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Manual Purpose and Structure

Manual Purpose
You should read this manual if you want to know:

• how to use the TASKING Embedded Profiler
• the features of the TASKING Embedded Profiler

Manual Structure

Chapter 1, Installing the Software
Explains how to install and license the TASKING Embedded Profiler.

Chapter 2, Introduction to the TASKING Embedded Profiler
Contains an introduction to the TASKING Embedded Profiler and contains an overview of the features.

Chapter 3, Tutorial
Contains a step-by-step tutorial how to use the demo projects with the TASKING Embedded Profiler.

Chapter 4, Using the TASKING Embedded Profiler
Explains how to use the TASKING Embedded Profiler. You can run the TASKING Embedded Profiler in two ways, via an interactive graphical user interface (GUI) or via the command line.

Chapter 5, Reference
Contains an overview of all the fields and columns in an analysis result output.

Related Publications
• Getting Started with the TASKING VX-toolset for TriCore
• TASKING VX-toolset for TriCore User Guide
• AURIX™ TC21x/TC22x/TC23x Family User’s Manual, V1.1 [2014-12, Infineon]
• AURIX™ TC26x A-Step User’s Manual, V1.1 [2013-12, Infineon]
• AURIX™ TC26x B-Step User’s Manual, V1.2 [2014-02, Infineon]
• AURIX™ TC27x User’s Manual, V1.4 [2013-11, Infineon]
• AURIX™ TC27x B-Step User’s Manual, V1.4.1 [2014-02, Infineon]
• AURIX™ TC27x C-Step User’s Manual, V2.2 [2014-12, Infineon]
• AURIX™ TC27x D-Step User’s Manual, V2.2 [2014-12, Infineon]
TASKING Embedded Profiler User Guide

- AURIX™ TC29x B-Step User’s Manual, V1.3 [2014-12, Infineon]
Chapter 1. Installing the Software

This chapter guides you through the installation process of the TASKING® Embedded Profiler. It also describes how to license the software.

In this manual, TASKING Embedded Profiler and Embedded Profiler are used as synonyms.

1.1. Installation for Windows

System Requirements

Before installing, make sure the following minimum system requirements are met:

• Windows 7 or higher
• 2 GHz Pentium class processor
• 1 GB memory
• 500 MB free hard disk space
• Screen resolution: 1024 x 768 or higher

Installation

1. If you received a download link, download the software and extract its contents.

   - or -

   If you received an USB flash drive, insert it into a free USB port on your computer.

2. Run the installation program (setup.exe).

   The TASKING Setup dialog box appears.

3. Select a product and click on the Install button. If there is only one product, you can directly click on the Install button.

4. Follow the instructions that appear on your screen. During the installation you need to enter a license key, this is described in Section 1.2, Licensing.

1.2. Licensing

TASKING products are protected with TASKING license management software (TLM). To use a TASKING product, you must install that product and install a license.

The following license types can be ordered from Altium.
**Node-locked license**

A node-locked license locks the software to one specific computer so you can use the product on that particular computer only.

For information about installing a node-locked license see Section 1.2.3.2, *Installing Server Based Licenses (Floating or Node-Locked)* and Section 1.2.3.3, *Installing Client Based Licenses (Node-Locked)*.

**Floating license**

A floating license is a license located on a license server and can be used by multiple users on the network. Floating licenses allow you to share licenses among a group of users up to the number of users (seats) specified in the license.

For example, suppose 50 developers may use a client but only ten clients are running at any given time. In this scenario, you only require a ten seats floating license. When all ten licenses are in use, no other client instance can be used.

For information about installing a floating license see Section 1.2.3.2, *Installing Server Based Licenses (Floating or Node-Locked)*.

**License service types**

The license service type specifies the process used to validate the license. The following types are possible:

- **Client based** (also known as 'standalone'). The license is serviced by the client. All information necessary to service the license is available on the computer that executes the TASKING product. This license service type is available for node-locked licenses only.

- **Server based** (also known as 'network based'). The license is serviced by a separate license server program that runs either on your companies' network or runs in the cloud. This license service type is available for both node-locked licenses and floating licenses.

Licenses can be serviced by a cloud based license server called "Remote TASKING License Server". This is a license server that is operated by TASKING. Alternatively, you can install a license server program on your local network. Such a server is called a "Local TASKING License Server". You have to configure such a license server yourself. The installation of a local TASKING license server is not part of this manual. You can order it as a separate product (SW000089).

The benefit of using the Remote TASKING License Server is that product installation and configuration is simplified.

Unless you have an IT department that is proficient with the setup and configuration of licensing systems we recommend to use the facilities offered by the Remote TASKING License Server.

**1.2.1. Obtaining a License**

You need a license key when you install a TASKING product on a computer. If you have not received such a license key follow the steps below to obtain one. Otherwise, you cannot install the software.
Obtaining a server based license (floating or node-locked)

• Order a TASKING product from Altium or one of its distributors.

  *A license key will be sent to you by email or on paper.*

If your node-locked server based license is not yet bound to a specific computer ID, the license server binds the license to the computer that first uses the license.

**Obtaining a client based license (node-locked)**

To use a TASKING product on one particular computer with a license file, Altium needs to know the computer ID that uniquely identifies your computer. You can do this with the **getcid** program that is available on the TASKING website. The detailed steps are explained below.


2. Execute the **getcid** program on the computer on which you want to use a TASKING product. The tool has no options. For example,

   ```
   C:\Tasking\getcid
   Computer ID: 5Dzm-L9+Z-WFbO-aMkU-5Dzm-L9+Z-WFbO-aMkU-MDAy-Y2Zm
   ```

   *The computer ID is displayed on your screen.*

3. Order a TASKING product from Altium or one of its distributors and supply the computer ID.

  *A license key and a license file will be sent to you by email or on paper.*

When you have received your TASKING product, you are now ready to install it.

**1.2.2. Frequently Asked Questions (FAQ)**

If you have questions or encounter problems you can check the support page on the TASKING website.


This page contains answers to questions for the TASKING license management system TLM.

If your question is not there, please contact your nearest Altium Sales & Support Center or Value Added Reseller.

**1.2.3. Installing a License**

The license setup procedure is done by the installation program.

If the installation program can access the internet then you only need the licence key. Given the license key the installation program retrieves all required information from the remote TASKING license server. The install program sends the license key and the computer ID of the computer on which the installation program is running to the remote TASKING license server. No other data is transmitted.
If the installation program cannot access the internet the installation program asks you to enter the required information by hand. If you install a node-locked client based license you should have the license file at hand (see Section 1.2.1, Obtaining a License).

Floating licenses are always server based and node-locked licenses can be server based. All server based licenses are installed using the same procedure.

1.2.3.1. Configure the Firewall in your Network

For using the TASKING license servers the TASKING license manager tries to connect to the Remote TASKING servers lic1.tasking.com .. lic4.tasking.com at the TCP ports 8080, 8936 or 80. Make sure that the firewall in your network has transparent access enabled for one of these ports.

1.2.3.2. Installing Server Based Licenses (Floating or Node-Locked)

If you do not have received your license key, read Section 1.2.1, Obtaining a License before you continue.

1. If you want to use a local license server, first install and run the local license server before you continue with step 2. You can order a local license server as a separate product (product code SW000089).

2. Install the TASKING product and follow the instruction that appear on your screen.

   The installation program asks you to enter the license information.

   ![License Key Information Screen]

3. In the License key field enter the license key you have received from Altium and click Next to continue.
The installation program tries to retrieve the license information from a remote TASKING license server. Wait until the license information is retrieved. If the license information is retrieved successfully subsequent dialogs are already filled-in and you only have to confirm the contents of the dialogs by clicking the **Next** button. If the license information is not retrieved successfully you have to enter the information by hand.

4. Select your **License type** and click **Next** to continue.

   You can find the license type in the email or paper that contains the license key.

5. Select **Remote TASKING license server** to use one of the remote TASKING license servers, or select **Local TASKING license server** for a local license server. The latter requires optional software.

6. (For local license server only) specify the **Server name** and **Port number** of the local license server.

7. Click **Finish** to complete the installation.

### 1.2.3.3. Installing Client Based Licenses (Node-Locked)

If you do not have received your license key and license file, read **Section 1.2.1, Obtaining a License** before continuing.

1. Install the TASKING product and follow the instruction that appear on your screen.

   The installation program asks you to enter the license information.

2. In the **License key** field enter the license key you have received from Altium and click **Next** to continue.
The installation program tries to retrieve the license information from a remote TASKING license server. Wait until the license information is retrieved. If the license information is retrieved successfully subsequent dialogs are already filled-in and you only have to confirm the contents of the dialogs by clicking the Next button. If the license information is not retrieved successfully you have to enter the information by hand.

3. Select **Node-locked client based license** and click **Next** to continue.

4. In the **License file content** field enter the contents of the license file you have received from Altium.

   *The license data is stored in the file licfile.txt in the etc directory of the product.*

5. Click **Finish** to complete the installation.
Chapter 2. Introduction to the TASKING Embedded Profiler

After your application has been verified, thoroughly tested and debugged, and by itself behaves correctly, you may still run into performance and timing issues. Many timing issues can be addressed simply by improving the performance of the applications that caused a missed deadline. Furthermore, by reducing the core load of your applications you may be able to go for a device that is cheaper because it has fewer cores. A way to address these issues is performance tuning.

With performance tuning we refer to optimizing your application for a specific target device. Common situations where performance tuning of your application makes sense are:

- You are using self-made libraries that are called a lot and thus have a big impact on overall application performance.
- You develop/adapt low level drivers and basic software (BSW) or operating system (OS) components.
- You are close to or above your core load budget limit.
- You have a timing problem in your schedule that could be fixed by speeding up specific tasks but want to avoid changing the schedule.
- You want to try and target a smaller electronic control unit (ECU) in order to save costs.
- You care about easily and cost effectively tracking and improving the performance of your code on target devices.

Embedded hardware platforms are too complex for the average software developer to predict or understand the performance of his code. In order to optimize code for a specific platform (cores plus peripherals), developers need feedback from the hardware on which specific part of their code is suboptimal (in terms of memory consumption, jitter, execution time, …) and what is the root cause of the performance impact. The TASKING Embedded Profiler is a smart profiling tool that provides this feedback.

The TASKING Embedded Profiler communicates with an embedded processor (CPU) to gather real-time tracing and performance data. The tool gives an overview over the current clock settings — no need to get an oscilloscope to verify that the clocks are configured properly for a benchmark run. After verification of correct clock setup, you are guided through a few easy steps that pinpoint the source lines that have the greatest performance impact. The tool indicates the root cause of the performance impact and gives simple instructions on how to address the problem. The data is presented in graphics and tables and into computer readable formats.
After applying the suggested mitigation, you can use the TASKING Embedded Profiler to confirm that the problem has indeed been fixed. With the default settings of the tool this all happens non-intrusively with real data collected from the application running on the real device. Using such a performance tuning tool, non-expert users can often highly speed up untuned applications.

Features of the TASKING Embedded Profiler

- Performance analysis
- Memory access analysis
- Function-level analysis
- Compare analysis runs of the same kind
- Organize analyses and results in projects
- Load/store analysis results
- Graphical user interface (GUI) and command line support
Introduction to the TASKING Embedded Profiler

- Support for Device Access Server (DAS) v6.0 and Device Access Port (DAP) miniWiggler

**Performance analysis**

This type of analysis traces instructions and performance events. It measures the CPU clock count and it finds branch misses, cache misses and stalls due to memory access delays or pipeline hazards. You can run this type of analysis on the whole application or select specific functions.

**Memory access analysis**

This type of analysis traces function calls, function returns and data accesses. You can run this type of analysis on the whole application or select specific functions.

**Function-level analysis**

This type of analysis traces all function calls and function returns. This is the fastest analysis.

### 2.1. Emulation Device (ED)

The standard TriCore/AURIX™ processors (production devices) lack debug trace functionality. However, this functionality is very useful when you develop and test your application. Therefore pin compatible Emulation Devices (ED) are available. An Emulation Device has an Emulation Extension Chip (EEC) added to the same silicon, which is accessible through the JTAG or DAP interface. The TASKING Embedded Profiler supports the on-chip trace feature of the Emulation Device. See the processor documentation for detailed information about the device.

Some Production Devices, such as the TC29x, are equipped with a mini-MCDS, which is a subset of the on-chip trace feature that is available on Emulation Devices. The mini-MCDS memory is not suitable for safety related data and must not be used for data storage by safety applications. See the processor documentation for detailed information about the device.

**Naming convention**

You can see by the name on the processor what type of device it is. For example, with SAK-TC299TE the last letter indicates the "Feature Package". If this letter is an 'E' or 'F' you have an Emulation Device.

For a detailed naming convention see the AURIX™ Product Naming PDF on the Infineon website.

### 2.2. Trace Support

The TASKING Embedded Profiler uses the on-chip trace (MCS) concept. For detailed information about the Multi-Core Debug Solution (MCDS) we recommend that you read the processor documentation belonging to the Emulation Device.
Tile memory range

Trace information is stored in a dedicated trace buffer. With an Emulation Device you can allocate part of the Emulation Memory (EMEM) as trace buffer memory. The Emulation Memory is divided in so-called 'tiles', and you can choose which part of the Emulation Memory should be used for tracing. Be careful that the same tile memory range used for tracing is not used by the target application, as this can lead to unexpected trace results. The number of tiles vary per Emulation Device.

Trace mode

When you run a trace analysis in the TASKING Embedded Profiler, you can set the trace mode:

- **One shot mode.** In this mode the analysis will run until the trace buffer is full. This is non-intrusive, meaning that the trace does not interfere the running processor. After the trace has stopped the profiler reads the collected data.

- **Continuous trace.** In this mode the analysis will run until the application stops or when you stop the analysis manually. This mode is intrusive, meaning that the processor is stopped temporarily every time the trace buffer has been filled, so that the profiler can read the collected data. After that the processor continues writing to the buffer.

Attach mode

When you run a trace analysis in the TASKING Embedded Profiler, you can set the attach mode:

- **Reset device.** In this mode the device is reset first and then the analysis starts.

- **Hot attach.** In this mode the analysis will start at the current execution position of the running application.
Chapter 3. Tutorial

The profiler\tutorials directory of the TASKING Embedded Profiler installation contains several examples. They serve as a good starting point for your own profiling analysis project.

- demo_dspr - A project for the TC29xB demonstrating how defaulting to the wrong scratch pad memory results in a penalty in stalls.
- demo_dcache - A project for the TC29xB demonstrating how multiple passes over a large buffer can cause many data cache misses.
- demo_concurrent - A project for the TC29xB demonstrating how accessing the same memory from multiple cores causes stalls.

All examples come with embedded profiler projects (files with the .EmbProf extension), with pre-run analyses. You can open a project in the TASKING Embedded Profiler to inspect the various analysis results, without having to run the examples on a target board.

In this tutorial we will use the demo_dspr example to go through the process of preparing your project from scratch, running a profiling analysis, fixing the problem and rerunning a profiling analysis to see the improvement. After this tutorial you can use the other tutorials yourself in a similar way.

3.1. Prepare Demo Project in Eclipse

Before you can use the TASKING Embedded Profiler, you must have an application ELF file with debug information and the application must be downloaded onto a target board.

The example projects delivered with the TASKING Embedded Profiler are Eclipse projects suitable for the TASKING VX-toolset for TriCore v6.2r1 or higher. For this part of the tutorial it is assumed that you have this toolset installed.

Import an example project

1. Start the TASKING VX-toolset for TriCore Eclipse IDE.
2. From the File menu, select Import.

   The Import dialog appears.
3. Select **General » Existing Projects into Workspace** and click **Next**.

The Import Projects dialog appears.
4. Click **Select archive file** and browse to the example ZIP file delivered with the TASKING Embedded Profiler.

5. Leave the other settings in this dialog as is and click **Finish**.

   *The project will be added to your workspace.*

You can now examine the source files, build the project (for your target) and flash the application.

**Examine source file**

1. In the C/C++ Projects view double-click on the source file `demo_dspr.c`.

   *The file will be opened in the source editor.*

2. Examine the source file and make sure that the following define has the value 0:

   ```c
   #define FIXED   0
   ```

   This define is used to demonstrate the different profiler results before and after fixing the source file.

**Set project options**

The resulting application ELF file must contain debug information. The demo projects already have debugging enabled by default. So, for the demo projects you can skip this step. For your own project, make sure that debugging is enabled.

1. From the **Project** menu, select **Properties for**. Alternatively, you can click the 🔄 button.

   *The Properties for demo_dspr dialog appears.*

2. If not selected, expand **C/C++ Build** and select **Settings** to access the TriCore tool settings.

3. On the Tool Settings tab, expand **C/C++ Compiler » Debugging**, set option **Generate symbolic debug information** to **Default** or **Full** and click **OK**.
Build the project

* From the **Project** menu, select **Build demo_dspr**, or click ![icon] from the toolbar.

**Run the debugger to flash the application onto the target board**

1. Connect the Infineon TriBoard TC29xB to your computer. See the documentation that came with the board for more information.

2. From the **Debug** menu, select **Debug project**.
   Alternatively you can click the ![icon] button in the main toolbar.

*Before you can debug a project, you need a Debug launch configuration. Such a configuration, identified by a name, contains all information about the debug project: which debugger is used, which project is used, which binary debug file is used, ... and so forth. So, initially the Debug Configurations dialog appears.*

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3. On the **Target** tab, select the **Infineon Triboard TC29xB** and click **Debug**.

   *The TASKING Debug perspective is associated with the TASKING C/C++ Debugger. Because the TASKING C/C++ perspective is still active, Eclipse asks to open the TASKING Debug perspective.*

4. Optionally, enable the option **Remember my decision** and click **Yes**.

   *The debug session is launched. This may take a few seconds.*

5. From the **Debug** menu, select **Resume** (■) to run the application on the target board.

   *The output of the application appears in the FSS (File System Simulation) view.*

6. Inspect the FSS view and notice the number of ticks.
7. From the **Debug** menu, select **Terminate (■)** to stop the debugging session. This is necessary to free the connection with the target board.

### 3.2. Analyze Project in TASKING Embedded Profiler

Now it is time to start analyzing the demo project.

**Create a project**

1. Start the TASKING Embedded Profiler.

![TASKING Embedded Profiler window](image)

The TASKING Embedded Profiler window is divided into two panes. The left pane is reserved for the project tree and the right pane is reserved for analysis results.

2. From the **Project** menu, select **New Project**.

*The New Project dialog appears.*
3. In the **Project name** field, enter the name of the project (for example, you can use the same name as the Eclipse project, `demo_dspr`).

4. In the **Project directory** field, specify the directory where you want to store the Embedded Profiler project file (file with extension `.EmbProf`).

5. In the **Executable file** field, specify the name of the ELF file. This file is usually relative to the project directory. If the executable file is stored in another directory, the full path name is shown.

6. Optionally specify a **Source code directory**. Normally, the location of the source files is taken from the ELF file.

7. Select the **Processor**. For example, TC29xED.

8. For the **Device server**, enter the server name (leave blank for localhost).

9. Leave the rest of the dialog as is and click **Create**.

   *The new project is created and opened.*

Create a **Performance analysis**

1. From the **Analysis** menu, select **New Analysis**.

   *The New Analysis wizard appears.*
2. Three types of analyses are possible. Select **Performance analysis** and click **Next**. The **Analysis Scope page** appears.

3. For this tutorial select **Whole Application**. If you select **Specific Functions**, select one or more **Application functions** and click **>**.

4. Click **Next**.
The Analysis Name page appears.

5. Specify the analysis name. A default name has already been filled in based on the analysis type and a sequence number, but you can specify your own name.

6. Click Finish.

The new analysis is created and is visible in the project tree.

The Run Analysis dialog appears.

3. Enter an Analysis result name (default Result- and a sequence number).

4. Select a Trace mode. A One shot mode trace ends when the hardware trace buffer is full. A Continuous trace ends when the program finishes (ends at a break instruction) or when it is stopped explicitly by the user.

5. Select an Attach mode. With Reset device, tracing starts by running the program in the embedded device from the reset vector. With Hot attach, tracing starts by continuing tracing from the current program counter location.

Run the analysis

1. In the project tree select the analysis you want to run.

2. From the Analysis menu, select Run Analysis.

The Run Analysis dialog appears.
6. In the **Core index** field, select the TriCore core for which you want to run the analysis.

7. For emulation devices only, enter a **Trace memory tile range**. Trace memory of emulation devices consists of a consecutive number of tiles. Select the first and last tile index you want to use for trace memory.

8. Click **Start**.

   *The analysis starts. After the analysis is finished the result is present in the project tree.*

9. If a Windows Security Alert appears that the firewall has blocked some features, select a network type and click **Allow access**.

**Inspect the result of the Performance analysis**

1. In the project tree select the result you want to inspect (PerfAnalysis-1, Result-1).

   *The result appears in several tabs.*
2. On the **Summary** tab, notice the high number of **Average stalls per clock** (0.88).

3. On the **Hot Functions** tab, notice the high number of **Stalls** with functions _c_init_entry and main.

4. Double-click on **main**.

   *The Source tab opens.*
5. Notice the high number of stalls is in the for loop.

6. Enable Show disassembly on the Source tab to show disassembly intermixed with the source lines, or open the Disassembly tab. Notice that the stalls are related to memory access.
Create and run a Memory access analysis

1. Repeat the steps described above with Create a Performance analysis, but in Step 2 select Memory access analysis.

2. Run the new analysis similar as described above with Run the analysis.

Inspect the result of the Memory access analysis

1. In the project tree select the result you want to inspect (MemAnalysis-1, Result-1).

The result appears in several tabs.
2. On the **Summary** tab, notice the high number of **DSPR2 accesses** (32836). When you hover the mouse over a value, a context sensitive help box with additional information can appear.

3. Scroll down to the **Data access intensive functions** and notice that `_c_init` and `main` both access variable `x` in DSPR2.
4. Hover the mouse over DSPR2 in **main**.

   *A context sensitive help box appears with a suggestion to solve the problem.*

### 3.3. Fix the Problem

Now that we have analyzed the problem, we can fix it.

1. In the TASKING TriCore Eclipse IDE, double-click on the source file `demo_dspr.c`.

   *The file will be opened in the source editor.*

2. Change the following source line:

   ```c
   #define FIXED 0
   ```
into:

#define FIXED 1

3. From the **Project** menu, select Rebuild demo_dspr.

4. From the **Debug** menu, select Debug project.

5. From the **Debug** menu, select Resume to run the application on the target board.

*The output of the application appears in the FSS (File System Simulation) view.*

6. Inspect the FSS view and notice the number of ticks has reduced significantly.

7. From the **Debug** menu, select Terminate to stop the debugging session. This is necessary to free the connection with the target board.

### 3.4. Verify Fix in TASKING Embedded Profiler

Now that we have fixed the problem, we can use the TASKING Embedded Profiler to rerun both the Performance analysis and the Memory access analysis mentioned in Section 3.2, Analyze Project in *TASKING Embedded Profiler* and see the new results of the analyses.

#### Rerun the Performance analysis and inspect the result

1. In the TASKING Embedded Profiler, select PerfAnalysis-1.

2. From the **Analysis** menu, select Run Analysis.

3. Click **Start**.

   *This creates a Result-2.*

4. Select Result-2 and notice that on the **Summary** tab, the number of **Average stalls per clock** has reduced significantly from 0.88 to 0.09.
5. Also inspect the other tabs yourself to see the results.

**Rerun the Memory access analysis**

1. In the TASKING Embedded Profiler, select MemAnalysis-1.
2. From the Analysis menu, select Run Analysis.
3. Click Start.

   *This creates a Result-2.*

4. Select Result-2 and notice that on the Summary tab, the accesses are now in DSPR0. And notice that main is no longer listed in the list of Data access intensive functions.
3.5. Compare Results

The Embedded Profiler has a feature to compare results. This is very useful to see the differences before and after a fix. Note that you can only compare results from the same analysis.

1. In the TASKING Embedded Profiler, select a result. For example, Result-2 of PerfAnalysis-1.

2. From the Result menu, select Compare Results.

3. Select another result, for example Result-1. The results you can select are marked yellow.

The comparison starts and a difference report is created. The numbers in the report are calculated as the "first selected result" minus the "second selected result".
3.6. Export Results

You can export analysis results and comparison results to comma separated values (CSV) files. You can choose to export instructions, functions or memory depending on the analysis type.

1. In the TASKING Embedded Profiler, select a result. For example, Result-1 of PerfAnalysis-1.

2. From the Result menu, select Export to CSV.

   The Export to CSV dialog appears.

3. Enter the filename(s) and click Export.
Chapter 4. Using the TASKING Embedded Profiler

You can run the TASKING Embedded Profiler in two ways, via an interactive graphical user interface (GUI) or via the command line. The GUI variant is useful in showing graphical analysis results with hints how to improve the code. The command line interface is useful in automated scripts and makefiles to generate analysis results in comma separated values (CSV) files.

4.1. Run the Embedded Profiler in Interactive Mode

To start the Embedded Profiler select Embedded Profiler from the Windows Start menu. The program starts with an empty window except for a menu bar and a toolbar at the top. The area below that consists of two panes. The left pane is used to display a project tree, with a project name, one or more analysis names and one or more result names. The right pane is used to display an analysis result. You can resize a pane by dragging one of its four corners and you can move a pane by dragging its title. You can drag the button toolbar to another place, for example vertically to the left side or even detach it from the main window.

Normal project management is available. You can create, open, edit, close or delete a project. A project filename will have the extension .EmbProf.
The steps to:

- create a project
- create an analysis
- run an analysis

are described in Section 3.2, Analyze Project in TASKING Embedded Profiler.

See also Section 3.5, Compare Results and Section 3.6, Export Results. For details about the Results see Chapter 5, Reference.

### 4.2. Run the Embedded Profiler from the Command Line

To run the Embedded Profiler from the command line use the `EmbProfCmd` batch file in a Windows Command Prompt. Enter the following command to see the usage:

```
EmbProfCmd --help
```

The general invocation syntax is:

```
EmbProfCmd options project.EmbProf
```

where, `project.EmbProf` refers to an existing Embedded Profiler project file.

The following `options` are available:

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>-? / --help</td>
<td>This option causes the program to display an overview of all command line options.</td>
</tr>
<tr>
<td>--compare=result</td>
<td>This option allows you to compare the results of a run with another result. You must specify the name of an existing reference result. Option <code>--run</code> should be used together with this option.</td>
</tr>
<tr>
<td>--continuous</td>
<td>This option allows you to run the analysis in continuous trace mode. Without this option, the default is one shot mode.</td>
</tr>
<tr>
<td>--core=core-nr</td>
<td>This option allows you to specify the core index number.</td>
</tr>
<tr>
<td>--run=analysis</td>
<td>This option allows you to run an existing analysis.</td>
</tr>
<tr>
<td>--server=hostname</td>
<td>This option allows you to specify the device server name. If you omit this option, the default is localhost.</td>
</tr>
<tr>
<td>--version</td>
<td>This option shows the program version header.</td>
</tr>
</tbody>
</table>

**To run an existing analysis**

Use the following syntax to run an existing analysis from the command line:

```
EmbProfCmd --run=analysis project.EmbProf
```
where, project.EmbProf refers to an existing Embedded Profiler project file.

**To run and compare an existing analysis**

Use the following syntax to run an existing analysis and compare the results with a previous result from the command line:

```
EmbProfCmd --run=analysis --compare=result project.EmbProf
```

where, project.EmbProf refers to an existing Embedded Profiler project file.

### 4.2.1. Command Line Tutorial

In this section we use tutorial demo_dspr with the delivered demo_dspr.EmbProf to illustrate the use of the command line options of the Embedded Profiler.

**Prepare command line**

Before you run the Embedded Profiler from the command line, follow these steps to configure the Windows command prompt.

1. Start the Windows Command Prompt and go to the workspace directory containing the tutorial demo_dspr.

2. Add the executable directory of the Embedded Profiler to the environment variable PATH. The executable directory is the profiler directory in the installation directory. Substitute version with the correct version number.

   ```
   set PATH=%PATH%;"C:\Program Files (x86)\TASKING\prof version\profiler"
   ```
**Command line examples**

1. To run a performance analysis in `demo_dspr` using one shot trace mode, enter:

   ```bash
   EmbProfCmd --run=PerfAnalysis demo_dspr.EmbProf
   ```

   The results are exported to the CSV files `functions.csv` and `instructions.csv`. You can inspect these files with any text editor. The first line in a CSV file shows the columns that are used.

   Note that the command line invocation does not add a new result entry to the `demo_dspr.EmbProf` file.

2. To run a performance analysis in `demo_dspr` using one shot trace mode and compare the results with `original`, enter:

   ```bash
   EmbProfCmd --run=PerfAnalysis --compare=original demo_dspr.EmbProf
   ```

   The results of the comparison are exported to the CSV file `functions.csv`. If all value fields are zero, this indicates that the results are identical. This should be the case with this example.

3. To run a performance analysis in `demo_dspr` using one shot trace mode and compare the results with `fixed`, enter:

   ```bash
   EmbProfCmd --run=PerfAnalysis --compare=fixed demo_dspr.EmbProf
   ```

   The results of the comparison are exported to the CSV file `functions.csv`. Fields that contain zeros indicate no change. Fields with negative values indicate an improvement, fields with positive values indicate worse performance. In this example the comparison is worse, because we compare the original result (non-fixed sources) with a version where the sources have been fixed. Normally, you compare your results with a previous result.

4. To run an analysis using continuous trace mode use option `--continuous`. Be aware that this mode requires that the application ends and does not contain endless `while` loops. Otherwise an analysis run will not end.

   ```bash
   EmbProfCmd --run=PerfAnalysis --compare=fixed --continuous demo_dspr.EmbProf
   ```

5. To run an analysis on a specific core, use option `--core=core-nr`. For the TC29x derivative your can use the values 0, 1 and 2. Be aware that a core needs to be enabled in the startup code of the application. Otherwise the analysis run will not terminate.

   ```bash
   EmbProfCmd --run=PerfAnalysis --compare=fixed --continuous --core=0 demo_dspr.EmbProf
   ```

6. To specify a remote host to connect to the target, use option `--server=hostname`. The default, if you do not specify this option, is `localhost`.

   ```bash
   EmbProfCmd --run=PerfAnalysis --compare=fixed --continuous --core=0 --server=myservername demo_dspr.EmbProf
   ```
Chapter 5. Reference

Every analysis result shows a number of tabs with information. What information is shown depends on the type of the analysis: performance analysis, memory access analysis or function-level analysis.

This chapter contains an overview of all the fields and columns in an analysis result output.

5.1. Summary Tab

On the Summary tab the following information is available for the different analysis types

**Performance analysis**
- Info
- Performance hotspots
- ICache misses
- DCache misses

**Memory access analysis**
- Info
- Performance hotspots
- Data access intensive functions
- Memory access conflicts
- DCache misses

**Function-level analysis**
- Info
- Performance hotspots
5.1.1. Info

The Info part of the Summary tab contains the following information.

![Info Table](image)

<table>
<thead>
<tr>
<th>Information</th>
<th>Description</th>
<th>Perf Analysis</th>
<th>Mem Analysis</th>
<th>Func Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Processor</td>
<td>The name of the selected processor device</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Timestamp</td>
<td>The date and time the analysis was run</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Execution time</td>
<td>The time it took on the PC to run the analysis</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Core index</td>
<td>The TriCore core (0, 1, 2, ...) the analysis was run for</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>CPU clock count</td>
<td>The number of CPU clock cycles on the board it took to run the analysis</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Clock frequencies</td>
<td>The values of several clock frequencies. The values are read at the start of the analysis before any reset. If the CPU was reset or halted at analysis start, the clock frequencies are not measured.</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>CPU data/program cache</td>
<td>The CPU 0, 1, 2, ... data cache (DCache) and program cache (PCache) settings. D0=on means CPU0.DCACHE is enabled, P1=off means CPU1.PCACHE is disabled. The values are read at the start of the analysis before any reset.</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>
### Information

<table>
<thead>
<tr>
<th>Information</th>
<th>Description</th>
<th>Perf Analysis</th>
<th>Mem Analysis</th>
<th>Func Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stalls</td>
<td>The number of clock cycles the CPU stalls on branch misses, ICache misses and/or DCache misses</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average stalls per clock</td>
<td>The average of stalls / CPU clock count</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ICache misses</td>
<td>The number of failed attempts to read or write instructions from the instruction cache (ICache)</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DCache misses</td>
<td>The number of failed attempts to read or write data from the data cache (DCache)</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>DSPR0 accesses</td>
<td>The number of read or write accesses to Data Scratchpad RAM 0</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DSPR1 accesses</td>
<td>The number of read or write accesses to Data Scratchpad RAM 1</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DSPR2 accesses</td>
<td>The number of read or write accesses to Data Scratchpad RAM 2</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FLASH memory accesses</td>
<td>The number of read or write accesses to flash memory</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>External Bus Unit memory accesses</td>
<td>The number of read or write accesses to the EBU</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Local Memory Unit accesses</td>
<td>The number of read or write accesses to the LMU</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Items that are marked red are high values that may be improved. Hover the mouse over a value to see additional information.

#### 5.1.2. Performance Hotspots

The **Performance hotspots** part of the Summary tab show a Hotspots chart. It show the functions with the highest clock count. This chart is available for all analysis types. As you can see in the following example, most of the time is spent in the functions `_c_init` and `main`. 
If you double-click on a function, the Source tab opens at the selected function.

5.1.3. Data Access Intensive Functions

The **Data access intensive functions** part of the Summary tab shows the functions with the highest number of data accesses to memory. This chart is available for memory access analyses only.

The first column is the name of the global variable, if the address is associated with a variable, otherwise "Unidentified access" is shown. The second column is the name of the memory. The third column shows the type of access read (R) or write (W). The fourth column shows the total number of accesses. The fifth column shows the approximate cache miss rate for this specific access.

Hover the mouse over a value to see additional information.
5.1.4. Memory Access Conflicts

The Memory access conflicts part of the Summary tab shows the conflicts where two variables from different cores access the same memory at the same time. This is called concurrent access. The demo_concurrent tutorial delivered with the product demonstrates this problem. This chart is available for memory access analyses only.

The first column is the name of the first global variable that accesses the memory. The second column shows the type of access read (R) or write (W) of the first variable. The third column is the name of the second global variable that accesses the memory and causes the conflict. The fourth column shows the type of access read (R) or write (W) of the second variable. The fifth column shows the core from which the conflicting access originated. The sixth column shows the total number of access conflicts.

Hover the mouse over a value to see additional information.
5.1.5. ICache Misses

The ICache misses part of the Summary tab show an ICache Miss chart. It show the functions with the highest number of instruction cache (ICache) misses. This chart is available for performance analyses only.

5.1.6. DCache Misses

The DCache misses part of the Summary tab show a DCache Miss chart. It show the functions with the highest number of data cache (DCache) misses. This chart is available for performance analyses and memory access analyses.
5.2. Hot Functions Tab

The Hot Functions tab shows a list with all the measured functions. This tab is available in all analysis types. The performance analysis contains the most columns. Click on a column to sort the list according to the information in that column. If you double-click on a function, the Source tab opens at the selected function. If no source lines can be displayed, the Disassembly tab opens. Hover the mouse over a column to see additional information.

The Hot Functions tab contains the following information:

<table>
<thead>
<tr>
<th>Column</th>
<th>Description</th>
<th>Perf Analysis</th>
<th>Mem Analysis</th>
<th>Func Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Function Name</td>
<td>The name of the measured function</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Source File</td>
<td>The relative path to the source file as stored in the application ELF file</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Function Address</td>
<td>The address of the function in the application ELF file</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Clocks</td>
<td>The total number of CPU clocks spent in the function</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>
### 5.3. Source Line Results Tab

The Source Line Results tab shows a list with all the source lines of the measured functions where branch misses, instruction cache misses, data cache misses and/or stalls appear. This tab is available for performance analyses only. Click on a column to sort the list according to the information in that column. Hover the mouse over a column to see additional information.

If you double-click on a row, the Source tab opens at the selected source line.

The Source Line Results tab contains the following information:

<table>
<thead>
<tr>
<th>Column</th>
<th>Description</th>
<th>Perf Analysis</th>
<th>Mem Analysis</th>
<th>Func Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Position</td>
<td>The source line number, function name and relative path to the source file</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Clocks</td>
<td>The total number of CPU clocks spent on the source line</td>
<td></td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Branch Misses</td>
<td>The total number of branch misses</td>
<td></td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>ICache Misses</td>
<td>The total number of instruction cache misses</td>
<td></td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>DCache Misses</td>
<td>The total number of data cache misses</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Stalls</td>
<td>The total number of stalls due to memory access delays or pipeline hazards</td>
<td></td>
<td>✓</td>
<td></td>
</tr>
</tbody>
</table>
### 5.4. Instruction Results Tab

The Instruction Results tab shows a list with all the instructions of the measured functions where branch misses, instruction cache misses, data cache misses and/or stalls appear. This tab is available for performance analyses only. Click on a column to sort the list according to the information in that column. Hover the mouse over a column to see additional information.

If you double-click on a row, the Disassembly tab opens at the selected instruction.

The Instruction Results tab contains the following information:

<table>
<thead>
<tr>
<th>Column</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Address</td>
<td>The instruction address and function name where the problem occurred</td>
</tr>
<tr>
<td>Clocks</td>
<td>The total number of CPU clocks spent on the instruction</td>
</tr>
<tr>
<td>Branch Misses</td>
<td>The total number of branch misses</td>
</tr>
<tr>
<td>ICache Misses</td>
<td>The total number of instruction cache misses</td>
</tr>
<tr>
<td>DCache Misses</td>
<td>The total number of data cache misses</td>
</tr>
<tr>
<td>Stalls</td>
<td>The total number of stalls due to memory access delays or pipeline hazards</td>
</tr>
</tbody>
</table>

### 5.5. Source Tab

The Source tab shows the source code for the selected 'hot function'. For performance analyses only, trace data is also present grouped by source line.
The columns are the same as explained in Section 5.3, Source Line Results Tab. Red values indicate a miss or a stall. Hover the mouse over a value to see additional information.

With the Browse button you can open another source file.

When you enable Show disassembly, the disassembly will be intermixed with the source lines.

5.6. Disassembly Tab

The Disassembly tab shows the instructions for the selected 'hot function'. For performance analyses only, trace data is also present grouped by instruction address.
The columns are the same as explained in Section 5.4, *Instruction Results Tab*. Red values indicate a miss or a stall. Hover the mouse over a value to see additional information.

Note that due to hardware constraints, a miss or a stall cannot always be linked to the exact assembly instruction.