Getting Started with WPSD & YSF

Presented by Derek Moyes/K1DDM
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What is WPSD?

WPSD 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 M17, DMR, D-Star, Yaesu System Fusion (YSF/C4FM), P25, NXDN digital voice modes & POCSAG data/paging. WPSD is available as installable disk images, and multiple platforms & devices are supported. The WPSD Project is free and open-source software (FOSS).

Although WPSD began as a derivative of the original Pi-Star software and shares some minor similarities, WPSD is vastly different and is its own software. Expect to learn about these differences and nuances to become familiar with WPSD [, if you've used Pi-Star before].

- https://w0chp.radio/wpsd/

What is YSF, or Yaesu System Fusion?

In the early 2000s, minimum-shift keying (GMSK) technology emerged in the amateur radio market as the dominant digital mode.

In 2013, YAESU launched its own digital mode [] for amateur radio: "System Fusion" utilizing C4FM 4-level FSK [Frequency-shift keying] technology for transmitting digital voice data. Like other digital modes, Fusion utilize[s] a narrower radio bandwidth. With [YSF], special attention was paid to compatibility with analog FM radio. The [YSF] communication protocol enables devices to analyze an incoming signal and automatically determine if it is using C4FM or conventional FM mode. This was intended to simplify migration of the existing amateur radio repeaters from analog to digital technology.

- Summarized from https://en.wikipedia.org/wiki/Yaesu_(brand)

What does this mean?

This means you can ragchew, or chat, with people anywhere in the world, using a WPSD hotspot and a compatible radio, as long as you have the proper components, the correct setup, and access to the internet.

Common digital voice modes include:

- DMR   (Digital Mobile Radio https://en.wikipedia.org/wiki/Digital_mobile_radio),
- D-STAR   (Digital Smart Technologies for Amateur Radio https://en.wikipedia.org/wiki/D-STAR),
- YSF   (Yaesu System Fusion http://systemfusion.yaesu.com/what-is-system-fusion/)

How do I use it?

Personally, this slideshow is focused on the **YSF mode**, as that's what I have experience with. The slides that I'll show pretty much all only show YSF.

For YSF, you'll need a Yaesu brand radio that supports C4FM. I own a Yaesu FT-70DR HT radio.

If you have an FT-5DRm also check out:
https://wpsd-docs.w0chp.net/zero_hero/yaesu_ft-5dr/

If you're not interested in YSF, don't tune me out, yet. I'm going to go over the basics of getting WPSD setup, which you'll need even if you choose other modes!

Other ways to use your hotspot…

For **DMR** there are multiple brands, of which **AnyTone** is one well-known brand.

For **D-Star**, you'll probably want an **ICOM** or **Kenwood** brand radio. If you already have one of these brands, check your documentation to see which digital voice modes it can do, if any.

- https://en.wikipedia.org/wiki/List_of_amateur_radio_modes
- https://wpsd-docs.w0chp.net/modes/

So, what do you need to get started? 1 of 2

Six things:

- A Raspberry Pi or compatible computer. I recommend using one with wifi built-in. Very recently, W0CHP released a new build of WPSD that supports the Raspberry Pi 5 natively, while still supporting the rPi4. I personally still use an rPi4. The rPi 3B also has wifi built-in, but running the dashboard will be *much* slower, so I cannot recommend this option, unless you already have one, and just want to try this out before buying a new device. https://www.raspberrypi.com/products/raspberry-pi-5/
- A compatible microSD card. The required micro SD card size is 8G, but a 16G one is pretty inexpensive these days, and will give you tons more room than you need. Mine happens to have a 64G card, and I'm using about 2G. Note that WPSD runs better on faster SD cards.

So, what do you need to get started? 2 of 2

Six things, continued:

- An MMDVM hotspot "hat".
  https://smile.amazon.com/Duplex-Hotspot-Display-Support-Raspberry/dp/B0878WF7HW (or similar)
- Computer to download the WPSD image to the microSD card. This computer will also be used to configure and manage the WPSD software, using the web interface.
- A radio compatible with the hotspot mode you intend to run, in our case, YSF.
- Internet access.

Download and flash the WPSD image.

Download the **latest** image from WPSD to your Windows, Mac, or Linux-based computer (not the Raspberry Pi). You can choose between an image for a Raspberry Pi 5, or an older image for older rPi computers. Images are available here: https://w0chp.radio/wpsd/#download-wpsd

Flash the image file itself (filename ends with .img.xz) to a blank or overwritable microSD card. A good app for this is Etcher by balena (https://www.balena.io/etcher/), available for Windows, Mac, and Linux. Raspberry Pi also makes available an app, but Etcher is much easier, and is also cross-platform. The Etcher app will automatically uncompress the .xz file before writing the .img file to your SD card.

First boot.

Insert the microSD card in the Pi, plug it in and boot it. You don't need a screen, keyboard or mouse plugged into the hotspot. It takes a minute or so for my rPi4 to boot, but older boards might take a bit longer.

Once your Pi boots, if it's not already configured with wifi, WPSD will scan for wifi for a few minutes, (maybe, five minutes total) and then start up a wifi network to connect to. Be patient the first time.

The created wifi network will be called **Pi-Star-Setup**, and will have a connection password of *raspberry* (I think).

First connect.

Configure your computer to connect to this temporary wifi network, then use your browser to connect to the WPSD admin page:

- http://pi-star.local/ (or 192.168.50.1 if the name doesn't work).

Note that if you have the Bookworm (rPi5 version) the default URL is http://wpsd.local/, and the default user is wpsd.

On first boot, you may not need the default user & pass of *pi-star / raspberry*.

Note that you can skip the wifi stuff altogether if you connect an ethernet cable to your rPi, but you'll have to look into your local DHCP server (which might be your router) for the IP address that gets assigned to WPSD.

Configure WPSD to use your actual wifi.

Now that you're connected, your next goal is to get your actual wifi configured, as WPSD needs internet access to do it's magic anyway.

If you see the No Mode Defined screen, that's ok, you haven't run through setup yet. Click **Configuration**, or just wait 10 seconds.

Scroll down to the **Wireless Configuration** section, and setup your actual wireless network. Use the **Scan** button, find your **SSID**, input your **PSK**, then click **Save (and connect)**.

Scroll back up to the **Power** menu and choose **Reboot**.

Connect to your WPSD, via your real wifi.

While your WPSD reboots, switch your computer back over to the same wifi you just configured your WPSD for.

Once connected, bring up the WPSD admin page again:

- http://pi-star.local/ or http://wpsd.local/ (again, depending on the version)

Once the admin page loads, congrats! This is the about the most difficult part of configuring your hotspot!

Basic Configuration - Starting

There are several parts to getting WPSD working for you, we'll start by covering the most basic settings.

Navigate to the **Admin / Configuration** page.

Note that you'll want to **Apply Changes** for each *section* of changes that you make. When you apply changes, necessary services are restarted. Changing some options requires a reboot, so note that via each section's extensive built-in help.

Basic Configuration - General 1 of 3

Under **General Configuration**, you'll need to input some gathered information. We'll walk you through these items.

The **Hostname** *pi-star* (or *wpsd*) should be fine, unless you are configuring your second (or third) hotspot, etc…

If you do change this, you'll need to reboot your hotspot. If you plan on configuring multiple hotspots for multiple modes, I'd recommend names like "wpsd-*$callsign-$mode*" or something similar, in case you decide to take your hotspot to Field Day! Remember, though, this will affect your connection URL. For any letters in the hostname, it's better to use lowercase.

Your **Node Callsign** will be your FCC assigned callsign.

DMR/CCS7 & **NXDN ID**s won't be used for YSF Mode, so we won't cover them.

Basic Configuration - General 2 of 3

Radio Mode is Simplex mode.

Even if you want to use Duplex eventually, I recommend starting with Simplex Mode, as it will be easier. For Duplex, you'll also need to ensure you have a duplex "hat", and you'll want to know that the Hotspot's RX and TX are the EXACT OPPOSITE of the ones you'll configure on your radio. The first time I configured it, it took me a while to figure this out!

Radio Frequency RX will be the actual radio frequency your radio will connect to.

Obviously, stay within your band plan, but also don't use specific frequencies assigned for other uses, for example *145.8-146.0* and *435.0-438.0*, as these are used for satellite communication, and can be disrupted even by low power hotspots.

Basic Configuration - General 3 of 3

Radio/Modem Type describes the actual hardware and driver that will be used. It will likely be one of the *MMDVM … for Pi (GPIO)* choices in most cases. **Port** and **Baud Rate** will be determined by your hardware.

Sometimes, when selecting your modem from the list, and applying changes, you may receive a warning that the selection list has been updated, and to re-select your modem from the list. Simply re-select your radio/modem type and re-apply the changes.

System Time Zone & **Dashboard Language** allow you to configure your hotspot's time zone and dashboard (configuration) language.

Update Notifier will let you know on your main dashboard when updates are available.

Apply Changes to complete this section. Reboot if necessary.

Basic Configuration - Node Location

Lat, Lon, Town, and **Country** allows you to define where your hotspot is located.

- You can use https://www.latlong.net/ to easily find your exact location.

URL can be set to **Auto**, which will auto-fill in your callsign. https://www.qrz.com/db/[CALLSIGN]

APRS Gateway enables location reporting to APRS. Choose a Host near you, then enable it at your preference. I chose *noam.aprs2.net* for North America. Your location will be reported as per the previous Lat/Lon settings above. You only need to publish APRS for modes you will run on this hotspot.

GPSd is useful is you have an external GPS device, and want to use it.

Apply Changes to complete this section.

Basic Configuration - Radio/MMDVM Modem

In the **Radio/MMDVMHost Modem Configuration** section, turn on the digital modes you want to use. Again, I use only **YSF Mode**, so that's what I've enabled.

A good rule of troubleshooting is that if you want to use multiple modes; get ONE working first, then add each additional mode one at a time later.

I don't use **Radio Cross-Modes**, and it would likely be outside the scope of this tutorial, anyway.

Apply Changes. When you apply these changes, services will be restarted, and additional sections of the configuration might be enabled, such as for configuring YSF Mode.

Basic Configuration - MMDVMHost Display

This section lets you choose the MMDVM Display Type. In order to set that, check out (https://amateurradionotes.com/pi-star.htm#mmdvmhostconfig) or refer to the documentation that came with your MMDVM hotspot hat.

For my hotspot, I use OLED type 3 (0.96") on /dev/ttyAMA0 with layout G4KLX.

I leave my display always active, with scrolling enabled & NOT inverted to reduce burn-in. Depending on how you mount your hotspot will determine whether you need the display rotated or not.

Apply Changes. When you apply these changes, services will be restarted, and you'll want to test your screen. A handy thing it will show is your assigned IP address!

Basic Configuration - Complete & Update

This completes the basic configuration of your WPSD!

Before we move on, we want to update our WPSD. The main reason for doing this now is to get the latest updates before configuring the services.

From the Configuration page, choose **WPSD Update** at the top. The update will automatically begin. Wait until it's complete, then choose **Power**, and **Reboot**.

The latest Dashboard version changes frequently, as this software is under active development. The version is listed at the very top right of the dashboard.

Yaesu System Fusion Configuration - 1 of 2

Once your hotspot restarts, choose **Admin / Configuration**. Scroll down to **Yaesu System Fusion Configuration**.

YSF Startup Host lets you select the YSF host you want to use when your hotspot starts. A "host" or talkgroup is akin to a chatroom. I recommend starting with *YSF3292 - US-America-Link - AmericaLink*. Once you get your radio connecting & working, there are **plenty** of talkgroups to explore.

Yaesu System Fusion Configuration - 2 of 2

UPPERCASE Hostfiles should probably be *On* by default. Some radios, including mine, the FT-70DR, require uppercase names for Hostnames.

FCS Network, **WiresX Passthrough**, **Enable DGid Gateway**, and **YCS Network Options** are advanced options, accept the defaults for now.

Apply Changes if you made any, to complete this section.

Node Access Control Configuration

Node Type generally, when first starting out, leave it set to *Private*. This is an advanced option.

Apply Changes if you made any, or skip this section.

Firewall and Auto Access Point Configuration

uPNP Enabled allows your hotspot to create firewall rules on your router.

Dashboard Access, **ircDDBGateway**, and **SSH Access** should all be set to *Private* while you are still learning.

Auto AP should be *On* if you plan to move your hotspot to new locations. This is what enables the **Pi-Star-Setup** wifi if your hotspot cannot connect to your actual wifi for any reason. Others have noted that it's good to turn this *Off* if you won't be moving your hotspots between wifi networks, or only moving it between known networks.

Apply Changes if you made any, to complete this section. Reboot if necessary.

Using WPSD - Overview 1 of 3: Modes

Scroll back to the top, and choose **Dashboard**.

At this point, in the left sidebar, under **Mode Status**, **YSF** should be GREEN.

If your hotspot has connected properly to the internet, under **Network Status, YSF Net** should be GREEN. If you've configured APRS, **APRS Net** should be green.

YSF Status will display the Host, or talkgroup, you've selected, and whether it's [Linked].

APRS Gateway Status should show the Pool, Server, and Publishing Modes you've selected.

Using WPSD - Overview 2 of 3: Hardware

Across the top of the screen, you'll see information for your **Radio Status**, **Frequencies**, **Mode**, and your modem hardware info. Some of these items will change color when your hotspot receives or transmits.

Additionally, you can use the SysInfo menu button to display your hotspot's hardware information, including **CPU Load** and **Temp**, **Memory** and **Disk Usage**, and **Network Traffic**.

Below all that, **Gateway Activity** should begin to show callsigns and other information as people use the Host / talkgroup you've selected.

Depending on the time of day, this may or may not be quite busy.

Local RF Activity will show only when you key up to talk.

Using WPSD - Overview 3 of 3: Dashboards

Back to the dashboard, on the top screen menu, you'll also find buttons called **Live Caller** and **Simple View**.

Simple View removes all the "configuration" stuff from your display, and only shows you the **Gateway Activity** and your **Local RF Activity.**

Live Caller shows you a very simple view of who's currently talking, with some basic information, so that you can quickly see it from across the room.

Remember, if you have multiple monitors, you could have multiple displays running simultaneously, just by using two or more browser windows.

Congratulations! You've completed the setup of your WPSD! Easy, right?

Backup your hotspot configuration!

Once you get your hotspot working, backup your configuration, and back it up again *before* you make any major changes, like adding a new service!

Navigate to **Admin** / **Configuration**.

Choose **Backup/Restore**.

Choose **Download Configuration**, and store the downloaded file in a safe place!

You can use the downloaded file to restore your configuration later.

Remember to backup your settings again once you get your next mode working, if you choose to set up multiple modes.

Admin Overview

Once you get comfortable with the Dashboard view, additional information can be seen via the **Admin** screen. You can also quickly change YSF Hosts using the **YSF Manager** there.

Hotspot LEDs & Screen

You'll also notice several LEDs on the MMDVM will be on, or blinking. In general, the green PWR LED will be on, and the red SVC LED will be blinking.

When YSF traffic is happening, between the hotspot and your radio, the white YSF LED will also be lit.

The screen, if configured, will also show status updates.

Obviously, these may differ depending on your hardware.
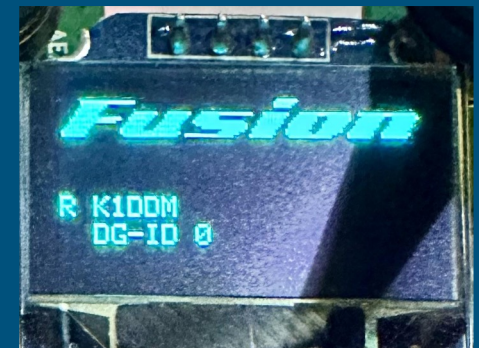
Using WPSD - Configuring Your Radio 1 of 2

Assuming you've used your radio before, and you set **Simplex** mode on your dashboard, simply turn on your radio and tune to your selected frequency. As we're using Simplex, that will be both your transmit and receive frequency.

You should begin to hear folks talking, as you see their names show up in the **Activity** section of your dashboard. Depending on the time of day, the room may or may not be busy.

If you've never set up your radio before, you'll likely need some help getting the basic configuration input (like your callsign) before you want to use it for digital modes. A good primer (for the FT-70) can be found here:
https://0x9900.com/going-digital-with-the-ft-70d/

Using WPSD - Configuring Your Radio 2 of 2

If you have a different radio, do a search for "wpsd with $RADIO" or "YSF with $RADIO", chances are someone's published a tutorial.

Also, if you have difficulty, I'd recommend attending a local radio club meeting, or asking *that friend* who got you interested in being an amateur operator to help. Even if that friend doesn't know how to do it, they'll likely want to help you figure it out, or know someone who can help!

You can find a club using ARRL's website, here: https://www.arrl.org/find-a-club

Notes…

Remember that the *regulations* and *best practices* that apply to amateur radio also apply to our use of personal, low power hotspots.

In general, remember that these **repeaters, reflectors,** & **talkgroups** are **SHARED resources**. When you're having a longer chat, it's good to pause for a few seconds between transmissions to give other hams a chance to access the resources.

Additionally, know that with digital modes there can be a slight delay after pressing PTT (push-to-talk) before the transmission initiates. It's a good idea to wait a full second before starting to speak, and to stop speaking a second before releasing PTT.

WPSD & YSF by Derek Moyes/K1DDM

WPSD & Docs:
https://w0chp.radio/wpsd/ and https://wpsd-docs.w0chp.net/

Much of this slideshow was adapted from my original Pi-Star presentation: http://bit.ly/3ia2YEo

Access this presentation for later reference:
https://bit.ly/4b5aKVc

WPSD & YSF