Do I need an external antenna?

The stock antenna that comes with most LoRa boards is a rubber duck (flexible whip) antenna, typically 1-3 dBi gain (often a quarter-wave stubby around 2 dBi). For many use cases, this is adequate - but upgrading to an external antenna is one of the most cost-effective improvements you can make.

When the Stock Antenna is Fine

- Indoor portable use (office, home) within 200-500m of your nearest mesh node
- Temporary deployments where you're moving frequently
- Testing and development before a permanent installation
- Dense urban areas with many nearby nodes (short hop distances)

When You Should Upgrade

- **Fixed outdoor installation** - Any permanent outdoor node should use an external antenna rated for outdoor use. Stock rubber ducks are not weatherproof.
- **Coverage issues** - If you can't reach nodes you'd expect to reach, a better antenna is the first thing to try.
- **Backbone repeater** - Repeaters covering a neighborhood or city need the best possible antenna. A 5-8 dBi fiberglass omni provides several dB more gain than a stock whip, which can substantially extend range (roughly doubling it under line-of-sight conditions; the gain in cluttered terrain is smaller).
- **Point-to-point link** - If you're trying to bridge two specific locations, a directional yagi (commonly 6-10 dBi for compact 915 MHz models) extends range significantly. **FCC compliance:** on US 915 MHz, FCC 15.247(b)(4)(i) requires you to reduce conducted transmit power 1 dB for every dB of antenna gain above 6 dBi - and, unlike the 2.4 GHz band, the 902-928 MHz band has *no* point-to-point exception that relaxes this. For example, with a 12 dBi yagi you must drop conducted power roughly 6 dB below 1 W to stay within the EIRP limit. Most firmware lets you set TX power accordingly; do not run full power behind a high-gain antenna.

What External Antenna to Buy

For most fixed outdoor deployments, a 915 MHz fiberglass omnidirectional antenna is the right choice:

- **Taoglas TI.92.2113 (3 dBi)** - $15-20, compact, good for moderate ranges
- **Proxicast 5 dBi (ANT-DB5-5)** - $25-35, good all-around outdoor omni
- **Taoglas FXP73 (5 dBi, mag base)** - $25-40, great for vehicle or temporary mounts
- **L-com HG908U-PRO (8 dBi)** - $45-60, excellent for high-gain omni backbone nodes

Connector Adapters

Most LoRa boards use a standard SMA connector (male pin on the antenna/pigtail, female body on the board) or a u.FL connector. External antennas typically use an N-connector or SMA. **Watch out:** SMA and RP-SMA (reverse-polarity SMA) look almost identical but do not mate - RP-SMA swaps the center pin and socket, so an SMA antenna will not connect to an RP-SMA board (and vice versa). Check which gender and polarity your specific board revision uses before ordering a pigtail or antenna. Match your connectors:

- **Heltec V3, T-Beam:** SMA female on board - use SMA male on pigtail or antenna (verify your revision, as some units ship RP-SMA)
- **RAK4631:** u.FL (IPEX) connector - needs u.FL to SMA pigtail (~$5) to connect to any standard antenna
- **T-Deck, T-Echo:** SMA female - use SMA male pigtail or direct-connect SMA antenna

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