VKDMR Hotspot Setup Guide

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Document Version

Version	Date	Changes	Change Author
0.5	10/10/2020	Initial Release for Review	Michael Lanagan
0.6	11/10/2020	Updated Dashboard webservers to reflect new servers Added the DMR+ Network String Added update of the password Added configuration backup	Michael Lanagan
1.0	14/10/2020	Added Title Page Added Contents Added Pi-Star update section Added BER section Added Backup of configuration Updated radio setup to use low power	Michael Lanagan
1.1	21/10/2020	Updated the Beacon Settings Added Auto AP section	Michael Lanagan
1.2	2/11/2020	Updated purchase options	Michael Lanagan
1.3	15/11/2020	Updated the dashboard URLs Updated Static/Dynamic TalkGroup description Updated the Hot Spot DMR config string to include more static TalkGroups	Michael Lanagan
1.4	23/03/2025	Updated pi-star configuration	Michael Lanagan

Contents

Introduction

This document is intended to be a simple setup guide to get your Simplex Hotspot up and working on the VKDMR network.

To keep the guide as simple as possible I have omitted the more complicated setup options and additional digital modes that can be setup on the Hotspot. These can be addressed in a further guide.

It is assumed that you already have a DMR radio that can connect and communicate on one of the VKDMR repeaters and you have the capability to program additional channels and talk groups into your DMR radio.

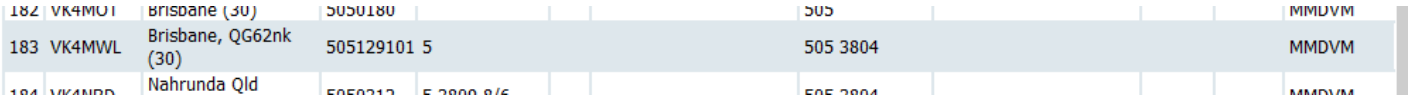
What is a Hotspot?

A Hotspot is like a mini repeater with a limited range due to the low power output of approximately 10mW. Your handheld connects to the Hotspot using RF and then the hotspot connects to the dashboard over the internet.

A hotspot is useful for areas that do not have easy access to the local DMR repeater.

DMR Dashboards

There are two VKDMR dashboards, one for public repeaters (http://rpt.vkdmr.com/) and another one for Hotspots (http://hot.vkdmr.com/). Once your Hotspot is setup correctly it will show up on the Hotspot dashboard against your callsign - see below.



DMR ID

This document assumes that you already have a working DMR radio and DMR ID.

The Hotspot will use your existing DMR Radio ID. See below extract from the Radio ID FAQ page.

*"Hotspots: **** MMDVM, DV4MINI, openSPOT, DVMEGA, and all other hotspot type devices do NOT require a separate ID, use an existing ID only, check the hotspot tab on your account dashboard, do NOT request an ID for them ****
If you own more than one hotspot, use your personal ID number and add a 2 digit suffix, example: Radio ID 3020111, use 302011101, 302011102, etc.
NEVER operate multiple hotspot within range of each other on the same frequency even with different ID's. This will create serious network issues in most cases.
Hotspots do not require repeater ID's." - Reference - https://www.radioid.net/faq#!*

If you are not sure of you DMR ID you can look it up at https://database.radioid.net/database/search#!

Hotspot Frequency

There are two frequencies allocated in the 70cm Band for Internet Gateways (Reference “WIA Amateur Band Plans”). Choose one of these frequencies.

439.125MHz & 439.150MHz

Hotspot Talk Groups – Static vs Dynamic

Hotspots can be configured with specific talk groups. These are called static talk groups, as they are always monitored and retransmitted on your hotspot frequency.

To listen to talk groups that are not configured as static you need to use dynamic talk groups. These are accessed by keying up your radio on the talk group you want to use. Your hotspot will then receive any transmissions on that talk group. After 15 seconds of inactivity the hotspot will return to monitoring static talk groups. This timeout is set by the “RelinkTime” parameter.

As a starting point I suggest configuring the following talk groups as static: -

- 5 - time slot 1/All repeaters
- 13 – time slot 1/Worldwide English
- 53 – time slot 1/Chat
- 113 – time slot 1/QSY to here after establishing DX on TG1 or TG13
- 123 – time slot 1/ QSY to here after establishing DX on TG1 or TG13
- 505 - time slot 2/All VK repeaters
- 3084 - time slot 2/All QLD repeaters

These are configured using the option string below that is added to the DMR configuration on the configuration web page. This is explained further in the configuration section.

RelinkTime=15;UserLink=1;TS1_1=5;TS1_2=13;TS1_3=53;TS1_4=113;TS1_5=123;TS2_1=505;TS2_2=3804;

Hotspot Hardware

There are several different Hotspots on the market. This document covers the Jumbospot MMDVM Hotspot which uses the following components.

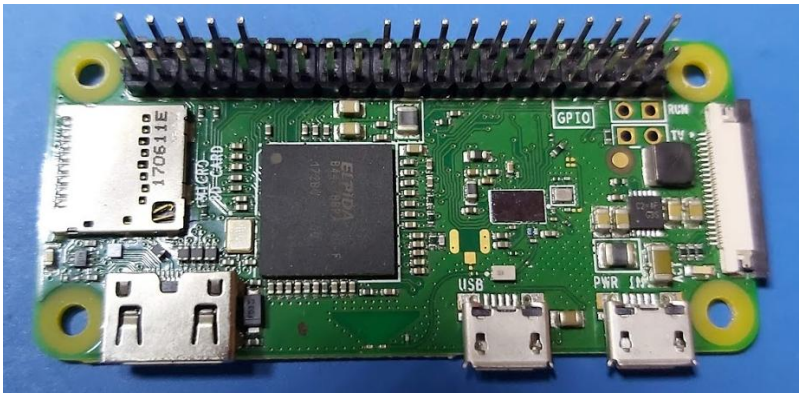
1. Raspberry Pi Zero W (Single Board Computer that runs Linux)
2. Jumbospot MMDVM board (Multi Mode Digital Voice Modem - UHF Radio Board)
3. OLED Display (Usually supplied with the MMDVM board)
4. Metal Case
5. UHF Antenna
6. Micro USB Power Supply
7. 16GB MicroSD memory card
8. Dual row header pins

These parts can be sourced separately or purchased as a kit.

VKDirect (https://vkdirect.com.au) and QSLComms (https://qslcomms.com.au) have kits available.

Alternatively you can buy parts from the below websites :-
- https://core-electronics.com.au/ (Raspberry Pi, Power Supply, SD Card)
- Aliexpress
- eBay

Raspberry Pi Zero W

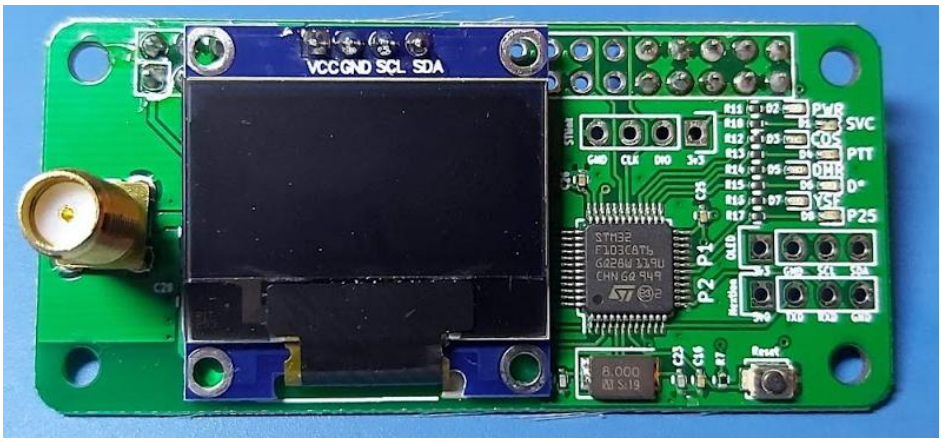


There are two versions of the Raspberry Pi Zero W and Raspberry Pi Zero WH. The “W” version does not come with headers and the “WH” version includes headers pre-soldered.

If you get the one with headers already soldered as shown in the photo here you will need snip pins 12,14,16,18 so they do not interfere with the pins from the OLED display.

The MMDVM boards come with 2 sets of 2x5 header pins that can be soldered to the Raspberry Pi, so if you can solder in the pins, I recommend that you buy the Raspberry Pi Zero W as it is cheaper.

MMDVM



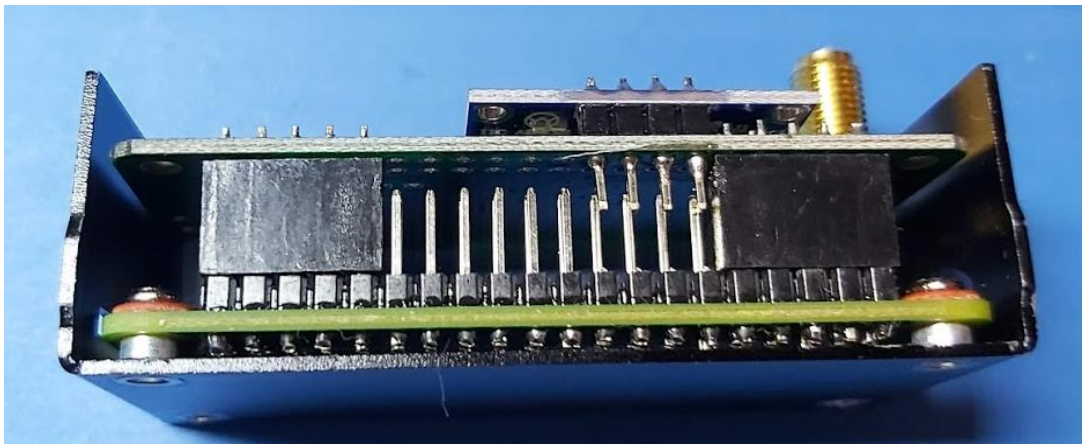
This board provides the RF interface between the Raspberry Pi and your DMR radio.

Hardware Construction

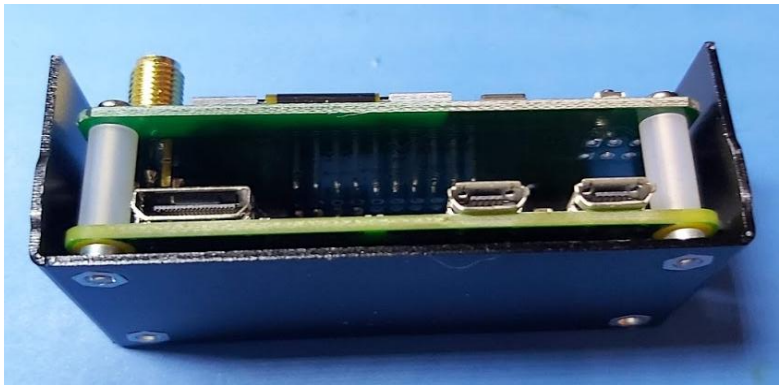
1. Solder the 2 sets of 2x5 header pins to the component side of the Raspberry Pi Zero W where required
2. Separate the 2 case pieces. Note that one end has an oval hole this must line up with the SDCard slot of the Raspberry Pi

3. Install the Raspberry Pi into the lower case using the 2 short screws next to the header pins. Note the SD Card Slot is on the left in the photo.

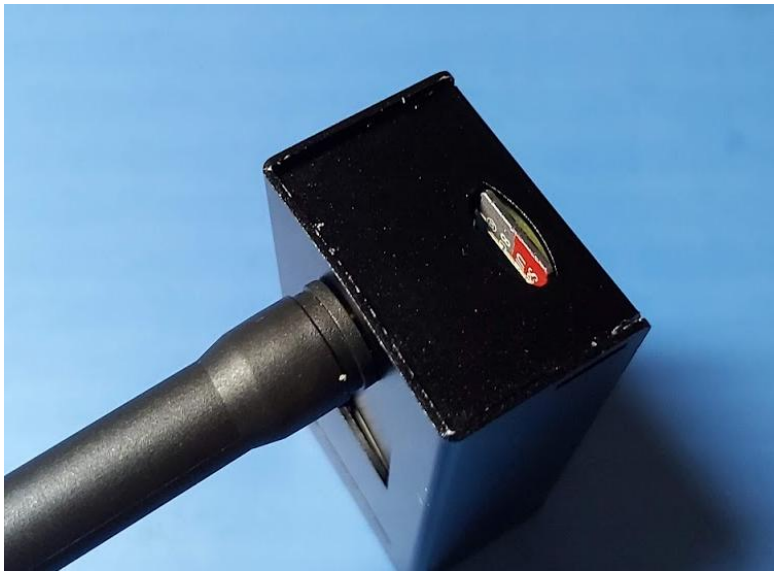
4. Install the MMDVM Board by plugging it into the Raspberry Pi. Note that the pins from the OLED are not touching any of the pins on the Raspberry Pi.



5. Use a pair of long nose pliers or tweezers to hold the two plastic spacers while installing the 2 long screws.



6. Align the SMA connector on top of the MMDVM board with the top part of the case and clip the case into place. Note the case should easily clear the connectors on the Raspberry Pi, if it doesn't check that the Raspberry Pi is installed in the correct orientation with the oval hole on the SD Card side of the Raspberry Pi.



7. Screw on the antenna. Don't install the SD Card Yet as we need to install the software onto it.

Pi-Star - Software

Pi-Star is the operating system that runs on the Raspberry Pi Zero W, it is a modified linux build that is specifically setup with a number of applications and a configuration webpage.

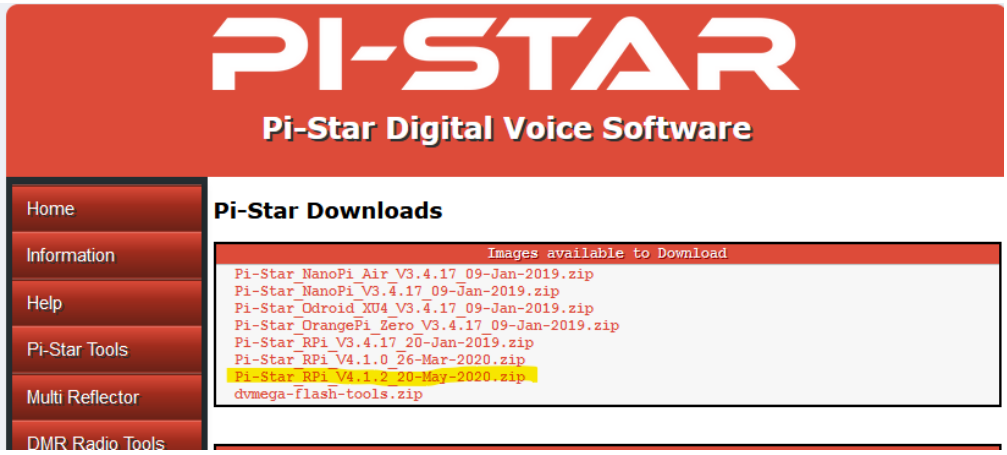
The Raspberry Pi Zero W connects to the DMR network via your home wireless internet.

Pi-Star needs to be installed onto the SD Card which is then inserted into the Raspberry Pi.

You will need a USB MicroSD Card reader to complete the next task. The below one is made by Kingston.

Setting up the MicroSD Card

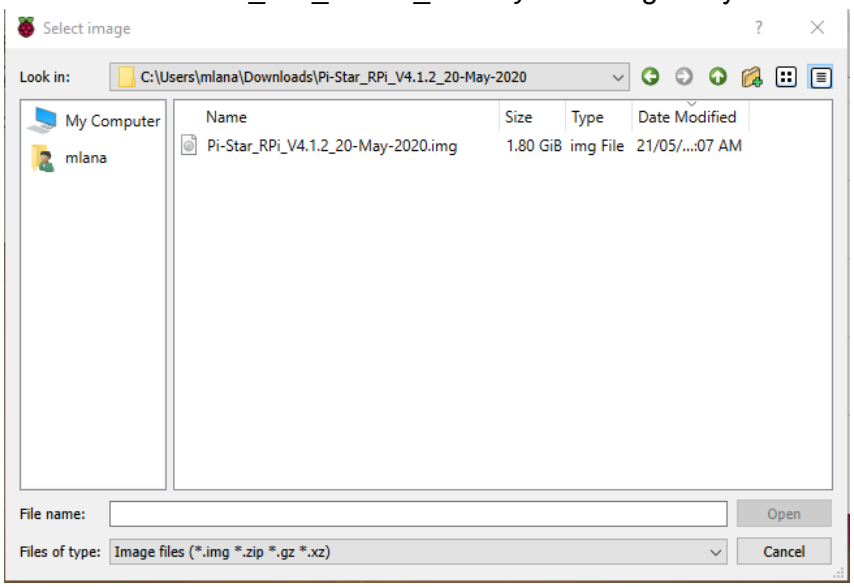
1. Download the latest version for Pi-Star "Pi-Star_RPi_V4.1.2_20-May-2020.zip" at the time of writing.



2. Unzip the Pi-Star_RPi_V4.1.2_20-May-2020.zip file. Take note of the location of the "Pi-Star_RPi_V4.1.2_20-May-2020.img" file
3. Download "Raspberry Pi Imager for Windows" from https://www.raspberrypi.org/downloads/

4. Install the “Raspberry Pi Imager for Windows” application and run it.

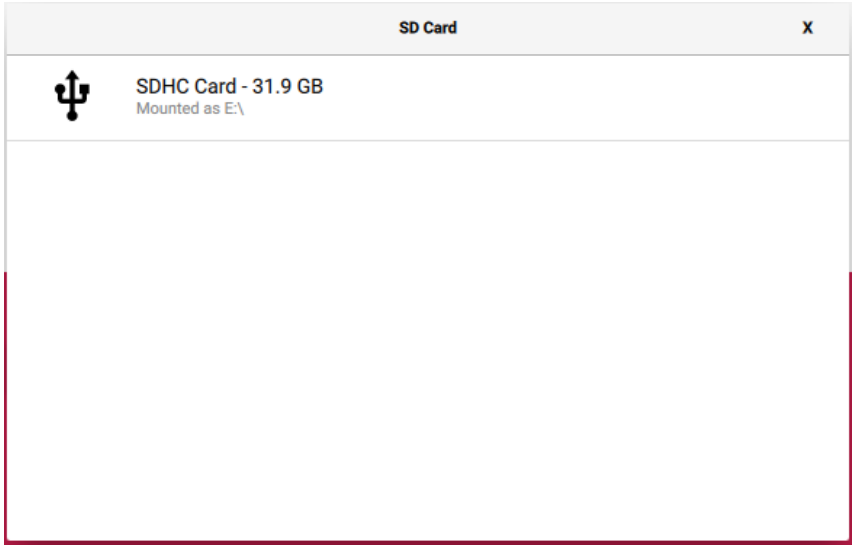
5. Click on “Choose OS”, scroll to the bottom and select “Use custom”
6. Locate the “Pi-Star_RPi_V4.1.2_20-May-2020.img” file you extracted in step 2 and select it.



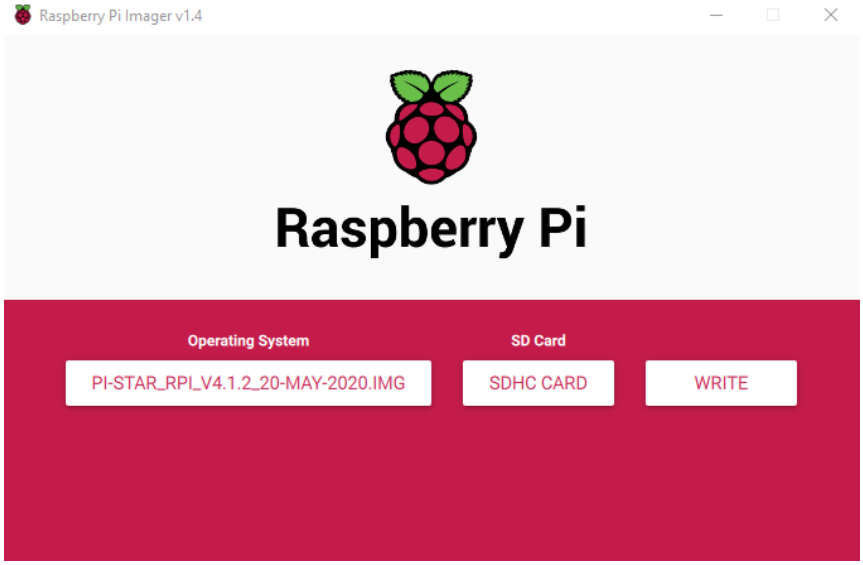
7. Plug the MicroSD Card into the card reader and plug the card reader into the computer

8. Click “Choose SD C....”

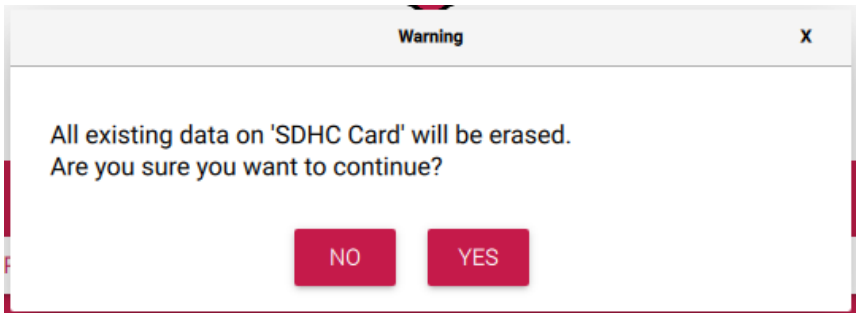
9. Select the SD Card.



10. Click “WRITE”

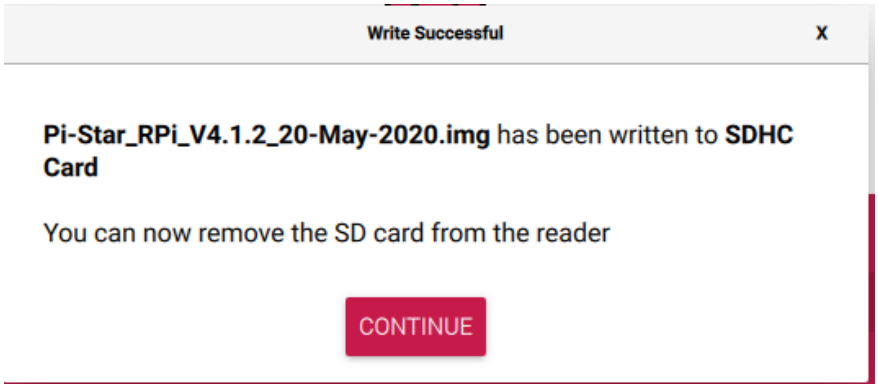


11. Click “YES”



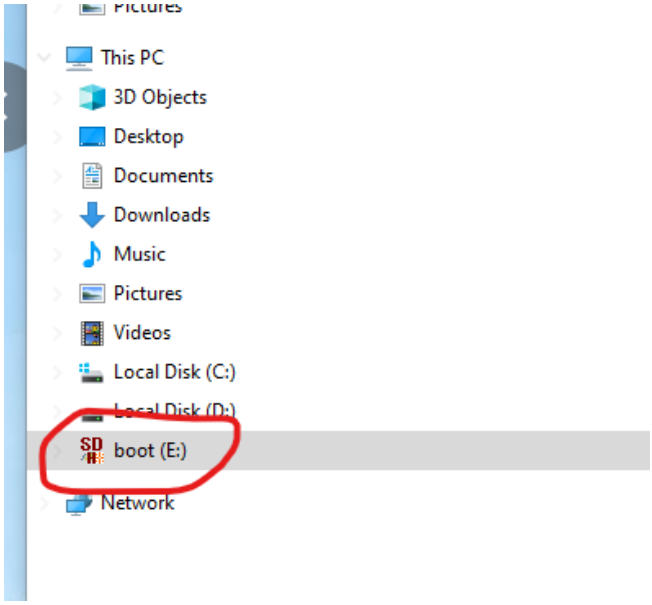
12. Wait until the image is finished writing and verifying to the MicroSD Card

13. Click continue and unplug and plug the SD Card reader from the computer

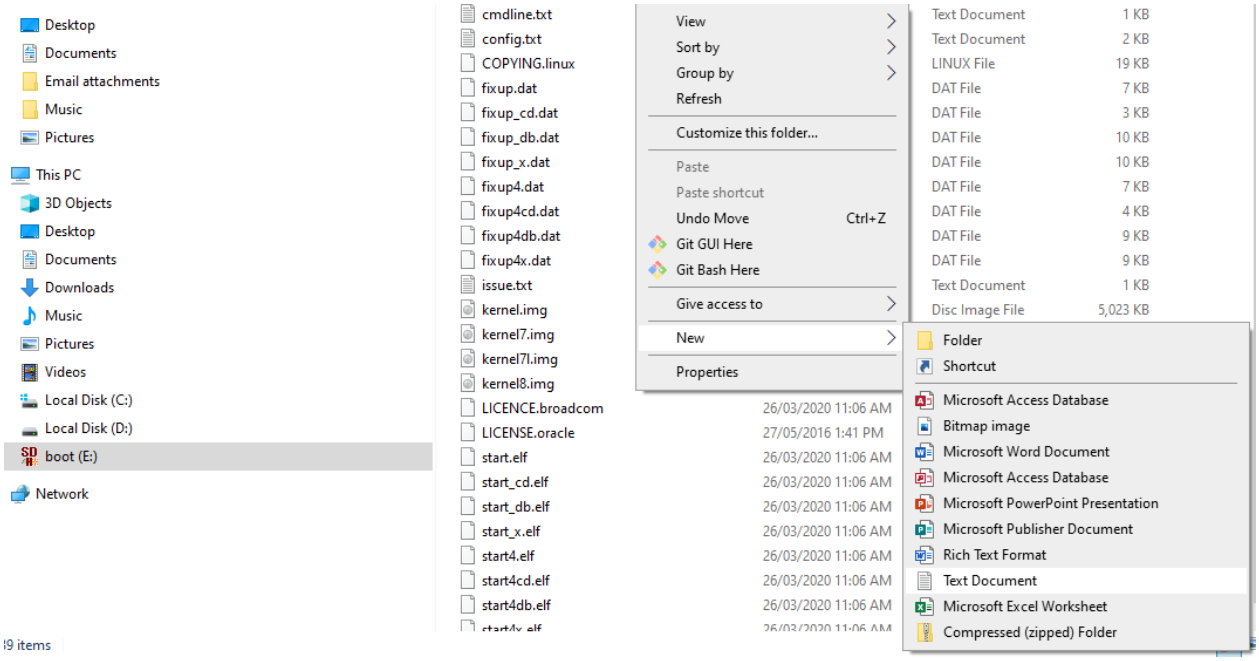


WiFi Configuration

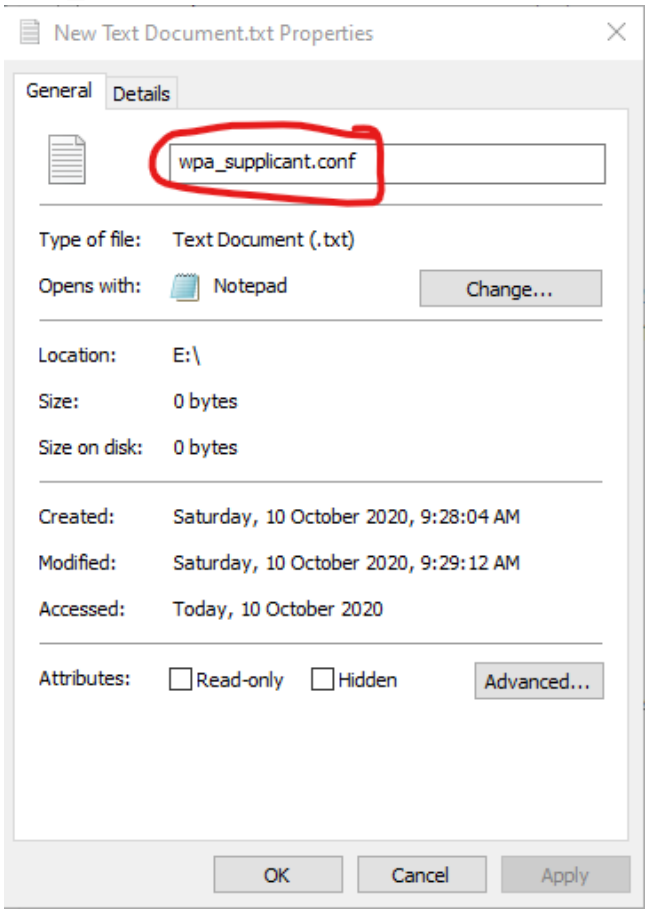
1. Insert the MicroSD card into the card reader and connect to the USB port of the computer
2. Open File Explorer and you should see a new drive letter



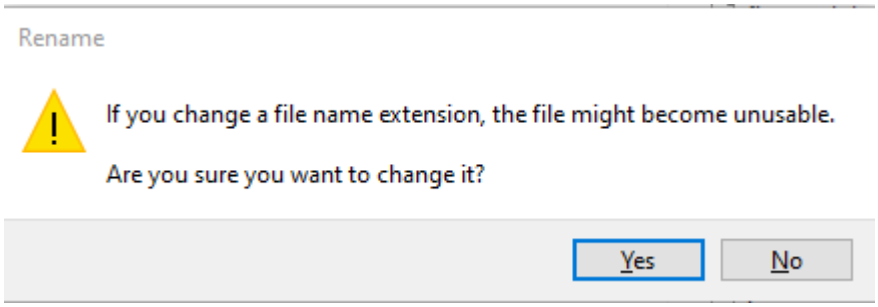
3. Within the root directory create a new text file (Right click New>Text Document)



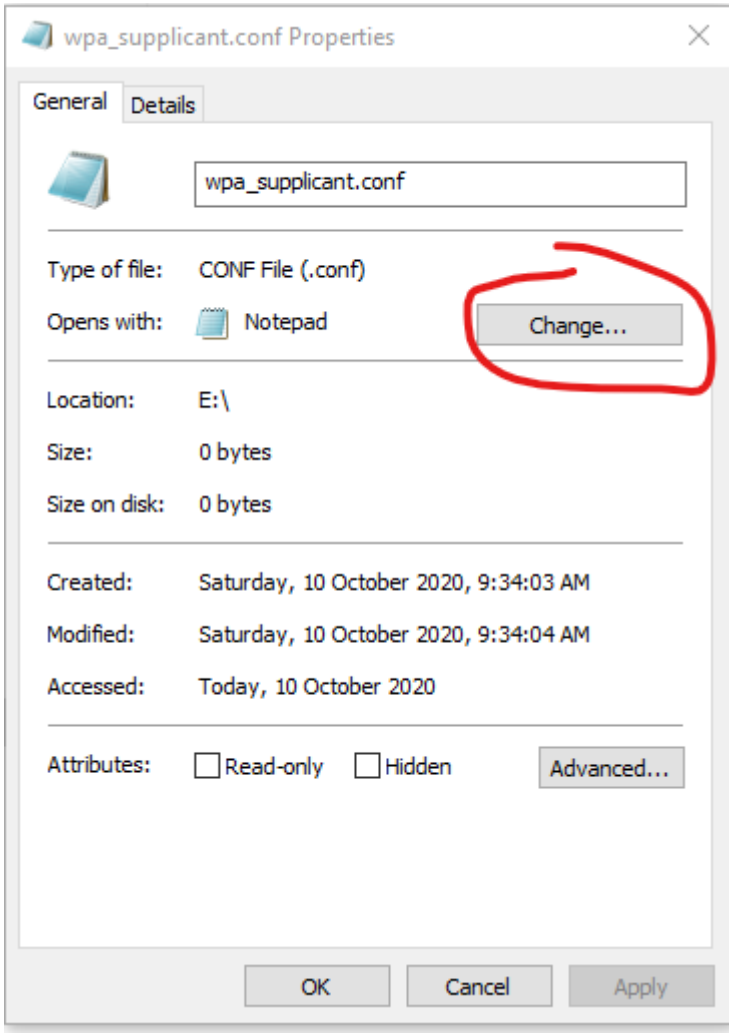
4. Right click on the new file and select properties. Change the name of the file to “wpa_supplicant.conf” and click “OK”



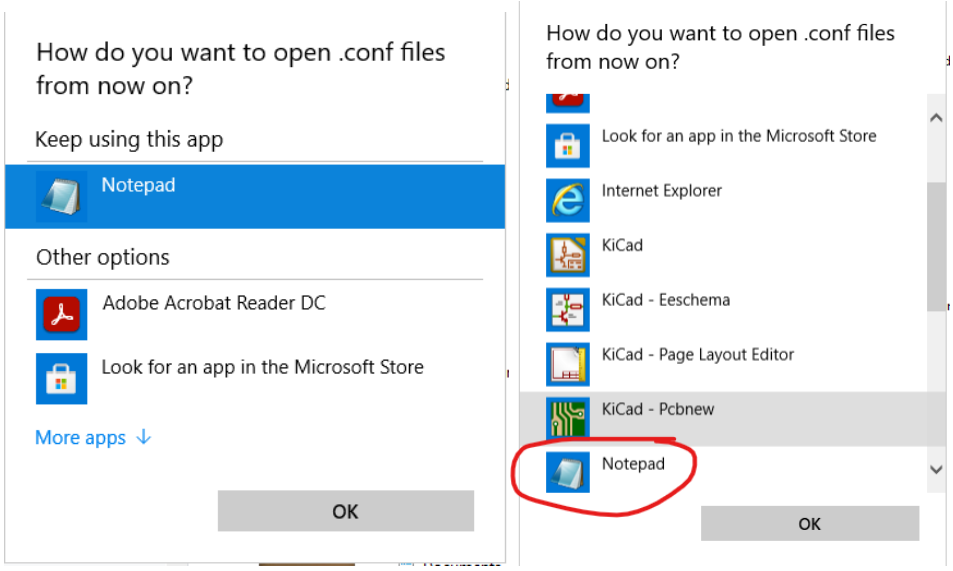
5. Click “Yes” to the warning message



6. Right click on the “wpa_supplicant.conf” file and select “Properties”
7. Click “Change”



8. Click “More Apps” and select notepad

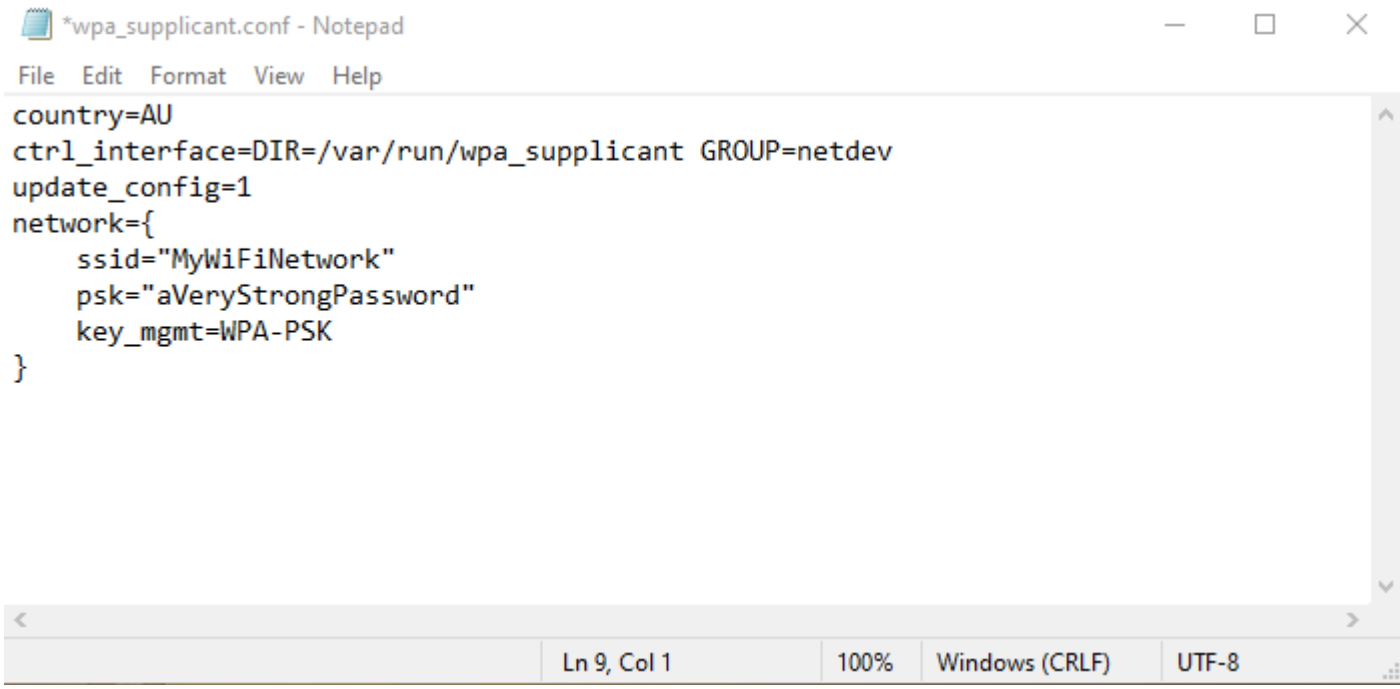


9. Double click on the “wpa_supplicant.conf” file to open it in Notepad

10. Cut and paste in the following text into the Notepad window

```
country=AU
ctrl_interface=DIR=/var/run/wpa_supplicant GROUP=netdev
update_config=1
network={
        ssid="MyWiFiNetwork"
        psk="aVeryStrongPassword"
        key_mgmt=WPA-PSK
}
```

11. It should look like this after step 10

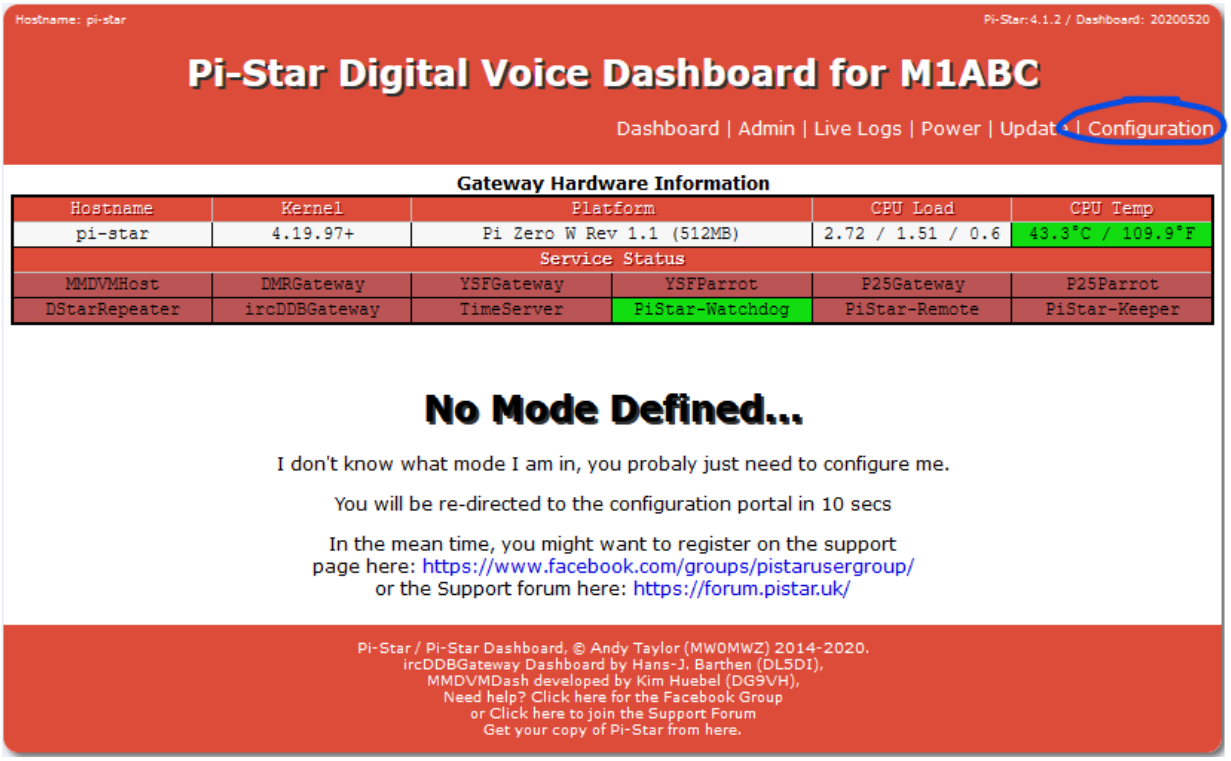


12. Replace the string MyWiFiNetwork with your home WiFi SSID
13. Replace the string aVeryStrongPassword with you home WiFi password
14. Close Notepad and click Save to save the file
15. Remove the MicroSD card from the reader and install it into the Raspberry Pi. It will be almost flush with the case when installed correctly.

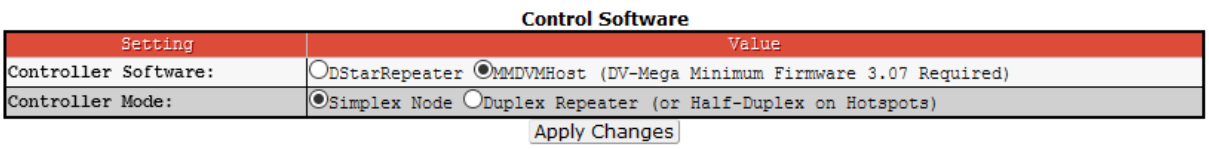
16. Plugin the power to the Raspberry Pi and turn it on

Pi-Star Configuration

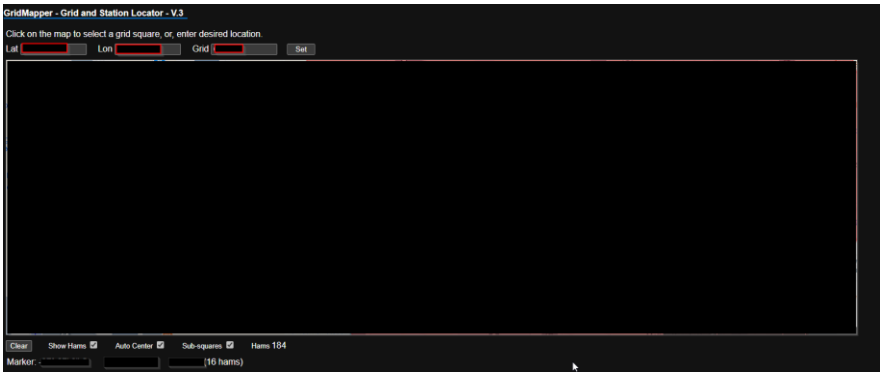
1. The Raspbery Pi takes approximately 5 minutes to boot after power on
2. Once booted you should be able to click on this link http://pi-star/admin/ and you will be prompted for a username and password
3. Enter the user name : pi-star and password : raspberry
4. Click on Configuration in the top left corner



5. Configure the Control Software section as below and click “Apply Changes”

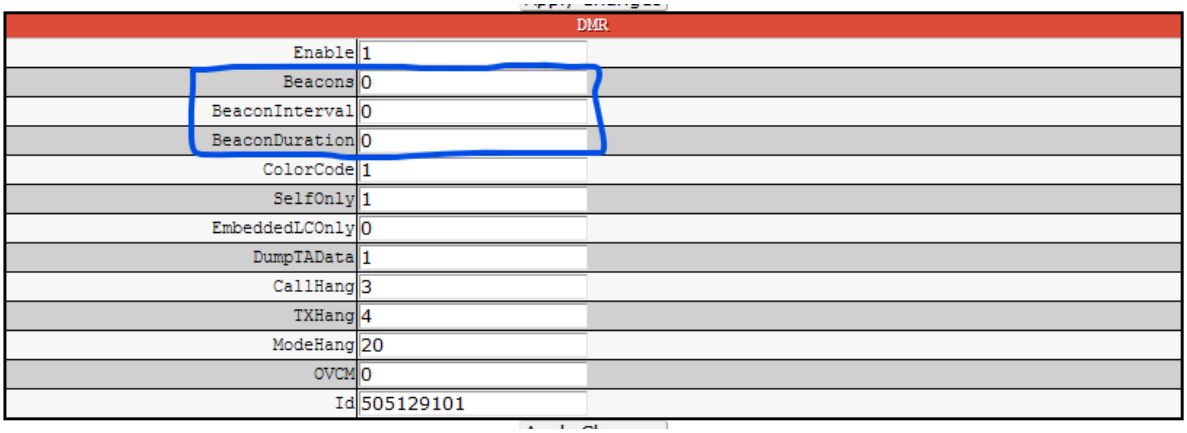


6. Configure the General Configuration section as below and click “Apply Changes” (**note it takes a little while for the page to refresh and restart the services before you can continue**)
    a. Callsign
    b. Frequency (439.125MHz or 439.150MHz)
    c. Your Latitude, Longitude, Town, Grid Location
    (Find your Coordinates and Grid with this website https://www.qrz.com/gridmapper)
    Note that the decimal coordinates and Grid are at the top of the page, whereas Degrees/Min/Sec is displayed at the bottom.

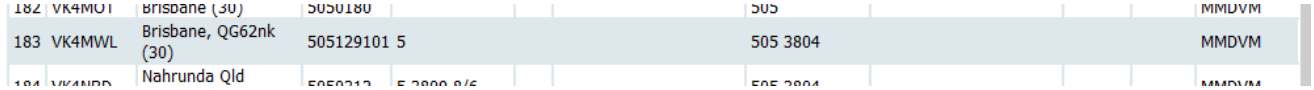


d. Change URL to “Auto”
e. Change the Radio/Modem Type to “STM32-DVM / MMDVM_HS - Raspberry Pi Hat (GPIO)”
f. Change the APRS host to “aunz.aprs2.net”
g. Change the timezone to “Australia/Brisbane”

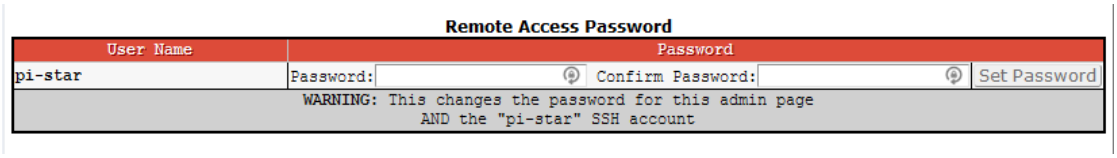
7. After applying the configuration the services will restart and you will now see the MMDVMHost Configuration section. Update the below settings and apply changes.
   a. Turn on “DMR Mode”
   b. Change the MMDVM Display to “OLED Type 3”
8. After applying the changes there will be a new option in the General Configuration section, “CCS7/DMR ID:” enter you DMR ID and apply changes
9. After the services restart configure the following options in the “DMR Configuration” section and apply changes.
   a. DMR Master “DMR+_IPSC2-VKHOTSPOT”
   b. DMR ESSID: - change the drop down to “01”
10. After the services restart, return to the DMR Configuration section and add the following to the new DMR Options field that has now appeared.
    a. Add the following string to DMR+ Network “*StartRef=4000; RelinkTime=15;UserLink=1;TS1_1=5;TS1_2=13;TS1_3=53;TS1_4=113;TS1_5=123;TS2_1=505;TS2_2=3804;”*
11. Apply changes.
12. Navigate to http://pi-star/admin/expert/edit_mmdvmhost.php
13. Scroll down to the DMR section and change “Beacons”, “BeaconInterval” and “BeaconDuration” to 0 and apply changes.



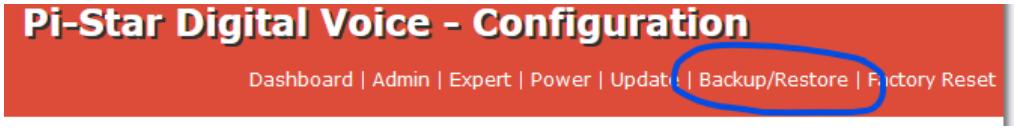
14. Open the VKDMR Hotspot Dashboard http://hot2.vkdmr.com/ and search for your callsign you should see some like this



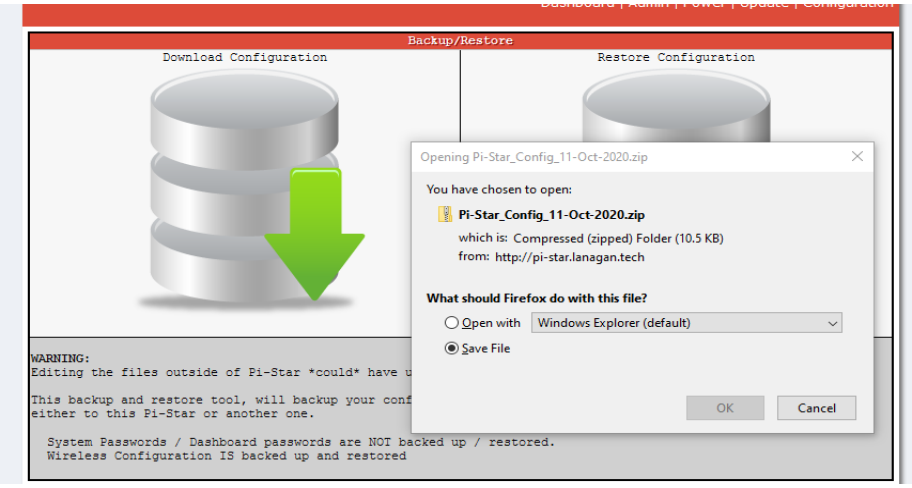
15. Update the admin password on your Pi-Star



16. Create a back of the configuration
    a. At the top of the configuration page click



    b. Click on Download Configuration and save the file to a safe location



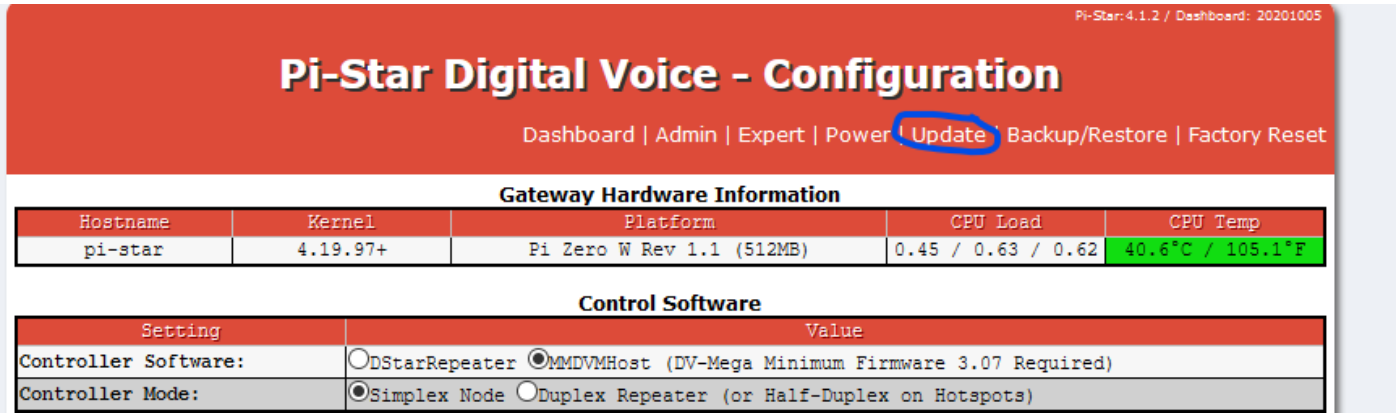
17. Complete a Pi-Star Update described below.

Pi-Star Updates

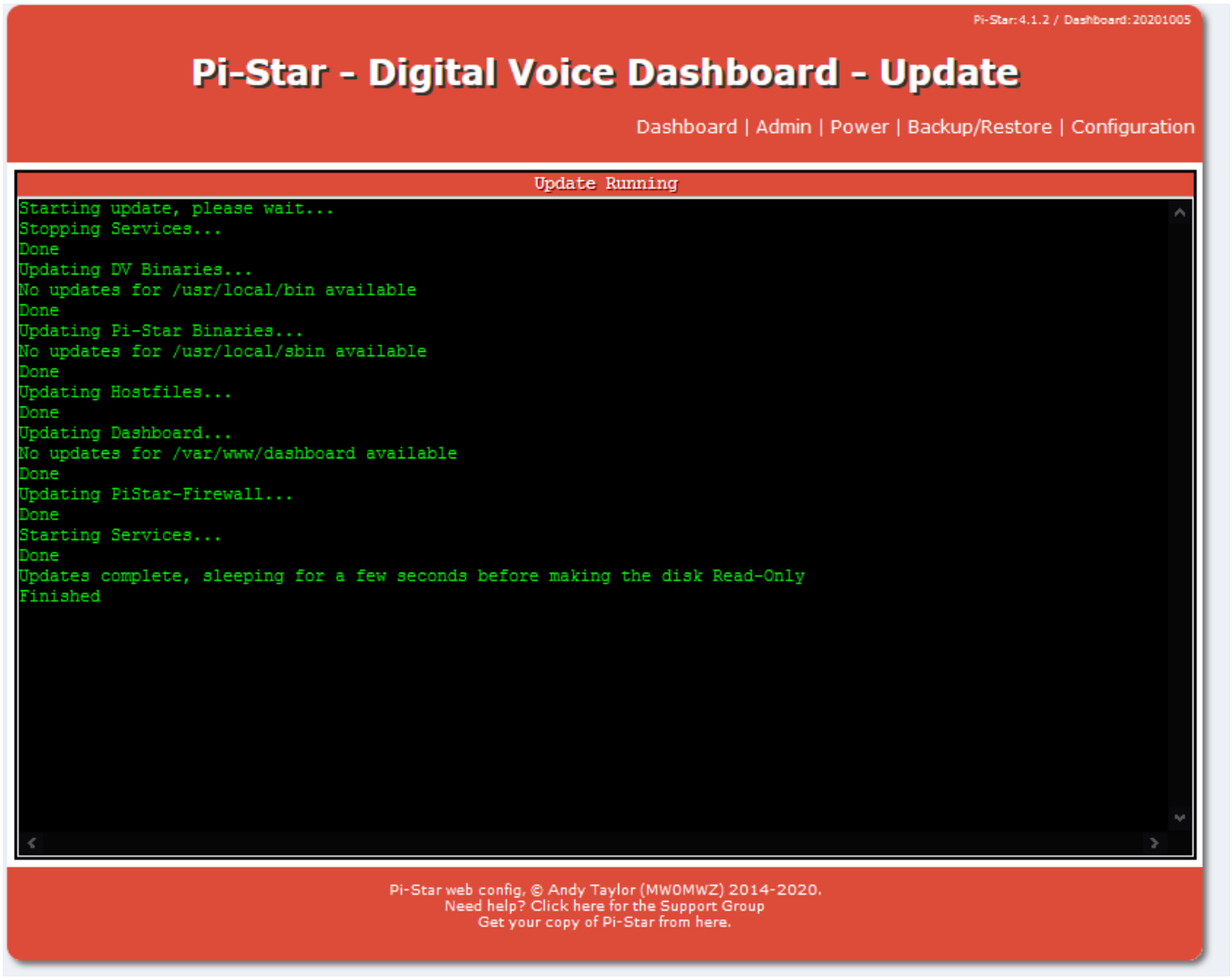
From time to time you will need to complete an update on the Pi-Star.

The update will update various operating system and Pi-Star application components.

1. Navigate to http://pi-star/admin/configure.php and enter your user “pi-star” and password
2. Click on Update



3. You will see a page like the below image, wait until you see “Finished” before navigating away.


Pi-Star:4.1.2 / Dashboard:20201005
Pi-Star - Digital Voice Dashboard - Update
Dashboard | Admin | Power | Backup/Restore | Configuration
Update Running
Starting update, please wait...
Stopping Services...
Done
Updating DV Binaries...
No updates for /usr/local/bin available
Done
Updating Pi-Star Binaries...
No updates for /usr/local/sbin available
Done
Updating Hostfiles...
Done
Updating Dashboard...
No updates for /var/www/dashboard available
Done
Updating PiStar-Firewall...
Done
Starting Services...
Done
Updates complete, sleeping for a few seconds before making the disk Read-Only
Finished
Pi-Star web config, © Andy Taylor (MW0MWZ) 2014-2020.
Need help? Click here for the Support Group
Get your copy of Pi-Star from here.

Radio Configuration

You will need to configure an additional channel and associated talkgroups in your codeplug and download to the DMR radio. This new channel will use the TX/ RX Frequency that you configured on the Hotspot configuration page. (439.125MHz or 439.150MHz)

Important : Set you radio to low power before transmitting on your Hotspot frequency as they are usually close by and can be overdriven by high power causing intermodulation or potentially damage to your Hotspot.

Once this is configured select your hotspot channel and TalkGroup 9990 (Parrot) and do a test transmission.

You should see information light up on the display of the hotspot and hear your voice back from the parrot.

You will also see info in the Hotspot Dashboard while you are transmitting.

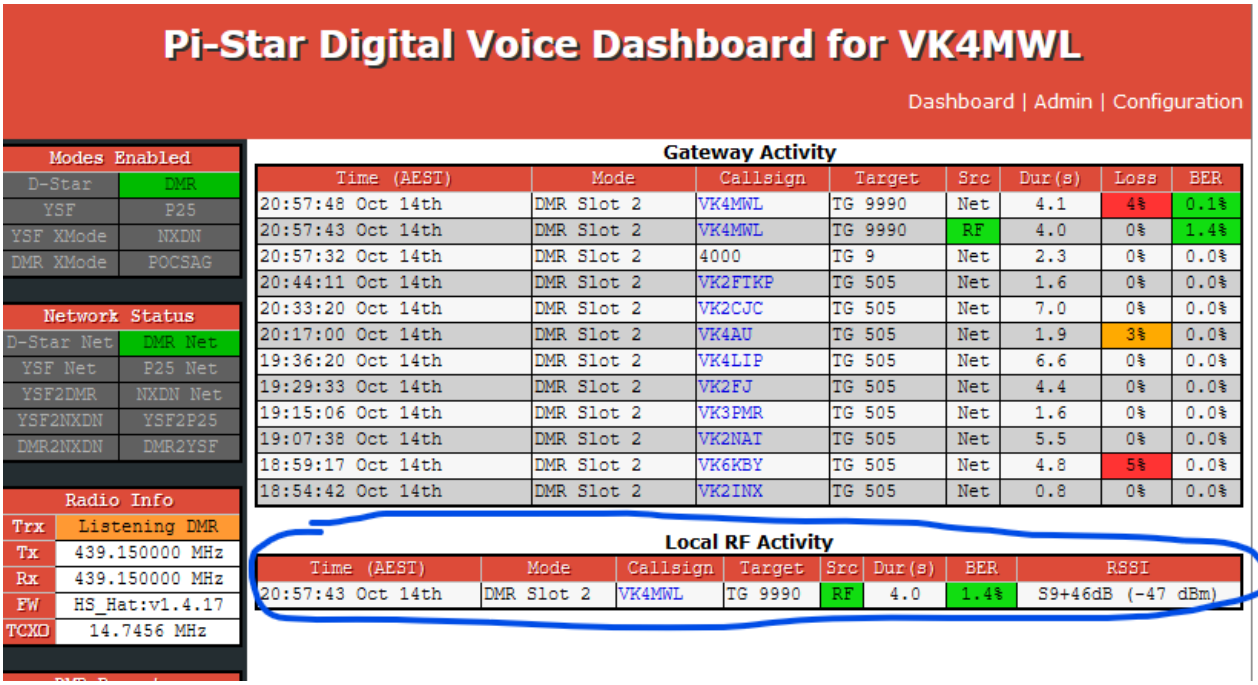
Bit Error Rate (BER)

DMR is digital radio and encodes your voice as ones and zeros over RF. Bit Error Rate or BER is the ratio of bit errors to total bits sent.

High BER indicates that the Hotspot (or any repeater) is not receiving your signal correctly.

In the case of Hotspots they use cheap transmitter chips and sometimes need a frequency offset to be setup to correct high BER.

To see the BER of your transmissions access the Pi-Star dashboard http://pi-star/ and look for your call sign in the “Local RF Activity” section. (You may need to do a test transmission to the parrot to generate a log entry)



If you are experiencing higher than 1% BER you can adjust the frequency offsets in the expert configuration pages.

1. Leave the Dashboard open and open another browser tab or window using this link http://pi-star/admin/expert/edit_mmdvmhost.php
2. Scroll down the page to the “Modem” section and locate “RXOffset”
3. Adjust the offsets in +/-100 step offsets and test using the TG 9990 parrot
4. Monitor the BER in the dashboard and adjusting in increments of +/-50 the +/-10 to reduce the BER below 1%

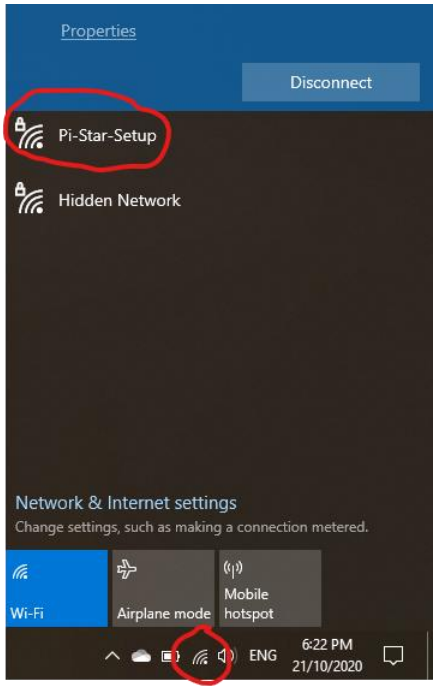
Further info about this process can be found on the webpage https://amateurradionotes.com/pi-star-notes.htm#tuningber by Toshen, KE0FHS and this Facebook post https://www.facebook.com/groups/743300879089972/permalink/2408935665859810/ by Glenn, VK4NGA.

WiFi Auto AP

If the Pi-Star fails to connect to a known WiFi network it will automatically create it own WiFi Access Point(AP). This is a failsafe to allow you to connect to Pi-Star and re-configure the WiFi settings.

Follow these steps to connect

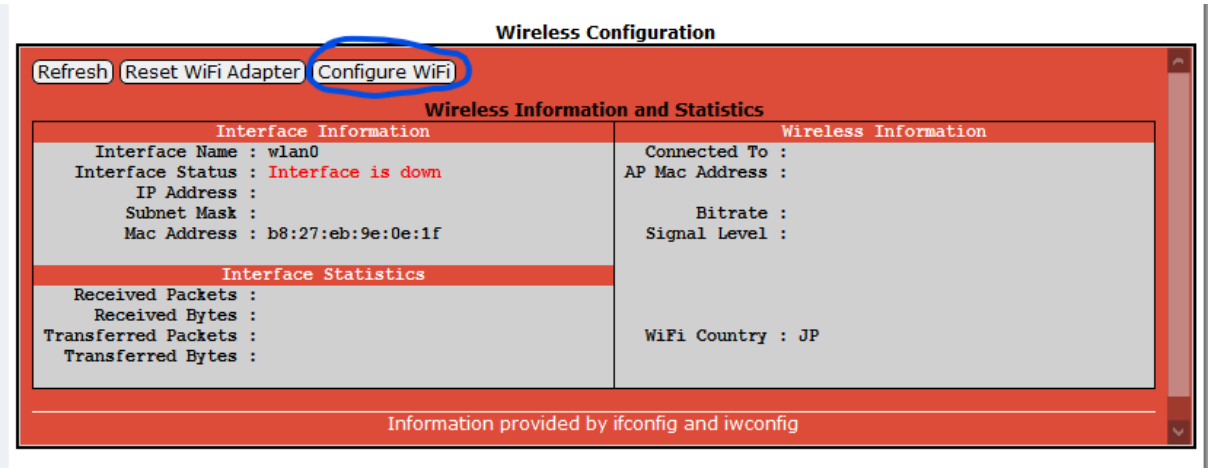
1. Turn on the Pi-Star and wait approximately 2-3 minutes
2. Using a laptop click on the small WiFi icon in the bottom right corner of the screen.



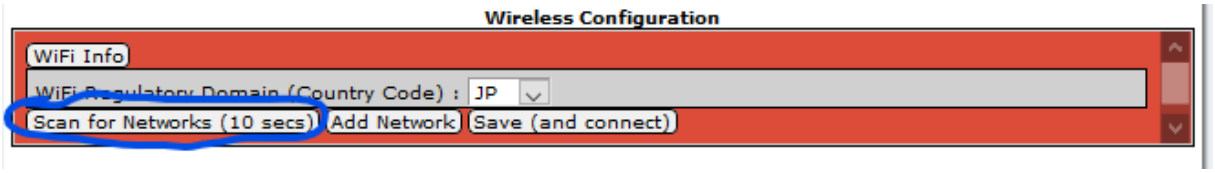
3. You should see a new WiFi SSID listed called “Pi-Star-Setup”. Click on it and click connect.
4. Enter the password “raspberry”

5. Open the following link in a web browser http://pi-star.local It should open up the configuration page.

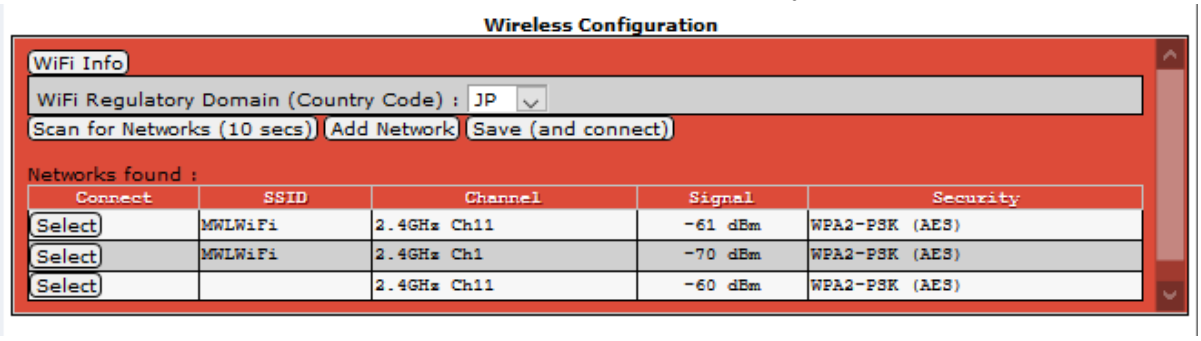
6. Scroll down to the Wireless Configuration section and click “Configure WiFi”



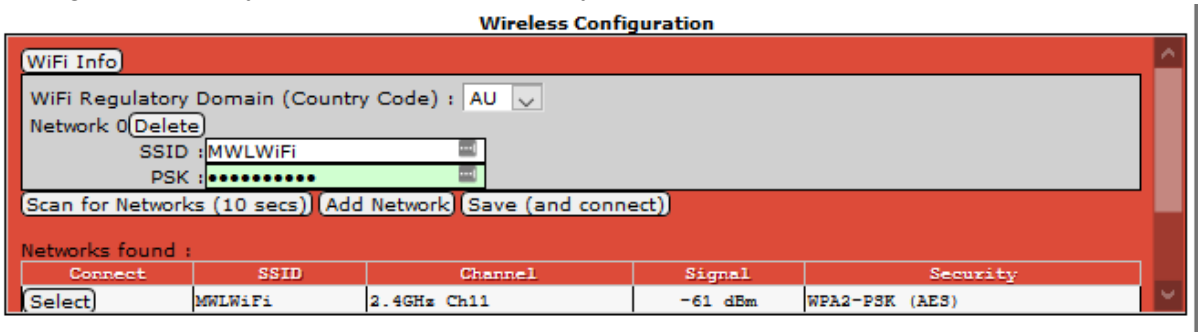
7. Click “Scan for Networks”



8. You should see a list of available networks. Click “Select” on your home WiFi network



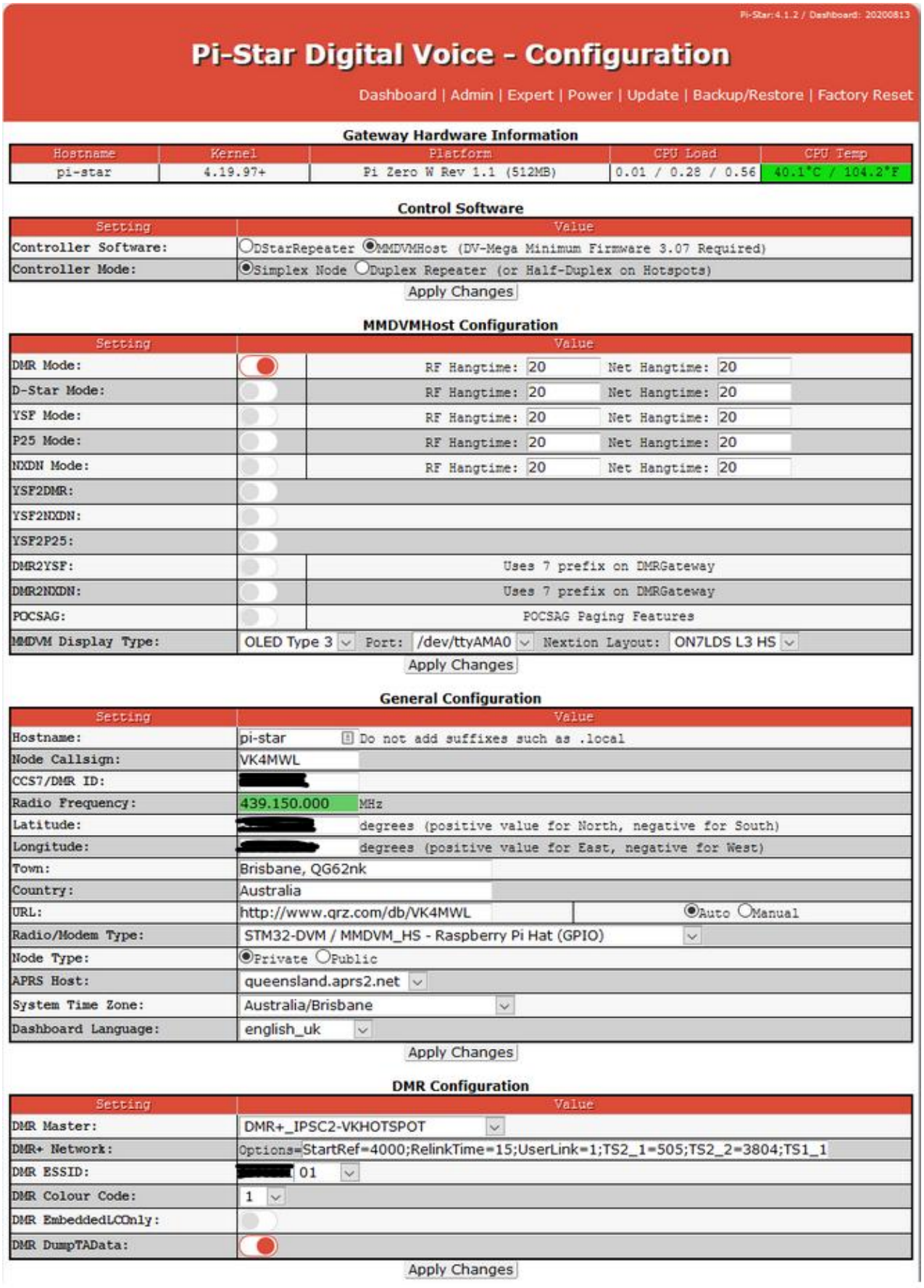
9. Change the Country Code to “AU” and enter your WiFi password in the “PSK” field.



10. Click “Save and Connect”
11. Restart the Pi-Star
12. Reconnect your laptop to your Home WiFi
13. Click on this link to connect to the Pi-Star Dashboard http://pi-star.local

VKDMR Configuration Page Example

This is a copy of my configuration for reference.



Pi-Star:4.1.2 / Dashboard: 20200813

Pi-Star Digital Voice - Configuration

Dashboard | Admin | Expert | Power | Update | Backup/Restore | Factory Reset

Gateway Hardware Information

Hostname	Kernel	Platform	CPU Load	CPU Temp
pi-star	4.19.97+	Pi Zero W Rev 1.1 (512MB)	0.01 / 0.28 / 0.56	40.1°C / 104.2°F

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

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 Type 3	Port: /dev/ttyAMA0	Nextion Layout: ON7LDS L3 HS	

Apply Changes

General Configuration

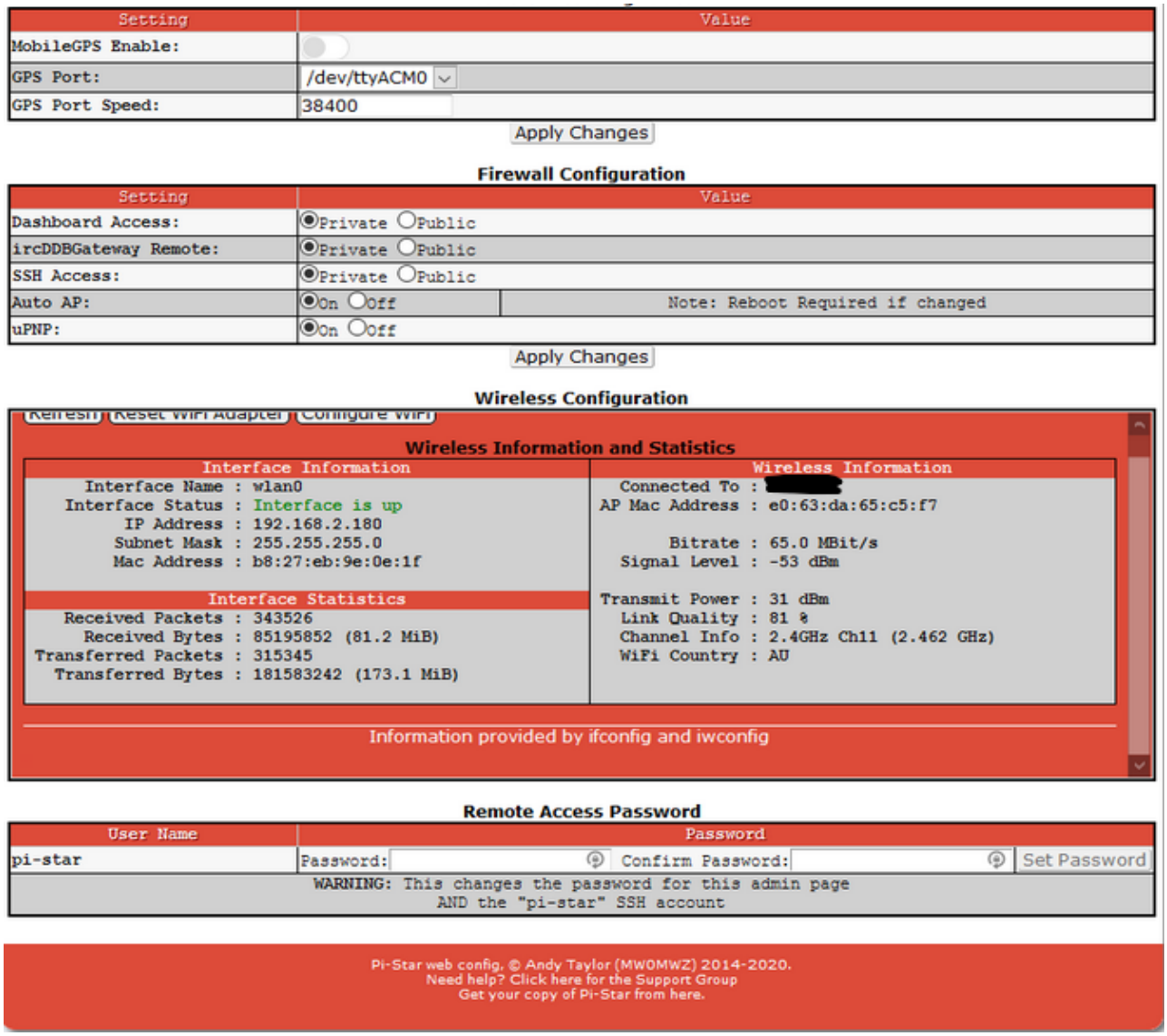
Setting	Value
Hostname:	pi-star Do not add suffixes such as .local
Node Callsign:	VK4MWL
CCS7/DMR ID:	[redacted]
Radio Frequency:	439.150.000 MHz
Latitude:	[redacted] degrees (positive value for North, negative for South)
Longitude:	[redacted] degrees (positive value for East, negative for West)
Town:	Brisbane, QG62nk
Country:	Australia
URL:	http://www.qrz.com/db/VK4MWL ◉Auto ○Manual
Radio/Modem Type:	STM32-DVM / MMDVM_HS - Raspberry Pi Hat (GPIO)
Node Type:	◉Private ○Public
APRS Host:	queensland.aprs2.net
System Time Zone:	Australia/Brisbane
Dashboard Language:	english_uk

Apply Changes

DMR Configuration

Setting	Value
DMR Master:	DMR+_IPSC2-VKHOTSPOT
DMR+ Network:	Options=StartRef=4000;RelinkTime=15;UserLink=1;TS2_1=505;TS2_2=3804;TS1_1
DMR ESSID:	[redacted] 01
DMR Colour Code:	1
DMR EmbeddedLCOnly:	
DMR DumpTAData:	

Apply Changes



Further Reading

https://www.pistar.uk/
https://forum.pistar.uk/
https://amateurradionotes.com/pi-star.htm#learningpistar
http://www.lyonscomputer.com.au/ (Lots of info on lots of stuff including DMR. Thanks Glenn VK4PK)