NETWORKING CONSIDERATIONS FOR THE AMATEUR PACKET NETWORK

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Abstract

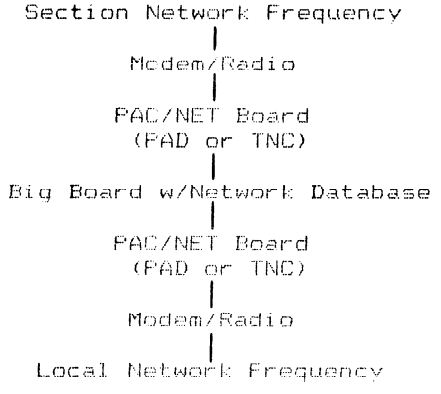
Several issues related to inter-network communication require the discussion and consensus of the amateur community if packet communications facilities are to be flexible for the users and coordinators alike. In this article, the reader will be shown a system of suggested network hierarchies and the interface control procedures required. These hierarchies are patterned after the ARRL's National Traffic System. This is not to say that this writer is suggesting a monolithic structure. In fact, some sections or regions may evolve with several networks covering the same area. This will occur as a result of demand or interest in a particular area. Such a situation is like having early and late sessions of an NTS net, except packet networks can run continuously and simultaneously.

Local Networks

During the past few years, U.S. amateurs have developed local networks using the AX.25 PAD devices. These microprocessor-based controllers convert asynchronous data characters into HDLC frames. The PADS then convert HDLC frames into asynchronous data. This approach allows for a "universal interface" to be developed without regard to the user terminal or computer. It also offloads the frame management functions to an auxiliary processor. The asynchronous link to the user terminal or computer may, at the user's option, support X-ON/X-OFF or RTS/CTS flow control procedures. There are several designs available in kit or semi-kit form. All are supporting the AX.25 protocol and therefore are able to communicate with one another.

The AX.25 protocol has only standardized link-level (level two) procedures. "Link level" refers to the control procedures between two stations in direct communication. Some groups have chosen to use the link-level repeater field in order to quickly develop communications beyond the local RF domain. The use of "digipeaters" has helped improve activity in most areas where it has been introduced, but such operation has its drawbacks. Digipeaters operate solely in the local RF domain and they transparently repeat all data with the proper repeater ID. As a result, the operational throughput is cut by more than 50%. Experience has shown digipeaters to be somewhat encumbering when the local network expands. If your station is "lucky" enough to be in close proximity to more than one operating digipeater, you may find the frequency too busy for anything but the most intermittent of transmissions.

Packet Switch Configuration



Local to Sectional Network Access

The need to communicate beyond the local RF domain will certainly be well served by digipeaters as well as by a more sophisticated network hierarchy. A system of connected local networks or nodes, would remove some of the traffic from the local sub-networks by creating geographically smaller networks and providing links on frequencies other than the local networks. This greatly reduces contention for the local channels and improves local and inter-network throughput.

In order to develop a network consisting of many local networks, procedures will be needed to control

call setup, data transfer and clearing. Special management facilities will be required to route and service the extended network user. The local networks will be provided with these services by special facilities called "Packet switches". The switches will maintain a list of: active stations by establishing a connection to each during idle periods. This list may be accessed to check the availability of another user. If the desired station is down or busy, the caller should be able to leave a "please call me" message for the other user in the switch. This message would be automatically used by the switch to set up the call once the station becomes available. Similarily, if the user is not at his normal location, forwarding information should be left in the switch data base and used to automatically reroute incoming calls.

The switch functions in the local network as any other station, but the switch should have links going on several local and remote frequencies. If a station wishes to communicate beyond the local network, then a connect is made to a local switch port. The switch then presents a menu of options for the user. This would include a call request with routing data from the switch data base, a call request, based on user supplied data, an option to leave a "please call me" message or call forwarding information. Other features, including a mini-message service, could be added if local interest warrants.

Sectional Network

Over the inter-network links many users data can be transmitted. This done by multiplexing the data using an agreeable protocol. The CCITT's recommendation X.25 specifies procedures for this packet level (level three) communication. Some derivation of this would give the amateurs the required procedures to operate the network. There also must be some method of inter-switch communication, This is needed to handle special call request facilities and switch status information, The latter issue is of importance if a cluster of switches is acting as a regional network. If links have been established, the regional network may wish to present itself to the outside world as a homogeneous structure with the means to locate and reroute stations for the calling station.

For example, KA2BOE, located in a local network, which is a part of the Southern New Jersey Section Packet network, wishes to place a call to N2DSY in the Northern New Jersey Section. He establishes a connection to his local switch, then informs the switch of his desire to contact N2DSY in Northern New Jersey. The calling switch has no real idea where N2DSY really is within Northern New Jersey, but he places the call. If the Northern New Jersey section net has enough "smarts" to find N2DSY in one of the switch data bases, then a call will be routed to the switch nearest N2DSY and the link will be brought up. If the link is not brought up or if N2DSY is busy, the call will be cleared with the appropriate cause and diagnostic code. If the Northern New Jersey section network needs more routing information from the caller, the inter-sectional switch in Northern New Jersey will clear the call and may offer a list of local network names to try. This latter information may only be available if the caller specified in a call request facility that such information would be desirable in the event of a call clearing condition. The format and variety of these facilities will require some discussion.

Upper Level Inter-Network Access

The upper level packet switches may have a fairly simple job of routing data, but the volumes that they will be required to handle may be larger than a radio club or even a club federation could finance. No studies have been

made in this area and it requires our attention. Some surplus commercial equipment could be pressed into service, but it must then be operated, housed, powered and maintained. If real-time facilities are to be available, the amateur community will need significant amounts of money and support for the network.

The variety of sectional network capabilities must be addressed by our packet level procedures. The amateur community may be better off if X.75 single link procedures are incorporated in a single packet level (level three) standard. This would then eliminate the need for a separate standard and implementation. On the other hand, it would require the implementation to be more comprehensive. A call could then be placed via a "transit network". A transit network is one which forwards data as a third party to the call. To properly inform the transit networks of their role, they will require additional control information (inter-network facilities) in the call request. In the event of an unsuccessful call, the clearing station must be able to include the information needed to successfully retry the call.

Summary

The packet switches, initially planned for use in the Northern New Jersey Section by the Radio Amateur Telecommunications Society and the Cherryville Amateur Repeater Club, will consist of Digitgal Research Big Boards and PADS from Bill Ashby and Son. These PADS will perform all link overhead while the CP/M based Big Boards will perform switching and data base functions. The network will have a service area extending from Philadelphia, Pennsylvania to Fairfield County, Connecticut. Other groups interested in extending this are welcome. The network also has a variety of "host" computers available on the network 24 hours a day. A major university has expressed great interest in having their "electronic conferencing" system on the network, and the details are being worked out at this time. A local chapter of the American Red Cross has also started to explore computers and radios in the field to maintain a list of disaster victims and their status.

It should be remembered that this technology will grow rapidly and as it becomes popular, the methods and systems in use will be in a constant state upheaval. We shall see, in the next few years, many changes and improvements - --------- ENJOY THEM !!!