Field Sensor Deployment Guide

Site Selection

Place sensors where you need data - not where it is convenient to access. Ideal sites are often inconvenient: a peak for a weather station, a stream bank for water level, a crop row for soil temperature. Choose the site first, then engineer the power and connectivity to support it.

Weatherproofing Sensors

Temperature and humidity sensors require a **radiation shield** (white louvered housing) for accurate readings. Direct sunlight on a bare sensor will read 10 - 20 °C high. Heat trapped inside a sealed enclosure will do the same. Rules:

- Never seal a BME280 or BME680 inside a closed waterproof enclosure - humidity will read 100 % and temperature will reflect enclosure heat, not ambient air.
- Mount the sensor in a **Stevenson screen** or a louvered radiation shield (widely available from weather station suppliers for under $15).
- If you cannot use a radiation shield, at minimum shade the sensor from direct sun and allow free airflow.

Enclosure Strategy

Keep electronics and sensors in separate compartments:

- Main board, battery, and solar charge controller in an **IP67 sealed enclosure** (ABS or polycarbonate, UV-rated).
- Run sensor wiring through a cable gland or a small hole sealed with self-amalgamating tape.
- BME280 / BME680: mount in the radiation shield outside the enclosure and run I2C wiring inside. Limit I2C cable length to under 50 cm; use a level-shifted I2C buffer for longer runs.
- For insect protection, cover any ventilation holes with fine stainless mesh - spiders love warm enclosures.

Power Sizing

Sensor node consumption is extremely low with the right hardware and firmware:

Component	Average current (10-min TX interval)
nRF52840 MCU (sleep)	~2 µA
BME280 (sleep)	~0.1 µA
LoRa TX burst (10 s/day total)	~0.1 mA averaged
Total daily	**< 5 mAh/day**

- **Battery-only:** 3 000 mAh LiPo → ~600 days.
- **Solar-maintained:** a 1 W (6 V) panel in any climate with 4+ hours of peak sun keeps a 3 000 mAh pack full indefinitely.
- For critical sensors in low-light environments (north-facing, dense canopy), upsize to 2 - 3 W and add a 5 000 - 6 000 mAh pack.

Connectivity Range

Sensor nodes use the same LoRa mesh relay infrastructure as every other node. A sensor 20 km from the nearest internet gateway can still deliver data in near-real-time if the mesh has relay coverage along the path. When planning a sensor deployment, map out the relay chain first:

1. Identify the target sensor location.
2. Verify line-of-sight or near-LOS to at least one repeater.
3. Trace that repeater's path to a node with internet/MQTT uplink.
4. Add intermediate repeaters if any hop is marginal.

Data Gaps and Local Storage

If the mesh path to a gateway is down, sensor readings are lost - sensor nodes have no local storage. Mitigation options:

- **Store-and-Forward (Meshtastic):** nearby nodes with S&F enabled buffer packets and deliver them when the gateway returns. Suitable for short outages (hours).
- **MeshCore room servers:** can buffer messages when a gateway is temporarily offline, then flush when reconnected.
- **Local SD card logging:** for critical sensors add an SD card module and log locally in CSV format. A recovery script can push historical data to InfluxDB when connectivity is restored.

Maintenance Planning

Remote sensor nodes require infrequent but non-zero maintenance:

- BME280 radiation shield accumulates dust, pollen, and spider webs over time - clean annually or after wildfire smoke events.
- INA219 shunt connections can corrode in marine environments - inspect annually and apply dielectric grease.
- Battery capacity degrades over 2 - 4 years - plan for a pack swap.
- **Label every enclosure** with the node name, deployment date, battery install date, and a contact name/number. Future you (or a search and rescue volunteer) will be grateful.
- Design for access: if a node is on a 3-hour hike, make the enclosure tool-free to open (quarter-turn latches rather than screws).

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