

Answer Key

Chapter 02

Exercise 01

1. The table at the top of platform.h says that WICED_SH_LED0 connects to WICED_GPIO_7, Arduino header D10, and WICED_PWM_2. Explain how this mapping was determined. You will need to refer to platform.h, platform.c and the schematic for the base board.

From platform.h line 403, WICED_SH_LED1 is mapped to WICED_GPIO_7

From platform.c line 48, WICED_GPIO_7 is assigned to PIN_GPIO_11

From platform.c line 119, PIN_GPIO_11 is assigned to WICED_PWM_2

From the schematic page 9, GPIO_11 connects to D10

Exercise 02

1. Why can't you read the value of the LED using the *wiced_gpio_input_get* function instead of using a variable to remember the state?

The *wiced_gpio_input_get* function is only valid if the pin is configured as an input pin.

2. In what file and on what line does the WICED_SH_LED1 get assigned to the correct pin for this kit?

platform.h, line 360.

3. In what file and on what line is the pin connected to the LED set as an output?

platform.c, line 333.

Exercise 08

1. What I2C addresses are found?

0x42 Analog Co-processor

0x3C OLED Display

0x33 ADC

Chapter 03

Exercise 02

1. Do you need `wiced_rtos_delay_milliseconds` in the LED thread? Why or why not?

No, because the semaphore causes the thread to suspend until it is set by the button ISR.

2. What happens if you use a value of 100 for the semaphore timeout? Why?

The LED will blink every 100ms because the semaphore will timeout even when the button is not pressed.

Exercise 03

1. What happens if you forget to unlock the mutex in one of the threads? Why?

That thread will keep running but the other thread will stay suspended because it can never get access to the mutex.

2. Do the LEDs still blink? Why?

One of the LEDs will not blink and one of the print statements will not execute (the one that doesn't unlock the mutex will continue to blink but the other one will not).

Exercise 05

1. Can the main application loop be empty in this case? Why?

Yes, because there is only one thread. It doesn't matter that the main thread never suspends.

2. What happens if you don't remove the `while(1)` loop from the function that blinks the LED? Why?

The LED will appear to stay on all the time (in fact, it is blinking on/off rapidly) so it appears dim. The reason is that as soon as the timer executes the LED blinking function once, it never exits so it continually blinks the LED with no delay.

Chapter 07b

Exercise 03

1. How do the MQTT library functions (e.g. `wiced_mqtt_publish`) get into your project?

The line `$(NAME)_COMPONENTS := protocols/MQTT` in the make file causes the MQTT library functions to be included in the project.

2. What function is called when the button is pressed?

`publish_callback`

3. How does the button callback unlock the main thread?

It sets a semaphore using `"wiced_rtos_set_semaphore(&wake_semaphore);"`

4. What WICED-SDK RTOS mechanism does the `"wait_for_response"` function use to `"wait"`?

It gets a semaphore using `"wiced_rtos_get_semaphore(&msg_semaphore, timeout)"`

5. Why did the firmware author create a function called `"wait_for_response"`?

This function is used in several of the functions in the main application to cause the thread to sleep until a specific MQTT event occurs.

6. Are all messages sent to the AWS IOT MQTT Message Broker required to be in JSON format?

No, but messages that affect the shadow have to be JSON.

7. What are the 7 WICED MQTT events? What file are they defined in?

`WICED_MQTT_EVENT_TYPE_CONNECT_REQ_STATUS`
`WICED_MQTT_EVENT_TYPE_DISCONNECTED`
`WICED_MQTT_EVENT_TYPE_PUBLISHED`
`WICED_MQTT_EVENT_TYPE_SUBSCRIBED`
`WICED_MQTT_EVENT_TYPE_UNSUBSCRIBED`
`WICED_MQTT_EVENT_TYPE_PUBLISH_MSG_RECEIVED`
`WICED_MQTT_EVENT_TYPE_UNKNOWN`
They are defined in `mqtt_common.h`.

8. Do you have to name the client certificate `client.cer`? How would you change the name?

No, the name can be changed in the make file `$(NAME)_RESOURCES`.

9. What is the naming convention used to differentiate WICED MQTT library functions versus wrappers around those functions in the publisher app?

The library functions all start with `"wiced_mqtt"` while the wrapper functions start with `"mqtt"`.

10. What steps are required to get an MQTT connection established?

- Initialize `wiced_mqtt_security_t` with the credentials from the DCT using `resource_get_readonly_buffer`
- Allocate memory for the MQTT object using `malloc`

- Get the IP address of the MQTT message broker using `wiced_hostname_lookup`.
- Call `wiced_mqtt_init` to initialize.
- Call `mqtt_open_connection` to open the connection.

11. What prevents a hung connection from deadlocking the publisher app?

The `wait_for_response` function has a timeout parameter that is passed as a timeout to the semaphore.

12. What is the name of the flag that prevents the firmware from sending multiple button presses before the publish is finished?

`pub_in_progress`

Exercise 06

1. What is the sequence of events that changes the LED from On to Off?

- A shadow */update* message is published by the device. This contains a JSON message to turn off the LED.
- The document is updated and a shadow */update/documents* message is published by AWS.
- A shadow */update/accepted* message is published by AWS.