TI-RSLK

Texas Instruments Robotics System Learning Kit

Texas Instruments

Module 20

Introduction: Wi-Fi

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Educational Objectives:

REVIEW Synchronous serial communication
UNDERSTAND basic RTOS concepts
DEVELOP a set of Wi-Fi communication functions
LEARN how to interact with web services
DESIGN, BUILD & TEST A SYSTEM
Interface a Wi-Fi radio module to the microcontroller

Prerequisites (Modules 1, 4, 6, 11, 14, and 18)

- Running code on the LaunchPad using CCS (Module 1)
- Basic C programming (Module 4)
- GPIO (Module 6)
- Interface LCD (Module 11)
- I/O Triggered Interrupts (Module 14)
- Serial Communications (Module 18)

Recommended reading materials for students:

- Volume 2 Sections 11.3, and 11.4
  Embedded Systems: Real-Time Interfacing to the MSP432 Microcontroller, ISBN: 978-1514676585, Jonathan Valvano, copyright (c) 2017
- Volume 3 Chapters 3, 4, and 5
  Embedded Systems: Real-Time Operating Systems for ARM Cortex-M Microcontrollers, ISBN: 978-1466468863, Jonathan Valvano, copyright (c) 2017

Wi-Fi (short for "Wireless Fidelity") is ubiquitous in modern embedded systems. With more devices requiring a direct connection to the internet, the Wi-Fi standard is a popular option and by many criteria the easiest option to create IoT applications. Wi-Fi radios make use of the SPI (see Module 11) or can in some instances be driven through AT commands with UART (see Module 18). The synchronous peripheral interface (SPI) system can operate as a master or as a slave. The channel can have one master and one slave, or it can have one master and multiple slaves. In this module, the MSP432 will be the master and the Wi-Fi module will be the slave. The master initiates all data communication.

Wi-Fi requires a network stack to manage the connections. A network or protocol stack is the software implementation of the communication protocols and is common for most types of RF communication. Sometimes this stack can be implemented on the main microcontroller or sometimes is can be running on the RF module, leaving more memory for the application code on the primary microcontroller. In this module, the MSP432 will make use of the SimpleLink SDK connectivity drivers to control the CC3120 Wi-Fi radio.

The CC3120 communicates with the MSP432 over SPI. The SPI protocol includes four I/O lines. The slave select STE is an optional negative logic control signal from master to slave signal signifying that the channel is active. The second line, CLK, is a 50% duty cycle clock generated by the master. The slave in master out (SIMO) is a data line driven by the master and received by the slave. The slave out master in (SOMI) is a data line driven by the slave and received by the master. In order to work properly, the transmitting device uses one edge of the clock to change its output, and the receiving device uses the other edge to accept the data.

In the lab associated with this module, we will interface a CC3120 using the SimpleLink SDK APIs (Application Programming Interface). APIs are specialized functions provided by software tools to interface or pass data. In this case, TI provides API access to the CC3120 Wi-Fi radio that we can use with the MSP432 very easily. We will also need to connect our system to the cloud. This can be done in a near infinite amount of ways by connecting to available web services or creating your own client and server implementations.

The SimpleLink SDK leverages a different software structure that is called a Real-Time Operating System or RTOS. The RTOS will help us manage the complexity of the application that now includes Wi-Fi communication. We will learn a few RTOS concepts with the goal of helping us implement the SimpleLink Wi-Fi.

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