Maximizing Packet Radio Reception

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Digital radio transmission and reception is increasingly recognized as a critical feature of emergency communications. Think Winlink, DMR, APRS, Vara FM or any of a host of other digitally based radio communication protocols. They all share the advantage of requiring very little power to transmit and the narrowest band usage possible. The method used in digital radio communications is known as AFSK, or Audio Frequency Shift Keying.

In using Audio Frequency Shift Keying we use a Terminal Node Controller (TNC) to translate data input into two separate tones, generally at 1200 and 2200 Hz, which are then transmitted over the air to a receiver that uses it's own Terminal Node Controller to decipher the tones back into data bits and bytes that their computer can understand. Packet radio used in this way can send low power signals over great distances while maintaining very reliable data integrity.

However, modern HAM radios have a few built-in characteristics that can dramatically affect the receivability of the signal you produce from your combination of TNC and computer. If you simply un-boxed your TNC, plugged it in and (eventually) began transmission of packet radio it is almost certain that your signal is not tuned to produce the best possible reception by those who can hear you. If your signal is garbled the receiver will automatically request a re-send of the packet until it is sure it has an accurate copy of the packet. This process, repeated over and over in milliseconds, slows down reception of the packet and may even declare your signal to be unintelligible.

The culprit causing your signal to become garbled or unintelligible lies in the combination of the Pre-emphasis / De-emphasis circuits within HAM radios and the Audio Clipper feature designed to prevent overdriving of the human voice over radio waves.

Here is how it works: the audio signal generated by your radio passes through a Pre-emphasis circuit which automatically increases the amplitude of higher frequency sounds (like the human voice) relative to the amplitude of lower frequencies.

At the other end the receiving radio automatically reduces the amplitude of higher frequencies back down to recreate the original sound. This process is used in virtually all HAM radios as a method to reduce high frequency noise in the received signal. This is exactly how Dolby Noise Reduction was used to reduce hiss in cassette tapes, if you remember back that far.

So far, so good. Your higher frequencies are boosted for transmission then reduced by the receiver to get back to the original signal. The problem lies in the combination of this process with the built in Audio Clipper circuit also found in almost all HAM radios. The Audio Clipper makes sure that the transmitted frequency does not deviate more than about 5 Khz no matter how loud the audio input to the radio may be.

If the audio input is below the clipper threshold the signal passes through unchanged. However, if it is above that level, the clipper will chop off your signal so that it fits in the maximum 5 Khz deviation.

Unfortunately, the audio clipper is downstream of the pre-emphasis circuit in your radio. The clipper is working on a signal that has already had the higher frequency levels adjusted upward by pre-emphasis, as we have learned. If the boosted higher frequency is above the audio clipper limit it is chopped off.

The truncated signal is what is then transmitted by your radio.

This, my friends, is where the problem with your digital transmission lies.

At the other end the receiving station will automatically de-emphasize the higher frequency portion of your signal. The receiving station now has a signal where the high tone ends up being weaker than the low tone, a situation guaranteed to make your transmission difficult or even impossible for the receiving TNC to decode.

All TNC's want a signal where higher frequencies are amplified relative to low frequencies. The fix is in calibrating your TNC's high tone, then adjusting the TX Audio potentiometer of your TNC to avoid your radio's built-in audio clipper.

By sending packets that are easy for other stations to decode you can more than double the effective range of your station.

See "Setting Your TNC's Audio Drive Level" by John Ackermann, N8UR, at www.febo.com

See also " A RTTY Tutorial for Beginners" by Simone, IW5EDI, at www.iw5edi.com