Ham 44 - Nlos plots

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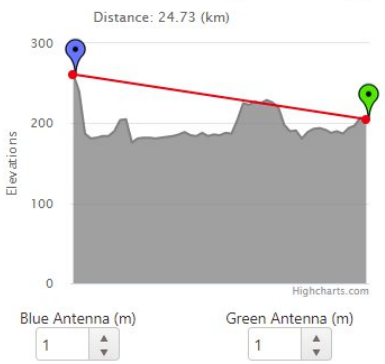
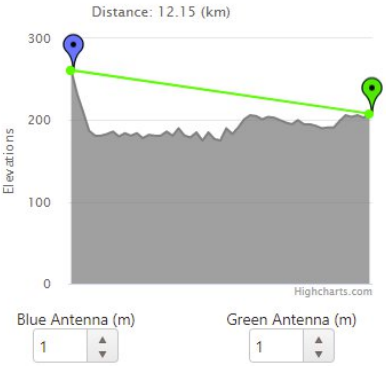
VHF and higher frequencies are regarded as line-of-sight (LOS) signals which are only effective if there are no obstructions in the path between the transmitter and receiver. Other than over open water, there are always some obstructions. Our area is rolling hills which makes reliable reception very difficult.

A very useful web-app plots the line-of-sight between two locations, showing natural terrain variations and obstructions, but does not include other obstructions such as buildings and trees. https://www.scadacore.com/tools/rf-path/rf-line-of-sight/

Consider actual examples between some of the stations in our group. ‘B’ is westside across the river. ‘M’ is south side also across the river on a hill. ‘R’ is eastside near the highway interchanges. ’E’ is a repeater in the middle area, elevated 18 meters above the local terrain. Can the stations talk simplex? Can the stations hit the repeater?



The first figure is ‘M’ to ‘B’. Although only 25 km, the signal clips a substantial hill. The communications is fair simplex.

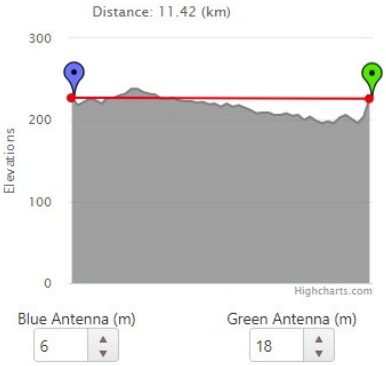


The second figure is ‘M’ to ‘E’. This is the definition of line-of-sight. Reliable communications should occur.

The third figure is ‘R’ to ‘E’. ‘R’ clips a nearby hill, reducing its signal effectiveness. ‘M’ receives the station with static.

The fourth figure is ‘B’ to ‘E’. The same hill really hinders the communications.

In our community, reliable line-of-sight communications is dubious, even on a short 11 km path. Does that mean communications are shutdown? When a radio signal encounters an obstruction, three things happen to the incident incoming wave. (1) Part is absorbed by the obstruction. (2) Part is reflected back at an angle. (3) Part is refracted around at a slight angle.



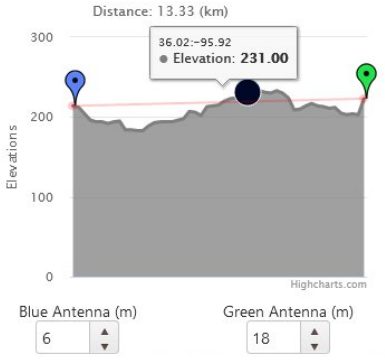
Through the process of multiple reflections and refractions, a little energy may get through. However, the signals take different amounts of time to reach the receiver. This delay is a phase shift. When two or more signals are received out of phase, then the result is distorted.

What will improve the signal at the destination? (1) Raise the antennas. (2) Increase power of the transmitter. (3) Change antenna design.

Raising one or both antennas helps the signal get across the obstruction, but that is often a limited option.

In the words of Tim Allen, ‘More power’ is always part of the solution. With more transmitted power, the reflected and refracted is greater around the obstruction, allowing more reach the destination. There are reasonable limits on equipment cost.

Changing the antenna design offers many choices. Antenna design is about trade-offs.



Some designs direct energy in a particular direction. That ability is called gain. Unfortunately, gain makes the signal more directed or more line-of-sight. If the obstruction is too great, gain provides little benefit. Beams are a primary example. When they work, it is great, but when they don’t the results are abysmal losing most signals in all directions.

A new paradigm antenna is near-line-of sight (NLOS). Wi-Fi is a well-known example. The signal bounces around numerous obstructions. Multiple antennas may point in a variety of directions to capture usable signal levels. Then the signals combine in a way to compensate for the phase-shift (difference in time) of the received signals. In the amateur, land mobile, and government systems Compactenna makes a suite of very effective NLOS designs.

‘B ’installed a variety of antennas, including J-pole and beams with predictable limited success. However, a Compactenna 9” yields consistent, reliable communications between ‘B’ and ‘M’. Why? It uses the multipath from the obstructions. ‘B’ can talk to ‘M’ mobile near the base of the hill, who is also using a Compactenna.

Handi-talkies are low power and near the earth surface, so they have a very limited range, slightly greater than how far you can throw them. Even these radically improve with a near-line-of-sight antenna. With a cheap 4-watt hand-held, ‘M’ routinely hits a repeater 20-miles (32 km) away (wow).

Life is good. Enjoy.