Antenna and Signal Range Factors

What determines your repeater's range

Several factors interact to determine how far your repeater can reach. Understanding them helps you make better placement and hardware decisions.

Antenna height and line-of-sight (most important)

This is the dominant factor by a wide margin. Higher placement gives more line-of-sight coverage. Even a few meters of additional height can meaningfully extend coverage. Use terrain analysis tools to identify locations with the best natural line-of-sight before committing to a deployment.

Antenna type and gain

Omnidirectional antennas

Standard for general-purpose repeaters. Higher gain concentrates the signal horizontally, increasing range but reducing coverage of areas directly below. As a common community rule of thumb, many repeater deployments use 3 - 6 dBi omnidirectional antennas as a reasonable balance between reach and overhead coverage; this is not an official Meshtastic specification, so consider your own terrain and coverage goals. Note also that antenna gain counts toward your EIRP limit (see Transmit power below): an antenna over 6 dBi requires a corresponding reduction in conducted power under FCC rules.

Directional antennas (Yagi)

Best for linking two specific points across a long distance. Directional antennas can achieve dramatically longer range in one direction but provide no coverage off-axis. Useful for point-to-point relay links, not general area coverage.

Antenna and cable quality

Upgrading from a stock antenna to a quality external antenna is often one of the highest-return improvements available. Use short, low-loss coaxial cable (LMR-200 or LMR-400) between the radio and antenna. Long cable runs with cheap coax can negate antenna gain improvements.

LoRa modem presets

Meshtastic provides eight primary preset modem configurations (plus a deprecated ninth, Very Long Slow / `VERY_LONG_SLOW`, which is not recommended and is being phased out). Each preset is a named combination of Spreading Factor (SF), Bandwidth (BW), and Coding Rate (CR) that determines the tradeoff between range, data rate, and airtime. The official preset names are: `SHORT_TURBO`, `SHORT_FAST`, `SHORT_SLOW`, `MEDIUM_FAST`, `MEDIUM_SLOW`, `LONG_FAST`, `LONG_MODERATE`, `LONG_SLOW`, and the deprecated `VERY_LONG_SLOW`.

Preset	SF	BW	CR	Data Rate	Link Budget	Notes
Short Turbo	7	500 kHz	4/5	21.9 kbps	140 dB	500 kHz: legal in the US 902-928 MHz band; restricted in some narrower regional bands
Short Fast	7	250 kHz	4/5	10.9 kbps	143 dB	
Short Slow	8	250 kHz	4/5	6.25 kbps	145.5 dB	
Medium Fast	9	250 kHz	4/5	3.52 kbps	148 dB	
Medium Slow	10	250 kHz	4/5	1.95 kbps	150.5 dB	Recommended for dense networks
Long Fast	11	250 kHz	4/5	1.07 kbps	153 dB	Firmware default

Preset	SF	BW	CR	Data Rate	Link Budget	Notes
Long Moderate	11	125 kHz	4/8	0.34 kbps	156 dB	
Long Slow	12	125 kHz	4/8	0.18 kbps	158.5 dB	Maximum range; very low throughput

Higher link budget = more range. Higher data rate = more network capacity and less airtime per message. Note: these link-budget figures assume a 22 dBm TX power and 0 dBi antennas (the Meshtastic reference conditions); adjust for your actual TX power and antenna gain (e.g. with the Semtech LoRa calculator). They are relative comparisons between presets, not absolute path-loss budgets.

Choosing a preset for your network

The most important rule: match whatever preset the rest of your local network uses. Nodes on different presets cannot hear each other, even on the same channel name. A preset sets SF, bandwidth and coding rate; nodes must match SF and bandwidth to demodulate each other, and because bandwidth also determines the frequency-slot grid, mismatched presets generally also transmit on different center frequencies.

- **Check with your local community first.** Many regional networks have standardized on a specific preset. Check local Discord servers, forums, or network maps before deploying.
- **Long Fast** (firmware default) - widely used, works well for sparse networks and rural deployments. Good starting point if no local standard exists.
- **Medium Slow / Medium Fast** - increasingly common in larger networks (60+ nodes). Faster data rate reduces airtime collisions in dense areas while still covering similar distances.
- **Long Slow** - maximum range, but much lower throughput. Can cause network congestion at scale. Not recommended for regular deployment. (The even slower `VERY_LONG_SLOW` preset is deprecated.)
- **Short Turbo** - highest throughput. It uses 500 kHz bandwidth, which is legal in the US 902-928 MHz band but restricted or prohibited in some narrower regional bands (e.g. EU 868 MHz). US operators may use it; verify compliance for your region first.

Transmit power

More transmit power increases range up to the legal limit. In the US, FCC Part 15 (47 CFR 15.247) caps conducted power at 1 W (30 dBm) in the 902-928 MHz band. Antenna gain up to 6 dBi is

allowed at full power. For every dB of antenna gain above 6 dBi, you must reduce conducted power by the same amount (47 CFR 15.247(b)(4)). The frequently quoted 36 dBm (4 W) EIRP figure is simply what 30 dBm + 6 dBi works out to - it is a derived ceiling, not a flat license to radiate 36 dBm with any antenna. The region setting in your firmware is the master control that enforces the legal power cap, so set it correctly. Meshtastic's defaults are compliant with standard antennas, but you remain responsible for EIRP compliance with any non-standard or high-gain antenna - custom setups require the gain-reduction calculation above.

Interference

The 902 - 928 MHz ISM band is a shared, unlicensed band, so other devices operating in it (Wi-Fi extenders, cordless phones, industrial telemetry, and other LoRa networks) can reduce effective range. If you suspect interference, try changing the channel frequency slot within the band and comparing performance.

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