A Word or Two About Signal to Noise Ratio

Some have asked about signal to noise ratio with different receiving antennas. The unfortunate part of this question is that it is nearly impossible to predict for any given antenna. However there are some generalizations we can make that will allow us to at least compare receiving antennas.

Here is some of what we do know. There are basically two kinds of unwanted noise that affect the SNR (Signal to Noise Ratio) of a received signal. There is the galactic noise that approaches a receiving antenna from all directions and there are also the point noise sources such as power lines or lightning that come from a more or less single direction. The directivity of the antenna is of prime importance in reducing the received noise. If the noise is coming from all directions at once, we can rate receiving antennas with the factor called RDF (Relative Directivity Factor). This factor is derived from a calculation of the difference between an antennas peak forward gain in dB and its over all directions average gain in dB. In other words, the level of signal will we receive in the desired direction of the antenna is compared to the signal from all directions. If the noise is coming from a general direction like a point source, the SNR can be affected mostly by the ability of the antenna to peak the desired signal while notching out the noise signal. It is not often our noise will be exactly opposite a desired signal. Therefore the ability to move the notch becomes important.

So, the bottom line in selecting a receiving antenna could be generalized as looking for a high RDF in combination with a good ability to steer a notch in as many directions as possible. Hi-Z Antennas™ offers 3, 4 and soon 8 element RX arrays. These designs maximize the capability to peak the desired signal while notching noise source(s) to achieve the best possible SNR and RDF! Here are a few comparisons. For more comparisons, look at the comparison chart on http://www.hizantennas.com/receiving_antennacomparison_char.htm .

An inverted L TX (transmitting) antenna with 80 foot vertical shows an RDF of 5 dB at a 20 deg elevation angle.

A top loaded 90 foot TX antenna shows nearly the same RDF of 5 dB at a 20-deg elevation.

An inverted V TX antenna shows an RDF of 0 dB at the same 20 degree elevation angle.

Now, if you look at a couple receiving antennas like a 4 square we can make some comparisons.

A well-made RX 4-square has an RDF of 12 dB. If you were receiving an incoming 20-degree signal on the inverted V antenna with 0 dB RDF and you had a 3 dB signal to noise ratio, you could expect the RX antenna to give you 12dB (RX antenna) minus 0 dB (TX antenna) or 12 dB better signal to noise ratio. That is then 3db (TX antenna SNR) + 12 dB (4-square SNR) or 15 dB SNR using the 4-square.

Comparing the 4-square to the inverted L with the same incoming 20-degree elevation signal you would see the 12 db RDF of 4-square minus the 5 dB RDF of the inverted L and the difference is 7dB. Therefore you could expect the SNR of the receiving antenna to be 7 dB better than the inverted L TX antenna. The result is a 10 dB SNR using the 4-square. This may seem counter-intuitive but remember that the Inverted L antenna takes a 5 dB smaller signal to get the same 3dB SNR as the inverted V because of their difference in RDF. Having used a fixed signal for comparison instead of output SNR would have shown the overall SNR for the 4-square to be the same in both cases.

These comparisons are only true for noise from all directions. The actual signal to noise ratio when there are point sources will be defined by both factors, the RDF and the ability to place the offending noise in a rear ward notch in the antenna response.

Therefore it is a user choice in receiving antennas as to what fits at different locations.

The Hi-Z Antennas choices are;

3 element array…….. RDF 9 dB 30 dB notch in 6 directions
4 element array……...RDF 12 dB 30 dB notch in 4 directions
8 element array……...RDF 13.5dB 30 dB notch in 8 directions

All the above choices show a very favorable comparison to Beverages, loops, and etc.