RGx00U&RM500U Series
PCIe Driver User Guide

5G Module Series

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About the Document

Revision History

Version	Date	Author	Description
-	2023-03-08	Achang Zhang	Creation of the document
1.0	2023-04-10	Achang Zhang	First official release

Contents

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1 Introduction

Quectel RG200U-CN, RG500U series and RM500U-CN modules communicate with the host through PCIe, so the PCIe driver needs to be ported into the host. The host can communicate with the module normally after the PCIe driver is ported successfully and realize functions such as sending AT commands, capturing log and dialing up.

This document introduces how to port the PCIe driver into the host and how to use the PCIe port to realize related functions in Quectel RG200U-CN, RG500U series and RM500U-CN.

2 PCIe Driver Porting

2.1. Driver Porting Method

You only need to decompress *Quectel_Linux&Android_SPRD_PCIE_Driver* to *drivers* directory of Linux source code, and then add the following content to the *Makefile* in this directory and the driver can be compiled into the kernel.

```
obj-y += sprd_pcie_drv/
```

If the PCIe driver is ported correctly and compiled successfully, device nodes such as spipe_nr0-14, stty_nr0-31, snv_nr, slog_nr, and sdiag_nr can be generated in the *dev* directory of the host, and NIC such as pciex (the name of NIC and the range of "x" is 0–3) and sipa_dummy can also be generated.

NOTE

Please contact Quectel Technical Support to obtain the latest compressed package of *Quectel_Linux&Android_SPRD_PCIE_Driver*.

2.2. Big-endian and Little-endian Modes of Host

Modify the configuration in *include\sipc_big_to_little.h* in the driver package according to the big-endian and little-endian modes of the host. If the host is in little-endian mode, you need to comment out **CONFIG_SIPC_BIG_TO_LITTLE**. If the host is in big-endian, you need to uncomment **CONFIG_SIPC_BIG_TO_LITTLE** .

3 Operation Method

Quectel RG200U-CN, RG500U series and RM500U-CN modules support functions such as sending AT commands through the PCIe port, capturing log and dialing up in PCIe EP mode. The following chapters describe how to realize the above functions through the PCIe port.

3.1. Switching PCIe Mode

Only when the module is in PCIe EP mode, functions such as sending AT commands, capturing log and dialing up can be realized. You can query the current mode of the module by executing **AT+QCFG="pcie/mode"**. 0 means PCIe EP mode and 1 means PCIe RC mode. If the module is in RC mode, you can execute **AT+QCFG="pcie/mode",0** and reboot the module to switch the PCIe mode to EP mode. For details about the AT command, see *document [1]*.

After the mode is switched successfully, you can power on the module and the host simultaneously and execute **lspci** on the command line of the host to list the recognized devices to check whether the module can be recognized normally. For example, the device ID of RG500U series module is 0x16c3, 0xabcd, and if the device ID of the module is correctly recognized, the PCIe mode is switched successfully.

3.2. Sending AT Commands

If the module is in PCIe EP mode and is connected to the host, the host can send AT commands to the module through QCOM and the corresponding serial port is */dev/stty_nr31*. You can send AT commands after executing **microcom -s 115200 /dev/stty_nr31** on the host. For more information about the tool, see *document [2]*.

3.3. Capturing Log

If the module is in PCIe EP mode and is connected to the host, the host can capture log of the module. You can use QLog tool to capture the log. For more information about the tool, see *document [3]*.

3.4. Dialing up

3.4.1. Single Dial-up

Step 1: The PCIe driver is ported into the host. See *Chapter 2.1*.

Step 2: Execute **AT+CGDCONT** and **AT+QICSGP** to configure the parameter of PDP context.

Step 3: Execute **AT+COPS?**, **AT+CGREG?** to query whether the module registers the network successfully.

Step 4: After the successful network registration, execute **AT+QNETDEVCTL=<cid>,<op>,<state>** to PCIe NIC dial-up.

<cid>	Integer type. ID of PDP context. Range: 1–4 (PCIe supports no more than 4 dial-ups).
<op>	Integer type. Set dial-up operation.
	0 Disconnect the dial-up and do not save the configuration
	1 Executing the dial-up and do not save the configuration
	2 Disconnect the dial-up and save the configuration
	3 Executing the dial-up and save the configuration
<state>	Integer type. Whether to enable automatic connection and it is only valid when **<op>**=1 or 3, that is, whether to enable automatic reconnection after dialing up.
	$\underline{0}$ Disable automatic connection and the return value responds synchronously. The return value can occur after the dial-up result comes out. After disconnection, it will not automatically reconnect, and you need to configure it by yourself
	1 Enable automatic reconnection and the return value responds immediately. After the PDP is disconnected, the redial mechanism can be triggered immediately. The retry can be made every 8 seconds, 16 seconds, 32 seconds...2^n times, and the maximum retry interval is 512 seconds

Step 5: Execute **AT+CGPADDR** to query the IP address of the module after the module dials up successfully.

Step 6: Execute the following command on the host command line to set the PCIe mode on the host as the normal mode.

```
echo normal>/sys/class/net/pcie0/mode          //<x> is the value of <cid> minus 1.
```

Step 7: The host can directly obtain the corresponding IP address through the DHCP program, that is, the IP address of the module after the module dials up successfully. Execute the following commands to dial up.

```
ifconfig sipa_dummy0 up
udhcpc -i pcie<x>                                //<x> is the value of <cid> minus 1.
```

Step 8: Execute **AT+QNETDEVSTATUS=<cid>** to query NIC status.

Step 9: The host sets the routing and DNS resolution through the udhcpc program according to the obtained NIC status.

NOTE

For details about the AT commands used during dial-up, see *document [1]*.

3.4.2. Multiple Dial-ups

If you need to perform multiple dial-ups, you can perform a single dial-up as described in *Chapter 3.4.1* first and then perform the following steps. A maximum of 4 dial-ups are supported.

Step 1: Execute **AT+QNETDEVCTL=<cid>,<op>,<state>** to perform the second dial-up.

Step 2: Execute **AT+CGPADDR** to query the IP address of the module.

Step 3: Execute the following command on the host command line to set the PCIe mode as the normal mode.

```
echo normal >/sys/class/net/pcie<x>/mode          //<x> is the value of <cid> minus 1.
```

Step 4: The host can directly obtain the corresponding IP address through the DHCP program, that is, the IP address of the module after the module dials up successfully. Execute the following commands to dial up.

```
ifconfig sipa_dummy0 up
udhcpc -i pcie<x>                                  //<x> is the value of <cid> minus 1.
```

Step 5: Execute **AT+QNETDEVSTATUS=<cid>** to query NIC status.

Step 6: The host sets the routing and DNS resolution through the udhcpc program according to the obtained NIC status.

NOTE

For details about the AT commands used during dial-up, see *document [1]*.

---

4 Module Reboot Mechanism

In PCIe EP mode, if the module is rebooted due to any reason in use, it can re-establish a link and performs PCIe communication with the host.
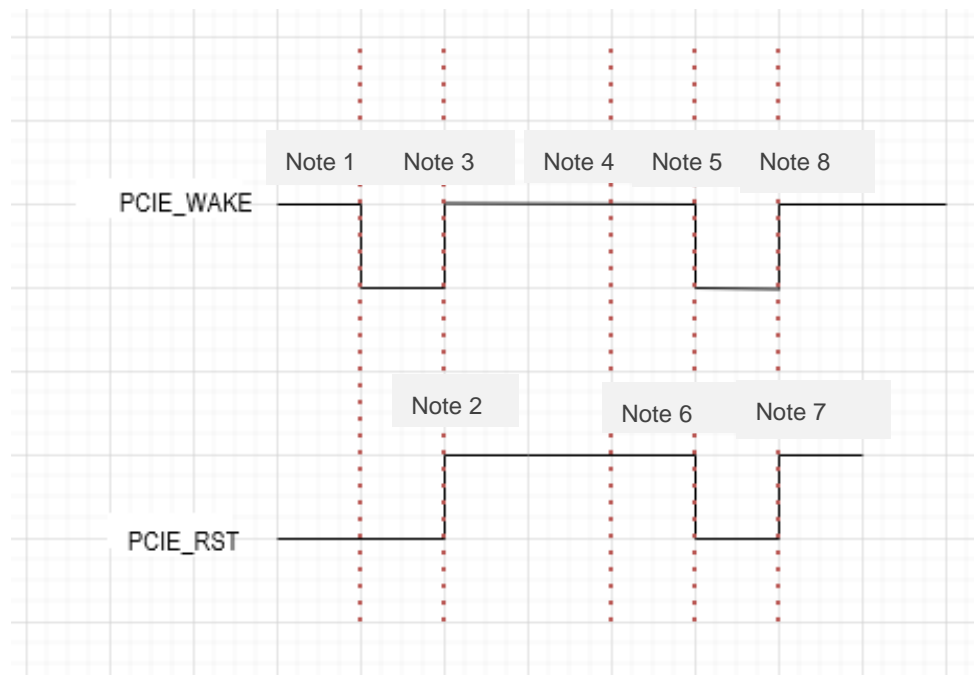
4.1. Sequence Diagram of Normal Boot and Reboot

Figure 1: Sequence Diagram of Normal Boot and Reboot

When the module and host are booted normally or the module is rebooted, "**Note 1**" to "**Note 8**" in above figure are described as follows:

1. **Module and host are booted normally**

   Note 1: The module starts up and pulls down PCIE_WAKE to notify the host.
   Note 2: After the host detects that PCIE_WAKE is pulled down, it pulls up PCIE_RST and starts the enumeration of PCIe.
   Note 3: After the module detects that PCIE_RST is pulled up, it pulls up PCIE_WAKE and starts the enumeration of PCIe.

2. **Module is rebooted**

   Note 4: Module is rebooted.
   Note 5: After the module is rebooted successfully, it pulls down PCIE_WAKE to notify the host.
   Note 6: After the host detects that PCIE_WAKE is pulled down, it executes the PCIe remove operation and pulls down PCIE_RST.
   Note 7: The host executes the PCIe rescan operation to rescan and establish a link, and pulls up PCIE_RST.
   Note 8: After the module detects that PCIE_RST is pulled up, it pulls up PCIE_WAKE and starts the enumeration of PCIe.

NOTE

1. The PCIe wake-up and reset pins of RG500U series are PCIE_WAKE and PCIE_RST respectively; for RG200U-CN and RM500U-CN modules, the PCIe pins are PCIE_WAKE_N and PCIE_RST_N respectively.
2. The interrupt processing for detecting PCIE_WAKE pin needs to be added to the main control code of the PCIe on the host: after the host detects that the module pulls down PCIE_WAKE, it executes PCIe remove and PCIe rescan operations.

4.2. Operating Log of PCIE_WAKE

When the module pulls down PCIE_WAKE, the following log is printed at the Debug port.

```
assert pcie_wake
```

When the module pulls up PCIE_WAKE, the following log is printed at the Debug port.

```
set gpiod_wakeup high success
```

5 Appendix Reference

Table 1: Related Documents

Document Name
[1] Quectel_RGx00U&RM500U_Series_AT_Commands_Manual
[2] Quectel_QCOM_User_Guide
[3] Quectel_QLog_Linux&Android_User_Guide

Table 2: Terms and Abbreviations

Abbreviations	Descriptions
DHCP	Dynamic Host Configuration Protocol
DNS	Domain Name Resolution
ID	Mostly refers to Identifier in terms of software
IP	Internet Protocol
NIC	Network Interface Card
PCIe	Peripheral Component Interconnect Express
PCIe EP	PCI Express Endpoint Device
PCIe RC	PCI Express Root Complex
PDP	Packet Data Protocol