

Bluetooth® Low Energy Software for the Kinetis MKW41Z Dual Mode Wireless Microcontroller, Version 1.2.6

Release Notes

1 Overview

These release notes pertain to the platform software that was developed for the MKW41Z Kinetis-based Bluetooth® low energy (BLE) v4.2 compliant platforms, and the associated development boards FRDM-KW41Z, USB-KW41Z. These notes pertain to the Kinetis BLE Platform Software version 1.2.6.

Contents

1	Overview.....	1
2	Release Contents	2
2.1	List of Pre-compiled Binaries	3
3	What's New and Change Log	4
3.1	MKW41Z BLE Software v1.2.6 Changes.....	4
3.2	MKW41Z BLE Software v1.2.5 Changes.....	4
3.3	MKW41Z BLE Software v1.2.4 Changes.....	4
3.4	MKW41Z BLE Software v1.2.3 Changes.....	4
3.5	MKW41Z BLE Software v1.2.2 Changes.....	5
3.6	MKW41Z BLE Software v1.2.1 Changes.....	5
3.7	MKW41Z BLE Software v1.2.0 Changes.....	6
3.8	Supported GATT Profiles.....	7
4	Software Deployment Considerations.....	8
5	Embedded System Considerations.....	8
6	Known Limitations.....	9
7	Documentation Included in this Package.....	10
8	BLE Applications Memory Footprints.....	11



2 Release Contents

The NXP Kinetis MKW41Z Bluetooth® LE Software version 1.2.6 release main wireless connectivity components are listed in the table below.

Table 1. Release Contents

(File Folder) Name	Description
boards/[board]/wireless_examples/bluetooth	Demo applications on top of GATT standard profiles: <ul style="list-style-type: none"> - BPS – Blood Pressure Sensor - CSCS – Cycling Speed Cadence Sensor - HID – Host and Device - CPS – Cycling Power Sensor - HRS – Heart Rate - HTS – Health Thermometer - PXR – Proximity Reporter - IPv6 – IPSP Node and Router - RSCS – Running Speed and Cadence Sensor - ANS – Alert Notification Sensor - GLS – Glucose Sensor - PLXP – Pulse Oximeter Demo applications not based on standard GATT profiles: <ul style="list-style-type: none"> - Temperature Sensor - Temperature Collector - Wireless UART - OTAP server and client - Beacon advertiser - Shell/Console application - IPv6 node/router
boards/[board]/wireless_examples/hybrid	Hybrid dual mode (BLE + 802.15.4) applications
middleware/wireless/bluetooth_1.2.6/host	Bluetooth® LE v4.2 host stack
middleware/wireless/bluetooth_1.2.6/controller	Bluetooth® LE v4.2 controller
middleware/wireless/bluetooth_1.2.6/profiles	Bluetooth® LE GATT profiles
doc/wireless	Wireless connectivity documentation
middleware/wireless/framework_5.3.6/Common	Connectivity Framework common files
middleware/wireless/framework_5.3.6/DSP	Signal processing and bit manipulation helper functions
middleware/wireless/framework_5.3.6/FSCI	Freescale Serial Connectivity Interface
middleware/wireless/framework_5.3.6/LowPower	Low Power Module
middleware/wireless/framework_5.3.6/MemManager	Memory Manager
middleware/wireless/framework_5.3.6/Messaging	Messaging API
middleware/wireless/framework_5.3.6/NVM	Non Volatile Memory support
middleware/wireless/framework_5.3.6/OtaSupport	Over-The-Air Programming support files
middleware/wireless/framework_5.3.6/Panic	Panic module
middleware/wireless/framework_5.3.6/RNG	Random Number Generator wrapper
middleware/wireless/framework_5.3.6/SerialManager	Serial Manager for various interface
middleware/wireless/framework_5.3.6/Shell	Shell/Console module
middleware/wireless/framework_5.3.6/TimersManager	Timers Manager module
middleware/wireless/framework_5.3.6/SecLib	Security Library
tools/wireless/binaries	Demo applications binaries
tools/wireless/host_sdk	Python host SDK and BLE bindings for FSCI

2.1 List of Pre-compiled Binaries

The *tools/wireless/binaries* folder contains the following pre-compiled binaries:

- *sniffer_usbkw41z_kw41z.bin* – Hybrid (802.15.4 and BLE) sniffer firmware for the KW41Z silicon on the USB-KW41Z board
- *sniffer_usbkw41z_k22f.bin* – Hybrid (802.15.4 and BLE) sniffer firmware for the K22F silicon on the USB-KW41Z board, linked at 0x0 (no OpenSDA bootloader provisioning)
- *sniffer_usbkw41z_k22f_0x8000.bin* – Hybrid (802.15.4 and BLE) sniffer firmware for the K22F silicon on the USB-KW41Z board, linked at 0x8000 (OpenSDA bootloader provisioning)
- *bootloader_fsci_ack_frdmku41z.bin* – FSCI Bootloader for the FRDM-KW41Z board with the ACK-enabled FSCI protocol
- *bootloader_fsci_ack_usbkw41z.bin* – FSCI Bootloader for the USB-KW41Z board with the ACK-enabled FSCI protocol
- *bootloader_fsci_frdmku41z.bin* – FSCI Bootloader for the FRDM-KW41Z board with the ACK-disabled FSCI protocol
- *bootloader_fsci_usbkw41z.bin* – FSCI Bootloader for the FRDM-KW41Z board with the ACK-disabled FSCI protocol
- *bootloader_otap_frdmku41z.bin* – OTAP Bootloader for the FRDM-KW41Z board
- *bootloader_otap_usbkw41z.bin* – OTAP Bootloader for the USB-KW41Z board

Please refer to <http://www.nxp.com/connectivity> for more information on NXP wireless connectivity platforms.

3 What's New and Change Log

This section describes the major changes and new features implemented in the BLE software releases, as well as the list of GATT supported profiles:

3.1 MKW41Z BLE Software v1.2.6 Changes

- This version corresponds to a maintenance release of build of the MKW41Z BLE Software. Some of its major new features, compared to the previous BLE release on Kinetis MKW41Z wireless microcontrollers, include:
 - Add required changes described in Bluetooth Specification Erratum 10734
 - Updated Framework Security Library Module
 - Updated BLE Host Security Manager Module
 - Updated transceiver driver for better RF performance
 - Updated BLE v4.2 sniffer for USB-KW41Z
 - Bug fixing

3.2 MKW41Z BLE Software v1.2.5 Changes

- This version corresponds to a maintenance release of build of the MKW41Z BLE Software. Some of its major new features, compared to the previous BLE release on Kinetis MKW41Z wireless microcontrollers, include:
 - BLE - ZigBee hybrid demo applications
 - Added new functionalities in the Wireless Framework modules

3.3 MKW41Z BLE Software v1.2.4 Changes

- This version corresponds to a maintenance release of build of the MKW41Z BLE Software. Some of its major new features, compared to the previous BLE release on Kinetis MKW41Z wireless microcontrollers, include:
 - Updated transceiver driver for better RF performance
 - General bug fixing

3.4 MKW41Z BLE Software v1.2.3 Changes

- This version corresponds to a maintenance release of build of the MKW41Z BLE Software. Some of its major new features, compared to the previous BLE release on Kinetis MKW41Z wireless microcontrollers, include:
 - Adopted NVM wear-levelling for pairing and bonding data storage.
 - Enhanced NVM module to allow declaration of datasets from multiple files
 - MCUXpresso IDE support

- Enhanced WLAN coexistence module with more configurability for the protocol
- FreeRTOS v9.0.0 support
- Updated transceiver driver for better RF performance
- Updated DCDC converter driver with new voltage ranges
- BLE controller library API cosmetic changes (see API reference manual for details)
- Better integration with the Kinetis BLE Toolbox mobile application
- General bug fixing
- Discontinued uC/OS-II RTOS support
- Discontinued Kinetis Design Studio support
- Discontinued the BLE Mesh support

3.5 MKW41Z BLE Software v1.2.2 Changes

- This version corresponds to the General Availability (GA) build of the MKW41Z BLE Software. Some of its major new features, compared to Beta BLE release on Kinetis MKW41Z wireless microcontrollers, include:
 - The Bluetooth® LE v4.2 features in this release have undergone a Bluetooth® SIG qualification listing process, as follows:
 - Host stack: https://www.bluetooth.org/tpg/QLI_viewQDL.cfm?qid=31668
 - Controller: https://www.bluetooth.org/tpg/QLI_viewQDL.cfm?qid=31669
 - Full IPv6 stack enablement over 6LoBLE and the IPSP profile, including router and node applications.
 - Time services (NDCS, RTUS and CTS) in example applications
 - A4WP Wireless Power Transfer System BLE profile plus Power Receiving Unit (PRU) and Power Transmitting Unit (PTU) example applications for the BLE profiles.
 - HTTP proxy service
 - Coexistence mechanism with WLAN co-located chips
 - Optimized MCU low power management during radio events.
 - Better alignment of connectivity folder structure with the Kinetis SDK.
 - Optional packaging in .tar.gz format for Linux host machines
 - uC/OS-II support for hybrid applications

3.6 MKW41Z BLE Software v1.2.1 Changes

- This version corresponds to the Beta build of the MKW41Z BLE Software. Some of its major new features, compared to Alpha BLE release on Kinetis MKW41Z wireless microcontrollers, include:
 - Implementation of a flooding-based BLE Mesh layer with demo applications
 - Support for the Kinetis Design Studio IDE and the GNU Toolchain
 - Support for the Micrium uC/OS-II RTOS
 - Pulse Oximeter GATT profile and example application
 - BLE v4.2 Secure LE Connections support in the Over-The-Air update applications
 - BLE v4.2 Secure LE Connections usage as default security in all demo applications
 - BLE v4.2 Enhanced Controller Privacy usage in all demo applications

- Dual mode (BLE and IEEE 802.15.4) support and hybrid demo applications
- FSCI host applications running on the K22F MCU on USB-KW41Z
- FSCI Host SDK support for BLE v4.2 in Python scripts
- BLE v4.2 sniffer firmware for USB-KW41Z

3.7 MKW41Z BLE Software v1.2.0 Changes

- This version corresponds to the Alpha build of the MKW41Z BLE Software. Some of its major new features, compared to previous BLE releases on Kinetis MKW40Z wireless microcontrollers, include:
 - Bluetooth® LE v4.2 Secure LE Connections support
 - Bluetooth® LE v4.2 Enhanced Controller Privacy support
 - Bluetooth® LE v4.2 Data Packet Length Extension support (up to 254 bytes)
 - Support for two Link Layer hardware connection engines
 - Console/Shell command line interface application for easy interaction with the host stack, usable with a serial terminal program
 - KSDK 2.0 integration of the BLE and Connectivity Framework software
 - Enablement for the FRDM-KW41Z and USB-KW41Z evaluation boards

3.8 Supported GATT Profiles

The complete list of GATT profiles and services defined by the Bluetooth SIG, along with the corresponding versions of the specifications, supported in the demo applications included in this release is enumerated below:

• BAS - Battery Service	v1.0
• BLP - Blood Pressure Profile	v1.0
• BLS - Blood Pressure Service	v1.0
• CSCP - Cycling Speed and Cadence Profile	v1.0
• CSCS - Cycling Speed and Cadence Service	v1.0
• HIDS - Human Interface Device Service	v1.0
• HOGP - HID over GATT Profile	v1.0
• HRP - Heart Rate Profile	v1.0
• HRS - Heart Rate Service	v1.0
• HTP - Health Thermometer Profile	v1.0
• HTS - Health Thermometer Service	v1.0
• PXP - Proximity Profile	v1.0.1
• DIS - Device Information Service	v1.1
• IAS - Immediate Alert Service	v1.0
• LLS - Link Loss Service	v1.0.1
• TPS - Tx Power Service	v1.0
• CPP - Cycling Power Profile	v1.0
• CPS - Cycling Power Service	v1.0
• IPSP - Internet Protocol Support Profile	v1.0
• RSCP - Running Speed and Cadence Profile	v1.0
• RSCS - Running Speed and Cadence Service	v1.0
• GLP - Glucose Profile	v1.0
• GLS - Glucose Service	v1.0
• ANP - Alert Notification Profile	v1.0
• ANS - Alert Notification Service	v1.0
• PLXP - Pulse Oximeter Profile	v1.0
• RTUS - Reference Time Update Service	v1.0
• CTS - Current Time Service	v1.1
• NDCS - Next DST Change Service	v1.0
• HPS - HTTP Proxy Service	v1.0

This software package supports the following profiles standardized outside the Bluetooth SIG

- **A4WP** - AirFuel™ Alliance Wireless Power Transfer System **v1.3**

4 Software Deployment Considerations

- The Bluetooth® low energy applications in this package have been built in a Kinetis SDK version 2 environment, making use of the FreeRTOS kernel and microcontroller peripheral drivers included in this SDK. This package includes a full build of the Kinetis SDK v2 for Kinetis MKW41Z/31Z/21Z.
- IAR Embedded Workbench for ARM® v8.22.2 was used to build and test the Bluetooth low energy example IDE projects included in this release.
- MCUXpresso IDE v10.2.1 was used to build the Bluetooth low energy associated example applications IDE projects.
- This release is compatible with the Test Tool for Connectivity Products v12.8.2 or later. It is recommended to use the BLE_1.2.6.xml file found in the tools/wireless/xml_fsci folder of this package or the Test Tool installation, with the Test Tool Command Console functionality to interact with the FSCI black box applications provided in this package. For more information, please refer Test Tool User's Guide included in the Test Tool installation.

5 Embedded System Considerations

- This release supports the FRDM-KW41Z and USB-KW41Z evaluation boards
- The FRDM-KW41Z and USB-KW41Z boards feature a composite USB device called OpenSDA which serves as debugger interface and as USB to serial converter via a virtual COM port application. Several firmware images can be programmed on the FRDM-KW41Z OpenSDA device, among which:
 - <https://github.com/mbedmicro/CMSIS-DAP>
 - <https://www.segger.com/opensda.html>
 - <http://www.pemicro.com/opensda/>
- If your FRDM-KW41Z board is configured for the buck or boost modes of the DCDC converter inside the KW41Z microcontroller, the firmware too needs to be configured for these modes of the DCDC, by setting the following defines: *gDCDC_Enabled_d* to 1 and *APP_DCDC_MODE* to *gDCDC_Mode_Buck_c* or *gDCDC_Mode_Boost_c* respectively, in the *app_preinclude.h* header file.
- The pre-compiled binaries for FRDM-KW41Z are optimized for the DCDC buck mode configuration of the board.
- The A4WP example applications are configured by default for the DCDC bypass settings of the FRDM-KW41Z board, to fully leverage the RGB LED capabilities available at 3.3V supply voltage.

6 Known Limitations

- This release supports only the IAR Embedded Workbench and MCUXpresso IDEs and toolchains, the FreeRTOS kernel and a bare-metal non-preemptive task scheduler. Other RTOSes and toolchains supported in the KSDK have not been tested with this release.
- Applications like the *heart_rate_sensor* or the *temperature_sensor* are configured to enter low power immediately after boot, to be woken up on a switch press. This functionality will cause a connected debugger to disconnect. To debug these applications, please disable the low power functionality in the *app_preinclude.h* header file.
- Most sensor applications have the pairing and bonding disabled to allow a faster interaction with mobile applications. These two security features can be enabled in the *app_preinclude.h* header file.
- Maximum file path length in Windows® 7 Operating System: Windows OS 7 imposes a 260-character maximum length for file paths. The same limitation influences the command line for build tools in various toolchains, which cannot exceed 8191 characters. When deploying this package, it is recommended to place it in a directory close to the root of the disk drive to prevent the limitations described above. The recommended location is the C:\NXP folder."
- For the FRDM-KW41Z evaluation board, the default pin configuration when enabling in the code an off-chip Bluetooth LE/WLAN coexistence model, does not allow the LED software module and the SW3 button to be active.
- NVM usage for pairing/bonding information storage in the FSCI black-box application must be complemented by the enablement of the FSCI protocol ACK feature, to ensure flash writes do not interfere with the serial communication. More specifically, when enabling *gAppUseNvm_d* in the *app_preinclude.h* file associated with the FSCI black-box application, *gFsciTxAck_c* and *gFsciRxAck_c* must be enabled as well. The corresponding FSCI host must also enable FSCI ACKs. Please note that by default all these preprocessor switches are set to zero and ACKs are disabled in the Host SDK and the BLE FSCI host applications. For more information, please refer the Kinetis FSCI Host Application Programming Interface User's Guide.
- One may experience a warning for "cmsis_iar.h" with IAR EWARM 8.22.x. The patch can be found on the IAR's My Pages.
- One may experience a warning for "Warning[Pa182]: bitwise operation drops significant bits from a constant" with IAR EWARM 8.30.1. This is a false warning and will be fixed in new IAR release.

7 Documentation Included in this Package

The following connectivity-supporting documentation is included in this package:

- *BLE Quick Start Guide.pdf*
- *BLE Quick Start Guide.pdf*
- *BLE Host Stack API Reference Manual*
- *BLE Application Developer's Guide*
- *BLE Demo Applications User's Guide*
- *BLE Host Stack API Reference Manual*
- *BLE Host Stack FSCI Reference Manual*
- *USB-KW41Z Wireless Protocol Sniffer Quick Start Guide.pdf*

For detailed reference documentation on this software package, please visit

<https://nxp.com/infocenter>

The *docs/wireless/Bluetooth/ICS* folder contains Implementation Conformance Statement (ICS) files for the Bluetooth® LE v4.2 profiles included in this package. The files are in PTS format, which can be opened with the Bluetooth® Profile Tuning Suite.

8 BLE Applications Memory Footprints

The following tables represent the memory footprints of the listed BLE-based applications:

Application – Beacon		
Configuration - FreeRTOS, IAR Embedded Workbench, FRDM-KW41Z		
	RAM [bytes]	Flash [bytes]
Application code	3,567	5,167
Kinetis base SDK	336	6,723
Connectivity Framework	4,335	23,528
RTOS	8,672	5,394
BLE Host	3,747	64,348
BLE Controller	1,775	42,170
Total	22,432	147,820

Application – Heart Rate Sensor		
Configuration - FreeRTOS, IAR Embedded Workbench, FRDM-KW41Z		
	RAM [bytes]	Flash [bytes]
Application code	3,900	7,879
Kinetis base SDK	336	7,247
Connectivity Framework	8,415	27,564
RTOS	8,672	5,394
BLE Host	3,067	46,441
BLE Controller	1,775	42,209
Total	26,165	136,734

Application – Wireless UART		
Configuration - FreeRTOS, IAR Embedded Workbench, FRDM-KW41Z		
	RAM [bytes]	Flash [bytes]
Application code	4,673	8,289
Kinetis base SDK	336	7,980
Connectivity Framework	28,636	25,287
RTOS	8,672	5,514
BLE Host	3,747	66,250
BLE Controller	1,775	42,165
Total	47,839	155,485

Application – HID Host		
Configuration - FreeRTOS, IAR Embedded Workbench, FRDM-KW41Z		
	RAM [bytes]	Flash [bytes]
Application code	1,845	8,479
Kinetis base SDK	336	7,655
Connectivity Framework	12,792	36,099
RTOS	9,172	5,520
BLE Host	2,902	48,710
BLE Controller	1,775	42,192
Total	28,822	148,655

Application – IPv6 Router Configuration - FreeRTOS, IAR Embedded Workbench, FRDM-KW41Z		
	RAM [bytes]	Flash [bytes]
Application code	5,605	11,553
Kinetis base SDK	360	8,080
Connectivity Framework	10,055	37,531
RTOS	13,672	5,559
BLE Host	2,993	47,247
BLE Controller	1,765	42,056
BLE IPV6	92	36,202
Total	34,379	188,651

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