



Perfect Wireless Experience
完美无线体验

FIBOCOM NL668 Application

Business Process Manual

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Date: 2018.04.13



Applicability type

| No. | Product model | Description |
|-----|---------------|-------------|
| 1 | NL668 Series | NA |
| | | |
| | | |



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Versions

| Version | Update Date | Description |
|---------|-------------|-------------------------|
| V1.0.0 | 2016-08-18 | Initial version |
| V2.0.0 | 2018-04-13 | Normalized modification |
| | | |

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1 Foreword

The NL668 application business process describes the common service process of the NL668 module and provides reference for engineers of client application software development.

1.1 Document Purpose

The main document purpose is to guide developers of client application to use the NL668 module. This document recommends the corresponding AT interaction process for the common services of the module with a view to assist the developer in completing the relevant application development as soon as possible.

1.2 Content List

This document is divided into the following sections:

- Chapter 1 mainly introduces the document purpose, related materials, revision records, and explanations of abbreviations;
- Chapter 2 briefly describes of the basic information of the NL668 module;
- Chapter 3 describes the common service process of the NL668 module.

1.3 Related Documents

- NL668 Module Specification
- NL668 AT Instruction Set
- NL668 Module Hardware Interface Manual
- NL668 Reference Design Circuit
- NL668 EVB Operation Manual

1.4 Abbreviations

Table 2: Abbreviation Description

| Abbreviation | Description |
|--------------|---|
| CS | Circuit Switched (CS) domain |
| CSD | Circuit Switched Data |
| DCE | Data communication equipment |
| DTE | Data terminal equipment |
| EDGE | Enhanced Data rates for GSM Evolution |
| EGSM | Enhanced GSM |
| GPIO | General Purpose Input Output |
| GPRS | General Packet Radio Service |
| GSM | Global Standard for Mobile Communications |
| HR | Half Rate |
| HSDPA | High Speed Downlink Packet Access |
| HSUPA | High Speed Uplink Packet Access |
| HSPA | HSPA High-Speed Packet Access |
| IMEI | International Mobile Equipment Identity |
| I/O | Input/Output |
| ISO | International Standards Organization |
| ITU | International Telecommunications Union |
| bps | bits per second |
| LED | Light Emitting Diode |
| M2M | Machine to machine |
| MO | Mobile Originated |
| MT | Mobile Terminated |
| PC | Personal Computer |
| PCB | Printed Circuit Board |
| PCS | Personal Cellular System |
| PCS | Personal Communication System |
| PDU | Packet Data Unit |
| PPP | Point-to-point protocol |
| PS | Packet Switched |

| Abbreviation | Description |
|--------------|--|
| QPSK | Quadrature Phase Shift Keying |
| SIM | Subscriber Identity Module |
| TCP/IP | Transmission Control Protocol/ Internet Protocol |
| USIM | Universal Subscriber Identity Module |
| UMTS | Universal Mobile Telecommunications System |
| USB | Universal Serial Bus |
| WCDMA | Wideband Code Division Multiple Access |

2 Introduction

The NL668 wireless communication module has a robust square appearance and small size, and adopts the MI-PCIE package form. Its physically supported peripheral interfaces include reset control interface, USB interface, UART interface, sleep and wakeup control interface, PCM interface, analog audio interface, USIM/SIM interface, network indicator interface, and flight mode control interface. In terms of network protocol, NL668 supports multiple network formats including

SR-LTE/TDD-LTE/FDD-LTE/TD-SCDMA/WCDMA/EHRPD/EVDO/CDMA/GPRS/GSM.

In each network standard, the supported access rates are: TDD-LTE (130Mbps/35Mbps), FDD-LTE (150Mbps/50Mbps), WCDMA up to DC-HSPA+ (42Mbps/5.76Mbps), TD-SCDMA (2.8Mbps)/2.2Mbps), CDMA (153.6kbps/153.6kbps), EVDO (3.1 Mbps/1.8 Mbps), EDGE (236.8 Kbps/236.8 Kbps), and GPRS access rate up to 56Kbps.

The NL668 supports AT command extension and QMI interface specification. It provides PCM, SMS, address book, and GPS positioning. It can be widely used in mobile broadband access, video surveillance, security, financial POS devices, handheld devices, vehicle equipment, and M2M segmented industry products.

3 Basic business process

This document mainly describes the basic services such as how to check the status of the SIM card, query the mobile network system, mobile network switching, ordinary voice, SMS, multi-party call, and PPP dial in multi-mode and general conditions. The flow charts described in the document are typical ones. Refer to the *NL668 AT Command Set* for details of the AT commands.

3.1 SIM Status Query

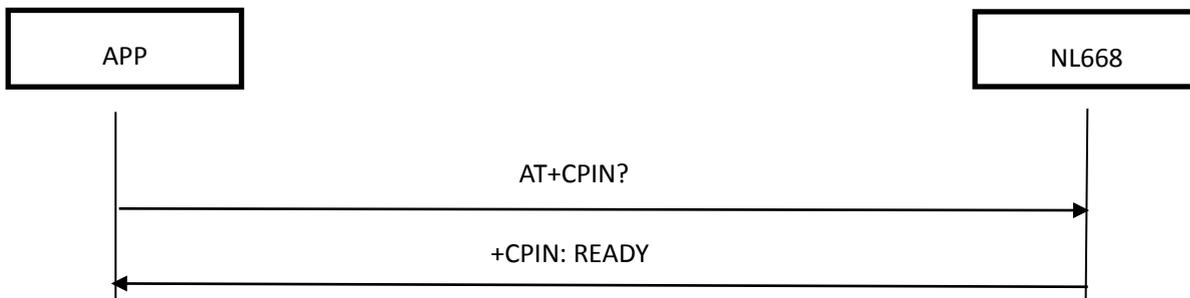


Figure 1: SIM Card Status Query Flow Chart

Enter AT+CPIN?, at the AP. If a SIM card is detected, it returns +CPIN:READY. If a SIM card error is detected, an error value is returned according to the status. For details, see the Fibocom AT Manual.

| | | | |
|-------------------------------|-------------|---|---|
| Query comma nd | AT+CPIN? | +CPIN:<Code> | - |
| | | ERROR/+CMS | - |
| | | ERROR:<err> | - |
| Code | READY | ME no longer requires a password | |
| | SIM PIN | ME waits to provide PIN code for SIM card | |
| | SIM PUK | ME waits to provide PUK code for SIM card | |
| | PH-SIM PIN | ME waits to provide password from phone to SIM card | |
| | PH-FSIM PIN | ME waits to provide password from mobile phone to initial SIM card | |
| | PH-FSIM PUK | ME waits to provide unblocking password from mobile phone to initial SIM card | |

| | |
|------------------|--|
| SIM PIN2 | <p>ME waits to provide unblocking password from mobile phone to initial SIM card</p> <p>ME waits to provide SIM card PIN2 (It is recommended that <Code> only return after the last PIN2 authentication failure using this command (eg: +CME ERROR:17); after authentication fails, if wrong PIN2 is entered again, it is recommended that ME does not block this operation)</p> |
| SIM PUK2 | <p>ME waits to provide SIM card PIN2 (It is recommended that <Code> only be returned after the last PIN2 authentication failure using this command (eg: +CME ERROR:18); after authentication fails, if wrong PIN2 and new PIN2 are entered again, it is not recommended that ME block this operation)</p> |
| PH-NETPIN | ME waits to provide customized network password |
| PH-NETPUK | Waits to provide customized network unblocking password |
| PH-NETSUB PIN | ME waits to provide customized network subset password |
| PH-NETSUB PUK | Network waits to provide its own unblocking password |
| PH-SPPIN | ME waits for service provider's customized password |
| PH-SPPUK | ME waits for service provider's customized unblocking password |
| PH-CORPPIN | ME waits for enterprise customized password |
| PH-CORPPU K | ME waiting |

3.2 Operator Name Query

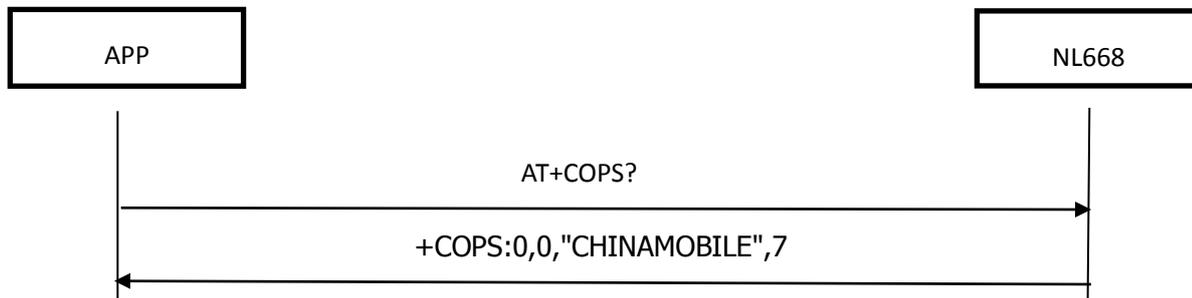


Figure 1 Operator Name Query

Enter AT+COPI? at the AP. Under normal circumstances, if the network registration is successful, the operator name of the SIM card will be returned: for example, CHINAMOBILE or a digital form of the network name (ie plmn): 46002 will be returned. For specific commands, see the Fibocom AT Command Set.

| | | | |
|---------------|----------|--|--|
| Query command | AT+COPI? | +COPI:<Mode>[,<Format>,<oper>[,<AcT>]] | - |
| | | ERROR/+CMS ERROR:<err> | This error is related to the ME function |

3.3 Registered Network Query

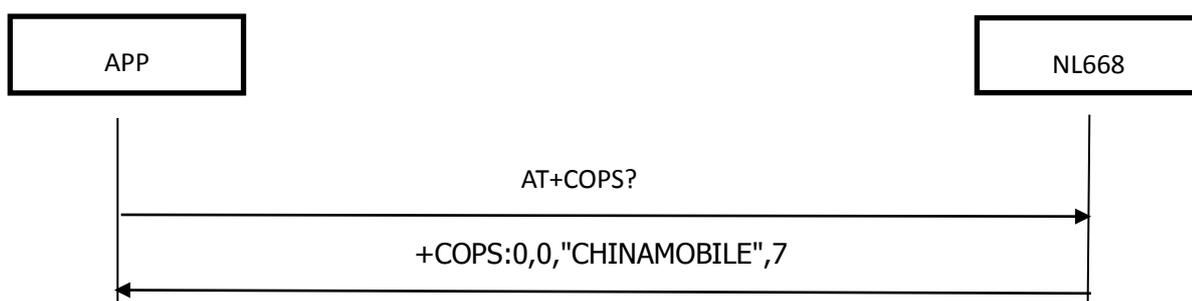


Figure 3 Query Current Networkby COPI

AT+COPI? belongs to the 3GPP standard protocol, and the third parameter act represents the currently registered network. For example, in the example picture, 7 represents registered LTE. For specific command, see the Fibocom AT Command Set.

| | | | |
|---------------|----------|--|--|
| Query command | AT+COPS? | +COPS:<Mode>[,<Format>,<oper>[,<AcT>]] | - |
| | | ERROR/+CMS ERROR:<err> | This error is related to the ME function |

| | | |
|-----|----|--------------------------------|
| Act | 0 | GSM |
| | 1 | GSMcompact |
| | 2 | UTRAN |
| | 3 | GSMw/EGPRS(seeNOTE1) |
| | 4 | UTRANw/HSDPA(seeNOTE2) |
| | 5 | UTRANw/HSUPA(seeNOTE2) |
| | 6 | UTRANw/HSDPAandHSUPA(seeNOTE2) |
| | 7 | E-UTRAN |
| | 8 | CDMA |
| | 9 | CDMA&EVDO |
| | 10 | EVDO |

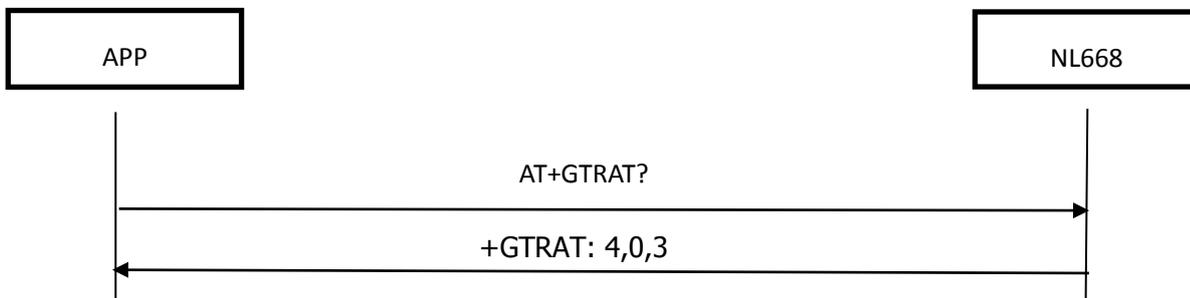


Figure 4 Query Current Networkby GTRAT

The query method 2 uses the GTRAT command to query the current network system. The command is a Fibocom private command, not a 3GPP standard protocol command. It can be used to query the currently registered network standard. For specific command, see Fibocom AT command Set.

| | |
|-----------|---|
| AT+GTRAT? | +GTRAT :<Act>[,<PreferredAct1>[,<PreferredAct2>]] |
| | OK |

<AcT>: integer type; indicates the radio access technology and may be

- 0 GSM
- 1 GSM/UMTS
- 2 UMTS
- 3 LTE
- 4 LTE/UMTS
- 5 LTE/GSM
- 6 LTE/UMTS/GSM
- 7 TD-SCDMA
- 8 eMTC
- 9 NB-IoT
- 10 Automatic
- 11 CDMA
- 12 CDMA/EVDO
- 13 EVDO

<PreferredAct1>: integer type; Selected parameter must be a part of <Act>

- 0 GSM is preferred
- 1 TD-SCDMA is preferred
- 2 WCDMA is preferred
- 3 LTE is preferred
- 4 CDMA is preferred
- 5 EVDO is preferred

<PreferredAct2>: integer type; Selected parameter must be a part of <Act>

- 0 GSM is secondary preferred
- 1 TD-SCDMA is secondary preferred
- 2 WCDMA is secondary preferred
- 3 LTE is secondary preferred
- 4 CDMA is secondary preferred
- 5 EVDO is secondary preferred

3.3 Network Setting

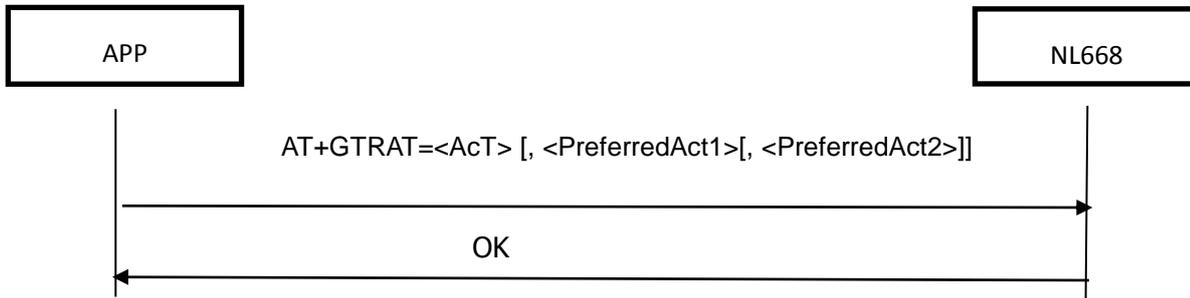


Figure 5 Set Network Type byGTRAT

Use the GTRAT command to set the expected network. The command is a Fibocom private command, not a 3GPP standard protocol command. It can be used to set the current network. OK indicates success, and ERROR indicates setting failure. For specific command, see Fibocom AT command Set.

3.3 Voice Call Process

3.3.1 NL668 as a Caller

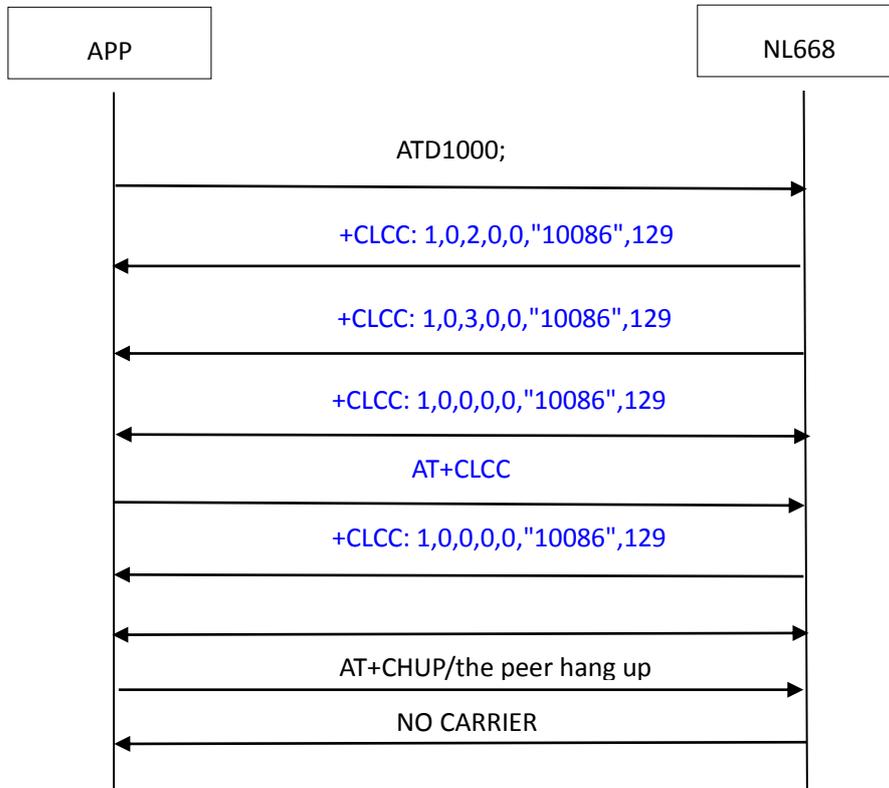


Figure 6: NL668 Caller Flow Chart

- 1) Enter "ATD10086;" at AP, and return OK, (this command is a voice telephone dial command, take 10086 as an example);
- 2) +CLCC: 1,0,2,0,0,"10086",129, the third parameter 2 indicates that the module reports call dialing. For detailed parameters, see the CLCC Command Parameters.
- 3) +CLCC: 1,0,3,0,0,"10086",129, the third parameter 3 indicates that the module reports the call prompt. For detailed parameters, see the CLCC Command Parameters.
- 4) +CLCC: 1,0,0,0,0,"10086",129, the third parameter 0 indicates that the call has been activated to establish a call connection;
- 5) Enter AT+CLCC at AP to query call status, NL668 will return +CLCC: 1,0,0,0,0,"10086",129,
- 6) You can use AT+CHUP to hang up the call and the called terminal receives the hang-up event.
- 7) The NL668 actively reports NO CARRIER to indicate the end of the call

Note 1: The blue part of the expression is AT + CLCC = 1, that is, in the case of CLCC active open, it takes the initiative to report, and if you do not set AT + CLCC = 1, the blue part is not reported.

Note 2: The process of entering AT+CLCC is not a necessary process. It is only used to prompt the client to use this command to query the call status at any time. When there is not a call, it only returns OK. When there is a call, it returns to the call status and the call number.

3.3.2 NL668 as a Called

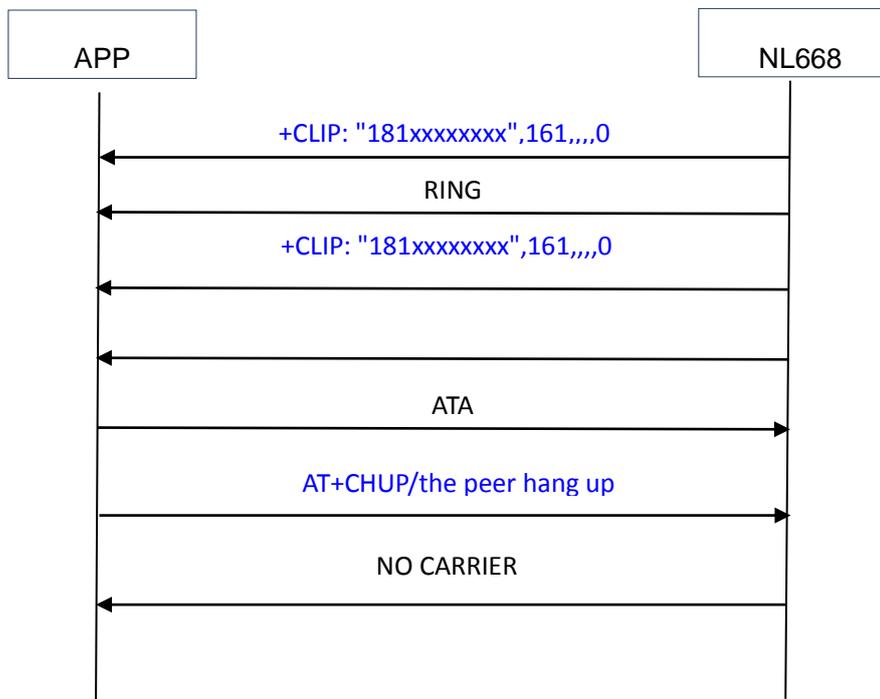


Figure 7: NL668 Called Flow Chart

- 1) After receiving a call request, NL668 actively reports +CLIP: "181xxxxxxx", 161,,,0 shows caller ID
- 2) NL668 reports RING to indicate that the call is ringing
- 3) Display the incoming call continuously until the terminal enters ATA to answer the incoming call and establish a voice connection
- 4) NL668 issues AT+CHUP to hang up or the caller hangs up. The called terminal receives the hang-up event.
- 5) NL668 initiatively reports NO CARRIER to indicate the end of the call
- 6)

Note 1: The CLIP display is shown when AT+CLIP=1 is input and CLIP is turned on. The CLIP indication may not be turned on unless it is necessary.

3.4 SMS Transceiver Process

3.4.1 Send PDU Format SMS

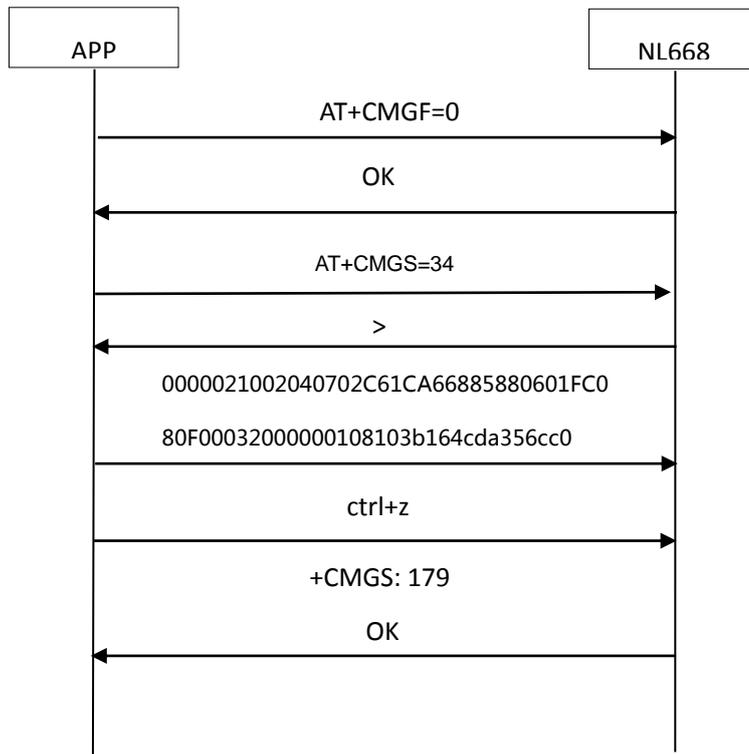


Figure 8: Send PDU Format SMS Flow Chart

- 1) Enter AT + CMGF = 0 at AT, and return OK. This command sets the SMS PDU format
- 2) Enter AT+CMGS=34 at AP. This command is a message sending command. Under the PDU format, parameter 34 is the length of SMS content (except the number of the Service Center Address);
- 3) After the CMGS is sent, the module will report >, and the PDU code of the SMS needs to be entered. When the module registers on the 3GPP2 network (including SRLTE), the encoding standard of the PDU shall comply with the 3GPP2, and when the module registers on the 3GPP network, the encoding standard of the PDU shall comply with the 3GPP.
- 4) After the PDU content is entered, you need to input CTRL+Z to send the SMS. See Table 6 for details.
- 5) After successful sending, the module will report +CMGS:<index> for success indication

Table 6:

| |
|--|
| <p>[CR] Enter to change line; Note: The corresponding hexadecimal is 0x0d 0x0a.</p> |
|--|

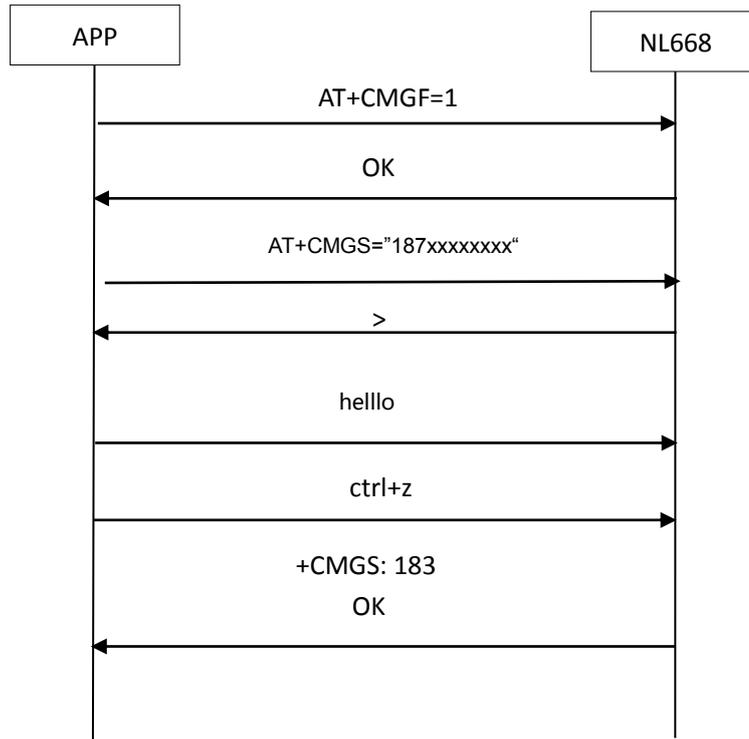
[CTRL+Z] Send SMS, input SMS and press [CTRL+Z] to send

Note: The corresponding hexadecimal is 0x1a.

<ESC> The <ESC> key can terminate SMS content editing and jump out

Note: The corresponding hexadecimal is 0x1b.

3.4.2 Send Text Format SMS



Send TEXT Format SMS Flow Chart

- 1) Enter AT + CMGF = 1 at AT, and return OK. This command sets the SMS TEXT format
- 2) Enter AT+CMGS="187xxxxxxx" at AT
- 3) After the CMGS is sent, the module will report >, and the SMS content needs to be entered.
- 4) After the TEXT content is entered, you need to input CTRL+Z to send the SMS. See Table 6 for details.
- 5) After successful sending, the module will report +CMGS:<index> for success indication

3.4.2 Send Chinese SMS

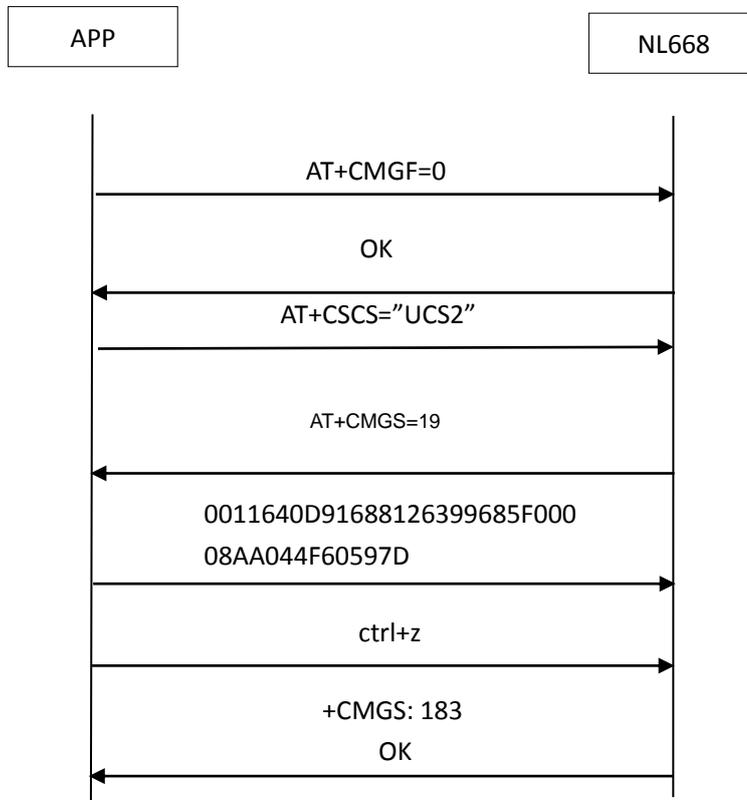


Figure 9: Send TEXT Format SMS Flow Chart

- 6) Enter AT + CMGF = 0 at AT, and return OK. This command sets the SMS PDU format, and TEXT mode can not send Chinese SMS.
- 7) Enter AT+CSCS=19 at AT. 19 represents the length of the PDU string.
After the CMGS is sent, the module will report >, and the SMS content needs to be entered. The PDU string is the format of the PDU encoding, which requires the user to encode and input the required data.
- 8) Send CTRL+Z to send SMS.
- 9) After successful sending, the module will report +CMGS:<index> for success indication.

3.4.3 Receive SMS

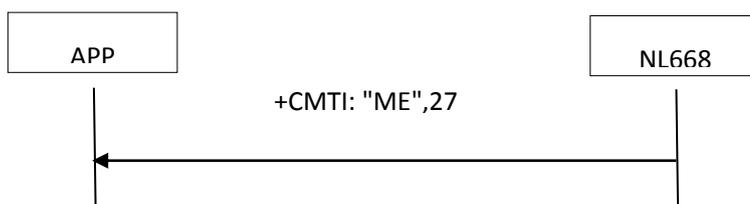


Figure 10: Receive SMS Flow Chart

1) When there is a SMS, the module will automatically report the CMTI to send a SMS. (The CMTI report is based on the CNMI command setting. See the Fibocom AT Manual for details.)

Note: For CMTI report, CNMI (AT+CNMI) needs to be set in advance according to the situation. In this use case, it is set to AT+CNMI=2,1, which means that after the SMS is stored in the ME or SIM card, a new SMS indication is given. For specific commands, see the Fibocom AT Manual

3.4.4 Read SMS

1. Read TEXT format SMS

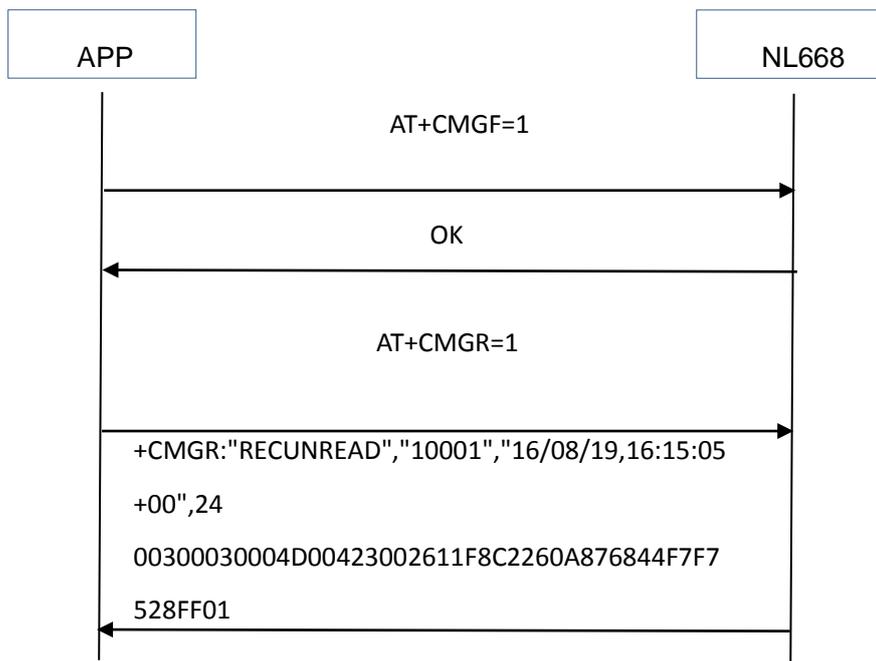


Figure 11: NL668 SMS Read Flow Chart

- 1) Enter AT + CMGF = 1 at AP, and return OK. This command sets the SMS TEXT format
- 2) Send the AT+CMGR=1 command to read the SMS content

2. Read PDU format SMS

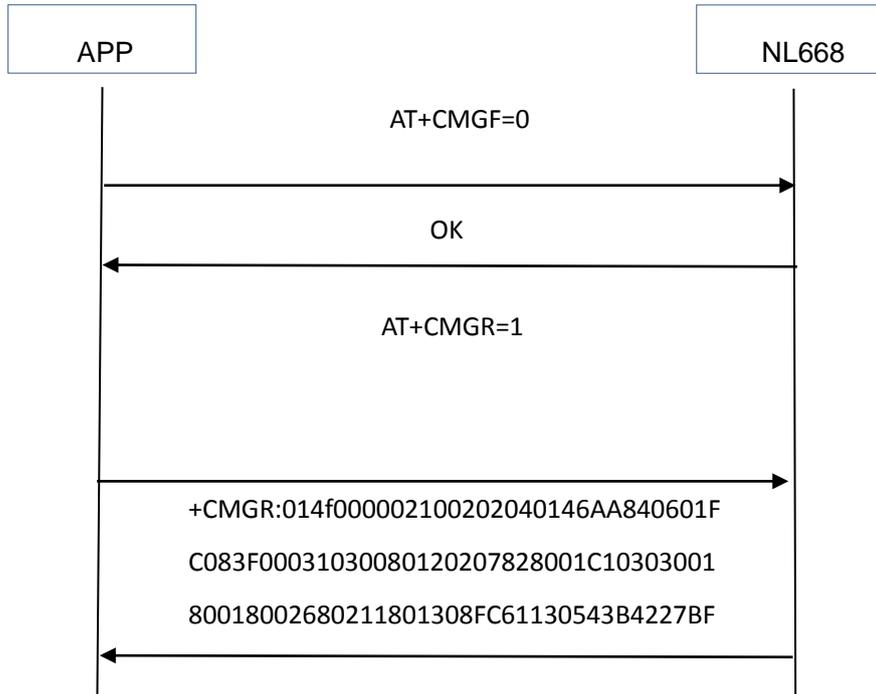


Figure 12: NL668 SMS Read Flow Chart

- 1) Enter AT + CMGF = 0 at AP, and return OK. This command sets the SMS PDU format
- 2) Send the AT+CMGR=1 command to read the SMS content

3.5 Data Link Process

Prerequisite: Use data services, and when using carrier’s SIM

1. Must first configure the corresponding APN name,
2. Must configure the corresponding user name, password, especially in the use of Internet of things special network card, must have a user name and password, otherwise it can not register dedicated network, or use data services
3. The following is the common public network APN, user name and password. Clients need to obtain dedicated network APN user name and password.

| | | | |
|-----------------|---------------------|-------------------|--------------------------|
| Carrier name | CMCC | CU | CT |
| APNname | cmnet/cmwap | 3gnet/3gwap/wonet | Ctnet/ctwap/ctlte |
| User name | card | card | Card/ctnet@mycdm a.cn |
| Password | card | card | Card/vnet.mobi |
| PPP dial number | *99#/*98*1#/*99***1 | *99# | *99#/#777 |



APN query is as follows:

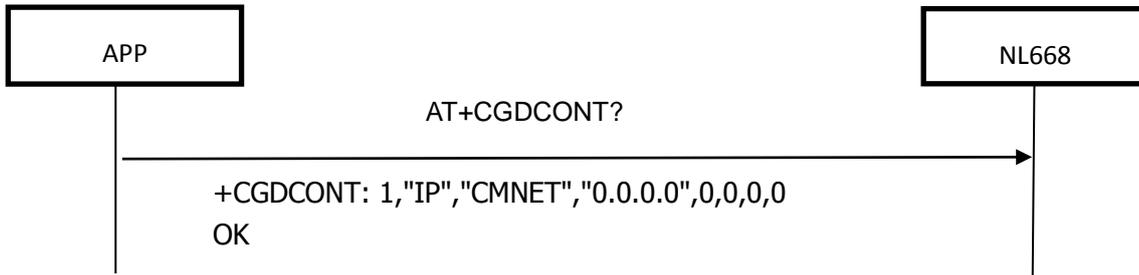


Figure 13: APN Query

3.5.1 Dial Method under 3GPP Protocol

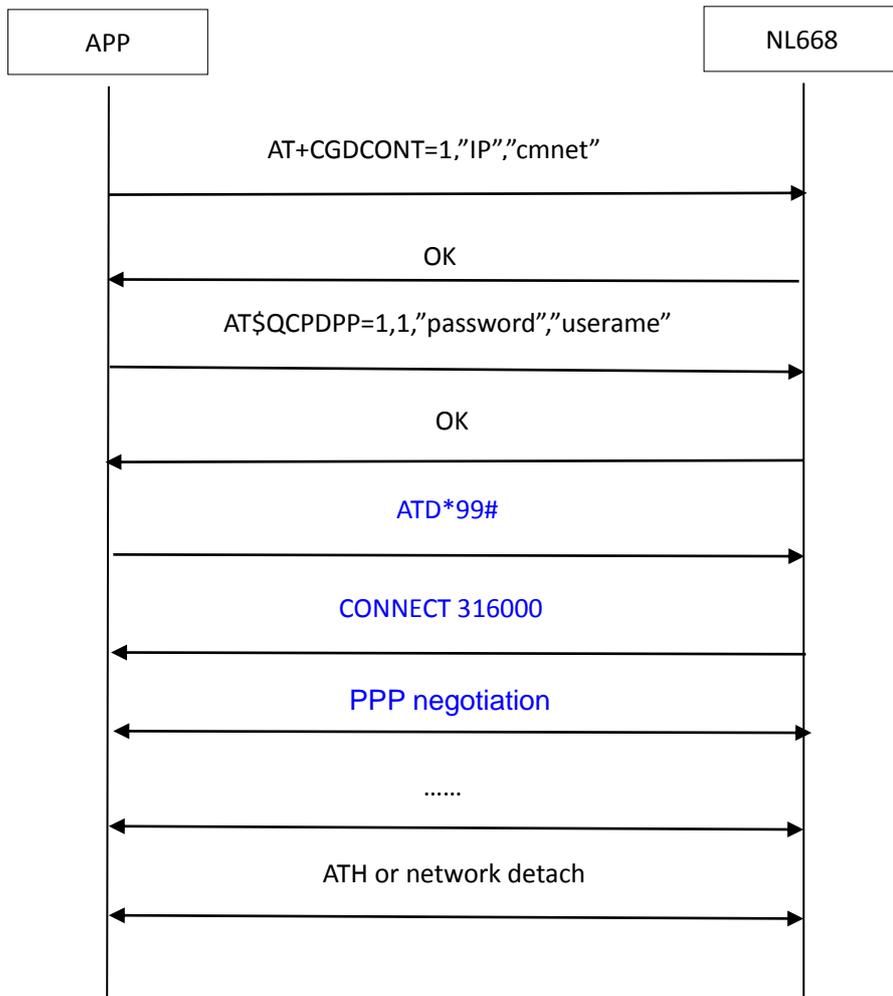


Figure 14: PPP Dial Method under 3GPP Protocol Flow Chart

1) Enter AT+CGDCONT=1, IP, cmnet at AP to set the PDP context (take China Mobile APN: “CMNET” as

an example);

Note: contact the local carrier to obtain the APN, and set it according to the actual APN.

- 2) AP sets the user name and password for dial;
- 3) Dial the “ATD*99#” at the AP;
- 4) Start PPP negotiation. After the negotiation succeeds, the IP address is obtained and the network data exchange can be performed normally.
- 5) ATH hangs up data connection or network hangs up

Note 1: Under win, when PPP dials, first establish a win dial connection, in the dial, configure the user name and password, as shown below

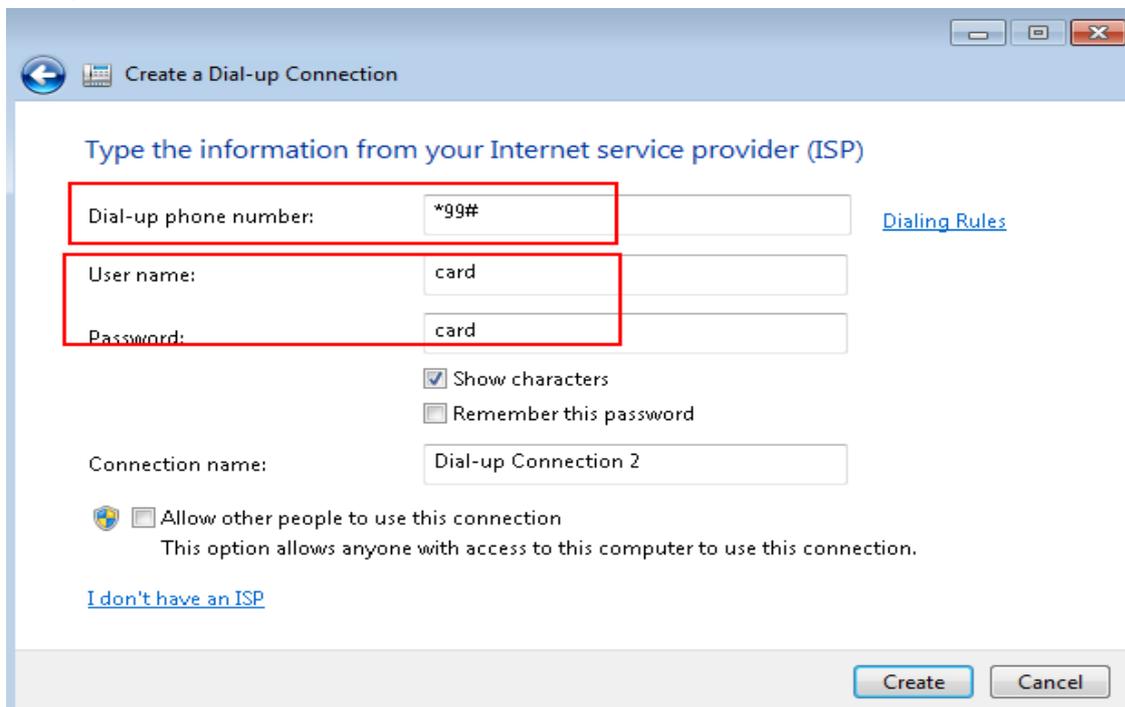


Figure 15: PPP Dial under Win

Note 2: The blue part is an command for dial under LINUX, which is not required in the windows system.

3.5.2 PPP Dial Method under 3GPP2 Protocol

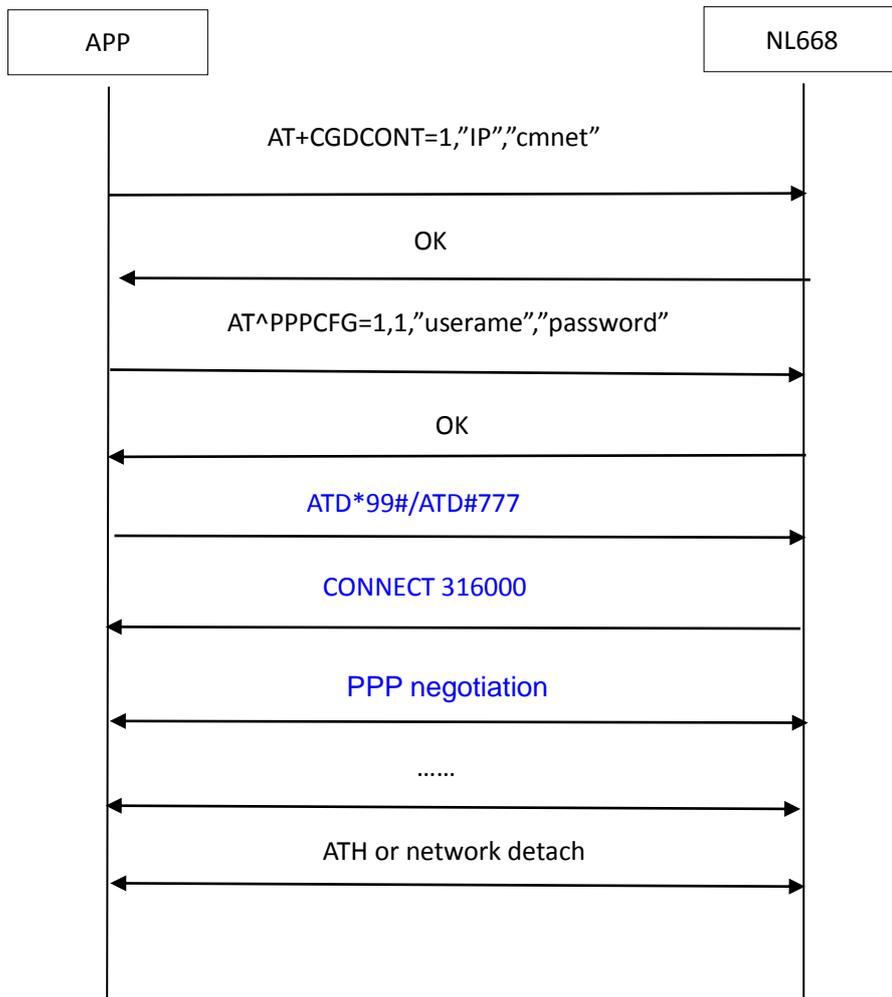


Figure 14: PPP Dial Method under 3GPP Protocol Flow Chart

6) Enter AT+CGDCONT=1, IP, cmnet at AP to set the PDP context (take China Mobile APN: “CMNET” as an example)

Note: contact the local carrier to obtain the APN, and set it according to the actual APN.

7) AP sets the dial username and password by using AT^PPPCFG;

8) Enter “ATD*99#” or ATD#777 dial at AP, Telecom 4G can use *99#, Telecom 2G, 3G use ATD#777 to dial;

9) Start PPP negotiation. After the negotiation succeeds, the IP address is obtained and the network data exchange can be performed normally.

10) ATH hangs up data connection or network hangs up

Note 1: Please note that Telecom 4G is a 3GPP protocol, and 2G, 3G is Telecom 3GPP2 protocol. The way to configure user name and password is different. One is the qcpdpp command, and the other is the pppcfg command.

3.5.3 NDIS Dial Method under 3GPP Protocol

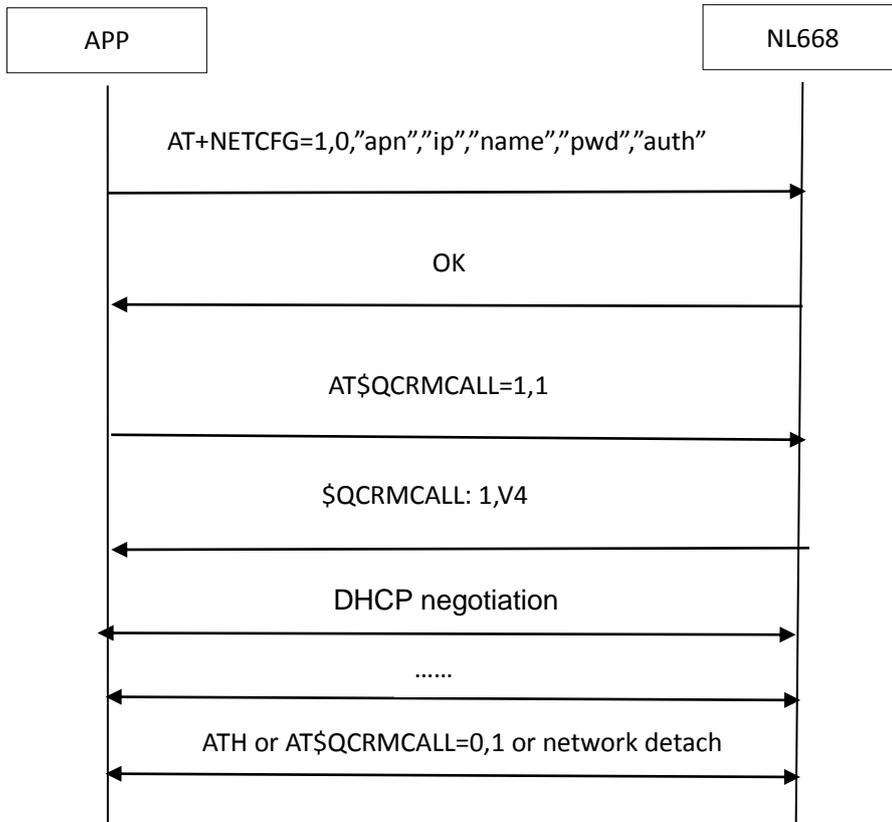


Figure 16: NDIS Dial under 3GPP Protocol Flow Chart

- 1) Enter AT+NETCFG command at AP to pre-set the carrier information. The second parameter 0 indicates the input of the Mobile dialing information, and 1 indicates the Unicom dialing information.
- 2) Enter AT\$QCRM_CALL = 1, 1 at AP to dial;
- 3) Start the NDIS negotiation. After the negotiation succeeds, the IP address is obtained and the network data exchange can be performed normally.
- 4) The method of hanging up NDIS dial is as follows: ATH hangs up, AT\$QCRM_CALL = 0, 1 hangs up, or the network hangs up.

3.5.4 NDIS Dial Method under 3GPP2 Protocol

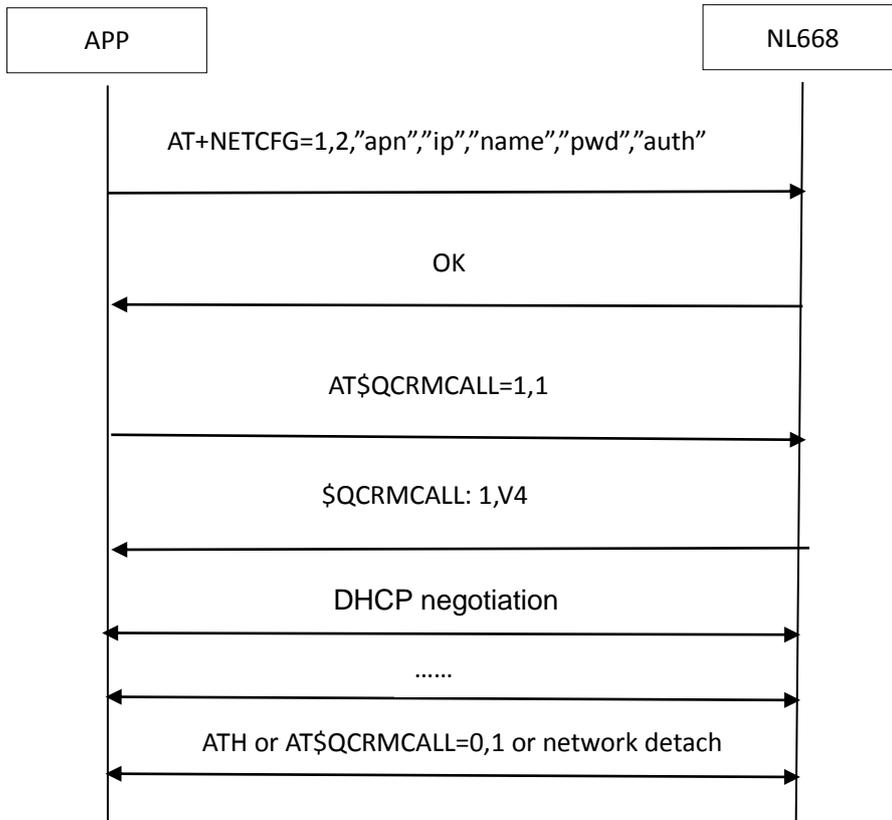


Figure 17: NDIS Dial under 3GPP2 Protocol Flow Chart

- 1) Enter AT+NETCFG command at AP to pre-set the carrier information. The second parameter 2 indicates the input of the Telecom dialing information.
- 2) Enter AT\$QCRM_CALL = 1, 1 at AP to dial;
- 3) Start the NDIS negotiation. After the negotiation succeeds, the IP address is obtained and the network data exchange can be performed normally.
- 4) The method of hanging up NDIS dial is as follows: ATH hangs up, AT\$QCRM_CALL = 0, 1 hangs up, or the network hangs up.

3.5.5 GTRNDIS Dial Method under 3GPP Protocol

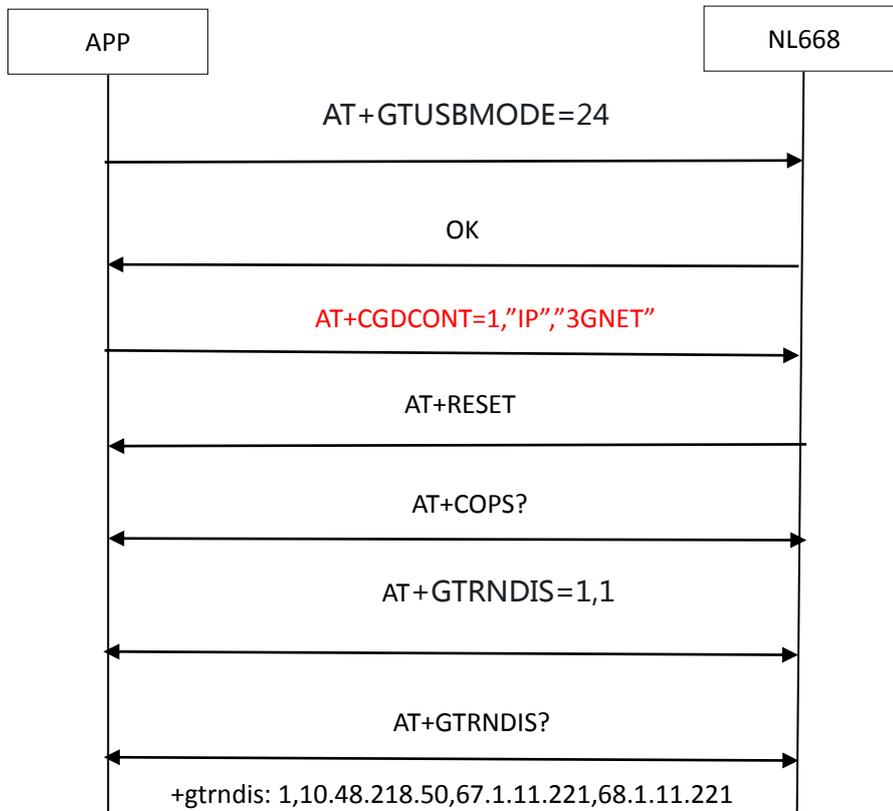


Figure 18:NDIS Dial under 3GPP2 Protocol Flow Chart

- 1) Enter AT+GTUSBMODE=24 command to switch the USB mode
- 2) Enter AT+RESET at AP to restart the module.
- 3) After the restart, enter AT+CGDCONT=1, "IP", "3GNET" at AP to configure required APN.
- 4) Check the current network registration status at AP, and dial after registering on the network.
- 5) After the network registration is normal, enter AT+GTRNDIS=1,1 at AP to dial rndis.
- 6) Use the command AT+GTRNDIS? for query. If you obtain an IP address, the dial is successful.

3.5.6 QMI Dial Method under 3GPP Protocol

Qmi dial is based on the Qualcomm QMITestPro tool for processing. The following is a brief description of the tool's dial method.

- 1) Install the QC USB driver: qud.win.1.1_installer_10051.7.zip
- 2) Connect the Fibocom 668 CN 00 product, enter AT+GTUSBMODE=19, SER=3,1, and switch the port

to the Qualcomm default.

- 3) Open Qualcomm tool QMITetsPro,  and WDS optio
- 4) Select Qualcomm WWAN adapter 9025 port, and select sub, tech, IP type
- 5) Enter the APN name
- 6) Select profile
- 7) Enter username and password
- 8) Select authentication method QMI_WDS_MASK_AUTH_PAP\QMI_WDS_MASK_AUTH_CHAP
- 9) Select CONNECT
- 10) Confirm whether the dial is successful. You can check the dial connection under win, as shown in the figure below. View the IP address in CMD and obtain the IP address to indicate that the dial is successful.

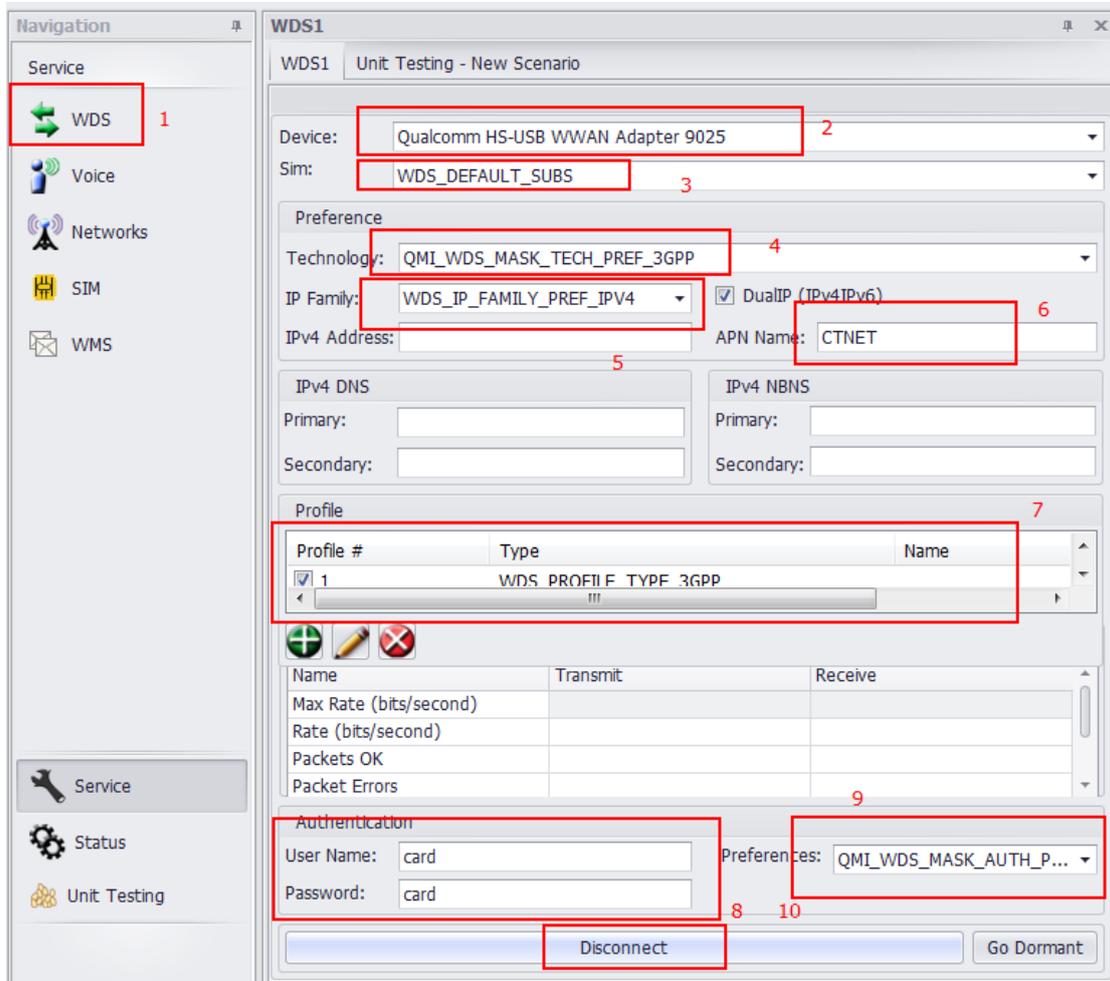


Figure 19 QMITESTPro WDS interface



Figure 20 Check The QMI Dial Connection Under Win

```
Windows IP Configuration

Mobile Broadband adapter ?????? 4:

    Connection-specific DNS Suffix . : 
    IPv4 Address. . . . . : 10.80.12.235
    Subnet Mask . . . . . : 255.255.255.248
    Default Gateway . . . . . : 10.80.12.236
```

3.5.7 ECM Dial Method under 3GPP Protocol

For details, refer to NL668 Application Guide_Linux ECM Dial_V1.0.0