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TELECHIPS ANDROID FIRMWARE UPDATE GUIDE

Telechips Android 4.4.2(Kitkat) Firmware Update Guide

Rev. 1.7.1

Apr 2, 2014

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Revision History

Date	Version	Description
2012.05.18	0.1	Ice cream sandwich initial release
2012.11.29	1.4	Update package signing and build
2013.03.05	1.5	Remove MTD Partition and Internal storage update
2014.02.13	1.6	Android v4.4(Kitkat) Beta Release
2014.03.28	1.7	- Android v4.4.2(Kitkat) Official Release 1) Signed image build procedure is modified. 2) Exception handling description for sudden power-off event is added.
2014.04.02	1.7.1	- Fix Partition Size Bug for Boot and Recovery Partition in MBR Table

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1. Overview

This guide provides useful information for understanding how to upgrade Android device with new image or images package. Additionally, basic information about Telechips Android platform – various boot mode, partition structure, and etc.- will be also provided.

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2. Basics

Telechips Android platform supports 2 types of flash memory.

- 1) Internal Storage – this is non-removable storage used as main boot storage.
- 2) External Stotage – this is removable memory such as SD card and USB memory stick that you can write to and is mainly used for storing multimedia data.

When you turn on Android device, it boots into one of several different boot modes listed at Tables 1.

System area of internal storage is divided into several partitions where contain boot image, system image, data, etc. You can overwrite these partitions by copying image or upgrading device, which allows you to install different modification of the operating system.

Copying/upgrading procedure will be described in “5. How to flash devices in detail”.

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3. Boot Mode

There are several boot modes which can be entered by starting the Android device with different key combinations. Here is a list of them.

Name	How to start	Description
Normal boot mode	Press power button, and device will boot as normal	This is the way to start the phone as normal.
Recovery mode	Hold Volume up button and press reset button	In this mode, you can upgrade your device with recovery image package.
Fastboot mode	Hold Back button and press reset button, press back button until screen shows bootloader console.	In this mode, you can flash boot, recovery and system images(*.img files) on to the device using fastboot command on the host computer.

Table 1. Boot Mode

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4. Ext4(eMMC / NAND V8) Partition

System area of internal flash memory contains following block device(eMMC) partitions.

Partitions	Name	Size	Description
/dev/block/mmcblk0p1	boot	15MB	Hold boot.img (the kernel and initrd.)
/dev/block/mmcblk0p2	System	650MB	Holds the Android platform. Mounted read-only
/dev/block/mmcblk0p3	Cache	150MB	Used by various purpose: 1. Stores OTA image 2. Radio or bootloader upgrades 3. Used temporarily for downloading file If there is no need for OTA update, this partition can be shrunk.
/dev/block/mmcblk0p4	Recovery	15MB	Hold recovery.img (a kernel and initrd) used for rebuilding / updating the device. A copy is stored in /system/recovery.img which is flashed onto the mmcblk0p6 partition when the device is turned off.
/dev/block/mmcblk0p5	Splash	5MB	Used for vendor's splash image
/dev/block/mmcblk0p6	Kpanic	5MB	Android kernel panic handler (apanic) writes kernel dump data when kernel panic is occurred.
/dev/block/mmcblk0p7	Misc	1MB	Used for communicating with boot loader
/dev/block/mmcblk0p8	Tcc(optional)	1MB	Used for set-top flash write
/dev/block/mmcblk0p9	Userdata	Available	Hold all the user applications and data

Table 2. eMMC Block Device Partitions(GPT)

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Partitions	Name	Size	Description
/dev/block/mmcblk0p1	boot	15MB	Hold boot.img (the kernel and initrd.)
/dev/block/mmcblk0p2	System	650MB	Holds the Android platform. Mounted read-only
/dev/block/mmcblk0p3	Userdata	Available	Holds all the user applications and data
/dev/block/mmcblk0p4	Extended	-	Linux Extended Partition
/dev/block/mmcblk0p5	Cache	150MB	Used by various purpose: 4. Stores OTA image 5. Radio or bootloader upgrades 6. Used temporarily for downloading file If there is no need for OTA update, this partition can be shrunk.
/dev/block/mmcblk0p6	Recovery	15MB	Hold recovery.img (a kernel and initrd) used for rebuilding / updating the device. A copy is stored in /system/recovery.img which is flashed onto the mmcblk0p6 partition when the device is turned off.
/dev/block/mmcblk0p7	Kpanic	5MB	Android kernel panic handler (apanic) writes kernel dump data when kernel panic is occurred.
/dev/block/mmcblk0p8	Splash	1MB	Used for vendor's splash image
/dev/block/mmcblk0p9	misc	1MB	Used for communicating with boot loader

Table 3. eMMC Block Device Partitions(MBR)

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System area of internal flash memory contains following block device(NAND V8) partitions.

Partitions	Name	Size	Description
/dev/block/ndda1	boot	15MB	Hold boot.img (the kernel and initrd.)
/dev/block/ndda2	System	650MB	Holds the Android platform. Mounted read-only
/dev/block/ndda3	Cache	150MB	Used by various purpose: <ol style="list-style-type: none"> 1. Stores OTA image 2. Radio or bootloader upgrades 3. Used temporarily for downloading file If there is no need for OTA update, this partition can be shrunk.
/dev/block/ndda4	Recovery	15MB	Hold recovery.img (a kernel and initrd) used for rebuilding / updating the device. A copy is stored in /system/recovery.img which is flashed onto the mmcblk0p6 partition when the device is turned off.
/dev/block/ndda5	Splash	5MB	Used for vendor's splash image
/dev/block/ndda6	Kpanic	5MB	Android kernel panic handler (apanic) writes kernel dump data when kernel panic is occurred.
/dev/block/ndda7	Misc	1MB	Used for communicating with boot loader
/dev/block/ndda8	Tcc(optional)	1MB	Used for set-top flash write
/dev/block/ndda9	Userdata	Available	Hold all the user applications and data

Table 4. NAND-v8 Block Device Partitions(GPT)

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Partitions	Name	Size	Description
/dev/block/ndda1	boot	15MB	Hold boot.img (the kernel and initrd.)
/dev/block/ndda2	System	650MB	Holds the Android platform. Mounted read-only
/dev/block/ndda3	Userdata	Available	Holds all the user applications and data
/dev/block/ndda4	Extended	-	Linux Extended Partition
/dev/block/ndda5	Cache	150MB	Used by various purpose: <ol style="list-style-type: none"> 1. Stores OTA image 2. Radio or bootloader upgrades 3. Used temporarily for downloading file If there is no need for OTA update, this partition can be shrunk.
/dev/block/ndda6	Recovery	15MB	Hold recovery.img (a kernel and initrd) used for rebuilding / updating the device. A copy is stored in /system/recovery.img which is flashed onto the mmcblk0p6 partition when the device is turned off.
/dev/block/ndda7	Kpanic	5MB	Android kernel panic handler (apanic) writes kernel dump data when kernel panic is occurred.
/dev/block/ndda8	Splash	1MB	Used for vendor's splash image
/dev/block/ndda9	misc	1MB	Used for communicating with boot loader

Table 5. NAND-v8 Block Device Partitions(MBR)

NOTE : The size can be changed according to the display and eMMC or NAND size.

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5. How to Make Images

5.1. Signed Image

In the root path of Android source, do “mksigimg” command with password after build environment was executed. If the “mksigimg” command is successfully finished, signed images and signed update package(update.zip) are shown at “signature_image” directory like following figure :

```
B120040@C2-G3-Dev10:/home2/B120040/kitkat4.4.2/140325$ ls
abi      build    development  frameworks  libnativehelper  packages  signature_img
art      cts      device      hardware     Makefile         pdk       system
bionic   dalvik   docs        kernel       ndk              prebuilts tools
bootable developers external  libcore       out            sdk       vendor
B120040@C2-G3-Dev10:/home2/B120040/kitkat4.4.2/140325$
B120040@C2-G3-Dev10:/home2/B120040/kitkat4.4.2/140325$
B120040@C2-G3-Dev10:/home2/B120040/kitkat4.4.2/140325$ ls -alh signature_img/
total 1019M
drwxr-xr-x  2 B120040 Default_Group 4.0K Mar 28 12:30 .
drwxr-xr-x 30 B120040 Default_Group 4.0K Mar 28 12:36 ..
-rw-r--r--  1 B120040 Default_Group  18 Mar 28 12:24 android-info.txt
-rw-r--r--  1 B120040 Default_Group 11M Jan  1 2009 boot.img
-rw-----  1 B120040 Default_Group 5.3M Mar 28 12:30 cache.img
-rw-r--r--  1 B120040 Default_Group 12M Jan  1 2009 recovery.img
-rw-r--r--  1 B120040 Default_Group 208M Mar 28 12:30 signed_img.zip
-rw-r--r--  1 B120040 Default_Group 209M Mar 28 12:29 signed.zip
-rw-r--r--  1 B120040 Default_Group 354M Jan  1 2009 system.img
-rw-r--r--  1 B120040 Default_Group 203M Mar 28 12:31 update.zip
-rw-----  1 B120040 Default_Group  19M Mar 28 12:30 userdata.img
B120040@C2-G3-Dev10:/home2/B120040/kitkat4.4.2/140325$
```

NOTE : We don't support updating signed packages in fastboot mode. Updating package is supported only in recovery mode.

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5.2. Fastboot Image

After building Android source code, you will get several images as follows.

- boot.img – contain the kernel and initrd(ram disk)
- recovery.img – contain files used for rebuilding/updating the system
- system.img – contain the Android platform/apps of the specific Android version
- userdata.img – ext4 image for userdata partition

You can download these images to corresponding NAND V8 or eMMC partition independently by using fastboot mode.

The following command makes fastboot update file:

```
$ make updatepackage (output will be saved at out/target/product/<your product>/xxx-img-xxx.zip)
```

And all of storage partitions can be downloaded at once with below command:

```
$ fastboot update out/target/product/<your product>/xxx-img-xxx.zip
```

5.3. Preparing Recovery Image Package

To update overall system at once, recovery image package should be used.

Recovery image package includes following images.

- boot.img
- recovery.img
- system files
- radio (only for phone application) or bootloader images

To make recovery images package

1. run make

```
$ make otapackage (output will be located at out/target/product/<your product>/xxx-ota-xxx.zip)
```

or

```
$ make dist (output will be saved in out/dist/xxx-ota-xxx.zip)
```

2. Copy zip file to SD card

3. This file should be renamed as "update.zip" to be used for updating system

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6. Upgrading Device

This section describes how to copy an image file to the device and upgrade device in detail.

6.1. Choosing upgrading methods

There are three alternative ways used to flash Android device with new image.

- 1) Copying an image to device using fastboot command
This approach is slightly more complicated and involves fastboot tool to flash system images independently.
To use this method, Telechips original bootloader supporting fastboot protocol must be used.
- 2) Upgrading the device using recovery mode
This approach involves using updated radio image(only for phone application) and recovery image on the eMMC or NAND storage area.
This method can be activated by magic key during boot or Settings menu.
- 3) OTA update
OTA update involves getting updated files through wireless network includes WiFi and 3G network etc.
Because this method can be fully implemented by android device manufacturers, Telechips will provide only simple reference example.

Before upgrading the device, follow below guidances.

- 1) If you want to flash a special whole partition, please use fastboot mode.
- 2) If you want to update system fully or incrementally, please use recovery mode.

6.2. Upgrading a Device using Fastboot

This approach can be done by using fastboot method and will completely replace a particular partition by overwriting it with an image file.

Image files name must be named with the ".img" suffix.

Follow the below steps to flash an image file to the device.

- 1) Boot a device into fastboot mode.
To enter fastboot mode, press RETURN(BACK) key during initial boot time.
Keep pressing RETURN(BACK) key down until the bootloader screen is visible.
The device is now in fastboot mode and is ready to receive fastboot command.
- 2) Connect the device to host computer over USB cable if it isn't connected with.
- 3) Use fastboot command from PC to erase image that you are going to overwrite.
For example, if you want to overwrite system partition, do below command:
\$ fastboot erase system
- 4) Use fastboot command to flash partition.
e.g. for system partition (with image file stored current dir)
\$ fastboot flash system system.img
- 5) Reboot device by using below command from host computer.
\$ fastboot reboot

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To get more fastboot information, use below command:

\$ fastboot

6.3. Upgrading a Device using Recovery Mode

This method will update whole partitions by overwriting various files including entire image files.

Recovery image package includes

- A boot image
- A recovery image
- System files
- A radio image (only for phone application)
- Bootloader image

The recovery image package must be renamed as update.zip.

After preparing package, follow the below steps.

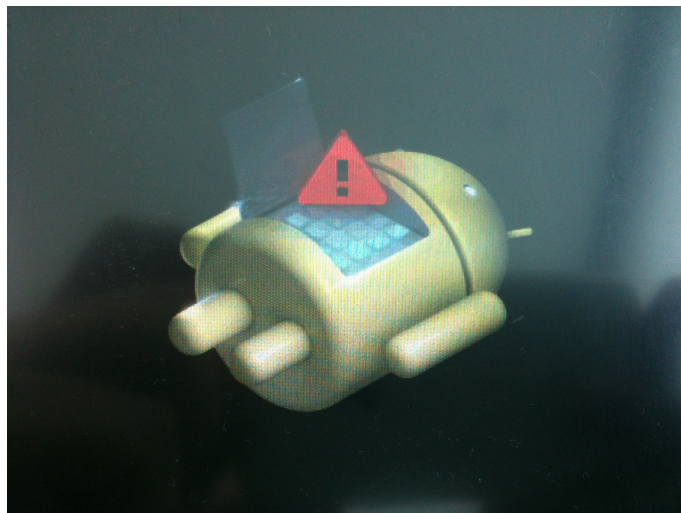
There are 2 methods to boot into recovery mode:

1. Using magic key
2. Using Settings menu

6.3.1 Using magic key

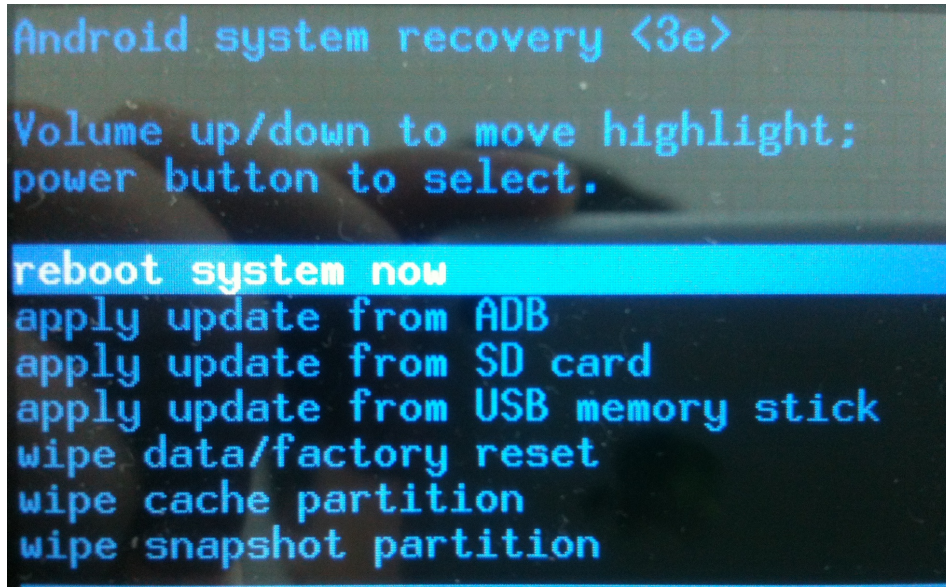
1. Copying update file to the root of SD card.
2. Ensure that SD card contains update file.
3. Reboot the device into recovery mode by holding down the Volume up key during initial boot sequence.

When the device enters recovery mode, it displays a android like below figure.



4. Press "Volume Up" key with "Power" key to show recovery menu.

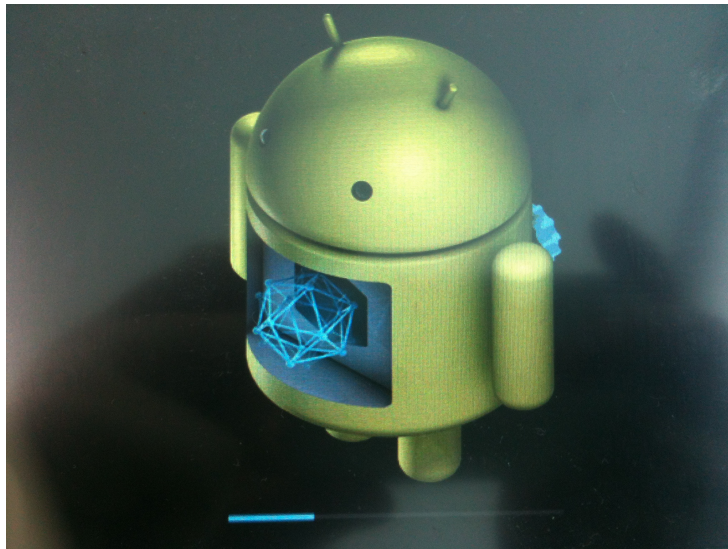
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This menu includes following items.

- 1) Reboot system now
- 2) Apply update : ADB Interface
- 3) Apply update from Internal Storage(update.zip)
- 4) Apply update from SD card(update.zip)
- 5) Apply update from USB memory stick(update.zip)
- 6) Wipe data / factory reset
- 7) Wipe cache partition

To start upgrade, place cursor between 2nd and 5th item and press "Power" key to execute. Progressive bar will be displayed, and upgrade will be started



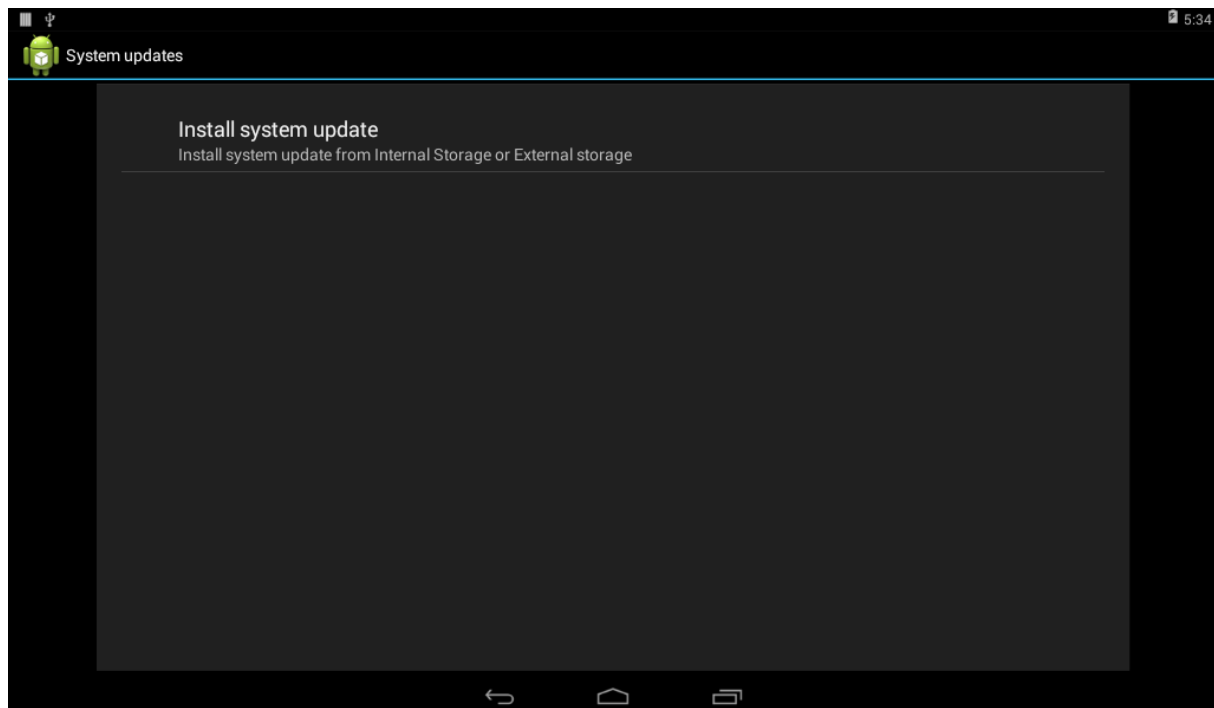
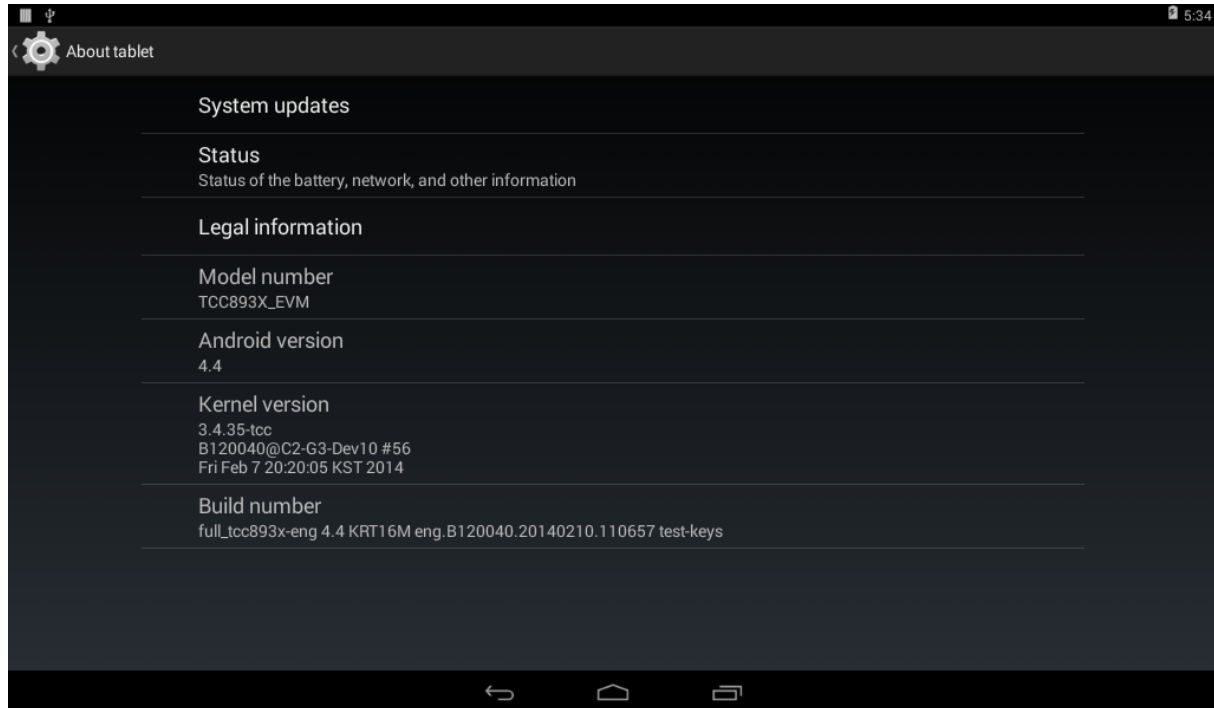
When the progressive bar completes, the installation is finished
After finishing upgrade, the device will automatically reboot into normal mode.

6.3.2 Using Settings Menu

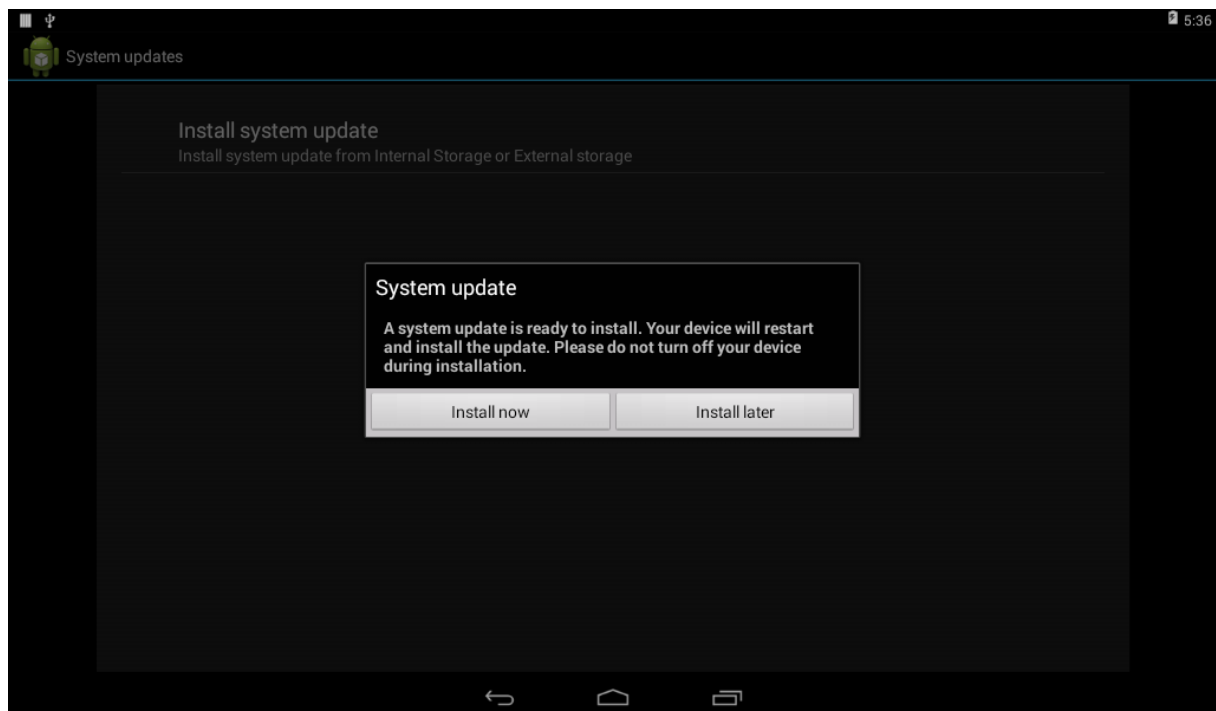
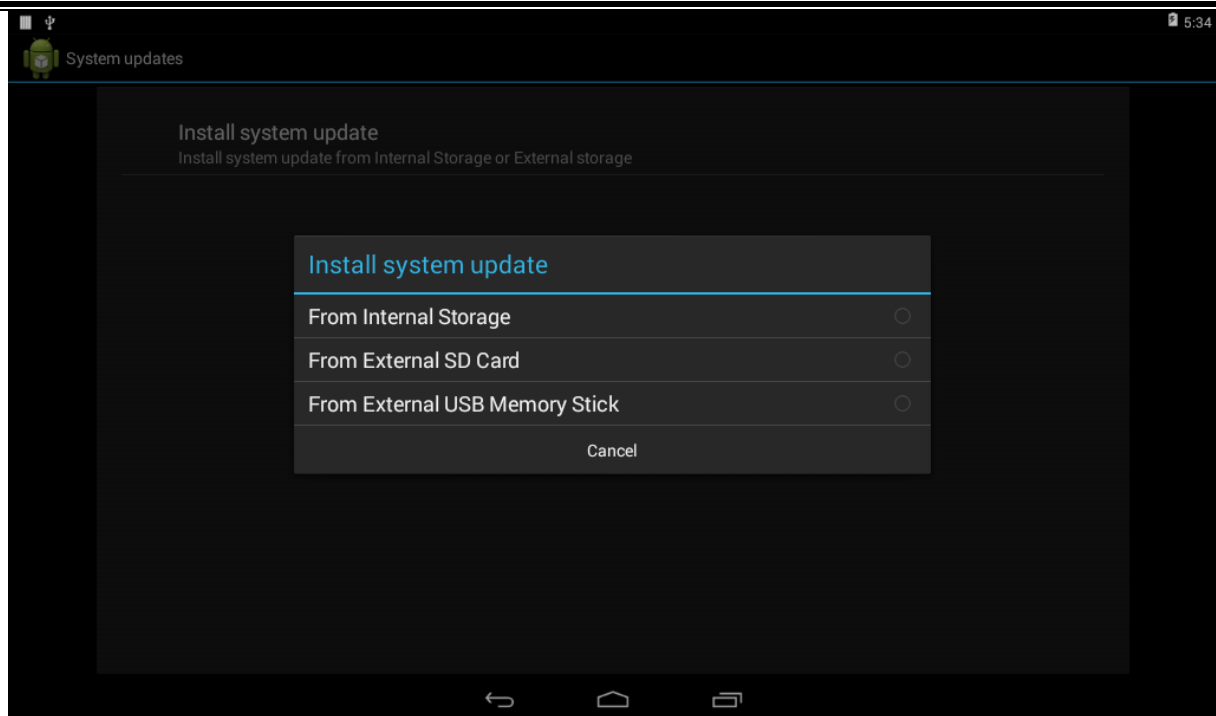
1. Copying update file to the root of Internal Storage or External storage.

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2. Select Settings->About phone->System updates->Install system update menu.
3. After selecting "Install system update" menu, select "From Internal Storage" or "From External storage".



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4. System will reboot into recovery mode ,and then updates system files automatically.
5. After updating system files, it will reboot into normal mode automatically.

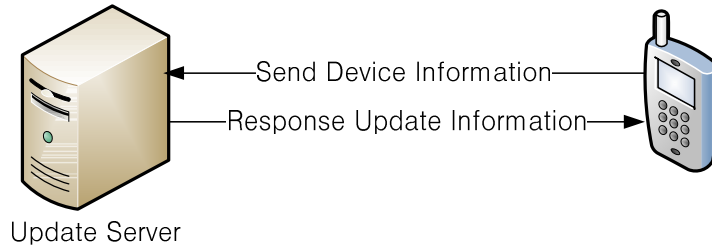
6.4. OTA updates

Telechips provides basic OTA update function and this can be found in the Telechips Android source directory device/telechips/common/app/TelechipsSystemUpdater. Because this function can not be fully implemented by Telechips, the function is disabled by default. Vendors can activate OTA by adding following system properties in /system/system.prop.

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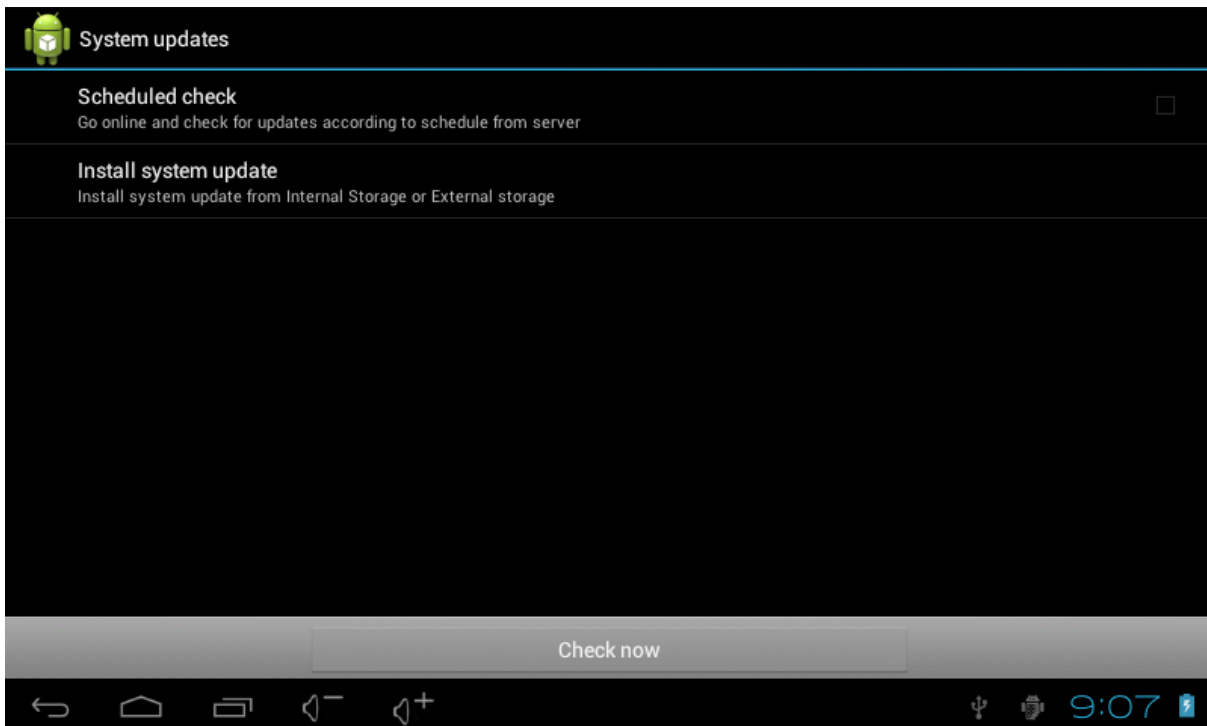
ro.fota.enable=1

ro.fota.url=vendor's server URL



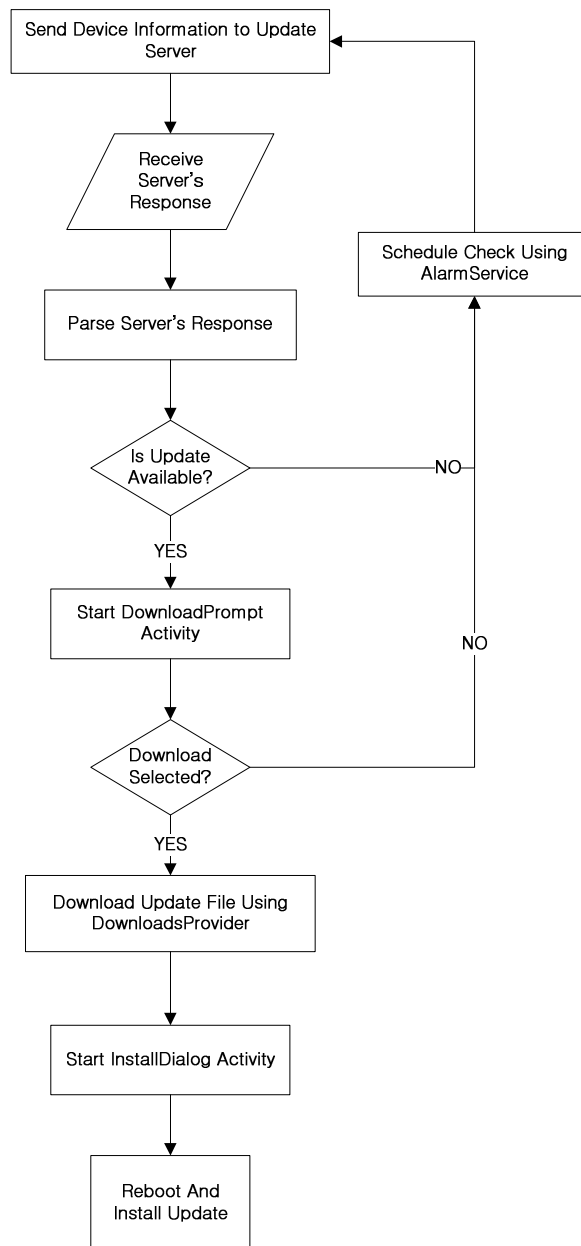
If users activate the scheduled check, system checks for updates every a week (7 days) from the server which is provided by vendor. If there are new updates, system will notify the updates.

User can view update details and download the updates by selecting the notification. After download is completed, a dialog is appeared and installations is started by clicking Install now button.



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Here is a flowchart for OTA scheduled check:



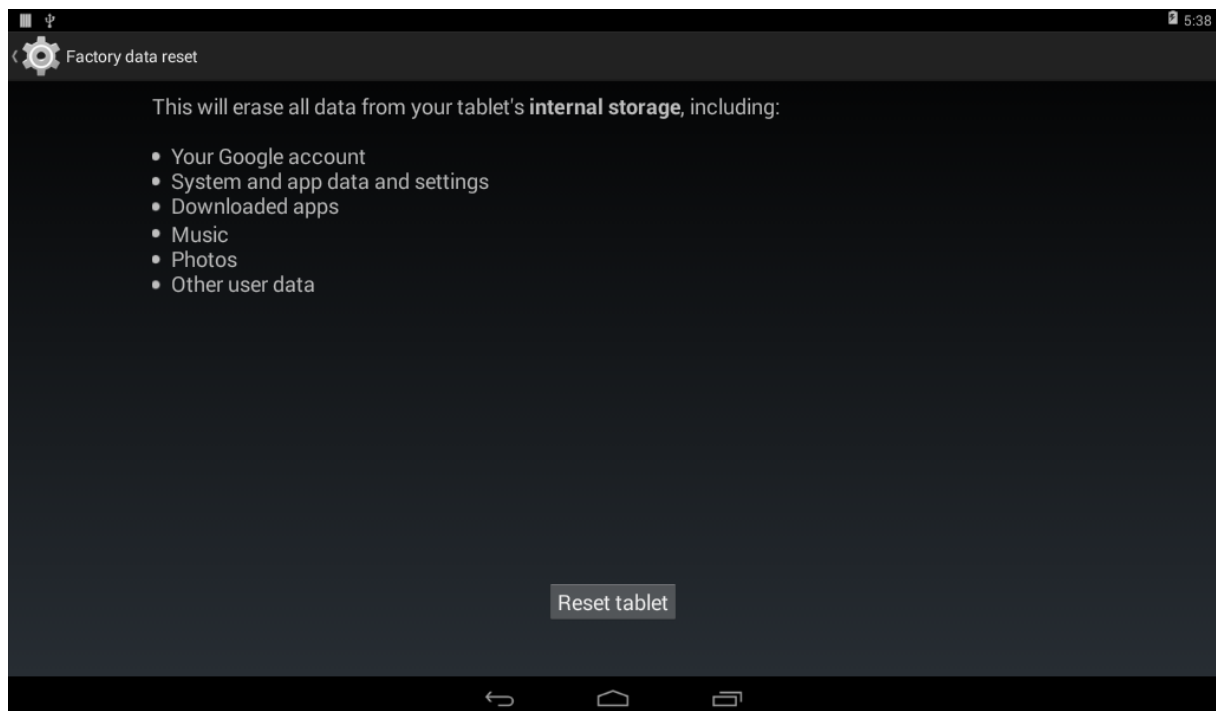
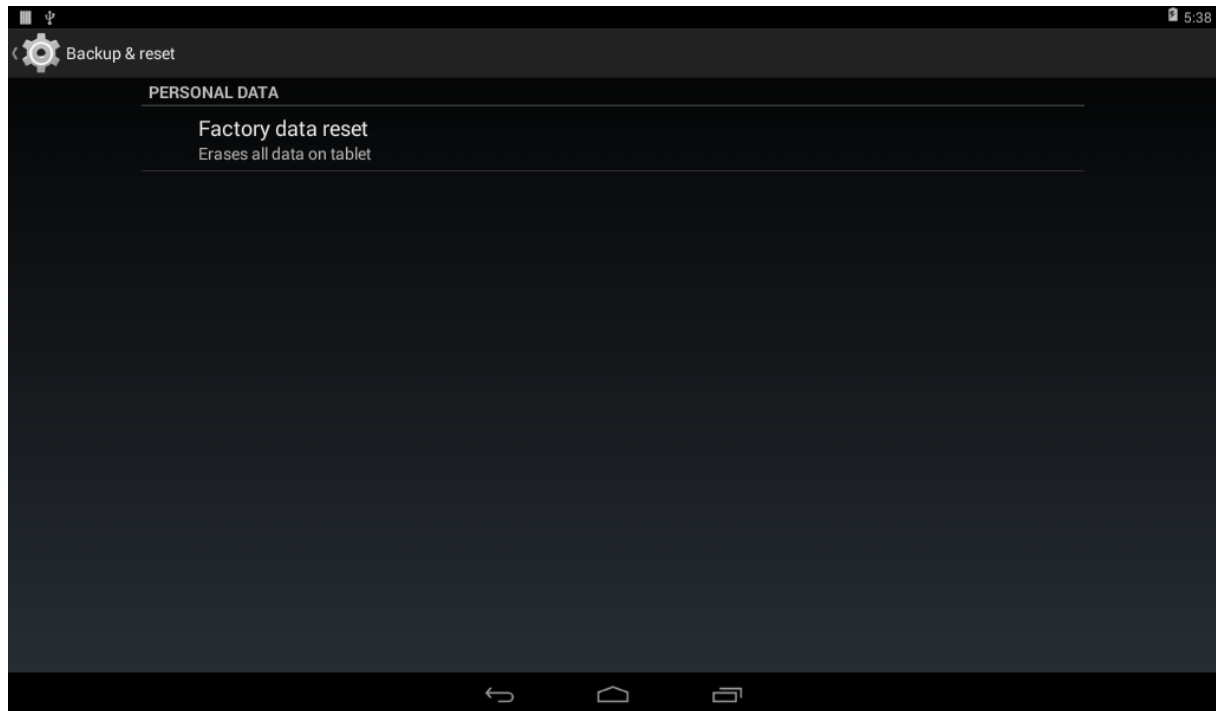
Another method to check the updates is pressing Check Now button in Settings -> About phone -> System updates menu. Similar to scheduled check, if the system updates is available, users can download and install the updates.

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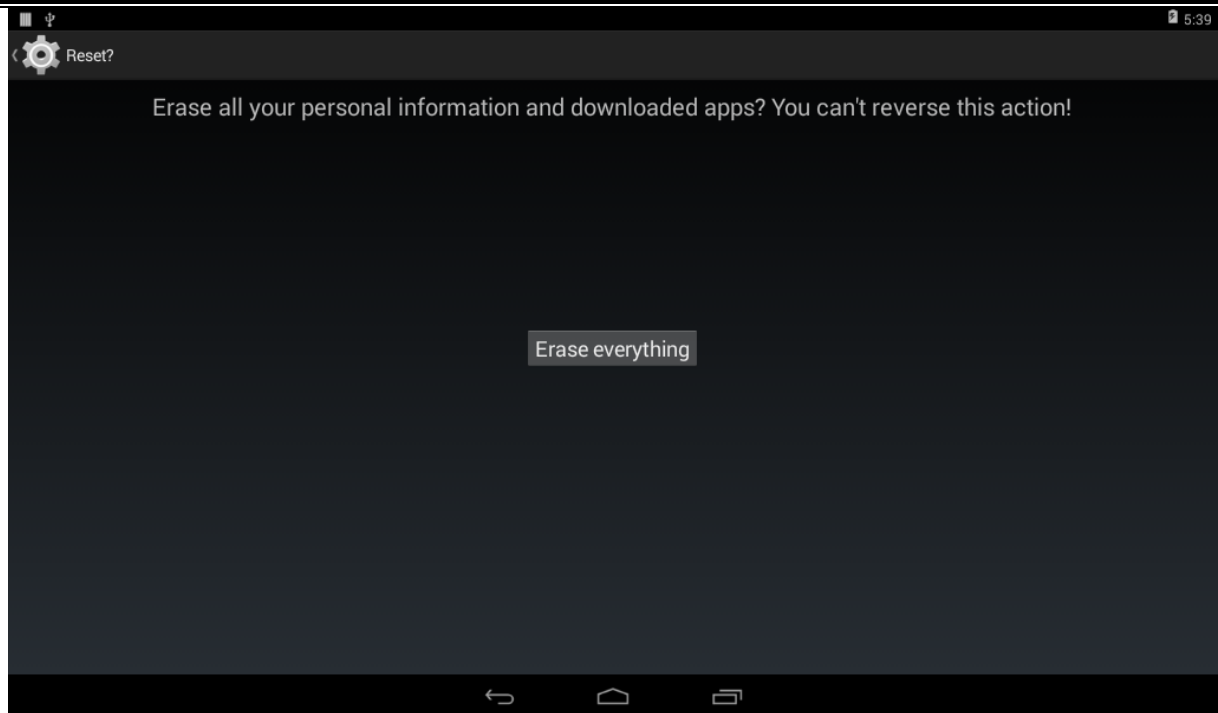
7 Reset Device to Factory Settings

You can reset device to factory settings as follows.

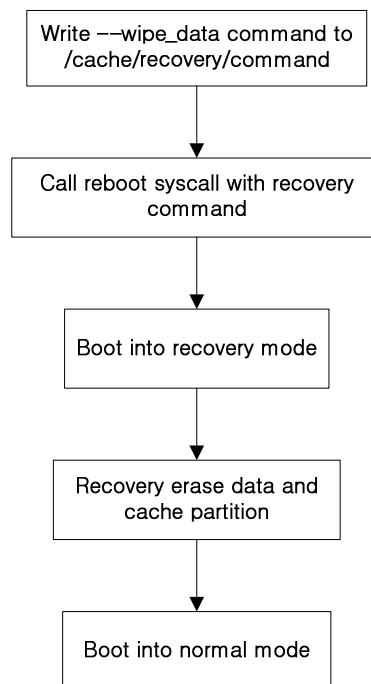
Select Settings->Backup & Reset ->Factory data reset



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If you select 'Erase everything', it will restart into recovery mode and wipes out /data folder contents.

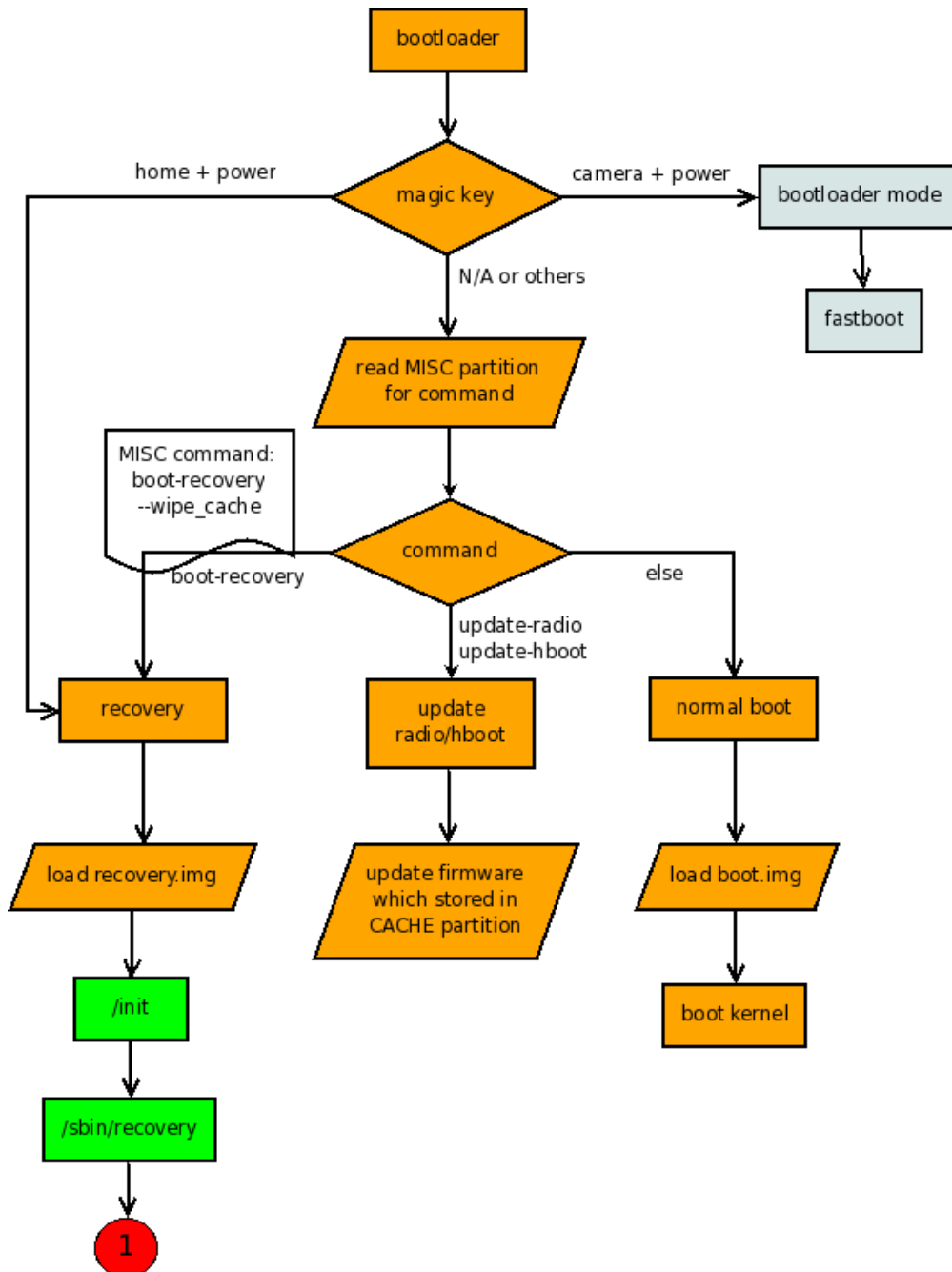


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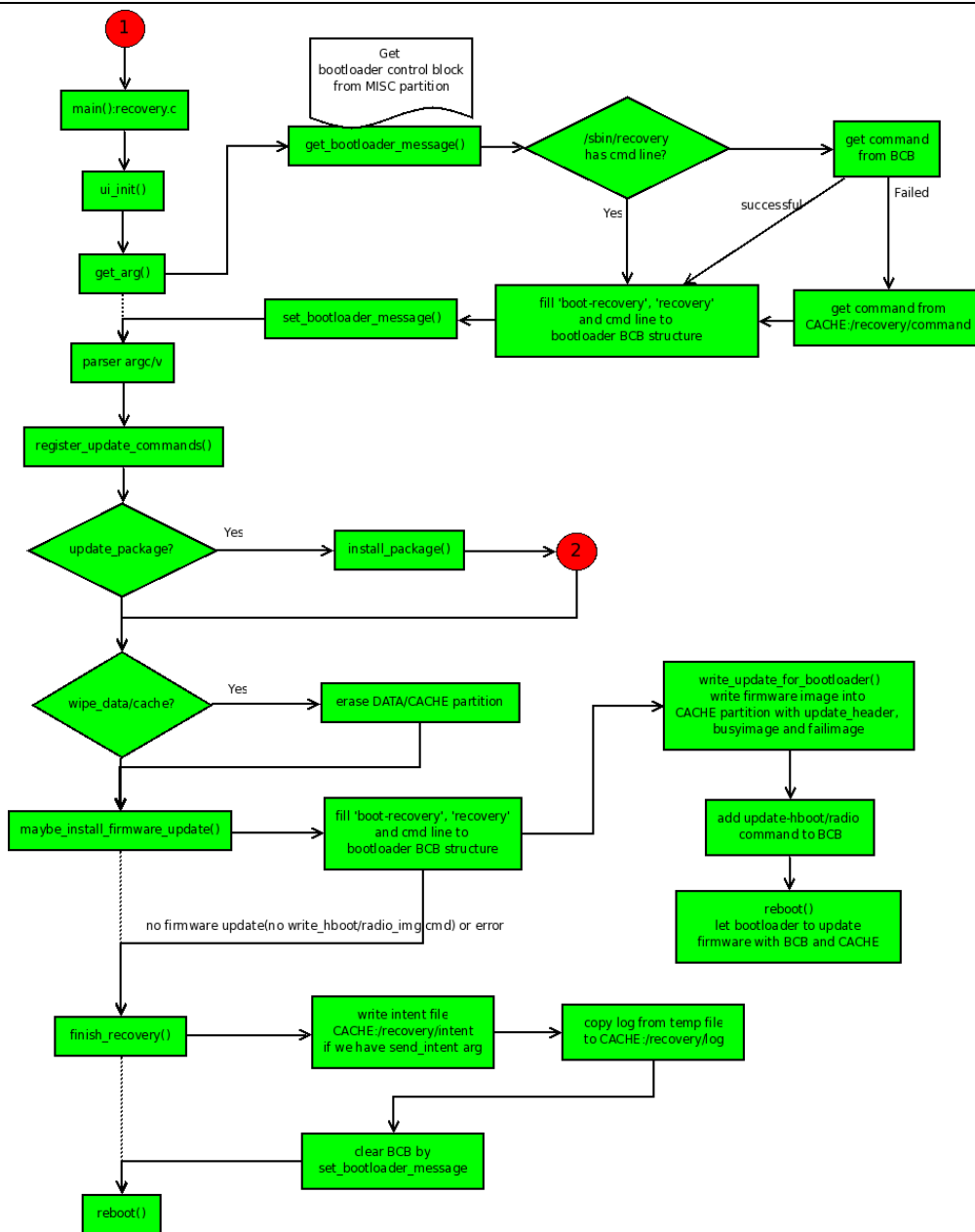
8 Appendix

8.1 Recovery Mechanism

This describes recovery mechanism and how to communicate bootloader and Android system. (It is quoted from China Linux Forum, http://blog.chinaunix.net/u/14459/showart_1911144.html).



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8.2 How to Update Bootloader

The OTA package can contain a bootloader image and can be updated in recovery mode. If you remove following line

```
TARGET_NO_BOOTLOADER := true
```

in the BoardConfig.mk and copy your bootloader image which is renamed lk.rom to bootloader.img to device directory (device/<your vendor name>/<your product name>/bootloader.img), the Android build system adds your bootloader image to OTA package file.

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8.3 How to Get Tool

To flash an image/recovery image package to android device, you need to have access to the proper tools. If you are flashing android device using the recovery image method, you need the adb tool to copy it to External Storage or Internal storage.

If you are flashing android device using fastboot method, you need the fastboot tool in addition to the adb tool

1) adb tool

The adb tool is included in the Android SDK.

If you have already installed Android SDK, you will find adb in the SDK.

2) fastboot tool

fastboot source code is available in the Telechips Android source repository and is compiled whenever you build from that tree

You will find the fastboot executable in this location.

<build-dir>/out/host/<platform>/bin/

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8.4 Update System from Jellybean to Kitkat

When a system is updated from Jellybean to Kitkat, update package including “bootloader.img” is not operated in Jellybean recovery image. Because of this, to update system including “bootloader.img” between different android version(Jellybean→Kitkat), you must update bootloader independently after normal image(boot.img, system.img, and recovery.img) is upgraded from Jellybean to Kitkat.

To do this, execute follow update sequence.

Phase 1. Update all of system image from Jellybean to Kitkat.

To do this, make update package(“update.zip”) including “boot.img”, “system.img”, and “recovery.img” like below command.

```
$ make otapackage
```

Phase 2. Make only “bootloader.img”

Phase 2.1. Enable making bootloader only option.

```
$ vim device/telechips/<platform>/BoardConfig.mk
```

\$ Change “TARGET_UPDATE_ONLY_BOOTLOADER” variable from false to true

```
TARGET_USERIMAGES_USE_EXT4 := true

TARGET_BOOTLOADER_BOARD_NAME := tcc893x_evm

TARGET_NO_BOOTLOADER := true
TARGET_NO_RADIOIMAGE := true
TARGET_UPDATE_ONLY_SPLASH := false
TARGET_UPDATE_ONLY_BOOTLOADER := true

# Splash Partition Use
TARGET_SPLASH_USE := true

KERNEL_DEFCONFIG := tcc893x_defconfig

BOARD_CFLAGS := -DTCC893X
TARGET_BOOTLOADER_BOARD_CFLAGS := -D_TCC8930_

BOARD_FLASH_BLOCK_SIZE := 4096
BOARD_SYSTEMIMAGE_PARTITION_SIZE := 681574400 #650MB System
BOARD_USERDATAIMAGE_PARTITION_SIZE := 3077455872

BOARD_CACHEIMAGE_PARTITION_SIZE := 157286400
BOARD_CACHEIMAGE_FILE_SYSTEM_TYPE := ext4

"device/telechips/tcc893x/BoardConfig.mk" [Modified] 147 lines --21%-- 31,0-1 17%
```

Phase 2.2. Copy lk.rom to “device/telechips/<platform>/” directory.

In this step, the lk.rom has to be named to “bootloader.img”

```
$ cp bootable/bootloader/lk/build-<platform>/lk.rom device/telechips/<platform>/bootloader.img
```

Phase 2.3. Execute “make otapackage”. With this package, you can update bootloader independently.

```
$ make otapackage
```

Additionally, some configuration files related with partition layout such as “fstab.XXX”, “recovery.XXX” have to be modified because default partition layout is adjusted with partition table scheme(MBR→GPT) from Kitkat. To apply this easily, run following example operation:

1. Move Target Device Directory in Android Kitkat
\$ cd device/telechips/<platform>
2. Change Partition Layout
\$ cp -rf parttype_mbr/* ./

Telechips

8.5 Exception Handling for Sudden Power-off Event during System Update using FOTA

In system update operation, a device may face sudden power-off event due to a lot of unpredictable reasons. In this crash situation, the device won't boot normally. To care this critical scenario, Android OS copes with it by inserting a way to boot recovery mode again when a device is unexpectedly switched off in the middle of recovery mode operation such as FOTA and Factory Reset.

Approximate design components are next ones:

1. A special command which can be entered recovery mode is always written to specific storage partition("misc") at start point of recovery mode when a device enters recovery mode from normal boot mode.
2. Bootloader always checks the specific partition in boot phase.

