

# Interference and Noise at 915 MHz

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The 902 - 928 MHz ISM (Industrial, Scientific, and Medical) band is shared with a wide variety of devices that can interfere with LoRa mesh operation. Understanding who shares this band, how their signals manifest, and how to identify and mitigate interference is essential for reliable mesh network operation.

## The 902 - 928 MHz ISM Band Landscape

LoRa operates in this band under FCC Part 15.247 (spread spectrum) and Part 15.249 (low-power devices). It shares this spectrum with many other systems:

| Technology                              | Frequency Range                                | Modulation                  | Typical Power     | Interference Risk                             |
|-----------------------------------------|------------------------------------------------|-----------------------------|-------------------|-----------------------------------------------|
| LoRa (US915 plan)                       | 902 - 928 MHz, 8 uplink sub-bands + 1 downlink | CSS (chirp spread spectrum) | 17 - 30 dBm       | N/A (desired signal)                          |
| Zigbee 900 MHz                          | 902 - 928 MHz                                  | DSSS                        | 0 - 10 dBm        | Low; different modulation                     |
| Z-Wave (North America)                  | 908.42 MHz / 916 MHz                           | FSK/GFSK                    | 0 - 14 dBm        | Low to moderate; narrow channels in LoRa band |
| FHSS devices (phones, security systems) | 902 - 928 MHz, frequency hopping               | FHSS/FSK                    | Varies            | Moderate; wideband hopping                    |
| 900 MHz cordless phones (older)         | 902 - 928 MHz                                  | FHSS or DECT variants       | 100 mW            | Moderate; common in homes                     |
| Baby monitors (900 MHz type)            | 902 - 928 MHz                                  | FM/FHSS                     | 10 - 100 mW       | Moderate locally                              |
| ISM telemetry (AMR meters, SCADA)       | 902 - 928 MHz                                  | FSK/OOK                     | Varies; up to 1W  | Low to high; site-dependent                   |
| WiFi 802.11ah (HaLow)                   | 902 - 928 MHz                                  | OFDM                        | Typically <30 dBm | Emerging; not yet widespread                  |

| Technology               | Frequency Range | Modulation | Typical Power      | Interference Risk                                                     |
|--------------------------|-----------------|------------|--------------------|-----------------------------------------------------------------------|
| Cellular Band 8 uplink   | 880 - 915 MHz   | LTE/WCDMA  | Up to 2W           | Adjacent band; high-power cellular near tower can cause blocking      |
| Cellular Band 8 downlink | 925 - 960 MHz   | LTE/WCDMA  | Up to 43 dBm tower | Adjacent band; strong tower signal can cause receiver desensitization |

## How LoRa Handles Interference

LoRa's CSS modulation has inherent interference rejection properties. The chirp spread spectrum processing gain allows LoRa to decode signals 15 - 20 dB below the noise floor. However, strong narrowband interferers can still cause problems:

- **Blocking/desensitization:** A strong signal anywhere near 915 MHz can saturate the LoRa radio's LNA or ADC, raising the effective noise floor and degrading sensitivity to all LoRa signals. This is the most common form of interference damage.
- **Intermodulation:** Two strong interferers at frequencies  $f_1$  and  $f_2$  can produce intermodulation products at  $2f_1 - f_2$  and  $2f_2 - f_1$  that fall on LoRa channels.
- **Direct channel co-channel interference:** Less common at 915 MHz due to the 26 MHz bandwidth shared among many users, but possible in dense deployments.

## Identifying Interference

Symptoms of interference in a LoRa mesh network:

- SNR (signal-to-noise ratio) readings consistently lower than expected given [link budget calculations](#)
- Elevated RSSI on channels with no active transmissions ("noise floor rise")
- Time-of-day correlation with interference events (e.g., worse during business hours when nearby office equipment is active)
- Geographic correlation - nodes near specific buildings, industrial sites, or utility infrastructure experience worse performance
- Intermittent packet loss despite strong RSSI - suggests bursty interferers like FHSS devices occasionally hitting LoRa channels

Tools for characterizing interference:

- **LoRa channel activity detection (CAD):** Built into SX1276/SX1262; scan all channels and report which show elevated energy - differentiates LoRa vs non-LoRa interference
- **RTL-SDR + SDR# / GQRX:** A \$25 RTL-SDR dongle can display the entire 902 - 928 MHz spectrum in real time, revealing the presence, frequency, and character of interferers

- **HackRF / Aircspy:** Higher-end SDR for more detailed analysis; can capture wideband spectral views and decode modulations

# Mitigation Strategies

## Channel Plan Management

LoRaWAN US915 defines 64 uplink channels (902.3 - 914.9 MHz, 200 kHz spacing) and 8 downlink channels. Meshtastic and other mesh firmware may allow channel selection. If interference is identified on specific channels, reprogram nodes to avoid those frequencies. For 915 MHz LoRa in the US, the upper portion of the band (916 - 928 MHz) is less heavily used by legacy FHSS devices and may have lower ambient interference.

## Antenna Selection and Placement

[Directional antennas](#) inherently reject interference from outside their main beam. A 10 dBi Yagi aimed at a target node will have 15 - 25 dB of front-to-back rejection, meaning interferers behind the antenna are attenuated by that amount. For fixed infrastructure links experiencing interference from a known direction, switching from omni to directional can provide dramatic improvement.

## Physical Separation and Height

Interference from consumer devices (baby monitors, cordless phones) drops off rapidly with distance due to their low power and proximity effects. Raising the antenna above the local RF clutter level (above rooftops, not at window height) often improves SNR by 10 - 20 dB by placing the antenna in a "quieter" RF environment.

## Filtering

Band-pass filters for 902 - 928 MHz can be installed between the antenna and the LoRa radio to reject out-of-band energy (especially cellular downlink at 925 - 960 MHz) that might cause blocking. Mini-Circuits, Johanson Technology, and similar vendors offer suitable filters:

- Look for a passband of 902 - 928 MHz with at least 40 dB rejection outside the band
- Insertion loss within passband should be under 2 dB
- Rated input power should exceed your maximum EIRP (important: filter goes between radio and antenna, so it sees TX power)

Note that filtering is only effective against out-of-band interference. In-band interference (e.g., another user in the 902 - 928 MHz band) cannot be filtered without also removing the desired LoRa signal.

## Firmware-Level Mitigation

- **Lower the hop timing aggressiveness:** Reducing retransmission aggressiveness in meshing firmware reduces the probability that any given packet collides with a bursty interferer

- **Use higher spreading factors:** SF11 and SF12 provide more interference rejection (processing gain) at the cost of reduced throughput
- **Enable Listen-Before-Talk (LBT):** Some LoRa firmware supports carrier sense before transmitting, reducing collisions with other ISM band users

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