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The queue registry only stores a pointer to the string - so the string must be persistent (global or preferably in ROM/Flash), not on the stack. StaticTask_t xTaskBuffer; // Buffer that the task being created will use as its stack. } } Returns If the mutex was successfully created then a handle to the created semaphore is returned. This must not be modified. Example usage: * * // The callback function that will execute in the context of the daemon task. uxIndexToClear – The index within the target task's array of notification values in which to clear the bits. It is safe to use this macro from within an interrupt service routine. Setting xTicksToWait to portMAX_DELAY will cause the task to wait indefinitely (without timing out), provided INCLUDE_vTaskSuspend is set to 1 in FreeRTOSConfig.h. A task does not use any CPU time when it is in the Blocked state. The first parameter is * // not used in this case. pxMessage = & xMessage; xQueueSend(xQueue2, (void *) &pxMessage, (TickType_t) 0); } // ... } } } Parameters xMutex – A handle to the mutex being released, or 'given'. Returns If xTriggerLevel was less than or equal to the stream buffer's length then the trigger level will be updated and pdTRUE is returned. xTimerChangePeriod(xTimer, xNewPeriod, xTicksToWait) BaseType_t xTimerChangePeriod(TimerHandle_t xTimer, TickType_t xNewPeriod, TickType_t xTicksToWait); Timer functionality is provided by a timer service/daemon task. If an event groups is created using xEventGroupCreate() then the required memory is automatically dynamically allocated inside the xEventGroupCreate() function. When the count value reaches zero there are no free resources. Process // the message here.... That will ensure the interrupt returns directly to the highest priority Ready state task. if(xSemaphoreGive(xSemaphore) != pdTRUE) { // We would not expect this call to fail because we must have // obtained the semaphore to get here. BaseType_t xStreamBufferIsFull(StreamBufferHandle_t xStreamBuffer) Queries a stream buffer to see if it is full. Note that binary semaphores created using the vSemaphoreCreateBinary() macro are created in a state such that the first call to 'take' the semaphore would pass, whereas binary semaphores created using xSemaphoreCreateBinary() are created in a state such that the the semaphore must first be 'given' before it can be 'taken'. The call will return immediately if this is set to 0 and the queue is full. Values 0 or 1 indicate the index number of the CPU which the task should be pinned to. taskENTER_CRITICAL() Macro to mark the start of a critical code region. } } // ... * // xHigherPriorityTaskWoken was set to pdFALSE where it was defined * // (within this function). Setting bits in an event group will automatically unblock tasks that are blocked waiting for the bits. An alternative, tiny, third party, and limited functionality implementation of sprintf() is provided in many of the FreeRTOS/Demo sub-directories in a file called printf-stdarg.c (note printf-stdarg.c does not provide a full snprintf() implementation!). Parameters xStreamBuffer – The handle of the stream buffer being queried. configQUEUE_REGISTRY_SIZE defines the maximum number of handles the registry can hold. }; int main(void) { TaskHandle_t xHandle; // Create a task from the const structure defined above. xGetFreeStackSpace – The TaskStatus_t structure contains a member to report the stack high water mark of the task being queried. ulBitsToClearOnExit – If a notification is pending or received before the calling task exits the xTaskNotifyWait() function then the task's notification value (see the xTaskNotify() API function) is passed out using the pulNotificationValue parameter. xTaskNotifyStateClearIndexed() is the function that clears a pending notification without reading the notification value. In most FreeRTOS ports this is done by simply passing // xHigherPriorityTaskWoken into portYIELD_FROM_ISR(), which will test the // variables value, and perform the context switch if necessary. This performs hardware specific operations such as stopping the kernel tick. Use xMessageBufferSend() to write to a message buffer from a task. This function must not be called from an interrupt service routine. If the semaphore is a binary semaphore then uxSemaphoreGetCount() returns 1 if the semaphore is available, and 0 if the semaphore is not available. Release the // semaphore. Restart the kernel. This macro must also not be used on semaphores created using xSemaphoreCreateRecursiveMutex(). pxHigherPriorityTaskWoken – *pxHigherPriorityTaskWoken should be initialised to pdFALSE before it is passed into xStreamBufferSendCompletedFromISR(). As another example, if a task is blocked on a read of an empty stream buffer that has a trigger level of 10 then the task will not be unblocked until the stream buffer contains at least 10 bytes or the task's block time expires. The size is specified as the number of indexes in the array, or the number of TaskStatus_t structures contained in the array, not by the number of bytes in the array. xMessageBufferReceiveFromISR(xMessageBuffer, pvRxData, xBufferLengthBytes, pxHigherPriorityTaskWoken) An interrupt safe version of the API function that receives a discrete message from a message buffer. Instead, ESP-IDF FreeRTOS is started automatically. } } } void vTask1(void *pvParameters) { for(;;) { // Perform task functionality here. } // If xHigherPriorityTaskWoken was set to pdTRUE inside // xMessageBufferReceiveFromISR() then a task that has a priority above the // priority of the currently executing task was unblocked and a context // switch should be performed to ensure the ISR returns to the unblocked // task. Note This may alter the stack (depending on the portable implementation) so must be used with care! taskENTER_CRITICAL_FROM_ISR() taskENTER_CRITICAL_ISR() taskEXIT_CRITICAL() Macro to mark the end of a critical code region. * UBaseType_t uxVariableToIncrement = 0; * * // A software timer callback function that increments a variable passed to * // it when the software timer was created. } } } Returns pdTRUE if the semaphore was obtained. Calling xTimerStopFromISR() writes a message to the timer command queue, so has the potential to transition the timer service/daemon task out of the Blocked state. xResult = xEventGroupSetBitsFromISR(xEventGroup, // The event group being updated. If 5 seconds pass * // without a key being pressed, then the LCD back-light is switched off. xSemaphoreCreateCounting(uxMaxCount, uxInitialCount) Creates a new recursive mutex type semaphore instance, and returns a handle by which the new recursive mutex can be referenced. Parameters pcWriteBuffer – A buffer into which the above mentioned details will be written, in ASCII form. BaseType_t xTaskGenericNotifyFromISR(TaskHandle_t xTaskToNotify, UBaseType_t uxIndexToNotify, uint32_t ulValue, eNotifyAction eAction, uint32_t *pulPreviousNotificationValue, BaseType_t *pxHigherPriorityTaskWoken) See for details. If xEventGroupSync() returned because all the bits it was waiting for were set then the returned value is the event group value before any bits were automatically cleared. void vTaskGenericNotifyGiveFromISR(TaskHandle_t xTaskToNotify, UBaseType_t uxIndexToNotify, BaseType_t *pxHigherPriorityTaskWoken) A version of xTaskNotifyGiveIndexed() that can be called from an interrupt service routine (ISR). To help others as they make their way through this process, we decided to document and release our findings as a FreeRTOS tutorial for developers. Items are queued by copy, not by reference, so this is the number of bytes that will be copied for each posted item. 100, // usStackDepth - the stack size DEFINED IN BYTES. } } if(xQueue2 != 0) { // Send a pointer to a struct AMessage object. pxHigherPriorityTaskWoken – It is possible that a stream buffer will have a task blocked on it waiting for data. The sbSEND_COMPLETED() macro is called from within the FreeRTOS APIs when data is sent to a message buffer or stream buffer. * // The callback function does nothing but count the number of times the * // associated timer expires, and stop the timer once the timer has expired * // 10 times. void vTaskFunction(void * pvParameters) { TickType_t xLastWakeTime; const TickType_t xFrequency = 10; BaseType_t xWasDelayed; // Initialise the xLastWakeTime variable with the current time. xTaskNotifyFromISR() does not have this parameter and always sends notifications to index 0. * if(xTimerResetFromISR(xBacklightTimer, &xHigherPriorityTaskWoken) != pdPASS) * { * // The reset command was not executed successfully. vTaskAllocateMPURegions(NULL, xAltRegions); // Now the task can continue its function, but from this point on can only // access its stack and the ucOneKByte array (unless any other statically // defined or shared regions have been declared elsewhere). Use the handle // to suspend the task. * } * * // If xHigherPriorityTaskWoken equals pdTRUE, then a context switch * // should be performed. param xBlockTime The time in ticks to wait for the semaphore to become available. eNoAction - The task receives a notification without its notification value being updated. Example usage: * #define NUM_TIMERS 5 * * // An array to hold handles to the created timers. uxPriority – The priority at which the task will run. Returns If the queue or semaphore was successfully removed from the queue set then pdPASS is returned. // The human readable table is written to pcWriteBuffer void vTaskGetRunTimeStats(char *pcWriteBuffer) { TaskStatus_t *pxTaskStatusArray; volatile UBaseType_t uxArraySize, x; uint32_t ulTotalRunTime, ulStatsAsPercentage; // Make sure the write buffer does not contain a string. // Use the handle to raise the priority of the created task. xMessageBufferSendCompletedFromISR(xMessageBuffer, pxHigherPriorityTaskWoken) For advanced users only. In real // code these would not be just sequential calls as this would make // no sense. Example usage: // This example demonstrates how a human readable table of run time stats // information is generated from raw data provided by uxTaskGetSystemState(). This sets the maximum number of bytes to receive in one call. TaskHandle_t xTaskGetHandle(const char *pcNameToQuery) NOTE: This function takes a relatively long time to complete and should be used sparingly. Returns If the queue is created then a handle to the created queue is returned. Example usage: void vTask1(void * pvParameters) { for(;;) { // Task code goes here. However, pdPASS is the only value that can be returned because xQueueOverwrite() will write to the queue even when the queue is already full. Parameters xMessageBuffer – The handle of the stream buffer from which data was read. Returns If the task referenced by xTask was not in the Blocked state then pdFAIL is returned. BaseType_t xTaskGenericNotifyWait(UBaseType_t uxIndexToWaitOn, uint32_t ulBitsToClearOnEntry, uint32_t ulBitsToClearOnExit, uint32_t *pulNotificationValue, TickType_t xTicksToWait) Waits for a direct to task notification to be pending at a given index within an array of direct to task notifications. } } Parameters xEventGroup – The event group in which the bits are being tested. A mechanism is provided that allows the interrupt to return directly to the task that will subsequently execute the pended callback function. Returns The number of TaskStatus_t structures that were populated by uxTaskGetSystemState(). Note 3: A receive (in the case of a queue) or take (in the case of a semaphore) operation must not be performed on a member of a queue set unless a call to xQueueSelectFromSet() has first returned a handle to that set member. How a context switch is requested from an ISR is dependent on the port - see the documentation page for the port in use. xQueueSendFromISR(xRxQueue, &cIn, &xHigherPriorityTaskWoken); } while(portINPUT_BYTE(BUFFER_COUNT)); // Now the buffer is empty we can switch context if necessary. uxBitsToSet – A bitwise value that indicates the bit or bits to set. I recommend to ~4 Gigabytes of RAM and click nextSelect Create a virtual hard disk now and click nextSelect VDI and click nextSelect Fixed size and click nextSet disk size for your virtual machine. // Other code that uses the stream buffer can go here. } } // Function that creates a task. It is provided to enable application writers to implement their own version of sbRECEIVE_COMPLETED(), and MUST NOT BE USED AT ANY OTHER TIME. // Receive the next stream from the stream buffer. Internally, within the FreeRTOS implementation, recursive mutexs use a block of memory, in which the mutex structure is stored. Calling xTimerChangePeriodFromISR() writes a message to the timer command queue, so has the potential to transition the timer service/ daemon task out of the Blocked state. uint32_t ulTaskGetIdleRunTimeCounter(void) configGENERATE_RUN_TIME_STATS and configUSE_STATS_FORMATTING_FUNCTIONS must both be defined as 1 for this function to be available. pdPASS will be returned if the command was successfully sent to the timer command queue. pxStaticStreamBuffer – Must point to a variable of type StaticStreamBuffer_t, which will be used to hold the stream buffer's data structure. All three tasks have reached the // synchronisation point when all the ALL_SYNC_BITS are set. In * // this case, the timer is a one-shot timer, and unlike the example given for * // the xTimerReset() function, the key press event handler is an interrupt * // service routine. if(xSemaphoreTakeRecursive(xSemaphore, (TickType_t) 10) == pdTRUE) { // We were able to obtain the mutex and can now access the // shared resource. Returns Handle to the created semaphore. } // Send the string to the stream buffer. This is an interrupt service routine so can only * // call FreeRTOS API functions that end in "FromISR". To wait for bits 0 and bit 1 and bit 2 set uxBitsToWaitFor to 0x07. * void vProcessInterface(void *pvParameter1, uint32_t ulParameter2) * { * BaseType_t xInterfaceToService; * * // The interface that requires servicing is passed in the second * // parameter. The // function's parameter is not NULL, so the function will not attempt any // dynamic memory allocation, and therefore the function will not return // return NULL. Returns pdFAIL will be returned if the command to change the timers period could not be sent to the timer command queue. pvTxData – A pointer to the message that is to be copied into the message buffer. * static StaticTimer_t xTimerBuffer; * * // A variable that will be incremented by the software timer's callback * // function. xDataLengthBytes – The maximum number of bytes to copy from pvTxData into the stream buffer. If a recursive mutex is created using xSemaphoreCreateRecursiveMutex() then the required memory is automatically dynamically allocated inside the xSemaphoreCreateRecursiveMutex() function. If a binary semaphore is created using xSemaphoreCreateBinary() then the required memory is automatically dynamically allocated inside the xSemaphoreCreateBinary() function. This function must not be used in an interrupt service routine. Specifying values larger than (portNUM_PROCESSORS - 1) will cause the function to fail. xQueueSelectFromSet() effectively allows a task to block (pend) on a read operation on all the queues and semaphores in a queue set simultaneously. EventGroupHandle_t xEventGroup; void anInterruptHandler(void) { // Clear bit 0 and bit 4 in xEventGroup. If xEventGroupWaitBits() returned because the bits it was waiting for were set then the returned value is the event group value before any bits were automatically cleared in the case that xClearOnExit parameter was set to pdTRUE. Check the // documentation for the port in use for port specific instructions. xSemaphoreGive(xSemaphore); } else { // We could not obtain the semaphore and can therefore not access // the shared resource safely. * xReturned = xTimerStart(xTimer, 0); * * // ... eIncrement - The target notification value is incremented. void vTaskSetTimeOutState(TimeOut_t *const pxTimeOut) BaseType_t xTaskCheckForTimeOut(TimeOut_t *const pxTimeOut, TickType_t *const pxTicksToWait) Determines if pxTicksToWait ticks has passed since a time was captured using a call to vTaskSetTimeOutState(). For example, specifying a block period of 100 ticks will cause the task to unblock 100 ticks after vTaskDelay() is called. * lExpireCounters[lArrayIndex] += 1; * * // If the timer has expired 10 times then stop it from running. The macro pdMS_TO_TICKS() can be used to convert a time specified in milliseconds into a time specified in ticks. See xTaskDelayUntil() for an alternative API function designed to facilitate fixed frequency execution. Context switching from an // ISR uses port specific syntax. Then choose Next: ReviewChoose Add permissionsSetting up ESP32Depending on the platform (Linux, Mac, Windows) select the following documentation and install the needed modules/ software.If you haven't downloaded a FreeRTOS configuration go to the FreeRTOS console. * xBacklightTimer = xTimerCreate("BacklightTimer", // Just a text name, not used by the kernel. } // ... Setting ulBitsToClearOnExit to ULONG_MAX (if limits.h is included) or 0xffffffffUL (if limits.h is not included) will have the effect of resetting the task's notification value to 0 before the function exits. Local storage pointers set for a task can reference dynamically allocated resources. Semaphores are implemented using queues. if(xHigherPriorityTaskWoken) { // Actual macro used here is port specific. As this is an interrupt service routine, only * // FreeRTOS API functions that end in "FromISR" can be used. Wait // indefinitely for this to happen. Example usage: void vOtherFunction(void) { TaskHandle_t xHandle; // Create the task, storing the handle. If xSemaphoreGiveFromISR() sets this value to pdTRUE then a context switch should be requested before the interrupt is exited. pxHigherPriorityTaskWoken – The timer service/daemon task spends most of its time in the Blocked state, waiting for messages to arrive on the timer command queue. This macro must not be used from an ISR. Receive an item from a queue without removing the item from the queue. It it not valid to call xTimerGetTimerDaemonTaskHandle() before the scheduler has been started. A queue set must be explicitly created using a call to xQueueCreateSet() before it can be used. Adjusting xTicksToWait to account for // any time that has been spent in the Blocked state within this // function so far to ensure the total amount of time spent in the // Blocked state does not exceed MAX_TIME_TO_WAIT. Example usage: SemaphoreHandle_t xSemaphore = NULL; StaticSemaphore_t xSemaphoreBuffer; void vATask(void * pvParameters) { // Semaphore cannot be used before a call to xSemaphoreCreateBinary() or // xSemaphoreCreateBinaryStatic(). Mutex type semaphores cannot be used from within interrupt service routines. Otherwise pdFALSE is returned and pxTicksToWait is updated to reflect the number of remaining ticks. Example usage: SemaphoreHandle_t xSemaphore = NULL; // A task that creates a semaphore. } Parameters xTask – Handle of the task being queried. A stream buffer is empty if it does not contain any data. size_t xStreamBufferReceiveFromISR(StreamBufferHandle_t xStreamBuffer, void *pvRxData, size_t xBufferLengthBytes, BaseType_t *const pxHigherPriorityTaskWoken) An interrupt safe version of the API function that receives bytes from a stream buffer. Note ESP-IDF FreeRTOS is based on Vanilla FreeRTOS v10.4.3 Vanilla FreeRTOS allows ports and applications to configure the kernel by adding various #define config... Otherwise pdFAIL is returned. // The semaphore's data structures will be placed in the xSemaphoreBuffer // variable, the address of which is passed into the function. CONFIG_FREERTOS_ASSERT_ON_UNTESTED_FUNCTION will trigger a halt in functions in ESP-IDF FreeRTOS that have not been fully tested in an SMP context. pcQueueName – The name to be associated with the handle. Switch off the LCD back-light. pvValue – Pointer value to set. xQueueSendToBackFromISR(xRxQueue, &cIn, &xHigherPriorityTaskWoken); } while(portINPUT_BYTE(BUFFER_COUNT)); // Now the buffer is empty we can switch context if necessary. Example usage: // Dimensions the buffer that the task being created will use as its stack. Returns pdTRUE if the semaphore was obtained. If the priority of the timer daemon task is higher than the priority of the currently running task (the task the interrupt interrupted) then *pxHigherPriorityTaskWoken will be set to pdTRUE by xEventGroupSetBitsFromISR(), indicating that a context switch should be requested before the interrupt exits. UBaseType_t uxTaskPriorityGetFromISR(const TaskHandle_t xTask) A version of uxTaskPriorityGet() that can be used from an ISR. static inline TaskHandle_t xTaskCreateStatic(TaskFunction_t pvTaskCode, const char *const pcName, const uint32_t ulStackDepth, void *const pvParameters, UBaseType_t uxPriority, StackType_t *const puxStackBuffer, StaticTask_t *const pxTaskBuffer) Create a new task and add it to the list of tasks that are ready to run. No matter how many times this loop iterates only one // task will be woken. A context switch will occur before the function returns if the priority being set is higher than the currently executing task. Alternatively, if the timer must expire after 500ms, then xPeriod can be set to (500 / portTICK_PERIOD_MS) provided configTICK_RATE_HZ is less than or equal to 1000. } else if((uxBits & BIT_4) != 0) { // xEventGroupWaitBits() returned because just BIT_4 was set. // Use a NULL handle to raise our priority to the same value. The notification value at the same array index is not altered. * * TimerHandle_t xBacklightTimer = NULL; * * // The callback function assigned to the one-shot timer. ulBitsToClear – Bit mask of the bits to clear in the notification value of xTask. Request the * // vProcessInterface() callback function is executed, passing in the * // number of the interface that needs processing. xTicksToWait is ignored if xTimerChangePeriod() is called before the scheduler is started. pxHigherPriorityTaskWoken – It is possible that a message buffer will have a task blocked on it waiting for data. portYIELD_FROM_ISR(); // or portEND_SWITCHING_ISR() depending on the port. UBaseType_t uxTaskGetNumberOfTasks(void) Returns The number of tasks that the real time kernel is currently managing. * pdFALSE, // The timer is a one-shot timer. Timers are created in the dormant state. } } Parameters xBufferSizeBytes – The total number of bytes the stream buffer will be able to hold at any one time. Both will now be clear (not set). Not used by FreeRTOS. QueueHandle_t xQueueGenericCreateStatic(const UBaseType_t uxQueueLength, const UBaseType_t uxItemSize, uint8_t *pucQueueStorage, StaticQueue_t *pxStaticQueue, const uint8_t ucQueueType) Generic version of the function used to create a queue using dynamic memory allocation. eIncrement - The task's notification value is incremented. TaskHandle_t xTaskGetIdleTaskHandle(void) xTaskGetIdleTaskHandle() is only available if INCLUDE_xTaskGetIdleTaskHandle is set to 1 in FreeRTOSConfig.h. Simply returns the handle of the idle task. No block time is specified, and even if one was * // it would be ignored because the scheduler has not yet been * // started. void vISR_Routine(void) { BaseType_t xTaskWokenByReceive = pdFALSE; char cRxedChar; while(xQueueReceiveFromISR(xQueue, (void *) &cRxedChar, &xTaskWokenByReceive)) { // A character was received. Parameters xTimer – The handle of the timer being updated. Returns If the queue is in the registry then a pointer to the name of the queue is returned. If xTimerChangePeriodFromISR() sets this value to pdTRUE then a context switch should be performed before the interrupt exits. *pcWriteBuffer = 0x00; // Take a snapshot of the number of tasks in case it changes while this // function is executing. c in the demo/PC directory for an example that uses vTaskEndScheduler (). BaseType_t xTimerPendFunctionCall(PendedFunction_t xFunctionToPend, void *pvParameter1, uint32_t ulParameter2, TickType_t xTicksToWait) BaseType_t xTimerPendFunctionCall(PendedFunction_t xFunctionToPend, void *pvParameter1, uint32_t ulParameter2, TickType_t xTicksToWait); Used to defer the execution of a function to the RTOS daemon task (the timer service task, hence this function is implemented in timers.c and is prefixed with 'Timer'). If there was insufficient FreeRTOS heap available to create the event group then NULL is returned. * vSetBacklightState(BACKLIGHT_ON); * if(xTimerReset(xBacklightTimer, 100) != pdPASS) * { * // The reset command was not executed successfully. portYIELD_FROM_ISR(xHigherPriorityTaskWoken); } Parameters xMessageBuffer – The handle of the message buffer to which a message is being sent. Example usage: See the xTimerChangePeriod() API function example usage scenario. It is // provided as a mechanism for applications to know the size of the event // group (which is dependent on the architecture and configuration file // settings) without breaking the strict data hiding policy by exposing the // real event group internals. In the case that a task function mistakenly returns (i.e. does not call vTaskDelete()), the call flow will return to the wrapper function. } } Parameters xTask – Handle of the task to be queried. If a task is created using xTaskCreateStatic() then the application writer must provide the required memory. configUSE_TASK_NOTIFICATIONS must be undefined or defined as 1 for these macros to be available. Systems that include MPU support can alternatively create an MPU constrained task using xTaskCreateRestricted(). The task handle // is requested (the second parameter is not NULL) but in this case just for // demonstration purposes as its not actually used. void vATask(void * pvParameters) { for(;;) { // We want this task to run every 10 ticks of a timer. FreeRTOS does not allow nondeterministic operations to be performed in interrupts or from critical sections. * void vAnExampleInterruptServiceRoutine(void) * { * BaseType_t xHigherPriorityTaskWoken = pdFALSE; * * // The interrupt has occurred - simply stop the timer. Each task contains an array of pointers that is dimensioned by the configNUM_THREAD_LOCAL_STORAGE_POINTERS setting in FreeRTOSConfig.h. The kernel does not use the pointers itself, so the application writer can use the pointers for any purpose they wish. pxHigherPriorityTaskWoken – *pxHigherPriorityTaskWoken should be initialised to pdFALSE before it is passed into xMessageBufferReceiveCompletedFromISR(). Use xStreamBufferReceiveFromISR() to read bytes from a stream buffer from an interrupt service routine (ISR). The task does not consume any CPU time while it is in the Blocked state. Perform a context // switch so this interrupt returns directly to the unblocked task. A trigger level is set when the stream buffer is created, and can be modified using xStreamBufferSetTriggerLevel(). Setting ulBitsToClearOnEntry to 0 will leave the task's notification value unchanged. This is equal to the number of items that can be sent to the queue before the queue becomes full if no items are removed. Parameters xTimer – The timer being updated. If either pucStreamBufferStorageArea or pxStaticstreamBuffer are NULL then NULL is returned. * (100 * x), // The timer period in ticks. This // continues until either the buffer contains at least uxWantedBytes bytes, // or the total amount of time spent in the Blocked state reaches // MAX_TIME_TO_WAIT – at which point the task reads however many bytes are // available up to a maximum of uxWantedBytes. xQueueCreateStatic() therefore allows a queue to be created without using any dynamic memory allocation. Events can be sent to a task using an intermediary object. vTaskSetTimeOutState(&xTimeOut); // Loop until the buffer contains the wanted number of bytes, or a // timeout occurs. Aborting now! abort() was called at PC 0x40085c53 on core 0 Unlike Vanilla FreeRTOS, users must not call vTaskStartScheduler(). Example usage: void vAFunction(void) { // Create at least one task before starting the kernel. size_t xStreamBufferSpacesAvailable(StreamBufferHandle_t xStreamBuffer) Queries a stream buffer to see how much free space it contains, which is equal to the amount of data that can be sent to the stream buffer before it is full. pdTRUE, // BIT_0 and BIT_4 should be cleared before returning. } Parameters pxStaticSemaphore – Must point to a variable of type StaticSemaphore_t, which will then be used to hold the semaphore's data structure, removing the need for the memory to be allocated dynamically. Example usage: // Task to be created. // At some point we want to end the real time kernel processing // so call ... Returns The period of the timer in ticks. Tasks are reported as blocked ('B'), ready ('R'), deleted ('D') or suspended ('S'). xTaskCreate(vTaskCode, "NAME", STACK_SIZE, NULL, tskIDLE_PRIORITY, NULL); // Start the real time kernel with preemption. Passing xTask as NULL has the effect of calling the Running tasks (the calling task) hook function. For each pointer, a callback function can be set. The mutex must have previously been created using a call to xSemaphoreCreateRecursiveMutex(); configUSE_RECURSIVE_MUTEXES must be set to 1 in FreeRTOSConfig.h for this macro to be available. Then choose Next: ReviewChoose Add permissionsAWSIoTFullAccessIn the navigation pane, choose UsersInput your username in search box, and select your nameChoose Add permissionsChoose Attach existing policies directlySearch AWSIoTFullAccess and select it from the list. Therefore xEventGroupSetBitsFromISR() sends a message to the timer task to have the set operation performed in the context of the timer task - where a scheduler lock is used in place of a critical section. If the queue was not in the queue set, or the queue (or semaphore) was not empty, then pdFAIL is returned. static const MemoryRegion_t xAltRegions[portNUM_CONFIGURABLE_REGIONS] = { // Base address Length Parameters { ucOneKByte, 1024, portMPU_REGION_READ_WRITE }, { 0, 0, 0 }, { 0, 0, 0 } }; void vATask(void *pvParameters) { // This task was created such that it has access to certain regions of // memory as defined by the MPU configuration. Items are queued by copy not reference so it is preferable to only queue small items, especially when called from an ISR. pxHigherPriorityTaskWoken – [out] A task may be blocked waiting for space to become available on the queue. Returns If a notification was received (including notifications that were already pending when xTaskNotifyWait was called) then pdPASS is returned. ulVarToSend = 100; xQueueOverwrite(xQueue, &ulVarToSend); // This time read from the queue, leaving the queue empty once more. If a recursive mutex is created using xSemaphoreCreateRecursiveMutexStatic() then the application writer must provide the memory that will get used by the mutex. In * // this case, the timer is a one-shot timer. Parameters xTimer – The timer being queried. } if(cTaskWokenByPost != (char) pdFALSE; { taskYIELD (); } } Parameters xQueue – The handle to the queue from which the item is to be received. The timer command queue is private to the kernel itself and is not directly accessible to application code. This is done purely to assist debugging. Returns xQueueSelectFromSet() will return the handle of a queue (cast to a QueueSetMemberHandle_t type) contained in the queue set that contains data, or the handle of a semaphore (cast to a QueueSetMemberHandle_t type) contained in the queue set that is available, or NULL if no such queue or semaphore exists before before the specified block time expires. Many of the public FreeRTOS timer API functions send commands to the timer service task through a queue called the timer command queue. Check the documentation here and scroll down to the Download and configure FreeRTOS sectionEnter pip install tornado noseEnter pip install boto3Make sure you are inside the FreeRTOS directory and enter source vendors/espressif/esp-idf/export.shNavigate to vendors/espressif/esp-idf/tools there should be a file called idf.pyExecute chmod +x idf.py This will enable us to run the scriptThen in the FreeRTOS directory execute the following:idf.py -DVENDOR=espressif -DBOARD=esp32_wrover_kit -DCOMPILER=xtensa-esp32 buildidf.py erase_flash flash monitorEach one of these can be run individually the first wipes the esp32, the second flashes binaries on it, and the third launches a terminal to see what the esp32 is printingIf everything works fine you will see a bunch of lines and addresses being printed.Next Up: FreeRTOS Tutorial #3: Creating a Hello World Application ESP-IDF Programming Guide This section contains documentation of FreeRTOS types, functions, and macros. pdFALSE if an error occurred. } } Parameters xQueue – The handle to the queue on which the item is to be posted. xQueueSend(xQueue, pvItemToQueue, xTicksToWait) This is a macro that calls xQueueGenericSend(). xTaskNotifyGive() does not have this parameter and always sends notifications to index 0. If xStreamBufferSendFromISR() sets this value to pdTRUE, then normally a context switch should be performed before the interrupt is exited. uxItemSize – The number of bytes each item in the queue will require. * } * } * Parameters xTimer – The timer being queried. * for(;;); * } * Parameters pcTimerName – A text name that is assigned to the timer. A block time of zero can be used to poll the semaphore. If a queue is created using xQueueCreate() then both blocks of memory are automatically dynamically allocated inside the xQueueCreate() function. Returns The number of bytes that can be written to the message buffer before the message buffer would be full. If either pxStackBuffer or pxTaskBuffer are NULL then the task will not be created and errCOULD_NOT_ALLOCATE_REQUIRED_MEMORY is returned. xTimerReset(xTimer, xTicksToWait) BaseType_t xTimerReset(TimerHandle_t xTimer, TickType_t xTicksToWait); Timer functionality is provided by a timer service/daemon task. See xQueueReceiveFromISR for an alternative that can. Returns The name assigned to the timer specified by the xTimer parameter. The configUSE_TIMERS configuration constant must be set to 1 for xTimerStop() to be available. if(xSemaphoreTake(xSemaphore, (TickType_t) 10) == pdTRUE) { // We were able to obtain the semaphore and can now access the // shared resource. eSetValueWithOverwrite - The target notification value is set to the value of ulValue, even if the task being notified had not yet processed the previous notification at the same array index (the task already had a notification pending at that index). Parameters uxEventQueueLength – Queue sets store events that occur on the queues and semaphores contained in the set. Example use: void vAFunction(void) { StreamBufferHandle_t xStreamBuffer; const size_t xStreamBufferSizeBytes = 100, xTriggerLevel = 10; // Create a stream buffer that can hold 100 bytes. "ATask", // pcName - just a text name for the task to assist debugging. Example usage: // Bits used by the three tasks. xReceivedBytes = xMessageBufferReceive(xMessageBuffer, (void *) ucRxData, sizeof(ucRxData), xBlockTime); if(xReceivedBytes > 0) { // A ucRxData contains a message that is xReceivedBytes long. If a mutex is created using xSemaphoreCreateMutex() then the required memory is automatically dynamically allocated inside the xSemaphoreCreateMutex() function. Returns Dependent on the value of eAction. All three tasks have reached the synchronisation // point when all the ALL_SYNC_BITS are set. Example usage: #define BIT_0 (1 = TICKS_TO_WAIT) { // Unblock the task by releasing the semaphore. } } Parameters xEventGroup – The event group in which the bits are to be set. Returns The number of bytes that can be written to the stream buffer before the stream buffer would be full. This is mainly used to facilitate debugging. Example usage: void vTaskCode(void * pvParameters) { for(;;) { // Task code goes here. Returns If NULL is returned, then the message buffer cannot be created because there is insufficient heap memory available for FreeRTOS to allocate the message buffer data structures and storage area. Parameters xQueue – The handle of the queue being removed from the registry. and obtained using sSemaphoreTake(). Again it is unlikely that real code would have // these calls sequentially, but instead buried in a more complex // call structure. xTimerChangePeriod() changes the period of a timer that was previously created using the xTimerCreate() API function. xTaskCreateRestricted(&xRegTest1Parameters, &xHandle); // Start the scheduler. } } void vTask2(void *pvParameters) { for(;;) { // Perform task functionality here. For more details regarding the effects of running ESP-IDF FreeRTOS on a single core, refer to ESP-IDF FreeRTOS Single Core. The EventBits_t type is used to store event bits within an event group. * void vKeyPressEventInterruptHandler(void) * { * BaseType_t xHigherPriorityTaskWoken = pdFALSE; * * // Ensure the LCD back-light is on, then reset the timer that is * // responsible for turning the back-light off after 5 seconds of * // key inactivity. Here you can download a pre-configured FreeRTOS that has some prebuilt modules depending on the services you might want to use and depending on chip architecture.Under My configurations, you can make your own FreeRTOS version that can include (or exclude) certain libraries.For our ESP32 in search bar enter ESP32 download the row that has configuration Connect to AWS Greengrass with hardware platform ESP32-DevKitCOnce downloaded unzip and make note where the extract folder is (we will be using the command line in this directory)Rename the folder with a name with no special characters, if you don't rename the folder and it still has special characters it may mess with cmakeIn command line/ Terminal. } else { // The message buffer was created successfully and can now be used. UBaseType_t uxQueueMessagesWaiting(const QueueHandle_t xQueue) Return the number of messages stored in a queue. xQueue1 = xQueueCreate(10, sizeof(uint32_t)); if(xQueue1 == 0) { // Queue was not created and must not be used. However, in ESP-IDF FreeRTOS, the ``FreeRTOSConfig.h`` file is considered a private and must not be modified by users. xTaskCreateRestrictedStatic() therefore allows a memory protected task to be created without using any dynamic memory allocation. ulTotalRunTime /= 100UL; // Avoid divide by zero errors. Timer periods are specified in tick periods, so the constant portTICK_PERIOD_MS can be used to convert a time that has been specified in milliseconds. xEventGroupGetBits(xEventGroup) Returns the current value of the bits in an event group. It might be that bit 4 was cleared automatically as a // task that was waiting for bit 4 was removed from the Blocked // state. void vAnotherTask(void * pvParameters) { // ... // Post some characters that will be used within an ISR. pxHigherPriorityTaskWoken – [out] xQueueOverwriteFromISR() will set *pxHigherPriorityTaskWoken to pdTRUE if sending to the queue caused a task to unblock, and the unblocked task has a priority higher than the currently running task. If the queue // is full then this task will block for xTicksToWait ticks. When the command is actually processed will depend on the priority of the timer service/daemon task relative to other tasks in the system. The kernel itself only ever references a timer by its handle, and never by its name. The actual time that the task remains blocked depends on the tick rate. xTicksToWait is ignored if xTimerReset() is called before the scheduler is started. TickType_t xTimerGetExpiryTime(TimerHandle_t xTimer) TickType_t xTimerGetExpiryTime(TimerHandle_t xTimer); Returns the time in ticks at which the timer will expire. Calling xTaskNotifyGiveFromISR() is equivalent to calling xTaskNotifyGiveIndexedFromISR() with the uxIndexToNotify parameter set to 0. vTaskEndScheduler () will cause all of the resources allocated by the kernel to be freed - but will not free resources allocated by application tasks. A task can use xTaskNotifyWaitIndexed() to [optionally] block to wait for a notification to be pending, or ulTaskNotifyTakeIndexed() to [optionally] block to wait for a notification value to have a non-zero value. Wait for 10 ticks for space to become // available if necessary. Returns If the message buffer was reset then pdPASS is returned. pxHigherPriorityTaskWoken – It is possible that a message buffer will have a task blocked on it waiting for space to become available. vTaskStartScheduler(); // Will only get here if there was insufficient memory to create the idle // and/or timer task. Actual FreeRTOS semaphores are taken using the xSemaphoreTake() API function, the equivalent action that instead uses a task notification is ulTaskNotifyTakeIndexed(). // Is our priority higher than the created task? A stream buffer handle must not be used after the stream buffer has been deleted. Example usage: See the xTimerCreate() API function example usage scenario. pvItemToQueue – A pointer to the item that is to be placed on the queue. cIn = portINPUT_BYTE(RX_REGISTER_ADDRESS); // Post each byte. Do other time functions. Note the value passed out will not be effected by the clearing of any bits caused by ulBitsToClearOnExit being non-zero. At some point it is // desired that these MPU regions are replaced with that defined in the // xAltRegions const struct above. See xQueueSendFromISR () for an alternative which may be used in an ISR. See the example implemented in FreeRTOS/Demo/Minimal/MessageBufferAMP.c for additional information. param xSemaphore A handle to the semaphore being taken - obtained when the semaphore was created. xMessageBufferSendCompletedFromISR() does the same thing. uxIndexToClear – The index within the target task's array of notification values to act upon. pxHigherPriorityTaskWoken – xSemaphoreGiveFromISR() will set *pxHigherPriorityTaskWoken to pdTRUE if giving the semaphore caused a task to unblock, and the unblocked task has a priority higher than the currently running task. Returns The value of the event group at the time either the bits being waited for became set, or the block time expired. * } * } * Parameters xTimer – The handle of the timer that is to be started, reset, or restarted. However, pdPASS is the only value that can be returned because xQueueOverwriteFromISR() will write to the queue even when the queue is already full. Use xStreamBufferReceiveFromISR() to read from a stream buffer from an interrupt service routine (ISR). xQueue = xQueueCreate(10, sizeof(char)); if(xQueue == 0) { // Failed to create the queue. For a full list of ESP-IDF FreeRTOS configurations, see Project Configuration CONFIG_FREERTOS_UNICORE will run ESP-IDF FreeRTOS only on CPU0. Use xStreamBufferSend() to write to a stream buffer from a task. The size of StackType_t is dependent on // the RTOS port. xTaskCreate(vTaskCode, "NAME", STACK_SIZE, NULL, tskIDLE_PRIORITY, &xHandle); // Use the handle to delete the task. If uxAutoReload is set to pdFALSE then the timer will be a one-shot timer and enter the dormant state after it expires. Parameters xMessageBuffer – The handle of the message buffer to be deleted. // The address of xMutexBuffer is passed into the function, and will hold // the mutexes data structures - so no dynamic memory allocation will be // attempted. xMessageBufferReceive(xMessageBuffer, pvRxData, xBufferLengthBytes, xTicksToWait) Receives a discrete message from a message buffer. pxHigherPriorityTaskWoken – [out] xQueueSendToBackFromISR() will set *pxHigherPriorityTaskWoken to pdTRUE if sending to the queue caused a task to unblock, and the unblocked task has a priority higher than the currently running task. A notification sent to a task can optionally perform an action, such as update, overwrite or increment one of the task's notification values. eNoAction - The task receives a notification at the specified array index without the notification value at that index being updated. For example, a call to xMessageBufferCreate() returns an MessageBufferHandle_t variable that can then be used as a parameter to xMessageBufferSend(), xMessageBufferReceive(), etc. The memory used to hold // both the stream buffer structure and the data in the stream buffer is // allocated dynamically. Messages can be of variable length and are copied out of the buffer. xMessageBufferReceiveCompletedFromISR(xMessageBuffer, pxHigherPriorityTaskWoken) For advanced users only. return pdPASS if the task was successfully created and added to a ready list, otherwise an error code defined in the file projdefs.h Example usage: // Create an TaskParameters_t structure that defines the task to be created. The macro used is port specific and // will be either portYIELD_FROM_ISR() or portEND_SWITCHING_ISR() - // refer to the documentation page for the port being used. To be absolutely certain that events are not lost uxEventQueueLength should be set to the total sum of the length of the queues added to the set, where binary semaphores and mutexes have a length of 1, and counting semaphores have a length set by their maximum count value. Example usage: SemaphoreHandle_t xSemaphore = NULL; void vATask(void * pvParameters) { // Create the semaphore to guard a shared resource. Example usage: SemaphoreHandle_t xSemaphore; void vATask(void * pvParameters) { SemaphoreHandle_t xSemaphore = NULL; // Semaphore cannot be used before a call to xSemaphoreCreateCounting(). If xQueueOverwriteFromISR() sets this value to pdTRUE then a context switch should be requested before the interrupt is exited. } Parameters xBufferSizeBytes – The size, in bytes, of the buffer pointed to by the pucMessageBufferStorageArea parameter. xTicksToWait – The maximum amount of time that the task should wait in the Blocked state for the task's notification value to be greater than zero, should the count not already be greater than zero when ulTaskNotifyTake() was called. uxIndexToClear must be less than configTASK_NOTIFICATION_ARRAY_ENTRIES. It gets around the problem of the value overflowing on 8-bit types without breaking backward compatibility for applications that expect an 8-bit return type. } // Send the string to the message buffer. IDs are assigned to timers using the pvTimerID parameter of the call to xTimerCreated() that was used to create the timer, and by calling the vTimerSetTimerID() API function. configUSE_TASK_NOTIFICATIONS must be undefined or defined as 1 for this function to be available. This sets the maximum length of the message that can be received. For format you could leave it empty or set it to jsonThis would be helpful if you want to use IoT Core directly from the ESP32 without using Greengrass. Example usage: SemaphoreHandle_t xSemaphore; StaticSemaphore_t xSemaphoreBuffer; void vATask(void * pvParameters) { SemaphoreHandle_t xSemaphore = NULL; // Counting semaphore cannot be used before they have been created. ulValue is not used and xTaskNotifyIndexed() always returns pdPASS in this case. * for(x = 0; x < NUM_TIMERS; x++) * { * xTimers[x] = xTimerCreate("Timer", // Just a text name, not used by the kernel. xTicksToWait – The maximum amount of time the task should remain in the Blocked state to wait for data to become available if the stream buffer is empty. xTaskNotifyAndQueryFromISR() performs the same operation as xTaskNotifyFromISR() with the addition that it also returns the subject task's prior notification value (the notification value at the time the function is called rather than at the time the function returns) in the additional pulPreviousNotifyValue parameter. BaseType_t xTimerIsTimerActive(TimerHandle_t xTimer) BaseType_t xTimerIsTimerActive(TimerHandle_t xTimer); Queries a timer to see if it is active or dormant. Successfully received items remain on the queue so will be returned again by the next call, or a call to xQueueReceive(). EventBits_t xEventGroupWaitBits(EventGroupHandle_t xEventGroup, const EventBits_t uxBitsToWaitFor, const BaseType_t xClearOnExit, const BaseType_t xWaitForAllBits, TickType_t xTicksToWait) [Potentially] block to wait for one or more bits to be set within a previously created event group. Parameters pcWriteBuffer – A buffer into which the execution times will be written, in ASCII form. If xMessageBufferSendFromISR() sets this value to pdTRUE, then normally a context switch should be performed before the interrupt is exited. BaseType_t xQueueGiveFromISR(QueueHandle_t xQueue, BaseType_t *const pxHigherPriorityTaskWoken) BaseType_t xQueueReceiveFromISR(QueueHandle_t xQueue, void *const pvBuffer, BaseType_t *const pxHigherPriorityTaskWoken) Receive an item from a queue. If the message buffer was created using dynamic memory (that is, by xMessageBufferCreate()), then the allocated memory is freed. A non-NULL value being returned indicates that the message buffer has been created successfully - the returned value should be stored as the handle to the created message buffer. Rest of task code. c for the PC port). Wait 10 ticks for the command to be successfully sent * // if it cannot be sent immediately. See the demo application file main.c for an example of creating tasks and starting the kernel. static const TaskParameters_t xCheckTaskParameters = { vATask, // pvTaskCode - the function that implements the task. vPortFree(pxTaskStatusArray); } } Parameters pxTaskStatusArray – A pointer to an array of TaskStatus_t structures. Returns pdTRUE if the semaphore was successfully taken, otherwise pdFALSE xSemaphoreCreateMutex() Creates a new mutex type semaphore instance, and returns a handle by which the new mutex can be referenced. When suspended a task will never get any microcontroller processing time, no matter what its priority. Returns pdTRUE if the semaphore was released. * vSetBacklightState(BACKLIGHT_OFF); * } * * // The key press event handler. void vTaskCode(void * pvParameters) { // The parameter value is expected to be 1 as 1 is passed in the // pvParameters value in the call to xTaskCreateStatic(). NULL is returned if no matching name is found. QueueSetMemberHandle_t xQueueSelectFromSet(QueueSetHandle_t xQueueSet, const TickType_t xTicksToWait) xQueueSelectFromSet() selects from the members of a queue set a queue or semaphore that either contains data (in the case of a queue) or is available to take (in the case of semaphore). ulStatsAsPercentage = pxTaskStatusArray[x].ulRunTimeCounter / ulTotalRunTime; if(ulStatsAsPercentage > 0UL) { sprintf(pcWriteBuffer, "%s\t\t%lu\t\t%lu%%\r", pxTaskStatusArray[x].pcTaskName, pxTaskStatusArray[x].ulRunTimeCounter, ulStatsAsPercentage); } else { // If the percentage is zero here then the task has // consumed less than 1% of the total run time. Will be pdTRUE if the task way delayed and pdFALSE otherwise. Returns pdTRUE if the semaphore was successfully given, otherwise errQUEUE_FULL. Should be of type SemaphoreHandle_t. Remove a task from the RTOS real time kernel's management. * int32_t lExpireCounters[NUM_TIMERS] = { 0 }; * * // Define a callback function that will be used by multiple timer instances. Example usage: // Define an array of MemoryRegion_t structures that configures an MPU region // allowing read/write access for 1024 bytes starting at the beginning of the // ucOneKByte array. * } * } * } * * // ... uxSemaphoreGetCount(xSemaphore) If the semaphore is a counting semaphore then uxSemaphoreGetCount() returns its current count value. for(;;); } Parameters pxTaskDefinition – Pointer to a structure that contains a member for each of the normal xTaskCreate() parameters (see the xTaskCreate() API documentation) plus an optional stack buffer and the memory region definitions. If a task times out before it can write all xDataLengthBytes into the buffer it will still write as many bytes as possible. xQueueReceive() will return immediately if xTicksToWait is zero and the queue is empty. * * // The interrupt service routine that changes the period of xTimer. TaskStatus_t structures contain, among other things, members for the task handle, task name, task priority, task state, and total amount of run time consumed by the task. This task will self delete when app_main returns Idle Tasks (IDLEx) CPU0 and CPU1 0 Idle tasks created for (and pinned to) each CPU IPC Tasks (ipcx) CPU0 and CPU1 24 IPC tasks created for (and pinned to) each CPU. * (void *) x, // Assign each timer a unique id equal to its array index. pulTotalRunTime can be set to NULL to omit the total run time information. if(ulTotalRunTime > 0) { // For each populated position in the pxTaskStatusArray array, // format the raw data as human readable ASCII data for(x = 0; x < uxArraySize; x++) { // What percentage of the total run time has the task used? Any data that was in the stream buffer is discarded. pucQueueStorage – If uxItemSize is not zero then pucQueueStorageBuffer must point to a uint8_t array that is at least large enough to hold the maximum number of items that can be in the queue at any one time - which is (uxQueueLength * uxItemsSize) bytes. if(!xTaskResumeAll ()) { taskYIELD (); } } } Returns If resuming the scheduler caused a context switch then pdTRUE is returned, otherwise pdFALSE is returned. } // Task to peek the data from the queue. Returns pdPASS if the task was successfully created and added to a ready list, otherwise an error code defined in the file projdefs.h TaskHandle_t xTaskCreateStaticPinnedToCore(TaskFunction_t pvTaskCode, const char *const pcName, const uint32_t ulStackDepth, void *const pvParameters, UBaseType_t uxPriority, StackType_t *const pxStackBuffer, StaticTask_t *const pxTaskBuffer, const BaseType_t xCoreID) Create a new task with a specified affinity. The length of the timer command queue is set by the configTIMER_QUEUE_LENGTH configuration constant. pvParameter1 – The value of the callback function's first parameter. uint8_t *pxTaskGetStackStart(TaskHandle_t xTask) Returns the start of the stack associated with xTask. NULL is used as the task handle to indicate that this // function should modify the MPU regions of the calling task. * void vBacklightTimerCallback(TimerHandle_t pxTimer) * { * // The timer expired, therefore 5 seconds must have passed since a key * // was pressed. pxTimerBuffer – Must point to a variable of type StaticTimer_t, which will be then be used to hold the software timer's data structures, removing the need for the memory to be allocated dynamically. uxBits = xEventGroupSetBits(xEventGroup, // The event group being updated. } else if((uxBits & BIT_4) != 0) { // Bit 4 remained set when the function returned, but bit 0 was // cleared. xQueueGenericSendFromISR(xRxQueue, &cIn, &xHigherPriorityTaskWokenByPost, queueSEND_TO_BACK); } while(portINPUT_BYTE(BUFFER_COUNT)); // Now the buffer is empty we can switch context if necessary. Calling xTaskDelayUntil with the same xTimeIncrement parameter value will cause the task to execute with a fixed interface period. There are two reasons why the returned value might have the bits specified by the uxBitsToSet parameter cleared. // Wait in the Blocked state (so not using any CPU processing time) for a // maximum of 100ms for the full sizeof(ucRxData) number of bytes to be // available. uxBitsToWaitFor – A bitwise value that indicates the bit or bits to test inside the event group. ulTaskNotifyTakeIndexed() can either clear the task's notification value at the array index specified by the uxIndexToWaitOn parameter to zero on exit, in which case the notification value acts like a binary semaphore, or decrement the notification value on exit, in which case the notification value acts like a counting semaphore. vSemaphoreCreateBinary(xSemaphore); if(xSemaphore != NULL) { if(xSemaphoreGive(xSemaphore) != pdTRUE) { // We would expect this call to fail because we cannot give // a semaphore without first "taking" it! } // Obtain the semaphore - don't block if the semaphore is not // immediately available. Block for a maximum of 100 ticks if the * // change period command cannot immediately be sent to the timer * // command queue. Calling xTaskNotifyGive() is equivalent to calling xTaskNotifyGiveIndexed() with the uxIndexToNotify parameter set to 0. If the timeout has not occurred, pxTicksToWait is updated to reflect the number of remaining ticks. uint32_t ulTaskGenericNotifyValueClear(TaskHandle_t xTask, UBaseType_t uxIndexToClear, uint32_t ulBitsToClear) See for details. Example usage: void vAFunction(void) { TaskHandle_t xHandle; // Create a task, storing the handle. If vTaskNotifyGiveFromISR() sets this value to pdTRUE then a context switch should be requested before the interrupt is exited. It is not valid to specify a trigger level that is greater than the buffer size. * xTimer = xTimerCreateStatic("T1", // Text name for the task. // Suspend ourselves. Returns If the stream buffer is full then pdTRUE is returned. BaseType_t xStreamBufferIsEmpty(StreamBufferHandle_t xStreamBuffer) Queries a stream buffer to see if it is empty. When the command is actually processed will depend on the priority of the timer service/daemon task relative to other tasks in the system, although the timers expiry time is relative to when xTimerStartFromISR() is actually called. // This is a macro so pass the variable in directly. The main task is one of multiple tasks that are automatically spawned by ESP-IDF during startup. Returns pdTRUE if an item was successfully received from the queue, otherwise pdFALSE. xTaskCreate(vTaskCode, "NAME", STACK_SIZE, NULL, tskIDLE_PRIORITY, &xHandle); // ... if(uxTaskPriorityGet(xHandle) < uxTaskPriorityGet(NULL)) { // Our priority (obtained using NULL handle) is higher. xTimerStartFromISR(xTimer, pxHigherPriorityTaskWoken) BaseType_t xTimerStartFromISR(TimerHandle_t xTimer, BaseType_t *pxHigherPriorityTaskWoken); A version of xTimerStart() that can be called from an interrupt service routine. pvTimerID – An identifier that is assigned to the timer being created. A message buffer can only be reset if there are no tasks blocked on it. components/freertos/FreeRTOS-Kernel/include/freertos/semphr.h semBINARY_SEMAPHORE_QUEUE_LENGTH semSEMAPHORE_QUEUE_ITEM_LENGTH semGIVE_BLOCK_TIME vSemaphoreCreateBinary(xSemaphore) xSemaphoreCreateBinary() Creates a new binary semaphore instance, and returns a handle by which the new semaphore can be referenced. BaseType_t xQueueGenericSendFromISR(QueueHandle_t xQueue, const void *const pvItemToQueue, BaseType_t *const pxHigherPriorityTaskWoken, const BaseType_t xCopyPosition) It is preferred that the macros xQueueSendFromISR(), xQueueSendToFrontFromISR() and xQueueSendToBackFromISR() be used in place of calling this function directly. Parameters xMessageBuffer – The handle of the message buffer being queried. xTaskCreateRestricted() should only be used in systems that include an MPU implementation. &xTaskBuffer); // Variable to hold the task's data structure. This function must be used with care. Internally, within the FreeRTOS implementation, tasks use two blocks of memory. Otherwise pdPASS is returned. If there was a task that was blocked on the message or stream buffer waiting for data to arrive then the sbRECEIVE_COMPLETED() macro sends a notification to the task to remove it from the Blocked state. If xClearOnExit is set to pdFALSE then the bits set in the event group are not altered when the call to xEventGroupWaitBits() returns. If the call did not time out then xDataLengthBytes is returned. sizeof(size_t) is typically 4 bytes on a 32-bit architecture, so on most 32-bit architectures a 10 byte message will take up 14 bytes of message buffer space. If calling xMessageBufferReceiveFromISR() causes a task to leave the Blocked state, and the unblocked task has a priority higher than the currently executing task (the task that was interrupted), then, internally, xMessageBufferReceiveFromISR() will set *pxHigherPriorityTaskWoken to pdTRUE. Returns If the message buffer is created successfully then a handle to the created message buffer is returned. Do other things. See xTaskCreateStatic() for a version that does not use any dynamic memory allocation. See Inter-Processor Call for more details. ulTaskNotifyValueClear() does not have this parameter and always clears bits in the notification value at index 0. Execution then resumes from the point where vTaskStartScheduler () was called, as if vTaskStartScheduler () had just returned. Calling xStreamBufferReceiveFromISR() can make space available, and so cause a task that is waiting for space to leave the Blocked state. void *pvTimerGetTimerID(const TimerHandle_t xTimer) void *pvTimerGetTimerID(TimerHandle_t xTimer); Returns the ID assigned to the timer. Parameters xTask – Handle of the task to be queried. The message can be any length that fits within the buffer's free space, and is copied into the buffer. The second block is used to hold items placed into the queue. See the example code below for an example. xSemaphore = xSemaphoreCreateRecursiveMutex(); if(xSemaphore != NULL) { // The semaphore was created successfully. xSemaphore = xSemaphoreCreateBinary(); if(xSemaphore != NULL) { // The semaphore was created successfully. To change this enter sudo usermod -a -G dialout $USER and then reboot the machine/VMAfter rebooting don't forget to rerun source vendor/espressif/esp-idf/export.sh from the FreeRTOS directoryFlashing ESP32First in terminal/command line check the version of python using python3 --version. Obtain the priority of any task. If calling xTimerStartFromISR() causes the timer service/daemon task to leave the Blocked state, and the timer service/ daemon task has a priority equal to or greater than the currently executing task (the task that was interrupted), then *pxHigherPriorityTaskWoken will get set to pdTRUE internally within the xTimerStartFromISR() function. xSemaphoreTakeFromISR(xSemaphore, pxHigherPriorityTaskWoken) Macro to take a semaphore from an ISR. Ideally an interrupt service routine (ISR) is kept as short as possible, but sometimes an ISR either has a lot of processing to do, or needs to perform processing that is not deterministic. vToggleLED(); vTaskDelay(xDelay); } } Parameters xTicksToDelay – The amount of time, in tick periods, that the calling task should block. Post an item to the back of a queue. This is the handle returned when the semaphore was created. This is the amount of time the idle task has actually been executing. Setting xTicksToWait to portMAX_DELAY will cause the task to wait indefinitely (without timing out), provided INCLUDE_vTaskSuspend is set to 1 in FreeRTOSConfig.h. Tasks do not use any CPU time when they are in the Blocked state. Memory allocated by the task code is not automatically freed, and should be freed before the task is deleted. xTimerPeriodInTicks – The timer period. pxTaskStatusArray = pvPortMalloc(uxArraySize * sizeof(TaskStatus_t)); if(pxTaskStatusArray != NULL) { // Generate raw status information about each task. Here a // recursive mutex is created using xSemaphoreCreateRecursiveMutexStatic(). To wait for bits 0 and/or bit 1 and/or bit 2 set uxBitsToWaitFor to 0x07. * if(xTimerChangePeriod(xTimer, 500 / portTICK_PERIOD_MS, 100) == pdPASS) * { * // The command was successfully sent. cIn = portINPUT_BYTE(RX_REGISTER_ADDRESS); // Post the byte. For example, to wait for bit 0 and/or bit 2 set uxBitsToWaitFor to 0x05. A stream buffer is full if it does not have any free space, and therefore cannot accept any more data. sizeof(size_t) is typically 4 bytes on a 32-bit architecture, so on most 32-bit architecture a 10 byte message will take up 14 bytes of message buffer space. StaticMessageBuffer_t xMessageBufferStruct; void MyFunction(void) { MessageBufferHandle_t xMessageBuffer; xMessageBuffer = xMessageBufferCreateStatic(sizeof(ucBufferStorage), ucBufferStorage, &xMessageBufferStruct); // As neither the pucMessageBufferStorageArea or pxStaticMessageBuffer // parameters were NULL, xMessageBuffer will not be NULL, and can be used to // reference the created message buffer in other message buffer API calls. A task that has been suspended by one or more calls to vTaskSuspend () will be made available for running again by a single call to vTaskResume (). configUSE_TRACE_FACILITY and configUSE_STATS_FORMATTING_FUNCTIONS must both be defined as 1 for this function to be available. pxHookFunction – Pointer to the hook function. Inspect the demos for the port you are using to find the * // actual syntax required. // The semaphore can now be used. Max length defined by configMAX_TASK_NAME_LEN - default is 16. Returns The number of bytes that can be read from the stream buffer before the stream buffer would be empty. For example, unsigned longs can be cast to a void *, or the void * can be used to point to a structure. This allows the callback function to execute contiguously in time with the interrupt - just as if the callback had executed in the interrupt itself. * if(xTimerStartFromISR(xBacklightTimer, &xHigherPriorityTaskWoken) != pdPASS) * { * // The start command was not executed successfully. Etc. EventGroupHandle_t xEventGroup; void

anInterruptHandler(void) { BaseType_t xHigherPriorityTaskWoken, xResult; // xHigherPriorityTaskWoken must be initialised to pdFALSE. A task will enter the Blocked state when it is waiting for an event. Once created, standard FreeRTOS queues and semaphores can be added to the set using calls to xQueueAddToSet(). The time is defined in tick periods so the constant portTICK_PERIOD_MS can be used to convert a time that has been specified in milliseconds. Returns The number of bytes actually written to the stream buffer, which will be less than xDataLengthBytes if the stream buffer didn't have enough free space for all the bytes to be written. xTriggerLevelBytes – The number of bytes that must be in the stream buffer before a task that is blocked on the stream buffer to wait for data is moved out of the blocked state. A non-NULL value being returned indicates that the stream buffer has been created successfully - the returned value should be stored as the handle to the created stream buffer. This includes all ready, blocked and suspended tasks. xTriggerLevel – The new trigger level for the stream buffer. The semaphore must have previously been created with a call to xSemaphoreCreateBinary() or xSemaphoreCreateCounting(). In this case the * // parameter is not used. typedef QueueHandle_t SemaphoreHandle_t components/freertos/FreeRTOS-Kernel/include/freertos/timers.h TimerHandle_t xTimerCreate(const char *const pcTimerName, const TickType_t xTimerPeriodInTicks, const UBaseType_t uxAutoReload, void *const pvTimerID, TimerCallbackFunction_t pxCallbackFunction) TimerHandle_t xTimerCreate(const char * const pcTimerName, TickType_t xTimerPeriodInTicks, UBaseType_t uxAutoReload, void * pvTimerID, TimerCallbackFunction_t pxCallbackFunction); Creates a new software timer instance, and returns a handle by which the created software timer can be referenced. pxCreatedTask – Used to pass back a handle by which the created task can be referenced. ulTaskNotifyTake() is the original API function, and remains backward compatible by always operating on the notification value at index 0 in the array. Parameters xSemaphore – A handle to the semaphore to be deleted. ulBitsToClearOnEntry – Bits that are set in ulBitsToClearOnEntry value will be cleared in the calling task's notification value before the task checks to see if any notifications are pending, and optionally blocks if no notifications are pending. Parameters xQueue – The handle to the queue from which the item is to be received. pxMessage = & xMessage; xQueueGenericSend(xQueue2, (void *) &pxMessage, (TickType_t) 0, queueSEND_TO_BACK); } // ... Here is how to get started with ESP32 on Linux.Initial ObservationsOne can set up and install AWS FreeRTOS on numerous microcontrollers. UBaseType_t uxTaskGetStackHighWaterMark(TaskHandle_t xTask) Returns the high water mark of the stack associated with xTask. If the timer cannot be created (because either there is insufficient FreeRTOS heap remaining to allocate the timer structures, or the timer period was set to 0) then NULL is returned. See vSemaphoreCreateBinary() for an alternative implementation that can be used for pure synchronisation (where one task or interrupt always 'gives' the semaphore and another always 'takes' the semaphore) and from within interrupt service routines. typedef struct QueueDefinition *QueueHandle_t typedef struct QueueDefinition *QueueSetHandle_t Type by which queue sets are referenced. * if(*puxVariableToIncrement == 5) * { * // This is called from a timer callback so must not block. NOTE: In many usage scenarios it is faster and more memory efficient to use a direct to task notification in place of a binary semaphore! Internally, within the FreeRTOS implementation, binary semaphores use a block of memory, in which the semaphore structure is stored. Instead the calls are likely to be buried inside // a more complex call structure. UBaseType_t uxTaskGetSystemState(TaskStatus_t *const pxTaskStatusArray, const UBaseType_t uxArraySize, uint32_t *const pulTotalRunTime) configUSE_TRACE_FACILITY must be defined as 1 in FreeRTOSConfig.h for uxTaskGetSystemState() to be available. Stops the real time kernel tick. void vEventGroupDelete(EventGroupHandle_t xEventGroup) Delete an event group that was previously created by a call to xEventGroupCreate(). xMessageBufferSpaceAvailable(xMessageBuffer) Returns the number of bytes of free space in the message buffer. For example, if the timer must expire after 100 ticks, then xTimerPeriodInTicks should be set to 100. * configASSERT(pxTimer); * * // Which timer expired? If xTaskNotifyFromISR() sets this value to pdTRUE then a context switch should be requested before the interrupt is exited. Parameters xTask – Handle of the task associated with the stack returned. const char *pcTimerGetName(TimerHandle_t xTimer) const char * const pcTimerGetName(TimerHandle_t xTimer); Returns the name that was assigned to a timer when the timer was created. // At some point the task wants to perform a long operation during // which it does not want to get swapped out. Suspend any task. Call pcQueueGetName() to look up and return the name of a queue in the queue registry from the queue's handle. BaseType_t xTaskResumeFromISR(TaskHandle_t xTaskToResume) INCLUDE_xTaskResumeFromISR must be defined as 1 for this function to be available. NOTE: The idle task is responsible for freeing the kernel allocated memory from tasks that have been deleted. If calling xStreamBufferSendCompletedFromISR() removes a task from the Blocked state, and the task has a priority above the priority of the currently running task, then *pxHigherPriorityTaskWoken will get set to pdTRUE indicating that a context switch should be performed before exiting the ISR. } Returns If the event group was created then a handle to the event group is returned. xBytesSent = xStreamBufferSendFromISR(xStreamBuffer, (void *) pcStringToSend, strlen(pcStringToSend), &xHigherPriorityTaskWoken); if(xBytesSent != strlen(pcStringToSend)) { // There was not enough free space in the stream buffer for the entire // string to be written, ut xBytesSent bytes were written. Calling xTaskNotifyWait() is equivalent to calling xTaskNotifyWaitIndexed() with the uxIndexToWaitOn parameter set to 0. * if(lExpireCounters[lArrayIndex] == xMaxExpiryCountBeforeStopping) * { * // Do not use a block time if calling a timer API function from a * // timer callback function, as doing so could cause a deadlock! * xTimerStop(pxTimer, 0); * } * } * * void main(void) * { * int32_t x; * * // Create then start some timers. Returns xQueueOverwrite() is a macro that calls xQueueGenericSend(), and therefore has the same return values as xQueueSendToFront(). uxBits = xEventGroupWaitBits(xEventGroup, // The event group being tested. eInvalid); // Include the task state in xTaskDetails. Therefore xEventGroupClearBitsFromISR() sends a message to the timer task to have the clear operation performed in the context of the timer task. pxHigherPriorityTaskWoken – [out] xQueueSendFromISR() will set *pxHigherPriorityTaskWoken to pdTRUE if sending to the queue caused a task to unblock, and the unblocked task has a priority higher than the currently running task. Parameters xEventGroup – The event group being deleted. xMessageBufferIsFull(xMessageBuffer) Tests to see if a message buffer is full. Parameters xTaskToNotify – The handle of the task being notified. It is not valid to call xTaskGetIdleTaskHandle() before the scheduler has been started. pxQueueBuffer – Must point to a variable of type StaticQueue_t, which will be used to hold the queue's data structure. // The actual number of bytes read (which might be less than // uxWantedBytes) is returned. Could try again to send the remaining bytes. If xTimerStopFromISR() sets this value to pdTRUE then a context switch should be performed before the interrupt exits. * vBacklightTimerCallback // The callback function that switches the LCD back-light off. taskYIELD_FROM_ISR(xHigherPriorityTaskWoken); } Parameters xStreamBuffer – The handle of the stream buffer to which a stream is being sent. Parameters xMessageBuffer – The handle of the message buffer being reset. The mutex doesn't become available again until the owner has called xSemaphoreGiveRecursive() for each successful 'take' request. BaseType_t xStreamBufferSetTriggerLevel(StreamBufferHandle_t xStreamBuffer, size_t xTriggerLevel) A stream buffer's trigger level is the number of bytes that must be in the stream buffer before a task that is blocked on the stream buffer to wait for data is moved out of the blocked state. Returns If neither pxStackBuffer or pxTaskBuffer are NULL, then the task will be created and pdPASS is returned. xSemaphoreTake(xSemaphore, xBlockTime) Macro to obtain a semaphore. pxHigherPriorityTaskWoken – It is possible that a stream buffer will have a task blocked on it waiting for space to become available. } else if((uxBits & BIT_0) != 0) { // Bit 0 was set before xEventGroupClearBits() was called. Returns If the recursive mutex was successfully created then a handle to the created recursive mutex is returned. // It was created with tskIDLE_PRIORITY, but may have changed // it itself. xTaskNotifyAndQueryFromISR(xTaskToNotify, ulValue, eAction, pulPreviousNotificationValue, pxHigherPriorityTaskWoken) xTaskNotifyWait(ulBitsToClearOnEntry, ulBitsToClearOnExit, pulNotificationValue, xTicksToWait) xTaskNotifyWaitIndexed(uxIndexToWaitOn, ulBitsToClearOnEntry, ulBitsToClearOnExit, pulNotificationValue, xTicksToWait) xTaskNotifyGiveIndexed(xTaskToNotify, uxIndexToNotify) Sends a direct to task notification to a particular index in the target task's notification array in a manner similar to giving a counting semaphore. Returns The number of bytes read from the stream buffer, if any. do { // Obtain a byte from the buffer. The number of bytes copied into the buffer was defined when the queue was created. Examples of such objects are queues, semaphores, mutexes and event groups. * xTimerPeriod, // The period of the timer in ticks. If xWaitForAllBits is set to pdFALSE then xEventGroupWaitBits() will return when any one of the bits set in uxBitsToWaitFor is set or the specified block time expires. vTaskStartScheduler (); // Will only get here when the vTaskCode () task has called // vTaskEndScheduler (). } } Parameters xEventGroup – The event group in which the bits are to be cleared. uxAutoReload – If uxAutoReload is set to pdTRUE then the timer will expire repeatedly with a frequency set by the timer's period (see the xTimerPeriodInTicks parameter of the xTimerCreate() API function). xTaskNotifyIndexed() always returns pdPASS in this case. If xTimerResetFromISR() sets this value to pdTRUE then a context switch should be performed before the interrupt exits. xEventGroupClearBitsFromISR(xEventGroup, uxBitsToClear) A version of xEventGroupClearBits() that can be called from an interrupt. When task notifications are being used as a binary or counting semaphore equivalent then the task being notified should wait for the notification using the ulTaskNotificationTakeIndexed() API function rather than the xTaskNotifyWaitIndexed() API function. This type of semaphore uses a priority inheritance mechanism so a task 'taking' a semaphore MUST ALWAYS 'give' the semaphore back once the semaphore it is no longer required. Semaphore and mutex handles can also be passed in here. xTimerCreateStatic() has an extra parameter * // than the normal xTimerCreate() API function. This should equal the number returned by the uxTaskGetNumberOfTasks() API function, but will be zero if the value passed in the uxArraySize parameter was too small. xSemaphore = xSemaphoreCreateRecursiveMutexStatic(&xMutexBuffer); // As no dynamic memory allocation was performed, xSemaphore cannot be NULL, // so there is no need to check it. if(xQueue1 != 0) { // Send an uint32_t. If the timer had already been started and was already in the active state, then xTimerReset() will cause the timer to re-evaluate its expiry time so that it is relative to when xTimerReset() was called. In most FreeRTOS ports this is done by simply passing // xHigherPriorityTaskWoken into taskYIELD_FROM_ISR(), which will test the // variables value, and perform the context switch if necessary. // The max value to which the semaphore can count should be 10, and the // initial value assigned to the count should be 0. Returns The value of the event group at the time the call to xEventGroupSetBits() returns. Returns pdTRUE if the data was successfully sent to the queue, otherwise errQUEUE_FULL. Parameters xTask – Handle of the task to set the hook function for Passing xTask as NULL has the effect of setting the calling tasks hook function. If xMessageBufferReceiveFromISR() sets this value to pdTRUE, then normally a context switch should be performed before the interrupt is exited. } else { // We could not obtain the mutex and can therefore not access // the shared resource safely. Note when using the semaphore for synchronisation with an // ISR in this manner there is no need to 'give' the semaphore back. typedef struct tmrTimerControl *TimerHandle_t typedef void (*TimerCallbackFunction_t)(TimerHandle_t xTimer) typedef void (*PendedFunction_t)(void*, uint32_t) components/freertos/FreeRTOS-Kernel/include/freertos/event_groups.h EventGroupHandle_t xEventGroupCreate(void) Create a new event group. If xBufferLengthBytes is too small to hold the next message then the message will be left in the message buffer and 0 will be returned. If xQueueSendToBackFromISR() sets this value to pdTRUE then a context switch should be requested before the interrupt is exited. StreamBufferHandle_t xStreamBuffer; void vAnInterruptServiceRoutine(void) { size_t xBytesSent; char *pcStringToSend = "String to send"; BaseType_t xHigherPriorityTaskWoken = pdFALSE; // Initialised to pdFALSE. Returns If the stream buffer is created successfully then a handle to the created stream buffer is returned. Context switches will not occur while the scheduler is suspended. } } Parameters xSemaphore – A handle to the semaphore being released. } Parameters xQueue – The handle to the queue on which the item is to be posted. pucMessageBufferStorageArea – Must point to a uint8_t array that is at least xBufferSizeBytes + 1 big. sizeof(size_t) is typically 4 bytes on a 32-bit architecture, so on most 32-bit architecture setting xDataLengthBytes to 20 will reduce the free space in the message buffer by 24 bytes (20 bytes of message data and 4 bytes to hold the message length). configQUEUE_REGISTRY_SIZE must be greater than 0 within FreeRTOSConfig.h for the registry to be available. StaticStreamBuffer_t xStreamBufferStruct; void MyFunction(void) { StreamBufferHandle_t xStreamBuffer; const size_t xTriggerLevel = 1; xStreamBuffer = xStreamBufferCreateStatic(sizeof(ucBufferStorage), xTriggerLevel, ucBufferStorage, &xStreamBufferStruct); // As neither the pucStreamBufferStorageArea or pxStaticStreamBuffer // parameters were NULL, xStreamBuffer will not be NULL, and can be used to // reference the created stream buffer in other stream buffer API calls. BaseType_t xStreamBufferSendCompletedFromISR(StreamBufferHandle_t xStreamBuffer, BaseType_t *pxHigherPriorityTaskWoken) For advanced users only. Example usage: #define BIT_0 (1

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