

# nRF Connect *Bluetooth*<sup>®</sup> low energy

**User Guide**

v2.1

# Contents

	Revision history. . . . .	iii
1	nRF Connect <i>Bluetooth</i> low energy. . . . .	4
2	Installing nRF Connect <i>Bluetooth</i> low energy. . . . .	5
3	Establishing serial port connection to a local device. . . . .	6
4	Establishing <i>Bluetooth</i> low energy connections. . . . .	8
5	Viewing service details. . . . .	10
6	Updating connection parameters. . . . .	11
7	Pairing devices. . . . .	12
8	Configuring server setup. . . . .	14
9	Setting up advertising. . . . .	16
10	Updating firmware over the air. . . . .	17
11	Adding UUID definitions. . . . .	20
12	Troubleshooting. . . . .	21
	Legal notices. . . . .	22

# Revision history

Date	Version	Description
February 2018	2.1	<ul style="list-style-type: none"><li>• Server setup can be applied multiple times with adapter reset</li></ul>
July 2017	2.0	<ul style="list-style-type: none"><li>• Application ported to new framework</li><li>• Added support for multiple custom properties in advertisement data</li><li>• Added support for Buttonless DFU Service</li></ul>
January 2017	1.1	<ul style="list-style-type: none"><li>• Added Secure DFU</li><li>• Added support for nRF52 Development Kit PCA10056</li></ul>
July 2016	1.0	First release

# 1 nRF Connect *Bluetooth* low energy

nRF Connect *Bluetooth*<sup>®</sup> low energy is an app for the nRF Connect desktop application for getting familiar with, developing, and testing *Bluetooth* low energy devices. It allows you to set up a local device, connect it to advertising devices and discover their services, maintain the connection and the connection parameters, pair the devices, and change the server setup for your local device. It also offers a detailed log for troubleshooting purposes.

## **Supported devices**

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

## **Supported operating systems**

- Microsoft Windows 7, 8, and 10
- OS X 10.10 and above
- Ubuntu Linux 14.04 and 16.04

# 2

## Installing nRF Connect *Bluetooth* low energy

This section describes the installation procedure for the nRF Connect *Bluetooth* low energy app.

To install the app, you need to have the nRF Connect desktop application installed.

After installing nRF Connect, you can install the nRF Connect *Bluetooth* low energy app:

1. Open nRF Connect.
2. Click **Add/remove apps**.
3. Click **Install** next to *Bluetooth* low energy.

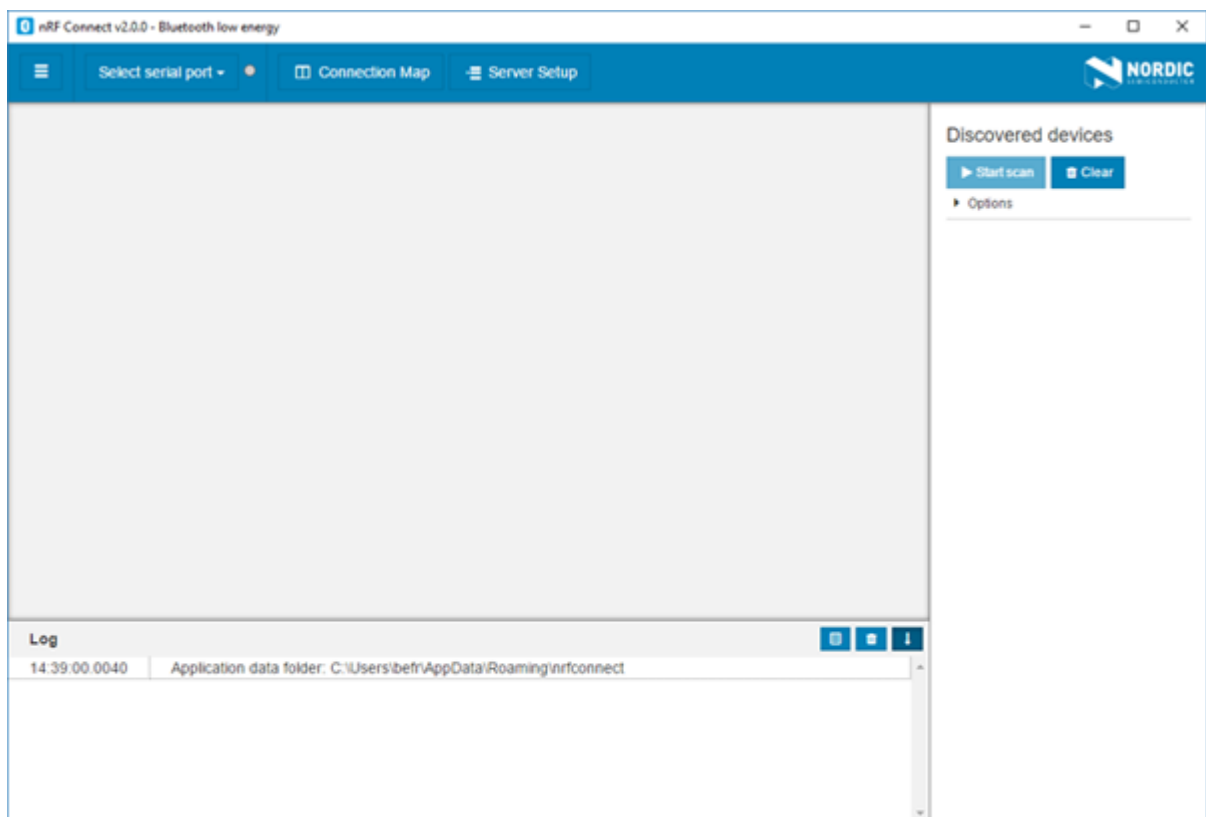


Figure 1: Application window

After starting the nRF Connect *Bluetooth* low energy app, a window consisting of the following main elements is displayed:

- Main view in the center: Initially empty, but will be populated with local and remote *Bluetooth* low energy devices
- Navigation bar at the top: Selecting serial port and application screen
- Three-dash button on the top-left corner of the navigation bar: Opening the nRF Connect app manager
- Discovered devices view on the right side: Starting scan and viewing discovered devices
- Log view at the bottom: Viewing the most important log events tagged with a timestamp

# 3

## 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 or dongle. The nRF SoC (System on Chip) on the development kit or dongle 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 a development kit or dongle to the computer with USB.
2. In the navigation bar, click on the **Select serial port** menu.
3. Select a serial port for the device.

When the serial port is selected, the **Select serial port** menu shows the name of the selected port.

If the development kit or dongle 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 proceed. When the nRF SoC has been programmed with the correct firmware, the nRF Connect *Bluetooth* low energy app proceeds to connect to it over UART. When the connection is established, the device appears in the main view.

**Important:** 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](http://www.nordicsemi.com/nRFConnectOSXfix) for more information.

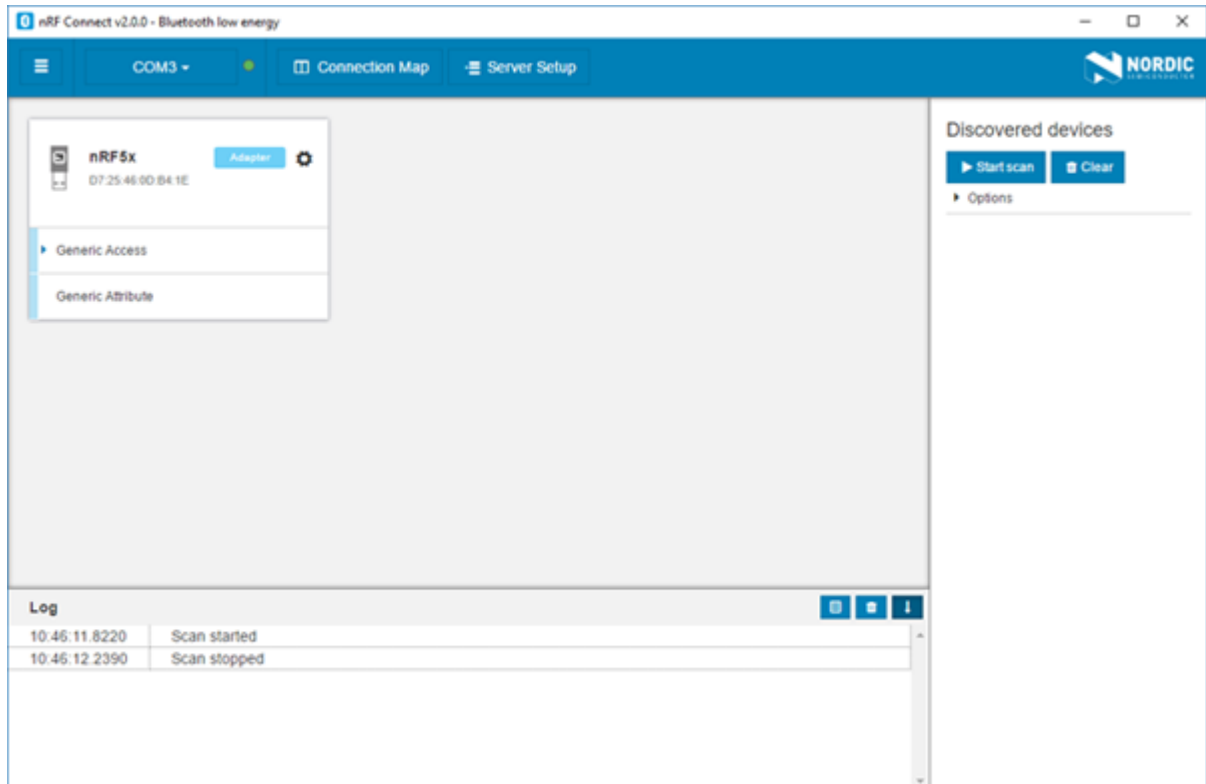



Figure 2: Local device view

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 .

# 4

## 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 16.

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.

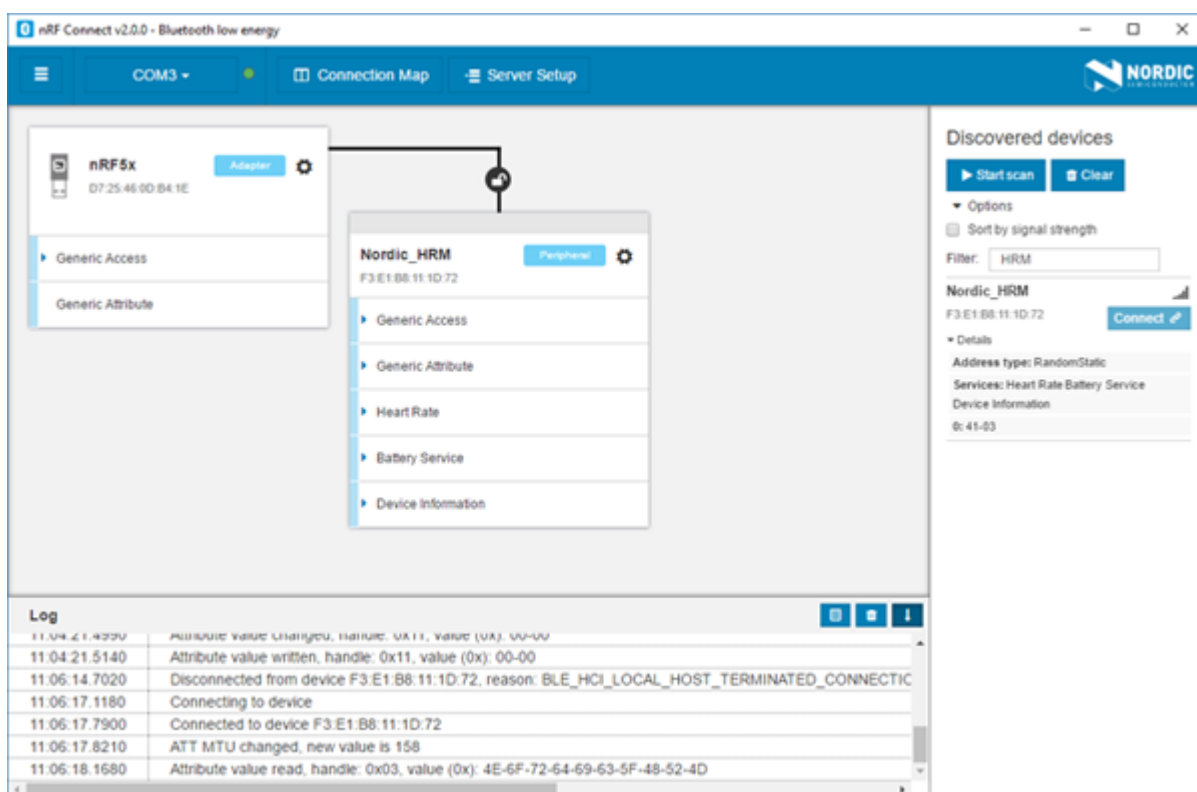


Figure 3: Discovered services

When the connection has been established, a new device appears in the main view 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 20.



A line connects the local and remote device to signal that they are connected over *Bluetooth*. Move the mouse pointer over the padlock icon on the line to open a connection info dialog that shows the parameters of the connection as well as the encryption and bond state.

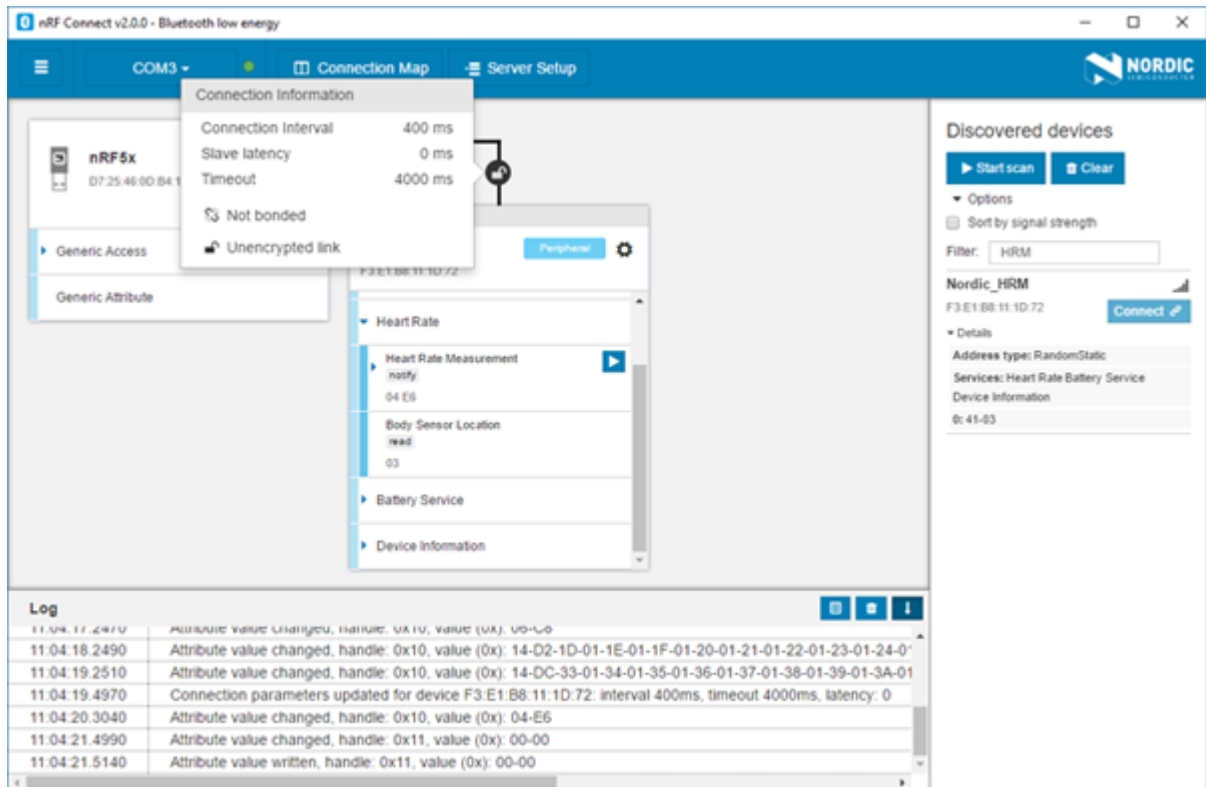


Figure 4: Hovering over the padlock icon

# 5 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.

- 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.

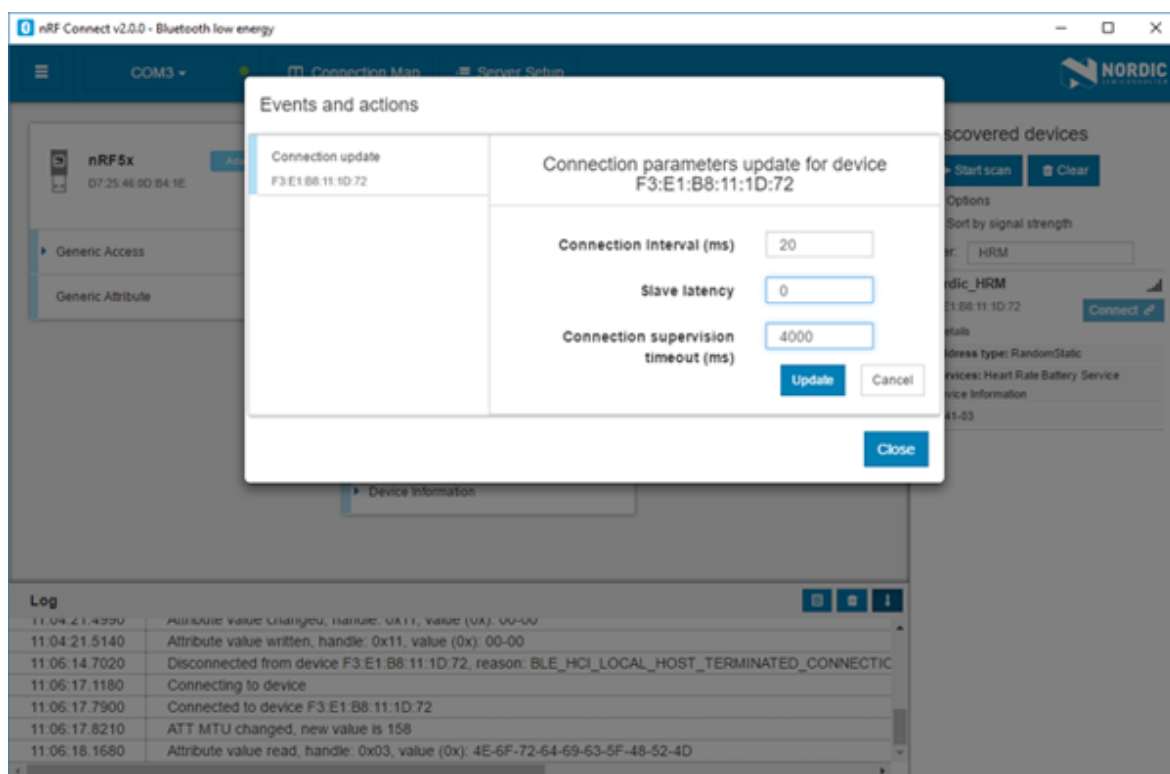
If a service or characteristic does not have any child attributes, the list is empty when you click the **Expand/collapse** icon ▶.

# 6 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 Connection update 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:

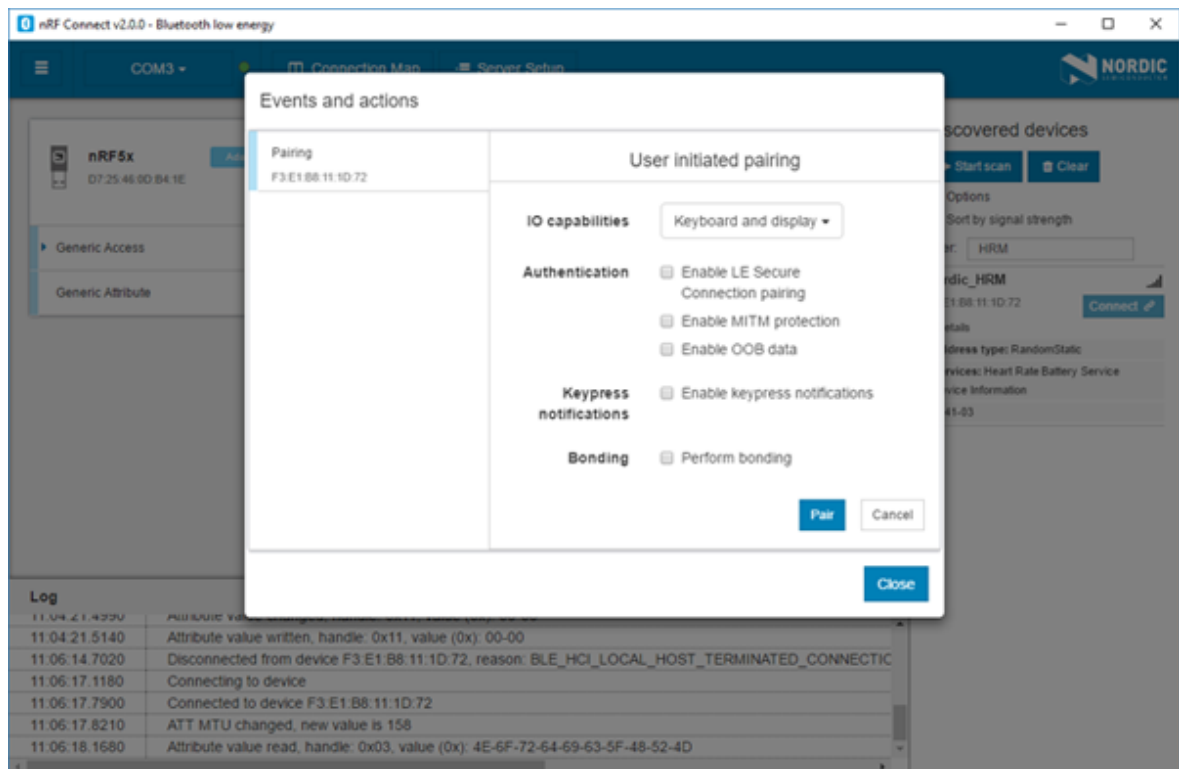
1. Click the local **Device options** icon ⚙️.
2. Select or deselect **Auto accept update requests**.

# 7 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 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...**



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 connection info padlock changes to locked if the connection is encrypted.
- The event view text turns green to indicate success.

Bonding can also be established, which means you can create and exchange long-term keys that are used for reestablishing an encrypted link without having to go through the pairing process.


nRF Connect *Bluetooth* low energy app can reply automatically to incoming pairing request by default, or they 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.

**Important:**

- 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.

# 8 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 added service.  
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 added characteristic.  
A form is displayed.
7. Define the attribute values, then click **Save**.

**Important:** 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 added descriptor.  
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.

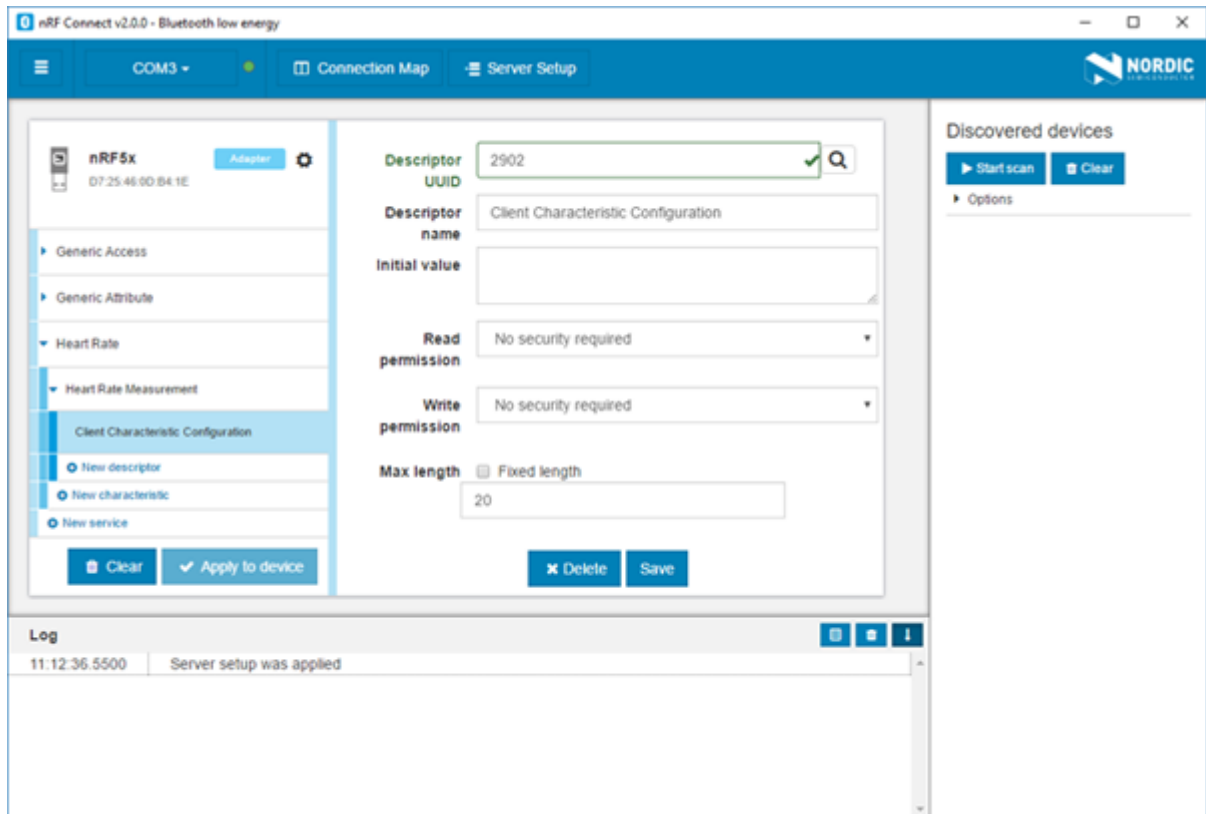




Figure 5: Server setup

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**.

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

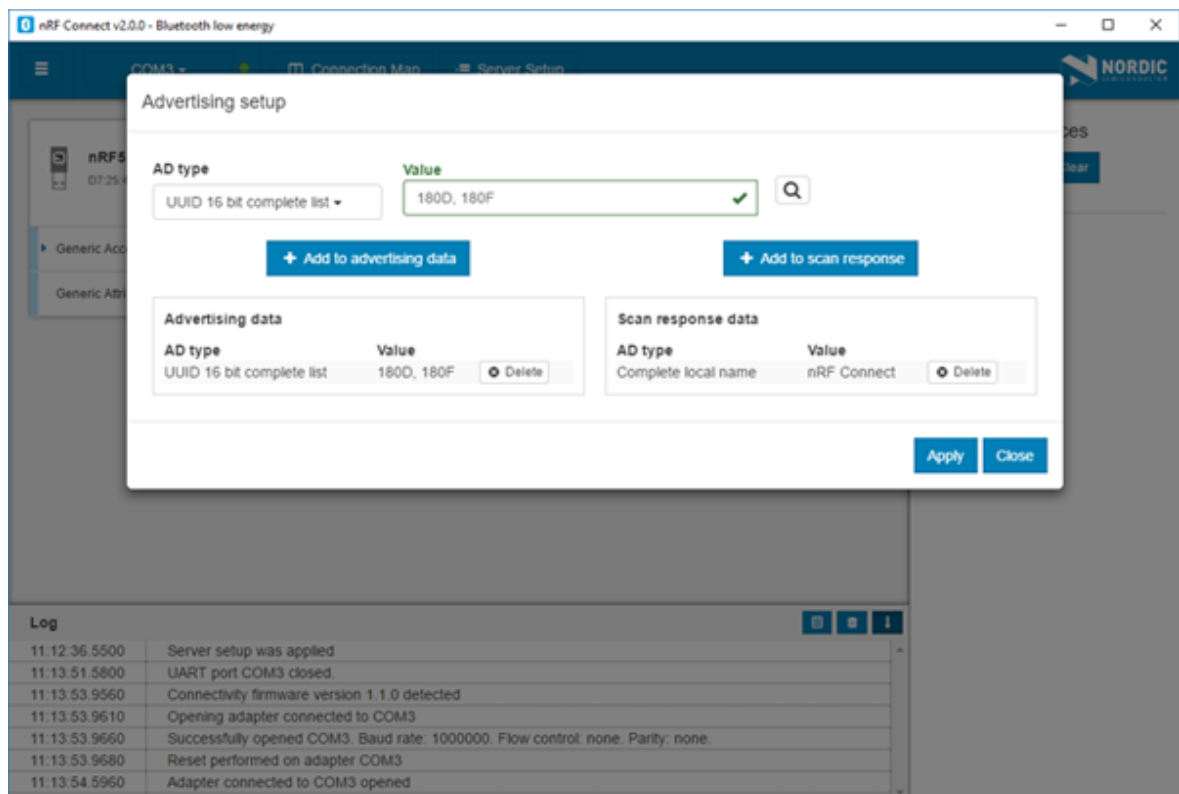
After the setup has been applied to the device, you can view the resulting setup by clicking the **Connection map** button in the navigation bar. The new setup is reflected in the local device.

# 9 Setting up advertising

The nRF Connect *Bluetooth* low energy app can make the local device operate as a peripheral and start sending 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**.



# 10 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.

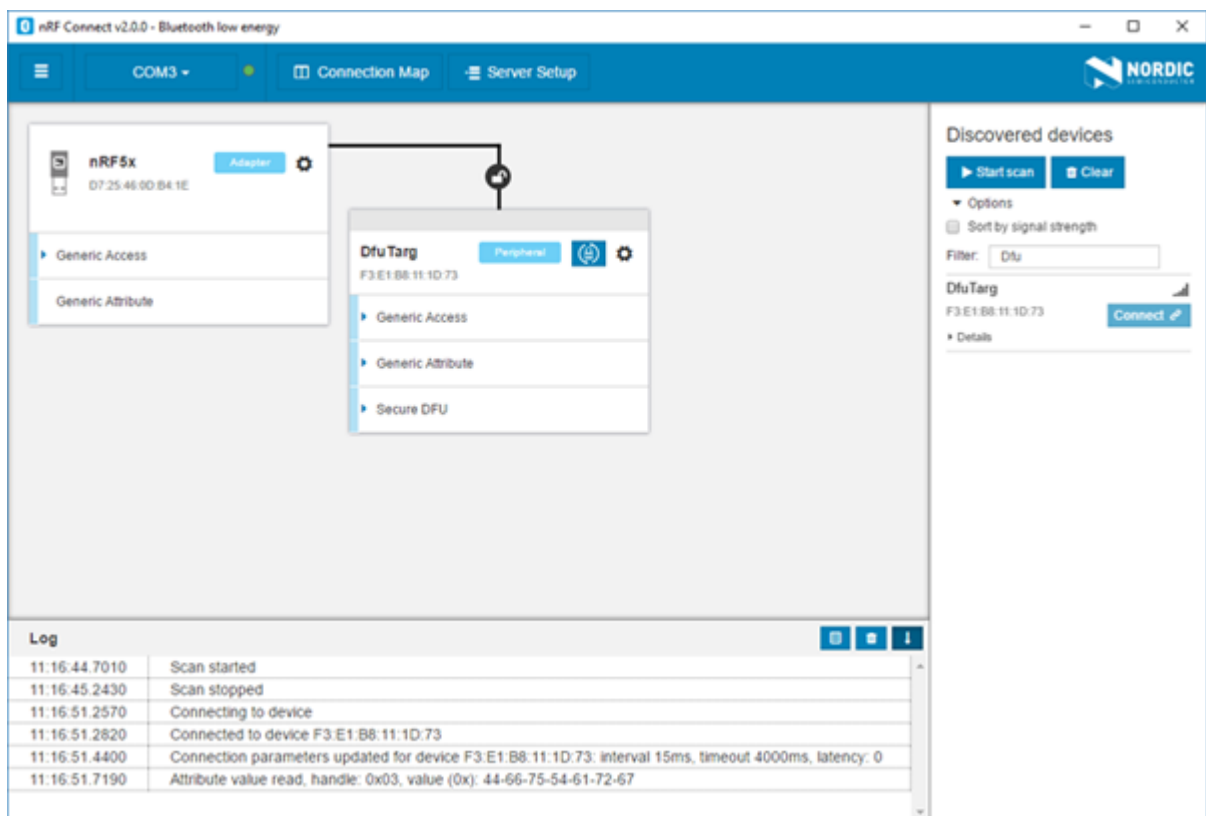



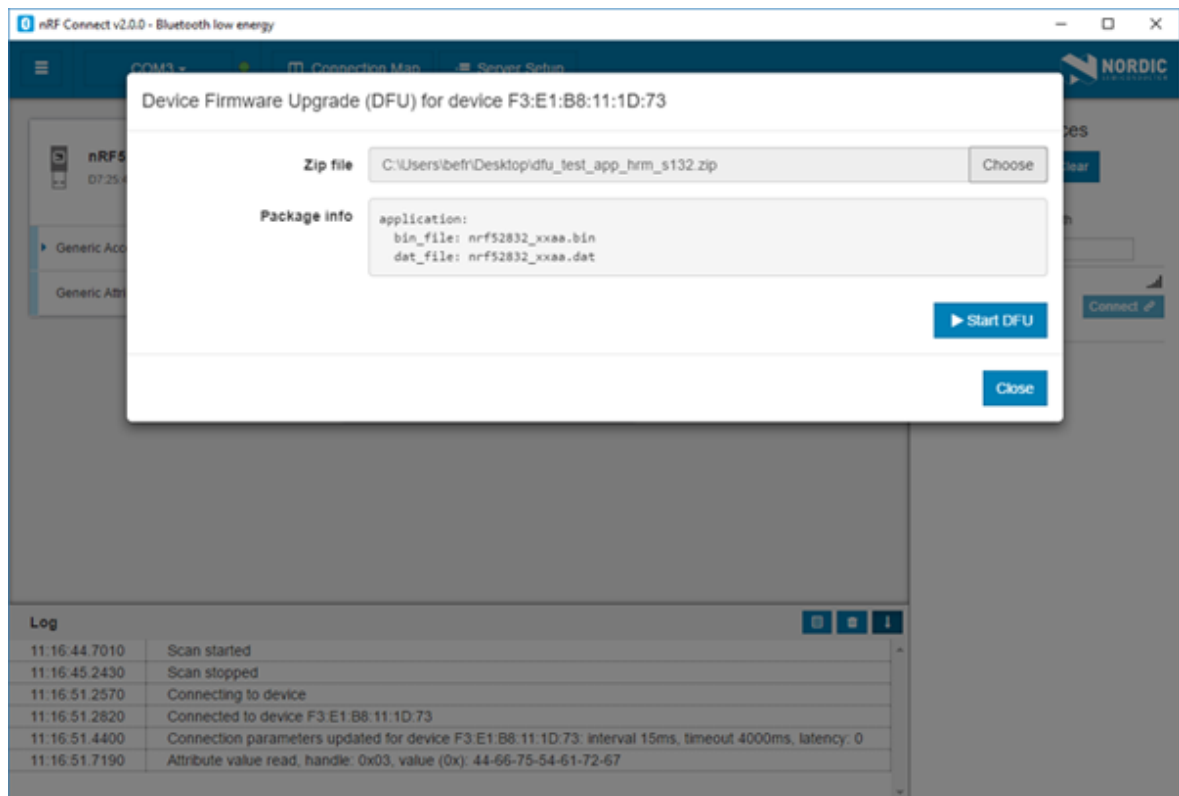
Figure 6: Secure DFU in the list of discovered services

To update the firmware, complete the following steps:

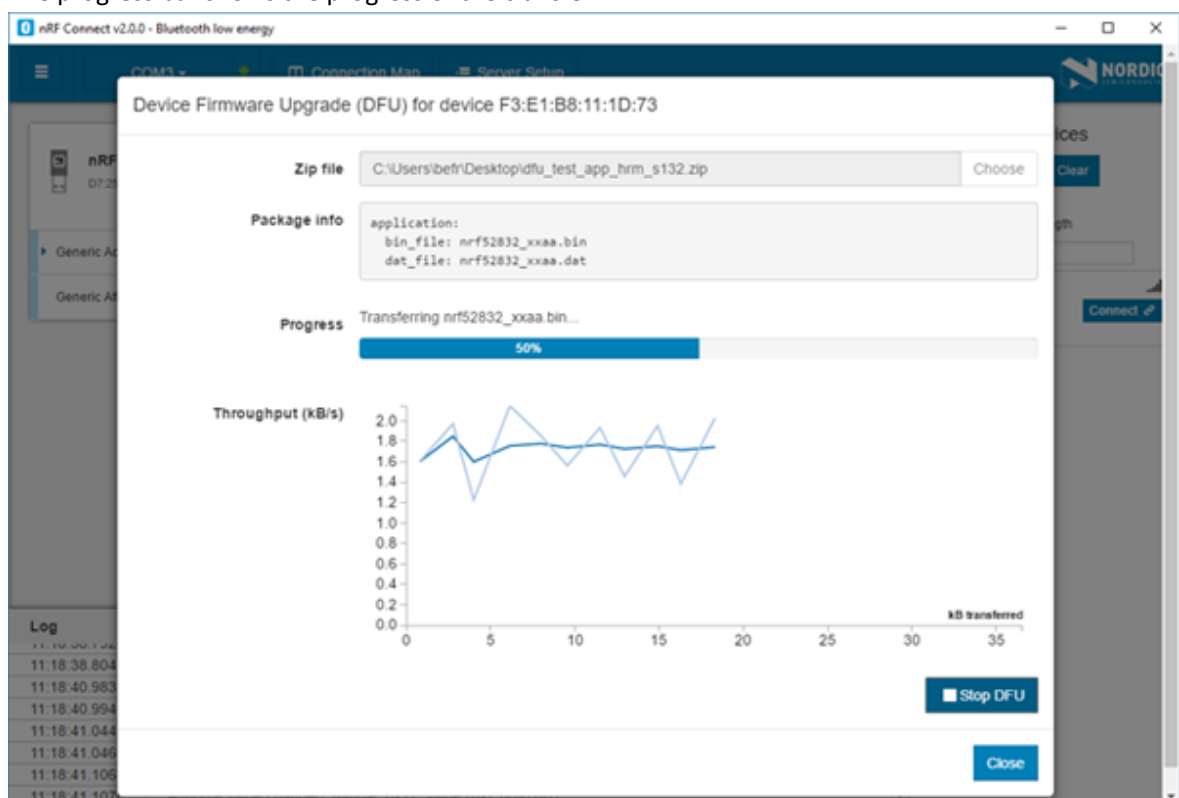
1. To open the DFU dialog, click the **Start Secure DFU** button .
2. Browse and select a DFU zip package file on your computer.

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

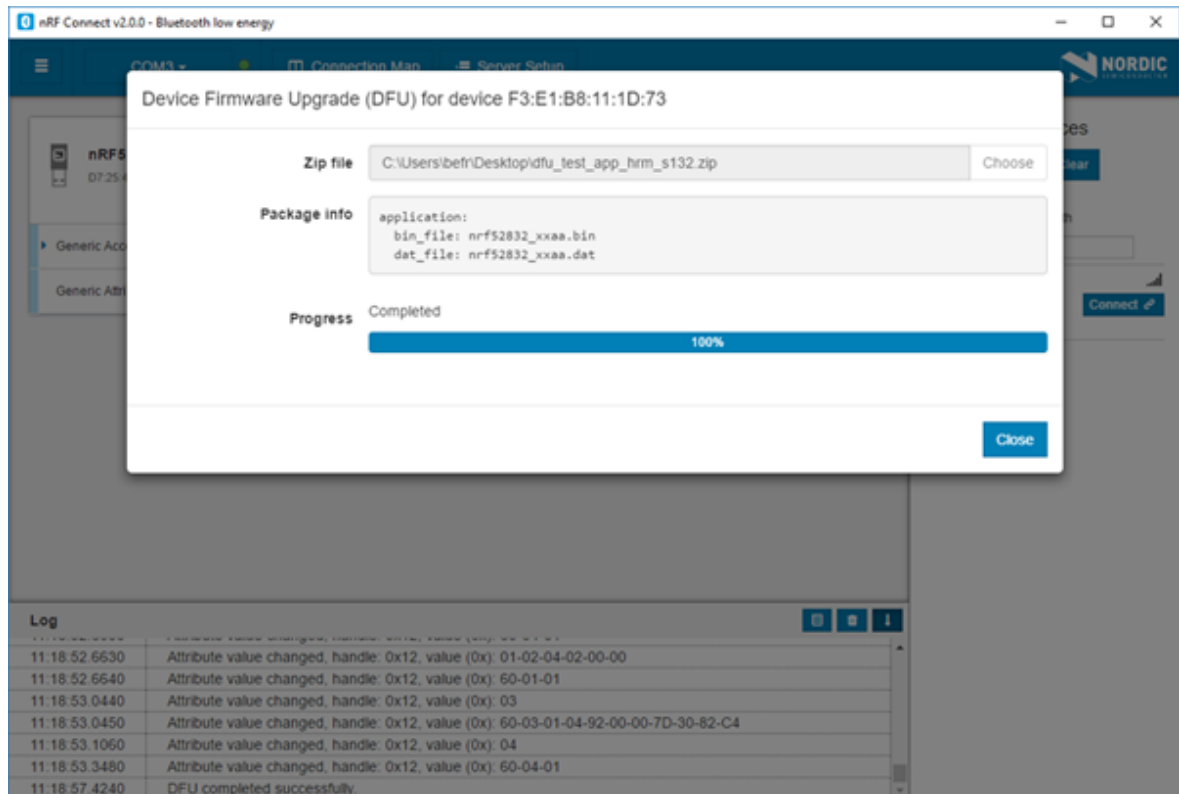
Information on the content of the DFU zip package is displayed in the Package info field.



3. 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.



4. 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.

# 11 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**).

# 12 Troubleshooting

For troubleshooting, the nRF Connect *Bluetooth* low energy app has a more detailed log file than the one shown in the log view. To open the detailed log file, click the **Open log file** button in the log view.

## 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](http://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>
```

# Legal notices

By using this documentation you agree to our terms and conditions of use. Nordic Semiconductor may change these terms and conditions at any time without notice.

## Liability disclaimer

Nordic Semiconductor ASA reserves the right to make changes without further notice to the product to improve reliability, function or design. Nordic Semiconductor ASA does not assume any liability arising out of the application or use of any product or circuits described herein.

All information contained in this document represents information on the product at the time of publication. Nordic Semiconductor ASA reserves the right to make corrections, enhancements, and other changes to this document without notice. While Nordic Semiconductor ASA has used reasonable care in preparing the information included in this document, it may contain technical or other inaccuracies, omissions and typographical errors. Nordic Semiconductor ASA assumes no liability whatsoever for any damages incurred by you resulting from errors in or omissions from the information included herein.

## Life support applications

Nordic Semiconductor products are not designed for use in life support appliances, devices, or systems where malfunction of these products can reasonably be expected to result in personal injury.

Nordic Semiconductor ASA customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify Nordic Semiconductor ASA for any damages resulting from such improper use or sale.

## RoHS and REACH statement

Nordic Semiconductor products meet the requirements of *Directive 2011/65/EU of the European Parliament and of the Council* on the Restriction of Hazardous Substances (RoHS 2) and the requirements of the *REACH* regulation (EC 1907/2006) on Registration, Evaluation, Authorization and Restriction of Chemicals.

The SVHC (Substances of Very High Concern) candidate list is continually being updated. Complete hazardous substance reports, material composition reports and latest version of Nordic's REACH statement can be found on our website [www.nordicsemi.com](http://www.nordicsemi.com).

## Trademarks

All trademarks, service marks, trade names, product names and logos appearing in this documentation are the property of their respective owners.

## Copyright notice

© 2018 Nordic Semiconductor ASA. All rights are reserved. Reproduction in whole or in part is prohibited without the prior written permission of the copyright holder.

