Sensor Node Hardware Selection

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Choosing the right sensor hardware determines the long-term reliability, accuracy, and maintainability of your mesh monitoring deployment. This page compares the two dominant approaches: RAK WisBlock modular sensor boards and Meshtastic telemetry running on commodity hardware such as the TTGO T-Beam.

RAK WisBlock Sensor Modules

WisBlock is RAK Wireless's modular ecosystem: a WisBlock Core module (e.g., the RAK4631 = Nordic nRF52840 / SX1262) pairs with a WisBlock Base board such as the RAK19007 (other bases exist, e.g. RAK5005-O and RAK19003). Sensor modules snap onto the base board's sensor slots with no soldering required, making field assembly and repair straightforward.

- **RAK1906 (BME680)** - Measures temperature (±1°C), relative humidity (±3% RH), barometric pressure (±0.6 hPa), and volatile organic compound (VOC) air quality index. The BME680 gas sensor requires a burn-in period of roughly 48 hours before IAQ readings stabilise (IAQ also depends on the Bosch BSEC library and ongoing calibration). Current draw: ~0.15 µA sleep; the standard temperature/humidity/pressure measurement is in the microamp range (a few µA at 1 Hz), while the integrated gas (VOC) heater draws several mA in bursts only when VOC sensing is enabled. Ideal for indoor air quality and outdoor environmental monitoring.
- **RAK12500 (u-blox ZOE-M8Q GPS)** - Adds GNSS positioning for mobile or asset-tracking nodes. Cold-start TTFF ~29 s, hot-start ~1 s. Active current ~17-18 mA; disable when stationary to preserve battery. Compatible with external active antenna via U.FL connector.
- **RAK12004 (MQ-2 Gas Sensor)** - Detects LPG, propane, hydrogen, methane, and smoke. The MQ-2 heater (~150 mA) cannot be put to sleep and must run continuously for valid readings; duty-cycling it to save power makes gas readings unreliable until the heater re-stabilises (tens of seconds to minutes after warm-up). This ~150 mA continuous draw (~3.6 Ah/day) dominates the power budget, so the MQ-2 is poorly suited to small solar/battery nodes and should not be relied on as a life-safety combustible-gas detector.

- **RAK1901 (SHTC3)** - Dedicated temperature/humidity sensor with ±0.2°C and ±2% RH accuracy. Lower-power alternative to the BME680 when pressure and air quality are not needed. Current: ~0.5 mA during measurement, <1 µA idle.

Meshtastic Telemetry on T-Beam / Generic Boards

Meshtastic supports telemetry from I2C sensors wired to the GPIO header of ESP32-based boards. Common pairings include:

- **BMP280 / BME280** - Temperature, pressure, and (BME280) humidity. Widely available and inexpensive. Direct I2C wiring to SDA/SCL pins. The BME280 draws only ~3.6 µA active (typical, @ 1 Hz, humidity+pressure+temperature) and well under 1 µA in sleep per the Bosch datasheet - negligible relative to the radio and MCU.
- **SHT31** - High-accuracy temperature and humidity (±0.3°C, ±2% RH). More robust against contamination than the cheap capacitive temperature/humidity modules often used on hobbyist nodes.
- Enable the Telemetry module in Meshtastic and set the sensor type in the module config. Data is broadcast on the mesh as Protobuf telemetry packets at the configured interval.

Power Consumption Comparison

Component	Active Current	Sleep Current
RAK4631 base node (LoRa TX)	10 - 50 mA (lower-power TX); SX1262 reaches ~118 mA at +22 dBm	2.5 µA
BME680 (RAK1906)	+microamps (T/RH/P); gas heater several mA in bursts only when enabled	+0.15 µA
SHTC3 (RAK1901)	+~0.5 mA (during measurement)	+0.5 µA
ZOE-M8Q GPS (RAK12500)	+~17-18 mA	+7.5 µA (backup)
MQ-2 heater (RAK12004)	+150 mA	Cannot sleep heater
T-Beam + BME280 (Meshtastic)	~80 mA (board-level)	~500 µA

Note: the T-Beam figures are board-level (ESP32 + GPS + peripherals). Stock T-Beam deep-sleep current is frequently in the low-mA range unless peripherals are disabled, and is often higher than 500 µA in practice; the BME280's own contribution is microamp-level.

For battery-constrained outdoor deployments the RAK WisBlock platform with BME680 or SHTC3 is strongly preferred. Base sleep current below 5 µA enables multi-month operation on a modest LiPo without solar, assuming moderate temperatures - cold significantly reduces usable battery

capacity. **Outdoor lithium-powered nodes (including LiFePO4) must not be charged below 0°C (32°F);** see the deployment pages for low-temperature charge-cutoff guidance when a node is solar-equipped.

Form Factor and Weatherproofing

Outdoor sensor nodes must be rated for the deployment environment. Common IP ratings relevant to mesh sensor nodes:

- **IP65** - Dust-tight, protected against low-pressure water jets. Minimum for exposed outdoor use.
- **IP67** - Dust-tight, temporary immersion to 1 m. Suitable for ground-level or flood-risk sites.
- **IP68** - Continuous submersion rated. Required near water crossings or in humid tropical climates.

Membrane vents (Gore-Tex or equivalent) are essential for enclosures containing humidity sensors. A sealed enclosure traps heat and distorts readings. In the Northern Hemisphere, mount the enclosure on a north-facing surface to minimise solar heating effects on temperature sensors, or use a radiation shield (Stevenson screen style) for meteorological-grade accuracy.

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