atollic

Application Note

AN1202: FreeRTOS Kernel Awareness

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DOCUMENT IDENTIFICATION

ASW-AN1202 October 2012

REVISION

First version October 2012

Second version June 2016

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Contents

Introduction 4
Intended Readers 4
Usage 5
Requirements 5
Finding the Views 5
Task List 6
Queues 7
Semaphores 8
Timers 9

INTRODUCTION

This Application Note provides information regarding the debug support and kernel awareness features for the FreeRTOS and OpenRTOS real-time operating systems, available in the ***Atollic® TrueSTUDIO®*** product.

As FreeRTOS and OpenRTOS are technically identical, we will only refer to FreeRTOS in this document, but the information applies equally to both.

The kernel awareness features for FreeRTOS in ***Atollic TrueSTUDIO*** provide the developer with a detailed insight into the internal data structures of the FreeRTOS kernel. During a debug session, the current state of the FreeRTOS kernel and the various FreeRTOS kernel objects such as tasks, mailboxes, semaphores and software timers, can be easily inspected in a set of dedicated views, in the ***Atollic TrueSTUDIO*** debug perspective.

INTENDED READERS

This document is primarily intended for software developers using the FreeRTOS or OpenRTOS operating system in ***Atollic TrueSTUDIO*** projects.

USAGE

This section outlines the information provided in the FreeRTOS-specific debugger views in the ***Atollic TrueSTUDIO*** debugger. After reading this section, you should be able to use this information in your own project.

REQUIREMENTS

In order for the **FreeRTOS Queues** and the **FreeRTOS Semaphores** views to be able to locate the appropriate RTOS kernel data structures, the associated kernel objects need to be added to the FreeRTOS queue registry. Please consult the *FreeRTOS reference manual* for details.

FINDING THE VIEWS

A number of debugger views are available in the ***Atollic TrueSTUDIO*** **Debug** perspective when debugging an application containing the FreeRTOS real-time operating system.

These views are available from either the **View** top level menu or the **Show View** toolbar dropdown list button.

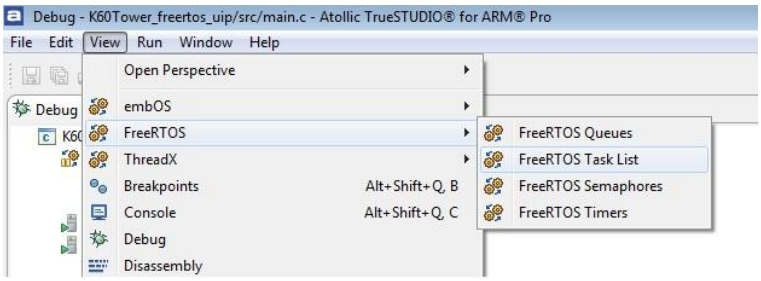


Figure 1 - View Top Level Menu

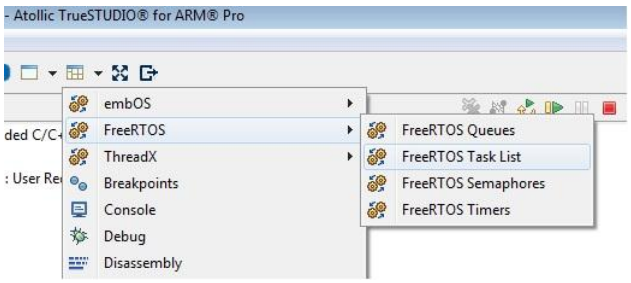
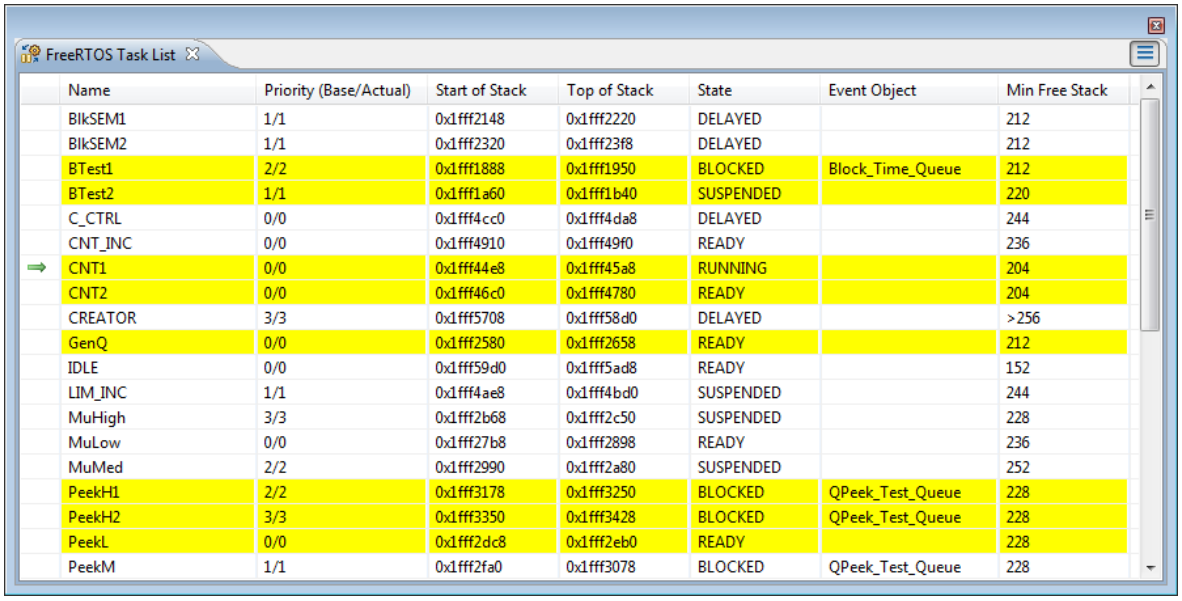


Figure 2 - Show View Toolbar Button

TASK LIST

The **FreeRTOS Task List** view displays detailed information regarding all available tasks in the target system. The task list is updated automatically each time the target execution is suspended.

There is one column for each type of task parameter, and one row for each task. If the value of any parameter for a particular task has changed since the last time the debugger was suspended, the corresponding row will be highlighted in yellow.



Name	Priority (Base/Actual)	Start of Stack	Top of Stack	State	Event Object	Min Free Stack
BlkSEM1	1/1	0x1fff2148	0x1fff2220	DELAYED		212
BlkSEM2	1/1	0x1fff2320	0x1fff23f8	DELAYED		212
BTest1	2/2	0x1fff1888	0x1fff1950	BLOCKED	Block_Time_Queue	212
BTest2	1/1	0x1fff1a60	0x1fff1b40	SUSPENDED		220
C_CTRL	0/0	0x1fff4cc0	0x1fff4da8	DELAYED		244
CNT_INC	0/0	0x1fff4910	0x1fff49f0	READY		236
CNT1	0/0	0x1fff44e8	0x1fff45a8	RUNNING		204
CNT2	0/0	0x1fff46c0	0x1fff4780	READY		204
CREATOR	3/3	0x1fff5708	0x1fff58d0	DELAYED		>256
GenQ	0/0	0x1fff2580	0x1fff2658	READY		212
IDLE	0/0	0x1fff59d0	0x1fff5ad8	READY		152
LIM_INC	1/1	0x1fff4ae8	0x1fff4bd0	SUSPENDED		244
MuHigh	3/3	0x1fff2b68	0x1fff2c50	SUSPENDED		228
MuLow	0/0	0x1fff27b8	0x1fff2898	READY		236
MuMed	2/2	0x1fff2990	0x1fff2a80	SUSPENDED		252
PeekH1	2/2	0x1fff3178	0x1fff3250	BLOCKED	QPeek_Test_Queue	228
PeekH2	3/3	0x1fff3350	0x1fff3428	BLOCKED	QPeek_Test_Queue	228
PeekL	0/0	0x1fff2dc8	0x1fff2eb0	READY		228
PeekM	1/1	0x1fff2fa0	0x1fff3078	BLOCKED	QPeek_Test_Queue	228

Figure 3 - FreeRTOS Task List View

Please note that due to performance reasons, stack analysis (the **Min Free Stack** column) is disabled by default. To enable stack analysis, use the **Stack analysis** toggle toolbar button in the **View** toolbar:

The available parameters are described in the table below:

Name	Description
N/A	Indicates the currently running task. The currently running task is indicated by a green arrow symbol.
Name	The name assigned to the task.
Priority (Base/Actual)	The task base priority and actual priority. The base priority is the priority assigned to the task. The actual priority is a temporary priority assigned to the task due to the priority inheritance mechanism.

Name	Description
Start of Stack	The address of the stack region assigned to the task.
Top of Stack	The address of the saved task stack pointer.
State	The current state of the task.
Event Object	The name of the resource that has caused the task to be blocked.
Min Free Stack	The stack “high watermark”. Displays the minimum number of bytes left on the stack for a task. A value of 0 (most likely) indicates that a stack overflow has occurred. Note! This feature must be enabled in the **View** toolbar.

Table 1 – FreeRTOS Task Parameters

QUEUES

The **FreeRTOS Queues** view displays detailed information regarding all available queues in the target system. The queues view is updated automatically each time the target execution is suspended.

There is one column for each type of queue parameter, and one row for each queue. If the value of any parameter for a particular queue has changed since the last time the debugger was suspended, the corresponding row will be highlighted in yellow.

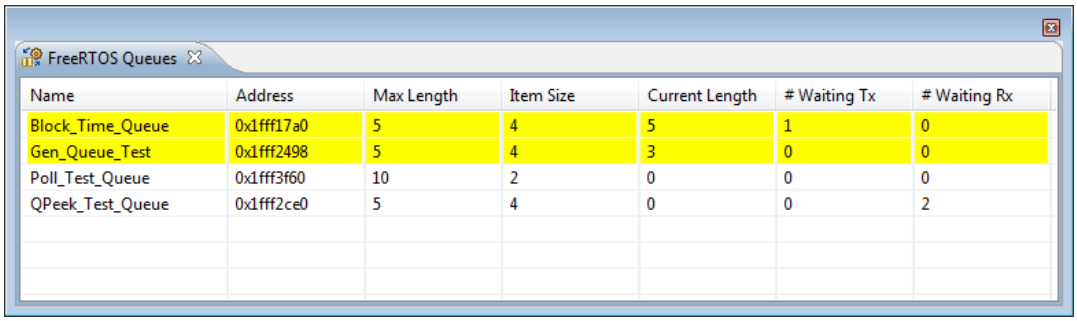


Figure 4 - FreeRTOS Queues View

The available parameters are described in the table below:

Name	Description
Name	The name assigned to the queue in the queue registry.

Name	Description
Address	The address of the queue.
Max Length	The maximum number of items that the queue can hold.
Item Size	The size in bytes of each queue item.
Current Length	The number of items currently in the queue.
#Waiting Tx	The number of tasks currently blocked waiting to send to the queue.
#Waiting Rx	The number of tasks currently blocked waiting to receive from the queue.

Table 2 – FreeRTOS Queue Parameters

SEMAPHORES

The **FreeRTOS Semaphores** view displays detailed information regarding all available synchronization objects in the target system, including:

- Mutexes
- Counting semaphores
- Binary semaphores
- Recursive semaphores

The view is updated automatically each time the target execution is suspended.

There is one column for each type of semaphore parameter, and one row for each semaphore. If the value of any parameter for a particular semaphore has changed since the last time the debugger was suspended, the corresponding row will be highlighted in yellow.

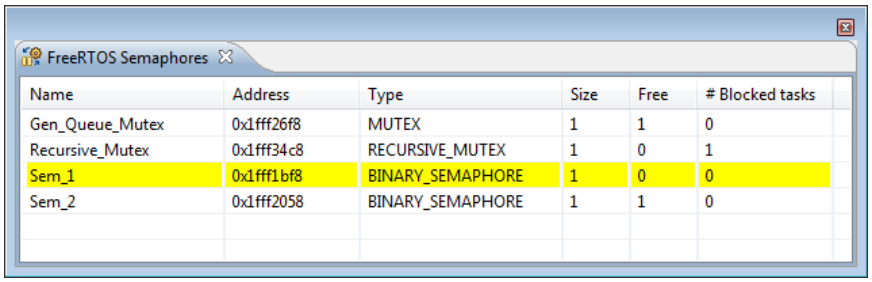


Figure 5 - FreeRTOS Semaphores View

The available parameters are described in the table below:

Column	Description
Name	The name assigned to the object in the queue registry.
Address	The address of the object.
Type	The type of the object.
Size	The maximum number of owning tasks.
Free	The number of free slots currently available.
#Blocked tasks	The number of tasks currently blocked waiting for the object.

Table 3 – FreeRTOS Semaphore Parameters

TIMERS

The **FreeRTOS Timers** view displays detailed information regarding all available software timers in the target system. The timers view is updated automatically each time the target execution is suspended.

There is one column for each type of timer parameter, and one row for each timer. If the value of any parameter for a particular timer has changed since the last time the debugger was suspended, the corresponding row will be highlighted in yellow.

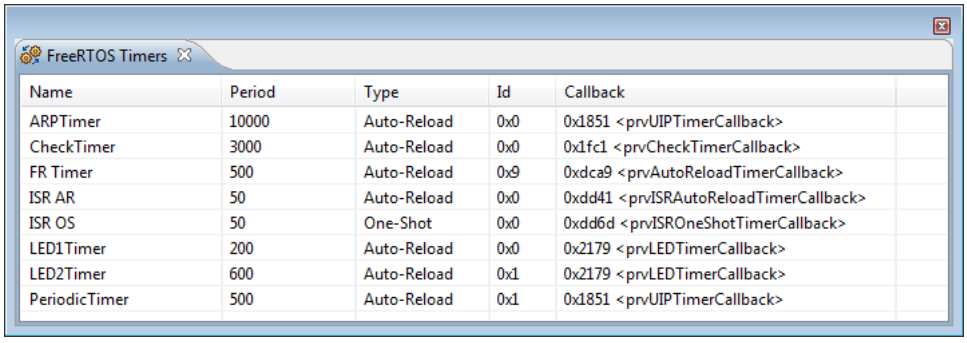


Figure 6 - FreeRTOS Timers View

The available parameters are described in the table below:

Name	Description
Name	The name assigned to the timer.
Period	The time (in ticks) between timer start and the execution of the callback function.
Type	The type of timer. Auto-Reload timers are automatically reactivated after expiration. One-Shot timers expires only once.
Id	The timer identifier.
Callback	The address and name of the callback function executed when the timer expires.

Table 4 – FreeRTOS Timer Parameters