Channel Utilization Management

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Channel utilization (CU) is one of the most important health metrics for a Meshtastic network, yet it is frequently misunderstood or ignored until problems become severe. Understanding what CU measures, what causes it to rise, and how to bring it back down is essential knowledge for any network operator running more than a handful of nodes.

What Is Channel Utilization?

Channel utilization is the percentage of time the radio channel is occupied by transmissions, measured over a rolling **1-minute window**. Meshtastic breaks the minute into six 10-second sub-windows and sums the milliseconds of airtime used in each. A CU of 10% therefore means the channel was busy for roughly 6 seconds out of the last minute (not 90 seconds out of 15 minutes). Meshtastic calculates CU locally on each node by monitoring the time its own radio is keyed up, plus time spent sensing channel activity from other nodes (via Channel Activity Detection). Note that CU counts the airtime of *all* LoRa traffic heard on the same modem settings, including non-Meshtastic LoRa. The reported CU figure is visible in the Meshtastic app under the node detail view and in the device telemetry metrics channel. (Do not confuse this 1-minute window with the EU 10% duty-cycle limit, which is measured over a 1-hour window.)

Healthy, Warning, and Critical Thresholds

These bands match the color coding used by the Meshtastic apps:

- **Under 25% (green):** Healthy. The channel has ample headroom for message traffic, routing overhead, and telemetry. Packet loss due to collisions is rare.
- **25-50% (orange):** Warning zone. You may begin seeing occasional packet loss, especially during bursts of activity. Investigate the causes and plan remediation before the situation worsens.
- **Over 50% (red):** Critical. At this level, the probability of two nodes transmitting simultaneously and causing a collision is high enough to cause significant packet loss on a

sustained basis. User-visible symptoms include messages that appear to send but are not received, slow acknowledgements, and missed position updates.

If you prefer a stricter operational target for infrastructure (for example, keeping a busy backbone channel below ~20-25% to preserve headroom for incident traffic), treat that as a conservative operator guideline, not the system threshold. CU is also a lagging rolling average: a channel can briefly saturate while the reported figure still looks healthy.

Common Causes of High Channel Utilization

Several factors drive CU up. Understanding which ones apply to your network guides the correct fix:

- **Too many ROUTER nodes in close proximity:** ROUTER (and REPEATER) nodes always rebroadcast packets they hear, and in a dense cluster those retransmissions pile on top of each other. As an illustration, several co-located ROUTERs can multiply retransmission traffic without providing a proportional coverage benefit. Managed flooding (listen-before-rebroadcast plus duplicate detection) partially mitigates this, so the multiplier is approximate rather than an exact law, but co-located always-rebroadcasting ROUTERs still inflate traffic and collision rates.
- **Hop limit too high for network geography:** A hop_limit of 5 in a network where the farthest node is only 2 hops from the origin means packets are retransmitted up to 5 times unnecessarily. Every extra retransmission is wasted airtime.
- **High message traffic:** Active communities that send many messages, combined with frequent position and telemetry updates from many nodes, can saturate even a well-configured channel.
- **Routing loops:** Meshtastic actively suppresses persistent routing loops via hop-limit decrement and duplicate detection, so true loops are uncommon. If a node appears twice in a traceroute path, treat it as an unusual symptom worth investigating (asymmetric links or misconfiguration) rather than a routine loop indicator.

Remediation Strategies

These remediations are proactive. They must be applied *before* an incident. Once a channel saturates during an event, Meshtastic has no automatic congestion recovery; the only mid-incident fix is to reduce traffic (fewer senders, shorter messages, suppress telemetry), which requires discipline from every operator rather than a single config change - and reconfiguring deployed nodes mid-incident is often impossible. Provision capacity headroom in advance.

- **Reduce hop_limit:** Set hop_limit to the minimum value that still delivers packets to all nodes in your network. For most community deployments, three to four hops is sufficient.

- **Convert excess ROUTER nodes to CLIENT_MUTE or CLIENT:** Audit your node roles. Nodes in the same area do not all need to be ROUTERs. Designate one or two strategically placed nodes as ROUTER and set the rest to CLIENT or CLIENT_MUTE to suppress retransmissions from densely packed areas. (CLIENT still rebroadcasts under managed flooding; CLIENT_MUTE does not rebroadcast at all.)
- **Separate co-located networks by frequency slot:** Two networks on different logical channel numbers but the same modem preset still share the same RF frequency and will still collide. To actually separate them in RF you must change the LoRa frequency slot (or the modem preset / region settings), not just the logical channel index.
- **Consider MeshCore for large networks:** Meshtastic uses managed flooding for broadcasts - nodes listen first and suppress their rebroadcast if a neighbor already relayed the packet, while ROUTER/REPEATER nodes always rebroadcast (since v2.6, direct messages use next-hop routing rather than flooding). In networks with dozens of active nodes and high message traffic, broadcast flooding is a major driver of high CU. MeshCore uses path discovery with source/next-hop routing - it floods once to discover or recover a route, then sends future messages along the learned path - which can scale better in large, dense, high-traffic community networks. Consult the official MeshCore documentation for its exact routing model.

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