Fixed Infrastructure Node Hardware Selection

Fixed infrastructure nodes - backbone repeaters, room server hosts, and long-term outdoor installations - have different hardware requirements than portable client nodes. Reliability, power efficiency, and maintainability are the priorities.

Primary Hardware Candidates

RAK4631 (nRF52840 + SX1262)

The RAK4631 WisBlock core is the most popular choice for fixed infrastructure in 2025-2026:

- **Current draw:** ~17 mA in continuous LoRa receive (RAK datasheet), ~125 mA transmit at 22 dBm (SX1262 ~118 mA per Semtech, plus MCU). Sleep is ~2.0 µA. A ~3 mA figure would be a duty-cycled/averaged idle value, not steady receive.
- **Average power:** ~8-15 mA in typical repeater operation (estimate; actual average depends on RX duty cycle and traffic - mostly RX at ~17 mA with brief TX bursts and low-power sleep between)
- **Advantages:** Modular WisBlock system allows easy sensor/GPS/display add-ons; nRF52840 has excellent power management; SX1262 supports all required frequencies
- **Form factor:** Small enough to fit in an IP67 enclosure with a 18650 battery pack
- **Firmware:** MeshCore (REPEATER or Companion), Meshtastic

LILYGO T-Beam Supreme (ESP32-S3 + SX1262)

Good choice when WiFi/MQTT gateway capability is needed at a fixed site:

- **Current draw:** ~80-120 mA approximate whole-board current with ESP32 WiFi active, ~30 mA (WiFi off, LoRa only; depends on GPS on/off and CPU activity). Both are board-level estimates, not single datasheet values.
- **Advantages:** Built-in GPS, WiFi for MQTT bridge, USB-C, relatively large community

- **Disadvantages:** Higher power draw than nRF52 makes solar budget larger; ESP32 requires periodic watchdog resets in some deployments
- **Best for:** Gateway nodes with internet connectivity, sites with reliable grid or large solar panels

Heltec HT-n5262 / HT-n5262M (nRF52840 + SX1262)

Ultra-compact option for space-constrained installations:

- **Current draw:** Comparable to the RAK4631 (both are nRF52840 + SX1262): expect ~17 mA continuous LoRa RX, ~125 mA TX at 22 dBm, microamp-range sleep. Verify against Heltec's datasheet for the specific variant.
- **Advantages:** Extremely small form factor (the HT-n5262M is a 1.27 mm stamp-hole solder-down module for integration onto your own PCB). Note: the bare module does not include a LiPo/JST connector; a built-in battery connector applies only to a dev-board variant - confirm the variant you are buying.
- **Best for:** Discreet indoor deployments, installations with severe space constraints

Hardware Selection Matrix

Use Case	Recommended Hardware	Reason
Solar outdoor repeater	RAK4631	Lowest power, weatherproof WisBlock ecosystem
Indoor backbone with internet gateway	T-Beam Supreme	WiFi for MQTT bridge (GPS is largely unusable indoors without sky view, so position tracking applies only to an outdoor/rooftop gateway)
High-altitude remote repeater	RAK4631	Low power essential for limited solar; reliable firmware
Room Server host: RAK4631 or Heltec V3 running MeshCore Room Server firmware	RAK4631 via USB serial	Pi handles room server; RAK handles LoRa radio. Verify the supported host hardware and architecture against docs.meshcore.io Room Server requirements before deploying.

Antenna Considerations for Fixed Sites

Infrastructure nodes should use external antennas rather than the stub antennas included with most development boards:

- **Omnidirectional (5-8 dBi fiberglass):** Best for covering 360 degrees; mount at highest practical point
- **Yagi/directional (10-15 dBi):** Best for point-to-point backbone links over long distances; requires careful alignment. Note for unlicensed US (Part 15.247) operation: antenna gain above 6 dBi requires a dB-for-dB reduction in conducted transmitter power, so high-gain Yagis above 6 dBi must be paired with a correspondingly lower TX power setting.
- **Antenna cable:** LMR-195 or LMR-400 (minimize cable length to reduce loss). LMR-400 has ~1.3 dB/10 m (12.8 dB/100 m, 3.9 dB/100 ft) loss at 900 MHz per the Times Microwave datasheet.

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