The WPSD User Manual

Amateur Radio Digital Voice Software

Version

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KC1AWV • AAoNT • WoCHP • The WPSD Project

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WPSD[1] is a next-generation digital voice software suite & distribution for amateur radio use, enjoyed by many thousands of hams around the globe. It is used for personal hotspots and repeaters alike. It supports DMR, D-Star, Yaesu System Fusion (YSF/C4FM), P25, NXDN digital voice modes & POCSAG data/paging.

This is the *official* WPSD User Manual, and we encourage both new and existing users to read it.

Tip

There are two formats of the WPSD User Manual:

1. The default WPSD User Manual online[2], which is a chapter-centric, browser-based version and is available in multiple languages.
2. A PDF version of this WPSD User Manual[3] (en_US only), suitable for saving to your device and for printing. Note that the defaut *online* version of the WPSD User Manual is a "living document" and is updated & edited regularly. Once the PDF is printed or saved, it is considered an "uncontrolled document".

The WPSD User Manual is available in other languages, availble online (only): https://manual.wpsd.radio

[1] <https://wpsd.radio>
[2] <https://manual.wpsd.radio/>
[3] <https://manual.wpsd.radio/WPSD_User_Manual.pdf>

1 Get Started

Getting started with WPSD is reasonably straightforward. This section will prepare you and your hotspot or repeater for use with WPSD.

Note

The current documentation author, Lee (AA0NT), has a Yaesu FT-5DR and a duplex MMDVM board from BI7JTA and a Pi Zero 2W. Therefore, I have written these documents using those selections as examples. While many, if not most, of the steps should apply universally, I expect the ham reading this documentation to critically read and understand this documentation to avoid a mistake.

There are three main parts of WPSD:

1. **Your radio** Yes, you must have a digital-capable radio. The radio is responsible for the digital encoding and decoding the voice streams. I know you are thinking you should be able to do everything with the Pi or a computer. Technically, you can, but if you are capable of that, you don't need to read instructions like these. The radio encodes your voice digitally and then transmits it as an FM signal to be received by your MMDVM modem.
2. **Your modem** The MMDVM or "Multi-Mode Digital Voice Modem" you have probably seen talked about. It is generally supplied as a HAT or "Hardware Attached on Top." The HAT interfaces with the General Purpose Input/Output (GPIO) pins on the host.
3. **Your host** This is a single-board computer (SBC) such as a Raspberry Pi. The host runs the WPSD software, which handles the configuration, user choices, and Internet gateway tasks.

Another way of looking at this configuration is that there is a radio and a hotspot. The hotspot combines the MMDVM and the host, often in a case with (optionally) batteries and a display. Neither the batteries nor the display are necessary, of course. The batteries can help you be more flexible, and the screen is preferred by those who enjoy visual feedback, such as seeing the callsign of the person to whom they are speaking.

We'll approach getting you started with three main tasks:

- *Gathering Hardware*
- *Installing Software*
- *Initial Startup*

Attention

Once you have your system installed and configured, it's **strongly** recommended that you back it up and save the backup, along with your dashboard password, somewhere safe. WPSD has a comprehensive backup capability built into the dashboard. For help, see the *Backup and Restore Configuration* section under *Maintenance Items* in this manual.

2 Gathering the Hardware

Here, I'll review the acquisitions you need to make to create your WPSD system.

2.1 A Radio

You may use nearly any digital-capable radio supporting:

- DMR
- D-Star
- Yaesu System Fusion (YSF/C4FM)
- P25
- NXDN digital voice modes
- POCSAG data/paging

There is no practical difference between modes in the functionality of the hotspot. Choose a radio based on your local circumstances, such as what the local repeaters support, your local club preferences, or your favorite color. Any radio that supports one of the above digital modes should work with WPSD.

Because you generally will not be transmitting any distance, higher radio power levels are unnecessary, and sometimes, too much power can overwhelm the modem.

Since people will ask for a recommendation, despite me saying, "Just pick one," I'll give two *possible* choices to get you going:

- Low price: **Retevis RT3S** available on Amazon[4] for under $100 shipped (if you are a Prime member.)
- Lower priced premium brand: **Yaesu FT-70DR** available on Amazon[5] for under $200 shipped (if you are a Prime member.)

Events such as Black Friday are great times to shop for better prices.

[4] <https://www.amazon.com/Retevis-RadioTime-Contacts-Function-Programming/dp/B07HR7XVVC>
[5] <https://www.amazon.com/FT-70DR-Original-Yaesu-Handheld-Transceiver/dp/B06Y2697RX>

2.2 Single Board Computer

SBC hosts and Hotspots supported by WPSD are:

- Raspberry Pi
  - Zero 2W
  - Models 3, 4, 5.
- Nano Pi Neo
- DVMEGA Cast
- DVMEGE EuroNode
- ZUMSpot Mini 1.3
- ZUMSpot Mini 2.4
- ZUMSpot Elite 3.5
- ZUMSpot USB Stick
- BridgeCom SkyBridge MAX/Plus

Any other SBC/device is **not** supported if I have not listed it.

While not specifically part of the project, I recommend you do not save pennies by purchasing a cheap power supply. These switching power supplies are notoriously noisy, and not all manufacturers are honest about their power levels. Be sure the power supply you use is capable of supporting your SBC. Some people use a rechargeable battery pack, which avoids issues with power supplies.

2.3 Modem

Your modem will be an MMDVM modem board with or without an ADF7021 RF chip.

Note

MMDVM modems with the ADF7021 RF chip are called “hotspot boards” and usually have a single SMA antenna connector or an onboard ceramic antenna. MMDVM modems without an RF chip are called “repeater boards;” these have no antenna connections. MMDVM modems with two ADF7021 RF chips are called “duplex boards,” come with two SMA antenna connections, and are typically used for advanced DMR configurations. Some boards with RF capabilities use onboard ceramic antennas, which are a good choice if you do not want to run an external antenna. WPSD supports all three types.

The modem receives the digital signal from your radio and transcodes it to a digital format capable of being sent over the Internet. While your voice is digitally encoded, your radio transmits it as an analog signal. It must be received, encoded, and transmitted across the Internet via the host.

The modem has two primary integrated circuits, or ICs. The first is one (or two) ADF7021 ICs responsible for receiving and transmitting RF. These are low-power devices in the 0.10w - 0.25w range. The second is a microcontroller,

similar to the Arduino some of you may be familiar with. This microcontroller has a “firmware “ program loaded, which is responsible for the modem operations.

Modem/hotspot manufacturers known to work well with WPSD are:

- ZUMSpot GPIO and USB MMDVM Boards and MMDVM-Pi Repeater Boards
- DVMega (Netherlands; *not* the UK) Boards & Hotspots / Devices
- LoneStar N5BOC GPIO and USB MMDVM Boards
- BridgeCom Systems SkyBridge Hotspots
- BI7JTA MMDVM Boards
- Repeater Builder STM32-DVM Boards

Some modems behave poorly within the ecosystem, and be sure to read this article[6] addressed to modem vendors to understand some of the issues. Also, understand that the ***WPSD project does not provide support for modems, their peculiarities, or develop the binaries for them.***

2.4 SD Card

I recommend a Class 10 or better SD card of 8GB or more. Since WPSD stores very little on your SD card, a card with more storage may be an unnecessary expense.

2.5 A Computer

You will use your computer to create an image on the SD card and for configuration and operations. While it is possible to configure and run WPSD using a tablet or other mobile device, a computer running ChromeOS, Windows, Linux or Mac OS is strongly recommended. Mobile devices have screen limitations that may hinder you from seeing the required menu and status items in the browser.

[6] <https://w0chp.radio/articles/letter-to-mmdvm-vendors/>

3 Installing the Software

SBCs commonly use an SD card as their "disk." At the same time, some people use SSDs. As with other areas of this documentation, if you know enough to argue with me about using an SSD, you know enough to be responsible for the changes.

Your hardware configuration may differ from the one used to create this documentation, so please adjust your steps accordingly.

3.1 Obtaining the Disk Image

You may obtain the WPSD disk image from *WPSD.radio* from the following URL:

https://wpsd.radio/#download-wpsd[7]

Download the disk image file appropriate for your SBC. In most cases, you do not need to unzip the downloaded file.

[7] <https://w0chp.radio/wpsd/#download-wpsd>

Hint

if you don't see a disk image in the matrix for your specific hardware, it doesn't exist. (read the faqs[8])

Also included on the page is the file `WPSD_SHA256-SUMS.txt`. This file contains cryptographic signatures for the disk image files that you may use to verify the download you received has no errors or has not been tampered with in transit. Verifying the checksum is entirely optional and outside of the scope of this document. Check out the article How to Verify MD5, SHA-1, and SHA-256 Checksum in Windows[9] for additional information.

3.2 Write the Image

There are several tools used to write your SD card. Some prefer graphical front ends, like Balena Etcher and Raspberry Pi Imager. Some classic OS tools like `dd` may also be used.

We recommend Balena Etcher for those less experienced people taking on this project. More experienced hams may have their preferences.

3.2.1 Using Balena Etcher

Tip

The WPSD Team recommends using Balena Etcher over other tools such as the Raspberry Pi Imager, etc. This because the WPSD disk images are pre-configured with many settings, etc., and using other disk imaging tools which allow for post-write modifications run the risk of breaking the installation. Caveat Emptor.

Balena Etcher is available for Windows, MacOS, and Linux for x86. Download the appropriate version directly from the Balena Etcher downloads page[10] and install it.

1. **Insert SD:** Insert the SD card into the computer using your adapter if required.
2. **Open Balena Etcher.**
3. **Select Image:** With the "*Select image*" button, navigate to choose the compressed disk image file you downloaded, e.g., `WPSD_RPi-Trixie.img.xz`.
4. **Select Drive:** Select the SD card with the "*Select drive*" button, and choose the SD card you previously inserted into the computer.
5. **Flash:** Select the "*Flash*" button and allow the program to write the disk image to the SD card. The writing process may take a while, depending on the speed of the SD card, the speed of the computer, and the speed of the card reader
6. Balena Etcher will notify you when the writing and verifying process has finished. When complete, you may safely eject the SD card.

[8] <https://w0chp.radio/wpsd-faqs/>
[9] <https://www.maketecheasier.com/verify-md5-sha-1-sha-256-checksum-windows10/>
[10] <https://etcher.balena.io/#download-etcher>

3.2.2 Using Raspberry Pi Imager

Raspberry Pi Imager is available for Windows, MacOS, and Ubuntu for x86. Download the appropriate version directly from the Raspberry Pi downloads page[11] and install it.

1. **Insert SD:** Insert the SD card into the computer using your adapter if required.
2. **Open Raspberry Pi Imager.**
3. **Raspberry Pi Device:** A window will pop up where you may select the device to flash. At the top, choose *No Filter.*
4. **Choose OS:** A window will pop up where you may select the Operating System to flash. *Do not* choose one of the Raspberry Pi OSes; scroll nearly to the bottom and choose "Use custom." The tool will present you with a file chooser window where you may navigate to and choose the image you downloaded, e.g., `WPSD_RPi-Trixie.img.xz`.
5. **Choose Storage:** If you have inserted your SD card properly, it should show in the window.
6. **Advanced Options:** Pay special attention to either NOT create a user or use the `pi-star` user. Adding any other user with this tool will break WPSD.
    1. Press *Shift + Control + X* to bring up the OS Customization screen.
    2. Do not set a username and password. If you cannot deselect this option, uncheck *Enable SSH* on the *Services* tab. SSH will be available to you no matter what.

        > **Warning**
        >
        > The `pi-star` user and password are already on the disk image and are for many WPSD programs to function correctly. (You can change the "`pi-star`" user password from the WPSD configuration page *after* you first boot up WPSD.)

    3. *Configure wireless LAN:* Carefully type your local WiFi SSID and password. Select the appropriate Wireless LAN country, e.g., "*US*."
    4. *Set locale settings:* to whatever is correct for your local use.
    5. Scroll down to the "*Save*" button, and you will return to the original screen.
7. Select *Next* or *Write* and a pop-up will ask if you want to apply the customized settings. Select *Yes* and then *Yes* again to begin writing. The imager will take a few minutes to write and verify the image. When complete, you may safely eject the SD card.

You may insert the SD card into your SBC and continue to *Initial Startup*.

3.2.3 Debian / Ubuntu / MacOS

Using these tools is more advanced, and these instructions assume you are comfortable working at the command line.

You may use the `dd` command from the coreutils project to write the disk image file to the SD card. You must first decompress the .xz file, which can be piped into `dd` if desired.

[11] <https://www.raspberrypi.com/software/>

1. Open a terminal window and change the directory where you downloaded the compressed disk image file. Typically, this will be in `~/Downloads`.
2. Decompress the file using `unxz`, replacing `$IMAGE` with the file you downloaded.

```
$ unxz WPSD_$IMAGE.img.xz
```

3. Insert the SD card into the computer, and use `lsblk` to determine which device is the correct SD card.

```
$ lsblk
```

4. Write the disk image file to the SD card using `dd`. You may need to be root to do this or use `sudo`. Using `/dev/sda` as an example for your SD card:

```
$ dd bs=4M if=WPSD_$IMAGE.img of=/dev/sda
```

5. When the disk image writing process has finished, remove the SD card from the computer

4 Network Configuration

You have three network setup options:

1. Ethernet
2. Wi-Fi
3. Access Point Mode (“AutoAP”)

If you plan on using #1, simply connect your WPSD instance to Ethernet and move onto the next page/section. If you plan on using #3, move onto the next page/section. If you plan on using method #2, read this entire page/section...

4.1 Create WiFi configuration

If you used the Raspberry Pi Imager and followed the instructions for “Advanced Configuration,” you will not need to follow these steps.

An optional step you may perform before the initial startup of WPSD is creating the WiFi configuration file. Doing this step now can save some time during the initial configuration, but it is optional due to the AutoAP functionality built into WPSD.

W0CHP.radio has an official online tool that you can use to create this file, and you may find it here:

https://wochp.radio/wifi-config-generator/[12]

Fill in the SSID and PSK Passphrase fields, and select the country where your WiFi router operates. Click on the *Generate Config* button, and the WiFi configuration text will display on your screen. You may also download this file by clicking the *Download Config File* button above the generated text.

Important

You will need to select the Operating System you are running with WPSD (Trixie/Bookworm, Bullseye, etc.) when using the W0CHP WiFi configuration tool.

[12] <https://w0chp.radio/wifi-config-generator/>

4.1.1 Windows

1. Download the resultant WiFi configuration file to your computer.
2. Insert the SD card into the computer.
3. Windows should automatically open the File Explorer to the `/boot` volume.
4. Find the downloaded WiFi configuration file on your computer. You should be able to find it in your *Downloads* folder.
5. Either drag and drop or copy and paste the WiFi configuration file file onto the `/boot` volume of the SD card.
6. Optionally, right-click anywhere in the boot volume's white space and select New > Text Document. Name the file `ssh` and delete the `.txt` extension before you hit Enter. If Windows Explorer on your computer does not show file extensions, click *View* and *Enable File Name Extensions* in the menu bar.
7. Safely eject the SD card from your computer.

4.1.2 Linux / MacOS

1. Open a Terminal window.
2. Insert the SD card into the computer.
3. Use the `lsblk` command to find the SD card device.

> **Hint**
>
> The `/boot` volume should be the first partition on the SD card.

4. Mount the SD card's `/boot` volume to a folder your user can access.

> **Hint**
>
> You may need to create a new, empty folder before mounting the SD card.

5. Change the directory to the mounted volume.
6. Use a text editor (e.g., `nano`, `vi`, or similar) to create a new WiFi configuration file file.
7. Copy and paste the text from the *WPA / WiFi Configuration Generator* page into the file.
8. Save and Exit the text editor.
9. Unmount the SD card and remove it from the computer.

5 Initial Startup

You will have two paths here depending on whether you used the Raspberry Pi Imaging tool (or manually added a WiFi configuration file) to create your WiFi configuration.

5.1 If you created a WiFi Config

After approximately five minutes (possibly longer if you have a slower SBC,) your dashboard should be available at `http://wpsd.local` (or replace the hostname before the `.local` with your chosen name portion if you chose a different one.)

Note

- If you installed a ZumSpot disk image, the URL will be `http://zumspot.local`.
- If you installed a SkyBridge disk image, the URL will be `http://skybridge.local`.
- If you installed a DVMEGA Cast disk image, the URL will be `http://dvmega-cast.local`.
- If you installed a DVMEGA EuroNode disk image, the URL will be `http://dvmega-euronode.local`.

5.2 If you *did not* create a Wifi Config

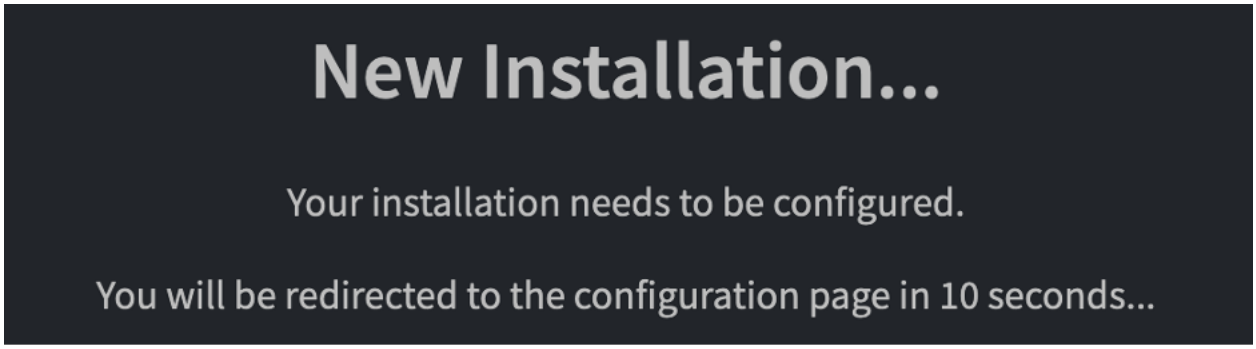
After approximately five minutes (possibly longer if you have a slower SBC,) you will see an available access point named `WPSD-Setup`. Connect your computer to this wireless network. Open your web browser and navigate to `http://wpsd.local/`. Scroll down to *Wireless Configuration* and select *Configure WiFi*.

Either *Scan for Networks* and select your local network and enter your PSK, or* Add New WiFi Network* and enter your SSID and PSK.

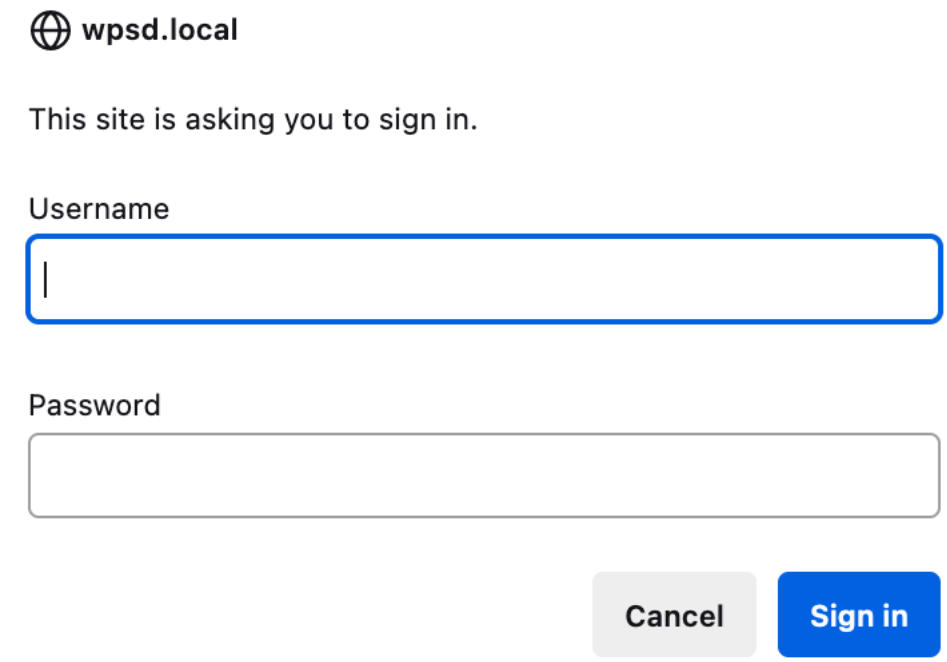
When you have entered the proper network data, you can then "`Connect`" WPSD to the new saved network. After a few minutes, your dashboard should be available at `http://wpsd.local` (or replace the hostname before the `.local` with your chosen name portion if you chose a different one.)

5.3 Initial Dashboard Access

On your first visit to the dashboard, you will notice that the system automatically redirects you to the *Configuration* page.

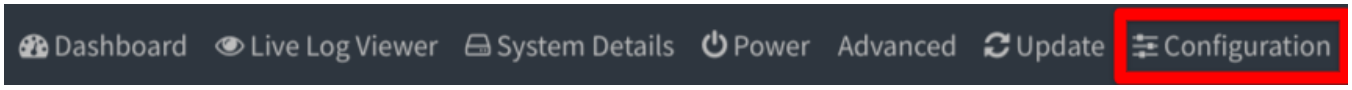


Again, on your first access, you will be prompted for your login credentials:



Your login name will be `pi-star`, and your initial password will be `raspberry`.

In the future, you can return to the *Configuration* page by clicking on the *Admin -> Configuration* link in the dashboard nav bar.



5.4 General Configuration

Important

You must apply changes you make on the Configuration page of WPSD by clicking the *Apply Changes* button on the configuration page floating top banner.

The General Configuration section sets up the basic operational information about your hotspot. You must fill in this information for proper operation.

This section is also the first you must complete during the initial startup of a new hotspot.

5.4.1 Simplex Hotspots / Nodes

Setting	Description
Hostname	The hostname for the hotspot on your network
Node Callsign	YOUR callsign, do not use anyone else's
DMR/CCS7 ID:	Required for DMR Mode (If you don't have one, get a DMR ID from RadioID.Net[13])
NXDN ID:	Required for NXDN Mode (If you don't have one, get a NXDN ID from RadioID.Net[14])
Radio Mode	Should be set to Simplex for a simplex hotspot board or single radio node
Radio Frequency	The frequency desired for operation with the hotspot
Radio / Modem Type	The type of hotspot radio board or modem installed on the SBC
Modem Baud Rate	The baud rate used for the SBC to communicate with the hotspot radio board
System Time Zone	The hotspot's local time zone. Time format may also be selected (12/24 hour)
Dashboard Language	The display language for WPSD
Update Notifier	Enable or turn off the automatic software notifications on the dashboard header. Does not affect automatic updates

[13] <https://radioid.net/account/register>
[14] <https://radioid.net/account/register>

5.4.2 Duplex Hotspots / Nodes

Setting	Description
Hostname	The hostname for the hotspot on your network
Node Callsign	The call sign of the hotspot over the air
DMR/CCS7 ID:	Required for DMR Mode (If you don't have one, get a DMR ID from RadioID.Net[15])
NXDN ID:	Required for NXDN Mode (If you don't have one, get a NXDN ID from RadioID.Net[16])
Radio Mode	Should be set to Duplex for a duplex hotspot board or repeater
Radio Frequency RX	The receive (uplink) frequency *to* the hotspot
Radio Frequency TX	The transmit (downlink) frequency *from* the hotspot
Radio / Modem Type	The type of hotspot radio board or modem installed on the SBC
Modem Baud Rate	The baud rate used for the SBC to communicate with the hotspot radio board
System Time Zone	The hotspot's local time zone. Time format may also be selected (12/24 hour)
Dashboard Language	The display language for WPSD
Update Notifier	Enable or turn off the automatic software notifications on the dashboard header. Does not affect automatic updates

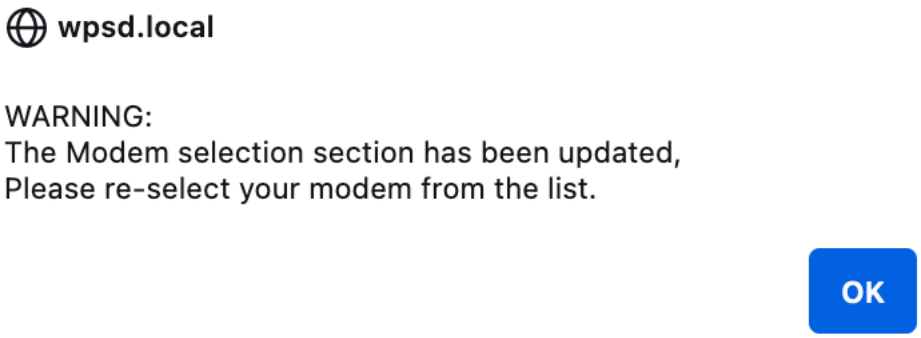
[15] <https://radioid.net/account/register>
[16] <https://radioid.net/account/register>

Important

Please note that the duplex frequencies are for the *modem*, not your radio. In other words, the radio's TX frequency should be the modem's RX frequency and vice versa.

5.5 No Modem

If you have yet to select a modem type or the choices have changed, the web page may prompt you to (re) choose one.



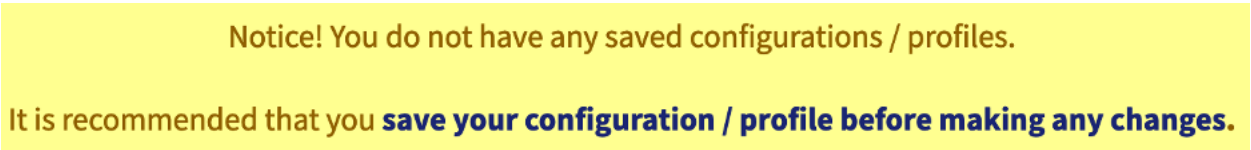
Hint

If yout need to determine the modem type you have installed, run the following command in SSH then select the modem displayed in the result:

```
sudo wpsd-detectmodem
```

5.6 No Profile

At some point, you will see a banner on the top of the screen prompting you to save your profile:



Follow the link provided, or navigate to to the dashboard, and click the *Profiles* button. Give your profile a descriptive name. Be aware that non-alphanumeric characters are not permitted. Spaces are allowed.

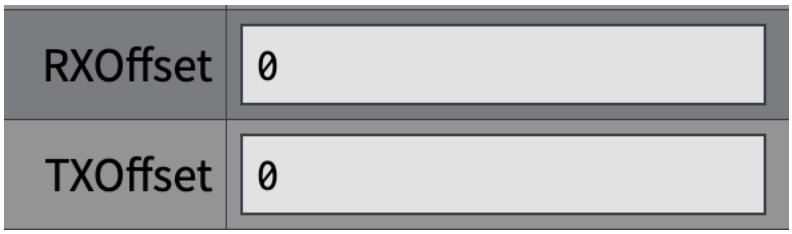
Todo

Create a section/page/etc. on creating, managing, deleting profiles and how/when/why to use them

5.7 Radio Offset

Your modem supplier may have included documentation about the radio offset. This information is on the underside of the case or the documentation that came with the modem.

Navigate to: *Advanced* -> *Quick Editors* -> *MMDVMHost*. Scroll to the *Modem* section and enter your RXOffset and TXOffset in the appropriate fields.



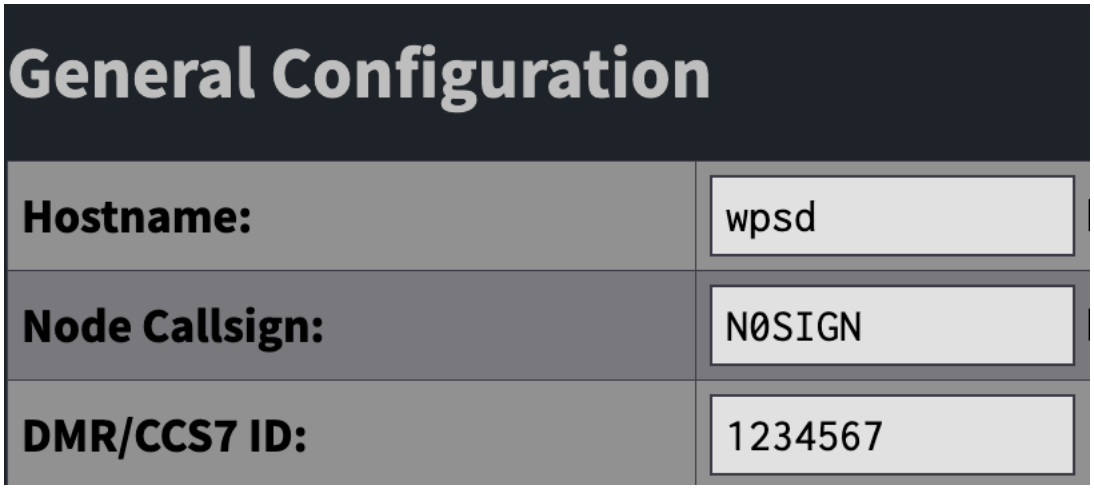
6 Configuring for Digital Voice Modes

Configuring WPSD for a particular mode seems trivial to an experienced user. If you are that user, you may bypass this page; there are no epiphanies to receive here. Read on if you are not experienced and need a step-by-step to give you a springboard into digital radio.

The digital radio you own will largely determine your choice of mode. You may jump to the mode you are interested in on the right.

6.1 DMR

To begin, enter your DMR/CCS7 ID in the *General Configuration* section on the configuration page if it was not auto-populated based on your entered callsign. If you do not have a DMR ID, register for one at RadioID.net[17].



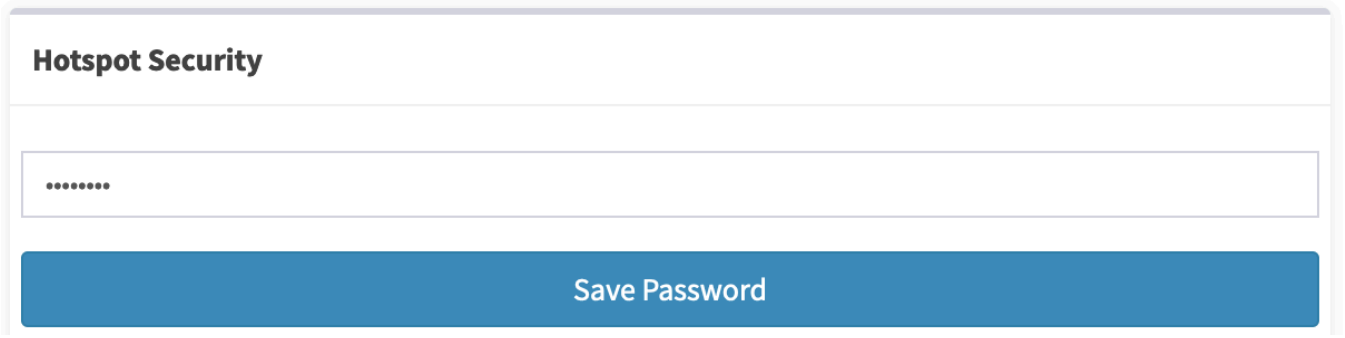
Next, in the *MMDVMHost Modem Configuration* section, toggle DMR mode on:

[17] <https://radioid.net/account/register>

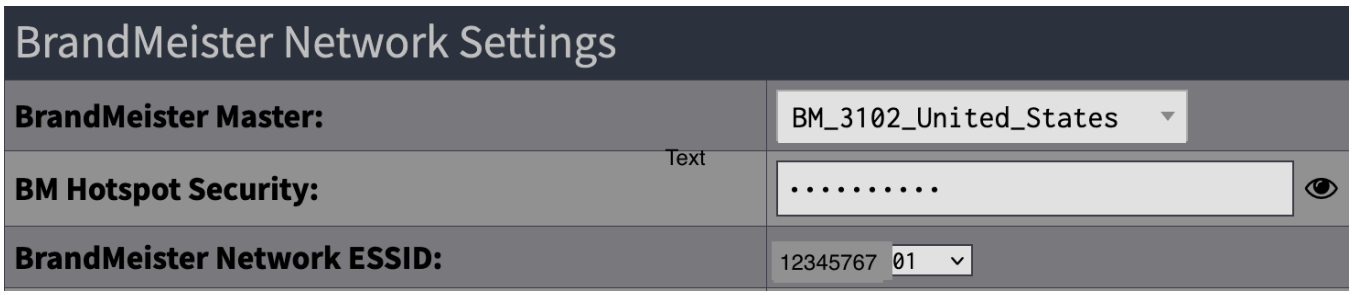
Apply Changes to save the configuration. After the hotspot re-starts and the page returns, scroll to the *DMR Configuration* section.

You must now configure a DMR Network. For this exercise, we will be connecting to the BrandMeister DMR Network...

First, at the BrandMeister website[18], register, and in the Self-care[19] section, create a *Hotspot Security* password.



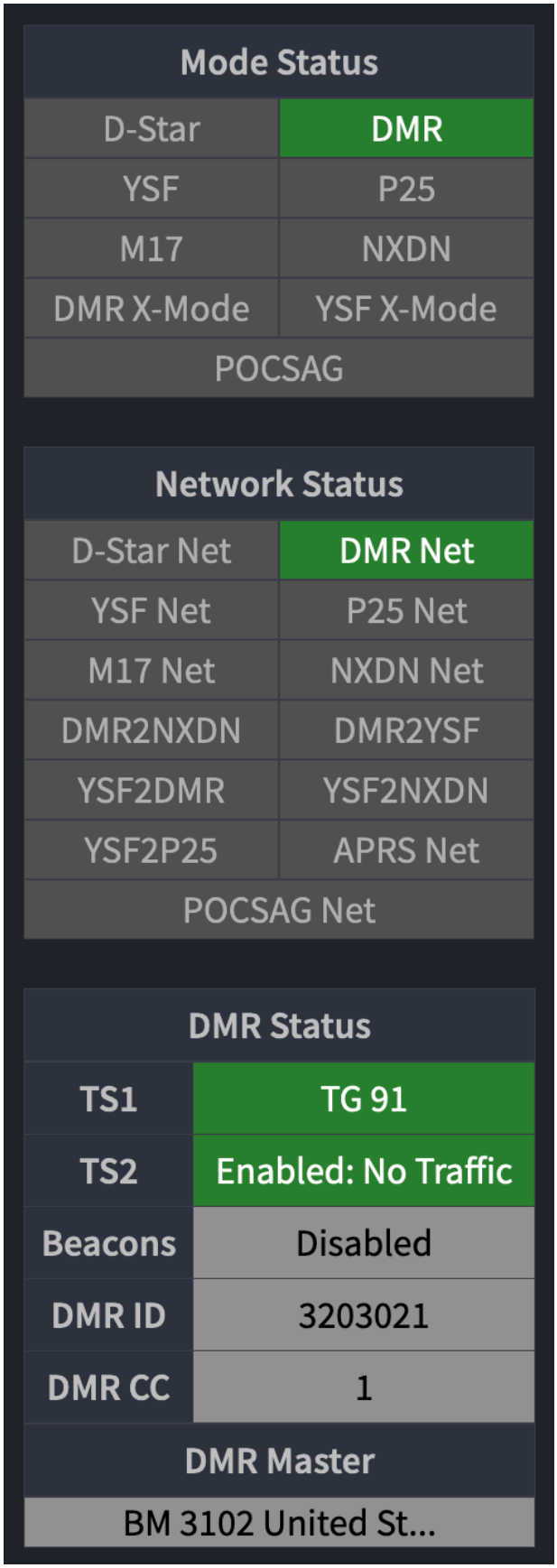
Save this password somewhere secure, and scroll to the *BrandMeister Network Settings*.



Select the *BrandMeister Master* that is appropriate for you. In this case, I will select *BM_3102_United_States*. Enter the *BM Hotspot Security* password you created on the BrandMeister website. Your DMR ID will populate the *BrandMeister Network ESSID* section, and in default cases, there is no reason to change the extended ID. Ensure *BrandMeister Network Enable* is toggled on and *Apply Changes*.

If you have followed the instructions correctly, on your *Dashboard* in *Mode Status*, you should see *DMR* green; in *Network Status*, you should see *DMR Net* green. Below that, in *DMR Status*, you should see your *TS1* and *TS2* green; one should show a connection to a talk group.

[18] <https://brandmeister.network/>
[19] <https://brandmeister.network/?page=selfcare>


Mode Status
D-Star
DMR
YSF
P25
M17
NXDN
DMR X-Mode
YSF X-Mode
POCSAG
Network Status
D-Star Net
DMR Net
YSF Net
P25 Net
M17 Net
NXDN Net
DMR2NXDN
DMR2YSF
YSF2DMR
YSF2NXDN
YSF2P25
APRS Net
POCSAG Net
DMR Status
TS1
TG 91
TS2
Enabled: No Traffic
Beacons
Disabled
DMR ID
3203021
DMR CC
1
DMR Master
BM 3102 United St...

You have completed configuring your hotspot for DMR mode on the BrandMeister network. Continue to *Zero to Hero* for information about setting up your radio the first time.

Tip

You can connect to multiple DMR networks simultaneously. For more information, see DMR Operation and Functionality to read about advanced DMR operations.

6.2 D-Star

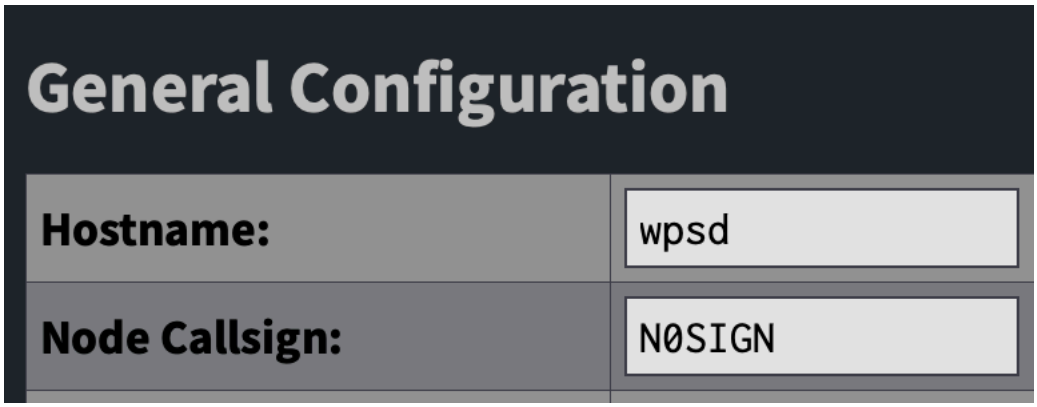
D-Star is is an open standard digital voice and data protocol developed by the Japan Amateur Radio League. It is supported by numerous popular and recent ICOM, Kenwood, and Flex radios, notably excepting the ICOM IC-7300.

To begin, register your callsign with the D-Star system, if you have not already done so. It is preferable to register with your nearest D-Star repeater, but you can also register here https://regist.dstargateway.org/instructions/. There are two steps to D-Star registration:

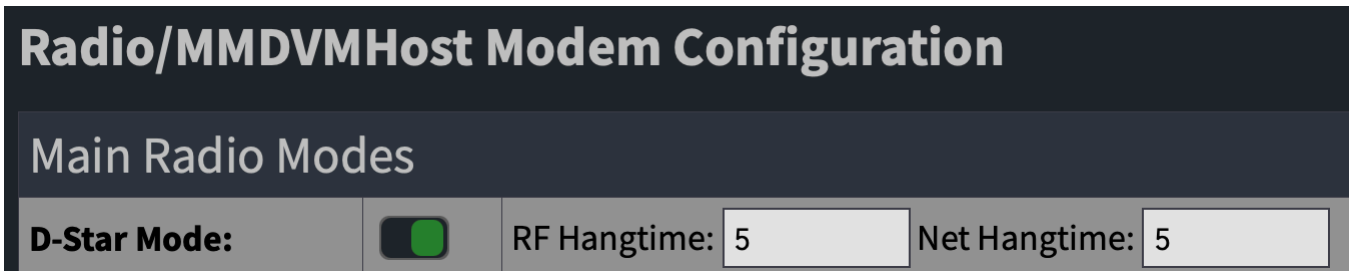
```
1. Register at your local repeater or the main D-Star website
2. Activate your callsign in the D-Star system
```

If you have already registered with D-Star to use your other radio(s), you do not need to register again to use WPSD on D-Star.

Make sure your WPSD node is configured with your callsign:

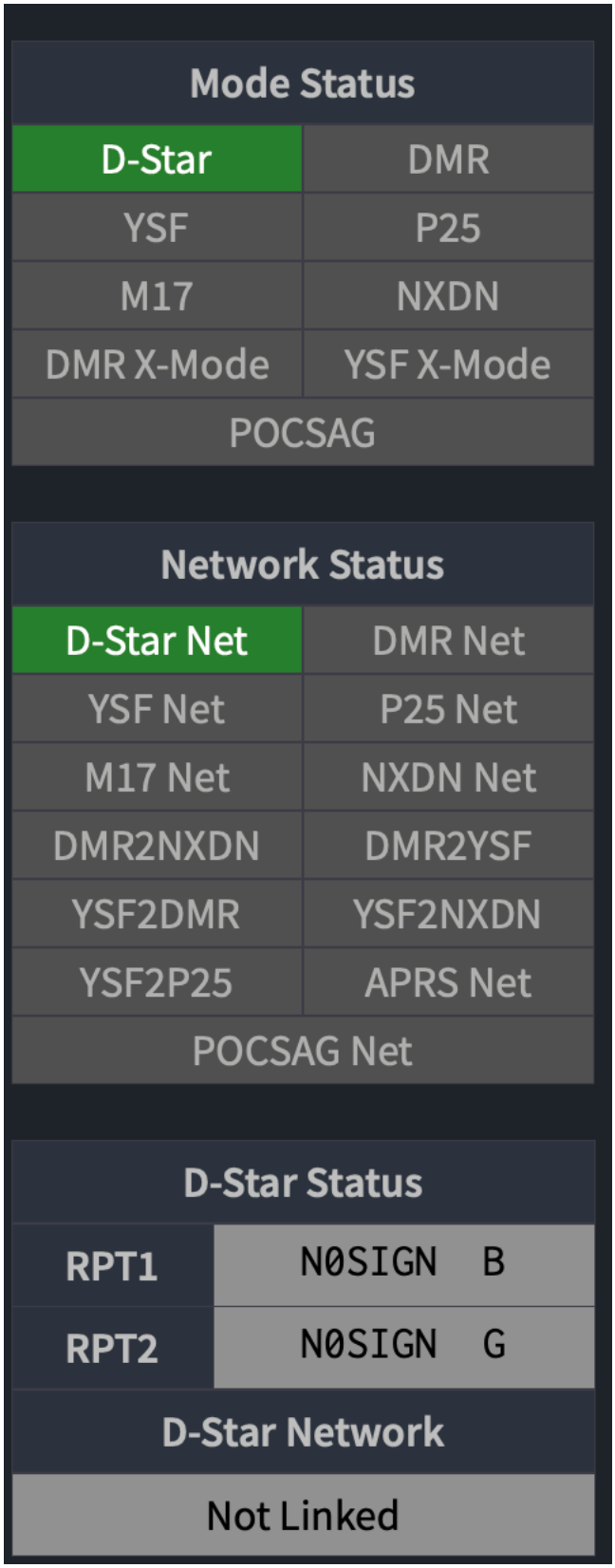


To use D-Star on WPSD, in the *MMDVMHost Modem Configuration* section, toggle D-Star mode on:



Apply Changes to save the configuration. After the hotspot re-starts and the page returns, scroll to *Yaesu System Fusion Configuration*.

If you have followed the instructions correctly, on your *Dashboard* in *Mode Status*, you should see *D-Star* green; in *Network Status*, you should see *D-Star Net* green. Below that, in *D-Star Status*, you should see that your node *RPT1* as your callsign followed by the letter "B" (e.g., *NOSIGN B*), and *RPT2* as your callsign followed by the letter "G" right-aligned (e.g., *NOSIGN G*). The status should also show *D-Star Network* as *Not Linked*.



The D-Star configuration parameters should be automatically configured here:

You have completed configuring your hotspot for D-Star mode on the D-Star network. Continue to *Zero to Hero* for information about setting up your radio the first time.

Tip

When configuring your radio to access a single-radio (simplex) WPSD node, make sure to set *DUP+* or *DUP-* with an offset of *zero* (0). Turning DUP 'off' does not work because ICOM radios expect D-Star to be used only on repeaters and that repeaters always use DUP+ or DUP-, even with an offset of zero. If you turn DUP 'off', the radio thinks you are not talking to a repeater and thus it will not use D-Star.

6.3 YSF

Yaesu System Fusion is proprietary to Yaesu radios. Example Yaesu devices supporting Fusion are:

Handheld

- FT-5DR
- FT-70DR

Mobile

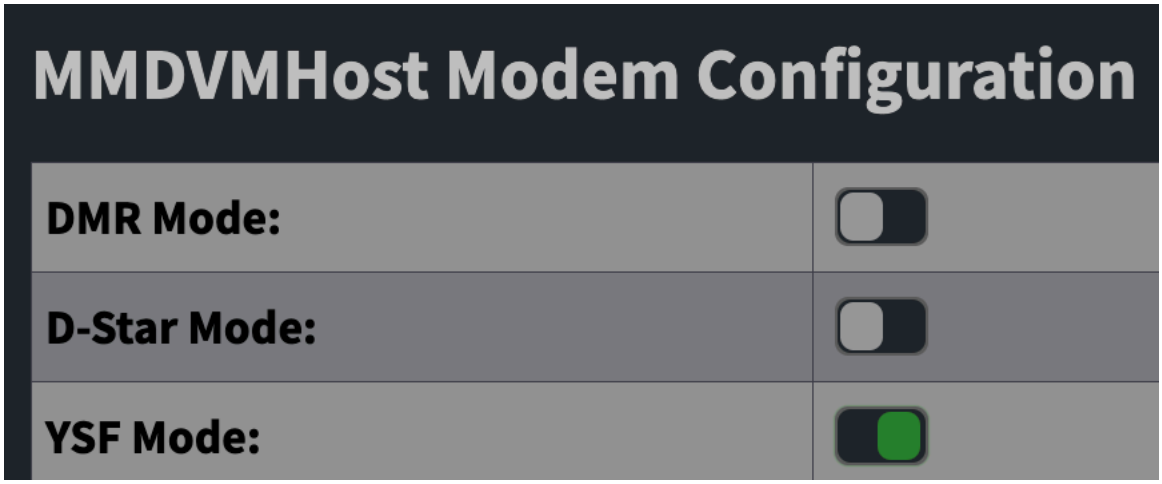
- FTM-500DR
- FTM-300DR
- FTM-200DR

Base

- FT-991A

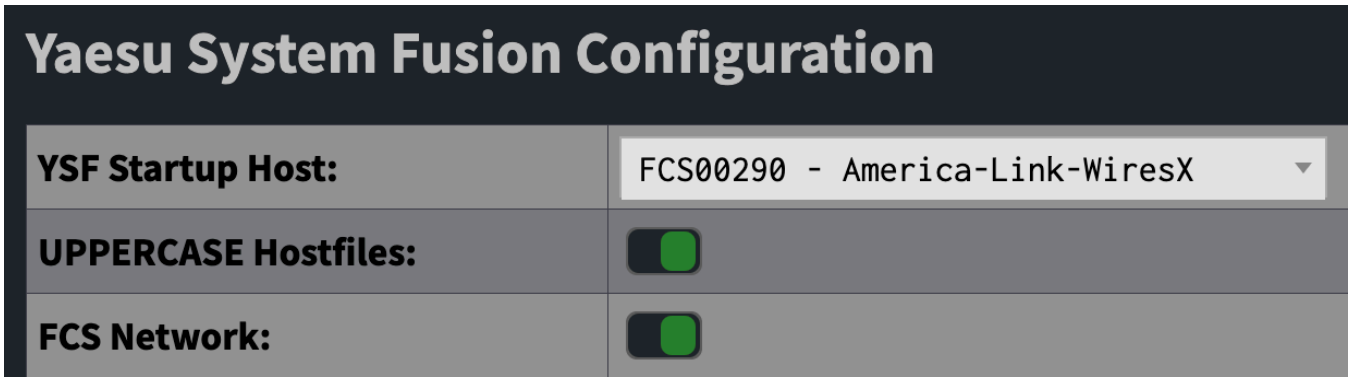
There are other models still available that support Fusion as well.

To begin, in the *MMDVMHost Modem Configuration* section, toggle YSF mode on:



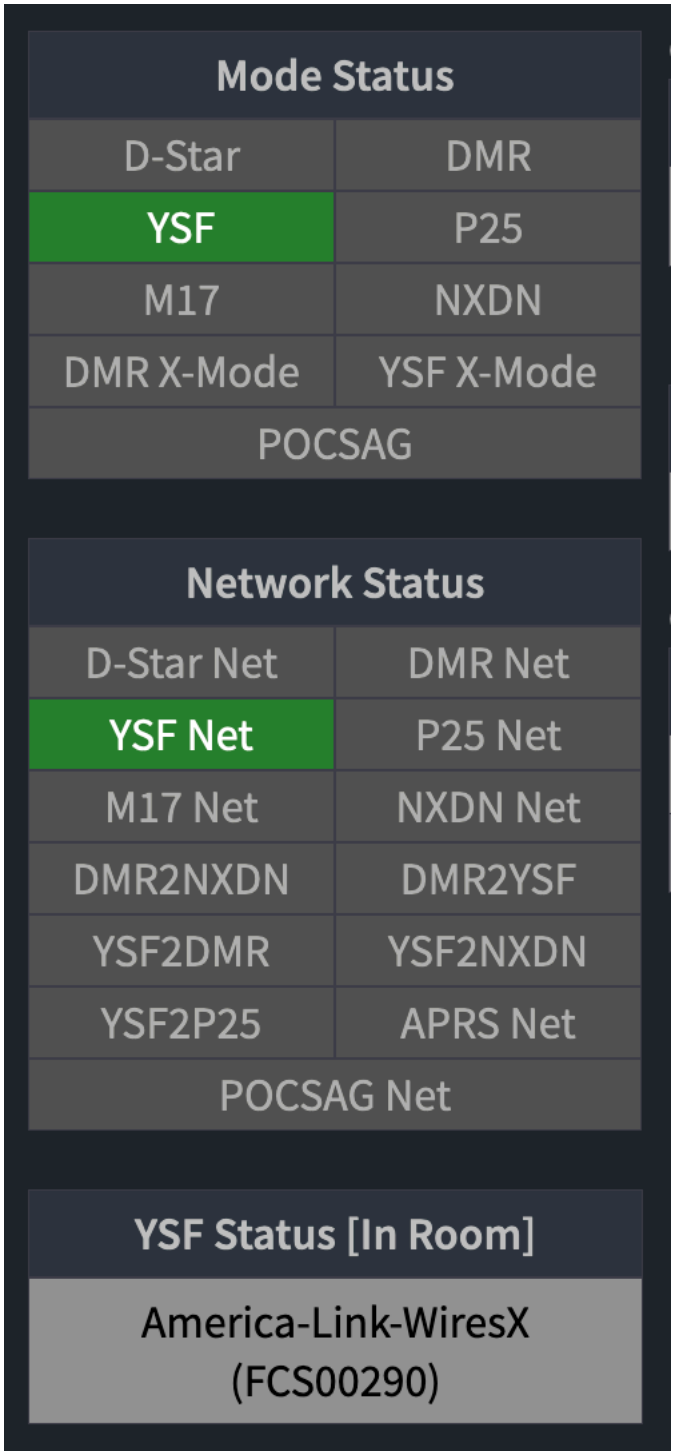
Apply Changes to save the configuration. After the hotspot re-starts and the page returns, scroll to *Yaesu System Fusion Configuration*.

Set a *YSF Startup Host*. In this example, I will set "FCS00290 - America-Link-WiresX", but you may choose any other.



Leave *UPPERCASE Hostfiles* and *FCS Network* toggled on. You need not make any other changes in this section. *Apply Changes* to save the configuration.

If you have followed the instructions correctly, on your *Dashboard* in *Mode Status*, you should see *YSF* green; in *Network Status*, you should see *YSF Net* green. Below that, in *YSF Status*, you should see that you are in a room (such as America-Link-WiresX).



You have completed configuring your hotspot for YSF mode on the Fusion network. Continue to *Zero to Hero* for information about setting up your radio the first time.

6.4 P25

Todo

Volunteers needed to provide instructions specific to P25 mode.

6.5 NXDN

Todo

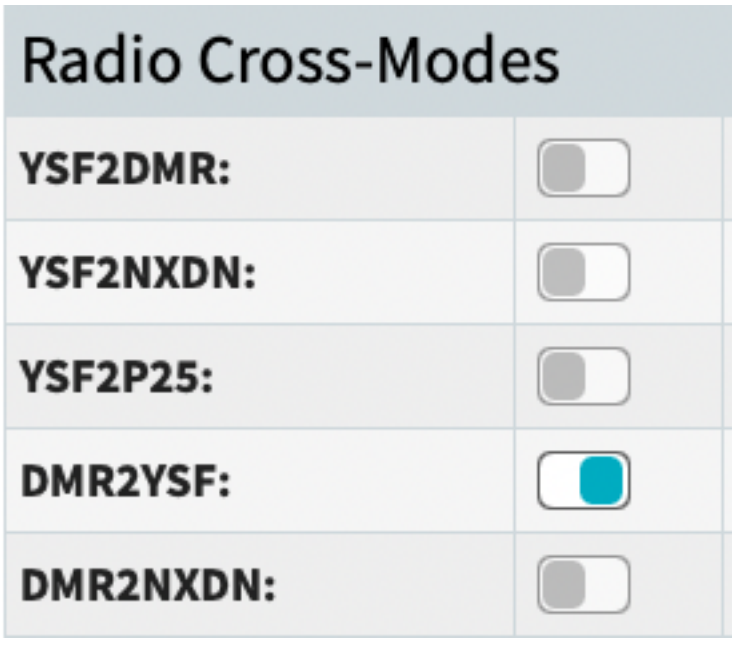
Volunteers needed to provide instructions specific to NXDN mode.

6.6 DMR2YSF

Yaesu System Fusion (YSF), and particularly Wires-X, is proprietary to Yaesu radios however DMR2YSF allows access to the open parts of YSF via your DMR radio.

6.6.1 Configuration

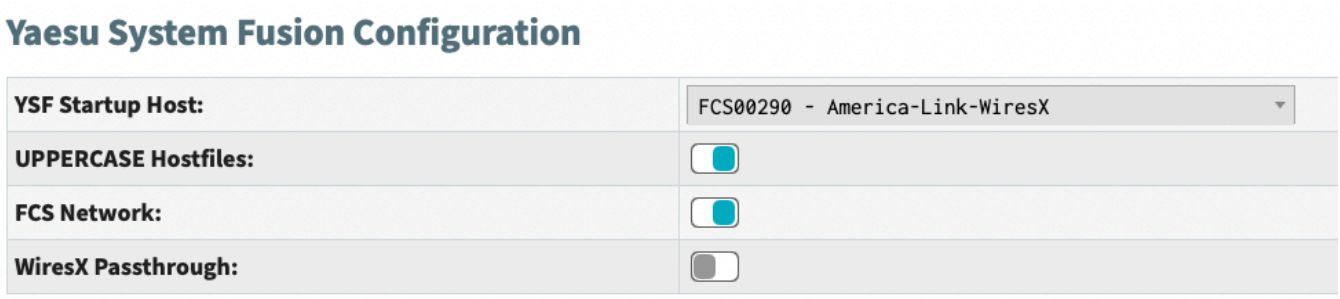
To begin, in the *MMDVMHost Modem Configuration* section, make sure you have DMR enabled, then toggle DMR2YSF mode on:



Apply Changes to save the configuration. After the hotspot re-starts and the page returns, scroll to *Yaesu System Fusion Configuration*.

Set a *YSF Startup Host*. This sets a YSF or FCS reflector that will be connected to when the system starts. This example sets it to "FCS00290 - America-Link-WiresX", but you may choose any other. It might be a good idea to

set this to “None” and then use the *YSF Manager* (as detailed below) to connect when desired.



Leave *UPPERCASE Hostfiles* and *FCS Network* toggled on. You need not make any other changes in this section. *Apply Changes* to save the configuration.

If you have followed the instructions correctly, on your *Dashboard* in *Mode Status*, you should see *DMR X-Mode* green; in *Network Status*, you should see *DMR2YSF Net* green. Below that, in *YSF Status*, you should see that you are in a room (such as America-Link-WiresX).

Mode Status	
D-Star	**DMR**
YSF	P25
NXDN	POCSAG
DMR X-Mode	YSF X-Mode

Network Status	
D-Star Net	**DMR Net**
YSF Net	P25 Net
NXDN Net	POCSAG Net
DMR2NXDN	**DMR2YSF**
YSF2DMR	YSF2NXDN
YSF2P25	APRS Net

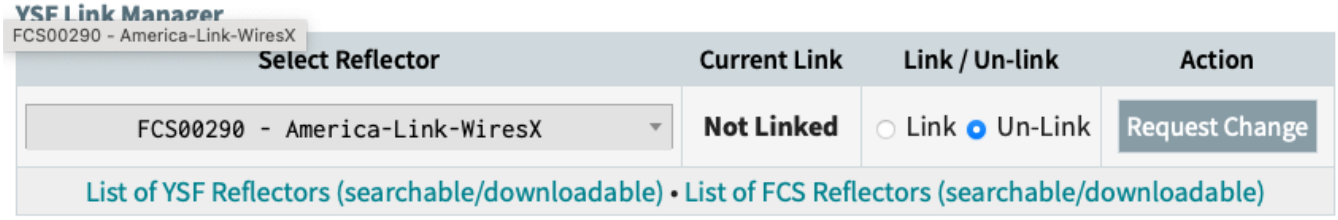
DMR Status	
TS1	**Enabled**
TS2	**Enabled**
DMR ID	5051326
DMR CC	1
DMR Masters	
DMR+ IPSC2-VKHOTSPOT	
DMR2YSF Cross-Mode	

YSF Status [In Room]
America-Link-WiresX (FCS00290)

You have completed configuring your hotspot for DMR2YSF mode.

6.6.2 Unlinking or changing reflectors via the web dashboard

Once you have DMR2YSF configured you can manage which reflector you are connected to via the **YSF Manager**. To find the YSF Manager click on **Admin** on the top right of the Dashboard then clock on **YSF Manager** from the boxes below.



6.6.3 Unlinking or changing reflectors via your DMR radio

Linking and unlinking reflectors from your DMR radio is supported however the system gives you no audio feedback so it can be a bit confusing to use.

To start, make sure you are not linked to a default reflector via the dashboard. Select `None` as the reflector in the YSF Configuration section of the Configuration page.

To **unlink** a reflector send a kerchunk to `TG 7000000`. This may take a couple of tries. There is no audio feedback, so the only indication that you have successfully unlinked will be via the web dashboard.

To **link** to a YSF reflector send a kerchunk to `TG 70xxxxx` where `xxxxx` is the zero padded reflector number. For example, to connect to **GB-CQ-WORLD** use `TG 7000013`. There is no audio feedback, so the only indication that you have successfully linked will be via the web dashboard.

Important

While YSF reflectors have a consistant numbering scheme and map into DMR talkgroups cleanly, FCS reflectors are different and *don't* map cleanly making them difficult to reliably access.

Linking to a FCS reflector is possible but the exact talkgroup to use is arbitrary and may change every time the FCS reflector list is changed. If you want to connect to an FCS reflector, it's almost certainly best to use the web dashboard.

6.6.4 Talking via the connected reflector

To talk to a YSF reflector, use `TG 70xxxxx` where `xxxxx` is the zero padded reflector number. For example, to talk on **YSF00013, GB-CQ-WORLD** use `TG 7000013`.

For FCS reflectors the easiest option is to watch on the web dashboard for someone already talking on the reflector and see what talkgroup they appear on, then set your radio to use that talkgroup. For example, at the time of writing **FCS00290, America-Link-WiresX** comes though on `TG 7000290`.

Important

If you have a duplex hotspot, all of the above talkgroups use timeslot **2**.

7 Zero to Hero

Or: How to get your first "beep"

Since some hams approach this project as their first digital experience, I want to present some work plans that will take you from unboxing, to that first "beep" when your radio connects (as opposed to the "boop" when it does not.) There is a world beyond just that beep, but sometimes getting off the starting block is less than straightforward.

This page will be the nexus for those work plans, as they are developed. Each page is written around a specific radio. Often, the instructions will also hold for others with the same mode or manufacturer. These will be noted as they are identified.

7.1 Specific Radios:

7.1.1 Zero to Hero: Anytone AT-878UVII

The radio I used for this was the Anytone AT-878UVII, but the 868UV and the UVII-Plus version should be the same. A lot of this applies to DMR radios in general. Their operation confuses people who may be more familiar with "select a frequency, get contact" methods.

There are several parts that you must set up correctly for everything to work the way you want it to.

You may have heard the term CPS, "Code Plug Software." Before discussing CPS, *read what a code plug is*.

Hold your Horses (USB)

DO NOT PLUG THE USB CABLE INTO YOUR COMPUTER YET. You won't thank me now, but you would undoubtedly cuss me later if I did not warn you.

Start from Zero

I have detailed these instructions starting from a factory-clean reset. You can easily be confused by partially setting items and setting others incorrectly. If you are new at this, do yourself a favor and do a factory reinitialization.

Turn the radio off, hold down the PTT and P1 (just under the PTT) buttons, and turn the radio on. Do not release the buttons until you see:

> "Are you sure you want to initialize radio?"

Press the green button to confirm.

Allow the radio to reset itself and "Confirm" the date without setting it. Do yourself a second favor by not doing additional customization until later, so you do not feel bad about wiping it out with another reset if you mess things up.

Before anyone rushes to argue about wiping their radio, if you're already "moved in" with local channels, follow the instructions through the next three steps to "Import Intial Code Plug." Save that as your backup, and then come back here and "Start from Zero." Once you know what you are doing, you can re-load your backup and try adding your Hotspot setup.

Install USB Driver

This step is where people who did not heed my advice will have gone wrong. Some computers already have the proper drivers for the USB cable. It will not hurt to follow these instructions either way.

Many USB cables made to interface with devices have a small chip inside the USB plug, called an FTDI interface. FTDI is a product of *Future Technology Devices International* and many suppliers use these chips in their cables.

Virtual COM port (VCP) drivers cause the radio attached to the USB cable (via the FTDI chip) to appear as an additional COM port available to the computer. The CPS can access the radio in the same way as it would access a standard COM port. Go to the FTDI site and download the Virtual COM Port[20] drivers. Open the archive in Windows and execute the `CDM212364_Setup.exe` installer within. Complete the installation and return here.

Install the CPS

Turn on your radio and go to Menu -> Settings -> Device Info. Scroll down to see your firmware version.

Download the Code Plug Software from Bridgecom's wesbite[21]. At the time of this writing, the most recent is "AnyTone AT-D878UVII PLUS - CPS V3.02 & Firmware V3.02," but you should download the version corresponding to the firmware on your radio. Right-click the archive and select "Extract all." Open the new folder, which is likely similar to `D878UVII PLUS Vn.nn official release nnnn`.

Open the folder with "CPS" in the name, such as `D878UVII Vn.nn CPS nnnnnn`. Execute the installer within, complete the installation, and return here.

Import Intial Code Plug

Plug your cable into your radio, and plug the USB into the computer. Turn the radio on and allow it to finish booting. Run the CPS, which is likely available as an icon on your desktop named "D878UVII_*n.nn*."

- Menu -> Set -> Set COM: There should only be a single COM port listed. If there is more than one, unplug all peripherals from your computer except for the Radio connected to the USB cable.
- Program -> Read From Radio
- When the CPS finishes reading, File -> Save and navigate somewhere you can remember. Save the initial CPS as something descriptive like `D878UVII_Stock`.

We'll now proceed with the creation of your new code plug.

[20] <https://ftdichip.com/drivers/vcp-drivers/>
[21] <https://support.bridgecomsystems.com/anytone-878-v2-model-cps-firmware-downloads>

Create New Code Plug

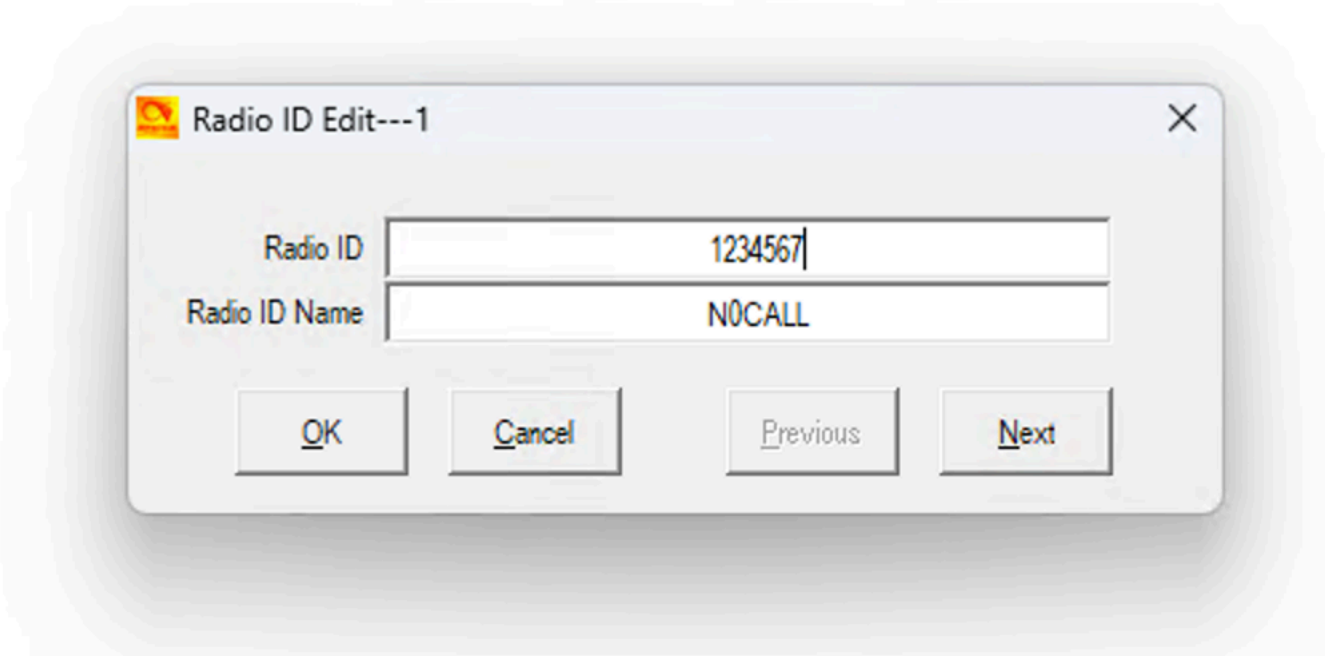
We'll follow these steps in order:

1. Create Radio ID
2. Import Talkgroups
3. Create Channels
4. Create Zones

The order here is important. If you know enough to argue with that, you know enough to skip my instructions.

Radio ID

First, you must add your radio ID so the network will know who you are. In the tree on the left, expand *Digital* and then select Radio ID List. You can have multiple IDs here, but we will use just one. Double-click on the *1* in the "No." column.



Change the Radio ID to the ID you were given previously on RadioID.net and that which you entered on your WPSD configuration page. Change the Radio ID Name to your callsign.

Create Talk Groups

Rather than creating Talk Groups from scratch, we will import them. The defacto DMR network for PTT talkgroup activation is BrandMeister, and the easiest way to get them all is to download them already in the Anytone format from the WPSD website[22]. Download the AnyTone Contact TG Format file[23]; it is updated daily.

After downloading the file:

- Select Tool -> Import.

[22] <https://w0chp.radio/brandmeister-talkgroups/>
[23] <https://w0chp.radio/brandmeister-talkgroups/BM-TGs_Anytone-Format.csv>

- Click the Talk Groups button.
- Navigate to and select the downloaded `BM-TGs_Anytone-Format.csv` file.

Once the import is complete, select the Contact/Talk Groups section and view the list.

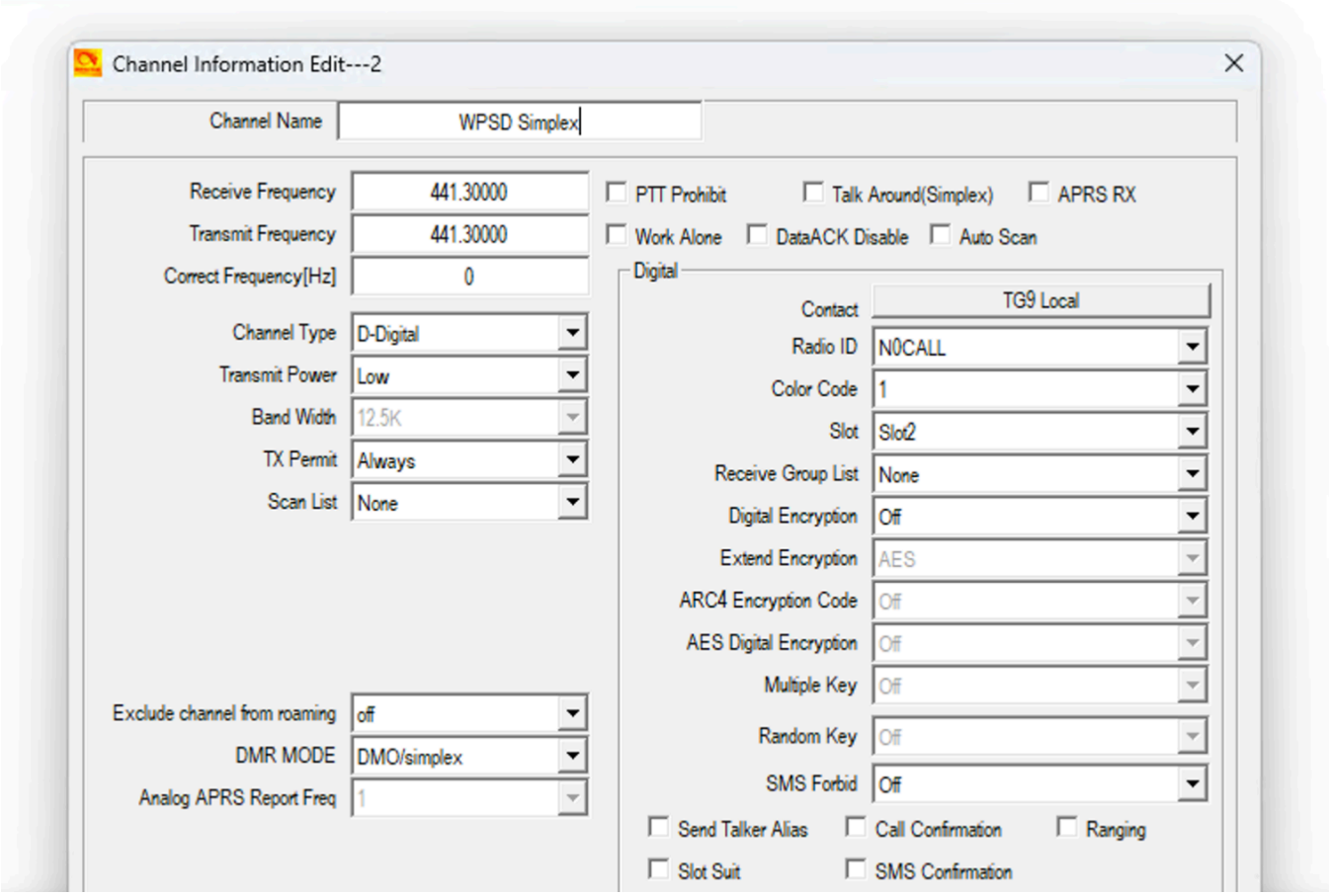
Create Channels

A channel is where we finally start getting into more familiar territory. In the *Common Settings* section, open *Channel*. Here, you can see some default channels or none at all. Before hurrying to program anything else, bear with me and slow down. Delete your channels by right-clicking and selecting "Delete" on the lines that are there.

Double-click in the "No." column on *1*. You have two ways to set this up depending on whether you have a simplex or duplex hotspot.

Simplex Hotspots

1. **Channel Name:** Give it any name you like. In this example, we will use "WPSD Simplex."
2. **Receive/Transmit Frequency:** Use whatever frequency you applied to your hotspot.
3. **Channel Type:** Set this to Digital.
4. **Transmit Power:** Generally, this is set to "Low," especially if you are in the same room as your hotspot.
5. **DMR Mode:** Leave this on DMO/Simplex.
6. **Digital Settings:**
    1. **Contact:** Click the button to display the talk groups you imported earlier. Scroll to the bottom, then up a few lines, and you will see "TG9 Local." Double-click on that, and the button will change to "TG9 Local."
    2. **Radio ID:** Select the Radio ID Name you set up previously.
    3. **Color Code:** Leave this on *1*.
    4. **Slot:** Set this to *Slot2*.



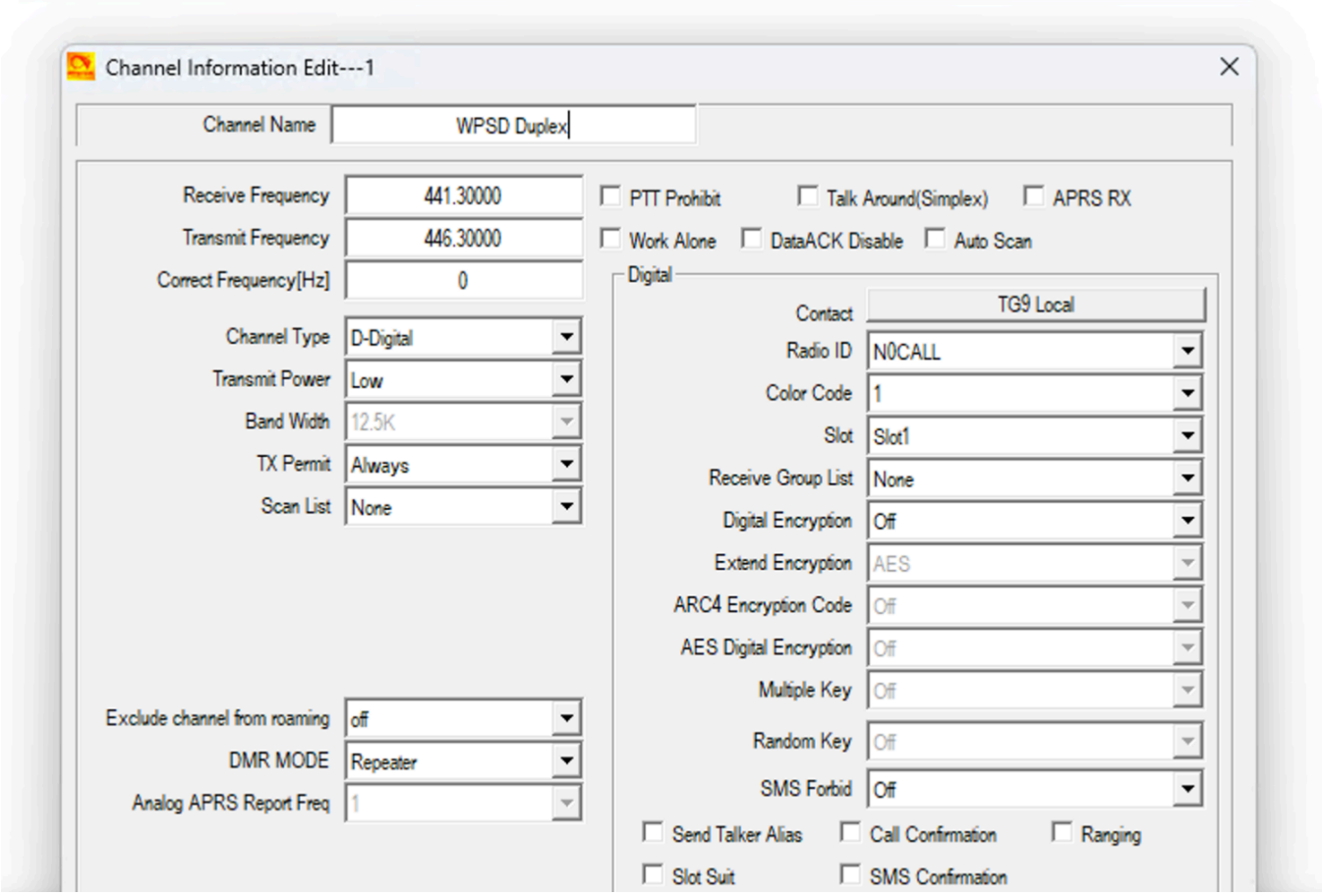
Leave the rest on defaults and click *Ok*.

Duplex Hotspots

1. **Channel Name:** Give it any name you like. In this example, we will use “WPSD Duplex.”
2. **Receive Frequency:** Use whatever frequency your hotspot is set to use on *transmit**.
3. **Transmit Frequency:** Use whatever frequency your hotspot is set to use on *receive**.

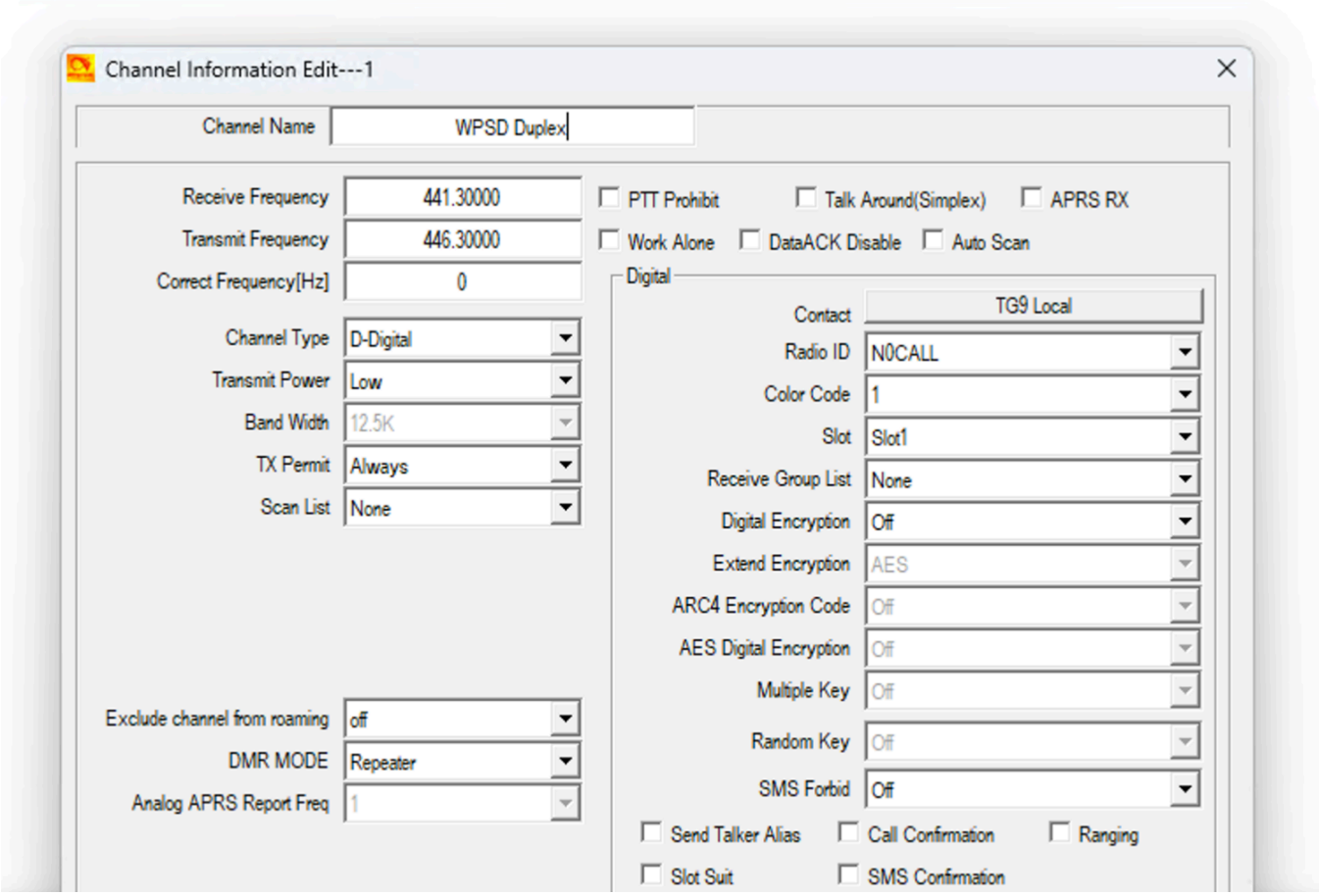
   * *Make sure these frequencies are the opposite of how you set your hotspot.*
4. **Channel Type:** Set this to Digital.
5. t **Transmit Power:** Generally, this is set to “Low,” especially if you are in the same room as your hotspot.
6. **DMR Mode:** Change this to “Repeater.”
7. **Digital Settings:**
   1. **Contact:** Click the button, and the talk groups you imported earlier will be displayed somewhat haphazardly. Scroll to the bottom, then up a few lines, and you will see “TG9 Local.” Double-click on that, and the button will change to “TG9 Local.”
   2. **Radio ID:** Select the Radio ID Name you set up previously.
   3. **Color Code:** Leave this on 1.

4. **Slot:** Set this to *Slot1*.



Create Zones

1. Again in *Common Settings* select *Zone*.
2. Double-click in the “No.” column on *1*.
3. There should only be one channel on the left side. Highlight and move it to the right with the “»” button.
4. Click “Ok” to finish.



Save Your Code Plug

File -> Save and navigate somewhere you can remember. Save your new CPS as something descriptive like `D878UVII_Hotspot`.

Load Your Code Plug

Now, load up your new code plug: Program -> Write to Radio. Once you have finished, and assuming you have followed the instructions in other sections correctly, you should be able to connect to your hotspot.

Disconnect your radio from USB, and if you followed the instructions to start with no other entries, you should be able to connect to your hotspot on *TG9 Local*. If you'd like to test without bothering anyone else, select *Menu*, *Talk Group*, *Manual Dial*, and enter *310997*. This talk group is a special one called a *Parrot*. If you key up and speak, you should hear your voice back after a moment when you release the PTT.

You may use this method to connect to any other talk group by direct dial or use the *List* button to scroll through all the talk groups and find an interesting one.

Other Networks

Want to get into networks like FreeDMR, TGIF, and others? Build on what you've learned here and see where it takes you.

Special Thanks, by AA0NT

I do want to give thanks to Mike W2FBI for his help translating the past part of the Monolith that I was staring at like a monkey. It was ONE step, but I have to admit that, sadly, it took me several days to get past it the first time. DMR radios are very much a "once you know, you know" thing, but it looks pretty convoluted to most newcomers.

7.1.2 Zero to Hero: Yaesu FT5DR

The radio I used for this was the Yaesu FT5DR, but there may be enough similarities to allow you to use these instructions with many of the contemporary Yaesu Digital handhelds.

There are several parts that you must set up correctly for everything to work the way you want it to.

You may have heard the term CPS, "Code Plug Software." Before discussing CPS, *read what a code plug is*. I own and use RT Systems, Inc. "YPS-FT5D Programming Software Only for the Yaesu FT-5DR radio[24]." This tutorial will use that software for the examples, but other products should be similar. Generally, Yaesu and the software for it do not use the term Code Plug, but you should know what it is. A single entry on your radio in Yaesu-speak is a "Channel."

According to RT Systems: "*The Programmer cannot make the radio do anything that it cannot do from the face of the unit. It makes it easier to set options for the existing functions.*" This statement is accurate; however, managing solely from the radio will quickly become cumbersome.

I have borrowed some sections of this tutorial from the FT5DHelp Programmer Help PDF[25] from RT Systems. See that document for more good information.

Hold your Horses (USB)

DO NOT PLUG THE USB CABLE INTO YOUR COMPUTER YET. You won't thank me now, but you would undoubtedly cuss me later if I did not warn you.

Install USB Driver

This step is where people who did not heed my advice will have gone wrong. Some computers already have the proper drivers for the USB cable. It will not hurt to follow these instructions either way.

Many USB cables are more than just cables; they have circuitry to assist with interface tasks. The RT Systems cable is one such cable. Virtual COM port (VCP) drivers cause the radio attached to the USB cable to appear as an additional COM port available to the computer. The CPS can access the radio in the same way as it would access a standard COM port.

To use this cable under Windows or MacOS, please install the driver on their support page[26].

Other cables may work; I will not address them here. You should have received a genuine cable when you purchased the software.

[24] <https://www.rtsystemsinc.com/YPS-FT5D-Programming-Software-Only-for-the-brYaesu-FT-5DR-radio_p_1978.html>
[25] <https://www.rtsystemsinc.com/assets/images/ProgrammerHelpPDF/FT5DHelp.pdf>
[26] <https://www.rtsystems.us/drivers/>

Install the RT Systems Programming Software

Install the software as indicated by the supplier. If you need assistance with the software, please see RT Systems' Support Pages[27]. They also have a Knowledge Base[28] as well as a selection of How To Videos[29].

Import Intial Program

It is always a good practice to import and save your existing setup from the radio before beginning with additions. This process allows you to return to a known state if you mess something up.

Open the application. Your last code plug may be visible if you have previously used the application. Start with what is in your radio now: Close the tab on your former code plug and select File > New for a blank slate.

From the menu, select Communications> Get data from radio. Next:

1. Plug the RTSystems USB-68 or the Yaesu SCU-18/19 cable into the DATA jack on the side of the radio.
2. Press and hold the [Fmenu] while turning the radio on.
3. Verify the radio displays CLONE.
4. Click the OK button.
5. Press and release the SEND button to begin the transfer.

After a couple of minutes, the application will finish transferring the data. The software will tell you to turn off the radio and disconnect the cable. To prevent any timeouts, do that now.

We'll now create your new code plug (or perform edits to your former one).

Create Hotspot Channel

If you are familiar with DMR or commercial radios, you know that the process is to:

1. Create Radio ID
2. Import Talkgroups
3. Create Channels
4. Create Zones

Observe that list, think, "That it's a lot of work for one channel," then put it out of your mind. Next, congratulate yourself for buying a Yaesu and not having to mess with that.

Your setup now looks like a spreadsheet. If you have programmed your radio previously, it may have many channels. A stock Yaesu will have a couple of generic channels.

Either insert a new channel where you want it or start on an empty channel. You will be adding:

1. Receive Frequency
2. Transmit Frequency
3. Offset Frequency

[27] <https://www.rtsystemsinc.com/Support_ep_5.html>
[28] <https://www.rtsystemsinc.com/knowledgebase.html>
[29] <https://www.rtsystemsinc.com/How-to-Videos_ep_3.html>

4. Offset Direction
5. Operating Mode
6. Name

First, enter your Receive Frequency. Remember that this is the ***Transmit Frequency*** shown by your hotspot. Be sure not to cross those up in your head. Hit `Tab` to go to "Transmit Frequency." Notice that almost everything else has been pre-populated. There's another point for Yaesu and RT Systems.

If your hotspot "Offset Direction" is "Plus" and is 5.00 MHz, which is somewhat standard, you can leave what's in there now. If you went off on your own, change these columns accordingly.

Change the operating mode to "DN" for Digital Narrow. Uncheck the box in the AMS column; there's no need to auto-negotiate the mode with your hotspot.

Finally, give your channel a name like "WPSD." This name will display on your radio when in use.

Save Your Program

Select File > Save As from the menu and navigate to where you would like to save the file, give it a name you will remember, and "Save."

Load Your Program (Send to Radio)

From the menu, select Communication > Send Data to Radio.

1. Plug the RTSystems USB-68 or the Yaesu SCU-18/19 cable into the DATA jack on the side of the radio.
2. Press and hold the [Fmenu] key while turning on the radio.
3. Verify the radio displays CLONE.
4. Press the [RECEIVE] key on the radio.
5. Verify that the radio shows WAIT
6. Click OK to start transferring the data.

After a couple of minutes, the software will finish transferring the data. The software will tell you to turn off the radio and disconnect the cable. Do that, and then turn your radio back on and select your hotspot channel. Try to avoid kerchunking; I know you were about to.

Connect to a Reflector

In your WPSD dashboard, under Yaesu System Fusion Configuration, under "Startup Host," select `YSF00001 - Parrot`. Now, you can identify yourself; your voice should return to you in a few seconds.

Other Networks

Once you have verified your setup with a Parrot, browse the rest of the Reflectors and see what you find. One of the more common reflectors is `YSF32453 - US-KCWide - AMERICA-KCW`. If you are searching via the drop-down box, you'll need to search by the "Description" column, so as you type "AMERICA_KC," you should see it.

You may have noticed there are two places to change this. The first is in your Configuration page, under the Yaesu System Fusion Configuration under "Startup Host." That becomes your default host. In your Dashboard, select

"Admin" and "YSF Manager." Here, you can unlink or link to a different reflector. Changing here is a temporary link. When your hotspot restarts (such as during evening maintenance,) it will go back to the default reflector.

7.2 Specific Modes:

7.2.1 Zero to Hero: D-Star (applies to all radios)

There are numerous D-Star 'getting-started' guides available via your favorite search engine. This description focuses on the unique differences associated with using a WPSD D-Star node.

Add your WPSD D-Star node to your radio

Tip

If your WPSD node is simplex, make sure to set *DUP+* or *DUP-* with an offset of *zero* (0). Turning DUP 'off' does not work because ICOM radios expect D-Star to be used only on repeaters and that repeaters always use DUP+ or DUP-, even with an offset of zero. If you turn DUP 'off', the radio thinks you are not talking to a repeater and thus it will not use D-Star.

You can add your node to your radio's memories in one of two ways:

1. As a D-Star repeater
2. As a regular memory entry

If you use D-Star repeater memories (DV), don't forget to include your node's GPS location; it is useful when trying to find "near repeaters".

If you use a regular memories, you will want to create separate entries as follows (where ^ indicates a space; all fields are always 8 spaces, and all commands such as link, unlink, echo and info are in the eighth position):

usage	URCALL or MYCALL	RPT1	RPT2
Simplex	CQCQCQ^^	^^^^^^^^	^^^^^^^^
Use Repeater	CQCQCQ^^	NOSIGN^B	NOSIGN^G
Echo	^^^^^^^E	NOSIGN^B	NOSIGN^G
Information	^^^^^^^I	NOSIGN^B	NOSIGN^G
Unlink	^^^^^^^U	NOSIGN^B	NOSIGN^G

In the above example, NOSIGN is your WPSD's callsign (your callsign) and "B" is the channel configured on the WPSD D-Star configuration page, based on the wavelength of your radio.

You will also probably want one line for each repeater you link to, whose contents depends on that repeater's callsign.

Using your node

Use your node as you would any other D-Star repeater.

Keep in mind that the D-Star parameters can be set to either connect to a reflector on boot/restart and/or to determine how long a reflector stays connected before being dropped.

Connecting to Reflectors

Aside from connecting to repeaters, you will probably want to connect to one of the many reflectors available, see the **XLX Reflector List** on the Digital (Ham) Radio Lists[30] page at WoCHP.radio[31].

There are actually a number of different types of reflectors out there, and not all of them support D-Star. Of the ones that support D-Star, those listed as *DCS*, *D-Plus* or *DExtra* are an older type of reflector typically dedicated to D-Star.

The other type, *XLX*, is a multiprotocol reflector that, given the right hardware by the owner, may support different digital voice modes, even on the same module and allow communication (called *transcoding*) between whem.

Reflectors typically support a number of *channels* called **modules**. Modules are typically identified by a suffix of `A` to `Z` appended to the reflector callsign. e.g. Module `C` on `XLX` reflector `301` would be `XLX301C`. When planning on connecting to a reflector, it's always worth checking out the reflector's webpage or dashboard to see what modules are in use, what modes they support, what they are used for, and whether they support transcoding between different modes.

With WPSD there are three ways to establish a link to a reflector:

1. Using the WPSD Web Dashboard
2. Using a link command programmed into your radio,
3. Using DTMF commands via you radio's keypad and

Web Dashboard

Probably the easiest and most convenient method is to use the WPSD Web Dashboard.

Navigate to the **Admin** -> **D-Star Manager** page, select the target reflector and module, select *Link* or *Unlink* and press **Execute Action**.

Once the hotspot is connected, use the *Use Repeater* memory (the one with `CQCQCQ^^` and both RPT1 and RPT2 filled out) to talk over the link.

Use the same process to *Unlink* from the reflector.

This may be the only way to disconnect from a reflector if the reflector is busy and there is no time between transmissions to get your commands in via the radio.

[30] <https://w0chp.radio/digital-radio-lists/>
[31] <https://w0chp.radio>

Radio Link Command

This requires you to program into one of your radio's memories an entry similar to the *Use Repeater* entry above, but with a **URCALL** of the reflector callsign with the letter "L" in the 8th position. (e.g. XLX301CL which will link your hotspot to XLX reflector 301 module C.) To make the link, you just keyup using that memory. Once the hotspot is linked then you switch back to the *Use Repeater* memory (the one with CQCQCQ^^ and both RPT1 and RPT2 filled out) to talk over the link. Use the ^^^^^^^U memory to unlink from the repeater.

DTMF Linking

WPSD also supports using DTMF from your radio's keypad. To transmit the DTMF code, set your radio to the *Use Repeater* memory, hold down the PTT button and press the appropriate keys on the keypad. Release the PTT once done. WPSD will respond with a voice prompt if your command was accepted.

The commands are:

Table 1: [DTMF Commands]

Type	DTMF Key	Format	Description
Unlink	**#**	#	Unlink the hotspot from the reflector
Info	**00**	00	Obtain info about the link. WPSD will respond with the callsign and module of the linked reflector if linked, or with *unlinked*.
XLX	**A**	Annnzz	Connect to a XLX reflector (A30103 for XLX301C)
DCS	**D**	Dnnnzz	Connect to a DCS reflector (D00103 for DCS001C)
D-Plus	*****	*nnnzz	Connect to a REF reflector (*00101 for REF001A)
DExtra		nnzz	Connect to a DExtra reflector (00105 for XRF001E) **NOTE** There is no prefix for this connection.

In place of zz you can also use DTMF keys A, B, C or D to access the first four modules.

8 Maintenance Items

8.1 Calibrating your Modem / Tuning BER

See W0CHP's video on how to calibrate your modem[32].

8.2 How to Update Modem Firmware

This document explains how you can update your modem firmware using the included modem firmware update utility in WPSD, `wpsd-modemupgrade`. There are two methods you may employ, described below.

8.2.1 Via the WPSD Dashboard

You can access the modem firmware tool via: *Admin -> Advanced -> Modem Firmware Upgrade*.

8.2.2 Via Command Line Interface/SSH

In an SSH session, you must run a specific command for your device type. The relevant device firmware upgrade commands are as follows:

Modem Type	Command
MMDVM_HS_Hat (14.7456MHz TCXO) GPIO:	`wpsd-modemupgrade hs_hat`
MMDVM_HS_Hat (12.2880MHz TCXO) GPIO:	`wpsd-modemupgrade hs_hat-12mhz`
MMDVM_HS_Dual_Hat (14.7456MHz TCXO) GPIO:	`wpsd-modemupgrade hs_dual_hat`
MMDVM_HS_Dual_Hat (12.2880MHz TCXO) GPIO:	`wpsd-modemupgrade hs_dual_hat-12mhz`
ZUMSpot RPi boards/hotspots GPIO:	`wpsd-modemupgrade zum_rpi`
ZUMSpot RPi duplex GPIO board/hotspots:	`wpsd-modemupgrade zum_rpi-duplex`
ZUMspot USB stick:	`wpsd-modemupgrade zum_usb`
ZUMspot Libre Kit or generic MMDVM_HS board:	`wpsd-modemupgrade zum_libre`

continues on next page

[32] <https://youtu.be/Qj70By_oSEo>

Table 1 – continued from previous page

Modem Type	Command
DVMega - Pi Hat (Single or Dual Band) GPIO:	`wpsd-modemupgrade dvmega_gpio`
DVMega - Shield for Arduino Uno USB (ttyUSB0):	`wpsd-modemupgrade dvmega_usb_uno`
DVMega - Shield for Arduino Mega USB (ttyUSB0):	`wpsd-modemupgrade dvmega_usb_mega`
DVMega - EuroNode hotspots (14.7456MHz TCXO) GPIO:	`wpsd-modemupgrade euronode`
SkyBridge hotspots (14.7456MHz TCXO) GPIO:	`wpsd-modemupgrade skybridge`
NANO_DV NPi GPIO by BG4TGO:	`wpsd-modemupgrade nanodv_npi`
NANO_DV USB by BG4TG:	`wpsd-modemupgrade nanodb_usb`
Nano_hotSPOT by BI7JTA (14.7456MHz TCXO) GPIO:	`wpsd-modemupgrade hs_hat_nano_hotspot`
Nano_hotSPOT Duplex by VR2VYE (14.7456MHz TCXO) GPIO:	`wpsd-modemupgrade hs_hat_nano_hotspot-duplex`
LoneStar LS MMDVM USB (14.7456MHz TCXO) USB:	`wpsd-modemupgrade hs_hat_lonestar-usb`
HS_HAT_AMBE (14.7456MHz TCXO) GPIO:	`wpsd-modemupgrade hs_hat_ambe`
MMDVM_HS_GENERIC (14.7456MHz TCXO) GPIO:	`wpsd-modemupgrade hs_hat_generic`
MMDVM_HS_GENERIC_DUPLEX (14.7456MHz TCXO) GPIO:	`wpsd-modemupgrade hs_hat_generic_duplex`
MMDVM_HS_GENERIC_DUPLEX (14.7456MHz TCXO) USB:	`wpsd-modemupgrade hs_hat_generic_duplex-usb`
Repeater - Nucleo64 F446RE GPIO:	`wpsd-modemupgrade rpt_nucleo-64`
Repeater - Nucleo144 F767ZI GPIO:	`wpsd-modemupgrade rpt_nucleo-144`
Repeater - MMDVM_RPT_Hat v0.2 GPIO:	`wpsd-modemupgrade rpt_mmdvm_hat-v0.2`
Repeater - MMDVM_RPT_Hat v0.3 GPIO:	`wpsd-modemupgrade rpt_mmdvm_hat-v0.3`
Repeater - ZUM Radio MMDVM for Pi v0.9 GPIO:	`wpsd-modemupgrade rpt_zum-v0.9`
Repeater - ZUM Radio MMDVM for Pi v1.0 GPIO (F4):	`wpsd-modemupgrade rpt_zum-v1.0-F4`
Repeater - ZUM Radio MMDVM for Pi v1.0 GPIO (F7):	`wpsd-modemupgrade rpt_zum-v1.0-F7`
Repeater - Repeater Builder STM32_DVM v3 GPIO:	`wpsd-modemupgrade rpt_builder_v3`
Repeater - Repeater Builder STM32_DVM v4 GPIO:	`wpsd-modemupgrade rpt_builder_v4`
Repeater - Repeater Builder STM32_DVM v5 GPIO:	`wpsd-modemupgrade rpt_builder_v5`
Repeater - Repeater Builder STM32_DVM_MTR2K v3 GPIO:	`wpsd-modemupgrade rpt_builder_mtr2k_v3`

Other Hints

To flash your modem with user-specified custom firmware, invoke the following command:

```
sudo wpsd-modem-flash_custom
```

To attempt to have the system detect the type of modem installed, invoke this command:

```
sudo wpsd-detectmodem
```

8.2.3 Notes

But what if I don't know which modem I have or which firmware to choose?"

The most common boards we see are the "MMDVM_HS_Hat" boards and "MMDVM_HS_Dual_Hat" for duplex boards. When in doubt, you can always try those modem types. You can also invoke the 'sudo wpsd-detectmodem' command in WPSD to try detecting and displaying the board/modem type you have installed before you flash it.

If you have an obscure modem or an MMDVM repeater board, or if none of the above commands apply to your device type, you will need to download, compile, and install the MMDVM modem firmware or the MMDVM_HS hotspot firmware yourself. The modem firmware is outside the scope of WPSD, and you will be on your own. There are plenty of instructions on the Internet.

We are not firmware developers and offer no support for firmware. We provide programs to update the firmware for popular and common devices. You must utilize other support resources from the firmware developers/maintainers and the device vendors for actual firmware support.

8.3 Resetting WPSD

8.3.1 Reset WPSD Updater

Sometimes you will run into an issue where the updater hangs. It could be because the SD card is going bad. You can however run this command to reset the updater and force things into compliance; In an SSH terminal:

```
curl -fsSL https://wpsd-swd.w0chp.net/WPSD-SWD/WPSD-Helpers/raw/branch/master/reset-wpsd-sbin | sudo␣
↪bash
```

8.3.2 Reset the WPSD Software

If you run into strange issues with WPSD, and have exhausted all other options, there is a non-destructive way to reset/reinstall the WPSD software; In an SSH terminal:

```
sudo reset-wpsd
```

This will forcefully reinitialize the WPSD software suite, but will keep all of your settings, profiles, etc.

If that fails as well, you can perform a Factory Reset (destructive, as you will need to reconfigure WPSD): `Admin -> Configuration -> Factory Reset`

8.4 Backup and Restore Configuration

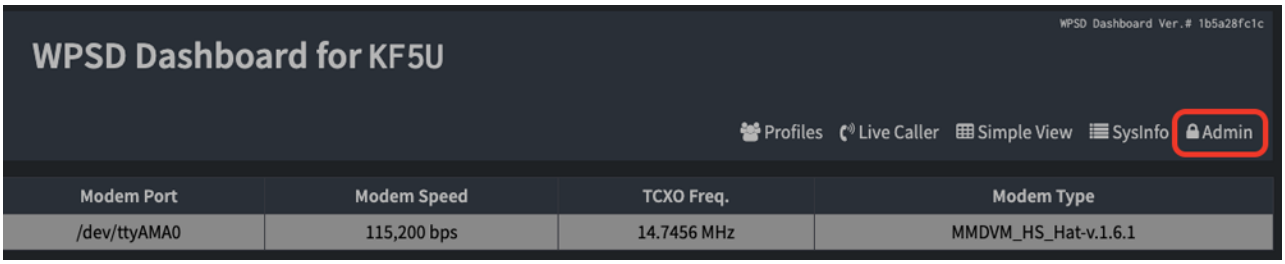
The ability to backup (and restore) your configuration is not only provided, but highly recommended. It is possible that the solution given to an issue you may be experiencing may be to re-flash a new SD card, and restore your backup. This is the nature of the beast with a Pi, and not a limitation of WPSD.

WPSD provides a straightforward way to backup your hotspot configuration through its web interface. This backup includes all your settings, radio configurations, and personal preferences. Regular backups are recommended before making significant changes or updating your configuration.

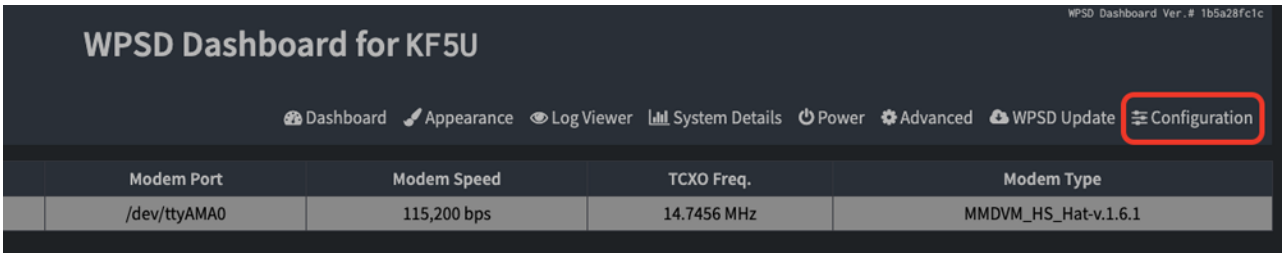
8.5 Step-by-Step Backup Process

8.5.1 1. Access the Backup/Restore Page

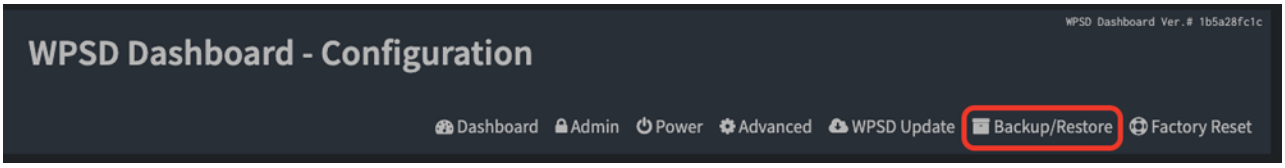
1. Open your web browser and navigate to your WPSD dashboard (typically `http://wpsd.local` or your hotspot's IP address)
2. Log in if prompted
3. Click on "Admin" in the navigation menu



4. Click on "Configuration" in the top navigation menu

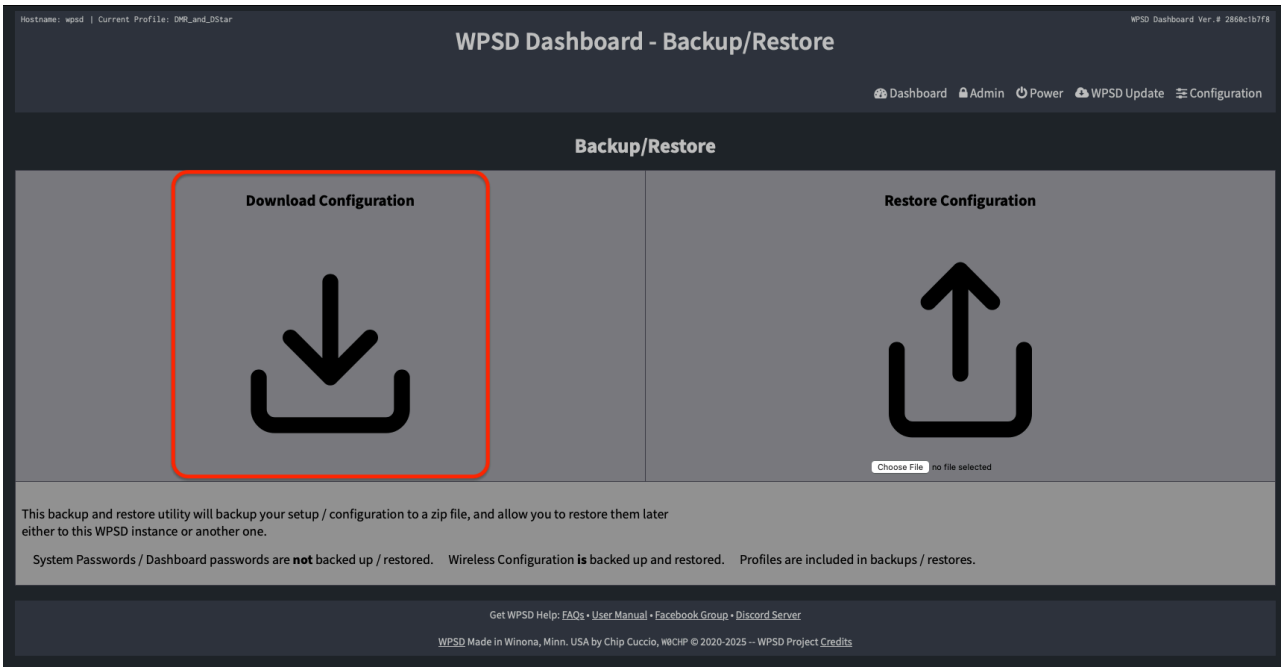


5. Click on "Backup/Restore" in the top navigation menu



8.5.2 2. Initiate the Backup

1. Click the "Download Configuration" button



2. Your browser will automatically start to download a file named `WPSD_Config_<hostname>_YYYY-Month-DD.zip` where <hostname> is the hostname of the hotspot, typically `wpsd` (or whatever you named the hostname).

Note

Please note that

- System Passwords/Dashboard passwords are **NOT** backed up/restored
- Wireless Configuration **IS** backed up and restored
- Profiles **ARE** included in backups/restores

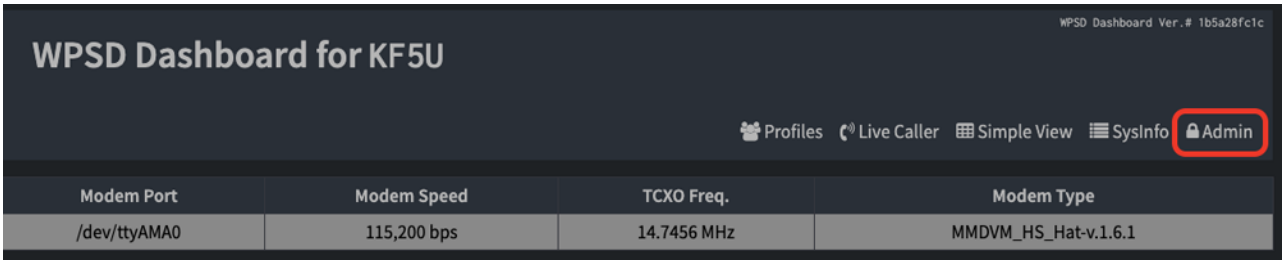
8.5.3 Important Notes

- Store your backup in a safe location
- Consider keeping multiple versions of your backup
- Label backups with meaningful names including the date

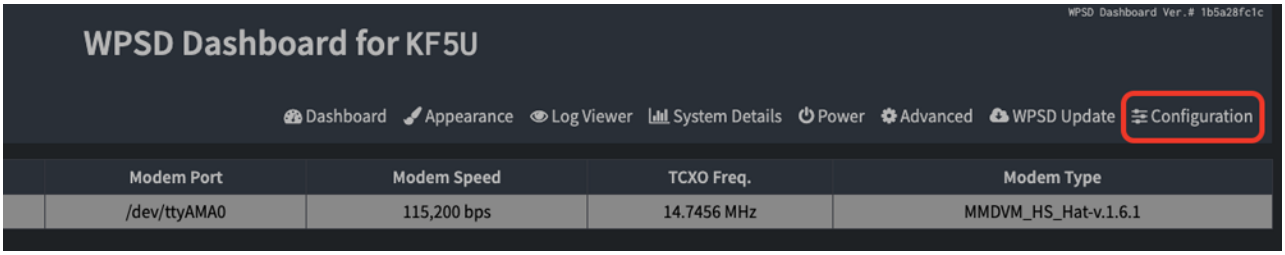
8.6 Step-by-Step Restore Process

8.6.1 1. Access the Backup/Restore Page

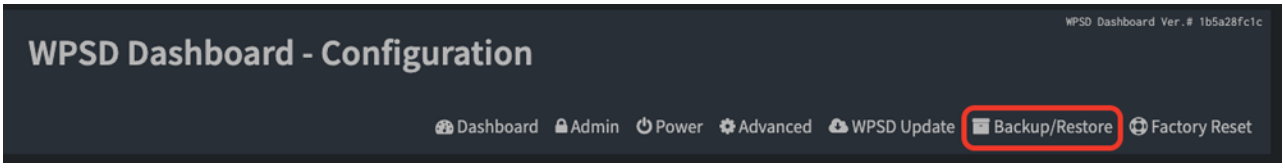
1. Open your web browser and navigate to your WPSD dashboard
2. Log in with your credentials if required
3. Click on “Admin” in the top navigation menu



4. Click on “Configuration” in the top navigation menu



5. Click on “Backup/Restore” in the top navigation menu

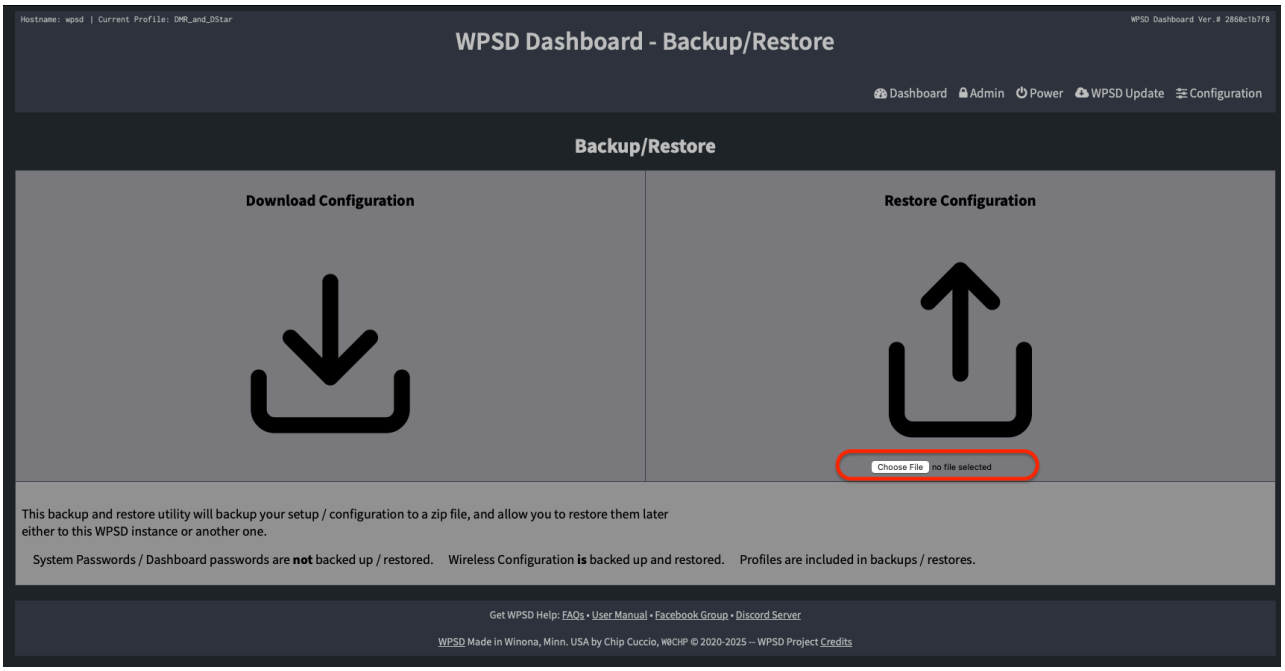


Note

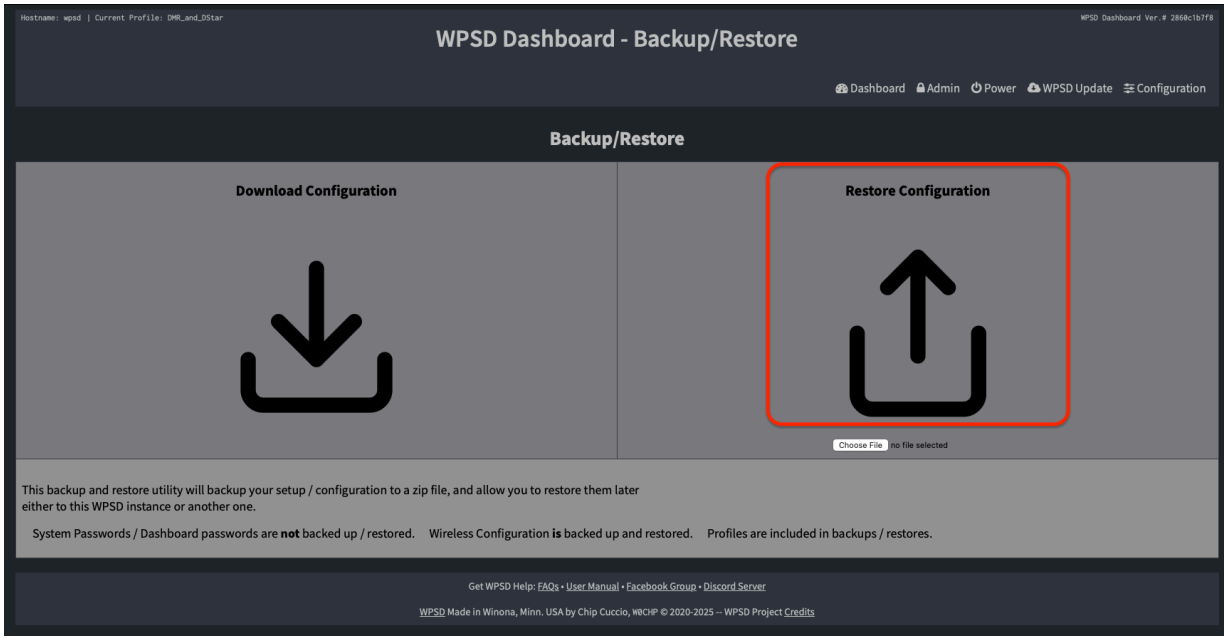
Consider creating a backup of your **current** configuration before proceeding

8.6.2 2. Upload and Restore

1. In the “Restore Configuration” section, click on “Choose File”



2. Navigate to and select your backup file
3. Click Ok
4. Click on the Upload icon **DO NOT CLICK MULTIPLE TIMES**
    - There is no indicator other than the page refresh button changing until the process is complete



5. Wait for the restore process to complete
    - Do not close your browser
    - Do not power off your hotspot

- The process can typically take 1-2 minutes

8.6.3 3. Post-Restore Steps

1. Verify you can access the dashboard
2. Check that your configuration has been properly restored
   - Verify radio settings
   - Check network configurations
   - Confirm operating modes

Todo

Add common issues and troubleshooting steps for backup and recovery.

8.7 Upgrade WPSD

Most of the time, updating WPSD happens automatically overnight, or when you manually click on the *Update* button. However, occasionally new versions of WPSD are released which require you to reinstall a new image to the SD Card. This typically happens when a new major version of the underlying operating system is released.

Upgrading to a new image can be done quite easily by following these steps:

1. Take a backup of your existing hotspot's configuration by following the *Step by Step Backup Process* listed above.
2. Download the new image for your device and write the image to an SD Card. Follow the instructions in *Installing the Software* however stop after you have written the SD Card and before you boot the hotspot for the first time.

Tip

Use a new SD Card rather than overwriting your old SD Card so if something goes wrong, you still have a functioning system available.

3. Copy the `WPSD_Config_<hostname>_YYYYMMDD_HHMMSS.zip` configuration backup file into the top level directory on the SD Card. Copy the zipfile as a single file, do not extract the contents.
4. Insert the SD Card into the hotspot.
5. Boot the hotspot and access it via the web interface.

Important

The hotspot will take a while to load the first time it is booted as it has a list of things to do including expanding the filesystem to fill the SD Card and restoring your configuration. This might be a good time to read the rest of this manual.

9 Advanced Topics

While WPSD is designed to be easy for new users and those fresh to digital voice modes the underlying software is very powerful and is used for many advanced purposes such as managing repeaters and custom links.

This section is for advanced topics that the majority of WPSD users won't need to configure and probably shouldn't touch. If you are looking to use WPSD on your hotspot for private use then feel free to skip this section entirely. If you are trying to do something not supported by the web configuration then read on, there might be some hints here.

9.1 DMR

9.1.1 DMRGateway Configuration File

DMRGateway allows for the connection of up to 6 different DMR networks to one MMDVM system. One of the networks is defined as being an XLX reflector, while the other five may be any combination of DMR+, BrandMeister, TGIF, or local HBLink systems.

The software uses rewriting rules in each DMR network definition to remap talkgroup numbers for each network into a single number range so all the enabled networks are presented to the DMR client radio as if they were all in a single network. These rewriting rules are documented in the chapter *DMRGateway Rewrite Rules*.

This chapter looks at all the other options in the `DMRGateway` file.

Let's start by looking at a complete DMRGateway file;

Listing 1: DMRGateway Configuration File

```
[General]
RptAddress=127.0.0.1
RptPort=62032
LocalAddress=127.0.0.1
LocalPort=62031
RuleTrace=0
Daemon=1
Debug=0
```

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```
RFTimeout=20
NetTimeout=20
Suffix=R

[Log]
DisplayLevel=0
FileLevel=1
FilePath=/var/log/pi-star
FileRoot=DMRGateway

[Voice]
Enabled=1
Language=en_US
Directory=/usr/local/etc/DMR_Audio

[Info]
Enabled=0
RXFrequency=431150000
TXFrequency=431150000
Power=1
Latitude=0.0
Longitude=0.0
Height=0
Location="Town, L0C4T0R"
Description="Country"
URL=https://w0chp.radio

[XLX Network]
Enabled=0
Startup=493
File=/usr/local/etc/XLXHosts.txt
Port=62030
Password=passw0rd
ReloadTime=60
Slot=2
TG=6
Base=64000
Relink=60
Debug=0
Id=1234567
UserControl=1
Module=E

[DMR Network 1]
Enabled=0
```

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```
Address=3102.master.brandmeister.network
Port=62031
TGRewrite0=2,9,2,9,1
PCRewrite0=2,94000,2,4000,1001
TypeRewrite0=2,9990,2,9990
SrcRewrite0=2,4000,2,9,1001
PassAllPC0=1
PassAllTG0=1
PassAllPC1=2
PassAllTG1=2
Password="passw0rd"
Id=1234567
Debug=0
Location=1
Name=BM_3102_United_States

[DMR Network 2]
Enabled=0
Address=usacentral.ddns.net
Port=62031
TGRewrite0=2,8,2,9,1
PCRewrite0=2,84000,2,4000,1001
Password="passw0rd"
Id=1234567
Debug=0
Location=0
Name=FreeDMR_USA-Central
PCRewrite1=1,8009990,1,9990,1
PCRewrite2=2,8009990,2,9990,1
PCRewrite3=1,4000001,1,1,999999
PCRewrite4=2,4000001,2,1,999999
TypeRewrite1=1,8009990,1,9990
TypeRewrite2=2,8009990,2,9990
TGRewrite1=1,8000001,1,1,999999
TGRewrite2=2,8000001,2,1,999999
SrcRewrite1=1,9990,1,8009990,1
SrcRewrite2=2,9990,2,8009990,1
SrcRewrite3=1,1,1,8000001,999999
SrcRewrite4=2,1,2,8000001,999999

[DMR Network 3]
Enabled=0
Name=HBLink
Address=1.2.3.4
Port=5555
```

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```
TGRewrite=2,11,2,11,1
Password="PASSWORD"
Location=0
Debug=0
#Id=specific_id
TGRewrite0=2,11,2,11,1

[DMR Network 4]
Enabled=0
Address=tgif.network
Port=62031
PCRewrite0=1,4009990,1,9990,1
PCRewrite1=2,4009990,2,9990,1
TypeRewrite0=1,4009990,1,9990
TypeRewrite1=2,4009990,2,9990
TGRewrite0=1,4000001,1,1,999999
TGRewrite1=2,4000001,2,1,999999
SrcRewrite0=1,9990,1,4009990,1
SrcRewrite1=2,9990,2,4009990,1
SrcRewrite2=1,1,1,4000001,999999
SrcRewrite3=2,1,2,4000001,999999
Password="passw0rd"
Location=1
Name=TGIF_Network
Debug=0

[DMR Network 5]
#Id=specific_id
Address=dmr.freestar.network
Password="passw0rd"
Port=62031
Name=SystemX_United_Kingdom
TGRewrite0=2,4,2,9,1
PCRewrite0=2,44000,2,4000,1001
PCRewrite1=1,4009990,1,9990,1
PCRewrite2=2,4009990,2,9990,1
TypeRewrite1=1,4009990,1,9990
TypeRewrite2=2,4009990,2,9990
TGRewrite1=1,4000001,1,1,999999
TGRewrite2=2,4000001,2,1,999999
SrcRewrite1=1,9990,1,4009990,1
SrcRewrite2=2,9990,2,4009990,1
SrcRewrite3=1,1,1,4000001,999999
SrcRewrite4=2,1,2,4000001,999999
Options="RelinkTime=30;UserLink=1;TS1_1=2350;"
```

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```
Enabled=1
Location=0
Debug=0
PCRewrite3=1,4000001,1,1,999999
PCRewrite4=2,4000001,2,1,999999

[DMR Network Custom]
#Id=specific_id
Enabled=0
WPSD_AutoRewrites=1
Name=W0CHP_DMR
Address=urf493.w0chp.radio
Port=62030
Password="passw0rd"
TGRewrite0=2,11,2,9,1
TGRewrite1=1,9000001,1,1,999999
TGRewrite2=2,9000001,2,1,999999
PCRewrite0=2,94000,2,4000,1001
PCRewrite1=1,9000001,1,1,999999
PCRewrite2=2,9000001,2,1,999999
TypeRewrite1=1,9009990,1,9990
TypeRewrite2=2,9009990,2,9990
SrcRewrite1=1,1,1,9000001,999999
SrcRewrite2=2,1,2,9000001,999999
Location=0
Debug=0


[GPSD]
Enable=0
Address=127.0.0.1
Port=2947

[APRS]
Enable=0
Address=127.0.0.1
Port=8673
Suffix=D
Description=APRS for DMRGateway
Symbol="Wi"

[Dynamic TG Control]
Enabled=1
Port=3769
```

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```
[Remote Control]
Enable=1
Port=7643
Address=127.0.0.1

[DMR Network 5]
Location=0
Debug=0
Id=1234567
Address=usa.freestar.network
Password="passw0rd"
Port=62031
Name=SystemX_United_States
TGRewrite0=2,4,2,9,1
PCRewrite0=2,44000,2,4000,1001
PCRewrite1=1,4009990,1,9990,1
PCRewrite2=2,4009990,2,9990,1
PCRewrite3=1,4000001,1,1,999999
PCRewrite4=2,4000001,2,1,999999
TypeRewrite1=1,4009990,1,9990
TypeRewrite2=2,4009990,2,9990
TGRewrite1=1,4000001,1,1,999999
TGRewrite2=2,4000001,2,1,999999
SrcRewrite1=1,9990,1,4009990,1
SrcRewrite2=2,9990,2,4009990,1
SrcRewrite3=1,1,1,4000001,999999
SrcRewrite4=2,1,2,4000001,999999
Enabled=0
```

DMRGatewway Sections

The DMRGateway configuration file is an *ini* style file with defined sections configuring various program options. The sections are;

[General]

This section configures global DMRGateway options.

Table 1: [General]

Option	Default	Description
RptAddress=<ip address>	127.0.0.1	Connect to this MMDVMHost instance. Typically this is 127.0.0.1 unless you're running MMDVMHost on a different host.
RptPort=<port number>	62032	Connect to this port on the MMDVMHost instance.
LocalAddress=<ip address>	127.0.0.1	Use this local address for the connection. Typically this is 127.0.0.1 however if you are connecting to MMDVMHost on a different host, then you can use this to steer the connection out of a particular interface.
LocalPort=<port number>	62031	Use this local port for the connection. Make sure the specified port is not already in use.
RuleTrace=[0|1]	0	Enables tracing of rewrite rules into the logs. 0=False, 1=True.
Daemon=[0|1]	0	Run the DMRGateway program as a background daemon.
Debug=[0|1]	0	Enable additional debug logging.
RFTimeout=<integer>	10 Seconds	When the user initiates traffic, the timeslot involved is solely linked to that DMR Network for a small period of time. This stops other DMR networks interfering with the conversation. These options configure how long that slot is linked to that DMR network based on where the last transmission came from.
NetTimeout=<integer>	10 Seconds	When the traffic comes in via a DMR network (Net) the timeslot involved is solely linked to that DMR Network for a small period of time. This stops other DMR networks interfering with the conversation. These options configure how long that slot is linked to that DMR network based on where the last transmission came from.

[Log]

This section defines general logging options for the DMRGateway daemon.

The logging levels are;

- 0 - Disabled
- 1 - Debug
- 2 - Message
- 3 - Information
- 4 - Warning
- 5 - Error
- 6 - Fatal

Table 2: [Log]

Option	Default	Description
DisplayLevel=<integer>	`0`	Set the DMRGateway logging level emitted to the terminal. If DMRGateway is run as a daemon, then this is disabled.
FileLevel=<integer>	`0`	Set DMRGateway logging level for logging to the logfile.
FilePath=<file path>	None	Set the directory where logfiles will be stored.
FileRoot=<string>	None	Set the first part of the filename for the log. The filename will be *<FilePath>*/*<FileRoot>*-YYYY-mm-dd.log if *FileRotate* below is true, or just the *FileRoot* if false.
FileRotate=`[0|1]`	`1` (Enabled)	Enables DMRGateway to rotate the logfiles each day.

[Voice]

This section enables over-the-air voice prompts and selects which language from the available pre-encoded ambe files to use.

Table 3: [Voice]

Option	Default	Description
Enabled=<integer>	`1`	Enable prompts.
Language=<Language>	en_GB	Which language to use. These are in in ISO Language format, but there are currently only 11 languages with a corresponding ambe prompt file. Look in the directory listed below for the current ones. NOTE: While DMRGateway itself defaults to en_GB, WPSD overrides this default to en_US.
Directory=<file path>	None	Where the ambe prompt files and there associated indexes reside. In WPSD this is usually `/usr/local/etc/DMR_Audio`.

[Info]

Some station information. This information is only used to send updates to APRS-IS if that facility is enabled. It is not used for anything else.

Table 4: [Info]

Option	Default	Description
RXFrequency=<Frequency in Hertz>	None	What frequency, in Hz, where the radio is listening. NOTE: This not used by DMRGateway. It is inserted for use by WPSD.
TXFrequency=<Frequency in Hertz>	None	What frequency, in Hz, where the radio is transmitting. NOTE: This not used by DMRGateway. It is inserted for use by WPSD.
Power=<integer>	`0`	Radio output power in watts. NOTE: This not used by DMRGateway. It is inserted for use by WPSD.
Latitude=<Signed decimal degrees>	`0.0`	The latitude of the station. This is specified in decimal degrees with a - prefix for north of the equator and no prefix for south of the equator. For example Canberra, Australia is at `-35.28000`.
Longitude=<Signed decimal degrees>	`0.0`	The longitude of the station. This is specified in decimal degrees with a - prefix for west of the International Reference Meridian (old Grenwich Meridian) and no prefix for east of the International Reference Meridian. For example Santiago, Chile is at `-70.65047`.
Height=<Height above MSL in meters>	`0`	Station height above Mean Sea Level in meters.
Location="<string>"	None	A short free text string identifying where you are.
Description="<string>"	None	A short free text string describing your station.
URL=<URL>	None	A pointer to your station website.

[XLX Network]

This section configures connections into the XLX reflector network.

Table 5: [XLX Network]

Option	Default	Description
Enabled=[0|1]	0	Enable the XLX linking functionality
Startup=<integer>	4000	Specifies the XLX server that will be automatically connected when the Relink timer expires. 4000 specifies do not link.
File=<filename>	None	This file contains the mapping of XLX reflectors to their IPv4 address. It is updated regularly by WPSD. While there is no default in the software, by convention this filename is XLXHosts.txt.
Port=<port number>	62030	Remote port on the XLX server to connect to.
Local-<port number>	0	Local port number that the UDP packets will originate from. Must not be used by anything else. If 0 a random port will be used.
Password=<string>	passw0rd	A custom password for the XLX server you are connected to. Only needed if specified by the XLX server.
ReloadTime=<integer minutes>	60	Time in minutes for DMRGateway to reload the XLXHosts file.
Slot=[1|2]	2	DMR Slot to rx/tx XLX transmissions on.
TG=<integer talkgroup number>	8	This is the talkgroup number that you use to communicate with XLX reflectors. DMRGateway has a hardcoded default of 8, but in WPSD this is changed to 6 via the default configuration file. Communication on this talkgroup will be sent to the reflector, and where received audio appears.
Base=<integer>	84000 - Changed to 64000 in WPSD default configuration file	This is the base *private call* number used for controlling DMRGateway to connect or disconnect from a reflector. To use it, make a *private call* to the base (ie 84000 in this example.) to *disconnect* from the current reflector. Make a *private call* to the base+<reflector number> to connect to that reflector. ie. make a *private call* to 64301 (in default WPSD) to connect to XLX301.
Module=<char A-Z>	None - WPSD default configuration is E	XLX reflectors can have up to 26 separate modules, each appears like a different "channel". This specifies which module to connect to when the XLX reflector is linked automatically.
Relink=<integer minutes>	0 - WPSD default is 60 minutes.	This specifies how long DMRGateway will wait without RF or network traffic before reconnecting to the default reflector, if configured.
Debug=[0|1]	0	Enable extra debugging output in the DMRGateway log.
Id=<integer DMR ID>	0	What DMR Id to present to the XLX reflector. 0 pulls your DMR id from MMDVMHost.
UserControl=[0|1]	1	Allow users to control XLX linking from the radio side.

[DMR Network x]

This section configures connections into multiple DMR networks. DMRGateway supports connection to up to 5 DMR networks at the same time. Rewrite rules map talkgroups (group calls) and private calls into a single talkgroup range so all of these networks appear like a single network to the radio client.

The x in the section header are the numbers 1 to 5 or the word `Custom`. Each section is mostly identical apart from that labelling, so will be described below only once with any differences identified.

Table 6: [DMR Network *x*]

Option	Default	Description
Enabled=[0|1]	0	Enable connection to this DMR Network.
Address=<DMR master>	None	The DNS name of the DMR master.
Port=<integer port>	0	The port on the destination DMR master for the connection.
Rewrite Rules		Put the rewrite rules here that modify talkgroups and private calls as they transit DMRGateway. These are complex and are covered in a separate chapter *DMRGateway Rewrite Rules*.
Password=<string>	"passw0rd"	Password required to access the remote DMR master.
Id=<DMR Id>	0	What DMR id you want to present this gateway as to the remote DMR network. A 0 pulls this DMR id from MMDVMHost.
WPSD_AutoRewrites=[0|1]	1	Custom DMR network automatic rewrite rules switch. If you turn it off (0), WPSD will not automatically adjust rewrite rules for the custom DMR network according to network prefixes. This is so that you can manually configure them in the mmdvmhost configuration file without the web configuration overwriting them. *This only applies to the Custom DMR Network.*
Debug=[0|1]	0	Enable additional logging.
Location=[0|1]	1	This enables sending the location field of the hotspot to the DMR master via the MMDVM protocol. Some DMR networks may use this to update an APRS location, others don't. This is completely seperate to any radio based location provided by radio clients.
Name=<string>	None	A nice readable name for this DMR network for display in logs and on the dashboard.
Options=<quoted string>	None	A line of options to send to the DMR Master. This is dependant on the particular DMR network to which you are connecting, so check with them to configure this properly.
Local=<integer port>	0	Defines the local port to be used for outbound connections. 0 means a random port.

[GPSD]

This section configures DMRGateway to obtain the location of the DMRGateway host via a network connection to a GPSD server. This will then be used instead of the latitude and longitude specified in the `[INFO]` section.

Table 7: [GPSD]

Option	Default	Description
Enable=`[0|1]`	`0`	Enable calling a GPSD server for location.
Address=<IP Address>	None	The IP Address of the GPSD server.
Port=<integer port>	None	What port the GPSD Server is listening on. This is typically `2947`.

[APRS]

This section configures DMRGateway to send APRS position and status updates to the specified APRS-IS server.

Table 8: [APRS]

Option	Default	Description
Enable=`[0|1]`	`0`	Enable APRS status updates.
Address=<IP Address>	None	IP Address of the APRS-IS Server
Port=<integer port>	None	Port on the APRS-IS server.
Suffix=<string>	-	A small string providing the callsign suffix. Originally this was the SSID from the AX.25 packet and so was limited to the numbers 0-15, but this AX.25 limitation doesn't apply here. You can use any simple string, but this string, your callsign, and a dash - must be 9 characters or less in length. Typical use for a DMR station would be `D`. See the APRS SSID Specification[33]
Description=<String>	None	A small text description to send to APRS
Symbol="<String>"	None	The APRS Symbol to display on your station. This is a complex topic documented on the APRS Symbol Page[34]. WPSD defaults to `"Wi"`.

[Dynamic TG Control]

This section configures a UDP port to receive control messages to manage dynamic TG rewrites.

Table 9: [Dynamic TG Control]

Option	Default	Description
Enabled=`[0|1]`	`0`	Enable Dynamic TG Control
Port=<integer port>	`3769`	UDP port for recieving control messages.

[33] <http://www.aprs.org/aprs11/SSIDs.txt>
[34] <http://www.aprs.org/symbols.html>

[Remote Control]

This section configures a UDP port to receive control messages to provide some remote control capabilites for DMRGateway.

Table 10: [Remote Control]

Option	Default	Description
Enable=[0|1]	0	Enable Remote Control functionality.
Port=<integer port>	0	UDP port to listen on.
Address=<IP Address>	127.0.0.1	IP Address to bind the UDP socket to.

9.1.2 DMRGateway Rewrite Rules

Different DMR networks typically have talkgroup numbers that overlap. WPSD is currently designed for Brandmeister to be the primary DMR network and alternate networks, when enabled, are accessed via different prefixes.

If this configuration doesn't suit you then you will need to manually configure the rewrite rules in the DMRGateway file. The easiest way is to use the *Full Editors* menu in the *Advanced* section of the web interface.

Important

Making **any** change in the main *Configuration* page will overwrite any changes you have made to the DMRGateway file itself. You can either take a copy of the file and store it elsewhere, or use the *Profiles* feature to recover.

Tip

This page is taken almost completely from Jonathan Naylor's documentation[35] on Github. If a command below doesn't seem to be working as it should, it might be worth checking out his page to see if things have changed.

DMRGateway File

The DMRGateway file contains all the configuration for connecting the hotspot/controller to one or more DMR networks. This section of the documentation is concerned solely with the part of the configuration file that manages rewriting talkgroup and private call numbers on-the-fly to allow a correctly programmed radio to access multiple networks simply by selecting the right talkgroup or private call number.

General Usage

DMR Gateway will only pass traffic to the different networks if it's referenced in a rewrite rule in the .ini file.

[35] <https://github.com/g4klx/DMRGateway/wiki/Rewrite-Rules>

TGRewrite

TGRewrite allows you to translate one talk group ID to another, and to alter the time slot. TGRewrite can also be used to route a talk group and slot combination to a particular network. 'from' applies to DMR frames entering the Gateway via MMDVMHost (RF), and 'to' is where they are routed on the network side (Net). The rules apply to DMR frames traversing the gateway in both directions.

Syntax

```
TGRewrite=fromSlot,fromTG,toSlot,toTG,range
```

Examples

The rule below will translate a group call to talk group talk group 8 to talk group 9 on DMR Network 1.

```
[DMR Network 1]

# Reflector TG on to slot 2 TG8
TGRewrite=2,8,2,9,1
```

The rules below will route a group call to 9990 on time slot 1 to DMR Network 1, and a group call to 9990 on time slot 2 to DMR Network 2.

```
[DMR Network 1]

# Echo on slot 1 TG9990
TGRewrite=1,9990,2,9990,1

[DMR Network 2]

# Echo on slot 2 TG9990
TGRewrite=2,9990,2,9990,1
```

PCRewrite

This is almost identical to the TGRewrite except it only operates on private calls. PCRewrite can be used to add a prefix on a private call to a reflector to 'steer' them to a particular network. The prefix will then be removed before being routed to the DMR network. This rule only works on DMR frames passing from the RF side to the network.

Typically used to remap reflector control calls to a different local range to avoid clashes, and for permitting GPS position reports and private calls to a particular network.

Syntax

```
PCRewrite=fromSlot,fromId,toSlot,toId,range
```

Examples

The rules below will route any private calls on time slot 2 in the range 94000 - 95000 to 4000 - 5000 on DMR Network 1, and the range 84000 - 85000 to 4000 - 5000 on DMR Network 2.

```
[DMR Network 1]

# Reflector control command slot 2 94000->4000 to 95000->5000
PCRewrite=2,94000,2,4000,1001

[DMR Network 2]

# Reflector control command slot 2 84000->4000 to 85000->5000
PCRewrite=2,84000,2,4000,1001
```

SrcRewrite

SrcRewrite will rewrite the source/from Talk Group ID to another ID.

Syntax

```
SrcRewrite=fromSlot,fromId,toSlot,toTG,range
```

Examples

The rule below will rewrite calls from 4000-5000 on DMR Network 1, to talk group 9 on slot 2. This is useful for ensuring reflector announcements are heard on talk group 9. This rule only works on DMR frames passing from the network side to the RF side.

```
[DMR Network 1]

# Reflector status returns
SrcRewrite=2,4000,2,9,1001
```

TypeRewrite

TypeRewrite maps a group call to a private call. This rule only works on DMR frames passing from the RF side to the network side.

Syntax

```
TypeRewrite==fromSlot,fromId,toSlot,toId
```

Example

The rules below translate a group call to 9990 on slot 1, to a private call on DMR Network 1. The SrcRewrite rule then allows the reply to traverse the gateway.

This could be used for converting Brandmeister's private call echo service to a group call method like DMR+, to make the usage more uniform across the networks.

```
[DMR Network 1]

# Echo on RF slot 1 TG9990 to network slot 1 9990
TypeRewrite=1,9990,1,9990
SrcRewrite=1,9990,1,9990,1
```

PassAllTG

Passes all talk groups without specific matching rules, and can only be used on a single DMR network. The rules apply to DMR frames traversing the gateway in both directions.

Syntax

PassAllTG=Slot

Example

The rules below allow group calls to traverse from DMR network 2 to either time slot on the RF side.

```
[DMR Network 2]
# Pass all of the other talk group traffic on slot 1 and slot 2
PassAllTG=1
PassAllTG=2
```

PassAllPC

Passes all private calls without specific rules, and can only be used on a single DMR network. The rules apply to DMR frames traversing the gateway in both directions.

Syntax

PassAllPC=Slot

Example

The rules below allow private calls to traverse from DMR network 2 to either time slot on the RF side.

```
[DMR Network 2]
# Pass all of the other private traffic on slot 1 and slot 2
```

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```
PassAllPC=1
PassAllPC=2
```

TGDynRewrite

This is designed to handle dynamic talkgroups on the one particular network and may be of limited use on other networks.

The aim is for a group of dynamic talk groups can be mapped to a single talk group, along with voice acknowledgements and control over which one is being used.

Syntax

```
TGDynRewrite=slot,start TG,disconnect TG,status TG,comms TG,Number of TGs
```

Example

```
TGDynRewrite=2,23500,4000,5000,9,100
```

The 2 means using slot 2 for all of the following talk groups and private calls. The 23500 is the first of the dynamic talk groups, and the 100 at the end is the number of talk groups from that number to use. This maps talk groups 23500 to 23599 in this example. These are triggered by sending a private call to the desired talk group number. This cases a spoken confirmation to be transmitted. 4000 is the private call number to disconnect the dynamic talk group. This causes a spoken confirmation to be transmitted. 5000 is the private call number to cause the current talk group mapping information to be spoken. 9 is the talk group to be used for all communications to the selected dynamic talk group, as well as the voice messages.

The reason for using private calls is the ability of many radios to have front panel programming so the dynamic talk group numbers can be done manually or programmed on your radio.

IdRewrite

This rewrites the DMR Id of the radio on the RF side to a different DMR Id when passed to the network, and converts it back on Network to RF traffic.

This could be used to have a single DMR Id programmed into your radio, but present a different DMR Id to a connected network.

Syntax

```
IdRewrite=RFId,NetworkID
```

Example

```
IdRewrite=5059876,1001234
```

This would rewrite DMR Id 5059876, as programmed into your radio, into DMR Id 1011234 which is what the upstream network would see.

9.1.3 WPSD API

WPSD has a simple API to retrieve last heard information in JSON format.

Many WPSD based repeaters are running on low power hardware at remote sites, often on low bandwidth links. You can use the API to provide a close to real time display of repeater activity by using an Internet facing host to cache and proxy the last heard list.

Accessing the API

The API can be accessed via the following URL pattern:

`http://<hostname>/api`

Where <hostname> is the name of the WPSD host.

Options

Table 11: [General]

Option	Default	Description
limit=<integer>	None	Determins the number of entries returned. A lower number will reduce the load on the WPSD host, and return the data faster.
names=[true|false]	`true`	Resolve and display the name of the heard station.
country=[true|false]	`true`	Resolve and display the country of the heard station.

Examples

`http://wpsd.local/api/?limit=10`

Retrieve the last 10 entries in the heard list in JSON format from the host `wpsd.local`.

`http://wpsd.local/api/?limit=10&names=false`

Retrieve the last 10 entries in the heard list in JSON format from the host `wpsd.local` without the `names` field.

`http://wpsd.local/api/?limit=10&country=false`

Retrieve the last 10 entries in the heard list in JSON format from the host `wpsd.local` without the `country` field.

Sample Proxy Code

A basic PHP proxy client using APCu to cache the data is available at https://repo.wochp.net/vk1kcm/viewapi.

10 Getting Help/Support

1. Read The FAQs[36].
2. Before you ask for help, read how to ask for help properly[37].
3. Some great users, fans, and contributors of WPSD have set up a Facebook Group[38] and a Discord Server[39] to get community support, etc. These are the only official online support mediums for my software.
4. **Do NOT ask for WPSD support in any official or unofficial Pi-Star support page/group/forum/medium/etc.** WPSD is not the original Pi-Star software by Andy Taylor (MW0MWZ)!
5. XLX-493 ; Module E[40] is the WPSD Chat Module. A direct DMR conference to this module/room is bridged with BrandMeister; call TalkGroup 3170603.
6. Toshen, KE0FHS, has written comprehensive documentation and notes on Digital Voice[41]; much of it is still relevant to WPSD.
7. Please read about *the (non-)warranty*.

10.1 WPSD Non-Warranty

WPSD Project is the culmination of hard work and design by Chip, W0CHP, and a group of volunteers who provide this software and documentation free of charge.

No warranty is expressed or implied. While the WPSD Developers try to provide a software distribution free of bugs and security flaws, it is free software. Use at your own risk.

By using WPSD, the User agrees to hold harmless and indemnify WPS Developers from any claims, damages, losses, liabilities, and expenses arising from or related to the operation and use of WPSD. This agreement includes but is not limited to any personal injury, property damage, or financial loss incurred due to operating or using WPSD. The User assumes all risks associated with operating or using WPSD and releases the WPSD Developers from any responsibility or liability.

[36] <https://w0chp.radio/wpsd-faqs/>
[37] <https://w0chp.radio/documents/how-to-get-wpsd-help-the-right-way/>
[38] <https://www.facebook.com/groups/wpsdproject>
[39] <https://discord.gg/b8Hv5ygPdF>
[40] <https://w0chp.radio/xlx493-reflector/>
[41] <https://amateurradionotes.com/pi-star.htm>

Where this document or help texts in WPSD fail, help is available for users through multiple channels. You may find support links such as Facebook Groups, Discord, and any other relevant community support links in the footer text on the main Dashboard page of WPSD or at WPSD.radio[42]

Contacting the WPSD Development team directly without seeking community support may be ignored. We imply no direct support from the WPSD Developers.

10.2 WPSD Core Development Team:

- Chip, W0CHP
- Steve, KC1AWV
- Carl, VK1KCM
- Alexander, UR6LKW
- Simon, M7DHQ
- Jonathan, G4KLX
- Florian, DF2ET

10.2.1 WPSD Project Frequent Contributors

- Lee, AA0NT
- Jim, KI6ZUM
- Ruud, PE1MSZ
- Hafizi 9W2LGX

[42] <https://wpsd.radio/#getting-helpsupport>

11 Glossary

11.1 Code Plug

While somewhat generically used for digital radio and even FM VHF and UHF radios, people who talk about DMR radios especially throw the term CPS about it like it's salt.

Radios used crystals to control the frequencies, and sometimes, users applied internal jumpers for the various options. Later, builders moved the internal jumpers to a jack on the back of the radio. A "plug" with wire jumpers plugged into the jack enabled these options. These became the original code plugs. Later, builders and manufacturers controlled more things using these code plugs, such as tone encode/decode selection.

Later, as radios became microprocessor-controlled, the external code plugs moved inside the radio as programmed information. The term has, unfortunately, remained with us. The code plug contains the operating frequencies, tone selections, timeout values, system IDs, etc. In some instances, some parts of the radio definition itself are in the code plug. These days, the code plug is just a relatively small file transferred to the radio with Code Plug Software.

11.2 D-Star

Digital Smart Technologies for Amateur Radio A digital voice and data protocol specification for Amateur Radio by the Japan Amateur Radio League published in 2001. D-Star implements GFSK modulation in a 6kHz wide channel.

11.3 DMR

Digital Mobile Radio An ETSI standard digital radio specification for professional, commercial, and private radio users published in 2005. Implements 4-level FSK modulation in a 12.5kHz wide channel using TDMA, effectively 'doubling' channel capacity.

11.4 Dynamic Talkgroup/Reflector

A talkgroup or reflector that is not commanded by the WPSD configuration to be monitored on the Internet. Often one is enabled by the implicit or explicit commands from the RF link.

11.5 ETSI

European Telecommunications Standards Institute The European Telecommunications Standards Institute is an independent, not-for-profit, standardization organization in the field of information and communications.

11.6 FSK

Frequency-shift keying Frequency-shift keying is a frequency modulation scheme in which digital information is encoded on a carrier signal by periodically shifting the frequency of the carrier between several discrete frequencies.

11.7 GFSK

Gaussian frequency-shift keying Rather than directly modulating the frequency with the digital data symbols, "instantaneously" changing the frequency at the beginning of each symbol period, Gaussian frequency-shift keying filters the data pulses with a Gaussian filter to make the transitions smoother.

11.8 Hotspot

An SBC flashed with a hotspot image (for example, WPSD), with either a simplex or duplex hotspot board (HAT) connected to the Internet. Hotspots usually have radios built in, typically with an ADF7021 RF chip and one or two SMA antenna connectors or an onboard ceramic antenna.

11.9 MMDVM

Multi-Mode Digital Voice Modem MMDVM hardware and software are at the core of most digital mode hotspots on the market. The success of the MMDVM Project comes from different people and projects going back to the earliest days on D-STAR. MMDVM now supports D-STAR, DMR, YSF, P25, NXDN, POCSAG, and analog.

11.10 Node

A simplex hotspot, using an MMDVM modem board and an *external* radio. The modem board does *not* include an RF chip and typically connects to a higher-power mobile radio.

11.11 NXDN

Next Generation Digital Narrowband A digital voice and data radio protocol developed jointly by Icom and Kenwood for public land mobile radio systems, published in 2005. NXDN implements 4-level FSK modulation in either a 12.5kHz or 6.25kHz wide channel.

11.12 P25

Project 25 Also known as APCO-25, is a set of digital voice and data radio protocols developed by public safety professionals starting in 1989. Implements C4FM 4-level FSK in a 12.5kHz wide channel (Phase I).

11.13 Repeater

A duplex hotspot, using an MMDVM modem board and *two external radios* or attached to a *repeater* or *repeater controller*. The modem board does *not* include an RF chip and typically connects to an existing repeater or repeater controller.

11.14 SBC

A single-board computer A common example of an SBC is the ubiquitous Raspberry Pi.

11.15 Static Talkgroup/Reflector

A talkgroup or reflector configured by the user in WPSD and constantly monitored for incoming traffic from the Internet. When traffic is received, WPSD passes one of the active talkgroups over the RF link. This acts similiar to a scan list in some radios.

11.16 WPSD

"WPSD Plausibly Stands for Divergence"
WPSD is the name of the software suite and project.

> **Hint**
>
> WPSD = WPSD Plausibly Stands for Divergence

11.17 YSF

Yaesu System Fusion A digital voice and data protocol specification developed by Yaesu for Amateur Radio in 2013. Implements C4FM 4-level FSK in a 16kHz wide channel.

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