

# Packet Radio Basics

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

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## **There are three basic parts to a Packet Radio Station:**

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

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

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

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

## Radio

For the purposes of this class, we will be using 2 meter rigs, both HT's and Mobiles. As is normal operating procedure, please reduce the power level of your rig to the absolute minimum necessary to achieve connectivity. 5 watts of power is all you would ever need for this type of exercise, and if possible, less in the case of HT's.

The Radio to TNC cable is probably the most crucial component, besides remembering to hook up the antenna and power to your rig. Sometimes the cables require two connections on a Radio – the Mic port and the speaker jack. If one becomes loose or disconnected, not much will happen except operator anxiety.

Some configurations between Radios and TNC's require the radio to be set up properly as well as tuned. Squelch may have some impact as to the ability of your station to make a successful connection. If set too high, it may not 'hear' the acknowledgment sent by the remote station.

*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

Many computer operating systems come packaged with or have available simple terminal programs. These are the simplest of programs, provided primarily for troubleshooting connections. It is possible to use these simple terminal programs to operate packet, but by no means the easiest way.

There are many free or 'included' software programs that will provide an easier interface as well as tools to make the operator's job simpler. Not all programs will work with all TNC's, so try them out before you need them.

Some programs like AirMail have multiple programs within a suite, giving more options and enhanced capabilities like sending email messages with attachments between systems.

If you have a choice in the matter, find a computer that is low power, can be run from a 12v source and has an external serial port . Older laptops will have serial port connections while the newer ones may only have USB available. Not all USB to serial converters have been shown to work properly, so ask for assistance and choose wisely.

## TNC – Terminal Node Controller

The interface between the Radio and the Computer. This device translates the digital signal from the computer to an analog modulated signal that can be sent over RF, as well as back again. It is simply put, a Modem – Modulator and Demodulator.

Not all TNC's were created equal. There are different versions of hardware and firmware that can limit your ability to fully function in the modern packet environment. Some units available on the popular auction sites may not be able to perform all of the functions you would like them to ... *caveat emptor*.

The TNC connects to the computer via a serial cable – please note that a Null Modem cable will not work. Verify that it is a straight through serial cable, not a Null Modem. When in doubt, have a spare cable to test with. Serial cables have rarely but sometimes been known to go bad. In most cases, the computer will have a 9 pin serial port, and the TNC will have a 25 pin port. Of course, not all pins are used in the cable, but are thankfully standard as far as the serial communication is concerned.

Connecting the TNC to the Radio is usually the trickiest part of packet radio operation. Ready made cables can be purchased to go between specific radios and TNC's, or they can be created. You can count on at least 4 separate connections with VHF/UHF Radio to TNC cables: TX, RX, Ground and PTT. If one is bad, two way communication will not occur.

Some example modern 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.

## What's A Packet?

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

A packet is a group of bits (binary digits) structured and standardized 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.

Usually 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, each with a unique number identifier (SSID). No duplicates are allowed at any one time. This allows an amateur to have more devices utilizing their callsign.

K7PKT-7 is my mobile APRS station

K7PKT-2 is my node (ARESGW)

K7PKT is my Cluster (ARESDX)

K7PKT-8 for when I'm using my 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 as 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.***

## What is a Digipeater?

Digipeater is the term we use to describe a packet radio digital repeater. Unlike the FM voice repeaters, most digipeaters operate on simplex and do not receive and transmit simultaneously. They receive the digital information, temporarily store it and then turn around and retransmit it. Digipeaters are used primarily to assist low power stations to reach further. Sometimes your propagation path will not allow a direct connection to your intended recipient – a digipeater may be able to provide a solid connection.

Your TNC will allow you to enter up to eight digipeaters in your connect sequence, but using more than 3 usually means long waits, lots of repeated packets, and frequent disconnects, due to noise and other signals encountered on the frequency.

***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 springboard 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.

## What's a Node?

Part of the packet network, it's a device that allows you to connect to other parts of the network -similar to a telephone switchboard. Nodes establish routes and remember where other nodes are. Properly configured nodes can have a very extensive list of routes to other nodes even in different states or countries. A node may have multiple ports as well as multiple operating frequencies.

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.

### **What is a BBS?**

A BBS or Bulletin Board System is a message center and information store. You are able to connect to the BBS, send messages, retrieve messages and read bulletins or announcements. Not only is a BBS a User Area, it's designed to be user friendly. One of the most common features of a BBS is an online extensive help file. Try typing help or simply typing a question mark to get this help file.

### **What is a Cluster?**

It's a conference room, a Node, a BBS all rolled up into one. When you connect to a cluster you can retrieve messages, read news and bulletins, send messages as well as participate in conferences. Behind the scenes, the cluster is communicating on the Backbone and transferring messages, news and network updates to other parts of the packet network. It's a multiuser, multiconnect tool designed for a specific purpose or group use. A cluster is very effective for Emergency Communication 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.

### **What Packet Software Should I use?**

There are many different terminal software packages out there that are available and free. One of the least complicated and most available is the HyperTerm software that comes standard with Windows OS's. There are no bells and whistles or easy macros to take care of complex functions.

Other terminal/packet software programs include WinPack, PacketWin, Yapp, Buxterm, PacTerm, Airmail (Packet Client) and Hostmaster just to name a few. Some of these programs are proprietary to specific TNC's so be aware that they may.

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 Hyperterm.

### 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 7-11** 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 230** Indicates the number of characters in the packets you transmit

**RETRY 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 15 Spokane Valley, WA 1200Local January 17, 2009**

**Scott Grimmett, AD7KV  
509-993-9968**

***Scott x thanks for getting  
us organized at the training  
meeting 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 "?" 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.
- 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 a variety of programs.



