Realtek Wi-Fi SDK for Android KK 4.4 ver. 1.1.1

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Release History

| 0.0.1 | 2013/11/22 | 1. Beta release |
|-------|------------|--|
| | | 1.1. realtek_wifi_SDK_for_android_KK_4.4_20131122.tar.gz |
| | | 1.2. wpa_supplicant_8_kk_4.4_rtw_r9640.20131122.tar.gz |
| 1.0.0 | 2014/01/17 | 1. First formal release |
| | | 1.1. realtek_wifi_SDK_for_android_KK_4.4_20140117.tar.gz |
| 1.1.0 | 2014/02/20 | 1. wpa_supplicant_8_kk_4.4_rtw_r10450.20140220.tar.gz |
| 1.1.1 | 2019/8/21 | CONFIG_RTW_ANDROID in Makefile |

SDK packages

- hardware/realtek/*
 Folder to store config files, private code from Realtek.
- hardware/libhardware_legacy/wifi/Android.mk
 Reference codes for applying wifi realtek.c
- * For wpa_supplicant_8_kk_4.4_rtw_r10450.20140220.tar.gz or newer version, see wpa supplicant hostapd folder of our SW release package or consult our contact window.

Introduction

This document provides a simple guide to help engineers to apply Realtek Wi-Fi solution onto their Android KK 4.4 system. For now, we have supported the following two scenarios:

- STA/AP Switch between STA mode and AP mode
- (STA+P2P)/AP Switch between STA+P2P(Wi-Fi Direct) concurrent mode and AP mode

To port Realtek Wi-Fi driver onto Android 4.4 platform, you can go through the following guide with reference codes within our driver package's realtek wifi SDK for android KK 4.4 20140117.tar.gz.

Because Android's SDK may differ from platform to platform, our reference codes may not be applied on every platform without modifications. You should check if our reference code is suitable for you to use.

In this document, ANDROID_SDK is the path of top folder of the target Android SDK; this term is used in the following paragraphs.

1. Copy Necessary Files into SDK

After unzipping realtek_wifi_SDK_for_android_KK_4.4_20140117.tar.gz, copy the following folder into ANDROID_SDK/hardware/ folder:

hardware/realtek

2. Platform Related Files

2.1. BoardConfig.mk

To apply Realtek Wi-Fi solution onto your Android KK system, you need to define some compile-time variables in BoardConfig.mk of your platform. In general, the BoardConfig.mk file is located in:

ANDROID_SDK /device/<soc_vendor_name>/<board_name>/
Take TI panda board for example:

ANDROID SDK /device/ ti/panda/ BoardConfig.mk

Please define the following compile-time variables below:

```
BOARD WIFI VENDOR := realtek
ifeq ($(BOARD_WIFI_VENDOR), realtek)
  WPA_SUPPLICANT_VERSION := VER_0_8_X
  BOARD_WPA_SUPPLICANT_DRIVER := NL80211
  CONFIG_DRIVER_WEXT := y
  BOARD_WPA_SUPPLICANT_PRIVATE_LIB := lib_driver_cmd_rtl
  BOARD_HOSTAPD_DRIVER
                               := NL80211
  BOARD HOSTAPD PRIVATE LIB := lib driver cmd rtl
  BOARD WLAN DEVICE := rtl8192cu
  #BOARD WLAN DEVICE := rtl8192du
  #BOARD_WLAN_DEVICE := rtl8192ce
 #BOARD_WLAN_DEVICE := rtl8192de
#BOARD_WLAN_DEVICE := rtl8723as
#BOARD_WLAN_DEVICE := rtl8723au
  #BOARD WLAN DEVICE := rtl8189es
  #BOARD WLAN DEVICE := rtl8723bs
  #BOARD WLAN DEVICE := rtl8723bu
  WIFI_DRIVER_MODULE_NAME := "wlan"
  WIFI DRIVER MODULE PATH := "/system/lib/modules/wlan.ko"
  WIFI DRIVER MODULE ARG := "ifname=wlan0 if2name=p2p0"
  WIFI_FIRMWARE_LOADER
  WIFI_DRIVER_FW_PATH_STA := ""
  WIFI_DRIVER_FW_PATH_AP := ""
  WIFI DRIVER FW PATH P2P := ""
  WIFI DRIVER FW PATH PARAM := ""
endif
```

BOARD_WIFI_VENDOR := realtek

To distinguish the platform Wi-Fi device from products of other vendors, we define variable BOARD_WIFI_VENDOR as realtek. This is for compile-time choices to be applied for Realtek Wi-Fi solutions.

• WPA_SUPPLICANT_VERSION := VER_0_8_X
For Android KK, please set WPA_SUPPLICANT_VERSION as VER_0_8_X to

use wpa supplicant 8.

- BOARD WPA SUPPLICANT DRIVER := NL80211
- BOARD WPA SUPPLICANT PRIVATE LIB := lib driver cmd rtl
- BOARD HOSTAPD DRIVER := NL80211
- BOARD_HOSTAPD_PRIVATE_LIB := lib_driver_cmd_rtl

We use NL80211 as the driver interface for wpa_supplicant and hostapd to communicate with driver and provide lib driver cmd rtl as the private library.

• BOARD WLAN DEVICE

Realtek provide a variety of Wi-Fi solutions to choose. For now, BOARD_WLAN_DEVICE is not used for any purpose but we suggest setting this variable for your Wi-Fi solution you used.

- WIFI DRIVER MODULE NAME
- WIFI DRIVER MODULE PATH
- WIFI_DRIVER_MODULE_ARG

These three variables will be used in libhardware_legacy (wifi.c/wifi_realtek.c) to do insmod and remmod. The value of WIFI_DRIVER_MODULE_NAME should match the value of MODULE_NAME specified in our driver's Makefile at compile-time. Please refer to "Platform Setting Section in Detail" of:

document/Quick_Start_Guide_for_Driver_Compilation_and_Installation.pdf

- WIFI FIRMWARE LOADER :=""
- WIFI DRIVER FW PATH STA :=""
- WIFI DRIVER FW PATH AP :=""
- WIFI DRIVER FW PATH P2P :=""
- WIFI DRIVER FW PATH PARAM :=""

Because our driver has FW embedded inside, and will automatically load FW at NIC initialization process, there is no need to set these 5 variables, just keep them empty.

2.2. init.xxx.rc

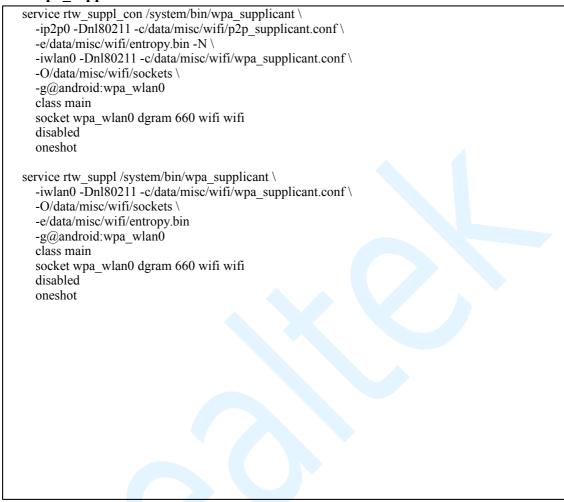
For Wi-Fi to operate properly, we need some daemons to be defined as service inside init.xxx.rc. In general, the init.xxx.rc file is located in:

ANDROID_SDK/device/<soc_vendor_name>/<board_name>/
Take TI panda board for example:

ANDROID SDK/device/ti/panda/init.omap4pandaboard.rc.

Please add the service definitions below:

• wpa_supplicant



dhcpcd

```
service dhcpcd wlan0 /system/bin/dhcpcd -aABDKL
  class main
  disabled
  oneshot
service dhcpcd p2p/system/bin/dhcpcd -aABKL
  class main
  disabled
  oneshot
service iprenew wlan0 /system/bin/dhcpcd -n
  class main
  disabled
  oneshot
service iprenew p2p /system/bin/dhcpcd -n
  class main
  disabled
  oneshot
```

2.3. Others

For topics mentioned here, you can add the following code segments in any .mk file which your platform will use. Take TI panda board for example:

ANDROID_SDK /device/ ti/panda/device.mk.

• Add android.hardware.wifi.xml

To claim Wi-Fi support for you device, please add the rule in the PRODUCT_COPY_FILES variable to copy the permission definition file of Wi-Fi to the /system/etc/permissions/ folder of your system image.

```
PRODUCT_COPY_FILES += \frameworks/native/data/etc/android.hardware.wifi.xml:system/etc/permissions/android.hardware.wifi.xml
```

• Add android.hardware.wifi.direct.xml

To claim Wi-Fi Direct (P2P) support for your device, please add the rule in the

PRODUCT_COPY_FILES variable to copy the permission definition file of Wi-Fi Direct to the /system/etc/permissions/ folder of your system image.

```
PRODUCT_COPY_FILES += \ frameworks/native/data/etc/android.hardware.wifi.direct.xml:system/etc/permissions/android.hard
```

Make sure your driver is configured for STA+P2P concurrent mode or you may encounter error when you open the Wi-Fi. Please refer to "7. Driver Configurations for Android KK"

• Set wifi.interface

ware.wifi.direct.xml

To specify the wifi interface name in Android, a system property named "wifi.interface" is used. For Realtek Wi-Fi driver, Wi-Fi interface name is assigned with "wlan%d". In general, you should set wifi.interface as "wlan0".

```
PRODUCT_PROPERTY_OVERRIDES += \
wifi.interface=wlan0
```

3. System Resource Configurations

You should set the following four resource configurations for your platform to configure the network function and enable the corresponding UI interface. In general, you can set the following configurations in your platform dependent config.xml file. Take TI panda board for example:

 $ANDROID_SDK/device/ti/panda/overlay/frameworks/base/core/res/res/values/config.xml$

Or the global config.xml file:

ANDROID SDK/frameworks/base/core/res/res/values/config.xml

networkAttributes

To define the system's available network interfaces, make sure the wifi and wifi_p2p interface items is defined in the networkAttributes resource configuration in the config.xml. For example:

radioAttributes

To define the system's available network interfaces, we need to define interface items for wifi in the radioAttributes resource configuration. For example:

• config tether wifi regexs

The interfaces set here are tetherable Wi-Fi interfaces which will be used as interfaces for Wi-Fi LAN port. We use 'wlan0' by default when our Wi-Fi is set as softap mode. So it needs to set 'wlan0' here. For example:

• config tether upstream types

The connection types set here are used as the interfaces for WAN port to connect to internet. For example, adding Wi-Fi and Ethernet:

At least one item should be declared here to enable the "Tehtering&portable hotspot" option of WirelessSettings in Settings.apk.

To know the definition and set other upstream connection types, please refer to ANDROID SDK/frameworks/base/core/java/android/net/ConnectivityManager.java.

4. libhardware legacy

The libhardware_legacy library includes functionality for Wi-Fi to operate. We have made modifications and extensions for our Wi-Fi solutions. To apply this, please modify ANDROID_SDK/hardware/libhardware_legacy/wifi/Android.mk to include

wifi realtek.c instead of wifi.c into LOCAL SRC FILES. For example:

```
ifeq ($(BOARD_WIFI_VENDOR), realtek)
LOCAL_SRC_FILES += ../realtek/wlan/libhardware_legacy/wifi/wifi_realtek.c
else
LOCAL_SRC_FILES += wifi/wifi.c
endif
```

5. wpa_supplicant_8

We provide wpa_supplicant_8_kk_4.4_rtw_r10450.20140220.tar.gz or newer version in the wpa_supplicant_hostapd/ of our SW release package. You can:

Compare and merge with your own wpa supplicant 8

Compare and merge from wpa_supplicant_8_kk_4.4_rtw by your own. For both ANDROID_SDK/external/wpa_suppliant_8/wpa_supplicant/Android.mk and ANDROID_SDK/external/wpa_suppliant_8/hostapd/Android.mk, you should notice that the two macros REALTEK_WIFI_VENDOR and ANDROID_P2P should be added into L CFLAGS. For example:

```
ifeq ($(BOARD_WLAN_DEVICE), bcmdhd)
L_CFLAGS += -DANDROID_P2P
endif

ifeq ($(BOARD_WIFI_VENDOR), realtek)
L_CFLAGS += -DREALTEK_WIFI_VENDOR
L_CFLAGS += -DANDROID_P2P
Endif

# Use Android specific directory for control interface sockets
```

Here is the description of the specific macros:

| MACRO | Description | | |
|---------------------|--|------|--|
| ANDROID_P2P | Android's wpa_supplicant_8 patch. | Must | |
| REALTEK_WIFI_VENDOR | General purpose patch made by Realtek. | Must | |

• Use the wpa supplicant 8 kk 4.4 rtw instead of the original

A. Backup and remove the original external/wpa supplcant 8/ folder

- B. Extract and copy the wpa_supplicant_8_kk_4.4_rtw tar file to the external/folder of your Android SDK.
- C. Rename wpa supplicant 8 kk 4.4 rtw as wpa supplicant 8.
- * We have enabled the two macros ANDROID_P2P and REALTEK_WIFI_VENDOR by default.
- 6. Driver Configurations for Android KK

Android KK support two scenarios for Wi-Fi solution:

- STA/AP Switch between STA and AP mode
- (STA+P2P)/AP Switch between STA+P2P concurrent and AP mode

The configuration of driver to fit the requirement of each scenario, see the following table:

| MACRO | STA/AP | (STA+P2P)/AP | Kernel ver. |
|------------------------------|--|-------------------|----------------|
| CONFIG_IOCTL_CFG80211 | Defined | Defined | ver. >= 2.6.35 |
| RTW_USE_CFG80211_STA_EVENT | Defined | Defined | ver. >= 3.2.0 |
| CONFIG_CONCURRENT_MODE | Undefined | Defined | - |
| CONFIG_WFD | Don't Care | Must for Miracast | - |
| RTW_ENABLE_WIFI_CONTROL_FUNC | Must for platform device/driver mechanism | | |
| CONFIG_RTW_ANDROID | Must set this when rtk driver ver >= v5.9, | | |
| | please refer to section 6.1 | | 1 |

• RTW_USE_CFG80211_STA_EVENT is used for driver to indicate new cfg80211 STA event which is required by wpa_supplicant_8 of Android 4.4. Linux kernel supports this feature after kernel 3.2. For kernel version between 3.0 and 3.2, please refer to the patch file:

linux-3.0.42 STATION INFO ASSOC REQ IES.diff

• RTW_ENABLE_WIFI_CONTROL_FUNC is used to register platform driver callbacks. If your platform needs those callbacks, please define this macro to register platform driver callback functions. For example, these functions include:

By default, the probe callback is used to set up Wi-Fi power and remove callback is used to close Wi-Fi power.

Please modify both the include/autoconf.h and the specific autoconf file(needed for compound driver release) for your Wi-Fi product.

| Chip type | Autoconf file to modify |
|------------------|--------------------------------|
| RTL8192CU-series | autoconf_rtl8192c_usb_linux.h |
| RTL8192CE-series | autoconf_rtl8192c_pci_linux.h |
| RTL8192DU-series | autoconf_rtl8192d_usb_linux.h |
| RTL8192DE-series | autoconf_rtl8192d_pci_linux.h |
| RTL8723AS-series | autoconf_rtl8723a_sdio_linux.h |
| RTL8723AU-series | autoconf_rtl8723a_usb_linux.h |
| RTL8723BS-series | autoconf_rtl8723b_sdio_linux.h |
| RTL8189ES-series | autoconf_rtl8189e_sdio_linux.h |
| RTL8188EU-series | autoconf_rtl8188e_usb_linux.h |
| RTL8723BS-series | autoconf_rtl8723b_sdio_linux.h |
| RTL8723BU-series | autoconf_rtl8723b_usb_linux.h |

For example, if you want to configure RTL8192CU-series driver (ex: RTL8188CUS, RTL8192CU) to fit the scenario of (STA+P2P)/AP, make sure the macros: CONFIG_IOCTL_CFG80211, RTW_USE_CFG80211_STA_EVENT and CONFIG_CONCURRENT_MODE in both include/autoconf.h and autoconf_rtl8192c_usb_linux.h(needed for compound driver release) are defined. As following:

```
#define CONFIG_IOCTL_CFG80211
#ifdef CONFIG_IOCTL_CFG80211
#define RTW_USE_CFG80211_STA_EVENT
//#define CONFIG_CFG80211_FORCE_COMPATIBLE_2_6_37_UNDER
//#define CONFIG_DEBUG_CFG80211_1
#endif
...
#define CONFIG_CONCURRENT_MODE
...
```

To compile our Wi-Fi driver, please refer to the following document for more infomations:

document/Quick Start Guide for Driver Compilation and Installation.pdf

6.1. CONFIG RTW ANDROID

From Wifi driver version 5.9, a new setting CONFIG_RTW_ANDROID is added in Makefile, We can set CONFIG_RTW_ANDROID with the Android version in Makefile. e.g. CONFIG_RTW_ANDROID = 4

Please note that we must set CONFIG_RTW_ANDROID with correct Android version from wifi driver version 5.9, otherwise there will be problem in wifi driver for Android. And the default value of CONFIG_RTW_ANDROID is 0, which means the driver is for pure linux, not Android.

```
(CONFIG RTW ANDROID=4 means Android 4.4)
```

Example in Makefile:

Then most of the settings mentioned above are set automatically by Android version (CONFIG_RTW_ANDROID) in drv_conf.h, and we don't need to write these setting in Makefile; Except CONFIG_CONCURRENT_MODE and RTW_ENABLE_WIFI_CONTROL_FUNC still need to be set manually, depends on the platforms in Makefile as above as before.

```
Drv_conf.h

#define CONFIG_IOCTL_CFG80211

#define RTW_USE_CFG80211_STA_EVENT

#if (CONFIG_RTW_ANDROID > 4)

#ifndef CONFIG_RADIO_WORK

#define CONFIG_RADIO_WORK

#endif

#endif
```

7. FAQ

7.1. Wi-Fi (STA mode)

7.1.1. Why Wi-Fi can't enable?

The whole Wi-Fi enabling procedure includes the following three main check points. Please check in sequence:

• Is network interface(s) created?

- insmod driver success
- Wi-Fi device is recognized
- wlan0 (and p2p0) is created

Does wpa supplicant run successfully?

- wpa supplicant.conf (and p2p supplicant.conf) exists and is correct
- Service definition of wpa supplicant exists and is correct
- Binary file wpa supplicant exists and is executable

Do connections of communication socket setup?

- Make sure the communication socket settings is matched below:
 - ctrl_interface in:
 /data/misc/wifi/wpa_supplicant.conf
 (and /data/misc/wifi/p2p_supplicant.conf)
 - Service definition of wpa supplicant
 - ◆ Paths of communication socket in wifi.c (or wifi realtek.c)

7.2. Portable Wi-Fi hotspot (AP mode)

7.2.1. Why Portable Wi-Fi hotspot can't enable?

The whole Portable Wi-Fi hotspot enabling procedure includes the following three main check points. Please check in sequence:

• Is network interface created?

- insmod driver success
- Wi-Fi device is recognized
- wlan0 is created

Does netd and hostapd run successfully?

- /data/misc/wifi/hostapd.conf exists and is correct
- Binary file netd and hostapd exist and are executable

Does dnsmasq run successfully?

■ Binary file dnsmasq exist and are executable

7.3. Wi-Fi Direct (P2P mode)

7.3.1. There is no Wi-Fi Direct UI shown?

Please refer to "Add android.hardware.wifi.direct.xml" in chapter 2.3. Others to enable Wi-Fi Direct functionality of Android KK.

7.3.2. Wi-Fi Direct can't scan any peer?

First, make sure you have workable Wi-Fi Direct device nearby. Make them into Wi-Fi Direct scanning state. Push "SEARCH FOR DEVICES" button also in our device and wait for a while.

If there is still no peer shown the problem is usually caused by wrong service definition of wpa_supplicant services. Please refer to "wpa_supplicant" in chapter 2.2. init.xxx.rc to check your service definition of wpa supplicant.