

# **s132\_nrf52 release notes**

## **Introduction to the s132\_nrf52 release notes**

### **About the document**

The release notes describe the changes in the s132\_nrf52 from version to version.

The release notes are intended to list all relevant changes in a given version. They are kept brief to make it easy to get an overview of the changes. More details regarding changes and new features can be found in the s132\_nrf52 migration document (normally available for major releases only).

Issue numbers in parentheses are for internal use and should be disregarded by the customer.

Copyright (c) Nordic Semiconductor ASA. All rights reserved.

## s132\_nrf52\_6.0.0

The main new features of s132\_nrf52\_6.0.0 compared to s132\_nrf52\_5.1.0 are Quality of Service (QoS) information and limited support for LE Extended Advertising.

Notes:

- This release has changed the Application Programmer Interface (API). This requires applications to be recompiled.
- The memory requirements of the S132 SoftDevice have changed.
- The release notes list changes since s132\_nrf52832\_5.1.0.
- The LE Advertising Extensions feature is not Bluetooth Qualified in this production release. The feature is suitable for development purposes but cannot be used in end products. The feature is limited in functionality, may not function as specified, and may contain issues. The Qualified Design Identifier (QDID) for S132 will not include qualification of these features. In future releases of this SoftDevice, LE Advertising Extensions will be fully qualified. At that time, a new QDID will be available which includes this feature for new product listings.
- The SoftDevice release naming convention has changed: Instead of specifying the platform supported by the SoftDevice in the release name, the release notes will have this information.

## SoftDevice properties

- This SoftDevice variant is production tested for nRF52832.
- This version of the SoftDevice contains the Master Boot Record (MBR) version 2.2.2 (DRGN-9537).
- The combined MBR and SoftDevice memory requirements for this version are as follows:
  - Flash: **152 kB** (0x26000 bytes).
  - RAM: **5.54 kB** (0x1628 bytes). This is the minimum required memory. The actual requirements depend on the configuration chosen at `sd_ble_enable()` time.
- The Firmware ID of this SoftDevice is 0x00A8.

## New functionality

- SoftDevice
  - The SoftDevice API for advertising and scanning is updated and prepared to support future features. For more information, see the migration document (DRGN-9712).
- GAP
  - Channel number for RSSI measurement is now available in advertising reports (DRGN-9473).
  - Channel number for RSSI measurement is now available for connections (DRGN-9667).
  - API for channel survey (noise measurement) (DRGN-9580).
  - Support for setting channel map for the Observer role (DRGN-9518).
  - The SoftDevice now supports the configuration of TX power per link and per role (DRGN-6659).
- LL
  - Limited support for the LE Extended Advertising feature. (DRGN-7504).

## Changes

- SoftDevice
  - The SoftDevice now returns `NRF_ERROR_BUSY` from flash API functions until the event generated after a previous flash operation has been pulled (DRGN-9565).
  - The SoftDevice now has an additional API for write-protecting memory. This can now be achieved by accessing the BPROT peripheral configuration registers through `sd_protected_register_write()` (DRGN-9337).
  - A message sequence chart for Unexpected Security Packet Reception has been added to Peripheral Security Procedures in the API documentation (DRGN-9479).
- GATT
  - The SoftDevice will now return `NRF_ERROR_TIMEOUT` instead of `NRF_ERROR_BUSY` from GATT API functions if a GATT procedure is blocked due to a previous procedure timeout (DRGN-9545).
  - Clarified API documentation: The length field in the parameter struct passed to `sd_ble_gatts_hvx()` may be written to by the SoftDevice (DRGN-9620).
- GAP
  - The `sd_ble_gap_data_length_update()` input parameter requirements have been relaxed. Previous requirements, which have now been removed, included symmetric input parameters and `BLE_GAP_DATA_LENGTH_AUTO` as the only valid input for `max_tx_time_us` and `max_rx_time_us` (DRGN-8499).
- LL
  - The documentation of the PHY Update procedure is improved (DRGN-9678).
  - Bluetooth Core Specification Erratum #7408 is incorporated, meaning that it is now accepted to receive an `LL_UNKNOWN_RSP` during encryption procedure (DRGN-8414).

- nRF52832 with build code E00 or E10 is now autodetected and workarounds for ERRATA-102 and ERRATA-106 are not applied for those devices. The workaround in ERRATA-182 is applied for those devices (DRGN-9748, DRGN-9851).

## Bug fixes

- SoftDevice
  - Fixed an issue where `sd_ble_gap_rssi_get()` could sometimes return `NRF_ERROR_SUCCESS` with an invalid RSSI (DRGN-9746).
  - Fixed an issue where the HFXO would sometimes not be released properly after RC calibration (DRGN-9920).
- GATT
  - Fixed an issue where the SoftDevice could drop a write request if it was received at the same time as a write command (DRGN-9709).
- GAP
  - Fixed an issue where the SoftDevice would sometimes not report the actual negotiated RX parameters in the `BLE_GAP_EVT_DATA_LENGTH_UPDATE` event (DRGN-9939).
  - Fixed an issue where the SoftDevice could assert if the white list and identity list were set at the same time with matching addresses (DRGN-9535).
- LL
  - Fixed an issue where the slave could disconnect with status code `BLE_HCI_DIFFERENT_TRANSACTION_COLLISION` if master sent an `LL_UNKNOWN_RSP` after a PHY procedure collision (DRGN-9870).
  - Fixed an issue where the SoftDevice might advertise with the RxAdd bit set to 1 for undirected advertisements. According to the Bluetooth Core Specification v 5.0, the RxAdd bit is reserved for future use for these PDU types (DRGN-9739).
  - Fixed an issue where the SoftDevice could assert if the identity list was used while advertising or scanning (DRGN-9723).
  - Fixed an issue where the SoftDevice might send an `LL_LENGTH_RSP` with illegal values for TX/RX octets if the event length configured for the link was either 4 or 5 and LE 2M PHY was used (DRGN-9839).
  - Fixed an issue where incorrect timing calculations during the LE Data Length Update procedure could lead to an assert (DRGN-9612).

## Limitations

- SoftDevice
  - If Radio Notifications are enabled, flash write and flash erase operations initiated through the SoftDevice API will be notified to the application as Radio Events (FORT-809).
  - Synthesized low frequency clock source is not tested or intended for use with the BLE stack.
  - Applications must not modify the `SEVONPEND` flag in the `SCR` register when running in priority levels higher than 6 (priority level numerical values lower than 6) as this can lead to undefined behavior.
  - The LE Advertising Extension implementation is incomplete and may not function as specified. The feature is only suitable for development purposes, not production.
    - The main functionality that is missing is scanner privacy for advertising extensions, advertising and scanning AUX\_CHAIN\_IND PDUs, and advertising intervals longer than 10.24 s.
- GATTS
  - To conform to the Bluetooth Core Specification v 5.0, there shall be no secondary service that is not referenced somehow by a primary service. The SoftDevice does not enforce this (DRGN-906).

## Known Issues

- SoftDevice
  - If the application writes to protected memory, the SoftDevice HardFault handler can hang while trying to read an invalid value from the call stack (DRGN-9694).
  - If the application calls a NULL pointer, there will be a HardFault inside the SoftDevice HardFault handler (DRGN-9607).
  - If the application configures too many L2CAP Connection-oriented Channels in total for all connections, the SoftDevice will assert during `sd_ble_enable()`. Less than 150 channels are supported (DRGN-9946).
  - When the scanner times out, the source of the timeout event might be set to `BLE_GAP_TIMEOUT_SRC_CONN` instead of `BLE_GAP_TIMEOUT_SRC_SCAN` (DRGN-10000)
  - If `sd_ble_gap_addr_set()` or `sd_ble_gap_privacy_set()` is called after `sd_ble_gap_adv_set_configure()` and before `sd_ble_gap_adv_start()`, the advertiser will not update its address type (DRGN-10025).
  - If the application calls `sd_ble_gap_adv_set_configure()` with `ble_gap_adv_properties_t::type` set to a legacy advertising type and either `ble_gap_adv_properties_t::anonymous` or `ble_gap_adv_properties_t::include_tx_power` is set to 1, the SoftDevice will assert (DRGN-10024).

## s132\_nrf52\_5.1.0

This is a production release that contains minor but important changes to the s132\_nrf52\_5.0.0 release.

Notes:

- The SoftDevice RAM usage is reduced in this release compared to the s132\_nrf52\_5.0.0.
- The priority of SoftDevice interrupts SD\_EVT\_IRQn (SWI2\_IRQn) and RADIO\_NOTIFICATION\_IRQn (SWI3\_IRQn) is 6. This is different from S132 4.x and previous SoftDevices. This was not listed as a change in the s132\_nrf52\_5.0.0 release notes (DRGN-9245).

## SoftDevice properties

- An updated SoftDevice Specification document will be available at <http://infocenter.nordicsemi.com/>.
- This version of the SoftDevice contains the Master Boot Record (MBR) version 2.2.2 (DRGN-9537).
- The combined MBR and SoftDevice memory requirements for this version are as follows:
  - Flash: **140 kB** (0x23000 bytes).
  - RAM: **4.88 kB** (0x1380 bytes). This is the minimum required memory. The actual requirements depend on the configuration chosen at `sd_ble_enable()` time.

## New functionality

This release has no new features compared to the s132\_nrf52\_5.0.0.

## Changes

- SoftDevice
  - References to EGU\* have been removed from `nrf_soc.h` and `nrf_nvic.h` as the SoftDevice is using SWI and not EGU to generate interrupts (DRGN-9257).
- L2CAP
  - Improved overall throughput for L2CAP connection-oriented channels, especially when using long connection event lengths (DRGN-9127).
- LL
  - The SoftDevice now sends `LL_REJECT_EXT_IND` instead of `LL_REJECT_IND` if the peer has indicated support for `LL_REJECT_EXT_IND` (DRGN-9539).

## Bug fixes

- SoftDevice
  - Fixed an issue where Radio Notification could be suppressed between connection events when Connection Event Length Extension was enabled (DRGN-7687).
  - Fixed an issue where `sd_ble_gatts_attr_get()` and `sd_ble_gatts_value_get()` could return undocumented `BLE_ERROR_INVALID_ATTR_HANDLE` error code in a situation where they should have returned `NRF_ERROR_NOT_FOUND` (DRGN-9216).
  - Fixed an issue where the `BLE_EVT_LEN_MAX(ATT_MTU)` macro did not return the worst-case event length because it did not account for a corner case related to GATT primary service discovery response (DRGN-9610).
- GATT
  - Fixed an issue where the SoftDevice could assert if ATT packets longer than the LL packet size were sent and received at the same time (DRGN-9328).
- LL
  - Fixed an issue where the SoftDevice could send `LL_FEATURE_RSP` with incorrect `FeatureSet` (DRGN-9551).
  - Fixed an issue where the slave could disconnect with reason `HCI_LOCAL_HOST_TERMINATED_CONNECTION` instead of `HCI_STATUS_CODE_PIN_OR_KEY_MISSING` if the LTK (Long Term Key) was missing (DRGN-9190).
  - Fixed an issue where the SoftDevice could get stuck in a deadlock where it would always NACK what the peer was sending. This could happen if LE Data Packet Length Extension was used and `ble_cfg.conn_cfg.params.gap_conn_cfg.event_length` was less than 5 (DRGN-9494).
  - Fixed an issue where the SoftDevice could get stuck in a deadlock where it would always NACK what the peer was sending. This could happen if the peer reduced the data length during the Data Length Update procedure (DRGN-9367).

## Limitations

- SoftDevice
  - If Radio Notifications are enabled, flash write and flash erase operations initiated through the SoftDevice API will be notified to the application as Radio Events (FORT-809).
  - Synthesized low frequency clock source is not tested or intended for use with the BLE stack.
  - Applications must not modify the `SEVONPEND` flag in the `SCR` register when running in priority levels higher than 6 (priority level numerical values lower than 6) as this can lead to undefined behavior.
- GATTS
  - To conform to the Bluetooth Core Specification v 5.0, there shall be no secondary service that is not referenced somehow by a primary service. The SoftDevice does not enforce this (DRGN-906).

## Known Issues

- GAP
  - The SoftDevice can assert if the whitelist and identity list is set at the same time with matching addresses. A workaround for this issue is to clear the whitelist before setting the identity list (DRGN-9535).

## s132\_nrf52\_5.0.0

The main new features of this major version compared to the 4.0.0 version are the L2CAP Connection-Oriented Channels, the LE 2M PHY, and Network Privacy. The updates from the previous alpha version (5.0.0-3.alpha) include support for the Channel Selection algorithm #2 and some minor changes and bug fixes. This is the first version of the SoftDevice that is Bluetooth 5.0 qualified.

Notes:

- The development of the s132\_nrf52\_5.0.0 started from s132\_nrf52\_3.0.0 and has been going in parallel with the development of the s132\_nrf52\_4.0.x SoftDevices. All features and all relevant changes done in the s132\_nrf52\_4.0.x series have been brought into the s132\_nrf52\_5.0.0 and released in the 5.0.0 alpha releases (s132\_nrf52\_5.0.0-1.alpha, -2.alpha and -3.alpha) and in this production release. They are mentioned in the corresponding release notes.
- This release has changed the Application Programmer Interface (API) from the 4.0.0 release. This requires applications to be recompiled.
- The memory requirements of the SoftDevice have changed.

## SoftDevice properties

- An updated SoftDevice Specification document will be available at <http://infocenter.nordicsemi.com/>.
- This version of the SoftDevice contains the Master Boot Record (MBR) version 2.2.0 (DRGN-8852).
  - This version of the MBR is compatible with the previous versions.
- The combined MBR and SoftDevice memory requirements for this version are as follows:
  - Flash: **140 kB** (0x23000 bytes).
  - RAM: **5.18 kB** (0x14b8 bytes). This is the minimum required memory with the BLE stack enabled. The actual requirements depend on the configuration chosen at `sd_ble_enable()` time.

## New functionality

- BLE
  - The SoftDevice now supports Channel Selection algorithm #2 (DRGN-7147).

## Changes

- SoftDevice
  - Added definitions for timing constraints that must be taken into account when using the `NRF_RADIO_SIGNAL_CALLBACK_ACTION_EXTEND` action with the Radio Timeslot API (DRGN-8931).
- LL
  - The SoftDevice slave role now accepts overlapping peer-initiated Link Layer control procedures (DRGN-8623). The following LL control procedures can be executed in parallel with any other control procedure, except for themselves: LE Ping, Feature Exchange, Data Length Update, and Version Exchange. This is done for compatibility reasons.
  - The SoftDevice now has improved control procedure performance in scenarios involving multiple links (DRGN-9001).
- GAP
  - A flag `lesc` is added to the `ble_gap_evt_auth_status_t` struct, indicating if an authentication procedure has resulted in an LE Secure Connection (DRGN-7801).
- GATT
  - The SoftDevice will no longer prevent using "Write Command" on Characteristic Descriptors (DRGN-9085). This change reverts a change done for s132\_nrf52\_4.0.0. Note that according to the Bluetooth Core Specification v 5.0 (Vol. 3, Part G Chapter 4.12.3), when writing Characteristic Descriptors "The Attribute Protocol Write Request is used for this sub-procedure". While the SoftDevice will no longer prevent the use of the "Write Command", it is up to the application to ensure the correct procedure is used.

## Bug fixes

- SoftDevice
  - Fixed an issue where the SoftDevice might assert in some cases if the application delayed pulling of SoftDevice events (DRGN-8823).
- LL
  - Fixed an issue where the master could initiate a Channel Map Update or Connection Parameter Update procedure while a slave-initiated PHY Update procedure is in progress (DRGN-7975, DRGN-8898).
  - Fixed an issue where the slave would accept that master initiates a Channel Map Update or Connection Parameter Update procedure while a slave-initiated PHY Update procedure is in progress (DRGN-7975, DRGN-8898). Previously this could lead to an assert. Now the slave will instead disconnect in this situation.

- Fixed an issue where the slave would assert if a control packet was received in the same event as it sent a LL\_LENGTH\_RSP packet ( DRGN-9036 ).
  - Fixed an issue where the slave could assert if it received a PAUSE\_ENC\_REQ followed by an LL\_ENC\_REQ (DRGN-9035). This sequence of packets is illegal behavior according to the Bluetooth Core Specification v 5.0, so the slave will now disconnect in this situation.
  - Fixed an issue where the slave in some cases could disconnect with wrong disconnect reason ( BLE\_HCI\_DIFFERENT\_TRANSACTION\_COLLISION instead of BLE\_HCI\_CONN\_TERMINATED\_DUE\_TO\_MIC\_FAILURE ) if master misbehaves (DRGN-8998).
  - Fixed an issue where scanner/initiator would use wrong local IRK when SoftDevice is configured to use more than one local IRK (DRGN-9072).
  - Fixed an issue which could lead to a deadlock in the Channel Map Update procedure if an unexpected disconnection occurred before the instant (DRGN-9033). The deadlock would have blocked any future Channel Map Updates.
  - Reverted a fix done in s132\_nrf52\_5.0.0-3.alpha, where BLE\_HCI\_LOCAL\_HOST\_TERMINATED\_CONNECTION was reported instead of BLE\_HCI\_STATUS\_CODE\_LMP\_RESPONSE\_TIMEOUT as disconnect reason when a TERMINATE\_IND packet was not acknowledged (DRGN-8837, DRGN-9005). The revert is done because the related test specification erratum (TSE ID: 8670) is still open.
- GATT
    - Fixed an issue where setting gatts\_conn\_cfg.hvn\_tx\_queue\_size or gattc\_conn\_cfg.write\_cmd\_tx\_queue\_size to 0 would lead to a SoftDevice assert during connect for the last connection that fits in memory (DRGN-9056).

## Limitations

- SoftDevice
  - If Radio Notifications are enabled, flash write and flash erase operations initiated through the SoftDevice API will be notified to the application as Radio Events (FORT-809).
  - Synthesized low frequency clock source is not tested or intended for use with the BLE stack.
  - Applications must not modify the SEVONPEND flag in the SCR register when running in priority levels higher than 6 (priority level numerical values lower than 6) as this can lead to undefined behavior.
- GATTS
  - To conform to the Bluetooth Core Specification v 5.0, there shall be no secondary service that is not referenced somehow by a primary service. The SoftDevice does not enforce this (DRGN-906).

## Known Issues

- SoftDevice
  - If Connection Event Length Extension is enabled, the Radio Notification may be suppressed between connection events (DRGN-7687).

## s132\_nrf52\_5.0.0-3.alpha

The main new feature of this alpha version, compared to the 5.0.0-2.alpha version, is the implementation of the L2CAP Connection-Oriented Channels in LE Credit Based Flow Control Mode.

Notes:

- This release has changed the Application Programmer Interface (API) from the 5.0.0-2.alpha release. This requires applications to be recompiled.
- The memory requirements of the SoftDevice have changed.

## SoftDevice properties

- This version of the SoftDevice contains the Master Boot Record (MBR) version 2.2 (DRGN-8340).
  - New command, `SD_MBR_COMMAND_IRQ_FORWARD_ADDRESS_SET` added.
- The combined MBR and SoftDevice memory requirements for this version are as follows:
  - Flash: **140 kB** (0x23000 bytes).
  - RAM: **4.86 kB** (0x1368 bytes). This is the minimum required memory. Actual requirements depend on the configuration chosen at `sd_ble_enable()` time.
  - Call stack: The SoftDevice uses a call stack combined with the application. The worst-case stack usage for the SoftDevice is **1.48 kB** (0x05f4 bytes). Application writers should ensure that enough stack space is reserved to cover the worst-case SoftDevice call stack usage combined with worst-case application call stack usage.

## New functionality

- L2CAP
  - Connection-Oriented Channels in LE Credit Based Flow Control Mode (DRGN-8572).
- LL
  - PA/LNA supported for LE 2M PHY (DRGN-8259).

## Using L2CAP Credit Based Flow Control Mode

The SoftDevice provides several new SV calls and events related to setting up and using L2CAP Credit Based Flow Control. For more details, refer to `ble_l2cap.h` and the L2CAP Message Sequence Charts ([s132\\_nrf52\\_5.0.0-3.alpha\\_API/doc/html/index.html](s132_nrf52_5.0.0-3.alpha_API/doc/html/index.html) -> dragoon -> Modules -> Logical Link Control And Adaptation Protocol (L2CAP) -> Message Sequence Charts) inside the API documentation.

## Changes

- GAP
  - In Bluetooth Specification Version 5.0 the definition of LE Security Mode 1 Level 4 has changed. LESC MITM protected encrypted link using a 128-bit strength encryption key is now required (DRGN-8759).
  - `BLE_GAP_EVT_TIMEOUT {src: BLE_GAP_TIMEOUT_SRC_SECURITY_REQUEST}` is replaced with `BLE_GAP_EVT_AUTH_STATUS {auth_status: BLE_GAP_SEC_STATUS_TIMEOUT}` (DRGN-8752).
  - `BLE_GAP_ADV_NONCON_INTERVAL_MIN` is now removed (DRGN-8611)
  - Stack will no longer return `NRF_ERROR_BUSY` when calling `sd_ble_gap_connect()`, `sd_ble_gap_scan_start()`, `sd_ble_gap_authenticate()`, or `sd_ble_gap_adv_start()` (DRGN-8843)
  - Stack will now only return `NRF_ERROR_BUSY` on `sd_ble_gap_conn_param_update()` when a connection parameter update is already in progress (DRGN-8843)

## Bug fixes

- SoftDevice
  - Fixed the implementation in `sd_flash_protect()`, allowing it to support SoftDevice flash size > 128 kB (DRGN-8710)
  - Fixed an issue where calling `sd_ble_gap_sec_params_reply()`, `sd_ble_user_mem_reply()`, or `sd_ble_gatts_rw_authorize_reply()` more than 6 times without pulling events in between would in some cases lead to link disconnect (DRGN-8627)

- GAP
  - Fixed an issue where the calling `sd_ble_gap_privacy_get()` could cause a hardfault (DRGN-8899)
- GATTS
  - Fixed an issue where incoming packet processing would in some cases be delayed when the `BLE_EVT_USER_MEM_REQUEST` event is pulled by the application (DRGN-8595)
  - Fixed an issue where the value of the attribute in `BLE_GATTS_EVT_RW_AUTHORIZE_REQUEST` event corresponding to the first Prepare Write Request could be corrupted if the application delays the pulling of SoftDevice events (DRGN-8595)
- LL
  - Fixed an issue where a peripheral accepted a `PHY_UPDATE_IND` packet, which indicated PHYs that had not been negotiated in the PHY Update procedure (DRGN-8135)
  - Fixed an issue where a central in some cases did not send a `REJECT_EXT_IND` packet in a valid control procedure collision scenario (DRGN-8926)
  - Fixed an issue with T\_IFS violation in LE connection events with asymmetric PHYs (TX: 1MPHY, RX: 2MB PHY) (DRGN-8762)
  - Fixed an issue where the PA/LNA implementation for symmetric 1M PHY LE connections asserted the PA pin too early (DRGN-8782)
  - Fixed an issue where `BLE_HCI_STATUS_CODE_LMP_RESPONSE_TIMEOUT` was reported as disconnect reason when `TERMINATE_IND` packet was not acknowledged. The reason is now correctly reported as `BLE_HCI_LOCAL_HOST_TERMINATED_CONNECTION` (DRGN-8837).
  - Fixed an issue that was causing a REM request to be blocked indefinitely, if a REM session uses the REM extend feature (DRGN-8859)
  - Fixed an issue where a central would ignore any received `LL_REJECT_EXT_IND` PDUs (DRGN-8737)
  - Fixed an issue where a peripheral ignored a received `LL_UNKNOWN_RSP` after an `LL_PHY_RSP` was sent (DRGN-8134)

## Limitations

- SoftDevice
  - If Radio Notifications are enabled, flash write and flash erase operations initiated through the SoftDevice API will be notified to the application as Radio Events (FORT-809).
  - Synthesized low frequency clock source is not tested or intended for use with the BLE stack.
  - Applications must not modify the `SEVONPEND` flag in the `SCR` register when running in priority levels higher than 6 (priority level numerical values lower than 6) as this can lead to undefined behavior.
- GATTS
  - To conform to the Bluetooth specification, there shall not be a secondary service that is not referenced somehow by a primary service. The SoftDevice does not enforce this (DRGN-906).

## Known Issues

- SoftDevice
  - If Connection Event Length Extension is enabled, the Radio Notification may be suppressed between connection events (DRGN-7687).
- LL
  - To conform to the Bluetooth specification, master shall not initiate a Channel Map Update or Connection Parameter Update procedure while a slave-initiated PHY Update procedure is in progress (incompatible LL procedures). This is not enforced by the SoftDevice, and doing this can lead to an assert or incorrect behavior (DRGN-7975).

## s132\_nrf52\_5.0.0-2.alpha

The main new features of this alpha version, compared to the 5.0.0-1.alpha version, are application control of the Data Length Update and PHY Update Procedures, SoftDevice configuration API extensions, support for Network Privacy Mode, support for multiple peripheral connections, support for up to 20 connections in total, and configuration of individual links including per link ATT\_MTU configuration.

Notes:

- This release has changed the Application Programmer Interface (API) from the 5.0.0-1.alpha release. This requires applications to be recompiled.
- The memory requirements of the SoftDevice have changed.

## SoftDevice properties

- The combined MBR and SoftDevice memory requirements for this version are as follows:
  - Flash: **132 kB** (0x21000 bytes).
  - RAM: **5.12 kB** (0x1478 bytes). This is the minimum required memory. Actual requirements are dependent upon the configuration chosen at `sd_ble_enable()` time.
  - Call stack: The SoftDevice uses a call stack combined with the application. The worst-case stack usage for the SoftDevice is **1.48 kB** (0x5EC bytes). Application writers should ensure that enough stack space is reserved to cover both worst-case SoftDevice call stack usage combined with worst-case application call stack usage.

## New functionality

- SoftDevice
  - The SoftDevice now supports sleep clock accuracy values less than 20 ppm as a peripheral (DRGN-8158).
  - The RC oscillator accuracy can now be set to any of the defined `NRF_CLOCK_LF_ACCURACY` values, and there is no default anymore. In other words, the `nrf_clock_lf_cfg_t::accuracy` parameter now has the same functionality when used with the RCOSC clock source as with the XTAL clock source (DRGN-8666).
- BLE
  - Support for 20 links in total with freely selectable role (Central/Peripheral) for each link (DRGN-7102, DRGN-7152, DRGN-7848).
  - The BLE bandwidth configuration and application packet concept has been replaced with per link configurable:
    - Event length (DRGN-7858)
    - Write without response queue size (DRGN-7488, DRGN-7858)
    - Handle Value Notification queue size (DRGN-7487, DRGN-7858)
  - The GPIO pin to toggle can now be the same for PA and LNA (DRGN-8354).
- LL
  - The SoftDevice can be configured to disable and enable slave latency (DRGN-8305). This allows the application to override the slave latency set by the master.
  - The SoftDevice can be configured to not disconnect if the peer initiates parallel version and feature exchange procedures (DRGN-8306).
  - Support for Network Privacy Mode (DRGN-8658)
- GAP
  - The event length (i.e. the time set aside on every connection interval) can now be configured per link by the application (DRGN-7858).
  - The application is given control of the Data Length Update Procedure. The application can initiate the Data Length Update Procedure and has to respond when initiated by the peer (DRGN-8297).
  - The application is given control of the PHY Update Procedure. The application can initiate the PHY Update Procedure and has to respond when the procedure is initiated by the peer (DRGN-8473).
  - GAP option `BLE_GAP_OPT_PREFERRED_PHYS_SET` to set the default PHY preferences for the SoftDevice is removed (DRGN-8473).
- GATT
  - The maximum ATT\_MTU can now be configured per link by the application (DRGN-7858).
- GATTC
  - The application packet concept has been replaced with a dedicated transmission queue for Write without responses. Also, the `BLE_EVT_TX_COMPLETE` event has been replaced with `BLE_GATTC_EVT_WRITE_CMD_TX_COMPLETE`. Write without response queue size can now be configured per link by the application (DRGN-7488, DRGN-7858).
- GATTS
  - The application packet concept has been replaced with a dedicated transmission queue for Handle Value Notifications. Also, the `BLE_EVT_TX_COMPLETE` event has been replaced with `BLE_GATTS_EVT_HVN_TX_COMPLETE`. Handle Value Notification queue size can now be configured per link by the application (DRGN-7487, DRGN-7858).

## Using 2 Mbps

The SoftDevice provides a new SV call `sd_ble_gap_phy_update()` and two new events, `BLE_GAP_EVT_PHY_UPDATE_REQUEST` and `BLE_GAP_EVT_PHY_UPDATE`, to support initiating or responding to a PHY Update procedure and to be notified about incoming peer initiated PHY Update procedures and link PHY updates. Upon receiving a `BLE_GAP_EVT_PHY_UPDATE_REQUEST`, the application needs to respond with an `sd_ble_gap_phy_update()` SV call. For more information, see API documentation.

This alpha version of the SoftDevice supports connection establishment using the 1 Mbps PHY and then changing either the transmitting PHY or the receiving PHY (asymmetric link configuration), or both (symmetric link configuration) to use the 2 Mbps PHY. The PHYs can be changed using the abovementioned SV call.

Link Layer encryption and long data packet payload (up to 251 octets) are supported on both 1 Mbps and 2 Mbps PHYs.

## Changes

- SoftDevice
  - The `sd_power_ramon_set()`, `sd_power_ramon_clr()`, and `sd_power_ramon_get()` SoftDevice APIs have been replaced with `sd_power_ram_power_set()`, `sd_power_ram_power_clr()`, and `sd_power_ram_power_get()` (DRGN-8117). Therefore, the application now has access to the registers `RAM[x].POWER` instead of the deprecated `RAMON/RAMONB`.
  - SWI3 is no longer reserved for use by the SoftDevice and is available for the application (DRGN-8367).
  - Interrupt priority 5 is now available to the application (DRGN-8853).
- BLE
  - More pointers have been defined as `const` in the BLE API allowing the application to put more data into flash instead of RAM if desired (DRGN-6133).
  - Configuration parameters passed to `sd_ble_enable()` have been moved to the SoftDevice configuration API (DRGN-8107).
- Documentation
  - The Message Sequence Charts (MSCs) for LL Data Length Update Procedure have been corrected, extended, and improved (DRGN-8722).
  - Improved documentation for `sd_ble_gap_adv_start()` (DRGN-8799)

## Bug fixes

- SoftDevice
  - Fixed an issue where `sd_ble_enable()` may corrupt up to 8 bytes above the returned `app_ram_base` when the SoftDevice is configured with 0 Peripheral roles and 0 Central roles (DRGN-8802).
  - The `sd_power_pof_threshold_set` API has been fixed to support all the new levels that were introduced in nRF52 (DRGN-8348).
  - Fixed an issue where the SoftDevice could trigger a BusFault when forwarding a HardFault to the application (DRGN-8604).
  - Fixed an issue where scanning or advertising with timeout greater than 256 seconds and having two host protocol timers running at the same time might lead to delayed timeouts (DRGN-7804).
  - `sd_softdevice_enable()` now returns an error code if called with `fault_handler` set to `NULL` or to an invalid function pointer. If the application returns from the `fault_handler` function, the SoftDevice will do an `NVIC_SystemReset()` (DRGN-7122).
  - It is no longer required to clear `INTENSET` for `TIMER0` before the timeslot ends if the application uses `TIMER0` inside a timeslot scheduled with the Radio Timeslot API (DRGN-7776).
  - The `SVCALL` macro can now be used with the GCC C++ compiler as well (DRGN-8028).
- BLE
  - Several Doxygen documentation errors have been corrected (DRGN-7386, DRGN-7853, DRGN-8136).
- LL
  - Fixed an issue where using more than eight links and receiving a lot of data concurrently could lead to undefined behavior (DRGN-8433).
  - Fixed an issue where the SoftDevice could assert if scan parameters are updated after the scanner has accepted a new LE connection (DRGN-8635).
  - Fixed an issue where using encryption on multiple master links at the same time could cause an assert (DRGN-8532).
  - Fixed an issue where the SoftDevice would only be able to send two packets per connection event after a Data Length Update Procedure to a LL Data Channel PDU payload size of more than 34 bytes (DRGN-8392).
  - Fixed an issue where a connection parameter update from a short connection interval to a longer connection interval when using long ATT MTUs could lead to reduced bandwidth (DRGN-8427).
  - Fixed an issue where the controller completed a procedure when it received an `LL_UNKNOWN_RSP` without checking if it was the expected procedure that returned the error opcode (DRGN-7999).
  - The SoftDevice no longer rejects `LL_LENGTH_REQ` and `LL_LENGTH_RSP` with parameters which are out of range according to Bluetooth 4.2 specification (DRGN-7872).

- Fixed an issue where bit errors in the length field of an encrypted packet caused the packet to be interpreted as longer than was sent by the peer (DRGN-7898). This issue could have manifested in the following ways:
  - SoftDevice memory buffer corruption which could lead to an assert or incorrect behavior.
  - SoftDevice may send a packet with an incorrect MIC field leading to a disconnect from the peer.
- The SoftDevice no longer accepts `LL_PHY_REQ` and `LL_PHY_RSP` with empty TX and/or RX PHY fields (DRGN-7950).
- GAP
  - Fixed an issue where the `BLE_GAP_DATA_LENGTH_AUTO` value for `p_dl_params->max_tx_octets` and `p_dl_params->max_rx_octets` in `sd_ble_gap_data_length_update()` might not work as expected on connections using a configuration with configured event length of 2, 3, or 4 (DRGN-8779).
  - Fixed an issue where the `conn_handle` parameter in the event `BLE_GAP_EVT_DATA_LENGTH_UPDATE_REQUEST` was not populated correctly (DRGN-8749).
  - Fixed an issue where the SoftDevice would assert when `sd_ble_gap_device_identities_set()` was called while advertiser is running (DRGN-8634).
  - Two missing Advertising Data Types have been added: `BLE_GAP_AD_TYPE_LESC_CONFIRMATION_VALUE` (0x22) and `BLE_GAP_AD_TYPE_LESC_RANDOM_VALUE` (0x23) (DRGN-8101).
  - `sd_ble_gap_connect()` now always stops the scanner (DRGN-7679).
  - Fixed an issue where `sd_ble_gap_conn_param_update()` called in peripheral role may in some cases return `NRF_ERROR_BUSY` for 30 seconds after the previous procedure initiated by that call was completed (DRGN-8577).
- GATTC
  - It is no longer possible to issue a write command if the write command queue size is set to 0 on the config API (DRGN-8353).
- GATTS
  - It is no longer possible to issue an HVN if the HVN queue size is set to 0 on the config API (DRGN-8353).
- Documentation
  - Fixed documentation for `sd_ble_gap_addr_set()` and `sd_ble_gap_privacy_set()` (DRGN-8624).
  - Fixed documentation for `sd_ble_adv_start()` (DRGN-8624).
  - Fixed documentation for `sd_ble_gap_privacy_get()` (DRGN-8896).

## Limitations

- SoftDevice
  - If Radio Notifications are enabled, flash write and flash erase operations initiated through the SoftDevice API will be notified to the application as Radio Events (FORT-809).
  - Synthesized low frequency clock source is not tested or intended for use with the BLE stack.
  - Applications must not modify the `SEVONPEND` flag in the `SCR` register when running in priority levels higher than 6 (priority level numerical values lower than 6) as this can lead to undefined behavior.
- GATTS
  - To conform to the Bluetooth specification, there shall not be a secondary service that is not referenced somehow by a primary service. The SoftDevice does not enforce this (DRGN-906).

## Known Issues

- SoftDevice
  - If Connection Event Length Extension is enabled, the Radio Notification may be suppressed between connection events (DRGN-7687).
  - Calling `sd_ble_gap_sec_params_reply()`, `sd_ble_user_mem_reply()`, or `sd_ble_gatts_rw_authorize_reply()` more than 6 times without pulling events in between may in some cases lead to link disconnect (DRGN-8627).
- GATTS
  - When `BLE_EVT_USER_MEM_REQUEST` event is pulled by the application, incoming packet processing may in some cases be delayed until the application replies with the `sd_ble_user_mem_reply()` call (DRGN-8595).
  - The value of the attribute in `BLE_GATTS_EVT_RW_AUTHORIZE_REQUEST` event corresponding to the first Prepare Write Request on a link with heavy traffic may get corrupted if the application delays the pulling of SoftDevice events (DRGN-8595).

## s132\_nrf52\_5.0.0-1.alpha

The s132 is a SoftDevice for the nRF52832 chip.

These release notes list the changes and differences from **s132\_nrf52\_3.0.0**.

Notes:

- This is a major release which has changed the Application Programming Interface (API), requiring applications to be recompiled.
- The memory requirements of the SoftDevice have changed.

## SoftDevice properties

- The combined MBR and SoftDevice memory requirements for this version are as follows:
  - Flash: **128 kB** (0x20000 bytes).
  - RAM: **6.43 kB** (0x19C0 bytes) (minimum required memory - actual requirements are dependent upon the configuration chosen at `sd_ble_enable()` time).
  - Call stack: The SoftDevice uses a call stack combined with the application. The worst case stack usage for the SoftDevice is **1.54 kB** (0x624 bytes) (s132\_nrf52\_3.0.0 has 0x600 bytes of worst case stack usage). Application writers should ensure that enough stack space is reserved to cover both worst case SoftDevice call stack usage combined with worst case application call stack usage.

## New functionality

- LL
  - Support for transmitting and receiving on the 2 Mbps PHY has been added (DRGN-7552).

## Using 2 Mbps

The SoftDevice provides a new GAP option `BLE_GAP_OPT_PREFERRED_PHYS_SET`, a new SV call `sd_ble_gap_phy_request()`, and a new event, `BLE_GAP_EVT_PHY_UPDATE` to support the new PHY. Please read the API documentation for more details about these.

This alpha version of the SoftDevice supports connection establishment using the 1 Mbps PHY and then changing either the transmitting PHY or the receiving PHY (asymmetric link configuration), or both (symmetric link configuration) to use the 2 Mbps PHY. The PHYs can be changed using the above mentioned SV call.

Link Layer encryption and long data packet payload (up to 251 octets) are supported on both 1 Mbps and 2 Mbps PHYs.

## Bug fixes

There are no bug fixes in this release.

## Limitations

- SoftDevice
  - If Radio Notifications are enabled, flash write and flash erase operations initiated through the SoftDevice API will be notified to the application as Radio Events (FORT-809).
  - Synthesized low frequency clock source is not tested or intended for use with the BLE stack.
  - Applications must not modify the `SEVONPEND` flag in the `SCR` register when running in priority level 1 as this can lead to undefined behavior.
  - If the application uses `TIMER0` inside a timeslot (scheduled with the Radio Timeslot API), `INTENSET` for `TIMER0` must be cleared before the timeslot ends (DRGN-7776).
- LL
  - The peripheral role has priority over the central role when it comes to keeping the links alive.
  - For 2 Mbps, see the section "Using 2 Mbps" above.
- GAP
  - A broadcaster **and** a scanner cannot both be active if there are 8 connections established (DRGN-6543).

- GATTS
  - To conform to the Bluetooth specification there shall not be a secondary service that is not referenced somehow by a primary service. The SoftDevice does not enforce this (DRGN-906, DRGN-2260).

## Known Issues

- If `sd_softdevice_enable()` is called with `fault_handler` set to `NULL`, an invalid function pointer, or a pointer to a returning function, the behavior will be undefined (DRGN-7122).
- If Connection Event Length Extension is enabled, the Radio Notification may be suppressed between connection events (DRGN-7687).
- When `sd_ble_gap_connect()` returns an error code, the scanner may be stopped (DRGN-7679). To ensure the scanner is in a known state, `sd_ble_gap_scan_stop()` should be used to stop the scanner when `sd_ble_gap_connect()` returns an error code.