Bluetooth® LE SDK 7.0.0.0 GA

Gecko SDK Suite 4.4

December 13, 2023

Silicon Labs is a leading vendor in Bluetooth hardware and software technologies, used in products such as sports and fitness, consumer electronics, beacons, and smart home applications. The core SDK is an advanced Bluetooth 5.4-compliant stack that provides all of the core functionality along with multiple API to simplify development. The core functionality offers both standalone mode allowing a developer to create and run their application directly on the SoC, or in NCP mode allowing for the use of an external host MCU.

These release notes cover SDK version(s):

7.0.0.0 GA released December 13, 2023

Bluetooth

KEY FEATURES

Bluetooth

- New feature component bluetooth_feature_connection_analyzer provides the functionality to capture and analyze the RSSI of transmissions on a Bluetooth connection

Multiprotocol

- Concurrent Listening support (RCP) – MG21 and MG24
- Concurrent Multiprotocol (CMP) Zigbee NCP + OpenThread RCP – production quality
- Dynamic Multiprotocol Bluetooth + Concurrent Multiprotocol (CMP) Zigbee and OpenThread support on SoC

Compatibility and Use Notices

For information about security updates and notices, see the Security chapter of the Gecko Platform Release notes installed with this SDK or on the TECH DOCS tab on https://www.silabs.com/developers/bluetooth-low-energy. Silicon Labs also strongly recommends that you subscribe to Security Advisories for up-to-date information. For instructions as well as notes on using Secure Vault features, or if you are new to the Silicon Labs Bluetooth SDK, see Using This Release.

Compatible Compilers:

IAR Embedded Workbench for ARM (IAR-EWARM) version 9.40.1.

- Using wine to build with the IarBuild.exe command line utility or IAR Embedded Workbench GUI on macOS or Linux could result in incorrect files being used due to collisions in wine's hashing algorithm for generating short file names.
- Customers on macOS or Linux are advised not to build with IAR outside of Simplicity Studio. Customers who do should carefully verify that the correct files are being used.

GCC (The GNU Compiler Collection) version 12.2.1, provided with Simplicity Studio.

Contents

1 New Items

This release of the Gecko SDK (GSDK) will be the last with combined support for all EFM and EFR devices, except for patches to this version as needed. Starting in mid-2024 we will introduce separate SDKs:

- The existing Gecko SDK will continue with support for Series 0 and 1 devices.
- A new SDK will cater specifically to Series 2 and 3 devices.

The Gecko SDK will continue to support all Series 0 and 1 devices with no change to the long-term support, maintenance, quality, and responsiveness provided under our software policy.

The new SDK will branch from Gecko SDK and begin to offer new features that help developers take advantage of the advanced capabilities of our Series 2 and 3 products.

This decision aligns with customer feedback, reflecting our commitment to elevate quality, ensure stability, and enhance performance for an exceptional user experience across our software SDKs.

1.1 New Features

Added in release 7.0.0.0

Bluetooth Connection Analyzer

New feature component bluetooth_feature_connection_analyzer provides the functionality to capture and analyze the RSSI of transmissions on a Bluetooth connection.

1.2 New APIs

Added in release 7.0.0.0

sl_bt_connection_analyzer_start command: Start to analyze another device's connection and report the RSSI measurements.

sl_bt_connection_analyzer_stop command: Stop analyzing another device's Bluetooth connection.

sl_bt_evt_connection_analyzer_report event: Triggered when packets transmitted on a connection are captured.

sl_bt_evt_connection_analyzer_completed event: Triggered when the operation of analyzing a connection is completed.

sl_bt_connection_get_scheduling_details command: Get parameters and next connection event scheduling details of a connection.

sl_bt_connection_get_median_rssi command: Get the RSSI value measured on a connection.

sl_bt_sm_resolve_rpa command: Find the identity address of a bonded device by a resolvable private address (RPA).

sl_bt_evt_connection_set_parameters_failed event: Triggered when the peer device rejected an L2CAP connection parameter update request.

ID #	Description
1203776	Introduce a new ESL C library event ID: ESL_LIB_EVT_PAWR_CONFIG. A PAwR configuration is now subject to a preliminary sanity check by the ESL C library before the configuration is set - if the check fails, the configuration is rejected.
1196297	Added support to HADM for arbitrary number of channels up to 80.
1187941	‘bt_abr_host_initiator’ now has the function to save the jsonl logfiles to a selected folder using the command argument '-d'. In case the parameter is empty or a non-valid path to a directory it will use the current working directory and inform the user.
1158040	Add quality metrics to HADM Initiator by displaying the calculated distance likeliness on the user interface.
1152853	New communication channel option added to NCP-host examples: SPI over Co-Processor Communication (CPC).

1108849	Python script create_bl_files.py introduced to merge the .bat and .sh scripts into one. New features compared to the old scripts: - helper and additional command arguments to select required configuration - interactive mode: in case some of the tools or files are missin this script will help you to set it up - generate compressed GBLs (both lzma and lz4 compression methods) - device logic handling for series-1 and series-2 devices

2 Improvements

2.1 Changed Items

Changed in release 7.0.0.0

ID #	Description
1203109	Improved detection logic for ESLs that do not have a valid GATT configuration according to the ESL Service specification. The new logic now prevents a number of false positive detections and the resulting exclusion of valid ESLs from the network.
1144612	cJSON third party library update from GitHub: https://github.com/DaveGamble/cJSON @commit: b45f48e600671feade0b6bd65d1c69de7899f2be (master)
1193924	Migrate BLE SDK examples to use either legacy_scanner API or extended_scanner API instead of the deprecated scanner API.
1177424	Opening the Component Library in Studio and selecting any of the components that come from app/bluetooth now shows a "Documentation" section under "Dependencies" and "Dependents" sections with the content hosted on docs.silabs.com for that component.

2.2 Changed APIs

Changed in release 7.0.0.0

None.

2.3 Intended Behavior

Changed in release 7.0.0.0

None.

3 Fixed Issues

Fixed in release 7.0.0.0

ID #	Description
1077663	Fix an issue that could cause some Bluetooth commands to return success without actually performing the command if an RTOS and the Bluetooth on-demand start component was used and the application issued a Bluetooth command while the Bluetooth stack was stopped.
1130635	Fix an issue that could cause a crash on FreeRTOS if the Bluetooth on-demand start feature is used and the FreeRTOS timer task has been configured to have a lower priority than the Bluetooth tasks.
1164357	Update the error code from insufficient_encryption to insufficient_authentication as specified in Bluetooth specification when GATT client tries to access GATT attribute which requires security and the connection is not bonded or encrypted.
1170640	Fix a race condition in GATT Client that the ATT MTU exchange could be prevented if the user application calls a GATT Client command that in turn starts a GATT procedure with the remote GATT Server under the context of sl_bt_evt_connection_opened event handling in SoC mode.
1180413	Fix an issue that could cause thread priority inversion and decrease Bluetooth connection reliability with FreeRTOS if the FreeRTOS timer task has been configured to have a lower priority than the Bluetooth tasks.
1192858	Improve advertisement report handling over the HCI interface. Now it is possible to configure maximum number of queued advertisement reports. This improves performance over slow HCI connection.
1196365	Fix an issue seen with DTM when watchdog timer component presents.
1196429	Optimize connection establishment in a DMP configuration. In certain cases the packet was not processed fast enough which caused connection loss.
1198175	Fix PAwR scanner window widening calculation after missed subevent packet. Add PAwR response slot window widening calculation to advertiser device. The fix is available in Bluetooth SDK 6.2.0 and newer.
1206647	Fix a bug in the Bluetooth link layer that was caused by incorrect handling an error if the transmission of the connection indication packet by the central failed.
1209154	Fix a bug that could prevent the demo mode from working more than once in an ESL AP session. The AP Pyhon sample code now does not allow changing the mode while the EFR Connect application is connected in demo mode, and it is now possible to query the current state of the demo via the CLI interface.
1212515	Fix an issue in the RCP mode that made the LE_Set_Periodic_Advertising_Subevent_Data HCI command erroneously fail when data for multiple subevents was set at the same time with certain lengths. Fix another issue in the RCP mode that allowed indefinitely reserving an unusable connection handle when the Host did not wait for the Connection Complete HCI event before calling another LE_Create_Connection command.
1215158	PAwR subevent data requesting-setting procedure now follows the core specification strictly. Data provided by the host will be sent in the given order and data arriving too late will not be sent in the forthcoming periodic advertising interval.
1216550	Fix a bug in command sl_bt_gatt_server_send_user_read_response that the GATT server may add more than ATT MTU - 4 number of bytes as the characteristic value in the read response to opcode ATT_READ_BY_TYPE_REQ. The documentation of this command is also fixed that the maximum number of bytes in response to opcode ATT_READ_BY_TYPE_REQ is ATT MTU - 4.
1218112	Fix a race condition between the connection termination and channel map update procedure that could cause a double buffer free.
1223155	Fix a memory access violation in the host stack when processing the HCI_LE_Read_Remote_Features_Complete event if the connection handle in the event is invalid.
1218866	Bluetooth RAIL DMP - SoC Empty FreeRTOS/Micrium OS Sample Apps are now available for xG28 (BRD4400A/B/C, BRD4401A/B/C).
1214140	BLE ESL examples now support BRD4402B and BRD4403B boards.
1212633	Fix iop_create_bl_files.sh script failure on MacOS.
1209154	Fixed a bug that could prevent the ESL demo mode from working more than once in an AP session. The AP Python sample code now does not allow changing the mode while the EFR Connect application is connected in demo mode, while it is now possible to query the current state of the demo via the CLI interface.
1205333	Eliminated the need to manually change the type of UART flow control after creating the ESL AP NCP project for numerous supported boards.
1205317	The Silabs vendor specific 0x1F opcode for the ESL experimental PAwR interval skip function has been added to the ESL AP readme document.

ID #	Description
1192305	Added a configurable delay to In-Place OTA DFU component before closing the connection with the Central device. This resolves the procedure's issues with In-Place OTA transfer and the latest EFR Connect v2.7.1 or later.
1225207	Fixed issue: NULL dereferencing can occur in ESL C lib which leads to ESL AP to crash in while configuring large networks.
1223186	Corrected app_timer for OS to apply ceiling of the requested value based on OS timer frequency to operate in the same way as bare-metal variant. Extended documentation that describes the limitations on resolution and mentions OS timer frequency configuration parameters that can be set to modify the timer frequency (and the resolution).
1203408	Application OTA DFU may enter an incorrect state if the application sends an sl_bt_evt_gatt_server_user_write_request_id event.
1208252	Initiator now closes connection at exit.
1180678	Stability improvements

4 Known Issues in the Current Release

Issues in bold were added since the previous release. If you have missed a release, recent release notes are available on https://www.si-labs.com/developers/bluetooth-low-energy in the Tech Docs tab.

ID #	Description	Workaround
361592	The sync_data event does not report TX power.	None
368403	If setting CTE interval to 1, a CTE request should be sent in every connection interval. But it is sent only in every second connection interval.	None
641122	The Bluetooth stack component does not provide a configuration for RF antenna path.	This is an issue specifically for BGM210P. One workaround is to manually update the configuration in sl_bluetooth_config.h in text edit mode. If the OTA with Apploader is used, include the bluetooth_feature_ota_config component in application project. Call command sl_bt_ota_set_rf_path() to set the RF path for OTA mode.
650079	LE 2M PHY on EFR32[B|M]G12 and EFR32[B|M]G13 doesn't work with smartphones using the Mediatek Helio chip due to an interoperability issue.	No workaround exists. For application development and testing, the disconnection can be avoided by disabling 2M PHY with sl_bt_connection_set_preferred_phy() or sl_bt_connection_set_default_preferred_phy().
682198	The Bluetooth stack has an interoperability issue on the 2M PHY with a Windows PC.	No workaround exists. For application development and testing, the disconnection can be avoided by disabling 2M PHY with sl_bt_connection_set_preferred_phy() or sl_bt_connection_set_default_preferred_phy().
730692	4-7% packet error rate is observed on EFR32M|BG13 devices when RSSI is between -25 and -10 dBm. The PER is nominal (as per the datasheet) both above and below this range.	None
756253	The RSSI value on a Bluetooth connection returned by the Bluetooth API is incorrect on EFR32M|B1, EFR32M|B12, EFR32M|B13, and EFR32M|B21 devices. On EFR32M|B21 devices. It is about 8~10 dBm higher than the actual value, according to a measurement.	Install the "RAIL Utility, RSSI" component in the application project. This component provides a default RSSI offset for the chip that is applied at the RAIL level and can help to achieve more accurate RSSI measurements.
845506	When the Bluetooth_feature_afh component for AFH is included, the feature initialization always enables AFH.	To include the component but not to enable AFH at device boot, change the parameter value from 1 to 0 in the function call of sl_btctrl_init_afh() in sl_bt_stack_init.c.
1031031	Changing the configuration in the bt_aoa_host_locator application results in the application crashing.	None
1227955	amazon_aws_soc_mqtt_over_ble and amazon_aws_soc_gatt_server examples don't advertise after booting up.	Increase configTIMER_TASK_STACK_DEPTH to 600 or above in config/FreeRTOSConfig.h in the project.

5 Deprecated Items

Deprecated in release 7.0.0.0

Command sl_bt_connection_get_rssi

6 Removed Items

Removed from release 7.0.0.0

ID #	Description
1219750	Python based HADM visualization script removed. Customers should use the Studio HADM GUI going forward.

7 Multiprotocol Gateway and RCP

7.1 New Items

Added in release 7.0.0.0

Concurrent listening, the ability for the Zigbee and OpenThread stacks to operate on independent 802.15.4 channels when using an EFR32xG24 or xG21 RCP, is released. Concurrent listening is not available for the 802.15.4 RCP/Bluetooth RCP combination, the Zigbee NCP/OpenThread RCP combination, or for the Zigbee/OpenThread system-on-chip (SoC). It will be added to those products in a future release.

The OpenThread CLI vendor extension has been added to the OpenThread host apps of multiprotocol containers. This includes the coex cli commands.

7.2 Improvements

Changed in release 7.0.0.0

The Zigbee NCP/OpenThread RCP multiprotocol combination is now production quality.

7.3 Fixed Issues

Fixed in release 7.0.0.0

ID #	Description
1081828	Throughput issue with FreeRTOS-based Zigbee/BLE DMP sample applications.
1090921	Z3GatewayCpc had trouble forming a network in a noisy environment.
1153055	An assert on the host was caused when there was a communication failure when reading the NCP version from the zigbee_ncp-ble_ncp-uart sample app.
1155676	The 802.15.4 RCP discarded all received unicast packets (after MAC acking) if multiple 15.4 interfaces shared the same 16-bit node ID.
1173178	The host falsely reported hundreds of packets received with mfglib in the Host-RCP setup.
1190859	EZSP error when sending mfglib random packets in the Host-RCP setup.
1199706	Data polls from forgotten end device children were not properly setting a pending frame on the RCP to queue a Leave & Rejoin command to the former child.
1207967	The "mfglib send random" command was sending out extra packets on Zigbeed.
1208012	The mfglib rx mode did not update packet info correctly when receiving on the RCP.
1214359	The coordinator node crashed when 80 or more routers tried to join simultaneously in the Host-RCP setup.
1216470	After relaying a broadcast for address mask 0xFFFF, a Zigbee RCP acting as a parent device would leave the pending data flag set for each child. This resulted in each child staying awake expecting data after each poll, and required some other pending data transaction to each end device to eventually clear this state.

7.4 Known Issues in the Current Release

Issues in bold were added since the previous release. If you have missed a release, recent release notes are available on https://www.si-labs.com/developers/gecko-software-development-kit.

ID #	Description	Workaround
811732	Custom token support is not available when using Zigbeed.	Support is planned in a future release.
937562	Bluetoothctl ‘advertise on’ command fails with rcp-uart-802154-blehci app on Raspberry Pi OS 11.	Use btmgmt app instead of bluetoothctl.

ID #	Description	Workaround
1022972	**Coex not working on ZB NCP + OT RCP.**	**Support is planned for a future release.**
1074205	The CMP RCP does not support two networks on the same PAN id.	Use different PAN ids for each network. Support is planned in a future release.
1122723	In a busy environment the CLI may become unresponsive in the z3-light_ot-ftd_soc app.	No known workaround.
1170052	**CMP Zigbee NCP + OT RCP and DMP Zigbee NCP + BLE NCP may not fit on 64KB and lower RAM parts in this current release.**	**64KB parts not currently supported for these apps.**
1213701	**RCP may fail to indicate pending data for sleepy child during OTA upgrade to child in a noisy environment, resulting in update process terminating unexpectedly.**	**Will be addressed in a future release.**
1221299	**Mfglib RSSI readings differ between RCP and NCP.**	**Will be addressed in a future release.**

7.5 Deprecated Items

None

7.6 Removed Items

Removed in release 7.0.0.0

The "NONCOMPLIANT_ACK_TIMING_WORKAROUND" macro has been removed. All RCP apps now by default support 192 µsec turnaround time for non-enhanced acks while still using 256 µsec turnaround time for enhanced acks required by CSL.

8 Using This Release

This release contains the following

- Silicon Labs Bluetooth stack library
- Bluetooth sample applications

For more information about the Bluetooth SDK see https://docs.silabs.com/bluetooth/latest/ . If you are new to Bluetooth see UG103.14: Bluetooth LE Fundamentals.

8.1 Installation and Use

The Bluetooth SDK is provided as part of the Gecko SDK (GSDK), the suite of Silicon Labs SDKs. To quickly get started with the GSDK, install Simplicity Studio 5, which will set up your development environment and walk you through GSDK installation. Simplicity Studio 5 includes everything needed for IoT product development with Silicon Labs devices, including a resource and project launcher, software configuration tools, full IDE with GNU toolchain, and analysis tools. Installation instructions are provided in the online Simplicity Studio 5 User's Guide.

Alternatively, Gecko SDK may be installed manually by downloading or cloning the latest from GitHub. See https://github.com/SiliconLabs/gecko_sdk for more information.

Simplicity Studio installs the GSDK by default in:

- (Windows): C:\Users\<NAME>\SimplicityStudio\SDKs\gecko_sdk
- (MacOS): /Users/<NAME>/SimplicityStudio/SDKs/gecko_sdk

Documentation specific to the SDK version is installed with the SDK. Additional information can often be found in the knowledge base articles (KBAs). API references and other information about this and earlier releases is available on https://docs.silabs.com/.

8.2 Security Information

Secure Vault Integration

When deployed to Secure Vault High devices, sensitive keys such as the Long Term Key (LTK) are protected using the Secure Vault Key Management functionality. The table below shows the protected keys and their storage protection characteristics.

Wrapped Key	Exportable / Non-Exportable	Notes
Remote Long Term Key (LTK)	Non-Exportable	
Local Long Term Key (legacy only)	Non-Exportable	
Remote Identity Resolving Key (IRK)	Exportable	Must be Exportable for future compatibility reasons
Local Identity Resolving Key	Exportable	Must be Exportable because the key is shared with other devices.

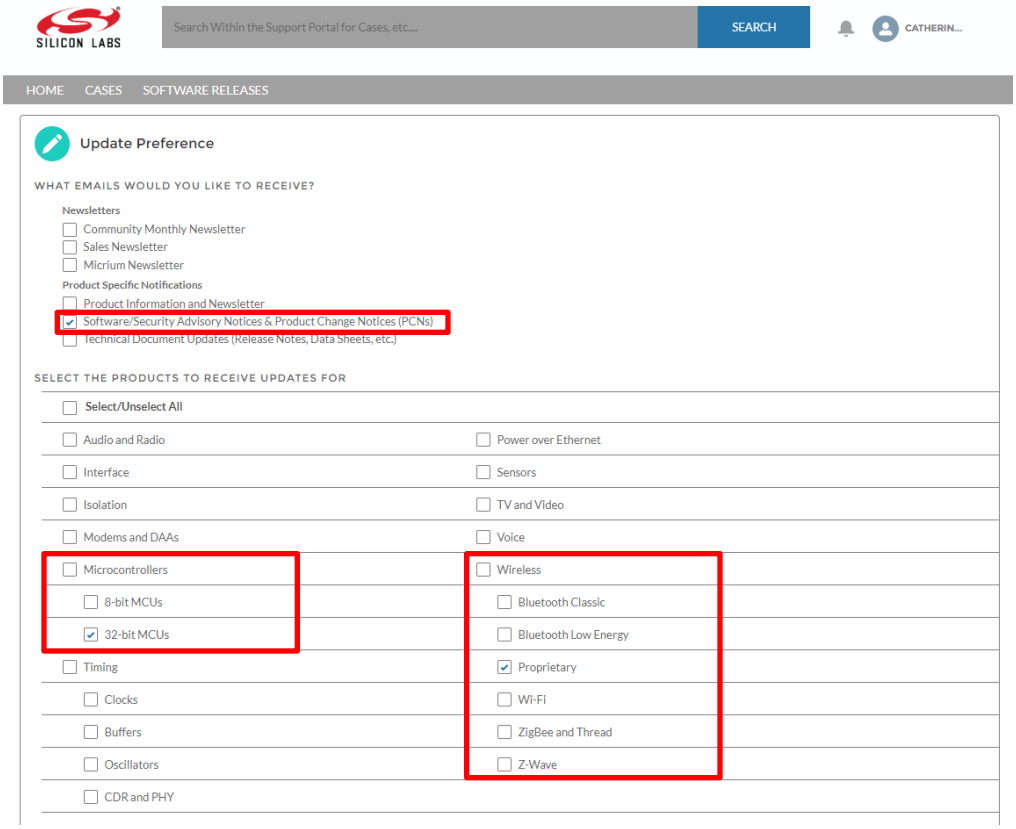
Wrapped keys that are marked as "Non-Exportable" can be used but cannot be viewed or shared at runtime.

Wrapped keys that are marked as "Exportable" can be used or shared at runtime but remain encrypted while stored in flash.

For more information on Secure Vault Key Management functionality, see AN1271: Secure Key Storage.

Security Advisories

To subscribe to Security Advisories, log in to the Silicon Labs customer portal, then select **Account Home**. Click **HOME** to go to the portal home page and then click the **Manage Notifications** tile. Make sure that 'Software/Security Advisory Notices & Product Change Notices (PCNs)' is checked, and that you are subscribed at minimum for your platform and protocol. Click **Save** to save any changes.



8.3 Support

Development Kit customers are eligible for training and technical support. Use the Silicon Labs Bluetooth LE web page to obtain information about all Silicon Labs Bluetooth products and services, and to sign up for product support.

You can contact Silicon Laboratories support at http://www.silabs.com/support.

Simplicity Studio

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