

IoT Security and Privacy

Assignment 3 – ESP32 UART and Flash Hack

(10 points)

Kush Patel
Worked with Ishan Patel

Questions

1. There are three serial ports on the ESP32. UART0 is often used for programming and communication with outside of ESP32 while the other two UART ports are unused. For example, the Micro-USB connector of our IoT kit is connected to UART0 through a USB-UART bridge chip. If there is no protection of UART0, a hacker can access the flash through UART.

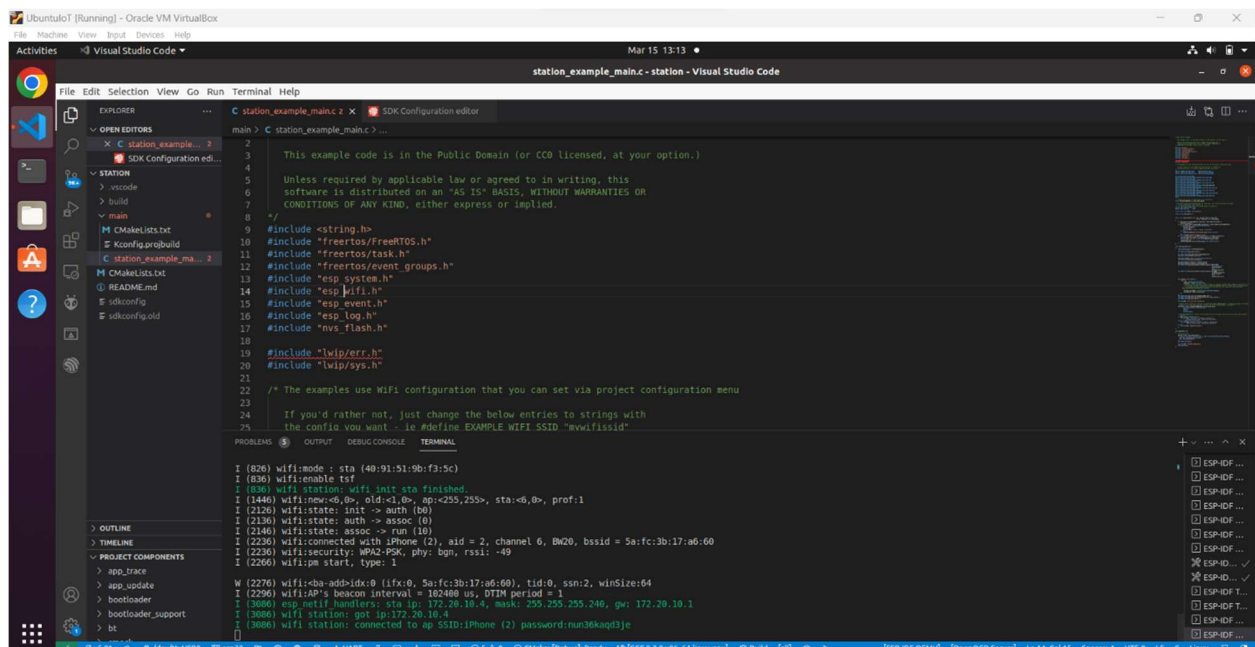
- a. Please explain how a hacker may identify UART pins on a PCB if there is no obvious label for the UART. (1 point)

A hacker can use a couple different methods. They can do trial and error until they identify the UART pins. They can also use a multimeter to test the continuity between different components on the PCB

- b. The access to UART can be protected by a password if the firmware is written properly. That is, a user must enter the correct password to upload firmware and communicate with the IoT kit. Please discuss how a hacker may recover the password. (1 point)

One way is to use brute force until the correct password is found. Another way is to use read the binary code and use malware analysis techniques/tools.

2. Please read [ESP32 UART and Flash Hack](#) at GitHub. Read [Build and run the WiFi station firmware](#). Use a screenshot to show the ESP32 is connected to a WiFi router (e.g., a hotspot on a smartphone) with the firmware from the WiFi station example project. (2 points)

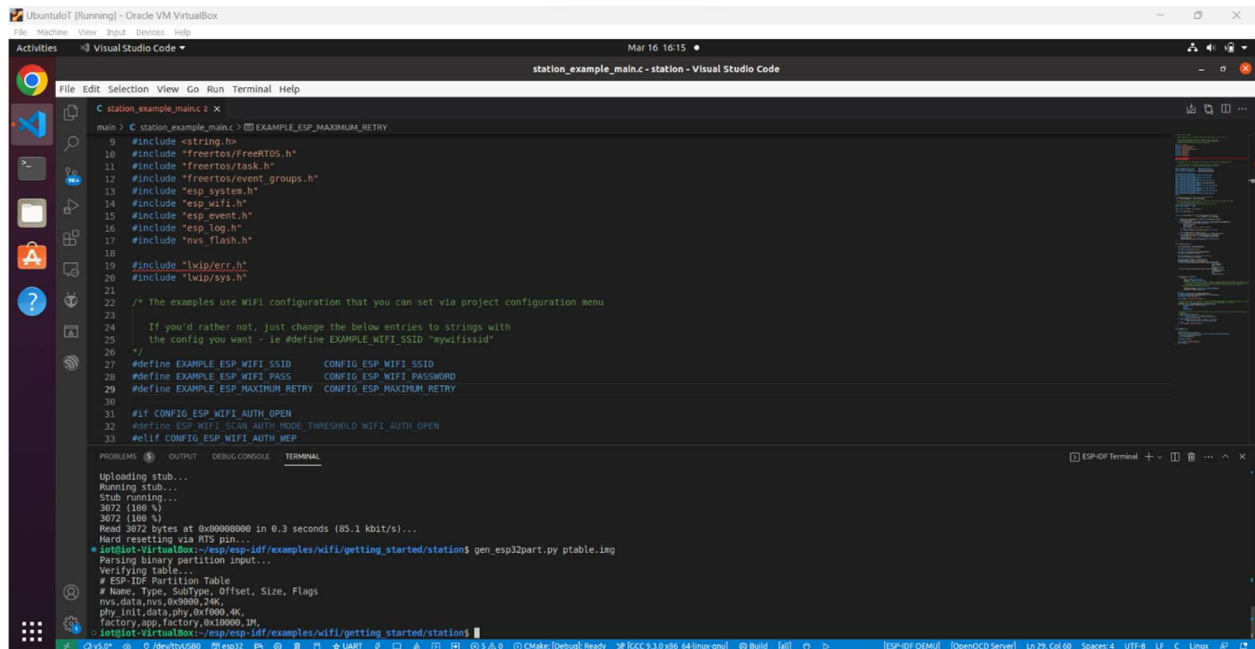


The screenshot shows the Visual Studio Code editor with the 'station_example_main.c' file open. The code includes headers for string, freertos, event groups, esp system, esp wifi, esp event, esp log, nvs flash, lwip err, and lwip sys. It also includes a comment about WiFi configuration. The terminal output shows the following log messages:

```
I (826) wifi:mode : sta (40:91:51:9b:f3:5c)
I (830) wifi:enable txf
I (830) wifi:station wifi init sta finished.
I (1446) wifi:new=<0,0>, old=<1,0>, ap=<255,255>, sta=<0,0>, prof:1
I (2126) wifi:state: init -> auth (0)
I (2126) wifi:state: auth -> assoc (0)
I (2146) wifi:state: assoc -> run (10)
I (2226) wifi:connected with iPhone (2), aid = 2, channel 6, Bn20, bssid = 5a:fc:3b:17:a6:60
I (2226) wifi:security: WPA2-PSK, phy: bgn, rssi: -49
I (2266) wifi:pm start, type: 1
W (2276) wifi:ba-add-idx:0 (lfx:0, Ssfc:3b:17:a6:60), tid:0, ssn:2, winSize:64
I (2296) wifi:AP's beacon interval = 102400 us, DTIM period = 1
I (3086) esp_wifi_handlers: sta ip: 172.20.10.4, mask: 255.255.255.240, gw: 172.20.10.1
I (3086) wifi station: got ip:172.20.10.4
I (3086) wifi station: connected to ap SSID: iPhone (2) password:run36kaq3je
```

3. Please read [Retrieve partition table](#).

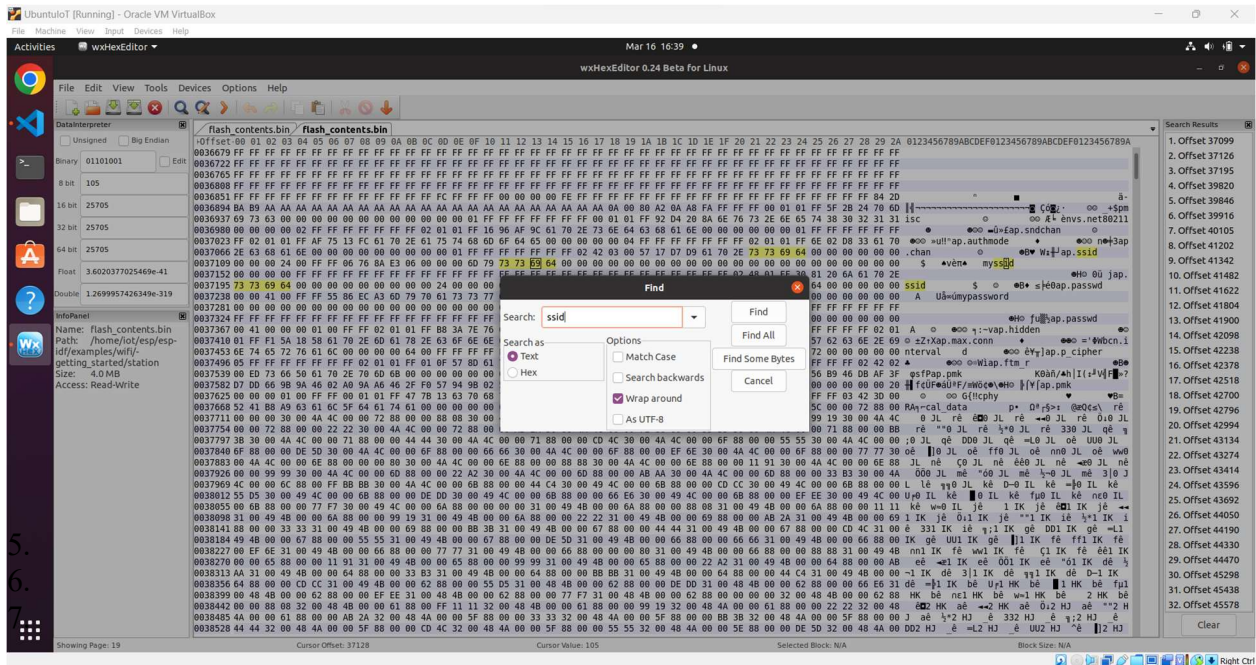
a. Use a screenshot to show the partition table of the ESP32. (1 point)



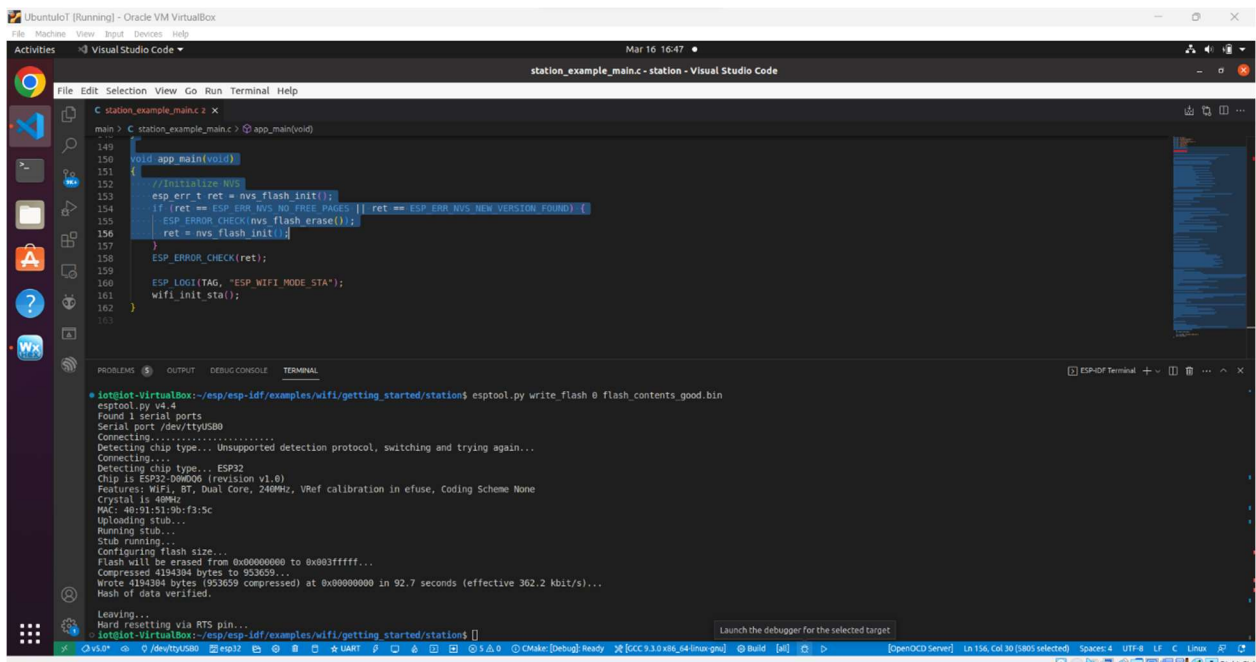
```
main > C:\station_example_main.c > EXAMPLE_ESP_MAXIMUM_RETRY
9 #include <string.h>
10 #include "freertos/FreeRTOS.h"
11 #include "freertos/task.h"
12 #include "freertos/event_groups.h"
13 #include "esp_system.h"
14 #include "esp_wifi.h"
15 #include "esp_event.h"
16 #include "esp_log.h"
17 #include "nvs_flash.h"
18
19 #include "lwip/err.h"
20 #include "lwip/sys.h"
21
22 /* The examples use WiFi configuration that you can set via project configuration menu
23
24 If you'd rather not, just change the below entries to strings with
25 the config you want - ie #define EXAMPLE_WIFI_SSID "mywifissid"
26 */
27 #define EXAMPLE_ESP_WIFI_SSID      CONFIG_ESP_WIFI_SSID
28 #define EXAMPLE_ESP_WIFI_PASS      CONFIG_ESP_WIFI_PASSWORD
29 #define EXAMPLE_ESP_MAXIMUM_RETRY  CONFIG_ESP_MAXIMUM_RETRY
30
31 #if CONFIG_ESP_WIFI_AUTH_OPEN
32 #define ESP_WIFI_SEC_AUTH_MODE    THRESHOLD_WIFI_AUTH_OPEN
33 #elif CONFIG_ESP_WIFI_AUTH_WEP
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4. Please read [Search firmware for sensitive info](#). Use a screenshot to show the WiFi password can be found in the firmware within a hex editor such as wxHexEditor. (2 points)



5. Please read [Change the firmware](#).
- a. Use a screenshot to show esptool.py can be used to write the changed firmware back to the ESP32. (1 point)



- b. With the changed firmware, can the ESP32 still connect to the WiFi router? Why?
(1 point)

No, because the password to the wifi has been changed.