MeshCore Repeater AGC Behavior and Density-Based Tuning

1. Overview

Automatic Gain Control (AGC) plays a central role in MeshCore repeater performance, especially in SF7 deployments where preamble detection is fast and sensitivity margins are tight. The AGC reset interval determines how often the receiver clears its gain history and re-establishes a baseline for incoming packets. This behavior directly affects weak-node detectability, near/far stability, and overall repeater reliability.

This white paper provides a density-based tuning model aligned with Sparse, Medium, Dense, and Regional classifications.

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2. AGC Fundamentals in MeshCore Repeaters

MeshCore repeaters experience wide RSSI swings due to mixed-distance nodes, elevation differences, and environmental variability. AGC must adapt to these swings without becoming biased by strong packets or drifting into suboptimal gain states. MeshCore provides an AGC Reset Interval control.

The SX1261/62/68 radios have only a manual/automatic AGC control, which is enabled in the firmware. There are some read-only registers but they are for diagnostic purposes.

2.1 What AGC Controls

- The current gain baseline of the receiver
- Sensitivity to weak packets following strong ones
- Stability of preamble detection
- Churn and processing overhead under load

Why AGC reset interval does not help with back-to-back packets

Back-to-back packets—one strong, one weak—are handled entirely by the **radio's internal AGC state machine**, which operates on the order of:

- **tens of microseconds** for gain settling
- **hundreds of microseconds** for RSSI sampling
- **milliseconds** for full preamble acquisition

The AGC Reset Interval parameter is in **seconds**. So the periodic reset is *never* in play during two adjacent packets. But the AGC level can "drift" over time depending on the distribution of the strength of the packets received.

3. Density-Based AGC Reset Interval Recommendations

The following table provides AGC reset intervals for each MeshCore density class.

Because there is a natural large variation in signal reception due to the number of repeaters, how close they are to each other (some will be near, others will be far away), different transmit power levels (different hardware), different receiver sensitivity (different hardware and AGC implementation), there isn't a one size fits all recommendation. But characterizing repeaters by their density seems to be a reasonable way to set the AGC reset interval. Repeaters do come and go, but they are in relatively stable locations. So, the number of neighboring repeaters will be a stable metric to use and does represent the local traffic variations.

Table 1 — Recommended AGC Reset Interval by Density Class

Density Class	Neighbor Count	RSSI Spread	Recommended Interval	Rationale
Sparse	0–3	10–20 dB	360-720 s	A longer interval because AGC drift is slow, resetting too often risks missing a weak preamble, reducing decode probability for fringe nodes.
Medium	4–8	10–25 dB	180-360 s	Balances churn and sensitivity; handles moderate near/far conditions.
Dense	9-10	15–30 dB	90-240 s	Reduces AGC churn under load; stabilizes throughput.
Regional	11, 12+	10–40 dB	180-420 s	Extreme RSSI variance requires more frequent resets to counter temperature RF drift.

4. Behavior and Setting Variance by Density Class

4.1 Sparse Networks

- **Behavior:** Mostly weak packets with occasional strong ones, long idle intervals.
- Longer intervals: You want the AGC to **stay settled** for long weak-signal receptions. Resetting every few minutes is enough to correct slow drift.

4.2 Medium Networks

- **Behavior:** Mix of moderate and strong packets.
- Moderate intervals: You want periodic correction, but not so often that you disrupt normal reception. Balanced sensitivity and stability.

4.3 Dense Networks

- **Behavior:** Higher packet volume with moderate RSSI variance.
- A shorter interval - AGC is more likely to get stuck in: Low-gain mode after a strong local packet or High-gain mode after a quiet period
- But not too short: the network is bursty human traffic, not continuous.

4.4 Regional Networks

- **Behavior:** Extreme RSSI swings and high fan-out.
- Enough resets to counter temperature and RF drift.
- But not so many that you disrupt weak long-range packets.

7. Implementation Guidance

Use the CLI Command to set the value:

Set agc.reset.interval [secs] The value can be 0-1020 seconds, rounded up the 4-sec intervals.

8. Conclusion

AGC reset interval is only one tuning parameter for MeshCore repeaters. It is not the most critical for overall mesh stability but does correct for longer-term effects. By aligning AGC behavior with network density, operators can address weak-node detectability, reduce near/far bias, and stabilize repeater performance under varying conditions (RD .