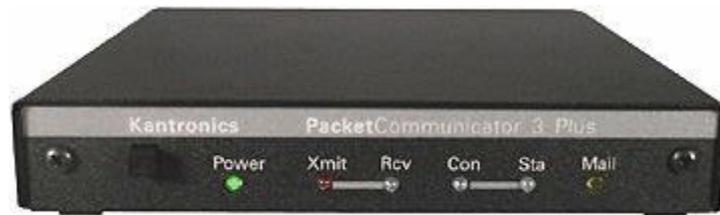


Introduction to Packet Radio



By Matt Mitchell
KB8UVN

Who am I?

- Matt Mitchell, KB8UVN
- Licensed in 1994
- Active on Packet Radio since 1995
- TCP/IP Coordinator for Ohio AMPR Net (44.x.x.x)
- Webmaster of <https://ohiopacket.org>
- Moderator of ohiopacket on groups.io

What do I do?

- Support/operate 5 Packet switches throughout Ohio with more on the way
- Operate 3 APRS Digipeaters including 2 I-Gates and HF Gateway (30m)
- Packet Mail forwarding hub for Central Ohio
- Operate a Winlink RMS Gateway
- Work with surrounding clubs and individuals to help grow packet radio interest and infrastructure

What is Packet Radio?

- An effective, error free way to transfer information both manually and automatically
- Fills in the gap between very slow, weak signal, long distance HF communications (WSJT-X, JS8Call) and high speed, short distance Wi-Fi based networking on UHF/SHF (AREDN, HamWAN)
- A framework which other applications can be built upon (will cover more later)
- An additional service we can provide to fellow hams, similarly to running a repeater system
- A great way to meet hams in neighboring areas

What Packet Radio is not?

- A competitor to broadband Internet Access (speeds typically range from 1200 to 19200 Baud from 50 MHz through 450 MHz)
- HF packet is also possible, most commonly 300 baud below 28 MHz, but late in 2023 the FCC lifted the symbol rate limitation in favor of bandwidth limitation (FCC-23-93A1)

How to get started

- Most packet stations consist of 3 components
 - Radio
 - Computer (with associated software)
 - TNC (or other interface)

Radio

- Most packet operations take place on 2m. The unofficial “calling” frequency for 2m, 1200 baud packet is 145.010 MHz. Packet is often found between 144.91-145.09 and 145.51-145.77 MHz
- APRS in North America can be found on 144.390 MHz
- 6m, 1¼m and 70cm are also usable but less popular
- Packet radios typically stay on one frequency and do not need CTCSS to function. Converted commercial radios are great for this service.

Computer

- Just about any computer will work (Including Raspberry Pi and old thin clients), some better than others and the newer the system, the newer the software can be usable (mainly in the Windows world)
- It's possible to run packet on a dumb terminal, but it requires the use of a hardware TNC.
- Most of us likely have a computer in our shack that can be put into packet service already.

TNC

- TNC stands for “Terminal Node Controller”
- Similar to a telephone modem, but with circuitry to handle the PTT line on radios
- Usually interfaces via serial line to a computer
 - May require a USB to RS232 converter for newer computers
- Some or all capability is retained while disconnected from the computer (to host a digipeater for example)

TNC Types

- There are 4 major vendors of TNCs
 - Kantronics
 - Mostly popular with the KPC-3, also offering a KPC-9612 and KAM for Multimode operation on HF.
 - MFJ
 - Manufacturer of the widely developed TNC2 clone (from TAPR) with their 1270b, 1270c and most recently released TNC-X models.
 - AEA/Timewave
 - Offers TNC units that can be used to build networks with the PK-12 and PK-96 and PK-232 for Multimode operation on HF.
 - Paccomm (discontinued)
 - Offers several flavors of TNC, for awhile the only TNC2 clone available. Several different options available.

Soundcard Interfaces

- West Mountain Radio
 - Several Rigblaster models which cover packet and other modes
- Tigertronics
 - Offer Signalink USB interface which does not require an existing soundcard
- EasyDigi
 - Low cost kit to use existing soundcard and Serial port, GPIO pin (Raspberry Pi) or Parallel port (Direwolf on Linux only) for PTT
- Other
 - Several other options are available. It is possible to home brew your own interface and run cables directly to the soundcard already in your computer.
 - The CM108 USB interface can handle audio and PTT in one low cost package

Why Soundcard interface?

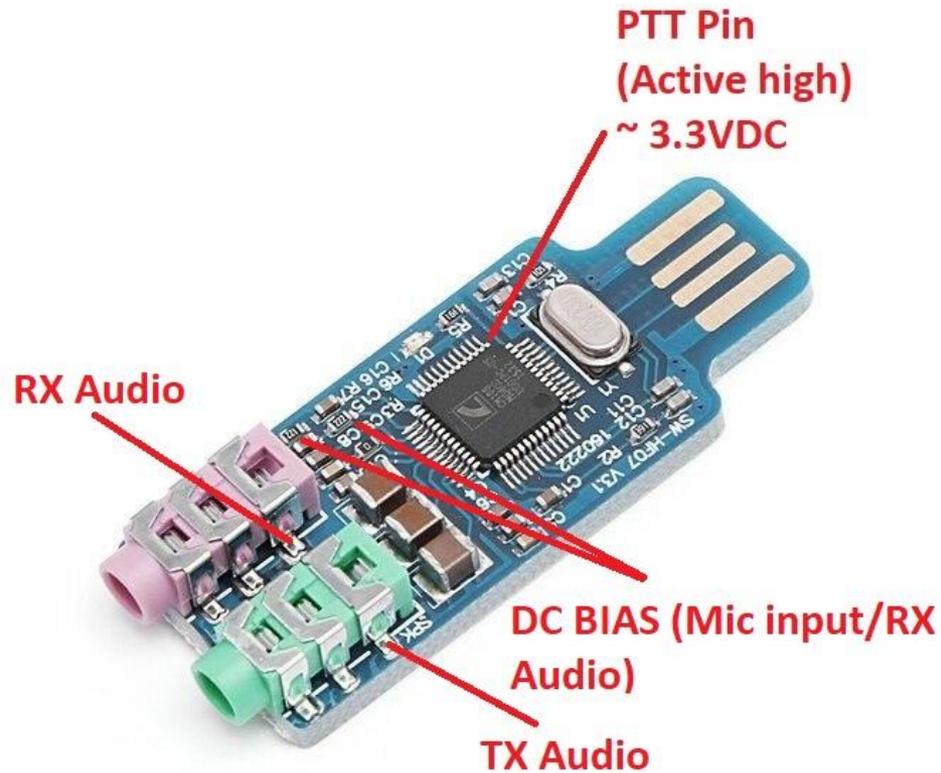
- More commonly available than hardware TNCs
 - Only current commercially produced hardware TNCs are from Kantronics, MFJ and Timewave
 - A group from North Carolina developed the NinoTNC in kit form
- Can be significantly less expensive than hardware TNCs
 - CM108 based home brew
 - EasyDigi (kit or assembled)
- Capable of a wide range of speeds and modem types
 - 300, 1200, 2400, 4800 and 9600 baud AFSK/FSK via software configuration change
 - Early support for FEC over AX.25 (FX.25) and Improved Layer 2 Protocol (IL2P)
 - Quickly implemented BPSK, QPSK, 8PSK, HAPN and other modulation techniques
 - Often will outperform hardware TNCs when it comes to decoding
 - Excellent performance with SSB when utilizing multiple, parallel decoders to handle slightly off frequency stations
- Can be used with other software in addition to packet
 - Fldigi for NBEMS
 - VARA HF/VARA FM, ARDOP and WinRPR (Robust Packet) for Winlink
 - WSJT-X
 - JS8Call
 - Hamlib/rigctl
 - Allstarlink (CM108 only on Linux)
 - SVXLink Repeater Controller, Echolink node (Linux)

CM108 Interface

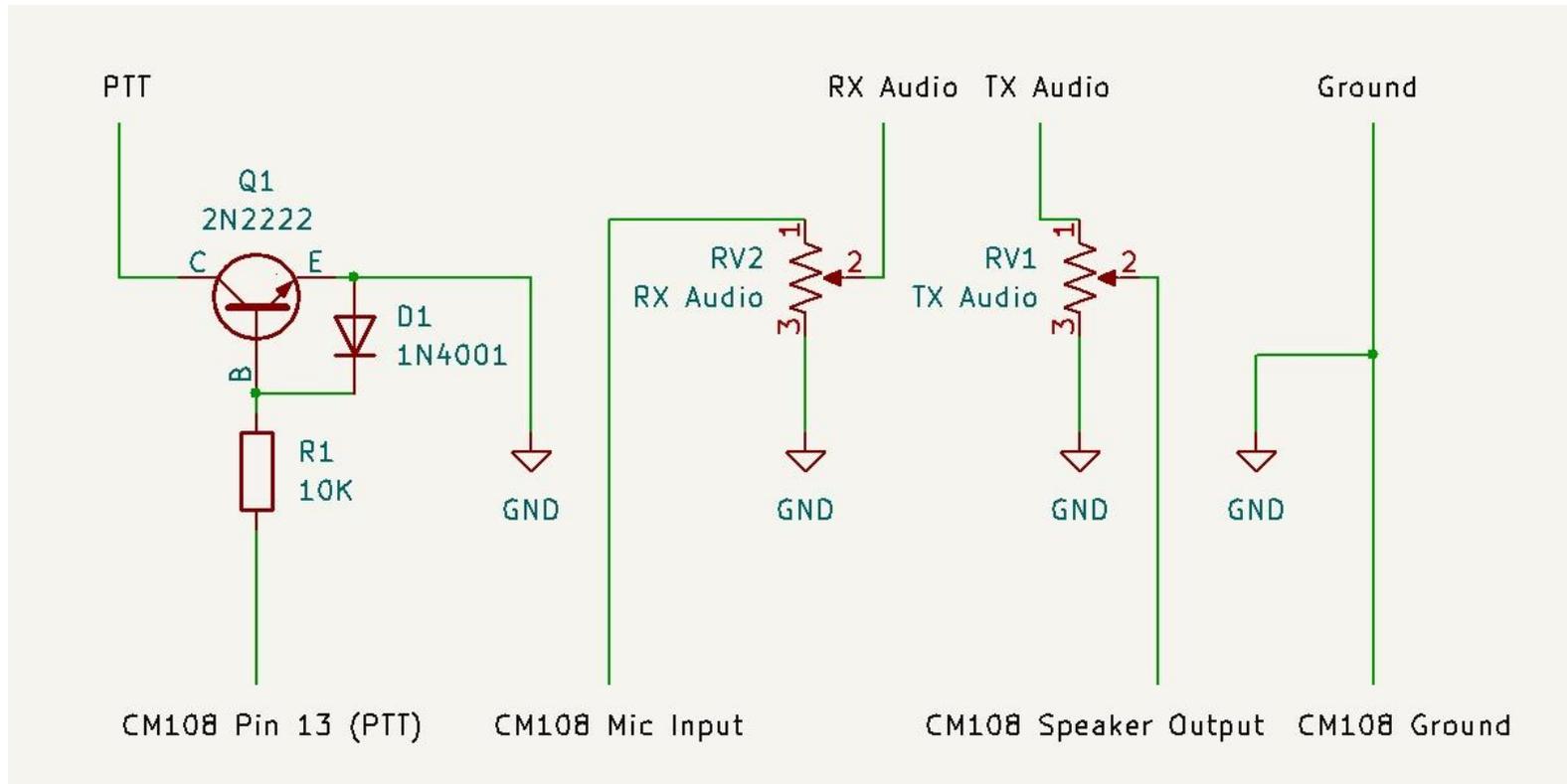


- Low cost USB soundcard
 - Often available for \$3-5 USD (eBay)
- Needs basic PTT circuit
 - 2n2222 NPN transistor or equivalent
 - 10k resistor (1/4w or larger)
 - 1n4001 diode (or similar, back voltage protection)
- Optional fixed or variable resistors for audio level adjustment (Recommended)
 - Simple fixed voltage divider or trim potentiometers for both RX audio (Mic) and TX audio (Speaker)
- Has DC bias on microphone input which can power audio preamplifier, but may require a DC blocking capacitor or removal of bias resistors

CM108 Interface Connections



CM108 Interface Schematic



CM108 Installed in Radio



Just add power, computer with USB port and antenna and you're up and running!

Packet Software

- Available for DOS (No longer being developed), Linux and Windows
- Most is tailored for a specific application which is built on top of packet.
- In it's simplest form, when using a TNC, it is possible to use basic terminal software such as PuTTY on Windows or Minicom on Linux

DOS Software

- Paket
 - Freeware available for download from TAPR's website
- KaGold/PkGold
 - Commercial software, very versatile but only works with Kantronics or AEA/Timewave TNCs
- G8BPQ Net/Rom software (v4.09d and earlier)
- G8PZT XRouter
- F6FBB BBS software
- TNOS & JNOS TCP/IP software

Linux Software

- Linux natively supports packet radio in the kernel!
 - This equates to extensive support for many hardware types which may or may not be supported by DOS or Windows (DRSI Boards, USB Interfaces, etc)
- F6FBB BBS
- G8BPQ packet switch and BBS software
- G8BPQ QtTermTCP (User interface)
- G8PZT XRouter
- TNOS and JNOS can both be run on Linux
- DX Spider Spotting system
- Direwolf console based software TNC (can run on Mac too)
- QtSoundmodem GUI based software TNC

Windows Software

- Terminal interfaces
 - Winpack - Basic terminal interface with scriptable connections from G4IDE (SK)
 - Easyterm – AGWPE based client with terminal and basic personal mailbox support from UZ7HO
 - QtTermTCP – AGWPE, KISS, TCPKISS and G8BPQ packet switch terminal from G8BPQ
- MixW
 - Handles many modes as well as packet
- AGWPE
 - Can be an underlying interface to many TNC/interfaces including soundcards
- G8BPQ 32 Bit
 - Utilized for Net/Rom packet switches, terminal, web interface
- G8PZT Xrouter (XR32)
 - Utilized for Net/Rom packet switches
- F6FBB 32 Bit
 - Used for store and forward packet BBS systems
- Outpost PMM (Packet Message Manager)
 - An email like program that can send and receive packet messages from remote BBS systems
- Direwolf console based TNC
- Soundmodem GUI based TNC from UZ7HO
- QtSoundmodem GUI based TNC from G8BPQ (UZ7HO port)

Popular Packet Applications

- Packet Bulletin Boards (BBS)
- Chat (Round table discussions)
- DX Spotting (DX Cluster)
- TCP/IP gateway/support
- Automatic Packet Reporting System (APRS)
- Winlink (Internet email)
- Net/Rom packet networking

BBS

- Used to store and forward both personal and public messages.
- Can be used to route NTS traffic as well as general discussion, for sale items, etc
- More advanced systems require the use of a computer to store large amounts of messages and forward across the globe
- Can be a repository for file uploads and downloads

Chat

- Roundtable chat with all users connected
- Possible to run a packet “net” from the keyboard
- Can be linked to other chat systems to create a larger network spanning the region, state, country or world

DX Cluster

- Used to send and receive DX spotting information
- Linked together to other DX Cluster systems over RF and the Internet to produce a wide area network of DX spot systems
- Can be accessed via packet (RF) or over the Internet (telnet)

TCP/IP Gateway

- Can encapsulate TCP/IP that is used on the Internet into Packet Radio, which allows support for protocols like HTTP, FTP, SMTP/POP3 (email) and other applications
- Can create AX.25 over IP (axip) wormholes and link different packet systems together over high speed IP links and/or the Internet

APRS

- Used for the reporting of many types of information, including position of mobile stations, weather information, local services (such as Repeaters, Echolink/IRLP systems, etc)
- Useful for spotting VHF propagation distances and conditions
- Can be used for Instant Message type communications

Winlink

- Used to send and receive email over both VHF/UHF packet as well as many HF packet modes
- Can be used in emergency situations to correspond with hams and non-hams alike
- Several clients available which have a similar to email feel

Net/Rom

- Net/Rom is a dynamic routing protocol which is at the foundation of most packet networks
- It allows routing information to be exchanged between neighboring node systems to automatically spread reachable systems
- When configured properly, it will allow for fault tolerance to reroute traffic based on available systems
- Today we call this “mesh networking”

Packet Switch LANSW2:K8QIK-7

- Hardware based TNCs MFJ-1270B



Packet Switch CHLSW1:W8BAP-7

- Software based TNC on Raspberry Pi 3B+ inside Linksys WRT54G



Packet Switch CMHSW1:AD8CM-7

- Software based TNC on HP Thin client



Any questions?



Links of Interest

- Tucson Amateur Packet Radio (TAPR)
 - <http://www.tapr.org>
- Outpost PMM
 - <https://outpostpm.org/index.php>
- G8BPQ Packet Software
 - <https://www.cantab.net/users/john.wiseman/Documents/>
- Direwolf soundcard modem
 - <https://github.com/wb2osz/direwolf>
- Soundmodem from UZ7HO
 - <http://uz7.ho.ua/packetradio.htm>
- QtSoundmodem from G8BPQ
 - <https://www.cantab.net/users/john.wiseman/Documents/QtSoundModem.html>
- APRS
 - <http://www.aprs.org>
- Groups.io
 - <https://groups.io/g/ohiopacket>
 - <https://groups.io/g/xrouter>
 - <https://groups.io/g/bpq32>
 - <https://groups.io/g/Winlink>
- Ohio Packet
 - <https://ohiopacket.org> (wiki)
- Winlink
 - <https://winlink.org/>

Contact me

- Please feel free to contact me with questions about anything covered here or related to packet radio
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