

Training and Exercises

- [Running a Mesh Communications Exercise](#)
- [Training New Operators on Mesh Equipment](#)

Running a Mesh Communications Exercise

Running a Mesh Communications Exercise

Exercises are the primary mechanism by which emergency communications groups validate their capabilities before they are needed in an actual incident. A well-designed mesh communications exercise will surface coverage gaps, equipment failures, procedural ambiguities, and operator skill deficiencies in a controlled environment where mistakes have no real-world consequences.

HSEEP Framework Basics

The Homeland Security Exercise and Evaluation Program (HSEEP) provides a standardised methodology for designing, conducting, and evaluating exercises. Key HSEEP concepts relevant to mesh communications exercises include:

- **Exercise types:** Tabletop exercises (TTX) involve discussion of scenarios around a table with no equipment deployment; functional exercises (FE) are operations-based exercises that test functions and decision-making using a system of simulators and exercise injects, with no movement or actual "boots on the ground" field deployment of personnel (in a mesh context this typically means activating and operating equipment from fixed positions rather than deploying teams to the field); full-scale exercises deploy people and equipment to simulate an actual incident response. For mesh communications, starting with a TTX to validate procedures, then a functional exercise to validate equipment, is a recommended progression before attempting a full-scale exercise.
- **Objectives:** HSEEP requires that exercises have specific, measurable objectives tied to core capabilities. Frame objectives as things to *measure* rather than reliability levels to assume — for example, "measure what fraction of welfare-check messages originating from designated neighbourhood nodes reach the EOC within 10 minutes" (set the target from your own baseline data, and expect best-effort mesh delivery rates to vary widely with load and terrain rather than assuming a high fixed percentage), or "network operator can reconfigure channel settings within 5 minutes of a security compromise notification."

- **After-Action Report (AAR):** HSEEP-compliant exercises produce an AAR that documents exercise objectives, observed strengths, areas for improvement, and a corrective action plan with assigned owners and target completion dates.

Designing a Realistic Scenario

Effective mesh communications exercises are anchored in plausible local hazard scenarios. Three scenarios that work well for most communities:

- **Extended power outage (3-7 days):** For this exercise, assume cellular towers are on generator backup and that local cell sites begin failing after roughly 24-48 hours — but treat this as a scenario assumption, not a fact: actual battery/generator endurance varies widely by carrier and site (often only a few hours on battery alone, longer with generators and refuelling). Internet is intermittent or unavailable. The exercise tests whether the mesh can carry welfare traffic and coordinate resource distribution without internet or cellular infrastructure.
- **Wildfire evacuation:** Multiple zones are under evacuation orders. Road closures and smoke limit travel. The exercise tests whether the mesh can relay evacuation status, shelter capacity, and resource requests between field teams, the EOC, and reception centres.
- **Earthquake with infrastructure damage:** Multiple buildings are damaged. A simulated percentage of nodes are offline (to represent destroyed or inaccessible nodes). The exercise tests whether the remaining nodes can keep traffic flowing around the gaps — note that Meshtastic reroutes via managed flood rebroadcast only where an alternate in-range node exists; it does not compute repaired routes like a routed network, so "self-healing" only works if another node is within RF range of the gap — and whether operators can identify and document coverage holes.

Facilitator Guide Structure

A mesh communications exercise facilitator guide should include: exercise overview and objectives; scenario narrative with inject schedule (pre-scripted events delivered to players at designated times to drive exercise activity); expected player actions for each inject; evaluator guidance (what to observe, how to score); and facilitated hot wash guidance (structured discussion immediately after the exercise to capture initial observations before memory fades).

Common After-Action Findings

Common issues anticipated in mesh communications exercises — based on general emergency-communications experience rather than a specific published study — include:

- **Coverage gaps in specific neighbourhoods:** Often correlate with terrain features (hills, valleys, dense tree canopy) not fully accounted for in the network design. Corrective action typically involves adding a node on an elevated structure in the gap area.
- **Operators needing more training:** Operators who can turn on and send a message but have not practised configuration tasks can be expected to struggle when asked to change channels or assist a neighbour with an equipment problem. (The Level 1/2/3 operator tiering used elsewhere in this library is our own framework, not an external standard.)
- **Procedural gaps:** Absence of documented check-in procedures (who checks in with whom, at what interval, using what format) leads to confusion about network status. Writing and distributing a one-page standard operating procedure for check-ins is a common corrective action.

Training New Operators on Mesh Equipment

Training New Operators on Mesh Equipment

A mesh network is only as capable as the operators who deploy and use it. A structured training programme ensures that operators at all levels can perform their expected functions reliably under the stress of an actual emergency - not just in the familiar environment of their home or club meeting.

Operator Competency Levels

A three-level competency framework gives training coordinators a clear structure and gives operators a defined progression path. This Level 1/2/3 framework is this book's own construct (referenced from the companion page "Running a Mesh Communications Exercise"), not an external standard:

Level 1: Basic User

A Level 1 operator can independently power on a node, connect to it via the [Meshtastic app](#) on a smartphone, send and receive text messages, and verify that their node appears on the network map. This level is appropriate for neighbourhood participants who will carry a node during an incident but are not responsible for network infrastructure. Expected training time: 60-90 minutes in a group setting, followed by self-directed practice at home.

Level 1 competency checklist:

- Powers on node and confirms LED status
- Connects smartphone to node via Bluetooth
- Sends a test message to the group channel
- Confirms message was received by at least one other node. A successful test confirms the link worked at that moment; mesh delivery is best-effort and not guaranteed, so re-test periodically and do not assume a one-time success means the link is reliable.

- Locates their own node on the map view
- Can describe what to do if the node battery dies (recharge procedure)

Level 2: Configured Operator

A Level 2 operator can configure node settings (channel name, PSK, transmit power, GPS interval), change channels in response to a security compromise or coordination need, assist a Level 1 operator with connectivity problems, and interpret basic RSSI and SNR readings to assess link quality. This level is appropriate for neighbourhood zone leaders and ARES/RACES members who are part of the communications plan. Expected training time: 4-6 hours total, including hands-on configuration exercises. When adjusting transmit power, operators must keep the node within FCC Part 15.247 limits (max 1 W / 30 dBm conducted) and account for antenna gain above 6 dBi requiring a dB-for-dB power reduction; never exceed the device's certified output.

Level 2 competency checklist (in addition to Level 1):

- Changes node name and role settings
- Configures a new channel with a specified PSK
- Adjusts transmit power and GPS reporting interval. **Never set transmit power above the legal limit for your region/band.** In the US 915 MHz ISM band, stay within FCC Part 15 limits (1 W / 30 dBm conducted, EIRP-capped); do not exceed the device's certified output. Ham-mode operation is separate and governed by Part 97.
- Reads and interprets RSSI/SNR values for two active links
- Assists a Level 1 operator who cannot connect via Bluetooth
- Documents node configuration in the deployment log

Level 3: Infrastructure Operator

A Level 3 operator can plan and deploy a mesh network for a defined area, select and mount infrastructure node hardware (antenna selection, weatherproofing, power supply), troubleshoot RF issues (interference, path loss, multipath), and train Level 1 and Level 2 operators. This level is appropriate for team leaders, club technical officers, and EMCOMM coordinators. Expected training time: 10-20 hours of structured training plus documented field deployment experience.

Running a Mesh Familiarisation Session in 90 Minutes

A 90-minute session can introduce complete beginners to the basics, but expect some participants — especially genuinely non-technical people — to need follow-up help, particularly with Bluetooth pairing and app setup, before they can operate reliably under stress. Plan self-paced practice and a refresher rather than treating one session as full Level 1 competency. Suggested schedule:

1. **0-15 min:** Introduction to LoRa and mesh networking (what it is, why it matters for emergency communications, how it differs from cellular and WiFi).
2. **15-35 min:** [Hardware overview](#): show and pass around nodes, explain the indicator LEDs, demonstrate pairing with a smartphone.
3. **35-65 min:** Hands-on practice: each participant pairs their smartphone to a node, sends a message, and locates their node on the map. Facilitator circulates to assist.
4. **65-80 min:** Scenario walk-through: facilitator narrates a simple scenario (power outage, neighbourhood check-in) and participants practice the check-in procedure.
5. **80-90 min:** Q&A, resource distribution (quick-reference card, link to Meshtastic documentation), and next steps (how to get a node, Level 2 training dates).

In-Person vs. Self-Paced Training

In-person training is strongly preferred for Levels 1 and 2, because the most common failure modes (Bluetooth pairing issues, incorrect channel configuration) are easiest to diagnose and correct when a knowledgeable facilitator is physically present. Self-paced video training works well as a supplement for operators who miss a session or need to review a specific procedure. Several ARRL and Meshtastic community members have published tutorial videos suitable for self-paced Level 1 and Level 2 training. Level 3 training requires field experience that cannot be replicated in a self-paced format.

Maintaining Operator Readiness

Skills degrade without practice. Scheduling quarterly mesh nets (structured on-air sessions where operators check in, pass practice traffic, and report node status) keeps all operator levels engaged and surfaces equipment problems before they matter in a real incident. Pairing quarterly nets with the exercises described in the companion page "[Running a Mesh Communications Exercise](#)" (which uses the Level 1/2/3 framework defined on this page) provides a complete readiness maintenance programme.