Realtek Wi-Fi SDK for Android 11.x
ver. 1.0.0

Contents

Release History

1.0.0	2020/10/15	1. First formal release

SDK packages

- hardware/realtek/*

  Folder to store private code from Realtek.

- supplicant_overlay_configs/*

  Folder to store supplicant overlay config files

Introduction

This document provides a simple guide to help engineers to apply Realtek Wi-Fi solution onto their Android 11.x system. The following two scenarios are supported

- **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 11.x platform, you can go through the following guide with reference codes within our driver package's realtek_wifi_SDK_for_android_11.x_<date>.tgz.

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

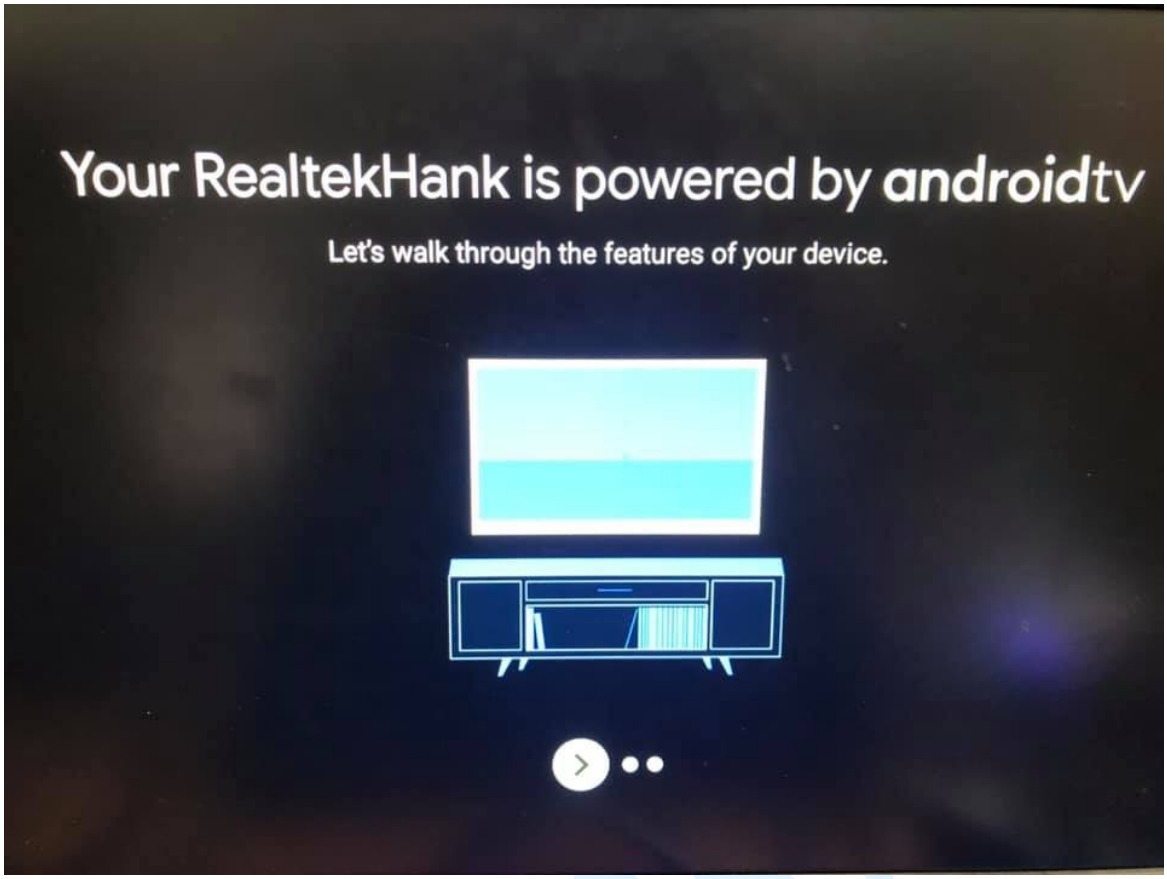
After unzipping realtek_wifi_SDK_for_android_11.x_<date>.tgz, copy the following folder into ANDROID_SDK/hardware/folder:

- hardware/realtek

2. Platform Related Files

Reference Platform

Realtek Hank - DHC 1319 platform



BoardConfig.mk

To apply Realtek Wi-Fi solution onto your Android 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>/

If we use Realtek DHC 1319 platform as example, it is located at

ANDROID_SDK/device/realtek/hank/BoardConfig.mk

```
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_PRIVATE_LIB := lib_driver_cmd_rtl
    BOARD_HOSTAPD_DRIVER := NL80211


    BOARD_WLAN_DEVICE := realtek

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 10, 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**

BOARD_WLAN_DEVICE is used to choose which vendor wifi_hal should be applied. You have to set BOARD_WLAN_DEVICE := realtek to use realtek's wifi_hal.

init.xxx.rc

For Wi-Fi to operate properly, we need some actions and 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>/

If we use Realtek DHC 1319 platform as example, it is located at

ANDROID_SDK/device/realtek/hank/common/init.hank.rc

Please add the service definitions below:

- **mkdir for wpa_supplicant and copy config file**

  Please make sure the directories used by the Wireless and related wpa_supplicant config filess will be created and copied in init rc.

```
on zygote-start
# Create the directories used by the Wireless subsystem
# Copy wpa_supplicant config files to related dir
    mkdir /data/misc/wifi 0770 wifi wifi
    mkdir /data/misc/wifi/wpa_supplicant 0770 wifi wifi
    mkdir /data/vendor/wifi 0771 wifi wifi
    mkdir /data/vendor/wifi/wpa 0770 wifi wifi
    mkdir /data/vendor/wifi/wpa/sockets 0770 wifi wifi
    mkdir /data/misc/dhcp 0770 dhcp dhcp
    chown dhcp dhcp /data/misc/dhcp
```

- **insmod**

  Please select one of action definitions below according to your requirement.

  Meanwhile, please make sure your wlan.ko has right seclabel and mode as

```
-rw-r--r-- 1 root root  u:object_r:vendor_file:s0 3429448 1970-01-01 00:19 wlan.ko
```

  You can use command "ls -alZ" to check seclabel of wlan.ko.

  (For concurrent mode)

```
on boot

    exec u:r:vendor_modprobe:s0 root root -- /vendor/bin/toybox_vendor insmod
/system/vendor/lib/modules/wlan.ko ifname=wlan0 if2name=p2p0
```

(For STA only)

```
on boot
    exec u:r:vendor_modprobe:s0 root root -- /vendor/bin/toybox_vendor insmod
/system/vendor/lib/modules/wlan.ko ifname=wlan0
```

- **wpa_supplicant**

  Please define wpa_supplicant service as below.

  If we use Realtek DHC 1319 platform as example, it is located at

  ANDROID_SDK/device/realtek/hank/common/prebuilt/vendor/etc/init/wpa_supplicant.rc

```
service wpa_supplicant /vendor/bin/hw/wpa_supplicant \
    -O/data/vendor/wifi/wpa/sockets \
    -g@android:wpa_wlan0
    interface android.hardware.wifi.supplicant@1.0::ISupplicant default
    interface android.hardware.wifi.supplicant@1.1::ISupplicant default
    interface android.hardware.wifi.supplicant@1.2::ISupplicant default
    interface android.hardware.wifi.supplicant@1.3::ISupplicant default
    socket wpa_wlan0 dgram 660 wifi wifi
    class main
    disabled
    oneshot
```

Others

For topics mentioned here, you can add the following code segments in any .mk file which your platform will use.

- **Add wifi related packages**

These packages are needed for Wifi support, please make sure these packages are added in .mk

If we use Realtek DHC 1319 platform as example, it is located at

ANDROID_SDK/device/realtek/hank/device.mk

```
PRODUCT_PACKAGES += \
libwpa_client wpa_supplicant hostapd wificond wifilogd wpa_supplicant.conf \
  hostapd.conf libwifi-hal android.hardware.wifi.supplicant@1.0-service \
  android.hardware.wifi.supplicant@1.1-service \
  android.hardware.wifi.supplicant@1.2-service \
  android.hardware.wifi.supplicant@1.3-service \
  android.hardware.wifi@1.0-service android.hardware.wifi@1.0-service-lib \
  android.hardware.wifi@1.1-service android.hardware.wifi@1.1-service-lib \
  android.hardware.wifi@1.2-service android.hardware.wifi@1.2-service-lib \
  android.hardware.wifi@1.3-service android.hardware.wifi@1.3-service-lib \
  android.hardware.wifi@1.4-service android.hardware.wifi@1.4-service-lib \
  android.hardware.wifi.hostapd@1.0-service \
  android.hardware.wifi.hostapd@1.1-service \
  android.hardware.wifi.hostapd@1.2-service
```

- **Add android.hardware.wifi.xml**

To claim Wi-Fi support for your 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.

If we use Realtek DHC 1319 platform as example, it is located at

ANDROID_SDK/device/realtek/hank/common/deviceCommon.mk

```
PRODUCT_COPY_FILES += \
frameworks/native/data/etc/android.hardware.wifi.xml:$
(TARGET_COPY_OUT_VENDOR)/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.

If we use Realtek DHC 1319 platform as example, it is located at ANDROID_SDK/device/realtek/hank/common/deviceCommon.mk

```
PRODUCT_COPY_FILES += \
frameworks/native/data/etc/android.hardware.wifi.direct.xml:$
(TARGET_COPY_OUT_VENDOR)/etc/permissions/android.hardware.wifi.direct.xml
```

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 **"5. Driver Configurations for Android"**

If we use Realtek DHC 1319 platform as example, it is located at ANDROID_SDK/device/realtek/hank/common/deviceCommon.mk

- **Set wifi.interface**

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".

If we use Realtek DHC 1319 platform as example, it is located at ANDROID_SDK/device/realtek/hank/common/deviceCommon.mk

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

- **Set wifi.direct.interface**

If you require p2p support, you have to set wifi.direct.interface as "p2p0"

If we use Realtek DHC 1319 platform as example, it is located at ANDROID_SDK/device/realtek/hank/common/deviceCommon.mk

```
PRODUCT_PROPERTY_OVERRIDES += \
    wifi.direct.interface=p2p0
```

- **Toybox_vendor**

  It's at android/platform/external/toybox, and toybox_vendor can be built out in default, defined in Android.bp

- **WIFI_HAL**

If we use Realtek DHC 1319 platform as example, it is located at

ANDROID_SDK/frameworks/opt/net/wifi/libwifi_hal/Android.mk

```
# Pick a vendor provided HAL implementation library.
# ============================================================
LIB_WIFI_HAL := libwifi-hal-fallback
….
else ifeq ($(BOARD_WLAN_DEVICE), realtek)
  # support RTK WIFI HAL
  LIB_WIFI_HAL := libwifi-hal-rtk
endif
….
```

- **Device manifest file**

The Device manifest file is provided by the device. It lives in the Android source tree at device/${VENDOR}/${DEVICE}/manifest.xml and on the device at /vendor/manifest.xml

If we use Realtek DHC 1319 platform as example, it is located at

ANDROID_SDK/device/realtek/hank/common/manifest.xml

RTK wifi needs Iwifi , ISupplicant and IHostapd. Not like Android 10 or earlier versions, in Android 11, these should be declared at

Hardware/interface/wifi/1.4/default/android.hardware.wifi@1.0-service.xml
External/wpa_supplicant_8/wpa_supplicant/hidl/1.3/manifest.xml
External/wpa_supplicant_8/hostapd/android.hardware.wifi.hostapd.xml

So we don't need to do these definitions in manifest.xml,
if there is some conflicts after defining in this manifest.xml

```
<hal format="hidl">
    <name>android.hardware.wifi</name>
    <transport>hwbinder</transport>
    <version>1.4</version>
    <interface>
        <name>IWifi</name>
        <instance>default</instance>
    </interface>
</hal>
<hal format="hidl">
    <name>android.hardware.wifi.supplicant</name>
    <transport>hwbinder</transport>
    <version>1.3</version>
    <interface>
        <name>ISupplicant</name>
        <instance>default</instance>
    </interface>
</hal>
<hal format="hidl">
    <name>android.hardware.wifi.hostapd</name>
    <transport>hwbinder</transport>
    <version>1.2</version>
    <interface>
        <name>IHostapd</name>
        <instance>default</instance>
    </interface>
</hal>
```

- **Supplicant_overlay config file**

After “1. Copy Necessary Files into SDK.” accomplished, you should find out **wpa_supplicant_overlay.conf** and **p2p_supplicant_overlay.conf** in folder $ANDROID_SDK/devices/${VENDOR}/${TARGET}.
Please modify $ANDROID_SDK/devices/${VENDOR}/${TARGET}/BoardConfig.mk as below.

```
PRODUCT_COPY_FILES += device/${VENDOR}/$
{TARGET}/wpa_supplicant_overlay.conf:$
(TARGET_COPY_OUT_VENDOR)/etc/wifi/wpa_supplicant_overlay.conf

PRODUCT_COPY_FILES += device/${VENDOR}/$
{TARGET}/p2p_supplicant_overlay.conf:$
(TARGET_COPY_OUT_VENDOR)/etc/wifi/p2p_supplicant_overlay.conf
```

If you need **wowlan** function, the below line
wowlan_triggers=any
should be added in your **wpa_supplicant_overlay.conf**

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.

If we use Realtek DHC 1319 platform as example, it is located at
ANDROID_SDK/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 interface items is defined in the networkAttributes resource configuration in the config.xml.
For example:

```
<string-array translatable="false" name="networkAttributes">
    <item>"wifi,1,1,1,-1,true"</item>
    <item>"bluetooth,7,7,0,-1,true"</item>
    <item>"ethernet,9,9,2,-1,true"</item>
</string-array>
```

- **radioAttributes**

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

```
<string-array translatable="false" name="radioAttributes">
    <item>"1,1"</item>
    <item>"7,1"</item>
    <item>"9,1"</item>
</string-array>
```

- **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:

```
<string-array translatable="false" name="config_tether_wifi_regexs">
    <item>"wlan0"</item>
</string-array>
```

- **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:

```
<integer-array translatable="false" name="config_tether_upstream_types">
    <item>1</item>
    <item>9</item>
</integer-array>
```

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.

- **config_enableWifiDisplay**

To enable Wi-Fi Display(Miracast) function, set config_enableWifiDisplay to true:

```
<bool name="config_enableWifiDisplay">true</bool>
```

4. wpa_supplicant_8

We provide **wpa_supplicant_8_11.0.0.r3_rtw_<date>** or newer version in this release package. You can:

- **Use the wpa_supplicant_8_11.0.0.r3_rtw_<date> instead of the original**

1. Backup and remove the original external/wpa_supplcant_8/ folder
2. Extract and copy the wpa_supplicant_8_11.x _rtw_<date> tar file to the external/ folder of your Android SDK.
3. Rename wpa_supplicant_8_11.0.0.r3_rtw_<date> as wpa_supplicant_8.

5. Driver Configurations for Android

Android 11.x 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_RADIO_WORK	Defined	Defined	-
CONFIG_CONCURRENT_MODE	Undefined	Defined	-
RTW_ENABLE_WIFI_CONTROL_FUNC	Defined for platform device/driver mechanism		
CONFIG_RTW_WIFI_HAL	Defined if android version >= 8.x		ver. >= 3.18
CONFIG_RTW_ANDROID	Must set this when rtk driver ver >= v5.9, please refer to section 5.1		

- **CONFIG_IOCTL_CFG80211** is used for driver to enable cfg80211 ioctl interface, which is required by Realtek Wi-Fi to operate on Android 11.x system.

- **RTW_USE_CFG80211_STA_EVENT** is used for driver to indicate new cfg80211 STA event, which is required by wpa_supplicant_8 Linux kernel supports this feature after kernel 3.2.

- **CONFIG_RADIO_WORK** is used for driver to fit 'radio work' mechanism of wpa_supplicant_8. If this MACRO doesn't exist in driver's source code, please contact with Realtek technical windows for suitable driver.
  If you use rtk driver ver. >= v5.9, you do not need to set this compile flag.
  Instead, you have to set CONFIG_RTW_ANDROID according to section "5.1 CONFIG_RTW_ANDROID"

- **CONFIG_CONCURRENT_MODE** is used for driver to enable concurrent mode, which is required by STA+P2P concurrent mode.

- **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:

```
static struct platform_driver wifi_device =
        .probe              = wifi_probe,
        .remove             =
```

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

To compile Realtek Wi-Fi driver with the above setting, please refer to the following document:

document/Quick_Start_Guide_for_Driver_Compilation_and_Installation.pdf

Adding platform selection and setting sections for compilation settings of your platform.

For example, if you want to configure Realtek Wi-Fi driver for the (STA+P2P)/AP scenario, make sure the macros: CONFIG_IOCTL_CFG80211, RTW_USE_CFG80211_STA_EVENT, CONFIG_RADIO_WORK and CONFIG_CONCURRENT_MODE are defined into the EXTRA_CFLAGS settings as following:

```
CONFIG_PLATFORM_ANDROID_M60_SAMPLE = y
…
…
…
ifeq ($(CONFIG_PLATFORM_ANDROID_ML0_SAMPLE), y)
EXTRA_CFLAGS += -DCONFIG_LITTLE_ENDIAN
EXTRA_CFLAGS += -DCONFIG_CONCURRENT_MODE
EXTRA_CFLAGS += -DCONFIG_IOCTL_CFG80211 -DRTW_USE_CFG80211_STA_EVENT
EXTRA_CFLAGS += -DCONFIG_RADIO_WORK
ARCH := arm
CROSS_COMPILE := /toolchain/bin/arm-none-linux-gnueabi-
KSRC := / android_sdk/android_l/ kernel
endif
```

- **CONFIG_RTW_WIFI_HAL** is defined if android version is >= 8.x :
  For supporting Android version >= 8.x, make sure CONFIG_RTW_WIFI_HAL is set to "y" in Makefile as follows,

```
…
CONFIG_RTW_WIFI_HAL = y
…
```

If you use rtk driver ver. >= v5.9, you do not need to set this compile flag.
Instead, you have to set CONFIG_RTW_ANDROID according to section "5.1 CONFIG_RTW_ANDROID"

According to Google's suggestion, you must use kernel 3.18 or newer.
For more detail, you can refer
https://source.android.com/devices/architecture/kernel/modular-kernels

5.1 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 = 10

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:

```
############################## Android ##############################
# CONFIG_RTW_ANDROID - 0: no Android, 4/5/6/7/8/9/10/11 : Android version
CONFIG_RTW_ANDROID = 11

ifeq ($(shell test $(CONFIG_RTW_ANDROID) -gt 0; echo $$?), 0)
EXTRA_CFLAGS += -DCONFIG_RTW_ANDROID=$(CONFIG_RTW_ANDROID)
endif
```

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

#if (CONFIG_RTW_ANDROID >= 8)
        #if (LINUX_VERSION_CODE >= KERNEL_VERSION(3,18,0))
        #ifndef CONFIG_RTW_WIFI_HAL
        #define CONFIG_RTW_WIFI_HAL
        #endif
        #else
        #error "Linux kernel version is too old\n"
        #endif
#endif
```

6. FAQ

6.1 Wi-Fi (STA mode)

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

- **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

- **Do connections of communication socket setup?**
  - Make sure the communication socket settings is matched below:
    - ctrl_interface in:
      /data/vendor/wifi/wpa/wpa_supplicant.conf
      (and /data/vendor/wifi/wpa/p2p_supplicant.conf)
    - Service definition of wpa_supplicant
    - Paths of communication socket in wifi.c

6.2 Portable Wi-Fi hotspot (AP mode)

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

6.3 Wi-Fi Direct (P2P mode)

2. 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 P.

3. 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.

6.4 VTS test

4. VtsHalWifiHostapdV1_2TargetTest AddPskAccessPointWithAcsAndInvalidFreqRange

We have relative patches at hostapd. Please refer to "4. wpa_supplicant_8" to patch it..

6.5 CTS test

5. CtsNetTestCases – TCP keep alive item failed

We can disable "config_networkSupportedKeepaliveCount" in Android config.xml as below

```
<!-- Default supported concurrent socket keepalive slots per transport type, used by
     ConnectivityManager.createSocketKeepalive() for calculating the number of keepalive
     offload slots that should be reserved for privileged access. This string array should be
     overridden by the device to present the capability of creating socket keepalives. -->

  <!-- An Array of "[NetworkCapabilities.TRANSPORT_*],[supported keepalives] -->
  <string-array translatable="false" name="config_networkSupportedKeepaliveCount">
```