


**WELCOME!**

# Packet Radio Basics

Introduction to Packet Radio operation with emphasis on parameters and connecting with other stations, nodes, clusters, digis or BBS's

Presented by Todd Cady, K7PKT – October 18th, 2018

# Packet Radio History

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- Mid-1960's - Data Packet Technology born
  - 1969 - ARPANET
  - 1970 - ALOHANET – U of HI
  - 1978 - Montreal, Canada May 31<sup>st</sup>  
- *First Amateur Packet Radio Tx*
  - 1980 – FCC grants ability to TX ASCII via radio
  - 1998 - Sound card/Software TNC born
  - 2009 – Last time Todd stumbled through this class

Hardware

# There are 3 basic parts to a Packet Radio Station:

**1. Radio** - 2 meter handheld or mobile rig  
Normally use 5 watts or less, tone NOT required



**2. Computer** - Laptop, Desktop or PDA with software  
Needs to have a 9 pin serial port or USB to serial.



**3. TNC\*** - Terminal Node Controller or Modem  
1200 baud capable, 9600 optional.



*\* Or a sound card hookup between the computer and the radio*

# Radios

***Always use the lowest power needed for connectivity.  
Power savings and signal quality depend on it!***

## Connections

Radio to TNC or Computer Sound Card to Radio

TNC's come with pre-made cables, but only at the TNC end.

Find Schematic resources on the web

TX, RX and Ground most important.

## Settings Check

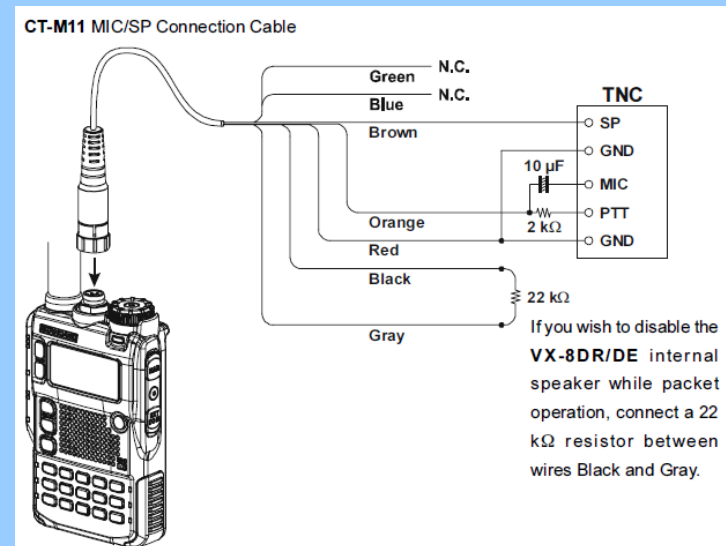
Power

Antenna

Volume level

Squelch

Tuning



*A simple checklist of parameters, cabling and reminders would be a great help during times of emergency or stress. For best results, attach it to your rig or TNC.*

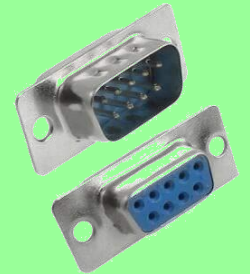
# Computer

## Ports

Serial 9-Pin or DB9

USB (to Serial 9-Pin) – some issues with compatibility

Mic and Speaker (sound card)



## Software (See Software section below)

Simple Terminal Software – i.e. Hyperterminal

Free Software (see handout)

Paid software

Software Suite – AirMail, MultiPSK – multiple programs in one

*Check for functionality in all cases!*

## Power Requirements

Will it run on batteries? For how long?

Does it require a generator? Solar? Vehicle?



# TNC – Terminal Node Controller

The interface between the Radio and the Computer

This device translates the digital signal to an analog modulated signal and back again.

It is simply put, a Modem – Modulator and Demodulator.

Not all TNC's were created equal... *caveat emptor*.

The TNC connects to the computer via a serial cable –

*Verify that it is a straight through serial cable, not a Null Modem.*

Have a spare cable to test with. Serial cables have been known to go bad.

Connecting the TNC to the Radio is usually the trickiest part of packet radio operation.

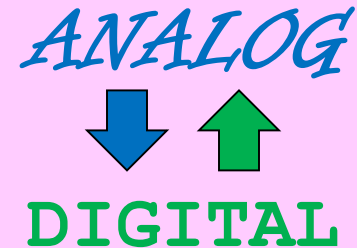
Ready made cables/purchased or Homebrewed.

At least 4 separate connections with VHF/UHF Radio to TNC cables:

-TX, RX, Ground and PTT.

Example Modem/TNC's are Kantronics, HAL, RigBlaster, BayCom, MFJ, PK-232, Tasco. Sound Card interfaces are another option.

Ask other amateurs what they chose and why.



# Networking

# What Network Protocol is Packet?

**X.25** – ATM's, Financial transaction systems, telecommunications

- Replaced by IP and TCP/IP
- Remember CompuServe, Tymnet, Dow Jones Online?

**AX.25** – Amateur X.25 – adapted for our use in networking over radios

- Connection based
- Error Correcting
- Narrow bandwidth – efficient use of frequency

**Wireless?**

- GSM, PCS, D-AMPS, 2G, 3G, 4G, LTE, 5G
- IEEE 802.11 a,b,g,n

# What is a Packet?

**A Packet** is a digital package delivered by a TNC and it can include:

- Text (or *other data*) to be delivered to the receiving station
- Size - an indication of the size of the packet
- Destination - station to where the data is headed
- Direction - how to get there (address)
- Return Address - the name of the station that originated the packet
- Error Checking - information used to check the accuracy of reception



# What's A Packet?

*Warning: Very technical 'geek' info to follow*

A packet is a standardized and structured group of bits (binary digits) that has contained within it the addressing information, message, error-checking and control information. The information is organized into a **Frame**. A **Frame** is a set sized template for sending information.

The Amateur X.25 protocol or AX.25 Protocol is the manner in which we send Frames. Both the sending and receiving TNC is programmed to encode into Frames to be sent, and decode received Frames.

**Three different types of Frames: Unnumbered, Supervisory, Information.**

**Unnumbered** - begins connections, ends connections and allows for CQ.

**Supervisory** - maintains the connection, assures organization and readiness of sender /receiver.

Flag	Address	Control	FCS	Flag
8 Bits	112 - 560 Bits	8 Bits	16 Bits	8 Bits
1111110	Callsigns & SSIDs of Destination, Source and Optionally, Digipeaters	Frame Type	Calculated Value	1111110

**Information** – contains “**from** and **to** callsigns and path” as well as actual info to be transmitted.

Flag	Address	Control	PID	Information	FCS	Flag
8 Bits	112 -560 Bits	8 Bits	8 Bits	N X 8 Bits	16 Bits	8 Bits
1111110	Callsigns & SSIDs of Destination, Source and Optionally, Digipeaters	Frame Type	Layer 3 Prot. Type	User Data	Calculated Value	1111110

# What is an SSID?

An **SSID** is a **Secondary Station Identification** – callsign-1 through callsign-15.

Your callsign by itself is considered callsign-0.

By some standards, using a SSID of 1 denotes your mailbox.

You may have up to 16 of your callsign active at any one time

No duplicates are allowed at any one time.

This allows an amateur to have more devices utilizing their callsign.

- K7PKT-7 - mobile APRS station
- K7PKT-2 - my node (ARESGW)
- K7PKT-1 - my Cluster (ARESDX)
- K7PKT-8 - when using HT for APRS,  
or -11 for my home APRS.

It's important to have a plan for how you will be utilizing your SSID's. Make a plan and stick to it or it may lead to confusion in the future.

# The Packet Network

Many selfless amateurs have invested much time and money into setting up, configuring and maintaining routes around the world in which to pass traffic via packet and other modes. Digipeaters, Nodes, BBS's and Clusters are tools that can be used to communicate with packet over a wide area. Each of these network parts has an amateur callsign and SSID assigned to them. They may also have an Alias. Using an alias instead of a callsign and SSID can help amateurs remember nodes. Some examples of aliases used in our area are SPOKN, SPOKN1, SPOKN2, PULLMN, NUKE, ORFINO, ARESGW, ARESDX, SPODX. *When sending packet mail, use of the aliases will not work but the callsign –ssid will.*

The network is very similar to a computing network as exists in businesses and schools. If you were to divide the Packet Network into two parts, it would be 'User Area' and 'Backbone'. User Areas are available to anyone, but Backbone areas and frequencies should be avoided.

*If someone tries to utilize the backbone for connecting to remote sites, they could very well bring a major part of the system down.*

***DON'T be THAT GUY!***

# What is a Digipeater?

Digipeater is a packet radio digital repeater.

Most digipeaters operate on simplex - Store and Forward

Used primarily to assist low power stations to reach further.

Provides alternate propagation path when direct connection doesn't work.

Your TNC will allow you to enter up to 8 digipeaters in your connect sequence

- 3 or more = Long waits, repeated packets, and frequent disconnects

***Please note: There cannot be spaces between the digipeaters names; they are separated only by commas.***

Example: **C K7PKT VIA digip-1,digip-2,digip-3**

*(a v can be used in place of via)*

Digipeaters are like lily-pads or stepping-stones. A digipeater is a **User Area**.

You will need to know what digipeaters are out there before you begin randomly trying to connect to someone. Turn **MONITOR ON** and watch for the paths that other stations are using. Use **MHEARD** to find out what other stations have connected recently.

# What's a Node?

Part of the packet network,

- It allows you to connect to other parts of the network
- Similar to a telephone switchboard.
- Nodes establish routes and remember where other nodes are.
- Nodes can have a very extensive list of routes to other nodes
- Nodes may have multiple ports as well as multiple operating frequencies.
- May have an alias

Nodes are more effective at “getting someplace” than digipeaters as they have **established links** and can provide the most direct route. A node is a tool to allow users to get to other places easier and faster. A node is a **User Area**.

There are usually menu options available when you are connected to a node – simply type a question mark (?) or help to get the list of commands available on that node.

Example Node: 144.93MHz, K7TJ-9 (EWAWAB alias) on Lookout Point

## What is a BBS?

A BBS or Bulletin Board System

A message center and information store

Send messages, retrieve messages and read bulletins or announcements

A **User Area**, it's designed to be user friendly

Online extensive help file - try using a question mark (?)

## What is a Cluster?

It's a conference room, a Node, a BBS all rolled up into one:

Retrieve messages, read news/bulletins, send messages, participate in conferences.

The Cluster communicates on the Backbone, transfers messages, news and network updates to other parts of the packet network.

It's a multi-user, multi-connect

A cluster is very effective for EmComm use because of it's real-time functionality.

## What is 'Keyboard to Keyboard'?

Keyboard to Keyboard is simply a direct connection with another user, both of you able to send and receive each others messages. If both parties have CONOK set to ON, connecting will be easy. ***Know your settings!***

Software

## What Packet Software Should I use?

There are many different terminal software packages out there that are available and free. One program is PuTTY, downloadable for free, works with Linux and Windows OS's. You can make it as complex or as easy as you want.

Other terminal/packet software programs include WinPack (Donationware), PacTerm, Airmail (Packet Client), and AGW just to name a few. Some of these programs are proprietary to specific TNC's so be aware that they may not work with all of them.

Undoubtedly, once you start with a specific program you'll have an affinity for that program as it was your first. It is recommended that you learn multiple packet programs so you'll be able to use what is available in the event of an emergency. At the very least, learn how to use PuTTY.

## Common TNC Commands

The following list of commands are common to modern TNC's

- MYCALL or MY callsign** The callsign of the amateur station. Typing MY will give the current callsign.
- ECHO on or off** If characters are repeated or echoed on the screen, turning ECHO OFF should help.
- CONOK on or off** On, users will be able to connect automatically. Off, all connect attempts are denied.
- DWAIT Range 16-30** Number of time units the TNC will wait after last hearing data before it transmits.
- FRACK or FRA Range 5-11** How long your TNC will wait for an acknowledgment before resending a packet.
- MAXFRAME Range 4-7** The upper limit on the # of unacknowledged outstanding packets the TNC can have.
- PACLEN or PACL 128 - 230** Indicates the number of characters in the packets you transmit
- RETRY 5-10** # of times the TNC will try to get the packet through before disconnecting.
- TXDELAY Range 25-35** Tells the TNC how long to wait before sending data after it has keyed the transmitter.
- MCON on or off** Monitor other frames while connected.
- MALL on or off** Monitor connected and unconnected (unproto) frames.
- MCOM on or off** Monitor only data or all frames.
- CTRL-C** For command mode. Will return with the CMD: prompt
- CONNECT <station, node, digi, cluster, bbs>**  
To connect to a station, type CONNECT or just C, then a space, then the destination.
- DISCONNECT** To cancel or disconnect from another station or cease a connect attempt.
- CONVERS** Enter CONV mode from CMD: (Alt is "K") Enter the converse mode from Command Mode.

# **Sending Traffic via Packet**

Packet is a very reliable method by which we can send traffic. It's been used for emergencies before, an example being during Ice Storm '96. It is precise as well as easy to copy. Once set up, it's reliable and bandwidth thrifty. Multiple stations can be utilizing the same frequency. A packet station normally has a lower duty cycle than a voice station.

## **How To Make a Packet Radiogram – Without using the NTS Form**

Remember that you need a preamble, the address, the body of the message and the signature.

*Number Precedence Handling Station of Origin Check Place of origin Time Filed Date*  
*Address*  
*Body Text*  
*Signature*

Example:

***M10 Routine HXB K7PKT 16 Spokane, WA 1200Local October 18, 2018***

***Sam Smalls, WA7XXX***

***509-555-1212***

***Hi Sam x thanks for getting us organized for training in packet x please confirm receipt***

***Todd Cady, K7PKT***

## Simple Rules to keep in mind:

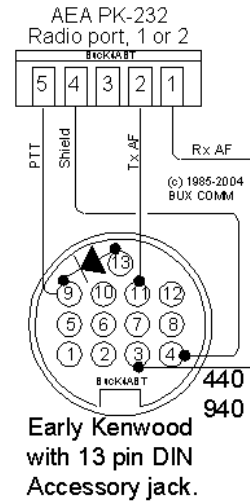
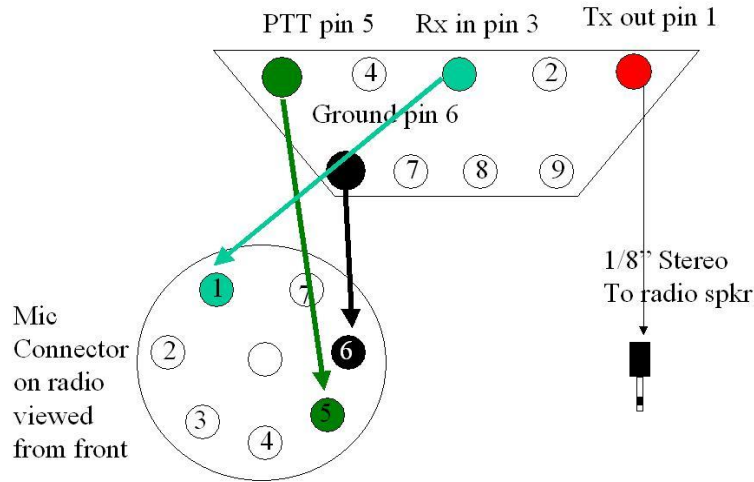
- Keep power low. Remember it's simplex.
- Learn to use the Question Mark “?” or “h” to find out what commands are available when connected to a node, cluster or BBS.
- Make sure to properly exit a node, cluster or BBS - use the Bye – or B to exit the system, or Q for Quit. Don't just turn off the system.
- Don't interfere with existing packet systems operation – tune in, wait 5 minutes, then use the command MHEARD.
- Know your settings for FRACK, PACLEN and MAXFRAME
- Frequently use your gear to make sure it's in good working order.
- Keep a log or good notes of your settings with your gear.

# Demo Time!

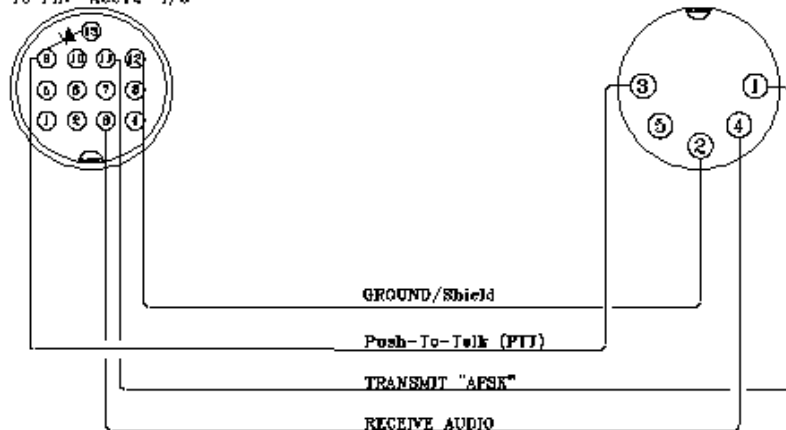
Time to show you connectivity between systems (keyboard to keyboard) and node/BBS/Cluster utilizing different hardware and software.

# Example pin-out schematics for making Radio-TNC adapter cables

DRSI as viewed at pins.



KENWOOD TS-440 & 940  
13 PIN "ACCY2" I/O



## 9600 BPS PACKET SETUP

9600 BPS

1. Connect the TNC's "Data In" (RX Audio), Ground, "Data Out" (TX Audio) and PTT lines to Pins ②, ③, ④ and ⑤ of the right side MIC jack (see illustration).

