
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.

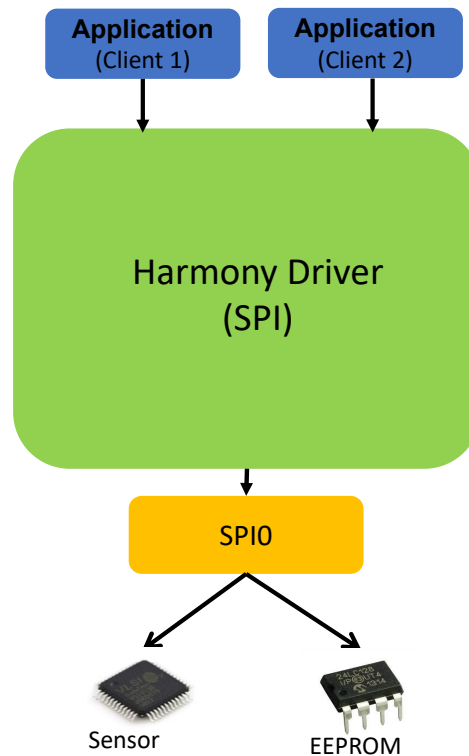
USART Driver API	USART PLIB API
DRV_USART_WriteBufferAdd(...)	USART1_Write(...)
	USART2_Write(...)

.....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.

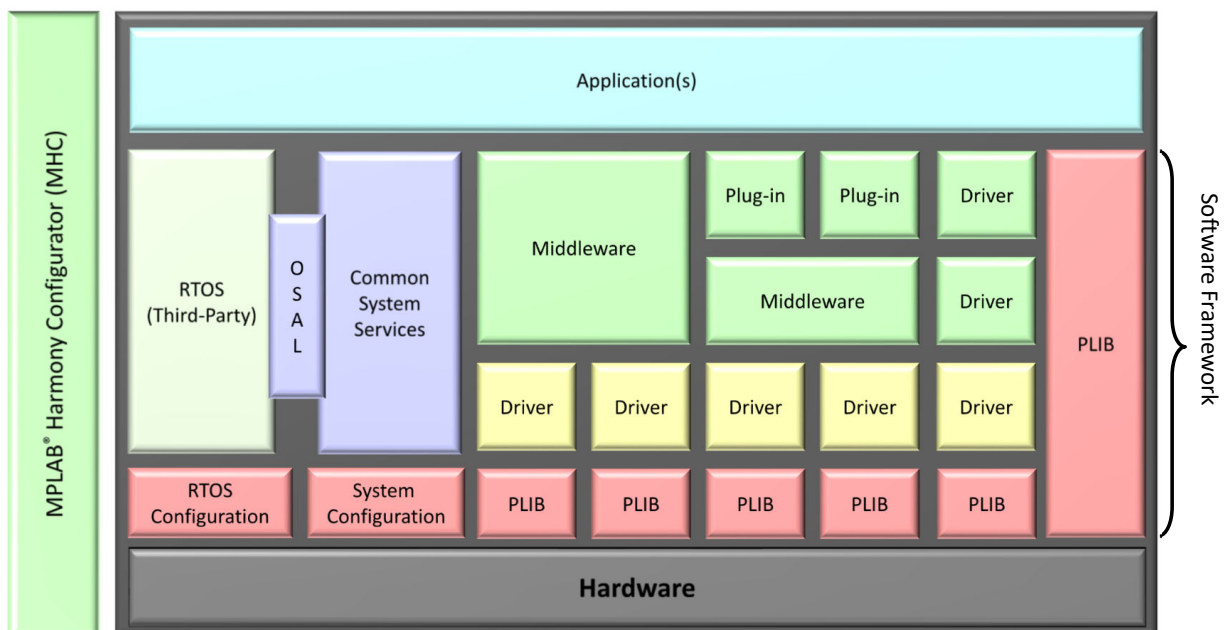
1.3 Usage Recommendation of Peripheral Libraries (PLIBs) and Drivers

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](https://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.

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