

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.

Mesh is a supplement, not a lifeline. LoRa mesh (Meshtastic) is best-effort with no guaranteed delivery: messages may silently fail to arrive, links degrade with terrain, obstruction, and congestion, and a user's device must be within radio range of a surviving, powered node. Pre-positioning improves the odds but does not guarantee a message gets through. It is NOT a replacement for 911, NWS alerts, or licensed voice nets. Validate coverage by testing — do not assume 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

Approach	How It Works	When It Fails	Best For
Pre-Positioned Infrastructure	Nodes permanently installed at key sites before any disaster; running continuously on solar power	When the site itself is physically destroyed or solar+battery is exhausted — and, barring hardware/firmware faults, lightning damage, water ingress, antenna/coax failure, RF congestion, or loss of relaying neighbor nodes. Mesh is best-effort with no guaranteed delivery.	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 can survive the disaster alongside the buildings they're mounted on and be available without on-the-spot deployment. They are not a guarantee, however: a node can be physically powered yet still fail to deliver a message. A user's device must be within radio range of a surviving node, mesh delivery is best-effort and not guaranteed, and coverage should be validated by testing, not assumed.

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

Site Type	Value	Access Notes
Water towers	Very high - where present, water towers are often among the highest accessible points and offer wide line of sight	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. Note: a mesh node co-located at an amateur repeater site still operates under FCC Part 15 — it must not cause harmful interference to the licensed repeater and must accept interference from it. Do not combine the mesh onto amateur-licensed transmit equipment; sharing antennas/feedlines must respect each service's rules.
Community/recreation centers	Medium - potential shelter and community gathering sites	Parks and Recreation department; typically accessible

Hardening Pre-Positioned Nodes for Disasters

Installation safety and authorization. Lightning protection, grounding/bonding, rooftop and tower mounting, mast/wind loading, and any mains/AC electrical work must comply with the National Electrical Code and local codes and should be performed or inspected by qualified, licensed professionals. This guidance is informational only and is not a substitute for professional installation — improper work can cause fire, electrocution, or falling-object injury. Work on third-party property (hospitals, fire stations, water towers, schools) requires the property owner's written authorization before any installation.

Power System: LiFePO4, Not LiPo

Strongly prefer 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:

- Has a much higher thermal-runaway threshold and resists thermal runaway under abuse conditions
- Tolerates partial state of charge better than LiPo
- Lasts 2,000 - 4,000+ charge cycles vs. 300 - 500 for LiPo
- Tolerates a wide operating window: LiFePO4 can **discharge** from about -20°C to +60°C, but must **NOT be CHARGED below 0°C (32°F)** — charging a cold lithium cell, including LiFePO4, permanently damages it. For cold-climate solar installs, use a BMS with a low-temperature charge cutoff or a self-heating battery (a BMS blocks cold charging; it does not enable it).
- 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 node drawing ~100mA can run on the order of ~10-13 days without any solar input after accounting for usable capacity (~80%) and conversion losses. Treat this as an estimate, derate further for cold and battery aging, and do not plan to the theoretical maximum.

Enclosure: IP66 (NEMA 4X) or Better for All External Installations

- Use NEMA 4X (IP66) or better enclosures for all exterior nodes. NEMA 4X protects against hose-directed water (roughly IP66), not prolonged immersion (IP67) — for rain and water jets, IP66/NEMA 4X is the target; only specify IP67 if the enclosure will genuinely be submerged.
- 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 your site's design wind load. As a rule of thumb, allow margin above the highest sustained wind on record for your area (e.g. ~20%), but for any permanent or tall install defer to TIA-222 (Structural Standard for Antenna Supporting Structures and Antennas) wind-load design or your local building-code wind maps rather than a flat percentage.
- 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 that extend well above their mount — roughly 3 feet is a common rule of thumb, but actual guying need depends on mast diameter, material, wind load, and antenna size; defer to the mast manufacturer's specs or TIA-222 guying guidance.
- 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 accordance with NEC Article 810 and local code; have grounding/bonding performed or inspected by a qualified professional.
- 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 safely accessible beforehand, disconnect the antenna cable at the node side to protect the radio.
Never service a rooftop node during an active storm — disconnect only when it is safe to access the node well ahead of the storm.

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
lab12cd34	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
lef56gh78	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 written agreements in place with site owners. Site agreements should address liability, insurance/indemnification, who maintains the equipment, access, and removal/restoration obligations; have counsel review agreements for installations on third-party property.
- ☐ Node inventory spreadsheet current with all installed nodes
- ☐ All nodes using LiFePO4 batteries (no LiPo in outdoor installations)
- ☐ All exterior enclosures IP66+ (NEMA 4X) rated with sealed cable glands
- ☐ Lightning arrestors installed and bonded to earth ground on all antenna runs (per NEC and local code; professionally installed or inspected)
- ☐ Antenna mounts rated for local design wind speed (per TIA-222 / local code)
- ☐ 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 on a tested, known-good firmware version compatible across the fleet (do not blindly chase the latest release on hard-to-reach nodes)
- ☐ Channel configuration consistent across all pre-positioned nodes
- ☐ Go-bag reserve nodes stored separately for cache-and-deploy if pre-positioned nodes are damaged