Marine and Water Recreation

- LoRa Mesh for Boating and Kayaking
- Fleet Coordination on the Water

LoRa Mesh for Boating and Kayaking

LoRa Mesh Communications in the Marine Environment

The marine environment is simultaneously ideal for LoRa propagation and deeply hostile to electronics. Salt spray, humidity, UV exposure, and submersion risk demand careful hardware selection and installation practice. When properly deployed, Meshtastic mesh nodes on boats and kayaks deliver exceptional range and reliable communication for flotillas, cruising groups, and multi-vessel expeditions.

Propagation Advantages on Open Water

Open water is among the best environments for LoRa propagation. Without terrain obstacles, 915 MHz signals travel in an almost unobstructed line to the radio horizon. A node at deck level (1-2 m) achieves a radio horizon of roughly 5 km. A node at the masthead of a 12-metre sailboat (mast height ~15 m) extends the horizon to approximately 16 km (4.124 x √15) to sea level; because node-to-node range is the sum of both antennas' horizons, a masthead-to-masthead link between two such boats can be considerably longer. Practical ranges of **10-30 km** are achievable between vessels in calm conditions, but only when both antennas are elevated (masthead-mounted) and the path is clear; deck-level handheld nodes will see far less. Range degrades in heavy chop when wave crests periodically block the signal path, but multi-hop relay via intermediate vessels in the flotilla maintains fleet-wide coverage.

Marine Environment Hardware

Enclosures: All electronics should be housed in IP67-rated or better enclosures. Pelican cases, Hammond polycarbonate boxes with foam gaskets, or purpose-built marine electronics enclosures are appropriate. Apply conformal coating (e.g., MG Chemicals 422B) to all exposed PCBs. Use marine-grade stainless or anodised aluminium hardware for all external mounting.

Antenna selection: Stock PCB antennas on most Meshtastic hardware are inadequate for marine deployment. Options include:

- **Fiberglass marine whip (915 MHz):** 3 dBi gain, UV-stable fiberglass radome, stainless base. Mount on a rail bracket or backstay. Commercially available from vendors such as Taoglas and Linx Technologies.
- **Stainless rail bracket:** Many boaters mount both VHF and LoRa antennas on a stern rail bracket. LMR-200 is relatively lossy at 915 MHz (roughly 0.4-0.55 dB/m), so a very short (<1 m) run keeps losses acceptable; for anything longer, use a lower-loss coax such as LMR-240 or LMR-400.

Power: Connect to the 12V house bank via a fused spur with a DC-DC step-down converter. Peak draw is device-dependent but typically well under 500 mA for a single node (some ESP32 boards transmitting at full power with GPS/WiFi active can spike higher); a 1A fused circuit is sufficient for any single node. Check the specific board's datasheet.

AIS Relationship

AIS (Automatic Identification System) is a key position-reporting and situational-awareness aid for vessels in navigable waters; it supplements, but does not replace, the visual lookout and radar that are the primary means of collision avoidance under the COLREGs (the USCG states AIS should never be solely relied upon for collision avoidance). LoRa mesh does *not* replace AIS, marine VHF (Ch 16/DSC), or an EPIRB. The systems are complementary: AIS reports position to all nearby vessels and Vessel Traffic Services; LoRa provides private messaging and coordinated position sharing within a defined group. LoRa operates in the 915 MHz ISM band, entirely separate from the VHF marine band (156-174 MHz), with no regulatory conflict or interference risk.

Kayak Installations

A T-Echo or Heltec V3 in a small waterproof case can be mounted on the deck with RAM mount hardware or bungeed to deck rigging. A short external whip antenna epoxied into a cable gland on the case lid significantly improves range over a buried PCB antenna. For sea kayak expeditions, some paddlers integrate the node inside a transparent waterproof deck bag, allowing the E-Ink display to be read without opening the bag.

Recommended Marine Configuration

- **Modem preset:** choose based on traffic and range needs, not vessel count - use a faster preset (e.g. MediumFast/LongFast) when many nodes or frequent traffic risk channel congestion, and a slower preset (e.g. LongSlow) only when maximum range is needed and added delay is acceptable
- **GPS broadcast interval:** 2-5 minutes underway; 15 minutes at anchor

- **Role:** CLIENT on each vessel; ROUTER_CLIENT (deprecated; use ROUTER or REPEATER instead) on any vessel that is anchored and can serve as a relay
- **Channel:** Custom PSK shared with all vessels at the pre-departure check-in

Fleet Coordination on the Water

Coordinating Multi-Vessel Groups with Meshtastic

Whether managing a sailing club race, leading a kayak tour, or keeping a cruising rally cohesive across an anchorage, coordinating multiple vessels has traditionally required constant VHF radio chatter, pre-agreed schedules, and visual signals. Meshtastic mesh networking reduces radio congestion, enables passive position awareness, and keeps groups connected without requiring constant active communication.

> **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 does NOT replace marine VHF (Ch 16 distress / DSC), an EPIRB, a PLB, or AIS. Search and rescue and the Coast Guard do NOT monitor Meshtastic. Carry dedicated marine safety gear; use mesh only as a supplement.

Sailing Club Racing

- **Start line communication:** The Race Committee vessel carries a mesh node. Signals, postponements, and course changes are sent as text messages received by competing boats within mesh range without occupying the race channel.
- **Fleet position display:** Spectator boats and coach vessels see the entire fleet on the Meshtastic map. A coach can identify a struggling boat without VHF interruption.
- **Safety check-ins:** At the end of offshore races, each finisher can send a check-in message. Mesh check-ins can supplement, not replace, VHF roll call - treat a missing check-in as a possible comms failure and follow up via VHF / established safety procedure rather than assuming a boat is accounted for.

Kayak Tour Groups

A commercial kayak tour operator leading 8-12 paddlers over open water faces the challenge of communication between a lead guide and a sweep guide, neither of whom can easily use a VHF handset while paddling. Meshtastic on waterproofed deck-bag nodes allows:

- Lead-to-sweep text: "Rounding the point, group spread 500 m, holding for rest stop."
- Position tracking: The sweep guide can see the lead guide's last reported position even around a headland without visual contact (subject to mesh range and best-effort delivery).
- Emergency: A capsized-guide SOS reaches other group members and, if an internet-connected (MQTT) node happens to be in range, only people monitoring that private channel - NOT the Coast Guard or SAR. MQTT forwards only to subscribers of that broker/channel; it is not a distress mechanism and does not summon outside rescue. For a real water emergency use a VHF DSC distress call, EPIRB, or PLB. Mesh is not a distress service.

Cruising Rallies

A cruising rally of 15-20 boats uses mesh for safety coordination outside the net schedule:

- **Night watches:** Positions update on an interval (e.g. every 5 minutes). Periodic position updates aid general fleet awareness and cohesion. They are NOT a collision-avoidance system - vessels move significantly between updates and packets can drop. Maintain a proper visual / radar / AIS watch per COLREGs.
- **Arrival sequencing:** The lead boat sends waypoints for the anchorage and available depth. Following boats plan their approach without clogging the SSB net.
- **Social channel:** A secondary Meshtastic channel (separate PSK) serves as social chat, keeping the primary safety channel clean.

Dinghy Rescue Coordination

When a dinghy capsizes in a sailing regatta, multiple rescue boats may respond. A Meshtastic node on the committee boat and each rescue vessel can help the RC direct the closest rescue boat without radio congestion - as a coordination aid that supplements, not replaces, VHF for rescue. If the capsized boat's node was broadcasting position and its last packet was received, that last-known position may appear on rescue vessel maps - particularly useful in poor visibility or heavy wind noise that makes VHF difficult - but it may be stale or unavailable if the node was lost or submerged on capsize. Keep VHF as the primary distress and coordination channel.

Example Configuration: 10-Boat Sailing Club

An example configuration suitable for a ~10-boat club might be:

- **Hardware:** 10x Heltec V3 nodes in waterproof enclosures, mounted on stern rails with 3 dBi marine whip antennas, connected to 12V house bank
- **Meshtastic preset:** LongFast, custom channel "CLUB" with PSK distributed at the season briefing
- **GPS interval:** 3 minutes underway
- **Shore relay:** One Heltec V3 on the clubhouse rooftop (set to CLIENT or ROUTER_LATE; the dedicated ROUTER role is deprecated as of firmware 2.7.11) with MQTT enabled, bridging to the club's Telegram group for race results
- **Total cost:** Approximately $600 hardware, zero ongoing subscription cost
- **Training:** 1-hour orientation at season start; new members pair phones and verify channel access

Limitations and Best Practices

Meshtastic is not a substitute for VHF DSC distress calling, EPIRB, AIS, or a PLB. Position it as an enhancement to existing safety equipment, not a replacement. Note that AIS itself is not the primary collision-avoidance tool - per USCG/COLREGs a proper visual and radar lookout is primary and AIS should never be solely relied upon. Range varies with conditions: wave-obscured horizons temporarily reduce range for low-mounted nodes, and multi-hop via other fleet vessels only helps when a powered relay node is actually in range. Always verify all fleet nodes are communicating at the pre-departure check-in before leaving the dock.