TI-RSLK

Texas Instruments Robotics System Learning Kit

Texas Instruments

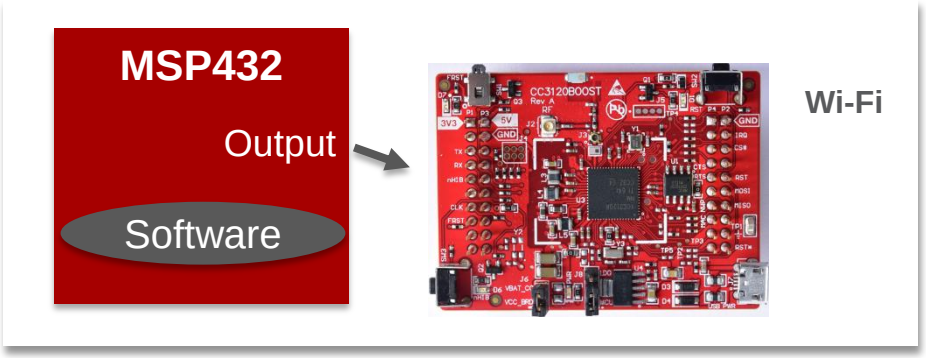
Module 20

Lecture: Wi-Fi Theory

Wi-Fi

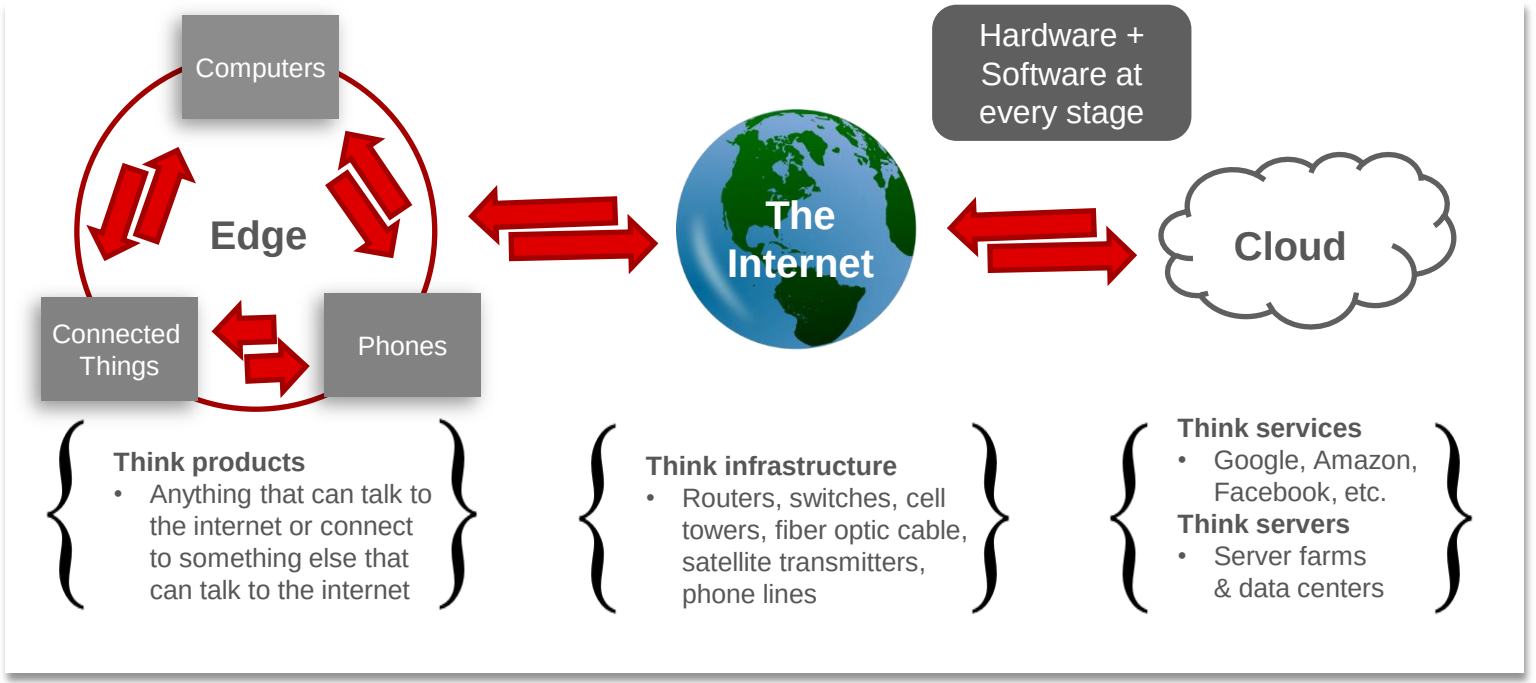
You will learn in this module

- Fundamentals of synchronous serial communication — Lab 11
- Basic operations of a real-time operating system (RTOS) — This lecture
- How to interface a Wi-Fi radio to TI's LaunchPad Development board
- Make use of software driver (set of functions to create an abstract module)
- Connect to cloud services



The Internet of Things; a bird's-eye view

IoT Data passes from physical hardware layers to software layers back and forth, connecting the real and digital worlds



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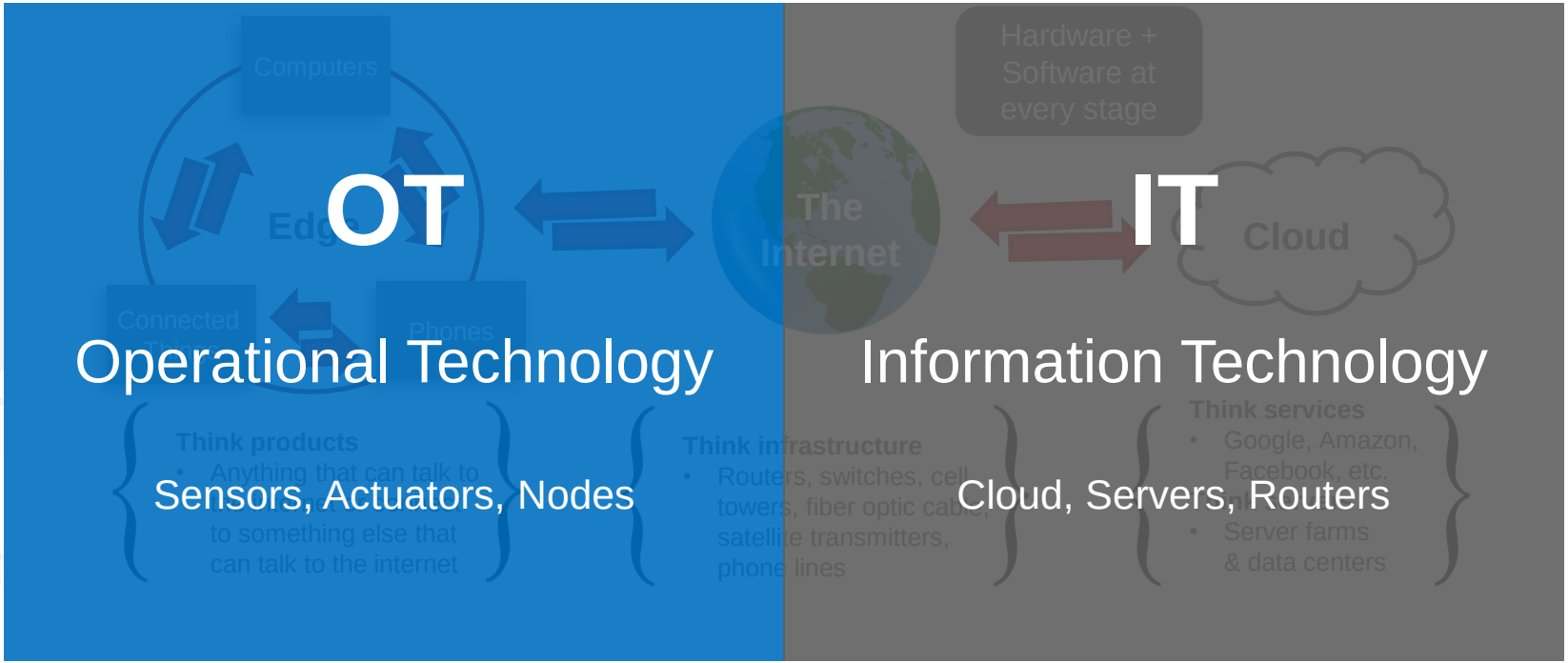


The Wi-Fi standard

Pros
- Ubiquitous infrastructure
- Direct connection to Internet
- Access a wide variety of APIs directly
- Only requires domain expertise in internet and firmware
- High data rate
- Security

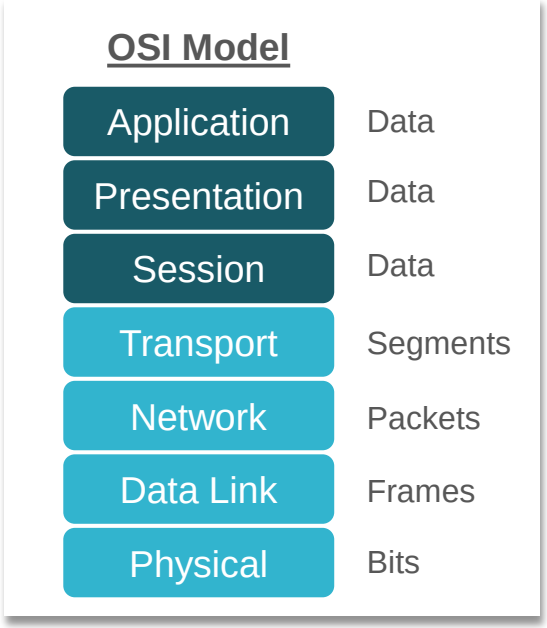
Cons
- Poor for mobile and rural use cases
- Higher power consumption relative to some wireless standards
- Heavily reliant on network availability

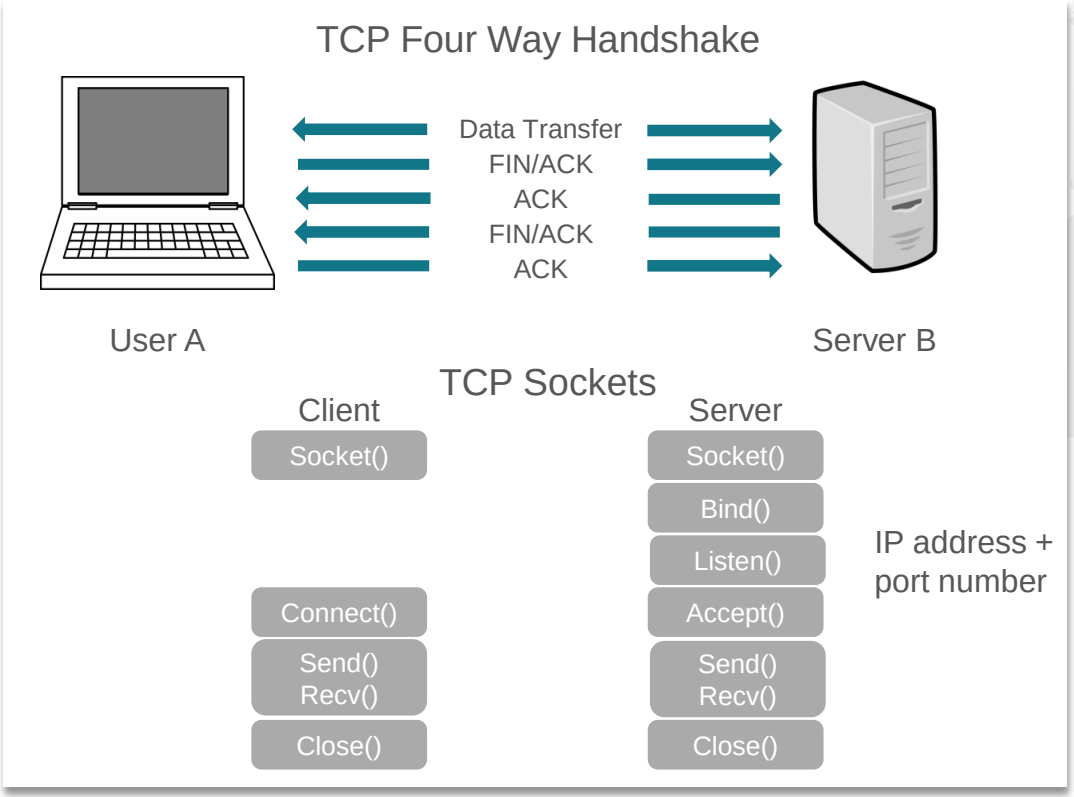
Wi-Fi Primary Use Cases
- Smart Home
- Industrial/Commercial
- Fixed position connectivity
- Medical

TCP/IP

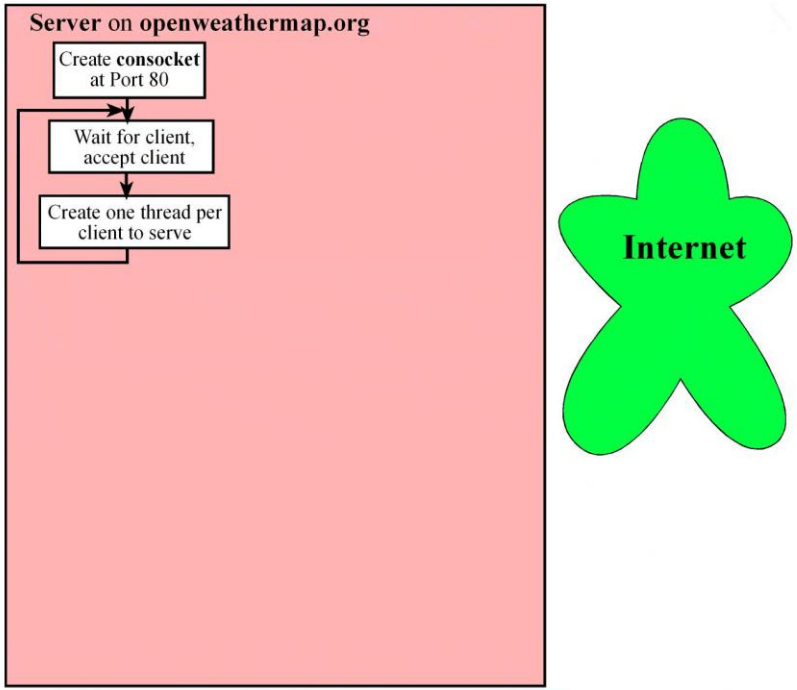
TCP is a more reliable way of Internet communication compared to UDP

- Transport Layer in the OSI model
- Use of Sockets





Client server



SimpleLink™

MCU Platform

One environment.
Unlimited potential.

Texas Instruments

TI SimpleLink™ SDK Software Tools

Software Tools

Code Composer Studio™ IDE	CCS Cloud IDE	Energia IDE
Industry-leading tool suite for advanced optimization	Quickest path to developing a real application	Brings Arduino (Wiring) APIs to TI SimpleLink MCUs

Tool Chain Support

IAR SYSTEMS · KEIL™ Tools by ARM · GCC

Configure → Build → Debug

- PinMux
- GCC
- UniFlash
- EnergyTrace

- Multiple IDE support: TI CCS, CCS Cloud, Energia
- Local & Cloud-based access
- Multiple toolchain options to match your development needs

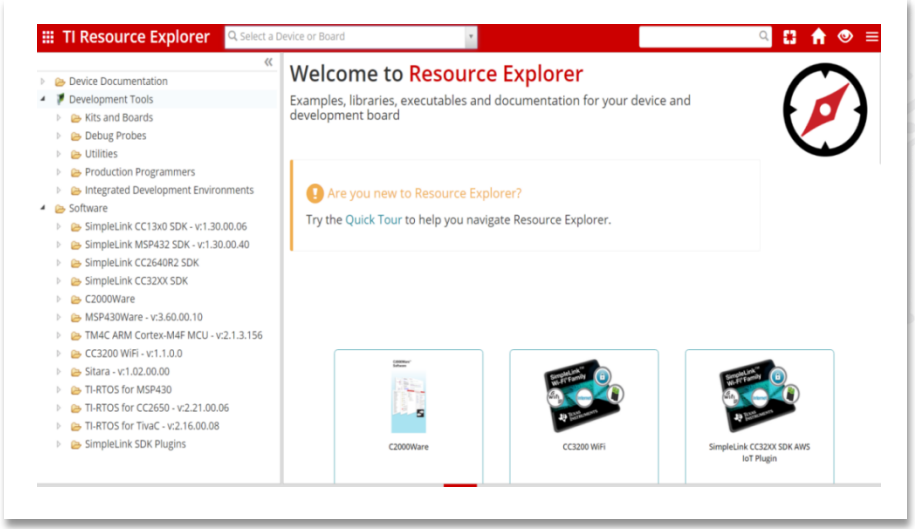
Get things done with TI Cloud Tools *from your web browser*

1. Immerse yourself in SimpleLink ecosystem
2. Import into CCS Cloud IDE
3. Edit, Build, Debug & Flash

Resource Explorer and SimpleLink Academy

Access Resource Explorer to import the latest code examples to CCS

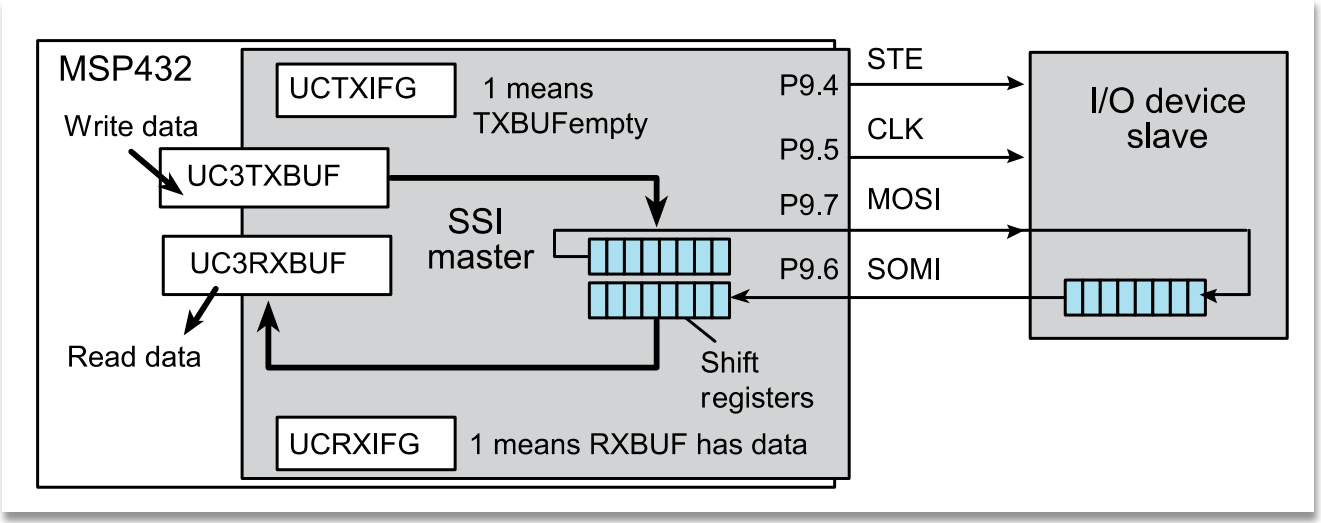
- Accessible from inside CCS (View → Resource Explorer) or from dev.ti.com
- Materials for all TI processors searchable by part number and EVM
- When searching for MSP432 inside Resource Explorer it also contains SimpleLink Academy training with labs that can be imported into CCS that cover topics like TI-RTOS and Connectivity
- Support for TI-RTOS, FreeRTOS, and non-RTOS based code examples



Review of Synchronous Serial Communication on the MSP432

- Synchronous means send clock and data
  - Send data on one edge of clock
  - Receive data on other edge

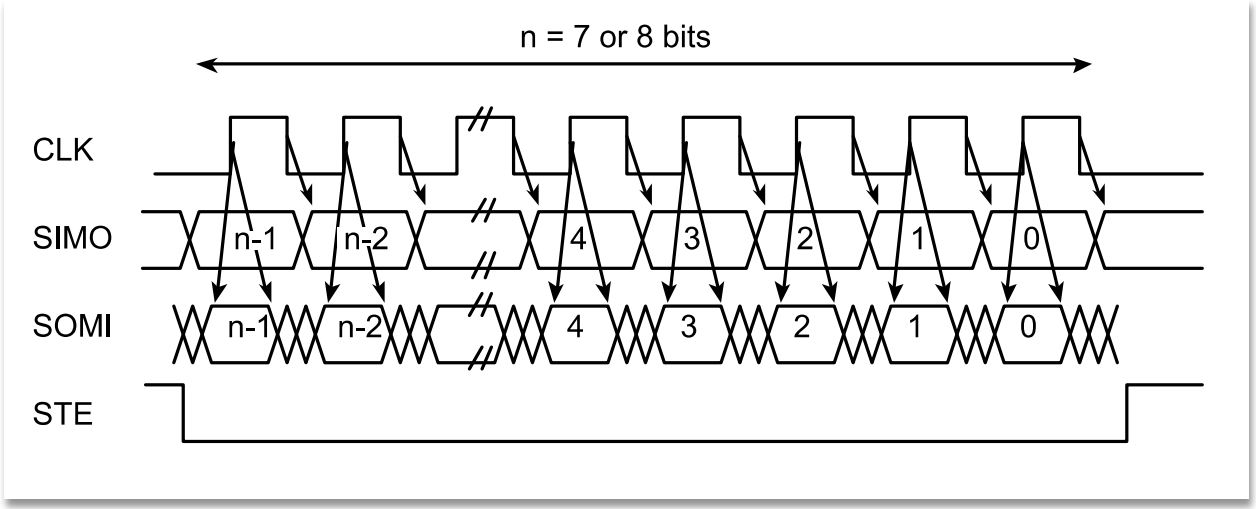
- Serial Peripheral Interface (SPI) Protocol



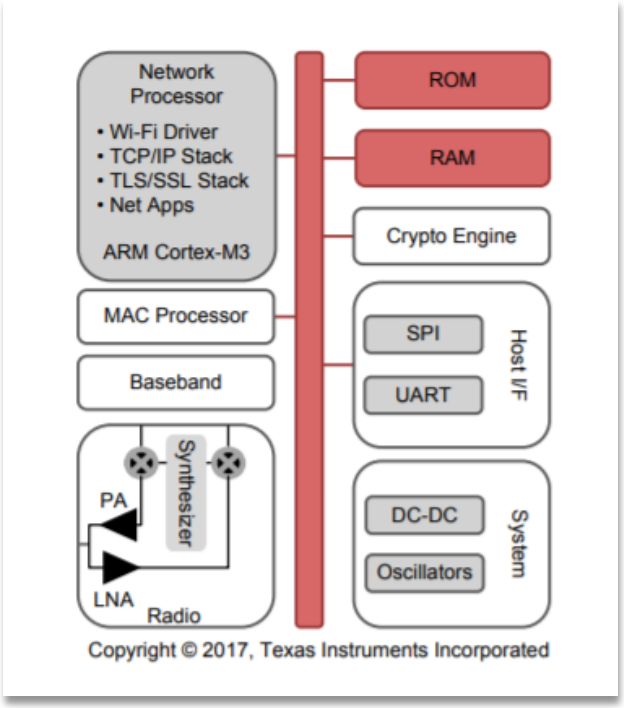
Serial Peripheral Interface (SPI) Timing

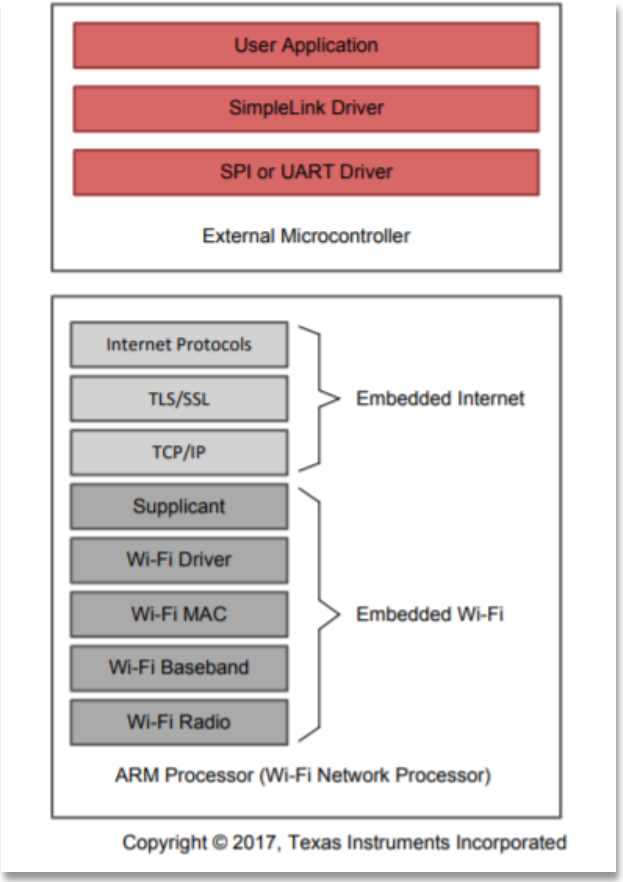
Signals

- Clock
- Data out
- Data in
- Enable



CC3120 Hardware





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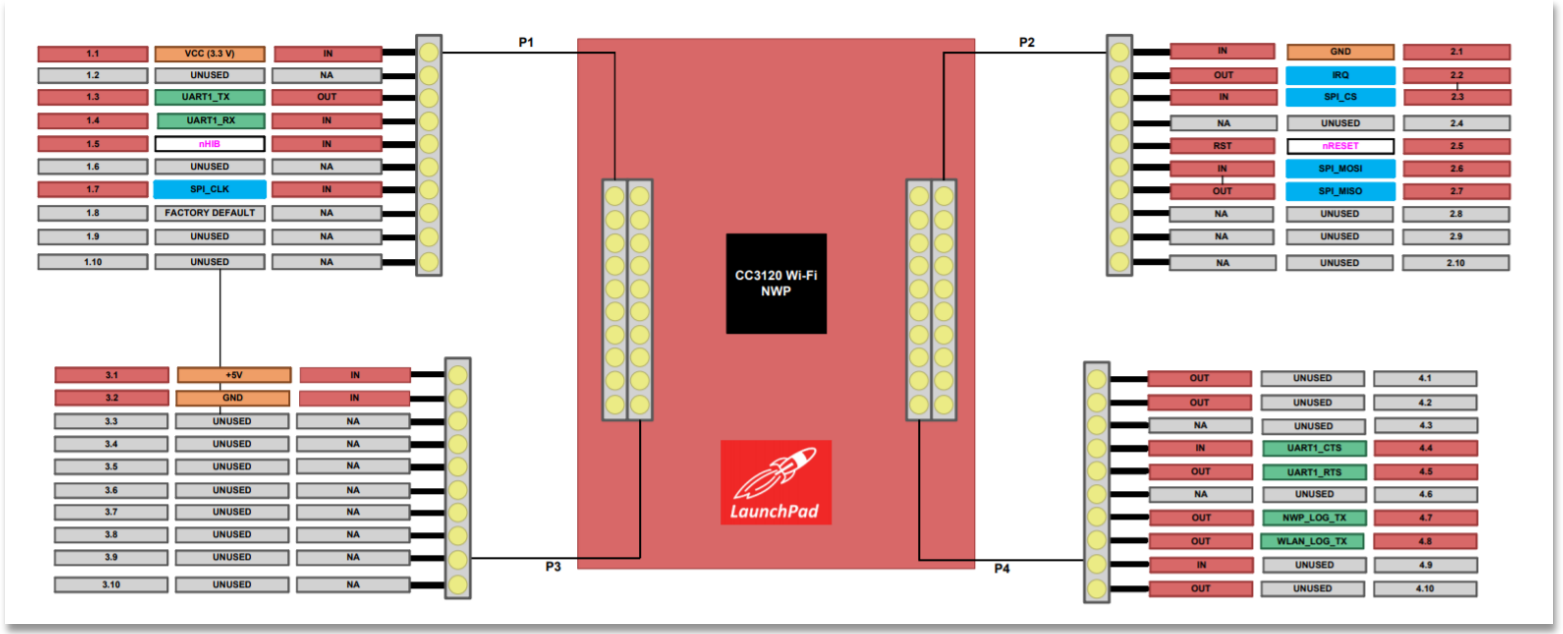
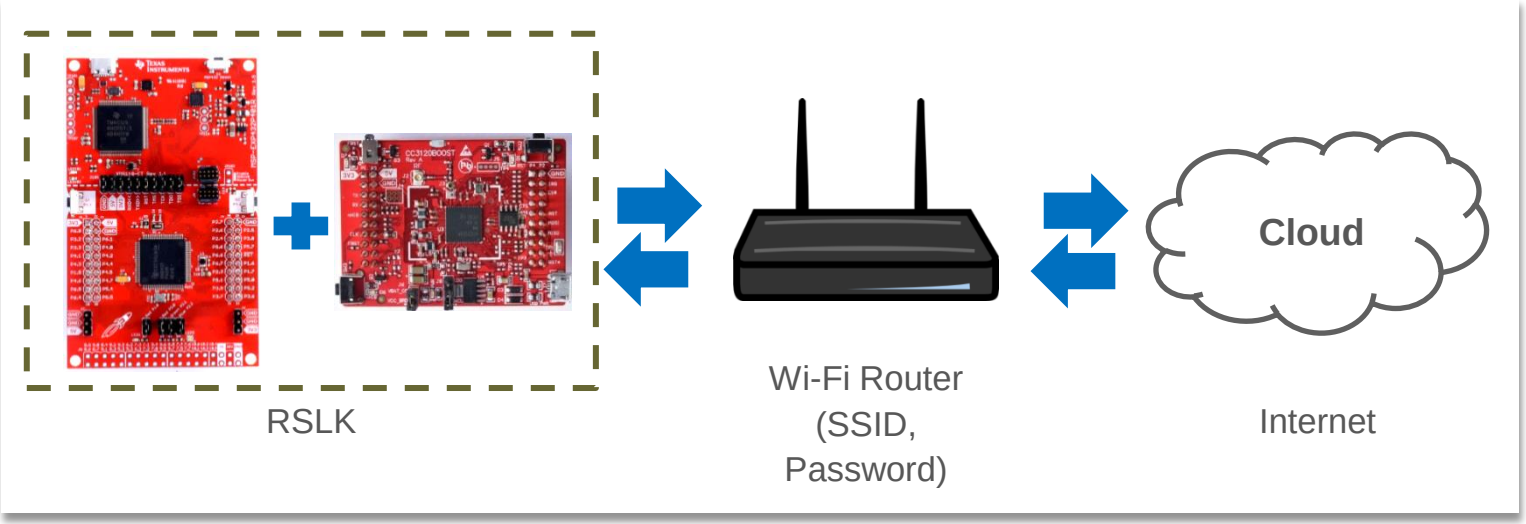


Application

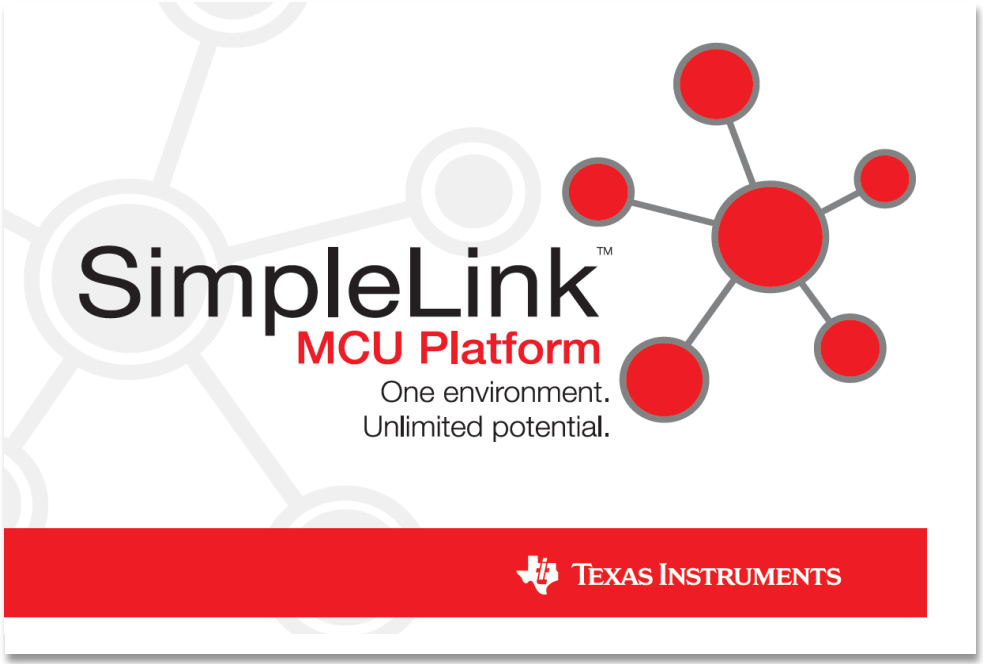
Wi-Fi provides

1. Communication to the robot for remote control or to receive external data
2. Robot can autonomously query information from the web that may be relevant to its operation



Summary

- Internet of Things
- Wi-Fi Standard using SimpleLink
- TCP/IP
- Client-server paradigm
- Review of SPI
- Overview of CC3120



Module 20

Lecture: Wi-Fi RTOS

Wi-Fi

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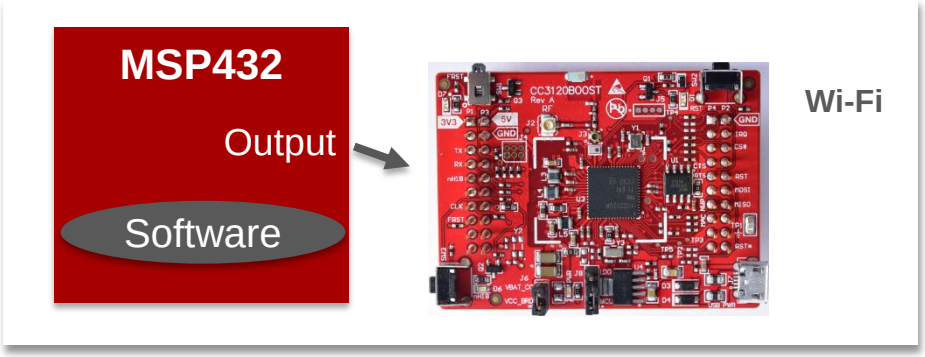
Lab 11

This lecture



TI-RTOS and FreeRTOS

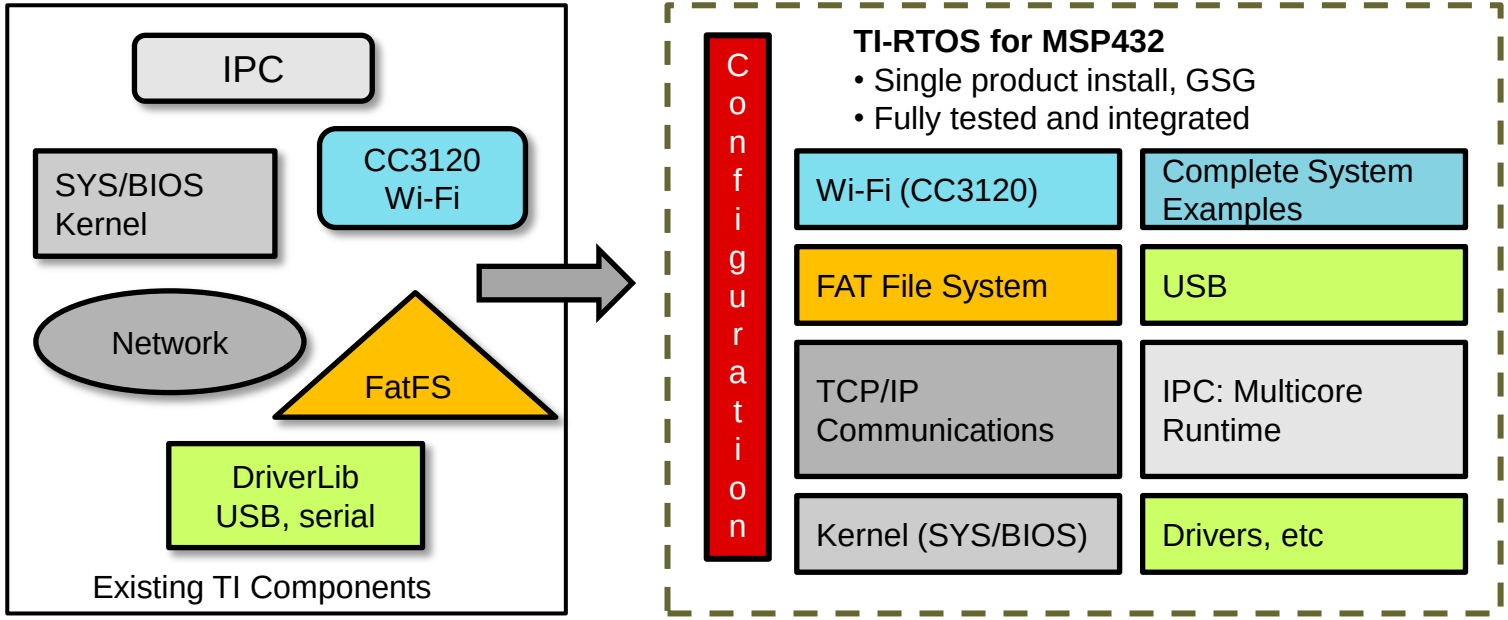
- The use of Real-Time Operating Systems (RTOS) is getting more common for IoT firmware deployment
- A simple operating system can schedule tasks and do a variety of functions
- RTOS helps with maximizing power efficiency, implementing security, managing wireless communication, and other complex functions
- Improves software quality and portability

Download TI-RTOS at ti.com/tool/ti-rtos

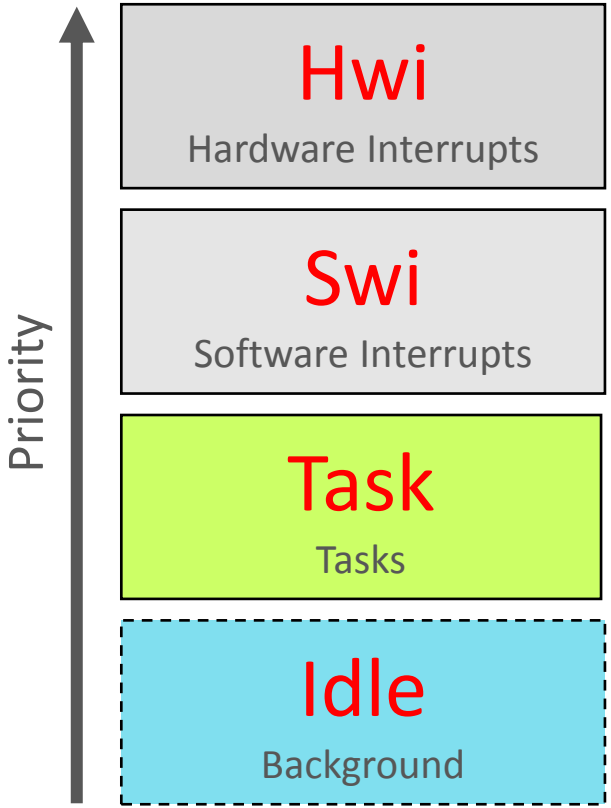
- Many free and open source options available today with TI RTOS and FreeRTOS recommended for TI devices

RTOS Basics

- A Software Development Kit (SDK) that contains a real-time operating system
- Combines kernel (SYS/BIOS) with middleware such as TCP/IP and USB stacks, FAT file system and device drivers that are “BIOS aware”



TI-RTOS Thread Types



- Hardware event triggers Hwi to run
- Hwi triggers follow-up processing
- Priorities set in silicon

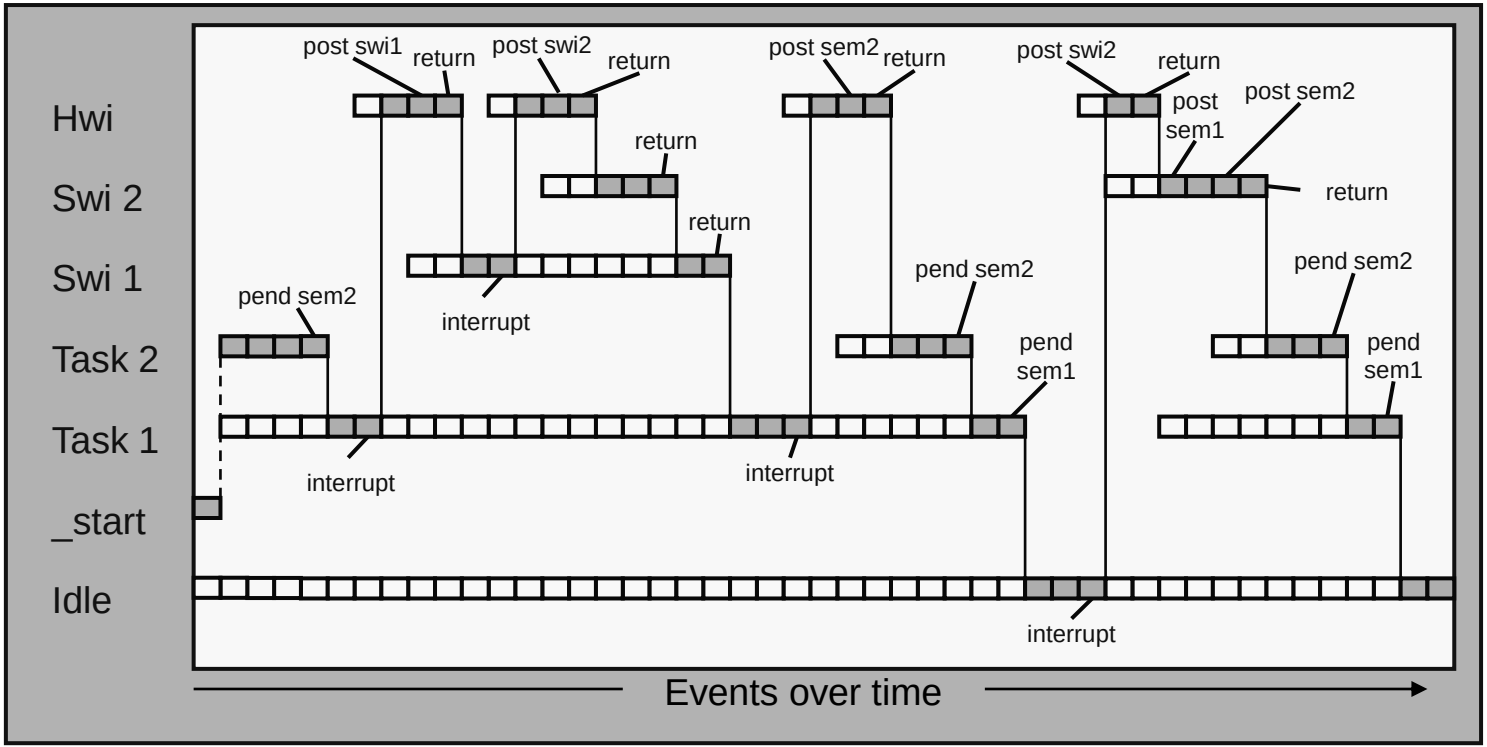
- Software *posts* Swi to run
- Performs Hwi '*follow-up*' activity (process data)

- Usually enabled to run by posting a '*semaphore*' (a task signaling mechanism)
- Designed to run concurrently – pauses when waiting for data (semaphore)

- Runs as an infinite while(1) loop
- Users can assign multiple functions to Idle
- Single priority level

Clocks and Events in RTOS

What kinds of events cause these threads to run?



Summary

- Real-time, responds quickly
- RTOS Basics
- TI-RTOS thread types
- Clocks and Events in RTOS

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