s140_nrf52 release notes

Introduction to the s140_nrf52 release notes

About the document

These release notes describe the changes in the s140_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 s140_nrf52 migration document (normally available for major releases only).

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.

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

Contents

s140_nrf52_7.3.0

The main new feature of this version compared to the s140_nrf52_7.2.1 version is the possibility for the application to configure the slave to wake up every connection event if it detects that the master is not receiving its packets.

Notes:

- The release notes list changes since s140_nrf52_7.2.1.

- This SoftDevice is binary compatible with the s140_nrf52_7.2.1, and memory requirements have not changed. Applications are therefore not required to be recompiled.

SoftDevice properties

- This SoftDevice variant is compatible with nRF52811, nRF52820, nRF52833, and nRF52840.

- 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: **156.0 kB** (0x27000 bytes).

    - RAM: **5.6 kB** (0x1678 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 **1.8 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 0x0123.

New Features

- GAP

    - A new option named `BLE_GAP_SLAVE_LATENCY_WAIT_FOR_ACK` is available to the application. This can be used to configure the slave to wake up every connection event if it has not received an ACK from the master for at least the length of the slave latency events. This configuration may increase the power consumption in environments with a lot of radio activity (DRGN-15555).

Bug Fixes

- LL

    - Fixed an issue where the last advertising event within the configured advertising duration may end with sending a packet without listening for a `CONNECT_IND`, `SCAN_REQ`, `AUX_CONNECT_REQ`, or `AUX_SCAN_REQ` packet (DRGN-15484).

    - Fixed an issue where an extended advertiser configured with a non-zero duration may time out after the first primary channel packet in the last advertising event (DRGN-10367).

    - Fixed an issue in the central role where the SoftDevice low priority interrupt might not return. This occurred when QoS connection events were enabled with continuous interval, and at

least two connections with peer peripherals were established in succession. This resulted in the application not being able to call any SoftDevice APIs (DRGN-15515).

- Fixed an issue where the SoftDevice could assert when calling `sd_ble_gap_qos_channel_survey_start()` (DRGN-15545).

- GAP

    - Fixed an issue where the application might not receive a `BLE_GAP_EVT_DISCONNECTED` event if the application does not continuously pull events from the SoftDevice (DRGN-15619).

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).

    - Synthesized low frequency clock source is not tested or intended for use with the Bluetooth LE 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.

    - Applications aiming at initiating LE connections on LE Coded PHY must have configured the length of the connection event to be large enough to transmit and receive at least one pair of data channel PDUs with a payload of 27 octets. Otherwise, the SoftDevice will not be able to connect on LE Coded PHY.

    - 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 v5.2, there shall be no secondary service that is not referenced somehow by a primary service. The SoftDevice does not enforce this (DRGN-906).

- LL

    - In connections, the Link Layer payload size is limited to 27 bytes on LE Coded PHY (DRGN-8476).

Known Issues

- MBR

    - When copying the Bootloader on the nRF52811 using the `SD_MBR_COMMAND_COPY_BL` MBR command, the MBR will not write-protect itself. This does not change the behavior of the MBR or DFU process as the MBR cannot be configured to overwrite itself (DRGN-11287).

- SoftDevice

    - 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. A workaround is to remove the device address from the device identity list (DRGN-10659).

    - When running on nRF52811, nRF52820, and nRF52833, using `sd_power_dcdc0_mode_set` API can lead to undefined behavior.

    - 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). 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 the Peer Preferred Connection Parameters Characteristic (PPCP) contains "No specific values indication (0xFFFF)", application should not perform a peripheral initiated connection parameter update using PPCP. Otherwise invalid values will be used in `L2CAP_CONNECTION_PARAMETER_UPDATE_REQ`. A workaround is to always specify the connection parameters in the `sd_ble_gap_conn_param_update` call (DRGN-15111).

    - The `BLE_GAP_EVT_SEC_INFO_REQUEST` event will not report the identity address of the peer to the application. 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).

    - `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 `sd_ble_gattc_primary_services_discover()` or `sd_ble_gattc_read()` is called when a Primary Service Discovery by Service UUID is already ongoing. 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()` (DRGN-11300).

- 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).

s140_nrf52_7.2.1

The main new features of this version compared to the s140_nrf52_7.2.0 version are:

- The application can configure CCCD permission for the service change characteristic.
- Fixing an issue where the high duty cycle advertiser did not connect successfully.

Notes:

- The release notes list changes since s140_nrf52_7.2.0.
- This SoftDevice is binary compatible with the s140_nrf52_7.2.0 and memory requirements have not changed. Applications are therefore not required to be recompiled.

SoftDevice properties

- This SoftDevice variant is compatible with nRF52811, nRF52820, nRF52833 and nRF52840.
- 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: **156.0 kB** (0x27000 bytes).
    - RAM: **5.6 kB** (0x1678 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 0x0116.

New Features

- GATTS
    - The application can configure CCCD permission for the Service Changed characteristic, using `BLE_GATTS_CFG_SERVICE_CHANGED_CCCD_PERM` (DRGN-15034).

Bug Fixes

- LL
    - Fixed an issue where the high duty cycle advertiser did not always connect successfully if the RC was used as the source for the LFCLK, and the peer didn't initiate the connection fast enough (DRGN-15003).

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).

- Synthesized low frequency clock source is not tested or intended for use with the Bluetooth LE 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.

- Applications aiming at initiating LE connections on LE Coded PHY must have configured the length of the connection event to be large enough to transmit and receive at least one pair of data channel PDUs with a payload of 27 octets. Otherwise, the SoftDevice will not be able to connect on LE Coded PHY.

- 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 v5.2, there shall be no secondary service that is not referenced somehow by a primary service. The SoftDevice does not enforce this (DRGN-906).

- LL

  - In connections, the Link Layer payload size is limited to 27 bytes on LE Coded PHY (DRGN-8476).

Known Issues

- MBR

  - When copying the Bootloader on the nRF52811 using the `SD_MBR_COMMAND_COPY_BL` MBR command, the MBR will not write-protect itself. This does not change the behavior of the MBR or DFU process as the MBR cannot be configured to overwrite itself (DRGN-11287).

- SoftDevice

  - **Update 1:** ~~When running on nRF52811, using sd_power_usb_* APIs can lead to undefined behavior (DRGN-12720).~~ This is now documented in the API.

  - **Update 1:** ~~When running on nRF52811, using sd_protected_register_write API can lead to undefined behavior (DRGN-12447).~~ This is inorrect.

  - 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. A workaround is to remove the device address from the device identity list (DRGN-10659).

  - When running on nRF52811, nRF52820, and nRF52833, using `sd_power_dcdc0_mode_set` API can lead to undefined behavior.

  - 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). 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 the Peer Preferred Connection Parameters Characteristic (PPCP) contains "No specific values indication (0xFFFF)", application should not perform a peripheral initiated connection parameter update using PPCP. Otherwise invalid values will be used in `L2CAP_CONNECTION_PARAMETER_UPDATE_REQ`. A workaround is to always specify the connection parameters in the `sd_ble_gap_conn_param_update` call (DRGN-15111).

  - The `BLE_GAP_EVT_SEC_INFO_REQUEST` event will not report the identity address of the peer to the application. 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).

  - 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 `sd_ble_gattc_primary_services_discover()` or `sd_ble_gattc_read()` is called when a Primary Service Discovery by Service UUID is already ongoing. 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()` (DRGN-11300).

- 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).

s140_nrf52_7.2.0

The main new features of this version compared to the s140_nrf52_7.0.1 version is the efficient discovery of 128-bit UUIDs.

Notes:

- The release notes list changes since s140_nrf52_7.0.1.

- This SoftDevice is binary compatible with the s140_nrf52_7.0.1, and memory requirements have not changed. Applications are therefore not required to be recompiled.

SoftDevice properties

- This SoftDevice variant is compatible with nRF52811, nRF52820, nRF52833 and nRF52840.

- 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: **156.0 kB** (0x27000 bytes).

    - RAM: **5.6 kB** (0x1678 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 0x0100.

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).

    - Synthesized low frequency clock source is not tested or intended for use with the Bluetooth LE 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.

    - Applications aiming at initiating LE connections on LE Coded PHY must have configured the length of the connection event to be large enough to transmit and receive at least one pair of data channel PDUs with a payload of 27 octets. Otherwise, the SoftDevice will not be able to connect on LE Coded PHY.

    - 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 v5.2, there shall be no secondary service that is not referenced somehow by a primary service. The SoftDevice does not enforce this (DRGN-906).

- LL

    - In connections, the Link Layer payload size is limited to 27 bytes on LE Coded PHY (DRGN-8476).

Known Issues

- MBR

    - When copying the Bootloader on the nRF52805 or nRF52811 using the `SD_MBR_COMMAND_COPY_BL` MBR command, the MBR will not write-protect itself. This does not change the behavior of the MBR or DFU process as the MBR cannot be configured to overwrite itself (DRGN-11287).

- SoftDevice

    - 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. A workaround is to remove the device address from the device identity list (DRGN-10659).

- When running on nRF52811, nRF52820, and nRF52833, using `sd_power_dcdc0_mode_set` API can lead to undefined behavior.

- 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). 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

  - The `BLE_GAP_EVT_SEC_INFO_REQUEST` event will not report the identity address of the peer to the application. 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).

  - 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 `sd_ble_gattc_primary_services_discover()` or `sd_ble_gattc_read()` is called when a Primary Service Discovery by Service UUID is already ongoing. 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()` (DRGN-11300).

- 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).

s140_nrf52_7.0.1

This is a production release that contains minor, backward compatible, changes to the 7.0.0 release.

For some combinations of SoftDevice and nRF52 IC, only Bluetooth Core Specification v5.1 qualified listings are available with corresponding QDIDs from v7.0.1.

Updating to this version from v7.0.0 is recommended.

Notes:

- The release notes list changes since s140_nrf52_7.0.0.

- This SoftDevice is binary compatible with the s140_nrf52_7.0.0 and memory requirements have not changed. Applications are therefore not required to be recompiled.

SoftDevice properties

- This SoftDevice variant is compatible with nRF52811, nRF52820, nRF52833, and nRF52840.

- 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: **156 kB** (0x27000 bytes)

    - RAM: **5.6 kB** (0x1678 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) . A pplication 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 0x00CA.

Changes

- SoftDevice

    - Bluetooth Core Specification v5.1 qualified (DRGN-12400).

    - The VersNr field in the LL_VERSION_IND packet now contains the value 0x0A to indicate Bluetooth Core Specification v5.1 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 SpecificationErratum #10818 is incorporated. The SoftDevice now allows HCI ACL data packets with 0-length payload, but does not transmit anything until receiving the next non-zero continuation fragment (DRGN-11430).

    - Bluetooth Core SpecificationErratum #10750 is incorporated. The BLE_GAP_EVT_DATA_LENGTH_UPDATE event will now be raised to the application when switching to and from Coded PHY. On-air behavior has not changed (DRGN-11435).

Bug fixes

- SoftDevice

  - Fixed an issue where the SoftDevice failed to start the RC oscillator on nRF52811, making it not possible to use the RC as a clock source (DRGN-12442).

  - Fixed an issue where wakeup from sleep can take longer, even if the vector table is in RAM (DRGN-12508).

  - Fixed an issue where the time scheduled for a flash write or flash page erase using `sd_flash_write` or `sd_flash_page_erase` APIs on nRF52811 will be longer than required. The same applies for nRF52832 (DRGN-12539).

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.

  - Applications aiming at initiating LE connections on LE Coded PHY must have configured the length of the connection event to be large enough to transmit and receive at least one pair of data channel PDUs with a payload of 27 octets. Otherwise, the SoftDevice will not be able to connect on LE Coded PHY.

  - 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).

- LL

  - In connections, the Link Layer payload size is limited to 27 bytes on LE Coded PHY (DRGN-8476).

Known Issues

- MBR

  - When copying the Bootloader on the nRF52811 using the `SD_MBR_COMMAND_COPY_BL` MBR command, the MBR will not write-protect itself. This does not change the behavior of the MBR or DFU process as the MBR cannot be configured to overwrite itself (DRGN-11287).

- SoftDevice

  - When running on nRF52811, using `sd_power_usb*` APIs can lead to undefined behavior (DRGN-12720).

  - When running on nRF52811, using `sd_protected_register_write` API can lead to undefined behavior (DRGN-12447).

- 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 map 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 following issue is not valid. The same applies to the previous release notes: The MWU protection may become disabled in certain cases if application ISR is interrupted by SoftDevice ISR [STRIKEOUT:(DRGN-10361).]

- 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.

- When running on nRF52833, using `sd_power_dcdc0_mode_set` API can lead to undefined behavior.

- The following issue was previouslymistakenly removed from the release notes:

  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 `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).

s140_nrf52_7.0.0 (Deprecated)

The main new features of this version compared to the s140_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 s140 SoftDevice have changed.
- The release notes list changes since s140_nrf52_6.1.1.

SoftDevice properties

- This SoftDevice variant is compatible with nRF52811 and nRF52840.
- 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: **156 kB** (0x27000 bytes)
    - RAM: **5.6 kB** (0x1678 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 0x00C1.

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.

    - Applications aiming at initiating LE connections on LE Coded PHY must have configured the length of the connection event to be large enough to transmit and receive at least one pair of data channel PDUs with a payload of 27 octets. Otherwise, the SoftDevice will not be able to connect on LE Coded PHY.

    - 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).

- LL

    - In connections, the Link Layer payload size is limited to 27 bytes on LE Coded PHY (DRGN-8476).

Known Issues

- MBR

    - When copying the Bootloader on the nRF52811 using the `SD_MBR_COMMAND_COPY_BL` MBR command, the MBR will not write-protect itself. This does not change the behavior of the MBR or DFU process as the MBR cannot be configured to overwrite itself (DRGN-11287).

- SoftDevice

    - The time scheduled for a flash write or flash page erase using `sd_flash_write` or `sd_flash_page_erase` APIs on nRF52811 will be longer than required and the same as for nRF52832.

- When running on nRF52811, using `sd_power_usb*` APIs can lead to undefined behaviour.

- When running on nRF52811, using `sd_protected_register_write` API can lead to undefined behaviour.

- 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 `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()`.

s140_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 s140_nrf52_6.1.0 release.

- This SoftDevice is binary compatible to the s140_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 nRF52840.

- 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 s140_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 0x00B6.

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).

  - Fixed an issue in the workaround for Errata 172 that could lead to high packet error rate when receiving on LE Coded PHY in noisy environments (DRGN-10652).

- 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).
- Fixed an issue with the Data Length Update procedure by limiting MaxTxTime and MaxRxTime in the procedure PDUs to 2120 µs unless the link is on LE Coded PHY or is about to change to LE Coded PHY. (DRGN-10264, DRGN-10751).

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.
  - Applications aiming at initiating LE connections on LE Coded PHY must have configured the length of the connection event to be large enough to transmit and receive at least one pair of data channel PDUs with a payload of 27 octets. Otherwise, the SoftDevice will not be able to connect on LE Coded PHY.
  - 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).

- LL

  - In connections, the Link Layer payload size is limited to 27 bytes on LE Coded PHY (DRGN-8476).

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).

- 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).

s140_nrf52_6.1.0

The main new feature for s140_nrf52_6.1.0 compared to s140_nrf52_6.0.0 is the full support for all mandatory LE Advertising Extensions features and qualified LE Coded PHY feature.

Notes:

- The release notes list changes since the s140_nrf52_6.0.0 release.

- This SoftDevice is binary compatible to the s140_nrf52_6.0.0. Applications are therefore not required to be recompiled and memory requirements have not changed.

- The LE Advertising Extensions and LE Long Range (LE Coded PHY) features are Bluetooth Qualified in this production release and can be used in end products.

- s140_nrf52_6.1.0 contains Errata workarounds and timing configurations for the LE Coded PHY feature that are optimized for nRF52840 production silicon. This SoftDevice should therefore be used with nRF52840 production silicon when qualifying LE Coded PHY in a product, and for measuring performance. Previous versions of the S140 SoftDevice were compatible with Engineering versions of nRF52840 which excluded some optimizations (DRGN-9867).

SoftDevice Properties

- This SoftDevice is production tested for nRF52840.

- This SoftDevice contains the Master Boot Record (MBR) version 2.3.0 (DRGN-9755).

- The combined MBR and SoftDevice memory requirements for this version are the same as for the s140_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 0x00AE.

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 Coded PHY feature (DRGN-5702).

    - 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).

    - GPIO port 1 pins (P1.00 to P1.15) can now be used for PA/LNA on the nRF52840 (DRGN-9995).

- GAP

  - The scanner and initiator roles can now be configured to receive ADV_EXT_IND PDUs on both 1M and Coded PHY, using a single call to `sd_ble_gap_scan_start()` or `sd_ble_gap_connect()` (DRGN-8668).

  - 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 time reserved by the SoftDevice is reduced by 297 Âµs when performing a flash word write, and by 4.7 ms when performing a flash page erase. This increases the probability of successfully scheduled flash operations (DRGN-9048).

  - 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 s140_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

  - The maximum value of parameters `max_tx_time_us` and `max_rx_time_us` provided to `sd_ble_gap_data_length_update()` is now raised to 2704. The previous maximum value was 2120 (DRGN-9904, DRGN-10263, DRGN-10264).

- 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 s140_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 Âµs before RADIO TX start, instead of 5 Âµs before RADIO TX start. The LNA pin is set active 5 Âµs 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 waiting for an event disabled the memory protection (DRGN-10198).

  - 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 SoftDevice might not respect the MaxTxOctets of the peer if the peer transmits on LE Coded PHY using the S=2 coding scheme (DRGN-9714).

  - Fixed an issue that would lead to high packet error rate when receiving on LE Coded PHY in noisy environments (DRGN-9768).

  - Fixed an issue that could cause links to disconnect (DRGN-9844).

  - 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).

  - Fixed an issue where the SoftDevice could assert while scanning on LE Coded PHY (DRGN-9932).

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.

    - Applications aiming at initiating LE connections on LE Coded PHY must have configured the length of the connection event to be sufficiently large to transmit and receive at least one pair of data channel PDUs with a payload of 27 octets. Otherwise, the SoftDevice will not be able to connect on LE Coded PHY.

    - 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).

- LL

    - In connections, the Link Layer payload size is limited to 27 bytes on LE Coded PHY (DRGN-8476).

    - This SoftDevice is not backwards compatible with the s132_nrf52_3.0.0 SoftDevice for the Data Length Update procedure (DRGN-10264).

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).

s140_nrf52_6.0.0

s140_nrf52_6.0.0 is the first SoftDevice production release for nRF52840. The main new features of this version compared to the s140_nrf52840_6.0.0-6.alpha are the Master Boot Record (MBR) 2.3, LE Coded PHY with S=2 coding support for connections, and Quality of Service (QoS) information.

Notes:

- This release has changed the Application Programmer Interface (API). This requires applications to be recompiled.

- The memory requirements of the S140 SoftDevice have changed.

- The release notes list changes since s140_nrf52840_6.0.0-6.alpha.

- LE Advertising Extensions and LE Long Range (LE Coded PHY) features are not Bluetooth Qualified in this production release. These features are suitable for development purposes but cannot be used in end products. These features are limited in functionality, may not function as specified, and may contain issues. The Qualified Design Identifier (QDID) for S140 will not include qualification of these features. In future releases of this SoftDevice, LE Advertising Extensions and LE Long Range (LE Coded PHY) will be fully qualified. At that time, a new QDID will be available which includes these features for new product listings.

- s140_nrf52_6.0.0 contains Errata workarounds that are adapted for the prototype version of the nRF52840 (revision A). The latest version compatible with nRF52840 revision A Errata was s140_nrf52840_6.0.0-6.alpha. s140_nrf52_6.0.0 should be used with nRF52840 revision B or later for production or performance measurements.

- 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 nRF52840.

- This version of the SoftDevice contains the Master Boot Record (MBR) version 2.3.0 (DRGN-9755).

  - It is possible to perform Device Firmware Upgrade from earlier s140 alpha (withmbr_nrf52_2.3.0-x.alpha) releases to s140_nrf52_6.0.0 for development purposes.

  - MBR 2.3.0 should be used in all production devices.

- 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 0x00A9.

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).

  - The SoftDevice now has the functionality of write-protecting memory. This can be achieved by accessing the ACL peripheral configuration registers through `sd_protected_register_write()` (DRGN-8303).

- 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).

- LL

  - LE Coded PHY S=2 (500 kbps) coding scheme support for connected roles (DRGN-8474).

  - Active scanning for advertising extensions (DRGN-9735).

  - Scannable advertiser for advertising extensions (DRGN-9644).

  - Non-connectable non-scannable advertiser for advertising extensions (DRGN-9317).

  - Anonymous advertiser for advertising extensions (DRGN-9317).

  - Support for channel hopping on secondary channels for the extended advertiser (DRGN-8550).

  - Support for window widening for advertising extensions when following Aux Pointers (DRGN-9643).

  - Privacy support for extended advertising events in the advertiser role (DRGN-9235).

  - Support for Power Amplifier and Low Noise Amplifier (PA/LNA) for LE Coded PHY (DRGN-8166).

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 support for 9dBm TX power on nrf52840 has been removed. The maximum TX power supported is 8dBm (DRGN-9431).

  - The application now has access to both DC/DC converters of the nRF52840. See API in nrf_soc.h (DRGN-9122).

  - The application can now set the power failure comparator threshold value for high voltage using the `sd_power_pof_thresholdvddh_set()` API (DRGN-9123).

  - 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).

    - Improved reception on LE Coded PHY in noisy environments by removing a workaround for ERRATA-164 that is only applicable tonRF52840 Engineering A (DRGN-9847).

    - 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 `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).

    - 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. This was fixed for s140_nrf52840_6.0.0-6.alpha, but was missing in the release notes(DRGN-9610).

    - Removed a limitation where Radio Notification could be suppressed between connection events when Connection Event Length Extension was enabled. This was fixed for s140_nrf52840_6.0.0-6.alpha, but was missing in the release notes (DRGN-7687).

    - Fixed an issue where flash writes would sometimes return `NRF_ERROR_FORBIDDEN` (DRGN-9144).

    - Fixed an issue where the LNA pin would be activated after the READY event from the radio for LE Coded PHY (DRGN-9868).

- 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 `sd_ble_gap_connect()` could return `NRF_SUCCESS` when given invalid parameters (DRGN-9362).

  - Fixed an issue where `sd_ble_gap_phy_update()` would return `NRF_ERROR_INTERNAL` if the application preferred LE Coded PHY on a connection with short event length configuration (DRGN-9495).

  - 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 slave could disconnect with a status code other than `HCI_STATUS_CODE_PIN_OR_KEY_MISSING` when LTK was missing (DRGN-9190).

  - Fixed an issue where connection establishment could fail on LE 2M PHY or LE Coded PHY (DRGN-9231).

  - Host is no longer allowed to set a PHY with lower bit rate if the connection event length is too short (DRGN-9154).

  - Fixed an issue where the SoftDevice as a slave might violate Bluetooth Core Specification v 5.0 timing restrictions if the master sent an LL_PHY_UPDATE_IND with Coded PHY (DRGN-9871).

  - Fixed an issue that could lead to high packet error rate when receiving on LE Coded PHY (DRGN-9793).

  - 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 that could cause an assert when generating advertising report for a directed advertising event (DRGN-9552).

  - Fixed an issue where the SoftDevice had problems connecting to non-Nordic devices using the LE Extended Advertising feature (DRGN-9543).

  - 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).

  - 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. This was fixed for s140_nrf52840_6.0.0-6.alpha, but was missing in the release notes (DRGN-9494).

  - Fixed an issue where the extended advertiser did not use the proper clock accuracy when switching between primary and secondary advertising channels (DRGN-8554).

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.

    - Applications aiming at initiating LE connections on LE Coded PHY must have configured the length of the connection event to be sufficiently large to transmit and receive at least one pair of data channel PDUs with a payload of 27 octets. Otherwise, the SoftDevice will not be able to connect on LE Coded PHY.

    - GPIO port 1 pins (P1.00 to P1.15) can not be used for PA/LNA on nRF52840 (DRGN-9995).

    - The LE Advertising Extensionand LE Coded PHY implementations are incomplete and may not function as specified. These features are 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).

- LL

    - The Link-Layer payload size is limited to 27 bytes for LE Coded PHY (DRGN-8476, DRGN-9817).

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).

- LL

    - The SoftDevice might not respect the MaxTxOctets of the peer if the peer transmits on LE Coded PHY using the S=2 coding scheme (DRGN-9714).

    - The SoftDevice can assert while scanning on LE Coded PHY (DRGN-9932).

    - The packet error rate is high when r eceiving on LE Coded PHY in noisy environments (DRGN-9768).

s140_nrf52840_6.0.0-6.alpha

This release continues the series of S140 alpha releases. But for this release, the major version number has been incremented from 5 to 6. This is done for consistency with previous and future SoftDevice releases and has no other significance.

The main change in the s140_nrf52840_6.0.0-6.alpha version, as compared to the s140_nrf52840_5.0.0-3.alpha version, is support for L2CAP Connection-Oriented Channels and application control of the PHY Update Procedure.

Notes:

- This release has changed the Application Programmer Interface (API). This requires applications to be recompiled.
- The memory requirements of the s140 SoftDevice have changed.

SoftDevice properties

- This alpha version of the SoftDevice contains the Master Boot Record (MBR) version 2.3.0-1.alpha (DRGN-8852).
- The combined MBR and SoftDevice memory requirements for this version are as follows:
  - Flash: 148 kB (0x25000 bytes).
  - RAM: 5.296 kB (0x1530 bytes) This is the minimum required memory. The actual requirements depend on the configuration chosen at sd_ble_enable() time.

New functionality

SoftDevice

- The SoftDevice API now provides access to USB power handling registers (DRGN-7793).

L2CAP

- Connection-Oriented Channels in LE Credit Based Flow Control Mode (DRGN-8572).

LL

- The SoftDevice now implements a range delay (packet time of flight compensation) corresponding to a distance of 5 km when using LE Coded PHY (DRGN-9069).
- The SoftDevice now supports Channel Selection algorithm #2 (DRGN-7147).
- PA/LNA is now supported for LE 2M PHY and LE Coded PHY (DRGN-8259).
- Support for Network Privacy Mode has been added (DRGN-8658).

Changes

- SoftDevice
  - Add SoftDevice unique string in the SoftDevice info structure (DRGN-7852).
  - Interrupt priority 5 is now available to the application (DRGN-8853).
- GAP

- The application is now given control of the PHY update procedure (DRGN-8473). The application can initiate the PHY update procedure and has to respond when the procedure is initiated by the peer.

- The SoftDevice now supports the configuration of Tx power per link and per role (DRGN-6659).

- 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).

- 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).

- 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).

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)

  - Fixed an issue where the SoftDevice could trigger a BusFault when forwarding a HardFault to the application (DRGN-8604).

  - 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).

- GAP

  - Fixed an issue where the SoftDevice was disallowing the application to set new advertising data after configuring an extended advertiser (DRGN-9134).

  - Fixed an issue where calling `sd_ble_gap_privacy_get()` could cause a hardfault (DRGN-8899).

- 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).

- LL

  - Fixed an issue that was causing a sensitivity drop on LE Coded PHY (DRGN-9108). This issue could have lead to reduced range.

  - 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)

  - 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 the SoftDevice could assert if scan parameters are updated after the scanner has accepted a new LE connection (DRGN-8635).

  - The SoftDevice no longer accepts `LL_PHY_REQ` and `LL_PHY_RSP` with empty TX and/or RX PHY fields (DRGN-7950).

  - Fixed an issue where the encryption of long link layer packets (payload length greater than 27 bytes) over 2 Mbps PHY could lead to MIC failures and cause the peer to disconnect (DRGN-8748).

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.

  - Applications aiming at initiating LE connections on LE Coded PHY must have configured the length of the connection event to be sufficiently large to transmit and receive at least 1 pair of

Data channel PDUs with a payload of 27 octets. Otherwise, the SoftDevice will not be able to connect on LE Coded PHY.

- 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).

- LL

    - The Link-Layer payload size is limited to 27 bytes for LE Coded PHY

Known Issues

SoftDevice

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

GAP

- `sd_ble_gap_phy_update()` will return `NRF_ERROR_INTERNAL` when the application prefers LE Coded PHY on a connection with low event length configuration (DRGN-9495). To avoid this, configure an event length of 6 or above using `sd_ble_cfg_set()`.

s140_nrf52840_5.0.0-3.alpha

The main change in the 5.0.0-3.alpha version, as compared to the 5.0.0-2.alpha version, is support for establishing Bluetooth LE connections directly on Long Range (that is using LE Coded PHY).

Notes:

- The Application Programming Interface (API) in the 5.0.0-3.alpha has been changed as compared to the API in the 5.0.0-2 alpha release. This requires applications to be modified in order to adapt to the proper usage of the new API.

- The memory requirements of the s140 SoftDevice have changed.

SoftDevice properties

- This alpha version of the SoftDevice contains the Master Boot Record (MBR) version 2.1.0.

- The combined MBR and SoftDevice memory requirements for this version are as follows:

  - Flash: 143 kB (`0x24000` bytes).

  - RAM: 5.18 kB (`0x14B8` bytes) This is the minimum required memory. The actual requirements depend on the configuration chosen at `sd_ble_enable()` time.

New functionality

- The SoftDevice now supports establishing LE connections directly on either 2MBPS or LE Coded PHY (Long Range) in addition to 1MBPS (DRGN-8280 and DRGN-8274).

- The SoftDevice now supports sleep clock accuracy values less than 20 ppm as a peripheral (DRGN-8158).

- The application can now set the sleep clock accuracy for the RC oscillator (DRGN-8666).

Changes

- SWI3 is no longer reserved for use by the SoftDevice and is available for the application (DRGN-8367).

Bug fixes

- Documentation

  - Fixed documentation for `sd_ble_gap_addr_set()` and `sd_ble_gap_privacy_set()` (DRGN-8624).

- SoftDevice

  - 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 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).

GAP

- 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).

- Fixed an issue where `sd_ble_gap_conn_param_update()` called in peripheral role mayin 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

- Fixed an issue where incoming packet processing may be delayed in some cases until the application replies with the `sd_ble_user_mem_reply()` call 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 on a link with heavy traffic may get corrupted if the application delays the pulling of SoftDevice events (DRGN-8595).

- It is no longer possible to issue an HVN if the HVN queue size is set to 0 on the config API (DRGN-8353).

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 using encryption on multiple master links at the same time could cause an assert (DRGN-8532).

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.

  - Applications aiming at initiating LE connections on LE Coded PHY must have configured the length of the connection event to be sufficiently large to transmit and receive at least 1 pair of Data channel PDUs with a payload of 27 octets. Otherwise, the SoftDevice will not be able to connect on LE Coded PHY.

- 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).

- LL

  - For LE Coded PHY and 2 MBPS, see the section "Using LE Coded PHY and 2 Mbps" below.

  - PA/LNA is not supported for LE Coded PHY and 2Mbps (DRGN-8166).

Using LE Coded PHY and 2 Mbps

This alpha version of the SoftDevice supports LE connection establishment using legacy advertising or Advertising Extensions. Applications may use legacy advertising to establish connections on 1 Mbps or Advertising Extensions to establish connections on either 1 Mbps, 2 Mbps, or LE Coded PHY. After connections are established on any PHY, applications may initiate a PHY Update procedure to attempt to modify the connection TX and RX PHYs.

The following table shows the supported PHY combinations of this SoftDevice when using LE Coded PHY and 2 Mbps. Encrypted links are not supported in all combinations as indicated in the table. Where encryption is not supported, the link must be established with 1 Mbps PHY and not encrypted before changing PHY.

PHY		Max PDU payload size		Encryption support
TX	RX	TX	RX	
1 Mbps	1 Mbps	up to 251	up to 251	Yes
1 Mbps	2 Mbps	up to 251	up to 251	Yes
1 Mbps	2 Mbps	27	27	Yes
1 Mbps	Coded (S=8)	27	27	Yes
2 Mbps	1 Mbps	up to 251	up to 251	No
2 Mbps	1 Mbps	27	27	Yes
2 Mbps	2 Mbps	up to 251	up to 251	No
2 Mbps	2 Mbps	27	27	Yes
2 Mbps	Coded (S=8)	27	27	Yes
Coded (S=8)	1 Mbps	27	27	Yes
Coded (S=8)	2 Mbps	27	27	Yes
Coded (S=8)	Coded (S=8)	27	27	Yes

Note: This alpha version of the SoftDevice does not support the 500 kbps bit rate (S=2 encoding scheme).

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 six times without pulling events in between may in some cases lead to link disconnect (DRGN-8627).

    - If the SoftDevice is configured with 0 Peripheral roles and 0 Central roles, `sd_ble_enable()` may corrupt up to 8 bytes above the returned `app_ram_base`. For applications that have such a configuration, set the application RAM start to 8 bytes or more above the returned `app_ram_base` (DRGN-8802).

- GAP

    - 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()` does not work as expected on connections using a configuration with configured event length of 2, 3 or 4, when maximum ATT_MTU in the same connection configuration is more than 69, 147 or

225 octets respectively. In these cases, `sd_ble_gap_data_length_update()` will return error code `NRF_ERROR_RESOURCES`, and not have an effect (DRGN-8779).

- LL

  - Encryption of long link layer packets (payload length greater than 27 bytes) over 2 Mbps PHY leads to MIC failures and causes the peer to disconnect (DRGN-8748).

s140_nrf52840_5.0.0-2.alpha

The s140 is a SoftDevice for the nRF52840 chip.

The main changes of this version compared to the previous alpha is that the features and API of s132 4.0.0 have been integrated. This includes application control of the Data Length Update Procedure, SoftDevice configuration API extensions, support for multiple peripheral connections, support for up to 20 connections in total, and configuration of individual links including per link ATT_MTU configuration. The API is now the same as for S132 4.0.0 with some additions for s140-specific features.

Notes:

- This release has changed the API from the previous s140 alpha. 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 2.1.0 (DRGN-8507).
    - The changes from the previous version are header file modifications only.
- The combined MBR and SoftDevice memory requirements for this version are as follows:
    - Flash: **133 kB** (`0x21400` bytes).
    - RAM: **5.10 kB** (`0x1468` bytes) This is the minimum required memory. The actual requirements depend on the configuration chosen at `sd_ble_enable()` time.

New functionality

- SoftDevice
    - Support for sleep clock accuracy values less than 20 ppm as a peripheral (DRGN-8158).
- 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).
- 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).

- 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).

- 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).

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()`. The application therefore now has access to the registers `RAM[x].POWER` instead of the deprecated `RAMON/RAMONB` (DRGN-8117).

    - SWI3 is no longer reserved for use by the SoftDevice and is available for the application (DRGN-8367).

- 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).

Bug fixes

- SoftDevice

    - `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 also with the GCC C++ compiler (DRGN-8028).

- 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 nRF52840 was not supported in nrf_nvic.h and nrf_soc.h headers (DRGN-8407).

- 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).

- BLE

  - Several documentation errors have been corrected (DRGN-7386, DRGN-7853, DRGN-8136).

- 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).

- GAP

  - 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 in some cases may return NRF_ERROR_BUSY for 30 seconds after the previous procedure initiated by that call was completed (DRGN-8577).

- LL

  - 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.

  - 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 using encryption on multiple master links at the same time could cause an assert (DRGN-8532).

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 SV-calls `sd_mbr_command_vector_table_base_set()` and `sd_mbr_command_copy_bl()` are not supported (DRGN-8197). Using these calls leads to undefined behavior.

    - The SV-calls `sd_flash_write()` and `sd_flash_page_erase()` do not check whether the flash pages being written or erased are write protected by ACL. Calling these functions on protected flash memory leads to undefined behavior (DRGN-8307, DRGN-8308).

- LL

    - For LE Coded PHY and 2 Mbps, see the section "Using LE Coded PHY and 2 Mbps" below.

    - PA/LNA is not supported for LE Coded PHY and 2Mbps (DRGN-8166).

- 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).

Using LE Coded PHY and 2 Mbps

This alpha version of the SoftDevice supports connection establishment using the 1 Mbps PHY and changing to use the other PHY options (2 Mbps and 125 kbps, also known as Coded S=8). It does not support connection with other PHY configurations. The link must be established first in 1 Mbps PHY and then the PHY can be changed using the above mentioned SV call.

The following table shows the supported PHY combinations of this alpha version of the SoftDevice when using LE Coded PHY and 2 Mbps. Encrypted links are not supported in all combinations as indicated in the table. Where encryption is not supported, the link must be established with 1 Mbps PHY and not encrypted before changing PHY.

PHY		Max PDU payload size		Encryption support
TX	RX	TX	RX	
1 Mbps	1 Mbps	up to 251	up to 251	Yes
1 Mbps	2 Mbps	up to 251	up to 251	Yes
1 Mbps	2 Mbps	27	27	Yes
1 Mbps	Coded (S=8)	27	27	Yes
2 Mbps	1 Mbps	up to 251	up to 251	No
2 Mbps	1 Mbps	27	27	Yes
2 Mbps	2 Mbps	up to 251	up to 251	No
2 Mbps	2 Mbps	27	27	Yes
2 Mbps	Coded (S=8)	27	27	Yes
Coded (S=8)	1 Mbps	27	27	Yes

| Coded (S=8) | 2 Mbps | 27 | 27 | Yes |
| Coded (S=8) | Coded (S=8) | 27 | 27 | Yes |

Note: This alpha version of the SoftDevice does not support the 500 kbps bit rate (S=2 encoding scheme).

Known issues

- SoftDevice

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

- GAP

    - The `conn_handle` parameter in the event `BLE_GAP_EVT_DATA_LENGTH_UPDATE_REQUEST` is not populated correctly (DRGN-8749).

    - 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()` does not work as expected on connections using a configuration with configured event length of 2, 3 or 4, when maximum ATT_MTU in the same connection configuration is more than 69, 147 or 225 octets respectively. In these cases `sd_ble_gap_data_length_update()` will return error code `NRF_ERROR_RESOURCES`, and not have an effect (DRGN-8779).

- LL

    - Encryption of long link layer packets (payload length greater than 27 bytes) over 2 Mbps PHY leads to MIC failures and causes the peer to disconnect (DRGN-8356).

- GATTS

    - When BLE_EVT_USER_MEM_REQUEST event is pulled by the application, incoming packet processing may be delayed in some cases 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 application delays the pulling of SoftDevice events (DRGN-8595).

    - The SoftDevice is incorrectly identified as s132 in the SoftDevice information structure (DRGN-8363).

- Documentation

    - The documentation for `sd_ble_gap_addr_set()` and `sd_ble_gap_privacy_set()` states that these functions cannot be called while BLE roles are running. This is wrong. These functions can be called while in connection, but not while advertising, scanning, or creating a connection (DRGN-8624).

The documentation for `sd_ble_adv_start()` states that a connectable advertiser cannot be started after the BLE_GAP_EVT_CONNECTED event is received. This is wrong. A connectable advertiser can be started as long as no other advertiser is running and there are fewer active Peripheral connections than configured (DRGN-8624).

s140_nrf52840_5.0.0-1.alpha

The s140 is a SoftDevice for the nRF52840 chip. This release, s140_nrf52840_5.0.0-1.alpha, is the first alpha release of the s140.

The s140 is based upon Nordic Semiconductor's s132 SoftDevice. 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 Programmer Interface (API) from the s132, requiring applications to be recompiled.

SoftDevice properties

- The combined MBR and SoftDevice memory requirements for this version are as follows:

  - Flash: **132 kB** (`0x21000` bytes).
  - RAM: **6.43 kB** (0x19C0 bytes) (minimum required memory - actual requirements are dependent upon the configuration chosen at `sd_ble_enable()` time).

New functionality

- LL

  - Support for transmitting and receiving on the 2 Mbps PHY has been added (DRGN-7552).
  - Support for transmitting and receiving on LE Coded PHY (Long Range) using the 125 kbps bit rate (S=8 encoding scheme) has been added (DRGN-5702).

Using LE Coded PHY and 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 PHYs. 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 changing to use the other PHY options (2 Mbps and 125 kbps (Coded S=8)). It does not support connection with other PHY configurations. The link must be established first in 1 Mbps PHY and then the PHY can be changed using the above mentioned SV call.

The following table shows the supported PHY combinations of this alpha version of the SoftDevice when using LE Coded PHY and 2 Mbps. Encrypted links are not supported in all combinations as indicated in the Table. Where encryption is not supported, the link must be established with 1 Mbps PHY and not encrypted before changing PHY.

PHY		Max PDU payload size		Encryption support
TX	RX	TX	RX	
1 Mbps	1 Mbps	up to 251	up to 251	Yes
1 Mbps	2 Mbps	up to 251	up to 251	Yes
1 Mbps	2 Mbps	27	27	Yes
1 Mbps	Coded (S=8)	27	27	Yes
2 Mbps	1 Mbps	up to 251	up to 251	No

2 Mbps	1 Mbps	27	27	Yes
2 Mbps	2 Mbps	up to 251	up to 251	No
2 Mbps	2 Mbps	27	27	Yes
2 Mbps	Coded (S=8)	27	27	Yes
Coded (S=8)	1 Mbps	27	27	Yes
Coded (S=8)	2 Mbps	27	27	Yes
Coded (S=8)	Coded (S=8)	27	27	Yes

Note: This alpha version of the SoftDevice does not support the 500 kbps bit rate (S=2 encoding scheme).

Changes

- GAP

    - The SV-call `sd_ble_gap_tx_power_set()` is extended to support higher TX power (up to +9dBm) (DRGN-8310).

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).
    - The SV-calls `sd_mbr_command_vector_table_base_set()` and `sd_mbr_command_copy_bl()` are not supported (DRGN-8197). Using these calls leads to undefined behavior.
    - The SV calls `sd_flash_write()` and `sd_flash_page_erase()` do not check whether the flash pages being written or erased are write protected by ACL. Calling these functions on protected flash memory leads to undefined behavior (DRGN-8307).

- LL

    - The peripheral role has priority over the central role when it comes to keeping the links alive.
    - For LE Coded PHY and 2 Mbps, see the section "Using LE Coded PHY and 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 ivalid 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.

- Encryption of long link layer packets (payload length > 27 bytes) over 2 Mbps PHY leads to MIC failures and causes the peer to disconnect (DRGN-8356).

- The SoftDevice is incorrectly identified as s132 in the SoftDevice information structure (DRGN-8363).