

nRF Connect Bluetooth Low Energy 4.0.0

User Guide

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Revision history

Date	Description
2022-09-06	Updated for installation changes in nRF Connect <i>Bluetooth</i> ® Low Energy v4.0.0 and new user interface in version 3.0.1 and later.
2021-06-02	Editorial changes
September 2019	Updated to match nRF Connect Bluetooth Low Energy v2.3.1: <ul style="list-style-type: none">• Updated Installing the Bluetooth Low Energy app on page 5• Clarified supported devices
May 2019	<ul style="list-style-type: none">• Updated Installing the Bluetooth Low Energy app on page 5• Editorial changes
June 2018	<ul style="list-style-type: none">• Added support for nRF52840 Dongle PCA10059
February 2018	<ul style="list-style-type: none">• Server setup can be applied multiple times with adapter reset
July 2017	<ul style="list-style-type: none">• Application ported to new framework• Added support for multiple custom properties in advertisement data• Added support for Buttonless DFU Service
January 2017	<ul style="list-style-type: none">• Added Secure DFU• Added support for nRF52 Development Kit PCA10056
July 2016	First release

Previous versions

PDF files for relevant previous versions are available here:

- [nRF Connect Bluetooth® Low Energy User Guide v2.3.1](#)(corresponds to nRF Connect Bluetooth Low Energy v2.3.1)
- [nRF Connect Bluetooth® Low Energy User Guide v2.1](#) (corresponds to nRF Connect Bluetooth Low Energy v2.1.0)
- [nRF Connect Getting Started Guide v1.1](#) (corresponds to nRF Connect v1.1.0)
- [nRF Connect Getting Started Guide v1.0](#) (corresponds to nRF Connect v1.0.0)

1 Introduction

nRF Connect Bluetooth Low Energy helps you learn how to configure and test Bluetooth Low Energy devices. It allows you to set up a local device, connect it to advertising devices and discover their services. You can maintain the connection parameters, pair devices, update firmware OTA and change local device server setup. It also offers a detailed log for troubleshooting purposes.

Supported devices

- PCA10056 nRF52840 Development Kit
- PCA10040 nRF52 Development Kit
- PCA10059 nRF52840 Dongle
- PCA10028 nRF51 Development Kit
- PCA10031 nRF51 Dongle

2

Installing the Bluetooth Low Energy app

Bluetooth Low Energy is installed as an app for nRF Connect for Desktop.

Before you can install the app, you must download and install [nRF Connect for Desktop](#) (version 3.2.0 or later).

To install the Bluetooth Low Energy app:

1. Open nRF Connect for Desktop.
2. Find Bluetooth Low Energy in the list of apps and click **Install**.
A proxy app is installed, and the Bluetooth Low Energy button changes to **Open**.
3. To complete the installation, you must press **Open**.
4. You will be prompted to **Download and install**, do this to complete installation of the app.

Once the app is installed, you can launch it by clicking **Open**.

If a new version of the app becomes available, an **Update** button is displayed next to the **Open** button. Click this button to install the latest version.

To uninstall the app, follow the steps appropriate for your operating system:

- *Windows*: Open **Control Panel** and navigate to **Uninstall a program**. Find **nRF Connect for Desktop Bluetooth Low Energy 4.0.0** and proceed to uninstall the application.
- *Ubuntu*:
 - Delete the folder `~/opt/nrfconnect-bluetooth-low-energy`.
 - You may also delete additional config files from `~/.config/nrfconnect-bluetooth-low-energy`
- *macOS*: Move the **nRF Connect for Desktop Bluetooth Low Energy 4.0.0** application to bin, from where it is located, normally placed inside the Applications folder.

Note:

From version 4.0.0, the Bluetooth Low Energy app is installed as a standalone application, for reasons of driver compatibility. The application functionality remains the same, and a proxy app is used from nRF Connect for Desktop. A desktop shortcut is also created automatically, during the install process.

To receive information on updated versions, you are recommended to use nRF Connect for Desktop to install, open and update the application. However, **Uninstall** removes only the proxy app and **Create shortcut** is no longer necessary.

3 Overview and user interface

After starting nRF Connect Bluetooth Low Energy, the application window is displayed.

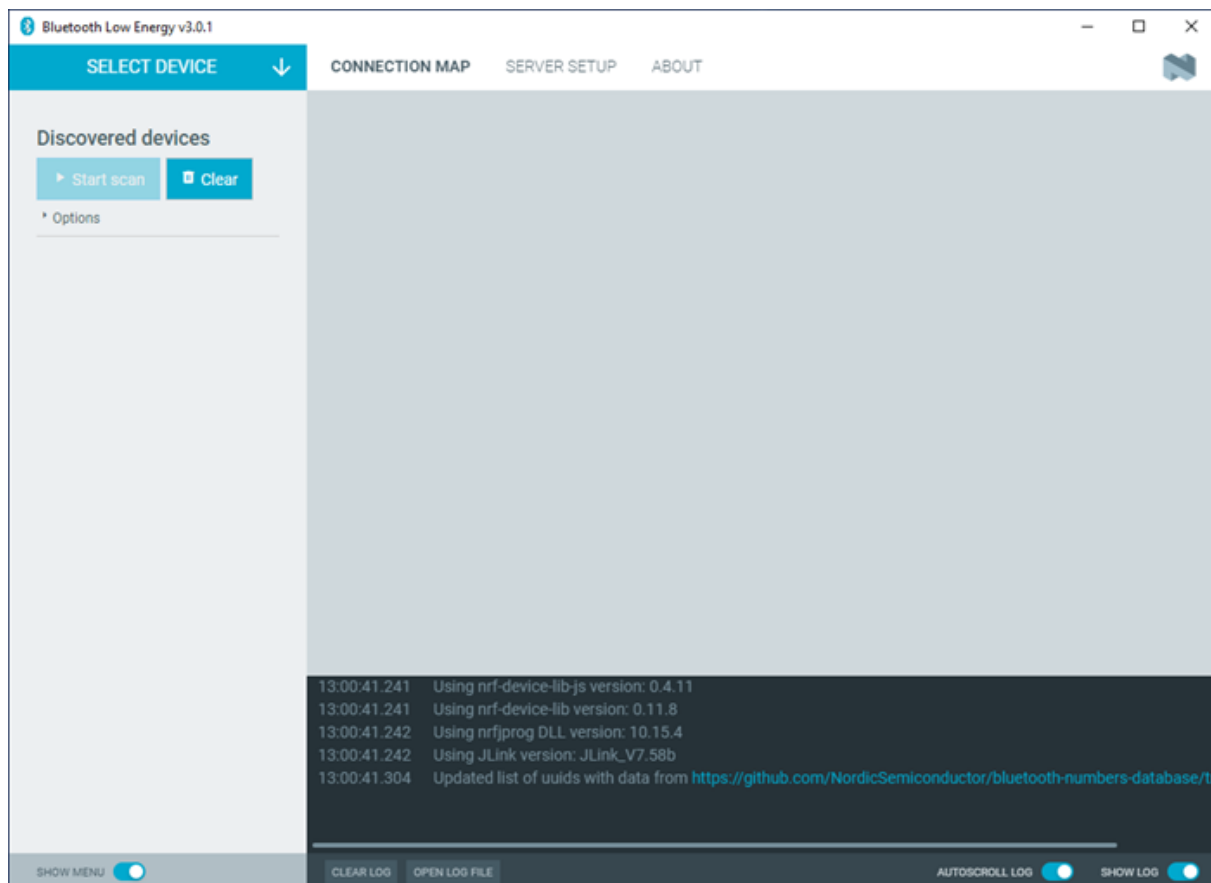


Figure 1: Application window

It consists of the following main elements:

Select Device

To the upper left, you can select a local serial device. You can use the selected local device to scan for Bluetooth Low Energy devices, which are listed in the side panel below.

You can switch between the following application tabs, using the navigation bar.

Connection Map

This view is initially empty but will be populated with local and remote Bluetooth Low Energy devices when they are discovered.

Server Setup

You can configure the local device's GATT (Generic Attribute profile) attribute table. Adding attributes to the server setup allows the local device to exchange data with a connected peer device.

About tab

You can view application information, restore defaults, access source code, and documentation. You also can find information on the selected device, access support tools, and enable verbose logging.

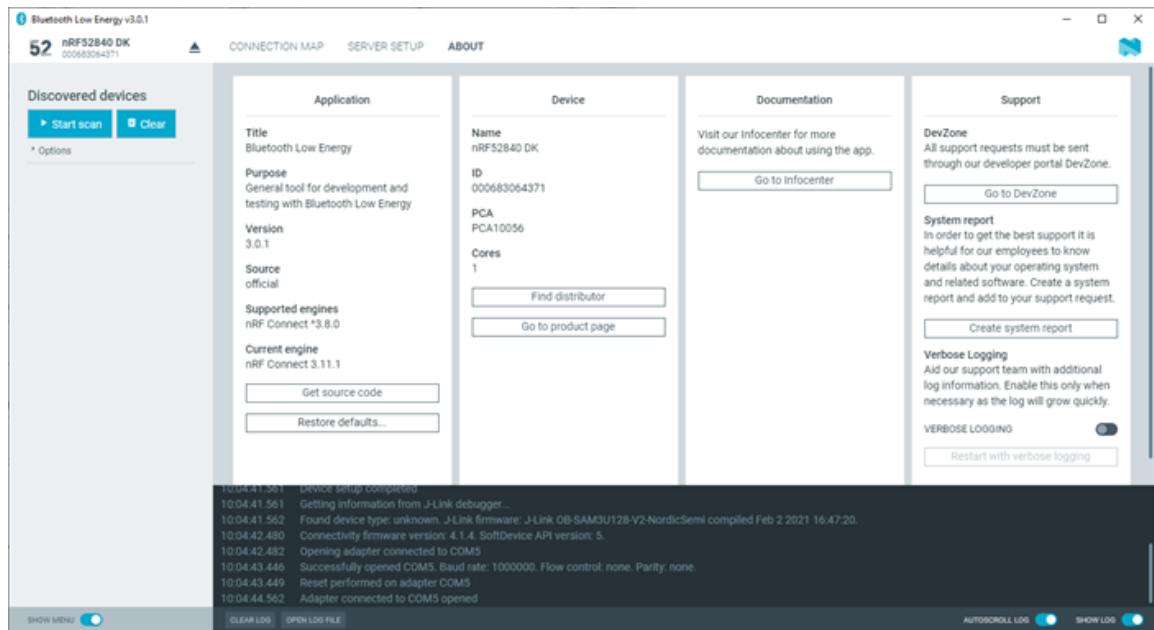


Figure 2: nRF Connect for Desktop Bluetooth Low Energy About tab

Log

The Log panel allows you to view the most important log events, tagged with a timestamp. Each time you open the app, a new session log file is created. You can find the Log panel and its controls, below the main application Window.

- When troubleshooting, to view more detailed information than shown in the Log panel, use **Open log file** to open the current log file in a text editor.
- To clear the information currently displayed in the Log panel, use **Clear Log**. The contents of the log file are not affected.
- To hide or display the Log panel in the user interface, use **Show Log**.
- To freeze Log panel scrolling, use **Autoscroll Log**.

4 Establishing serial port connection to a local device

The nRF Connect Bluetooth Low Energy app requires a serial port connection to a local *Development Kit (DK)* or dongle. The nRF *System on Chip (SoC)* on the device is controlled by the app which sends serialized commands to it over a serial port.

To set up a local device, complete the following steps:

1. Connect the device to a *Universal Serial Bus (USB)* port on your computer and power it on.
2. In the navigation bar, click on **Select device**
3. Select a device by clicking on its name in the drop-down list.

You can access the following options by selecting the arrow under the device name.

- Show the device at the top of the list by making it favorite.
- Rename the device.
- View and select between device Com Ports.

The name of the selected device is displayed on the navigation bar.

If the device has not been used with the nRF Connect Bluetooth Low Energy app before, you may be asked to update the J-Link firmware and connectivity firmware for the device. You need to have the correct connectivity firmware on the nRF SoC to continue. When the nRF SoC has been programmed with the correct firmware, the nRF Connect Bluetooth Low Energy app proceeds to connect to it over *Universal Asynchronous Receiver/Transmitter (UART)*. When the connection is established, the device appears in the main view.

Note: When using OS X, an issue with the SEGGER J-Link OB firmware leads to the corruption of long packets over UART. See www.nordicsemi.com/nRFConnectOSXfix for more information.

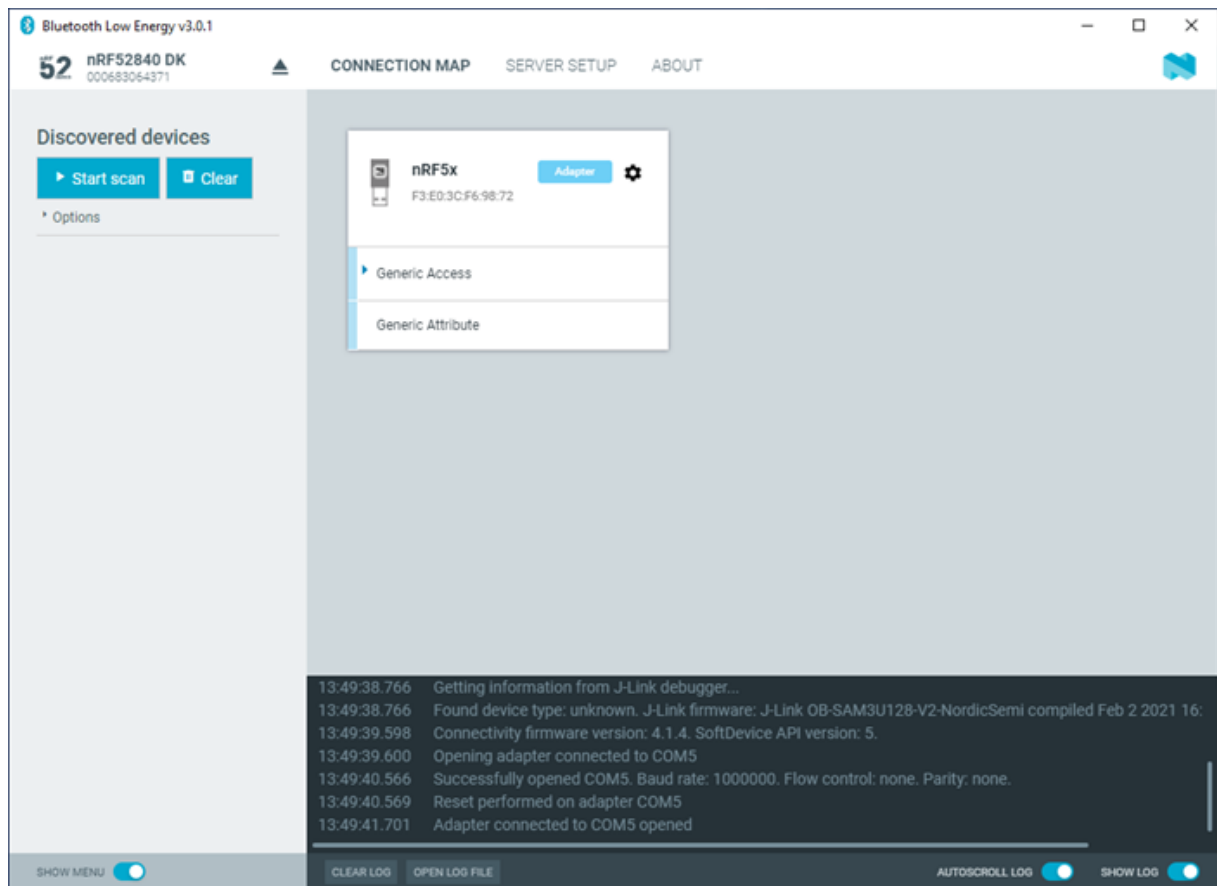



Figure 3: Local device view

The local device is labeled **Adapter** to signal that it is connected locally to the computer. The device name and Bluetooth device address are shown at the top. The attribute table of the device is shown below them.

To expand a menu that shows actions and configurations available for the local device, click the **Device options** icon .

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Establishing Bluetooth Low Energy connections

The nRF Connect Bluetooth Low Energy app can establish and maintain up to eight simultaneous Bluetooth Low Energy connections.

To connect to devices, complete the following steps:

1. To scan for nearby Bluetooth devices, click the **Start scan** button in the **Discovered devices** view.

The advertising devices start to appear in a list in the **Discovered devices** view. Each entry in the list shows the name, address, and RSSI of the received advertising packet. For information on how to set up advertising for a device, see [Setting up advertising](#) on page 18.

To view the advertising type and data fields of a packet, select the packet entry in the list.

To sort the list according to signal strength and thus according to which device is closest, click **Options** and select **Sort by signal strength**.

2. To establish a Bluetooth connection with a peer device, click the **Connect** button associated with the device.

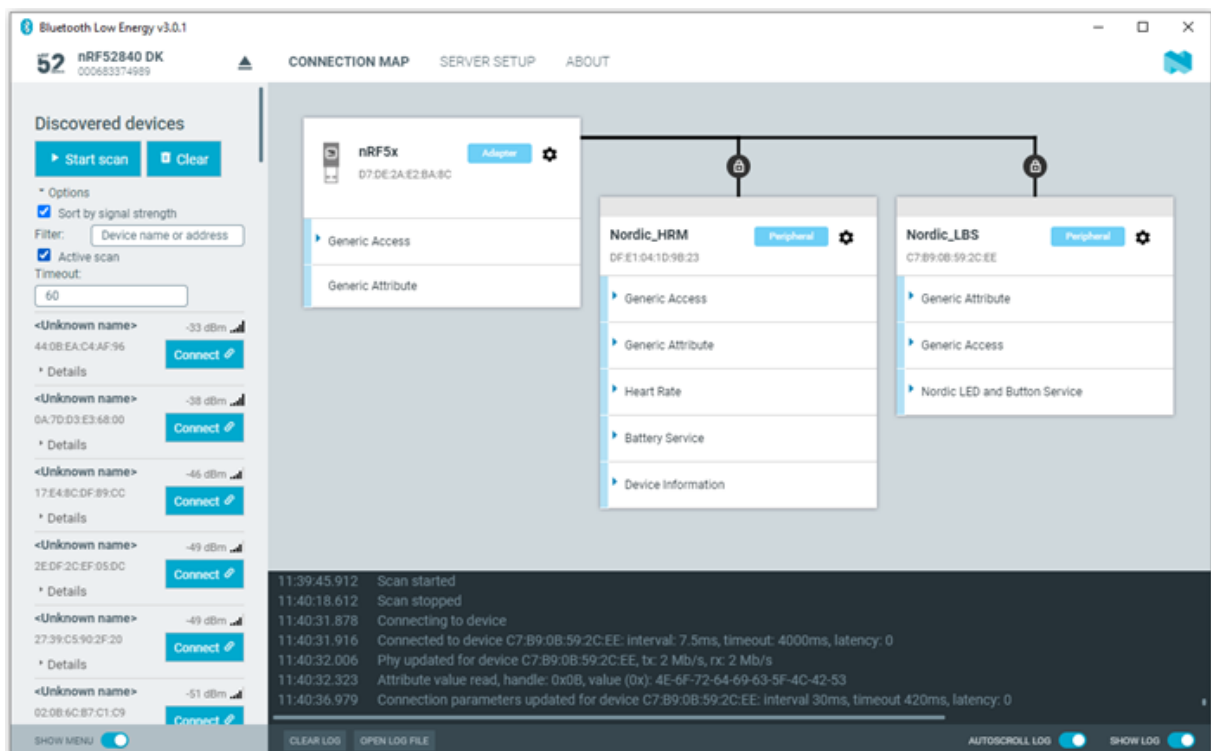


Figure 4: Discovered services

When the connection has been established, a new peripheral device appears in the **Connection Map**, to the right of the local device. The nRF Connect Bluetooth Low Energy app automatically performs an initial service discovery. The discovered services are listed below the connected device. Attributes that are known to the application are shown by their name. Attributes that are unknown to the application are shown by their UUID only. For information on how to add UUID definitions, see [Adding UUID definitions](#) on page 22.

A line connects the local and remote device signaling that they are connected over Bluetooth. To open a connection info dialog displaying the parameters of the connection, encryption, and bond state, hover the mouse pointer over the padlock icon.

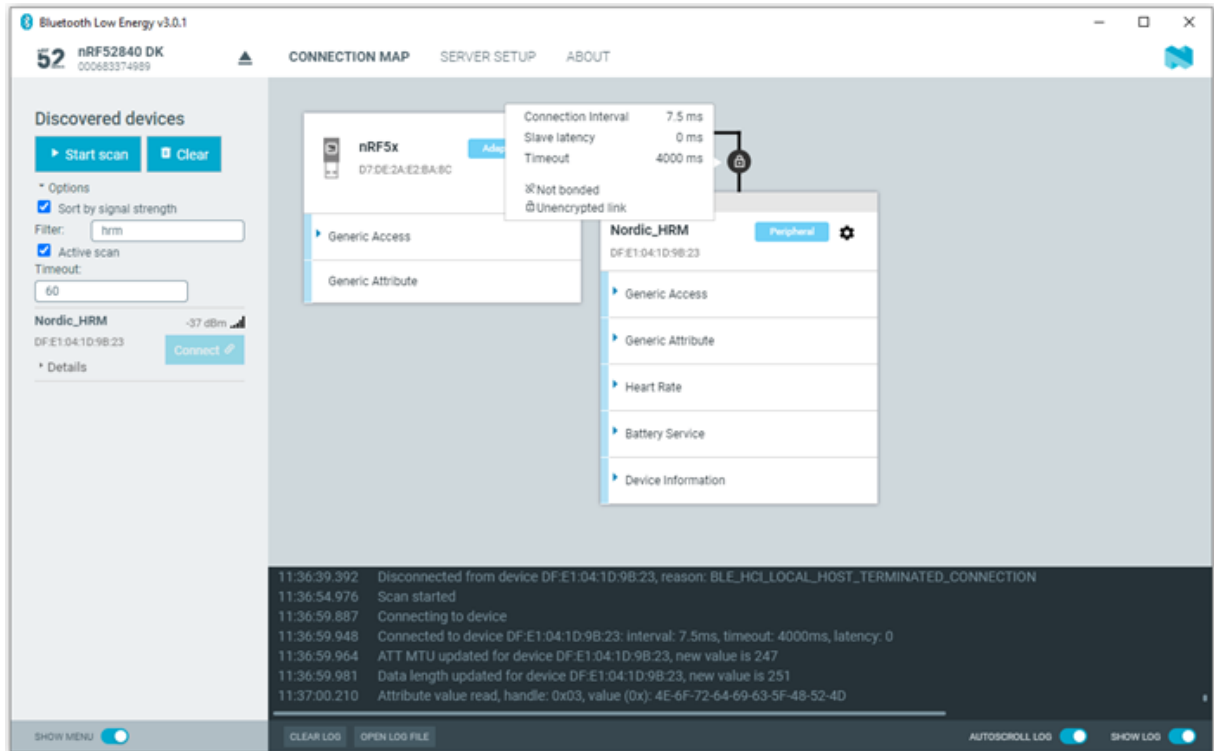


Figure 5: Hovering over the padlock icon

6 Viewing service details

The nRF Connect Bluetooth Low Energy app can discover and display services, characteristics, and descriptors of a connected peer device's attribute table.

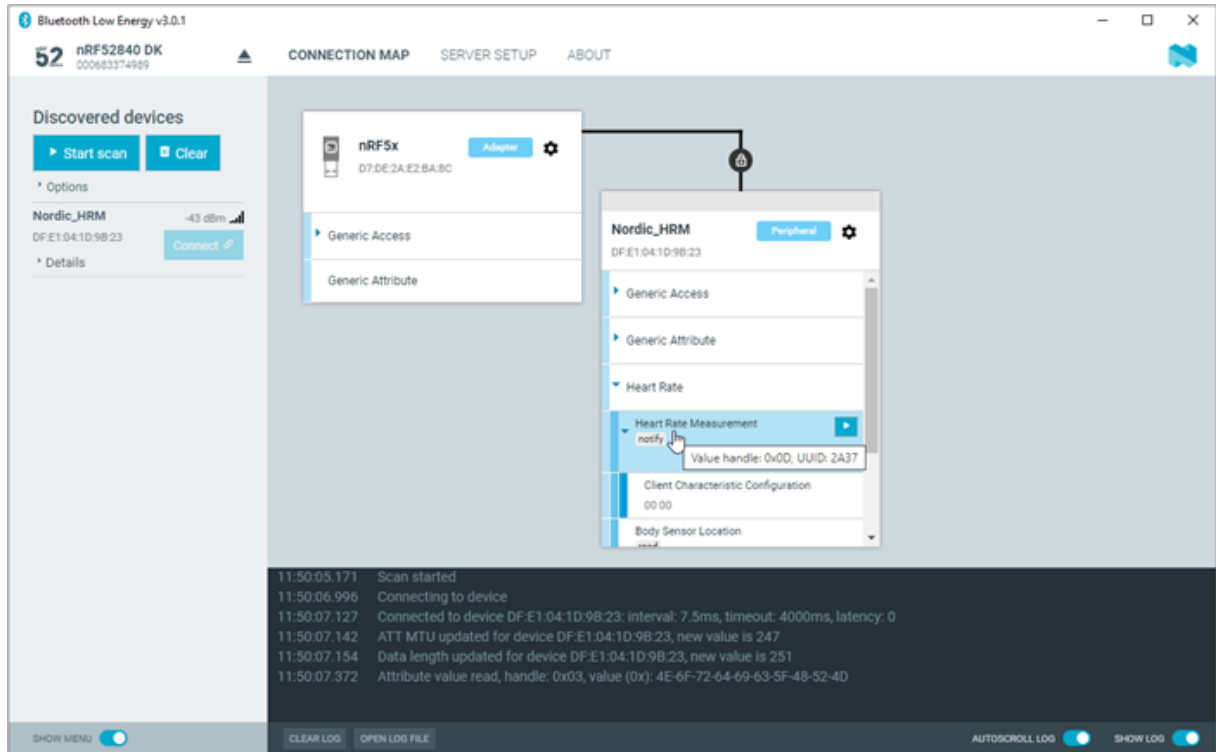


Figure 6: Service details

- To view the handle and *UUID* of an attribute, move the mouse pointer over the attribute name. A hover text is displayed.
- To view the characteristics of a service, click the **Expand/collapse** icon ▶.
- The characteristics have different buttons available depending on the associated properties. Read, write, and notify actions are available if the corresponding properties are available for the characteristic.
- To view descriptors, expand the characteristics.
- To configure the peer device to start sending notifications, click the **Toggle notifications** icon ▶.

When a device receives a notification, the corresponding attribute is highlighted, and its value is updated.

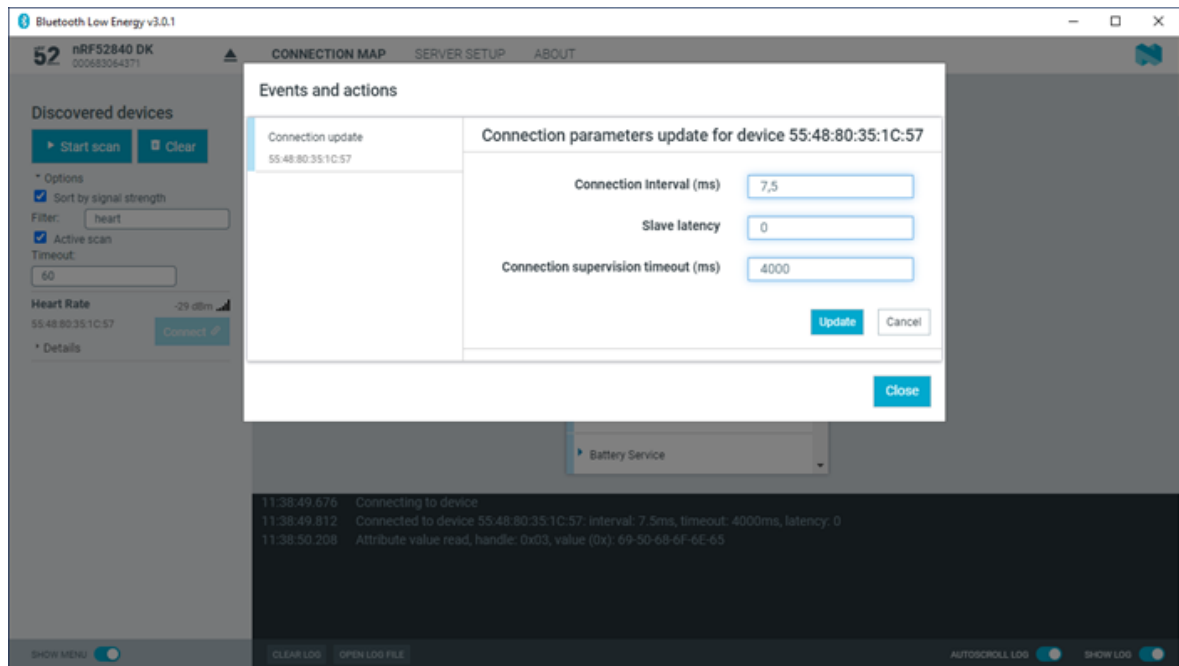
If a service or characteristic does not have any child attributes, the list is empty when you click the **Expand/collapse** icon ▶.

7 Updating connection parameters

In a connection, you can request new connection parameters and respond to an incoming connection parameter update request.

To define connection parameters, complete the following steps:

1. To view device options for the connected device, click the **Device options** icon ⚙️.
2. To open the **Connection update** dialog, click **Update connection....**



3. Set the desired parameters in the dialog, then click **Update**.
4. To close the dialog, click **Close**.

There are two main options for responding to update requests: Letting the nRF Connect Bluetooth Low Energy app accept the request automatically (default) or responding to the request manually.

To select the responding option, complete the following steps:

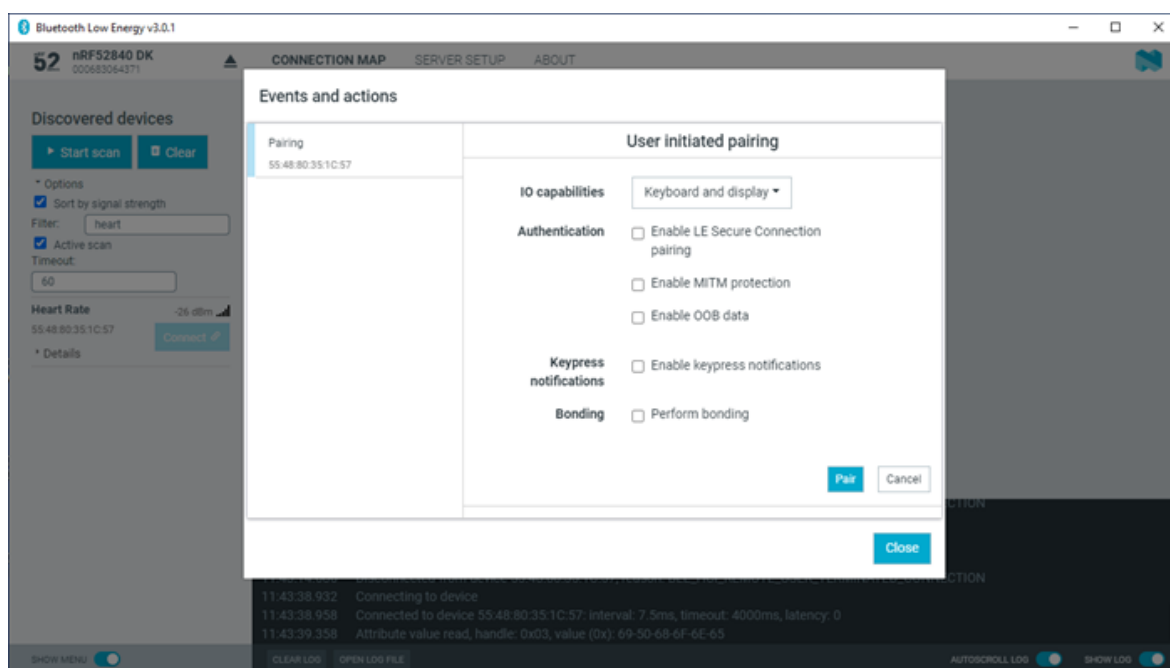
1. Click the local **Device options** icon ⚙️.
2. Select or deselect **Auto accept update requests**.

8 Pairing devices

Pairing is the process of exchanging security keys and establishing an encrypted link. The level of security is configurable, and it ranges from an unencrypted link with no security, to an encrypted link with authentication and protection against *Man-in-the-Middle (MITM)* attacks.

To pair with a connected device, complete the following steps:

1. To view device options for the connected device, click the **Device options** icon ⚙️.
2. To open the Pairing dialog, click **Pair...**





- To define the device's Input/Output capabilities, use **IO capabilities**
 - **LE Secure Connection pairing** provides protection against eavesdropping and MITM attacks. It uses an Elliptic Curve Diffie-Hellman (ECDH) key agreement to derive encryption keys. It was introduced as an alternative to LE Legacy pairing, in version 4.2 of the Bluetooth Low Energy Core Specification.
 - When using LE Legacy pairing, you can use the following:
 - To enable MITM protection, use **MITM**.
 - To enable *Out of Band (OOB)* pairing **Enable OOB data**.
 - When doing LESC, to inform the remote device when keys have been entered or erased, use **Keypress notification**.
 - To re-establish a secure link, without having to go through the pairing process each time use **Perform Bonding**, which means long-term keys are created and exchanged.
3. Set the desired parameters in the dialog, then click **Pair**.

Depending on the chosen security parameters, an additional dialog may be shown for passkey, out-of-band data, or numerical comparison input.

4. To close the Pairing dialog, click **Close**.

When the pairing procedure has been completed, the following changes are displayed:

- A log entry shows the new security level of the connection.
- The pairing text in **Event and actions** view turns green to indicate success.


- The connection info padlock icon changes to solid white , if the connection is encrypted. Otherwise a padlock outline is displayed .

Note:

- Bonding is supported, but the keys are not retained across application restarts.
- Address resolving is currently not supported. Therefore, using keys from a bond after the device has changed address will most likely fail.
- LE Security bonding might not work for some configurations.


The nRF Connect Bluetooth Low Energy app can reply automatically to an incoming pairing request by default, or it can be handled by the user.

To select the reply option for pairing requests, complete the following steps:

1. Click the local **Device options** icon .
2. Select or deselect **Auto reply security requests**.

When Auto reply security requests is selected, the nRF Connect Bluetooth Low Energy app uses the settings specified in Security parameters when automatically replying to the request.

To edit security parameters, complete the following steps:

1. Click the local **Device options** icon .
2. To open the Security parameters dialog, click **Security parameters**.
3. Click **Apply** when done.

9 Configuring server setup

The nRF Connect Bluetooth Low Energy app supports the configuration of the local device's GATT (Generic Attribute profile) attribute table, also known as server setup. Adding attributes to the server setup allows the local device to exchange data with a connected peer device.

The default server setup consists of two mandatory services: GATT and GAP (Generic Access Profile). These services can be modified, but they cannot be removed, and you cannot extend them with more characteristics or descriptors.

To add new attributes to the server setup, complete the following steps:

1. In the navigation bar, click the **Server setup** button.
Initially, the default server setup that is displayed contains only GAP and GATT services.
2. Click **New service**.
3. Select the service you just added.
A form is displayed.
4. Define the attribute values, then click **Save**.
5. To add a new characteristic, expand the added **New Service**, then click **New characteristic**.
6. Select the characteristic you just added.
A form is displayed.
7. Define the attribute values, then click **Save**.

Note: When adding a notify or indicate property on a characteristic, you need to add a Client Characteristic Configuration Descriptor (CCCD) for that characteristic.

8. To add a new descriptor, expand the added **New Characteristic**, then click **New descriptor**.
9. Select the descriptor you just added.
A form is displayed.
10. Define the attribute values, then click **Save**.
11. When you have completed the server setup, click **Apply to device** to upload the setup to the local device.

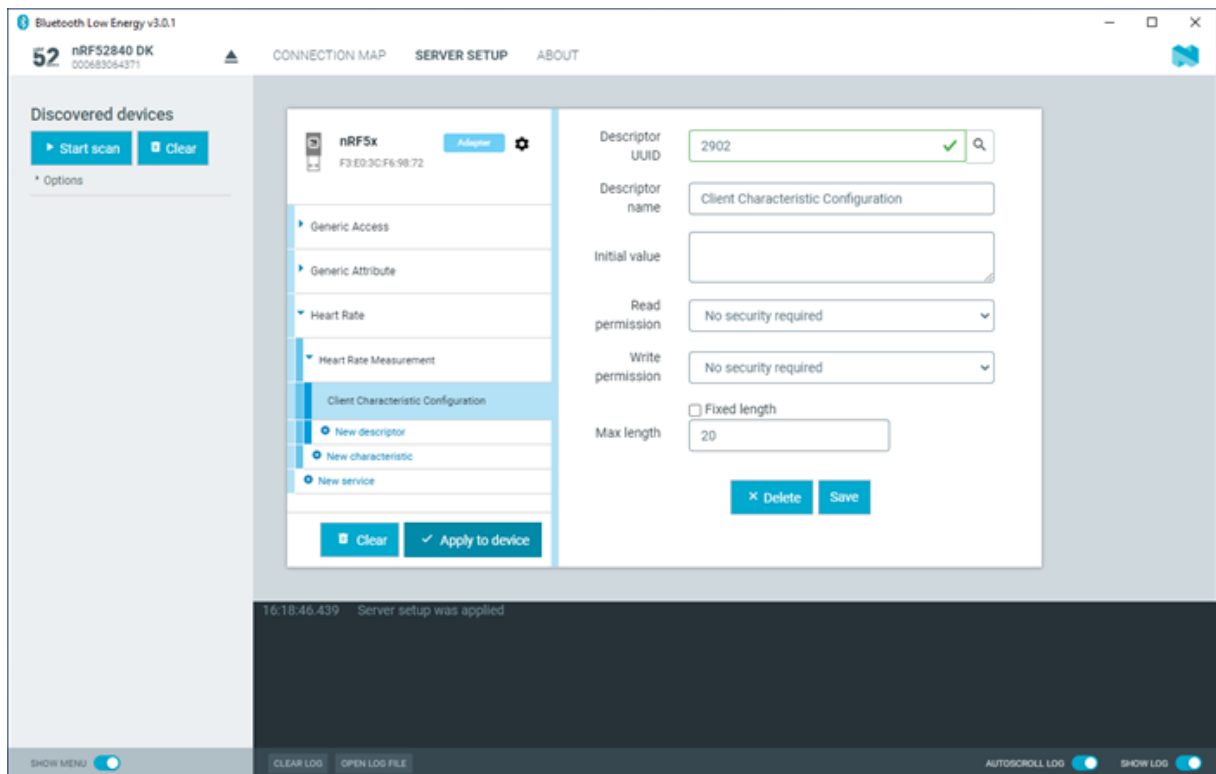




Figure 7: Server setup

To save a server setup to file for later use, complete the following steps:

1. Click the local **Device options** icon .
2. Click **Save setup....**
3. Choose a directory and type a file name, then click **Save**.

To load a previously saved server setup from file, complete the following steps:

1. Click the local **Device options** icon .
2. Click **Load setup....**
3. Navigate to the right directory and select the file, then click **Open**.


Note: If you remove or overwrite a setup from the device, you need to reset and reopen it. When prompted, confirm the reset.

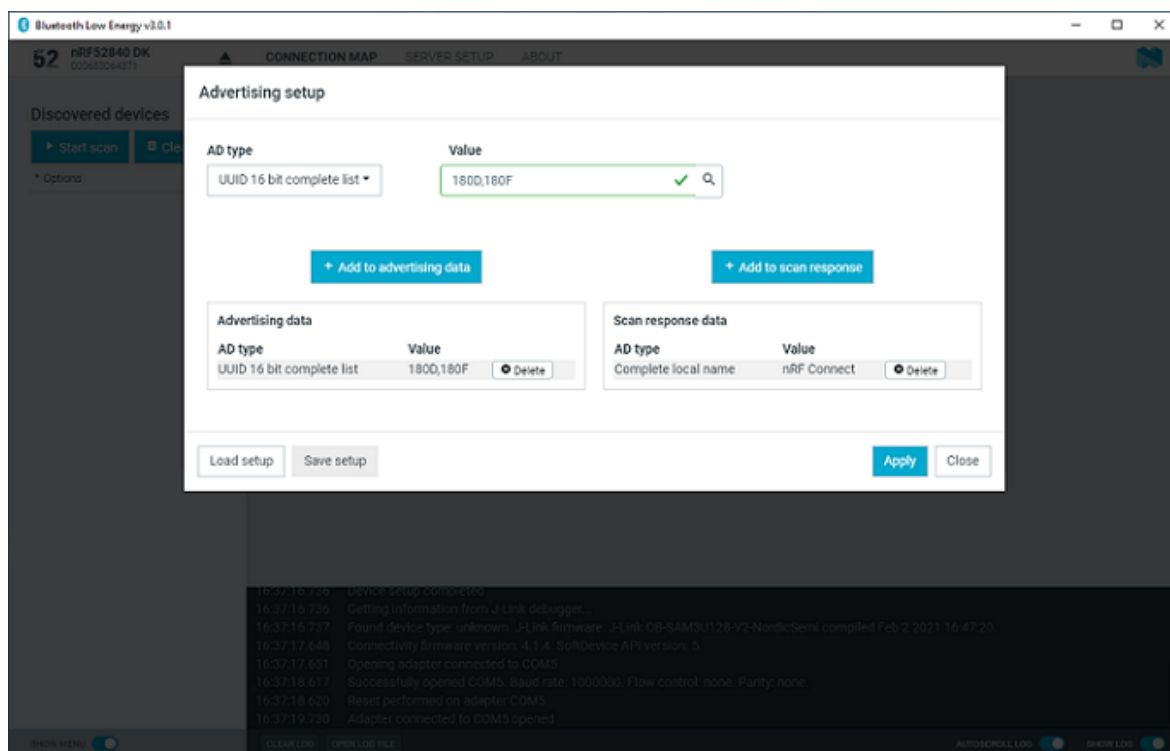
After the setup has been applied to the device, you can view the resulting setup by clicking the **Connection map** button in the navigation bar. The new setup is reflected in the local device.


10 Setting up advertising

The nRF Connect Bluetooth Low Energy app enables the local device to operate as a peripheral that can send connectable advertising packets. The contents of the advertising packets can be configured in the advertising setup.

To start sending advertising packets, complete the following steps:

1. Click the local **Device options** icon .
2. To start advertising the device, click **Start advertising**.
3. Specify the contents of the advertising packets:



- a) Click the local **Device options** icon .
- b) To display the Advertising setup dialog, click **Advertising setup**.
- c) From the AD type drop-down menu, select an AD type.
- d) In the Value field, add a data value.
- e) Select **Add to advertising data** or **Add to scan response**.
- f) Repeat until all wanted fields are present.
- g) Click **Apply**, then click **Close**.

To save an advertising setup to file for later use, complete the following steps:

1. Click the **Save setup** button.
2. Choose a directory and type a file name, then click **Save**.

To load a previously saved advertising setup from file, complete the following steps:

1. Click the **Load setup** button.
2. Navigate to the right directory and select the file, then click **Open**.

11 Updating firmware over the air

If the connected device has Nordic Device Firmware Update (DFU) Service, you can update the firmware on the device.

For more information on the DFU process, see [Device Firmware Update process](#). For DFU bootloader examples, see [DFU bootloader examples](#).

For a device that has DFU Service, Secure DFU appears in the device's list of discovered services and the Start Secure DFU button appears in the list header.

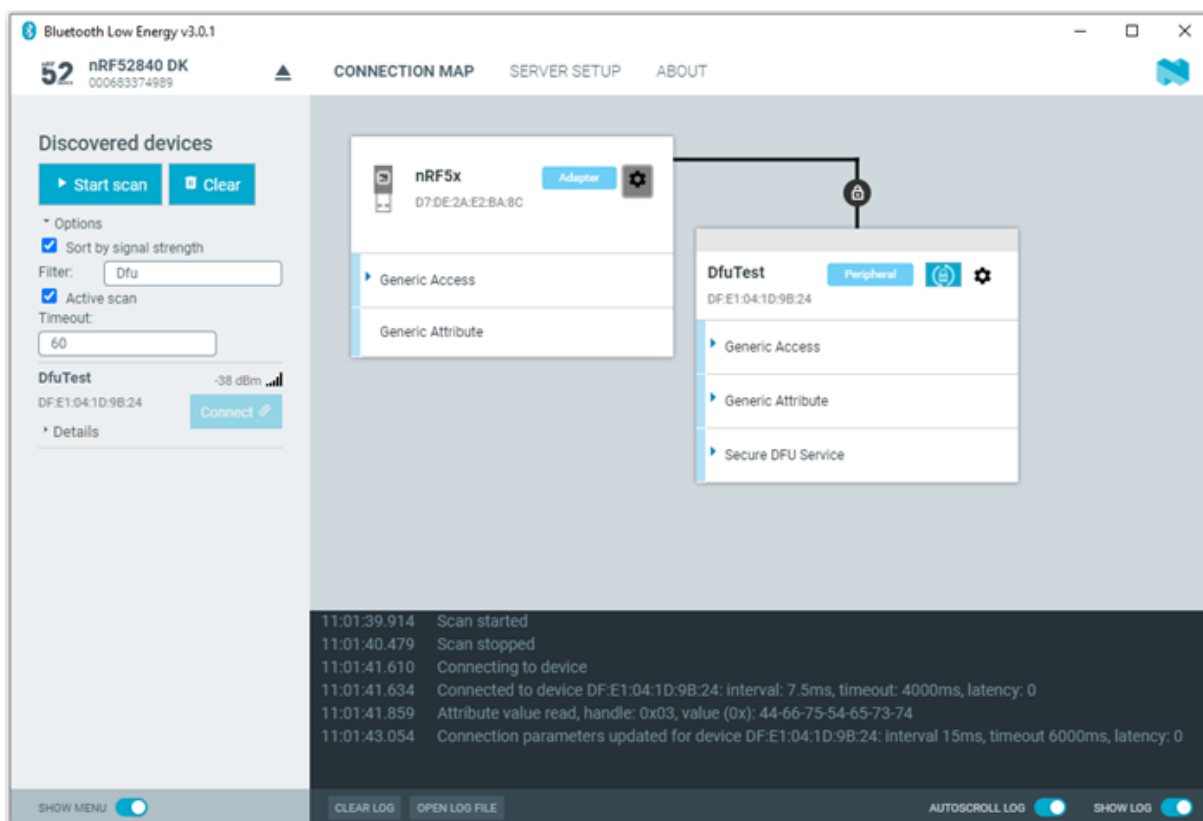



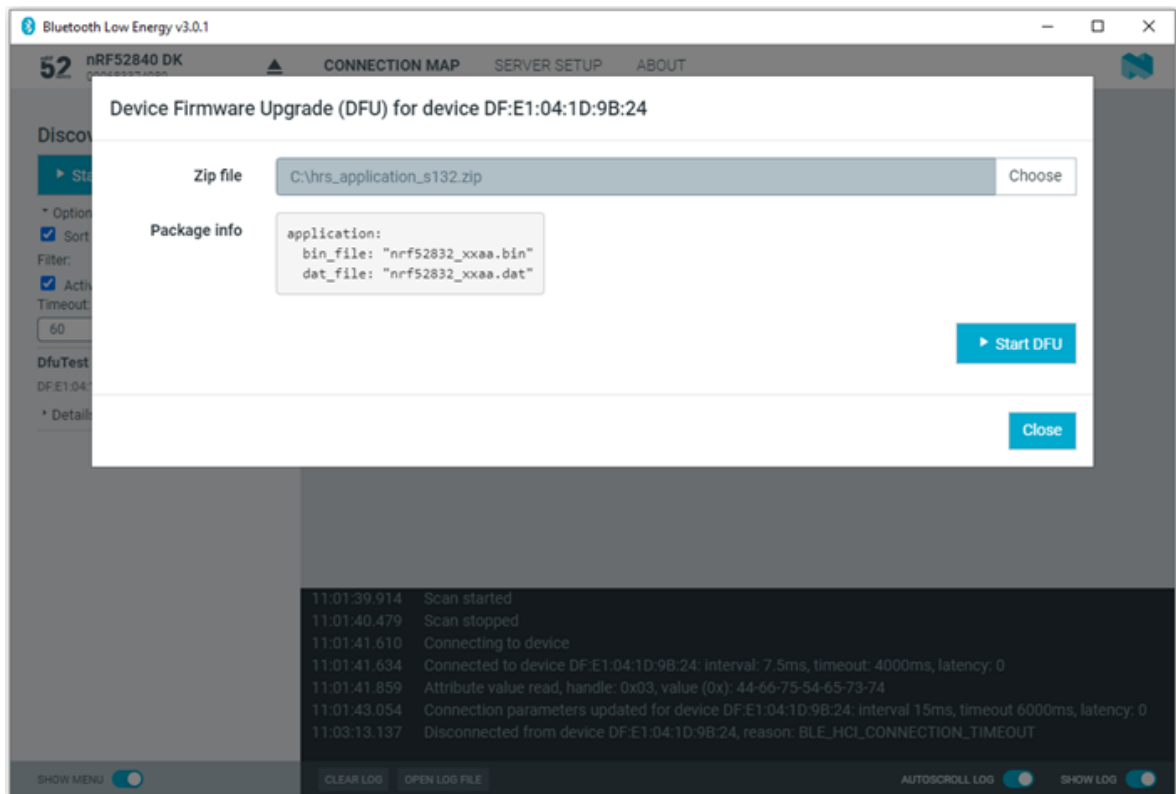
Figure 8: Secure DFU in the list of discovered services

To update the firmware, complete the following steps:

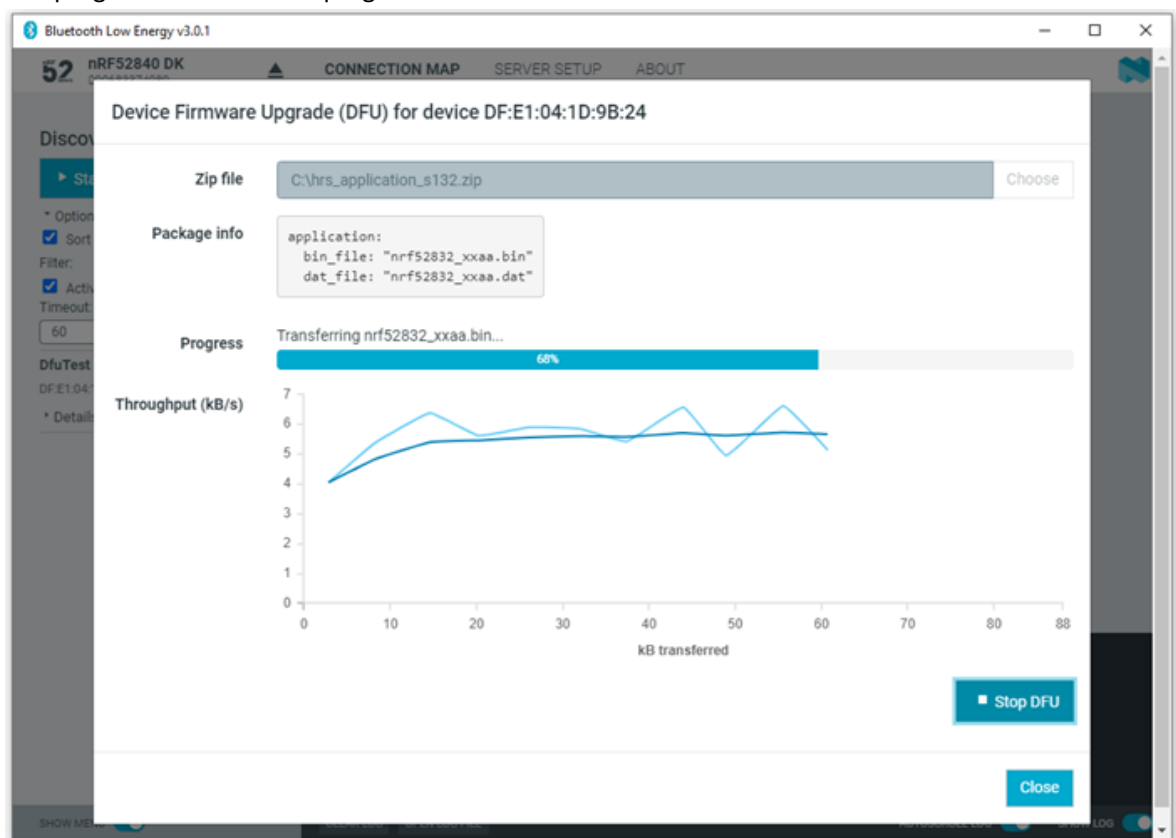
1. To open the DFU dialog, click the **Start Secure DFU** button .
2. Browse and select a DFU zip package file on your computer.

Important: To create the DFU zip package file, use the nrfutil tool. See the [nrfutil documentation](#) for more information.

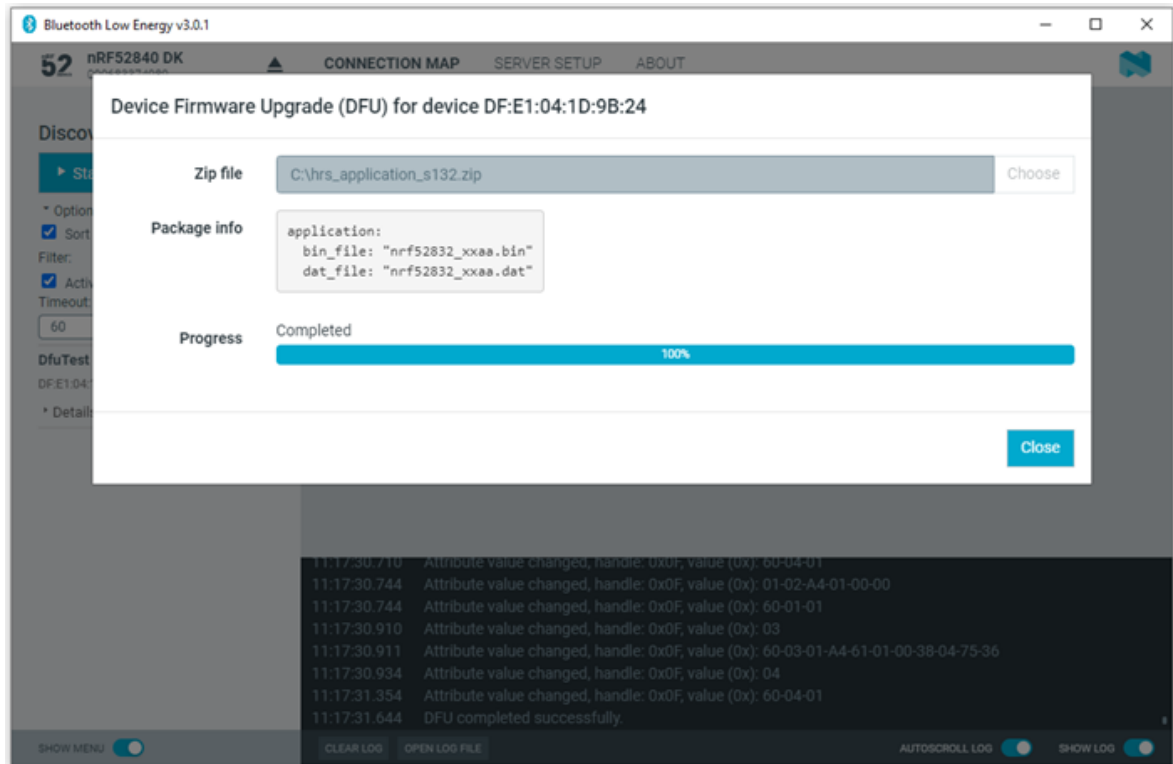
Information on the content of the DFU zip package is displayed in the Package info field.



- To start the transfer of the DFU package to the connected peer device, click **Start DFU**. The progress bar shows the progress of the transfer.



- When the progress bar has reached 100%, click **Close**.




To stop the transfer, click **Stop DFU**. The transfer continues from where it was stopped when you click **Start DFU** again.

If you click **Close** before the DFU transfer has completed, a confirmation dialog appears. If you click **OK** in the confirmation dialog, the transfer is canceled.

12 Adding UUID definitions

The nRF Connect Bluetooth Low Energy app comes with a list of predefined names and *UUIDs* for some well-known profiles. You can extend this list with custom definitions.

To extend the list of known UUIDs, complete the following steps:

1. To expand the device options for the local device, click the **Device options** icon .
2. Click **Open UUID definitions file**.
The definitions file is opened in your default application for `.json` files.
3. Following the examples in the file, add your UUIDs, then save the file.
4. To load the changes, reconnect to the adapter or reload the application (**CTRL + r**).

13 Troubleshooting

When troubleshooting, to view more detailed information than shown in the Log panel, use **Open log file** to open the current log file in a text editor.

Firmware programming

If you receive the error **Could not connect to debug probe**, verify that J-Link software is properly installed on the system.

If the device has been programmed with memory protection, the nRF Connect Bluetooth Low Energy app cannot program the firmware. To erase the device, download nRF Command Line Tools from Nordic Semiconductor and issue the following command from the command line:

```
nrfjprog -e -f <nrf51 or nrf52>
```

In Windows: If you receive the error **Could not load nrfjprog DLL**, verify that nRF Command Line Tools are installed.

OS X J-Link issue

In OS X: An issue with the SEGGER J-Link OB firmware leads to the corruption of long packets over UART. See www.nordicsemi.com/nRFConnectOSXfix for more information.

Serial port access permissions on Ubuntu Linux

If you receive errors when trying to open the serial port in the nRF Connect Bluetooth Low Energy app on Ubuntu Linux, you may need to grant serial port access permissions to your user. To do this, run the following command:

```
sudo usermod -a -G dialout <username>
```

nRF52840 USB problems

If you receive errors related to the nRF52840 Dongle USB connection on Windows, see [GitHub](#).

Glossary

Development Kit (DK)

A hardware development platform used for application development.

Man-in-the-Middle (MITM)

A form of eavesdropping where communication between two devices is monitored and modified by an unauthorized party who relays information between the two devices giving the illusion that they are directly connected.

Out of Band (OOB)

A communication channel that is outside of the defined activity. For example, in Bluetooth Low Energy, Out of Band pairing can be used to share encryption keys or authentication data using a different communication channel (such as NFC).

Received Signal Strength Indication (RSSI)

An indication of the power of a received radio signal.

System on Chip (SoC)

A microchip that integrates all the necessary electronic circuits and components of a computer or other electronic systems on a single integrated circuit.

Universal Asynchronous Receiver/Transmitter (UART)

A hardware device for asynchronous serial communication between devices.

Universal Serial Bus (USB)

An industry standard that establishes specifications for cables and connectors and protocols for connection, communication, and power supply between computers, peripheral devices, and other computers.

UUID

Universally Unique Identifier

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