Directional Antennas

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Directional antennas concentrate RF energy in a specific direction rather than radiating omnidirectionally. They are used for point-to-point backbone links between fixed sites where maximum range is needed in a known direction.

ALFA 12 dBi Yagi - $50+

A Yagi-Uda directional antenna with 12 dBi gain at 915 MHz. A 12 dBi Yagi has a half-power beam width of approximately 30 - 40 degrees and must be aimed precisely at the target node. Used for connecting distant nodes or bridging a gap in mesh coverage across a valley or open terrain.

- **Gain:** 12 dBi
- **Pattern:** Directional (Yagi)
- **Use case:** Point-to-point links, extending mesh over long distances in one direction

When to Use a Directional Antenna

- You need to extend the mesh over a specific long-distance path (e.g., across a lake or through a valley cut)
- You have two sites that need reliable high-margin connectivity but no intermediate repeaters
- You want to add gain without affecting nearby nodes in other directions

When NOT to Use a Directional Antenna

- For a general community repeater that should cover all directions - a Yagi will be deaf and blind to nodes not in its beam
- When nodes are located in multiple directions from the installation point
- On handheld portable devices - you would have to point the device at the target node at all times

Aiming a Yagi

A 12 dBi Yagi has a half-power beam width of roughly 35 degrees. Aiming must be reasonably accurate:

1. Use a compass bearing to the target node.
2. Tilt slightly toward the target if it is at a higher or lower elevation.
3. Use the MeshCore or Meshtastic RSSI/SNR values from the target node to fine-tune aim while rotating the antenna.
4. Lock the mount when signal is maximised. Mark the final orientation so you can verify it has not shifted after a windstorm.

Link Budget for a Directional Link

Example: Two Station G2 nodes (36.5 dBm TX, - 130 dBm sensitivity) with 12 dBi Yagi antennas, 20km apart, flat terrain:

- TX power: 36.5 dBm
- TX antenna gain: +12 dBi
- EIRP: 48.5 dBm (check your regional EIRP limits before deploying - FCC limits EIRP for point-to-point at this power level)
- Free space path loss at 20km, 915 MHz: ~117 dB
- RX antenna gain: +12 dBi
- Received power: 48.5 - 117 + 12 = - 56.5 dBm
- RX sensitivity: - 130 dBm
- Link margin: 73.5 dB - more than adequate

In practice, real-world obstructions and multipath reduce this margin. 20 dB of link margin is considered comfortable; 73 dB provides very high reliability.

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