Digital Mobile Radio Networks From Zero to Hero

DMR with or without a radio

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February 2025 (v0.2 draft)

Dedicated to my lovely wife, Lillian, for tolerating my strange hobbies. ♡

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Introduction

Hams have a way of both driving new technology and piggybacking on commercial and government tech. Hams were instrumental in developing cell telephone technology and moon bounce technology. But we've also borrowed radio gear from various other radio users, such as the military and public services, such as police and fire. Digital voice technology is rapidly taking over what was historically VHF and UHF FM bands, and with good reason. Even using a tiny inexpensive handheld radio, you can use a digital voice repeater to access a network of hundreds of other repeaters and stations around the world.

I've been a ham for nearly 50 years. I've gone from a time when most mobile rigs were crystal-controlled, and digital displays were a pricey luxury to the days when you can buy a VHF HT for less than it costs to get lunch. Like you, I wanted to get involved in "digital radio," but I found it very difficult to find a single source of good information about how to get started. But with what I've been able to figure out, I can share it with you and give you a good jump start on getting ready.

You don't need to spend a lot of money initially. In fact, if you have an Internet connection and either a computer or a cell phone, you can probably get started with no expenditure. Sure, later you may want to buy a digital radio, a gateway, and maybe even an antenna. But by then, you'll know that you are already hooked. You do, however, need a ham license. While that may seem strange since much of the traffic is over the Internet, you will have your transmissions sent over the radio waves, sometimes in far-away countries. So a license is required to access the network.

This document will mainly cover DMR on Brandmeister, Peanut, and the TGIF network. If that doesn't mean anything to you, don't worry. It will by the time you finish reading. However, there are many other networks, and we'll talk about some of them. However, you'll need to do a little more homework if you want to use those networks. But, if you understand one network, it is usually easier to learn about the others.

What is DR?

I'm going to talk about DR as Digital Radio. This is often known as DMR–Digital Mobile Radio–but that's actually just one kind of digital radio. There are other kinds, too. They are all somewhat similar and all somewhat different.

At the core of the DR networks are computer servers around the world that cooperate with each other. They maintain what you can think of as chat rooms often called talkgroups. Repeaters and gateways connect to this computer network. Audio can come in over the radio or over the network. It is sent to other users who are listening to the same talk group.

So here's an example. Your local DMR repeater is in a talkgroup with other repeaters in your area, some of them up to 250 miles away. You hear a ham calling for directions over the repeater. That ham might actually be talking to one of the other repeaters in the network. The network computers forward the audio to the other repeaters where you then hear it. You are able to respond in the same way, and the computers will carry your audio back to the distant repeater. It will also carry it to the other repeaters. If someone in your group is away on travel, they might be using a computer to connect to the talk group from their hotel room in London. They'll hear your conversation, too. They could even break in and help.
Of course, the devil is in the details, and we'll get to those soon. The point is that melding radios and Internet technology can give you unprecedented reach with even modest equipment. In general, digital modes make better use of spectrum, too. For example, many systems can squeeze two simultaneous conversations on one repeater. There are also ways to let many types of users share one channel. Sometimes, these features are made more for commercial users, but hams may use it, too.

Is it Radio?

There are people who think using network transport between stations isn't "really radio." And people thought AM phone was destroying ham radio. Then SSB. Ham radio has many different aspects, and this is one of them.

Consider amateur satellites. Exciting stuff. But you can't really talk for long, usually (depending on the satellite), and it might not be very practical for emergency communications. That's OK. It is still a great thing that adds a lot to our hobby and the state of the radio art. DR is the same. It is true that in a big emergency, the Internet or the servers could be down. But that's not every case. For example, a hurricane might take down the network in an area. But relief efforts could still use DR to coordinate and portable low-power repeaters could build the radio network up very quickly compared to some other scenarios.

Don't let anyone tell you how to enjoy your hobby. People use ham radio to fly RC planes. They aren't talking to anyone. Some people trade photos instead of talking. You do you!

Even after almost six decades, there are parts of ham radio that I haven't tried. They didn't appeal to me. But if they appeal to you, I'm glad. DR won't be for everyone, either.

The Granddaddy: Echo Link

Perhaps the oldest DR system of all is EchoLink. While Echolink does serve a similar purpose, it isn't as flexible as modern systems. For the most part, repeaters and links connect over the network, and nodes on the network can connect to them. They do have "conferences" which are similar to talk groups. However, they aren't as flexible and there isn't availability of Echo Link native radios.

I'm not going to talk about Echo Link much, but if you want to know more, visit: https://www.echolink.org/. You can find clients for Windows and it will run under WINE on Linux. There are also Linux-native clients (https://flathub.org/apps/org.svxlink.Qte), a client you can run in your browser (https://webapp.echolink.org/), and ones made for mobile phones (https://www.echolink.org/download.ht).

Like many DR systems, one challenge is finding people who want to talk to you. In theory, you should be able to go to a conference (or talk group) about whatever you want to talk about. But in practice, there are many conferences and groups, so it takes a little guesswork or tools to find out where people are. However, EchoLink does have a "CQ" function where you can get matched with other people calling "CQ" at random, based on languages you indicate (so you can indicate you only want to speak English, for example).

The No Radio Solutions

Echo Link works in two modes. If you want to create a link or a repeater, you will need radio gear. Keep in mind that while Echo Link handles data over the network, on the radio side, it is all analog.

However, you can just access the network directly with a computer and a network connection. Many DMR networks have this same capability. Let's talk about what a typical network looks like and then dig into how you can try one out with nothing but software, a computer, and an Internet connection. There are other networks that act more or less like digital trunk lines between repeaters. For example, check out IRLP (https://www.irlp.net/) and AllStar (https://www.allstarlink.org/) which operate similar networks.

Anatomy of a Network

The most common DR network currently is the Brandmeister network, which uses Digital Mobile Radio (DMR). This is an open source protocol that is very popular among repeaters and radio users. There are other DMR networks, and we'll cover some of them later, but we'll start with Brandmeister.

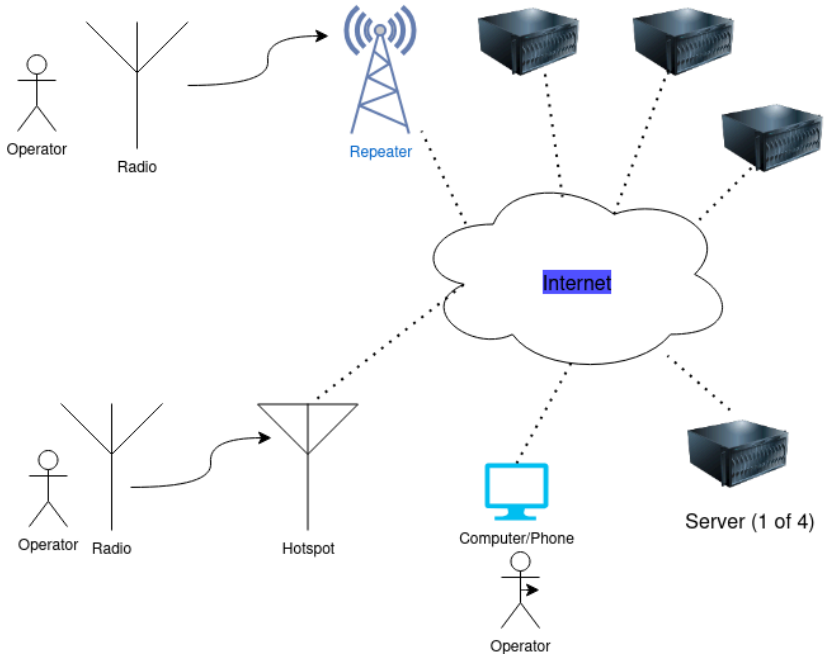
To connect to the network, you need a DMR ID, which you can obtain for free. You also need a free account on the Brandmeister network. If you have an ID and you have your radio configured properly, you can access the network.

Some people use a "hotspot" instead of a repeater. Actually, this is a kind of repeater, but with very low power. It connects to your Internet and listens for your DMR radio, which can be set to low power since you are presumably near it. So, more or less, it is a (typically) very low power repeater you operate yourself. Some are simplex, and others are duplex, but either way, they still work basically the same. They are also typically inexpensive. Cheap units are available for well under $30. A few hundred dollars will get you a top-of-the-line model.

To use a hotspot, you need to register it on the network and assign it a password, which your radio will need. Otherwise, operation is just like with a repeater.

But I promised you that you don't need to buy anything, so how does that work? There is software which is essentially a hotspot without a radio. Instead of taking audio from a radio, it reads and plays sound via the computer's sound card.

So, there are at least three ways users can access the network (see the diagram below). All these users can talk to each other. In addition, DMR radios can talk directly to each other with the usual limitations of simplex communications.



Three users accessing the network in different ways

Any of the operators in the figure could be talking to each other by joining the same talk groups. You'll learn more about this later.

Every repeater or hotspot needs to have a server address to use. These are roughly divided into areas, with highly populated areas having multiple servers. For example, the United States has three at the moment. You generally want the server that has the lowest latency (the best ping time). However, regardless of which server you connect to, you will have access to the entire network. You don't have to be on the same server to talk to other people in the Brandmeister network.

Each repeater has, of course, an input and output frequency along with a "color code" (really a number). This is similar to an access tone on an analog repeater. In addition, each repeater has two "time slices." The repeater documentation will tell you what talk groups are available on

each time slice. Often, TG1 or TG9 is set for local or nearby traffic, often on time slice (or TS) 2. Usually, time slice 1 is for wider area groups.

If you are using software only, you really only need the hotspot password, the server, and the talk group of interest. We'll cover all of this in detail in the next section. Meanwhile, here's a summary of what you need to get:

	Software-only	Radio+Hotspot	Radio+Repeater
DMR ID	x	x	x
Brandmeister Login	x	x	x
Hotspot password	x	x	
Server	x	x	
Input/Output Freq		x	x
Time Slot		x	x
Color Code		x	x
Talkgroup(s)	x	x	x

Note that your local repeater may have a talkgroup of its own or participate in a regional one. That means that even with the software-only or hotspot configuration, you can still talk on such a repeater. You just talk to it over the network and not over the airwaves. Many repeaters also have analog peers, so someone could be answering you using an analog radio, in that case.

Your local repeater may be on the Brandmeister network. If so, you can usually access any talkgroup you like. Other systems like DMR-MARC allow the repeater owner to control what talkgroups you can use.

Let's Go!

There are ten simple steps to get to your first DMR QSO. Actually, there are only nine, but you'll want to do the tenth after you get your feet wet.

1. Get a DMR ID
2. Register with Brandmeister
3. Get a hotspot password
4. Download and Install the Software (we will use DroidStar)
5. Configure DroidStar
6. Talk to a Parrot (for testing)
7. Pick a Talkgroup
8. Listen

9. Make your First QSO
10. Managing Your Talkgroups

Step 1: Get a DMR ID

Your DMR ID is a 7-digit number like a phone number that identifies you and is tied to your license. Your default radio will use the same number, but you may have more than one radio (or hotspot or software). To that end, you can add two more digits – the ESSID – to the end of the number. So if your DMR ID was 1234567 you could have one radio set to that number and more radios with an ESSID like 123456789 or 123456701. I'm not sure if a blank ESSID is the same as 00, but since you have 99 other options, I'd use 00 as a last resort.

To get started, visit https://radioid.net/. You'll need a PDF copy of your FCC license. This has to be an "official" copy and not one the public can get or a copy.

- Click Log In/Sign Up at the bottom of the left options bar
- Create an account and follow the prompts
- Upload an official copy of your FCC license
- Wait for an email with your new ID within a few days

If you are a US ham, you can get your license PDF from the FCC:

- Log into the FCC system at http://wireless2.fcc.gov/UlsEntry/licManager/login.jsp
- Click "Download Electronic Authorizations" in the left side menu
- Select your callsign and click ADD >
- Click Download > at the bottom right of the page
- Save the PDF file

It does take a few hours or a day or two for someone to verify your license. Once you get your ID number, you are ready for the next step.

Step 2: Register with Brandmeister

- Go to the BrandMeister Dashboard (https://brandmeister.network)
- Click on the "Register" link at the top right of the page.
- In the registration form, enter your callsign, email address (using the same email as your RadioID account), and select "Personal User Account."
- Create a password and confirm it.
- Answer the anti-spam question: "What is the wavelength of the UHF band in centimeters?" Oddly, this doesn't change and you probably know the answer is "70."
- Complete the CAPTCHA and click the "Register!" button.

After registering, you'll receive a confirmation email. Check your inbox and spam folders. Click the confirmation link in the email to verify your address. Final approval may take up to 48 hours. All of this is run by volunteers so it is impressive it doesn't take longer.

If you just created your DMR ID and you are getting a message that the ID is invalid, it may be that the systems haven't received your information yet. This could take a few hours or even a few days. However, before you decide to wait, double-check that you have the correct number.

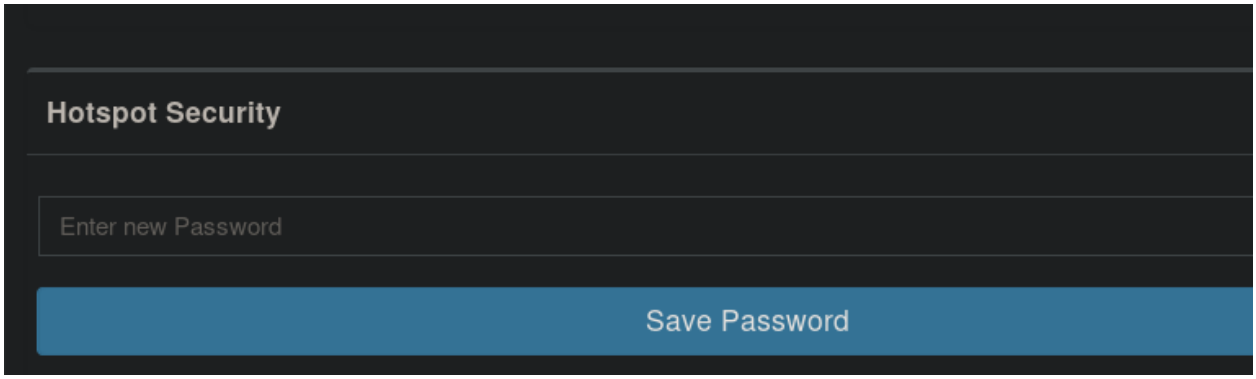
Log into your Dashboard and you are ready to go to step 3.

Step 3: Get a Hotspot Password

Once you log into your Brandmeister dashboard, you'll find a section called "Self Care." You can find it on the left-hand menu or click your call sign at the upper right and then pick that option.

From within Self Care, locate the "Hotspot Security" option and toggle it on. Set a password. You could use the same password you used to get in, but they probably don't suggest that. This password is what you'll need to set up your hotspot.

If you are using software-only, you still need the hotspot password. The software appears on the network as a hotspot, even though it doesn't have a radio. The computer or phone sound hardware replaces the radio in a traditional hotspot, but to the network, it is the same thing.



The password you've entered there will go into the BM Pass field in DroidStar

Step 4: Download and Install Software

For a software-only solution, the best option I've found is "DroidStar." Unfortunately, there are a few issues that make it a little harder than it should be.

1. It requires either a hardware CODEC to do voice encoding or a software plugin.
2. The software plugin may or may not have some legal encumbrances, so it can be hard to find.
3. The original developer seems to have let it go, and there are a few branches of it with varying degrees of quality that may come and go.

If you want to install on an Android or iOS phone, I suggest a recent branch that has many improvements and has the CODEC built in. You can find it here: https://github.com/rohithzmoi/Droidstar-DMR.

For Android, there is an "official" play store entry, but it lacks some features: https://play.google.com/store/apps/details?id=org.dudetronics.droidstar. If you prefer Apple, you will need a side loader, which you can find here: https://sideloadly.io/. Some people mention needing TestFlight from https://apps.apple.com/us/app/testflight/id899247664, too.

If you use Linux, there is a Flathub install that works well. It also has the codec built in. You can find it on GitHub: https://flathub.org/apps/io.github.nostar.DroidStar.

For Windows, you will find prebuilt versions at http://pizzanbeer.net/droidstar/ and also at https://dudestar.gw8szl.co.uk/Droidstar/, You can also find the CODEC plugins if you need them. You don't need to download the CODEC directly. Instead, you'll give DroidStar the URL and let it download it so it can properly install it. Finally, the GitHub for the current "base" version seems to be: https://github.com/nostar/DroidStar.

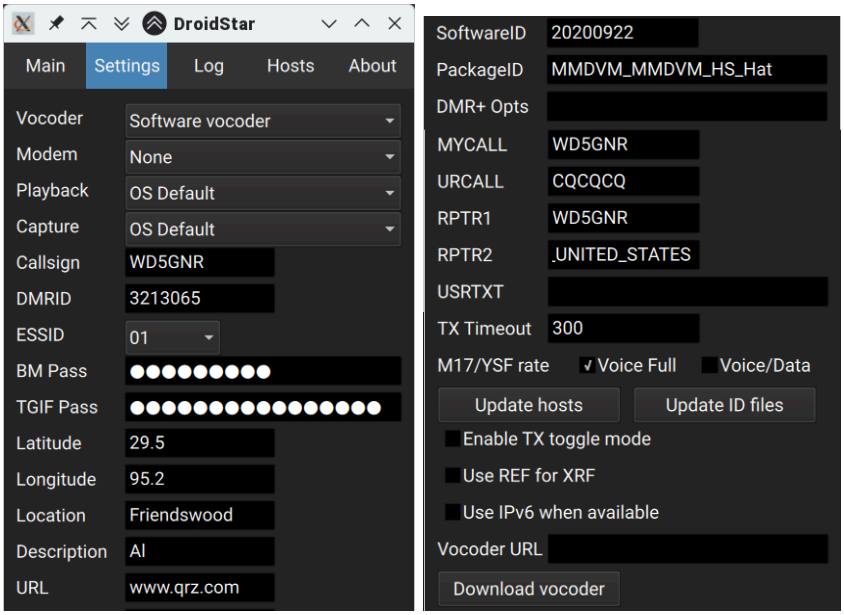
Of course, like everything on the Internet, these things come, go, and change from time to time. Exactly how you install and what is going to depend on the platform and what you've downloaded.

Step 5: Configure DroidStar

DroidStar looks the same no matter what platform you use which is the good news. The bad news is that the user interface is kind of interesting. Along the top there are some tabs and one says "Settings." That's the one you want. Here are the entries and what you need to do with them (some of these don't really apply to DMR, but I'll include them anyway):

- Vocoder: Software vocoder (unless you have a hardware dongle)
- Modem: None
- Playback: OS Default (you could, in theory, select speakers you want to use)
- Capture: OS Default (you could, in theory, select a microphone you want to use)
- Callsign: Your callsign. Some documents show that want you to add a "B" or other letter to the 8th character. That's for DSTAR. It is OK if you do this, but for what we are doing, it isn't necessary. But if you see something like "WD5GNR_B" (where the underscore here is really a space) then that's a setup for DSTAR
- DMRID: Your DRM ID from Step 1
- ESSID: Leave None if this is your first setup. Every time you set up a radio or hotspot it should have a different two digit ESSID (e.g., 01, or 99)
- BM Pass: The hotspot security password from step 4 for Brandmeister
- TGIF Pass: The hotspot security password for the TGIF network (we'll cover that later; leave blank for now)
- Latitude: Your latitude
- Longitude: Your longitude

- Location: Your city name (not a grid locator)
- Description: Anything you want
- URL: Your website URL If you want; defaults to www.qrz.com
- SoftwareID: Shouldn't change
- PackageID: Shouldn't change
- DMR+ Opts: Blank (not needed here)
- MYCALL: Also your call
- URCALL: CQCQCQ
- RPTR1: Your call (again)
- RPTR2: Leave blank (the system may fill it in later)
- USRTXT: Leave blank
- TX Timeout: 300 (5 minutes/300 seconds it the default which is fine)
- M17/YSF Rate: Voice Full (not needed here, but ok to leave the default)
- Enable TX toggle mode: Suggest you uncheck (see below)
- Use REF for XRF: Unchecked
- Use IPV6 when available: Suggest unchecked and it is sometimes unstable with IPV6 in testing
- Vocoder URL: Blank (this is the CODEC plugin download URL if you need it)



Some of the options available to configure DroidStar

There are also several fields at the bottom that really only apply if you are using an external modem/hotspot.

I suggest you do not turn on the TX toggle option, especially on a phone. If you accidentally hit the TX button, you will be "transmitting" until you either hit it again, or the timeout hits (either 5

minutes or the talkgroup's, whichever is less). On a desktop, it might be useful to keep it checked, though.

There are three buttons on this screen. One downloads the CODEC if you have something in the Vocoder URL box. Usually, you don't need this, but if you do, that's how you download and install the CODEC.

The other two buttons update the hosts file and the ID files from the network. You need to occasionally do these updates, so I'd press them when doing the initial setup. Otherwise, you shouldn't need to do it very often.

While you don't have to update the hosts and ID files often, they do need updates. Don't forget to push them from time to time and especially if you are having strange connection issues.

Step 6: Talk to a Parrot

We are almost ready to get started. Return to the home page using the Home tab at the top of the window/screen. You want to pick the DMR network. Since we aren't really using a repeater, the S1/S2 (timeslice) and CC0 options aren't very useful. Those work with repeaters. For this test, check "Private"

Pick a nearby server, for example BM_3103_United_States. You should pick a server that starts with BM (Brandmeister) that is at least somewhat close to you. Click SWTX, SWRX, and AGC (although, with no modem, it should check the first two for you when you transmit – they indicate software transmit and receive, respectively). See Appendix 5 for more information about the items on the main screen of DroidStar.

Finally, click the Connect button. If you can't connect and your Internet connection works, be sure you have the right password in the BM Pass box. Remember, this isn't necessarily the password you use to log into Brandmeister. It is the hotspot password you set in step 3. The only way the other password will work is if you set them both the same. If the button says "Connecting" for a long time and never turns to say "Disconnect" then you aren't finding the host. You can click on "Connecting" to abort the attempt and try again (perhaps with a different server).

If you just created your DMR ID and you are getting a message that the ID is invalid, it may be that the systems haven't received your information yet. This could take a few hours or even a few days. However, before you decide to wait, double-check that you have the correct number.

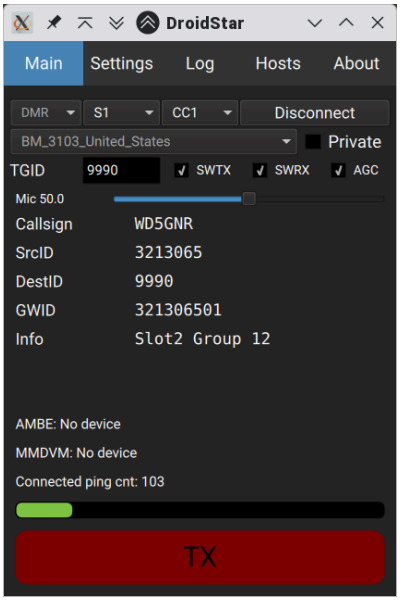
If the blue button at the bottom does not say TX, then you are not connected. Assuming you see it, put 9990 into the TGID so you can talk to a "Parrot." That is an automatic server that will repeat anything you say to it. Remember, we clicked Private up at the top, but make sure it is still ticked.

Press the TX button. If you have the toggle mode turned on, you can let go right away. Otherwise, hold down on the button with your mouse while you speak. You should wait a second because the system often takes a little bit to connect everything and if you start speaking right away, the first part of your speech might get lost.

Identify with your callsign and say “Testing” along with anything else you want to say. The connection is kind of private, but kind of not, so maybe nothing too terrible. When you are don’t, do not immediately turn off the TX button! If you do, the tail end of what you are saying will get cut off. Instead, hold the button down (or don’t click on it if in toggle mode) for about a full second. Then release it. A few seconds later, you should hear your voice coming back to you.

If you don’t see anything, that probably means you have something wrong, and you should go back and check the configuration. If you see the Parrot respond but you don’t hear audio, or it is very low, try adjusting the Mic slider and try again until you are happy with the results. If your audio cuts out at the start or the end, practice waiting a bit before you press or release the microphone button until you get good results.

There are other parrot servers on the network. Each master server has one that ends in 997. So if you are on, for example, BM_3103_United_States, you can use 310997 as a parrot server (again, a private call). The documentation claims can also make a group call to 31000 (where the 310 is from the server name), but this doesn’t seem to work from my testing.



DroidStar talking to the parrot

As you speak, you should see a green bar near the bottom deflect with your voice. You should also see your call and your DMRID just under the Mic slider. The DestID should be 9990.

Note that near the top left of the screen you selected DMR. There are other systems you can use, and they will change the options in that area of the screen. Those options correspond to other systems like DSTAR, XRF, and more.

Step 7: Pick a Talkgroup

Since this is a private call, you don't really need to do anything to drop it, but that won't be true later. For now, uncheck private and enter a new TGID. A common one that is often busy is 91 which is a global channel. You might also try 93, the North America talkgroup or 3100 which is a bridge for several systems in the United States.

If you want to connect to a local repeater, you could enter its talkgroup or a talkgroup it uses here. Check out the repeater's website or ask around.

Step 8: Listen

You might expect that once you set the new talk group, you'd start hearing things from it. But you won't. By default, your system is listening to no talk groups, and the TGID box is simply about transmitting.

Let's assume you are on talk group 93. The Brandmeister server has no way to know you want to listen to talk group 93 and it isn't going to send you all traffic from all talk groups. That isn't feasible.

Not all talk groups are very active. You will see how to find active talkgroups soon, but for now consider one of these, which are frequently very active: 91 (worldwide), 93 (US), 3100 (US)

To let the server know you want to hear, you need to "kerchunk" the talkgroup. That is, just make a short silent transmission. The network knows who you are, so it will show your callsign on people's screens–this isn't considered rude on talkgroups. If you are too hesitant, the system may not register you. You need to make a good solid push of the PTT button.

Now the server knows you want to hear things from that talkgroup and will add it to any active talkgroups which, in our case, is none (well, other than the Parrot talkgroup which isn't going to do anything and is private to us).

We'll talk more about managing talkgroups, but for now, just know that kerchunking will connect you to that talkgroup for about 15 minutes (although that period of time can vary wildly). As long as you stay active, the timer keeps resetting. After 15 minutes of inactivity, you won't get any audio from that talkgroup until you use it or, at least, kerchunk it again.

After you kerchunk, you should listen for a good bit before making a call. Because people need time to connect and disconnect, it is customary to pause a few seconds between calls. So if you connect to the group and immediately start talking, you may be interrupting an existing QSO.

As you listen, you might hear someone announce their call and state they are monitoring or ask if anyone is monitoring. That's your cue.

Step 9: Talkgroup Etiquette and Your First QSO

Wait a few seconds to be polite, and if no one else answers, key your TX button and respond. If you have listened to several talkgroups, you need to make sure you are on the same talkgroup. In fact, most people will say something like "Whisky Delta Five Golf November Romeo monitoring talk group 3100." You can also see it on your screen when they talk.

So assuming you are on the right talk group and you reply to the calling station, there is a good bet they will respond and you can conduct a QSO. A few basic pieces of etiquette will help.

First, there is no need to identify on each and every call like you might on HF. However, you do have to identify according to your local regulations. For example, if you normally have to ID every ten minutes, then you'll need to do that here, too.

You may wonder why you have to ID when people can see your call clearly on their screens. Keep in mind, though, that some repeaters will pick up your talkgroup traffic and rebroadcast it as an analog signal. Anyone listening to a repeater like that will have no way to identify you. Don't forget to wait, key up, wait a bit, talk, wait a bit, and release the key. This gives others a chance to break in, as well as to connect or disconnect from the group.

If you are on a wide area talkgroup like 91 or 93, it is good practice to not have protracted QSOs. A better idea is to move to a TAC group (tactical). So if your QSO partner wants to have a detailed conversation about the latest movie, maybe move to a TAC group like 310, for example. Some talkgroups will time you out, if you go overtime. You'll see later how to find a list of talkgroups and what they are for.

If you've listened to more than one group, you may be surprised to hear someone from a group you aren't currently talking on coming in. That's a feature because the Brandmeister network has kept your groups connected until you time out.

The problem is, if you are trying to talk to someone on 93 and the 3100 group keeps interrupting, you can't talk to the guy on 93. There are a few ways to disconnect all your groups. Note that different devices behave differently. Some will automatically drop talkgroups when you switch to another. But if you have traffic coming from different groups and you want it to stop, you probably should try the following trick.

The easiest way to drop talkgroups is to “kerchunk” talk group 4000. Depending on the server, you might not hear anything or you might hear “Not Linked.” You aren’t annoying anyone, that’s what the group is for. After that, you’ll need to go connect back to whatever group or groups you want.

This is one reason to leave longer pauses between transmissions. People need time to leave the talkgroup. In addition, pushing the PTT button sometimes takes a second to setup and also your voice might be a little “behind.” It is good practice to pause, push the TX button, wait a beat, start talking, pause a beat, then let go of the TX button. Otherwise your voice might get cut off. You should also limit the length of your transmissions (some groups/systems/radios will timeout anyway) and limit your QSO length on talkgroups where you are covering a wide area. A common thing to do is move to a “TAC” talkgroup reserved for longer conversations.

If you are on the Brandmeister Website, you can do it from there, too. On the left-hand side of the screen you’ll see “Devices”. If you pick your device, you’ll see “Actions” buttons that read:

- Get IP Address - Find the connected IP address
- Drop Call - Release the currently active call
- Drop Dynamic Groups - Drop the dynamic groups (like 4000 does)
- Reset Connection - Reset everything for the device (back to defaults)

Another idea is to simply disconnect from the server and reconnect. Unless you are listening to the default talkgroup, that should work.

When you are talking to someone, ask about your audio quality. You may need to adjust the mic slider on the DroidStar app until your voice is clear. You might also consider trying different microphones.

Step 10: Managing your Talkgroups

Unfortunately, DroidStar doesn’t have much in the way of talkgroup management. You plug your numbers in, and that’s about it. It is possible on the BrandMeister “My Devices” section to set up static talkgroups. In theory, then, you’d always listen to those talk groups. Although that works that way on some hardware, it doesn’t always work on DroidStar (and on some other devices like simplex hotspots, we’ll talk about later).

What that means is that you really do have to “kerchunk” the talkgroup to connect to it. In some cases, if you add multiple talkgroups, they will stay active until they timeout or you drop everything with a 4000 connect or the action buttons. However, DroidStar–like some hotspots–seems to drop a previous talkgroup when you switch to another. If it seems like that’s not true, you probably didn’t kerchunk long enough or you tried to switch while the channel was busy. If in doubt, though, you can use 4000 or just disconnect from the server and reconnect.

You might consider putting your favorites in a spreadsheet for copying and pasting. The newer version for Android and iOS linked above does have a drop down that shows you the last few TGs you've used. That's handy, but you still have to remember which one is which.

What if you want your own talkgroup? You sort of already have one. You can listen to your DMR ID and others can talk to you there either in private mode (one-on-one) or group chat (a regular talkgroup). However, I've found that everyone in the conversation needs to be on the exact same server you are. So if you are on BM_3103_United_States, everyone else has to be as well. Normal talkgroups propagate between the servers, but your private one, apparently, does not.

You can also use ESSIDs with your DMRID as a talkgroup with the same caveat. So if your DMRID is 1234567, you might use 123456743 as your "family" channel and 123456722 as your "neighborhood" channel, and so on.

Note: For some reason, using your own ID and/or the ESSID as a talkgroup only seems to work on BM_3103_United_States, at least in the United States.

Other devices may behave differently with respect to self-ID talkgroups and even using TG 4000. Other devices may also have better ways to manage groups, some of which we'll talk about later. Meanwhile, go make some contacts, some new friends, and enjoy the Brandmeister network. But when you get a little bored, we can add a new network to our repertoire.

If you use a hotspot, you can go into the device configuration for Brandmeister and set static talkgroups. These are groups the radio will always listen to. It is also possible to set times (e.g., connect talkgroup 1234 for an hour every day at the same time).

This doesn't seem to work well with DroidStar, but if you set one static group, it may cause DroidStar to listen to that talkgroup upon startup.

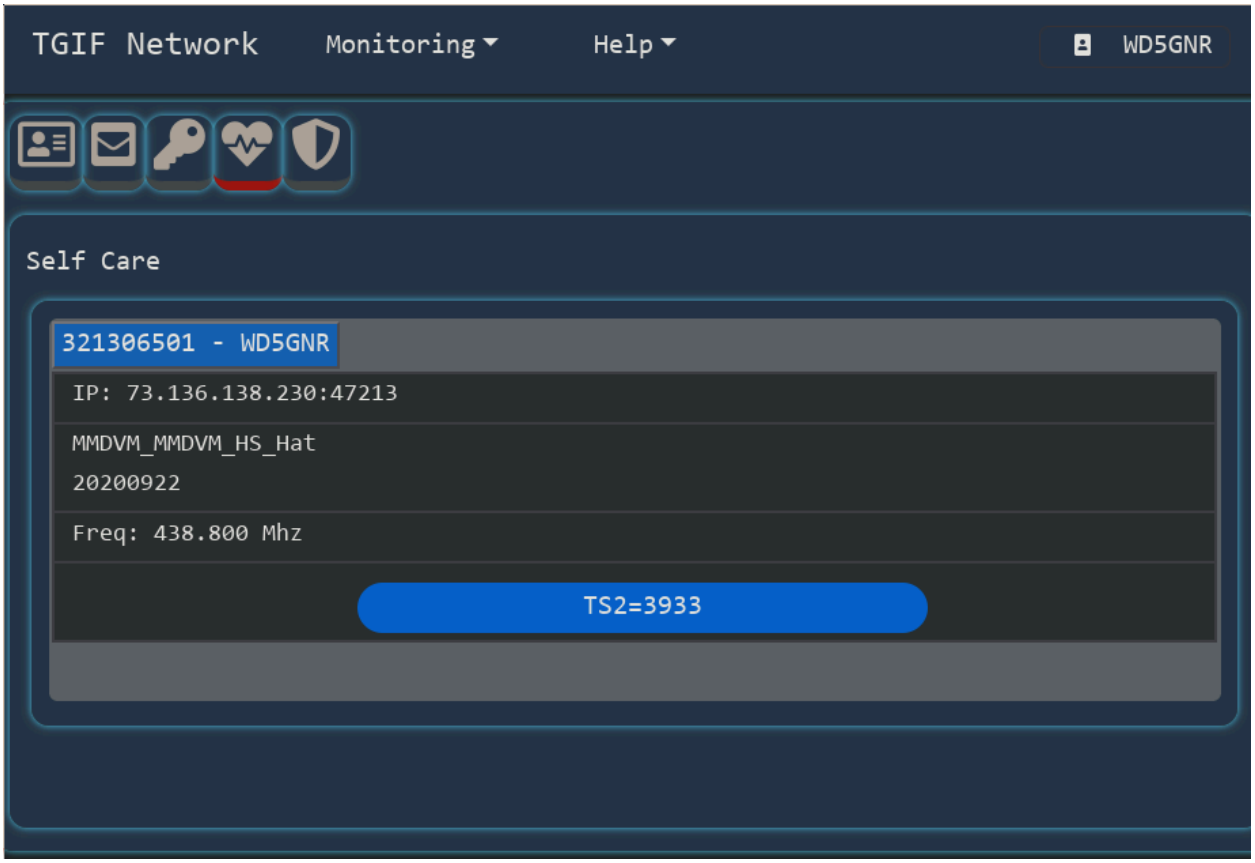
What's Next? TGIF

The TGIF network is very similar to Brandmeister, although perhaps a bit smaller. It uses similar concepts, but it does not accumulate talkgroups. The basic steps to join are very similar. You need an account at the website after you have your DMR ID: https://tgif.network/. You can and should use the same DMR ID you are already using.

Once you are logged in, you can click on your callsign in the top left corner. This will bring up a menu where you can, again, select "Self Care." That will lead to a screen that has some icons. One (the last one as of right now) looks like a shield and if you let the mouse hover over it says "User Security." You can generate a new password or read the old one here.

This password is what goes into the TGIF Pass filed on DroidStar settings. Once you have that, you can change the server from one of the BM_ servers to the TGIF_Network selection. You'll need to disconnect from the other server, first, of course.

Otherwise, everything is just about the same, although specific talkgroup numbers may differ between the two networks. The TGIF network only lets you hear one talkgroup at a time, so you don't need to use TG 4000 to drop groups. However, the 4000 group doesn't route, so you "tune" to it if you just want things to be quiet.



The TGIF session is listening to TG3933

If you can't find a break in the conversation to change TGs, you can do it from the self-care screen. The "Heart" icon shows your current sessions, and by pressing the blue button, you can pick a new talk group from the list.

Common TGs on this server are 110 for North America and 31665, known as "TGIF The Mothership." You'll learn more about other talk groups shortly.

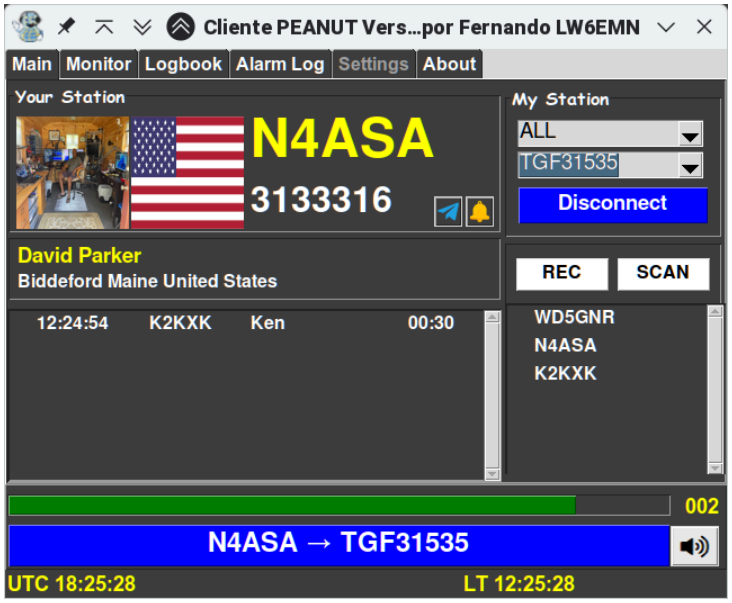
About Peanut

Another option you can use on Windows or Android is Peanut by PA7LIM (https://www.pa7lim.nl/peanut/). Not only does it allow you to communicate with others, it has bridges to DMR and other systems.

Like other systems, you need to register with a copy of your license. To do this, you need to access their registration portal: https://register.peanut.network/.

You can find a list of talk groups and real-time activity here: https://peanut.pa7lim.nl/. Note that many of the groups are cross-linked to other systems. Note that Peanut is all digital. The only way to be “on the air” with Peanut is to use a talkgroup that bridges to another system that is on the air.

There is an interesting Windows and Linux client by LW6EMN for Peanut that has good audio quality and many features at https://lw6emn.ar/. However, if you don’t read Spanish, you might want to check out the English instructions at https://lw6emn.ar/software/manual/manual_EN.pdf.



The LW6EMN Program (Cliente PEANUT)

Among the LW6EMN program’s features are:

- Pulls image from QRZ.com for station talking
- Displays country flag
- Shows other information such as name and QTH
- Shows who is in a talkgroup
- Has a log book that can be published to eQSL or exported to ADIF

While it might not be obvious at first glance, the bar at the bottom of the program that has your callsign is the push-to-talk button (the blue bar in the picture above).

When you start the program, it will probably default to Spanish. To switch to English, simply click Configuración at the top of the window and then find the drop-down that says Idioma. Select

English in that box. Press the red button that says Grabar (save). A red message in Spanish will appear which is asking you to restart the program. When you do, everything will be in English.

Finding Activity

Before you explore other systems, it pays to learn how to find things on DMR/Brandmeister and TGIF. We've seen how Peanut has an activity page. The other services have, generally, ways to see lists of all talkgroups and a way to see which talkgroups are active at any given time. They also often have a way to show you active users, too.

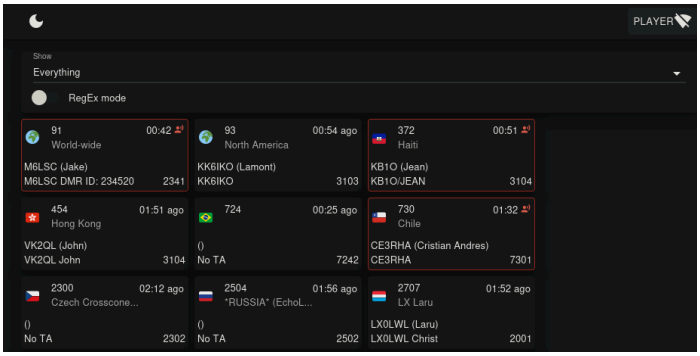
In fact, on the Brandmeister network, you can listen in right now with no software, no ID, no login, and you don't even need a ham radio license. They provide a webpage called "the hose line" (https://hose.brandmeister.network/). You don't even need to log in to use it (see my article about this at https://hackaday.com/2025/01/15/no-ham-license-listen-anyway-in-your-browser/ for more details).

The hose will show you all the recent activity on the network. Boxes with red borders are currently transmitting. You can filter by country by clicking on the top left corner that says "Everything." Click on it, and you can deselect Everything and then pick one or more country flags to cut the list down.

If you really want to filter, you can turn on RegEx mode and use a regular expression to select certain talk group numbers. That's beyond the scope of this tutorial (try https://regexone.com/), but if you know regular expressions, it isn't hard to figure out.

Here's the interesting part: If you click one of the squares, you'll be able to hear the talkgroup through your speakers. At the top right of the screen is a box labeled "Player." While audio is playing, you can click it see details about the QSO. You can also use the dropdown there to directly select a talkgroup to eavesdrop on. You can also put on some headphones and use it to listen to your own audio when you talk (you should probably use talkgroup 98, the test group, if you want to do that). Just like the parrot, this is a useful way to troubleshoot any audio problems you might be having.

You can also get the hose on your Android device (https://play.google.com/store/apps/details?id=network.brandmeister.hose&hl=en_US). Just the thing to keep tabs on what's happening when you are on the go, but you can't transmit.



The Hose

You can find more information about the talkgroups and even download the data in different formats from a different web page: https://brandmeister.network/?page=talkgroups.You'll see buttons that let you track the last heard on the talkgroup, open the hose, or open a page in the Wiki about the talkgroup. In addition, if you click the talkgroup number you can see a list of all the devices connected to the talkgroup. Keep in mind that some of these may be repeaters or gateways that might not have any people listening to them, or may have dozens of people listening to them. You can't really tell.

You might also want to track active users at this page: https://brandmeister.network/?page=lh.

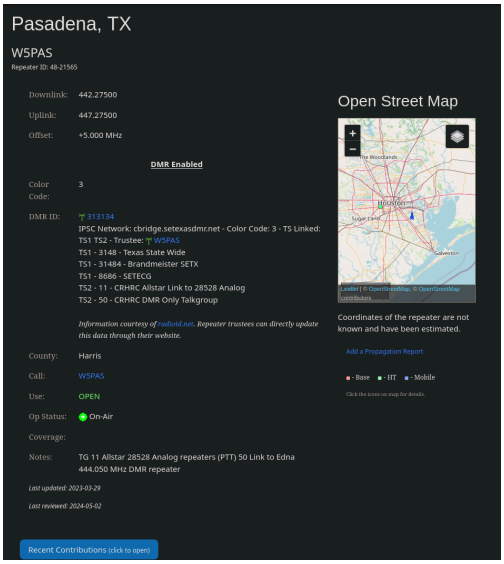
The TGIF network doesn't quite have as many options, but you can find similar data on their web site. The list of all TGIF talkgroups is here: https://tgif.network/talkgroups.php. Active talkgroups appear here: https://tgif.network/activetg.php. You can find active users at this page: https://tgif.network/lastheard.php.

Finding Repeaters

Sometimes, you want to hang out on a local repeater–or even a repeater that isn't local. In the first case, you can use a radio if you have one handy. But if you don't, or if the repeater is out of your range, you can connect to its talkgroup or a talkgroup that it repeats.

Most common repeater databases like https://www.repeaterbook.com/repeaters/niche/index.php?mode=DMR will show the DMR details. You can also find web pages for the repeater (or the club or trustee) that will show this information.

For example, here is an entry from RepaterBook for a repeater local to me:



A typical repeater's info page

This tells us quite a bit. Obviously, we know the up and down frequency and the color code, which we need if we have an actual radio. The DMR ID is 313134. On time slice 1, there are several talkgroups linked (3148, 31484, and 8686). Time slice 2 has a link to an Allstar system and another talk group. Often, some talkgroups will show some mark like PTT 10. This means you have to key the talk group to listen to that group and it will expire after ten minutes of inactivity. Note, however, that the page mentions this is on a "C-bridge" network. That means that TG3148 here won't be the same as TG3148 on Brandmeister (or TGIF, for that matter). Sometimes groups are linked together, but it seems fairly rare.

So, if you have a regular radio, you could request any of these talk groups by setting your radio to that group and keying up or, in the case of static groups, just listening.

Network Gateways and Clusters

This repeater has links to other systems and this isn't uncommon. That means if your friend has a different DR system, you may be able to connect anyway via a gateway. For example, Brandmeister TG 31444 links a node that is also on Allstar, TGIF, YSF, D-Star, NXDN, P25, and Echolink (this is the Rhode Island Digital Link Network run by KA1MXL; see https://www.qrz.com/db/KA1MXL).

You can often identify these gateways in the talkgroup lists or on the repeater pages. There are a few talkgroups of special interest that are also linked across multiple systems.

Another term you may hear is "cluster." This is when several repeaters are linked together. Unless you are configuring a repeater, you probably won't worry much about clusters. Just realize that on some repeaters, you may be keying up a number of other repeaters every time to you talk.

Nets

Another way to find people to talk to is to participate in nets. There are many lists of nets online, some more up-to-date than others. One good site is NetFinder (https://netfinder.radio/nets/modes/dmr) which lets you search by a number of criteria.

Many nets are on different systems and groups at the same time. For example, the Absolute Tech Net (https://www.absolutetech.org/) is on TGIF talkgroup 326, but also has conferences under Fusion, AllStar, IRLP, and EchoLink and others.

Other Systems

There are many other systems and networks out there. Sometimes, you can find gateways between systems since most won't directly interoperate with each other. For example, FreeDMR is another system, but it lists a number of bridges between Peanut, Echolink, DMR, and other systems we haven't talked about yet at https://www.freedmr.uk/index.php/bridges-to-freedmr/.

Here's a short summary of at least some of the other systems available:

- FreeDMR - DMR with no registration, but not always as stable on the backend
- YSF - Yaesu System Fusion - Only for Yaesu, of course
- AllStar - Repeater linking via Asterisk
- DMR+ - DMR with additional features
- D-Star - First mainstream digital mode
- NXDN - Very narrowband
- P25 - Used in public safety, but some ham use, too
- M17 - Developed for Hams, but not widely supported at this time

Mode	RF/ Internet	Open?	Audio Quality	Ease of Use	Cost	Notes
DMR	Both	Mixed	Good	Moderate	Low/ Free	Most popular
FreeDMR	Both	Yes	Good	Easy	Low	Community-based
YSF	RF	No	Great	Easy	Mid	Yaesu System Fusion (Fusion; also FCS)
Allstar	Both	Yes	Analog	Moderate	Low	Flexible
DMR+	Both	Mixed	Good	Moderate	Low	Features over DMR
Peanut	Internet	No	Great	Easy	Free	No RF
D-STAR	RF	Mixed	Good	Moderate	High	GPS/Data integration

Mode	RF/ Internet	Open?	Audio Quality	Ease of Use	Cost	Notes
						(Dextra, DPLUS, DCS)
NXDN	RF	No	Good	Moderate	High	Rare for ham use
P25	RF	No	Great	Difficult	High+	Public service standard
M17	Both	Open	Good	Moderate	Low	Open Source

Of course, audio quality may be subjective. In addition, it can depend on how your system encodes and decodes audio, so, for example, software decoding on DroidStar may not sound as good as a hardware encoder. Some systems have differences from the way the systems in this document work. For example, D-STAR uses reflectors and ports or "modules" that act like talkgroups. Just as there are networks like Brandmeister, you'll find networks like WiRES-X on that network.

Each network may have its own registration requirements. D-Star, for example, has a trust system (used by reflectors that start with REF). XLX reflectors (http://xreflector.net/) and DCS reflectors on that system don't require registration. You can find many XLX reflectors, for example, in DroidStar (as servers) and servers for other systems like DMR+. Some reflectors, like XRF reflectors, have their own registration mechanisms.

These reflectors or somewhat akin to servers in the DMR world. Instead of talk groups, there are ports, usually lettered from A to Z. Again, this is specific to D-Star, but each system will have a little different way of doing basically the same things.

A few pages to help you with other systems:

- FreeDMR - https://www.freedmr.uk/index.php/world-wide-talk-groups/
- YSF List from W0CHP - https://w0chp.radio/ysf-reflectors/
- D-STAR - http://www.dstarinfo.com/repeater-list.aspx
- D-STAR - A great document from Charles Johnston III: https://sites.google.com/site/wcarasite/digital-comm/d-star-for-dummies (if link doesn't work, search for "D-Star for Dummies." The latest version I am aware of is 4.0).
- D-STAR - Another great document by Susan Mackay VK3ANZ https://www.la1b.no/wp-content/uploads/2016/12/Newbies-Guide-to-D-Star-V2.0.pdf
- Many other systems are listed at https://w0chp.radio/digital-radio-lists/ and in each network area on https://www.pistar.uk. RepeaterBook (https://www.repeaterbook.com/DMR/all_talk_groups.php) also maintains a list of groups that is useful.
- Although it talks about the system in Ireland, this book has a wealth of information about many different DR networks: https://www.galwayradio.com/wp-content/uploads/2021/09/Digital-Radio-Operating-Manual-v2.pdf

Leaping to Radio: Codeplugs, Zones

Eventually, you'll probably want to switch to a DMR radio. In general, you'll make a "codeplug" which configures your radio, and exactly how you do that will depend on your radio.

As mentioned before, you'll certainly need the input and output frequency, the "color code" of the repeater and which time slice you want to use. You can often set up multiple talkgroups to receive at one time. Note that despite being called a color code, the code is just a number from zero to 15.

Many radios have zones that are just collections of "channels." For example, you might have a zone you use when at home and another zone for when you are at work.

Many repeaters use talkgroup 2 to hit the cluster and group 9 as a local talkgroup. You still should verify everything with the repeater owner. Repeater owners may pick a few static talk groups and allow you to kerchunk some others, but not all (and those will time out if there is no activity).

Some radios have a promiscuous mode where it will let you listen to whatever is on frequency regardless of color code, time slot, or even talk group. That also means that someone with such a radio could listen to you even if you have different settings (including a private call).

Why the strange terminology? The original digital radios were programmed with "plugs" and the selective calling number was identified by a colored spot (the color code).

DMR radios don't significantly increase the range of a mobile radio. However, the sound quality is generally great until it drops out completely. In addition, a repeater can easily handle two timeslots which means two stations can use the repeater at the same time.

Of course, if one person is talking on, say, talkgroup 9 on time slot 1, no one else on that repeater can use time slot 1. It won't interfere with someone talking on talkgroup 100 with time slot 2.

Other terms you may hear if you are using a radio:

- Roaming - Some radios can determine if they are weak into a repeater and switch to another repeater. Only useful with coordinated repeaters, though.
- Admit Criteria - This is a rule about when your transmitter is free to transmit.
- CPS - Software to program a code plug (see below).

Programming Software

Programming a DMR radio is a fairly complex affair, so much so that some don't let you do it from the front panel. Even if yours does, you'll probably want to use some kind of software.

Traditional programming software like CHIRP doesn't support these radios because the information needed to program a DMR radio is quite different.

Your radio probably has programming software available for it, but you may or may not like it. If you use Linux, you might look at qdmr (https://dm3mat.darc.de/qdmr/) which can program most features on many radios. If you prefer text-based Linux, there is DMRconfig (https://github.com/OpenRTX/dmrconfig).

There are also some paid 3rd party software available for Windows, notable RT Systems (https://www.rtsystemsinc.com/) which can handle many different radios and costs about $25.

Using a Hotspot

There are a number of ways to create a hotspot, which is essentially your own private (and usually low-power) repeater. You use your radio to talk to your hotspot, which also connects to your network via WiFi or Ethernet.

You can buy ready-to-go hotspots or you can roll your own with a Raspberry Pi, a radio board (sometimes called a hat), and some special software. Here are some common choices:

Product	Description	Approximate Price
Shark RF openSpot 4 Pro	Portable	$320
Bridgecom SkyBridge Max	Dual band	$425
Mokxihit Duplex	Duplex	$160
Pi Star	Homebrew with Raspberry Pi (not actively developed)	Varies (free software)
WPSD	Homebrew similar to Pi Star	Varies (free software)

If you are building your own, you'll want either Pi-Star (https://www.pistar.uk/) or WPSD (https://w0chp.radio/wpsd/). You'll need some inexpensive hardware that plugs into a common Raspberry Pi. In addition, some radios can act as hotspots (which implies you will use it with another radio and a computer, of course).

Either way, you'll have a few things to choose from with respect to radio hardware:

- Single vs dual band - A single band hotspot only listens on one band (e.g., 70cm). There's no real advantage if you are using it for yourself, unless you have different radios that are on different single bands. Most people use UHF single band hotspots or dual-band that stay on UHF all the time, anyway.
- Simplex or full duplex - A duplex hotspot can send you audio while listening for your to key up on a different frequency. This is useful if you need to switch talkgroups while

someone is talking. You can usually drop a connection from the hotspot or the hotspot's web page, too. However, duplex hotspots are a bit harder to set up.

- Supported modes - If you want to use modes like D-STAR, NXDN, etc. You'll want to be sure your choice works in those modes. Also, some hotspots can allow, for example, a D-STAR radio to a DMR network. If that's important to you, do your homework first.
- Analog support - A few hotspots can use a regular analog radio and bridge it to the network. Typically, only higher-end hotspots have this feature.
- Networking - You need a compatible connection to the Internet so be sure to understand if your hotspot choice uses Ethernet, WiFi, or if you want it to use a cellular connection.
- Interface and package - Some hotspots are just boards on top of a Raspberry Pi. Others have cases. Some have screens that show their status and some buttons for operation.
- Portability and power - If you plan to operate portably, be sure you understand how your hotspot will be powered.

One important thing to think about is what frequency you want to use to operate your hotspot. Typically, you'll use a 70cm frequency. While your hotspot is probably very weak, it can still interfere with other stations, so avoid the calling and simplex frequencies as well as repeater frequencies.

For simplex hotspots, the suggestion is to use 430.4125, 430.4250, 439.4125, or 439.4250 MHz. Duplex pairs include: 430.4375/439.4375, 430.4500/439.4500, 430.4625/439.4625, and 430.4750/439.4750 MHz. It doesn't matter which frequency is transmit and which is receive. Of course, listen first and cooperate if you are causing interference. The MichiganOne DMR Net has a longer list of suggestions: https://www.michiganonedmr.net/2021/04/picking-frequency-or-pair-for-your-dmr.html. Or, check out this list from the repeater coordination people: https://ncdcc.net/digital-hotspot-frequencies/.

Most networks will let you configure your hotspot similar to a repeater. You can have talkgroups that always route to your device (static talkgroups) but you can kerchunk to add groups. On Brandmeister, duplex hotspots work much like repeaters. The dynamic groups will stay until you don't use them over a certain period (usually 15 minutes). However, simplex hotspots use, on the Brandmeister network, one set talkgroup at a time (known as auto-static). That means once your hotspot registers for a talkgroup, that talkgroup stays routed to you until you change it. More information here: https://help.brandmeister.us/talk-groups/dynamic-vs-static.

However, note that this is network-specific. The TGIF FAQ (https://tgif.network/faq.php), for example, says that when you change talkgroups, that's your new talkgroup until you change it. That means the ideal setup for each type of hotspot is different and may depend on the network or networks you are using.

Speaking of networks, hotspots can often route different traffic into your radio using something like DMRGateway. On WPSD, for example, the default setup uses Brandmeister as the "default" DMR network. But if you are set up for TGIF, you can simply add a 5 to the start of the talkgroup ID (which now has to be 7 digits) and it will route traffic to TGIF. So to monitor TGIF TG 31656,

you would actually tell your radio to get 5031656 and the hotspot will take care of the rest. Note, you have to use all the digits. TG 531656 would not work.

Recommendation

If you have a Raspberry Pi and a few bucks to get a board to plug into it, it is hard to go wrong with WPSD. It does just about everything you want and it is actively maintained. If you have an extra radio that can take the OpenGD77 firmware, it is possible to set it up to be the radio part of the hotspot.

If you can't decide between WPSD and Pi-Star, why not try both? It is easy to put one on one SD card and the other on another card. Then you can easily try both and see what you like best. However, if you don't want to be bothered, start with WPSD.

WPSD works well and should be all you need. Rather than duplicate the setup instructions here, get the current version directly from https://w0chp.radio/wpsd/.

Simplex and Direct Operation (and Private, Too)

If you want to talk directly between DMR radios, you can configure your radios to match. Set one of your IDs as a talkgroup or the common simplex talk group 99. You'll need to match time slot, color code, and, of course, frequency.

If you select "Private" with a radio ID, then your audio will only route to the station you are talking to and there will only be the two of your conversing. However, don't forget that this is still radio. People could possibly overhear your "private" conversation.

Here are the recommended frequencies for simplex operations (all use Talkgroup 99, timeslot 1, and color code 1): 441.000, 446.500, 446.075, 433.450, 145.790, and 145.510. Of course, you can always manage your talkgroup, timeslot, and color code among the other operators you want to talk to.

Logging and DX

It is easy to work stations around the world using DMR. Because of this, traditional DXing really isn't a thing on DMR. That doesn't mean that people don't have conversations with people from around the world. But you won't hear pileups of people chasing rare DX with short QSOs.

However, it is still fun to log your contacts so you can keep track of who you've talked to and when. You probably won't be able to count those log entries for contests, but you still should keep track. However, in the United States, at least, there is no legal requirement for you to log your digital radio activity.

Conclusion and the Future

There's more to all this than I've covered. Most DR networks allow for text messages, APRS, and even more. There's a lot to explore and more innovation every day. Enjoy exploring DMR!

Appendix A: Selected Brandmeister Talkgroups

Full list: https://brandmeister.network/?page=talkgroups

Number	Name	Notes
9	Local	Local Communication
2	Cluster	Local Cluster
310-312	USA TAC Channels	TAC Channels used when moving conversations from a statewide or high traffic talkgroup. TACs are not calling channels.
313-319	USA TAC Channels	TAC Channels used when moving conversations from a statewide or high traffic talkgroup. TACs are not calling channels
3100	BM US Nationwide Bridge	General Talk Group for USA-based Users
31001	Net Talkgroup 1	Channel for Daily Nets
31002	Net Talkgroup 2	Channel for Daily Nets
3101	Alabama	Alabama Statewide
3102	Alaska	Alaska Statewide
3104	Arizona	Arizona Statewide
3105	Arkansas	Arkansas Statewide
3106	California	California Statewide
3108	Colorado	Colorado Statewide

Number	Name	Notes
3109	Connecticut	Connecticut Statewide
3110	Delaware	Delaware Statewide
3111	D.C.	D.C. Statewide
3112	Florida	Florida Statewide
3113	Georgia	Georgia Statewide
3115	Hawaii	Hawaii Statewide
3116	Idaho	Idaho Statewide
3117	Illinois	Illinois Statewide
3118	Indiana	Indiana Statewide
3119	Iowa	Iowa Statewide
3120	Kansas	Kansas Statewide
3121	Kentucky	Kentucky Statewide
3122	Louisiana	Louisiana Statewide
3123	Maine	Maine Statewide
3124	Maryland	Maryland Statewide
3125	Massachusetts	Massachusetts Statewide
3126	Michigan	Michigan Statewide
3127	Minnesota	Minnesota Statewide
3128	Mississippi	Mississippi Statewide
3129	Missouri	Missouri Statewide
3130	Montana	Montana Statewide

Number	Name	Notes
3131	Nebraska	Nebraska Statewide
3132	Nevada	Nevada Statewide
3133	New Hampshire	New Hampshire Statewide
3134	New Jersey	New Jersey Statewide
3135	New Mexico	New Mexico Statewide
3136	New York	New York Statewide
3137	North Carolina	North Carolina Statewide
3138	North Dakota	North Dakota Statewide
3139	Ohio	Ohio Statewide
3140	Oklahoma	Oklahoma Statewide
3141	Oregon	Oregon Statewide
3142	Pennsylvania	Pennsylvania Statewide
3144	Rhode Island	Rhode Island Statewide
3145	South Carolina	South Carolina Statewide
3146	South Dakota	South Dakota Statewide
3147	Tennessee	Tennessee Statewide
3148	Texas	Texas Statewide
3149	Utah	Utah Statewide
3150	Vermont	Vermont Statewide
3151	Virginia	Virginia Statewide

Number	Name	Notes
3153	Washington	Washington Statewide
3154	West Virginia	West Virginia Statewide
3155	Wisconsin	Wisconsin Statewide
3156	Wyoming	Wyoming Statewide
3181	POTA	ARRL Parks on the Air (POTA) - Used for coordination and general discussion for POTA Activities.
9990	Parrot	Private connection for echo test
31600	Regional	Regional Communication Based on Calling Area of Repeater for Area 0
31601	Regional	Regional Communication Based on Calling Area of Repeater for Area 1
31602	Regional	Regional Communication Based on Calling Area of Repeater for Area 2
31603	Regional	Regional Communication Based on Calling Area of Repeater for Area 3
31604	Regional	Regional Communication Based on Calling Area of Repeater for Area 4
31605	Regional	Regional Communication Based on Calling Area of Repeater for Area 5
31606	Regional	Regional Communication Based on Calling Area of Repeater for Area 6
31607	Regional	Regional Communication Based on Calling Area of Repeater for Area 7

Number	Name	Notes
31608	Regional	Regional Communication Based on Calling Area of Repeater for Area 8
31609	Regional	Regional Communication Based on Calling Area of Repeater for Area 9

Appendix B: Selected TGIF Talkgroups

Full list: https://tgif.network/talkgroups.php

TG Number	TG Name
101	Tac-101
102	Tac-102
103	Tac 103
104	Tac-104
105	Tac-105
106	Tac-106
107	Tac-107
108	Tac-108
109	Tac-109
110	North America
111	Europe
112	Asia Pacific
113	World Wide English
114	World Wide
115	HAM BAND HOOK UP

TG Number	TG Name
116	United Kingdom
117	HF TALK
118	Sailing Hams
140	Ham Projects
146	Computer Lounge
171	DX WORLD-WIDE
173	New Ham Elmer's Shack
174	Worldwide Weather and Technology
589	Science Talk
842	United States Radio Club
845	Ham and Tech
1111	Cw morse code
1313	Motorcycle and 3 wheel talk
1934	Philosophy/Literature Ham
1945	WW 2 History
1947	UFO (UAP) Witness Group
1981	NASA - Space / Ground Communications
2004	Linux Talk
3232	Ham Tech
7373	Parks On The Air (POTA)
7700	Aviation Chat
10367	Ten Forward
22272	OpenAI ChatGPT

TG Number	TG Name
31268	DMR Tech Net
31665	TGIF The Mothership
31535	Tech Talk

Appendix C: Selected Peanut Talkgroups

Full list: https://peanut.pa7lim.nl/rooms.html

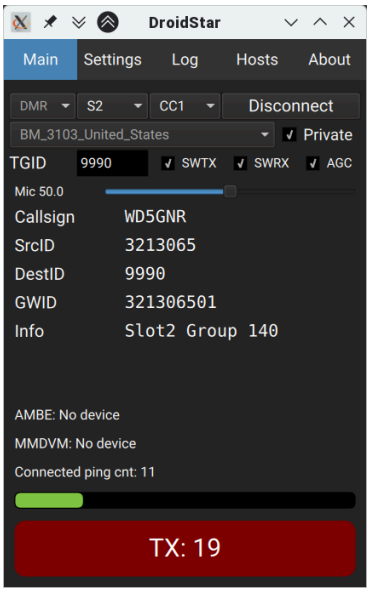
Name	Description
CQ-POTA	Parks on the Air
CW-ONLY	Morse code only
ECHOECHO	Echo test (“parrot”)
YSFWORLD	Link to Fusion global chat
WWRARN	Peanut world chat

Appendix D: Glossary

AMBE: A CODEC chip that is used in many DR systems to convert speech to digital form and vice versa.
Brandmeister: A global network of interconnected DMR repeaters and hotspots that supports various talkgroups for communication.
Codeplug: A file used to program a DMR radio with channel information, talkgroup IDs, and other operational settings.
Color Code: A numerical identifier (0-15) used in DMR systems to separate different groups of users on the same frequency, similar to CTCSS in analog radios.
DMR (Digital Mobile Radio): A digital radio standard used in amateur and commercial communications, allowing features like talkgroups and text messaging.
DMR ID: A unique number assigned to a licensed amateur radio operator, used to identify the operator in digital networks.
DroidStar: Software that allows users to access DMR and other digital radio systems from a computer or mobile device without a physical radio.
ESSID: An optional two-digit extension added to a DMR ID to differentiate between multiple devices or instances of use by the same operator.

Hotspot: A low-power, user-operated device that connects a DMR radio to a digital network via the Internet.
Kerchunk: A brief keying of the transmitter without speaking, used to signal the network to add a talkgroup or confirm functionality.
Parrot (Echo Test): A special talkgroup or service that repeats transmitted audio back to the sender for testing purposes.
Private Call: A one-on-one communication mode in DMR, directed at a specific DMR ID.
Promiscuous Mode: A feature on some DMR radios that allows users to monitor all transmissions on a frequency, regardless of the configured talkgroup or color code.
Repeater: A radio station that retransmits received signals, extending the range of communications. In DMR, it can also link to a digital network.
Talker Alias (TA): Data about a station sent with the transmission to avoid requiring a database lookup.
Talkgroup (TG): A virtual channel on a DMR network that groups users for specific topics or geographic regions.
Time Slot (TS): DMR repeaters divide their frequency into two alternating "time slots," enabling two simultaneous conversations.
TAC (Tactical) Channel: A talkgroup used for in-depth discussions or long conversations to avoid monopolizing busy or general-purpose talkgroups.
Zone: A collection of channels programmed into a DMR radio, typically organized by location or use case.
TGIF Network: Another popular DMR network, smaller than Brandmeister, offering similar functionality but without accumulating multiple talkgroups simultaneously.
YSF (Yaesu System Fusion): A digital mode developed by Yaesu, primarily for amateur radio use.

Appendix E: The DroidStar Screen



The DroidStar Screen during transmission

Here's a detailed look at the items on the DroidStar main tab:

- DMR - This is a drop down that lets you select several different modes. In particular:
  - M17 - A newer mode. Instead of talkgroups, you select a module from the drop down next to the server. For example, you can find a popular M17 reflector's info on the Web (https://selink.lmarc.net/m17dash/index.php). This is server M17-SEL and if you see a station on module "X", you can pick "X" on the dropdown next to the server before you connect. The CAN is the channel access number, which can act like a key for transmit access (similar to a color code).
  - YSF - Yaesu System Fusion. You can check activity here: https://cloud9.hamradio.solutions/ndr/. There isn't much to pick but a reflector.
  - FCS - A variant of YSF "Fusion Communication System".
  - DMR - The system we've spent the entire document talking about!
  - P25 - The P25 system uses servers and talkgroups, much like DMR.
  - NXDN - Next Generation Digital Narrowband. This mode takes a server and little else, also.
  - REF, XRF, DCS - These are all variations of D-STAR reflectors. The REF reflectors require you to be verified by the US trust system (https://regist.dstargateway.org/instructions/). XRF reflectors and DCS are different. XLX reflectors, by the way, speak all three variants of D-STAR plus one other. Find REF lists here: http://www.dstarinfo.com/reflectors.aspx.
  - IAX - A mode based on the telephone software asterisk.
  - Note that you can add hosts that DroidStar doesn't know about using the HOSTS tab which show you an example of the entry format.
- S2 - The time slot (S1 or S2) for transmitting.
- CC1 - The color code for transmitting.
- Disconnect - This button will say "Connect" "Connecting" or "Disconnect"
- BM_3103_United_states - The current server. This list will change based on the mode setting. BM servers are for Brandmeister, while other networks will use other servers.
- Private - Checking this causes traffic to only be sent between you and the receiver.
- TGID - The talk group ID (this won't always appear, depending on mode; see above).
- SWTX - Use software CODEC for transmit (will check automatically if you don't have an AMBE device).
- SWRX - Use software CODEC for receive (will check automatically if you don't have an AMBE device).
- AGC - Automatic Gain Control
- Mic - Mic gain. Overdriving will make you sound bad to others.

The rest of the items (except the PTT button) are simply for display. You can't change them and they are frequently.

- Callsign - The callsign of the station talking, or you if you are transmitting.
- SrcID - The DMR ID of the station currently sending.
- DestID - The TGID or DMR ID of the station being targeted.

- GWID - The server or gateway ID.
- Info - The time slot and group (the group number rises rapidly as voice packets are sent).
- AMBE - Indicates if you have a hardware CODEC.
- MMDVM - Indicates if you have a hotspot.
- Connected ping cnt - Number of times you have ping responses to/from the server.
- Green bar - This is a VU meter that shows audio level on both transmit and receive.
- TX - This is the PTT button. If you have the “Enable TX toggle mode” option set, it will also show a timer when you are transmitting (the 19 in this picture). If that option is off, the timer doesn’t appear. The PTT button is blue when you are receiving and red when you transmit.

About the Author, Acknowledgments, and Revision History

I’m Al Williams, and I got my first ham radio license–WD5GNR, which is the same one I have now–back in 1977. I started out doing mostly CW and traffic handling. When I went to college, I dabbled in RTTY and ham satellites while I was president of the University ham club, W5YD. I spent a good bit of time doing packet radio just after college, too.

I’ve written articles for QST, QEX, 73, Nuts & Volts, and many computer magazines, including Dr. Dobb’s Journal, where I was a regular contributor. Today, I write for Hackaday (http://www.hackaday.com), and I’ve published many software books and a few hardware-oriented books on things like Basic Stamps and PCB fabrication.

In addition to RTTY, I got interested in PSK31 quite early and wrote the popular PSKGNR companion software that people used to use with Peter Martinez’s original PSK31 software.

I developed an interest in DMR after hearing very little activity on the local VHF/UHF repeaters, and since it was so hard to get started, I decided to document what I had learned. I hope it helps you. I welcome any comments you have on how to improve this document.

73, and see you on the air!

– WD5GNR
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Many people have given me comments, suggestions, or taught me something that appears in there. There are too many to list, but I would recognize WM8S, N4ASA, and KC0MYP along with many others in the various “Tech Takgroups” (TGIF 31535 and 31268).

Revision history:

Version 0.1 (31 January 2025) - Initial draft
Version 0.1a (31 January 2025) - Small typo corrections (thanks KC0MYP)

Version 0.2 (February 2025) - More on hotspots and auto-static vs dynamic. Added a few informational links. Removed index for now (too hard to maintain; will reindex at version 1.0).