

Best Hardware for Fixed Repeaters

A fixed repeater node has one job: forward mesh packets reliably, indefinitely, with as little power consumption as possible. This page covers the hardware decisions that matter most for solar-powered or battery-backed repeater deployments.

The Core Decision: nRF52840 vs ESP32

For repeater use, the MCU platform is the single most important hardware choice. The nRF52840 (used in the RAK4631 and T-Echo) consumes roughly **3 orders of magnitude less sleep power** than the ESP32-S3, which is the state a repeater spends most of its time in. (Note: the Station G2 is an ESP32-S3 high-power base station, not an nRF52840 board - it is covered separately under base stations, not here.)

Power Draw Comparison by Board (Repeater Mode)

The figures below are **estimates**, not manufacturer-datasheet power tables. They assume a 5% active duty cycle and typical regulator/peripheral quiescent draw; real-world results vary with baseboard, firmware, mesh traffic, and radio settings. Datasheet anchor points are cited where available.

Board	MCU	Active Current (mA)	Sleep Current (mA)	Avg Draw @ 1 tx/min (mA)	18650 Runtime (hrs)*
RAK4631 (WisBlock)	nRF52840	~15 (RX; datasheet RX ~17, TX ~125 at 20 dBm)	0.002 (module datasheet 2.0 μ A; higher on a populated baseboard)	~2.5 (est.)	~800+ (est.)

Board	MCU	Active Current (mA)	Sleep Current (mA)	Avg Draw @ 1 tx/min (mA)	18650 Runtime (hrs)*
T-Echo	nRF52840	~18 (est.)	~0.012 (est.; LILYGO publishes no power table)	~3.0 (est.)	~660 (est.)
T-Beam Supreme	ESP32-S3	~80 - 120 (est.; GPS + PMIC dominate)	~1.0 - 2.5 (est.)	~12 - 18 (est.)	~110 - 165 (est.)
Heltec WiFi LoRa 32 V3	ESP32-S3	~70 - 100 (est.)	~1.5 - 3.0 (est.; regulator/OLED leakage)	~14 - 20 (est.)	~100 - 140 (est.)
ESP32 generic LoRa	ESP32	~100 - 160 (est.; varies by regulator)	~2.0 - 5.0 (est.)	~18 - 28 (est.)	~70 - 110 (est.)

*18650 capacity assumed at 2500 mAh (a conservative, realistic usable-capacity planning figure; cells are commonly 2500-3500 mAh). Active time assumed at 5% duty cycle. Runtime values are derived estimates, not datasheet specs - real-world results will vary based on mesh traffic, firmware version, and radio settings. (The Station G2 is omitted from this repeater table: it is an ESP32-S3 mains/PD-powered high-power base station, not a low-power solar-repeater candidate.)

Gold Standard: RAK4631 (RAK WisBlock)

The **RAK4631** is the best board available for fixed repeater deployments. Its key advantages for repeater use:

- **2.0 μ A module sleep current (datasheet)** - the radio and MCU together draw less than most voltage regulators leak; expect somewhat higher on a populated baseboard due to the baseboard regulator's quiescent current
- **Modular design** - base board, core module, and optional IO modules are separate. The base board includes the battery management and charging circuit; you supply the battery.
- **Industrial temperature range:** -40°C to +85°C. (Standard ESP32 / ESP32-S3 parts are also rated -40°C to +85°C, so the MCU silicon is not the limiting factor; in practice the LiPo battery - typically rated ~0°C to +45°C for charging - sets the real-world thermal envelope for either platform.)
- **SX1262 radio** with excellent receiver sensitivity: ~-137 dBm at SF12 / 125 kHz bandwidth (the headline -148 dBm figure applies only at the narrowest bandwidth, not BW125)

- **Hardware cryptographic acceleration** via the Arm TrustZone CryptoCell-310 accelerator - useful for secure mesh deployments. (Note: this is a crypto accelerator, not Cortex-M33 TrustZone-M memory isolation; the nRF52840 is a Cortex-M4F.)
- **Excellent Meshtastic and MeshCore support** - actively maintained firmware targets

RAK WisBlock Solar Repeater BOM

All prices below are approximate commodity / store prices as of 2026-06-08 and are volatile; verify against the RAK store and vendor listings before ordering. Present the total as an estimate range, not a fixed quote.

Component	Part	Est. Cost (as of 2026-06-08)
Core module	RAK4631 (nRF52840 + SX1262)	~\$25 - \$30 (verify RAK store; often listed near \$25-30)
Base board	RAK19007 (\$9.99) or RAK19003 (mini)	\$10 - \$18 (verify RAK store SKUs)
Solar charge module	CN3791-based MPPT board (verify the correct RAK solar SKU - RAK12007 is a WisBlock sensor module, not a solar charger)	\$8 - \$15
LiPo battery	3.7V 3000 - 5000 mAh flat pack	\$8 - \$15
Solar panel	5V 1W - 2W panel (60mm × 110mm typical; size for worst-case winter insolation)	\$5 - \$12
Antenna	915 MHz fiberglass or tuned whip	\$8 - \$25
Enclosure	IP67 ABS box (100×68×50mm)	\$6 - \$12 (approximate commodity price)
Total		~\$70 - \$125 (estimate range, as of 2026-06-08)

Alternative: T-Echo as a Repeater

The **T-Echo** makes an excellent fixed repeater when you want a complete ready-to-flash unit without assembly. It uses the same nRF52840 platform as the RAK4631 and achieves similar sleep power. Tradeoffs versus the WisBlock approach:

- The T-Echo includes a 1.54" e-paper display (useful for diagnostics; wastes a tiny amount of power even off)
- Battery capacity is limited to the small internal flat LiPo (the bundled cell is commonly cited around ~850 mAh and is not user-removable; an optional ~2400 mAh expansion accessory exists), vs the large external packs usable with WisBlock. Verify the bundled

cell capacity against the current LILYGO listing.

- GPS can be disabled in firmware to save the current the Quectel L76K draws when active (~10 mA active; see the L76K datasheet) - important for pure repeater duty
- The antenna uses a U.FL/IPEX connector (sources conflict on SMA vs U.FL - verify against your unit) and is easily replaced with a higher-gain antenna for elevated installs

Why Not Just Use an ESP32 Board?

ESP32 boards like the T-Beam Supreme are perfectly capable of repeater duty with AC power (plugged in). If you have mains power at the repeater site, the ESP32's higher power draw is irrelevant and its better WiFi connectivity can be useful for firmware OTA updates and gateway bridging. However:

- A solar system sized for an ESP32 repeater costs 3 - 4x more than one for a WisBlock, because the panel and battery must be larger
- For a given small panel/battery, an ESP32 repeater is more likely to run out of charge in cloudy or short-day conditions than an nRF52840 system. (A properly sized ESP32 system can survive winter, and an undersized nRF52840 one can fail - the deciding variable is panel/battery sizing, not the MCU alone.)
- The practical indoor/mains-powered exception: T-Beam Supreme repeaters work well in building deployments where power is available and WiFi/BLE features are useful

Antenna Recommendations for Fixed Repeaters

A fixed repeater benefits more from antenna quality than almost any other hardware upgrade. Typical improvements from the standard rubber duck to a quality fiberglass antenna range from +3 dB to +6 dB gain, which roughly doubles to quadruples effective range in ideal (free-space) conditions. In real-world obstructed paths (path-loss exponent ~2.7-4) the improvement is typically less.

Antenna Type	Gain	Use Case	Notes
Rubber duck (included)	1 - 2 dBi (nominal)	Basic testing only	Adequate for indoor, room-scale use
Tuned whip ($\lambda/4$ over a ground plane)	~5.15 dBi ideal (2 - 5 dBi real-world)	Outdoor mounted, no cable run	DIY option; cheap and effective. (Note: ~2.15 dBi is the half-wave dipole figure, not the monopole-over-groundplane value.)

Antenna Type	Gain	Use Case	Notes
Fiberglass 3 dBi (e.g., Taoglas OMB.8912 - verify band/gain on datasheet)	3 dBi	Pole-mounted outdoor repeater	Good all-around choice
Fiberglass 5 - 6 dBi collinear (verify example part against datasheet - the Linx ANT-916-CW-RCS is a near-unity-gain quarter-wave whip and does not match this 5-6 dBi class)	5 - 6 dBi	Hilltop / elevated repeater	Narrower vertical beam; best at elevation
Yagi directional (verify gain on datasheet)	10 - 14 dBi	Point-to-point links	Only useful for specific directional paths

FCC note: Antennas above 6 dBi gain require reducing conducted power dB-for-dB under FCC Part 15.247(b)(4) (subject to the fixed point-to-point provisions of 15.247(c)). Plan your link budget as $EIRP = \text{conducted power} + \text{antenna gain} - \text{feedline loss}$, and keep within the applicable limits for your operating authority.

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