Application Note

AN1202: FreeRTOS Kernel Awareness
COPYRIGHT NOTICE

© Copyright 2012 - 2016 Atollic AB. All rights reserved. No part of this document may be reproduced or distributed without the prior written consent of Atollic AB.

TRADEMARK

Atollic, Atollic TrueSTUDIO, and Atollic TrueSTORE and the Atollic logotype are trademarks or registered trademarks owned by Atollic. ECLIPSE™ is a registered trademark of the Eclipse foundation. All other product names are trademarks or registered trademarks of their respective owners.

DISCLAIMER

The information in this document is subject to change without notice and does not represent a commitment of Atollic AB. The information contained in this document is assumed to be accurate, but Atollic assumes no responsibility for any errors or omissions. In no event shall Atollic AB, its employees, its contractors, or the authors of this document be liable for any type of damage, losses, costs, charges, claims, demands, claim for lost profits, fees, or expenses of any nature or kind.

DOCUMENT IDENTIFICATION

ASW-AN1202 October 2012

REVISION

First version October 2012
Second version June 2016

Atollc AB
Science Park
Gjuterigatan 7
SE-553 18 Jönköping
Sweden

+46 (0) 36 19 60 50
E-mail: sales@atollic.com
Web: www.atollic.com

Atollc Inc
241 Boston Post Road, West Marlborough, MA 01752

+1 (617) 674-2655 (Voice)
+1 (877) 218-9117 (Toll Free)
+1 (978) 401-0680 (Fax)

E-mail: sales.usa@atollic.com
Web: www.atollic.com
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.
**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.

![FreeRTOS Task List View](image)

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:

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>N/A</td>
<td>Indicates the currently running task. The currently running task is indicated by a green arrow symbol.</td>
</tr>
<tr>
<td>Name</td>
<td>The name assigned to the task.</td>
</tr>
<tr>
<td>Priority (Base/Actual)</td>
<td>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.</td>
</tr>
</tbody>
</table>
**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.

![FreeRTOS Queues View](image)

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

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.

![FreeRTOS Semaphores View](image-url)

Figure 5 - FreeRTOS Semaphores View
The available parameters are described in the table below:

<table>
<thead>
<tr>
<th>Column</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>The name assigned to the object in the queue registry.</td>
</tr>
<tr>
<td>Address</td>
<td>The address of the object.</td>
</tr>
<tr>
<td>Type</td>
<td>The type of the object.</td>
</tr>
<tr>
<td>Size</td>
<td>The maximum number of owning tasks.</td>
</tr>
<tr>
<td>Free</td>
<td>The number of free slots currently available.</td>
</tr>
<tr>
<td>#Blocked tasks</td>
<td>The number of tasks currently blocked waiting for the object.</td>
</tr>
</tbody>
</table>

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.

![FreeRTOS Timers](image)

Figure 6 - FreeRTOS Timers View

The available parameters are described in the table below:
<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>The name assigned to the timer.</td>
</tr>
<tr>
<td>Period</td>
<td>The time (in ticks) between timer start and the execution of the callback function.</td>
</tr>
<tr>
<td>Type</td>
<td>The type of timer. Auto-Reload timers are automatically reactivated after expiration. One-Shot timers expires only once.</td>
</tr>
<tr>
<td>Id</td>
<td>The timer identifier.</td>
</tr>
<tr>
<td>Callback</td>
<td>The address and name of the callback function executed when the timer expires.</td>
</tr>
</tbody>
</table>

Table 4 – FreeRTOS Timer Parameters