RAK WisBlock System for MeshCore

The RAKwireless WisBlock ecosystem is a modular hardware platform built around stackable boards connected by standardized slot connectors. For MeshCore deployments, WisBlock is the most flexible and field-proven hardware option available. This page explains the WisBlock architecture, the relevant modules, and recommended configurations for different MeshCore node roles.

WisBlock Architecture Overview

A WisBlock node combines a Base board, a Core module, and one or more IO/Sensor modules. RAK categorizes WisBlock modules as Core, Sensor, and IO/Interface:

1. **Base Board** - provides power management (LiPo connector, solar input on some variants), USB, and slot connectors for the Core module and the sensor/IO modules.
2. **Core Module** - the RAK4631, containing the nRF52840 MCU and SX1262 radio. This is the "brain" of the node.
3. **IO/Sensor Modules** - plug into the sensor/IO slots on the base board to add GPS, environmental sensors, displays, and other peripherals.

Base Boards

RAK19007 (Full-size Base Board)

- Dimensions: 30 × 60 mm
- One Core slot, one IO slot, and four sensor module slots (A-D). Slots A-C take 10 mm modules; slot D takes up to 23 mm (e.g. GNSS).
- LiPo battery connector: JST PHR-2, 2 mm pitch (the solar input uses JST ZHR-2, 1.5 mm pitch)
- USB Type-C for charging and programming
- Solar input via separate connector

- **Recommended for:** Fixed repeaters, room servers, sensor nodes - any node where size is not constrained.

RAK19003 (Mini Base Board)

- Dimensions: 30 × 35 mm (per the RAK19003 datasheet; as of 2026)
- One Core slot and a single module slot (Slot A)
- LiPo battery connector
- USB Type-C
- No solar input connector
- **Recommended for:** Portable client nodes, installations where size matters. Not ideal for sensor nodes requiring multiple IO modules.

RAK5005-O (Legacy Full-size Base Board)

- Older variant, still widely used in the community.
- Full-size form factor with sensor/IO slots and solar input.
- Uses Micro-USB instead of USB-C.
- Broadly compatible with WisBlock Core and IO modules; note that the Slot D pinout differs from the 2nd-generation boards.

Core Module: RAK4631

The RAK4631 (nRF52840 + SX1262) is the primary WisBlock core module used for MeshCore. It is not the only RAK device that runs MeshCore - check the MeshCore flasher for the current supported RAK device list rather than assuming a single board. Key specifications:

- **MCU:** Nordic nRF52840 - ARM Cortex-M4F @ 64 MHz, 1 MB flash, 256 KB RAM
- **Radio:** Semtech SX1262 - LoRa/FSK, up to +22 dBm TX power. The SX1262 silicon spans 150 - 960 MHz, but the RAK4631 is sold in band-specific variants (e.g. 868 MHz for EU, 915 MHz for North America) with front-end matching for its rated band - you cannot move a single RAK4631 across bands, so buy the variant matching your region. (EIRP note: at +22 dBm conducted with a 5 dBi antenna, EIRP is ~27 dBm, well within the US 36 dBm EIRP limit; verify EIRP if using higher-gain antennas.)
- **Connectivity:** BLE 5.0 (used for MeshCore app connection and CLI access), NFC (tag mode)
- **Interfaces:** SPI, I2C, UART, GPIO - all exposed on WisBlock connector and routed to the sensor/IO slots
- **Power:** Operates from 3.3 V; integrates with the base board's power management

- **Antenna:** IPEX/U.FL connector on module; the base board/enclosure routes the antenna to an external connector (SMA on some, IPEX on others) depending on the base board and enclosure

LoRa Module: RAK13300

The RAK13300 is a standalone SX1262 LoRa module that plugs into a WisBlock IO slot. It is an alternative radio path for custom builds, but for standard MeshCore use the integrated radio on the RAK4631 is preferred. The RAK13300 is primarily useful for advanced dual-radio or custom PCB integrations.

Sensor and Peripheral Modules

RAK1906 - BME680 Environmental Sensor

- **Measures:** Temperature, humidity, barometric pressure, and gas resistance (a proxy for VOC/air quality; a true IAQ index requires the Bosch BSEC library, which MeshCore does not run)
- **Interface:** I2C
- **Connects to:** any WisBlock sensor IO slot (A-F) on the base board
- **MeshCore firmware:** SENSOR variant reads BME680 data and transmits it as a sensor packet over the mesh
- **Use case:** Environmental monitoring node - weather station, air quality sensor, remote temperature logger
- Note: the BME680 (gas) differs from the simpler BME280 (temperature, humidity, pressure only). MeshCore's environmental sensor support may include the BME280 in addition to the BME680 - confirm against your firmware build's sensor support before relying on a specific part.

RAK12500 - GPS Module (uBlox ZOE-M8Q)

- **Provides:** GPS position, altitude, course, speed, UTC time
- **Interface:** UART or I2C
- **Connects to:** IO Slot A (UART or I2C) or Slot C (I2C only)
- **MeshCore firmware:** GPS data is used for position reporting in the mesh - visible in the MeshCore app map view
- **Use case:** Any node where location tracking or time synchronization is needed

- **Cold start:** Typically ~26-30 s (up to ~60 s) to first fix outdoors. The ZOE-M8Q supports AssistNow A-GNSS, but MeshCore nodes have no network connection to obtain assistance data, so cold-start times apply.

RAK1921 - 0.96" OLED Display

- **Display:** 128×64 pixel SSD1306 OLED
- **Interface:** I2C
- **Use:** Shows node status, last received message, SNR, and battery level in supported firmware builds
- **Note:** MeshCore repeater firmware typically does not drive a display; Companion firmware may show status information

Recommended Module Combinations

Basic Repeater Node

Base board	RAK19007 or RAK19003
Core	RAK4631
IO modules	None required
Firmware	REPEATER
Antenna	External antenna for your region (the US ISM band is 902-928 MHz, commonly called "915 MHz"; EU is 868 MHz) via SMA connector on base board. A gain antenna (3 - 5 dBi fiberglass) is strongly recommended for fixed installs. Note: under FCC 15.247, antenna gains above 6 dBi trigger conducted-power-reduction rules, so a 3-5 dBi antenna stays within the no-reduction zone.
Power	LiPo + solar panel (connected to base board solar input) for off-grid deployment

Sensor Node (Environmental Monitoring)

Base board	RAK19007
Core	RAK4631

IO Slot A	RAK1906 (BME680 environmental sensor)
Firmware	SENSOR
Antenna	Region-appropriate external antenna (902-928 MHz in the US / 868 MHz in the EU) via SMA
Power	LiPo battery; sensor firmware uses a very low duty cycle, so battery life can reach weeks to months depending on battery capacity (mAh) and transmit interval. Treat runtimes as estimates - actual life depends on TX interval, spreading factor, and battery size.

GPS-Equipped Companion Node (with Position)

Base board	RAK19007
Core	RAK4631
IO Slot A	RAK12500 (GPS)
IO Slot B	RAK1921 (OLED display, optional)
Firmware	Companion
Use case	Field node for search and rescue, event operations, or any scenario requiring node position on the map

Enclosures

RAKwireless sells several official enclosures for WisBlock nodes:

- **RAK Unify Enclosure** - IP67-rated weatherproof enclosure, available in multiple sizes, with a pre-mounted RP-SMA antenna bulkhead and an M8 connector for 5V/solar power input. Ideal for permanent repeater installations.
- **RAK5804 IO Extension Module** - a WisBlock interface extension board that adds more IO slots, useful for custom form-factor builds requiring additional IO. Pair it with a custom enclosure as needed.
- Third-party 3D-printable enclosure designs are available in the RAK community forums and on Printables for the RAK19007 base board.

Why WisBlock is the Most Flexible MeshCore Platform

The WisBlock system's modular design means you can build exactly the node you need:

- **Upgrade in the field:** Add a GPS module to a repeater without changing the core or base board.
- **Cost efficiency:** Buy base boards in bulk and swap core modules between development and production nodes.
- **Expandability:** RAKwireless offers dozens of WisBlock sensor and IO modules covering sensors, displays, motor drivers, cellular, and more - broadly compatible with the same base board (some modules require specific slots or base boards).
- **Low power:** The nRF52840 SoC draws as little as ~0.4 µA in System OFF (deep sleep); a complete WisBlock node typically idles around a few µA, making solar/battery deployments practical for months.
- **Production-ready:** Many WisBlock modules carry FCC and/or CE certification; check the RAK product-compliance page for the specific module before deploying, and note that final-product compliance (especially antenna/EIRP) is the deployer's responsibility.

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