GR551x Fast DFU Example Application

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Shenzhen Goodix Technology Co., Ltd.

Headquarters: 2F. & 13F., Tower B, Tengfei Industrial Building, Futian Free Trade Zone, Shenzhen, China

TEL: +86-755-33338828 FAX: +86-755-33338099

Website: www.goodix.com

Preface

Purpose

This document introduces how to quickly implement Fast DFU on GR551x SoCs with the debugging App GRToolbox (Android) by using Bluetooth Low Energy (Bluetooth LE) technology, to help users have better understanding of Fast DFU for GR551x SoCs.

Audience

This document is intended for:

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

Release Notes

This document is the third release of *GR551x Fast DFU Example Application*, corresponding to GR551x SoC series.

Revision History

Version	Date	Description
1.5	2020-08-30	Initial release
1.6	2020-12-15	Updated GRToolbox UI figures based on software update.
1.7	2021-08-09	Changed the section “Supported Development Platform” into “Preparation”.

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1 Introduction

The Fast Device Firmware Update (Fast DFU) enables downloading the target firmware to a target device and enables the device to automatically check and update the firmware through Bluetooth transmission.

Compared with the over-the-air (OTA) technology which also enables downloading and updating the target firmware through Bluetooth transmission, GR551x Fast DFU greatly shortens the time for firmware update by providing Fast OTA Service which enables control, interaction, and various features of Fast DFU, as well as optimizing data read and write.

As a solution for wireless firmware update, Fast DFU features faster update process and better user experience. This document elaborates on principles and applications of Fast DFU for GR551x SoCs.

Before getting started, you can refer to the following documents.

Table 1-1 Reference documents

Name	Description
GR551x Developer Guide	Introduces the software/hardware and quick start guide of GR551x SoCs.
Bluetooth Core Spec	Offers official Bluetooth standards and core specification from Bluetooth SIG.
J-Link/J-Trace User Guide	Provides J-Link operational instructions. Available at 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/.
GR551x Bluetooth Low Energy Stack User Guide	Introduces the BLE Protocol Stack supported by GR551x SoCs.

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2 Fast DFU Overview

This chapter introduces fundamental concepts about GR551x Fast DFU.

2.1 Device Roles

Two Fast DFU device roles are defined:

- Control device (the host): a device, such as a mobile phone, that sends update data to the target device
- Target device (the device): a device, such as a wristband, that receives update data from the control device

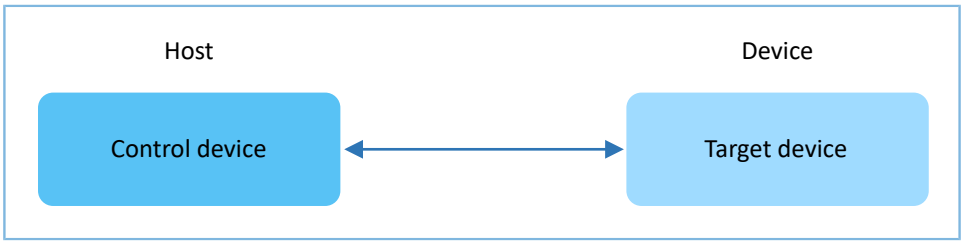

Figure 2-1 Device role

2.2 Interactions

To speed up data transmission, only firmware information/data/checksum interactions are supported between the host and the device.

The interaction procedures between the host and the device are shown in Figure 2-2.

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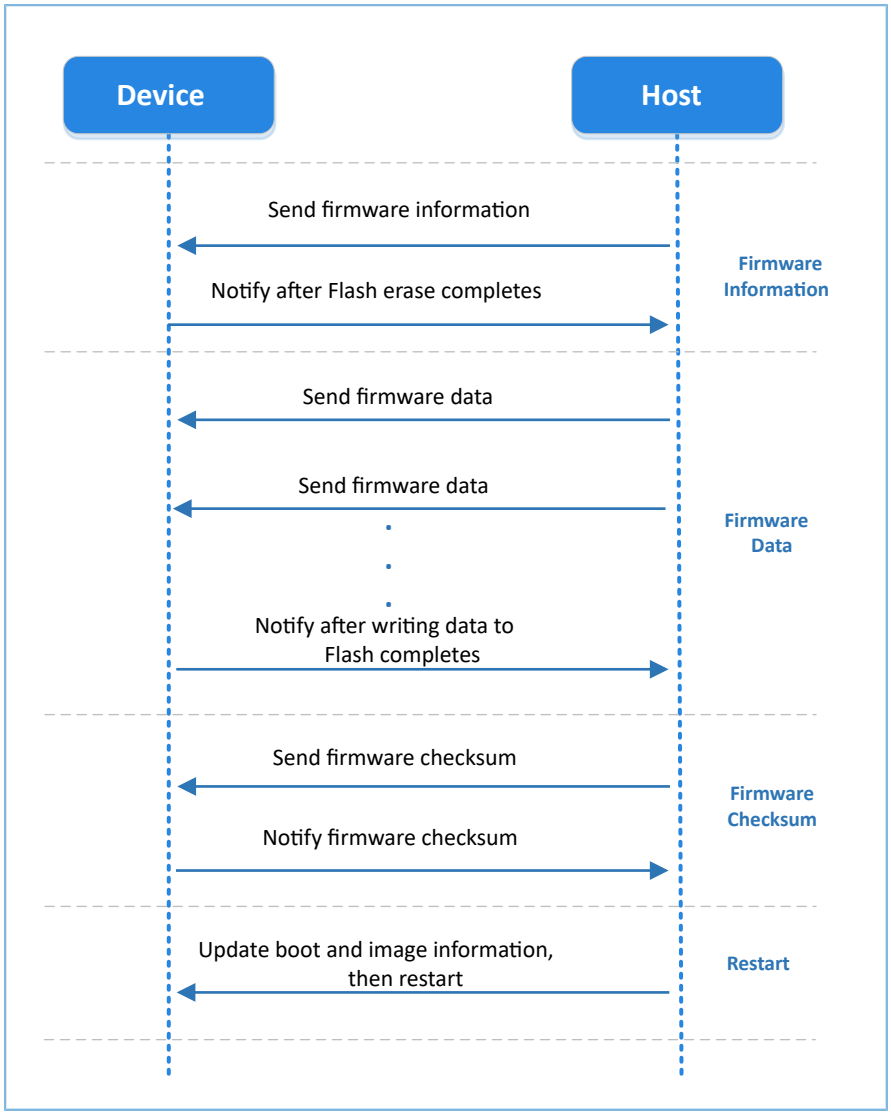

Figure 2-2 Fast DFU interaction procedures

1. Firmware information interaction: The host sends the target firmware information to the device; after receiving the information, the device erases the flash memory to be used for firmware update for one time and then notifies the host.
2. Firmware data interaction: The host sends the target firmware data to the device continuously; then the device caches the received data in a local ring buffer. When the data in the ring buffer reaches the set length, the device writes the data for one time to the flash. After writing all the firmware data to the flash, the device notifies the host.
3. Firmware checksum interaction: The host and the device send the calculated firmware checksums to each other for comparison.

If the checksums from the host and the device are consistent, the boot and image information will be updated and the device will restart.

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3 Enablement of Fast DFU

This chapter introduces how to enable Fast DFU for GR551x SoCs.

The Fast DFU functionality is encapsulated in the Fast DFU module (available in SDK_Folder\components\libraries\fast_dfu). To use Fast DFU in applications, you only need to call related APIs. Details are provided below by taking ble_dfu_fast as an example.

Note:

SDK_Folder is the root directory of GR551x SDK.

3.1 ble_dfu_fast Project

The ble_dfu_fast example is in SDK_Folder\projects\ble\dfu\ble_dfu_fast, and the project file is in the Keil_5 folder.

Double-click the project file, *ble_dfu_fast.uvprojx*, to view the project directory structure of ble_dfu_fast in Keil. For related files, see Table 3-1.

Table 3-1 File description of ble_dfu_fast

Group	File	Description
gr_libraries	fast_dfu.c	Initializes Fast DFU Service, including protocol control and process scheduling for Fast DFU.
gr_profiles	ble_prf_utils.c	Contains profile-related operational tools.
	fast_otas.c	Implements Fast OTA Service.
user_callback	user_gap_callback.c	Implements GAP callbacks, such as connection, disconnection, and GAP parameter update.
	user_gatt_common_callback.c	Implements GATT common callbacks, such as MTU exchange.
user_platform	user_periph_setup.c	Configures the serial port parameters, device address, power management mode, and Fast DFU.
user_app	main.c	Contains the main() function.
	user_app.c	Implements Fast OTA profile registration and logical processing.

3.2 Steps

Follow the steps below to apply Fast DFU in applications.

1. Initialize the Fast DFU functionality.

   Path: user_platform\user_periph_setup.c under the project directory

   Name: app_periph_init();

   Call fast_dfu_init() in this function to initialize Fast DFU.

```
void app_periph_init(void)
{
```

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```
    SET_BD_ADDR(BD_ADDR_NVDS_TAG, BD_ADDR_LENGTH, s_bd_addr);
    bsp_uart_init();
    user_log_init();
    fast_dfu_init(NULL, &dfu_pro_call);
    pwr_mgmt_mode_set(PMR_MGMT_ACTIVE_MODE);
    APP_LOG_DEBUG("DFU FAST DEMO START");
}
```

Table 3-2 Input parameter description for fast_dfu_init()

Parameter	Description	Value
p_dfu_func	Whether to program the external flash. To program the external flash, it is required to input the corresponding interface pointer for the external flash operation (read/write/erase).	• Yes: The external flash operation API implemented by users is assigned to this parameter. • No: **NULL** is assigned to this parameter.
p_state_callback	Enable/Disable monitoring on update status at the application layer.	• Yes: The Fast DFU status handling callback function implemented by users is assigned to this parameter. • No: **NULL** is assigned to this parameter.

Note:

- In the example code, **NULL** is assigned to the input parameter **p_dfu_func** of fast_dfu_init(), and the Fast DFU status handling callback **dfu_pro_call** is assigned to **p_state_callback**.
- To use the external flash, it is required to implement the **fast_dfu_func_t** structure in *fast_dfu.h* (in SDK_Folder\components\libraries\fast_dfu), and assign the pointer of the structure to **p_dfu_func**. To program the external flash through SPI, ONCE_WRITE_DATA_LEN in *fast_dfu.h* shall be less than 4096 bytes.

2. Initialize the Fast DFU service.

   Path: user_app\user_app.c under the project directory

   Name: services_init();

   Call fast_dfu_service_init() in this function to register the Fast DFU service.

```
static void services_init(void)
{
    fast_dfu_service_init();
}
```

3. Call fast_dfu_schedule() in the while(1) { } loop of the main() function to schedule the Fast DFU functionality.

   Path: user_app\main.c under the project directory

   Name: main();

```
int main(void)
{
    // Initialize user peripherals.
    app_periph_init();
```

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```
    // Initialize BLE Stack.
    ble_stack_init(&s_app_ble_callback, &heaps_table);

    // loop
    While (1)
    {
        fast_dfu_schedule();
        pwr_mgmt_schedule();
    }
}
```

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4 Test and Verification

The GR551x SDK provides a Fast DFU example. This chapter introduces how to test and verify the Fast DFU functionality by using a GR5515 Starter Kit Board (SK Board) and an Android phone.

4.1 Preparation

Perform the following tasks before the test.

- **Hardware preparation**

Table 4-1 Hardware preparation

Name	Description
Development board	GR5515 Starter Kit Board (SK Board)
Android phone	A mobile phone running on Android 5.0 (KitKat) or later
Connection cable	Micro USB 2.0 cable

- **Software preparation**

Table 4-2 Software preparation

Name	Description
Windows	Windows 7 or later
J-Link driver	A J-Link driver. Available at www.segger.com/downloads/jlink/ .
Keil MDK5	An integrated development environment (IDE). MDK-ARM Version 5.20 or later is required. Available at www.keil.com/download/product/.
GRToolbox (Android)	A Bluetooth LE debugging tool. Available in SDK_Folder\tools\GRToolbox.
GProgrammer (Windows)	A programming tool. Available in SDK_Folder\tools\GProgrammer.

4.2 Downloading Fast DFU Firmware to SK Board

The GR551x SDK contains the Fast DFU example and precompiled firmware. To perform the Fast DFU test, first download the Fast DFU firmware to the SK Board, and then connect the Android phone with the SK Board through GRToolbox to fast update the target firmware.

Download the Fast DFU firmware *ble_dfu_fast_fw.bin* to the SK Board. For details, see *GProgrammer User Manual*.

Note:

- The load address and run address of *ble_dfu_fast_fw.bin* are 0x01002000.
- *ble_dfu_fast_fw.bin* is in SDK_Folder\projects\ble\dfu\ble_dfu_fast\build\.

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

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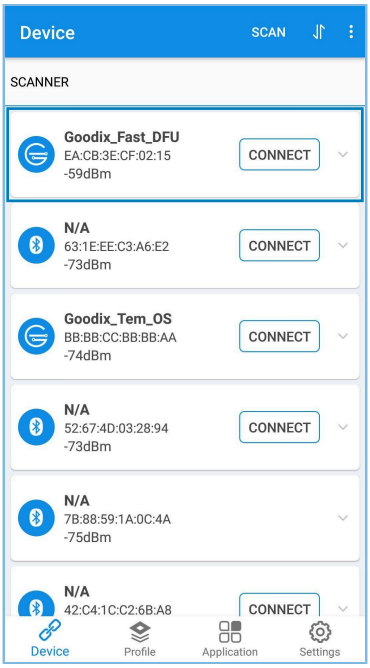

Figure 4-1 Discovering **Goodix_Fast_DFU**

Note:

Screenshots of GRToolbox in this document are for reference only, to help users better understand the software operation. In the case of interface differences due to version changes, the interface of GRToolbox in practice shall prevail.

Goodix_Fast_DFU refers to the device advertising name defined in *ble_dfu_fast_fw.bin*.

4.3 Fast DFU Through GRToolbox on the Mobile Phone

This section introduces how to perform Fast DFU by using the target firmware *ble_tem_dfu_fw.bin* through GRToolbox on the mobile phone.

Note:

- The load address and run address of *ble_tem_dfu_fw.bin* are 0x01040000, which shall not conflict with those of *ble_dfu_fast_fw.bin*.
- The *ble_tem_dfu_fw.bin* is in: SDK_`Folder\projects\ble\ble_peripheral\ble_app_template_dfu\build\`.

---

1. Copy the target firmware to the mobile phone.

   Copy *ble_tem_dfu_fw.bin* to `\Goodix\SaveData` in the root directory of the mobile phone.

2. Load the target firmware.

   (1). Run GRToolbox (Android). Tap **Application** and then select **Fast DFU** to enter the Fast DFU interface.

   (2). Tap **SELECT** in the **Update** area and then load *ble_tem_dfu_fw.bin* which is copied in Step 1.

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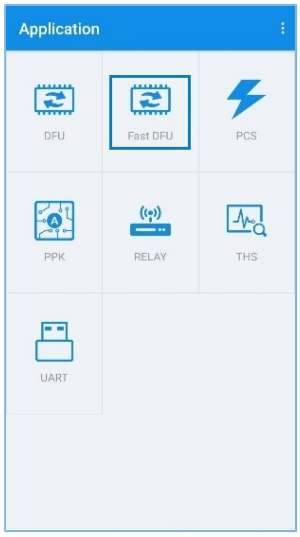

Figure 4-2 Selecting **Fast DFU**

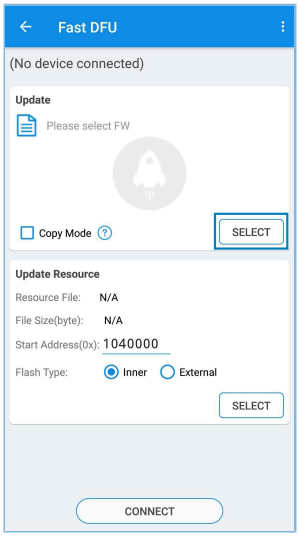

Figure 4-3 Selecting the target firmware

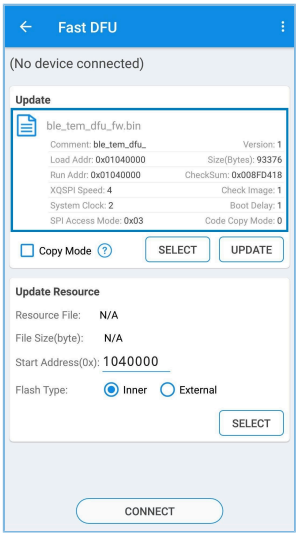

Figure 4-4 Viewing firmware information

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 4-4.

3. Connect the mobile phone to the SK Board through Bluetooth.

Note:

Turn on Bluetooth on the mobile phone before connection.

Tap **CONNECT** and select **Goodix_Fast_DFU** from the device list (the advertising name of the SK Board downloaded with Fast DFU firmware; for details, see "Section 4.2 Downloading Fast DFU Firmware to SK Board") to establish a connection, as shown in Figure 4-5.

If a pop-up message **Connect Success** displays, connection between the mobile phone and the SK Board has been established, as shown in Figure 4-6.

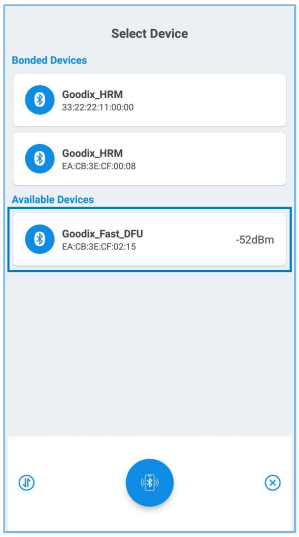

Figure 4-5 Connecting to **Goodix_Fast_DFU**

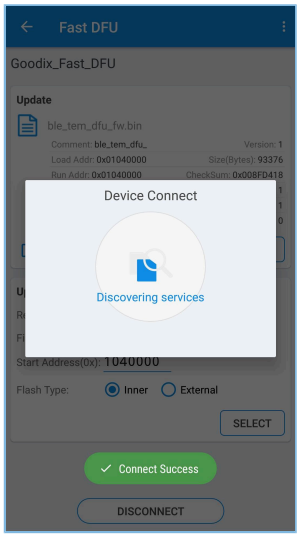

Figure 4-6 **Connect Success**

4. Tap **UPDATE** (Figure 4-7) to start updating.

   When the progress achieves 100%, the firmware update is completed.

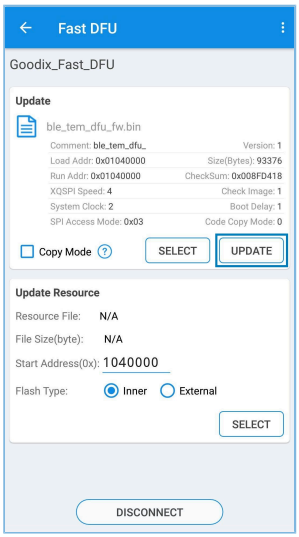

Figure 4-7 Tapping **UPDATE**

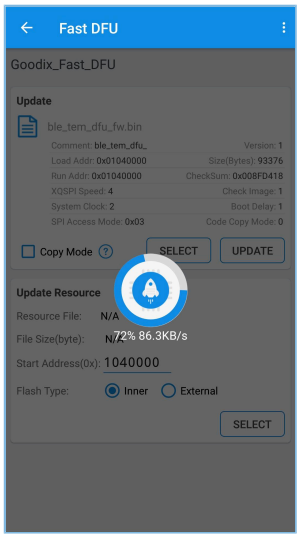

Figure 4-8 Updating

5. Check whether Fast DFU is completed successfully.

   The device automatically starts and runs the target firmware after the update is completed. If the target firmware (the updated firmware) runs successfully, it initiates an advertisement named as **Goodix_Tem_DFU**. Run GRToolbox and enter the **Device** interface. Pull to refresh the device list (or tap **SCAN** in the upper-right corner) to check whether **Goodix_Tem_DFU** is in the device list.

   If **Goodix_Tem_DFU** is in the device list (as shown in Figure 4-9), Fast DFU is completed successfully.

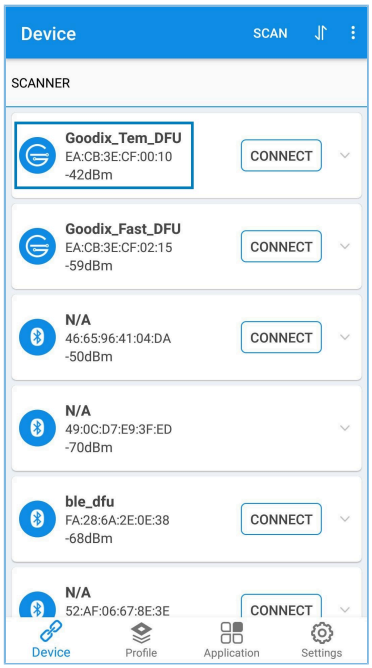

Figure 4-9 Discovering **Goodix_Tem_DFU**

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5 FAQ

This chapter describes possible problems, reasons, and solutions during Fast DFU.

- Description

  Firmware update fails.

- Analysis

  1. For Fast DFU at 2.4 GHz with severe interference, the Bluetooth connection may be broken, resulting in update failure.
  2. The run address of the target firmware conflicts with that of the Fast DFU firmware, so an error occurs during update, resulting in update failure.

- Solution

  1. Make sure there is no severe interference in the operating environment of Fast DFU.
  2. Make sure the run address of the target firmware does not conflict with that of the Fast DFU firmware.

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