Why can’t I be heard?

by Alan Skerker, KC4ZA
assisted by Joseph L. Pontek Sr., V31JP

We have all been there and it’s frustrating! A strong station is heard sending a CQ and your transceiver is spot-on, yet no matter how many times you try to call back you can’t connect. You are probably thinking, why is it if I can hear the station so clearly, that station can’t hear me? Perhaps you have heard the word reciprocity and wonder why it does not appear to apply? Unfortunately reciprocity does not apply because it refers to the characteristics of your antenna; specifically, the fact that the radiation pattern and impedance of the antenna are the same whether you are using that antenna to transmit or receive. The mistake being made is thinking that the principle of reciprocity always applies to the propagation path between the two stations. It may under special circumstances but does not apply in general. DXCC would be a cinch if only that were true!

There are several reasons for not being heard so let us jump in one step at a time. Consider the noise level at the station you are trying to call. Noise can make it very difficult or impossible for that station to hear your signal yet it has no effect on what that station transmits. But noise alone is half the story. The signal to noise ratio (S/N or SNR) at the receiving station is the key parameter. The signal level must be high enough with respect to the noise level for an incoming signal to be heard clearly. Since the signal and noise levels are independent, increasing the signal level or decreasing the noise level or both can improve the S/N ratio. What can radio operators control and what is beyond their control?

The signal level at the receiver depends upon propagation conditions between the two stations, the output power of the transmitter, and the antenna characteristics of both stations. If you can, increasing your transmit power may put you over the other stations threshold; however, remember that to gain an S-unit your power must increase four-fold (6dB). If your antenna can be rotated horizontally or even tilted vertically you may be able to place your antenna pattern in a more favorable direction for propagation conditions. If you can arrange a schedule with the other station on a different band you may be able to take advantage of better propagation conditions.

The noise level depends upon the environment at the receiving station and includes the effects of terrestrial and space weather, other signals in the man-made sources, and the noise floor, the internal noise generated by the receiver. The noise floor of the receiver at HF is normally of no consequence. Unless one lives in an industrial area or near some other strong man-made sources, the dominant noise source is the radio frequency radiation from lightning strikes. These are always happening, some 1.4 billion lightning strikes occur around the world each year. The closer you are to thunderstorms the greater will be the noise. The noise level can be so bad that even very strong signals cannot be copied. Sources of man-made noise include the computer or TV sitting next to your rig, fluorescent lights, the room fan overhead, and a vacuum cleaner, air conditioner or other motorized appliance. You can turn off man-made sources at your station and move computer cables and TV screens away from the rig. In some cases moving the location of your antenna can decrease the noise it picks up from house wiring and other nearby electrical sources. Finally, use the tools available in your receiver to minimize the effects of noise. Receivers have different capabilities so you will need to check your manual to learn what capabilities you rig has and how the different controls work and interact. Some receivers will not have these capabilities. Narrow your bandwidth as much as possible. Receivers differ in the way this is done. Turn on your attenuator if there are strong adjacent signals. Similarly, if the S-meter is moving in response to background noise, the pre-amplifier can be turned off. This will also protect against intermodulation distortion. Another tool at your disposal is to use separate transmit and receive antennas. A loop antenna serves well for receiving. It is inherently less susceptible to noise than the typical wire antenna used for transmissions.

If the signal level is at or below the noise it will be much more difficult to pull your signal through than if your signal is several S-units above the ambient noise. The larger the difference between a constant signal and lowered noise levels, the louder the signal will appear to be. This is due to the logarithmic response of the ears to sound pressure. In fact this type of response is true for all of our senses. Make a cup of coffee and add a spoonful of sugar. The coffee is sweet. Add a little bit more sugar and you probably won't taste the difference, but increase the sugar by 3 dB (add another spoonful), and the coffee is decidedly sweeter.

We haven't yet talked about solar noise so let's consider what actions to take to mitigate these effects. The sun sends our way a constant stream of high-energy charged particles, electrons, protons, and ions of helium and other elements. During active periods this background solar wind is enhanced by solar flares and coronal mass ejections. In addition the sun is a very strong x-ray emitter, and these x-rays penetrate deep into our atmosphere and ionize oxygen (O_2) and nitrogen (N_2) molecules.

While one can't control the sun, we can use knowledge about solar and geomagnetic phenomena to optimize station operation. Here are a few tips. Major solar flares will blackout communications, but rarely will these last for more than an hour. When the flare is over, get back on the air because noise levels will be lower and the propagation conditions in the ionosphere will improve signal levels. In terms of S/N, S has increased and N has decreased, therefore S/N improves. Higher frequency bands may open because of the increased ionization. The condition usually lasts until nightfall. So have fun.

The velocity of the solar wind is variable so that there are regions in space where both the speed and direction of the solar wind change dramatically. As the earth passes through regions where the solar wind velocity is changing, pressure is put on the earth's magnetic field causing it to vibrate. The vibrating magnetic field generates an electron current that flows along its field lines and can create burst of noise in the HF bands we call geomagnetic storms. After a strong geomagnetic storm look for low noise levels on 40 meters and below.

There are other factors such as the geometry of the ionosphere and wave polarization that can either enhance or degrade the ability to communicate but we will save that for the future. In the meantime, we wish you good DX and memorable ragchews.