System Analyzer

User’s Guide

Texas Instruments

Literature Number: SPRUH43F
March 2014

Preface

About This Guide

System Analyzer is a tool suite that provides visibility into the real-time performance and behavior of your software. It allows you to analyze the load, execution sequence, and timing of your single-core or multicore target applications. System Analyzer included the features in both the **Tools > RTOS Analyzer** and **Tools > System Analyzer** menus in CCS. Together, they are made up of a number of components.

This document applies to the RTOS Analyzer and System Analyzer features supported in Code Composer Studio (CCS) v6.0. Many of the features described in this document are also provided as part of CCS v5.3 and higher.

The key components of RTOS Analyzer and System Analyzer are:

- **DVT.** Various features of DVT provide the user interface for RTOS Analyzer and System Analyzer within CCS. The DVT is automatically installed as part of CCS.
- **UIA.** The Unified Instrumentation Architecture (UIA) defines APIs and transports that allow embedded software to log instrumentation data for use within CCS. In order to use UIA, you will need to install TI-RTOS, which is available in the TI App Center within CCS. UIA is the TI-RTOS Instrumentation component. TI-RTOS is provided with full source code and requires no up-front or runtime license fees.

This document provides information about both the host-side and target-side components of RTOS Analyzer and System Analyzer.

Intended Audience

This document is intended for users of RTOS Analyzer and System Analyzer.

This document assumes you have knowledge of inter-process communication concepts and the capabilities of the processors available to your application. This document also assumes that you are familiar with Code Composer Studio, SYS/BIOS, and XDCtools.

See Section 3.1, *Different Types of Analysis for Different Users* for more about the categories of users for RTOS Analyzer and System Analyzer.

Notational Conventions

This document uses the following conventions:

- When the pound sign (#) is used in filenames or directory paths, you should replace the # sign with the version number of the release you are using. A # sign may represent one or more digits of a version number.
- Program listings, program examples, and interactive displays are shown in a `mono-spaced font`. Examples use **`bold`** for emphasis, and interactive displays use **`bold`** to distinguish commands that you enter from items that the system displays (such as prompts, command output, error messages, etc.).

- Square brackets ([and]) identify an optional parameter. If you use an optional parameter, you specify the information within the brackets. Unless the square brackets are in a **bold** typeface, do not enter the brackets themselves.

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March 18, 2014

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Chapter 1

Overview of System Analyzer

This chapter provides an introduction to System Analyzer's host-side and target-side components.

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1.1 Introduction

Instrumenting software with print statements to provide visibility into the operation of the software at run-time has long been one of the keys to creating maintainable software that works. As devices become increasingly complex, the system-level visibility provided by software instrumentation is an increasingly important success factor, as it helps to diagnose problems both in the lab during development and in the field.

One of the key advantages of instrumented software is that, unlike debug sessions, the statements used are part of the code-base. This can help other developers figure out what is going on as the software executes. It can also highlight integration problems and error conditions that would be hard to detect otherwise.

As a result, many groups create their own logging APIs. Unfortunately, what often happens is that the logging APIs they create are closely tied to particular hardware and operating systems, use incompatible logging infrastructures, make assumptions about the acceptable amount of memory or CPU overhead, generate logs in a diverse range of formats, may not include timestamps, or may use different time-bases (ticks, cycles, wall-clock, etc.). All of these differences make it difficult to port code from one system to another, difficult to integrate software from different development groups, difficult or impossible to correlate events from different cores on the same device, and costly to create tooling to provide ease-of-use, analysis and visualization capabilities.

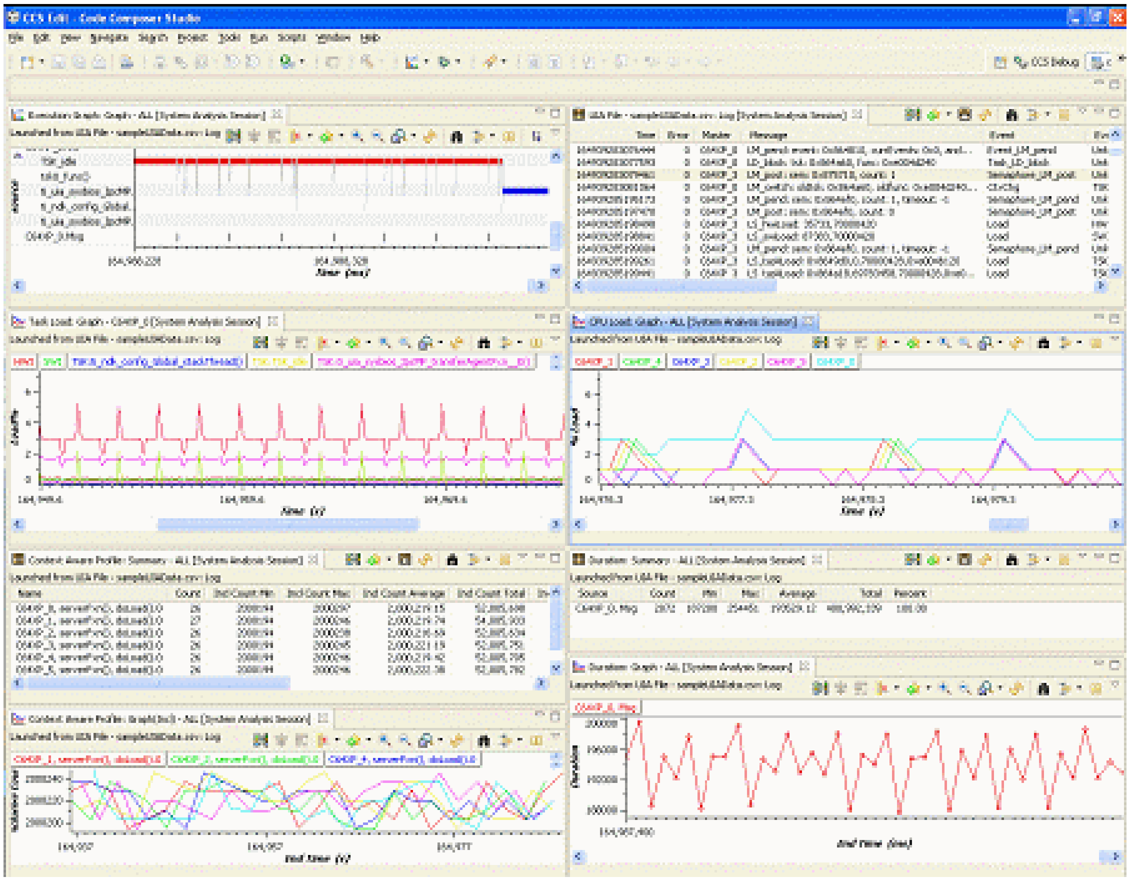
The System Analyzer tool suite provides a consistent and portable way to instrument software. It enables software to be re-used with a variety of silicon devices, software applications, and product contexts. It includes both host-side tooling and target-side code modules (the UIA software package). These work together to provide visibility into the real-time performance and behavior of software running on TI's embedded single-core and multicore devices.

1.1.1 What Analysis and Visualization Capabilities are Provided?

System Analyzer included the features in both the **Tools > RTOS Analyzer** and **Tools > System Analyzer** menus in CCS. These host-side tools use TI's Data Visualization Technology (DVT) to provide the following features for target applications that have been instrumented with the UIA target software package:

- **Advanced analysis features for data analysis and visualization.** Features include the ability to view the CPU and thread loads, the execution sequence, thread durations, and context profiling.
- **Multicore event correlation.** Allows software instrumentation events from multiple cores on multicore devices to be displayed on the same timeline, allowing users to see the timing relationships between events that happened on different CPUs.
- **Run-time analysis.** For targets that support either the UIA Ethernet transport or real-time JTAG transport, events can be uploaded from the target to RTOS Analyzer and System Analyzer while the target is running without having to halt the target. This ensures that actual program behavior can be observed, without the disruption of program execution that occurs when one or more cores are halted.

- **Recording and playback of data.** You can record real-time event data and later reload the data to further analyze the activity. Both CSV and binary files are supported by RTOS Analyzer and System Analyzer.


CCS Edit - Code Composer Studio
File Edit View Navigate Search Project Tools Run Scripts Window Help
CCS Debug
Execution Graph: Graph - ALL [System Analysis Session]
UIA File - sampleUIAData.csv: Log [System Analysis Session]
Task Load: Graph - C64XP_0 [System Analysis Session]
CPU Load: Graph - ALL [System Analysis Session]
Context Aware Profile: Summary - ALL [System Analysis Session]
Duration: Summary - ALL [System Analysis Session]
Duration: Graph - ALL [System Analysis Session]
Context Aware Profile: Graph(Incl) - ALL [System Analysis Session]
Time (ms)
Time (s)
End Time (ms)
End Time (s)

1.1.2 What the UIA Target Software Package Provides

For the target, the Unified Instrumentation Architecture (UIA) target package, a component of TI-RTOS, provides the following:

- **Software instrumentation APIs.** The xdc.runtime.Log module provides basic instrumentation APIs to log errors, warnings, events and generic instrumentation statements. A key advantage of these APIs is that they are designed for real-time instrumentation, with the burden of processing and decoding format strings handled by the host. Additional APIs are provided by the ti.uia.runtime package to support logging blocks of data and dynamic strings (the LogSnapshot module), context change events (the LogCtxChg module), and multicore event correlation information (the LogSync module).
- **Predefined software events and metadata.** The ti.uia.events package includes software event definitions that have metadata associated with them to enable RTOS Analyzer and System Analyzer to provide performance analysis, statistical analysis, graphing, and real-time debugging capabilities.
- **Event loggers.** A number of event logging modules are provided to allow instrumentation events to be captured and uploaded to the host over both JTAG and non-JTAG transports. Examples include LoggerStopMode, which logs events to a buffer in memory, and LoggerSM, which logs events to shared memory and enables events to be decoded and streamed to a Linux console window.

- **Transports.** Both JTAG-based and non-JTAG transports can be used for communication between the target and the host. Non-JTAG transports include Ethernet, with UDP used to upload events to the host and TCP used for bidirectional communication between the target and the host.
- **SYS/BIOS event capture and transport.** For example, when UIA is enabled, SYS/BIOS uses UIA to transfer data about CPU Load, Task Load, and Task Execution to the host.
- **Multicore support.** UIA supports routing events and messages across a central master core. It also supports logging synchronization information to enable correlation of events from multiple cores so that they can be viewed on a common timeline.
- **Scalable solutions.** UIA allows different solutions to be used for different devices.
- **Examples.** UIA includes working examples for the supported boards.
- **Source code.** UIA modules can be modified and rebuilt to facilitate porting and customization.

1.2 System Analyzer Terminology

You should be familiar with the following terms when using this manual.

- **System Analyzer.** A suite of host-side tools that use data captured from software instrumentation, hardware instrumentation, and CPU trace to provide visibility into the real-time performance and behavior of target applications. In this document, the term "System Analyzer" actually includes the menu commands in both the **Tools > RTOS Analyzer** and the **Tools > System Analyzer** menus.
- **UIA.** Unified Instrumentation Architecture. A target-side package that provides instrumentation services. UIA is the "TI-RTOS Instrumentation" component of the TI-RTOS product. Both names refer to the same component. You may see the "TI-RTOS Instrumentation" name in other documents and on Texas Instruments websites. This new name does not require any code changes on your part; directory and module names are not affected by this change.
- **DVT**. Data Visualization Technology. Provides a common platform to display real-time SYS/BIOS and trace data as lists and graphically. Used in the RTOS Analyzer and System Analyzer features. Also used in such CCS features as STM Logic and Statistics Analyzer and Trace Analyzer.
- **CCS**. Code Composer Studio. The integrated development environment (IDE) for TI's DSPs, microcontrollers, and application processors.
- **Analysis Feature**. A tool provided by DVT for use in the analysis of instrumentation data. A feature typically consists of several related views. For example, "CPU Load" is an Analysis Feature that includes summary, detail, and graph views.
- **Core.** An embedded processor. Also called a CPU.
- **Host**. The processor that communicates with the target(s) to collect instrumentation data. For example, a PC running Code Composer Studio.
- **Target**. A processor running target code. Generally this is an embedded processor such as a DSP or microcontroller.
- **UIA Packets**. Generic term for either Events or Messages. A UIA packet can hold multiple events or a single message.
- **Events**. Instrumentation data sent from the target to the host For example, Log records.
- **Messages**. Actions that are sent between the host and target. For example, commands, acknowledgements, and results.

- **Service**. A component that supplies some type of host/target interaction. There can be multiple services in a system. An example is the Rta Service that provides XDC Log information.
- **IPC**. Inter-Processor Communication. A software product containing modules designed to allow communication between processors in a multi-processor environment. IPC is the "TI-RTOS Interprocessor Communication" component of the TI-RTOS product.
- **JTAG**. Joint Test Action Group. IEEE specification (IEEE 1149.1) for a serial interface used for debugging integrated circuits.
- **MADU**. Minimum Addressable Data Unit. Also called MAU. The minimum sized data that can be accessed by a particular CPU. Different architectures have different size MADUs. For the C6000 architecture, the MADU for both code and data is an 8-bit byte.
- **NDK**. Network Developer’s Kit. Contains libraries that support the development of networking applications. NDK is the "TI-RTOS Networking" component of the TI-RTOS product.
- **SYS/BIOS**. A real-time operating system for a number of TI's DSPs, microcontrollers, and application processors. SYS/BIOS is the "TI-RTOS Kernel" component of the TI-RTOS product. Previously called DSP/BIOS.
- **SysLink**. Run-time software and an associated porting kit to simplify the development of embedded applications in which either General-Purpose microprocessors (GPPs) or DSPs communicate with each other.
- **RTSC.** Real-Time Software Components. A standard for packaging and configuring software components. XDCtools is an implementation of the RTSC standard.
- **TI-RTOS.** A scalable, one-stop embedded tools ecosystem for TI devices. It scales from a real-time multitasking kernel to a complete RTOS solution including additional middleware components and device drivers. Its components include TI-RTOS Kernel (SYS/BIOS), TI-RTOS Instrumentation (UIA), TI-RTOS Networking (NDK), and TI-RTOS Interprocessor Communication (IPC). It also includes drivers, board software, and examples.
- **UART**. Universal Asynchronous Receiver/Transmitter. A UART chip controls the interface to serial devices.
- **XDCtools**. A product that contains tools needed to create, test, deploy, install, and use RTSC components. RTSC standardizes the delivery of target content.
- **xdc.runtime.** A package of low-level target-software modules included with XDCtools that provides "core" services appropriate for embedded C/C++ applications, including real-time diagnostics, concurrency support, memory management, and system services.

1.3 Using System Analyzer with Your Application Software

System Analyzer provides flexible ways to instrument your application and to configure how logged events are uploaded to the host.

1.3.1 Instrumenting Your Application Using UIA

There are a number of different ways to take advantage of the real-time visibility capabilities provided by System Analyzer and the UIA target software:

- SYS/BIOS modules provide built-in software instrumentation that can be enabled to provide visibility into CPU Load, Task Load, and Task Execution "out of the box". (See Section 3.2 and Section 3.3).

- The UIA and xdc.runtime.Log APIs can be used in your C or C++ code directly to log software events to instrument your application code. You don't have to write RTSC modules; just #include the appropriate header files in your software and call the provided APIs. Examples are provided in Section 5.4 as well as in the help files that ship with the UIA target content.
- Macros can be used to wrap the UIA and XDC event logging APIs so that they can be called using the same API signature as other event logging APIs your software may already be using for software instrumentation. More information is provided on the wiki page at http://processors.wiki.ti.com/index.php/Multicore_System_Analyzer.

1.3.2 Capturing and Uploading Events Using UIA

UIA allows you to configure the infrastructure used to capture and upload software instrumentation events without having to change your application software C code. The LoggingSetup module in the ti.uia.sysbios package provides the following loggerType configuration options, which can be configured by adding a couple of script statements or settings in XGCONF:

Table 1–1. Logger Types

Logger Type	Description	LoggingSetup.loggerType Setting
JTAG Stop-Mode	Events are uploaded over JTAG when the target halts. This is the default.	LoggerType_STOPMODE
JTAG Run-Mode	Events are streamed from the target to the host via JTAG while the target is running (available on C64x+, C66x and C28x targets only).	LoggerType_JTAGRUNMODE
Non-JTAG Run-Mode	Events are uploaded over a non-JTAG transport such as Ethernet.	LoggerType_RUNMODE
Min	Events are logged into a small footprint logger and uploaded over JTAG when the target halts.	LoggerType_MIN
Idle	Events are uploaded in the SYS/BIOS idle loop using an application provided transport function.	LoggerType_IDLE

For details about the benefits and constraints for each of these modes, see *Configuring the UIA Logger*, page 5-94.

Configuring the UIA Logger

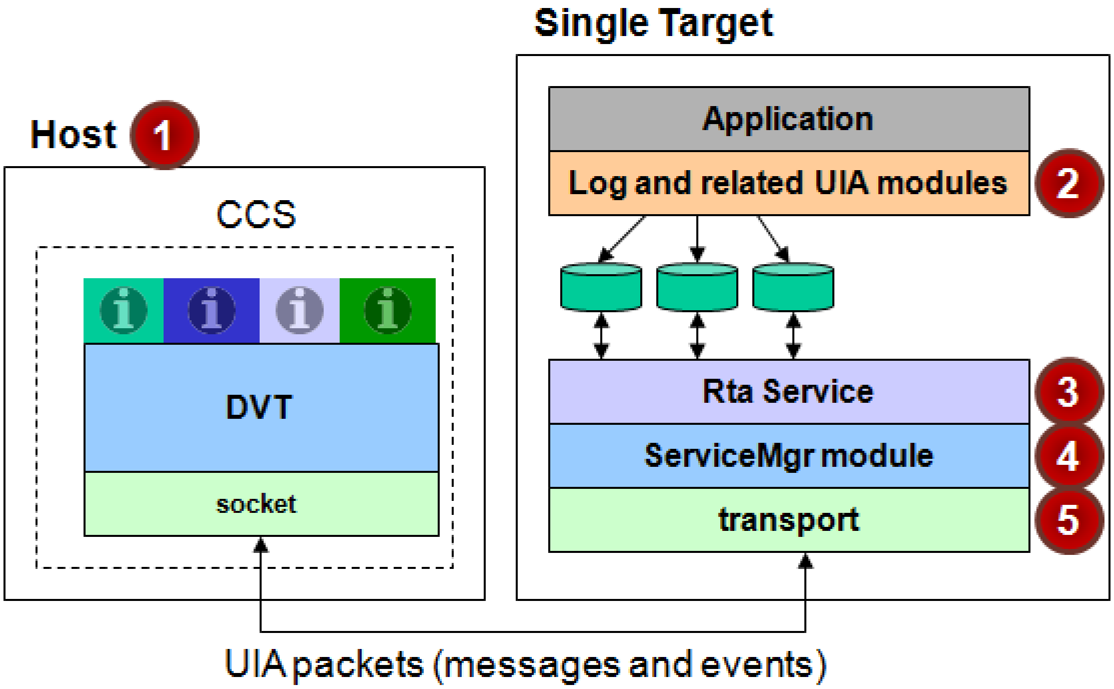
- **Specialized Logger.** Logger modules can implement a host-to-target connection in various ways. For example, the LoggerSM module provided with UIA uses shared memory reads and writes to directly communicate with a Linux application.
- **UIA ServiceMgr Framework.** UIA provides a full-featured pluggable framework. It supports both default SYS/BIOS instrumentation and extensive custom instrumentation. Communication via Ethernet, files over JTAG, and other methods can be plugged into this framework. The advantage of this technique is its power and flexibility. The disadvantage is that the code and data footprint on the target may be too large for memory-constrained targets. More information is provided in Section 1.4.

Note: UIA does not support RTDX (Real-Time Data eXchange). Please use JTAG Run-Mode.

1.4 Communicating Over Non-JTAG Transports

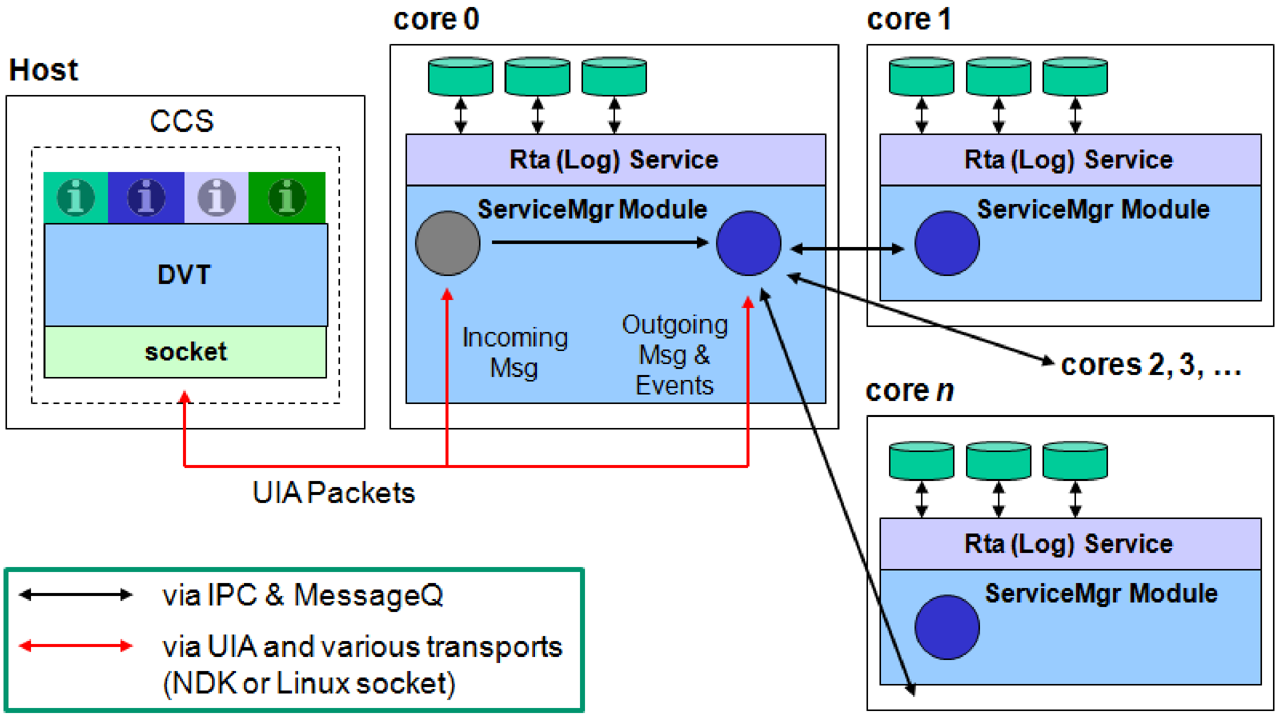
UIA manages communication between the target(s) and the host by providing a ServiceMgr module that is responsible for sending and receiving packets between the services on the target and the host.

The following is a simplified diagram of the components and connections involved in single-core target applications. The numbers correspond to the items in the numbered list after the diagram.



1. **Host.** The host is typically a PC running Code Composer Studio. Within CCS, the System Analyzer features provided by DVT (the "i" icons in the diagram) display and make sense of the UIA packets received via the socket connection.
2. **Target application.** The target runs an application that uses SYS/BIOS and/or XDCtools for configuration and APIs. Internally, the SYS/BIOS modules make API calls to log events related to threading. You can also add additional configuration and calls to make use of the logging, event-handling, and diagnostics support in UIA, SYS/BIOS, and XDCtools.
3. **Rta service.** UIA's Rta module on the target collects events from the log written to by both the pre-instrumented SYS/BIOS threads and any custom instrumentation you have added. By default, it collects events every 100 milliseconds. Rta then sends the events on to the UIA ServiceMgr module.
4. **ServiceMgr module.** This module moves data off the target primarily in the background. You configure the ServiceMgr module to specify the following:
   - — Whether you have a single-core or multicore application.
   - — If you have a multicore application, which core is designated the master core, which communicates directly with the host.
   - — The type of physical connection used for data transport between the master core and the host. Options are Ethernet, file (over JTAG), and user-defined (for custom connections).
5. **Transport.** By default, TCP is used to transport messages and UDP is used to transport events over an Ethernet connection. The application is responsible for setting up the Ethernet connection, for example by using the NDK on an EVM6472.

If there are multiple cores, the simplified diagram of the connections looks similar to the following:



In the multicore case, the ServiceMgr module on each core is configured to identify the master core. UIA packets from other cores are sent to the master core by the ServiceMgr module via the MessageQ module, which is part of both IPC and SYSLink.

The master core sends the UIA packets on to the host via the Ethernet transport in the case of a master core that runs a SYS/BIOS application and via standard Linux socket calls in the case of an ARM master core.

1.4.1 Communication for EVM6472 Single-Core

If the target application runs on a single-core EVM6472, the ServiceMgr module on the target uses NDK as its transport. The NDK communicates with the host via sockets. The NDK transport functions are in the ti.uia.sysbios.TransportNdk module provided with UIA. See the <*uia_install*>\packages\ti\uia\sysbios directory.

1.4.2 Communication for EVM6472 Multicore

If the target application is running on multiple cores on an EVM6472, all non-master cores communicate to the “master” core via IPC’s MessageQ module.

The ServiceMgr module on the master core communicates with the host by using NDK as its transport. The NDK communicates with the host via sockets. The NDK transport functions, which are only used by the master core, are in the ti.uia.sysbios.TransportNdk module provided with UIA. See the <*uia_install*>\packages\ti\uia\sysbios directory.

1.4.3 Communication for EVMTI816x

If the target application is running on the ARM, DSP, and M3 cores of an EVMTI816x, the ServiceMgr module is used on all cores. The ARM core is configured to be the master core. The DSP and M3 cores communicate with the ARM core via SysLink's MessageQ module. The ARM core communicates with the host via standard Linux socket calls. That is, the ARM core acts as a router for the UIA packets.

1.5 About this User Guide

The remaining chapters in this manual cover the following topics:

- Chapter 2, "Installing System Analyzer", describes how to install UIA.
- Chapter 3, "Tasks and Roadmaps for System Analyzer“, explains how to begin using System Analyzer.
- Chapter 4, “Using RTOS Analyzer and System Analyzer“, describes the analysis features provided in Code Composer Studio for examining instrumentation data.
- Chapter 5, “UIA Configuration and Coding on the Target“, describes how to configure and code target applications using UIA modules.
- Chapter 6, “Advanced Topics for System Analyzer“, provides additional information about using System Analyzer components.

Note: Please see the release notes in the installation before starting to use System Analyzer. The release notes contain important information about feature support, issues, and compatibility information.

1.6 Learning More about System Analyzer

To learn more about System Analyzer and the software products used with it, refer to the following documentation:

- **UIA online reference help** (also called "CDOC"). Open with CCSv6 online help or run <*uia_install*>/docs/cdoc/index.html. Use this help system to get reference information about static configuration of UIA modules and C functions provided by UIA.
- **Tutorials.** http://processors.wiki.ti.com/index.php/Multicore_System_Analyzer_Tutorials
- **TI Embedded Processors Wiki.** http://processors.wiki.ti.com
  - **System Analyzer.** http://processors.wiki.ti.com/index.php/Multicore_System_Analyzer
  - **Code Composer Studio.** http://processors.wiki.ti.com/index.php/Category:Code_Composer_Studio_v6
  - **SYS/BIOS.** http://processors.wiki.ti.com/index.php/Category:SYSBIOS
  - **TI-RTOS.** http://processors.wiki.ti.com/index.php/TI-RTOS
  - **NDK.** http://processors.wiki.ti.com/index.php/Category:NDK
  - **SysLink.** http://processors.wiki.ti.com/index.php/Category:SysLink
  - **UIA cTools.** http://processors.wiki.ti.com/index.php/UIAcTools
  - **cUIA.** http://processors.wiki.ti.com/index.php/CUIA

- **RTSC-Pedia Wiki.** http://rtsc.eclipse.org/docs-tip for XDCtools documentation.
- **TI E2E Community.** http://e2e.ti.com/
  - For CCS and DVT information, see the Code Composer forum at http://e2e.ti.com/support/development_tools/code_composer_studio/f/81.aspx
  - For SYS/BIOS, XDCtools, IPC, NDK, and SysLink information, see the TI-RTOS forum at http://e2e.ti.com/support/embedded/f/355.aspx
  - Also see the forums for your specific processor(s).
- **SYS/BIOS Product Folder.** http://focus.ti.com/docs/toolsw/folders/print/dspbios6.html
- **Embedded Software Download Page.** http://software-dl.ti.com/dsps/dsps_public_sw/sdo_sb/targetcontent/index.html for downloading individual SYS/BIOS, XDCtools, UIA, IPC, and NDK versions. See the CCS App Center to download TI-RTOS.

Chapter 2

Installing System Analyzer

This chapter covers how to install the System Analyzer components.

2.1 Installing UIA as Part of TI-RTOS

The System Analyzer host-based tools are automatically installed as part of Code Composer Studio v6 (CCSv6). However, UIA and SYS/BIOS are required in order to use System Analyzer. These components are part of TI-RTOS, which is *not* installed with CCSv6. To install TI-RTOS, follow these steps:

1. In CCS, choose **Help > CCS App Center**.
2. Choose the version of TI-RTOS for your device family. If you use devices in multiple families, you can install multiple TI-RTOS versions.
3. Follow the prompts in the installation.

System Analyzer updates will be available through the CCS Update Installer. You can check for updates by choosing **Help > Check for Updates** from the menus.

This document applies to System Analyzer features supported in CCS v6.0. Many of the features described in this document are also provided as part of CCS v5.3 and higher.

System Analyzer support is available for the targets listed in the release notes and at http://processors.wiki.ti.com/index.php/Multicore_System_Analyzer. Specific examples are provided for multicore targets such as the evm6472 and the evmTI816x. In addition, pre-built libraries are provided for a number of single-core targets.

System Analyzer makes use of the following other software components and tools, which must be installed in order to use System Analyzer. See the UIA release notes for compatible version information.

- Code Composer Studio (CCS)
- SYS/BIOS (installed as part of TI-RTOS)
- XDCtools (installed as part of CCStudio)
- IPC (installed as part of TI-RTOS for certain device families)
- NDK (installed as part of TI-RTOS for certain device families)
- Code Generation Tools (version required depends on target)
- PDK and simulator (required for simTCI6616)
- SysLink (for evmTI816x)

2.2 Installing UIA Outside CCS

You can also install the UIA target-side modules on a Linux machine for use outside the CCS environment. On a Linux machine, you should unzip the UIA target package in the same root directory where XDCtools and SYS/BIOS are installed.

If you want to build applications with UIA modules outside of CCS, add the UIA package path to your XDCPATH definition. The UIA package path is the /packages subfolder of the UIA target-side installation. For example, the package path may be the C:\Program Files\Texas Instruments\uia_2_#_#_#\packages folder.

Chapter 3

Tasks and Roadmaps for System Analyzer

This chapter explains how to begin using RTOS Analyzer and System Analyzer. It provides roadmaps for common tasks related to using RTOS Analyzer and System Analyzer.

Topic **Page**

3.1 Different Types of Analysis for Different Users

A variety of users make use of RTOS Analyzer and System Analyzer, but different users perform different types of analysis. To find tasks that apply to your needs, choose the use case that matches your needs best from the following list:

1. **Analyst for a deployed system.** You have an existing system for which you need a performance analysis. You do not need to know about the actual target code, and are interested in using the GUI features of RTOS Analyzer to find answers about CPU utilization. You will want to use the CPU Load and possibly the Task Load analysis features.
2. **Linux developer.** You have a multicore application with Linux on the master core and SYS/BIOS applications on other cores. You want data about how the SYS/BIOS applications are running, but do not want to modify these applications yourself. You should use the CPU Load, Task Load, and Execution Graph analysis features.
3. **SYS/BIOS application developer (simple case).** You want to analyze default information provided by SYS/BIOS, but do not want to add custom instrumentation code. You may be adding support for RTOS Analyzer to a deployed application. You should use the CPU Load, Task Load, and Execution Graph analysis features.
4. **SYS/BIOS application developer (custom instrumentation).** You want to get additional information about threading and the time required to perform certain threads. In addition to the CPU Load, Task Load, and Execution Graph analysis features, you should use the Duration and Context Aware Profile features.
5. **SYS/BIOS application developer (custom communication).** You want to use RTOS Analyzer and System Analyzer on a multicore platform with a setup that varies from the defaults. You may want to modify the transport or modify the behavior of the ServiceMgr module.

The following table shows tasks that apply to users in the previous list.

Table 3-1. Task Roadmaps for Various Users

User Type	Load Analysis	Execution Analysis	Benchmarking Analysis	SYS/BIOS & UIA Configuration	SYS/BIOS & UIA API Coding	Multicore IPC, NDK, or SysLink setup
1	Yes			*		
2	Yes	Yes		*		Maybe
3	Yes	Yes		Yes		
4	Yes	Yes	Yes	Yes	Yes	Maybe
5	Yes	Yes	Yes	Yes	Yes	Yes

***** A few SYS/BIOS configuration settings need to be modified and applications need to be rebuilt. Users who are not familiar with SYS/BIOS, should ask a SYS/BIOS application developer to make the configuration changes described in Section 5.1.

To learn about the tasks that apply to your needs, see the following sections:

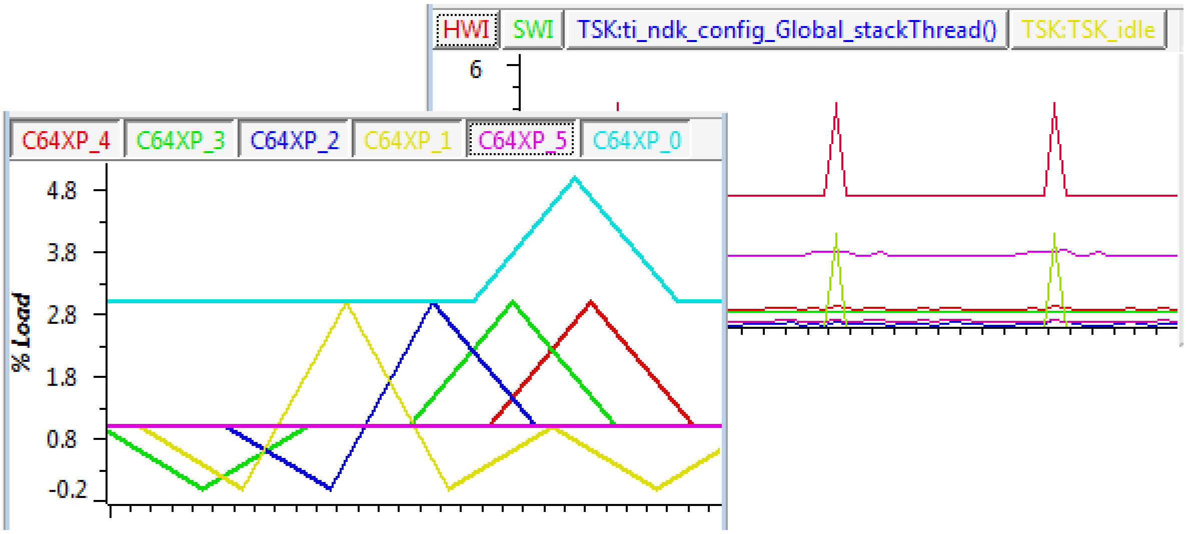
- **Load Analysis.** This includes using the CPU Load and Task Load analysis features. See Section 3.2 for a roadmap.
- **Execution Analysis.** This includes using the Execution Graph, Concurrency, and Task Profiler analysis features. See Section 3.3 for a roadmap.
- **Benchmarking Analysis.** This includes using the Context Aware Profile, Duration, Count Analysis, and Printf Logs features. The target code needs to be modified in order to perform this type of analysis. See Section 3.5 for a roadmap.
- **SYS/BIOS and UIA Configuration.** This involves editing the *.cfg configuration file for the target application either with a text editor or with XGCONF in CCS. See Section 5.1 for the simple setup and Section 5.3 for custom configuration.
- **SYS/BIOS and UIA API Coding.** You can add C code to your target application to provide data to the Context Aware Profile and Duration analysis features. You can also add code for custom instrumentation. See Section 5.4 for details.
- **Multicore IPC, NDK, or SysLink setup.** See Section 5.3.3, *Configuring ti.uia.runtime.ServiceMgr*, Section 5.3.7, *Configuring ti.uia.runtime.LogSync*, Section 5.3.8, *Configuring IPC*, and documentation for IPC, NDK, SysLink, etc.

3.2 Analyzing System Loading with RTOS Analyzer

You can use RTOS Analyzer to perform CPU and Task load analysis on SYS/BIOS applications.

- **CPU Load** is calculated on the target by SYS/BIOS and is based on the amount of time spent in the Idle thread. That is, the CPU Load percentage is the percent of time not spent running the Idle thread.
- **Task Load** is calculated on the target based on the amount of time spent in specific Task threads and in the Hwi and Swi thread-type contexts.

If configured to do so, the target application periodically logs load data on the target and transports it to the host. This data is collected and processed by RTOS Analyzer, which can provide graph, summary, and detailed views of this data.



Performing Load Analysis

Follow these steps to perform load analysis for your application. Follow the links below to see detailed instructions for a particular step.

Step 1: If you have not already done so, install TI-RTOS from the CCS App Center (choose **Help > CCS App Center**). TI-RTOS contains the UIA component.

— See Section 2.1, *Installing UIA as Part of TI-RTOS*

Step 2: Configure your target application so that UIA logging is enabled. Using UIA's LoggingSetup module as described in the first link below automatically enables logging of events related to the CPU and Task load. You can skip the links to more detailed information that follow if you just want to use the default configuration.

— First, see Section 5.1, *Quickly Enabling UIA Instrumentation*.

— For more details, see Section 5.2.1, *Enabling and Disabling Load Logging*.

— For even more details, see Section 5.3, *Customizing the Configuration of UIA Modules*.

Note: If you are analyzing a deployed system or are integrating a system that includes SYS/BIOS applications, the step above may have already been performed by the application developer. If so, you can skip this step.

Step 3: If the application is not already loaded and running, build, load, and run your application.

Step 4: Start a CCS Debugging session with a target configuration to match your setup.

Step 5: Capture instrumentation data using RTOS Analyzer. Note that when you start a session, you can choose to also send the data to a file for later analysis.

— See Section 4.2, *Starting an RTOS Analyzer or System Analyzer Session*.

Step 6: Analyze data using the CPU Load and/or Task Load Analyzer.

— See Section 4.10, *Using the CPU Load View*.

— See Section 4.11, *Using the Task Load View*.

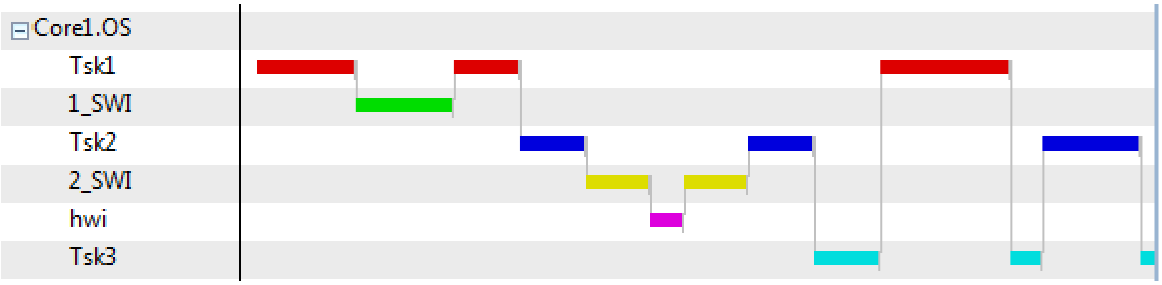
See Also

- Section 4.10.3, *How CPU Load Works*
- Section 4.11.3, *How Task Load Works*
- Section 3.8, *Special Features of RTOS Analyzer and System Analyzer Data Views*
- To troubleshoot data loss: Section 3.6.3, *If RTOS Analyzer and System Analyzer Events are Being Overwritten*

3.3 Analyzing the Execution Sequence with RTOS Analyzer

You can use RTOS Analyzer to perform execution sequence analysis on SYS/BIOS applications. The execution sequence and start/stop benchmarking events are shown in the Execution Graph.

If configured to do so, the target application periodically logs event data on the target and transports it to the host. This data is collected and processed by RTOS Analyzer, which can provide a graph view of this data.



Performing Execution Sequence Analysis

Follow these steps to perform an execution sequence analysis for your application. Follow the links below to see detailed instructions for a particular step.

Step 1: If you have not already done so, install TI-RTOS from the CCS App Center (choose **Help > CCS App Center**). TI-RTOS contains the UIA component.

— See Section 2.1, *Installing UIA as Part of TI-RTOS*

Step 2: Configure your target application so that UIA logging is enabled. Using UIA's LoggingSetup module as described in the first link for this step automatically enables logging of execution sequence events related to Task threads. You can enable execution sequence events for Swi and Hwi threads (which are off by default) as described at the second link. You can skip the links to more detailed information if you just want to use the default configuration.

— First, see Section 5.1, *Quickly Enabling UIA Instrumentation*.

— For more details, see Section 5.2.2, *Enabling and Disabling Event Logging*.

— For even more details, see Section 5.3, *Customizing the Configuration of UIA Modules*.

Note: If you are analyzing a deployed system or are integrating a system that includes SYS/BIOS applications, the previous step may have already been performed by the application developer. If so, you can skip this step.

Step 3: If the application is not already loaded and running, build, load, and run your application.

Step 4: Start a CCS Debugging session with a target configuration to match your setup.

Step 5: Capture instrumentation data using RTOS Analyzer. Note that when you start a session, you can choose to also send the data to a file for later analysis.

— See Section 4.2, *Starting an RTOS Analyzer or System Analyzer Session*.

Step 6: Analyze data using the Execution Graph.

— See Section 4.8, *Using the Execution Graph*.

- If you have a multicore application, you may find the Concurrency view useful for analyzing when the multiple cores are used efficiently. See Section 4.9, *Using the Concurrency Feature*.
- If you have multiple Task threads, you may find the Task Profiler useful for determining how much time each Task spends in various execution states. See Section 4.13, *Using the Task Profiler*.
- You may also find the Count columns in the CPU Load and Task Load summary views useful for analyzing the execution sequence. See Section 4.10.1, *Summary View for CPU Load* and Section 4.11.1, *Summary View for Task Load*.

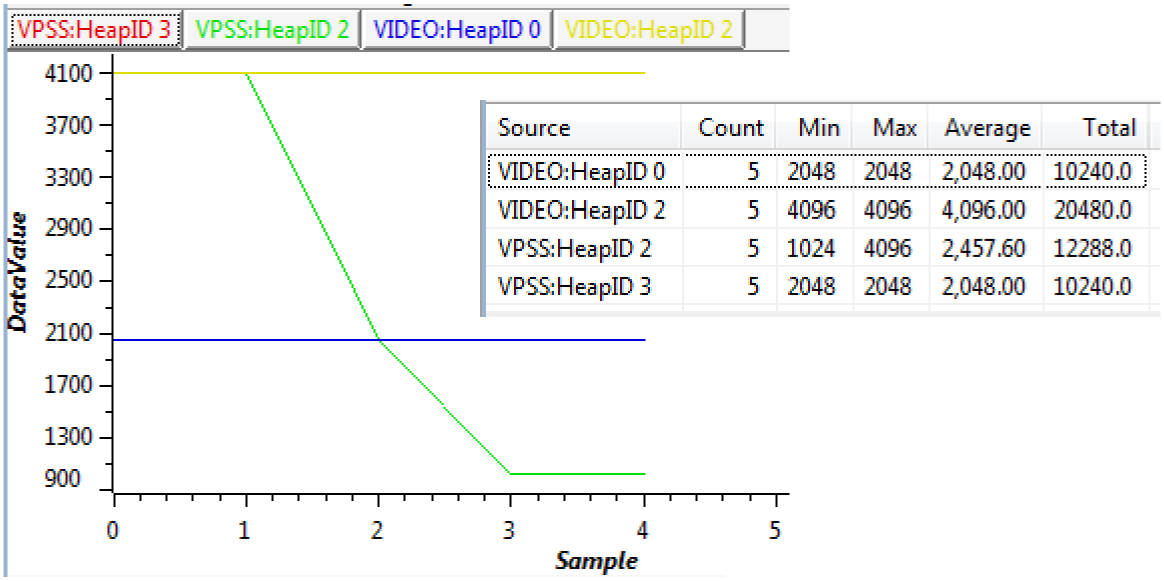
See Also

- Section 4.8.1, *How the Execution Graph Works*
- Section 3.8, *Special Features of RTOS Analyzer and System Analyzer Data Views*
- To troubleshoot data loss: Section 3.6.3, *If RTOS Analyzer and System Analyzer Events are Being Overwritten*

3.4 Performing Count Analysis with System Analyzer

You can use System Analyzer to perform count analysis on SYS/BIOS applications. For example, you might want to use Count Analysis to analyze how a data value from a peripheral changes over time. Or, you might want to find the maximum and minimum values reached by some variable or the number of times a variable is changed. The results are shown in the Count Analysis feature.

In order to use this feature, you will need to add code to your target to log data values for one or more sources. If you do this the target application transports the data to the host. This data is collected and processed by System Analyzer, which can provide graph, summary, and detailed views of this data.



Source	Count	Min	Max	Average	Total
VIDEO:HeapID 0	5	2048	2048	2,048.00	10240.0
VIDEO:HeapID 2	5	4096	4096	4,096.00	20480.0
VPSS:HeapID 2	5	1024	4096	2,457.60	12288.0
VPSS:HeapID 3	5	2048	2048	2,048.00	10240.0

Performing Count Analysis

Follow these steps to perform a count analysis for your application. Follow the links below to see detailed instructions for a particular step.

Step 1: If you have not already done so, install TI-RTOS from the CCS App Center (choose **Help > CCS App Center**). TI-RTOS contains the UIA component.

- See Section 2.1, *Installing UIA as Part of TI-RTOS*

Step 2: Configure your target application so that UIA logging is enabled. Using UIA's LoggingSetup module as described in the first link for this step automatically enables logging of execution sequence events related to Task threads. You can enable execution sequence events for Swi and Hwi threads (which are off by default) as described at the second link. You can skip the links to more detailed information if you just want to use the default configuration.

- First, see Section 5.1, *Quickly Enabling UIA Instrumentation*.
- For more details, see Section 5.2.2, *Enabling and Disabling Event Logging*.
- For even more details, see Section 5.3, *Customizing the Configuration of UIA Modules*.

Note: If you are analyzing a deployed system or are integrating a system that includes SYS/BIOS applications, the previous step may have already been performed by the application developer. If so, you can skip this step.

Step 3: Add code to your target application that logs the UIAEvt_intWithKey event.

- See Section 4.16.3, *How Count Analysis Works*.

Step 4: Build, load, and run your application.

Step 5: Start a CCS Debugging session with a target configuration to match your setup.

Step 6: Capture instrumentation data using System Analyzer. Note that when you start a session, you can choose to also send the data to a file for later analysis.

- Section 4.2, *Starting an RTOS Analyzer or System Analyzer Session*.

Step 7: Analyze data using the Count Analysis feature.

- Section 4.16, *Using the Count Analysis*.
- If you want to perform statistical analysis on the primary and auxiliary data values, export records from the Count Analysis Detail view to a CSV file that can be opened with a spreadsheet. To do this, right-click on the view and choose **Data > Export All**.

See Also

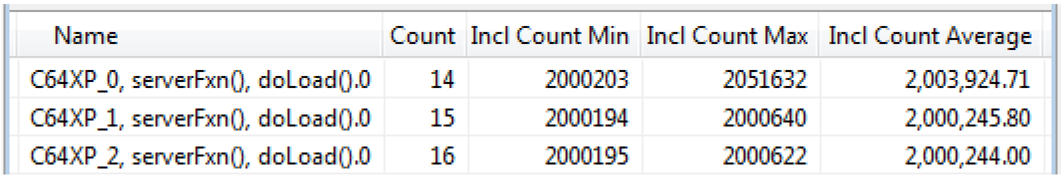
- Section 3.8, *Special Features of RTOS Analyzer and System Analyzer Data Views*
- To troubleshoot data loss: Section 3.6.3, *If RTOS Analyzer and System Analyzer Events are Being Overwritten*

3.5 Benchmarking with System Analyzer

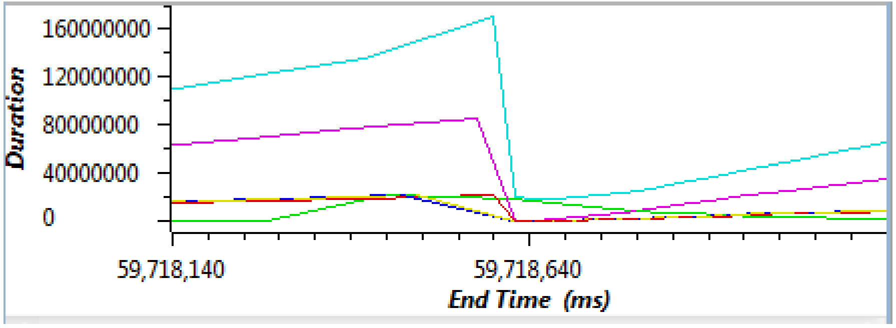
You can use System Analyzer to perform benchmarking analysis on SYS/BIOS applications. The results are shown in the Duration and Context Aware Profile features.

- **Duration Benchmarking.** Use this type of benchmarking if you want to know the absolute amount of time spent between two points in program execution.
- **Context Aware Profiling.** Use this type of benchmarking if you want to be able to measure time spent in a specific thread's context vs. time spent in threads that preempt or are yielded to by this thread.
- **Printf Logs.** Use this type of debugging if you want to send messages about the execution state to CCS.

In order to use these features, you will need to add code to your target to start and stop the benchmarking timer. If you do this the target application transports the data to the host. This data is collected and processed by System Analyzer, which can provide graph, summary, and detailed views of this data.



Name	Count	Incl Count Min	Incl Count Max	Incl Count Average
C64XP_0, serverFxn(), doLoad().0	14	2000203	2051632	2,003,924.71
C64XP_1, serverFxn(), doLoad().0	15	2000194	2000640	2,000,245.80
C64XP_2, serverFxn(), doLoad().0	16	2000195	2000622	2,000,244.00



Performing Benchmarking Analysis

Follow these steps to perform a benchmarking analysis for your application. Follow the links below to see detailed instructions for a particular step.

Step 1: If you have not already done so, install TI-RTOS from the CCS App Center (choose **Help > CCS App Center**). TI-RTOS contains the UIA component.

— See Section 2.1, *Installing UIA as Part of TI-RTOS*

Step 2: Configure your target application so that UIA logging is enabled. Using UIA's LoggingSetup module as described in the first link for this step automatically enables logging of execution sequence events related to Task threads. You can enable execution sequence events for Swi and Hwi threads (which are off by default) as described at the second link. You can skip the links to more detailed information if you just want to use the default configuration.

— First, see Section 5.1, *Quickly Enabling UIA Instrumentation*.

— For more details, see Section 5.2.2, *Enabling and Disabling Event Logging*.

— For even more details, see Section 5.3, *Customizing the Configuration of UIA Modules*.

Note: If you are analyzing a deployed system or are integrating a system that includes SYS/BIOS applications, the previous step may have already been performed by the application developer. If so, you can skip this step.

Step 3: Add benchmarking code to your target application.

- For duration benchmarking, see Section 4.14.3, *How Duration Analysis Works*.
- For context aware profiling, see Section 4.15.2, *How Context Aware Profiling Works*.
- For printf logs, see Section 4.12, *Using the Printf Logs*.

Step 4: Build, load, and run your application.

Step 5: Start a CCS Debugging session with a target configuration to match your setup.

Step 6: Capture instrumentation data using System Analyzer. Note that when you start a session, you can choose to also send the data to a file for later analysis.

- Section 4.2, *Starting an RTOS Analyzer or System Analyzer Session*.

Step 7: Analyze data using the appropriate features.

- Section 4.14, *Using the Duration Feature*.
- Section 4.15, *Using Context Aware Profile*
- Section 4.12, *Using the Printf Logs*

See Also

- Section 3.8, *Special Features of RTOS Analyzer and System Analyzer Data Views*
- To troubleshoot data loss: Section 3.6.3, *If RTOS Analyzer and System Analyzer Events are Being Overwritten*

3.6 Troubleshooting RTOS Analyzer and System Analyzer Connections

The following sections describe issues that might occur as you use RTOS Analyzer and System Analyzer with UIA.

3.6.1 If You Cannot Connect to the Target with Ethernet Transport

If you are using LoggerRunMode with the Ethernet transport and cannot connect to the target, check the following items:

- Verify that the UIA configuration specifies the correct transports.
- Verify that the configuration code for the target application includes the ti.uia.services.Rta module. You can use the **Tools > RTOS Object View (ROV)** menu command in a CCS debugging session to confirm this.
- Verify that the correct transport functions were selected. You can do this by looking at the ti.uia.sysbios.Adaptor (or IpcMP) transport functions.

3.6.2 If No Events are Shown in RTOS Analyzer and System Analyzer Features

If you can connect to the target, but no events are shown in the Session or File Log view, check the following items:

- Confirm that the target application is using ti.uia.sysbios.LoggingSetup or one of the UIA loggers.
- Confirm that events are being logged. You can check this by using the RTOS Object View (ROV) tool to look at the Logger module used by your application. The "serial" field should be non-zero and increasing.
- If the application is using LoggerRunMode with the Ethernet transport, confirm that the UIA task is not being starved. You can check this by using the ROV tool to look at the ti.uia.runtime.ServiceMgr module. The "runCount" in the Proxy tab should be incrementing.
- Confirm that you've enabled logging by setting the common$.Diags mask accordingly in your configuration file. See Section 5.2.2. **Note:** If you used ti.uia.sysbios.LoggingSetup in your application's configuration, the Diags masks should have been configured automatically.

3.6.3 If RTOS Analyzer and System Analyzer Events are Being Overwritten

If you can connect to the target and events are shown in the Session or File Log view, events may still be overwritten. The status bars in RTOS Analyzer and System Analyzer views tell how many records are shown and how many gaps occurred.

To prevent events from being overwritten, try one or more of the following:

- Increase the logger buffer size.
- Increase the frequency of Rta by lowering its period. The minimum is 100ms.
- Reduce the number of logged events.
- If this is a multicore application, increase the number of event packets on the non-master processors. This allows UIA to move the records off in a faster manner. For example:

```
ServiceMgr.numEventPacketBufs = 4;
```

3.6.4 If RTOS Analyzer and System Analyzer Packets are Being Dropped

If UIA packets are being dropped, examine your configuration of IPC, NDK, or other communications software.

3.6.5 If Events Stop Being Shown Near the Beginning

For a multicore system, check the status message at the bottom of the Session or File Log View. If the message says "Waiting UIA SyncPoint data", it is possible that the critical SyncPoint events were dropped in transport. Try using the **Stop** and **Run** commands.

3.6.6 If Data is Not Correlated for Multicore System

The following situations can cause correlation (out-of-sequence) errors:

- **The clock setting is not correct.** Each core has clock settings (local and global) that are used to convert from local to global time. If any setting is incorrect, the global time conversion will be off and will affect the system-level correlation. Check the clock settings on the target side.

- **SyncPoint is not logged properly.** For a multicore platform, there must be a common global timer that each core can reference. If there is no global timer available or it is not configured properly, the converted global time in each core may not be correct. Also, since most global timers have a lower clock frequency, time precision may be lost with respect to the core's local timer. Check the SyncPoint events reported at the beginning of the log.
- **Transport delay.** Under certain conditions, some logs may be transported to the host computer with a huge delay. In this case, some old data may be received after newer data has been reported. Check the transport, especially when using UDP. If the transport is not reliable for a live data stream, specify a binary file to contain the live data. After the data has been captured, open the binary file to analyze the results.

3.6.7 *If the Time Value is Too Large*

If the Time value shown in the logs is much larger than you expect, you should power-cycle the target board or perform a system reset before testing the application.

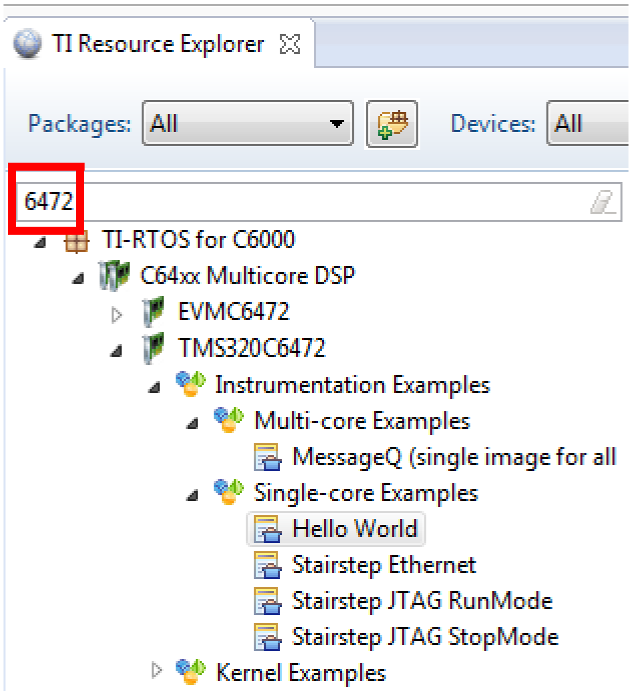
3.7 Creating Sample RTOS Analyzer and System Analyzer Projects

System Analyzer provides examples that you can import as CCS project from the TI Resource Explorer. These examples have UIA enabled, so that you can use them with RTOS Analyzer.

To import an example, follow these steps:

1. Open CCS. If you do not see the TI Resource Explorer area, make sure you are in the CCS Edit perspective and choose **View > TI Resource Explorer**.
2. Type part of the name of your device in the "enter search keyword" field to hide all the examples that don't apply to your device.
3. Expand the **TI-RTOS** item until you see the Instrumentation Examples for your device. For example, if you type "6672" in the search field, you can expand the tree to see a list of examples similar to the one shown here.

   Not all devices have instrumentation (UIA) examples. If there is no instrumentation example for your device, you can use a kernel (SYS/BIOS) example and modify the example by enabling UIA's LoggingSetup module as described in Section 5.1, *Quickly Enabling UIA Instrumentation*.



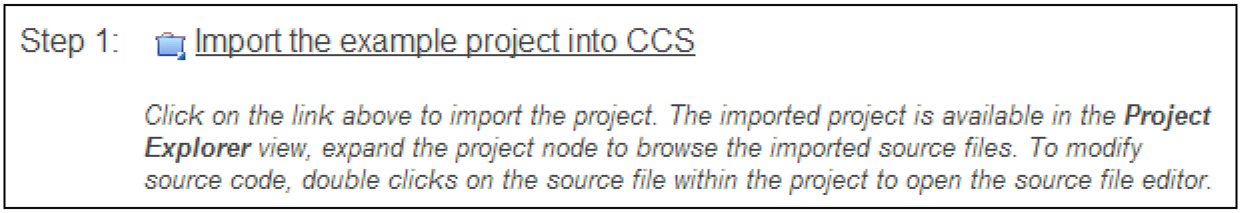
Packages: All

Devices: All

6472

4. Select the example you want to create. A description of the selected example is shown to the right of the example list.

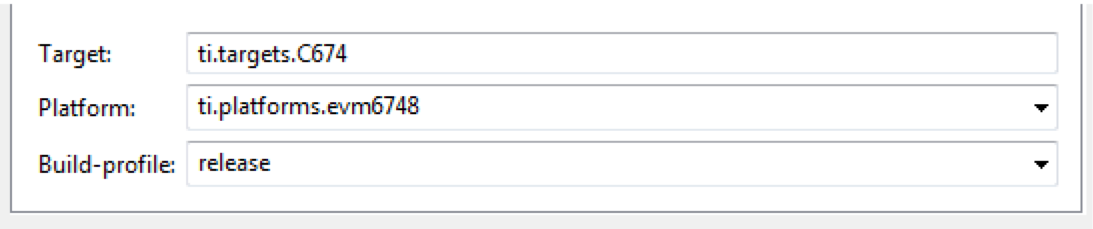
5. Click the **Step 1** link in the right pane of the TI Resource Explorer to **Import the example project into CCS**. This adds a new project to your Project Explorer view. Once you have completed a step for a particular example and device, a green checkmark is shown next to that step.



Step 1: Import the example project into CCS

*Click on the link above to import the project. The imported project is available in the **Project Explorer** view, expand the project node to browse the imported source files. To modify source code, double clicks on the source file within the project to open the source file editor.*

6. For some examples, you see a RTSC Configuration Settings dialog because the board is not defined for the example. Click the **Platform** field. A message says platforms are being loaded. Then, click again on the **Platform** field and select your board from the list as shown in the following figure. If your board is not shown, choose the closest option or a generic board. Then click **Finish**.

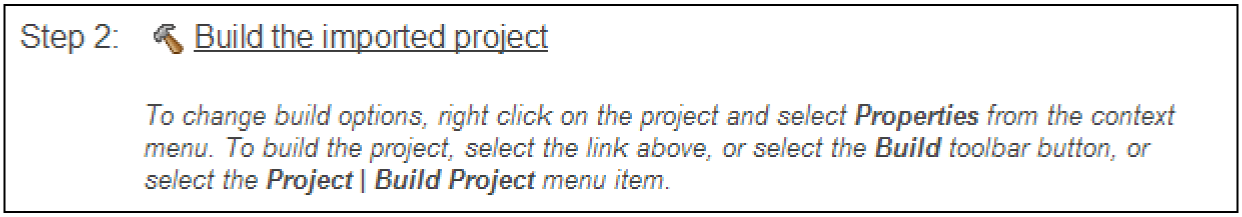


Target: ti.targets.C674
Platform: ti.platforms.evm6748
Build-profile: release

7. The project created will have a name with the format <*example_name*>_<*device*>. You can expand the project to view or change the source code and configuration file.

8. The page shown when you select an example in the TI Resource Explorer provides additional links to perform common actions with that example.

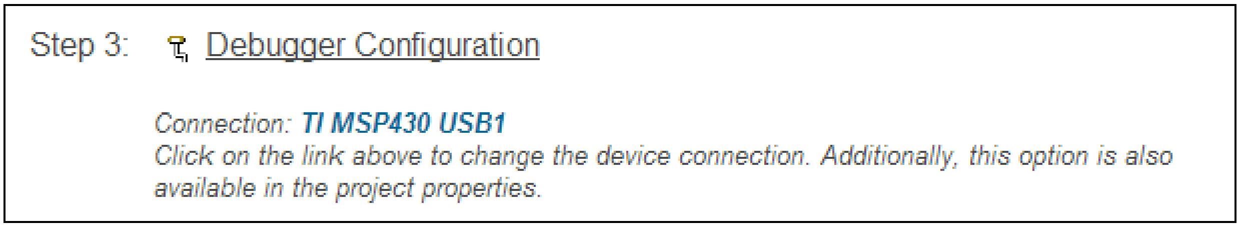
9. Use the **Step 2** link when you are ready to build the project. If you want to change any build options, right click on the project and select **Properties** from the context menu. For example, you can change compiler, linker, and RTSC (XDCtools) options.



Step 2: Build the imported project

*To change build options, right click on the project and select **Properties** from the context menu. To build the project, select the link above, or select the **Build** toolbar button, or select the **Project | Build Project** menu item.*

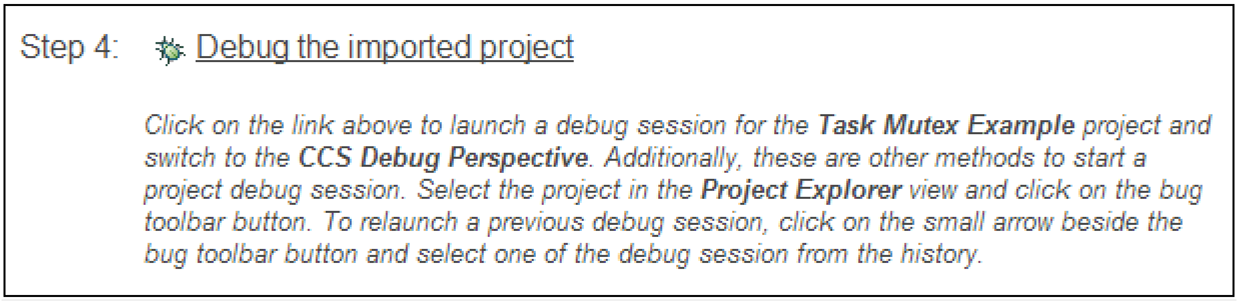
10. Use the **Step 3** link to change the connection used to communicate with the board. The current setting is shown in the TI Resource Explorer page for the selected example.



Step 3: Debugger Configuration

*Connection: **TI MSP430 USB1***
Click on the link above to change the device connection. Additionally, this option is also available in the project properties.

11. Use the **Step 4** link to launch a debug session for the project and switch to the **CCS Debug** Perspective.



Step 4: Debug the imported project

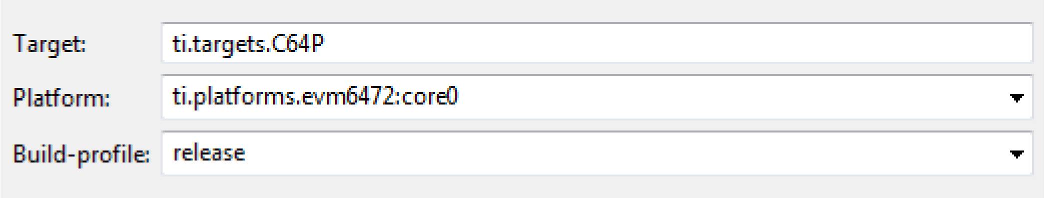
Click on the link above to launch a debug session for the ***Task Mutex Example*** *project and switch to the* ***CCS Debug Perspective****. Additionally, these are other methods to start a project debug session. Select the project in the* ***Project Explorer*** *view and click on the bug toolbar button. To relaunch a previous debug session, click on the small arrow beside the bug toolbar button and select one of the debug session from the history.*

See the sections that follow for any specific notes about settings or changes you need to make to the project files before building, loading, and running it.

3.7.1 Notes for EVM6472 MessageQ Project Templates

In the TI Resource Explorer, select the "evm6472: MessageQ" template. This example shows how to use IPC's MessageQ module with UIA. The same image must be loaded on all cores.

The RTSC Configuration Settings page automatically has the correct RTSC Target, Platform, and Build-Profile set.



Target: ti.targets.C64P
Platform: ti.platforms.evm6472:core0
Build-profile: release

After creating the project, examine the message.c and message.cfg files.

In the message.c file, notice the two calls to Log_write2() in tsk0_func(), which runs only on CORE0. The calls to Log_write2() pass event types of UIABenchmark_start and UIABenchmark_stop. These are used to bracket the code that uses MessageQ to send and receive a message from a remote processor.

In the message.cfg file, notice that the LoggingSetup module is configured to use the LoggerType_RUNMODE mode. This mode uses Ethernet as the default transport to move Log records to CCS via the UIA ServiceMgr framework. This example configures the ServiceMgr module to use a multicore topology. All the cores route their data to the ServiceMgr module running on Linux. The configuration also contains a section that configures the NDK, which is used by the Ethernet transport.

UIA ships pre-built EVM6472 Ethernet drivers. The libraries are in the <*uia_install*>\packages\ti\uia\examples\evm6472\ndkdrivers directory. These libraries were copied out of the PDK_1_00_00_05 package. This was done to make building the examples easier.

Within the configuration file of EVM6472 example, the following line gets the pre-built Ethernet libraries and includes them in the build. If you have an updated PDK, simply remove this statement and add the libraries into the project (or follow the instructions with the PDK).

```
var ndkdrivers = xdc.loadPackage('ti.uia.examples.evm6472.ndkdrivers');
```

Note that the NDK currently supports only the COFF format.

You can use the following RTOS Analyzer and System Analyzer analysis features when running this example: CPU Load, Task Load, Execution Graph, Duration, and Context Aware Profile.

3.7.2 Notes for Single-Core Stairstep Project Templates

In the TI Resource Explorer, choose a single-core "Stairstep" template for your device. These examples use Hwi, Swi, and Task threads run to add to the CPU load of the system. This example periodically generates log events.

Each of the examples uses a different transport mode. These modes are configured by setting the LoggingSetup.loggerType parameter.

The following list provides notes that apply to specific versions of this example:

- **Stairstep Ethernet.** This template is configured for use on the EVM6472 with NDK. Within the configuration file, the following line gets the pre-built Ethernet libraries and includes them in the build. If you have an updated PDK or are using a different device, simply remove this statement and add the libraries into the project (or follow the instructions with the PDK). See Section 3.7.1 for more about using the NDK with an application for the EVM6472.

  ```
  var ndkdrivers = xdc.loadPackage('ti.uia.examples.evm6472.ndkdrivers');
  ```

- **Stairstep JTAG RunMode.** This mode is only supported on CPUs that support real-time JTAG access. This support is provided on the C64x+ and C66x CPUs. When the LoggerType_JTAGRUNMODE is used, the UIA ServiceMgr framework and NDK are not used.
- **Stairstep JTAG StopMode.** The JTAG StopMode template is not-platform specific. This template does not use the UIA ServiceMgr framework or the NDK.

In the Stairstep example, the cpuLoadInit() function gets the CPU frequency and fills arrays with load values corresponding to 0, 25, 50, 75, and 95 percent CPU loads. The timerFunc() function is a Hwi thread that runs every 100ms to launch a Hwi, Swi, and Task thread. Each thread then performs a doLoad() function before relinquishing the CPU. After staying at each load setting for 5 seconds, timerFunc() calls the step() function to advance to the next set of Hwi, Swi, and Task load values. The cycle repeats after reaching the 95 percent load.

You can use the following RTOS Analyzer analysis features when running these examples: CPU Load, Task Load, and Execution Graph.

3.8 Special Features of RTOS Analyzer and System Analyzer Data Views

RTOS Analyzer and System Analyzer provide three types of data views for working with collected data. Each type of data view has some power features you can use to navigate, analyze, and find points of interest. The sections that follow provide help on using the special features of these data views.

- **Table Views** are used to display data in a table. Table views are used for Summary and Detail views in RTOS Analyzer and System Analyzer.
- **Line Graphs** are used for x/y plotting, mainly for viewing changes of a variable against time. RTOS Analyzer and System Analyzer use line graphs for all graphs except the Execution Graph and Concurrency Graph.
- **DVT Graphs** depict state transitions and events against time. Groups of related states form a timeline for a core or thread. Different types of data are assigned different colors. RTOS Analyzer uses this graph type for the Execution Graph.

Special features provided for these view types are as follows:

- **Views** drop-down lets you open additional views of this data. For example, you can open the Summary or Detail view from a Graph view.
- **Groups and Synchronous Scrolling** causes several views to scroll so that data from the same time is shown. See Section 3.8.4.
- **Measurement Markers (graphs only)** measure distances in a graph. See Section 3.8.2.
- **Bookmarks** highlight certain rows and provide ways to quickly jump to marked rows. See Section 3.8.3.
- **Zoom (graphs only)** adjusts the scaling of the graph. See Section 3.8.1.
- **Auto Fit (tables only)** adjusts table column widths to display complete values.
- **Find** lets you search this view using a field value or expression. See Section 3.8.5.
- **Filter** lets you display only data that matches a pattern you specify using the Set Filter Expression dialog. See Section 3.8.6.
- **Scroll Lock** controls scrolling due to updates. See Section 3.8.8.
- **Column Settings** lets you control which columns are displayed and how they are shown. See Section 3.8.9.
- **Tree Mode** toggles between flat and tree mode on y-axis labels in the Execution Graph. See Section 4.8.
- **Data > Export** (in the right-click menu) sends selected data to a CSV file. See Section 3.8.7.

Also see page 4–51 and page 4–62 for additional descriptions of toolbar icons, including those shown only in the Session or File Log view.

3.8.1 Zoom (Graphs Only)

Zooming is only available in graph views. You can zoom in or out on both the x- and y-axis in line graphs. For DVT graphs (like the Execution Graph), you can only zoom on the x-axis.

You can zoom using any of these methods:

Using the Mouse

- Hold down the **Alt** key and drag the mouse to select an area on the graph to expand.
- Drag the mouse to the left or below the graph where the axis units are shown (without holding the Alt key) to select a range to expand.
- Click on the x-axis legend area below the graph and use your mouse scroll wheel to zoom in or out.

Using the Keyboard

- Press **Ctrl +** to zoom in.
- Press **Ctrl -** to zoom out.

Using the Toolbar

- The **Zoom In** toolbar icon increases the graph resolution to provide more detail. It uses the zoom direction and zoom factor set in the drop-down.
- The **Zoom Out** toolbar icon decreases the graph resolution to provide more detail. It uses the zoom direction and zoom factor set in the drop-down.
- The **Reset Zoom** toolbar icons resets the zoom level of the graph to the original zoom factor.
- The **Select Zoom Options** drop-down next to the Reset Zoom icon lets you select the zoom factor and directions of the zoom for a line graph. By default, zooming affects both the x- and y-axis and zooms by a factor of 2. You can choose options in this drop-down to apply zooming to only one axis or to zoom by factors of 4, 5, or 10.

Note: When you use the keyboard, scroll-wheel, or toolbar icons for zooming, the cursor position is used as the center for zooming. If there is no current cursor position, the center of the graph is used. To set a cursor position, click on the point of interest on the graph area. This places a red line or cross-hair on the graph, which is used for zooming.

3.8.2 Measurement Markers (Graphs Only)

Use the **Measurement Marker Mode** toolbar icon to add a measurement marker line to a view. A measurement marker line identifies the data value at a location and allows you to measure the distance between multiple locations on a graph.

Click the icon to switch to Measurement mode. Then, you see marker lines as you move the mouse around the graph. You can click on the graph to add a marker at that position. You stay in the "add marker" mode until you add a marker or click the Measurement Marker icon again.

The legend area above the graph shows the X and Y values of markers. Right-click inside the graph to enable or disable the **Legend** from the shortcut menu.

If you create multiple measurement markers, the legend also shows the distance (or delta) between consecutive data points. For example, as:

```
X2-X1 = 792  Y1-Y2 = 2.4
```

To add a marker, move the mouse to a graph location, right-click and select **Insert Measurement Mark**.

To move a marker to a different location on the graph, hold down the Shift key and drag a marker to a new location.

To remove a marker from the view, right-click on the graph, select **Remove Measurement Mark** and click on an individual marker. Or, double-click on a measurement marker to remove it. To remove all the markers, right-click on the graph and select **Remove All Measurement Marks**.

The drop-down menu to the right of the Measurement Marker icon allows you to select marker modes:

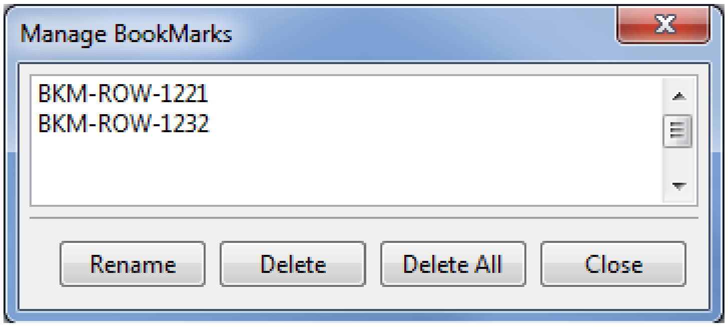
- **Freeform** is the default mode, which lets you add a marker line at any point on the view.
- **Snap to Data** forces you to add markers only at data points. When you move the mouse over the graph in this mode, you see circles on the four closest data points and a dot on the closest data point. Click on the graph to add a marker at the closest data point.
- **X-axis/Y-axis/Both** determines whether placing a marker adds lines that intersect the x-axis, the y-axis, or both axes.

3.8.3 Bookmarks

Use the ☆ **Bookmarks** toolbar icon to create a bookmark on any data point of a graph or table. The bookmark will be displayed as a vertical red dashed line in a graph or a row with a red background in a table.

You can use the drop-down next to the ☆ icon to jump to a previously created bookmark. Each bookmark is automatically assigned an ID string. A bookmarks applies only to the view in which you created it.

Choose **Manage the Bookmarks** from the drop-down list to open a dialog that lets you rename or delete bookmarks.



BKM-ROW-1221
BKM-ROW-1232

3.8.4 Groups and Synchronous Scrolling

You can group data views together based on common data such as time values. Grouped views are scrolled synchronously to let you easily navigate to interesting points. For example, if you group the CPU load graph with the Session or File Log view, then if you click on the CPU Load graph, the Session or File Log view displays the closest record to where you clicked in the graph.

To enable grouping, toggle on the **View with Group** icon on the toolbar. Then, simply move the cursor in a grouped table or on a graph as you normally would.

For graphs, the x-axis is used for the common reference value. For tables you can define the reference column. Also, you can use the drop-down to define multiple view groups.

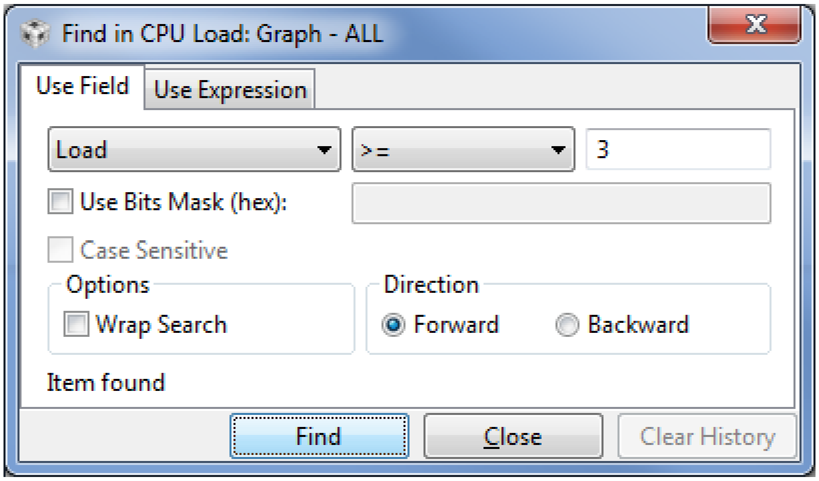
In graphs you can use the **Align Horizontal Center** and **Align Horizontal Range** icons to determine whether this view should be grouped according to the center value currently displayed on the x-axis or the full range of values displayed on the x-axis.

3.8.5 Find

Click to open a dialog that lets you locate a record containing a particular string in one of the fields or a record whose fields satisfy a particular expression. Clicking **Find** repeatedly moves you through the data to each instance of the desired value or string.

The **Use Field** tab is best for simple searches that compare a field value using common operators such as ==, <, != etc. Follow these steps in the **Use Field** tab:

1. Click the **Find** icon in the toolbar.
2. Select the **Use Field** tab.



Find in CPU Load: Graph - ALL

Load ▾ >= ▾ 3

□ Use Bits Mask (hex):

□ Case Sensitive

Options: □ Wrap Search

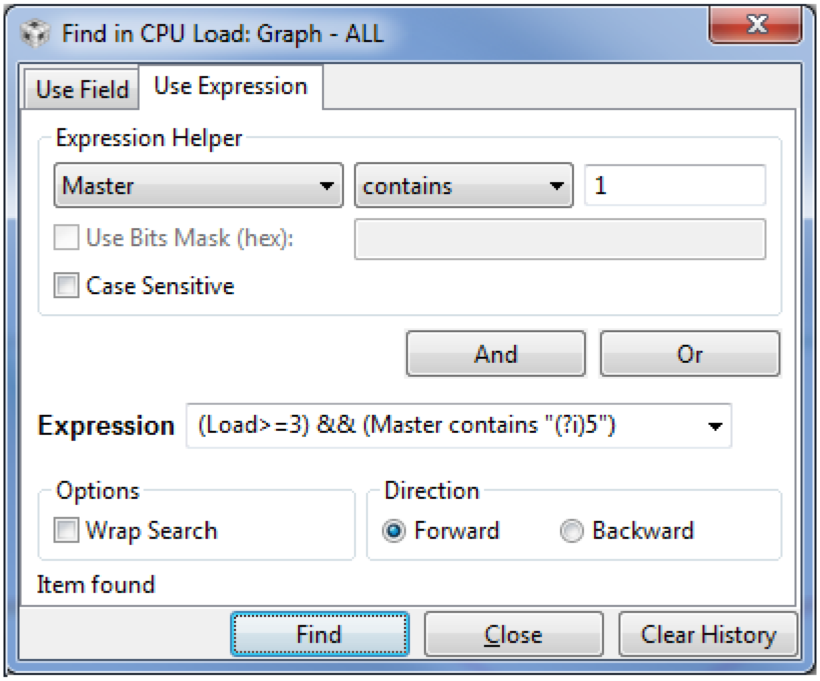
Direction: ● Forward ○ Backward

Item found

3. Select a field name from the left drop-down list. This list shows all the data columns used in the detail view for this analysis feature.
4. Select an operation from the middle drop-down list. The operators depend on the datatype for the field you selected.
5. Type a field value for the comparison in the text box.
6. [Optional] Check the **Use Bits Mask (hex)** box and specify a hexadecimal bit mask in the adjacent field if you want to exclude a portion of a value from consideration.
7. [Optional] Check the **Case Sensitive** box if you want a case-sensitive search.
8. [Optional] Check the **Wrap Search** box if you want to continue searching from the top of the table once the end is reached.
9. [Optional] Select a **Direction** option for the search.
10. Click **Find** to start the search.

The **Use Expression** tab lets you enter a regular expression for pattern matching and lets you combine expressions with Boolean operators. Follow these steps in the **Use Expression** tab:

1. Click the **Find** icon in the toolbar.
2. Select the **Use Expression** tab.



Find in CPU Load: Graph - ALL

Use Field | Use Expression

Expression Helper

Master ▾ contains ▾ 1

□ Use Bits Mask (hex):

□ Case Sensitive

Expression (Load>=3) && (Master contains "(?i)5") ▾

Options

□ Wrap Search

Direction

● Forward ○ Backward

Item found

3. Create a regular expression within the **Expression** text box. Visit the link for info on creating expressions used to find data. You can type a regular expression directly or use the Expression Helper to assemble the expression. To use the Expression Helper, follow these sub-steps:
   - Select a field name from the left drop-down list. This list shows all data columns used in the detail view for this analysis feature.
   - Select an operation from the middle drop-down list. The operators depend on the datatype for the field you selected.
   - Type a field value for the comparison in the text box.
   - [Optional] Check the **Use Bits Mask (hex)** box and specify a hexadecimal bit mask in the adjacent field if you want to exclude a portion of a value from consideration.
   - [Optional] Check the **Case Sensitive** box if you want a case-sensitive search.
   - Click **And** or **Or** to create the regular expression and add it to the existing statement in the **Expression** text box.
4. [Optional] Check the **Wrap Search** box if you want to continue searching from the top of the table once the end is reached.
5. [Optional] Select a **Direction** option for the search.
6. Click **Find** to start the search.

To clear the drop-down list of previously searched items in the **Expression** field, click **Clear History**.

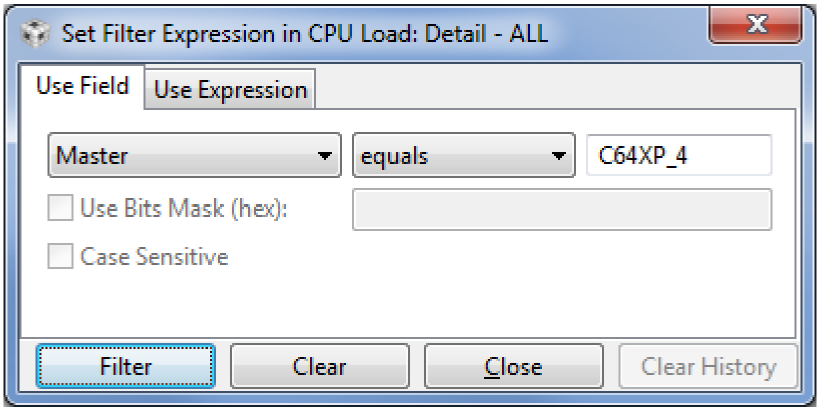
Information about regular expression syntax is widely available on the web.

3.8.6 Filter

Click ⇛ to open a dialog that filter the view to display only records that contain a particular string in one of the fields or records whose fields satisfy a particular expression.

The **Use Field** tab is best for simple filters that compare a field value using common operators such as ==, <, != etc. Follow these steps in the **Use Field** tab:

1. Click the ⇛ **Filter** icon in the toolbar.
2. Select the **Use Field** tab.



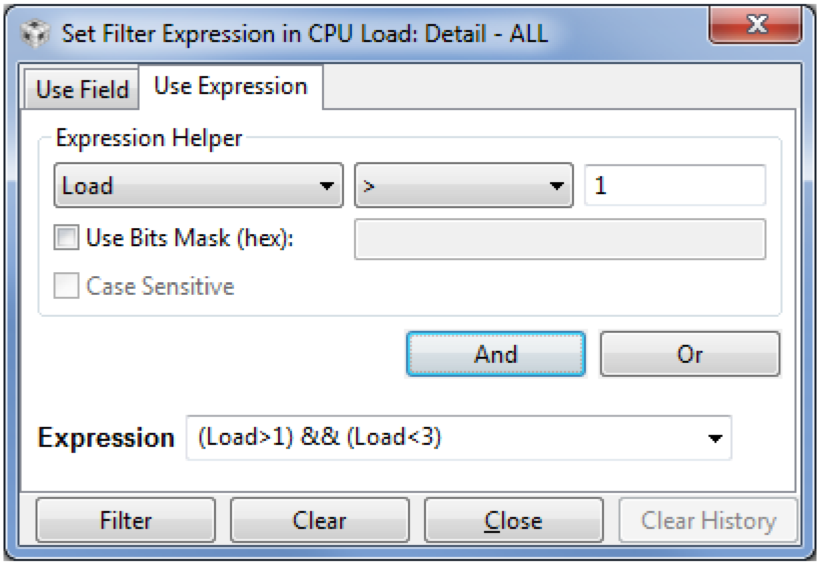
Set Filter Expression in CPU Load: Detail - ALL

Master | equals | C64XP_4

3. Select a field name from the left drop-down list. This list shows all the data columns used in the detail view for this analysis feature.
4. Select an operation from the middle drop-down list. The operators depend on the datatype for the field you selected.
5. Type a field value for the comparison in the text box.
6. [Optional] Check the **Use Bits Mask (hex)** box and specify a hexadecimal bit mask in the adjacent field if you want to exclude a portion of a value from consideration.
7. [Optional] Check the **Case Sensitive** box if you want a case-sensitive filter.
8. Click **Filter** to limit the records or data points displayed.

The **Use Expression** tab lets you enter a regular expression for pattern matching and lets you combine expressions with Boolean operators. Follow these steps in the **Use Expression** tab:

1. Click the **Filter** icon in the toolbar.
2. Select the **Use Expression** tab.



Set Filter Expression in CPU Load: Detail - ALL

Expression Helper

Load > 1

☐ Use Bits Mask (hex):

☐ Case Sensitive

Expression (Load>1) && (Load<3)

3. Create a regular expression within the **Expression** text box. Visit the link for info on creating expressions used to filter data. You can type a regular expression directly or use the Expression Helper to assemble the expression. To use the Expression Helper, follow these sub-steps:
   - — Select a field name from the left drop-down list. This list shows all data columns used in the detail view for this analysis feature.
   - — Select an operation from the middle drop-down list. The operators depend on the datatype for the field you selected.
   - — Type a field value for the comparison in the text box.
   - — [Optional] Check the **Use Bits Mask (hex)** box and specify a hexadecimal bit mask in the adjacent field if you want to exclude a portion of a value from consideration.
   - — [Optional] Check the **Case Sensitive** box if you want a case-sensitive search.
   - — Click **And** or **Or** to create the regular expression and add it to the existing statement in the **Expression** text box.
4. Click **Filter** to limit the records or data points displayed.

To clear the drop-down list of previously searched items in the **Expression** field, click **Clear History**.

Information about regular expression syntax is widely available on the web.

3.8.7 Export

You can save data in a table or graph view to an external file by using the **Data > Export** commands. All columns contained in the table (not just the displayed columns) and the displayed graph numbers are placed into a comma-separated value file format (*.csv filename extension).

Numeric values are stored in the CSV format using a general format. You can use spreadsheet software such as Microsoft Excel to perform additional computations or create annotated charts from the exported information.

To export data to an external CSV file:

1. Select a table or a graph view.
2. If you want to export only some rows from a table view, hold down the Shift key and select a range of rows or hold down the Ctrl key while selecting multiple rows.
3. Right-click on the table or graph and select **Data > Export All** or **Data > Export Selected** from the right-click menu.
4. In the Save As dialog, browse for the location where you want to save the file and type a filename. Click **Save**.
5. Open the file you created using a spreadsheet or other software program. Alternately, you can later reopen the CSV file in an RTOS Analyzer or System Analyzer session as described in Section 4.6.1.

3.8.8 Cursor and Scroll Lock

Data views scroll to the end whenever new data is received. If you click on a point in a graph or table while data is updating, automatic scrolling is stopped, even though data is still being added at to the end.

To continue scrolling to the end automatically, toggle off the **Scroll Lock** button on the toolbar.

Note that if you have enabled grouping (the icon is toggled on), the scroll lock icon does not lock the scrolling of grouped views.

Use the **Freeze Update** command in the right-click menu to freeze the data updates and automatic refreshing completely.

3.8.9 Column Settings and Display Properties

Right-click on an RTOS Analyzer or System Analyzer table view and choose **Column Settings**. You can choose which columns to make visible in the table by checking boxes for those fields. For most views, you can choose how each column should be formatted (for example, as binary, decimal, hex, or time), how to justify (align) the column, the font for the column, and whether to display a vertical bar corresponding to the size of the value.

Right-click on an RTOS Analyzer or System Analyzer graph view and choose **Display Properties**. You can choose which channels (rows or data sets) to make visible in the table by checking boxes for those fields. For most views, you can choose whether each channel is visible and expanded. You can also change other aspects of how the graph is displayed.

Chapter 4

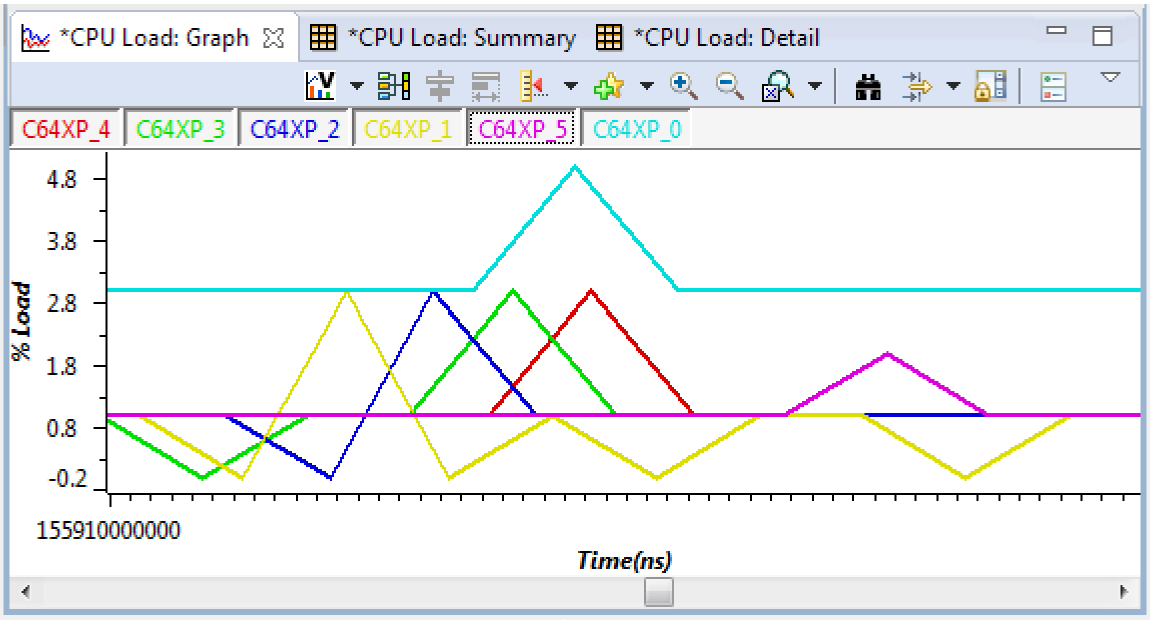
Using RTOS Analyzer and System Analyzer

This chapter describes the host-side analysis features provided in Code Composer Studio for examining instrumentation data sent to the host.

Topic **Page**

4.1 Overview of RTOS Analyzer and System Analyzer Features

The **Tools > RTOS Analyzer** and **Tools > System Analyzer** menus in CCS provide a number of analysis features you can use when debugging your UIA-enabled application. You can view CPU and thread loads, the execution sequence, thread durations, context profiling, and more. The features include graphs, detailed logs, and summary logs.



You can use these features at run-time and can also record the run-time data for later analysis.

- **Run-time analysis.** Real-time data analysis can be performed without the need to halt the target program. This ensures that actual program behavior can be observed, since halting multiple cores can result in threading that differs from real-time behavior.
- **Recording and playback of data.** You can record real-time data and later reload the data to further analyze the activity. RTOS Analyzer and System Analyzer lets you record and playback using both CSV and binary files.

This chapter describes how to start data collection and analysis. It also describes how to use specific RTOS Analyzer and System Analyzer features.

To gather data, you need an instrumented application running on the target(s). If you have not done so already, enable UIA logging by configuring the application as described in Section 5.1, *Quickly Enabling UIA Instrumentation*. Once you have enabled UIA logging, SYS/BIOS applications provide UIA data to the RTOS Analyzer and System Analyzer features in CCS.

4.2 Starting an RTOS Analyzer or System Analyzer Session

To gather live data, you need an instrumented application running on the target(s). If it has not already been done, enable UIA logging by configuring the application as described in Section 5.1, *Quickly Enabling UIA Instrumentation*. Once you have enabled UIA logging, SYS/BIOS applications provide UIA data to the RTOS Analyzer and System Analyzer features in CCS.

You may want to create a CCS target configuration and make it the default. This enables System Analyzer to auto-configure your session. (Alternatively, you can create a UIA configuration and save it to a file as described in Section 4.5. If you use a configuration from a file, you do not need to be running a CCS debugging session, because System Analyzer data is collected via Ethernet transports rather than streaming JTAG.)

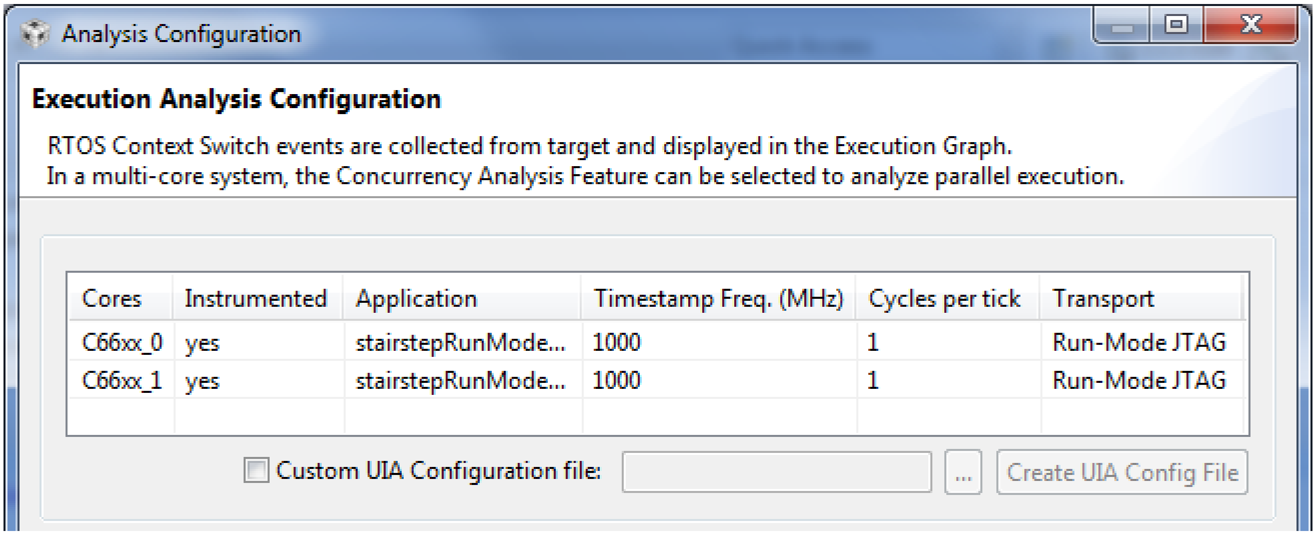
To start a live RTOS Analyzer or System Analyzer session, follow these steps:

1. Load your UIA-enabled application in CCS and move to **CCS Debug** mode.
2. Choose a command from the **Tools > RTOS Analyzer** or **Tools > System Analyzer** menu. The items in the **RTOS Analyzer** menu generally do not require any changes to your application beyond enabling UIA. The items in the **System Analyzer** menu do require code changes in order to perform the additional logging needed for these types of analysis.
3. You will see the Analysis Configuration dialog. The default Analysis Feature for the command you select will be checked. The commands available are as follows:

Table 4–1. Analyzer Menu Commands and View Names

RTOS Analyzer Menu Command	View Name	See Section
Execution Analysis	Execution Graph	Section 4.8
Load Analysis	CPU Load and Task Load	Section 4.10 and Section 4.11
Printf and Error Logs	Printf Logs	Section 4.12
Task Profiler	Task Profiler	Section 4.13
--	Concurrency	Section 4.9
System Analyzer Menu Command	**View Name**	**See Section**
Duration Analysis	Duration	Section 4.14
Function Profiler	Context Aware Profile	Section 4.15
Statistical Analysis	Count Analysis	Section 4.16

4. The top section of the dialog shows the core and application running in the current debug session. By default, this information is automatically discovered using the current CCS target configuration, the *.out file that is currently loaded, and auto-detected IP addresses.



Analysis Configuration

Execution Analysis Configuration

RTOS Context Switch events are collected from target and displayed in the Execution Graph.
In a multi-core system, the Concurrency Analysis Feature can be selected to analyze parallel execution.

Cores	Instrumented	Application	Timestamp Freq. (MHz)	Cycles per tick	Transport
C66xx_0	yes	stairstepRunMode...	1000	1	Run-Mode JTAG
C66xx_1	yes	stairstepRunMode...	1000	1	Run-Mode JTAG

☐ Custom UIA Configuration file:

You are prompted for any settings that can’t be determine from the loaded application and target configuration. The dialog can get port information faster if you leave the application running when starting an analysis feature. If the application is halted at a breakpoint or paused, it may take about 30 seconds to get the list of ports.

— **Cores:** The auto-detected target cores or cores defined in the UIA configuration file are listed in this column. If this is a multicore device and multiple cores are running in the debugger, there are multiple rows.

— **Instrumented:** If this application has UIA’s LoggingSetup module enabled, this column says "yes".

— **Application:** This column shows the filename for the *.out file being run on this core.

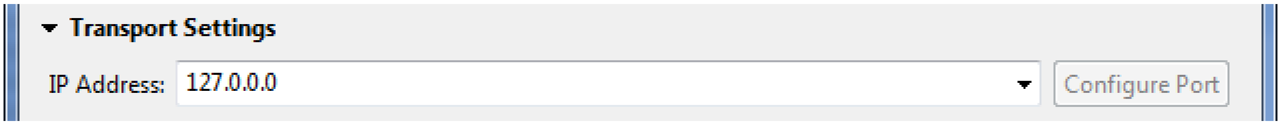
— **Timestamp Freq. (MHz):** This column shows the frequency of the timer used for generating timestamps. In the configuration, UIA uses BIOS.getTimestampFreqMeta() to get this value. SYS/BIOS gets the Timestamp frequency from the xdc.runtime.Timestamp delegate.

— **Cycles per tick:** This column shows the number of CPU cycles per Timestamp timer’s tick.

— **Transport:** This column shows the transport specified by the application’s *.cfg configuration file. The options are listed in Table 1–1.

5. If you want to change any of the detected settings, check the **Custom UIA Configuration file** box. You can click "..." to browse for an existing UIA configuration (a *.usmxml file) or click **Create UIA Config File** to create a new configuration file. See Section 4.5 to learn about creating UIA Configuration files.

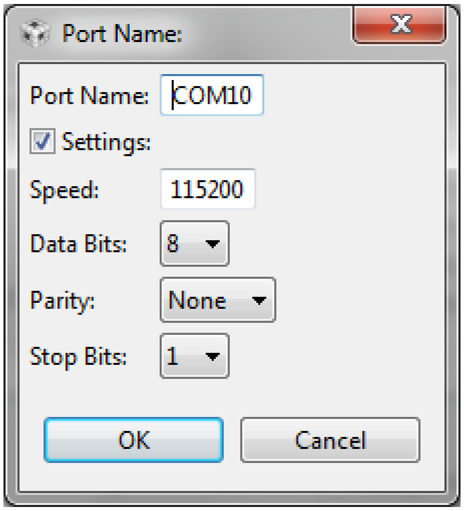
6. If the transport selected can be configured, you can expand the **Transport Settings** area to set the appropriate value.



▾ Transport Settings

IP Address: 127.0.0.0

- **IP Address:** If the Transport is TCPIP, USB, or UDP, the IP address of the target board is autodetected and shown here. You can type a different value if the value shown is incorrect.
- **Port Name:** If the Transport is UART, you can select a port or click **Configure Port** to specify a port name. If you check the **Settings** box in the Port Name dialog, you can also configure the speed, data bits, parity, and stop bits. The value placed in the Port Name field after you configure the port contains speed, bit, and parity information. For example: `COM10:115200/8N1` is the resulting Port Name from the following settings.



Port Name: COM10

☑ Settings:

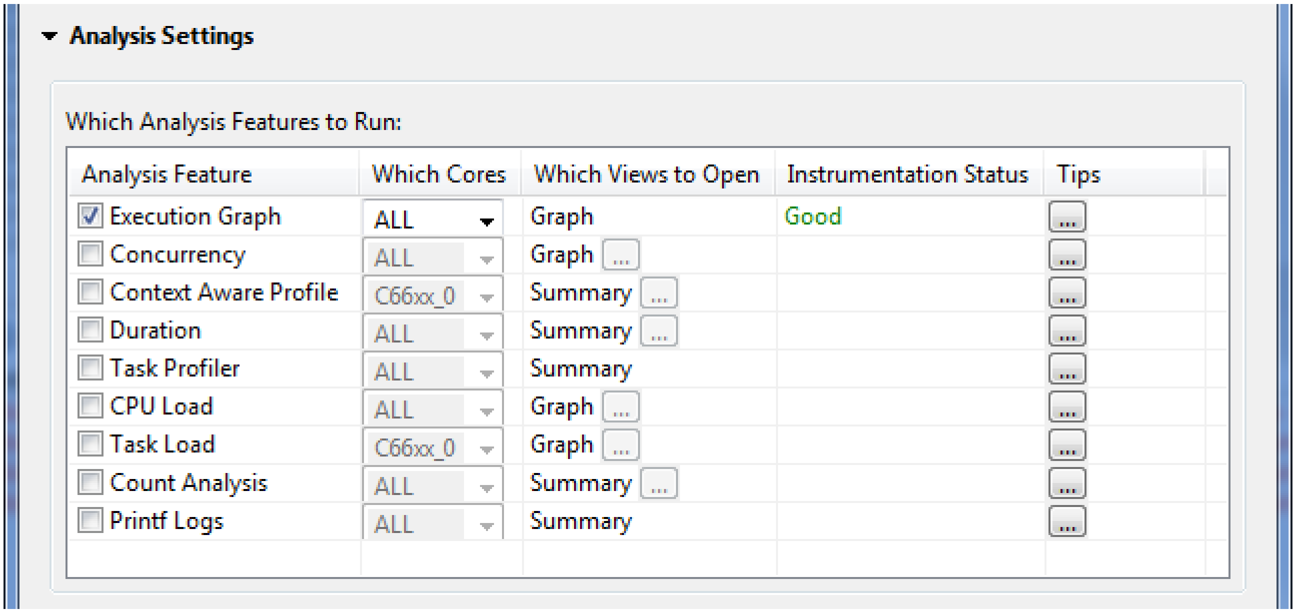
Speed: 115200

Data Bits: 8

Parity: None

Stop Bits: 1

7. The **Analysis Settings** section of the dialog lets you select which views of the data to open and analyze. A different analysis feature is selected depending on which menu command you used to open this dialog.



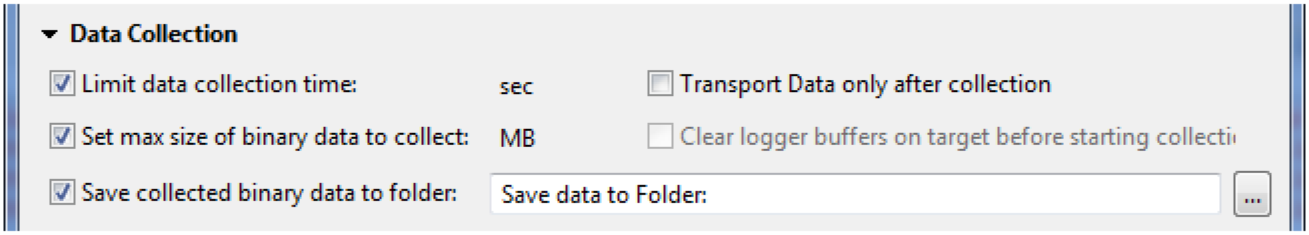
Which Analysis Features to Run:

Analysis Feature	Which Cores	Which Views to Open	Instrumentation Status	Tips
☑ Execution Graph	ALL	Graph	Good	...
□ Concurrency	ALL	Graph ...		...
□ Context Aware Profile	C66xx_0	Summary ...		...
□ Duration	ALL	Summary ...		...
□ Task Profiler	ALL	Summary		...
□ CPU Load	ALL	Graph ...		...
□ Task Load	C66xx_0	Graph ...		...
□ Count Analysis	ALL	Summary ...		...
□ Printf Logs	ALL	Summary		...

- **Analysis Feature:** Choose features you want to open. See Section 4.3 for a list of features and links to details. (You can open additional analysis features from the **Analyze** drop-down after starting a session.) When you check a box, the **Instrumentation Status** column shows whether the application is instrumented to provide this data.

- — **Which Cores:** For multicore devices, you can choose whether to display events from ALL cores or a single core. The drop-down list shows the core names in your current UIA configuration along with core names for any active CCS target configuration for a debugging session. For the Context Aware Profile and Task Load features, a specific core name is required (not ALL), and you can select or type the name.
- — **Which Views to Open:** Click "..." to choose the view types you want to open. You can later open more views, but these checkboxes provide an easy way to open several views.
- — **Instrumentation Status:** Shows "good" if the application contains the correct settings to provide this data. If this column shows "inadequate", click the link for hints on modifying the application.
- — **Tips:** Click the link for a brief description of the view.

8. The **Data Collection** section of the dialog lets you specify how the data will be collected and stored.



Data Collection

☑ Limit data collection time: sec

☐ Transport Data only after collection

☑ Set max size of binary data to collect: MB

☐ Clear logger buffers on target before starting collecti

☑ Save collected binary data to folder: Save data to Folder:

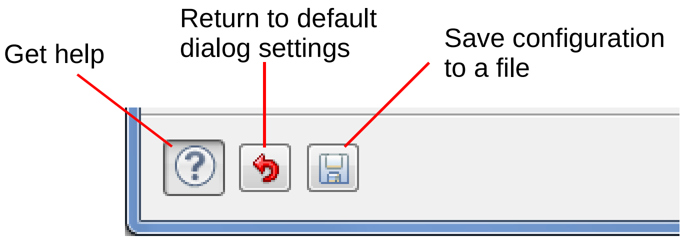
- — **Limit data collection time:** Check this box and type the number of seconds to collect data. This time is measured on the host unless you check the **Transport Data only after collection** box. Leave this box unchecked if you want to collect data until you pause or stop the data collection or halt the application.
- — **Set max size of binary data to collect:** Check this box and type the maximum number of megabytes of data to collect before halting the collection.
- — **Save collected binary data to folder:** By default, data is shown in the Session or File Log view and is saved to binary files in a folder called systemAnalyzerData in your CCS workspace. Later, you can reopen the saved data to analyze it further. You can browse to select a different location. If you do not want to save the data, uncheck the box next to this item. If you choose a location that contains records from a previous run, the records will be cleared at the start of the run.
- — **Transport Data only after collection:** (Ethernet only) Check this box if you want to get event data from the target only after the collection time expires. That is, the target will run for the specified time without transferring data; the target restarts the transfer at the end of the time. Using this option reduces the intrusiveness of the transport while data is being collected. However the amount of data that can be collected is limited to the log buffer size. This option is supported only if you use the LoggerType_RUNMODE mode for the LoggingSetup.loggerType property and the Ethernet transport and your target supports control messages.
- — **Clear logger buffers on target before starting collection:** (Non-JTAG only) Check this box if you want to erase any log records stored in the log buffers on the target when data collection starts.

Note: If you let RTOS Analyzer or System Analyzer collect events for a significant amount of time (or even for a short period of time if the data rate is very high), your system resources will get used up resulting in slow performance.

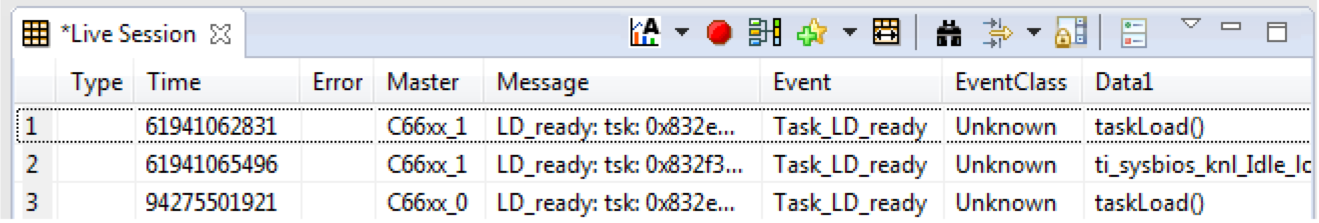
Note: Depending on the data rate, multicore event correlation may not work well when viewing live data. If events seem out of order, save the data, then open the binary data for later processing to improve the event correlation.

Note: Multicore event correlation for events uploaded via JTAG transports is unsupported.

9. A **Warnings/Error** section is shown if there are problems with your configuration.
10. The buttons at the bottom of the dialog allow you to perform several actions:


Get help
Return to default dialog settings
Save configuration to a file

11. Click **Start** to connect to the target and show a Live Session detail view and the other views you selected. See Section 4.7 for information about using the Session view.



	Type	Time	Error	Master	Message	Event	EventClass	Data1
1		61941062831		C66xx_1	LD_ready: tsk: 0x832e...	Task_LD_ready	Unknown	taskLoad()
2		61941065496		C66xx_1	LD_ready: tsk: 0x832f3...	Task_LD_ready	Unknown	ti_sysbios_knl_Idle_lc
3		94275501921		C66xx_0	LD_ready: tsk: 0x832e...	Task_LD_ready	Unknown	taskLoad()

If you start a new live session when a live session is already running, the current session is closed so the new session can be opened. You can run only one live session or binary file session at a time. (You can have multiple CSV files open along with a single live session or binary file.)

If you want to save instrumentation data to a CSV file (instead of a binary file), right-click on the Session or File Log view and choose **Data > Export All.** For information about using binary and CSV files that store instrumentation data, see Section 4.6, *Opening CSV and Binary Files Containing Analyzer Data*.

For other ways to open analysis features and views, see Section 4.3.1 through Section 4.3.2.

4.3 RTOS Analyzer and System Analyzer Features and Views

RTOS Analyzer provides the following features:

- **Execution Graph.** Shows threads on the target(s). See Section 4.8.
- **Concurrency.** Shows how many cores are active at once and when. See Section 4.9.
- **CPU Load.** Shows the SYS/BIOS load data collected for all cores in the system. See Section 4.10.
- **Task Load.** Shows the CPU load data measured within a SYS/BIOS Task thread. See Section 4.11.
- **Printf Logs.** Shows messages sent via Log_printf() calls. See Section 4.12.
- **Task Profiler.** Shows percent of time tasks spend in each execution state. See Section 4.13.

System Analyzer provides the following features:

- **Duration.** Calculates the total duration between pairs of execution points. See Section 4.14.
- **Context Aware Profile.** Calculates duration with awareness of interruptions by other threads and functions. See Section 4.15.
- **Count Analysis.** Tracks values on the target. See Section 4.16.

The Execution Graph, Concurrency, CPU Load, Task Load, and Printf Logs features display information automatically provided by SYS/BIOS. The Task Profiler, Duration, Context Aware Profile, and Count Analysis features display data only if you have modified target code to instrument the required events.

There are several ways to view most analysis features. For example: a summary table, detail table, and a graph. The following table shows the types of views available for each feature:

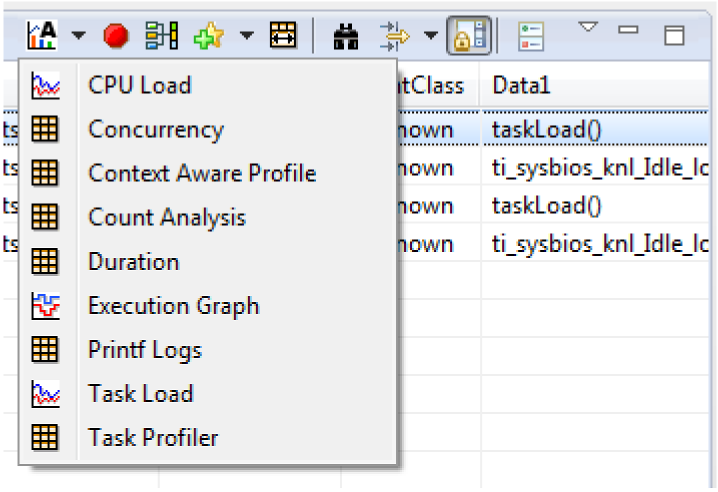
Table 4–2. Views Available for Various Analysis Features

Feature	Detail View	Graph View	Summary View
Execution Graph	No	Yes (default)	No
Concurrency	No	Yes (default)	Yes
CPU Load	Yes	Yes (default)	Yes
Task Load	Yes	Yes (default)	Yes
Printf Logs	No	No	Yes (default)
Task Profiler	No	No	Yes (default)
Duration	Yes	Yes	Yes (default)
Context Aware Profile	Yes	No	Yes (default)
Count Analysis	Yes	Yes	Yes (default)
Raw Logs	Yes (default)	No	No

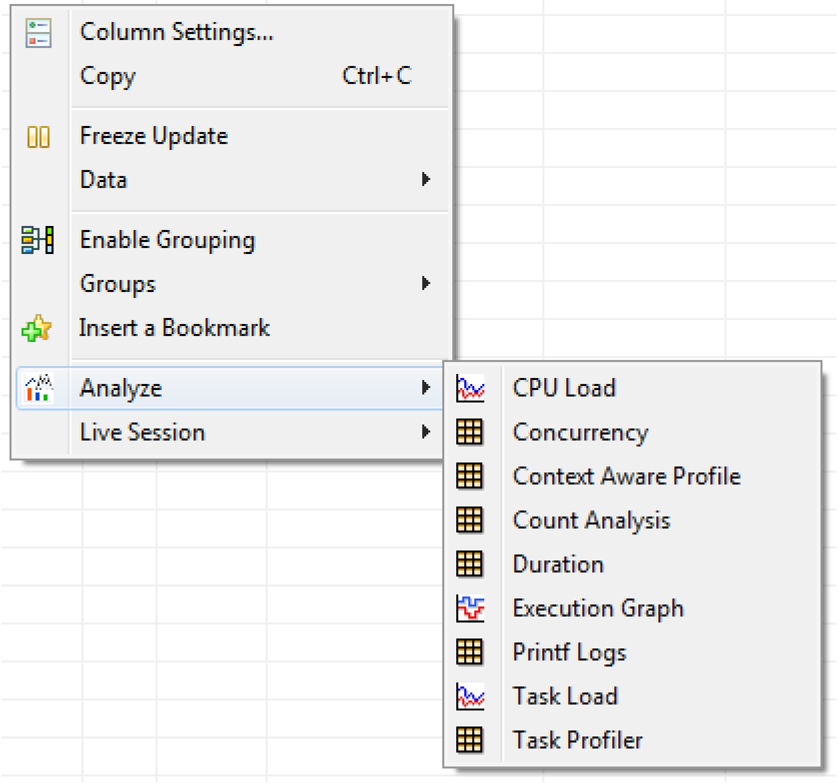
4.3.1 More Ways to Open Analysis Features

In addition to opening analysis features with the **Tools > RTOS Analyzer** and **Tools > System Analyzer** menus (Section 4.2), you can also use the following methods:

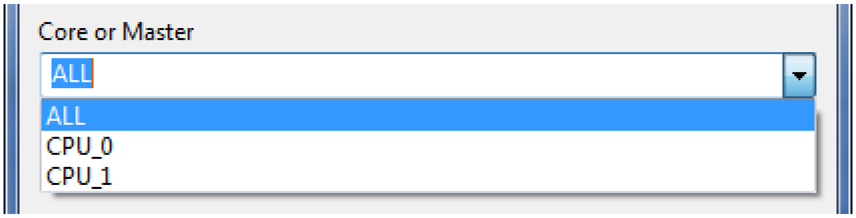
- In a Session or File Log view, click the **Analyze** drop-down and select an analysis feature to open its default view.



- Right-click on the Session or File Log view. From the context menu, choose **Analyze** and then an analysis feature.



If you open an analysis feature for a multicore target, you are prompted to choose whether to display events from ALL cores or a single core. You are not prompted to specify the core if only one of the cores is instrumented. You can type the name of a core in this field. The drop-down list shows the core names in your currently selected UIA configuration file along with core names for any active CCS target configuration for a debugging session.

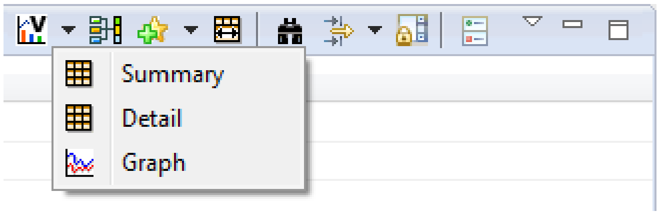


When you choose to open the Count Analysis feature, you are also asked whether you want to plot the graph vs. the time or a sample sequence number. See Section 4.16.

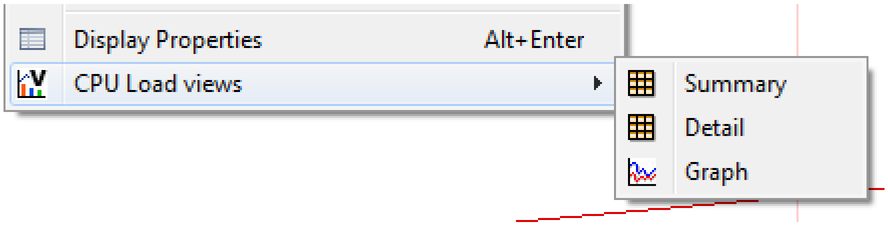
4.3.2 More Ways to Open Views

To open views other that the default view for an analysis feature that you have already started, do any of the following:

- In an analyzer view, click the **Views** drop-down list and select any view for that analysis feature.



- Right-click on an analysis view and choose another view for that analysis feature. For example, in the CPU Load graph, you can right-click and choose **CPU Load views > Summary**.



You can synchronize the scrolling and cursor placement in views for the same session by clicking **View with Group** icon in the toolbars of the views you want to synchronize.

4.4 Managing an RTOS Analyzer or System Analyzer Session

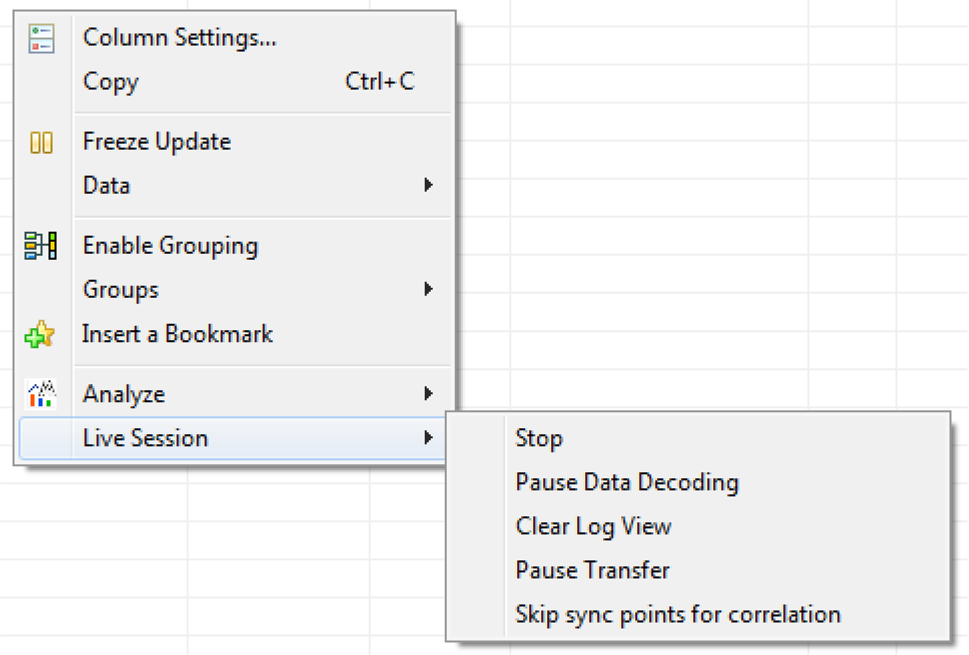
You can manage RTOS Analyzer and System Analyzer sessions—including live sessions and binary files—with commands in the Session or File Log view toolbar and right-click menu. The commands in the following lists apply to the current state of the session.

For descriptions of toolbar icons that control the view display rather than the session behavior, see page 3–32 and page 4–62.

Icons for the following commands are provided in the toolbar of the Session or File Log view:

- **Run** connects to the target(s) using the UIA configuration during a live session. **Stop** disconnects from the target. If you are using a binary file, the Run command reruns the file. Data is cleared from the views when you use the Run command. (Live and binary sessions only.)
- **Scroll Lock** lets you examine records as data is being collected without having the display jump to the end whenever new records are added to the view. See Section 3.8.8.

The right-click menu for the Session or File Log view for a live session or binary file has the following commands:



- **Run/Stop** connects to or disconnects from the target(s) using the UIA configuration during a live session. If you are using a binary file, the Run command reruns the file. Data is cleared from the RTOS Analyzer and System Analyzer views when you use the Run command.
- **Pause/Resume Data Decoding** halts and resumes processing of records received from the target. Available only for live sessions.
- **Clear Log View** erases all records from the Session Log view. Available only for live sessions.
- **Pause/Resume Transfer** halts and resumes the transfer of records from the target(s) to the host. This command is supported only if you are using an Ethernet transport (that is, you have set LoggingSetup.loggerType to LoggingSetup.LoggerType_RUNMODE) and if your target supports control messages. Available only for live sessions.

- **Skip sync points for correlation** causes RTOS Analyzer and System Analyzer not to wait until they receive sync-point events that are used for multicore event correlation. You should set this option if your application does not log sync-point events or if you are not concerned about event correlation across cores. For example, you might use this command if the status line at the bottom of a System Analyzer view says "Waiting for UIA SyncPoint." Note that this command applies only to the current session.
- ⏸ **Freeze/Resume Data Update** halts and resumes updates to the current view. If you pause data updates with this icon, data decoding continues in the background.

Data is processed in the following sequence: data transfer, then data decoding, then data updates. So, for example, if you use **Pause Transfer**, data that has already been transferred to the host will be decoded and updated in the display; once all transferred data has been processed, the data decoding and updates will need to wait for more data. Similarly, if you **Pause Data Decoding**, data updates will need to wait once all the decoded records have been displayed.

The following commands are available only for CSV files. Right-click in the File Log view and use the **CSV Viewer** sub-menu.

- **Stop** halts processing of the current file.
- **Clear Data** clears all data in all open RTOS Analyzer and System Analyzer feature views.
- **Open File** lets you select a CSV or binary file to open and process.

If you reload your program or load a different program in CCS, the RTOS Analyzer and System Analyzer views you have open are reconfigured to handle data from the new program.

4.4.1 Closing an RTOS Analyzer or System Analyzer Session

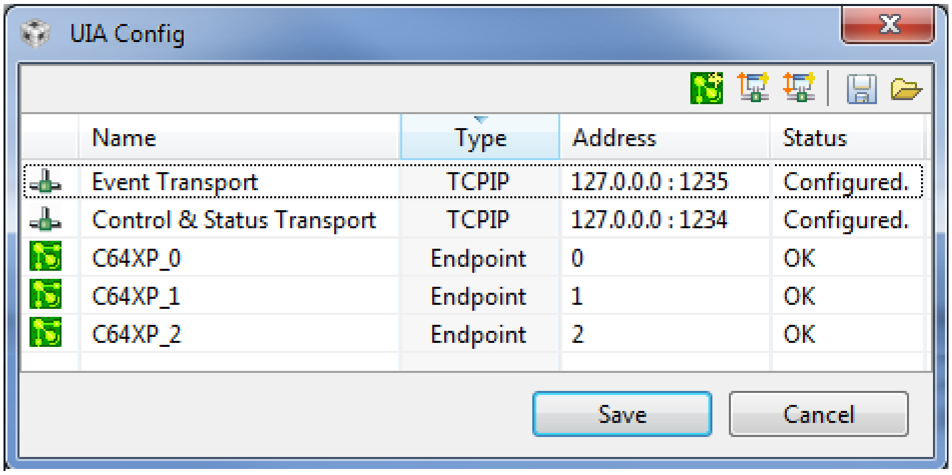
RTOS Analyzer and System Analyzer sessions—including live sessions, binary files, and CSV files—remain open even if you close all the views of the session except the Session or File Log view. You may want to close a session, for example, in order to open a different live session or a binary file, since only one of these can be open at a time.

To completely close a session, close the tab for the Session or File Log view or choose the **Tools > RTOS Analyzer > *session name* > Close Session** menu command or the **Tools > System Analyzer > *session name* > Close Session** menu command from the main CCS menu bar.

4.5 Configuring Transports and Endpoints

If you want more control over the target configuration used in the analysis or want to save a configuration to a file, you can click the **Create UIA Config File** button in the Analysis Configuration dialog.

A UIA configuration specifies the transports used to send logs and commands between the target and host. It also specifies the cores that will be sending data to RTOS Analyzer and System Analyzer. You can save a configuration after you create it for later use.

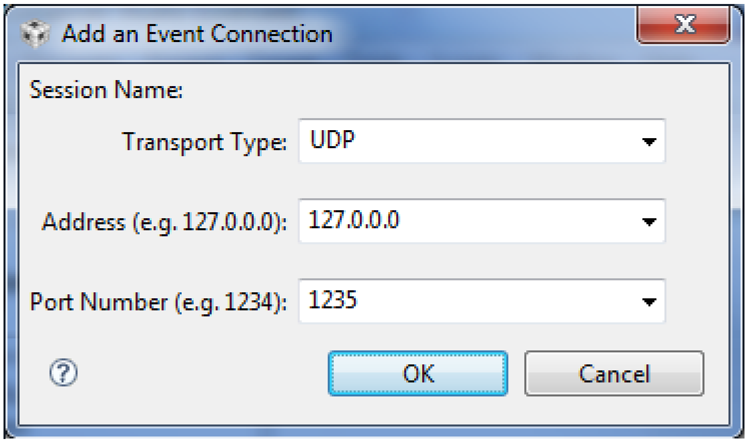


Name	Type	Address	Status
Event Transport	TCPIP	127.0.0.0 : 1235	Configured.
Control & Status Transport	TCPIP	127.0.0.0 : 1234	Configured.
C64XP_0	Endpoint	0	OK
C64XP_1	Endpoint	1	OK
C64XP_2	Endpoint	2	OK

Notice in the figure above that a UIA configuration contains an Event Transport, a Control and Status Transport, and endpoints for each core in the application.

To create a UIA configuration, follow these steps:

1. In CCS, choose a **Tools > RTOS Analyzer** or **Tools > System Analyzer** command.
2. In the Analysis Configuration dialog, check the **Custom UIA Configuration file** box. Click **Create UIA Config File** to open the UIA Config dialog, which lets you create a configuration file.
3. Click the **Event Transport** icon in the UIA Config dialog. This lets you specify the transport used for moving logs from the target to the host.
4. In the Add an Event Connection dialog, provide details about the transport you want to use. Different target connections require different transports.



Session Name:

Transport Type: UDP

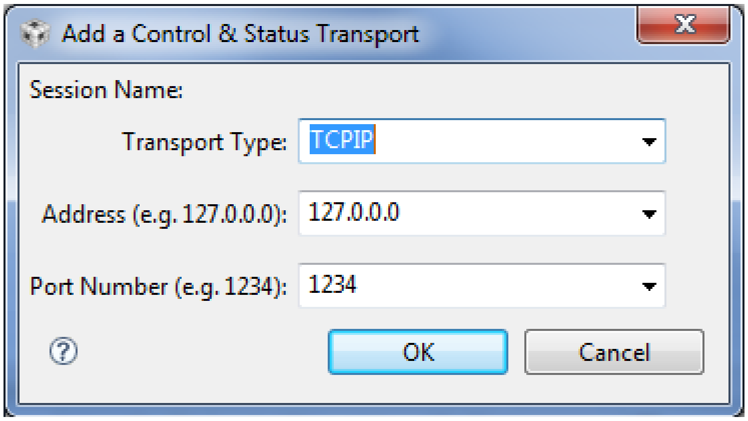
Address (e.g. 127.0.0.0): 127.0.0.0

Port Number (e.g. 1234): 1235

— The Transport Type options are UDP, TCPIP, JTAG, FILE, and UART. The default is UDP.

- The Address is the IP address of the target or of the master core in the case of a multicore application.
- The Port is the TCP or UDP port number. The default is 1235.

5. Click the **Control & Status Transport** icon. This transport is used for sending and receiving commands. Different target connections require different transports.



Session Name:

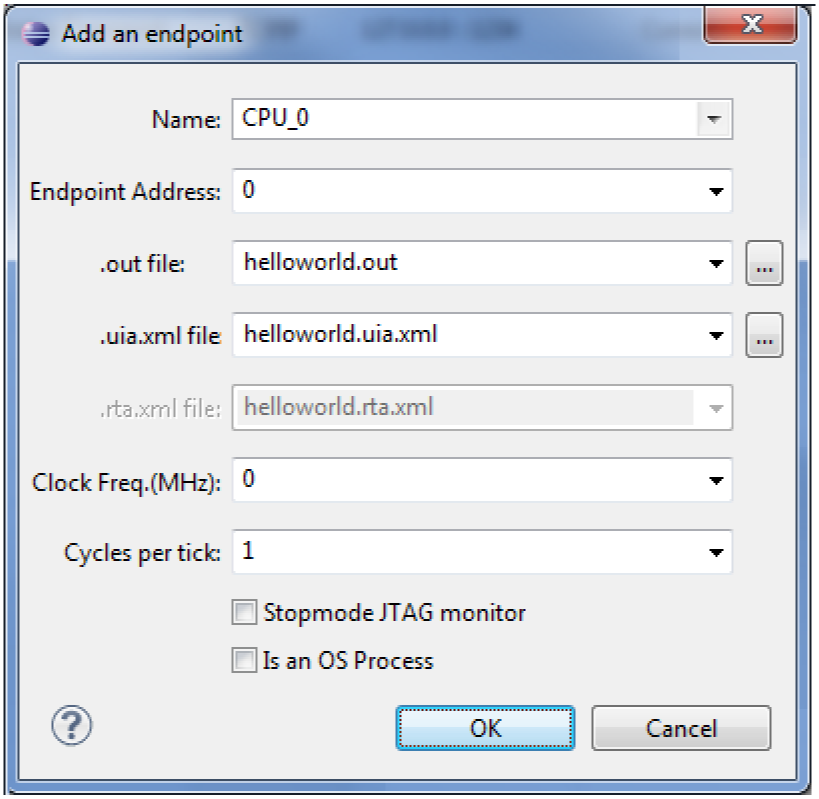
Transport Type: TCPIP

Address (e.g. 127.0.0.0): 127.0.0.0

Port Number (e.g. 1234): 1234

- TCP/IP, UDP, or UART can be used as the transport type. The default transport type is TCP/IP. If you are using a JTAG event transport, set the control and status transport type to "NONE".
- The default port is 1234.

6. For each core in your application, click the **Endpoint** icon. An "endpoint" is a description of a core and the target application it is running. This provides the host with a list of cores to use in interpreting System Analyzer log data.



Name: CPU_0

Endpoint Address: 0

.out file: helloworld.out

.uia.xml file helloworld.uia.xml

.rta.xml file: helloworld.rta.xml

Clock Freq.(MHz): 0

Cycles per tick: 1

□ Stopmode JTAG monitor

□ Is an OS Process

- **Name.** Type the name of the target. If a CCS debug session is running and the target configuration matches that of your target application, you can select a name from the drop-down list. The actual name chosen here is not important, but it is best to use the same names here and the CCS Target Configuration.
- **EndPoint Address.** This is the number of the core starting from 0. For example, use 0 for CPU 0, 1 for CPU1, and so on. These numbers must correspond to the ServiceMgr module's Core ID, which usually defaults to the index number of the ti.sdo.utils.MultiProc ID from IPC.
- **.out file.** The filename of the compiled and linked target application. Click the **...** button and browse to find the file. The file extension may be .out or may contain the platform, for example, .x64P. When you click OK, the dialog checks to make sure this file exists.
- **.uia.xml file.** Name of the generated System Analyzer metadata file. This is an XML file that is created if your target application includes any UIA modules. It is typically auto-discovered when you select an .out file and click OK. If the file cannot be found automatically, click **...** and browse to find the file. For example, the file may be stored in the Default\configPkg\package\cfg subdirectory of the project when you build the project.
- **.rta.xml file.** Name of the generated RTA metadata file. This file is created if your target application includes the Rta module. It is typically auto-discovered when you select an .out file and click OK. If the file cannot be found automatically, click **...** and browse to find the file. This file is likely to be stored in the same directory as the .uia.xml file.
- **Clock freq (MHz).** Type the clock speed for this CPU in MHz. If you do not provide the correct value here, the durations reported by System Analyzer will not be converted to nanoseconds correctly.
- **Cycles per tick.** Type the number of cycles per clock tick for this CPU here. If you do not provide the correct value here, the durations reported by System Analyzer will not be converted to nanoseconds correctly.
- **Stopmode JTAG monitor.** Check this box if you want records to be transferred via JTAG when the target is halted. That is, check this box if the target application on this endpoint is configured to use any of the following settings for the loggerType parameter of the LoggingSetup module: LoggerType_STOPMODE or LoggerType_MIN.
- **Is an OS Process.** Check this box if this is a cUIA application running on a multi-process operating system such as Linux. See the wiki page on cUIA for information about UIA for Linux.

7. Once you have created both transports and the endpoints for each core, save the configuration by clicking the **Save** button. Browse for a directory to contain the file and type a filename. The Save As dialog shows that the configuration is saved in a file with an extension of .usmxml. The .usmxml file is used if you want to specify a saved configuration to use in a live session (page 4–43) or when opening a binary file (page 4–58). Behind the scenes, a file with the same name but an .xml extension is also saved, but you can ignore the .xml file.

If you want to edit an item in the configuration, you can double-click on it or right-click and select **Edit the selected item** to open the dialog used to create that item. To delete an item, right-click and select **Delete the selected item**.

To load a UIA configuration, click the 📂 **Open** icon in the toolbar. Browse for and open a configuration file you have saved (with a file extension of .usmxml).

4.6 Opening CSV and Binary Files Containing Analyzer Data

The RTOS Analyzer and System Analyzer features can save analysis data in two different file types:

- **CSV files** include UIA configuration information, so you *do not* need a UIA configuration in order to use a CSV file. See Section 4.6.1 for information about opening data saved to a CSV file.
- **Binary files** do not include UIA configuration information, so you *do* need a UIA configuration in order to see analysis data saved to a binary file. See Section 4.6.2 for information about opening data saved to a binary file.

Sample CSV data files are provided with CCS so that you can try the RTOS Analyzer and System Analyzer features immediately. See Section 4.6.1.

See Section 4.2 for information about creating binary files during data collection. See Section 3.8.7 for information about creating CSV files.

4.6.1 Opening a CSV File

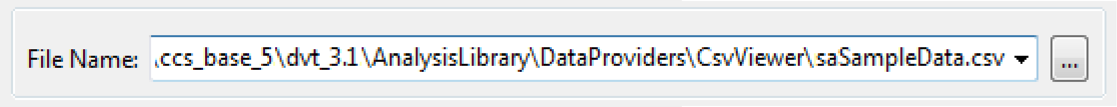
You can experiment with the host-side RTOS Analyzer and System Analyzer features using the CSV (comma-separated values) data files that are provided with the DVT. You do not need to load an application (in fact, you do not even need a target device) in order to view the data in a CSV file with RTOS Analyzer or System Analyzer.

Code Composer Studio provides the following example CSV files:

- `saSampleData.csv` is a recording of instrumentation data collected in a run-time session using a 6-core EVM6472 application. It is located in `<ccs_install_dir>\ccsv6\ccs_base\dvt_3.#.#.#\AnalysisLibrary\DataProviders\CsvViewer`.
- The `<ccs_install_dir>\ccsv6\ccs_base\dvt_3.#.#.#\AnalysisLibrary\AnalysisFeatures` directory contains a number of CSV files in subdirectories named for the analysis feature they are designed to demonstrate.

To load a CSV file, follow these steps:

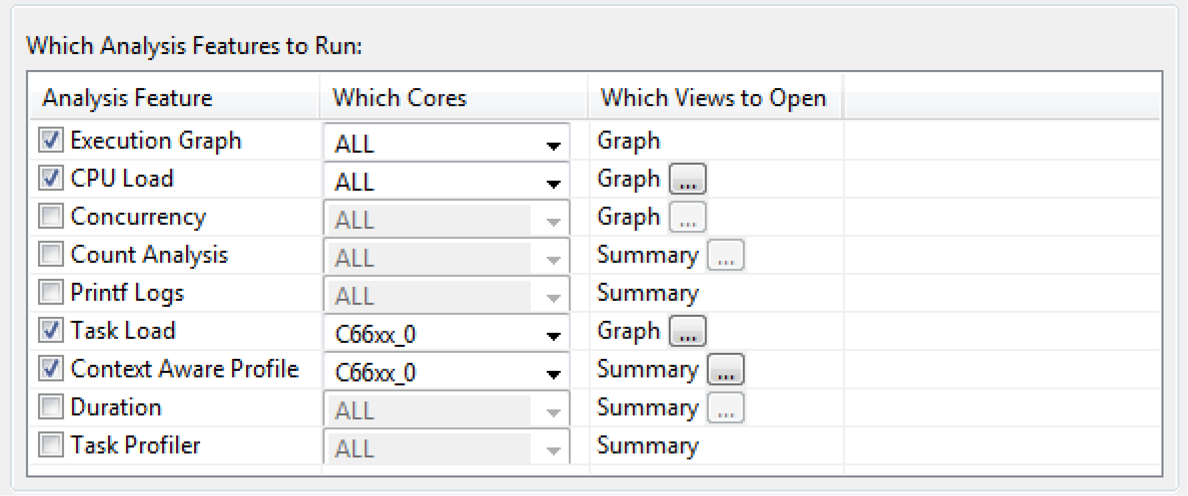
1. In Code Composer Studio, move to CCS Debug mode. You do not need to build or load a project.
2. Choose the **Tools > RTOS Analyzer > Open File > Open CSV File** menu command or the **Tools > System Analyzer > Open File > Open CSV File** menu command.
3. In the Open CSV File Configuration dialog, click the "…" button to the right of the **File Name** field.
4. Browse to one of the locations in the previous list of example CSV files.
5. Select the CSV file and click **Open**.



File Name: ,ccs_base_5\dvt_3.1\AnalysisLibrary\DataProviders\CsvViewer\saSampleData.csv

6. In the **Analysis Feature** column, choose features you want to use. These features will process events that apply to them when you open the CSV file. (You can start additional analysis features after you open the file.)
7. In the **Which Cores** column, choose whether to display events from ALL cores or a single core. The drop-down list shows the core names for any active CCS target configuration for a debugging session. For the Context Aware Profile and Task Load features, a specific core name is required (not ALL), and you can select or type the name.

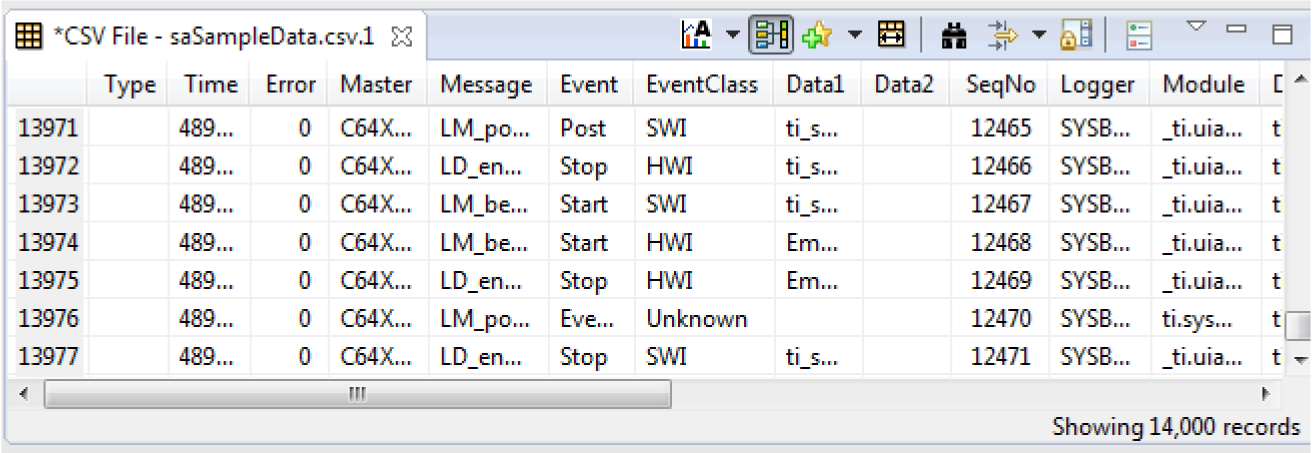
8. In the **Which Views to Open** column, choose the view types you want to open automatically. You can later open more views, but this is an easy way to open several of them. For example, you might check the following boxes:



Which Analysis Features to Run:

Analysis Feature	Which Cores	Which Views to Open
☑ Execution Graph	ALL	Graph
☑ CPU Load	ALL	Graph ...
□ Concurrency	ALL	Graph ...
□ Count Analysis	ALL	Summary ...
□ Printf Logs	ALL	Summary
☑ Task Load	C66xx_0	Graph ...
☑ Context Aware Profile	C66xx_0	Summary ...
□ Duration	ALL	Summary ...
□ Task Profiler	ALL	Summary

9. Click **Start**. You will see the CSV File Log view, which displays the events stored in the CSV file. See Section 4.7 for information about how to use the Log view.



*CSV File - saSampleData.csv.1

	Type	Time	Error	Master	Message	Event	EventClass	Data1	Data2	SeqNo	Logger	Module	D
13971		489...	0	C64X...	LM_po...	Post	SWI	ti_s...		12465	SYSB...	_ti.uia...	t
13972		489...	0	C64X...	LD_en...	Stop	HWI	ti_s...		12466	SYSB...	_ti.uia...	t
13973		489...	0	C64X...	LM_be...	Start	SWI	ti_s...		12467	SYSB...	_ti.uia...	t
13974		489...	0	C64X...	LM_be...	Start	HWI	Em...		12468	SYSB...	_ti.uia...	t
13975		489...	0	C64X...	LD_en...	Stop	HWI	Em...		12469	SYSB...	_ti.uia...	t
13976		489...	0	C64X...	LM_po...	Eve...	Unknown			12470	SYSB...	ti.sys...	t
13977		489...	0	C64X...	LD_en...	Stop	SWI	ti_s...		12471	SYSB...	_ti.uia...	t

Showing 14,000 records

10. You will also see the views you selected in the dialog.

After learning to use RTOS Analyzer and System Analyzer features, you can analyze data from your own applications and record your own sessions as CSV files. See page 4–62 for information about creating your own CSV files.

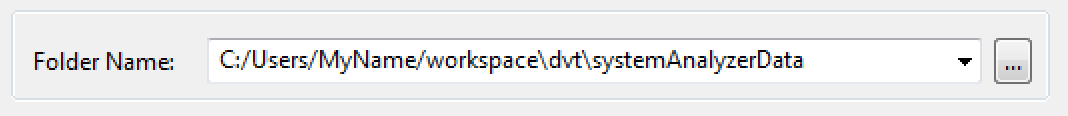
4.6.2 Opening a Binary File

Opening a binary file that you saved during a run-time session lets you do later analysis of the results. See Section 4.2 for information about creating binary files.

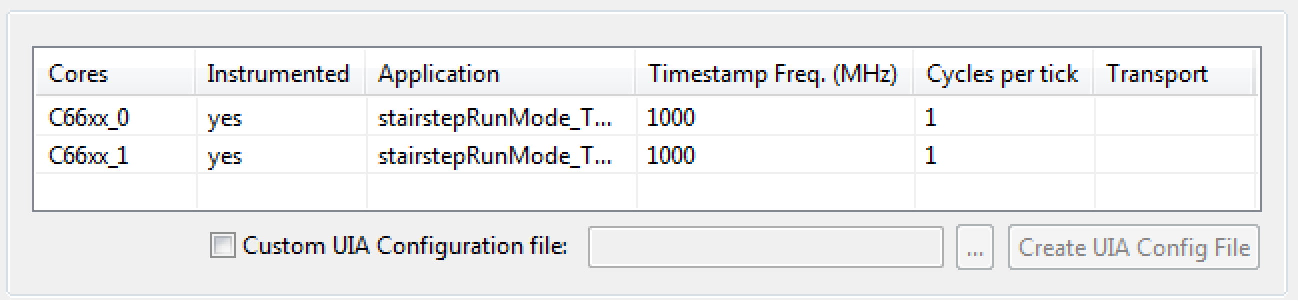
You can load a binary file that contains instrumentation data if you have a UIA configuration that matches the configuration with which the analysis data was saved or if you have a Debugger session open that matches the target configuration for the target used to create the binary file. (In contrast, opening a CSV file containing instrumentation data does not require a UIA configuration or a loaded application because the data is already decoded.)

To load a binary file containing RTOS Analyzer and System Analyzer event logs, follow these steps:

1. Start Code Composer Studio.
2. Create a CCS target configuration and start a debugging session, This enables RTOS Analyzer and System Analyzer to auto-configure your session. (Alternatively, you can create a UIA configuration and save it to a file as described in Section 4.5.)
3. Choose the **Tools > RTOS Analyzer > Open File > Open Binary File** menu command or the **Tools > System Analyzer > Open File > Open Binary File** menu command.
4. In the first section of the Binary File Parameters dialog, browse for the directory that contains the data you want to open. The default folder name is `dvt\systemAnalyzerData` in your workspace directory.


Folder Name: C:/Users/MyName/workspace\dvt\systemAnalyzerData

5. The next section of the dialog lets you control the UIA configuration, which controls how RTOS Analyzer and System Analyzer interpret the cores referenced in the binary data.

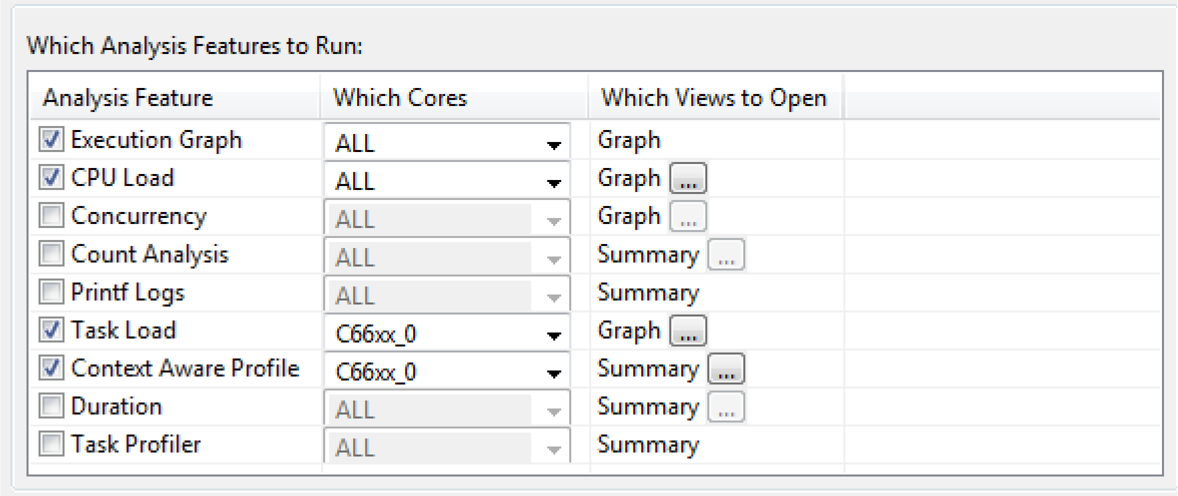


Cores	Instrumented	Application	Timestamp Freq. (MHz)	Cycles per tick	Transport
C66xx_0	yes	stairstepRunMode_T...	1000	1	
C66xx_1	yes	stairstepRunMode_T...	1000	1	

☐ Custom UIA Configuration file:

6. If you want to change any of the detected settings, check the **Custom UIA Configuration file** box. You can click "..." to browse for an existing UIA configuration (a *.usmxml file) or click **Create UIA Config File** to create a new configuration file. See Section 4.5 to learn about creating UIA Configuration files.

7. Choose the views you want to open.

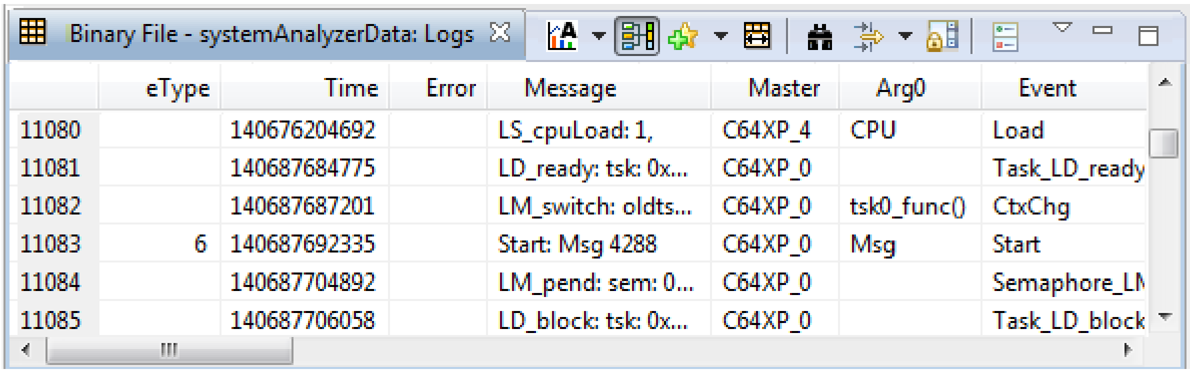


Which Analysis Features to Run:

Analysis Feature	Which Cores	Which Views to Open
☑ Execution Graph	ALL	Graph
☑ CPU Load	ALL	Graph ...
☐ Concurrency	ALL	Graph ...
☐ Count Analysis	ALL	Summary ...
☐ Printf Logs	ALL	Summary
☑ Task Load	C66xx_0	Graph ...
☑ Context Aware Profile	C66xx_0	Summary ...
☐ Duration	ALL	Summary ...
☐ Task Profiler	ALL	Summary

- — In the **Analysis Feature** column, choose features you want to use. These features will process events that apply to them when you open the CSV file. (You can run additional analysis features after you open the file.)
- — In the **Which Cores** column, choose to display events from ALL cores or a single core. The drop-down list shows core names in the selected UIA configuration and in the current CCS target configuration. For the Context Aware Profile and Task Load features, a specific core name is required (not ALL); you can select or type a name.
- — In the **Which Views to Open** column, choose views to open automatically. You can later open more views, but these checkboxes provide an easy way to open a number of them.

8. Click **Start** to open the binary file you selected. This opens the Binary File Log view and displays the events stored in the binary file. You will also see the views you selected in the dialog. See Section 4.7 for information about how to use the Log view.



Binary File - systemAnalyzerData: Logs

	eType	Time	Error	Message	Master	Arg0	Event
11080		140676204692		LS_cpuLoad: 1,	C64XP_4	CPU	Load
11081		140687684775		LD_ready: tsk: 0x...	C64XP_0		Task_LD_ready
11082		140687687201		LM_switch: oldts...	C64XP_0	tsk0_func()	CtxChg
11083	6	140687692335		Start: Msg 4288	C64XP_0	Msg	Start
11084		140687704892		LM_pend: sem: 0...	C64XP_0		Semaphore_LM
11085		140687706058		LD_block: tsk: 0x...	C64XP_0		Task_LD_block

4.7 Using the Session or File Log View

The Session or File Log view opens automatically when you start a live data collection session or open a binary or CSV file containing RTOS Analyzer or System Analyzer data.

Log View Column Descriptions

The Session or File Log view shows the details of all records. The log contains the following columns:

- **Row Number.** This column indicates only the row number in the current log display. If you filter the records displayed, all the row numbers change.
- **Type.** Displays the event type. For live sessions and binary files, an icon is shown. For CSV files, a numeric value is shown. This field lets you quickly locate or filter certain types of events. A message can have multiple types, such as Error and Analysis; the type with the lower value is shown. For filtering, the type has a value from 0 to 11.

Table 4–3. Event Types

Icon	Value	Type	Comments
	0	Unknown	
⊗	1	Error	
⚠	2	Warning	
i	3	Information	
👓	4	Details	
↻	5	Life Cycle	
📊	6	Analysis	
M1	7	Module 1	Module-specific type
M2	8	Module 2	Module-specific type
M3	9	Module 3	Module-specific type
	10	Emergency	
	11	Critical	

- **Time.** The time the event was logged in nanoseconds. The time in this column has been adjusted and correlated on the host to provide the global time based on a common timeline. The time is converted to nanoseconds using the clock and cycle information provided for each CPU in the UIA configuration.

- **Error.** Displays an icon if an error occurred. Individual views display a message in the bottom status line if a data loss is detected.

Table 4–4. Error Types

Icon	Value	Type	Comments
☒	0	Data loss error	This error indicates that some SeqNo values are missing on a per logger basis.
☒	1	Sequence Error	This error is determined by comparing Global Time values. Such errors can indicate that either records from a single core or between cores are out-of-sequence.
⊗	2	Multiple errors	Both a data loss error and a sequence error were detected.

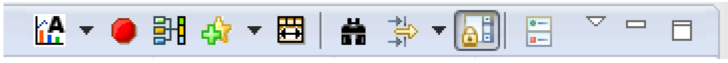
- **Master.** The core on which the event was logged. For example, C64XP_0 and C64XP_1.
- **Message.** A printf-style message that describes the logged event. Values from the Arg0 through Arg8 arguments are plugged into the message as appropriate. In general, messages beginning with "LM" are brief messages, "LD" indicates a message providing details, "LS" messages contain statistics, and "LW" indicates a warning message.
- **Event.** The type of event that occurred. Supported events include the following:
  - — Synchronization events (at startup)
  - — CtxChg (for context change)
  - — Pend, post, and block events from various modules
  - — Load, ready, start, and stop events from various modules
  - — Set priority and sleep events from the Task module
- **EventClass.** The class of the event that occurred. Supported event classes include:
  - — CPU (for Load events, for example from the ti.sysbios.utils.Load module)
  - — TSK (for task threads)
  - — HWI (for hardware interrupt threads)
  - — SWI (for software interrupt threads)
  - — FUNC (for Enter and Exit events for the ti.uia.events.UIAProfile module)
- **Data1.** The main information returned with an event. For many events, Data1 returns the name of the task or the thread type in which the event occurred.
- **Data2.** Further information returned with an event. For load events, for example, Data2 returns the load percentage.
- **SeqNo.** The sequence number with respect to the source logger on the source core. Each logger has its own sequence numbering. This number is used when detecting data loss.
- **Logger.** The name of the logger to which the event was sent. UIA creates several default loggers, and your target code can configure additional loggers.

- **Module.** The module that defines the type of event that occurred. This may be a UIA module, SYS/BIOS module, XDCtools module, or a RTSC module from some other software component. CCS adds an underscore before the module name for certain types of events for internal processing for other views.
- **Domain.** The module that logged the event.
- **Local Time.** The local timestamp on the core where the event was logged. This timestamp typically has a higher resolution than the global timestamp. Local timestamps are not correlated and adjusted to show timing interactions with events on other cores.
- **Arg1 to Arg 8.** Raw arguments passed with the event. Although the number of arguments associated with an event is not limited, typically events are logged with 0, 1, 2, 4, or 8 arguments. If more than 8 arguments are logged, only the first 8 are shown here.

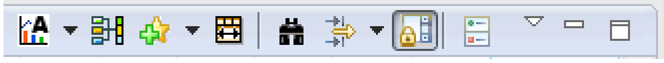
Log View Toolbar Icons and Right-Click Menu Commands

The Session or File Log view contains a number of toolbar icons that let you control the view's behavior. The toolbar is slightly different depending on whether you are viewing the log for a live session, binary file, or CSV file.

Live Session or Binary File



CSV File

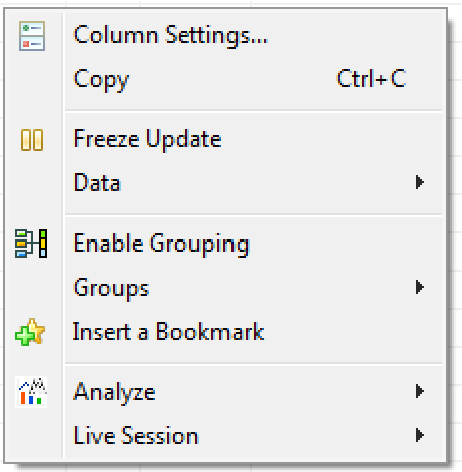


- **Analyze** lets you start any of the Analysis Features—such as the CPU Load or Count Analysis. The default view for the feature you select is opened.
- **Run** and **Stop** (live and binary only) connect to or disconnect from the target(s) using the UIA configuration during a live session. If you are using a binary file, the Run command reruns the file. Data is cleared from the analysis views when you use the Run command.
- Toggle **Enable Grouping** on and off (Shift+G). A "group" synchronizes views of instrumentation data so that scrolling in one view causes similar movement to happen automatically in another. For example, if you group the CPU load graph with the Session or File Log view, then click on the CPU Load graph, the Log view displays the closest record to where you clicked in the graph. See Section 3.8.4.
- Click to turn on **Bookmark Mode**. The next record you click in the log will be highlighted in red. Jump to a bookmarked event by using the drop-down list next to the Bookmark Mode icon. Choose **Manage the Bookmarks** from the drop-down list to open a dialog that lets you rename or delete bookmarks. See Section 3.8.3.
- **Auto Fit Columns** sets the column widths in the Log to fit their current contents.
- Open the **Find In** dialog to search this log. See Section 3.8.5.
- **Filter** the log records to match a pattern by using the Set Filter Expression dialog. See Section 3.8.6.
- **Scroll Lock** lets you examine records as data is being collected without having the display jump to the end whenever new records are added to the view. See Section 3.8.8.
- **Column Settings** lets you control which columns are displayed and how they are shown. You can use the dialog to change the alignment, font, and display format of a column (for example, decimal, binary, or hex). See Section 3.8.9.

- Select **Row Count** from this drop-down to toggle the column that shows row numbers in the log on and off.

Additional icons described in Section 4.4 differ depending on whether you are running a live session or a stored file session and let you control data transfer activity.

You can right-click on the Session or File Log view to choose from a menu of options. In addition to toolbar commands, you can use the following additional commands from the right-click menu:

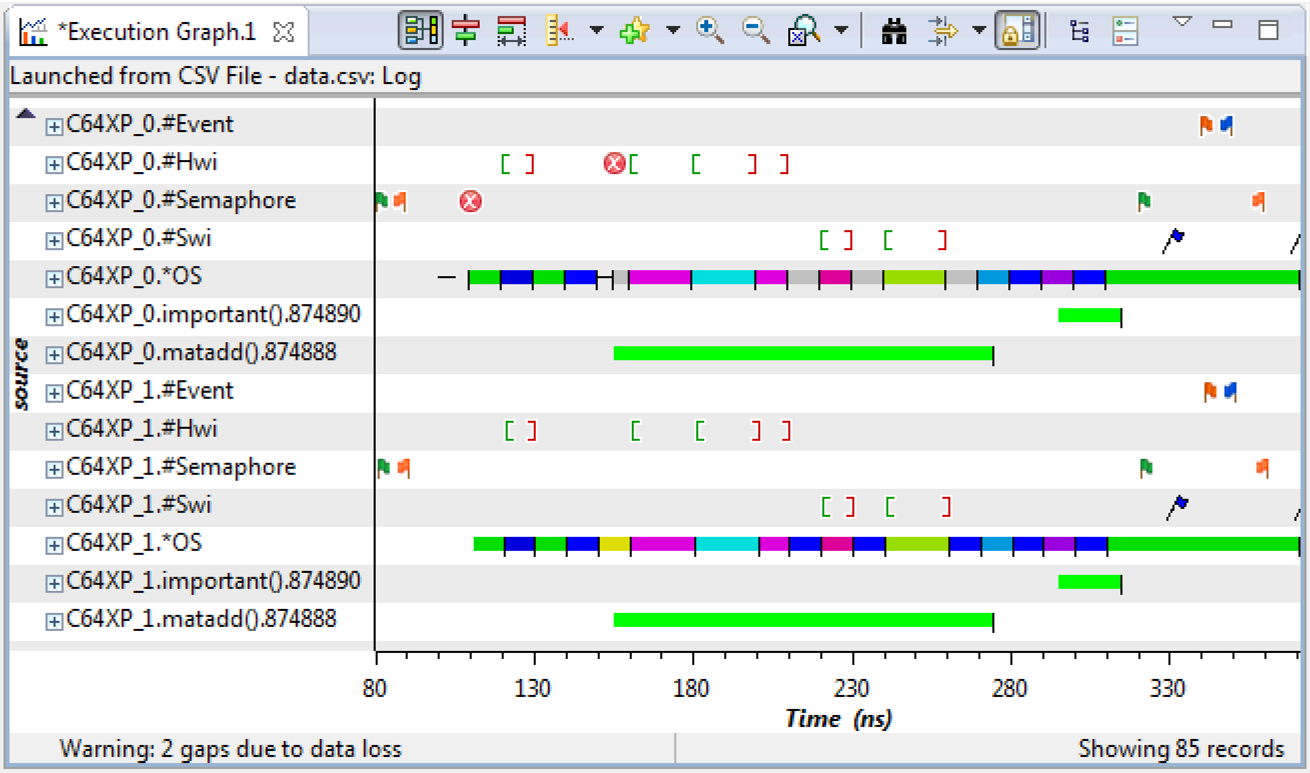


- **Copy.** Copies the selected row or rows to the clipboard.
- **Freeze/Resume Data Update** halts and resumes updates to the current view. See Section 4.4.
- **Data > Export Selected.** Lets you save the selected rows to a CSV (comma-separated value) file. See Section 3.8.7.
- **Data > Export All.** Lets you save all the rows to a CSV file. For example, you might do this so that you can perform statistical analysis on the data values.
- **Enable Grouping.** Lets you define and delete groups that contain various types of log messages. See Section 3.8.4.
- **Insert a Bookmark** adds a highlight to the selected certain rows and provide ways to quickly jump to marked rows. See Section 3.8.3.
- **Analyze.** Start one of the analysis features. See Section 4.10.
- **Live Session or CSV Viewer.** Lets you pause, resume, and reset a live or binary file session. Lets you stop or reset a CSV file session. See Section 4.4, *Managing an RTOS Analyzer or System Analyzer Session*.

4.8 Using the Execution Graph

The Execution Graph shows which thread is running at a given time.

To open this feature, choose **Tools > RTOS Analyzer > Execution Analysis**. If you already have a session running, you can choose **Execution Graph** from the ▾ **Analyze** drop-down in the Session or File Log view.



*Execution Graph.1

Launched from CSV File - data.csv: Log

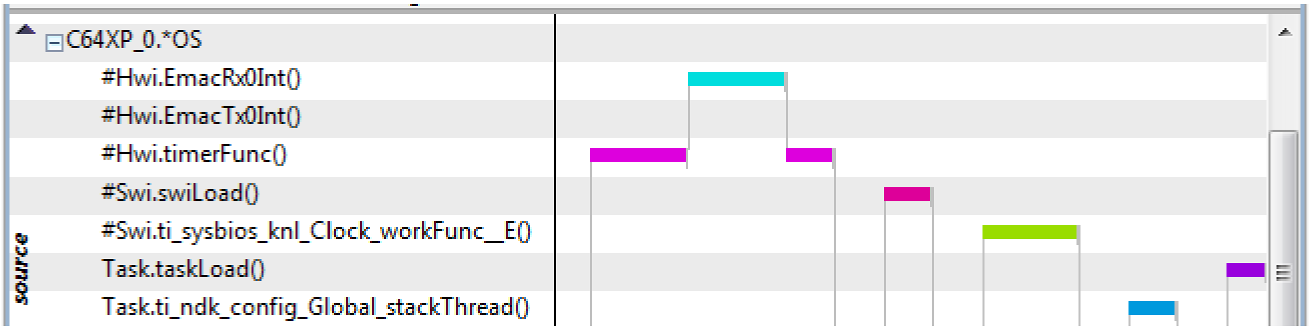
Warning: 2 gaps due to data loss

Showing 85 records

Thread categories are listed in the left column. Click on a category to show more details. The details depend on the type of thread.

- **Semaphores and Events.** Pend ⚑ and post ⚑ events are identified by flag icons. If any data loss events were detected, the ⊗ icon shows that event.
- **Hwi threads.** For hardware interrupt threads, brackets [ ] show when the Hwi started and stopped running. If any data loss events were detected, the ⊗ icon shows that event.
- **Swi threads.** The ⚑ icon shows when a Swi was posted. Brackets [ ] show when a Swi started and stopped running. For any data loss events, a separate row in the details shows that event.

- **OS.** When you expand an OS row, you see a list of threads on that core. A colored line for each item shows when that context was in control. Activity by Hwi, Swi, and Task threads is shown, along with activity by the SYS/BIOS scheduler, unknown activity, and data loss events.



- **Other threads.** Other functions are listed after the OS item.

Data loss is shown as a dashed line in the expanded OS graph. The Hwi, Swi, Semaphore, and Event rows show only the time when the data loss was detected, not the extent of the data loss until further data was received.

Click the **Tree Mode** icon to display categories in a tree that lets you hide or display each core. The # and * signs in the category names are used to control the sort order of the categories.

Use the toolbar buttons to group (synchronize), measure, zoom, search, and filter the graph. You will likely need to zoom in a significant amount to see the execution transitions that interest you.

Right-click on the graph and choose **Display Properties** to customize the graph. For example, you can hide categories.

See Also

- Section 3.3, *Analyzing the Execution Sequence with RTOS Analyzer*

4.8.1 How the Execution Graph Works

The Execution Graph uses the same events as the Duration feature and the Context Aware Profile. The Execution Graph displays data about Task, Swi, and Hwi threads provided automatically by internal SYS/BIOS calls. SYS/BIOS threads are pre-instrumented to provide such data via a background thread.

Hwi and Swi can be expanded to list their threads separately only if you enable logging of events for the Hwi and Swi modules. Such logging is turned off by default for performance reasons. See Section 5.2.2, *Enabling and Disabling Event Logging* for how to turn on and off Hwi and Swi event logging.

If a data loss is detected, it is shown in the appropriate thread categories and at the bottom of the graph. Data loss errors are detected if SeqNo values in the logged events are missing.

If data is returned to the host out of sequence, this graph may have unpredictable behavior for state transitions beyond the visible range of the graph.

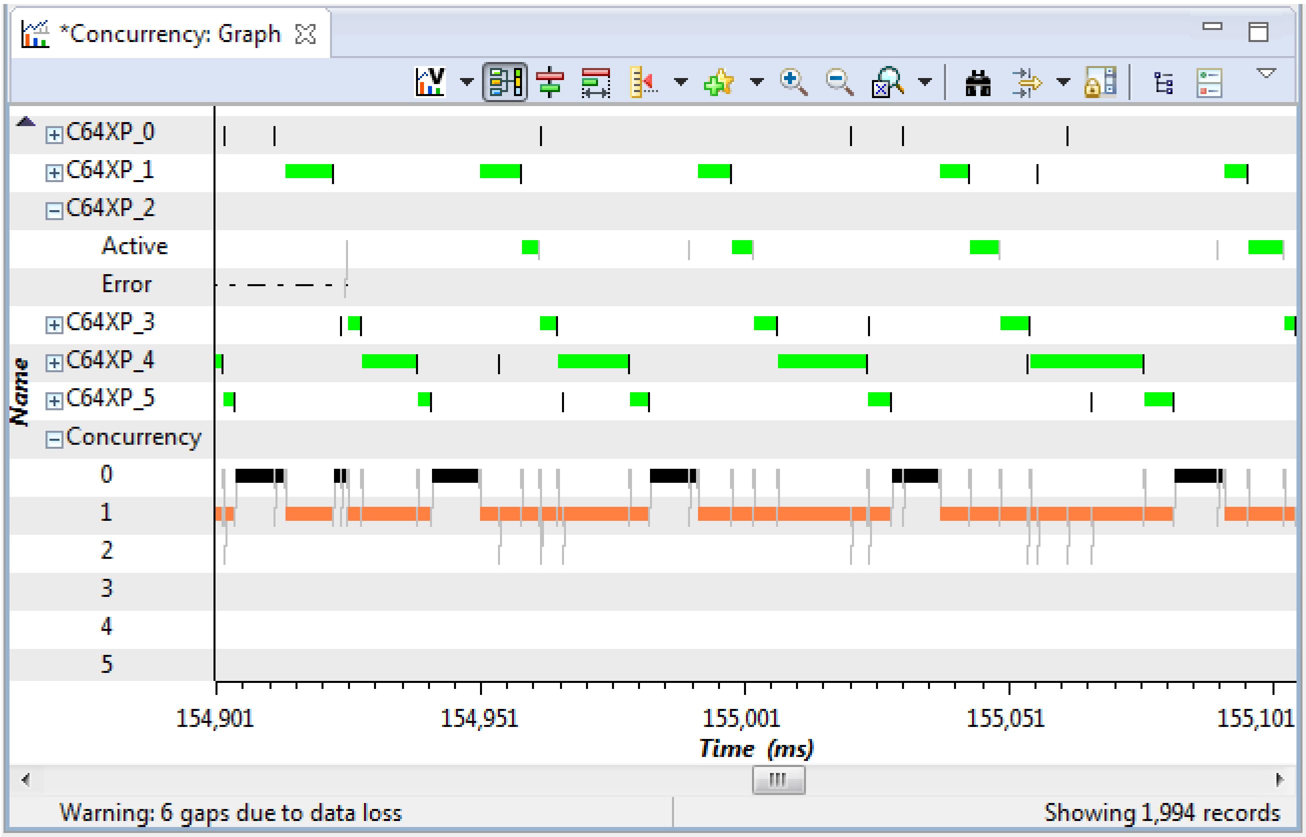
See Also

To learn how to log additional events for display in the Execution Graph, see these sections:

- Section 4.14.3, *How Duration Analysis Works*
- Section 4.15.2, *How Context Aware Profiling Works*
- Section 4.15.3, *Profiling Functions Using Enter and Exit Hook Functions*

4.9 Using the Concurrency Feature

The Concurrency view shows when each core is active (not running the Idle thread) and the level of concurrency in the system. This view is similar to the Execution Graph, but it correlates data for multiple cores. The concurrency level shown is the number of cores active at that time.



Warning: 6 gaps due to data loss

Showing 1,994 records

To open this feature, select the **Concurrency** feature when using another item from the **Tools > RTOS Analyzer** menu. If you already have a session running, you can choose **Concurrency** from the **Analyze** drop-down in the Session or File Log view.

Graph View for Concurrency

The Graph view opens by default. The rows for each core show when that core was active in green. You can expand a core row to separate activity and any data gaps.

Expand the Concurrency row to see how many cores were active as the application ran. For example, 0 means that no cores were running, 1 means a single core was running, and so on.

To open other views for the Concurrency feature, use the **Views** drop-down list in the toolbar of any Concurrency view.

- The Summary view presents the percent of time at each concurrency level. See Section 4.9.1.

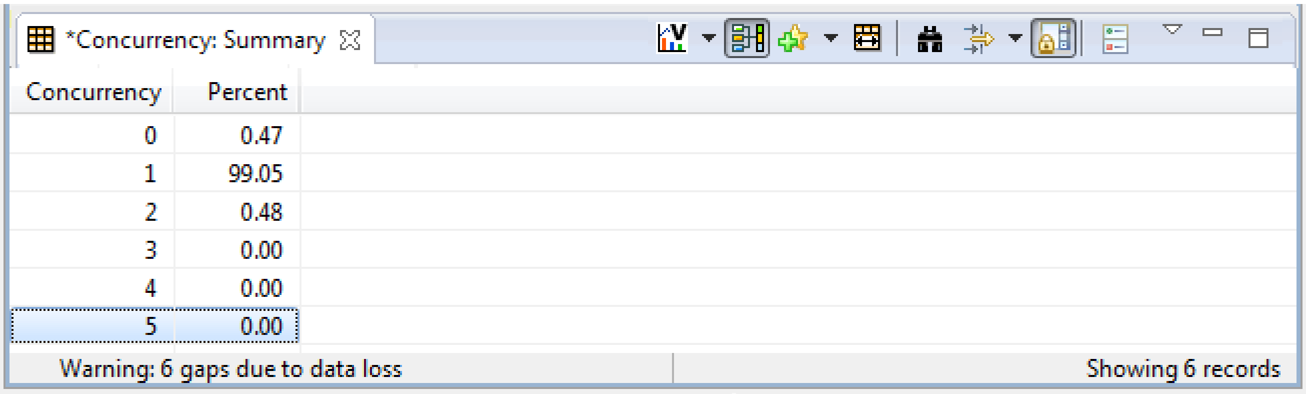
See Also

- Section 3.3, *Analyzing the Execution Sequence with RTOS Analyzer*

4.9.1 Summary View for Concurrency

To open the Summary view for the Concurrency feature, use the **Views** drop-down list in the toolbar of any Concurrency view.

The Summary view for the Concurrency feature shows the percent of time spent at each concurrency level. That is, what percent of the time were 0, 1, or more cores active. The total of the percents shown is 100%.


*Concurrency: Summary

Concurrency	Percent
0	0.47
1	99.05
2	0.48
3	0.00
4	0.00
5	0.00

Warning: 6 gaps due to data loss

Showing 6 records

- **Concurrency.** Number of cores active at once.
- **Percent.** Percent of time spent at this concurrency level.

4.9.2 How Concurrency Works

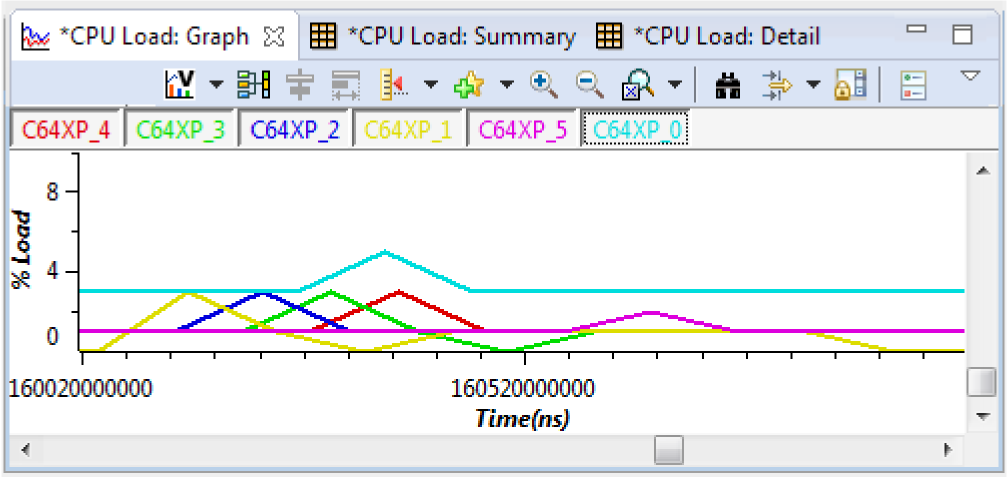
The Concurrency feature uses the same events as the Execution Graph, Duration feature, and the Context Aware Profile. It displays data about Task, Swi, and Hwi threads provided automatically by internal SYS/BIOS calls. SYS/BIOS threads are pre-instrumented to provide such data via a background thread.

If a data loss is detected, it is shown in the appropriate rows and at the bottom of the graph. Data loss errors are detected if SeqNo values in the logged events are missing.

If data is returned to the host out of sequence, this graph may have unpredictable behavior for state transitions beyond the visible range of the graph.

4.10 Using the CPU Load View

The CPU Load feature shows the SYS/BIOS load data collected for all CPUs in the system. The CPU load is the percentage of time a CPU spends running anything other than the SYS/BIOS Idle loop.



To open this feature, choose **Tools > RTOS Analyzer > CPU Load**. If you already have a session running, you can choose **CPU Load** from the **Analyze** drop-down in the Session or File Log view.

Graph View for CPU Load

The Graph view opens by default. It shows the change in CPU load (as a percentage) with time for each CPU. Clicking on the name of a CPU above the graph highlights the corresponding line in the graph. (If you do not see these buttons, right click on the graph and choose **Legend**.)

Use the toolbar buttons to group (synchronize), measure, zoom, search, and filter the graph. Right-click on the graph to adjust the display properties of the graph.

To open Summary or Detail views for this feature, use the **Views** drop-down list in the toolbar.

- The Summary view presents the minimum, maximum, and average CPU load. See Section 4.10.1.
- The Detail view presents the raw CPU load data. See Section 4.10.2.

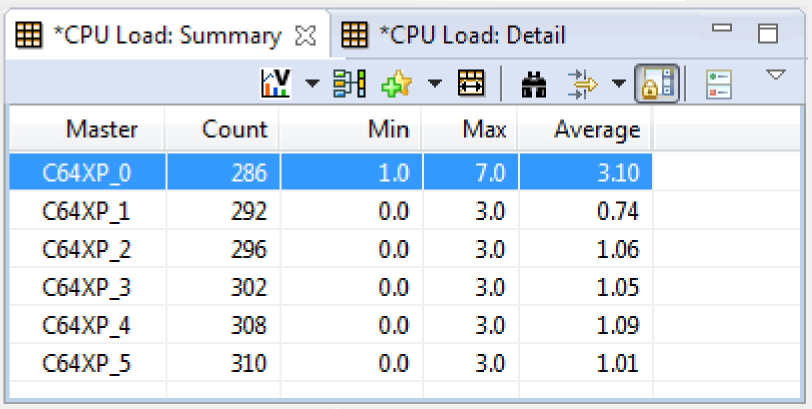
See Also

- Section 3.2, *Analyzing System Loading with RTOS Analyzer*

4.10.1 *Summary View for CPU Load*

To open the Summary view for the CPU Load feature, right-click on a CPU Load view and choose **CPU Load views > Summary**.

The Summary view for the CPU Load feature shows the count, minimum, maximum, and average of the reported CPU load measurements for each CPU.



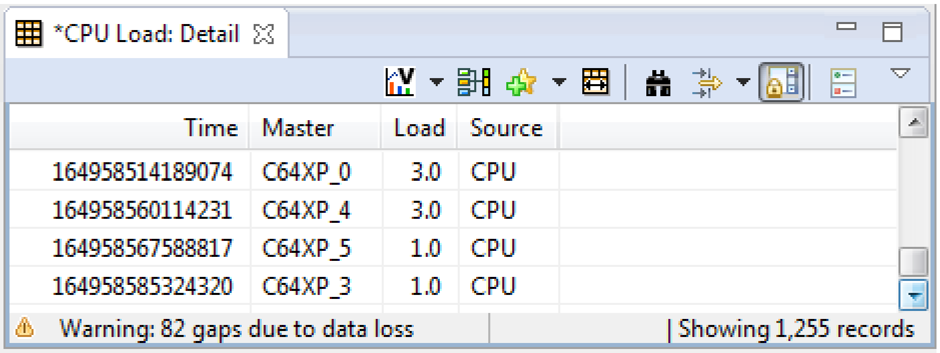
Master	Count	Min	Max	Average
C64XP_0	286	1.0	7.0	3.10
C64XP_1	292	0.0	3.0	0.74
C64XP_2	296	0.0	3.0	1.06
C64XP_3	302	0.0	3.0	1.05
C64XP_4	308	0.0	3.0	1.09
C64XP_5	310	0.0	3.0	1.01

- **Master.** The name of the CPU.
- **Count.** The number of CPU load measurements for this CPU.
- **Min.** The minimum CPU load percentage reported for this CPU.
- **Max.** The maximum CPU load percentage reported for this CPU.
- **Average.** The average CPU load percentage for this CPU.

4.10.2 *Detail View for CPU Load*

To open the Detail view for the CPU Load feature, use the **Views** drop-down list in the toolbar of another CPU Load view.

The Detail view of the CPU Load feature shows records that report the CPU load. The status bar tells how many records are shown and how many gaps occurred.



Time	Master	Load	Source
164958514189074	C64XP_0	3.0	CPU
164958560114231	C64XP_4	3.0	CPU
164958567588817	C64XP_5	1.0	CPU
164958585324320	C64XP_3	1.0	CPU

Warning: 82 gaps due to data loss | Showing 1,255 records

- **Time.** The time (correlated with other cores) of this load event.
- **Master.** The name of the core on which the load was logged.

- **Load.** The CPU load percentage reported.
- **Source.** The source of the load percentage event.

The columns in this view are also displayed in the Session or File Log view (but in a different order). See page 4–60 for column descriptions.

4.10.3 How CPU Load Works

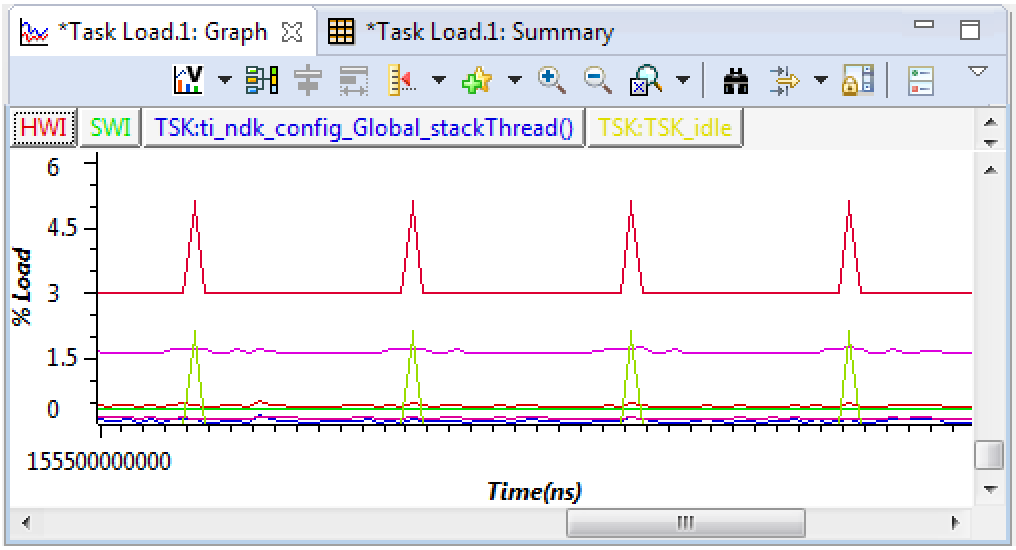
The CPU load is the percentage of time a CPU spends running anything other than the SYS/BIOS Idle loop, which is run by the TSK_idle low-priority Task thread.

The CPU Load feature displays data provided automatically by internal SYS/BIOS calls to functions from the ti.sysbios.utils.Load module. SYS/BIOS threads are pre-instrumented to provide load data using a background thread.

See Section 5.2.1, *Enabling and Disabling Load Logging* for information about how to disable CPU load logging.

4.11 Using the Task Load View

The Task Load view shows CPU load data collected on a per-Task and per-thread type basis for the specified CPU. Note that the Task Load feature does not allow you to select all cores; you must select a single core.



To open this feature, choose **Tools > RTOS Analyzer > Task Load**. If you already have a session running, you can choose **Task Load** from the **Analyze** drop-down in the Session or File Log view.

Graph View for Task Load

The Graph view opens by default; it shows the change in load over time on a per-Task basis as a line graph.

Click on the names of Tasks above the graph to highlight those lines in the graph. If you don't see the Task names, right-click on the graph and choose **Legend** from the context menu. If you make the Graph view area wider, more Task names will be shown.

To open other views for the Task Load feature, use the **Views** drop-down list in the toolbar of any Task Load view.

- The Summary view presents the minimum, maximum, and average load on a per-Task basis. See Section 4.11.1.
- The Detail view presents the raw Task load data. See Section 4.11.2.

Clicking on the name of a thread above the graph highlights the corresponding line in the graph. (If you do not see these buttons, right click on the graph and choose **Legend**.)

Use the toolbar buttons to group (synchronize), measure, zoom, search, and filter the graph. Right-click on the graph to adjust the display properties of the graph.

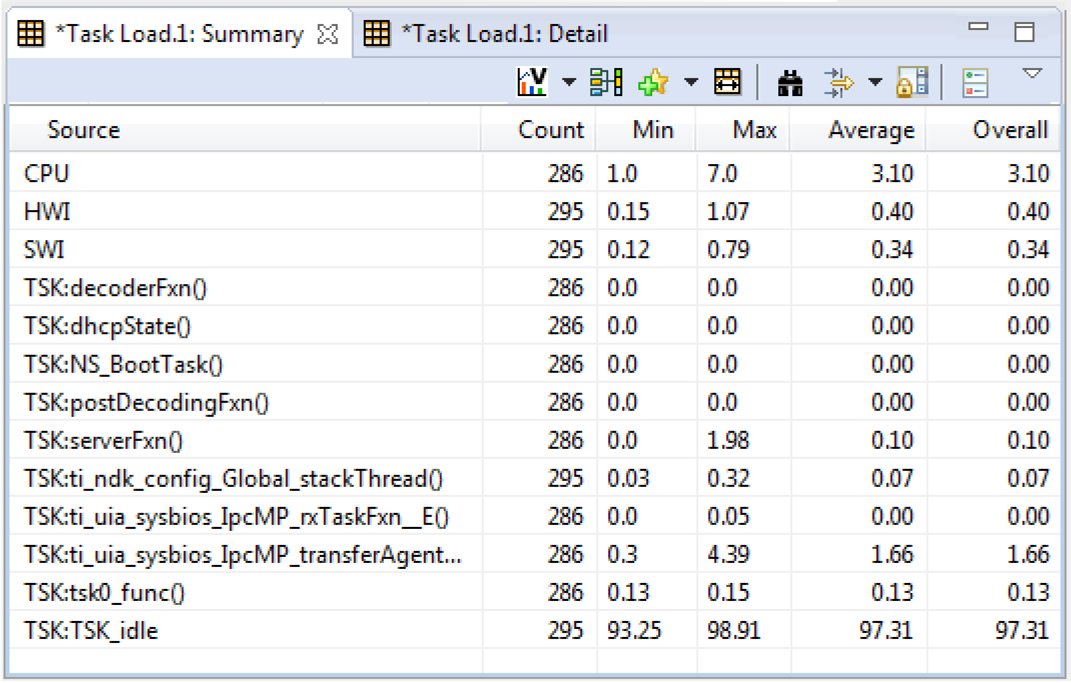
See Also

- Section 3.2, *Analyzing System Loading with RTOS Analyzer*

4.11.1 Summary View for Task Load

To open the Summary view for the Task Load feature, use the **Views** drop-down list in the toolbar of any Task Load view.

The Summary view for the Task Load feature shows the count, minimum, maximum, and average of the reported Task load measurements for each Task.



Source	Count	Min	Max	Average	Overall
CPU	286	1.0	7.0	3.10	3.10
HWI	295	0.15	1.07	0.40	0.40
SWI	295	0.12	0.79	0.34	0.34
TSK:decoderFxn()	286	0.0	0.0	0.00	0.00
TSK:dhcpState()	286	0.0	0.0	0.00	0.00
TSK:NS_BootTask()	286	0.0	0.0	0.00	0.00
TSK:postDecodingFxn()	286	0.0	0.0	0.00	0.00
TSK:serverFxn()	286	0.0	1.98	0.10	0.10
TSK:ti_ndk_config_Global_stackThread()	295	0.03	0.32	0.07	0.07
TSK:ti_uia_sysbios_IpcMP_rxTaskFxn__E()	286	0.0	0.05	0.00	0.00
TSK:ti_uia_sysbios_IpcMP_transferAgent...	286	0.3	4.39	1.66	1.66
TSK:tsk0_func()	286	0.13	0.15	0.13	0.13
TSK:TSK_idle	295	93.25	98.91	97.31	97.31

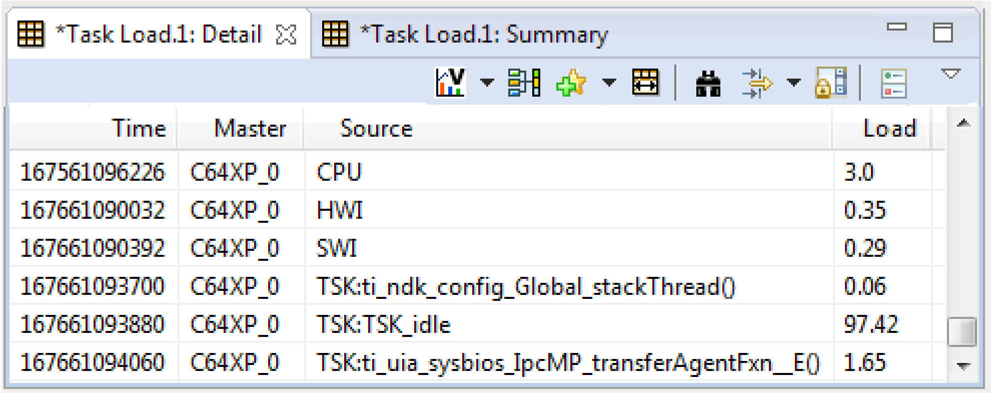
The CPU load is the percentage of time the CPU spent running anything other than the SYS/BIOS Idle loop. The averages for all the sources listed except for the CPU typically add up to approximately 100%. However, that total may be somewhat different if events were dropped, particularly when the load was high.

- **Source.** The name of the task or the thread type.
- **Count.** The number of CPU load measurements reported for this task or thread type.
- **Min.** The minimum CPU load reported for this task or thread type.
- **Max.** The maximum CPU load reported for this task or thread type.
- **Average.** The average CPU load for this task or thread type.
- **Overall.** The average CPU load for this task or thread type. The Overall average is different from the Average in cases where there are multiple instances of the same task running in parallel or when the application dynamically creates tasks and exits from them. In such cases, the Overall values will add up to a total load of 100%, but the Average values will not.

4.11.2 Detail View for Task Load

To open the Detail view for the Task Load feature, use the **Views** drop-down list in the toolbar of any Task Load view.

The Detail view of the Task Load feature shows all records that report the load. These may be for individual Task threads, the Swi module, the Hwi module, or the overall CPU load.



Time	Master	Source	Load
167561096226	C64XP_0	CPU	3.0
167661090032	C64XP_0	HWI	0.35
167661090392	C64XP_0	SWI	0.29
167661093700	C64XP_0	TSK:ti_ndk_config_Global_stackThread()	0.06
167661093880	C64XP_0	TSK:TSK_idle	97.42
167661094060	C64XP_0	TSK:ti_uia_sysbios_IpcMP_transferAgentFxn__E()	1.65

- **Time.** The time (correlated with other cores) of this load event.
- **Master.** The name of the core on which the load was logged.
- **Source.** The name of the task or thread type.
- **Load.** The CPU load percentage reported.

The columns in this view are also displayed in the Session or File Log view (but in a different order). See page 4–60 for column descriptions.

4.11.3 How Task Load Works

The Task Load feature displays data provided automatically by internal SYS/BIOS calls to functions from the ti.sysbios.utils.Load module. SYS/BIOS threads are pre-instrumented to provide load data using a background thread.

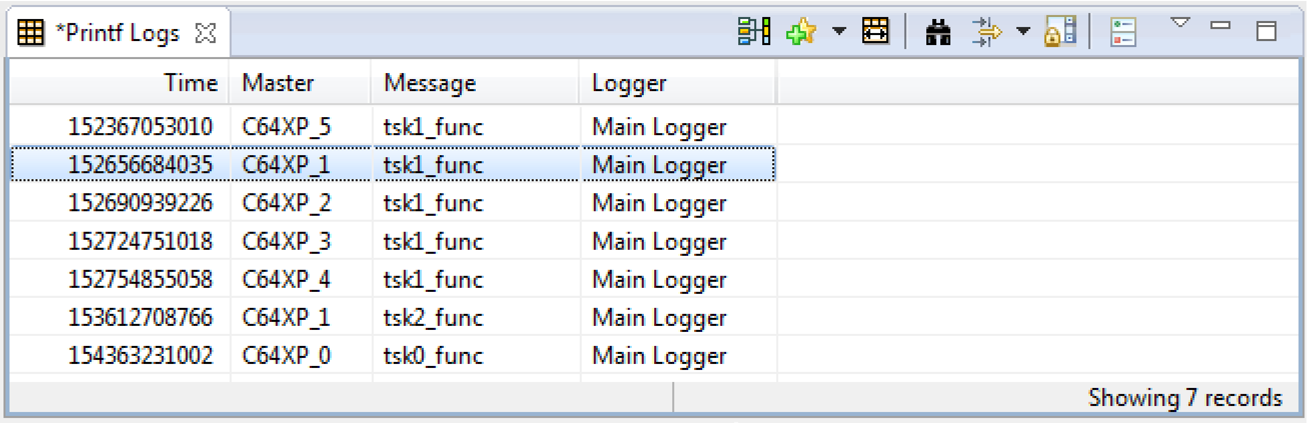
See Section 5.2.1, *Enabling and Disabling Load Logging* for information about how to disable various types of load logging.

4.12 Using the Printf Logs

The Printf Logs analysis feature shows messages output by the program through calls to the XDCtools Log_printf#() APIs.

To open this feature, choose **Tools > RTOS Analyzer > Printf Logs**. If you already have a session running, you can choose **Printf Logs** from the **Analyze** drop-down in the Session or File Log view.

The Summary view is the only view available.



Time	Master	Message	Logger
152367053010	C64XP_5	tsk1_func	Main Logger
152656684035	C64XP_1	tsk1_func	Main Logger
152690939226	C64XP_2	tsk1_func	Main Logger
152724751018	C64XP_3	tsk1_func	Main Logger
152754855058	C64XP_4	tsk1_func	Main Logger
153612708766	C64XP_1	tsk2_func	Main Logger
154363231002	C64XP_0	tsk0_func	Main Logger

Showing 7 records

By default, this view shows the Time, Master, Message, and Logger. You can right-click and choose **Column Settings** to enable additional columns.

- **Time.** The time (correlated with other cores) of this event.
- **Master.** The name of the core on which the message was logged.
- **Message.** A printf-style message that describes the logged event.
- **Logger.** The name of the logger to which the event was sent. UIA creates several default loggers, and your target code can configure additional loggers.

See page 4–62 for information about using the toolbar icons and right-click menu in the Summary view.

See Also

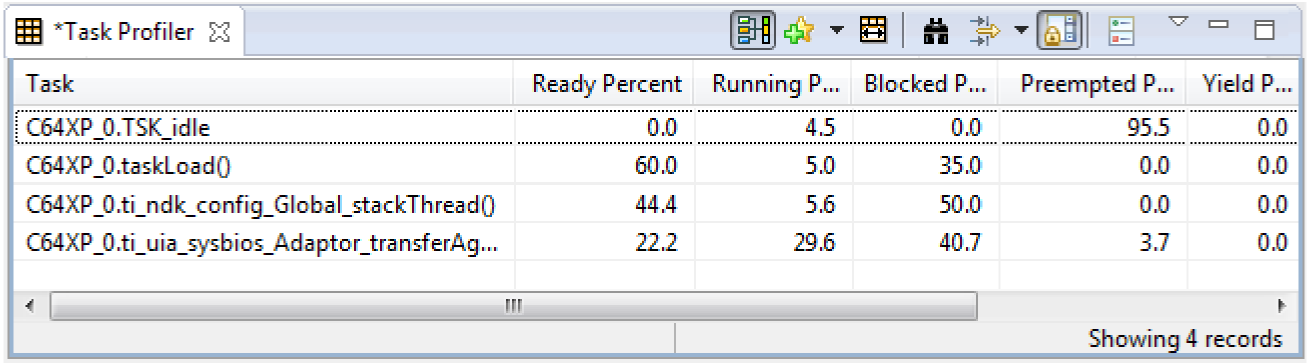
- Section 4.7, *Using the Session or File Log View*

4.13 Using the Task Profiler

The Task Profiler analysis feature shows the percent of time that each Task thread spent in each of its possible states.

To open this feature, choose **Tools > RTOS Analyzer > Task Profiler**. If you already have a session running, you can choose **Task Profiler** from the **Analyze** drop-down in the Session or File Log view.

The Summary view is the only view available.



*Task Profiler

Task	Ready Percent	Running P...	Blocked P...	Preempted P...	Yield P...
C64XP_0.TSK_idle	0.0	4.5	0.0	95.5	0.0
C64XP_0.taskLoad()	60.0	5.0	35.0	0.0	0.0
C64XP_0.ti_ndk_config_Global_stackThread()	44.4	5.6	50.0	0.0	0.0
C64XP_0.ti_uia_sysbios_Adaptor_transferAg...	22.2	29.6	40.7	3.7	0.0

Showing 4 records

By default, this view shows only the percent of time in each state. Total time in each row equals 100%. You can right-click and choose **Column Settings** to display additional columns, including Count, Min, Max, Total, and Average values for each state.

The Task states are as follows:

- **Ready.** The Task was scheduled for execution subject to processor availability during this time.
- **Running.** The Task was the one running on the processor during this time.
- **Blocked.** The Task could not execute during this time because it was waiting for a resource to become available (by posting a Semaphore, for example).
- **Preempted.** The Task could not execute during this time because it was preempted by a higher-priority thread.
- **Yield.** The Task was not running during this time because it called Task_yield() to allow other Tasks of the same priority to run. The time spent in this state is typically small because once a Task calls Task_yield() it is placed in the Ready state. The Yield Count column may be more useful to you than the Yield Percent.
- **Sleep.** The Task was not running during this time because it called Task_sleep() to allow lower-priority Tasks to run. The time spent in this state is typically small because once a Task calls Task_sleep() it is placed in the Blocked state. The Sleep Count column may be more useful to you than the Sleep Percent.
- **Unknown.** The Task was not running during this time. The specific reason is not known. For example, this may be the Task state at program startup or after data loss occurred.

See page 4–62 for information about using the toolbar icons and right-click menu in the Summary view.

See Also

- Section 3.3, *Analyzing the Execution Sequence with RTOS Analyzer*

4.14 Using the Duration Feature

The Duration analysis feature provides information about the time between two points of execution on the target. These points must be instrumented by adding code that passes the `UIABenchmark_start` and `UIABenchmark_stop` events to calls to the Log_write1() function.

The Duration feature displays data only if you modify your target code to include UIABenchmark events as described in Section 4.14.3.

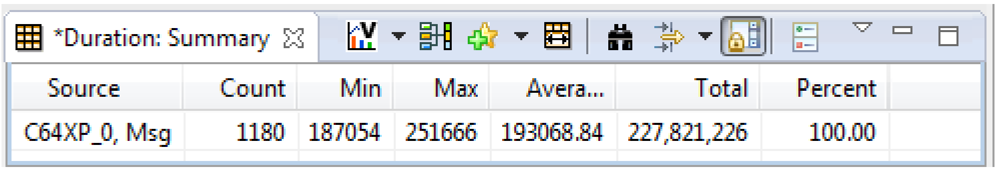
The Duration feature matches start and stop pairs for each "source". A source is identified by combining the core name and the arg1 argument passed to the Log_write1() function when the event argument is `UIABenchmark_start` or `UIABenchmark_stop`. For example, if the target program on CPU_5 makes the following calls, the source identifier will be "`CPU_5, running`".

```
Log_write1(UIABenchmark_start, (xdc_IArg)"running");
...
Log_write1(UIABenchmark_stop, (xdc_IArg)"running");
```

To open this feature, choose **Tools > System Analyzer > Duration**. If you already have a session running, you can choose **Duration** from the **Analyze** drop-down in the Session or File Log view.

Summary View for Duration Analysis

By default, the Summary view is shown when you open the Duration feature. This view shows the count, minimum, maximum, average, and total time measured between the start and stop times.



Source	Count	Min	Max	Avera...	Total	Percent
C64XP_0, Msg	1180	187054	251666	193068.84	227,821,226	100.00

This view provides only one record for each unique source. The columns shown are as follows:

- **Source.** This column shows the identifier that the Duration feature uses to match up Start/Stop pairs.
- **Count.** The number of start/stop pairs that occurred for this source.
- **Min.** The minimum time in nanoseconds between start and stop for this source.
- **Max.** The maximum time in nanoseconds between start and stop for this source.
- **Average.** The average time in nanoseconds between start and stop for this source.
- **Total.** The total time in nanoseconds between all start/stop pairs for this source.
- **Percent.** The percent of the total time for all sources measured that was spent in this source.

See page 4–62 for information about using the toolbar icons and right-click menu in the Summary view.

To open Detail or Graph views for the Duration feature, use the **Views** drop-down list in the toolbar of any Duration view.

- The Detail view presents the raw start and stop times for each start/stop pair that has occurred. See Section 4.14.1.
- The Graph view shows the change in duration over time. See Section 4.14.2.

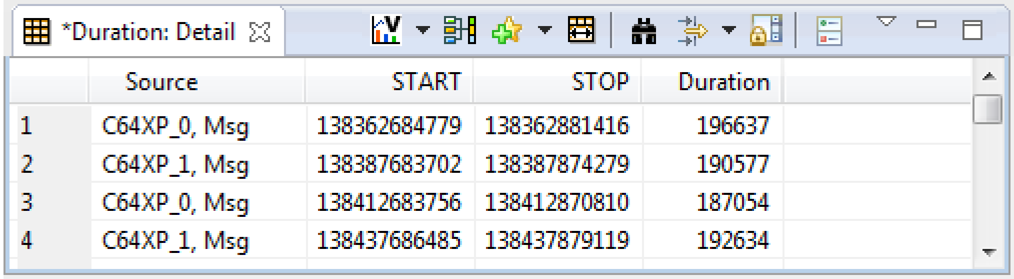
See Also

- Section 3.5, *Benchmarking with System Analyzer*

4.14.1 Detail View for Duration Analysis

To open the Detail view for the Duration feature, use the ▾ **Views** drop-down list in the toolbar of any Duration view.

Each record in the Detail view corresponds to a pair of `UIABenchmark_start` or `UIABenchmark_stop` events passed to the Log_write1() function.



*Duration: Detail

	Source	START	STOP	Duration
1	C64XP_0, Msg	138362684779	138362881416	196637
2	C64XP_1, Msg	138387683702	138387874279	190577
3	C64XP_0, Msg	138412683756	138412870810	187054
4	C64XP_1, Msg	138437686485	138437879119	192634

There are likely to be multiple records in this view for the same source if the start/stop pairs are in threads that execute multiple times.

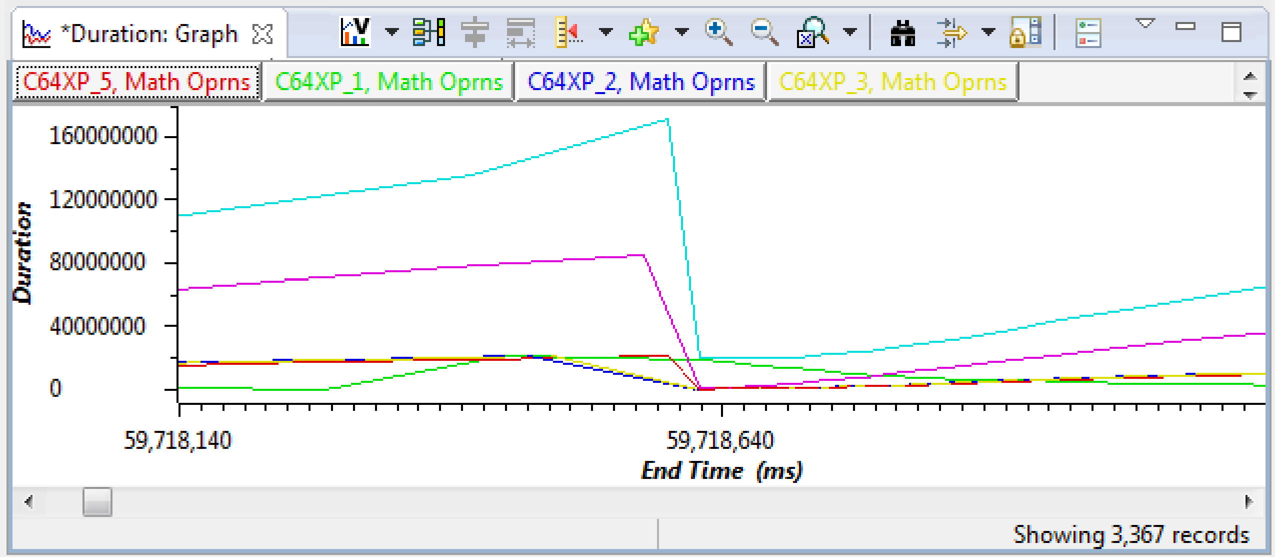
- **Source.** This column shows the identifier that the Duration feature uses to match up Start/Stop pairs. See Section 4.14 for details.
- **Start.** A timestamp for when the `UIABenchmark_start` event occurred.
- **Stop.** A timestamp for when the `UIABenchmark_stop` event occurred.
- **Duration.** The Stop - Start time.

See page 4–62 for information about using the toolbar icons and right-click menu in the Detail view.

4.14.2 Graph View for Duration Analysis

To open the Graph view for the Duration feature, use the **Views** drop-down list in the toolbar of any Duration view.

The Graph view shows the change in duration with time for each unique source.



Clicking on the name of a measurement above the graph highlights the corresponding line in the graph. (If you do not see these buttons, right click on the graph and choose **Legend**.)

Use the toolbar buttons to group (synchronize), measure, zoom, search, and filter the graph. Right-click on the graph to adjust the display properties of the graph.

4.14.3 How Duration Analysis Works

The Duration feature matches pairs of `UIABenchmark_start` and `UIABenchmark_stop` events (from the ti.uia.events.UIABenchmark module) in target code for a given "source". These events are sent to the host via calls to Log_write1().

A source is identified by combining the core name and the arg1 argument passed to the Log_write1() function when the event argument is `UIABenchmark_start` or `UIABenchmark_stop`. For example, if the target program on CPU_5 makes the following calls, the source identifier will be "`CPU_5, process 1`".

```
#include <xdc/runtime/Log.h>
#include <ti/uia/events/UIABenchmark.h>
...

Log_write1(UIABenchmark_start, (xdc_IArg)"process 1");
...
Log_write1(UIABenchmark_stop, (xdc_IArg)"process 1");
```

The Log_write1() function comes from the XDCtools xdc.runtime.Log module.

- The first parameter (`UIABenchmark_start` or `UIABenchmark_stop`) is an event of type Log_Event.

- The second parameter is a source name string cast as an argument. The entire second parameter is shown in both the Source field in Duration views and in the Message column of the Session or File Log view.

You can also use any of the Log_writeX() functions from Log_write2() to Log_write8() to pass additional arguments for use in rendering the format string. For example:

```
Log_write2(UIABenchmark_start, (IArg)"Process ID: %d", 5);
```

See Section 5.4.2, *Enabling Event Output with the Diagnostics Mask* for information about how to enable and disable logging of UIABenchmark events.

The Duration feature handles missing Start or Stop events by ignoring events as needed.

- If a Start event is followed by another Start event for the same source, the second Start event is ignored and the first Start event is used.
- If a Stop event is followed by another Stop event for the same source, the second Stop event is ignored.
- If a Stop event occurs without a matching Start event for the same source, the Stop event is ignored.

Check the Error column in the Session or File Log view for a value that indicates a data loss occurred. See page 4–60 for details.

4.15 Using Context Aware Profile

The Context Aware Profile feature calculates duration while considering context switches, interruptions, and execution of other functions.

The Context Aware Profile displays data only if you modify your target code to include UIAProfile events as described in Section 4.15.2. Your code needs to explicitly instrument all function entries and exits in order for context aware profiling to provide valid data. No emulation logic is used to do this automatically.

You can use this feature to see information about "inclusive time" vs. "exclusive time".

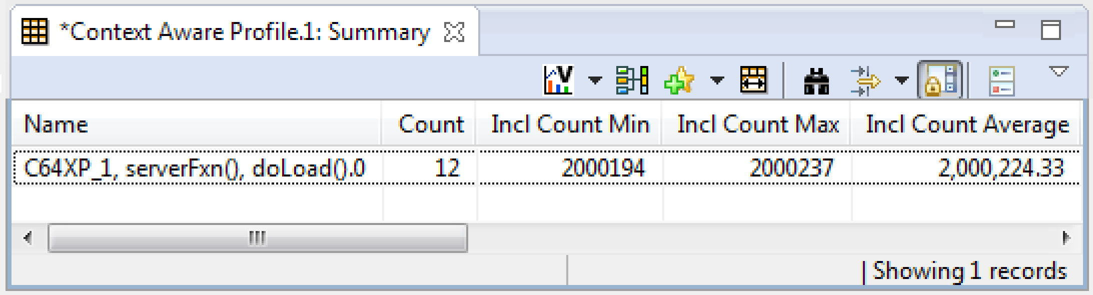
- **Inclusive time** is the entire time between a given pair of start times and stop times.
- **Exclusive time** is the inclusive time minus any time spent running any other thread context. Time spent in called functions and time spent running threads that preempt are yielded to by the thread being measured are not counted in exclusive time.

See Section 4.15.2 for details about how inclusive and exclusive time are calculated.

To open this feature, choose **Tools > System Analyzer > Context Aware Profile**. If you already have a session running, you can choose **Context Aware Profile** from the **Analyze** drop-down in the Session or File Log view.

Summary View for Context Aware Profile

By default, the Summary view opens, which shows the minimum, maximum, average, and total number of nanoseconds within each thread for the selected core. These statistics are reported both for inclusive and exclusive time.



*Context Aware Profile.1: Summary

Name	Count	Incl Count Min	Incl Count Max	Incl Count Average
C64XP_1, serverFxn(), doLoad().0	12	2000194	2000237	2,000,224.33

| Showing 1 records

The summary view shows statistics about each duration context that was measured. The statistics summarize multiple measurements made for each context. The columns in this view are as follows:

- **Name.** The name of the item for this row of statistics. The name has the following format:

  ```
  <master>,<task name>,<function name>.<function id logged>
  ```

  If the Task context or the function running cannot be determined, those portions of the name are listed as “Unknown” in the generated Name.
- **Count.** The number of enter/exit pairs that measured this item’s duration.
- **Incl Count Min.** The minimum inclusive time measured.
- **Incl Count Max.** The maximum inclusive time measured.
- **Incl Count Average.** The average inclusive time measured.
- **Incl Count Total.** The total inclusive time measured.
- **Incl Count Percent.** The percent of all the inclusive times reported due to this item.
- **Excl Count Min.** The minimum exclusive time measured.
- **Excl Count Max.** The maximum exclusive time that was measured.
- **Excl Count Average.** The average exclusive time measured.
- **Excl Count Total.** The total exclusive time measured.
- **Excl Count Percent.** The percent of all the exclusive times reported due to this item.

To open the Detail view, use the **Views** drop-down list in the toolbar of any Context Aware Profile view.

- The Detail view presents the raw start and stop times for each enter/exit pair measured. See Section 4.15.1.

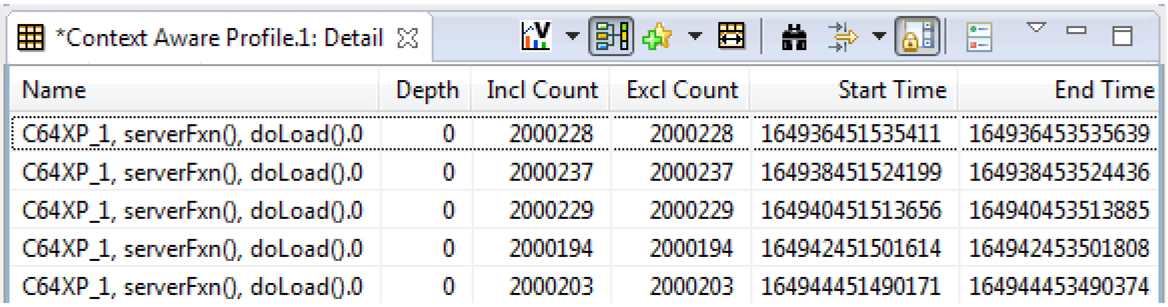
See Also

- Section 3.5, *Benchmarking with System Analyzer*

4.15.1 Detail View for Context Aware Profile

To open the Detail view for the Context Aware Profile feature, use the **Views** drop-down list in the toolbar of any Context Aware Profile view.

The detail view shows a record for each enter/exit pair of durations recorded.



*Context Aware Profile.1: Detail

Name	Depth	Incl Count	Excl Count	Start Time	End Time
C64XP_1, serverFxn(), doLoad().0	0	2000228	2000228	164936451535411	164936453535639
C64XP_1, serverFxn(), doLoad().0	0	2000237	2000237	164938451524199	164938453524436
C64XP_1, serverFxn(), doLoad().0	0	2000229	2000229	164940451513656	164940453513885
C64XP_1, serverFxn(), doLoad().0	0	2000194	2000194	164942451501614	164942453501808
C64XP_1, serverFxn(), doLoad().0	0	2000203	2000203	164944451490171	164944453490374

The columns in this view are as follows:

- **Name.** The name of the CPU combined with the function or thread that was measured.
- **Depth.** The number of levels deep for this function context. The top-level function has a depth of 0; functions called by the top-level have a depth of 1, and so on.
- **Incl Count.** The inclusive time for this measurement.
- **Excl Count.** The exclusive time for this measurement.
- **Start Time.** The time in nanoseconds when this measurement was started.
- **End Time.** The time in nanoseconds when this measurement was stopped.

4.15.2 How Context Aware Profiling Works

The Context Aware Profile feature matches pairs of enter and exit events from the ti.uia.events.UIAProfile module. These events occur only if you add code to your target application that calls Log_write2() and passes the UIAProfile_enterFunctionAdrs or the UIAProfile_exitFunctionAdrs events.

For example, the following code would produce an enter/exit pair that would be used by the Context Aware Profile for the myFunc() function:

```
#include <xdc/runtime/Log.h>
#include <ti/uia/events/UIAProfile.h>
void myFunc(){
    Log_write2( UIAProfile_enterFunctionAdrs, 0, (IArg)&myFunc);
    ...
    Log_write2( UIAProfile_exitFunctionAdrs, 0, (IArg)&myFunc);
    return;
};
```

Note: If your existing code uses the UIABenchmark_startInstanceWithAdrs and UIABenchmark_stopInstanceWithAdrs events for context-aware profiling, the Context Aware Profile and Execution Graph features will still work. New code should use the UIAProfile_enterFunctionAdrs and UIAProfile_exitFunctionAdrs events.

To profile the entire time spent in the function, your code would use the UIAProfile_enterFunctionAdrs event at the beginning of the function and the UIAProfile_exitFunctionAdrs event just prior to any line the could cause the function to return.

In the Session or File Log view the EventClass for these events is shown as "FUNC" because a function reference is passed with the event to identify the function that is being profiled.

The Log_write2() function comes from the XDCtools xdc.runtime.Log module. It is possible to use any of the Log_writeX() functions from Log_write2() to Log_write8(). If you use a Log_writeX() function with additional arguments, all other arguments are ignored by the Context Aware Profile feature. The parameters passed to Log_write2() are as follows:

- **evt.** An event (`UIAProfile_enterFunctionAdrs` or `UIAProfile_exitFunctionAdrs`) of type Log_Event.
- **arg0.** Could be used in the future to specify the instance of the function, but the Context Aware Profile currently expects a value of 0.
- **arg1.** A function reference to identify what this enter/exit pair is profiling.

See Section 5.4.2, *Enabling Event Output with the Diagnostics Mask* for information about how to enable and disable logging of UIAProfile events. See Section 5.4.3, *Events Provided by UIA* for more about UIAProfile events.

The Context Aware Profile also uses context switching information about Task, Swi, and Hwi threads to calculate the inclusive and exclusive time between an enter/exit. The following table shows whether various types of contexts are included in inclusive and exclusive time. Since the Duration views (page 4–75) are not context-aware, time spent in any context is included in those views.

Table 4–5. Inclusive vs. Exclusive Time

Context or Function Type	Counted for Inclusive Time	Counted for Exclusive Time	Counted for Duration
Time spent in the specified function’s context.	Yes	Yes	Yes
Time spent in functions called from the specified context. For example, you might want to benchmark function A(), which calls functions B() and C().	Yes	No	Yes
Time spent in other Task functions as a result of preemption, yielding, and pend/post actions.	Yes	No	Yes
Time spent in Hwi or Swi thread contexts.	No	No	Yes

The Context Aware Profile feature handles missing Enter or Exit events by ignoring events as needed.

- If an Enter event is followed by another Enter event for the same source, the second Enter event is ignored and the first Enter event is used.
- If an Exit event is followed by another Exit event for the same source, the second Exit event is ignored.
- If an Exit event occurs without a matching Enter event for the same source, the Exit event is ignored.

Check the Error column in the Session or File Log view for a value that indicates a data loss occurred. See page 4–60 for details.

4.15.3 Profiling Functions Using Enter and Exit Hook Functions

In order to do inclusive and exclusive profiling of functions (using Context Aware Profiling), a UIA log event needs to occur at the entry and exit point of functions. You can add entry and exit hook functions to every function in the source by doing the following:

1. Use the following compiler options when compiling the source:

```
--entry_hook=functionEntryHook
--entry_parm=address
--exit_hook=functionExitHook
--exit_parm=address
```

2. To use the required UIA APIs, add this #include statement to your code:

```
#include <ti/uia/events/UIAProfile.h>
```

3. Add entry and exit hook functions such as the following to your source code.

```
void functionEntryHook( void (*addr)() ){
    Log_write2(UIAProfile_enterFunctionAdrs, (IArg)0, (IArg)addr);
}
void functionExitHook( void (*addr)() ){
    Log_write2(UIAProfile_exitFunctionAdrs, (IArg)0, (IArg)addr);
}
```

   The parameter after the message string is a context parameter that can be used to specify an additional level of qualification. For this example, we can just set it to 0.

If Task Aware Profiling is needed, the Task context has to be logged. SYS/BIOS automatically logs events for task switches and Swi and Hwi Start and Stop events. See Section 5.2.2, *Enabling and Disabling Event Logging*. Context changes can also be explicitly logged by the application. For more on profiling using System Analyzer, see Section 3.5, *Benchmarking with System Analyzer*.

Note that hook functions are not called from functions in libraries that are linked with your application. As a result, the Exclusive counts of functions that make calls to functions in the library will include the duration of library functions.

4.16 Using the Count Analysis

The Count Analysis feature provides statistics and visualization regarding a data value (32-bit signed) logged using a specific target-side UIA event (UIAEvt_intWithKey). For example, you might use Count Analysis to analyze how a data value from a peripheral changes over time. Or, you might want to find the maximum and minimum values reached by some variable or the number of times a variable is changed. The analysis is done on groups of log records with matching formatted strings that specify the source.

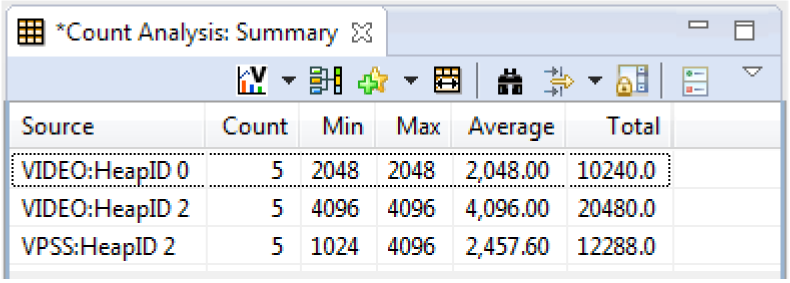
The Count Analysis feature displays data only if you modify your target code to include UIAEvt_intWithKey events as described in Section 4.16.3.

To open this feature, choose **Tools > System Analyzer > Count Analysis**. If you already have a session running, you can choose **Count Analysis** from the **Analyze** drop-down in the Session or File Log view.

When you choose to open the Count Analysis feature, in addition to selecting the core to analyze, you are also asked whether you want to plot the graph vs. the time or sample sequence numbers.

Summary View for Count Analysis

The Summary view is shown when you open the Count Analysis feature. This view shows the count, minimum, maximum, average, and total of the data values reported for each particular source.



Source	Count	Min	Max	Average	Total
VIDEO:HeapID 0	5	2048	2048	2,048.00	10240.0
VIDEO:HeapID 2	5	4096	4096	4,096.00	20480.0
VPSS:HeapID 2	5	1024	4096	2,457.60	12288.0

This view provides only one record for each unique source. The columns shown are as follows:

- **Source.** Statistics are performed on groups determined by combining the core name with a formatted string passed to the Log_writeX() call that created this record.
- **Count.** The number of instances of this source.
- **Min.** The minimum data value for this source.
- **Max.** The maximum data value for this source.
- **Average.** The average data value for this source.
- **Total.** The total data value for this source.

See page 4–62 for information about using the toolbar icons and right-click menu in the Summary view.

To open other views for the Count Analysis feature, use the **Views** drop-down list in the toolbar of any Count Analysis view.

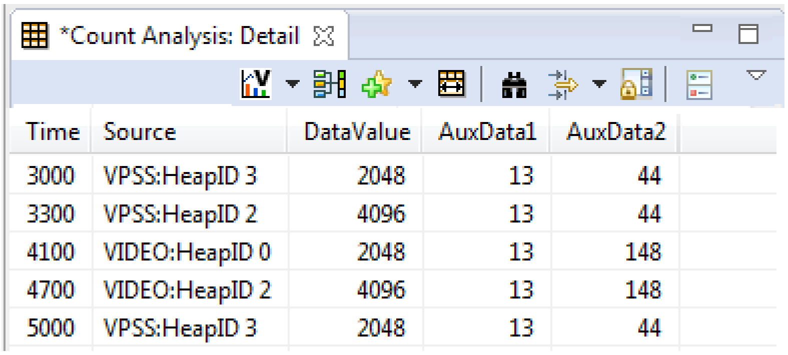
- The Detail view presents all log records for the UIAEvt_intWithKey event. See Section 4.16.1.
- The Graph view shows the change in the data value over time. See Section 4.16.2.

See Also

- Section 3.4, *Performing Count Analysis with System Analyzer*

4.16.1 Detail View for Count Analysis

To open the Detail view for this feature, use the **Views** drop-down list in the toolbar of any Count Analysis view.



Time	Source	DataValue	AuxData1	AuxData2
3000	VPSS:HeapID 3	2048	13	44
3300	VPSS:HeapID 2	4096	13	44
4100	VIDEO:HeapID 0	2048	13	148
4700	VIDEO:HeapID 2	4096	13	148
5000	VPSS:HeapID 3	2048	13	44

Each record in the Detail view corresponds to a specific UIAEvt_intWithKey event logged on the target.

You can export the records from the Count Analysis Detail view to a CSV file that can be used by a spreadsheet. To do this, right-click on the view and choose **Data > Export All**. You might do this in order to perform statistical analysis on the primary and auxiliary data values.

- **Time.** This column shows the correlated time at which this event occurred.
- **Source.** This column identifies the group for this event, which was determined by combining the core name with the resulting formatted string from the Log_writeX() call that created this record.
- **DataValue.** The value used for the analysis.
- **AuxData1.** These fields are used to pass auxiliary data that may need to be observed. This is the Arg2 field of the input to the AF.
- **AuxData2.** This is the Arg3 field of the input to the AF.

See page 4–62 for information about using the toolbar icons and right-click menu in the Detail view.

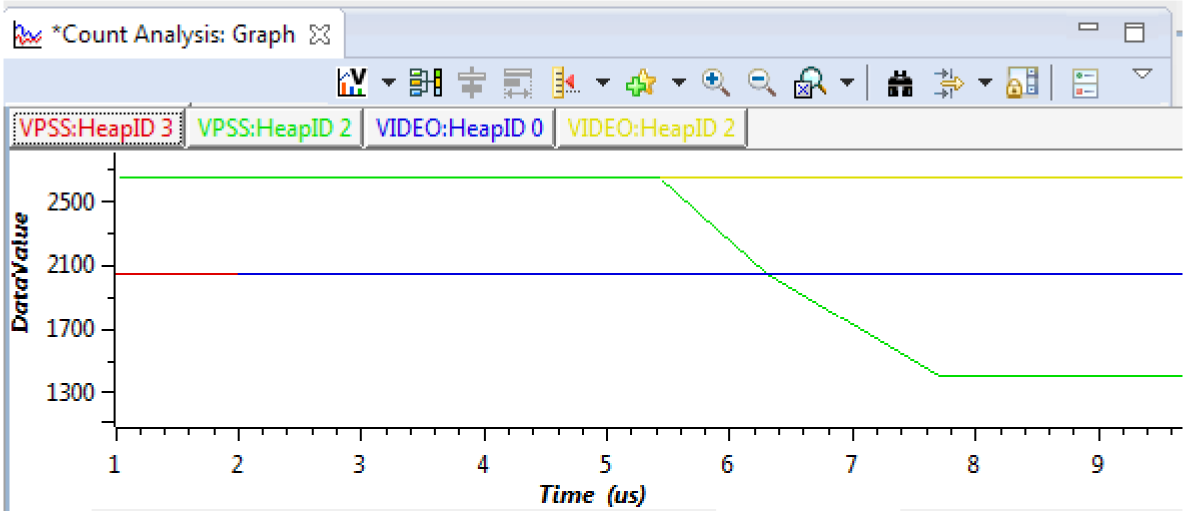
See Also

- Section 3.4, *Performing Count Analysis with System Analyzer*

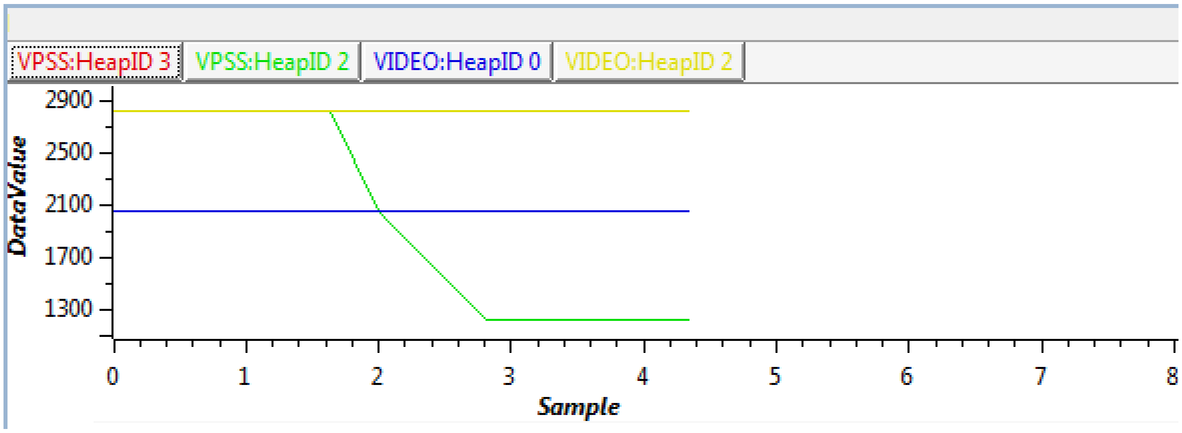
4.16.2 Graph View for Count Analysis

To open the Graph view for the Count Analysis feature, use the **Views** drop-down list in the toolbar of any Count Analysis view. The Graph view shows changes in data values for each unique source. When you open this view, you can choose the core or master whose data values you want to plot (or all cores).

You can also choose whether to plot the data values against time or sample number. By default, data values are plotted vs. time.



In some cases, such as when the data values change at irregular intervals, you might want to plot the data values against the sample sequence number. For example:



Clicking on the name of a measurement above the graph highlights the corresponding line in the graph. (If you do not see these buttons, right click on the graph and choose **Legend**.)

Use the toolbar buttons to group (synchronize), measure, zoom, search, and filter the graph. Right-click on the graph to adjust the display properties of the graph.

4.16.3 How Count Analysis Works

Count analysis works with log events that use the UIAEvt_intWithKey event. This event is provided by the ti.uia.events.UIAEvt module. You must add these events to your target code in order to see data in the Count Analysis views.

The following call to Log_write6() logs an event that can be used by the Count Analysis views:

```
Log_write6( UIAEvt_intWithKey, 0x100, 44, 0,
    (IArg)"Component %s Instance=%d", (IArg)"CPU", 1);
```

The parameters for this call are as follows:

1. Use UIAEvt_intWithKey as the first parameter to log an event for Count Analysis.
2. The data value to be listed or plotted for this source. The value will be treated as a 32-bit integer. In the previous example, the data value is 0x100.
3. Additional data to be displayed in the AuxData1 column of the detail view. This value is not plotted in the graph. The value will be treated as a 32-bit integer. If you do not need to pass any auxiliary data here, pass a placeholder value such as 0. In the previous example, the auxData1 value is 44.
4. Additional data to be displayed in the AuxData2 column of the detail view. This value is not plotted in the graph. The value will be treated as a 32-bit integer. If you do not need to pass any auxiliary data here, pass a placeholder value such as 0. In the previous example, the auxData1 value is 0.
5. A string to be used as the source for this record. Statistics are performed on groups of records with matching sources in the Summary view. Groups of records with matching sources are plotted as a data series in the Graph view. This can be a formatted data string such as, "Component %s Instance=%d". Since the values passed after this string are "CPU" and 1, this record would belong to a group of events that shares a formatted data string of "Component CPU Instance=1"
6. Any variables to me used in the formatted data strong for the previous parameter should be added from the sixth parameter on.

Chapter 5

UIA Configuration and Coding on the Target

This chapter describes how to configure and code target applications using UIA modules.

Topic **Page**

5.1 Quickly Enabling UIA Instrumentation

You can begin analyzing data provided by UIA by enabling data collection from pre-instrumented SYS/BIOS threads. Later, you can add target-side code to collect additional data specific to your application.

Once you perform the necessary configuration, you will be able to view UIA data in the Session or File Log view, CPU Load, Task Load, and Execution Graph features. Only the Context Aware Profile and Duration features display no data unless you modify your target code by adding benchmarking calls as described in Section 4.14.3, *How Duration Analysis Works* and profiling calls as described in Section 4.15.2, *How Context Aware Profiling Works*.

In order to enable data collection from pre-instrumented SYS/BIOS threads and have that data transferred from the target(s) to the host PC running CCS, you must do the following:

Configuration Steps to Perform on All Targets

1. **Remove Legacy Modules.** Remove any statements in your application's configuration file (*.cfg) that include and configure the following modules:

   — ti.sysbios.rta.Agent

   — ti.rtdx.RtdxModule

   — ti.rtdx.driver.RtdxDvr

   If you have logger instances for the xdc.runtime.LoggerBuf, delete those instances.

2. **Remove xdc.runtime.LoggerBuf** from your application's configuration file. Events logged with LoggerBuf cannot be viewed in RTOS Analyzer.

3. **Use the LoggingSetup Module.** Add the following statement to include UIA's LoggingSetup module in your application's configuration. For example:

   ```
   var LoggingSetup =
       xdc.useModule('ti.uia.sysbios.LoggingSetup');
   ```

   Including the LoggingSetup module creates logger instances needed by UIA and assigns those loggers to the modules that need them in order to provide UIA data.

4. **If you intend to use a UIA logger other than LoggerStopMode,** set the LoggingSetup.loggerType parameter as described in “Configuring the UIA Logger” on page 94. This example uses the LoggerMin minimal footprint logger:

   ```
   LoggingSetup.loggerType = LoggingSetup.LoggerType_MIN;
   ```

Configuration Steps to Perform on Multicore Targets Only

If you are using a multicore device, perform these additional steps:

1. **Configure physical communication, such as NDK.** Configure physical communication between the cores. The application is responsible for configuring and starting the physical communication. For example, this communication may use the NDK. See the target-specific examples provided with UIA (and NDK) for sample code.
2. **Configure the Topology.** If your multicore application routes data through a single master core, edit your application's configuration file to include UIA's ServiceMgr module and configure MULTICORE as the topology, and identify the master core using the ServiceMgr.masterProcId parameter. For example:

   ```
   var ServiceMgr =
       xdc.useModule('ti.uia.runtime.ServiceMgr');
   ServiceMgr.topology = ServiceMgr.Topology_MULTICORE;
   ServiceMgr.masterProcId = 3;
   ```

   The EVMTI816x routes to the ARM, which runs Linux. The EVM6472 routes to the master core. In general, if only one core can access the peripherals, use the MULTICORE topology.

   If each core in your multicore application sends data directly to CCS on the host, configure the topology as Topology_SINGLECORE (which is the default).

   See Section 5.3.3 for more information about configuring the topology.
3. **Configure IPC.** You must also configure and initialize IPC and any other components needed to enable communication between the cores. For example, you might also need to set up the NDK. See the target-specific examples provided with UIA (and IPC) for sample code. UIA may not be the only user of these resources, so it is left to the application to configure and initialize them.
4. **Configure GlobalTimestampProxy and CpuTimestampProxy.** You must configure the GlobalTimestampProxy parameter in the LogSync module as described in Section 5.3.7. If the frequency of your local CPU will change at run-time, you must also configure the CpuTimestampProxy parameter.

5.1.1 Using XGCONF to Enable UIA Instrumentation

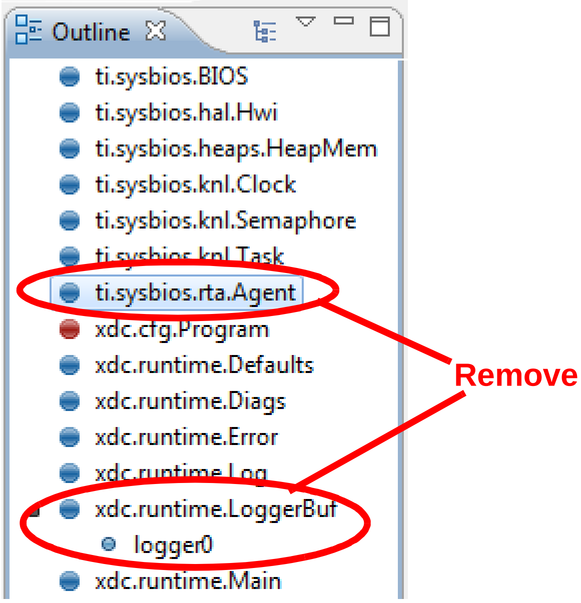
Instead of editing configuration scripts directly, you can use the XGCONF tool within CCS to visually edit an application's configuration. XGCONF shows the RTSC modules—including XDCtools, SYS/BIOS, IPC, and UIA—that are available for configuration.

XGCONF lets you add the use of modules to your application, create instances, and set parameter values. It performs error checking as you work, and so can save you time by preventing you from making configuration errors that would otherwise not be detected until you built the application.

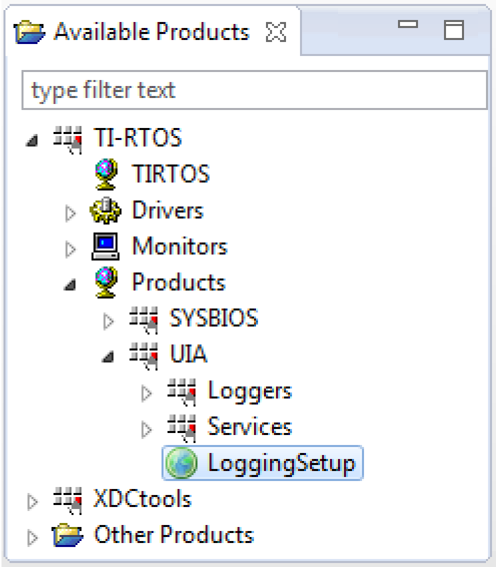
For example, to add UIA instrumentation to a SYS/BIOS application that uses the legacy ti.sysbios.rta.Agent and xdc.runtime.LoggerBuf modules, follow these steps:

1. In CCS, right-click on the project and choose **Show Build Settings**.
2. In the Properties dialog, choose the **General** category, then the **RTSC** tab.
3. In the **Products and Repositories** area, check the box next to **TI-RTOS** for your device family. If there are multiple versions, select the most recent version. This makes the UIA modules available within XGCONF.
4. Click **OK**.

5. Open the project's configuration file (*.cfg) with XGCONF in CCS. Notice that TI-RTOS is now listed in the Available Packages list.
6. Look at the **Outline** list, which is usually on the right side of the CCS window.
7. If you see the ti.sysbios.rta.Agent module listed in the **Outline** list, right-click on it and choose **Stop Using Agent**.
8. If a LoggerBuf logger is listed in the Outline pane, right-click on the logger instance (for example, "logger0") and choose **Delete**. If you see error messages, select the **Source** tab at the bottom of the center pane. Delete all statements related to the logger instance, and save the file.
9. If the xdc.runtime.LoggerBuf module is listed in the Outline pane, right-click on it and choose **Stop Using LoggerBuf**.
10. If there are any RTDX modules or drivers, remove those from the Outline.



11. Expand the **Available Products** tree to see the modules in **TI-RTOS > Products > UIA**.
12. Drag the **LoggingSetup** module to the Outline pane.
13. Select the LoggingSetup module in the Outline. Notice that the properties for this module are then shown in the center pane. If you see the configuration script instead, click the **LoggingSetup** tab at the bottom of this area.
14. Set a property. For example, in the **Built-in Software Instrumentation** properties, you can enable event logging for individual Swi threads by checking the **Swi Context** box below the **RTOS Execution Analysis** item.
15. Set properties and add other modules as needed.
16. Press Ctrl+S to save your configuration file.



5.2 Configuring SYS/BIOS Logging

You can configure the types of SYS/BIOS events that are logged and sent to RTOS Analyzer.

- **Load logging** is enabled by default for CPU, Task, Swi, and Hwi threads. As a result, information about loads for those items is available in the CPU Load and Task Load features.
- **Event logging** used to display the Execution Graph is enabled by default only for Task threads. You can enable it for Swi and Hwi threads by configuring the LoggingSetup module.

See Section 5.4.2 for information about configuring other types of logging messages.

5.2.1 Enabling and Disabling Load Logging

By default, all types of SYS/BIOS load logging are enabled as a result of adding the LoggingSetup module to the configuration.

If you want to disable CPU Load logging, you would include the following statement in your target application's configuration file. However, note that disabling CPU load logging also disables all other load logging.

```
LoggingSetup.loadLogging = false;
```

To disable Task, Swi, or Hwi load logging, you can use the corresponding statement from the following list:

```
var Load = xdc.useModule('ti.sysbios.utils.Load');
Load.taskEnabled = false;
Load.swiEnabled = false;
Load.hwiEnabled = false;
```

Another way to disable load logging is to modify the setting of the Load.common$.diags_USER4 mask, which controls whether load logging is output. For example, the following statements disable all load logging:

```
var Load = xdc.useModule('ti.sysbios.utils.Load');
var Diags = xdc.useModule('xdc.runtime.Diags');
Load.common$.diags_USER4 = Diags.ALWAYS_OFF;
```

The Load.common$.diags_USER4 mask is set to Diags.RUNTIME_ON by the LoggingSetup module unless you have explicitly set it to some other value.

5.2.2 Enabling and Disabling Event Logging

By default, the event logging used to display the Execution Graph is enabled by default only for SYS/BIOS Task threads. As a result, the Execution Graph can be expanded to show individual Task threads, but shows all Swi thread execution as one row, and all Hwi thread execution in another row without showing Swi and Hwi thread names.

Enabling Logging

You can enable event logging for SYS/BIOS Swi and Hwi threads by configuring the LoggingSetup module as follows:

```
LoggingSetup.sysbiosSwiLogging = true;
LoggingSetup.sysbiosHwiLogging = true;
```

Enabling event logging for Swi and Hwi allows you to see the execution status of individual Swi and Hwi threads. Application performance may be impacted if you enable such logging for applications with Swi or Hwi functions that run frequently. In addition, logging many frequent events increases the chance of the oldest data in the logger buffer being overwritten, if the buffer fills up before being read by the host.

For Task threads, the events logged are ready, block, switch, yield, sleep, set priority, and exit events. For Swi threads, the events logged are post, begin, and end events. For Hwi threads, the events logged are begin and end events.

The following configuration statements enable logging of all function entry and exit events by your application. This is because your main() function and other user-defined functions (that is, for example, all non-XDCtools, non-SYS/BIOS, non-IPC, and non-UIA modules) inherit their default Diags configuration from the Main module's Diags configuration.

```
Main.common$.diags_ENTRY = Diags.ALWAYS_ON;
Main.common$.diags_EXIT = Diags.ALWAYS_ON;
```

Disabling Logging

To disable Task, Swi, Hwi, or Main event logging, you can use the appropriate statement from the following list:

```
LoggingSetup.sysbiosTaskLogging = false;
LoggingSetup.sysbiosSwiLogging = false;
LoggingSetup.sysbiosHwiLogging = false;
LoggingSetup.mainLogging = false;
```

Another way to disable event logging is to modify the setting of the common$.diags_USER1 and common$.diags_USER2 masks for the appropriate module. This controls whether event logging is output. For example, the following statements disable all event logging:

```
var Task = xdc.useModule('ti.sysbios.knl.Task');
Task.common$.diags_USER1 = Diags.ALWAYS_OFF;
Task.common$.diags_USER2 = Diags.ALWAYS_OFF;

var Swi = xdc.useModule('ti.sysbios.knl.Swi');
Swi.common$.diags_USER1 = Diags.ALWAYS_OFF;
Swi.common$.diags_USER2 = Diags.ALWAYS_OFF;

var Hwi = xdc.useModule('ti.sysbios.hal.Hwi');
Hwi.common$.diags_USER1 = Diags.ALWAYS_OFF;
Hwi.common$.diags_USER2 = Diags.ALWAYS_OFF;

Main.common$.diags_USER1 = Diags.ALWAYS_OFF;
Main.common$.diags_USER2 = Diags.ALWAYS_OFF;
```

5.2.3 *More About Diags Masks*

Since logging is not always desired because of the potential impact on the system performance, you can use the xdc.runtime.Diags module to enable/disable logging both statically and dynamically on a global or per module basis.

By default the ti.uia.sysbios.LoggingSetup module sets the following diagnostics masks to Diags.RUNTIME_ON:

- **diags_USER1 and diags_USER2:** Main, Task, Semaphore, and Event modules. These masks control event logging.
- **diags_USER4:** Main and Load modules. This mask controls load logging.
- **diags_USER3, diags_USER5, and diags_USER6:** Main module.
- **diags_STATUS:** Main module. This mask controls the output of some events provided in the ti.uia.events package.
- **diags_ANALYSIS:** Main module. This mask controls the output of some events provided in the ti.uia.events package.

- **diags_INFO:** Main module. This mask controls the output of some events provided in the ti.uia.events package.

For Swi and Hwi event logging, the diags_USER1 and diags_USER2 masks are set to Diags.RUNTIME_ON only if you have set LoggingSetup.sysbiosSwiLogging or LoggingSetup.sysbiosHwiLogging to true. By default, these are off.

This leaves other masks that are rarely or never used by UIA—diags_ENTRY, diags_EXIT, diags_LIFECYCLE, diags_INTERNAL, diags_ASSERT, diags_USER7, and diags_USER8—at their default values.

The XDCscript portion of the CDOC online reference contains details about which diagnostics masks must be enabled for particular events to be logged.

Note: You should be careful about setting any Defaults.common$ parameters. Such parameter settings are inherited by *all* modules for which the parameter is not explicitly set. This includes all XDCtools, SYS/BIOS, IPC, and UIA modules.

5.2.4 Setting Diags Masks at Run-time

Run-time checking is performed when a diagnostics mask is set to RUNTIME_ON. To improve performance by removing run-time checking, you may want to change the configuration to use Diags.ALWAYS_ON or Diags.ALWAYS_OFF.

If you configure a diagnostics mask to be set to Diags.RUNTIME_ON or Diags.RUNTIME_OFF, your C code can change the setting at run-time by calling the Diags_setMask() function. For example:

```
// turn on USER1 & USER2 events in the Swi module
Diags_setMask("ti.sysbios.knl.Swi+1");
Diags_setMask("ti.sysbios.knl.Swi+2");
...
// turn off USER4 (load) events in the Swi module
Diags_setMask("ti.sysbios.knl.Swi-4");
```

For information about the tradeoffs between Diags.ALWAYS_ON and Diags.RUNTIME_ON, see Section 7.5.2 and its subsections in the *SYS/BIOS User's Guide* (SPRUEX3). Ignore any mention of the ti.sysbios.rta.Agent module and RTDX; these are replaced by the modules provided with UIA.

See Section 5.4.2 for more about run-time diagnostics configuration.

5.3 Customizing the Configuration of UIA Modules

You can further customize the behavior of UIA modules as described in the subsections that follow:

- Section 5.3.1, *Configuring ti.uia.sysbios.LoggingSetup*
- Section 5.3.2, *Configuring ti.uia.services.Rta*
- Section 5.3.3, *Configuring ti.uia.runtime.ServiceMgr*
- Section 5.3.4, *Configuring ti.uia.loggers.LoggerStopMode*
- Section 5.3.5, *Configuring ti.uia.runtime.LoggerSM*
- Section 5.3.6, *Configuring ti.uia.sysbios.LoggerIdle*

- Section 5.3.7, *Configuring ti.uia.runtime.LogSync*

You can further control UIA behavior through the following:

- Section 5.3.8, *Configuring IPC*

5.3.1 Configuring ti.uia.sysbios.LoggingSetup

In order to enable UIA instrumentation, your application's configuration file should include the ti.uia.sysbios.LoggingSetup module as follows:

```
var LoggingSetup =
    xdc.useModule('ti.uia.sysbios.LoggingSetup');
```

See Section 5.2 for how to configure the types of events that are logged and sent to RTOS Analyzer and System Analyzer.

Besides using the LoggingSetup module to configure event logging, you can also configure the loggers that are created as a result of including this module.

Configuring the UIA Logger

By default, events are logged using LoggerStopMode, and are uploaded over JTAG when the target halts. This mode requires that JTAG connections are supported by the target.

If you want to upload data while the target is running (only available for some targets), you will need to use a different logger, such as LoggerRunMode or LoggerIdle. You can do this by configuring the LoggingSetup.loggerType parameter. For example, to upload over JTAG while the target is running (available on C6x only):

```
LoggingSetup.loggerType = LoggingSetup.LoggerType_JTAGRUNMODE;
```

The available logger types are as follows:

Table 5–1. LoggingSetup.loggerType Values

Value	Description
LoggerType_STOPMODE	Events are uploaded over JTAG when the target halts. This mode is not supported on CPUs running multi-process operating systems such as Linux. (This is the default mode.)
LoggerType_MIN	Events are written to a minimal footprint logger, LoggerMin, and uploaded over JTAG when the target halts. This is useful for memory-constrained applications.
LoggerType_JTAGRUNMODE	Events are uploaded directly from the buffers via JTAG while the target is running. Note that while events can be uploaded via JTAG, commands cannot be sent to the target via JTAG. This mode is currently supported only on C6x devices.
LoggerType_RUNMODE	Events are uploaded over the non-JTAG transport specified by the ServiceMgr.transportType parameter. For example, by Ethernet or File. See Section 5.3.3.
LoggerType_IDLE	Events are uploaded during the Idle loop by a user-implemented transport function.

The various loggers have different pros and cons. The following table compares them. Comments below the table explain the columns in more detail.

Table 5–2. Comparison of UIA Loggers

Logger	Event Upload Mode	Features and Limitations	Ease-of-Use
LoggerStopMode	Events uploaded over JTAG when the target halts.	Supports multiple logger instances, Snapshot events, and filtering of events by level. Larger memory footprint.	Easy
LoggerMin	Events uploaded over JTAG when the target halts.	Single buffer for all Log events. No Snapshot events or filtering. Minimal footprint.	Easy
LoggerRunMode (JTAG)	Events uploaded over real-time JTAG. Available on C64+ and C66x targets only.	Supports multiple instances, Snapshot events, and event filtering. Similar memory footprint to LoggerStopMode.	Easy
LoggerRunMode (Ethernet)	Events uploaded through ServiceMgr user-pluggable transport function.	Supports multiple instances, Snapshot events, and event filtering. Larger memory footprint for ServiceMgr and transport.	Complex
LoggerIdle	Events uploaded over UART, USB, or Ethernet in the SYS/BIOS Idle Task. User must provide the transport function for uploading the events.	A single buffer for all Log events. Snapshot events and filtering are not supported to provide a smaller memory footprint.	Moderate

If you are using a simulator, you should use LoggerType_STOPMODE.

The only loggers that do not require a JTAG connection are LoggerRunMode (when configured to use Ethernet transport) and LoggerIdle.

If you select LoggerRunMode with Ethernet transport, you will also need to configure and use ServiceMgr. (See Section 5.3.3.1, *Configuring the topology*) This will increase the memory footprint and have a small impact on the performance of the application, because Log records are retrieved from a low-priority Task thread.

The memory footprint is smaller for modes that do not use the ServiceMgr framework.

Non-JTAG modes have a small performance impact on the application because Log records are retrieved from a low-priority Task thread by the ServiceMgr framework or during Idle processing for LoggerIdle.

The Loggers listed as being easy to use are easy because there are very few decisions to be made. The LoggerRunMode logger, when configured to use Ethernet, allows you to customize the behavior of the ServiceMgr framework, so there are more choices available to you. LoggerIdle is less complicated than ServiceMgr, but it still requires the user to set up and implement the transport that will be used.

See the ti.uia.sysbios.LoggingSetup topic in the online help API Reference (CDOC) for more information about this module.

Default Logger Instances

The LoggingSetup module creates logger instances for the following purposes:

- **SYSBIOS System Logger.** Receives events related to SYS/BIOS context-switching. For example, pend and post events for the Semaphore and Event modules go to this log. The default size of this logger is 1024 MADUs.

- **Load Logger.** Receives load information for the CPU, thread types (Hwi and Swi), and Task functions. The default size of this logger is 512 MADUs.
- **Main Logger.** Receives benchmarking information from pre-instrumented objects and any events you add to the target code. The default size of this logger is 1024 MADUs.

All loggers use circular buffers. If the buffer fills up before the host gathers data from the buffer, the logger overwrites the oldest data in the buffer. If you encounter this problem, you can increase the buffer size.

For LoggerMin and LoggerIdle, there is only one buffer for the logs. The default size of the LoggerMin buffer is 512 MADUs. The default size of the LoggerIdle buffer is 256 32-bit words. See the API Reference (CDOC) for any changes to the default sizes.

Loggers are responsible for handling events sent via APIs in the xdc.runtime.Log module and the Log extension modules provided by UIA (for example, LogSnapshot and LogSync).

If you want more control over the way a logger is configured—for example, to specify which section of memory contains the logger's event buffer—you can create your own instance of a logger, configure its parameters, and assign this logger to the LoggingSetup module via the loadLogger, sysbiosLogger, and mainLogger configuration parameters.

Configuring Loggers

To configure a Logger module, add the module that corresponds to your LoggingSetup.loggerType from the list in Table 5–3. You can add a module in XGCONF or by adding a statement similar to the following to your *.cfg file:

```
var LoggerStopMode = xdc.useModule('ti.uia.loggers.LoggerStopMode');
```

Table 5–3. LoggerType and Loggers

LoggingSetup Configuration	Logger
LoggingSetup.loggerType = LoggingSetup.**LoggerType_MIN**;	ti.uia.loggers.LoggerMin
LoggingSetup.loggerType = LoggingSetup.**LoggerType_STOPMODE**;	ti.uia.loggers.LoggerStopMode
LoggingSetup.loggerType = LoggingSetup.**LoggerType_JTAGRUNMODE**; /* * The default transport type of LoggerRunMode is JTAG, * so the following line is not really necessary. */ LoggerRunMode.transportType = LoggerRunMode.**TransportType_JTAG**;	ti.uia.loggers.LoggerRunMode
LoggingSetup.loggerType = LoggingSetup.**LoggerType_RUNMODE**; /* * To use LoggerRunMode with a non-JTAG transport, (currently * Ethernet is the only other option, and this is available * only on some targets) you must configure the transport * type. You must also configure ti.uia.runtime.ServiceMgr * (see examples). */ LoggerRunMode.transportType = LoggerRunMode.**TransportType_ETHERNET**;	ti.uia.loggers.LoggerRunMode

LoggingSetup Configuration	Logger

`LoggingSetup.loggerType = LoggingSetup.LoggerType_IDLE;`
 	
`/* If you use LoggerIdle, configure the transport fxn */`
`LoggerIdle.transportType = LoggerIdle.TransportType_UART;`
`LoggerIdle.transportFxn = '&mySend';`
	ti.uia.sysbios.LoggerIdle

Configuring Logger Buffer Sizes: Log events may be overwritten if the logger's circular buffer fills up before the events are uploaded. For this reason, you may want to increase the size of the buffer, depending on the number of events logged and the frequency they are uploaded. Events generally range in size from 8 bytes to 48 bytes. You can change the default sizes of the three loggers created by LoggingSetup as follows:

```
LoggingSetup.loadLoggerSize = 2048;
LoggingSetup.mainLoggerSize = 16384;
LoggingSetup.sysbiosLoggerSize = 16384;
```

If you are using LoggerMin or LoggerIdle, LoggingSetup will choose the largest of any of these three sizes you have set, since these loggers have only one buffer for all Log events.

See Section 5.3.4, *Configuring ti.uia.loggers.LoggerStopMode*, for an example that configures a logger by customizing the logger size and memory section use.

Note: Use of xdc.runtime.LoggerBuf is not supported by UIA. This module is provided for use by legacy applications that were written prior to the introduction of UIA and does not use data structures that are supported by RTOS Analyzer and System Analyzer.

5.3.2 Configuring ti.uia.services.Rta

For LoggerRunMode using the Ethernet transport (`LoggingSetup.loggerType = LoggingSetup.LoggerType_RUNMODE`), UIA uses the ti.uia.services.Rta module to provide a real-time analysis service. The Rta module enables a service that collects events from logger instances and sends them to the host.

Your application's configuration file does not need to include the ti.uia.services.Rta module, because it is automatically included when you set the LoggingSetup.loggerType parameter to LoggerType_RUNMODE.

Note: You should not include the ti.uia.services.Rta module in your configuration file or set any of its parameters if you are using any logger other than LoggerRunMode with Ethernet transport.

By default, the Rta module collects events every 100 milliseconds. You can configure a different interval as in the following example:

```
Rta.periodInMs = 500;
```

You should shorten the period if you are using a simulator. For example:

```
Rta.periodInMs = 5;
```

Setting the periodInMs parameter does not guarantee that the collection will run at this rate. Even if the period has expired, the collection will not occur until the current running Task has yielded and there are no other higher priority Tasks ready.

Setting the period to 0 disables all collection of events.

When you include the Rta module, Rta automatically includes the ti.uia.runtime.ServiceMgr module—the module that actually communicates with the instrumentation host. The ServiceMgr module is described in Section 5.3.3.

A periodInMs parameter is also provided by the ServiceMgr module. When setting the Rta.periodInMs parameter, you should consider the interactions between the settings you use for the SYS/BIOS clock interval (in the ti.sysbios.knl.Clock module), the ServiceMgr.periodInMs parameter, and the Rta.periodInMs parameter.

- The SYS/BIOS clock interval should be the shortest interval of the three. By default it is 1 millisecond.
- The ServiceMgr.periodInMs parameter should be larger than the SYS/BIOS clock interval, and it should be a whole-number multiple of the SYS/BIOS clock interval. By default it is 100 milliseconds.
- The Rta.periodInMs parameter should be equal to or greater than the ServiceMgr.periodInMs parameter, and it should also be a whole-number multiple of ServiceMgr.periodInMs. By default it is 100 milliseconds.

In summary:

SYS/BIOS clock interval < ServiceMgr.periodInMs <= Rta.periodInMs

If periodInMs for ServiceMgr and Rta are too small, your system performance may suffer because of all the context switches. If periodInMs is too large, logger buffers, which are circular, may fill up before the period elapses and you may lose data.

See the ti.uia.services.Rta topic in the online help API Reference (CDOC) for more information.

5.3.3 Configuring ti.uia.runtime.ServiceMgr

(This section applies only to LoggerRunMode with the Ethernet transport).

The ti.uia.runtime.ServiceMgr module is responsible for sending and receiving packets between the services on the target and the instrumentation host.

When the LoggingSetup module includes the Rta module (because the LoggingSetup.loggerType is LoggerType_RUNMODE and LoggerRunMode.transportType is Ethernet), Rta automatically includes the ti.uia.runtime.ServiceMgr module. If you have a single-core application, you can use the default configuration of the ServiceMgr module.

The ServiceMgr module provides three key configuration parameters in setting up UIA for your device based on your architecture:

- **topology.** Specifies whether you are using a single-core or multicore target. See Section 5.3.3.1.
- **transportType.** Specifies transport to use. See Section 5.3.3.2.
- **masterProcId.** If this is a multicore application, specifies which core is routing events to the instrumentation host. See Section 5.3.3.3.

5.3.3.1 Configuring the topology

The default for the ServiceMgr.topology configuration parameter is Topology_SINGLECORE, which means that each core on the device communicates directly with the host.

If you have a multicore application and the routing of events to CCS is done via a single master core (which then sends the data to CCS), you must include the ServiceMgr module explicitly and configure MULTICORE as the topology. For example:

```
var ServiceMgr =
    xdc.useModule('ti.uia.runtime.ServiceMgr');
ServiceMgr.topology = ServiceMgr.Topology_MULTICORE;
```

The EVMTI816x routes to the ARM, which runs Linux. The EVM6472 routes to the master core. In general, if only one core can access the peripherals, use the MULTICORE topology.

Communication with other cores is routed via the master core, which is specified by the ServiceMgr.masterProcId parameter.

Routing between cores is done via Ipc's MessageQ module. ServiceMgr uses IPC to discover the core configuration and to communicate between the cores. The cores use MessageQ to talk to each other. The masterProcId communicates to CCS. For ’C6472, the master core uses NDK to send and receive TCP/UDP packets to and from CCS.

Note: ServiceMgr expects the application to configure and initialize IPC.

If each core in your multicore application sends data directly to CCS on the host, configure the topology as Topology_SINGLECORE and do not specify a value for the masterProcId parameter.

5.3.3.2 Configuring the transportType

The ServiceMgr.transportType configuration parameter is used to specify in the type of physical connection to use. For example:

```
ServiceMgr.transportType = ServiceMgr.TransportType_FILE;
```

The following transport options are available:

- **TransportType_ETHERNET.** Events and control messages are sent between the host and targets via Ethernet. By default, the NDK is used. The application is responsible for configuring and starting networking stack.
- **TransportType_FILE.** Events are sent between the host and targets via File over JTAG. (Note that control messages cannot be sent via this transport.)
- **TransportType_USER.** You plan write your own transport functions or use transport functions from some other source and specify them using the ServiceMgr.transportFxns parameter. See Section 5.4.8, *Custom Transport Functions for Use with ServiceMgr* if you plan to use this option.

Not all transport options are supported on all devices.

If you do not specify a transportType, UIA picks an appropriate transport implementation to use based on your device. The defaults are found using the ti.uia.family.Settings module. If the device is unknown to ServiceMgr, TransportType_ETHERNET is used.

5.3.3.3 Configuring the masterProcId

If this is a multicore application, you need to set the ServiceMgr.masterProcId parameter to indicate which core you want to act as the master core for UIA. All packets will be routed through the master core to the instrumentation host.

The core ID numbers correspond the IPC’s MultiProc ID values. The ServiceMgr module uses IPC to discover the core configuration and to communicate between cores.

Note: The core chosen as the master must be started first.

For example to have core 3 be the masterProcId on a multicore device:

```
var ServiceMgr =
    xdc.useModule('ti.uia.runtime.ServiceMgr');
ServiceMgr.topology = ServiceMgr.Topology_MULTICORE;
ServiceMgr.masterProcId = 3;
```

5.3.3.4 Configuring Other ServiceMgr Parameters

You can configure how often the ServiceMgr gathers events from logs and transfers them to the host. For example:

```
ServiceMgr.periodInMs = 200;
```

See Section 5.3.2, *Configuring ti.uia.services.Rta* for details on the interactions between the ServiceMgr.periodInMs parameter, the Rta.periodInMs parameter, and the SYS/BIOS clock interval.

UIA makes a distinction between event and message (control) packets.

- **Event packets** are large in order to hold several event records. For example, if you are using an Ethernet transport, the maximum event packet size is 1472 bytes, which includes the packet header. UIA chooses the size and number of event packets based on the transport and device. In a multicore architecture, you may want to increase the value of the numEventPacketBufs parameter beyond the default of 2 if a lot of logging is done on the non-master cores. This will help reduce the number of events lost.
- **Message (control) packets** are small and hold only a control message sent from the instrumentation host. The default message packet size is 128 bytes. Note that control messages are only supported via the Ethernet transport. The ServiceMgr.supportControl parameter specifies whether control messages are enabled; it is set automatically as a result of the transport that is used. Control packets occur much less frequently than event packets, so it is rarely necessary to increase the number of control packet buffers. For those rare cases, you can use the numIncomingCtrlPacketBufs and numOutgoingCtrlPacketBufs parameters to configure the number of message packets.

The ServiceMgr module uses one or two Task threads depending on whether control message handling is enabled. By default, these Tasks have a priority of 1, the lowest level. The receive Task receives control messages from the instrumentation host and forwards them to the transfer agent Task. The transfer agent Task handles all other activities, including period management, event collection, communicating with remote cores, and sending UIA packets to the instrumentation host. The ServiceMgr module provides the following parameters for configuring the priority, stack sizes, and placement of these tasks: rxTaskPriority, rxTaskStackSize, rxTaskStackSection, transferAgentPriority, transferAgentStackSize, and transferAgentStackSection.

See the ti.uia.runtime.ServiceMgr topic in the online help API Reference (CDOC) for more information about this module.

5.3.4 Configuring ti.uia.loggers.LoggerStopMode

As described in Section 5.3.1, *Configuring ti.uia.sysbios.LoggingSetup*, UIA creates and uses several loggers to contain events.

Loggers are implementations of an interface, ILogger, which is defined by XDCtools. By default, the loggers created by LoggingSetup use the ti.uia.loggers.LoggerStopMode implementation provided with UIA.

Note: You can only use loggers from ti.uia.loggers and ti.uia.sysbios with UIA. You cannot use xdc.runtime.LoggerBuf with UIA.

LoggerStopMode maintains variable-length logger instances that store events in a compressed, non-decoded format in memory.

For multicore devices, each core must have its own logger instances. Instances cannot be shared among multiple cores due to the overhead that would be required for multicore synchronization.

You can use the LoggerStopMode module to configure your own loggers for UIA (instead of using ti.uia.sysbios.LoggingSetup's defaults). This allows you to configure parameters for the loggers, such as the section that contains the buffer.

For example, the following statements configure a Load logger to be used by LoggingSetup. The size is larger than the default and the logger is stored in a non-default memory section:

```
var loggerParams = new LoggerStopMode.Params();

loggerParams.bufSize = 2048;
/* must also place memory section via Program.sectMap */
loggerParams.bufSection = ".myLoggerSection";

var logger = LoggerStopMode.create(loggerParams);
logger.instance.name = "Load Logger";

var LoggingSetup = xdc.useModule('ti.uia.sysbios.LoggingSetup');
LoggingSetup.loadLogger = logger;
```

You can also create extra LoggerStopMode instances to handle events from certain modules. It is advantageous to put critical events in a dedicated logger instance, where they will not be overwritten. For example, the following code creates a logger just for the Swi module.

```
var LoggerStopMode = xdc.useModule('ti.uia.loggers.LoggerStopMode');
var Swi = xdc.useModule('ti.sysbios.knl.Swi');

/* Give the Swi module its own logger. */
var loggerParams = new LoggerStopMode.Params();
loggerParams.bufSize = 65536;
var swiLog = LoggerStopMode.create(loggerParams);
swiLog.instance.name = "Swi Logger";
Swi.common$.logger = swiLog;

/* Enable the Swi module to log events */
Swi.common$.diags_USER1 = Diags.RUNTIME_ON;
Swi.common$.diags_USER2 = Diags.RUNTIME_ON;
```

Events generally range in size from 8 bytes (Log_write0 with no timestamp) to 48 bytes (Log_write8 with timestamp). Note that snapshot and memory dump events can be even larger.

See the ti.uia.loggers.LoggerStopMode topic in the online help API Reference (CDOC) for more information about this module.

5.3.4.1 Configuring a Shared LoggerStopMode when Multiple Cores Run the Same Image

If you have a single target image that is loaded onto multiple cores, and the LoggerStopMode loggers are stored in shared memory (for example, external memory), you should set the loggerParams.numCores parameter to specify the number of cores running the same image.

The numCores parameter provides a solution to the problem that occurs if the logger's buffer is in shared memory (for example, DDR). Since the image is the same for all the cores, each core attempts to write to the same buffer in the shared memory.

The following example shows how to set the numCores parameter for a logger that is stored in shared memory.

```
var loggerParams = new LoggerStopMode.Params();

loggerParams.bufSize = 1024;
loggerParams.numCores = 4;
/* must also place memory section via Program.sectMap */
loggerParams.bufSection = ".sharedMemSection";

var logger = LoggerStopMode.create(loggerParams);
logger.instance.name = "Load Logger";

var LoggingSetup =
    xdc.useModule('ti.uia.sysbios.LoggingSetup');
LoggingSetup.loadLogger = logger;
```

Setting numCores to a value greater than 1 causes LoggerStopMode to statically allocate additional memory to allow each core to have bufSize amount of memory. The amount of memory allocated is the logger’s bufSize * numCores.

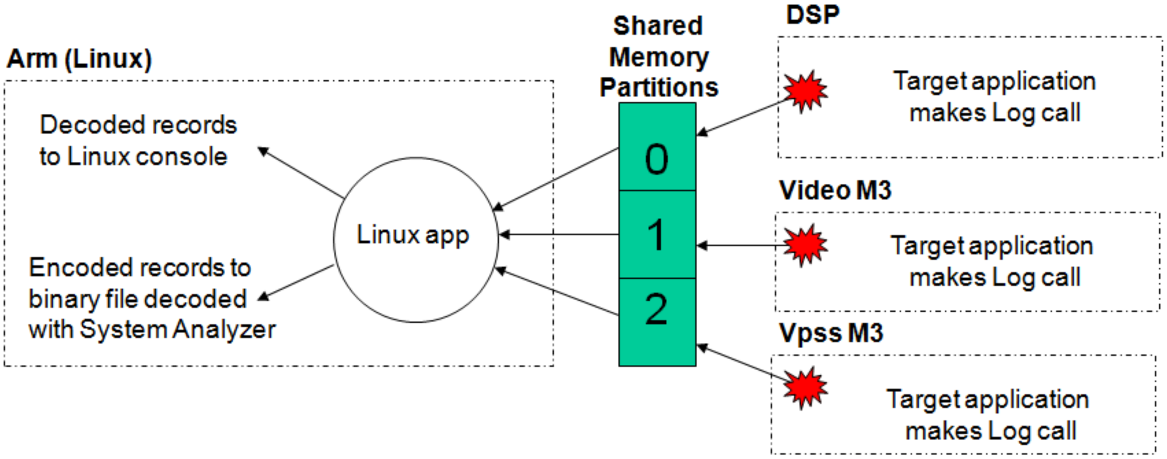
Note: You should set the numCores parameter to a value greater than one *only* if a single image is used on multiple cores of a multicore device *and* the logger instance's buffer is stored in shared memory. Increasing numCores in other cases will still allow the application to function, but will waste memory.

The default value for numCores is 1, which does not reserve any additional memory for the logger.

5.3.5 Configuring ti.uia.runtime.LoggerSM

The LoggerSM logger implementation stores log records into shared memory. It is intended to be used with a SoC system (such as EVMTI816x) where Linux is running on the host core (such as CortexA8) and SYS/BIOS is running on the targets (for example, M3 and DSP).

When a Log call is made on the target, the record is written into the shared memory. On the Linux host, the records can be read from the shared memory and either displayed to the console or written to a file to be processed by RTOS Analyzer and System Analyzer at a later time.


Arm (Linux)
Decoded records to Linux console
Encoded records to binary file decoded with System Analyzer
Linux app
Shared Memory Partitions
0
1
2
DSP
Target application makes Log call
Video M3
Target application makes Log call
Vpss M3
Target application makes Log call

Each target is assigned its own partition of the shared memory, and writes its log events to that partition only.

For use on Linux, UIA ships a LoggerSM module that can be used to process the records and a command-line application that can make use of the LoggerSM module.

The example that uses LoggerSM on EVMTI816x is located in <*uia_install_dir*>\packages\ti\uia\examples\evmti816x. The tools for use on Linux when the targets are using LoggerSM are located in <*uia_install_dir*>/packages/ti/uia/linux.

Constraints

- The shared memory must be in a non-cacheable region. LoggerSM does not perform any cache coherency calls. You can place memory in non-cached memory via different mechanisms on different target types. For example, use ti.sysbios.hal.ammu.AMMU for the M3 cores and the ti.sysbios.family.c64p.Cache module for the DSP on the EVMTI816x. See the EVMTI816x examples provided with UIA for details.
- The shared memory must be aligned on a 4096 boundary.
- The shared memory must be in a NOLOAD section if multiple cores are using the memory.
- All cores, including the targets and Linux ARM core, must have the same size memory units, also called Minimum Addressable Data Unit (MADU).
- Currently the targets and host must all have the same endianness. Removing this restriction is a future enhancement. For example, the EVMTI816x's CortexA8, DSP, and M3 all are little endian.

Configuring the Targets

The following example configuration script causes a target to use the LoggerSM module to place UIA events in shared memory:

```
var LoggerSM = xdc.useModule('ti.uia.runtime.LoggerSM');
var LoggingSetup =
    xdc.useModule('ti.uia.sysbios.LoggingSetup');
var MultiProc = xdc.useModule('ti.sdo.utils.MultiProc');

LoggerSM.sharedMemorySize = 0x20000;
LoggerSM.numPartitions = 3;
LoggerSM.partitionId = MultiProc.id;
LoggerSM.bufSection = ".loggerSM";
var logger = LoggerSM.create();

LoggingSetup.loadLogger = logger;
LoggingSetup.mainLogger = logger;
LoggingSetup.sysbiosLogger = logger;
```

Alternately, since only one LoggerSM instance is used for all logging, you can create the logger instance and use it in all cases where logging occurs as follows:

```
Defaults.common$.logger = LoggerSM.create();
```

The parameters you can set include:

- **sharedMemorySize** specifies the total size of the shared memory for all targets. You must set this parameter to the same value on all targets. The default size is 0x20000 MADUs. For example, on the EVMTI816x, if the sharedMemorySize is 0x3000, each target—DSP, videoM3 and vpssM3—would get 0x1000 MADUs of shared memory for log records.
- **numPartitions** specifies the number of cores that can use the shared memory. The memory will be divided into this number of equal partitions. You must set this parameter to the same value on all targets. The default is 3 partitions. If the sharedMemorySize is not evenly divisible by 3, the extra memory is unused at the end of the shared memory.
- **partitionID** determines which partition this target uses. This value must be different on all targets. For example, in the EVMTI816x examples, the DSP gets partition 0, videoM3 gets 1, and vpssM3 gets 2. This corresponds with the IPC Multicore IDs. You can set this parameter at run-time using the LoggerSM_setPartitionId() API, which must be called before module startup occurs. For example, you could call this function using the xdc.runtime.Startup.firstFxns array.
- **decode** specifies whether the target decodes the record before writing it to shared memory. The default is true, which means the target decodes the record into an ASCII string and writes the string into the shared memory. The Linux tool extracts the string and prints it to the Linux console. This approach is expensive from a performance standpoint. The benefit is that it is easy to manage and view on the host.

  If you set decode to false, encoded records are written to the shared memory. The Linux tool writes the encoded records to a single binary file (see page 5–106) that can be decoded by RTOS Analyzer and System Analyzer. This approach makes Log module calls much faster on the target. Note that different cores can have different decode values.

- **overwrite** determines what happens if the shared memory partition fills up. By default, any new records are discarded. This mode allows you to read the records while the target is running. If you set this parameter to true, old records are overwritten by new records. In this mode, records can only be read on Linux when the targets are halted (or crashed), because both the target and host must update a read pointer.
- **bufSection** specifies the section in which to place the logger's buffer. See the next section for details.

Placing the Shared Memory

The **bufSection** parameter tells LoggerSM where to place the buffer it creates. Each core's bufSection must be placed at the same address. For example, the EVMTI816x examples all place the ".loggerSM" section at 0x8f000000 with the following configuration statements:

```
LoggerSM.bufSection = ".loggerSM";
...
Program.sectMap[".loggerSM"] = new Program.SectionSpec();
Program.sectMap[".loggerSM"].loadAddress = 0x8f000000;
  // or loadSegment = "LOGGERSM";
Program.sectMap[".loggerSM"].type = "NOLOAD";
```

Note that the "NOLOAD" configuration is required. Without this, as each core is loaded, it would wipe out the previous core's initialization of its partition of the shared memory.

The LoggerSM module requires that all targets sharing the memory have the same base address. To confirm all targets have the same address, look at the address of the ti_uia_runtime_LoggerSM_sharedBuffer__A symbol in all the targets' mapfiles. The address must be the same on all targets. This physical address must also be used in the Linux LoggerSM and loggerSMDump tools.

There are several ways to place the shared memory for the .loggerSM section. Here are two ways.

- The EVMTI816x LoggerSM examples use a custom platform file (in ti/uia/examples/platforms) where an explicit memory segment is created as follows:

```
["DDR_SR0", {name: "DDR_SR0", base: 0x8E000000,
   len: 0x01000000, space: "code/data",access: "RWX"}],
["DDR_VPSS", {name: "DDR_VPSS", base: 0x8F800000,
   len: 0x00800000, space: "code/data",access: "RWX"}],
["LOGGERSM", {name: "LOGGERSM", base: 0x8F000000,
   len: 0x00020000, space: "data",access: "RWX"}],
```

- You can create a custom memory map in the config.bld file as follows:

```
/* For UIA logging to linux terminal */
memory[24] = ["LOGGERSM", {name: "LOGGERSM",
    base: 0x8F000000, len: 0x00020000, space: "data"}];
```

Using the Linux LoggerSM Module

The non-XDC LoggerSM module knows how to read the shared memory contents and process them. If the records are decoded, it displays them to the Linux console. If the records are encoded, they are written (along with the UIA events headers) into a binary file. This module is provided in <*uia_install_dir*>/packages/ti/uia/linux.

The two main APIs in this module are LoggerSM_run() and LoggerSM_setName().

- **LoggerSM_run()** processes logs in all the partitions. The syntax is as follows:

  ```
  int LoggerSM_run(  unsigned int physBaseAddr,
                     size_t sharedMemorySize,
                     unsigned int numPartitions,
                     unsigned int partitionMask,
                     char *filename)
  ```

  — **physBaseAddr** specifies the physical address of the shared memory. The address used here must match the address configured on all the targets.

  — **sharedMemorySize** specifies the total size of the shared memory. This size must match the targets' sharedMemorySize parameter.

  — **numPartitions** specifies the number of partitions in the shared memory. This must match the targets' numPartitions parameter.

  — **partitionMask** is a bitmask to determine which partitions to process. For example, if numPartitions is 3, but you only want to process partitions 1 and 2, set the partitionMask to 0x6 (110b).

  — **filename** specifies a filename to use if encoded records are found. If this is NULL, the default name is loggerSM.bin. Encoded records from all targets that send encoded records are placed in the same file. Since a UIA Packet header is also included, RTOS Analyzer and System Analyzer can determine which records go with which core.

  This function returns LoggerSM_ERROR if any parameters are invalid; otherwise, this function never returns.

- **LoggerSM_setName()** associates a name to a partition ID. Calling this function for each target before you call LoggerSM_run() allows the decoded output to include the name instead of just the partition ID. The syntax is as follow:

  ```
  int LoggerSM_setName(  unsigned int partitionId,
                         char *name);
  ```

  This function returns LoggerSM_SUCCESS if it is successful or LoggerSM_ERROR if any parameters are invalid.

See the source code in LoggerSM.c and LoggerSM.h for more APIs.

Using the Linux loggerSMDump Tool

UIA also provides the loggerSMDump.c file, which shows how to use the Linux LoggerSM module with the EVMTI816x board to send decoded records to the console and encoded records to a binary file. This example is provided in the <*uia_install_dir*>/packages/ti/uia/examples/evmti816x directory. The directory also includes a makefile to build the tool. the loggerSMDump.c file calls both LoggerSM_setName() and LoggerSM_run().

The command-line syntax is:

```
loggerSMDump.out <addr> <core_name> [<filename>]
```

To terminate the tool, press Ctrl+C.

- **addr.** The physical address of the shared memory in Hex. The shared memory physical address must be 4 KB aligned.
- **core_name.** The name of the cores that are processed. Valid names are: "dsp", "video", "vpss", "m3" or "all". "m3" processes both video and vpss. "all" processes all three targets.

- **filename.** If target sends encoded records, specify the name of the file to store the encoded records. They can be decoded by RTOS Analyzer and System Analyzer. This parameter is optional. If no filename is specified and encoded events are found, the default file name is loggerSM.bin.

Here are some command-line examples:

```
./loggerSMDump.out 0x8f000000 video myBinaryFile
```

```
./loggerSMDump.out 0x8f000000 m3 myBinaryFile
```

```
./loggerSMDump.out 0x8f000000 all
```

This example shows output from loggerSMDump. In this case, the video M3's records were encoded, so they went into the binary file instead.

```
N:VPSS  P:2 #:00113 T:00000000|21f447cd S:Start:
N:VPSS  P:2 #:00114 T:00000000|21f637d3 S:Stop:
N:VPSS  P:2 #:00115 T:00000000|21f69b15 S:count = 35
N:DSP   P:0 #:00249 T:00000000|3ce48c2f S:Stop:
N:DSP   P:0 #:00250 T:00000000|3ce5f28d S:count = 80
N:DSP   P:0 #:00251 T:00000000|3d8689eb S:Start:
N:DSP   P:0 #:00252 T:00000000|3da59483 S:Stop:
N:DSP   P:0 #:00253 T:00000000|3da6facf S:count = 81
N:VPSS  P:2 #:00116 T:00000000|22d92a23 S:Start:
N:VPSS  P:2 #:00117 T:00000000|22db1689 S:Stop:
N:VPSS  P:2 #:00118 T:00000000|22db7797 S:count = 36
```

Use the following legend to parse the output:

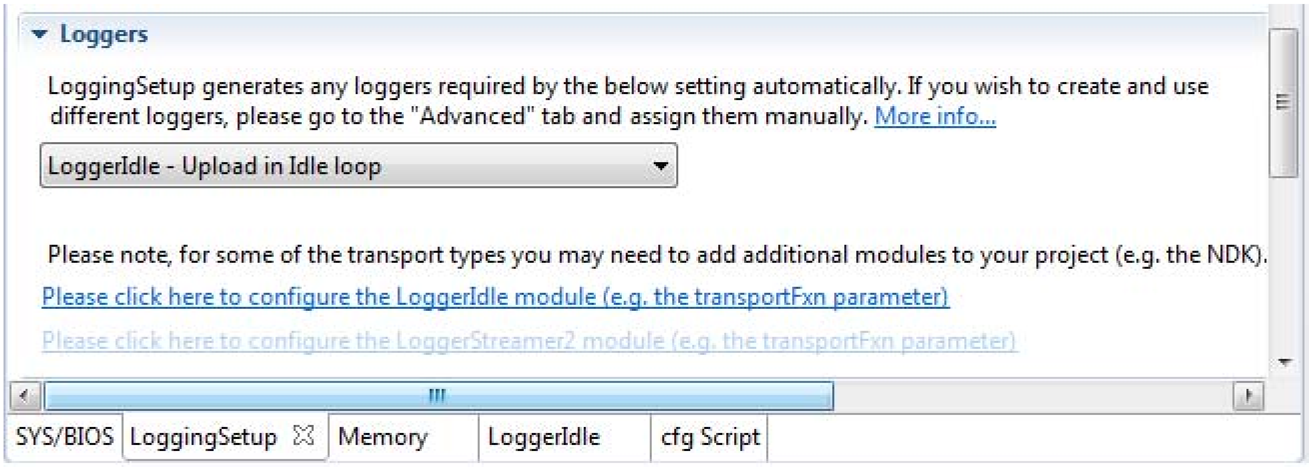
- N: name of the partition owner
- P: partition Id
- T: timestamp [high 32 bits | low 32 bits]
- S: decoded string

5.3.6 Configuring ti.uia.sysbios.LoggerIdle

When using LoggerType_IDLE as described in Section 5.3.1, *Configuring ti.uia.sysbios.LoggingSetup*, UIA will use the LoggerIdle module for all logging.

LoggerIdle is a single-instance logger. This means that there is only one buffer and one data stream for all log events. CCS currently supports upload via UART, USB, and Ethernet.

Selecting LoggerIdle in the LoggingSetup configuration enables you to add LoggerIdle to your project in XGCONF by checking the box to Add the LoggerIdle module to your configuration.


Loggers

LoggingSetup generates any loggers required by the below setting automatically. If you wish to create and use different loggers, please go to the "Advanced" tab and assign them manually. More info...

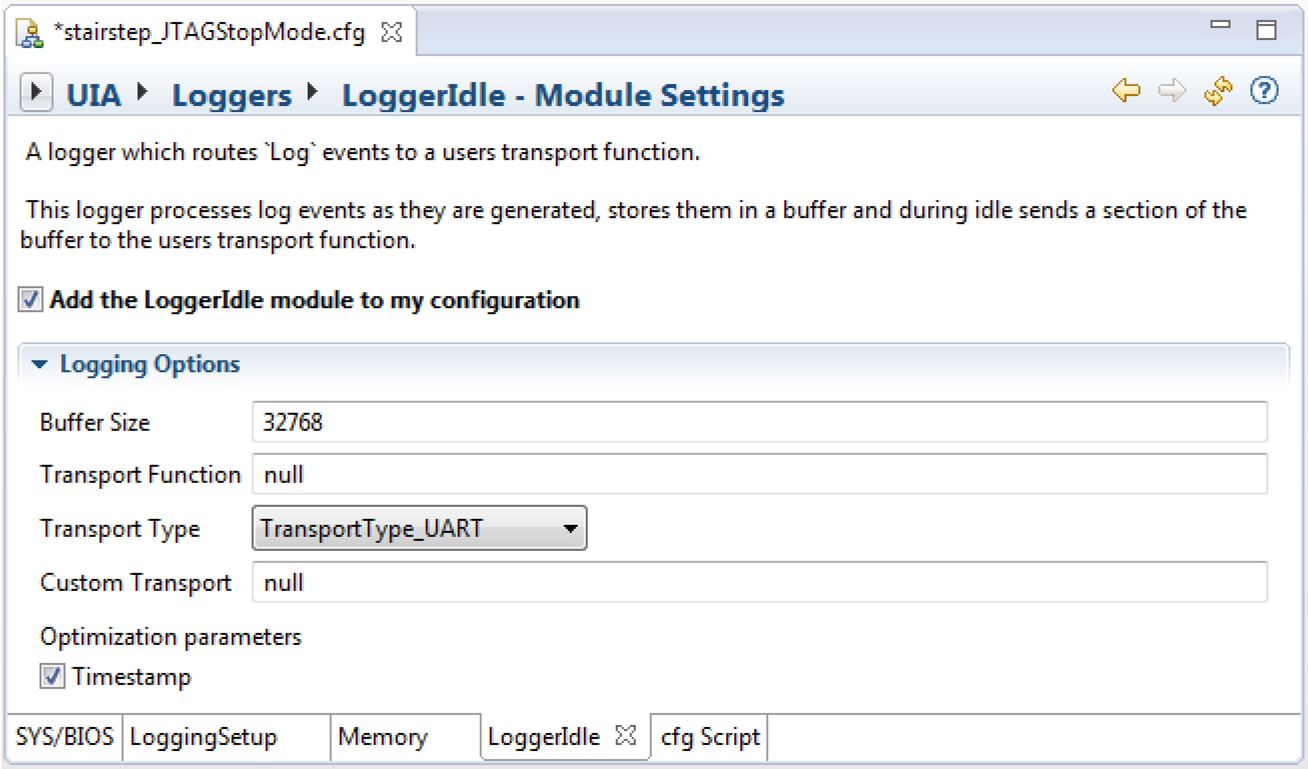
LoggerIdle - Upload in Idle loop

Please note, for some of the transport types you may need to add additional modules to your project (e.g. the NDK).

Please click here to configure the LoggerIdle module (e.g. the transportFxn parameter)

Please click here to configure the LoggerStreamer2 module (e.g. the transportFxn parameter)

However, selecting this mode does not configure all the logger-specific settings for you. Buffer size configuration changes made in LoggingSetup are transferred to LoggerIdle, even though changes are not shown in the LoggerIdle configuration page. However, when the configuration step of the build is run, the LoggerIdle buffer size will be set to the value configured in LoggingSetup. Also, if you look at the generated cfg script, you will see that LoggingSetup.loadLoggerSize has been set to the value that you configured for the buffer size. This value will still be transferred to the LoggerIdle buffer size, even if you do not use Load. To configure LoggerIdle, click the link below the LoggerType field in the LoggingSetup configuration page.


*stairstep_JTAGStopMode.cfg
UIA ▸ Loggers ▸ LoggerIdle - Module Settings

A logger which routes `Log` events to a users transport function.

This logger processes log events as they are generated, stores them in a buffer and during idle sends a section of the buffer to the users transport function.

☑ Add the LoggerIdle module to my configuration

Logging Options

Buffer Size	32768
Transport Function	null
Transport Type	TransportType_UART
Custom Transport	null

Optimization parameters

☑ Timestamp

The size of the buffer used by LoggerIdle is measured in 32-bit words (MAUs). LoggerIdle only has a single buffer instance, and this buffer should be sized appropriately. A general rule is to use the sum of the buffer sizes you would use for the SYS/BIOS, Load, and Application Logging buffers in LoggingSetup.

LoggerIdle also requires you to implement and set a transport function and type. The transport function uses the following prototype:

```
Int transportFxn(UChar *ptr, Int length)
```

The `ptr` is a pointer to a buffer of unsigned characters with a size sufficient to hold the `length` to be written. The function should return the number of unsigned characters sent by the transport. The transport *must* send a multiple of four unsigned characters to avoid dropping any data. Host processing of Log events may or may not handle dropping partial Log events. The implementation of LoggerIdle will never send partial Log events as long as the transport sends a multiple of four unsigned characters.

Set the Transport Type field to tell the host how to handle the implemented transport function. Currently TransportType_UART, TransportType_USB, and TransportType_ETHERNET are supported by CCS. If you are using some other transport, you can use TransportType_CUSTOM and provide the transport name in the Custom Transport field.

LoggerIdle provides an option to log a timestamp with every Log event by setting the Optimization parameter to true. Timestamps are 8 bytes long and should be considered when calculating the buffer size and transfer rate.

The following statements configure LoggingSetup and LoggerIdle in the .cfg source file.

```
var LoggingSetup = xdc.useModule('ti.uia.sysbios.LoggingSetup');
LoggingSetup.loggerType = LoggingSetup.LoggerType_IDLE;

var LoggerIdle = xdc.useModule('ti.uia.sysbios.LoggerIdle');
LoggerIdle.bufferSize = 1024;
LoggerIdle.transportFxn = "&transportFxn";
LoggerIdle.transportType = LoggerIdle.TransportType_USB;
LoggerIdle.isTimestampEnabled = true;
```

5.3.7 Configuring ti.uia.runtime.LogSync

Events that are logged by different CPUs are typically timestamped using a timer that is local to that CPU in order to avoid the overhead of going off-chip to read a shared timer.

In order to correlate one CPU’s events with those logged by another CPU, it is necessary to log "sync point events" that have, as parameters, both the local CPU’s timestamp value and a "global timestamp" that was read from a global shared timer. Any CPUs that log sync point events with global timestamps read from the same global shared timer can be correlated with each other and displayed against a common timeline for analysis and comparison.

The ti.uia.runtime.LogSync module is provided in order to support this type of event correlation. It provides sync events that are used to correlate timestamp values. If you are using LoggerRunMode with Ethernet transport, then the Rta module handles all of the sync point event logging that is required in order to support the event correlation.

In general, you will need to configure the LogSync module, and you will need to call the module’s APIs from your application. For information about LogSync module APIs, see Section 5.4.5.

Note: Multicore event correlation of events uploaded via JTAG transports is not fully supported.

Setting the Global Timestamp Module Proxy

If you have a multicore application, your application must configure the GlobalTimestampProxy parameter on a target-specific basis to provide a timestamp server.

This parameter defaults correctly for the C6472 and TCI6616 platforms. However, for EVMTI816x, it defaults to null, which prevents any multicore event correlation from being performed. In general, you can use a timestamp module that implements the IUIATimestampProvider interface for your target. You should configure the GlobalTimestampProxy as follows:

```
var LogSync = xdc.useModule('ti.uia.runtime.LogSync');
var GlobalTimestampTimer =
xdc.useModule('ti.uia.family.c64p.TimestampC6472Timer');

LogSync.GlobalTimestampProxy = GlobalTimestampTimer;
```

- **C6472.** Use the ti.uia.family.c64p.TimestampC6472Timer module as the proxy. When you use this proxy, the default value for the maxCpuClockFreq is 700 MHz.
- **TCI6616 (simulator).** The ti.uia.family.c66.TimestampC66XGlobal module should be the proxy.
- **EVMTI816x.** The ti.uia.family.dm.TimestampDM816XTimer module should be the proxy. This setting is not auto-configured.

- **Other.** If no module that implements the IUIATimestampProvider interface for your target is available, you can use, for example, a timer provided by SYS/BIOS as the global timer source for event correlation "sync point" timestamps. The following statements configure such as proxy:

  ```
  var LogSync = xdc.useModule('ti.uia.runtime.LogSync');
  var BiosTimer =
   xdc.useModule('ti.sysbios.family.c64p.TimestampProvider');
  LogSync.GlobalTimestampProxy = BiosTimer;
  ```

  If you are using a global timer that does not implement the IUIATimestampProvider interface, you must also configure the maxGlobalClockFreq parameter. If the maxGlobalClockFreq parameter is not configured, you see a warning message at build time that says UIA Event correlation is disabled. You must configure both the maxGlobalClockFreq.lo and maxGlobalClockFreq.hi parameters, which set the lower and upper 32 bits of the frequency, respectively.

  ```
  LogSync.maxGlobalClockFreq.lo = 700000000; //low 32b
  LogSync.maxGlobalClockFreq.hi = 0;         //upper 32b
  ```

  If the CPU timestamp clock frequency is not 700 MHz, you must also configure the lo and hi parameters. For example:

  ```
  LogSync.maxCpuClockFreq.lo = 1000000000;   //low 32b
  LogSync.maxCpuClockFreq.hi = 0;            //upper 32b
  ```

Setting the Local Timestamp Module Proxy

If the frequency of the local CPU may change at run-time, you also need to configure the CpuTimestampProxy parameter of the LogSync module. The timestamp proxies provided for this purpose are:

- ti.uia.family.c64p.TimestampC64XLocal
- ti.uia.family.c66.TimestampC66XLocal

Configuring the CpuTimestampProxy with a local timestamp module allows applications that change the CPU frequency to report this information to RTOS Analyzer and System Analyzer so that event timestamps can be adjusted to accommodate the change in frequency.

The following configuration script shows how to configure the C66x Local Timestamp module for use as the CpuTimestampProxy:

```
var TimestampC66Local =
    xdc.useModule('ti.uia.family.c66.TimestampC66Local');
TimestampC66Local.maxTimerClockFreq = {lo:1200000000,hi:0};
var LogSync = xdc.useModule('ti.uia.runtime.LogSync');
LogSync.CpuTimestampProxy = TimestampC66Local;
```

Injecting Sync Points into Hardware Trace Streams

Correlation with hardware trace (for example, the C64x+ CPU Trace) can be enabled by injecting references to the sync point events into the hardware trace stream. The LogSync.injectIntoTraceFxn parameter allows you to inject sync point information into hardware trace streams. You can specify a pointer to a function that handles the ISA-specific details of injecting information into the trace stream.

For C64x+ Full-GEM (Generalized Embedded Megamodule) devices, which support CPU trace and Advance Event Triggering (AET), use the address of the GemTraceSync_injectIntoTrace() function provided by the ti.uia.family.c64p.GemTraceSync module. For information about GEM, see the *TMS320C64x+ DSP Megamodule Reference Guide* (SPRU871).

This example for the TMS320C6472 platform shows configuration statements with multicore event correlation for the CPUs enabled. More examples are provided in the CDOC for the LogSync module.

```
// Including Rta causes Log records to be collected and sent
// to the instrumentation host. The Rta module logs sync
// point events when it receives the start or stop
// command, and prior to sending up a new event packet if
// LogSync_isSyncPointEventRequired() returns true.
var Rta = xdc.useModule('ti.uia.services.Rta');

// By default, sync point events are logged to a dedicated
// LoggerRunMode buffer named 'SyncLog' assigned to the
// LogSync module. A dedicated event logger buffer helps
// ensure that sufficient timing information is captured to
// enable accurate multicore event correlation. Configure
// LogSync.defaultSyncLoggerSize to set a buffer size.
var LogSync = xdc.useModule('ti.uia.runtime.LogSync');

// For C64x+ and C66x devices that provide CPU trace hardware
// capabilities, the following line enables injection of
// correlation information into the GEM CPU trace, enabling
// correlation of software events with the CPU trace events.
var GemTraceSync =
   xdc.useModule('ti.uia.family.c64p.GemTraceSync');

// Configure a shared timer to act as a global time reference
// to enable multicore correlation. The TimestampC6472Timer
// module implements the IUIATimestampProvider interface, so
// assigning this timer to LogSync.GlobalTimestampProxy
// configures LogSync's global clock params automatically.
var TimestampC6472Timer =
   xdc.useModule('ti.uia.family.c64p.TimestampC6472Timer');
LogSync.GlobalTimestampProxy = TimestampC6472Timer;
```

Setting CPU-Related Parameters

LogSync provides a number of CPU-related parameters—for example, CpuTimestampProxy, cpuTimestampCyclesPerTick, maxCpuClockFreq, and canCpuCyclesPerTickBeChanged. These parameters generally default to the correct values unless you are porting to a non-standard target. For example, the CpuTimestampProxy defaults to the same proxy used by the xdc.runtime.Timestamp module provided with XDCtools.

Setting the globalTimestampCpuCyclesPerTick parameter is optional. It is used to convert global timestamp tick counts into CPU cycle counts for devices where there is a fixed relationship between the global timer frequency and the CPU clock. For example:

```
LogSync.globalTimestampCpuCyclesPerTick = 6;
```

5.3.8 Configuring IPC

When ServiceMgr.topology is ServiceMgr.Topology_MULTICORE, the underlying UIA code uses IPC (or more specifically its MessageQ and SharedRegion modules) to move data between cores. See the IPC documentation for details on how to configure communication between cores for your multicore application.

The following IPC resources are used by UIA:

- Uses up to 4 message queues on each processor.
- Uses the SharedRegion heap when allocating messages during initialization. Which SharedRegion heap is determined by the IpcMP.sharedRegionId parameter. The default is SharedRegion 0.
- Determines the SharedRegion allocation size by the size and number of packets. This is calculated using ServiceMgr parameters as follows:

```
maxCtrlPacketSize *
(numIncomingCtrlPacketBufs + numOutgoingCtrlPacketBufs)
+ maxEventPacketSize * numEventPacketBufs
```

See Section 6.1, *IPC and SysLink Usage* for further information.

Note that, depending on the cache settings, these sizes might be rounded up to a cache boundary.

5.4 Target-Side Coding with UIA APIs

By default, SYS/BIOS provides instrumentation data to be sent to CCS on the host PC if you have configured UIA. It is not necessary to do any additional target-side coding once UIA is enabled.

If you want to add additional instrumentation, you can do by adding C code to your target application as described in the sections that follow.

In general, UIA provides a number of new events that can be using with the existing Log module provided as part of XDCtools. Section 5.4.1 describes how to log events, Section 5.4.2 describes how to enable event logging, and Section 5.4.3 provides an overview of the events provided by UIA.

Section 5.4.4 describes the LogSnapshot module APIs, which allow you to log memory values, register values, and stack contents.

Section 5.4.5 describes ways to configure and customize the synchronization between timestamps on multiple targets.

Section 5.4.6 describes the APIs provided by the LogCtxChg module, which allows you to log context change events.

Section 5.4.7 describes how to use the Rta module APIs to control the behavior of loggers at run-time.

Section 5.4.8 explains how to create and integrate a custom transport.

5.4.1 Logging Events with Log_write() Functions

The Log_writeX() functions—Log_write0() through Log_write8()—provided by the xdc.runtime.Log module expect an event as the first argument. This argument is of type Log_Event.

The ti.uia.events package contains a number of modules that define additional events that can be passed to the Log_writeX() functions. For example, this code uses events defined by the UIABenchmark module to determine the time between two calls:

```
#include <ti/uia/events/UIABenchmark.h>
...
Log_write1(UIABenchmark_start, (xdc_IArg)"start A");
...
Log_write1(UIABenchmark_stop, (xdc_IArg)"stop A");
```

In order to use such events with Log_writeX() functions, you must enable the correct bit in the appropriate module's diagnostics mask as shown in Section 5.4.2 and choose an event to use as described in Section 5.4.3.

5.4.2 Enabling Event Output with the Diagnostics Mask

For an overview of how to enable SYS/BIOS load and event logging, see Section 5.2. This section discusses how to enable logging of events provided by the ti.uia.events module.

Whether events are sent to the host or not is determined by the particular bit in the diagnostics mask of the module in whose context the Log_writeX() call executes. For example, UIABenchmark events are controlled by the ANALYSIS bit in the diagnostics mask.

For example, suppose you placed calls that pass UIABenchmark events to Log_write1() in a Swi function to surround some activity you want to benchmark.

```
Log_write1(UIABenchmark_start, (xdc_IArg)"start A");
...
Log_write1(UIABenchmark_stop, (xdc_IArg)"stop A");
```

If the ANALYSIS bit in the diagnostics mask were off for the Swi module, no messages would be generated by these Log_write1() calls.

By default, the LoggingSetup module sets the ANALYSIS bit to on only for the Main module, which affects logging calls that occur during your main() function and other functions that run outside the context of a SYS/BIOS thread. However, LoggingSetup does not set the ANALYSIS bit for the Swi module.

To cause these benchmark events to be output, your configuration file should contain statements like the following to turn the ANALYSIS bit for the Swi module on in all cases:

```
var Swi = xdc.useModule('ti.sysbios.knl.Swi');
var Diags = xdc.useModule('xdc.runtime.Diags');
var UIABenchmark =
    xdc.useModule('ti.uia.events.UIABenchmark');

Swi.common$.diags_ANALYSIS = Diags.ALWAYS_ON;
```

Alternately, you could enable output of UIABenchmark events within the Swi context by setting the ANALYSIS bit to RUNTIME_OFF and then turning the bit on and off in your run-time code. For example, your configuration file might contain the following statements:

```
var Swi = xdc.useModule('ti.sysbios.knl.Swi');
var Diags = xdc.useModule('xdc.runtime.Diags');
var UIABenchmark =
    xdc.useModule('ti.uia.events.UIABenchmark');

Swi.common$.diags_ANALYSIS = Diags.RUNTIME_OFF;
```

Then, your C code could contain the following to turn ANALYSIS logging on and off. (See the online documentation for the Diags_setMask()Diags_setMask() function for details about its control string argument.)

```
// turn on logging of ANALYSIS events in the Swi module
Diags_setMask("ti.sysbios.knl.Swi+Z");
...
// turn off logging of ANALYSIS events in the Swi module
Diags_setMask("ti.sysbios.knl.Swi-Z");
```

5.4.3 Events Provided by UIA

The ti.uia.events package contains a number of modules that define additional events that can be passed to the Log_writeX() functions. Section 5.4.2 uses the UIABenchmark_start and UIABenchmark_stop events from the ti.uia.events.UIABenchmark module as an example.

To use an event described in this section, you must do the following:

- Include the appropriate UIA module in your .cfg configuration file. For example:

  ```
  var UIABenchmark =
      xdc.useModule('ti.uia.events.UIABenchmark');
  ```

  or

  ```
  var UIAProfile =
      xdc.useModule('ti.uia.events.UIAProfile');
  ```

- Include the appropriate header files in your C source file. For example:

  ```
  #include <xdc/runtime/Log.h>
  #include <ti/uia/events/UIABenchmark.h>
  ```

  or

  ```
  #include <xdc/runtime/Log.h>
  #include <ti/uia/events/UIAProfile.h>
  ```

- Use the event in your C source file. For example:

  ```
  Log_write2(UIABenchmark_start, (xdc_IArg)"Msg %d", msgId);
  ```

  or

  ```
  Log_write2( UIAProfile_enterFunctionAdrs, 0, (IArg)&myFunc);
  ```

The following UIA modules provide events you can use with the Log_writeX() functions:

Table 5–4. Log_Event Types Defined by UIA Modules

Module	Events	Diagnostics Control Bit	Comments
UIABenchmark	Start and stop events.	diags_ANALYSIS	UIABenchmark reports time elapsed exclusive of time spent in other threads that preempt or otherwise take control from the thread being benchmarked. This module's events are used by the Duration feature described in Section 4.14.
UIAErr	Numerous error events used to identify common errors in a consistent way.	diags_STATUS (ALWAYS_ON by default)	These events have an EventLevel of EMERGENCY, CRITICAL, or ERROR. Special formatting specifiers let you send the file and line at which an error occurred.
UIAEvt	Events with detail, info, and warning priority levels.	diags_STATUS or diags_INFO depending on level	An event code or string can be used with each event type.
UIAMessage	Events for msgReceived, msgSent, replyReceived, and replySent.	diags_INFO	Uses UIA and other tools and services to report the number of messages sent and received between tasks and CPUs.
UIAProfile	Start and stop events. Functions can be identified by name or address. These events are designed to be used in hook functions identified by the compiler's --entry_hook and --exit_hook command-line options.	diags_ENTRY and diags_EXIT	UIAProfile reports time elapsed exclusive of time spent in other threads that preempt or otherwise take control from the thread being profiled. This module's events are used by the Context Aware Profile feature described in Section 4.15.
UIAStatistic	Reports bytes processed, CPU load, words processed, and free bytes.	diags_ANALYSIS	Special formatting specifiers let you send the file and line at which the statistic was recorded.

See the online reference documentation (CDOC) for the modules in the ti.uia.events package for more details and examples that use these events.

The online reference documentation for the event modules in the ti.uia.events package contains default message formats for each event in the XDCscript configuration (red) section of each topic. A number of the message formats for these events contain the special formatting specifiers %$S and %$F.

- **%$S —** Handles a string argument passed to the event that can, in turn, contain additional formatting specifiers to be interpreted recursively. Note that you cannot use the $S formatting specifier in strings passed as a parameter. For example, the message format for the UIAErr_fatalWithStr event includes the 0x%x format specifier for an integer error code and the %$S format specifier for a string that may in turn contain format specifiers. This example uses that event:

```
#include <xdc/runtime/Log.h>
#include <ti/uia/events/UIAErr.h>
...
Int myFatalErrorCode = 0xDEADC0DE;
String myFatalErrorStr = "Fatal error when i=%d";
Int i;
...
Log_write3(UIAErr_fatalWithStr, myFatalErrorCode,
          (IArg)myFatalErrorStr, i);
```

- **%$F** — Places the file name and line number at which the event occurred in the message. The call to Log_writeX() for an event that includes the %$F specifier in its formatting string should pass the filename (using the __FILE__ constant string) and the line number (using __LINE__). For example:

```
#include <xdc/runtime/Log.h>
#include <ti/uia/events/UIAErr.h>
...
Log_write2(UIAErr_divisionByZero, (IArg)__FILE__,
    __LINE__);
```

The resulting message might be:

```
"ERROR: Division by zero at demo.c line 1234."
```

The ti.uia.services.Rta module defines Log_Events that are use internally when that module sends events to the host. You should not use these events in application code.

5.4.4 LogSnapshot APIs for Logging State Information

You can use snapshot events to log dynamic target state information. This lets you capture the execution context of the application at a particular moment in time.

You call functions from the ti.uia.runtime.LogSnapshot module in order to use a snapshot event. The diags_ANALYSIS bit in the module's diagnostics mask must be on in order for snapshot events to be logged. (This bit is on by default.)

The LogSnapshot module provides the following functions:

- **LogSnapshot_getSnapshotId()** Returns a unique ID used to group a set of snapshot events together.
- **LogSnapshot_writeMemoryBlock()** Generates a LogSnapshot event for a block of memory. The output is the contents of the memory block along with information about the memory block. See Example 1 that follows.
- **LogSnapshot_writeNameOfReference()** This function lets you associate a string name with the handle for a dynamically-created instance. A common use would be to log a name for a dynamically-created Task thread. The host-side UIA features can then use this name when displaying data about the Task's execution. You might want to call this API in the create hook function for SYS/BIOS Tasks. See Example 2 that follows.
- **LogSnapshot_writeString()** Generates a LogSnapshot event for a string on the heap. Normally, when you log a string using one of the Log APIs, what is actually logged is the address of a constant string that was generated at compile time. You can use this API to log a string that is created at run-time. This API logs the value of the memory location that contains the contents of the string, not just the address of the string. See Example 3 that follows.

Example 1: Logging a Snapshot to Display the Contents of Some Memory

For example, the following C code logs a snapshot event to capture a block of memory:

```
#include <ti/uia/runtime/LogSnapshot.h>
...
UInt32* pIntArray = (UInt32 *)malloc(sizeof(UInt32) * 200);
...
LogSnapshot_writeMemoryBlock(0, "pIntArray",
      (UInt32)pIntArray, 200);
...
```

The following will be displayed for this event in the Message column of the Session or File Log view, where *pIntArray* is the full, unformatted contents of the array. Note that depending on the length of the memory block you specify, the output may be quite long.

```
Memory Snapshot at demo.c line 1234 [ID=0,adrs=0x80002000,len=200 MAUs] pIntArray
```

Example 2: Logging a Name for a Dynamically-Created Task

The following C code logs a Task name:

```
#include <ti/uia/runtime/LogSnapshot.h>
#include <ti/sysbios/BIOS.h>
#include <ti/sysbios/knl/Task.h>
...
// Task create hook function that logs the task name.
// Note: Task name is not required when creating a BIOS task.
// However, providing a name makes using the host-side
// analysis features easier to use.

Void tskCreateHook(Task_Handle hTask, Error_Block *eb) {
    String name;
    name = Task_Handle_name(hTask);
    LogSnapshot_writeNameOfReference(hTask,
        "Task_create: name=%s", name, strlen(name)+1);
}
```

The following text would be displayed for this event in the Message column of the Session or File Log view if a handle to the "10msThread" were passed to this tskCreateHook function.

```
nameOfReference at demo.c line 1234 [refID=0x80002000]
     Task_create: name=10msThread.
```

Example 3: Logging the Contents of a Dynamically-Created String

The following C code logs the contents of the string stored in `name`.

```
#include <ti/uia/runtime/LogSnapshot.h>
...
Void myFunc(String name){
    ...
    LogSnapshot_writeString(0, name, (UInt32)name,
        strlen(name));
}
```

The following text will be displayed for this event, where `ValueOfParm` is the value of the string rather than the address:

```
String Snapshot at demo.c line 1234 [snapshotID=0]
    Processing name=ValueOfParm
```

5.4.5 LogSync APIs for Multicore Timestamps

You can use sync events from the LogSync module to correlate timestamp values in a multicore application. The host uses the difference between the timestamp on the target and the global timestamp to correlate the sequence of events across multiple targets.

The ti.uia.services.Rta module automatically uses the LogSync module to send sync point events if the target has been suspended or halted since the last time an event packet was sent to the host. It also sends sync point events when you start or reset the Session or File Log view on the host.

Since the Rta module handles synchronization automatically, in most cases you would only call functions from this module in your application if you are using your own NDK stack and/or are writing a custom service to take the place of the Rta module.

For information about configuring the LogSync module, see Section 5.3.7.

5.4.6 LogCtxChg APIs for Logging Context Switches

The ti.uia.runtime.LogCtxChg module provides a number of functions that log context-switching events. In most cases, you would only use the LogCtxChg APIs if you are instrumenting an OS other than SYS/BIOS.

SYS/BIOS automatically logs events for Task switches and Swi and Hwi start and stop events. You only need to make sure the correct diagnostics settings are enabled to see these events in the UIA analysis features.

In addition to functions that log Task, Swi, and Hwi events (which is done automatically by SYS/BIOS), the LogCtxChg module also provides functions to log changes in application, channel, frame, and user-defined contexts. You might use these APIs in a SYS/BIOS application if you need to keep track of contexts other than the normal threading contexts. For example, the following C code logs a context change event that identifies a newly loaded application ID:

```
#include <ti/uia/runtime/LogCtxChg.h>
...
Void loadApplication(Int newAppId){
    ...
    LogCtxChg_app("New AppID=0x%x",newAppId);
}
```

This event prints the Log call site (%$F) and a format string (%$S) that is formatted with any additional arguments. The following text is an example of what could be displayed for the event:

```
"AppID Ctx Change at Line 123 in appLoader.c
    [Prev. AppID = 0x1234] New AppID=0x1235"
```

5.4.7 Rta Module APIs for Controlling Loggers

The ti.uia.services.Rta module provides a number of APIs you can use to control loggers and the transmission of data by Rta. When you use these Rta APIs, you should be aware that the RTOS Analyzer and System Analyzer features on the host may also be sending similar requests to the target in response to user activity within CCS.

Note: The Rta module is available only if you have set LoggingSetup.loggerType to LoggerType_RUNMODE, and you have configured LoggerRunMode.transportType to TransportType_ETHERNET.

Rta provides several run-time APIs that let you control whether loggers are enabled. These APIs are:

- **Rta_disableAllLogs()** disables all loggers serviced by Rta. All Log records are discarded by a logger when it is disabled.
- **Rta_enableAllLogs()** enables all loggers that are currently disabled.
- **Rta_resetAllLogs()** empties the contents of all loggers serviced by Rta. This function does not change the state of the loggers.

Rta provides run-time APIs to control the transmission of data. These APIs are:

- **Rta_startTx()** tells Rta to begin reading the logs and sending the records to the host.
- **Rta_stopTx()** tells Rta to stop reading the logs and sending them to the host.
- **Rta_snapshotAllLogs()** allows the application to delay reading the logs for the specified waitPeriod. The reset parameter tells Rta whether it should reset all the logs.

Note some transports might require the host to send a "connect" request. For example the TransportNdk needs to obtain the IP address of the host before it can send events.

See the ti.uia.services.Rta topic in the online help for more information about these APIs.

5.4.8 Custom Transport Functions for Use with ServiceMgr

The ti.uia.runtime.Transport module defines function prototypes for the transport functions that can be plugged into the ServiceMgr. UIA ships several implementations of this interface in the <*uia_install_dir*>\packages\ti\uia\sysbios directory.

The transport implementations do not have to be XDC modules. They are simply files containing a set of standard C functions. For an example, see <*uia_install_dir*>\packages\ti\uia\sysbios\TransportNdk.c. Only one transport set can be used on a target. The functions need to be configured at build time via the ti.uia.runtime.ServiceMgr.transportFxns parameter. The ServiceMgr module plugs the transportFxns automatically if the ti.uia.runtime.ServiceMgr.transportType is set to TransportType_USER.

For example, if you or someone else creates a transport called RapidIO, that transport can be plugged in by setting the transportType parameter to ti.uia.runtime.ServiceMgr.TransportType_USER and then plugging the transportFxns manually. It must also set up the following parameters as directed by the developer of the new transport:

- **ServiceMgr.supportControl.** Set to true if the transport supports receiving messages from the host. For example TransportFile does not.
- **ServiceMgr.maxEventPacketSize.** Specify the maximum size of an outgoing event packet. For example TransportNdk uses 1472, which is the EMAC size minus the headers.

- **ServiceMgr.maxCtrlPacketSize.** Specify the maximum size of the control message packets. This can be zero if supportControl is false.

These three parameters are undefined by default, so they must be set if you are using TransportType_USER.

The following example shows a configuration script that plugs a transport called "TransportXYZ" into the ServiceMgr module:

```
var ServiceMgr =
    xdc.useModule('ti.uia.runtime.ServiceMgr');
ServiceMgr.transportType = ServiceMgr.TransportType_USER;
var xyzTransport = {
    initFxn:  '&TransportXYZ_init',
    startFxn: '&TransportXYZ_start',
    recvFxn:  '&TransportXYZ_recv',
    sendFxn:  '&TransportXYZ_send',
    stopFxn:  '&TransportXYZ_stop',
    exitFxn:  '&TransportXYZ_exit',
};
ServiceMgr.transportFxns = xyzTransport;

ServiceMgr.supportControl     = true;
ServiceMgr.maxEventPacketSize = 1024
ServiceMgr.maxCtrlPacketSize  = 1024;
```

The following list describes the transport functions. Note that all of these functions are called by the ServiceMgr module. An application should not call these functions directly. The function call syntax is shown in case you are writing your own transport functions.

- **initFxn()** is called during module startup, which occurs before main() runs. Minimal actions can take place at this point, since interrupts are not yet enabled and the state of the application is just starting up. Generally only internal initialization is performed by this function. This function must have the following call syntax:

  ```
  Void (*initFxn)();
  ```

- **startFxn()** is called once or twice (depending on whether control messages are supported) after the SYS/BIOS Task threads have started to run.
  - This function is called with the UIAPacket_HdrType_EventPkt argument before any events are sent. This allows the transport to initialize anything needed for event transmission. The function returns a handle to a transport-specific structure (or NULL if this is not needed). This handle is passed to the sendFxn() and stopFxn().
  - If the transport supports control messages from a host, startFxn() is also called with the UIAPacket_HdrType_Msg argument. This allows the transport to initialize anything needed for message transmission (both sending and receiving). Again, the transport can return a transport-specific structure. This structure can be different from the one that was returned when the UIAPacket_HdrType_EventPkt argument was passed to startFxn().

  This function must have the following call syntax:

  ```
  Ptr (*startFxn)(UIAPacket_HdrType);
  ```

- **recvFxn()** is called to receive incoming messages from the host. The handle returned by the startFxn() is passed to the recvFxn(). Also passed in is a buffer and its size. The buffer is passed in as a double pointer. This allows the transport to double-buffer. For example, the recvFxn() can return a different buffer than the one it was passed. This potentially reduces extra copies of the data. The recvFxn() can be a blocking call. The recvFxn() returns the actual number of bytes that are placed into the buffer. If the transport does not support control messages, this function can simply return zero. This function must have the following call syntax:

```
SizeT (*recvFxn)(Ptr, UIAPacket_Hdr**, SizeT);
```

- **sendFxn()** is called to send either events or messages. If sendFxn() is called to transmit an event, the first parameter is the handle returned from the startFxn(UIAPacket_HdrType_EventPkt) call. Similarly, if a message is being sent, the first parameter is the handle returned from the startFxn(UIAPacket_HdrType_Msg) call. The size of the packet is maintained in the UIAPacket_Hdr. The sendFxn() can be a blocking call. This function returns true or false to indicate whether the send was successful or not. Again, a double pointer is used to allow the transport to return a different buffer to allow double-buffering. This function must have the following call syntax:

```
Bool (*sendFxn)(Ptr, UIAPacket_Hdr**);
```

- **stopFxn()** is the counterpart to the startFxn() function. The stopFxn() is called the same number of times as the startFxn(). The calls will pass the handles returned by the startFxn(). This function must have the following call syntax:

```
Void (*stopFxn)(Ptr);
```

- **exitFxn()** is the counterpart to the initFxn() function. This function must have the following call syntax:

```
Void (*exitFxn)(Void);
```

Transports are allowed to have additional functions that can be directly called by the application. For example in the provided TransportFile transport, there is a TransportFile_setFile() function. The downside to adding extended functions is that subsequent ports to a different transport will require changes to the application code.

Chapter 6

Advanced Topics for System Analyzer

This chapter provides additional information about using System Analyzer components.

6.1 IPC and SysLink Usage

This section lists the IPC and SysLink modules used on various types of cores by UIA. It describes how they are used.

DSP/Video/VPSS

On a DSP, Video, or VPSS core, the ti.uia.runtime.ServiceMgr module uses the following IPC modules.

- **MessageQ.** The ServiceMgr proxy creates four message queues. Two are used to maintaining "free" messages. These are using instead of allocating messages from a heap.
- **SharedRegion.** The ServiceMgr proxy allocates memory from the SharedRegion at startup time. It places these buffers onto the "free" message queues. Which SharedRegion to use is configurable.
- **MultiProc.** The ServiceMgr proxy uses this module to identify the cores.
- **Ipc.** The ServiceMgr proxy uses the userFxn hook to make sure Ipc is started before UIA tries to use it.

See Section 5.3.8, *Configuring IPC* for more information.

Note: The examples provided with UIA do not use IPC explicitly. They were designed this way to make porting easier.

Linux ServiceMgr Module

In a core running Linux, the Linux ServiceMgr module uses IPC modules as follows:

- **MessageQ.** ServiceMgr creates two message queues. One is used to maintain "free" messages. These message queues are used instead of allocating messages from a heap.
- **SharedRegion.** ServiceMgr allocates memory from SharedRegion at startup time. It places these buffers onto the "free" message queue. Which SharedRegion to use is configurable.
- **MultiProc.** ServiceMgr uses this module to identify the cores.

Linux Application

A Linux application running on a Linux master core uses the following SysLink modules:

- **SysLink.** Used for setup and destroy calls.
- **ProcMgrApp.** Used to load the other cores.

6.2 Linux Support for UIA Packet Routing

UIA currently supports the routing of UIA packets on Linux. By default, events are sent out from the Linux core over Ethernet. They are not written to a file by default.

Support for logging on Linux is currently available if you are using the LoggerSM shared memory logger implementation on the EVMTI816x platform. See Section 5.3.5, *Configuring ti.uia.runtime.LoggerSM*.

To use this routing capability, the ti\uia\linux\bin\servicemgr.a library must be linked into your Linux application. The Linux application must call the ServiceMgr_start() API after Ipc has been initialized. If must also call the ServiceMgr_stop() API before Ipc is shutdown. For example code, see the <*uia_install_dir*>packages\ti\uia\examples\evmti816x\uiaDemo.c file.

Since the ServiceMgr on Linux is not an XDC module, you configure it using the ServiceMgr_setConfig() API. There is also a corresponding ServiceMgr_getConfig() API. Both functions are passed the following configuration structure, which is specified in the ServiceMgr.h file:

```
typedef struct ServiceMgr_Config {
    Int maxCtrlPacketSize;
    Int numIncomingCtrlPacketBufs;
    Int sharedRegionId;
    Char fileName[128];
} ServiceMgr_Config;
```

Refer to the ServiceMgr.h file for details about the parameters.

If you do not call ServiceMgr_setconfig(), no usable defaults are supplied.

The uiaDemo.c Linux application example basically performs the following steps:

```
main()
{
    SysLink_setup()
    ProcMgrApp_startup() //on all cores specified on cmdline

    ServiceMgr_start()

    Osal_printf("\nOpen DVT and start getting events." \
                "[Press Enter to shutdown the demo.]\n");
    ch = getchar();

    ServiceMgr_stop()
    ProcMgrApp_shutdown() //on all cores specified on cmdline
    SysLink_destroy()
}
```

6.3 Rebuilding Target-Side UIA Modules

Rebuilding UIA itself from the provided source files is straightforward, whether you are using the TI compiler toolchain or the GNU GCC toolchain. UIA ships with a `uia.mak` file in the top-level installation directory. This makefile enables you to easily (re)build UIA using your choice of compilers and desired "targets". A target incorporates a particular ISA and a runtime model; for example, cortex-M3 and the GCC compiler with specific options.

The instructions in this section can be used to build UIA applications on Windows or Linux. If you are using a Windows machine, you can use the regular DOS command shell provided with Windows. However, you may want to install a Unix-like shell, such as Cygwin.

For Windows users, the XDCtools top-level installation directory contains `gmake.exe`, which is used in the commands that follow to run the Makefile. The gmake utility is a Windows version of the standard GNU "make" utility provided with Linux.

If you are using Linux, change the "gmake" command to "make" in the commands that follow.

For these instructions, suppose you have the following directories:

- `$BASE/uia_2_##_##_##` — The location where you installed UIA.
- `$BASE/copy-uia_2_##_##_##` — The location of a copy of the UIA installation.
- `$BASE/xdctools_3_##_##_##` — The location where you installed XDCtools.
- `$TOOLS/gcc/bin/arm-none-eabi-gcc` — The location of a compiler. This is a GCC compiler for M3.

The following steps refer to the top-level directory of the XDCtools installation as *`<xdc_install_dir>`*. They refer to the top-level directory of the *copy* of the UIA installation as *`<uiacopy_install_dir>`*.

Follow these steps to rebuild UIA:

1. If you have not already done so, install XDCtools, SYS/BIOS, and UIA.
2. Make a copy of the UIA installation you will use when rebuilding. This leaves you with an unmodified installation as a backup. For example, use commands similar to the following on Windows:

   ```
   mkdir c:\ti\copy-uia_2_##_#_##

   copy  c:\ti\uia_2_##_##_##  c:\ti\copy-uia_2_##_##_##
   ```

   Or, use the a command similar to the following on Linux:

   ```
   cp -r $BASE/uia_2_##_##_##/*  $BASE/copy-uia_2_##_##_##
   ```

3. Make sure you have access to compilers for any targets for which you want to be able be able to build applications using the rebuilt UIA. Note the path to the directory containing the executable for each compiler. These compilers can include Texas Instruments compilers, GCC compilers, and any other command-line compilers for any targets supported by UIA.
4. If you are using Windows and the gmake utility provided in the top-level directory of the XDCtools installation, you should add the *`<xdc_install_dir>`* to your PATH environment variable so that the gmake executable can be found.
5. You may remove the top-level doc directory located in *`<uiacopy_install_dir>`*`/docs` if you need to save disk space.
6. At this point, you may want to add the remaining files in the UIA installation tree to your Software Configuration Management (SCM) system.

7. Open the `<uiacopy_install_dir>/uia.mak` file with a text editor, and make the following changes for any options you want to hardcode in the file. (You can also set these options on the command line if you want to override the settings in the `uia.mak` file.)

   — Ignore the following lines near the beginning of the file. These definitions are used internally, but few users will have a need to change them.

   ```
   # Where to install/stage the packages
   # Typically this would point to the devkit location
   #
   DESTDIR ?= <UNDEFINED>

   packagesdir ?= /packages
   libdir ?= /lib
   includedir ?= /include
   ```

   — Specify the locations of XDCtools, SYS/BIOS, IPC, and the NDK. IPC and NDK are not necessary for the build. If these packages are not found, the uia libraries will be built without ndk support. For example:

   ```
   XDC_INSTALL_DIR ?= $(BASE)/xdctools_3_##_##_##
   BIOS_INSTALL_DIR ?= $(BASE)/bios_6_##_##_##
   IPC_INSTALL_DIR ?= $(BASE)/ipc_3_##_##_##
   NDK_INSTALL_DIR ?= $(BASE)/ndk_2_##_##_##
   ```

   — Specify the location of the compiler executable for all targets you want to be able to build for with UIA. Use only the directory path; do not include the name of the executable file. Any targets for which you do not specify a compiler location will be skipped during the build. For example, on Linux you might specify the following:

   ```
   ti.targets.C28_float ?= /opt/ti/ccsv6/tools/compiler/c2000
   ti.targets.arm.elf.M3 ?= /opt/ti/ccsv6/tools/compiler/tms470
   ```

   Similarly, on Windows you might specify the following compiler locations:

   ```
   ti.targets.C28_float ?= c:/ti/ccsv6/tools/compiler/c2000
   ti.targets.arm.elf.M3 ?= c:/ti/ccsv6/tools/compiler/tms470
   ```

   — If you need to add any repositories to your XDCPATH (for example, to reference the packages directory of another component), you should edit the XDCPATH definition.

   — You can uncomment the line that sets XDCOPTIONS to “v” if you want more information output during the build.

8. Clean the UIA installation with the following commands. (If you are running the build on Linux, change all "`gmake`" commands to "`make`".)

   ```
   cd <uiacopy_install_dir>
   gmake -f uia.mak clean
   ```

9. Run the `uia.mak` file to build UIA as follows. (Remember, if you are running the build on Linux, change all "`gmake`" commands to "`make`".)

   ```
   gmake -f uia.mak
   ```

10. If you want to specify options on the command line to override the settings in `uia.mak`, use a command similar to the following.

```
gmake -f uia.mak XDC_INSTALL_DIR=<xdc_install_dir> ti.targets.C28_float=<compiler_path>
```

Revision History

Table A–1 lists significant changes made since the previous version of this document.

Table A–1. Revision History

Chapter	Location	Additions/Modifications/Deletions
Preface		This document applies to CCS software version 6.0.
Overview and UIA	Section 1.3.2 and Section 5.3.1	LoggerMin, has been added. This logger does not have all the features of Logger-StopMode, but it is much smaller. All Log events go to one buffer.
Overview and UIA	Section 1.3.2 and Section 5.3.1	The LoggerProbePoint logger has been removed.
Overview and UIA	Section 1.3.2 and Section 5.3.1 and Section 5.3.4	The ti.uia.runtime.LoggerStopMode and ti.uia.runtime.LoggerCircBuf loggers have been replaced by the ti.uia.loggers.LoggerStopMode and ti.uia.loggers.Logger-RunMode loggers. These replacements are smaller and faster.
Installing	Section 2.1	UIA is not provided as part of the CCS installation. Instead, TI-RTOS should be installed from the CCS App Center. UIA and SYS/BIOS are components of TI-RTOS.
Tasks	Section 3.7	System Analyzer examples are provided in TI Resource Explorer and should be imported from there.
Using Tools	Section 4.2	Analysis features are now listed in the **Tools > RTOS Analyzer** and **Tools > System Analyzer** menus. Choosing any of these items opens an Analysis Configuration window that has that analysis feature selected. These choices replace the **Tools > System Analyzer > Live** menu command.
Using Tools	Section 4.3.1 and Section 4.3.2	Icons have replaced the **Analyze** and **Views** drop-downs in analysis views.
Using Tools	Section 4.5	The **Tools > System Analyzer > UIA Config** menu command has been removed. Instead, to create a UIA configuration, click the **Create UIA Config File** button in the Analysis Configuration dialog
Using Tools	Section 4.6.1	The **Tools > System Analyzer > Open CSV File** menu command has been moved to the T**ools > RTOS Analyzer > Open File > Open CSV File** menu command.
Using Tools	Section 4.6.2	The **Tools > System Analyzer > Open Binary File** menu command has been moved to the T**ools > RTOS Analyzer > Open File > Open Binary File** menu command.
UIA	Section 5.1.1	UIA modules are integrated into TI-RTOS in the list of Available Products in XGCONF.
UIA	Section 5.3.1 and Section 5.3.6	The LoggingSetup module has been revised so that you now specify the Logger you want to use instead of the eventUploadMode. You can now control Task, Swi, and Hwi load logging through the LoggingSetup module, instead of through ti.sysbios.utils.Load.
	Section 5.3.1	The default logger sizes have changed.

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