Processor SDK RTOS Automotive Getting Started Guide

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Introduction

The **Processor Software Development Kit (Processor-SDK)** provides the core foundation and building blocks that facilitate application software development on TI's embedded processors. This *Getting Started Guide* focuses on the Real-time operating system (RTOS) and provides information on getting the software and running basic examples/demonstrations bundled in the SDK.

By the end of this *Getting Started Guide*, the user will have

- Installed Code Composer Studio
- Installed latest Emulation package (for connecting to target using JTAG)
- Installed the Processor SDK RTOS Automotive software
- Executed the RTOS out-of-box application(s)

Setup software

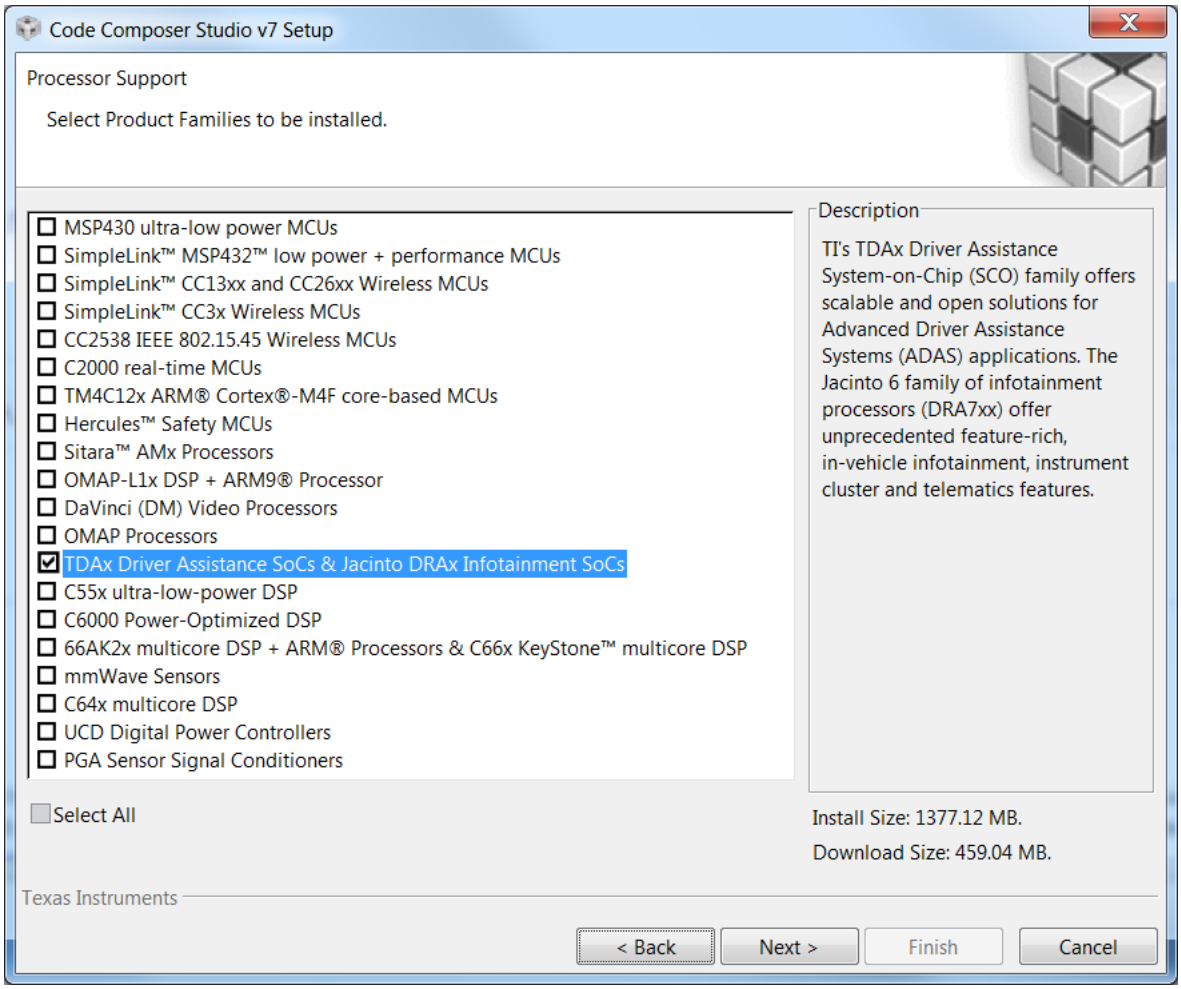
See the Release Notes for information on minimum requirements for host.

Code Composer Studio

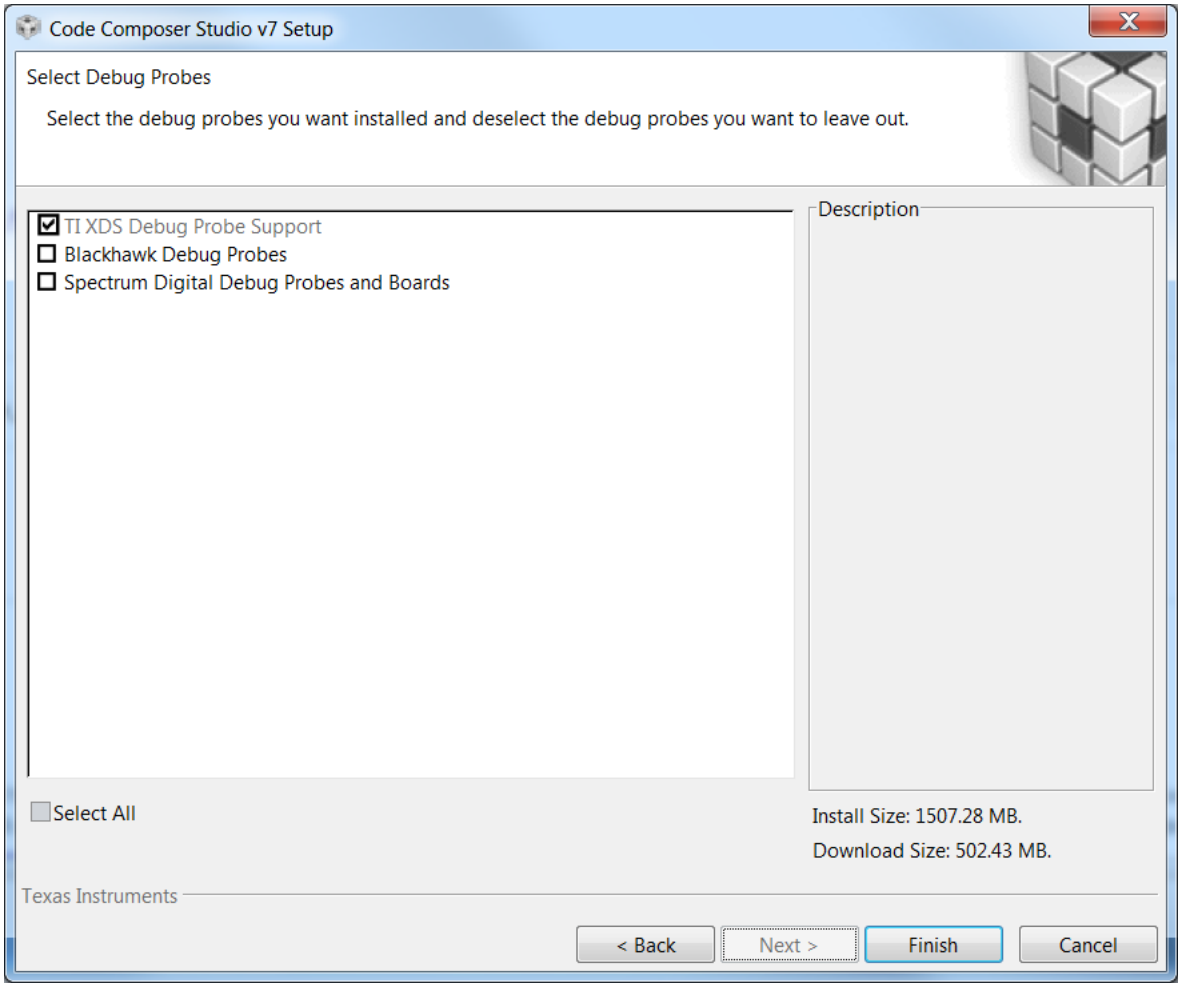
The Processor SDK RTOS Automotive uses *Code Composer Studio* as the host integrated development environment for development and debug. To download CCS, see this page (http://processors.wiki.ti.com/index.php/Download_CCS).

> **NOTE**
>
> See the Release Notes for the recommended version of CCS. This is the version that was validated with the software in the SDK and will provide the best user experience.

To install CCS, please refer to the instructions provided in the Code Composer Studio v7 landing page (http://processors.wiki.ti.com/index.php/Category:Code_Composer_Studio_v7). When installing CCS, you can choose to control what is installed for processor architecture.



> **NOTE**
>
> If you plan to use emulators other than the XDS100 class or XDS200 class of emulators, please select the appropriate emulation drivers at the time of install. Code composer studio does not allow upgrades on drivers that were not installed during the first install.



Processor SDK RTOS Automotive

The final step is to download and install the Processor SDK RTOS Automotive. See the software product page to get the latest version of this software:

- Processor SDK for DRA7XX (http://www.ti.com/tool/PROCESSOR-SDK-DRA7X)

From the software product page, go to the download page by clicking "Get Software" for the RTOS Automotive package.

> **NOTE**
>
> - To avoid configuring CCS "Tool Discovery Path" to search for components in different directories, it is recommended to install the SDK in the same directory as CCS. This is *C:/TI* for Windows and */home/[user]/ti* for Linux.
> - Once installer has started, the Cancel button may not work properly.

Setup EVM hardware

> **CAUTION** The EVM board is sensitive to electrostatic discharges (ESD). Use a grounding strap or other device to prevent damaging the board. Be sure to connect communication cables before applying power to any equipment.

The EVM provides the ability to utilize a variety of capabilities of the SoC. Follow instructions in the included *EVM Quick Start Guide* for information on hardware configuration and other pertinent information. This guide is included in the EVM kit and also available for download from the software download page for your particular device. The list of supported EVMs are provided in the Release Notes.

If you connect to the EVM UART, use the following host configuration:

- **Baud Rate**: 115200
- **Data Bits**: 8
- **Parity**: None
- **Flow Control**: Off

Setting up CCS for EVM and Processor-SDK RTOS Automotive

After the Processor SDK is installed, launch Code Composer Studio and make sure that the components inside Processor SDK are discovered by the CCS eclipse environment. If you installed the SDK in the same directory as CCS, this is as simple as starting CCS and it will auto-detect the newly installed components.

> **NOTE**
>
> If you installed the SDK and CCS in different paths, see the Custom Installation Path (http://software-dl.ti.com/processor-sdk-rtos/esd/docs/04_03_00_05/rtos/How_to_Guides.html#update-environment-when-installing-to-a-custom-path) **How To** page that provides instructions to configure for a custom installation path.

The next step is to make a connection between CCS and your EVM (or *target*). If you need help with this step, see the Setup CCS (http://software-dl.ti.com/processor-sdk-rtos/esd/docs/04_03_00_05/rtos/How_to_Guides.html#setup-ccs-for-evm-and-processor-sdk-rtos) **How To** page explaining this further.

Useful Tip

At this point, you should be able to connect to target using CCS. Do not proceed to below steps until this is complete.

Running examples/demonstrations

The SDK comes with some simple *examples* to get started using the software and IDE. The *demonstrations* contain a richer set of software and perform more complex features. If new to the SDK, it is suggested to go through the examples before writing your application.

Bare metal examples (http://software-dl.ti.com/processor-sdk-rtos/esd/docs/04_03_00_05/rtos/Examples_and_Demonstrations.html#no-os-bare-metal-example)

The bare-metal examples gets user started with development of code without an operating system. These are simple examples that does not get into details of software components provided in the SDK.

TI-RTOS kernel examples (http://software-dl.ti.com/processor-sdk-rtos/esd/docs/04_03_00_05/rtos/Examples_and_Demonstrations.html#ti-rtos-kernel-example)

The RTOS examples gets user started with development of code using the TI-RTOS real-time operating system. These are simple examples that does not get into details of software components provided in the SDK.

Peripheral driver examples

For peripheral driver examples that are provided in Platform Development kit (PDK), please refer to the **Rebuilding The PDK** instructions under PDK Example and Test Project Creation (http://software-dl.ti.com/processor-sdk-rtos/esd/docs/04_03_00_05/rtos/How_to_Guides.html?highlight=rebuilding%20pdk#rebuild-drivers-from-pdk-directory) for generating CCS project for driver examples supported in the SDK.

Enhanced Ethernet Packet Inspection

This is an enhancement to the baseline established in the Ethernet Packet Inspection example found in the EMAC LLD overview (http://software-dl.ti.com/processor-sdk-rtos/esd/docs/04_03_00_05/rtos/Device_Drivers.html#emac).

Additional changes can be made to the driver and application in order to reduce the CPU load and also increase the max traffic rate that can be inspected. The changes are aimed to reduce the impact of cache management in the following areas of the receive data path:

- Skipping unneeded cache invalidation for read only buffers. After the application has consumed a RX packet, the associated data buffer has to be cache invalidated to ensure that the buffer doesn't have any dirty lines that could cause problem after giving it to the hardware. This example doesn't change the content of the packet buffer. It only inspects the IPv6 header of each packet. So this cache invalidate call can be safely skipped.
- Invalidating only the region of interest for packet inspection. Allowing cache management to be done by the application helps narrowing the invalidate area to what's actually needed by the app, as opposed to having the driver invalidate the entire packet buffer. This example inspects the IPv6 header area in order to classify the packets, so the cache invalidate size can be reduced to the first 56 bytes of the packet buffer.

Download **this** patch to the EMAC driver. It is applied from the pdk_dra7xx_[version]/packages/ti/drv/emac directory using a patch utility as below (Windows users must do this using some GNU tool collection like that provided by Cygwin (https://www.cygwin.com/) or MinGW (http://www.mingw.org/)):

```
patch -p1 < 0001-examples-PacketInspection-Reduce-CPU-load-by-improvi.patch
```

Rebuild the emac component using the instructions outlined in **Rebuild drivers from PDK directory** (http://software-dl.ti.com/processor-sdk-rtos/esd/docs/04_03_00_05/rtos/How_to_Guides.html?highlight=rebuilding%20pdk#rebuild-drivers-from-pdk-directory) and then rebuild the Ethernet Packet Inspection demo. The table below shows the expected M4 CPU load with and without the improvements described in the previous paragraph.

M4 CPU Load (%)

Traffic (Mbps)	Baseline (RTOS Auto 4.3)	R/O Buffers	R/O Buffers + IPv6 Hdr Cache Inv
100	31	20	12
200	59	36	17
300	88	52	25
400		70	34
500		89	40
600			46
700			54

EVE FFT/IFFT Demonstration

This demonstration is used to show how to offload a processing intensive operation to the Embedded Vector Engine (EVE), which can free up other processors to perform additional processing (i.e. DSP). The operation offloaded to the EVE vector core in this example is a 1024-point, 32-bit data, 32-bit twiddle factor, Fast Fourier Transform (FFT) and Inverse Fast Fourier Transform (IFFT). Refer to processor_sdk_rtos_dra7xx_[version]/demos/eve_audio/examples/fft/readme.txt for more information on building and running this example.

An application report "Getting Started with EVE Audio" is also included under processor_sdk_rtos_dra7xx_[version]/demos/eve_audio/doc/DRA7XX_EVE_Audio to more generally present the EVE programming environment and provide a guideline to start developing audio software for the EVE core.

EVE PFC Demonstration

This demonstration extends the EVE FFT/IFFT functionality by implementing a complex multiply kernel, optimized memory management scheme, and basic DSP host framework to perform Partitioned Fast Convolution operation on the EVE. The demo includes two sample 3000-tap low-pass FIR filters with 200 Hz and 2 kHz cutoff frequencies. The filters may be used as-is or modified to achieve the desired frequency response.

This demo can now also be integrated with real-time audio streaming on the DSP. The capabilities are limited by the device and EVM so this is limited to DRA75x only.

Refer to processor_sdk_rtos_dra7xx_[version]/demos/eve_audio/examples/pfc/readme.txt for more information on building and running this example in the various permutations.

EVE FIR Demonstration

This demonstration shows how to offload FIR filtering to the EVE. The demo includes two sample 3072-tap low-pass FIR filters with 200 Hz and 2 kHz cutoff frequencies. The filters may be used as-is or modified to achieve the desired frequency response. Refer to processor_sdk_rtos_dra7xx_[version]/demos/eve_audio/examples/fir/readme.txt for more information on building and running this example.

Multicore Streaming Demonstration

The multicore streaming demonstration uses IPC APIs to implement a streaming usecase using cached zero-copy memory between two cores in the system. Refer to processor_sdk_rtos_dra7xx_[version]/demos/multicore_streaming/readme.txt for more information on building, running, and validating the example.

Next steps

Now that you have a solid baseline set up, see the Processor SDK RTOS Software Developer Guide (http://software-dl.ti.com/processor-sdk-rtos/esd/docs/04_03_00_05/rtos/index.html) for more information.

> **NOTE**
>
> The SBL (Boot) component in this SDK different than the component which is described in Processor SDK RTOS Boot (http://software-dl.ti.com/processor-sdk-rtos/esd/docs/04_03_00_05/rtos/Foundational_Components.html#boot). Please refer to the SBL_UserGuide.pdf found under pdk_dra7xx_[version]/packages/ti/boot/sbl_auto/doc

How to

Speed up downloading the installer

The size of the installer is large since we want to provide one bundle for all the components. The bad side of this is that if you are manually downloading the Processor-SDK installer, you may run into issues such as download stall or slow download. One simple solution is to run a download manager/accelerator. One open source solution is http://www.freedownloadmanager.org/.

Archive

Processor SDK RTOS Automotive 04.01.00 Getting Started Guide (http://processors.wiki.ti.com/index.php?title=Processor_SDK_RTOS_Automotive_Getting_Started_Guide&oldid=230971)

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