# **Answer Key**

## Chapter 02

### Exercise 01

1. Which WICED GPIO pin is WICED\_PWM\_1 connected to?

WICED\_GPIO\_11

1. Which module pin is WICED\_PWM\_1 connected to?

MICRO\_I2C1\_SCL

1. Which Arduino header pin is WICED\_PWM\_1 connected to?

D15

### Exercise 03

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.

1. In what file and on what line does the WICED\_LED1 get assigned to the correct pin for this kit?

platform.h, line 203.

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

platform.c, line 491.

### Exercise 13

1. What addresses are found on the shield?

0x08 – Analog Co-processor

0x50, 0x51 - FRAM

## Chapter 03

### Exercise 02

1. Do you need *wiced\_rtos\_delay\_millisecon*ds 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.

1. 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.

1. 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 than the main thread never suspends.

1. 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.

1. Run the debugger. How many threads are in this application?

There are 5 threads: app, system monitor, 2 worker threads, and WWD.

## 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.

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

publish\_callback

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

It sets a semaphore using “wiced\_rtos\_set\_semaphore( &wake\_semaphore );”

1. 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 )”

1. 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.

1. 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.

1. 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.

1. 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).

1. 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”.

1. 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.

1. 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.

1. 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.