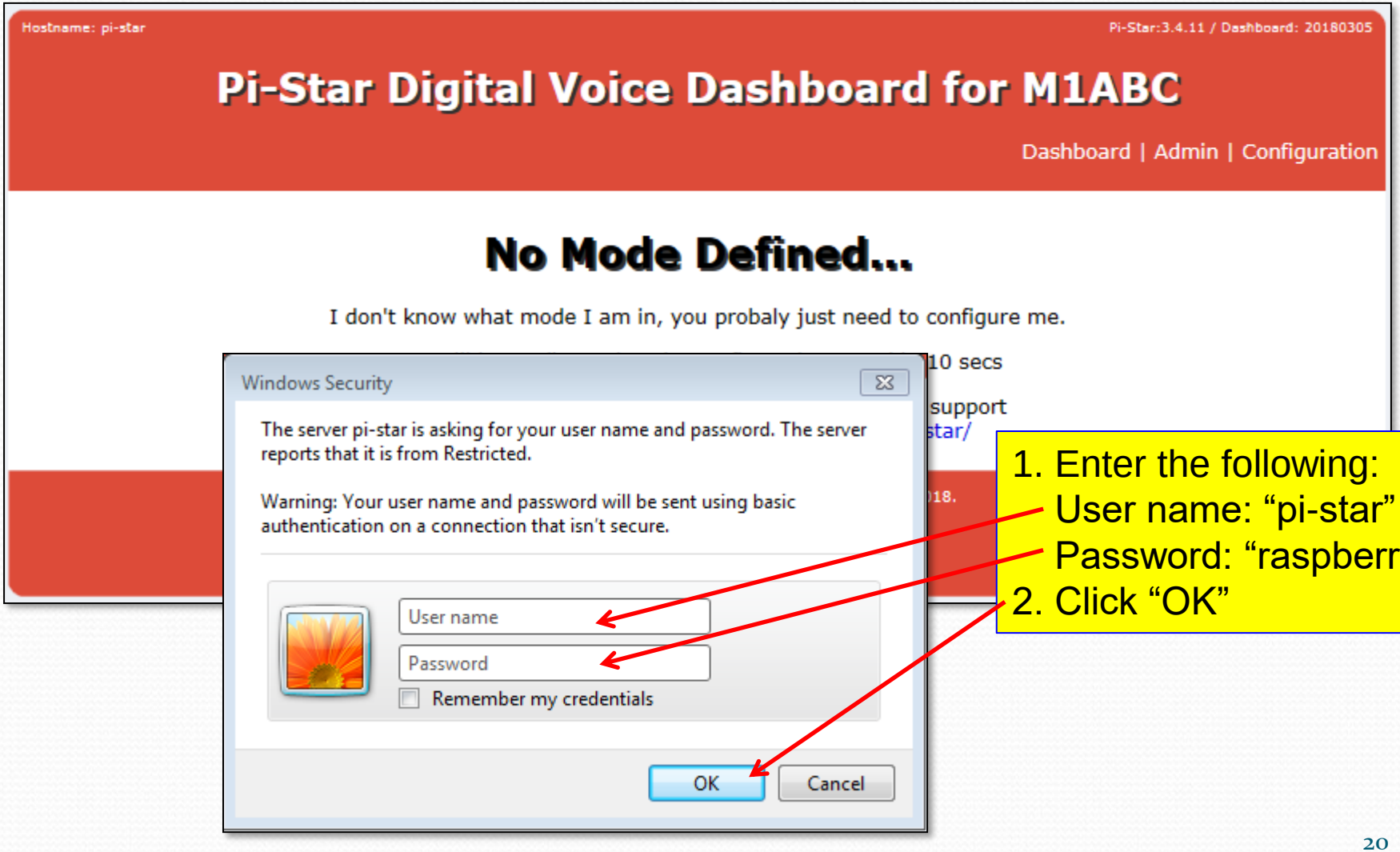
Once log’ed on, you should see the Initial Pi-Star info screen shown on the next page. Proceed to set up Pi-Star as directed below. Make sure that you set up at least one WiFi account when directed toward the end so you can connect your hot spot.

Initial Pi-Star Info Screen:

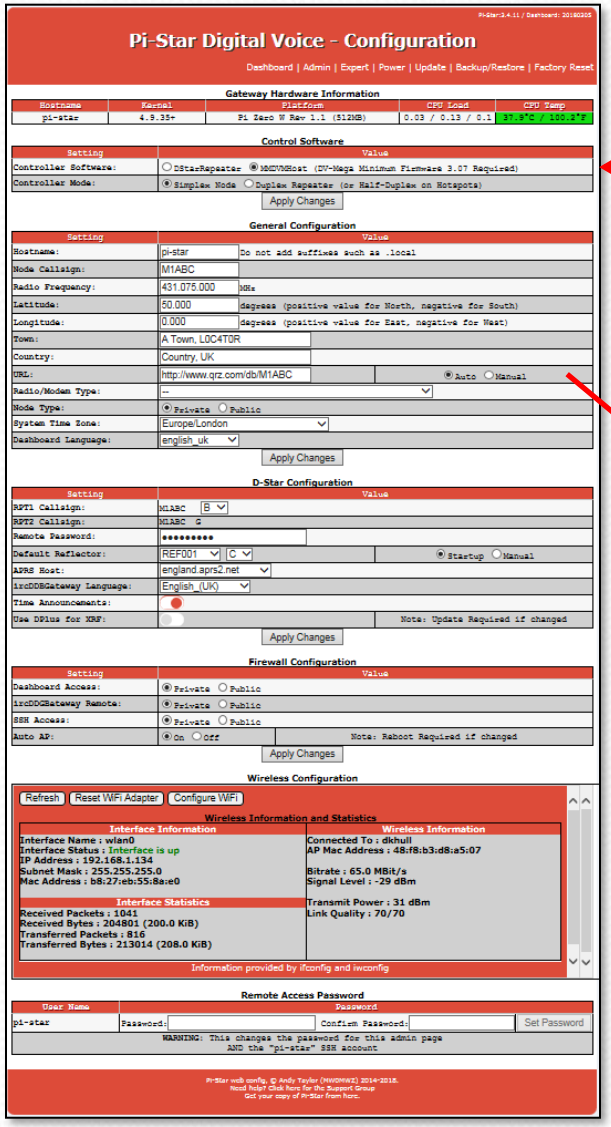


Wait about 10 seconds for the security pop-up to appear.

Windows Security Pop-Up:

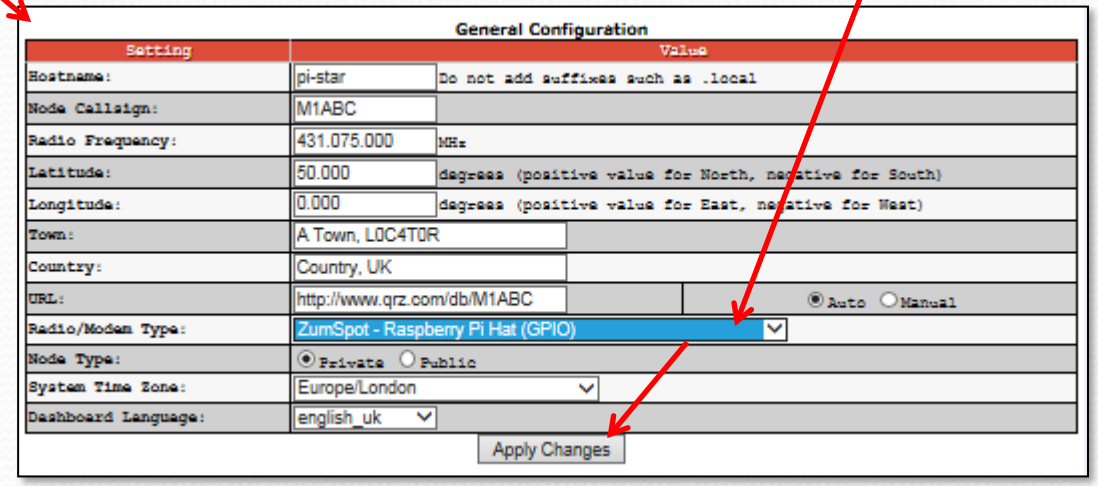


Pi-Star Configuration Screen:



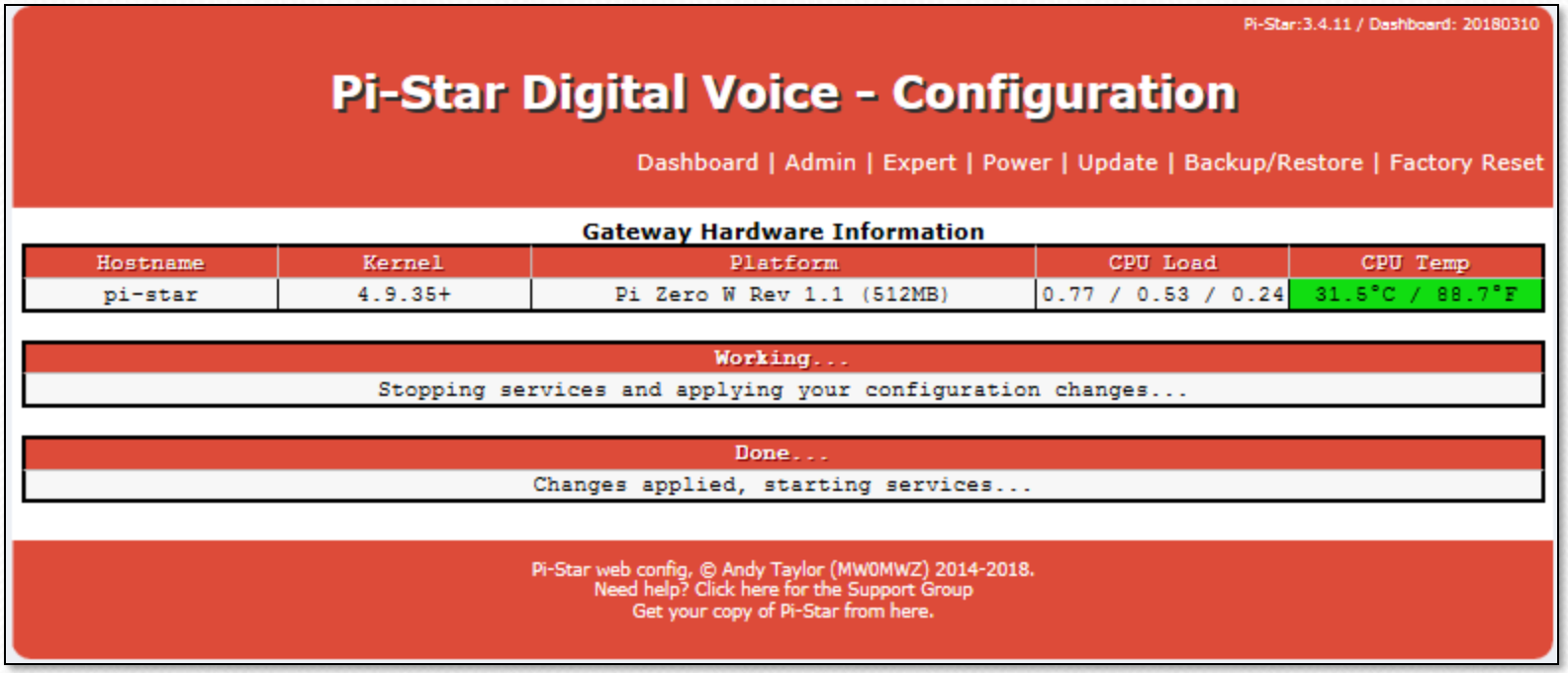
This will bring you the “Pi-Star Configuration Screen” to the right. The default setup is probably going to show DSTAR.

In the “General Configuration” block, select “ZUMspot – Raspberry Pi Hat (GPIO)” as the Radio/Modem Type and click “Apply Changes”

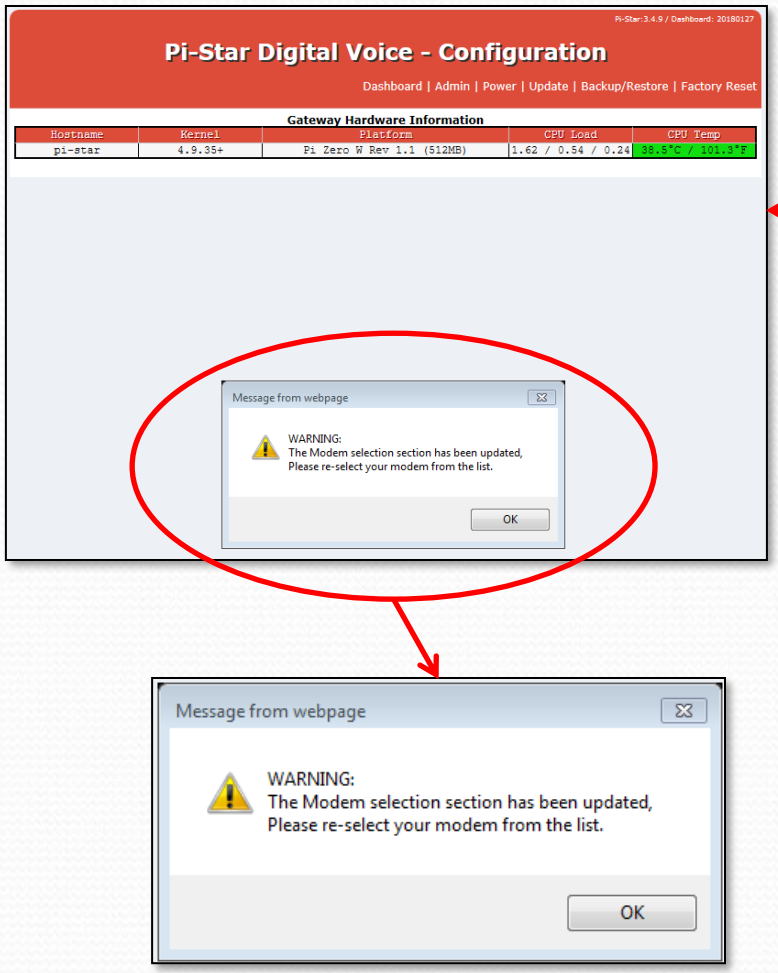


Pi-Star Apply Changes Notice

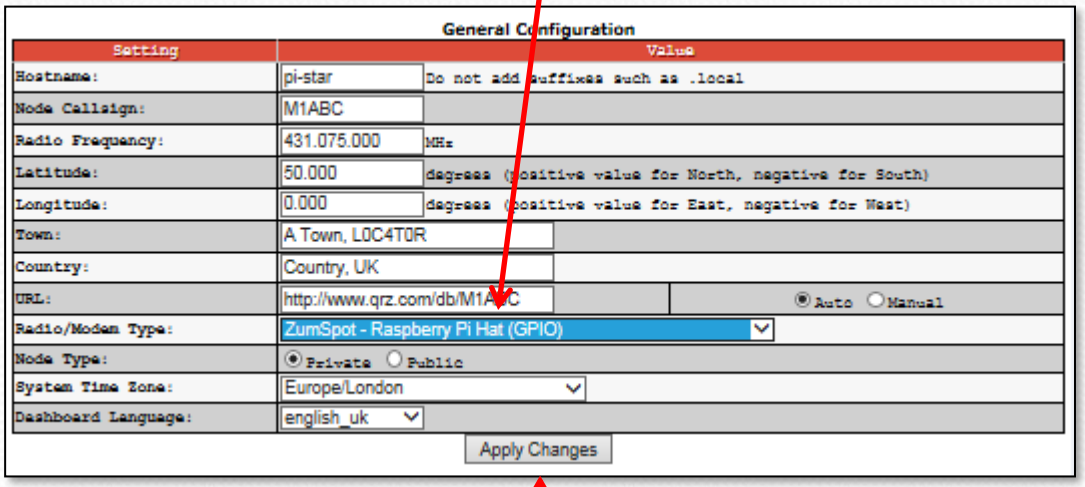
After clicking “Apply Changes”, please wait for Pi-Star to go through it’s update and re-set process. This screen comes up 20 seconds or so after applying new changes followed shortly by the return of the configuration screen with the new changes applied. You will do this several times during this setup and will need to wait out this cycle each time.



Modem Warning Pop-Up:

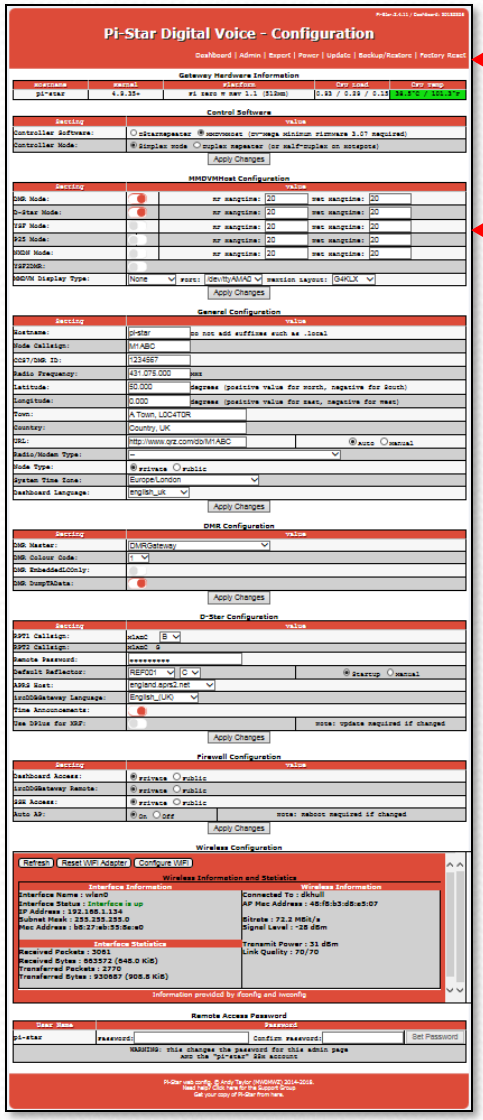


Once this first reset cycle completes, you will probably be greeted with a message asking you to re-select your modem from the drop-down list. If so, select “ZUMspot – Raspberry Pi Hat (GPIO)” again.



After re-entering the Modem Type, click “Apply Changes” once again and let it reset.

Pi-Star Configuration Screen:



The new configuration screen will look something like this: There will be is a new block now that represents the Capabilities of the "ZUMspot – Raspberry Pi Hat (GPIO)" that is installed atop your Raspberry Pi Zero/W.

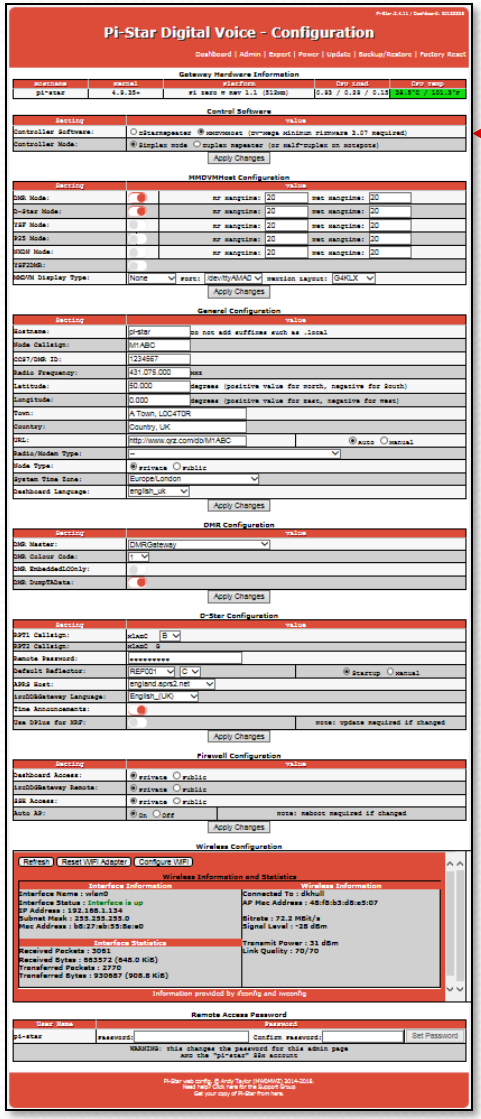
MMDVMHost Configuration

Setting	Value				
DMR Mode:		RF Hangtime:	20	Net Hangtime:	20
D-Star Mode:		RF Hangtime:	20	Net Hangtime:	20
YSF Mode:		RF Hangtime:	20	Net Hangtime:	20
P25 Mode:		RF Hangtime:	20	Net Hangtime:	20
NXDN Mode:		RF Hangtime:	20	Net Hangtime:	20
YSF2DMR:					
YSF2NXDN:					
YSF2P25:					
DMR2YSF:		Uses 7 prefix on DMRGateway			
DMR2NXDN:		Uses 7 prefix on DMRGateway			
MMDVM Display Type:	OLED	Port:	/dev/ttyAMA0	Nextion Layout:	G4KLX

Apply Changes

Here is where you will tell your ZUMspot/Pi-Star what you want it to do for you. Most can leave it as is since DMR and DSTAR is what many will want. If you want YSF (Fusion), APCO P25 and/or YSF2DMR, turn these on. A new configuration block for each will appear (once you click "Apply Changes") and the system does it's reset.

Pi-Star Control SW Setup:



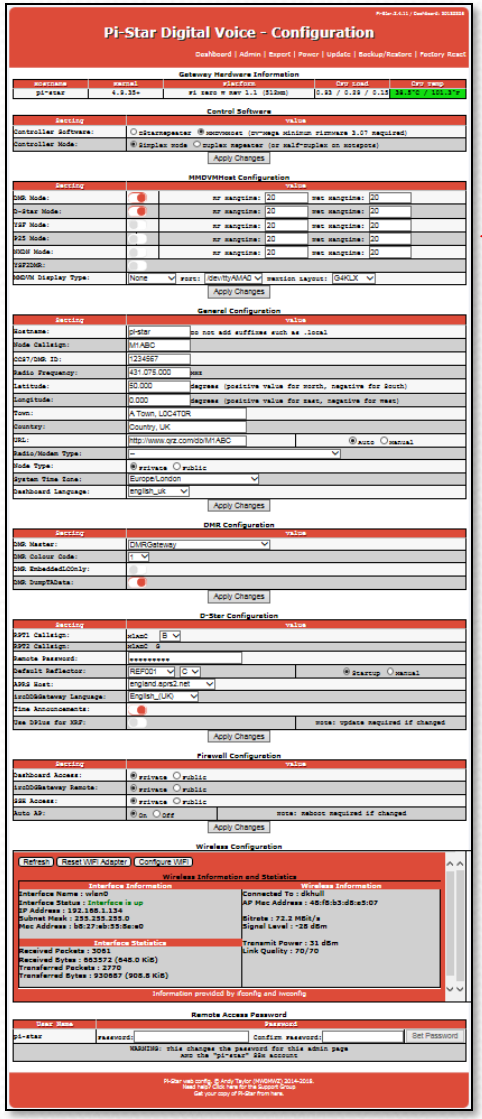
Control Software

Setting	Value
Controller Software:	○ DStarRepeater ◉ MMDVMHost (DV-Mega Minimum Firmware 3.07 Required)
Controller Mode:	◉ Simplex Node ○ Duplex Repeater (or Half-Duplex on Hotspots)

Apply Changes

Make sure your “Control Software” Section is set up as Shown above. The default should be good. If you change Something, remember to click “Apply Changes” and wait for the reset cycle to complete and the new changes to appear.

Pi-Star MMDVM Host Setup:



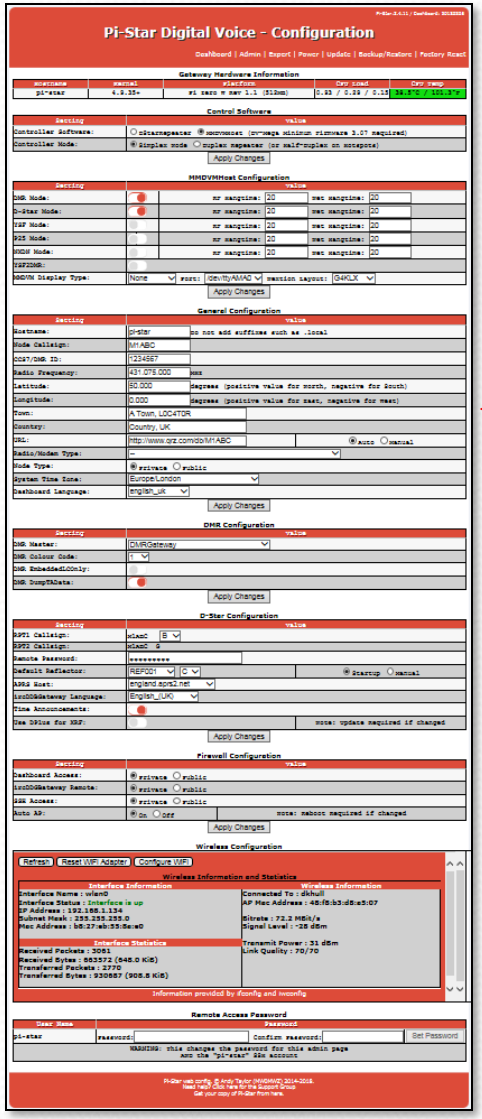
MMDVMHost Configuration

Setting	Value				
DMR Mode:		RF Hangtime:	20	Net Hangtime:	20
D-Star Mode:		RF Hangtime:	20	Net Hangtime:	20
YSF Mode:		RF Hangtime:	20	Net Hangtime:	20
P25 Mode:		RF Hangtime:	20	Net Hangtime:	20
NXDN Mode:		RF Hangtime:	20	Net Hangtime:	20
YSF2DMR:					
YSF2NXDN:					
YSF2P25:					
DMR2YSF:		Uses 7 prefix on DMRGateway			
DMR2NXDN:		Uses 7 prefix on DMRGateway			
MMDVM Display Type:	OLED	Port:	/dev/ttyAMA0	Nextion Layout:	G4KLX

Apply Changes

Here is where you will select the communications options that you want your ZUMspot/Pi-Star setup to support. Mine (shown here) is set up for DMR, DSTAR and YSF (Fusion). You have to have at least one mode enabled. The ZUMspot/Pi-Star device will “scan” whatever modes are enabled here. You can change the scan dwell and hang times as desired. The defaults are 20 seconds as Shown above. Click “Apply Changes” when done. NOTE: The image shown here reflects the features in v3.4.15.

Pi-Star General Config. Setup:



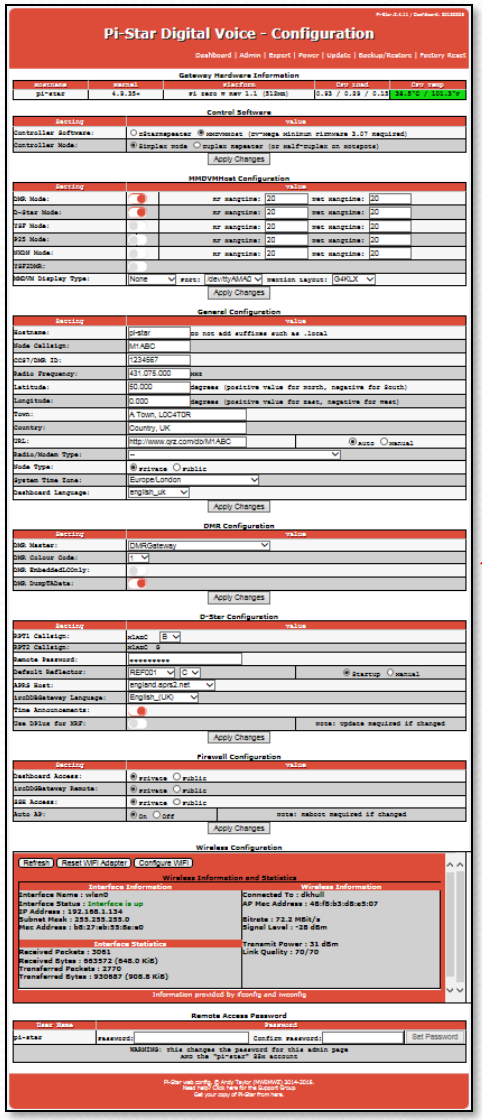
General Configuration

Setting	Value	
Hostname:	pi-star	Do not add suffixes such as .local
Node Callsign:	KC6N	
CCS7/DMR ID:	3106564	
Radio Frequency:	439.025.000	MHz
Latitude:	32.717	degrees (positive value for North, negative for South)
Longitude:	-117.16	degrees (positive value for East, negative for West)
Town:	San Diego, CA	
Country:	USA	
URL:	http://www.qrz.com/db/KC6N	Auto / Manual
Radio/Modem Type:	ZumSpot - Raspberry Pi Hat (GPIO)	
Node Type:	Private / Public	
System Time Zone:	America/Los_Angeles	
Dashboard Language:	english_us	

Apply Changes

Here is where you will customize Pi-Star for your station. Add your Callsign, DMR ID, set the Zum/Pi Operating Frequency, etc. “Node Type” determines whether the Zum/Pi responds only to your DMR ID or any DMR ID – set “Public” if you expect multiple radios with different ID’s to use your hot spot Click “Apply Changes” and wait for the reset cycle to complete.

Pi-Star DMR Config. Setup:



Set up the DMR specifics here. Select your DMR Master Server, set your Color Code, etc. Turning on the last switch will allow your ZUM/Pi to pass Talker Alias data to your radio, if it supports it (Hytera, MD-380 w/tools). Click “Apply Changes” when done.

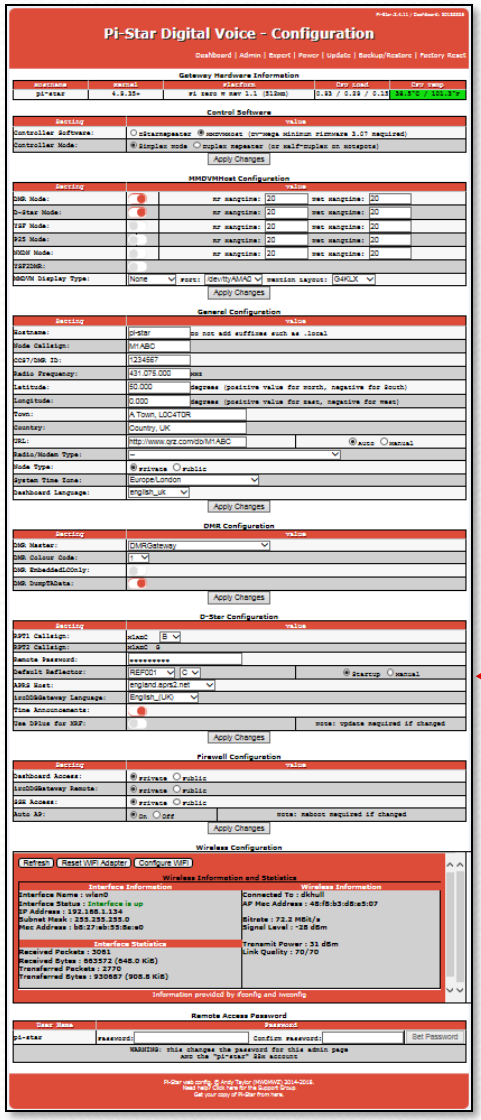
DMR Configuration

Setting	Value
DMR Master:	BM_United_States_3103
BrandMeister Network:	Repeater Information | Edit Repeater (BrandMeister Selfcare)
DMR Color Code:	1
DMR EmbeddedLCOnly:	
DMR DumpTAData:	

Apply Changes

Note: This block may initially come up looking a bit different. Once you Apply Changes it should return looking like this once the reset cycle completes.

Pi-Star DSTAR Config. Setup:



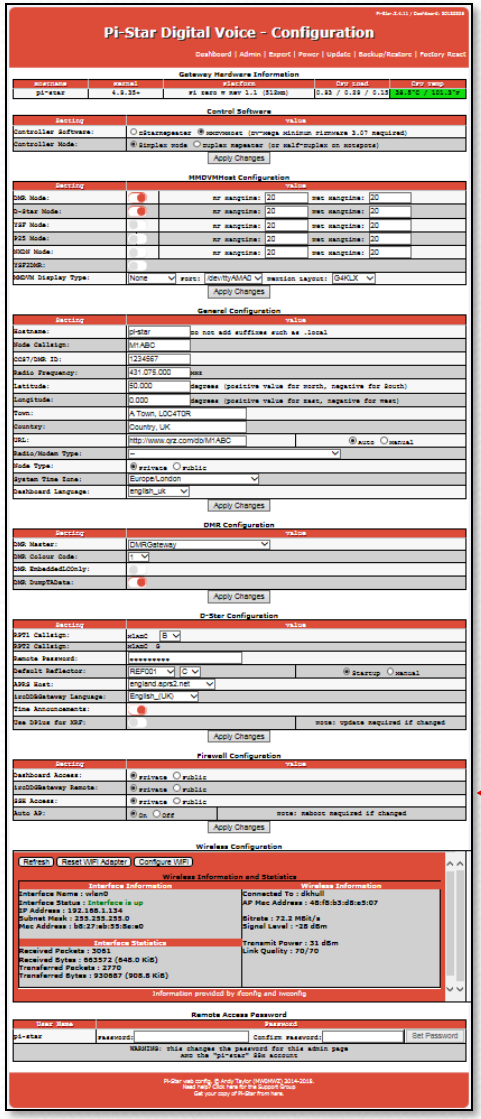
Set up the DSTAR specifics here. Enter your RPT1 module letter (“B” in most cases). RPT2 will be generated for you. DO NOT change the Remote Password. Set a default reflector (this is where your DSTAR configuration will land on startup). Pick an APRS Host and language. Turn on Time Announcements (optional). Leave “Use DPlus for XRF” off for now (there is info later on what to do with this switch). Click “Apply Changes” when done.

D-Star Configuration

Setting	Value	
RPT1 Callsign:	KC6N B	
RPT2 Callsign:	KC6N G	
Remote Password:	●●●●●●●●●	
Default Reflector:	REF012 A	Startup / Manual
APRS Host:	socal.aprs2.net	
ircDDBGateway Language:	English_(US)	
Time Announcements:		
Use DPlus for XRF:		Note: Update Required if changed

Apply Changes

Pi-Star Firewall Config. Setup:



These settings determine who can see your ZUMspot.
I set all of these to private. If this pi-star were running on an MMDVM driving a multi-mode repeater you might Want to make some of these public. But for a private node, I'd keep them private.

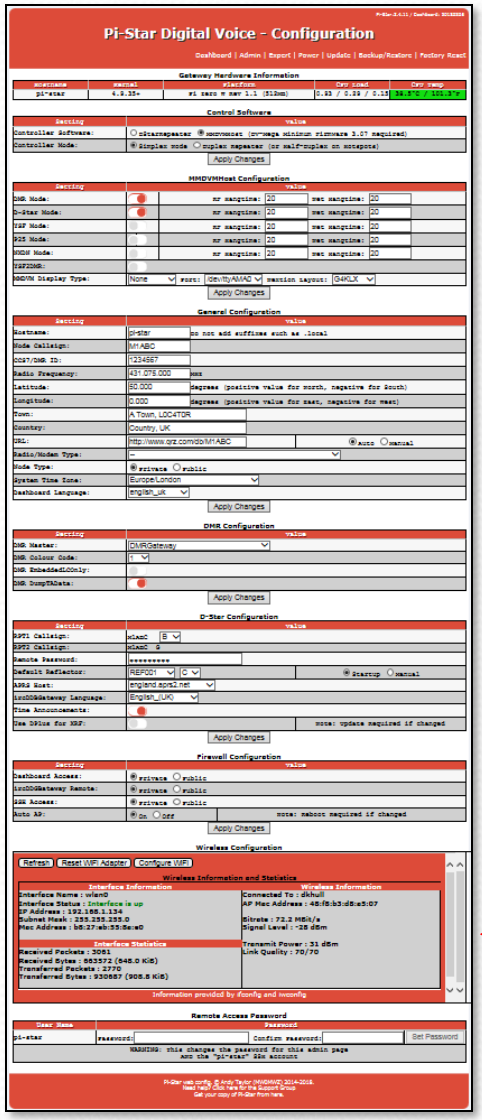
AutoAP: When set to "On" (default) the ZUMspot will automatically revert to "access point" mode if it finds no accessible WiFi networks. This allows direct programming of the ZUMspot WiFi as we are doing here.

Firewall Configuration

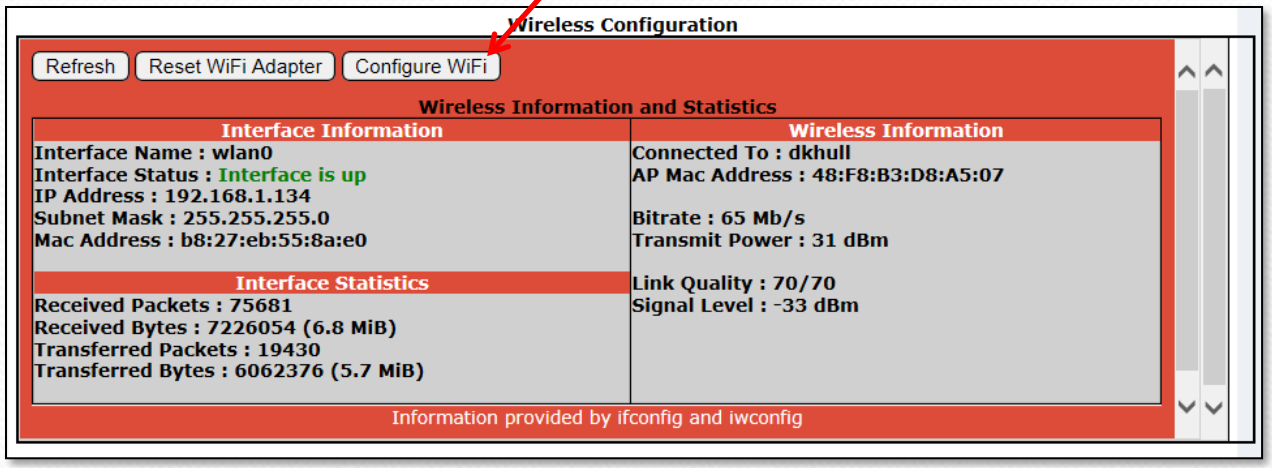
Setting	Value	
Dashboard Access:	(•) Private ( ) Public	
ircDDGBateway Remote:	(•) Private ( ) Public	
SSH Access:	(•) Private ( ) Public	
Auto AP:	(•) On ( ) Off	Note: Reboot Required if changed

Apply Changes

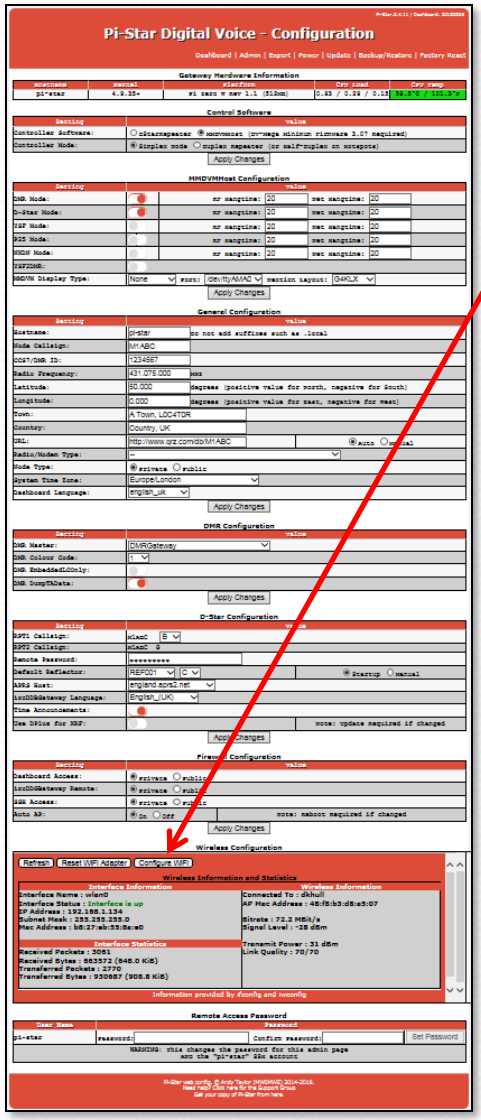
Pi-Star Wireless Setup:



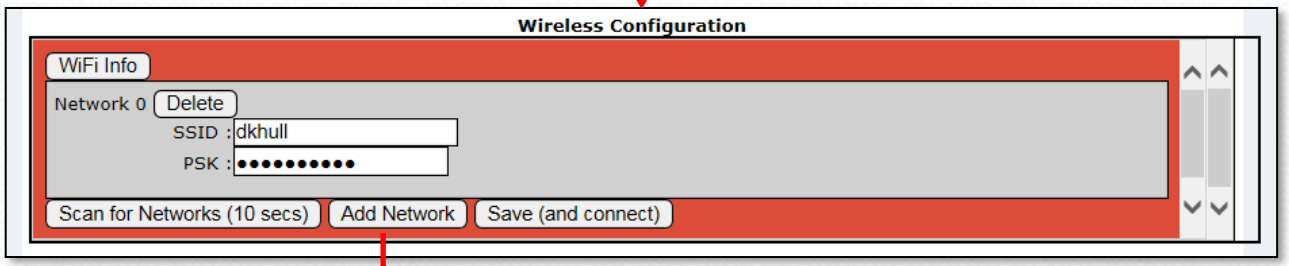
This area shows you what your WiFi is doing. At this Point your Pi-Star is operating in “Auto AP” mode and there should be no WiFi network specified. At this point you need to click “Configure WiFi” to add one (or more) SSID/PSK pairs to so your ZUM/Pi can connect to a WiFi network. You can set up for your home, your Phone, your wife’s phone, etc. Pi-Star will sequentially hunt for an available WiFi network.

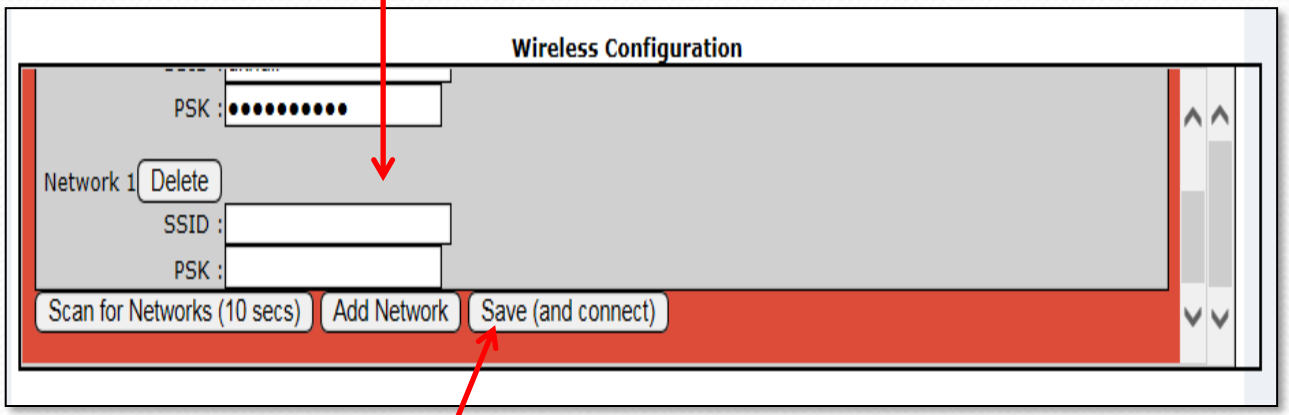


Pi-Star adding additional WiFi:



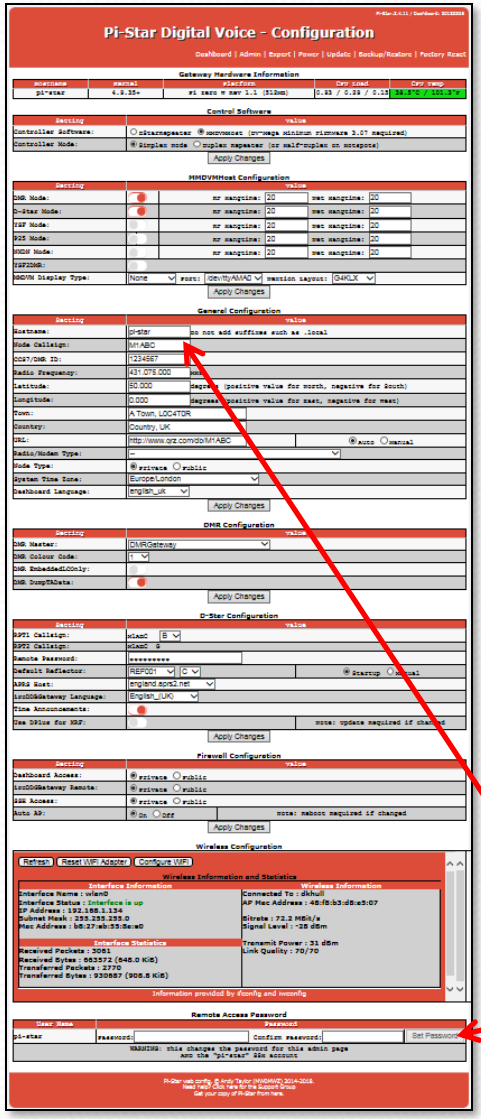
Click “Configure WiFi” then Click “Add Network” to open up the add network dialogue. Add the additional SSID and PSK for the new network. Repeat as needed.





Click “Save and Connect” when done.

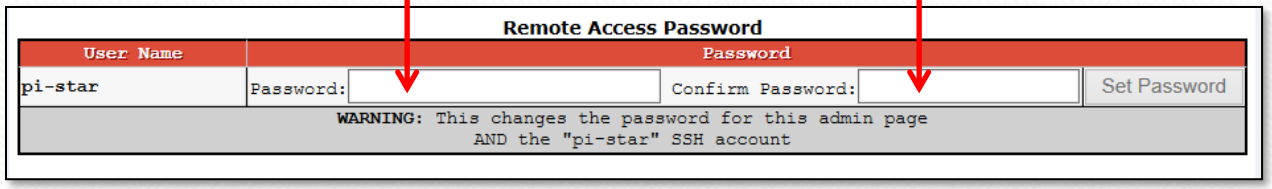
Pi-Star Password Setup:



This dialog allows you to personalize your Pi-Star Credentials by changing the password. Initially your Credentials are:

HostName: “pi-star”
Password: “raspberry”

Here you can customize your log on credentials.



Your HostName is set at the top of the General Configuration block.

Change Password here if you want something different.

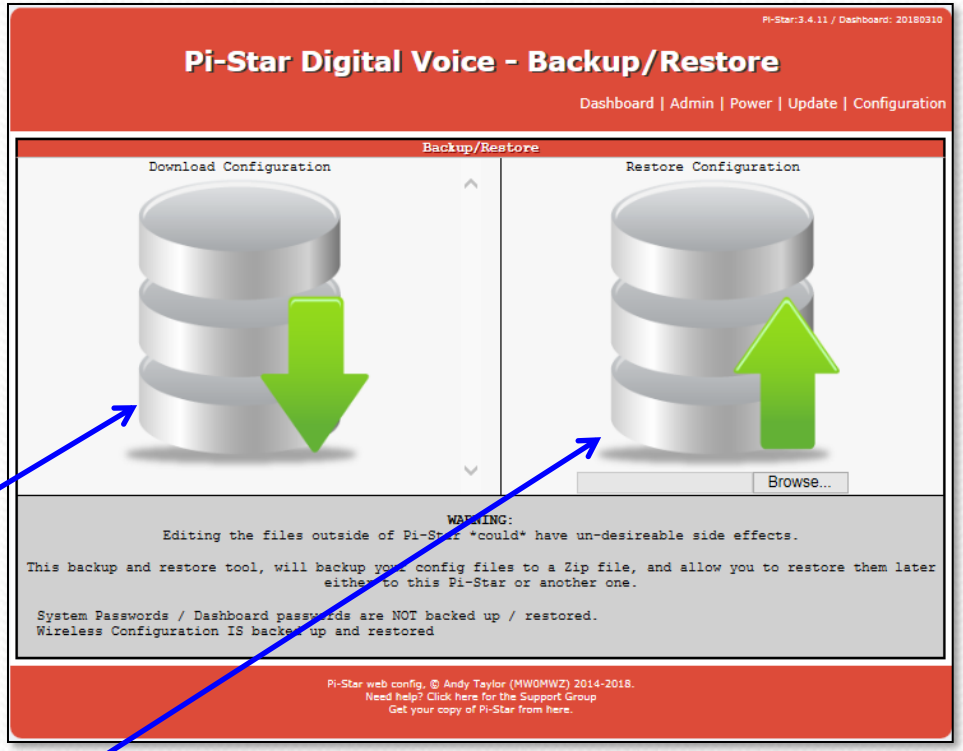
Pi-Star Backup/Restore:

Now that you have everything set up, it would be a good idea to back up your configuration.

Selecting “Backup/Restore” at the top of the configuration page will bring up the dialog shown on the right.

Select “Download Configuration” which will create a “zip” file containing all the information you just so painstakingly entered. Save this file somewhere you will remember (you can rename it if you like).

Later you can restore the configuration by referencing the file in the RH plane and clicking the green up arrow.



Note: if you have a previous back-up “zip” file stored, you can skip everything in this section and just copy that “zip” file to the boot sector of a newly imaged µSD card if you like.

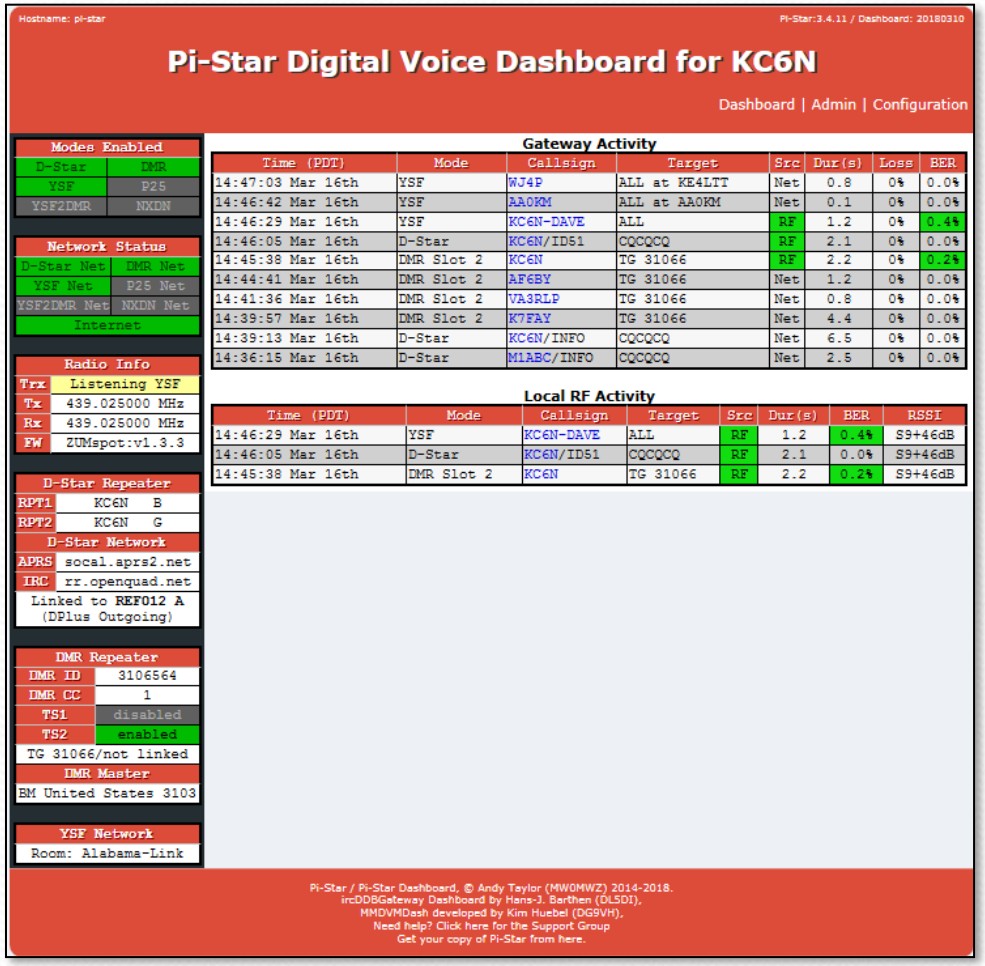
Pi-Star Dashboard:

At this point you are done. Click “Dashboard” at the top of the page to switch to see your customized landing page.

This is the page that will come up when you call up http://pi-star or http://pi-star.local from your browser.

Your “Gateway Activity” and “Local RF Activity” lists may be empty at first, but will fill out as time progresses.

There is no “Log-In” needed for this page.



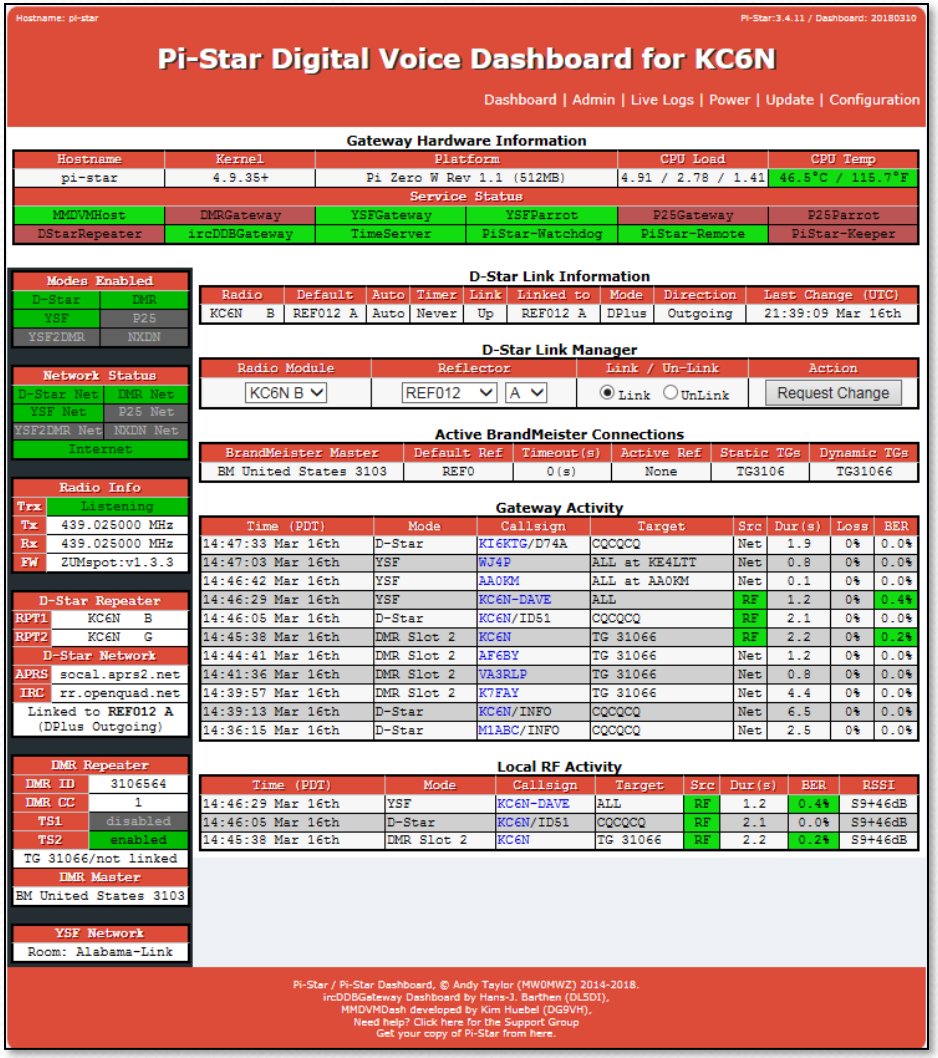
Pi-Star Admin Dashboard:

Click “Admin” at the top of the page to switch to see your “Admin” page. You will need to provide your credentials to get here:

UN: pi-star
PW: raspberry

Assuming you haven’t changed from the defaults.

There are various other options:
Live Logs: allows you to start a log
Power let’s you power down and reboot
Update: initiates a SW refresh
Configuration: we already looked at



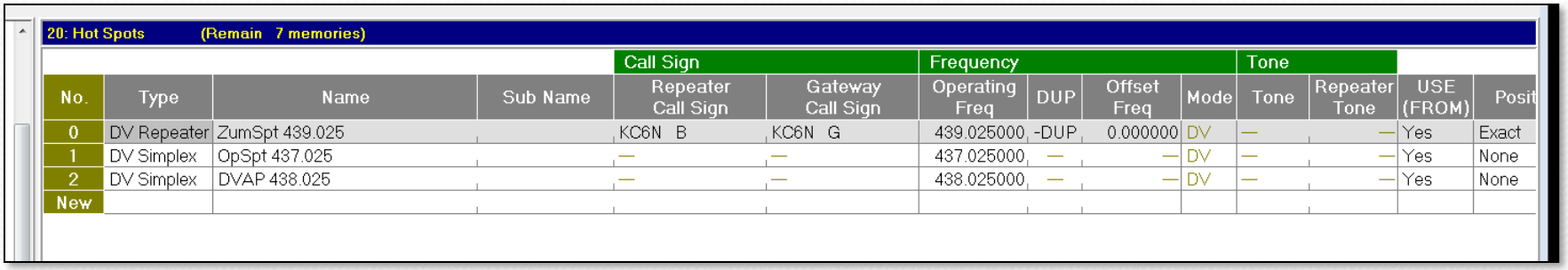
ZUMspot/PiStar

Part III

Setting up your radios

DSTAR (ID-51 example):

For DSTAR, you need to create a channel in the form of a DV Repeater with the receive frequency being your ZUMspot frequency (439.025 MHz in this case), set –DUP (or +DUP will work as well) and an Offset Frequency of “0.00” as shown below. Add your RPT1 callsign (KC6N^^^B in my case) and your RPT2 callsign (KC6N^^^G in my case). You should also fill out the remainder of the channel information including the geographic coordinates which will allow your hot spot to show up in your Near Repeater search.



20: Hot Spots (Remain 7 memories)

				Call Sign		Frequency				Tone			
No.	Type	Name	Sub Name	Repeater Call Sign	Gateway Call Sign	Operating Freq	DUP	Offset Freq	Mode	Tone	Repeater Tone	USE (FROM)	Posit
0	DV Repeater	ZumSpt 439.025		KC6N B	KC6N G	439.025000	-DUP	0.000000	DV	—	—	Yes	Exact
1	DV Simplex	OpSpt 437.025		—	—	437.025000	—	—	DV	—	—	Yes	None
2	DV Simplex	DVAP 438.025		—	—	438.025000	—	—	DV	—	—	Yes	None
New													

Note that I also have an OpenSpot and a DVAP each of which can be set as a simple simplex channel as shown but the ZUMspot/Pi-Star requires a duplex setup as shown above. This is an Icom ID-51 Plus example.

DMR:

- Duplicate a Zone in your radio
- For each channel in the new Zone:
  - Set TX and RX to the ZUMspot frequency
  - Set the Color Code to “1”
  - Set the Time Slot for all channels to “2”
  - Set Admit Criteria to “Always”
  - Set the Talk Group (Group Call Code) to the TGID you want.

Yaesu System FUSION:

- Set up a channel in your radio that is simplex on the ZUMspot Frequency
- That's it.
- None of the HotSpots do Wires-X
- The latest versions (3.4.12 and later) support FCS reflectors.
- There is no hotspot access to WiresX (complain to Yaesu)

APCO Project 25 (P25):

- Using Motorola terminology here:
- Build a personality in your radio with a simplex channel on your hot spot frequency for each of your reflectors.
- Make sure that the NAC on your Hot Spot agrees with your radio (probably 293).
- Build a zone referencing each of these channels – pretty much the same as DMR

NXDN:

- I do not have an NXDN radio but there is information herein on how to access this mode via cross-mode from Yaesu System Fusion and DMR radio.
- One thing you will need is an NXDN ID. Follow the instructions found here: http://nxmanager.weebly.com/
- NXDN provides a “Talker Alias” feature, it is recommended that you turn that on and add your Ham Radio Callsign.

ZUMspot/PiStar

Appendix A

Communicating with your ZUMspot

The computer that you want to use to control the ZUMspot must be joined to the same WiFi network that the ZUMspot is joined to. Be careful of firewalls, routers etc.

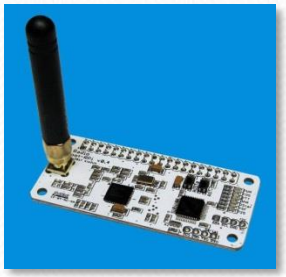
Communicating with ZUMspot

- In order to log onto your ZUMspot, your computer must be operating in the same WiFi domain as your ZUMspot
- Next page shows all devices logged into “MyHomeWiFi” so all can reach ZUMspot
- The subsequent page shows two domains, MyHomeWiFi and My iPhone. ZUMspot is on My iPhone so it cannot be seen by devices operating in the MyHomeWiFi domain.

Communicating with ZUMspot

Domain is:
MyHomeWiFi

Home desktop connected to "MyHomeWifi"



ZUMspot connected to "MyHomeWifi"

SSID: MyHomeWifi
PW: cth23kypo71j5

Devices wanting to talk to the ZUMspot must be logged into The same internet domain as the ZUMspot as shown. Both computers can communicate with the ZUMspot here.

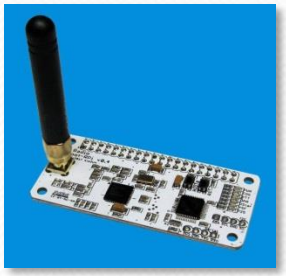
Laptop connected to "MyHomeWifi"

Communicating with ZUMspot

Domain is:
MyHomeWiFi

Home Desktop connected to "MyHomeWifi" (cannot reach ZUMspot)

SSID: MyHomeWifi
PW: cth23kypo71j5



ZUMspot connected to "My iPhone"

Laptop connected to My iPhone (can reach ZUMspot)

SSID: My iPhone
PW: xyzzy3256jjy

Domain is:
My iPhone

A couple other things:

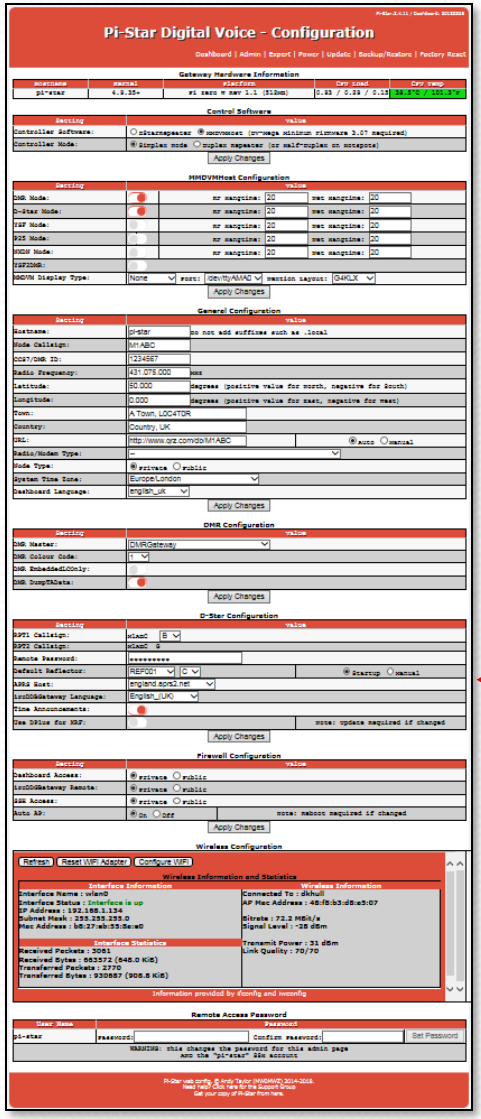
- Be careful about Typo's in your WiFi SSID and Password this can cause problems.
- Be careful about "Guest" Networks these networks do not necessarily allow you to reach a control computer that is also in the "Guest" network, creating a problem similar to that on the previous page.

ZUMspot/PiStar

Appendix B

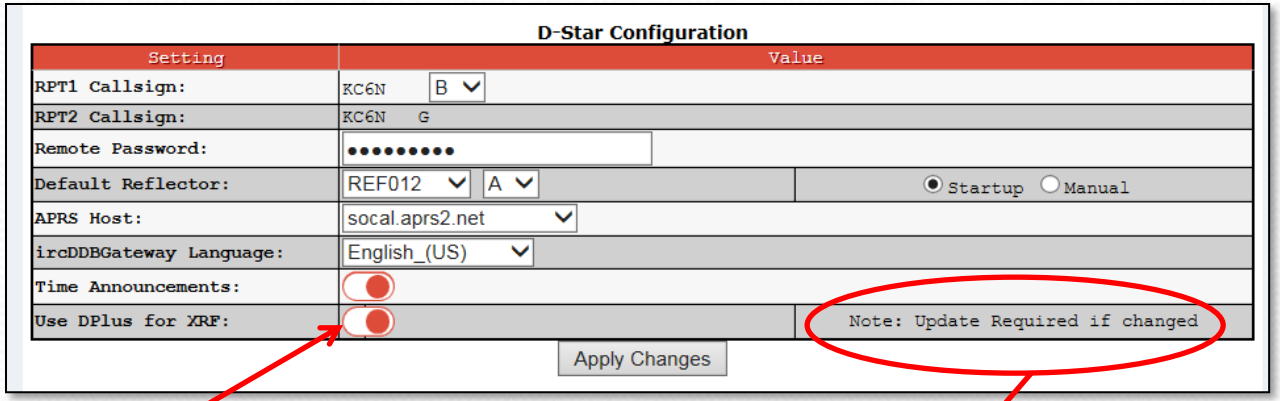
Setting the “Use DPlus for XRF” switch

Pi-Star DSTAR XRF012A Setup:



To make sure that you can work “X” reflectors such as XRF012A (w/o the need for passing ports on your router), Turn on “Use Dplus for XRF” (this forces the system to use the “Dplus” protocol for the XRF reflectors). You will need to do an “update” after applying this change.
Click “Apply Changes” when done then do an “update”.

“Update” can be found at the top of the configuration page (note that it may run for a while).

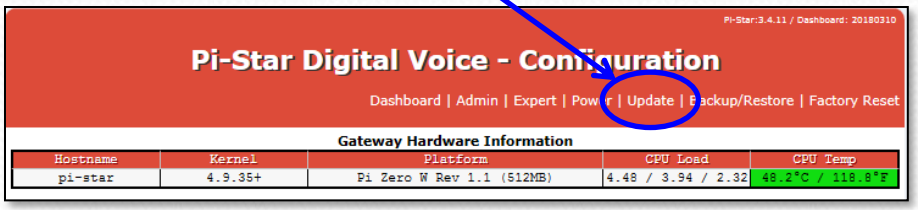


Set “Use DPlus for XRF” to “ON”

Do an Update

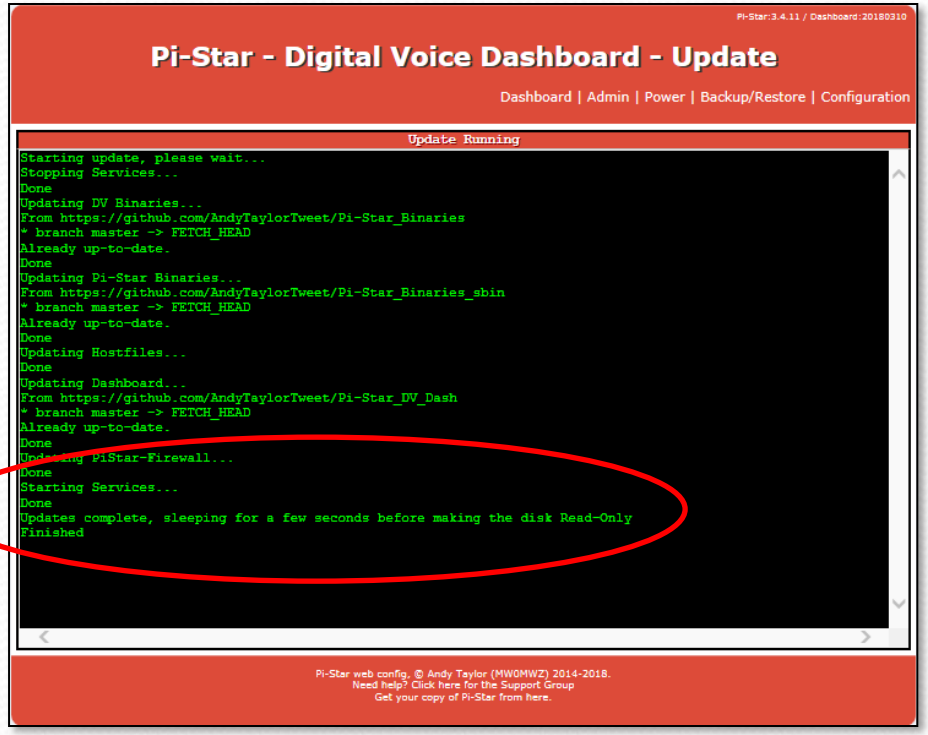
Pi-Star Update:

Click “Update” at the top of the configuration page:



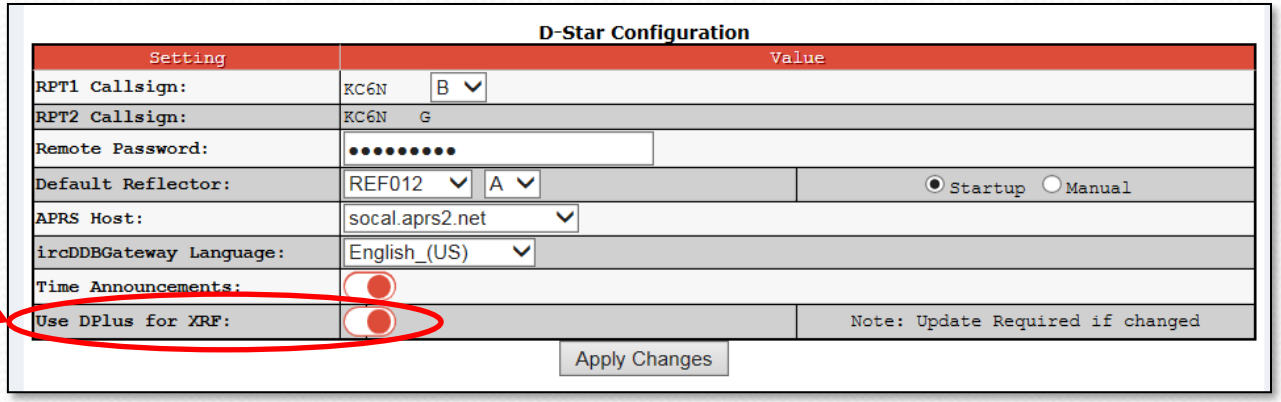
The update window will open and it will run for a while, depending on how long it has been since the image was built. Once done, you will see:

“Starting Services”
“Done”
“Update Complete, Sleeping….”
“Finished”.



Restoring from a backup:

Note that “Backup” (as described earlier) does not save the setting of this switch.



If you restore from a previously saved backup, you will need to reset “Use Dplus for XRF” to ON and then do the update again. In other words repeat the process described in this section.

This would become necessary if you were to build a fresh image on a new card (a version upgrade perhaps) and you restore your previous configuration settings from a backup. In this case the restored settings will come up with “Use Dplus for XRF” turned “OFF”. Switch it to “ON”, Apply Changes, and do the update.

ZUMspot/PiStar

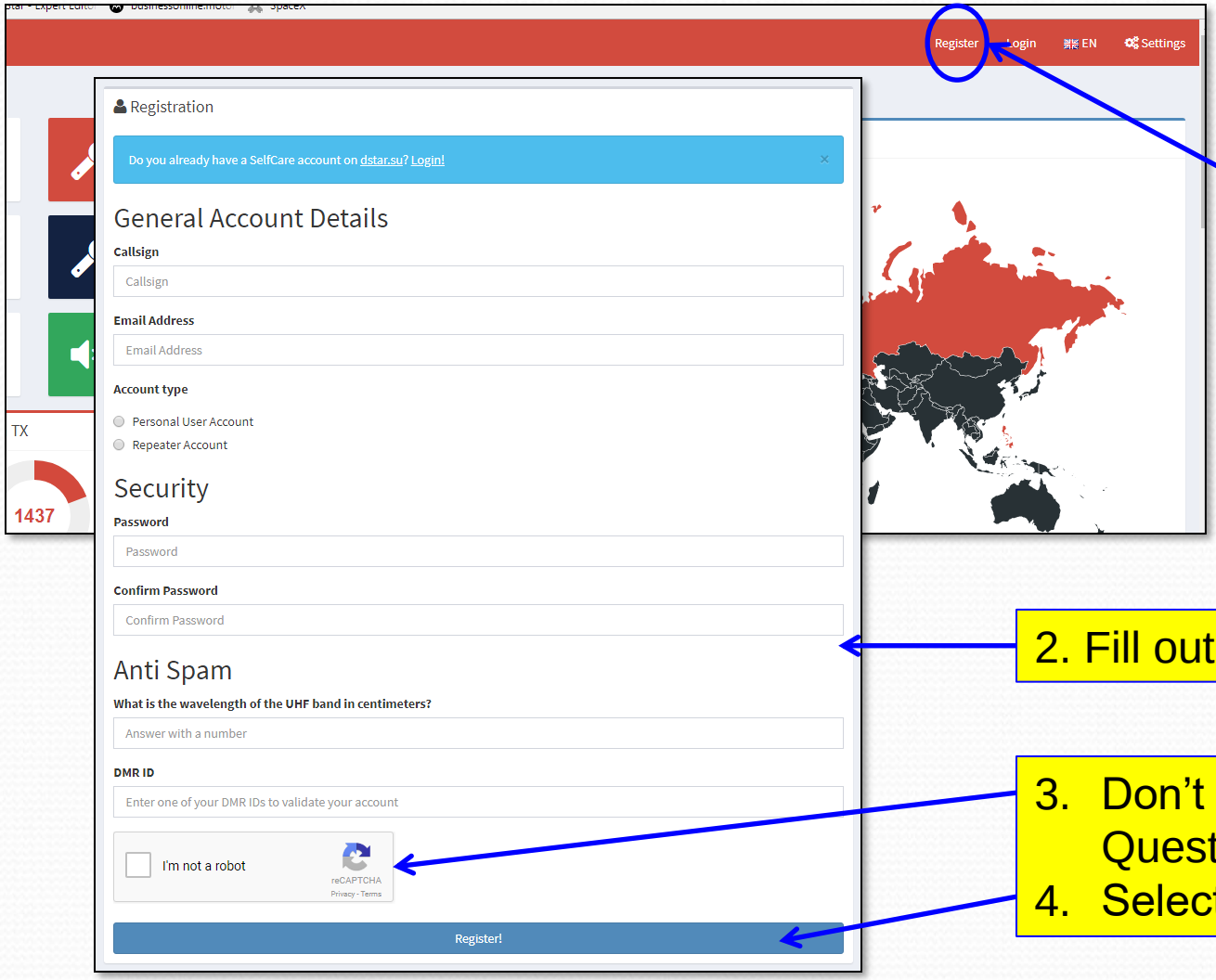
Appendix C

Setting up HotSpot support on Brandmeister

Setting up BM HotSpot Support

- Once you have your HS running you will want to set up Brandmeister support.
- This will allow you to do the following:
  - Designate Static talk groups
  - Kill QSO's on dynamic TG's and delete these quasi-static TG's as needed
- First you need to create an account. If you have done that, skip the first slide.

Create a Brandmeister Account

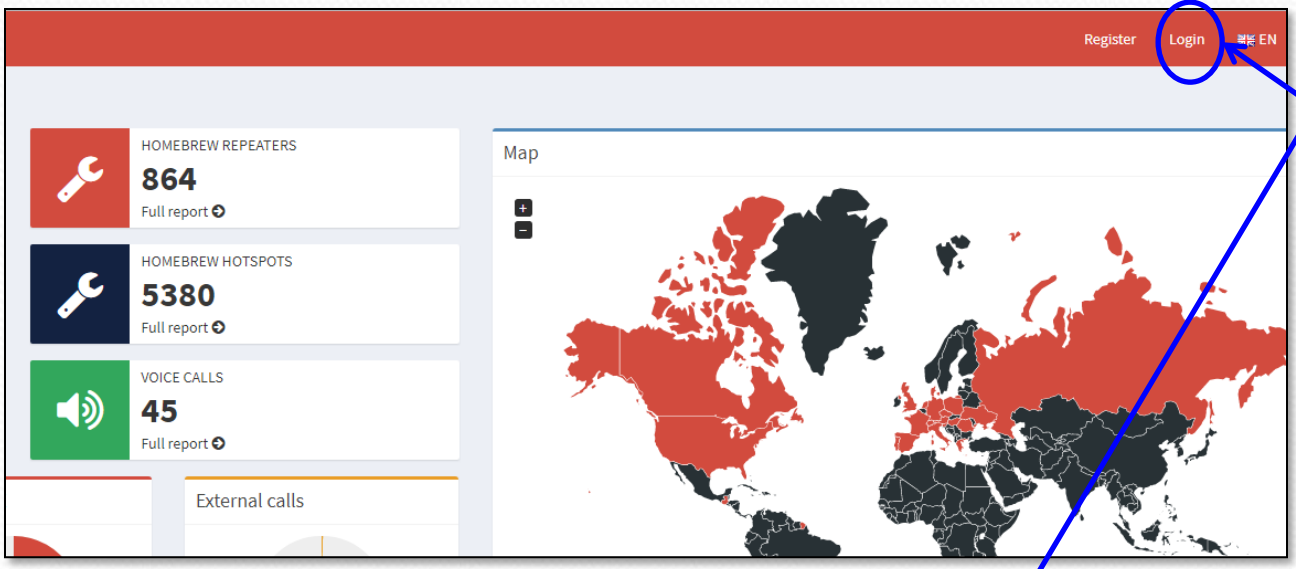


1. From the front page, Select "Register"

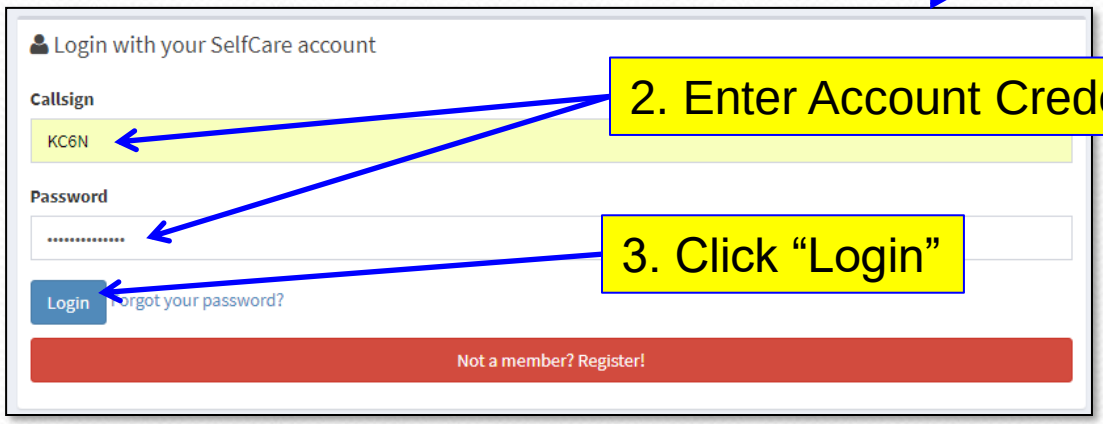
2. Fill out the registration form

3. Don't forget the CAPTCHA Question.
4. Select "Register"

Log onto your BM Account



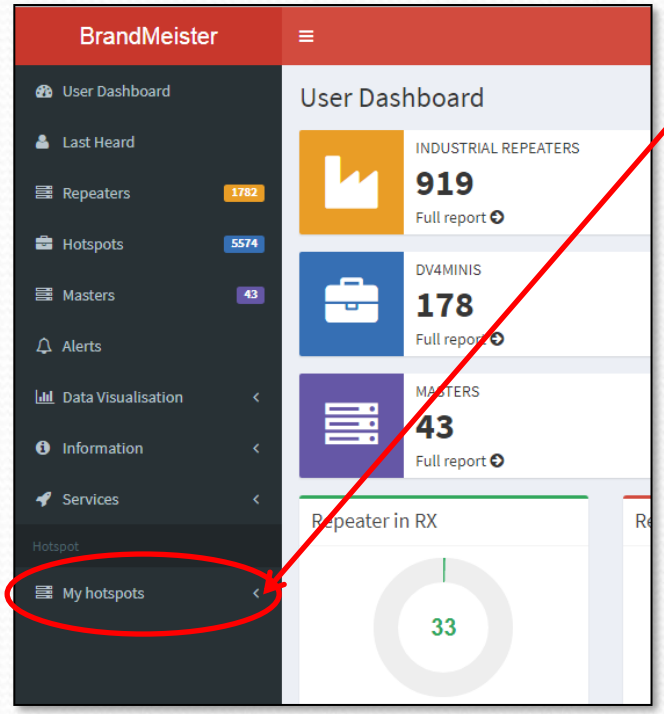
1. Click “Login” to Log onto your BM account



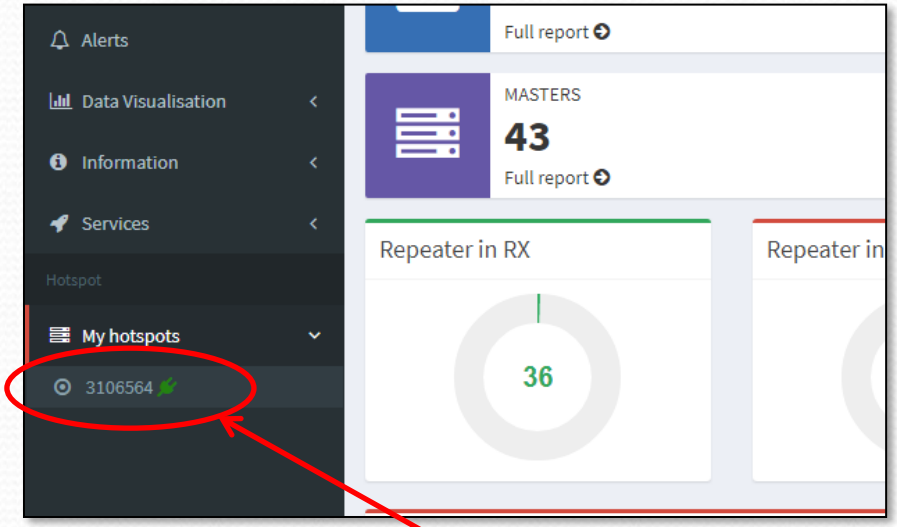
2. Enter Account Credentials

3. Click “Login”

Find your HotSpot settings page



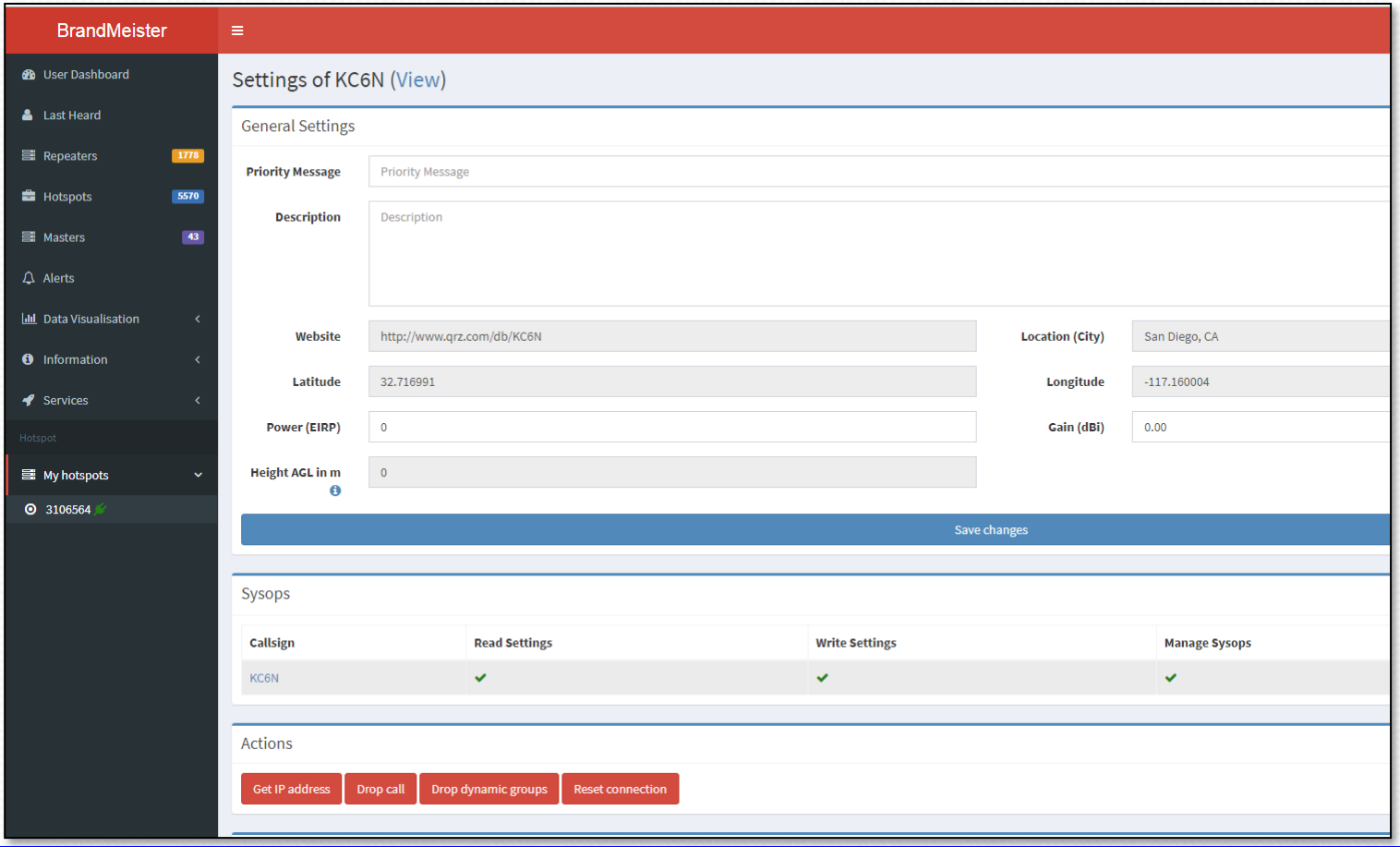
1. Click the Left pointing arrow next to "My Hotspots"



2. Your hotspot will show up in the "drop down"

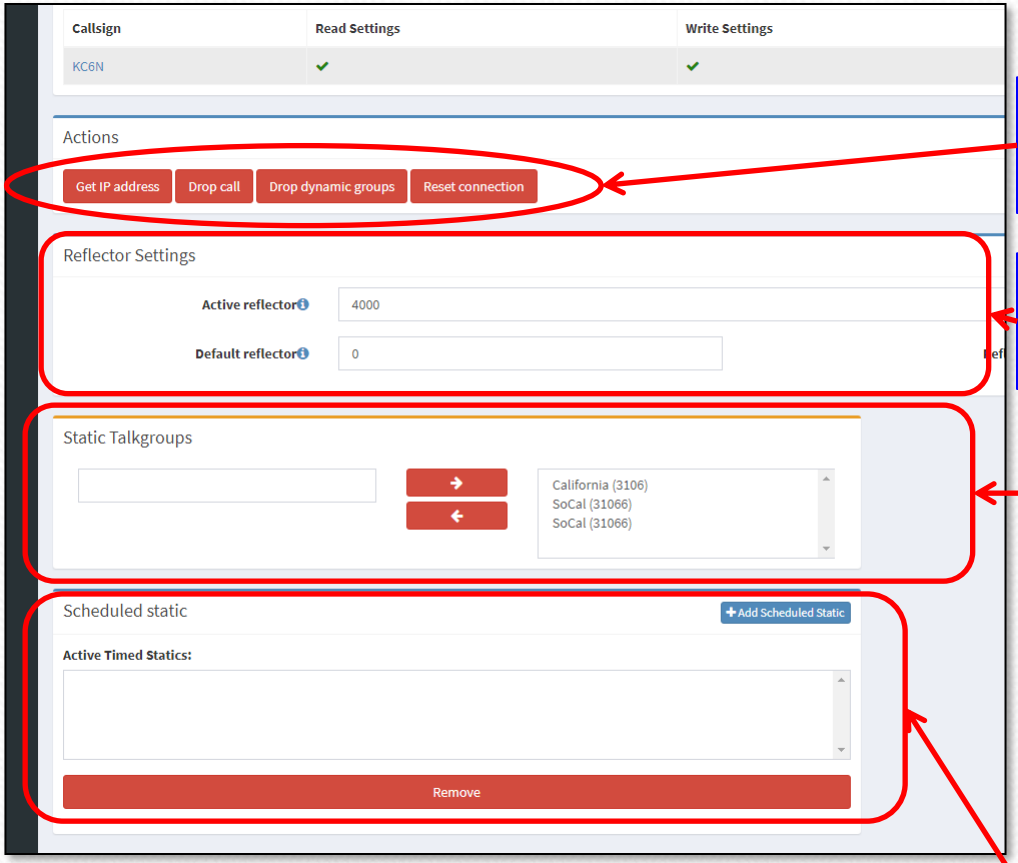
3. Click on the number of the hotspot

HotSpot settings page



Fill out the information on the form (part of which is shown here). We'll focus on the Bottom part of the page where you will actually set up how your HS behaves on BM.

HotSpot settings management



Here you can add and drop active Calls drop dynamic talk groups etc.

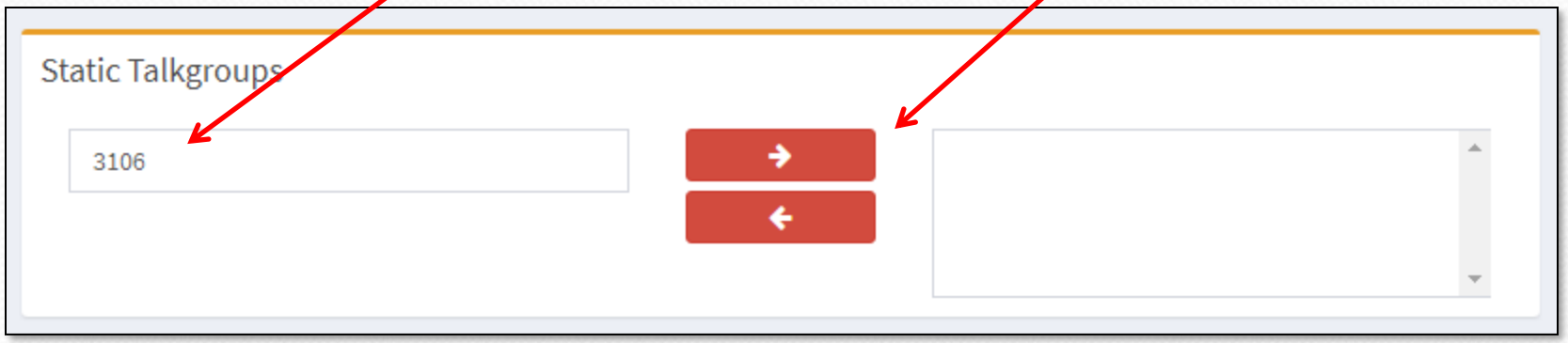
Here is where you can set up and manage a reflector if you want one

Here is where you set up and manage static talk groups. I have “SoCal” (31066) and CA “StateWide” (3106) set in this example.

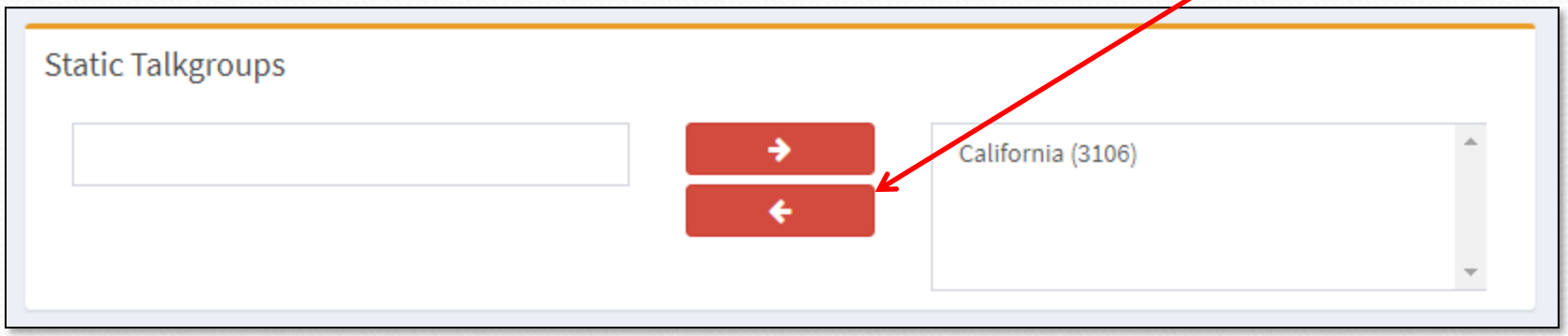
You can set timed static talk groups here which are talk groups you want to become static at particular times (a net time for example).

Managing static talk groups

To make California Statewide a Static on your hot spot, simply enter the TGID In the entry box on the left as shown below and click the right arrow



Now the entry, California (3106) has been moved to the right hand box and is static on your HotSpot. To delete it, highlight it and use the left arrow.



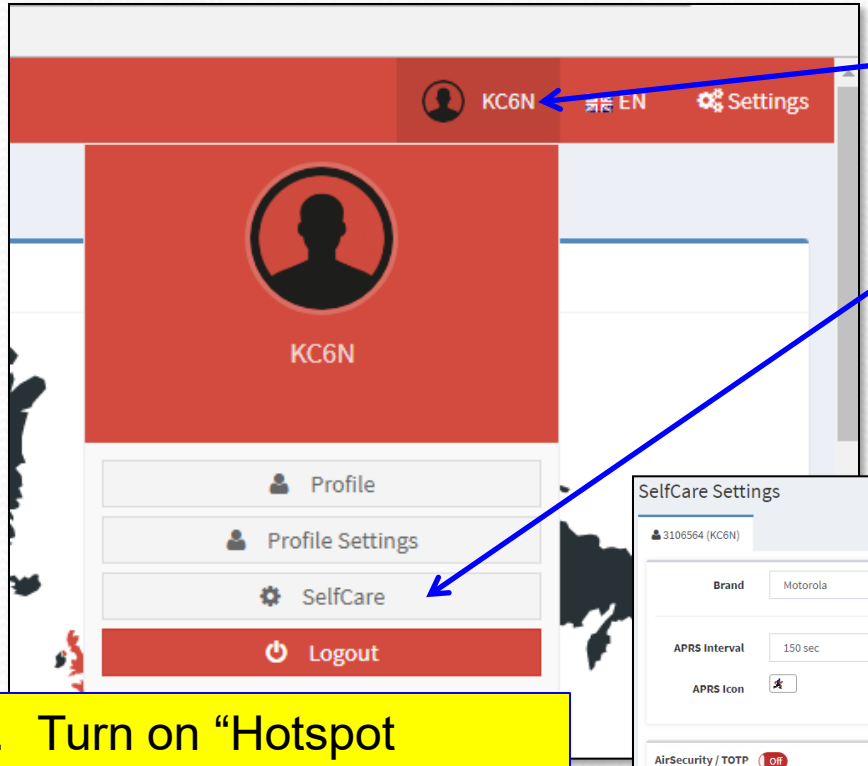
Managing Talk Groups

- You can set up additional ones as you like
- It is probably best to limit this to a couple that you really want to monitor since activity on static TG's will lock up your HS.
- If you key up on another TG, not in your list, it will be added as a dynamic TG. On HotSpots, these do not expire after 15 minutes like on repeaters. If one becomes annoying, you may need to kill it using the management tools.

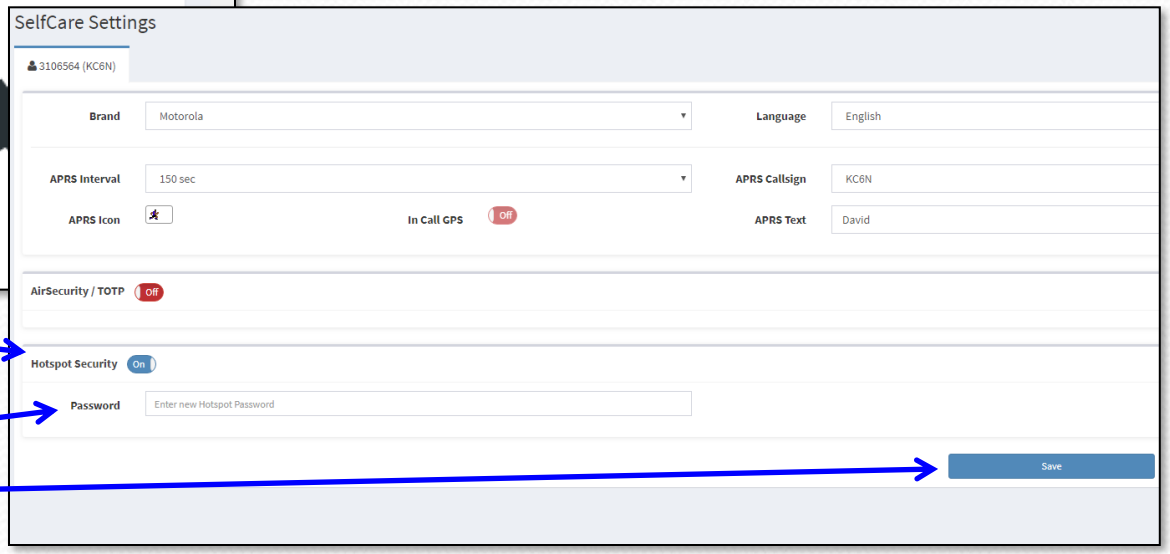
Setting up HotSpot Security

- Brandmeister **now requires** that users set a personalized security password. Without this, anyone can configure a HS with your DMR ID and show up as you. Not good.
- If you are a multiple HotSpot user (see Appendix N) you only need one PW for all of them.
- Here's how to do it:

HotSpot Security Brandmeister

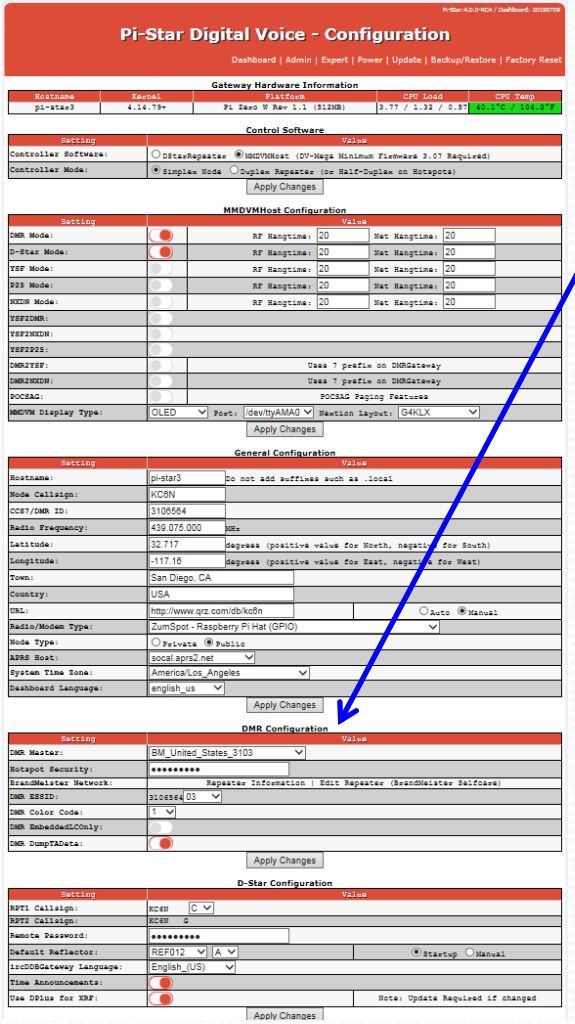


1. Log into your account and click on your callsign to see the drop down to the left.
2. Click “SelfCare” in the dropdown.

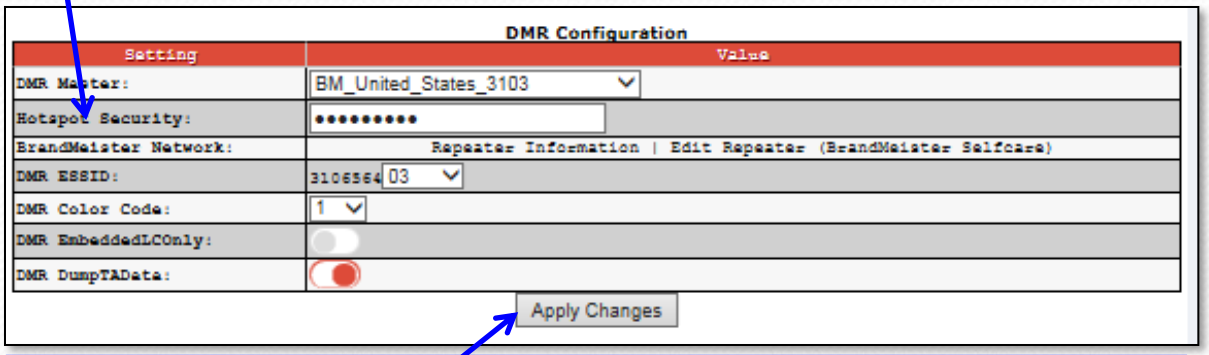


3. Turn on “Hotspot Security” here:
4. Enter a password for your HotSpot(s) here:
5. Click “Save”

HotSpot Security Pi-Star

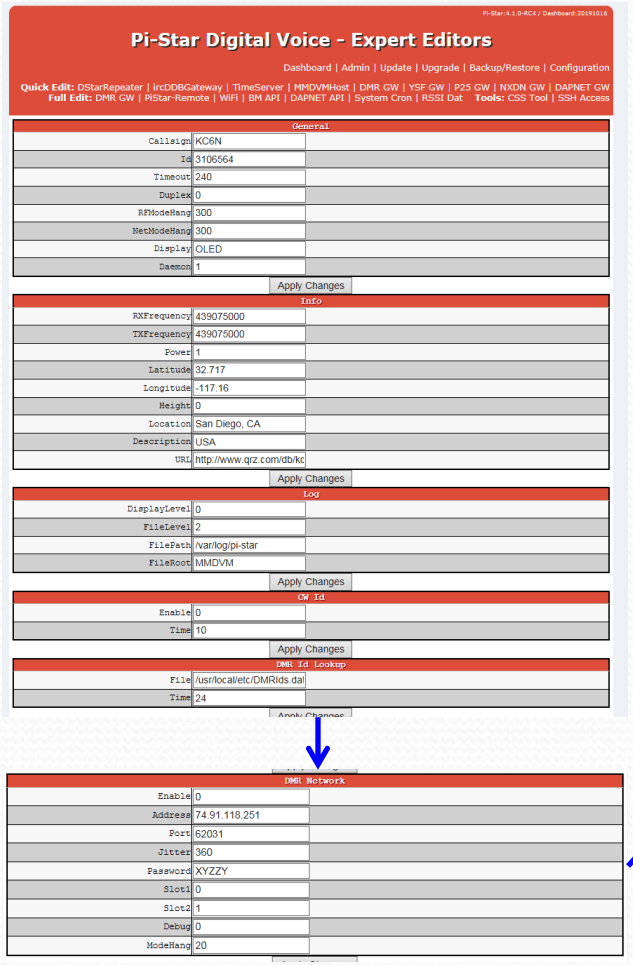


1. On the configuration page for Pi-Star, Locate the “DMR Configuration” section (see left).
2. Enter your chosen password in the “Hotspot Security” section.

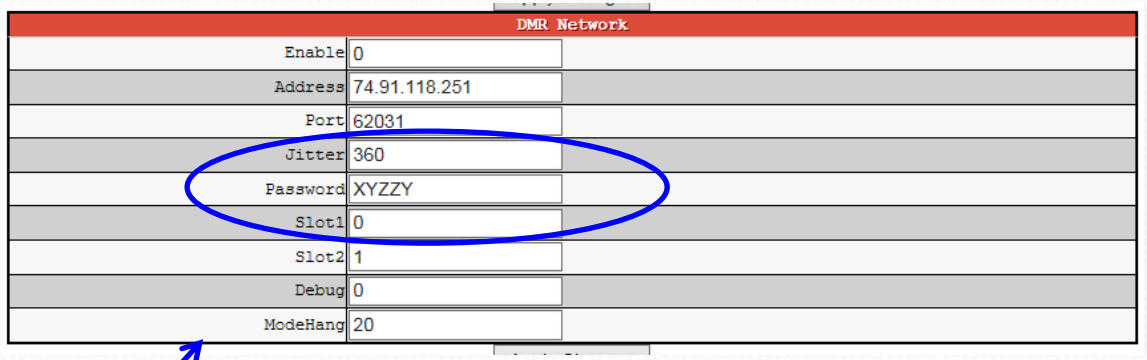


3. Click “Apply Changes”
4. Confirm that your HotSpot appears in the Brandmeister list on your BM page and make sure that it works.

HotSpot Security Pi-Star (cont)



Note: Should you forget your password, you can find it at EXPERT > MMDVMHOST in the DMR Network block as shown below.



ZUMspot/PiStar

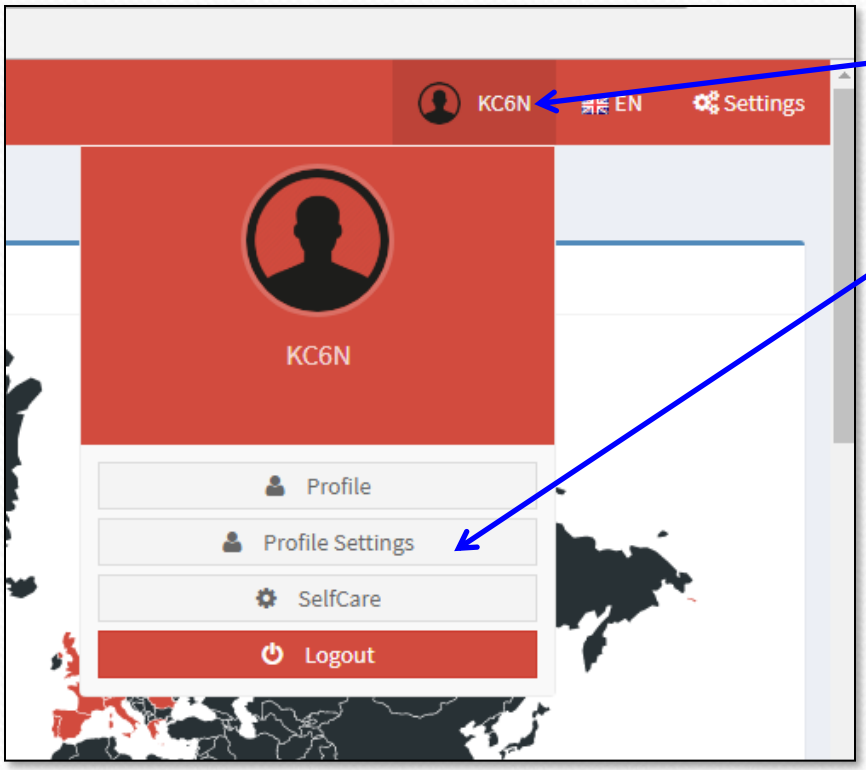
Appendix D

Adding a Brandmeister Self Care Panel to Pi-Star

Adding BM Self Care to Pi-Star

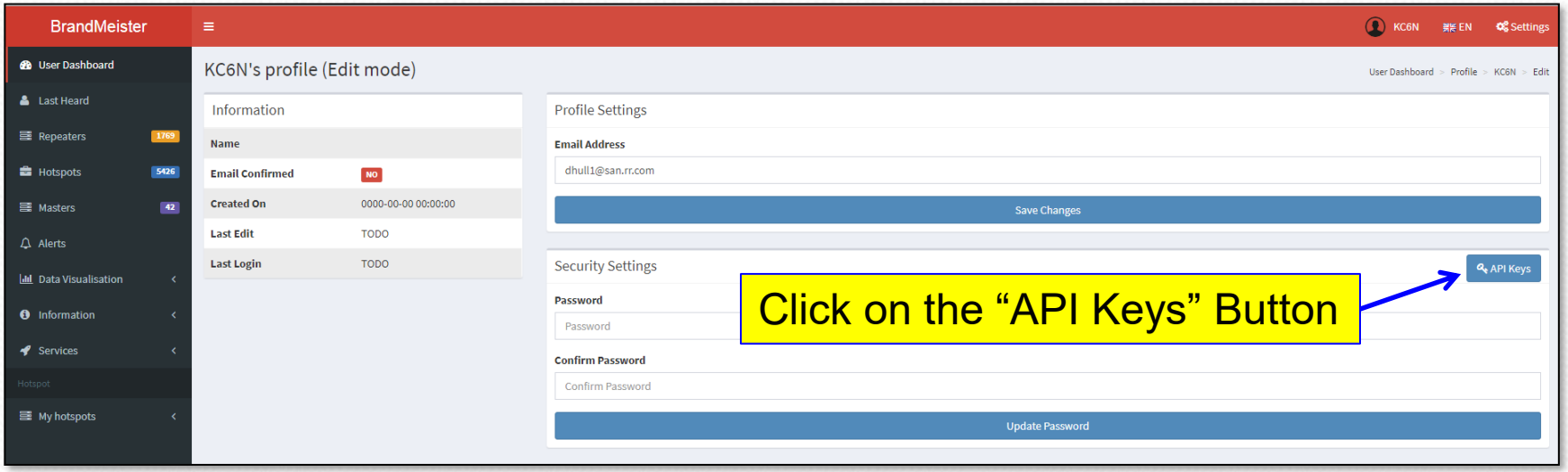
- For those using Brandmeister, it is possible to add the self care features.
- This will allow you to manage your BM connected hotspot from the Pi-Star admin dashboard.
- This section assumes you will log into your established Brandmeister account, if you don’t have an account, you will need to create one.

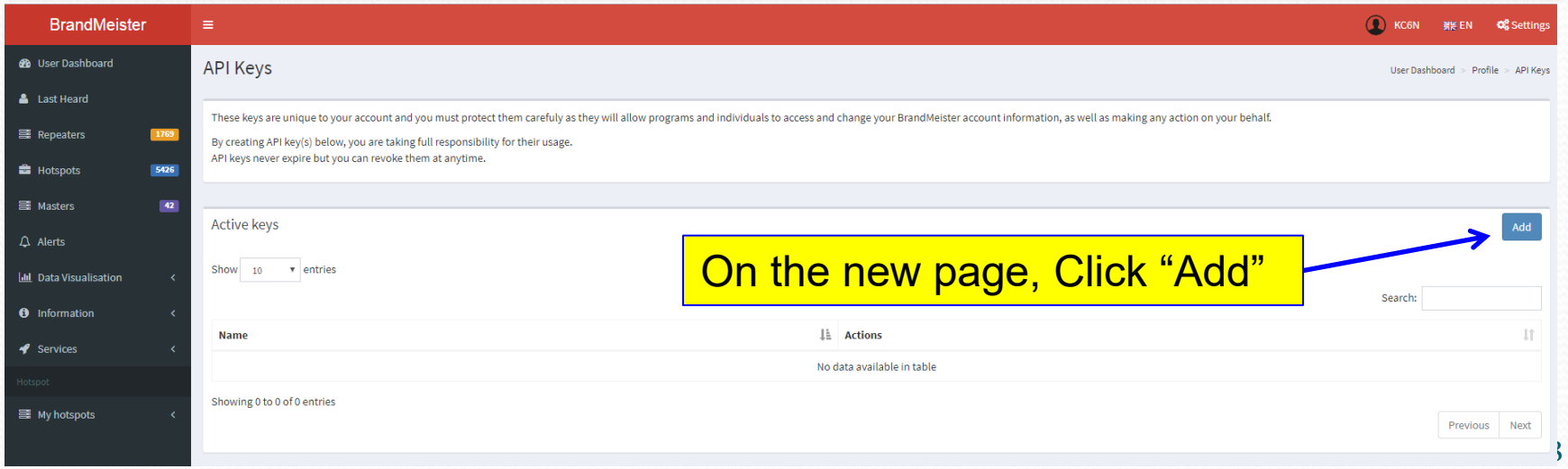
Generate BM Pi-Star API Key



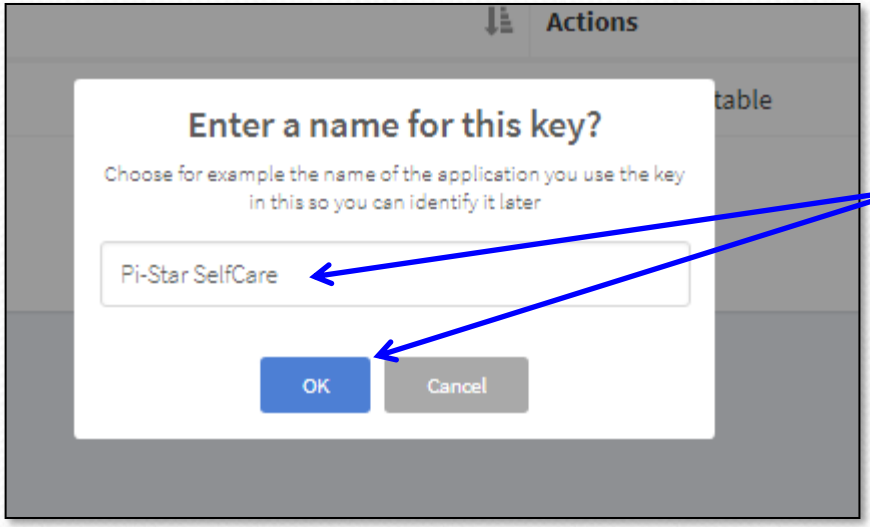
1. Log into your account and click on your callsign to see the drop down to the left.
2. Click “Profile Settings” in the dropdown.

Adding BM Self Care to Pi-Star





Adding BM Self Care to Pi-Star

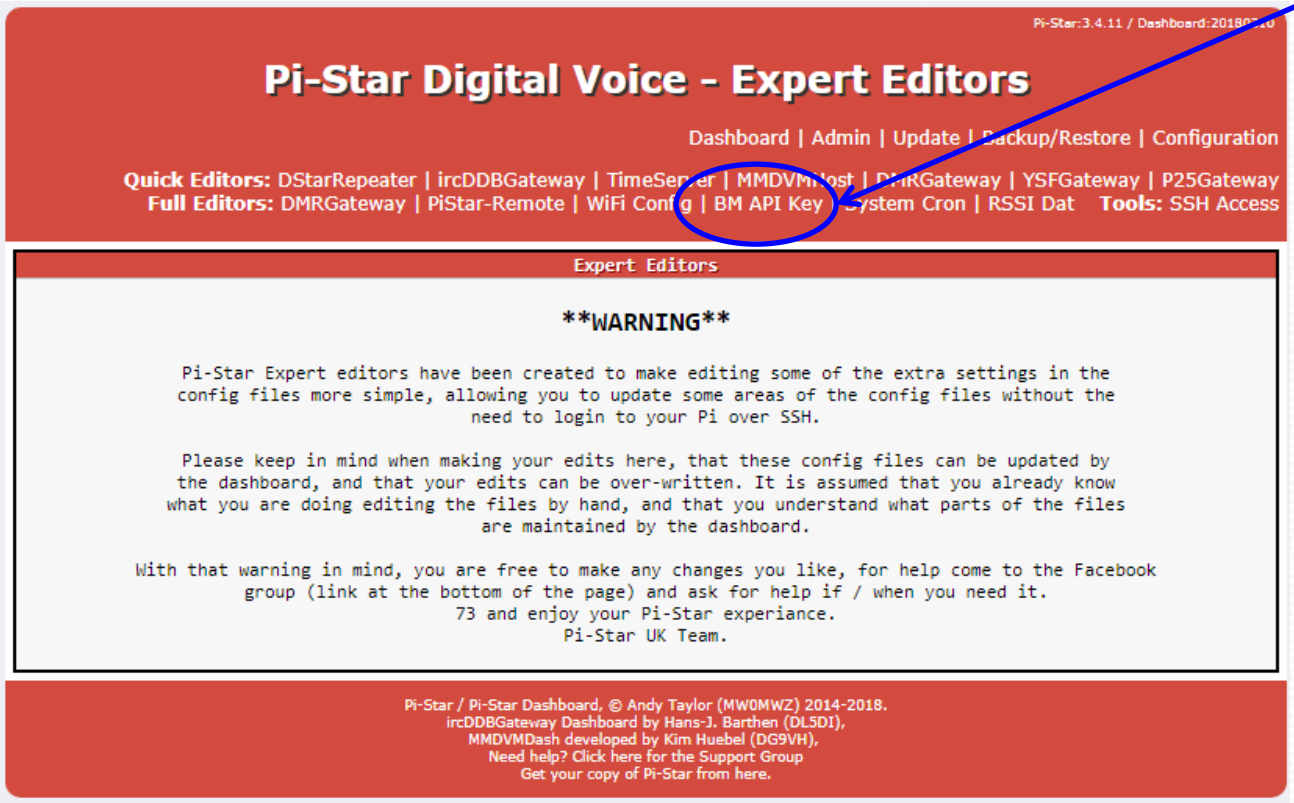


At this point you will get a pop-up asking for a name for the key that will be created. Put one in and click OK. I used “Pi-Star SelfCare” as shown

When you click OK, BM will create an “API Key” that is unique to you. You will need to copy this to your clipboard to paste it into Pi-Star. Click “Copy” then click “OK”

Adding API key to Pi-Star

1. Open Pi-Star in expert mode: by entering “http://pi-star/admin/expert” into your browser.
2. Click on “BM API Key” in the menu.



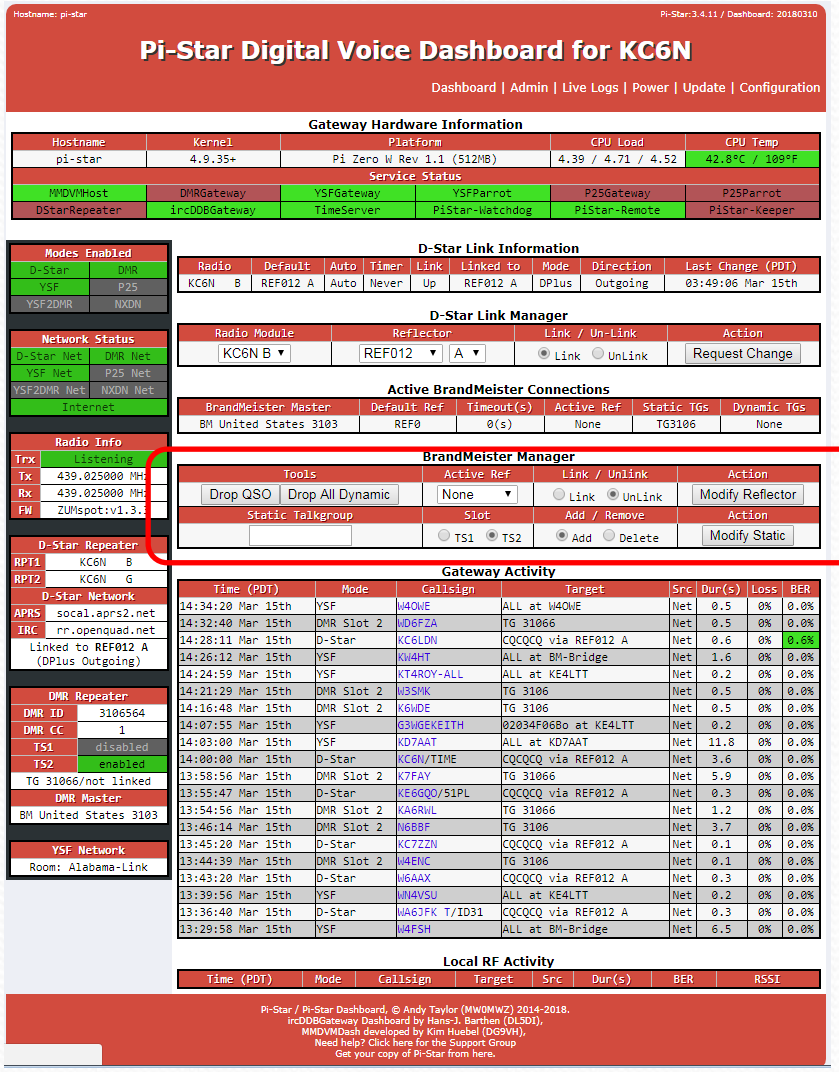
Adding API key to Pi-Star

1. Paste your API Key in the box labeled "Key" in the resulting dialogue.

3. Click "Admin" to return to your admin dashboard

2. Click on "Apply Changes". Wait for the box to clear.

New BM Self Care Panel

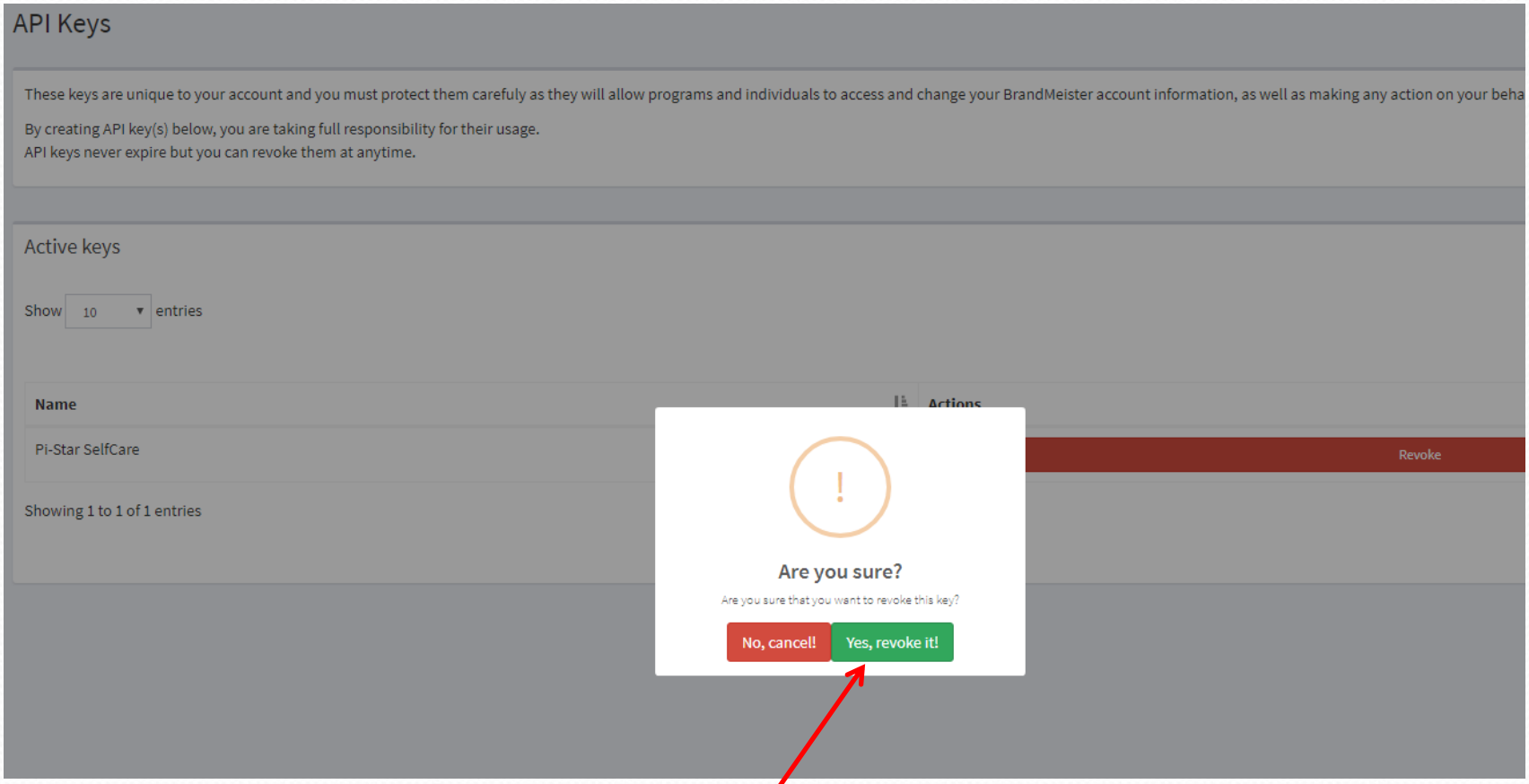


You will see a new “BrandMeister Manager” panel here.

This provides most of the same BrandMeister “SelfCare” functionality without having to “fire up” (no pun intended*) Brandmeister.

*Brandmeister is “Fire Chief” in German.

Revoking a key



Should you change your mind, you can clear the key in Pi-Star and “Revoke the Key” in Brandmeister and you are back to where you began.

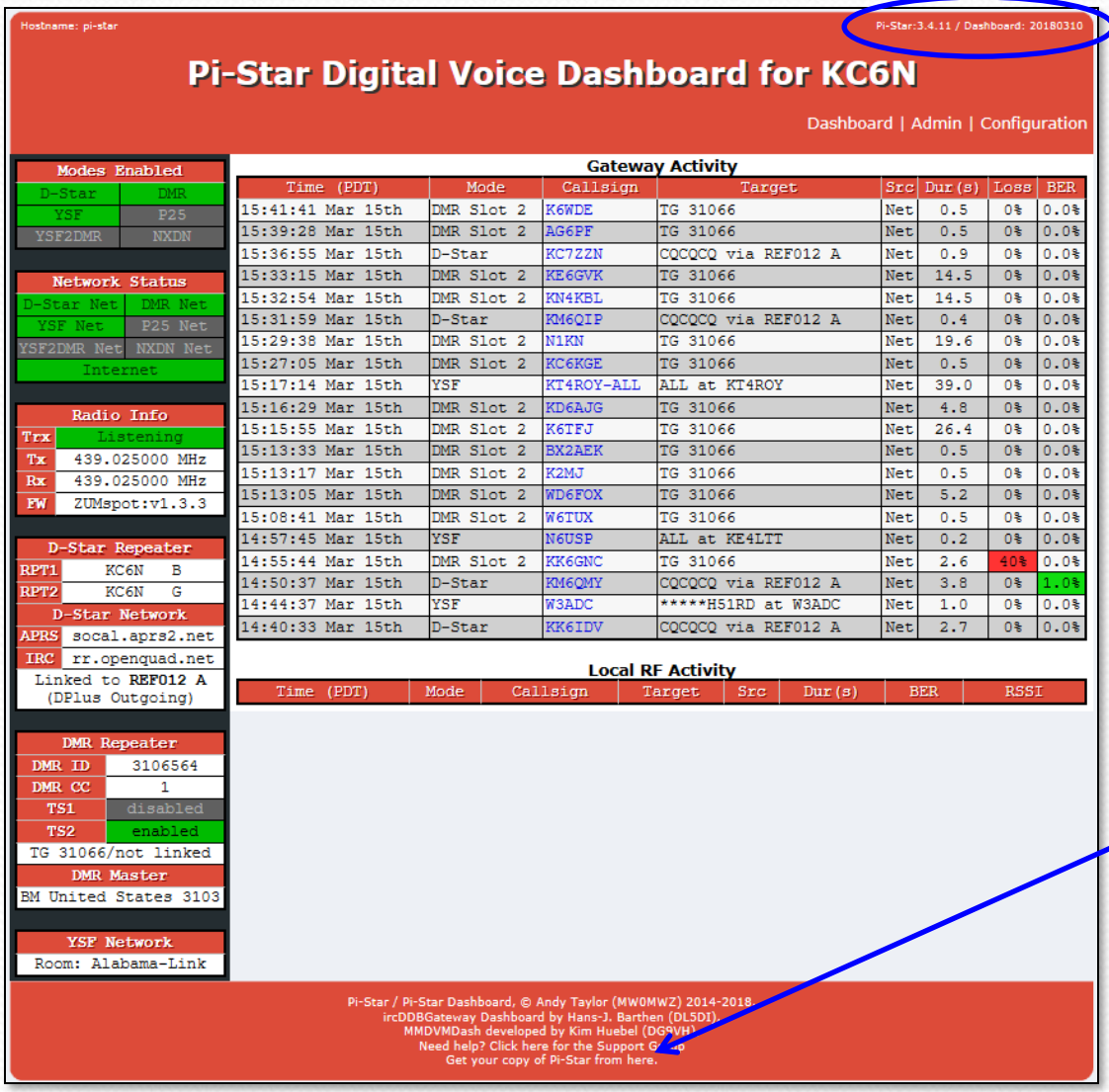
ZUMspot/PiStar

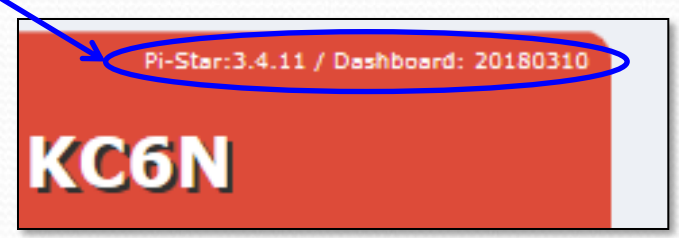
Appendix E

Updating the Pi-Star firmware

NOTE: This does NOT update the ZUMspot board FW. That is covered in a subsequent appendix.

Checking your Firmware:

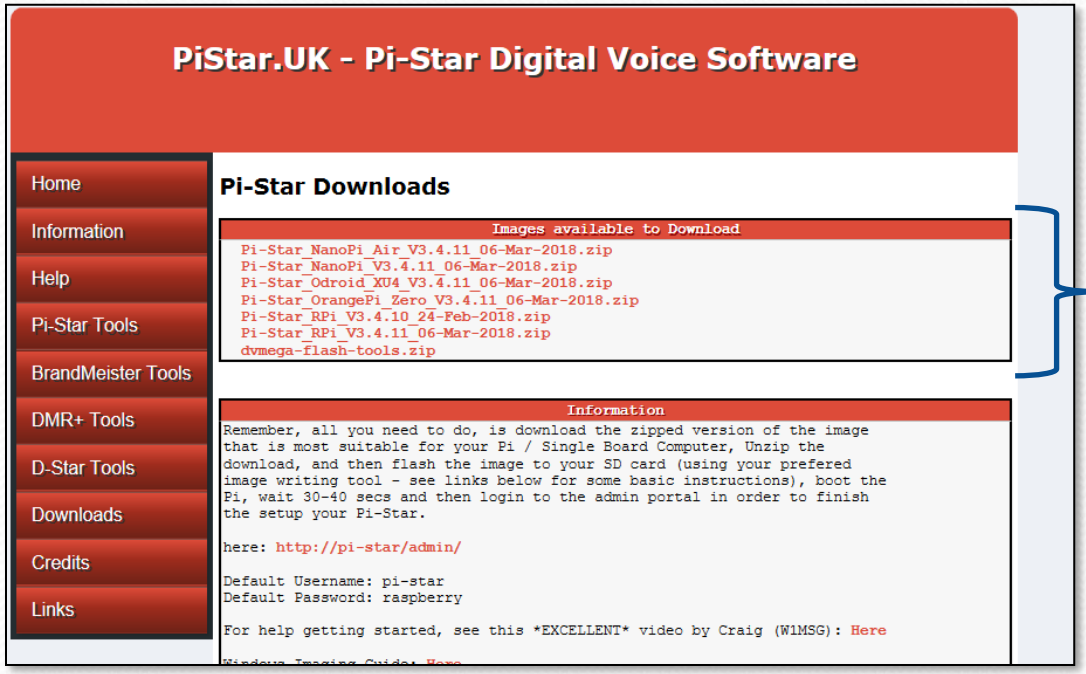




To find the latest firmware go here:
http://www.pistar.uk/downloads/

The quickest way to get there is by clicking “here” (literaly ☺).

Updating Firmware (method 1):



The current release versions are shown here. Pick the latest one that starts with “Pi-Star RPI”.

If you decide you need an update, follow the instructions in Parts I, II and III to prepare a new card. Note that if you have a backup “zip” file from a previous setup (with working WiFi credentials), you may simply copy this file into the root directory of the freshly minted card and start your boot up. If you had set the “Use Dplus for XRF” switch (see appropriate appendix) you will need to do that again and do the update step.

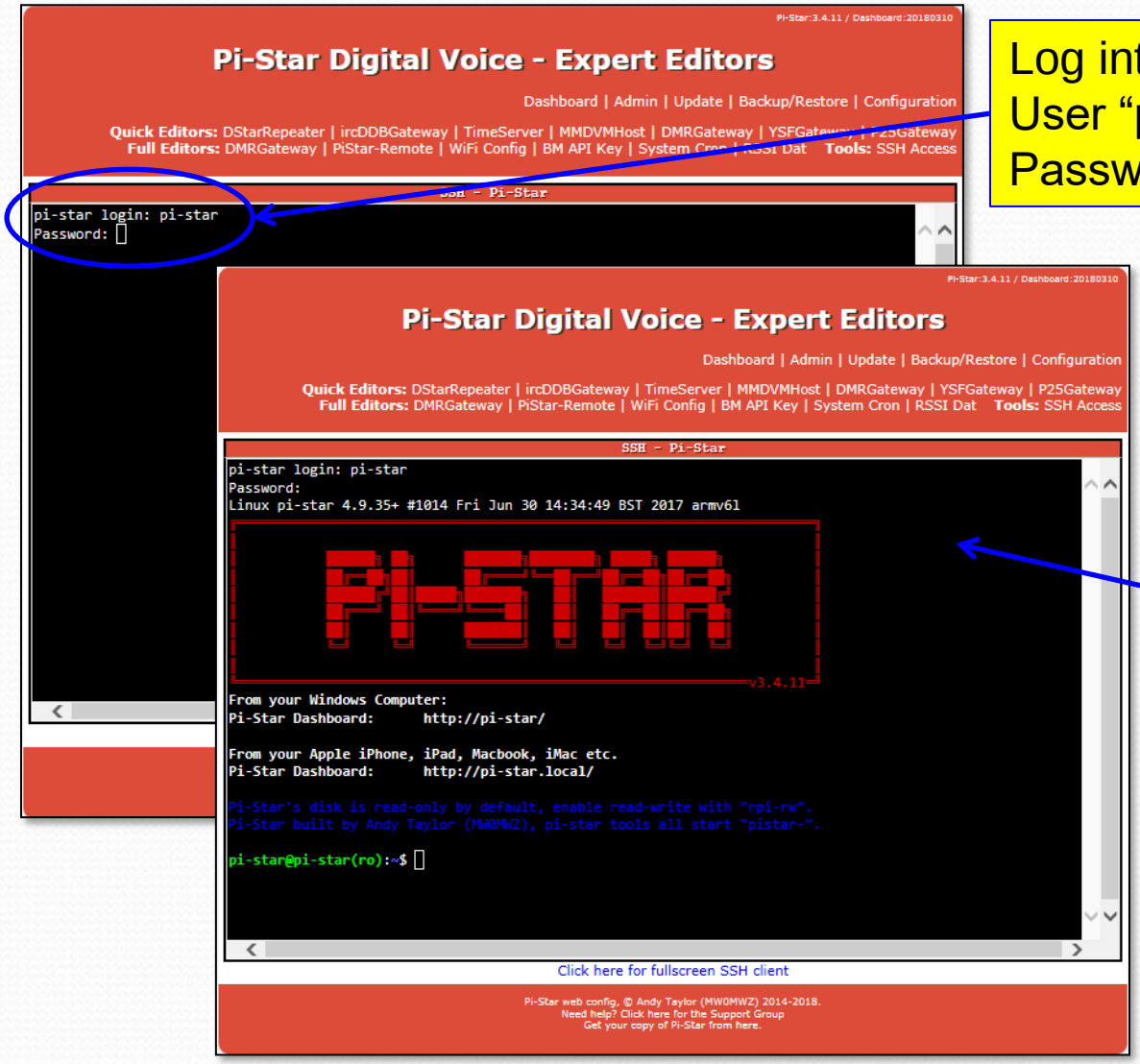
Updating Firmware (method 2)

- Log onto the Pi-Star admin expert page:
  - http://pi-star/admin/expert/

Click "**Tools:** SSH Access" To bring up the built in SSH Editor. If you don't see it, try a different browser.

Note: the method shown here (using SSH) is probably the best method if you already have a working build and just want to move to the latest version.

Log into the SSH editor:



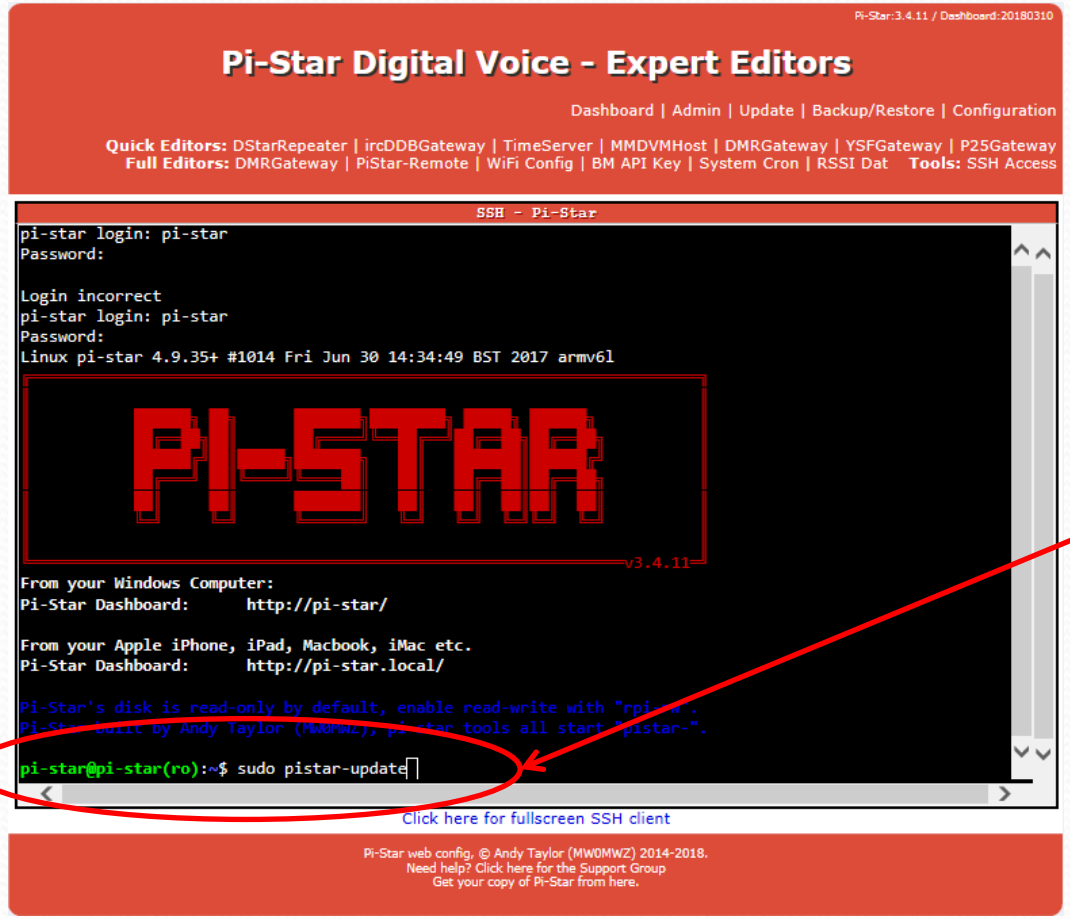
Log into the SSH Editor:
User “pi-star” <enter>
Password: “raspberry” <enter>

The Pi-Star SSH editor will open up as shown Here, with the command prompt: pi-star@pi-star(ro):=$

Updating/Upgrading using SSH

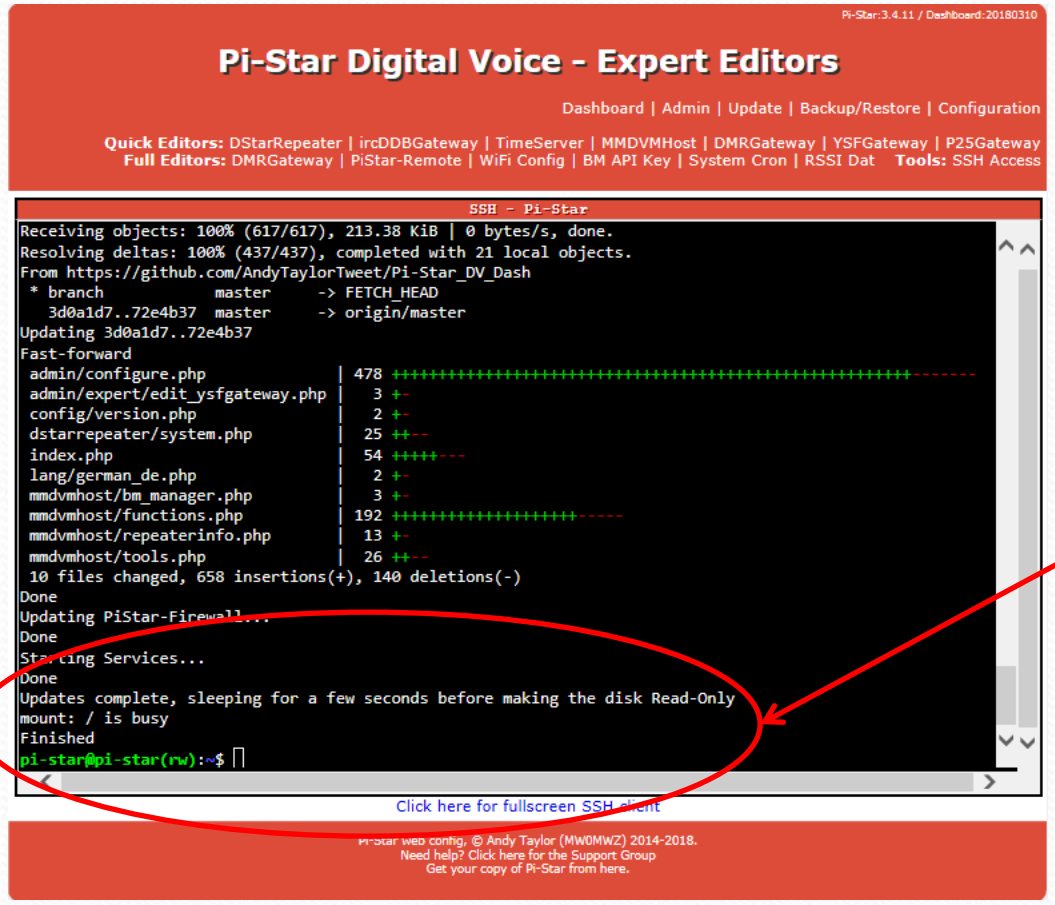
- To update the operating system and upgrade Pi-Star to the latest version (whatever it may be) do the following:
- From the command prompt issue:
  - sudo pistar-update <ENTER>
  - sudo pistar-upgrade <ENTER>
- Do these in the sequence shown.
- The first line updates the raspian OS, the second line upgrades Pi-Star.

Enter the “update” command:



At the command prompt, pi-star@pi-star(ro):=$, enter the string “sudo pistar-update” Without the quotes as shown here and hit enter. This will update the OS.

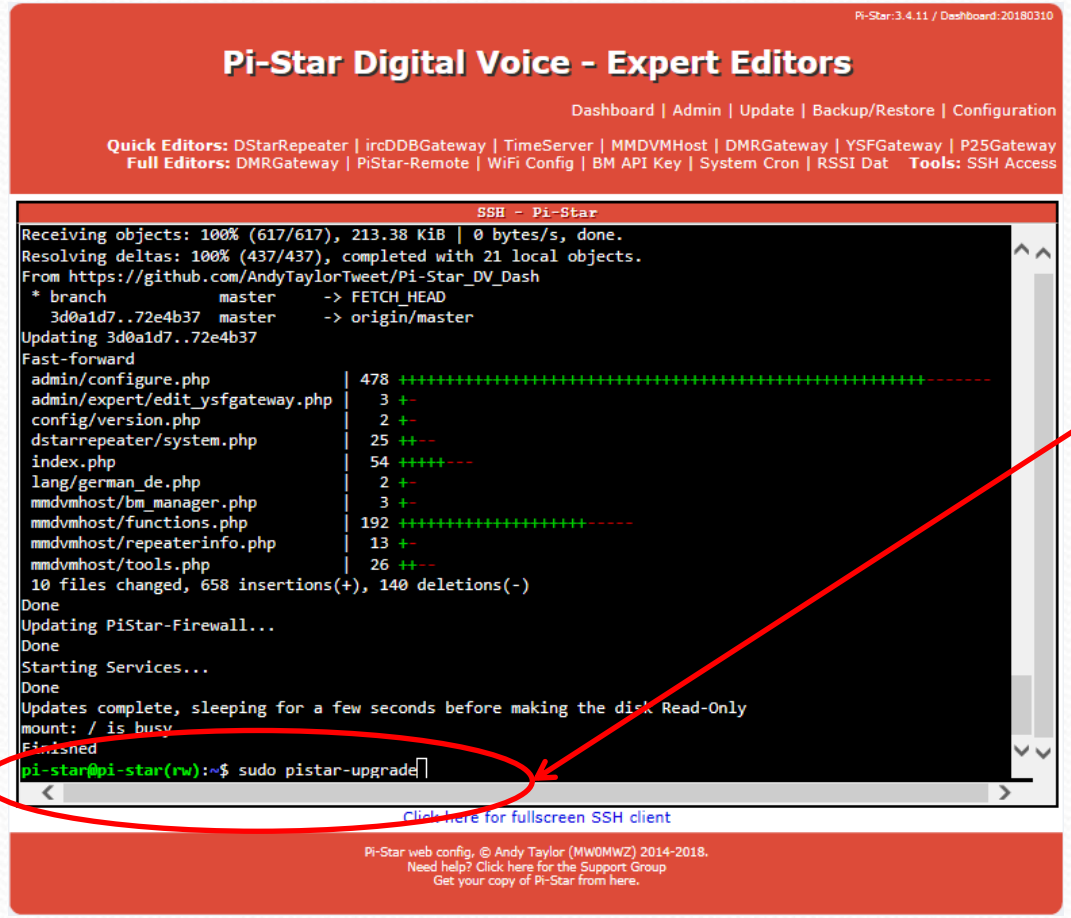
Wait for update to complete:



Let the flash process run to completion, You will see something like this when complete.

Now Pi-Star needs to be upgraded.

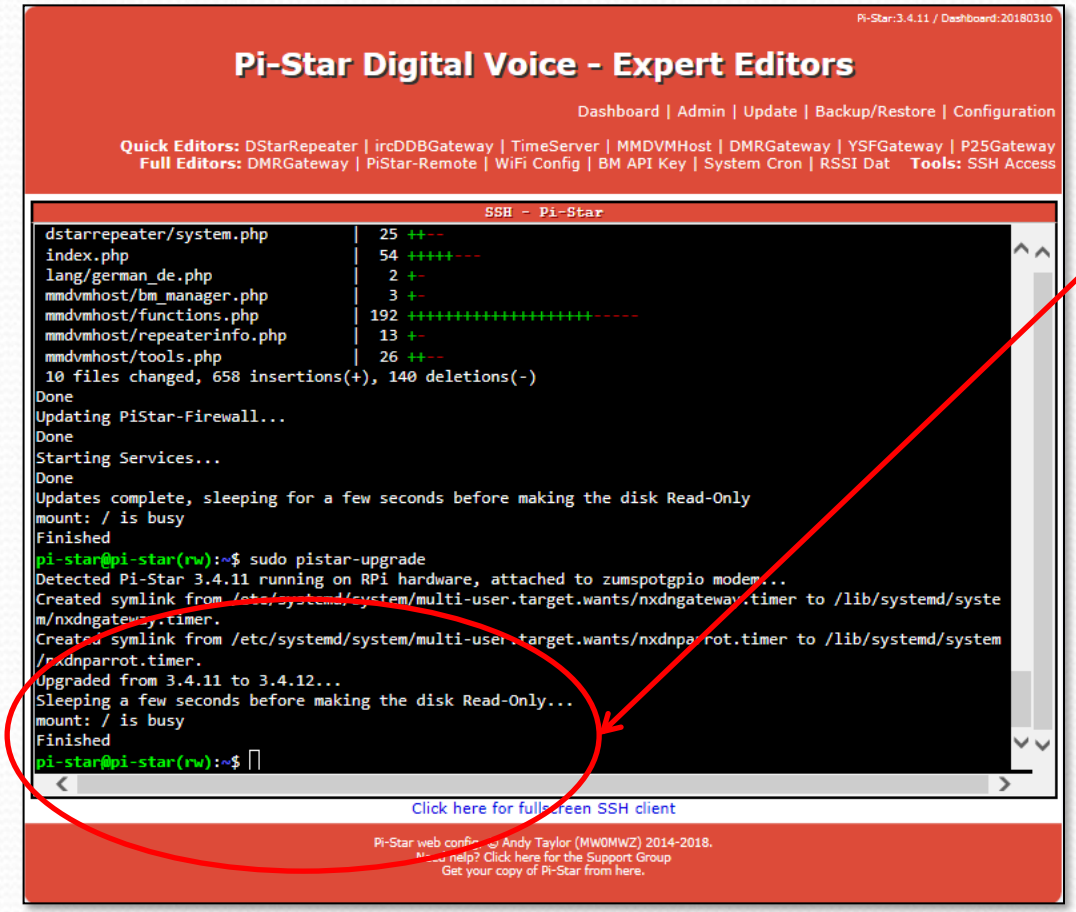
Enter the “upgrade” command:



At the command prompt, pi-star@pi-star(ro):=$, enter the string “sudo pistar-upgrade” Without the quotes as shown here and hit enter. This will update Pi-Star to the latest version (whatever that may be). Note that it may be later than the one shown on the Pi-Star download site.

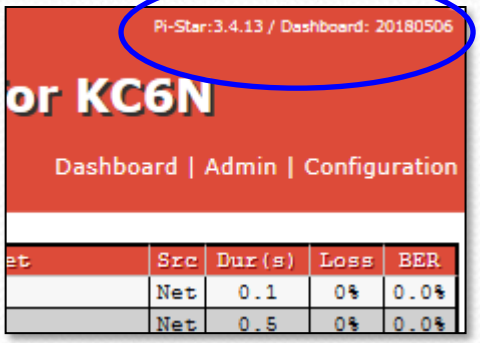
This procedure should always get you the latest build.

Wait for upgrade to complete:

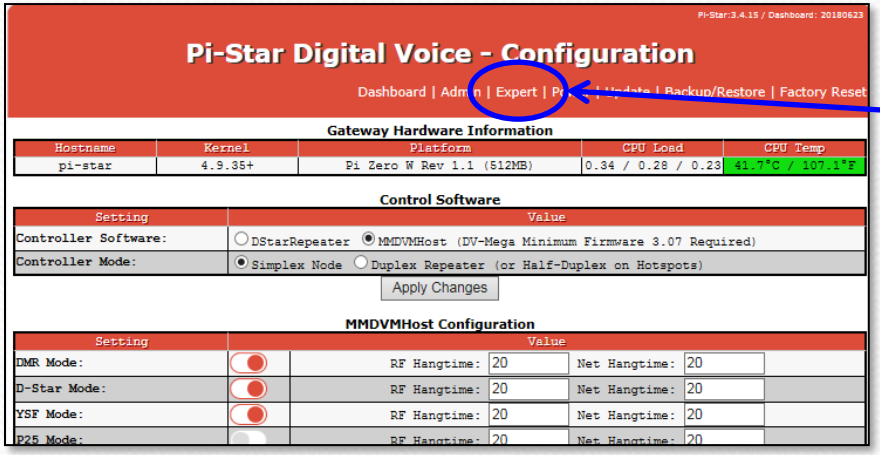


Let the flash process run to completion, You will see something like this when complete.

Now you can return to the dashboard and check the revision number at the top of the page. Note: I had to run this twice to get from 3.4.11 to 3.4.13



Version 3.4.15 and forward:



From the configuration page, click “Expert” or enter the command line: http://pi-star/admin/expert/ to get the expert screen.

You will find “Update” and “Upgrade” here. Use them the same way, execute “Update” followed by “Upgrade” as many times as needed you get to the latest version. It will tell you when you are done.

ZUMspot/PiStar

Appendix F

Updating the ZUMspot board firmware

Updating the ZUMspot FW

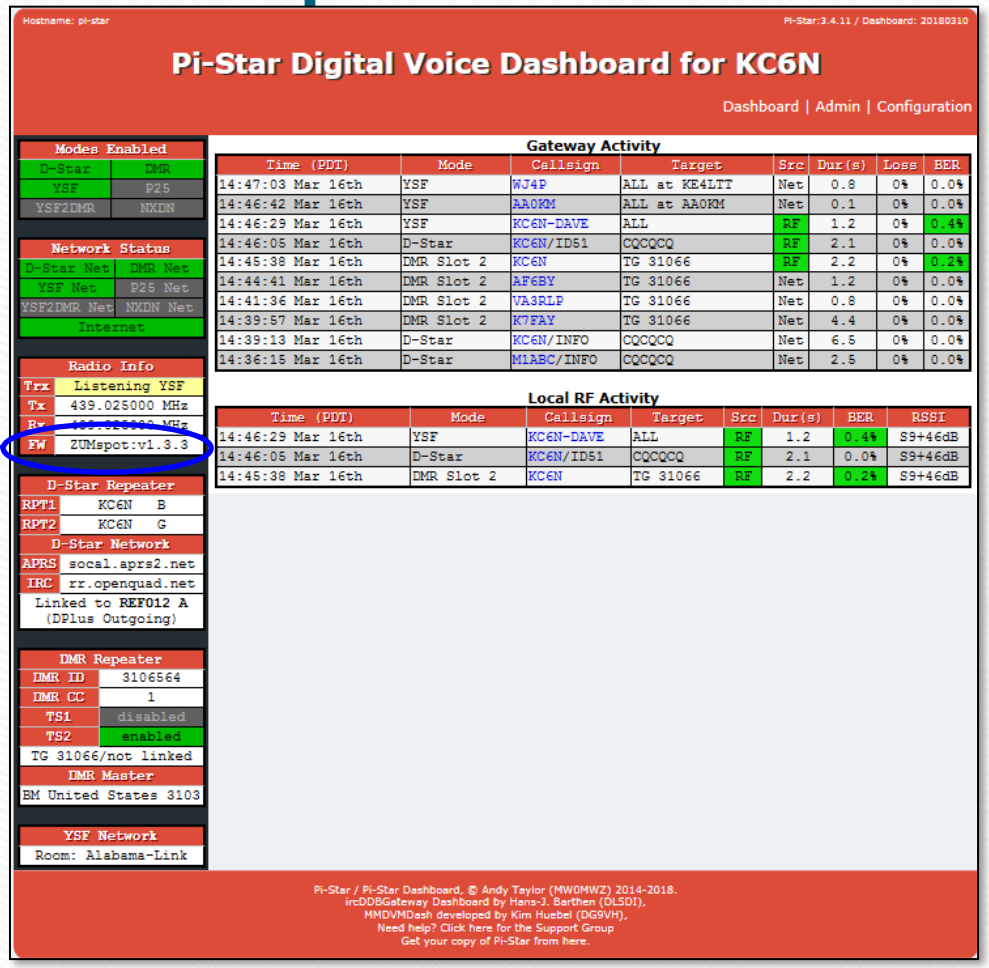
- The ZUMspot Pi Hat has it's own microcontroller with it's own firmware.
- This section will cover:
  - How to determine the installed ZUMspot FW version
  - How to determine the latest release FW version
  - How to update the ZUMspot flash memory with new FW using Pi-Star

Checking your ZUMspot FW ver

The ZUMspot's currently installed Firmware is shown here on the main dashboard.

You can check the current release version here: https://github.com/juribeparada/MMDVM_HS/releases

If you are ready for an update, Pi-Star has a built in methodology for doing this.

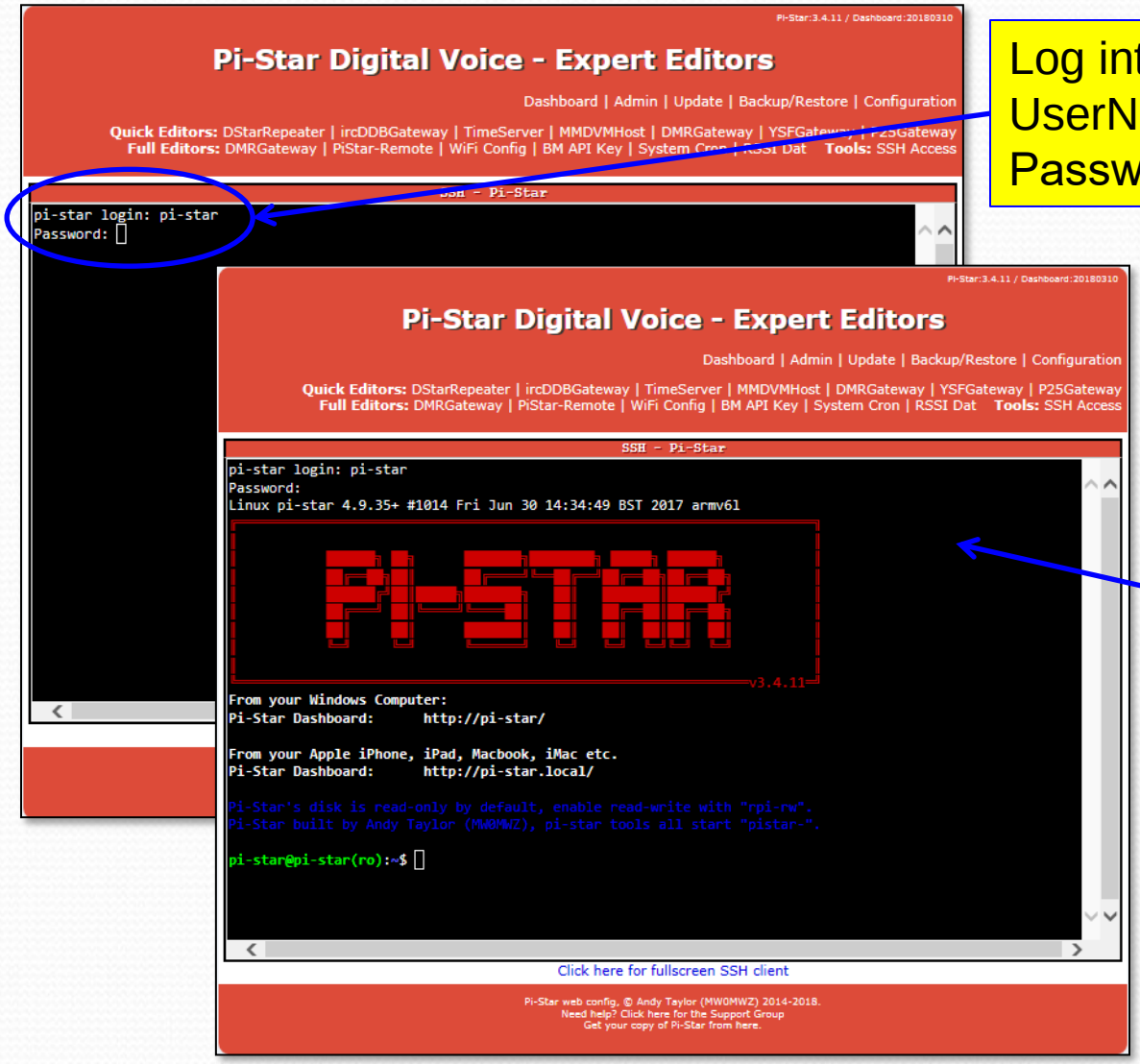


ZUM board FW update Process

- Log onto the Pi-Star admin expert page:
  - http://pi-star/admin/expert/

Click "**Tools:** SSH Access" To bring up the built in SSH Editor. If you don't see it, try a different browser.

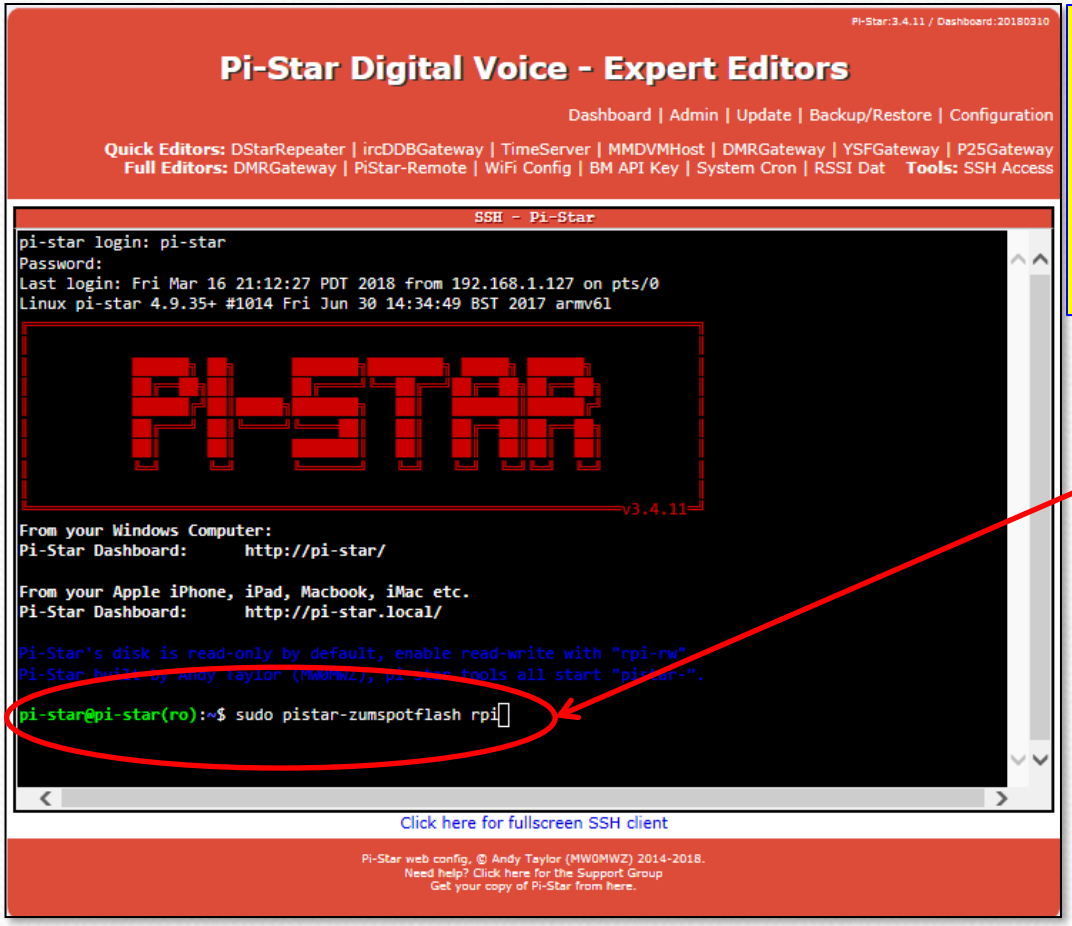
Log into the SSH editor:



Log into the SSH Editor:
UserName: “pi-star” <enter>
Password: “raspberry” <enter>

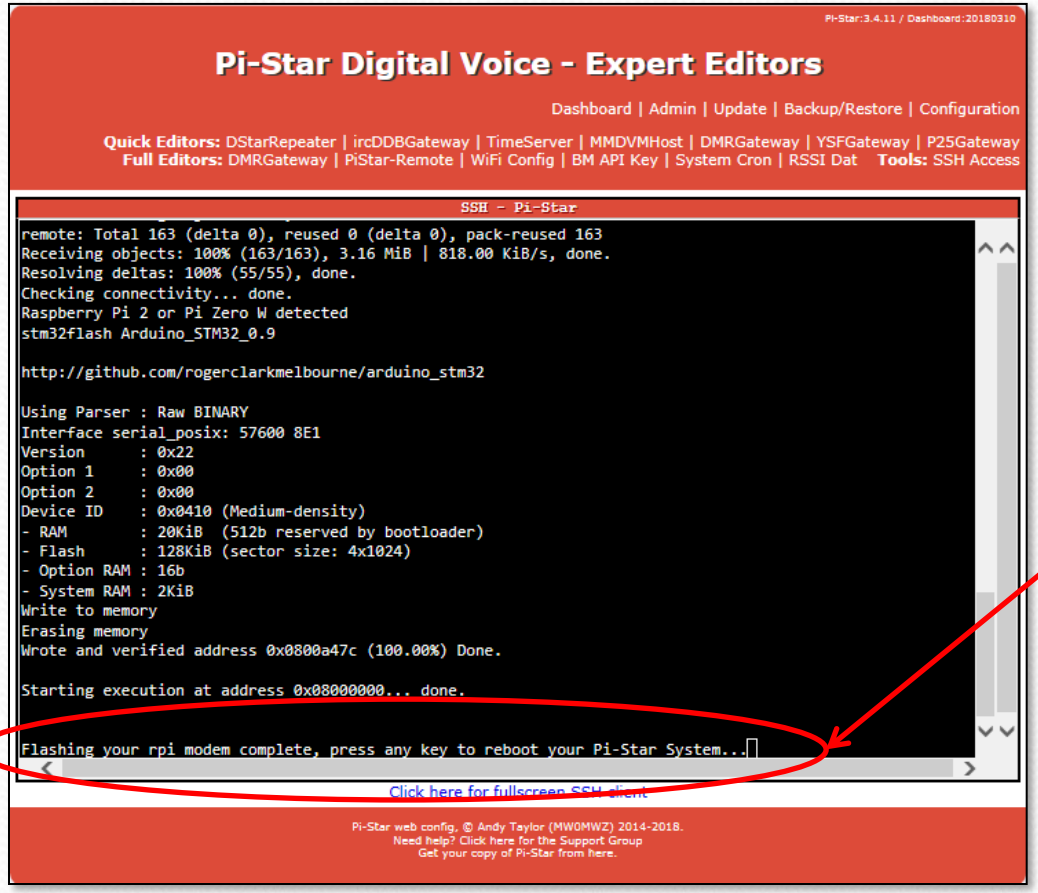
The Pi-Star SSH editor will open up as shown Here, with the command prompt: pi-star@pi-star(ro):=$

Enter the flash command:



At the command prompt, pi-star@pi-star(ro):=$, enter the string “sudo pistar-zumspotflash rpi” Without the quotes as shown here and hit enter.

Wait for flash complete:

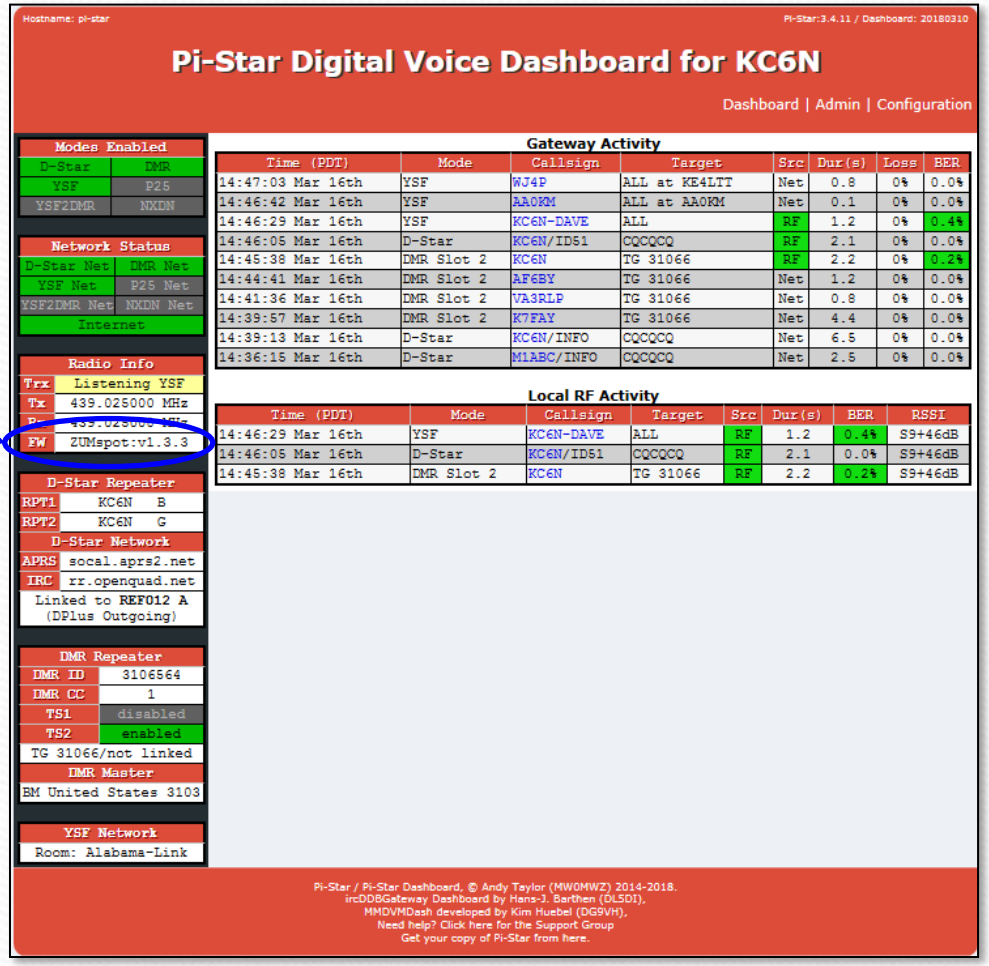


Let the flash process run to completion, follow any instructions presented. It will likely ask you to hit a key to begin a reboot. As usual, give the reboot about 3 minutes.

Verify new ZUMspot FW ver.

Once the boot cycle completes you can verify the ZUMspot's new FW version on the main dashboard.

That's it, all done.



ZUMspot/PiStar

Appendix G

Alternative bring up methodology

This works for any version of P-Star. While the AutoAP mode can only be used with version 3.4.11 (or later).

Note:

Your hotspot must be able to make a WiFi connection in order to be configured. This section outlines the “classic” method that will work with any version of Pi-Star. This is useful for people attempting to bring up a hot spot using a computer w/o WiFi. This might be a situation where a wired workstation is used for set-up that does not have it’s own WiFi. Both PC and hot spot must be in the same domain.

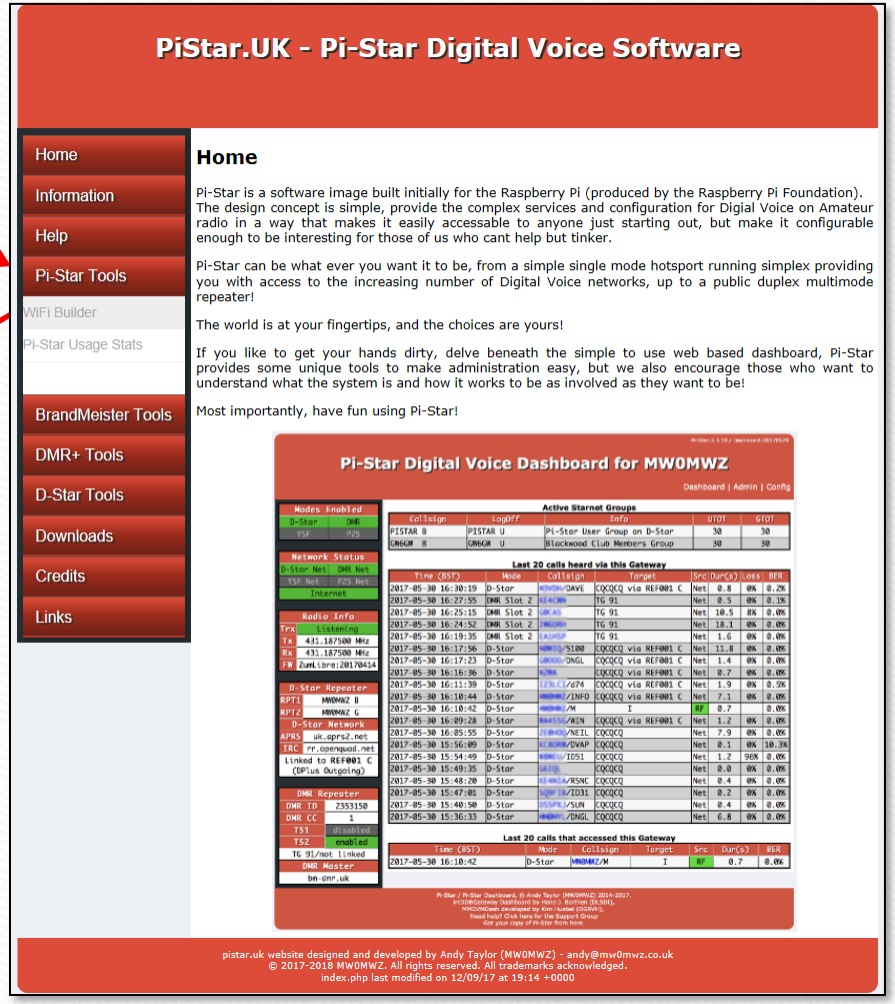
Gather up the following:

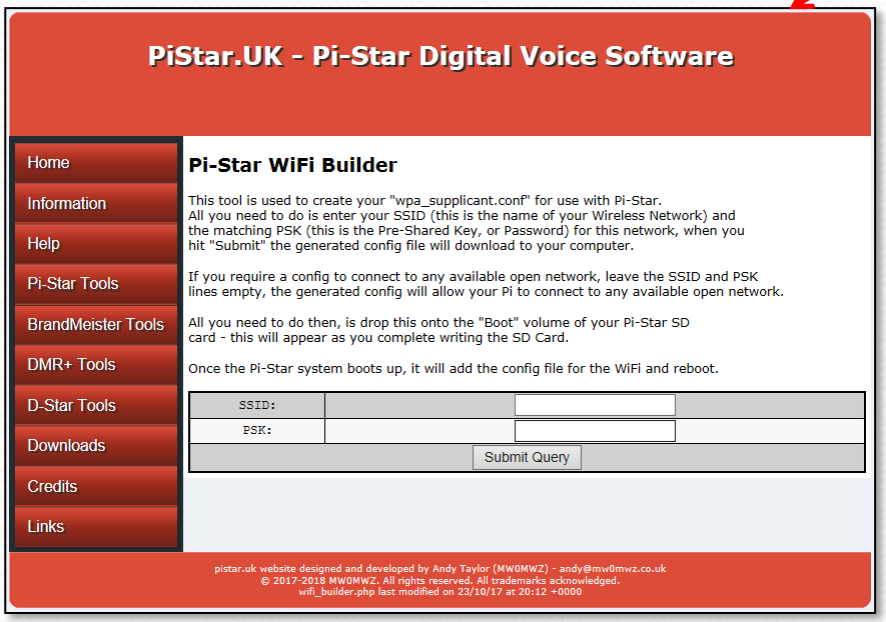
- Basic ZUMspot kit
  - ZUM Board (w/ Antenna)
  - Raspberry Pi ZeroW (w/ connector)
  - µSD card (w/ Image)
  - Case (Optional)
- Windows PC with Internet access
- USB µSD card reader
- WiFI Credentials for at least one WiFi connection (SSID and PSK), DMR ID

Setting up your WiFi (Slide 1)

Go to the following URL:
http://www.pistar.uk/index.php

Click Pi-Star Tools, select “WiFi Builder





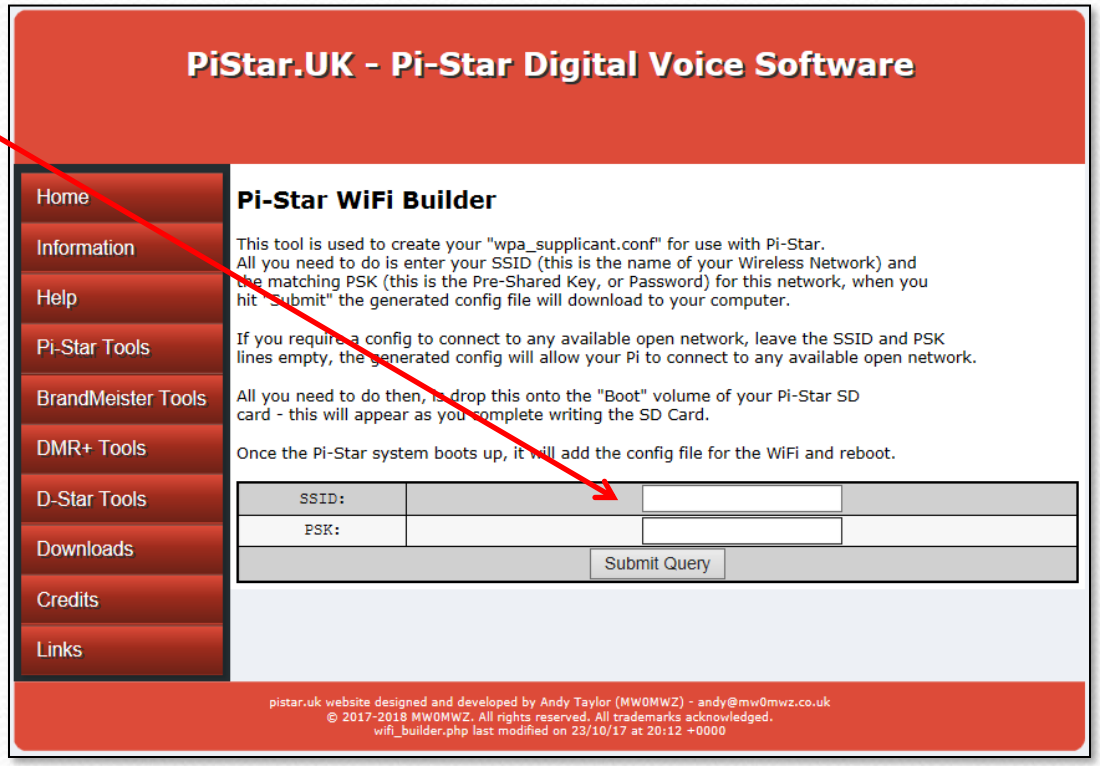
Setting up your WiFi (Slide 2)

1. Enter your WiFi Credentials: SSID, and Password (PSK) for the network you want to use for bring-up.

2. Click “Submit Query”

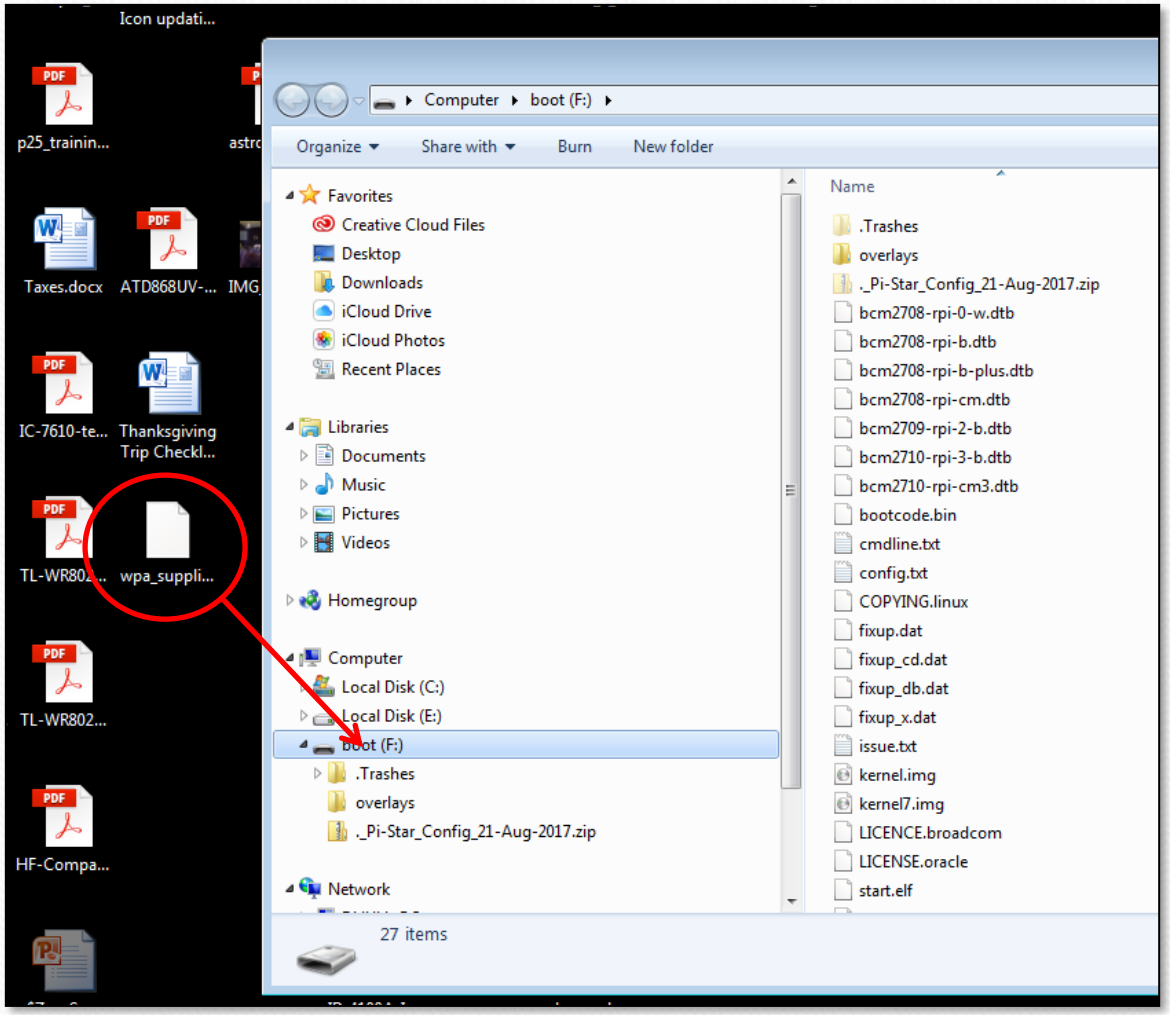
3. When the save dialogue appears, save the resulting “wpa_suplicant.conf” file in a location you will remember.

You will move this to your imaged card so that your WiFi will start up in the subsequent steps.



Setting up your WiFi (Slide 3)

1. Place your card containing the Pi-Star image in a µSD card reader in your PC.
2. Drag and Drop the “wpa_suplicant.conf” file into the root directory of your µSD card.
3. Install the µSD card containing your image and the wpa_suplicant file into your Raspberry Pi Zero W.
4. Power the hot spot, wait about three minutes then proceed with bring-up as described in Part III



ZUMspot/PiStar

Appendix H

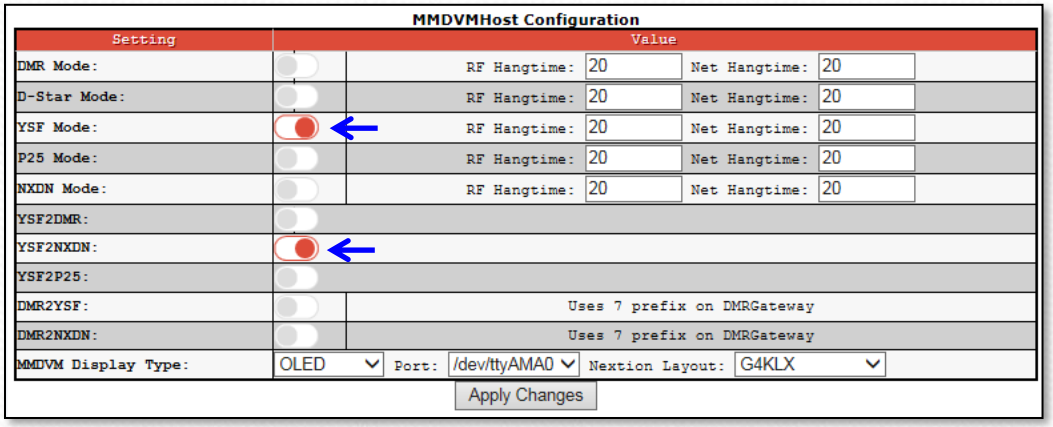
Cross Mode Operation

Cross-mode operation

- Pi-Star offers the ability to operate cross-mode between many (but not all) modes.
- This is achieved using bridges built into the pi-star framework.
- Each of the next few pages shows the setup needed to initialize a specific cross mode scenario.
- This section will be updated periodically as new capability is added to PiStar.

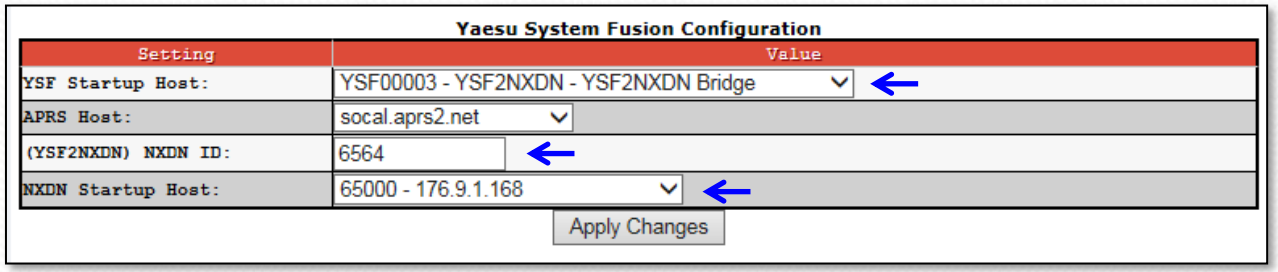
Cross-mode YSF to NXDN

Turn “on” YSF mode and YSF2NXDN In the MMDVM Host Dialog as shown Below.



Note: For this mode to work, your Fusion radio must be in DN mode. The reason for this is that NXDN runs its vocoder at a rate of 3600 bits/s. This is the vocoder rate used by Yaesu System Fusion in its DN mode.

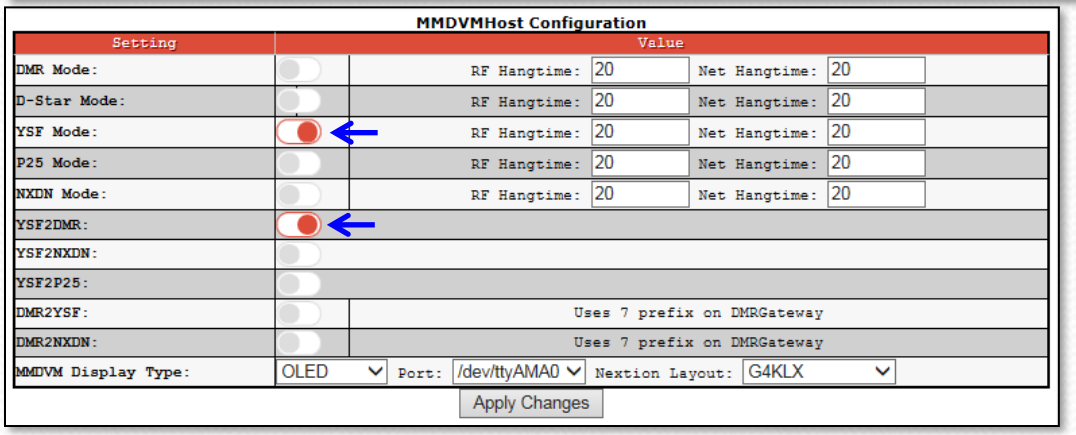
Click “Apply Changes” and wait for the reset to complete. Once it does, Fill out the Yaesu System Fusion Dialog as shown below. Select “YSF00003 – YSF2NXDN – YSF2NXDN Bridge” as your YSF Startup Host. Set your APRS Host, enter your NXDN ID (mine is shown). Select your desired NXDN “talk group” (last line) and “Apply Changes”.



The NXDN Startup Host (last line here) determines which talk group you will be using on NXDN.

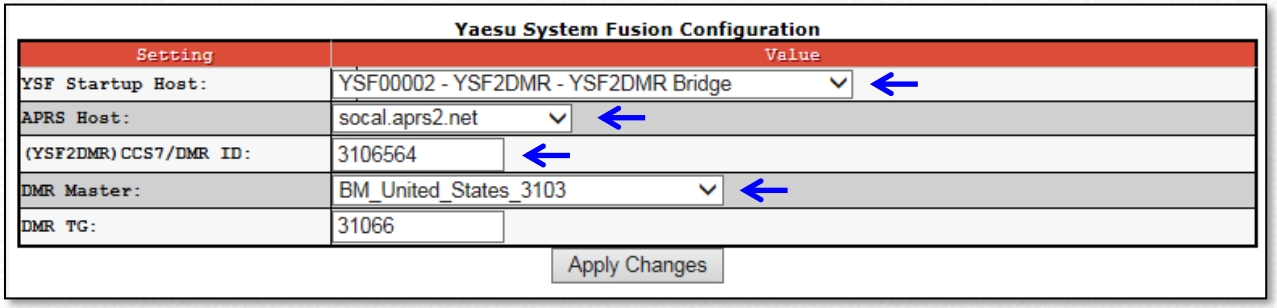
Cross-mode YSF to DMR

Turn “on” YSF mode and YSF2DMR in the MMDVM Host Dialog as shown Below.



Note: For this mode to work, your Fusion radio must be in DN mode. The reason for this is that DMR runs its vocoder at a rate of 3600 bits/s. This is the vocoder rate used by Yaesu System Fusion in its DN mode.

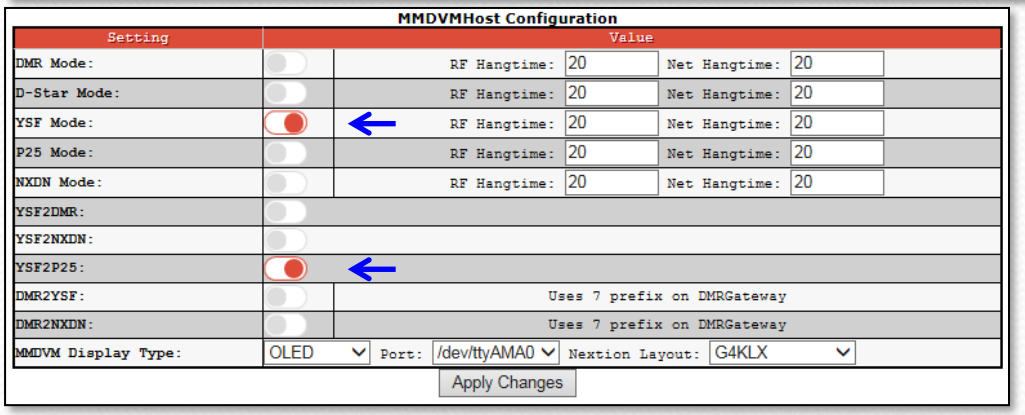
Click “Apply Changes” and wait for the reset to complete. Once it does, Fill out the Yaesu System Fusion Dialog as shown below. Select “YSF00002 – YSF2DMR – YSF2DMR Bridge” as your YSF Startup Host. Set your APRS Host, enter your DMR ID (mine is shown) and DMR Master. Select a DMR “talk group” (last line) and “Apply Changes”.



The DMR TG entry (last line here) determines which DMR talk group you will be using on DMR.

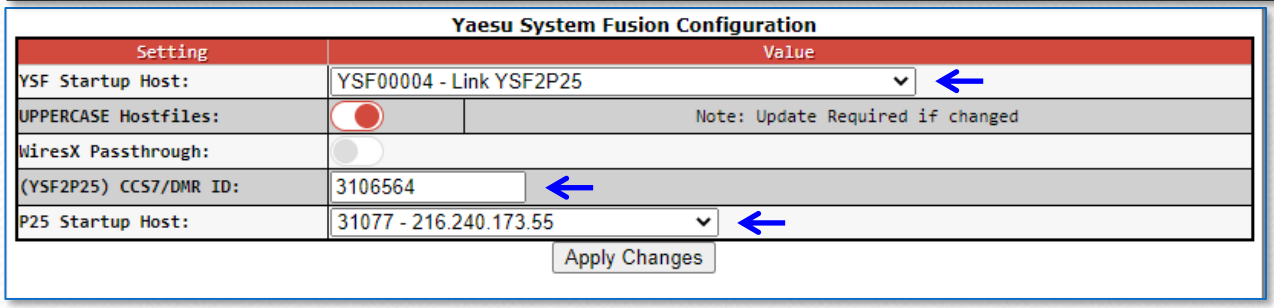
Cross-mode YSF to P25

Turn “on” YSF mode and YSF2P25 in the MMDVM Host Dialog as shown Below.



Note: For this mode to work, you need to set your Fusion radio to VM mode. This forces the Fusion radio to run its vocoder at 7200 bits/s which is the P25 vocoder rate (and one reason that P25 audio is so good).

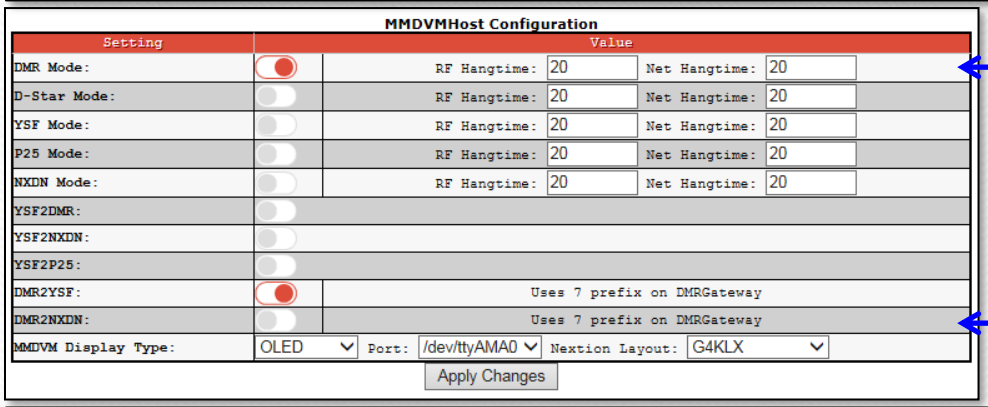
Click “Apply Changes” and wait for the reset to complete. Once it does, Fill out the Yaesu System Fusion Dialog as shown below. Select “YSF00004 – YSF2P25 – YSF2P25 Bridge” as your YSF Startup Host. Set your APRS Host, enter your DMR ID (mine is shown). Select your desired P25 “talk group” (last line) and “Apply Changes”.



The “P25 Startup Host” selection determines your talk group on P25.

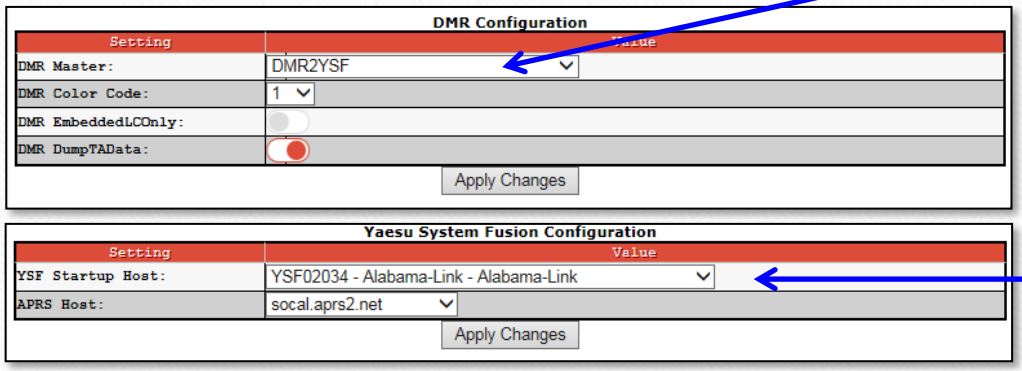
Cross-mode DMR to YSF/FCS

Turn “on” DMR mode and DMR2YSF in the MMDVM Host Dialog as shown Below.



Note: This page illustrates the simplest of two ways to bridge DMR to YSF. This requires the MMDVMHost settings shown to the left and the DMR master setting of DMR2YSF shown below. In this mode all you need for your DMR radio is a talk group (any TG ID will do) that is on the correct frequency, color code and timeslot.

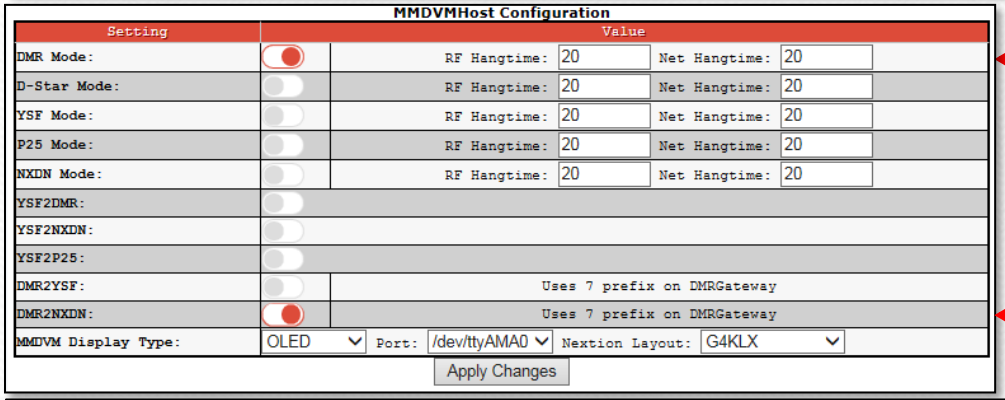
Click “Apply Changes” and wait for the reset to complete. Once it does, change the DMR Master to “DMR2YSF” in the “DMR Configuration” pane. This mode uses the “YSF Startup Host” to determine the target room for YSF. Click “Apply Changes.



The setting chosen for the “YSF Startup Host” determines the room you will be talking into. This mode works in both networks, YSF and FCS.

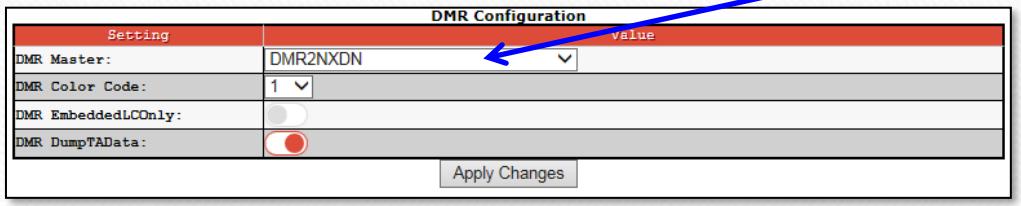
Cross-mode DMR to NXDN

Turn “on” DMR mode and DMR2NXDN as shown Below.

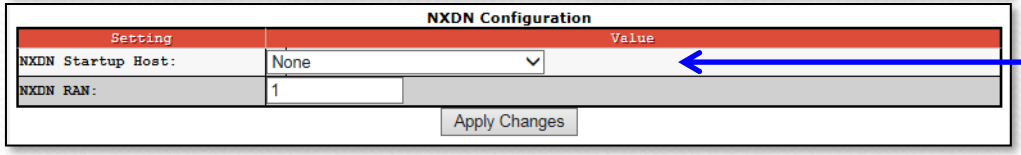


Note: This page illustrates the simplest of two ways to bridge DMR to NXDN. This requires the MMDVMHost settings shown to the left and the DMR master setting of DMR2NXDN shown below. You will need to program channels in your DMR radio for the NXDN talk groups that you intend to use. The DMR Channel TGID will be the NXDN TGID.

Click “Apply Changes” and wait for the reset to complete. Once it does, change the DMR Master to “DMR2NXDN” in the “DMR Configuration” pane. The DMR2NXDN gateway passes the talk group set in the DMR radio so it doesn’t really matter how the NXDN Host is set. Click “Apply Changes.



For example: To talk on the World Wide NXDN talk group, set a talk group in your DMR radio for TGID=65000.



In this mode, the NXDN Startup Host setting is ignored, I recommend setting this to “None”.

Cross-mode operation Notes

- You can have other modes operational while using cross-mode and the ZUMspot will scan.
- The mode you are crossing over to should not be enabled. In other words if you are setting up DMR2NXDN set the NXDN switch to “off”.
- You may want to create backup files for specific “setups”. Simply create a backup and re-name it for clarity.

Cross-mode operation notes

MMDVMHost Configuration

Setting	Value
DMR Mode:	RF Hangtime: 20 Net Hangtime: 20
D-Star Mode:	RF Hangtime: 20 Net Hangtime: 20
YSF Mode:	RF Hangtime: 20 Net Hangtime: 20
P25 Mode:	RF Hangtime: 20 Net Hangtime: 20
NXDN Mode:	RF Hangtime: 20 Net Hangtime: 20
YSF2DMR:	
YSF2NXDN:	
YSF2P25:	
DMR2YSF:	Uses 7 prefix on DMRGateway
DMR2NXDN:	Uses 7 prefix on DMRGateway
MMDVM Display Type:	OLED Port: /dev/ttyAMA0 Nextion Layout: G4KLX

Apply Changes

Yaesu System Fusion Configuration

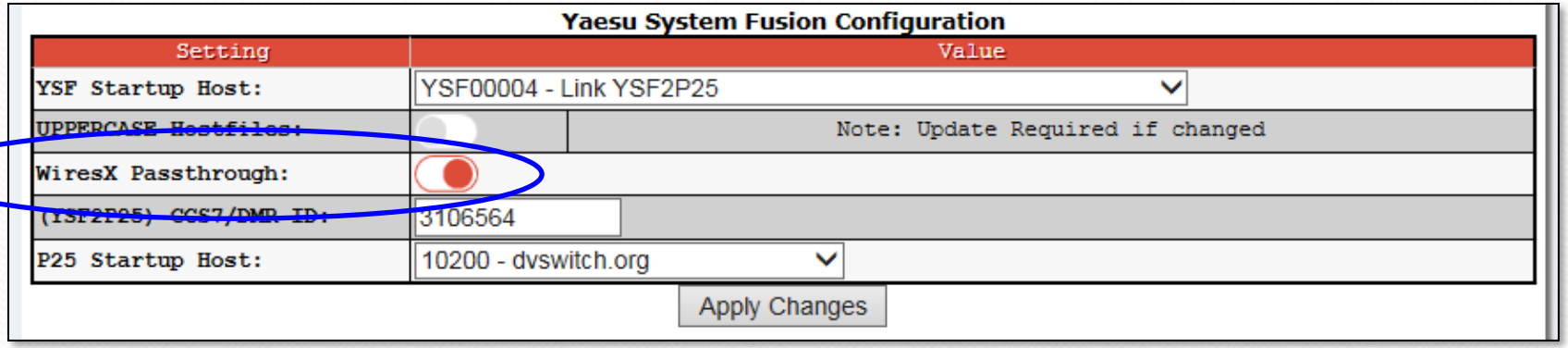
Setting	Value
YSF Startup Host:	YSF00004 - YSF2P25 - YSF2P25 Bridge
APRS Host:	socal.aprs2.net
(YSF2P25) CCS7/DMR ID:	3106564
P25 Startup Host:	10200 - dvswitch.org

Apply Changes

Here the ZUMspot is set up to scan for signals on DMR, DSTAR, and YSF but the YSF is actually listening for signals coming in from P25 reflector 10200 (P25 North America).

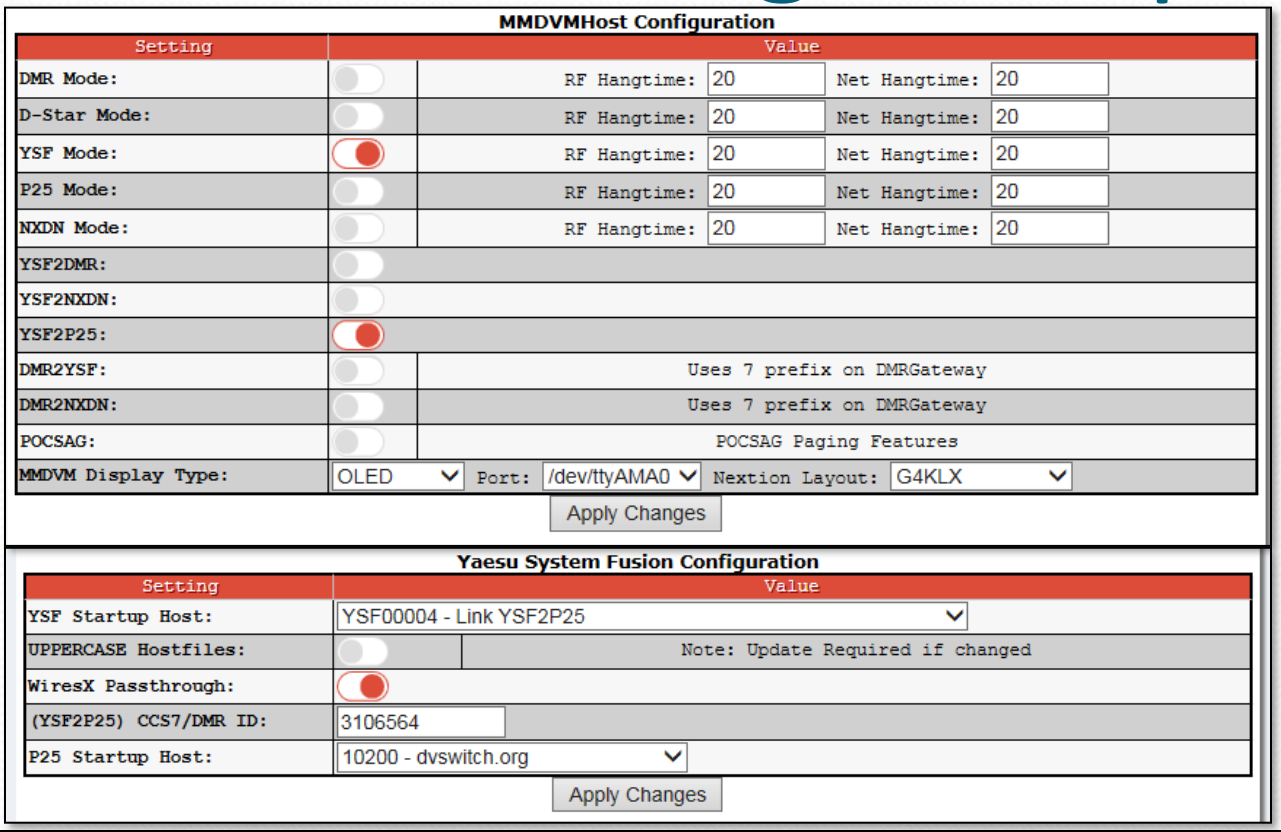
Control via WiresX Commands

- Recent versions of Pi-Star (v4.x.x) have added a WiresX Pass-through feature to the Fusion Panel as shown below:



- This allows a user to switch reflectors in P25 and NXDN modes just like you change rooms in Yaesu System Fusion.

WiresX Pass-through setup



MMDVMHost Configuration

Setting	Value
DMR Mode:	RF Hangtime: 20 Net Hangtime: 20
D-Star Mode:	RF Hangtime: 20 Net Hangtime: 20
YSF Mode:	RF Hangtime: 20 Net Hangtime: 20
P25 Mode:	RF Hangtime: 20 Net Hangtime: 20
NXDN Mode:	RF Hangtime: 20 Net Hangtime: 20
YSF2DMR:	
YSF2NXDN:	
YSF2P25:	
DMR2YSF:	Uses 7 prefix on DMRGateway
DMR2NXDN:	Uses 7 prefix on DMRGateway
POCSAG:	POCSAG Paging Features
MMDVM Display Type:	OLED Port: /dev/ttyAMA0 Nextion Layout: G4KLX

Apply Changes

Yaesu System Fusion Configuration

Setting	Value
YSF Startup Host:	YSF00004 - Link YSF2P25
UPPERCASE Hostfiles:	Note: Update Required if changed
WiresX Passthrough:	
(YSF2P25) CCS7/DMR ID:	3106564
P25 Startup Host:	10200 - dvswitch.org

Apply Changes

Here we have a simple configuration for YSF2P25. Startup host will be 10200 (Nationwide) but (once WiresX passthrough is “ON” you can change P25 reflectors just like you would change WiresX rooms. This also works for NXDN, and, of course Yaesu System Fusion and YSF Rooms (reflectors).

How to use it

Set your Pi-Star as shown on the previous page. Set your Fusion radio to your Hot Spot channel and make a brief transmission using your radio. This will get the hot spot's attention and stop any scan that may be in progress. The HS needs to be ready for fusion before you hit the "***D$_x$***" or "***X***" key on your radio.

Yaesu FT-3

1. Give your HotSpot a quick kerchunk using the PTT key

2. Once your HS is sitting on Fusion, press the "***X***" key

3. Touch "Search & Direct"

Note: The reflector you are currently on is shown here. In this case 10200, N. America.

Making WX Pass-through work

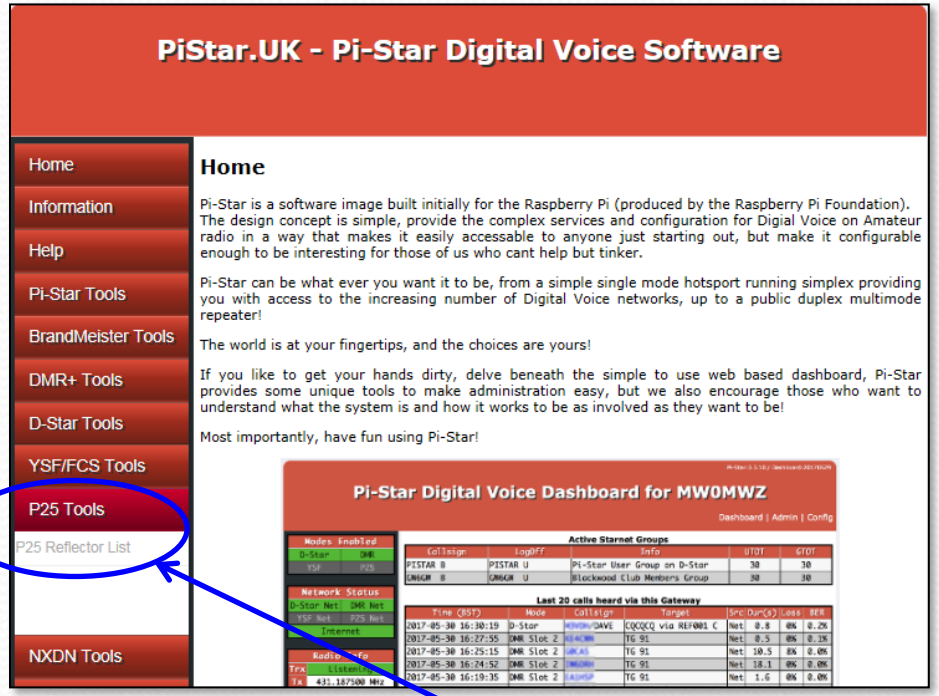
4. After a bit of a wait, you will see this screen.

5. Touch “ALL”, which after a brief wait will launch the screen on the right.

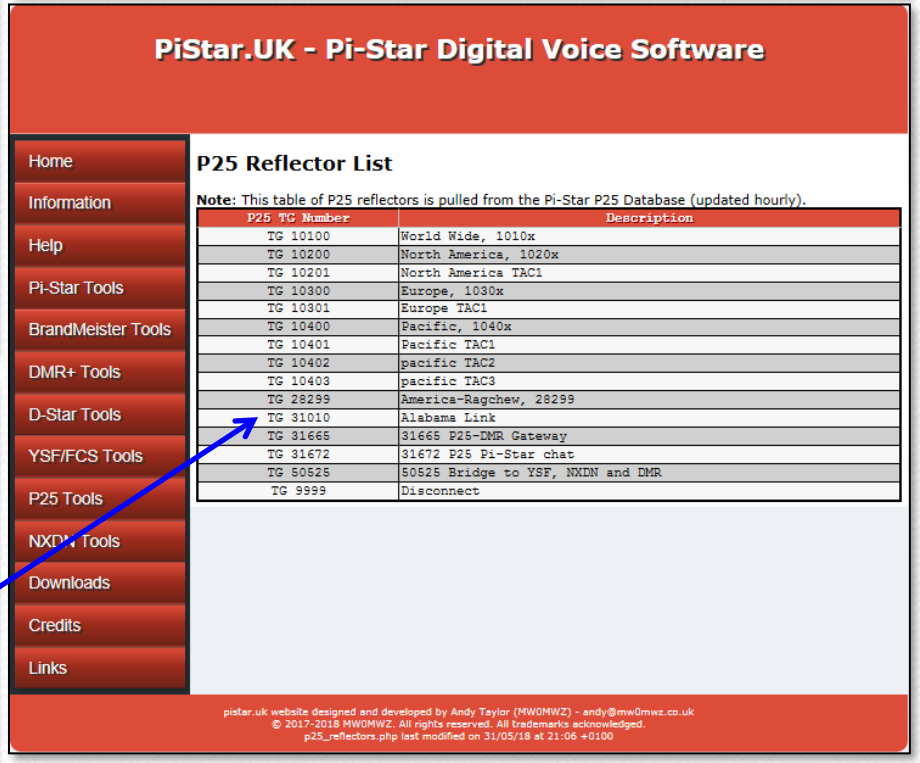
You can use the channel selector to scroll through the list if you like, but you will still need to touch the one you want, once you get there.

Simply touch to select the reflector you want to change to. “TOP” takes you to the top of the list, the up/down arrows load other pages from the list. When done, hold down the “X” key for a second or so to cancel out of select mode. This is for P25 but it works for NXDN, Fusion and YSF. Make sure your radio is in VM mode for P25, it may switch back to DN during this process. Use DN mode for NXDN.

Where to find the reflector ID's



Most of these modes operate in reflector mode. This includes P25, NXDN, DMR+ and YSF/FCS (yea, they call them "rooms"). Pi-Star maintains updated lists for these reflectors on the home page.



Go to: http://www.pistar.uk/ and check the "Tools" pulldown specific to the mode you are interested in. There you are likely to find an option to list the reflectors currently available for the mode. Select the reflector list option to see what is available (updated regularly).

Final note on cross mode

- I have tried to show the simplest connection method in this section, I did not show the use of the “DMR Gateway” which is somewhat more complicated.
- There is an excellent paper on the use of the DMRGateway by John Fields titled “XLX and XRF Reflectors, DMR and use with DMRGateway” which can be found on the web.

ZUMspot/PiStar

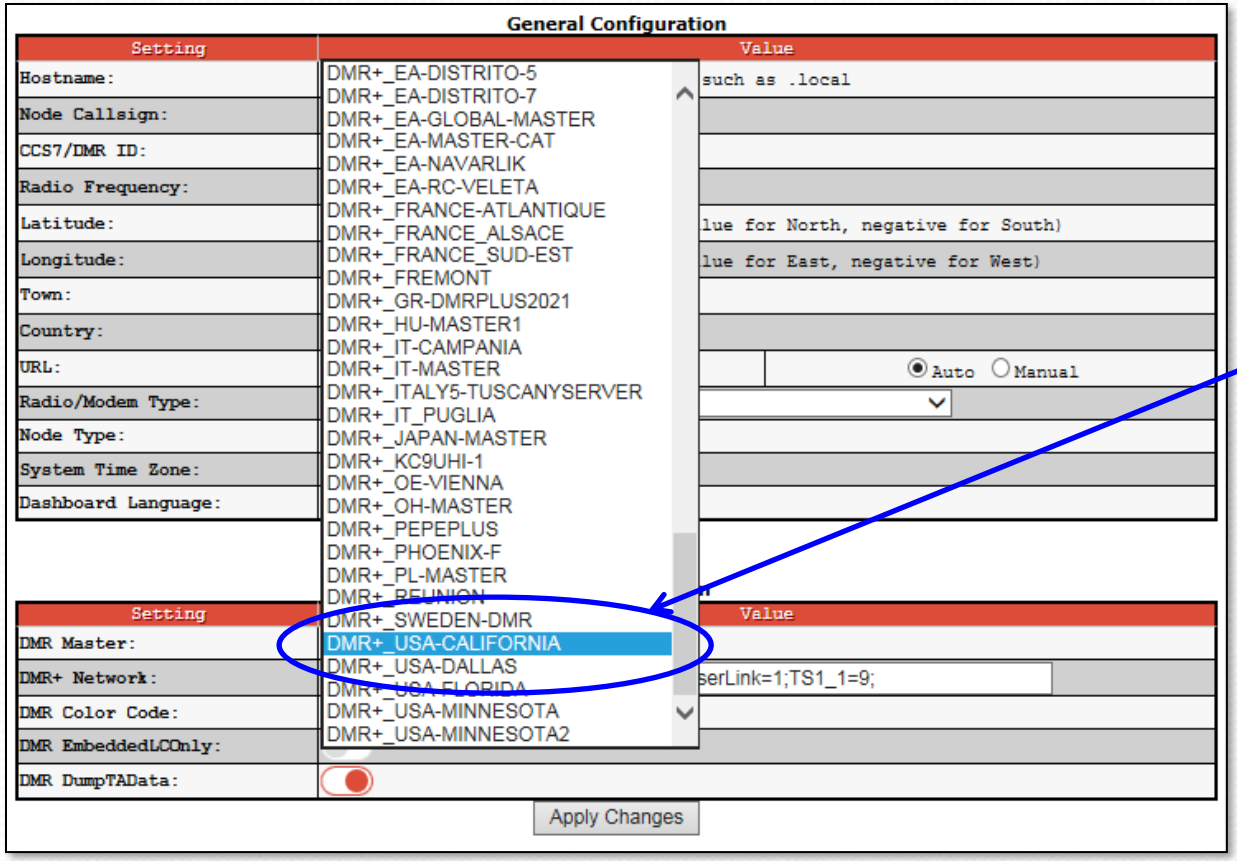
Appendix I

DMR+ Setup and Operation

DMR+ Background Info

- The DMR+ network is another group of networked repeaters, like Brandmeister.
- DMR+ is mostly deployed in Europe with a few repeaters and servers in the US.
- While communication on Brandmeister takes place primarily via talk groups with its available reflectors being used rarely, communication on DMR+ is mostly via reflectors with talk-groups used rarely.

DMR+ Background Info

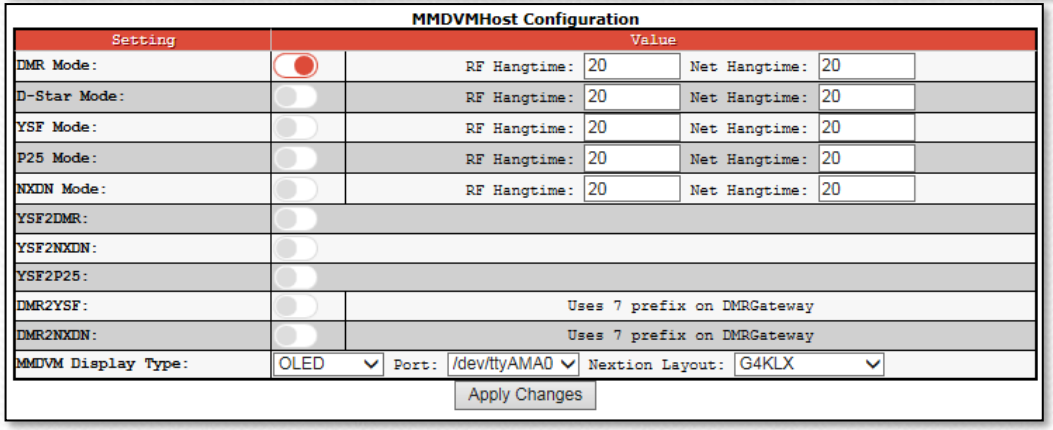


The DMR+ network can be accessed by selecting one of the DMR+ servers listed in the DMR Master pulldown in the DMR Configuration dialog.

I would suggest picking one close to your geographical area.

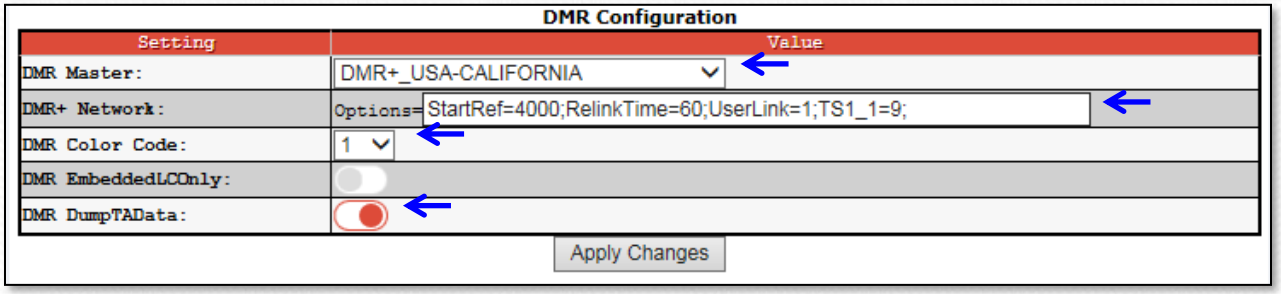
Pi-Star DMR+ Setup

Turn “on” DMR mode in the MMDVM Host Dialog as shown Below.



Note: DMR+ makes extensive use of reflectors. The DMR+ Network Options entry (discussed below) allows the system to start with a specific reflector designated. You can also start with the UNLINK command “4000” as shown in the example below. This will start the system with no reflector connected.

Click “Apply Changes” and wait for the reset to complete. Once it does, fill out the DMR Configuration Dialog as shown below. Select one of the DMR+ servers near your location. I have selected “DMR+_USA-CALIFORNIA” which is close to me. You may want to add the string “StartRef=****;RelinkTime=60;UserLink=1;TS1_1=9;” as shown below. Replace the “****” with the ID of your desired start-up reflector.



Set “DMR DumpTAData to “ON” to if you use talker alias. Make sure the color code is correct.

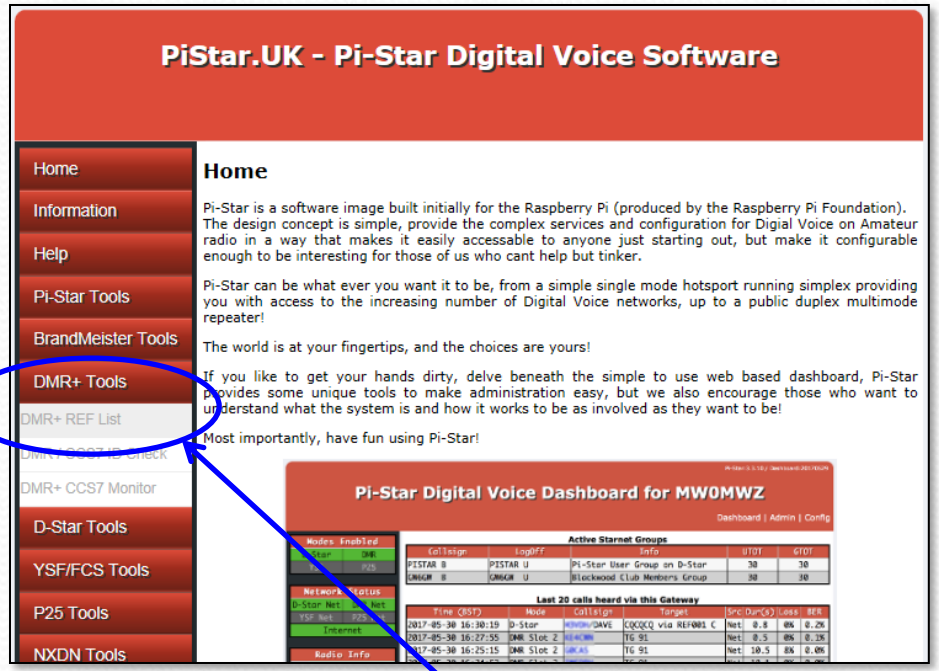
Linking to a DMR+ Reflector

- Set up your ZUMspot for DMR+ operation as described on the previous pages
- Set your DMR radio to communicate with your ZUMspot on DMR Talk-Group 9
- Using your DMR radio, issue a “Private Call” to the reflector ID of the reflector you want to use. This links you to the reflector.
- The reflector will respond with a connect announcement.

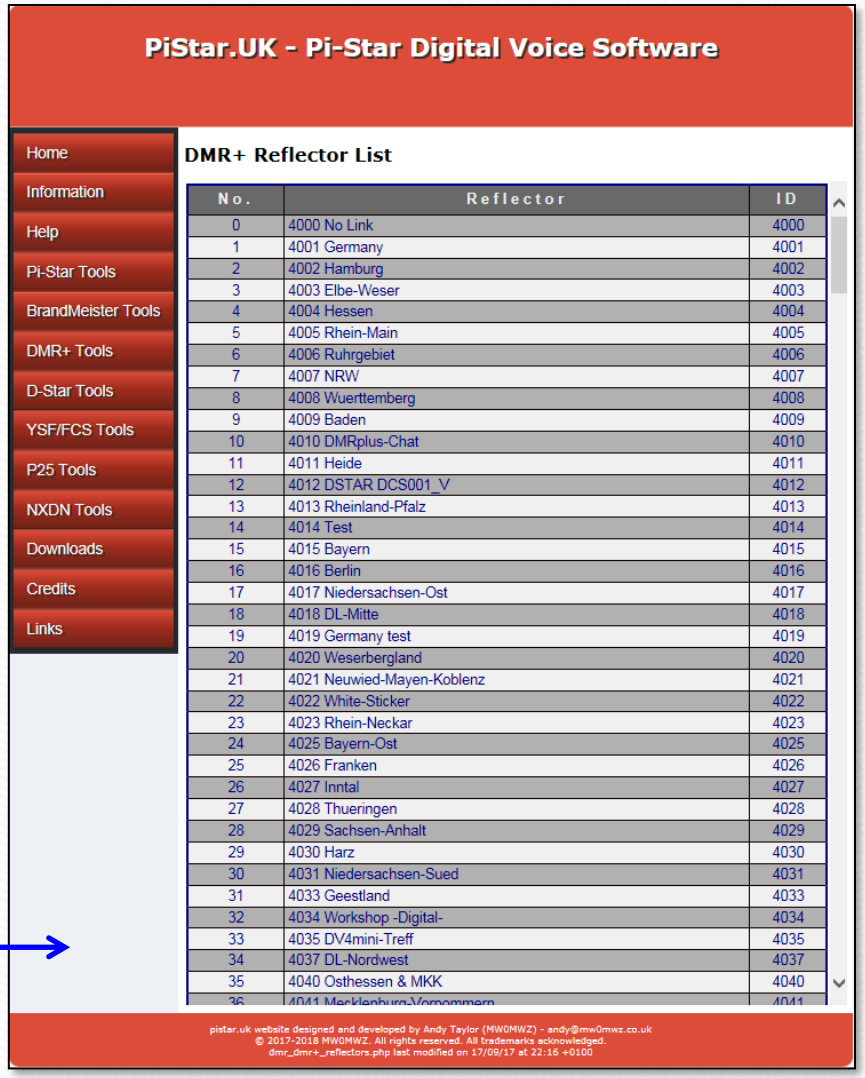
Using the DMR+ Reflector

- Once connected you will communicate with the reflector using Talk-Group 9
- Example: to use USA-Nationwide, set your radio to TG 9, Make a private call to ID 4639. After the connect response, use TG9 for calls
- To switch reflectors, simply make another private call to the new reflector ID.

Where to find the reflector ID's



Go to: http://www.pistar.uk/ and select "DMR+ REF List" in the "DMR+ Tools" pull down. This will bring up the list of currently available DMR+ reflectors similar to what is shown to the right.



No.	Reflector	ID
0	4000 No Link	4000
1	4001 Germany	4001
2	4002 Hamburg	4002
3	4003 Elbe-Weser	4003
4	4004 Hessen	4004
5	4005 Rhein-Main	4005
6	4006 Ruhrgebiet	4006
7	4007 NRW	4007
8	4008 Wuerttemberg	4008
9	4009 Baden	4009
10	4010 DMRplus-Chat	4010
11	4011 Heide	4011
12	4012 DSTAR DCS001_V	4012
13	4013 Rheinland-Pfalz	4013
14	4014 Test	4014
15	4015 Bayern	4015
16	4016 Berlin	4016
17	4017 Niedersachsen-Ost	4017
18	4018 DL-Mitte	4018
19	4019 Germany test	4019
20	4020 Weserbergland	4020
21	4021 Neuwied-Mayen-Koblenz	4021
22	4022 White-Sticker	4022
23	4023 Rhein-Neckar	4023
24	4025 Bayern-Ost	4025
25	4026 Franken	4026
26	4027 Inntal	4027
27	4028 Thueringen	4028
28	4029 Sachsen-Anhalt	4029
29	4030 Harz	4030
30	4031 Niedersachsen-Sued	4031
31	4033 Geestland	4033
32	4034 Workshop -Digital-	4034
33	4035 DV4mini-Treff	4035
34	4037 DL-Nordwest	4037
35	4040 Osthessen & MKK	4040

A few more DMR+ notes

- To disconnect from a reflector, issue a private call to ID 4000.
- To determine where you are currently connected, make a private call to ID 5000.
- Note that there is a set of reflectors on Brandmeister that mirror the set on DMR+ but while they may have the same number, they are not the same and are not connected. Similarly for talk-groups.

ZUMspot/PiStar

Appendix J

XLX, XRF Reflectors, DMR and DMRGateway

DMR Gateway Operation (1)

- This appendix will take a look at the DMR Gateway option and will provide an overview of what you can do with it.
- The DMRGateway is yet another option in the DMR configuration panel and provides the ability to simultaneously connect to the XLX reflector, Brandmeister and DMR+ infrastructures using a single Pi-Star DMR configuration (without scanning).

DMR Gateway Operation (2)

- The current incarnation of the Gateway allows one to maintain a simultanious connection to the Brandmeister and DMR+ networks as well as a single XLX Master.
- This mode provides yet another way to set up cross-mode as well. However, IMO, the method covered in Appendix H is much more straightforward and easier to use.

DMR Gateway Operation (3)

- **Brandmeister:** With the DMRGateway, you will access Brandmeister exactly as you always have.
  - Program a zone with the talk-groups you want to use and select talk groups using the normal procedure on your radio.
  - Whatever setup you already have should work fine in this mode.

DMR Gateway Operation (4)

- **DMR+:** DMR+ is a reflector based network which, once configured, is accessed and controlled via talk-group 8.
  - Switch reflectors by issuing a “Private Call” (PC) to 8xxxx where “xxxx” is the ID of the desired reflector (for example: 84639)
  - To see where you are connected, issue a PC to 85000
  - To disconnect, issue a PC to 84000

DMR Gateway Operation (5)

- **XLX Servers:** This is a reflector based network which, once configured, is accessed and controlled via talk-group 6.
  - Select an XLX Master in PiStar, then switch modules (reflectors) on the selected master by issuing a “Private Call” (PC) to 6xxxx where “xxxx” is the reflector ID.
  - To see where you are connected, issue a PC to 65000
  - To disconnect, issue a PC to 64000

DMR Gateway Operation (6)

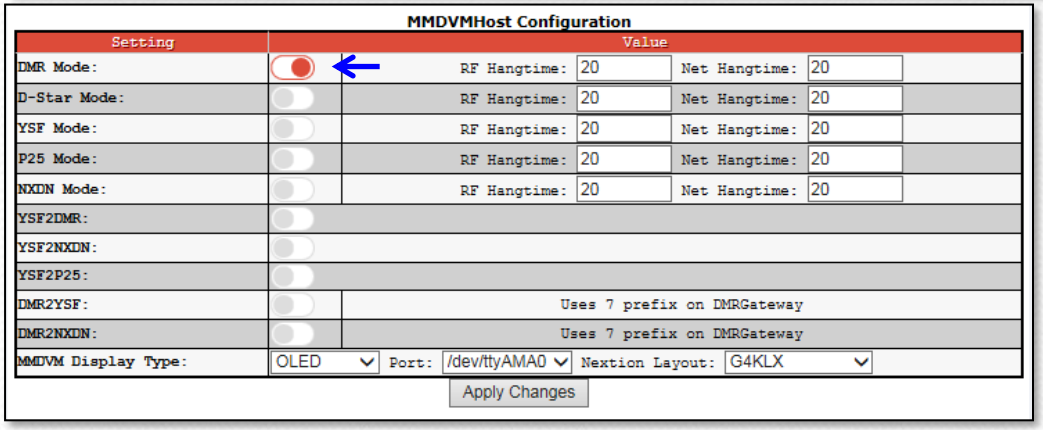
- An XLX Master can have up to 26 modules. These can be set up for either DMR or DSTAR. In the DSTAR case they are referenced as A trough Z. In the case of DMR, they are referenced as 4001 through 4026.
- Note that many XLX modules seem to be configured for DMR. However XRF210D is definitely configured for DMR, and can be used to validate your setup.

DMR Gateway Operation (7)

- Note that there does not appear to be as much DMR activity on XLX and activity in general on DMR+ seems to be less than for Brandmeister and MARC. Reflector 4639 on DMR+ is a good place to start.
- For more info, please refer to the excellent paper by John Fields titled: "*XLX and XRF Reflectors, DMR and use with DMRGateway*" (which can be found on the web) for more information.

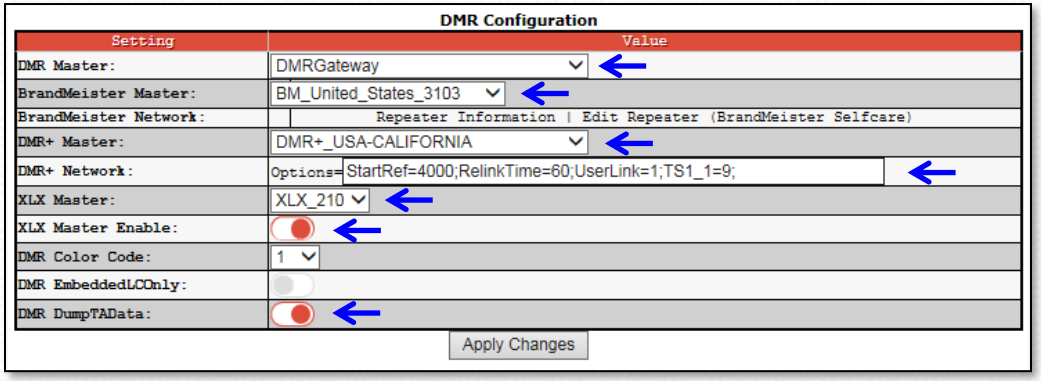
DMR Gateway Setup

Turn on DMR Mode in the MMDVM Host Dialog



Note: For Brandmeister, all communications are carried out normally using talk groups in a zone. For DMR+ all communications are carried out on talk group 8. Reflector selection requires a Private Call to the reflector ID prefixed by "8" i.e. 84639. For the XLX network all communications are carried out on talk group 6. Module selection requires a Private Call to the Module ID prefixed by "6" i.e. 64004 (sets Module D on the master selected in PiStar).

Click "Apply Changes" and wait for the reset to complete. Once it does, Set the DMR Master selection in the DMR configuration dialog to "DMRGateway" and "Apply Changes" This will return a new version of the DMR Configuration dialog as shown:



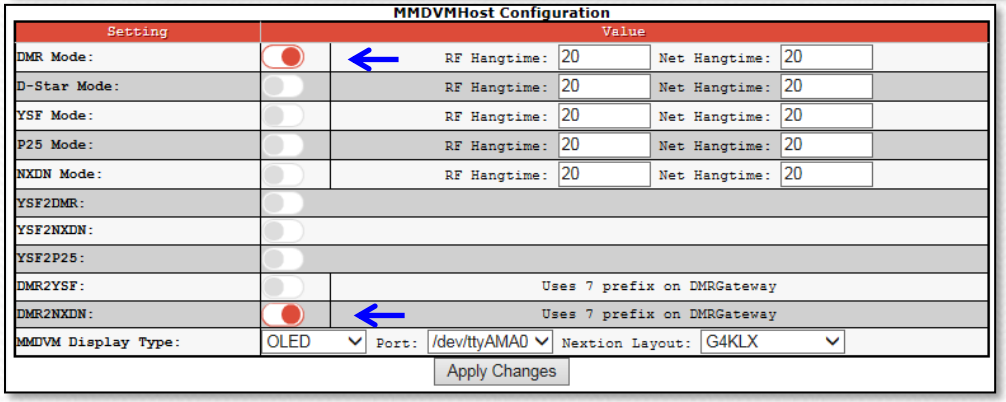
Set your "BrandMeister Master", your desired "DMR+ Master", your "DMR+ Network Options" String (optional), your "XLX Master", and set the "XLX Master Enable"="ON". Set your Color Code ("1" usually). Turn on DMR DumpTAData if you use talker alias on BM.

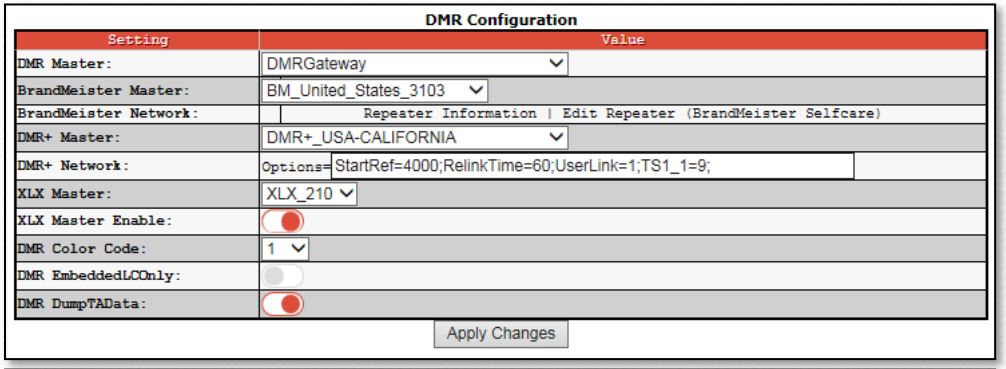
DMR Gateway Examples

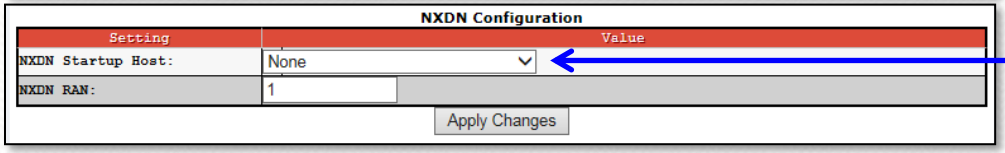
- You should be able to talk into XLX210D by executing a Private Call (PC) on TG 6 to 64004 to set module D. Then use Talk Group 6 to communicate to BM TG 31210.
- You should be able to use reflectors on DMR+ (such as 4639) by executing a PC to 84639 on TG 8 then use TG 8 to communicate normally.
- Brandmeister operation works as always with your standard zone and talk groups.

DMRGateway DMR to NXDN

The DMRGateway provides yet another way to do the DMR2NXDN cross-mode







Note: In my opinion, the methodology outlined in Appendix H is easier to use and more straightforward.

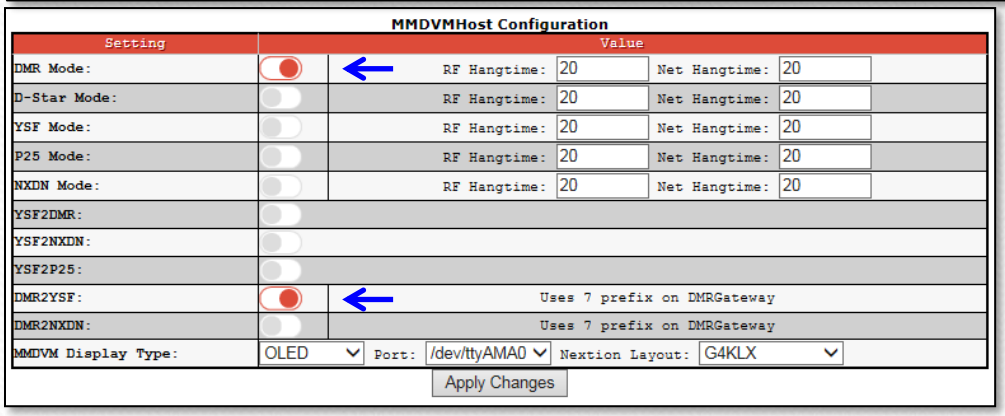
To operate cross mode to NXDN using a DMR radio with the DMRGateway to, set the MMDVMHost settings shown to the left. Use the DMRGateway setup we have been using throughout this section. DMR+ and XLX will work as described earlier (or you can turn them off). You will need to program channels in your DMR radio for the NXDN talk groups that you intend to use. The DMR Channel Group Call ID will be the desired NXDN TGID, prefixed by “7”.

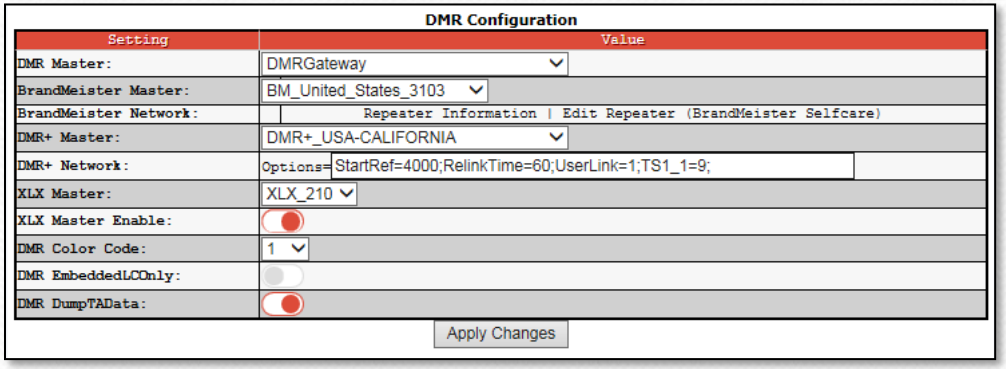
For example: To talk on the World Wide NXDN talk group, 65000, set a talk group in your DMR radio for TGID=765000 (add a “7” ahead of the TG ID of 65000). For NXDN North America, TG 10200, program a channel in your DMR radio with a group call TG ID = 710200.

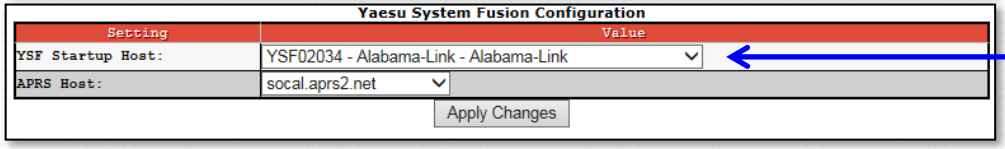
In this mode, the NXDN Startup Host settings are ignored, Set these to “None”. If you have an NXDN ID, Load it into “NXDN RAN”.

DMRGateway DMR to YSF/FCS

The DMRGateway provides yet another way to do the DMR2YSF cross-mode







In my opinion, the methodology outlined in Appendix H is more straightforward and easier to use.

To operate cross mode to YSF/FCS with a DMR radio, using the DMRGateway, use MMDVMHost settings shown to the left. Use the DMRGateway setup we have been using throughout this section (as shown to the left). DMR+ and XLX will work as described earlier (or you can turn them off). You will need to program a channel in your DMR radio for DMR2YSF. In this case, the actual number doesn't matter but it must be in the range 700001 to 799999. Where you come out on YSF/FCS is determined by the settings in the "Yaesu System Fusion Configuration" dialog as shown at the bottom left and discussed below:

In this mode, the DMR radio talk group is ignored but it must be a Group Call in the range of 700001 to 799999. If you do NXDN, your channel for TG ID 765000 will do nicely. The setting for "YSF Startup Host" in the "Yaesu System Fusion Configuration" dialog determines where you will come out on YSF.

ZUMspot/PiStar

Appendix K

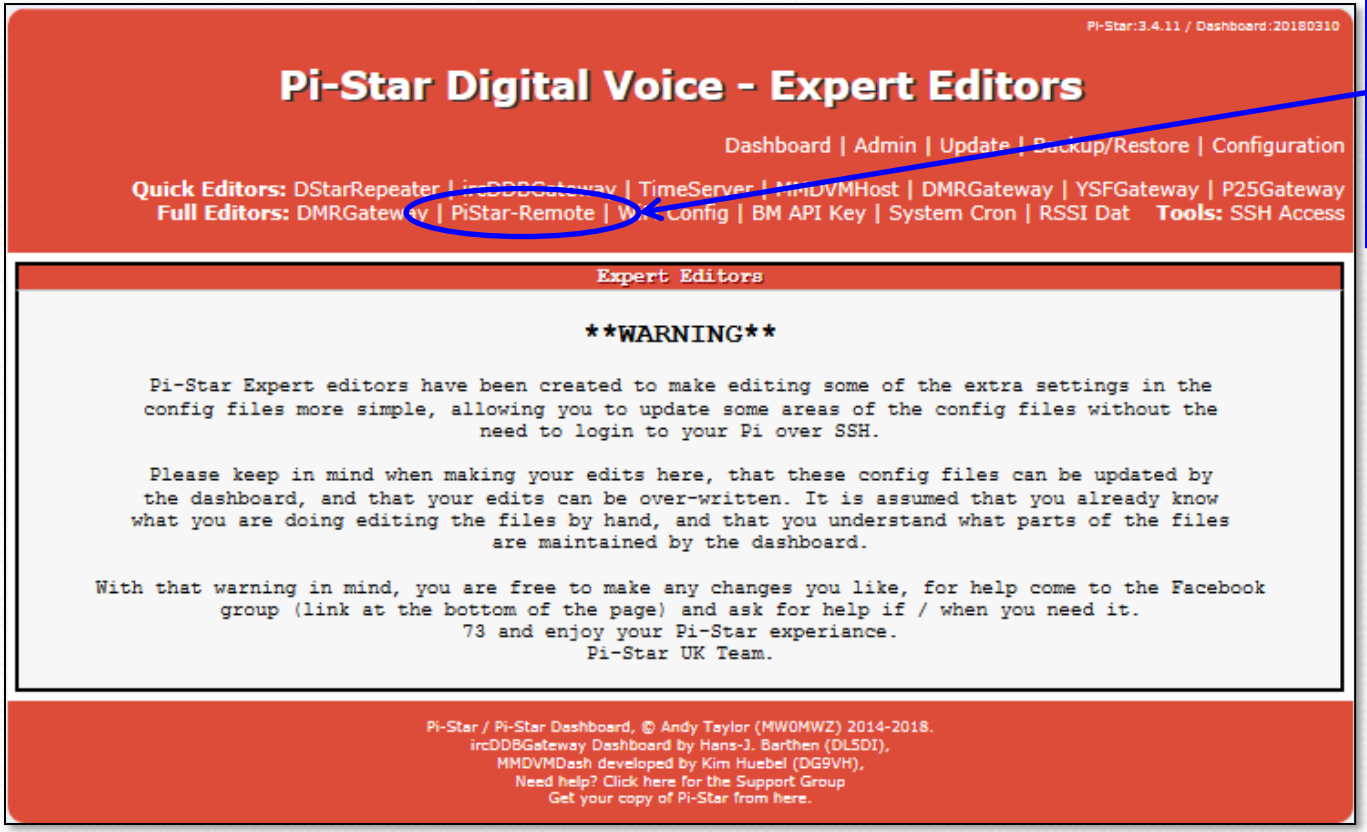
Controlling Pi-Star from your radio

Pi-Star Remote Control

- Pi-Star includes features which allow your hotspot to be controlled remotely over the air.
- Codes for Reboot, Power Down, etc. are available in each mode.
- These can be accessed from the admin/expert pages by pointing the browser to:
- http://pi-star/admin/expert/

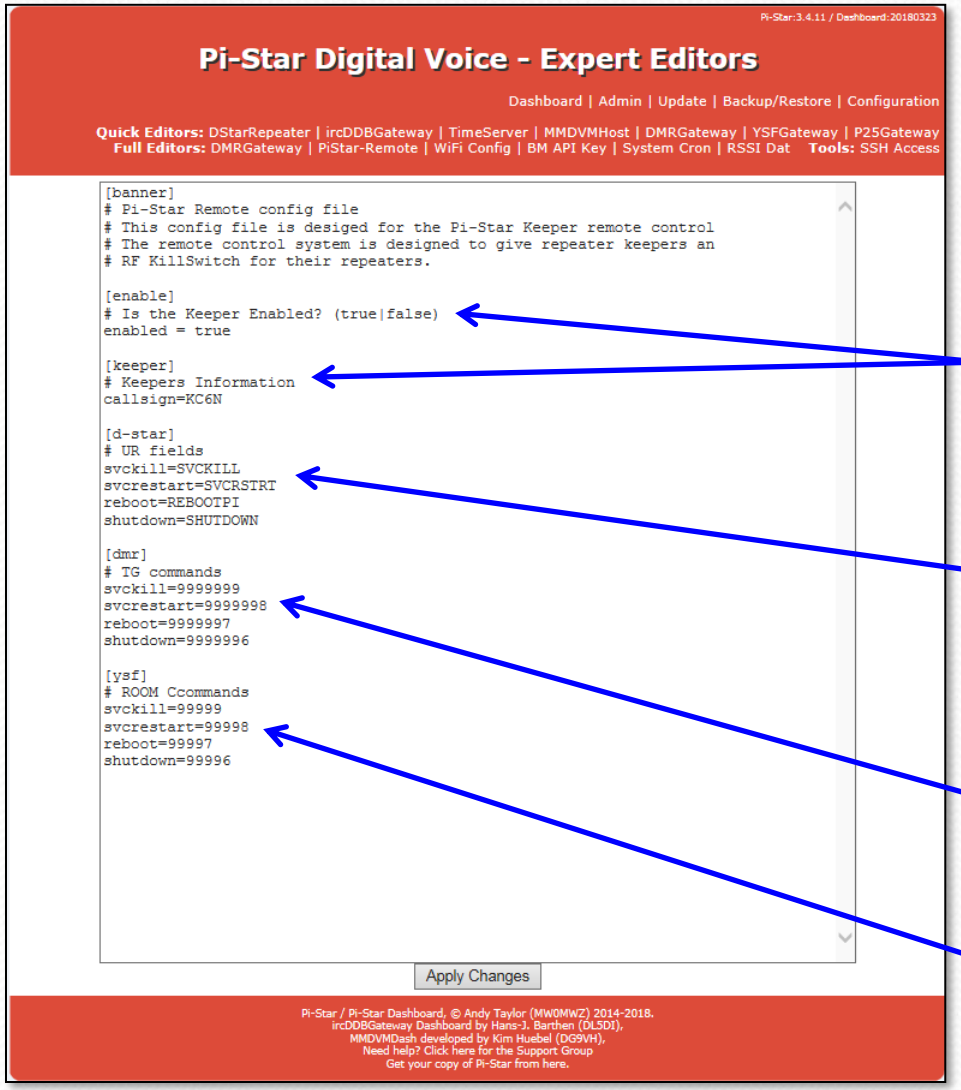
Pi-Star remote control modes

- Log onto the Pi-Star admin expert page:
  - http://pi-star/admin/expert/



Click "**PiStar Remote**" To bring up the remote control code page.

Pi-Star remote control modes



Here is where you will find all of the “mode compatible” commands needed to operate your hotspot remotely via your radio.

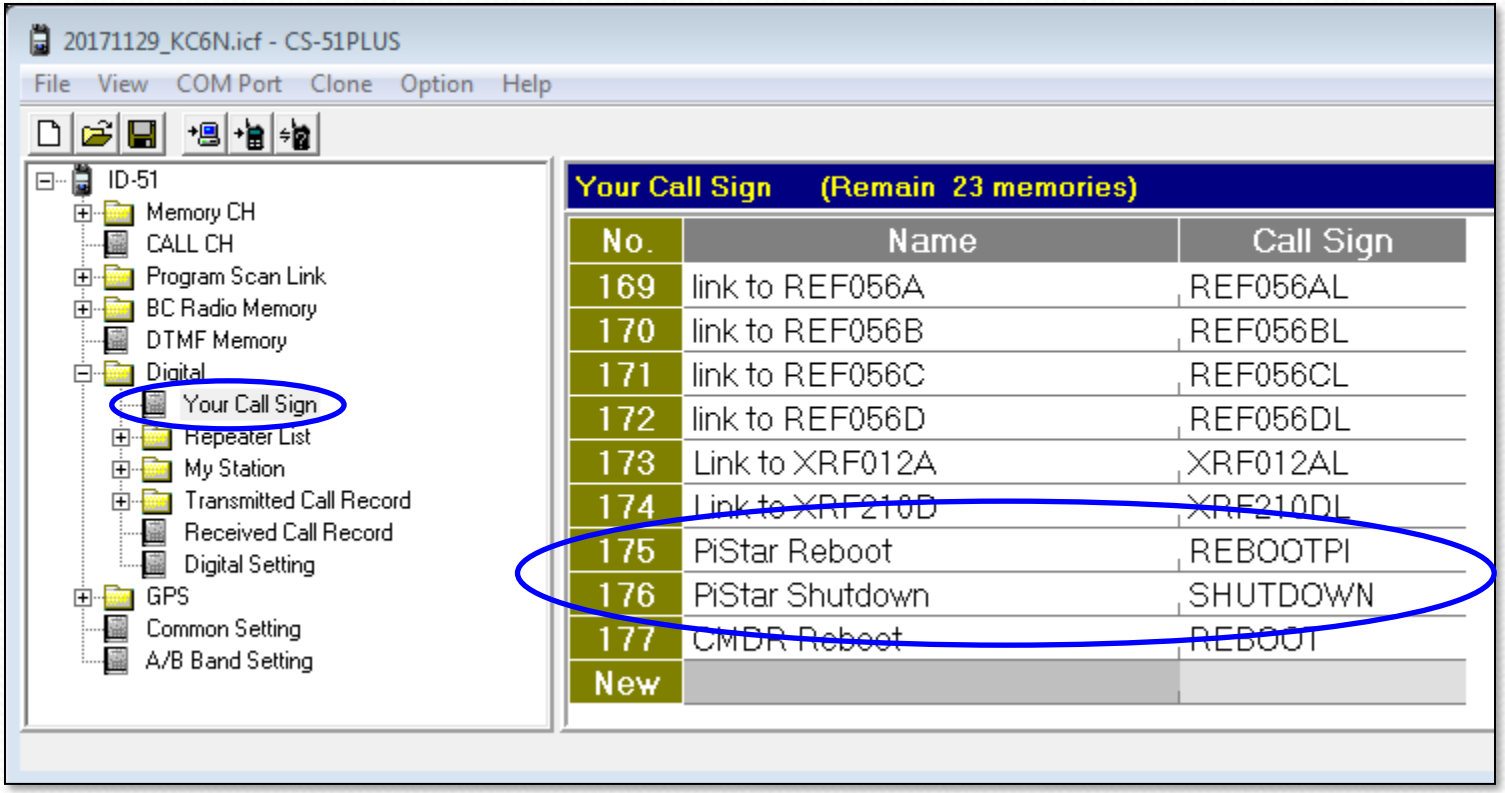
Make sure that “Keeper” is enabled here, make sure that your callsign is set as the “Keeper” in UPPER CASE.

For DSTAR: you need to make these commands available in the “UR Call” field of your radio.

For DMR: you need to these talk group commands and create channels for these in your zone.

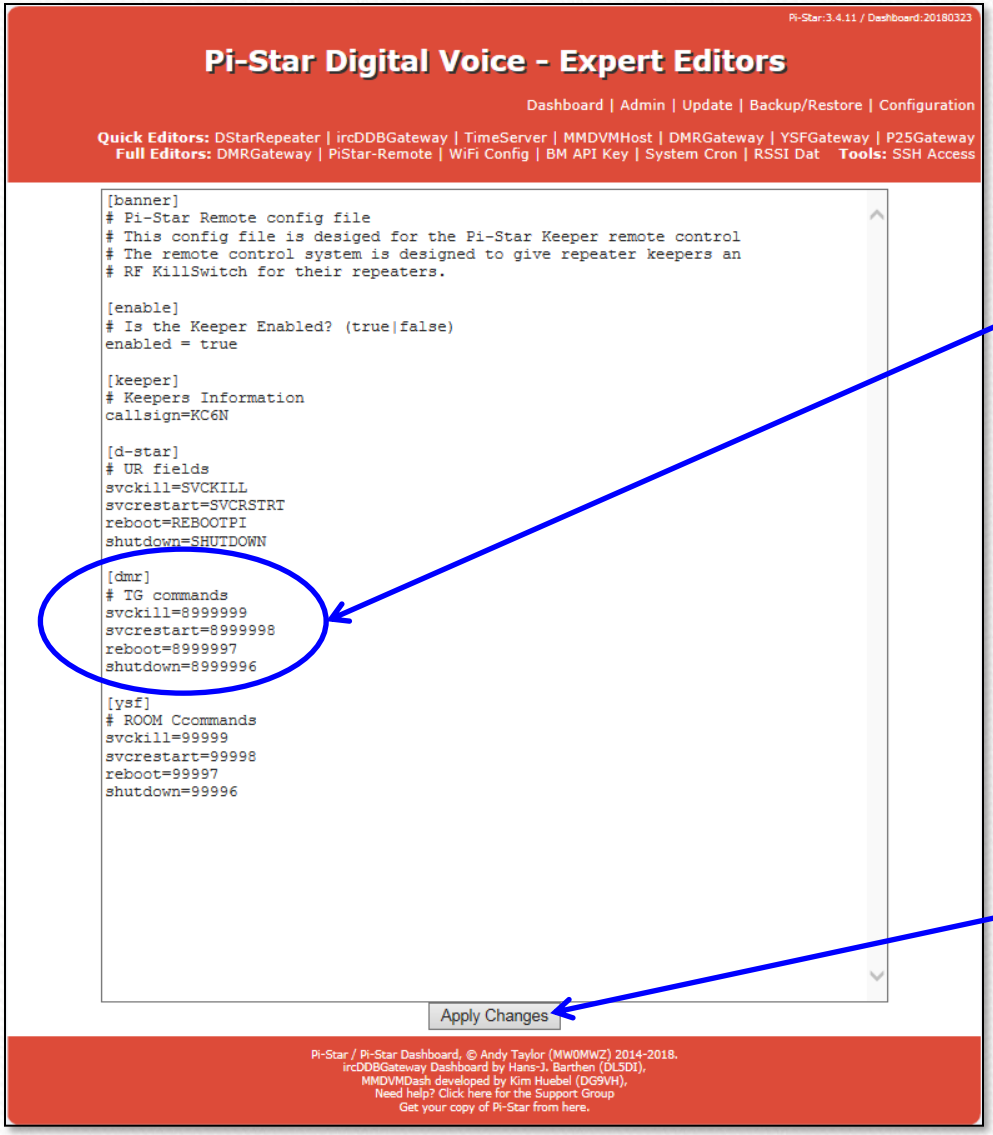
Fusion uses “room codes” of course

Pi-Star remote control DSTAR



Add the commands to the “UR Call” (or Your Call) memory of your DSTAR radio so that they are accessable in DR mode. The commands REBOOTPI and SHUTDOWN are shown here. You may have these for other devices as well as shown.

Pi-Star Remote Control DMR



The default commands for DMR begin with “9” as shown earlier. You will need to change these to avoid conflicts with some commands that Brandmeister uses internally. So, for example, edit svckill to “8999999” (from “9999999”), etc. … as shown here. There may be other options as well (thanks to Michael Rickey, AF6FB for this one).

It would appear that you can edit any of these to be anything you want as long as it doesn’t create a conflict somewhere. As always don’t forget to “Apply Changes” when done.

Do a back up so these are saved.

Pi-Star Remote Control DMR (2)

- You will need to add 2 Private Call ID's
  - PiStar Reboot, PCID=8999997
  - PiStar Shutdown, PCID=8999996
- Access these in whatever way works best for you.
  - I create a couple PC ID's as shown above
  - You can add these to a zone or just search for them in your contact list. You can also "Manual Dial" the numbers if you remember them.

Pi-Star Remote Control FUSION

- Similarly to DMR, You will make a manual call to the appropriate “room number”
  - Reboot PiStar, TGID=99997
  - Shutdown PiStar, TGID=99996
- To run this:
  - Connect to your HotSpot in YSF mode
  - Key in the code using DTMF mode.

ZUMspot/PiStar

Appendix L

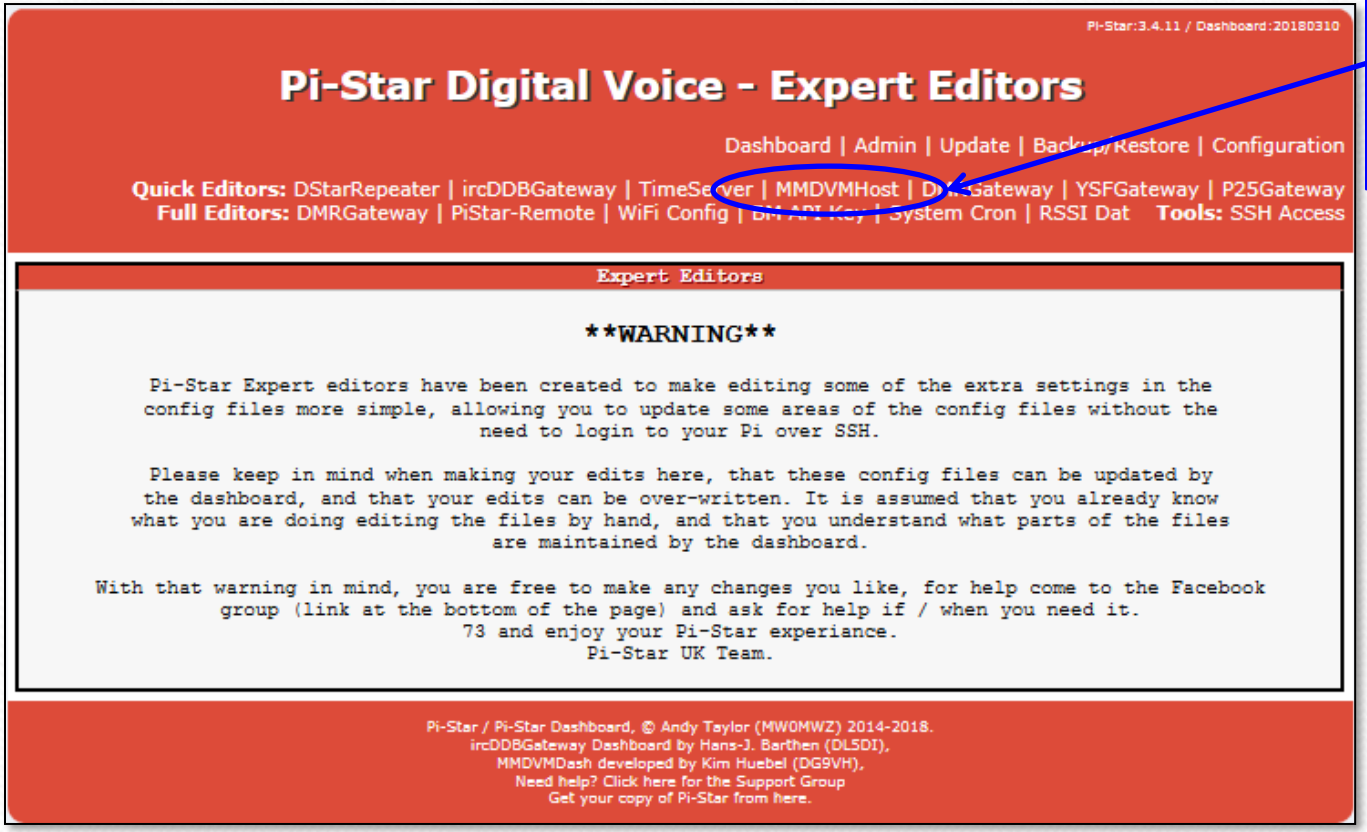
Solving BER problems. Offsets and Hot Spot Calibration

Pi-Star Offset adjustments

- Pi-Star includes a facility to adjust for the frequency offset of the modem relative to the radio.
- These adjustments can resolve issues with excessive bit error rate (BER) on outbound transmissions (local radio transmitting to the hot spot).
- These can be found in the admin/expert area as shown on the following pages.

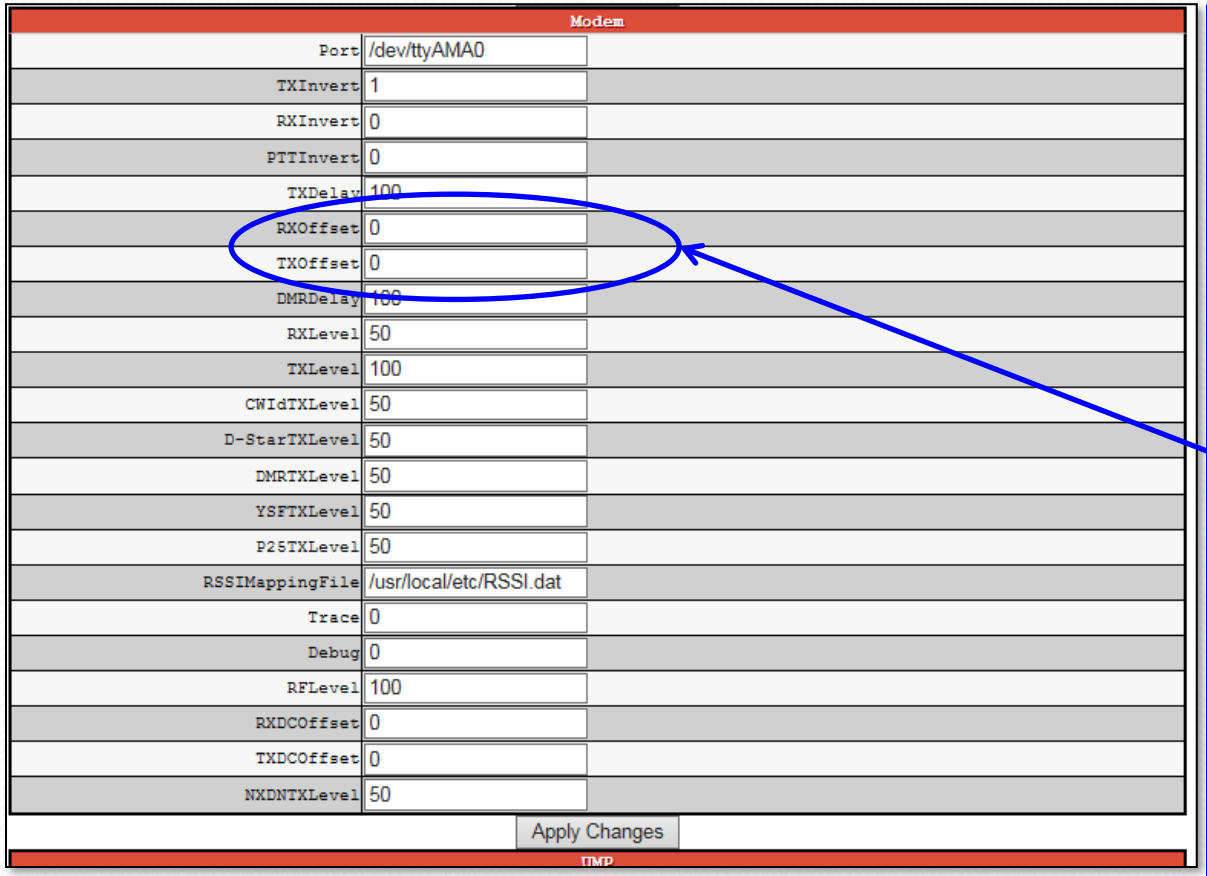
Pi-Star Offset adjustments

- Log onto the Pi-Star admin expert page:
  - http://pi-star/admin/expert/



Once there, click "**MMDVM Host**" To bring up the MMDVM Host page.

Pi-Star Offset adjustments



In the “Modem” section you will probably see:

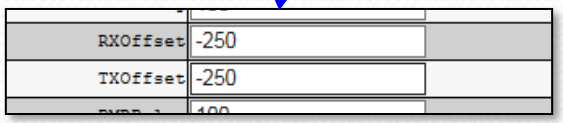
RXOffset = 0

TXOffset = 0

As shown here.

Adjust the RXOffset positive or negative to optimize the BER issue as shown below.

You will need to Apply changes, check the error rate in the dashboard and repeat until it is good enough. Rather tedious.



Note: An offset of -250 will cause the synthesizer in the AD2071 chip to set its actual frequency 250 Hz below the programmed hot spot frequency.

Calibration Program

- One way to resolve the frequency offset error is to try different values of RX offset while watching the reported BER on the dashboard. This is tedious but does work.
- However, Pi-Star also provides a built-in tool called MMDVMCAL which provides all the functionality you need to fully calibrate your device. Not only BER but other things as well.

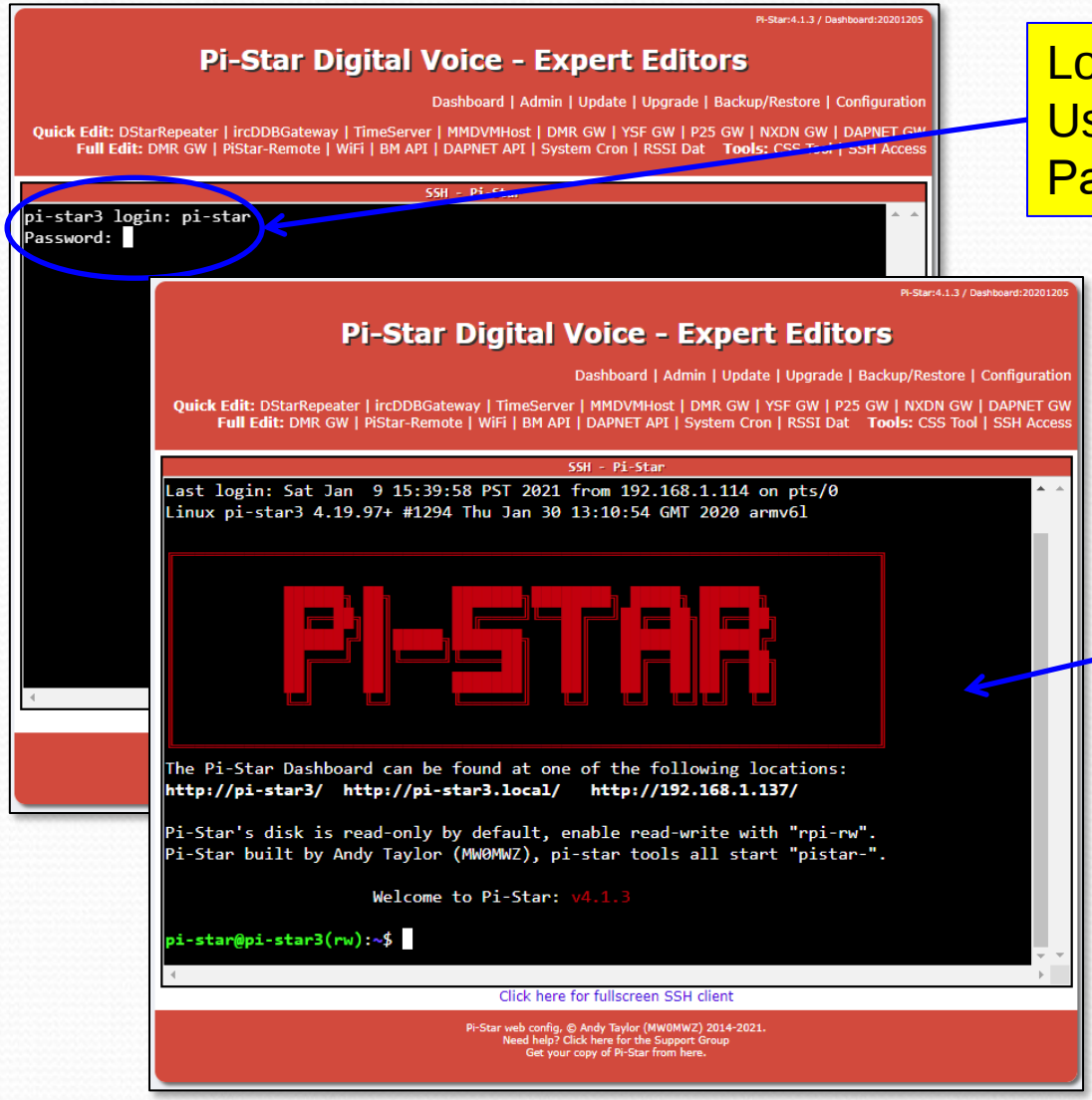
Performing Calibration

- Log onto the Pi-Star admin expert page:
  - http://pi-star/admin/expert/

Click "**Tools:** SSH Access" To bring up the built in SSH Editor. If you don't see it, try a different browser.

Initialization is the same as with any of the other options which require SSH Access, (FW update, file snooping etc.)

Preparing for Calibration (SSH)



Log into the SSH Editor:
UserName: “pi-star” <enter>
Password: “raspberry” <enter>

The Pi-Star SSH editor will open up as shown Here, with the command prompt: pi-star@pi-star(ro):=$

Launch mmdvmcal via SSH

At the command prompt, pi-star@pi-star(rw):=$, enter the string “sudo pistar-mmdvmcal” Without the quotes as shown here and hit enter.

After some preliminaries, you will see the MMDVMCAL Linux style menu shown on the following page.

The menu provides a wealth of calibration and engineering test features. We will only cover a couple of them here.

ZUM board Calibration Setup

As can be seen by the menu, there are all sorts of things that can be “adjusted” here.

H/h (upper/lower case) re-loads the command list menu.

Q/q will exit the calibration routine. Use this when you are finished

Note: Once MMDVMCAL is active, your hot spot is stopped and disconnected from whatever network you normally use.

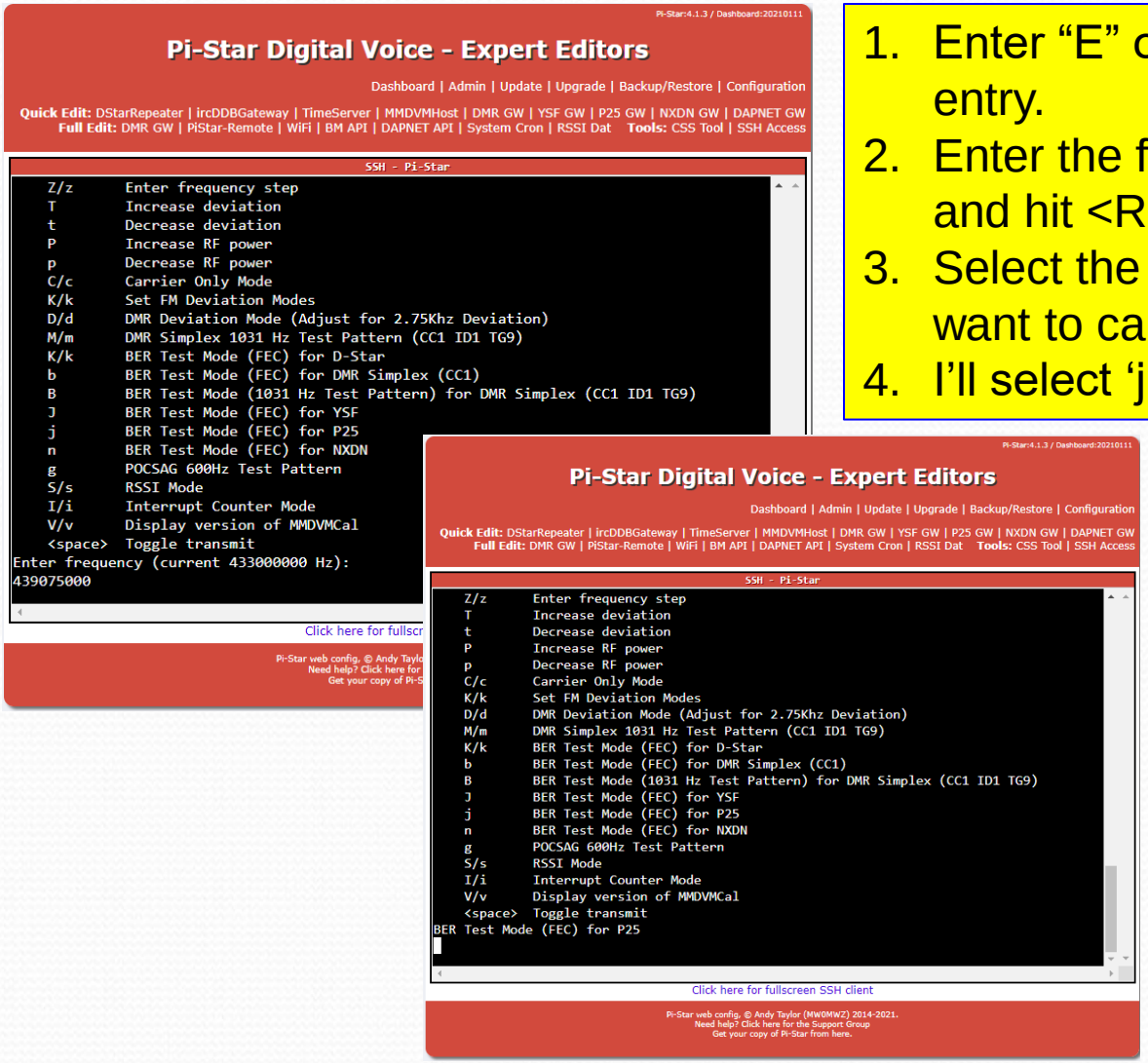
HotSpot RX offset optimization

- This will adjust the frequency of the hot spot receiver to yield optimal BER with the specific radio used in the calibration.
- This works best when a specific hot spot is used with a specific radio in a single mode. For your dedicated P25 hot spot with your XTS 5000 radio, for example.
- You can also calibrate a multi-mode / multi-radio setup, but you will need to find a compromise offset number.

Optimizing RX Offset using BER

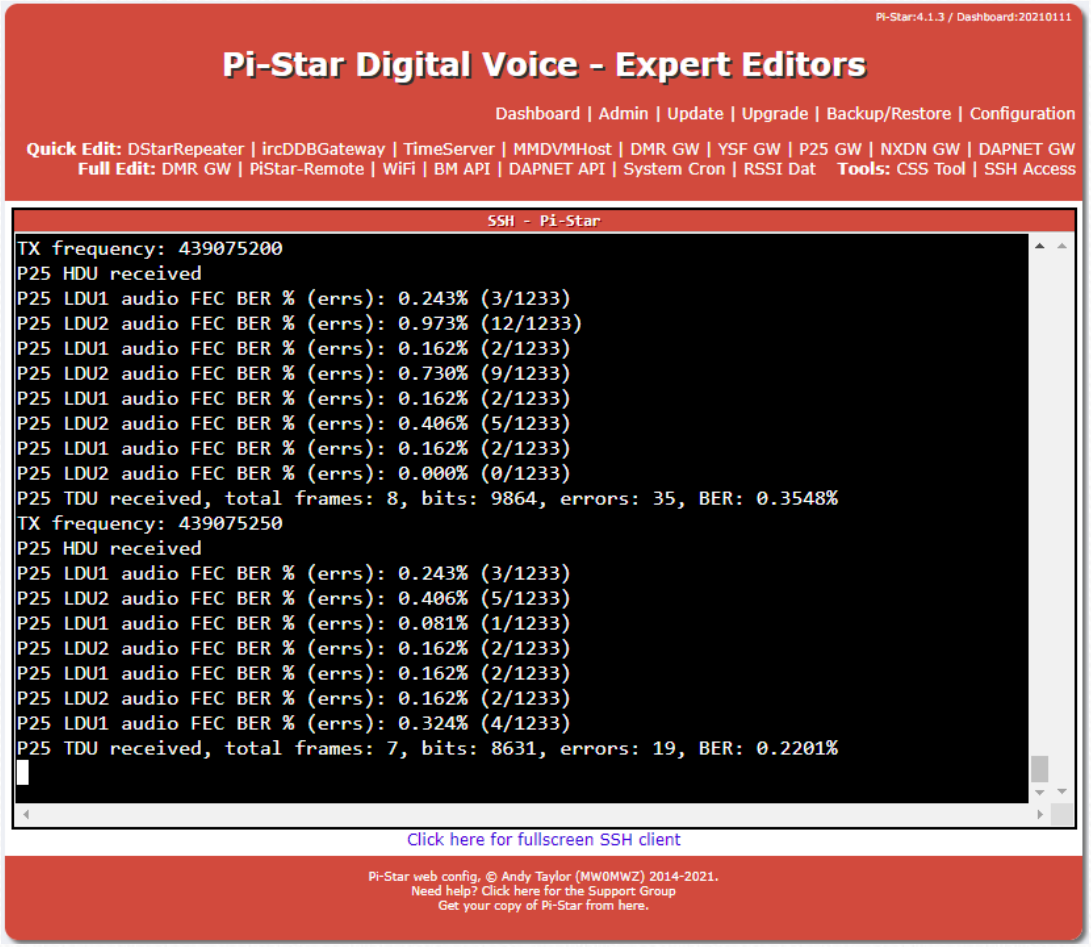
- Select the frequency that you want to use. This is the frequency that the hot spot will listen on and must be the frequency your radio will transmit on.
- Enter “E” (or ‘e”) to start the frequency entry routine.
- Then input the frequency (in Hz) at the prompt. And hit <Return>
- See following page.

Optimizing RX Offset using BER



1. Enter “E” or “e” to enable frequency entry.
2. Enter the frequency in Hz as shown and hit <Return>
3. Select the BER test mode, that you want to calibrate.
4. I’ll select ‘j’ for P25 to calibrate P25

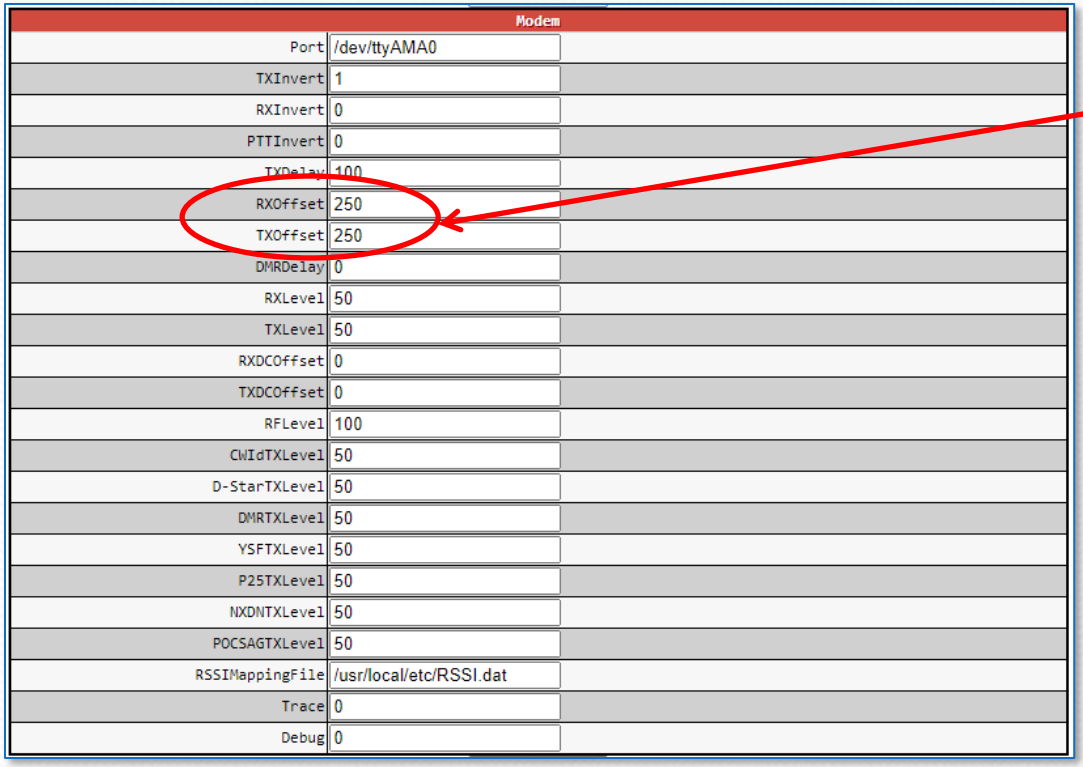
Optimizing RX Offset using BER



1. Now perform a few transmissions (talk group, CC, NAC, etc. are irrelevant)
2. Use F/f to move the frequency Up/Down in increments of 50 Hz
3. Do this until you see the best BER reading and record the offset value.
4. Enter “Q” or “q” to exit the routine and re-start your hot spot.
5. Type “exit” at the Linux command prompt to exit the SSH routine.
6. Select MMDVMHost in the configuration panel.

Note: you can change the frequency step using “Z” or “z” if you want finer adjustment here.

Optimizing RX Offset using BER



1. Enter the newly determined optimal offset value in both the RXOffset and TXOffset spots, as shown.
2. Click “Apply Changes” to enforce the change.

What’s going on: This offset value is telling the AD2071 chip in your MMDVM hot spot to program its on-board frequency synthesizer to use an “actual” frequency 250 Hz higher (+0.57 ppm) than the hot spot’s programmed frequency to achieve the best error rate.

Note: You have now optimized a single radio to a single MMDVM Hotspot. If you have several radios and several modes, you might want to repeat this for the other radios and modes and strike a compromise.

ZUMspot/PiStar

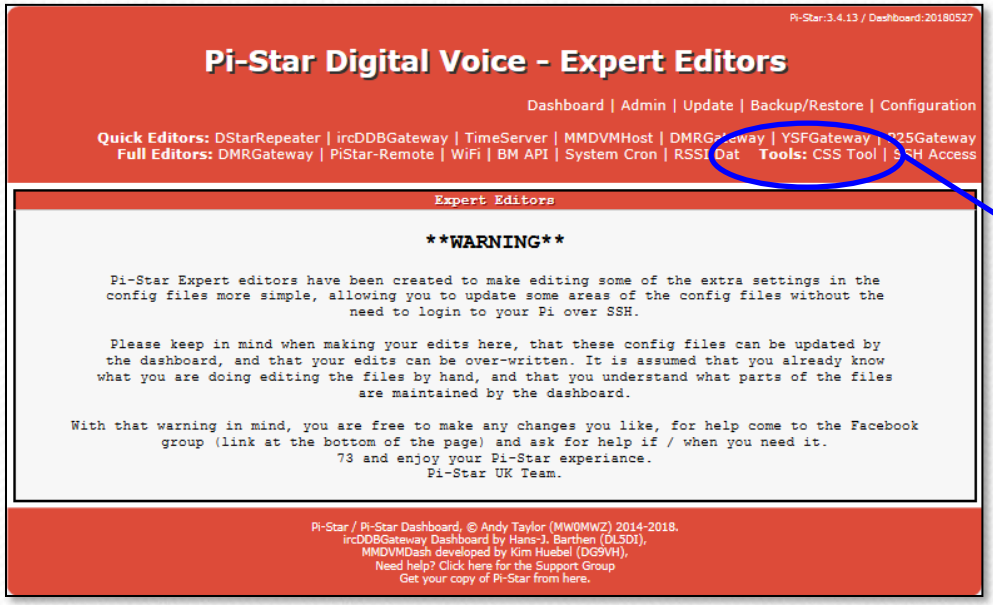
Appendix M

Customizing Pi-Star Dashboard Colors

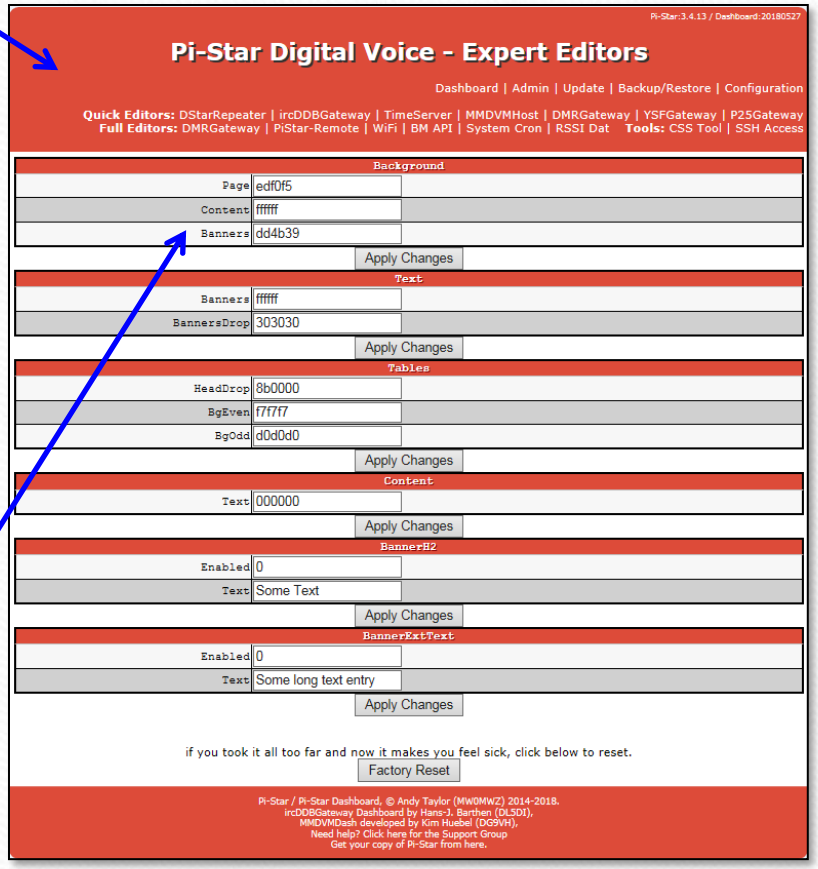
Customizing PiStar Colors

- Pi-Star includes the capability to customize the dashboard display colors.
- This can be accessed from the admin/expert pages by pointing the browser to: http://pi-star/admin/expert/ , logging into Pi-Star and selecting "**Tools:** CSS Tool" from the expert options.
- This will open the CSS menu shown on the following page.

Customizing Pi-Star Colors



Click
"**Tools:** CSS Tool"
To bring up the CSS Tool page.



Entries specify the color for various aspects of the user interface dashboard in terms of six digit hexadecimal entries representing the color in terms of (Red value, Green value, Blue value). Pure red would be (ff0000) representing (255, 0 ,0). The banner default, for example, is (dd4b39).

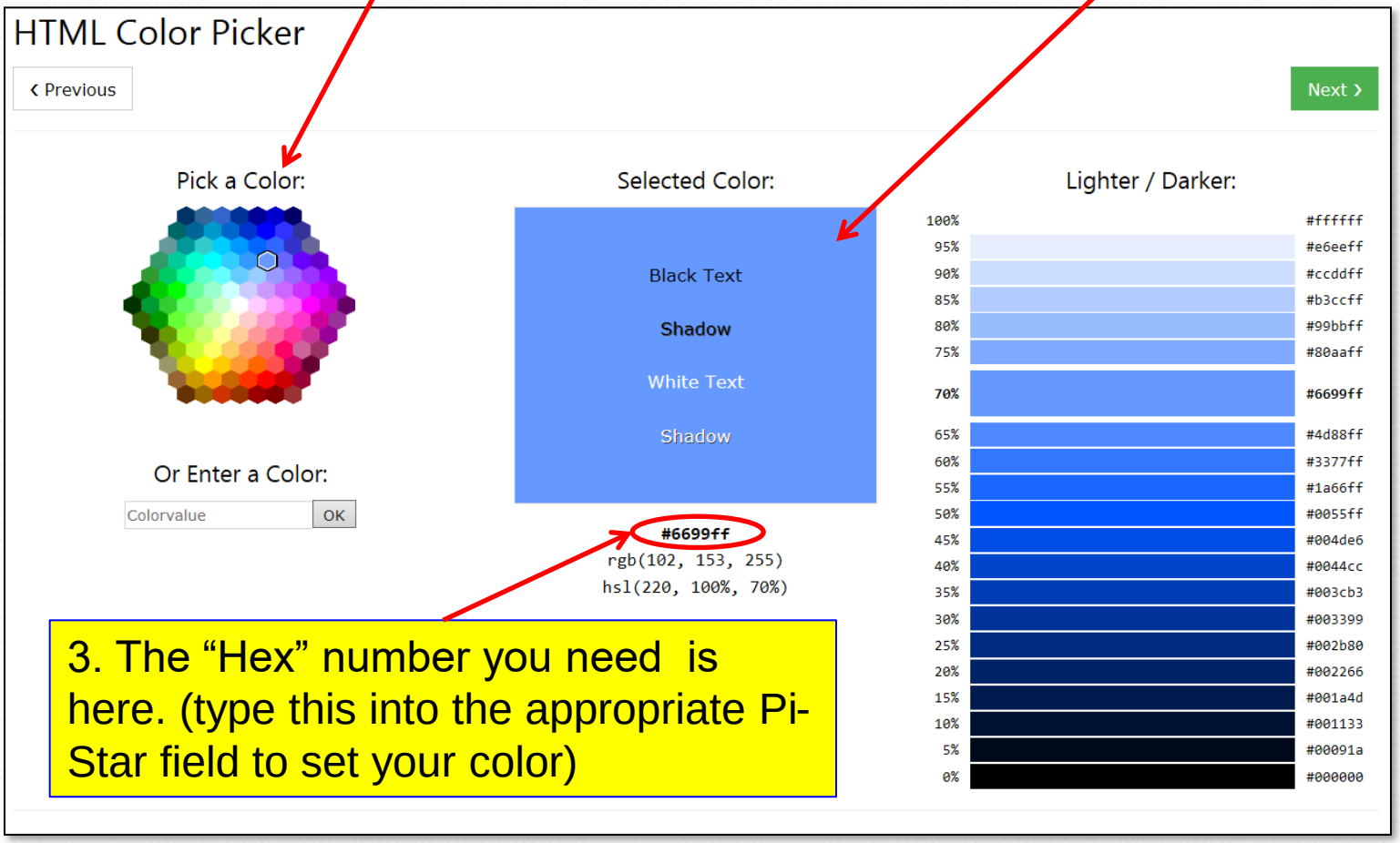
Customizing PiStar Colors

- Use a color picker (many available) to calculate the color values.
- One can be found here: https://www.w3schools.com/colors/colors_picker.asp
- This will allow you to pick a color and it will give you the proper hexadecimal numeric value to load.
- See example on next page

Customizing Pi-Star Colors

1. Pick a color you like here

2. See your selected color here

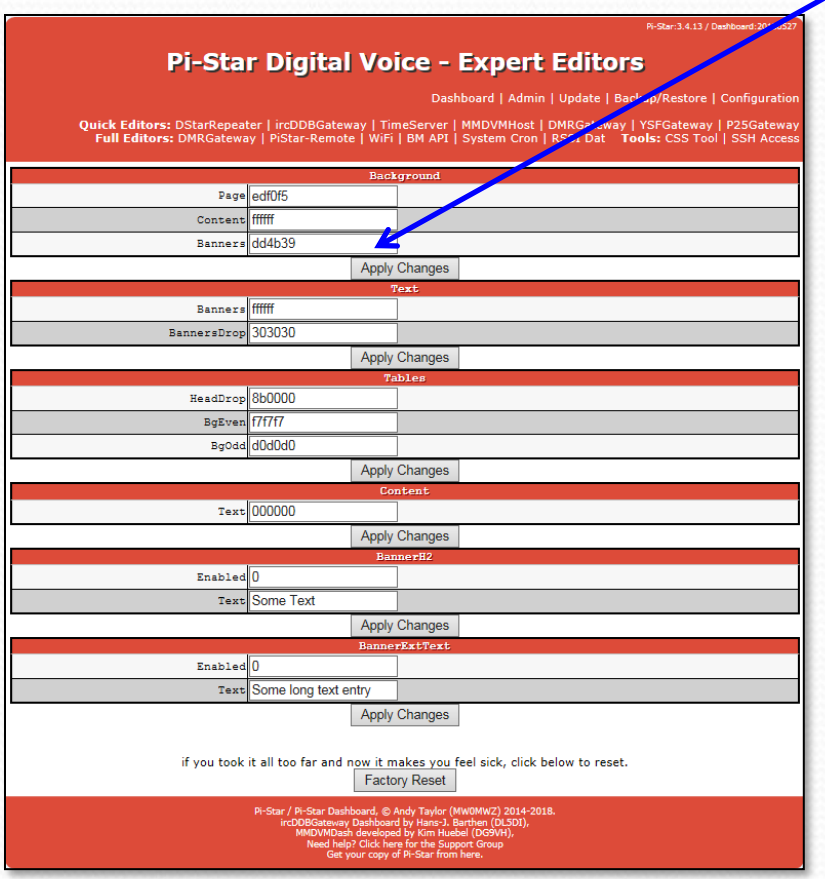


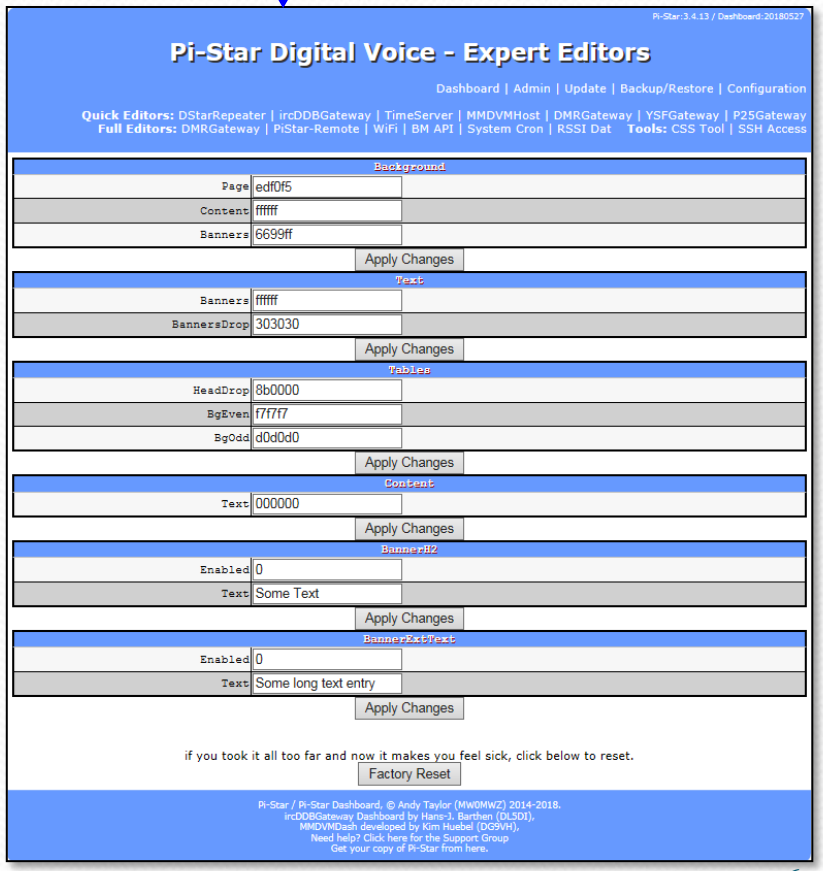
3. The “Hex” number you need is here. (type this into the appropriate Pi-Star field to set your color)

https://www.w3schools.com/colors/colors_picker.asp

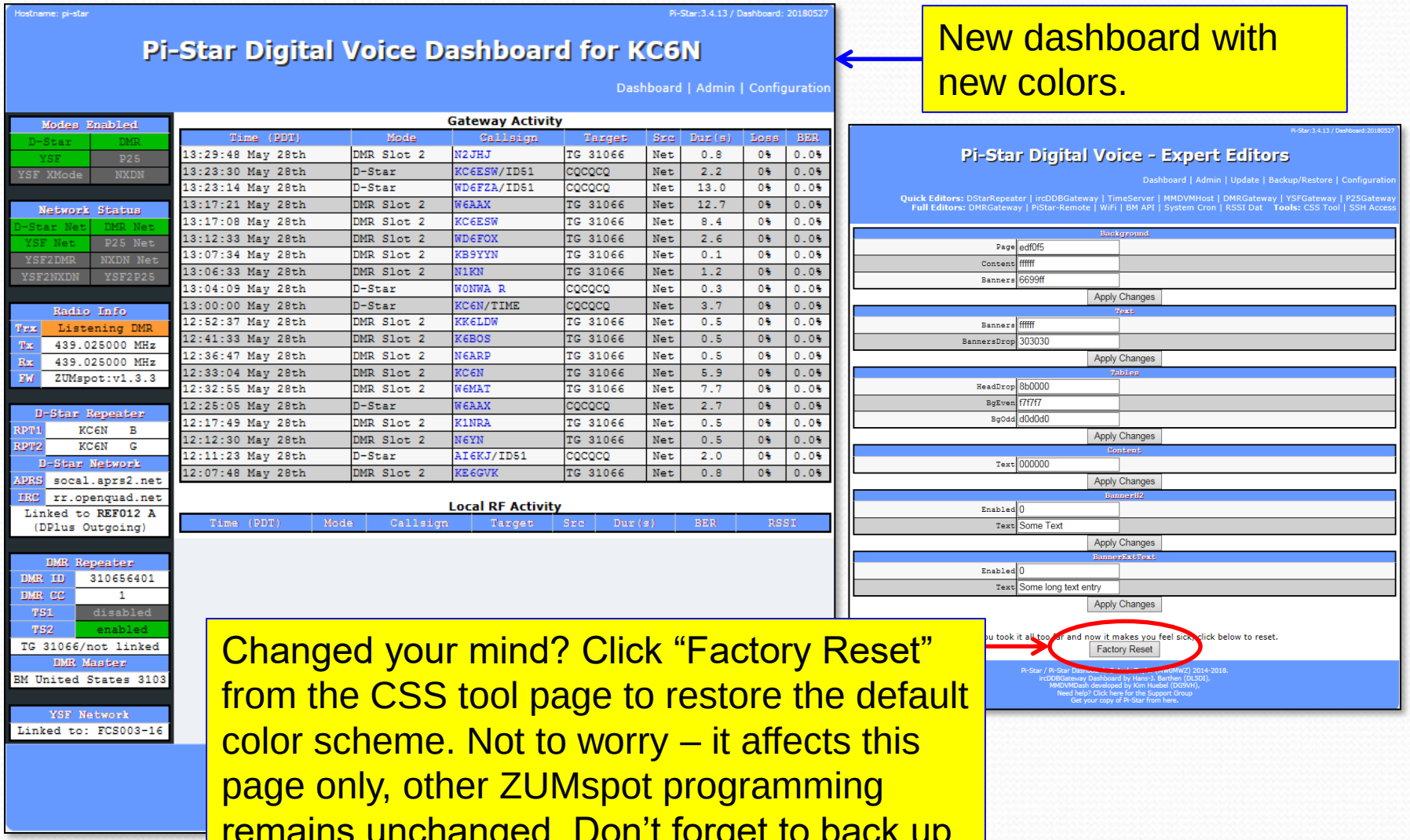
Customizing Pi-Star Colors

So let's change the background banners to the blue color we picked on the previous page. Change the default from "dd4b39" to "6699ff" and Apply Changes.





Customizing Pi-Star Colors



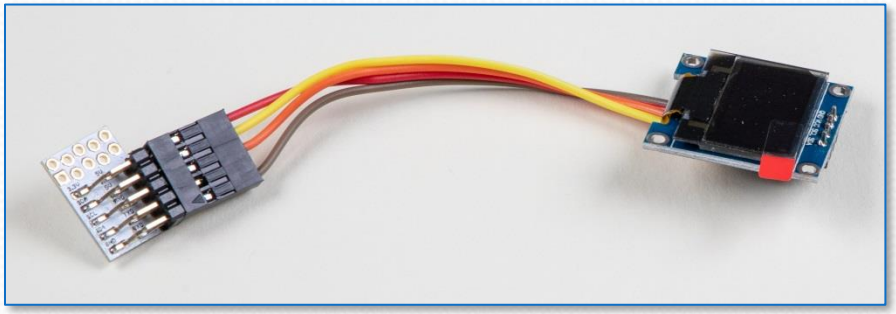
ZUMspot/PiStar

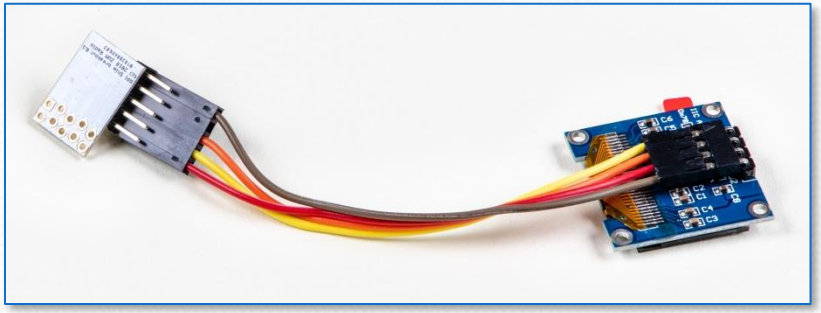
Appendix N

Adding an OLED Display

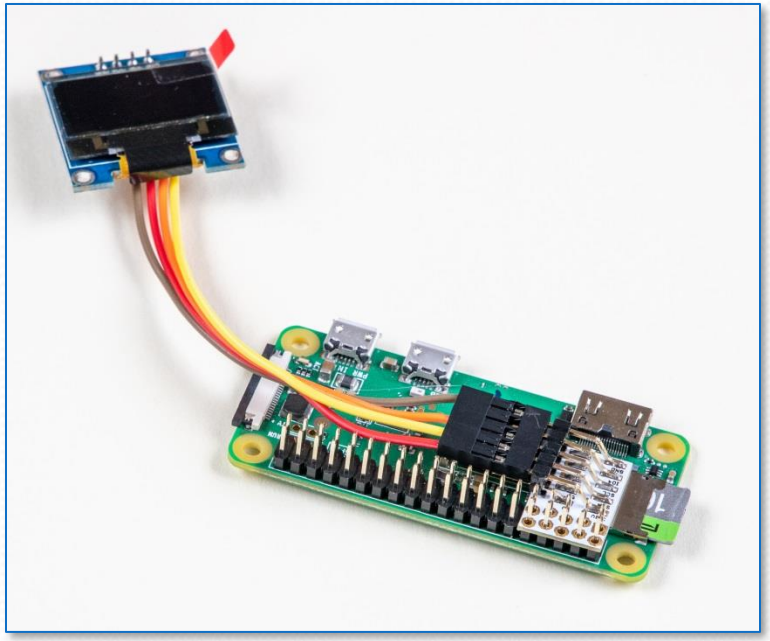
Adding an OLED Display (1)

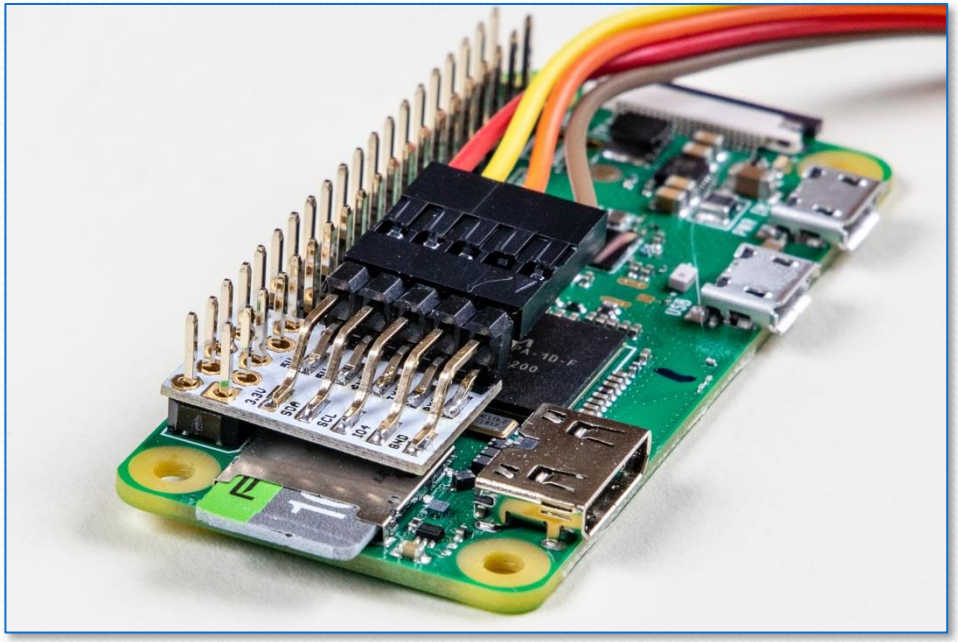
- Some may find a small display a nice improvement over the on-board LED's.
- This appendix will show how to connect the small 0.96" or the 1.3" OLED display sold by ZUM Radio through Ham Radio Outlet in the US (shown below):





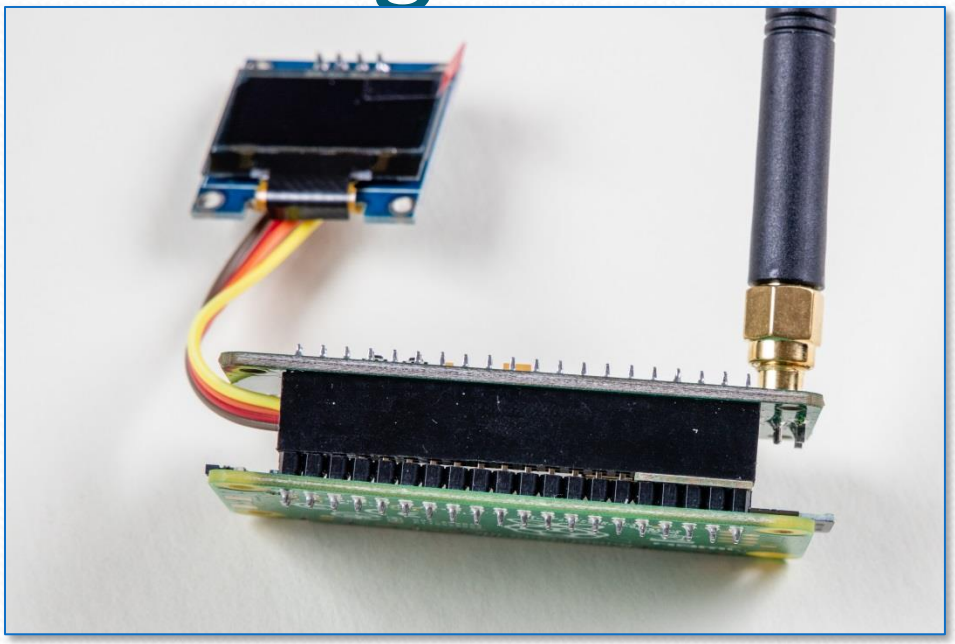
Adding an OLED Display (2)

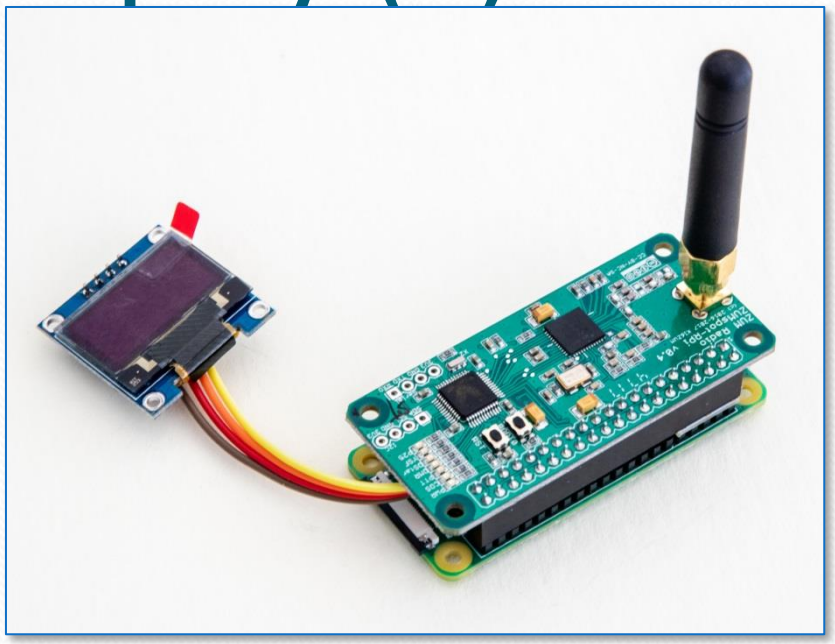




The OLED display is designed such that no soldering is required. The small PCB holes are drilled in a slightly offset pattern such that it can slip down over the pins on the Raspberry Pi ZeroW's GPIO connector. It is held in place by the tension of the pins and the female connector on the ZumSpot board itself. Simply align the holes of the display PCB over the pins on the GPIO connector (at the µSD card end) and press it flush with the GPIO connector as shown in the photos above. Make sure that all connections ae properly secured.

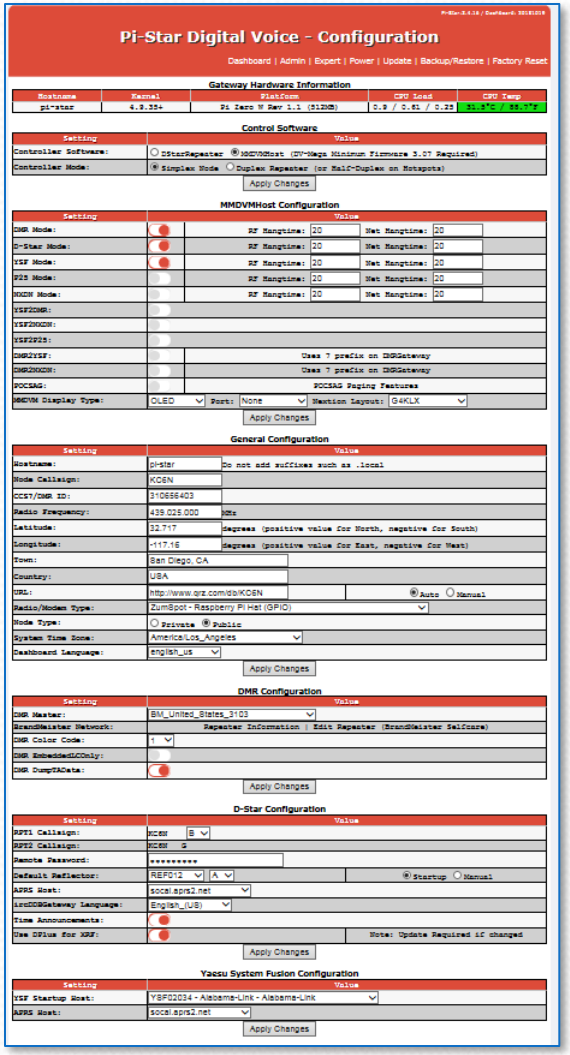
Adding an OLED Display (3)

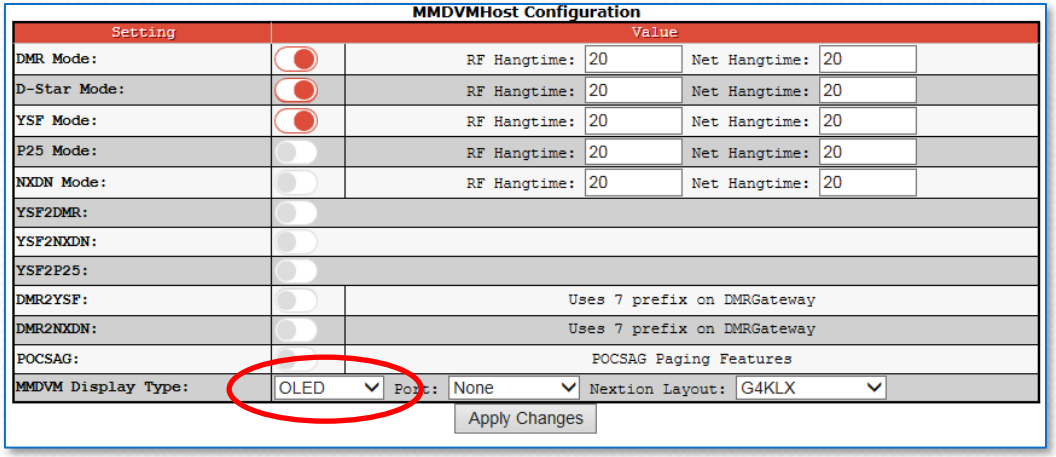




Finally, align the ZumSpot connector to the Raspberry Pi ZeroW GPIO header and press the ZumSpot board down onto the connector as shown. Because of the space required by the display PCB, there will be a bit of a gap between the two connectors in the space not occupied by the display PCB This is not an issue. If you use spacers to secure the Pi and Zum boards together you may need to add a washer to compensate for the height added by the new board. At this point you can power the system and set up Pi-Star (next page).

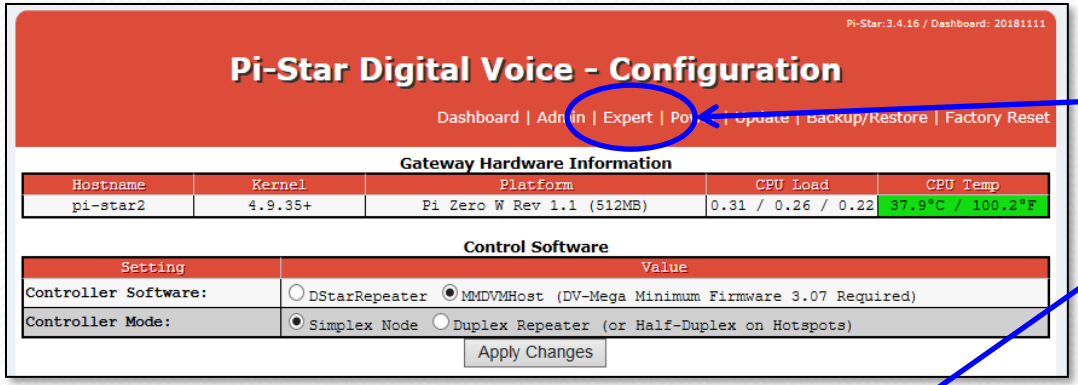
Setting up Pi-Star

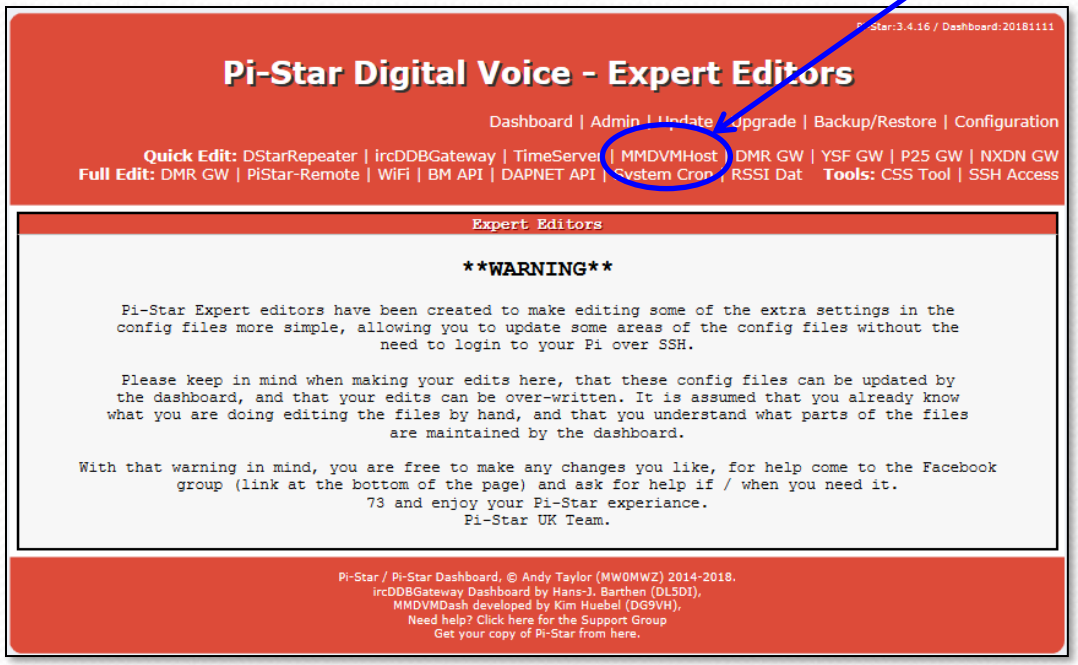




At this point, I'll assume that you have a working Pi-Star configuration that you are happy with and you are simply adding the OLED display. In this case it is quite straightforward (and it is probably already set up by default). In the MMDVMHost Configuration block, make sure that the first entry "MMDVM Display Type" line is set to "OLED" as shown. You can set the Port to "None" and "Nextion Layout" to "G4KLX" if you like but it doesn't really matter as these two entries are actually ignored when OLED is selected.

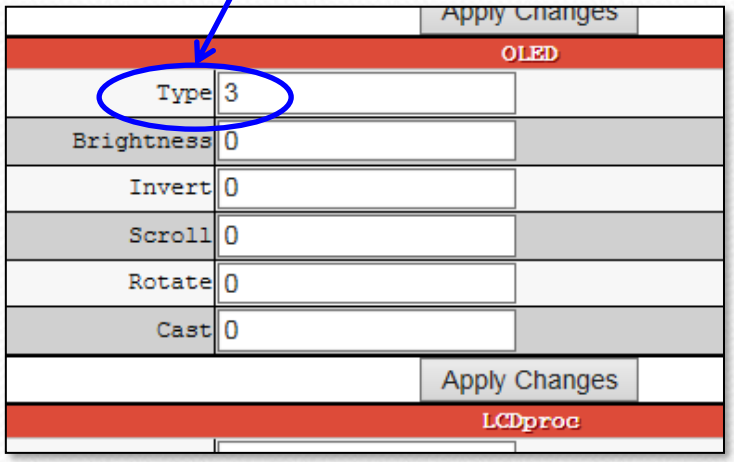
OLED Display Expert settings





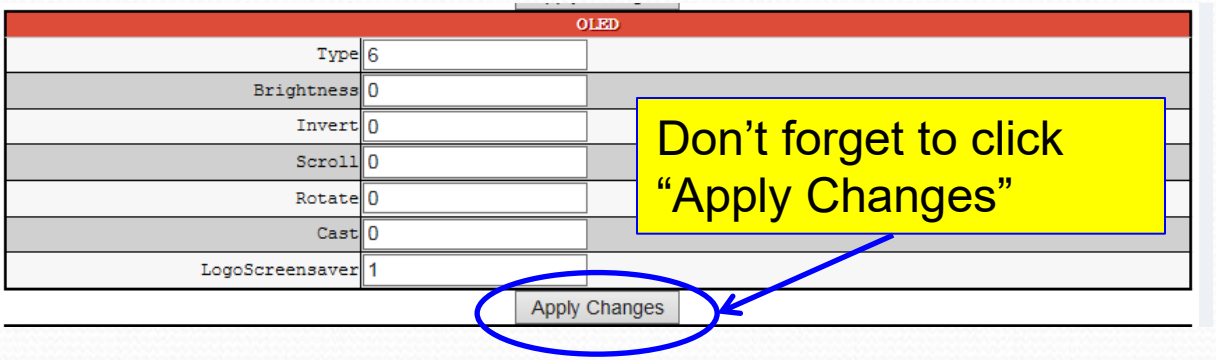
To set up your display:

1. Go to the configuration page and select “Expert” as shown.
2. Select MMDVMHost
3. Find the OLED section and set “Type” = 3 for a 0.96 inch display or “Type” = 6 for a 1.3” OLED display.



OLED Display settings (cont.)

There are a few additions to this block in the latest Beta (v4.10 RC4). I am not sure when these came in but here's what they do.



Type: set depending on your display type, as described earlier

Brightness: Adjusts the display brightness (slightly on OLED)

Invert: Setting this to "1" changes display to white background

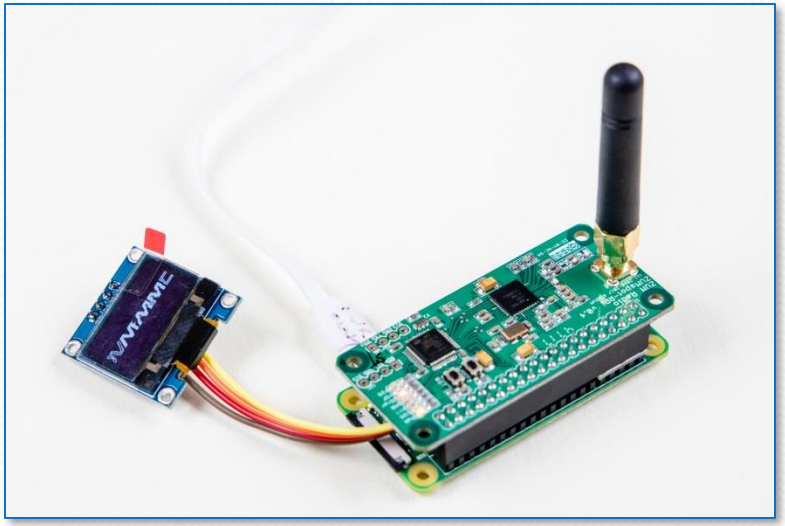
LogoScreenSaver: This is the one that caused me to add this slide. If you set this to "0" the "screen saver" disapears (you probably didn't know it had one). This means that the Idle state display that says MMDVM will be blanked which looks strange. If this happens, check this bit and make sure it is set to "1"

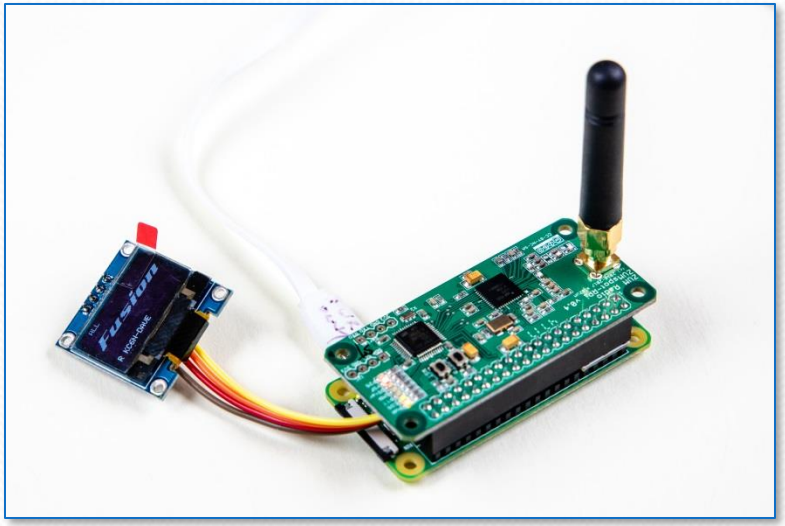
Scroll: No effect seen

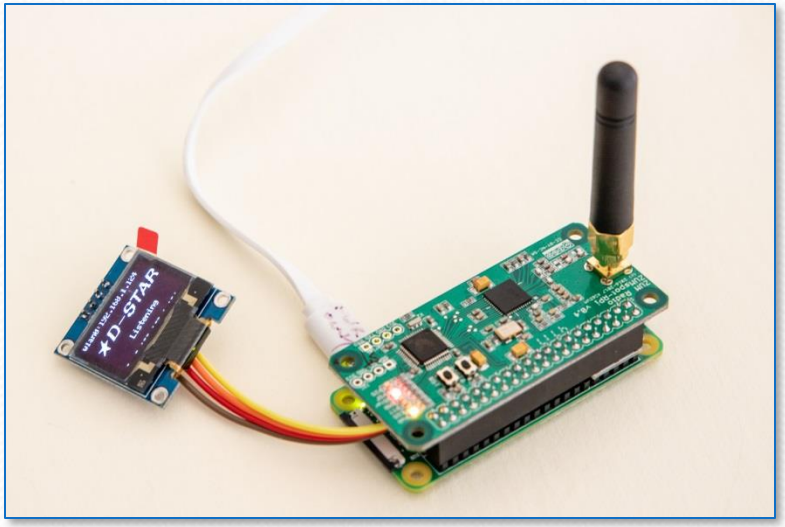
Rotate: Flips display test 180 degrees

Cast: No effect seen

Check out and operation







If all is well, you should see "MMDVM" scrolling across your little display when idle (upper left). As signals are received the display will give you information showing current activity (YSF, DMR, DSTAR, NXDN and P25). For example, Fusion (above right) and *D-STAR* (adjacent right).

ZUMspot/PiStar

Appendix O

Using Multiple ZumSpots

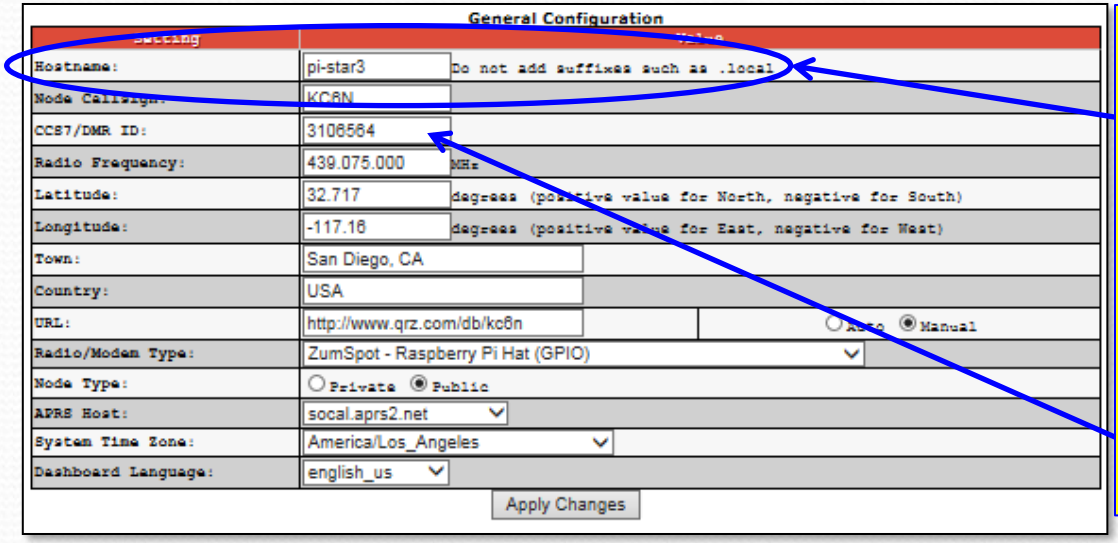
Create unique DMR ID's (1)

- You can build up a ZumSpot with a nice case and all the trimmings for around US $150
- Eventually you may end up with more than one, for any of a number of reasons. This section will show you how to configure them so that they work together.

Create unique DMR ID's (2)

- You can set up multiple HotSpots in Brandmeister by giving them different DMR ID numbers based on your DMR ID.
- If your DMR ID is 3107XXX, for example:
  - Your first one would be 3107XXX01
  - Your second one would be 3107XXX02
  - Your third one would be 3107XXX03
  - …and so forth. Pi-Star now takes care of appending the digits for you. You just need to tell it what to append. Here's how:

Give each a unique Host Name



General Configuration

Setting	Value	
Hostname:	pi-star3	Do not add suffixes such as .local
Node Callsign:	KC6N	
CCS7/DMR ID:	3106564	
Radio Frequency:	439.075.000	MHz
Latitude:	32.717	degrees (positive value for North, negative for South)
Longitude:	-117.16	degrees (positive value for East, negative for West)
Town:	San Diego, CA	
Country:	USA	
URL:	http://www.qrz.com/db/kc6n	Auto / Manual
Radio/Modem Type:	ZumSpot - Raspberry Pi Hat (GPIO)	
Node Type:	Private / Public	
APRS Host:	socal.aprs2.net	
System Time Zone:	America/Los_Angeles	
Dashboard Language:	english_us	

Apply Changes

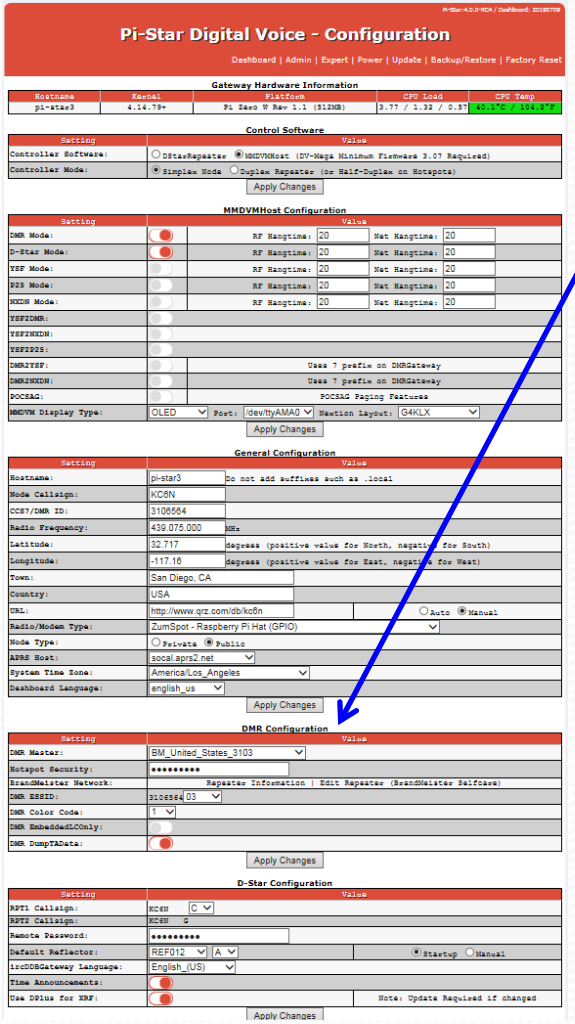
This is taken care of in the “General Configuration” dialog block on the “Configuration Page” by changing the “Hostname”. Here I have set one to pi-star2.

Note: Put your regular DMR ID here, don’t append anything.

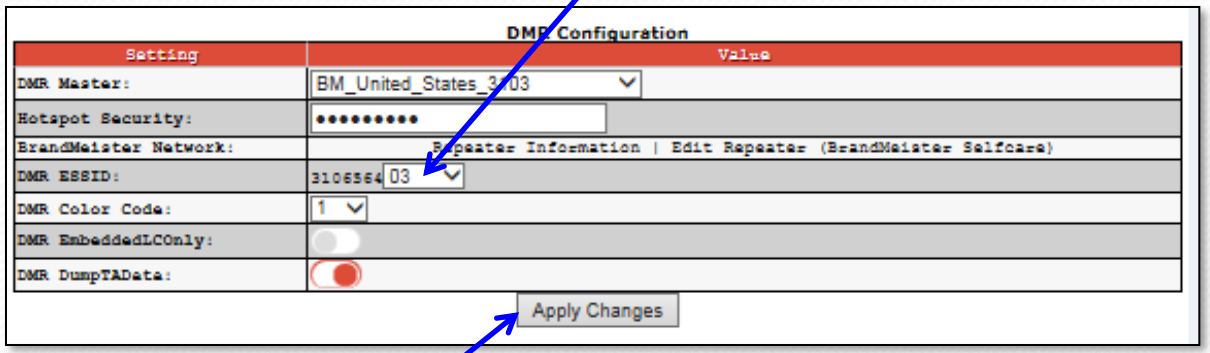
Note that this only changes how you will address the device when you hunt it down on the internet. For example you will address this one from your browser as http://pi-star3/ (windows) or http://pi-star3.local (iOS). His does not change the pi-star login for the device which will still be UN: pi-star, PW: raspberry (unless you changed it).

Note that you can use the color editor here to make the dashboards look different as well. Red for pi-star1, Green for Pi-star2 and Blue for pi-star3 (for example).

Setting the unique hotspot ID

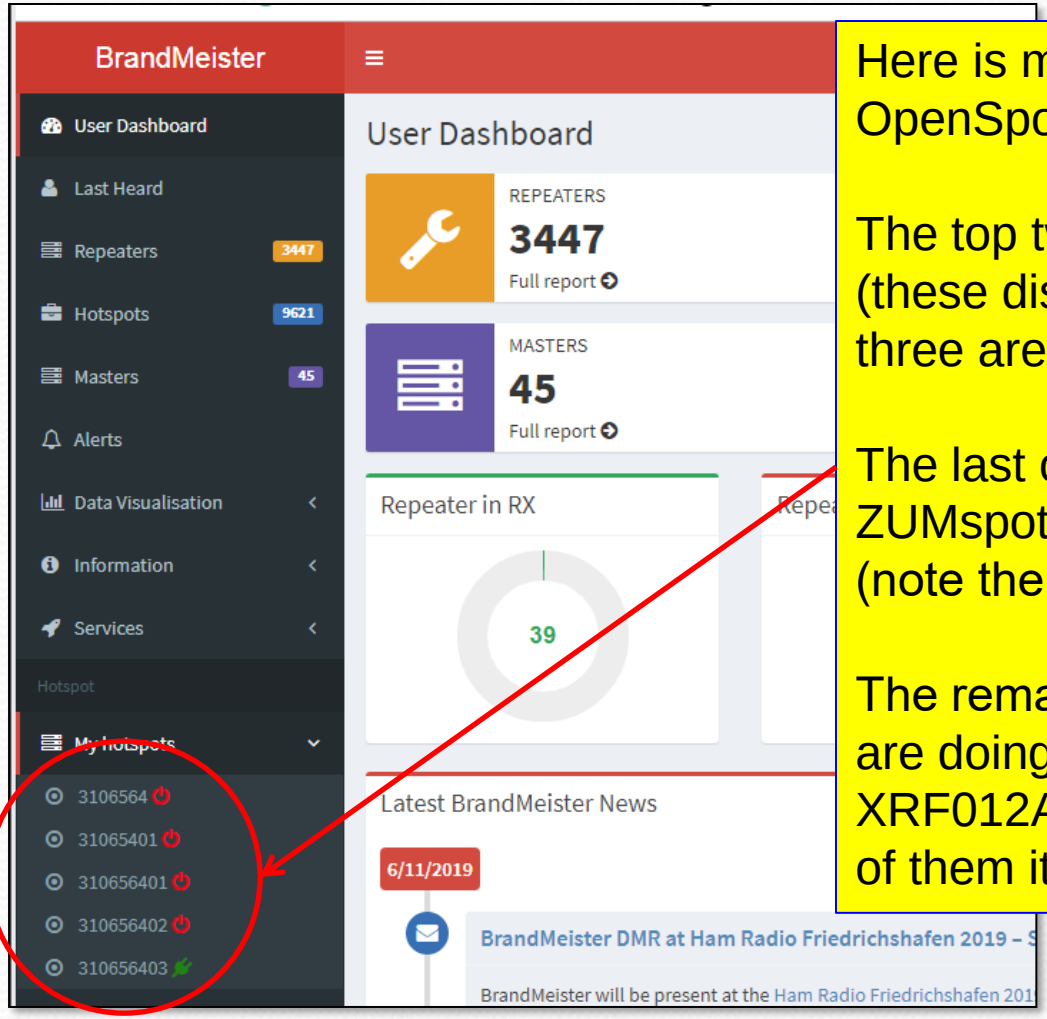


1. On the configuration page for Pi-Star, Locate the "DMR Configuration" section (see left).
2. Set the desired two digit extension for this specific hotspot in the "DMR ESSID" section.



3. Click "Apply Changes"
4. Confirm that your HotSpot appears in the Brandmeister list on your BM page and make sure that it works. See Next Page.

BM Multiple HotSpot Example



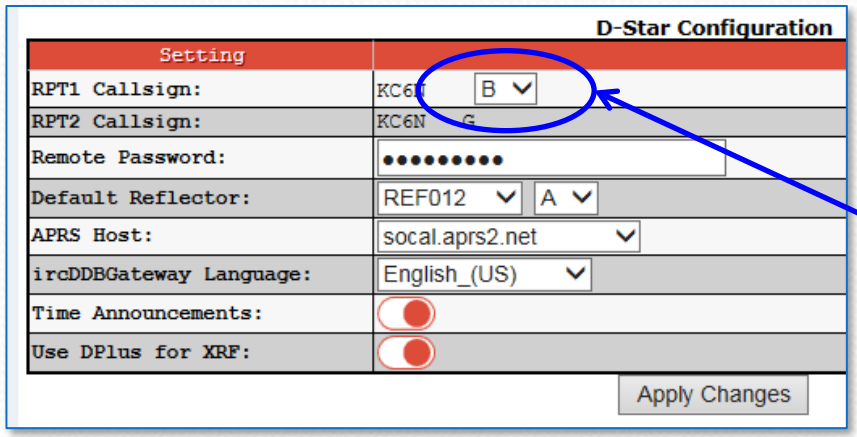
Here is my setup for three hotspots, an OpenSpot and a pair of ZUM Spots:

The top two numbers are no longer used (these disappear eventually). The last three are my currently active ZUMspots.

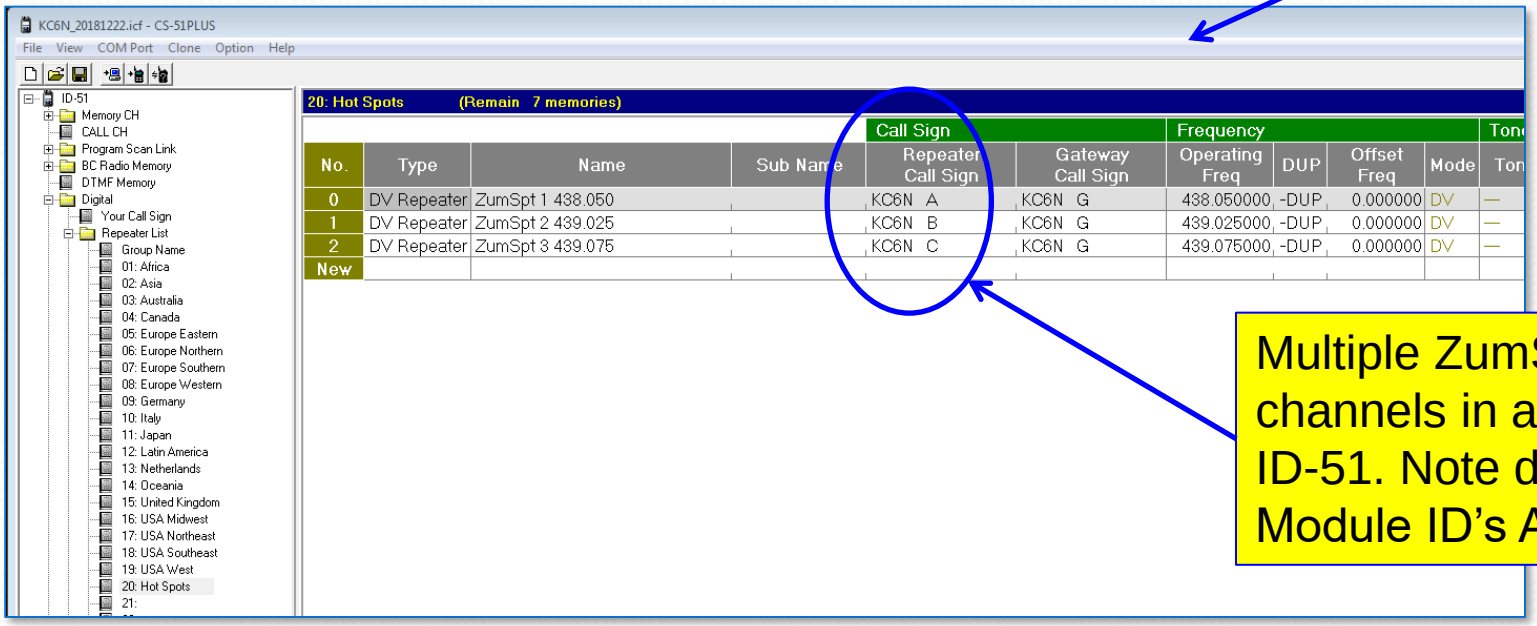
The last one (3106564**03**) is the only ZUMspot which is on-line at the moment (note the little green “plug” symbol).

The remainder, are “ON” and in use but are doing other things like TGIF, DSTAR XRF012A, etc. If I Activate DMR on one of them it will go green like the last one.

Multiple ZumSpots for DSTAR



In the DSTAR case, give each of your ZumSpots a different “Module ID” using the Module ID pull down in the D-Star Configuration Panel located on the Configuration Page as shown to the left. Then, create separate channels in your radio as in the example below.



Multiple ZumSpot channels in an ICOM ID-51. Note different Module ID’s A, B and C

ZUMspot/PiStar

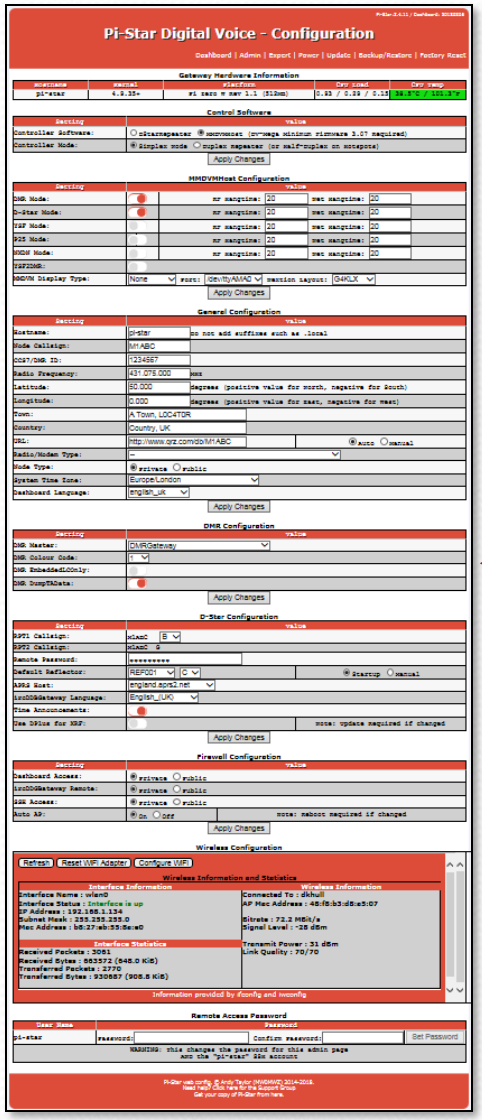
Appendix P

Using Configuring for the TGIF Network

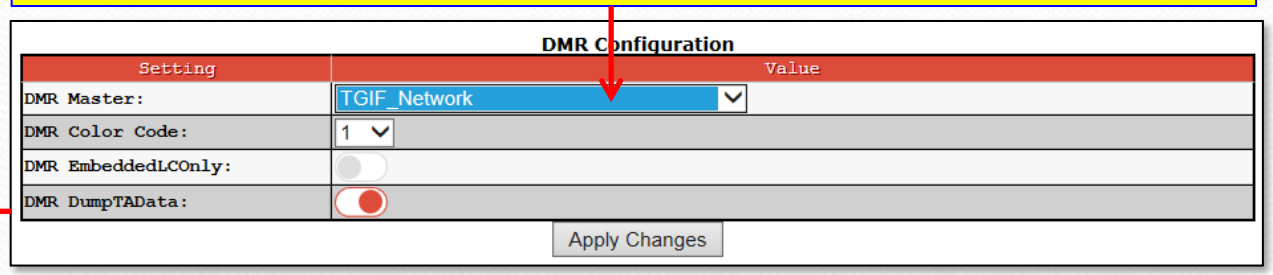
Using the TGIF DMR Network

- The TGIF DMR network is another network like DMR+, DCI, MARC, Brandmeister, etc.
- TGIF has its own servers, Talk Group List and cast of characters. Info below:
- Info: http://www.k9npx.com/2018/11/the-tgif-network.html
- Dashboard: http://tgif.network/lastheard/index.html
- Forum: https://tgifnetwork.createaforum.com/

Pi-Star DMR TGIF Config. Setup:

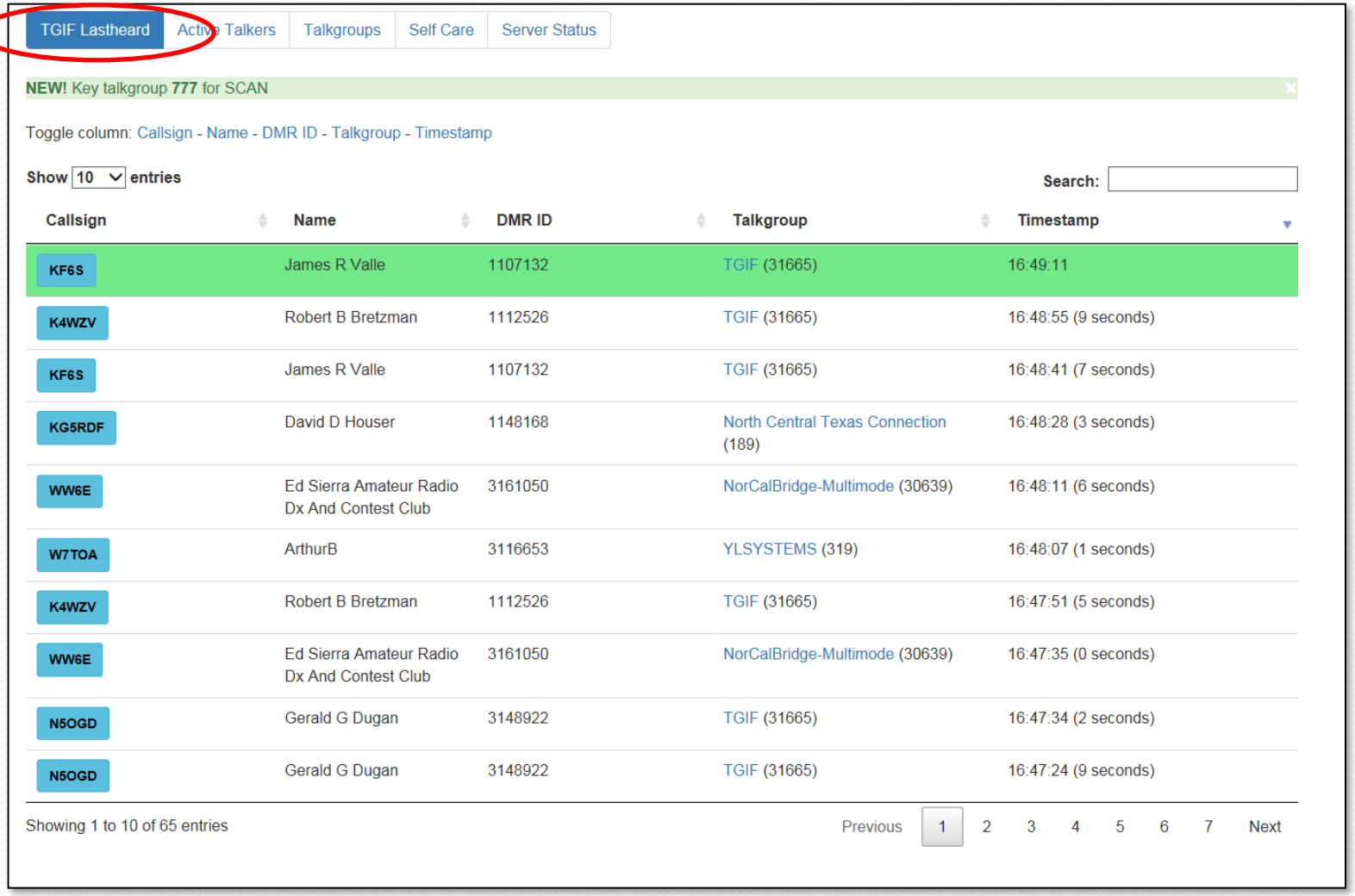


Set up for this network is as simple as selecting the "TGIF Network option in the DMR Master Pull-down. As before, Turning on the last switch will allow your ZUM/Pi To pass Talker Alias data to your radio, if it supports it. Click "Apply Changes" when done.



Once you Apply Changes and the reset cycle completes this network will be in effect. It works pretty much the same as Brandmeister with a large list of talk groups available. TG switching is achieved in the same manor as Brandmeister. Program your radio for these new talk groups in exactly the same way you would for MARC or Brandmeister. You might want to make a new zone.

TGIF Last Heard List:



TGIF Lastheard | Active Talkers | Talkgroups | Self Care | Server Status

NEW! Key talkgroup **777** for SCAN

Toggle column: Callsign - Name - DMR ID - Talkgroup - Timestamp

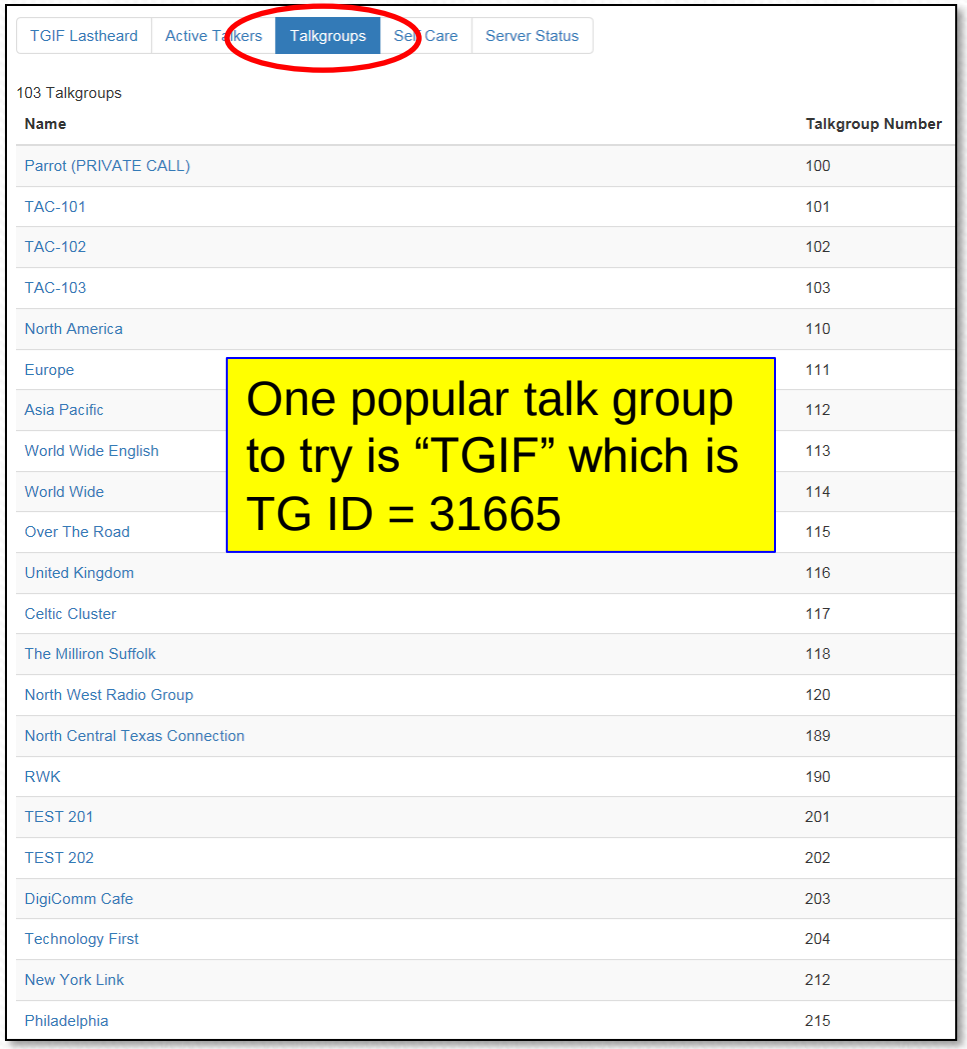
Show 10 entries Search:

Callsign	Name	DMR ID	Talkgroup	Timestamp
KF6S	James R Valle	1107132	TGIF (31665)	16:49:11
K4WZV	Robert B Bretzman	1112526	TGIF (31665)	16:48:55 (9 seconds)
KF6S	James R Valle	1107132	TGIF (31665)	16:48:41 (7 seconds)
KG5RDF	David D Houser	1148168	North Central Texas Connection (189)	16:48:28 (3 seconds)
WW6E	Ed Sierra Amateur Radio Dx And Contest Club	3161050	NorCalBridge-Multimode (30639)	16:48:11 (6 seconds)
W7TOA	ArthurB	3116653	YLSYSTEMS (319)	16:48:07 (1 seconds)
K4WZV	Robert B Bretzman	1112526	TGIF (31665)	16:47:51 (5 seconds)
WW6E	Ed Sierra Amateur Radio Dx And Contest Club	3161050	NorCalBridge-Multimode (30639)	16:47:35 (0 seconds)
N5OGD	Gerald G Dugan	3148922	TGIF (31665)	16:47:34 (2 seconds)
N5OGD	Gerald G Dugan	3148922	TGIF (31665)	16:47:24 (9 seconds)

Showing 1 to 10 of 65 entries Previous 1 2 3 4 5 6 7 Next

LH List URL: http://tgif.network/lastheard/index.html

TGIF Active Talkers/Talk Groups



One popular talk group to try is “TGIF” which is TG ID = 31665

That's all!

For now, anyway, Thanks.
Please contact me at the address below with questions and comments, corrections, etc.

Dave Hull, KC6N
dhull1@san.rr.com

Revision List:

- 01/20/2018: Original Release presented at the PAPA San Diego Luncheon Sat Jan 20 2018
- 03/27/2018: Extensive rework incorporating suggestions received since original release
- 04/03/2018: Added Appendix J, a page on Etcher, and this revision list.
- 05/12/2018: Updated Appendix E to include SSH update/upgrade methodology. Complete re-write of Appendix H to address cross-mode Fusion to P25 and NXDN. Added some setup info for NXDN and P25 to part IV. Made cosmetic edits to quite a few pages (mostly for clarity).
- 06/02/2018: Added Appendix K, Customizing Pi-Star Colors, Completely rewrote Appendix H to cover the cross-mode options included as part of 3.4.15. Does not cover cross mode with DMR Gateway. (second release, 06/05/2018) fixed a couple typos. 06/07/2018 typo in Pi-Version #.
- 07/04/18: Added comment about Node Type on page 27, Moved the Note on SW Versions to page 7, Changed WiFi setup method to Auto-AP which allowed the slides to be streamlined a bit by combining the old sections II and III. Moved the former WiFi pages to Appendix G so the "supplicant" method is still documented but it looks like most people are taking advantage of AutoAP these days. Added Reflector "Find it" page at end of Appendix H. Added Appendix I which discusses use of the DMR+ network. Added Appendix J which covers the DMRGateway.
- 10/23/18: Added Appendix M (OLED Display), added a couple warnings at the end of Appendix A, added Appendix M (multiple ZumSpots) and fixed a couple of ever-present typos ☹.
- 12/22/18: Added a instructions for using multiple ZumSpots with typical DSTAR radios to Appendix M.
- 02/20/19: Added Appendix O covering configuring for the TGIF DMR network
- 07/16/19: Removed multiple hotspot slides from Appendix C and added HotSpot security. Updated Appendix N (multiple HotSpots).

Revision List:

- 10/20/2019: Added a slide to the OLED display section describing the additional expert settings that appeared in v4.x.x. Added slide to HotSpot Security section showing where the password can be found.
- 11/05/2019: Added a few slides in the “cross-mode” section describing the WiresX Pass-through feature and WiresX style control for cross mode from a Fusion radio. Thanks to Toshen, KE0FHS for some of this one. FWIW: He has a great site, lots of good info on Pi-Star. https://amateurradionotes.com/pi-star.htm
- 10/06/2020: Changed bottom of page 103 to show PAPA talk group 31077 instead of 10200 so it is clearer for the PAPA crowd.
- 12/04/2020: Edited Page 41 Re APCO P25 (now that I have a P25 radio). Rewrote appendix “K” on calibration to cover the MMDVMCAL feature. Edited the Brandmeister Setting up Hotspot Security page in appendix C to note that a hotspot password is NOW REQUIRED.
- 11/12/2021: All I changed here was the version # on the cover page. It was 4.1.3 which I changed to 4.1.5 to reflect the current version. Pi Star has been stable for a while.
- 11/15/2021: Edits recommended by Rutger, PA3CQJ: Fixed replicated appendix J so appendix entries after J got incremented by one letter. Edits on page 177. Revised what is now Appendix “L” to focus just on RX Offset calibration.