LEVEL 3 POSITION PAPER

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Introduction

Now that the amateur packet radio community seems to have agreed on a protocol at layer 2, the link level of the Open System Interface Reference Model (OSI-RM), it appears that it is time to begin work on the layer 3, or network layer. Layer 3 is actually made up of two sub-layers, a local or metropolitan network sub-layer, and an internetwork sublayer.

The local area network is responsible for the proper transfer of packets among a group of local users. The term local can be misleading, as a local network could actually be a network operating on hf, where the participants are actually spread out over a large geographical area. A local network is generally considered a group of devices interconnected directly together at the layer immediately above the link layer. These devices may be corresponding directly, or they may be operating thru an intermediary such as a local (or metropolitan) network controller.

The internetwork sub-layer is half a step above the local network, and is used to interconnect individual local networks. This allows a user on one local network to communicate with another user on a different local network. Depending on how the internet sublayer operates another layer above it (layer 4, transport layer) may be required to assist in the re-assembly of data sent over the internet layer.

Types of Network Operation

There are two basic types of networks, both at the local and internet sublayers. One is the connection type, and the other is the datagram type.

Connection Type Networks

The connection type of network requires a connection be established and maintained between the two devices wishing to communicate before any data can be transferred. The connection looks very much like the HDLC type layer 2 links that are established before I frames may be passed along the link.

The connection network is like a small town telephone company. Whenever a local call is made, as long as it is between the same two people, the connection will be made the same way every time (usually for a different reason though, because that's the only way a connection can be made between the two people, not necessarily the best way). in a connection network, once the connection is made, all frames MUST follow the same path. If anything should happen to that path, the connection must be torn down and re-established over again.

The main advantages of the connection type of network are.:

1. Once the connection is established, very little overhead is required to maintain proper operation.
2. Generally, a connection oriented network does not allow data packets to be received out of their proper sequence, thereby greatly simplifying the transport layer required.

Some of the disadvantages of the connection type of network are:

1. Once a connection is established, all packets must follow the path generated while the connection was being made. This could be a problem if either the network or one of the devices involved are marginal in nature.
7. Out of sequence packets are not, usually allowed, meaning a valid packet may have to be retransmitted because an earlier packet got lost.

Datagram Type Net-works

A datagram type network operates in a different manner than a connection type network. Each packet in a datagram network contains a header that should have all the information necessary to get it from its source to its destination totally independently of all packet:; sent; before or after it. A datagram network is like sending a bunch of letters to the same person on different days from the same post office-; Just because the same post office was used, and the addressee is the same, doesn't mean all letters follow tne same path from you to the destination.

The basic advantages and disadvantages Of a datagram network are Just the opposite as those of the connect ion network. While every packet can be routed a different way (potentially going around trouble spots in the network), the added size of each packet (due to a larger header) and the added comblexity of the transport layer (to re-align out 0f sequence packets) add up to more overall complexity in the software or hardware used to implement a datagram network.

History

When AMRAD first started looking into the layers higner than layer 2, we were sold on the datagram type of network. It seemed to us that the amateur radio enviroment that a network must operate in can become very unreliable (not only because the rf medium may vary dramatically, but also because of the voluntary nature of tne amateurs participating). Datagrams can find their way from on end of a network to tne Otner no matter how convoluted the network may become due to equipnent or operator failure, as long as there is at least one good path to the destination.

Our initial decision to use a datagram network was quickly tempered however, when we found out how large a program would be required to handle datagrams properly. We couldn't find anyone who was operation a network level datagram service without having implemented in a higher-level language on a large mainframe computer (or at the very least a mini). Obviously, we weren't going to write a program of this size in the not too distant future.

When AMRAD got together with the New Jersey packet contigent to discuss the level 2 AX.25 protocol, we met at Telenet witn Eric Scace, K3NA. Eric has worked with X.25 for quite a while (he was involved in the writing of the X.25 recommendation), and he was able t0 bring to our meetings invaluable insight into the inner workings Of x.25. I found out there is a hugh difference between reading a protocol specification, and talking to someone about that protocol: actual implementation. Eric was able t 0 convince us th at a connection oriented network such as X.25 could be implemented properly in an amateur radio environment. He also halped us decide how to implement the X.25 level 3 protocol properly, and how to add information necessary to make the protocol operate in an Amateur Radio enviroment while still maintaining the integrety of tne X.25 protocol specification. Fortunately, Eric was able meet witn the packet crowd at the AMSAT sponsored get-together last October. I think that a lot of questions were answered at that meeting, and al-

though the rest of the crowd isn't convinced that X.25 is the proper way to go at layer 3, we at AMRAD have decided to go with X.25 for our local network. Gordon Beattie Jr., N2DSY, from The Radio Amateur Telecommunications Society (the New Jersey group mentioned above) is in the process of writing up the layer 3 AX.25 protocol specification now, and it will be available soon.

Basically, AX.25 level 3 follow the CCITT X.25 level 3 protocol having to do with virtual circuits. All references to datagram and permanent virtual circuits are to be ignored.

We have added two amateur radio network facilities. These facilities allow for either explicit route selection or implicit route selection. Explicit route selection is where the requesting station describes exactly the route the connection should take. Implicit route selection is where the requesting station describes where the station is, and the actual path is determined by the network.

Unfortunatly, the level 3 protocol is just too complex to present in a paper of this type, so if you are interested in AX.25 layer 3 details, I suggest you get in touch with AMRAD or Gordon Beattie, and we will keep you advised as the protocol develops.