**Thermostat System and Peripheral Support**

The thermostat system in this project integrates various peripherals for temperature control, user interaction, and cloud communication. Key peripherals include I2C, GPIO, and UART, all of which play vital roles in monitoring and controlling the system. Additionally, cloud connectivity is achieved via Wi-Fi, with the system requiring efficient use of memory and processing capabilities.

**Peripherals in the Thermostat System**

1. **Temperature Sensor (I2C):**
   * The thermostat uses an I2C temperature sensor to monitor room temperature every 500ms. This value is compared with a user-defined set-point to control the heater, simulated by an LED.
2. **Buttons (GPIO):**
   * Buttons are used to increase or decrease the set-point temperature by 1°C. The system checks button states every 200ms using GPIO interrupts.
3. **LED Control (GPIO):**
   * The thermostat controls an LED that represents the heater. When the room temperature is lower than the set-point, the LED is turned on (heater on); otherwise, it is turned off.
4. **UART Communication:**
   * Every second, the system sends status updates via UART to the cloud, reporting room temperature, set-point, heater status, and seconds since reset. The format is <AA,BB,S,CCCC>, where AA is the room temperature, BB is the set-point, S indicates heater status (on/off), and CCCC is the elapsed time.

**Cloud Connectivity via Wi-Fi**

The thermostat system connects to the cloud using Wi-Fi, requiring an MCU with either built-in Wi-Fi or an external Wi-Fi module. Each architecture (TI, Microchip, and Freescale) offers distinct solutions for cloud connectivity:

1. **Texas Instruments (TI):**
   * TI’s **CC32xx** series (e.g., **CC3200**, **CC3220**) integrates built-in Wi-Fi, simplifying cloud connectivity in IoT applications. These MCUs also support secure connections and real-time OS integration, making them ideal for thermostat systems.
   * For non-Wi-Fi MCUs, TI provides the **CC3100** module, which can interface via SPI or UART for cloud communication.
2. **Microchip (Atmel/SAM):**
   * Microchip’s **SAMW25** MCU offers integrated Wi-Fi, simplifying cloud connectivity. Alternatively, the **ATWINC1500** Wi-Fi module can be used with Microchip’s other MCUs (like the **SAM D21**) via SPI or UART, allowing flexibility in design.
3. **Freescale (NXP):**
   * NXP’s **KW40Z** family supports wireless communication like Bluetooth or 802.15.4, while external Wi-Fi modules like the **MW322** enable cloud connectivity via SPI or UART. The **i.MX RT** series can support more advanced applications with integrated or external Wi-Fi modules.

**Flash and RAM Support**

Efficient management of Flash and RAM is critical in this project due to the need to store system code, peripheral drivers, and Wi-Fi stacks while ensuring real-time operation.

**Texas Instruments (TI):**

* The **CC3220** MCU offers up to 1MB of Flash and 256KB of SRAM, sufficient for the thermostat’s application code, peripheral drivers (I2C, UART, GPIO), and Wi-Fi communication. The large memory ensures smooth operation for both sensor data handling and cloud communication.

**Microchip (Atmel/SAM):**

* Microchip’s **SAMW25** provides 512KB of Flash and 64KB of RAM, accommodating the thermostat firmware, including the Wi-Fi stack. The **SAM D21** MCU, commonly paired with the **ATWINC1500** Wi-Fi module, provides 256KB of Flash and 32KB of RAM, enough for simpler IoT applications.

**Freescale (NXP):**

* NXP’s **KW41Z** MCU offers 512KB of Flash and 128KB of SRAM, providing sufficient memory for wireless communication stacks and control logic. The **i.MX RT** family supports even more memory, making it ideal for complex IoT applications with heavy processing and cloud interaction needs.

**Conclusion**

The thermostat system utilizes I2C, GPIO, and UART peripherals to monitor and control temperature while maintaining cloud connectivity via Wi-Fi. All three architectures—TI, Microchip, and Freescale—offer robust solutions with varying degrees of integration, memory capacities, and connectivity options.

* **TI** provides an all-in-one solution with integrated Wi-Fi in the **CC32xx** series.
* **Microchip** offers flexibility with both integrated and external Wi-Fi modules.
* **Freescale (NXP)** supports a wide range of connectivity and memory options, making it suitable for more advanced systems.

Each architecture supports the required peripheral operations, making them viable choices for implementing the thermostat system based on specific application requirements.

Work Cited

Texas Instruments. (2020). *CC3220R, CC3220S, and CC3220SF SimpleLink™ Wi-Fi® single-chip wireless MCU solutions* (Rev. C). Retrieved from <https://www.ti.com/lit/ds/symlink/cc3220s.pdf>

NXP Semiconductors. (2021). *KW41Z – Bluetooth Low Energy and IEEE 802.15.4 Wireless Microcontroller Datasheet*. Retrieved from <https://www.nxp.com>

Microchip Technology Inc. (2019). *SAMW25 – SMART SAM W25 Wi-Fi Module Data Sheet*. Retrieved from <https://www.microchip.com>