Hardware FAQ

Which board should I buy as a beginner?

Short answer: Heltec WiFi LoRa 32 V3 or T-Beam Supreme

For most beginners in North America, either of these is an excellent first choice:

Board	Price (approx)	Best for	Notes
Heltec WiFi LoRa 32 V3	$18-25	Lowest cost, quick start	Small OLED display built-in; ESP32-S3; USB-C charging; no GPS
LILYGO T-Beam Supreme	$35-45	All-in-one handheld	Integrated GPS; large battery connector; OLED display; good antenna connector
RAK WisBlock Starter Kit	$40-55	Best battery life	nRF52840-based; excellent for portable use; modular expansion
T-Echo	$55-65	Best handheld device	E-ink display; GPS; nRF52840; weeks of battery; premium feel

Prices are approximate and change over time; confirm against a current listing before buying. (Note: the "T-Beam Supreme" is a distinct, newer product from the older plain "T-Beam" - check that the listing names the exact model you want.)

What to Avoid as a Beginner

- **868 MHz boards** - Common on AliExpress. Check the listing carefully for "915 MHz" or "US version." 868 MHz hardware will not work on North American mesh networks.
- **No-name ESP32 LoRa clones** - Very cheap boards with no external antenna connector. Beyond poor range from the PCB trace antenna, a board whose LoRa front-end is not

properly matched can present a poor SWR, which stresses the radio's power amplifier when transmitting. Choose a board with a real SMA or u.FL antenna port and a properly matched RF front-end - it's worth the extra $5.
- **LoRaWAN gateways** - These are different from LoRa mesh nodes and will not run Meshtastic or MeshCore. Check for "Meshtastic compatible" in the listing.

Where to Buy Reliably

- **Amazon** - Faster shipping; check seller carefully; returns are easy.
- **Official distributors** - Rokland (US), Heltec official store (AliExpress), LILYGO official store (AliExpress). Ships from source but slower delivery from China. Prices are approximate and change; lookalike "official store" listings are common, so confirm a seller is the genuine official store by following the link from the manufacturer's own website.
- **Local ham radio events and swaps** - Other operators often sell tested hardware at reasonable prices.

Do I Need to Buy an Antenna?

The stock rubber duck antenna included with most boards is functional but not optimal. For a handheld or portable device, the included antenna is fine. For a fixed repeater or rooftop node, upgrading to a fiberglass vertical (5-6 dBi) on a short coax run provides significantly better performance. See the Antennas & RF book for details.

Before you mount anything outdoors: a rooftop node needs proper grounding and a coax lightning arrestor, and roof work carries fall and overhead power-line hazards. Read the antenna-installation safety guidance in the Antennas & RF book before installing.

Why isn't my GPS getting a fix?

GPS fix time expectations

Getting a GPS fix takes time - particularly on a cold start (first power-on or after being stored). Under normal outdoor conditions:

Condition	Expected fix time
Cold start, outdoors, clear sky	30 seconds - 5 minutes
Warm start (powered recently)	5-15 seconds
Indoors, near window	2-10 minutes (often fails entirely)
Indoors, no window	Will not get a fix

Common Causes of No GPS Fix

Indoors

GPS signals are extremely weak (-130 dBm from satellites). They are heavily attenuated by buildings and concrete and effectively blocked by metal. High-sensitivity receivers can sometimes get a fix near a window, but reliable acquisition requires going outdoors with a clear view of the sky.

Antenna not connected or loose

Boards with a U.FL GPS antenna connector (T-Beam, some RAK boards) have a small snap-fit U.FL connector between the GPS module and the antenna. This connector can come loose in shipping. Open the case and verify the connector is fully seated - it should click into place.

GPS module disabled in firmware

If you (or a previous configuration) disabled GPS to save power, the module will not attempt to acquire satellites. For most users, the easiest path is the app: **Radio Config → Position → GPS Mode** → set to Enabled.

Advanced (requires the Meshtastic command-line tool, a separate install, with the device connected over USB):

```
meshtastic --set position.gps_mode ENABLED
```

Power brownout

If the GPS module is not receiving adequate voltage (often seen when running from a nearly depleted battery), it may fail to initialize. Try with a freshly charged battery or USB power.

AGPS data expired

Some boards support AGPS (Assisted GPS), which provides almanac data to speed up acquisition. If the AGPS data is stale (more than 2 weeks old), fix time increases significantly. Re-upload AGPS data via the app when connected to the internet.

Testing GPS Without Going Outside

Place the device on an outdoor windowsill with the GPS antenna facing up toward the sky. This is the minimum viable indoor setup for GPS - results vary significantly by window direction and whether metal frames or low-E glass are present.

T-Beam GPS Note

GPS modules vary by T-Beam variant: older T-Beam v1.x units use a Quectel L76K or NEO-6M module, while the newer T-Beam Supreme uses a different module and layout - so the specifics below apply mainly to the classic T-Beam, not necessarily the Supreme. The NEO-6M found in older T-Beam versions has been discontinued; Quectel L76K in newer units is generally faster to acquire. The GPS is connected to the ESP32 via UART2 - if you see GPS-related errors in the serial console, check that the GPS power is enabled (some T-Beam versions have a GPS power pin that must be asserted).

Can I use my node inside my house or vehicle?

Short Answer

Yes, with significant range reduction. Interior use is practical for connecting to a nearby outdoor repeater or for testing. It's not suitable as a repeater location.

What Signal Loss to Expect

The figures below are rough, environment-dependent estimates at ~900 MHz, not precise measurements - actual building and vehicle penetration loss varies widely with construction, materials, frequency, and geometry. Published 900 MHz studies (e.g., NTIA Report 94-306 and vendor app notes) report mean building-penetration losses broadly in line with these ranges (for example ~4 dB for a single wood/drywall wall and ~10-12 dB for a typical interior or single concrete wall), but treat any single number as illustrative.

Location	Typical Signal Loss (estimate)	Notes
Near a window, wood frame house	~3-6 dB	Manageable; roughly equivalent to halving your range
Interior room, wood frame	~6-15 dB	Significant; may still reach nearby repeaters
Concrete/brick building	~10-25 dB	Severe; the low end reflects a single wall, the high end multiple walls or whole-building paths; may not reach anything without a nearby repeater
Metal building, basement	~20-40+ dB	Qualitative estimate (Faraday-cage effect); effectively unusable for mesh
Vehicle (windshield path)	~3-8 dB (rough estimate)	Acceptable for personal use; mount near windshield
Vehicle (metal roof path)	~20-30 dB (rough estimate)	Much worse; magnetic mount external antenna required

Improving Indoor Performance

- **Windowsill placement** - Even 6 inches from a window vs deep in a room makes a measurable difference. Place the node as close to a window facing the direction of the nearest repeater as possible.
- **External antenna on a cable** - Many setups run the node indoors with a short coax to a small external antenna mounted outside or near a window. With genuine low-loss cable (LMR-240/400 class), 3-5 meters costs under 1 dB of loss and puts the antenna in a dramatically better RF environment. Note that thin/cheap coax such as RG-58, RG-174, or RG-316 will lose considerably more than 1 dB over 5 meters at 915 MHz - use good cable.
- **Higher floor** - Upper floors have less obstruction from building materials and more line-of-sight above street-level clutter. A third-floor window is significantly better than a ground-floor window.

Vehicle Use

A node placed on the dashboard or near the windshield can typically receive and send to nearby repeaters. For best vehicle performance:

- Mount near the windshield on the upper dash, antenna pointing up. **Safety:** position the device so it does not obstruct your view of the road and is clear of airbag deployment areas, and secure it so it cannot become a projectile in a collision.
- For dedicated vehicle installations, use a magnetic mount external antenna on the roof. NMO or SMA-compatible magnetic mounts are available, but confirm the antenna *element itself* is tuned for 902-928 MHz - many magnetic-mount/NMO antennas are cut for cellular or VHF/UHF and will present a poor SWR at 915 MHz even though the connector fits.
- Power from the 12V accessory port via a USB adapter