The Realities of Packet Radio in the Amateur Radio Service, circa 1985
or
How to deal with a user base.

Harold E. Price, NK6K

Abstract.

The author postulates the existence of two major experimenter groups in amateur packet radio; those who experiment with data sent via packet radio and those who experiment with the way data is sent via packet radio. The problems of these groups in the face of 5000 or more packet users by the time of the 5th ARRL networking conference are discussed.

Let me preface this discussion by noting that some of the thoughts presented here were the result of group discussions during a meeting of the ARRL Ad Hoc Digital Communications Committee in 1984. At that meeting, the major discussion was layer three networking.

We have the privilege of witnessing the birth of a major force in amateur radio, one that may even have a lasting effect on its future. It is clear that the majority of technically minded junior and senior high school kids are now taking up computers as a hobby instead of amateur radio as in years past. If any of the plans being set in motion by the ARRL, magazines, and manufacturer's groups are successful in bringing new blood to amateur radio, the technology oriented newcomers will surely bring their computers with them. Packet radio will be a carrot to attract new blood.

In 1985, we will see a large increase in the amount of "press" the packet radio gets. 1984 was a good year, with major articles in the amateur press as well as such non-amateur publications as 'BYTE". There were also several peripheral mentions in PACSAT and UoSAT-11 articles in several areas; IEEE Institute, INFOWORLD, USA Today, Science, and others.

1985 will see several more articles is such places as IEEE Spectrum and a special issue of IEEE Communications. The biggest increase in packet's visibility will come from new manufacturers entering the market. The number of advertising pages containing packet equipment will double or triple in the next few months.

The bottom line is that packet will continue to grow at an increasing rate. It has grown from 240 to more than 2400 users in the last 14 months. It will at least double in the next year. As the growth of packet continues, so will the split between two groups, those who want to use the network, and those who want to build it.

There are those involved in packet radio who want to "play" with networks. Here the word "play" is not used as in Webster's definition 2(vi) 1c(2) ".... to behave frivolously", but rather as in 2(vi) 2b(2) "to move or operate in a lively, irregular, or intermittent manner". Those packeteers with the right stuff wish to push the edges of the envelope. They in particular, to judge from conversations that spring up at all gatherings where networking is discussed, wish to experiment with routing schemes. Zip codes, area codes, grid squares, zones, directions, random chance, casting of bones, any number of schemes are waiting to be tried.

Then there is the other group of packet users who wish to take the existence of a network for granted and get on with using it. Emergency nets, tornado spotting, traffic handling, newsletter distribution, public service events, earthquake detection (presumably by detecting a drop in traffic from California), and other data utilization topics are discussed in user's forums. The old term "appliance user" doesn't apply to these folks, anymore than it did to an oldtime op who didn't draw his own wire from an ingot to make a cat whisker for his crystal set. As we move into the future, the size and inner complexity of the basic building blocks changes. A good example of this is the WORLI store and forward message system. No knowledge of the inner workings of the AX.25 protocol was required to use a TNC for a building block to create something new, a way to get messages passed automatically between local area nets, and over HF, VHF, and Oscar 10.

Both groups need each other. A network must be designed and built to provide the services required by user community. And on the other hand, a network is no fun if it has no users: how can you get enjoyment out of providing an elegant bottleneck avoidance algorithm if no one creates bottlenecks in the first place?

As the number of AX.25 TNCs grows, it becomes more difficult to make radical changes to them. The "TNC" will become a basic building block, it will have a set of assumed functions and a set place in the scheme of things, at least for a few years. As an example, when someone says "Grab your two meter HT and come help out in the marathon", there is almost no question that it will be compatible with all other two meter HTs. It will put out l-2 watts, be somewhere around 5 KHz deviation, and can be moved to any .005 MHz channel in the 144 to 147.995 range. There remain a few rockbound amateurs, just as there are still some TAPR 1.0 roms and Vl VADCG boards around, but you get the idea.

As it turns out, the requirement to build a network while not making any changes to the basic user TNC is a feature, not a bug. It forces a network design that isolates the inner workings of the long haul routing network from the general user. The result is a much smaller number of network routing devices. The smaller the number of devices and people involved, the more often changes can be made.

Figure 1 shows the architecture of a network that meets the goals stated above, requires no changes to the basic TNC, and reduces the number of devices with direct networking capability. In this diagram, users, denoted by boxes containing a 2 to show the highest protocol layer in use, connect to a network access node. Several users can connect at a time, and more than one frequency can be used. They establish a standard AX.25 connection with the device, and enter into a conversation with it to begin the connection process to some other network user. This is analogous to picking up a telephone handset. When you do so, you are "connected" to the telephone network. You tell the network who you want to talk to by entering an identification code. It is not necessary to know how the connection is made, only how to access the network (pick up the handset) and make a connection with another user (dial the number). The only other knowledge required is recognition of various error messages; busy, fast busy, a number of "We're sorry" messages, and a timeout on no action.

These same error messages will be present on a packet radio network access node. Since a network implementation will most likely be staged, the initial messages will be quite simplistic, perhaps even the familiar CONNECTED and RETRY COUNT EXCEEDED.

In Figure 1, the ---- connection lines are the standard AX.25 protocol. Lines marked as ====== can be any other protocol, although most planners have agreed to use AX.25 as the layer two protocol with various higher layers added on top. The important point is that the exact details of the connections between boxes marked III need not be known by the majority of packet users. As long as the interface between the user and the network access node (the boxes labeled III) stays the same, the network gurus can change the network at will so long as connectivity and throughput are maintained.

A final interesting point in figure 1 is the bottom left hand user. Since AX.25 is used for access to the network, simple digipeating can still be used by those on the fringes of local area nets. The added expense of a network access node is not required for users in very low activity areas.

Here is an example of the type of exchange that would take place between a user and the network access node. The actual data sent and received is in upper case, comments are in lower case and delimited by {}.

CONNECT NLA
*** CONNECTED TO NLA
NORTH LA NETWORK ACCESS NODE HERE.

{ A connection is established to a network access node. Node names need not be callsigns, the node could identify every 10 minutes with a UI frame.1

DI STATUS
{The user asks for status. Almost anything could be displayed here }

THERE ARE 5 OTHER USERS CONNECTED.
SB LINK IS UP
EASTLA LINK IS DOWN
SD LINK IS UP

{The list of connected network nodes is displayed. In the first networks, this will tell a user who he can expect to reach, based on his knowledge of the network. In the next 12 months, network nodes will be few in number and big in fanfare, so each local users will know the topology. A help file could be provided on the node for those who didn't}

CONNECT K6XXX @SFO
***CONNECTION ESTABLISHED.

{A connection via some number of III boxes is initiated and established.1

Once the connection is made, a transparent path is established through the network node, and data is passed directly to K6XXX, who is reached through the SFO network node. An escape sequence similar to the transparent mode escape on the TAPR TNC or standard "smart modem" devices can be used to get back to the network node command level.

This method of network access allows for a staged implementation, something that is extremely likely to occur in the real world. When the network is simple, the network access program can be complex, allowing paths to be specified explicitly. As the network becomes smarter in routing, the connect command becomes simpler, until it is finally CONNECT **W3IWI.**

The intent here has been to quickly describe a way to implement a more complex network than is currently available while at the same time minimizing the impact of network construction on the majority of packet users. Many schemes are underfoot to provide network access devices, and the protocols to connect them. TAPR has agreed to work on the network node access protocol (the language used to **"talk"** to the node and get connected to someone at another node). Several people have suggested the use of the **A.3/X.28/A.29** protocols for TNC and network access node control. It is beyond the scope of this paper to go into depth on the exact access protocol or the network protocol itself, but it is hopefully not beyond the efforts of the amateur packet radio community. **Let's** get connected for Christmas.

```
+-------+                                                   +-------+
|       |                                                   |       |
|   2   |\                                                 /|   2   |
|       | \                                               / |       |
+-------+  \                                             /  +-------+
            \                                           /
+-------+    \ +-------+      +-------+      +-------+ /    +-------+
|       |     \|       |      |       |      |       |/     |       |
|   2   |------|  III  |======|  III  |======|  III  |------|   2   |
|       |     /|       |      |       |      |       |\     |       |
+-------+    / +-------+      +-------+      +-------+ \    +-------+
            /                                           \
+-------+  /                                             \  +-------+
|       | /                                               \ |       |
|   2   |/                                                 \|   2   |
|       |                                                   |       |
+-------+                                                   +-------+
    |
    |
+-------+
|       |
|   2   |
|       |
+-------+
```

Figure 1.