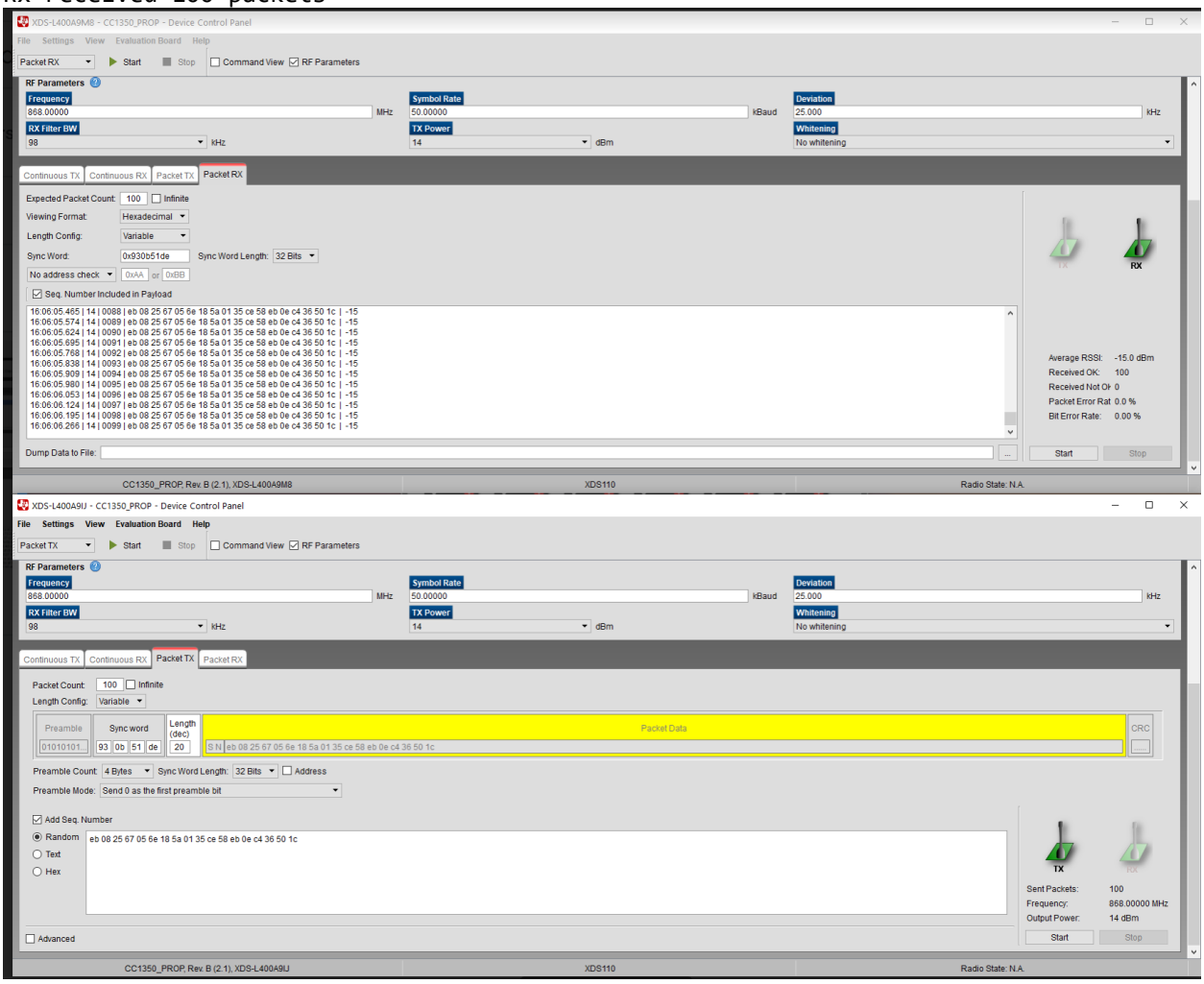
Tenniel Takenaka-Fuller
Github root directory: Please see webcampus submission for link.

Date Submitted: **11/17/19**

Task 01:

Youtube Link: https://youtu.be/bu7-8PtorkA

Rx received 100 packets



Task 02:

Youtube Link: https://youtu.be/nEkJP2sRmuE

Run RF packet example

<u>Grading scheme:</u> 30% Coding, 30% Documentation, 40% Execution/Video.

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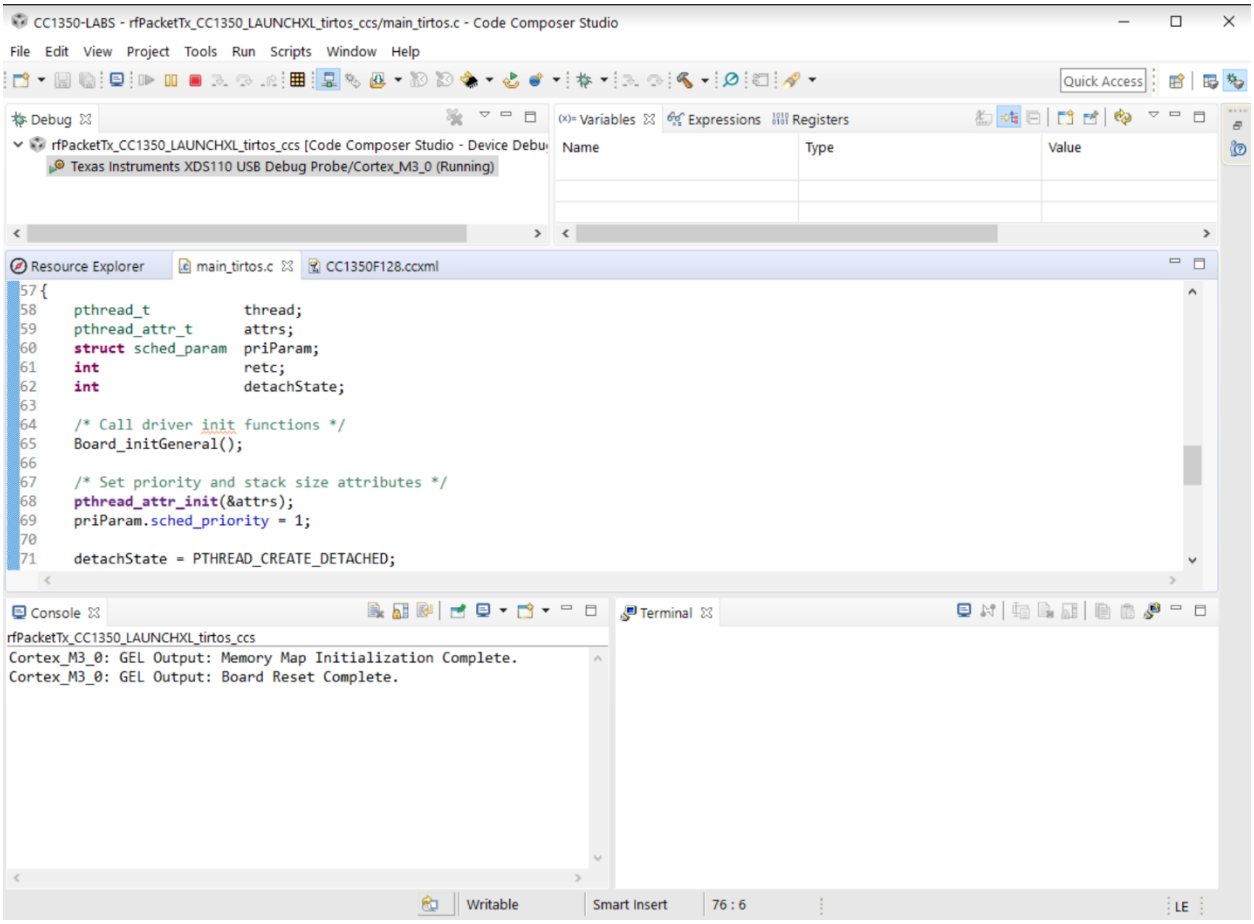

Task 03:

Youtube Link: https://youtu.be/xTbTA79hZoc
Code export screenshot example

Grading scheme: 30% Coding, 30% Documentation, 40% Execution/Video.

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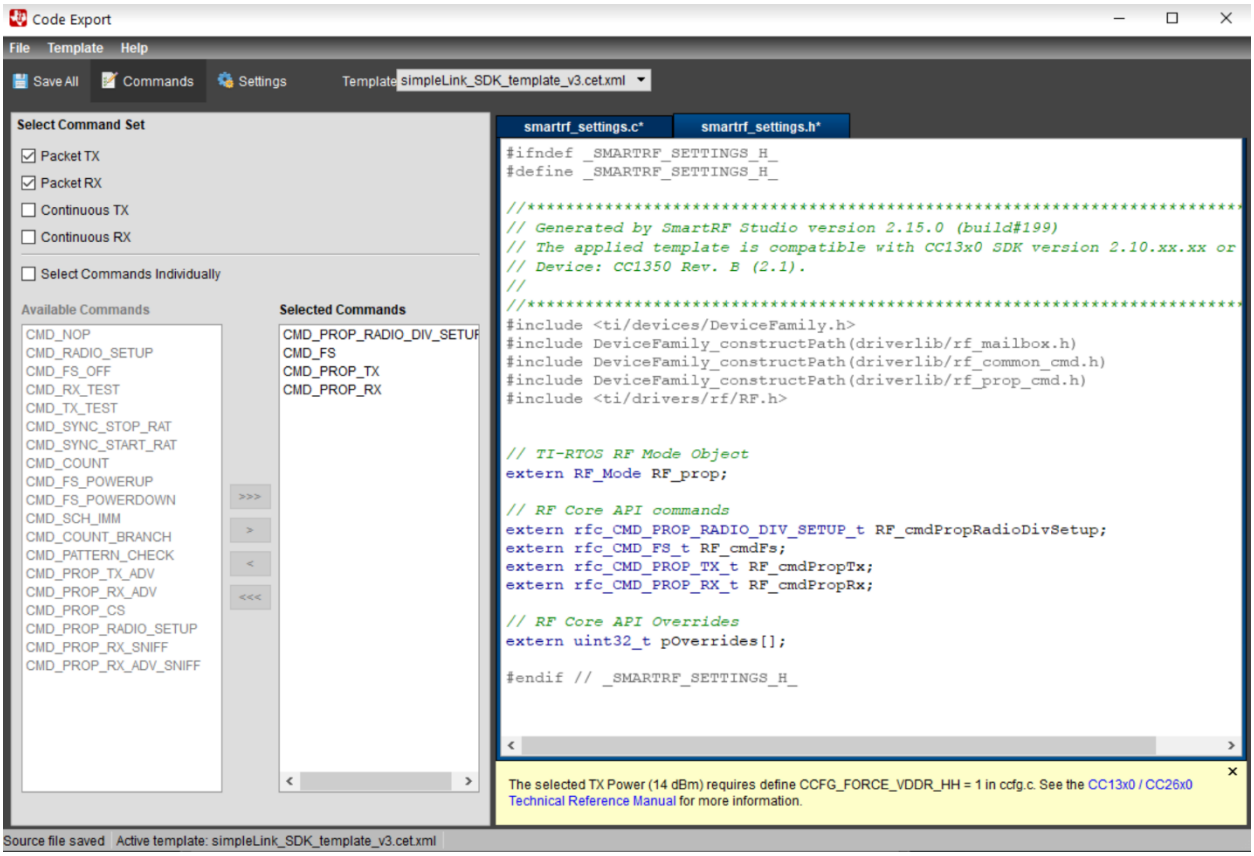
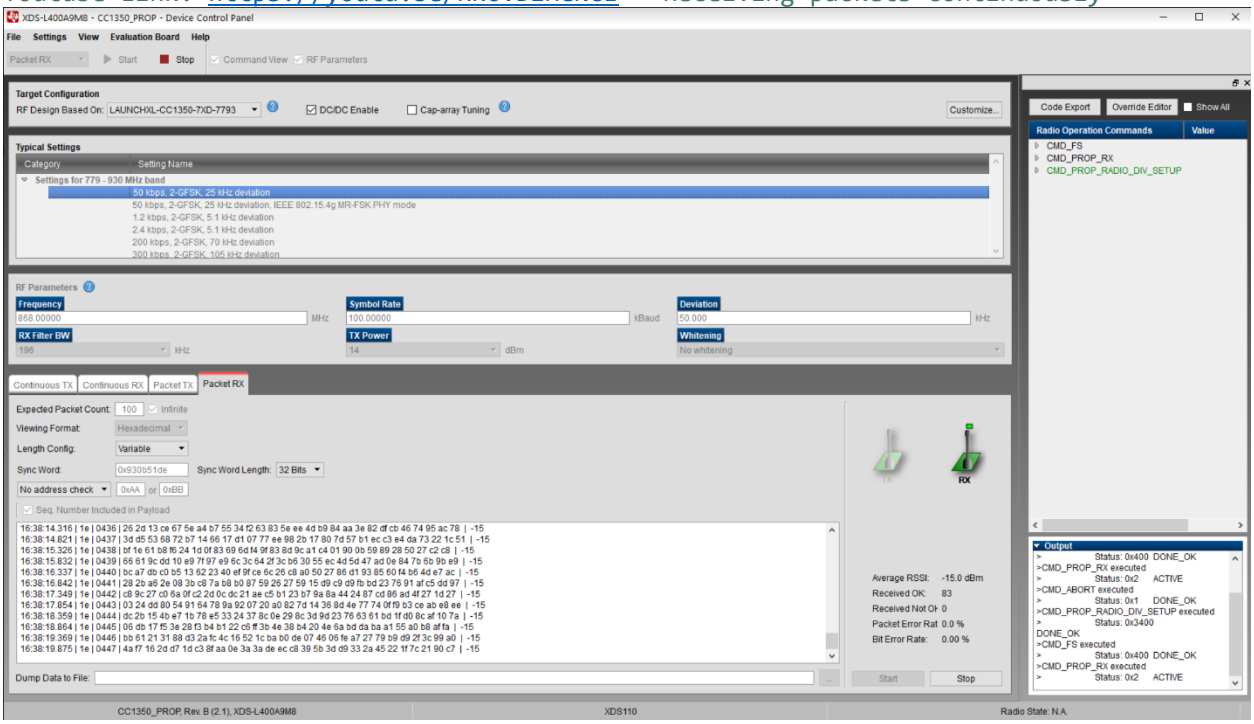


Task 04:

Youtube Link: https://youtu.be/RK6VBzHGNcE - Receiving packets continuously



Grading scheme: 30% Coding, 30% Documentation, 40% Execution/Video.

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Task 05:

Youtube Link: No youtube link required since it is a very short task.

Task 6 & 7:

Youtube Link: https://youtu.be/5sQGqIG02jI

No screenshot since it was just the same as task 1 where the TX is transmitting, and the RX is receiving. The lights are shown in the youtube video, however, that for every receive RX blinks red and for every transmit TX blinks green.

Task 08:

RF Packet TX.c

```
/***** Includes *****/
/* Standard C Libraries */
#include <stdlib.h>
#include <unistd.h>

/* TI Drivers */
#include <ti/drivers/rf/RF.h>
#include <ti/drivers/PIN.h>
#include <ti/drivers/pin/PINCC26XX.h>

/* Driverlib Header files */
#include DeviceFamily_constructPath(driverlib/rf_prop_mailbox.h)

/* Board Header files */
#include "Board.h"
#include "smartrf_settings/smartrf_settings.h"

/***** Defines *****/

/* Do power measurement */
//#define POWER_MEASUREMENT

/* Packet TX Configuration */
#define PAYLOAD_LENGTH      30
#ifdef POWER_MEASUREMENT
#define PACKET_INTERVAL     5  /* For power measurement set packet
interval to 5s */
#else
#define PACKET_INTERVAL     500000  /* Set packet interval to 500000us or
500ms */
#endif
```

Grading scheme: 30% Coding, 30% Documentation, 40% Execution/Video.

```
/***** Prototypes *****/

/***** Variable declarations *****/
static RF_Object rfObject;
static RF_Handle rfHandle;

/* Pin driver handle */
static PIN_Handle ledPinHandle;
static PIN_State ledPinState;

static uint8_t packet[PAYLOAD_LENGTH];
static uint16_t seqNumber;

/*
 * Application LED pin configuration table:
 *   - All LEDs board LEDs are off.
 */
PIN_Config pinTable[] =
{
    Board_PIN_LED1 | PIN_GPIO_OUTPUT_EN | PIN_GPIO_LOW | PIN_PUSHPULL |
PIN_DRVSTR_MAX,
#ifdef POWER_MEASUREMENT
#if defined(Board_CC1350_LAUNCHXL)
    Board_DIO30_SWPWR | PIN_GPIO_OUTPUT_EN | PIN_GPIO_HIGH | PIN_PUSHPULL
| PIN_DRVSTR_MAX,
#endif
#endif
    PIN_TERMINATE
};

/***** Function definitions *****/

void *mainThread(void *arg0)
{
    RF_Params rfParams;
    RF_Params_init(&rfParams);

    /* Open LED pins */
    ledPinHandle = PIN_open(&ledPinState, pinTable);
    if (ledPinHandle == NULL)
    {
        while(1);
    }

#ifdef POWER_MEASUREMENT
#if defined(Board_CC1350_LAUNCHXL)
    /* Route out PA active pin to Board_DIO30_SWPWR */
    PINCC26XX_setMux(ledPinHandle, Board_DIO30_SWPWR,
PINCC26XX_MUX_RFC_GPO1);
#endif
#endif

    RF_cmdPropTx.pktLen = PAYLOAD_LENGTH;
    RF_cmdPropTx.pPkt = packet;
```

```
    RF_cmdPropTx.startTrigger.triggerType = TRIG_NOW;

    /* Request access to the radio */
#if defined(DeviceFamily_CC26X0R2)
    rfHandle = RF_open(&rfObject, &RF_prop,
(RF_RadioSetup*)&RF_cmdPropRadioSetup, &rfParams);
#else
    rfHandle = RF_open(&rfObject, &RF_prop,
(RF_RadioSetup*)&RF_cmdPropRadioDivSetup, &rfParams);
#endif// DeviceFamily_CC26X0R2

    /* Set the frequency */
    RF_postCmd(rfHandle, (RF_Op*)&RF_cmdFs, RF_PriorityNormal, NULL, 0);

    while(1)
    {
        /* Create packet with incrementing sequence number and random
payload */
        packet[0] = (uint8_t)(seqNumber >> 8);
        packet[1] = (uint8_t)(seqNumber++);
        uint8_t i;
        for (i = 2; i < PAYLOAD_LENGTH; i++)
        {
            packet[i] = Board_ADCBUF0; //transmit adc values
        }

        /* Send packet */
        RF_EventMask terminationReason = RF_runCmd(rfHandle,
(RF_Op*)&RF_cmdPropTx,
                                                   RF_PriorityNormal,
NULL, 0);

        switch(terminationReason)
        {
            case RF_EventLastCmdDone:
                // A stand-alone radio operation command or the last radio
                // operation command in a chain finished.
                break;
            case RF_EventCmdCancelled:
                // Command cancelled before it was started; it can be
caused
            // by RF_cancelCmd() or RF_flushCmd().
                break;
            case RF_EventCmdAborted:
                // Abrupt command termination caused by RF_cancelCmd() or
                // RF_flushCmd().
                break;
            case RF_EventCmdStopped:
                // Graceful command termination caused by RF_cancelCmd()
or
                // RF_flushCmd().
                break;
            default:
                // Uncaught error event
```

Grading scheme: 30% Coding, 30% Documentation, 40% Execution/Video.

```
                while(1);
        }

        uint32_t cmdStatus = ((volatile RF_Op*)&RF_cmdPropTx)->status;
        switch(cmdStatus)
        {
            case PROP_DONE_OK:
                // Packet transmitted successfully
                break;
            case PROP_DONE_STOPPED:
                // received CMD_STOP while transmitting packet and
finished
                // transmitting packet
                break;
            case PROP_DONE_ABORT:
                // Received CMD_ABORT while transmitting packet
                break;
            case PROP_ERROR_PAR:
                // Observed illegal parameter
                break;
            case PROP_ERROR_NO_SETUP:
                // Command sent without setting up the radio in a
supported
                // mode using CMD_PROP_RADIO_SETUP or CMD_RADIO_SETUP
                break;
            case PROP_ERROR_NO_FS:
                // Command sent without the synthesizer being programmed
                break;
            case PROP_ERROR_TXUNF:
                // TX underflow observed during operation
                break;
            default:
                // Uncaught error event - these could come from the
                // pool of states defined in rf_mailbox.h
                while(1);
        }

#ifndef POWER_MEASUREMENT
        PIN_setOutputValue(ledPinHandle,
Board_PIN_LED1,!PIN_getOutputValue(Board_PIN_LED1));
#endif
        /* Power down the radio */
        RF_yield(rfHandle);

#ifdef POWER_MEASUREMENT
        /* Sleep for PACKET_INTERVAL s */
        sleep(PACKET_INTERVAL);
#else
        /* Sleep for PACKET_INTERVAL us */
        usleep(PACKET_INTERVAL);
#endif

    }
}
```

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RF PACKET RX.c

```
/***** Includes *****/
/* Standard C Libraries */
#include <stdlib.h>

/* TI Drivers */
#include <ti/drivers/rf/RF.h>
#include <ti/drivers/PIN.h>

/* Driverlib Header files */
#include DeviceFamily_constructPath(driverlib/rf_prop_mailbox.h)

/* Board Header files */
#include "Board.h"

/* Application Header files */
#include "RFQueue.h"
#include "smartrf_settings/smartrf_settings.h"

/***** Defines *****/

/* Packet RX Configuration */
#define DATA_ENTRY_HEADER_SIZE 8  /* Constant header size of a Generic
Data Entry */
#define MAX_LENGTH             30 /* Max length byte the radio will accept
*/
#define NUM_DATA_ENTRIES       2  /* NOTE: Only two data entries supported
at the moment */
#define NUM_APPENDED_BYTES     2  /* The Data Entries data field will
contain:
                                   * 1 Header byte
(RF_cmdPropRx.rxConf.bIncludeHdr = 0x1)
                                   * Max 30 payload bytes
                                   * 1 status byte
(RF_cmdPropRx.rxConf.bAppendStatus = 0x1) */



/***** Prototypes *****/
static void callback(RF_Handle h, RF_CmdHandle ch, RF_EventMask e);

/***** Variable declarations *****/
static RF_Object rfObject;
static RF_Handle rfHandle;
char input;
const char startPrompt[] = "start typing\r\n";
UART_Handle uart;
UART_Params uartParams;
UART_init();

/* Pin driver handle */
static PIN_Handle ledPinHandle;
static PIN_State ledPinState;
```

Grading scheme: 30% Coding, 30% Documentation, 40% Execution/Video.

```
/* Buffer which contains all Data Entries for receiving data.
 * Pragmas are needed to make sure this buffer is 4 byte aligned
(requirement from the RF Core) */
#if defined(__TI_COMPILER_VERSION__)
#pragma DATA_ALIGN (rxDataEntryBuffer, 4);
static uint8_t
rxDataEntryBuffer[RF_QUEUE_DATA_ENTRY_BUFFER_SIZE(NUM_DATA_ENTRIES,
                                                  MAX_LENGTH,
                                                  NUM_APPENDED_BYTES)];
#elif defined(__IAR_SYSTEMS_ICC__)
#pragma data_alignment = 4
static uint8_t
rxDataEntryBuffer[RF_QUEUE_DATA_ENTRY_BUFFER_SIZE(NUM_DATA_ENTRIES,
                                                  MAX_LENGTH,
                                                  NUM_APPENDED_BYTES)];
#elif defined(__GNUC__)
static uint8_t
rxDataEntryBuffer[RF_QUEUE_DATA_ENTRY_BUFFER_SIZE(NUM_DATA_ENTRIES,
                                                  MAX_LENGTH,
                                                  NUM_APPENDED_BYTES)]

__attribute__((aligned(4)));
#else
#error This compiler is not supported.
#endif

/* Receive dataQueue for RF Core to fill in data */
static dataQueue_t dataQueue;
static rfc_dataEntryGeneral_t* currentDataEntry;
static uint8_t packetLength;
static uint8_t* packetDataPointer;


static uint8_t packet[MAX_LENGTH + NUM_APPENDED_BYTES - 1]; /* The length
byte is stored in a separate variable */

/*
 * Application LED pin configuration table:
 *   - All LEDs board LEDs are off.
 */
PIN_Config pinTable[] =
{
    Board_PIN_LED2 | PIN_GPIO_OUTPUT_EN | PIN_GPIO_LOW | PIN_PUSHPULL |
PIN_DRVSTR_MAX,
       PIN_TERMINATE
};

/***** Function definitions *****/

//Initialize uart to output the receive
UART_Params_init(&uartParams);
uartParams.writeDataMode = UART_DATA_BINARY;
uartParams.readDataMode = UART_DATA_BINARY;
```

```
uartParams.readReturnMode = UART_RETURN_FULL;
uartParams.readEcho = UART_ECHO_OFF;
uartParams.baudRate = 115200;

uart = UART_open(Board_UART0, &uartParams);
if (uart==NULL) {
while(1);
}

UART_write(uart, startPrompt, sizeof(startPrompt));

void *mainThread(void *arg0)
{
    RF_Params rfParams;
    RF_Params_init(&rfParams);

    /* Open LED pins */
    ledPinHandle = PIN_open(&ledPinState, pinTable);
    if (ledPinHandle == NULL)
    {
        while(1);
    }

    if( RFQueue_defineQueue(&dataQueue,
                            rxDataEntryBuffer,
                            sizeof(rxDataEntryBuffer),
                            NUM_DATA_ENTRIES,
                            MAX_LENGTH + NUM_APPENDED_BYTES))
    {
        /* Failed to allocate space for all data entries */
        while(1);
    }

    /* Modify CMD_PROP_RX command for application needs */
    /* Set the Data Entity queue for received data */
    RF_cmdPropRx.pQueue = &dataQueue;
    /* Discard ignored packets from Rx queue */
    RF_cmdPropRx.rxConf.bAutoFlushIgnored = 1;
    /* Discard packets with CRC error from Rx queue */
    RF_cmdPropRx.rxConf.bAutoFlushCrcErr = 1;
    /* Implement packet length filtering to avoid PROP_ERROR_RXBUF */
    RF_cmdPropRx.maxPktLen = MAX_LENGTH;
    RF_cmdPropRx.pktConf.bRepeatOk = 1;
    RF_cmdPropRx.pktConf.bRepeatNok = 1;

    /* Request access to the radio */
#if defined(DeviceFamily_CC26X0R2)
    rfHandle = RF_open(&rfObject, &RF_prop,
(RF_RadioSetup*)&RF_cmdPropRadioSetup, &rfParams);
#else
    rfHandle = RF_open(&rfObject, &RF_prop,
(RF_RadioSetup*)&RF_cmdPropRadioDivSetup, &rfParams);
#endif// DeviceFamily_CC26X0R2
```

```
    /* Set the frequency */
    RF_postCmd(rfHandle, (RF_Op*)&RF_cmdFs, RF_PriorityNormal, NULL, 0);

    /* Enter RX mode and stay forever in RX */
    RF_EventMask terminationReason = RF_runCmd(rfHandle,
(RF_Op*)&RF_cmdPropRx,
                                               RF_PriorityNormal,
&callback,
                                               RF_EventRxEntryDone);

    switch(terminationReason)
    {
        case RF_EventLastCmdDone:
            // A stand-alone radio operation command or the last radio
            // operation command in a chain finished.
            break;
        case RF_EventCmdCancelled:
            // Command cancelled before it was started; it can be caused
            // by RF_cancelCmd() or RF_flushCmd().
            break;
        case RF_EventCmdAborted:
            // Abrupt command termination caused by RF_cancelCmd() or
            // RF_flushCmd().
            break;
        case RF_EventCmdStopped:
            // Graceful command termination caused by RF_cancelCmd() or
            // RF_flushCmd().
            break;
        default:
            // Uncaught error event
            while(1);
    }

    uint32_t cmdStatus = ((volatile RF_Op*)&RF_cmdPropRx)->status;
    switch(cmdStatus)
    {
        case PROP_DONE_OK:
            // Packet received with CRC OK
            break;
        case PROP_DONE_RXERR:
            // Packet received with CRC error
            break;
        case PROP_DONE_RXTIMEOUT:
            // Observed end trigger while in sync search
            break;
        case PROP_DONE_BREAK:
            // Observed end trigger while receiving packet when the
command is
            // configured with endType set to 1
            break;
        case PROP_DONE_ENDED:
            // Received packet after having observed the end trigger; if
the
```

```
            // command is configured with endType set to 0, the end
trigger
            // will not terminate an ongoing reception
            break;
        case PROP_DONE_STOPPED:
            // received CMD_STOP after command started and, if sync found,
            // packet is received
            break;
        case PROP_DONE_ABORT:
            // Received CMD_ABORT after command started
            break;
        case PROP_ERROR_RXBUF:
            // No RX buffer large enough for the received data available
at
            // the start of a packet
            break;
        case PROP_ERROR_RXFULL:
            // Out of RX buffer space during reception in a partial read
            break;
        case PROP_ERROR_PAR:
            // Observed illegal parameter
            break;
        case PROP_ERROR_NO_SETUP:
            // Command sent without setting up the radio in a supported
            // mode using CMD_PROP_RADIO_SETUP or CMD_RADIO_SETUP
            break;
        case PROP_ERROR_NO_FS:
            // Command sent without the synthesizer being programmed
            break;
        case PROP_ERROR_RXOVF:
            // RX overflow observed during operation
            break;
        default:
            // Uncaught error event - these could come from the
            // pool of states defined in rf_mailbox.h
            while(1);
    }

    while(1);
}

void callback(RF_Handle h, RF_CmdHandle ch, RF_EventMask e)
{
    if (e & RF_EventRxEntryDone)
    {
        /* Toggle pin to indicate RX */
        PIN_setOutputValue(ledPinHandle, Board_PIN_LED2,
                           !PIN_getOutputValue(Board_PIN_LED2));

        /* Get current unhandled data entry */
        currentDataEntry = RFQueue_getDataEntry();

        /* Handle the packet data, located at &currentDataEntry->data:
         * - Length is the first byte with the current configuration
```

```
         * - Data starts from the second byte */
        packetLength      = *(uint8_t*)(&currentDataEntry->data);
        packetDataPointer = (uint8_t*)(&currentDataEntry->data + 1);

        /* Copy the payload + the status byte to the packet variable */
        memcpy(packet, packetDataPointer, (packetLength + 1));

        RFQueue_nextEntry();
    }
}
```

Grading scheme: 30% Coding, 30% Documentation, 40% Execution/Video.