8. Modules & Extensions

SMHUB is designed to be modular. The **main board** provides essential radios, networking, and I/O, while additional **hardware modules** extend functionality for power resilience, connectivity, and advanced integrations.

8.1 USB Passthrough

- **Purpose:** Enables SMHUB to act either as a **USB host** (powering connected peripherals) or as a **USB device** (connected to a PC or another host).
- **Logic:**
  - Automatically decides whether to supply or draw power.
  - Prevents reverse powering through integrated FET switching.
- **Use Cases:**
  - Attach Z-Wave or extra Zigbee dongles, printers, audio devices, storage etc.
  - Connect SMHUB to a PC for development/debugging.
  - Power downstream devices safely.

8.2 SD Card

- **Slot:** Standard microSD slot on the main board.
- **Purpose:** Expand storage for logs, app data, or backups.
- **Integration:**
  - Mounted automatically by the Linux OS.
  - Users can format, mount/unmount, and monitor usage from the UI.
  - Support up to 2Tb volume.

8.3 PoE Module

- **Standard:** IEEE 802.3af-compliant.
- **Input:** Power delivered via Ethernet cable from a PoE-enabled switch or injector.
- **Output:** Stable **5V regulated** supply to the hub.
- **Protection:** Surge and ESD protection integrated.
- **Monitoring:** “PoE Power Check” exposed in the system for telemetry.
- **Use Case:** Ideal for enterprise deployments where powering over Ethernet is standard.

8.4 UPS Module

- **Battery:** Supports **18650 Li-ion cells** (user-installed).
- **Charger:** advanced circuit with overcharge/undervoltage protection.
- **Conversion:** Step-up/step-down converters to maintain **5V, 3.3V, 1.8V** rails.
- **Telemetry:**
  - Monitors voltage/current
  - Provides battery health and charge state in the UI.
- **Inputs:** Can also accept **DC power** or **solar panels**, making SMHUB deployable off-grid.
- **Use Case:** Ensures uninterrupted operation during outages.

8.5 4G/LTE Module

- **Connectivity:** LTE Cat 1 with fallback modes.
- **Interfaces:**
  - Main UART.
  - USB.
  - Debug UART.
- **SIM Slot:** NanoSIM with detection circuitry.
- **Antennas:** Dedicated connectors for LTE and GNSS.
- **UI Integration:**
  - Settings → Radios → 4G/LTE.
  - SIM/APN configuration, LTE signal telemetry.
- **Status:** Hardware available, **software support in development**.

8.6 DIY Pinouts & Interfaces

For advanced users and developers, SMHUB exposes additional hardware interfaces:

- **GPIO pins** for general use.
- **UART, SPI, and I²C** buses.
- **Custom module connectors** for prototyping or specialized hardware.
- **Use Case:** Attach sensors, control boards, or experimental expansions not covered by official modules.

8.7 Integrated Peripherals

While not separate modules, the following are considered part of SMHUB’s extension capabilities:

- **IR Transmitter & Receiver**
  - Control TVs, AC units, and IR-based devices.
  - Capture IR codes for learning mode.
- **Audio Output (3.5 mm)**
  - System alerts and future media/streaming support.
- **Buzzer**
  - Local audible notifications.
- **LED Systems**
  - **12 WS2812B RGB LEDs (Ambilight)** – running by default, user configurable.
  - **4 Service LEDs** – network, power, radio status.

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