**Cloud Connectivity Architecture Recommendation**

**1. Introduction** SysTec’s next phase goal is to connect the smart thermostat prototype to the cloud over Wi-Fi. This report evaluates three candidate hardware platforms against SysTec’s business and technical requirements:

*The thermostat must support existing peripherals (I²C AHT20 sensor, PWM LEDs, buttons, LCD, UART), connect to the cloud via Wi-Fi, and have sufficient Flash and RAM to run the control logic and networking stack.*

**2. Candidate Platforms**

| **Platform** | **Wi‑Fi Connectivity** | **Peripherals Support** | **Flash / RAM** | **Pros** | **Cons** |
| --- | --- | --- | --- | --- | --- |
| **Raspberry Pi Zero W** | Onboard 802.11n Wi‑Fi | Full Linux drivers for I²C, GPIO, SPI, UART, PWM | ~4 GB SD card + 512 MB RAM | • Built‑in Wi‑Fi, Python/Linux environment• Abundant community libraries• Easy OTA updates | • Higher power consumption• Longer boot time |
| **Microchip PIC32MZ** | External Wi‑Fi module\* | MPLAB‑supported I²C, SPI, UART, PWM | 2 MB Flash, 512 KB RAM | • Low power, real‑time performance• Mature C toolchain | • Requires separate Wi‑Fi chip• More firmware complexity |
| **NXP i.MX RT1060** | External or on‐board (with Wi‑Fi add‑on) | I²C, SPI, UART, PWM via SDK | 1 MB Flash, 512 KB SRAM | • High‑performance MCU• RTOS support• Good peripheral mix | • External Wi‑Fi integration needed• Higher cost/per board |

*Wi-Fi connectivity on PIC32MZ and i.MX RT typically uses an external module (e.g., Microchip WINC15xx or NXP Wi-Fi add on) connected via SPI or SDIO.*

**3. Analysis**

1. **Peripheral Compatibility**: All three platforms can interface with I²C sensors, PWM LEDs, GPIO buttons, and a parallel LCD. Raspberry Pi Zero W has built in Linux drivers that simplify integration. Microchip and NXP MCUs require vendor SDKs and manual driver configuration in C.
2. **Wi-Fi Connectivity**: Raspberry Pi Zero W has integrated Wi-Fi, reducing BOM and design complexity. The MCU options require external Wi-Fi modules, adding cost and integration effort (driver porting, antenna layout).
3. **Memory & Performance**: The Zero W’s SD card filesystem and 512 MB RAM far exceed the firmware size and runtime stack needed for sensor polling, state machine logic, and a TCP/HTTPS client. The MCU options with 1–2 MB Flash and 512 KB RAM are borderline for a full TLS stack plus application code; they often require a lightweight RTOS and careful memory budgeting.
4. **Development Ecosystem**: Python on Linux (Raspberry Pi) accelerates development and debugging. MCUs rely on C/C++ with IDEs like MPLAB X or MCUXpresso, increasing firmware complexity especially when integrating Wi-Fi stacks.

**4. Recommendation** Given SysTec’s priorities of rapid prototyping, minimized hardware design risk, integrated Wi-Fi, ample memory headroom, and easy over the air updates, the **Raspberry Pi Zero W** is the clear recommendation for the next phase. It meets all peripheral requirements out of the box and avoids the design overhead of an external Wi-Fi module and TLS firmware footprint constraints.

In a subsequent production iteration, a custom SoC or MCU based solution could be revisited for cost and power optimizations once the use case and scale are fully validated on the Pi platform.

References:

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NXP Semiconductors. (2025). i.MX RT1172DVMAA crossover microcontroller specifications. Retrieved June 18, 2025, from https://www.microchipusa.com/product/nxp-usa-inc/microcontrollers/MIMXRT1172DVMAA?utm\_source=GoogleAds&utm\_medium=Google&utm\_campaign=TargetedGadsNXPExactMatch2&gad\_source=1&gad\_campaignid=20429801887&gbraid=0AAAAApFlGtutrSVC8zLfJ9qt1onPu\_Chu&gclid=CjwKCAjwx8nCBhAwEiwA\_z\_\_03AIgfAX6tkgMnVYQ1CgDnowDpP5WHIcF71aOv9K9kdNB9OmWVIsxhoCD-8QAvD\_BwE