Chapter 5: Connecting to Access Points (AP)

Objective

Finally! After almost a full day we get to WiFi!

We will discuss STA and AP, TCP/IP, DCT

You will connect to the WiFi access point.

TCP/IP Networking Stack

Complex systems are almost always divided into layers

Isolate the user of a layer from the complexity of lower layers

Simplify communication to the layer above it

TCP/IP Network Stack is such a hierarchical system

Each layer has well defined inputs and outputs to the layer above and below

Layer 1: Physical, Protocol: 802.11

Below: Radio Waves

Above: 1's and 0's (stream of bits)

This is the central magic of our WiFi chips – doing this reliably is harder than it seems

- Tx power, Rx sensitivity, Channels, etc.

Layer 2: Datalink, Protocol: 802.11 MAC

Below: Streams of Bits

Above: Frames: A unit of data to transmit – a collection of bytes plus source/destination MAC address

This is layer disappears when you leave the LAN

Layer 3: Network, Protocol: IP

Below: Frames

Above: Packets: This is the currency of the internet

Frame data plus source and destination IP address and CRC

Packets can arrive in any order and are not guaranteed to arrive at all

Layer 4: Transport, Protocol TCP or UDP:

Below: Packets

Above: TCP (reliable, ordered, and error checked stream of bytes)

(Transmission Control Protocol)

Like a pipe – data in one end comes out the other

UDP (not guaranteed order and not guaranteed to be delivered - broadcast)

(User Datagram Protocol)

Datagram: Like sending a letter

Layer 5: Application, Protocol: MQTT, HTTP, DNS, DHCP, etc.

Below: TCP/UDP

Above: HTTP, MQTT, etc.: Data

(Physical/Datalink) Wi-Fi Basics

Station and Access Point

To connect, need to know SSID, Encryption type, and password (if needed)

WICED takes care of the rest (band, channel)

Encryption: Mostly WPA2 in use with 1 of 2 password schemes

PSK (pre shared key)

Enterprise

MAC address is a unique 48-bit number

Datalink layer addresses each frame with a source and destination MAC address

When the Network layer sends a frame (with IP addresses) to the datalink layer, the datalink layer needs to figure out the MAC address for each IP address.

ARP – Address Resolution Protocol

Each device has an ARP table (MAC to IP map)

Each device listens to ARP requests and if it hears its IP address responds with its MAC

If you ARP for an address not on your LAN, the router responds with its MAC

This is what allows the hierarchical routing to happen

Device Configuration Table (DCT)

Table in flash with WiFi information (SSID, password, etc.)

This is where the instructions for wiced_network_up are stored

Programmed into flash but can be read/written by the app on the fly (e.g. to change the AP you will connect to)

Need to add string to the make file

Start with template

3 modes:

1. Client AP (station) – if you are station, this is the AP you will connect to
2. Soft AP (access point)
3. Config AP (access point only for configuration)

How to find available values (right click)

Hierarchical nature of the DCT structure – talk through hierarchy

Point out paragraphs on how to read/write

Needs to be done in sections

The WICED Wi-Fi SDK

wiced_network_up is the magic of WICED studio – just make one call and you are connected

Interface is STA, AP, P2P or Ethernet

Config is how you get IP address, netmask, etc. Can be static or DHCP

IP_Settings is a structure it settings if you use static, otherwise NULL

WICED_RESULT_T

returned by many functions

just a giant enumeration - good idea to look at return values and print to UART in key places

Documentation

Components→Management→Network Management

Components→IP Communication→Raw IP.

WICED-DCT.pdf

Introducers

Introducers – how you get your IoT to connect to WiFi

1. Use Bluetooth to configure WiFi settings
2. Use a USB or serial connection
3. Have the IoT device act as an AP until it is configured, then it becomes a STA
4. Pre-program

We will mostly use method 4 for simplicity

Exercise(s)

60 minutes

Point out where the AP name and password are located on the manual

Tell them to open a serial terminal window