2022-02-07 Hamlet Net - Antenna Gain

Announcements:

- Test Session Info
    - Next VE session is Saturday, February 25th. ARRL session, so $15 fee to take test

- Rocky Mountain Ham Radio is hosting their NerdFEST this Saturday, February 11th from 8:30am until noon. This event features numerous short presentations on technical subjects. This year's topics include IP Data over DMR, Programming an HT over the web, Antenna Isolation in Multiple Radio Vehicle Installations, and UPS Waveforms: The good, the bad and the ugly.

  You can attend this free event either in person or via Zoom. For more information, see their web page at: rmham.org and click on the "Sign up for RMHAM University" link under the "RMHAM UNIVERSITY" menu.

- You can start earning your 2023 membership or future renewal by acting as NCS for at least 5 nets this year. You can run either this Tuesday night net or the Thursday night net (or both). We have scripts available for both, so all you need is a good connection into the repeater, and somewhere to keep track of names and call signs as people check in. If you're going to be on the net anyway, why not save some dough at the same time! There are four free memberships available for 2023, so don't wait to get started!

- If you didn't find what you wanted at the NCARC hamfest this past weekend, the next hamfest in this area is the ARA Swapfest on February 19th at the Adams County Fairgrounds from 9am to 1pm. More info at: https://n0ara.org/the-swapfest-info-and-directions/

- The Club is also looking for presentation topics for 2023. If you have any ideas, or better yet, would like to present, please let Chuck know and we'll get you on the schedule!

- All club activities are open to anyone - members and non-members. If you have questions, ask them on a net or send email to **elmer@w0eno.org**

- Club breakfast Saturday mornings at 8am at the Hidden Cafe in Longmont

    - Come meet other Club members and discuss amateur radio

Presenter: Bryan, AF0W

Topic: Antenna Gain

- Most hams have heard or seen the term "gain" when discussing antennas

- Antennas may be advertised as "high gain," or "improve your signal by 12 dB!" or that "the rubber duck antenna that came with your handheld has negative gain"
- But what does all this really mean?
- First off, we need to define some terms:
- **Antenna gain** is the relative measurement of an antenna's ability to direct or concentrate the signal radiating from it
    a. Note that it is a relative measurement - it is a comparison to something else
    b. It is typically measured in decibels
- **Isotropic radiator**: This is a theoretical antenna that radiates energy equally in every direction - much like the sun
- **½ wave dipole**: Two elements, each ¼ wavelength
    a. Gain measurements referenced to a dipole will be lower than to an isotropic radiator, as a dipole has about 2.15 dB of gain compared to an isotropic radiator.
- **Decibel**: a unit used to measure the power level of an electrical signal by comparing it with a given level on a logarithmic scale
    a. A change in power by a factor of 10 is a 10 dB change
    b. Every 3 dB change doubles or halves the power
    c. A logarithmic scale is used as it allows you to work with very large and very small numbers at the same time.
- The gain in dB of an antenna must have something to reference.
    a. The two main references are the isotropic radiator, called dBi, and the dipole, called dBd
- Note that even though they seem magical, antennas do not create energy
- Antenna gain is the result of focusing the energy from an antenna
- In our licensing classes, we have a demo where we show a camping lantern that has two configurations.
    a. In the first, it functions as a lantern, and the bulb is fairly uncovered, resulting in light radiating in all directions, similar to an isotropic radiator.

    b. In the second, a reflector slides over the bulb to allow it to function more like a flashlight. In this configuration, the light is concentrated in one direction, resulting in a brighter spot on a nearby wall. This is similar to a directional antenna, such as a Yagi.

    c. The actual bulb is the same brightness in each case - the only difference is the focusing into a single direction

- If we use an isotropic radiator as our reference antenna, we are assigning it a gain of 0 dBi

- If we then look at a ¼ wave vertical antenna, it will have a gain of approximately 1 dBi

- A ½ wave vertical will have a gain of approximately 3 dBi (so double the apparent power of the isotropic radiator)

- A directional antenna, such as a 3-element Yagi, will have an even higher gain, say, in the neighborhood of 5.5 - 7 dBi

    a. Adding more elements to the Yagi will increase the gain even more

- So does that mean that a higher gain antenna is always better?

    a. Not necessarily - there are a number of factors that influence antenna choice

    b. For example, in many antenna designs, such as the vertical antennas we use for mobile VHF and UHF installations, higher gain antennas tend to have a lower angle of radiation. In areas like ours where many of the repeaters are located up high on mountain tops, the additional gain of such an antenna may not help you as much as you think, because the majority of the signal is not being sent up towards those repeaters.

    c. A lower gain antenna with a higher radiation pattern may be more beneficial.

    d. Of course, if you live in the flat lands of Florida, the high gain antenna may be just what you need.

    e. A higher gain antenna may also have a smaller usable bandwidth, making it unusable or requiring tuning to operate through one or multiple bands

- The gain of an antenna works both ways - for receiving as well as transmitting

    a. Using a high gain antenna in a radio-dense urban environment may worsen the problem of overloading the front end of your radio with too many signals

- What about the "HT rubber ducks have negative gain?"

- There actually is truth to this statement
- For starters, very many antennas (and antenna installations) are compromised - due to space, HOA restrictions, aesthetics or other reasons
- In the case of an HT antenna, one of the main considerations is portability, so their antennas tend to be small.
- For example, the 2m/70cm quarter wave antenna supplied with the Baofeng UV-5R radios are either 12 or 16.5 centimeters, or 4.7 or 6.5 inches
- If we take the output frequency of the 2m LARC repeater of 147.270 MHz, that translates to a wavelength of approximately 2 meters.
    a. A quarter wavelength is therefore ½ meter or about 19.68 inches.
    b. So the Baofeng antenna at 5 to 7 inches is much shorter than the expected length
- The antenna attempts to correct for this with a coil and capacitor in the base of the antenna, but this further compromises the antenna's performance
- This results in the antenna actually reducing or attenuating your outgoing signal, which does translate to negative gain
- Can you believe the advertised gain figures on antennas?
- Many times, you'll see an antenna advertised with something like "+10 dB gain!" The first thing that should stand out to you is that the ad did not specify what that gain was measured in relation to. If it instead said "+10 dBd" or "+10 dBi," you would at least know what they claim to be referencing.
- This would be like seeing a can of soup in the store with a bright label stating "Now with 20% more!" but no explanation as to 20% more than what
- Another issue is the complexity and expense in actually testing an antenna to find out its true gain. While you can perform a very informal comparison by putting different antennas on your HT and seeing how far away you can access the repeater with each, this will not give you an actual gain figure.
- One manufacturer, Arrow Antenna, does not specify the gain of many of their antennas, and even has a web page dedicated to why (https://www.arrowantennas.com/arrowii/gain.html)

- If someone advertises a dipole and says it has "+5 dBi of gain," you can immediately become suspicious, as a theoretical perfect dipole will only have a 2.15 dBi of gain, and the laws of physics are pretty much a constant for all antennas!
- There is a saying that goes something like "spend 80% of your budget on your antenna system, and 20% on your radio"
    a. This is likely meant for serious contesters, but again, the idea does have a lot of truth to it.
    b. If you have a super-duper $3700 decked out Flex 6700 radio, but connect it to 100 feet of cheap e-bay RG-8X from an unknown Chinese manufacturer connected to a half-wave dipole mounted 8 feet off the ground, you're going to think your Flex radio is broken, but in reality your severely compromised antenna system is attenuating all our signal strength!
- So what can you take away from this discussion?
- First, that antenna gain is a more complicated topic than you may have at first assumed
- Realize that there is more to evaluating an antenna than just the gain figure, which is likely to be inaccurate anyway
- You must consider your operating bands, the locations of the stations you are trying to reach, the parts of the bands you plan to use (for example, are you only operating on CW, or do you do voice and data), your ability to install the antenna in an optimal location among other things
- Just because another ham extols the virtues of their antenna doesn't mean it really is good, or that you will get the same results if you buy one for your own station
- For example, I have a G5RV Junior, which is a 52-foot long dipole that's advertised to let you work 40 through 10 meters - this is shorter than the ideal 40 meter dipole which would span 67 feet.
- I've made many contacts on it using SSB voice and digital modes
- However, it is my first HF antenna, so I can't really honestly say that it's a good antenna. Maybe it's one step above a dummy load, and I just don't know it due to my lack of experience with other antenna systems
- At this point in my ham career, I'm plenty happy as long as I'm able to make any contacts!

- I haven't had very many HF DX contacts over in Europe, so if your goal is to get DXCC on voice (which requires confirmed contacts to 100 different DX entities), you would likely be disappointed using this antenna as I have it configured.

- My primary reason for choosing this antenna was I had no idea what bands I wanted to use, so I thought I'd get an antenna that could handle all of them. What I did not realize at the time is that this frequently results in a lot of compromises having to be made to the antenna, reducing the performance for a given band.

- If I was to choose an antenna with the knowledge I have today, I'd make sure it performed well on 20 and 40 meters, as these are the primary bands I utilize.

Questions:

- **The question for the week is:** Do you have an antenna other than the one that came with your HT, or do you have an HF antenna? If so, how did you go about selecting it, and are you planning to try a different antenna in the future?

- **In my case,** I've purchased one upgraded antenna - a Super Elastic Signal Stick from signalstuff antennas. This is a 19" dual band antenna meant for HTs, with the radiator made out of a very flexible material, which allows the antenna to move and bend yet still return to its proper shape.

  I bought the model with a BNC connector on it, and then have BNC adapters attached to many of my HTs so I can move the antenna around as I use different radios.

More Info:

- Signal Stuff Antennas: https://signalstuff.com/

- Doublet antenna: https://www.hamuniverse.com/hfdoublet.html
  https://ftp.unpad.ac.id/orari/library/library-sw-hw/amateur-radio/ant/docs/Introducing%20the%20All-Band%20Doublet.htm

- Fan dipole: https://www.hamuniverse.com/multidipole.html
  https://www.onallbands.com/ham-radio-101-what-is-a-fan-dipole-antenna/

- Wolf River Coils: https://www.wolfrivercoils.com/

- HT Antenna COnnectors:
  https://signalstuff.com/2016/08/choosing-the-correct-antenna-connector-for-your-radio/

Notes:

- If you have ideas for net topics or general meeting topics / presenters, please let us know! Tell us on a net, or send email to k0itp@w0eno.org

Email to elmer@w0eno.org