On The Use of a Two Frequency Traditional Voice Repeater for Local Area Packet Networking

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Abstract

In using the VADCG Terminal Node Controller (TNC) board in the Washington D.C. Metro area, members of the Amateur Radio Research and Development Corporation (AMRAD) have found it convenient to use an existing voice two meter repeater for packet work. This paper addresses some of the problems encountered with this approach and some of the benefits that accrue.

Introduction

In traditional two meter amateur radio voice communication, a two frequency repeater is employed to facilitate communication between stations that are not in line of sight distance of each other. The output of a receiver tuned to one frequency is fed into a transmitter tuned to another frequency. A carrier operated relay on the receiver keys the repeater transmitter. A duplexer is used to allow a single antenna to be used for both receiving and transmitting. Some delay is usually included on access and the transmitter remains on for some short time after loss of input. The two frequencies are seperated by 600 Khz on two meters by agreement. AMRAD's voice repeater operates on a frequency of 147.81 Mhz transmit and 147.21 Mhz receive. For several years it has been used to share voice and data, often successfully.

When members of AMRAD began packet radio work, it was a natural evolution to use our existing voice repeater to experiment on. A number of problems surfaced that were not readily apparent.

Problems Encountered

AMRAD packet radio activities began with Bill Moran (W4MIB) purchasing a VADCG TNC board and convincing several others to join him in packet experimentation. The actual building of the boards went rather quickly once the two critical parts (the 8273 Protocol Controller and 8250 USART) were procurred. Surplus modems were obtained by our local club modem buyer who searched each hamfest at the crack Of dawn to obtain Bell 202 devices for us to use on the repeater. After several false starts, the modems were correctly hooked to the TNC boards. Transmitter keying was a problem if the surplus modem selected did not handle Request-to-send and clear-to-send signals correctly. The speaker audio output of our two meter rigs often was not flat across the range of 202 modem frequencies (1200 Hz to 2200 Hz) and one tone or the other is attenuated. Transmitters do not transmit at once when commanded. If a relay is involved, many milliseconds could elapse before RF appears at the antenna jack. These small problems were surmounted and W4MIB transmitted the first packet on our repeater.

As soon as the second user tried to receive W4MIB's packet, the next problem was evident. The repeater was not coming up quickly enough. The machine would not come up fast enough to catch the HDLC preframe sync or flag. It caught the data and frame check sequence as well as the closing flag and CW-ID, but nothing appeared on the receivers terminal screen. Hank Magnuski (KA6M) supplied a fix to allow RTS to go high and turn on the transmitter, then delay a while until the repeater got the idea to turn on and repeat. This simple fix allowed packet work to begin in earnest and new users appeared. Quickly the demand for a QST packet every 8 minutes was evident. New users had to have something to tune up on witnout waiting for the nightly packet sessions.

Doug Lockhart (VE7APU) had supplied a program to do the QST packet and it was quickly implemented at the QTH of Terry Fox (WB4JFI). Another problem quickly surfaced. We received the QST correctly most of the time. However, when we left the shack and came back some time later, the screen was filled with last lines only. The QST packet had six lines! Where did the other five lines go? Sandy (WB5MMB) correctly laid the cause to the repeater ID. The repeater ID fires every 10 minutes when people are using the machine. But if no one uses the machine for five minutes or so, the repeater ID will not fire until the first access. The long dry spells of no activity were broken every 8 minutes by the QST packet which fired the repeater ID which squashed the first five lines of the packet. Sandy fixed this problem for us by decreasing the volume of the repeater ID tone and lowering the audio frequency of the tone. Now all six lines of the repeater made it every time.....unless.....noise appeared on the repeater input at the same time as the QST packet. The QST packet is now a good indication of the circuit condition. If all

of us are consistently receiving all six lines of the QST packet, conditions are right for super terminal to terminal packet operations.

Voice interference is a problem in packet work on a shared repeater. This comes in two forms, intentional and accidental. Accidental interference occurs when two voice users think the packets (usually very short) ar noise bursts and transmit away on top of the packets. They win in FM voice operation if they capture the repeater input with a strong signal. One night when a voice user appeared in the middle of a packet QSO between WMIb and myself, we carried on for 20 minutes by interleaving our packets in between their voice transmissions. We would wait until one voice user dropped his carrier and before the repeater dropped we would bang the line feed key to fire off the packet. Finally the voice users caught on. I think we got away with it for so long because some repeaters transmit a small tone when a user drops his transmitter. This tone allows the receiver to know it is OK to transmit. We carefully explained packet radio to the voice users who have never been seen again on the machine.

Intentional voice interference (not really malicious) occurs when voice users just cannot wait until the packet QSO is over. They sneak in a quick call to their buddy between packets (same trick we used in reverse in the previous example). Malicious voice interference occurs when someone fires the autopatch (the great bugaboo of data people) in the middle of a packet session. Channel sharing between packet and voice could work if users would let it.

Design Problems

Two frequency repeaters must be coordinated with other users in the area. This is done through local repeater councils who allot frequency pairs. There usually are none to allot on two meters. We already had ours and thus did not need a new allocation.

Startup expense for two frequency repeaters is high. The duplexer is typically $500. Problems get worse from there, ask Sandy, one of our control operators.

Advantages

Single frequency packet repeaters of the type constructed by Hank (KA6M) suffer from a hidden transmitter problem. In packet work, the modem tones are sensed (carrier sense) and other packet users do not transmit if they sense a modem is on frequency at the time they wish to transmit. If a given station cannot hear all other people on the repeater frequency, collisions are certain. A two frequency machine does not have that problem as all users hear each other (at least their modems do, the software ignores direct packets when connected).

AMRAD users find it convenient to develop software for the TNC using the AMRAD two frequency already available repeater. We are planning a single frequency repeater, but the software can be checked out before emplacing it at the new site.

The greatest advantage to using an already owned voice repeater is startup costs are already depreciated probably. It is inexpensive if your already have it - serendipity.

Possible Enhancements

If your group can afford the luxury of a two frequency packet repeater, two enhancements can be added at once.

First, never allow any voice. Use voice on your normal repeater to service the data channel if required. Accept no substitutes on the input. Only 1200 Hz and 2200 Hz tones, nothing else.

Second, allow multiple inputs on the repeater (phone line, HF, etc.) and transmit all inputs on the output.

Other ideas need to be tried. All input modem tones of the correct frequency should be repeated, thus no "request for repeat" bit is required and hard addresses coded up to 127 users. A logging computer should measure thruput and report to any user submitting a query.

Conclusion

It has been the experience of AMRAD that a shared voice and packet repeater attracts new packet users who want to see what is being sent in those packets. One new user is worth a few intentional voice jammers. The newcomers ask questions and some eventually get up in packet. The QST packet every eight minutes, in addition to acting as a circuit tester and new user board checker, attracts questions. It is easy to find a retired ham to watch the device at his home and insure it is well fed. Most people who use the AMRAD machine own or use some kind of computer. These are the type of people we need to attract to packet data communications.