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



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

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!* (<u>https://cqwpxrtty.com/rules.htm</u>) There are many more. Use your internet search engine to find more like: <u>https://www.rttycontesting.com/</u> <u>https://www.arrl.org/arrl-digital-contest</u>

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. (<u>https://www.youtube.com/watch?v=i6jS6Apxzcg</u>)

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. <u>https://www.arrl.org/nbems</u>

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: <u>https://www.winlink.org/tags/ares</u>

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

Other notable items for EmComms: Ribbit/RattleGram <u>https://www.ribbitradio.org/#/</u> (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



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

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 <u>https://www.westmountainradio.com/rigblaster.php</u>
- * Digirig <u>https://digirig.net/</u>
- * Tigertronics Signalink <u>https://tigertronics.com/slusbmain.htm</u>
- * DIY with Computer \$7 USB Sound Card <u>https://www.amazon.com/Sabrent-External-Adapter-Windows-AU-MMSA</u>
- * Others found on the internet like <u>https://www.unifiedmicro.com/sci6.htm</u>
- * 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 <u>https://downloads.winlink.org/User%20Programs/</u>
VARA FM and or VARA HF <u>https://downloads.winlink.org/VARA%20Products/</u>

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WSJT For FT4/FT8, JT4/Jtxx, MSK144, etc: - WSJT-X https://wsjt.sourceforge.io/wsjtx.html

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

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

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There are many more software packages out there!

And this document is just and 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 – <u>Meshtastic</u>, 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!





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 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).