TB3291

The Difference Between MPLAB Harmony v3 PLIBs and Drivers, and When to Use Them

Introduction

MPLAB® Harmony v3 provides layered and modular software libraries that support a flexible embedded software development model. The core libraries under MPLAB Harmony v3 includes Peripheral Libraries (PLIBs), drivers, and system services. The PLIBs provide low-level device-specific support. The drivers and system services provide hardware abstraction upon which a highly capable Middleware is built.

This document explains the differences between the MPLAB Harmony v3 PLIBs and drivers, and it also describes when to use them.

1. Description

1.1 Peripheral Libraries

The MPLAB Harmony v3 Peripheral Library (PLIB) is a low-level interface library to access a peripheral on a microcontroller. The PLIB Application Program Interfaces (APIs) hide peripheral register details and make it easier to configure the peripheral per the application requirements by calling the PLIB APIs.

The MPLAB Harmony v3 Peripheral Library features are as follows:

- Simple and user-friendly APIs.
- Abstraction layers are not implemented; has direct register access.
- Clean code and no conditional macros (for example, #if, #elif).
- Easy to integrate into existing applications.
- Self-containing and self-sufficient implementation. In general, all PLIBs are interrupt driven, but few PLIBs have blocking implementation in addition to interrupt driven implementation.
- PLIBs can be easily extended to add new features.
- PLIBs provide status using polling and interrupt mode (through a callback mechanism) implementation models for data transaction operations. By using these models, the application can either poll the status of the submitted request, or choose to get notified when the request is complete by registering a callback API in an application.
- Consistent API signature for similar peripherals across 32-bit SAM and PIC microcontroller families. The following table illustrates the PLIB API signatures.

Usage	UART	SPI	I2C/TWI
Initialization	`UARTx_Initialize()`	`SPIx_Initialize()`	`TWIx_Initialize()`
Transaction	`UARTx_Write()`	`SPIx_Write()`	`TWIx_Write()`
	`UARTx_Read()`	`SPIx_Read()`	`TWIx_Read()`
	-	`SPIx_WriteRead()`	`TWIx_WriteRead()`
Status	`UARTx_ReadIsBusy()`	`SPIx_IsBusy()`	`TWIx_IsBusy()`
	`UARTx_WriteIsBusy()`		

1.2 Drivers

The MPLAB Harmony v3 drivers are a highly abstracted interface to control, access, manage peripherals, and other resources on the 32-bit SAM and PIC microcontrollers. The driver interface allows applications and other client modules (drivers, Middleware libraries and system services) to interact with the peripheral.

The following are MPLAB Harmony v3 driver features:

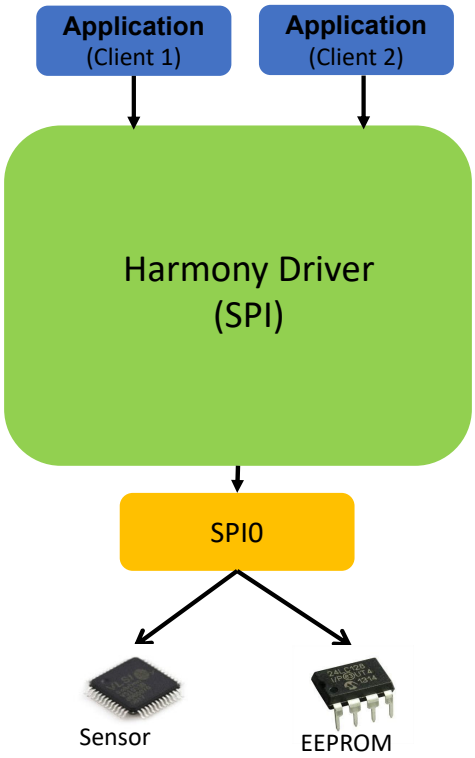
- Abstracted interfaces: Enables portability and interoperability.
- Drivers are built on the top of the PLIBs.
- A driver is capable of handling multiple instances of a peripheral without duplicating the driver code to handle the individual instance of a peripheral. The multiple instance support of MPLAB Harmony v3 drivers enables the application to remain the same even when the peripheral instance is changed.

USART Driver API	USART PLIB API
`DRV_USART_WriteBufferAdd(…)`	`USART1_Write(…)`
	`USART2_Write(…)`

.....continued	
USART Driver API	**USART PLIB API**
DRV_USART_ReadBufferAdd(…)	USART1_Read(…)
	USART2_Read(…)

- Multiple Client Support: Access of a peripheral by more than one entity. The multiple client support of MPLAB Harmony v3 drivers enables seamless handling of client specific differences.

  Figure 1-1. Multiple Client Example



- Supports DMA transfer mode: Provides an application with the option to enable the DMA for data transfer operations. The driver interface/API remains the same with or without the DMA transfer mode.
- Provides queuing support: MPLAB Harmony v3 drivers provide applications with the ability to line up multiple data transfer requests while an ongoing request is processing. The result of the data transfer request is notified through a transfer complete event.
- MPLAB Harmony v3 drivers provide a non-blocking implementation model for data transfer operations known as the Asynchronous Driver mode.
- MPLAB Harmony v3 drivers provide another driver model known as Synchronous mode to adhere to the blocking need of applications using an RTOS. The synchronous driver mode of the MPLAB Harmony v3 driver provides blocking implementation for the data transfer operations.
- MPLAB Harmony v3 drivers enable the usage of RTOS through the Operating System Abstraction Layer (OSAL).
- MPLAB Harmony v3 drivers have a choice to configure both the Asynchronous and Synchronous modes in both the non-RTOS and RTOS environments.
- The OSAL provides a consistent interface to the MPLAB Harmony v3 drivers. The OSAL takes care of the underlying differences between the available and supported RTOS Kernels in MPLAB Harmony v3, and ensures the correct operation in bare-metal (non-RTOS) and RTOS-based application environments.
- MPLAB Harmony v3 drivers handle cache maintenance operations on devices that have a data cache.

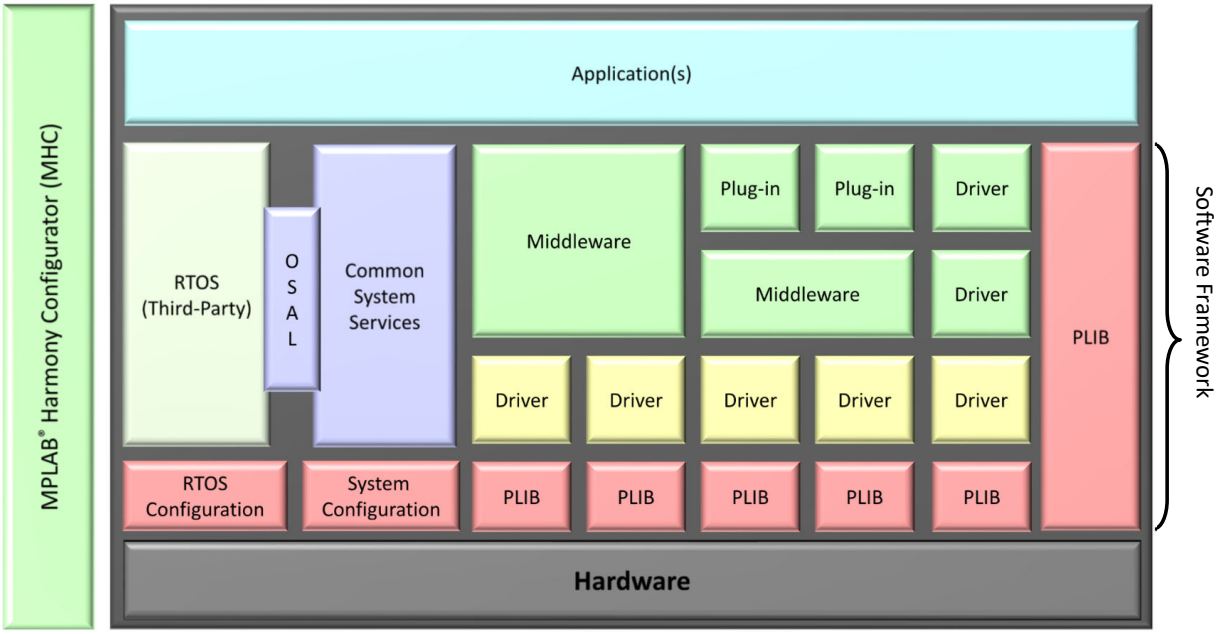
1.3 Usage Recommendation of Peripheral Libraries (PLIBs) and Drivers

PLIBs are suitable for applications where hard real time response and performance are the key criteria. These applications prefer minimum abstraction and try to operate close to the hardware. For example, a motor control application where the speed and position of the motor are sensed and passed to a control algorithm, which then controls the motor in real time. Because PLIBs are simple, user friendly, and are closer to the hardware can be a preferred choice for time critical applications.

Drivers are suitable for use in larger, feature rich applications. For example, an audio player application plays audio from multiple sources, such as SD card, Bluetooth®, or USB Thumb® drive, and contains a graphical display. These applications require well abstracted interfaces for all the modules to work together. The MPLAB Harmony v3 drivers provide the foundation for Middleware libraries to build such a large and feature-rich applications, therefore making it suitable to use in these applications.

The following figure illustrates the MPLAB Harmony v3 architecture showing the locations of the PLIBs and drivers. The PLIBs have direct access to the hardware, where the drivers are built on the top of the PLIBs and provide an abstracted interface to other MPLAB Harmony v3 software components (plug-ins, Middleware, and system services) and applications.

Figure 1-2. MPLAB Harmony v3 Architecture



In addition to the usage scenarios discussed above, the application can choose the PLIBs or the driver-based application requirements through matching the features provided by them. The following table outlines the comparative features of the PLIBs and drivers.

Peripheral Libraries	Drivers
Minimal abstraction to access a peripheral.	Highly abstracted interface to a peripheral.
Direct register access.	Built on the top of PLIBs.
Provides status polling and interrupt mode (through callback mechanism) implementation models for data transaction operations.	Provides status polling and interrupt mode (through callback mechanism) implementation models for data transaction operations.
PLIBs do not maintain the state of the peripheral instance. This makes shared access of multiple instances difficult.	Drivers maintain the state of the peripheral instance, this helps in shared access of multiple peripheral instances by multiple clients.

.....continued

Peripheral Libraries	Drivers
PLIBs do not support queuing of requests.	Drivers support queuing of requests.
No DMA support. Application must handle DMA-based operations.	Provides DMA support. APIs remain the same in DMA and Non-DMA based configurations.
Application must handle thread safety.	Drivers enable the usage of RTOS support through the OSAL.
No Special RTOS mode.	Provides a special operation mode (synchronous) for RTOS-based environments.
Consistent data transfer API signature for similar peripherals across 32-bit SAM and PIC microcontroller families.	Same data transfer API signature for similar peripherals across 32-bit SAM and PIC® microcontroller families.

2. References

- MPLAB Harmony v3 “quick_docs” provides standalone help pages for users to get started developing applications on Microchip’s 32-bit SAM and PIC MCUs. The online version of the same can be found at microchip-mplab-harmony.github.io/quick_docs/.
- For additional information on MPLAB Harmony v3, go to the Microchip websites: https://www.microchip.com/mplab/mplab-harmony and .microchipdeveloper.com/harmony3:start
- Detailed documentation on various MPLAB Harmony v3 PLIBs and drivers can be found in the “doc” folder of the corresponding repository.
- The Differences Between MPLAB Harmony v3 Synchronous and Asynchronous Drivers and When to Use Them ww1.microchip.com/downloads/en/DeviceDoc/The-Difference-Between-MPLAB-Harmonyv3-Synchronous-and-Asynchronous-Drivers-and-When-to-Use-DS90003269A.pdf.

The Microchip Website

Microchip provides online support via our website at www.microchip.com/. This website is used to make files and information easily available to customers. Some of the content available includes:

- **Product Support** – Data sheets and errata, application notes and sample programs, design resources, user's guides and hardware support documents, latest software releases and archived software
- **General Technical Support** – Frequently Asked Questions (FAQs), technical support requests, online discussion groups, Microchip design partner program member listing
- **Business of Microchip** – Product selector and ordering guides, latest Microchip press releases, listing of seminars and events, listings of Microchip sales offices, distributors and factory representatives

Product Change Notification Service

Microchip's product change notification service helps keep customers current on Microchip products. Subscribers will receive email notification whenever there are changes, updates, revisions or errata related to a specified product family or development tool of interest.

To register, go to www.microchip.com/pcn and follow the registration instructions.

Customer Support

Users of Microchip products can receive assistance through several channels:

- Distributor or Representative
- Local Sales Office
- Embedded Solutions Engineer (ESE)
- Technical Support

Customers should contact their distributor, representative or ESE for support. Local sales offices are also available to help customers. A listing of sales offices and locations is included in this document.

Technical support is available through the website at: www.microchip.com/support

Microchip Devices Code Protection Feature

Note the following details of the code protection feature on Microchip devices:

- Microchip products meet the specifications contained in their particular Microchip Data Sheet.
- Microchip believes that its family of products is secure when used in the intended manner and under normal conditions.
- There are dishonest and possibly illegal methods being used in attempts to breach the code protection features of the Microchip devices. We believe that these methods require using the Microchip products in a manner outside the operating specifications contained in Microchip's Data Sheets. Attempts to breach these code protection features, most likely, cannot be accomplished without violating Microchip's intellectual property rights.
- Microchip is willing to work with any customer who is concerned about the integrity of its code.
- Neither Microchip nor any other semiconductor manufacturer can guarantee the security of its code. Code protection does not mean that we are guaranteeing the product is "unbreakable." Code protection is constantly evolving. We at Microchip are committed to continuously improving the code protection features of our products. Attempts to break Microchip's code protection feature may be a violation of the Digital Millennium Copyright Act. If such acts allow unauthorized access to your software or other copyrighted work, you may have a right to sue for relief under that Act.

Legal Notice

Trademarks

ISBN: 978-1-5224-7036-6

Quality Management System

For information regarding Microchip's Quality Management Systems, please visit www.microchip.com/quality.

Worldwide Sales and Service

AMERICAS	ASIA/PACIFIC	ASIA/PACIFIC	EUROPE
Corporate Office 2355 West Chandler Blvd. Chandler, AZ 85224-6199 Tel: 480-792-7200 Fax: 480-792-7277 Technical Support: www.microchip.com/support Web Address: www.microchip.com **Atlanta** Duluth, GA Tel: 678-957-9614 Fax: 678-957-1455 **Austin, TX** Tel: 512-257-3370 **Boston** Westborough, MA Tel: 774-760-0087 Fax: 774-760-0088 **Chicago** Itasca, IL Tel: 630-285-0071 Fax: 630-285-0075 **Dallas** Addison, TX Tel: 972-818-7423 Fax: 972-818-2924 **Detroit** Novi, MI Tel: 248-848-4000 **Houston, TX** Tel: 281-894-5983 **Indianapolis** Noblesville, IN Tel: 317-773-8323 Fax: 317-773-5453 Tel: 317-536-2380 **Los Angeles** Mission Viejo, CA Tel: 949-462-9523 Fax: 949-462-9608 Tel: 951-273-7800 **Raleigh, NC** Tel: 919-844-7510 **New York, NY** Tel: 631-435-6000 **San Jose, CA** Tel: 408-735-9110 Tel: 408-436-4270 **Canada - Toronto** Tel: 905-695-1980 Fax: 905-695-2078	**Australia - Sydney** Tel: 61-2-9868-6733 **China - Beijing** Tel: 86-10-8569-7000 **China - Chengdu** Tel: 86-28-8665-5511 **China - Chongqing** Tel: 86-23-8980-9588 **China - Dongguan** Tel: 86-769-8702-9880 **China - Guangzhou** Tel: 86-20-8755-8029 **China - Hangzhou** Tel: 86-571-8792-8115 **China - Hong Kong SAR** Tel: 852-2943-5100 **China - Nanjing** Tel: 86-25-8473-2460 **China - Qingdao** Tel: 86-532-8502-7355 **China - Shanghai** Tel: 86-21-3326-8000 **China - Shenyang** Tel: 86-24-2334-2829 **China - Shenzhen** Tel: 86-755-8864-2200 **China - Suzhou** Tel: 86-186-6233-1526 **China - Wuhan** Tel: 86-27-5980-5300 **China - Xian** Tel: 86-29-8833-7252 **China - Xiamen** Tel: 86-592-2388138 **China - Zhuhai** Tel: 86-756-3210040	**India - Bangalore** Tel: 91-80-3090-4444 **India - New Delhi** Tel: 91-11-4160-8631 **India - Pune** Tel: 91-20-4121-0141 **Japan - Osaka** Tel: 81-6-6152-7160 **Japan - Tokyo** Tel: 81-3-6880- 3770 **Korea - Daegu** Tel: 82-53-744-4301 **Korea - Seoul** Tel: 82-2-554-7200 **Malaysia - Kuala Lumpur** Tel: 60-3-7651-7906 **Malaysia - Penang** Tel: 60-4-227-8870 **Philippines - Manila** Tel: 63-2-634-9065 **Singapore** Tel: 65-6334-8870 **Taiwan - Hsin Chu** Tel: 886-3-577-8366 **Taiwan - Kaohsiung** Tel: 886-7-213-7830 **Taiwan - Taipei** Tel: 886-2-2508-8600 **Thailand - Bangkok** Tel: 66-2-694-1351 **Vietnam - Ho Chi Minh** Tel: 84-28-5448-2100	**Austria - Wels** Tel: 43-7242-2244-39 Fax: 43-7242-2244-393 **Denmark - Copenhagen** Tel: 45-4485-5910 Fax: 45-4485-2829 **Finland - Espoo** Tel: 358-9-4520-820 **France - Paris** Tel: 33-1-69-53-63-20 Fax: 33-1-69-30-90-79 **Germany - Garching** Tel: 49-8931-9700 **Germany - Haan** Tel: 49-2129-3766400 **Germany - Heilbronn** Tel: 49-7131-72400 **Germany - Karlsruhe** Tel: 49-721-625370 **Germany - Munich** Tel: 49-89-627-144-0 Fax: 49-89-627-144-44 **Germany - Rosenheim** Tel: 49-8031-354-560 **Israel - Ra'anana** Tel: 972-9-744-7705 **Italy - Milan** Tel: 39-0331-742611 Fax: 39-0331-466781 **Italy - Padova** Tel: 39-049-7625286 **Netherlands - Drunen** Tel: 31-416-690399 Fax: 31-416-690340 **Norway - Trondheim** Tel: 47-72884388 **Poland - Warsaw** Tel: 48-22-3325737 **Romania - Bucharest** Tel: 40-21-407-87-50 **Spain - Madrid** Tel: 34-91-708-08-90 Fax: 34-91-708-08-91 **Sweden - Gothenberg** Tel: 46-31-704-60-40 **Sweden - Stockholm** Tel: 46-8-5090-4654 **UK - Wokingham** Tel: 44-118-921-5800 Fax: 44-118-921-5820