

# s110\_nrf51822 release notes

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## Introduction to the s110\_nrf51822 release notes

These release notes describe the changes in the s110\_nrf51822 from version to version.

This is how the document is laid out:

- There is one main section per new version of the s110\_nrf51822. This section will describe the changes from the previous version.
- Within each main section, there are sections for:
  - New functionality
  - Changes
  - Bugfixes
  - Limitations
  - Known issues

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 available in the s110\_nrf51822 migration document.

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# s110\_nrf51822\_7.1.0

This release adds the Low Duty Cycle Directed Advertising feature, an option to run the CPU while the radio is being used, an increase to the RX listening window when receiving packets, and bug fixes.

Users implementing HID applications or applications using a concurrent peripheral and broadcaster are recommended to update to this version of the SoftDevice.

## New functionality

- SoftDevice
  - Using the options API `sd_ble_opt_set()`, it is now possible for the application to use the CPU while the radio is active. By default in this version, and in previous versions of the SoftDevice, the CPU execution is blocked by the stack during radio activity. Note that this option cannot be used when running the SoftDevice on nRF51822 devices affected by PAN no. 44 "CCM may exceed real time requirements" and PAN no. 45 "AAR may exceed real time requirements" described in the nRF51822-PAN (DRGN-4511, DRGN-4815).
- GAP
  - Added support for Low Duty Cycle Directed Advertising (DRGN-1760).

## Changes

- LL
  - The maximum RX listening time after sending a packet is increased from 152 us to 156 us to ensure that packets are successfully received from PC central protocol stacks that have been observed to send packets later than the `T_IFS` time of 150+/-2us (DRGN-4719).
- GAP
  - The link will no longer be automatically disconnected if a pairing or bonding procedure fails (DRGN-3122, DRGN-4837).

## Bug fixes

- BLE
  - Fixed an issue, effecting nRF51 chips with more than 16 kB of RAM, that could cause an assert at `sd_ble_enable()` or cause SVC calls to return `NRF_ERROR_INVALID_ADDRESS` when a pointer to RAM above 16 kB was supplied (DRGN-4927, NRFFOETT-900).
  - Fixed an issue where sending data after the link had been disconnected might lead to reduced maximum throughput for the next connection (DRGN-4519).
- LL
  - Fixed an issue that could cause an assert if slave latency was used for a peripheral connection over which data was being transferred, and a broadcaster was active (DRGN-4807, DRGN-4820, NRFFOETT-880).
  - Fixed an issue that could cause the CPU to be active on each possible connection event (ignoring slave latency) if a peripheral connection and a broadcaster were active (DRGN-4832).
  - Fixed an issue that may occur when slave latency is used: After every 65536 connection events, queued data may not be sent at the next connection event, but after slave latency has expired (DRGN-4943).
- GAP
  - Fixed an issue where the Identity Address Information sent to the peer during a pairing procedure was not initialized (DRGN-4521). The application no longer needs to manually initialize this field.
  - Fixed an issue where an invalid passkey was used when the application set the static passkey with ascii characters outside the range 0x30 to 0x39. The static passkey setting in the options API will now return `NRF_ERROR_INVALID_PARAM` if this occurs (DRGN-4886).

## 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.
- DC/DC 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).
- 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

- GATTS
  - The `conn_handle` member of the `ble_gatts_evt_t` structure for a `BLE_GATTS_EVT_SYS_ATTR_MISSING` event does not contain a valid connection handle (DRGN-4501). The application should store the connection handle upon connection establishment and use the stored value in subsequent `sd_ble_gatts_sys_attr_set()` calls.
  - Pointers to attribute values using the `VLOC_USER` modifier are not checked to be in a valid range (DRGN-4406). The application must provide a pointer to a valid area in RAM to avoid a Hard Fault during the processing of attribute operations.

## s110\_nrf51822\_7.0.0

This release adds several new features, among them support for over-the-air Device Firmware Update, support for running other protocol stacks concurrently with the SoftDevice BLE protocol stack and support for concurrent broadcasting while in an active connection. A full description of the new functionality is given below. The release also contains a number of changes and bugfixes. This release is qualified to the Bluetooth specification version 4.1.

### Notes:

- This is a major release which has changed a limited part of the Application Programmer Interface, requiring applications to be recompiled.
- This SoftDevice version is not Production tested on all chip variants. Please see the "nRF51822 Compatibility Matrix" for SoftDevice version suitability for development and/or production. (The "nRF51822 Compatibility Matrix" can be found in the white paper nWP-018, in the downloads section on the nRF51822 product page within the Nordic Semiconductor web page.)

## Bugfixes

- SoftDevice
  - Fixed an issue where stopping advertising after a flash operation is triggered and then starting advertising again could lead to undefined behaviour (DRGN-3785, DRGN-3788, DRGN-4151).
  - The Concurrent Multiprotocol Timeslot API (which first appeared in the 7.0.0-2.alpha release) priorities are now correctly named.
- GAP
  - Fixed an issue where the key exchange bitmaps in the `ble_gap_evt_auth_status_t` event structure could be set incorrectly when re-bonding with an already bonded device (DRGN-3888).
  - Fixed an issue where the `offset` member in the `ble_gattc_evt_write_rsp_t` event structure was not set to 0 in case of a Write Response (DRGN-4402).
  - Fixed an issue where re-authenticating before the key distribution phase of the previous authentication procedure had finished could cause an assert (DRGN-3710, NRFFOETT-592).
- GATTS
  - Fixed an issue where the previous value of the CCCD would be returned on a new connection (NRFFOETT-663, DRGN-3746).

## Changes

- SoftDevice
  - The size of the SoftDevice has been increased to 88 kB.
  - The FWID is no longer stored in the UICR. Updated versions of the tools (nRFgo Studio, nrfjprog) compatible with this change are available as downloads from the Nordic Semiconductor web page.
  - The SoftDevice hex file no longer contains the SoftDevice size in the `UICR.CLENR0` register. This means that the SoftDevice is no longer protected by default. The updated versions of the tools (nRFgo Studio, nrfjprog) will write the SoftDevice size to the `UICR.CLENR0` register by default, thereby restoring default protection. Having protection enabled will not allow Device Firmware Update to a SoftDevice of larger size than the original, therefore the tools make it optional to not set the `UICR.CLENR0` register.
  - The `sd_softdevice_forward_to_application()` call has been replaced with `sd_softdevice_vector_table_base_set()`, which takes the forwarding address as an argument (FORT-815, NRFFOETT-688).
  - SVC number changes.
- BLE
  - A new API call, `sd_ble_enable()` has been added. This must be called to initialize and enable the BLE stack after invoking `sd_softdevice_enable()` and previous to any BLE activity (DRGN-2879, NRFFOETT-215).
- GAP
  - The `sd_ble_gap_address_set()` API call now takes an additional argument to support Privacy 1.1 (DRGN-4310, NRFFOETT-579).
  - New advertising data types introduced by the specification have been added (DRGN-4311).
  - The default appearance in the GAP service is now set to be 0x0000 (DRGN-3741).
- GATTS
  - Characteristic User Description descriptors may now be stored in application flash (if read only) or application RAM (DRGN-3745, NRFFOETT-624).
  - The application can now call `sd_ble_gatts_value_set()` with `p_value` set to NULL to update the length of `VLOC_USER` attributes (DRGN-3748, NRFFOETT-670).

## New functionality

- **SoftDevice**
  - 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 (DRGN-1010, DRGN-4074, DRGN-3456, DRGN-3176, FORT-828).
  - The SoftDevice now contains a Master Boot Record (MBR), which enables Device Firmware Update (DFU) of the SoftDevice itself (in addition to the application and bootloader) over the air. The MBR API enables copying and comparing regions in flash memory, and interrupt forwarding (DRGN-2282, DRGN-3738, FORT-822).
  - `RCOSC` calibration can now be configured to be temperature dependent (FORT-790).
  - The Flash API is now available also when the SoftDevice is disabled (FORT-836).
  - An Options API has been introduced to allow the application to set and get advanced configuration options for the SoftDevice (DRGN-1183).
  - The SoftDevice can now be configured to forward interrupts to one of several applications using the new `sd_softdevice_vector_table_base_set()` API call (FORT-815, NRFFOETT-688).
- **BLE**
  - 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, NRFFOETT-215).
- **GAP**
  - The SoftDevice now supports broadcasting while in a active connection (DRGN-810, DRGN-4008).
  - Privacy 1.1: The SoftDevice is now able to generate and refresh resolvable and non-resolvable private addresses while advertising or broadcasting. The application may set a custom IRK and an address cycle interval, but also retains the option to set addresses explicitly (DRGN-4310, NRFFOETT-579).
  - The application can now provide its own display passkey during a pairing procedure that uses the passkey entry algorithm (DRGN-4169, NRFFOETT-716).

## 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_dc_dc_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)
- **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

- **GAP**
  - The Identity Address Information sent to the peer during a pairing procedure needs to be initialized manually by the application (DRGN-4521). This can be achieved by setting a public or a random static device address with the `sd_ble_gap_address_set()` API call. If the application wants to use the factory default random static address, it may retrieve it with the `sd_ble_gap_address_get()` API before setting it.
- **GATTS**
  - The `conn_handle` member of the `ble_gatts_evt_t` structure for a `BLE_GATTS_EVT_SYS_ATTR_MISSING` event does not contain a valid connection handle (DRGN-4501). The application should store the connection handle upon connection establishment and use the stored value in subsequent `sd_ble_gatts_sys_attr_set()` calls.
  - Writable attribute values using the `VLOC_USER` modifier are not checked against RAM boundaries (DRGN-4406). The application must provide a pointer to a valid area in RAM to avoid a Hard Fault during the processing of incoming write operations.

## s110\_nrf51822\_6.0.0

This release adds support for Write Long Characteristics/Descriptors and support for Reliable Writes to the GATT client and server. This release also supports an increased number of Vendor Specific 128 bits UUIDs. The SoftDevice interface has been extended with asynchronous flash memory write and erase support.

This is a major release which has changed a limited part of the Application Programmer Interface, requiring applications to be recompiled.

As of the time of this release, s110\_nrf51822\_5.0.0 and s110\_nrf51822\_5.2.1 remain supported releases of the S110 SoftDevice. Users wishing to take advantage of new features or resolved limitations in this release should upgrade to s110\_nrf51822\_6.0.0.

This SoftDevice version is not Production tested on all chip variants. Please see "nRF51822 Compatibility Matrix" for SoftDevice version suitability for development and/or production. (The "nRF51822 Compatibility Matrix" can be found at the nRF51822 product page at the Nordic Semiconductor web page.)

## Bugfixes

- SoftDevice
  - 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 reset (DRGN-3305, FORT-797).
  - Resolved a bug affecting S110\_nrf51822\_5.1.0 and S110\_nrf51822\_5.2.0 where the advertiser (undirected or directed) stopped sending advertisement packets for a period of approximately 15 seconds (DRGN-3128). The device would recover and continue advertising, though as a result, connections to a peer device might appear to take an extended amount of time. There were no events generated by the SoftDevice indicating the advertiser stalled, so the application would have no knowledge that the SoftDevice was not sending packets. This issue had a low probability of occurrence and might remain undetected in development and testing.
- GAP
  - Fixed an issue where, on a bonded device using IRK based whitelisting, the white list was not effective until after the first advertising event (NRFFOETT-515, DRGN-3141, DRGN-3239).
  - Fixed an issue where the SoftDevice would assert if `sd_ble_gap_sec_params_reply()` was called after disconnect (DRGN-3129).
  - Fixed an issue where calling `sd_ble_gap_rssi_stop()` after connection had ended would cause an assert. In addition, RSSI will now be stopped automatically when the connection ends (NRFFOETT-499, DRGN-3131).
- GATT
  - Triggering transactions repeatedly no longer causes the GATT client to fail (DRGN-3467).

## Changes

- Softdevice
  - API facing event structures and functions now consistently use "evt" in their names (DRGN-2232).
  - SVC number ranges adjusted (DRGN-3147, FORT-798).
  - Updates and improvements to internal radio scheduling (DRGN-3223, DRGN-2790, DRGN-2781, DRGN-2768, DRGN-2762, DRGN-2363, DRGN-3542).
- GAP
  - `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).
  - 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).
  - 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).
  - Reason codes for `sd_ble_gap_disconnect()` documented (NRFFOETT-526, DRGN-3235).
- GATT
  - `sd_ble_gatts_value_get()` now returns the full length of the value if the value is longer than the buffer provided (DRGN-3009).
  - GATT events now include the handle from the error response when applicable (DRGN-1966).

- The maximum number of 128-bit Vendor Specific UUIDs has been increased to 10 (DRGN-3055).
- `sd_ble_uuid_vs_add()` now checks whether the UUID was previously added and therefore redundant (NRFFOETT-359, DRGN-2881).

## 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 (FORT-788).
  - Temperature sensor support added to the SoftDevice interface (FORT-790).
  - 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).
- GATTS
  - Support for the Write Long Characteristic Values and Descriptors procedures (DRGN-2920).
  - Support for the Reliable Writes procedure (DRGN-2920).
- 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).

## 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).
- 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).
- SoftDevice
  - 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)

## Known Issues

- SoftDevice
  - Stopping advertising (either by calling `sd_ble_gap_adv_stop()` or by a timeout) after a flash operation is started and then starting advertising again before the flash operation is complete may lead to undefined behaviour (DRGN-3785).  
**Note:** The nRF51 SDK does use flash operations in the bond manager and in the Alert Notification service.  
 Workarounds are:
    - Either wait 50 ms or more from stopping advertising until starting advertising again.
    - Or wait until the flash operation end event (`NRF_EVT_FLASH_OPERATION_SUCCESS` or `NRF_EVT_FLASH_OPERATION_ERROR`) has been received before starting advertising again.

# s110\_nrf51822\_5.2.0

This release addresses some minor limitations in the SoftDevice, and adds compatibility for future hardware revisions of the nRF51822.

## Bugfixes

No bugfixes in this version.

## Changes

- GAP
  - Increased maximum device name length from 20 to 31 characters (DRGN-2802). Note limitation below.
  - Added "-30" dBm as new valid radio power parameter in `sd_ble_gap_tx_power_set()`. The value "-40" dBm still exists, but is deprecated. If used, it will still behave as in previous releases and give the minus 30dBm mode of the nRF51822 chip (DRGN-2869, DRGN-2702).

## New functionality

No new functionality in this version.

## Limitations

- GAP
  - If the GAP device name is longer than 20 bytes, then its permissions cannot be set to writable.
  - Key missing notification during pairing using `BLE_GAP_AUTH_KEY_TYPE_NONE` in `sd_ble_gap_auth_key_reply` is currently not supported, the application can ignore or disconnect instead (DRGN-2540).
- GATTS
  - To conform to the Bluetooth specification there shall not be a secondary service that is not referenced somehow by a primary service. (DRGN-906, DRGN-2260)
- SoftDevice
  - 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)

## Known Issues

- GAP
  - In the `BLE_GAP_EVT_DISCONNECTED` event, the peer address field in the event structure is invalid, and must not be used (DRGN-2638).

# s110\_nrf51822\_5.1.0

Summary: This version improves interrupt latency during advertising, especially for directed advertising (see "Changes" below). It also fixes a bug affecting channel map update (see "Bugfixes" below). Users of the the softdevice should upgrade to this version if affected by any of these issues.

## Bugfixes

Link layer

Fixed a bug causing the new channel map to be used immediately if a channel map update is received before an event counter wraparound and the instant is after the wraparound (DRGN-2629).

## Changes

- Link layer
  - The application is now allowed to run during directed advertising by allocating CPU time to the application between each advertising packet transmission. Interrupt latency has been reduced for all types of advertising (DRGN-2597).

## New functionality

No new functionality in this version.

## Limitations

- GAP
  - Key missing notification during pairing using BLE\_GAP\_AUTH\_KEY\_TYPE\_NONE in sd\_ble\_gap\_auth\_key\_reply is currently not supported, the application can ignore or disconnect instead (DRGN-2540).
- GATTS
  - To conform to the Bluetooth specification there shall not be a secondary service that is not referenced somehow by a primary service. (DRGN-906, DRGN-2260)
- SoftDevice
  - 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)

## Known Issues

- GAP
  - In the BLE\_GAP\_EVT\_DISCONNECTED event, the peer address field in the event structure is invalid, and must not be used (DRGN-2638).
  - The "-40" dBm radio power parameter in sd\_ble\_gap\_tx\_power\_set() corresponds to, and will give, the minus 30 dBm mode of the nRF51822 chip (DRGN-2702).

# s110\_nrf51822\_5.0.0

## Bugfixes

- SoftDevice
  - The Random Number generator is now stopped earlier to improve power savings (DRGN-1455)
  - The radio notification distance of 800us is now available (DRGN-2133, NRFFOETT-188)
- Link Layer
  - Current consumption is reduced and Application Low interrupts are no longer prevented from executing for a period after stopping advertising (DRGN-2018, NRFFOETT-233)
  - Fixed a possible malfunction and lockup related to packet transmission queueing (DRGN-2319, NRFFOETT-250, DRGN-2365)
  - Fixed a possible malfunction when performing undirected connectable advertising after a successful directed advertisement (DRGN-2472)
  - Fixed a possible malfunction when stopping advertising (DRGN-2441)
- BLE
  - The stack will no longer stall if the application fails to retrieve pending events (DRGN-2396)
  - Fixed an issue that could cause the application to receive invalid data in events (DRGN-2294)
- GAP
  - Fixed an issue where the stack would fail to advertise after two directed advertising attempts with no connection established (DRGN-2024)
  - Fixed the SMP implementation to allow for LTK encryption during an ongoing pairing procedure (DRGN-2019)
  - Unlimited advertising timeout is no longer accepted when performing limited advertising (DRGN-2236, DRGN-2410)
- GATTC and GATTS
  - The UUID encoding and decoding functions now correctly check the UUID type value (DRGN-2357)
  - gatts\_descriptor\_add() no longer returns wrong handle value (DRGN-2313)

## 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). Therefore, current consumption during radio activity is higher than in previous releases.
- GAP
  - The stack will no longer issue a BLE\_GAP\_EVT\_AUTH\_STATUS when the connection is closed before a pairing procedure has completed (DRGN-2164)
- GATTC and GATTS
  - ATT packet headers are now checked strictly by the stack, dropping non-conformant packets (DRGN-2274, NRFFOETT-222)

## New functionality

(No new functionality in this version)

## Improvements

- The API documentation now includes Message Sequence Charts that illustrate the operation of most calls and events (DRGN-614, NRFFOETT-234)

## Limitations

- SoftDevice
  - nrf\_power\_dcdc\_mode must not be set to NRF\_POWER\_DCDC\_MODE\_AUTOMATIC while advertising. Only NRF\_POWER\_DCDC\_MODE\_OFF and NRF\_POWER\_DCDC\_MODE\_ON can be used while advertising. To use the DCDC converter while in a connection, nrf\_power\_dcdc\_mode should be NRF\_POWER\_DCDC\_MODE\_OFF while advertising, then

when connected, `nrf_power_dcdc_mode_set()` can be used to change the mode to `NRF_POWER_DCDC_MODE_AUTOMATIC`. (DRGN-2420)

- GAP
  - Synthesized low frequency clock source is not tested or intended for use with BLE stack.
  - Key missing notification during pairing using `BLE_GAP_AUTH_KEY_TYPE_NONE` in `sd_ble_gap_auth_key_reply` is currently not supported, the application can ignore or disconnect instead (DRGN-2540)
- GATTS
  - To conform to the Bluetooth specification there shall not be a secondary service that is not referenced somehow by a primary service. (DRGN-906, DRGN-2260)

## Known Issues

(No known issues in this version)