HUAWEI MU609 HSPA LGA Module
V100R002

Application Guide

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About This Document

Revision History

Document Version	Date	Chapter	Descriptions
01	2013-07-18		Creation
02	2013-09-18	1.3	Updated USB Port description
		All	Deleted MSA Positioning Using the User Plane Protocol in issue 01
		19.3	Added section 19.3 Exception Handling
03	2015-06-15		Updated the description about copyright
04	2016-02-24	12.4	Updated XTRA Positioning
05	2017-01-06	1.2	Updated Organization of This Document
		1.3.2	Updated The MU609 supports AT commands
		6	Deleted chapter 6 in issue 04: Voice and Supplementary Service Application Scenarios
		9.3.4	Updated the content about “Other aperiodic events include”
		9.3.5	Updated the description of Wake-up Source
		9.4	Updated the description of Application Scenarios: System with USB Connection only
		9.4.2	Updated the table of Software Procedure
		9.4.3	Updated the description of Advantages
		9.5	Updated the description of Application Scenarios: System with USB and WAKEUP_OUT
		9.5.3	Updated the description of Advantages

Document Version	Date	Chapter	Descriptions
		10.2	Updated the content of Notes
		13.1	Deleted section 13.1 in issue 04: Voice Calls and Text Messaging
		13.3	Deleted section 13.3 in issue 04: Internal/External Protocol Stacks and Voice Calls

Contents

1 Overview

This document is intended to provide references for customers to choose appropriate command sequences to start using the MU609 in a faster manner. This document also contains examples and relevant description.

This document will be updated based on customers' requirements.

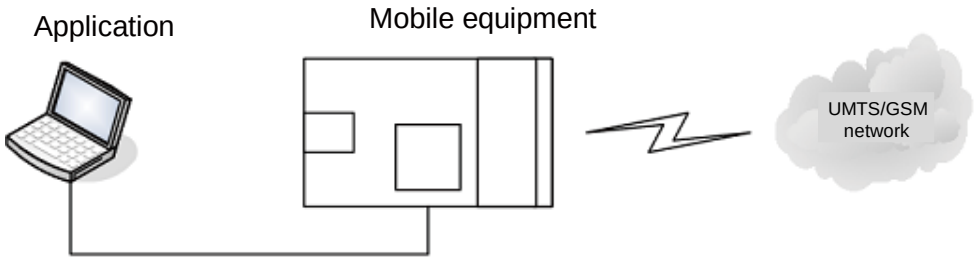
1.1 Conventions and Definitions

1.1.1 Conventions

Convention	Description
<…>	Value range of AT command parameters
XXXX	Personal Identification Number (PIN), Personal Unlock Key (PUK), or password

1.1.2 Definitions

Term	Definition
Connected	Indicates that a link has been set up between two modules or a module and a terminal.
Registered	Indicates that the module is registered with a UMTS/GSM network.
Module	HUAWEI UMTS/GSM module

Term	Definition
	

1.2 Organization of This Document

Chapter	Description
Chapter 1 Overview	Describes the contents and organization of this document
Chapter 2 Initialization Application Scenarios	Describes scenarios for initialization
Chapter 3 Serial Port Configuration Application Scenarios	Describes scenarios for serial port configuration
Chapter 4 External Protocol Stack Application Scenarios	Describes scenarios for external protocol stack
Chapter 5 Internal Protocol Stack Application Scenarios	Describes scenarios for internal protocol stack
Chapter 6 Text Message Application Scenarios	Describes scenarios for the text message
Chapter 7 Phonebook Application Scenarios	Describes scenarios for phonebook
Chapter 8 SIM Operation Application Scenarios	Describes scenarios for PIN management
Chapter 9 Sleeping and Waking Up Application Scenarios	Describes scenarios for power management
Chapter 10 Thermal Protection Application Scenarios	Describes scenarios for thermal protection
Chapter 11 GPS Application Scenarios	Describes scenarios for GPS
Chapter12 Concurrent Service Application Scenarios	Describes scenarios for concurrent service of data service and text

Chapter	Description
Chapter13 STK Application Scenarios	Describes scenarios for STK
Chapter14 USSD Application Scenarios	Describes scenarios for USSD
Chapter15 FOTA Application Scenarios	Describes scenarios for FOTA
Chapter16 ECM Application Scenarios	Describes scenarios for ECM
Chapter17 Local Upgrade Application Scenarios	Describes scenarios for Local Upgrade
Chapter18 Appendix	Appendix

1.3 Basic AT Command Processing Principles

1.3.1 Ports

The MU609 supports two configurations with USB connection, and the second configuration will be selected as the default configuration on Linux/Android OS.

NOTE

The first configuration is reserved and not used currently.

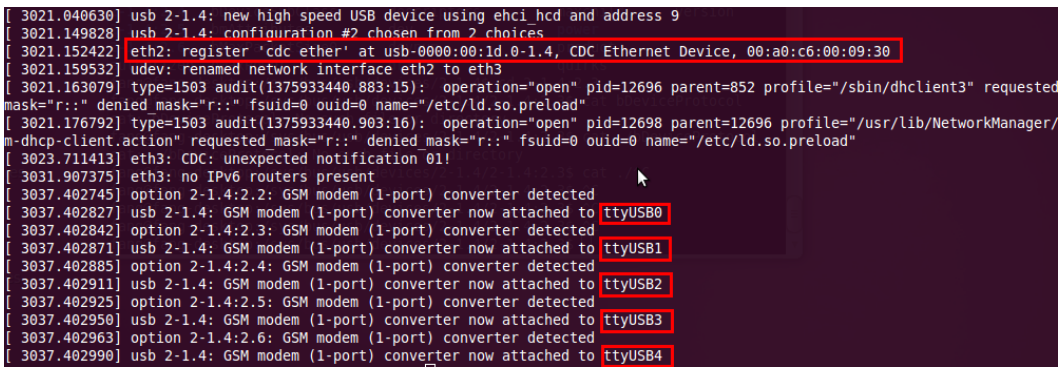
The MU609 provides six ports to interact with USB connection as shown in Figure 1-1 .

The following steps show how to find the six ports.

Step 1 Execute **dmesg** command.

Step 2 Find the mapping details between the ttyUSBx and the USB port.

Figure 1-1 Port sequence on Linux



- ECM port: simulated using USB, for establishing communication connection. This is eth2 in Figure 1-1 .

- MODEM port: simulated using USB, for AT command interaction and establishing data connection. This is ttyUSB0 in Figure 1-1 .
- DIAG port: simulated using USB, for DIAG (diagnostic) command interaction (mainly used to debug modules at present). This is ttyUSB1 in Figure 1-1 .
- PCUI port: simulated using USB, for AT command interaction only. This is ttyUSB2 in Figure 1-1 .
- GPS NMEA port: simulated using USB, sending unsolicited indications for NMEA positioning data only. This is ttyUSB3 in Figure 1-1 .
- GPS Control port: simulated using USB, for GPS AT command interaction only. This is ttyUSB4 in Figure 1-1 .

NOTE

The number of ethx and ttyUSBx may be different between different operation systems, yet the port sequence is the same as shown in Figure 1-1 .

The MU609 also provides a physical serial port:

UART port: physical serial port, for AT command interaction and establishing data connection.

A host controls a module using AT commands. If AT commands are unavailable, a module can be deemed unavailable.

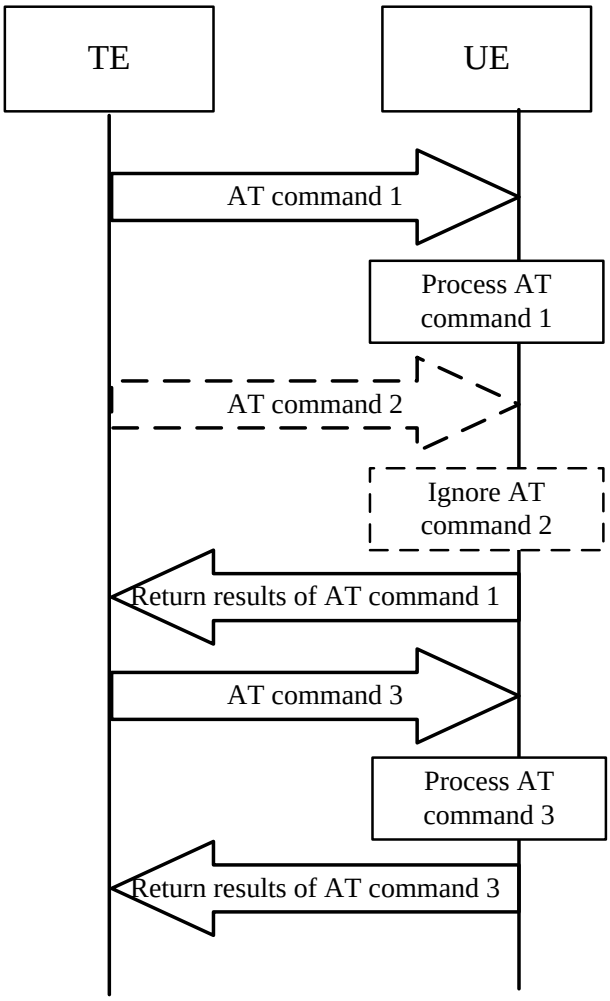
1.3.2 AT Command Processing Mechanism

A module processes AT commands from the ports (MODEM, PCUI, Control, and UART) in series. An AT command can be processed when and only when the previous AT command processing has been completed. If the module is processing an AT command, most new AT commands from the same port will be ignored and other commands from other ports will be buffered until the current AT command is processed.

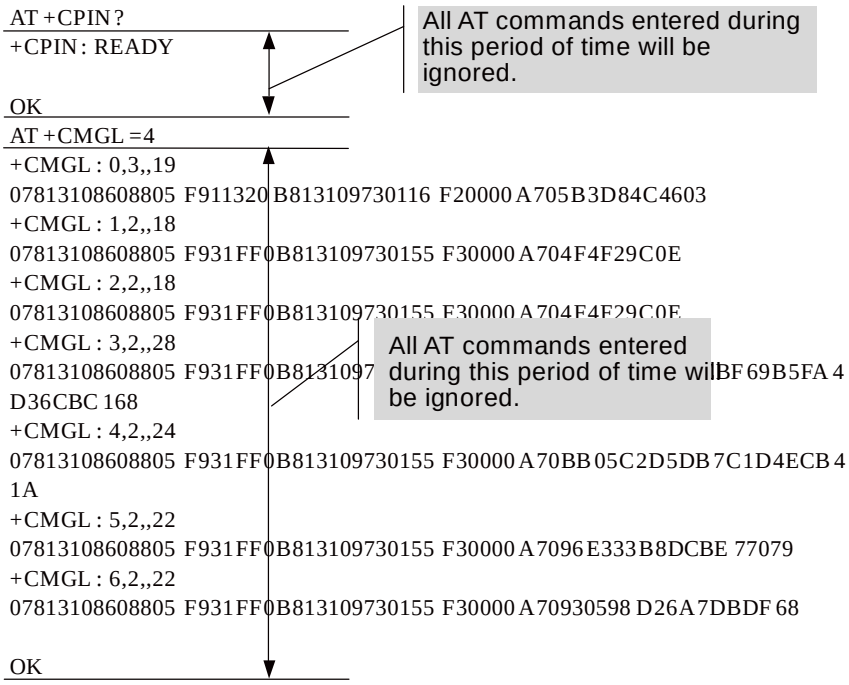
This rule also applies to COM ports converted from USB ports.

The processing of an AT command starts when the AT command is entered from the TE, and ends when the UE (the module) returns all the results in response to the command.

Figure 1-2 AT command processing sequence diagram



Example:



Some special AT commands can be aborted by new AT commands. Such special commands are called abortive commands.

The MU609 supports the following abortive AT commands:

- The AT+COPS Set command
- AT+CLCK
- The IPINIT Execute command
- IPOPEN
- IPSEND
- IPSENDEX
- IPCLOSE

Example:

AT+COPS=1,2,23415 OK	Before the results of AT+COPS is returned, enter any characters (such as "AT"), the module will terminate the processing of AT+COPS and return **OK**. The entered characters are used to abort the command only .

Some commands can be executed when SIM card is inserted. MU609 would return to SIM failure if SIM card is not inserted. For more information, see Property Description of related AT in the latest version of MU609 V100R002 of *HUAWEI MU609 HSPA LGA Module AT Command Interface Specification*.

Example:

AT+CREG?

+CME ERROR: SIM failure

NOTE

SIM failure indicates that SIM card is not inserted.

1.3.3 Recommended Timeout Mechanism for AT Commands Processed by a Host

A module processes AT commands in series. Do not send another AT command before the result for the current command is returned or the current command times out (except when the current command is an abortive AT command). The following table lists AT command timeout durations (starting from the time when an AT command arrives at a port).

Table 1-1 AT command timeout duration

AT Command	Timeout Duration
General AT commands	30s
AT+CMSS/AT+CMGS (used to send text messages)	60s
AT+COPS=? (used to search for networks)	120s

After an AT command times out, it is recommended that the host check whether the module is functioning normally. The following procedure is provided for your reference:

1. The host sends **AT** to the module.
2. If the module returns failure information, go to step 5.

3. If the module returns success information, the module is functioning normally.
4. If the host times out (the host waits for a response for over 30 seconds) three times when waiting for the response from the module, go to step 5. Otherwise go to step 1.
5. The host deems that the current module does not exist or is unavailable. Close the port, stop sending all AT commands, exit the procedure to determine whether the module is normal, and re-search for modules.

2 Initialization Application Scenarios

2.1 Startup Indication ^SYSSTART

2.1.1 Reference Process

Command	Description
	A module, without solicitation, presents **^SYSSTART** to its host to indicate that the module is starting.
^SYSSTART	Indicate that a module is starting.

NOTE

- **^SYSSTART** is presented only when a module is starting and will not be presented after a module has started.
- **^SYSSTART** is presented only after the radio frequency (RF) initialization completes and will not be presented in offline mode.

2.1.2 Troubleshooting

Scenario	Possible Error Information	Solution
The module presents **^SYSSTART** during startup. After that, the module presents **^SYSSTART** again.	Indicate that the module has been reset.	If **^SYSSTART** is presented repeatedly, send the module to the specified repair center.

2.2 Querying Basic Information

2.2.1 Reference Process

Command	Description
AT+GMR/CGMR	Query software version.
Software version **OK**	Software version. e.g. 11.103.03.00.00
AT+GMI/CGMI	Query manufacturer identification.
Manufacturer Identification **OK**	For example: Huawei Technologies Co., Ltd.
AT+GMM/CGMM	Query model identification.
Model identification **OK**	For example: MU609
AT+GSN/CGSN	Query product IMEI.
IMEI **OK**	For example: 865261010004010

NOTE

The previously listed commands are Query commands and cannot be used to configure settings.

2.2.2 Troubleshooting

Scenario	Possible Error Information	Solution
AT+GSN/CGSN	**+CME ERROR: memory failure**	This error occurs when a module's IMEI is not specified. This problem is solved after the IMEI is written into the module.

2.3 Network Service Operations

2.3.1 Reference Process

Command	Description
AT+CFUN?	Query a module's current mode. **1** indicates online mode.
+CFUN: 1 **OK**	
AT+CPIN?	Query whether a module's SIM card is password protected. **READY** indicates that the SIM card is ready.
+CPIN: READY **OK**	
AT+CSQ	Query the network's signal strength.
+CSQ: 31,99 **OK**	
AT+COPS?	Return the current network selection mode, information about the operator with which the module is registered, and the wireless access standard.
+COPS: "Network status information" **OK**	For example: **+COPS: 1,0, "CHINA MOBILE "**
AT+COPS=0	Automatically search for networks.
OK	
AT+CREG?	Query the state of the currently registered network.
+CREG: 0,1 **OK**	
AT+CREG=1	Set the **+CREG** unsolicited indication.
OK	

2.3.2 Troubleshooting

Scenario	Possible Error Information	Solution
AT+COPS?	**+CME ERROR: SIM failure**	No SIM card is detected. Insert a SIM card.
AT+CREG?	**+CME ERROR: SIM failure**	No SIM card is detected. Insert a SIM card.

3 Serial Port Configuration Application Scenarios

3.1 Baud Rate Configuration

3.1.1 Reference Process

Command	Description
AT+IPR?	Query the baud rate currently used by a module.
+IPR: 115200 **OK**	
AT+IPR="<baud rate>"	Set a module's baud rate. After a new baud rate is specified, the module communicates using the new baud rate.
OK	

NOTE

- If a module's baud rate is too low, its communication speed will be slow.
- At present, the MU609 supports the following baud rates: 300, 600, 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200, and 230400.

3.1.2 Troubleshooting

Scenario	Possible Error Information	Solution
Specify a baud rate not supported by a module.	**AT+IPR="<baud rate>"** **ERROR**	Check that the specified baud rate is within the range of supported baud rates.

3.2 DTR Hang Up Data Services

3.2.1 Reference Process

Command	Description
AT&D0	Establish a dial-up connection through a serial port for data services. After this command is executed, data can be transferred properly.
OK	
AT&D2	This command is used to configure the action to be executed when DTR pin is high level or low level. Which is: After **AT&D2** is executed, when DTR pin is high level, data will be transmitted normally; when DTR pin is low level, data transmission will be terminated.
OK	

NOTE

At present, only **AT&D0** and **AT&D2** are supported. **AT&D1** is not supported.

3.2.2 Troubleshooting

Scenario	Possible Error Information	Solution
AT&D1	**AT&D1** **ERROR**	At present, only **AT&D0** and **AT&D2** are supported. **AT&D1** is not supported.

3.3 DCD Pin Control

3.3.1 Reference Process

Command	Description
AT&C0	Set the DCD pin to be always valid regardless of data services.
OK	
AT&C1	Set the DCD pin to be valid when there are ongoing data services and invalid after data services are disconnected.

OK

3.3.2 Troubleshooting

Scenario	Possible Error Information	Solution
AT&C2	**ERROR**	Unsupported parameter value

3.4 Setting Hardware Flow Control

3.4.1 Reference Process

Command	Description
AT+IFC=0,0	Turn hardware flow control off. After hardware flow control is turned off, communication between the UE and the DTC is not restricted by flow control.
OK	
AT+IFC=2,2	Turn hardware flow control on. After hardware flow control is turned on, communication between the UE and the TE is restricted by flow control: Data transmission stops when UE's or TE's buffer level exceeds 80% and resumes when the buffer level is below 20%.
OK	

NOTE

If hardware flow control is enabled, no AT commands can be executed.

3.4.2 Troubleshooting

None

4 External Protocol Stack Application Scenarios

4.1 Prerequisites

4.1.1 Reference Process

Command	Description
AT+CGDCONT=1,"IP","1234"	Configure PDP contexts. In this example provided in the left column, the APN is **1234**. In fact, the APN is provided by your network service provider.
OK	
AT+CGATT?	Obtain PS domain service status.
+CGATT: 1	If **1** is returned, attaching to the PS domain succeeded.
OK	If **OK** is returned, the command has been executed successfully

NOTE

External protocol stack supports UART or MODEM ports only. After the pre-configuration is complete, ensure that the desired port is not occupied by other processes.

4.1.2 Troubleshooting

Scenario	Possible Error Information	Solution
AT+CGATT?	**+CGATT: 0** **OK** The UE does not obtain any PS domain services.	Run **AT+CGATT=1** to manually attach to the PS domain. If attaching to the PS domain still fails or times out (refer to 3GPP TS 24.008 4.7.3), refer to section 2.3.

4.2 Establishing Data Connections

Reference process 1:

Command	Description
ATD*99#	***99#** is the dial string. This command is usually used in Windows and only used in the modem port. The UE switches from command mode to data mode. After the TE starts the PPP negotiation process, the UE automatically performs the actions (including PS domain attaching and PDP activation) required for establishing data connections.
CONNECT xxx	**CONNECT** indicates that the data service dial-up command is being processed by the module. xxx indicates the data rate, which depends on the network standard and capability level.

Reference process 2:

Command	Description
AT+CGDATA="PPP",1	This command is equivalent to **ATD*99#**. This command is usually used in the Android Radio Interface Layer (RIL).
CONNECT	

NOTE

- Using the previously configured profile, the PPP negotiation between the TE and the UE, and the PDP negotiation between the UE and the network, the TE obtains the IP and DNS addresses to establish the routing between the TE and the network.
- When establishing data service connections, the TE must start the PPP negotiation after the UE enters data mode. Otherwise the UE will only enter data mode but will not establish data connections with the network.
- The data mode means: After entering data mode, the UE only transfers data packets between the UE and the network, and will not respond to any AT commands except that comes from the PCUI port.

4.2.1 Troubleshooting

Scenario	Possible Error Information	Solution
Failure to open ports or register with a network	Error xxx: The modem (or other connected device) is in use. Note: **xxx** is usually a number indicating an error. For example, **633**.	1. Check whether the Modem port is in use. Ensure that the Modem port is not being used by other connections. 2. Check that the current network is operating normally. Data service connections can be established only when the network is operating normally.

4.3 Data Transmission

1. Data can be transmitted after data service connections are established.
2. According to 3GPP TS 25.306, HSDPA (FDD) terminals are classified into 24 categories. Different categories have different peak data rates. The following table lists common categories and their key parameters.

Common Terminal Category	Maximum Number of Codewords	Soft Channel Size (Bits)	Minimum Transmission Time Interval (TTI)	Modulation Mode	Theoretical Peak Rate (Mbit/s)
Category 8	10	134400	1	QPSK 16QAM	7.2
Category 10	15	172800	1	QPSK 16QAM	14.4
Category 14	15	259200	1	QPSK 16QAM 64QAM	21.6
Category 16	15	345600	1	QPSK 16QAM MIMO+16QAM Note: 64QAM is not supported.	28.8
Category 18	15	345600	1	QPSK 16QAM 64QAM MIMO+16QAM	28.8

Common Terminal Category	Maximum Number of Codewords	Soft Channel Size (Bits)	Minimum Transmission Time Interval (TTI)	Modulation Mode	Theoretical Peak Rate (Mbit/s)
Category 20	15	518400	1	QPSK 16QAM 64QAM MIMO+16QAM MIMO+64QAM	43.2
Category 24	15	518400	1	QPSK 16QAM 64QAM DC	43.2

HSUPA (FDD) terminals are classified into seven categories. The following table lists common categories and their key parameters.

Common Terminal Category	Maximum Number of E-DCH	Minimum SF	Support 2 ms TTI	Modulation Mode	Theoretical Peak Rate (Mbit/s)
category 5	2	SF2	No	QPSK	2
category 6	4	SF2	Yes	QPSK	5.76

3. According to the Radio Resource Control (RRC) version, the WCDMA/HSDPA/HSUPA/HSPA/DC_HSPA rate in theory are as follows:

WCDMA RRC Version	Modulation Mode		Theoretical Peak Rate (Mbit/s)	
3GPP Rel	Downlink	Uplink	Downlink	Uplink
R99/R4	QPSK	BPSK	0.384	0.384
Rel-5	16QAM+	QPSK	14.4	0.38
Rel-6	16QAM	QPSK	14.4	5.76
Rel-7	16QAM 64QAM	16QAM 16QAM	28.8 21.6	11.52 11.52
Rel-8	64QAM DC-SHDPA+64QAM	16QAM 16QAM	43.2 43.2	11.52 11.52
Rel-9	DC-SHDPA+64QAM	DC-SHUPA	84	23

4.4 Switch Between Data Mode and Command Mode

4.4.1 Reference Process

Command	Description
ATD*99#	UE dials up.
CONNECT	
+++	Enter **+++** (three plus signs) to switch the data service port from data mode to command mode. The UE can then respond to AT commands and perform corresponding actions.
ATO	Switch the data service port back to data mode so that the UE can continue to transmit data.
CONNECT	

NOTE

- If there are no data links available, the module will not switch back to data mode but remains in command mode.
- If the data link is connected, when the module switches from data mode to command mode, data transmission will be suspended.
- If the data link is connected, when the module switches from command mode to data mode, data transmission will be resumed.
- Switching between data mode and command mode applies to UART and Modem ports.

4.4.2 Troubleshooting

Scenario	Possible Error Information	Solution
+++	Failed to switch to command mode.	**+++** must be consecutively entered within 0.9s.

4.5 Disconnecting Data Service Connections

4.5.1 Reference Process

Process 1:

Command	Description
+++	

ATH	Before this command is executed, the **+++** sequence must be sent to the data service port. This command is used to disconnect data service connections. This command is usually used in Windows.
OK	

Process 2:

Command	Description
AT+CGACT=0	In Android RIL, after a PPP connection is disconnected, this command is executed to deactivate the PDP context to release the data link and disconnect the data services. The use of this command is the same as that of **ATH**.
OK	

1. Terminating a data service connection from the TE: the TE sends a PPP Terminate packet to the UE to pull down the DTR signal. The UE disconnects the PPP connection, releases the wireless link resource, pulls down the CD signal, and returns **NO CARRIER**. As a result, the data service connection is disconnected. This method of disconnecting data service connections is usually implemented by the disconnection function of the TE's application.
2. Terminating a data service connection from the UE: The TE sends an AT command to the UE to pull down the DTR signal. After receiving the AT command, the UE releases the connection to the network, pulls down the CD signal, and returns **NO CARRIER**. As a result, the data service connection is disconnected. This mode of disconnecting data service connections requires an AT command interaction tool.
3. When disconnecting data service connections in Android RIL, the module must kill pppd to disconnect PPP connections before using **AT+CGACT=0** to deactivate PDP contexts and release wireless link resources.

5 Internal Protocol Stack Application Scenarios

5.1 Initializing Internet Services

5.1.1 Reference Process

Command	Description
AT^IPINIT="1234","card","card"	In this example provided in the left column, the APN is **1234**, and the user name and password are both **card**. After this command is executed, the PDP active process will be caused.
OK	
AT^IPINIT?	Query the obtained IP and DNS addresses.
^IPINIT: 1, "192.168.70.59","1234","172.22.44.200","172.22.44.201" **OK**	

NOTE

Internal protocol stack supports UART ports only.

5.1.2 Troubleshooting

Scenario	Possible Error Information	Solution
AT^IPINIT?	**^IPINIT: 0** **OK**	Initialization has not been performed. Initialize the internal protocol stack and query again.

Scenario	Possible Error Information	Solution
AT^IPINIT="1234","card","card"	**+CME ERROR: Normal error**	Initialization failed. 1. Check that the current network signal strength is good and the parameters are set correctly. 2. Ensure that no IP stack termination command has been executed.
AT^IPINIT="1234","card","card"	**+CME ERROR: The link has been established already**	**AT^IPINIT?** queries whether the internal protocol stack has been initialized. If the internal protocol stack has been initialized, it does not need to be initialized again. If it has not been initialized, there are ongoing dial-up services. Hang up the dial-up services and re-send **AT^IPINIT** to start initialization.

5.2 Creating a Listen Server

5.2.1 Reference Process

Command	Description
AT^IPINIT="1234","card","card"	Initialize the internal protocol stack.
OK	
AT^IPLISTEN="TCP",5000	Create a TCP server whose listen port number is 5000 (users can specify this number as required). For the method to create UDP servers, refer to the AT command document.
OK	
AT^IPLISTEN?	Query the information about the server that has been created.
^IPLISTEN: "TCP",5000,5	
OK	

NOTE

- Only one server is supported by the internal protocol stack.
- The internal protocol stack must be initialized before you create a listen server.

5.2.2 Troubleshooting

Scenario	Possible Error Information	Solution
AT^IPLISTEN="TCP",5000	**+CME ERROR: The network has not been opened yet**	Run **AT^IPINIT** to initialize the internal protocol stack, and then create the listen server.
AT^IPLISTEN="UDP",5000	**+CME ERROR: The server has been established already**	A listen server already exists. Run **AT^IPCLOSE=6** to close the existing listen server.
AT^IPLISTEN="UDP",5000	**+CME ERROR: Fail to bind the specified port with server**	The local port is in use. Change the port and re-send the command.

5.3 Creating TCP/UDP Links

5.3.1 Reference Process

Command	Description
AT^IPINIT="1234","card","card"	Initialize the internal protocol stack.
OK	
AT^IPOPEN=1,"TCP","172.22.44.33",5000,5500	Use a specified IP address to connect to the remote server and establish a TCP link. For the method to create UDP links link, refer to the AT command document.
OK	
AT^IPOPEN=2,"TCP","www.huawei.com",80	Use a specified domain name to connect to the remote server and establish a TCP link.
OK	
AT^IPOPEN?	Query link information.

^IPOPEN: 1,"TCP",5500,"172.22.44.33",5000,3,0

OK

^IPOPEN: 2,"TCP",5600,"172.22.44.33",80,3,0

OK

NOTE

- When creating a listen server, the local port number can be ignored. If the port number is ignored, the module will randomly assign a local port number.
- When creating a TCP link, ensure that the remote server has been started.
- The maximum segment size (MSS) for creating TCP links is 1220 bytes. Data larger than the MSS will be segmented into several packets.

5.3.2 Troubleshooting

Scenario	Possible Error Information	Solution
AT^IPOPEN=1,"TCP","172.22.44.33",5000	**+CME ERROR: The network has not been opened yet**	Initialize the internal protocol stack before sending the command to create the link.
AT^IPOPEN=1,"TCP","172.22.44.33",5000	**+CME ERROR: The link has been established already**	Run **AT^IPCLOSE** to close the corresponding link. Alternatively, change the link ID and send the command to create the link.
AT^IPOPEN=1,"TCP","172.22.44.33",5000,5000	**+CME ERROR: Fail to bind the specified port**	Change the local port number, or leave the local port number blank.
AT^IPOPEN?	**OK**	No link information is available. Create a link, or accept the link as a server, and then query the link information again.

5.4 Sending Data

5.4.1 Reference Process

Command	Description
AT^IPINIT="1234","card","card"	Initialize the internal protocol stack.

OK	
AT^IPOPEN=1,"TCP","172.22.44.33",5000,5500	Create a link.
OK	
AT^IPSEND=1,"31323334"	Send data. In this example, **31323334** is sent.
^IPSEND: 1	Data is successfully sent and received.
OK	
^IPDATA: 1,8,31323334	
AT^IPSENDEX=1,0,"31323334"	Send data in mode 0. In this example, **31323334** is sent.
^IPSENDEX: 1	
OK	
^IPDATA: 1,8,31323334	
AT^IPSENDEX=1,1,"31323334"	Send data in mode 1. In this example, **1234** is actually sent.
^IPSENDEX: 1	
OK	
^IPDATA: 1,4,1234	
AT^IPSENDEX=1,2,<datalen>	Send data in mode 2.
OK **(Wait for the user to enter user data with a length of <datalen>)** **^IPSENDEX: 1**	
OK	

NOTE

- **IPSEND** and mode 0 of **IPSENDEX** can send displayable characters only. Mode 1 and mode 2 of **IPSENDEX** can send all characters.
- In mode 2 of IPSENDEX (length restriction mode), except the port that receives data entered by the user, all other ports are unavailable before the user finishes entering the user data.

5.4.2 Troubleshooting

Scenario	Possible Error Information	Solution
AT^IPSEND=1,"data"	**+CME ERROR: The network has not been opened yet**	Before sending data, initialize the protocol stack or accept the link as a server.
AT^IPSEND=1,"data"	**+CME ERROR: Remain data is sending**	The module is exiting transparent transmission mode and cannot send data. Wait until the module completely exits transparent transmission mode.
AT^IPSEND=1,"data"	**+CME ERROR: The link has not been established yet**	Before sending data, create a link or accept the link as a server.
AT^IPSEND=1,"data"	**+CME ERROR: Normal error**	The module failed to send the data. Ensure that the current network's signal strength is good.
AT^IPSENDEX=1,2,<datalen>	**+CME ERROR: Too many data to be sent**	The length of the data entered by the user exceeds the length specified by the command. Ensure that the length of the data is equal to the data length specified by mode 2 of **IPSENDEX**.

5.5 Closing TCP/UDP Links

5.5.1 Reference Process

Command	Description
AT^IPCLOSE=<link_id>	Close the specified link, server, or network, and at the same time release the corresponding resources. For details about the parameters, refer to the related AT command document.

OK	
AT^IPCLOSE?	Query the current link status.
^IPCLOSE: 1,0,0,0,0	**1** indicates that the link is open, and **0** indicates that the link is closed.
OK	

5.5.2 Troubleshooting

Scenario	Possible Error Information	Solution
AT^IPCLOSE=<link_id>	**+CME ERROR: Normal error**	The command is terminated. Run the **AT^IPCLOSE** command again.

5.6 Transparent Transmission Mode

5.6.1 Reference Process

Command	Description
AT^IPINIT="1234","card","card"	Initialize the internal protocol stack.
OK	
AT^IPOPEN=1,"UDP","172.22.44.33",5000,5500	Create a link.
OK	
AT^IPCFL=12,0	Set the transparent transmission mode to time- and length-based transmission mode.
OK	
AT^IPCFL=5,100	Set the timer for triggering transparent transmission to 10s (100 x 0.1s).
OK	
AT^IPCFL=10,1220	Set the TCP/UDP MSS to 1220 bytes.
OK	
AT^IPENTRANS=1	Enable transparent transmission mode.
OK	

313233347D5D7D5E7E	Send user data. User data is sent once the data length reaches the segment length specified by parameter 10 of **AT^IPCFL**. If the user data length is shorter than the specified length, the data will be sent when the timer set by parameter 5 of **AT^IPCFL** counts down to 0. For details about the transmission mechanism, refer to the description of ^IPENTRANS in the AT command document. In this example, the data entered by the user is 313233347D5D7D5E7E in hexadecimal format. The data sent by the module is the original data entered by the user.
313233347D5D7D5E7E	Receive user data in time- and length-based transmission mode. In this example, the data received by the module is 313233347D5D7D5E7E. The original data received by the module is presented.
+++	Exit transparent transmission mode. For the rules about the +++ sequence, refer to the AT command document.
OK	
AT^IPCFL=12,1	Set the transparent transmission mode to 7E detection mode.
OK	
AT^IPENTRANS=1	Enable transparent transmission mode.
OK	
AT^IPENTRANS?	Query the link ID for entering transparent transmission mode from a non-transparent port.
^IPENTRANS: 1	
313233347D5D7D5E7E	Send data in 7E detection mode (applies to UDP only). In this example, the data that the user wants to send is 313233347D7E in hexadecimal format. Therefore, the user needs to transform 7D to 7D5D and 7E to 7D5E, and adds 7E as the ending characters to the end of the data. After the module recognizes the data packet, the data actually sent by the module is 313233347D7E.

313233347D5D7D5E7E	Receive data in 7E detection mode (applies to UDP only). The data received by the module is 313233347D7E in hexadecimal format. After receiving the data, the module transforms 7D to 7D5D and 7E to 7D5E, and adds 7E as the ending characters to the end of the data before presenting the data to the user.

NOTE

- The transparent transmission mode of the internal protocol stack supports UART only.
- The internal protocol stack allows only one link to enter transparent transmission mode. In addition, before entering transparent transmission mode, ensure that only one link exists at the current physical port. If the module functions as a server, the link can enter transparent transmission mode only when the link is requested by a remote client and accepted by the server.
- The settings (including the time- and length-based transmission mode and 7E detection mode) of transparent transmission mode must be configured using **AT^IPCFL** before the transparent transmission mode is enabled. For details about how to configure the settings, refer to the AT command document.

5.6.2 Troubleshooting

Scenario	Possible Error Information	Solution
AT^IPENTRANS=1	**+CME ERROR: Invalid port for transparent mode**	This indicates that the link is not established at a UART port. To solve this problem, establish a link from a UART port and set the UART port to enter transparent transmission mode.
AT^IPENTRANS=1	**+CME ERROR: More than one link in physical port**	There are more than one link. Use **AT^IPCLOSE** to close other links before entering transparent transmission mode.
AT^IPENTRANS=1	**+CME ERROR: The physical port is in listen state and has no client**	The module functions as the server but does not accept the link requested by the client. Accept the link before entering transparent transmission mode.
AT^IPCFL=5,10	**+CME ERROR: Forbidden operation in transparent mode**	**AT^IPCFL** cannot be used during transparent transmission. Exit transparent transmission mode before running **AT^IPCFL**.

5.7 Packet Statistics

5.7.1 Reference Process

Command	Description
AT^IPFLOWQ?	Query packet statistics. In this example, the returned result indicates that 3 bytes of characters are successfully received by and sent from link 1. For details about the parameters. Refer to the AT command document.
^IPFLOWQ: 1,3,3,3,3,3 **^IPFLOWQ: 2,0,0,0,0,0** **^IPFLOWQ: 3,0,0,0,0,0** **^IPFLOWQ: 4,0,0,0,0,0** **^IPFLOWQ: 5,0,0,0,0,0** **OK**	
AT^IPFLOWQ=<linkid>	Clear the traffic statistics on the specified link (<linkid> is from 1 to 5).
OK	
AT^IPFLOWQ=0	Clear the traffic statistics on all links.
OK	

5.8 TCP/UDP Link Change Indication

5.8.1 Reference Process

Command	Description
AT^IPINIT="1234","card","card"	Initialize the internal protocol stack.
OK	
AT^IPLISTEN="TCP",5000	Create a server.
OK **(The client requests to connect to the server.)** **^IPSTATE: 1,1,1**	The server accepts the link requested by the client.
(The other party of the link closest the link.)	
^IPSTATE: 1,0,0	

(Network connection is broken.)	
^IPSTATE: 1,0,2 **^IPSTATE: 6,0,2** **^IPSTATE: 7,0,2**	Indicate presented without solicitation for broken links, connection to the server, and network connections.
	The number of current links has reached the supported maximum. New link requests will be rejected.
^IPSTATE: 0,0,3	
	The module rejects new link requests because it functions as the server and is in transparent transmission mode.
^IPSTATE: 0,0,4	

6 Text Message Application Scenarios

6.1 Pre-configuration (CPMS)

6.1.1 Reference Process

Command	Description
AT+CPMS=?	Query the types of supported storage.
+CPMS: ("ME","SM"),("ME","SM"),("ME","SM") **OK**	
AT+CPMS="SM","SM","SM"	For details about the parameters, refer to the latest version of MU609 V100R002 in *HUAWEI MU609 HSPA LGA Module AT Command Interface Specification*. It is recommended that you keep the three types of storage consistent.
+CPMS: 3,40,3,40,3,40 **OK**	
AT+CPMS?	Query the current storage type, used storage space and maximum storage capacity.
+CPMS: "SM",3,40,"SM",3,40,"SM",3,40 **OK**	

6.1.2 Troubleshooting

Scenario	Possible Error Information	Solution
Error information is returned in response to one of the previous commands.	**+CME ERROR: SIM PIN required**	Enter the correct PIN.
	+CMS ERROR: 500	SIM card initialization has not completed. Try again later.
	ERROR	Unsupported storage.

6.2 Sending English Text Messages in PDU Format

6.2.1 Reference Process

Command	Description
AT+CMGF=0	Set the message format to PDU format (see the note).
OK	
AT+CMGS=21 **>0891683108608805F911000B813109730137F10000FF07EDF27C1E3E9701** **\0x1A**	Send a text message using PDU of 21 bytes in length (excluding the service center number 0891683108608805F9). The message content is "message". Press ctrl+z (0x1A) to stop entering message content and send the message.
+CMGS: 4 **OK**	The message is successfully sent. <*TP-MR*> is returned. For details about <*TP-MR*>, refer to the *3GPP TS 23.040*.
AT+CMGS=10 **>0891683108608805F911000B813109730137F10008FF0677ED6D88606F** **\0x1A**	Send a text message using PDU of 20 bytes in length (excluding the service center number 0891683108608805F9). The message content is "短消息". Press ctrl+z (0x1A) to stop entering message content and send the message.
+CMGS: 5 **OK**	The message is successfully sent.

NOTE

For details about the structure of a PDU packet, refer to the *3GPP TS 23.040.*

6.2.2 Troubleshooting

Scenario	Possible Error Information	Solution
Error information is returned in response to one of the previous commands.	**+CMS ERROR: 500**	The text message cannot be sent because of network errors, incorrect service center number, or other errors. Resend the message.
	+CMS ERROR: 304	Incorrect PDU packet content.

6.3 Sending Chinese Character Text Messages in Text Format

6.3.1 Reference Process

Command	Description
AT+CMGF=1	Set the message format to Text format.
OK	
AT+CSMP=,,0,8	Set the data coding scheme to UCS2.
OK	
AT+CSCA="8613800688509",145	Set the service center number.
OK	
AT+CSCS="UCS2"	Set the TE's character set to UCS2 encoding.
OK	
AT+CMGS="00310033003300310032 00330034003500360037003 8" **> 534E4E3A** **\0x1A**	Send the message to the destination address "13312345678" that must be enclosed in double quotation marks. The message content is the UCS2 codes for the Chinese characters "华为". Press ctrl+z (0x1A) to stop entering message content and send the message.

+CMGS: 6 **OK**	The message is successfully sent.
AT+CSMP=,,0,0	Set the data coding scheme to GSM 7bit
OK	
AT+CSCS="GSM"	Set the TE's character set to GSM 7bit encoding.
OK	
AT+CMGS="13312345678" **>huawei** **\0x1A**	Send the message to the destination address "13312345678" that must be enclosed in double quotation marks. The message content is the UCS2 codes for the Chinese characters "华为". Press ctrl+z (0x1A) to stop entering message content and send the message.
+CMGS: 7 **OK**	The message is successfully sent.

6.3.2 Troubleshooting

Scenario	Possible Error Information	Solution
Error information is returned in response to one of the previous commands.	**+CMS ERROR: 305**	The message content does not comply with the encoding scheme specified by **AT+CSMP**.

6.4 Receiving Text Messages

6.4.1 Reference Process

Command	Description
AT+CNMI=2,1,0,0,0	Store the message on the SIM card or ME, and presents the new message indication.

OK	
+CMTI: "SM",4	Present the storage and location without solicitation.
AT+CNMI=1,2,0,0,0	Receive and directly presents the message instead of storing it.
OK	
+CMT: "+8613312345678",,"12/05/05,18:10:36 +00" **huawei** **^SMMEMFULL: "SM"**	Directly present the message instead of storing it. In this example, the message is in Text mode. In PDU mode, PDU packets are presented. Present an indication, without solicitation, when the message storage is full.
AT+CMGR=4	Read the message stored in index 4.
+CMGR: "REC UNREAD","+8613312345678",,"12/05/17,16:13:08+00" **huawei** **OK**	
AT+CMGL="ALL"	In Text mode, list all the messages in the current storage.
+CMGL: 2,"REC READ","+8613903710742",,"12/05/17,16:12:30+00" **test1** **+CMGL: 3,"REC READ","+8613903710742",,"12/05/17,16:13:08+00"** **test2** **OK**	
AT+CMGL=0	In PDU mode, list all the received unread messages.
+CMGL: 1,0,,25 **0891683108608805F9040D91683109730147F20000215071617235000 5F4F29C4E03** **OK**	
AT+CMGD=1	Delete the message stored in index 1.
OK	
AT+CMGD=1,4	Delete all the messages in the current storage.
OK	

6.4.2 Troubleshooting

Scenario	Possible Error Information	Solution
Error information is returned in response to one of the previous commands.	**ERROR**	In Text mode, run **AT+CMGL=4** (number), or in PDU mode, run **AT+CMGL="ALL"** (string), and ERROR is returned.
	+CMS ERROR: 500	During SIM card initialization, run **AT+CMGL** or **AT+CMGD** to read or delete a message, and an error is returned.

6.5 Segmenting and Reassembling Long Text Messages

6.5.1 Segmenting

In PDU mode, text messages can be encoded using GSM 7-bit, 8-bit or UCS2. The GSM 7-bit encoding scheme is used to encode common ASCII characters, compressing every 8 characters into 7 characters. The 8-bit encoding scheme is usually used to encode data such as pictures and ringtones. The UCS2 encoding scheme is used to encode Unicode characters. According to the existing 3GPP protocols, the size of the user data contained a PDU is 140 bytes. Therefore, the maximum number of characters contained in a single message is 160, 140 and 70 for the GSM 7-bit, 8-bit, and UCS2 encoding schemes respectively. If the number of characters contained in a text message exceeds the maximum number, the message will be segmented into several messages. An English letter, a Chinese character, or a byte of data is considered as a character.

According to the existing 3GPP protocols, after a long text message is segmented, the number of characters that each message segment can contain is as follows:

- GSM 7-bit encoding: 153 characters
- 8-bit encoding: 134 characters
- UCS2 encoding: 67 characters

The number of available characters per segment is lower, because each segment must contain segmentation information.

The storage space occupied by a character is as follows:

- GSM 7-bit encoding: 7 bits
- 8-bit encoding: 8 bits
- UCS2 encoding: 16 bits

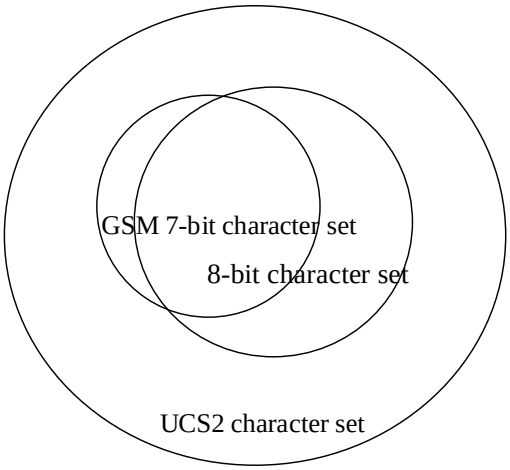
The storage space occupied by a segment of a long text message is as follows:

- GSM 7-bit encoding: 153 bits x 7 = 1071 bits

- 8-bit encoding: 134 bits x 8 = 1072 bits
- UCS2 encoding: 67 bits x 16 = 1072 bits

For all the three encoding schemes, a short message occupies a maximum of 1120 bits (160 x 7, 140 x 8, or 70 x 16) in the storage. If a text message's size is larger than 1120 bits, the message is a long message.

Figure 6-1 Relationships between character sets



Relationships between character sets

6.5.2 Reassembling

The host applications can reassemble the segments of a long text based on the following:

- The protocol header in the user data (TP-UD) of a PDU (see the *3GPP TS 23.040 9.2.3.24.1*)
- The sender's number contained in each segment
- The interval between the time when each segment is received (The interval between the two neighboring segments' receiving time is less than 60 seconds, and the maximum interval between the first and the last segments' receiving time is 24 hours)

7 Phonebook Application Scenarios

7.1 Memory Operations

7.1.1 Reference Process

Command	Description
AT+CPBS=?	Query the current storage type.
+CPBS: ("SM","EN","ON") **OK**	
AT+CPBS="SM"	Set the current storage type to "SM".
OK	
AT+CPBS?	
+CPBS: "SM",241,250 **OK**	**241** indicates that 241 entries have been stored in the storage. **250** indicates that the maximum storage capacity of the current storage ("SM") is 250 entries.

7.1.2 Troubleshooting

Scenario	Possible Error Information	Solution
Error information is returned in response to one of the previous commands.	**+CME ERROR: SIM busy**	Phonebook initialization has not completed. Try again later.
	+CME ERROR: SIM PIN required	Enter the correct PIN.

Scenario	Possible Error Information	Solution
	+CME ERROR: SIM PUK required	Enter the correct PUK.

7.2 Writing/Deleting Phonebook Entries

7.2.1 Reference Process

Command	Description
AT^CPBW=1,"1234567890",129,"HUAWEI",0	Write an entry in GSM 7-bit format into index 1 in the phonebook.
OK	
AT^CPBW=1,"1234567890",129,"80534E4E3A",1	Write an entry in raw data format into index 1 in the phonebook.
OK	
AT^CPBW=,"12345678901234567890123",128,"80534E4E3A",1	Write an entry into the first empty location in the phonebook.
OK	
AT^CPBW=1	Delete the entry in index 1 in the phonebook.
OK	

7.2.2 Troubleshooting

Scenario	Possible Error Information	Solution
Error information is returned in response to one of the previous commands.	**+CME ERROR: SIM busy**	Phonebook initialization has not completed. Try again later.
	+CME ERROR: SIM PIN required	Enter the correct PIN.
	+CME ERROR: SIM PUK required	Enter the correct PUK.
Error information is returned when writing an entry into the phonebook.	**+CME ERROR: dial string too long**	Check that the phone number is not too long.

Scenario	Possible Error Information	Solution
Error information is returned in response to one of the previous commands.	**+CME ERROR: invalid index**	Check that the location index and phone number type are valid.
Error information is returned when writing an entry into the phonebook.	**+CME ERROR: invalid characters in dial string**	The phone number to be written into the phonebook contains invalid characters. Delete the invalid characters and try again.
AT^CPBW=,"123456789 01234567890123",128," 80534E4E3A"**,1**	**+CME ERROR: memory full**	The storage is full. Delete some entries and try again.

7.3 Reading Phonebook Entries

7.3.1 Reference Process

Command	Description
AT^CPBR=<index1>	Read the entry stored in index 1 in the phonebook memory.
OK	
AT^CPBR=<index1>,<index2>	Read all entries stored in locations between index 1 and index 2 (including index 1 and index 2).
^CPBR: <index1>,<number>,<type>,<text>,<coding> **^CPBR: <index2>,<number>,<type>,<text>,<coding>** **OK**	
AT^CPBR=?	Query the index range of storage locations in the phonebook, the maximum length (<nlength>) of a phone number, and the maximum length (<tlength>) of a name.
(list of supported<index>s,<nlength>,<tlength>) **OK**	

7.3.2 Troubleshooting

Scenario	Possible Error Information	Solution
Error information is returned in response to one of the previous commands.	**+CME ERROR: SIM busy**	Phonebook initialization has not completed. Try again later.
	+CME ERROR: SIM PIN required	Enter the correct PIN.
	+CME ERROR: SIM PUK required	Enter the correct PUK.
AT^CPBR=<index1>	**+CME ERROR: invalid index**	The index is invalid. Check that <index 1> is within the supported range.
AT^CPBR=<index1>,<index2>	**+CME ERROR: invalid index**	The index is invalid. Check that <index 1> and <index 2> are within the supported range and that <index 1> is not greater than <index 2>.
AT^CPBR=<index1>	**+CME ERROR: not found**	No entries are found in the storage locations in <index 1>. Check that there have been entries successfully written into these locations.
AT^CPBR=<index1>,<index2>	**+CME ERROR: not found**	No entries are found in the storage locations between <index 1> and <index 2>. Check that there have been entries successfully written into these locations.

7.4 Searching for Phonebook Entries

7.4.1 Reference Process

Command	Description
AT+CPBF=<findtext>	Search the current storage for phonebook entries that contain the <findtext> field.
+CBPF: <index1>,<number>,<type>,<text> **+CBPF: <index2>,<number>,<type>,<text>** **...**	

OK	
AT+CPBF=?	Return the maximum phone number length and maximum name length supported by the current phonebook storage.
+CPBF: <nlength>,<tlength> **OK**	

7.4.2 Troubleshooting

Scenario	Possible Error Information	Solution
Error information is returned in response to one of the previous commands.	**+CME ERROR: SIM busy**	Phonebook initialization has not completed. Try again later.
	+CME ERROR: SIM PIN required	Enter the correct PIN.
	+CME ERROR: SIM PUK required	Enter the correct PUK.
AT+CPBF=<findtext>	**+CME ERROR: not found**	No matches were found. Check whether the current phonebook storage has entries that match the search criterion.

7.5 Querying User Number

7.5.1 Reference Process

Command	Description
AT+CNUM	Query the SIM number.
+CNUM: [<alpha1>],<number1>,<type1> **+CNUM: [<alpha2>],<number2>,<type2>** **...** **OK**	

7.5.2 Troubleshooting

Scenario	Possible Error Information	Solution
Error information is returned in response to one of the previous commands.	**+CME ERROR: SIM busy**	Phonebook initialization has not completed. Try again later.
	+CME ERROR: SIM PIN required	Enter the correct PIN.
	+CME ERROR: SIM PUK required	Enter the correct PUK.

7.6 Setting the TE's Character Sets

7.6.1 Reference Process

Command	Description
AT+CSCS=?	Query the character sets supported by the UE.
+CSCS: ("IRA","GSM","UCS2") **OK**	
AT+CSCS?	Query the current character set.
+CSCS: "IRA" **OK**	
AT+CPBR=1	Read the first phonebook entry. The TE character set is the International Reference Alphabet (IRA). The content of the first entry's name field is "HUAWEI".
+CPBR: 1,"0123456789",129,"HUAWEI" **OK**	
AT+CSCS="UCS2"	Set the TE's character set to UCS2 alphabet.
OK	
AT+CPBW=1,"0123456789",129, "00480055004100570045004 9"	The character set is the UCS2 alphabet. The content of the phonebook entry's name field is 00480055004100570045004 9, which is "HUAWEI" in the IRA.

OK	
AT+CPBR=1	Read the first phonebook entry. The TE character set is UCS2 alphabet. The content of the first entry's name field is 00480055004100570045004900 ("HUAWEI" in the IRA).
+CPBR: 1,"0123456789",129,"00480055004100570045004900"	
OK	

7.6.2 Troubleshooting

None

8 SIM Operation Application Scenarios

8.1 PIN Operations

8.1.1 Reference Process

Command	Description
AT+CLCK="SC",1,"<pwd>"	Enable PIN authentication. (<pwd> specifies the PIN. See note 1.)
OK	
AT+CPIN="<pwd>"	Request the PIN after the module restarts.
OK	
AT+CPWD="SC","<oldpwd>","<newpwd>"	Change the PIN (<newpwd> will be the new PIN).
OK	

NOTE

1. After PIN authentication is enabled using **AT+CLCK**, the module must be restarted for the change to take effect.
2. Either **AT^CPIN** or **AT+CPIN** can be used to authenticate the PIN.

8.1.2 Troubleshooting

Scenario	Possible Error Information	Solution
AT+CLCK="SC",1,"<pwd>"	**+CME ERROR: operation not allowed**	If PIN authentication has been enabled, it cannot be enabled again. Check whether PIN authentication has been enabled.

Scenario	Possible Error Information	Solution
AT+CPIN="<pwd>"	**+CME ERROR: incorrect password**	Enter the correct PIN. The original PIN is provided by the operator.
	+CME ERROR: SIM PUK required	Incorrect PINs have been entered three times and the SIM card is blocked. Run **AT+CPIN="<PUK>","<pwd>"** to enter the PUK to unblock the SIM card. The PUK is provided by the operator and cannot be changed by users. If incorrect PUKs are entered 10 times, the SIM card will be permanently blocked.
AT+CPWD="SC","<oldpwd>","<newpwd>"	**+CME ERROR: incorrect password**	<oldpwd> must be the current PIN. Like the PIN authentication, if incorrect PINs are entered three times, the PUK will be required. If incorrect PUKs are entered 10 times, the SIM card will be permanently blocked.

8.2 CRSM Command

8.2.1 Reference Process

Command	Description
AT+CRSM=176,12258,0,0,10	Read the file EF_{iccid} with a transparent structure. (**12258** is 0X2FE2, the EF_{iccid} file's FID).
+CRSM: 144,0,"<record>" **OK**	After the command is processed successfully, the EF_{iccid} file's content (<record>) is returned.
AT+CRSM=178,28476,1,4,176,,"7F10"	Use an absolute path to read the first entry from the EF_{sms} file on the SIM card's $DF_{telecom}$ folder.
+CRSM: 144,0,"<record>" **OK**	<record> is the content of the first entry. The length of <record> is 176 bytes.
AT+CRSM=192,12258	Get response of EF_{iccid}.

+CRSM: 144,0,"<response>" **OK**	<response> is the response data of EF_{iccid}. For details about <response>, refer to the *ETSI TS 102.221* protocol.
AT+CRSM=214,28421,0,0,2,"0012"	Update the content of the transparent structure EF_{li} file on the SIM card.
+CRSM: 144,0,"" **OK**	Update succeeded.
AT+CRSM=220,28476,1,4,176,"1111","7F10"	Update the content of the linear fixed structure EF_{sms} file on the SIM card.
+CRSM: 144,0,"" **OK**	Update succeeded.
AT+CRSM=242	Obtain the current directory information.
+CRSM: 144,0,"<status>" **OK**	<status> indicates the current directory status.

NOTE

- To read or update a file, appropriate commands must be used according to the file's structure type (for details, refer to the description of file properties in the *3GPP TS 31.102* protocol). For transparent structure files, use 176 (Read Binary) and 214 (Update Binary). For linear fixed structure files, use 178 (Read Record) and 220 (Update Record).
- If <pathid> is not contained in the command, the module will prefer to access the files with the same FID in the current directory.
- Files can be accessed only when the access criteria are met. Otherwise the SIM card will return PSWs indicating that the access authentication failed. If an EF file's read privilege is PIN protected and the module does not have the PIN authenticated, PSWs indicating that the access authentication failed will be returned after the **AT+CRSM** command is used to read the EF file.
- To use the **AT+CRSM** command to access the file content on the SIM card, the parameters contained in the command must strictly meet the requirements in the *ETSI TS 102.221* and *3GPP TS 31.102*. For detailed requirements, refer to the *ETSI TS.102.221* and *3GPP TS 31.102*.

8.2.2 Troubleshooting

Scenario	Possible Error Information	Solution
AT+CRSM=178,12258,0,0,10	**+CRSM: 105,129,""** **OK**	The status word (SW) indicates a Read command error occurred. Files with a transparent structure should be read using 176 (READ BINARY).

Scenario	Possible Error Information	Solution
AT+CRSM=220,28476,1,4, 176,"1111","7F10"	**+CRSM: 105,130,""** **OK**	The PSW indicates that the security conditions were not met. To update the EFsms file, the correct PIN is required.

9 Sleeping and Waking Up Application Scenarios

As an embedded component in the host, the module also consumes power, which increases the power consumption of the integrated product. Therefore, the most important task of power management is to reduce the power consumption of the integrated product by enabling the module's sleep mode when necessary.

The host and the module need to wake each other up from sleep if communication is required. Therefore, another task of power management is to provide a wake-up control mechanism for the host and module.

Power management involves three parts: the host system software (including the USB driver/UART driver/GPIO driver/sleep mechanism functions), connection hardware between the host and module, and the module's software wake-up mechanism.

This chapter is mainly concerned with the module's software wakeup mechanism, including the wake-up principle, how USB related events impact on the waking up of the module and remotely waking up the module, and how the module remotely wakes up the host.

This chapter briefly describes the power management related connection hardware between the host and module.

This chapter does not describe the host system software. For example, if the host runs on a Windows or Mac system, Huawei will provide a USB driver program corresponding to the module. If the host runs on an Android system, Huawei will provide *Guide to Kernel Driver Integration in Linux for Huawei Modules* for users to configure the USB-based wakeup function of the module.

This document describes typical module application scenarios. A host can be designed based on the actual system features and the application scenarios of the module to reduce power consumption of both the module and integrated product.

After the host is designed as recommended by this document, the module's power consumption and the whole unit's power consumption can meet the performance requirements. For details, see related description in the product manual.

9.1 Hardware Interfaces

The module communicates with the host using mainly USB or UART. For details about pins related to power management, see Table 9-1 ..

For corresponding interface numbers and reference design for the pins, see *Hardware Guide* for each product.

Table 9-1 Power management related pins

Interface	Pin name	Pin Name	Input/Output	Description
LGA	WAKEUP_OUT	Output	When a wake-up source (see section 9.3.5) arrives, these pins output a low-level-voltage pulse lasting for 1s during which if other wake-up sources arrive, the module will ignore the later wake-up requests. In other words, the module will not output a second pulse during this 1s.	Figure 9-1
PCIE	WAKE#			
LGA	WAKEUP_IN	Input	When the pin carries a high-level voltage, the states of the module are as follows: The module will be prohibited to enter sleep mode if the module is awake. The module will be woken up if the module is in sleep mode. When the pin carries a low-level voltage, the module is allowed to enter sleep mode. (By default, the pin is set to INPUT/PD, which is, the software detects a low-level voltage on the pin when the pin is not connected.)	Figure 9-2
LGA	SLEEP_STATUS	Output	Indicates the state of the module. When the pin carries a high-level voltage, the module is in working mode. When the pin carries a low-level voltage, the module is in sleep mode.	Figure 9-3

NOTE

The PCIE interface does not support UART.

9.2 Sequence Diagram

Figure 9-1 WAKE#/WAKEUP_OUT (when a NPN triode is externally connected to the WAKEUP_OUT pin) output sequence

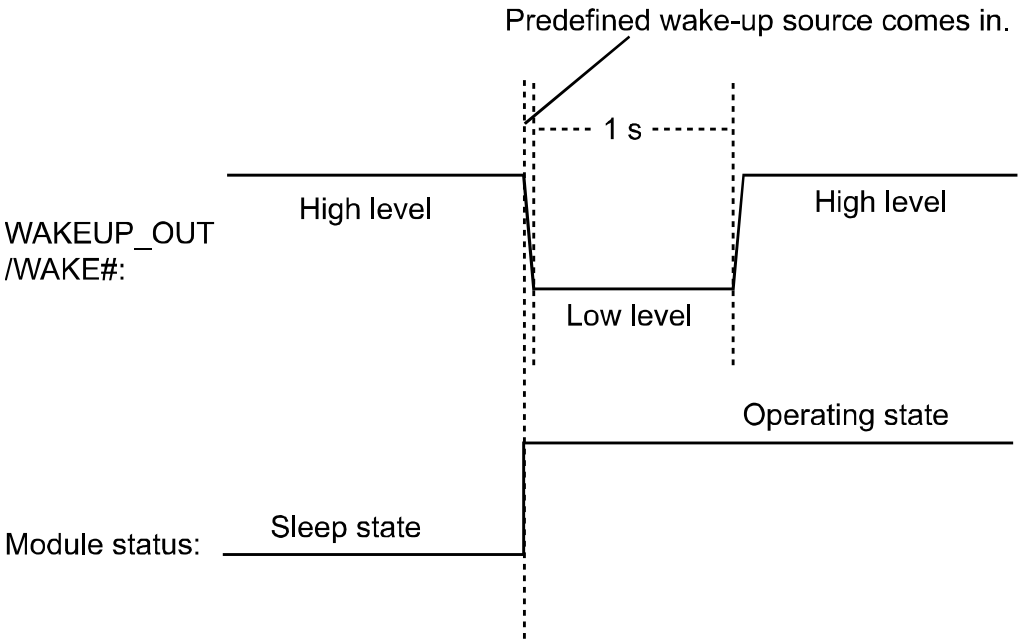
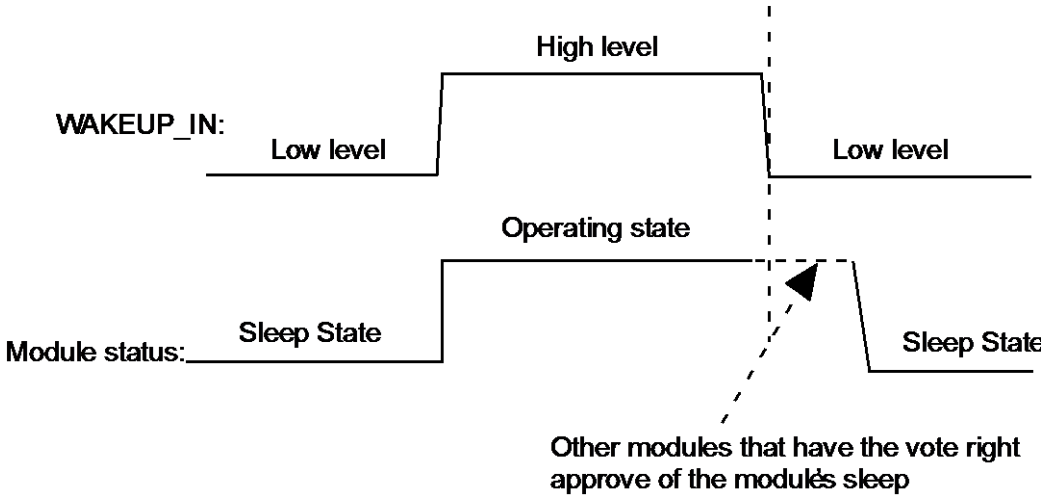
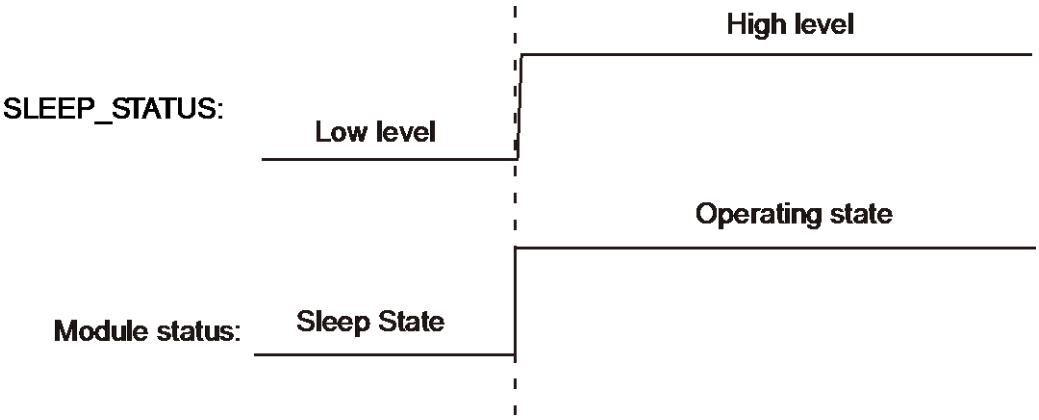


Figure 9-2 WAKEUP_IN input sequence



About the vote, see section 9.4.1 .

Figure 9-3 SLEEP_STATUS output sequence

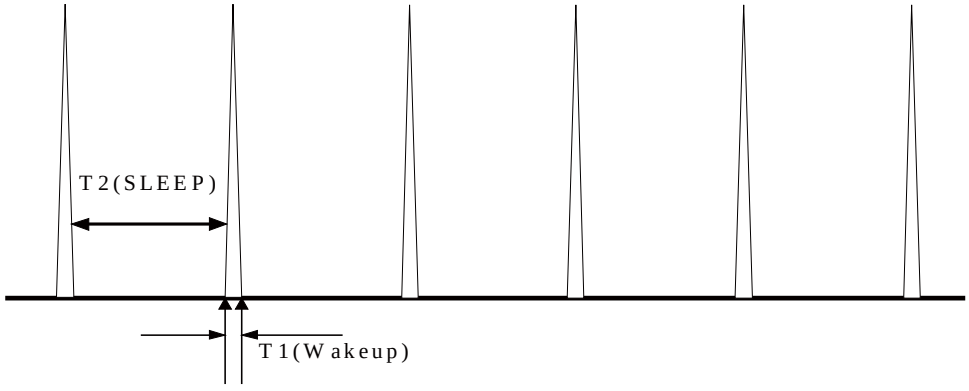


9.3 Software Interfaces

9.3.1 Principle

The module runs on a multi-task software system. The sleep task is granted with the lowest priority and assigned to detect whether the module can enter sleep mode. Other tasks (such as the RF, SIM card, USB, and UART) have voting rights. They vote to decide whether the module can enter sleep mode. When no other tasks are running, the sleep task is executed. If the sleep task detects that all other tasks agree on the module's sleep, the module enters sleep mode, as shown in Figure 9-4 . At this time, the baseband chip reduces the work frequency, and the RF enters the Discontinuous Reception (DRX) mode.

Figure 9-4 Currency state when the module is in sleep mode



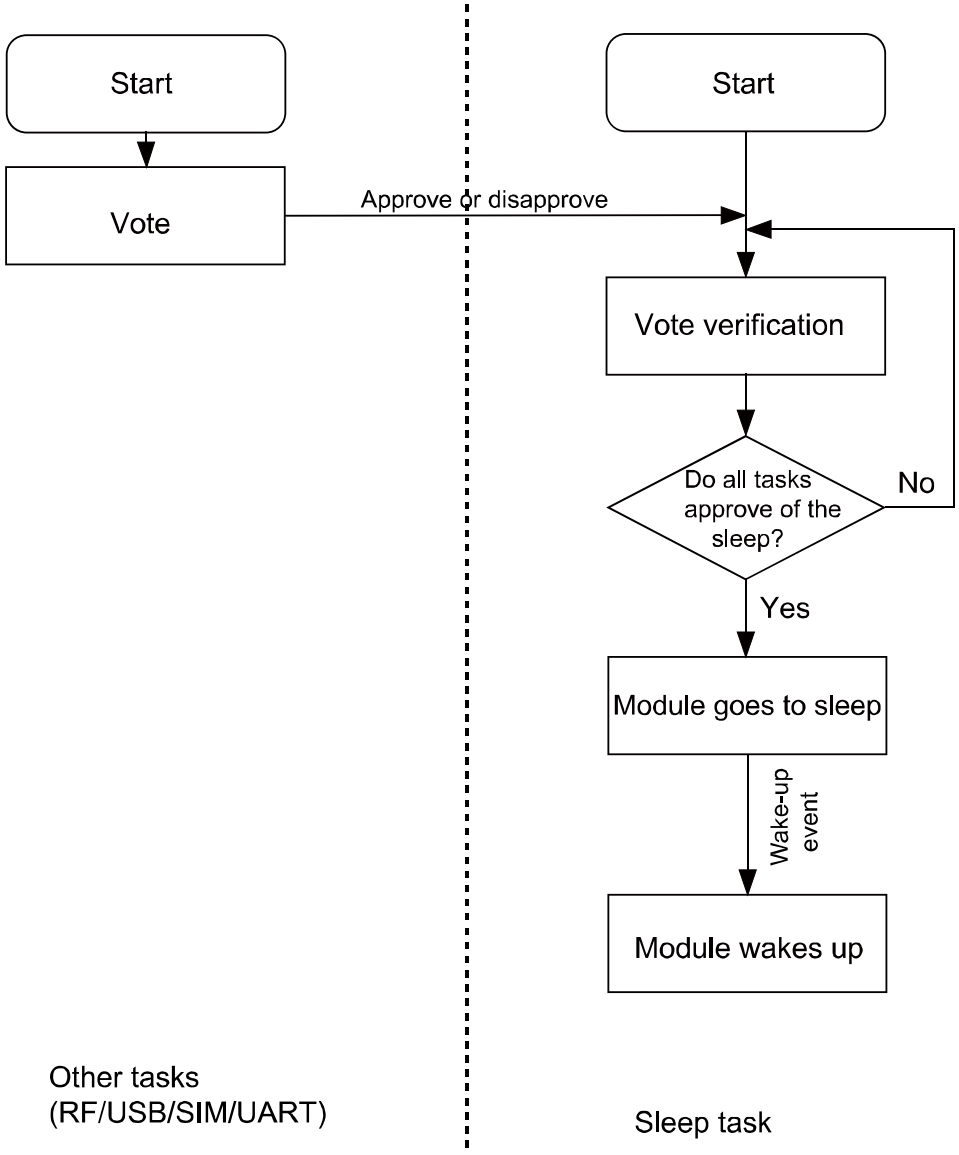
For more information about the module's sleep procedure, see Figure 9-5 .

NOTE

The module's sleep mode is different from working mode or flight mode set using the **AT+CFUN** command. The RF will be turned off when the module enters LPM mode using the command **AT+CFUN=0** while the RF will enter DRX mode without being turned off when the module is in sleep mode. For more details, refer to the latest version of MU609 V100R002 in *HUAWEI MU609 HSPA LGA Module AT Command Interface Specification*.

The module enters sleep mode automatically when the sleep task detects that all other tasks agree on the module's sleep. The sleep period of the module depends on the current working state and circumstance. The period may last for several seconds, or up to several minutes.

Figure 9-5 Sleep procedure



9.3.2 USB and Sleep

USB is an important communication channel between the module and the host. According to the USB protocol, normally a hub or a root hub periodically sends Start of Frame (SOF) data packages (one data package per ms using full-speed USB and one package per 125 µs using high-speed USB). Through this mechanism, USB always votes to stop the module from entering sleep mode.

When the USB driver provided by Huawei detects that the module and the host have not exchanged data in 5 seconds, the USB driver will enable the port's suspend feature, stopping SOF data packages being sent and suspending the USB controller. This enables the USB to vote to agree the module's sleep.

NOTE

If the USB driver used is developed by users or is integrated with external application, ensure that the USB driver supports the USB suspend features (including selective suspend and global suspend, as defined in the USB standard) .

9.3.3 UART and Sleep

UART is an important communication channel between the module and the host. If the host uses UART (a TTL level Interface), it can connect to the module's UART directly. If the host uses RS232, it can connect to the module's UART through a conversion chip such as MAX232.

NOTE

Regardless of the connection modes, when there is no data transmitted on the UART, the host should set the RX pin of the module's UART to low level so that the module can enter sleep mode.

9.3.4 Module Wake-up

RF periodically wakes up the module based on the DRX cycle (depending on the actual configuration of the network system), as shown in Figure 9-4 .

Other aperiodic events include:

1. The host sends data using USB/UART or pulls WAKEUP_IN up.
2. Changes on the network, for example, an incoming text message, a signal change, a network working mode change, a network search, an IP data package (when a dial-up network connection is set up).
3. Software system events such as a timer
4. Abnormal events, for example, an antenna drops or a SIM card becomes loose.

9.3.5 Host Woken up by Module

Wake-up Source

A wake-up source is a module event that can wake up the host, for example, a text message, data (PPP data, TCP/UDP data from the network), and unsolicited messages.

Remotely Waking up the Host Using USB

When the host is in sleep mode and the USB controller is in suspended mode, if the module needs to send data to the host (for example, a wake-up source has arrived), the module sends a remote wake-up signal that lasts 3 ms to inform the host to start USB resume (as shown in Figure 9-6). To complete the procedure, the following conditions must be met:

1. The USB controller on the host supports USB remote wake-up and can wake up the host.
2. The USB driver enables or disables remote wake-up by executing SET_FEATURE and CLEAR_FEATURE commands. Therefore, remote wake-up must be enabled on the USB driver before USB enters suspended mode.
3. When the host receives the remote wake-up signal from the module, the host needs to send a full speed K signal that lasts at least 20 ms. When the USB controller resumes, the host must send the SOF token within 3 ms from the startup of the idle state. Otherwise, the module enters suspended mode again, as shown in Figure 9-6 .

Figure 9-6 USB resume time sequence

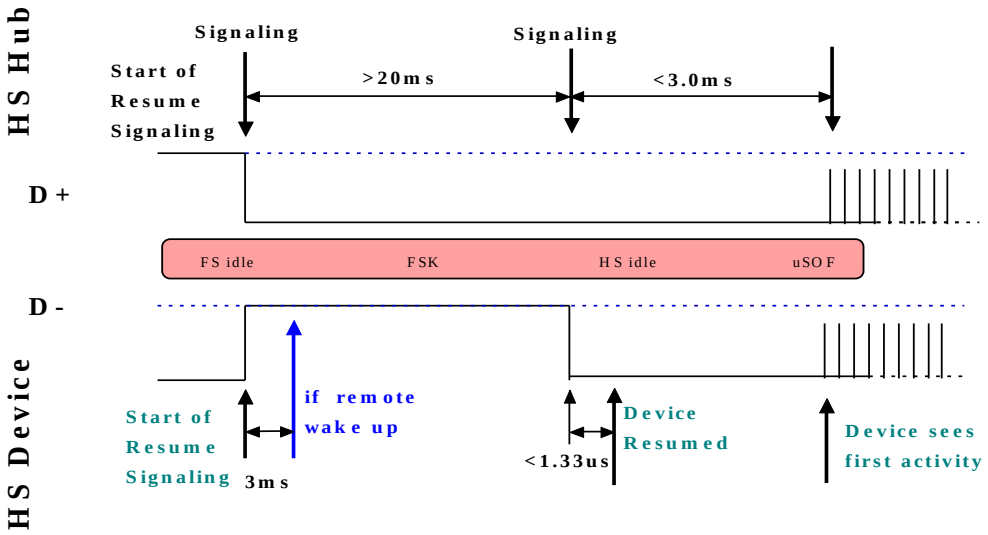
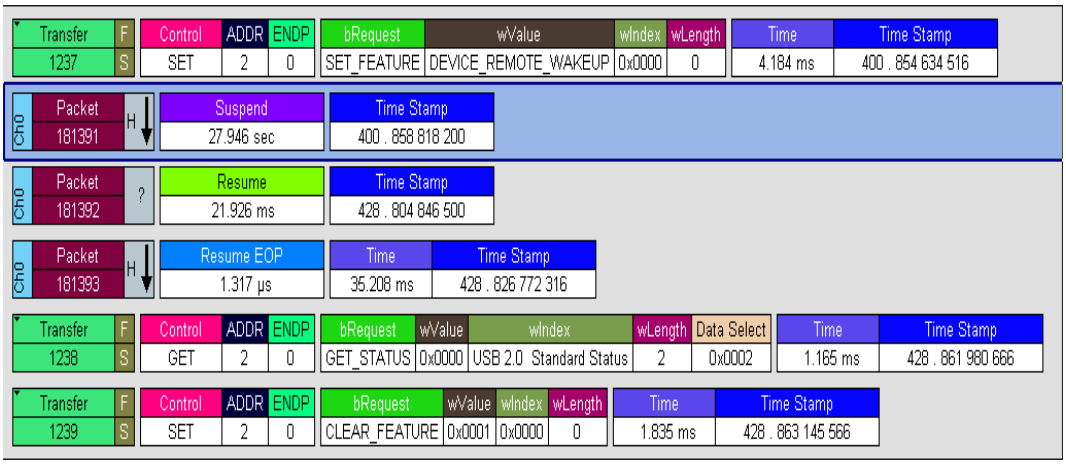


Figure 9-7 Successful procedure of remote wake-up



WAKEUP_OUT Waking up the Host

The module will output a 1s pulse using WAKEUP_OUT/WAKE# as shown in Figure 9-1 when a wake-up source arrives. The host wakes itself up after detecting the level change.

Remote Wake-up Configuration

The power consumption of the host increases if it is frequently woken up. The host can configure the module's wake-up sources using **AT^WAKEUPCFG** and **AT^CURC** command so as to reduce the power consumption.

The **AT^WAKEUPCFG** command can be used to choose wake-up sources and the wake-up channel (USB or WAKEUP_OUT). The **AT^CURC** command can choose unsolicited messages. For more details, refer to AT Command Interface Specification.

9.4 Application Scenarios: System with USB Connection only

A host runs Android, with support for USB suspend, USB remote resume and text messages.

9.4.1 Hardware Connection

The host connects to the module using USB.

9.4.2 Software Procedure

Command	Description
AT^WAKEUPCFG=?	Query the parameter range.
^WAKEUPCFG: (0-1),(0-3),(0-15)	

OK	
AT^WAKEUPCFG=1,2,15	Configure the module to make sure that incoming text messages, data, and unsolicited messages can remotely wake up the host using USB.
OK	
AT^CURC=?	Query the parameter range.
^CURC: (0-2) **OK**	
AT^CURC=2,800820,1FFFFFFFFFFFFFFF	The host wakes up from sleep if any of the following occurs: The SIM card state changes such as the SIM card is removed (^SIMST); the number of text messages exceeds the limit (**^SMMEMFULL**).Other unsolicited messages are saved in the cache when the host is in sleep mode, and reported to the host when it wakes up.
OK	

9.4.3 Advantages

With software configuration, while the system requirements (text messages) are met, the number of times the host is woken up by unsolicited messages, and consequently the power consumption, are reduced.

9.5 Application Scenarios: System with USB and WAKEUP_OUT

A host running Android, with support for text messages, but not USB remote resume..

9.5.1 Hardware Connection

The host must connect to the module using USB and WAKEUP_OUT pins.

9.5.2 Software Procedure

Command	Description
AT^WAKEUPCFG=?	Query the parameter range.
^WAKEUPCFG: (0-1),(0-3),(0-15)	

OK	
AT^WAKEUPCFG=1,1,14	Configure the module to make sure that text messages, data, and unsolicited messages can remotely wake up the host using the WAKEUP_OUT pin.
OK	
AT^CURC=?	Query the parameter range.
^CURC: (0-2) **OK**	
AT^CURC=2,820,1FFFFFFFFFFFFFFF	The host wakes up from sleep if either of the following occurs: The SIM card state changes, such as the SIM card is removed (**^SIMST**); the number of text messages exceeds the limit (**^SMMEMFULL**). Other unsolicited messages are saved in the cache when the host is in sleep mode, and reported to the host when it wakes up. When the host is awake, unsolicited messages are reported to the host.
OK	

9.5.3 Advantages

A solution is provided for systems not supporting USB remote resume.

With software configuration, while the system requirements (text messages) are met, the number of times the host is woken up by unsolicited messages, and consequently the power consumption, are reduced.

9.6 Application Scenarios: System with UART and WAKEUP_OUT

A host is constructed based on a single-chip microcomputer. There is no user interface. The host supports UART and text messages. After receiving a text message, the host decodes it and takes corresponding actions.

9.6.1 Hardware Connection

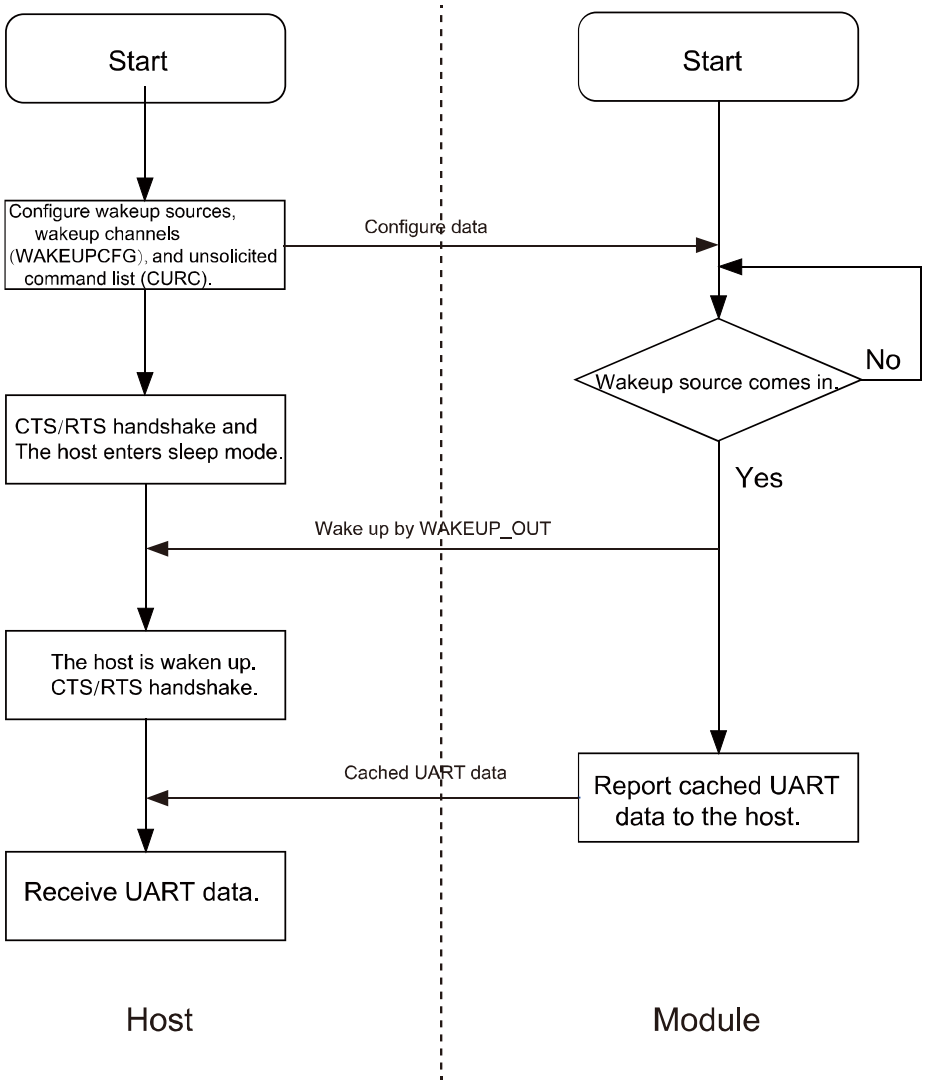
The host must connect to the module using the UART and WAKEUP_OUT pins.

9.6.2 Software Procedure

Command	Description
AT^WAKEUPCFG=?	Query the parameter range.
^WAKEUPCFG: (0-1),(0-3),(0-15) **OK**	
AT^WAKEUPCFG=1,1,2	Configure the module to make sure that text messages can remotely wake up the host by WAKEUP_OUT.
OK	
AT^CURC=?	Query the parameter range.
^CURC: (0-2) **OK**	
AT^CURC=2,800,1FFFFFFFFFFFFFF	The host wakes up from sleep if the number of text messages exceeds the limit.
OK	

The host and the module must handshake to prevent data loss when the module wakes up the host.

Figure 9-8 Wake-up and hand-shaking using UART(CTS/RTS) and WAKEUP_OUT pins



NOTE

If the host connects to the module using the TXD or RXD pin only, handshake is not implemented and consequently data on the UART may be lost when the host is in sleep mode.

9.6.3 Advantages

This solution enables handshake between UART and WAKEUP_OUT.

With software configuration, the host can go to sleep with no data loss.

9.7 System with Other Connection Methods

If the host can be connected to the module only using UART, refer to the Hardware Guide. If the host can connect to the module using USB/UART/WAKEUP_OUT and can support USB remote wake-up and UART remote wake-up, prioritize USB remote

wake-up over WAKEUP_OUT remote wake-up. For details about the software procedure, refer to the earlier sections while considering the host system feature.

10 Thermal Protection Application Scenarios

10.1 Pre-configuration

Command	Description
AT^CURC=2,0x870,0x872	Enable the thermal protection unsolicited indication when the module is working or in sleep mode.
OK	
^THERM: 1	When the temperature is higher than the threshold, the module enables thermal protection: The module turns off its RF, and will automatically shut down if the temperature continues to rise to be higher than the module's turn-off threshold.
^THERM: 0	When the temperature is lower than the RF's turn-off threshold, the module turns on its RF and disables thermal protection.

10.1.1 Troubleshooting

None

10.2 Thermal Protection Process

- When the module's temperature is lower than 105°C, the module works normally.
- When the module's temperature reaches 105°C, the module enables thermal protection: turns off its RF and presents the **^THERM: 1** indication. When the module's temperature is lower than 100°C, the module disables thermal protection: turns on its RF transmission, and presents the **^THERM: 0** indication.
- When the module's temperature reaches 100°C, the module automatically shuts down.

NOTE

Thermal protection is designed to protect the module from being damaged by overtemperature. To work in high temperature environments, both the module and its peripheral components must be able to resist the same temperature.

11 GPS Application Scenarios

11.1 Introduction to GPS

11.1.1 GPS Positioning Methods

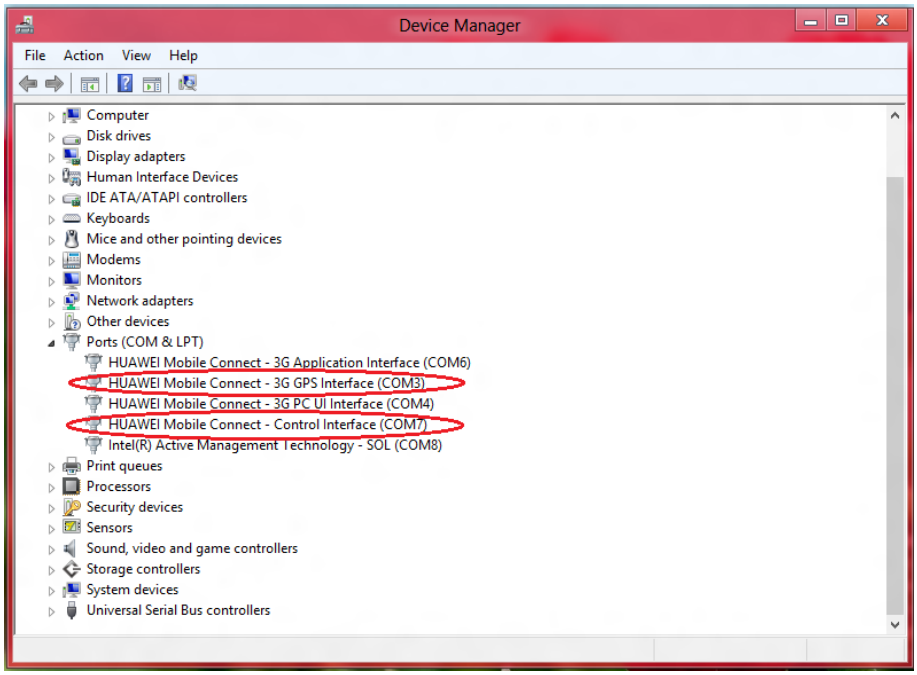
Table 11-1 GPS positioning methods

Positioning methods	Description	Benefits	Drawbacks
Standalone	This is a traditional GPS positioning method. Using this method, a module receives satellite signals directly and makes calculations to obtain positioning results.	No communication with the network is invoked, incurring no data traffic between the module and the network.	Long time to first fix (TTFF) in code mode.
Mobile Station Based (MSB) positioning using the User Plane Protocol	Requests the assistant data from the network to assist and accelerate the positioning. This method is one of the Assisted GPS (A-GPS) methods.	• Significantly reduces the TTFF after cold start and increases the rate of successful positioning. • Enables positioning in environments with very poor satellite signals.	Requires the assistant data from the network, incurring network traffic.

Positioning methods	Description	Benefits	Drawbacks
XTRA positioning	Downloads XTRA data from the Qualcomm's XTRA server to assist positioning. The XTRA data is valid for 7 days.	• Reduces the TTFF after cold start. • Long valid period for the XTRA data, eliminating frequent data downloading.	• Cannot reduce the TTFF after cold start as significantly as the A-GPS methods. • The XTRA data's ability to assist positioning declines as time goes by.
Cell ID	Base station mode, this approach will be based on the cell ID number of the mobile terminal is located to determine the location of the user.	This mode can be use when other optioning methods are failed.	Very low accuracy.
Global navigation satellite system (abbreviated as GNSS)	Uses both the GPS and GLONASS for positioning.	Using more satellites, increases the successful positioning rate and the positioning accuracy.	

11.1.2 GPS Ports

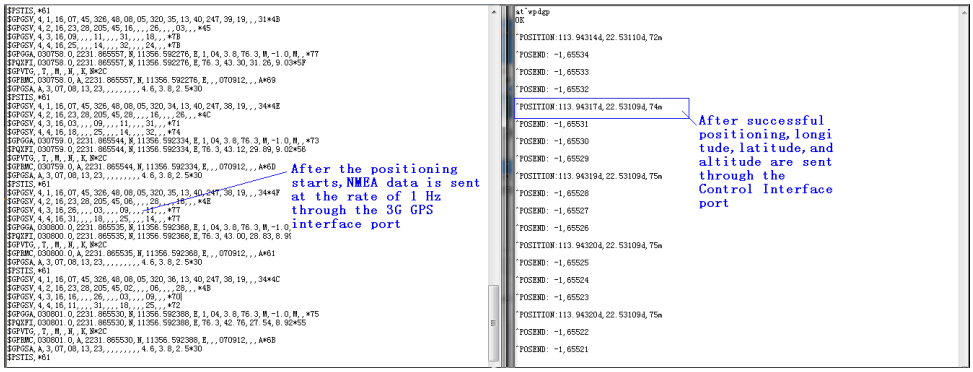
Figure 11-1 Control Interface and 3G GPS Interface detected after the module is connected to a computer



The Control Interface port is used to send GPS-related AT commands, and the 3G GPS Interface port is used to send unsolicited indications for NMEA positioning data.

Figure 11-2 Data sent through the control interface and 3G GPS interface ports

3G GPS Interface: Control Interface:



11.2 Standalone Positioning

Command	Description
AT^WPDOM=0	Set the positioning method to Standalone.
OK	
AT^WPDST=0	Set the session type to single positioning.
OK	
AT^WPDST=1	Set the session type to tracking and positioning.
OK	
AT^WPDFR=65535,1	Set the number of positioning times and the interval between each positioning for the tracking and positioning. If the session is a single positioning, you do not need to set these parameters.
OK	
AT^WPQOS=255,500	Set the positioning service quality. The first parameter indicates the response time, and the second indicates the horizontal accuracy threshold.
OK	
AT^WPDGP	Start positioning.
OK	
^POSITION: 113.94026d,22.53206d,270m	Present the positioning result.
^POSEND: -1,9	The first value indicates positioning end reason, and the second indicates the left positioning times.

NOTE

- The Standalone method can be used when the module has no SIM card inserted.
- If there is an ongoing positioning session, the session must be terminated before setting the positioning parameters so that the parameters can take effect for the positioning to be started. This rule applies to all positioning methods.
- Execute "AT^WPEND" command can terminate the current positioning session.

11.3 MSB Positioning Using the User Plane Protocol

Command	Description
AT^WPDOM=5	Set the positioning method to MSB.

OK	
AT^WPDST=1	Set the session type to tracking and positioning.
OK	
AT^WPDFR=65535,1	Set the number of positioning times and the interval between each positioning for the tracking and positioning.
OK	
AT^WPQOS=255,500	Set the positioning service quality. The first parameter indicates the response time, and the second indicates the horizontal accuracy threshold.
OK	
AT^WPURL=SUPL.GOOGLE.COM:7276	Set the A-GPS server address and port number. This address is just Google AGPS server. Some of the AGPS server requires certificate authentication.
OK	
AT+CGDCONT=15,"IP","CMNET"	Set the PDP context required by A-GPS dial-up. By default, A-GPS dial-up uses the fifteenth PDP context. "CMNET" is the APN of network that module have registered.
OK	
AT^WPDGP	Start positioning.
OK	
^POSITION: 113.94026d,22.53206d,270m	Present the positioning result.
^POSEND: -1,9	The first value indicates positioning end reason, and the second indicates the left positioning times.

NOTE

The MSB method requires the module to register with a network, and will incur data traffic during positioning. When the MSB positioning fails, the module will automatically switch to the Standalone positioning if NV3756 = 1, but will not switch to the Standalone positioning if NV3756 = 0.

11.4 XTRA Positioning

Command	Description
AT^WPDOM=6	Set the positioning method to gpsOneXTRA.

OK	
AT^XTRASTA	Query the status of XTRA data. If the date of the obtained XTRA data is more than seven days earlier than the current date, the XTRA data is invalid, and the module needs to download new XTRA data. (The XTRA data's ability to assist positioning declines as time goes by. Therefore, it would be appropriate to set the XTRA data's valid period to three days. You can also download the latest XTRA data without querying the existing XTRA data information.)
OK	Notify XTRA Data Query Result.
^XDSTATUS: 0,0,0,0	
AT^XTRATIME……	Upper layer applications use this command to access the SNTP server to obtain the current time information, and inject the information into the module.
OK	
^TIMESETRULT: 0	Notify XTRA Time Injected Result.
AT^XTRADATA=155,1,011b07030023015d303bc600009af607371b10be9307371b0963000061c0100251407100f0e0d0c0b0a0c370810100f0e0d0c0a090e5308110f0e0e0c0c09080d96020b05020303c21f0100233e0f0cd5fd5a00a10cf3ffa753f1000fa924ffba8f85fffb00000738020077b10ffeecfd4800a10c26ffa5c975ffa3ee30ffccf9bd02560001073803000074b0f0abefd4900a10ce9ffd1bd18ff969b2600070a12016a0002073804005ce00ffe4efd4700a10d11ffa66894002b462cffb02f25ffedffff0738050021e50f0268fd3d00a10c17ffd1723a000f1a99003279c1ff0d000107380600013f0f0cc2fd5900a10dbcffa6fb46ff8e08c8fffcb92f00bc00,512,1	Host application needs to download XTRA data (xtra.bin or xtra2.bin) from the Qualcomm's XTRA server, and then divides the XTRA data (xtra.bin or xtra2.bin) to packets. Then the host application uses **AT^XTRADATA** command to send the packets data one by one to the module. For the details about the **AT^XTRADATA** command, please refer to the module AT command document. There are two types of XTRA files stored on the XTRA server: • xtra.bin file: contains predicted two-line orbital elements for GPS satellites, about 45 KB. • xtra2.bin file: contains predicted two-line orbital elements for GPS and GLONASS satellites, about 80 KB.
OK	

AT^XTRADATA=155,2,02073 8070045400f1210fd5a00a10d 5e002812bdff8fe98effa02d21 01ea00010738090003c70f09e 9fd4100a10df0fffc3a250069b a6dfff5506fff50ffff07380a007 8a50fff06fd3900a10d04ffd20 efa00260220003f2a40ff45000 007380b0081a50fdffbfd1b00 a10d65ff99016f00396bb1ffa2 8f98fd9cffff07380c002dde0f1 ebefd5100a10d040053a5930 018eae1ff89c69c013a000107 380d00298b0f14d2fd5200a10 d0a0000ebfa00553dd1ffbef9 e7ff81ffff07380e0043230f0fe bfd4c00a10c65ffff8285ffaf74 88000d548b003dffff07380f00 3aa40ffa2afd2900a10cb5fffa7 0d5000ff8e9fff2a675fef6ffff07 38100043020f,512,1	
OK	
…	This place overlaps the rest **AT^XTRADATA** command and the XTRA data.
^DATASETRULT: 50	Notify XTRA Data injected Result.
AT^WPDST=1	Set the session type to tracking and positioning.
OK	
AT^WPDFR=65535,1	Set the number of positioning times and the interval between each positioning for the tracking and positioning.
OK	
AT^WPQOS=255,500	Set the positioning service quality. The first parameter indicates the response time, and the second indicates the horizontal accuracy threshold.
OK	
AT^WPDGP	Start positioning.
OK	
^POSITION: 113.94026d,22.53206d,270m	Present the positioning result.
^POSEND: -1,9	The first value indicates positioning end reason, and the second indicates the left positioning times.

NOTE

XTRA date must be injected before XTRA data is injected.

11.5 GNSS Positioning

The GNSS positioning uses both the GPS and GLONASS satellites for positioning.

Command	Description
AT^WGNSS=1	Set GNSS as the positioning system to use both the GPS and GLONASS satellites for positioning. To switch from one positioning system to another, the module must restart. To switch the module to use GPS satellites only, run **AT^WGNSS=0** and restart the module.
OK	
AT^WPDOM=*a value within the value range*	For MSB positioning method, the data obtained from the server is two-line orbital elements of GPS satellites, which will not help the GLONASS positioning, but the module will still search for GLONASS satellites.
OK	
AT^WPDST=1	Set the session type to tracking and positioning.
OK	
AT^WPDFR=65535,1	Set the number of positioning times and the interval between each positioning for the tracking and positioning.
OK	
AT^WPQOS=255,500	Set the positioning service quality. The first parameter indicates the response time, and the second indicates the horizontal accuracy threshold.
OK	
AT^WPDGP	Start positioning.
OK	
^POSITION: 113.94026d,22.53206d,270m	Present the positioning result.
^POSEND: -1,9	The first value indicates positioning end reason, and the second indicates the left positioning times.

NOTE

After **AT^WGNSS** is executed, the module must be restarted to allow the settings configured by **AT^WGNSS** to take effect.

12 Concurrent Service Application Scenarios

12.1 Internal/External Protocol Stacks and Text Messaging

WCDMA networks support concurrent internal/external protocol stack services and text messaging.

When data is transmitted using the external protocol stack, text messages can be sent through only the ports on which no data is being transmitted.

When the internal protocol stack is in use, text messages can be sent through all ports in non-transparent transmission mode and through only the USB in transparent transmission mode.

Table 12-1 describes the details.

Table 12-1 Ports available to text messaging during data services

	Service Port	Message Sending Port	Message Receiving Port
External protocol stack application	MODEM	PCUI, UART	PCUI, UART
	UART	PCUI, MODEM	PCUI, MODEM
Internal protocol stack application	UART (non-transparent transmission mode)	MODEM, PCUI, UART	MODEM, PCUI, UART
	UART (transparent transmission mode)	MODEM, PCUI	MODEM, PCUI

Command	Description
AT^IPOPEN=1,"TCP","172.22.44.33",7000,6000	Establish a TCP link at the module's UART port.
OK **^IPDATA: 1,1024,No.6:**…****	The module transmits data through the UART port.
AT+CMSS=0	The module sends text messages through the PCUI port.
+CMSS: 48 **OK** **(UART)** **^IPDATA: 1,1024,No.7:**…**** **^IPDATA: 1,1024,No.8:**…**** **+CMTI: "SM",4** **^IPDATA: 1,1024,No.9:**…****	The module can send text messages without interrupting the data transmission through the UART. After receiving text messages, the module presents them through all ports (the format of the text messages is set by **AT+CNMI**).

On GSM/GPRS networks, data transmission using the internal/external protocol stack services will be suspended when text messages are sent and will be resumed after the text messages are sent.

Command	Description
AT^IPOPEN=1,"TCP","172.22.44.33",7000,6000	Establish a TCP link at the module's UART port.
OK **^IPDATA: 1,1024,No.6:**…****	The module transmits data continuously.
AT+CMSS=0	The module sends text messages through the PCUI port.
+CMSS: 48 **OK** **+CMT: "+8613912345",,"12/01/01,12:00:00+00"**	The data transmission through the UART port is suspended for the text messaging service through the PCUI port. The data transmission will be resumed after the messages are sent or received.

1234

(UART)

^IPDATA: 1,1024,No.7:…****

^IPDATA: 1,1024,No.8:…****

12.2 Other Services

Configuration operations (initialization and serial port configuration), phonebook operations, and PIN operations can be performed when the module is not in sleep mode; no matter the module is idle or processing services, because no interaction between the module and the network is required.

Especially, if the module is processing internal/external protocol stack services, operations such as configuration, phonebook and PIN operations must be performed at ports that are not used to provide data services.

Table 12-2 Ports available to configuration, phonebook and PIN operations when the module is processing data services

	Service Port	Ports Available to Configuration, Phonebook and PIN Operations
External protocol stack application	MODEM	PCUI, UART
	UART	PCUI, MODEM
Internal protocol stack application	UART	MODEM, PCUI

13 STK Application Scenarios

13.1 Unsolicited Report of STK Proactive Commands

13.1.1 Reference Process

Command	Description
AT^STSF=1,2	Activate the STK interface function, set the STK interface to 3GPP standard mode.
OK	
+CUSATP: " **D081A2810301250082028182850F8000550053 0049004D53615E9475288F0A11807CBE54C16 3A883508F0A318059296C14988462A58F0A32 80822A73ED67E58BE28F0A338051FA884C63 0753578F0A34804F53575B5FEB8BAF8F0C51 8065B095FB65E9665A62A58F0A5280624B673 A97F34E508F0A5380624B673A96058BFB8F0 A5480624B673A90AE7BB18F0A558077ED4FE 152A974068F0C5680624B673A84254E1A5385 "**	Content of the **SET UP MENU** proactive command. The string should be interpreted according to the ETSI protocol TS102223. The protocol states that the command type is determined by the 7th byte if the string length is greater than 127 bytes, and the 6th byte if the string length is 127 bytes or less. In the provided example, the 7th byte is 25, which indicates SET UP MENU.
AT+CUSATT="8103012500820282818301 00"	The CAT client uses the AT command to respond to the proactive command. This string means "command performed successfully".
OK	

NOTE

- STK activation and deactivation still take effect after the device is restarted.
- **<proactive_command>** and **<terminal_response>** consist of the full BER-TLV data object as defined in 3GPP TS 31.111.
- For MU609, STK proactive commands can be divided into three categories:

  Category 1: proactive commands that must be processed by the CAT client, including DISPLAY TEXT, GET INKEY, GET INPUT, PLAY TONE, SELECT ITEM, SET UP MENU, LANGUAGE NOTIFICATION, and LAUNCH BROWSER.

  Category 2: proactive commands processed by the module (the CAT client is still notified), including **SEND SHORT MESSAGE**, **SEND SS**, **SEND USSD**, **SET UP EVENT LIST**, **and REFRESH**.

  Category 3: other proactive commands that are processed by the module (the CAT client is not notified).
- Only commands of categories 1 and 2 are reported using the +CUSATP interface.
- Only terminal responses to commands of category 1 can be delivered using the AT interface.

13.1.2 Troubleshooting

Scenario	Possible Error Information	Solution
The SIM card has sent an STK proactive command, but the module does not unsolicitedly report it to the CAT client.	None	**AT^STSF=1,2**
AT+CUSATT="<terminal_response>"	**+CME ERROR: SIM PIN required**	Unblock the PIN before delivering the terminal response.
AT+CUSATT="<terminal_response>"	**+CME ERROR: SIM busy**	Wait until the SIM card initialization is complete before delivering the terminal response.

Scenario	Possible Error Information	Solution
AT+CUSATT="<terminal_response>"	**ERROR**	1. Use **AT^STSF?** to check whether STK has been activated and the interface has been set to 3GPP standard mode. If yes, proceed to the next step. 2. Check whether the proactive command reported needs to be processed by the CAT client. If yes, proceed to the next step. 3. Check whether **<terminal_response>** complies with the 3GPP TS 31.111 protocol. If yes, proceed to the next step. 4. Check whether the terminal response is delivered more than 2 minutes and 5 seconds after the proactive command is reported. If yes, the module does not receive terminal responses sent from the CAT client.

13.2 Querying the STK Main Menu

13.2.1 Reference Process

Command	Description
AT^CUSATM?	Check the content of **SET UP MENU**.
^CUSATM: "D081A28103012500820281828 50F80005500530049004D53615E9475288F0A11807CBE54C163A883508F0A318059296C14988462A58F0A3280822A73ED67E58BE28F0A338051FA884C630753578F0A34804F53575B5FEB8BAF8F0C518065B095FB65E9665A62A58F0A5280624B673A97F34E508F0A5380624B673A96058BFB8F0A5480624B673A90AE7BB18F0A558077ED4FE152A974068F0C5680624B673A84254E1A5385"	Content of **SET UP MENU**
OK	

NOTE

- This command is not specified in the standard interface protocol but is introduced to prevent the main menu information from being lost because **SET UP MENU** is sent too quickly.
- If the SIM card does not deliver **SET UP MENU**, then **^CUSATM: ""** will be returned after the main menu is queried.

13.2.2 Troubleshooting

Scenario	Possible Error Information	Solution
AT^CUSATM?	**ERROR**	**AT^STSF=1,2**
AT^CUSATM?	**+CME ERROR: SIM PIN required**	Unblock the PIN before delivering the command.

13.3 STK Envelope Command

13.3.1 Reference Process

Command	Description
AT+CUSATE="D30782020181900156"	Deliver the envelope command **MENU SELECTION**.
+CUSATE: "",0 **OK**	The SIM card's response to the envelope command. For details, see notes 2 and 3 below.

NOTE

1. **<envelope_command>** and **<envelope_response>** consist of the full BER-TLV data object as defined in 3GPP TS 31.111.
2. **<envelope_response>** is the SIM card's response to the envelope command. It may be empty.
3. **<busy>** indicates the SIM card status. If **<busy>** is **0**, the SIM card is normal and the envelope command has been processed. If **<busy>** is **1**, the SIM card is busy. The envelope command can be resent when the SIM card is idle. If **<busy>** is **2**, the SIM card is faulty. Check the SIM card and do not resend the envelope command until the SIM card has been fixed.

13.3.2 Troubleshooting

Scenario	Possible Error Information	Solution
AT+CUSATE="<envelope_command>"	**ERROR**	**AT^STSF=1,2**
AT+CUSATE="<envelope_command>"	**+CME ERROR: SIM PIN required**	Unblock the PIN before delivering the envelope command.
AT+CUSATE="<envelope_command>"	**+CME ERROR: SIM busy**	Wait until the SIM card initialization is complete before delivering the envelope command.
AT+CUSATE="<envelope_command>"	**ERROR**	Check whether **<envelope_command>** complies with the 3GPP TS 31.111 protocol.

14 USSD Application Scenarios

14.1 USSD Initialize and Configration

14.1.1 Reference Process

Command	Description
AT+CSCS="IRA"	Set the TE supported character set as "IRA".
OK	
AT^USSDMODE=0	Set the transmitted mode, and select USSD non-transparent mode
OK	

NOTE

The default transmitted mode is transparent mode.

In non-transparent transmission mode:

- When running **AT+CSCS="IRA"**, the MT will transfer the USSD string to GSM 7bit directly;
- When running **AT+CSCS="UCS2"**, the MT will encode every four characters of the USSD string as hexadecimal.

In transparent transmission mode, the USSD string is not controlled by **AT+CSCS**. The MT will transfer the USSD string to hexadecimal directly.

14.1.2 Troubleshooting

Scenario	Possible Error Information	Solution
The parameter is out of the correct range.	**ERROR**	Refer to the AT command document.

14.2 Send the USSD Command in non-Transparent Mode

14.2.1 Reference Process

Command	Description
AT^USSDMODE=0	Set as non-Transparent mode
OK	
AT+CSCS="IRA"	Set the TE supported character set as "IRA"
OK	
AT+CUSD=1,"*133*950#",15	Send the USSD code to network.
OK **+CUSD: 1,"0031002E80A17968537365F6884C60C5000A0032002E80A18BC4000A0033002E90FD5E02751F6D3B000A0034002E5F697968000A0035002E751F6D3B5B9D5178000A0036002E65F65C1A751F6D3B000A0037002E5A314E504F1195F2000A0038002E516C51714FE1606F000A0039002E592753434E16754C000A002A002E900051FA000A0000",72**	The network sends the menu information to the TE.
AT+CUSD=2	End the USSD session
OK	
AT+CSCS="UCS2"	
OK	
AT+CUSD=1,"00310032",15	Send the USSD code to network, encoded as UCS2.
OK **+CUSD: 2**	The network does not support.

NOTE

"***133*950#**" is just available in China Mobile network in Shen Zhen area. The USSD code is various in different network.

14.2.2 Troubleshooting

Scenario	Possible Error Information	Solution
Network does not support the USSD	**+CUSD: 2**	Use correct USSD code that the network supports.
The PIN is not authenticated.	**+CME ERROR: SIM PIN required**	Enter the correct PIN.

14.3 Send the USSD Command in Transparent Mode

14.3.1 Reference Process

Command	Description
AT^USSDMODE=1	Set as transparent mode
OK	
AT+CUSD=1,"aad808",15	Send the USSD code to network.
OK	The network sends the MSISDN to the TE.
+CUSD: 0,"CD69724A74EA1A385B6C9683CD6EB1184E4603",15	

NOTE

"**aad808**" is just available in dedicated lab network. The USSD code is various in different network.

14.3.2 Troubleshooting

Scenario	Possible Error Information	Solution
Network does not support the USSD.	**+CUSD: 2**	Use correct USSD code that the network supports.
The PIN is not authenticated.	**+CME ERROR: SIM PIN required**	Enter the correct PIN.

14.4 Network Initiated USSD Operation

14.4.1 Reference Process

Command	Description
+CUSD: 1, "7076393C2F83D26E789D0E0ABB41697AB90D9287DDE732C82C7FB7413010FD0DCA01"	USSD request is initiated by network. One of the digits "0–9" is required to be input.
AT+CUSD=1,"31",15	"**1**" is input to the network.
OK	The network notifies user that no response is needed.
+CUSD:0,"CF6508",15	

NOTE

This function must be supported by the network. The request and notification content sent by the network depends on the manufactories.

14.4.2 Troubleshooting

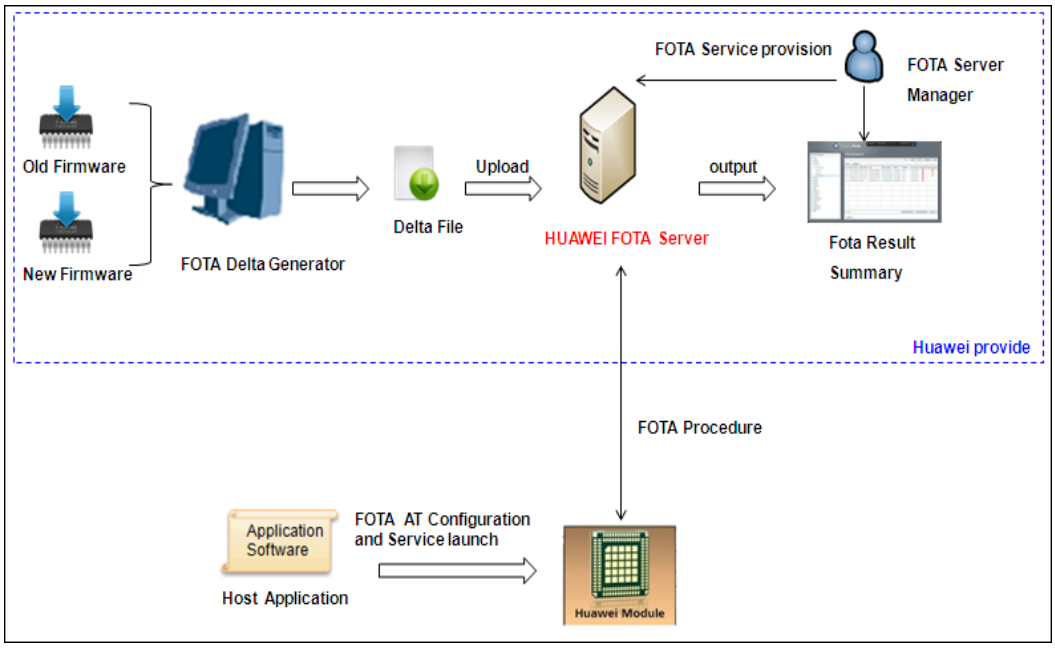
Scenario	Possible Error Information	Solution
The PIN is not authenticated.	**+CME ERROR: SIM PIN required**	Enter the correct PIN.
Network has sent USSD request or notification, yet which is not unsolicitedly reported by the module.	None	USSD unsolicited report: **AT+CUSD=1**
The module cannot report USSD request or notification with non-GSM7bit code sent by network (such as UCS2 8bit code)	None	Set the transmitted mode as USSD transparent mode: **AT^USSDMODE=1**

15 FOTA Application Scenarios

15.1 FOTA Process

15.1.1 Upgrade Module Firmware Over Air Through Delta Package

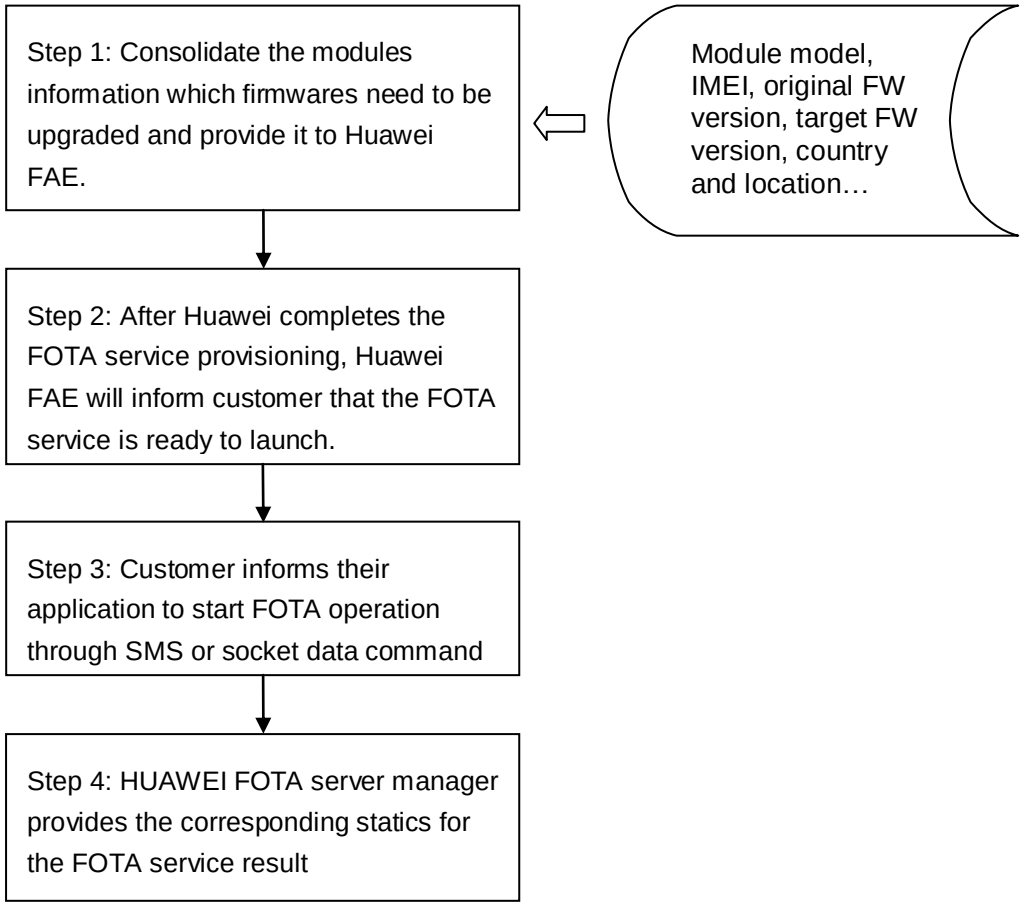
Figure 15-1 Upgrade module firmware over air through delta package



15.1.2 Procedure for FOTA Implementation

This chapter describes the workflow of HUAWEI Module FOTA feature.

Figure 15-2 FOTA data flow



NOTE

If the module is powered off during the firmware installing progress, after the module is restarted, the firmware will resume installing at the last point.

AT command example (after customer application received SMS or socket command to perform FOTA upgrade):

Command	Description
AT+GMR	Query the module's software version.
12.815.01.03.00 **OK**	
AT^FOTACFG="1234","","",2	Configure APN.
OK	
AT^FOTAMODE=0,0,1,1	Set FOTA mode.
OK	
AT^FOTASTATE?	

^FOTASTATE: 10	Indicate that the FOTA state is idle.
OK	
AT^FOTADET	Start to detect if new version exists in Huawei FOTA server.
OK	
^FOTASTATE: 11	
^FOTASTATE: 12,12.815.01.04.00,79114,"Support send sms background"	Get the module's new version "12.815.01.04.00".
AT^FOTADL=1	Start to download the new version and upgrade.
OK	
^FOTASTATE: 30	Indicate that it is downloading FW delta file.
AT^FOTADLQ	Query file download.
^FOTADLQ: 1,"IMAGE",1324,1324 **^FOTADLQ: 2,"XNV",47104,77778**	
OK	
^FOTASTATE: 40	Indicate that FW delta file is completely downloaded.
^FOTASTATE: 50	Indicate that FW is ready to update.
^FOTASTATE: 90	After few minutes, FW is successfully upgraded.
AT+GMR	Query the module's software version after the upgrade.
12.815.01.04.00	The software version has been changed.
OK	

15.2 Setting FOTA Mode

15.2.1 Reference Process

Command	Description
AT^FOTAMODE=?	Check the parameter range supported by the command.
^FOTAMODE: (0-1),(0-1),(0-1),(0-1),(1-65535) **OK**	
AT^FOTAMODE?	Query the current settings.
^FOTAMODE: 0,0,0,1,7 **OK**	Return the current FOTA mode: manual query, manual download, manual upgrade, and resumable data transfer enabled. The value 7 indicates that the query cycle is seven days, which is meaningless when manual query is used.
AT^FOTAMODE=1,1,1,1,15	Configure FOTA mode as auto query, auto download, auto upgrade, and resumable data transfer enabled. And the auto query cycle is set to 15 days.
OK	

NOTE

- Parameter settings are all saved upon power-off.
- All parameters will be restored to their default values after the upgrade.

15.2.2 Troubleshooting

Scenario	Possible Error Information	Solution
An error message is returned.	**+CME ERROR: Error command parameters**	The parameter is incorrectly set. For details, see the latest version of MU609 V100R002 in *HUAWEI MU609 HSPA LGA Module AT Command Interface Specification*.

15.3 Setting FOTA Connection Parameters

15.3.1 Reference Process

Command	Description
AT^FOTACFG="cmnet","","",2	Set the APN to **cmnet** and authentication mode to **CHAP**. Leaves the user name and password blank. These parameters should be set according to the contracted values.
OK	
AT^FOTACFG?	Query the current settings.
^FOTACFG: "cmnet","","",2 **OK**	

NOTE

- Parameter settings are all saved upon power-off.
- This command does not provide a test command. For details, see the latest version of MU609 V100R002 in *HUAWEI MU609 HSPA LGA Module AT Command Interface Specification*.

15.3.2 Troubleshooting

Scenario	Possible Error Information	Solution
An error message is returned.	**+CME ERROR: Operation not supported**	The operation is not supported. For details, see the latest version of MU609 V100R002 in *HUAWEI MU609 HSPA LGA Module AT Command Interface Specification*.
An error message is returned.	**+CME ERROR: Error command parameters**	The parameter is incorrectly set. For details, see the latest version of MU609 V100R002 in *HUAWEI MU609 HSPA LGA Module AT Command Interface Specification*.

15.4 Manually Querying for Upgrade Firmware Version

15.4.1 Reference Process

Command	Description
AT^FOTACFG="cmnet","","",2	This command is used to configure the PDP context. For example, sets the APN to **cmnet** (the value of APN is provided by the network server) and authentication mode to **CHAP**.
OK	
AT^FOTAMODE=0,0,0,1	Configure FOTA mode as manual query, manual download, manual upgrade, and resumable data transfer enabled.
OK	
AT^FOTASTATE?	Query the current FOTA state.
^FOTASTATE: 10 **OK**	Indicate that the FOTA state is idle.
AT^FOTADET	Check for updates.Ensure that the module is registered with a valid network before you run this command.
OK **^FOTASTATE: 11** **^FOTASTATE: 12,12.815.01.04.00,79114,"Support send sms background"**	Return **OK** (success) or return **+CME ERROR** (failure). Report that the query operation is in process. Report information about the new version, including the version number, size of the file to be downloaded, and change description.
AT^FOTASTATE?	Query the current FOTA state.
^FOTASTATE: 12 **OK**	Indicate that a new version is found.
AT^FOTADL=0	Delete the detected new version.
OK	
AT^FOTASTATE?	Query the current FOTA state.

^FOTASTATE: 10	Indicate that the FOTA state is idle.
OK	
AT^FOTADET	Check for updates after deleting the new version on the server.
OK	
^FOTASTATE: 11	
^FOTASTATE: 14	Report that no new version is found.

NOTE

- Version detection is allowed only if the FOTA state is idle.
- If the module is undergoing the PS data service or IPSTACK service, the FOTA service cannot be initiated, including version detection, download, and upgrade.
- The parameter <description> of the **AT^FOTASTATE** command is a string composed of ASCII characters. This parameter is used to describe the changed items (corresponding to the feature items in **changelog.xml** in the upgrade package) of the new version. The parameter contains a maximum of five records, each containing up to 255 characters. Records are separated by semicolon.

15.4.2 Troubleshooting

Scenario	Possible Error Information	Solution
An error message is returned.	**+CME ERROR: FOTA is in collision state**	Check whether the PS data service or IPSTACK service is going on, or use **AT^FOTASTATE?** command to check whether the FOTA state is idle.
An error message is returned.	**+CME ERROR: Previous command is not complete**	Wait for the previous command to be completely executed.
An error message is returned.	**+CME ERROR: SIM PIN required**	Use the PIN to unlock the SIM card.
The module reports a query failure.	^FOTASTATE: 13,<error_code>	Upon a query failure, the module restores the FOTA state to idle and deletes the downloaded files. For error codes, see the latest version of MU609 V100R002 in *HUAWEI MU609 HSPA LGA Module AT Command Interface Specification*.

15.5 Periodically Querying the Version

15.5.1 Reference Process

Command	Description
AT^FOTAMODE=1,0,0,1,7	Configure FOTA mode as auto query, auto download, auto upgrade, and resumable data transfer enabled and the query cycle to seven days.
OK	The command is successfully executed. The module automatically checks for updates when the query time arrives.
^FOTASTATE: 11	Report that the query operation is in process.
^FOTASTATE: 12,12.815.01.04.00,79114,"Support send sms background"	Report information about the new version.

NOTE

- Periodical query is based on either of the two timekeeping modes: network timekeeping or local timekeeping. If network timekeeping is unavailable, local timekeeping is used. Local timekeeping may not be accurate.
- Local timekeeping is affected by **AT+CCLK** command. Upon a power-off event, the CCLK value changes to **1980**. After you choose to use local timekeeping and change the CCLK value, the query operation cannot be carried out at the correct time.

15.5.2 Troubleshooting

Scenario	Possible Error Information	Solution
Auto query is in use.	No query operation is initiated when the query time arrives.	1. Check if the FOTA state is idle. If not, change the FOTA state to idle by using the **AT^FOTADL=0** command. 2. Check whether the PS data service or IPSTACK service is going on. If yes, terminate the service.

15.6 Manually Downloading the Version

15.6.1 Reference Process

Command	Description
AT^FOTASTATE?	Query the current FOTA state.
^FOTASTATE: 12 **OK**	Indicate that a new version is found.
AT^FOTADL=1	Run this command to manually download the version.
OK **^FOTASTATE: 30**	The command is successfully executed. Report that the download is in process.
AT^FOTADLQ	Query the download progress.
^FOTADLQ: 1,"IMAGE",1324,1324 **^FOTADLQ: 2,"XNV",47104,77778** **OK**	Return that the IMAGE file size is 1324 bytes, and 1324 bytes have been downloaded. The XNV file size is 77778 bytes, and 47104 bytes have been downloaded.
^FOTASTATE: 40	Report that the version is completely downloaded and passes the MD5 verification.
AT^FOTADL=?	Query the parameters supported by the command.
^FOTADL: (0-1) **OK**	Return the supported parameters. **0**: not to download. **1**: download.

NOTE

- Version download is allowed only if the FOTA state is **12** (new version detected) and **31** (download pending).
- The prerequisites for version download and query are:

  Module registered with a valid network.

  No ongoing PS data service or IPSTACK service.

15.6.2 Troubleshooting

Scenario	Possible Error Information	Solution
An error message is returned.	**+CME ERROR: Operation not supported**	The command is incorrect.
An error message is returned.	**+CME ERROR: SIM PIN required**	Use the PIN to unlock the SIM card.
An error message is returned.	**ERROR**	The command is executed in incorrect FOTA state. Ensure that the FOTA state is **12** or **31** before you run the command.
The module reports a download failure.	**^FOTASTATE: 20,<error_code>**	Upon a download failure, the module restores the FOTA state to idle and deletes the downloaded file. For error codes, see the latest version of MU609 V100R002 in *HUAWEI MU609 HSPA LGA Module AT Command Interface Specification*.

15.7 Automatically Downloading the Firmware

15.7.1 Reference Process

Command	Description
AT^FOTAMODE=0,1,0,1	Configure auto download mode.
OK	
AT^FOTADET	Run this command to manually check for upgrades.

OK	
^FOTASTATE: 11	Report that the query operation is in process.
^FOTASTATE: 12,12.815.01.01.00,79102,"Support send sms background"	Report that a new version is found and information about the new version.
^FOTASTATE: 30	Automatically download the new version and reports that the download is in process.
^FOTASTATE: 40	Report that the version is completely downloaded and passes the MD5 verification.

15.7.2 Troubleshooting

None

15.8 Using the Resumable Data Transfer Function

15.8.1 Reference Process

Command	Description
AT^FOTAMODE=0,0,0,1	Enable resumable data transfer.
OK	
AT^FOTASTATE?	Query the FOTA state.
^FOTASTATE: 31	Indicate that the download is pending.
OK	
AT^FOTADL=1	Resume the transmission from the break point.
OK	
^FOTASTATE: 30	Report that the download is in process.
^FOTASTATE: 40	Report that the download is complete.

NOTE

If resumable data transfer is disabled, the download pending due to network disconnection or TCP link breakoff will be regarded as a download error.

15.8.2 Troubleshooting

Scenario	Possible Error Information	Solution
The function of resumable data transfer is disabled, and the network or TCP link is disconnected.	**^FOTASTATE: 20,18** Or other download error	The module deletes the downloaded file and restores the FOTA state to idle.
The function of resumable data transfer is enabled, and the module is powered off.	**^FOTASTATE: 31**	The module prompts that the download can be resumed.

15.9 Manually Canceling the Download

15.9.1 Reference Process

Command	Description
AT^FOTADL=1	Initiate the version download.
OK	
^FOTASTATE: 30	Report that the download is in process.
AT^FOTADL=0	Cancel the download, deletes the downloaded file, and restores the FOTA state to idle.
OK	The command is successfully executed.
AT^FOTASTATE?	
^FOTASTATE: 10 **OK**	Report that the operation to cancel the download is complete. The FOTA state is idle**.**

15.9.2 Troubleshooting

None

15.10 Manually Upgrading the Version

15.10.1 Reference Process

Command	Description
AT^FOTASTATE?	
^FOTASTATE: 40 **OK**	Report that the download is complete.
AT^FWUP	Run this command to manually start the upgrade.
OK	The command is successfully executed.
^FOTASTATE: 50	Report that the upgrade starts. The module restarts, and then starts the upgrade.
^FOTASTATE: 90	Report that the upgrade succeeds.

NOTE

- The module restarts several times during the upgrade. Ensure that during this process, the module is powered on. Do not send AT commands during the upgrade.
- If the upgrade fails, the module enters forcible loading mode, you can perform any of the following:

  1. One-click upgrade from devices running Windows (full upgrade using the .exe file)

  2. Upgrade from devices that run Android or Linux using **UpdateWizard** (full upgrade using the .bin file)

  3. Local upgrade no matter the host having the operation system or not (for details, see section 17 Local Upgrade Application Scenarios.

15.10.2 Troubleshooting

Scenario	Possible Error Information	Solution
An error message is returned.	**+CME ERROR: Previous command is not complete**	Wait for the previous command to be completely executed.
An error message is returned.	**+CME ERROR: FOTA is in collision state**	1. Check whether the PS data service or IPSTACK service is going on. 2. Check that the FOTA state is not **40** (download is complete).

Scenario	Possible Error Information	Solution
An error message is returned.	**ERROR**	The command format is incorrect. Please see the latest version of MU609 V100R002 in *HUAWEI MU609 HSPA LGA Module AT Command Interface Specification*.
The module reports an upgrade failure.	**^FOTASTATE: 80,<error_code>**	The module automatically changes the FOTA state to idle and deletes the downloaded file. You can use the **AT^FOTADL=0** command to set the FOTA state to idle manually. For error codes, see the latest version of MU609 V100R002 in *HUAWEI MU609 HSPA LGA Module AT Command Interface Specification*.

15.11 Automatically Upgrading the Version

15.11.1 Reference Process

Command	Description
AT^FOTAMODE=0,1,1,1	Configure FOTA mode as auto download and auto upgrade.
OK	
AT^FOTADET	Check for upgrades.
OK	
^FOTASTATE: 11	
^FOTASTATE: 12,12.815.01.02.00,79114,"Support send sms background"	Return information about the new version.
^FOTASTATE: 30	Automatically download the version.
^FOTASTATE: 40	Report that the version is completely

	downloaded and passes the MD5 verification.
^FOTASTATE: 50	Report that the module is ready for the upgrade.
^FOTASTATE: 90	Report that the upgrade succeeds.
AT^FOTASTATE?	Query the FOTA state.
^FOTASTATE: 10	The FOTA state changes to idle after the upgrade.
OK	

15.11.2 Troubleshooting

None

16 ECM Application Scenarios

16.1 ECM Dialing

16.1.1 Reference Process

Command	Description
AT^NDISDUP=?	Check the parameter range supported by the command.
^NDISDUP: (1-16),(0-1) **OK**	
AT^NDISDUP=1,1,"1234"	Set up a dial-up connection using the APN provided by the network server.
OK	The command is successfully executed.
^NDISSTAT: 1,,,IPV4	Report the dial-up connection state.
AT^NDISDUP=1,1,"4321","huawei", "huawei",1	Set up a dial-up connection using the account, password, and authentication mode provided by the network server.
OK	The command is successfully executed.
^NDISSTAT: 1,,,IPV4	Report the dial-up connection state.

The process of obtaining the IP address:

1. After the dial-up is successful, the module will establish the DHCP service automatically.
2. The PC driver will get the dial-up state and send net_ready state to the network manage.
3. The network manager sends the DHCP service discover.

4. The module responses the service discover, and then sends the IP and DNS address which is obtained from the PDP active process to the network managing device.

16.1.2 Troubleshooting

Scenario	Possible Error Information	Solution
AT^NDISDUP=1,1,"1234"	**+CME ERROR: SIM failure**	No SIM card is detected. Insert a SIM card.
AT^NDISDUP=1,1,"4321","huaei","huawei",1	**OK** **^NDISSTAT: 0,33,,IPV4** **^NDISEND:1,29**	**NDISEND** indicates the failure reason during the dial-up. **29** indicates that the authenticated information is not correct.
AT^NDISDUP=1,1,"abcd"	**OK** **^NDISSTAT: 0,33,,IPV4** **^NDISEND:1,33**	**NDISEND** indicates the failure reason during the dial-up. **33** indicates that request service is not specified. In this case, the network don not support this APN "abcd".

16.2 Querying the Dial-up Connection State

16.2.1 Reference Process

Command	Description
AT^NDISSTATQRY?	Query the dial-up connection state.
^NDISSTATQRY: 0,0,,IPV4 **OK**	Report that the connection is not set up.
AT^NDISSTATQRY?	Query the dial-up connection state.
^NDISSTATQRY: 1,,,IPV4 **OK**	Report that the connection is set up.

16.2.2 Troubleshooting

None

16.3 Disconnecting the Dial-up Connection

16.3.1 Reference Process

Command	Description
AT^NDISDUP=1,0	Disconnect the dial-up connection.
OK	The command is successfully executed.
^NDISSTAT:0,0,,IPV4	IPv4 changes from the connected state to the disconnected state.

16.3.2 Troubleshooting

None

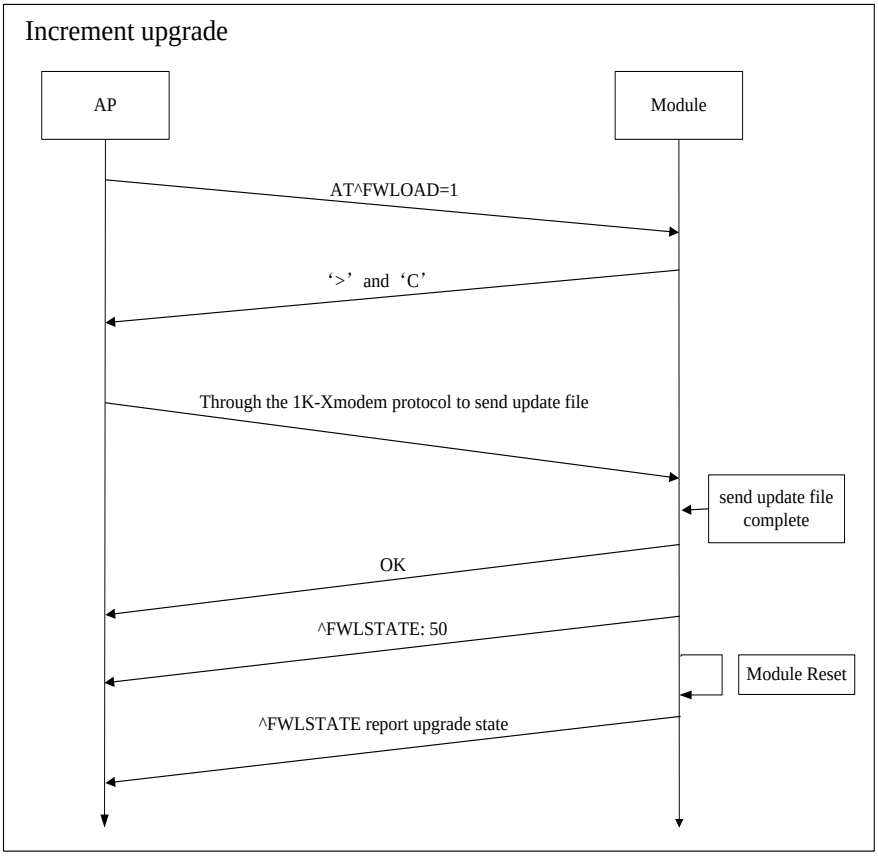
17 Local Upgrade Application Scenarios

17.1 Starting the Local Upgrade

17.1.1 Local Upgrade Flow Chart

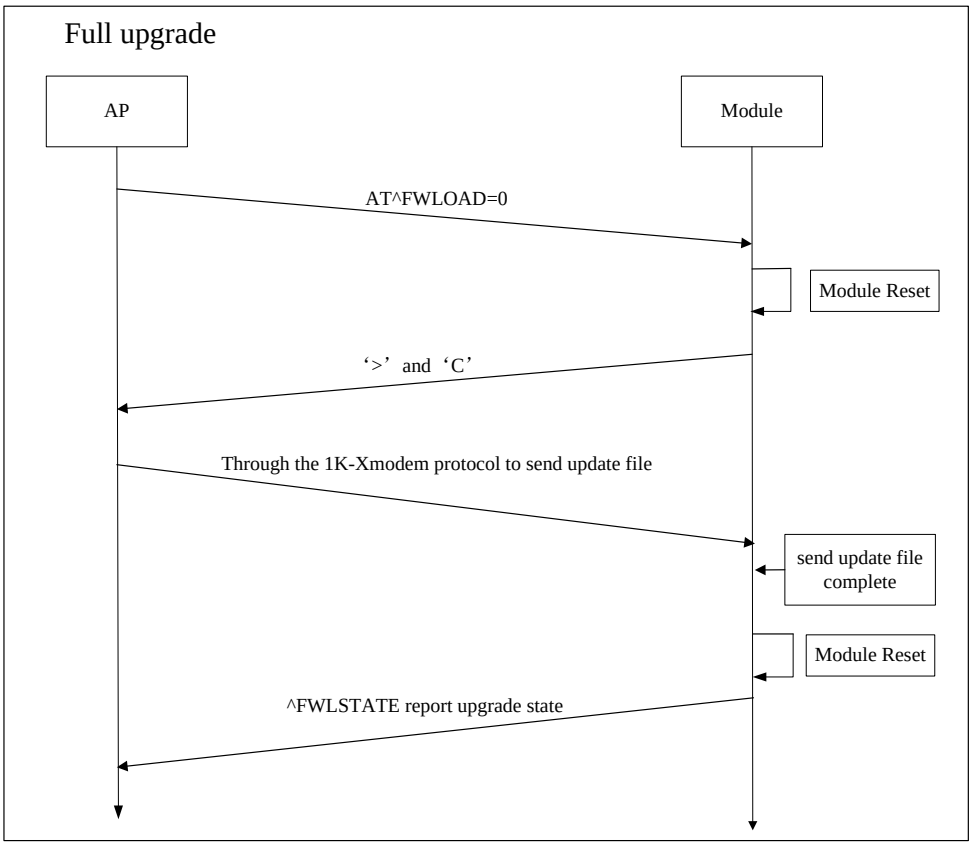
Increment Upgrade Flow

Figure 17-1 Increment upgrade flow



Full Upgrade Flow

Figure 17-2 Full upgrade flow



17.1.2 Test Steps

Tools and Test Steps

This document takes the increment upgrade flow for example; the test is taken on Windows system with Hyper Terminal tool.

NOTE

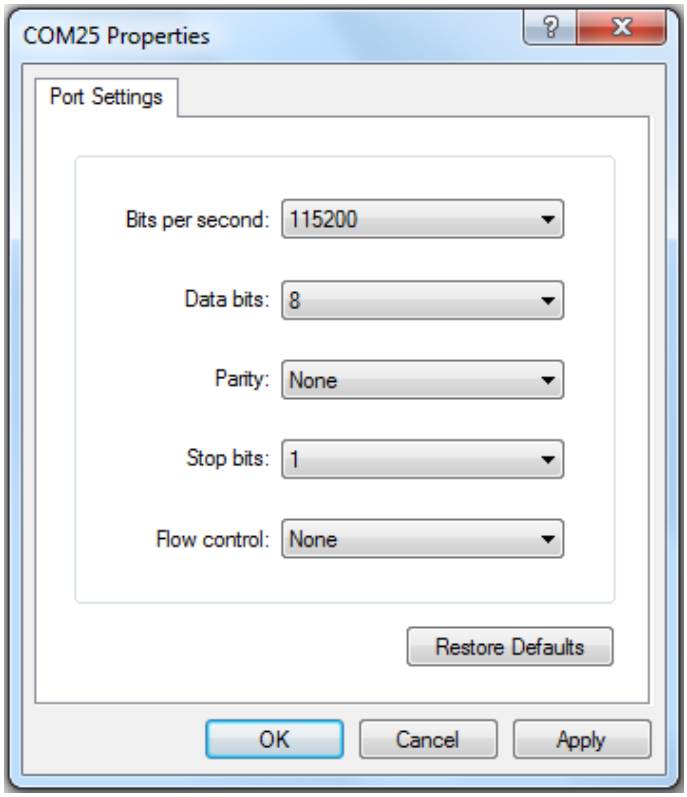
The Hyper Terminal tool supports 1k-modem protocol transfer files.

Step 1 Open the Hyper Terminal tool and choose the modem port number. (In this document, the modem port is **COM25**.)

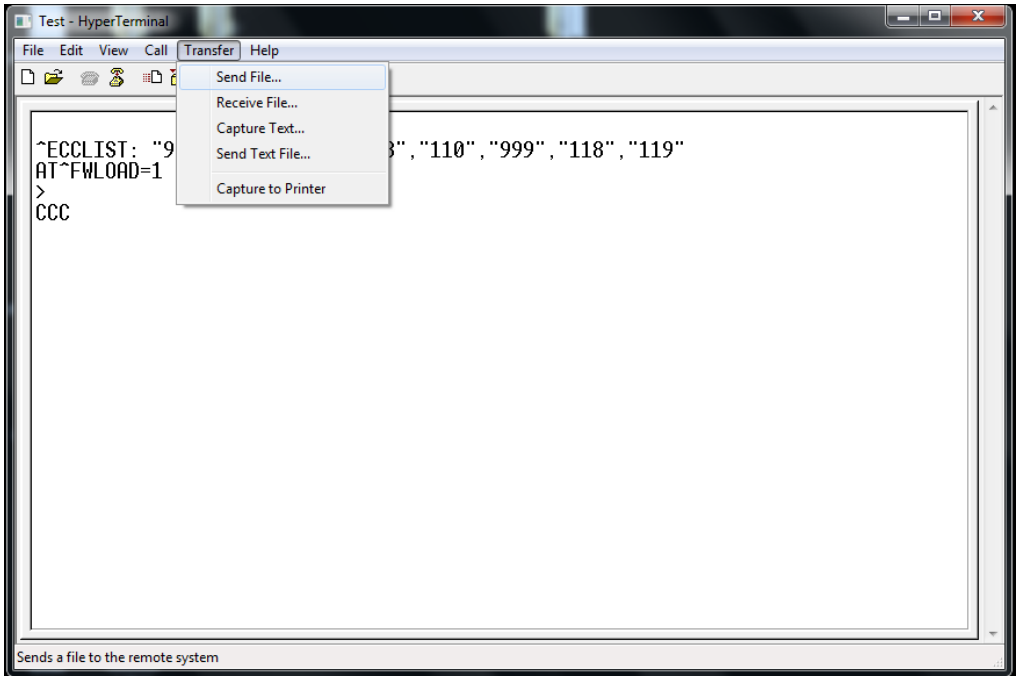
Step 2 Set the parameters of the COM25 port.

NOTE

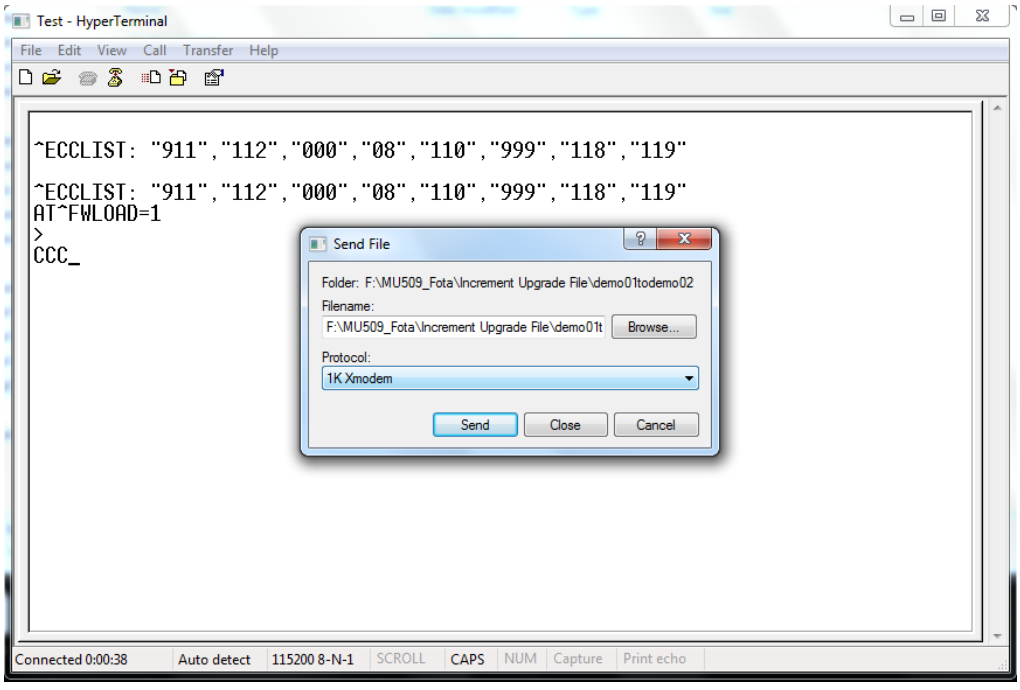
Run the **AT+IPR?** command, get the return value and use this value to set the **Bits per second**.



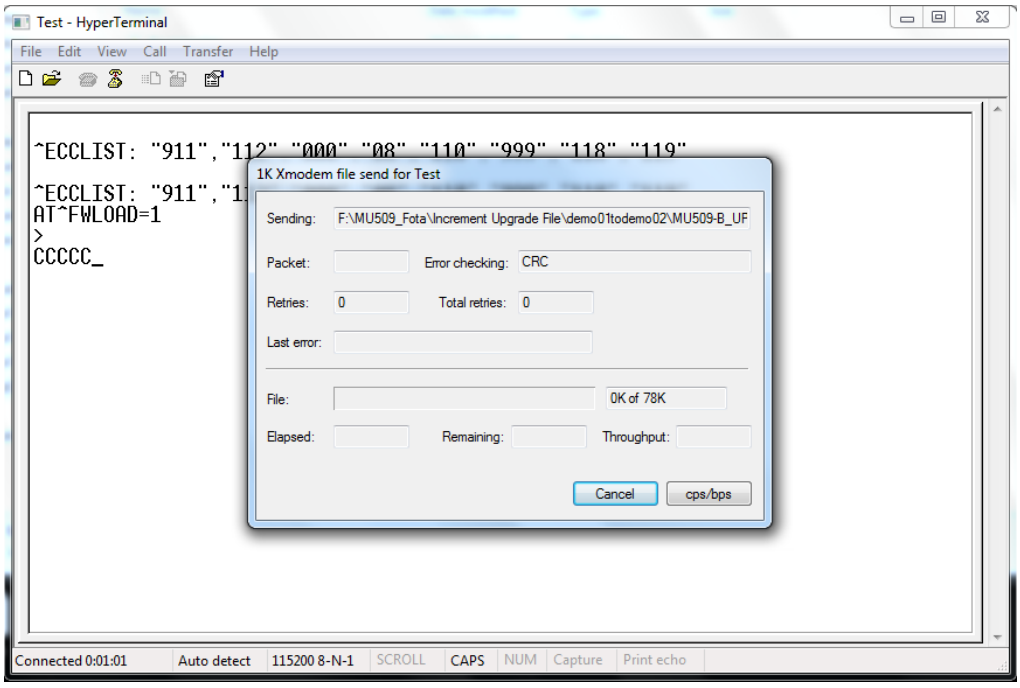
Step 3 Run the **AT^FWLOAD=1** command, and launch an increment upgrade.



Step 4 Choose the file which will be sent to the module and choose the **1K Xmodem** protocol.



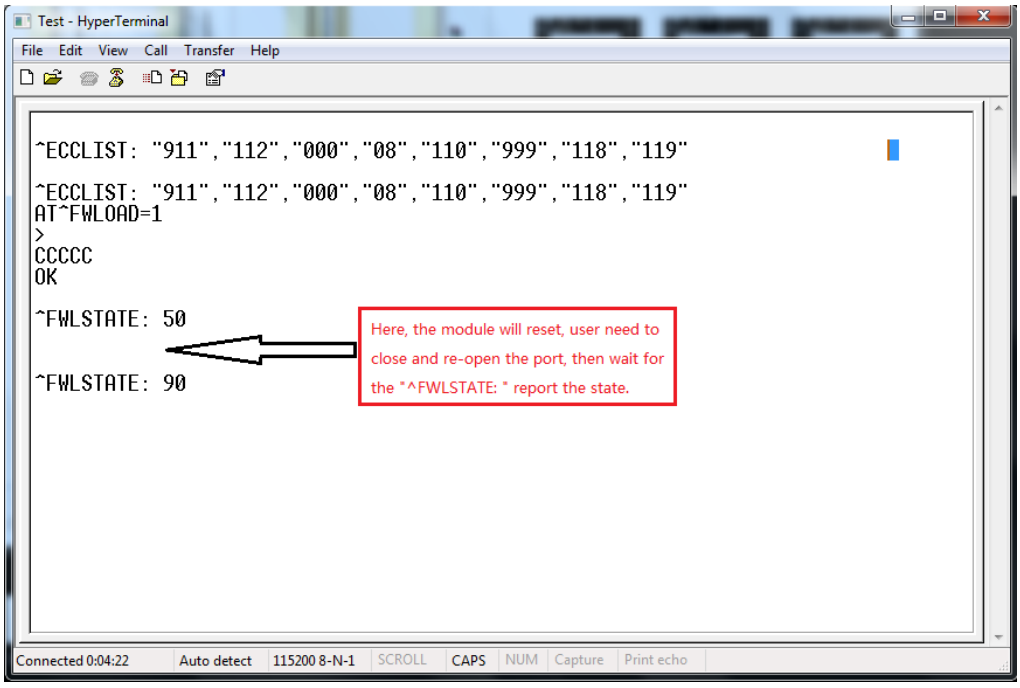
Step 5 Begin to transfer the local file to the module flash.



Step 6 After finishing the file transmission, start the upgrade. And the module will reset automatically to finish the upgrade.

If the upgrade is successful, the module will return **^FWLSTATE: 90**.

If the upgrade comes across some error, the **^FWLSTATE** will give an error code.



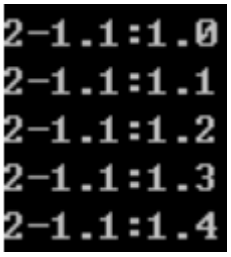
Requirement of the AP

The AP is required to have 4KB RAM at least (used to store the cache data). If AP only needs to support the increment upgrade, AP FLASH memory must be larger than 1 MB. If AP needs to support the full upgrade, or both the increment upgrade and the full upgrade, AP FLASH memory must be larger than 22 MB. (The full size of MU609 firmware upgrade files is 22 MB.)

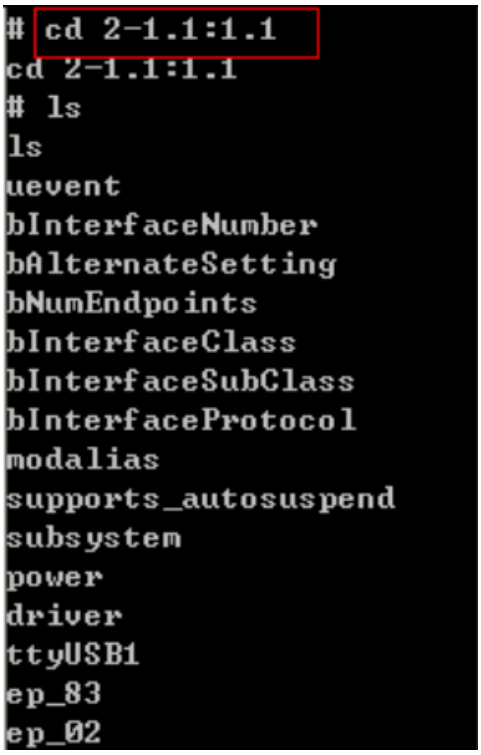
1. AP should be able to access and load the upgrade files.
2. AP should have a file transmission tool, this tool need to support 1K-Xmodem protocol.

Finding the PCUI port on Android and Linux System

Step 1 Enter **/sys/bus/usb/drivers/option**, and look out the following types of folders.



Step 2 Enter these folders, and view the **bInterfaceProtocol** value.



If the **bInterfaceProtocol** value is **02**, the port is PCUI.

```
# cat bInterfaceNumber
cat bInterfaceNumber
02
```

17.1.3 Reference Process

Command	Description
AT^FWLOAD=0	Start the full upgrade.
> **C**	
AT^FWLOAD=1	Start the increment upgrade.
> **C**	

NOTE

After the module reports '**C**', the host transmits the upgrade package to the module using the xmodem or 1k_xmodem protocol.

Interfaces supported by the module:

Full upgrade: serial ports and PCUI port (baud rate: 115200 bit/s)

Increment upgrade: serial ports and modem ports (baud rate: current baud rate of the module)

The full upgrade takes up much time, so the increment upgrade is recommended.

17.1.4 Troubleshooting

If using the full upgrade by the PCUI port, after the module is restarted, the PCUI port number may be changed. So you need to find the corresponding port, and then send the local upgrade package.

17.2 Reporting the Local Upgrade State

17.2.1 Reference Process

Command	Description
AT^FWLOAD=0	
> **C**	
The board restarts, and the	

upgrade starts.	
^FWLSTATE: 90	Report that the local upgrade succeeds.

NOTE

After the data have been transmitted completely and successfully, the MT will not send **OK** to the TE.

17.2.2 Troubleshooting

None

18 Appendix

18.1 Relative Documents

1. The latest version of MU609 V100R002 of HUAWEI MU609 HSPA LGA Module AT Command Interface Specification
2. 3GPP TS 27.007 AT command set for User Equipment (UE)
3. 3GPP TS 27.005 Equipment (DTE-DCE) interface for Short Message Service (SMS) and Cell Broadcast Service (CBS)
4. 3GPP TS 23.040 Technical realization of the Short Message Service(SMS)
5. 3GPP TS 31.102 Universal Subscriber Identity Module(USIM) application
6. 3GPP TS 24.008 Mobile radio interface Layer 3 specification; Core network protocols; Stage 3
7. 3GPP TS 29.002 Mobile Application Part (MAP) specification
8. 3GPP TS 22.004 General on supplementary services
9. ETSI TS 102.221 Smart Cards; UICC-Terminal interface; Physical and logical characteristics

18.2 Acronyms and Abbreviations

Table 18-1 List of Abbreviations

Acronym or Abbreviation	Expansion
3GPP	Third Generation Partnership Project
APN	Access Point Name
AT	Attention
CS	Circuit Switched (CS) domain
DCE	Data Circuit-terminating Equipment
DTE	Data Terminal Equipment
GPRS	General Packet Radio Service

Acronym or Abbreviation	Expansion
GSM	Global System for Mobile Communications
IMEI	International Mobile Equipment Identity
IP	Internet Protocol
ME	Mobile Equipment
MS	Mobile Station
PDP	Packet Data Protocol
PDU	Protocol Data Unit
PIN	Personal Identity Number
PPP	Point-to-Point Protocol
PUK	PIN Unblocking Key
PS	Packet Switched (PS) domain
QoS	Quality of Service
SIM	Subscriber Identity Module
SMS	Short Message Service
TE	Terminal Equipment
UE	User Equipment
UMTS	Universal Mobile Telecommunications System
USIM	Universal Subscriber Identity Module
WCDMA	Wideband CDMA
NDIS	Network Driver Interface Specification
ECM	Ethernet Control Model
FOTA	Firmware Over The Air

Table 18-2 Phonebook-related abbreviations

Abbreviation	Full Name
SM	SIM phonebook
EN	SIM emergency number
ON	SIM own numbers

18.3 Exception Handling

In the industrial product design, in order to ensure reliable operation of the device for a long time, the host need take into account fault-tolerant design. This is because that the operation of the terminal environment is very complex and not easy to design the system architecture for complete simulation. Since the environment maybe change, and the various hardware components within the device are not always guaranteed to work at the expected condition, even if the module is able to maintain the electrical specifications claimed to work, but the external signal may also lead to abnormal changes in the module beyond the normal working condition. For example, the power supply voltage drop may cause the module reboots, so we recommend in the system design customers should consider the types of abnormal events, and add a corresponding recovery process, so that the module can be restored after a brief interruption to the normal communication.

18.3.1 Module Reset

- Exception Description

In some extreme condition (for example, the power voltage is not stable), the module may be reset.

- How to Detect the Exception by the Host

The module will report **"^SYSSTART"** to the host.

- Host Resume Steps

After the module reset, the host need reconfigure the configuration, and reconnect the data service, if the module was connected to network before resetting. If the module is connected to network by embedded protocol IP stack or external protocol stack, the host need reconnect too.

- Host Resume Example

For the data service reconnected by external protocol stack, please take the following two steps.

Step 1 Input **AT+CGDCONT=1,"IP","1234"**

Step 2 Input **ATD*99#**

For detail, please refer to Chapter 4 External Protocol Stack Application Scenarios.

18.3.2 Module Going to Dump Status

- Exception Description

In some extreme condition, the module may go to dump status to protect itself. In this status, it cannot response to any ATcommand, and its USB port status is not the same as normal status.

- How to Detect the Exception by the Host

Any AT command input will have no response, and the module only has two USB ports.

- Host Resume Steps

If the module goes to dump status, please make sure the power voltage are recommended in Hardware Guide of the module. And then power off the UE for several minutes, then power on it again.

18.3.3 Module Data Service Disconnected

- Exception Description

In some extreme condition, the data service may be disconnected automatically. The reason maybe the network signal is not good, or the network is busy, or it is disconnected by the network.

- How to Detect the Exception by the Host

Query the current PDP Activation state:

Run: AT+CGACT?

Response: +CGACT: 1,0

OK

For details, please refer to the latest version of MU609 V100R002 of *HUAWEI MU609 HSPA LGA Module AT Command Interface Specification*.

- Host Resume Steps

In this condition, the host need reconnect the network.

- Host Resume Example

For data service reconnected by internal protocol stack

Step 1

Run: AT^IPINIT="1234"

Response: OK

Step 2

Run: AT^IPOPEN=1,"TCP","172.22.44.33",5000,5500

Response: OK

For details, please refer to Chapter 5 Internal Protocol Stack Application Scenarios.

18.3.4 User Configuration Lost

- Exception Description

In some extreme condition, the user configuration maybe loses after reset for several times.

- How to Detect the Exception by the Host

The AT command "**AT+IPR?**" will return the baud rate, but the baud is not what the host set or have no response by the UART.

The AT command "**AT+CGDCONT?**" will return the pdp profile, but the pdp profile will be empty or not the same as that the host set.

- Host Resume Steps

In this condition, the host need reconfigure the setting. We suggest the host configure the setting after powering on the module.

- Host Resume Example

Try to connect the module with the baud rates the module supports, and change the baud rate that the host needs.

Run: AT+IPR=115200

Response: OK