s132_nrf52_7.2.0 update 1 release notes

Introduction to the s132_nrf52 release notes

About the document

These 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 may 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.

*This document may be updated for an already released version of SoftDevice. The changes will be tagged with "**Update X**", where X is a number incremented each time the document has been revised.*

s132_nrf52_7.2.0

The main new feature of this version compared to the s132_nrf52_7.0.1 version is the efficient discovery of 128-bit UUIDs.

Notes:
- The release notes list changes since s132_nrf52_7.0.1.
- This SoftDevice is binary compatible with the s132_nrf52_7.0.1, and memory requirements have not changed. Applications are therefore not required to be recompiled.

SoftDevice Properties

- **Update 1:** This SoftDevice variant is compatible with nRF52832.
    - A previous release of this document mistakenly marked nRF52810 as supported by s132_nrf52_7.2.0. This is incorrect.
- This SoftDevice contains the Master Boot Record (MBR) version 2.4.1 (DRGN-10680).
    - This MBR version is compatible with previous MBR versions.
- The combined MBR and SoftDevice memory requirements for this version are as follows:
    - Flash: **152 kB** (0x26000 bytes)
    - RAM: **5.6 kB** (0x1668 bytes). This is the minimum required memory. The 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 **1.75 kB** (0x700 bytes). Application writers should ensure that enough stack space is reserved to cover the worst-case SoftDevice call stack usage combined with the worst-case application call stack usage.
- The Firmware ID of this SoftDevice is 0x0101.

New Features

- GATTC
    - 128-bit UUIDs can be discovered more efficiently by enabling the `BLE_GATTC_OPT_UUID_DISC` option. This option enables the automatic insertion of discovered 128-bit UUIDs to the Vendor Specific UUID table (DRGN-9653).

Changes

- LL
    - The slave accepts an `LL_REJECT_IND` as a valid response to an `LL_PHY_UPDATE_REQ` for aborting a self-initiated PHY update procedure. This change was added to improve the interoperability with devices not conforming to the Bluetooth Specification when aborting the PHY update procedure (DRGN-14193).

Bug Fixes

- GAP
  - Fixed an issue where the peripheral raised a `BLE_GAP_EVT_CONN_PARAM_UPDATE` event delayed by 30 s. This was happening when the connection parameter update resulted in the already active parameters for the link (DRGN-9865).

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 (DRGN-5197/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.
  - If the scanner is configured with a scan window larger than 16 seconds, the scanner will truncate the scan window to 16 seconds (DRGN-10305).
  - The SoftDevice may generate several events when connected, based on peer actions, meaning without previous action from the application. The BLE_GAP_EVT_PHY_UPDATE_REQUEST event, for instance, is generated when a connected peer sends a Phy Update Request, even when an application does not include logic to change PHY. There are several such events that may require action from an application if they are received. For more information, see the sd_ble_enable() API in SoftDevice.
- GATT
  - To conform to the Bluetooth Core Specification v 5.2, 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
  - The BLE_GAP_EVT_SEC_INFO_REQUEST event will not report the identity address of the peer to the application. This issue was also present in previous releases. A workaround is to do a mapping of the connection handle to the peer's identity address (DRGN-10340).
  - `sd_ble_gap_device_name_set()` may return `NRF_ERROR_INTERNAL` instead of `NRF_ERROR_NO_MEM` if the allocated space for the device name is too small. A workaround is to allocate enough space for the device name before calling `sd_ble_gap_device_name_set()` (DRGN-10195).
  - The SoftDevice will generate a resolvable address for the TargetA field in directed advertisements if the target device address is in the device identity list with a non-zero IRK, even if privacy is not enabled and the local device address is set to a public address. This issue was present also in previous releases. A workaround is to remove the device address from the device identity list (DRGN-10659).
  - A memory access fault (`NRF_FAULT_ID_APP_MEMACC`) can occur in `sd_nvic_critical_region_exit()` if a high priority SoftDevice interrupt occurs during a critical section, for example due to radio traffic (DRGN-10613). This issue was present also in previous releases. It can be fixed by editing `__NRF_NVIC_SD_IRQS_1` in nrf_nvic.h so that it becomes:

    ```
    #define __NRF_NVIC_SD_IRQS_1 ((uint32_t)(1U << (MWU_IRQn - 32)))
    ```

- GAP

    - If an extended advertiser is configured with limited duration, it will time out after the first primary channel packet in the last advertising event (DRGN-10367).
    - ble_gap_cfg_role_count_t::adv_set_count configuration parameter is not functional. The application should set it to BLE_GAP_ADV_SET_COUNT_DEFAULT when configuring the role count (DRGN-14113).
- GATTC
    - The `ble_gattc_service_t::uuid` field is incorrectly populated in the `BLE_GATTC_EVT_PRIM_SRVC_DISC_RSP` event if the `sd_ble_gattc_primary_services_discover()` or `sd_ble_gattc_read()` is called when a Primary Service Discovery by Service UUID is already ongoing (DRGN-11300). When the application has called `sd_ble_gattc_primary_services_discover()`, it should wait for the `BLE_GATTC_EVT_PRIM_SRVC_DISC_RSP` event before calling `sd_ble_gattc_primary_services_discover()` or `sd_ble_gattc_read()`.
- LL
    - If the application adds an all zeroes IRK with the `sd_ble_gap_device_identities_set()`, it will be treated as a valid entry in the device identity list. An all zeroes IRK is invalid and must not be added (DRGN-9083).

s132_nrf52_7.0.1

This is a production release that contains minor but important changes to the 7.0.0 release.

Notes:

- The release notes list changes since s132_nrf52_7.0.0.
- This SoftDevice is binary compatible to the s132_nrf52_7.0.0 and memory requirements have not changed. Applications are therefore not required to be recompiled.

SoftDevice properties

- This SoftDevice variant is production tested for nRF52832.
- This SoftDevice contains the Master Boot Record (MBR) version 2.4.1 (DRGN-10680).
  - This MBR version is compatible with previous MBR versions.
- The combined MBR and SoftDevice memory requirements for this version are as follows:
  - Flash: **152 kB** (0x26000 bytes)
  - RAM: **5.6 kB** (0x1668 bytes). This is the minimum required memory. The 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 **1.75 kB** (0x700 bytes). Application writers should ensure that enough stack space is reserved to cover the worst-case SoftDevice call stack usage combined with the worst-case application call stack usage.
- The Firmware ID of this SoftDevice is 0x00CB.

Changes

- SoftDevice
  - Bluetooth Core Specification v 5.1 compatibility (DRGN-12400).
  - The VersNr field in the LL_VERSION_IND packet now contains the value 0x0A to indicate Bluetooth Core Specification v 5.1 compatibility (DRGN-12466).
  - References to Errata are added to the documentation of all the events and APIs which report RSSI and should be observed if using RSSI measurements.
- LL
  - Bluetooth Core Specification Erratum #10818 is incorporated, allow HCI ACL data packets with 0-length payload, but do not transmit anything until receiving the next non-zero continuation fragment (DRGN-11430).

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 (DRGN-5197/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.
    - If the scanner is configured with a scan window larger than 16 seconds, the scanner will truncate the scan window to 16 seconds (DRGN-10305).
- GATT
    - 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
    - The BLE_GAP_EVT_SEC_INFO_REQUEST event will not report the identity address of the peer to the application. This issue was also present in previous releases. A workaround is to do a mapping of the connection handle to the peer's identity address (DRGN-10340).
    - `sd_ble_gap_device_name_set()` may return `NRF_ERROR_INTERNAL` instead of `NRF_ERROR_NO_MEM` if the allocated space for the device name is too small. A workaround is to allocate enough space for the device name before calling `sd_ble_gap_device_name_set()` (DRGN-10195).
    - The SoftDevice will generate a resolvable address for the TargetA field in directed advertisements if the target device address is in the device identity list with a non-zero IRK, even if privacy is not enabled and the local device address is set to a public address. This issue was present also in previous releases. A workaround is to set the IRK to zero or to remove the device address from the device identity list (DRGN-10659).
    - The SoftDevice may generate several events, when connected, based on peer actions, i.e. without prior action from the application. The BLE_GAP_EVT_PHY_UPDATE_REQUEST event, for instance, will be generated when a connected peer sends a Phy Update Request, even when an application does not include logic to change phy. There are several such events that may require action from an application if they are received. For more details check sd_ble_enable() API in SoftDevice.
    - A memory access fault (`NRF_FAULT_ID_APP_MEMACC`) can occur in `sd_nvic_critical_region_exit()` if a high priority SoftDevice interrupt occurs during a critical section, for example due to radio traffic (DRGN-10613). This issue was present also in previous releases. It can be fixed by editing `__NRF_NVIC_SD_IRQS_1` in nrf_nvic.h so that it becomes:

      ```
      #define __NRF_NVIC_SD_IRQS_1 ((uint32_t)(1U << (MWU_IRQn - 32)))
      ```

- GAP
    - If an extended advertiser is configured with limited duration, it will time out after the first primary channel packet in the last advertising event (DRGN-10367).
- GATTC
    - The `ble_gattc_service_t::uuid` field is incorrectly populated in the `BLE_GATTC_EVT_PRIM_SRVC_DISC_RSP` event if the `sd_ble_gattc_primary_services_discover()` or `sd_ble_gattc_read()` is called when a Primary Service Discovery by Service UUID is already ongoing (DRGN-11300). When the application has called `sd_ble_gattc_primary_services_discover()`, it should wait for the `BLE_GATTC_EVT_PRIM_SRVC_DISC_RSP` event before calling `sd_ble_gattc_primary_services_discover()` or `sd_ble_gattc_read()`.
- LL
    - If the application adds an all zeroes IRK with the `sd_ble_gap_device_identities_set()`, it will be treated as a valid entry in the device identity list. An all zeroes IRK is invalid and must not be added (DRGN-9083).

s132_nrf52_7.0.0 (Deprecated)

The main new features of this version compared to the s132_nrf52_6.1.1 are the ability to configure the inclusion of the Central Address Resolution (CAR) and Peripheral Preferred Connection Parameters (PPCP) characteristics and the ability to trigger a task, for example a GPIOTE task, at the start of a connection event.

Notes:

- This release has changed the API. This requires applications to be recompiled.
- The memory requirements of the s132 SoftDevice have changed.
- The release notes list changes since s132_nrf52_6.1.1.

SoftDevice properties

- This SoftDevice variant is production tested for nRF52832.
- This SoftDevice contains the Master Boot Record (MBR) version 2.4.1 (DRGN-10680).
  - This MBR version is compatible with previous MBR versions.
- The combined MBR and SoftDevice memory requirements for this version are as follows:
  - Flash: **152 kB** (0x26000 bytes)
  - RAM: **5.6 kB** (0x1668 bytes). This is the minimum required memory. The 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 **1.5 kB** (0x600 bytes). Application writers should ensure that enough stack space is reserved to cover the worst-case SoftDevice call stack usage combined with the worst-case application call stack usage.
- The Firmware ID of this SoftDevice is 0x00C2.

New functionality

- GAP
  - API to obtain the next connection event counter (DRGN-10913).
  - API for triggering a task when the SoftDevice is about to start a connection event (DRGN-10914).
  - API for inclusion configuration of the CAR and PPCP characteristics (DRGN-10874).

Changes

- SoftDevice
  - Removed macros defining PPI channels and groups available to the application (DRGN-10382).
- GAP
  - The API for configuring improved advertiser role scheduling is removed. The SoftDevice now uses the improved scheduling configuration by default (DRGN-10754).

Bug fixes

- SoftDevice
  - Fixed an issue in the QoS channel survey feature where the reported RSSI value for a channel was influenced by the noise on the previously checked channel (DRGN-10441).
  - Fixed an issue where the application would be blocked when requesting an earliest possible Radio Timeslot (DRGN-10402).
- LL
  - Fixed an issue where the slave might disconnect if many packets where lost and there was an ongoing Connection Parameter Update (DRGN-11147).

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.
  - If the scanner is configured with a scan window larger than 16 seconds, the scanner will truncate the scan window to 16 seconds (DRGN-10305).
- GATT
  - 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
  - The BLE_GAP_EVT_SEC_INFO_REQUEST event will not report the identity address of the peer to the application. This issue was also present in previous releases. A workaround is to do a mapping of the connection handle to the peer's identity address (DRGN-10340).
  - `sd_ble_gap_device_name_set()` may return `NRF_ERROR_INTERNAL` instead of `NRF_ERROR_NO_MEM` if the allocated space for the device name is too small. A workaround is to allocate enough space for the device name before calling `sd_ble_gap_device_name_set()` (DRGN-10195).
  - The MWU protection may become disabled in certain cases if application ISR is interrupted by SoftDevice ISR (DRGN-10361).
  - A memory access fault (`NRF_FAULT_ID_APP_MEMACC`) can occur in `sd_nvic_critical_region_exit()` if a high priority SoftDevice interrupt occurs during a critical section, for example due to radio traffic (DRGN-10613). This issue was present also in previous releases. It can be fixed by editing `__NRF_NVIC_SD_IRQS_1` in nrf_nvic.h so that it becomes:

    ```
    #define __NRF_NVIC_SD_IRQS_1 ((uint32_t)(1U << (MWU_IRQn - 32)))
    ```

  - The SoftDevice will generate a resolvable address for the TargetA field in directed advertisements if the target device address is in the device identity list with a non-zero IRK, even if privacy is not enabled and the local device address is set to a public address. This issue was present also in previous releases. A workaround is to set the IRK to zero or to remove the device address from the device identity list (DRGN-10659).

- GAP
  - If an extended advertiser is configured with limited duration, it will time out after the first primary channel packet in the last advertising event (DRGN-10367).
- GATTC
  - The `ble_gattc_service_t::uuid` field is incorrectly populated in the `BLE_GATTC_EVT_PRIM_SRVC_DISC_RSP` event if the `sd_ble_gattc_primary_services_discover()` or `sd_ble_gattc_read()` is called when a Primary Service Discovery by Service UUID is already ongoing (DRGN-11300). When the application has called `sd_ble_gattc_primary_services_discover()`, it should wait for the `BLE_GATTC_EVT_PRIM_SRVC_DISC_RSP` event before calling `sd_ble_gattc_primary_services_discover()` or `sd_ble_gattc_read()`.

s132_nrf52_6.1.1

This is a production release that contains minor but important changes to the 6.1.0 release.

Notes:

- The release notes list changes since the s132_nrf52_6.1.0 release.
- This SoftDevice is binary compatible to the s132_nrf52_6.1.0 and memory requirements have not changed. Applications are therefore not required to be recompiled.

SoftDevice Properties

- This SoftDevice is production tested for nRF52832.
- This SoftDevice contains the Master Boot Record (MBR) version 2.4.1 (DRGN-10680).
  - This MBR version is compatible with previous MBR versions.
- The combined MBR and SoftDevice memory requirements for this version are the same as for the s132_nrf52_6.1.0:

  - 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 0x00B7.

Changes

- SoftDevice
  - The MBR 2.4.1 is a minor backward compatible configuration update of the MBR for this release. There were no bugs resolved in this update, only minor build configuration option changes (DRGN-10680).
  - Applications can improve the radio utilization for multiprotocol applications by enabling the improved advertiser role scheduling configuration through the BLE Option API. The time reserved for an advertising event will then be decreased by up to 1.3 ms (DRGN-10398).

Bug Fixes

- SoftDevice
  - Fixed an issue with the QoS channel survey feature, where the LNA control would only work for the first channel to be checked in the survey (DRGN-10466).
  - Fixed a problem where calling `sd_ble_gap_connect()` with `scan_phys` set to only `BLE_GAP_PHY_2MBPS` would cause an assert when starting to scan (DRGN-10654).
  - Fixed an issue where NRF_TIMER0 may not be reset at the start of a radio timeslot (DRGN-10650).

- LL
  - Fixed an issue where the SoftDevice would sometimes delay the LL_LENGTH_RSP in a Data Length Update procedure if a PHY Update procedure was ongoing at the same time (DRGN-10853).
  - Fixed an issue where the SoftDevice could assert when receiving long packets during extended scanning (DRGN-10880).

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.
  - If the scanner is configured with a scan window larger than 16 seconds, the scanner will truncate the scan window to 16 seconds (DRGN-10305).
- GATT
  - 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
  - `sd_ble_gap_device_name_set()` may return `NRF_ERROR_INTERNAL` instead of `NRF_ERROR_NO_MEM` if the allocated space for the device name is too small. A workaround is to allocate enough space for the device name before calling `sd_ble_gap_device_name_set()` (DRGN-10195).
  - The MWU protection may become disabled in certain cases if application ISR is interrupted by SoftDevice ISR (DRGN-10361).
  - If the application requests an earliest possible Radio Timeslot and the timeslot is blocked, the SoftDevice will repeat the same request until it times out, thereby blocking the main context and the lower application interrupt priority levels. A workaround is to increase the timeout of the Radio Timeslot request to make it able to fit after the event that is blocking the request (DRGN-10402).
  - When using the QoS channel survey feature, the reported RSSI value for a channel is influenced by the noise on the previously checked channel (DRGN-10441).
  - The SoftDevice will generate a resolvable address for the TargetA field in directed advertisements if the target device address is in the device identity list with a non-zero IRK, even if privacy is not enabled and the local device address is set to a public address. This can make devices certified for Bluetooth versions older than 4.2 ignore the advertising packets. This issue is present in SoftDevice versions 3.0.0 and later. A workaround is to set the IRK to zero or to remove the device address from the device identity list (DRGN-10659).
  - If an extended advertiser is configured with limited duration, it will time out after the first primary channel packet in the last advertising event (DRGN-10367).

s132_nrf52_6.1.0

The main new feature for s132_nrf52_6.1.0 compared to s132_nrf52_6.0.0 is the full support for all mandatory LE Advertising Extensions features.

Notes:

- The release notes list changes since the s132_nrf52_6.0.0 release.
- This SoftDevice is binary compatible to the s132_nrf52_6.0.0. Applications are therefore not required to be recompiled and memory requirements have not changed.
- The LE Advertising Extensions feature is Bluetooth Qualified in this production release and can be used in end products.

SoftDevice Properties

- This SoftDevice is production tested for nRF52832.
- This SoftDevice contains the Master Boot Record (MBR) version 2.2.2 (DRGN-9537).
- The combined MBR and SoftDevice memory requirements for this version are the same as for the s132_nrf52_6.0.0:
  - 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 0x00AF.

New Functionality

- SoftDevice
  - The SoftDevice variant, flash usage, reserved PPIs, and reserved interrupt priorities are now available at compile time to the application through new APIs (DRGN-9627).
  - Qualified LE Advertising Extensions feature (DRGN-7504).
  - An API is added to enable the application to remove an unused UUID entry from the UUID table (DRGN-10389).
- GAP
  - Message sequence charts for Advertising Extensions are added (DRGN-9285).
  - With the new `sd_ble_gap_adv_addr_get()` API, the application can now get the Bluetooth device address that is being used by the advertiser (DRGN-10470).
- LL
  - It is now possible to send and receive advertising packets with up to 255 bytes of payload (DRGN-9315).
  - Privacy for Advertising Extensions is fully supported (DRGN-9340).
  - The SoftDevice is now able to receive chained advertisements (DRGN-9734).
  - The SoftDevice is now able to send chained advertisements. The advertising data fragmentation is handled autonomously by the SoftDevice (DRGN-9802).
  - The scanner is now able to follow AUX pointers outside the scan window (DRGN-9886).
  - The scanner and initiator roles for Advertising Extensions now implement a backoff procedure (DRGN-10271).

Changes

- SoftDevice
  - The sleep current has been improved (DRGN-9628).
  - Improved documentation for the `NRF_ERROR_INVALID_STATE` error code (DRGN-9693).
  - When the SoftDevice is acting as a peripheral, and the RC oscillator is used as the LFCLK source, the configured RC calibration period can now be increased. By default, the SoftDevice will now increase the receive window if two consecutive packets are missed and will then perform RC calibration if necessary (DRGN-9852).
  - SoftDevice s132_nrf52_6.0.0 accepted an advertising interval larger than BLE_GAP_ADV_INTERVAL_MAX as an experimental feature. However, this configuration could make the SoftDevice assert. Now, the SoftDevice will return NRF_ERROR_INVALID_PARAM if the application configures an advertising interval larger than BLE_GAP_ADV_INTERVAL_MAX (DRGN-10322).
  - Radio utilization for multi-protocol applications are improved significantly as the time allocated for a normal Radio Timeslot request session has decreased by up to 1 ms (DRGN-10405).
- GATT
  - `sd_ble_gatts_rw_authorize_reply()` now allows sending the 0xFC (Write Request Rejected) profile error code which was introduced in the Bluetooth Core Specification Supplement CSSv7 (DRGN-10373).
- GAP
  - Setting the `ble_gap_adv_properties_t::anonymous` or `ble_gap_adv_properties_t::include_tx_power` bits when configuring a legacy advertiser is no longer permitted (DRGN-10024).
  - Using a too short duration for the advertising event when advertising is no longer accepted by the API (DRGN-10067).
  - The advertising data length limit for a connectable extended advertiser is now properly documented and limited in the API to 238 bytes (DRGN-10420).
- LL
  - Packet content validation is improved for the scanning of extended advertising PDUs (DRGN-9686).
  - The optional TxPower field is not included in the extended header in extended advertising PDUs (DRGN-8545).
  - Instead of disconnecting, the SoftDevice will now respond with LL_UNKNOWN_RSP when receiving control procedure PDUs with invalid lengths (DRGN-9997).

Bug Fixes

- SoftDevice
  - Fixed an issue where a HardFault could generate a new HardFault if the application called a NULL pointer (DRGN-9607).
  - Fixed an issue where the SoftDevice HardFault handler could hang if the application wrote to protected memory (DRGN-9694).
  - Fixed an issue where the SoftDevice could assert if configured with too many L2CAP Connection-oriented Channels (DRGN-9946).
  - Fixed an issue where the HFXO would sometimes not be released properly after RC calibration. This is in addition to the bug fix for a similar condition resolved in s132_nrf52_6.0.0 (DRGN-9920, DRGN-10166).
  - Fixed an issue where the PA/LNA GPIOs could be triggered too late. Furthermore, the PA pin is now set active 23 µs before RADIO TX start, instead of 5 µs before RADIO TX start. The LNA pin is set active 5 µs before RADIO RX start, as before (DRGN-9928).
  - Fixed documentation for `SD_EVT_IRQHandler` and `RADIO_NOTIFICATION_IRQHandler`, where the default interrupt priority was documented incorrectly (DRGN-10174).
  - Fixed an issue where LFRC oscillator calibration could fail (DRGN-10255).
  - Fixed an issue that could make the SoftDevice assert when scheduling events close together (DRGN-10316).
- GAP
  - Fixed an issue where the source of the timeout event might be set to `BLE_GAP_TIMEOUT_SRC_CONN` instead of `BLE_GAP_TIMEOUT_SRC_SCAN` when the scanner times out (DRGN-10000).
  - Fixed an issue where the advertiser would not update its address type if `sd_ble_gap_addr_set()` or `sd_ble_gap_privacy_set()` was called after `sd_ble_gap_adv_set_configure()` and before `sd_ble_gap_adv_start()` (DRGN-10025).

- Fixed an issue where the SoftDevice incorrectly reported advertising packets from non-whitelisted devices if the `BLE_GAP_SCAN_FP_WHITELIST_NOT_RESOLVED_DIRECTED` filter policy was used (DRGN-10196).
- Fixed an issue where the scanner incorrectly reported the `data_id` field in extended advertising PDUs as zero (DRGN-10204).
- Fixed an issue where passing a zero-initialized parameter to `sd_ble_gap_connect()` could cause an assert (DRGN-10331).
- Fixed an issue where the SoftDevice could return `NRF_ERROR_INVALID_STATE` if the application called `sd_ble_gap_scan_start()` or `sd_ble_gap_connect()` right after receiving `BLE_GAP_EVT_TIMEOUT` for a previous call to `sd_ble_gap_connect()` (DRGN-10215).
- Fixed an issue where the SoftDevice could return `NRF_ERROR_INVALID_STATE` if the application called `sd_ble_gap_scan_start()` or `sd_ble_gap_connect()` right after calling `sd_ble_gap_connect_cancel()` (DRGN-10226).
- Fixed an issue that could cause an assert when an advertiser configured with invalid parameters connected to a peer (DRGN-10355).
- Fixed an issue that could cause an assert when the advertiser was stopped (DRGN-10364).

- LL
  - Fixed an issue where the advertiser could send advertising packets beyond the set advertising duration (DRGN-10069).
  - Fixed an issue where the slave might not listen during the entire connection parameter update (DRGN-10086).
  - Fixed an issue where the master used wrong timings while establishing a connection with Advertising Extensions (DRGN-10112).
  - Fixed an issue where a privacy enabled extended advertiser would never be able to connect (DRGN-10205).
  - Fixed an issue where the SoftDevice sent ADV_EXT_IND PDUs with an incorrect AUX Offset (DRGN-10207).
  - Fixed an issue where the extended advertiser could assert if receiving longer PDUs than expected (DRGN-10232).
  - Fixed an issue that could result in lost advertising reports and advertising reports with all fields set to zero (DRGN-10393).
  - Fixed an issue where the scanner would not generate a report for information received in scanned ADV_EXT_IND and AUX_ADV_IND if the AUX_SCAN_RSP was missed (DRGN-10397).

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.
  - If the scanner is configured with a scan window larger than 16 seconds, the scanner will truncate the scan window to 16 seconds (DRGN-10305).
- GATT
  - 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
  - `sd_ble_gap_device_name_set()` may return `NRF_ERROR_INTERNAL` instead of `NRF_ERROR_NO_MEM` if the allocated space for the device name is too small. A workaround is to allocate large enough space for the device name before calling `sd_ble_gap_device_name_set()` (DRGN-10195).
  - The memory protection provided by the MWU peripheral may be disabled. Corrupting the SoftDevice memory can cause the SoftDevice to malfunction (DRGN-10361).
  - If the application requests an earliest possible Radio Timeslot and the timeslot is blocked, the SoftDevice will repeat the same request until it times out, thereby blocking the main context and the lower application interrupt priority levels. A possible workaround is to increase the timeout of the Radio Timeslot request to make it able to fit after the event that is blocking the request (DRGN-10402).
  - When using the QoS channel survey feature, the reported RSSI value for a channel is influenced by the noise on the previously checked channel (DRGN-10441).

    - When using the QoS channel survey feature, the LNA control only works for the first channel that is checked in the survey (DRGN-10466).
- GAP
    - If an extended advertiser is configured with limited duration, it will time out after the first primary channel packet in the last advertising event (DRGN-10367).

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 -> 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 an 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()` mig ht 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 then 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.