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OS Awareness Manual pSOS+

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MANUAL

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Version 13-Feb-2025

History

04-Feb-21 Removing legacy command TASK.TASKState.

Overview

The OS Awareness for pSOS+ contains special extensions to the TRACE32 Debugger. This manual describes the additional features, such as additional commands and statistic evaluations.

Brief Overview of Documents for New Users

Architecture-independent information:

- **"Debugger Tutorial"** (debugger_tutorial.pdf): Get familiar with the basic features of a TRACE32 debugger.
- **"General Commands"** (general_ref_<*x*>.pdf): Alphabetic list of debug commands.
- **"OS Awareness Manuals"** (rtos_<*os*>.pdf): TRACE32 PowerView can be extended for operating system-aware debugging. The appropriate OS Awareness manual informs you how to enable the OS-aware debugging.

Architecture-specific information:

- **"Processor Architecture Manuals"**: These manuals describe commands that are specific for the processor architecture supported by your Debug Cable. To access the manual for your processor architecture, proceed as follows:
  - Choose **Help** menu > **Processor Architecture Manual**.

Supported Versions

Currently pSOS is supported for the following versions:

- pSOS 1.1A with pROBE 1.0A on Intel x86, real mode
- pSOS 1.1.x, 1.2.x, 2.0.E, 2.1.x on M68k
- pSOS 2.0.7 with pROBE 3.0.8 on PowerPC
- pSOS 2.1.x on ARM7
- pSOS 2.2.3 on PPC
- pSOS 2.2.6 on Intel 386, protected mode.
- pSOS 2.3.0 on M68K,
- pSOS 2.5.x on PPC

Configuration

The **TASK.CONFIG** command loads an extension definition file called “psos.t32” (directory ~~/demo/*<processor>*/kernel/psos). It contains all necessary extensions.
Automatic configuration tries to locate the pSOS internals automatically. For this purpose all symbol tables must be loaded and accessible at any time the OS Awareness is used.
If a system symbol is not available or if another address should be used for a specific system variable then the corresponding argument must be set manually with the appropriate address. This can be done by manual configuration which can require some additional arguments, too.
If you want to have dual port access for the display functions (display “On The Fly”), you have to map emulation memory to the address space of all used system tables.

Manual Configuration

Manual configuration for the OS Awarenesss for pSOS+ is only necessary for M68k controllers when using the kernel patch.The PRACTICE file 'ppsos.cmm' patches pSOS+ and pROBE and configures the OS Awareness. The macros defined at the beginning of the file specify the address of pROBE+/68k, the address of the current-tcb pointer, and the vectors which are used to enter the kernel.

Format: **TASK.CONFIG psos** *<magic_address>* *<sleep>* *<args>*

<magic_address> Specifies a memory location that contains the current running task.

<sleep> The argument for *<sleep>* is currently not used. Specify '0'.

<args> The additional arguments of the **TASK.CONFIG** command must be the address of the system call routine, the node configuration table, the pSOS data structures and a flag indicating the main pSOS version.

If the task selective debugging features are not used, the patching of the kernel is not required. The first two arguments are then not required. The PRACTICE script ~~/demo/m68k/kernel/psos/*<version>*/ppsos.cmm can make the required patches to pSOS+ and configures the display commands:

```
DO ppsos nopatch              ; configures only display functions
                              ; no patches are made (TASK.OFF)

DO ppsos noprobe              ; patches pSOS when pROBE is not loaded
                              ; task selective debugging in on

DO ppsos notask noprobe       ; patches pSOS when pROBE is not loaded
                              ; task selective debugging in off

DO ppsos                      ; patched pSOS and pROBE for task selective
                              ; debugging
```

The PRACTICE script file must be modified, when the pSOS node anchor is not at the default location. When patching is required the patch area in the PRACTICE script file must be modified to point to an unused memory area.

The demo script 'psos.cmm' in the ~~/demo/m68k/kernel/psos directory can be started with the same parameters. The application may require modifying the 'psos.cmm' file to load the currently used version of pSOS+.

Automatic Configuration

For system resource display and analyzer functionality, you can do an automatic configuration of the OS Awareness. For this purpose it is necessary that all system internal symbols are loaded and accessible. Each of the **TASK.CONFIG** arguments can be substituted by '0', which means that this argument will be searched and configured automatically. For a fully automatic configuration specify '0' to the magic and sleep arguments and omit all other arguments:

Format:	**TASK.CONFIG psos 0 0**

If a system symbol is not available, or if another address should be used for a specific system variable, then the corresponding argument must be set manually with the appropriate address.

Quick Configuration Guide

To access all features of the OS Awareness you should follow the following roadmap:

1. Run the demo script (~~/demo/m68k/kernel/psos/<*version*>/psos.cmm) with your kernel without any patching. This requires that you copy the files from this demo together with your version of the pSOS+ kernel in your directory. Start the demo with 'do psos nopatch'. Add the argument 'noprobe' if you don't want to load pROBE+. The result should be a list of tasks, which continuously change their state.
2. Run the demo script with patching. For CPU32(+) devices you need the argument 'notask'. (skip for x86 and PPC)
3. Try single stepping, starting and stopping a task. Display kernel resources. On CPU32(+) devices the interrupts during single stepping can be suppressed by **SETUP.IMASKASM**, by a monitor extension (**SYStem.MonFile**) which stops the interrupt source in the chip or by freezing the timer.
4. Try the analyzer demo scripts (tasksc, taskstat and taskfunc).
5. Make a copy of the 'ppsos.cmm' PRACTICE file. Modify the file according to your application. This can be changing the pSOS+ node anchor or choosing a different memory area for the patches.
6. Run the modified version in your application **without patching** (with 'nopatch' argument). This should allow you to display the kernel resources and use most of the analyzer features (except the system call display).
7. Run your application with patching, but without task selective debugging ('notask' argument). (skip for x86 and PPC)
8. Run your application with task selective debugging, when required (not CPU32(+) devices). (skip for x86 and PPC)

Hooks & Internals in pSOS+

Kernel patching for M68k:
To determine the entry of a task, the patching of pSOS+, and pROBE+ when used, is required. All returns to the task context (usually RTE instructions) are patched to pass control to the multitask monitor. The patch writes the current executing tcb address to the magic-word of the OS Awareness and runs to a breakpoint.The entries to pSOS are patched directly in the vector table. The patches write the value 1 to the magic-word and run to a breakpoint. The 'breakpoint'-trap of pROBE+ should be patched too. This will ease the combination of pROBE+ breakpoints together with the state analyzer.
The task-delete hook of pSOS is used to detect if a task has been deleted. If this hook (KC_DELETECO) is already in use, an additional patch in required.
To stop a task and continue the kernel, the debugger uses the 'manual round robin' feature of PSOS. In this case the debugger will executed the function-call 'tm_wkafter(1)'.

No hooks are used for x86 and PPC.

Features

The OS Awareness for pSOS+ supports the following features.

Display of Kernel Resources

The extension defines new commands to display various kernel resources. The commands can either give an overview about one resource type or display a single resource in detail. The resource can be defined by its ID, magic or name. The following information can be displayed:

The following information can be displayed for i386, M68k and PPC:

TASK.QC		Configuration
TASK.QO		Objects
TASK.QT		Tasks
TASK.QQ		Queues
TASK.QS		Semaphores
TASK.QR		Regions
TASK.QP		Partitions
TASK.QD		Date and time
TASK.QV	**(only available on PPC)**	Versions
TASK.SC	**(only available on M68k)**	System calls

For a detailed description of each command, refer to chapter “pSOS Commands for i386, M68k and PPC”.

The following information can be displayed for x86:

TASK.QC	Configuration
TASK.QP	Process table
TASK.QT	Time

For a description of the commands, refer to chapter “pSOSx86 Commands”.

When working with emulation memory or shadow memory, these resources can be displayed “On The Fly”, i.e. while the target application is running, without any intrusion to the application. If using this dual port memory feature, be sure that emulation memory is mapped to all places, where pSOS holds its tables.

When working only with target memory, the information will only be displayed if the target application is stopped.

(only available for PPC) pSOS+ users can call for a TRACE32 board support package. This package is based on the SBC821 BSP. It allows to create applications that run on the in circuit emulator without any target.

The BSP contains a special console driver which connects the pROBE+ with a terminal emulation window of the emulator. The 'break' command pROBE, to stop a running application (default: 'CTRL-C') is changed to 'TAB'. The communication between pROBE+ and the terminal is done via two memory cells, requiring no external interface.

Our demo application was built with this TRACE32 BSP.

Task Runtime Statistics

The time spent in a task can be analyzed by marking the accesses to a word holding the current task descriptor. All kernel activities are added to the calling task. The example PRACTICE script 'taskfunc.cmm' can be used to make the measurement for this analysis.

Analyzer.List List.TASK DEFault	Display trace buffer and task switches
Analyzer.STATistic.TASK	Display task runtime statistic evaluation
Analyzer.Chart.TASK	Display task runtime time chart

Task State Analysis

The time different tasks are is a certain state (running, ready, suspended or waiting) can be displayed as a statistic or in graphical form. This feature is implemented by recording all accesses to the status words of all tasks. Additionally the accesses to the current tcb pointer or the magic word are traced. This is required as the status of a task makes no difference between 'running' and 'ready'. The example script 'taskstat.cmm' makes a task state analysis with the demo application.

Analyzer.STATistic.TASKState	Display task state statistic evaluation
Analyzer.Chart.TASKState	Display task state time chart

Function Runtime Statistics

All function related statistic and time chart functions can be used with task specific information. The task switch can be displayed in the analyzer list with the **List.TASK** keyword. The example script 'taskfunc.cmm' makes a task-selective performance analysis for the demo application.

Analyzer.List List.TASK FUNC	Display function nesting
Analyzer.STATistic.TASKFunc	Display function runtime statistic
Analyzer.STATistic.TASKTREE	Display functions as call tree
Analyzer.Chart.TASKFunc	Display function time chart

System Calls

Manually executing system calls requires a small program on the target, which makes the system call and stops execution after the call. Such a program is part of the standard patch procedure (ppsos.cmm). The memory at the system parameter buffer (a part of the patch area) must be mapped internal (only available for M68k).

Task Selective Debugging

Task selective debugging allows to disable or enable the analyzer and the trigger system for specific tasks and to stop one task while others continue to operate. This function has an impact on the response time of the multitask kernel. The feature should not be used when making performance or time measurements or with extremely time critical applications. Task selective debugging not available on x86, PPC, CPU32 and CPU32+ processors.

pSOS specific Menu

The menu file “psos.men” contains a menu with pSOS specific menu items. Load this menu with the **MENU.ReProgram** command.

You will find a new menu called **pSOS+**.

- The **pROBE Terminal** menu item brings up a terminal emulation window, which communicates with the preconfigured pROBE+ debugger.
- The **Break to pROBE** menu item performs a special break command inside the terminal emulation to gain control to pROBE (see TRACE32 BSP).
- The **Query** menu items launch the kernel resource display windows.

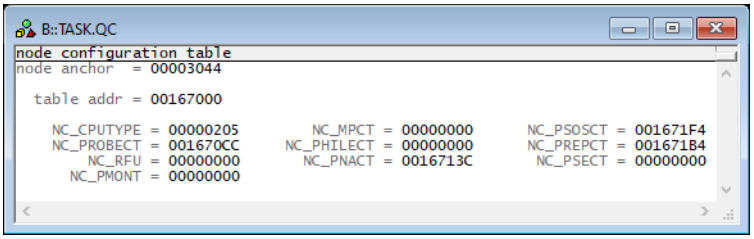
In addition, the menu file (*.men) modifies these menus on the TRACE32 main menu bar:

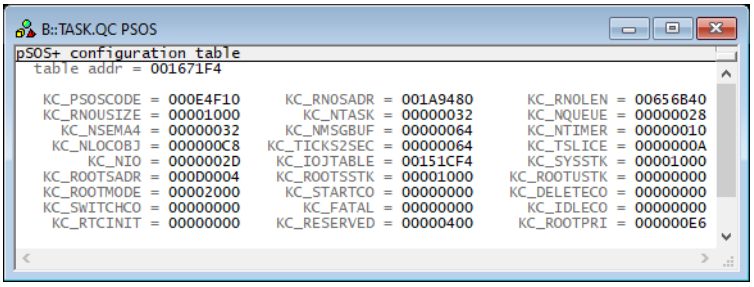
- The **Trace** -> **List** submenu is changed. You can additionally choose if you want a trace list window to show only task switches (if any) or task switches and defaults.
- The **Perf** menu contains the additional submenus for task runtime statistics, task-related function runtime statistics and statistics on task states. For the function runtime statistics, a PRACTICE script file called “men_ptfp.cmm” is used. This script file must be adapted to your application.

TASK.QC Configuration

Format: **TASK.QC** [**NODE** | **PSOS** | **PROBE**]

Displays the configuration tables of pSOS+. Some of the fields are mouse sensitive. Double clicking on them will show the appropriate information.

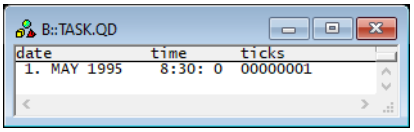




Format: **TASK.QD**

Displays the current time and tick.

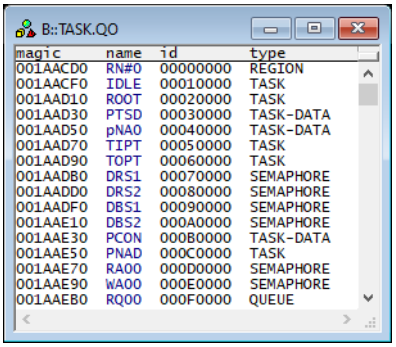
The 'ilevel' field displays the level of nested interrupts. This value should always be positive and near to zero.



Format: **TASK.QO** [<*id*> | <*name*>]

Displays the object-table of pSOS+.

With arguments it displays one object in detail.

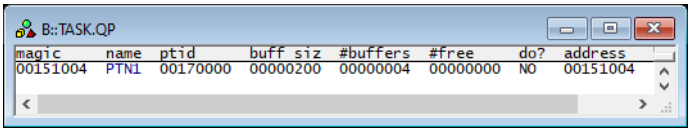


TASK.QP Partitions

Format: **TASK.QP** [<*partition_id*> | <*partition_name*>]

Displays the partition table of pSOS+.

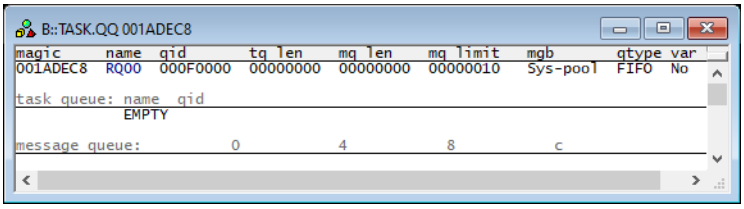
With arguments it displays one partition in detail.



Format: **TASK.QQ** [<*queue_id*> | <*queue_name*>]

Displays the queue table of pSOS+.

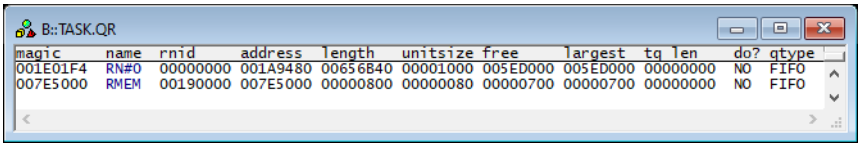
With arguments it displays one queue in detail.

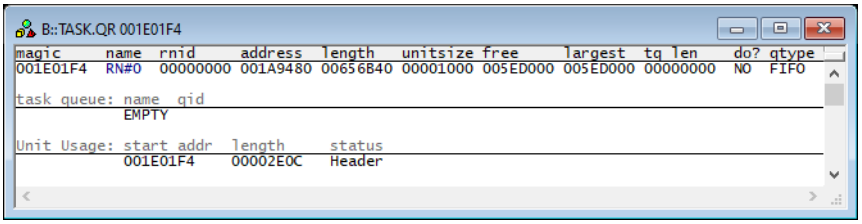


Format: **TASK.QR** [<*region_id*> | <*region_name*>]

Displays the region table of pSOS+.

With arguments it displays one region in detail.

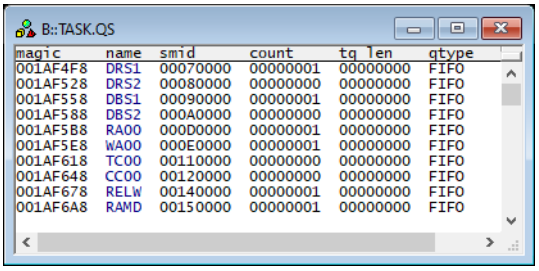


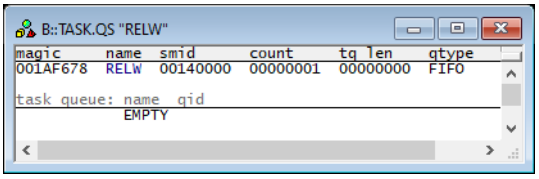


Format: **TASK.QS** [<*semaphore_id*> | <*semaphore_name*>]

Displays the semaphore table of pSOS+.

With arguments it displays one semaphore in detail.

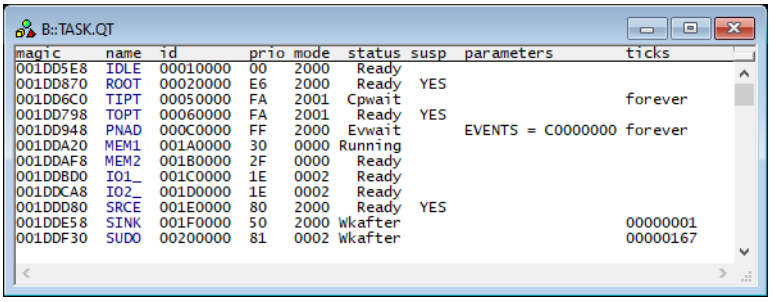


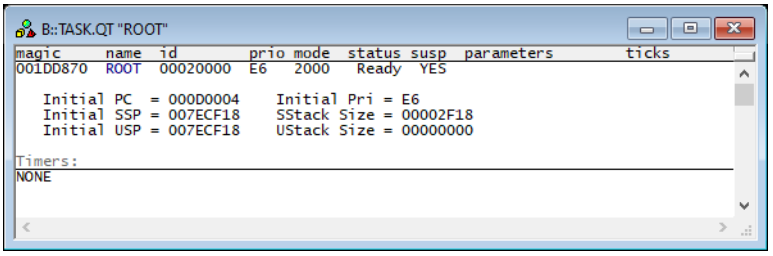


Format: **TASK.QT** [<*task_id*> | <*task_name*>]

Displays the task-table of pSOS+.

With arguments it displays one task in detail

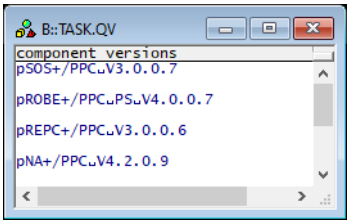




TASK.QV Version

Format: **TASK.QV**

Displays the pSOS+ and pROBE+ versions.



Format:	**TASK.SysCall** <*function*> <*d1*> <*d2*> <*d3*> <*d4*> <*d5*> <*a0*> <*a1*>
<*function*>:	**PT_SGETBU** | **Q_BROADCA** | **EV_RECEIV** | **TM_WKAFTE** **TM_EVEVER** | **Q_VRECEIV** | **Q_VBROADC** | **Q_AVURGEN** <*function*>

Executes a pSOS system call.

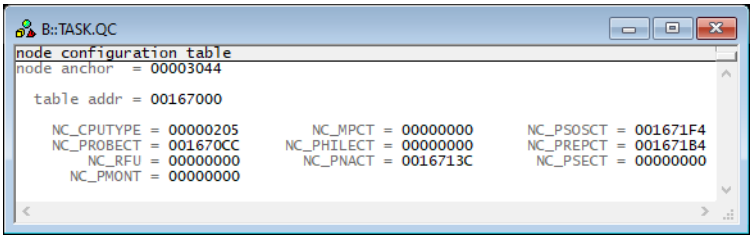
The function can only be executed, when the currently selected task is already stopped or can be stopped by the OS Awareness. When the task selective debugging is not active, the emulation must be stopped (in a regular task) before executing the command. Some functions are abbreviated to nine characters (see above list).

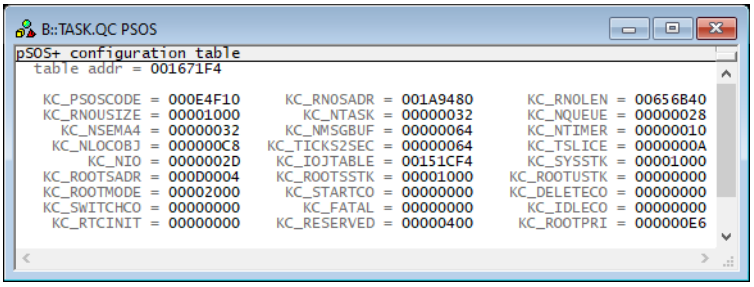
```
task.sc q_create 41424344 4 0 0 7         ; create new queue

task.sc q_send 0c0000 12 34 56 78         ; send message to queue
```

TASK.QC Configuration

Format:	**TASK.QC** [**SYSTEM** | **PSOS** | **PROBE**]

Displays the configuration tables of pSOS+.

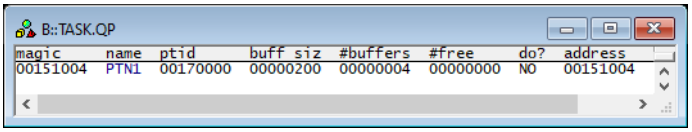




Format: **TASK.QP**

Displays the process table of pSOS-86.

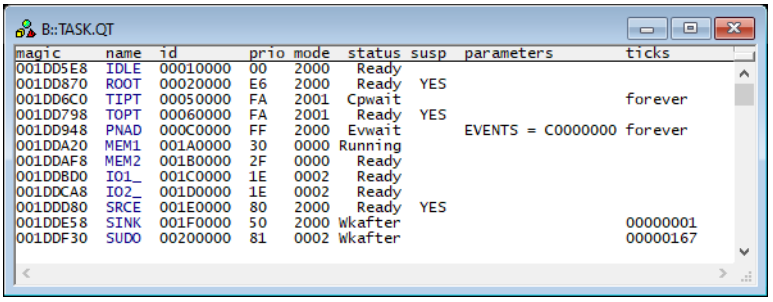
The state 'Running' is not displayed.



TASK.QT Time

Format: **TASK.QT**

Displays the current time and the nesting levels of system calls and interrupts.



TASK.TASKState Mark task state words

Format: **TASK.TASKState**

This command sets Alpha breakpoints on all task status words.

The statistic evaluation of task states (see **Task State Analysis**) requires recording of the accesses to the task state words. By setting Alpha breakpoints to these words and selectively recording Alpha's, you can do a selective recording of task state transitions.

Because setting the Alpha breakpoints by hand is very hard to do, this utility command automatically sets the Alpha's to the status words of all tasks currently created. It does NOT set breakpoints to tasks that terminated or haven't yet been created.

There are special definitions for pSOS specific PRACTICE functions.

TASK.CONFIG() OS Awareness configuration information

Syntax: **TASK.CONFIG(magic | magicsize)**

Parameter and Description:

magic	**Parameter Type**: String (***without*** quotation marks). Returns the magic address, which is the location that contains the currently running task (i.e. its task magic number).
magicsize	**Parameter Type**: String (***without*** quotation marks). Returns the size of the task magic number (1, 2 or 4).

Return Value Type: Hex value.