

INTRODUCTION TO PACKET RADIO

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This material is no longer actively updated, although corrections to outdated information are welcome.
73, Larry Kenney, WB9LOZ

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Introduction



Figure 1: Author Larry Kenney,
WB9LOZ

This series of eighteen articles was originally written in 1988 to appear in Nuts & Volts, the newsletter of the San Francisco Amateur Radio Club. The series has been widely distributed since then, with revisions issued in 1991, 1993, and 1995. Occasional revisions were made to this version on the web thereafter, in the late 1990s.

The author is no longer active in packet radio and is unable to provide up to date information on packet radio; however he has left this material on the Internet for access by those who might find it helpful.

Chapter 1

What Is Packet Radio?

1.1 A Short History - How it all began

It was in March, 1980, that the Federal Communications Commission approved the transmission of ASCII for Amateur Radio in the United States. That was a year and a half after Canadian hams had been authorized to transmit digital “packet radio,” and the Canadians had already been working on a protocol for it. Doug Lockhart, VE7APU, of Vancouver, British Columbia, had developed a device that he called a terminal node controller (TNC). It worked with a modem to convert ASCII to modulated tones and convert the demodulated tones back to ASCII. Doug had also formed the Vancouver Amateur Digital Communications Group (VADCG) and named his TNC the “VADCG board”.

Hams here in the U.S. started experimenting with the VADCG board, but in December, 1980, a ham from the San Francisco Bay Area, Hank Magnuski, KA6M, put a digital repeater on 2 meters using a TNC that he had developed. A group of hams interested in Hank’s TNC started working together on further developments in packet radio and formed the Pacific Packet Radio Society (PPRS). AMRAD, the Amateur Radio Research and Development Corporation, in Washington, DC became the center for packet work on the east coast, and in 1981 a group of hams in Tucson, Arizona, founded the Tucson Amateur Packet Radio Corporation (TAPR).

Working together these groups developed a modified version of the commercial X.25 protocol called Amateur X.25 (AX.25) and in November, 1983, TAPR released the first TNC in kit form, the TAPR TNC1. In 1984, a great deal of packet experimentation was done, software for packet bulletin board systems was developed, and packet radio started becoming more and more popular all across the U.S. and Canada.

Packet Radio was one of the major developments to hit the world of Amateur Radio and thousands of hams soon caught the “packet bug”. If you’re wondering what it’s all about and why so many people got so excited about it, continue reading. You’re about to find out.

1.2 Packet Radio - What It’s All About

Packet seems to offer something different from other facets of Amateur Radio, yet it can be used for everything from a local QSO to a DX contact thousands of miles away, for electronic mail, message transmission, emergency communications, or just plain tinkering in the world of digital communications. It presents a new challenge for those tired of the QRM on the low bands, a new mode for those already on FM, and a better, faster means of message handling for those on RTTY. Packet is for the rag chewer, the traffic handler, the experimenter, and the casual operator.

A ham can get involved very easily with relatively small out-of-pocket expenses. All you need is a

transceiver, a computer, and a TNC or special packet modem and software. A two-meter rig is preferred, since that's where most of the packet activity is located. You probably already have the rig and the computer, so all you need to buy is the TNC, which costs just over \$100, or the special modem and software, which sell together for about \$50.

The TNC, the Terminal Node Controller, is a "little black box" that's wired between the computer and the radio. It contains software for controlling the outgoing and incoming transmissions for your station and a modem that converts the data from the computer into AFSK tones for transmission and changes the tones that are received by the radio into data for the computer. The TNC modem works much like a modem that's used to connect your computer to the telephone lines. It's a simple matter of wiring up a plug and a couple of jacks to become fully operational on packet. If you prefer to use the small modem instead of a TNC, you'll need special software for your computer to replace the software in the TNC. Either method works equally well.

Packet is communications between people either direct or indirect. You can work "keyboard to keyboard" or use electronic mailboxes or bulletin board systems to leave messages. Due to the error checking by the TNC, all of it is error free, too. (That is, as error free as the person at the keyboard types it!) As the data is received it's continuously checked for errors, and it isn't accepted unless it's correct. You don't miss the information if it has errors, however, because the information is resent until it is correctly received.

The data that is to be transmitted is collected in the TNC and sent as bursts, or packets, of information, hence the name. Each packet has the call sign or address of who it's going to, who it's coming from and the route between the two stations included, along with the data and error checking. Since up to 256 characters can be included in each packet, more than three lines of text can be sent in a matter of a couple of seconds. There is also plenty of time between packets for several stations to be using the same frequency at the same time.

If all of this sounds confusing, don't let it bother you, because the TNC or special packet software does everything for you automatically. Packet radio might seem very confusing at first, but in a day or two you'll be in there with the best of them. In this series I'll be telling you all about packet radio - how you get on the air and how to use it. We'll talk about the little black box, the TNC, and tell you about all its inner-most secrets. We'll discuss mailboxes, bulletin board systems, and the packet networks that allow you to work stations hundreds, even thousands, of miles away using just a low powered rig on 2 meters, 220 or 450. The world of packet radio awaits you!

Chapter 2

GETTING ON THE AIR WITH PACKET

In the first chapter of this series I told you, in general terms, what packet radio was all about. Now I'm going to tell you how to get on the air, make a QSO, and become familiar with your packet station. Whether you're new to packet, have been involved for just a short time, or are one of the "old timers", this series should help all of you. Even if you don't yet have equipment to get on the air, you should keep this series of articles handy for future use. I'll bet you'll be joining us soon!

The equipment that's needed to get on the air with packet is a transceiver, a computer or terminal, and a TNC - a terminal node controller - the little black box I talked about in chapter 1. Or, if you're using a computer, not just a terminal, you can use special software and a small packet modem instead of a TNC. You need a special modem, though, not one that's used to connect your computer to the telephone line. The tones used for packet are different than those used on the phone.

I highly recommend that you start with a 2 meter transceiver. There is packet activity on 220, 440 and HF, but 2 meters is where most of the action is and that's the best place to start.

When you buy a TNC or packet modem and take it out of the box, you'll find a cable supplied for connecting it to the radio, but you'll have to attach the appropriate mic and speaker jack connectors for the radio you're going to use. You'll have to furnish the cable that connects the TNC to your computer or terminal. In most cases, the TNC or modem is connected to the standard RS-232 communications port of the computer. On a PC this port is called a serial or COM port. On other systems it may be referred to as a telecommunications port or telephone port. You can make up the cable that goes between the TNC and computer yourself, or you can purchase it at a local computer store. As an option, you may be able to purchase one or both of the needed cables from the manufacturer of your TNC with the appropriate connectors factory installed for your particular radio and computer. The operating manuals that are supplied with TNCs and modems have a good description of the cabling needed for the various computers. Please read the introduction and set up procedures for your particular TNC or packet modem very carefully. Most companies have supplied excellent manuals, and you shouldn't have any trouble figuring out your particular set up from the information supplied in the manual.

Once you have everything connected as described above, you've completed the hardware phase of the installation. Now you need to turn your attention to software. If you're using a TNC, you'll need a terminal or communications program for your computer. Any software used for a telephone modem, such as Procomm or the Windows Terminal program, will work well for packet. There are also many special programs that have been developed specifically for packet radio use, such as PC PACRATT, MFJCOM, PAKET, PacketGold, TPK, etc. If you're using the small modem instead of a TNC, you'll need to use the special packet software written for the modem, such as Baycom. Read the instructions carefully for setting up the program on your computer.

No matter what software you use, you'll have to specify the communications port you'll be using and

set the baud rate (data rate) and data parameters for that port.

(**Note:** There are two baud rates associated with your packet station: 1-the baud rate between your computer and TNC and 2-the baud rate of the packets on the air. Here I am discussing the first of these baud rates. The second will be discussed in chapter 3 of this series.)

Refer to the manual or help information for the specific program you've chosen, to set the baud rate and data parameters. The baud rate of your computer must match the baud rate of your TNC. Some TNCs will automatically set their baud rate to match the computer. Other TNCs have software commands or switches for setting the baud rate. Again, you'll need to refer to your manual for specific instructions. When setting the data parameters, 8-N-1 is normally used: 8 data bits, no parity, 1 stop bit. But like the baud rate, the computer and TNC parameters must match.

Now I need to point out the various levels of communicating you can do from the keyboard. First, you can communicate with your computer for setting up your software program; second, you can communicate with the TNC or packet software; and third, you can send data over the radio. It's very important that you know which level you're in when working packet. You need to know where your keystrokes are going! If you're not using a TNC, you will have to figure out the difference between software set up and software usage. This is explained in the program instructions.

Once you have your communications program or packet software up and running, you can move on to the next step. If you're using a TNC, you now need to set it up. First, turn it on. You should get a "greeting" or sign on message from the TNC on your screen showing the manufacturer's name, the software version, a date, etc. If you see a bunch of gibberish, such as &tf\$d.h#sxn, it means that the parameters of the TNC and computer don't agree and you'll have to make adjustments. If you don't see a "greeting" or the gibberish, check your cables and connections. Make sure that you have everything connected properly, that the right wires are on the right pins, and so on.

Next, do a "control C" (press the CNTL and the letter C simultaneously); this puts the TNC in COMMAND mode, the level where you communicate directly with the TNC from the keyboard. You should see "cmd:" on your screen. Enter:

```
MYCALL ----
```

with your callsign in place of the dashed lines, such as:

```
MYCALL WB9LOZ
```

followed by a carriage return <CR>. (The carriage return key is labeled "Enter" or "Return" on most keyboards.) All commands must be followed by a <CR>. This sets into the TNC memory the call that you're going to use on the air. Now if you type:

```
MYCALL <CR>
```

it should respond with your callsign. If it does, you've proven that the computer to TNC link is working fine. If you do not see anything on the screen when you type, blindly enter the following:

```
ECHO ON <CR>
```

If you see two of everything that you type, such as MMYCCAALLLL, enter:

ECHO OFF <CR>

Now enter the following commands:

MONITOR ON <CR> MRPT ON <CR>

For those using packet software and a modem instead of a TNC, you should have already entered your callsign in the configuration file during the set up procedure. If you have not, refer to the software instructions for preparing the configuration file for your station. Also note that with this software, you don't enter Control C to go into command mode. You simply use the ESC (Escape) key prior to entering each command.

You're now ready to go on the air! Turn on your radio, make sure the volume is turned up about a third of a turn (about the "10 or 11 o'clock" position) and make sure the squelch is set. It should be at the point where the background noise disappears, just as it would be set for a voice QSO. Tune the receiver to any odd numbered frequency between 144.91 and 145.09 or 145.61 and 145.79 MHz and set the rig for simplex operation. You might have to tune around for a frequency with activity in your area. Watch your screen. You should soon be seeing the packets that are being sent over the air by other stations.

Let's look at what you might see. You should see something similar to this:

WB9LOZ > W6PW-3: The meeting will be held at 8:00 pm.

This shows a packet being sent by WB9LOZ to W6PW-3. Watch for callsigns with asterisks next to them in packets that look like this:

WB9LOZ > W6PW-3,W6PW-1*: The meeting will be held at 8:00 pm.

The asterisk indicates that you're receiving the packet from W6PW-1, not the originating station, WB9LOZ. The packets are being digitally repeated, or digipeated, by W6PW-1. The station that's doing the digipeating is called a digipeater. You'll also note that some stations are using names or a series of letters rather than callsigns. You might see something like SFW, BERKLY, or BLUE. These are packet stations set up to operate as nodes. The stations are usually located in higher locations, and they're installed to make connections to other stations easier. They often use a name or letters, called an alias, that identify their location. They send both their alias and callsign at 10 minute intervals to identify themselves and to be legal. (Both digipeaters and nodes will be discussed in detail in a later chapter of this series.)

You'll also notice that some callsigns have a trailing number attached to them. On packet you can have up to 16 different stations on the air at the same time using the same callsign. That's where the numbers at the end of the callsign come into play. The calls W6PW, W6PW-1, W6PW-2, W6PW-3, W6PW-4 and W6PW-5 are all individual stations operating under the same station license. A callsign without a number is the same as -0. These numbers are called Secondary Station IDs or SSIDs, and are used to differentiate between the various stations. There should never be more than one station using the same callsign and SSID on the air at the same time.

Now that you're familiar with what you might see on packet, you're ready to make your first packet QSO! If you're using a TNC, make sure it's still in command mode. (Remember, it's Control-C.) Watch for a familiar call on the screen or note calls you see frequently. Be sure to note whether or not a digipeater is being used. When the station you want to contact is finished with his QSO, enter the command:

C ---- or

C ---- V ----

(depending on whether or not a digipeater is needed) followed by <CR>. Replace the dashed lines after the “C” with the call of the station you want to contact and the dashed lines after the “V” with the digipeater call, if needed. Don’t forget the SSID if the call has one. The C means CONNECT and the V means VIA. Example:

C WB9LOZ V W6PW-1

means connect to WB9LOZ via W6PW-1. If you’re successful, you should soon see “*** CONNECTED TO (callsign)” on your screen and your first packet QSO is underway!

You have now entered the third level of communications, called CONVERSE mode, and this is where you communicate from the keyboard to the radio. Anything you type on the keyboard will be transmitted over the air as a packet every time you hit a <CR> and it will appear on the other station’s screen. Anything sent by the other station will be transmitted to you and will appear on your screen.

When you’re finished with your QSO, be sure to do a CONTROL C to get back into command mode on your TNC, or hit the ESC key if using the packet software, then enter D to disconnect from the other station. You’ll see “DISCONNECTED” on the screen. If you get connected to a station but you don’t receive a response, you might have reached an unattended station or a node. Don’t despair, disconnect and try someone else.

You’re on the way now to lots of packet fun and adventure! If you are still having problems at this point, contact a friend that has some experience on packet and ask for help. The initial set up of the computer, TNC, software and radio is probably the biggest stumbling block in packet. Any experienced packet operator will be happy to help you get through this process to get you on the air.

Chapter 3

TNC Commands - Part 1 of 3

In chapter 2 I talked about how to get on the air and make your first QSO. Now let's take a look at some of the commands that are available in your TNC or packet software to help improve your station operation.

The TNC (Terminal Node Controller) has more than 100 different commands available for you to use. You're able to customize your packet operating with these commands and turn on and off various features as you wish. Not all TNCs are exactly alike, but all have pretty much the same set of commands. I'll be using the command set in the TNC2 and clones in my examples. You might want to check the command list in your TNC operating manual to see if your TNC uses the commands as I indicate here.

For those of you who are using the packet software and modem instead of a TNC, you'll find a list of the commands in your help documentation. You will find that some of the commands cannot be modified while the software is running. Some have to be changed with the program's configuration file. Check the help document for instructions on how to change these commands in your particular software.

We covered a few of the commands previously: `CONTROL C` for entering command mode, `MYCALL`, `MONITOR`, `ECHO`, `CONNECT`, and `DISCONNECT`. (Refer to chapter 2 if you need information on these commands.) Now let's discuss a few that will affect the way your station functions on the air.

3.1 CONV (converse mode)

Your TNC will automatically switch to this mode when you connect with someone, but you can also switch to this mode by entering `CONV <CR>` at the `Cmd:` prompt. When you're in converse mode and are NOT connected to another station, anything you type will be transmitted via the path you set with the `UNPROTO` command. (See the next paragraph for `UNPROTO`.) Packets sent via `UNPROTO` are sent only once and are not acknowledged, so there is no guarantee that they'll get through. This mode is used frequently for sending CQ's.

3.2 UNPROTO

Designates the path used when you send BEACONS or when you're in converse mode and NOT connected to another station. The default is `CQ`, but you can enter a series of digipeaters if you wish, or a specific group or club name. Some examples:

```
CQ v WB6SDS-2,W6SG-1,AJ7L SFARC v W6PW-1,W6PW-4
```

If you include digipeaters in your `UNPROTO` path, you will have to change the information for each frequency you use. (BEACONS will be discussed in a later chapter of this series.)

3.3 FRACK

Determines how long your TNC will wait for an acknowledgement before resending a packet. It shouldn't be set too low, or you'll simply clutter up the frequency, yet it shouldn't be too high, or you'll spend too much time waiting. I use FRACK set to 7, and have found that to be a good overall value.

3.4 DWAIT

Used to avoid collisions, DWAIT is the number of time units the TNC will wait after last hearing data on the channel before it transmits. I have DWAIT set to 16, and have found that to work well.

3.5 PACLEN

Indicates the number of characters in the packets you transmit, ranging from 0 to 255. (A value of 0 equals 256.) The more characters you send per packet, the longer it takes to transmit the information and the greater your chances are of noise, interference or another station wiping it out. I've found a PACLEN of 80, which is the length of one line, to be a good value. When working a station nearby, PACLEN can be increased. When working a distant station, it should be decreased.

3.6 RETRY

Your TNC will retransmit a packet if it doesn't receive an acknowledgement from the station you're working. RETRY indicates the number of times the TNC will try to get the packet through before giving up and disconnecting. This can be set from 0 to 15, but I've found 8 to 10 to work well. Less than that causes an unnecessary disconnect if the channel happens to be busy, but more than that clutters up the channel. Do NOT set RETRY to 0. That means infinite retries, and serves no useful purpose. It simply clutters up the frequency needlessly.

The following commands affect "monitoring", which is what you see on your screen from stations you're NOT connected to.

3.7 MONITOR

This must be ON for you to monitor anything. When ON, you see packets from other stations on the frequency you're tuned to. What packets you see is determined by other commands from the list below. If MONITOR is OFF, you only see the packets that are sent to you while you're connected to another station.

Note: On some TNCs, such as the AEA PK-232, monitoring functions are selected by a number after the MONITOR command, such as:

```
MONITOR 3 or  
M 3
```

Refer to your TNC operating manual for details.

3.8 MALL

If MALL is ON, you receive packets from stations that are connected to other stations, as well as packets sent in unproto (unconnected) mode. This should be ON for "reading the mail". If MALL is OFF, you receive only packets sent in unproto mode by other stations.

3.9 MCOM

If ON, you see connect <C or SABM>, disconnect <D>, acknowledge <UA> and busy <DM> frames in addition to information packets. If OFF, only information packets are seen.

3.10 MCON

If ON, you see packets from other stations while you're connected to someone else. This can get very confusing, but is useful when your path is bad and you want to see if your packets are being digipeated okay. If OFF, the monitoring of other stations is stopped when you're connected to another station.

3.11 MRPT

If ON, you see a display of all the stations used as digipeaters along with the station originating the packet and the destination station. If OFF, you see only the originating and destination stations. For example, if you have MRPT ON, you might see a transmission such as this:

```
K9AT>WB6QVU,W6PW-5*: I'll be leaving for the meeting at about 7:30.
```

If MRPT was OFF, the same transmission would look like this:

```
K9AT>WB6QVU: I'll be leaving for the meeting at about 7:30.
```

In the first case, you can see that the W6PW-5 digipeater was being used. The asterisk indicates which station you were hearing the packet from. In the second case you have no idea if digipeaters are being used or what station you were receiving.

3.12 HEADERLN

If you have this turned ON, the header of each packet is printed on a separate line from the text. If OFF, both the header and packet text are printed on the same line.

3.13 MSTAMP

The date and the time the monitored packets are received is indicated if the MSTAMP command is ON. If it's OFF, the date/time stamp is not shown. NOTE: The date and time must be entered into your TNC memory using the DAYTIME command before the MSTAMP command will function.

I run my station with all of these commands, except MCON, turned ON so that I can really see what's happening on the frequency I'm monitoring. Try various combinations of these commands and then decide on the combination you like best for your station.

3.14 MORE COMMANDS

The commands discussed here are a few of the basic TNC commands. I'll discuss many of the other commands available to you in chapters 13 and 14 of this series.

Chapter 4

DIGIPEATERS AND NODES - THE BASICS

4.1 DIGIPEATERS

Digipeater is the term used 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. Your TNC can be used by others as a digipeater if you have the command DIGIPEAT turned ON.

You use a digipeater by entering its callsign after a V or VIA in your connect sequence. Here are some examples of proper connect sequences:

- C W6PW-3 V WB9LOZ-2
- C N6ZYL V WA6FSP-1,WD6EOB-3
- C W6ABY-4 V K6MYX,N2WLP-2,AB6X0

In the first example, the sequence shown means: Connect to W6PW-3 via the WB9LOZ-2 digipeater.

Your TNC will allow you to enter up to eight digipeaters in your connect sequence or in your UNPROTO path, 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.

When entering the list of digipeaters in your connect sequence, you must make sure that you enter them in the exact order that your signal will use them. You must separate the calls by commas, without any spaces, and the EXACT callsigns must be used, including the SSID, if any. That means you 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.

Something to remember when using digipeaters is the difference between making a connection and sending information packets. If the path isn't all that good, you might be able to get a connect request through, but will have a difficult time with packets after that. The connect request is short so it has much less of a chance of being destroyed by noise or collisions than a packet containing information. Keeping information packets short (PACLEN set to 40 or less) can help keep retries down when the path is less than ideal.

4.2 NODES

Net/Rom, TheNet, G8BPQ packet switch and KA-Node are names that refer to a device called a packet node. This is another means of connecting to other packet stations. Later on in this series you'll find a

complete review of node operation, but for now we'll cover the basics so that you can begin to use the node network. The difference between a digipeater and a node that you should note here is that you connect to a node rather than using it in a connect path as you do with a digipeater. Some packet stations are set up so that they can be used as a digipeater and as a node.

First, you need to determine what nodes are located close to you. You can do this by monitoring and watching for an ID, or by watching to see what other stations in your area are using. It is most common for a node to have an alias ID in addition to its callsign. Once you determine the callsign or alias of a local node, you connect to it the same way as you connect to any other packet station. You may use either the callsign or the alias to make the connection. For example, the node I operate has the alias ID of BERKLY and the callsign of WB9LOZ-2, so you could connect to it using:

```
C BERKLY or  
C WB9LOZ-2
```

Either one will work.

When you connect to a node, your TNC automatically switches to converse mode, just like when you connect to any packet station. Anything you now type is sent to the node as a packet, and the node acknowledges each packet back to your TNC. For the remainder of your connection your TNC works only with this one node.

To use the node network to connect to another local station, you simply connect to the node and then enter a connect request to the other station. Say you wanted to connect to K9AT using the WB9LOZ-2 node. You first connect to WB9LOZ-2:

```
C WB9LOZ-2
```

and then, while you ARE STILL CONNECTED TO THE NODE, you enter the connect request to K9AT:

```
C K9AT
```

The node will then retransmit your connect request and you'll receive one of two responses: "Connected to K9AT" or "Failure with K9AT". Once you are connected you hold your QSO just as if you had connected direct or via a digipeater. When your QSO is finished, go to command mode on your TNC (Control C) and enter:

```
D <CR>
```

and you will be disconnected from the node and the station you were working.

Some nodes have a BYE command available for disconnecting. You can get a list of available commands from any node by sending a question mark. All of the node commands will be covered in detail later in this series.

NOTE: If the node you're using is a G8BPQ packet switch, it might have several frequency ports. You'll have to enter a port number between the C and the callsign in your connect request to indicate the frequency you want to use, such as:

```
C 2 K9AT
```

Enter PORTS for a list of the frequency ports available.

4.3 NODE NETWORK

The packet nodes work together to form a packet node network. Once an hour each node transmits a list of other nodes that it knows about. The neighboring nodes use this information to keep track of the other nodes in the network. We will discuss how all of this works later on in the series.

When you're connected to a node you can enter:

```
NODES <CR> or  
N <CR>
```

and you'll receive a list of other nodes that you can reach on the network from the node you're using. You'll note that the node list will vary in length and in the calls listed as you move from frequency to frequency, since all frequencies are not linked together. The list gives both an alias ID and a callsign for each node. The alias ID often gives you a hint as to where the node is located, but not always. To find out for sure where a node is located you'll need to get a copy of the descriptive node listings that are available on most packet bulletin board systems. These complete lists give the alias, callsign, location, frequency and other information on each node in the network.

To connect to a station in another area using the node network you first must determine which node is closest to the station you want to work. For demonstration purposes, let's say we want to connect to N6XYZ. He's told you he uses the W6ABC-3 node, so you check the node list and see that GOLD:W6ABC-3 is listed. WHILE YOU ARE STILL CONNECTED TO YOUR LOCAL NODE you connect to the distant node by sending a normal connect request, in this case:

```
C GOLD or  
C W6ABC-3
```

Your TNC will send this as a packet to your local node and your local node will acknowledge it. The network will then go to work for you and find the best path between your local node and the one you're trying to reach. Remember, with digipeaters you needed to know the exact sequence of stations. With nodes you don't. The network does that for you.

You might have to be a little patient here, since it sometimes takes a few minutes for the connection to be completed. Don't type anything while you're waiting for a response because any new information received by your local node will override any previously entered information. When the network has completed its work you'll receive one of two responses: "Connected to W6ABC-3" OR "Failure with W6ABC-3". If it can't connect for some reason, try again later. It could be that W6ABC-3 is temporarily off the air or the path has decayed and is no longer available. We're going to be positive here and say we received the first option and got connected to the node.

Once you're connected to W6ABC-3, enter:

```
C N6XYZ
```

Again, your TNC will send this as a packet to your local node and the local node will acknowledge it and send it down the path to W6ABC-3. W6ABC-3 will then attempt to connect to N6XYZ. Here again you'll get one of the two responses: "Connected to N6XYZ" OR "Failure with N6XYZ". If you get connected, you hold your QSO just as you normally would, but there's one BIG difference – your TNC is receiving acknowledgements from your local node, and N6XYZ is receiving acknowledgements from W6ABC-3. The acknowledgements do not have to travel the entire distance between the two end stations.

Each node in the path handles the acknowledgement with the next node in line. Because of this, retries are greatly reduced and your packets get through much faster than when using a similar number of digipeaters.

When you're finished with the QSO, you disconnect in the normal manner. Use the BYE command, if available, or go to Command Mode on your TNC and enter:

D <CR>

Using either method, the entire path will disconnect for you automatically.

Nodes offer a variety of other features besides allowing you to connect to other stations. We'll look at those and go into much more detail on the packet network in chapters 10 and 11 of this series.

Chapter 5

INTRODUCTION TO THE BULLETIN BOARD SYSTEM

In this chapter of the series I will introduce you to the basics of bulletin board system (BBS) use; in chapter 6 I will discuss BBS commands in detail. There are now dozens of different packet radio bulletin board system programs available to the packet community. You might find a few minor differences in the commands used, but for the most part they are the same. If you find that a command does not function as I describe here, use the ? or H – HELP command to get more specific details for the BBS program you’re using.

You connect to a BBS exactly the same way as you connect any other station. Don’t forget the SSID for the BBS callsign if one is required. Once you’re connected, you will receive a welcoming message, information for that particular BBS and some basic instructions. Read the information and the instructions carefully. The first or second time you connect you might receive a request to enter your name, QTH, zip code and home BBS for the system’s user file. Some systems will simply ask you for the information, while others will ask you to “register”. On some systems, the software will not allow you to use any of the commands except HELP until you have entered this information.

After you receive the welcoming message and information from the BBS, you should note that the last line ends with a >. This is known as the PROMPT. When the BBS sends the prompt it is telling you that it has finished sending you information, and it is waiting for you to tell it what to do next. You do this by sending it a command. You must follow each command by a carriage return <CR>, just like on your TNC, which you send by hitting the “Enter” or “Return” key.

When checking in to a BBS for the first time, you should become familiar with the commands available to you. Enter a ? or H and read the general instructions for the BBS you’re using. It should tell you how to get a list of the commands that are available. Review the command list to see what features the BBS offers.

When entering a BBS command, you must be careful to enter it exactly as the program requires. Some commands are just a single letter, while other commands require added information. Computers are not very forgiving and expect things to be entered in proper form. Enter only one command at a time, and be sure to read the information that is sent to you by the BBS. Take your time, check out the various features that the BBS offers and enjoy yourself. There’s no need to feel rushed or intimidated. If you get to a point where you don’t know what to do next, don’t give up and disconnect. Enter a ? or H again for further assistance. That’s what the help information is there for! Remember this important point: whenever you’re using a BBS and you don’t know what to do next, enter a ? or H the HELP instructions. I suggest that you make a printed copy of the complete help document so that you have the information available as a reference when using the BBS.

Now let's go through the basic procedures you should follow when checking into a BBS. After you connect and receive the welcome message, you will receive a list of your mail if there are any personal messages addressed to your callsign. Enter the command RN to read your mail. If that command isn't available, note the message numbers and then enter: R followed by the message numbers, separating each by a space. Example:

```
R 24112 24174
```

If there were messages addressed to you, you should erase or "kill" them once you've read them. You can do this with the KM command, which means "Kill Mine". This command will erase all messages that are addressed to you that have been read. You can also kill each message individually by entering:

```
K XXXX
```

where the X's are the message number.

After reading your mail, the next thing I recommend that you do is list the new messages, by entering L. The BBS program updates the user file each time you check in, logging the latest message number. The next time you check in, only the new messages that have been received by the system are included in your list. The first time you check in, you might want to avoid using L by itself. Many systems have more than 1000 active messages available, and since you haven't seen any of them, the L will list all of them for you. As an alternative, I suggest that you use the LL (LIST LAST) command. You enter LL followed by a space and then the number of messages you'd like to see. Example:

```
LL 30
```

will list the last 30 messages that were received by the BBS. When you receive the list, you'll note that each message has a number, and that the size of the message, the topic, the originating station, a date and time, the subject, and other information are given. I will discuss each of these parts later in the series. For now, note the numbers of the messages you're interested in reading - that's the number to the far left of the screen.

Some BBS programs have a paging feature that will send just enough information to fill your screen and then stop. You simply enter a <CR> by hitting the "Enter" or "Return" key to tell the BBS to continue. When listing the new messages, you might have the option of reading the ones you're interested in before continuing with another page from the message list. As mentioned earlier, be sure to read the information that is sent to you by the BBS program before you proceed with your next operation.

To read the messages you're interested in, enter:

```
R XXXX
```

where the Xs represent the message number(s). Example:

```
R 14521 14528
```

Note that there is a space between the command and the number. If the paging feature is not available or not turned on, it's best to "capture" your messages or have your printer turned on when reading messages. They're apt to come in faster than you're able to read them. (By "capture" I mean using your communications program to save incoming data to a file. You can read it later after you've disconnected from the BBS.)

Once you've read all the messages you're interested in, you have several options. You can look back at old messages, send messages to other stations, see what's available in the file directories - the BBS library, download a file, upload a file, check the list of stations that have recently checked in to the BBS or stations that have been heard on the BBS frequency, check the status of the BBS to find out what other stations are connected and who has mail waiting for them, or a variety of other things. We look at the BBS commands in detail in chapter 6 and explain how to do all of these things and more.

Oh, so that we don't leave you connected forever, when you're ready to leave the BBS, enter a B. You should always use the B command rather than just disconnecting so that the system updates your user file.

Chapter 6

BBS COMMANDS - USING THE PACKET BBS

In chapter 5 I discussed the basics of using a packet bulletin board system. Now let's look at the commands you use on a BBS. As previously mentioned, some of the commands on your BBS might vary slightly from the information I'll be presenting to you here. Remember, all of the commands you enter must be followed by a carriage return <CR>.

? or H (Help) - Every BBS has help available for the user. When you don't understand how to use a command, the help documentation will give you the details. For help on a specific command enter: ? or H followed by the letter of the command you'd like more information about. Either ? or H will work on some BBSs. On others, only one of them will work.

Example: ?L or HL will give you details on how to use the LIST command and its many variations.

A ? or an H, by itself, will give you general help information and specific instructions on how to use the help documentation on your BBS.

6.1 MESSAGE COMMANDS

LIST

One of the commands you will want to use when connecting to a BBS is the LIST command. There are many variations available, but L, by itself, is the one used most often:

- L (List) - Lists all new messages that have been received by the BBS since you last logged in, except for other users' personal messages. This command will show you all of the bulletins and NTS messages on the BBS that you haven't seen, plus any personal messages that are to or from you.

If you want to list specific messages, you may use one of the following variations of the L command:

- LM - (List Mine) - Lists all messages addressed to you.
- LL #- Lists the last # messages.

Example:

LL 30 will list the last 30 messages received at the BBS, excluding others' personal messages.

- L> callsign or category - Lists all messages TO the callsign or the category indicated.

Examples:

L> N6XYZ
L> SALE

- L< callsign - Lists all messages FROM the callsign indicated.
Example:

L< N6XYZ

- L@ designator - Lists all messages that have that “designator” in the @ BBS column of the message header.
Example:

L@ NCA

will list all messages with NCA in the @ BBS column.

There are several other variations depending on the type of BBS you’re using. Enter: ?L for a complete list.

6.2 READ

To READ a message, you enter an R followed by a space then the message number. Examples: If you wanted to read message 25723, you would enter:

R 25723

To read several messages, such as numbers 25723, 25726 and 25730, you’d enter:

R 25723 25726 25730

Note that you separate the numbers with a space, not commas.

You may also read messages in a way that will give you all of the forwarding headers in detail, rather than giving you just the callsigns. The forwarding headers show the list of BBSs that handled the message to get it from the originating BBS to the one you’re using, along with the date and time it was received, the BBS address and other information. Depending on the BBS software being used, either the RH or V command replaces the R. Examples: To read message 25723 with the full headers, you’d enter either:

RH 25723 or
V 25723

There is another variation of the READ command that you’ll find very useful, and that’s RM. Entering RM by itself will give you all of the messages addressed to you that have not yet been read.

6.3 ERASING MESSAGES

Once you have read a personal message, please erase it. The sysop will appreciate your help in clearing out the “dead” messages. You use the K - KILL command to do this. You can enter:

K #, such as K 25723

which will erase that particular message, or you can enter:

KM

which will erase all of the personal messages you have read. If you use the KM command, the BBS will list the message numbers for you as they’re killed.

6.4 THE S COMMAND(S)

You’ll find the S command used for SENDING messages on all BBSs, and on some systems the S is also used for STATUS. On WORLI-type systems, the letter S by itself will give you a reading of the BBS status, showing the callsigns of stations using the system, the time that they connected, the ports and tasks they’re using, etc. It will also show you information on the mail waiting for users and on the messages waiting to be forwarded to other bulletin board systems. S, by itself, on other systems will either prompt you for further information on sending a message, or it will give you an “illegal command” error message. (STATUS on an FBB BBS is obtained by entering ! - an exclamation point.)

SENDING A MESSAGE: The S command is mainly used for sending a message, but it should always be used with another letter specifying the type of message you’re sending. There are three types of messages found on packet bulletin board systems: Personal, Bulletin, and Traffic.

- SP is used for sending a personal message to one other station,
- SB for sending a bulletin (a message available to all), and
- ST for sending a message that’s going to be handled by the National Traffic System.

You’re able to send a message to one particular person, to everyone on the local BBS, to everyone at every BBS in your area, in the entire state, all across the country or around the world. It all depends on how you address the message.

Each message has three parts to it: The ADDRESS, the SUBJECT and the TEXT. I’ll discuss each part separately.

6.5 THE MESSAGE ADDRESS

Personal messages:

To send a personal message you enter SP followed by a space and then the callsign of the person you want to receive the message. Normally, that’s all that’s needed. A database of user information called the White Pages will fill in the address if it’s known. (I’ll discuss the White Pages later on in this series.) If the callsign is not known, you must then enter the full packet address, known as the hierarchical address. This address consists of the callsign of the BBS where you want the message to be delivered, the local

area, state or province, country and continent. The local area is usually preceded by the # sign, and is optional in some areas. However, it helps deliver the message to its final destination more directly, so use it if you know what it is. The state or province is the two-letter abbreviation used by the post office; the country is the three-letter country code and the continent is the four-letter continent code. You should find a list of these codes on your BBS either in the help file or in the files section.

Here are some examples of some correctly entered addresses for a personal message:

- SP WB9LOZ @ W6PW.#NCA.CA.USA.NOAM - That's how you would address a message to me in San Francisco.
- SP WM2D @ WA2NDV.#NLI.NY.USA.NOAM - WM2D uses the WA2NDV BBS located in the Northern Long Island (#NLI) area of New York state.
- SP G8BPQ @ G3DAD.#32.GBR.EURO - Note that BBSs in Great Britain, Japan and some other countries use numbers for the local area and do not use the state part of the address.

The hierarchical address will be discussed in detail in chapter 7 of this series.

Bulletins:

A bulletin is addressed to a CATEGORY. The category is limited to six characters and should indicate the nature of the message, such as PACKET, INFO, SALE, WANTED, DEBATE, ARES, etc. To send a bulletin to more than just the local BBS, you must add a forwarding designator that will specify the area where you want the message distributed. This can be the local area, the entire state, a region, all of the US or the world. Each state uses different designators, so you'll need to check your local BBS for this information. Try entering ?S or ?SB for a list.

These are some examples of how you would address a bulletin:

- SB INFO - This bulletin is offering "information" (on a topic that would be given in the "subject") and it would be available only to users of the BBS where it was entered since no distribution is specified.
- SB SALE @ CA - This bulletin lists an item that's for sale, and it will be sent to all BBSs in the state of California. (Note: CA is used in California, but the designator used in your state might use a different format.)

National Traffic System (NTS) messages: NTS messages require special addressing and a prescribed format. They're entered:

ST ZIPCODE @ NTSXX

where the zipcode is that of the person the message is going to, and the XX is the two-letter state abbreviation. NTS messages can be sent to the US and possessions and Canada only.

Examples:

ST 03452 @ NTSNH

ST 60626 @ NTSIL

ST V7L1J3 @ NTSBC

6.6 THE MESSAGE SUBJECT

When you have the address line of your message complete, you enter a carriage return <CR>. You'll then receive a prompt asking for the SUBJECT or TITLE of the message.

For a personal message you may enter anything you wish, but you're limited to a maximum of 30 characters. I usually indicate what I will be discussing in the message.

For a bulletin, you should enter a brief description (again, 30 characters or less) describing what the message will be about. Lots of bulletins are received everyday, so your SUBJECT should help the one listing messages to determine whether or not your message is to be read. You should attempt to describe the contents of your bulletin briefly but with detail. For SALE or WANTED messages, be specific about the equipment and include the brand and model. If you used INFO as a category, indicate what the information is about. For a personal message, the subject entered is really not important, since people will read any message directed to them. For a bulletin, though, the subject is critical. It is in these thirty characters that you must "sell" your message to potential readers.

An NTS message requires a specific format for the subject: City, State, Telephone Area Code and Prefix. Example:

Boston, MA 617-267

6.7 MESSAGE TEXT

Next, you'll be asked to enter the TEXT of the message. This is where you enter the actual message information. When entering the text, you should insert carriage returns at the end of each line, as if you were typing a letter. A normal line has a maximum of 80 characters, so when you have 70 to 75 characters typed, enter a carriage return and continue on the next line. This will prevent words from wrapping around to the next line and the program inserting an unnecessary blank line in the text. Some programs require the carriage return or anything after the first 80 characters will not be able to be read.

An NTS message requires you to use the ARRL message format for the text. I will tell you more about the National Traffic System and NTS messages in part 12 of this series.

When you have completed the text, you end the message with a CONTROL Z (you send a CONTROL Z by holding down the CONTROL key and hitting the Z key) or with /EX at the beginning of a new line. You must follow the CONTROL Z or the /EX with a carriage return <CR>.

Many BBSs will send you information about your message once it has been received completely: the message identification, the size, and the fact that it has been saved, etc. Some systems do not, so you have to make sure you receive the BBS prompt. Only when you receive the prompt are you sure that the message has been accepted by the BBS.

6.8 FILE DIRECTORY COMMANDS

The files on a BBS offer you a variety of information on a wide range of subjects. The file section is often referred to as the BBS library. Each BBS has its own unique set of files as determined by the sysop (the system operator), yet the libraries of many BBSs contain a lot of the same information. The files are stored in directories according to subject and are listed by file name.

To determine what directories and files are available on your BBS you use the W (WHAT) command. Entering W, by itself, gives you a list of the directories available on the BBS along with an associated letter or topic name and a general description of the subject for each directory. To list the files stored in a specific directory you enter W followed the directory letter or topic name that you received with the directory list.

Example: WA or W ARRL depending on the software used at your BBS. Enter: ?W to find out which form is used on your system.

If you want to read a file you use the D (Download) command. You enter D followed by the letter or topic name for the directory where it's stored and then the exact file name. Here are some examples:

- DF FCC EXAM.LST or D FCC FCC EXAM.LST
- DM TS440S.MOD or D MODS TS440S.MOD

You can enter ?D to find out which form is used on your BBS.

To send a file to the BBS you use the U (Upload) command. The command must be used with the letter or topic name for the directory you want to store the file in, followed by the filename you're assigning to the file. The filename can have up to 8 characters preceding the period and 3 characters following the period. (Normal DOS format.) Some examples:

UG FLEAMKT.INF or U GENERAL FLEAMKT.INF

would upload a file named FLEAMKT.INF into the G or GENERAL directory.

UP BBSTIPS.01 or U PACKET BBSTIPS.01

would upload the file BBSTIPS.01 into the P or PACKET directory. The BBS program will not allow you to upload a file with a filename that already exists. Some directories are set by your local sysop for downloading only, so they won't permit you to upload files to them. Enter ?U for more information on uploading to your local BBS.

6.9 OTHER COMMANDS

You'll find a variety of other commands available on your BBS, but which ones you find depends on the software being used. Here is an explanation of some of the ones you might find.

A - ABORT - Many systems offer the A (Abort) command, allowing you to stop the BBS from sending you further information. If you want to stop receiving a message list, a message, a file, or whatever is being sent to you, enter an A followed by a <CR>. When the TNC buffer is emptied, the flow of data will stop.

COPY - The COPY command is a C on some systems and SC (SEND COPY) on some others. The command is used to make a copy of an existing message and send it to another station. Enter ?C or ?SC for information.

C - CONFERENCE - Some BBS software offers a conference mode. This lets BBS users engage in a round-table QSO. Enter ?C on systems where this feature is available to get specific information.

D - DOS - The FBB BBS offers FBBDOS for listing, downloading, uploading and copying files, along with some other features. If you're using an FBB system, enter ?D for specific information.

E - EDIT - If you enter a message and then notice that you made an error entering the addressee's callsign, home BBS or address or decide you want to change the Subject of the message, some BBSs offer the EDIT command to make the desired changes. You can only change the message type, TO, BBS, address and subject. You cannot edit the message text. Enter ?E for details.

F - SERVERS - The FBB software offers several servers which you access by entering F, by itself. Enter ?F on an FBB BBS for an explanation of the servers available.

G - GATEWAY - A gateway feature is available on some BBSs, allowing you to connect to stations on a different BBS port than the one you're using. Enter ?G for details on how to use the gateway.

I - INFO - This command can give you details on the location of the BBS, the hardware, software and RF facilities of the system you're using, or on some systems, a page of upcoming events, helpful hints, or other useful information.

On WORLI and F6FBB type BBSs, there are several other variations of the I command:

I callsign - gives you the name, QTH, zip code and home BBS of the person with that callsign, if they're listed in the local "White Pages" database. Example:

I K1TGZ

IZ zipcode - gives you a list of all active packet stations in the specified zip code that are stored in the local "White Pages". An asterisk may be used in place of the end numbers to give you a wider area. Examples:

IZ 94114 would give you stations listed in the 94114 zip code only. IZ 941* would give you the stations in all zip codes that begin with 941. I@ BBS - lists all callsigns in the "White Pages" having the specified BBS as their home BBS. Example: I@ W6PW IH location - lists all callsigns in the "White Pages" having the specified location. Examples: IH CA IH GBR Enter: ?I for more detailed information on using this command.

J - Displays a listing of stations that were heard by the BBS or that connected to the BBS. The command must be used with a port identifier, such as JA, JB, etc. If entered by itself, J will list the ports for you or give you an error message. You'll find several variations of the J command depending on the type of software being used. Enter: ?J for details.

M - On MSYS BBSs M, by itself, will give you the message of the day.

N - The N command has several variations that are used for entering your name, QTH, zip code and home BBS. To enter your name you type the letter N followed by a space and then your first name, such as:

N Larry

Your QTH is entered using NQ followed by a space then your full city name and two letter state abbreviation, such as:

NQ San Francisco, CA

You enter your zip code with NZ followed by a space and your five-digit zip. NH is the command for entering your "home BBS". This is the system that you plan to use regularly and want all of your personal

messages delivered to. Make sure that it's a full service BBS, not a personal mailbox, since only full service systems are included in the message forwarding network. You enter your home BBS by typing NH followed by a space and then the callsign of the BBS, such as:

NH W6PW

Note: SSIDs are not used with BBS operation except for when making the initial connection. Most BBS software ignores all SSIDs.

REBBS type systems will ask you to register and you'll then be prompted for your name and other information. FBB type systems will automatically ask for your name and other information the second time you connect. On both of these BBSs, you will only need to use the N commands to change your user information.

This user information is stored at the local BBS and is also sent to a central database known as the "National White Pages Directory". The information can be accessed by anyone. You can use it to find the name, QTH and home BBS of your friends. How to use the "National White Pages" will be discussed in part 9 of this series.

O - OPTIONS - FBB systems offer several user selectable options - the language used by the BBS, paging, mail listing and base message number. Enter ?O for an explanation of how to use these options if you're using an FBB BBS.

P - PATH - On MSYS BBSs, P followed by a callsign will give you the path last used by that station to connect to the BBS. Example:

P W6PW

B - BYE - When you're finished using the BBS, enter a B to disconnect. You should always use the B instead of disconnecting with the TNC DISCONNECT command. On most BBSs, your user file is updated only when you leave the BBS using the B. If you don't use the B, the update doesn't occur, so the L command will not have the correct information for the next time you use the BBS.

Remember, you won't find all of these commands on the BBS you're using, but you might find others available that aren't listed here. Check your local BBS help document for a complete list of the commands available to you.

Chapter 7

PACKET MESSAGE ADDRESSING

Messages are directed throughout the worldwide BBS network using a scheme called HIERARCHICAL ADDRESSING. The format for a hierarchical address is:

```
addressee-call @ BBS-call.#local-area.state-province.country.continent
```

For example: My hierarchical packet address is:

```
WB9LOZ @ W6PW.#NCA.CA.USA.NOAM
```

It might look complicated, but it's not. First, note that each section of the format is separated by a period. State and province codes are the recognized two-character codes established by the US and Canadian Post Offices. These may be found in the Callbook, your phone directory, or any zip code listing. Don't guess on the state and province code if you aren't sure what it is, and make sure you use only the two-letter abbreviation. You could send the message to the wrong state or province or keep it from being forwarded altogether.

The codes used for the countries and continents are standards, now accepted throughout the world. You should be able to find a list of them in the help document or file section of your BBS. The country code has three letters and the continent code has four letters. (An older version of the continent code, still used by some BBSs, has only two letters.)

The code for the local area is optional. Since you probably have no idea what code is being used in upper New York state or in Iowa City, IA, for example, you don't have to enter it. If you do know the local code, please use it, because it will help get the message closer to where it's going more directly.

For messages going outside of the US or Canada, the state-province section is not always used.

Using the hierarchical format, here are some examples of packet addresses:

- KB6LQV @ N6ZGY.#CCA.CA.USA.NOAM
- KC6NVL @ K6VE.#SCA.CA.USA.NOAM
- KC3XC @ N4QQ.MD.USA.NOAM
- VE3XYZ @ VE3RPT.ON.CAN.NOAM
- JA1ABC @ JA1KSO.#42.JPN.ASIA

You'll note that the local area code is preceded by the octothorpe (now, how's that for a \$5 word?), better known as the number or pound sign. The reason is that in Great Britain, Japan, and possibly other areas, they use routing numbers for the local area, which could get confused with zip and postal codes. Using the # on all local area codes will eliminate forwarding problems.

We need to emphasize two very important points: hierarchical addressing DOES NOT indicate a forwarding PATH, and ONLY ONE BBS call should be included in the address. A list of BBS calls separated by periods will not get your message to its destination. In fact, it can cause your message to loop between BBSs and your message probably won't be delivered. The addressing scheme is said to be one area inside another area. Using my hierarchical address as an example, WB9LOZ @ W6PW.#NCA.CA.USA.NOAM, here's how you would describe the address: "WB9LOZ at W6PW which is in Northern California which is in California which is in the USA which is in North America."

USING THE HIERARCHICAL ADDRESS: This section explains how the BBS software uses the hierarchical addressing scheme. For an example, let's say that I send a message to my friend Richard, KA7FYC, who uses the KD7HD BBS in Missoula, MT as his home BBS. I would enter:

```
SP KA7FYC @ KD7HD.#MSL.MT.USA.NOAM
```

All BBSs have a routing list called a "forward file." Like your local postal sorter, it "knows" about local routings in detail, but as the destination grows more distant, it knows only about larger geographical areas. If the only items in my BBS's forward file are other California BBSs plus a list of state abbreviations, country and continent codes, let's see how this message would be forwarded. The BBS software will attempt to find a match between the items in the BBS forward file and the various parts of the hierarchical address starting with the left-most item in the address field. In our case, it would not find a match for KD7HD. If there isn't a match, it then moves to the next section to the right. It wouldn't find a match for #MSL, so it would again move to the right. Since all of the state abbreviations are listed in the forward file, it would find MT and that match would allow the message to be forwarded. The forward file would indicate the call of the next BBS in line to receive a message addressed to MT. Once the message is received at the next BBS, the process would start all over again until the message is finally delivered to its destination.

Chapter 8

THE PACKET MESSAGE – A DETAILED LOOK

The following is an example of what you see when listing messages on a BBS. On some systems the information is displayed in a different order, but the same information is given.

MSG#	STAT	SIZE	TO	FROM	@ BBS	DATE/TIME	SUBJECT
14723	PN	1084	WD5TLQ	WA6XYZ	N5SLE	0604/1240	Software working great!
14721	B\$	771	PACKET	WB9LOZ	WUSA	0604/1154	INTRO TO PACKET-Part 7 of 20
14717	BF	2387	EXAMS	W6NLG	NCA	0603/1020	FCC Exams: March – June
14715	TN	275	94114	W1AAR	0604/0959		San Francisco 415-821
14714	BF	1663	DEBATE	N2DEQ	WW	0602/2314	CW REALLY NEEDED?
14712	BF	918	INFO	N6ZYX	NCA	0603/1845	9600 BAUD DEMONSTRATION

The MESSAGE NUMBER is assigned by the BBS program when the message is received and it cannot be changed. The numbers are assigned sequentially.

The STATUS of the message includes several different bits of information. The first letter of the STATUS indicates the TYPE of message: B for Bulletin, P for Personal, or T for Traffic for the National Traffic System. Bulletins are messages of general interest to all users, and they can be read by everyone using the system. Personal messages are listed only for the sender, the addressee and the sysop, and they're the only ones who can read them. The list above would have to have been requested by WD5TLQ, WA6XYZ or a sysop. Can you see why? It lists an outgoing personal message. (NOTE: Although personal messages can't be read by everyone using the BBS, anyone in monitor mode can see a personal message as it's being sent over the air, of course.) Traffic messages, type T, are listed for everyone and can be read by anyone. In fact, all users are encouraged to participate in the delivery of NTS messages addressed to your area. (Refer to chapter 12 of this series for information on NTS messages.)

STATUS also shows whether or not the message has been read, has already been forwarded to all designated stations, or has not been forwarded. You might see one of these letters: N – no, it hasn't been read, Y – yes, it has been read, F – it has been forwarded, \$ – it has not been forwarded, I – it's in the process of being forwarded right now.

The SIZE indicates the combined total of characters, including punctuation, in the message text. The forwarding headers (explained below) are considered to be part of the text and are included in the size. What starts out as a short message can grow in size as it's forwarded from BBS to BBS.

TO is the call sign of the addressee for personal messages, the category or interest group for bulletins and the zip code of the addressee for NTS messages. While you might find bulletins addressed TO AMSAT, TO PACKET or TO SALE, they're actually messages about AMSAT, about PACKET or about equipment for SALE. You're apt to see anything in the TO column: ALL, USERS, EXAMS, CODE, SALE, WANTED, DEBATE, SAT, PACKET, etc.

FROM shows the callsign of the station originating the message.

@ BBS is used for forwarding a personal message to someone at another BBS, for forwarding NTS messages and for general distribution of a bulletin using a forwarding designator. In the list shown above, the personal message would automatically be forwarded to WD5TLQ at the N5SLE BBS. By entering a special designator, such as NCA, in the "@ BBS" column a bulletin may be forwarded to specific areas. (See chapters 6 and 7 of this series for details on the addressing of personal messages and bulletins and on using the forwarding designators. Addressing of NTS messages is discussed in part 12.)

Next is the DATE and TIME showing when the message was received at the BBS you're using, or when the message was written. (This varies depending on the type of software being used at the BBS.) If the message originated at another BBS, the date and time when the message was originally entered will be shown in the forwarding headers, as explained below, and at the top of the message when you read it. The date and time indicated can be either local time or GMT (Zulu time) depending on the time used by the BBS.

The SUBJECT (or TITLE) is a short description of the message content. For bulletins, this is the information that determines whether or not someone is going to read your message when he sees it in the message list. It should be brief, but it also should be informative. You need to tell the other users what the message is about as clearly and concisely as you can with just 30 characters.

The parts of the message mentioned so far are all seen when you ask for a message list using the L (LIST) command. On some systems, entering a semicolon after the list command will give you more information about the message, such as the message ID, the full hierarchical address, the number of times the message has been read, etc. Example:

```
LL 35 ;
```

If a message has been forwarded from another BBS, forwarding headers are added at the top of the actual message TEXT. This information is added by each BBS that is used to get the message from its origination point to the destination. Each BBS adds one line showing the time the message was received by that particular BBS, its callsign and address, and possibly the QTH, zip code, message number and other information. If you use the RH or V command (depending on your software), rather than just R, when reading a message, you'll receive complete headers. With just the R, headers are reduced to a list of the BBS callsigns. The complete headers are useful if you want details on the path a message took to reach you or how long it took to be forwarded from system to system from the source to destination.

The TEXT of the message contains the information you want to convey to the reader. It can be of any length. However, if the message will be going to a distant BBS and will most likely be forwarded on the HF network, there is a 2.5K size limit. This limit has been set by the HF gateway sysops to keep traffic moving smoothly despite poor conditions and QRM. Extremely long messages can tie up the forwarding system unnecessarily, so users are advised to break up long messages into parts.

As mentioned in chapter 6, when entering a message into a BBS, use carriage returns at the ends of your lines, as if you were using a typewriter. The normal screen width is 80 characters, so you should enter a carriage return prior to the 80th character on each line. A message entered without the carriage returns can be very difficult to read as words are cut at improper points, lines vary drastically in length, and blank lines are often inserted. On some terminal programs and printers, any line exceeding 80 characters without a carriage return inserted will not be seen or printed past the 80th character.

You should include your name, call and packet address at the end of the text so that the person reading your message will be able to send a return message to you if he or she wishes to do so. You end your message with a control-Z or a /ex at the beginning of a new line. This will tell the BBS to save the message. Don't disconnect until you receive the prompt back from the BBS. Otherwise you won't know

whether or not your message was saved.

Chapter 9

PACKET RADIO WHITE PAGES DATABASE

In this part of the series we're going to look at the White Pages. No, not your local telephone directory, but the packet radio directory known as the "White Pages". You help supply the information for "WP", and you can also use it to find the home BBS, QTH and zip code of your friends on packet.

"White Pages" was initially designed by Eric Williams, WD6CMU, of Richmond, California. Hank Oredson, W0RLI, later added a WP database to his packet bulletin board software, and now most of the BBS software programs have some form of the White Pages available. It's a database of packet users showing their name, home BBS, QTH and zip code. It's updated and queried by packet message, allowing stations from all over the world to take advantage of it.

When users enter their name and other information into their BBS user file, it gets included in the WP database. The White Pages server at each BBS also scans the forwarding headers of all messages received, extracts callsign information and adds that to the database. The software automatically assembles an update once a day containing all of the new WP information and any changes the database has received in the past 24 hours. This update is then forwarded to the regional White Pages server. The regional server, in turn, takes all of the information it has received from other BBSs and sends out updates to other BBSs in the area, as well as to the N6IYA BBS in Fulton, California, the national White Pages server. As a result, we have a large database of information on packet users world-wide. By querying WP, you can easily find the name, home BBS, QTH and zip code of other stations on packet.

If your BBS is operating with its own WP database, you may make inquiries of it using either the I or Q command, depending on the software being used. Simply enter I or Q followed by the callsign you'd like information about. If you wanted information on WB9LOZ, for example, you would enter:

```
I WB9LOZ or Q WB9LOZ
```

Check the help information on your BBS to see which command is the one used there. Some BBSs also offer commands that allow you to search the WP database for station lists using location or zipcode information. Try ?I or ?Q or ?WP for details.

If your local BBS doesn't have the information you are looking for, it can be obtained from your regional WP server or from the national WP server. Since query messages are read and answered by the WP software, not by a person, you must use the correct format:

```
callsign ?
```

You address your query to WP @ the callsign of the server you want to use. The word QUERY is

entered for the subject. You may then include as many requests as you wish in the text of each message, but each must be on a separate line.

Here's an example of a message sent to N6IYA, the national White Pages server:

```
SP WP @ N6IYA.#CCA.CA.USA.NOAM
Enter subject of message: Query
Enter text:
K9AT ?
WA6DDM ?
NG2P ?
W1KPL ?
(Control Z OR /EX)
```

(The same format would be used
to send a query message to your
regional WP database.)

Capital and lower case letters may both be used within the message.

Just like all other packet messages, messages addressed to WP are forwarded from BBS to BBS toward their destination. If a BBS operating with the WORLI WP Server handles a query message, it will respond with any pertinent information that it has available. As a result, you might receive more than one response to your WP query.

If the information on a callsign in a WP database is not updated, it is deleted after a certain length of time specified by the sysop. This time frame is normally 90 to 180 days, although some systems retain information for up to a year.

It is important to note here that you should choose ONLY ONE BBS as your home BBS, the one where you want all of your messages delivered. You should also make sure that it is a full service BBS, not a personal mailbox, or mail will not be forwarded to you. Always enter that callsign when you are asked to enter your home BBS, even if you are using another system at the time.

When a message arrives at the destination BBS given in the "@ BBS" column, some of the BBS software will check the White Pages information to make sure that the message has been delivered to the right place. If it finds that a different BBS is listed as the addressee's home BBS, it will insert that BBS callsign in the message and send it on its way. If you enter different home BBS calls on several BBSs, your mail could easily end up being sent from BBS to BBS and never reach you.

If you move or change your home BBS, you should then make sure that you update the information for your call in the White Pages database. Use the NH, NQ and NZ commands to update the information. Making sure that the information in the White Pages is correct will help to get your messages delivered to the correct BBS.

Chapter 10

USING THE NODE NETWORK - PART 1 OF 2

In this and the next part of the series we're going to take an in depth look at the packet node network. In chapter 4 I explained how to use the network for connecting to another station. Now we'll look at the other features a node offers.

10.1 THE PACKET NODE NETWORK

Using the packet node network can make your operating time on packet more enjoyable and it can greatly expand the area that you can reach. The network of NET/ROM, TheNet, G8BPQ and KAM nodes is expanding very quickly and now covers most of the country. New nodes are showing up almost daily. Thanks to all of these stations and the interconnecting links, you can now connect to stations in many distant places using a low powered 2 meter rig. Some nodes are set up for cross-banding, and with the introduction of nodes on 10 meter FM, there's the possibility of working a station just about anywhere.

A packet node, in most cases, is still set up for digipeater operation, so you can still use it as a regular digipeater, but for most of your connections you'll want to use the node features. Why? When using a string of digipeaters your packets have to reach their destination parity correct and the receiving TNC has to return an acknowledgement (ack) to your TNC for each packet to be accepted. As you add more digipeaters to the path the chances of each packet being accepted becomes less and less. Other stations on the frequencies being used and noise along the route can be the cause of many retries. When using a node, however, your packets no longer have to reach their destination before the acknowledgements are returned to your TNC. Each node acknowledges your packet as its sent along the way toward its destination.

If you've been monitoring lately, you might have seen the nodes in action. You might have wondered why they were sending all of those weird symbols like @fx/<~|. What you're seeing is the nodes communicating with each other and updating their node lists. You also might have noted callsigns with high numbered SSIDs, such as WB9LOZ-14, WA6DDM-15, W6PW-12, etc. The nodes change the SSIDs of all stations that originate packets so that the callsigns sent via the network are not the same as those sent directly. If you were to use a node to connect to another station in the local area, there's the possibility of your packets being received by this station both from you directly and from the node. If the callsign through the node wasn't changed, the TNCs involved would be totally confused as it would appear that two stations were connecting using the same callsign. The node automatically changes the SSID using the formula 15-N, where N is your usual SSID. A call with -0 becomes -15, a -1 becomes -14, -2 becomes -13, etc.

The node network is very simple to use. As explained in part 4, to use the node network you first connect to a local node. It should be one where you can connect to it direct with good signal strength. Once you've connected, you then have several options – connect to another station within range of the node, connect to another node, connect to an associated BBS, obtain a list of the nodes that are available, or check route and user status. On NET/ROM and TheNet nodes you can also answer or call CQ.

There are several commands available on your local node. All have CONNECT, NODES, ROUTES and USERS, and depending on the type of node you're using, you might also find the BBS, BYE, CQ, INFO, MHEARD, PARMS or PORTS commands available.

10.2 THE PACKET NODE COMMANDS

CONNECT

The CONNECT command (which can be abbreviated as C) is used just like you use the CONNECT command with your TNC. To connect to another local station using a node, first connect to the node and then enter C followed by the callsign of the station you want to reach. To connect to another node you can use either the callsign or the alias. For example, to connect to the BERKLY:WB9LOZ-2 node:

you can use C WB9LOZ-2, or
you can use the alias C BERKLY

Either one will work. Review chapter 4 of this series for more information on making connections via the node network.

PORTS

There's a special consideration when making connections from a node using the G8BPQ Packet Switch software. Since these nodes are capable of having several different frequencies operating from the one node, you have to indicate which frequency port you want to make your connection on. The PORTS command, abbreviated P, will give you a list of the ports available, such as this:

SF:WB9LOZ-1} Ports: 1 144.99 MHz 2 223.56 MHz 3 441.50 MHz You then insert the port number between the C and the callsign to indicate which frequency you want to use, in this case the port 1 frequency of 144.99 MHz:

C 1 WB6QVU

NODES

The NODES command can be abbreviated as N and when entered without any other information will give you a listing of other nodes that can be worked from the node you're using. The list contains both the alias and the callsign of each node. The alias might give you a hint of a node's location, but you'll need a list of the local nodes to be able to tell for sure where each node is located. (You'll probably find node lists in the file section of your local BBS.) As you move from node to node, the list of nodes you find will vary in length and will contain different callsigns since all of the frequencies are not linked.

The NODES command has a feature that gives you a simple way to find out how easy it will be to connect to another node in the list. All you need to do is enter N followed by either the alias or callsign of the node that you want to reach, such as:

```
N FRESNO or
N W6ZFN-2
```

You'll receive a report showing up to three routes to the node you asked about, how good these routes are and how up to date the information is. If there is no information available, you will receive either "Not found" or the complete node list, depending on the type of node or switch you're using.

Let's take a look at a typical report you would receive after entering N FRESNO. If you were connected to a NET/ROM or TheNet node the report would look like this:

```
SFW:W6PW-1} Routes to: FRESNO:W6ZFN-2
105 6 0 WB9LOZ-1
78 6 0 W6PW-6
61 5 0 WA8DRZ-7
```

If you were connected to a G8BPQ packet switch you would see one less column in the report and it would look like this:

```
SF:WB9LOZ-1} Routes to: FRESNO:W6ZFN-2
> 126 6 W6PW-10
78 6 W6PW-6
60 4 W6PW-1
```

Each line is a route to the node you asked about. The symbol > indicates a route that's in use. The first number is the quality of the route. 255 is the best possible quality and means a direct connect via hard wire to a coexisting node at the same site; zero is the worst, and means that the route is locked out. 192 is about the best over the air quality you'll find, and it usually means that the node is only one hop away. If you see a quality of less than 80, you'll probably have a difficult time getting any information through via that route. The second number is the one that tells you how up to date the information is; it's call the obsolescence count. This number is a 6 when the information for the route is less than an hour old. For each hour that an update on the route is not received, this number is decreased by one. A 5 means the information is an hour old, a 4 means that it's two hours old, and so on. The next number, shown only on NET/ROM and TheNet nodes, indicates the type of port. A 0 is an HDLC port; a 1 is an RS-232 port. You don't need to pay any attention to this figure. The callsign is that of the neighboring node that's next in line on the route.

This quick check on a node that you want to reach can save you a lot of time. You'll know immediately whether or not the node is available, and if it is, how good the available routes are to it. You then won't have to spend time trying to connect to a node that isn't available or is of poor quality.

If you find that there's a decent route to the node or switch you want to reach, it's normally best to let the network make the connection for you. Simply enter a connect to the alias or callsign you want rather than connecting to each individual node along the route yourself.

If a route exists but the quality is not very good, you might want to connect to the neighboring node shown for the best route, then do another quality check, repeating this procedure until you find a route with decent quality. You can actually get through to some distant nodes using this method if you have the time and patience to work on it.

(We continue with more commands used on the packet nodes in chapter 11)

Chapter 11

USING THE NODE NETWORK - PART 2 OF 2

11.1 COMMANDS

...continued from chapter 10

ROUTES

The ROUTES command (abbreviated as R) will give you a list of the direct routes to other nodes from the node you're using. The direct routes are the ones where the node can connect directly to the other node. The quality of each route is shown along with the obsolescence count. (See the NODES command in chapter 10 for an explanation of obsolescence count.) Any route marked with an exclamation point (!) means that the route values have been entered manually by the owner of the node and it usually means that the route is not reliable for regular use.

USERS

The USERS command (abbreviated as U) will show you the callsigns of all the stations now using the node that you're connected to. There are five descriptions used by the node to describe how users are connected:

- UPLINK: The station indicated is connected directly to the node.
- DOWNLINK: The node has made a connection from the first station to the second station.

Example:

DOWNLINK (K9AT-15 N6UWK)

would mean that the node connected to N6UWK at the request of K9AT.

- CIRCUIT: Indicates that the station indicated has connected FROM another node when the node and user callsign are on the left of the <--> and indicates that the station has connected TO another node if node is on the right of the <-->. If you see dashes between the arrows, the circuit is in use. If you see < >, the connection is in progress. The alias and call of any other nodes being used are shown prior to the user's callsign. Examples:

- Circuit (SFW:W6PW-1 WA6DDM) <-> AA6ZV would mean that WA6DDM is using this node, that he connected to it from the SFW node and is now connected to AA6ZV.
 - N6PGH <-> Circuit (DIA:WB6SDS-2 N6PGH) would mean that N6PGH connected direct to this node and has connected to the DIA node.
 - Circuit (SSF2:KA6EYH-2 KK6SD) < > (AMCYN:WZ6X-2) indicates that KK6SD has connected to the node you're using from the SSF2 node and is now attempting to connect to the AMCYN node.
- CQ: See "CQ command" below.
 - HOST: The user is connected directly from the node terminal. This is seen when the owner of the node is a user, or the BBS associated with the node is using it to forward messages.

CQ

The CQ command is used both for calling CQ and for replying to the CQ of another station. The command is available only in the latest versions of NET/ROM and TheNet. Enter a ? when connected to a node to see if it's available there. The CQ command is used to transmit a short text message from a node, and is also used to enable stations that receive the transmission to connect to the station that originated it. The command is entered as:

CQ textmessage

The "textmessage" can be any information up to 77 characters long including spaces and punctuation, and it's optional. In response to a CQ command, the node transmits the specified textmessage in "unproto" mode, using the callsign of the originating user as the source and "CQ" as the destination. As with all node transmissions, the SSID will be translated; that is, the SSID will be 15-N, where N is the SSID of the original callsign. WB9LOZ-0 would become WB9LOZ-15, WB9LOZ-1 would become WB9LOZ-14, etc.

Here is an example of how the node CQ command is used: If station W6XYZ-3 connects to a node and issues the command:

CQ Anybody around tonight?

the node would then transmit:

W6XYZ-12>CQ:Anybody around tonight?

After making the transmission in response to the CQ command, the node arms a mechanism to permit other stations to reply to the CQ. A station wishing to reply may do so simply by connecting to the originating callsign shown in the CQ transmission (W6XYZ-12 in the example above). Note here that you connect to the station using the translated SSID. A CQ command remains armed to accept replies for 15 minutes, or until the originating user issues another command or disconnects from the node.

Any station connected to a node may determine if there are any stations awaiting a reply to a CQ by issuing a USERS command. An armed CQ channel appears in the USERS display as:

(Circuit, Host, or Uplink) < > CQ(usercall)

The station may reply to such a pending CQ by issuing a CONNECT to the user callsign specified in the CQ(...) portion of the USERS display—it is not necessary for the station to disconnect from the node and reconnect.

Here's what a typical transmission would look like: (**bold text** = entered by user)

```
cmd: C W6PW-1
cmd: *** Connected to W6PW-1
USERS
SFW:W6PW-1 NET/ROM 1.3 (669)
Uplink(K9AT)
Circuit(LAS:K7WS-1 W1XYZ) < > CQ(W1XYZ-15)
Uplink(WB6QVU) <-> Circuit(SFBBS:W6PW-3 WB6QVU)
CONNECT W1XYZ-15
SFW:W6PW-1 Connected to W1XYZ
Hello! This is George in San Francisco
Hi George! Thanks for answering my CQ. etc.
```

Users of the CQ command are cautioned to be patient in waiting for a response. Remember, your CQ will remain armed for 15 minutes, and will be visible to any user who issues a USERS command at the node during that time. Wait a few minutes before issuing another CQ to give other stations a chance to reply to your first one! Don't be surprised, however, if you don't receive a response. For some unknown reason, I've found that very few users take advantage of the feature. When you connect to a distant node, the CQ command is a great way to start a QSO with a station in that area, but more users need to be made aware of the CQ feature before it will become very useful.

BBS

The BBS command (which cannot be abbreviated) is available on nodes using the G8BPQ software and having an associated packet bulletin board system. Entering BBS will connect you to the associated BBS.

IDENT

The IDENT command (abbreviated as I) found on NET/ROM nodes will give you the identification of the node you're using.

INFO

The INFO command (abbreviated as I) found on TheNet nodes will give you information about the node, usually the alias, callsign and location. The INFO command (abbreviated as I) found on G8BPQ nodes will give you the identification of the node and a list of the commands available.

MHEARD

The MHEARD command (abbreviated as M) found on TheNet and G8BPQ nodes will give you a list of stations heard by the node. If the node has more than one port, you must specify which port you want the listing for by entering a space after the M and then the port number. Examples:

M 1 will give you a list for port 1
M 2 will give you a list for port 2

Use the PORTS (P) command to get a list of the ports and the associated frequencies.

PARMS

The PARMS (Parameters) command (abbreviated as P) found on NET/ROM and TheNet nodes is for the owner's use in determining how his station is working. It will give you a list of the node's parameters.

PORTS

The PORTS command (abbreviated as P) found on G8GPQ nodes will list the frequencies of all ports available.

BYE

The BYE command (abbreviated as B) is available on TheNet and G8BPQ nodes. It's used for disconnecting from the node. If the node has other software, you must disconnect using the D command in your TNC.

?

Entering a ? will give you a list of the commands available on the node.

Remember, when you are connected to a network of nodes, any commands you send will be directed to the last node you connected to.

Chapter 12

NATIONAL TRAFFIC SYSTEM AND PACKET RADIO

The National Traffic System, known as NTS, is the ARRL sponsored Amateur Radio message handling network. Packet radio is now playing a very important part in the network, so let's take a look at the system and give you some tips on handling NTS traffic by packet.

Handling third party traffic is the oldest tradition in amateur radio. Nationwide, the National Traffic System has hundreds of local and section nets meeting daily in order to facilitate the delivery and origination of such messages. More and more of this traffic is being originated, relayed, and delivered on packet. If you enjoy traffic handling, you can easily get involved in NTS via packet. If you're on packet but know nothing about NTS, this part of the series will get you off to a good start. At the end you'll also find some references for further information on NTS.

Local packet BBSs have to be checked daily for traffic that needs to be delivered or relayed. When you check into your local BBS, enter the LT command, meaning "List Traffic." The BBS will display a list of all NTS traffic awaiting delivery. It'll look similar to this example:

MSG#	STAT	SIZE	TO	FROM	@BBS	DATE/TIME	SUBJECT
37893	TN	486	60625	KB6ZYZ	NTSIL	1227/0712	CHICAGO, IL 312-267
37802	TF	320	06234	WB6DOB	NTSCT	1227/0655	NEW HAVEN, CT
37854	TF	588	93432	KA4YEA		1227/0625	CRESTON, CA 93432
37839	TN	412	94114	KA8UHL		1227/0311	SAN FRANCISCO 415-821
37781	TF	298	94015	W1KPL		1226/2356	DALY CITY, CA 415-992

You might see traffic that is being relayed by your local BBS to some other part of the country as well as traffic for your local area. The "Subject" or "Title" column of the listing will show the destination of the traffic. If you see a message that is within your local area, help out and deliver it.

12.1 RECEIVING A MESSAGE

To take a message off of the Bulletin Board for telephone delivery, or for relay to a local NTS net, enter R followed by the message number. Using the list above, entering the following would send you the message from KA8UHL for San Francisco:

R 37839

You'll find the message in a special NTS RADIOGRAM format, with a preamble, address, telephone number, text and signature, ready for delivery. After the message has been saved to your printer or disk, the message should be erased from the BBS. Use the K command, as you do for killing your own messages. To kill message 37839, for example, you'd enter:

```
K 37839
```

This prevents the message from being delivered again by someone else.

12.2 DELIVERING OR RELAYING A MESSAGE

Once you have received the NTS Radiogram, it should, of course, be handled expeditiously. If it's for your immediate area, you should deliver the message by telephone. If you took the message for delivery to the local traffic net, you should make an effort to see that it gets relayed as quickly as possible. If you're unable to deliver the message, due to an incorrect phone number, no answer after several tries, or some other problem, send a return message to the originator advising him of the non-delivery, and why.

12.3 SENDING MESSAGES

Any amateur can originate a message on behalf of another individual, whether the person is a licensed amateur or not. It is the responsibility of the originating amateur, however, to see that the message is in proper form before it's transmitted. A special format is used for NTS traffic so that the messages are compatible across the entire network. Each message should contain the following components in the order given: number, precedence, handling instructions (optional), the station of origin, check, place of origin, time filed, date, address, telephone number, text and signature. The destination of all NTS traffic must be to a point in the US, its possessions, or Canada.

When the message is ready to be entered into your local BBS, you must use the ST command, which means "Send Traffic," followed by the zip code of the destination city, then @ NTS followed by the two letter state abbreviation. The form used is:

```
ST ZIPCODE @ NTSxx
```

A message being sent to Boston, MA 02109 would be entered as follows:

```
ST 02109 @ NTSMA
```

and a message for Iowa City, IA 52245 would be entered as:

```
ST 52245 @ NTSIA
```

The message SUBJECT or TITLE should contain the destination city and state and the telephone area code and exchange, if available. See the examples in the listing above. Only one NTS message should be included in each packet message (no "book" messages). The actual radiogram should be included entirely within the TEXT of the packet message, including all of the components listed above. End the message with the usual Control-Z or /ex.

12.4 IN TIME OF EMERGENCY

The National Traffic System functions on a daily basis as a public service for both your fellow hams and the general public. It serves another function as well. The NTS provides a well oiled and trained national system of experienced traffic handlers able to handle large volumes of third party traffic accurately and efficiently during disasters. Your participation now will help prepare you for that time of emergency. Following the Loma Prieta Earthquake in October of 1989, over 7000 NTS messages were handled by packet BBSs in the San Francisco Bay Area. We needed and used all of the help we could get.

12.5 REFERENCE MATERIAL

The ARRL booklet “An Introduction to Operating an Amateur Radio Station” offers detailed information on handling and preparing NTS Radiograms. There are also many files with detailed information on NTS available for downloading from your local BBS. They give a complete rundown on how to prepare and send an NTS message on packet, how to deliver NTS messages, etc. Check your local BBS files section for them if you want to get involved. Your help will certainly be welcome!

Chapter 13

TNC COMMANDS - PART 2 OF 3

In this chapter and the next we'll take a look at some of the TNC commands available to you that we haven't covered previously. You might find that some of the commands are not available in your particular TNC or that they're used in a slightly different manner than what is presented here. Not all TNCs operate exactly the same. Please refer to your owner's manual for specific details on how to use these commands if they don't function as described here.

13.1 8BITCONV

This command enables the transmission of 8-bit data in converse mode. Used with AWLEN - see below. For normal packet operation, such as keyboard to keyboard transmissions, use of bulletin board systems, and the transmission of ASCII files, 8BITCONV should be OFF. If you need to transmit 8-bit data, set 8BITCONV ON and set AWLEN to 8. Make sure that the TNC at the receiving end is also set up this way. This procedure is normally used for transmission of executable files or a special non-ASCII data set.

13.2 AWLEN

This parameter defines the word length used by the serial input/output port of your TNC. For normal packet operation, as described above, AWLEN should be set to 7. Set to 8 only if you're going to send 8-bit data.

13.3 AX25L2V2

This command determines which level of AX.25 protocol you're going to use. If OFF, the TNC will use AX.25 Level 2, Version 1.0. If ON, the TNC will use AX.25 Level 2, Version 2.0. Note: Some early TNCs will not digipeat Version 2.0 packets. With AX25L2V2 OFF, if your TNC sends a packet and the packet doesn't get acknowledged the first time it was sent, it will send it again and again, until an "ack" is received or the TNC retries out. With AX25L2V2 ON, if your TNC sends a packet and doesn't receive an "ack" the first time, it will send a poll frame to see if the other TNC received the packet. If yes, then it would continue, if not then it would send the last packet again. The advantage here is that short poll frames are sent, rather than long packets containing data. This can greatly reduce channel congestion. For VHF/UHF operation, it is almost essential that every TNC have AX25L2V2 ON. Many operators have

suggested that Version 2.0 NOT be used on the HF bands as it tends to clutter the frequency with poll frames. See the CHECK command below for related information.

13.4 BEACON

Used with EVERY or AFTER to enable beacon transmissions.

BEACON EVERY n - send a beacon at regular intervals specified by n. BEACON AFTER n - send a beacon once after a time interval specified by n having no packet activity on the frequency.

n = 0 to 250 - specifies beacon timing in ten second intervals: 1 = 10 seconds, 2 = 20 seconds, 30 = 300 seconds or 5 minutes, 180 = 1800 seconds or 30 minutes, etc.

Examples:

BEACON EVERY 180 (or B E 180): the TNC will transmit a beacon every 30 minutes.

BEACON AFTER 180 (or B A 180): the TNC will transmit a beacon after it hears no activity on the frequency for 30 minutes.

B E 0: will turn the beacon off.

The text of the beacon is specified by BTEXT and can contain up to 120 characters. The path used for the beacon transmission is specified by the UNPROTO command. YOU SHOULD USE BEACONS INTELLIGENTLY! Beacons are often a point of controversy in the packet community because they tend to clutter the frequency if used too frequently. You should keep your beacons short and infrequent, and they should only be used for meaningful data. Bulletin boards use the beacon for advising the community of who has mail waiting for them, clubs use beacons for meeting announcements, and beacons are used for severe weather warnings. In areas with heavy packet activity, beacons should not be used just to let everyone know that you're monitoring the frequency, that your mailbox is ready, or that you'd like someone to connect to you. You should monitor the frequency for activity and make some connections yourself.

13.5 CHECK n

Sets a timeout value for a packet connection. When a connection between your station and another seems to "disappear" due to changing propagation, channel congestion or loss of the path, your TNC could remain in the connected state indefinitely. If the CHECK command is set to a value other than 0, the TNC will attempt to recover the connection or disconnect. The action taken depends on the setting of AX25L2V2. The value of CHECK (n) may be set from 0 to 250 and the timing is based on the formula of $n * 10$ seconds. (n = 1 is 10 seconds, n = 5 is 50 seconds, n = 30 is 300 seconds or 5 minutes, etc. A value of 30 is a recommended value to use.) If CHECK is set to 0, it disables the command. If AX25L2V2 is ON, the TNC will send a "check packet" to verify the presence of the other station if no packets have been heard after (n * 10) seconds. If a response to the "check packet" is received, the connection will remain. If no response is received, the TNC will begin the disconnect sequence, just as if the DISCONNECT command had been sent. If AX25L2V2 is OFF, after no packets are heard for n * 10 seconds, the TNC will not send a check packet, but will begin the disconnect sequence.

CMSG: Enables the automatic sending of a connect message whenever a station connects to your TNC. If CMSG is ON, the TNC will send the message contained in CTEXT as the first packet of the connection.

CTEXT can contain up to 120 characters. Of course, you must have a message in CTEXT for CMSG to function. This feature is often used when the station is on but the operator is not present. The connect message is used to advise the other station of that fact, and often says to leave a message in the TNC buffer or mailbox. If CMSG is OFF, the CTEXT message is not transmitted.

KISS: Enables the TNC to act as a modem for a host computer, allowing programs such as TCP/IP, the G8BPQ Packet Switch, various BBS programs, and other programs using the Serial Link Interface Protocol (SLIP) to be run. Before turning KISS on, set the radio baud rate and terminal baud rate to the desired values. Set KISS to ON and then issue a RESTART command.

Chapter 14

TNC COMMANDS - PART 3 OF 3

14.1 MAXFRAME

Sets the upper limit on the number of unacknowledged packets the TNC can have outstanding at any time. (The outstanding packets are those that have been sent but have not been acknowledged.) MAXFRAME also determines the maximum number of contiguous packets that can be sent during one transmission. The value can be set from 1 to 7. The best value to use depends on the frequency conditions. The better the conditions are, the higher the value you can use. If conditions are poor due to frequency congestion, noise, or other variables, (shown by lots of retries) MAXFRAME should be reduced to improve throughput. The best value of MAXFRAME is determined through experimentation. MAXFRAME of 1 should be used for best results on HF packet.

14.2 MFILTER

This command allows you to enter up to four ASCII character codes, 0 - \$7F, for the control characters that you want eliminated from your monitored packets. Codes may be entered in either Hex or Decimal. Here are the ASCII codes for some of the more troublesome control characters found in monitored packets:

HEX	DEC	FUNCTION	POSSIBLE RESULT
\$07	07	Control G	Rings your bell or “beeps” your speaker
\$0C	12	Control L	Form feed - could clear your screen
\$13	19	Control S	Can cause your screen to stop scrolling
\$1A	26	Control Z	Can clear your screen
\$1B	27	Escape	Can cause your cursor to move to a random point on your screen and can raise havoc with printer control.

AEA has added a new code, \$80, that will not allow ANY control characters to be displayed on the user’s screen from monitored packets.

14.3 MHEARD

An immediate command that causes the TNC to display a list of stations that have been heard since the command MHCLEAR was given or the TNC was powered on. This command is useful for determining what stations can be worked from your QTH. Stations that are heard through digipeaters are marked with an *

on most TNCs. On the AEA PK-232, the stations heard direct are marked with the *. (Check your TNC manual.) The maximum number of stations in the list is 18. If more stations are heard, earlier entries are discarded. Logging of stations heard is disabled when the PASSALL command is ON. (See below.) If the DAYTIME command has been used to set the date and time, entries in the MHEARD list will show the date and time the stations were heard.

14.4 PASSALL

Causes the TNC to display packets that have invalid checksums. The error-checking is disabled. If PASSALL is ON, packets are accepted for display, despite checksum errors, if they consist of an even multiple of eight bits and are up to 330 bytes. The TNC attempts to decode the address field and display the callsigns in standard format, followed by the text of the packet. PASSALL can be useful for testing marginal paths or for operation under unusual conditions. PASSALL is normally turned OFF.

14.5 PERSIST

Used in conjunction with the SLOTTIME command (see below) to SLOTTIME less clutter on a busy packet frequency. As more and more TNCs are upgraded to include the PERSIST and SLOTTIME commands, fewer and fewer packet collisions will occur. If you have these commands available in your TNC, you should set DWAIT to 0 and set these commands for use. Note: On some TNCs, such as the PK-232, you have another command that determines whether you use DWAIT or PERSIST /SLOTTIME. It's the PPERSIST command (with 2 P's). Set it ON to use PERSIST /SLOTTIME; set it OFF to use DWAIT. I strongly recommend that you set PPERSIST to ON.

PERSIST specifies a threshold value for a random-number attempt to transmit. The value ranges from 0 to 255. 0 signifies a 1/256th chance of transmitting every SLOTTIME; 255 allows the TNC to key the transmitter every SLOTTIME. Through experimentation, it has been determined that the best value for PERSIST is in the 60 to 70 range.

14.6 SLOTTIME

This command determines the time interval the TNC waits between generating random numbers to see if it can transmit. This random number generation and the value of PERSIST work together to provide smoother operation on a busy packet frequency. The SLOTTIME value may be set from 0 to 250. Through experimentation it has been determined that the best value for SLOTTIME is in the range of 10 to 20.

14.7 SCREENLN n

This parameter determines the length of a line of text on your computer screen. The value may be 0 to 255, and is usually set to 40 or 80 depending on the screen display you have. A carriage return and line feed <CR/LF> are sent to the terminal in Command and Converse modes when n characters have been displayed. A value of zero inhibits this action. If your computer automatically formats output lines, this feature should be disabled.

14.8 TRANS

This is an immediate command causing the TNC to change from Command mode to Transparent Mode. Transparent mode is used when you want to send data such as executable programs where characters in the data would conflict with the operation of the TNC. Characters such as “Control C”, “Control R”, “Control S”, “carriage return”, “linefeed”, etc. all effect the operation of the TNC when in Converse Mode. In Transparent Mode none of the data characters affect the operation. All eight bits of each character are sent to the radio exactly as they are received by the TNC from the computer or keyboard. Packets are transmitted at regular intervals set by the PACTIME command or whenever a full packet of information is ready. The receiving TNC must also be in Transparent mode and nodes and digipeaters cannot be used in the transmit path. Since the characters normally used for TNC operation have no affect in this mode, a special procedure is required to exit Transparent Mode and return to Command Mode. Refer to your TNC operating manual for details on how this procedure is performed on your particular TNC. You should also check your manual for information on the CMDTIME, PACTIME, START, STOP, TRFLOW, TXFLOW, XFLOW, XOFF and XON commands before using Transparent Mode.

14.9 TXDELAY n

This parameter tells the TNC how long to wait before sending data after it has keyed the transmitter. All transmitters need some start up time to put a signal on the air. Some need more, some need less. Synthesized radios and radios with mechanical relays need more time, while crystal controlled radios and radios with diode switching require less time. External amplifiers usually require additional delay. Experiment to determine the best value for your particular radio. TXDELAY can also be useful to compensate for slow AGC recovery or squelch release times at the distant station.

There are many additional commands available to you. Spend some time reading the owner’s operating manual that came with your TNC to discover some of the surprises the other commands offer. New versions of the TNC software have added several commands that you might find useful in your packet operating.

Chapter 15

TIPS FOR BETTER PACKET OPERATION

Here are some tips to help make your packet operating more enjoyable. Whether it's while making local QSOs, checking into a BBS or mailbox, or working DX, there are a few things you should take into consideration that will help eliminate problems and waiting time, increase your "throughput" and make packet a lot more fun. ("Throughput" is a word that has come into common usage by packet operators and means the amount of usable packet information transmitted or received.)

When connecting to another station, don't use a digipeater or node unless you have to. Each digipeater you add to the path increases the time required to get your signal to its destination and to get an acknowledgement returned. It also increases the chance for interference and for collisions with other packets. You'll be amazed at the difference in throughput when comparing a direct connect to one with just one digipeater in the path.

The packet node network, as discussed in previous articles in this series, does a great deal to help you get your packets through, but you must remember that throughput there, too, is affected by the number of nodes used and by the conditions between you and the destination station. The big advantage of the nodes is that the acknowledgements do not have to return all the way from the destination station before your TNC is satisfied. Packets are acknowledged from node to node, so that eliminates a large part of the problems encountered. Getting the original packet through, however, remains to be as much of a problem for the nodes as it is for you when using digipeaters. It can take several minutes to get a packet through when you're working a station some distance away. Have patience!

Dr. Tom Clark, W3IWI, has determined that for EACH HOP in a packet path the loss of packets can vary anywhere from 5% to 50% depending on the amount of traffic. Remember, each digipeater and node adds a hop, compounding the problem, and you have twice as many hops as you might think, because of the acknowledgements. You can see how quickly the path deteriorates as traffic increases and digipeaters and nodes are added to it.

If you have a choice, use a frequency that doesn't have a lot of other traffic on it. It makes sense that the more stations there are on a frequency, the more chances there are for collisions and retries. A path that will work perfectly without a lot of traffic, can become totally useless under heavy traffic conditions. Just one additional station on the frequency can decrease throughput by about half in many cases.

Another consideration, especially if working over a long distance, is atmospheric conditions. You might not have experienced this before on VHF, but with packet's high sensitivity to noise, a slight change in signal strength can mean the difference between getting your packets through or not getting them through. Long paths between nodes are very susceptible to these changing conditions. There are times, especially on a hot summer day, when it's impossible to get a packet from one node to the other on what is normally a good path. At other times, "thermals" can increase your range dramatically and you're able to use node paths that normally don't exist. In the San Francisco Bay Area, the fog has a significant

affect on VHF signals. When a fog bank is moving in off the Pacific, it can act as an excellent reflector. Signals that normally aren't heard or are very weak can reach signal strengths of 40 over S9.

Multipath is another problem that can greatly affect your packet signal. Multipath is the term used to describe the receipt of multiple signals from one source due to reflections off of buildings, hills or mountains. The "ghost" in a television picture is a form of multipath. A station with a very strong signal into a digipeater or node often cannot use that path if multipath causes the signal to be distorted. Each packet is checked for 100% accuracy and is not acknowledged unless it is. Multipath reflection can cause occasional bits to be lost so you can end up with multiple retries and a poor path even with strong signals.

To sum up, for best results on VHF use the least number of digipeaters and nodes as possible, use a frequency with low activity, and be aware of atmospheric conditions and multipath problems. Remember, by decreasing PACLEN and MAXFRAME in your TNC, you improve your chances of getting packets through under poor conditions.

If you use packet on HF, remember to change your transmit baud rate to 300 and to use a short PACLEN (a value of 40 seems to work quite well) and a MAXFRAME of 1. The chances of getting a short packet through the noise and QRM are much better than for a long one.

Chapter 16

PACKET RADIO REVIEW - QUIZ

In this chapter, let's do some reviewing. I'm going to present a short quiz on packet radio covering the basics that I've presented in the past 15 chapters. Let's see how well you can answer the following questions without looking back for the answers. In chapter 17 I'll discuss each question and give you the correct answers.

1. What are the three TNC modes of communication?
 - (a) Connect, Converse, Terminal
 - (b) Command, Converse, Terminal
 - (c) Command, Converse, Transparent
 - (d) Command, Connect, Transparent
2. What TNC command is used to set the transmit path for beacons and CQs?
3. What is the TNC command CHECK used for?
4. While you're connected to another station, what command is used to monitor other traffic on the frequency?
5. If you saw one of the following lines on your screen when in monitor mode, what would the asterisk indicate?
 - W6ABC-3>N6XYZ,W6PW-1*: Hi Bob
 - W6ABC-3>W6PW-1*>N6XYZ: Hi Bob

(Displays vary with various TNCs, so both common types are shown.)
6. Why does the packet node network improve communications compared to the use of digipeaters?
7. If you're connected to a station in New Mexico using the node network, how do you disconnect?
8. If N6ZYX-2 connected to you via a node, what would the SSID of the station become at your end of the connection?
9. When you're connected to another station, what are the two most probable causes for packets to NOT be received by the other station?

10. There are several basic commands used on a packet bulletin board system. Indicate what you would enter to perform the following:
 - (a) Receive a list of messages.
 - (b) Read message 47134.
 - (c) Download a file in the General (ID G) directory called FCCEXAMS.LST.
 - (d) Enter a personal message to Jim, WA6DDM, who uses the W6PW BBS in San Francisco, California.
 - (e) Change your home BBS from W9ABC to W7XYZ.
11. To send an NTS message via packet addressed to Tom Smith, 123 Main Street, Keene, NH 03431, telephone (603) 555-4321, what would you enter at the BBS prompt?
12. If a message has a STATUS of BF, what does that indicate?
13. When sending a bulletin, what is the most important thing to remember when entering the SUBJECT?
14. If you wanted to send a message to your friend John, W4IP, but you didn't know what the call of his home BBS was, what could you do to try to find out what the call is?
15. What is the maximum value for MAXFRAME? If you're working a station on 30 meters and are sending a lot of retries, should you increase or decrease MAXFRAME?

Well, how did you think you did? We'll take a look at the answers to these questions and more in chapter 17.

Chapter 17

PACKET RADIO REVIEW - ANSWERS

How did you do on the review quiz in the previous part of this series? If you haven't taken it, you might want to read chapter 16 and take the quiz now before reading any further.

Here are the correct answers and the series part numbers where you can read more about the subject:

1. Answer C is correct. The three TNC modes of communication are Command, Converse and Transparent. Command mode is for communicating with the TNC. Converse mode is for normal QSOs, connects to a BBS or mailbox, etc. and Transparent mode is used for binary file transfer. (Chapters 2, 3 and 14)
2. The UNPROTO command is used for setting the transmit path for both beacons and CQs. (Chapters 3 and 13)
3. The CHECK command is used for setting a timeout value in your TNC. If set to a value other than zero, the TNC will attempt to recover a connection after a certain specified time if nothing is received from the other station. This command is used in combination with the AX25L2V2 command. (Chapter 13)
4. The MCON command (Monitor while CONnected) is used to monitor other traffic on the frequency while you're connected to another station. (Chapter 3)
5. When monitoring, the asterisk indicates the station that you actually heard the packet from. The MRPT command must be ON for the monitor display to show digipeaters. (Chapters 2 and 3)
6. The packet node network improves communications because packets are acknowledged between your station to the first node, and then node to node to the destination. A packet doesn't have to reach the destination before an ack is returned. (Chapters 4, 10 and 11)
7. When using the node network (no matter who you're connected to) you disconnect by going to command mode on your TNC and entering a D, just like at other times. Some nodes have the B (Bye) command available, so a B might also work. The fact that you're using several nodes or are connected to a distant station makes no difference. The network will take care of disconnecting all stations and links. (Chapters 4, 10 and 11)
8. N6ZYX-2 would appear as N6ZYX-13 if he connects to you using a node. The nodes change the SSID using the formula 15-N. (Chapter 10)

9. The two most probable causes for a packet not to get through are collisions with other packets on the frequency and noise due to weak signals. (Chapter 15)
10. BBS commands: (Chapters 5, 6, 7 and 8)
 - (a) To receive a list of messages you enter: L
 - (b) To read message 47134 enter: R 47134
 - (c) To download a file in the General (G) directory called FCCEXAMS.LST you'd enter: D GENERAL FCCEXAMS.LST or DG FCCEXAMS.LST depending on the software being used by your BBS.
 - (d) To send a personal message to Jim, WA6DDM, you would enter:
SP WA6DDM @ W6PW.CA.USA.NOAM
If his callsign was known in the White Pages database on your BBS, you would only have to enter:
SP WA6DDM
 - (e) To change your home BBS from W6ABC to W7XYZ you would enter: NH W7XYZ
11. If you wanted to send an NTS message to Tom Smith, 123 Main Street, in Keene, NH 03431, you would enter the following at the BBS prompt > ST 03431 @ NTSNH (Chapters 6 and 12)
12. A message with a STATUS of BF means that the message is a bulletin and that it has been forwarded to all stations that are supposed to receive it from the BBS you're using. (Chapter 8)
13. When entering the SUBJECT of a bulletin, you should give information that will help users listing your bulletin to determine whether or not they should read it. If you're entering a SALE or WANTED bulletin, tell what the item is and give the manufacturer and model. For an INFO bulletin indicate what you're offering information about. (Chapters 6 and 8)
14. To find the call of the HOME BBS of your friends, use the White Pages database. If the BBS you're using has the WP feature enabled, you'll find the I command (or Q command on some systems) to be useful, otherwise send an inquiry to your regional WP server or the national WP server. (Chapter 9)
15. The maximum value for MAXFRAME is 7. MAXFRAME is the number of packets transmitted by your TNC contiguously, and the number of unacknowledged packets the TNC can have outstanding. You decrease MAXFRAME when the conditions are poor. Your TNC will send fewer packets at one time, so there will be less information to collide with other packets on the frequency and less chance of information being wiped out by noise. (Chapter 14)

There is no passing grade on the quiz. It was designed for you to check your general packet knowledge, and you'll have to be your own judge of that. I hope you did well on it!

Chapter 18

WB9LOZ'S PARTING COMMENTS

In the previous 17 chapters, I have attempted to cover all of the basics of packet radio – from setting up your TNC and making your first QSO, to using digipeaters, the packet node network, and bulletin board systems. Many of the TNC commands have been explained, including the best settings for normal use, and I've offered some suggestions that should make it easier and more enjoyable for you to use packet radio.

Now that you have the basics, you might want to continue with your study by investigating some of the other facets of packet radio. There are several programs available that I haven't covered in this series that you might find interesting. There's the Packet Cluster software used by the DX Spotting Network for finding those rare DX stations, APRS-the Automatic Packet Reporting System that's now very popular for station locating and for use with GPS, the Global Positioning Satellites, J-NOS and T-NOS for use with TCP/IP, other networking programs like Tex-Net and Rose, and new computer programs specifically written for packet and the other digital modes. The list goes on and on. PAC-SAT, the amateur packet satellite program, is growing in popularity as more satellites carrying packet radio equipment are released. High speed modems running at speeds of up to 56 kilobaud are just around the corner for general use on packet radio. What developments will be next?

To keep up with the latest developments in Packet Radio, join your local packet radio group or digital communications club. Become a member of TAPR, the Tucson Amateur Packet Radio Corporation, the national organization that is devoted to packet radio development and education. TAPR has a quarterly newsletter and offers kits, publications, and a disk library of software and information (including this "Introduction to Packet Radio" that you're reading). You can contact them at (817) 383-0000. Read the packet columns in "QST", "CQ", "73" and other ham magazines and look for bulletins on your local BBS offering new information and discussions of developing systems, software and hardware. Packet Radio, and digital communications in general, are still relatively new areas and I'm sure you'll be seeing lots of changes in the years ahead.

I'd like to thank the following people for their help in preparing this series: Don Simon, NI6A; Bill Choisser, K9AT; Don Fay, K4CEF; Scott Cronk, N7FSP; Roy Engehausen, AA4RE; and Hank Oredson, W0RLI. Their help and their answers to my questions are greatly appreciated.

If you have any comments on this "Introduction to Packet Radio" series or you would like to correct or update any of the information contained in this work, please please contact me through my web site, given below. I would enjoy hearing from you, and your comments would be very much appreciated. I hope that you've found this to be informative and helpful in making packet radio more enjoyable for you.

73, Larry Kenney, WB9LOZ

<http://www.choisser.com/hamradio/packet.html>