AVAILABILITY OF SEVENTY 9600 BAUD PACKET CHANNELS ON TWO METERS

By Bob Bruninga WB4APR @ WB3V.MD

Unbelievable? Not really! With the advent of the latest 9600 baud packet radio modems, there is an unexploited mechanism for opening up dozens of half duplex data channels without ANY impact on existing voice and data bandplans. Read this proposal thoroughly before jumping to any conclusions. First you must consider two apparently unrelated facts:

TINY PACKETS: With the new 9600 baud packet modems, not only is there potential for higher speeds, but the packets are also 8 times shorter than conventional packets. This means that each packet occupies the channel for less than l/10 of a second at a time. If another signal appears on the data channel, then the presence of the new signal can be detected in 0.1 second.

AVAILABLE CHANNELS: Throughout the two meter band, in every corner of the country, there are ailmost 70 FM channels assigned to single VOICE receivers that, in general, only use their single frequency about 1% to 40% of the time. If a mechanism could be designed to permit these single receivers to continue to use their frequencies on a primary basis, at any time, with priority access and control, then the rest of the time (60% to 99%) they could use their channel for moving digitial data. This mechanism could more than double the bandwidth available in the two meter band! (I used 2 meters only to get your attention. One hundred twenty channels on the 440 band is the actual target because of the availability of 2 Watt 9600 baud UHF data radios for under $150 each.)

VOICE/DATA CHANNEL SHARING: In the past, attempts to share voice and packet have all failed, not because it is a bad idea, but because it has not been done properly. Under a very unique set of conditions, however, voice and data can easily share a narrowband FM channel, IF:

1) VOICE has priority at ALL TIMES and all voice operations are completely transparent to the voice user
2) DATA can never interrupt or attempt to use a busy channel
3) VOICE users can pre-empt/interrupt data instantly at ANY time
4) VOICE users do NOT hear packets or in any way are encumbered by shared use.
5) NO MODIFICATIONS TO ANY voice radio is required

In other words, voice users do not even know that the channel is shared with data. To make data use of a channel work on a secondary basis (behind the scenes) with NO impact on voice usage, there are additional requirements:

1) There must be ONLY one voice RECEIVER on the channel, and it MUST be able to hear EVERY voice user on the channel.
2) This single voice receiver and its conventional COR or un-modified squelch circuit must have total control over channel use.

THE BEST KEPT SECRET: Think for a moment about the input frequency of a typical voice repeater. There is only one receiver listening, and it can hear EVERYONE that desires to use the repeater. If the repeater RECEIVER does not hear anyone using the channel, then IT alone can decide to use the channel itself for data! Now if the data is transmitted in 0.1 second bursts, FROM THIS SITE (on the input channel), with a pause in-between to listen for voice users, then no one will be denied access to the voice repeater for any longer than 0.1 second! Also, while the repeater is transmitting data on its input frequency, nothing is being transmitted to anoy users on the output! In this manner, we can TRANSMIT data FROM this repeater site at 9600 baud on the input frequency WHENEVER THE REPEATER IS NOT OTHERWISE BEING USED FOR VOICE.

MAKING A DATA LINK: Now combine one such voice repeater with another operating in the same manner, and you have a two-way data link between these two sites. Not only is this a FULL DUPLEX channel, but it also operates with NO HIDDEN transmitters, and NO CONTENTION, because there is only ONE transmitter on each such channel. From a data perspective, each repeater site is a data node that transmits on ONE assigned frequency and can LISTEN on as many additional channels as desired. This is an ideal multi-node backbone network for passing traffic point-to-point over long distances!

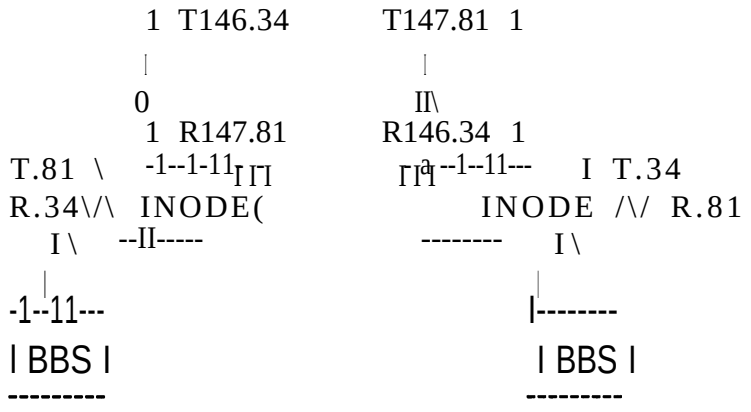
HARDWARE: To avoid even momentary delays during normal repeater conversations, the external carrier detect of the modem is not only driven by the COR of the repeater receiver, but also by the HANG-TIME of the repeater transmitter as an indication that the repeater is engaged in a conversation. This way, data will only be transferred after the repeater has been unused by voice users for a while.

FORWARDING: Obviously, this type of channel will NOT support any traffic where an impatient human is on one end. This channel, however, is ideal for off-hour BULK forwarding between multi-channel level-4 nodes under computer control.

BAUDRATE: Although I suggested off the shelf 9600 baud radios, the use of 15 KHz repeater channels in most areas of the country might require slowing to 4800 baud to be certain that all energy is contained within 12 KHz. Also, the $139 TEKK 2 watt UHF data radio was actually designed commercially for 4800 baud, and performs excsllently at that rate. Also, to avoid co- channel interference, operating at power levels above 2 watts is probably not advisable. Fortunately, 9600 baud data sounds just like white noise, and usually will NOT open the squelch of another repeater anyway. Finally, to experiment with this concept, you can actually try conventional 1200 baud during off hours. You can limit packets to a single frame (about .8 second instead of the usual 3 to 5 seconds), by setting MAXFRAME to 1 instead of the default 7. By adding an additional hang-time timer, so that the DATA mode is only activated when the repeater is unused for over 3 minutes, a new voice in-the-night will probably not even notice a maximum of 0.8 second delay.

SYSTEM LINKS: Remember, ONLY THE REPEATER ITSELF can transmit on its own INPUT frequency. The way to build a network is then to have each such repeater node TRANSMIT on its own input frequency and similarly LISTEN to the other nodes transmitting on THEIR input frequencies. To get data from your basement BBS, simply have it LISTEN to the repeater node on the input frequency and the BBS then TRANSMITS on its OWN unique frequency. The repeater node then listens on this unique frequency. If you are willing to cut throughput in half in order to save on hardware costs, you can let your BBS transmit (at low power) on the same frequency as some distant repeater node (its

voice input freq). This causes a hidden transmitter problem at your repeater which will hear both your BBS and the remote repeater, but with the tremendous bandwidth available, this is probably not a problem. The following diagram shows a typical arrangement for the nodes located at a pair of 146.34/94 and 147.81/21 voice repeaters.



Notice that by pairing up a 146 MHz repeater with a 147 MHz repeater, you get at least 1.6 MHz spacing between the two digital frequencies and about 1 MHz between the digitial and the Voice repeater output (which of course is NEVER transmitting when the digital is in use.

Also notice, that to save dual receivers at the NODE sites, we are cheating a PURE network design by allowing the BBS's to also transmit on the same frequecy as the DISTANT repeater node. This must be done with a beam or low power so that the distant repeater CANNOT hear nor even detect the presence of the BBS. Otherwise, the BBS would KEY UP the distant VOICE repeater!

CONCLUSION: Even if only 30% of the voice repeaters begin to share their channels, this could open up over 600 Kbytes PER SECOND of additional digital forwarding capacity on 2m and 70 cm! Why not?