SEGGER SystemView

Recording and analyzing runtime behavior of embedded systems

User Guide

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Credits

Special thanks to Jean Labrosse for continuous feedback, beta testing, and good ideas.

Manual versions

This manual describes the current software version. If you find an error in the manual or a problem in the software, please inform us and we will try to assist you as soon as possible. Contact us for further information on topics or functions that are not yet documented.

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Software	Revision	Date	By	Description/SYSVIEW_*
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2.52	3	180809	NV	• Section “No OS” added link to generic setup example.
2.52	2	180315	NV	• Section “FreeRTOS” updated for V10.
2.52	1	170907	JL	• Section “FreeRTOS” updated. • Section “uC/OS-II” added.
2.52	0	170818	JL	• Section “Command Line Options” added. • Section “Micrium OS Kernel” added. • Chapter “API reference” updated.
2.50	0	170426	JL	• Section “SystemView PRO” added. • Section “Event filter” added.
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Software	Revision	Date	By	Description/SYSVIEW_*
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2.38	0	160624	JL	• Section “Renesas RX” to “Supported Devices” added.
2.36	0	160524	JL	• Section “Getting started with SystemView” updated. • Section “The SystemView Application” updated. • Section “Supported OSes” updated. • Section “Integration guide” updated.
2.34	0	160401	JL	• Section “Optimizing SystemView” added. • Section “uC/OS-III” to “Supported OSes” added.
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2.26	1	160106	JL	Configuration for embOS and FreeRTOS added.
2.26	0	151223	JL	• Printf functionality added.
2.24	0	151216	JL	• macOS and Linux version added.
2.22	0	151214	JL	• GUI and performance improvements.
2.20	1	151119	JL	• Screenshots updated. • Fixed defines in configuration.
2.20	0	151118	JL	• SystemViewer GUI elements restructured. • SystemView Config module added.
2.10	0	151106	JL	• Official Release.
2.09	0	151026	JL	• Initial Pre-Release.

About this document

Assumptions

This document assumes that you already have a solid knowledge of the following:

- The software tools used for building your application (assembler, linker, C compiler).
- The C programming language.
- The target processor.
- DOS command line.

If you feel that your knowledge of C is not sufficient, we recommend *The C Programming Language* by Kernighan and Ritchie (ISBN 0--13--1103628), which describes the standard in C programming and, in newer editions, also covers the ANSI C standard.

How to use this manual

This manual explains all the functions and macros that the product offers. It assumes you have a working knowledge of the C language. Knowledge of assembly programming is not required.

Typographic conventions for syntax

This manual uses the following typographic conventions:

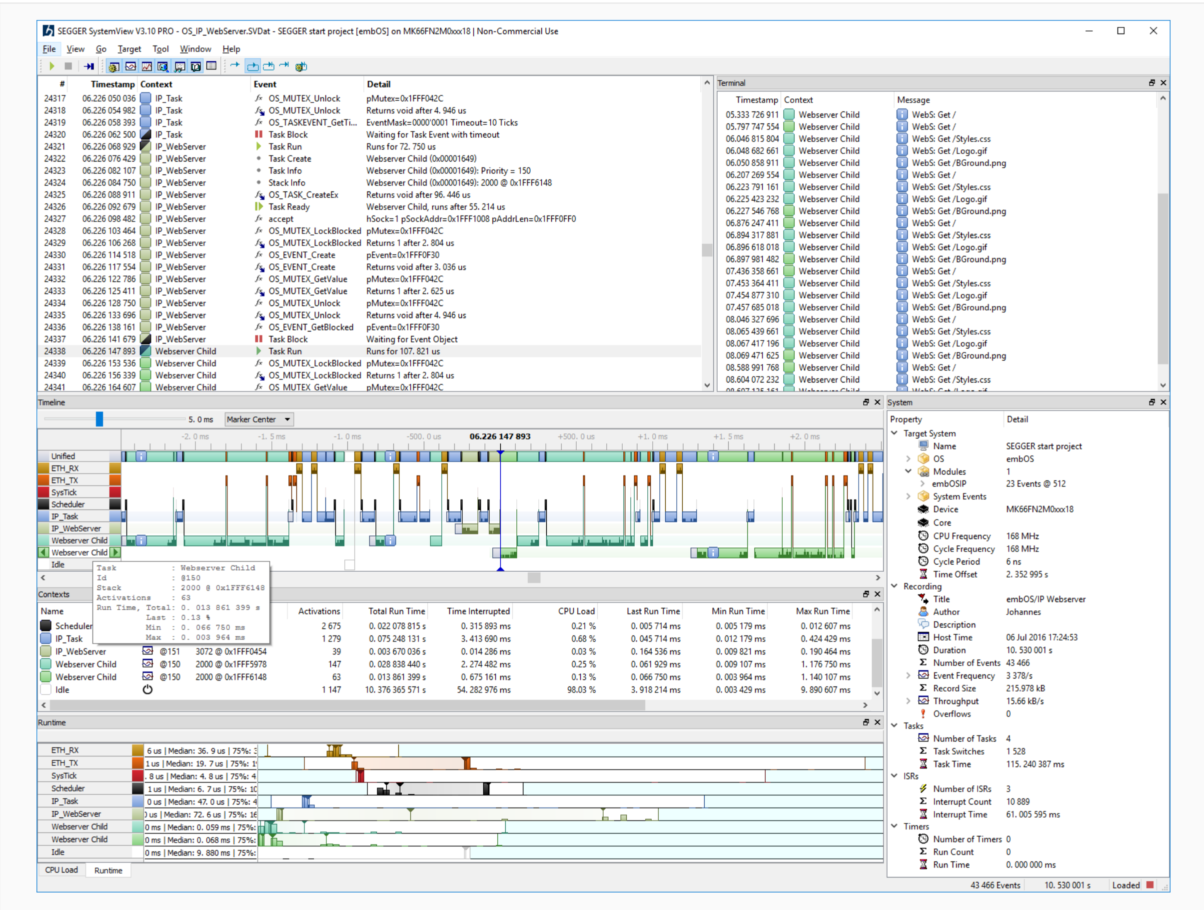
Style	Used for
Body	Body text.
`Keyword`	Text that you enter at the command prompt or that appears on the display (that is system functions, file- or pathnames).
`Parameter`	Parameters in API functions.
`Sample`	Sample code in program examples.
`Sample comment`	Comments in program examples.
Reference	Reference to chapters, sections, tables and figures or other documents.
GUIElement	Buttons, dialog boxes, menu names, menu commands.
Emphasis	Very important sections.

Table of contents

Chapter 1

Overview

This section describes SEGGER SystemView in general.



1.1 What is SEGGER SystemView?

SystemView is a toolkit for visual analysis of any embedded system. SystemView gives complete insight into an application, to gain a deep understanding of the runtime behavior, going far beyond what a debugger is offering. This is particularly advantageous when developing and working in complex systems with multiple tasks and events.

SystemView consists of two parts:

- The PC visualization *SystemView Application*,
- Code that gathers telemetry data on the target system.

The SystemView application allows analysis and profiling of the behavior of an embedded system. It records the telemetry data generated by the embedded system and visualizes that information in a variety of ways. The recording can be saved to a file for later analysis or for documentation of the system.

The telemtery data is recorded through the debug interface, through a network connection, or over a serial line. When recording through the debug interface, no additional hardware (and additional pinning) is required to use SystemView. It can be used on any system that allows debug access.

With a SEGGER J-Link and its *Real Time Transfer* (RTT) technology, SystemView can continuously record, analyze, and visualize data in real time. With SystemView's multicore support, the entire system, including the inter-core communication, can be visualized.

SystemView makes it possible to analyze which interrupts, tasks, and software timers have executed, how often, when exactly and how much time they have used. It sheds light on what exactly happened, in which order, which interrupt has triggered which task switch, which interrupt and task has called which API function of the underlying modules.

Cycle-accurate profiling can be performed and performance markers can be added in the system to measure timings.

SystemView can be used to verify that the embedded system behaves as expected and can be used to find problems and inefficiencies, such as superfluous and spurious interrupts, unexpected task changes, or badly-chosen task priorities. It can be used with any (RT)OS which is instrumented to call SystemView event functions, but also in systems without an instrumented RTOS or without any RTOS at all, to analyze interrupt execution and to time user functionality like time-critical subroutines.

1.1.1 How does it work?

On the target side a small software module, containing SYSTEMVIEW and RTT, must be included. The SYSTEMVIEW module collects and formats the monitor data and passes it to RTT.

The target system calls SYSTEMVIEW functions in certain situations, such as interrupt start and interrupt end, to monitor events. SystemView stores these events together with a configurable, high-accuracy timestamp. Timestamps can be as accurate as 1 CPU cycle, which equates to 5 ns on a 200 MHz CPU.

The RTT module stores the data in the target buffer, which enables continuous recording, as well as single-shot recording and post-mortem analysis.

The recorder interface reads the data from the RTT buffer and sends it to the SystemView Application.

In case of a multicore recording, each core stores its data in a separate buffer, the recorder interface then reads all the buffers.

1.1.2 What resources are required on the target side?

The combined ROM size of RTT and the SYSTEMVIEW modules is less than 2 KByte. For typical systems, about 600 bytes of RAM are sufficient for continuous recording. For system-triggered recording the buffer size is determined by the time to be recorded and the amount of events. No other hardware is required. The CPU requires less than 1 us for typical events (based on a 200 MHz Cortex-M4 CPU), which results in less than 1% overhead in a system with 10,000 events per second. Since the debug interface (JTAG, SWD, FINE, ...) is used to transfer the data, no additional pins are required.

1.1.3 On which CPUs can SystemView be used?

SystemView can be used on any CPU. Continuous real-time recording can be carried out on any system supported by J-Link RTT technology or using a network connection or serial line. RTT requires the ability to read memory via the debug interface during program execution which is generally supported in ARM Cortex-M0, M0+, M1, M3, M4, M7, M23, M33 processors as well as all Renesas RX devices.

On systems which are not supported by the RTT technology the buffer content can also be read manually through the debug probe when the system is halted, which allows single-shot recording until the buffer is filled and post-mortem analysis to capture the latest recorded data. Single-shot and post-mortem recording can be triggered by the system to be able to control when a recording starts and stops.

1.1.4 How much work is it to add it to a target system?

Not very much. A small number of files need to be added to the makefile or project. If the operating system supports SystemView, then only one function needs to be called. In a system without RTOS or non-instrumented RTOS, two lines of code need to be added to every interrupt or function which should be monitored. That’s all and should not take more than a few minutes.

1.2 The SEGGER SystemView package

The following sections describe how to install the SEGGER SystemView package and its contents.

1.2.1 Download and installation

The SEGGER SystemView package is available for Windows, macOS and Linux as an installer setup and a portable archive.

Download the latest package for your operation system from https://www.segger.com/systemview.

In order to do live recording the current J-Link Software and Documentation Package must be installed. Download and instructions are available at https://www.segger.com/jlink.

Windows Installer

Download the latest setup from http://www.segger.com/systemview and execute it. The setup wizard guides through the installation.

After installation the package content can be accessed through the Windows *Start* menu or from the file explorer.

Windows Portable Package

Download the latest zip from http://www.segger.com/systemview and extract it to any directory on the file system.

No installation is required, after extraction the package content can be used directly.

macOS Installer

Download the latest pkg installer from http://www.segger.com/systemview and execute it. The package installer guides through the installation.

After installation the SystemView Application can be accessed through Launchpad.

Linux Requirements

To run SystemView on Linux the Qt V4.8 libraries have to be installed on the system.

Linux Installer

Download the latest DEB or RPM installer for your Linux from http://www.segger.com/systemview and execute it. The software installer guides through the installation.

Linux Portable Package

Download the latest archive for your Linux from http://www.segger.com/systemview and extract it to any directory on the file system.

No installation is required, after extraction the package content can be used directly.

Target Sources

Download the latest sources to be included in the embedded application from http://www.segger.com/systemview and extract it to a folder of your choice.

Sources to interface with SEGGER software, such as embOS are also included.

1.2.2 Package content

The SEGGER SystemView package includes everything needed for application tracing — the host PC visualization SystemView Application and sample trace files for a quick and easy start.

The following tables list the package content.

SystemView package

File	Description
./SystemView*	The SystemView analysis and visualization tool.
./Doc/UM08027_SystemView.pdf	This documentation.
./Doc/Release_SystemView.html	Release notes and revision history.
./Description/SYSVIEW_*.txt	SystemView API description files.
./Sample/FS_DeviceActivity.SVDat	Demonstrates the usage of the callback invoked on each device operation.
./Sample/FS_Performance.SVDat	SystemView Sample recording of SEGGER emFile, testing read and write performance of the Macronix NAND Flash (MX30LF1GE8ABTI) on the SEGGER emPower board (Freescale MK66FN2M0VMD18)
./Sample/OS_IP_WebServer.SVDat	SystemView sample trace file of a web server application.
./Sample/OS_Start_LEDBlink.SVDat	SystemView sample trace file of a simple embOS application.
./Sample/Sample_DataPlot.SVDat	SystemView sample recording showing SystemView's DataPlot window.
./Sample/Sample_MultiCore.SVDat	SystemView sample recording showing SystemView's multicore support.
./Sample/Sample_Overflow.SVDat	SystemView sample recording showing SystemView buffer overflows.
./Sample/uCOS_Start.SVDat	SystemView sample trace file of a simple uC/OS-III application.

Target source package

File	Description
./Src/Config/Global.h	Global data types for SystemView.
./Src/Config/SEGGER_RTT_Conf.h	SEGGER Real Time Transfer (RTT) configuration file.
./Src/Config/SEGGER_SYSVIEW_Conf.h	SEGGER SYSTEMVIEW configuration file.
./Src/Sample/COMM	Recorder via network connection using embOS and emNet.
./Src/Sample/embOS	Initialization and configuration of SystemView with embOS.
./Src/Sample/FreeRTOSV8	Initialization and configuration of SystemView with FreeRTOS V8.
./Src/Sample/FreeRTOSV9	Initialization and configuration of SystemView with FreeRTOS V9.
./Src/Sample/FreeRTOSV10	Initialization and configuration of SystemView with FreeRTOS V10.
./Src/Sample/MicriumOSKernel	Initialization and configuration of SystemView with the Micrium OS Kernel.
./Src/Sample/NoOS	Initialization and configuration of SystemView with no OS.

File	Description
./Src/Sample/uCOS-II	Initialization and configuration of SystemView with uC/OS-II.
./Src/Sample/uCOS-III	Initialization and configuration of SystemView with uC/OS-III.
./Src/SEGGER/SEGGER.h	Global types & general purpose utility functions.
./Src/SEGGER/SEGGER_RTT.c	SEGGER RTT module source.
./Src/SEGGER/SEGGER_RTT.h	SEGGER RTT module header.
./Src/SEGGER/SEGGER_RTT_ASM_ARMv7M.S	Optimized RTT routines for Cortex-M.
./Src/SEGGER/SEGGER_SYSVIEW.c	SEGGER SYSTEMVIEW module source.
./Src/SEGGER/SEGGER_SYSVIEW.h	SEGGER SYSTEMVIEW module header.
./Src/SEGGER/SEGGER_SYSVIEW_ConfDefaults.h	SEGGER SYSTEMVIEW configuration fallback.
./Src/SEGGER/SEGGER_SYSVIEW_Int.h	SEGGER SYSTEMVIEW internal header.
./Src/SEGGER/Syscalls/SEGGER_RTT_Syscalls_*.c	Sources for toolchain dependent low level routines for I/O via RTT.

1.3 Licensing

SystemView can be used free of charge for non-commercial purposes under SEGGER's Friendly License (https://www.segger.com/license-sfl). For any other use a commercial-use license is required.

There are no feature limitations with a non-commercial license. SystemView enables unlimited recording and comes with features for better analysis, search, and filtering.

Commercial-use licenses for SystemView are available as single-user licenses as well as group or company-wide licenses. For more information refer to SEGGER's Commercial-use License (https://www.segger.com/license-cul).

1.3.1 Non-commercial license

SystemView may be used with a non-commercial license for evaluation, educational and hobbyist purposes.

When you use SystemView under the non-commercial license, no activation is required. On start of the SystemView Application, a popup is presented. Click continue to accept the license terms.

Chapter 2

Getting started with the SystemView Application

This section describes how to get started with SEGGER SystemView. It explains how to analyze an application based on monitored data.

This chapter refers to the sample data file `OS_IP_WebServer.SVDat` which is part of the SEGGER SystemView package.

The sample data file shows the behavior of a target system running the embOS RTOS, the emNet TCP/IP stack and a web server application.

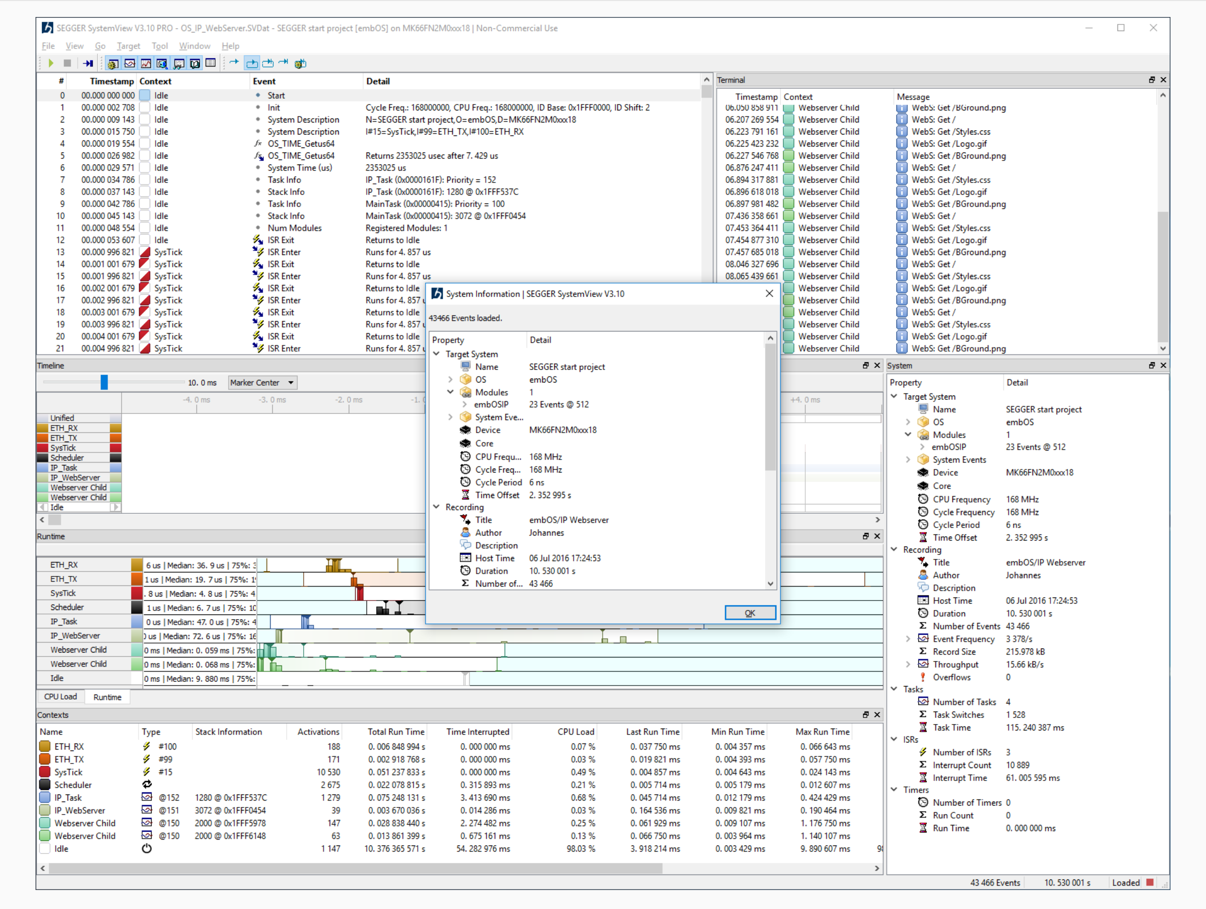
We are going to analyze what the application is doing with the information from SEGGER SystemView.

2.1 Starting SystemView and loading data

SystemView can monitor data live from the target application. The monitored data can be saved to a file for later work with it. Saved data can analyzed without a J-Link and even without the target hardware or the target application. This enables analysis of the system by developers who do not have physical access to it.

- Start the SystemView Application (`SystemView.exe`) from the Windows *Start* menu or the installation directory.
- On the first start of SystemView it will open the sample recording.
- On further starts select `File→Recent Files → $PackageInstallationDir$/Sample/OS_IP_WebServer.SVdat`.

SystemView loads and analyzes the data, shows the system information of the loaded recording, and should now look like this:



SystemView after File Load

The recording was done for an application that creates a web server that delivers the embOS/IP demo web page, when accessed by a web-browser. The sample data has been gathered while the web server was running and the browser loaded the web page multiple times.

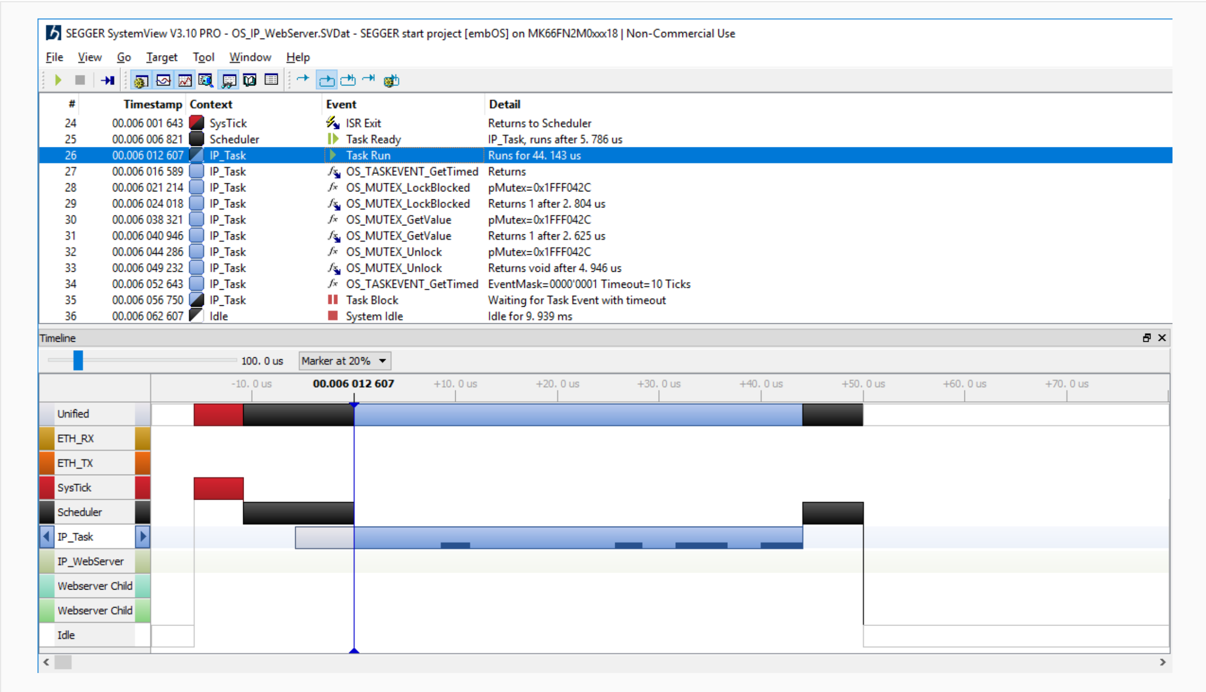
2.2 A first look at the system

We will take a first look at the data to get some information about the monitored system.

System Information

The System Information dialog, shown after loading the data, provides a first overview on the recording. It displays information about the target system, the recording and statistical information of tasks, interrupts, and events. The system information is reported by the application, therefore SystemView does not require any additional configuration to analyze and display the system behavior.

Timeline



SystemView Timeline

The *Timeline* window shows the complete monitored data. In the *Events* list, scroll to the first item to get started.

The *Timeline* window visualizes the system activity by *context* (task, interrupt, scheduler and idle) over the system time. Each row refers to one context item and we can see all items which have been used in the application while it has been monitored.

At the beginning we can see that there are two tasks, `IP_Task` and `IP_WebServer`, indicated by the light background in the context row.

Zoom in to a timeline width of 2.0 ms and double-click on the vertical line below '+1. 0 ms' to center and select the item. (Use the mouse wheel or the [+]/[-] keys to zoom, or use the menu or context menu to set the zoom level to a distinct value.)

There is some system activity every millisecond from the SysTick interrupt.

Move the mouse over a context name to get more information about the context type and run time information.

Click on the right arrow button of the `IP_Task` context to jump to its next execution.

Zoom in or out to show the activity in detail.

We can see the SysTick interrupt returned to the OS Scheduler, which makes the `IP_Task` ready, indicated by the grey bar in the `IP_Task`'s row, and lets it run. The `IP_Task` returns from the embOS API function `OS_TASKEVENT_GetTimed` with return value 0, which indicates that no event has been signaled in time.

The IP_Task calls three other embOS API functions which quickly return and OS_TASKEVENT_GetTimed, which activates the scheduler, deactivates the task, and puts the system into idle. IP_Task will be activated again when the event (EventMask = 1) occurs or after the timeout of 10 ticks (i.e. 10.0 ms, as a tick occures every 1.0 ms).

Recorded function calls are visualized in the timeline as small bars in the context row. The vertical peak line indicates the call of a function, the bar shows the length of the call. Stacked bars visualize nested function calls.

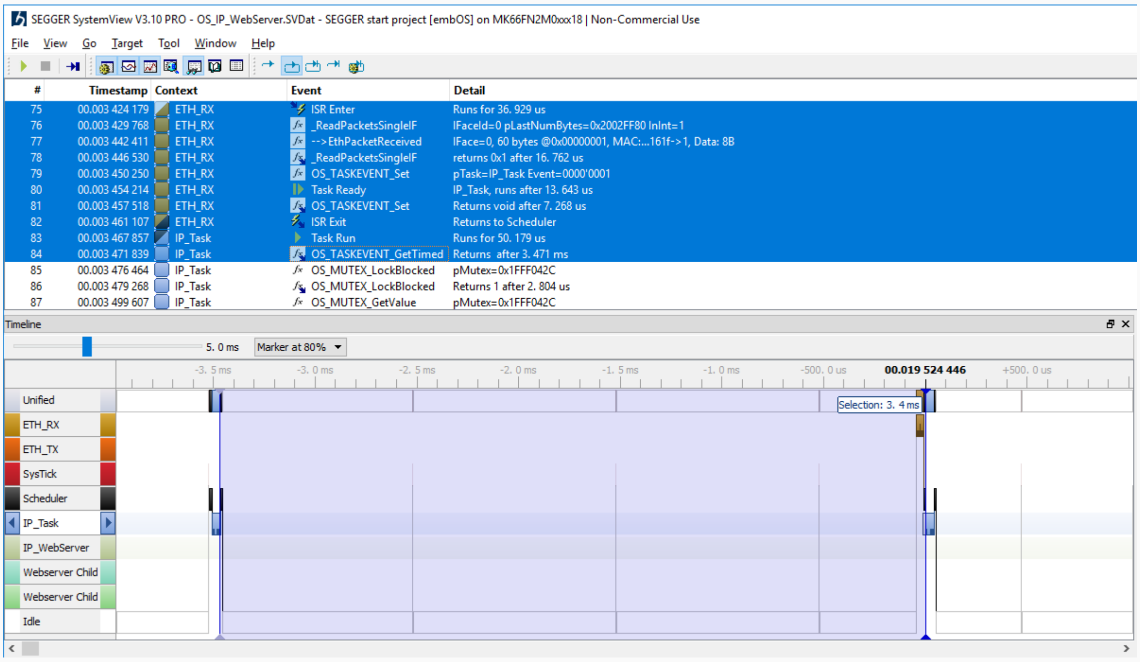
Move the mouse over the context activity to get more information about context runtime, events and function calls.

Conclusion

We have got some first information about the monitored system. From the Timeline we know which tasks and interrupts are used by the application, that it is controlled by the 1 kHz SysTick interrupt, and the IP_Task is activated at least every 10 ms.

2.3 Analysing system activity

After getting some information of the system we will analyze how the system is activated.



SystemView Events List and synchronized Timeline

Events list

The Events list shows all events as they are reported from the system and displays their information, including timestamp of the event, active context, type of event and event details. It is synchronized with the Timeline.

We have seen that every millisecond the SysTick ISR enters and exits and that it activates the `IP_Task` every 10 ms because its timeout occurred.

Go to event #66 with `Go`→`Goto Event…` (Keyboard shortcut: `Ctrl+G`). It is a call of `OS_TASKEVENT_GetTimed` with a timeout of 10 ms from the `IP_Task` at 00.016 052 607. The timeout would happen at 00.026 052 607.

Set a time reference on the event (`View`→`Toggle Reference`, Right-Click → `Toggle Reference`, or (Keyboard shortcut `R`). All following timestamps in the Events list are measured from the latest reference.

To now see whether the `IP_Task` runs because of the timeout or because of the event it waits for, go to the next activity of `IP_Task` with `Go`→`Forward` (Keyboard shortcut: `F`).

The timestamp is 00.003 467 857, so 3 ms after the last reference and clearly before the 10 ms timeout. So the task has been activated by the event it waited for.

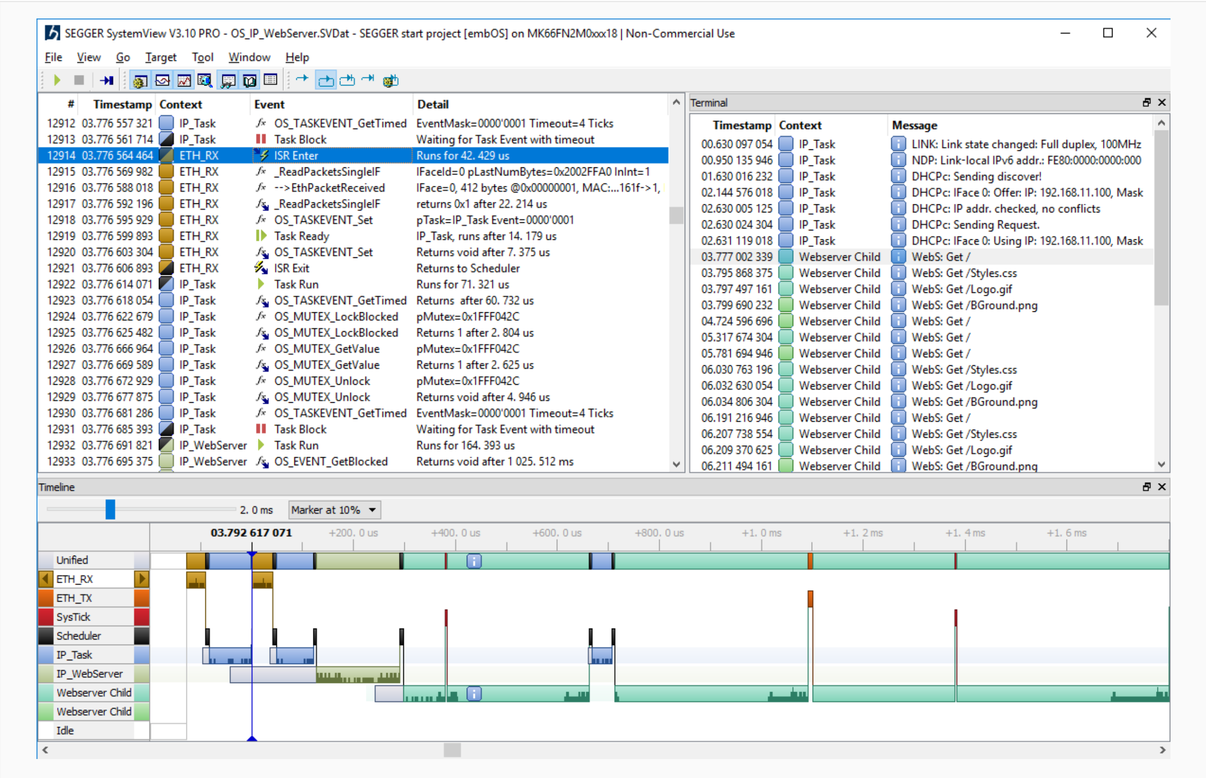
We can see the `ETH_Rx` interrupt happened before. We received a packet via ethernet (60 Bytes on interface 0). Therefore the `ETH_Rx` interrupt signaled the event, which marked the task as ready as indicated in the timeline. The `ETH_Rx` interrupt returns to the Scheduler. `IP_Task` runs and returns from `OS_TASKEVENT_GetTimed` with return value `0b1`, indicating that this event happened.

Conclusion

Going further through the events, we can see that the `IP_Task` is activated after the 10 ms timeout occurred or after we received something and the `ETH_Rx` interrupt occurred.

2.4 Further analysis of the application core

We now know that the system is mainly controlled by the `ETH_Rx` interrupt. The next step is to see what the system does when it is more active.



SystemView Application Analysis

Timeline, Events list, Terminal and Contexts window

The windows of SystemView are synchronized and provide the best possibilities for system analysis when used together.

The Log output of the web-server application has also been sent through SystemView and is displayed in the Terminal window along with the timestamp it has been logged and the active context.

Select a message in the Terminal to also select it in the Events list and the Timeline. The Timeline also indicates all Terminal output.

Go through the messages to see the system initialization when the Ethernet connection is established and select “WebS: Get /”, which is the request from the browser to get the root index webpage.

Go to event #12894, right before the message for detailed analysis.

Here we see that an `ETH_Rx` interrupt occurred, which calls the embOS/IP function `_ReadPacketsSingleIF` and receives the packet. Upon reception the embOS event is signaled as seen before, and the interrupt exits into the scheduler which activates the `IP_Task`.

The `IP_Task` sets the system event which signals the `IP_WebServer` Task to become ready. Another packet is received immediately and handled by the `IP_Task`.

When `IP_WebServer` starts running it is in `accept()` which calls some OS functions and then returns. It then checks if the Webserver Child task exists and creates it since it did not.

On creation of the task it is added to the contexts and marked with a light background in the timeline while it is not active.

`IP_WebServer` waits for another connection in `accept()` and the Webserver Child handles the received HTTP request and serves the webpage. While Webserver Child is active, it may be interrupted by other `ETH_Rx` interrupts, which cause a preemptive task switch to the `IP_Task`, because the `IP_Task` has a higher priority than the Webserver Child.

Note: Tasks are ordered by priority in the Timeline, the exact task priority can be seen in the Contexts window.

2.5 Analysis conclusion

We analyzed what a system does without insight into the application code. With the application source we can check with SEGGER SystemView that the system does what it is supposed to do.

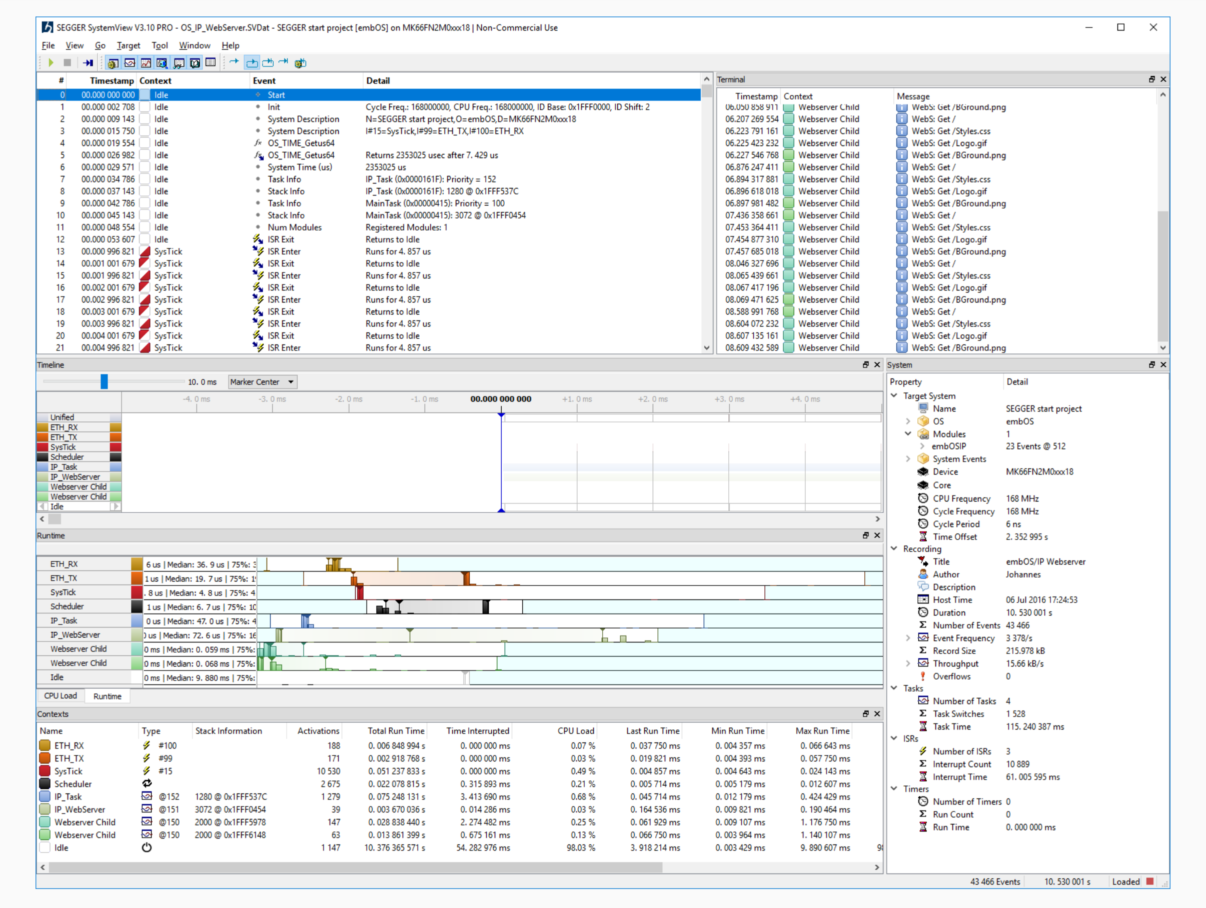
SEGGER SystemView can actively help developing applications, since it not only shows what the system does, but also allows exact time measurement and visualizes the influence of interrupts and events on the application flow. This provides advanced possibilities to find problems and to improve the system.

Chapter 3

The SystemView Application

This section describes the SystemView analysis and visualization tool.

3.1 Introduction



SystemView Application

The SystemView Application is the host PC visualization tool for SEGGER SystemView. It connects to the target application, controls the system events and reads its data. The monitored data is analyzed on runtime and visualized in the different windows of SystemView. After recording has stopped, the data can be saved to a file which allows later analysis of the application trace.

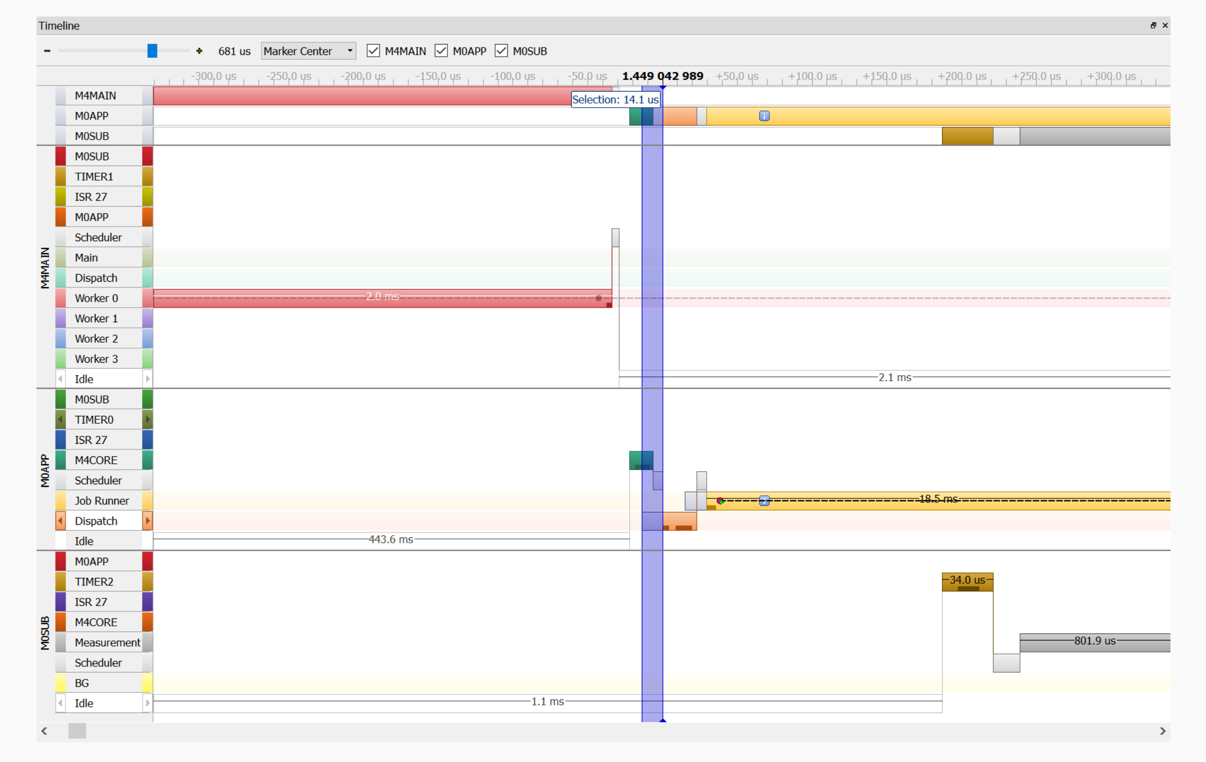
To get started with SystemView please refer to the previous chapter.

SystemView provides different windows to visualize the execution in the system, measure timing and analyze the CPU load. All windows are synchronized to always get all information of the currently selected state.

For a description of the application windows please refer to the following sections.

SystemView allows going through the monitored data and keeping track of what happened in the system at any time.

3.2 Timeline



SystemView Timeline

The *Timeline* window gathers all system information within one view. It shows the system activity by *context* (task, interrupt, scheduler, timer and idle) over the system time. Each row refers to one context item to show all context items which have been used in the application while it has been monitored. For multicore recordings, the contexts are grouped by cores. Individual cores can be hidden via the checkboxes above the timeline.

A mouse-over tooltip on the context items reveals more details and run time information about the context.

A mouse-over tooltip on context activity shows the details of the current event and the invokated functions if available.

A ruler shown on mouse-over on context activity, marks the activity time span.

A tasks life time is marked with a light background from creation to termination to provide a quick overview which tasks exist at any time.

Switches between contexts are displayed as connection lines to easily identify which events cause context switches and when they occurred.

Tasks which are marked ready for execution are displayed with a light grey bar until their execution starts.

Contexts are ordered by priority. The first row displays all activity in a unified context. Interrupts are top of the list, ordered by Id. Followed by the Scheduler and software timers, if they are used in the system. Below the Scheduler (and timer) the tasks are ordered by priority. The bottom context displays idle time, when no other context is active.

The Timeline is synchronized with the Events list. The event marker (the blue line or range) matches the event selection in the Events list.

The corresponding context label is highlighted when context under the event marker is active.

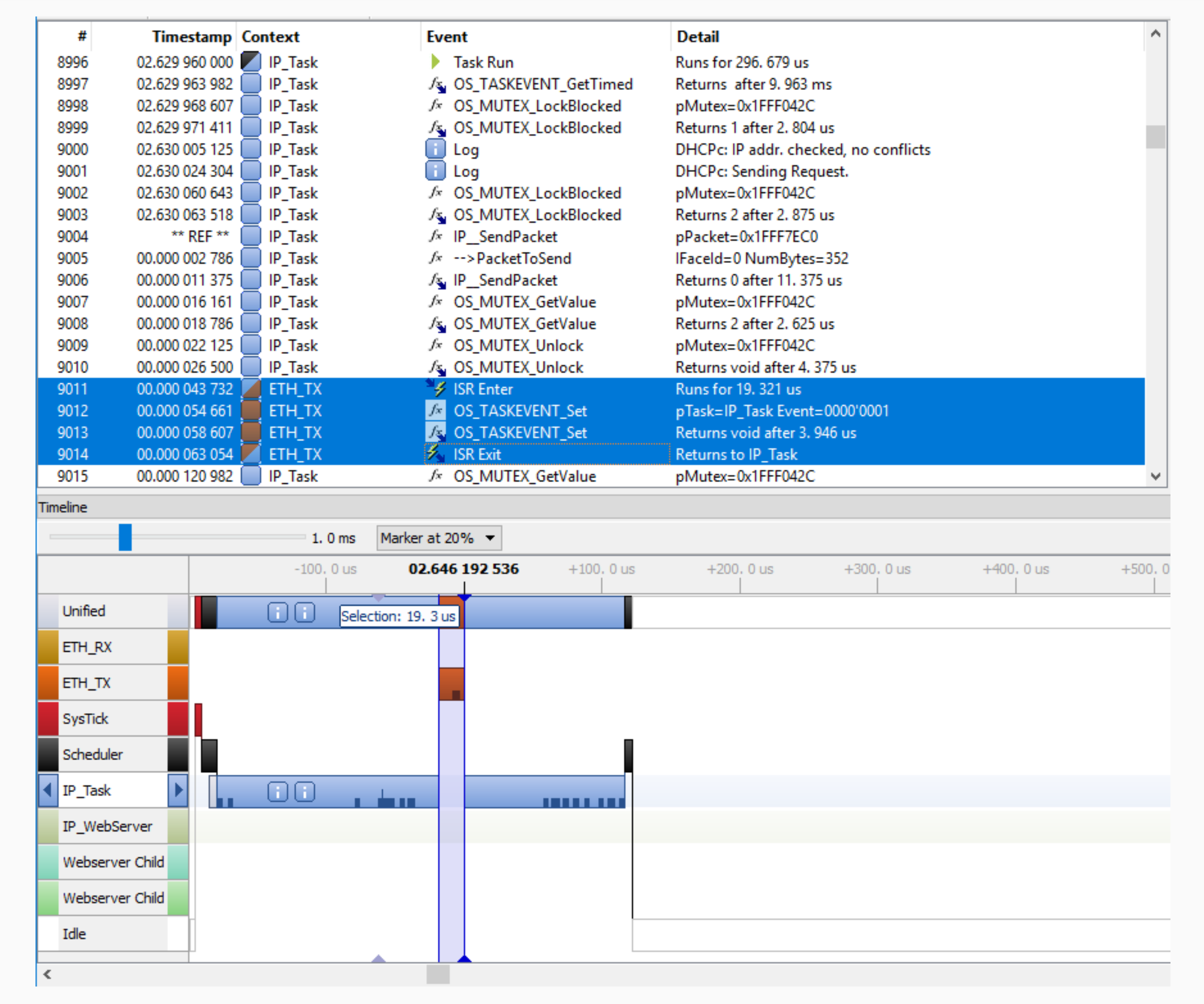
The marker can be fixed at 10% to 90% of the window and update the selection in the Events list when scrolling through the timeline.

An event can be dragged under the event marker to select the corresponding event in the Events list and vice-versa.

To get an overview of the whole system or to see the exact duration of an event the Timeline view can be zoomed in or out.

To jump to the next or previous activity of a context, the context labels include buttons for forward and backward naviagtion on mouse-over, or use the shortcut keys F and B, respectively.

3.3 Events list



SystemView Events list and Timeline

The *Events list* window shows all events as they are reported by the system and displays their information. An event is displayed with the following items:

- An ID to locate events in the list.
- A timestamp selectable to be shown either in target time or recording time, with a resolution down to nanoseconds, if applicable.
- The active context during event reporting, i.e. the task which was running.
- An event description, displayed with the type of event (IRS enter and exit, task activity, API call).
- Event details describing the parameters of the event, for example the API call parameters.

For multicore recordings, the events of each core are displayed in a seperate Events list. When starting/loading a recording, a corresponding number of Events lists are opend automatically.

The Events list allows browsing through the list, jumping to the next or previous context, or to the next or previous similar event. The Timeline and CPU Load windows are synchronized to match the currently selected event. In case multiple Events lists are used, all Events lists are synchronized to each other. When selecting an event in one Events list, all other Events lists will automatically select an event in the same time range.

The timestamps in the Events list could be displayed as relative to the start of recording or to the target system time, when reported by the system (`View`→`Display Target Time` and `Display Recording Time`, respectively). Events can be set as time reference for following events to allow easy measurement of when an event occurred after another one (shortcut `R`).

For multicore recordings, the cores are time-synchronized (requires a common time base for all cores). This feature can be deactivated via `View →Synchronize Cores`.

The Events list has an event filter that allows to show or hide APIs, ISRs, System Information, Messages, Tasks, and User Events.

3.3.1 Event Filter

The Events list features filtering of events. This can be useful for example to hide interrupt events or to show only task execution.

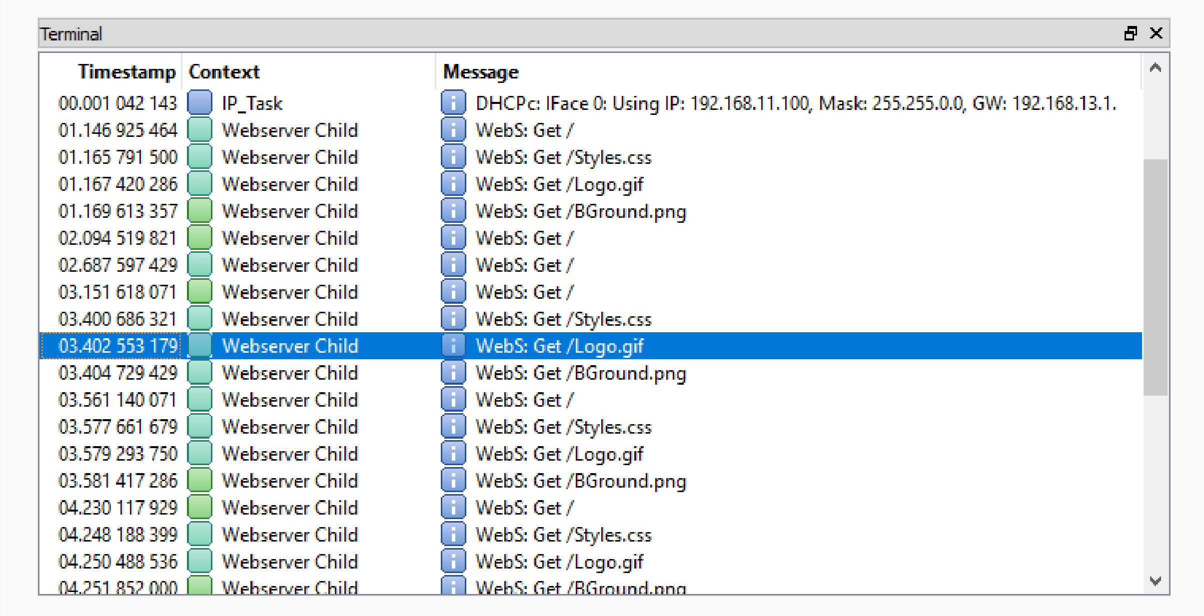
In SystemView events can be filtered by different groups:

- APIs - OS or module generated events.
- ISRs - Interrupt enter and exit.
- Messages - Terminal Output.
- System Events - System and Task information.
- Tasks - Task execution.
- Markers - Performance marker start, stop, and mark.
- Data Sample - Data Sample events.

The setting of filters for single system events as well as registered OS or middleware events could be done individual in the System window (*System* on page 38).

Event filters can be set individually for each Events list (each core).

3.4 Terminal



SystemView Terminal

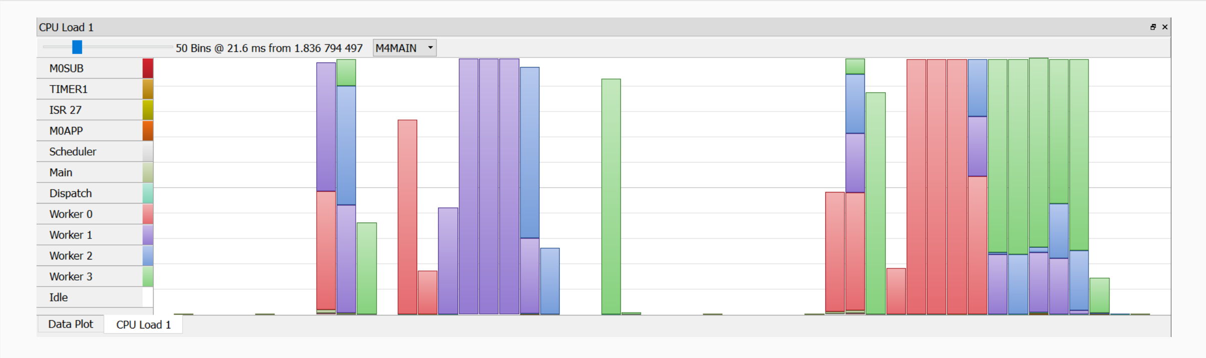
The Terminal window shows `printf()` output from the target application next to the task context from which the output has been sent and the timestamp when the message was sent. Additionally, the core which generated the respective output is displayed. The column headers support filtering according to particular contexts and cores via a drop-down menu.

Double-click on a message to show it with all information in the Events list.

The Timeline window also displays indicators for output. When indicators overlapping in display they are ordered by severity level - Errors are shown always on top. The minimum severity level for output indicators to be displayed in Timeline can be configured via `View` → `Message Indicators…`.

SystemView `printf` output (`SEGGER_SYSVIEW_Print*`) can be sent formatted by the application or unformatted with all parameters for formatted display by the SystemView application.

3.5 CPU Load



SystemView CPU Load

The CPU Load window is linked to the time span displayed in the Timeline.

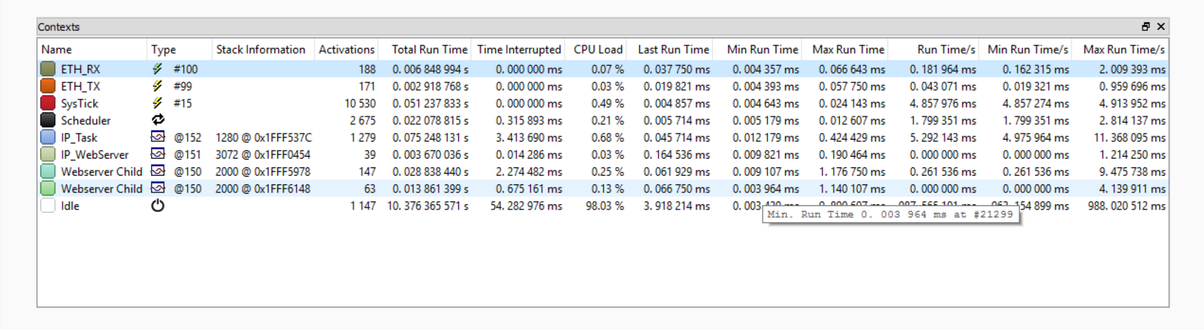
The time span displayed in the Timeline window is divided into a configurable number of bins displayed in the CPU Load window. For each context its active time is displayed relative to the corresponding bin width. The CPU load distribution in a bin is shown in order of context priority.

The number of bins can be adjusted for finer or coarser time granaularity. When using a single bin the CPU load ratios are calculated over the entire displayed Timeline section.

The drop-down menu is used to select the core which is displayed in this instance. To analyze multiple cores simultaneously, additional CPU Load windows can be added via `Window`→`CPU LOad`→`New CPU Load Window`.

The grid lines can be configured via the context menu or via the toolbar.

3.6 Contexts



Contexts

Name	Type	Stack Information	Activations	Total Run Time	Time Interrupted	CPU Load	Last Run Time	Min Run Time	Max Run Time	Run Time/s	Min Run Time/s	Max Run Time/s
ETH_RX	#100		188	0. 006 848 994 s	0. 000 000 ms	0.07 %	0. 037 750 ms	0. 004 357 ms	0. 066 643 ms	0. 181 964 ms	0. 162 315 ms	2. 009 393 ms
ETH_TX	#99		171	0. 002 918 768 s	0. 000 000 ms	0.03 %	0. 019 821 ms	0. 004 393 ms	0. 057 750 ms	0. 043 071 ms	0. 019 321 ms	0. 959 696 ms
SysTick	#15		10 530	0. 051 237 833 s	0. 000 000 ms	0.49 %	0. 004 857 ms	0. 004 643 ms	0. 024 143 ms	4. 857 976 ms	4. 857 274 ms	4. 913 952 ms
Scheduler			2 675	0. 022 078 815 s	0. 315 893 ms	0.21 %	0. 005 714 ms	0. 005 179 ms	0. 012 607 ms	1. 799 351 ms	1. 799 351 ms	2. 814 137 ms
IP_Task	@152	1280 @ 0x1FFF537C	1 279	0. 075 248 131 s	3. 413 690 ms	0.68 %	0. 045 714 ms	0. 012 179 ms	0. 424 429 ms	5. 292 143 ms	4. 975 964 ms	11. 368 095 ms
IP_WebServer	@151	3072 @ 0x1FFF0454	39	0. 003 670 036 s	0. 014 286 ms	0.03 %	0. 164 536 ms	0. 009 821 ms	0. 190 464 ms	0. 000 000 ms	0. 000 000 ms	1. 214 250 ms
Webserver Child	@150	2000 @ 0x1FFF5978	147	0. 028 838 440 s	2. 274 482 ms	0.25 %	0. 061 929 ms	0. 009 107 ms	1. 176 750 ms	0. 261 536 ms	0. 261 536 ms	9. 475 738 ms
Webserver Child	@150	2000 @ 0x1FFF6148	63	0. 013 861 399 s	0. 675 161 ms	0.13 %	0. 066 750 ms	0. 003 964 ms	1. 140 107 ms	0. 000 000 ms	0. 000 000 ms	4. 139 911 ms
Idle			1 147	10. 376 365 571 s	54. 282 976 ms	98.03 %	3. 918 214 ms	0. 003 [illegible]	[illegible]	[illegible]	[illegible]54 899 ms	988. 020 512 ms

SystemView Contexts

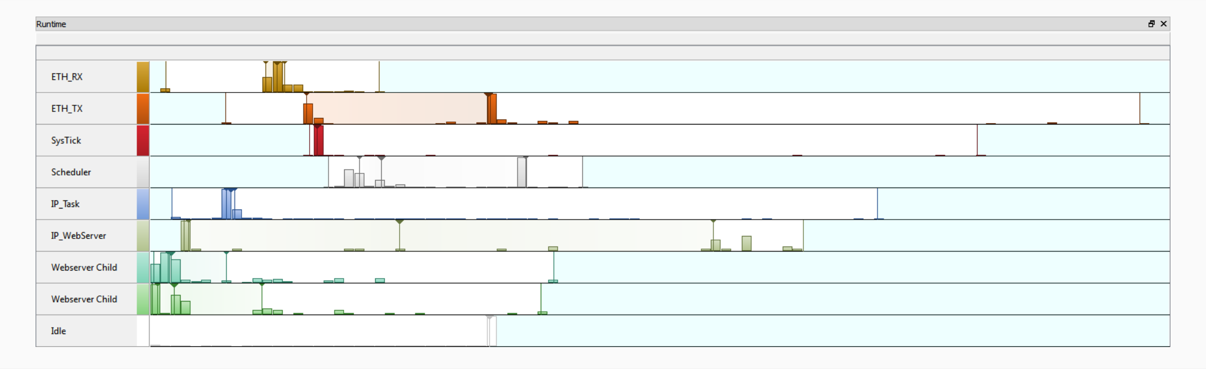
The Contexts window shows statistical information for each reported context (Tasks, Interrupts, Scheduler, Timer, and Idle). Each context can be identified by its Name and Type. The Type includes the priority for tasks and the ID for interrupts (e.g. the Cortex-M SysTick is interrupt ID #15.)

The Contexts window information include following items:

- The context name and type.
- Stack information for tasks, if available.
- Number of activations of the context.
- Total, Min and Max Blocked Time, total, minimal and maximal duration the context was ready, but not active, respectively.
- Total Run Time, total time the context was active.
- Time Interrupted, total time the context was suspended by interrupts.
- CPU Load, ratio of contexts active time to complete recorded time.
- Last, Min and Max Run Time, the duration of the latest, shortest and longest time the context was active, respectively.
- Min and Max Run Time/s, the minimal and maximal contexts active time in the last recorded second.

The Contexts window is updated during the recording.

3.7 Runtime



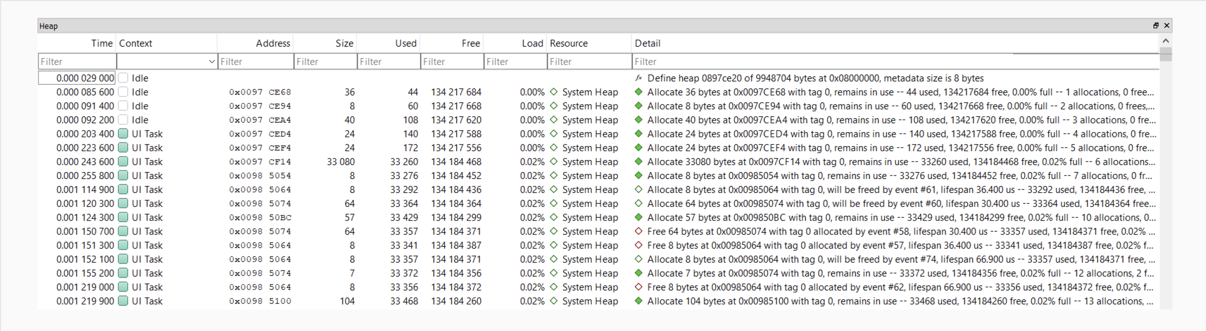
SystemView Runtime

The Runtime window displays statistical measures for every context regarding its active time. The measures shown are (over all invocations of a certain context):

- Minimal active time,
- Quartiles (25%, 50%, 75%)
- Maximal active time.

The statistical measures will be shown on request as a box plot over activation time as multiples of 1 or 5 * 10^N cycles as reported by target. N is chosen dynamically so, that the until then appearing maximum active time will fit. The histogram of duration samples always consists of 100 bins over the box plot span for a certain context.

3.8 Heap



SystemView Heap

The Heap window records allocations and deallocations of dynamic memory recorded using `SEGGER_RTL_HeapAlloc()`, `SEGGER_RTL_HeapFree()`, and other heap-related API functions.

Each allocation or deallocation event updates SystemView's model of one or more heaps maintained by the application. SystemView maintains this model and each allocation and deallocation event in the Event and Heap window shows the state of this model. If event overflow causes allocation or deallocation events to be lost, the model of the heap becomed invalid.

3.8.1 Heap events

Each allocation or deallocation event records the address and size of the block allocated on the target. In addition to these, the event detail displayed in the Event and Heap windows can show, for each monitored heap on a per-heap basis:

- The number of bytes in use (allocated)
- The number of bytes free (unallocated)
- The loading, i.e. the percentage of the heap used for allocated bytes
- The total number of allocation events
- The total number of deallocations events
- The user-provided tag for the allocated block
- The peak number of bytes in use
- The peak loading
- The number of allocation events without a matching deallocation
- The lifespan of an allocated block in the heap, i.e. for how long the block was allocated
- The matching allocation or deallocation event for the block

Color coding of the events enabled swift identification of potential memory leaks:

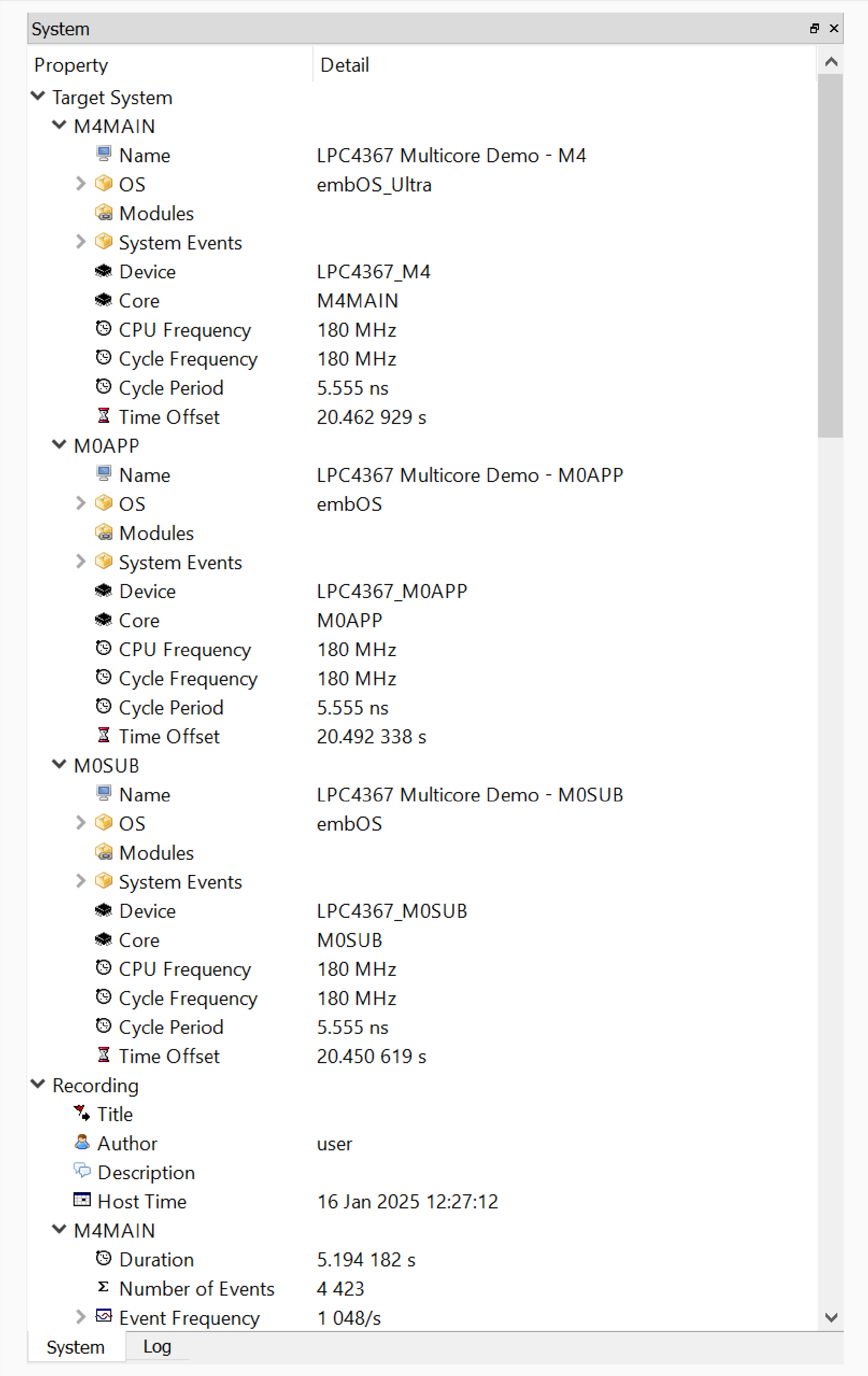
- An allocation event with matching dellocation is shown as a green hollow diamond
- A deallocation event with matching allocation is shown as a red hollow diamond
- An allocation event with no matching deallocation is shown as a solid green diamond

3.8.2 API Functions

The following are the API functions to monitor a heap:

- *`SEGGER_SYSVIEW_HeapDefine`* on page 195
- *`SEGGER_SYSVIEW_HeapAlloc`* on page 196
- *`SEGGER_SYSVIEW_HeapAllocEx`* on page 197
- *`SEGGER_SYSVIEW_HeapFree`* on page 198

3.9 System



SystemView System

The System window displays:

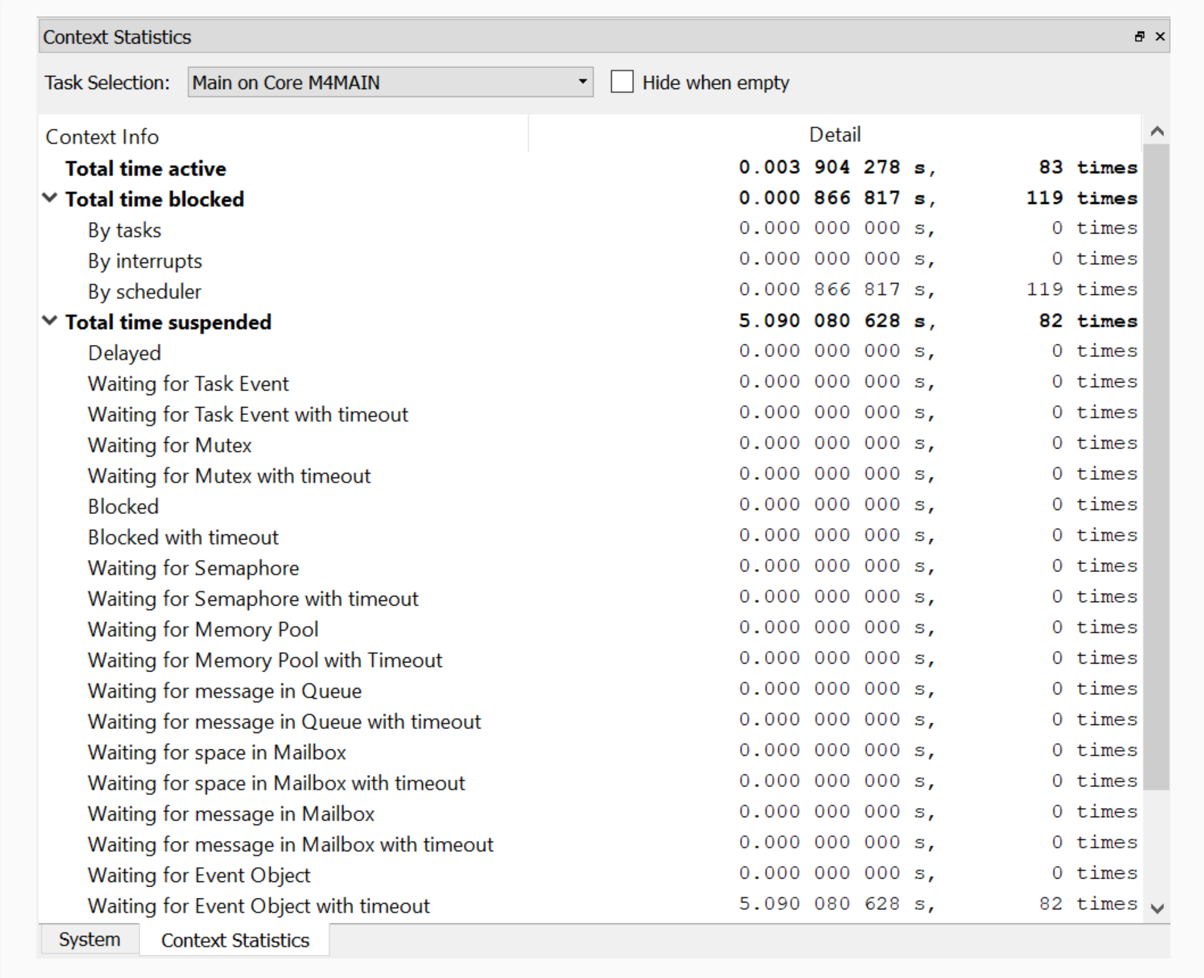
- Target System, information about the system, which has been reported by the application to identify it. Also located in this section are user-settable properties for configuring the display of operating system, module and system events.
- Recording information, like Number of Events, the average and peak event frequency and additional user provided meta-information about the record.
- Analysis information, statistical information about the analysis phase of recording.
- Statistics about tasks, interrupts, timers and other SystemView events.

The Target System information include i.a. the application name, the running OS, information about the target hardware, and timing information. Additional information about task switches and interrupt frequency provide a quick overview of the system.

The properties and meta-information settable by the user are saved with the record and allow identification and pre-set configuration of a record for later analysis.

All entries are grouped by the respective core.

3.10 Context Statistics



SystemView Context Statistics

The Context Statistics window displays detailed information about task runtime statistics. The purpose is to analyze an individual task in more detail, especially in terms of the extend to which this task was blocked or suspended. The following information is provided:

- Total time the task was running
- Total time the task was blocked
- Total time the task was suspended

In addition to the duration, the number of times this event has occured is also displayed for each entry.

The drop-down menu is used to select the task for which the information is displayed.

The checkbox `Hide when emtpy` toggles the option to display events that have not occured.

3.10.1 Total time running

Total time running displayes the accumulated time the selected task was active.

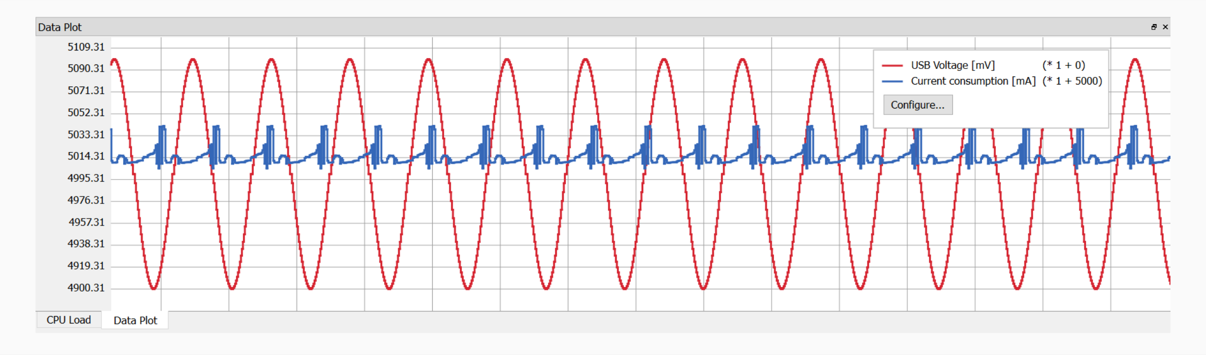
3.10.2 Total time blocked

Total time blocked displays the time the selected task was blocked. The information is itemized in blocked by tasks, blocked by interrupts and blocked by scheduler. Tasks and interrupts are itemized further, showing which specific task or interrupt is responsible for blocking the analyzed task.

3.10.3 Total time suspended

Total time suspended displays the time the selected task was suspended. The information is itemized which event is responsible for the suspension. This list is generated dynamically by the respective description file. Refer to *OS description file* on page 131.

3.11 Data Plot



SystemView Data Plot window

The DataPlot window is used to visualize user defined data over time. The window is synchronized with all other windows of SystemView so the same time range is always displayed in all windows.

The plots are drawn in the Data Plot window, the corresponding events are also shown in the Events list.

Supported data types are `U32`, `I32` and `float`.
Multiple plots are supported. Each data plot needs to be registered first, see Registration.

3.11.1 Registration

In order to start plotting data, the registration event needs to be sent to SystemView via `SEGGER_SYSVIEW_RegisterData()` first. The registration event contains mandatory and optional parameters which are described in the following table:

Item	Description	Default
Id	User defined Id of the data.	Mandatory
Name	Name of the data .	Mandatory
Data type	Data type of the data. (see enum `SEGGER_SYSVIEW_PLOT_DATA_TYPE`).	`U32`
Offset	y-Offset of the data.	`0`
Range Min	Minimum value of data range (range of y-axis).	`0`
Range Max	Maximum value of data range (range of y-axis).	`0`
Scaling factor	Scaling factor of data.	`1`
Unit	Unit of the sampled data.	

If value of an item is set to `0`, the default value is used.

If `Range Min` and `Range Max` are both set to `0`, the range is automatically determined by SystemView.

Example

```
static void _cbSendSystemDesc(void) {
  SEGGER_SYSVIEW_DATA_REGISTER VoltagePlot;

  [SystemView descriptions ...]

  VoltagePlot.ID                = 0;
  VoltagePlot.sName             = "USB Voltage";
  VoltagePlot.DataType          = SEGGER_SYSVIEW_TYPE_U32;
  VoltagePlot.Offset            = 0;
  VoltagePlot.RangeMin          = 0;
  VoltagePlot.RangeMax          = 0;
```



```
  VoltagePlot.ScalingFactor = 1;
  VoltagePlot.sUnit         = "mV";
  SEGGER_SYSVIEW_RegisterData(&VoltagePlot);
}
```

3.11.2 Data plotting

After the registration event is sent, the data values can be sent with `SEGGER_SYSVIEW_SampleData()`. The event contains the Id of the corresponding data, followed by the current value of the data.

Example

```
U32 _VUsb;
SEGGER_SYSVIEW_DATA_SAMPLE PlotVoltage;
[...]
//
// Initialize data sample struct.
//
PlotVoltage.Id           = 0;
PlotVoltage.pValue.pU32  = &_VUsb;
[...]
//
// Send event to SystemView.
//
SEGGER_SYSVIEW_SampleData(&PlotVoltage);
[...]
```

3.11.3 Options

The Data Plot window provides several options to adjust and modify the plotting of the data. The different options are explained below.

3.11.3.1 y-Offset

The y-offset can be used to shift the values on the y-axis. A typical scenario is that multiple data plots are to be analyzed but they lie in different value ranges. With the use of the offset, the values can be moved into the same range.

3.11.3.2 Scaling factor

All values are multiplied with the defined scaling factor. With the factor the value range can be stretched or shrunk.

3.11.3.3 Configure dialog

Via the Configure dialog, the user has the opportunity edit the y-offset or adjust the scaling factor. Each option can be set individually for a given data plot. A drop-down list allows the selection of the respective data plot.

The Configure dialog can be opend via the context menu of the Data Plot window or by clicking on the `Configure…`-Button shown in the legend.

3.11.3.4 Display types

The Data Plot window offers three different display types for the data:

- Discrete - data points are connect by horizontal lines.
- Continuously - data points are connect continuously by straight lines (linear interpolation).
- Points - only the data points are shown, points are not connect to each other.

The display type can be set via the context menu.

3.11.3.5 Mouse-over annotation

The activation of the mouse-over annotation can be toggled via the context menu.

3.12 Trigger Modes

During a real-time continuous recording and analysis of events, trigger modes allow the automatic selection and a focused display of events meeting configurable criteria.

The Trigger Mode can be seleced in the toolbar.

In Manual Scroll Mode, the selection is not automatically updated and the user can scroll through the events and analyze the system while recording is done.

In Auto Scroll Mode, the selection is synchronized every 100 ms. The event with the last multiple of 100 ms is selected.

In the continuous trigger mode, the user can configure at which event and in which context (taks, interruption or marker) the triggering should occur. SystemView then always selects the last occurrence of an event that meets the configured condition.

In single trigger mode, SystemView triggers once on the next received event that meets the configured condition and switches back to manual scrolling mode.

3.13 GUI controls

SystemView can be controlled with mouse and keyboard, via menus and context menus. The most important controls are also accessible in the toolbar.

The following table describes the controls of SystemView.

Action	Menu	Shortcut
Recording control		
Start recording on the target.	`Target` →`Start Recording`	`F5`
Stop recording.	`Target` →`Stop Recording`	`Shift+F5`
Read post-mortem or single-shot data from the system.	`Target` →`Read Recorded Data`	`Ctrl+F5`
Configuring the recorder interface to target	`Target` →`Recorder Configuration`	`Alt+Enter`
Configuring trigger modes	`Target` →`Trigger` →...	
Data handling		
Save recorded data to a file.	`File` →`Save Data`	`Ctrl+S`
Load a record file.	`File` →`Load Data`	`Ctrl+O`
Load a recently used file.	`File` →`Recent Files`	`none`
Load a sample recording.	`File` →`Sample Recordings`	`none`
Export recorded data as file with CSV (comma separated values).	`File` →`Export Data`	`Ctrl+E`
View, Timeline		
Set/clear the current event as time reference.	`View` →`Toggle Reference`	`R`
Remove all time references.	`View` →`Clear References`	`Ctrl+Shift+R`
Display timestamps as absolute target time.	`View` →`Display Target Time`	`None`
Display timestamps relative to start of recording.	`View` →`Display Recording Time`	`None`
Enable/disable time synchronization of multiple cores.	`View` →`Synchronize Cores`	`None`
Zoom in.	*when Timeline is focused*	`+, scroll up`
Zoom out.	*when Timeline is focused*	`-, scroll down`
Quick set defined Timeline width (in us, ms or s, in 1-2-5 steps ...)	`View` →`Zoom` →`View 10us`, ..., `View 1ms`, ..., `View 1s`, ..., `View 100s`	`None`
Set the marker to 0% of the timeline.	`View` →`Marker` →`Marker Left`	`0`
Set the marker to *x*% of the timeline. (x=10% .. 90%, 10% steps)	`View` →`Marker` →`Marker at 10%` ... →`Cursor at 90%`	`1` ... `9`
Set the marker to 100% of the timeline.	`View` →`Marker` →`Marker Right`	`None`
Show all output indicators in Timeline	`View` →`Message Indicators` →`Show All Messages`	`None`
Show output indicators with severity error and warning in Timeline	`View` →`Message Indicators` →`Show Errors and Warnings`	`None`

Action	Menu	Shortcut
Show output indicators with severity error in Timeline	View →Message Indicators →Show Errors only	None
Focus on the slected core. All other Events Lists are closed. The selected core is set in all input fields (Terminal, CPU Load, Terminal, Heap).	View →Focus on Core… →…	None
View, Events list		
Show/Hide API calls in the Events list.	View →Event Filter →Show APIs	Shift+A
Show/Hide ISR Enter/Exit in the Events list.	View →Event Filter →Show ISRs	Shift+I
Show/Hide Messages in the Events list.	View →Event Filter →Show Messages	Shift+M
Show/Hide System events in Events list.	View →Event Filter →Show System Events	Shift+S
Show/Hide Task activity in Events list.	View →Event Filter →Show Tasks	Shift+T
Show/Hide output indicators in Events list.	View →Event Filter →Show Markers	Shift+E
Show/Hide Data Sample events in Events list.	View →Event Filter →Show Data Sample	Shift+D
Show only API calls in the Events list.	View →Event Filter →Show APIs only	Ctrl+Shift+A
Show only ISR Enter/Exit in the Events list.	View →Event Filter →Show ISRs only	Ctrl+Shift+I
Show only Messages in the Events list.	View →Event Filter →Show Messages only	Ctrl+Shift+M
Show only System events in Events list.	View →Event Filter →Show System Events only	Ctrl+Shift+S
Show only Task activity in Events list.	View →Event Filter →Show Tasks only	Ctrl+Shift+T
Show only output indicators in Events list.	View →Event Filter →Show Markers only	Ctrl+Shift+E
Show only Data Sample events in Events list.	View →Event Filter →Show Data Sample only	Ctrl+Shift+D
Hide registered API invocation (and corrsponding exit) event. (Only available on selected invocation event)	View →Event Filter →Hide This Event	Shift+Ctrl+H
Reset all event filters.	View →Event Filter →Reset all Filters	Ctrl+Shift +Space
Trigger control		
Manually Scroll mode while recording.	Target →Trigger →Manual Scroll	
Automatic Scroll mode while recording.	Target →Trigger →Auto Scroll	
Continuously trigger on a condition and focus triggering event while recording.	Target →Trigger →Continuous Trigger	

Action	Menu	Shortcut
Trigger on a condition once and focus on triggering event while recording.	`Target` →`Trigger` →`Trigger Once`	
Configure the trigger condition.	`Target` →`Trigger` →`configure Trigger`	
View, Runtime		
Show/Hide statistic measures in Runtime window	`View` →`Show Runtime Statistics`	None
Show/Hide boxplots for statistic measures in Runtime window	`View` →`Show Runtime Boxplot`	None
Show/Hide histograms in boxplots in Runtime window	`View` →`Show Runtime Histogram`	None
View, CPU Load		
Hide gridlines in CPU Load window.	`View` →`Divisions` →`None`	None
Divide CPU Load window dynamically by window size.	`View` →`Divisions` →`Auto`	None
Divide CPU Load window into 4 sections.	`View` →`Divisions` →`4 Divisions`	None
Divide CPU Load window into 10 sections.	`View` →`Divisions` →`10 Divisions`	None
Navigation, Timeline		
Jump to the next context switch.	`Go` →`Forward`	`F`
Jump to the previous context switch.	`Go` →`Back`	`B`
Jump to the next similar event.	`Go` →`Next [Event]`	`N`
Jump to the previous similar event.	`Go` →`Previous [Event]`	`P`
Jump to the next similar event with the same context.	`Go` →`Next [Event] in [Context]`	`Shift+N`
Jump to the previous similar event with the same context.	`Go` →`Previous [Event] in [Context]`	`Shift+P`
Open dialog to go to an event by Id.	`Go` →`Go to Event…`	`Ctrl+G`
Open dialog to go to an event by timestamp.	`Go` →`Go to Timestamp…`	`Ctrl+Shift+G`
Scroll forward.	*when Timeline is focused*	`Left`, `Ctrl+Scroll up`, `Click&Drag`
Scroll back.	*when Timeline is focused*	`Right`, `Ctrl+Scroll down`, `Click&Drag`
Window		
Show/hide the System information window.	`Window` →`System`	None
Show/hide the Timeline window.	`Window` →`Timeline`	None
Show/hide the CPU Load window.	`Window` →`CPU Load`	None
Show/hide the Runtime window.	`Window` →`Runtime`	None

Action	Menu	Shortcut
Show/hide the Contexts window.	`Window` →`Context View`	`None`
Show/hide the Terminal window.	`Window` →`Terminal View`	`None`
Show/hide the Log window.	`Window` →`Log View`	`None`
Show/Hide the Status bar	`Window` →`Show Status Bar`	`None`
Show/Hide the Tool bar	`Window` →`Show Tool Bar`	`None`
Miscellaneous		
Open application preferences dialog.	`Tool` →`Preferences`	`Alt+.`
Open License manager dialog.	`Tool` →`Licence Manager`	`Alt+L`
Help		
Open this SystemView Manual.	`Help` →`User Guide`	`F11`
Show SystemView information.	`Help` →`About`	`F12`

3.14 Command Line Options

SystemView can be controlled and configured via command line options. To skip the configuration dialog on start of recording, the target configuration can be given via command line options.

After the configuration options, zero, one, or multiple options can be given on the command line to control SystemView and to automate part of its execution.

If started in single instance mode, the first instance of SystemView starts normally and parses its command line. Any further instance passes its command line control options to the already running instance.

Alternatively, a running instance can be controlled by sending the commands on a TCP/IP socket to localhost:19050.

```
C:> SystemView.exe <Filename>
Load a selected recording file on start of SystemView.
(Used for drag and drop on SystemView executable.)
```

```
C:> SystemView.exe [-recorder J-Link|UART|IP] [-device <Device>] [-usb [<SN>]]|[-
ip <Host>] [-if SWD|JTAG|FINE] [-speed <Speed>] [-rttcbaddr <Addr>]|[-rttcbrange
 auto|<Range>] [-start|-stop|-quit|-save [<Filename>]|-load[<Filename>]|-export
 [<Filename>]|-export-contexts [<Filename>]|-export-terminal [<Filename>]]*

Command Line Options:
-recorder   Select the recorder interface.               Parameter: J-Link,
 UART, IP.

-device     Set the target device.                       Parameter: Device name
 as supported by J-Link.

-usb        Connect to J-Link via USB.                   Parameter: S/N of J-
Link. (Optional)
-ip         Connect to J-Link via IP.                    Parameter: IP or S/N of
 J-Link.

-if         Set the target interface.                    Parameter: SWD, JTAG,
 or FINE.
-speed      Set the target interface speed.              Parameter: Speed in
 kHz.
-jtagconf   Set the JTAG scan chain configuration.       Parameter: IRPre and
 DRPRe of the target device.

-rttcbaddr  Set the RTT Control Block address.           Parameter: Address in
 hexadecimal.
-rttcbrange Set the search range for RTT Control Block.  Parameter: auto or
 ranges as "<Address> <Size>".

-single     Start SystemView in single instance mode.
-port       Set local port for single instance mode.     Parameter: Port.

Command Line Control:
-start              Start recording.
-stop               Stop recording.
-quit               Quit SystemView.
-load               Load a recording from file.                  Parameter: File
 to load.
-save               Save current recording.                      Parameter: File
 to save to.
-export             Export the current recording to a file.      Parameter: File
 to export to.
-export-contexts    Export the Contexts window to csv.           Parameter: File
 to export to.
-export-terminal    Export the Terminal window to csv.           Parameter: File
 to export to.
```



```
-delay              Delay before executing the next command.      Parameter: Time
 to delay in ms.
```

3.15 Recording with SystemView

This section describes how to use the SystemView Application for continuous recording and how to do manual single-shot recording with a debugger.

3.15.1 Continuous recording

SystemView can continuously record target execution in real time, while the target is running.

Continuous recording can be done externally and non-intrusively with a J-Link debug probe, which reads the recorded events through the debug interface, or controlled by the target application which sends the data through a network connection or over a serial line.

Start recording

To start continuous recording, connect the target and the chosen recorder interface.

Select `Target` →`Start Recording`. On the first start of SystemView, the recorder configuration is opened. The configuration is saved for subsequent recordings. To switch to another recorder or change the configuration, select `Target` →`Recorder Configuration`.

When the recorder is configured, SystemView connects and starts recording.

Stop recording

To stop recording select `Target` →`Stop Recording`.

3.15.1.1 J-Link Recorder

To use the J-Link Recorder, the connection to J-Link, connection to target, and the location of the RTT control block needs to be configured.

Select to connect to J-Link via USB or IP and optionally enter the serial number or IP to select a specific J-Link.

Enter or select the device name. If the current device is not part of the list, it can be entered manually or selected from the device selection dialog.

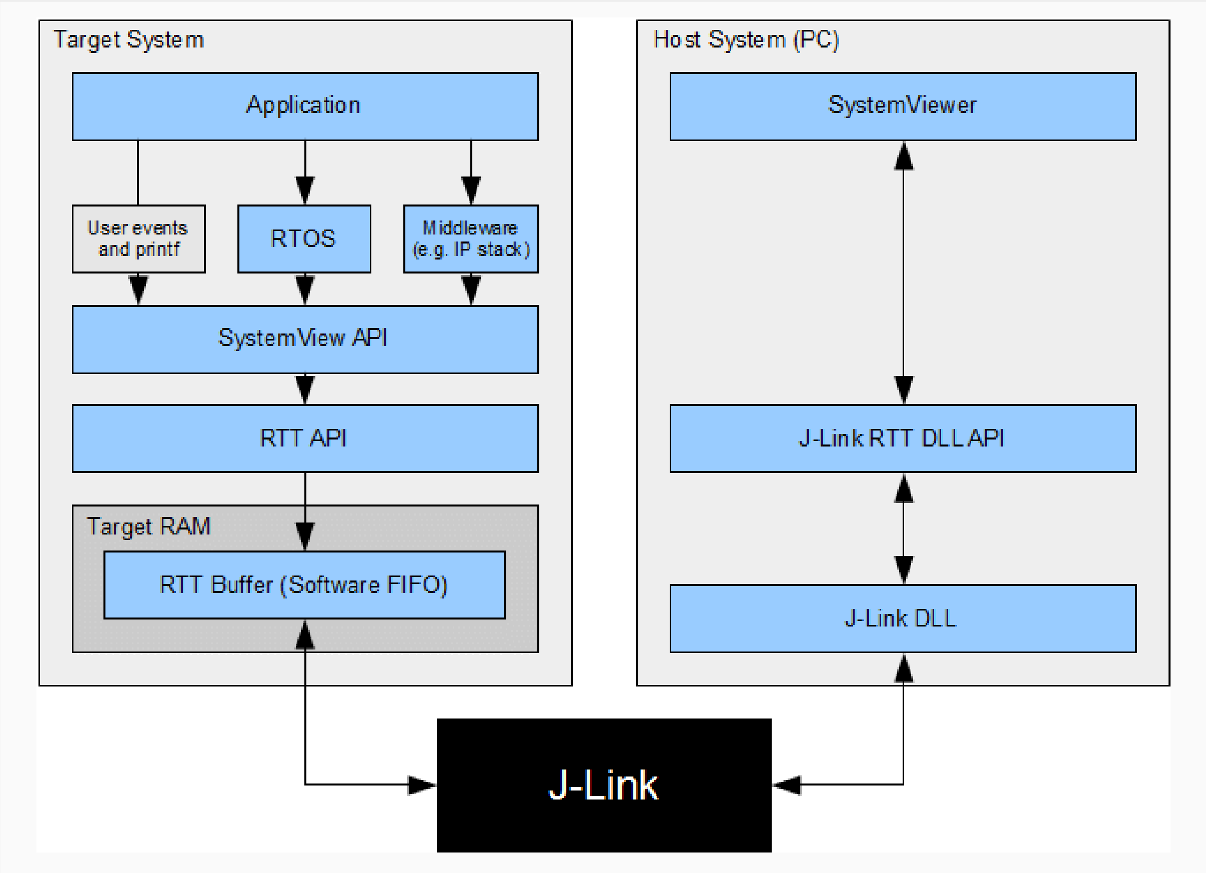
> **Note**
>
> For RTT Control Block Auto Detection, as well as to properly connect to a device, the exact device has to be known. It is recommended to not select a generic core instead.

Select the target interface and target interface speed for the connected device as well as the number of cores (if `0` is selected all cores are found automatically by SystemView).

Configure the RTT Control Block Detection. In most cases Auto Detection can be used. If the RTT Control Block can not be detected, get the address of `_SEGGER_RTT` from the application or its map file and enter it, or enter a Search Range in which the symbol might be located in the format `<StartAddress> <Size>`, for example `0x10000000 0x10000`.

> **Note**
>
> SystemView can be used parallel to a debugger. In this case recording can be done while the debugger is running. Make sure all required configuration is done in the debugger. When the debugger is stopped, SystemView recording will stop, too.

With a J-Link debug probe and the SEGGER Real Time Transfer technology (RTT), SystemView can continuously record target execution in real time, while the target is running. RTT requires the ability of reading memory via the debug interface during program execution. This especially includes ARM Cortex-M0, M0+, M1, M3, M4 and M7 processors as well as all Renesas RX devices.



How Systemview works with J-Link

3.15.1.2 IP Recorder

The SystemView IP Recorder connects to its counterpart running on the target device.

On the target the “IP Recorder host” is running and accepting connections form the SystemView Application to send its data to.

Select the IP of the target device and the port (default: 19111).

3.15.1.3 UART Recorder

The UART Recorder connects to the target over a serial line, i.e. UART on RS232. On modern computers usually a USB to RS232 converter is used.

On the target the UART needs to be configured to receive commands and store it in the SystemView buffer, as well as send data from the SystemView buffer when it becomes available.

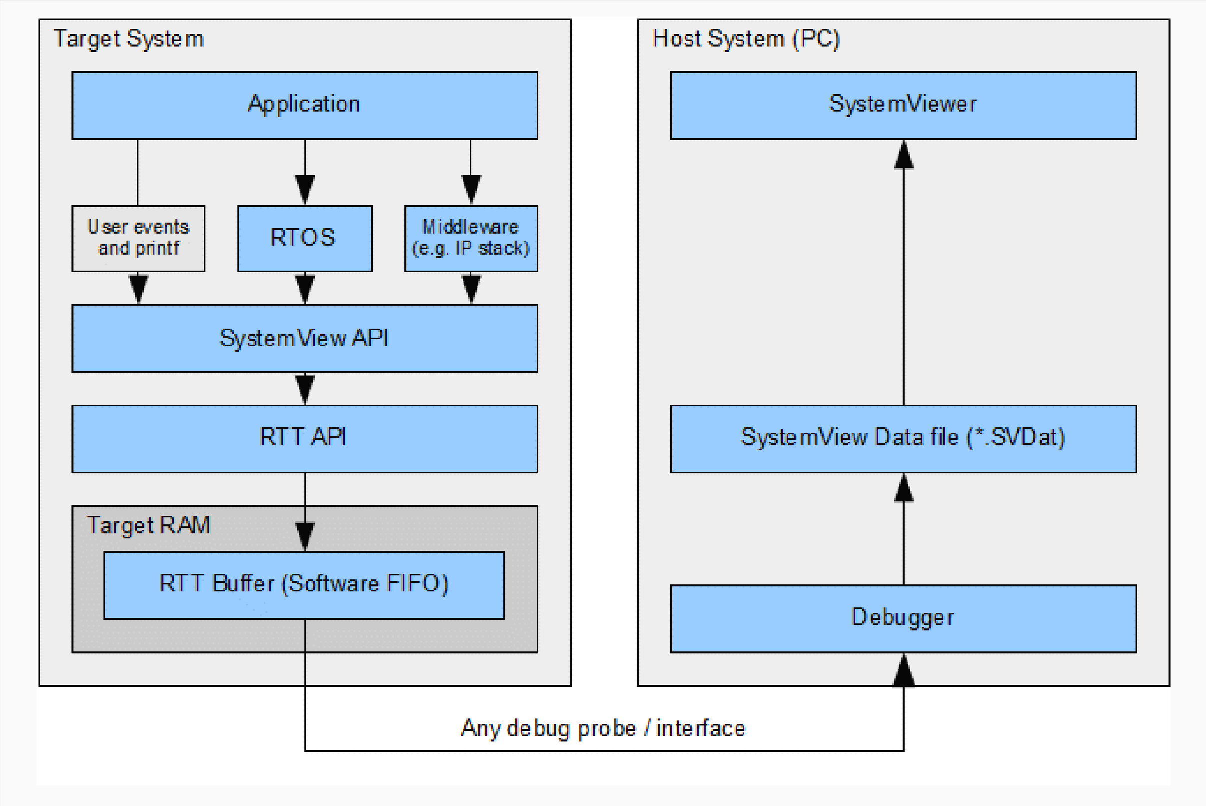
Select the COM Port the target is connected to and the Baud rate to communicate with via UART.

3.15.2 Single-shot recording

When the target device does not support RTT or when no J-Link is used, SEGGER SystemView can be used to record data until its target buffer is filled.

In single-shot mode the recording is started manually in the application, which allows recording only specific parts, which are of interest.

As a usual application generates about 5 to 15 kByte recording data per second and peaks only to higher rates at full load, even a small buffer in the internal RAM can be used to record data for analysis of critical parts. When using external RAM SystemView can record for a long time, even in single-shot mode.



How Systemview works in single-shot mode

Get single-shot data from the system

To get the data which has been recorded in single-shot mode, the SystemView buffer has to be read via the SystemView Application or an external debugger.

- Connect a debugger and load the target application.
- Configure and initialize SystemView from the application (`SEGGER_SYSVIEW_Conf()` or `SEGGER_SYSVIEW_Init`).
- Start recording in the application from where it should be analyzed (`SEGGER_SYSVIEW_Start`).

;With a J-Link SystemView can automatically read single-shot data from the target. ; ;

- Start the SystemView Application and select `Target →Read Recorded Data`. ; ;Without a J-Link or without SystemView the data can be read using following steps: ;
- Halt the application in the debugger when the buffer is full or after recording has been done.
- Get the SystemView RTT buffer address and the number of bytes used (Normally `_SEGGER_RTT.aUp[1].pBuffer` and `_SEGGER_RTT.aUp[1].WrOff`).
- Save the number of bytes from the buffer to a file with .SVDat extension.
- Open the file with the SystemView Application.

To be able to record more than once, the buffer write offset (`_SEGGER_RTT.aUp[1].WrOff`) can be set to 0 when the data has been read. To prevent SystemView overflow events to happen, the application should be halted as soon as the buffer is filled and cannot hold another SystemView event.

3.15.3 Post-mortem analysis

Post-mortem analysis is similar to single-shot recording, with one difference: SystemView events are continuously recorded and the SystemView buffer wraps around to overwrite older events when the buffer is filled. When reading out the buffer, the newest events are available.

Post-mortem analysis can be useful when a system runs for a long time and suddenly crashes. In this case the SystemView buffer can be read from the target and SystemView can show what happened in the system immediately before the crash.

> **Note**
>
> Post-mortem analysis requires the debugger or debug probe to be able to connect to the target system without resetting it or modifying the RAM.

To get as much useful data for analysis as possible it is recommended to use a large buffer for SystemView, 8 kByte or more. External RAM can be used for the SystemView buffer.

To configure the target system for post-mortem mode, please refer to *SEGGER_SYSVIEW_POST_MORTEM_MODE* on page 73 and *SEGGER_SYSVIEW_SYNC_PERIOD_SHIFT* on page 74.

Get post-mortem data from the system

To get the data which has been recorded in post-mortem mode, the SystemView buffer has to be read via the SystemView Application or an external debugger.

- Configure and initialize SystemView from the application (`SEGGER_SYSVIEW_Conf()` or `SEGGER_SYSVIEW_Init`).
- Start recording in the application from where it should be analyzed (`SEGGER_SYSVIEW_Start`).
- Connect a debugger, load the target application, and let the system run.

With a J-Link SystemView can automatically read post-mortem data from the target.

- Start SystemView and select `Target` →`Read Recorded Data`.

Without a J-Link or without SystemView the data can be read using following steps:

Since the SystemView buffer is a ring buffer, the data might have to be read in two chunks to start reading at the beginning and save as much data as possible.

- Configure and initialize SystemView from the application (`SEGGER_SYSVIEW_Conf()` or `SEGGER_SYSVIEW_Init`).
- Start recording in the application from where it should be analyzed (`SEGGER_SYSVIEW_Start`).
- Connect a debugger, load the target application, and let the system run.
- when the system crashed or all tests are done, attach with a debugger to the system and halt it.
- Get the SystemView RTT buffer (Usually `_SEGGER_RTT.aUp[1].pBuffer`).
- Save the data from `pBuffer` + WrOff until the end of the buffer to a file.
- Append the data from `pBuffer` until `pBuffer` + RdOff - 1 to the file.
- Save the file as *.SVdat or *.bin.
- Open the file with the SystemView Application.

3.15.4 Save and load recordings

When recording is stopped, the recorded data can be saved to a file for later analysis and documentation. Select `File` →`Save Data`. The Recording Properties Dialog pops up, which allows saving a title, author, and description with the data file. Click `OK`. Select where to save the data and click `Save`.

Saved data can be opened via `File` →`Load Data`. The most recently used data files are available via the menu at `File` →`Recent Files`, too. SystemView can open *.bin and *.SVDat files.

3.15.5 Export recordings

For further analysis in external tools, recorded events can be exported to a csv file. Select `File` →`Export Data`. Each event will be exported to the csv file as it is shown in the Events Window.

Additionally the contents of the Contexts Window and the Terminal Window can be exported to csv files. From the context menu of the window select `Export...`.

Chapter 4

Getting started with SystemView on the target

This section describes how to add the SystemView modules to a target system.

4.1 Including SystemView in the application

The following files are part of the SEGGER SystemView target implementation. We recommend to copy all files into the application project and keep the given directory structure.

File	Description
/Config/Global.h	Global type definitions for SEGGER code.
/Config/SEGGER_RTT_Conf.h	SEGGER Real Time Transfer (RTT) configuration file.
/Config/SEGGER_SYSVIEW_Conf.h	SEGGER SYSTEMVIEW configuration file.
/Config/SEGGER_SYSVIEW_Config_[SYSTEM].c	Initialization of SystemView for [SYSTEM].
/Sample/OS/SEGGER_SYSVIEW_[OS].c	Interface between SYSTEMVIEW and [OS].
/Sample/OS/SEGGER_SYSVIEW_[OS].h	Interface header.
/SEGGER/SEGGER.h	Global header for SEGGER global types and general purpose utility functions.
/SEGGER/SEGGER_RTT.c	SEGGER RTT module source.
/SEGGER/SEGGER_RTT.h	SEGGER RTT module header.
/SEGGER/SEGGER_SYSVIEW.c	SEGGER SYSTEMVIEW module source.
/SEGGER/SEGGER_SYSVIEW.h	SEGGER SYSTEMVIEW module header.
/SEGGER/SEGGER_SYSVIEW_ConfDefaults.h	SEGGER SYSTEMVIEW configuration fallback.
/SEGGER/SEGGER_SYSVIEW_Int.h	SEGGER SYSTEMVIEW internal header.

4.1.1 Generic files

The generic files, `SEGGER_SYSVIEW`, and `SEGGER_RTT` are located in `/SEGGER/`. They need to be added to any project, and the folder should be set as include directory.

4.1.2 Generic configuration

The generic configuration files for SYSVIEW and RTT are located in `/Config/`. The folder needs to be set as include directory.

`SEGGER_SYSVIEW_Conf.h` and `SEGGER_RTT_Conf.h` can be modified to match the target system.

4.1.3 OS-specific and target-specific files

The SystemView target sources include integration with different RTOSes that have already been instrumented and configurations for different target systems.

The matching files for the target system need to be added to the project.

Example

For a system with embOS on a Cortex-M3 include `/Sample/embOS/Config/Cortex-M/SEGGER_SYSVIEW_Config_embOS.c`, `/Sample/embOS/SEGGER_SYSVIEW_embOS.c` and `/Sample/embOS/SEGGER_SYSVIEW_embOS.h`.

For a system with no OS or no instrumented OS on a Cortex-M3 include `/Sample/NoOS/Config/Cortex-M/SEGGER_SYSVIEW_Config_NoOS.c` only.

4.1.4 Recorder files

When SystemView events are not recorded via J-Link, but via IP connection or serial line, the recorder sources need to be added to the project, too.

The SystemView target sources include an example recorder using embOS and emNet in `/Sample/COMM/`.

4.2 Initializing SystemView

The system information are sent by the application. This information can be configured via defines in `SEGGER_SYSVIEW_Config_[SYSTEM].c`. Add a call to `SEGGER_SYSVIEW_Conf()` in the main function to initialize SystemView.

```
#include "SEGGER_SYSVIEW.h"

/*********************************************************************
*
*       main()
*
* Function description
*   Application entry point
*/
int main(void) {
  OS_IncDI();                        /* Initially disable interrupts         */
  OS_InitKern();                     /* Initialize OS                        */
  OS_InitHW();                       /* Initialize Hardware for OS           */
  BSP_Init();                        /* Initialize BSP module                */

  SEGGER_SYSVIEW_Conf();             /* Configure and initialize SystemView  */

  /* You need to create at least one task before calling OS_Start() */
  OS_CREATETASK(&TCB0, "MainTask", MainTask, 100, Stack0);
  OS_Start();                        /* Start multitasking                   */
  return 0;
}
```

The generic part of SEGGER SystemView is now ready to monitor the application.

When using embOS V4.12 or later with profiling enabled, SystemView events for ISRs, Task, and API calls are generated. When not using embOS, appropriate events must be generated by the application.

Download the application to the target and let it run. As long as the SystemView Application is not connected, and `SEGGER_SYSVIEW_Start()` is not called, the application will not generate SystemView events. When SystemView is connected or `SEGGER_SYSVIEW_Start()` is called it will activate recording SystemView events.

4.3 Sending system information

The included files `SEGGER_SYSVIEW_Config_[SYSTEM].c` provide the system information to the SystemView Application and can in most cases be used without modification.

```
/*********************************************************************
*                    (c) SEGGER Microcontroller GmbH                 *
*                         The Embedded Experts                       *
*                            www.segger.com                          *
**********************************************************************

-------------------------- END-OF-HEADER -----------------------------

File    : SEGGER_SYSVIEW_Config_embOS.c
Purpose : Sample setup configuration of SystemView with embOS.
Revision: $Rev: 25330 $
*/
#include "RTOS.h"
#include "SEGGER_SYSVIEW.h"
#include "SEGGER_SYSVIEW_embOS.h"

/*********************************************************************
*
*       Defines, fixed
*
**********************************************************************
*/
#define DEMCR         (*(volatile U32*) (0xE000EDFCuL))
  // Debug Exception and Monitor Control Register
#define TRACEENA_BIT  (1uL << 24)                       // Trace enable bit
#define DWT_CTRL      (*(volatile U32*) (0xE0001000uL))  // DWT Control Register
#define NOCYCCNT_BIT  (1uL << 25)
  // Cycle counter support bit
#define CYCCNTENA_BIT (1uL << 0)
  // Cycle counter enable bit
//
// If events will be recorded without a debug probe (J-Link) attached,
// enable the cycle counter
//
#define ENABLE_DWT_CYCCNT (SEGGER_SYSVIEW_POST_MORTEM_MODE || SEGGER_SYSVIEW_USE_INTERNAL_RECORD

/*********************************************************************
*
*       Local functions
*
**********************************************************************
*/
/*********************************************************************
*
*       _cbSendSystemDesc()
*
*  Function description
*    Sends SystemView description strings.
*/
static void _cbSendSystemDesc(void) {
  SEGGER_SYSVIEW_SendSysDesc("N=" SEGGER_SYSVIEW_APP_NAME ",O=embOS,D=" SEGGER_SYSVIEW_DEVICE_NA
#ifdef SEGGER_SYSVIEW_SYSDESC0
  SEGGER_SYSVIEW_SendSysDesc(SEGGER_SYSVIEW_SYSDESC0);
#endif
#ifdef SEGGER_SYSVIEW_SYSDESC1
  SEGGER_SYSVIEW_SendSysDesc(SEGGER_SYSVIEW_SYSDESC1);
#endif
#ifdef SEGGER_SYSVIEW_SYSDESC2
  SEGGER_SYSVIEW_SendSysDesc(SEGGER_SYSVIEW_SYSDESC2);
#endif
}
```



```
/*********************************************************************
*
*       Global functions
*
**********************************************************************
*/
/*********************************************************************
*
*       SEGGER_SYSVIEW_Conf()
*
* Function description
*   Configure and initialize SystemView and register it with embOS.
*
* Additional information
*   If enabled, SEGGER_SYSVIEW_Conf() will also immediately start
*   recording events with SystemView.
*/
void SEGGER_SYSVIEW_Conf(void) {
#if ENABLE_DWT_CYCCNT
  //
  // If no debugger is connected, the DWT must be enabled by the application
  //
  if ((DEMCR & TRACEENA_BIT) == 0) {
    DEMCR |= TRACEENA_BIT;
  }
#endif
  //
  //  The cycle counter must be activated in order
  //  to use time related functions.
  //
  if ((DWT_CTRL & NOCYCCNT_BIT) == 0) {       // Cycle counter supported?
    if ((DWT_CTRL & CYCCNTENA_BIT) == 0) {    // Cycle counter not enabled?
      DWT_CTRL |= CYCCNTENA_BIT;              // Enable Cycle counter
    }
  }
  SEGGER_SYSVIEW_Init(SEGGER_SYSVIEW_TIMESTAMP_FREQ, SEGGER_SYSVIEW_CPU_FREQ,
                      &SYSVIEW_X_OS_TraceAPI, _cbSendSystemDesc);
  OS_SetTraceAPI(&embOS_TraceAPI_SYSVIEW);   // Configure embOS to use SYSVIEW.
#if SEGGER_SYSVIEW_START_ON_INIT
  SEGGER_SYSVIEW_Start();
  // Start recording to catch system initialization.
#endif
}

/*************************** End of file ****************************/
```


4.4 Start and stop recording

When the data is read continuously with SystemView, the recording is started and stopped automatically by the SystemView Application. While SystemView is not recording the target system will not generate SystemView events, minimizing the system overhead.

For single-shot recording `SEGGER_SYSVIEW_Start()` must be called in the application to activate recording SystemView events. Events are recorded until the SystemView buffer is filled or `SEGGER_SYSVIEW_Stop()` is called.

For post-mortem analysis `SEGGER_SYSVIEW_Start()` must be called in the application to activate recording SystemView events. Events are recorded until `SEGGER_SYSVIEW_Stop*(` is called. Older events are overwritten when the SystemView buffer is filled.

4.5 Compile-time configuration

SEGGER SystemView is configurable to match the target device and application. The default compile-time configuration flags are preconfigured with valid values, to match the requirements of most systems and normally do not require modification.

The default configuration of SystemView can be changed via compile-time flags which can be added to `SEGGER_SYSVIEW_Conf.h`.

For multicore recordings, some additional adjustments are required (see the description of the respective compile-time flags). For further information on multicore recordings, please visit: https://kb.segger.com/How_to_use_SystemView_Multicore

4.5.1 System-specific configuration

The following compile-time configuration is required to match the target system. The sample configuration in `SEGGER_SYSVIEW_Conf.h` defines the configuration to match most systems (for example Cortex-M devices with Embedded Studio, GCC, IAR or Keil ARM). If the sample configuration does not include the used system, the configuration must be adapted accordingly.

For a detailed description of the system-specific configuration, refer to *Supported CPUs* on page 89.

4.5.1.1 SEGGER_SYSVIEW_GET_TIMESTAMP()

Function macro to retrieve the system timestamp for SystemView events.

On Cortex-M3/4/7 devices the Cortex-M cycle counter can be used as system timestamp.

Default on Cortex-M3/4/7: `(*(U32 *)(0xE0001004))`

On most other devices the system timestamp has to be generated by a timer. With the default configuration the system timestamp is retrieved via the user-provided function `SEGGER_SYSVIEW_X_GetTimestamp()`.

Default on other cores: `SEGGER_SYSVIEW_X_GetTimestamp()`

For an example, please refer to `Sample/embOS/Config/Cortex-M0/SEGGER_SYSVIEW_Config_embOS_CM0.c` or `Sample/NoOS/Config/RX/SEGGER_SYSVIEW_Config_NoOS_RX.c`

> **Note**
>
> The frequency of the system timestamp has to be provided in `SEGGER_SYSVIEW_Init()`.

4.5.1.2 SEGGER_SYSVIEW_TIMESTAMP_BITS

Number of valid low-order bits delivered by clock source as system timestamp.

If an unmodified clock source is used as system timestamp, the number of valid bits is the bit-width of the clock source (e.g. 32 or 16 bit).

Default: 32 (32-bit clock source used)

Example to save bandwidth

As SystemView packets use a variable-length encoding, shifting timestamps can save both buffer space and bandwidth.

A 32-bit clock source, e.g. the Cortex-M cycle counter on Cortex-M4 can be shifted by 4, resulting in the number of valid timestamp bits to be 28 and the timestamp frequency, as used in `SEGGER_SYSVIEW_Init`, to be the core clock frequency divided by 16.

```
#define SEGGER_SYSVIEW_GET_TIMESTAMP() ((*(U32 *)(0xE0001004)) >> 4)
```

```
#define SEGGER_SYSVIEW_TIMESTAMP_BITS 28.
```


4.5.1.3 SEGGER_SYSVIEW_GET_INTERRUPT_ID()

Function macro to get the currently active interrupt.

On Cortex-M devices the active vector can be read from the ICSR.

Default on Cortex-M3/4/7: `((*(U32*)(0xE000ED04)) & 0x1FF)`

Default on Cortex-M0/1: `((*(U32*)(0xE000ED04)) & 0x3F)`

On other devices the active interrupt can either be retrieved from the interrupt controller directly, can be saved in a variable in the generic interrupt handler, or has to be assigned manually in each interrupt routine.

By default this can be done with the user-provided function `SEGGER_SYSVIEW_X_GetInterruptId()` or by replacing the macro definition.

For an example refer to `Sample/embOS/Config/RX/SEGGER_SYSVIEW_Config_embOS_RX.c` or *Cortex-A/R Interrupt ID* on page 100.

4.5.1.4 SEGGER_SYSVIEW_LOCK()

Function macro to recursively lock SystemView transfers from being interrupted. I.e. disable interrupts.

SEGGER_SYSVIEW_LOCK() must preserve the previous lock state to be restored in SEGGER_SYSVIEW_UNLOCK().

Recording a SystemView event must not be interrupted by recording another event. Therefore all interrupts which are recorded by SystemView (call SEGGER_SYSVIEW_RecordEnterISR / SEGGER_SYSVIEW_RecordExitISR), call an instrumented function (e.g. an OS API function), cause an immediate context switch, or possibly create any other SystemView event must be disabled.

SEGGER_SYSVIEW_LOCK() can use the same locking mechanism as SEGGER_RTT_LOCK().

Default: SEGGER_RTT_LOCK()

SEGGER_RTT_LOCK() is defined for most systems (for example Cortex-M devices with Embedded Studio, GCC, IAR or Keil ARM, and RX devices with IAR) in SEGGER_RTT_Conf.h. If the macro is not defined, or empty, it has to be provided to match the target system.

4.5.1.5 SEGGER_SYSVIEW_UNLOCK()

Function macro to recursively unlock SystemView transfers from being interrupted. I.e. restore previous interrupt state.

`SEGGER_SYSVIEW_UNLOCK()` can use the same locking mechanism as `SEGGER_RTT_UNLOCK()`.

Default: `SEGGER_RTT_UNLOCK()`

`SEGGER_RTT_UNLOCK()` is defined for most systems (for example Cortex-M devices with Embedded Studio, GCC, IAR or Keil ARM, and RX devices with IAR) in `SEGGER_RTT_Conf.h`. If the macro is not defined, or empty, it has to be provided to match the target system.

4.5.2 Generic configuration

The following compile-time flags can be used to tune or change how SystemView events are recorded.

The default compile-time configuration flags are preconfigured with valid values, to match the requirements of most systems and normally do not require modification.

4.5.2.1 SEGGER_SYSVIEW_RTT_BUFFER_SIZE

Number of bytes that SystemView uses for the recording buffer.

For continuous recording a buffer of 1024 bytes is sufficient in most cases. Depending on the target interface speed, the target speed and the system load the buffer size might be increased to up to 4096 bytes.

For single-shot recording the buffer size determines the number of events which can be recorded. A system might generate between 10 and 200 kByte/s, depending on its load. A buffer of at least 8 kByte, up to the whole free RAM space is recommended. The buffer can also be in external RAM.

For post-mortem analysis the buffer size determines the maximum number of events which will be available for analysis. A system might generate between 10 and 200 kByte/s, depending on its load. A buffer of at least 8 kByte, up to the whole free RAM space is recommended. The buffer can also be in external RAM.

Default: 1024 bytes

4.5.2.2 SEGGER_SYSVIEW_RTT_CHANNEL

The RTT Channel used for SystemView event recording and communication. 0: Auto selection

> **Note**
>
> `SEGGER_RTT_MAX_NUM_UP_BUFFERS`, defined in `SEGGER_RTT_Conf.h` has to be greater than `SEGGER_SYSVIEW_RTT_CHANNEL`.

Default: 0

4.5.2.2.1 Multicore

For multicore recordings, each core needs a separate RTT channel. For example if the target systems uses three CPU cores, three RTT channels (e.g. channel `1`, `2` and `3`) are required. Make sure that the correct channel is set for each core.

4.5.2.3 SEGGER_SYSVIEW_USE_STATIC_BUFFER

If set to 1 SystemView uses a static buffer to create SystemView events. This in general saves space, since only one buffer is required and task stacks can be as small as possible. When a static buffer is used, critical code executed between SystemView locking invocations takes slightly longer.

If set to 0 SystemView events are created on the stack. Make sure all task stacks, as well as the C stack for interrupts are large enough to hold the largest SystemView events (~228 bytes). SystemView locks only while transferring the stack buffer into the RTT buffer.

Default: 1

4.5.2.4 SEGGER_SYSVIEW_POST_MORTEM_MODE

If set to 1 post-mortem analysis mode is enabled.

In post-mortem mode, SystemView uses a cyclical buffer and preserves all events up to the final recorded even rather than dropping events when the buffer is full.

Note

Do not use post-mortem analysis mode when an attached J-Link actively reads RTT data.

Default: 0

4.5.2.5 SEGGER_SYSVIEW_SYNC_PERIOD_SHIFT

Configure how often `Sync` and `System Info` events are sent in post-mortem mode. Make sure at least one sync is available in the SystemView buffer.

The recommended sync frequency is `Buffer Size / 16`

Default: 8 = Sync every 256 Packets

4.5.2.6 SEGGER_SYSVIEW_ID_BASE

Value to be subtracted from IDs recorded in SystemView packets.

IDs are TaskIds, TimerIds, and ResourceIds, which are usually pointers to a structure in RAM. Parameters sent in OS and middleware API events can also be encoded as IDs by the instrumentation.

> **Note**
>
> If the instrumented OS does not use pointers for TaskIds, TimerIds, or ResourceIds, `SEGGER_SYSVIEW_ID_BASE` must be set to 0.

As SystemView packets use a variable-length encoding for pointers, correctly re-basing addresses can save both buffer space and bandwidth.

Define as the lowest RAM address used in the system.

Can be overridden by the application via `SEGGER_SYSVIEW_SetRAMBase()` on initialization.

In case of doubt define `SEGGER_SYSVIEW_ID_BASE` as 0.

Default: `0x10000000`

4.5.2.7 SEGGER_SYSVIEW_ID_SHIFT

Number of bits to shift IDs recorded in SystemView packets.

IDs are TaskIds, TimerIds, and ResourceIds, which are usually pointers to a structure in RAM. Parameters sent in OS and middleware API events can also be encoded as IDs by the instrumentation.

> **Note**
>
> If the instrumented OS does not use pointers for TaskIds, TimerIds, or ResourceIds, `SEGGER_SYSVIEW_ID_SHIFT` must be set to 0.

As SystemView packets use a variable-length encoding for pointers, correctly shifting addresses can save both buffer space and bandwidth.

For most applications on 32-bit processors, all IDs recorded in SystemView events are really pointers and as such multiples of 4, so that the lowest 2 bits can be safely ignored.

In case of doubt define `SEGGER_SYSVIEW_ID_SHIFT` as 0.

Default: 2

4.5.2.8 SEGGER_SYSVIEW_MAX_STRING_LEN

Maximum string length to be recorded by SystemView events.

Strings are used in the SystemView `printf`-style user functions, as well as in `SEGGER_SYSVIEW_SendSysDesc()` and `SEGGER_SYSVIEW_RecordModuleDescription`. Make sure `SEGGER_SYSVIEW_MAX_STRING_LEN` matches the string length used in these functions.

Default: 128

4.5.2.9 SEGGER_SYSVIEW_MAX_ARGUMENTS

Maximum number of arguments to be sent with SEGGER_SYSVIEW_PrintfHost, SEGGER_SYSVIEW_PrintfHostEx, SEGGER_SYSVIEW_WarnfHost, and SEGGER_SYSVIEW_ErrorfHost.

If these functions are not used in the application SEGGER_SYSVIEW_MAX_ARGUMENTS can be set to 0 to minimize the static buffer size.

Default: 16

4.5.2.10 SEGGER_SYSVIEW_SECTION

The SystemView RTT Buffer may be placed into a dedicated section, instead of the default data section. This allows placing the buffer into external memory or at a given address.

When SEGGER_SYSVIEW_SECTION is defined, the section has to be defined in the linker script.

Default: SEGGER_RTT_SECTION or not defined

Example in Embedded Studio

```
//
// SEGGER_SYSVIEW_Conf.h
//
#define SEGGER_SYSVIEW_SECTION "SYSTEMVIEW_RAM"

//
// flash_placement.xml
//
<MemorySegment name="ExtRAM">
  <ProgramSection load="No" name="SYSTEMVIEW_RAM" start="0x40000000" />
</MemorySegment>
```

4.5.3 RTT configuration

The following compile-time flags can be used to tune or change RTT.

The default compile-time configuration flags are preconfigured with valid values, to match the requirements of most systems and normally do not require modification.

4.5.3.1 BUFFER_SIZE_UP

Number of bytes to be used for the RTT Terminal output channel.

RTT can be used for printf terminal output without modification. `BUFFER_SIZE_UP` defines how many bytes can be buffered for this.

If RTT Terminal output is not used, define `BUFFER_SIZE_UP` to its minimum of 4.

Default: 1024 Bytes

4.5.3.2 BUFFER_SIZE_DOWN

Number of bytes to be used for the RTT Terminal input channel.

RTT can receive input from the host on the terminal input channel. `BUFFER_SIZE_DOWN` defines how many bytes can be buffered and therefore sent at once from the host.

If RTT Terminal input is not used, define `BUFFER_SIZE_DOWN` to its minimum of 4.

Default: 16 Bytes

4.5.3.3 SEGGER_RTT_MAX_NUM_UP_BUFFERS

Maximum number of RTT up (to host) buffers. Buffer 0 is always used for RTT terminal output, so to use it with SystemView `SEGGER_RTT_MAX_NUM_UP_BUFFERS` has to be at least 2.

> **Note**
>
> For multicore reordings, this value needs to be adjusted. `SEGGER_RTT_MAX_NUM_UP_BUFFERS` needs to be at least `1 + NumberOfCores`. For example, if the target uses three cores, the minimum value of `SEGGER_RTT_MAX_NUM_UP_BUFFERS` is `4`.

Default: 2

4.5.3.4 SEGGER_RTT_MAX_NUM_DOWN_BUFFERS

Maximum number of RTT down (to target) buffers. Buffer 0 is always used for RTT terminal input, so to use it with SystemView SEGGER_RTT_MAX_NUM_DOWN_BUFFERS has to be at least 2.

> **Note**
>
> For multicore reordings, this value needs to be adjusted. SEGGER_RTT_MAX_NUM_DOWN_BUFFERS needs to be at least 1 + NumberOfCores. For example, if the target uses three cores, the minimum value of SEGGER_RTT_MAX_NUM_DOWN_BUFFERS is 4.

Default: 2

4.5.3.5 SEGGER_RTT_MODE_DEFAULT

Mode for pre-initialized RTT terminal channel (buffer 0).

Default: `SEGGER_RTT_MODE_NO_BLOCK_SKIP`

4.5.3.6 SEGGER_RTT_PRINTF_BUFFER_SIZE

Size of buffer for RTT printf to bulk-send chars via RTT. Can be defined as 0 if `SEGGER_RTT_Printf` is not used.

Default: 64

4.5.3.7 SEGGER_RTT_SECTION

The RTT Control Block may be placed into a dedicated section, instead of the default data section. This allows placing it at a known address to be able to use the J-Link auto-detection or easily specify a search range.

When `SEGGER_RTT_SECTION` is defined, the application has to make sure the section is valid, either by initializing it with 0 in the startup code or explicitly calling `SEGGER_RTT_Init()` at the start of the application. `SEGGER_RTT_Init()` is implicitly called by `SEGGER_SYSVIEW_Init()`.

Default: not defined

4.5.3.8 SEGGER_RTT_BUFFER_SECTION

The RTT terminal buffer may be placed into a dedicated section, instead of the default data section. This allows placing the buffer into external memory or at a given address.

> **Note**
>
> For multicore recordings, all RTT buffers must be accessible by the core which is connected to the J-Link. For example, if a system uses one Cortex-M4 and a coprocessor Cortex-M0, and J-Link connects to the M4, the M4 must be able to access the RTT buffer of the M0.

Default: `SEGGER_RTT_SECTION` or not defined

4.5.4 Optimizing SystemView

In order to get the most precise run-time information from a target system, the recording instrumentation code must be fast, least intrusive, small, and efficient. The SystemView code is written to be efficient and least intrusive. Speed and size of SystemView are a matter of target and compiler configuration. The following sections describe how to optimize SystemView.

4.5.4.1 Compiler optimization

The compiler optimization of the SystemView target implementation should always be turned on, even in debug builds, to generate fast recording routines, causing less overhead and be least intrusive.

The configuration to favour speed or size optimization is compiler-dependent. In some cases a balanced configuration can be faster than a speed-only configuration.

4.5.4.2 Recording optimization

SystemView uses a variable-length encoding to store and transfer events, which enables saving buffer space and bandwidth on the debug interface.

The size of some event parameters can be optimized via compile-time configuration.

Shrink IDs

IDs are pointers to a symbol in RAM, for example a Task ID is a pointer to the task control block. To minimize the length of recorded IDs they can be shrunken.

`SEGGER_SYSVIEW_ID_BASE` is subtracted from a pointer to get its ID. It can be set to subtract the base RAM address from pointers, which still results in unique, but smaller IDs. For example if the RAM range is `0x20000000` to `0x20001000` it is recommended to define `SEGGER_SYSVIEW_ID_BASE` as `0x20000000`, which results in the pointer `0x20000100` to have the ID `0x100` and requires two instead of four bits to store it.

`SEGGER_SYSVIEW_ID_SHIFT` is the number of bits a pointer is shifted right to get its ID. If all recorded pointers are 4 byte aligned, `SEGGER_SYSVIEW_ID_SHIFT` can be defined as 2. A pointer `0x20000100` would then have the ID `0x8000040` or with the previous subtraction of `SEGGER_SYSVIEW_ID_BASE` as `0x20000000` the ID would be `0x40`, requiring only one byte to be recorded.

Timestamp source

Event timestamps in SystemView are recorded as the difference of the timestamp to the previous event. This saves buffer space per se.

While it is recommended to use a timestamp source with the CPU clock frequency for highest time resolution, a lower timestamp frequency might save additional buffer space as the timestamp delta is lower.

With a CPU clock frequency of 160 MHz the timestamp might be shifted by 4, resulting in a timestamp frequency of 10 MHz (100 ns resolution), and 4 bits less to be encoded.

When the timestamp size is not 32-bit any more, i.e. it wraps around before `0xFFFFFFFF`, `SEGGER_SYSVIEW_TIMESTAMP_BITS` has to be defined as the timestamp size, e.g. as 28 when shifting a 32-bit timestamp by 4.

4.5.4.3 Buffer configuration

The recording and communication buffer size for SystemView and RTT can be set in the target configuration.

For continuous recording a small buffer of 1 to 4 kByte is sufficient in most cases and allows using SystemView even with a small internal RAM.

For single-shot and post-mortem mode a larger buffer can be desirable. In this case `SEGGER_SYSVIEW_RTT_BUFFER_SIZE` can be set to a larger value. To place the SystemView recording buffer into external RAM a `SEGGER_SYSVIEW_SECTION` can be defined and the linker script adapted accordingly.

If only SystemView is used and no terminal output with RTT, `BUFFER_SIZE_UP` in `SEGGER_RTT_Conf.h` can be set to a smaller value to save memory.

4.6 Supported CPUs

This section describes how to set up and configure the SystemView modules for different target CPUs.

SEGGER SystemView virtually supports any target CPU, however, continuous recording is only possible with CPUs, which support background memory access - ARM Cortex-M and Renesas RX. On other CPUs SystemView can be used in single-shot or post-mortem analysis mode. Refer to *Single-shot recording* on page 54.

In order for SystemView to run properly, some target-specific configuration nust be undertaken. This configuration is described for some CPUs below.

4.6.1 Cortex-M3 / Cortex-M4

Recording mode	Supported?
Continuous recording	Yes
Single-shot recording	Yes
Post-mortem analysis	Yes

4.6.1.1 Event timestamp

The timestamp source on Cortex-M3 / Cortex-M4 can be the cycle counter, which allows cycle-accurate event recording.

In order to save bandwith when recording events, the cycle counter can optionally be right-shifted, for example by 4 bits, which results in a timestamp frequency of core speed divided by 16.

Configuration:

```
//
// Use full cycle counter for higher precision
//
#define SEGGER_SYSVIEW_GET_TIMESTAMP()  (*(U32 *)(0xE0001004))
#define SEGGER_SYSVIEW_TIMESTAMP_BITS   (32)
//
// Use cycle counter divided by 16 for smaller size / bandwidth
//
#define SEGGER_SYSVIEW_GET_TIMESTAMP()  ((*(U32 *)(0xE0001004)) >> 4)
#define SEGGER_SYSVIEW_TIMESTAMP_BITS   (28)
```

4.6.1.2 Interrupt ID

The currently active interrupt can be directly identified by reading the Cortex-M ICSR[8:0], which is the active vector field in the interrupt controller status register (ICSR).

Configuration:

```
//
// Get the interrupt Id by reading the Cortex-M ICSR[8:0]
//
#define SEGGER_SYSVIEW_GET_INTERRUPT_ID()   ((*(U32 *)(0xE000ED04)) & 0x1FF)
```

4.6.1.3 SystemView lock and unlock

Locking and unlocking SystemView to prevent transferring records from being interrupted can be done by disabling interrupts. On Cortex-M3 / Cortex-M4 not all interrupts need to be disabled, only those which might itself generate SystemView events or cause a task switch in the OS.

By default the priority mask is set to 32, disabling all interrupts with a priority of 32 or lower (higher numerical value).

Make sure to mask all interrupts which can send RTT data, i.e. generate SystemView events, or cause task switches. When high-priority interrupts must not be masked while sending RTT data, `SEGGER_RTT_MAX_INTERRUPT_PRIORITY` must be adjusted accordingly. (Higher priority = lower priority number)

Default value for embOS: 128u

Default configuration in FreeRTOS: `configMAX_SYSCALL_INTERRUPT_PRIORITY: ( configLIBRARY_MAX_SYSCALL_INTERRUPT_PRIORITY << (8 - configPRIO_BITS) )`

In case of doubt disable all interrupts.

Lock and unlock for SystemView and RTT can be the same.

Configuration:

```
//
// RTT locking for GCC toolchains in SEGGER_RTT_Conf.h
//
#define SEGGER_RTT_LOCK()     {                                              \
                                  unsigned int LockState;                    \
                                __asm volatile ("mrs   %0, basepri  \n\t"     \
                                                "mov   r1, $32     \n\t"     \
                                                "msr   basepri, r1  \n\t"     \
                                                : "=r" (LockState)           \
                                                :                            \
                                                : "r1"                       \
                                                );

#define SEGGER_RTT_UNLOCK()     __asm volatile ("msr   basepri, %0  \n\t"     \
                                                :                            \
                                                : "r" (LockState)            \
                                                :                            \
                                                );                           \
                              }
//
// Define SystemView locking in SEGGER_SYSVIEW_Conf.h
//
#define SEGGER_SYSVIEW_LOCK()   SEGGER_RTT_LOCK()
#define SEGGER_SYSVIEW_UNLOCK() SEGGER_RTT_UNLOCK()
```

4.6.1.4 Sample configuration

SEGGER_SYSVIEW_Conf.h

```
/*********************************************************************
*            (c) 1995 - 2018 SEGGER Microcontroller GmbH             *
**********************************************************************
-------------------------- END-OF-HEADER -----------------------------

File        : SEGGER_SYSVIEW_Conf.h
Purpose     : SEGGER SysView configuration for Cortex-M3 / Cortex-M4.
*/

#ifndef SEGGER_SYSVIEW_CONF_H
#define SEGGER_SYSVIEW_CONF_H

/*********************************************************************
*
*       SysView timestamp configuration
*/
// Cortex-M cycle counter.
#define SEGGER_SYSVIEW_GET_TIMESTAMP()      ((*(U32 *)(0xE0001004)))
// Number of valid bits low-order delivered as timestamp.
```



```
#define SEGGER_SYSVIEW_TIMESTAMP_BITS       32

/*********************************************************************
*
*       SysView Id configuration
*/
// Default value for the lowest Id reported by the application.
// Can be overridden by the application via SEGGER_SYSVIEW_SetRAMBase().
#define SEGGER_SYSVIEW_ID_BASE         0x20000000
// Number of bits to shift the Id to save bandwidth.
// (e.g. 2 when all reported Ids (pointers) are 4 byte aligned)
#define SEGGER_SYSVIEW_ID_SHIFT        0

/*********************************************************************
*
*       SysView interrupt configuration
*/
// Get the currently active interrupt Id. (read Cortex-M ICSR[8:0]
 = active vector)
#define SEGGER_SYSVIEW_GET_INTERRUPT_ID()   ((*(U32 *)(0xE000ED04)) & 0x1FF)

/*********************************************************************
*
*       SysView locking
*/
// Lock SysView (nestable)
#define SEGGER_SYSVIEW_LOCK()             SEGGER_RTT_LOCK()
// Unlock SysView (nestable)
#define SEGGER_SYSVIEW_UNLOCK()           SEGGER_RTT_UNLOCK()

#endif

/*************************** End of file ****************************/
```

SEGGER_SYSVIEW_Config_NoOS_CM3.c

```
/*********************************************************************
*            (c) 1995 - 2018 SEGGER Microcontroller GmbH             *
*                        The Embedded Experts                        *
*                           www.segger.com                           *
**********************************************************************

-------------------------- END-OF-HEADER -----------------------------

File    : SEGGER_SYSVIEW_Config_NoOS.c
Purpose : Sample setup configuration of SystemView without an OS.
Revision: $Rev: 9599 $
*/
#include "SEGGER_SYSVIEW.h"
#include "SEGGER_SYSVIEW_Conf.h"

// SystemcoreClock can be used in most CMSIS compatible projects.
// In non-CMSIS projects define SYSVIEW_CPU_FREQ.
extern unsigned int SystemCoreClock;

/*********************************************************************
*
*       Defines, configurable
*
**********************************************************************
*/
// The application name to be displayed in SystemViewer
#define SYSVIEW_APP_NAME        "Demo Application"

// The target device name
#define SYSVIEW_DEVICE_NAME     "Cortex-M4"
```

```
// Frequency of the timestamp. Must match SEGGER_SYSVIEW_Conf.h
#define SYSVIEW_TIMESTAMP_FREQ  (SystemCoreClock)

// System Frequency. SystemcoreClock is used in most CMSIS compatible projects.
#define SYSVIEW_CPU_FREQ        (SystemCoreClock)

// The lowest RAM address used for IDs (pointers)
#define SYSVIEW_RAM_BASE        (0x10000000)

// Define as
 1 if the Cortex-M cycle counter is used as SystemView timestamp. Must match SEGGER_SYSVIEW_Conf
#ifndef   USE_CYCCNT_TIMESTAMP
  #define USE_CYCCNT_TIMESTAMP    1
#endif

// Define as
 1 if the Cortex-M cycle counter is used and there might be no debugger attached while recording
#ifndef   ENABLE_DWT_CYCCNT
  #define ENABLE_DWT_CYCCNT
  (USE_CYCCNT_TIMESTAMP & SEGGER_SYSVIEW_POST_MORTEM_MODE)
#endif

/*********************************************************************
*
*       Defines, fixed
*
**********************************************************************
*/
#define DEMCR                      (*(volatile unsigned long*) (0xE000EDFCuL))
  // Debug Exception and Monitor Control Register
#define TRACEENA_BIT               (1uL << 24)
  // Trace enable bit
#define DWT_CTRL                   (*(volatile unsigned long*) (0xE0001000uL))
  // DWT Control Register
#define NOCYCCNT_BIT               (1uL << 25)
  // Cycle counter support bit
#define CYCCNTENA_BIT              (1uL << 0)
  // Cycle counter enable bit

/*********************************************************************
*
*       _cbSendSystemDesc()
*
*  Function description
*    Sends SystemView description strings.
*/
static void _cbSendSystemDesc(void) {
  SEGGER_SYSVIEW_SendSysDesc("N="SYSVIEW_APP_NAME",D="SYSVIEW_DEVICE_NAME);
  SEGGER_SYSVIEW_SendSysDesc("I#15=SysTick");
}

/*********************************************************************
*
*       Global functions
*
**********************************************************************
*/
void SEGGER_SYSVIEW_Conf(void) {
#if USE_CYCCNT_TIMESTAMP
#if ENABLE_DWT_CYCCNT
  //
  // If no debugger is connected, the DWT must be enabled by the application
  //
  if ((DEMCR & TRACEENA_BIT) == 0) {
    DEMCR |= TRACEENA_BIT;
  }
#endif
  //
```



```
  //  The cycle counter must be activated in order
  //  to use time related functions.
  //
  if ((DWT_CTRL & NOCYCCNT_BIT) == 0) {       // Cycle counter supported?
    if ((DWT_CTRL & CYCCNTENA_BIT) == 0) {    // Cycle counter not enabled?
      DWT_CTRL |= CYCCNTENA_BIT;              // Enable Cycle counter
    }
  }
#endif
  SEGGER_SYSVIEW_Init(SYSVIEW_TIMESTAMP_FREQ, SYSVIEW_CPU_FREQ,
                      0, _cbSendSystemDesc);
  SEGGER_SYSVIEW_SetRAMBase(SYSVIEW_RAM_BASE);
}

/*************************** End of file ****************************/
```

4.6.2 Cortex-M7

Same features / settings etc. as for Cortex-M4 apply. For more information, please refer to *Cortex-M3 / Cortex-M4* on page 89.

Cache

When placing the RTT buffer for SystemView into memory that is cacheable, the performance is slightly lower (< 1% decrease in performance) for continuous recording mode via J-Link and RTT. This is because J-Link must perform cache maintenance operations when accessing the RTT buffer.

4.6.3 Cortex-M0 / Cortex-M0+ / Cortex-M1

Recording mode	Supported?
Continuous recording	Yes
Single-shot recording	Yes
Post-mortem analysis	Yes

4.6.3.1 Cortex-M0 Event timestamp

Cortex-M0, Cortex-M0+ and Cortex-M1 do not have a cycle count register. the event timestamp has to be provided by an application clock source, for example the system timer, SysTick. `SEGGER_SYSVIEW_X_GetTimestamp()` can be used to implement the functionality.

When the SysTick interrupt is used in the application, e.g. by the RTOS, the SysTick handler should increment `SEGGER_SYSVIEW_TickCnt`, otherwise a SysTick handler has to be added to the application and configured accordingly.

Configuration:

```
//
// SEGGER_SYSVIEW_TickCnt has to be defined in the module which
// handles the SysTick and must be incremented in the SysTick
// handler before any SYSVIEW event is generated.
//
// Example in embOS RTOSInit.c:
//
// unsigned int SEGGER_SYSVIEW_TickCnt; // <<-- Define SEGGER_SYSVIEW_TickCnt.
// void SysTick_Handler(void) {
// #if OS_PROFILE
//   SEGGER_SYSVIEW_TickCnt++;  // <<-- Increment SEGGER_SYSVIEW_TickCnt asap.
// #endif
//   OS_EnterNestableInterrupt();
//   OS_TICK_Handle();
//   OS_LeaveNestableInterrupt();
```



```
// }
//
extern unsigned int SEGGER_SYSVIEW_TickCnt;

/*********************************************************************
*
*       Defines, fixed
*
**********************************************************************
*/
#define SCB_ICSR
  (*(volatile U32*) (0xE000ED04uL)) // Interrupt Control State Register
#define SCB_ICSR_PENDSTSET_MASK     (1UL << 26)     // SysTick pending bit
#define SYST_RVR
  (*(volatile U32*) (0xE000E014uL)) // SysTick Reload Value Register
#define SYST_CVR
  (*(volatile U32*) (0xE000E018uL)) // SysTick Current Value Register
/*********************************************************************
*
*       SEGGER_SYSVIEW_X_GetTimestamp()
*
* Function description
*   Returns the current timestamp in ticks using the system tick
*   count and the SysTick counter.
*   All parameters of the SysTick have to be known and are set via
*   configuration defines on top of the file.
*
* Return value
*   The current timestamp.
*
* Additional information
*   SEGGER_SYSVIEW_X_GetTimestamp is always called when interrupts are
*   disabled. Therefore locking here is not required.
*/
U32 SEGGER_SYSVIEW_X_GetTimestamp(void) {
  U32 TickCount;
  U32 Cycles;
  U32 CyclesPerTick;
  //
  // Get the cycles of the current system tick.
  // SysTick is down-counting, subtract the current value from the number of cycles per tick.
  //
  CyclesPerTick = SYST_RVR + 1;
  Cycles = (CyclesPerTick - SYST_CVR);
  //
  // Get the system tick count.
  //
  TickCount = SEGGER_SYSVIEW_TickCnt;
  //
  // If a SysTick interrupt is pending, re-read timer and adjust result
  //
  if ((SCB_ICSR & SCB_ICSR_PENDSTSET_MASK) != 0) {
    Cycles = (CyclesPerTick - SYST_CVR);
    TickCount++;
  }
  Cycles += TickCount * CyclesPerTick;

  return Cycles;
}
```

4.6.3.2 Cortex-M0 Interrupt ID

The currently active interrupt can be directly identified by reading the Cortex-M ICSR[5:0], which is the active vector field in the interrupt controller status register (ICSR).

Configuration:

```
//
// Get the interrupt Id by reading the Cortex-M ICSR[5:0]
//
#define SEGGER_SYSVIEW_GET_INTERRUPT_ID()   ((*(U32 *)(0xE000ED04)) & 0x3F)
```

4.6.3.3 Cortex-M0 SystemView lock and unlock

Locking and unlocking SystemView to prevent transferring records from being interrupted can be done by disabling interrupts.

Lock and unlock for SystemView and RTT can be the same.

Configuration:

```
//
// RTT locking for GCC toolchains in SEGGER_RTT_Conf.h
//
#define SEGGER_RTT_LOCK()       {                                              \
                                  unsigned int LockState;                      \
                                  __asm volatile ("mrs   %0, primask  \n\t"    \
                                                  "mov   r1, $1     \n\t"      \
                                                  "msr   primask, r1  \n\t"    \
                                                  : "=r" (LockState)           \
                                                  :                            \
                                                  : "r1"                       \
                                                  );

#define SEGGER_RTT_UNLOCK()       __asm volatile ("msr   primask, %0  \n\t"    \
                                                  :                            \
                                                  : "r" (LockState)            \
                                                  :                            \
                                                  );                           \
                                }

//
// Define SystemView locking in SEGGER_SYSVIEW_Conf.h
//
#define SEGGER_SYSVIEW_LOCK()   SEGGER_RTT_LOCK()
#define SEGGER_SYSVIEW_UNLOCK() SEGGER_RTT_UNLOCK()
```

4.6.3.4 Cortex-M0 Sample configuration

SEGGER_SYSVIEW_Conf.h

```
/*********************************************************************
*            (c) 1995 - 2018 SEGGER Microcontroller GmbH             *
**********************************************************************
-------------------------- END-OF-HEADER -----------------------------

File        : SEGGER_SYSVIEW_Conf.h
Purpose     : SEGGER SysView configuration for Cortex-M0, Cortex-M0+,
              and Cortex-M1
*/

#ifndef SEGGER_SYSVIEW_CONF_H
#define SEGGER_SYSVIEW_CONF_H

/*********************************************************************
*
*       SysView timestamp configuration
*/
// Retrieve a system timestamp via user-defined function
```

```
#define SEGGER_SYSVIEW_GET_TIMESTAMP()      SEGGER_SYSVIEW_X_GetTimestamp()
// number of valid bits low-order delivered by SEGGER_SYSVIEW_X_GetTimestamp()
#define SEGGER_SYSVIEW_TIMESTAMP_BITS       32

/*********************************************************************
*
*       SysView Id configuration
*/
// Default value for the lowest Id reported by the application.
// Can be overridden by the application via SEGGER_SYSVIEW_SetRAMBase().
#define SEGGER_SYSVIEW_ID_BASE         0x20000000
// Number of bits to shift the Id to save bandwidth.
// (for example 2 when all reported Ids (pointers) are 4 byte aligned)
#define SEGGER_SYSVIEW_ID_SHIFT        0

/*********************************************************************
*
*       SysView interrupt configuration
*/
// Get the currently active interrupt Id. (read Cortex-M ICSR[8:0]
 = active vector)
#define SEGGER_SYSVIEW_GET_INTERRUPT_ID()   ((*(U32 *)(0xE000ED04)) & 0x3F)

/*********************************************************************
*
*       SysView locking
*/
// Lock SysView (nestable)
#define SEGGER_SYSVIEW_LOCK()             SEGGER_RTT_LOCK()
// Unlock SysView (nestable)
#define SEGGER_SYSVIEW_UNLOCK()           SEGGER_RTT_UNLOCK()

#endif

/*************************** End of file ****************************/
```

SEGGER_SYSVIEW_Config_embOS_CM0.c

```
/*********************************************************************
*                    (c) SEGGER Microcontroller GmbH                 *
*                         The Embedded Experts                       *
*                            www.segger.com                          *
**********************************************************************

-------------------------- END-OF-HEADER -----------------------------

File    : SEGGER_SYSVIEW_Config_embOS_CM0.c
Purpose : Sample setup configuration of SystemView with embOS
          on Cortex-M0/Cortex-M0+/Cortex-M1 systems which do not
          have a cycle counter.
Revision: $Rev: 25330 $

Additional information:
  SEGGER_SYSVIEW_TickCnt must be incremented in the SysTick
  handler before any SYSVIEW event is generated.

  Example in embOS RTOSInit.c:

  void SysTick_Handler(void) {
  #if (OS_PROFILE != 0)
    SEGGER_SYSVIEW_TickCnt++;  // Increment SEGGER_SYSVIEW_TickCnt before calling
 OS_EnterNestableInterrupt().
  #endif
    OS_EnterNestableInterrupt();
    OS_TICK_Handle();
    OS_LeaveNestableInterrupt();
  }
```

```
*/
#include "RTOS.h"
#include "SEGGER_SYSVIEW.h"
#include "SEGGER_SYSVIEW_embOS.h"

/*********************************************************************
*
*       Defines, fixed
*
**********************************************************************
*/
#define SCB_ICSR  (*(volatile U32*) (0xE000ED04uL))
  // Interrupt Control State Register
#define SCB_ICSR_PENDSTSET_MASK     (1UL << 26)      // SysTick pending bit
#define SYST_RVR  (*(volatile U32*) (0xE000E014uL))
  // SysTick Reload Value Register
#define SYST_CVR  (*(volatile U32*) (0xE000E018uL))
  // SysTick Current Value Register

/*********************************************************************
*
*       Local functions
*
**********************************************************************
*/
/*********************************************************************
*
*       _cbSendSystemDesc()
*
*  Function description
*    Sends SystemView description strings.
*/
static void _cbSendSystemDesc(void) {
  SEGGER_SYSVIEW_SendSysDesc("N=" SEGGER_SYSVIEW_APP_NAME ",O=embOS,D=" SEGGER_SYSVIEW_DEVICE_NA
#ifdef SEGGER_SYSVIEW_SYSDESC0
  SEGGER_SYSVIEW_SendSysDesc(SEGGER_SYSVIEW_SYSDESC0);
#endif
#ifdef SEGGER_SYSVIEW_SYSDESC1
  SEGGER_SYSVIEW_SendSysDesc(SEGGER_SYSVIEW_SYSDESC1);
#endif
#ifdef SEGGER_SYSVIEW_SYSDESC2
  SEGGER_SYSVIEW_SendSysDesc(SEGGER_SYSVIEW_SYSDESC2);
#endif
}

/*********************************************************************
*
*       Global functions
*
**********************************************************************
*/
/*********************************************************************
*
*       SEGGER_SYSVIEW_Conf()
*
* Function description
*   Configure and initialize SystemView and register it with embOS.
*
* Additional information
*   If enabled, SEGGER_SYSVIEW_Conf() will also immediately start
*   recording events with SystemView.
*/
void SEGGER_SYSVIEW_Conf(void) {
  SEGGER_SYSVIEW_Init(SEGGER_SYSVIEW_TIMESTAMP_FREQ, SEGGER_SYSVIEW_CPU_FREQ,
                      &SYSVIEW_X_OS_TraceAPI, _cbSendSystemDesc);
  OS_SetTraceAPI(&embOS_TraceAPI_SYSVIEW);   // Configure embOS to use SYSVIEW.
#if SEGGER_SYSVIEW_START_ON_INIT
```



```
  SEGGER_SYSVIEW_Start();
  // Start recording to catch system initialization.
#endif
}

/*********************************************************************
*
*       SEGGER_SYSVIEW_X_GetTimestamp()
*
* Function description
*   Returns the current timestamp in cycles using the system tick
*   count and the SysTick counter.
*   All parameters of the SysTick have to be known and are set via
*   configuration defines on top of the file.
*
* Return value
*   The current timestamp.
*
* Additional information
*   SEGGER_SYSVIEW_X_GetTimestamp is always called when interrupts are
*   disabled. Therefore locking here is not required.
*/
U32 SEGGER_SYSVIEW_X_GetTimestamp(void) {
  U32 TickCount;
  U32 Cycles;
  U32 CyclesPerTick;
  //
  // Get the cycles of the current system tick.
  // SysTick is down-counting, subtract the current value from the number of cycles per tick.
  //
  CyclesPerTick = SYST_RVR + 1;
  Cycles = (CyclesPerTick - SYST_CVR);
  //
  // Get the system tick count.
  //
  TickCount = SEGGER_SYSVIEW_TickCnt;
  //
  // If a SysTick interrupt is pending, re-read timer and adjust result
  //
  if ((SCB_ICSR & SCB_ICSR_PENDSTSET_MASK) != 0) {
    Cycles = (CyclesPerTick - SYST_CVR);
    TickCount++;
  }
  Cycles += TickCount * CyclesPerTick;

  return Cycles;
}

/*************************** End of file ****************************/
```

4.6.4 Cortex-A / Cortex-R

Recording mode	Supported?
Continuous recording	Yes/NO
Single-shot recording	Yes
Post-mortem analysis	Yes

Continuous recording is only supported on Cortex-A / Cortex-R devices, which support RTT via background memory access via the AHB-AP. For more information please refer to the J-Link User Manual and website.

4.6.4.1 Cortex-A/R Event timestamp

The Cortex-A and Cortex-R cycle counter is implemented only as part of the Performance Monitor Extension and might not always be accessible. Cortex-A and Cortex-R do not have a generic system timer source, like the Cortex-M SysTick, either.

For an example on how to initialize the Performance counter, refer to *TI AM3358 Cortex-A8 sample configuration* on page 105.

Otherwise the event timestamp has to be provided by an application clock source. Refer to *Renesas RZ/A1 Cortex-A9 sample configuration* on page 102.

For the clock source any suitable timer can be used. It is recommended to use the OS system timer if possible, since it normally saves additional configuration and resource usage. If no timer is used in the application, a suitable timer has to be configured to be used with SystemView.

Some OSes implement API functions to get the OS time in cycles. If such a function is available it can be used directly or wrapped by `SEGGER_SYSVIEW_X_GetTimestamp()` If the OS does not provide functionality to retrieve the OS time in cycles, `SEGGER_SYSVIEW_X_GetTimestamp()` has to be implemented to get the timestamp from the timer.

- The timer should run at 1 MHz (1 tick/us) or faster.
- The timer should generate an interrupt on overflow or zero
- The timer should be in auto reload mode

Dummy configuration:

```
//
// SEGGER_SYSVIEW_TickCnt has to be defined in the module which
// handles interrupts and must be incremented in the interrupt
// handler as soon as the timer interrupt is acknowledged and
// before any SYSVIEW event is generated.
//
// Example:
//
// unsigned int SEGGER_SYSVIEW_TickCnt; // <<-- Define SEGGER_SYSVIEW_TickCnt.
// void OS_irq_handler(void) {
//   U32  InterruptId;
//   InterruptId  = INTC_ICCIAR & 0x3FF;  // read and extract the interrupt ID
//   if (InterruptId == TIMER_TICK_ID) {
//     SEGGER_SYSVIEW_TickCnt++;  // <<-- Increment SEGGER_SYSVIEW_TickCnt asap.
//   }
//   SEGGER_SYSVIEW_InterruptId
 = InterruptId; // Save active interrupt for SystemView event
//   SEGGER_SYSVIEW_RecordEnterISR();
//   //
//   // Handle interrupt, call ISR
//   //
//   SEGGER_SYSVIEW_RecordExitISR();
// }
//
extern unsigned int SEGGER_SYSVIEW_TickCnt;

/*********************************************************************
*
*       Defines, fixed
*
**********************************************************************
*/
//
// Define the required timer registers here.
//
#define TIMER_RELOAD_VALUE        /* as value which is used to initialize and
 reload the timer */
#define TIMER_COUNT               /* as timer register which holds the current
 counter value */
#define TIMER_INTERRUPT_PENDING() /* as check if a timer interrupt is pending */
```



```
/*********************************************************************
*
*       SEGGER_SYSVIEW_X_GetTimestamp()
*
* Function description
*   Returns the current timestamp in ticks using the system tick
*   count and the SysTick counter.
*   All parameters of the SysTick have to be known and are set via
*   configuration defines on top of the file.
*
* Return value
*   The current timestamp.
*
* Additional information
*   SEGGER_SYSVIEW_X_GetTimestamp is always called when interrupts are
*   disabled. Therefore locking here is not required.
*/
U32 SEGGER_SYSVIEW_X_GetTimestamp(void) {
  U32 TickCount;
  U32 Cycles;
  U32 CyclesPerTick;
  //
  // Get the cycles of the current system tick.
  // Sample timer is down-counting,
  // subtract the current value from the number of cycles per tick.
  //
  CyclesPerTick = TIMER_RELOAD_VALUE + 1;
  Cycles = (CyclesPerTick - TIMER_COUNT);
  //
  // Get the system tick count.
  //
  TickCount = SEGGER_SYSVIEW_TickCnt;
  //
  // Check if a timer interrupt is pending
  //
  if (TIMER_INTERRUPT_PENDING()) {
    TickCount++;
    Cycles = (CyclesPerTick - TIMER_COUNT);
  }
  Cycles += TickCount * CyclesPerTick;

  return Cycles;
}
```

4.6.4.2 Cortex-A/R Interrupt ID

As the Cortex-A and Cortex-R core does not have an internal interrupt controller, retrieving the currently active interrrupt Id depends on the interrupt controller, which is used on the target device. `SEGGER_SYSVIEW_GET_INTERRUPT_ID()` must be implemented to match this interrupt controller.

The configuration below shows how to get the interrupt Id on devices, which include the ARM Generic Interrupt Controller (GIC).

For other interrupt controllers the operation may vary. Refer to *TI AM3358 Cortex-A8 sample configuration* on page 105.

Since the active interrupt Id can only be retrieved from the GIC in connection with an acknowledge of the interrupt it can only be read once. Therefore the Id has to be stored in a variable when acknowledging it in the generic interrupt handler.

Dummy configuration:

```
//
// SEGGER_SYSVIEW_InterruptId has to be defined in the module which
// handles the interrupts and must be set to the acknowledged interrupt Id.
```



```
//
// Example:
//
// #define GIC_BASE_ADDR   /* as base address of the GIC on the device */
// #define GICC_BASE_ADDR  (GIC_BASE_ADDR + 0x2000u)
// #define GICC_IAR        (*(volatile unsigned*)(GICC_BASE_ADDR + 0x000C))
//
// unsigned int SEGGER_SYSVIEW_InterruptId; //
 <<-- Define SEGGER_SYSVIEW_InterruptId.
// void OS_irq_handler(void) {
//
//   int_id = GICC_IAR & 0x03FF;  // Read interrupt ID, acknowledge interrupt
//   SEGGER_SYSVIEW_InterruptId = iar_val;
//   OS_EnterInterrupt();         // Inform OS that interrupt handler is running
//   pISR();                      // Call interrupt service routine
//   OS_LeaveInterrupt();
  // Leave interrupt, perform task switch if required
// }
//
extern unsigned int SEGGER_SYSVIEW_InterruptId;

#define SEGGER_SYSVIEW_GET_INTERRUPT_ID()  (SEGGER_SYSVIEW_InterruptId)
```

4.6.4.3 Cortex-A/R SystemView lock and unlock

As the Cortex-A and Cortex-R core does not have an internal interrupt controller, locking and unlocking SystemView to prevent transferring records from being interrupted can be done generic by disabling FIQ and IRQ completely, or by using interrupt controller specific methods. The configuration below shows how to disable all interrupts for RTT and SystemView.

Lock and unlock for SystemView and RTT can be the same.

Configuration:

```
//
// RTT locking for GCC toolchains in SEGGER_RTT_Conf.h
// Set and restore IRQ and FIQ mask bits.
//
#define SEGGER_RTT_LOCK()       {                                                \
                                  unsigned int LockState;                        \
                                  __asm volatile ("mrs   r1, CPSR       \n\t"     \
                                                  "mov   %0, r1         \n\t"     \
                                                  "orr   r1, r1, #0xC0 \n\t"      \
                                                  "msr   CPSR_c, r1     \n\t"     \
                                                  : "=r" (LockState)              \
                                                  :                               \
                                                  : "r1"                          \
                                                  );

#define SEGGER_RTT_UNLOCK()       __asm volatile ("mov   r0, %0         \n\t"     \
                                                  "mrs   r1, CPSR       \n\t"     \
                                                  "bic   r1, r1, #0xC0 \n\t"      \
                                                  "and   r0, r0, #0xC0 \n\t"      \
                                                  "orr   r1, r1, r0     \n\t"     \
                                                  "msr   CPSR_c, r1     \n\t"     \
                                                  :                               \
                                                  : "r" (LockState)               \
                                                  : "r0", "r1"                    \
                                                  );                              \
                                }

//
// Define SystemView locking in SEGGER_SYSVIEW_Conf.h
//
#define SEGGER_SYSVIEW_LOCK()   SEGGER_RTT_LOCK()
```

```
#define SEGGER_SYSVIEW_UNLOCK() SEGGER_RTT_UNLOCK()
```

4.6.4.4 Renesas RZ/A1 Cortex-A9 sample configuration

This sample configuration for the Renesas RZ/A1 (R7S72100) retrieves the currently active interrupt and the system tick counter from embOS.

It uses the OS Timer for timestamp generation. The RZ/A1 includes a GIC.

SEGGER_SYSVIEW_Conf.h

```
/*********************************************************************
*            (c) 1995 - 2018 SEGGER Microcontroller GmbH             *
**********************************************************************
-------------------------- END-OF-HEADER -----------------------------

File        : SEGGER_SYSVIEW_Conf.h
Purpose     : SEGGER SysView configuration for Renesas RZ/A1 Cortex-A9
              with SEGGER embOS.
*/

#ifndef SEGGER_SYSVIEW_CONF_H
#define SEGGER_SYSVIEW_CONF_H

/*********************************************************************
*
*       SysView buffer configuration
*/
// Number of bytes that SysView uses for the buffer.
// Should be large enough for single-shot recording.
#define SEGGER_SYSVIEW_RTT_BUFFER_SIZE      1024 * 1024
// The RTT channel that SysView will use.
#define SEGGER_SYSVIEW_RTT_CHANNEL          1

/*********************************************************************
*
*       SysView timestamp configuration
*/
// Retrieve a system timestamp via OS-specific function
#define SEGGER_SYSVIEW_GET_TIMESTAMP()      SEGGER_SYSVIEW_X_GetTimestamp()
// number of valid bits low-order delivered by SEGGER_SYSVIEW_X_GetTimestamp()
#define SEGGER_SYSVIEW_TIMESTAMP_BITS       32

/*********************************************************************
*
*       SysView interrupt configuration
*/
//
// SEGGER_SYSVIEW_InterruptId has to be defined in the module which
// handles the interrupts and must be set to the acknowledged interrupt Id.
//
// Example:
//
// #define GIC_BASE_ADDR   /* as base address of the GIC on the device */
// #define GICC_BASE_ADDR  (GIC_BASE_ADDR + 0x2000u)
// #define GICC_IAR        (*(volatile unsigned*)(GICC_BASE_ADDR + 0x000C))
//
// unsigned int SEGGER_SYSVIEW_InterruptId; //
 <<-- Define SEGGER_SYSVIEW_InterruptId.
// void OS_irq_handler(void) {
//
//   int_id = GICC_IAR & 0x03FF;  // Read interrupt ID, acknowledge interrupt
//   SEGGER_SYSVIEW_InterruptId = iar_val;
//   OS_EnterInterrupt();         // Inform OS that interrupt handler is running
//   pISR();                      // Call interrupt service routine
//   OS_LeaveInterrupt();
  // Leave interrupt, perform task switch if required
```



```
// }
//
extern unsigned int SEGGER_SYSVIEW_InterruptId;

#define SEGGER_SYSVIEW_GET_INTERRUPT_ID()  (SEGGER_SYSVIEW_InterruptId)

/*********************************************************************
*
*       SysView locking
*/
// Lock SysView (nestable)
#define SEGGER_SYSVIEW_LOCK()             SEGGER_RTT_LOCK()
// Unlock SysView (nestable)
#define SEGGER_SYSVIEW_UNLOCK()           SEGGER_RTT_UNLOCK()

#endif

/*************************** End of file ****************************/
```

SEGGER_SYSVIEW_Config_embOS_RZA1.c

```
/*********************************************************************
*             (c) 1995 - 2018 SEGGER Microcontroller GmbH            *
**********************************************************************
-------------------------- END-OF-HEADER -----------------------------

File        : SEGGER_SYSVIEW_Config_embOS_RZA1.c
Purpose     : Sample setup configuration of SystemView with embOS
              for Renesas RZ/A1 Cortex-A9.
*/
#include "RTOS.h"
#include "SEGGER_SYSVIEW.h"
#include "SEGGER_SYSVIEW_embOS.h"

// SystemcoreClock can be used in most CMSIS compatible projects.
// In non-CMSIS projects define SYSVIEW_CPU_FREQ below.
extern unsigned int SystemCoreClock;

/*********************************************************************
*
*       Defines, configurable
*
**********************************************************************
*/
// The application name to be displayed in SystemView
#define SYSVIEW_APP_NAME        "embOS Demo Application"

// The target device name
#define SYSVIEW_DEVICE_NAME     "R7S72100"

// Frequency of the timestamp. Must match SEGGER_SYSVIEW_Conf.h
// and SEGGER_SYSVIEW_X_GetTimestamp().
#define SYSVIEW_TIMESTAMP_FREQ  (399900000u / 12)

// System Frequency. SystemcoreClock is used in most CMSIS compatible projects.
#define SYSVIEW_CPU_FREQ        (399900000u)

// The lowest RAM address used for IDs (pointers)
// Should be adjusted if the RAM does not start at 0x20000000.
#define SYSVIEW_RAM_BASE        (0x60020000)


#define TIMER_INTERRUPT_PENDING() /* as check if a timer interrupt is pending */


/*********************************************************************
*
```



```
*       _cbSendSystemDesc()
*
*  Function description
*    Sends SystemView description strings.
*/
static void _cbSendSystemDesc(void) {
  SEGGER_SYSVIEW_SendSysDesc("N="SYSVIEW_APP_NAME",D="SYSVIEW_DEVICE_NAME);
}

/*********************************************************************
*
*       Global functions
*
**********************************************************************
*/
void SEGGER_SYSVIEW_Conf(void) {
  SEGGER_SYSVIEW_Init(SYSVIEW_TIMESTAMP_FREQ, SYSVIEW_CPU_FREQ,
                      &SYSVIEW_X_OS_TraceAPI, _cbSendSystemDesc);
  SEGGER_SYSVIEW_SetRAMBase(SYSVIEW_RAM_BASE);
  OS_SetTraceAPI(&embOS_TraceAPI_SYSVIEW);    // Configure embOS to use SYSVIEW.
}

/*********************************************************************
*
*       SEGGER_SYSVIEW_X_GetTimestamp()
*
* Function description
*   Returns the current timestamp in ticks using the system tick
*   count and the SysTick counter.
*   All parameters of the SysTick have to be known and are set via
*   configuration defines on top of the file.
*
* Return value
*   The current timestamp.
*
* Additional information
*   SEGGER_SYSVIEW_X_GetTimestamp is always called when interrupts are
*   disabled. Therefore locking here is not required.
*/
U32 SEGGER_SYSVIEW_X_GetTimestamp(void) {
  U32 TickCount;
  U32 Cycles;
  U32 CyclesPerTick;
  //
  // Get the cycles of the current system tick.
  // Sample timer is down-counting,
  // subtract the current value from the number of cycles per tick.
  //
  CyclesPerTick = 33249 + 1;
  Cycles = (CyclesPerTick - OSTM_CNT);
  //
  // Get the system tick count.
  //
  TickCount = SEGGER_SYSVIEW_TickCnt;
  //
  // Check if a timer interrupt is pending
  //
  if (TIMER_INTERRUPT_PENDING()) {
    TickCount++;
    Cycles = (CyclesPerTick - OSTM_CNT);
  }
  Cycles += TickCount * CyclesPerTick;

  return Cycles;
}

/*************************** End of file ****************************/
```


4.6.4.5 TI AM3358 Cortex-A8 sample configuration

This sample configuration for the TI AM3358 retrieves the currently active interrupt directly. It initializes and uses the Cortex-A performance counter for timestamp generation.

The SystemView timestmap generation can be used for other Cortex-A devices, which include the performance counter unit.

SEGGER_SYSVIEW_Conf.h

```
/*********************************************************************
*            (c) 1995 - 2018 SEGGER Microcontroller GmbH             *
**********************************************************************
-------------------------- END-OF-HEADER -----------------------------

File        : SEGGER_SYSVIEW_Conf.h
Purpose     : Generic SEGGER SysView configuration for non-Cortex-M
              devices.
*/

#ifndef SEGGER_SYSVIEW_CONF_H
#define SEGGER_SYSVIEW_CONF_H

/*********************************************************************
*
*       SysView timestamp configuration
*/
// Retrieve a system timestamp via user-defined function
#define SEGGER_SYSVIEW_GET_TIMESTAMP()      SEGGER_SYSVIEW_X_GetTimestamp()
// number of valid bits low-order delivered by SEGGER_SYSVIEW_X_GetTimestamp()
#define SEGGER_SYSVIEW_TIMESTAMP_BITS       32

/*********************************************************************
*
*       SysView Id configuration
*/
// Default value for the lowest Id reported by the application.
// Can be overridden by the application via SEGGER_SYSVIEW_SetRAMBase().
#define SEGGER_SYSVIEW_ID_BASE         0
// Number of bits to shift the Id to save bandwidth.
// (for example 2 when all reported Ids (pointers) are 4 byte aligned)
#define SEGGER_SYSVIEW_ID_SHIFT        0

/*********************************************************************
*
*       SysView interrupt configuration
*/
#define SEGGER_SYSVIEW_GET_INTERRUPT_ID()   SEGGER_SYSVIEW_X_GetInterruptId()

/*********************************************************************
*
*       SysView locking
*/
// Lock SysView (nestable)
#define SEGGER_SYSVIEW_LOCK()             SEGGER_RTT_LOCK()
// Unlock SysView (nestable)
#define SEGGER_SYSVIEW_UNLOCK()           SEGGER_RTT_UNLOCK()

#endif

/*************************** End of file ****************************/
```

SEGGER_SYSVIEW_Config_embOS_AM3358.c

```
/*********************************************************************
*            (c) 1995 - 2018 SEGGER Microcontroller GmbH             *
```



```
**********************************************************************
-------------------------- END-OF-HEADER -----------------------------

File        : SEGGER_SYSVIEW_Config_embOS_RZA1.c
Purpose     : Sample setup configuration of SystemView with embOS
              for TI AM3358 Cortex-A8.
*/
#include "RTOS.h"
#include "SEGGER_SYSVIEW.h"
#include "SEGGER_SYSVIEW_embOS.h"

//
// SystemcoreClock can be used in most CMSIS compatible projects.
// In non-CMSIS projects define SYSVIEW_CPU_FREQ directly.
//
extern unsigned int SystemCoreClock;

/*********************************************************************
*
*       Defines, configurable
*
**********************************************************************
*/
// The application name to be displayed in SystemView
#ifndef   SYSVIEW_APP_NAME
  #define SYSVIEW_APP_NAME        "embOS start project"
#endif

// The target device name
#ifndef   SYSVIEW_DEVICE_NAME
  #define SYSVIEW_DEVICE_NAME     "AM3358"
#endif

// Frequency of the timestamp. Must match SEGGER_SYSVIEW_Conf.h
// The performance counter frequency equals the core clock frequency.
#define SYSVIEW_TIMESTAMP_FREQ  (SystemCoreClock)

// System Frequency. SystemcoreClock is used in most CMSIS compatible projects.
#ifndef   SYSVIEW_CPU_FREQ
  #define SYSVIEW_CPU_FREQ        (SystemCoreClock)
#endif

// The lowest RAM address used for IDs (pointers)
#ifndef   SYSVIEW_RAM_BASE
  #define SYSVIEW_RAM_BASE        (0x80000000)
#endif

#ifndef   SYSVIEW_SYSDESC0
  #define SYSVIEW_SYSDESC0        "I#67=SysTick,I#18=USB,I#17=USBSS,I#36=LCDC"
#endif

#define INTC_BASE                 (0x48200000uL)
#define INTC_SIR_IRQ              (*(volatile U32*) (INTC_BASE + 0x40uL))

/*********************************************************************
*
*       Local functions
*
**********************************************************************
*/
/*********************************************************************
*
*       _cbSendSystemDesc()
*
*  Function description
*    Sends SystemView description strings.
*/
static void _cbSendSystemDesc(void) {
```



```
  SEGGER_SYSVIEW_SendSysDesc("N="SYSVIEW_APP_NAME",O=embOS,D="SYSVIEW_DEVICE_NAME);
#ifdef SYSVIEW_SYSDESC0
  SEGGER_SYSVIEW_SendSysDesc(SYSVIEW_SYSDESC0);
#endif
#ifdef SYSVIEW_SYSDESC1
  SEGGER_SYSVIEW_SendSysDesc(SYSVIEW_SYSDESC1);
#endif
#ifdef SYSVIEW_SYSDESC2
  SEGGER_SYSVIEW_SendSysDesc(SYSVIEW_SYSDESC2);
#endif
}

/*********************************************************************
*
*       _InitPerformanceCounter
*
*  Function description
*    Initialize the internal Cortex-A Performance counter.
*    The function will work for Cortex-A8, Cortex-A9.
*    Please check whether this also suites for your core.
*/
static void _InitPerformanceCounter(U32 PerformReset, I32 UseDivider) {
 //
 // in general enable all counters (including cycle counter)
 //
 I32 Value = 1;

 //
 // Peform reset:
 //
 if (PerformReset) {
   Value |= 2;     // reset all counters to zero.
   Value |= 4;     // reset cycle counter to zero.
 }

 if (UseDivider) {
   Value |= 8;     // enable "by 64" divider for CCNT.
 }
 Value |= 16;

 // program the performance-counter control-register:
 __asm volatile ("MCR p15, 0, %0, c9, c12, 0\t\n"
                 :              // Output result
                 : "r"(Value)   // Input
                 :              // Clobbered list
                );
 //
 // Enable all counters
 //
 __asm volatile ("MCR p15, 0, %0, c9, c12, 1\t\n"
                 :                  // Output result
                 : "r"(0x8000000f)  // Input
                 :                  // Clobbered list
                );
 //
 // Clear overflows
 //
 __asm volatile ("MCR p15, 0, %0, c9, c12, 3\t\n"
                 :                  // Output result
                 : "r"(0x8000000f)  // Input
                 :                  // Clobbered list
                );
}

/*********************************************************************
*
*       Global functions
*
```



```
**********************************************************************
*/

/*********************************************************************
*
*       SEGGER_SYSVIEW_Conf
*
*  Function description
*    Configures SYSVIEW.
*
*    Please check whether this also suites for your core.
*/
void SEGGER_SYSVIEW_Conf(void) {
  //
  // Write USEREN Register
  //
  __asm volatile ("MCR p15, 0, %0, C9, C14, 0\n\t"
                 :              // Output result
                 : "r"(1)       // Input
                 :              // Clobbered list
                );

  //
  // Disable counter overflow interrupts
  //
  __asm volatile ("MCR p15, 0, %0, C9, C14, 2\n\t"
                  :                  // Output result
                  : "r"(0x8000000f)  // Input
                  :                  // Clobbered list
                );
  _InitPerformanceCounter(1, 0);
  SEGGER_SYSVIEW_Init(SYSVIEW_TIMESTAMP_FREQ, SYSVIEW_CPU_FREQ,
                      &SYSVIEW_X_OS_TraceAPI, _cbSendSystemDesc);
  SEGGER_SYSVIEW_SetRAMBase(SYSVIEW_RAM_BASE);
  OS_SetTraceAPI(&embOS_TraceAPI_SYSVIEW);    // Configure embOS to use SYSVIEW.
}

/*********************************************************************
*
*       SEGGER_SYSVIEW_X_GetTimestamp()
*
* Function description
*   Returns the current timestamp in ticks using the performance counter.
*
* Return value
*   The current timestamp.
*
* Additional information
*   SEGGER_SYSVIEW_X_GetTimestamp is always called when interrupts are
*   disabled. Therefore locking here is not required.
*/
U32  SEGGER_SYSVIEW_X_GetTimestamp(void) {
  register U32 r = 0;
  //
  // Read CCNT Register
  //
  __asm volatile ("MRC p15, 0, %0, c9, c13, 0"
                  : "+r"(r)   // Output result
                  :           // Inputs
                  : );        // Clobbered list
  return r;
}

/*********************************************************************
*
*       SEGGER_SYSVIEW_X_GetInterruptId()
*
*  Function description
```

```
*    Return the currently active IRQ interrupt number
*    from the INTC_SIR_IRQ.
*/
U32 SEGGER_SYSVIEW_X_GetInterruptId(void) {
  return (INTC_SIR_IRQ & (0x7Fu)); // INTC_SIR_IRQ[6:0]: ActiveIRQ
}
```

4.6.5 Renesas RX

Recording mode	Supported?
Continuous recording	Yes
Single-shot recording	Yes
Post-mortem analysis	Yes

4.6.5.1 Renesas RX Event timestamp

The event timestamp has to be provided by an application clock source timer. SEGGER_SYSVIEW_X_GetTimestamp() can be used to implement the functionality.

Before creating any other event in the timer interrupt, the interrupt handler should increment SEGGER_SYSVIEW_TickCnt.

Configuration:

```
//
// SEGGER_SYSVIEW_TickCnt has to be defined in the module which
// handles the system tick timer and must be incremented in the timer interrupt
// handler before any SYSVIEW event is generated.
//
// Example in embOS RTOSInit.c:
//
// unsigned int SEGGER_SYSVIEW_TickCnt; // <<-- Define SEGGER_SYSVIEW_TickCnt.
// void SysTick_Handler(void) {
// #if OS_PROFILE
//   SEGGER_SYSVIEW_TickCnt++;  // <<-- Increment SEGGER_SYSVIEW_TickCnt asap.
// #endif
//   OS_EnterNestableInterrupt();
//   OS_TICK_Handle();
//   OS_LeaveNestableInterrupt();
// }
//
extern unsigned int SEGGER_SYSVIEW_TickCnt;

/*********************************************************************
*
*       Defines, fixed
*
**********************************************************************
*/
// System Timer configuration
#define IRR_BASE_ADDR        (0x00087000u)
#define CMT0_VECT            28u
#define OS_TIMER_VECT        CMT0_VECT
#define TIMER_PRESCALE       (8u)
#define CMT0_BASE_ADDR       (0x00088000u)
#define CMT0_CMCNT           (*(volatile U16*) (CMT0_BASE_ADDR + 0x04u))

/*********************************************************************
*
*       SEGGER_SYSVIEW_X_GetTimestamp()
*
* Function description
*   Returns the current timestamp in ticks using the system tick
*   count and the system timer counter.
```



```
*   All parameters of the system timer have to be known and are set via
*   configuration defines on top of the file.
*
* Return value
*   The current timestamp.
*
* Additional information
*   SEGGER_SYSVIEW_X_GetTimestamp is always called when interrupts are
*   disabled. Therefore locking here is not required.
*/
U32 SEGGER_SYSVIEW_X_GetTimestamp(void) {
  U32 Time;
  U32 Cnt;

  Time = SEGGER_SYSVIEW_TickCnt;
  Cnt  = CMT0_CMCNT;
  //
  // Check if timer interrupt pending ...
  //
  if ((*(volatile U8*)(IRR_BASE_ADDR + OS_TIMER_VECT) & (1u << 0u)) != 0u) {
    Cnt = CMT0_CMCNT;      // Interrupt pending, re-read timer and adjust result
    Time++;
  }
  return ((SYSVIEW_TIMESTAMP_FREQ/1000) * Time) + Cnt;
}
```

4.6.5.2 Renesas RX Interrupt ID

The currently active interrupt level can be used as the interrupt ID on RX devices. In the sample configuration it is provided by `SEGGER_SYSVIEW_X_GetInterruptId()` in `SEGGER_SYSVIEW_Config_[System]_RX.c`.

Configuration:

```
//
// Get the interrupt Id via user-provided function
//
#define SEGGER_SYSVIEW_GET_INTERRUPT_ID()   SEGGER_SYSVIEW_X_GetInterruptId()
```

4.6.5.3 Renesas RX SystemView lock and unlock

Locking and unlocking SystemView to prevent transferring records from being interrupted can be done by disabling interrupts.

Lock and unlock for SystemView and RTT can be the same.

Configuration:

```
//
// RTT locking for IAR toolchains in SEGGER_RTT_Conf.h
//
  #define SEGGER_RTT_LOCK()   {                                          \
                                unsigned long LockState;                \
                                LockState = __get_interrupt_state();    \
                                __disable_interrupt();

  #define SEGGER_RTT_UNLOCK()   __set_interrupt_state(LockState);       \
                              }

//
// Define SystemView locking in SEGGER_SYSVIEW_Conf.h
//
#define SEGGER_SYSVIEW_LOCK()   SEGGER_RTT_LOCK()
#define SEGGER_SYSVIEW_UNLOCK() SEGGER_RTT_UNLOCK()
```


4.6.5.4 Renesas RX Sample configuration

SEGGER_SYSVIEW_Conf.h

```
/*********************************************************************
*            (c) 1995 - 2018 SEGGER Microcontroller GmbH             *
**********************************************************************
-------------------------- END-OF-HEADER -----------------------------

File        : SEGGER_SYSVIEW_Conf.h
Purpose     : SEGGER SysView configuration for Renesas RX
*/

#ifndef SEGGER_SYSVIEW_CONF_H
#define SEGGER_SYSVIEW_CONF_H

/*********************************************************************
*
*       SysView timestamp configuration
*/
// Retrieve a system timestamp via user-defined function
#define SEGGER_SYSVIEW_GET_TIMESTAMP()      SEGGER_SYSVIEW_X_GetTimestamp()
// number of valid bits low-order delivered by SEGGER_SYSVIEW_X_GetTimestamp()
#define SEGGER_SYSVIEW_TIMESTAMP_BITS       32

/*********************************************************************
*
*       SysView Id configuration
*/
// Default value for the lowest Id reported by the application.
// Can be overridden by the application via SEGGER_SYSVIEW_SetRAMBase().
#define SEGGER_SYSVIEW_ID_BASE         0
// Number of bits to shift the Id to save bandwidth.
// (for example 2 when all reported Ids (pointers) are 4 byte aligned)
#define SEGGER_SYSVIEW_ID_SHIFT        0

/*********************************************************************
*
*       SysView interrupt configuration
*/
// Get the currently active interrupt Id. (read Cortex-M ICSR[8:0]
 = active vector)
#define SEGGER_SYSVIEW_GET_INTERRUPT_ID()   SEGGER_SYSVIEW_X_GetInterruptId()

/*********************************************************************
*
*       SysView locking
*/
// Lock SysView (nestable)
#define SEGGER_SYSVIEW_LOCK()             SEGGER_RTT_LOCK()
// Unlock SysView (nestable)
#define SEGGER_SYSVIEW_UNLOCK()           SEGGER_RTT_UNLOCK()

#endif

/*************************** End of file ****************************/
```

SEGGER_SYSVIEW_Config_embOS_CM0.c

```
/*********************************************************************
*            (c) 1995 - 2018 SEGGER Microcontroller GmbH             *
*                        The Embedded Experts                        *
*                           www.segger.com                           *
**********************************************************************

-------------------------- END-OF-HEADER -----------------------------
```

```
File    : SEGGER_SYSVIEW_Config_NoOS_RX.c
Purpose : Sample setup configuration of SystemView on Renesas RX
          systems without an operating system.
Revision: $Rev: 18540 $
*/
#include "RTOS.h"
#include "SEGGER_SYSVIEW.h"
#include "SEGGER_SYSVIEW_embOS.h"

//
// SystemcoreClock can be used in most CMSIS compatible projects.
// In non-CMSIS projects define SYSVIEW_CPU_FREQ directly.
//
extern unsigned int SystemCoreClock;

/*********************************************************************
*
*       Defines, fixed
*
**********************************************************************
*/

/*********************************************************************
*
*       Defines, configurable
*
**********************************************************************
*/
// The application name to be displayed in SystemViewer
#ifndef   SYSVIEW_APP_NAME
  #define SYSVIEW_APP_NAME          "Demo Application"
#endif

// The target device name
#ifndef   SYSVIEW_DEVICE_NAME
  #define SYSVIEW_DEVICE_NAME       "RX64M"
#endif

// System Frequency. SystemcoreClock is used in most CMSIS compatible projects.
#ifndef   SYSVIEW_CPU_FREQ
  #define SYSVIEW_CPU_FREQ        (SystemCoreClock)
#endif

// Frequency of the timestamp. Must match SEGGER_SYSVIEW_Conf.h and RTOSInit.c
#ifndef   SYSVIEW_TIMESTAMP_FREQ
  #define SYSVIEW_TIMESTAMP_FREQ
  (SYSVIEW_CPU_FREQ/2u/8u) // Assume system timer runs at
 1/16th of the CPU frequency
#endif

// The lowest RAM address used for IDs (pointers)
#ifndef   SYSVIEW_RAM_BASE
  #define SYSVIEW_RAM_BASE        (0)
#endif

#ifndef   SYSVIEW_SYSDESC0
  #define SYSVIEW_SYSDESC0
  "I#0=IntPrio0,I#1=IntPrio1,I#2=IntPrio2,I#3=IntPrio3,I#4=IntPrio4"
#endif

//#ifndef   SYSVIEW_SYSDESC1
//  #define SYSVIEW_SYSDESC1
 "I#5=IntPrio5,I#6=IntPrio6,I#7=IntPrio7,I#8=IntPrio8,I#9=IntPrio9,I#10=IntPrio10"
//#endif

//#ifndef   SYSVIEW_SYSDESC2
```

```
//  #define SYSVIEW_SYSDESC2
 "I#11=IntPrio11,I#12=IntPrio12,I#13=IntPrio13,I#14=IntPrio14,I#15=IntPrio15"
//#endif

// System Timer configuration
#define IRR_BASE_ADDR        (0x00087000u)
#define CMT0_VECT            28u
#define OS_TIMER_VECT        CMT0_VECT
#define TIMER_PRESCALE       (8u)
#define CMT0_BASE_ADDR       (0x00088000u)
#define CMT0_CMCNT           (*(volatile U16*) (CMT0_BASE_ADDR + 0x04u))

extern unsigned SEGGER_SYSVIEW_TickCnt;
  // Tick Counter value incremented in the tick handler.

/*********************************************************************
*
*       _cbSendSystemDesc()
*
*  Function description
*    Sends SystemView description strings.
*/
static void _cbSendSystemDesc(void) {
  SEGGER_SYSVIEW_SendSysDesc("N="SYSVIEW_APP_NAME",D="SYSVIEW_DEVICE_NAME);
#ifdef SYSVIEW_SYSDESC0
  SEGGER_SYSVIEW_SendSysDesc(SYSVIEW_SYSDESC0);
#endif
#ifdef SYSVIEW_SYSDESC1
  SEGGER_SYSVIEW_SendSysDesc(SYSVIEW_SYSDESC1);
#endif
#ifdef SYSVIEW_SYSDESC2
  SEGGER_SYSVIEW_SendSysDesc(SYSVIEW_SYSDESC2);
#endif
}

/*********************************************************************
*
*       Global functions
*
**********************************************************************
*/
void SEGGER_SYSVIEW_Conf(void) {
  SEGGER_SYSVIEW_Init(SYSVIEW_TIMESTAMP_FREQ, SYSVIEW_CPU_FREQ,
                      0, _cbSendSystemDesc);
  SEGGER_SYSVIEW_SetRAMBase(SYSVIEW_RAM_BASE);
}

/*********************************************************************
*
*       SEGGER_SYSVIEW_X_GetTimestamp()
*
* Function description
*   Returns the current timestamp in ticks using the system tick
*   count and the SysTick counter.
*   All parameters of the SysTick have to be known and are set via
*   configuration defines on top of the file.
*
* Return value
*   The current timestamp.
*
* Additional information
*   SEGGER_SYSVIEW_X_GetTimestamp is always called when interrupts are
*   disabled.
*   Therefore locking here is not required and OS_GetTime_Cycles() may
*   be called.
*/
U32 SEGGER_SYSVIEW_X_GetTimestamp(void) {
  U32 Time;
```



```
  U32 Cnt;

  Time = SEGGER_SYSVIEW_TickCnt;
  Cnt  = CMT0_CMCNT;
  //
  // Check if timer interrupt pending ...
  //
  if ((*(volatile U8*)(IRR_BASE_ADDR + OS_TIMER_VECT) & (1u << 0u)) != 0u) {
    Cnt = CMT0_CMCNT;      // Interrupt pending, re-read timer and adjust result
    Time++;
  }
  return ((SYSVIEW_TIMESTAMP_FREQ/1000) * Time) + Cnt;
}

/*********************************************************************
*
*       SEGGER_SYSVIEW_X_GetInterruptId()
*
*  Function description
*    Return the priority of the currently active interrupt.
*/
U32 SEGGER_SYSVIEW_X_GetInterruptId(void) {
  U32 IntId;
 __asm volatile ("mvfc    PSW, %0           \t\n" // Load current PSW
                 "and     #0x0F000000, %0   \t\n" // Clear all except IPL
 ([27:24])
                 "shlr    #24, %0           \t\n" // Shift IPL to [3:0]
                 : "=r" (IntId)                   // Output result
                 :                                // Input
                 :                                // Clobbered list
                );
  return IntId;
}

/*************************** End of file ****************************/
```

4.6.6 Other CPUs

Recording mode	Supported?
Continuous recording	No
Single-shot recording	Yes
Post-mortem analysis	Yes

On CPUs, which are not covered by the sections above SystemView can be used in single-shot mode, too.

To properly run SystemView the same items have to be configured:

- Get an event timestamp.
- Get an interrupt Id of the active interrupt.
- Lock and unlock SystemView to prevent recording being interrupted.

4.7 Supported OSes

The following chapter describes which (RT)OSes are already instrumented to use SystemView and how to configure them.

4.7.1 embOS

SEGGER embOS (V4.12a and later) can generate trace events for SystemView and other recording implementations when profiling is enabled.

4.7.1.1 Configuring embOS for SystemView

Profiling is enabled in the `OS_LIBMODE_SP`, `OS_LIBMODE_DP` and `OS_LIBMODE_DT` embOS library configurations (For detailed information refer to the embOS User Manual UM01001).

In addition to the SYSTEMVIEW and RTT core module, the following file must be included in the application:

- For Cortex-M3 and Cortex-M4 targets include `SEGGER_SYSVIEW_Config_embOS.c`.
- For Cortex-M0 and Cortex-M1 targets include `SEGGER_SYSVIEW_Config_embOS.c`.

This file provides additionally required functions for SystemView and allows configuration to fit the target system, like defines for the application name, the target device and the target core frequency. It initializes the SYSTEMVIEW module and configures embOS to send trace events to SystemView. For an example configuration, refer to *Supported CPUs* on page 89.

At the start of the application, at main, after the target is initialized, `SEGGER_SYSVIEW_Conf()` has to be called to enable SystemView.

Now, when the application is running, SystemView can connect to the target and start recording events. All task, interrupt, and OS Scheduler activity, as well as embOS API calls are recorded when SystemView is connected or `SEGGER_SYSVIEW_Start()` has been called.

4.7.2 uC/OS-III

SystemView can be used with Micrium's uC/OS-III to record task, interrupt, and scheduler activity.

4.7.2.1 Configuring uC/OS-III for SystemView

In addition to the SYSTEMVIEW and RTT core module the following files have to be included in the application project:

`SEGGER_SYSVIEW_Config_uCOSIII.c` provides additionally required functions for SystemView and allows configuration to fit the target system, like defines for the application name, the target device and the target core frequency. The example configuration file, shipped with the SystemView package is configured to be used with most Cortex-M3, Cortex-M4, and Cortex-M7 targets. For an example configuration, refer to *Supported CPUs* on page 89.

`SEGGER_SYSVIEW_uCOSIII.c` and `os_trace_events.h` provide the interface between uC/OS-III and SystemView. They usually do not need to be modified.

`os_cfg_trace.h` is the minimal uc/OS-III Trace configuration file required for SystemView. If the project already includes this file, make sure the content fits the application. This file includes two defines to configure the maximum number of tasks and the maximum number of resources to be managed and named in the SystemView recording.

```
#define  TRACE_CFG_MAX_TASK                    16u
#define  TRACE_CFG_MAX_RESOURCES               16u
```

Enable recording

Recording of uC/OS-III events can be configured in `os_cfg.h`.

Define `OS_CFG_TRACE_EN` as `1u` to enable basic recording.

When `OS_CFG_TRACE_API_ENTER_EN` is defined as `1u`, API function calls will be recorded, too.

To also record when an API function exits, define `OS_CFG_TRACE_API_EXIT_EN` as `1u` as well.

Call `TRACE_INIT()` at the beginning of the application, after the system has been initialized:

```
  [...]
    BSP_Init(); /* Initialize BSP functions       */
    CPU_Init(); /* Initialize the uC/CPU services */

#if (defined(OS_CFG_TRACE_EN) && (OS_CFG_TRACE_EN > 0u))
    /* Initialize uC/OS-III Trace. Should be called after initializing the
 system. */
    TRACE_INIT();
#endif
  [...]
```

4.7.3 uC/OS-II

SystemView can be used with Micrium's uC/OS-II to record task, interrupt, and scheduler activity. SystemView support has been added with v2.92.13

For information on how to configure uC/OS-II for SystemView, follow the guide at https://doc.micrium.com/display/osiidoc/SEGGER+SystemView

4.7.3.1 Configuring uC/OS-II for SystemView

In addition to the SYSTEMVIEW and RTT core module the following files have to be included in the application project:

`SEGGER_SYSVIEW_Config_uCOSII.c` provides additionally required functions for SystemView and allows configuration to fit the target system, like defines for the application name, the target device and the target core frequency. The example configuration file, shipped with the SystemView package is configured to be used with most Cortex-M3, Cortex-M4, and Cortex-M7 targets. For an example configuration, refer to *Supported CPUs* on page 89.

`SEGGER_SYSVIEW_uCOSII.c` and `os_trace_events.h` provide the interface between uC/OS-II and SystemView. They usually do not need to be modified.

`os_cfg_trace.h` is the minimal uc/OS-II Trace configuration file required for SystemView. If the project already includes this file, make sure the content fits the application. This file includes two defines to configure the maximum number of tasks and the maximum number of resources to be managed and named in the SystemView recording.

```
#define   TRACE_CFG_MAX_TASK                     16u
#define   TRACE_CFG_MAX_RESOURCES                16u
```

Enable recording

Recording of uC/OS-II events can be configured in `os_cfg.h`.

Define `OS_CFG_TRACE_EN` as `1u` to enable basic recording.

When `OS_CFG_TRACE_API_ENTER_EN` is defined as `1u`, API function calls will be recorded, too.

To also record when an API function exits, define `OS_CFG_TRACE_API_EXIT_EN` as `1u` as well.

Call `TRACE_INIT()` at the beginning of the application, after the system has been initialized:

```
  [...]
    BSP_Init(); /* Initialize BSP functions       */
    CPU_Init(); /* Initialize the uC/CPU services */
```



```
#if (defined(OS_CFG_TRACE_EN) && (OS_CFG_TRACE_EN > 0u))
    /* Initialize uC/OS-II Trace. Should be called after initializing the system.
 */
    TRACE_INIT();
#endif
  [...]
```

4.7.4 Micrium OS Kernel

SystemView can be used with the Micrium OS Kernel to record task, interrupt, and scheduler activity.

4.7.4.1 Configuring Micrium OS Kernel for SystemView

In addition to the SYSTEMVIEW and RTT core module the following files have to be included in the application project:

SEGGER_SYSVIEW_Config_MicriumOSKernel.c provides additionally required functions for SystemView and allows configuration to fit the target system, like defines for the application name, the target device and the target core frequency. The example configuration file, shipped with the SystemView package is configured to be used with most Cortex-M3, Cortex-M4, and Cortex-M7 targets. For an example configuration, refer to *Supported CPUs* on page 89.

SEGGER_SYSVIEW_MicriumOSKernel.c and os_trace_events.h provide the interface between the Micrium OS Kernel and SystemView. They usually do not need to be modified.

os_cfg_trace.h is the minimal Micrium OS Kernel Trace configuration file required for SystemView. If the project already includes this file, make sure the content fits the application. This file includes two defines to configure the maximum number of tasks and the maximum number of resources to be managed and named in the SystemView recording.

```
#define  TRACE_CFG_MAX_TASK                      16u
#define  TRACE_CFG_MAX_RESOURCES                 16u
```

Enable recording

Recording of Micrium OS Kernel events can be configured in os_cfg.h.

Define OS_CFG_TRACE_EN as 1u to enable basic recording.

When OS_CFG_TRACE_API_ENTER_EN is defined as 1u, API function calls will be recorded, too.

To also record when an API function exits, define OS_CFG_TRACE_API_EXIT_EN as 1u as well.

Call TRACE_INIT() at the beginning of the application, after the system has been initialized:

```
  [...]
    BSP_Init(); /* Initialize BSP functions       */
    CPU_Init(); /* Initialize the uC/CPU services */

#if (defined(OS_CFG_TRACE_EN) && (OS_CFG_TRACE_EN > 0u))
    /* Initialize Micrium OS Kernel Trace. Should be called after initializing
 the system. */
    TRACE_INIT();
#endif
  [...]
```

4.7.5 FreeRTOS

FreeRTOS can also generate trace events for SystemView and allows basic but useful analysis without modification.

For more detailed analysis, like Scheduler activity and interrupts, the FreeRTOS source and the used port have to be slightly modified.

4.7.5.1 Configuring FreeRTOS for SystemView

In addition to the SYSTEMVIEW and RTT core module, `SEGGER_SYSVIEW_Config_FreeRTOS.c` must be included in the application. This file provides additionally required functions for SystemView and allows configuration to fit the target system, like defines for the application name, the target device and the target core frequency. For an example configuration, refer to *Supported CPUs* on page 89.

The `SEGGER_SYSVIEW_FreeRTOS.h` header has to be included at the end of `FreeRTOSConfig.h` or above every include of `FreeRTOS.h`. It defines the trace macros to create SYSTEMVIEW events..

To get the best results `INCLUDE_xTaskGetIdleTaskHandle` and `INCLUDE_pxTaskGetStackStart` should be defined as `1` in `FreeRTOSConfig.h`.

The patch file `Sample/FreeRTOSV8/Patch/FreeRTOSV8.2.3_Core.patch` shows the required modifications of the FreeRTOS 8.2.3 source and the GCC/`ARM_CM4F` port. It can be used as a reference when using another version or port of FreeRTOS. E.g. if another port than GCC/`ARM_CM4F` is used, the `traceISR_ENTER()`, `traceISR_EXIT()`, and `traceISR_EXIT_TO_SCHEDULER()` calls have to be added accordingly.

The patch file `Sample/FreeRTOSV9/Patch/FreeRTOSV9_Core.patch` can be used to patch FreeRTOS V9.

The patch file `Sample/FreeRTOSV10/Patch/FreeRTOSV10_Core.patch` can be used to patch FreeRTOS V10.0.0 and can be used as a reference to patch other versions of FreeRTOS.

Note: Due to certain limitations by FreeRTOS, SystemView must store task names manually. Per default 8 task names will be buffered. To increase this value go to the `SEGGER_SYSVIEW_FreeRTOS.h` and edit entry `SYSVIEW_FREERTOS_MAX_NOF_TASKS` to the number of tasks used in your application.

4.7.6 NuttX

SystemView can be used with NuttX RTOS to record system activity.

SystemView has been added to the NuttX mainline and can be enabled and configured in its setup tools.

More information is available in the NuttX project documentation.

4.7.7 Zephyr

SystemView can be used as a recorder in Zephyr to record events.

More information is available in the Zephyr project documentation.

4.7.8 Other OSes

Other OSes are not officially instrumented, yet.

If you want to use SystemView with an other OS, get it touch with SEGGER or the OS Vendor. The OS instrumentation can also be done with the guide in the following chapter.

4.7.8.1 No OS

SystemView can be used without any instrumented OS at all, to record interrupt activity and user events.

Configuring a system for SystemView

In addition to the SYSTEMVIEW and RTT core module, `SEGGER_SYSVIEW_Config_NoOS.c` must be included in the application. This file provides the basic configuration of the required functions for SystemView and can be modified to fit the system. For an example configuration, refer to *Supported CPUs* on page 89. An additional `SEGGER_SYSVIEW_OS_API` pointer can be passed in `SEGGER_SYSVIEW_Init` to provide information about the system time or “tasks” of the system.

For a description on how to record interrupts in the system, refer to *Recording interrupts* on page 128.

A generic guide on how to implement SystemView on a NoOS system can be found on our Knowledge Base: https://kb.segger.com/Use_SystemView_without_RTOS.

Chapter 5

SystemView on the target

This section describes how SystemView can be used in user application code to extend the analysis information generated by the instrumented OS.

5.1 Performance Markers

Performance Markers can be used to measure the timing in a system, for example the execution time of a routine, or the delay from receiving an Ethernet packet until it is analyzed and processed.

Performance Markers are shown in the Events list with runtime and count, and visualized in the Timeline window.

To add Performance Markers in the application, use `SEGGER_SYSVIEW_MarkStart()`, `SEGGER_SYSVIEW_Mark()`, and `SEGGER_SYSVIEW_MarkStop()`.

Performance Markers are identified and correlated by a MarkerId. For easier identification in the SystemView Application, a name can be set per Id with `SEGGER_SYSVIEW_NameMarker()`, which can be called from the system description callback.

5.2 Terminal Output

SystemView supports formatted output to the SystemView Application. This enables debug log messages to be shown within the Events list, which can add more information for better system analysis.

5.3 Resource Names

Resources, such as semaphores, mutextes, or mailboxes, are usually passed to API functions as pointer and recorded in events as a (compressed) address.

For easier identification in the SystemView Application, a name can be set for each resource address with `SEGGER_SYSVIEW_NameResource()`.

When the name is known, and the OS description identifies a parameter as resource, the name is shown instead of the resource address.

Chapter 6

Instrumenting OSes and software modules

This section describes how to integrate SEGGER SystemView into an OS or middleware module to be able to record its execution.

6.1 Integrating SEGGER SystemView into an OS

SEGGER SystemView can be integrated in any (RT)OS to get information about task execution, OS internal activity, like a scheduler, and OS API calls. For the following RTOSes this integration has already been done and can be used out-of-the box.

- SEGGER embOS (V4.12a or later)
- Micrium uC/OS-II
- Micrium uC/OS-III (V3.06 or later)
- FreeRTOS (V8.2.3 or later)

For integration into other OSes, contact the OS distributor or do the integration following the instructions in this sections.

The examples in this section are pseudo-code to illustrate when to call specific SystemView functions. To allow general integration of trace instrumentation tools calls to these functions can also be integrated as function macros or via a configurable trace API.

Instrumenting the OS core

In order to be able to record task execution and context switches, the OS core has to be instrumented to generate SystemView events at the appropriate core functions.

Interrupt execution is in most cases handled by the OS, too. This allows instrumenting the according OS functions called on enter and exit interrupt, which would otherwise have to be done for each ISR in the application.

The third aspect of instrumenting the OS core is to provide run-time information for a more detailed analysis. This information includes the system time to allow SystemView to display timestamps relative to the start of the application, instead of to the start of recording, and the task list, which is used by SystemView to display task names, stack information and to order tasks by priority.

6.1.1 Recording task activity

SystemView can record a set of pre-defined system events for the main information of system and OS activity, like task execution. These events should be generated by the OS in the corresponding functions.

The pre-defined events are:

Event	Description	SystemView API
Task Create	A new task is created.	*SEGGER_SYSVIEW_OnTaskCreate* on page 182
Task Start Ready	A task is marked as ready to start or resume execution.	*SEGGER_SYSVIEW_OnTaskStartReady* on page 184
Task Start Exec	A task is activated, it starts or resumes execution.	*SEGGER_SYSVIEW_OnTaskStartExec* on page 183
Task Stop Ready	A task is blocked or suspended.	*SEGGER_SYSVIEW_OnTaskStopReady* on page 186
Task Stop Exec	A task terminates.	*SEGGER_SYSVIEW_OnTaskStopExec* on page 185
System Idle	No task is executing, the system goes into Idle state.	*SEGGER_SYSVIEW_OnIdle* on page 181

6.1.1.1 Task Create

A new task is created.

Task Create events happen when a task is created by the system.

On Task Create events call `SEGGER_SYSVIEW_OnTaskCreate()` with the Id of the new task. Additionally it is recommended to record the task information of the new task with `SEGGER_SYSVIEW_SendTaskInfo()`.

Example

```
void OS_CreateTask(TaskFunc* pF, unsigned Prio, const char* sName, void* pStack) {
  SEGGER_SYSVIEW_TASKINFO Info;
  OS_TASK*                pTask;  // Pseudo struct to be replaced

  [OS specific code ...]

  SEGGER_SYSVIEW_OnTaskCreate((unsigned)pTask);
  memset(&Info, 0, sizeof(Info));
  //
  // Fill elements with current task information
  //
  Info.TaskID     = (U32)pTask;
  Info.sName      = pTask->Name;
  Info.Prio       = pTask->Priority;
  Info.StackBase  = (U32)pTask->pStack;
  Info.StackSize  = pTask->StackSize;
  SEGGER_SYSVIEW_SendTaskInfo(&Info);
}
```

6.1.1.2 Task Start Ready

A task is marked as ready to start or resume execution.

Task Start Ready events can for example happen, when the delay time of the task expired, or when a resource the task was waiting for is available, or when an event was triggered.

On Task Start Ready events call `SEGGER_SYSVIEW_OnTaskStartReady()` with the Id of the task which has become ready.

Example

```
int OS_HandleTick(void) {
  int TaskReady = 0;   // Pseudo variable indicating a task is ready

  [OS specific code ...]

  if (TaskReady) {
    SEGGER_SYSVIEW_OnTaskStartReady((unsigned)pTask);
  }
}
```

6.1.1.3 Task Start Exec

A task is activated, it starts or resumes execution.

Task Start Exec events happen when the context is about to be switched to the activated task. This is normally done by the Scheduler when there is a ready task.

On Task Start Exec events call `SEGGER_SYSVIEW_OnTaskStartExec()` with the Id of the task which will execute.

Example

```
void OS_Switch(void) {

  [OS specific code ...]

  //
  // If a task is activated
```



```
  //
  SEGGER_SYSVIEW_OnTaskStartExec((unsigned)pTask);
  //
  // Else no task activated, go into idle state
  //
  SEGGER_SYSVIEW_OnIdle()
}
```

6.1.1.4 Task Stop Ready

A task is blocked or suspended.

Task Stop Ready events happen when a task is suspended or blocked, for example because it delays for a specific time, or when it tries to claim a resource which is in use by another task, or when it waits for an event to happen. When a task is suspended or blocked the Scheduler will activate another task or go into idle state.

On Task Stop Ready events call `SEGGER_SYSVIEW_OnTaskStopReady()` with the Id of the task which is blocked and a ReasonId which can indicate why the task is blocked.

Example

```
void OS_Delay(unsigned NumTicks) {

  [OS specific code ...]

  SEGGER_SYSVIEW_OnTaskStopReady(OS_Global.pCurrentTask, OS_CAUSE_WAITING);
}
```

6.1.1.5 Task Stop Exec

A task terminates.

Task Stop Exec events happen when a task finally stops execution, for example when it has done its job and terminates.

On Task Stop Ready events call `SEGGER_SYSVIEW_OnTaskStopExec()` to record the current task as stopped.

Example

```
void OS_TerminateTask(void) {

  [OS specific code ...]

  SEGGER_SYSVIEW_OnTaskStopExec();
}
```

6.1.1.6 System Idle

No task is executing, the system goes into Idle state.

System Idle events happen, when a task is suspended or stopped and no other task is ready. The system can switch into an idle state to save power, wait for an interrupt or a task to become ready.

In some OSes Idle is handled by an additional task. In this case it is recommended to record System Idle events, when the Idle task is activated, too.

Time spent in Idle state is displayed as not CPU Load in SystemView.

On System Idle events call `SEGGER_SYSVIEW_OnIdle()`.

Example

```
void OS_Switch(void) {

  [OS specific code ...]

  //
  // If a task is activated
  //
  SEGGER_SYSVIEW_OnTaskStartExec((unsigned)pTask);
  //
  // Else no task activated, go into idle state
  //
  SEGGER_SYSVIEW_OnIdle()
}
```

6.1.2 Recording interrupts

SystemView can record entering and leaving interrupt service routines (ISRs). The SystemView API provides functions for these events which should be added to the OS when it provides functions to mark interrupt execution.

When the OS scheduler is controlled by interrupts, for example the SysTick interrupt, the exit interrupt event should distinguish between resuming normal execution or switching into the scheduler, and call the appropriate SystemView function.

6.1.2.1 Enter Interrupt

When the OS provides a function to inform the OS that interrupt code is executing, to be called at the start of an Interrupt Service Routine (ISR), the OS function should call `SEGGER_SYSVIEW_RecordEnterISR()` to record the Enter Interrupt event.

When the OS does not provide an enter interrupt function, or the ISR does not call it, it is the user's responsibility to call `SEGGER_SYSVIEW_RecordEnterISR()` to be able to record interrupt execution.

`SEGGER_SYSVIEW_RecordEnterISR()` automatically retrieves the interrupt ID via the `SEGGER_SYSVIEW_GET_INTERRUPT_ID()` function macro as defined in `SEGGER_SYSVIEW_Conf.h`.

Example

```
void OS_EnterInterrupt(void) {

  [OS specific code ...]

  SEGGER_SYSVIEW_RecordEnterISR();
}
```

6.1.2.2 Exit Interrupt

When the OS provides a function to inform the OS that interrupt code has executed, to be called at the and of an Interrupt Service Routine (ISR), the OS function should call:

- `SEGGER_SYSVIEW_RecordExitISR()` when the system will resume normal execution.
- `SEGGER_SYSVIEW_RecordExitISRToScheduler()` when the interrupt caused a context switch.

Example

```
void OS_ExitInterrupt(void) {

  [OS specific code ...]
  //
  // If the interrupt will switch to the Scheduler
```

```
  //
  SEGGER_SYSVIEW_RecordExitISRToScheduler();
  //
  // Otherwise
  //
  SEGGER_SYSVIEW_RecordExitISR();
}
```

6.1.2.3 Example ISRs

The following two examples show how to record interrupt execution with SystemView with OS interrupt handling and without.

Example with OS handling

```
void Timer_Handler(void) {
  //
  // Inform OS about start of interrupt execution
  // (records SystemView Enter Interrupt event).
  //
  OS_EnterInterrupt();
  //
  // Interrupt functionality could be here
  //
  APP_TimerCnt++;
  //
  // Inform OS about end of interrupt execution
  // (records SystemView Exit Interrupt event).
  //
  OS_ExitInterrupt();
}
```

Example without OS handling

```
void ADC_Handler(void) {
  //
  // Explicitly record SystemView Enter Interrupt event.
  // Should not be called in high-frequency interrupts.
  //
  SEGGER_SYSVIEW_RecordEnterISR();
  //
  // Interrupt functionality could be here
  //
  APP_ADCValue = ADC.Value;
  //
  // Explicitly record SystemView Exit Interrupt event.
  // Should not be called in high-frequency interrupts.
  //
  SEGGER_SYSVIEW_RecordExitISR();
}
```

6.1.3 Recording run-time information

SystemView can record more detailed run-time information like the system time and information about tasks. These information are recorded when the recording is started and periodically requested when SystemView is running.

To request the information a `SEGGER_SYSVIEW_OS_API` struct with the OS-specific functions as callbacks can be passed to SystemView upon initialization.

Setting the `SEGGER_SYSVIEW_OS_API` is optional, but is recommended to allow SystemView to display more detailed information.

SEGGER_SYSVIEW_OS_API

```
typedef struct {
  U64  (*pfGetTime)      (void);
  void (*pfSendTaskList) (void);
} SEGGER_SYSVIEW_OS_API;
```

Parameters

Parameter	Description
pfGetTime	Pointer to a function returning the system time.
pfSendTaskList	Pointer to a function recording the entire task list.

6.1.3.1 pfGetTime

Description

Get the system time, i.e. the time since starting the system, in microseconds.

If pfGetTime is NULL SystemView can show timestamps relative to the start of recording only.

Prototype

```
U64 (*pfGetTime) (void);
```

6.1.3.2 pfSendTaskList

Description

Record the entire task list via SEGGER_SYSVIEW_SendTaskInfo().

If pfSendTaskList is NULL SystemView might only get task information of tasks which are newly created while recording. pfSendTaskList is called on start of a recording when the SystemView Application connects to get all information on the current task list.

Prototype

```
void (*pfSendTaskList) (void);
```

Example

```
void cbSendTaskList(void) {
  SEGGER_SYSVIEW_TASKINFO Info;
  OS_TASK*                pTask;

  OS_EnterRegion(); // Disable scheduling to make sure the task list does not change.
  for (pTask = OS_Global.pTask; pTask; pTask = pTask->pNext) {
    //
    // Fill all elements with 0 to allow extending the structure
    // in future version without breaking the code.
    //
    memset(&Info, 0, sizeof(Info));
    //
    // Fill elements with current task information
    //
    Info.TaskID     = (U32)pTask;
    Info.sName      = pTask->Name;
    Info.Prio       = pTask->Priority;
    Info.StackBase  = (U32)pTask->pStackBot;
    Info.StackSize  = pTask->StackSize;
    //
```

```
    // Record current task information
    //
    SEGGER_SYSVIEW_SendTaskInfo(&Info);
  }
  OS_LeaveRegion(); // Enable scheduling again.
}
```

6.1.4 Recording OS API calls

In addition to the OS core instrumentation, SystemView can record OS API calls which are done from the application. API functions can be instrumented like the OS core.

Recording API events with SystemView can be done with the ready-to-use `SEGGER_SYSVIEW_RecordXXX()` functions when passing simple parameters, or by using the appropriate `SEGGER_SYSVIEW_EncodeXXX()` functions to create a SystemView event and calling `SEGGER_SYSVIEW_SendPacket()` to record it.

Example

```
/*********************************************************************
*
*       OS_malloc()
*
*  Function description
*    API function to allocate memory on the heap.
*/
void OS_malloc(unsigned Size) {
  SEGGER_SYSVIEW_RecordU32(ID_OS_MALLOC,  // Id of OS_malloc (>= 32)
                           Size           // First parameter
                          );

  [OS specific code...]
}
```

To record how long the execution of an API function takes and to record its return value, the return of an API function can be instrumented, too by calling `SEGGER_SYSVIEW_RecordEndCall` to only record the return or `SEGGER_SYSVIEW_RecordEndCallReturnValue` to record the return and its return value.

6.1.5 OS description file

In order for SystemView to properly decode API calls it requires a description file to be present in the `/description/` directory of SystemView. The name of the file has to be `SYSVIEW_<OSName>.txt` where `<OSName>` is the name as sent in the system description.

6.1.5.1 API Function description

A description file includes all API functions which can be recorded by the OS. Each line in the file is one function in the following format:

```
<EventID> <FunctionName> <ParameterDescription> | <ReturnValueDescription>
```

`<EventId>` is the Id which is recorded for the API function. It can be in the range of 32 to 511.

`<FunctionName>` is the name of the API function, displayed in the Event column of SystemView. It may not contain spaces.

`<ParameterDescription>` is the description string of the parameters which are recorded with the API function.

`<ReturnValueDescription>` is the description string of the return value which can be recorded with SystemView. The ReturnValueDescription is optional.

The parameter display can be configured by a set of modifiers:

- %b - Display parameter as binary.
- %B - Display parameter as hexadecimal string (e.g. 00 AA FF ...).
- %d - Display parameter as signed decimal integer.
- %D - Display parameter as time value.
- %I - Display parameter as a resource name if the resource id is known to SystemView.
- %p - Display parameter as 4 byte hexadecimal integer (e.g. 0xAABBCCDD).
- %s - Display parameter as string.
- %t - Display parameter as a task name if the task id is known to SystemView.
- %u - Display parameter as unsigned decimal integer.
- %x - Display parameter as hexadecimal integer.

Example

The following example shows a part of SYSVIEW_embOS.txt

```
35        OS_CheckTimer             pGlobal=%p
42        OS_Delay                  Delay=%u
43        OS_DelayUntil             Time=%u
44        OS_setPriority            Task=%t Pri=%u
45        OS_WakeTask               Task=%t
46        OS_CreateTask             Task=%t Pri=%u Stack=%p Size=%u
```

In addition to the default modifiers the description file can define NamedTypes to map numerical values to strings, which can for example be useful to display the textual value of enums or error codes.

NamedTypes have following format:

```
NamedType <TypeName> <Key>=<Value> [<Key1>=<Value1> ...]
```

NamedTypes can be used in the ParameterDescription and the ReturnValueDescription.

Example

```
#
# Types for parameter formatters
#
NamedType OSErr 0=OS_ERR_NONE
NamedType OSErr 10000=OS_ERR_A 10001=OS_ERR_ACCEPT_ISR
NamedType OSErr 12000=OS_ERR_C 12001=OS_ERR_CREATE_ISR
NamedType OSErr 13000=OS_ERR_D 13001=OS_ERR_DEL_ISR

NamedType OSFlag 0=FLAG_NONE 1=FLAG_READ 2=FLAG_WRITE 3=FLAG_READ_WRITE
#
# API Functions
#
34     OSFunc Param=%OSFlag | Returns %OSErr
```

6.1.5.2 Task State description

When a task pauses execution its state is recorded in the SystemView event.

This task state can be converted to a textual representation in SystemView with the TaskState desctiption.

TaskState has following format:

```
TaskState <Mask> <Key>=<Value>, [<Key1>=<Value1>, ...]
```

Example

```
#
```



```
# Task States
#
TaskState 0xFF 0=Ready, 1=Delayed or Timeout, 2=Pending, 3=Pending with Timeout,
 4=Suspended, 5=Suspended with Timeout, 6=Suspended and Pending, 7=Suspended and
 Pending with Timeout, 255=Deleted
```

6.1.5.3 Preempting Task State description

The PreemptingTaskStates contain the TaskStates which indicate a preemptive task switch. The information is used to accurately calculate the blocked time of each task.

PreemptingTaskStates has following format:

```
PreemptingTaskStates <TaskState>, [<TaskState>, ...]
```

Example

```
#
# Preempting Task States
#
PreemptingTaskStates 0
```

6.1.5.4 Option description

OS-Specific options can also be set in the description file to configure SystemView.

Currently available options to be inserted in the description files are:

`Option ReversePriority`: Higher task priority value equals lower task priority.

6.1.6 OS integration sample

The code below shows where to integrate SystemView in an OS based on pseudo-code snippets and can be used as reference.

```
/*********************************************************************
*            (c) 1995 - 2018 SEGGER Microcontroller GmbH             *
*                        The Embedded Experts                        *
*                           www.segger.com                           *
**********************************************************************
-------------------------- END-OF-HEADER -----------------------------

Purpose : Pseudo-code OS with SEGGER SystemView integration.
*/

/*********************************************************************
*
*       OS_CreateTask()
*
*  Function description
*    Create a new task and add it to the system.
*/
void OS_CreateTask(TaskFunc* pF, unsigned Prio, const char* sName, void* pStack) {
  SEGGER_SYSVIEW_TASKINFO Info;
  OS_TASK*                pTask;  // Pseudo struct to be replaced

  [OS specific code ...]

  SEGGER_SYSVIEW_OnTaskCreate((unsigned)pTask);
  memset(&Info, 0, sizeof(Info));
  //
  // Fill elements with current task information
  //
  Info.TaskID     = (U32)pTask;
  Info.sName      = pTask->Name;
```

```
  Info.Prio       = pTask->Priority;
  Info.StackBase  = (U32)pTask->pStack;
  Info.StackSize  = pTask->StackSize;
  SEGGER_SYSVIEW_SendTaskInfo(&Info);
}

/*********************************************************************
*
*       OS_TerminateTask()
*
*  Function description
*    Terminate a task and remove it from the system.
*/
void OS_TerminateTask(void) {

  [OS specific code ...]

  SEGGER_SYSVIEW_OnTaskStopExec();
}

/*********************************************************************
*
*       OS_Delay()
*
*  Function description
*    Delay and suspend a task for the given time.
*/
void OS_Delay(unsigned NumTicks) {

  [OS specific code ...]

  SEGGER_SYSVIEW_OnTaskStopReady(OS_Global.pCurrentTask, OS_CAUSE_WAITING);
}

/*********************************************************************
*
*       OS_HandleTick()
*
*  Function description
*    OS System Tick handler.
*/
int OS_HandleTick(void) {
  int TaskReady = 0;   // Pseudo variable indicating a task is ready

  [OS specific code ...]

  if (TaskReady) {
    SEGGER_SYSVIEW_OnTaskStartReady((unsigned)pTask);
  }
}

/*********************************************************************
*
*       OS_Switch()
*
*  Function description
*    Switch to the next ready task or go to idle.
*/
void OS_Switch(void) {

  [OS specific code ...]

  //
  // If a task is activated
  //
  SEGGER_SYSVIEW_OnTaskStartExec((unsigned)pTask);
  //
  // Else no task activated, go into idle state
```

```
  //
  SEGGER_SYSVIEW_OnIdle()
}

/*********************************************************************
*
*       OS_EnterInterrupt()
*
*  Function description
*    Inform the OS about start of interrupt execution.
*/
void OS_EnterInterrupt(void) {

  [OS specific code ...]

  SEGGER_SYSVIEW_RecordEnterISR();
}

/*********************************************************************
*
*       OS_ExitInterrupt()
*
*  Function description
*    Inform the OS about end of interrupt execution and switch to
*    Scheduler if necessary.
*/
void OS_ExitInterrupt(void) {

  [OS specific code ...]
  //
  // If the interrupt will switch to the Scheduler
  //
  SEGGER_SYSVIEW_RecordExitISRToScheduler();
  //
  // Otherwise
  //
  SEGGER_SYSVIEW_RecordExitISR();
}
```


6.2 Integrating SEGGER SystemView into a middleware module

SEGGER SystemView can also be integrated into middleware modules or even application modules to get information about execution of these modules, like API calls or interrupt-triggered events. This integration is for example used in SEGGER embOS/IP to monitor sending and receiving packets via IP and SEGGER emFile to record API calls.

For integration into other modules, contact your distributor or do the integration following the instructions in this section.

6.2.1 Registering the module

To be able to record middleware module events, the module has to register at SystemView via `SEGGER_SYSVIEW_RegisterModule()`.

The module passes a `SEGGER_SYSVIEW_MODULE` struct pointer, which contains information about the module and receives the event offset for the event Ids the module can generate.

`sDescription` and `NumEvents` have to be set in the `SEGGER_SYSVIEW_MODULE` struct when registering. Optionally `pfSendModuleDesc` can be set, too.

Upon return of `SEGGER_SYSVIEW_RegisterModule()`, `EventOffset` of the `SEGGER_SYSVIEW_MODULE` struct is set to the lowest event Id the module may generate, and `pNext` is set to point to the next registered module to create a linked list. Because of this, the `SEGGER_SYSVIEW_MODULE` struct has to be writeable and may not be allocated on the stack.

SEGGER_SYSVIEW_MODULE

```
struct SEGGER_SYSVIEW_MODULE {
  const char*                         sModule;
        U32                           NumEvents;
        U32                           EventOffset;
        void                          (*pfSendModuleDesc)(void);
        SEGGER_SYSVIEW_MODULE*        pNext;
};
```

Parameters

Parameter	Description
sModule	Pointer to a string containing the module name and optionally the module event description.
NumEvents	Number of events the module wants to register.
EventOffset	Offset to be added to the event Ids. Out parameter, set by this function. Do not modify after calling this function.
pfSendModuleDesc	Callback function pointer to send more detailed module description to SystemView.
pNext	Pointer to next registered module. Out parameter, set by this function. Do not modify after calling this function.

Example

```
SEGGER_SYSVIEW_MODULE IPModule = {
  "M=embOSIP, " \
  "0 SendPacket IFace=%u NumBytes=%u, " \
  "1 ReceivePacket Iface=%d NumBytes=%u", // sModule
  2,                                      // NumEvents
  0,
  // EventOffset, Set by SEGGER_SYSVIEW_RegisterModule()
  NULL,
  // pfSendModuleDesc, NULL: No additional module description
```



```
  NULL,
  // pNext, Set by SEGGER_SYSVIEW_RegisterModule()
};

static void _IPTraceConfig(void) {
  //
  // Register embOS/IP at SystemView.
  // SystemView has to be initialized before.
  //
  SEGGER_SYSVIEW_RegisterModule(&IPModule);
}
```

6.2.2 Recording module activity

In order to be able to record module activity, the module has to be instrumented to generate SystemView events in the appropriate functions.

Instrumenting a module can be done by integrating the SystemView functions directly, via configurable macro functions or with an API structure which can be filled and set by SystemView.

Recording events with SystemView can be done with the ready-to-use `SEGGER_SYSVIEW_RecordXXX()` functions when passing simple parameters, or by using the appropriate `SEGGER_SYSVIEW_EncodeXXX()` functions to create a SystemView event and calling `SEGGER_SYSVIEW_SendPacket()` to record it.

Example

```
int SendPacket(IP_PACKET *pPacket) {
  //
  // The IP stack sends a packet.
  // Record it according to the module description of SendPacket.
  //
  SEGGER_SYSVIEW_RecordU32x2(
  // Id of SendPacket (0) + Offset for the registered module
                             ID_SENDPACKET + IPModule.EventOffset,
  // First parameter  (displayed as event parameter IFace)
                             pPacket->Interface,
  // Second parameter (displayed as event parameter NumBytes)
                             pPacket->NumBytes
                            );

  [Module specific code...]
}
```

For more information refer to *Recording OS API calls* on page 131 and the *API reference* on page 139.

As with OSes, the middleware module description can be made available in a description file with the name of the module (Value of M=). Refer to *OS description file* on page 131.

6.2.3 Providing the module description

`SEGGER_SYSVIEW_MODULE.sModule` points to a string which contains the basic information of the registered module, which is a comma-separated list and can contain following items:

Item	Identifier	Example
Module name	M	"M=embOSIP"
Module token	T	"T=IP"
Description	S	"S='embOS/IP V12.09'"
Module event	<ID> <Event> <Parameter>	"0 SendPacket IFace=%u NumBytes=%u"

The string length may not exceed SEGGER_SYSVIEW_MAX_STRING_LEN which is 128 by default.

To send additional description strings and to send the name of resources which are used and recorded by the module, SEGGER_SYSVIEW_MODULE.pfSendModuleDesc can be set when registering the module.

SEGGER_SYSVIEW_MODULE.pfSendModuleDesc is called periodically when SystemView is connected. It can call SEGGER_SYSVIEW_RecordModuleDescription() and SEGGER_SYSVIEW_NameResource().

Example

```
static void _cbSendIPModuleDesc(void) {
  SEGGER_SYSVIEW_NameResource((U32)&(RxPacketFifo), "Rx FIFO");
  SEGGER_SYSVIEW_NameResource((U32)&(TxPacketFifo), "Tx FIFO");
  SEGGER_SYSVIEW_RecordModuleDescription(&IPModule, "T=IP, S='embOS/IP V12.09'");
}

SEGGER_SYSVIEW_MODULE IPModule = {
  "M=embOSIP, " \
  "0 SendPacket IFace=%u NumBytes=%u, " \
  "1 ReceivePacket Iface=%d NumBytes=%u", // sModule
  2,                                       // NumEvents
  0,                                       // EventOffset, Set by RegisterModule()
  _cbSendIPModuleDesc,                     // pfSendModuleDesc
  NULL,                                    // pNext, Set by RegisterModule()
};
```

Chapter 7

API reference

This section describes the public API of SEGGER SystemView.

7.1 Formatted output control strings

The functions in this section that accept a formatted output control string do so according to the specification that follows *for target formatting*.

7.1.1 Composition

The format is composed of zero or more directives: ordinary characters (not `%`, which are copied unchanged to the output stream; and conversion specifications, each of which results in fetching zero or more subsequent arguments, converting them, if applicable, according to the corresponding conversion specifier, and then writing the result to the output stream.

Each conversion specification is introduced by the character `%`. After the `%` the following appear in sequence:

- Zero or more *flags* (in any order) that modify the meaning of the conversion specification.
- An optional *minimum field width*. If the converted value has fewer characters than the field width, it is padded with spaces (by default) on the left (or right, if the left adjustment flag has been given) to the field width. The field width takes the form of an asterisk `*` or a decimal integer.
- An optional precision that gives the minimum number of digits to appear for the `d`, `u`, `x`, and `X` conversions. The precision takes the form of a period `.` followed an optional decimal integer; if only the period is specified, the precision is taken as zero. If a precision appears with any other conversion specifier, the behavior is undefined.
- A conversion specifier character that specifies the type of conversion to be applied.

7.1.2 Flag characters

The flag characters and their meanings are:

Flag	Description
`-`	The result of the conversion is left-justified within the field. The default, if this flag is not specified, is that the result of the conversion is left-justified within the field.
`+`	The result of a signed conversion *always* begins with a plus or minus sign. The default, if this flag is not specified, is that it begins with a sign only when a negative value is converted.
`0`	For `d`, `u`, `x`, and `X`, leading zeros (following any indication of sign or base) are used to pad to the field width rather than performing space padding. If the `0` and `-` flags both appear, the `0` flag is ignored. For `d`, `u`, `x`, and `X` conversions, if a precision is specified, the `0` flag is ignored. For other conversions, the behavior is undefined.

7.1.3 Length modifiers

The length modifiers `h` and `l` are both ignored.

7.1.4 Conversion specifiers

The conversion specifiers and their meanings are:

Flag	Description
`d`	The argument is converted to signed decimal in the style `[-]`*dddd*. The precision specifies the minimum number of digits to appear; if the value being converted can be represented in fewer digits, it is expanded with leading spaces. The default precision is one. The result of converting a zero value with a precision of zero is no characters.

Flag	Description
u, x, X	The unsigned argument is converted to unsigned octal for o, unsigned decimal for u, or unsigned hexadecimal notation for x or X in the style *dddd* the letters abcdef are used for x conversion and the letters ABCDEF for X conversion. The precision specifies the minimum number of digits to appear; if the value being converted can be represented in fewer digits, it is expanded with leading spaces. The default precision is one. The result of converting a zero value with a precision of zero is no characters.
c	The argument is converted to an unsigned char, and the resulting character is written.
s	The s specifier is not supported.
p	The argument is a pointer to void. The value of the pointer is converted in the same format as the x conversion specifier with a fixed precision of 2*sizeof(void *).
%	A % character is written. No argument is converted.

7.2 Control functions

Control functions to be called by the application.

Function	Description
SEGGER_SYSVIEW_Init()	Initializes the SYSVIEW module.
SEGGER_SYSVIEW_Start()	Start recording SystemView events.
SEGGER_SYSVIEW_Stop()	Stop recording SystemView events.
SEGGER_SYSVIEW_IsStarted()	Handle incoming packets if any and check if recording is started.
SEGGER_SYSVIEW_EnableEvents()	Enable standard SystemView events to be generated.
SEGGER_SYSVIEW_DisableEvents()	Disable standard SystemView events to not be generated.

7.2.1 SEGGER_SYSVIEW_Init()

Description

Initializes the SYSVIEW module. Must be called before the SystemView Application connects to the system.

Prototype

```
void SEGGER_SYSVIEW_Init(      U32                                  SysFreq,
                               U32                                  CPUFreq,
                         const SEGGER_SYSVIEW_OS_API              * pOSAPI,
                               SEGGER_SYSVIEW_SEND_SYS_DESC_FUNC    pfSendSysDesc);
```

Parameters

Parameter	Description
SysFreq	Frequency of timestamp, usually CPU core clock frequency.
CPUFreq	CPU core clock frequency.
pOSAPI	Pointer to the API structure for OS-specific functions.
pfSendSysDesc	Pointer to record system description callback function.

Additional information

This function initializes the RTT channel used to transport SEGGER SystemView packets. The channel is assigned the label "SysView" for client software to identify the SystemView channel.

The channel is configured with the macro `SEGGER_SYSVIEW_RTT_CHANNEL`.

7.2.2 SEGGER_SYSVIEW_Start()

Description

Start recording SystemView events.

This function is triggered by the SystemView Application on connect. For single-shot or post-mortem mode recording, it needs to be called by the application.

Prototype

```
void SEGGER_SYSVIEW_Start(void);
```

Additional information

This function enables transmission of SystemView packets recorded by subsequent trace calls and records a SystemView Start event.

As part of start, a SystemView Init packet is sent, containing the system frequency. The list of current tasks, the current system time and the system description string is sent, too.

7.2.3 SEGGER_SYSVIEW_Stop()

Description

Stop recording SystemView events.

This function is triggered by the SystemView Application on disconnect. For single-shot or postmortem mode recording, it can be called by the application.

Prototype

```
void SEGGER_SYSVIEW_Stop(void);
```

Additional information

This function disables transmission of SystemView packets recorded by subsequent trace calls. If transmission is enabled when this function is called, a single SystemView Stop event is recorded to the trace, send, and then trace transmission is halted.

7.2.4 SEGGER_SYSVIEW_IsStarted()

Description

Handle incoming packets if any and check if recording is started.

Prototype

```
int SEGGER_SYSVIEW_IsStarted(void);
```

Return value

0: Recording not started.

> 0	Recording started.

7.2.5 SEGGER_SYSVIEW_EnableEvents()

Description

Enable standard SystemView events to be generated.

Prototype

```
void SEGGER_SYSVIEW_EnableEvents(U32 EnableMask);
```

Parameters

Parameter	Description
EnableMask	Events to be enabled.

7.2.6 SEGGER_SYSVIEW_DisableEvents()

Description

Disable standard SystemView events to not be generated.

Prototype

```
void SEGGER_SYSVIEW_DisableEvents(U32 DisableMask);
```

Parameters

Parameter	Description
DisableMask	Events to be disabled.

7.3 Configuration functions

Configuration functions to be called by the application system. Usually included in the system callback functions.

Function	Description
SEGGER_SYSVIEW_SetRAMBase()	Sets the RAM base address, which is subtracted from IDs in order to save bandwidth.
SEGGER_SYSVIEW_SendTaskList()	Send all tasks descriptors to the host.
SEGGER_SYSVIEW_SendTaskInfo()	Send a Task Info Packet, containing TaskId for identification, task priority and task name.
SEGGER_SYSVIEW_SendStackInfo()	Send a Stack Info Packet, containing TaskId for identification, stack base, stack size and stack usage.
SEGGER_SYSVIEW_SendSysDesc()	Send the system description string to the host.
SEGGER_SYSVIEW_SendPacket()	Send an event packet.

7.3.1 SEGGER_SYSVIEW_SetRAMBase()

Description

Sets the RAM base address, which is subtracted from IDs in order to save bandwidth.

Prototype

```
void SEGGER_SYSVIEW_SetRAMBase(U32 RAMBaseAddress);
```

Parameters

Parameter	Description
RAMBaseAddress	Lowest RAM Address. (i.e. 0x20000000 on most Cortex-M)

7.3.2 SEGGER_SYSVIEW_SendTaskInfo()

Description

Send a Task Info Packet, containing TaskId for identification, task priority and task name.

Prototype

```
void SEGGER_SYSVIEW_SendTaskInfo(const SEGGER_SYSVIEW_TASKINFO * pInfo);
```

Parameters

Parameter	Description
pInfo	Pointer to task information to send.

7.3.3 SEGGER_SYSVIEW_SendStackInfo()

Description

Send a Stack Info Packet, containing TaskId for identification, stack base, stack size and stack usage.

Prototype

```
void SEGGER_SYSVIEW_SendStackInfo(const SEGGER_SYSVIEW_STACKINFO * pInfo);
```

Parameters

Parameter	Description
pInfo	Pointer to stack information to send.

7.3.4 SEGGER_SYSVIEW_SendTaskList()

Description

Send all tasks descriptors to the host.

Prototype

```
void SEGGER_SYSVIEW_SendTaskList(void);
```


7.3.5 SEGGER_SYSVIEW_SendSysDesc()

Description

Send the system description string to the host. The system description is used by the SystemView Application to identify the current application and handle events accordingly.

The system description is usually called by the system description callback, to ensure it is only sent when the SystemView Application is connected.

Prototype

```
void SEGGER_SYSVIEW_SendSysDesc(const char * sSysDesc);
```

Parameters

Parameter	Description
sSysDesc	Pointer to the 0-terminated system description string.

Additional information

One system description string may not exceed SEGGER_SYSVIEW_MAX_STRING_LEN characters. Multiple description strings can be recorded.

The Following items can be described in a system description string. Each item is identified by its identifier, followed by '=' and the value. Items are separated by ','.

Item	Identifier	Example
Application name	N	"N=Test Application"
Operating system	O	"O=embOS"
Additional module	M	"M=embOS/IP"
Target device	D	"D=MK66FN2M0xxx18"
Target core	C	"C=Cortex-M4"
Interrupt	I#<InterruptID>	"I#15=SysTick"

Example strings

- N=Test Application,O=embOS,D=MK66FN2M0xxx18
- I#15=SysTick,I#99=ETH_Tx,I#100=ETH_Rx

7.3.6 SEGGER_SYSVIEW_SendModule()

Description

Sends the information of a registered module to the host.

Prototype

```
void SEGGER_SYSVIEW_SendModule(U8 ModuleId);
```

Parameters

Parameter	Description
ModuleId	Id of the requested module.

7.3.7 SEGGER_SYSVIEW_SendModuleDescription()

Description

Triggers a send of the registered module descriptions.

Prototype

```
void SEGGER_SYSVIEW_SendModuleDescription(void);
```


7.3.8 SEGGER_SYSVIEW_SendNumModules()

Description

Send the number of registered modules to the host.

Prototype

```
void SEGGER_SYSVIEW_SendNumModules(void);
```

7.4 Application-level event recording functions

User event recording functions to be called in the user application.

Function	Description
Markers	
SEGGER_SYSVIEW_MarkStart()	Record a Performance Marker Start event to start measuring runtime.
SEGGER_SYSVIEW_Mark()	Record a Performance Marker intermediate event.
SEGGER_SYSVIEW_MarkStop()	Record a Performance Marker Stop event to stop measuring runtime.
Resources	
SEGGER_SYSVIEW_NameResource()	Send the name of a resource to be displayed in SystemView.
Data plot	
SEGGER_SYSVIEW_RegisterData()	Register data to sample the values via SystemView.
SEGGER_SYSVIEW_SampleData()	Send a Data Sample Packet, containing the data Id and the value.
Plain output functions	
SEGGER_SYSVIEW_Print()	Print a string to the host.
SEGGER_SYSVIEW_Warn()	Print a warning string to the host.
SEGGER_SYSVIEW_Error()	Print an error string to the host.
Host-based formatting	
SEGGER_SYSVIEW_PrintfHost()	Print a string which is formatted on the host by the SystemView Application.
SEGGER_SYSVIEW_PrintfHostEx()	Print a string which is formatted on the host by the SystemView Application with Additional information.
SEGGER_SYSVIEW_WarnfHost()	Print a warning string which is formatted on the host by the SystemView Application.
SEGGER_SYSVIEW_ErrorfHost()	Print an error string which is formatted on the host by the SystemView Application.
Target-based formatting	
SEGGER_SYSVIEW_PrintfTarget()	Print a string which is formatted on the target before sent to the host.
SEGGER_SYSVIEW_PrintfTargetEx()	Print a string which is formatted on the target before sent to the host with Additional information.
SEGGER_SYSVIEW_WarnfTarget()	Print a warning string which is formatted on the target before sent to the host.
SEGGER_SYSVIEW_ErrorfTarget()	Print an error string which is formatted on the target before sent to the host.

7.4.1 SEGGER_SYSVIEW_MarkStart()

Description

Record a Performance Marker Start event to start measuring runtime.

Prototype

```
void SEGGER_SYSVIEW_MarkStart(unsigned MarkerId);
```

Parameters

Parameter	Description
MarkerId	User defined ID for the marker.

7.4.2 SEGGER_SYSVIEW_Mark()

Description

Record a Performance Marker intermediate event.

Prototype

```
void SEGGER_SYSVIEW_Mark(unsigned int MarkerId);
```

Parameters

Parameter	Description
MarkerId	User defined ID for the marker.

7.4.3 SEGGER_SYSVIEW_MarkStop()

Description

Record a Performance Marker Stop event to stop measuring runtime.

Prototype

```
void SEGGER_SYSVIEW_MarkStop(unsigned MarkerId);
```

Parameters

Parameter	Description
MarkerId	User defined ID for the marker.

7.4.4 SEGGER_SYSVIEW_NameMarker()

Description

Send the name of a Performance Marker to be displayed in SystemView.

Marker names are usually set in the system description callback, to ensure it is only sent when the SystemView Application is connected.

Prototype

```
void SEGGER_SYSVIEW_NameMarker(      unsigned int   MarkerId,
                              const char         * sName);
```

Parameters

Parameter	Description
MarkerId	User defined ID for the marker.
sName	Pointer to the marker name. (Max. SEGGER_SYSVIEW_MAX_STRING_LEN Bytes)

7.4.5 SEGGER_SYSVIEW_NameResource()

Description

Send the name of a resource to be displayed in SystemView.

Marker names are usually set in the system description callback, to ensure it is only sent when the SystemView Application is connected.

Prototype

```
void SEGGER_SYSVIEW_NameResource(      U32    ResourceId,
                                 const char * sName);
```

Parameters

Parameter	Description
ResourceId	Id of the resource to be named. i.e. its address.
sName	Pointer to the resource name. (Max. SEGGER_SYSVIEW_MAX_STRING_LEN Bytes)

7.4.6 SEGGER_SYSVIEW_RegisterData()

Description

Register data to sample the values via SystemView.

Register functions are usually set in the system description callback, to ensure it is only sent when the SystemView Application is connected.

Prototype

```
void SEGGER_SYSVIEW_RegisterData(SEGGER_SYSVIEW_DATA_REGISTER * pInfo);
```

Parameters

Parameter	Description
pInfo	Struct containing all possible properties that can be sent via this registration event.

7.4.7 SEGGER_SYSVIEW_SampleData()

Description

Send a Data Sample Packet, containing the data Id and the value.

Prototype

```
void SEGGER_SYSVIEW_SampleData(const SEGGER_SYSVIEW_DATA_SAMPLE * pInfo);
```

Parameters

Parameter	Description
pInfo	Pointer to data sample struct to send.

7.4.8 SEGGER_SYSVIEW_Print()

Description

Print a string to the host.

Prototype

```
void SEGGER_SYSVIEW_Print(const char * s);
```

Parameters

Parameter	Description
s	String to sent.

7.4.9 SEGGER_SYSVIEW_PrintfHost()

Description

Print a string which is formatted on the host by the SystemView Application.

Prototype

```
void SEGGER_SYSVIEW_PrintfHost(const char * s,
                                             ...);
```

Parameters

Parameter	Description
s	String to be formatted.

Additional information

All format arguments are treated as 32-bit scalar values.

7.4.10 SEGGER_SYSVIEW_PrintfHostEx()

Description

Print a string which is formatted on the host by the SystemView Application with Additional information.

Prototype

```
void SEGGER_SYSVIEW_PrintfHostEx(const char * s,
                                       U32    Options,
                                              ...);
```

Parameters

Parameter	Description
s	String to be formatted.
Options	Options for the string. i.e. Log level.

Additional information

All format arguments are treated as 32-bit scalar values.

7.4.11 SEGGER_SYSVIEW_PrintfTarget()

Description

Print a string which is formatted on the target before sent to the host.

Prototype

```
void SEGGER_SYSVIEW_PrintfTarget(const char * s,
                                              ...);
```

Parameters

Parameter	Description
s	String to be formatted.

7.4.12 SEGGER_SYSVIEW_PrintfTargetEx()

Description

Print a string which is formatted on the target before sent to the host with Additional information.

Prototype

```
void SEGGER_SYSVIEW_PrintfTargetEx(const char * s,
                                         U32      Options,
                                                  ...);
```

Parameters

Parameter	Description
s	String to be formatted.
Options	Options for the string. i.e. Log level.

7.4.13 SEGGER_SYSVIEW_Warn()

Description

Print a warning string to the host.

Prototype

```
void SEGGER_SYSVIEW_Warn(const char * s);
```

Parameters

Parameter	Description
s	String to sent.

7.4.14 SEGGER_SYSVIEW_WarnfHost()

Description

Print a warning string which is formatted on the host by the SystemView Application.

Prototype

```
void SEGGER_SYSVIEW_WarnfHost(const char * s,
                                            ...);
```

Parameters

Parameter	Description
s	String to be formatted.

Additional information

All format arguments are treated as 32-bit scalar values.

7.4.15 SEGGER_SYSVIEW_WarnfTarget()

Description

Print a warning string which is formatted on the target before sent to the host.

Prototype

```
void SEGGER_SYSVIEW_WarnfTarget(const char * s,
                                            ...);
```

Parameters

Parameter	Description
s	String to be formatted.

7.4.16 SEGGER_SYSVIEW_Error()

Description

Print an error string to the host.

Prototype

```
void SEGGER_SYSVIEW_Error(const char * s);
```

Parameters

Parameter	Description
s	String to sent.

7.4.17 SEGGER_SYSVIEW_ErrorfHost()

Description

Print an error string which is formatted on the host by the SystemView Application.

Prototype

```
void SEGGER_SYSVIEW_ErrorfHost(const char * s,
                                            ...);
```

Parameters

Parameter	Description
s	String to be formatted.

Additional information

All format arguments are treated as 32-bit scalar values.

7.4.18 SEGGER_SYSVIEW_ErrorfTarget()

Description

Print an error string which is formatted on the target before sent to the host.

Prototype

```
void SEGGER_SYSVIEW_ErrorfTarget(const char * s,
                                              ...);
```

Parameters

Parameter	Description
s	String to be formatted.

7.5 Module and RTOS object functions

Middleware module registration and configuration functions.

Function	Description
SEGGER_SYSVIEW_RegisterModule()	Register a middleware module for recording its events.
SEGGER_SYSVIEW_RecordModuleDescription()	Sends detailed information of a registered module to the host.

7.5.1 SEGGER_SYSVIEW_RegisterModule()

Description

Register a middleware module for recording its events.

Prototype

```
void SEGGER_SYSVIEW_RegisterModule(SEGGER_SYSVIEW_MODULE * pModule);
```

Parameters

Parameter	Description
pModule	The middleware module information.

Additional information

SEGGER_SYSVIEW_MODULE elements: sDescription - Pointer to a string containing the module name and optionally the module event description. NumEvents - Number of events the module wants to register. EventOffset - Offset to be added to the event Ids. Out parameter, set by this function. Do not modify after calling this function. pfSendModuleDesc - Callback function pointer to send more detailed module description to SystemView Application. pNext - Pointer to next registered module. Out parameter, set by this function. Do not modify after calling this function.

7.5.2 SEGGER_SYSVIEW_RecordModuleDescription()

Description

Sends detailed information of a registered module to the host.

Prototype

```
void SEGGER_SYSVIEW_RecordModuleDescription
                                            (const SEGGER_SYSVIEW_MODULE * pModule,
                                             const char                  * sDescription);
```

Parameters

Parameter	Description
pModule	Pointer to the described module.
sDescription	Pointer to a description string.

7.6 Realtime event recording functions

OS-related event recording functions called by the OS instrumentation.

Function	Description
High-level RTOS state recording	
SEGGER_SYSVIEW_OnIdle()	Record an Idle event.
SEGGER_SYSVIEW_OnTaskCreate()	Record a Task Create event.
SEGGER_SYSVIEW_OnTaskStartExec()	Record a Task Start Execution event.
SEGGER_SYSVIEW_OnTaskStartReady()	Record a Task Start Ready event.
SEGGER_SYSVIEW_OnTaskStopExec()	Record a Task Stop Execution event.
SEGGER_SYSVIEW_OnTaskStopReady()	Record a Task Stop Ready event.
SEGGER_SYSVIEW_OnTaskTerminate()	Record a Task termination event.
Low-level realtime recording	
SEGGER_SYSVIEW_RecordEnterISR()	Format and send an ISR entry event.
SEGGER_SYSVIEW_RecordExitISR()	Format and send an ISR exit event.
SEGGER_SYSVIEW_RecordExitISRToScheduler()	Format and send an ISR exit into scheduler event.
SEGGER_SYSVIEW_RecordEnterTimer()	Format and send a Timer entry event.
SEGGER_SYSVIEW_RecordExitTimer()	Format and send a Timer exit event.
SEGGER_SYSVIEW_RecordSystime()	Formats and sends a SystemView Systime containing a single U64 or U32 parameter payload.

7.6.1 SEGGER_SYSVIEW_OnIdle()

Description

Record an Idle event.

Prototype

```
void SEGGER_SYSVIEW_OnIdle(void);
```


7.6.2 SEGGER_SYSVIEW_OnTaskCreate()

Description

Record a Task Create event. The Task Create event corresponds to creating a task in the OS.

Prototype

```
void SEGGER_SYSVIEW_OnTaskCreate(U32 TaskId);
```

Parameters

Parameter	Description
TaskId	Task ID of created task.

7.6.3 SEGGER_SYSVIEW_OnTaskStartExec()

Description

Record a Task Start Execution event. The Task Start event corresponds to when a task has started to execute rather than when it is ready to execute.

Prototype

```
void SEGGER_SYSVIEW_OnTaskStartExec(U32 TaskId);
```

Parameters

Parameter	Description
TaskId	Task ID of task that started to execute.

7.6.4 SEGGER_SYSVIEW_OnTaskStartReady()

Description

Record a Task Start Ready event.

Prototype

```
void SEGGER_SYSVIEW_OnTaskStartReady(U32 TaskId);
```

Parameters

Parameter	Description
TaskId	Task ID of task that started to execute.

7.6.5 SEGGER_SYSVIEW_OnTaskStopExec()

Description

Record a Task Stop Execution event. The Task Stop event corresponds to when a task stops executing and terminates.

Prototype

```
void SEGGER_SYSVIEW_OnTaskStopExec(void);
```


7.6.6 SEGGER_SYSVIEW_OnTaskStopReady()

Description

Record a Task Stop Ready event.

Prototype

```
void SEGGER_SYSVIEW_OnTaskStopReady(U32          TaskId,
                                    unsigned int Cause);
```

Parameters

Parameter	Description
TaskId	Task ID of task that completed execution.
Cause	Reason for task to stop (i.e. Idle/Sleep)

7.6.7 SEGGER_SYSVIEW_OnTaskTerminate()

Description

Record a Task termination event. The Task termination event corresponds to terminating a task in the OS. If the `TaskId` is the currently active task, `SEGGER_SYSVIEW_OnTaskStopExec` may be used, either.

Prototype

```
void SEGGER_SYSVIEW_OnTaskTerminate(U32 TaskId);
```

Parameters

Parameter	Description
`TaskId`	Task ID of terminated task.

7.6.8 SEGGER_SYSVIEW_RecordEnterISR()

Description

Format and send an ISR entry event.

Prototype

```
void SEGGER_SYSVIEW_RecordEnterISR(void);
```

Additional information

Example packets sent 02 0F 50 // ISR(15) Enter. Timestamp is 80 (`0x50`)

7.6.9 SEGGER_SYSVIEW_RecordExitISR()

Description

Format and send an ISR exit event.

Prototype

```
void SEGGER_SYSVIEW_RecordExitISR(void);
```

Additional information

Format as follows: 03 <TimeStamp> // Max. packet len is 6

Example packets sent 03 20 // ISR Exit. Timestamp is 32 (`0x20`)

7.6.10 SEGGER_SYSVIEW_RecordExitISRToScheduler()

Description

Format and send an ISR exit into scheduler event.

Prototype

```
void SEGGER_SYSVIEW_RecordExitISRToScheduler(void);
```

Additional information

Format as follows: 18 <TimeStamp> // Max. packet len is 6

Example packets sent 18 20 // ISR Exit to Scheduler. Timestamp is 32 (0x20)

7.6.11 SEGGER_SYSVIEW_RecordEnterTimer()

Description

Format and send a Timer entry event.

Prototype

```
void SEGGER_SYSVIEW_RecordEnterTimer(U32 TimerId);
```

Parameters

Parameter	Description
TimerId	Id of the timer which starts.

7.6.12 SEGGER_SYSVIEW_RecordExitTimer()

Description

Format and send a Timer exit event.

Prototype

```
void SEGGER_SYSVIEW_RecordExitTimer(void);
```

7.6.13 SEGGER_SYSVIEW_RecordSystime()

Description

Formats and sends a SystemView Systime containing a single U64 or U32 parameter payload.

Prototype

```
void SEGGER_SYSVIEW_RecordSystime(void);
```

7.7 Dynamic memory monitor functions

These functions provide monitoring for system heaps and other dynamically-allocated objects.

Function	Description
SEGGER_SYSVIEW_HeapDefine()	Define heap.
SEGGER_SYSVIEW_HeapAlloc()	Record a system-heap allocation event.
SEGGER_SYSVIEW_HeapAllocEx()	Record a per-heap allocation event.
SEGGER_SYSVIEW_HeapFree()	Record a heap deallocation event.

7.7.1 SEGGER_SYSVIEW_HeapDefine()

Description

Define heap.

Prototype

```
void SEGGER_SYSVIEW_HeapDefine(void         * pHeap,
                               void         * pBase,
                               unsigned int   HeapSize,
                               unsigned int   MetadataSize);
```

Parameters

Parameter	Description
pHeap	Pointer to heap control structure.
pBase	Pointer to managed heap memory.
HeapSize	Size of managed heap memory in bytes.
MetadataSize	Size of metadata associated with each heap allocation.

Additional information

SystemView can track allocations across multiple heaps.

HeapSize must be a multiple of the natural alignment unit of the target. This size is subject to compression, controlled by the specific setting of SEGGER_SYSVIEW_ID_SHIFT.

MetadataSize defines the size of the per-allocation metadata. For many heap implementations, the metadata size is a multiple of the word size of the machine and typically contains the size of the allocated block (used upon deallocation), optional pointers to the preceding and/or following blocks, and optionally a tag identifying the owner of the block. Note that MetadataSize is not compressed within the SystemView packet and is not required to be a multiple of 1<<SEGGER_SYSVIEW_ID_SHIFT.

7.7.2 SEGGER_SYSVIEW_HeapAlloc()

Description

Record a system-heap allocation event.

Prototype

```
void SEGGER_SYSVIEW_HeapAlloc(void          * pHeap,
                              void          * pUserData,
                              unsigned int    UserDataLen);
```

Parameters

Parameter	Description
pHeap	Pointer to heap where allocation was made.
pUserData	Pointer to allocated user data.
UserDataLen	Size of block allocated to hold user data, excluding any metadata.

Additional information

The user data must be correctly aligned for the architecture, which typically requires that the alignment is at least the alignment of a double or a long long. pUserData is, therefore, compressed by shrinking as IDs are compressed, controlled by the specific setting of SEGGER_SYSVIEW_ID_SHIFT.

In the same way, UserDataLen must reflect the size of the allocated block, not the allocation size requested by the application. This size is also subject to compression, controlled by the specific setting of SEGGER_SYSVIEW_ID_SHIFT.

As an example, assume the allocator is running on a Cortex-M device with SEGGER_SYSVIEW_ID_SHIFT set to 2 (the word alignment of the device). If a user requests an allocation of 5 bytes, a hypothetical heap allocator could allocate a block with size 32 bytes for this. The value of UserDataLen sent to SystemView for recording should be 32, not 5, and the 32 is compressed by shifting by two bits, the configured value of SEGGER_SYSVIEW_ID_SHIFT, and describes the number of bytes that are consumed from managed memory from which SystemView can calculate accurate heap metrics.

7.7.3 SEGGER_SYSVIEW_HeapAllocEx()

Description

Record a per-heap allocation event.

Prototype

```
void SEGGER_SYSVIEW_HeapAllocEx(void          * pHeap,
                                void          * pUserData,
                                unsigned int    UserDataLen,
                                unsigned int    Tag);
```

Parameters

Parameter	Description
pHeap	Pointer to heap where allocation was made.
pUserData	Pointer to allocated user data.
UserDataLen	Size of block allocated to hold user data, excluding any metadata.
Tag	Block tag, typically used to identify the owner of the block.

Additional information

The user data must be correctly aligned for the architecture, which typically requires that the alignment is at least the alignment of a double or a long long. pUserData is, therefore, compressed by shrinking as IDs are compressed, controlled by the specific setting of SEGGER_SYSVIEW_ID_SHIFT.

In the same way, UserDataLen must reflect the size of the allocated block, not the allocation size requested by the application. This size is also subject to compression, controlled by the specific setting of SEGGER_SYSVIEW_ID_SHIFT.

As an example, assume the allocator is running on a Cortex-M device with SEGGER_SYSVIEW_ID_SHIFT set to 2 (the word alignment of the device). If a user requests an allocation of 5 bytes, a hypothetical heap allocator could allocate a block with size 32 bytes for this. The value of UserDataLen sent to SystemView for recording should be 32, not 5, and the 32 is compressed by shifting by two bits, the configured value of SEGGER_SYSVIEW_ID_SHIFT, and describes the number of bytes that are consumed from managed memory from which SystemView can calculate accurate heap metrics.

7.7.4 SEGGER_SYSVIEW_HeapFree()

Description

Record a heap deallocation event.

Prototype

```
void SEGGER_SYSVIEW_HeapFree(void * pHeap,
                             void * pUserData);
```

Parameters

Parameter	Description
pHeap	Pointer to heap where allocation was made.
pUserData	Pointer to allocated user data.

Additional information

SystemViews track allocations and knows the size of the allocated data.

7.8 High-level API instrumentation functions

Event recording functions called by OS and module instrumentation.

Function	Description
API Function Call	
SEGGER_SYSVIEW_RecordVoid()	Formats and sends a SystemView packet with an empty payload.
SEGGER_SYSVIEW_RecordU32()	Formats and sends a SystemView packet containing a single U32 parameter payload.
SEGGER_SYSVIEW_RecordU32x2()	Formats and sends a SystemView packet containing 2 U32 parameter payload.
SEGGER_SYSVIEW_RecordU32x3()	Formats and sends a SystemView packet containing 3 U32 parameter payload.
SEGGER_SYSVIEW_RecordU32x4()	Formats and sends a SystemView packet containing 4 U32 parameter payload.
SEGGER_SYSVIEW_RecordU32x5()	Formats and sends a SystemView packet containing 5 U32 parameter payload.
SEGGER_SYSVIEW_RecordU32x6()	Formats and sends a SystemView packet containing 6 U32 parameter payload.
SEGGER_SYSVIEW_RecordU32x7()	Formats and sends a SystemView packet containing 7 U32 parameter payload.
SEGGER_SYSVIEW_RecordU32x8()	Formats and sends a SystemView packet containing 8 U32 parameter payload.
SEGGER_SYSVIEW_RecordU32x9()	Formats and sends a SystemView packet containing 9 U32 parameter payload.
SEGGER_SYSVIEW_RecordU32x10()	Formats and sends a SystemView packet containing 10 U32 parameter payload.
SEGGER_SYSVIEW_RecordString()	Formats and sends a SystemView packet containing a string.
API Function Return	
SEGGER_SYSVIEW_RecordEndCall()	Format and send an End API Call event without return value.
SEGGER_SYSVIEW_RecordEndCallU32()	Format and send an End API Call event with return value.

7.8.1 SEGGER_SYSVIEW_RecordVoid()

Description

Formats and sends a SystemView packet with an empty payload.

Prototype

```
void SEGGER_SYSVIEW_RecordVoid(unsigned int EventID);
```

Parameters

Parameter	Description
EventID	SystemView event ID.

7.8.2 SEGGER_SYSVIEW_RecordU32()

Description

Formats and sends a SystemView packet containing a single U32 parameter payload.

Prototype

```
void SEGGER_SYSVIEW_RecordU32(unsigned int EventID,
                              U32          Value);
```

Parameters

Parameter	Description
EventID	SystemView event ID.
Value	The 32-bit parameter encoded to SystemView packet payload.

7.8.3 SEGGER_SYSVIEW_RecordU32x2()

Description

Formats and sends a SystemView packet containing 2 U32 parameter payload.

Prototype

```
void SEGGER_SYSVIEW_RecordU32x2(unsigned int EventID,
                                U32          Para0,
                                U32          Para1);
```

Parameters

Parameter	Description
EventID	SystemView event ID.
Para0	The 32-bit parameter encoded to SystemView packet payload.
Para1	The 32-bit parameter encoded to SystemView packet payload.

7.8.4 SEGGER_SYSVIEW_RecordU32x3()

Description

Formats and sends a SystemView packet containing 3 U32 parameter payload.

Prototype

```
void SEGGER_SYSVIEW_RecordU32x3(unsigned int EventID,
                                U32          Para0,
                                U32          Para1,
                                U32          Para2);
```

Parameters

Parameter	Description
EventID	SystemView event ID.
Para0	The 32-bit parameter encoded to SystemView packet payload.
Para1	The 32-bit parameter encoded to SystemView packet payload.
Para2	The 32-bit parameter encoded to SystemView packet payload.

7.8.5 SEGGER_SYSVIEW_RecordU32x4()

Description

Formats and sends a SystemView packet containing 4 U32 parameter payload.

Prototype

```
void SEGGER_SYSVIEW_RecordU32x4(unsigned int EventID,
                                U32          Para0,
                                U32          Para1,
                                U32          Para2,
                                U32          Para3);
```

Parameters

Parameter	Description
EventID	SystemView event ID.
Para0	The 32-bit parameter encoded to SystemView packet payload.
Para1	The 32-bit parameter encoded to SystemView packet payload.
Para2	The 32-bit parameter encoded to SystemView packet payload.
Para3	The 32-bit parameter encoded to SystemView packet payload.

7.8.6 SEGGER_SYSVIEW_RecordU32x5()

Description

Formats and sends a SystemView packet containing 5 U32 parameter payload.

Prototype

```
void SEGGER_SYSVIEW_RecordU32x5(unsigned int EventID,
                                U32          Para0,
                                U32          Para1,
                                U32          Para2,
                                U32          Para3,
                                U32          Para4);
```

Parameters

Parameter	Description
EventID	SystemView event ID.
Para0	The 32-bit parameter encoded to SystemView packet payload.
Para1	The 32-bit parameter encoded to SystemView packet payload.
Para2	The 32-bit parameter encoded to SystemView packet payload.
Para3	The 32-bit parameter encoded to SystemView packet payload.
Para4	The 32-bit parameter encoded to SystemView packet payload.

7.8.7 SEGGER_SYSVIEW_RecordU32x6()

Description

Formats and sends a SystemView packet containing 6 U32 parameter payload.

Prototype

```
void SEGGER_SYSVIEW_RecordU32x6(unsigned int EventID,
                                U32          Para0,
                                U32          Para1,
                                U32          Para2,
                                U32          Para3,
                                U32          Para4,
                                U32          Para5);
```

Parameters

Parameter	Description
EventID	SystemView event ID.
Para0	The 32-bit parameter encoded to SystemView packet payload.
Para1	The 32-bit parameter encoded to SystemView packet payload.
Para2	The 32-bit parameter encoded to SystemView packet payload.
Para3	The 32-bit parameter encoded to SystemView packet payload.
Para4	The 32-bit parameter encoded to SystemView packet payload.
Para5	The 32-bit parameter encoded to SystemView packet payload.

7.8.8 SEGGER_SYSVIEW_RecordU32x7()

Description

Formats and sends a SystemView packet containing 7 U32 parameter payload.

Prototype

```
void SEGGER_SYSVIEW_RecordU32x7(unsigned int EventID,
                                U32          Para0,
                                U32          Para1,
                                U32          Para2,
                                U32          Para3,
                                U32          Para4,
                                U32          Para5,
                                U32          Para6);
```

Parameters

Parameter	Description
EventID	SystemView event ID.
Para0	The 32-bit parameter encoded to SystemView packet payload.
Para1	The 32-bit parameter encoded to SystemView packet payload.
Para2	The 32-bit parameter encoded to SystemView packet payload.
Para3	The 32-bit parameter encoded to SystemView packet payload.
Para4	The 32-bit parameter encoded to SystemView packet payload.
Para5	The 32-bit parameter encoded to SystemView packet payload.
Para6	The 32-bit parameter encoded to SystemView packet payload.

7.8.9 SEGGER_SYSVIEW_RecordU32x8()

Description

Formats and sends a SystemView packet containing 8 U32 parameter payload.

Prototype

```
void SEGGER_SYSVIEW_RecordU32x8(unsigned int EventID,
                                U32          Para0,
                                U32          Para1,
                                U32          Para2,
                                U32          Para3,
                                U32          Para4,
                                U32          Para5,
                                U32          Para6,
                                U32          Para7);
```

Parameters

Parameter	Description
EventID	SystemView event ID.
Para0	The 32-bit parameter encoded to SystemView packet payload.
Para1	The 32-bit parameter encoded to SystemView packet payload.
Para2	The 32-bit parameter encoded to SystemView packet payload.
Para3	The 32-bit parameter encoded to SystemView packet payload.
Para4	The 32-bit parameter encoded to SystemView packet payload.
Para5	The 32-bit parameter encoded to SystemView packet payload.
Para6	The 32-bit parameter encoded to SystemView packet payload.
Para7	The 32-bit parameter encoded to SystemView packet payload.

7.8.10 SEGGER_SYSVIEW_RecordU32x9()

Description

Formats and sends a SystemView packet containing 9 U32 parameter payload.

Prototype

```
void SEGGER_SYSVIEW_RecordU32x9(unsigned int EventID,
                                U32          Para0,
                                U32          Para1,
                                U32          Para2,
                                U32          Para3,
                                U32          Para4,
                                U32          Para5,
                                U32          Para6,
                                U32          Para7,
                                U32          Para8);
```

Parameters

Parameter	Description
EventID	SystemView event ID.
Para0	The 32-bit parameter encoded to SystemView packet payload.
Para1	The 32-bit parameter encoded to SystemView packet payload.
Para2	The 32-bit parameter encoded to SystemView packet payload.
Para3	The 32-bit parameter encoded to SystemView packet payload.
Para4	The 32-bit parameter encoded to SystemView packet payload.
Para5	The 32-bit parameter encoded to SystemView packet payload.
Para6	The 32-bit parameter encoded to SystemView packet payload.
Para7	The 32-bit parameter encoded to SystemView packet payload.
Para8	The 32-bit parameter encoded to SystemView packet payload.

7.8.11 SEGGER_SYSVIEW_RecordU32x10()

Description

Formats and sends a SystemView packet containing 10 U32 parameter payload.

Prototype

```
void SEGGER_SYSVIEW_RecordU32x10(unsigned int EventID,
                                 U32          Para0,
                                 U32          Para1,
                                 U32          Para2,
                                 U32          Para3,
                                 U32          Para4,
                                 U32          Para5,
                                 U32          Para6,
                                 U32          Para7,
                                 U32          Para8,
                                 U32          Para9);
```

Parameters

Parameter	Description
EventID	SystemView event ID.
Para0	The 32-bit parameter encoded to SystemView packet payload.
Para1	The 32-bit parameter encoded to SystemView packet payload.
Para2	The 32-bit parameter encoded to SystemView packet payload.
Para3	The 32-bit parameter encoded to SystemView packet payload.
Para4	The 32-bit parameter encoded to SystemView packet payload.
Para5	The 32-bit parameter encoded to SystemView packet payload.
Para6	The 32-bit parameter encoded to SystemView packet payload.
Para7	The 32-bit parameter encoded to SystemView packet payload.
Para8	The 32-bit parameter encoded to SystemView packet payload.
Para9	The 32-bit parameter encoded to SystemView packet payload.

7.8.12 SEGGER_SYSVIEW_RecordString()

Description

Formats and sends a SystemView packet containing a string.

Prototype

```
void SEGGER_SYSVIEW_RecordString(      unsigned int   EventID,
                                 const char         * pString);
```

Parameters

Parameter	Description
EventID	SystemView event ID.
pString	The string to be sent in the SystemView packet payload.

Additional information

The string is encoded as a count byte followed by the contents of the string. No more than SEGGER_SYSVIEW_MAX_STRING_LEN bytes will be encoded to the payload.

7.8.13 SEGGER_SYSVIEW_RecordEndCall()

Description

Format and send an End API Call event without return value.

Prototype

```
void SEGGER_SYSVIEW_RecordEndCall(unsigned int EventID);
```

Parameters

Parameter	Description
EventID	Id of API function which ends.

7.8.14 SEGGER_SYSVIEW_RecordEndCallU32()

Description

Format and send an End API Call event with return value.

Prototype

```
void SEGGER_SYSVIEW_RecordEndCallU32(unsigned int EventID,
                                     U32          Para0);
```

Parameters

Parameter	Description
EventID	Id of API function which ends.
Para0	Return value which will be returned by the API function.

7.9 Low-level event encoding functions

Event-record building functions.

Function	Description
SEGGER_SYSVIEW_EncodeU32()	Encode a U32 in variable-length format.
SEGGER_SYSVIEW_EncodeData()	Encode a byte buffer in variable-length format.
SEGGER_SYSVIEW_EncodeString()	Encode a string in variable-length format.
SEGGER_SYSVIEW_EncodeId()	Encode a 32-bit Id in shrunken variable-length format.
SEGGER_SYSVIEW_ShrinkId()	Get the shrunken value of an Id for further processing like in SEGGER_SYSVIEW_NameResource().

7.9.1 SEGGER_SYSVIEW_EncodeU32()

Description

Encode a U32 in variable-length format.

Prototype

```
U8 *SEGGER_SYSVIEW_EncodeU32(U8  * pPayload,
                             U32   Value);
```

Parameters

Parameter	Description
pPayload	Pointer to where U32 will be encoded.
Value	The 32-bit value to be encoded.

Return value

Pointer to the byte following the value, i.e. the first free byte in the payload and the next position to store payload content.

7.9.2 SEGGER_SYSVIEW_EncodeData()

Description

Encode a byte buffer in variable-length format.

Prototype

```
U8 *SEGGER_SYSVIEW_EncodeData(      U8             * pPayload,
                              const char           * pSrc,
                                    unsigned int     NumBytes);
```

Parameters

Parameter	Description
pPayload	Pointer to where string will be encoded.
pSrc	Pointer to data buffer to be encoded.
NumBytes	Number of bytes in the buffer to be encoded.

Return value

Pointer to the byte following the value, i.e. the first free byte in the payload and the next position to store payload content.

Additional information

The data is encoded as a count byte followed by the contents of the data buffer. Make sure NumBytes + 1 bytes are free for the payload.

7.9.3 SEGGER_SYSVIEW_EncodeString()

Description

Encode a string in variable-length format.

Prototype

```
U8 *SEGGER_SYSVIEW_EncodeString(      U8           * pPayload,
                                const char         * s,
                                      unsigned int   MaxLen);
```

Parameters

Parameter	Description
pPayload	Pointer to where string will be encoded.
s	String to encode.
MaxLen	Maximum number of characters to encode from string.

Return value

Pointer to the byte following the value, i.e. the first free byte in the payload and the next position to store payload content.

Additional information

The string is encoded as a count byte followed by the contents of the string. No more than 1 + MaxLen bytes will be encoded to the payload.

7.9.4 SEGGER_SYSVIEW_EncodeId()

Description

Encode a 32-bit Id in shrunken variable-length format.

Prototype

```
U8 *SEGGER_SYSVIEW_EncodeId(U8  * pPayload,
                            U32   Id);
```

Parameters

Parameter	Description
pPayload	Pointer to where the Id will be encoded.
Id	The 32-bit value to be encoded.

Return value

Pointer to the byte following the value, i.e. the first free byte in the payload and the next position to store payload content.

Additional information

The parameters to shrink an Id can be configured in SEGGER_SYSVIEW_Conf.h and via SEGGER_SYSVIEW_SetRAMBase(). SEGGER_SYSVIEW_ID_BASE: Lowest Id reported by the application. (i.e. 0x20000000 when all Ids are an address in this RAM) SEGGER_SYSVIEW_ID_SHIFT: Number of bits to shift the Id to save bandwidth. (i.e. 2 when Ids are 4 byte aligned)

7.9.5 SEGGER_SYSVIEW_ShrinkId()

Description

Get the shrunken value of an `Id` for further processing like in `SEGGER_SYSVIEW_NameResource()`.

Prototype

```
U32 SEGGER_SYSVIEW_ShrinkId(U32 Id);
```

Parameters

Parameter	Description
`Id`	The 32-bit value to be shrunken.

Return value

Shrunken Id.

Additional information

The parameters to shrink an `Id` can be configured in `SEGGER_SYSVIEW_Conf.h` and via `SEGGER_SYSVIEW_SetRAMBase()`. `SEGGER_SYSVIEW_ID_BASE`: Lowest `Id` reported by the application. (i.e. `0x20000000` when all Ids are an address in this RAM) `SEGGER_SYSVIEW_ID_SHIFT`: Number of bits to shift the `Id` to save bandwidth. (i.e. 2 when Ids are 4 byte aligned)

7.9.6 SEGGER_SYSVIEW_SendPacket()

Description

Send an event packet.

Prototype

```
int SEGGER_SYSVIEW_SendPacket(U8           * pPacket,
                              U8           * pPayloadEnd,
                              unsigned int   EventId);
```

Parameters

Parameter	Description
pPacket	Pointer to the start of the packet.
pPayloadEnd	Pointer to the end of the payload. Make sure there are at least 5 bytes free after the payload.
EventId	Id of the event packet.

Return value

≠ 0 Success, Message sent.
= 0 Buffer full, Message *NOT* sent.

7.10 Application-provided functions

Application provided functions.

Function	Description
SEGGER_SYSVIEW_Conf()	Initialize and configures SystemView.
SEGGER_SYSVIEW_X_GetTimestamp()	Callback called by SystemView to get the timestamp in cycles.

7.10.1 SEGGER_SYSVIEW_Conf()

Description

Can be used with OS integration to allow easier initialization of SystemView and the OS SystemView interface.

This function is usually provided in the `SEGGER_SYSVIEW_Config_<OS>.c` configuration file of the used OS.

Prototype

```
void SEGGER_SYSVIEW_Conf(void);
```

Example implementation

```
void SEGGER_SYSVIEW_Conf(void) {
  //
  // Initialize SystemView
  //
  SEGGER_SYSVIEW_Init(SYSVIEW_TIMESTAMP_FREQ,   // Frequency of the timestamp.
                      SYSVIEW_CPU_FREQ,         // Frequency of the system.
                      &SYSVIEW_X_OS_TraceAPI,
  // OS-specific SEGGER_SYSVIEW_OS_API
                      _cbSendSystemDesc
  // Callback for application-specific description
                     );
  SEGGER_SYSVIEW_SetRAMBase(SYSVIEW_RAM_BASE);
  // Explicitly set the RAM base address.
  OS_SetTraceAPI(&embOS_TraceAPI_SYSVIEW);
  // Configure embOS to use SystemView via the Trace-API.
}
```


7.10.2 SEGGER_SYSVIEW_X_GetTimestamp()

Description

This function must be implemented when `SEGGER_SYSVIEW_GET_TIMESTAMP()` is configured to call it. By default this is done on all non-Cortex-M3/4 targets.

Prototype

```
U32 SEGGER_SYSVIEW_X_GetTimestamp(void);
```

Return value

Returns the current system timestamp in timestamp cycles. On Cortex-M3 and Cortex-M4 this is the cycle counter.

Example implementation

```
U32 SEGGER_SYSVIEW_X_GetTimestamp(void) {
  U32 TickCount;
  U32 Cycles;
  U32 CyclesPerTick;
  //
  // Get the cycles of the current system tick.
  // SysTick is down-counting, subtract the current value from the number of cycles per tick.
  //
  CyclesPerTick = SYST_RVR + 1;
  Cycles = (CyclesPerTick - SYST_CVR);
  //
  // Get the system tick count.
  //
  TickCount = SEGGER_SYSVIEW_TickCnt; // SEGGER_SYSVIEW_TickCnt is incremented by the system tic
  //
  // If a SysTick interrupt is pending increment the TickCount
  //
  if ((SCB_ICSR & SCB_ICSR_PENDSTSET_MASK) != 0) {
    TickCount++;
  }
  Cycles += TickCount * CyclesPerTick;

  return Cycles;
}
```


Chapter 8

Performance and resource usage

This chapter covers the performance and resource usage of SystemView. It contains information about the memory requirements in typical systems which can be used to obtain sufficient estimates for most target systems.

8.1 Memory requirements

The memory requirements may differ, depending on the used OS integration, the target configuration and the compiler optimizations.

To achieve a balanced result of performance and memory usage, it is recommended to set the compiler optimization level for the SystemView and RTT module accordingly. Compiler optimizations should always be switched on for the SystemView and RTT module - even in Debug configuration builds.

8.1.1 ROM usage

The following table lists the ROM usage of SystemView by component. With a smart linker only the used functions will be included in the application.

Description	ROM
Minimum core code required when using SystemView	~920 Byte
Basic SystemView recording functions for application, OS and module events	~380 Byte
OS-related SystemView recording functions	~360 Byte
Middleware module-related recording functions	~120 Byte
Complete SystemView Module	*~1.8 KByte*

The following table list the ROM usage of SystemView with different configurations.

Description	Configuration	ROM
SystemView Module	Balanced optimization, no static buffer	~1.8 KByte
SystemView Module	Balanced optimization, static buffer	~2.1 KByte
SystemView Module	Balanced optimization, no static buffer, post-mortem mode	~1.4 KByte
SystemView Module	Balanced optimization, static buffer, post-mortem mode	~1.7 KByte
RTT Module	Balanced optimization	~0.5 KByte

8.1.2 Static RAM usage

The following table list the static RAM usage of SystemView with different configurations.

Description	Configuration	RAM
SystemView Module	No static buffer	~70 Byte + Channel Buffer
SystemView Module	Static buffer	~280 Byte + Channel Buffer
SystemView Module	No static buffer, post-mortem mode	~60 Byte + Channel Buffer
SystemView Module	Static buffer, post-mortem mode	~180 Byte + Channel Buffer
RTT Module		~30 Byte + Channel Buffer

8.1.3 Stack RAM usage

SystemView requires stack to record events in every context, which might record events in the application. This typically includes the system stack used by the scheduler, the interrupt stack and the task stacks.

Since SystemView handles incoming requests for the system description and task information, there must be enough free space on the stack to record an event and to send the system description, which is recording another event.

SystemView can be configured to select between lower stack usage or less static RAM use.

Description	Maximum Stack
Static buffer for event generation and encoding	~230 Bytes
Stack buffer for event generation and encoding	~510 Bytes
Static buffer for event generation and encoding, post-mortem mode	~150 Bytes
Stack buffer for event generation and encoding, post-mortem mode	~280 Bytes

Chapter 9

Frequently asked questions

Q: *Can I use the SystemView Application while I am debugging my application?*

A: Yes. SystemView can run in parallel to a debugger and do continuous recording. To make sure data can be read fast enough, configure the debugger connection to a high interface speed (≥ 4 MHz).

Q: *Can I do continuous recording without a J-Link?*

A: No. Continuous recording requires the J-Link Real Time Transfer (RTT) technology to automatically read the data from the target. Single-shot and post-mortem recording can be done with any debug probe.

Q: *Can I do continuous recording on Cortex-A, Cortex-R or ARM7, ARM9?*

A: No. RTT requires memory access on the target while the target is running. If you have one of these devices, only one-time recording can be done.

Q: *I get overflow events when continuously recording. How can I prevent this?*

A: Overflow events occur when the SystemVIew RTT buffer is full. This can happen for following reasons:

- J-Link is kept busy by a debugger and cannot read the data fast enough.
- The target interface speed is too low to read the data fast enough.
- The application generates too many events to fit into the buffer.

To prevent this:

- Minimize the interactions of the debugger with J-Link while the target is running. (e.g. disable live watches)
- Select a higher interface speed in all instances connected to J-Link. (e.g. the debugger and SystemView)
- Choose a larger buffer for SystemView. (1 - 4 kByte)
- Run SystemView stand-alone without a debugger.

Q: *SystemView cannot find the RTT Control Block, how can I configure it?*

A: Auto-detection of the RTT Control Block can only be done in a known RAM address range after it is initialized. Make sure the application startup has run when starting to record. If the RTT Control Block is outside the known range for the selected device, either select 'Address' and enter the exact address of the RTT Control Block or select 'Address Range' and enter an address range in which the RTT Control Block will be.

Q: *Do I have to select a Target Device to start recording?*

A: Yes. J-Link must know which target device is connected. The drop-down lists the most recently used devices. To select another device simply enter its name. A list of supported devices can be found here.

Q: *My question is not listed above. Where can I get more information?*

A: For more information and help please ask your question in the SEGGER forum https://forum.segger.com

