Mesh Networking in Amateur Radio Emergency Service (ARES)

> **Operational Note:** This page may be consulted during active emergency operations. Regulatory points on this page cite the specific FCC rule (47 CFR Part 15 or Part 97); verify against the current eCFR text and your local ARES group policies before deployment.

What Is ARES?

The **Amateur Radio Emergency Service (ARES)** is a program of the American Radio Relay League (ARRL) that organizes licensed amateur radio operators to provide emergency communication support to government agencies, relief organizations, and other served agencies when normal communications infrastructure fails or is overloaded. The ARRL ARES field organization has **four levels**: national (ARRL HQ), section (Section Emergency Coordinator, SEC), district (District Emergency Coordinator, DEC), and local (Emergency Coordinator, EC, managing groups at the county or city level). Note that an ARRL "Section" is an administrative region, not necessarily a single state.

ARES members hold FCC amateur radio licenses (Technician, General, or Extra class) and participate in regular nets, exercises, and deployments. ARES groups typically operate on designated VHF/UHF repeater frequencies for voice communications and may also operate HF stations for long-range traffic handling. The National Traffic System (NTS) provides formal written message traffic capability via radiogram.

How LoRa Mesh Complements VHF/UHF ARES Operations

Traditional ARES operations are voice-centric: operators check into nets, relay verbal messages, and pass formal radiograms by voice or digital modes like Winlink. LoRa mesh (particularly

Meshtastic) adds a complementary *data layer* that addresses specific gaps in traditional ARES capabilities:

Capability	Traditional ARES (VHF/UHF Voice)	LoRa Mesh Addition
Short text messaging	Voice relay only; requires operator attention	Asynchronous best-effort relay - intermediate nodes rebroadcast in real time; no operator attention needed. This is not guaranteed store-and-forward (Meshtastic's optional store-and-forward module is limited), so a message with no live path at send time is generally lost, not held.
Position reporting	Verbal position reports; APRS on separate system	Automatic GPS position sharing on mesh; visible to all nodes
Net congestion	Single voice channel; traffic serialized	Parallel data channel; does not compete for voice net time
Message logging	Manual logging by net control	Automatic message log on all receiving nodes
No-license users	Not applicable (licensed only)	On 915 MHz under Part 15 (unlicensed ISM), non-licensed served-agency staff may use the mesh. This is a separate legal regime from Part 97 amateur operation - it is not amateur radio and confers no amateur privileges.
Infrastructure requirement	Repeater or simplex range	No fixed infrastructure required to self-form, but coverage depends on powered relay nodes being in range

LoRa Mesh as a Supplemental Data Layer

In ARES deployments, LoRa mesh is most valuable as a **supplemental data layer** running alongside, not replacing, the primary voice net. LoRa mesh is best-effort with no guaranteed delivery, so it supplements but never replaces the voice net for time-critical or life-safety traffic. Common use cases include:

- **Position tracking:** Each ARES operator with a Meshtastic node automatically broadcasts GPS position. A Meshtastic client running on a laptop at net control can display all operator positions on a map without consuming voice net time for position reports.
- **Short message traffic:** Operators in the field can send short status messages ("shelter at Lincoln School now at 47 occupants") without requiring net control to be available to

receive a voice transmission.
- **Pre-positioned relay nodes:** ARES groups can deploy solar-powered mesh relay nodes at elevated sites (hilltops, water towers, repeater sites) to extend mesh coverage across the operating area.
- **Served agency liaison:** A mesh node at the served agency (Red Cross shelter, hospital, EOC), with the entire mesh segment running under Part 15 on 915 MHz ISM, allows served-agency staff to text ARES operators without a ham license. Both the licensed amateurs and the unlicensed staff are operating that mesh under Part 15; the amateur license is irrelevant to the 915 MHz mesh and grants no extra power or encryption privileges there. There is no regulatory mechanism for a Part 15 device to feed traffic into Part 97 amateur operation across the same RF link.

How to Introduce Mesh to Your Local ARES Group

1. **Start with the EC (Emergency Coordinator).** Schedule a 15-minute briefing. Lead with the problem mesh solves: "We can't track field operator positions without using net time." Avoid jargon. Bring a working demo node.
2. **Run a small demo at a regular meeting.** Set up two or three Meshtastic nodes in the room. Demonstrate position sharing on a phone screen. Let skeptical operators handle the hardware.
3. **Propose a parallel track at the next exercise.** Ask permission to run mesh alongside the normal voice exercise - not as a replacement. Offer to provide equipment for participants who want to try it.
4. **Document results.** After the exercise, provide a written after-action report comparing mesh message delivery vs. voice net efficiency. Numbers matter: "Mesh delivered 23 position updates automatically while voice net handled 8 formal messages."
5. **Propose group endorsement.** After successful exercises, request the EC formally endorse mesh as an ARES supplemental tool and add mesh node operation to the local ARES training curriculum.

FCC Part 15 vs. Part 97: Regulatory Considerations for ARES

Critical Regulatory Distinction

Meshtastic devices operating in the 915 MHz ISM band (US) operate under **FCC Part 15** - the same rules as Wi-Fi and Bluetooth. Part 15 operation:

- Requires **no license** to operate (with the conditions below)
- Limits conducted output power to **1 W (30 dBm) at the antenna port - not EIRP** (47 CFR 15.247). EIRP may be higher with antenna gain up to 6 dBi (about 36 dBm / 4 W EIRP); beyond 6 dBi the conducted power must be reduced dB-for-dB (47 CFR 15.247(b)(4)). Note this when using high-gain 8-13 dBi Yagis in go-kits.
- Prohibits causing harmful interference to licensed services
- Requires accepting interference from other Part 15 devices
- Does **not** allow power increases beyond Part 15 limits, even by licensed amateurs

Part 97 (Amateur Radio) allows licensed amateurs to operate in the 33 cm (902 - 928 MHz) band. However, for **spread-spectrum (SS) emissions - which LoRa is** - 47 CFR 97.313(j) caps transmitter output at **10 W PEP**. The 1.5 kW general Part 97 ceiling does **not** apply to LoRa/SS and must never be cited in this context. Part 97 operation also **prohibits**:

- Messages encoded for the purpose of obscuring their meaning, i.e. content encryption (47 CFR 97.113(a)(4))
- Commercial use or pecuniary interest
- Communications in which the licensee has a pecuniary interest

Meshtastic encrypts by default using **AES256-CTR**. (The default public channel uses a publicly known PSK, so default traffic is not actually confidential despite being encrypted.) Because Part 97 prohibits messages encoded to obscure meaning, **default-encrypted Meshtastic cannot lawfully transmit on amateur (Part 97) frequencies**. There is no Part 97 "mode" for encrypted traffic. To operate on amateur frequencies you must disable message encryption entirely. If you need encryption, keep the network on the 915 MHz ISM band under Part 15, where there is no license requirement and no encryption prohibition.

Practical guidance: Run ARES mesh on 915 MHz under Part 15 at Part 15 power levels. Amateur (Part 97) transmissions may **not** be encrypted to obscure meaning (47 CFR 97.113(a)(4)) - **no Section Manager, local coordinator, or other authority can waive this FCC rule**, and there is no jurisdiction in which a ham may encrypt amateur traffic. A mesh-to-Winlink or mesh-to-APRS bridge is lawful only if a licensed amateur keys the amateur leg and the content is plaintext (decrypted at the gateway). For questions about lawful operation, consult the FCC rules (47 CFR Part 97) directly and, if needed, an attorney or the ARRL regulatory information service.

Getting ARES Group Endorsement for Mesh Infrastructure

Formal ARES group endorsement provides several benefits: shared deployment of pre-positioned nodes, group funding or donations for equipment, and integration into official exercise planning. To pursue endorsement:

1. Write a one-page proposal for the EC describing: (a) the problem mesh solves, (b) equipment required and cost, (c) regulatory compliance (Part 15), (d) maintenance plan, (e) training requirements.
2. Present the proposal at a group meeting and invite questions.
3. Offer a formal training session covering Meshtastic setup, channel configuration, and emergency protocols.
4. Request inclusion in the group's Standard Operating Procedures (SOPs) as "Supplemental Mesh Data Layer."
5. Coordinate with the Section Emergency Coordinator (SEC) if seeking section-level endorsement or cross-group interoperability.

Quick Reference: ARES + Mesh Checklist

☐ EC briefed and supports mesh integration
☐ At least one mesh exercise conducted alongside voice net
☐ After-action report documenting mesh performance documented
☐ Channel plan documented and distributed to all mesh operators
☐ Part 15 power compliance verified on all deployed nodes
☐ Encryption policy documented: mesh runs unencrypted on any Part 97 leg; encryption only on the Part 15 ISM mesh
☐ Mesh roles assigned in ARES activation plan (mesh coordinator, relay node operators)
☐ At least two operators trained on mesh node setup and troubleshooting
☐ Mesh node inventory maintained with deployment locations
☐ Mesh SOP incorporated into ARES local plan

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