Cycling and MTB Applications

LoRa mesh for mountain biking group rides, trail networks, and long-distance bikepacking.

Mountain Biking Group Rides and Trail Networks

The Challenge of Large Group Rides

Mountain bike group rides are inherently dispersed. On a technical singletrack trail, riders string out over hundreds of metres within minutes of the start. By the time the lead riders reach a junction, the tail may still be ascending the previous climb. Riders at the front have no idea whether the back of the group has made the last turn, encountered a mechanical, or taken a wrong trail.

Traditional solutions - waiting at every junction, shouting, or relying on mobile phones - all fail at some point. Mobile coverage is often weak or absent in backcountry trail networks. Waiting at every junction stalls the ride for faster riders. Shouting is limited to line-of-sight and is ineffective on multi-directional trail systems.

Meshtastic brings low-power LoRa mesh tracking - a tool some search-and-rescue teams and expeditions have experimented with - to recreational rides: it can show riders' last reported positions on each other's screen where they are within mesh range. It is not standard, monitored SAR equipment, and SAR agencies do not monitor Meshtastic for public distress.

> **Mesh is a coordination tool, not a rescue system.** It is best-effort - messages may not get through, and positions can be stale or missing. It is NOT a substitute for a PLB/satellite messenger or 911. Search and rescue does NOT monitor Meshtastic. Carry dedicated safety gear; use mesh only as a supplement.

Tail-End Charlie Awareness

The most valuable use case for group rides is knowing when the last rider - "tail-end Charlie" - completes a section. Practical workflow:

- The designated sweep rider (tail-end Charlie) carries a Meshtastic device.

- The group leader's device shows the sweep's last reported position on the map when within mesh range.
- At regrouping points, the leader waits only until the sweep's icon arrives - no guessing, no unnecessary waiting for riders who are already there.
- If the sweep's position stops moving for more than a few minutes mid-trail, the leader sends a check-in message. A response via text confirms all is well; no response triggers a turnaround.

This system requires only two devices (one sweep, one leader) to add meaningful coordination to any group ride. With all riders equipped, the situational picture is more complete - though it remains best-effort.

Crash Alert and Position Sharing

A rider who crashes and is unable to ride can send a pre-configured distress message with a single button press, provided the device has a button mapped for it. The Meshtastic app allows setting up canned messages (the Canned Message module) for exactly this scenario; note that not all nodes support a single-press distress send. Group members within mesh range receive the message with the sender's last reported position - delivery is best-effort and not guaranteed (broadcasts are not acknowledged) - allowing nearby riders to divert and assist.

For riders who crash and are unconscious or unable to press a button, the last broadcast position can provide a last-known location to searchers - but only if a recent position was successfully transmitted and received before the incident. On dispersed canopy singletrack the last fix may be minutes old, or never received if the node lost GPS lock or was out of range. When a usable position exists, combining it with the trail map can narrow the search corridor compared to a verbal description of where someone was last seen.

Fixed Nodes at Key Trail Intersections

Major trail networks - particularly those managed by trail associations with infrastructure access - benefit from fixed relay nodes at key intersections. Benefits:

- Extend coverage into deep valley sections where handheld-to-handheld range would be insufficient.
- Provide named waypoint markers visible on all riders' maps - especially useful for visitors unfamiliar with the trail system.

- Ensure a rider's position packets are relayed even where rider-to-rider range is poor. Note a fixed node does NOT improve the rider's own GPS fix under dense canopy - it only relays the position the rider's own GPS computed.

Solar-powered fixed nodes at trailheads and major junctions, housed in weatherproof enclosures attached to existing signage infrastructure, can be deployed for under $150 per node and require maintenance only once or twice per year.

Handlebar Mounting Hardware

Mounting a Meshtastic device on a mountain bike handlebar requires balancing visibility, vibration resistance, and protection from impact. Proven approaches:

- **Bar bag with window:** A small handlebar bag with a transparent top panel protects the device and keeps it visible without adding a hard-mount point that can crack a case on impact.
- **RAM Tough-Strap mount:** The RAM 1" ball mount with a strap clamp grips the handlebar without drilling and provides a stable platform for a small RAM case or device adapter. Rubber ball joints absorb some vibration.
- **Stem bag mount:** A small top-tube or stem bag is less exposed to impact than handlebar mounting and keeps weight centred on the bike. Use with a T-Echo for its readable e-ink display - visible through the bag window without opening it.

Vibration-Resistant Enclosures for Bikes

Mountain bike trails generate continuous vibration with periodic large-amplitude impacts from drops, rock gardens, and roots. Unprotected electronics are at high risk of damage and connector failure on rough trails; a proper enclosure greatly improves reliability. Key requirements:

- **Foam-lined hard case:** Pelican 1010 micro case with closed-cell foam insert protects the node from both vibration and impact. Use a properly rated waterproof cable gland or bulkhead connector for antenna routing; a bare drilled hole voids the case IP67 rating.
- **Internal rubber standoffs:** Mount the PCB on rubber grommets inside the enclosure rather than hard-mounting it to the case wall. This decouples the PCB from the case vibration frequency.
- **Secure all connectors:** Hot-glue or secure with strain-relief clips all cable connections inside the enclosure. USB micro connectors are particularly vulnerable to vibration failure.

Battery Management: Dynamo Hub and Auxiliary Packs

Mountain bikes rarely cover distances long enough to exhaust a typical node battery in a single ride. Runtime varies widely by hardware: a 1000-3000 mAh node with GPS active typically lasts a full day ride, but small-battery devices with GPS on can fall short while larger-cell devices run much longer. Battery management becomes relevant mainly on multi-day stages.

For bikepacking or multi-day enduro events:

- **USB dynamo hub charger:** A SON Dynamo hub with a Cinq5 or Sinewave Beacon converter produces 5 V USB at low rolling speed, keeping a small auxiliary battery topped up throughout a long day. The Meshtastic node charges from the auxiliary pack, ensuring continuous operation.
- **Small auxiliary pack (5000 - 10000 mAh):** For day rides, a compact auxiliary battery in a frame bag provides days of Meshtastic operation and also charges phones. Keep it inside the frame bag away from direct mud and water exposure.

Long-Distance Cycling and Bikepacking

Cycling Through Cellular Dead Zones

Long-distance cyclists and bikepackers regularly traverse hundreds of kilometres of terrain with no mobile phone coverage. Classic routes - the Tour Divide, the Pacific Coast, the TransAmerica - pass through remote river valleys, desert plateaus, and mountain passes where the nearest cell tower is hours away. In these environments, a Meshtastic node can be one of the few communication options that does not depend on fixed infrastructure - but mesh only works when another node is within LoRa range. For a solo rider with no nearby nodes, the mesh has nothing to talk to; in that case a two-way satellite communicator is the truly infrastructure-independent option.

This is not an emergency-only tool. Knowing that a riding partner a few miles ahead has stopped for mechanical work, or that you are approaching a named waypoint with water, is useful every hour of every day on a long route.

Friend and Family Tracking via MQTT Gateway

Meshtastic supports forwarding position data to an MQTT broker, which in turn can feed publicly accessible mapping services such as the community-run mesh map at map.meshamerica.com. When a cyclist passes through a town or rural area where an internet-connected gateway node is within LoRa range, their position can be forwarded to MQTT and become visible to anyone with the shared map link. Note that on the default public broker, location precision is intentionally degraded for privacy; full-precision sharing requires a custom channel/PSK and a self-hosted or configured broker.

Setup is straightforward:

1. Enable MQTT on the device and enter the broker address (the default public Meshtastic broker works for this purpose). Note that enabling MQTT alone does not upload your position - your node publishes to MQTT only by way of an in-range, internet-connected gateway node. A node with MQTT enabled but no gateway in range uploads nothing.
2. Share the map URL with family and friends before departure.
3. Position packets are forwarded to MQTT automatically by any in-range, internet-connected gateway node - no manual action required - but coverage depends on a gateway being within LoRa range.

Frequency of updates depends on gateway node density along the route. In populated corridors, updates may be near-continuous. In remote sections, gaps of several hours or days are normal. Family members should understand this is a check-in system, not a real-time tracker - for real-time coverage, a two-way satellite communicator (e.g. inReach, SPOT) is still required.

Daily Check-In Messaging Near Gateway Nodes

Many bikepackers use a simple daily check-in protocol: when riding near or through a town with a gateway node, send a brief status message over the mesh. This message can reach the MQTT network and be forwarded to a support contact at home - but only if that contact subscribes to the same channel via an MQTT client and holds the shared channel keys. This is not automatic. The Meshtastic app shows your own node's MQTT connection state (whether your node is connected to a broker); it does not detect nearby gateways. When your node is reaching MQTT, a brief text message via the app can reach anyone monitoring the same channel.

This requires no cellular data and no Wi-Fi on your end. However, gateway coverage is highly variable - do not assume a town has a gateway. Verify route coverage in advance and treat message delivery as best-effort: a message gets out only if an internet-connected gateway node is within LoRa range when you send it.

Offline-Capable App Operation

The Meshtastic app caches known nodes' last-known positions, channel configurations, and recent message history locally on the phone - it is not a complete persistent map or a full message archive. This means the app still works offline: you can view group members' last-known positions, send and receive messages, and navigate using downloaded offline map tiles without any internet or cellular connection.

Before a multi-day trip, download offline map tiles for the entire route using the app's built-in download function. On Android and iOS, offline tiles from OpenStreetMap or other providers load automatically when no internet is present. The mesh operates entirely over LoRa radio regardless of internet state.

Node Mounting on Drop Handlebars and Stem Bags

Road and gravel bikes with drop handlebars offer different mounting options than flat-bar mountain bikes:

- **Top tube bag:** A small top-tube bag with a transparent window panel is the preferred location for a T-Echo. The e-ink display is readable through the window. The bag protects the device from road spray and light rain, and the central mounting position keeps weight low and centred.
- **Stem bag:** Similar benefits to the top-tube bag; slightly further from spray thrown up by the front wheel. Works well on bikes where the top tube geometry does not suit a bag.
- **Bar bag outer pocket:** A small zippered outer pocket on a handlebar bag is accessible without dismounting on a flat road section. Less ideal in wet conditions unless the pocket is waterproof.

Avoid mounting the node or its antenna inside a bag packed with damp gear - wet camping equipment absorbs RF and will reduce effective range. The antenna should be positioned with a clear line toward the sky, even if the node body is inside a bag.

Solar Charging from a Rear Rack Panel

A 5 - 10 W flexible solar panel lashed to a rear rack and pointed skyward provides a steady trickle charge to an auxiliary battery throughout the riding day. With adequate sun, even partial cloud cover and non-ideal panel angles can produce enough current to offset Meshtastic's modest consumption. Typical active draw is roughly 30 - 130 mA depending on the device, GPS duty cycle, display, and TX rate; treat 50 - 80 mA during active GPS operation as a rough midpoint.

Practical setup:

- 5 W panel (e.g., SunPower flexible, 330 mm × 180 mm) attached to the top of rear rack with hook-and-loop straps.

- A solar lithium charge controller with input current limiting (e.g., the Adafruit Universal USB/DC Solar Lithium Charger or equivalent - note this is a current-limiting charger, not a true MPPT controller) connected to a 10 Ah lithium battery pack in the rack bag.
- Node powered from the battery pack via USB.

With adequate sunlight, the panel can keep the auxiliary battery topped up; a 10 Ah pack gives a few days of reserve at typical node draw in overcast conditions.

Realistic Range Expectations: Moving vs. Stationary

Range while cycling is meaningfully different from stationary operation. The figures below are approximate and depend heavily on antenna, terrain, and line of sight:

- **Stationary on a ridge or elevated location:** approximately 5 - 15 km to another stationary node in open terrain (best case, with line of sight).
- **Moving at road level in flat terrain:** roughly 1 - 3 km, limited mainly by terrain and the low antenna height of a road-level node.
- **Moving in hilly terrain:** Highly variable; roughly 200 m around a dense hill to 3 km on a ridgeline traverse.
- **Node to node via fixed relay on a hilltop:** Relay nodes dramatically extend practical coverage; a single well-placed relay can cover a 10 km valley that would otherwise have multiple dead zones.

For bikepacking, the most useful mental model is: assume the mesh works reasonably when you are within 2 - 3 km of another active node, treat anything beyond that as a bonus, and do not rely on the mesh as a sole safety system on a remote solo route. Use Meshtastic for coordination and awareness; carry a PLB or satellite communicator for emergency signalling.