Exercise 2 Creating and managing threads

In this project we will create and manage some additional threads. Each of the threads created will toggle a GPIO pin on GPIO port B to simulate flashing an LED. We can then view this activity in the simulator.

Open the Pack Installer.

Select the Boards::Designers Guide Tutorial.

Select the example tab and Copy "EX 9.2 and 9.3 CMSIS-RTOS2 Threads".

A reference copy of the first exercise is included as Exercise 9.1

This will install the project to a directory of your choice and open the project in **µVision.**

Open the Run Time Environment Manager 

In the board support section the MCBSTM32E:LED box is ticked. This adds support functions to control the state of a bank of LED's on the Microcontroller's GPIO port B.

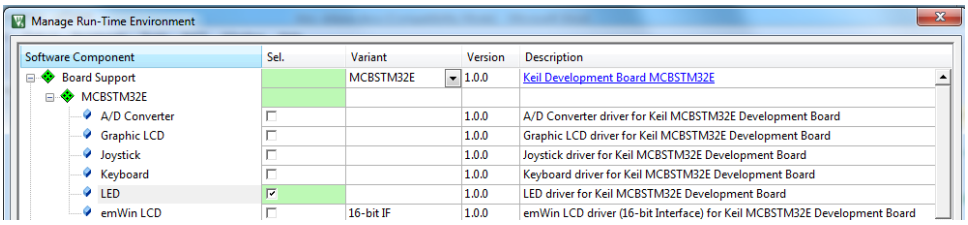


Fig 19 selecting the board support components

As in the first example main() creates app_main() and starts the RTOS. Inside app_main() we create two additional threads. First we create handles for each of the threads and then define the structures for each thread. The structures are defined in two different ways, for app_main we define the full structure and use NULL to inherit the default values.

```
static const osThreadAttr_t threadAttr_app_main = {
    "app_main",
    NULL,
    NULL,
    NULL,
    NULL,
    NULL,
    osPriorityNormal,
    NULL,
    NULL
};
```

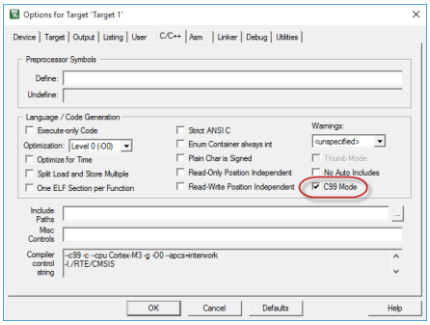
For the thread LED1 a truncated syntax is used as shown below;

```
static const osThreadAttr_t ThreadAttr_LED2 = {
```

```
    .name = "LED_Thread_2",
};
```

In order to use this syntax the compiler options must be changed to allow C99 declarations

Project → Options for Target→C/C++



Now app_main() is used to first initialise the bank of LED's and then create the two threads. Finally app_main() is terminated with the osThreadExit() api call.

```
void app_main (void *argument) {

        LED_Initialize ();

        led_ID1 = osThreadNew(led_thread1, NULL, &threadAttr_LED1);

        led_ID1 = osThreadNew(led_thread2, NULL, &threadAttr_LED2);

        osThreadExit();

}
```

Build the project and start the debugger

Start the code running and open the Debug → OS Support → System and Thread Viewer

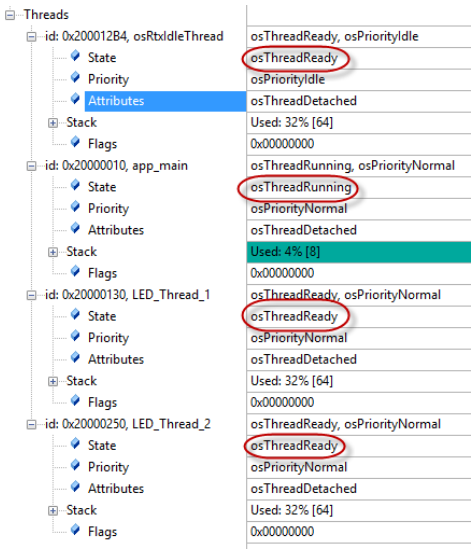


Fig 20 The running Threads

Now we have four active threads with one running and the others ready.

Now open the Peripherals → General Purpose IO → GPIOB window

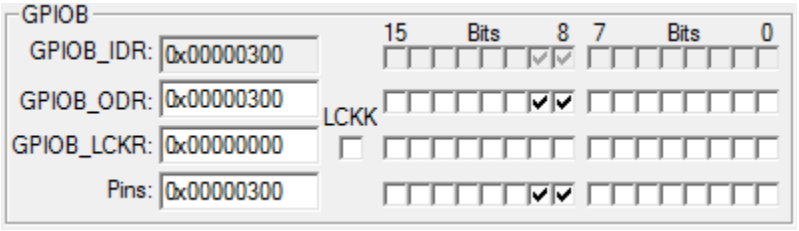


Fig 22 the peripheral window shows the LED pin activity

Our two led threads are each toggling a GPIO port pin. Leave the code running and watch the pins toggle for a few seconds.

If you do not see the debug windows updating check the view/periodic window update option is ticked.

```
void led_thread2 (void const *argument) {

for (;;) {

        LED_On(1);

        delay(500);

        LED_Off(1);

        delay(500);

}}
```

Each thread calls functions to switch an LED on and off and uses a delay function between each on and off. Several important things are happening here. First the delay function can be safely called by each thread. Each thread keeps local variables in its stack so they cannot be corrupted by any other thread. Secondly none of the threads enter a descheduled waiting state, this means that each one runs for its full allocated time slice before switching to the next thread. As this is a simple thread most of its execution time will be spent in the delay loop effectively wasting cycles. Finally there is no synchronization between the threads. They are running as separate 'programs' on the CPU and as we can see from the GPIO debug window the toggled pins appear random.