



A76XX Series_Linux USB_Application Note

LTE Module

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About Document

Version History

Version	Date	Owner	What is new
V1.00	2019.06.06	Yulong.zheng	New version
	2019.08.07	Yulong.zheng	1.Add+DIALMODE and \$MYCONFIG description. 2.Replace/DEV/ttyUSB3 with /DEV/ttyUSB2.
	2020.11.27	Yulong.zheng	Add +USBNETIP
	2021.12.21	Yulong.zheng	Add NMEA port
V1.01	2022.06.06	Chunyan.yang Yanan.Sun	Some modification
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Scope

Based on module AT command manual, this document will introduce Linux USB application process. Developers could understand and develop application quickly and efficiently based on this document. This document applies to A1601 Series ,A1603 Series, A1803S Series, A1802 Series.

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Contents

About Document	2
Version History	2
Scope	3
Contents	4
1 Introduction	5
1.1 Purpose of the document	5
1.2 Related documents	5
1.3 Conventions and abbreviations	5
2 USB Device Driver Installation	6
2.1 Add VID/PID	6
2.2 Building a Linux Driver Module	6
2.3 Kernel Compilation Configuration	7
2.3.1 Compilation Configuration for USB Serial Driver	7
2.3.2 Compilation Configuration for RNDIS Driver	7
2.3.3 Compilation Configuration for ECM Driver	7
2.3.4 Compilation Configuration for PPP Driver	7
3 Modem Usage	9
3.1 Related AT Command	9
3.1.1 AT+DAILMODE Enable/Disable USBNET network	9
3.1.2 AT+\$MYCONFIG Set RNDIS/ECM Mode	10
3.1.3 AT+USBNETIP Change RNDIS/ECM Private IP to Public IP	11
3.1.4 AT+USBNETMAC Set USBNET MAC Address	12
3.2 Test AT Command communication	14
3.3 PPP Dial Up	14
3.3.1 Example of chat script	15
3.3.2 Example of option script	15
3.3.3 Dial-Up Connection	16
3.4 ECM Dial Up	18
3.5 RNDIS Dial Up	19
4 Troubleshooting	21
4.1 The Linux can not detect module	21
4.2 How to load kernel module	21
5 Appendix Abbreviations	22

1 Introduction

1.1 Purpose of the document

This application note will describe how to install the USB driver on Linux OS for A76XX series of module and how to apply typical application with Linux such as PPP\RDNIS.

1.2 Related documents

[1] A76XX Series_AT Command Manual

1.3 Conventions and abbreviations

VID Vendor ID;

PID Product ID;

2 USB Device Driver Installation

There are few interfaces supported by the USB device system from A76XX series of module, the Linux OS will enumerate the USB device by recognizing the PID\VID from module and install USB serial driver for these interface. After successful driver installation there will be corresponding device node for these interfaces, usually as following:

- /dev/ttyUSB0 Diagnostic port for log messages
- /dev/ttyUSB1 AT port for AT commands communication
- /dev/ttyUSB2 Modem port for PPP dial up
- /dev/ttyUSB3 NMEA port for GNSS NMEA message output

2.1 Add VID/PID

Usually the code file for USB serial on Linux is located in <kernel>/drivers/usb/serial/option.c, customer need to add the PID/VID for A76XX to the list as following.

- Open <kernel>/drivers/usb/serial/option.c
- Check if the following `#define` statement exists, if the `#define` does not exist, then add it.

```
#define SIMCOM_VENDOR_ID          0x1e0e
#define SIMCOM_PRODUCT_PID_X9011  0x9011
```

- Check if the following struct statement exists, if not then add it.

```
static const struct option_blacklist_info simcom_pid9011_blacklist = {
    .reserved = BIT(0) | BIT(1),
}
```

- Add the following code in `usb_device_id option_ids[]` struct, if not then add it.

```
{ USB_DEVICE(SIMCOM_VENDOR_ID, SIMCOM_PRODUCT_PID_X9011),
    .driver_info = (kernel_ulong_t)&simcom_pid9011_blacklist }
```

If your kernel code is different from the above, please be careful to modify it as appropriate.

2.2 Building a Linux Driver Module

If you need to compile a driver module and install later, please follow steps:

Step 1: Enter to kernel directory.

```
cd <your kernel directory>
```

Step 2: Build the driver.

```
sudo make -C /lib/modules/`uname -r`/build M=`pwd`/drivers/usb/serial obj-m=option.o modules
```

Step 3: Load the driver and reboot.

```
sudo cp drivers/usb/serial/option.ko /lib/modules/`uname -r`/kernel/drivers/usb/serial
sudo depmod
sudo reboot
```

2.3 Kernel Compilation Configuration

2.3.1 Compilation Configuration for USB Serial Driver

Configuration	Configuration(Y/N)
CONFIG_USB_SERIAL	Y
CONFIG_USB_SERIAL_OPTION	Y

2.3.2 Compilation Configuration for RNDIS Driver

Configuration	Configuration(Y/N)
CONFIG_USB_SERIAL	Y
CONFIG_USB_SERIAL_OPTION	Y
CONFIG_USB_USBNET	Y
CONFIG_USB_NET_RNDIS_HOST	Y

2.3.3 Compilation Configuration for ECM Driver

Configuration	Configuration(Y/N)
CONFIG_USB_SERIAL	Y
CONFIG_USB_SERIAL_OPTION	Y
CONFIG_USB_USBNET	Y
CONFIG_USB_NET_CDCETHER	Y

2.3.4 Compilation Configuration for PPP Driver

Configuration	Configuration(Y/N)
CONFIG_USB_SERIAL	Y

CONFIG_USB_SERIAL_OPTION	Y
CONFIG_PPP	Y
CONFIG_PPP_FILTER	Y
CONFIG_PPP_MULTILINK	Y
CONFIG_PPP_BSDCOMP	Y
CONFIG_PPP_ASYNC	Y
CONFIG_PPP_SYNC_TTY	Y
CONFIG_PPP_DEFLATE	Y

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3 Modem Usage

This chapter mainly introduces several commonly used dialing methods and their general processes.

USB devices must be recognized before use modem.

3.1 Related AT Command

3.1.1 AT+DAILMODE Enable/Disable USBNET network

AT+DAILMODE Enable/Disable USBNET network	
Test Command AT+DIALMODE=?	Response +DIALMODE:(0-1) OK
Read Command AT+DIALMODE?	Response +DIALMODE:<modes> OK
Write Command AT+DIALMODE=<mode>	Response a)If successfully: OK b)If failed: ERROR

Defined Values

<mode>	The Auto Dial status Enable/Disable, the default value is 1. 0 –Enable USBNET network 1 –Disable USBNET network The function will take effect immediately.
--------	---

3.1.2 AT\$MYCONFIG Set RNDIS/ECM Mode

AT\$MYCONFIG Set RNDIS/ECM Mode	
Test Command AT\$MYCONFIG=?	Response a) If successfully: \$MYCONFIG: \\"usbnetmode\\", (0,2), (0,1), <macName> OK b) If failed: ERROR
Write Command AT\$MYCONFIG="USBNETMODE"[, <netmode>[, <netport>][, <macName>]]	Response a) If successfully: OK b) If failed: ERROR
Read Command AT\$MYCONFIG?	Response b) If successfully: \$MYCONFIG: \\"usbnetmode\\", <netmode>, <netport> OK b) If failed: ERROR

Defined Values

<netmode>	The RNDIS/ECM mode, the default value is 0. <u>0</u> –RNDIS 1 –ECM 2 –AUTO adapt system The function will reset modem then take effect.
<netport>	The name of Netcard, the default value is 1 <u>0</u> –ETH <u>1</u> –USB
<macName>	Set usbnet name under mac pc

NOTE

This command will auto reboot(take effect after reboot).

3.1.3 AT+USBNETIP Change RNDIS/ECM Private IP to Public IP

AT+USBNETIP Change RNDIS/ECM Private IP to Public IP	
Test Command AT+USBNETIP=?	Response +USBNETIP:(0-1)[,(0-255)[,(0-255)[,(1-254)[,(0-2147483647)]]]]
	OK
Write Command AT+USBNETIP=mode[,tpos[,dhcps[,dhcpe[,leasetime]]]]	Response a)If successfully: OK b)If failed: +CME ERROR: Incorrect parameters
Read Command AT+USBNETIP?	Response a)If successfully mode=0: +USBNETIP:0,tpos,dhcps,dhcpe,leasetime OK a)If successfully mode=1: +USBNETIP:1,,,,leasetime OK b)If failed: ERROR
Parameter Saving Mode	AUTO_SAVE

Defined Values

<mode>	0 –Private Ip(default, 192.168.0.xxx etc.) 1 –Public Ip(the ip from the network)
<tpos>	The third position of Gateway Address
<dhcps>	Dhcp start value
<dhcpe>	Dhcp end value
<leasetime>	Dhcp lease time, default value 86400

Examples:

Windows OS open cmd.exe and input ipconfig

Ethernet adapter Ethernet 7:

Connect to a specific DNS suffi :

```
IPv6 address . . . . . : 2409:8960:1e58:324c:2934:bda5:f9e8:88d7
Temporary IPv6 address . . . . . : 2409:8960:1e58:324c:65cd:269c:30d1:17f0
Local link IPv6 address . . . . . : fe80::2934:bda5:f9e8:88d7%18
Address of IPv4 . . . . . : 192.168.0.100
Subnet mask . . . . . : 255.255.255.0
The default gateway . . . . . : fe80::1234%18
                               192.168.0.1
```

Send AT+USBNETIP=0,10,117 then check ipconfig

```
Ethernet adapter Ethernet 7:
Connect to a specific DNS suffix. . . . . :
IPv6 address . . . . . : 2409:8960:1e58:324c:2934:bda5:f9e8:88d7
Temporary IPv6 address. . . . . : 2409:8960:1e58:324c:65cd:269c:30d1:17f0
Local link IPv6 address. . . . . : fe80::2934:bda5:f9e8:88d7%18
IPv4 address . . . . . : 192.168.10.117
Subnet mask . . . . . : 255.255.255.0
The default gateway . . . . . : fe80::1234%18
                               192.168.0.1
```

Send AT+USBNETIP=0,12,98 and check ipconfig

```
Ethernet adapter Ethernet 7:
Connect to a specific DNS suffix. . . . . :
IPv6 address . . . . . : 2409:8960:1e58:324c:2934:bda5:f9e8:88d7
Temporary IPv6 address. . . . . : 2409:8960:1e58:324c:65cd:269c:30d1:17f0
Local link IPv6 address. . . . . : fe80::2934:bda5:f9e8:88d7%18
IPv4 address . . . . . : 192.168.12.98
Subnet mask . . . . . : 255.255.255.0
The default gateway . . . . . : fe80::1234%18
                               192.168.0.1
```

3.1.4 AT+USBNETMAC Set USBNET MAC Address

This write command is set the MAC address of the USBNET. If the write command returns OK, the current

USBNET MAC address can be read after the restart. The execution command is to restore default MAC address of the USBNET.

AT+USBNETMAC Set USBNET MAC Address	
Test Command AT+USBNETMAC=?	Response 1) OK 2) ERROR
Read Command AT+USBNETMAC?	1) +USBNETMAC: <mac_display> OK 2) ERROR 3) +CME ERROR: <err>
Write Command AT+USBNETMAC=<mac>	Response a)If successfully: OK b)If failed: ERROR
Execution Command AT+USBNETMAC	1) OK 2) ERROR 3) +CME ERROR: <err>

Defined Values

<mac>	String type, the MAC address of USBNET, maximum length 12
<mac_display>	String type,display the MAC address of USBNET, split with a '-'. with a '-'.

Examples

```

AT+USBNETMAC=?
OK
AT+USBNETMAC?
+ USBNETMAC: F0-0C-29-A3-9B-6D
  
```

OK

AT+USBNETMAC=AABBCCDDEEFF

OK

AT+USBNETMAC

OK

NOTE

This command take effect after reboot.

3.2 Test AT Command communication

Customer could send AT and receive response by echo and cat command as following, or use other terminal tool such as minicom for that.

```
#cat /dev/ttyUSB1 &
#echo -e "at\r\n">/dev/ttyUSB1
#
OK
```

3.3 PPP Dial Up

Please make sure the Linux OS has installed and supported the pppd program , if not then customer need to download the source code from <https://ppp.samba.org/download.html> and compile it to the Linux OS according to cross development environment. To start with PPP dial up there still need to have chat and option script(if PAP or CHAP encryption algorithm is used then also need related script).

The chat script could be used to configure about the AT command which will be sent to the module before dial up, for example AT+CGDCONT=xxx command could be used to set IP type and APN.

The option script could be used to configure all PPP related setting such as port number for dial up\hardware flow control and so on.

Customer could use own PPP dial up script or contact with SIMCom FAE to get following common example script and put them in /etc/ppp/peers.

3.3.1 Example of chat script

simcom-connect-chat

```
#named simcom-connect-chat and place in /etc/ppp/peers
ABORT "BUSY"
ABORT "NO CARRIER"
ABORT "NO DIALTONE"
ABORT "ERROR"
ABORT "NO ANSWER"
TIMEOUT 30
"" AT
OK ATE0
OK ATI;+CSUB;+CSQ;+CPIN?;+COPS?;+CGREG?;&D2
# Insert the APN provided by your network operator, default apn is 3gnet
OK AT+CGDCONT=1,"IP","3gnet",,0,0
OK ATD*99#
CONNECT
```

simcom-disconnect-chat

```
#named simcom-disconnect-chat and place in /etc/ppp/peers
ABORT "ERROR"
ABORT "NO DIALTONE"
SAY "\nSending break to the modem\n"
"" +++
"" +++
"" +++
SAY "\nGoodbay\n"
```

3.3.2 Example of option script

simcom-pppd

```
# named simcom-pppd and place in /etc/ppp/peers
/dev/ttyUSB2 115200
#Insert the username and password for authentication, default user and password are test
user "test" password "test"
# The chat script, customize your APN in this file
```



```
connect 'chat -s -v -f /etc/ppp/peers/simcom-connect-chat'
# The close script
disconnect 'chat -s -v -f /etc/ppp/peers/simcom-disconnect-chat'
# Hide password in debug messages
hide-password
# The phone is not required to authenticate
noauth
# Debug info from pppd
debug
# If you want to use the HSDPA link as your gateway
defaultroute
# pppd must not propose any IP address to the peer
noipdefault
# No ppp compression
novj
novjccomp
noccp
ipcp-accept-local
ipcp-accept-remote
local
# For sanity, keep a lock on the serial line
lock
modem
dump
nodetach
# Hardware flow control
nocrtscts
remotename 3gppp
ipparam 3gppp
ipcp-max-failure 30
# Ask the peer for up to 2 DNS server addresses
usepeerdns
```

3.3.3 Dial-Up Connection

Customer could run “pppd call <option script>” to start PPP dial up. Here is the example

```
# pppd call simcom-pppd &
```

Customer will see following logs and get IP and DNS server address, that indicates the successful PPP dial up.

```
Connect: ppp0 <--> /dev/ttyUSB2
sent [LCP ConfReq id=0x1 <asynctest 0x0> <magic 0x5107d141> <pcomp> <accomp>]
rcvd [LCP ConfReq id=0x0 <asynctest 0x0> <auth chap MD5> <magic 0x9a5c1936> <pcomp> <accomp>]
sent [LCP ConfAck id=0x0 <asynctest 0x0> <auth chap MD5> <magic 0x9a5c1936> <pcomp> <accomp>]
rcvd [LCP ConfAck id=0x1 <asynctest 0x0> <magic 0x5107d141> <pcomp> <accomp>]
sent [LCP EchoReq id=0x0 magic=0x5107d141]
rcvd [LCP DiscReq id=0x1 magic=0x9a5c1936]
rcvd [CHAP Challenge id=0x1 <dd93b9f04d75e2bbba3786f6d24df3d7>, name = "UMTS_CHAP_SRVR"]
sent [CHAP Response id=0x1 <498d4d7cf3b59dacfc07a45ce6eb7e26>, name = "test"]
rcvd [LCP EchoRep id=0x0 magic=0x9a5c1936 51 07 d1 41]
rcvd [CHAP Success id=0x1 ""]
CHAP authentication succeeded
CHAP authentication succeeded
sent [IPCP ConfReq id=0x1 <addr 0.0.0.0> <ms-dns1 0.0.0.0> <ms-dns2 0.0.0.0>]
rcvd [IPCP ConfReq id=0x0]
sent [IPCP ConfNak id=0x0 <addr 0.0.0.0>]
rcvd [IPCP ConfNak id=0x1 <addr 10.51.68.23> <ms-dns1 222.66.251.8> <ms-dns2 116.236.159.8>]
sent [IPCP ConfReq id=0x2 <addr 10.51.68.23> <ms-dns1 222.66.251.8> <ms-dns2 116.236.159.8>]
rcvd [IPCP ConfReq id=0x1]
sent [IPCP ConfAck id=0x1]
rcvd [IPCP ConfAck id=0x2 <addr 10.51.68.23> <ms-dns1 222.66.251.8> <ms-dns2 116.236.159.8>]
Could not determine remote IP address: defaulting to 10.64.64.64
local IP address 10.51.68.23
remote IP address 10.64.64.64
primary DNS address 222.66.251.8
secondary DNS address 116.236.159.8
Script /etc/ppp/ip-up started (pid 6616)
Script /etc/ppp/ip-up finished (pid 6616), status = 0x0
```

Customer could run ifconfig(or ifconfig all) to check the state of PPP network interface. If customer could only PING or connect to numeric IP while domain name can not,then customer need to modify /etc/resolv.conf file to modify or add valid DNS server.

```
# ifconfig ppp0
```

```
ppp0      Link encap:Point-to-Point Protocol
          inet addr:10.216.159.39  P-t-P:10.64.64.64  Mask:255.255.255.255
          UP POINTOPOINT RUNNING NOARP MULTICAST  MTU:1500  Metric:1
          RX packets:9 errors:0 dropped:0 overruns:0 frame:0
          TX packets:9 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:3
          RX bytes:362 (362.0 B)  TX bytes:316 (316.0 B)
```

```
# cat /etc/resolv.conf
nameserver 221.180.132.108
```

```
# route -n
```

```
Kernel IP routing table
```

Destination	Gateway	Genmask	Flags	Metric	Ref	Use	Iface
0.0.0.0	0.0.0.0	0.0.0.0	U	0	0	0	ppp0
10.64.64.64	0.0.0.0	255.255.255.255	UH	0	0	0	ppp0

```
# ping baidu.com
```

```
PING baidu.com (220.181.57.216) 56(84) bytes of data.
64 bytes from 220.181.57.216: icmp_seq=1 ttl=50 time=84.0 ms
64 bytes from 220.181.57.216: icmp_seq=2 ttl=50 time=34.2 ms
```

Following commands can be used to terminate PPPD process to disconnect a PPP call:

```
# killall pppd
```

3.4 ECM Dial Up

Enable ECM mode and auto dial up.

```
# cat /dev/ttyUSB1 &
# echo -e "AT+DIALMODE=0\r\n">/dev/ttyUSB1
#
# OK
# echo -e "AT$MYCONFIG=\"usbnetmode\",1 ">/dev/ttyUSB1
#
# OK
```

Check IP/DNS/Route.

```
# ifconfig usb0
usb0      Link encap:Ethernet  HWaddr ae:68:46:d6:b2:80
          inet addr:192.168.0.100  Bcast:192.168.0.255  Mask:255.255.255.0
          inet6 addr: fe80::ac68:46ff:fed6:b280/64 Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:45 errors:0 dropped:0 overruns:0 frame:0
          TX packets:104 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:4237 (4.2 KB)  TX bytes:13148 (13.1 KB)
```

```
# ping baidu.com
PING baidu.com (123.125.114.144) 56(84) bytes of data.
64 bytes from 123.125.114.144: icmp_seq=1 ttl=56 time=114 ms
64 bytes from 123.125.114.144: icmp_seq=2 ttl=56 time=58.6 ms
64 bytes from 123.125.114.144: icmp_seq=3 ttl=56 time=45.1 ms
```

3.5 RNDIS Dial Up

Enable RNDIS mode and auto dial up.

```
# cat /dev/ttyUSB1 &
# echo -e "AT+DIALMODE=0\r\n">/dev/ttyUSB1
#
# OK
# echo -e "AT$MYCONFIG=\"usbnetmode\",0\r\n">/dev/ttyUSB1
#
# OK
```

Check IP/DNS/Route.

```
# ifconfig usb0
usb0      Link encap:Ethernet  HWaddr ae:68:46:d6:b2:80
          inet addr:192.168.0.100  Bcast:192.168.0.255  Mask:255.255.255.0
          inet6 addr: fe80::ac68:46ff:fed6:b280/64 Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:45 errors:0 dropped:0 overruns:0 frame:0
          TX packets:104 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
```

RX bytes:4237 (4.2 KB) TX bytes:13148 (13.1 KB)

```
# ping baidu.com
```

```
PING baidu.com (220.181.38.148) 56(84) bytes of data.
```

```
64 bytes from 220.181.38.148: icmp_seq=1 ttl=50 time=94.8 ms
```

```
64 bytes from 220.181.38.148: icmp_seq=2 ttl=50 time=135 ms
```

```
64 bytes from 220.181.38.148: icmp_seq=3 ttl=50 time=61.9 ms
```

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4 Troubleshooting

4.1 The Linux can not detect module

Please check following commands to make sure the hardware connection is OK and the Linux has successfully enumerate the USB device of module.

```
# lsusb  
# lsmod | grep option  
# dmesg | grep option
```

4.2 How to load kernel module

```
# modprobe option
```

5 Appendix Abbreviations

Table 1: Terms and Abbreviations

Value	Description
USB	Universal Serial Bus
PPP	Point-to-Point Protocol. The Point-to-Point Protocol is designed for simple links which transport packets between two ports. These links provide full-duplex simultaneous bi-directional operation, and are assumed to deliver packets in order. It is intended that PPP provides a common solution for easy connection of a wide variety of hosts, bridges and routers.
IPCP	IP Control Protocol
IP	Internet Protocol
DNS	Domain Name Server