Dual DMR network Pi-Star
full-duplex hotspot setup and configuration

Project Objective

The primary objective here is to make a DMR hotspot for personal use that can access both the TGIF and Brandmeister networks at the same time. We can accomplish this with a full-duplex MMDVM modem and some configuration on the hotspot and radio. Secondary objectives are to get comfortable with building and configuration of your own Pi-Star based DMR hotspot. Once yo have a working configuration, we can create and save a backup configuration file to a safe place. This will allow us to get back to a working state quickly if we ever decide to tinker with the hotspot or its settings (both of which are encouraged in the true spirit of amateur radio).

This guide assumes a few things. First, that you are a licensed Amateur Radio operator with a valid DMR ID. If not, there are many resources available to help you do this. I also assume that you are somewhat familiar with radio, DMR, and their terminologies. It's helpful to have some prior experience with the Pi-Star software, although I don't think it's required as long as you follow along with the guide. It's also helpful to be familiar with computers and their use, but I'll try to make this as beginner friendly as possible.

I also assume you have the required hardware: A Raspberry Pi board with case, SD card, full duplex MMDVM Raspberry Pi "hat" board with antennae, appropriate USB power supply, an internet connection (hard wired is required for initial setup), a DMR radio along with a way to program it. You will need a computer, along with some kind of SD card adapter, in order to write the Pi-Star image. You will also need to be registered on the TGIF and Brandmeister networks, and have your hotspot security keys handy; this is usually available under the self care section of their respective websites.

Assembling the Hardware

First and foremost, we need to assemble the hardware. There are many guides to help you do this, but generally you will mount your Raspberry Pi board into the case and then plug the MMVDM "hat" board onto the GPIO header on the Raspberry Pi board. Some modifications may be required based upon what case you have. Be creative and get it all mounted and assembled. Don't forget to attach the antennae.

The hardware I used in this project includes:

1. Raspberry Pi 3 Model B Rev 1.2 with a generic case bottom (no top yet, modification will be needed to accommodate the MMDVM board)
2. AURSINC MMDVM Duplex Hotspot Module Dual Hat V1.3 with OLED display (purchased from Amazon, of course, and can be located with that product name)
3. SanDisk Ultra Class 10 16GB Micro SD Card
4. Micro USB cable with a 2 amp power supply

Writing the SD Card Image

Once you have the hardware built, now it's time to tackle writing the software onto the SD card so we can get booting. First, head to www.pistar.uk and click downloads on the left side. Download the image Pi-Star_RPi_V4.1.5_30-Oct-2021.zip to your computer. Open the compressed file and extract the image file to a folder on your computer. If a later dates version is available, it will probably work as well.

Insert your blank or target SD card into your reader or adapter on your PC.

Next, lets get the software we need to write the SD card. Head over to the Raspberry pi website, https://www.raspberrypi.com/software/, locate and download the software called Raspberry Pi Imager. Install this to the computer and launch the software.

Click the Choose OS button, and then select Use custom (at the bottom of the list). Navigate to the location where your extracted Pi-Star image file is, then select it. Next, click on the button that says Choose Storage, then select the physical location that has your blank, target SD card. Click the write button, accept the dialog that states your SD card will be wiped out, and let the electrons flow onto the card. When finished, eject your card and remove it from your PC.

Before we power up this new hotspot, power down any other hotspots you have running currently on your local network (if any). This will help us configure the new hotspot. We can power them back on later.

Pop the SD Card into the slot on your Raspberry Pi. Plug in an Ethernet cable and then the power cable and wait a few moments as the unit boots up before we move on.

Pi-Star Base Configuration

After booting up your new Pi-Star setup, load up an internet browser on your computer. In the address bar, type in http://pi-star and hit enter to load up the Pi-Star configuration page. If this hostname doesn't work, you will need to find out the IP address that was assigned. This may be able to be seen in your router configuration pages, or with the help of a network scanning application. I use **Fing** for iOS to scan my local network for active IP addresses. Once you find the appropriate IP address, type that into the address bar and hit enter to load up the Pi-Star configuration page.

First and foremost, lets make sure we have the latest software. On the Pi-Star dashboard, and click on **configuration**. Enter the default username **pi-star** and password **raspberry** to login. Now click on **Update** on the top bar again, and let the update script execute. This may take a few moments.

When finished, click **Power**, then **reboot**. Wait a few moments and try to log into the dashboard again so we can do our configurations. Click on **configuration** one more time, and enter the default username and password again if prompted.

When tackling the Pi-Star configuration, I like to work in the groups on the page. Make all the required changes to each section and hit the apply button right under that section before you move on to the next section.

Under the first section, **Control Software**:

1. Make sure the options **MMDVMHost** is selected for **Controller Software.**
2. Select **Duplex Repeater** for the **Controller Mode.**
3. Hit apply and let the wizards work their magic.

Now, we can move on to the **MMDVMHost Configuration** settings. I did not enable any other modes in my configuration, lets keep it simple for now and just concentrate on the DMR.

1. Enable **DMR Mode,** and set **RF Hangtime** to **20** and **Net Hangtime** to **20**.
2. If you have the OLED screen installed, select **OLED Type 3** on port **/dev/ttyAMA0** for the **MMDVM Display type**. I don't think **Nextion** Layout matters since we aren't using a nextion display, but mine was set to **G4KLX**.
3. Hit apply and let it do its thing again.

Next, lets move on to the General Configuration.

1. Set the **DNS hostname** you would like to use for the device under the **Hostname** field. Choose a unique name if you have more than one hotspot. If not, the default should be fine. You can type this name into the address bar in an internet browser while connected to your local network to access the dashboard.
2. Type your **callsign** in under **Node Callsign**.
3. Type your **DMR ID** under **CCS7/DMR ID**.
4. Since this is a duplex hotspot, we will need to set the receive and transmit frequencies. Refer to your local radio bandplan and select an appropriate frequency pair. I used a standard 5MHz offset for my frequencies.
   Type the radio **uplink** frequency you selected into the **Radio Frequency RX** box. This is the frequency that your radio will *transmit* on and the hotspot will *receive* on.
5. Type your radio **downlink** frequency into the **Radio Frequency TX** field. This is the frequency that the hotspot will *transmit* on, and your radio will *receive* on.
6. You can manually enter **Latitude** and **Longitude** coordinates in the appropriate fields if you wish. If APRS Host is enabled, an station will display on the APRS map at the coordinates you define here.
7. Enter your appropriate **Town** and **Country** as requested next.
8. You can also enter a **URL** that will be passed with your ID data as well. Most people seem to use a link to their QRZ page here. Enter what you like and select the **Manual** radio button.
9. Select the appropriate **Radio/Modem Type** as required for the specific MMDVM board you are using. Refer to their documentation to make sure you select the correct modem here. If you are using the board that I did, the correct modem type would be:
   "**STM32-DVM / MMDVM_DS – Raspberry Pi Hat (GPIO)**".
10. Set your preferred **Node Type**, if you want your hotspot to be accessible on local RF to everyone (**public**) or only to your DMR ID (**private**).
11. If you wish for your hotspot to show up on the APRS map, select **APRS Host Enable** and select the appropriate **APRS Host** server for your location. In the United States, we can use "**noam.aprs2.net"**.
12. Select your appropriate **System Time Zone** and preferred **Dashboard Language**, respectively.
13. Apply the settings and wait for the magic to happen.

Now, onto the **DMR Configuration**. Since we are only focusing on using the Brandmeister and TGIF networks, the settings here (and a few more later on) are specific to this application. It may work with other DMR networks as well, with your own experimentation.

1. Set **DMR Master** to **DMRGateway**
2. Select the appropriate **Brandmeister Master** server for your physical location.
3. Enter your Brandmeister hotspot password under the **BM Hotspot Security** field.
4. If you are using multiple hotspots, choose a unique **Brandmeister Network ESSID**. If not, select **none**.
5. Make sure **BrandMeister network enable** is turned **on**.
6. Leave all the other settings in this section as **default**.
7. Make sure **DMR DumpTAData** is turned **on**.
8. Apply changes again.

Mobile GPS Configuration section I left as all the **default** values.

Under **Firewall Configuration,** select your preferred settings. The settings I used were:

1. **Dashboard Access: Private**
2. **ircDDBGateway Remote: Private**
3. **SSH Access: Private**
4. **Auto AP: On** (This puts the hotspot into access point mode if it cannot connect to any configured WiFi network)
5. **uPNP: On**
6. Apply Changes once more.

Now, onto the **Wireless Configuration**. Click **Configure Wifi** and follow the prompts to connect to your preferred WiFi network. If you wish to remain on Ethernet (recommended), then we can skip over this section.

Under **Auto AP SSID**, enter the network password (**PSK**) you would like the hotspot to use if it cannot connect to a network and starts Access Point mode. You will need to enter this password on your client after you connect to the hotspot in Access Point mode.
Finally, under **Remote Access Password**, enter a new administrator **password** for the hotspot. This password will be used instead of the default raspberry password in order to log into the hotspot configuration web browser interface, or to log into the hotspot via SSH Shell (advanced).

Before we move on to the next part of the configuration, double check all of your values on this entire page. Make sure they match the values outlined in this guide, or whatever that preferred setting is. Any changes made to this page after this point in time will cause the next steps of our custom configuration to be overwritten.

Pi-Star Advanced Routing Configuration

Ok. Now on to the custom configuration! Click on **Expert** on the top bar, then select **DMR GW** under the Full Edit sub-bar. Scroll down to the section that says [DMR Network 1]. Select all of the text in this group starting with the [DMR Network 1] tag and ending with the last block of text before the line break and press the delete key. Copy and paste the following text into the space you just created:

```
[DMR Network 1]
Enabled=1
Address=3104.master.brandmeister.network
Port=62031
PassAllPC1=2
PassAllTG1=2
Password="password"
Debug=0
Location=1
Id=1234567
Name=BM_3104_United_States
```

And lets change a few values here to match your specific configuration.

1. Above, we are set to use the 3104 east coast Brandmeister server. You can modify the value here to match your preferred server under the **Address=** and **Name=** fields
2. Type your Brandmeister hotspot security key into the **Password=** field. Keep the quotation marks.
3. Type your DMR id into the **Id=** field. If you have multiple hotspots, you should append a two digit ESSID on the end of that DMR ID (such as 123456702, in the case of ESSID 02 used on DMR ID 1234567)

Great. Now lets locate a similar looking block of text with the heading [DMR Network 3]. Select and delete this whole section as well, and paste in the following text:

```
[DMR Network 3]
Enabled=1
Name=TGIF
Address=tgif.network
Port=62031
Password="password"
Location=0
Debug=0
PassAllPC1=1
PassAllTG1=1
Id=1234567
```

And lets change a few values here to match your specific configuration.

1. Type your TGIF hotspot security key into the **Password=** field. Keep the quotation marks.
2. Type your DMR id into the **Id=** field. If you have multiple hotspots, you should append a two digit ESSID on the end of that DMR ID (such as 123456702, in the case of ESSID 02 used on DMR ID 1234567)

That's it! Hit apply changes and let the magic happen. Lets reboot the hotspot once more too... click on configuration, then Power, and reboot.

Using the Hotspot with your radio

As a rule of thumb, any traffic on Timeslot 1 will be sent to the TGIF network. Any traffic on Timeslot 2 will be sent to the Brandmeister network; and the same applies for any received traffic.

When you program your radio, set the Transmit and Receive frequencies to the ones you set above. Set your color code to 01, and use normal talkgroups on their appropriate timeslots. A good test would be:

TGIF : Timeslot 1 Group call to 9990 for parrot (will echo your test transmission back to you)
Brandmeister: Timeslot 2 Group call to 4000 for disconnect (will respond “not linked” back to you)

You can also key into any active talkgroup as shown on each network's respective netwatch page... or key into an empty talkgroup and then verify your activity on that same netwatch page.

Final Notes

As noted in the objectives section, make a copy of the configuration once you have everything working. This can be done from the Pi-Star dashboard. Click on **configuration**, **backup/restore**, and then **download configuration**. Save this file to your PC in case you need it later.

This guide is **version 1.0**, written by **Paul Ferrara, KC2GKP** on **December 22, 2021** and may be freely distributed within the Amateur Radio community as long as all credits are held intact. I have done my best to make a complete, easy to follow guide. Please send any questions, comments,or suggestions via email to KC2GKP@QSL.NET.

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This guide was written for Pi-Star 4.1.6 version. The Raspberry Pi imager was 1.6.2 version. Some differences may be present if the software has been updated after this guide was released.