

Android RIL Driver

User Guide

LTE/UMTS/HSPA(+)/GSM/GPRS Module Series

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About the Document

History

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1.0	2015-02-27	Carl YIN	Initial
1.1	2015-03-25	Carl YIN	Updated supported products
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1.6	2017-01-05	Macro GAO	<ol style="list-style-type: none">1. Added RIL driver integration by library in Section 3.5.2. Deleted how to modify the right of RILD.3. Added how to configure device permissions in Section 3.6.2.4. Added how to enable SELinux in Section 3.6.3.
1.7	2018-07-13	Macro GAO	Added Android 8.x in supported Android versions
1.8	2019-03-07	Macro GAO	<ol style="list-style-type: none">1. Added Android 9.x in supported Android versions.2. Added EC21, EC200T, EM06, EM12, EG12, AG36, UC200T& MC90 in supported products.3. Updated the description of system configuration in Chapter 3.4. Added how to configure SELinux in Chapter 4.

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1 Introduction

This document mainly introduces how to integrate RIL (Radio Interface Layer) driver into Android OS of customers' target devices as well as how to modify the configuration files for starting RIL service.

1.1. Applicable Products

The document is applicable to the following Quectel modules.

Table 1: Applicable Modules

LTE Standard Module Series	EC2x: includes EC20/EC25/EC20 R2.0/EC20 R2.1/EC21/EC200T modules
	EG9x: includes EG91/EG95 modules
LTE-A Module Series	Ex06: includes EM06/EP06/EG06 modules
	Ex12: includes EM12/EG12 modules
Automotive Module Series	AGxx: includes AG35/AG36 modules
UMTS/HSPA(+) Module Series	UCxx: includes UC15/UC20/UC200T modules
	UGxx: includes UG95/UG96 modules
GSM/GPRS Module Series	Mxx: includes M66/M72/M80/M85/M95
	MCxx: includes MC60/MC90 modules

2 Overview of Android RIL Driver

2.1. Directory Structure

The file structure of Quectel RIL driver package is shown as below.

```
-- arm64-v8a
|-- chat
|-- ip-down
|-- ip-up
|-- libreference-ril.so
-- armeabi
|-- chat
|-- ip-down
|-- ip-up
|-- libreference-ril.so
|-- ql-ril.conf
|-- x86
|-- chat
|-- ip-down
|-- ip-up
|-- libreference-ril.so
```

Figure 1: Structure of RIL Driver Package

2.2. Supported Functions

Table 2: Supported Functions

Function	Support or Not
SMS	YES
Voice Call	YES
Data Service	YES
(U)SIM Tool Kit	NO
Phonebook	YES

2.3. Supported Android Versions

Presently, Quectel RIL driver supports the following Android versions:

Table 3: Supported Android Versions

Versions	Support or not
Android 4.x	YES
Android 5.x	YES
Android 6.0	YES
Android 7.x	YES
Android 8.x	YES
Android 9.x	YES

3 RIL Integration

The chapter mainly describes the RIL driver structure and procedures of setting up an Android system with the RIL driver.

3.1. RIL Driver Structure

Android RIL provides the abstract layer between Android telephony service and radio hardware.

The following illustrates the RIL in the context of Android telephony architecture.

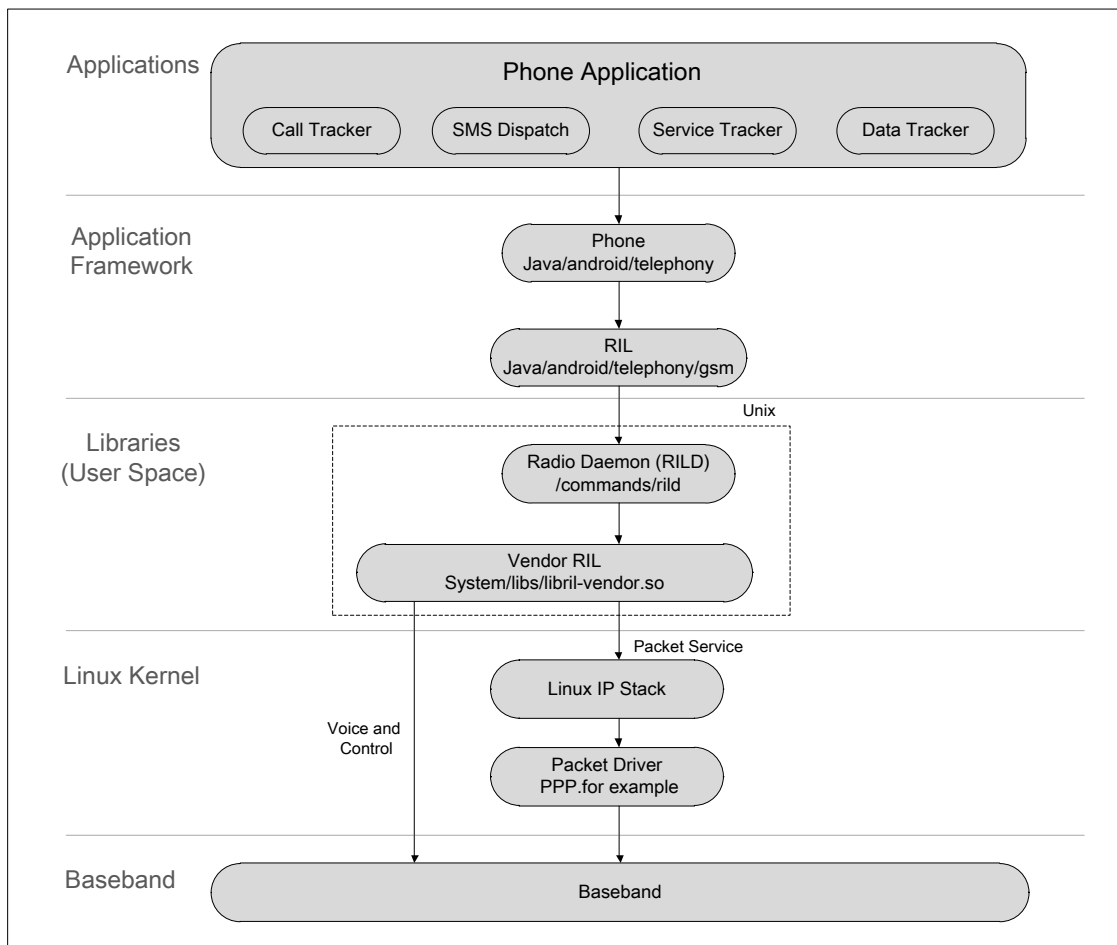


Figure 2: RIL Driver Structure

The RIL in Android is located between kernel and application framework. It is divided into two parts: RILD and Vendor RIL.

RILD is responsible for communications between socket and application framework.

Vendor RIL is responsible for radio communication via AT command channel and data communication with packet data channel (PDCH).

The java framework of RIL consists of two parts as well. One is RIL module and the other is Phone module. The RIL module is used to communicate with the lower RILD, and the phone module directly provides phone function interfaces to application.

3.2. PPP Configuration in Linux Kernel

The kernel needs to be configured to support PPP dial up. For detailed operation procedures, please refer to **Chapter 3.6** in *Quectel_WCDMA<E_Linux_USB_Driver_User_Guide*.

3.3. Driver Installation

If customers use EC2x, EG9x, Ex06, Ex12, AGxx, UCxx or UGxx modules, please integrate USB serial driver, CDC ACM driver, GobiNet driver or QMI WWAN driver in Linux kernel. Otherwise, please skip this section. For detailed operation procedures, please refer to **Chapter 3.2, Chapter 3.3, Chapter 3.4 or Chapter 3.5** in *Quectel_WCDMA<E_Linux_USB_Driver_User_Guide*.

3.4. RIL Driver Integration by Library

Please put the following RIL library files provided by Quectel into the Android system.

1. For Android versions prior to Android 8.0

- For 32-bit Android system

```
system/bin/chat
system/etc/ppp/ip-down
system/etc/ppp/ip-up
system/lib/libreference-ril.so
```

- For 64-bit Android system

```
system/bin/chat
system/etc/ppp/ip-down
system/etc/ppp/ip-up
system/lib64/libreference-ril.so
```

2. For Android 8.0 or later versions

- For 32-bit Android system

```
system/bin/chat
system/etc/ppp/ip-down
system/etc/ppp/ip-up
vendor/lib/libreference-ril.so
```

- For 64-bit Android system

```
system/bin/chat
system/etc/ppp/ip-down
system/etc/ppp/ip-up
vendor/lib64/libreference-ril.so
```

NOTE

If customers use Android 8.0 or later versions, Quectel RIL driver V1.42.08 or later versions should be used.

3.5. System Configuration

In order to use the RIL driver normally, some configuration files in Android system should be modified.

3.5.1. Configure *init.rc*

The *init.rc* can be configured by adding ril-daemon service to it. The relevant lines added to *init.rc* are different, depending on the accessing interfaces and the android versions being used.

3.5.1.1. Modules Accessed by USB Interface

If customers' modules are accessed by USB interface, like EC2x, EG9x, Ex06, Ex12, AGxx, UCxx and UGxx, please add the following lines to *init.rc*:

- For Android versions prior to Android 8.0

```
service ril-daemon /system/bin/rild -l /system/lib/libreference-ril.so
class main
socket rild stream 660 root radio
socket rild-debug stream 660 radio system
user root
group radio cache inet misc audio sdcard_rw log
```

- For Android 8.0 or later versions

```
service ril-daemon /vendor/bin/hw/rild -l /vendor/lib64/libreference-ril.so
class main
user root
group radio cache inet misc audio sdcard_rw log
```

3.5.1.2. Modules Accessed by UART Interface

If customers' modules are accessed by UART interface, like Mxx modules, please add the following lines to *init.rc*:

- For Android versions prior to Android 8.0

```
service ril-daemon /system/bin/rild -l /system/lib/libreference-ril.so -- -d <UART port name> -B
<baud rate> -C <hardware flow control>
class main
socket rild stream 660 root radio
socket rild-debug stream 660 radio system
user root
group radio cache inet misc audio sdcard_rw log
```

- For Android 8.0 or later versions

```
service ril-daemon /vendor/bin/hw/rild -l /vendor/lib64/libreference-ril.so -- -d
<UART port name> -B <baud rate> -C <hardware flow control>
class main
user root
group radio cache inet misc audio sdcard_rw log
```

Meanwhile, the following parameter needs to be configured accordingly:

- **-d <UART port name>**

UART port which is currently used. For example: /dev/ttyS1.

It is optional to configure the following two parameters:

- **-B <baud rate>**

The speed of UART port. For example: 115200bps, 230400bps or 460800bps. The default baud rate is 115200bps.

- **-C <hardware flow control>**

1: Enable the hardware flow control function

0: Disable the hardware flow control function (default setting)

The location of *init.rc* file varies with customers' project settings. The following gives a non-exhaustive list of file paths which may contain the *init.rc* file.

- *system/core/rootdir/init.rc*
- *device/fsl/imx6/init.rc*
- *device/ti/am335xevm_sk/init.am335xevm.rc*
- *device/generic/x86/init.rc*
- *device/samsung/smdkv210/init.smdkv210_sdmmc.rc*

3.5.2. Modify rild.c (Applicable for Android Versions prior to Android 8.0)

RILD (ril-daemon) requires root privileges, so please comment the function of `switchUser()` in the file `($Android_src)/hardware/ril/rild/rild.c`.

```
OpenLib:
#endif
    //switchUser();

    dlHandle = dlopen(rilLibPath, RTLD_NOW);
```

3.5.3. Add HIDL Description (Applicable for Android 8.0 or Later Versions)

On Android 8.0 or later versions, the communication interface between Android phone framework and ril-daemon service has been changed from socket to HIDL, so please make sure that the *manifest.xml* contains the following HIDL description.

```
<hal format="hidl">
    <name>android.hardware.broadcastradio</name>
    <transport>hwbinder</transport>
    <version>1.0</version>
    <interface>
        <name>IBroadcastRadioFactory</name>
        <instance>default</instance>
    </interface>
</hal>
<hal format="hidl">
    <name>android.hardware.radio.deprecated</name>
    <transport>hwbinder</transport>
    <version>1.0</version>
    <interface>
        <name>IOemHook</name>
        <instance>slot1</instance>
    </interface>
</hal>
<hal format="hidl">
    <name>android.hardware.radio</name>
    <transport>hwbinder</transport>
    <version>1.0</version>
    <interface>
        <name>IRadio</name>
        <instance>slot1</instance>
    </interface>
</hal>
```

The location of *manifest.xml* file varies with customers' project settings. For example:
device/rockchip/rk3399/manifest.xml.

4 Configure SELinux

If the SELinux installed in customers' Android devices is enabled and runs in enforcing mode, please follow the procedures below to make sure that Quectel RIL has full access to SELinux privileges. Otherwise, customers can skip this chapter.

4.1. Configure Service ril-daemon

To make sure Quectel RIL has full access to Selinux privileges, the user of service ril-daemon should be radio, so the user of service ril-daemon indicated in **Chapter 3.5.1** should be changed from root to radio. Besides, *capabilities BLOCK_SUSPEND NET_ADMIN NET_RAW* should be added to ril-daemon service. An example, taking Android 8.0 for instance, is shown below.

```
service ril-daemon /vendor/bin/hw/rild -l /vendor/lib64/libreference-ril.so
class main
user radio
group radio cache inet misc audio sdcard_rw log
capabilities BLOCK_SUSPEND NET_ADMIN NET_RAW
```

4.2. Uncomment the function of switchUser()

To make sure Quectel RIL has full access to Selinux privileges, the function of switchUser() mentioned in **Chapter 3.5.2** should be uncommented.

4.3. Configure SELinux Rule for RIL

The following definition should be added to *ueventd.rc*:

```
#quectel port
/dev/ttyUSB*          0660      radio    radio
/dev/cdc-wdm*        0660      radio    radio
/dev/qcqmimi*        0660      radio    radio
/dev/cdc-acm*        0660      radio    radio
```

The following definition should be added to *file_contexts*:

```
/dev/ttyUSB[0-9]*    u:object_r:tty_device:s0
/dev/ttyACM[0-9]*    u:object_r:tty_device:s0
/system/bin/rild      u:object_r:rild_exec:s0
/system/socket/rild   u:object_r:rild_socket:s0
/system/socket/rild-debug u:object_r:rild_debug_socket:s0
/system/bin/pppd      u:object_r:pppd_exec:s0
/dev/ppp              u:object_r:ppp_device:s0
```

The following definition should be added to *rild.te*:

```
allow rild default_prop:property_service set;
allow rild device:chr_file { read write ioctl open getattr };
allow rild kernel:system module_request;
allow rild net_radio_prop:property_service set;
allow rild ppp_device:chr_file { read write ioctl open };
allow rild ppp_exec:file { read execute open execute_no_trans };
allow rild radio_prop:property_service set;
allow rild self:capability { net_admin setuid };
allow rild shell_exec:file { read execute open execute_no_trans };
allow rild sysfs_wake_lock:file { open read write };
allow rild system_file:file execute_no_trans;
allow rild system_prop:property_service set;
```

The locations of *ueventd.rc*, *rild.te* and *file_contexts* may vary with customers' project settings, but in general, these files are located in the following paths respectively by default.

- *system/core/rootdir/ueventd.rc*
- *external/sepolicy/rild.te*
- *external/sepolicy/file_contexts*

5 Debugging Method

5.1. Catch Logs

- 1) Catch the logs of RIL module by typing the following command in Window's CMD tool:

```
adb logcat -b radio -v time
```

- 2) Catch the logs of Android system by typing the following command in Window's CMD tool:

```
adb logcat -v time
```

- 3) Sometimes, customers may want to perform tests on lots of devices or for a long time, and it is not convenient to connect all devices with PC via USB cables. In such case, customers can catch the log files by following command:

```
adb shell  
logcat -b radio -v time -f <filename> &
```

The character "&" makes the "logcat" process run in the background, thus customers' devices can be disconnected.

- 4) When customers' tests are finished, the log files can be fetched from devices to a local directory by the following command:

```
adb pull <filename> <local directory>
```

5.2. Common Log Tags

The following table lists some log tags that are commonly applied.

Table 4: Common Log Tags

RIL	<i>/hardware/ril/reference-ril/refereince-ril.c</i>
AT	<i>/hardware/ril/reference-ril/atchannel.c</i>
RILD	<i>/hardware/ril/rild/rild.c</i>
RILC	<i>/hardware/ril/libril/ril.cpp</i>
RILB	<i>/frameworks/base/telephony/java/com/android/internal/telephony/BaseCommands.java</i>
RILJ	<i>/frameworks/base/telephony/java/com/android/internal/telephony/gsm/RIL.java</i>
GSM	<i>/frameworks/base/telephony/java/com/android/internal/telephony/gsm/GSMPhone.java</i>

6 FAQs

6.1. How to Set the APN

If the dialling process is interrupted, it is quite possible that the APN has not been set yet. Please set the APN in Android UI: **Settings** → **WIRELESS & NETWORKS** → ... → **Mobile Networks** → **Access Point Names**.

If nothing is found in **Access Point Names**, it indicates that the APN has not been set. In such case, customers need to add a new APN to the system. The following is an example shows the access point editing interface. Please note that the Access Point Name varies with the operators and (U)SIM cards.

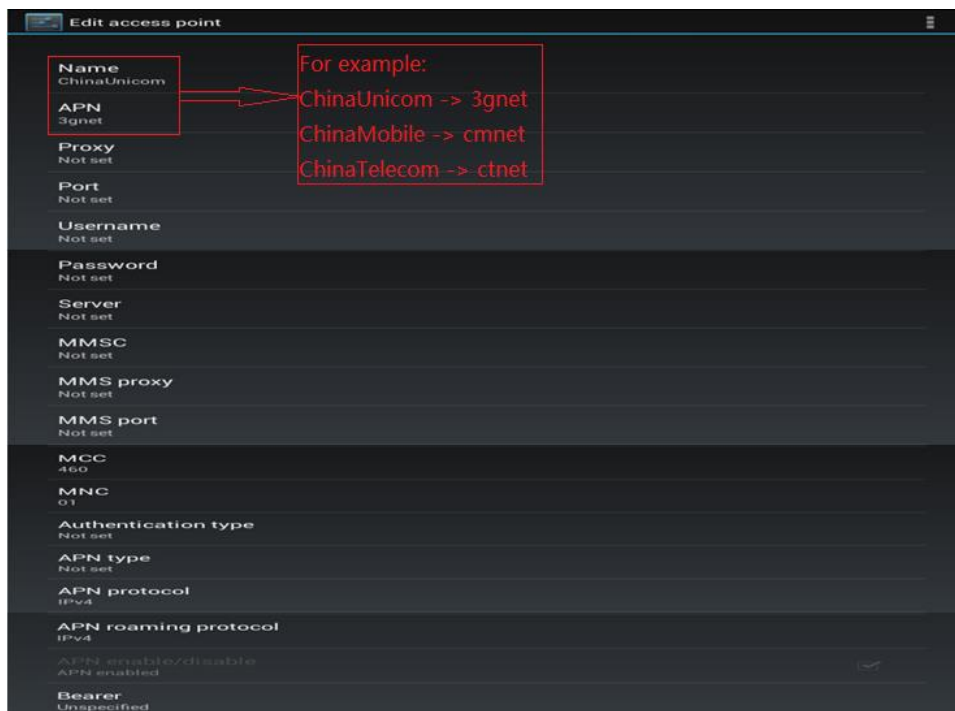


Figure 3: Edit Access Point

6.2. Why Quectel RIL Driver Does not Work

There are many reasons that may cause the failure of Quectel RIL operation, some common causes are listed as below for troubleshooting.

1. RIL Daemon is not running

Use command **getprop init.svc.ril-daemon** to check RIL daemon status. If non-value, **Stopped** or **Restarting** is returned, rather than **Running**, it indicates that RIL daemon is not running.

2. RIL library is not loaded correctly

Check the "ril-daemon" service definition in *init.rc* through command **cat /init.rc | grep ril-daemon**. The expected result should be **service ril-daemon /system/bin/rild -l /system/lib/libreference-ril.so**. Check the arguments, word spelling, blank space, etc. to make sure the RIL library is loaded correctly.

3. Cannot access USB serial port device file

- Use **ls -l /dev/ttyUSB*** command to check the access right of the device file.
- Use **getenforce** command to check whether the SELinux has been enabled. If yes, please use **setenforce 0** command to disable the SELinux.

4. The RIL library is not provided by Quectel

Use **getprop gsm.version.ril-impl** command to check the Quectel RIL version, and the return value should be started with **Quectel_Android_RIL_SR**. If not, then it indicates the RIL library is not provided by Quectel.

6.3. Why Short Messages cannot be Sent or Received

Use **getprop telephony.sms.receive** command or **telephony.sms.send** command to check whether the system has disabled SMS receive/send function.

If the return value is false, it indicates that the SMS receive/send function has been disabled.

If non-value is returned, please check *frameworks/base/core/res/res/values/config.xml* (the manufacturer override configure file) and find *config_sms_capable*. If the *config_sms_capable* configuration in the *config.xml* is false (e.g. `<bool name="config_sms_capable">false</bool>`), please change it to true.

7 Appendix A References

Table 5: Related Documents

SN	Document name	Remark
[1]	Quectel_WCDMA<E_Linux_USB_Driver_User_Guide	Linux USB driver user guide for WCDMA and LTE series modules

Table 6: Terms and Abbreviations

Abbreviation	Description
GSM	Global System for Mobile Communications
MS	Mobile Station
PID	Product ID
RIL	Radio Interface Layer
VID	Vendor ID
WCDMA	Wideband Code Division Multiple Access