2. Hardware Overview

SMHUB is a **Linux-based modular hub** designed to unify connectivity, automation, and control across multiple smart home and IoT standards. Its hardware architecture combines **high-performance networking, multiple radios, built-in peripherals, and modular power options**.

2.1 Core System

- **Processor:** 2 separate cores: C906@1GHz (for Linux) + C906@700MHz (for RTOS).
  C906 is an ultra-high-efficiency processor compatible with the RV64IMA[F]C[V] instruction set. It is one of the industry's first mass-produced processors supporting the RISC-V vector extension.
- **NPU (Neural Processing Unit):** 0.5 TOPS@INT8.
- **Memory:** 512 MB RAM.
- **Storage:** Onboard eMMC storage plus **microSD slot** for expansion.
- **Operating System:** Embedded Linux with Node.js runtime, supporting smart applications such as Zigbee2MQTT, Matterbridge, Node-RED, and custom Node.js/Python services.

2.2 Networking

- **Ethernet:** Integrated RJ-45 port for wired backbone connectivity.
- **Wi-Fi:**
  - Dual-band **2.4 GHz and 5 GHz** support.
  - Can operate in **Access Point** mode or **Client** mode.
  - CLI setup available, with web UI configuration in development.
- **Bluetooth:**
  - **Bluetooth 5.0** compliant.
  - Supports **Bluetooth Low Energy (BLE)** for pairing, sensors, and beacons.
  - Available for integrations and custom applications.

2.3 Radios

- **Zigbee (CC26xx)** → dedicated radio for Zigbee networks, fully compatible with Zigbee2MQTT.
- **Thread (EFR32MG series)** → native support for Thread and OpenThread Border Router (OTBR).

- **EFR32ZG23 Expansion Module** → provides **Sub-GHz communications including Z-Wave**, integrated via UART3 with dedicated reset, flash, and LED lines.

2.4 Expansion Modules

- **UPS Module (SM-HUB UPS)**
  - Powered by **18650 Li-ion battery cells**.
  - Charging via TP5100.
  - Step-up/step-down converters deliver **5 V, 3.3 V, and 1.8 V rails**.
  - **INA226 sensor** monitors voltage and current for telemetry.
  - Solar/DC charging input supported.
- **PoE Module (SM-HUB PoE)**
  - 802.3af compliant (Power over Ethernet).
  - Converts Ethernet-supplied power to regulated 5 V.
  - Surge and ESD protection integrated.
  - “Power-check” signals exposed for system monitoring.
- **4G/LTE Module (SM-HUB 4G)**
  - Based on **SIM7672G modem** with **GNSS (GPS/GLONASS)**.
  - NanoSIM slot with SIM detect.
  - Interfaces: main UART, USB, debug UART.
  - LTE and GNSS antenna connectors.
  - Power and network LED indicators.

2.5 Built-in Peripherals

- **LEDs:**
  - **12 × WS2812B addressable RGB LEDs** – configurable for system visualization, animations, or Ambilight effects.
  - **4 × service LEDs** – indicating power, network, and radio activity.
- **Buttons:**
  - **Reset button**.
  - **Pairing/Function button**.
  - **User-configurable button**.
- **Audio Output:**
  - **3.5 mm audio jack**.
  - Supports system notifications, alerts, or media playback.
- **Buzzer:**
  - Integrated piezoelectric buzzer.
  - Usable for system alerts, notifications, or user automation rules.
- **IR Modules:**
  - **IR transmitter** for controlling TVs, AC units, and other IR devices.
  - **IR receiver** for capturing signals from existing remotes.

2.6 Power Architecture

- **Primary Power:** USB-C PD input.
- **Optional Power Sources:**
  - PoE (via PoE module).
  - UPS battery module.
  - Solar/DC input (through UPS module).
- **Smart USB Power Switching:** Automatic host/device detection on USB-C CC lines with integrated FET switching. Prevents reverse powering and ensures safe operation whether SMHUB is supplying power to peripherals or being powered itself.

2.7 Expansion & DIY Interfaces

For developers and hardware enthusiasts, SMHUB exposes additional interfaces:

- **GPIO headers** with UART, SPI, and I²C.
- **DIY pinouts** for custom modules, sensors, or experimental expansions.

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