MPLAB Harmony Release Notes

MPLAB Harmony Integrated Software Framework

Volume I: Getting Started With MPLAB Harmony Libraries and Applications

This volume introduces the MPLAB® Harmony Integrated Software Framework.

Description

MPLAB Harmony is a layered framework of modular libraries that provide flexible and interoperable software "building blocks" for developing embedded PIC32 applications. MPLAB Harmony is also part of a broad and expandable ecosystem, providing demonstration applications, third-party offerings, and convenient development tools, such as the MPLAB Harmony Configurator (MHC), which integrate with the MPLAB X IDE and MPLAB XC32 language tools.

Legal Notices

Please review the *Software License Agreement* prior to using MPLAB Harmony. It is the responsibility of the end-user to know and understand the software license agreement terms regarding the Microchip and third-party software that is provided in this installation. A copy of the agreement is available in the `<install-dir>/doc` folder of your MPLAB Harmony installation.

The OPENRTOS® demonstrations provided in MPLAB Harmony use the OPENRTOS evaluation license, which is meant for demonstration purposes only. Customers desiring development and production on OPENRTOS must procure a suitable license. Please refer to one of the following documents, which are located in the `<install-dir>/third_party/rtos/OPENRTOS/Documents` folder of your MPLAB Harmony installation, for information on obtaining an evaluation license for your device:

- `OpenRTOS Click Thru Eval License PIC32MXxx.pdf`
- `OpenRTOS Click Thru Eval License PIC32MZxx.pdf`

TIP!

Throughout this documentation, occurrences of `<install-dir>` refer to the default MPLAB Harmony installation path:

- Windows: `C:/microchip/harmony/<version>`
- Mac OS/Linux: `~/microchip/harmony/<version>`

Release Information

This section provides MPLAB Harmony release information, include release notes, release contents, release types, and explains the version numbering system.

A PDF copy of the Release Notes is provided in the `<install-dir>/doc` folder of your MPLAB Harmony installation.

Description

This is a production release of MPLAB Harmony. It contains Middleware, Device Drivers, System Services, Peripheral Libraries, Board Support Packages, Demonstration Applications, graphical utilities, help documentation, and other collateral to simplify and accelerate firmware development on Microchip PIC32 devices. The Release Contents section provides a detailed listing and brief description of the contents of this release. The Release Notes section provides information on additions and updates to this release and identifies known issues. The Release Types and Version Numbers sections describe how Harmony libraries new content is identified and how updated versions are identified.

Previous versions of MPLAB Harmony are available in the Archives tab on the www.microchip.com/mplabharmony Web page.

Release Notes

This topic provides the release notes for this version of MPLAB Harmony.

Description

MPLAB Harmony Version: v2.06 **Release Date:** June 2018

Software Requirements

Before using MPLAB Harmony, ensure that the following are installed:

- MPLAB X IDE v4.20
- MPLAB XC32 C/C++ Compiler v2.10
- MPLAB Harmony Configurator v2.0.6.0

Updating to This Release of MPLAB Harmony

Updating to this release of MPLAB Harmony is relatively simple. For detailed instructions, please refer to Volume IV: MPLAB Harmony Development > Porting from MLA to MPLAB Harmony > Updating From a Previous Release.

What is New and Known Issues

The following tables list the features that have been changed or added and any known issues that have been identified. Any known issues that have yet to be resolved were retained from the previous release.

MPLAB Harmony:

Feature	Additions and Updates	Known Issues
General	*Pending*	MPLAB Harmony has not been tested with C++; therefore this programming language is not supported. The "`-O1`" optimization level (or greater) is recommended when building any projects that include the MPLAB Harmony prebuilt binary (.a file) peripheral library. This is necessary so that the linker will remove code from unused sections (for peripheral library features that are not used). Alternately, you may select "Remove Unused Sections" in the General options for the `xc32-ld` (linker) properties dialog box. The MPLAB Harmony uninstaller will delete all files installed by the installer, even if they were modified by the user. However, the uninstaller *will not* delete new files added by the user to the MPLAB Harmony installation folder. The MPLAB Harmony Display Manager plug-in provides complete configuration and simulation support to the LCC generated driver, and also provides basic support for all other graphics controller drivers. Full configuration and simulation support for the other graphics controller drivers will be added in a future release of MPLAB Harmony.

Middleware and Libraries:

Feature	Additions and Updates	Known Issues
Bootloader Library	N/A	The UDP bootloader does not compile for PIC32MZ devices when microMIPS is selected.
Crypto Library	N/A	Migrating projects that use the hardware Crypto library, and have multiple configurations, may run into a compile issue after regenerating code. MPLAB X IDE will show that the `pic32mz-crypt.h` and `pic32mz_crypt.c` files are excluded from the configuration, even though it tried to add them. The compiler will generate errors, saying that certain Crypto functions cannot be referenced. To work around this issue, remove both files (`pic32mz-crypt.h` and `pic32mz_crypt.c`) from the project and use the MPLAB Harmony Configurator (MHC) to regenerate all configurations that use these files. **Notes:** 1. Hardware accelerated hashes on PIC32MZ family devices require more heap space to run. If used in conjunction with TLS1.2, a heap of 4k is required during TLS negotiation. 2. Large hashes using hardware Crypto on the PIC32MZ family devices currently do not work.
Decoder Libraries	Added Speex to the encoder API	Due to memory requirements and the amount of available SRAM, some audio decoders cannot operate concurrently with other audio decoders. However, each audio decoder will operate individually in the universal_audio_decoders demonstration. The PNG image decoder utilizes dynamic memory at run-time. The heap size may need to be increased to ensure proper operation. The function `lodepng_decode_memory` will return code 53 if the system is not able to allocate enough memory for the decoding at run-time.
Graphics Library	**General Update:** • Added MHC config options for RTOS extensions **Aria User Interface Library Updates:** • Added circular widgets - Arc, Circular gauge, Circular slider/progress bar • Added graphing widgets - Pie Chart, Bar Graph, Line Graph • Added zoom, autohide and highlighting effects to Listwheel widget • Added image plus widget and radial menu widget • Added multi-line text support to Button widget • Added trigger property to Keypad widget • Fixed masking and alpha-blending for RLE images • Enhanced list widget performance for large number of items **Graphics Composer Updates:** • Added circular widgets - Arc, Circular gauge, Circular slider/progress bar • Added graphing widgets - Pie Chart, Bar Graph, Line Graph • Fixed color scheme helpers for various widgets • Added image plus widget and radial menu widget • Fixed code generation for List and Keypad widget • Add option to set size of default circle in radio button widget	JPEG images running on LCC operating on PIC32MX devices shows vertical line artifacts. The pic32mx_pcap_db configuration in the Aria Quickstart demonstration exhibits poor touch sensitivity. Some Newhaven displays require the I2C clock rate be reduced to approximately 5000 to 10000 Hz to compensate for touch system noise. The heap estimator can be inaccurate with estimating PNG images that have high pixel fidelity. When importing graphics designs from MPLAB Harmony v1.xx into v2.06, the default palette base color is sometimes set to black (0,0,0). Edit the v2.06 default palette to correct this. Images imported from v1.xx into v2.06 can show pixel blocking. Reimport the original image directly into v2.06 to correct this. Alpha-blend settings for radial menu is not functional for this release.
Graphics Library (continued)	**Hardware Abstraction Layer Updates:** • Added arc and ellipse drawing API **Device Support Updates:** • Removed ILI9488 parallel modes not supported in PIC32M • Significant performance improvement for the Nano2D library	

System Services	Input System Services Port System Services	• MPLAB Harmony Configurator can be used to select Input System Service to migrate projects that used Touch System Service. See Input System Service Migration. Touch System Service is deprecated in this release and may not be available in future releases. • MPLAB Harmony Configurator (MHC) may place the call to SYS_PORTS_Initialize from the function SYS_Initialize in the wrong place. This call may need to be after SYS_DEVCON_PerformanceConfig and before BSP_Initialize for proper operation of the application.
TCP/IP Stack	N/A	**SMTPC:** • API to abort a message, which is useful when retries are needed is currently not available • Multiple DNS addresses to provide a more reliable mail transmission is currently not available • Support for the optional mail header fields is currently not available **IGMP:** • The IGMP module is in Beta phase with limited testing for this release of MPLAB Harmony • An option to remove the source specific implementation options and to result in an IGMPv2 equivalent build is currently not available • A dynamic allocation version, which would allow a much more efficient resource management than the static version is currently not available
USB Device Library	N/A	While running the USB Device Stack on a PIC32MZ family device, the stack requires three seconds to initialize for PIC32MZ EC devices. MPLAB Harmony Configurator can be used to configure only One USB peripheral if there are multiple USB peripherals in the PIC32 microcontroller. MHC support for multiple USB peripherals will be available in a future release of MPLAB Harmony.
USB Host Library	N/A	The following USB Host Stack functions are not implemented: • USB_HOST_BusResume • USB_HOST_DeviceSuspend • USB_HOST_DeviceResume While running the USB Host Stack on a PIC32MZ family device, the stack requires three seconds to initialize for PIC32MZ EC devices. The USB Host Layer does not perform overcurrent checking. This feature will be available in a future release of MPLAB Harmony. The USB Host Layer does not check for the Hub Tier Level. This feature will be available in a future release of MPLAB Harmony. The USB Host Layer will only enable the first configuration when there are multiple configurations. If there are no interface matches in the first configuration, this causes the device to be become inoperative. Multiple configuration enabling will be activated in a future release of the of MPLAB Harmony. The MSD Host Client Driver has not been tested with Multi-LUN Mass Storage Device and USB Card Readers. MPLAB Harmony Configurator can be used to configure only One USB peripheral if there are multiple USB peripherals in the PIC32 microcontroller.

USB Host Library (Continued)		The USB Host SCSI Block Driver, the CDC Client Driver, and the Audio Host Client Driver only support single-client operation. Multi-client operation will be enabled in a future release of MPLAB Harmony. USB HID Host Client driver has not been tested with multiple usage devices. Sending of output or feature report has not been tested. The USB Audio Host Client driver does not provide implementation for the following functions: • USB_HOST_AUDIO_V1_DeviceObjHandleGet • USB_HOST_AUDIO_V1_FeatureUnitChannelVolumeRangeGet • USB_HOST_AUDIO_V1_FeatureUnitChannelVolumeSubRangeNumbersGet • USB_HOST_AUDIO_V1_StreamSamplingFrequencyGet • USB_HOST_AUDIO_V1_TerminalIDGet

Device Drivers:

Feature	Additions and Updates	Known Issues
I2C	N/A	**I2C Driver Using the Peripheral and the Bit-banged Implementation:** • Has only been tested in a single master environment • Does not support RTOS; therefore, it is not thread-safe when used in a RTOS environment • Has not been tested in a Polled environment • Operation in power-saving modes has not been tested **I2C Driver Using the Bit-banged Implementation**: • Non-blocking and uses a Timer resource for performing I2C operations. This Timer resource cannot be used for any other Timer needs. • The Timer Interrupt priority should be one of the highest priority interrupts in the application • Testing of this implementation has been done only with a system clock of 200 MHz and a peripheral bus clock of 100 MHz for the Timer • Can be configured to work only in Master mode • Only available in the dynamic driver setting • The baud rate is dependent on CPU utilization. It has been tested to run reliably up to 100 kHz. • Does not support PIC32MX family devices • Only works on the SCL and SDA pins of the corresponding I2C peripheral • Only works in Interrupt mode
Secure Digital (SD) Card	N/A	The SD Card Driver has not been tested in a high frequency interrupt environment.
SPI	N/A	The SPI Slave mode with DMA is not operational. This issue will be corrected in a future release of MPLAB Harmony. If the Reference Oscillator is used as the SPI clock source, the Clock System Service should not be used in Dynamic mode, as this may cause an exception.
SPI Flash	N/A	Flash features such as high-speed read, hold, and write-protect are not supported by the driver library. Static implementation of the driver library is not available.
Touch	mxt336t touch_adc	Deprecated previous touch drivers associated with touch system services. All new input touch drivers work with the new input system services.

USB	N/A	While running the USB Driver Library on a PIC32MZ family device, the stack requires three seconds to initialize for PIC32MZ EC devices. USB Host Driver Library Polled mode operation has not been tested for PIC32M microcontrollers.

Peripheral Libraries:

Feature	Additions and Updates	Known Issues
ADCHS	N/A	FIFO is not supported in this version of the peripheral library.
SQI	N/A	A SQI clock divider value higher than CLK_DIV_16 will not work. To achieve optimal SQI clock speeds, use a SQI clock divider value lower than CLK_DIV_16. **Note:** This issue is applicable to any applications that use the SQI module.

Board Support Packages (BSP):

Feature	Additions and Updates	Known Issues
BSP	Added BSPs for: • PIC32 Bluetooth Audio Development Kit + BM64 • PIC32 Bluetooth Audio Development Kit + BM64 + AK4954	N/A

Applications:

Feature	Additions and Updates	Known Issues
Audio Demonstrations	universal_audio_encoders Demonstration: • Support more than one encoders at runtime • Added speex encoder support • Added ak4954_bt_audio_dk configuration • Added list wheel widget to display for selecting encoder at runtime Added a new configuration for audio_microphone_loopback and the AK4954 Codec on the PIC32 Bluetooth Audio Development Kit. Added a new configuration for audio_tone and the AK4954 Codec on the PIC32 Bluetooth Audio Development Kit. Added a new demo, real_time_fft, on PIC32MZ EF SK + MEB2 Development Kit. Added a new demo, usb_smart_speaker, which demonstrates acoustic echo cancellation.	usb_headset, usb_microphone, and usb_speaker Demonstrations: • When switching between these applications, the Windows driver may become confused by the type of device that is connected. For example, audio streaming is prevented by the driver. If a condition like this occurs, do the following to remedy the issue: 1. While the device is connected, uninstall the driver. 2. A restart of the Windows operating system may be required. usb_speaker Demonstration: • The left and right output channels are swapped for the pic32mz_ef_sk_meb2 configuration at the output connector Note: This is an issue with the MEB II hardware and not the application software. • The mute feature (as controlled from the PC) does not function usb_headset Demonstration: • The mute feature (as controlled from the PC) does not function universal_audio_decoders Demonstration: • The 270f512lpim_bt_audio_dk configuration supports only the WMA and ADPCM decoders due to memory fragmentation • Volume control is only available on the bt_audio_dk and 270f512lpim_bt_audio_dk configurations • Minor audio glitches are present for 96 kHz WAVE audio files by default buffer size. As a workaround, eliminating glitches by using a larger buffer size. • Audio glitches may appear when playing high sampling rate AAC files. The higher the sampling rate, the more severe the glitch. • Some USB Flash drives may not work with this demonstration • Due to memory limitations, the Speex Decoder and the WMA Decoder cannot operate concurrently with other decoders • Some decoder combinations may not work together as in previous releases due to SRAM limitation, this issue will resolve in future releases audio_tone Demonstration: • Audio artifacts (clicking) are present when the volume control potentiometer is turned or the volume controls (+ and -) are pressed on the screen • Switch debounce is not implemented • For the pic32ef_sk_meb2_16bit_48000_RJ configuration, after selecting Chirp mode and then Sine mode, the program may internally remain in Chirp mode until the Time value is set to disabled sdcard_usb_audio Demonstration: The list widget has a performance issue and will slow down considerably after more than ten or twenty items are added.

Audio Demonstrations (Continued)	See the previous row.	mac_audio_hi_res Demonstration: • Do not change the sample rate during audio playback. sdcard_player The plug and play feature of the SD card is not supported. The demonstration does not respond if you remove the SD card and insert it back while the audio was being played. If you want to remove/connect or replace an SD card, Power down the device, remove/connect or replace the SD card, and power up the device. emwin_media_player The plug and play feature of the SD card is not supported. The demonstration does not respond if you remove the SD card and insert it back while the audio was being played. If you want to remove/connect or replace an SD card, power down the device, remove/connect or replace the SD card, and power up the device. The USB Flash drive must be inserted when the player is in the Flash Drive (USB) mode. Trying to insert a Flash drive while in the SD Card mode may result in the Flash drive not being detected and may require a power reset to detect the Flash drive. As a work around, the application stops running the SD Card driver task routine in `system_tasks.c` file, when the Flash drive mode is selected.
Bluetooth Demonstrations	Added bt_data_voice_control Demonstration. Added a new configuration for BM64_a2dp_hfp and the AK4954 Codec on the PIC32 Bluetooth Audio Development Kit.	a2dp_avrcp Display of track information is not updated immediately after connection, but requires a track change before the information is displayed. The Bluetooth device name will overwrite the BT address display field for the ak7755_bt_audio_dk configuration. The main screen will not update the Bluetooth name and Bluetooth address after a disconnect. When changing back to the Welcome screen after disconnect, the display of the Bluetooth device name and MAC Address is overwritten by the alphanumeric character set. However, reconnect using the switch, SW1, will still work. ble_rn4871_comm On disconnect, some smartphones do not turn the LED back to Blue. the demonstration will still connect and send data if this occurs. The CDC com port requires a command to be sent to it first before it will send data back. BM64_a2dp_hfp BM64_bootloader BM64_ble_comm When updating any of these demonstrations from Harmony 2.05 to Harmony 2.06, it is necessary to change the associated BSP configuration to one of the new BM64 BSP's, e.g. PIC32 Bluetooth Audio Development Kit (BM64+AK4384).

Bootloader Demonstrations	N/A	When the following configurations are built with the XC32-v1.43 compiler, the USB Device and UDP port enumeration fails. Therefore, it is not possible to program an application hex through these interfaces. • bootloader/basic/usbdevice_pic32mz_ef_sk • bootloader/basic/usbdevice_pic32mx_usb_sk2 • bootloader/basic/udp_pic32mz_ef_sk • bootloader/basic/udp_pic32mz_da_sk_intddr • bootloader/basic/udp_pic32mx_eth_sk
Cryptographic Demonstrations	Added the following demonstrations: • The ecc_symmetric demonstration was added • The ecc_asymmetric demonstration was added	• The ecc_symmetric and ecc_asymmetric demonstrations use Microchip's library (CryptoAuthLib) for interacting with the Crypto Authentication secure elements (ATECC608A, etc.). The library is integrated into the application and its source files are available as part of the demo project under apps\crypto\<ecc demonstrations>\firmware\src\system_config\pic32mz_ef_curiosity\framework\crypto\cryptoauthlib The Latest version of library can be found at: http://www.microchip.com/SWLibraryWeb/product.aspx?product=CryptoAuthLib • The CryptoAuthLib library implements the APIs in a blocking manner. i.e. the application calling the library APIs blocks for a designated amount of time (more than 100 milliseconds for some APIs) for execution of a command sent to the secure element. For details on the execution time of commands to the secure element, refer to the data sheet of the secure element. • The ecc_symmetric and ecc_asymmetric demonstration applications are implemented considering the blocking nature of CryptoAuthLib APIs. Any enhancement to these demonstrations or implementation of new application using the CryptoAuthLib library should consider the blocking time of the CryptoAuthLib APIs.
File System Demonstrations	N/A	sst25_fat demo: The demonstration application may fail to operate if the board is re-programmed. To get the application to work, perform a Power on Reset.

Graphics Demonstrations	**Added the following demonstrations:** • aria_showcase_reloaded • aria_image_viewer • aria_touchadc_calibrate • aria_oven_controller • aria_adventure • aria_radial_menu • Update to menu icons and replaced cook timer with circular gauge widget **Removed the following demonstration:** • aria_image_stretch	aria_quickstart: Added support for Console and Debug System Services through MCP2221 USB-USART Gateway for all DA/EF configuration. (Exceptions are the pic32mz_ef_sk_s1d_pictail_wqvga and pic32mz_ef_sk_xpro, which use one or more of the USART lines for touch support.) For more details on how this was done, consult Part 3 of the Creating Your First Project section of Volume 1. The following configurations do not support touch: • bt_audio_dk • pic32mz_ef_sk_xpro aria_video_player: USB playback on pic32mz_da_sk_extddr_meb2 configuration requires compiler version XC32 v2.10 or later. aria_external_resources: For the pic32mz_da_sk_extddr_meb2 target configuration: The application is unable to see images stored on SQI external memory. For the pic32mz_da_sk_intddr_meb2 target configuration: The application is unable to reliably detect the presence of a USB memory stick. For the pic32mz_ef_sk_meb2: No known issues. emwin_multilanguage: For the pic32mz_ef_sk_meb2 target configuration: • For some MEB2 boards there is a race condition in the application startup that can render the touch interface inoperative. To remedy this, modify the file .\framework\driver\input\touch\mxt336t\drvmxt336t.c file, line 663. Change delayN to be uint16_t instead of unint8_t and change the initial value from 5 to 32000. This change has not been tested for all other uses of the maXTouch 336t driver.
Peripheral Library Examples	N/A	Strings rendered on the screen that have a 'null' (\0) show up at a Zero ("0"). The pic32mz_ef_sk_meb2_16b configuration of the examples/peripheral/adchs/adchs_sensor demonstration application project does not function as intended. This is being investigated and will be corrected in a future release of MPLAB Harmony.
RTOS Demonstrations	N/A	The Express Logic Thread X demonstrations may not work with optimization enabled.
System Service Library Examples	N/A	The command_appio demonstration does not function using MPLAB X IDE v3.06, but is operational with v3.00. Demonstrations utilizing APPIO do not function using version 1.43 of the XC32 Compiler, but are operational when using version 1.44.

TCP/IP (and Wi-Fi) Demonstrations	The following configurations were added to the tcpip\wifi_wilc1000 demonstration: • pic32mx795_pim__e16__wilc__freertos_ap_scan • pic32mx795_pim__e16__wilc__freertos_mac_address_chip_info • pic32mx795_pim__e16__wilc__freertos_mode_change • pic32mx795_pim__e16__wilc__freertos_p2p_client • pic32mx795_pim__e16__wilc__freertos_tcp_client • pic32mx795_pim__e16__wilc__freertos_tcp_server • pic32mx795_pim__e16__wilc__freertos_udp_client • pic32mx795_pim__e16__wilc__freertos_udp_server • pic32mx795_pim__e16__wilc__freertos_wps • pic32mx795_pim__e16__wilc__sta • pic32mz_ef_sk__ioexp__wilc__freertos_wolfmqtt_client	The TCP/IP command, `if wlan0 up/down`, does not function properly in the Wi-Fi Web Server Demonstration/RTOS project for the PIC32 Ethernet Starter Kit, the PIC32MZ EC Starter Kit, and the Multimedia Expansion Board II. This will be corrected in a future release. The following issues apply to the wifi_easy_configuration demonstration: • The demonstration will not automatically display the scan results when the demonstration boots up. An application level console command can be used to see the scan results. • The `scanlist` Console command display is incorrect when issued in UART/Serial console mode **Note:** The tcpip_tcp_client demonstration using the ENC24xJ600 or the ENC28J60 configurations does not work properly if the SPI Driver enables DMA. Please disable the SPI DMA option for these configurations. This will be corrected in a future release of MPLAB Harmony. **Note**: The configurations of the wifi_wilc1000 demonstration will be split up into separate demonstrations, each of which demonstrates an individual capability (example tcp_server or udp_client) in a future release. Some configurations may be integrated into existing demonstrations. **All TCP/IP Demonstrations:** When compiler optimization –Os is turned on, the compiler may report some build warnings, especially the use of uninitialized variables. This is due to a known compiler bug. Simply clear the “Make warnings into errors” option and rebuild.
USB Demonstrations	N/A.	The msd_basic Device demonstration application when built using PIC32MZ devices, requires that the SCSI Enquiry response data structure to be placed in RAM. Placing this data structure in program Flash memory causes the enquiry response to become corrupted. This issue will be corrected in a future release.

Build Framework:

Feature	Additions and Updates	Known Issues
Math Libraries	ARM versions of DSP library removed from release. DSP libraries renamed to maintain FPU and non-FPU versions: • dsp_pic32mz_ef_fpu • dsp_pic32mz_nofpu Misspelling of libq C library routine libq_q15_multipy_q15_q15 has been deprecated in deference to the correctly spelled version: libq_q15_multiply_q15_q15	DSP Fixed-Point Math Library: • Optimized only for PIC32MZ devices with microAptiv™ core features, which utilize DSP ASE • Will not function with the `_Fract` data type LibQ Fixed-Point Math Library: • Optimized for PIC32MZ devices with microAptiv core features • The `_fast` functions have reduced precision

Utilities:

Feature	Additions and Updates	Known Issues
MPLAB Harmony Configurator (MHC)	N/A	When viewing the MPLAB Harmony Help in the MHC, the Index is accessible, but is not functional. This is due to a limitation in the browser that is utilized by MHC. As a work around, the Index is accessible and functional when the HTML Help is opened in an external Web browser. A tab character after `"---endhelp---"` in a `.hconfig` file may cause the next configuration symbol to be skipped. During code generation, some applications may display a message that back-up cannot be generated. Select 'Yes' to continue.

Third-Party Software:

Feature	Additions and Updates	Known Issues
SEGGER emWin Graphics Library	N/A	An API to retrieve the Dialog widget handle is not available in this release.

Release Contents

This topic lists the contents of this release and identifies each module.

Description

This table lists the contents of this release, including a brief description, and the release type (Alpha, Beta, Production, or Vendor).

Middleware and Libraries:

<install-dir>/framework/	Description	Release Type
bluetooth/cdbt	Bluetooth Stack Library (Basic)	Production
bluetooth/premium/audio/cdbt	Bluetooth Audio Stack Library (Premium)	Production
bluetooth/premium/audio/decoder/sbc	SBC Decoder Library (Premium)	Production
bootloader	Bootloader Library	Production
classb	Class B Library	Production
crypto	Microchip Cryptographic Library	Production
decoder/audio_decoders/adpcm	ADPCM Decoder Library	Production
decoder/audio_decoders/wav	WAV Decoder Library	Production
decoder/audio_decoders/opus	Opus Decoder Library	Production
decoder/audio_decoders/flac	Free Lossless Audio Codec (FLAC) Library	Beta
decoder/audio_decoders/speex	Speex Decoder Library	Production
decoder/audio_encoders/opus	Opus Encoder Library	Beta
decoder/premium/decoder_aac	AAC MX Decoder Library (Premium) AAC microAptiv™ Decoder Library (Premium)	Production Production
decoder/premium/decoder_mp3	MP3 microAptiv™ Decoder Library (Premium) MP3 Advanced Decoder Library (Premium)	Production Production
decoder/premium/decoder_wma	WMA MX Decoder Library (Premium) WMA M-Class Decoder Library (Premium)	Production Production
encoder/audio_encoders/adpcm	ADPCM Encoder Middleware	Production
encoder/audio_encoders/pcm	PCM Encoder Middleware	Production
encoder/audio_encoders/opus	OPUS Encoder Middleware	Beta
encoder/audio_encoders/speex	Speex Encoder Middleware	Beta
gfx/hal	Hardware Abstraction Layer	Production

gfx/libaria	Aria User Interface Library	Production
gfx/utils	Graphics Utilities Library (Image, Font, Palette Support)	Production
math/dsp	DSP Fixed-Point Math Library API header for PIC32MZ devices	Production
math/libq	LibQ Fixed-Point Math Library API header for PIC32MZ devices	Production
math/libq_C	LibQ Fixed-Point 'C' Math Library API header for all PIC32 devices	Production
net/pres	MPLAB Harmony Network Presentation Layer	Production
test	Test Harness Library	Production
tcpip	TCP/IP Network Stack	Production
usb	USB Device Stack USB Host Stack	Production Production

Device Drivers:

<install-dir>/framework/driver/	Description	Release Type
adc	Analog-to-Digital Converter (ADC) Driver *Dynamic Implementation* *Static Implementation*	 Beta Beta
bluetooth/bm64	BM64 Bluetooth Driver *Static Implementation*	 Beta
camera/ovm7690	OVM7690 Camera Driver *Dynamic Implementation only*	 Beta Deprecated
can	Controller Area Network (CAN) Driver *Static Implementation only*	 Beta
cmp	Comparator Driver *Static Implementation only*	 Beta
codec/ak4384	AK4384 Codec Driver *Dynamic Implementation only*	 Production
codec/ak4642	AK4642 Codec Driver *Dynamic Implementation only*	 Production
codec/ak4953	AK4953 Codec Driver *Dynamic Implementation only*	 Production
codec/ak4954	AK4954 Codec Driver *Dynamic Implementation only*	 Beta
codec/ak7755	AK7755 Codec Driver *Dynamic Implementation only*	 Production
codec/wm8904	WM8904 Codec Driver *Dynamic Implementation only*	 Beta
cpld	CPLD XC2C64A Driver *Static Implementation only*	 Production
eeprom	Data EEPROM Driver *Dynamic Implementation only*	 Alpha
enc28j60	ENC28J60 Driver Library *Dynamic Implementation only*	 Beta
encx24j600	ENCx24J600 Driver Library *Dynamic Implementation only*	 Beta

ethmac	Ethernet Media Access Controller (MAC) Driver *Dynamic Implementation only*	 Production
ethphy	Ethernet Physical Interface (PHY) Driver *Dynamic Implementation only*	 Production
flash	Flash Driver *Static Implementation only*	 Beta
i2c	Inter-Integrated Circuit (I2C) Driver *Dynamic Implementation* *Static Implementation*	 Production Beta
i2s	Inter-IC Sound (I2S) Driver *Dynamic Implementation only*	 Beta
ic	Input Capture Driver *Static Implementation only*	 Beta
input/touch/mxt336t	MaxTouch PCAP Driver	Beta
input/touch/touch_adc	Resistive ADC Driver	Beta
mcpwm	Motor Control PWM (MCPWM) Driver *Static Implementation only*	 Beta
nvm	Non-Volatile Memory (NVM) Driver *Dynamic Implementation* *Static Implementation*	 Production Beta
oc	Output Compare Driver *Static Implementation only*	 Beta
pmp	Parallel Master Port (PMP) Driver *Dynamic Implementation* *Static Implementation*	 Production Beta
rtcc	Real-Time Clock and Calendar (RTCC) Driver *Static Implementation only*	 Beta
sdcard	SD Card Driver (client of SPI Driver) *Dynamic Implementation only*	 Beta
spi	Serial Peripheral Interface (SPI) Driver *Dynamic Implementation* *Static Implementation*	 Production Beta
 spi_flash/sst25vf016b spi_flash/sst25vf020b spi_flash/sst25vf064c spi_flash/sst25	SPI Flash Drivers *Dynamic Implementation only* *Dynamic Implementation only* *Dynamic Implementation only* *Dynamic Implementation only*	 Beta Beta Beta Beta
sqi	Serial Quad Interface (SQI) Driver *Dynamic Implementation* *Static Implementation*	 Beta Beta
 sqi_flash/sst26	SQI Flash Driver *Dynamic Implementation only*	 Beta
tmr	Timer Driver *Dynamic Implementation* *Static Implementation*	 Production Beta

touch/touch_adc	ADC Touch Driver *Dynamic Implementation only*	 Deprecated
touch/adc10bit	ADC 10-bit Touch Driver *Dynamic Implementation only*	 Deprecated
touch/ar1021	AR1021 Touch Driver *Dynamic Implementation only*	 Deprecated
touch/generic	Generic Touch Driver *Dynamic Implementation only*	 Deprecated
touch/mtch6301	MTCH6301 Touch Driver *Dynamic Implementation only*	 Deprecated
touch/mtch6303	MTCH6303 Touch Driver *Static Implementation only*	 Deprecated
touch/mxt336t	mXT336T Touch Driver *Dynamic Implementation only*	 Deprecated
usart	Universal Synchronous/Asynchronous Receiver/Transmitter (USART) Driver *Dynamic Implementation* *Static Implementation*	 Production Beta
usbfs	PIC32MX Universal Serial Bus (USB) Controller Driver (USB Device) *Dynamic Implementation only*	 Production
usbhs	PIC32MZ Universal Serial Bus (USB) Controller Driver (USB Device) *Dynamic Implementation only*	 Production
usbfs	PIC32MX Universal Serial Bus (USB) Controller Driver (USB Host) *Dynamic Implementation only*	 Beta
usbhs	PIC32MZ Universal Serial Bus (USB) Controller Driver (USB Host) *Dynamic Implementation only*	 Beta
wifi/mrf24wn	Wi-Fi Driver for the MRF24WN controller *Dynamic Implementation only*	 Production
wifi/wilc1000	Wi-Fi Driver for the WILC1000 controller *Dynamic Implementation only*	 Alpha
wifiwinc1500	Wi-Fi Driver for the WINC1500 controller *Dynamic Implementation only*	 Beta

System Services:

<install-dir>/framework/system/	Description	Release Type
clk	Clock System Service Library *Dynamic Implementation* *Static Implementation*	 Production Production
command	Command Processor System Service Library *Dynamic Implementation only*	 Production
common	Common System Service Library	Beta
console	Console System Service Library *Dynamic Implementation* *Static Implementation*	 Beta Beta

debug	Debug System Service Library *Dynamic Implementation only*	Beta
devcon	Device Control System Service Library *Dynamic Implementation only*	Production
dma	Direct Memory Access System Service Library *Dynamic Implementation*	Production
fs	File System Service Library *Dynamic Implementation only*	Production
int	Interrupt System Service Library *Static Implementation only*	Production
Input	Input System Service Library	Beta
memory	Memory System Service Library *Static Implementation only*	Beta
msg	Messaging System Service Library *Dynamic Implementation only*	Beta
ports	Ports System Service Library *Static Implementation only*	Production
random	Random Number Generator System Service Library *Static Implementation only*	Production
reset	Reset System Service Library *Static Implementation only*	Beta
tmr	Timer System Service Library *Dynamic Implementation only*	Production
touch	Touch System Service Library *Dynamic Implementation only*	Deprecated
wdt	Watchdog Timer System Service Library *Static Implementation only*	Production

Peripheral Libraries:

<install-dir>/framework/	Description	Release Type
peripheral	Peripheral Library Source Code for the following device families:	
	PIC32MK General Purpose (GP) Family	Production
	PIC32MX1XX/2XX 28/36/44-pin Family	Production
	PIC32MX1XX/2XX 28/36/44-pin XLP Family	Production
	PIC32MX1XX/2XX/5XX 64/100-pin Family	Production
	PIC32MX320/340/360/420/440/460 Family	Production
	PIC32MX330/350/370/430/450/470 Family	Production
	PIC32MX5XX/6XX/7XX Family	Production
	PIC32MZ Embedded Connectivity (EC) Family	Production
	PIC32MZ Embedded Connectivity with Floating Point Unit (EF) Family	Production
	PIC32MZ Graphics (DA) Family	Production

Operating System Abstraction Layer (OSAL):

<install-dir>/framework/	Description	Release Type
osal	Operating System Abstraction Layer (OSAL)	Production

Board Support Packages (BSP):

<install-dir>/bsp/	Description	Release Type
bt_audio_dk	BSP for the PIC32 Bluetooth Audio Development Kit.	Production
bt_audio_dk+4642	BSP for the PIC32 Bluetooth Audio Development Kit connected to the Audio Codec Daughter Board AK4642.	Production
bt_audio_dk+ak4954	BSP for the PIC32 Bluetooth Audio Development Kit connected to the Audio Codec Daughter Board AK4954A.	Beta
bt_audio_dk+ak7755	BSP for the PIC32 Bluetooth Audio Development Kit connected to the Audio Codec Daughter Board AK7755.	Production
bt_audio_dk+bm64	BSP for the PIC32 Bluetooth Audio Development Kit connected to the BM64 Bluetooth Module Daughter Board.	Beta
bt_audio_dk+bm64+ak4954	BSP for the PIC32 Bluetooth Audio Development Kit connected to the BM64 Bluetooth Module Daughter Board and the Audio Codec Daughter Board AK4954A.	Beta
chipkit_wf32	BSP for the chipKIT™ WF32™ Wi-Fi Development Board.	Production
chipkit_wifire	BSP for the chipKIT™ Wi-FIRE Development Board.	Production
pic32_gdb_ef	BSP for the PIC32 Graphics Discovery Development Board.	Production
pic32_gdb_ef	BSP for the the PIC32 Graphics Discovery Development Board and the PIC32MZ EF Starter Kit.	Production
pic32mk_gp_db	BSP for the PIC32MK GP Development Board.	Production
pic32mk_gp_db+wqvga_mxt	BSP for the PIC32MK Development Board (with SSD1963 Graphics Controller) and High-Performance 4.3" WQVGA Display Module with maXTouch.	Production
pic32mk_gp_db+wvga_mxt	BSP for the PIC32MK General Purpose (GP) Development Board (with SSD1963 Graphics Controller) and a High-Performance WVGA Display Module with maXTouch	Production
pic32mx_125_sk	BSP for the PIC32MX1/2/5 Starter Kit.	Production
pic32mx_125_sk+lcc_pictail+qvga	BSP for the Low-Cost Controllerless (LCC) Graphics PICtail Plus Daughter Board with the Graphics Display Truly 3.2" 320x240 Board connected to the PIC32MX1/2/5 Starter Kit.	Production
pic32mx_bt_sk	BSP for the PIC32 Bluetooth Starter Kit.	Production
pic32mx_eth_sk	BSP for the PIC32 Ethernet Starter Kit.	Production
pic32mx_eth_sk2	BSP for the PIC32 Ethernet Starter Kit II.	Production
pic32mx_pcap_db	BSP for the PIC32 GUI Development Board with Projected Capacitive Touch	Production.
pic32mx_usb_digital_audio_ab	BSP for the PIC32 USB Audio Accessory Board	Production
pic32mx_usb_sk2	BSP the PIC32 USB Starter Kit II.	Production
pic32mx_usb_sk2+lcc_pictail+qvga	BSP for the Low-Cost Controllerless (LCC) Graphics PICtail Plus Daughter Board with the Graphics Display Truly 3.2" 320x240 Board connected to the PIC32 USB Starter Kit II.	Production
pic32mx_usb_sk2+lcc_pictail+wqvga	BSP for the Low-Cost Controllerless (LCC) Graphics PICtail Plus Daughter Board with the Graphics Display Powertip 4.3" 480x272 Board connected to the PIC32 USB Starter Kit II.	Production
pic32mx_usb_sk2+meb	BSP for the Multimedia Expansion Board (MEB) connected to the PIC32 USB Starter Kit II.	Production
pic32mx_usb_sk2+s1d_pictail+vga	BSP for the Graphics Controller PICtail Plus Epson S1D13517 Daughter Board with the Graphics Display Truly 5.7" 640x480 Board connected to the PIC32 USB Starter Kit II.	Production
pic32mx_usb_sk2+s1d_pictail+wqvga	BSP for the Graphics Controller PICtail Plus Epson S1D13517 Daughter Board with the Graphics Display Powertip 4.3" 480x272 Board connected to the PIC32 USB Starter Kit II.	Production
pic32mx_usb_sk2+s1d_pictail+wvga	BSP for the Graphics Controller PICtail Plus Epson S1D13517 Daughter Board with Graphics Display Truly 7" 800x480 Board connected to the PIC32 USB Starter Kit II.	Production
pic32mx_usb_sk2+ssd_pictail+qvga	BSP for the Graphics LCD Controller PICtail Plus SSD1926 Daughter Board with Graphics Display Truly 3.2" 320x240 Board connected to the PIC32 USB Starter Kit II.	Production
pic32mx_usb_sk3	BSP for the PIC32 USB Starter Kit III.	Production
pic32mx_xlp_sk	BSP for the PIC32MX XLP Starter Kit.	Production

pic32mx270f512l_pim+bt_audio_dk	BSP for the PIC32MX270F512L Plug-in Module (PIM) connected to the PIC32 Bluetooth Audio Development Kit.	Production
pic32mx_270f512l_pim+ bt_audio_dk+ak4642	BSP for the PIC32MX270F512L Plug-in Module (PIM) connected to the PIC32 Bluetooth Audio Development Kit with the AK4642 Audio Codec.	Production
pic32mx460_pim+e16	BSP for the PIC32MX460F512L Plug-in Module (PIM) connected to the Explorer 16 Development Board.	Production
pic32mx470_curiosity	BSP for the PIC32MX470 Curiosity Development Board.	Production
pic32mx470_pim+e16	BSP for the PIC32MX450/470F512L Plug-in Module (PIM) connected to the Explorer 16 Development Board.	Production
pic32mx795_pim+e16	BSP for the PIC32MX795F512L Plug-in Module (PIM) connected to the Explorer 16 Development Board.	Production
pic32mz_da_sk_extddr	BSP for the PIC32MZ Graphics (DA) External DDR RAM Starter Kit.	Production
pic32mz_da_sk_extddr+meb2	BSP for the Multimedia Expansion Board II (MEB II) connected to the PIC32MZ Graphics (DA) External DDR RAM Starter Kit	Production
pic32mz_da_sk_extddr+meb2_legacy	BSP for the First Generation Multimedia Expansion Board II (MEB II) connected to the PIC32MZ Graphics (DA) External DDR RAM Starter Kit (featuring 4.3" WQVGA PCAP Display Board).	Deprecated
pic32mz_da_sk_intddr	BSP for the 169-pin LFBGA CPU Daughter Board connected to the PIC32MZ Graphics (DA) Internal DDR RAM Starter Kit.	Beta
pic32mz_da_sk_intddr+meb2	BSP for the Multimedia Expansion Board II (MEB II) connected to the PIC32MZ Graphics (DA) Internal DDR RAM Starter Kit	Beta
pic32mz_da_sk_intddr+meb2_legacy	BSP for the First Generation Multimedia Expansion Board II (MEB II) connected to the PIC32MZ Graphics (DA) Internal DDR RAM Starter Kit (featuring 4.3" WQVGA PCAP Display Board).	Deprecated
pic32mz_da_sk_noddr+meb2	BSP for PIC32MZ Embedded Graphics with Disabled DRAM (DA) Starter Kit plus Multimedia Expansion Board II (MEB II).	Beta
pic32mz_da_sk_noddr+meb2_legacy	BSP for PIC32MZ Embedded Graphics with Disabled DRAM (DA) Starter Kit plus First Generation Multimedia Expansion Board II (MEB II).	Deprecated
pic32mz_da_sk_noddr+meb2+wvga	BSP for PIC32MZ Embedded Graphics with Disabled DRAM (DA) Starter Kit plus MEB II with High-Performance 5" WVGA Display Module with maXTouch.	Production
pic32mz_da_sk_noddr+meb2+wvga_legacy	BSP for PIC32MZ Embedded Graphics with Disabled DRAM (DA) Starter Kit plus MEB II and 5" WVGA PCAP Display Board BSP.	Deprecated
pic32mz_da_sk_extddr+meb2+wvga	BSP for the Multimedia Expansion Board II (MEB II) with the High-Performance WVGA Display Module with maXTouch.	Production
pic32mz_da_sk_extddr+meb2+wvga_legacy	BSP for the First Generation Multimedia Expansion Board II (MEB II) with the 5" WVGA PCAP Display Board connected to the PIC32MZ Graphics (DA) External DDR RAM Starter Kit.	Deprecated
pic32mz_da_sk_intddr+meb2+wvga	BSP for the Multimedia Expansion Board II (MEB II) with the High-Performance WVGA Display Module with maXTouch connected to the PIC32MZ Graphics (DA) Internal DDR RAM Starter Kit.	Production
pic32mz_da_sk_intddr+meb2+wvga_legacy	BSP for the Multimedia Expansion Board II (MEB II) with the 5" WVGA PCAP Display Board connected to the PIC32MZ Graphics (DA) Internal DDR RAM Starter Kit.	Deprecated
pic32mz_ec_pim+bt_audio_dk	BSP for the PIC32MZ2048ECH144 Audio Plug-in Module (PIM) connected to the PIC32 Bluetooth Audio Development Kit.	Production
pic32mz_ec_pim+e16	BSP for the PIC32MZ2048ECH100 Plug-in Module (PIM) connected to the Explorer 16 Development Board.	Production
pic32mz_ec_sk	BSP for the PIC32MZ Embedded Connectivity (EC) Starter Kit.	Production
pic32mz_ec_sk+meb2	BSP for the Multimedia Expansion Board II (MEB II) connected to the PIC32MZ Embedded Connectivity (EC) Starter Kit.	Production
pic32mz_ec_sk+meb2+wvga	BSP for the Multimedia Expansion Board II (MEB II) with the High-Performance WVGA Display Module with maXTouch connected to the PIC32MZ Embedded Connectivity (EC) Starter Kit.	Production
pic32mz_ec_sk+s1d_pictail+vga	BSP for the Graphics Controller PICtail Plus Epson S1D13517 Daughter Board with the Graphics Display Truly 5.7" 640x480 Board connected to the PIC32MZ Embedded Connectivity (EC) Starter Kit.	Production

pic32mz_ec_sk+s1d_pictail+wqvga	BSP for the Graphics Controller PICtail Plus Epson S1D13517 Daughter Board with the Graphics Display Powertip 4.3" 480x272 Board connected to the PIC32MZ Embedded Connectivity (EC) Starter Kit.	Production
pic32mz_ec_sk+s1d_pictail+wvga	BSP for the Graphics Controller PICtail Plus Epson S1D13517 Daughter Board with the High-Performance WVGA Display Module with maXTouch connected to the PIC32MZ Embedded Connectivity with Floating Point Unit (EC) Starter Kit.	Production
pic32mz_ef_curiosity	BSP for the PIC32MZ EF Curiosity Development Board.	Production
pic32mz_ef_pim+bt_audio_dk	BSP for the PIC32MZ2048EFH144 Audio Plug-in Module (PIM) connected to the PIC32 Bluetooth Audio Development Kit.	Production
pic32mz_ef_pim+bt_audio_dk+ak4642	BSP for the PIC32MX270F512L Plug-in Module (PIM) connected to the PIC32 Bluetooth Audio Development Kit with the Audio Codec Daughter Board AK4642EN.	Production
pic32mz_ef_pim+e16	BSP for the PIC32MZ2048EFH100 Plug-in Module (PIM) connected to the Explorer 16 Development Board.	Production
pic32mz_ef_sk	BSP for the PIC32MZ Embedded Connectivity with Floating Point (EF) Starter Kit.	Production
pic32mz_ef_sk+maxtouch_xplained_pro_3_5	BSP for the PIC32MZ Embedded Connectivity with Floating Point (EF) Starter Kit connected to a 3.5” 480x320 maXTouch Xplained Pro display board through the SPI.	Production
pic32mz_ef_sk+meb2	BSP for the Multimedia Expansion Board II (MEB II) connected to the PIC32MZ Embedded Connectivity with Floating Point Unit (EF) Starter Kit.	Production
pic32mz_ef_sk+meb2_legacy	BSP for the First Generation Multimedia Expansion Board II (MEB II) connected to the PIC32MZ Embedded Connectivity with Floating Point (EF) Starter Kit (featuring 4.3" WQVGA PCAP Display Board)	Deprecated
pic32mz_ef_sk+meb2+wvga	BSP for the Multimedia Expansion Board II (MEB II) with the High-Performance WVGA Display Module with maXTouch connected to the PIC32MZ Embedded Connectivity with Floating Point Unit (EF) Starter Kit.	Production
pic32mz_ef_sk+meb2+wvga_legacy	BSP for the Multimedia Expansion Board II (MEB II) with the 5" WVGA PCAP Display Board connected to the PIC32MZ Embedded Connectivity with Floating Point Unit (EF) Starter Kit.	Deprecated
pic32mz_ef_sk+s1d_pictail+vga	BSP for the Graphics Controller PICtail Plus Epson S1D13517 Daughter Board with the Graphics Display Truly 5.7" 640x480 Board connected to the PIC32MZ Embedded Connectivity with Floating Point Unit (EF) Starter Kit.	Production
pic32mz_ef_sk+s1d_pictail+wqvga	BSP for the Graphics Controller PICtail Plus Epson S1D13517 Daughter Board with the Graphics Display Powertip 4.3" 480x272 Board connected to the PIC32MZ Embedded Connectivity with Floating Point Unit (EF) Starter Kit.	Production
pic32wk_gbp_gpd_sk+module	BSP for the PIC32WK Wi-Fi Starter Kit.	Production

Audio Applications:

<install-dir>/apps/audio/	Description
audio_microphone_loopback	Audio Microphone Loopback Demonstration
audio_tone	Audio Tone Demonstration
emwin_media_player	SEGGER emWin Media Player Demonstration
mac_audio_hi_res	Hi-resolution Audio Demonstration
real_time_fft	Real-Time FFT Demonstration
sdcard_player	Audio SD Card Player Demonstration
sdcard_usb_audio	USB Audio Demonstration
universal_audio_decoders	Universal Software Audio Decoder Demonstration
universal_audio_encoders	Universal Software Audio Encoder Demonstration
usb_headset	USB Audio Headset Demonstration
usb_host_headset	USB Host Audio Headset Demonstration
usb_microphone	USB Audio Microphone Demonstration
usb_microphone_multirate	USB Audio Microphone Demonstration with Sample Rate Conversion (SRC)
usb_smart_speaker	USB Acoustic Echo Cancellation Demonstration
usb_speaker	USB Audio Speaker Demonstration
usb_speaker_hi_res	USB Audio Speaker Demonstration with 96 kHz Sampling Rate

Bluetooth Applications:

<install-dir>/apps/bluetooth/	Description
audio/BM64_a2dp_hfp	Bluetooth BM64 Audio Demonstration
data/BM64_ble_comm	Bluetooth BM64 Low-Energy Communications Demonstration
data/ble_rn4871_comm	Bluetooth Low-Energy Data Demonstration
data/data_basic	Bluetooth Basic Data Demonstration
data/data_temp_sens_rgb	Bluetooth Temperature Sensor and RGB Data Demonstration
premium/audio/a2dp_avrcp	Bluetooth Premium Audio Demonstration
utilities/BM64_bootloader	Bluetooth BM64 Bootloader Demonstration
data/bt_data_voice_control	Bluetooth Data Voice Control Demonstration

Bootloader Applications:

<install-dir>/apps/bootloader/	Description
basic	Basic Bootloader Demonstration
LiveUpdate_App	LiveUpdate Application Demonstration
LiveUpdate_Switcher	LiveUpdate Switcher Demonstration

Class B Library Applications:

<install-dir>/apps/classb/	Description
ClassBDemo	Class B Library Demonstration

Cryptographic Applications:

<install-dir>/apps/crypto/	Description
encrypt_decrypt	Crypto Peripheral Library MD5 Encrypt/Decrypt Demonstration
large_hash	Crypto Peripheral Library Hash Demonstration
ecc_symmetric	Demonstration for Symmetric Authentication of a remote device using CryptoAuthLib (Library for interacting with the Crypto Authentication secure element ‘ATECC608A’).
ecc_asymmetric	Demonstration for Asymmetric Authentication of a remote device using CryptoAuthLib (Library for interacting with the Crypto Authentication secure element ‘ATECC608A’).

Driver Applications:

<install-dir>/apps/driver/	Description
eeprom/eeprom_read_write	Data EEPROM Demonstration
i2c/i2c_rtcc	I2C RTCC Demonstration
nvm/nvm_read_write	NVM Read/Write Demonstration
spi/serial_eeprom	SPI Serial EEPROM Demonstration
spi/spi_loopback	SPI Loopback Demonstration
spi/spi_multislave	SPI Multi-slave Demonstration
spi_flash/sst25vf020b	SPI Flash SST25VF020B Demonstration
usart/usart_echo	USART Demonstration
usart/usart_loopback	USART Loopback Demonstration

Example Applications:

<install-dir>/apps/examples/	Description
my_first_app	MPLAB Harmony Tutorial Example Solution
peripheral	MPLAB Harmony Compliant Peripheral Library Examples
system	MPLAB Harmony Compliant System Service Library Examples

3rd_party_display	Final project demonstrating how to add a Mikroe 7 inch display to a PIC32MZ EF Starter Kit
3rd_party_display_start	Starting project for the tutorial that shows how to add a third party display to a PIC32MZ EF Starter Kit
creating_your_first_project	Project resulting from Creating Your First Project tutorial for a PIC32MZ EF Starter Kit
events_testbed	Graphics Events Testbed project

File System Applications:

<install-dir>/apps/fs/	Description
nvm_fat_single_disk	Single-disk Non-Volatile Memory FAT FS Demonstration
nvm_mpfs_single_disk	Single-disk Non-Volatile Memory MPFS Demonstration
nvm_sdcard_fat_mpfs_multi_disk	Multi-disk Non-Volatile Memory FAT FS MPFS Demonstration
nvm_sdcard_fat_multi_disk	Multi-disk Non-Volatile Memory FAT FS Demonstration
sdcard_fat_single_disk	Single-disk SD Card FAT FS Demonstration
sdcard_msd_fat_multi_disk	Multi-disk SD Card MSD FAT FS Demonstration
sst25_fat	SST26 Flash FAT FS Demonstration
sqi_fat	SQI Flash FAT FS Demonstration

Graphics Applications:

<install-dir>/apps/gfx/	Description
aria_adventure	Demonstrates Parallax and Sprite Animation using Aria User Interface Library
aria_basic_motion	Aria User Interface Library Basic Motion Demonstration
aria_benchmark	Aria User Interface Library Benchmark Demonstration
aria_counter	Aria User Interface Library Counter Demonstration
aria_coffee_maker	Aria User Interface Library Coffee Maker Demonstration
aria_external_resources	Aria User Interface Library External Resources Demonstration
aria_flash	Aria User Interface Library Flash Demonstration
aria_image_viewer	Aria User Interface Library Image Viewer Demonstration
aria_oven_controller	Aria User Interface Library Oven Controller Demonstration
aria_quickstart	Aria User Interface Library Quick Start Demonstration
aria_radial_menu	Aria User Interface Library Radial Menu Widget Demonstration
aria_scrolling	Aria User Interface Library Scrolling Demonstration
aria_showcase	Aria User Interface Library Advanced Features Showcase Demonstration
aria_showcase_reloaded	Aria User Interface Library Advanced Features Demonstration
aria_splash_screen	Aria User Interface Library Splash Screen Demonstration
aria_touchadc_calibrate	Aria User Interface Library Touch ADC Demonstration
aria_video_player	Aria User Interface Library Video Playback Demonstration
aria_weather_forecast	Aria User Interface Library Weather Forecast Demonstration
blank_quickstart	Hardware Abstraction Layer (HAL) Custom Graphics Demonstration
emwin_multilanguage	SEGGER emWin Multiple Language Demonstration
emwin_quickstart	SEGGER emWin Quick Start Demonstration
emwin_showcase	SEGGER emWin Advanced Features Showcase Demonstration

Motor Control Applications:

<install-dir>/apps/motor_control/	Description
dualshunt_pll_foc_mclv2_ext_opamp	Field Oriented Control of Permanent Magnet Synchronous Motor (PMSM) Using External Op amps Demonstration

dualshunt_pll_foc_mclv2_int_opamp	Field Oriented Control of Permanent Magnet Synchronous Motor (PMSM) Using Internal Op amps Demonstration
integrated_pfc_foc_mhcv3_ext_opamp	Power Factor Correction and Field Oriented Control of Permanent Magnet Synchronous Motor (PMSM) Using External Op amps Demonstration
integrated_pfc_foc_mchv3_int_opamp	Power Factor Correction and Field Oriented Control of Permanent Magnet Synchronous Motor (PMSM) Using Internal Op amps Demonstration

RTOS Applications:

<install-dir>/apps/rtos/	Description
embos	SEGGER embOS® Demonstrations
freertos	FreeRTOS™ Demonstrations
openrtos	OPENRTOS Demonstrations
threadx	Express Logic ThreadX Demonstrations
uC_OS_II	Micriμm® μC/OS-II™ Demonstrations
uC_OS_III	Micriμm® μC/OS-III™ Demonstrations

TCP/IP Applications:

<install-dir>/apps/tcpip/	Description
berkeley_tcp_client	Berkeley TCP/IP Client Demonstration
berkeley_tcp_server	Berkeley TCP/IP Server Demonstration
berkeley_udp_client	Berkeley TCP/IP UDP Client Demonstration
berkeley_udp_relay	Berkeley TCP/IP UDP Relay Demonstration
berkeley_udp_server	Berkeley TCP/IP UDP Server Demonstration
snmpv3_nvm_mpfs	SNMPv3 Non-Volatile Memory Microchip Proprietary File System Demonstration
snmpv3_sdcard_fatfs	SNMPv3 Non-Volatile Memory SD Card FAT File System Demonstration
tcpip_tcp_client	TCP/IP TCP Client Demonstration
tcpip_tcp_client_server	TCP/IP TCP Client Server Demonstration
tcpip_tcp_server	TCP/IP TCP Server Demonstration
tcpip_udp_client	TCP/IP UDP Client Demonstration
tcpip_udp_client_server	TCP/IP UDP Client Server Demonstration
tcpip_udp_server	TCP/IP UDP Server Demonstration
web_net_server_nvm_mpfs	Non-Volatile Memory Microchip Proprietary File System Web Server MPFS Demonstration
web_photoframe_demo	Web Server Photo Frame Demonstration
web_server_nvm_mpfs	Non-Volatile Memory Microchip Proprietary File System Web Server Demonstration
web_server_sdcard_fatfs	SD Card FAT File System Web Server Demonstration
wifi_ap_demo	Wi-Fi AP Demonstration
wifi_easy_configuration	Wi-Fi EasyConf Demonstration
wifi_rgb_easy_configuration	Wi-Fi EasyConf RGB Demonstration
wifi_sta_demo	Wi-Fi Station (STA) Mode Demonstration
wifi_sta_http_demo	Wi-Fi STA Mode HTTP Demonstration
wifi_sta_ota_demo	Wi-Fi STA Mode OTA Demonstration
wifi_sta_wolfssl_demo	Wi-Fi STA Mode wolfSSL Demonstration
wifi_staap_demo	Wi-Fi STA Mode AP Demonstration
wifi_wilc1000	WILC1000 Wi-Fi Demonstration
wifi_winc1500_socket	WINC1500 Wi-FI Driver Demonstration
wolfssl_tcp_client	wolfSSL TCP/IP Client Demonstration
wolfssl_tcp_server	wolfSSL TCP/IP Server Demonstration

USB Device Applications:

<install-dir>/apps/usb/device/	Description
cdc_com_port_dual	CDC Dual Serial COM Ports Emulation Demonstration
cdc_com_port_single	CDC Single Serial COM Port Emulation Demonstration
cdc_msd_basic	CDC Mass Storage Device (MSD) Demonstration
cdc_serial_emulator	CDC Serial Emulation Demonstration
cdc_serial_emulator_msd	CDC Serial Emulation MSD Demonstration
hid_basic	Basic USB Human Interface Device (HID) Demonstration
hid_joystick	USB HID Class Joystick Device Demonstration
hid_keyboard	USB HID Class Keyboard Device Demonstration
hid_mouse	USB HID Class Mouse Device Demonstration
hid_msd_basic	USB HID Class MSD Demonstration
msd_basic	USB Mass Storage Device (MSD) Demonstration
msd_fs_spiflash	USB File System SPI Flash Demonstration
msd_multiple_luns	USB Mass Storage Device (MSD) with Multiple Logical Units (LUN) Demonstration
msd_sdcard	USB Mass Storage Device (MSD) SD Card Demonstration
vendor	USB Vendor (i.e., Generic) Demonstration

USB Dual Role Applications:

<install-dir>/apps/usb/dual_role/	Description
host_msd_device_hid	USB Dual Role with MSD Host and HID Device Demonstration

USB Host Applications:

<install-dir>/apps/usb/host/	Description
audio_speaker	USB Audio v1.0 Host Class Driver Demonstration
cdc_basic	USB CDC Basic Demonstration
cdc_msd	USB CDC MSD Basic Demonstration
hid_basic_keyboard	USB HID Host Keyboard Demonstration
hid_basic_mouse_usart	USB HID Host Mouse USART Demonstration
hub_cdc_hid	USB HID CDC Hub Demonstration
hub_msd	USB MSD Hub Host Demonstration
msd_basic	USB MSD Host Simple Thumb Drive Demonstration

USB Multiple Controller Applications:

<install-dir>/apps/usb/host/	Description
cdc_com_port_dual	USB Multiple Controller CDC Single Serial COM Port Emulation Demonstration
msd_dual	USB Multiple Controller Dual MSD Demonstration

Prebuilt Binaries:

<install-dir>/bin/framework	Description	Release Type
bluetooth	Prebuilt PIC32 Bluetooth Stack Libraries	Production
bluetooth/premium/audio	Prebuilt PIC32 Bluetooth Audio Stack Libraries (Premium)	Production
decoder/premium/aac_microaptiv	Prebuilt AAC Decoder Library for PIC32MZ Devices with microAptiv Core Features (Premium)	Production
decoder/premium/aac_pic32mx	Prebuilt AAC Decoder Library for PIC32MX Devices (Premium)	Production

decoder/premium/mp3_microaptiv	Prebuilt MP3 Decoder Library for PIC32MZ Devices with microAptiv Core Features (Premium)	Production
decoder/premium/mp3_pic32mx	Prebuilt MP3 Decoder Library for PIC32MX Devices (Premium)	Production
decoder/premium/wma_mclass	Prebuilt WMA Decodr Library for PIC32MZ Devices with M-Class Core Features (Premium)	Production
decoder/premium/wma_microaptiv	Prebuilt WMA Decoder Library for PIC32MZ Devices with microAptiv Core Features (Premium)	Production
decoder/premium/wma_pic32mx	Prebuilt WMA Decoder Library for PIC32MX Devices (Premium)	Production
math/dsp	Prebuilt DSP Fixed-Point Math Libraries for PIC32MZ Devices	Production
math/libq	Prebuilt LibQ Fixed-Point Math Libraries for PIC32MZ Devices	Production
math/libq/libq/c	Math library with C-implementations compatible with both PIC32MX and PIC32MZ devices. (**Note:** These routines are not compatible with the functions of the LibQ Library)	Production
peripheral	Prebuilt Peripheral Libraries	Production

Build Framework:

<install-dir>/build/framework/	Description	Release Type
decoder/audio_decoders/flac	FLAC Codec Library Build Project	Production
decoder/audio_decoders/opus	OPUS Codec Library Build Project	Production
gpu/libnano2d	GPU Library Build Project	Beta
math/libq	LibQ Library Build Project	Production
math/libq	LibQ_C Library Build Project	Production
peripheral	Peripheral Library Build Project	Production
decoder/audio_decoders/speex	Speex Codec Library Build Project	Production

Utilities:

<install-dir>/utilities/	Description	Release Type
mhc/plugins/displaymanager/displaymanager.jar	MPLAB Harmony Display Manager Plug-in	Beta
mhc/com-microchip-mplab-modules-mhc.nbm	MPLAB Harmony Configurator (MHC) Plug-in MPLAB Harmony Graphics Composer (included in the MHC plug-in)	Production Beta
mib2bib/mib2bib.jar	Compiled Custom Microchip MIB script (`snmp.mib`) to generate `snmp.bib` and `mib.h`	Production
mpfs_generator/mpfs2.jar	TCP/IP MPFS File Generator and Upload Utility	Production
segger/emwin	SEGGER emWin utilities used by MPLAB Harmony emWin demonstration applications	Vendor
tcpip_discoverer/tcpip_discoverer.jar	TCP/IP Microchip Node Discoverer Utility	Production

Third-Party Software:

<install-dir>/third_party/	Description	Release Type
decoder/jidctint	JPEG Decoder Library Source Distribution	Vendor
decoder/lodepng	PNG Decoder Library Source Distribution	Vendor
gfx/emwin	SEGGER emWin® Graphics Library Distribution	Vendor
rtos/embOS	SEGGER embOS® Distribution	Vendor
rtos/FreeRTOS	FreeRTOS Source Distribution	Vendor
rtos/MicriumOSII	Micriμm® μC/OS-II™ Distribution	Vendor
rtos/MicriumOSIII	Micriμm® μC/OS-III™ Distribution	Vendor
rtos/OpenRTOS	OPENRTOS Source Distribution	Vendor

rtos/ThreadX	Express Logic ThreadX Distribution	Vendor
segger/emwin	SEGGER emWin® Pro Distribution	Vendor
tcpip/wolfmqtt	wolfMQTT Library Distribution	Vendor
tcpip/wolfssl	wolfSSL (formerly CyaSSL) Embedded SSL Library Open Source-based Distribution	Vendor
tcpip/iniche	InterNiche Library Distribution	Vendor

Documentation:

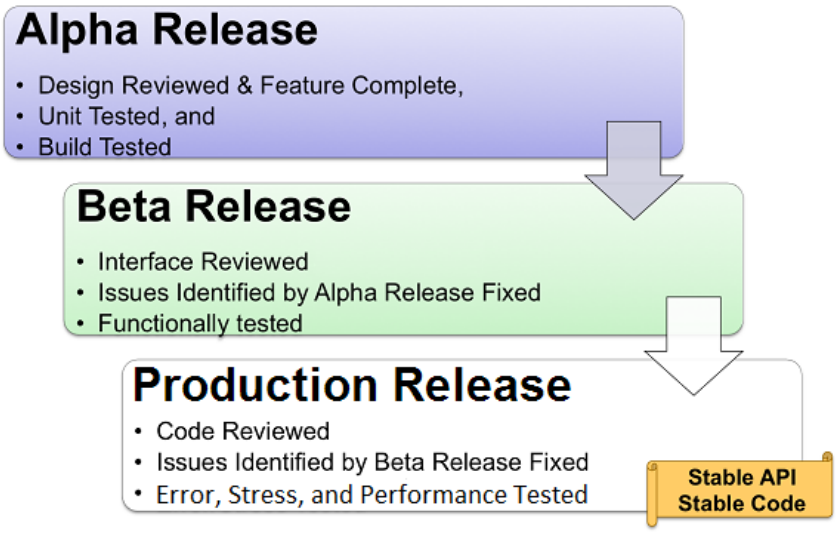
<install-dir>/doc/	Description
harmony_help_volume_I.pdf harmony_help_volume_II.pdf harmony_help_volume_III.pdf harmony_help_volume_IV.pdf harmony_help_volume_V.pdf harmony_help_volume_VI.pdf harmony_help_volume_VII.pdf	Volume I: Getting Started With MPLAB Harmony Libraries and Applications Volume II: Supported Hardware Volume III: MPLAB Harmony Configurator (MHC) Volume IV: MPLAB Harmony Development Volume V: MPLAB Harmony Framework Reference Volume VI: Third-Party Products Volume VII: Utilities
harmony_help.chm	MPLAB Harmony Help in Compiled Help (CHM) format
html/index.html	MPLAB Harmony Help in HTML format
harmony_compatibility_worksheet.pdf	PDF form for use in determining the level of MPLAB Harmony compatibility and to capture any exceptions or restrictions to the compatibility guidelines
harmony_release_brief_v2.06.pdf	MPLAB Harmony Release Brief, providing "at-a-glance" release information
harmony_release_notes_v2.06.pdf	MPLAB Harmony Release Notes
harmony_license_v2.06.pdf	MPLAB Harmony Software License Agreement in PDF

Release Types

This section describes the release types and their meaning.

Description

MPLAB Harmony module releases can be one of three different types, as shown in the following illustration.



Alpha Release

An alpha release version of a module is usually an initial release. Alpha releases will have complete implementations of their basic feature set, they are functionally unit tested and will build correctly. An alpha release is a great "preview" of what a new development Microchip is working on and it can be very helpful for exploring new features. However, it has not gone through the complete formal test process and it is almost certain that some of its interface will change before the production version is released, and therefore, is not recommended for production use.

Beta Release

A beta release version of a module has gone through the internal interface review process and has had formal testing of its functionality. Also, issues reported from the alpha release will have been fixed or documented. When a module is in a beta version, you can expect it to function

correctly in normal circumstances and you can expect that its interface is very close to the final form (although changes can still be made if required). However, it has not had stress or performance testing and it may not fail gracefully if used incorrectly.

Production Release

By the time a module is released in a production form, it is feature complete, fully tested, and its interface is "frozen". All known issues from previous releases will have been fixed or documented. The existing interface will not change in future releases. It may be expanded with additional features and additional interface functions, but existing interface functions will not change. This is stable code with a stable Application Program Interface (API) that you can rely on for production purposes.

Version Numbers

This section describes the meaning of MPLAB Harmony version numbers.

Description

MPLAB Harmony Version Numbering Scheme

MPLAB Harmony uses the following version numbering scheme:

`<major>.<minor>[.<dot>][<release type>]`

Where:

`<major>` = Major revision (significant change that affects many or all modules)

`<minor>` = Minor revision (new features, regular releases)

`[.<dot>]` = Dot release (error corrections, unscheduled releases)

`[<release type>]` = Release Type (a for alpha and b for beta, if applicable). Production release versions do not include a release type letter.

Version String

The SYS_VersionStrGet function will return a string in the format:

"`<major>.<minor>[.<patch>][<type>]`"

Where:

`<major>` is the module's major version number

`<minor>` is the module's minor version number

`<patch>` is an optional "patch" or "dot" release number (which is not included in the string if it equals "00")

`<type>` is an optional release type of "a" for alpha and "b" for beta. This type is not included if the release is a production version (i.e., not an alpha or a beta)

Note: The version string will not contain any spaces.

Example:

```
"0.03a"
"1.00"
```

Version Number

The version number returned from the SYS_VersionGet function is an unsigned integer in the following decimal format (not in a BCD format).

`<major> * 10000 + <minor> * 100 + <patch>`

Where the numbers are represented in decimal and the meaning is the same as described in Version String.

Note: There is no numerical representation of the release type.

Example:

For version "0.03a", the value returned is equal to: 0 * 10000 + 3 * 100 + 0.

For version "1.00", the value returned is equal to: 1 * 100000 + 0 * 100 + 0.

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