

# Ham Radio Licensing & Off-Grid Mesh Networking

The Communication chapter's core skill guide covers choosing between GMRS and ham radio at a high level. This is the actual next step: what a Technician license costs and requires, when GMRS is the better call instead, and how to set up a licence-free LoRa mesh network with Meshtastic, a capability that keeps growing at Tier 3 and 4 the way a stored battery bank doesn't.

## GMRS or a ham license: the concrete tradeoff

Both are legal, licensed ways to use serious radio power, and they solve different problems.

|               | GMRS                                                                                                                                  | Technician ham license                                                                                     |
|---------------|---------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------|
| Cost          | \$35 for a 10-year license, no exam                                                                                                   | \$35 FCC fee per person, plus a roughly \$15 exam session fee, both one-time                               |
| Who's covered | One license covers you and your immediate family (spouse, kids, parents, siblings, in-laws), regardless of whether they live with you | Strictly individual; every operator needs their own license and exam                                       |
| Power         | Up to 50W on repeater channels, 5W on the main channels                                                                               | Up to 1,500W above 50 MHz (in practice, most handhelds run 5W and mobiles 50W)                             |
| Repeaters     | Open to any GMRS licensee, but cannot legally be linked together over the internet to extend range beyond the local repeater          | Thousands of repeaters, many legally linked (IRLP, EchoLink, AllStarLink) for regional or nationwide reach |
| Modes         | Analog FM voice only, plus basic text/GPS data                                                                                        | VHF/UHF digital voice, packet/APRS, satellite work, and a path to HF once you upgrade past Technician      |

A reasonable household plan: get GMRS for simple, no-test family coverage, and have at least one person also get a Technician license for the added range and modes GMRS structurally can't reach.

## Getting a Technician license

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1. Study the current question pool. The exam draws 35 questions from a standard pool that gets replaced every four years (the pool in effect now runs July 2026 through June 2030), so confirm any study material or app is using the current pool before relying on it.
2. **Register for an FCC Registration Number (FRN) before exam day, not after.** Every first-time applicant needs one to give the volunteer examiners at the session; it's free and takes a few minutes at the FCC's own CORES registration system. Showing up without one is one of the most common reasons a first-time test-taker gets turned away or delayed at their own exam session.
3. Pass with 26 of 35 correct (about 74%). **No Morse code is required**; it was dropped from every U.S. license class in 2007.
4. Take the exam through an FCC-accredited Volunteer Examiner Coordinator (ARRL-VEC is the largest). Both in-person sessions and remote, video-proctored online sessions are common now; not every VEC offers remote testing, so check before counting on it.
5. Pay the exam session fee (commonly around \$15, collected by the local VE team) and, after passing, the separate \$35 FCC application fee paid directly through the FCC's licensing portal. The license is typically issued within 24-48 hours.

*Where to find it:* ARRL's own Getting Licensed page and exam session finder; free practice exams at HamStudy.org and ARRL's own exam review tool, both pulling from the real current question pool.

### What a Technician license actually authorizes

Full privileges on every amateur band above 50 MHz, at up to 1,500W. HF access is narrow: CW-only on small segments of 80m, 40m, and 15m, and both phone and data on 10 meters. If your interest is regional HF communication (see NVIS below), a Technician license alone won't get you there; that requires upgrading to General.

## Off-grid mesh networking with Meshtastic

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Meshtastic uses long-range, low-power LoRa radio to relay text messages and GPS location between small handheld nodes, hopping from node to node without cell service, Wi-Fi, or a repeater. In the U.S. it runs in the 902-928 MHz band under the FCC's unlicensed Part 15 rules, not because there's no regulation, but because it fits inside power limits (roughly 1W conducted, capped further by antenna gain) that don't require a license to operate.

| Device                                                 | Approx. price | Notes                                                                       |
|--------------------------------------------------------|---------------|-----------------------------------------------------------------------------|
| Heltec V3 (LoRa32 V3)                                  | ~\$25         | Cheapest common entry point, includes a small OLED screen                   |
| RAK WisBlock starter kit                               | ~\$25-37      | Modular, widely used for a first build                                      |
| LILYGO T-Deck / T-Deck Plus                            | ~\$43-85      | Built-in keyboard and touchscreen; Plus adds GPS and a bigger battery       |
| LILYGO T-Beam Supreme                                  | ~\$85-120     | Onboard GPS                                                                 |
| Solar repeater node (e.g., RAK WisMesh Solar Repeater) | ~\$70-130     | Fixed relay point to extend a mesh's coverage without a battery to recharge |

Set up through the Meshtastic phone app (Android, iOS, or web) over Bluetooth: flash the node, name it, and join or create a channel. It's text and location only, there's no voice calling on this network.

#### Set the region or the node won't transmit at all

A brand-new node ships with its region set to "Unset," and it will silently refuse to transmit any packet until that's fixed, one of the most common "why isn't this working" moments for a first-time setup. In the Meshtastic app, tap the connected device, go to Settings → LoRa → Region, and set it to **US** (the 915 MHz band used across North America). Every node you want to talk to needs the same region and the same modem preset; a mismatch there looks identical to a dead node.

#### WARNING

##### The default channel is effectively public

Meshtastic's default public channel ("LongFast") uses a trivial, publicly known encryption key, so treat anything sent on it as visible to anyone else running Meshtastic nearby. For anything you actually want private, create your own channel with a real AES-128 or AES-256 key and share that channel's name and key only with your own group, everyone on the channel needs the same one to communicate.

Realistic range varies enormously by terrain, and marketing numbers tend to cite the best case: expect roughly 2-10 miles with a decent antenna and clear line of sight, often just a few hundred meters to a couple of miles in a city with buildings in the way, and as little as a quarter mile in dense wet forest. A documented

mountain-to-mountain link once reached 205 miles, worth knowing as the extreme ceiling, not a planning number.

## NVIS: regional HF without a repeater

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Near Vertical Incidence Skywave (NVIS) is an HF technique that deliberately beams a signal almost straight up so it reflects back down at a steep angle instead of skipping over the horizon, covering roughly 100 to 300 miles with no repeater, no tower, and no internet link required at all. That makes it one of the few communication methods on this page that keeps working even if every local repeater site loses power.

The antenna itself works backwards from normal long-distance HF advice: a horizontal half-wave dipole mounted low, roughly a fifth of a wavelength above ground (a common example is a dipole peaking around 15 feet), on the lower HF bands, 40, 60, or 80 meters. NVIS requires a General class license or higher; Technician's only phone privilege (10 meters) doesn't behave the same way and isn't the band NVIS actually uses.

## Why licensing actually matters, beyond the legal requirement

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The FCC does levy real penalties for unauthorized or interfering operation, not routinely, but when it acts, the amounts are serious: a \$34,000 forfeiture affirmed in 2025 against someone who repeatedly interfered with U.S. Forest Service communications, a proposed fine as high as \$60,000 out of the FCC's Miami field office the same year, and a \$25,000 fine against an already-licensed ham who ran an unauthorized FM broadcast station. Enforcement generally targets significant, repeated interference, not a first-time mistake, but the amounts show this isn't a symbolic rule. Beyond the legal risk, licensing is also what gets you welcomed onto a repeater during an actual emergency: most ham and GMRS repeaters are maintained by volunteers or clubs who expect valid licensing from anyone using their system, not just goodwill.

## Sources

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- Technician exam format, question pool, and licensing steps: ARRL; Ham Radio School
- FRN required before taking the exam, effective May 2021: ARRL
- FCC application fee and exam session fees: ARRL; FCC
- Remote/online exam sessions: ARRL
- GMRS license fee, family coverage, and power limits: FCC; eCFR §95.1767
- GMRS repeater linking restrictions: National Communications Magazine

- Meshtastic regulatory basis, power limits, and channel security: Meshtastic docs; eCFR §15.247; Meshtastic channel docs
- A node won't transmit until its region is set, and the US915 region setting: Meshtastic docs; Meshtastic initial configuration
- Meshtastic device options and pricing: NodakMesh
- Meshtastic real-world range figures: SDR Store; technodabbler; Wikipedia
- NVIS propagation and antenna setup: jpole-antenna.com; Ham Radio School
- FCC enforcement actions and penalty amounts: FCC; ARRL