GR551x OTA Example Application

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Preface

Purpose

This document helps developers quickly implement OTA updates for firmware on GR551x SoCs via GRToolbox (Android), a debugging App.

Audience

This document is intended for:

- GR551x user
- GR551x developer
- GR551x tester
- Hobbyist developer
- Technical writer

Release Notes

This document is the seventh release of *GR551x OTA Example Application*, corresponding to GR551x SoC series.

Revision History

Version	Date	Description
1.0	2019-12-08	Initial release
1.3	2020-03-16	Updated the format of **Connect Success** tip in "Connect to GR5515 SK Board and Update the Target Firmware".
1.5	2020-05-30	Optimized descriptions of two update approaches in "Introduction"; updated the figure for successful download and running of the firmware demo in "Download ble_app_template_dfu Firmware".
1.6	2020-06-30	Optimized the operation procedures in "Download ble_app_template_dfu Firmware" and "Create Target Firmware for Update".
1.7	2020-11-25	Added descriptions about checking **Copy Mode** for firmware update in applications in "Connect to GR5515 SK Board and Update Firmware".
1.8	2020-12-15	Updated GRToolbox UI figures based on software update.
1.9	2021-01-29	Added "Why does Timeout occur on Jumping to Boot Firmware for OTA with GRToolbox (iOS)?" with problem description, analysis, and corresponding solution.

Contents

1 Introduction

The over-the-air (OTA) technology enables downloading a latest software release to a device and enables the device to automatically check and update firmware through wireless transmission. OTA allows users to quickly fix defects, provides a rich set of functions, and shortens the cycle of product iteration and update.

This document introduces how to update GR551x firmware through GRToolbox (Android) by using Bluetooth Low Energy (Bluetooth LE) technology. Two update approaches are available. Users can choose an appropriate one based on product requirements:

- Jump to Boot firmware for firmware update. During firmware update, the system jumps from applications to the Boot firmware, and the Boot firmware enables download of the target firmware. After download, the system jumps to the target firmware for running. During update, it is required to first disable Bluetooth connection on the mobile phone and then scan and reconnect to the Boot firmware via Bluetooth. Compared with the second approach, this approach makes the best use of flash.

- Perform update in application firmware (for example, ble_app_template_dfu). Run the application firmware to download the target firmware. After download, the system jumps to the target firmware for running. During update, users can update firmware directly without disabling Bluetooth connection on a mobile phone. This approach provides smooth user experience.

Before you get started, you can refer to the documents in Table 1-1.

Table 1-1 Reference documents

Name	Description
GR551x Developer Guide	Introduces the software/hardware and quick start guide of GR551x SoCs.
Bluetooth Core Spec v5.1	Offers official Bluetooth standards and core specification (v5.1) from Bluetooth SIG. Available at https://www.bluetooth.com/specifications/bluetooth-core-specification/.
J-Link/J-Trace User Guide	Provides J-Link operational instructions. Available at https://www.segger.com/downloads/jlink/UM08001_JLink.pdf.
Keil User Guide	Offers detailed Keil operational instructions. Available at www.keil.com/support/man/docs/uv4/.

2 Jump to Boot Firmware for OTA

The GR551x SDK provides firmware update demos. Users can follow the steps below to verify and test OTA update results.

2.1 Preparation

Perform the following tasks before an OTA test.

- **Hardware preparation**

Table 2-1 Hardware preparation

Name	Description
J-Link debug probe	JTAG emulator launched by SEGGER. For more information, visit http://www.segger.com/products/debug-probes/j-link/.
Development board	GR5515 Starter Kit Board (GR5515 SK Board)

- **Software preparation**

Table 2-2 Software preparation

Name	Description
Windows	Windows 7/Windows 10
J-Link driver	A J-Link driver. Available at http://www.segger.com/downloads/jlink/.
Keil MDK5	An integrated development environment (IDE). Available at www.keil.com/download/product/.
GRToolbox (Android)	A Bluetooth LE debugging tool for GR551x. Available in `SDK_Folder\tools\GRToolbox`.
GProgrammer (Windows)	A GR551x programming tool. Available in `SDK_Folder\tools\GProgrammer`.

2.2 Download Boot Firmware

If Boot firmware has been downloaded to the GR5515 platform (refers to GR5515 SK Board in this document), applications can jump to the Boot firmware directly; otherwise, users need to download the firmware to a GR5515 SK Board before running the firmware.

The GR551x SDK provides Boot firmware (ble_dfu_boot; advertising name: Goodix_DFU). In this update example, jump to the Boot firmware and run it; then connect the GR5515 SK Board to a mobile phone through GRToolbox to update firmware.

For details on downloading *ble_dfu_boot_fw.bin* to a GR5515 SK Board, see *GProgrammer User Manual*.

Note:

- The load address of *ble_dfu_boot_fw.bin* is consistent with its run address: 0x01002000.
- The *ble_dfu_boot_fw.bin* is in `SDK_Folder\projects\ble\dfu\ble_dfu_boot\build\`.

2.3 Download ble_app_template_dfu Firmware

Before firmware update, make sure the Boot firmware is available on the GR5515 SK Board. In the case of update for the first time, download the ble_app_template_dfu firmware to the GR5515 SK Board and run the firmware, to allow GRToolbox on the mobile phone to send commands to the GR5515 SK Board, so as to enable the board to enter the update mode.

For details on downloading *ble_tem_dfu_fw.bin* to a GR5515 SK Board, see *GProgrammer User Manual*.

📖 **Note**:

- The load address of *ble_tem_dfu_fw.bin* is consistent with its run address: 0x01040000.

- For GRToolbox (iOS), the advertising address of *ble_tem_dfu_fw.bin* shall be different from that of *ble_dfu_boot_fw.bin*.

- The *ble_tem_dfu_fw.bin* is in `SDK_Folder\projects\ble\ble_peripheral\ble_app_template_dfu\build\`.

Turn on Bluetooth on the mobile phone and run GRToolbox. If a device named as **Goodix_Tem_DFU** is discovered, the firmware demo runs normally.
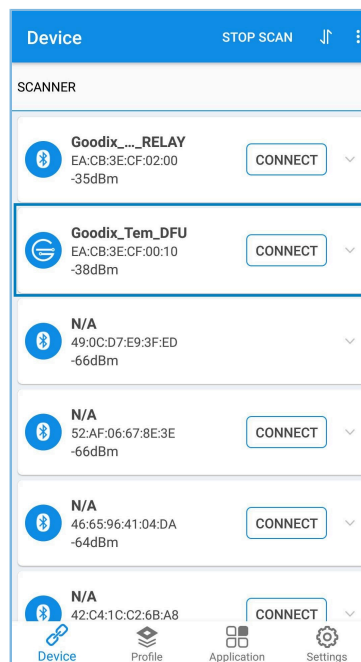

Figure 2-1 Discovering **Goodix_Tem_DFU**

2.4 Create Target Firmware for Update

1. Open `SDK_Folder\projects\ble\ble_peripheral\ble_app_template_dfu`; copy *ble_app_template_dfu* in this path and rename the copied one as *ble_app_template_dfu_mine*; open this project in Keil. For related files, see Table 2-3.

Table 2-3 File description of ble_app_template_dfu

Group	Description
gr_profiles	Add service source files.
user_callback	Contain user-defined Bluetooth LE callback functions.
user_platform	Initialize user peripherals.
user_app	Implement user application logics.

2. Follow the steps below to create a target firmware file for update.

📖 **Note**:

The target firmware file is in BIN format.

(1). Name the target firmware.

Change the advertising name of *user_app.c* (path: `SDK_folder\projects\ble\ble_peripheral\ble_app_template_dfu_mine\Src\user`) to **Goodix_Tem_New**. Steps are described below:

• Change the advertising name of the device.

```
#define DEVICE_NAME                          "Goodix_Tem_New" /**< Device Name which will be
 set in GAP. */
```

• Change the name used for scan response.

```
static const uint8_t s_adv_rsp_data_set[] =
{
    // Complete Name
    0x0f,
    BLE_GAP_AD_TYPE_COMPLETE_NAME,
    'G', 'o', 'o', 'd', 'i', 'x', '_','T','e','m','_','N','e','w',
    // Manufacturer specific adv data type
    0x05,
    BLE_GAP_AD_TYPE_MANU_SPECIFIC_DATA,
    // Goodix SIG Company Identifier: 0x04F7
    0xF7,
    0x04,
    // Goodix specific adv data
    0x02,0x03,
};
```

📖 **Note**:

For more information about advertising name configuration, see "Chapter 11 Advertising and Scan Response Data Format" (Vol 3, Part C) in *Bluetooth Core Spec v5.1*.

(2). Modify the load address and the run address. Open the *custom_config.h* file, and make sure APP_CODE_RUN_ADDR and APP_CODE_LOAD_ADDR are set to 0x01040000, to avoid overwriting the downloaded Boot firmware, as shown below:

```
#define APP_CODE_RUN_ADDR        0x01040000    /**<Code run address. */
```

```
#define APP_CODE_LOAD_ADDR        0x01040000      /**<Code save address in flash. */
```

📖 **Note**:

To jump to Boot firmware for firmware update, users need to plan the flash layout based on the size of the firmware. The load address of the target firmware should not overwrite the load address of the Boot firmware (*ble_dfu_boot_fw.bin*).

(3). Generate a BIN file.

Recompile the project. After compilation, the *ble_tem_dfu_fw.bin* file generated in `ble_app_template _dfu_mine\Keil_5\build` directory is the latest firmware.
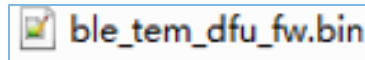
Figure 2-2 The *ble_tem_dfu_fw.bin* file (the target firmware)

2.5 Update Firmware Through GRToolbox on the Mobile Phone

This section introduces how to implement OTA through GRToolbox on the mobile phone by using the target firmware (*ble_tem_dfu_fw.bin*).

2.5.1 Select the Update Mode Through Boot Firmware

Follow the steps below to load the target firmware for update.

1. Copy the target firmware file to the mobile phone.

    Copy the *ble_tem_dfu_fw.bin* file to `..\Goodix\SaveData` in the root directory of the mobile phone, as shown in Figure 2-3.
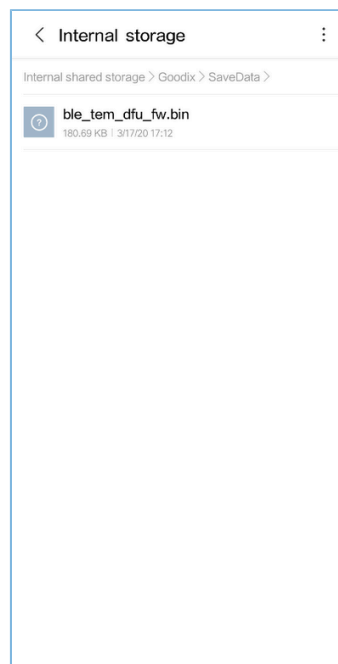

Figure 2-3 Copying the target BIN file for update

2. Enter the GRToolbox update interface.

Run GRToolbox (Android). Select and connect to **Goodix_Tem_DFU** from the device list (Figure 2-4). Tap 🔵 (Jump to Boot for OTA button) at the top of the page (Figure 2-5) to enter the DFU interface (Figure 2-6), which indicates that GR551x is restarted and enables the update mode.
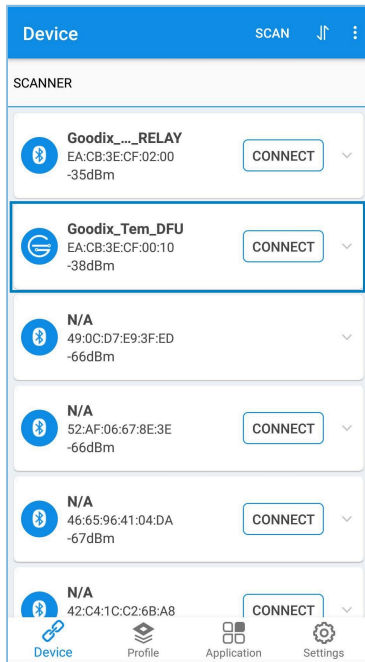

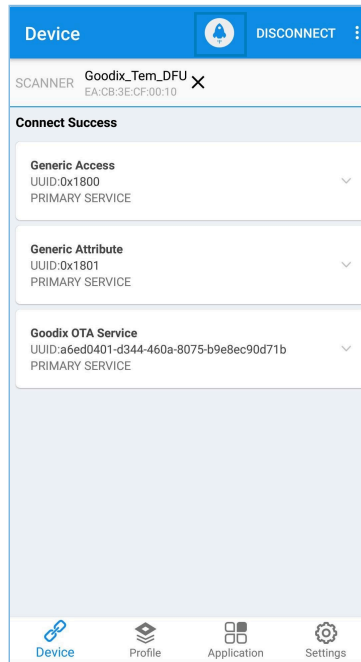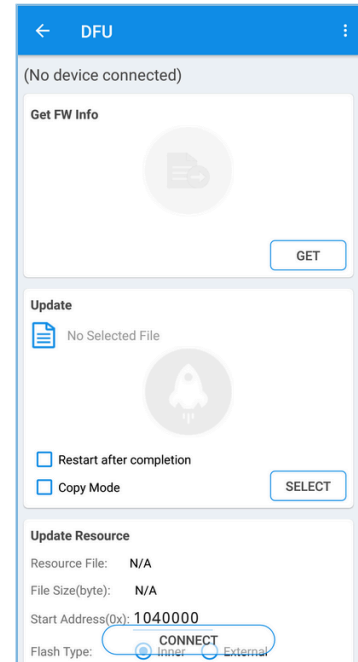Figure 2-4 Connecting to **Goodix_Tem_DFU**   Figure 2-5 Tapping the update icon   Figure 2-6 DFU interface

2.5.2 Load Firmware for Update

Tap **SELECT** (Figure 2-7) to select the target firmware which has been copied to the mobile phone, for example *ble_tem_dfu_fw.bin* (Figure 2-8).

When the file is loaded to GRToolbox successfully, information of the *ble_tem_dfu_fw.bin* file for update is displayed as shown in Figure 2-9.
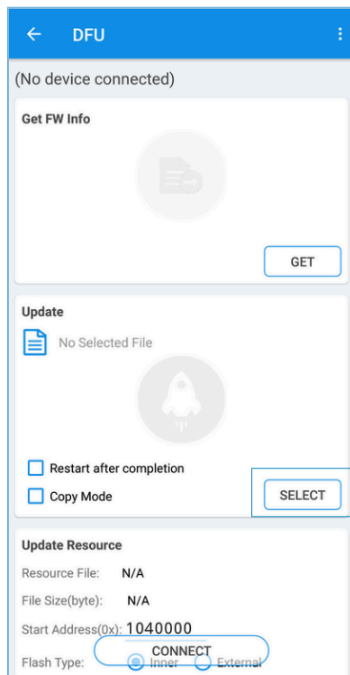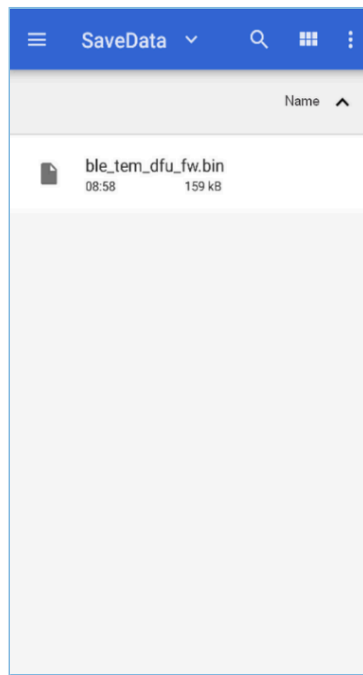
Figure 2-7 Tapping **SELECT**
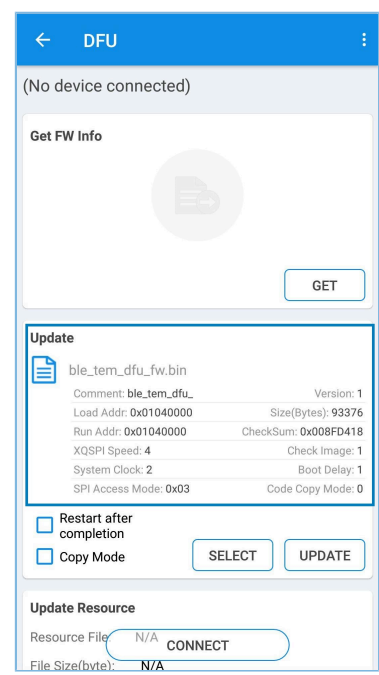

Figure 2-8 Selecting the target firmware

Figure 2-9 Viewing file information

2.5.3 Connect to GR5515 SK Board and Update the Target Firmware

Follow the steps below to connect the mobile phone to the GR5515 SK Board and update firmware.

1. Connect the mobile phone to the GR5515 SK Board through Bluetooth LE.

    Tap **CONNECT** in the DFU interface of GRToolbox, and select **Goodix_DFU** in the pop-up window to establish a connection (Figure 2-10).

    Wait a moment to establish the connection (Figure 2-11). The pop-up message **Connect Success** displayed indicates the successful connection between the mobile phone and the GR5515 SK Board (Figure 2-12).
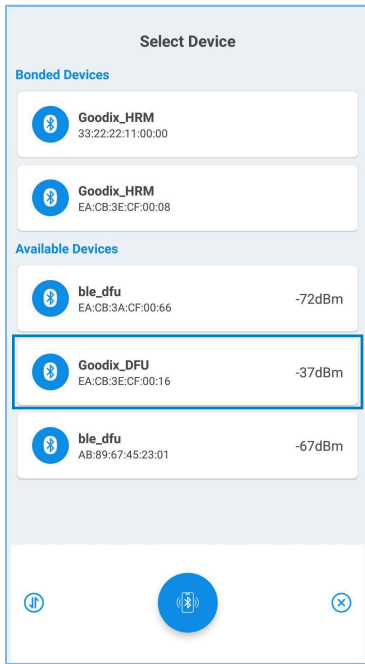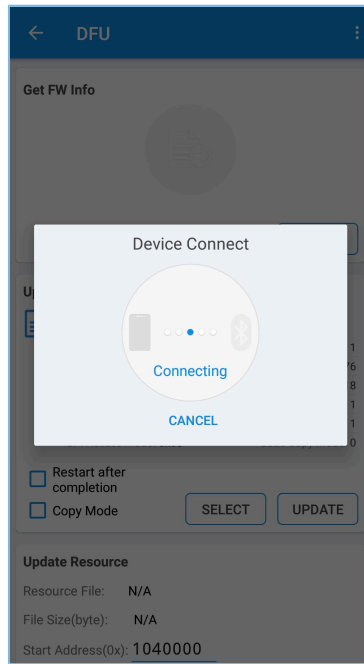
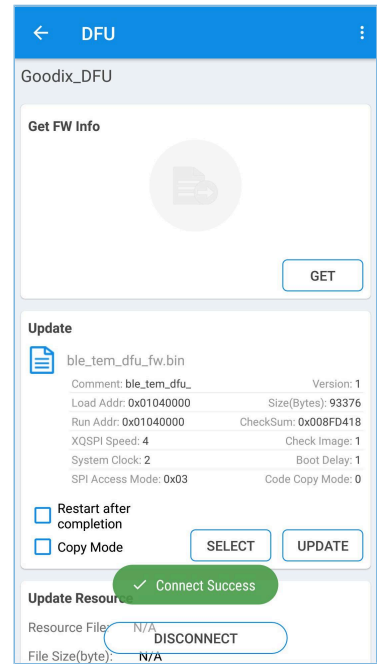Figure 2-10 Selecting **Goodix_DFU**

Figure 2-11 Connecting

Figure 2-12 **Connect Success**

2. Update firmware on the mobile phone.

Tap **UPDATE** (Figure 2-13) to allow the GR5515 SK Board to start update. Wait a moment (Figure 2-14) to complete the update (Figure 2-15).

Before the update, do not check the **Restart after completion** or **Copy Mode**. See "Section 2.5.4 Verify OTA Update Results" to check whether an OTA operation is successful.
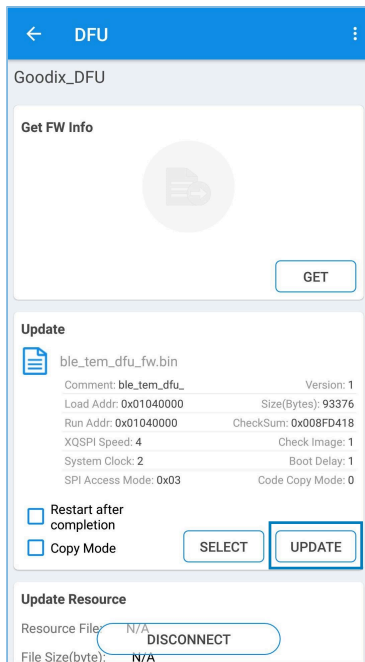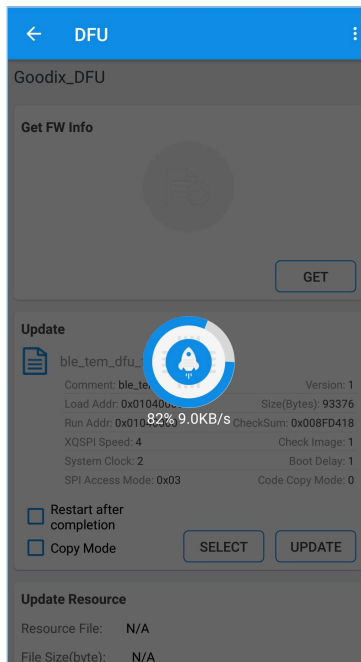

Figure 2-13 Tapping **UPDATE**
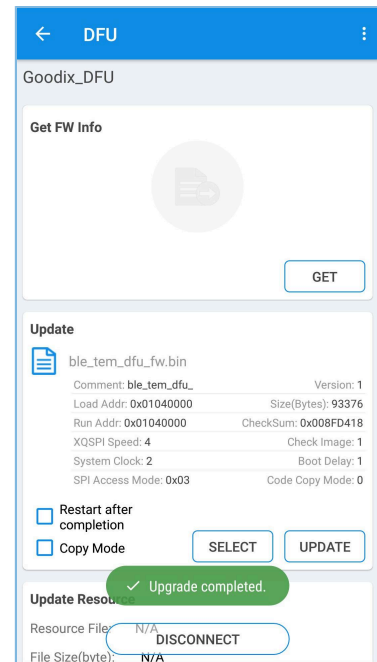
Figure 2-14 Updating

Figure 2-15 Successful update

2.5.4 Verify OTA Update Results

Follow the steps below to verify whether an OTA operation is successful.

1. Check whether the firmware is loaded to the GR5515 SK Board successfully.

    Tap **GET** in the DFU interface of GRToolbox (Figure 2-16), and then tap **ble_tem_dfu...** (Figure 2-17) for more information (Figure 2-18). If details about **ble_tem_dfu...** are displayed, the firmware is loaded over the air to the GR5515 SK Board successfully.
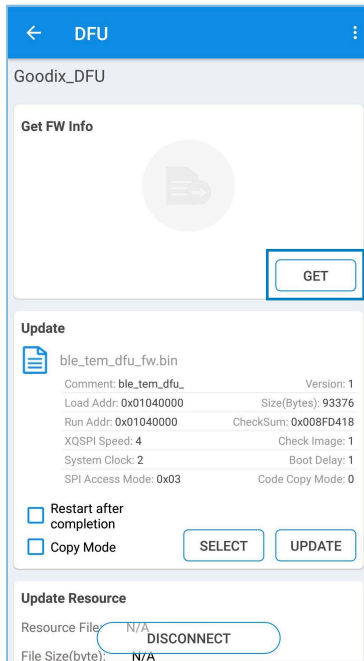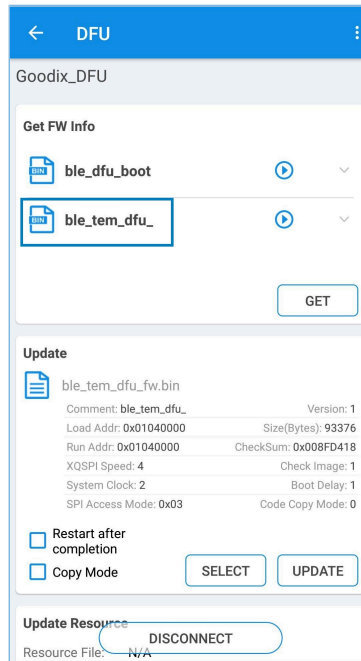

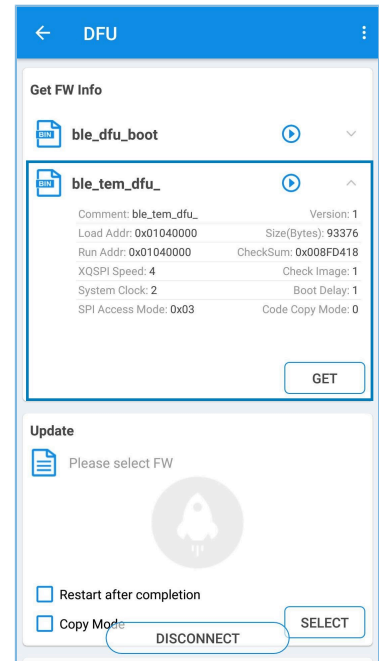Figure 2-16 Tapping **GET**   Figure 2-17 Selecting**ble_tem_dfu...**   Figure 2-18 Showing firmware information

2. Check whether the firmware update of the GR5515 SK Board is completed successfully.

    Tap ⊙ (**RUN**) to run the updated firmware (Figure 2-19). When the firmware runs successfully, the device interface of GRToolbox is displayed. Pull to refresh the device list. If new firmware with the advertising name of **Goodix_Tem_New** (Figure 2-20) is discovered after scanning, the target firmware is updated successfully.
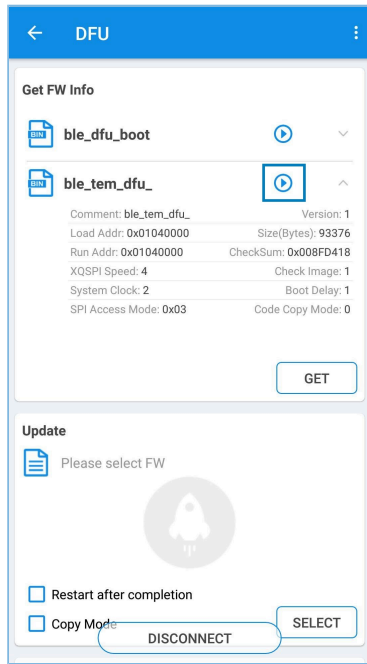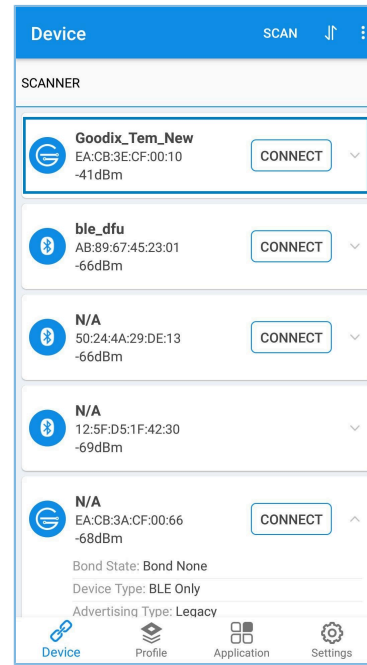
Figure 2-19 Tapping ⊙ (**RUN**)

Figure 2-20 Discovering the new firmware

3 Update Firmware in ble_app_template_dfu

Users can update firmware in ble_app_template_dfu directly, instead of using the approach by jumping to Boot firmware for firmware update. Steps are described below.

3.1 Preparation

To update firmware in ble_app_template_dfu, users need to create target firmware files. For more information, see "Section 2.4 Create Target Firmware for Update".

3.2 Update Firmware Through GRToolbox on the Mobile Phone

Download the demo for firmware update to the GR5515 SK Board, and then search for devices through GRToolbox on the mobile phone. The device **Goodix_Tem_DFU** is discovered:
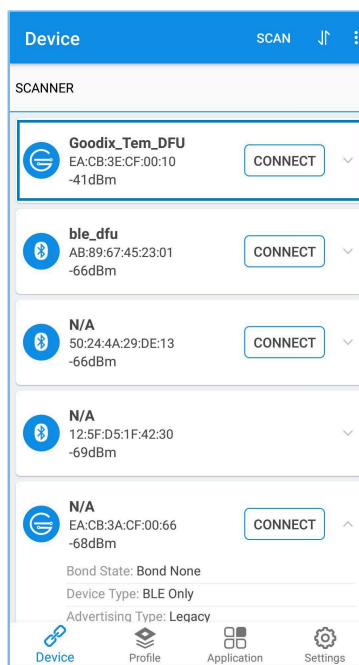

Figure 3-1 Searching for devices through the mobile phone

3.3 Connect to GR5515 SK Board and Update Firmware

For instructions on firmware update through GRToolbox on the mobile phone, see "Section 2.5.2 Load Firmware for Update", "Section 2.5.3 Connect to GR5515 SK Board and Update the Target Firmware", and "Section 2.5.4 Verify OTA Update Results".

Different from the approach by jumping to Boot firmware for OTA, this approach allows firmware update in applications by enabling users to use the **DFU** function of GRToolbox directly to control the GR5515 SK Board for update. Steps: Scan and discover **Goodix_Tem_DFU** through GRToolbox, and then connect **Goodix_Tem_DFU** to the mobile phone for firmware update. In addition, users need to check **Copy Mode**, as shown in Figure 3-2.
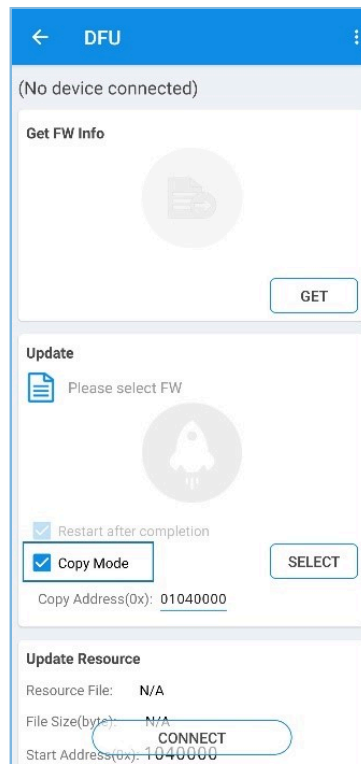
Figure 3-2 Searching for devices through the mobile phone

- **Restart after completion**: Selecting this option means the target firmware runs immediately after update completes.

- **Copy Mode**: Selecting this option means to first download the target firmware to other unused flash addresses, and then copy the firmware to the actual run address after update completes. If **Copy Mode** is checked, **Restart after completion** is checked automatically and an edit box of **Copy Address** is displayed.

📖 **Note**:

Checking **Copy Mode** overwrites contents in the area specified by **Copy Address**. In case of misconfiguration, this operation can lead to the loss of original information in the area.

4 FAQ

This chapter lists possible problems with corresponding solutions in OTA process for GR551x SoCs.

4.1 Why does Timeout occur on Jumping to Boot Firmware for OTA with GRToolbox (iOS)?

- Description

  During OTA by jumping to the Boot firmware with GRToolbox (iOS), timeout occurs on establishing connection between GRToolbox and the device, and it is found that the device has been bonded with the mobile phone by tapping **Setting** > **Bluetooth** on the mobile phone. After unbonding of the device, firmware can be updated with GRToolbox.

- Analysis

  If the device has ever been bonded with the mobile phone and OTA by jumping to the Boot firmware is performed, then when the device switches from the previous firmware to the Boot firmware and the advertising addresses of both firmware are the same, the device will be reconnected to the mobile phone automatically (even if GRToolbox shows the device has been disconnected). Thus timeout occurs on reconnection between GRToolbox and the device, and OTA fails.

- Solution

  Set a different advertising address for the Boot firmware from that of the previous firmware. For example, set the address to the advertising address of the previous firmware plus 1.