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8/17/2025

CS-350 Emerging Sys Arch & Tech

Hardware Architectures for a Wi-Fi Thermostat

Introduction

As the thermostat moves from prototype to production, selecting the right hardware platform is essential. The device must support existing peripherals, connect to the cloud via Wi-Fi, and have enough memory to run reliably. This paper compares three options—Raspberry Pi Zero 2 W, Microchip WFI32E01, and NXP RW612—and recommends the most suitable choice.

Requirements

• Peripheral Support: AHT20 sensor (I²C), 16×2 LCD, LEDs (PWM), buttons (GPIO), UART.

• Cloud Connectivity: Integrated Wi-Fi with secure cloud communication.

• Memory: Adequate Flash and RAM for code, networking, and security.

Architectures

Raspberry Pi Zero 2 W

The Raspberry Pi Zero 2 W offers a quad-core processor, 512 MB RAM, and 2.4 GHz Wi-Fi. It supports all required peripherals and can reuse existing Python code. However, it consumes more power and may face supply challenges (Raspberry Pi Foundation, 2021).

Microchip WFI32E01

The Microchip WFI32E01 integrates 2.4 GHz Wi-Fi, up to 2 MB Flash, and 640 KB RAM. It supports all peripherals and provides Trust&GO provisioning for easy cloud onboarding. It is low-power and designed for IoT devices (Microchip Technology, 2021).

NXP RW612

The NXP RW612 uses a Cortex-M33 with 1.2 MB SRAM and external flash support. It integrates dual-band Wi-Fi 6, Bluetooth, and 802.15.4 for future smart-home standards. It supports the necessary peripherals and offers strong security (NXP Semiconductors, 2023).

Comparison

• Peripheral Support: All three meet requirements.

• Cloud Connectivity: Pi (Wi-Fi 4), Microchip (Wi-Fi 4 + Trust&GO), NXP (Wi-Fi 6 + multi-radio).

• Memory: Pi offers the most, but is excessive; Microchip and NXP provide enough for RTOS-based IoT.

Conclusion

All platforms meet the requirements. The Raspberry Pi is easiest for quick deployment but less efficient. The NXP RW612 is the most advanced and future-proof but requires more engineering. The Microchip WFI32E01 strikes the best balance, offering integrated Wi-Fi, enough memory, low power use, and secure provisioning, making it the most practical choice for production.

References

Microchip Technology. (2021). WFI32E01 series Wi-Fi® microcontroller modules. https://www.microchip.com

NXP Semiconductors. (2023). RW612 wireless MCU for tri-radio IoT applications. https://www.nxp.com

Raspberry Pi Foundation. (2021). Raspberry Pi Zero 2 W product brief. https://www.raspberrypi.com