Directional Antennas

On-Air Training
Idaho Falls Bishops' Storehouse
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Welcome

Welcome to the training. Welcome to National Preparedness Month! We have several opportunities coming up in the next month or two. Grab a pen and paper, your calendar, Franklin Planner, smart phone or whatever you need to record a few dates.

On Saturday, September 17, there will be a Preparedness Expo at the high school in Rigby. Doors open to the public at 10:00. The event is free. There will be several training seminars and demonstration booths. Traditionally this is a well attended event and worth an hour or two or your time. For more information go to http://idahoprepare.com.

On Saturday, September 24, Rexburg is having a Run n' Ride event. I'm looking for 10 operators that would like to volunteer to help out with radio communication. If you are interested, send me an email at n7tms@yahoo.com and I'll get you more information.

There are a couple of Technician classes beginning in October. The Rexburg class begins on October 8 and the Idaho Falls class begins on October 22. I have more information on the Rexburg class and Steve Taylor KC7IHV has more information on the Idaho Falls class. Basic information can be found at http://RexburgHams.org/courses. Given recent events, we anticipate a lot of interest in these classes. Please spread the word through your wards to help make interested individuals aware that they are happening.

Finally, the ERC exercise is coming up on October 15. Keep that morning open and watch for more details. We've worked hard to avoid conflicts on that day and it seems we have been just slightly less than successful. Nevertheless, the exercise will proceed on October 15. We encourage *all* operators to prepare for and participate in this exercise with your priesthood leadership. Watch the ERC website and your email for more information.

Are there any questions about any of those events?

Introduction

Tonight I want to discuss directional antennas and a little bit about gain.

Directional Antennas

In many applications, the antenna's most important property is its ability to concentrate its radiated power in useful directions. This property, however, only has meaning with respect to other antennas, so a reference must be established.

An *isotropic radiator* is a theoretical, point-sized antenna that is assumed to radiate equally in all directions, or omnidirectional. Try to picture the three-dimensional radiation pattern as a perfect sphere. No such antenna actually exists, but it serves as a useful theoretical reference for comparison with real antennas.

The radiation from a practical antenna never has the same intensity in all directions. The intensity may even be near zero in some directions; in others it will probably be greater than an isotropic antenna. *Directional antennas* are designed specifically to concentrate their radiated power in one or more directions. In a perfect directional antenna, the radio energy would be concentrated in one direction only, called the *forward* direction. This is known as the *major lobe* or *main lobe* of radiation. Because no antenna is perfect, most directional antennas also have *minor* or *side* lobes.

The directions of minimum radiation between the lobes are called *nulls*. These are directions in which very little or no radiation emanates. By reducing radiation in the side and back directions and concentrating it instead in the forward direction, a beam antenna can transmit or receive a stronger signal than an isotropic antenna would in that direction.

It is difficult to show a picture using this FM voice mode of communication. So, instead, picture a three-leaf clover with the steam dangling at the bottom. This is how a radiation pattern might look for some antenna. The top, center leaf, if larger than the other two. This center leaf is your forward lobe. This is the direction of the strongest signal. The other two leaves are smaller. These represent minor lobes or side lobes. There is still some signal that radiates in these directions, but it is not as strong. The space in between the leaves, the v-like shapes, are nulls where little or no signal radiates.

[Consider mentioning the benefit of nulls to block out interfering signals.]

An antenna's gain is the ratio between the signal radiated from an antenna in the direction of its main lobe and the signal radiated from a reference antenna in the same direction and with the same power.

Remember, an isotropic radiator has no directivity at all, because the radiated signal strength is the same in all directions. For this reason, we can say the isotropic radiator has zero or no gain in any direction.

In contrast to an isotropic antenna, the radiation pattern of an ideal dipole antenna in *free space* resembles a doughnut. Free space means without any ground or conducting surfaces nearby to affect the pattern. Picture the wire of the dipole running through the center of the

donut. The signal radiating from a dipole is perpendicular to the wire with nulls in the center of the donut. If you placed dipole and isotropic antennas side by side and transmitted with the same amount of power to each, the radiation in the main lobe of a dipole would be 2.15 dB greater than would be expected from the isotropic radiator.

While the isotropic radiator is a handy mathematical tool, it can't be physically constructed. On the other hand, the dipole is a simple antenna that can be constructed and easily tested on an antenna range. For that reason, the dipole is also used as a reference antenna.

Imagine a beam antenna that has 6 dB of gain compared to a dipole, which means that it makes your signal *appear* four times stronger than if you were using a dipole with the same transmitter. Remember the rule of thumb: effective power doubles for every 3 dB of gain. So if your dipole appears to radiate 10 watts, what would this beam antenna that has 6 dB of gain compared to a dipole appear to radiate? (40 watts)

Another question: If an antenna has 6 dB of gain compared to a dipole, what is the gain in dB compared to an isotropic antenna? (8.15 dBi)

When we specify gain compared to a dipole, we use the units "dBd" and when we specify gain compared to an isotropic we use the units "dBi".

Be aware that nearby reflecting surfaces can dramatically increase or decrease an antenna's gain. When you compare specifications for several antennas, be sure that they all use the same reference antenna for comparison or convert the gains from one reference to another.

One other thing I would like to mention here. We talked a lot about the perceive strength of a transmitted signal. The opposite also holds true. If you antenna has 6 dB of gain with transmitting, it also has 6 dB of gain when receiving. Signals coming from the direction that the forward lobe is pointing seem stronger.

Conclusion

This a 10 minute review of material that entire books are written about. But are there any questions or comments about directional antennas or gain?

Closing

Thanks for listening in and participating this evening. This is N7TMS, back to net control.

Credit: ARRL Extra Class License Manual, Tenth Edition, pp. 9.1 - 9.4