



Rev 2.0

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Android SD upgrade application note

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Revision History

Revision	Author	Date	Description
0.1	WS Chen	2011 / 02 / 16	Initial draft
0.2	WS Chen	2011 / 04 / 20	Add wipe data/cache backup and restore user data description
0.3	WS Chen	2011 / 05 / 27	Add introduction
0.4	WS Chen	2011 / 06 / 10	Add how to update DSP_BL
0.5	WS Chen	2011 / 06 / 22	Add how to prepare DSP_BL
0.6	WS Chen	2011 / 06 / 30	Modify DSP_BL session
0.7	WS Chen	2011 / 10 / 12	Add how to prepare differential OTA package
0.8	WS Chen	2011 / 10 / 25	Add sign key option in differential OTA package
0.9	WS Chen	2011 / 11 / 21	Add MTK special factory reset
1.0	WS Chen	2012 / 05 / 02	Add recovery.fstab and debug session
1.1	WS Chen	2012 / 06 / 11	Modify MTK special factory reset for ICS
1.2	WS Chen	2012 / 06 / 21	Refine DSP_BL session & differential OTA package
1.3	WS Chen	2012 / 09 / 05	Add recovery key customization and /sdcard mount device
1.4	WS Chen	2012 / 11 / 15	Remove unnecessary part
1.5	WS Chen	2013 / 05 / 13	Add UBIFS limitation
1.6	Tony Kuo	2014 / 07 / 03	Add AOSP build command
1.7	Haohsiang Hsu	2015 / 02 / 06	Add Android Lollipop notes Add upgrade limitations
1.8	Haohsiang Hsu	2015 / 04 / 15	Add 2.3 Notice Modify the 3.2 and 3.3 build ota package command
1.9	Haohsiang Hsu	2015 / 09 / 15	Phase out MTK special factory reset Add upgrade Preloader and LK support Modify 3.1 Add Note Modify 3.34 Add item 10 th for new parameter -s Modify 4.5 Add Note
2.0	Haohsiang Hsu	2015 / 10 / 29	Add 2.4 Android M application note

1 Requirement

This application note is used for Android 2.3 and later firmware upgrade through SD card. The Android 2.1 and 2.2 is not suitable for this document.

Key usage:

Volume Up + Power -> Enter recovery mode

Home -> Enter recovery mode menu

Menu -> Select

Volume Up -> Move up

Volume Down -> Move down

(Recovery key customization : ref. 4.4)

2 Introduction

The SD upgrade does **NOT** support:

- The battery power is loss during upgrade phone.
- The sdcard hot-plug during upgrade phone.

The SD upgrade supports:

- Backup and restore user data.
- Upgrade with changing partition size.

2.1 Backup and Restore User Data

To support these features, there are some common rules **MUST BE** observed.

- SD card **MUST NOT BE** write-protected.
- SD card **MUST** have enough free space to store the user data.
- The size of new userdata partition **MUST BE** larger than the user data used.
- Backup of user data image is encrypted. The encrypted data can **ONLY** be restored to the original mobile device.

2.2 Upgrade with Changing Partition Size

To support Upgrade with Changing Partition Size, following rules **MUST BE** observed.

For Encrypted Phone

- Change partition is **NOT** allowed on Encrypted Phone, otherwise userdata partition will be lost.

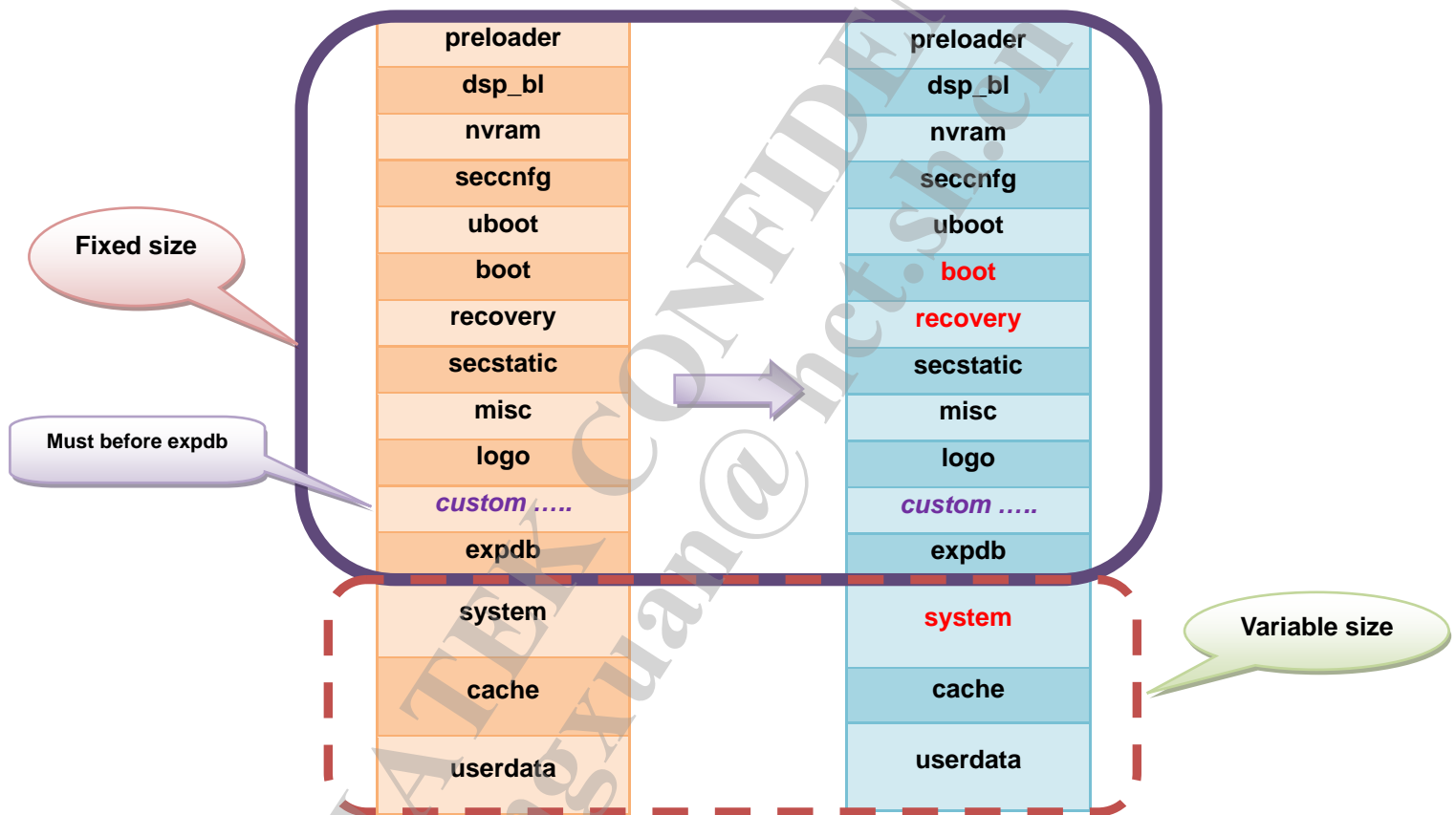
For Non-Encrypted Phone

- **ONLY** userdata, cache, and system partitions are allowed to resize.
 - In the Android L and later version, the phone **CANNOT** be upgrade with changing data partition size; otherwise userdata partition will be lost.
 - In the Android L and later version, the MTK special factory reset function is **phase out** due to SELinux policy.
- When user data partition size is changed, Backup and Restore User Data will be performed automatically. The rules in section 2.1 **MUST BE** also observed.
- eMMC device(GB) does **NOT** support changing partition size.
- When recovery use **external** SD card, the phone can upgrade from KK (KitKat) to L (Lollipop) with changing partition size.
- When recovery use **internal** SD card, the phone **CANNOT** upgrade from KK (KitKat) to L (Lollipop) with changing partition size.
- The number of partitions **MUST BE** consistent between the two versions.
- The order of the last three partitions **MUST BE** the order of system/cache/userdata.
- The default partition name of scatter file and format **CANNOT** be altered.
- The custom partition **ONLY** can be added before expdb partition.

- **ONLY** three partitions (system/cache/userdata) can have different size between the two versions.
- **ONLY** full update OTA package can do changed partition size upgrade. Differential OTA package **CANNOT** do changed partition size upgrade.

2.3 Notice

- If the SD card is FAT format, the update OTA package can **NOT** be larger than 2GB due to FAT file system format limitation.
- It is strongly recommended to use **full update OTA package**, when phone upgrades for different android version like KK to L.



2.4 Android L (5.0) upgrade to M (6.0) Note

- **Trustzone.bin** must be updated
- Strongly recommended to use **full package** for upgrade, the reasons are as follows
 - Because crossing different Android version, update package is larger and phone spends more time for updating.
 - If customer uses incremental package and phone power loss accidentally, it must only use full package to update phone.
- If **MTK security boot** is enabled,
 - **lk.bin** and **preloader_XXX.bin** must be updated.

- **Note:** If handset does NOT have lk2 partition, handset has a low risk to be dead when **power loss happened** during upgrade lk or preloader.
- /system/cache/data partition layout changed is **NOT** allowed, otherwise userdata partition will be lost.
 - It will show alert message (Notice user to backup data) on MOTA or SIU
 - If data partition is not encrypted, recovery will try to resize data partition
- Other partition layout changed is **NOT** allowed, otherwise MOTA will be fail.
- **MTK_2SDCARD_SWAP** on M (6.0) is phased out
 - If apps installed on SDCARD **will be lost**, if the handset had enabled MTK_2SDCARD_SWAP on previous version.

3 How to build SD upgrade image

3.1 Configure for recovery mode

alps/mediatek/config/<project>/recovery.fstab

Note: The new platform does NOT need to configure this recovery.fstab

NAND				
#	mount point	fstype	device	[device2]
	/boot	mtd	boot	
	/cache	yaffs2	cache	
	/data	yaffs2	userdata	
	/misc	mtd	misc	
	/recovery	mtd	recovery	
	/sdcard	vfat	/dev/block/mmcblk0p1	/dev/block/mmcblk0
	/system	yaffs2	system	

eMMC				
	mount point	fstype	device	[device2]
	/boot	emmc	boot	
	/cache	ext4	/dev/block/mmcblk0p2	
	/data	ext4	/dev/block/mmcblk0p3	
	/misc	emmc	misc	
	/recovery	emmc	recovery	
	/sdcard	vfat	/dev/block/mmcblk0p4	
	/system	ext4	/dev/block/mmcblk0p6	

If use external SD, /sdcard must be set as
/dev/block/mmcblk1p1
/dev/block/mmcblk1

3.2 Build full OTA update image step by step

[Non-AOSP environment]

1. Change directory to the root of code base
2. `./makeMtk <project> bm_new`
3. `./makeMtk <project> otapackage`
4. Copy out/target/product/<project>/<project>-ota-<mode>.<user_id>.zip to root directory of SD card and rename it to **update.zip**

[AOSP environment]

1. Change directory to the root of code base
2. `Full build project`
3. `make -j24 otapackage`
4. Copy out/target/product/<project>/<project>-ota-<mode>.<user_id>.zip to root directory of SD card and rename it to **update.zip**

3.3 Build differential OTA update image step by step

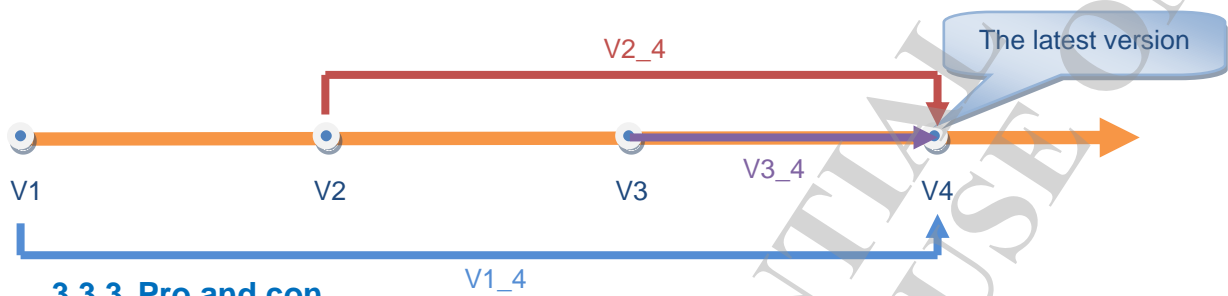
3.3.1 Differential OTA package size

The smaller OTA package size is the only advantage of differential OTA package. If power is loss during upgrade process by using differential OTA package, it may cause **CANNOT** upgrade by the same differential OTA package. At this time, **ONLY** use full OTA package to upgrade again.

3.3.2 Software maintenance

The software maintenance effort of differential OTA package is huge for customers. They must keep the entire source and OTA package when they release firmware. They also need to build the differential OTA package for every version they had released.

E.g. If the customer's latest version is V4. They want their end user to upgrade to latest version. Totally, they would build 3 versions of differential OTA packages. Which are V1_4, V2_4 and V3_4. The differential OTA package is only suggested for MOTA/FOTA.



3.3.3 Pro and con

	Full OTA package	Differential OTA package
Package size	X	O
Maintain effort	O	X
Changed partition size	O	X
Power loss fault-tolerance	O	X

3.3.4 Step by step to build differential OTA package

[Non-AOSP environment]

Need two codebase to build V2_4 differential OTA package for example:

1. Change directory to root of V2 codebase
2. `./makeMtk <project> bm_new`
3. `./makeMtk <project> otapackage`
4. copy out/target/product/<project>/obj/PACKAGING/target_files_intermediates/<project>-target_files-<user>.zip to the root directory of V4 as **V2_org.zip**
5. Change directory to root of V4 codebase
6. `./makeMtk <project> bm_new`
7. `./makeMtk <project> otapackage`
8. copy out/target/product/<project>/obj/PACKAGING/target_files_intermediates/<project>-target_files-<user>.zip to the root directory of V4 as **V4_new.zip**
9. Find out key path, usually in build/target/product/security/<project>/releasekey
`./build/tools/releasetools/ota_from_target_files --block -k <key_path> -i V2_org.zip V4_new.zip`
V2_4.zip

[AOSP environment]

Need two codebase to build V2_4 differential OTA package for example:

1. Change directory to root of V2 codebase
2. `Full build project`
3. `make -j24 otapackage`
4. copy out/target/product/<project>/obj/PACKAGING/target_files_intermediates/<project>-target_files-<user>.zip to the root directory of V4 as **V2_org.zip**
5. Change directory to root of V4 codebase
6. `Full build project`

7. `make -j24 otapackage`
8. copy out/target/product/<project>/obj/PACKAGING/target_files_intermediates/<project>-target_files-<user>.zip to the root directory of V4 as **V4_new.zip**
9. Find out key path, usually in device/mediatek/common/security/releasekey
`./build/tools/releasetools/ota_from_target_files --block -k <key_path> -i V2_org.zip V4_new.zip V2_4.zip`
10. Google native Android default update only **boot.img**, **system.img**, and **recovery.img**
 If handset must upgrade besides Google default image (ex: LK, Preloader, TEE ...) ,
 Please add parameter **-s** as follows
`./build/tools/releasetools/ota_from_target_files --block -s ./device/mediatek/build/releasetools/mt_ota_from_target_files -k <key_path> -i V2_org.zip V4_new.zip V2_4.zip`

3.4 Note and checking

/system/build.prop

ro.product.device

ro.build.product

ro.build.fingerprint (differential OTA package)

Signature key

Differential OTA package

Make sure device's load is the same as the old version of differential OTA package

Do not use adb push any files into /system, it will cause upgrade fail

File name (apk, ringtone etc.) **CANNOT** have a space character or Chinese when build OTA package

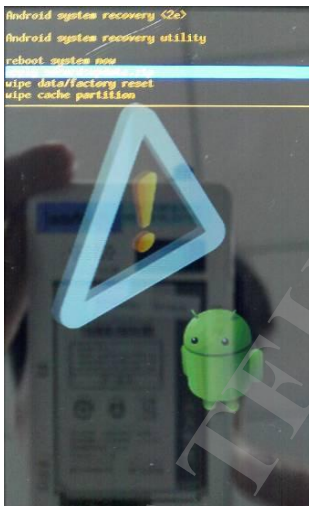
4 How to upgrade firmware by SD card

4.1 Upgrade procedure

1. Copy **update.zip** to the root directory of SD card and then plug SD card into you handset.
2. Press "**Volume up**" and "**Power key**" to enter recovery mode.



3. Press "**Home key**" to enter main menu



4. Use "**Volume down key**" to select "**apply update from sdcard**".
5. Press "**Menu key**" to enter file browser.
6. Use "**Volume up key**" or "**Volume down key**" to select your **update.zip** file.
7. Press "**Menu key**" to execute upgrade procedure.



8. After upgrade procedure is done, then reboot handset.

NOTE: The key setting is customizable and depends on the device setting.

4.2 Error handling

If the upgrade process is fail due to power failure. After power on, the system will back step 2 above. Please repeat through step 3 to step 6 to finish upgrade process.

4.3 Recovery mode debug

- ui_printf
 - Show message in LCD
- printf
 - In recovery mode and eng build
 - ◆ `adb pull /tmp/recovery.log` – submit eService please attach this file
 - Reboot to normal mode
 - ◆ `/cache/recovery/last_log` – submit eService please attach this file
- update.zip
 - META-INF\com\google\android\updater-script – submit eService please attach this file

4.4 Recovery key customization

For some devices which are without physical keys such as HOME/MENU, the recovery key operation can be customized.

Eg. `alps/mediatek/custom/<project>/recovery/inc/cust_keys.h`

```
#define RECOVERY_KEY_DOWN    KEY_VOLUMEDOWN
#define RECOVERY_KEY_UP      KEY_VOLUMEDOWN
#define RECOVERY_KEY_ENTER    KEY_VOLUMEUP
#define RECOVERY_KEY_MENU     KEY_POWER
```

4.5 /sdcard mount device

Below table are the default combinations of /sdcard mount device for eMMC devices

Note: The following options are phase out in Android M 6.0

	MTK_SHARED_SDCA RD = no	MTK_SHARED_SDCA RD = yes	MTK_2SDCARD_SW AP = no	MTK_2SDCARD_SW AP = yes
With FAT	Internal SD	External SD	Internal SD	External SD
Without FAT	External SD	External SD	External SD	External SD

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5 Other operation

5.1 Wipe data/factory reset

When execute this item, device's data and cache partitions will be erased. And device will be in factory reset state.

5.2 Wipe cache partition

When execute this item, it will erase device's cache partition.

5.3 Backup user data

When execute this item, SD card must be plugged into device. It will backup device's data partition to SD card.

5.4 Restore user data

When execute this item, SD card must be plugged into device. It can restore the previous backup data from SD card to device.

6 Upgrade Preloader and LK by OTA

6.1 All raw data partitions are able to upgrade

There are two kinds of partition upgrade as follows

1. Normal Partition Upgrade (single partition)
 - a. Boot ,recovery, and etc.
2. Loader Partition Upgrade (double partition for backup)
 - a. Ex: LK and LK2.

If your platform is earlier (without double partition for backup) and need to upgrade **preloader and lk**, please modify **build/core/Makefile**

Before:

```
$(hide) ./device/mediatek/build/releasetools/mt_ota_preprocess.py $(zip_root) $(PRODUCT_OUT)
$(PRODUCT_OUT)/ota_update_list.txt
```

After:

```
$(hide) MTK_LOADER_UPDATE=yes MTK_PRELOADER_OTA_BACKUP=no
./device/mediatek/build/releasetools/mt_ota_preprocess.py $(zip_root) $(PRODUCT_OUT)
$(PRODUCT_OUT)/ota_update_list.txt
```

7 UBIFS limitation

7.1 Introduction and limitation

The **Unsorted Block Image File System (UBIFS)** is a file system for use with NAND flash. UBIFS supports on-the-fly data compression. Due to this data compression feature, this may cause a problem during full OTA upgrade. Because compression ratio depends on the file placement in the file system, it is impossible to predict in advance whether the remaining free space is enough. Full OTA upgrade will erase the entire system partition and copy all system files to the system partition. It will change the file placement in the file system. The free space may insufficient during the upgrade process to cause upgrade fail.

7.2 Problem inspection SOP

1. NAND flash project
2. Use UBIFS as file system
3. The size of raw system image is larger than physical system partition size
4. last_log contains "No space left on device" keywords

7.3 Suggested solutions

In order to reduce the incidence of this problem, we provide two suggestions in the development as a reference:

1. Preserve a larger margin for system partition
2. Try to use the differential OTA instead of full OTA when the out of free space problem happened

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