NON-NET/ROM NETWORKING

This chapter focuses on several network schemes which do not follow the Net/Rom rules (KaNode, TexNet, FlexNet, TCP/IP and ROSE) . Chapter 9 was devoted entirely to Net/Rom networking. The goal of this chapter is to provide enough information so that you can use these packet networks effectively.

10.A KANODES

The term KaNode is apparently derived from the manufacturer's name, Kantronics. The products first developed by Kantronics made available in a well packaged product a device which provides basic connection services. While many are used only on VHF, their real popularity has been as two port nodes on VHF and HF. These provide an access method to HF for folks who are otherwise limited to VHF. For operational details, see Chapter 25 of Volume 2.

The KaNode provides no networking capability. Thus, it is intermediate in "smarts" between the digipeaters described in section 3.C and the networking nodes described in the Chapter 9 and in the following sections of this chapter.

Most KaNodes that the author has encountered seem to be dual frequency (two port). A few are single frequency. The following description applies to both except the comments concerning cross-connection between ports.

10.A.1 WHAT A KANODE DOES: A KaNode allows you to connect to it. Then, you can ask it to connect you to someone or something else. Many also have mailboxes attached. The convention often seems to be that mailbox, node, and digipeater function have different SSID's (see sections 3.A.1, 3.B, 4.E concerning SSID's). The example of section 3.B shows, in fact, a KaNode mailbox.

10.A.2 HOW TO CONNECT THROUGH A KANODE: To connect to another node or station using a KaNode, you must connect to it first. Then, you ask the node to make the connection for you. To make a connection on the same frequency as that on which you arrived at the KaNode, you simply send `C callsign` where callsign is either an amateur call or a node name. For example, if you connected to a KaNode on VHF and wanted to connect to W1MM who's station is in connect range and on the same VHF frequency, you would simple type *C W1MM*. The advantage of this method over using it as a digipeater is in error handling as discussed in section 3.D.

If you connected to a KaNode on HF and wanted to connect to W1MM who's station is in connect range and on the KaNode's VHF frequency, you would simple type `X W1MM`. When you wish to make a connect on the opposite frequency at that on which you arrived at the KaNode, you simply send `X callsign`. The "X" in this case means "cross-connect".

An interesting and useful feature of KaNodes is the stay-connected option. This is particularly useful on HF with its frequent disconnects. What happens with the usual link failure (due to excessive retries, usually) is that the node recognises that there is no longer a good link. It then generates a disconnect message which ripples back to the user and produces the familiar `*** DISCONNECTED` on your screen. The stay-connected option stops the disconnect at the KaNode from which you connected using this option. You make this happen by adding a space and an *S* at the end of your connect request.

10.A.3 Heard and Node lists: One of the common mysteries about KaNodes is how you find out what is there to connect to. Sending the node a *J* (for Just-heard) gives you a heard list. Depending on activity, the list may hold anywhere from a few minutes to 10 minutes of calls. Similarly, sending the node an *N* (for Nodes-heard) may give a list that is several days old in parts.

Each of the two lists (J & N) indicate which of the two ports (if there is more than one) the station or node was heard. One of the confusion factors is that the ports are often listed with a V (VHF) or H (HF). If you have worked through several KaNodes, especially HF/VHF combinations, it may be difficult to tell which side of a KaNode you entered on. There is, however, an easy way. Since you are connected to the node, it must have heard you! When you ask for the Just-heard list, your callsign is almost always the last one (the most recent heard before sending you the list). Next to your call is a symbol showing the port on which you are connected. reaching any call or node with the same symbol requires a *C* because it is the same port; any call with a different symbol requires an *X*.

Here is an example of a "J" list from a cross-band KaNode (shortened):

```
N8HEE-3/H    03/06/93  18:11:58
K7MYU/V      03/06/93  18:12:47
N7OO-3/H     03/06/93  18:12:51
AZ/H         03/06/93  18:13:54
N2EZH/H      03/06/93  18:14:04
N0SNS-14/H   03/06/93  18:15:52
WD7I/H       03/06/93  18:15:54
SALEM/V      03/06/93  18:16:33
AF7S-1/V     03/06/93  18:18:20
KA7EHK/V     03/06/93  18:18:21
WG0N/H       03/06/93  18:18:27
WH6ANH-15/H  03/06/93  18:19:15
KA7EHK-15/V  03/06/93  18:19:22
ENTER COMMAND: B,C,J,N,X, or Help ?
```

And here is an example of a shortened "J" list from a KaNode with both ports on VHF:

```
WB7SNH/2     00/00/00  00:03:28
VE7DBZ-15/1  00/00/00  00:04:00
SPR/1        00/00/00  00:05:05
VE7PL/1      00/00/00  00:07:50
VE7PL-3/1    00/00/00  00:07:59
K7TPN-8/2    00/00/00  00:08:24
WB7SNH-15/2  00/00/00  00:10:33
VE7DIE/1     00/00/00  00:11:56
VE7DHM-8/2   00/00/00  00:12:15
PTN/2        00/00/00  00:12:41
W7LD-15/2    00/00/00  00:12:41
VE7DIE-15/1  00/00/00  00:12:47
KA7EHK-15/1  00/00/00  00:12:48
ENTER COMMAND: B,C,J,N,X, or Help ?
```

Note the difference between port symbols!

10.A.4 NOTES ABOUT HF: If you are going to use a KaNode with an HF port, take a look at Chapter 12 about HF operation.

You should also be aware that the RF baud rate is usually lower (300 baud instead of 1200) and packet lengths are much shorter. Thus packets come through in smaller chunks than you might be used to and they appear more slowly.

The "hidden transmitter problem" (see section 3.E.2) is a way of life on HF. If you are in Washington and talking to a station in Colorado, there might be stations hidden (to you) in Texas or Brazil!

There is a great variety of networking nodes (of all flavors), KaNodes, & TNCs which digipeat on HF. Operation is much less defined than on VHF. The best thing I have found is to experiment, experiment, and experiment some more!

10.A.5 NETWORK-LEVEL ACTIVITY: Despite the appearance that a KaNode is simply a sophisticated digipeater, these nodes do utilize some network-level protocol (see Chapter 11).

When a connection is requested to another KaNode, a circuit similar to that of a Net/Rom node is created. This circuit becomes a pipeline for your packets. It also has additional error correcting. This activity is entirely at levels 3 and 4 of the OSI Networking Model (see section 11.B).

10.B. TexNet Networks

TexNet was developed by the Texas Packet Radio Society (TPRS). The two areas where this type of network seems to be in greatest use is in Texas-Oklahoma-Arkansas and in Michigan. TexNet nodes are described briefly in section 8.E.5. Here, we will focus on operation and use.

The TexNet protocol hides network activity quite a bit (but not entirely) from users. Routing (that is destination table maintenance) is semi-automatic.

10.B.1 Node services: TexNet nodes provide a slightly different set of services than is customary for Net/Rom nodes. Here is the list from a TexNet node near Oklahoma City, Oklahoma:

```
L                                   = List all known network LOCATIONS
C W5ABC @ LOCATION                  = Connect to station at remote LOCATION
C W5ABC VIA DIGI1,DIGI2 @ LOCATION  = Connect via digipeaters
C CQ @ LOCATION                     = Call CQ on user port at LOCATION
S @ LOCATION                        = Get statistics report from LOCATION
S Y @ LOCATION                      = Get yesterdays statistics
M (@ LOCATION)                      = Connect to the Packet Message Server
W                                   = Connect to the Weather Server
B                                   = Bye (Disconnect)
```

The Packet Message Server is a local mailbox which is programmed into the node as a mail server. When you ask for a connection to the mail server at your local node (or some other one), you are connected to the mailbox which has been pre-programmed for that node. These are generally not full service store-and-foreward bulletin boards.

The Weather Server is a mailbox which is reserved for weather information. It is typically a regional mailbox devoted to weather bulletins. The same mailbox may be programmed for use by several nodes. To some packeteers outside the region where TexNet is in use, this may seem a bit superfluous. But, within this region, some of the United State's most severe weather (tornados) are found. Very fast dissemination of weather alerts is very desirable. Thus, the Weather Server can be very useful.

One of the services which is not shown on this list is called alert. Alert is intended for emergency situations. When alert is turned on, any user who connects receives a message asking the user to disconnect unless the connect is related to the emergency.

10.B.2 Making a connection: Like Net/Rom, you must know what node a particular user uses in order to connect. And, like Net/Rom, you connect to your local node first. As far as you are concerned, the difference (between Net/Rom and TexNet) is that you do not connect to the distant node before connecting to the distant user. Instead, at your local node, you type the command:

C usercall @ nodename

In one complete process, your connect request is routed to the node you specified with *nodename* and that node makes the connection to the station you specified with *usercall* .

10.B.3 Routing: One of the features of TexNet is that users need not know the structure of the network. If a connection to a distant user is requested, it is naturally assumed that it will happen. How does it work?

Though not shown in the abbreviated command list (section 10.B.1), there is a routes command which returns the routing table of the node to which you are connected.

```
Network CMD ?
ROUTE

LOCATIONS served by the network are:

 173 000 000 000 000  CHOCTAW    172 172 001 000 075  OKEMAH
 162 172 002 000 075  MUSKOGE    161 172 003 000 075  MKOTST
 160 172 003 000 075  FTGIBSN    164 172 004 000 075  FAYETVL
 174 172 005 000 075  HOGEYE     175 172 006 000 075  GARFLD
 166 172 004 000 075  FTSMITH    165 172 005 000 075  CLAYTON
 176 172 007 000 075  OARSMO     046 172 006 000 075  SHERMAN
 169 172 004 000 075  TULWX      105 172 016 000 075  FLORES

Network CMD ?
```

The preceeding table may be interpreted as follows: the first column before each node name is the identification number of the node. The second column is the node number of the neighbor which has the best route to the given node. The third column is the number of hops to the given node. The fourth column is the node number of the neighbor with the second-best route to the given node. The fifth column is the number of hops via the second-best neighbor to the given node.

A quick survey of the table should show how it works. Look first at CHCTAW (the 6-character AX.25 alias for the node CHOCTAW), the node which provided the route list. It is node number 173 and there are no neighbors with a route to it (not a suprise!) Then look at the entry for OKEMAH on the top line. It is node number 172. It shows that the neighbor with the best route to OKEMAH is node number 172 and there is only 1 hop involved; one can infer from this entry that OKEMAH is a direct neighbor of CHCTAW. All other nodes in this table specify route through node 172 (OKEMAH). Thus, one can also infer from this that OKEMAH is the only neighbor (to CHCTAW)!

Further, MUSKOGE, node number 162 on the second line, is only 2 hops away and, like all of the others, must go via node 172. We can infer from this that MUSKOGE is a neighbor of OKEMAH. Since it is the only 2-hop node, it must be the only neighbor of OKEMAH.

What is not apparent from the preceeding discussion is how the routing tables are maintained. There is both an automatic route management system (somewhat like Net/Rom) and a Network Management System (NMS) which frequently (every 10 minutes) surveys nodes. If any node fails to respond, routing tables in other nodes are modified. The NMS also maintains data about retry rate, node usage, etc. Thus, routing tables are fully automatic in the Net/Rom sense but have an have an over-riding management system which deals with wide-area routing. The NMS helps to resolve the problem of the slow propagation of network changes; the NMS makes the changes network-wide much more quickly.

10.C. ROSE Networks

The ROSE network was developed by the Radio Amateur Telecommunications Society (RATS) in New Jersey. It is even more different from Net/Rom than is TexNet. Node naming and addressing is completely different and so is the method of making a connection. As mentioned in section 8.C, the convention in ROSE networks is to refer to nodes as switches.

ROSE networks are quite wide-spread in the Eastern United States. This network extends east of the Mississippi River to the Atlantic Ocean and from New York south to about Georgia. It extends westward into Oklahoma and Texas. There are also some isolated ROSE networks. One of which the author is aware is around Edmonton, Alberta, Canada.

10.C.1 Switch services: In comparison to other networks, the services provided by switches, themselves, is very limited. Most of the services which are found within Net/Rom networks are outside of ROSE networks. It is unusual, for example, to find a bulletin board which is an actual part of the network. That does not mean that such services are missing. Instead, they just are not an integral part of the network. This is a consequence of the network philosophy rather than any deficiency in the network, itself.

One can get information about how to use ROSE switches by connecting to a local switch. The switch returns a fairly detailed message. An incomplete example follows:

```
ROSE X.25 Packet Switch Version 3.2 (930303) by Thomas A. Moulton,
W2VY
SERVING THE EL RENO METRO AREA

This ROSE switch is located in El Reno OK.  Its call is AC5C-5.
frequency is 145.07
Its address is 405262.  Its digi call is AC5C5  Connect to stations
in the El Reno area with the command:
  C CALLSIGN V AC5C-5,405262
Connect with stations in other areas by using the ADDRESS of ROSE
switch in
```

```
that area instead of my ADDRESS.  For example, to connect to
"SOMEONE" in
Pauls Valley, use the command,
  C SOMEONE V AC5C-5,405238
Switches currently available on the ROSE network include:
    Oklahoma:                           Texas:
405226--ARDMORE (WA5YOM-5)          214050--DALLAS(TEXNET) (N5BCA-6)
405238--PAULS VALLEY (WB5CQU-5)     214223--DALLAS (N5DT-3)
405248--LAWTON (WJ5Y-5)             214234--NORTH DALLAS (N5BCA-2)
405262--EL RENO (AC5C-5)            214555--ROSE NETWORK NEWSLETTER
405444--VELMA (KA5ZZI-5)            409598--CENTER (WB5RIA-2)
405732--MIDWEST CITY (K5JB-5)       409845--COLLEGE STATION (W5AC-2)
405771--SPENCER (N0ELS-5)           713453--HOUSTON (W5FCN-2)
                                    713592--CLEVELAND (W5DN-2)
    Louisiana:                      817491--DOUBLE OAK (WB5
```

10.C.2 Making a connection: The method of making a connection is, to users, perhaps one of the most distinguishing features of ROSE networks.

Unlike Net/Rom or TexNet, one does not connect to the switch in order to connect to another station. Instead, a connection request is made as if the switch is a digipeater (using "via"). This method was apparently chosen in order to conform to AX.25 connection rules which are built into standard TNCs. According to AX.25, there are only two methods of connecting: either directly to a specified callsign or through digipeaters to a specified callsign. It is possible to use UI packets to carry messages without connecting (as in TCP/IP; see Section 10.D); but without special software, doing it is not easy.

The method for connecting to another station through a ROSE packet switch is:

C callsign V localswitch,distant switch

Of course, *callsign* is the call of the station you wish to reach. *Localswitch* is the callsign of the local ROSE switch, not its name. But *distantswitch* is the name, not the callsign, of the switch where you expect to find the station you are connecting to. This format is completely acceptable to any AX.25 TNC since it fits the format of connecting through a digipeater.

It is a little confusing when you wish to connect to someone who uses the same switch as your local one. In this case, *localswitch* and *distantswitch* refer to the same switch! But different characters need to go into these two slots and both slots must be filled. For example, if one were in Houston, Texas and wanted to connect to a local user, say

W5XX, on the ROSE switch (see list, above), one would enter

C W5XX V W5ECN-2, 713453

Note that W5ECN-2 and 713453 are the same switch.

10.C.3 Packet Switch addressing: To users of Net/Rom and TexNet networks, the addressing convention used by ROSE may be rather perplexing. In concept, however, it is quite simple. Names of switches are taken from telephone practice. The first three characters are the telephone area code of the area served by the switch. The last three characters are the telephone prefix of the area served by the switch. A switch may be set up to recognize a whole set of area codes or prefixes.

ROSE developers have indicated a desire to extend the addressing mechanism to complete telephone numbers with international routing prefixes. If this comes to pass, one could theoretically connect to another packet station just knowing its telephone number.

10.C.3 Routing: As can be seen from the description of the connection process, no knowledge of network structure is needed by users. In fact, it is not only not needed but hidden.

Despite the network structure being hidden, it works much like the other networks which have been described in this chapter and in Chapter 9. There are routing tables in each switch. But these tables are completely manual. That is, it takes direct action by the node operator to change the table. Thus, if a section of the network were to fail, there is no automatic adaptability. Routing is changed to accommodate such failures only when someone notices that it has happened.

10.D TCP/IP Networks

In this section, we will focus on the network aspects of TCP/IP. For other information, see Chapter 15.

Operation of TCP/IP networks can be very confusing to someone who's packet experience is mostly with one of the other network types discussed in this chapter and Chapter 9. The entire process is different, starting with the basic exchange of packets. There are no TNCs designed for radio TCP/IP (that the author is aware of, anyway). Regular TNCs work, but only when operated in KISS mode (where a computer does most of the real work). Thus, you cannot use generic terminal programs; you must use something like NET or NOS.

10.D.1 Packet exchanges: With TCP/IP, the familiar connection never occurs. Instead, a scheme called datagram is used. If the stations exchanging packets are local (that is, they can hear each other), each one sends UI packets (which still contain a destination callsign). These packets carry all of the message information including requests to resend error packets. The conventional AX.25 scheme uses special packets to represent each of the special conditions (information, connect, disconnect, etc); see Section 4.D for more information about packet types.

In a sense, TCP/IP uses a generic [UI] AX.25 packet for almost all transactions. All of the action is in the text portion of the packet.

10.D.2 Network architecture: As with other protocols, there is typically a local network linked with other local networks. Because of the large quantities of information often tranferred (such as program files), local network baud rates are often higher than 1200 baud; there are some local networks with baud rates up to 56Kbaud. TCP/IP networks are subject to all of the constraints discussed in Chapter 8.

One significant difference is that with the standard TCP/IP software, every station can also be a node. Thus, messages may be routed through a whole set of stations (a bit like digipeating, but with all of the error correction which nodes offer). While this operation reduces the efficiency of a local network, it does work.

10.D.3 Addressing: Addressing is discussed in much more detail in Chapter 15. The important feature to note here is that TCP/IP stations have an Internet-style (or IP) address. It consists of four numbers, each in the range of 0-255 (readers knowledgeable about the inner workings of computers may recognize these as 8-bit numbers so that the entire address is a 32-bit number).

Each TCP/IP station has an address, sometimes more than one. For hams, the first number of their address is 44. This designates the amateur network. Thus, all ham IP addresses are of the type 44.xx.yy.zz. The middle two parts of the address are generally associated with a specific physical location. The last part is associated with a specific machine. Actually, if a machine joins several networks, there is a separate address for each connection to that machine.

10.D.4 Local Routing: Routing is one of the big distinctions between TCP/IP and the other AX.25 protocols discussed so far. Suppose that you are in an area where the addresses all begin with 44.10.3 (just to pick a nearly random set of numbers). Suppose that your IP address is 44.10.3.17 and you want to send a message to 44.10.3.102. There are several ways this might happen.

You may already know that 44.10.3.102 is KA6PDQ-3 who is operating as part of your local network. In this case, the IP address and the corresponding call would be entered into a lookup table in your computer. Then the UI packets from your station will be labeled to KA6PDQ-3 and from you.

Suppose that you don't know the call of 44.10.3.102. Before sending message packets, your station needs to find the callsign of the destination station. Your station then sends a UI packet which has a special set of characters in the message identifying it as an ARP (Address Resolution Protocol) packet. This packet essentially says "is the station 44.10.3.102 out there, and if so, what is its callsign?" If 44.10.3.102 can hear your station, it will answer [again, with a UI packet] "I am 44.10.3.102 and my callsign is KA6PDQ-3." Once your station receives this response, it can begin sending packets.

10.D.5 Wide-Area Routing: Routing outside your local area takes place through a gateway. Gateway is the generic name in TCP/IP networks for a station with ports on different networks. In otherwords, a gateway is a like a node-stack (but is more general since it includes wire and other links to other kinds of networks). How routing is handled depends on the relationship between addresses and network construction in a particular area.

Suppose that a network is addressed hierarchically. This means that all stations have some part of their address the same when they use the same local network. For example, everyone on one local network might have an address 44.10.3.xx and all those on a neighboring local network might have addresses 44.10.5.xx. In this case, everyone on the 44.10.3 network would have programmed into their computers the fact that all messages destined for an address 44.10.5.xx would be sent to the gateway which has a route to that network. The gateway would have programmed how to route all of those messages to the station which is the gateway to the 44.10.5 network.

A flat network is one in which there is no relationship between network structure and addresses. In this case, there might be some with 44.10.3.xx addresses on one local network and others with addresses 44.10.3.xx on another local network. In this case, there must be individual routing instructions for every station in each of the networks!

In either case, a message destined for a TCP/IP station outside the local network begins as UI packets. The header includes the callsign of the originating station and the callsign of the gateway. The body of the message then must include the address of the destination so that the gateway (and any other stations along the way) know how to route the message.

In the case of a message destined for a very distant destination, the originating station must be programmed with the gateway to which the message is handed. In many local networks with only one gateway, the choice is obvious. Decisions are then made at various points within the network. These decisions might be of the form "all messages addressed to 44.89.xx.yy" will be directed to the neighbor handling messages to the north, etc". Since the second number in the address is often associated with states, or large sections of states, these decisions can be fairly comprehensive.

Lest one develop the opinion that wide-area routing is primarily manual, it should be said that there are several protocols developed for TCP/IP networks which perform automatic routing. One of the most widely used is RIP, (Routing Information Protocol). This involves periodic routing broadcasts by gateways (reminiscent of Net/Rom routing broadcasts). Another is RSPF (Radio Shortest Path First). The gateway software must include one or the other of these in order to make them work. This is seldom a problem with computer-based gateways but can be at hilltop sites.

10.E FlexNet Networks

The author has no first-hand information about FlexNet networks. As soon as it is possible, more information will be included.

10.F SUMMARY

Chapter 10 has investigated a number of the non-Net/Rom networking protocols.

KaNodes are included in this chapter primarily because they are not Net/Rom. But, they are also, for all practical purposes, not networking. KaNodes are connection servers in addition to supporting mail boxes. Many KaNodes are dual frequency and the version most popular with other users is the kind with one port on HF and the other on VHF. This arrangement gives VHF users access to HF which they would not otherwise have.

TexNet is a network protocol popular in Texas/Oklahoma and in Michigan. Network operation is generally hidden from users but it is possible to discern some of its structure. Maintenance of routing tables is automatic; the automatic processes is augmented by one or more stations in each network which is a routing manager. This station periodically probes the network and updates the node routing tables accordingly. The use of the routing manager speeds system adaptation to node changes.

ROSE switches utilize a connection procedure which differs entirely from any of the other nodes. One does not even connect to the node for a normal user connection. Instead, it is used as if it is a digipeater. Node names are taken from telephone area codes and prefixes.

TCP/IP uses network techniques developed for wired computer networks. They are quite different from our more common packet procedures and require special computer programs. AX.25 is still, however, the method used to carry the basic information.

FlexNet nodes are found throughout many of the countries in Europe. The author does not have sufficient information to provide operating details.