Rockchip DFU Upgrade Program Introduction

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Preface

Overview

This document is intended to help engineers to quickly use the Rockchip Linux platform DFU upgrade program.

Product Version

Chipset	Kernel Version
RV1126/1109	Linux 4.19
RV1103/1106	Linux 5.10

Intended Audience

This document (this guide) is mainly intended for:

Technical support engineers

Software development engineers

Revision History

Version	Author	Date	Change Description
V1.0.0	tony.xu	2021-03-09	Initial version
V1.1.0	tony.xu	2021-09-10	Support device to automatically choose to upgrade A partition or B partition
V1.2.0	alan.yan	2022-04-29	Add support for RV1103/1106

Contents

1. Introduction

DFU(Device Firmware Upgrade)is a program for forcing a device to be upgraded via USB. Rockchip DFU upgrade program includes two parts: DFU mode switch in kernel and DFU firmware download and upload in uboot.

2. Configuration and Compilation

2.1 Partition configuration

The u-boot upgrade partition definition is in the u-boot/include/configs directory.

RV1109/1126：include\configs\evb_rv1126.h

```
#define CONFIG_SET_DFU_ALT_INFO
#define DFU_ALT_BOOT_EMMC \
"gpt raw 0x0 0x20000;" \
"loader raw 0x20000 0xE0000;"\
"uboot part uboot;" \
"boot part boot;" \
"rootfs partubi rootfs;" \
"userdata partubi userdata\0"
#define DFU_ALT_BOOT_MTD \
"gpt raw 0x0 0x20000;" \
"loader raw 0x20000 0xE0000;"\
"vnvm part vnvm;" \
"uboot part uboot;" \
"boot part boot;" \
"rootfs partubi rootfs;" \
"userdata partubi userdata\0"
```

RV1103/1106: include/configs/rv1106_common.h

```
#if CONFIG_USB_FUNCTION_DFU
#define CONFIG_SET_DFU_ALT_INFO
#endif

#define DFU_ALT_BOOT_MTD        \
        "env part env;" \
        "idblock part idblock;"  \
        "uboot part uboot;"    \
        "boot part boot;"     \
        "rootfs partubi rootfs;"   \
        "oem partubi oem;"      \
        "userdata partubi userdata\0"
```

The description of partition definition:

MTD device DFU entry:

```
dfu_part layout <mtd_part> <start> <size>
```

Parameters:

- dfu_part: dfu partition name
- layout: partition type:
  - raw: no partition pre-erasing, need to define 'start' and 'size'.
  - rawubi: support partition pre-erasing, need to define 'start' and 'size'.
  - part: no partition pre-erasing, support automatic parsing of the partition table, no need to define 'start' and 'size'.
  - partubi: support partition pre-erasing, support automatic parsing of the partition table, no need to define 'start' and 'size'.
- mtd_part: optional, the local partition name, fill in when the layout parameter is specified as raw\rawubi.
- start: optional, the start address of the local partition, the unit is byte, fill in when the layout parameter is specified as raw\rawubi.
- size: optional, the size of the local partition, the unit is byte, fill in when the layout parameter is specified as raw\rawubi.

Notice:

- The partitions defined above for the upgrade partition must be consistent with those defined in parameter.txt/env. If there is no partition in parameter.txt/env, it cannot be defined in the upgrade partition (except gpt and loader).
- Please use raw or rawubi partition type for the part that uses A/B partition.
- Dfu mode is not compatible with adb mode**, because on the PC, they use the same driver, and it is easy to fail to open the dfu device.

2.2 Compile configuration

- u-boot configuration

Confirm that the defconfig of the corresponding product under u-boot (eg: rv1126_defconfig) has added the following configuration:

```
+CONFIG_CMD_DFU=y
+CONFIG_DFU_MMC=y
+CONFIG_DFU_MTD=y
+# CONFIG_DFU_NAND is not set
+# CONFIG_DFU_RAM is not set
+# CONFIG_DFU_SF is not set
+# CONFIG_DFU_TFTP is not set
+CONFIG_USB_FUNCTION_DFU=y
+CONFIG_AVB_LIBAVB_AB=y
+CONFIG_AVB_LIBAVB_USER=y
+CONFIG_ANDROID_AB=y
```

If the spi-nor of RV1103/1106 needs to support DFU, you need to use the secondary configuration: configs/rv1106-dfu.config, you can modify the configuration and compile as follows:

Modify the BoardConfig configuration:

```
# Uboot defconfig
export RK_UBOOT_DEFCONFIG=rv1106-spi-nor_defconfig

# Uboot defconfig fragment
export RK_UBOOT_DEFCONFIG_FRAGMENT=rv1106-dfu.config
```

Compile uboot：

```
./build.sh uboot
```

- kernel configuration

Confirm that the defconfig of the corresponding product under the kernel (eg: rv1126_defconfig) has added the following configuration:

```
CONFIG_USB_CONFIGFS_F_DFU=y
```

At the same time, please confirm that the kernel contains the following commit records:

```
commit 655bdb3710223ec4b6609a6d77cea27d59cf7636
Author: William Wu <william.wu@rock-chips.com>
Date:   Mon Feb 22 20:22:16 2021 +0800

    usb: gadget: support dfu driver

    Signed-off-by: William Wu <william.wu@rock-chips.com>
    Change-Id: I557bceaf94a95b8ac4ddde0b89ea4c491f05c671

commit c8efaf8641dbd7d900bd7c3a29b27e799633a335
Author: Tony Xu <tony.xu@rock-chips.com>
Date:   Wed Mar 10 14:52:20 2021 +0800

    ARM: dtsi: rv1126: add dfu boot mode

    Signed-off-by: Tony Xu <tony.xu@rock-chips.com>
    Change-Id: Ic0ae7c344d57eec1c50bdee4a5f65ffbb949baa7
```

Please confirm that the RV1103/RV1106 kernel contains the following commit records:

```
commit 9ea39f4fa66b54daf7a219ce16dca058c0f81512 (HEAD)
Author: alan.yan <alan.yan@rock-chips.com>
Date:   Fri Apr 29 17:59:40 2022 +0800

    usb: 1106g:add dfu download mode

    Signed-off-by: alan.yan <alan.yan@rock-chips.com>
    Change-Id: Iec8db07782cb06ba5f5a34dadcad2a94b30dffc8

commit f36031a741d40b820e30c2945adb0c830830125b
Author: William Wu <william.wu@rock-chips.com>
Date:   Mon Feb 22 20:22:16 2021 +0800

    usb: gadget: support dfu driver

    Signed-off-by: William Wu <william.wu@rock-chips.com>
```

```
    Change-Id: I557bceaf94a95b8ac4ddde0b89ea4c491f05c671
```

The above submission is mainly to support PC to switch the device to DFU mode through a third-party DFU tool.

- usb configure script

Please make sure that the usb configuration script corresponding to the product (usually in usb_config.sh or S50usbdevice script) contains the following patches. The DFU mode is disabled by default in the SDK. If you need to enable it, please ensure that DFU_EN=on in the usb configuration script.

```
--- a/oem/oem_uvcc/usb_config.sh
+++ b/oem/oem_uvcc/usb_config.sh
@@ -1,6 +1,7 @@
 #!/bin/sh

 ADB_EN=on
+DFU_EN=on
 if ( echo $2 |grep -q "off" ); then
 ADB_EN=off
 fi
@@ -247,6 +248,19 @@ esac

 ln -s ${USB_FUNCTIONS_DIR}/uvc.gs6 ${USB_CONFIGS_DIR}/f1

+if [ $DFU_EN = on ];then
+  mkdir /sys/kernel/config/usb_gadget/rockchip/functions/dfu.gs0
+  CONFIG_STR=`cat
/sys/kernel/config/usb_gadget/rockchip/configs/b.1/strings/0x409/configuration`
+  STR=${CONFIG_STR}_dfu
+  echo $STR > ${USB_CONFIGS_DIR}/strings/0x409/configuration
+  USB_CNT=`echo $STR | awk -F"_" '{print NF-1}'`
+  let USB_CNT=USB_CNT+1
+  echo "dfu on++++++ ${USB_CNT}"
+  ln -s ${USB_FUNCTIONS_DIR}/dfu.gs0 ${USB_CONFIGS_DIR}/f${USB_CNT}
+  ADB_EN=off
+  sleep .5
+fi
+
 if [ $ADB_EN = on ];then
   mkdir ${USB_FUNCTIONS_DIR}/ffs.adb
   CONFIG_STR=`cat
/sys/kernel/config/usb_gadget/rockchip/configs/b.1/strings/0x409/configuration`
```

Compile command:

```
 ./build.sh   \\Full compilation project, after the compilation is completed, the
corresponding firmware will be generated in the IMAGE directory
```

3. Enter DFU upgrade mode

- In the uboot command line mode, enter the following command:

```
=> dfu 0 $devtype $devnum
```

Notice:

If the above command is invalid, it may be that the relevant environment variables have been deleted, you can enter the command according to the specific flash type, such as spi-nor, you can enter the following command:

```
=> dfu 0 mtd 2
```

Define flash type:

```
/* define mtd device devnum */
#define BLK_MTD_NAND            0
#define BLK_MTD_SPI_NAND        1
#define BLK_MTD_SPI_NOR         2
```

- When the system is running normally, you can execute reboot dfu through the serial port or adb to enter the dfu mode.

```
[root@RV1126_RV1109:/]# reboot dfu
```

- dfu-util.exe tool switching (executed on the PC command line terminal):

```
.\dfu-util.exe -e
```

Notice:

When using DFU mode for the first time, the PC needs to install the driver. It is recommended to use Zadig, find the device USB download gadget, and then install the WinUSB driver. After installing the driver, use the dfu tool to view the dfu list of the board:

```
.\dfu-util.exe -l
dfu-util 0.9

Copyright 2005-2009 Weston Schmidt, Harald Welte and OpenMoko Inc.
Copyright 2010-2016 Tormod Volden and Stefan Schmidt
This program is Free Software and has ABSOLUTELY NO WARRANTY
Please report bugs to http://sourceforge.net/p/dfu-util/tickets/

Found DFU: [2207:0107] ver=0223, devnum=3, cfg=1, intf=0, path="1-1.3", alt=5,
name="rootfs", serial="5b4b8a3e80121814"
Found DFU: [2207:0107] ver=0223, devnum=3, cfg=1, intf=0, path="1-1.3", alt=4,
name="boot", serial="5b4b8a3e80121814"
Found DFU: [2207:0107] ver=0223, devnum=3, cfg=1, intf=0, path="1-1.3", alt=3,
name="uboot", serial="5b4b8a3e80121814"
Found DFU: [2207:0107] ver=0223, devnum=3, cfg=1, intf=0, path="1-1.3", alt=2,
name="vnvm", serial="5b4b8a3e80121814"
Found DFU: [2207:0107] ver=0223, devnum=3, cfg=1, intf=0, path="1-1.3", alt=1,
name="loader", serial="5b4b8a3e80121814"
Found DFU: [2207:0107] ver=0223, devnum=3, cfg=1, intf=0, path="1-1.3", alt=0,
name="gpt", serial="5b4b8a3e80121814"
```

4. Upgrade Firmware

Upgrade command:

```
dfu-util.exe 2207:0107 -a uboot -D uboot.img
```

Instructions: -a: the name of the partition to be burned, the name of the partition must be in the list obtained in the "dfu-util.exe -l" command; -D: means to download the firmware, "-D" is followed by the img address that needs to be programmed.

Notice: The first time you use a PC, you need to install the driver. Use Zadig to install the driver, find the Device Firmware Upgrade, and then install the WinUSB driver.

5. Export Firmware

The export firmware:

```
dfu-util.exe 2207:0107 -a uboot -U uboot.img
```

Instructions: -a: the name of the partition to be exported; -U: means to export firmware, "-U" is followed by the save address and name of the firmware.

6. Upgrade GPT Partition

GPT needs to be converted to binary format first (pre-programmed image), and the backup area at the end must also define partitions before upgrading.

6.1 Convert to a pre-programmed image (image programmed by the writer)

Tool: rkbin/tools/programmer_image_tool

Docs:
docs/Linux/ApplicationNote/Rockchip_Developer_Guide_Linux_Nand_Flash_Open_Source_Solution_CN.pdf

7. A/B Partition Firmware Upgrade

7.1 Program firmware

The firmware of the A/B partition must use raw or rawubi format, that is, the raw format or rawubi format must be used when configuring the include/configs/evb_rv1126.h partition table:

```
--- a/include/configs/evb_rv1126.h
+++ b/include/configs/evb_rv1126.h
@@ -52,11 +52,11 @@
        "loader raw 0x20000 0xE0000;"\
        "vnvm part vnvm;" \
        "uboot part uboot;" \
-       "boot_a part boot_a;" \
-       "boot_b part boot_b;" \
+       "boot_a raw 0x600000 0x400000;" \
+       "boot_b raw 0xA00000 0x400000;" \
        "misc part misc;" \
-       "system_a partubi system_a;" \
-       "system_b partubi system_b;" \
+       "system_a rawubi 0xE80000 0x3580000;" \
+       "system_b rawubi 0x4400000 0x3580000;" \
        "userdata partubi userdata\0"
 #endif /* !CONFIG_SPL_BUILD */
```

The partition table in raw format must indicate the starting address and size of the partition, and the address and size need to match with paramert.txt. The address unit in parameter.txt is sector, and one sector is 512 Bytes. So it needs to be multiplied by 512 when converting to the address in the patch.

7.2 A/B firmware switching

7.2.1 The host controls the upgrade logic

In earlier versions of the SDK, the device used the standard DFU upgrade mode, without A/B upgrade logic control, so the entire set of A/B upgrade business logic needs to be controlled by the host: The host can know which system is currently booted by the device through the XU command of UVC or adb, etc. After the upgrade partition is downloaded, the newly upgraded system can be booted by burning different misc.img.

misc.img can be obtained from sdk\device\rockchip\rockimg directory:

- dfu_misc_a.img boots system A
- dfu_misc_b.img boots system B

On the devices, can obtain which system is currently booted through the androidboot.slot_suffix parameter in /proc/cmdline.

```
# cat proc/cmdline
user_debug=31 storagemedia=mtd androidboot.storagemedia=mtd
androidboot.mode=normal  root=ubi0:rootfs skip_initramfs
androidboot.slot_suffix=_a androidboot.serialno=e5b27a79e5fb95b0
 earlycon=uart8250,mmio32,0xff570000 console=ttyFIQ0 ubi.mtd=5 rootfstype=ubifs
snd_aloop.index=7 mtdparts=spi-
nand0:0x100000@0x200000(vnvm),0x300000@0x300000(uboot),0x600000@0x600000(boot_a),
0x600000@0xc00000(boot_b),0x80000@0x1200000(misc),0x30c0000@0x1280000(system_a),0
x30c0000@0x4340000(system_b),0xb60000@0x7400000(userdata)
```

7.2.2 The device chooses to upgrade partition A or partition B independently

In order to support the independent control and upgrade of partition A or partition B on the device, u-boot needs to be updated to the following nodes:

```
commit deef35d91e8041575863d1d0dfc24ac703d09935
Author: Nico Cheng <nico.cheng@rock-chips.com>
Date:   Wed Sep 8 15:09:51 2021 +0800

    common: dfu: After the upgrade, switch the boot slot priority

    If the device current boot from slot A,then increase the boot priority of
    slot B.

    Signed-off-by: Nico Cheng <nico.cheng@rock-chips.com>
    Change-Id: Ie481f815d8a3b72b91fcf1acaf9524c19b8a71e8
```

If the device is in the A partition, then upgrade the B partition, and it will boot from the B partition after rebooting.

8. Third Party Tools

8.1 The dfu-util tool

Downloading and uploading firmware through DFU is mainly done through the dfu-util tool. The verified version is **dfu-util-0.9**, which is recommended.

For tool download and usage, please refer to: http://dfu-util.sourceforge.net/ .

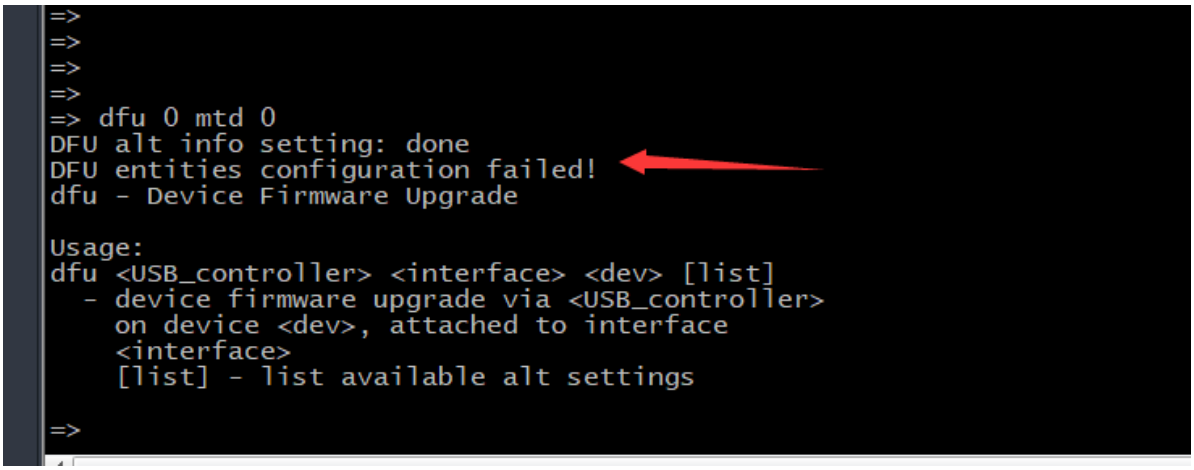
8.2 Driver installation tool

Zadig is recommended for USB driver installation tools.

The download and use of Zadig tools can refer to: https://zadig.akeo.ie/.

9. FAQ

- DFU entities configuration failed.



This situation is generally caused by the inconsistency between the partition defined in parameter.txt and the one defined in include\configs\evb_rv1126.h.

- It will not boot automatically after programming is completed

Just add -R after the programming command.

```
./dfu-util.exe -d 2207:0107 -a system_b -D rootfs.img -R \\Reboot after
programming the firmware
```