2

Best Practices

This chapter describes best practices for the following topics:

2.1 Antennas and Signals

Wireless communication relies on the following conditions:

- **Visual line-of-sight** – A direct visual line between antennas with no obstructions in the path.
- **Radio line-of-sight** – The Fresnel Zone (fruh-nel) surrounding the visual line-of-sight path.

The Fresnel Zone is an area around the line-of-sight based on the wavelength of the frequency and the distance between the sites. For an example, see *"Clear Line-of-Sight" on page 11*.

When there are objects in the line-of-sight or Fresnel Zone, the radio signal can be reduced or even blocked. Hard objects, such as rocks, the earth, fences, traffic, and buildings have a greater impact on the signal than softer objects such as trees and weeds. Wind and rain can also impact the signal strength.

In areas where there is a steep inclination, try one or more of the following:

- Reduce the inclination by going up or down at an angle rather than straight up or down (see *"Ways to Improve Communication" on page 16*).
- Use repeaters (see *"Ways to Improve Communication" on page 16*).
- Use geophone extenders so that you can move the xxx and antenna to a better location (see *"Ways to Improve Communication" on page 16*).

In areas where the line segment crosses a road or overpass, try one or more of the following:

- Use an extender (coaxial cable) with a riser to elevate the antenna above the road (see *"Clear Line-of-Sight – Traffic" on page 14* and *"No Line-of-Sight – Traffic" on page 14*.
- Use repeaters.
- Use geophone extenders so that you can move the xxx and antenna to a better location.

The following figures provide some examples of how to optimize communication in the field.

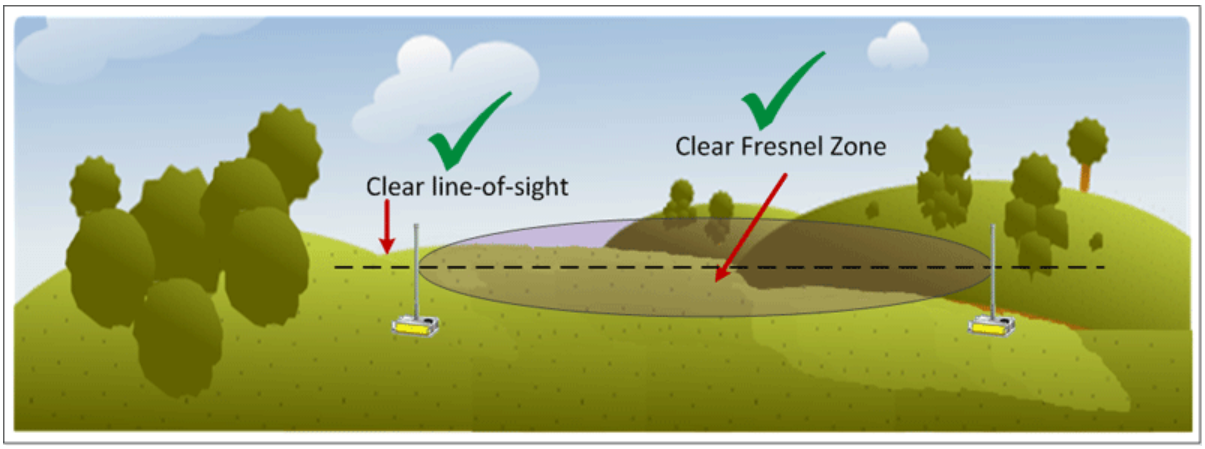

Figure 2–1 Clear Line-of-Sight

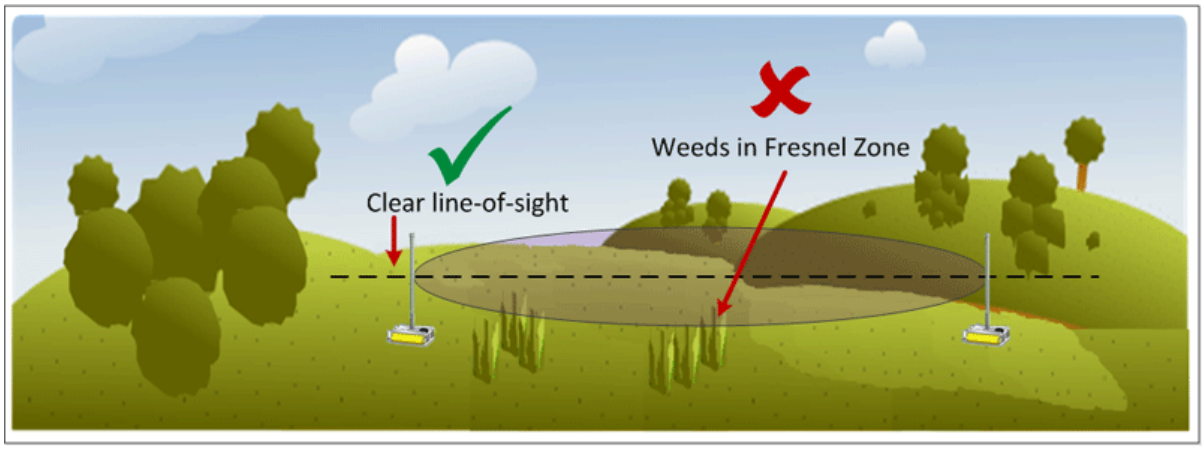

Figure 2–2 Near Line-of-Sight – Weeds

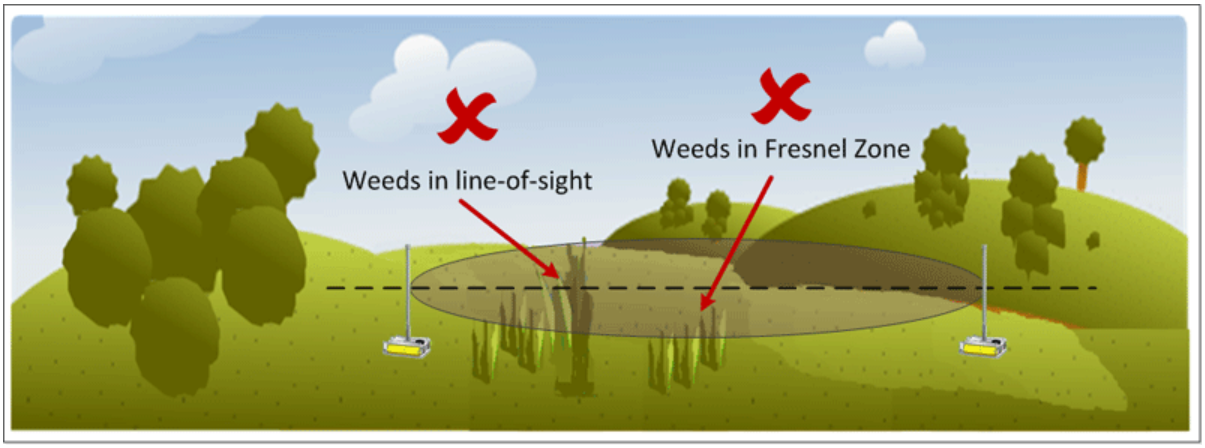

Figure 2–3 No Line-of-Sight – Weeds

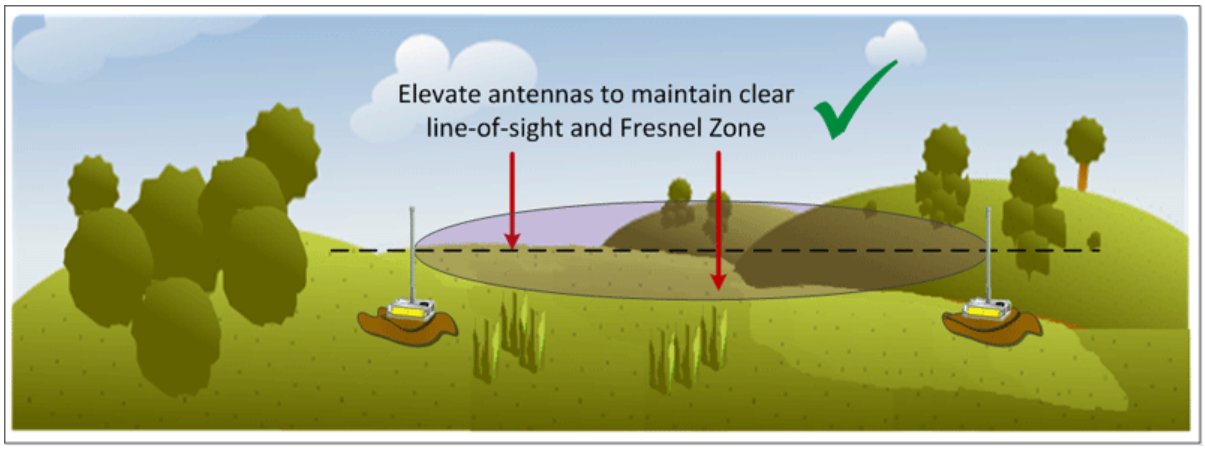

Figure 2–4 Clear Line-of-Sight – Elevate over Weeds

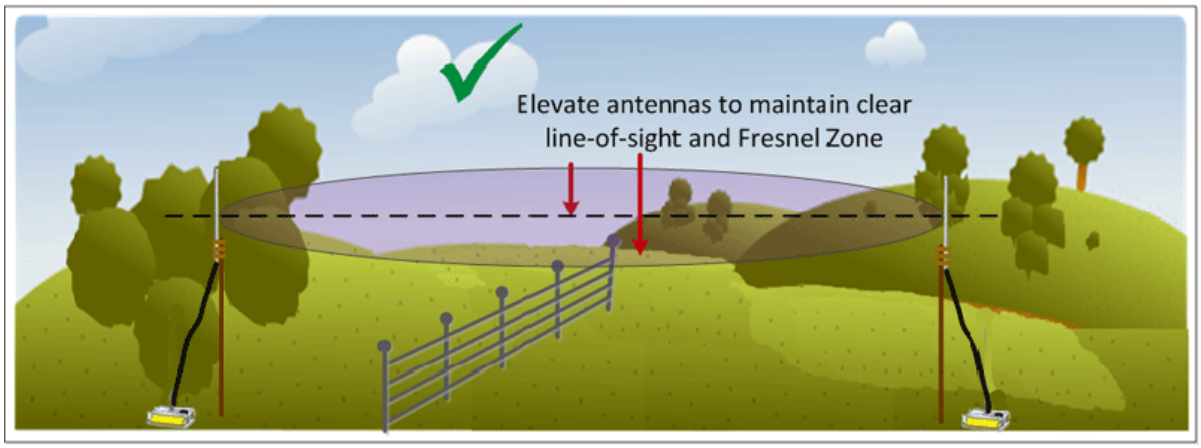

Figure 2–5 Clear Line-of-Sight – Fence

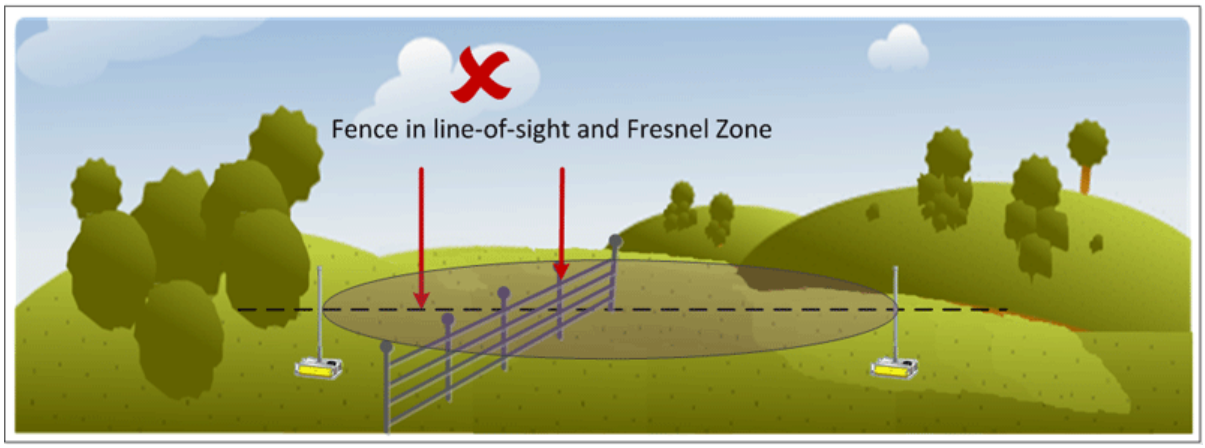

Figure 2–6 No Line-of-Sight – Fence

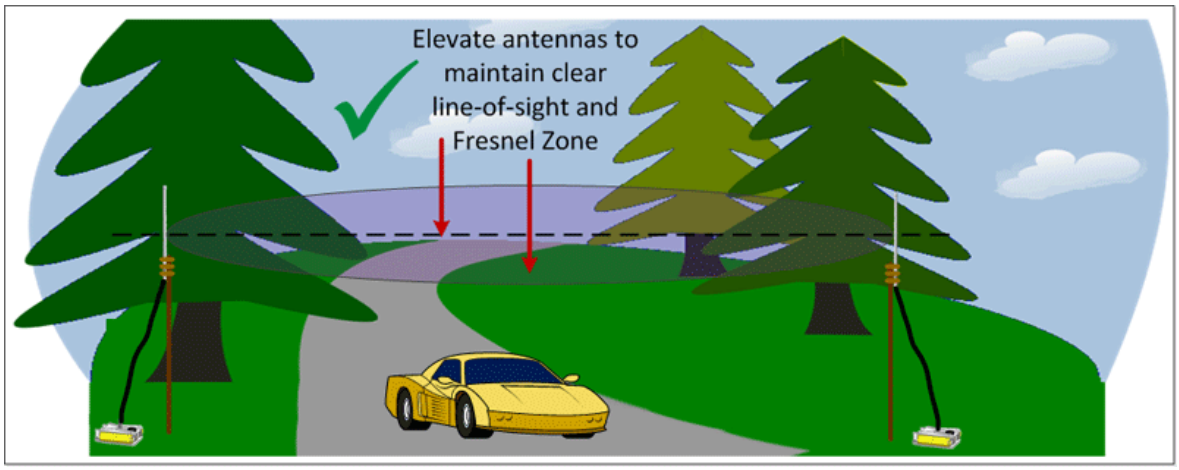

Figure 2–7 Clear Line-of-Sight – Traffic

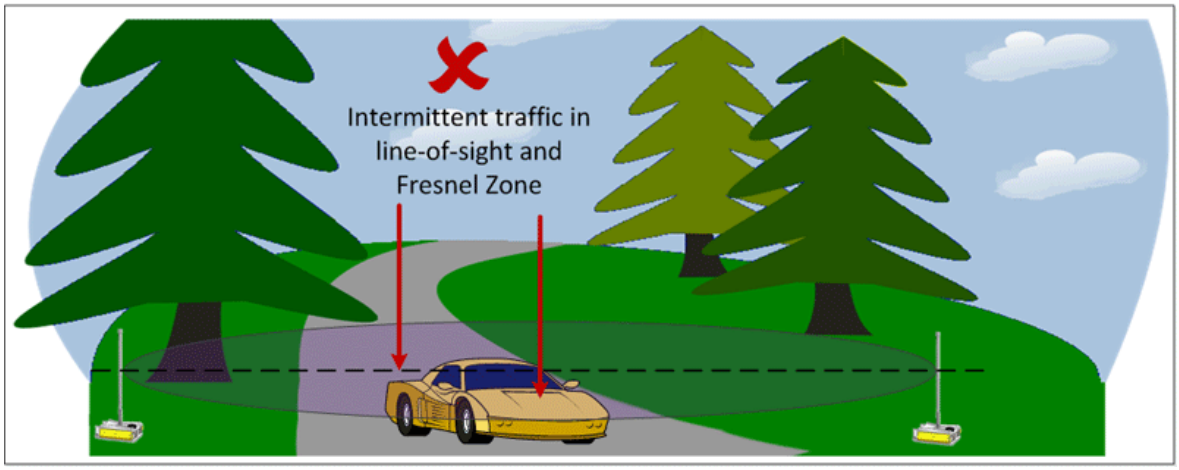

Figure 2–8 No Line-of-Sight – Traffic

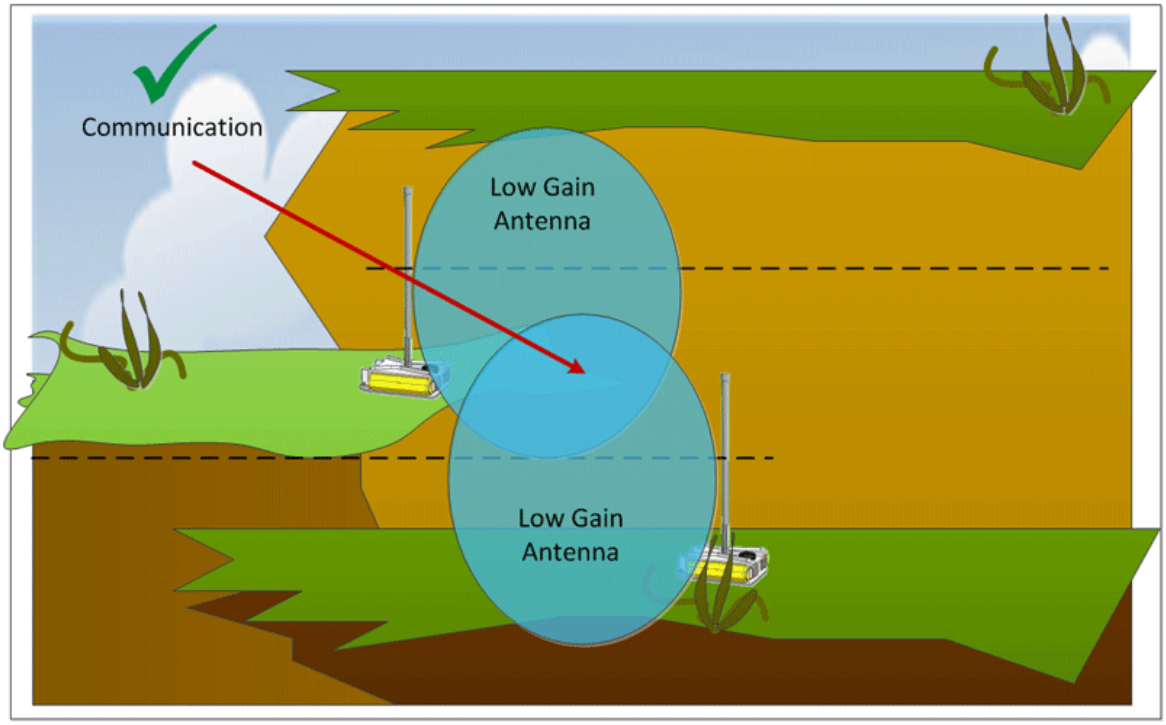

Figure 2–9 Clear Line-of-Sight – Elevation Change

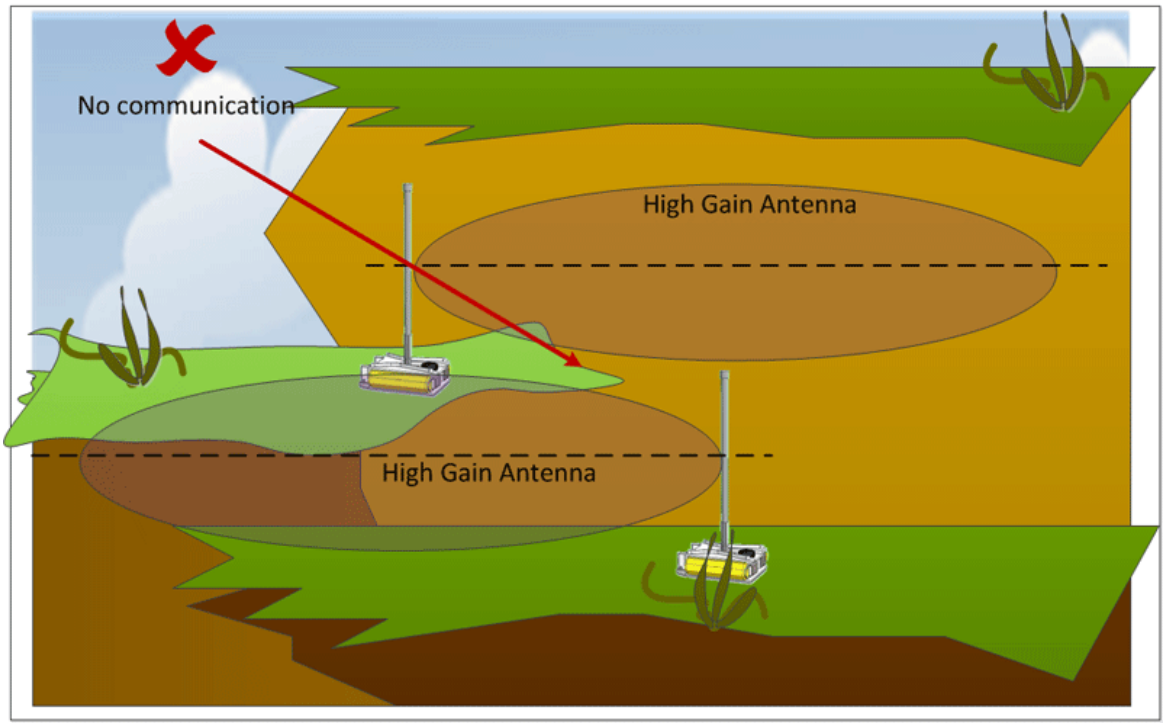

Figure 2–10 No Line-of-Sight – Elevation Change

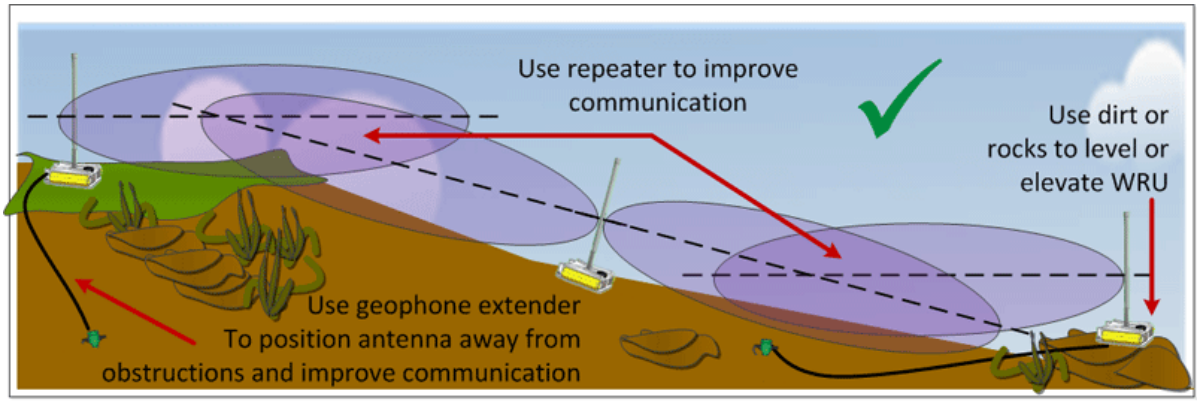

Figure 2–11 Ways to Improve Communication

The following figure shows example radiation patterns for different gain antennas.

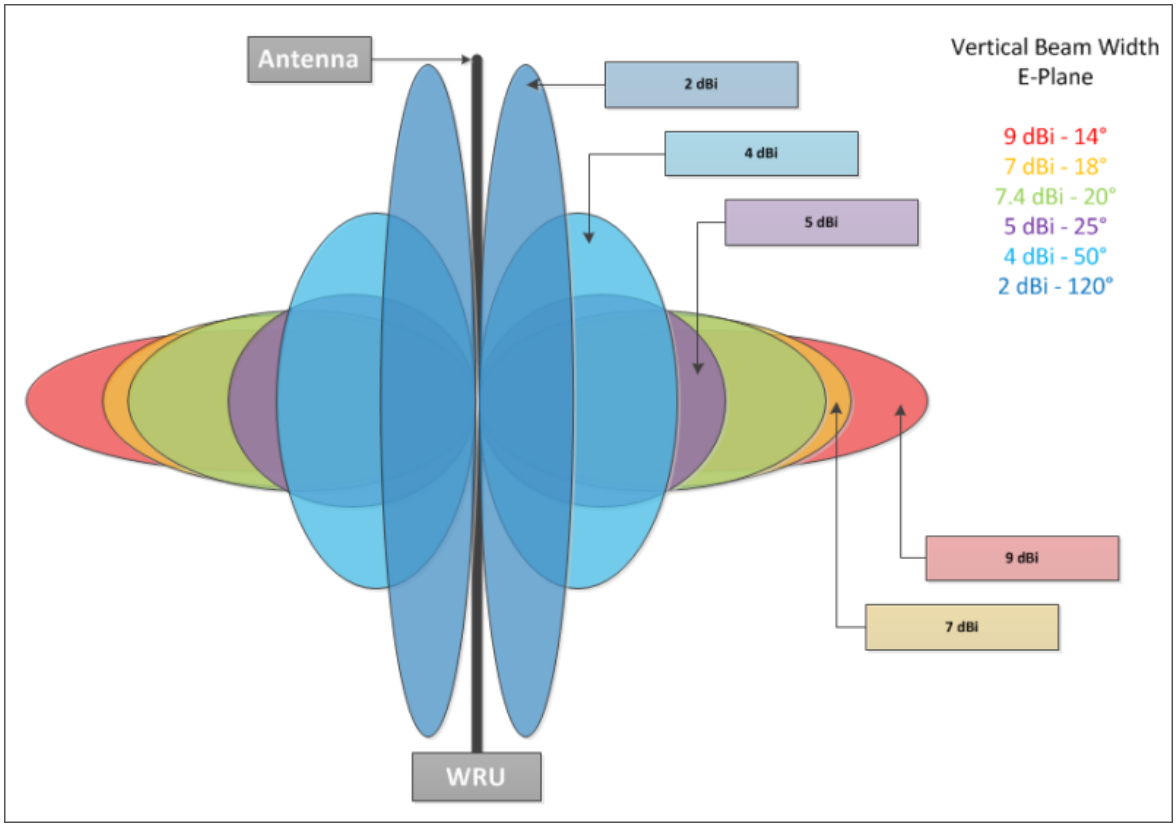

Figure 2–12 Antenna Radiation Patterns for Different Gains

Consider the presence of the following when placing xxxs and backhaul components, as they can interfere with wireless communication:

- **Buildings and fences** – Buildings and fences create a physical barrier that can block wireless communication.
- **Microwave signals** – Microwave signals are transmitted with a parabolic antenna; there may be an area near the base or on the opposite side of the antenna that is free from radiated signals, but signal interference may occur further out from the tower (see *"Microwave Signal Radiation Pattern" on page 18*).
- **Cell towers** – The radiation pattern of a cell tower is similar to that of a dipole antenna; there may be an area near the base that is free from radiated signals, but signal interference may occur further out from the tower (see *"Cell Tower Signal Radiation Pattern" on page 18*).
- **Power transmitters and lines** (both overhead and underground) – EMF signals are strongest directly below an overhead power line (see *"Power Line Signal Radiation Pattern" on page 18*), or above an underground power line. EMF signals decrease rapidly as you move away from the source.

  For an in-depth explanation of Electric and Magnetic Fields (EMFs), see the following link:

  http://www.emfs.info/

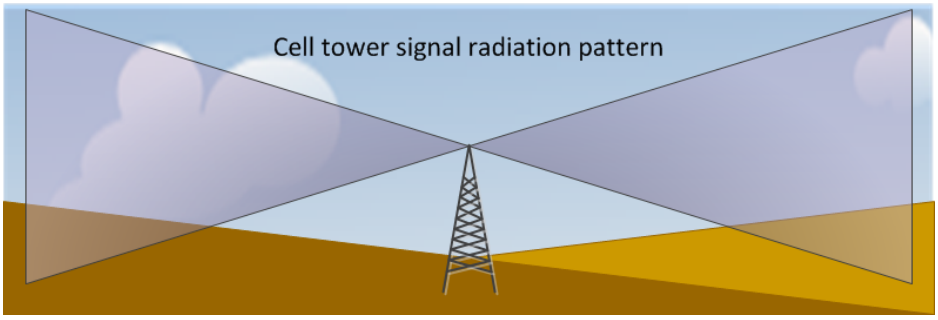

Figure 2–13 Cell Tower Signal Radiation Pattern

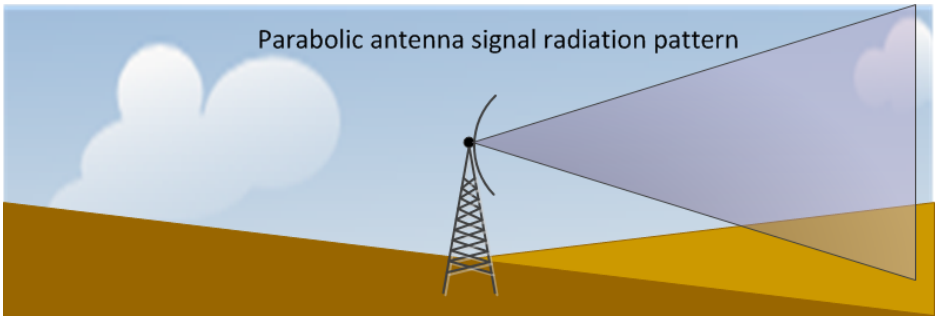

Figure 2–14 Microwave Signal Radiation Pattern

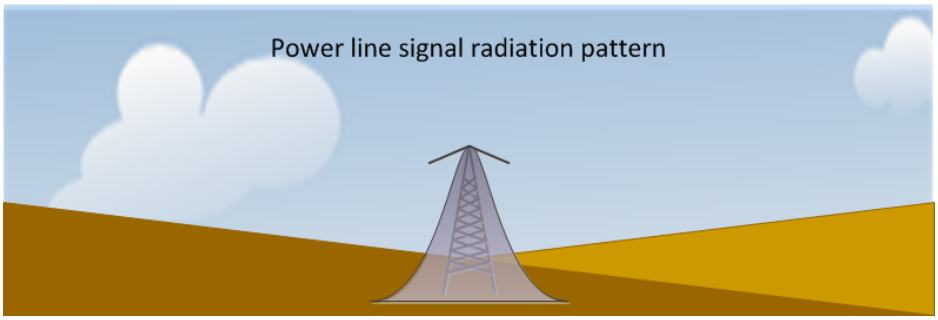

Figure 2–15 Power Line Signal Radiation Pattern