

Antenna knowledge

For information about how antennas work and how to choose one

- [Antenna Gain vs Length - Quick Reference](#)

Antenna Gain vs Length - Quick Reference

Antenna Gain vs Length - Quick Reference for 915 MHz Omnis

If you've ever wondered how to ballpark an antenna's gain just by looking at it, here's a cheat sheet:

2 dBi	→ ~120-170 mm
3 dBi	→ ~200-250 mm
4 dBi	→ ~280-350 mm
5 dBi	→ ~400-450 mm
6 dBi	→ ~500-600 mm
7 dBi	→ ~800-900 mm
8 dBi	→ ~1200-1350 mm
9 dBi	→ ~1500-1650 mm

Why does this work?

At 915 MHz, one wavelength (λ) is about 328 mm. Omnidirectional collinear antennas get their gain by stacking half-wave elements vertically with phasing stubs between them. More elements = longer antenna = more gain.

- **2 dBi** is basically a half-wave dipole ($\lambda/2 = 164$ mm). This is where most stock LoRa whip antennas land.
- **3 dBi** gets into 5/8-wave territory (~205 mm plus matching network)
- **4-5 dBi** covers short collinears and 2-element designs
- **6 dBi** around 550 mm is a 3-element collinear ($\sim 1.68\lambda$)
- **7 dBi** around 850 mm is a 4-5 element collinear ($\sim 2.6\lambda$)
- **8 dBi** around 1275 mm is pushing 7+ elements ($\sim 3.9\lambda$)
- **9 dBi** around 1600 mm is an 8+ element array ($\sim 4.88\lambda$)

The general rule is that doubling your elements gets you about +3 dB of gain. You'll notice the gaps get smaller as you go up because at higher element counts you hit diminishing returns from losses in the phasing network.

One caveat

Below 5 dBi, the length-to-gain correlation gets less reliable. Manufacturers use loaded and helical designs to shrink things down, so you'll see "2 dBi" antennas that are only 50-80 mm because they're coiled internally. The eyeball method really shines from 5 dBi and up where you're looking at full-size collinear builds.

TL;DR

Under 200 mm? Probably 2-3 dBi. Around 300-450 mm? 4-5 dBi range. Half a metre, ~6 dBi. Approaching a metre, ~7 dBi. Over a metre, ~8 dBi. Pushing 1.5m+, you're in 9 dBi territory. No spec sheet needed, just eyeball it.

Choosing the Right dBi and Wave Shape for Your Environment

- **2-3 dBi** (Omni / Rubber Duck)

- Wave Shape: Tall, rounded sphere.
- Best For: Dense urban areas, indoor gateways, mobile nodes (backpacks, cars, or kayaks), or hilly terrain where nodes are located above or below you. A wide vertical beam forgives tilt and varying node elevations.

- **5-6 dBi** (Short Fiberglass)

- Wave Shape: Balanced, medium donut.
- Best For: Suburban environments or mixed terrain. It clears local ground obstructions better than a 3 dBi antenna while maintaining enough vertical beamwidth to reach nodes that aren't on the exact same flat plane.

- **8-9 dBi** (Tall Fiberglass)

- Wave Shape: Thin, flat horizontal disk.
- Best For: Open, flat, rural terrain with clear line-of-sight. Warning: If mounted very high on a tall mast in non-flat terrain, the flat beam will literally shoot straight over nearby nodes, resulting in zero coverage for devices close to the ground.