



MPLAB Harmony Release Notes and Contents

MPLAB Harmony Integrated Software Framework v2.00b

Release Information

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

MPLAB Harmony v2.00 is now available in a Beta release. Microchip highly recommends that you download this version and give it a try as it has a number of advantages, which are outlined in this document. Please note that you are not required to update your MPLAB Harmony projects to the v2.00 release as the v1.xx line of releases will continue for the foreseeable future.

Note: To ensure that you get the most out of this version of MPLAB Harmony, please be sure to review all of the information in this document prior to downloading and installing this version.

Why a Major Version Number Update (v2.00), But Two Separate Releases (v1.08.xx and v2.00)?

Peripheral Libraries

- Foundation upon which the MPLAB Harmony framework is built
- No changes to the interfaces of the PLIB functions
- We recognize that not all client code is created equal and wanted to draw attention to the fact that a major change had occurred
- More comprehensive testing and compiler updates may force modest changes to drivers that call them
- All Microchip drivers within MPLAB Harmony now conform to these standards, and will be updated in the application upon MHC configuration
- Third-party drivers that relied on previous implementation may require some updates to comply with the API standards
 - Enum data may have been incorrect, but compiler checking now generates warnings (which fail)
 - Drivers that have changed to fix bad type passing include LCC, ADC. and others

Board Support Packages

- Changed from preimplemented code to code generated from templates.
- Format of the port and pin data used by the MHC to configure BSPs (and initialization) has changed from custom-defined XML files to MHC-standard Hconfig files.
- No changes to the interfaces of either of these libraries
- Draw attention to the fact that the underlying methods had changed
- Draw attention to the ability to create custom board configurations, which is a significant new feature
- BSPs have a new naming convention for generation, which may result in code changes if calling that macro directly
- BSPs can now have pins overwritten by user settings in the Pin Manager plug-in
- BSPs refer to specific I/O pins on the microcontroller, and may not fully abstract to pins of other peripheral devices (secondary controllers, bus expanders or GPIO driven by external devices)
- Custom BSPs may have architecture beyond the examples provided by Microchip

Custom (not Microchip) Drivers and Applications

- Custom drivers that use BSP inputs may have to be changed to comply with new naming conventions
- Custom applications that directly call I/O may have to change the name to comply with naming conventions of I/O pins
- Pin manager changes may be required to enable or change the status of specific I/O pins within the new pin manager

Updates for MPLAB Harmony v2.00

Peripheral Library (PLIB) Updates

- Reimplemented to more directly access physical registers
- More efficient and easier to read and understand.
- No changes to interface APIs

Board Support Packages (BSP) Updates

- Reimplemented using data-driven templates, instead of predefined C language code
- Better optimized for individual projects and more easily modified by the user
- MPLAB Harmony Configurator (MHC) Pin Manager to support creation of custom board configurations
- Minor changes were made to the BSP interface, primarily dealing with standardization of PPS and I/O pins

Pin Manager Plug-in Updates

- New capability to update and customize BSP functions

- Controls I/O, PPS, notifications, ADC, and other functions per pin
- Updated graphical and table inputs
- Migration: No known migration issues (CN, pin mapping, etc.)
 - Some new information and customization (i.e., pin names) is available, but not required
 - User settings in pin manager overwrite BSP settings for the same pin

Stand-alone Project Exporting

- New capability to export a project and the MHC functions from the MPLAB Harmony framework
- Project will continue to build and run, without the need to download the framework locally

Drivers Updates

- Drivers have been updated to conform more strictly to PLIB definitions
- Drivers have been updated to use new BSP or generated pin names for peripheral I/O
- Migration: Custom data types may have used incorrect value
 - APIs for PLIBs remain the same and are correct
 - Driver implementation of these in rare occasion was not correct
 - Custom drivers may have used MCHP model, and thus made similar incorrect API calls

Graphics v2.0 (coming soon, not in first release)

- Updated MPLAB Harmony Graphics Composer (MHGC) development environment, Java plug-in
- New graphics asset converter
 - Input and manage text, widgets, and images
 - Multi-language string manager
 - Refine compression, color depth, and image size
 - Target specific hardware to manage project memory
- Hardware abstraction
 - Work with external graphics processors (GPU)
 - Create equivalent software / hardware functions (blit, drawing, 2-D processing)
 - Manage or create drawing symbols without widgets
- Multi-layer capability
 - Use multiple layers (if supported) in LCD driver
 - Use up to 24-bit color graphics
- Advanced event management
 - Manage touch and graphical events and their interaction with other graphics elements
 - Input external (logical) events to affect graphics elements from other macros

Benefits of Switching to MPLAB Harmony v2.00

Peripheral Libraries

More optimized (particularly for use in dynamic, multi-instance drivers):

- Provide smaller and more efficient code.
- Access PIC32 Special Function Registers (SFRs) directly by name
- Easier to read and understand, and client code easier to debug
- Compliant to MISRA-C:2012 Mandatory standards

Board Support Packages

Generated based upon user configuration settings and inserted directly into the project:

- More efficient and more easily customized for specific configurations
- Initial board configurations allow users
- Capture any desired configuration settings
- Save them as a baseline
- New projects or configurations can be started without the need to re-enter configuration settings by hand

Stand-alone Application Exporting

Pin Manager Plug-In

- Ability to add or modify pins after BSP inputs, customization
- Ability to save custom configurations and save to BSP

Graphics v2.0 (future)

Updates for MPLAB Harmony v1.08.xx

Application Templates (beta)

- Code examples that can be added to other applications or combined
- Use MHC for user controls

Audio support

- New (multiple) applications supporting microphone features
- Updated audio codec drivers
- Updated I2S driver
- New PIC32MZ audio application configurations
- New Opus audio codec

Graphics updates

- New Double buffering supported in MPLAB Harmony Graphics Composer and applications
- New LCCG WVGA (800x480) display driver
- Updated PCAP touch drivers for MTCH6301/03
- New AR1021 resistive touch driver plus calibration functions
- Updated JPEG and GIF image decoders
- New SEGGER emWin User's Guide and example application
- New application for SD card and external media support

TCP/IP updates

- Updated drivers for static model

Framework

- Initial microMIPS™ ISA Support
- MPLAB Harmony Graphics Composer and MHC support
 - Import / Export / Move / Copy
 - Updated Pin Manager
- Multiple framework updates and improvements

Benefits of Staying with MPLAB Harmony v1.xx

Peripheral Libraries

- Client code may have made assumptions that violated the PLIB interface (e.g., directly utilizing the value of the peripheral index ID, which is intended to be opaque)
- Continuing to use the MPLAB Harmony v1.xx PLIBs will avoid any need to update client code to properly respect the PLIB interface

Board Support Packages

- Underlying implementations and the configuration data used to generate them has completely changed in MPLAB Harmony v2.00
- Avoid any issues due to potential errors in the new templates or data files used to generate BSPs in MPLAB Harmony v2.00.
- Avoid custom driver changes due to BSP generator I/O labels

Previous validated custom libraries and applications will not require changes.

New applications and driver functions will continue to be added in parallel with v2.00.

Considerations When Porting from MPLAB Harmony v1.xx to MPLAB Harmony v2.00

BSPs have changed, and with them specifics about the pin and GPIO management, which may:

- Impact custom drivers, and need refinement of the driver to correspond with pin names
- Impact custom pin manager settings
- Impact some applications, particularly that directly call GPIO (button, LED, external interrupt and enables)

Drivers have been changed:

- The APIs have not changed, so there should not be a direct reflection on applications that use them
- Drivers provided in MPLAB Harmony will be updated by MHC configuration, and you will need to use the latest MHC version and reconfigure your project

PLIBs have changed:

- APIs for the PLIBs have not changed; however, implementation checking is more rigid

- May cause some driver rewrite if they did not follow strict API convention

Compiler version has changed:

- MPLAB Harmony v1.08 and previous versions use MPLAB X IDE v1.40 (and parts support)
- MPLAB Harmony v2.00 and later uses MPLAB X IDE v1.42 and later
 - More strict checking of some structures in later compilers make cross compilation problematic (e.g., Zero to pointer instead of null)

Graphics tools have changed (future release):

- A one-way export from MPLAB Harmony v1.0x is possible
- An import of the previous export will be possible in the new version
- Some new elements like multi-layer and resource management will require additional data
- You can continue to develop basic graphics in MPLAB Harmony v1.xx and port that to MPLAB Harmony v2.0 at any time; however, the reverse is not possible

Release Notes

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

Description

MPLAB Harmony Version: v2.00b **Release Date:** July 2016

Software Requirements

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

- [MPLAB X IDE](#) v3.35
- [MPLAB XC32 C/C++ Compiler](#) v1.42
- MPLAB Harmony Configurator v2.0.0.xx (Beta)



IMPORTANT:

Before using this version of MPLAB Harmony, please be sure to review the information provided in the [Release Information](#) topic.

Updating to This Release of MPLAB Harmony

Updating to this release of MPLAB Harmony is relatively simple. For detailed instructions, please refer to Porting and Updating to MPLAB Harmony.

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	<p>General:</p> <ul style="list-style-type: none"> The Pin Manager was updated with functionality to allow pin naming All BSPs have been updated to move data from xml files into an hconfig file BSP files are now generated statically, with code generation Added the ability to generate custom BSP configurations and import them into new or existing projects All Peripheral Libraries were updated with a more optimized implementation Added the ability to generate stand-alone projects that do not have dependency on the MPLAB Harmony installation Added support for new PIC32 Curiosity Boards Added a new Memory System Service Library that combines functionality of EBI, DDR, and other external memories microMIPS support was added to the MHC and new microMIPS applications were created. <p>Application templates have been added for the following components:</p> <ul style="list-style-type: none"> Bootloader Crypto Codec, Flash, I2C, IC, OC, SPI, Timer, and USART Drivers TCP/IP Client and Server File System, Random Number Generator, and RTCC System Services USB CDC, HID, and Audio Device Classes USB CDC Host 	<p>MPLAB Harmony has not been tested with C++; therefore, support for this programming language is not supported.</p> <p>The "-O1" optimization level 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 <code>xc32-ld</code> (linker) properties dialog box.</p> <p>The MPLAB Harmony uninstaller will delete all files installed by the installer, even if they were modified by the user. However, the uninstaller <i>will not</i> delete new files added by the user to the MPLAB Harmony installation folder.</p>

Middleware and Libraries:

Feature	Additions and Updates	Known Issues
Bootloader Library	<p>The application interrupt vector table is now integrated into the main code area (<code>kseg0_program_mem</code>) for both PIC32MX and PIC32MZ devices. This update makes better use of the program memory, as some of the application code can be placed in between areas that the interrupt vector table does not use.</p> <p>The UDP bootloader now correctly shuts down the Ethernet interface before jumping to the application.</p> <p>Generated linker scripts (bootloader and application) have been updated for PIC32MX devices. Because of the changes to the linker scripts, these linker scripts will not work with previous versions of the MPLAB Harmony bootloader.</p>	<p>The UDP bootloader does not compile for PIC32MZ devices when microMIPS is selected.</p>

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 <code>pic32mz-crypt.h</code> and <code>pic32mz-hash.c</code> 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 (<code>pic32mz-crypt.h</code> and <code>pic32mz-hash.c</code>) from the project and use the MPLAB Harmony Configurator (MHC) to regenerate all configurations that use these files.
Decoder Libraries	The Opus Decoder Library was added.	Due to memory requirements and the amount of available SRAM, some decoders cannot operate concurrently with other decoders. However, each decoder will operate individually in the <code>universal_audio_decoders</code> demonstration.
Graphics Libraries	<p>Added ability to decode JPEG, GIF, and BMP image formats from external media via the File System Service.</p> <p>For JPEG decoding, the Burst Buffer Length configuration setting was added to the MPLAB Harmony Configurator. This setting controls the size of the buffer (128 to 51200 bytes) to be allocated for caching of raw image data from the external media.</p> <p>For GIF decoding, animated GIF and transparent GIF is supported to the GIF89a specification.</p> <p>The WVGA LCC driver was updated to support both the previous and the current revisions of the 5" WVGA PCAP Graphics Display Board.</p>	<p>JPEG decoding does not support progressive scanned images.</p> <p>Some transparency-incorporated animated GIF images may demonstrate tearing.</p>

TCP/IP Stack Libraries	<p>APIs were added to the HTTP and HTTP Net modules.</p> <p>The following general TCP/IP stack updates and software updates were included:</p> <p>NBNS:</p> <ul style="list-style-type: none">• An update was made to correct an issue with replying to the wrong host <p>TCP/IP Heap:</p> <ul style="list-style-type: none">• Enforced heap parameter checking at the top level• Added internal API for primary heap access• Software update to correct external memory allocator alignment <p>HTTP:</p> <ul style="list-style-type: none">• Software update to correct HTTP mpfs upload functionality <p>HTTP_NET:</p> <ul style="list-style-type: none">• Added the TCPIP_HTTP_NET_ConnectionDataBufferSizeGet function, which was missing from the last release of MPLAB Harmony• Software update to correct HTTP mpfs upload functionality <p>IPv4:</p> <ul style="list-style-type: none">• Added two filtering APIs, TCPIP_IPV4_PacketFilterSet and TCPIP_IPV4_PacketFilterClear <p>DHCP Server:</p> <ul style="list-style-type: none">• Deinitialization software correction. <p>ETHMAC Driver:</p> <ul style="list-style-type: none">• Added MAC Driver RX Filters selection• The TCPIP_MODULE_MAC_PIC32INT_CONFIG structure has added the Ethernet Module ID as driver initialization data <p>Various updates for compiler v1.42 errors and warnings.</p>	N/A
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TCP/IP Stack Libraries (continued)	<p>MPLAB Harmony Configurator (MHC):</p> <ul style="list-style-type: none">• Added independent network configuration start-up flags• Added independent HTTP NET configuration flags• Disabled the selection of IP_ADDRESS_TYPE_ANY where inappropriate <p>HTTP Net Module:</p> <ul style="list-style-type: none">• The HTTP_NET now supports a subset of the Server Side Includes (SSI) processing commands.• SSI could be used for adding dynamic content on web pages in a standard way that is supported by most HTTP servers – please see the Harmony HTTP_NET documentation for details on the SSI implementation.• Currently the supported SSI commands consist of #include, #set, and #echo. Additional commands will be provided in future releases of MPLAB Harmony.• The following SSI API can be used to evaluate or change the current value of the SSI variables:<ul style="list-style-type: none">• TCPIP_HTTP_NET_SSIVariableGet• TCPIP_HTTP_NET_SSIVariableSet• TCPIP_HTTP_NET_SSIVariableDelete	N/A
USB Device Library	N/A	<p>The USB Device Stack has been tested in limited capacity with RTOS.</p> <p>While running the USB Device Stack on a PIC32MZ family device, the stack requires three seconds to initialize for PIC32MZ EC devices and three milliseconds for PIC32MZ EF devices.</p>

USB Host Library	<p>The USB HID Host Keyboard Driver has been updated with keyboard LED glow functionality.</p>	<p>The following USB Host Stack functions are not implemented:</p> <ul style="list-style-type: none"> • USB_HOST_BusResume • USB_HOST_DeviceSuspend • USB_HOST_DeviceResume <p>The Hub, Audio v1.0, and HID Host Client Drivers have been tested in limited capacity.</p> <p>The USB Host Stack has been tested in limited capacity with RTOS.</p> <p>Polled mode operation has not been tested.</p> <p>Attach/Detach behavior has been tested in a limited capacity.</p> <p>While running the USB Host Stack on a PIC32MZ family device, the stack requires three seconds to initialize for PIC32MZ EC devices and three milliseconds for PIC32MZ EF devices.</p> <p>The USB Host Layer does not perform overcurrent checking. This feature will be available in a future release of MPLAB Harmony.</p> <p>The USB Host Layer does not check for the Hub Tier Level. This feature will be available in a future release of MPLAB Harmony.</p> <p>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 become inoperative. Multiple configuration enabling will be activated in a future release of the of MPLAB Harmony.</p> <p>The MSD Host Client Driver has been tested with a limited number of commercially available USB Flash drives.</p> <p>The MSD Host Client Driver and the USB Host Layer have not been tested for read/write throughput. This testing will be done in a future release of MPLAB Harmony.</p> <p>The MSD Host Client Driver and SCSI block driver can only be used with the File system if the file system Auto-Mount feature is enabled.</p> <p>The MSD Host Client Driver has not been tested with Multi-LUN Mass Storage Device and USB Card Readers.</p>
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USB Host (continued)	Library	See the previous row.	<p>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.</p> <p>USB HID Host Client driver has not been tested with multiple usage devices.</p> <p>Sending of output or feature report has not been tested.</p> <p>The USB Audio Host Client driver does not provide implementation for the following functions:</p> <ul style="list-style-type: none"> • 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
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Device Drivers:

Feature	Additions and Updates	Known Issues
AR1021 Touch	The AR1021 Touch Driver Library was added.	N/A
EBI	The EBI Driver Library was removed.	N/A
Graphics Driver Library	The LCC Driver was updated to interface with latest revision 5" WVGA display.	N/A

I2C		<p>I2C Driver Using the Peripheral and the Bit-banged Implementation:</p> <ul style="list-style-type: none"> • 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 <p>I2C Driver Using the Bit-banged Implementation:</p> <ul style="list-style-type: none"> • 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
MRF24WG Wi-Fi	New APIs were added.	N/A
MRF24WN Wi-Fi	N/A	<p>The <code>PwrSave</code> setting displays as <i>Disabled</i> in the <code>iwconfig</code> console command and does not reflect the correct configuration set by the <code>iwconfig power enable</code> and <code>iwconfig power disable</code> commands.</p> <p>The following errors may occur:</p> <ul style="list-style-type: none"> • The <i>Dropped Tx Packet</i> error may occur when attempting to transmit too much data in the Iperf UDP Client • Wi-Fi disconnect and reconnect may cause the error <i>Dropped the Tx packet. Invalid packet length 1923</i>. <p>The TCP/IP console commands, <code>reset</code> and <code>if mrf24wn up/down</code> are not supported in this release.</p>

USB	<p>The USB Driver Libraries were reorganized into the following sections:</p> <ul style="list-style-type: none"> • Common Interface • PIC32MX USB Driver • PIC32MZ USB Driver 	<p>The USB Driver Library has been tested in limited capacity with RTOS.</p> <p>While running the USB Driver Library on a PIC32MZ family device, the stack requires three seconds to initialize for PIC32MZ EC devices and three milliseconds for PIC32MZ EF devices.</p> <p>Some APIs for USB Host Driver Library may change in the next release.</p> <p>USB Host Driver Library Polled mode operation has not been tested.</p> <p>USB Host Driver Library Attach/Detach behavior has been tested in a limited capacity.</p>
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.
SPI Flash	N/A	<p>Flash features such as high-speed read, address auto-increment write, hold, and write-protect are not supported by the driver library.</p> <p>OSAL support is not available.</p> <p>Static implementation of the driver library is not available.</p>

Peripheral Libraries:

Feature	Additions and Updates	Known Issues
ADCHS	New APIs were added.	FIFO is not supported in this version of the peripheral library.
SQI	N/A	<p>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.</p> <p> Note: This issue is applicable to any applications that use the SQI module.</p>

Board Support Packages (BSP):

Feature	Additions and Updates	Known Issues
pic32mx470_curiosity	New BSP for the PIC32MX470 Curiosity Development Board.	N/A
pic32mz_da_sk+169lfbga_cpu	New BSP for the PIC32MZ Graphics (DA) Starter Kit and the 169-pin LFBGA CPU Daughter Board.	N/A
pic32mz_ef_curiosity	New BSP for the PIC32MZ EF Curiosity Development Board.	N/A
pic32_gdb_ef	New BSP for the PIC32 Graphics Discovery Board.	N/A

Applications:

Feature	Additions and Updates	Known Issues
Audio Demonstrations	<p>The sdcard_usb_audio demonstration was added.</p> <p>The pic32mz_bt_audio_int_dyn configuration was removed from the mac_audio_hi_res demonstration.</p> <p>The universal_audio_decoder demonstration was updated for use with the Opus Decoder Library and support for I2S Driver read/write full-duplex mode.</p> <p>The usb_headset demonstration was updated to include microphone input and bidirectional I2S audio streaming.</p> <p>The audio_microphone_loopback demonstration was updated to restore PIC32MZ configurations that use the dynamic I2C Driver for Codec configuration. In addition, the pic32mz_ec_pim_bt_audio_dk_ak4642 configuration was removed.</p> <p>Audio demonstrations that use the AK4642, AK4953, and AK7755 Codecs use the new dynamic I2C driver; therefore, the static I2C driver should not be used. Refer to the following topics in <i>Volume IV: MPLAB Harmony Framework Reference > Driver Libraries Help > Codec Driver Libraries</i> for additional information:</p> <ul style="list-style-type: none"> AK4642 Codec Driver Library > <i>Configuring the MHC</i> AK4953 Codec Driver Library > <i>Configuring the MHC</i> AK7755 Codec Driver Library > <i>Configuring the MHC</i> <p>The following audio demonstrations were added:</p> <ul style="list-style-type: none"> usb_microphone usb_speaker 	<p>usb_headset, usb_microphone, and usb_speaker Demonstrations:</p> <p>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:</p> <ol style="list-style-type: none"> While the device is connected, uninstall the driver. A restart of the Windows operating system may also be required. <p>universal_audio_decoder Demonstration:</p> <ul style="list-style-type: none"> The 270f512lpim_bt_audio_dk and pic32mz_da_sk_meb2 configurations do not support the display. The display may appear to be ON but is blank because the backlight is illuminated. The 270f512lpim_bt_audio_dk configuration does not support the WMA and AAC decoders. 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 <p>usb_headset Demonstration:</p> <ul style="list-style-type: none"> The bt_audio_dk_ak4642 configuration has dropouts for a short time sometimes at the beginning of playback. In the pic32mz_ef_sk_meb2 configuration, the left and right output channels are swapped <p>audio_tone Demonstration:</p> <ul style="list-style-type: none"> The display is static Switch debounce is not implemented <p>usb_speaker Demonstration:</p> <p>The left and right output channels are swapped in the pic32mz_ef_sk_meb2 configuration.</p> <p>mac_audio_hi_res Demonstration:</p> <p>For all configurations:</p> <ul style="list-style-type: none"> If the USB cable is disconnected and reconnected during playback, it may take several seconds for the audio to resume.

Bluetooth Demonstrations	<p>The data_basic demonstration was updated to include PIC32MZ EC and PIC32MZ EF device support. In addition, the following configurations were removed from the demonstration:</p> <ul style="list-style-type: none"> • pic32mz_ef_sk_meb2 • bt_audio_dk_freertos • pic32mz_ef_pim_bt_audio_dk <p>The following configurations were removed from the a2dp_avrcp premium demonstration:</p> <ul style="list-style-type: none"> • pic32mz_da_sk_meb2 • pic32mz_ec_sk_meb2 <p>The a2dp_avrcp Premium demonstration was updated, as follows:</p> <ul style="list-style-type: none"> • PIC32MZ EC and PIC32MZ EF device support was added • WVGA support for PIC32MZ EF devices was added • Touch screen support for WQVGA and WVGA displays was added • On-screen controls for WVGA and WQVG displays were added • The I2C driver implementation has been changed to Dynamic • The AK7755 Codec configuration was added • The bt_audio_dk_freertos FreeRTOS configuration was added 	N/A
Bootloader Demonstrations	The LiveUpdate_StateRetention demonstration was removed.	N/A
File System Demonstrations	N/A	<p>LED_3, which is used to indicate demonstration success does not illuminate, which affects the following demonstrations:</p> <ul style="list-style-type: none"> • sdcard_fat_single_disk (pic32mz_da_sk_adma configuration) • sdcard_msd_fat_multi_disk (pic32mz_da_sk_meb2 configuration) <p>As a work around, the user can place a breakpoint in the application code to see the status of the demonstrations.</p>

Graphics Demonstrations	<p>The <code>wvga_lcc</code> demonstration was renamed to <code>graphics_showcase</code>.</p> <p>The following demonstrations were added:</p> <ul style="list-style-type: none"> • <code>emwin_quickstart</code> • <code>media_image_viewer</code> • <code>resistive_touch_calibrate</code> 	<p>Starter kit PKOB programming and debugging may produce the following error: <i>The programmer could not be started: Failed to program the target device</i>. If this message occur, repower the device and the application will start. If debugging is required, the suggested work around is to install the appropriate header onto the starter kit using MPLAB REAL ICE.</p> <p>The following issues apply to the <code>external_resources</code> demonstration:</p> <ul style="list-style-type: none"> • Currently, JPEG decode support has been enabled for internal storage only • During the demonstration, latency is observed in fetching the images from external off-chip memory, which causes slow population of the display while rendering the images on screen memory. • A similar latency to the previous issue is also seen while displaying JPEG images on-screen due to the delay caused by JPEG run-time decoding <p>The <code>emwin_quickstart</code> demonstration contains three screens. This demonstration is highly sensitive to touch input and timing issues may occur when navigating from one screen to another. For example, the demonstration may jump to screen 3 while navigating from screen 1 to screen 2. A similar issue may be observed while navigating from screen 3 to screen 2.</p>
MEB II Demonstrations	N/A	The <code>segger_emwin</code> demonstration application does not yet include touch input.
Peripheral Library Examples	The NVM Peripheral Library example demonstration, <code>flash_modify</code> , was renamed to: <code>nvm_modify</code> .	N/A
RTOS Demonstrations	N/A	<p>The Express Logic Thread X demonstrations may not work with optimization enabled.</p> <p>Express Logic Thread X port files need to be updated to work with the MPLAB XC32 C/C++ Compiler, version 1.40.</p> <p>The SEGGER embOS Library with FPU support is required for PIC32MZ EF configuration and the user needs to explicitly include this. By default, the library without FPU support is included.</p>
System Service Library Examples	The <code>rtcc_timestamps</code> demonstration was added.	The <code>command_appio</code> demonstration does not function using MPLAB X IDE v3.06, but is operational with v3.00.

TCP/IP Demonstrations	Wi-Fi	N/A	<p>The TCP/IP command, <code>if wlan0 up/down</code>, 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.</p> <p>The following issues apply to the <code>wifi_easy_configuration</code> demonstration:</p> <ul style="list-style-type: none"> • 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 <code>scanlist</code> Console command display is incorrect when issued in UART/Serial console mode
Test Applications		N/A	<p>The FreeRTOS configurations for use with the PIC32MZ EF Starter Kit have the floating-point library disabled in the project options.</p>
USB Demonstrations		N/A	<p>The <code>msd_basic</code> 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.</p> <p>The <code>hid_basic_keyboard</code> Host demonstration captures keystrokes from A-Z, a-z, 0-9, Shift and CAPS LOCK key <i>only</i>. The keyboard LED glow functionality and support for other key combinations will be updated in a future release.</p> <p>In the <code>audio_speaker</code> Host demonstration, Plug and Play may not work for the <code>pic32mz_ef_sk_int_dyn</code> and <code>pic32mx_usb_sk2_int_dyn</code> configurations. This issue will be corrected in a future release.</p> <p>In the <code>hub_msd</code> Host demonstration application, Hub plug and play detection may occasionally fail. However, if the hub is plugged in before the PIC32MZ device is released from reset, the demonstration application operates as expected. This issue is under investigation and a correction will be available in a future release of MPLAB Harmony.</p> <p>It is recommended to use a self-powered hub while attempting to use the available hub demonstration applications. The VBUS supply regulator on the starter kit may not be able to meet the current requirements of a bus-powered hub, which would then cause unpredictable demonstration application behavior.</p>

Build Framework:

Feature	Additions and Updates	Known Issues
Math Libraries	N/A	DSP Fixed-Point Math Library: <ul style="list-style-type: none"> Optimized only for PIC32MZ devices with microAptiv™ core features, which utilize DSP ASE Will not function with the <code>_Fract</code> data type LibQ Fixed-Point Math Library: <ul style="list-style-type: none"> Optimized for PIC32MZ devices with microAptiv core features The <code>_fast</code> functions have reduced precision

Utilities:

Feature	Additions and Updates	Known Issues
MPLAB Harmony Configurator (MHC)	N/A	<ul style="list-style-type: none"> The MHC does not support changing the relative path from the project to the source files within the MPLAB Harmony installation, once the project has been created 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 "<code>---endhelp---</code>" in a <code>.hconfig</code> file may cause the next configuration symbol to be skipped

Third-Party Software:

Feature	Additions and Updates	Known Issues
JPEG Decoding	The DCT-based JPEG decoding algorithm, as provided by the Independent JPEG Group, has been updated to version 9b (January 17, 2016).	N/A
SEGGER emWin Graphics Library	New library with GUI and Touch wrapper support for SEGGER emWin.	Only the LCC display controller is supported. Support for other display controllers is not available in this release. 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
crypto	Microchip Cryptographic Library	Production
decoder/bmp/BmpDecoder	BMP Decoder Library	Beta
decoder/bmp/GifDecoder	GIF Decoder Library	Beta
decoder/bmp/JpegDecoder	JPEG Decoder Library	Beta
decoder/audio_decoders/decoder_opus	Opus Decoder Library	Beta
decoder/speex	Speex Decoder Library	Beta
decoder/premium/decoder_aac	AAC Decoder Library (Premium)	Beta
decoder/premium/decoder_mp3	MP3 Decoder Library (Premium)	Beta
decoder/premium/decoder_wma	WMA Decoder Library (Premium)	Beta
gfx	Graphics Library	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
net/pres	MPLAB Harmony Network Presentation Layer	Beta
test	Test Harness Library	Production
tcpip	TCP/IP Network Stack	Production
usb	USB Device Stack	Production
	USB Host Stack	Beta

Device Drivers:

<install-dir>/framework/driver/	Description	Release Type
adc	Analog-to-Digital Converter (ADC) Driver <i>Dynamic Implementation</i> <i>Static Implementation</i>	Beta Beta
camera/ovm7690	OVM7690 Camera Driver <i>Dynamic Implementation only</i>	Beta
can	Controller Area Network (CAN) Driver <i>Static Implementation only</i>	Beta
cmp	Comparator Driver <i>Static Implementation only</i>	Beta
codec/ak4384	AK4384 Codec Driver <i>Dynamic Implementation only</i>	Beta
codec/ak4642	AK4642 Codec Driver <i>Dynamic Implementation only</i>	Beta
codec/ak4953	AK4953 Codec Driver <i>Dynamic Implementation only</i>	Beta
codec/ak7755	AK7755 Codec Driver <i>Dynamic Implementation only</i>	Beta
cpld	CPLD XC2C64A Driver <i>Static Implementation only</i>	Production
enc28j60	ENC28J60 Driver Library <i>Dynamic Implementation only</i>	Beta
encx24j600	ENCx24J600 Driver Library <i>Dynamic Implementation only</i>	Beta

ethmac	Ethernet Media Access Controller (MAC) Driver <i>Dynamic Implementation only</i>	Production
ethphy	Ethernet Physical Interface (PHY) Driver <i>Dynamic Implementation only</i>	Production
flash	Flash Driver <i>Static Implementation only</i>	Beta
gfx/controller/lcc	Low-Cost Controllerless (LCC) Graphics Driver <i>Dynamic Implementation only</i>	Production
gfx/controller/otm2201a	OTM2201a LCD Controller Driver <i>Dynamic Implementation only</i>	Production
gfx/controller/s1d13517	Epson S1D13517 LCD Controller Driver <i>Dynamic Implementation only</i>	Production
gfx/controller/ssd1289	Solomon Systech SSD1289 Controller Driver <i>Dynamic Implementation only</i>	Production
gfx/controller/ssd1926	Solomon Systech SSD1926 Controller Driver <i>Dynamic Implementation only</i>	Production
gfx/controller/tft002	TFT002 Graphics Driver <i>Dynamic Implementation only</i>	Production
i2c	Inter-Integrated Circuit (I2C) Driver <i>Dynamic Implementation</i> <i>Static Implementation</i>	Alpha Alpha
i2s	Inter-IC Sound (I2S) Driver <i>Dynamic Implementation only</i>	Beta
ic	Input Capture Driver <i>Static Implementation only</i>	Beta
nvm	Non-Volatile Memory (NVM) Driver <i>Dynamic Implementation</i> <i>Static Implementation</i>	Beta Beta
oc	Output Compare Driver <i>Static Implementation only</i>	Beta
pmp	Parallel Master Port (PMP) Driver <i>Dynamic Implementation</i> <i>Static Implementation</i>	Production Beta
rtcc	Real-Time Clock and Calendar (RTCC) Driver <i>Static Implementation only</i>	Beta
sdcard	SD Card Driver (client of SPI Driver) <i>Dynamic Implementation only</i>	Beta
spi	Serial Peripheral Interface (SPI) Driver <i>Dynamic Implementation</i> <i>Static Implementation</i>	Production Beta
spi_flash/sst25vf016b spi_flash/sst25vf020b spi_flash/sst25vf064c	SPI Flash Drivers <i>Dynamic Implementation only</i> <i>Dynamic Implementation only</i> <i>Dynamic Implementation only</i>	Alpha Alpha Alpha
tmr	Timer Driver <i>Dynamic Implementation</i> <i>Static Implementation</i>	Production Beta

touch/adc10bit	ADC 10-bit Touch Driver <i>Dynamic Implementation only</i>	Beta
touch/ar1021	AR1021 Touch Driver <i>Dynamic Implementation only</i>	Beta
touch/mtch6301	MTCH6301 Touch Driver <i>Dynamic Implementation only</i>	Beta
touch/mtch6303	MTCH6303 Touch Driver <i>Static Implementation only</i>	Beta
usart	Universal Synchronous/Asynchronous Receiver/Transmitter (USART) Driver <i>Dynamic Implementation</i> <i>Static Implementation</i>	Production Beta
usbfs	PIC32MX Universal Serial Bus (USB) Controller Driver (USB Device) <i>Dynamic Implementation only</i>	Production
usbhs	PIC32MZ Universal Serial Bus (USB) Controller Driver (USB Device) <i>Dynamic Implementation only</i>	Production
usbfs	PIC32MX Universal Serial Bus (USB) Controller Driver (USB Host) <i>Dynamic Implementation only</i>	Beta
usbhs	PIC32MZ Universal Serial Bus (USB) Controller Driver (USB Host) <i>Dynamic Implementation only</i>	Beta
wifi/mrf24w	Wi-Fi Driver for the MRF24WG controller <i>Dynamic Implementation only</i>	Production
wifi/mrf24wn	Wi-Fi Driver for the MRF24WN controller <i>Dynamic Implementation only</i>	Production

System Services:

<install-dir>/framework/system/	Description	Release Type
clk	Clock System Service Library <i>Dynamic Implementation</i> <i>Static Implementation</i>	Production Production
command	Command Processor System Service Library <i>Dynamic Implementation only</i>	Production
common	Common System Service Library	Beta
console	Console System Service Library <i>Dynamic Implementation</i> <i>Static Implementation</i>	Beta Alpha
debug	Debug System Service Library <i>Dynamic Implementation only</i>	Beta
devcon	Device Control System Service Library <i>Dynamic Implementation only</i>	Production
dma	Direct Memory Access System Service Library <i>Dynamic Implementation</i> <i>Static Implementation</i>	Production Beta
fs	File System Service Library <i>Dynamic Implementation only</i>	Production

int	Interrupt System Service Library <i>Static Implementation only</i>	Production
memory	Memory System Service Library <i>Static Implementation only</i>	Beta
msg	Messaging System Service Library <i>Dynamic Implementation only</i>	Beta
ports	Ports System Service Library <i>Static Implementation only</i>	Production
random	Random Number Generator System Service Library <i>Static Implementation only</i>	Production
reset	Reset System Service Library <i>Static Implementation only</i>	Beta
tmr	Timer System Service Library <i>Dynamic Implementation only</i>	Beta
touch	Touch System Service Library <i>Dynamic Implementation only</i>	Beta
wdt	Watchdog Timer System Service Library <i>Static Implementation only</i>	Beta

Peripheral Libraries:


<install-dir>/framework/	Description	Release Type
peripheral	Peripheral Library Source Code for all Supported PIC32 Microcontrollers	Beta
	PIC32MK General Purpose (GP) Family	Beta
	PIC32MX1XX/2XX 28/36/44-pin Family	Beta
	PIC32MX1XX/2XX/5XX 64/100-pin Family	Beta
	PIC32MX320/340/360/420/440/460 Family	Beta
	PIC32MX330/350/370/430/450/470 Family	Beta
	PIC32MX5XX/6XX/7XX Family	Beta
	PIC32MZ Embedded Connectivity (EC) Family	Beta
	PIC32MZ Embedded Connectivity with Floating Point Unit (EF) Family	Beta
	PIC32MZ Graphics (DA) Family	Beta

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.	Beta
chipkit_wf32	BSP for the chipKIT™ WF32™ Wi-Fi Development Board.	Beta
chipkit_wifire	BSP for the chipKIT™ Wi-FIRE Development Board.	Beta
pic32mx_125_sk	BSP for the PIC32MX1/2/5 Starter Kit.	Beta

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.	Beta
pic32mx_125_sk+meb	BSP for the PIC32MX1/2/5 Starter Kit connected to the Multimedia Expansion Board (MEB).	Beta
pic32mx_bt_sk	BSP for the PIC32 Bluetooth Starter Kit.	Beta
pic32mx_eth_sk	BSP for the PIC32 Ethernet Starter Kit.	Beta
pic32mx_eth_sk2	BSP for the PIC32 Ethernet Starter Kit II.	Beta
pic32mx_pcap_db	BSP for the PIC32 GUI Development Board with Projected Capacitive Touch.	Beta
pic32mx_usb_digital_audio_ab	BSP for the PIC32 USB Audio Accessory Board	Beta
pic32mx_usb_sk2	BSP the PIC32 USB Starter Kit II.	Beta
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.	Beta
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.	Beta
pic32mx_usb_sk2+meb	BSP for the Multimedia Expansion Board (MEB) connected to the PIC32 USB Starter Kit II.	Beta
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.	Beta
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.	Beta
pic32mx_usb_sk2+s1d_pictail+wvga	BSP for the Graphics Controller PICtail Plus Epson S1D13517 Daughter Board with Graphics Display Truly 7" 800x400 Board connected to the PIC32 USB Starter Kit II.	Beta
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.	Beta
pic32mx_usb_sk3	BSP for the PIC32 USB Starter Kit III.	Beta
pic32mx270f512l_pim+bt_audio_dk	BSP for the PIC32MX270F512L Plug-in Module (PIM) connected to the PIC32 Bluetooth Audio Development Kit.	Beta
pic32mx460_pim+e16	BSP for the PIC32MX460F512L Plug-in Module (PIM) connected to the Explorer 16 Development Board.	Beta
pic32mx470_curiosity	BSP for the PIC32MX470 Curiosity Development Board.	Beta
pic32mx470_pim+e16	BSP for the PIC32MX450/470F512L Plug-in Module (PIM) connected to the Explorer 16 Development Board.	Beta
pic32mx795_pim+e16	BSP for the PIC32MX795F512L Plug-in Module (PIM) connected to the Explorer 16 Development Board.	Beta
pic32mz_da_sk	BSP for the PIC32MZ Graphics (DA) Starter Kit.	Beta
pic32mz_da_sk+169lfbga_cpu	BSP for the 169-pin LFBGA CPU Daughter Board connected to the PIC32MZ Graphics (DA) Starter Kit.	Beta
pic32mz_da_sk+meb2+wvga	BSP for the Multimedia Expansion Board II (MEB II) with the 5" WVGA PCAP Display Board (see Note) connected to the PIC32MZ Graphics (DA) Starter Kit.  Note: Please contact your local Microchip Sales Office for information on obtaining the 5" WVGA PCAP Display Board.	Beta
pic32mz_ec_pim+bt_audio_dk	BSP for the PIC32MZ2048ECH144 Audio Plug-in Module (PIM) connected to the PIC32 Bluetooth Audio Development Kit.	Beta
pic32mz_ec_pim+e16	BSP for the PIC32MZ2048ECH100 Plug-in Module (PIM) connected to the Explorer 16 Development Board.	Beta

pic32mz_ec_sk	BSP for the PIC32MZ Embedded Connectivity (EC) Starter Kit.	Beta
pic32mz_ec_sk+meb2	BSP for the Multimedia Expansion Board II (MEB II) connected to the PIC32MZ Embedded Connectivity (EC) Starter Kit.	Beta
pic32mz_ec_sk+meb2+wvga	BSP for the Multimedia Expansion Board II (MEB II) with the 5" WVGA PCAP Display Board (see Note) connected to the PIC32MZ Embedded Connectivity (EC) Starter Kit.  Note: Please contact your local Microchip Sales Office for information on obtaining the 5" WVGA PCAP Display Board.	Beta
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.	Beta
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.	Beta
pic32mz_ec_sk+s1d_pictail+wvga	BSP for the Graphics Controller PICtail Plus Epson S1D13517 Daughter Board with the 5" WVGA PCAP Display Board (see Note) connected to the PIC32MZ Embedded Connectivity with Floating Point Unit (EC) Starter Kit.  Note: Please contact your local Microchip Sales Office for information on obtaining the 5" WVGA PCAP Display Board.	Beta
pic32mz_ef_curiosity	BSP for the PIC32MZ EF Curiosity Development Board.	Beta
pic32mz_ef_pim+bt_audio_dk	BSP for the PIC32MZ2048EFH144 Audio Plug-in Module (PIM) connected to the PIC32 Bluetooth Audio Development Kit.	Beta
pic32mz_ef_pim+e16	BSP for the PIC32MZ2048EFH100 Plug-in Module (PIM) connected to the Explorer 16 Development Board.	Beta
pic32mz_ef_sk	BSP for the PIC32MZ Embedded Connectivity with Floating Point (EF) Starter Kit.	Beta
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.	Beta
pic32mz_ef_sk+meb2+wvga	BSP for the Multimedia Expansion Board II (MEB II) with the 5" WVGA PCAP Display Board (see Note) connected to the PIC32MZ Embedded Connectivity with Floating Point Unit (EF) Starter Kit.  Note: Please contact your local Microchip Sales Office for information on obtaining the 5" WVGA PCAP Display Board.	Beta
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.	Beta
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.	Beta
wifi_g_db	BSP for the Wi-Fi G Demo Board.	Beta

Audio Applications:

<install-dir>/apps/audio/	Description	Release Type
audio_microphone_loopback	Audio Microphone Loopback Demonstration	Production
audio_tone	Audio Tone Demonstration	Production
mac_audio_hi_res	Hi-resolution Audio Demonstration	Beta
sdcard_usb_audio	USB Audio Demonstration	Beta
universal_audio_decoders	Universal Audio Decoder Demonstration	Production
usb_headset	USB Audio Headset Demonstration	Production
usb_microphone	USB Audio Microphone Demonstration	Production
usb_speaker	USB Audio Speaker Demonstration	Production

Bluetooth Applications:

<install-dir>/apps/bluetooth/	Description	Release Type
data/data_basic	Bluetooth® Basic Data Demonstration	Production
data/data_temp_sens_rgb	Bluetooth Temperature Sensor and RGB Data Demonstration	Production
premium/audio/a2dp_avrcp	Bluetooth Premium Audio Demonstration	Production

Bootloader Applications:

<install-dir>/apps/bootloader/	Description	Release Type
basic	Basic Bootloader Demonstration	Production
LiveUpdate	Live Update Demonstration	Production

Cryptographic Applications:

<install-dir>/apps/crypto/	Description	Release Type
encrypt_decrypt	Crypto Peripheral Library MD5 Encrypt/Decrypt Demonstration	Production
large_hash	Crypto Peripheral Library Hash Demonstration	Production

Driver Applications:

<install-dir>/apps/driver/	Description	Release Type
i2c/i2c_rtcc	I2C RTCC Demonstration	Production
nvm/nvm_read_write	NVM Demonstration	Production
spi/serial_eeprom	SPI Demonstration	Production
spi/spi_loopback	SPI Demonstration	Production
spi_flash/sst25vf020b	SPI Flash SST25VF020B Device Demonstration	Production
usart/usart_echo	USART Demonstration	Production
usart/usart_loopback	USART Loopback Demonstration	Production

Example Applications:

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

External Memory Programmer Applications:

<install-dir>/apps/programmer/	Description	Release Type
external_flash	External Flash Bootloader Demonstration	Production
sqi_flash	External Memory Programmer SQI Flash Demonstration	Production

File System Applications:

<install-dir>/apps/fs/	Description	Release Type
nvm_fat_single_disk	Single-disk Non-Volatile Memory FAT FS Demonstration	Production
nvm_mpfs_single_disk	Single-disk Non-Volatile Memory MPFS Demonstration	Production
nvm_sdcard_fat_mpfs_multi_disk	Multi-disk Non-Volatile Memory FAT FS MPFS Demonstration	Production
nvm_sdcard_fat_multi_disk	Multi-disk Non-Volatile Memory FAT FS Demonstration	Production
sdcard_fat_single_disk	Single-disk SD Card FAT FS Demonstration	Production
sdcard_msd_fat_multi_disk	Multi-disk SD Card MSD FAT FS Demonstration	Production

Graphics Applications:

<install-dir>/apps/gfx/	Description	Release Type
emwin_quickstart	SEGGER emWin Quick Start Demonstration	Beta
external_resources	Stored Graphics Resources External Memory Access Demonstration	Production
graphics_showcase	Graphics Low-Cost Controllerless (LCC) WVGA Demonstration	Beta
lcc	Low-Cost Controllerless (LCC) Graphics Demonstration	Production
media_image_viewer	Graphics Media Image Viewer Demonstration	Beta
object	Graphics Object Layer Demonstration	Production
primitive	Graphics Primitives Layer Demonstration	Production
s1d13517	Epson S1D13517 LCD Controller Demonstration	Production
ssd1926	Solomon Systech SSD1926 Controller Demonstration	Production

Multimedia Expansion Board II (MEB II) Applications:

<install-dir>/apps/meb_ii/	Description	Release Type
gfx_camera	Graphics Camera Demonstration	Production
gfx_cdc_com_port_single	Combined Graphics and USB CDC Demonstration	Production
gfx_photo_frame	Graphics Photo Frame Demonstration	Production
gfx_web_server_nvm_mpfs	Combined Graphics and TCP/IP Web Server Demonstration	Production
emwin	SEGGER emWin® Capabilities on MEB II Demonstration	Beta

RTOS Applications:

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

TCP/IP Applications:

<install-dir>/apps/tcpip/	Description	Release Type
berkeley_tcp_client	Berkeley TCP/IP Client Demonstration	Production
berkeley_tcp_server	Berkeley TCP/IP Server Demonstration	Production
berkeley_udp_client	Berkeley TCP/IP UDP Client Demonstration	Production
berkeley_udp_relay	Berkeley TCP/IP UDP Relay Demonstration	Production
berkeley_udp_server	Berkeley TCP/IP UDP Server Demonstration	Production
wolfssl_tcp_client	wolfSSL TCP/IP TCP Client Demonstration	Production
wolfssl_tcp_server	wolfSSL TCP/IP TCP Server Demonstration	Production
snmpv3_nvm_mpfs	SNMPv3 Non-Volatile Memory Microchip Proprietary File System Demonstration	Production
snmpv3_sdcard_fatfs	SNMPv3 Non-Volatile Memory SD Card FAT File System Demonstration	Production
tcpip_tcp_client	TCP/IP TCP Client Demonstration	Production
tcpip_tcp_client_server	TCP/IP TCP Client Server Demonstration	Production
tcpip_tcp_server	TCP/IP TCP Server Demonstration	Production
tcpip_udp_client	TCP/IP UDP Client Demonstration	Production
tcpip_udp_client_server	TCP/IP UDP Client Server Demonstration	Production
tcpip_udp_server	TCP/IP UDP Server Demonstration	Production
web_server_nvm_mpfs	Non-Volatile Memory Microchip Proprietary File System Web Server Demonstration	Production
web_server_sdcard_fatfs	SD Card FAT File System Web Server Demonstration	Production
wifi_easy_configuration	Wi-Fi® EasyConf Demonstration	Production
wifi_g_demo	Wi-Fi G Demonstration	Production
wifi_wolfssl_tcp_client	Wi-Fi wolfSSL TCP/IP Client Demonstration	Production
wifi_wolfssl_tcp_server	Wi-Fi wolfSSL TCP/IP Server Demonstration	Production
wolfssl_tcp_client	wolfSSL TCP/IP Client Demonstration	Production
wolfssl_tcp_server	wolfSSL TCP/IP Server Demonstration	Production

Test Applications:

<install-dir>/apps/meb_ii/	Description	Release Type
test_sample	MPLAB Harmony Test Sample Application	Alpha

USB Device Applications:

<install-dir>/apps/usb/device/	Description	Release Type
cdc_com_port_dual	CDC Dual Serial COM Ports Emulation Demonstration	Production
cdc_com_port_single	CDC Single Serial COM Port Emulation Demonstration	Production
cdc_msd_basic	CDC Mass Storage Device (MSD) Demonstration	Production
cdc_serial_emulator	CDC Serial Emulation Demonstration	Production
cdc_serial_emulator_msd	CDC Serial Emulation MSD Demonstration	Production
hid_basic	Basic USB Human Interface Device (HID) Demonstration	Production
hid_joystick	USB HID Class Joystick Device Demonstration	Production
hid_keyboard	USB HID Class Keyboard Device Demonstration	Production

hid_mouse	USB HID Class Mouse Device Demonstration	Production
hid_msd_basic	USB HID Class MSD Demonstration	Production
msd_basic	USB Mass Storage Device (MSD) Demonstration	Production
msd_sdcard	USB MSD SD Card Demonstration	Production
vendor	USB Vendor (i.e., Generic) Demonstration	Production

USB Host Applications:

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

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)	Beta
decoder/premium/aac_pic32mx	Prebuilt AAC Decoder Library for PIC32MX Devices (Premium)	Beta
decoder/premium/mp3_microaptiv	Prebuilt MP3 Decoder Library for PIC32MZ Devices with microAptiv Core Features (Premium)	Beta
decoder/premium/mp3_pic32mx	Prebuilt MP3 Decoder Library for PIC32MX Devices (Premium)	Beta
decoder/premium/wma_microaptiv	Prebuilt WMA Decoder Library for PIC32MZ Devices with microAptiv Core Features (Premium)	Beta
decoder/premium/wma_pic32mx	Prebuilt WMA Decoder Library for PIC32MX Devices (Premium)	Beta
math/dsp	Prebuilt DSP Fixed-Point Math Libraries for PIC32MZ Devices	Production
math/libq	Prebuilt LibQ Fixed-Point Math Libraries for PIC32MZ Devices	Production
peripheral	Prebuilt Peripheral Libraries	Production/ Beta

Build Framework:

<install-dir>/build/framework/	Description	Release Type
math/libq	LibQ Library Build Project	Production
peripheral	Peripheral Library Build Project	Production

Utilities:

<install-dir>/utilities/	Description	Release Type
mhc/com-microchip-mplab-modules-mhc.nbm	MPLAB Harmony Configurator (MHC) Plug-in MPLAB Harmony Graphics Composer (included in the MHC plug-in)	Beta 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	JPEG Decoder Library Source Distribution	Vendor
gfx/emwin	SEGGER emWin® Graphics Library Distribution	Vendor
rtos/embOS	SEGGER embOS® Distribution	Vendor
rtos/FreeRTOS	FreeRTOS Source Distribution with Support for PIC32MZ Devices	Vendor
rtos/MicriumOSII	Micrium® µC/OS-II™ Distribution	Vendor
rtos/MicriumOSIII	Micrium® µC/OS-III™ Distribution	Vendor
rtos/OpenRTOS	OPENRTOS Source Distribution with Support for PIC32MZ Devices	Vendor
rtos/ThreadX	Express Logic ThreadX Distribution	Vendor
segger/emwin	SEGGER emWin® Pro Distribution	Vendor
tcpip/wolfssl	wolfSSL (formerly CyaSSL) Embedded SSL Library Open Source-based Demonstration	Vendor
tcpip/iniche	InterNiche Library Distribution	Vendor

Documentation:

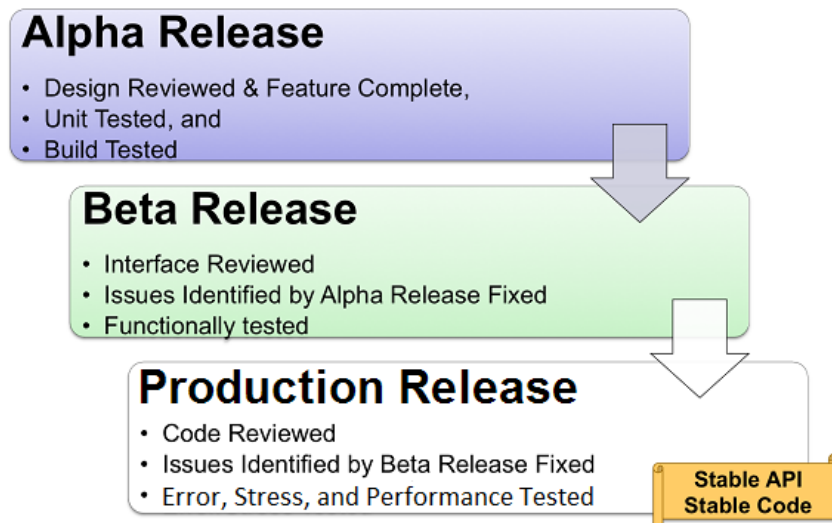
<install-dir>/doc/	Description	Release Type
harmony_help.pdf	MPLAB Harmony Help in Portable Document Format (PDF)	Production
harmony_help.chm	MPLAB Harmony Help in Compiled Help (CHM) format	Production
html/index.html	MPLAB Harmony Help in HTML format	Production
harmony_compatibility_worksheet.pdf	PDF form for use in determining the level of MPLAB Harmony compatibility and to capture any exceptions or restrictions to the compatibility guidelines	Production
harmony_release_brief_v2.00b.pdf	MPLAB Harmony Release Brief, providing "at-a-glance" release information	Production
harmony_release_notes_v2.00b.pdf	MPLAB Harmony Release Notes in PDF	Production
harmony_license_v2.00b.pdf	MPLAB Harmony Software License Agreement in PDF	Production

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. A beta release is not recommended for production use, but it can be used for development.

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).

$\text{<major> * 10000 + <minor> * 100 + <patch>}$

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: $1 * 10000 + 0 * 100 + 0$.