

## An introductory guide to digital modes for HAM operators.

For the East Alabama Amateur Radio Club by KB9V

February 6, 2025

### A brief start with HAM digital modes history:

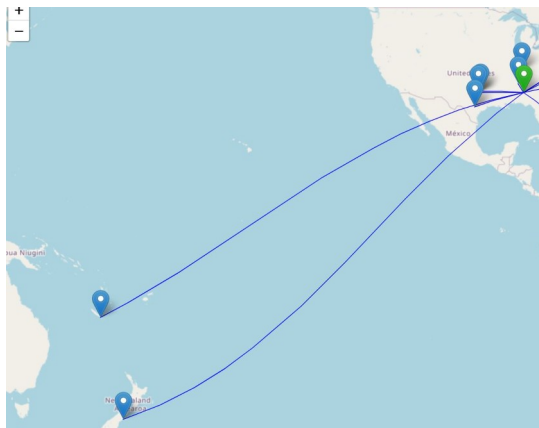
In the beginning: the first radio digital mode was actually CW. Since then, over the years a lot of new ways to communicate have come about. Since technology is more available and affordable in recent years, there has been an increase of experiments and protocols made for many different types of digital radio modes. As a HAM, you have a lot of options to choose from, and there are many use cases for going digital in HF/UHF/VHF.

### Why use a digital mode?

Digital modes typically have a much lower S/N ratio (usually 10-20db or better than voice transmission) allowing continued operation during poor signal/noise events and also allowing operating with compromised antennas and lower power. I recently saw my digital node pick up a station at -118db with its rubber duck antenna! Because of the signal efficiency of most digital modes, QRP enthusiast can work the world using very little power. It is said that the current CW record is over 1600 miles per milliwatt! Digital modes can typically “hear” better than ones ears, making HAM digital modes and interesting tool for DXers.

To show an example of how efficient this can be, I recently had a FT8 QSO 8,300 miles (Auburn to New Zealand) using only 3w of TX power (and a not using a very optimal antenna!)

<https://www.kb9v.com/blog/2024/20241221-qrp-power-do-you-need-100w>



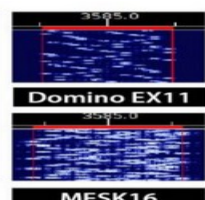
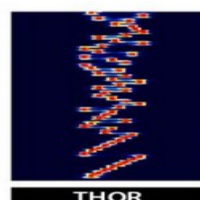
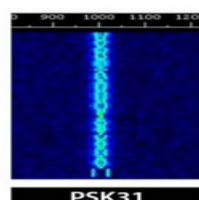
### What are the “modes” and why use them?

There are bunches!

The ARRL website currently lists the popular modes as:

\* FT8, Packet, PSK31, RTTY, Pactor, Clover, MFSK, Olivia, Throb, Domino, MT63, AMTOR

(<https://www.arrl.org/digital-data-modes>)



MFSK16

And there are more! Sometimes in use are “Legacy” digital modes and if you look around you may see or hear other creative operators working on new experimental modes. There are probably too many to list! In fact, there are so many, you may not have the time or equipment to try all of them!

Another benefit of using Digital Modes in HAM radio is to be able to operate quietly. If you live in an environment that you need to be quiet (shhh!) Turn your volume all the way down and type away quietly making some great QSOs!

For those that are living with a disability, digital modes can be a help with the HAM radio hobby! The following link is an interesting article that is of good interest for HAM radio for disabled.

<https://www.arrl.org/files/file/On%20the%20Air/QSTdisabilitySept2020.pdf> Richard McDonald, KK6MRH and Jim Snowbarger, WA0PSS also created an interface for the disabled blind to use the digital mode PSK-31. <https://cqnewsroom.blogspot.com/2017/05/psk-31-for-visually-impaired.html>

### **What if I REALLY like to contest?**

Well there are often contest organized for different modes. If getting cold during Winter Field Day was not your thing, from the warmth of your shack, you can try the **2025 CQ World Wide WPX RTTY** contest coming up **February 8-9, 2025!** (<https://cqwxrtty.com/rules.htm>)

There are many more. Use your internet search engine to find more like:

<https://www.rttycontesting.com/>

<https://www.arrl.org/arrl-digital-contest>

### **But all I want to do is POTA!**

Well then, POTA has a host of digital fun both for the park Activator or the Hunter. I have seen parks activating with FT8, FT4, HellSchreiber, SSTV and RTTY, and there is probably more out there I have not seen yet. Parks On The Air (POTA) using digital modes is fun and challenging too! Pileups, trying to out guess the other competing HAMS and catch openings in the bands are all just a part of Digital POTA.

### **What about Digital NETS?**

YES! There is that too! Some modes like Olivia have frequent nets. You can also check out some of the not so common nets like:

the “Field Hell Net” group that operates a net using the **Hellschreiber** protocol.

<https://sites.google.com/site/feldhellclub/Home/nets>

By the way “Field Hell” was one of the first TEXT transmission devices created in 1929, invented by a German engineer named Rudolph Hell. (<https://www.youtube.com/watch?v=i6jS6Apxzcg>)

### **How are digital modes used for EmComms?**

Amateur Radio Emergency Services (ARES) encourages the use of all communications modes to relay messages Using digital modes can enhance information distribution by both providing accurate copies and more detailed messages.

ARRL has a page about NBEMS, the Narrow Band Emergency Messaging Software, which is an Open Source software suite that is available on Windows, Mac and Linux, as well as any analog radio

without requiring specialized digital hardware or radios. NBEMS also works on VHF/UHF FM as well as HF. <https://www.arrl.org/nbems>

For ARES use, NBEMS uses digital modes such as Flmsg and Flarq to send and receive forms such as ICS-205, ICS-206, ICS-213, ICS-214, and ICS-216 and also other ARRL Radiograms.

Winlink is also used as a digital mode to pass messages and forms. Some ARES groups use Winlink as a way to send forms and email when there is no Internet or Cell service available. Winlink can operate both like traditional email with multiple hops, or peer-to-peer messaging directly between two stations.

Winlink.org has a news page for ARES events: <https://www.winlink.org/tags/ares>

A good video for how modes can be used for Emergency Comms is “Tech Based Comms – When Infrastructure Fails” <https://www.youtube.com/watch?v=fmUSwVsFFkQ>

Other notable items for EmComms:

Ribbit/RattleGram <https://www.ribbitradio.org/#/> (RattleGram is in your phone app store)

EmComm Training <https://emcomm-training.org/>

### **APRS and more.**

We are only scratching the surface of digital modes. APRS is used to report your position automatically. Then there are digital voice modes such as DSTAR, DMR, System Fusion, OpenDV, etc. There are really hundreds of “modes” and submodes to get involved with!

### **Sights and Sounds:**

Are you curious what that shape and sound is on the waterfall? Here is a website with common examples:

[https://www.sigidwiki.com/wiki/Category:Amateur\\_Radio](https://www.sigidwiki.com/wiki/Category:Amateur_Radio)

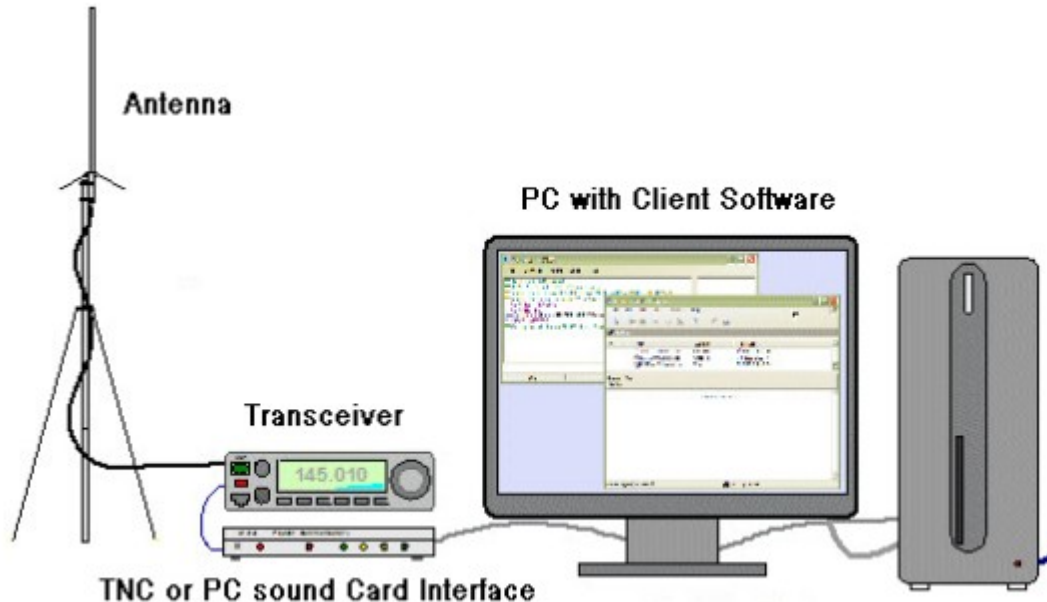


Another good site with examples: <https://www.w1hkj.org/modes/index.htm>

## I am ready to try it! What do I need to get started?

This is probably the hardest question to answer because everyone has a different set of gear and a different background. At a minimum you will need a Computer, some audio cables to interface your radio, and your radio+antenna.

A typical setup will be a computer <--> sound card or TNC interface <--> Radio.



(Image by KK6MTQ)

If you have a radio with built in sound card, you probably have everything you need already.

### Hardware needed:

You will likely be looking at one of the following options:

- \* Radios with integrated sound cards such as the FT-991A or the 7300.
- \* Rigblaster - <https://www.westmountainradio.com/rigblaster.php>
- \* Digirig - <https://digirig.net/>
- \* Tigertronics Signalink - <https://tigertronics.com/slusbmain.htm>
- \* DIY with Computer \$7 USB Sound Card <https://www.amazon.com/Sabrent-External-Adapter-Windows-AU-MMSA>
- \* Others found on the internet like <https://www.unifiedmicro.com/sci6.htm>
- \* or just your mic and speaker using old school acoustic coupling! Old School!

Most of the above interfaces have optional cables for your specific rig. Make sure you order the set you need. Or if you are DIY, research what you need for CAT/PTT control.

Also, there is something to be said for quality cables to reduce RF interference. Look for short, well shielded cables. Even if you are just using standard USB cables, the new cheaply made cables for phones and devices are not as well shielded as they once were. Most of the above manufactures sell cables that are designed to work with our RF sensitive environments.

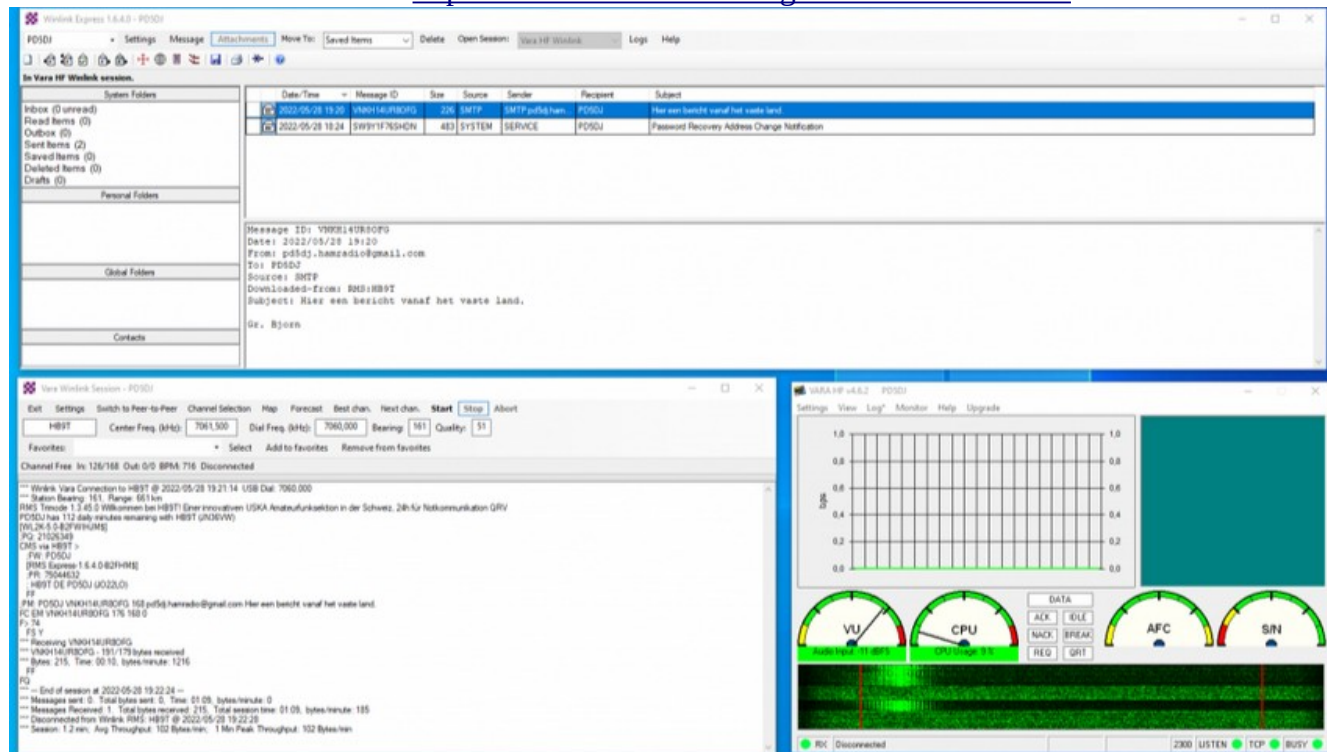
## And you will need software...

At a minimum, you will need the drivers for the interface, and a client software package. Most modern interfaces seem to be using chipsets that are automatically installed by Windows. It is best to read your documents before plugging in devices to see what is required.

Some examples of Client software:

### For Winlink you will need:

- Winlink Express <https://downloads.winlink.org/User%20Programs/>
- VARA FM and or VARA HF <https://downloads.winlink.org/VARA%20Products/>



**WSJT For FT4/FT8, JT4/Jtx, MSK144, etc:**  
 - WSJT-X <https://wsjt.sourceforge.io/wsjitx.html>

WSJT-X - Wide Graph

Controls: 500 1000 1500 2000 2500 3000

13:13:45 20m  
 13:13:30 20m  
 13:13:15 20m

Bins/Pixel 4 Start 100 Hz Palette Adjust... Flatten Ref Spec Spec 35 %  
 Split 2500 Hz N Avg 2 Digipan Cumulative Smooth 1

WSJT-X v2.6.0 by K1JT et al.

File Configurations View Mode Decode Save Tools Help

| Band Activity   |     |      |      |                             | Rx Frequency |     |      |      |                               |                               |
|-----------------|-----|------|------|-----------------------------|--------------|-----|------|------|-------------------------------|-------------------------------|
| UTC             | dB  | DT   | Freq | Message                     | UTC          | dB  | DT   | Freq | Message                       |                               |
| 131330          | 6   | -2.2 | 2562 | UV11 F55JH IN87             | 131030       | -13 | 0.1  | 1584 | JE6WKY DU3CQ RR73 Philippines |                               |
| 131330          | -13 | 0.1  | 1763 | CQ F4JGI IN94 France        | 131055       | Tx  | 2242 | ~    | DU3CQ DG2YCB J042             |                               |
| 131330          | -14 | 0.1  | 2735 | HS8AFA HZ1SF LL34           | 131130       | -14 | -0.1 | 1574 | ~                             | C6AGU DL6ZFG -18              |
| 131330          | -6  | 0.2  | 2149 | CQ SA0POW J099 Sweden       | 131130       | -17 | 0.2  | 1584 | ~                             | JK3DJX DU3CQ -14              |
| 131330          | -2  | 0.1  | 1448 | CQ UR5UX K050 Ukraine       | 131200       | -18 | 0.4  | 1584 | ~                             | JK3DJX DU3CQ RR73 Philippines |
| 131330          | -13 | 0.2  | 1954 | SV1GSP BX5AA RR73 Taiwan    | 131200       | -18 | -0.1 | 1574 | ~                             | C6AGU DL6ZFG -18              |
| 131330          | -14 | 0.1  | 452  | CQ DX F4HRG IN87 France     | 131230       | -11 | -0.1 | 1574 | ~                             | C6AGU DL6ZFG -18              |
| 131330          | -13 | 0.1  | 1077 | N3IZ EA7LU -05              | 131230       | -18 | 0.2  | 1585 | ~                             | CQ DU3CQ PK04 Philippines     |
| 131330          | -10 | -0.9 | 808  | C6AGU F4HRU JN07            | 131245       | -18 | 0.8  | 1575 | ~                             | N9TF C6AGU 73 Bahamas         |
| 131330          | -11 | 0.1  | 2624 | UA6AHR DF1KW R+10           | 131330       | -20 | 0.1  | 1585 | ~                             | VR2ZDA DU3CQ -09              |
| 131330          | -19 | 0.1  | 2716 | OE5EIN OV1T -09             |              |     |      |      |                               |                               |
| 131330          | -16 | 0.3  | 1980 | PD2GCM G3DR -10             |              |     |      |      |                               |                               |
| 131330          | -18 | 0.0  | 484  | IZ8PPI F5RMK 73 France      |              |     |      |      |                               |                               |
| 131330          | -13 | 0.1  | 550  | DL2BS HA1VG JN87            |              |     |      |      |                               |                               |
| 131330          | -17 | 0.1  | 543  | N0FW PD2SHB J021            |              |     |      |      |                               |                               |
| 131330          | -21 | -0.0 | 2091 | CQ EA1EAS IN70 a7 Spain     |              |     |      |      |                               |                               |
| 131330          | -5  | -0.2 | 1129 | CQ R7BL LN06 a7 EU Russia   |              |     |      |      |                               |                               |
| ----- 20m ----- |     |      |      |                             |              |     |      |      |                               |                               |
| 131345          | 7   | 0.1  | 2416 | CQ ES1KK K029 Estonia       |              |     |      |      |                               |                               |
| 131345          | 6   | 0.2  | 1137 | F6ARS HA3PT R+14            |              |     |      |      |                               |                               |
| 131345          | 6   | -0.1 | 2680 | RC1BP <UE23NY> -12          |              |     |      |      |                               |                               |
| 131345          | 16  | 0.2  | 1897 | VU2RS LY3AB K005            |              |     |      |      |                               |                               |
| 131345          | 2   | 0.1  | 2624 | DF1KW UA6AHR RR73 EU Russia |              |     |      |      |                               |                               |
| 131345          | 2   | 0.2  | 1215 | YC1LIN SV1FA KM18           |              |     |      |      |                               |                               |
| 131345          | 3   | 0.4  | 1084 | DK1AN EA3IGB -05            |              |     |      |      |                               |                               |
| 131345          | 2   | 0.1  | 2251 | E74K YO2NAA KN05            |              |     |      |      |                               |                               |
| 131345          | 5   | 0.2  | 648  | CQ DX LA6ZFA J059 Norway    |              |     |      |      |                               |                               |

CQ only Log QSO Stop Monitor Erase Decode Enable Tx Halt Tx Tune  Menus

20m **S** **14,074 000** Tx even/1st Hold Tx Freq Tx 2160 Hz Rx 1584 Hz Report -13 Auto Seq CQ: None

H DX Call DX Grid FT8 DU3CQ FT4 MSK Q65 JT65

2022 Dez 29 13:13:57

Generate Std Msgs Next Now Pwr

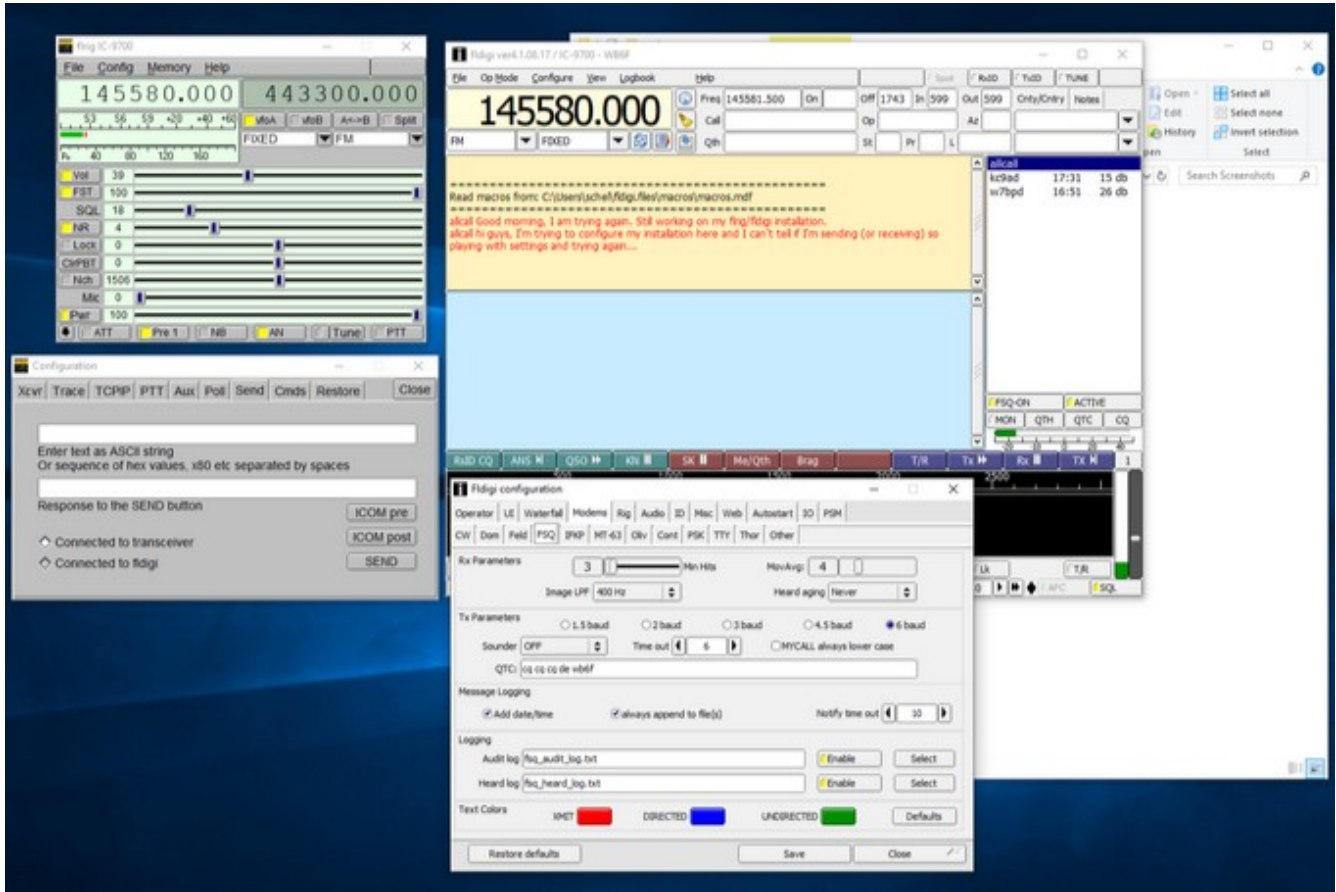
|                   |                                  |      |
|-------------------|----------------------------------|------|
| DU3CQ DG2YCB J042 | <input checked="" type="radio"/> | Tx 1 |
| DU3CQ DG2YCB -13  | <input type="radio"/>            | Tx 2 |
| DU3CQ DG2YCB R-13 | <input type="radio"/>            | Tx 3 |
| DU3CQ DG2YCB RR73 | <input type="radio"/>            | Tx 4 |
| DU3CQ DG2YCB 73   | <input type="radio"/>            | Tx 5 |
| CQ DG2YCB J042    | <input type="radio"/>            | Tx 6 |

Receiving DG2YCB FT8 13 12/15 WD:3m

**FLDigi for CW, PSK, MFSK, RTTY, Hell, DominoEX, Olivia, and Throb**

- Fldigi - <https://sourceforge.net/projects/fldigi/files/>

[https://sourceforge.net/p/fldigi/wiki/how\\_to/](https://sourceforge.net/p/fldigi/wiki/how_to/)



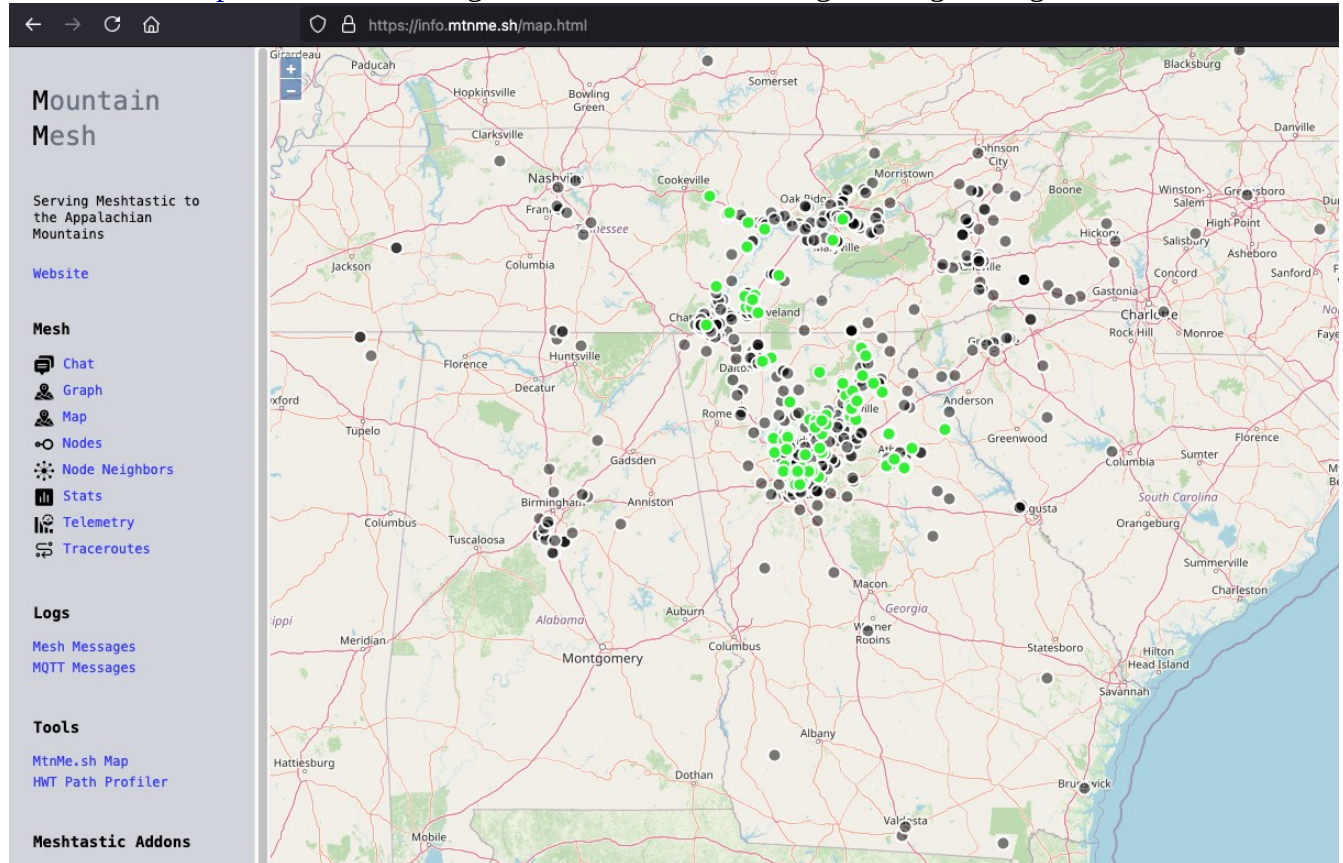
**There are many more software packages out there!**

**And this document is just an introductory examination as to what is possible and in reach for most HAMs.**

## A note about Digital mesh networks:

Mesh networks build a wireless infrastructure to pass data (and sometimes voice) around a region. There are many that use the “[LoRa](#)” technology – [Meshtastic](#), Helium, etc. Operate on both licensed and unlicensed portions of the spectrum, mostly 433mhz and 902-915mhz ranges, but some meshes can also operate in the WiFi bands 2.4GHz and 5GHz. These may be of interest if you have ever wanted to dabble in small antennas!

Here is an [example](#) of a 915MHz digital mesh network covering our neighboring states:



## Recent FCC news for Digital Modes

November 13, 2023: The Federal Communications Commission adopted a Report and Order that eliminated the baud rate limitation for certain Amateur Radio HF bands. Note that it is still limited to 300 baud if used on the 2200m and 630m bands. The FCC replaced the baud rate limitation with a 2.8 kilohertz (kHz) bandwidth limitation in the affected bands. Reference part 97.307(f).