Net Control Operations for Mesh Networks

Mesh vs. Voice Net Control: A Fundamental Difference

In a traditional amateur radio voice net, the Net Control Station (NCS) is the technical and operational hub of all communications - every transmission must be directed through or acknowledged by NCS. LoRa mesh networks operate on a fundamentally different principle: they are peer-to-peer systems with no central controller. Nodes contend for a shared, half-duplex channel (listen-before-talk, with airtime and duty-cycle limits), so they do not transmit arbitrarily at any time; the mesh routes messages on a best-effort basis without a central controller.

Despite this, the operational role of a net control function remains valuable and is recommended for any mesh network supporting an ICS activation. The difference is that mesh net control is a human coordination role, not a technical gatekeeping role.

Responsibilities of Mesh Net Control

- **Node inventory management**: Maintain a current list of all active nodes (name, operator, location, battery endurance). Update at each operational period change and whenever a node is added or goes offline.
- **Coverage verification**: Confirm that all assigned positions have mesh connectivity, either directly or via relayed path. Nodes that cannot reach any other node are isolated and may need repositioning.
- **Channel discipline**: Monitor for excessive traffic (bulk test messages, repeated retransmissions) that degrades bandwidth for others. Coordinate with the COML to address violations.

- **Liaison to COML**: Translate mesh network status into ICS-compatible status reports for inclusion in the Incident Action Plan.
- **Escalation to voice radio**: When mesh connectivity fails between critical nodes, escalate to the voice radio net for the affected link. This is recommended SOP precisely because LoRa mesh is best-effort with no guaranteed delivery - do not wait for the mesh to self-heal if the message is time-sensitive.

Structured Check-In Procedure

At the start of each operational period (operational periods in ICS are typically 12 to 24 hours), mesh net control should conduct a structured check-in:

1. Net control sends a broadcast message to all nodes: [OPPERIOD-2 CHECK-IN] All nodes reply with status. EOC-MAIN standing by.
2. Each node replies with a short status message: SHELTER-A: ONLINE, 85% battery, 4 nodes visible, 12 persons checked in.
3. Net control logs each reply in the ICS 214 activity log, noting time of receipt and node status.
4. Nodes that do not reply within 5 minutes (a configurable local threshold, not a fixed standard) are flagged as missing. Net control attempts contact via voice radio before recording the node offline on the ICS 214 activity log or incident status board. (Note: the ICS 217A is a pre-incident Communications Resource Availability Worksheet that feeds the ICS 205 comms plan - it is not a live node-status log, so do not record real-time outages there.)

Tracking Node Count and Coverage

Meshtastic provides a node list in the app showing all nodes heard (directly or via mesh). Net control should maintain a separate paper or spreadsheet log that includes:

Node Name	Operator	Location	Last Heard	Battery %	Status
EOC-MAIN	W6XYZ	City EOC Rooftop	Continuous	AC Power	ONLINE
SHELTER-A	KD9ABC	Franklin HS Gym	14:32	78%	ONLINE
DIV-B-RELAY	N7DEF	Oak Ave Water Tower	14:28	62%	ONLINE
SEARCH-1	KG5GHI	Mobile (Grid 4)	14:05	45%	MONITOR

Handling Message Relay Requests

Although the mesh automatically routes messages, operators at field positions may request manual relay assistance when:

- A message requires positive confirmation of delivery. The mesh delivers best-effort; Meshtastic does show an ACK/Delivered status per message, but those ACKs are not guaranteed, so a human relay provides positive confirmation when delivery is critical.
- The message contains sensitive information not suitable for broadcast (use the DM/direct message channel in Meshtastic).
- An ICS 213 form needs to be transcribed to paper at the EOC.

Net control should acknowledge all relay requests and provide confirmation to the originating node when a reply is received from the intended party. Absent a reply, assume the message did not arrive and escalate to voice.

Escalation to Voice Radio

Mesh net control must be prepared to escalate to voice radio immediately when:

- A node has been offline for more than 10 minutes without explanation.
- A critical message (MCI report, EOC request, shelter closure) has not been acknowledged within 5 minutes.
- The mesh channel appears to be experiencing congestion or RF interference (excessive retransmissions, failed acknowledgments).
- Any node reports battery below 20% without a relief operator on the way.

The voice radio escalation path should be pre-coordinated: establish the tactical frequency and call sign of the COML before the operational period begins, and ensure mesh net control has a radio capable of reaching EOC. Note that if the escalation path is an amateur (Part 97) frequency, only licensed amateurs may transmit on it, with call-sign identification every 10 minutes and at the end of communication per 47 CFR 97.119. Ensure the designated escalation operator is licensed, or use a license-appropriate service (GMRS with its own license, FRS, or business radio) suited to the users.

Log Keeping

Net control must maintain a continuous ICS 214 activity log throughout the operational period. Minimum entries:

- Activation and deactivation times for each node.
- All check-in responses and any non-responding nodes.
- Channel changes, configuration updates, or firmware actions taken.
- All message relay confirmations for ICS 213 traffic.
- Battery status at each check-in interval.
- All voice radio escalations and outcomes.

Mesh operations themselves are managed by the Communications Unit (COML) in the Logistics Section. At the end of each operational period, the completed ICS 214 is - like all unit logs - forwarded to the Documentation Unit in the Planning Section for inclusion in the incident file. (Forwarding logs to Planning's Documentation Unit does not make mesh a Planning-Section function; operational control remains with the COML in Logistics.)

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