Disaster Preparedness Planning

Pre-positioning infrastructure, operating during active disasters, and building neighborhood resilience.

Pre-Positioning Mesh Infrastructure for Disasters

> **Core Principle:** Infrastructure that survives a disaster is infinitely more valuable than infrastructure deployed after one. Pre-position before the threat window, not during it.

Cache and Deploy vs. Pre-Position: The Critical Distinction

There are two philosophies for emergency mesh infrastructure:

Approach	How It Works	When It Fails	Best For
Cache and Deploy	Nodes stored in a cache (car, emergency kit, warehouse); deployed by personnel after disaster occurs	When roads are impassable, personnel are unavailable, or the deployment window is too short (earthquake, tornado)	Slower-onset disasters (flood, pandemic); go-bag/field kit deployments; ARES activations
Pre-Positioned Infrastructure	Nodes permanently installed at key sites before any disaster; running continuously on solar power	Only when the site itself is physically destroyed or when solar+battery is exhausted	Earthquake, hurricane, wildfire, any disaster with a sudden onset or infrastructure destruction phase

For serious EMCOMM capability, pre-positioned infrastructure is the goal. Pre-positioned solar nodes survive the disaster alongside the buildings they're mounted on, and are operational the moment anyone with a Meshtastic device needs them - no deployment required.

Identifying Key Pre-Position Sites

Not all sites are equally valuable for pre-positioning. Priority sites have these characteristics:

- **High elevation or roof access** - extends radio range significantly
- **Likely to survive a regional disaster** - reinforced concrete buildings; fire stations are built to survive fires; hospitals have redundant power; water towers are physically resilient
- **Will be operationally active during a disaster** - someone will be there to notice if the node has a problem; the building has power for recharging if solar fails

- **Geographic distribution** - provides coverage across the operational area, not clustered in one location

Priority Pre-Position Site Types

Site Type	Value	Access Notes
Emergency Operations Center (EOC)	Highest - command and control hub for all emergency operations; must be on the mesh	Requires coordination with county/city OES; often receptive to ARES/amateur support
Fire stations	Very high - elevated, structurally reinforced, staffed 24/7, diesel generator backup	Fire department liaison; node on roof or upper exterior; coordinate with fire chief
Water towers	Very high - highest point in most neighborhoods; unobstructed line of sight in all directions	Public utility coordination; typically requires a formal agreement; excellent relay sites
Hospitals	High - critical served agency; will be operationally critical during any mass casualty event	Hospital facilities/communications department; often have ham radio infrastructure already
Schools designated as shelters	High - will become population centers during displacement events	School district facilities department; often easier access than city buildings
Amateur radio repeater sites	High - already at elevated locations with existing antenna infrastructure; often solar-powered	Repeater trustee; ARES can often coordinate directly
Community/recreation centers	Medium - potential shelter and community gathering sites	Parks and Recreation department; typically accessible

Hardening Pre-Positioned Nodes for Disasters

Power System: LiFePO4, Not LiPo

Always use LiFePO4 (lithium iron phosphate) batteries for pre-positioned nodes. LiPo (lithium polymer) and standard lithium-ion batteries used in consumer devices pose thermal runaway risk, especially in high-temperature environments (rooftop enclosures in summer). LiFePO4:

- Does not thermally run away under abuse conditions

- Tolerates partial state of charge better than LiPo
- Lasts 2,000 - 4,000+ charge cycles vs. 300 - 500 for LiPo
- Operates reliably in wider temperature range (-20°C to +60°C)
- Appropriate for permanent outdoor installation

Recommended: 12V LiFePO4 battery (20 - 40Ah) with a solar charge controller designed for LiFePO4 chemistry (MPPT preferred; Renogy Wanderer Li or Victron SmartSolar are well-proven options). At 40Ah, a Meshtastic node drawing ~100mA can run for 16+ days without any solar input.

Enclosure: IP67+ for All External Installations

- Use NEMA 4X (IP66+) or better enclosures for all exterior nodes
- Cable glands (IP68 rated) for all antenna and power connections through the enclosure wall
- Desiccant packs inside enclosure; replace annually
- Avoid vented enclosures in coastal or humid climates; sealed is safer
- For rooftop installations: steel or fiberglass enclosure preferred over ABS plastic (UV resistance)

Antenna Mounts: Wind-Rated

- Use mounts rated for sustained winds at least 20% above the highest wind speed on record for your area
- Stainless steel hardware for all mounting hardware (not zinc-plated; it corrodes faster than the antenna)
- J-pole or mast mounts with two attachment points minimum
- Guy wires for masts taller than 3 feet above the mounting surface
- Annual inspection: check all mounting hardware, antenna condition, and coax connections

Lightning Protection

- All antenna coax must pass through an inline lightning arrestor before entering the enclosure (Polyphaser IS-50NX or equivalent)
- Lightning arrestor must be bonded to a solid earth ground (ground rod or structural ground)
- In areas with high lightning incidence: consider a standalone suppressor at the Meshtastic node's antenna port as additional protection
- Disconnect protocol: if a major lightning storm is forecast and the node is accessible, disconnect the antenna cable at the node side to protect the radio

Inventory Management: Know Where Every Node Is

During an emergency activation, you need to know immediately: which nodes are deployed, where, what their power status is, and who is responsible for each one. Without an inventory system, critical nodes will be forgotten, batteries will die unnoticed, and coverage gaps will appear at the worst time.

Node Inventory Template

Node ID	Long Name	Location	GPS Coords	Power Type	Battery Capacity	Installed Date	Last Inspected	Custodian	Notes
!ab12cd34	RELAY-EOC-1	County EOC Roof	34.052°N, 118.243°W	Solar/LiFePO4	40Ah	2024-03-15	2025-01-10	John Smith W6XXX	MPPT controller; checked OK
!ef56gh78	RELAY-FIRESTN-3	Fire Station 3 Roof	34.061°N, 118.251°W	Solar/LiFePO4	20Ah	2024-05-02	2025-01-10	Jane Doe KD6YYY	Battery replaced 2025-01; check seal

Pre-Positioning Checklist

☐ All pre-position sites identified and agreements in place with site owners
☐ Node inventory spreadsheet current with all installed nodes
☐ All nodes using LiFePO4 batteries (no LiPo in outdoor installations)
☐ All exterior enclosures IP65+ rated with sealed cable glands
☐ Lightning arrestors installed and bonded to earth ground on all antenna runs
☐ Antenna mounts rated for local design wind speed
☐ Solar panels oriented and angled correctly for maximum winter sun
☐ Annual inspection schedule in calendar; last inspection date recorded for each node
☐ Coverage map updated showing all pre-positioned node locations and expected coverage
☐ Each node has a named custodian responsible for maintenance
☐ All nodes firmware-updated to current Meshtastic release
☐ Channel configuration consistent across all pre-positioned nodes
☐ Go-bag reserve nodes stored separately for cache-and-deploy if pre-positioned nodes are damaged

Mesh Communications During Active Disasters

If you are reading this during an active emergency: Jump to the Quick Start section below. Full context follows.

Quick Start: Mesh Operations During Active Disaster

1. **Power on all go-bag/mobile nodes.** Allow 60 seconds for GPS lock.
2. **Verify channel configuration.** All nodes must be on the same channel with the same key.
3. **Designate a Mesh Coordinator at EOC.** One person monitors mesh traffic; all others operate.
4. **Send a CHECK-IN message** from each active node: "CHECKIN [NODE NAME] [LOCATION] [STATUS]"
5. **Reserve voice for life-safety traffic.** All status/position updates go on mesh.
6. **Log all mesh traffic.** Screenshot or print message logs every 30 minutes.
7. **Check battery levels** on all nodes every 2 hours. Recharge before depletion.

Infrastructure Failure Sequence During Major Disasters

Understanding what fails in what order helps you plan which communications systems to rely on at each phase of a disaster:

Time After Event	What Typically Fails	What Still Works

0 - 15 min	Grid power (local); some cell towers (congestion); landlines (cable damage)	Cell (initially); internet via battery-backed routers; mesh (pre-positioned nodes); battery-backed repeaters; HF radio
15 - 60 min	Cell towers (battery exhaustion in high-call-volume events); some internet (routing failures)	Mesh (pre-positioned solar nodes); battery-backed repeaters; Winlink HF; satellite (Starlink)
1 - 6 hours	Cell network (extended outage); most commercial internet; repeaters (battery exhaustion if not refueled)	Mesh (solar nodes with LiFePO4); HF radio; satellite; generator-powered systems
6 - 72 hours	Generator-powered systems (fuel exhaustion); some repeater sites (refueling issues)	Solar mesh nodes (indefinitely while sun available); hand-charged systems; HF radio
72+ hours	Most unsupported infrastructure	Well-designed solar mesh nodes; manually recharged systems; satellite

Message Prioritization: Life-Safety First

All mesh message traffic should be evaluated against this priority hierarchy. The Mesh Coordinator at the EOC is responsible for escalating high-priority mesh traffic to the incident commander.

Mesh Message Priority Hierarchy

Priority	Traffic Type	Example	Action Required
FLASH	Life safety - immediate threat to life	"MAYDAY SHELTER4 FIRE IN BUILDING EVACUATING NOW"	Mesh Coordinator immediately relays to incident commander via voice. Do not wait.
URGENT	Medical emergency; immediate resource need	"URGENT SHELTER4 CARDIAC PATIENT NEEDS ALS NOW"	Relay to IC within 2 minutes. Log and timestamp.
PRIORITY	Significant situation change; safety-relevant	"PRIORITY ROAD12 BRIDGE OUT NORTHBOUND IMPASSABLE"	Log, brief IC at next opportunity. Note on situational map.
ROUTINE	Status updates, resource counts, position	"ROUTINE SHELTER4 CENSUS 47 OCCUPANTS NEEDS: WATER"	Log. Include in next situation report cycle.

Training requirement: All mesh operators must know the priority hierarchy before an activation. A FLASH message that sits unread in a mesh log because the Mesh Coordinator is unavailable defeats the entire purpose of the system.

The Mesh Coordinator Role at the EOC

In any activation with more than three mesh nodes, designate a dedicated **Mesh Coordinator** at the EOC. This is a full-time position during active operations; it cannot be effectively combined with net control or other communication roles in high-tempo situations.

Mesh Coordinator Responsibilities

- Monitor all mesh message traffic on the EOC laptop/display in real-time
- Maintain position awareness of all active nodes on the map view
- Immediately escalate FLASH and URGENT traffic to incident command
- Log all PRIORITY and ROUTINE traffic in the message log
- Update the physical or digital situational display with position and status data from mesh
- Troubleshoot connectivity issues: identify nodes that have gone offline or have coverage gaps
- Manage channel discipline: send reminders to operators who are sending non-essential mesh traffic
- Coordinate with voice net control to de-conflict mesh and voice traffic handling

Mesh Coordinator Equipment at EOC

- Laptop running Meshtastic web interface or Meshtastic map view
- Dedicated EOC mesh node with elevated antenna (not the go-bag portable; a proper fixed station)
- Message log sheet (paper backup if laptop fails)
- Direct communication link to incident commander (voice radio or in-person)

Operating Mesh During Specific Disaster Types

Hurricane

- Pre-position infrastructure before landfall (do not deploy during hurricane force winds)

- Antenna mounts must be rated for sustained winds exceeding forecast peak gusts
- After landfall: flooding may isolate neighborhoods; mesh provides connectivity across flooded roads
- Key nodes: shelters, fire stations, EOC, National Guard staging areas
- Solar charging will be degraded during storm cloud cover; ensure adequate battery reserves (40Ah+ per node)

Wildfire

- Mesh supports evacuation tracking: position data from evacuation checkpoints
- Rapidly changing fire perimeter means coverage needs change; mobile relay operators may need to reposition
- Smoke is generally transparent to 915 MHz LoRa; RF performance is not degraded by smoke
- Risk: pre-positioned nodes in the fire path may be destroyed; plan for rapid cache-and-deploy backup
- Key nodes: evacuation shelters, resource staging areas, fire camp EOC

Earthquake

- Immediate aftermath: grid power out, cell out, roads blocked; pre-positioned mesh is the only comms
- Building collapse may destroy some pre-positioned nodes; surviving nodes carry the load
- Search and rescue teams benefit most: continuous position tracking, message relay to command
- Key nodes: EOC, hospitals, fire stations, neighborhood triage sites
- Plan for aftershocks: operators should secure equipment against secondary shaking

Coordination with Public Information Officers (PIOs)

> **Warning:** Mesh message content is not authorized for public release without PIO review. Mesh operators do not speak for the incident command. All public information must be cleared through the designated PIO. Mesh operators should not post mesh message content to personal social media accounts during an active incident.

Logging Mesh Traffic for After-Action Review

All mesh traffic during an activation should be preserved for the after-action review (AAR). This serves multiple purposes: legal documentation, performance evaluation, and training improvement.

- **Meshtastic message logs:** The Meshtastic app and web client maintain a local message log. Export or screenshot the complete log at the end of each operational period.
- **Bridge logs:** If running a mesh-to-internet bridge, the bridge log captures all traffic with timestamps automatically. Preserve these files.
- **Paper log backup:** The Mesh Coordinator should maintain a paper log of FLASH and URGENT traffic as a backup. Paper survives power failures and software crashes.
- **Retention:** Retain all mesh logs for at least 90 days post-incident, or longer if the incident results in legal proceedings.

Building Neighborhood Disaster Preparedness Networks

Target Audience: CERT team leaders, neighborhood emergency preparedness group organizers, block captains, and city OES liaisons. No amateur radio license required for the core mesh network described here.

Why Neighborhoods Are the Right Unit for Mesh Networks

The first 72 hours after a major disaster are the most critical for community survival - and they are precisely when official emergency services are most overwhelmed and least available. FEMA's own guidelines encourage communities to be self-sufficient for 72 hours. A neighborhood-scale mesh network provides:

- **Hyperlocal situational awareness:** Who needs help on your block? Who has medical training? Which houses are damaged? Mesh enables this communication when phones don't work.
- **Resource coordination:** "I have a generator and can share power." "We need insulin in the refrigerator on Elm Street kept cold." Short mesh messages coordinate resources without driving through blocked streets.
- **Connection to official emergency services:** A mesh node at the neighborhood EOC staging area, connected to the official mesh network, bridges the neighborhood to city-level response.
- **Community resilience:** Neighbors who have trained together and have communication tools recover faster and experience less psychological distress during disasters.

CERT Teams and Neighborhood Preparedness Groups as Mesh Early Adopters

Community Emergency Response Teams (CERT) - FEMA-trained volunteer groups that provide immediate disaster response at the neighborhood level - are natural mesh early adopters. CERT teams:

- Already train for disasters; mesh is a natural addition to their toolkit
- Have an organizational structure that can absorb mesh training
- Have a relationship with city OES that provides legitimacy for mesh integration
- Are geographically distributed across the community - ideal for mesh coverage

How to approach your local CERT team: Contact the CERT coordinator through your city's OES or Fire Department (CERT programs are usually run by Fire). Offer a free 30-minute demonstration. Propose providing 2 - 3 Meshtastic nodes for CERT team use. Ask to be included in the next CERT exercise.

The Block Captain Model

The most scalable neighborhood mesh model assigns one mesh node to each **block captain** - a neighbor who has volunteered to be the communication point for their immediate block. The block captain:

- Maintains a Meshtastic node (typically a small, low-cost device like a WisBlock Meshtastic kit)
- Knows how to send and receive messages on the neighborhood channel
- Serves as the communication relay for neighbors who don't have mesh nodes
- Reports to a neighborhood zone leader (who reports to city OES)
- Checks in during exercises and activations

With 8 - 12 block captains equipped with mesh nodes across a typical neighborhood, coverage is generally adequate for all occupied blocks. Block captain nodes can also relay for neighbors who have their own Meshtastic devices (phones running the app, personal nodes, etc.).

Coverage Mapping for Your Neighborhood

Before committing to node placement, map your coverage. Two approaches:

Walk Test Method

1. Place one node at the proposed location of the primary relay (highest point accessible: roof, upper floor).
2. Walk the entire neighborhood with a second node (phone running Meshtastic).
3. Send test messages every 100 meters. Mark locations where messages fail to deliver on a map.

4. Identify coverage gaps. Add relay nodes at elevated points within the gap areas.
5. Repeat walk test after adding relays.

Coverage Prediction Method

1. Use a radio propagation prediction tool (HeyWhatsThat, RadioMobile, or SPLAT!) to model 915 MHz coverage from each proposed node location.
2. Input antenna height, terrain data, and typical LoRa link budget (~140 dB for medium-range Meshtastic settings).
3. Overlay coverage predictions on a neighborhood map to identify gaps before physical deployment.
4. Verify predictions with a walk test after deployment.

Integrating with City OES

City Office of Emergency Services (OES) departments vary widely in their receptiveness to amateur mesh technology. Approach strategically:

1. **Start with the CERT liaison.** If your city has a CERT program, the CERT coordinator is your best entry point. They already work with volunteers and understand non-professional capabilities.
2. **Request to participate in city exercises.** Most OES departments hold annual exercises. Request observer/participant status and demonstrate mesh alongside official comms.
3. **Offer to complement, not compete.** Never suggest mesh replaces city radio systems. Position it as "last-mile neighborhood comms" that fills a gap city systems don't cover.
4. **Provide documentation.** After exercises, provide written reports showing mesh performance and how it integrated with official operations.
5. **Pursue MOU/Letter of Support.** A formal letter of support from the OES director significantly increases the group's credibility when recruiting block captains and securing sites.

Equipment Storage and Rotation Plans

A neighborhood mesh program is only as good as its equipment. Establish a storage and rotation plan to ensure equipment is operational when needed:

Item	Storage Location	Maintenance Interval	Responsible Party
Block captain nodes (personal)	Block captain's home (powered at all times via USB charger)	Monthly charge check; annual firmware update	Block captain (self)

Item	Storage Location	Maintenance Interval	Responsible Party
Pre-positioned relay nodes (elevated)	Installed at site (solar powered)	Annual physical inspection; firmware update; battery test	Designated node custodian
Reserve/loaner nodes (cache)	Neighborhood emergency supply cache or CERT storage	Quarterly charge cycle; annual inspection	CERT coordinator or neighborhood team leader
Phone batteries / USB power banks	Stored with reserve nodes	Quarterly discharge/recharge cycle to maintain capacity	CERT coordinator

Equipment Rotation Policy

- LiFePO4 batteries: replace after 5 years regardless of apparent condition
- LiPo/Li-ion power banks: replace after 2 - 3 years or if capacity has dropped below 80%
- Meshtastic nodes: firmware-update annually; replace hardware after 5 - 7 years or if hardware fails
- Coaxial cable: inspect annually; replace any cable with cracked jacket or corroded connectors
- Antenna mounts: inspect annually; replace if corrosion is visible on structural hardware

Annual Testing Exercise Plan

An annual exercise keeps skills sharp, identifies equipment problems before a real disaster, and provides a regular community engagement opportunity. Template:

Annual Neighborhood Mesh Exercise: 2-Hour Format

Time	Activity	Objective
T+0:00	Exercise kickoff; "simulated earthquake" announced; all participants power on nodes	Verify all nodes come online and have GPS lock
T+0:10	All block captains send check-in message with simulated damage report	Verify message delivery from all locations; identify coverage gaps

Time	Activity	Objective
T+0:20	Neighborhood coordinator sends resource request messages to each captain	Test bidirectional communication; verify message latency
T+0:40	Inject: "One pre-positioned relay node is offline" - identify and diagnose	Practice troubleshooting; identify backup coverage path
T+0:60	Simulated mass casualty: FLASH message sent; all captains relay to households	Test priority message handling; verify Mesh Coordinator response
T+1:20	Equipment inspection: check battery levels, antenna condition, enclosure seals	Identify maintenance needs before next exercise
T+1:40	Debrief: what worked, what didn't, action items for next year	Continuous improvement; document corrective actions
T+2:00	Exercise close; data collection forms collected	Document message delivery rates, latency, and participation count

Neighborhood Preparedness Network Checklist

☐ Neighborhood or CERT team organizational structure established
☐ Block captain model defined; at least 50% of blocks have a mesh-equipped captain
☐ Coverage map completed; coverage gaps identified and addressed
☐ At least one pre-positioned relay node at highest accessible point in neighborhood
☐ Reserve node cache established (minimum 2 spare nodes)
☐ All captains trained on Meshtastic operation (send/receive/check battery)
☐ Channel configuration documented and shared with all participants
☐ Neighborhood mesh coordinator identified and trained
☐ OES or CERT coordinator briefed; relationship established
☐ Annual exercise scheduled and completed at least once
☐ Equipment inventory and maintenance log current
☐ Connection to city-level mesh infrastructure established (or in progress)