s120_nrf51 release notes

On this page

Introduction to the s120_nrf51 release notes

These release notes describe the changes in the s120_nrf51 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 the overview. More details regarding changes and new features may be found in the s120_nrf51 migration document (normally available for major releases only).

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

s120_nrf51_2.1.0

The changes in this release are the resolution of a SoftDevice assert when measuring connection RSSI and a very small reduction in the size of the GATT Server Attribute Table. The API header files and all functionality remain unchanged from the previous version.

Notes:

- This SoftDevice version is not Production tested on all IC revisions, and is **not compatible with nRF51 IC revision 1**. Users of the SoftDevice **must verify the compatibility of their SoftDevice/IC combination** for development and for production. Compatibility information is found in the nRF51 Series Compatibility Matrix, which can be downloaded from the Nordic Semiconductor web page.
- The Bluetooth qualification listings covering the s120 2.0.0 SoftDevice also cover this release.

SoftDevice properties

- The SoftDevice Specification corresponding to this release is the S120 nRF51 SoftDevice Specification v2.0.
- This version of the SoftDevice contains the Master Boot Record (MBR) version 1.0.0.
- The combined MBR and SoftDevice memory requirements for this version are as follows:
  - Flash: **116 kB** (`0x1D000` bytes)
  - RAM: **10 kB** (`0x2800` bytes)

New functionality

- No new functionality

Changes

- GATTS
  - The size of the GATT Server Attribute Table has been reduced by 32 bytes, from 1792 to 1760 bytes. This change will only impact users using more than 1760 bytes of stack GATT Server Attribute storage. Applications written for version 2.0.0 of the S120 SoftDevice and using more than 1760 bytes will have to be modified.

Bugfixes

- Link Layer
  - The SoftDevice will no longer assert when performing connection RSSI reporting concurrently with control procedures (NRFFOETT-962, DRGN-5466).

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.
- BLE
  - All BLE layers (GAP, GATTC and GATTS) are restricted to queuing no more than **one** system Tx packet and **one** applicatio n Tx packet **per connection** when operating in the central role. Because of this limitation, any API calls that require a system packet to be sent out may return `NRF_ERROR_BUSY` to the application. Since the SoftDevice does not inform the application when the system packet is again available, the application must simply retry (potentially with a timer) until the call succeeds (DRGN-4213).
- GAP
  - Security and connection parameter update procedures may time out locally or on the peer if multiple procedures have been started at the same time. This is due to the sequential execution nature of control procedures in the S120 SoftDevice and the fact that they can take a significant number of connection events to complete. With high connection intervals the amount of time required to perform those procedures approaches the timeout values set by the specification (DRGN-3597).
- GATTS
  - To conform to the Bluetooth specification there shall not be a secondary service that is not referenced by a primary service. The SoftDevice does not enforce this (DRGN-906, DRGN-2695).

- L2CAP
  - The following L2CAP API functions are **non-functional in the central role** in this release:
    - `sd_ble_l2cap_cid_register()`
    - `sd_ble_l2cap_cid_unregister()`
    - `sd_ble_l2cap_tx()`

Known issues

- SoftDevice
  - SoftDevice current consumption can remain high (1 mA) after disabling the SoftDevice when running on RC LFCLOCK (DRGN-5474, NRFFOETT-968). The workaround is to force low power mode after sd_softdevice_disable(): `NRF_POWER->TASKS_LOWPWR = 1;`
- GAP
  - Using the `BLE_GAP_SCAN_INTERVAL_MIN` constant when scanning (`sd_ble_gap_scan_start()`) or connecting (`sd_ble_gap_connect()`) will prevent the SoftDevice from performing any scanning and therefore receiving any advertising reports. Use `BLE_GAP_SCAN_INTERVAL_MIN+1` or higher instead (DRGN-4050).
  - The channel map update procedure and either the connection parameter update procedure or the pairing/encryption procedures may cause the SoftDevice to assert if they are initiated from the application in such a way that they end up executing at the same time (DRGN-5319). To guarantee safe sequential execution of these procedures, make sure to wait for the completion of the currently ongoing one before initiating a new one.
    - The channel map procedure is ongoing from the call to `sd_ble_opt_set(BLE_GAP_OPT_CH_MAP)` until `sd_ble_gap_opt_get(BLE_GAP_OPT_CH_MAP)` returns the new channel map.
    - The connection parameter update procedure is ongoing from the call to `sd_ble_gap_conn_param_update()` until the `BLE_GAP_EVT_CONN_PARAM_UPDATE` event is received by the application.
    - The pairing/encryption procedures are ongoing from the call to `sd_ble_gap_authenticate()` or `sd_ble_gap_encrypt()` until the `BLE_GAP_EVT_CONN_SEC_UPDATE` event is received by the application.
- GATTS
  - Retrieving the system attributes with `sd_ble_gatts_sys_attr_get()` can return an invalid array of data when invoked on a GATT Server containing no Client Characteristic Configuration Descriptors (CCCDs). This can happen when intializing the BLE stack without the Service Changed characteristic (DRGN-5310).

s120_nrf51_2.0.0

This version introduces a full non-concurrent peripheral role within the SoftDevice. The peripheral role functionality is based upon and mostly identical to the upcoming S110 8.0.0 SoftDevice release.

Notes:

- This is a major release which has changed the Application Programmer Interface (API), requiring applications to be recompiled.
- This SoftDevice version is not Production tested on all IC revisions, and is **not compatible with nRF51 IC revision 1**. Users of the SoftDevice **must verify the compatibility of their SoftDevice/IC combination** for development and for production. Compatibility information is found in the nRF51 Series Compatibility Matrix, which can be downloaded from the Nordic Semiconductor web page.
- A Bluetooth qualification listing covering the SoftDevice with all new features will be available in January 2015. Customers requiring a listing before that time and who are not using the new Peripheral role or Privacy 1.1 feature may qualify using the previous S120 qualification listing.

SoftDevice properties

- The SoftDevice Specification corresponding to this release is the S120 nRF51 SoftDevice Specification v2.0.
- This version of the SoftDevice contains the Master Boot Record (MBR) version 1.0.0.
- The combined MBR and SoftDevice memory requirements for this version are as follows:
  - Flash: **116 kB** (`0x1D000` bytes)
  - RAM: **10 kB** (`0x2800` bytes)

New functionality

- SoftDevice
  - A complete non-concurrent peripheral Bluetooth low energy stack is now included with the SoftDevice image. Role selection (central or peripheral) is enforced during stack initialization (DRGN-4626, DRGN-4743, DRN-4744).
  - The SoftDevice now supports concurrent multiprotocol operation using the Concurrent Multiprotocol Timeslot API. This enables the application to run a separate radio protocol from application space concurrently with the SoftDevice BLE protocol stack. A detailed description of this new functionality can be found in the SDS (DRGN-4624).
  - The SoftDevice now contains an updated Master Boot Record (MBR) that allows it to perform Device Firmware Update (DFU) of the SoftDevice itself (DRGN-985, DRGN-4619).
- GAP
  - Privacy 1.1: The SoftDevice is now able to generate and refresh resolvable and non-resolvable private addresses while scanning or connecting. The application may set a custom IRK and an address cycle interval, but also retains the option to set addresses explicitly (DRGN-1005, DRGN-4627).
  - Connection RSSI reporting: The application can now monitor the Received Signal Strength Indication (RSSI) of any or all active connections. The frequency of the reports is fully configurable and in addition the application can choose to manually poll for RSSI readings (DRGN-3003, DRGN-3475).
  - A new compatibility mode option has been introduced to ensure proper interoperability with certain legacy devices (DRGN-4872).
  - The application can now provide its own display passkey during a pairing procedure that uses the passkey entry algorithm (DRGN-4169).

Changes

- SoftDevice
  - The combined flash size of the MBR and SoftDevice has increased to 116 kB.
  - A new API call, `sd_ble_enable()` has been added. This must be called to initialize, select a role (central and peripheral), and enable the BLE stack after invoking `sd_softdevice_enable()` and previous to any BLE activity (DRGN-4743).
  - By default it is now possible for the application to use the CPU while the radio is active. In S120 1.0.x the CPU execution was blocked by the SoftDevice during radio activity. Note that this new default setting is incompatible with running this SoftDevice on nRF51 series IC revision 2 (devices affected by PAN #44 "CCM may exceed real time requirements" and PAN #45 "AAR may exceed real time requirements" described in the nRF51822-PAN). If you plan to run on devices affected by these PANs you will need to enable mutual exclusion between the radio and the application by means of the `sd_ble_opt_set()` SV call and the `BLE_COMMON_OPT_RADIO_CPU_MUTEX` option (DRGN-4620, DRGN-4815). (For IC revision information, see the nRF51 Series Compatibility Matrix, downloadable from the Nordic Semiconductor web page.)
  - The DC/DC converter usage has been simplified and enhanced. The DC/DC converter is now supported when running the SoftDevice on nRF51 series IC revision 3 (DRGN-2420, DRGN-4623). (For IC revision information, see the nRF51 Series Compatibility Matrix, downloadable from the Nordic Semiconductor web page.)
  - 6 previously reserved PPI channels have been freed and may be used by the application (DRGN-5097).
  - When writing or erasing flash memory with the `sd_flash_*` SV calls, the priority of the operations will now be automatically increased after a fixed amount of failed attempts (DRGN-5009).
- GAP
  - The connection will no longer be automatically disconnected if a pairing or bonding procedure fails (DRGN-2286, DRGN-3122).
  - The SoftDevice can now distribute its own LTK during bonding when acting as a central. This feature is useful to be able to reuse security keys even if GAP roles are switched in subsequent connections (DRGN-4998).
  - A Slave Security Request can now be cleanly rejected by the central if it does not desire to perform a security procedure at that time (DRGN-3954).
- GATTS
  - The application can choose not to include the Service Changed characteristic within the GATT server by using the parameters in the new `sd_ble_enable()` API call (DRGN-2879, DRGN-4690) .
  - The system attribute data can now be partially obtained and restored based on the type of service (system or user) it belongs to (DRGN-5112).
  - `sd_ble_gatts_value_set()` and `sd_ble_gatts_value_get()` now take a connection handle as an input parameter, allowing the application to set and get attributes that have different values per connection (DRGN-4988).

Bugfixes

- SoftDevice
  - When using IC variants that include 32 kB of RAM the SoftDevice will no longer return `NRF_ERROR_INVALID_ADDR` if pointers to memory above `0x20004000` are supplied as a parameter to SV calls (DRGN-3369, DRGN-4927).
- BLE
  - Simultaneous protocol timeouts in multiple connections (for example ATT protocol timeouts) can no longer lead to a SoftDevice assert (DRGN-4666).
  - Several invalid documentation crossreferences in the BLE header files have been corrected (DRGN-4007).

- Link Layer
  - After a Connection Parameter Update procedure, the Link Layer can no longer mistakenly raise its own priority, which resulted in less radio time available for other activities (DRGN-5151).
  - The updated supervision timeout during a connection parameter update procedure now takes effect immediately (DRGN-4862).
- GAP
  - Setting the transmit power using `sd_ble_gap_tx_power_set()` now works as expected even when invoked with active connections (DRGN-5062).
  - When performing a pairing procedure with a peripheral, if the peer requests bonding or key distribution while the application is in non-bondable mode the SoftDevice will now send a Pairing Failed packet (DRGN-3922).
- GATTS
  - When adding an attribute with `vloc == VLOC_USER` the SoftDevice now correctly initializes its initial length to the one provided in the `init_len` parameter (DRGN-5216).
  - The `sd_ble_gatts_value_set()` SV call now accepts pointers to values residing in flash memory (DRGN-4609).
  - When adding a writable attribute with `vloc == VLOC_USER` the SoftDevice will now make sure that the pointer provided refers to a value stored in RAM (DRGN-4406).
- GATTC
  - The `sd_ble_gattc_char_value_by_uuid_read()` SV call can no longer return `NRF_ERROR_INTERNAL` if an invalid UUID type is provided (DRGN-4715).
  - The `offset` field in `ble_gattc_evt_write_rsp_t` is now initialized to 0 for Write Response packets (DRGN-4403).

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.
- BLE
  - All BLE layers (GAP, GATTC and GATTS) are restricted to queuing no more than **one** system Tx packet and **one** applicatio n Tx packet **per connection** when operating in the central role. Because of this limitation, any API calls that require a system packet to be sent out may return `NRF_ERROR_BUSY` to the application. Since the SoftDevice does not inform the application when the system packet is again available, the application must simply retry (potentially with a timer) until the call succeeds (DRGN-4213).
- GAP
  - Security and connection parameter update procedures may time out locally or on the peer if multiple procedures have been started at the same time. This is due to the sequential execution nature of control procedures in the S120 SoftDevice and the fact that they can take a significant number of connection events to complete. With high connection intervals the amount of time required to perform those procedures approaches the timeout values set by the specification (DRGN-3597).
- GATTS
  - To conform to the Bluetooth specification there shall not be a secondary service that is not referenced by a primary service. The SoftDevice does not enforce this (DRGN-906, DRGN-2695).
- L2CAP
  - The following L2CAP API functions are **non-functional in the central role** in this release:
    - `sd_ble_l2cap_cid_register()`
    - `sd_ble_l2cap_cid_unregister()`
    - `sd_ble_l2cap_tx()`

Known issues

- GAP
  - Using the `BLE_GAP_SCAN_INTERVAL_MIN` constant when scanning (`sd_ble_gap_scan_start()`) or connecting (`sd_b le_gap_connect()`) will prevent the SoftDevice from performing any scanning and therefore receiving any advertising reports. Use `BLE_GAP_SCAN_INTERVAL_MIN+1` or higher instead (DRGN-4050).
  - The channel map update procedure and either the connection parameter update procedure or the pairing/encryption procedures may cause the SoftDevice to assert if they are initiated from the application in such a way that they end up executing at the same time (DRGN-5319). To guarantee safe sequential execution of these procedures, make sure to wait for the completion of the currently ongoing one before initiating a new one.
    - The channel map procedure is ongoing from the call to `sd_ble_opt_set(BLE_GAP_OPT_CH_MAP)` until `sd_ble _gap_opt_get(BLE_GAP_OPT_CH_MAP)` returns the new channel map.
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    - The pairing/encryption procedures are ongoing from the call to `sd_ble_gap_authenticate()` or `sd_ble_gap_ encrypt()` until the `BLE_GAP_EVT_CONN_SEC_UPDATE` event is received by the application.
- GATTS

- Retrieving the system attributes with `sd_ble_gatts_sys_attr_get()` can return an invalid array of data when invoked on a GATT Server containing no Client Characteristic Configuration Descriptors (CCCDs). This can happen when intializing the BLE stack without the Service Changed characteristic (DRGN-5310).

s120_nrf51822_1.0.1

This version contains minor internal bug fixes. There are no changes in the functionality and the API remains unchanged. This version deprecates version 1.0.0 of the S120 SoftDevice.

Bugfixes

- GATTS
  - The `conn_handle` member of the `ble_gatts_evt_t` structure for a `BLE_GATTS_EVT_SYS_ATTR_MISSING` event now contains a valid connection handle (DRGN-4501).
- GAP
  - Fixed an issue where a call to the API `sd_ble_gap_conn_param_update` followed immediately by `sd_ble_gap_disconnect` when an ongoing encryption procedure is about to finish will cause as assert (DRGN-4505)
- SoftDevice
  - Fixed an issue that prevented ECB and CCM_AAR interrupts from being forwarded when SoftDevice is disabled (DRGN-4241).

Changes

- SoftDevice
  - License information in public header files (API) updated (DRGN-4613).

New functionality

- None

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 BLE stack.
  - DCDC converter operation controlled by the SoftDevice may interfere with radio function. As a result, `nrf_power_dcdc_mode` should not be modified by the application. The mode must not be set to `NRF_POWER_DCDC_MODE_AUTOMATIC` or `NRF_POWER_DCDC_MODE_ON` at any time (DRGN-2420).
- BLE
  - All BLE layers (GAP, GATTC and GATTS) are restricted to queuing no more than **one** system Tx packet and **one** application Tx packet **per link**. Because of this limitation, any API calls that require a system packet to be sent out may return `NRF_ERROR_BUSY` to the application. Since the SoftDevice does not inform the application when the system packet is again available, the application must simply retry (potentially with a timer) until the call succeeds (DRGN-4213).
- GAP
  - Security and connection parameter update procedures may time out locally or on the peer if multiple procedures have been started at the same time. This is due to the sequential execution nature of control procedures in the S120 SoftDevice and the fact that they can take a significant number of connection events to complete. With high connection intervals the amount of time required to perform those procedures approaches the timeout values set by the specification (DRGN-3597).
  - Security: A peripheral's Security Request can only be responded to by initiating pairing or ignoring the request (DRGN-3954).
- 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-2695).

Known Issues

- GAP
  - Using the `BLE_GAP_SCAN_INTERVAL_MIN` constant when scanning (`sd_ble_gap_scan_start()`) or connecting (`sd_ble_gap_connect()`) will prevent the SoftDevice from performing any scanning and therefore receiving any advertising reports. Use `BLE_GAP_SCAN_INTERVAL_MIN+1` or higher instead (DRGN-4050).
- Master Boot Record
  - SD_MBR_COMMAND_COPY_BL will not work when CLENR0 in UICR is set so that the Bootloader is in CodeRegion1.

s120_nrf51822_1.0.0

This release contains multilink improvements, new features and various changes and bugfixes, see details below.

This SoftDevice release has internal changes that requires that the SoftDevice is programmed onto the chip in a specific way. The following Nordic tools handle this:

- nrfjprog version 5.0.1 or higher
- nRFgo Studio version 1.17.0 or higher.

If you have these updated tools, programming can be done as usual. If these tools are not available, a separate programming tool will be distributed with the release.

Bugfixes

- Link layer
  - SVC handler now checks SPSEL and will use the Process Stack Pointer (PSP) if `SPSEL=1`. Previously the SVC handler only supported the use of the Main Stack Pointer (MSP) and using the PSP would result in undefined behavior (NRFFOETT-317, NRFFOETT-426, FORT-787).
  - Fixed hard fault handler issue that could corrupt the `LR` register or give invalid return address if hard fault triggered when SoftDevice was disabled (NRFFOETT-478, FORT-793).
  - ECB, CCM and AAR peripherals are now properly reset at SoftDevice enable (DRGN-3305, FORT-797).
  - Fixed an issue which could lead to accepting packets with MIC failure, or incorrectly disconnect due to MIC failure (DRGN-3177).
  - Fixed an issue where the VERSION_IND procedure could cause links to be disconnected (DRGN-3926).
  - Fixed issue where control procedures initiated from master and slave simultaneously could trigger an assert (DRGN-3945).
  - Fixed an issue where, under certain conditions, a call to `sd_ble_gap_scan_stop()` could remain blocked until the next scan interval (DRGN-3936).
  - Fixed an issue where, under certain conditions, and especially with heavy data traffic ongoing, an encryption procedure could fail leading to a disconnection (DRGN-3880).
- GAP
  - Directed advertising packets not matching the scanner's address are now ignored and not forwarded up to the application (DRGN-4047, NRFFOETT-764).
  - Security: Fixed an issue where the SoftDevice would assert if sd_ble_gap_sec_params_reply() was called after disconnect (DRGN-3129).
  - Security: Fixed the cause of a possible assert during the pairing procedure (DRGN-3756, DRGN-3371, DRGN-3320).
  - Security: Starting encryption while sending data packets at the same time can no longer cause the encryption procedure to fail and disconnect the link (DRGN-4084).
  - Security: Pending Security Requests from peripherals no longer prevent the central from initiating authentication procedures on other links (DRGN-4134).
- GATTS
  - Fixed an issue where the SoftDevice would sometimes assert if the peer disconnected during the Write Long Characteristic Values and Reliable Writes procedures (DRGN-3759).
  - System attributes can now be written using the Write Long Characteristic Values or Reliable Writes procedures (DRGN-3493).
  - Fixed an issue where the SoftDevice would assert if the peer canceled the Write Long Characteristic Values and Reliable Writes procedures (DRGN-3492).

Changes

- SoftDevice
  - API facing event structures and functions now consistenly use `evt` in their names (DRGN-2232).
  - The `sd_softdevice_forward_to_application()` API now requires the application forwarding address (FORT-822).
  - SVC numbers changed (DRGN-3147, FORT-798, FORT-836).
- Link Layer
  - The Link Layer Version Parameter, `VersNr`, has been updated as a result of Bluetooth spec 4.1 qualification (DRGN-3956).
- BLE
  - `sd_ble_uuid_vs_add()` now checks whether the UUID was previously added and therefore redundant (NRFFOETT-359, DRGN-2881).
  - Fixed inconsistent use of `[in]`, `[out]` and `[in/out]` in API documentation. Also fixed inconsistent use of `const` keyword in API (DRGN-3440).
- GAP
  - `sd_ble_gap_scan_start()` and `sd_ble_gap_connect()` will no longer return `NRF_ERROR_BUSY`. No application retries are necessary anymore (DRGN-2997, DRGN-3831, DRGN-3309).

    - `sd_ble_gap_device_name_get()` now returns the full length of the name if the name is longer than the buffer provided (DRGN-3009, DRGN-3133).
    - The GAP device name permissions can now be set to writable regardless of name length (DRGN-3551).
    - The peer address field has been removed from the `BLE_GAP_EVT_DISCONNECTED` event (DRGN-2638).
    - Security: Passkey missing responses during pairing using `BLE_GAP_AUTH_KEY_TYPE_NONE` in `sd_ble_gap_auth_key_reply()` are now fully supported (DRGN-2540, NRFFOETT-290).
    - Documentation of `min_conn_interval` and `max_conn_interval` in `ble_gap_conn_params_t` clarified (NRFFOETT-451, DRGN-1040).
    - The maximum slave latency, `BLE_GAP_CP_SLAVE_LATENCY_MAX` has been adjusted to 499 according to the 4.1 specification (DRGN-2392).
    - The connection supervision timeout in `ble_gap_conn_params_t` is now subject to the following 4.1 specification constraint:

      `(conn_sup_timeout * 4) > ((1 + slave_latency) * max_conn_interval)` (DRGN-2392).
    - Reason codes for `sd_ble_gap_disconnect()` documented (NRFFOETT-526, DRGN-3235).
    - The default value for the Appearance Characteristic is set to `0x0000` (DRGN-3741).
    - Removed Peripheral Preferred Connection Parameters characteristic (DRGN-3636).
    - Security: `BLE_GAP_EVT_CONN_SEC_UPDATE` event now comes before `BLE_GAP_EVT_AUTH_STATUS` event for both pairing and bonding procedures (DRGN-3881).
- GATTS
    - `sd_ble_gatts_value_get()` now returns the full length of the value if the value is longer than the buffer provided (DRGN-3009).
    - Hardened `sd_ble_gatt_sys_attr_set()` against malformed or corrupted system attribute data (DRGN-4065).
- GATTC
    - GATTC events now include the handle from the error response when applicable (DRGN-1966).

New functionality

- SoftDevice
    - Asynchronous flash memory write and erase support added to the SoftDevice interface. This interface can be safely used during active BLE connections and is available even when the SoftDevice is disabled (FORT-788, FORT-836).
    - Faster SoftDevice enable when using RCOSC and 32k Clock source (DRGN-2390, FORT-792).
    - SoftDevice is now unprotected unless `CLENR0` in `UICR` is set (FORT-791).
    - Added temperature based RC oscillator calibration (FORT-827, FORT-790).
- BLE
    - New `sd_ble_opt_set()` and `sd_ble_opt_get()` API calls introduced for configuring optional stack parameters (DRGN-3970).
- Link Layer
    - Feature Exchange Link Layer Control Procedure fully supported (DRGN-3145).
- GAP
    - Concurrent master initiated connection parameter update and encryption procedures for multiple connections are now queued by the SoftDevice (DRGN-3762, DRGN-3830, DRGN-3603, DRGN-3573, DRGN-3355).
    - The connection channel map can now be set by the application (DRGN-3838, DRGN-4299, NRFFOETT-811).
    - Security: MITM protection is now supported (DRGN-2839).
    - Security: Whitelisting based on IRK is now supported (DRGN-2919).
- GATTC
    - Support for the Write Long Characteristic Values and Descriptors procedures (DRGN-3499, NRFFOETT-606).
    - Support for the Reliable Writes procedure (DRGN-3499, NRFFOETT-606).
- GATTS
    - The GATT server is now capable of operating on multiple connections concurrently. Each connection now has its own system attributes (DRGN-3720, DRGN-3252, DRGN-3004, DRGN-2649).

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 BLE stack.
    - DCDC converter operation controlled by the SoftDevice may interfere with radio function. As a result, `nrf_power_dcdc_mode` should not be modified by the application. The mode must not be set to `NRF_POWER_DCDC_MODE_AUTOMATIC` or `NRF_POWER_DCDC_MODE_ON` at any time (DRGN-2420).
- BLE
    - All BLE layers (GAP, GATTC and GATTS) are restricted to queuing no more than **one** system Tx packet and **one** application Tx packet **per link**. Because of this limitation, any API calls that require a system packet to be sent out may return `NRF_ERROR_BUSY` to the application. Since the SoftDevice does not inform the application when the system packet is again

available, the application must simply retry (potentially with a timer) until the call succeeds (DRGN-4213).

- GAP
  - Security and connection parameter update procedures may time out locally or on the peer if multiple procedures have been started at the same time. This is due to the sequential execution nature of control procedures in the S120 SoftDevice and the fact that they can take a significant number of connection events to complete. With high connection intervals the amount of time required to perform those procedures approaches the timeout values set by the specification (DRGN-3597).
  - Security: A peripheral's Security Request can only be responded to by initiating pairing or ignoring the request (DRGN-3954).
- 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-2695).

Known Issues

- GAP
  - Using the `BLE_GAP_SCAN_INTERVAL_MIN` constant when scanning (`sd_ble_gap_scan_start()`) or connecting (`sd_ble_gap_connect()`) will prevent the SoftDevice from performing any scanning and therefore receiving any advertising reports. Use `BLE_GAP_SCAN_INTERVAL_MIN+1` or higher instead (DRGN-4050).
- SoftDevice
  - ECB and CCM_AAR interrupts are not forwarded when SoftDevice is disabled. The ECB SoC API can be used, but the event has to be polled by the application to know when the result is ready. (DRGN-4241)
- Master Boot Record
  - SD_MBR_COMMAND_COPY_BL will not work when CLENR0 in UICR is set so that the Bootloader is in CodeRegion1.

s120_nrf51822_0.8.0-3.alpha

This S120 SoftDevice release adds multilink support, allowing the S120 to be connected to up to eight peripheral devices simultaneously. The SoftDevice implements a complete GAP Central, GAP Observer, GATT Client and a limited GATT Server API, and supports Just Works pairing. The S120 complements the S110 SoftDevice for development of end-to-end BLE applications.

The S120 API is subject to change in future releases but is suitable for application prototyping. Peripheral and Broadcaster specific APIs are published in this release, but are not supported and may remain so beyond the first production release of the S120.

In this release, example applications are added. For later releases, these will be moved to the nRF51 SDK and no longer distributed with the SoftDevice.

Bugfixes

- LL
  - Corrected a SoftDevice malfunction when connecting shortly after scanning (DRGN-3490).
  - Cancelling a connection no longer causes the Link Layer to malfunction (DRGN-2998, DRGN-2859).
  - Stray advertising reports now eliminated (DRGN-2892).
- GAP
  - Address whitelisting is now fully functional (DRGN-2891, DRGN-2712).
  - The peer address field is now correctly set on the disconnected event (DRGN-2637).
  - Security: DIV collisions are no longer possible (DRGN-2688).
  - Security: SMP Feature Exchange no longer causes the stack to malfunction (DRGN-3114).
  - Security: Incoming PDUs with an idle application no longer cause the SoftDevice to malfunction (DRGN-3005).
  - Security: Unexpected peer disconnection can no longer cause the SoftDevice to malfunction (DRGN-2878).
- GATTC
  - Triggering transactions repeatedly no longer causes the GATT client to fail (DRGN-3467).
  - Fixed an issue where an initialization failure could trigger stack malfunction (DRGN-3081).

Changes

- SoftDevice
  - SoftDevice memory requirements have been changed from the previous release (DRGN-3042, DRGN-3563):
    - 96kB of flash memory
    - 10kB of RAM
    - 1.5kB call stack memory
- Link Layer

        - CPU Suspend limited to connection only, suspend removed from the scanner (DRGN-3550, DRGN-3460). The CPU will not be available to the application during connection events but shall be during scanning events.
- GAP
    - A timeout can now be set when initiating a connection (DRGN-3051).
    - Memory has been optimized and streamlined to allow for 8 concurrent connections (DRGN-3156).
    - SuperVisor Calls applicable to the peripheral role only now return `NRF_ERROR_NOT_SUPPORTED` (DRGN-2889).
    - Security: Key Generation and Distribution has been redesigned to be more flexible and use less memory (DRGN-3143, DRGN-2767).
    - Security: Invalid SMP PDUs no longer generate a Pairing Failed response (DRGN-3352).

New functionality

- Link Layer
    - The Link Layer now supports up to 8 simultaneous connections (DRGN-1003, DRGN-2656, DRGN-2658, DRGN-2655, DRGN-2900, DRGN-2661).
- BLE
    - A new connection manager allows the SoftDevice to handle up to 8 simultaneous connections (DRGN-2903).
- GAP
    - GAP now supports up to 8 simultaneous connections (DRGN-2651, DRGN-2650).
    - RSSI is now reported during scanning (DRGN-3473).
    - Support for the Connection Parameter Update procedure as a central device (DRGN-3072).
- GATTC
    - A GATT client supporting up to 8 simultaneous connections is now functional and available to the application (DRGN-2648).
- GATTS
    - A read-only GATT server supporting up to 8 simultaneous connections is now functional and available to the application (DRGN-3416).
- L2CAP
    - A complete L2CAP data scheduler for concurrent links has been introduced (DRGN-2652, DRGN-3400).
    - Support for the L2CAP server role has been added to the SoftDevice (DRGN-2654, DRGN-3074).

Limitations

- GAP
    - Attempting to scan just after scanning or just after a connection cancellation may return an `NRF_ERROR_BUSY` error code. The application will need to retry until `sd_ble_gap_scan_start()` returns `NRF_SUCCESS` (DRGN-2997).
    - Attempting to connect just after or during scanning or just after a connection cancellation may return an `NRF_ERROR_BUSY` error code. The application will need to retry until `sd_ble_gap_connect()` returns `NRF_SUCCESS`.
    - Control Procedures (encryption and connection parameter update) initiated by the application using the corresponding API calls must be serialized by the application itself, since a single one is currently allowed to execute shared across all links. Failure to do so may result in an `NRF_ERROR_BUSY` error code. This applies to the following 2 functions:
        - `sd_ble_gap_encrypt()`
        - `sd_ble_gap_conn_param_update()` (update procedures initiated by the central only)
    - OOB pairing and Passkey Entry (MITM) are implemented but not verified for this release. Note: This implies that security mode 1, security level 2 is the only fully verified link security level. Security mode 1, level 3 is therefore available but not verified. Security mode 2 is not supported.
- GATTS
    - The GATT Server is currently read-only. While the APIs do not prevent the application to add writable attributes (`write_perm != BLE_GAP_CONN_SEC_MODE_SET_NO_ACCESS`) the stack will not function properly if such attributes are present on the ATT table (DRGN-2649).
    - Authorization is not currently supported. Attributes can not use the `rd_auth` and `wr_auth` bits in this release (DRGN-2649).
- L2CAP
    - The following L2CAP API functions are non-functional in this release:
        - `sd_ble_l2cap_cid_register`
        - `sd_ble_l2cap_cid_unregister`
        - `sd_ble_l2cap_tx`

Known Issues

- GAP
  - Security: The stack may malfunction if a security procedure on any link and a connection parameter update on any link (even the same one) happen to be triggered concurrently (DRGN-3330, DRGN-3355).

s120_nrf51822_0.6.0

This release enables SIG approved and proprietary profiles to be implemented in full. The s120 implements a complete GAP Central, GAP Observer, GATT Client and GATT Server API, and supports Just Works pairing. The s120 complements the s110 SoftDevice for development of end-to-end BLE applications.

The s120 API is subject to change in future releases but is suitable for application prototyping. Peripheral and Broadcaster APIs are published in this release, but are not supported and may remain so beyond first production release of the s120.

Bugfixes

Changes

- SoftDevice
  - Lower stack interrupts are extended by a “CPU Suspend” state during radio activity to improve link integrity. This means lower stack interrupts will block application and upper stack processing during a Radio Event for a time proportional to the number of packets transferred in the event (DRGN-2320, DRGN-2720)
  - A new error code (`BLE_ERROR_INVALID_ROLE`) has been added and used when relevant (DRGN-2623)
  - Better documentation layout and searching (DRGN-2539)
  - Message Sequence Charts added covering all of the Central functionality
- GATT Client
  - Full GATT Client functionality is now verified (DRGN-2639)

New functionality

- GAP
  - White list implemented for scanner (DRGN-2662)
  - Security: Pairing and Bonding with no MITM (Just Works) implemented (DRGN-2405)
  - Security: Encryption reestablishment with stored keys implemented (DRGN-2562)
- GATT Server:
  - Full GATT Server implemented (DRGN-2807)

Known Issues

- GAP
  - Peripheral and Broadcaster API functions are currently published, but will cause undefined behavior if called (DRGN-2889)
  - Pairing and bonding with MITM enabled may cause SoftDevice assertions (DRGN-2839)
  - Using the white list to create connections does not function correctly (DRGN-2891, DRGN-2859)
  - Triggering a pairing procedure immediately after a previous one has completed during the same connection may cause SoftDevice assertions (DRGN-2878)

s120_nrf51822_0.5.0

Bugfixes

(This is the first release, so no known bugs fixed)

Changes

(This is the first release, so no changes)

New functionality

- Link Layer
  - Scanner
  - Initiator
  - Master (single link)
- SoftDevice
  - sd_softdevice_enable()
- BLE
  - sd_ble_evt_get()
  - sd_ble_tx_buffer_count_get()
- GAP
  - Scan
    - sd_ble_gap_scan_start() (passive scanner)
    - sd_ble_gap_scan_stop()
  - Connect
    - sd_ble_gap_connect()
    - sd_ble_gap_disconnect()
    - sd_ble_gap_connect_cancel()
- GATTC
  - sd_ble_gattc_primary_services_discover()
  - sd_ble_gattc_characteristics_discover()
  - sd_ble_gattc_write()
- L2CAP

The s120 is based upon Nordic Semiconductor's existing Bluetooth Low Energy codebase. In addition to the functionality above, other functionality is exposed in the API. That other functionality may or may not be present or working in the softdevice, but is in any way not considered a part of the release. It is recommended to use only the APIs for the functionality listed above.

Known Issues

- Limited testing